SHOP MANUAL

KOMATSU

D65E,P-12
D65EX,PX-12

MACHINE MODEL	SERIAL NUMBER
D65E-12	**60001 and up**
D65P-12	**60001 and up**
D65EX-12	**60001 and up**
D65PX-12	**60001 and up**

- This shop manual may contain attachments and optional equipment that are not available in your area. Please consult your local Komatsu distributor for those items you may require. Materials and specifications are subject to change without notice.
- D65-12 mount the 6D125-1, S6D125-1, 6D125E-2 and S6D125E-2 engine.
  For details of the engine, see the 125 Series and 125-2 Series Engine Shop Manual.

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CONTENTS

014012

The affected pages are indicated by the use of the following marks. It is requested that necessary actions must be taken to these pages according to the list below.

Mark	Indication	Action required
○	Page to be newly added	Add
●	Page to be replaced	Replace
( )	Page to be deleted	Discard

Pages having no marks are not revised at this time.

LIST OF REVISED PAGES

Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number
●	00- 1	(21)		01-14	(14)		10-21			10-46	(14)		10-68	
	00- 2	(7)		01-15	(14)		10-22	(8)		10-47			10-69	
●	00- 2-1	(21)		01-16	(14)		10-23	(14)		10-48	(7)		10-70	
●	00- 2-2	(21)	●	01-17	(21)		10-23-1	(14)		10-49	(7)		10-71	
●	00- 2-3	(21)		01-18	(19)		10-24	(14)		10-50	(7)		10-72	
●	00- 2-4	(21)		01-19	(19)		10-25			10-51	(7)		10-73	
●	00- 2-5	(21)		01-20	(14)		10-25-2	(14)		10-52	(7)		10-74	
●	00- 3			01-20-1	(19)		10-25-3	(14)		10-52-1	(14)		10-75	
●	00- 4			01-21	(14)		10-25-4	(14)		10-52-2	(14)		10-76	(8)
●	00- 5			01-22	(14)		10-26	(14)		10-52-3	(14)		10-76-1	(8)
●	00- 6			01-23	(14)		10-27			10-52-4	(19)		10-76-2	(8)
●	00- 7			01-24	(14)		10-28			10-52-5	(14)		10-77	(8)
●	00- 8			01-25	(19)		10-29			10-52-6	(14)		10-78	(8)
●	00- 9			01-26	(19)		10-30	(7)		10-53	(8)		10-79	(4)
●	00-10			01-27	(14)		10-31			10-53-1	(14)		10-79-1	(8)
●	00-11			01-28	(19)		10-31-1	(14)		10-53-2	(14)		10-79-2	(19)
●	00-12			10- 1	(14)		10-31-2	(7)		10-54	(14)		10-80	(19)
●	00-13			10- 2			10-31-3	(14)		10-56			10-81	(11)
●	00-14			10- 3			10-31-4	(14)		10-57			10-82	(19)
●	00-15			10- 4	(8)		10-32			10-58			10-82-1	(11)
●	00-16			10- 5	(14)		10-33			10-59			10-82-2	(19)
●	00-17			10- 5-1	(14)		10-34			10-60			10-82-3	(11)
●	00-18			10- 6			10-35			10-61			10-83	
●	00-19			10- 7	(14)		10-36			10-62			10-84	(8)
●	00-20			10- 8			10-37			10-63			10-85	(8)
●	00-21			10- 9	(8)		10-38	(14)		10-64			10-85-1	(8)
●	00-22			10-10	(14)		10-39	(14)		10-64-1	(14)		10-85-2	(14)
	01- 1	(14)		10-11			10-40	(14)		10-64-2	(14)		10-85-3	(19)
	01- 2	(19)		10-12	(14)		10-41			10-64-3	(14)		10-86	(19)
	01- 3	(14)		10-13	(14)		10-42			10-64-4	(14)		10-87	(19)
	01- 4	(14)		10-13-1	(11)		10-43			10-64-5	(14)		10-88	(19)
	01- 5	(14)		10-13-2	(11)		10-44		●	10-64-6	(21)		10-89	(19)
	01- 6	(11)		10-14	(14)		10-45		●	10-64-7	(21)		10-89-1	(19)
	01- 7	(11)		10-15	(14)		10-45-2	(14)	●	10-64-8	(21)		10-89-2	(19)
	01- 8	(11)		10-15-1	(14)		10-45-3	(14)	●	10-64-9	(21)		10-90	(19)
	01- 9	(11)		10-16	(11)		10-45-4	(14)	●	10-64-10	(21)		10-91	(19)
	01-10	(11)		10-17			10-45-5	(14)		10-64-11	(14)		10-91-1	(19)
	01-11	(14)		10-18			10-45-6	(14)		10-65	(14)		10-91-2	(19)
●	01-12	(21)		10-19			10-45-7	(14)		10-66			10-92	(19)
	01-13	(14)		10-20			10-45-8	(14)		10-67			10-93	(19)

Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number
	10- 93-1	(19)		10-131	(4)		10-168	(4)		10-190	(14)		20- 15-15	(15)
	10- 93-2	(19)		10-133	(8)		10-169	(4)		10-191	(14)		20- 15-16	(15)
	10- 93-3	(19)		10-134	(4)		10-170	(4)		10-194	(8)		20- 15-17	(15)
	10- 93-4	(19)		10-135	(4)		10-171	(4)		10-195	(14)		20- 15-18	(15)
	10- 93-5	(19)		10-136	(4)		10-172	(4)		10-196	(14)		20- 15-19	(15)
	10- 93-6	(19)		10-137	(4)		10-173	(2)		10-196-1	(14)		20- 16	(18)
	10- 94	(8)		10-138	(4)		10-173-1	(8)		10-196-2	(14)		20- 17	
	10- 95			10-139	(10)		10-173-2	(8)	●	10-196-3	(21)		20- 18	
	10- 95-1	(8)		10-140	(4)		10-173-3	(8)		10-196-4	(14)		20-101	(15)
	10- 95-2	(8)		10-141	(4)		10-173-4	(8)		10-196-5	(14)		20-102	(10)
	10- 96			10-142	(4)		10-173-5	(8)		10-196-6	(14)		20-103	(12)
	10- 97			10-143	(4)		10-173-6	(8)		10-196-7	(14)		20-104	(1)
	10- 98			10-144	(4)		10-173-7	(8)		10-196-9	(14)		20-105	(1)
	10- 99			10-145			10-173-8	(8)		10-196-10	(14)		20-106	(1)
	10-100			10-146	(4)		10-173-9	(11)		10-197	(8)		20-107	(1)
	10-101			10-147			10-173-10	(8)		10-198			20-108	(1)
	10-102	(4)		10-147-1	(8)		10-173-11	(11)		10-199			20-109	(1)
	10-103			10-147-2	(8)		10-173-12	(8)		10-200			20-110	(1)
	10-104	(4)		10-147-3	(8)		10-173-13	(11)		10-201			20-111	(1)
	10-105	(4)		10-147-4	(8)		10-173-14	(8)		10-202			20-112	(1)
	10-106	(4)		10-147-6	(8)		10-173-15	(11)		10-203	(6)		20-113	(1)
	10-107	(4)		10-147-7	(8)		10-173-16	(8)		10-204			20-114	(9)
	10-108	(4)		10-147-8	(8)		10-173-17	(8)		20- 1	(15)		20-115	(1)
	10-109	(4)		10-147-9	(11)		10-173-18	(8)		20- 2	(9)		20-115-1	(15)
	10-109-1	(4)		10-147-10	(8)		10-173-19	(8)		20- 3	(9)		20-115-2	(9)
	10-110			10-147-11	(11)		10-173-20	(8)		20- 3-1	(9)		20-115-3	(15)
	10-111			10-147-12	(8)		10-173-21	(11)		20- 3-2	(9)		20-115-4	(15)
	10-112			10-147-13	(8)		10-173-22	(8)		20- 4	(9)		20-116	(9)
	10-113			10-147-14	(8)		10-173-23	(11)		20- 5	(9)		20-117	(17)
	10-114			10-147-15	(11)		10-173-24	(8)		20- 5-1	(9)		20-117-1	(15)
	10-115			10-147-16	(8)		10-173-25	(11)		20- 5-2	(9)		20-117-2	(17)
	10-116			10-147-17	(11)		10-173-26	(8)		20- 6	(9)		20-117-3	(16)
	10-116-1	(14)		10-147-18	(8)		10-175			20- 7			20-117-4	(16)
	10-116-2	(14)		10-147-19	(8)		10-176			20- 8			20-117-5	(17)
	10-116-3	(14)		10-147-20	(8)		10-177			20- 9			20-118	(9)
	10-116-4	(14)		10-148	(8)		10-178			20- 10	(7)		20-119	(17)
	10-118	(8)		10-149	(4)		10-179			20- 11			20-119-1	(17)
	10-119			10-150	(8)		10-180			20- 12			20-119-2	(17)
	10-120			10-151	(4)		10-181			20- 13			20-119-3	(15)
	10-121			10-152	(8)		10-182			20- 14			20-119-4	(17)
	10-122			10-153	(4)		10-183	(8)		20- 15			20-120	(15)
	10-122-2	(8)		10-154	(4)		10-184	(8)		20- 15-1	(15)		20-120-1	(15)
	10-122-3	(8)		10-155	(4)		10-185	(8)		20- 15-2	(15)		20-121	(1)
	10-122-4	(8)		10-156	(4)		10-186	(8)		20- 15-3	(9)		20-121-1	(9)
	10-122-5	(8)		10-157			10-186-1	(11)		20- 15-4	(9)		20-121-2	(9)
	10-122-6	(8)		10-158	(4)		10-186-2	(11)		20- 15-5	(9)		20-122-1	(5)
	10-122-7	(8)		10-159	(4)		10-186-3	(11)		20- 15-6	(9)		20-122-2	(19)
	10-122-8	(8)		10-160	(4)		10-186-4	(11)		20- 15-7	(9)		20-123	(9)
	10-122-9	(8)		10-161	(4)		10-186-6	(11)		20- 15-8	(9)		20-124	(12)
	10-124			10-162	(4)		10-186-7	(12)		20- 15-9	(9)		20-125	(1)
	10-125			10-163	(4)		10-186-8	(11)		20- 15-10	(9)		20-126	(12)
	10-126	(8)		10-164	(4)		10-186-9	(11)		20- 15-11	(15)		20-126-1	(12)
	10-128	(8)		10-165	(4)		10-187			20- 15-12	(15)		20-126-2	(12)
	10-129	(4)		10-166	(4)		10-188	(14)		20- 15-13	(15)		20-126-3	(12)
	10-130	(8)		10-167	(4)		10-189	(14)		20- 15-14	(15)		20-126-4	(12)

Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number
	20-127	(12)		20-216-8	(15)		20- 240	(2)		20-281-4	(15)		30- 26	(9)
	20-128	(1)		20-216-9	(15)		20- 241	(2)		20- 282	(2)		30- 27	(3)
	20-129	(12)		20-216-10	(15)		20- 242	(19)		20- 283	(2)		30- 28	(3)
	20-129-1	(12)		20-216-11	(15)		20- 243	(6)		20- 284	(15)		30- 29	(9)
	20-129-2	(12)		20-216-12	(15)		20- 244	(7)		20-284-1	(15)		30- 29-1	(9)
	20-129-3	(12)		20-216-13	(15)		20- 245	(6)		20-284-2	(15)		30-29-3	(9)
	20-129-4	(12)		20-216-14	(15)		20- 246	(6)		20- 285	(15)		30-29-4	(9)
	20-130	(1)		20-216-15	(15)		20- 247	(2)		20- 286	(2)		30-29-5	(9)
	20-131	(1)		20-216-16	(15)		20- 248	(9)		20- 287	(2)		30-29-6	(9)
	20-132	(1)		20-216-17	(15)		20-248-1	(9)		20- 288	(15)		30-29-7	(9)
	20-134	(9)		20-216-18	(15)		20- 249	(2)		20- 289	(2)		30-30-2	(6)
	20-134-1	(9)		20-216-19	(15)		20- 250	(9)		20- 290	(3)		30-30-3	(6)
	20-134-2	(9)		20-217	(15)		20-250-1	(9)		20- 291	(15)		30-30-4	(6)
	20-134-3	(9)		20-218	(15)		20- 251	(2)		20- 292	(15)		30-30-5	(7)
	20-135	(1)		20-219	(15)		20- 252	(2)		20-293	(15)		30-30-6	(6)
	20-136	(1)		20-219-1	(9)		20- 253	(2)		20-294	(15)		30-30-7	(6)
	20-137	(1)		20-219-2	(15)		20- 254	(2)		20-295	(15)		30-31	(5)
	20-138	(1)		20-219-3	(15)		20- 255	(2)		20-296	(15)		30-32	(5)
	20-139	(1)		20-219-4	(15)		20- 256	(2)		30- 1	(16)		30-33	(6)
	20-140	(15)		20-220-1	(4)		20- 258	(9)		30- 2	(16)		30-34	(6)
	20-141	(15)		20-220-2	(8)		20- 259	(2)		30- 2-1	(16)		30-34-1	(9)
	20-142	(15)		20-220-3	(4)		20-259-1	(15)		30- 3	(3)		30-34-2	(9)
	20-201	(9)		20-220-4	(4)		20-259-2	(9)		30- 4	(3)		30-34-3	(9)
	20-202	(2)		20-220-5	(8)		20-259-3	(15)		30- 5	(3)		30-34-4	(9)
	20-203	(9)		20-220-6	(8)		20-259-4	(15)		30- 6	(16)		30-35	(3)
	20-204	(9)		20-220-7	(4)		20- 260	(15)		30- 7	(16)		30-36	(3)
	20-205	(9)		20-220-8	(4)		20- 261	(3)		30- 8	(16)		30-37	(3)
	20-206	(9)		20-220-9	(8)		20-261-1	(15)		30- 9	(16)		30-38	(9)
	20-207	(9)		20-220-10	(8)		20-261-2	(15)		30- 10	(16)		30-39	(9)
	20-208	(9)		20-220-11	(4)		20- 262	(9)		30- 10-1	(16)		30-40	(9)
	20-209	(9)		20-220-12	(4)		20- 263	(2)		30- 11	(9)		30-41	(9)
	20-210	(9)		20-220-13	(8)		20-263-1	(15)		30- 11-1	(9)		30-41-1	(9)
	20-211	(9)		20-220-14	(4)		20-263-2	(9)		30- 11-2	(9)		30-41-2	(9)
	20-212	(2)		20-220-15	(4)		20-263-3	(15)		30- 12	(3)		30-41-3	(9)
	20-213-1	(6)		20-220-16	(4)		20-263-4	(15)		30- 13	(3)		30-41-4	(9)
	20-213-2	(6)		20-220-17	(4)		20- 264	(3)		30- 14	(3)		30-42	(9)
	20-213-3	(6)		20-220-18	(8)		20- 265	(15)		30- 15	(9)		30-43	(3)
	20-213-4	(6)		20-220-19	(4)		20- 266	(15)		30- 15-1	(9)		30-44	(9)
	20-213-5	(6)		20-221	(15)		20- 267	(3)		30- 16	(9)		30-44-2	(9)
	20-213-6	(6)		20-223	(7)		20- 268	(15)		30- 17	(9)		30-44-3	(9)
	20-214	(12)		20-225	(7)		20- 269	(3)		30- 18	(9)		30-44-4	(9)
	20-215	(9)		20-226	(15)		20- 270	(2)		30- 19	(9)		30-45	(3)
	20-215-1	(15)		20-227	(15)		20- 271	(2)		30- 19-1	(9)		30-46	(3)
	20-215-2	(9)		20-228	(2)		20- 272	(2)		30- 20	(9)		30-47	(3)
	20-215-3	(15)		20-229	(4)		20- 273	(2)		30- 21	(3)		30-48	(3)
	20-215-5	(15)		20-230	(2)		20- 274	(2)		30- 22	(3)		30-49	(9)
	20-215-6	(15)		20-231	(15)		20- 275	(3)		30- 23	(3)		30-50	(9)
	20-216	(15)		20-231-1	(15)		20- 277	(15)		30- 24	(9)		30-51	(9)
	20-216-1	(15)		20-232	(6)		20- 278	(2)		30- 25	(3)		30-52	(9)
	20-216-2	(15)		20-234	(6)		20- 279	(2)		30- 25-1	(9)		30-52-1	(9)
	20-216-3	(15)		20-235	(6)		20- 280	(9)		30- 25-2	(9)		30-52-2	(9)
	20-216-4	(15)		20- 236	(6)		20- 281	(2)		30- 25-3	(9)		30-53	(9)
	20-216-5	(15)		20- 237	(6)		20-281-1	(15)		30- 25-4	(9)		30-54	(9)
	20-216-6	(15)		20- 238	(2)		20-281-2	(9)		30- 25-5	(9)		30-55	(9)
	20-216-7	(15)		20- 239	(3)		20-281-3	(15)		30- 25-6	(9)		30-56	(9)

Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number
	30-56-1	(9)		30-97-1	(16)		30-119	(3)		30-147	(3)		30-179-2	(10)
	30-57	(3)		30-97-2	(16)		30-120	(3)		30-148	(7)		30-179-3	(10)
	30-58	(7)		30-97-3	(16)		30-121	(3)		30-149	(6)		30-179-4	(10)
	30-59	(7)		30-97-4	(16)		30-121-1	(16)		30-149-1	(6)		30-179-5	(10)
	30-60	(16)		30-97-5	(16)		30-121-2	(16)		30-149-2	(6)		30-180	(10)
	30-60-1	(16)		30-97-6	(16)		30-121-3	(16)		30-149-3	(6)		30-181	(3)
	30-61	(7)		30-97-7	(16)		30-121-4	(16)		30-149-4	(6)		30-182	(3)
	30-62	(7)		30-97-8	(16)		30-121-5	(16)		30-149-5	(6)		30-183	(4)
	30-62-1	(16)		30-97-9	(16)		30-121-6	(16)		30-149-6	(6)		30-184	(4)
	30-62-2	(16)		30-97-10	(16)		30-121-7	(16)		30-149-7	(6)		30-185	(4)
	30-63	(3)		30-97-11	(16)		30-121-8	(16)		30-149-8	(6)		30-186	(4)
	30-64	(3)		30-97-12	(16)		30-121-9	(16)		30-149-9	(6)		30-187	(4)
	30-65	(3)		30-97-13	(16)		30-121-10	(16)		30-149-10	(6)		30-188	(4)
	30-66	(3)		30-97-14	(16)		30-121-11	(16)		30-149-11	(6)		30-189	(4)
	30-67	(3)		30-98	(16)		30-121-12	(16)		30-149-12	(6)		30-190	(4)
	30-68	(3)		30-99	(3)		30-122	(16)		30-150	(3)		30-191	(4)
	30-69	(3)		30-100	(3)		30-123	(3)		30-151	(3)		30-192	(4)
	30-70	(3)		30-101	(3)		30-124	(3)		30-152	(3)		30-193	(4)
	30-71	(3)		30-102	(3)		30-125	(3)		30-153	(3)		30-194	(4)
	30-72	(3)		30-103	(3)		30-126	(3)		30-154	(3)		30-195	(4)
	30-73	(3)		30-103-1	(16)		30-127	(3)		30-155	(3)		30-196	(4)
	30-74	(3)		30-103-2	(16)		30-128	(3)		30-156	(3)		30-197	(4)
	30-75	(16)		30-103-3	(16)		30-129	(3)		30-157	(3)		30-198	(4)
	30-76	(3)		30-103-4	(16)		30-130	(3)		30-158	(3)		30-198-1	(4)
	30-77	(3)		30-103-5	(16)		30-131	(3)		30-159	(3)		30-199	(4)
	30-78	(3)		30-103-6	(16)		30-131-1	(16)		30-160	(3)		30-200	(4)
	30-79	(3)		30-103-7	(16)		30-131-2	(16)		30-161	(3)		30-201	(4)
	30-80	(3)		30-104	(16)		30-131-3	(16)		30-162	(3)		30-202	(4)
	30-81	(3)		30-105	(3)		30-131-4	(16)		30-163	(9)		30-203	(4)
	30-82	(3)		30-106	(3)		30-131-5	(16)		30-164	(9)		30-204	(4)
	30-83	(3)		30-107	(3)		30-131-6	(16)		30-164-1	(9)		30-205	(4)
	30-83-1	(16)		30-108	(7)		30-131-7	(16)		30-165	(10)		30-206	(3)
	30-83-2	(16)		30-109	(7)		30-131-8	(16)		30-166	(12)		30-207	(3)
	30-83-3	(16)		30-110	(7)		30-131-9	(16)		30-166-1	(12)		30-208	(3)
	30-83-4	(16)		30-111	(7)		30-131-10	(16)		30-166-2	(12)		30-209	(3)
	30-83-5	(16)		30-112	(7)		30-131-11	(16)		30-166-3	(12)		30-210	(3)
	30-83-6	(16)		30-112-1	(7)		30-131-12	(16)		30-166-4	(12)		30-211	(3)
	30-83-7	(16)		30-112-2	(7)		30-131-13	(16)		30-167	(10)		30-212	(6)
	30-83-8	(16)		30-112-3	(16)		30-131-14	(16)		30-167-1	(10)		30-212-1	(6)
	30-83-9	(16)		30-112-4	(16)		30-133	(3)		30-168	(9)		30-212-2	(6)
	30-83-10	(16)		30-112-5	(16)		30-134	(7)		30-169	(7)		30-212-3	(6)
	30-84	(16)		30-112-6	(16)		30-135	(3)		30-170	(7)		30-212-4	(6)
	30-85	(3)		30-112-7	(16)		30-136	(3)		30-170-1	(7)		30-212-5	(6)
	30-86	(3)		30-112-8	(16)		30-138	(7)		30-170-2	(12)		30-212-6	(6)
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	30-88	(3)		30-112-10	(16)		30-138-2	(7)		30-171	(3)		30-212-8	(6)
	30-89	(3)		30-112-11	(16)		30-138-3	(7)		30-172	(7)		30-212-9	(6)
	30-90	(3)		30-112-12	(16)		30-139	(7)		30-173	(7)		30-212-10	(6)
	30-91	(3)		30-112-13	(16)		30-140	(3)		30-174	(7)		30-212-11	(6)
	30-92	(3)		30-113	(16)		30-141	(3)		30-175	(3)		30-212-12	(6)
	30-93	(3)		30-114	(3)		30-142	(3)		30-176	(3)		30-212-13	(6)
	30-94	(3)		30-115	(3)		30-143	(3)		30-177	(3)		30-212-14	(6)
	30-95	(18)		30-116	(3)		30-144	(3)		30-178	(3)		30-213	(3)
	30-96	(3)		30-117	(3)		30-145	(3)		30-179	(10)		30-214	(9)
	30-97	(3)		30-118	(3)		30-146	(3)		30-179-1	(10)		30-215	(9)

Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number	Mark	Pages	Revision number
	30-215-1	(9)		30-257	(9)		40-36	(14)		90-12-1	(20)			
	30-216	(9)		30-257-1	(9)		40-37	(19)		90-12-2	(20)			
	30-217	(9)		30-257-2	(9)		40-38	(8)		90-13	(7)			
	30-218	(9)		30-257-3	(9)		40-39	(11)		90-14	(7)			
	30-219	(9)		30-257-4	(9)		40-39-1	(8)		90-15	(20)			
	30-219-1	(9)		40-1	(14)		40-39-2	(11)		90-15-1	(20)			
	30-219-2	(9)		40-2	(11)		40-40	(8)		90-15-2	(20)			
	30-219-3	(9)		40-3	(1)		40-40-1	(8)		90-16	(20)			
	30-219-4	(9)		40-4	(1)		40-41	(1)		90-17	(7)			
	30-220	(9)		40-6	(1)		40-42	(1)		90-18	(7)			
	30-221	(9)		40-7	(1)		40-43	(8)		90-19	(7)			
	30-221-1	(9)		40-8	(14)		40-44	(8)		90-20	(7)			
	30-222	(9)		40-9	(1)		40-45	(8)		90-21	(7)			
	30-223	(9)		40-9-1	(14)		40-46	(8)		90-21-1	(20)			
	30-223-1	(9)		40-9-2	(14)		40-47	(8)		90-21-2	(20)			
	30-223-2	(9)		40-10	(7)		40-48-1	(8)		90-21-3	(20)			
	30-224	(3)		40-10-1	(14)		40-48-2	(8)		90-21-4	(20)			
	30-225	(3)		40-10-2	(14)		40-48-3	(8)		90-22	(7)			
	30-226	(3)		40-11	(1)		40-48-4	(8)		90-23	(7)			
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	30-229	(3)		40-13-1	(14)		40-50	(8)		90-26	(13)			
	30-229-1	(9)		40-13-2	(14)		40-51	(8)		90-27	(13)			
	30-230	(9)		40-14	(14)		40-52	(8)		90-28	(13)			
	30-231	(3)		40-15	(1)		40-53	(8)		90-29	(13)			
	30-232	(3)		40-16	(14)		40-53-2	(8)		90-30	(13)			
	30-233	(3)		40-17	(1)		40-53-3	(8)		90-31	(13)			
	30-234	(3)		40-17-1	(14)		40-53-4	(8)		90-32	(13)			
	30-235	(3)		40-17-2	(14)		40-53-5	(8)		90-33	(13)			
	30-236	(3)		40-17-3	(14)		40-53-6	(8)		90-34	(13)			
	30-237	(3)		40-18	(14)		40-54	(3)		90-35	(13)			
	30-238	(3)		40-19	(14)		40-55	(5)		90-36	(13)			
	30-239	(3)		40-20	(1)		40-56	(11)		90-38	(13)			
	30-240	(3)		40-21	(8)		40-57	(11)		90-39	(13)			
	30-241	(3)		40-21-1	(8)		40-57-1	(11)		90-40	(13)			
	30-242	(3)		40-22	(8)		40-57-2	(12)		90-41	(13)			
	30-243	(3)		40-23	(8)		40-58	(1)		90-43	(13)			
	30-244	(3)		40-23-1	(8)		40-59	(12)						
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	30-253-2	(9)		40-30-6	(14)		90-8	(7)						
	30-253-3	(9)		40-31	(14)		90-8-1	(20)						
	30-253-4	(9)		40-32	(14)		90-9	(20)						
	30-254	(9)		40-33	(14)		90-10	(7)						
	30-255	(3)		40-34	(14)		90-11	(7)						
	30-256	(9)		40-35	(19)		90-12	(20)						

SAFETY

SAFETY NOTICE

IMPORTANT SAFETY NOTICE

Proper service and repair is extremely important for safe machine operation. The service and repair techniques recommended by Komatsu and described in this manual are both effective and safe. Some of these techniques require the use of tools specially designed by Komatsu for the specific purpose.

To prevent injury to workers, the symbol ⚠ is used to mark safety precautions in this manual. The cautions accompanying these symbols should always be followed carefully. If any dangerous situation arises or may possibly arise, first consider safety, and take the necessary actions to deal with the situation.

GENERAL PRECAUTIONS

Mistakes in operation are extremely dangerous. Read the Operation and Maintenance Manual carefully BEFORE operating the machine.

1. Before carrying out any greasing or repairs, read all the precautions given on the decals which are fixed to the machine.
2. When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
    - Always wear safety glasses when hitting parts with a hammer.
    - Always wear safety glasses when grinding parts with a grinder, etc.
3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, hand shield, cap and other clothes suited for welding work.
4. When carrying out any operation with two or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs on the controls in the operator's compartment.
5. Keep all tools in good condition and learn the correct way to use them.
6. Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.

PREPARATIONS FOR WORK

7. Before adding oil or making any repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.
8. Before starting work, lower blade, ripper, bucket or any other work equipment to the ground. If this is not possible, insert the safety pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.
9. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.
10. Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out.
    Before disconnecting or removing components of the oil, water or air circuits, first remove the pressure completely from the circuit.
12. The water and oil in the circuits are hot when the engine is stopped, so be careful not to get burned.
    Wait for the oil and water to cool before carrying out any work on the oil or water circuits.
13. Before starting work, remove the leads from the battery. Always remove the lead from the negative (–) terminal first.
14. When raising heavy components, use a hoist or crane.
    Check that the wire rope, chains and hooks are free from damage.
    Always use lifting equipment which has ample capacity.
    Install the lifting equipment at the correct places.
    Use a hoist or crane and operate slowly to prevent the component from hitting any other part.
    Do not work with any part still raised by the hoist or crane.
15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure, then slowly loosen the bolts to remove.
16. When removing components, be careful not to break or damage the wiring. Damaged wiring may cause electrical fires.
17. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips onto the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip, or can even start fires.
18. As a general rule, do not use gasoline to wash parts. In particular, use only the minimum of gasoline when washing electrical parts.
19. Be sure to assemble all parts again in their original places.
    Replace any damaged parts with new parts.
    - When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is being operated.
20. When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. Also, check that connecting parts are correctly installed.
21. When assembling or installing parts, always use the specified tightening torques. When installing protective parts such as guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.
22. When aligning two holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.
23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurements.
24. Take care when removing or installing the tracks of track-type machines.
    When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.

FOREWORD

GENERAL

This shop manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This shop manual mainly contains the necessary technical information for operations performed in a service workshop. For ease of understanding, the manual is divided into the following chapters; these chapters are further divided into the each main group of components.

STRUCTURE AND FUNCTION

This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.
In addition, this section may contain hydraulic circuit diagrams, electric circuit diagrams, and maintenance standards.

TESTING AND ADJUSTING

This section explains checks to be made before and after performing repairs, as well as adjustments to be made at completion of the checks and repairs.
Troubleshooting charts correlating "Problems" with "Causes" are also included in this section.

DISASSEMBLY AND ASSEMBLY

This section explains the procedures for removing, installing, disassembling and assembling each component, as well as precautions for them.

MAINTENANCE STANDARD

This section gives the judgment standards for inspection of disassembled parts.
The contents of this section may be described in STRUCTURE AND FUNCTION.

OTHERS

This section mainly gives hydraulic circuit diagrams and electric circuit diagrams.
In addition, this section may give the specifications of attachments and options together.

NOTICE

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Use the specifications given in the book with the latest date.

HOW TO READ THE SHOP MANUAL

VOLUMES

Shop manuals are issued as a guide to carrying out repairs. They are divided as follows:

Chassis volume: Issued for every machine model
Engine volume: Issued for each engine series
Electrical volume:
Attachments volume: } Each issued as one volume to cover all models

These various volumes are designed to avoid duplicating the same information. Therefore, to deal with all repairs for any model , it is necessary that chassis, engine, electrical and attachment volumes be available.

DISTRIBUTION AND UPDATING

Any additions, amendments or other changes will be sent to KOMATSU distributors. Get the most up-to-date information before you start any work.

FILING METHOD

1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number.
   Example 1 (Chassis volume):

   10 - 3
   Item number (10. Structure and Function)
   Consecutive page number for each item.

   Example 2 (Engine volume):

   12 - 5
   Unit number (1. Engine)
   Item number (2. Testing and Adjusting)
   Consecutive page number for each item.
3. Additional pages: Additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.
   Example:
   10-4 12-203
   10-4-1 ─┐ ┌─ 12-203-1
   10-4-2 ─┘ Added pages └─ 12-203-2
   10-5 12-204

REVISED EDITION MARK

When a manual is revised, an edition mark ((1)(2)(3)....) is recorded on the bottom of the pages.

REVISIONS

Revised pages are shown in the LIST OF REVISED PAGES next to the CONTENTS page.

SYMBOLS

So that the shop manual can be of ample practical use, important safety and quality portions are marked with the following symbols.

Symbol	Item	Remarks
⚠	Safety	Special safety precautions are necessary when performing the work.
★	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.
	Weight	Weight of parts of systems. Caution necessary when selecting hoisting wire, or when working posture is important, etc.
🔧	Tightening torque	Places that require special attention for the tightening torque during assembly.
	Coat	Places to be coated with adhesives and lubricants, etc.
	Oil, water	Places where oil, water or fuel must be added, and the capacity.
💧	Drain	Places where oil or water must be drained, and quantity to be drained.

HOISTING INSTRUCTIONS

HOISTING

> ⚠ Heavy parts (25 kg or more) must be lifted with a hoist, etc. In the **DISASSEMBLY AND ASSEMBLY** section, every part weighing 25 kg or more is indicated clearly with the symbol

- If a part cannot be smoothly removed from the machine by hoisting, the following checks should be made:
  1) Check for removal of all bolts fastening the part to the relative parts.
  2) Check for existence of another part causing interference with the part to be removed.

WIRE ROPES

1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

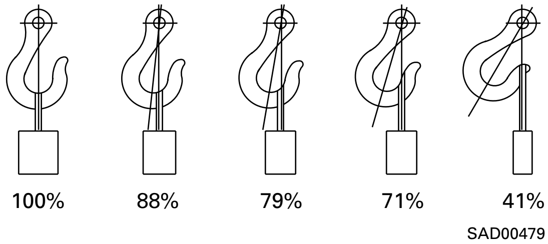
Wire ropes
(Standard "Z" or "S" twist ropes
without galvanizing)

Rope diameter	Allowable load	
mm	kN	tons
10	9.8	1.0
11.5	13.7	1.4
12.5	15.7	1.6
14	21.6	2.2
16	27.5	2.8
18	35.3	3.6
20	43.1	4.4
22.4	54.9	5.6
30	98.1	10.0
40	176.5	18.0
50	274.6	28.0
60	392.2	40.0

★ The allowable load value is estimated to be one-sixth or one-seventh of the breaking strength of the rope used.

2) Sling wire ropes from the middle portion of the hook.

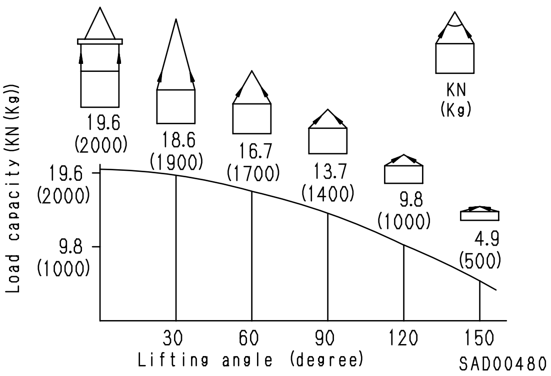
Slinging near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result. Hooks have maximum strength at the middle portion.



3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound onto the load.

   ⚠ Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident.

4) Do not sling a heavy load with ropes forming a wide hanging angle from the hook.
   When hoisting a load with two or more ropes, the force subjected to each rope will increase with the hanging angles. The table below shows the variation of allowable load kN {kg} when hoisting is made with two ropes, each of which is allowed to sling up to 9.8 kN {1000 kg} vertically, at various hanging angles.
   When two ropes sling a load vertically, up to 19.6 kN {2000 kg} of total weight can be suspended. This weight becomes 9.8 kN {1000 kg} when two ropes make a 120° hanging angle. On the other hand, two ropes are subjected to an excessive force as large as 39.2 kN {4000 kg} if they sling a 19.6 kN {2000 kg} load at a lifting angle of 150°.



METHOD OF DISASSEMBLING, CONNECTING PUSH-PULL TYPE COUPLER

⚠ Before carrying out the following work, release the residual pressure from the hydraulic tank. For details, see TESTING AND ADJUSTING, Releasing residual pressure from hydraulic tank.

⚠ Even if the residual pressure is released from the hydraulic tank, some hydraulic oil flows out when the hose is disconnected. Accordingly, prepare an oil receiving container.

Disconnection

1) Release the residual pressure from the hydraulic tank. For details, see TESTING AND ADJUSTING, Releasing residual pressure from hydraulic tank.

2) Hold adapter (1) and push hose joint (2) into mating adapter (3). (See Fig. 1)
   ★ The adapter can be pushed in about 3.5 mm.
   ★ Do not hold rubber cap portion (4).

3) After hose joint (2) is pushed into adapter (3), press rubber cap portion (4) against (3) until it clicks. (See Fig. 2)

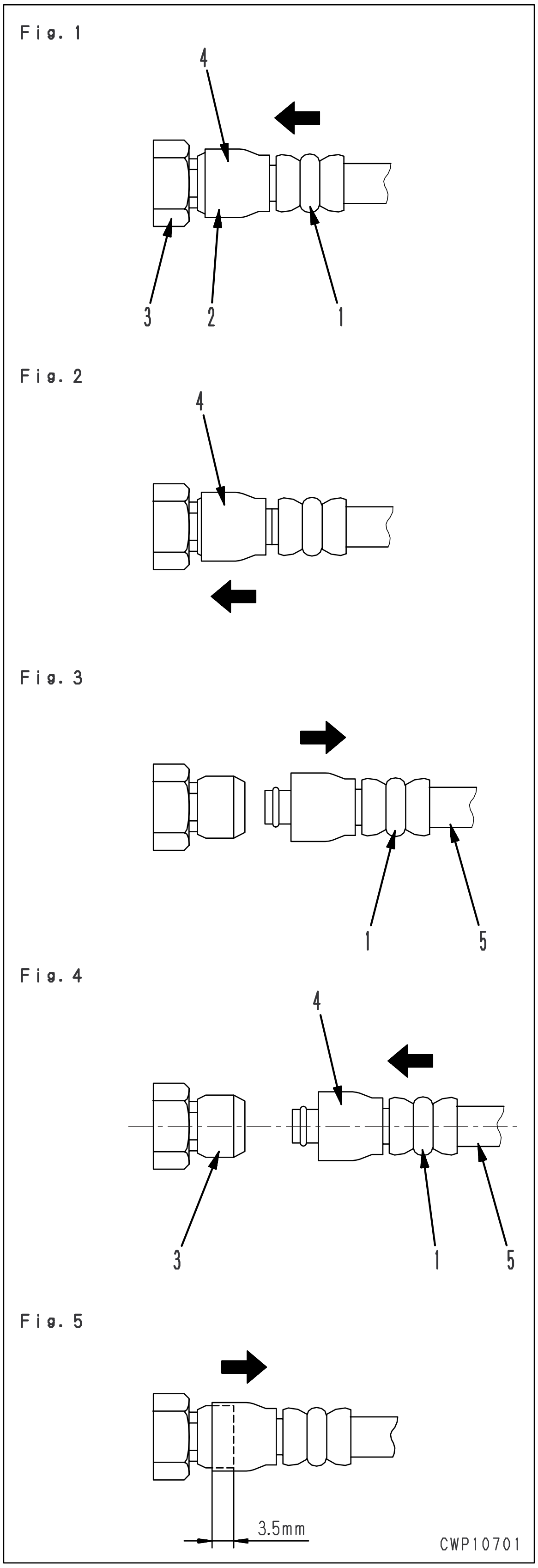
4) Hold hose adapter (1) or hose (5) and pull it out. (See Fig. 3)
   ★ Since some hydraulic oil flows out, prepare an oil receiving container.

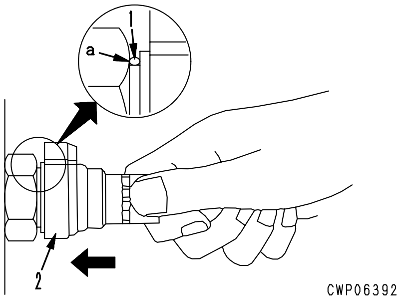
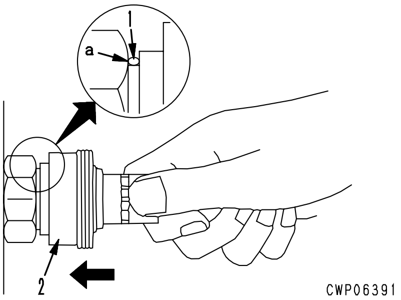
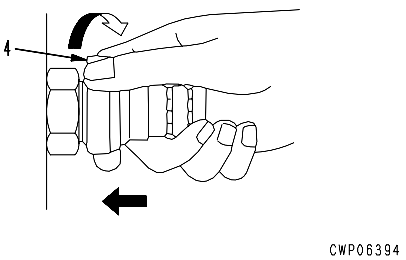
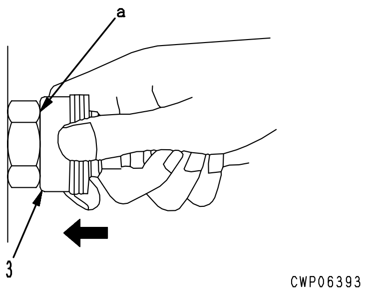
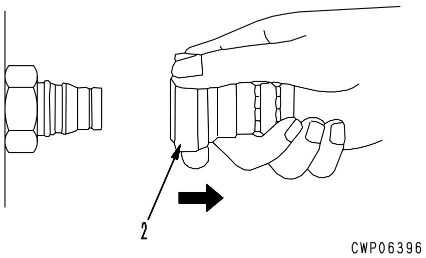
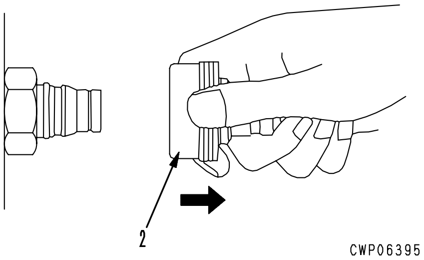
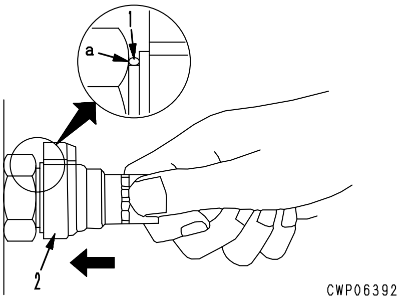
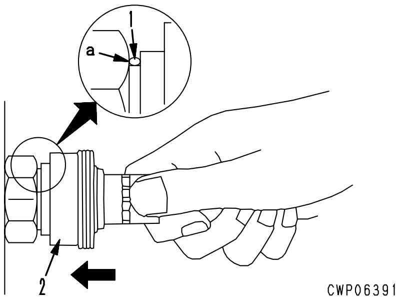
Connection

1) Hold hose adapter (1) or hose (5) and insert it in mating adapter (3), aligning them with each other. (See Fig. 4)
   ★ Do not hold rubber cap portion (4).

2) After inserting the hose in the mating adapter perfectly, pull it back to check its connecting condition. (See Fig. 5)
   ★ When the hose is pulled back, the rubber cap portion moves toward the hose about 3.5 mm. This does not indicate abnormality, however.

Type 1



	Type 2	Type 3
Disassembly	1) Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface **a** of the hexagonal portion at the male end.  	1) Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface **a** of the hexagonal portion at the male end. 
	2) Hold in the condition in Step 1), and turn lever (4) to the right (clockwise).  	2) Hold in the condition in Step 1), and push until cover (3) contacts contact surface **a** of the hexagonal portion at the male end. 
	3) Hold in the condition in Steps 1) and 2), and pull out whole body (2) to disconnect it.  	3) Hold in the condition in Steps 1) and 2), and pull out whole body (2) to disconnect it. 
Connection	• Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface **a** of the hexagonal portion at the male end to connect it.  	• Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface **a** of the hexagonal portion at the male end to connect it. 

COATING MATERIALS

★ The recommended coating materials such as adhesives, gasket sealants and greases used for disassembly and assembly are listed below.

★ For coating materials not listed below, use the equivalent of products shown in this list.

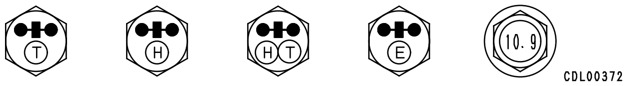
Category	Komatsu code	Part No.	Q'ty	Container	Main applications, features
Adhesives	LT-1A	790-129-9030	150 g	Tube	• Used to prevent rubber gaskets, rubber cushions, and cock plug from coming out.
	LT-1B	790-129-9050	20 g (2 pcs.)	Polyethylene container	• Used in places requiring an immediately effective, strong adhesive. Used for plastics (except polyethylene, polyprophylene, tetrafluoroethlene and vinyl chloride), rubber, metal and non-metal.
	LT-2	09940-00030	50 g	Polyethylene container	• Features: Resistance to heat and chemicals • Used for anti-loosening and sealant purpose for bolts and plugs.
	LT-3	790-129-9060 (Set of adhesive and hardening agent)	Adhesive: 1 kg Hardening agent: 500 g	Can	• Used as adhesive or sealant for metal, glass and plastic.
	LT-4	790-129-9040	250 g	Polyethylene container	• Used as sealant for machined holes.
	Holtz MH 705	790-126-9120	75 g	Tube	• Used as heat-resisting sealant for repairing engine.
	Three bond 1735	790-129-9140	50 g	Polyethylene container	• Quick hardening type adhesive • Cure time: within 5 sec. to 3 min. • Used mainly for adhesion of metals, rubbers, plastics and woods.
	Aron-alpha 201	790-129-9130	2 g	Polyethylene container	• Quick hardening type adhesive • Quick cure type (max. strength after 30 minutes) • Used mainly for adhesion of rubbers, plastics and metals.
	Loctite 648-50	79A-129-9110	50 cc	Polyethylene container	• Resistance to heat, chemicals • Used at joint portions subject to high temperatures.
Gasket sealant	LG-1	790-129-9010	200 g	Tube	• Used as adhesive or sealant for gaskets and packing of power train case, etc.
	LG-5	790-129-9080	1 kg	Can	• Used as sealant for various threads, pipe joints, flanges. • Used as sealant for tapered plugs, elbows, nipples of hydraulic piping.
	LG-6	790-129-9020	200 g	Tube	• Features: Silicon based, resistance to heat, cold • Used as sealant for flange surface, tread. • Used as sealant for oil pan, final drive case, etc.
	LG-7	790-129-9070	1 kg	Tube	• Features: Silicon based, quick hardening type • Used as sealant for flywheel housing, intake manifold, oil pan, thermostat housing, etc.
	Three bond 1211	790-129-9090	100 g	Tube	• Used as heat-resisting sealant for repairing engine.
	Three bond 1207B	419-15-18131	100 g	Tube	• Features: Silicone type, heat resistant, vibration resistant, and impact resistant sealing material • Used as sealing material for transfer case

Category	Komatsu code	Part No.	Q'ty	Container	Main applications, features	
Molybdenum disulphide lubricant	LM-G	09940-00051	60 g	Can	• Used as lubricant for sliding portion (to prevent from squeaking).	
	LM-P	09940-00040	200 g	Tube	• Used to prevent seizure or scuffling of the thread when press fitting or shrink fitting. • Used as lubricant for linkage, bearings, etc.	
Grease	G2-LI	SYG2-400LI SYG2-350LI SYG2-400LI-A SYG2-160LI SYGA-160CNLI	Various	Various	• General purpose type	
	G2-CA	SYG2-400CA SYG2-350CA SYG2-400CA-A SYG2-160CA SYGA-160CNCA	Various	Various	• Used for normal temperature, light load bearing at places in contact with water or steam.	
	Molybdenum disulphide grease LM-G (G2-M)	SYG2-400M SYG2-400M-A SYGA-16CNM	400 g × 10 400 g × 20 16 kg	Bellows type Bellows type Can	• Used for heavy load portion	
	Hyper White Grease G2-T G0-T (*) *: For use in cold district	SYG2-400T-A SYG2-16CNT SYG0-400T-A (*) SYG0-16CNT (*)	400 g 16 kg	Bellows type Can	• Seizure resistance and heat resistance higher than molybdenum disulfide grease • Since this grease is white, it does not stand out against machine body.	
	Biogrease G2B G2-BT (*) *: For high temperature and large load	SYG2-400B SYGA-16CNB SYG2-400BT (*) SYGA-16CNBT (*)	400 g 16 kg	Bellows type Can	• Since this grease is decomposed by bacteria in short period, it has less effects on microorganisms, animals, and plants.	
Primer	SUNSTAR PAINT PRIMER 580 SUPER	417-926-3910	20 ml	Glass container	Adhesive for cab glass	• Used as primer for cab side (Using limit: 4 months)
	SUNSTAR GLASS PRIMER 580 SUPER		20 ml	Glass container		• Used as primer for glass side (Using limit: 4 months)
Adhesive	SUNSTAR PENGUINE SEAL 580 SUPER "S" or "W"		320 ml	Polyethylene container		• "S" is used for high-temperature season (April - October) and "W" for low-temperature season (November - April) as adhesive for glass. (Using limit: 4 months)
	Sika Japan, Sikaflex 256HV	20Y-54-39850	310 ml	Polyethylene container		• Used as adhesive for glass. (Using limit: 6 months)
Caulking material	SUNSTAR PENGUINE SEAL No. 2505	417-926-3920	320 ml	Polyethylene container		• Used to seal joints of glass parts. (Using limit: 4 months)
	SEKISUI SILICONE SEALANT	20Y-54-55130	333 ml	Polyethylene container		• Used to seal front window. (Using limit: 6 months)

STANDARD TIGHTENING TORQUE

STANDARD TIGHTENING TORQUE TABLE (WHEN USING TORQUE WRENCH)

★ In the case of metric nuts and bolts for which there is no special instruction, tighten to the torque given in the table below.

Thread diameter of bolt	Width across flats	Tightening torque  CDL00372	
mm	mm	Nm	kgm
6	10	11.8 – 14.7	1.2 – 1.5
8	13	27 – 34	2.8 – 3.5
10	17	59 – 74	6 – 7.5
12	19	98 – 123	10 – 12.5
14	22	153 – 190	15.5 – 19.5
16	24	235 – 285	23.5 – 29.5
18	27	320 – 400	33 – 41
20	30	455 – 565	46.5 – 58
22	32	610 – 765	62.5 – 78
24	36	785 – 980	80 – 100
27	41	1150 – 1440	118 – 147
30	46	1520 – 1910	155 – 195
33	50	1960 – 2450	200 – 250
36	55	2450 – 3040	250 – 310
39	60	2890 – 3630	295 – 370

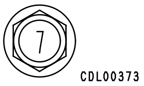
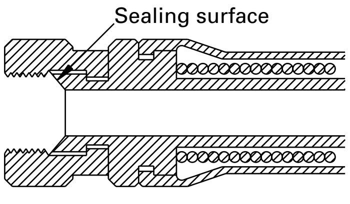
Thread diameter of bolt	Width across flats	Tightening torque  CDL00373	
mm	mm	Nm	kgm
6	10	5.9 – 9.8	0.6 – 1.0
8	13	13.7 – 23.5	1.4 – 2.4
10	14	34.3 – 46.1	3.5 – 4.7
12	27	74.5 – 90.2	7.6 – 9.2

TABLE OF TIGHTENING TORQUES FOR FLARED NUTS

★ In the case of flared nuts for which there is no special instruction, tighten to the torque given in the table below.



SAD00483

Thread diameter	Width across flat	Tightening torque	
mm	mm	Nm	kgm
14	19	24.5 ± 4.9	2.5 ± 0.5
18	24	49 ± 19.6	5 ± 2
22	27	78.5 ± 19.6	8 ± 2
24	32	137.3 ± 29.4	14 ± 3
30	36	176.5 ± 29.4	18 ± 3
33	41	196.1 ± 49	20 ± 5
36	46	245.2 ± 49	25 ± 5
42	55	294.2 ± 49	30 ± 5

TABLE OF TIGHTENING TORQUES FOR SPLIT FLANGE BOLTS

★ In the case of split flange bolts for which there is no special instruction, tighten to the torque given in the table below.

Thread diameter	Width across flat	Tightening torque	
mm	mm	Nm	kgm
10	14	59 – 74	6 – 7.5
12	17	98 – 123	10 – 12.5
16	22	235 – 285	23.5 – 29.5

TABLE OF TIGHTENING TORQUES FOR O-RING BOSS PIPING JOINTS

★ Unless there are special instructions, tighten the O-ring boss piping joints to the torque below.

Norminal No.	Thread diameter	Width across flat	Tightening torque (Nm {kgm})	
	mm	mm	Range	Target
02	14	Varies depending on type of connector.	35 – 63 {3.5 – 6.5}	44 {4.5}
03, 04	20		84 – 132 {8.5 – 13.5}	103 {10.5}
05, 06	24		128 – 186 {13.0 – 19.0}	157 {16.0}
10, 12	33		363 – 480 {37.0 – 49.0}	422 {43.0}
14	42		746 – 1010 {76.0 – 103}	883 {90.0}

TABLE OF TIGHTENING TORQUES FOR O-RING BOSS PLUGS

★ Unless there are special instructions, tighten the O-ring boss plugs to the torque below.

Norminal No.	Thread diameter	Width across flat	Tightening torque (Nm {kgm})	
	mm	mm	Range	Target
08	08	14	5.88 – 8.82 {0.6 – 0.9}	7.35 {0.75}
10	10	17	9.8 – 12.74 {1.0 – 1.3}	11.27 {1.15}
12	12	19	14.7 – 19.6 {1.5 – 2.0}	17.64 {1.8}
14	14	22	19.6 – 24.5 {2.0 – 2.5}	22.54 {2.3}
16	16	24	24.5 – 34.3 {2.5 – 3.5}	29.4 {3.0}
18	18	27	34.3 – 44.1 {3.5 – 4.5}	39.2 {4.0}
20	20	30	44.1 – 53.9 {4.5 – 5.5}	49.0 {5.0}
24	24	32	58.8 – 78.4 {6.0 – 8.0}	68.6 {7.0}
30	30	32	93.1 – 122.5 {9.5 – 12.5}	107.8 {11.0}
33	33	—	107.8 – 147.0 {11.0 – 15.0}	124.4 {13.0}
36	36	36	127.4 – 176.4 {13.0 – 18.0}	151.9 {15.5}
42	42	—	181.3 – 240.1 {18.5 – 24.5}	210.7 {21.5}
52	52	—	274.4 – 367.5 {28.0 – 37.5}	323.4 {33.0}

TIGHTENING TORQUE FOR 102 ENGINE SERIES

1) BOLT AND NUTS
   Use these torques for bolts and nuts (unit: mm) of Cummins Engine.

Thread diameter	Tightening torque	
mm	Nm	kgm
6	10 ± 2	1.02 ± 0.20
8	24 ± 4	2.45 ± 0.41
10	43 ± 6	4.38 ± 0.61
12	77 ± 12	7.85 ± 1.22

2) EYE JOINTS
   Use these torques for eye joints (unit: mm) of Cummins Engine.

Thread diameter	Tightening torque	
mm	Nm	kgm
6	8 ± 2	0.81 ± 0.20
8	10 ± 2	1.02 ± 0.20
10	12 ± 2	1.22 ± 0.20
12	24 ± 4	2.45 ± 0.41
14	36 ± 5	3.67 ± 0.51

3) TAPERED SCREWS
   Use these torques for tapered screws (unit: inch) of Cummins Engine.

Thread diameter	Tightening torque	
inch	Nm	kgm
1 / 16	3 ± 1	0.31 ± 0.10
1 / 8	8 ± 2	0.81 ± 0.20
1 / 4	12 ± 2	1.22 ± 0.20
3 / 8	15 ± 2	1.53 ± 0.41
1 / 2	24 ± 4	2.45 ± 0.41
3 / 4	36 ± 5	3.67 ± 0.51
1	60 ± 9	6.12 ± 0.92

TIGHTENING TORQUE TABLE FOR HOSES (TAPER SEAL TYPE AND FACE SEAL TYPE)

★ Tighten the hoses (taper seal type and face seal type) to the following torque, unless otherwise specified.
★ Apply the following torque when the threads are coated (wet) with engine oil.

Nominal size of hose	Width across flats	Tightening torque (Nm {kgm})		Taper seal type	Face seal type	
		Range	Target	Thread size (mm)	Nominal thread size - Threads per inch, Thread series	Root diameter (mm) (Reference)
02	19	34 – 54 {3.5 – 5.5}	44 {4.5}	–	$\frac{9}{16}$ – 18UN	14.3
		34 – 63 {3.5 – 6.5}	44 {4.5}	14	–	–
03	22	54 – 93 {5.5 – 9.5}	74 {7.5}	–	$\frac{11}{16}$ – 16UN	17.5
	24	59 – 98 {6.0 – 10.0}	78 {8.0}	18	–	–
04	27	84 – 132 {8.5 – 13.5}	103 {10.5}	22	$\frac{13}{16}$ – 16UN	20.6
05	32	128 – 186 {13.0 – 19.0}	157 {16.0}	24	1 – 14UNS	25.4
06	36	177 – 245 {18.0 – 25.0}	216 {22.0}	30	$1\frac{3}{16}$ – 12UN	30.2
(10)	41	177 – 245 {18.0 – 25.0}	216 {22.0}	33	–	–
(12)	46	197 – 294 {20.0 – 30.0}	245 {25.0}	36	–	–
(14)	55	246 – 343 {25.0 – 35.0}	294 {30.0}	42	–	–

ELECTRIC WIRE CODE

In the wiring diagrams, various colors and symbols are employed to indicate the thickness of wires.
This wire code table will help you understand WIRING DIAGRAMS.
Example: 5WB indicates a cable having a nominal number 5 and white coating with black stripe.

CLASSIFICATION BY THICKNESS

Norminal number	Copper wire			Cable O.D. (mm)	Current rating (A)	Applicable circuit
	Number of strands	Dia. of strands (mm^2)	Cross section (mm^2)			
0.85	11	0.32	0.88	2.4	12	Starting, lighting, signal etc.
2	26	0.32	2.09	3.1	20	Lighting, signal etc.
5	65	0.32	5.23	4.6	37	Charging and signal
15	84	0.45	13.36	7.0	59	Starting (Glow plug)
40	85	0.80	42.73	11.4	135	Starting
60	127	0.80	63.84	13.6	178	Starting
100	217	0.80	109.1	17.6	230	Starting

CLASSIFICATION BY COLOR AND CODE

Priority	Classification	Circuits	Charging	Ground	Starting	Lighting	Instrument	Signal	Other
1	Primary	Code	W	B	B	R	Y	G	L
		Color	White	Black	Black	Red	Yellow	Green	Blue
2	Auxiliary	Code	WR	—	BW	RW	YR	GW	LW
		Color	White & Red	—	White & Black	Red & White	Rellow & Red	Green & White	Blue & White
3		Code	WB	—	BY	RB	YB	GR	LR
		Color	White & Black	—	Black & Yellow	Red & Black	Yellow & Black	Green & Red	Blue & Yellow
4		Code	WL	—	BR	RY	YG	GY	LY
		Color	White & Blue	—	Black & Red	Red & Yellow	Yellow & Green	Green & Yellow	Blue & Yellow
5		Code	WG	—	—	RG	YL	GB	LB
		Color	White & Green	—	—	Red & Green	Yellow & Blue	Green & Black	Blue & Black
6		Code	—	—	—	RL	YW	GL	—
		Color	—	—	—	Red & Blue	Yellow & White	Green & Blue	—

CONVERSION TABLE

METHOD OF USING THE CONVERSION TABLE

The Conversion Table in this section is provided to enable simple conversion of figures. For details of the method of using the Conversion Table, see the example given below.

EXAMPLE

- Method of using the Conversion Table to convert from millimeters to inches

1. Convert 55 mm into inches.
   (1) Locate the number 50 in the vertical column at the left side, take this as Ⓐ, then draw a horizontal line from Ⓐ.
   (2) Locate the number 5 in the row across the top, take this as Ⓑ, then draw a perpendicular line down from Ⓑ.
   (3) Take the point where the two lines cross as Ⓒ. This point Ⓒ gives the value when converting from millimeters to inches. Therefore, 55 mm = 2.165 inches.
2. Convert 550 mm into inches.
   (1) The number 550 does not appear in the table, so divide by 10 (move the decimal point one place to the left) to convert it to 55 mm.
   (2) Carry out the same procedure as above to convert 55 mm to 2.165 inches.
   (3) The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (move the decimal point one place to the right) to return to the original value. This gives 550 mm = 21.65 inches.

Ⓑ

Millimeters to inches

1 mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
Ⓐ 50	1.969	2.008	2.047	2.087	2.126	Ⓒ 2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Millimeters to Inches

1 mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound

1 kg = 2.2046 lb

	0	1	2	3	4	5	6	7	8	9
0	0	2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	51.91	55.12	57.32	59.53	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.18	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.85	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.24	209.44	211.64	213.85	216.05	218.26

Liter to U.S. Gallon

1ℓ = 0.2642 U.S. Gal

	0	1	2	3	4	5	6	7	8	9
0	0	0.264	0.528	0.793	1.057	1.321	1.585	1.849	2.113	2.378
10	2.642	2.906	3.170	3.434	3.698	3.963	4.227	4.491	4.755	5.019
20	5.283	5.548	5.812	6.076	6.340	6.604	6.869	7.133	7.397	7.661
30	7.925	8.189	8.454	8.718	8.982	9.246	9.510	9.774	10.039	10.303
40	10.567	10.831	11.095	11.359	11.624	11.888	12.152	12.416	12.680	12.944
50	13.209	13.473	13.737	14.001	14.265	14.529	14.795	15.058	15.322	15.586
60	15.850	16.115	16.379	16.643	16.907	17.171	17.435	17.700	17.964	18.228
70	18.492	18.756	19.020	19.285	19.549	19.813	20.077	20.341	20.605	20.870
80	21.134	21.398	21.662	21.926	22.190	22.455	22.719	22.983	23.247	23.511
90	23.775	24.040	24.304	24.568	24.832	25.096	25.361	25.625	25.889	26.153

Liter to U.K. Gallon

1ℓ = 0.21997 U.K. Gal

	0	1	2	3	4	5	6	7	8	9
0	0	0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
10	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.740	3.950	4.179
20	4.399	4.619	4.839	5.059	5.279	5.499	5.719	5.939	6.159	6.379
30	6.599	6.819	7.039	7.259	7.479	7.969	7.919	8.139	8.359	8.579
40	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.778
50	10.998	11.281	11.438	11.658	11.878	12.098	12.318	12.528	12.758	12.978
60	13.198	13.418	13.638	13.858	14.078	14.298	14.518	14.738	14.958	15.178
70	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
80	17.598	17.818	18.037	18.257	18.477	18.697	18.917	19.137	19.357	19.577
90	19.797	20.017	20.237	20.457	20.677	20.897	21.117	21.337	21.557	21.777

kgm to ft. lb

1 kgm = 7.233 ft. lb

	0	1	2	3	4	5	6	7	8	9
0	0	7.2	14.5	21.7	28.9	36.2	43.4	50.6	57.9	65.1
10	72.3	79.6	86.8	94.0	101.3	108.5	115.7	123.0	130.2	137.4
20	144.7	151.9	159.1	166.4	173.6	180.8	188.1	195.3	202.5	209.8
30	217.0	224.2	231.5	238.7	245.9	253.2	260.4	267.6	274.9	282.1
40	289.3	296.6	303.8	311.0	318.3	325.5	332.7	340.0	347.2	354.4
50	361.7	368.9	376.1	383.4	390.6	397.8	405.1	412.3	419.5	426.8
60	434.0	441.2	448.5	455.7	462.9	470.2	477.4	484.6	491.8	499.1
70	506.3	513.5	520.8	528.0	535.2	542.5	549.7	556.9	564.2	571.4
80	578.6	585.9	593.1	600.3	607.6	614.8	622.0	629.3	636.5	643.7
90	651.0	658.2	665.4	672.7	679.9	687.1	694.4	701.6	708.8	716.1
100	723.3	730.5	737.8	745.0	752.2	759.5	766.7	773.9	781.2	788.4
110	795.6	802.9	810.1	817.3	824.6	831.8	839.0	846.3	853.5	860.7
120	868.0	875.2	882.4	889.7	896.9	904.1	911.4	918.6	925.8	933.1
130	940.3	947.5	954.8	962.0	969.2	976.5	983.7	990.9	998.2	1005.4
140	1012.6	1019.9	1027.1	1034.3	1041.5	1048.8	1056.0	1063.2	1070.5	1077.7
150	1084.9	1092.2	1099.4	1106.6	1113.9	1121.1	1128.3	1135.6	1142.8	1150.0
160	1157.3	1164.5	1171.7	1179.0	1186.2	1193.4	1200.7	1207.9	1215.1	1222.4
170	1129.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.1	1287.5	1294.7
180	1301.9	1309.2	1316.4	1323.6	1330.9	1338.1	1345.3	1352.6	1359.8	1367.0
190	1374.3	1381.5	1388.7	1396.0	1403.2	1410.4	1417.7	1424.9	1432.1	1439.4

kg/cm^2 to lb/in^2

1kg/cm^2 = 14.2233 lb/in^2

	0	1	2	3	4	5	6	7	8	9
0	0	14.2	28.4	42.7	56.9	71.1	85.3	99.6	113.8	128.0
10	142.2	156.5	170.7	184.9	199.1	213.4	227.6	241.8	256.0	270.2
20	284.5	298.7	312.9	327.1	341.4	355.6	369.8	384.0	398.3	412.5
30	426.7	440.9	455.1	469.4	483.6	497.8	512.0	526.3	540.5	554.7
40	568.9	583.2	597.4	611.6	625.8	640.1	654.3	668.5	682.7	696.9
50	711.2	725.4	739.6	753.8	768.1	782.3	796.5	810.7	825.0	839.2
60	853.4	867.6	881.8	896.1	910.3	924.5	938.7	953.0	967.2	981.4
70	995.6	1010	1024	1038	1053	1067	1081	1095	1109	1124
80	1138	1152	1166	1181	1195	1209	1223	1237	1252	1266
90	1280	1294	1309	1323	1337	1351	1365	1380	1394	1408
100	1422	1437	1451	1465	1479	1493	1508	1522	1536	1550
110	1565	1579	1593	1607	1621	1636	1650	1664	1678	1693
120	1707	1721	1735	1749	1764	1778	1792	1806	1821	1835
130	1849	1863	1877	1892	1906	1920	1934	1949	1963	1977
140	1991	2005	2020	2034	2048	2062	2077	2091	2105	2119
150	2134	2148	2162	2176	2190	2205	2219	2233	2247	2262
160	2276	2290	2304	2318	2333	2347	2361	2375	2389	2404
170	2418	2432	2446	2460	2475	2489	2503	2518	2532	2546
180	2560	2574	2589	2603	2617	2631	2646	2660	2674	2688
190	2702	2717	2731	2745	2759	2773	2788	2802	2816	2830
200	2845	2859	2873	2887	2901	2916	2930	2944	2958	2973
210	2987	3001	3015	3030	3044	3058	3072	3086	3101	3115
220	3129	3143	3158	3172	3186	3200	3214	3229	3243	3257
230	3271	3286	3300	3314	3328	3343	3357	3371	3385	3399
240	3414	3428	3442	3456	3470	3485	3499	3513	3527	3542

Temperature

Fahrenheit-Centigrade Conversion ; a simple way to convert a Fahrenheit temperature reading into a Centigrade temperature reading or vice versa is to enter the accompanying table in the center or boldface column of figures.

These figures refer to the temperature in either Fahrenheit or Centigrade degrees.

If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column as a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.

If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column as a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

1°C = 33.8°F

°C		°F	°C		°F	°C		°F	°C		°F
–40.4	**–40**	–40.0	–11.7	**11**	51.8	7.8	**46**	114.8	27.2	**81**	117.8
–37.2	**–35**	–31.0	–11.1	**12**	53.6	8.3	**47**	116.6	27.8	**82**	179.6
–34.4	**–30**	–22.0	–10.6	**13**	55.4	8.9	**48**	118.4	28.3	**83**	181.4
–31.7	**–25**	–13.0	–10.0	**14**	57.2	9.4	**49**	120.2	28.9	**84**	183.2
–28.9	**–20**	–4.0	–9.4	**15**	59.0	10.0	**50**	122.0	29.4	**85**	185.0
–28.3	**–19**	–2.2	–8.9	**16**	60.8	10.6	**51**	123.8	30.0	**86**	186.8
–27.8	**–18**	–0.4	–8.3	**17**	62.6	11.1	**52**	125.6	30.6	**87**	188.6
–27.2	**–17**	1.4	–7.8	**18**	64.4	11.7	**53**	127.4	31.1	**88**	190.4
–26.7	**–16**	3.2	–7.2	**19**	66.2	12.2	**54**	129.2	31.7	**89**	192.2
–26.1	**–15**	5.0	–6.7	**20**	68.0	12.8	**55**	131.0	32.2	**90**	194.0
–25.6	**–14**	6.8	–6.1	**21**	69.8	13.3	**56**	132.8	32.8	**91**	195.8
–25.0	**–13**	8.6	–5.6	**22**	71.6	13.9	**57**	134.6	33.3	**92**	197.6
–24.4	**–12**	10.4	–5.0	**23**	73.4	14.4	**58**	136.4	33.9	**93**	199.4
–23.9	**–11**	12.2	–4.4	**24**	75.2	15.0	**59**	138.2	34.4	**94**	201.2
–23.3	**–10**	14.0	–3.9	**25**	77.0	15.6	**0**	140.0	35.0	**95**	203.0
–22.8	**–9**	15.8	–3.3	**26**	78.8	16.1	**61**	141.8	35.6	**96**	204.8
–22.2	**–8**	17.6	–2.8	**27**	80.6	16.7	**62**	143.6	36.1	**97**	206.6
–21.7	**–7**	19.4	–2.2	**28**	82.4	17.2	**63**	145.4	36.7	**98**	208.4
–21.1	**–6**	21.2	–1.7	**29**	84.2	17.8	**64**	147.2	37.2	**99**	210.2
–20.6	**–5**	23.0	–1.1	**30**	86.0	18.3	**65**	149.0	37.8	**100**	212.0
–20.0	**–4**	24.8	–0.6	**31**	87.8	18.9	**66**	150.8	40.6	**105**	221.0
–19.4	**–3**	26.6	0	**32**	89.6	19.4	**67**	152.6	43.3	**110**	230.0
–18.9	**–2**	28.4	0.6	**33**	91.4	20.0	**68**	154.4	46.1	**115**	239.0
–18.3	**–1**	30.2	1.1	**34**	93.2	20.6	**69**	156.2	48.9	**120**	248.0
–17.8	**0**	32.0	1.7	**35**	95.0	21.1	**70**	158.0	51.7	**125**	257.0
–17.2	**1**	33.8	2.2	**36**	96.8	21.7	**71**	159.8	54.4	**130**	266.0
–16.7	**2**	35.6	2.8	**37**	98.6	22.2	**72**	161.6	57.2	**135**	275.0
–16.1	**3**	37.4	3.3	**38**	100.4	22.8	**73**	163.4	60.0	**140**	284.0
–15.6	**4**	39.2	3.9	**39**	102.2	23.3	**74**	165.2	62.7	**145**	293.0
–15.0	**5**	41.0	4.4	**40**	104.0	23.9	**75**	167.0	65.6	**150**	302.0
–14.4	**6**	42.8	5.0	**41**	105.8	24.4	**76**	168.8	68.3	**155**	311.0
–13.9	**7**	44.6	5.6	**42**	107.6	25.0	**77**	170.6	71.1	**160**	320.0
–13.3	**8**	46.4	6.1	**43**	109.4	25.6	**78**	172.4	73.9	**165**	329.0
–12.8	**9**	48.2	6.7	**44**	111.2	26.1	**79**	174.2	76.7	**170**	338.0
–12.2	**10**	50.0	7.2	**45**	113.0	26.7	**80**	176.0	79.4	**175**	347.0

UNITS

In this manual, the measuring units are indicated with Internatinal System of units (SI).
As for reference, conventionally used Gravitational System of units are indicated in parentheses { }.

Example:

N {kg}
Nm {kgm}
MPa {kg/cm^2}
kPa {mmH$_2$O}
kPa {mmHg}
kW/rpm {HP/rpm}
g/kWh {g/HPh}

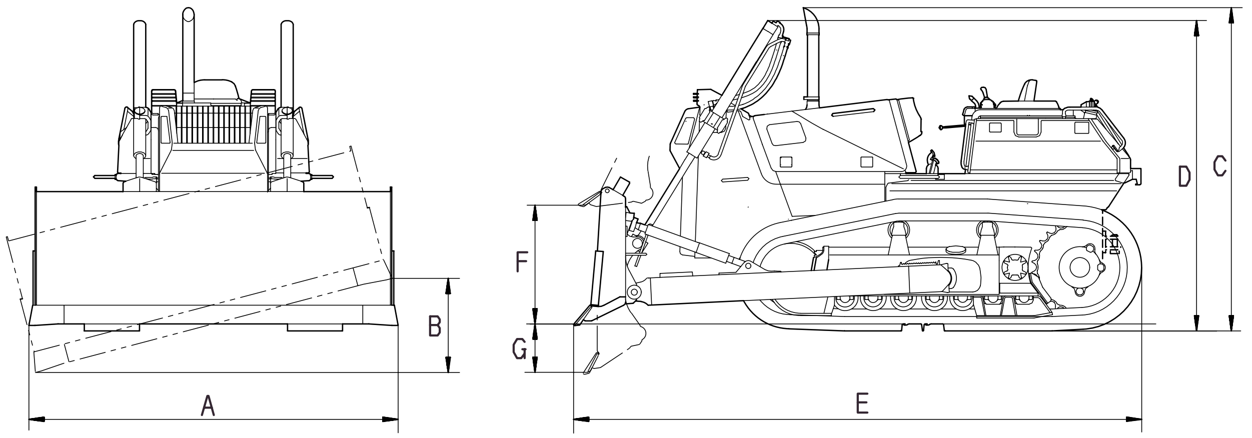
01 GENERAL

014012

GENERAL ASSEMBLY DRAWING

D65E-12
D65EX-12

- **Tiltdozer**



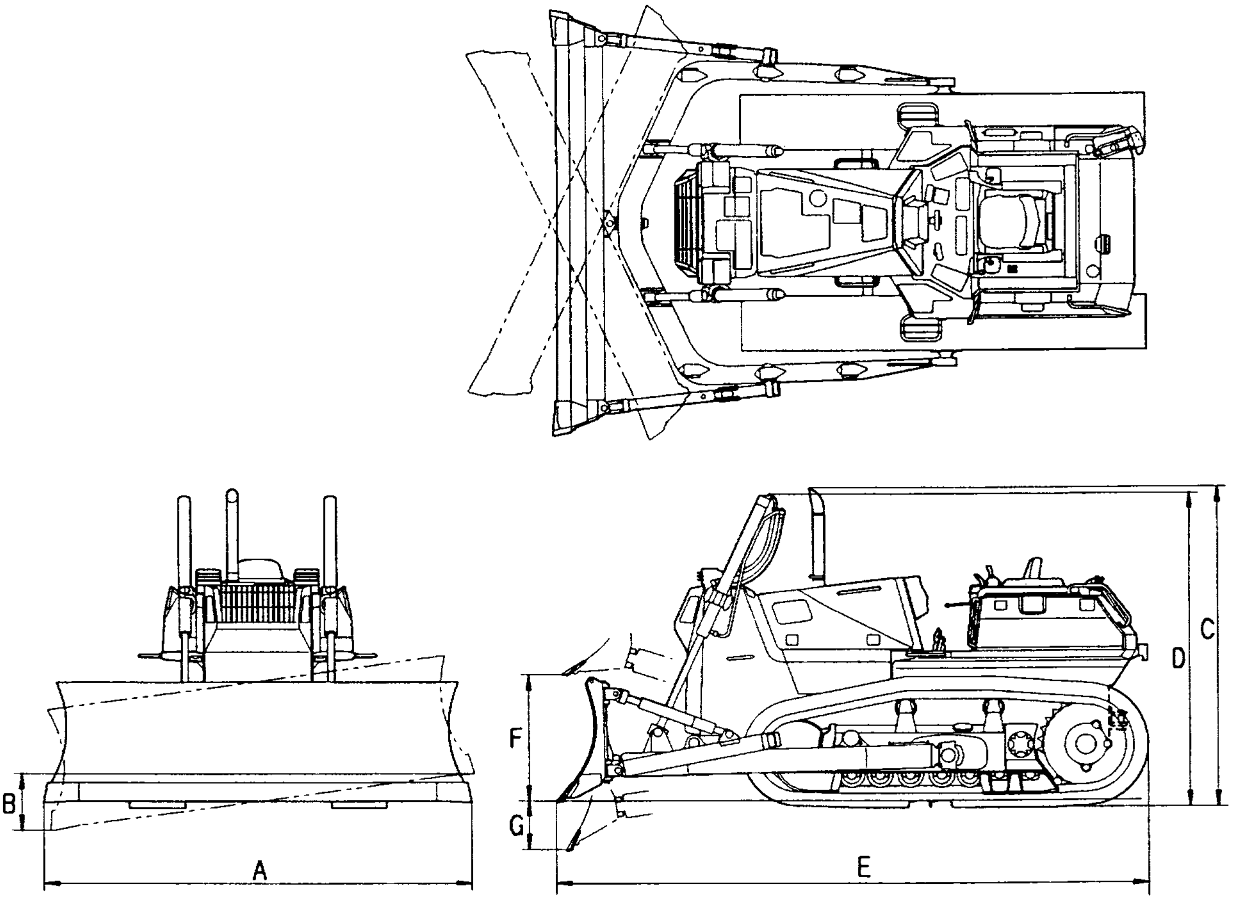
SXD04013

014012

	D65E-12	60001 – 60947	60948 – 65000	65001 –	—
	D65EX-12	60001 – 60941	60942 – 65000	65001 –	65001 –
A	Blade width (mm)	3,415 (3,360)	3,415 (3,460)	3,415 (3,460)	[3,640]
B	Max. tilting distance (mm)	870 (855)	870 (855)	870 (855)	[820]
C	Height of exhaust pipe end (mm)	2,980	2,980	2,990	2,990
D	Height of lift cylinder end (mm)	2,870	2,870	2,875	2,875
E	Overall length (mm)	5,260 (5,390)	5,260 (5,750)	5,260 (5,440)	[5,445]
F	Max. lift above ground (mm)	1,100 (1,095)	1,100 (1,095)	1,105	[1,100]
G	Max. drop below ground (mm)	450	450	440	[445]

Note: The values without ( ) are the values when the tiltdozer or semi-U blade are installed.
The values with ( ) are the values only when the semi-U blade is installed.
The values with [ ] are the values only when the wide gauges spec. semi-U blade is installed.

- **Angledozer**



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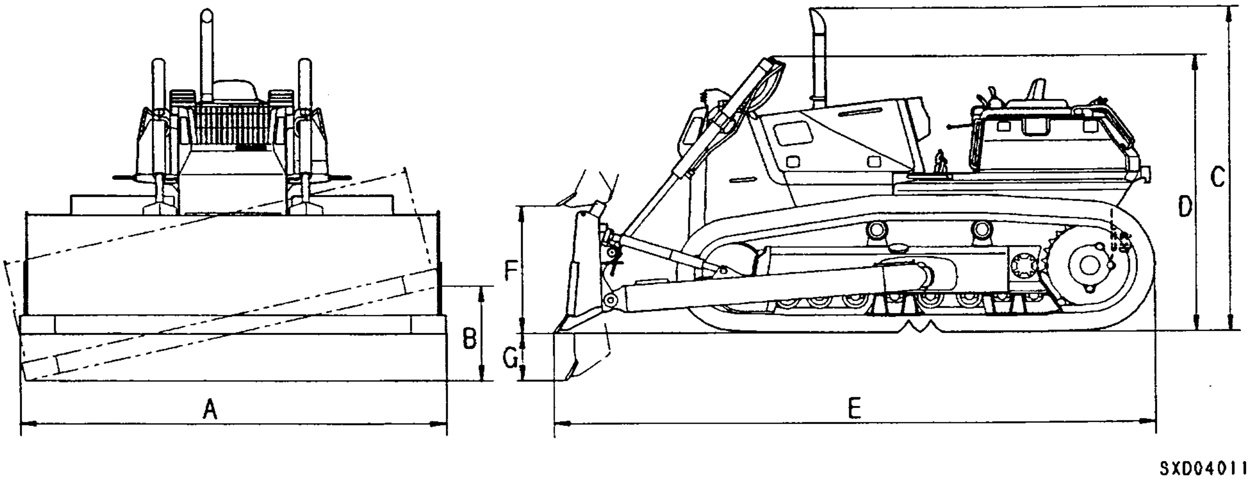
014012

	D65E-12	60001 – 60947	60948 – 65000	65001 –
	D65EX-12	60001 – 60941	60942 – 65000	65001 –
A	Blade width (mm)	3970	3970	3970
B	Max. tilting distance (mm)	400	400	400
C	Height of exhaust pipe end (mm)	2980	2980	2990
D	Height of lift cylinder end (mm)	2935	2935	2940
E	Overall length (mm)	5470	5470	5470
F	Max. lift above ground (mm)	1180	1180	1185
G	Max. drop below ground (mm)	460	460	450

D65P-12
D65PX-12

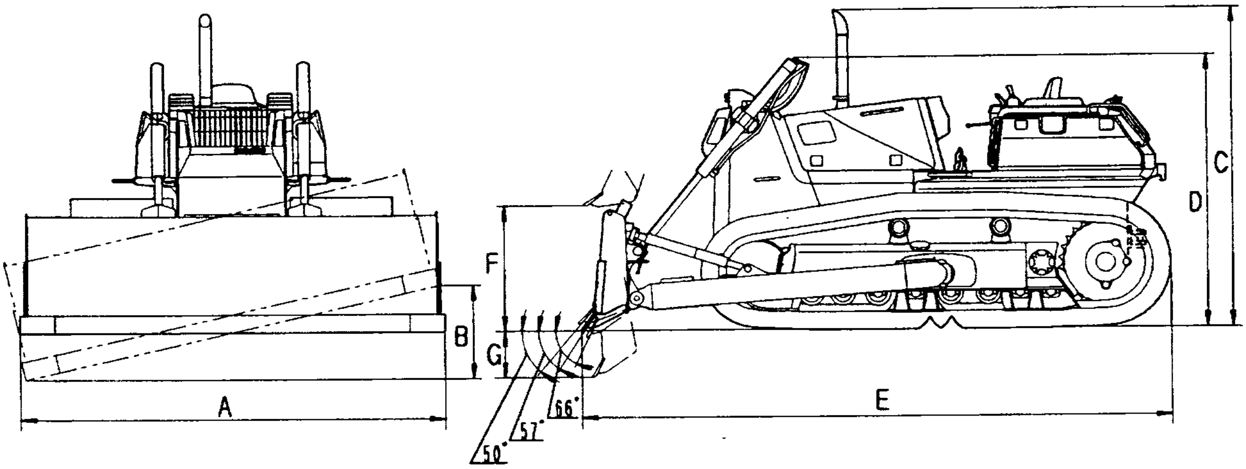
- **Tiltdozer**



		60001 – 60890	60891 – 65000	65001 –
	D65P-12	60001 – 60890	60891 – 65000	65001 –
	D65PX-12	60001 – 60914	60915 – 65000	65001 –
A	Blade width (mm)	3970	3970	3970
B	Max. tilting distance (mm)	890	890	890
C	Height of exhaust pipe end (mm)	3015	3015	3025
D	Height of lift cylinder end (mm)	2615	2615	2620
E	Overall length (mm)	5550	5550	5550
F	Max. lift above ground (mm)	1200	1200	1205
G	Max. drop below ground (mm)	445	445	440

014012

- **Power tilt, power pitch dozer**



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	D65P-12	60001 – 60890	60891 – 65000	65001 –
	D65PX-12	60001 – 60914	60915 – 65000	65001 –
A	Blade width (mm)	3970	3970	3970
B	Max. tilting distance (mm)	890	890	890
C	Height of exhaust pipe end (mm)	3015	3015	3025
D	Height of lift cylinder end (mm)	2615	2615	2620
E	Overall length (mm)	5550	5550	5550
F	Max. lift above ground (mm)	1200	1200	1205
G	Max. drop below ground (mm)	445	445	440

SPECIFICATIONS

Machine model				D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers				60001 – 60947	60001 – 60890	60001 – 60941	60001 – 60914
Weight		Operating weight	kg				
		• bare tracktor		14,820	15,840	14,890	15,840
		• with straight tiltdozer		18,000	18,600	16,200	18,600
		• with straight tilt + ripper + ROPS cab		[20,300]	[23,500]	[20,800]	[23,500]
		• with straight tilt + T/winch + ROPS cab		[20,300]	[23,500]	[20,800]	[23,500]
Performance		Min. truning radius	m	3.2	3.6	(Counterrotation turn)	(Counterrotation turn)
		Gradeability	deg	30	30	30	30
		Stability (front, rear, left, right)	deg	35	35	35	35
	Speed ranges	Forward 1st	km/h	3.9	3.9	3.9	3.9
		Forward 2nd		6.8	6.8	6.8	6.8
		Forward 3rd		10.6	10.6	10.6	10.6
		Reverse 1st	km/h	5.0	5.0	5.0	5.0
		Reverse 2nd		8.6	8.6	8.6	8.6
		Reverse 3rd		13.4	13.4	13.4	13.4
	Ground pressure	Bare tractor	Kpa {kg/cm^2}	52.96 {0.54}	26.48 {0.27}	53.94 {0.55}	26.48 {0.27}
		Straight tiltdozer		64.72 {0.66}	30.40 {0.31}	63.74 {0.65}	30.40 {0.31}
		Straight tilt + ripper + ROPS cab		[72.57 {0.74}]	–	[82.38 {0.84}]	–
		Straight tilt + T/winch + ROPS cab		–	[38.25 {0.39}]	–	38.25 {0.39}
Dimensions	Overall length	Bare tractor	mm	4,365	4,425	4,365	4,425
		With straight tiltdozer		5,260	5,550	5,260	5,550
	Overall width	Bare tractor	mm	2,390	3,000	2,390	3,000
		With straight tiltdozer		3,415	3,970	3,415	3,970
	Overall heights	To tip of exhaust pipe	mm	2,980	3,015	2,980	3,015
		To top of operator's compartment		2,230	2,365	2,230	2,365

Note: The values for the weight and ground pressure in [ ] are reference values.

014012

Machine model				D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers				60001 – 60947	60001 – 60890	60001 – 60941	60001 – 60914
Dimensions	Overall height	When ROPS cab is installed	mm	3,160	3,195	3,160	3,195
		When ROPS canopy is installed		3,160	3,195	3,160	3,195
		When canopy is installed		2,995	3,030	2,995	3,030
	Track gauge		mm	1,880	2,050	1,880	2,050
	Length of track on ground			2,675	3,285	2,675	3,285
	Width of track shoe (standard)			510	950	510	950
	Min. ground clearance (To bottom of undercover)			400	510	400	510
Engine	Model			6D125-1	S6D125-1		
	Type			4-cycle, water cooled, inline vertical type direct injection –	4-cycle, water cooled, inline vertical type direct injection Wtih turbocharger		
	No. of cylinder – bore x stroke		mm	6 – 125 x 150	6 – 125 x 150		
	Piston displacement		ℓ {cc}	11.04 {11,040}	11.04 {11,040}		
	Performance	Rated horsepower	kw/rpm {HP/rpm}	135/1,950 {183/1,950}	142/1,950 {193/1,950}		
		Max. torque	Nm/rpm {kgm/rpm}	799/1,100 {81.5/1,100}	980/1,200 {100/1,200}		
		High idling	rpm	2,100	2,100		
		Low idling	rpm	825	825		
		Min. fuel consumption ratio	g/kwh {g/HPh}	222 {161}	215 {155}		
	Starting motor			24V, 7.5kW			
	Alternator			24V, 35A			
	Battery			12V, 140Ah x 2			
	Radiator core type			D-6			
Power train system	Torque converter			3-element, 1-stage, 1 phase			
	Transmission			Planetary gear type, multiple disc clutch, hydraulically actuated, lubrication gear pump, force feed, forward 3 speed, reverse 3 speed, manual mechanical type			

014012

Machine model				D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers				60001 – 60947	60001 – 60890	60001 – 60941	60001 – 60914
Power train system		Bevel gear shaft		Spiral bevel gear, force feed lubrication gear pump			
	HSS steering	HSS steering system		–		Differential planetary gear type, hydraulic motor drive type, hand operated, hydraulically actuated	
		Master brake		–		Wet type, multiple disc, spring boosted, foot operated, hydraulically actuated	
	Clutch and brake	Steering clutch		Wet type, multiple disc, spring boosted, hand operated, hydraulically actuated		–	
		Steering brake		Wet type, multiple disc, spring boosted, foot operated, hydraulically actuated		–	
		Final drive		1-stage spur gear, 1-stage planetary gear, splash type lubrication			
Undercarriage		Suspension		Semi-rigid, floating beam			
		Carrier roller (each side)		2			
		Track roller (each side)		7	8	7	8
		Track shoe	510 mm	Assembly type, single grouser, 39 on each side, pitch:203.2 mm	–	Assembly type, single grouser, 39 on each side, pitch:203.2 mm	–
			950 mm	–	Assembly type, special swamp shoe, 45 on each side pitch:203.2 mm	–	Assembly type, special swamp shoe, 45 on each side pitch:203.2 mm
Power train, lubrication pump				Gear type (SAL(2)-045+045)			
PPC pump				Gear type (SBR(1)-010) Max. discharge pressure: 20.6 MPa {210 kg/cm^2} Theoretical discharge amount: 36.8 ℓ/min/3,500 rpm			
HSS motor				–		Piston type (HMF95DT), swash plate angle 16°, with brake valve Permissible peak pressure: 47 MPa {480 kg/cm^2} Rated flow (theoretical value): 183.2 ℓ/min/1,908 rpm	
Steering, work equipment hydraulic system		Hydraulic pump		Gear type (SAL(3)-100) Theoretical discharge amount: 251.3 ℓ/min/2,500 rpm Max. discharge pressure: 20.6 MPa {210 kg/cm^2}		Variable swash plate type (HPV95), CLSS, load sensing type Permissible peak pressure: 47 MPa {480 kg/cm^2}	

014012

Machine model					D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers					60001 – 60947	60001 – 60890	60001 – 60941	60001 – 60914
Steering, work equipment hydraulic system	Main control valve		Type • For ripper (D65E, EX only) • For blade lift • For blade tilt • For steering (D65E, PX only)		• 2-spool type, hydraulically assisted (Lift + tilt) • 2 + 1-spool type, hydraulically assisted (Ripper + lift + tilt)		• 3-spool type, hydraulically assisted (Lift + tilt + steering) • 3 + 1-spool type, hydraulically assisted (Ripper + lift + tilt + steering)	
	Type				Reciprocal type			
	Hydraulic cylinder	Dimensions of blade lift cylinder	Cylinder bore	mm	95	95	95	95
			Outside diameter of piston rod		65	65	65	65
			Piston stroke		A, ST: 1,165 SU: 1,215	ST, PP: 1,105	A, ST: 1,165 SU: 1,215	ST, PP: 1,105
			Max. distance between pins		A, ST, SU: 1,685	ST, PP: 1,905	A, ST, SU: 1,685	ST, PP: 1,905
			Min. distance between pins		A, ST: 520 SU: 470	ST, PP: 800	A, ST: 520 SU: 470	ST, PP: 800
		Dimensions of blade tilt, pitch cylinder	Cylinder bore	mm	140			
			Outside diameter of piston rod		70			
			Piston stroke		145			
			Max. distance between pins		1,222			
			Min. distance between pins		1,077			
	Hydraulic tank				Box type (externally installed control valve)			
Work equipment (straight tilt)	Type				Hydraulic straight tiltdozer			
	Blade support method				Brace type (tilt cylinder on right)			
	Performance		Max. lifting height (from ground)	mm	1,100	1,200	1,100	1,200
			Max. lowering depth (from ground)	mm	450	445	450	445
			Max. tilt	mm	870	890	870	890
			Range for blade cutting angle	deg	± 7	± 7	± 7	± 7
	Dimensions		Blade width	mm	3,415	3,970	3,415	3,970
			Blade height	mm	1,225	1,110	1,225	1,110
			Blade cutting angle	deg	55	57	55	57

Note: A: Angle
ST: Straight tilt
PP: Power pitch
SU: Semi-U

Machine model				D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers				60001 – 60947	60001 – 60890	60001 – 60941	60001 – 60914
Work equipment (angle, power pitch)	Type			Hydraulic angle dozer	Hydraulic power pitch dozer	Hydraulic angle dozer	Hydraulic power pitch dozer
	Blade support method			Brace type	Hydraulic cylinder type	Brace type	Hydraulic cylinder type
	Performance	Max. lifting height (from ground)	mm	1,180	1,200	1,180	1,200
		Max. lowering depth (from ground)	mm	460	445	460	445
		Max. tilt	mm	400	890	400	890
		Max. angle	deg	25	–	25	–
		Range for blade cutting angle	deg	–	+9, –7	–	+9, –7
	Dimensions	Blade width	mm	3,970	3,970	3,970	3,970
		Blade height	mm	1,120	1,110	1,120	1,110
		Blade cutting angle	deg	55	57	55	57
Work equipment (semi-U)	Type			Hydraulic semi-U dozer	–	Hydraulic semi-U dozer	–
	Blade support method			Brace type (tilt cylinder on right)	–	Brace type (tilt cylinder on right)	–
	Performance	Max. lifting height (from ground)	mm	1,095	–	1,095	–
		Max. lowering depth (from ground)	mm	450	–	450	–
		Max. tilt	mm	855	–	855	–
		Range for blade cutting angle	deg	±7	–	±7	–
	Dimensions	Blade width	mm	3,360	–	3,360	–
		Blade height	mm	1,425	–	1,425	–
		Blade cutting angle	deg	55	–	55	–

014012

Machine model				D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers				60948 – 65000	60891 – 65000	60942 – 65000	60915 – 65000
Weight		Operating weight	kg				
		• bare tracktor		14,820	16,190	14,870	16,200
		• with straight tiltdozer		17,420	18,810	17,590	18,940
		• with straight tilt + ripper + ROPS cab		[20,650]	[21,100]	[20,750]	[21,200]
		• with straight tilt + T/winch + ROPS cab		[20,650]	[21,100]	[20,750]	[21,200]
Performance		Min. truning radius	m	3.2	3.6	(Counterrotation turn)	(Counterrotation turn)
		Gradeability	deg	30	30	30	30
		Stability (front, rear, left, right)	deg	35	35	35	35
	Speed ranges	Forward 1st	km/h	3.9	3.9	3.9	3.9
		Forward 2nd		6.8	6.8	6.8	6.8
		Forward 3rd		10.6	10.6	10.6	10.6
		Reverse 1st	km/h	5.0	5.0	5.0	5.0
		Reverse 2nd		8.6	8.6	8.6	8.6
		Reverse 3rd		13.4	13.4	13.4	13.4
	Ground pressure	Bare tractor	kPa {kg/cm²}	52.96 {0.54}	25.50 {0.26}	52.96 {0.54}	25.50 {0.26}
		Straight tiltdozer		62.76 {0.64}	29.42 {0.30}	62.76 {0.64}	29.42 {0.30}
		Straight tilt + ripper + ROPS cab		[74.53 {0.76}]	–	[74.53 {0.76}]	–
		Straight tilt + T/winch + ROPS cab		–	[33.34 {0.34}]	–	33.34 {0.34}
Dimensions	Overall length	Bare tractor	mm	4,365	4,425	4,365	4,425
		With straight tiltdozer		5,260	5,550	5,260	5,550
	Overall width	Bare tractor	mm	2,390	3,000	2,390	3,000
		With straight tiltdozer		3,415	3,970	3,415	3,970
	Overall heights	To tip of exhaust pipe	mm	2,980	3,015	2,980	3,015
		To top of operator's compartment		2,230	2,365	2,230	2,365

Note: The values for the weight and ground pressure in [ ] are reference values.

Machine model				D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers				60948 – 65000	60891 – 65000	60942 – 65000	60915 – 65000
Dimensions	Overall height	When ROPS cab is installed	mm	3,160	3,195	3,160	3,195
		When ROPS canopy is installed		3,160	3,195	3,160	3,195
		When canopy is installed		2,995	3,030	2,995	3,030
	Track gauge		mm	1,880	2,050	1,880	2,050
	Length of track on ground			2,675	3,285	2,675	3,285
	Width of track shoe (standard)			510	950	510	950
	Min. ground clearance (To bottom of undercover)			400	510	400	510
Engine	Model			6D125E-2	S6D125E-2		
	Type			4-cycle, water cooled, inline vertical type direct injection –	4-cycle, water cooled, inline vertical type direct injection Wtih turbocharger		
	No. of cylinder – bore x stroke		mm	6 – 125 x 150	6 – 125 x 150		
	Piston displacement		ℓ {cc}	11.04 {11,040}	11.04 {11,040}		
	Performance	Rated horsepower	kw/rpm {HP/rpm}	135/1,950 {183/1,950}	142/1,950 {193/1,950}		
		Max. torque	Nm/rpm {kgm/rpm}	799/1,100 {81.5/1,100}	980.1,200 {100/1,200}		
		High idling	rpm	2,100	2,100		
		Low idling	rpm	825	825		
		Min. fuel consumption ratio	g/kwh {g/HPh}	222 {161}	215 {155}		
	Starting motor			24V, 7.5kW			
	Alternator			24V, 35A			
	Battery			12V, 140Ah x 2			
	Radiator core type			D-6			
Power train system	Torque converter			3-element, 1-stage, 1 phase			
	Transmission			Planetary gear type, multiple disc clutch, hydraulically actuated, lubrication gear pump, force feed, forward 3 speed, reverse 3 speed, manual mechanical type			

Machine model				D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers				60948 – 65000	60891 – 65000	60942 – 65000	60915 – 65000
Power train system		Bevel gear shaft		Spiral bevel gear, force feed lubrication gear pump			
	HSS steering	HSS steering system		–		Differential planetary gear type, hydraulic motor drive type, hand operated, hydraulically actuated	
		Master brake		–		Wet type, multiple disc, spring boosted, foot operated, hydraulically actuated	
	Clutch and brake	Steering clutch		Wet type, multiple disc, spring boosted, hand operated, hydraulically actuated		–	
		Steering brake		Wet type, multiple disc, spring boosted, foot operated, hydraulically actuated		–	
		Final drive		1-stage spur gear, 1-stage planetary gear, splash type lubrication			
Undercarriage		Suspension		Semi-rigid, floating beam			
		Carrier roller (each side)		2			
		Track roller (each side)		7	8	7	8
		Track shoe	510 mm	Assembly type, single grouser, 39 o each side, pitch: 203.2 mm	–	Assembly type, single grouser, 39 on each side, pitch: 203.2 mm	–
			950 mm	–	Assembly type, special swamp shoe, 45 on each side pitch: 203.2 mm	–	Assembly type, special swamp shoe, 45 on each side pitch: 203.2 mm
Power train, lubrication pump				Gear type (SAL(2)-045+045)			
PPC pump				Gear type (SBR(1)-014) Max. discharge pressure: 20.6 MPa {210 kg/cm²} Theoretical discharge amount: 49.4 ℓ/min/3,500 rpm			
HSS motor				–		Piston type (HMF95DT), swash plate angle 16°, with brake valve Permissible peak pressure: 47 MPa {480 kg/cm²} Rated flow (theoretical value): 183.2 ℓ/min/1,908 rpm	
Steering, work equipment hydraulic system		Hydraulic pump		Gear type (SAL(3)-080) Theoretical discharge amount: 201 ℓ/min/2,500 rpm Max. discharge pressure: 20.6 MPa {210 kg/cm²}		Variable swash plate type (HPV95), CLSS, load sensing type Permissible peak pressure: 47 MPa {480 kg/cm²}	

Machine model					D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers					60948 – 65000	60891 – 65000	60942 – 65000	60915 – 65000
Steering, work equipment hydraulic system	Main control valve		Type • For ripper (D65E, EX only) • For blade lift • For blade tilt • For steering (D65EX, PX only)		• 2-spool type, hydraulically assisted (Lift + tilt) • 2 + 1-spool type, hydraulically assisted (Ripper + lift + tilt)		• 3-spool type, hydraulically assisted (Lift + tilt + steering) • 3 + 1-spool type, hydraulically assisted (Ripper + lift + tilt + steering)	
	Type				Reciprocal type			
	Hydraulic cylinder	Dimensions of blade lift cylinder	Cylinder bore	mm	95	95	95	95
			Outside diameter of piston rod		65	65	65	65
			Piston stroke		A, ST: 1,165 SU: 1,215	ST, PP: 1,105	A, ST: 1,165 SU: 1,215	ST, PP: 1,105
			Max. distance between pins		A, ST, SU: 1,685	ST, PP: 1,905	A, ST, SU: 1,685	ST, PP: 1,905
			Min. distance between pins		A, ST: 520 SU: 470	ST, PP: 800	A, ST: 520 SU: 470	ST, PP: 800
		Dimensions of blade tilt, pitch cylinder	Cylinder bore	mm	140			
			Outside diameter of piston rod		70			
			Piston stroke		145			
			Max. distance between pins		1,222			
			Min. distance between pins		1,077			
	Hydraulic tank				Box type (externally installed control valve)			
Work equipment (straight tilt)	Type				Hydraulic straight tiltdozer			
	Blade support method				Brace type (tilt cylinder on right)			
	Performance		Max. lifting height (from ground)	mm	1,100	1,200	1,100	1,200
			Max. lowering depth (from ground)	mm	450	445	450	445
			Max. tilt	mm	870	890	870	890
			Range for blade cutting angle	deg	± 7	± 7	± 7	± 7
	Dimensions		Blade width	mm	3,415	3,970	3,415	3,970
			Blade height	mm	1,225	1,110	1,225	1,110
			Blade cutting angle	deg	55	57	55	57

Note: A: Angle ST: Straight tilt PP: Power pitch SU: Semi-U

014012

Machine model				D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers				60948 – 65000	60891 – 65000	60942 – 65000	60915 – 65000
Work equipment (angle, power pitch)		Type		Hydraulic angle dozer	Hydraulic power pitch dozer	Hydraulic angle dozer	Hydraulic power pitch dozer
		Blade support method		Brace type	Hydraulic cylinder type	Brace type	Hydraulic cylinder type
	Performance	Max. lifting height (from ground)	mm	1,180	1,200	1,180	1,200
		Max. lowering depth (from ground)	mm	460	445	460	445
		Max. tilt	mm	400	890	400	890
		Max. angle	deg	25	–	25	–
		Range for blade cutting angle	deg	–	+9, –7	–	+9, –7
	Dimensions	Blade width	mm	3,970	3,970	3,970	3,970
		Blade height	mm	1,120	1,110	1,120	1,110
		Blade cutting angle	deg	55	57	55	57
Work equipment (semi-U)		Type		Hydraulic semi-U dozer	–	Hydraulic semi-U dozer	–
		Blade support method		Brace type (tilt cylinder on right)	–	Brace type (tilt cylinder on right)	–
	Performance	Max. lifting height (from ground)	mm	1,095	–	1,095	–
		Max. lowering depth (from ground)	mm	450	–	450	–
		Max. tilt	mm	855	–	855	–
		Range for blade cutting angle	deg	±7	–	±7	–
	Dimensions	Blade width	mm	3,460	–	3,460	–
		Blade height	mm	1,425	–	1,425	–
		Blade cutting angle	deg	55	–	55	–

Machine model				D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers				65001 and up	65001 and up	65001 and up	65001 and up
Weight		Operating weight	kg				
		• bare tracktor		15,620	16,990	15,670	17,000
		• with straight tiltdozer + cab		18,700	20,100	18,900	20,250
		• with straight tilt + ripper + ROPS cab		[20,650]	[21,100]	[20,920]	[21,200]
		• with straight tilt + T/winch + ROPS cab		[20,650]	[21,100]	[20,750]	[21,200]
Performance		Min. truning radius	m	3.2	3.6	(Counterrotation turn)	(Counterrotation turn)
		Gradeability	deg	30	30	30	30
		Stability (front, rear, left, right)	deg	35	35	35	35
	Speed ranges	Forward 1st	km/h	3.9	3.9	3.9	3.9
		Forward 2nd		6.8	6.8	6.8	6.8
		Forward 3rd		10.6	10.6	10.6	10.6
		Reverse 1st	km/h	5.0	5.0	5.0	5.0
		Reverse 2nd		8.6	8.6	8.6	8.6
		Reverse 3rd		13.4	13.4	13.4	13.4
	Ground pressure	Bare tractor	kPa {kg/cm^2}	55.9 {0.57}	26.5 {0.27}	52.96 {0.54}	25.50 {0.26}
		Straight tiltdozer		67.7 {0.69}	31.4 {0.32}	62.76 {0.64}	29.42 {0.30}
		E: Straight tilt + ripper + ROPS		[74.5 {0.76}]	–	[74.53 {0.76}]	–
		P: Straight tilt + ROPS		–	[32.4 {0.33}]	–	33.34 {0.34}
Dimensions	Overall length	Bare tractor	mm	4,365	4,425	4,365	4,425
		With straight tiltdozer		5,260	5,550	5,260	5,550
	Overall width	Bare tractor	mm	2,390	3,000	2,390	3,000
		With straight tiltdozer		3,415	3,970	3,415	3,970
	Overall heights	To tip of exhaust pipe	mm	2,990	3,025	2,990	3,025
		To top of operator's compartment		2,300	2,335	2,300	2,335

Note: The values for the weight and ground pressure in [ ] are reference values.

014012

Millimeters to Inches

1 mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound

1 kg = 2.2046 lb

	0	1	2	3	4	5	6	7	8	9
0	0	2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	51.91	55.12	57.32	59.53	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.18	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.85	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.24	209.44	211.64	213.85	216.05	218.26

Machine model				D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers				65001 and up	65001 and up	65001 and up	65001 and up
Power train system	Bevel gear shaft			Spiral bevel gear, force feed lubrication gear pump			
	HSS steering	HSS steering system		–		Differential planetary gear type, hydraulic motor drive type, hand operated, hydraulically actuated	
		Master brake		–		Wet type, multiple disc, spring boosted, foot operated, hydraulically actuated	
	Clutch and brake	Steering clutch		Wet type, multiple disc, spring boosted, hand operated, hydraulically actuated		–	
		Steering brake		Wet type, multiple disc, spring boosted, foot operated, hydraulically actuated		–	
	Final drive			1-stage spur gear, 1-stage planetary gear, splash type lubrication			
Undercarriage	Suspension			Semi-rigid, floating beam			
	Carrier roller (each side)			2			
	Track roller (each side)			7	8	7	8
	Track shoe		510 mm	Assembly type, single grouser, 39 o each side, pitch: 203.2 mm	–	Assembly type, single grouser, 39 on each side, pitch: 203.2 mm	–
			810 mm	–	–	Assembly type, single grouser, 39 on each side, pitch: 203.2 mm	–
			950 mm	–	Assembly type, special swamp shoe, 45 on each side pitch: 203.2 mm	–	Assembly type, special swamp shoe, 45 on each side pitch: 203.2 mm
Power train, lubrication pump				Gear type (SAL(2)-050+045)		Gear type (SAL(2)-045+045)	
PPC pump				Gear type (SBR(1)-014) Max. discharge pressure: 20.6 MPa {210 kg/cm^2} Theoretical discharge amount: 49.4 ℓ/min/3,500 rpm			
HSS motor				–		Piston type (HMF95DT), swash plate angle 16°, with brake valve Permissible peak pressure: 47 MPa {480 kg/cm^2} Rated flow (theoretical value): 183.2 ℓ/min/1,908 rpm	
Steering, work equipment hydraulic system	Hydraulic pump			Gear type (SAL(3)-080) Theoretical discharge amount: 201 ℓ/min/2,500 rpm Max. discharge pressure: 20.6 MPa {210 kg/cm^2}		Variable swash plate type (HPV95), CLSS, load sensing type Permissible peak pressure: 47 MPa {480 kg/cm^2}	

014012

Machine model					D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers					65001 and up	65001 and up	65001 and up	65001 and up
Steering, work equipment hydraulic system	Main control valve		Type • For ripper (D65E, EX only) • For blade lift • For blade tilt • For steering (D65EX, PX only)		• 2-spool type, hydraulically assisted (Lift + tilt) • 2 + 1-spool type, hydraulically assisted (Ripper + lift + tilt)		• 3-spool type, hydraulically assisted (Lift + tilt + steering) • 3 + 1-spool type, hydraulically assisted (Ripper + lift + tilt + steering)	
	Type				Reciprocal type			
	Hydraulic cylinder	Dimensions of blade lift cylinder	Cylinder bore	mm	95	95	95	95
			Outside diameter of piston rod		65	65	65	65
			Piston stroke		A, ST: 1,165 SU: 1,215	ST, PP: 1,105	A, ST, SUW: 1,165 SU: 1,215	ST, PP: 1,105
			Max. distance between pins		A, ST, SU: 1,685	ST, PP: 1,905	A, ST, SU, SUW: 1,685	ST, PP: 1,905
			Min. distance between pins		A, ST: 520 SU: 470	ST, PP: 800	A, ST, SUW: 520 SU: 470	ST, PP: 800
		Dimensions of blade tilt, pitch cylinder	Cylinder bore	mm	140			
			Outside diameter of piston rod		70			
			Piston stroke		145			
			Max. distance between pins		1,222			
			Min. distance between pins		1,077			
	Hydraulic tank				Box type (externally installed control valve)			
Work equipment (straight tilt)	Type				Hydraulic straight tiltdozer			
	Blade support method				Brace type (tilt cylinder on right)			
	Performance		Max. lifting height (from ground)	mm	1,105	1,205	1,105	1,205
			Max. lowering depth (from ground)	mm	440	440	440	440
			Max. tilt	mm	870	890	870	890
			Range for blade cutting angle	deg	± 7	± 7	± 7	± 7
	Dimensions		Blade width	mm	3,415	3,970	3,415	3,970
			Blade height	mm	1,225	1,110	1,225	1,110
			Blade cutting angle	deg	55	57	55	57

Note: A: Angle ST: Straight tilt PP: Power pitch SU: Semi-U SUW: Semi-U Wide gauge

Machine model				D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers				65001 and up	65001 and up	65001 and up	65001 and up
Work equipment (angle, power pitch)	Type			Hydraulic angle dozer	Hydraulic power pitch dozer	Hydraulic angle dozer	Hydraulic power pitch dozer
	Blade support method			Brace type	Hydraulic cylinder type	Brace type	Hydraulic cylinder type
	Performance	Max. lifting height (from ground)	mm	1,185	1,205	1,185	1,205
		Max. lowering depth (from ground)	mm	450	440	450	440
		Max. tilt	mm	400	890	400	890
		Max. angle	deg	25	–	25	–
		Range for blade cutting angle	deg	–	+9, –7	–	+9, –7
	Dimensions	Blade width	mm	3,970	3,970	3,970	3,970
		Blade height	mm	1,120	1,110	1,120	1,110
		Blade cutting angle	deg	55	57	55	57
Work equipment (semi-U)	Type			Hydraulic semi-U dozer	–	Hydraulic semi-U dozer	–
	Blade support method			Brace type (tilt cylinder on right)	–	Brace type (tilt cylinder on right)	–
	Performance	Max. lifting height (from ground)	mm	1,105	–	1,105	–
		Max. lowering depth (from ground)	mm	440	–	440	–
		Max. tilt	mm	855	–	855	–
		Range for blade cutting angle	deg	±7	–	±7	–
	Dimensions	Blade width	mm	3,460	–	3,460	–
		Blade height	mm	1,425	–	1,425	–
		Blade cutting angle	deg	55	–	55	–

014012

Machine model				D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers				65001 and up	65001 and up	65001 and up	65001 and up
Work equipment (semi-U, wide gauge)	Type			Hydraulic semi-U dozer	–	Hydraulic semi-U dozer	–
	Blade support method			Brace type (tilt cylinder on right)	–	Brace type (tilt cylinder on right)	–
	Performance	Max. lifting height (from ground)	mm	–	–	1,100	–
		Max. lowering depth (from ground)	mm	–	–	445	–
		Max. tilt	mm	–	–	820	–
		Range for blade cutting angle	deg	–	–	±7	–
	Dimensions	Blade width	mm	–	–	3,640	–
		Blade height	mm	–	–	1,410	–
		Blade cutting angle	deg	–	–	55	–

WEIGHT TABLE

⚠ This weight table is a guide for use when transporting or handling components.

Unit: kg

Machine Model	D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers	60001 — 60947	60001 — 60890	60001 — 60941	60001 — 60914
Engine, damper assembly	1,080	1,200	1,200	1,200
• Engine assembly	1,030	1,150	1,150	1,150
• Damper assembly	45	45	45	45
• Parts mounted to engine (wiring)	1.5	1.5	1.5	1.5
Radiator assembly (including oil cooler)	165	165	165	165
• Oil cooler assembly (for hydraulic oil)	6	6	6	6
Fuel tank assembly	120	120	120	120
Power train unit assembly	1,570	1,570	1,580	1,580
• Steering clutch, brake assembly	700	700	—	—
• Steering valve assembly	25	25	—	—
• Transmission assembly	485	485	485	485
• Torque converter, PTO assembly	290	290	290	290
• Transmission valve assembly	17	17	17	17
• Main relief valve assembly	6	6	6	6
• HSS assembly	—	—	735	735
• Brake valve assembly	—	—	6	6
Final drive assembly (each side)	790	815	790	815
Sprocket assembly (each side)	8.3 × 9	8.3 × 9	8.3 × 9	8.3 × 9
Hull frame assembly	2,040	2,040	2,040	2,040
Track group assembly (each side)	1,545	1,745	1,545	1,745
• Track frame	640	750	640	750
• Idler assembly (each side)	200	200	200	200
• Track roller assembly (single :1)	54 × 5	54 × 6	54 × 5	54 × 6
• Track roller assembly (double: 1)	61 × 2	61 × 2	61 × 2	61 × 2
• Carrier roller assembly (1)	30 × 2	30 × 2	30 × 2	30 × 2

Unit: kg

Machine Model	D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers	60001 — 60947	60001 — 60890	60001 — 60941	60001 — 60914
Track shoe assembly (each side)				
(510 mm, wet type)	1,310	—	1,310	—
(950 mm, wet type)	—	2,110	—	2,110
Pivot shaft (each side)	90	100	90	100
Equalizer bar	125	145	125	145
Hydraulic tank assembly	55	55	55	55
Main control valve				
• Lift + tilt	71	71	—	—
• Ripper + lift + tilt	82	—	—	—
• Lift + tilt + steering	—	—	84	84
• Ripper + lift + tilt + steering	—	—	95	—
Engine underguard	105	80	105	80
Transmission underguard	30	30	30	30
Operator's seat	35	35	35	35
Straight tiltdozer assembly	1,890	1,920	1,890	1,920
• Blade	1,165	1,195	1,165	1,195
• Straight frame (each side)	255	255	255	255
• Tilt cylinder assembly	75	75	75	75
Blade lift cylinder assembly	95 × 2	95 × 2	95 × 2	95 × 2
Hydraulic pump assembly	15	15	—	—
Power train pump assembly	20	20	20	20
Hydraulic, HSS pump assembly	—	—	65	65
HSS motor assembly	—	—	45	45
ROPS assembly (for cab)	350	350	350	350
• Floor frame assembly	310	310	310	310
• Cab assembly	570	570	570	570
• ROPS canopy assembly	425	425	425	425
• Canopy assembly	145	145	145	145

014012

Unit: kg

Machine Model	D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers	60948 – 65000	60891 – 65000	60942 – 65000	60915 – 65000
Engine, damper assembly	1,100	1,220	1,220	1,220
• Engine assembly	1,050	1,170	1,170	1,170
• Damper assembly	45	45	45	45
• Parts mounted to engine (wiring)	1.5	1.5	1.5	1.5
Radiator assembly (including oil cooler)	165	165	165	165
• Oil cooler assembly (for hydraulic oil)	6	6	6	6
Fuel tank assembly	170	170	170	170
Power train unit assembly	1,570	1,570	1,580	1,580
• Steering clutch, brake assembly	700	700	—	—
• Steering valve assembly	25	25	—	—
• Transmission assembly	485	485	485	485
• Torque converter, PTO assembly	290	290	290	290
• Transmission valve assembly	17	17	17	17
• Main relief valve assembly	6	6	6	6
• HSS assembly	—	—	735	735
• Brake valve assembly	—	—	6	6
Final drive assembly (each side)	765	790	765	790
Sprocket assembly (each side)	8.3 × 9	8.3 × 9	8.3 × 9	8.3 × 9
Hull frame assembly	2,040	2,040	2,040	2,040
Track group assembly (each side)	1,495	1,695	1,495	1,695
• Track frame	590	700	590	700
• Idler assembly (each side)	200	200	200	200
• Track roller assembly (single :1)	54 × 5	54 × 6	54 × 5	54 × 6
• Track roller assembly (double: 1)	61 × 2	61 × 2	61 × 2	61 × 2
• Carrier roller assembly (1)	30 × 2	30 × 2	30 × 2	30 × 2

Unit: kg

Machine Model	D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers	60948 – 65000	60891 – 65000	60942 – 65000	60915 – 65000
Track shoe assembly (each side)				
(510 mm, wet type)	1,310	—	1,310	—
(950 mm, wet type)	—	2,110	—	2,110
Pivot shaft (each side)	90	100	90	100
Equalizer bar	125	145	125	145
Hydraulic tank assembly	50	50	50	50
Main control valve				
• Lift + tilt	71	71	—	—
• Ripper + lift + tilt	82	—	—	—
• Lift + tilt + steering	—	—	84	84
• Ripper + lift + tilt + steering	—	—	95	—
Engine underguard	105	80	105	80
Transmission underguard	30	30	30	30
Operator's seat	35	35	35	35
Straight tiltdozer assembly	1,890	1,920	1,890	1,920
• Blade	1,165	1,195	1,165	1,195
• Straight frame (each side)	255	255	255	255
• Tilt cylinder assembly	75	75	75	75
Blade lift cylinder assembly	95 × 2	95 × 2	95 × 2	95 × 2
Hydraulic pump assembly	15	15	—	—
Power train pump assembly	20	20	20	20
Hydraulic, HSS pump assembly	—	—	65	65
HSS motor assembly	—	—	45	45
ROPS assembly (for cab)	350	350	350	350
• Floor frame assembly	310	310	310	310
• Cab assembly	570	570	570	570
• ROPS canopy assembly	425	425	425	425
• Canopy assembly	145	145	145	145

014012

Unit: kg

Machine model	D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers	65001 and up	65001 and up	65001 and up	65001 and up
Engine, damper assembly	1,100	1,220	1,220	1,220
• Engine, assembly	1,050	1,170	1,170	1,170
• Damper assembly	45	45	45	45
• Parts mounted to engine (wiring)	1.5	1.5	1.5	1.5
Radiator assembly (including oil cooler)	165	165	165	165
• Oil cooler assembly (for hydraulic oil)	6	6	6	6
Fuel tank assembly	170	170	170	170
Power train unit assembly	1,345	1,570	1,403	1,580
• Steering clutch, brake assembly	622	700	–	–
• Steering valve assembly	25	25	–	–
• Transmission assembly	385	485	485	485
• Torque converter, PTO assembly	290	290	290	290
• Transmission valve assembly	17	17	17	17
• Main relief valve assembly	6	6	6	6
• HSS assembly	–	–	699	735
• Brake valve assembly	–	–	6	6
Final drive assembly (each side)	765	790	765 [790]	790
Sprocket assembly (each side)	8.3 x 9	8.3 x 9	8.3 x 9	8.3 x 9
Full frame assembly	2,040	2,040	2,040	2,040
Track group assembly (each side)	1,495	1,695	1,495 [1,535]	1,695
• Track frame	590	700	590 [610]	700
• Idler assembly (each side)	200	200	200	200
• Track roller assembly (single: 1)	54 x 5	54 x 6	54 x 5	54 x 6
• Track roller assembly (double: 1)	61 x 2	61 x 2	61 x 2	61 x 2
• Carrier roller assembly (1)	30 x 2	30 x 2	30 x 2	30 x 2

★ The values in [ ] are indicated for the wide gauge specification.

Unit: kg

Machine model	D65E-12	D65P-12	D65EX-12	D65PX-12
Serial Numbers	65001 and up	65001 and up	65001 and up	65001 and up
Track shoe assembly (each side)				
(510 mm, wet type)	1,375	–	1,375	–
(810 mm, wet type)	–	–	[1,735]	–
(950 mm, wet type)	–	2,180	–	2,180
Pivot shaft (each side)	90	100	90 [100]	100
Equalizer bar	125	145	125 [145]	145
Hydraulic tank assembly	50	50	50	50
Main control valve				
• Lift + tilt	71	71	–	–
• Ripper + lift + tilt	82	–	–	–
• Lift + tilt + steering	–	–	84	84
• Ripper + lift + tilt + steering	–	–	95	–
Engine underguard	105	80	105	80
Transmission underguard	30	30	30	30
Operator's seat	35	35	35	35
Straight tiltdozer assembly	1,890	1,920	1,890 [2,050]	1,920
• Blade	1,165	1,195	1,165 [1,325]	1,195
• Straight frame (each side)	255	255	255	255
• Tilt sylinder assembly	75	75	75	75
Blade lift cylinder assembly	95 x 2	95 x 2	95 x 2	95 x 2
Hydraulic pump assembly	15	15	–	–
Power train pump assembly	20	20	20	20
Hydraulic, HSS pump assembly	–	–	65	65
HSS motor assembly	–	–	45	45
ROPS assembly (for cab)	350	350	350	350
• Froor frame assembly	310	310	310	310
• Cab assembly	570	570	570	570
• ROPS canopy assembly	425	425	425	425
• Canopy assembly	145	145	145	145

★ The values in [ ] are indicated for the wide gauge specification.

014012

TABLE OF FUEL, COOLANT AND LUBRICANTS

D65P-12 60001 – 60890
D65E-12 60001 – 60947
D65PX-12 60001 – 60914
D65EX-12 60001 – 60941

RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE –22 –4 14 32 50 68 86 104°F –30 –20 –10 0 10 20 30 40°C	CAPACITY (ℓ)	
			Specified	Refill
Engine oil pan	Engine oil	SAE 30 SAE 10W SAE 10W-30 SAE 15W-40	44	38
Power train case		SAE 30 SAE 10W	75	50
Final drive case (each)			E, EX: 24 P, PX: 27	E, EX: 24 P, PX: 27
Damper case		SAE 30	D60: 1.5 D65: 1.7	D60: 1.5 D65: 1.7
Idler (each)			4.5	4.5
Pivot shaft case (each)			0.15	0.15
Hydraulic tank		SAE 10W SAE 10W-30 SAE 15W-40	95	55
Track roller (each)	Gear oil	GO 140	0.32	0.32
Carrier roller (each)			0.24	0.24
Fuel tank	Diesel fuel	ASTM D975 No. 2 ASTM D975 No. 1	340	—
Cooling system (including sub tank)	Coolant	Add antifreeze	58.2	—

014012

NOTE:

(1) When fuel sulphur content is less than 0.5 %, change oil in the oil pan every periodic maintenance hours described in this manual. Change oil according to the following table if fuel sulphur content is above 0.5 %.

Fuel sulphur content	Change interval of oil in engine oil pan
0.5 to 1.0 %	1/2 of regular interval
Above 1.0 %	1/4 of regular interval

ASTM: American Society of Testing and Material
SAE: Society of Automotive Engineers
API: American Petroleum Institute

(2) When starting the engine in an atmospheric temperature of lower than 0°C, be sure to use engine oil of SAE10W, SAE10W-30 and SAE15W-40 even though an atmospheric temperature goes up to 10°C more or less in the day time.

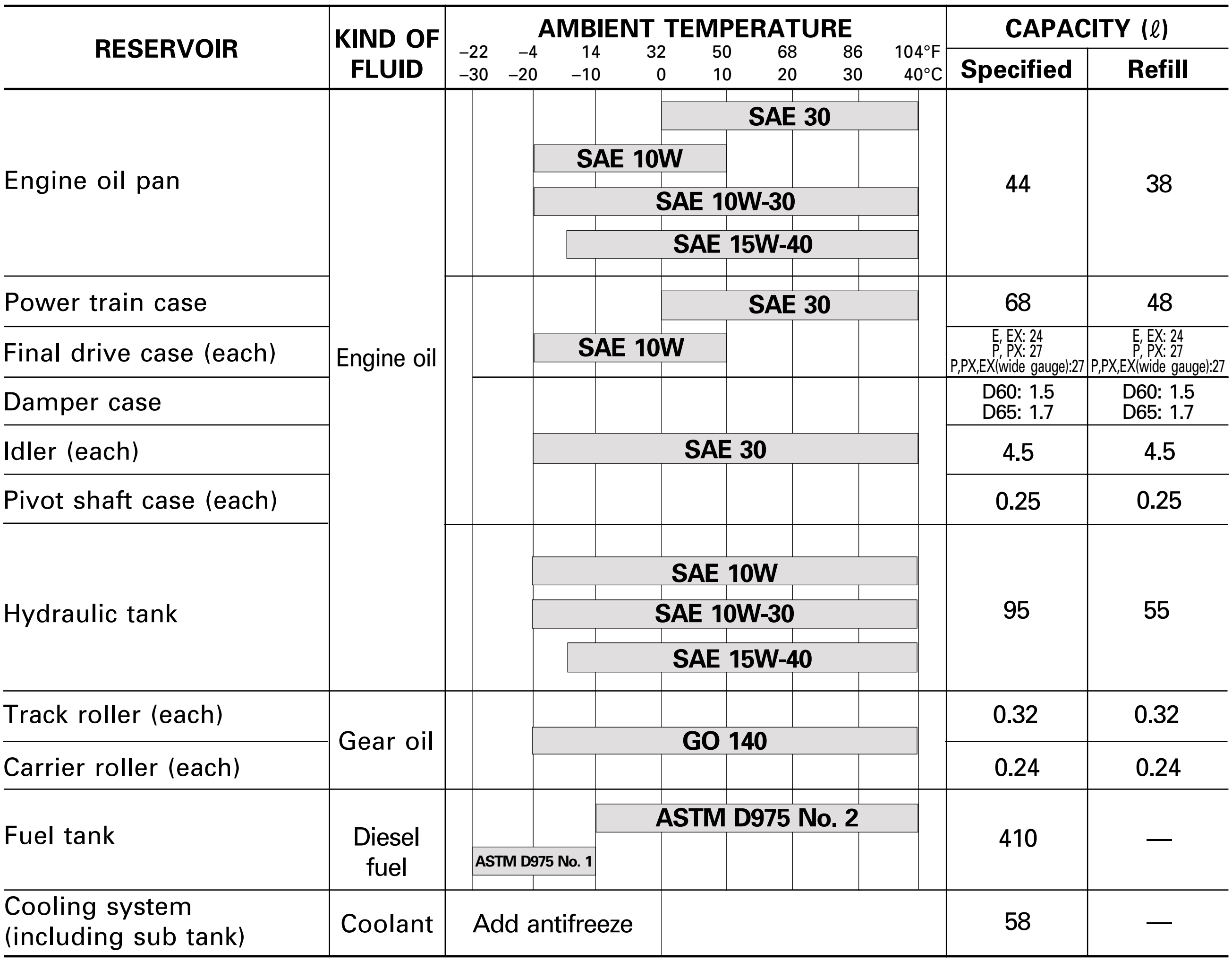
(3) Use API classification CD as engine oil and if API classification CC, reduce the engine oil change interval to half.

(4) There is no problem if single grade oil is mixed with multigrade oil (SAE10W-30, 15W-40), but be sure to add single grade oil that matches the temperature in the table on the left.

(5) We recommend Komatsu genuine oil which has been specifically formulated and approved for use in engine and hydraulic work equipment applications.

Specified capacity: Total amount of oil including oil for components and oil in piping.
Refill capacity: Amount of oil needed to refill system during normal inspection and maintenance.

D65P-12 60891 and up
D65E-12 60948 and up
D65PX-12 60915 and up
D65EX-12 60942 and up



RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE −22 −4 14 32 50 68 86 104°F −30 −20 −10 0 10 20 30 40°C	CAPACITY (ℓ)	
			Specified	Refill
Engine oil pan	Engine oil	SAE 30 SAE 10W SAE 10W-30 SAE 15W-40	44	38
Power train case		SAE 30	68	48
Final drive case (each)		SAE 10W	E, EX: 24 P, PX: 27 P,PX,EX(wide gauge):27	E, EX: 24 P, PX: 27 P,PX,EX(wide gauge):27
Damper case		SAE 30	D60: 1.5 D65: 1.7	D60: 1.5 D65: 1.7
Idler (each)			4.5	4.5
Pivot shaft case (each)			0.25	0.25
Hydraulic tank		SAE 10W SAE 10W-30 SAE 15W-40	95	55
Track roller (each)	Gear oil	GO 140	0.32	0.32
Carrier roller (each)			0.24	0.24
Fuel tank	Diesel fuel	ASTM D975 No. 2 ASTM D975 No. 1	410	—
Cooling system (including sub tank)	Coolant	Add antifreeze	58	—

014012

NOTE:

(1) When fuel sulphur content is less than 0.5 %, change oil in the oil pan every periodic maintenance hours described in this manual. Change oil according to the following table if fuel sulphur content is above 0.5 %.

Fuel sulphur content	Change interval of oil in engine oil pan
0.5 to 1.0 %	1/2 of regular interval
Above 1.0 %	1/4 of regular interval

ASTM: American Society of Testing and Material
SAE: Society of Automotive Engineers
API: American Petroleum Institute

(2) When starting the engine in an atmospheric temperature of lower than 0°C, be sure to use engine oil of SAE10W, SAE10W-30 and SAE15W-40 even though an atmospheric temperature goes up to 10°C more or less in the day time.

(3) Use API classification CD as engine oil and if API classification CC, reduce the engine oil change interval to half.

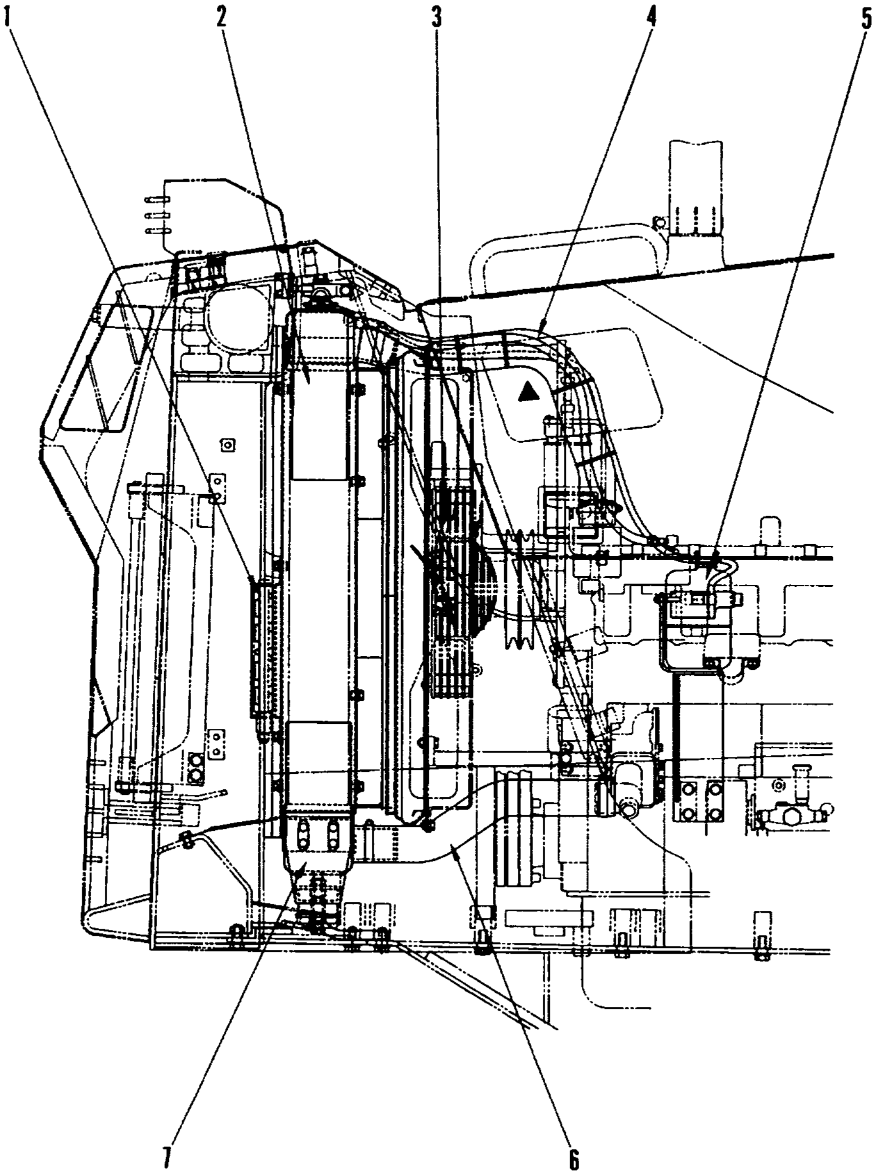
(4) There is no problem if single grade oil is mixed with multigrade oil (SAE10W-30, 15W-40), but be sure to add single grade oil that matches the temperature in the table on the left.

(5) We recommend Komatsu genuine oil which has been specifically formulated and approved for use in engine and hydraulic work equipment applications.

Specified capacity: Total amount of oil including oil for components and oil in piping.
Refill capacity: Amount of oil needed to refill system during normal inspection and maintenance.

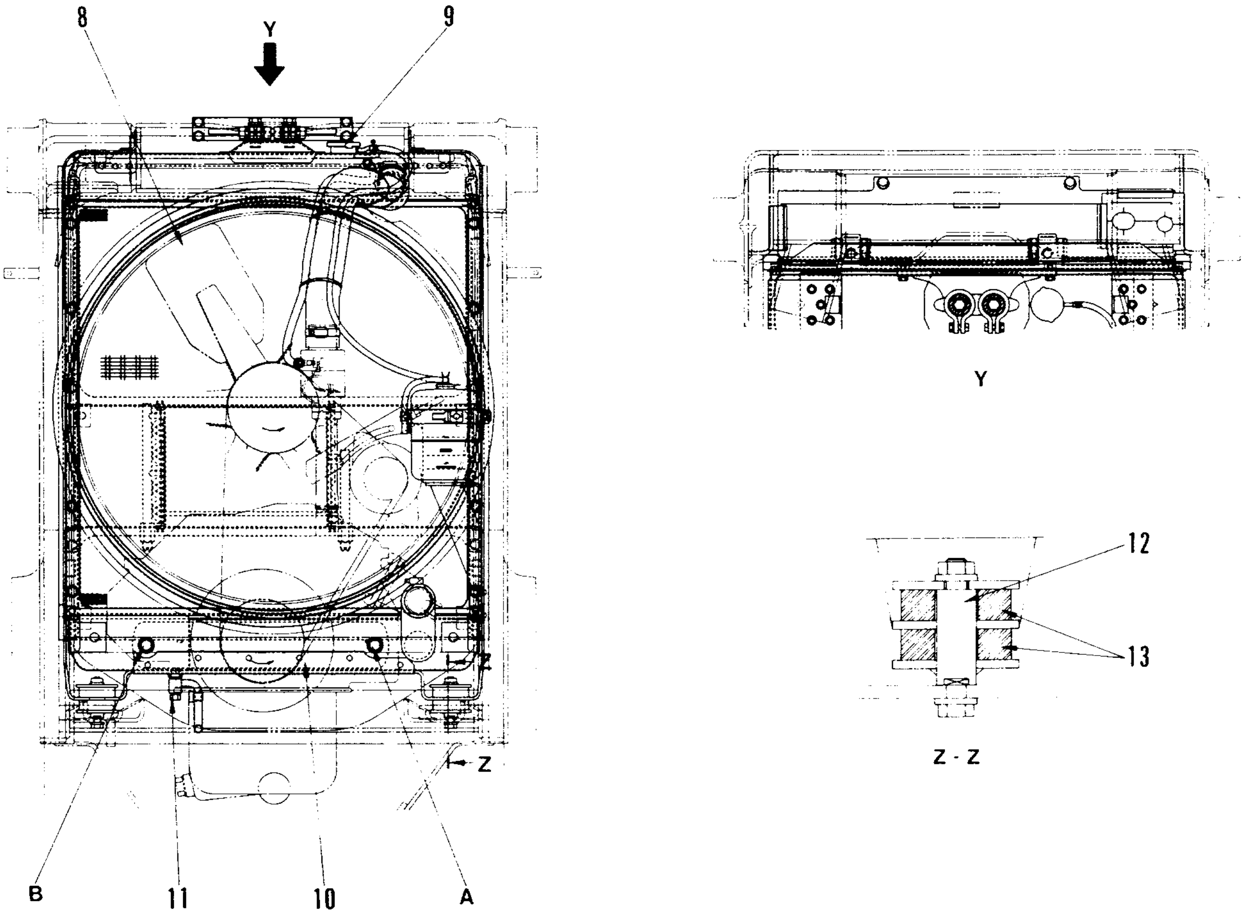
10 STRUCTURE AND FUNCTION

RADIATOR, OIL COOLER



A. Power train oil cooler inlet port
B. Power train oil cooler outlet port

1. Hydraulic oil cooler
2. Radiator core assembly
3. Fan guard
4. Inlet port hose
5. Reservoir tank
6. Outlet port hose
7. Lower tank
   (with built-in power train oil cooler)
8. Fan
9. Water filler cap
10. Power train oil cooler
11. Drain plug
12. Boss
13. Cushion



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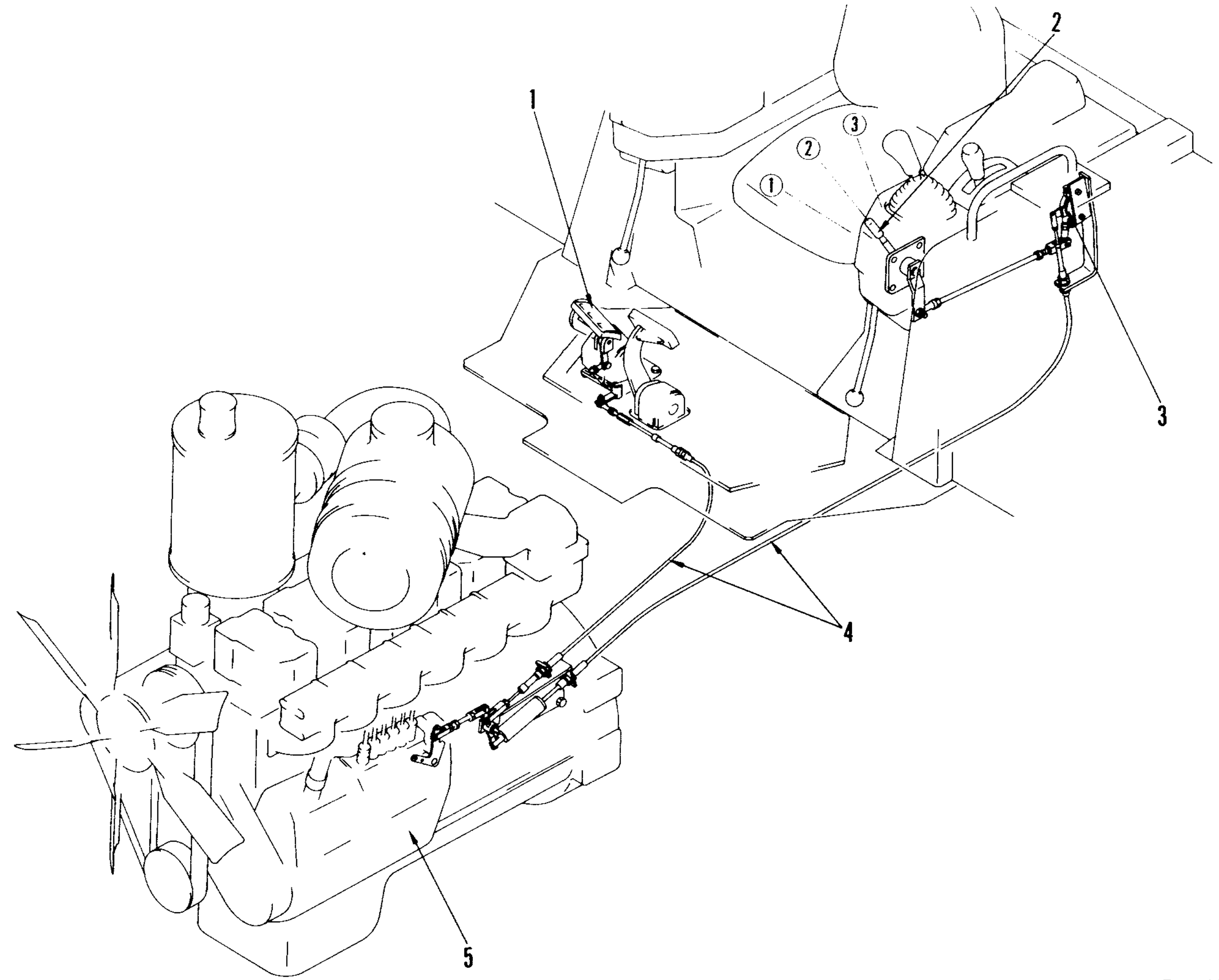
OUTLINE

- A reservoir tank has been installed for the radiator to make it possible to check the radiator water level.
- The power train oil cooler is built into the lower tank.

	Radiator	Power train oil cooler (built into lower tank)	Hydraulic oil cooler
	D65	D65	
Core type	D–6	PTO–LS	3A–CS
Fin pitch (mm)	4.0	—	3.5
Heat dissipation capacity (kca/h)	105000	30500	3800
Heat dissipation area (m^2)	52.63	1.839	1.86

ENGINE CONTROL

D65E-12 60001 – 60947
D65P-12 60001 – 60890
D65EX-12 60001 – 60941
D65PX-12 60001 – 60914



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014012

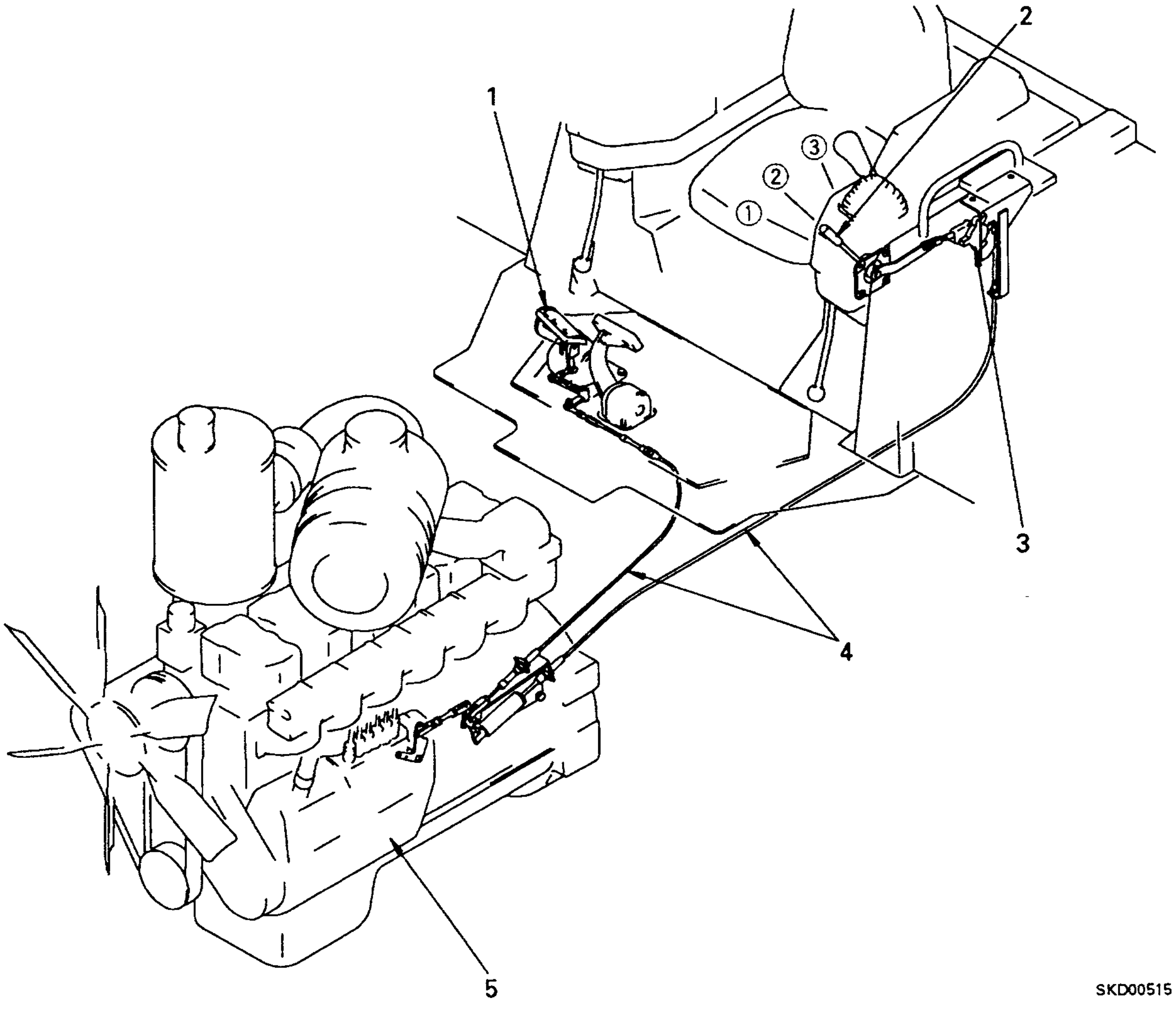
1. Decelerator pedal
2. Throttle lever
3. Clutch
4. Cable
5. Fuel injection pump

Lever positions

① STOP
② Low idling
③ High idling

OUTLINE

- The engine speed is controlled by throttle lever (2) or decelerator pedal (1).



1. Decelerator pedal
2. Throttle lever
3. Clutch
4. Cable
5. Fuel injection pump

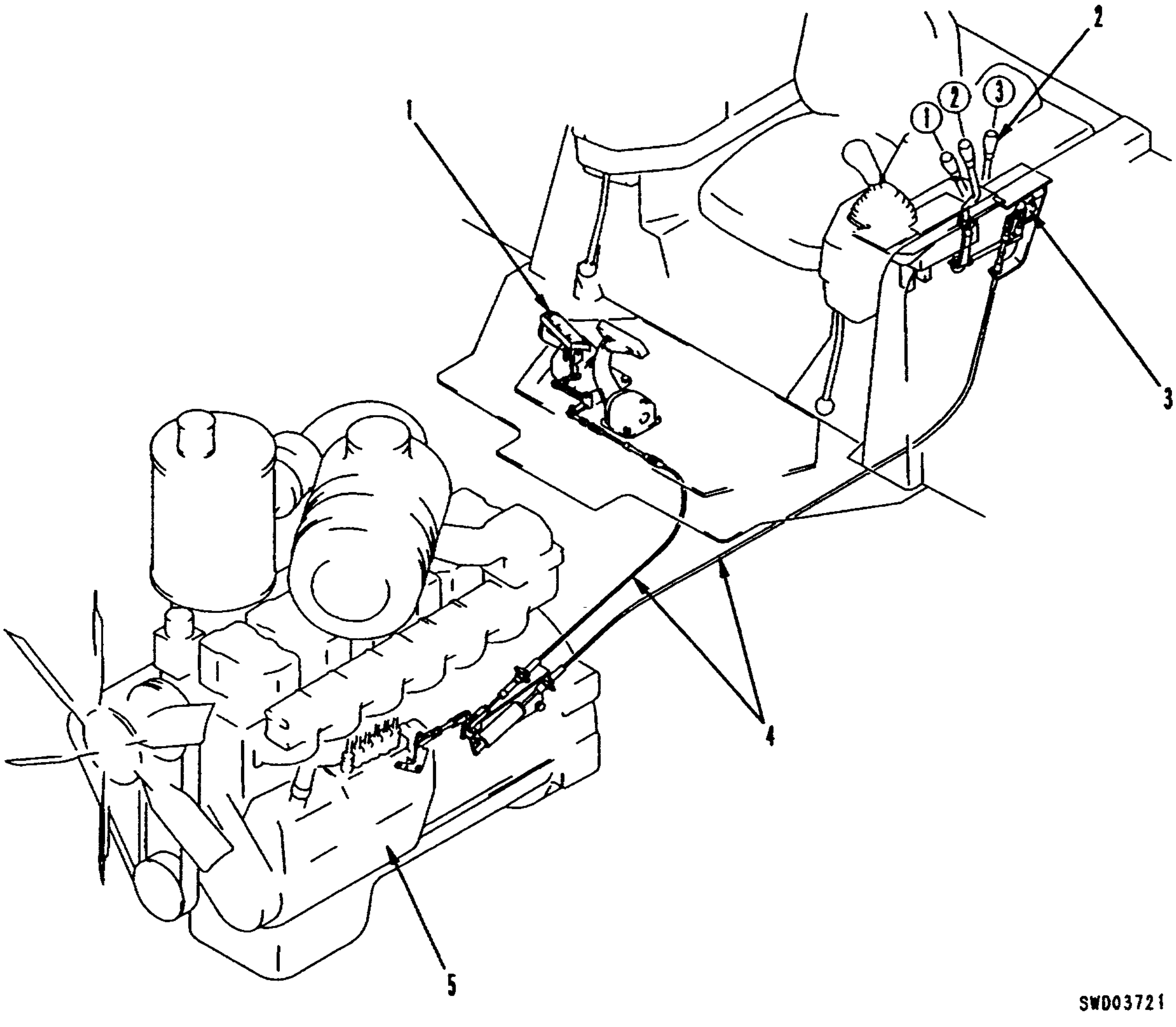
Lever positions

① STOP
② Low idling
③ High idling

OUTLINE

- The engine speed is controlled by throttle lever (2) or decelerator pedal (1).

D65E-12 65001 and up
D65P-12 65001 and up
D65EX-12 65001 and up
D65PX-12 65001 and up



1. Decelerator pedal
2. Throttle lever
3. Clutch
4. Cable
5. Fuel injection pump

Lever positions

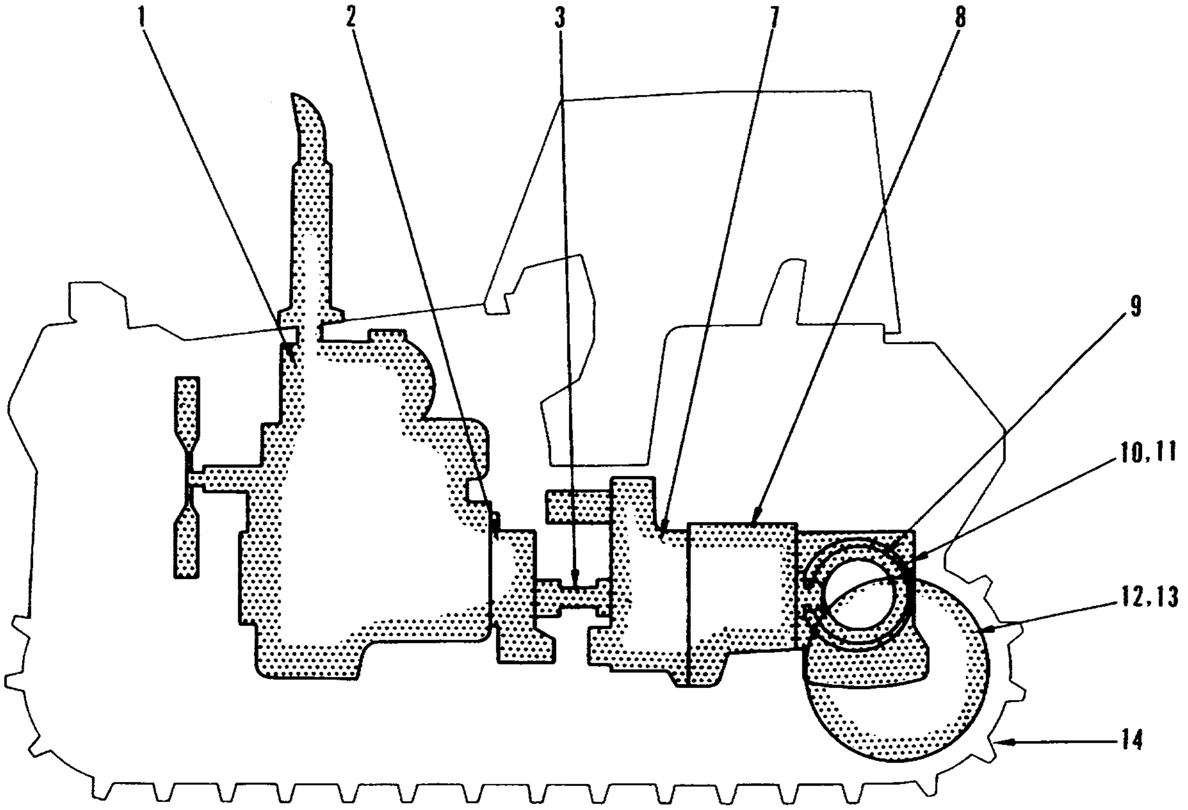
① STOP
② Low idling
③ High idling

OUTLINE

- The engine speed is controlled by throttle lever (2) or decelerator pedal (1).

POWER TRAIN SYSTEM

D65E, P-12



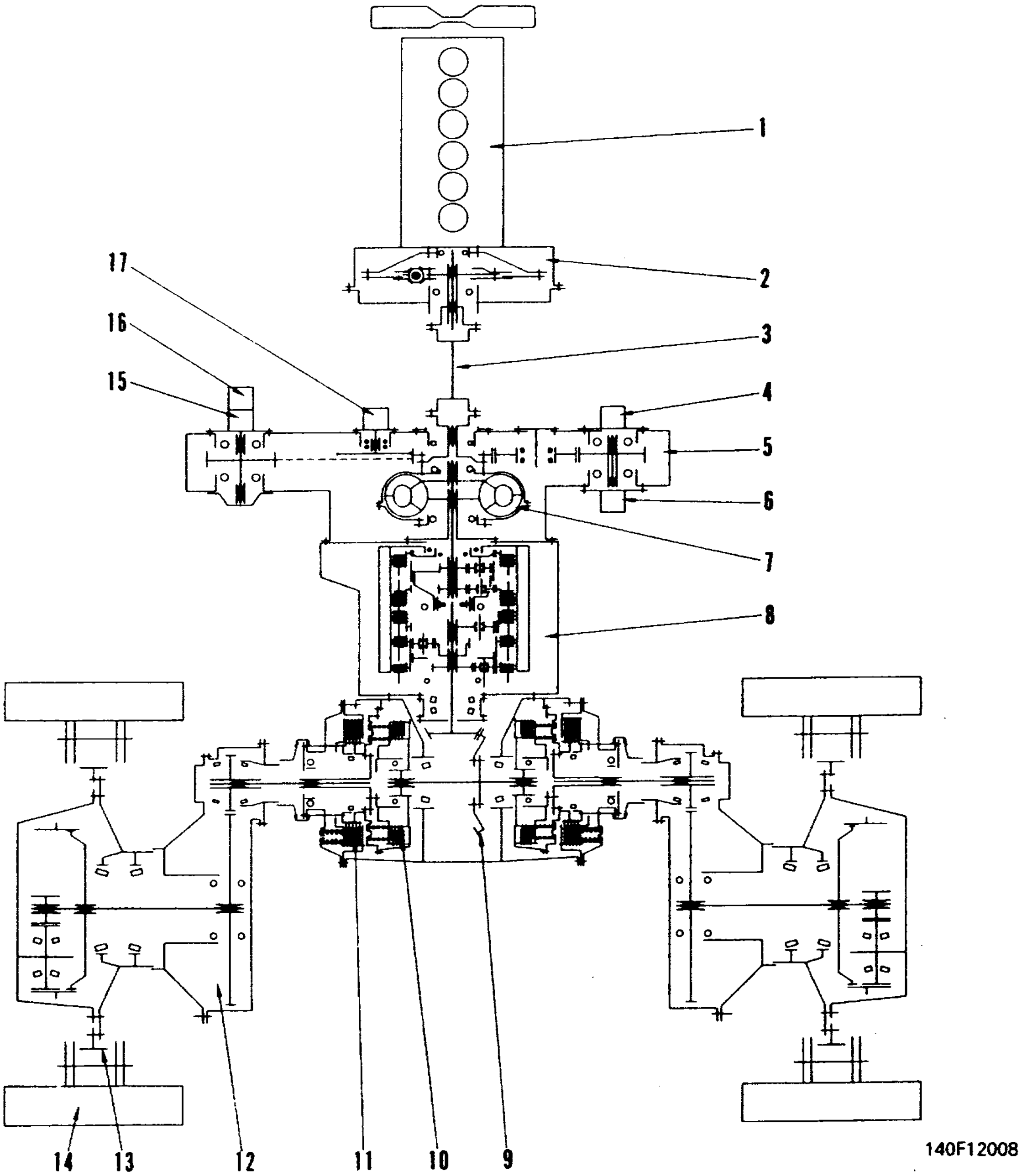
140F12007

014012

OUTLINE

- The twisting vibration of the motive force generated by engine (1) is reduced by damper (2). The motive force then passes through universal joint (3) and is transmitted to torque converter (7).
- In accordance with the change in the load, the motive force from the engine is transmitted by means of oil from torque converter (7) to the transmission input shaft (turbine shaft).
- In transmission (8), the speed is reduced and the speed range is selected (forward: 3 speeds, reverse: 3 speeds) by the combination of the planetary gear system and the hydraulic clutches. The pair of clutches selected according to the change in the loads are connected, and the motive force is transmitted from the bevel pinion at the rear end of the transmission to bevel gear (9).
- The motive force transmitted to the bevel gear is transmitted by engaging or disengaging steering clutch (10) and steering brake (11) to control the direction of travel. If the steering and directional lever is operated to steer the machine, the motive force at steering clutch (10) on the side to which the lever is operated is disengaged, and the direction of turn changes. The radius of the turn is controlled by using steering brake (11). Steering clutch (10) and steering brake (11) use wet-type, spring-boosted multiple disc clutches.
- The power coming from steering units (10) and (11) is transmitted to final drive (12). Final drive (12) consists of a single-stage spur gear and single-stage planetary gear. This reduces the speed and rotates sprocket (13) to drive track shoe (14) and move the machine.

POWER TRAIN SKELETON



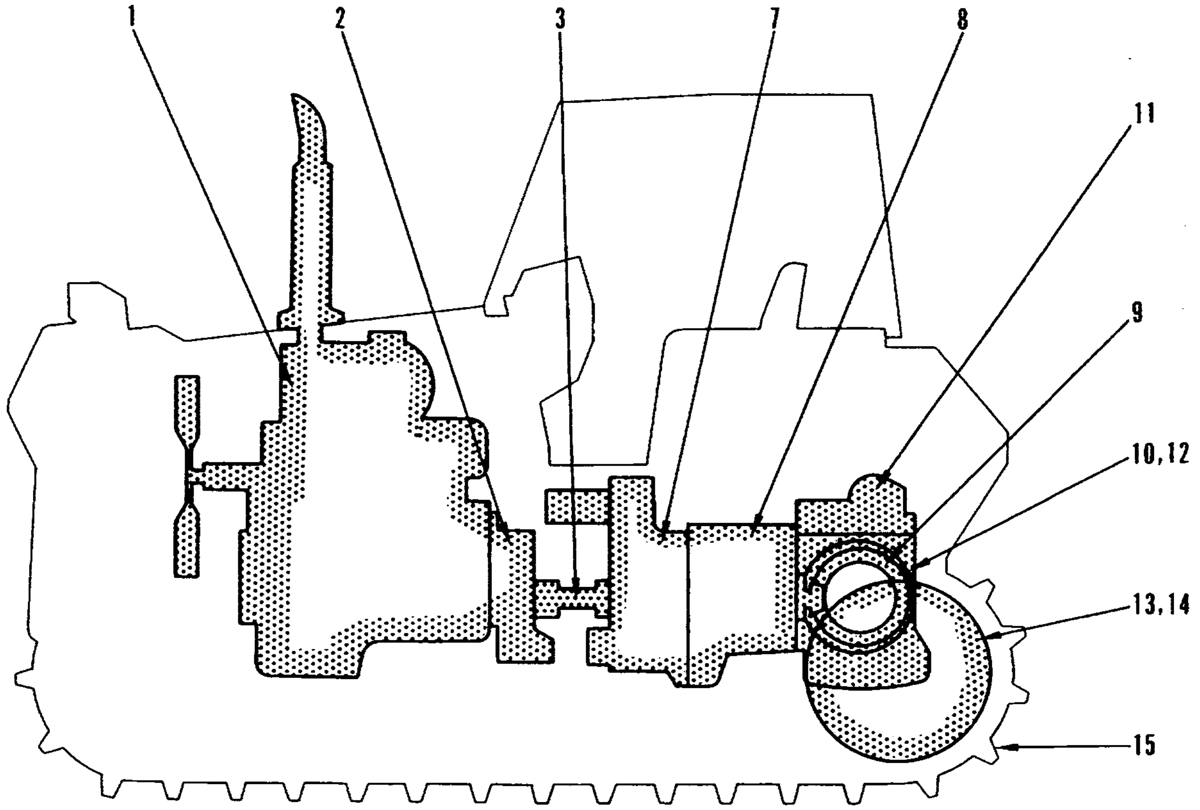
1. Engine (D65E: 6D125, D65P: S6D125)
2. Damper
3. Universal joint
4. Hydraulic pump (SAL(3)-100, ※SAL(3)-080)
5. P.T.O
6. PPC pump (SBR(1)-010, ※SBR(1)-014)
7. Torque converter
8. Transmission
9. Bevel gear
10. Steering clutch
11. Steering brake
12. Final drive
13. Sprocket
14. Track shoe
15. Power train pump (SAL(2)-045, ※※SAL(2)-050)
16. Power train lubrication pump (SAL(2)-045)
17. Scavenging pump

★ The ※ mark shows the following machines.
D65E-12: 60948 and up
D65P-12: 60891 and up

★ The ※※ mark shows the following machines.
D65E-12: 65001 and up
D65P-12: 65001 and up

POWER TRAIN SYSTEM

D65EX, PX-12

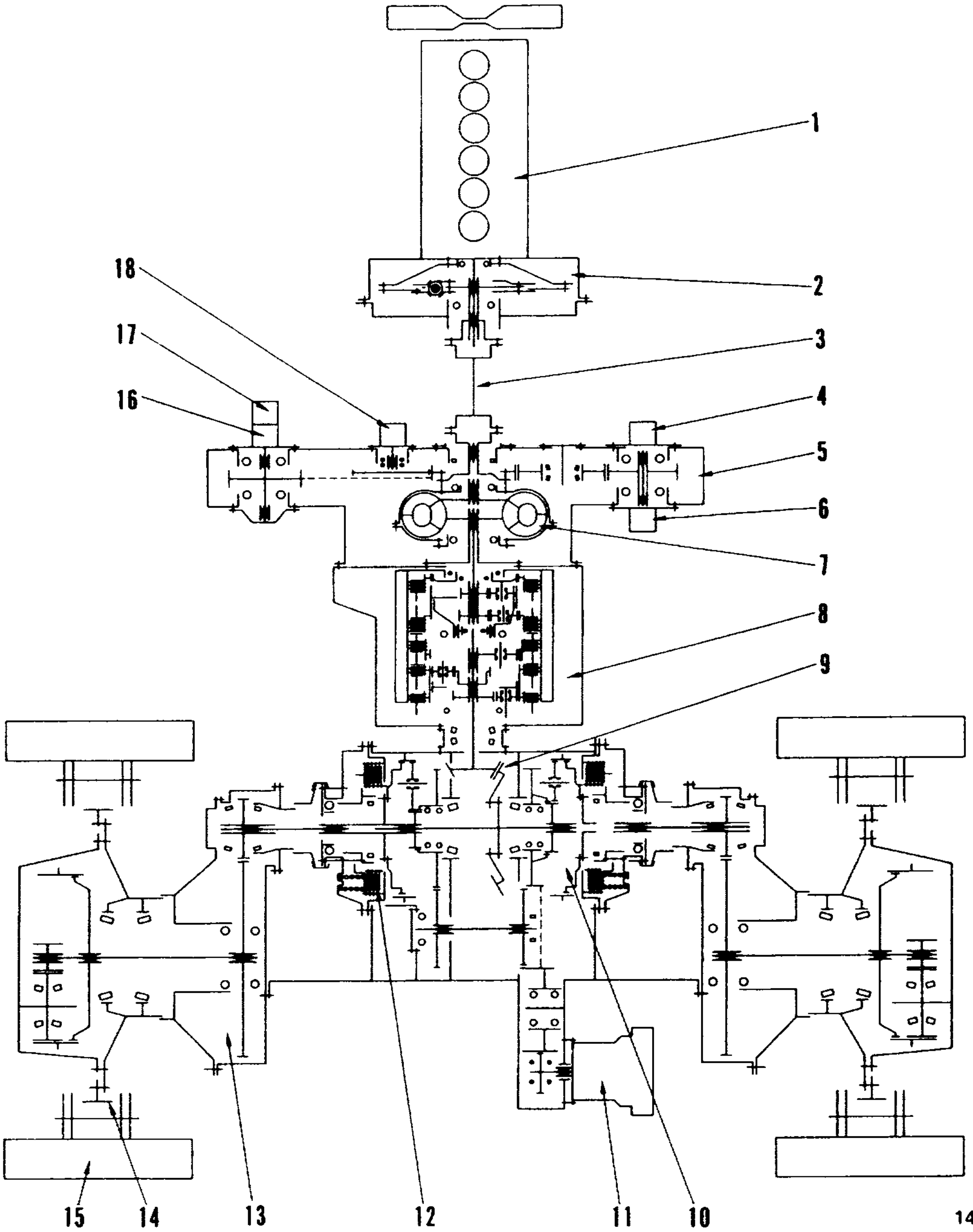


140F12009

OUTLINE

- The twisting vibration of the motive force generated by engine (1) is reduced by damper (2). The motive force then passes through universal joint (3) and is transmitted to torque converter (7).
- In accordance with the change in the load, the motive force from the engine is transmitted by means of oil from torque converter (7) to the transmission input shaft (turbine shaft).
- In transmission (8), the speed is reduced and the speed range is selected (forward: 3 speeds, reverse: 3 speeds) by the combination of the planetary gear system and the hydraulic clutches. The pair of clutches selected according to the change in the loads are connected, and the motive force is transmitted from the bevel pinion at the rear end of the transmission to bevel gear (9).
- The motive force transmitted to the bevel gear is transmitted to the HSS (Hydrostatic Steering System) (10). The machine is steered by generating a difference in rotating speeds on the left and right sides by using HSS motor (11) to control the rotation of the pair of planetary gears on the left and right sides of the HSS. It is also possible to use the HSS mechanism to ratate the left and right sides in opposite directions to enable the machine to carry out counterrotation turns.
- On HSS machines, brake (12) is only used for braking the machine. Brake (12) uses wet-type, spring-boosted multiple disc clutches.
- The power coming from brake (12) is transmitted to final drive (13).
- Final drive (13) consists of a single-stage spur gear and single-stage planetary gear. This reduces the speed and rotates sprocket (14) to drive track shoe (15) and move the machine.

POWER TRAIN SKELETON



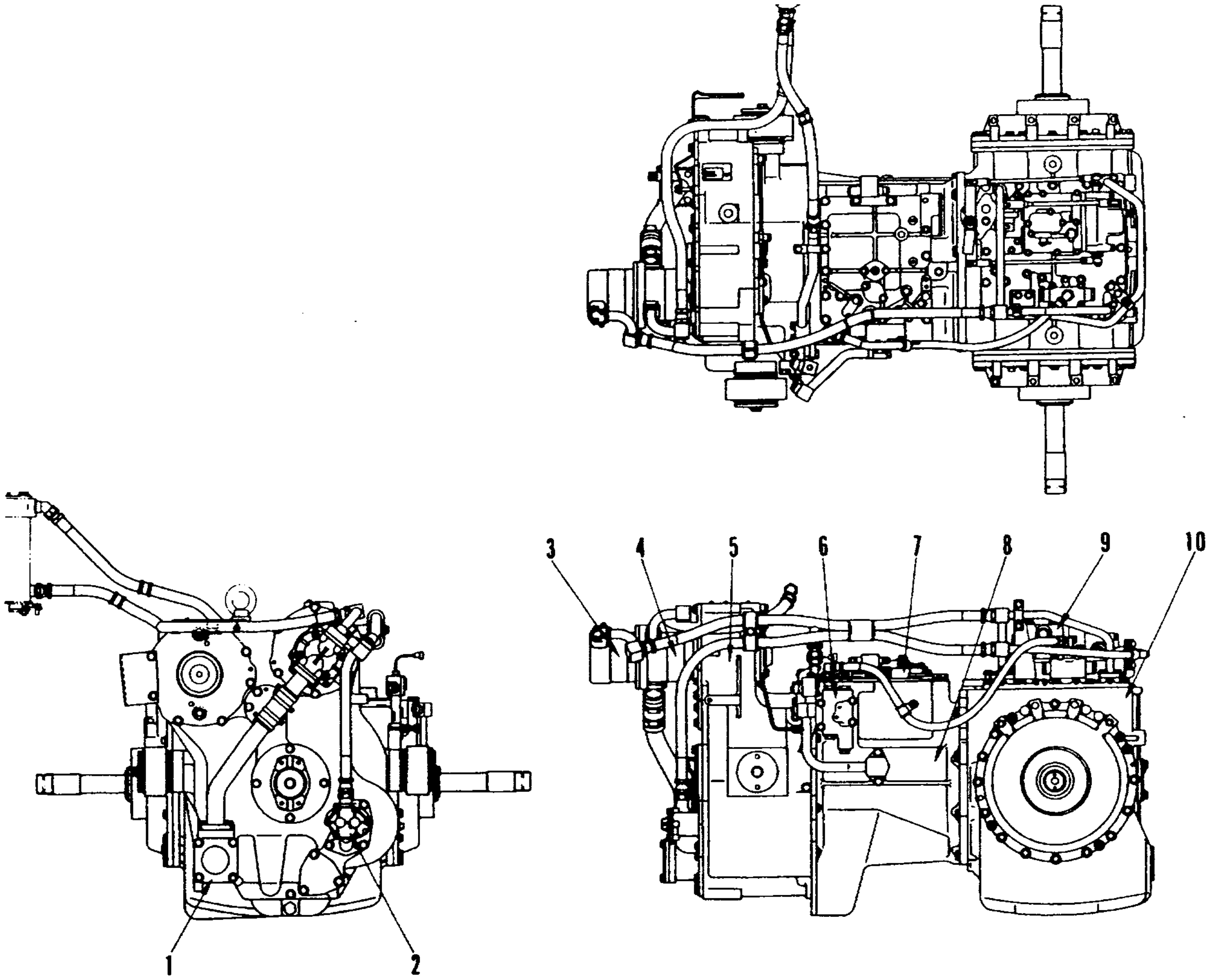
140F12010

1. Engine (S6D125)
2. Damper
3. Universal joint
4. Hydraulic, HSS pump (HPV95)
5. P.T.O
6. PPC pump (SBR(1)-010, ※SBR(1)-014)
7. Torque converter
8. Transmission
9. Bevel gear
10. HSS unit
11. HSS motor (HMF95)
12. Brake
13. Final drive
14. Sprocket
15. Track shoe
16. Power train pump (SAL(2)-045)
17. Power train lubrication pump (SAL(2)-045)
18. Scavenging pump

★ The ※ mark shows the following machines.
D65EX-12: 60942 and up
D65PX-12: 60915 and up

POWER TRAIN UNIT

D65E, P-12



140F12012

014012

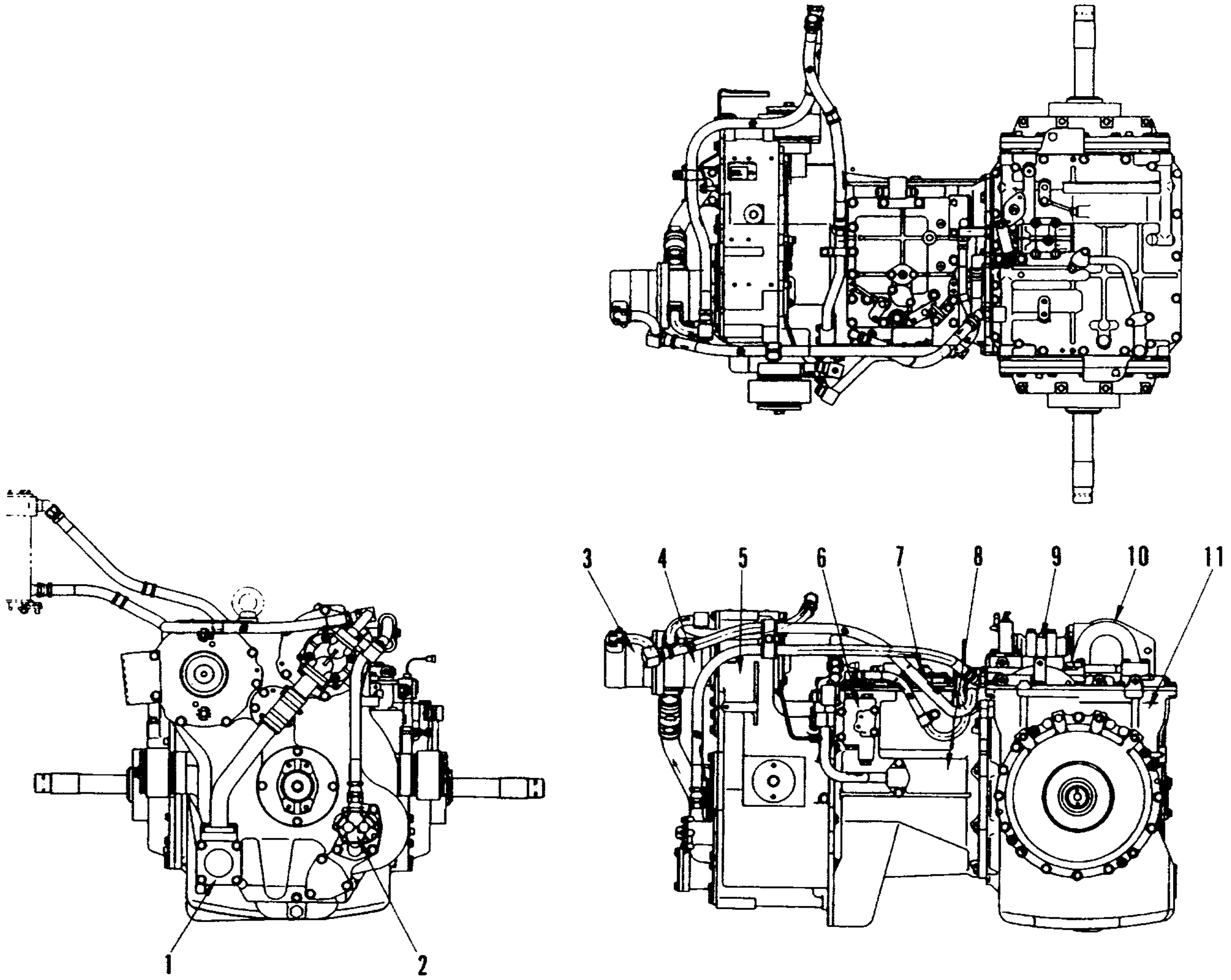
1. Power train oil strainer
2. Scavenging pump
3. Power train lubrication pump
   (SAL(2)-045, ※SAL(2)-050)
4. Power train pump (SAL(2)-045)
5. PTO, torque converter
6. Main relief valve
7. Transmission control valve
8. Transmission
9. Steering control valve
   (※ Steering brake valve)
10. Steering clutch, brake

※: Serial No. 65001 and up

OUTLINE

- The power train unit can be broadly divided into the following parts: torque converter (with PTO), transmission unit, and steering unit.
- Therefore, after the power train unit is removed, it can be divided into the torque converter, transmission unit, and steering unit.
- The steering unit consists of the transfer, bevel gear shaft, steering clutch, and steering brake.

D65EX, PX-12



140F12013

1. Power train oil strainer
2. Scavenging pump
3. Power train lubrication pump (SAL(2)-045)
4. Power train pump (SAL(2)-045)
5. PTO, torque converter
6. Main relief unit
7. Transmission control valve
8. Transmission
9. Brake valve
10. HSS motor (HMF95)
11. HSS unit

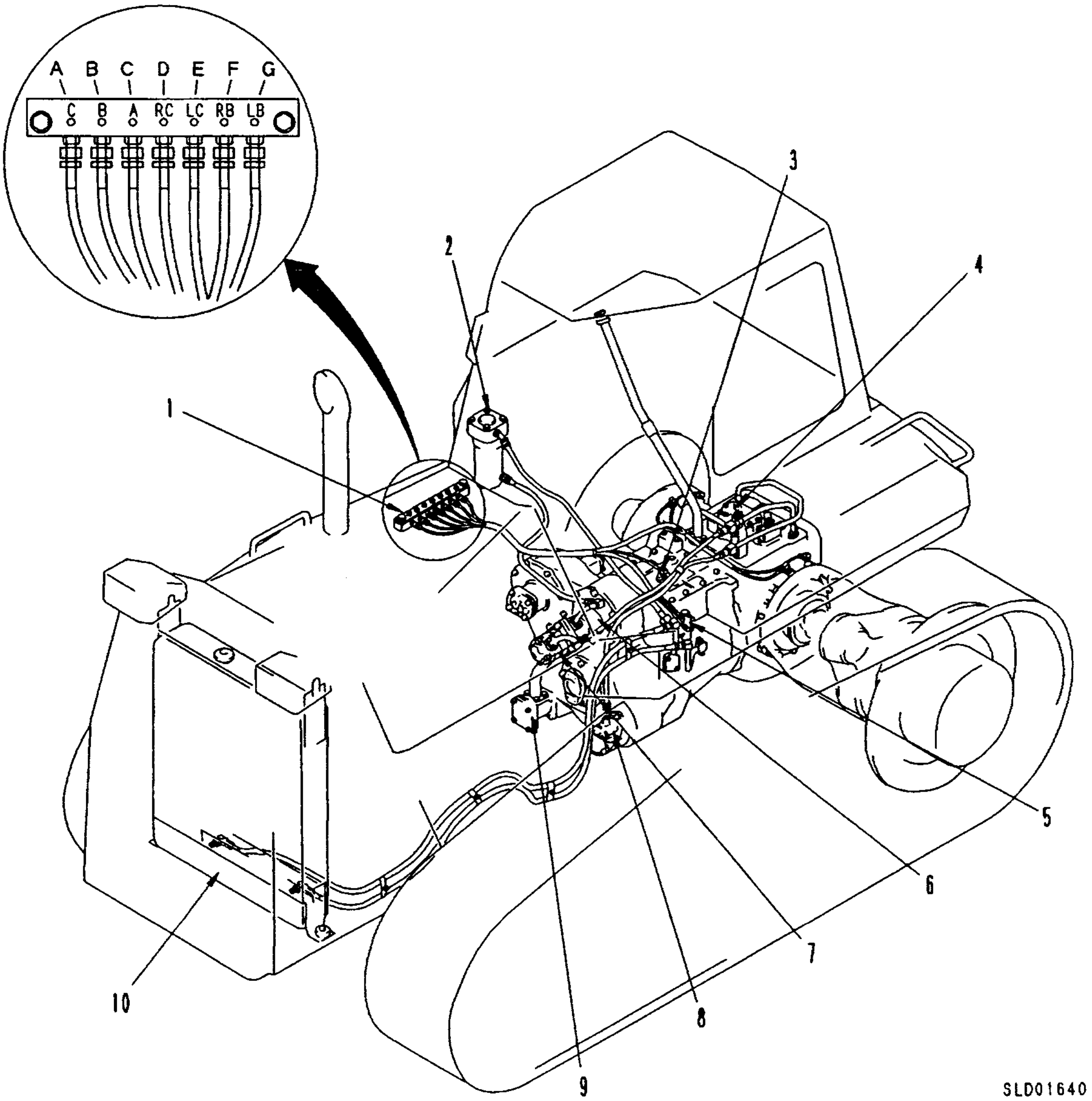
OUTLINE

- The power train unit can be broadly divided into the following parts: torque converter (with PTO), transmission unit, and HSS steering unit.
- Therefore, after the power train unit is removed, it can be divided into the torque converter, transmission unit, and HSS steering unit.
- The HSS steering unit consists of the transfer, bevel gear shaft, HSS motor, and planetary gear mechanism.

POWER TRAIN HYDRAULIC PIPING DIAGRAM

D65E, P-12

- **With central pressure detection**



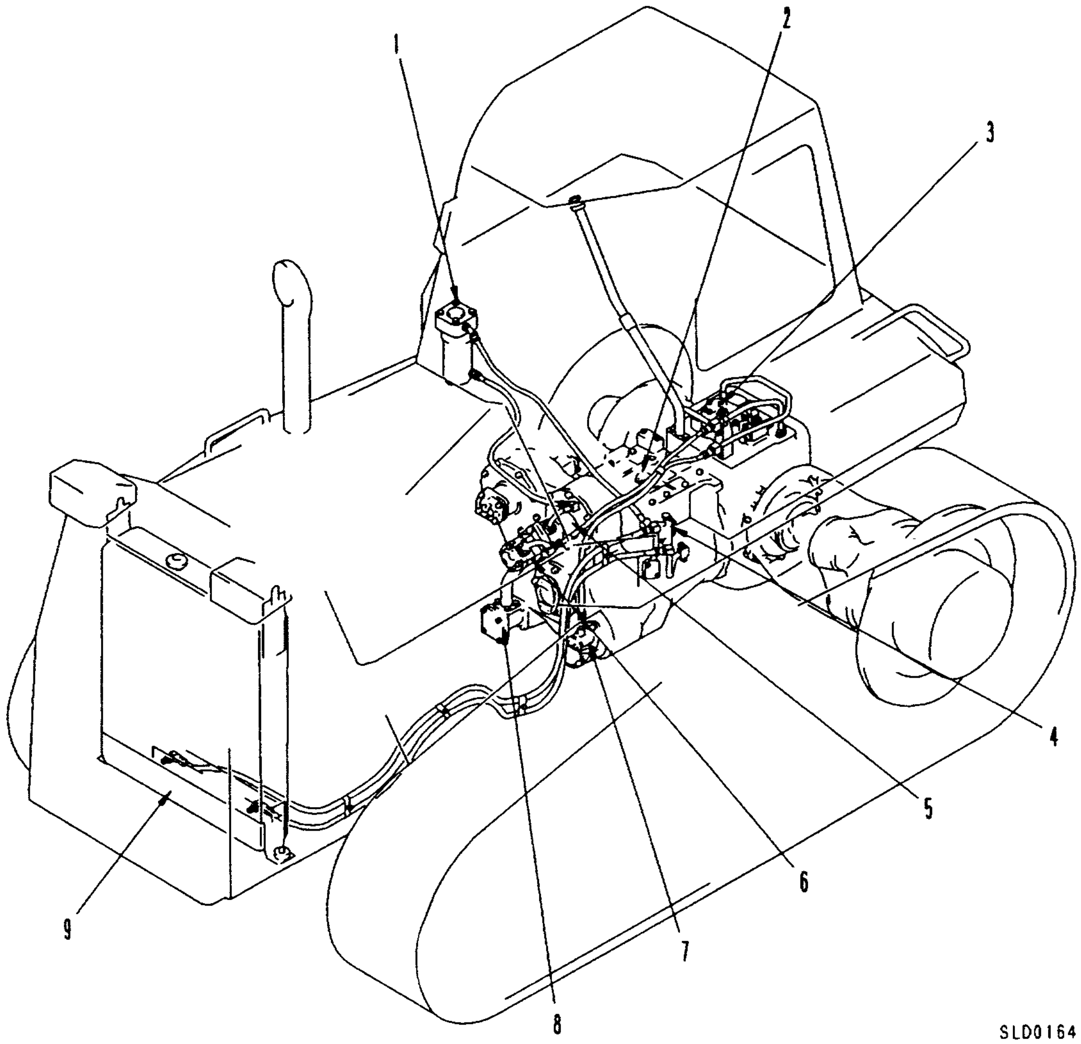
1. Central pressure detection port
2. Power train oil filter
3. Transmission control valve
4. Steering control valve
   (※ Steering brake valve)
5. Main relief valve
6. Power train pump (SAL(2)-045, ※SAL(2)-050)
7. Power train lubrication pump (SAL(2)-045)
8. Scavenging pump
9. Power train oil strainer
10. Power train oil cooler (built into radator lower tank)

A. Pressure detection port for torque converter outlet port
B. Pressure detection port for torque converter inlet port
C. Transmission modulating pressure detection port
D. Right clutch pressure detection port
E. Left clutch pressure detection port
F. Right brake pressure detection port
G. Left brake pressure detection port

※: Serial No. 65001 and up

D65E, P-12

- **Without central pressure detection**

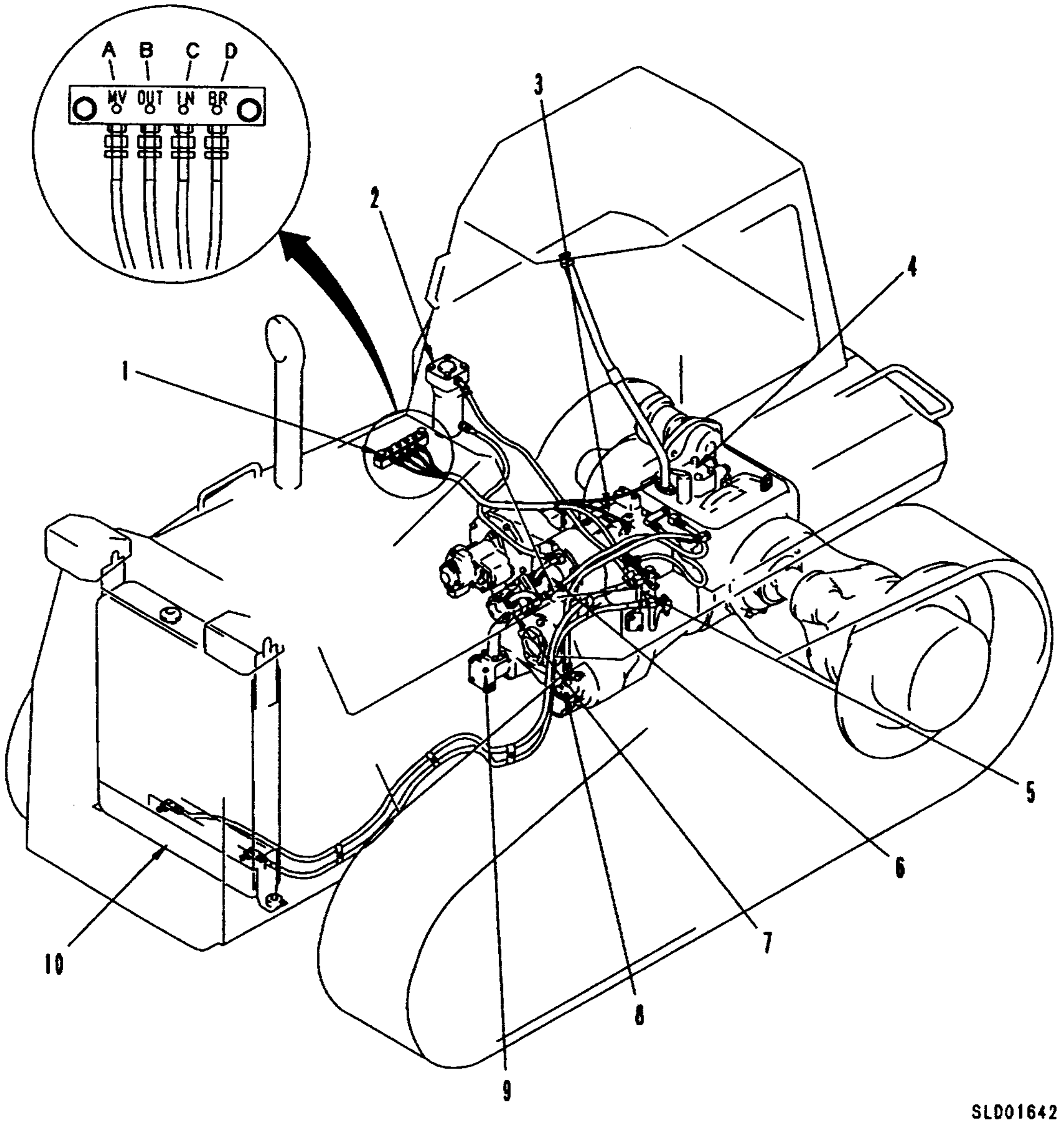


1. Power train oil filter
2. Transmission control valve
3. Steering control valve
   (※ Steering brake valve)
4. Main relief valve
5. Power train pump (SAL(2)-045, ※SAL(2)-050)
6. Power train lubrication pump (SAL(2)-045)
7. Scavenging pump
8. Power train oil strainer
9. Power train oil cooler (built into radiato
   lower tank)

※: Serial No. 65001 and up

D65EX, PX-12

• With central pressure detection

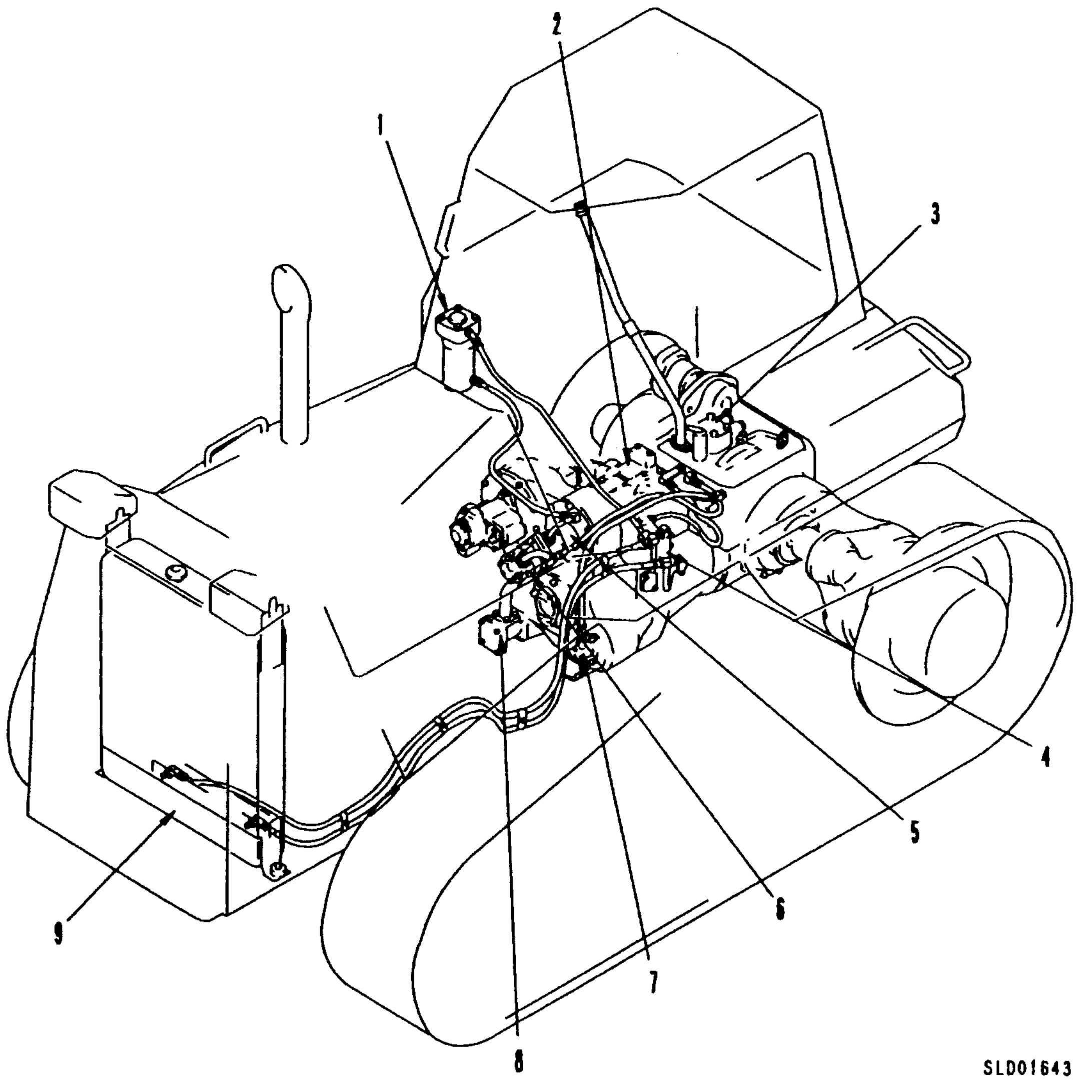


1. Central pressure detection port
2. Power train oil filter
3. Transmission control valve
4. Brake valve
5. Main relief valve
6. Power train pump (SAL(2)-045)
7. Power train lubrication pump (SAL(2)-045)
8. Scavenging pump
9. Power train oil strainer
10. Power train oil cooler (built into radator lower tank)

A. Transmission modulating valve pressure detection port
B. Pressure detection port for torque converter outlet port
C. Pressure detection port for torque converter inlet port
D. Brake pressure detection port

D65EX, PX-12

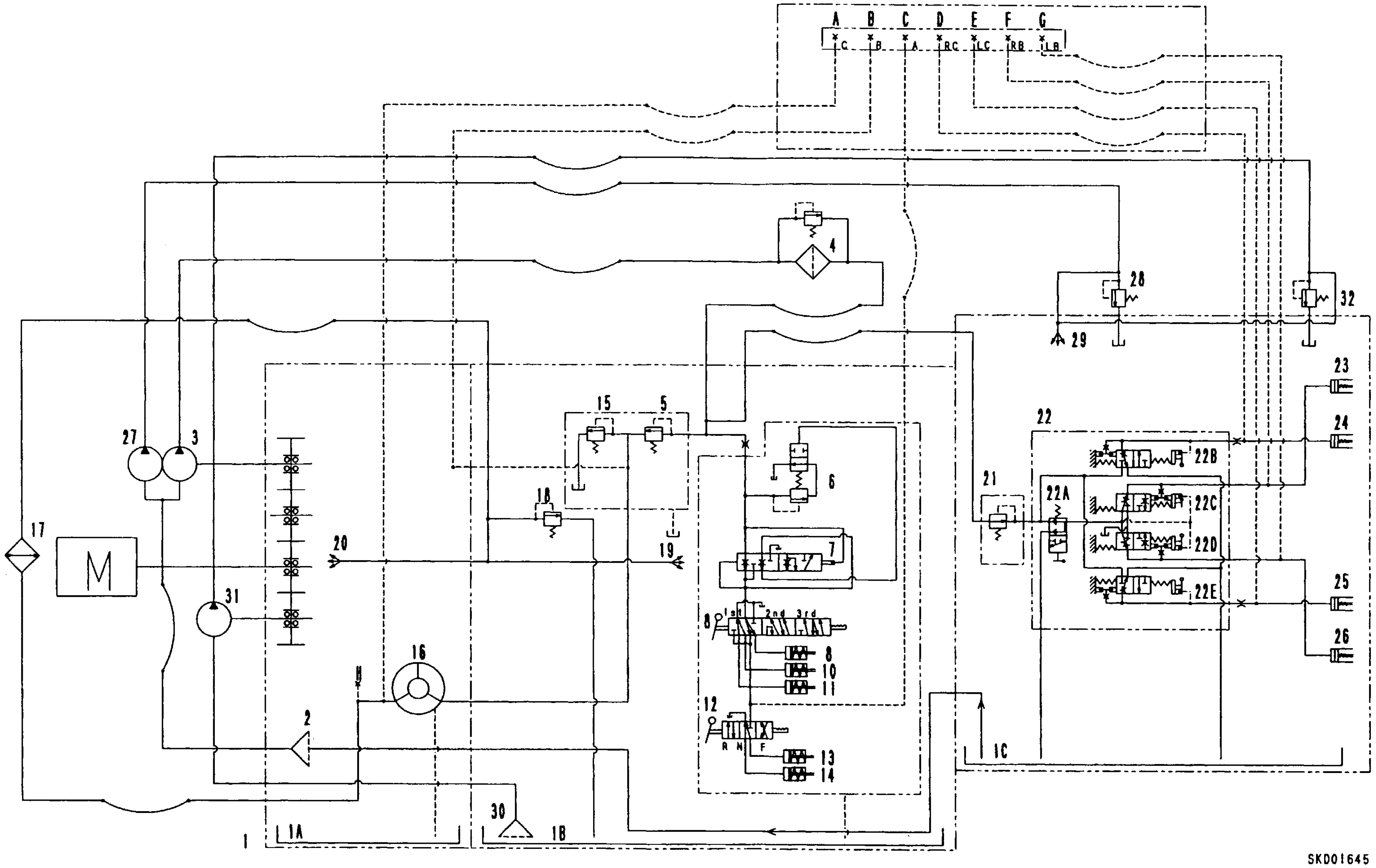
- **Without central pressure detection**



1. Power train oil filter
2. Transmission control valve
3. Brake valve
4. Main relief valve
5. Power train pump (SAL(2)-045)
6. Power train lubrication pump (SAL(2)-045)
7. Scavenging pump
8. Power train oil strainer
9. Power train oil cooler (built into radiato lower tank)

POWER TRAIN HYDRAULIC CIRCUIT DIAGRAM

D65E-12 60001 – 65000
D65P-12 60001 – 65000



For the machine with central pressure detection

014012

1. Power train oil pan
   1A. Torque converter case
   1B. Transmission case
   1C. Steering case
2. Oil strainer
3. Power train pump (SAL(2)-045)
4. Power train oil filter
   Set pressure: 0.15 MPa {1.5kg/cm²}
5. Main relief valve
   Set pressure:
   3.33 ± 0.1 MPa {34 ± 1 kg/cm²}
6. Modulating valve
7. Quick return valve
8. Speed valve
9. 1st clutch
10. 3rd clutch
11. 2nd clutch
12. Directional valve
13. Reverse clutch
14. Forward clutch
15. Torque converter relief valve
    Set pressure: 0.83 MPa {8.5 kg/cm²}
16. Torque converter
17. Oil cooler
18. Transmission lubrication valve
    Set pressure: 0.29 MPa
    {25 ± 1 kg/cm²}
19. Transmission lubrication
20. PTO lubrication
21. Reducing valve
    Set pressure:
    2.45 ± 0.1 MPa {25 ± 1 kg/cm²}
22. Steering control valve
    22A. Parking brake valve
    22B. Right clutch valve
    22C. Right brake valve
    22D. Left brake valve
    22E. Left clutch valve
23. Right brake
24. Right clutch
25. Left clutch
26. Left brake
27. Power train lubrication pump (SAL(2)-045)
28. Lubrication valve
    Set pressure: 0.33 MPa {3.4 kg/cm²}
29. Clutch, brake lubrication
30. Strainer
31. Scavenging pump
32. Lubrication valve
    Set pressure: 0.33 MPa {3.4 kg/cm²}

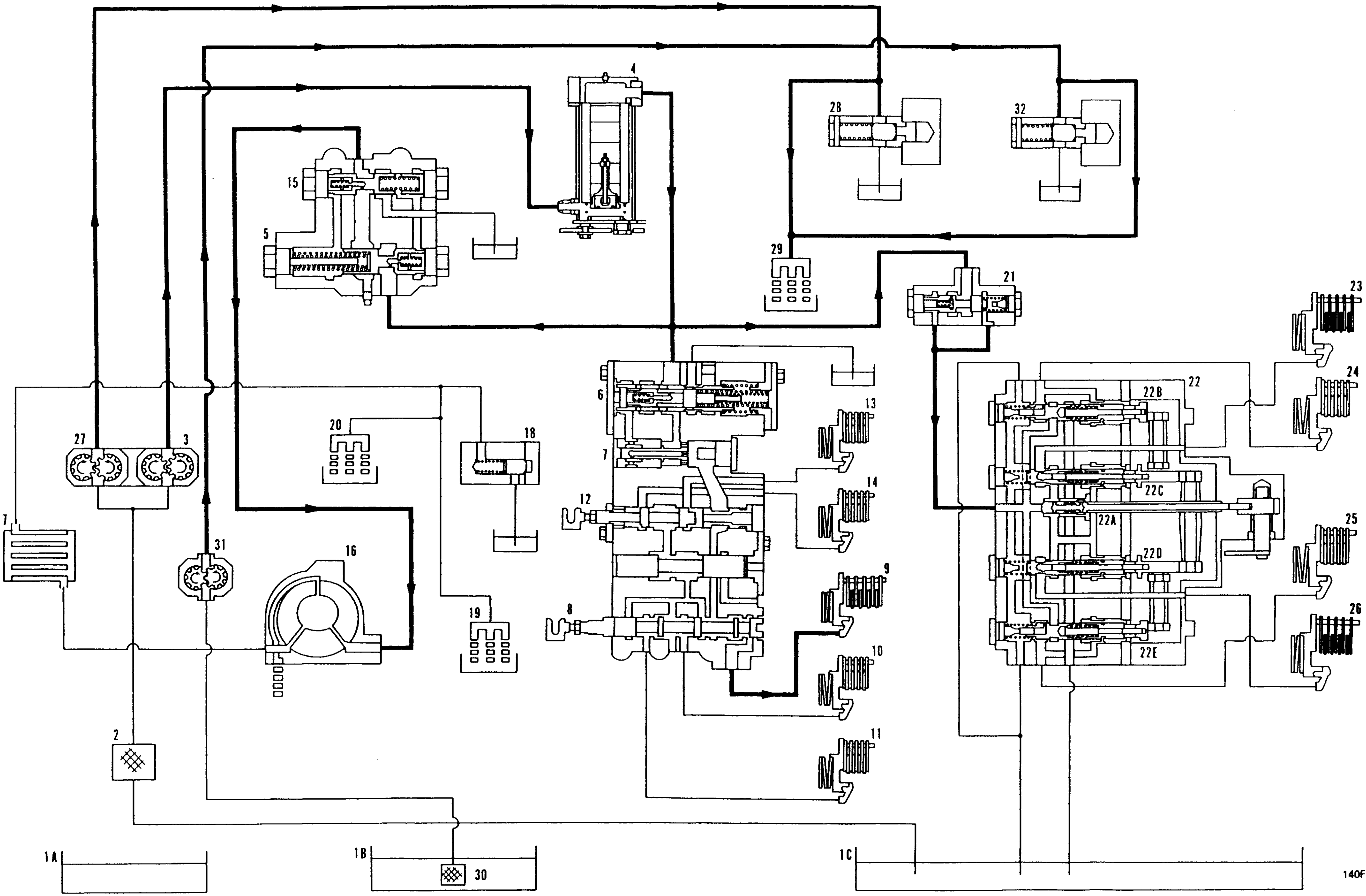
A.(C): Pressure detection port for torque converter outlet port
B.(B): Pressure detection port for torque converter inlet port
C.(A): Transmission modulating pressure detection port
D.(RC): Right clutch pressure detection port
E.(LC): Left clutch pressure detection port
F.(RB): Right brake pressure detection port
G.(LB): Left brake pressure detection port
H. : Power train oil temperature sensor mount

POWER TRAIN HYDRAULIC SYSTEM DIAGRAM

(Engine started, steering and directional lever at neutral, gear shift lever at 1st)

D65E-12 60001 – 65000
D65P-12 60001 – 65000

014012



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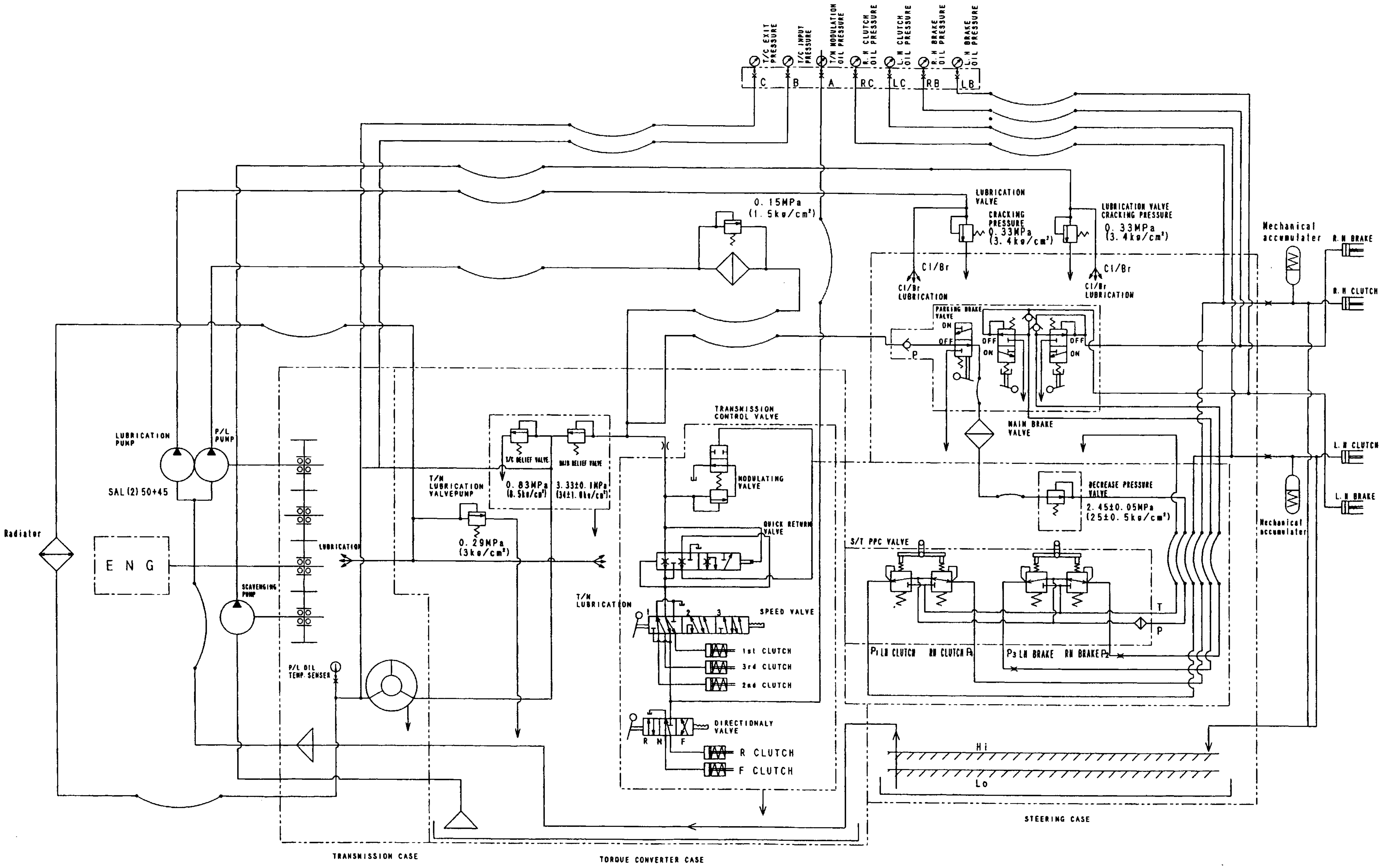
POWER TRAIN HYDRAULIC CIRCUIT DIAGRAM

D65E-12 65001 and up
D65P-12 65001 and up



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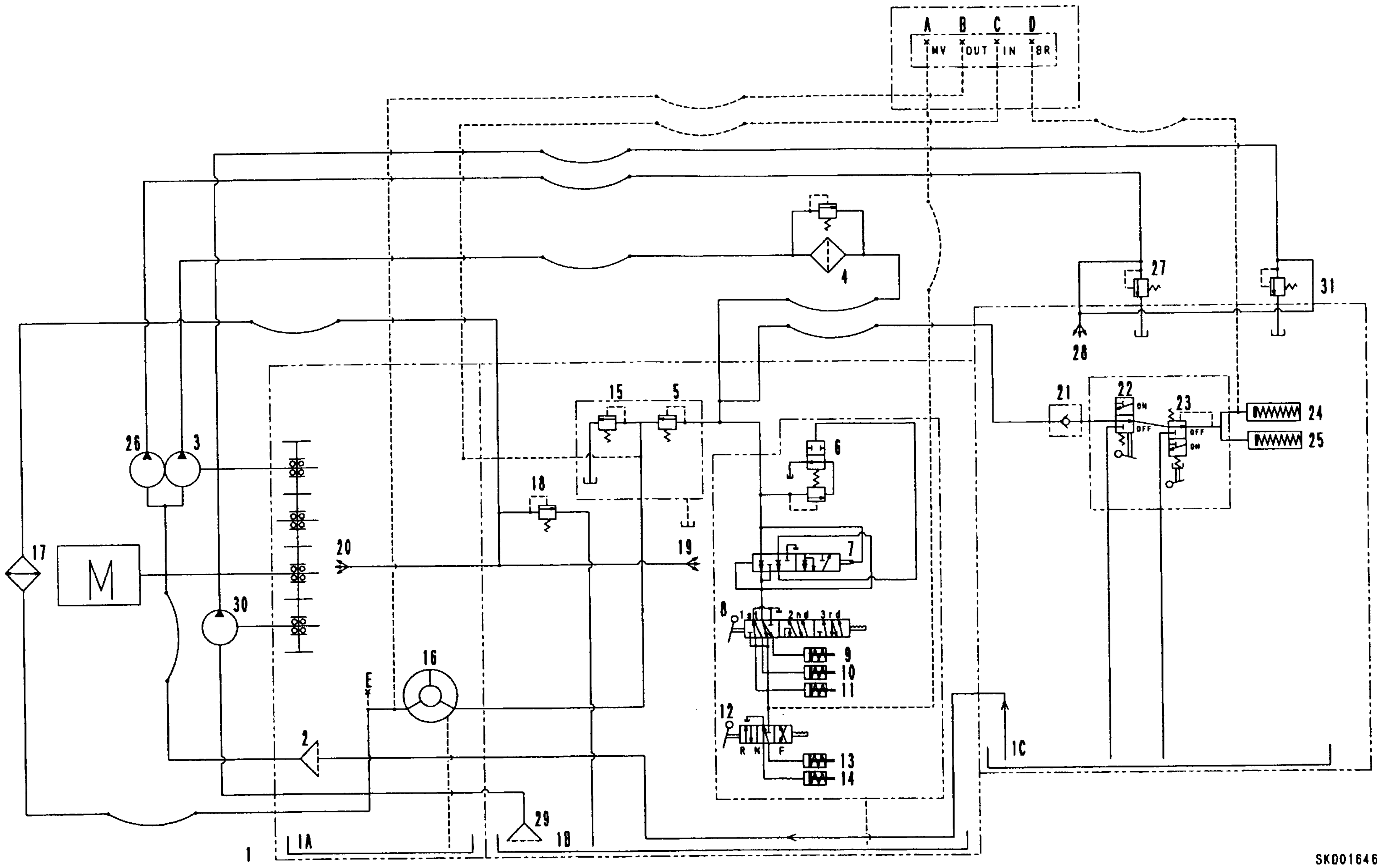
POWER TRAIN HYDRAULIC CIRCUIT DIAGRAM

D65EX, PX-12

For the machine with central pressure detection



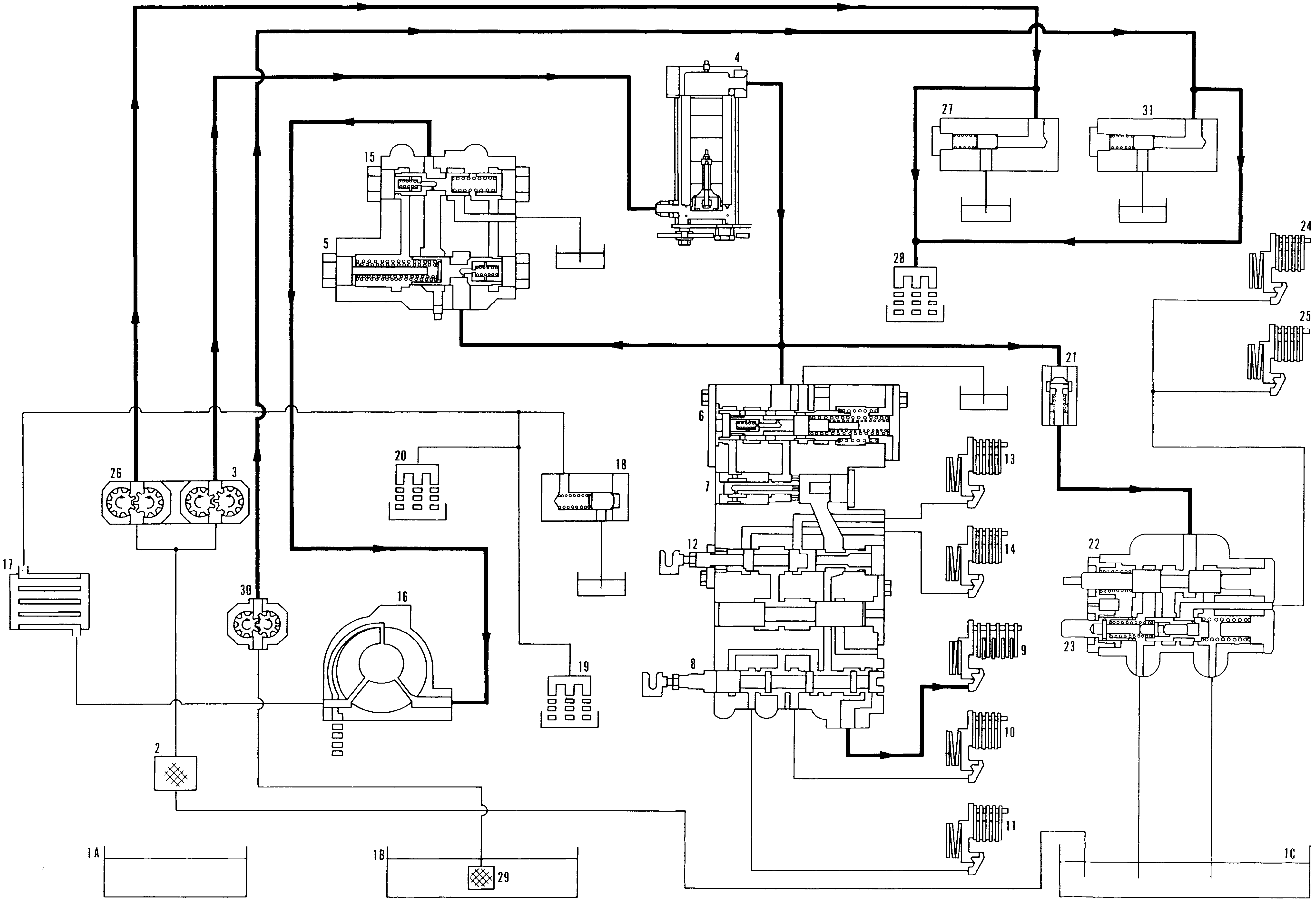
1. Power train oil pan
   1A. Torque converter case
   1B. Transmission case
   1C. Steering case
2. Oil strainer
3. Power train pump (SAL(2)-045)
4. Power train oil filter
   Set pressure: 0.15 MPa {1.5kg/cm²}
5. Main relief valve
   Set pressure:
   3.33±0.1 MPa {34±1 kg/cm²}
6. Modulating valve
7. Quick return valve
8. Speed valve
9. 1st clutch
10. 3rd clutch
11. 2nd clutch
12. Directional valve
13. Reverse clutch
14. Forward clutch
15. Torque converter relief valve
    Set pressure: 0.83 MPa {8.5 kg/cm²}
16. Torque converter
17. Oil cooler
18. Transmission lubrication valve
    Set pressure: 0.29 MPa {3 kg/cm²}
19. Transmission lubrication
20. PTO lubrication
21. Check valve
22. Parking brake valve
23. Brake control valve
24. Right brake
    Set pressure:
    2.65±0.1 MPa {27±1 kg/cm²}
25. Left brake
    Set pressure:
    2.65±0.1 MPa {27±1 kg/cm²}
26. Power train lubrication pump (SAL(2)-045)
27. Lubrication valve
    Set pressure: 0.29 MPa {3 kg/cm²}
28. HSS unit lubrication
29. Strainer
30. Scavenging pump
31. Lubrication valve
    Set pressure: 0.29 MPa {3 kg/cm²}

A.(MV) : Transmission modulating pressure detection port
B.(OUT) : Pressure detection port for torque converter outlet port
C.(IN) : Pressure detection port for torque converter inlet port
D.(BR) : Brake pressure detection port
E. : Power train temperature sensor mount

014012

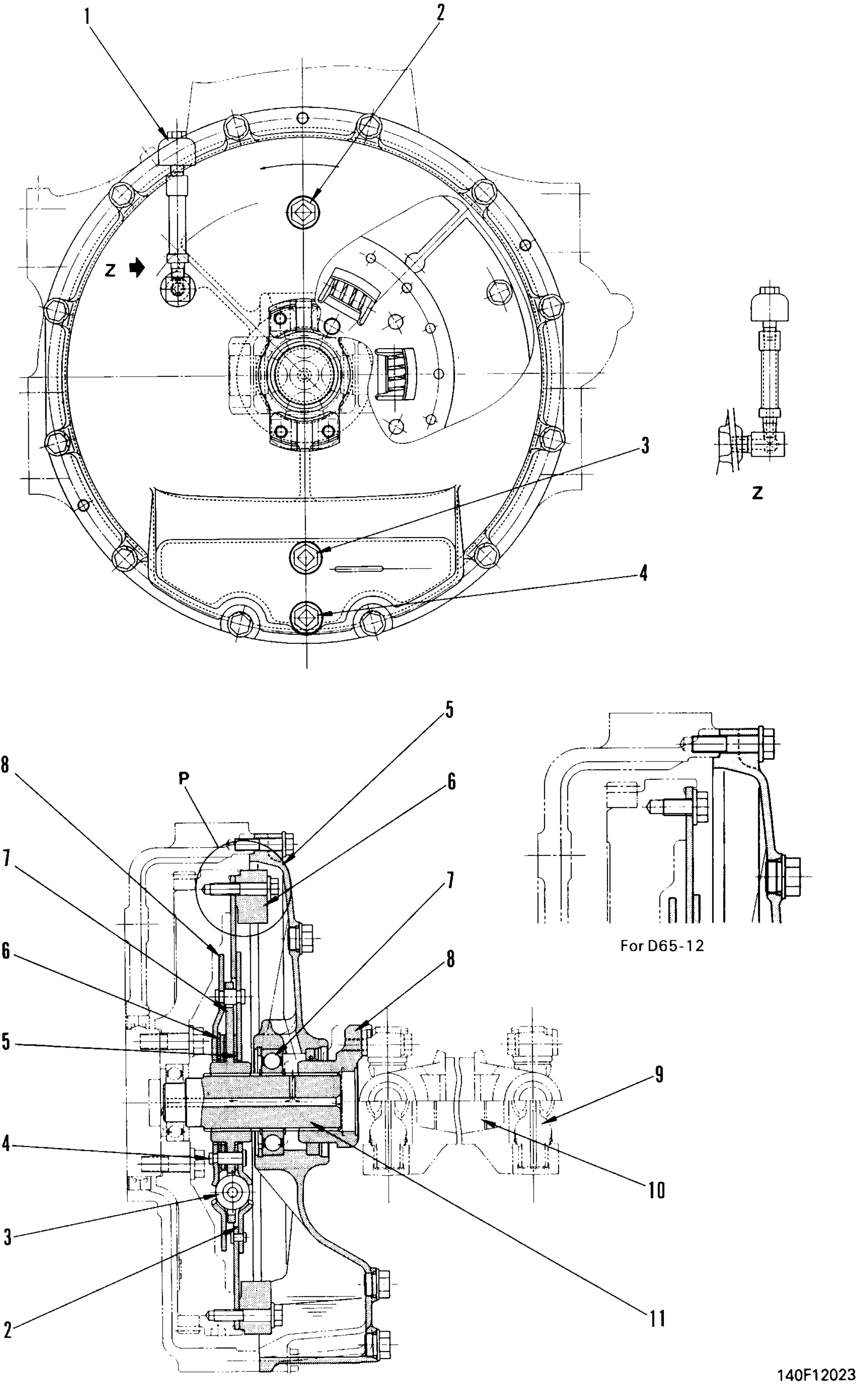
POWER TRAIN HYDRAULIC SYSTEM DIAGRAM

(Engine started, steering and directional lever at neutral, gear shift lever at 1st)



140F12022

DAMPER, UNIVERSAL JOINT



140F12023

1. Breather
2. Oil filler plug
3. Inspection plug
4. Drain plug
5. Damper case
6. Flyweight (D60 only)
7. Bearing
8. Coupling
9. Cross pin
10. Drive shaft
11. Shaft
12. Drive plate
13. Torsion plate
14. Stopper pin
15. Friction plate
16. Friction spring
17. Hub
18. Cover

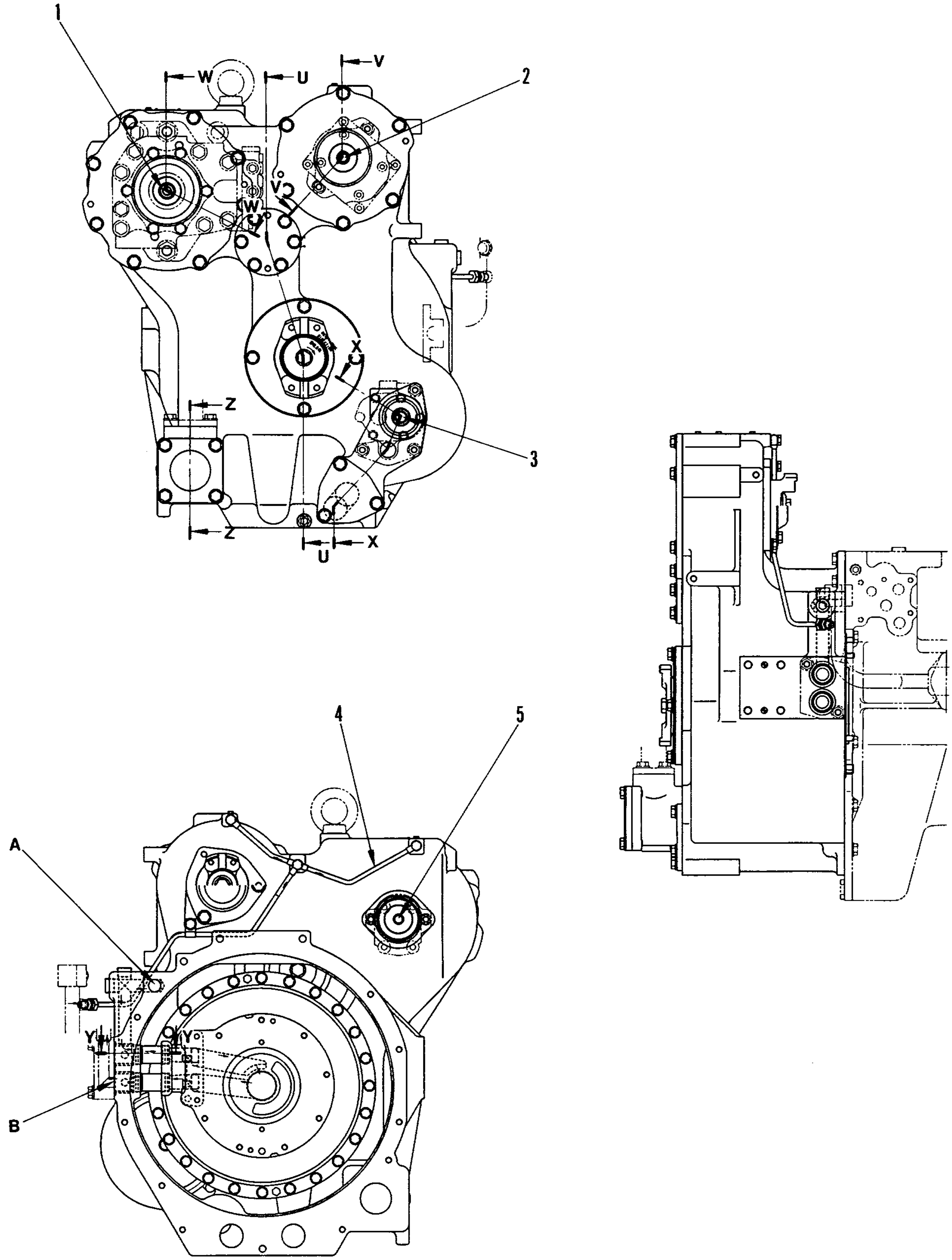
OUTLINE

- The damper is a wet type with a friction spring. The damper is set with a stopper angle of 4° and a stopper torque of 2667.4 Nm (272 kgm) (at a stopper angle of 4°).
- Flyweight (6) (for D60-12), which is tightened to the flywheel together with the damper, combines with the damper to reduce the impact torque generated when shifting gear, thereby reducing the load on the engine and other parts of the transmission.

014012

TORQUE CONVERTER AND PTO

TCS38-5A
TCS38-6A (For towing winch with PTO)



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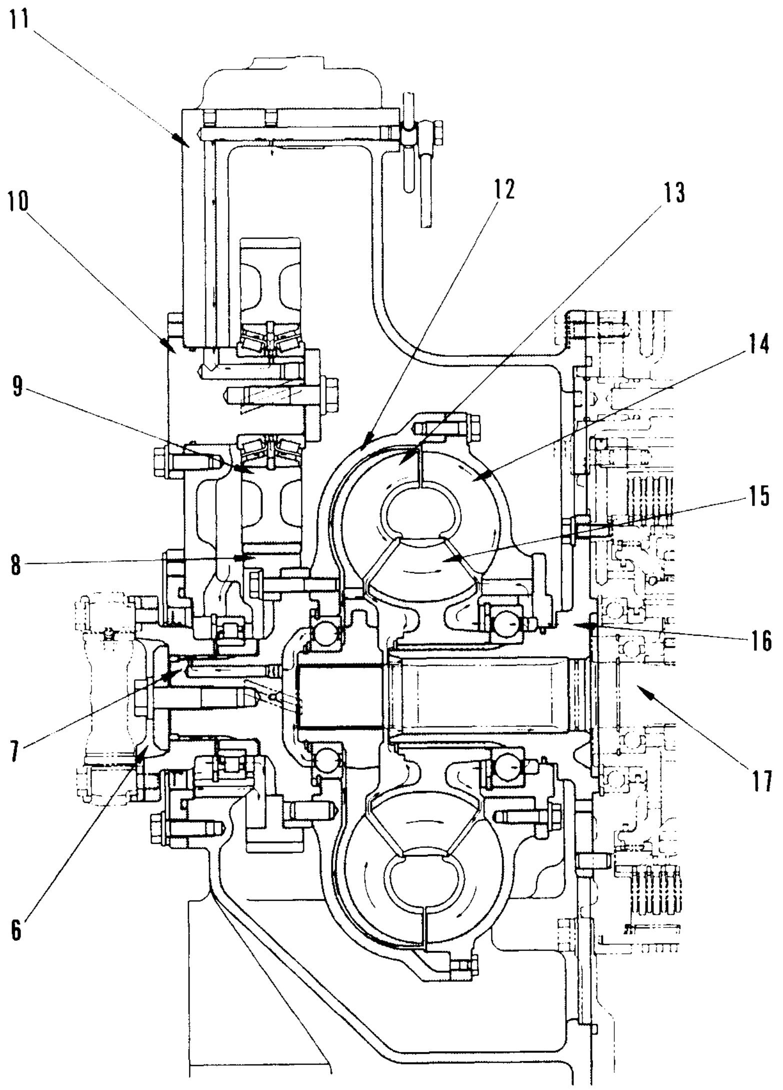
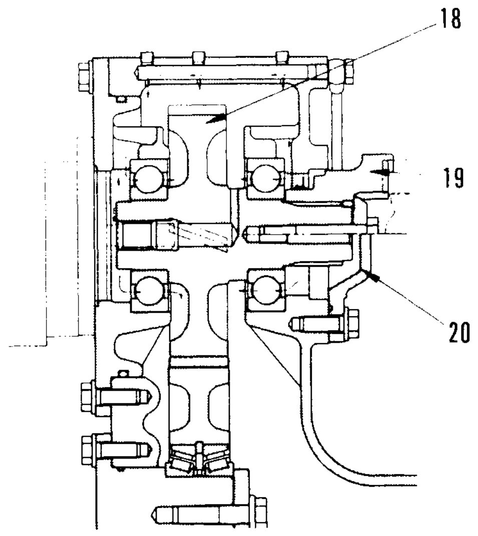
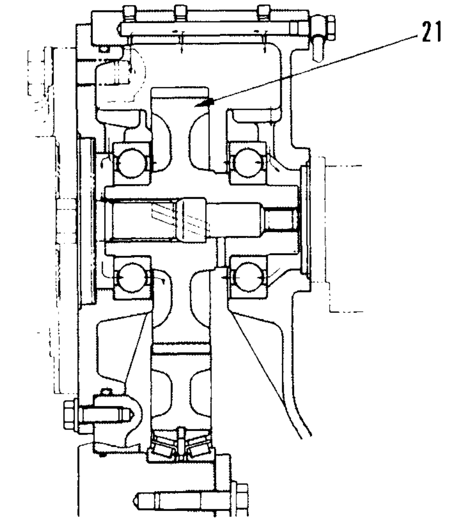
140F12037



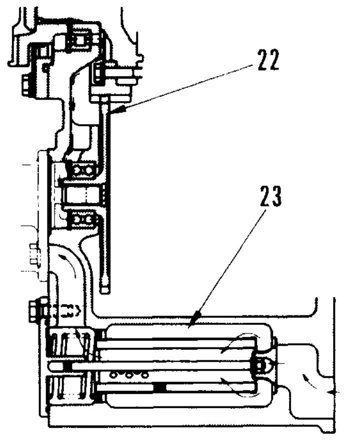
U - U



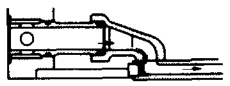
V - V



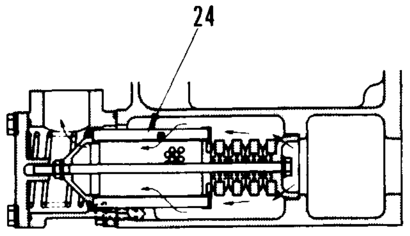
W - W



X - X



Y - Y



Z - Z

140F12038

OUTLINE

- The torque converter is a 3-element, 1-stage, 1-phase type and forms one unit with the transmission.
- Pump (14) forms one unit with coupling (6), input shaft (7) and drive case (12), and is rotated by the power from the engine.
- Tubine (13) forms one unit with transmission input shaft (17), and is rotated by the oil from the pump.
- Stator (15) forms one unit with stator shaft (16), and is fixed to PTO case (11).

Turbine

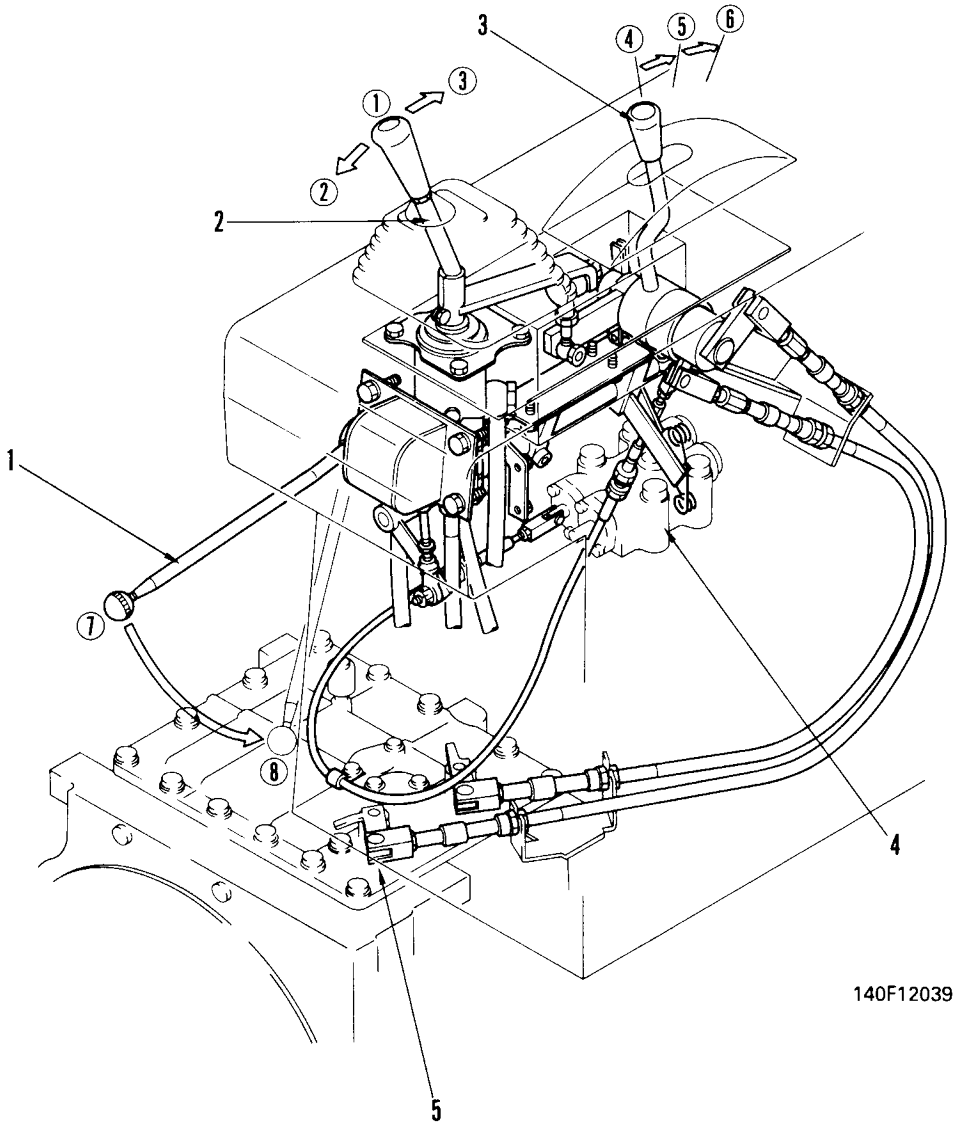
1. Hydraulic pump mount
2. Power train pump, lubrication pump mount
3. Scavenging pump mount
4. PTO lubrication tube
5. PPC pump mount
6. Coupling
7. Input shaft
8. PTO drive gear (No. of teeth: 62)
9. Idler gear (No. of teeth: 63)
10. Idler gear shaft
11. PTO case
12. Drive case
13. Turbine
14. Pump
15. Stator
16. Stator shaft
17. Transmission input shaft
18. Power train pump,lubrication pump gear (No. of teeth: 53)
19. Coupling (when PTO for towing winch is installed)
20. Cover
21. Hydraulic pump gear (No. of teeth: 53)
22. Scavenging pump drive gear (No. of teeth: 56)
23. Scavenging pump strainer
24. Power train pump strainer

A. Torque converter oil inlet port
B. To oil cooler

TRANSMISSION CONTROL

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

★ This diagram shows the D65EX, PX–12.



140F12039

Lever positions
① NEUTRAL
② FORWARD
③ REVERSE
④ 1st
⑤ 2nd
⑥ 3rd
⑦ FREE
⑧ LOCK

1. Safety lever
2. Steering and directional lever
3. Gear shift lever
4. Brake valve
5. Transmission control valve

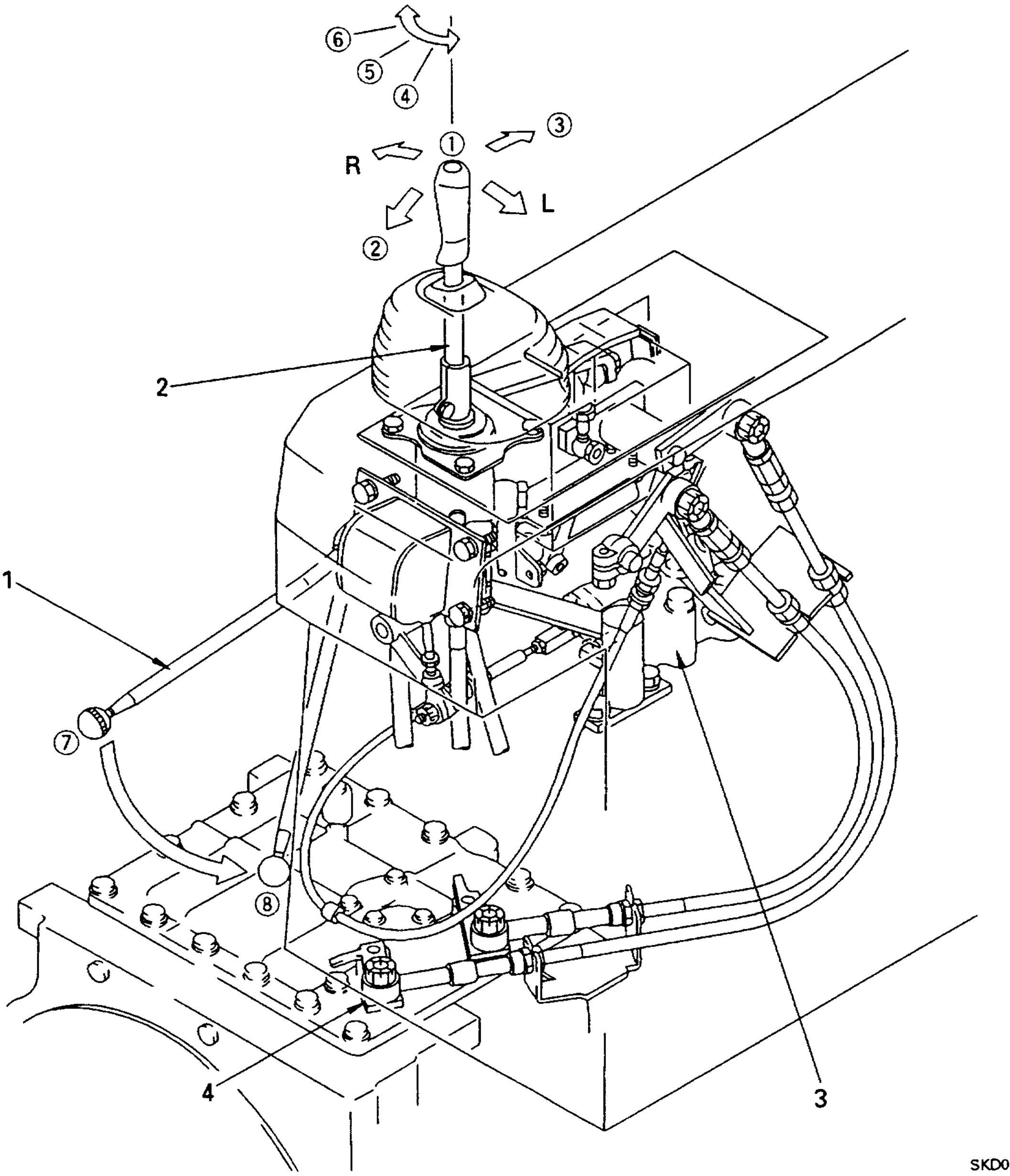
OUTLINE

- The transmission is controlled by steering and directional lever (2), which changes the direction of travel, and gear shift lever (3), which selects the speed clutch.

014012

D65E-12	**60948 – 65000**
D65P-12	**60891 – 65000**
D65EX-12	**60942 – 65000**
D65PX-12	**60915 – 65000**

★ This diagram shows the D65EX, PX-12.



Lever positions

① NEUTRAL
② FORWARD
③ REVERSE
④ 1st
⑤ 2nd
⑥ 3rd
⑦ FREE
⑧ LOCK

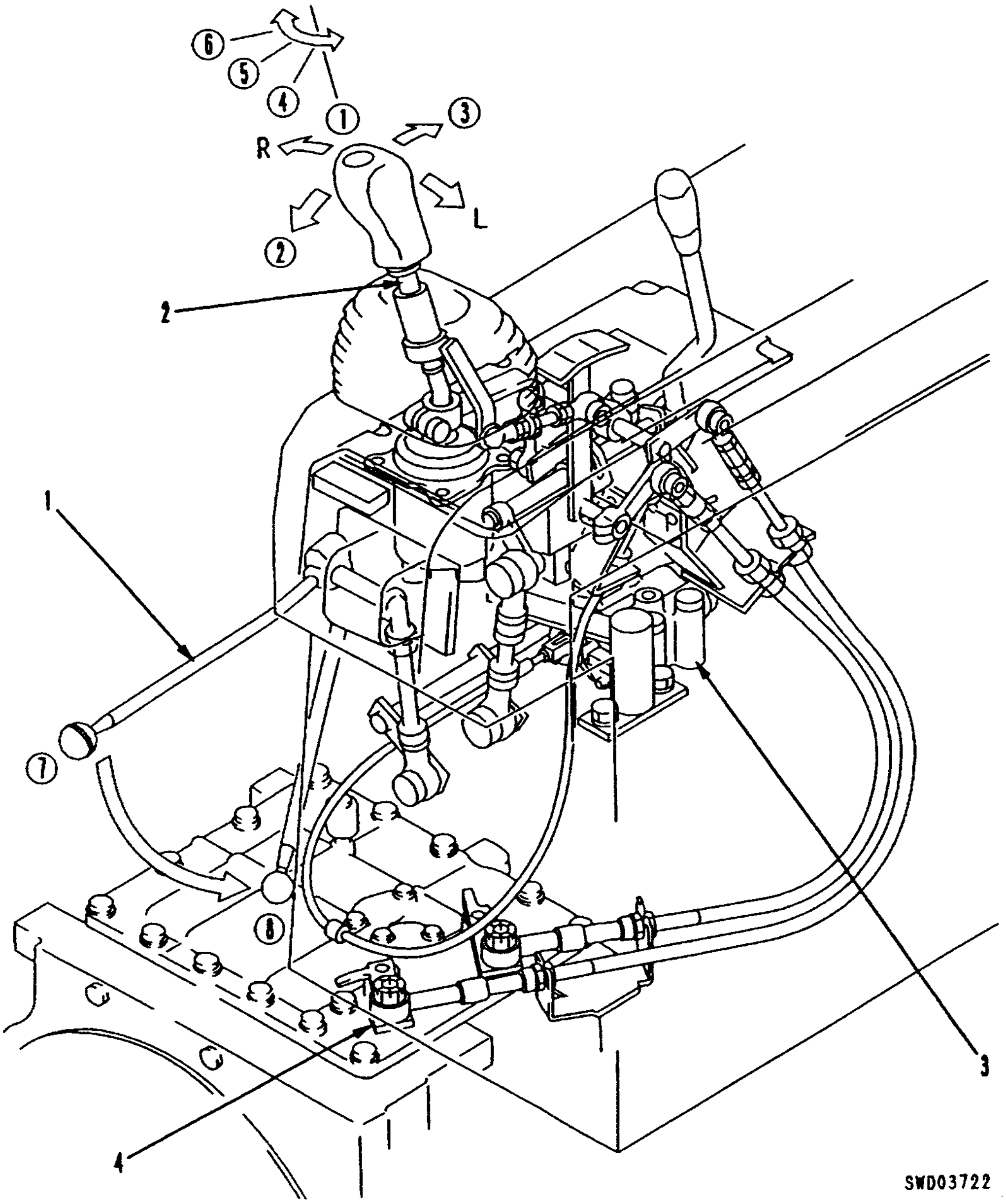
1. Safety lever
2. Joystick (directional change, gear shift)
3. Brake valve
4. Transmission control valve

OUTLINE

- The transmission controlled by joystick (2), which changes the direction of travel, and selects the gear shift.

D65E-12 65001 and up
D65P-12 65001 and up
D65EX-12 65001 and up
D65PX-12 65001 and up

★ This diagram shows the D65EX, PX–12.



Lever positions
① NEUTRAL
② FORWARD
③ REVERSE
④ 1st
⑤ 2nd
⑥ 3rd
⑦ FREE
⑧ LOCK

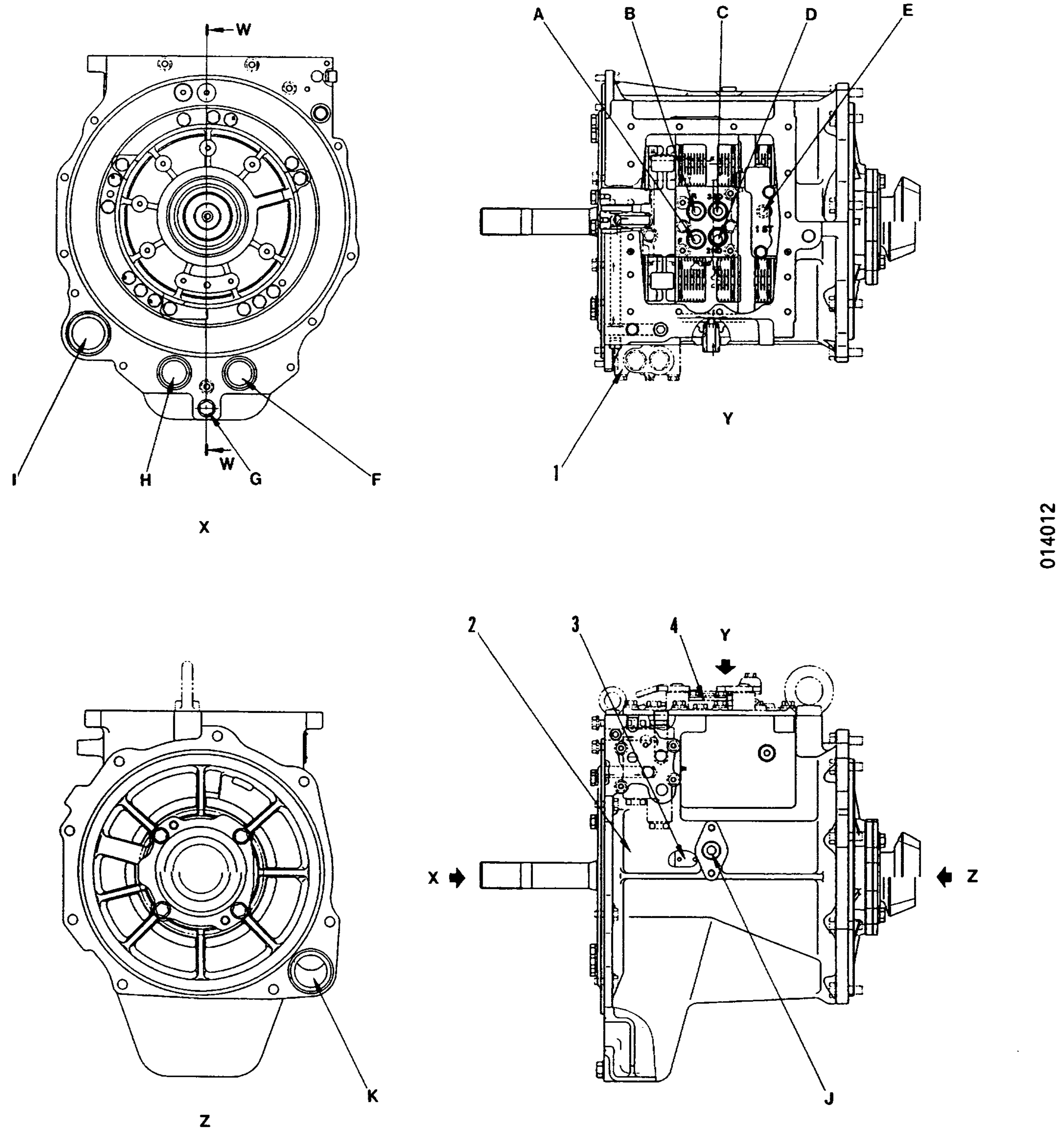
1. Safety lever
2. Joystick (directional change, gear shift)
3. Brake valve
4. Transmission control valve

OUTLINE

- The transmission controlled by joystick (2), which changes the direction of travel, and selects the gear shift.

TRANSMISSION

D65E, P-12 60001 – 65000
D65EX, PX-12 60001 – 65000



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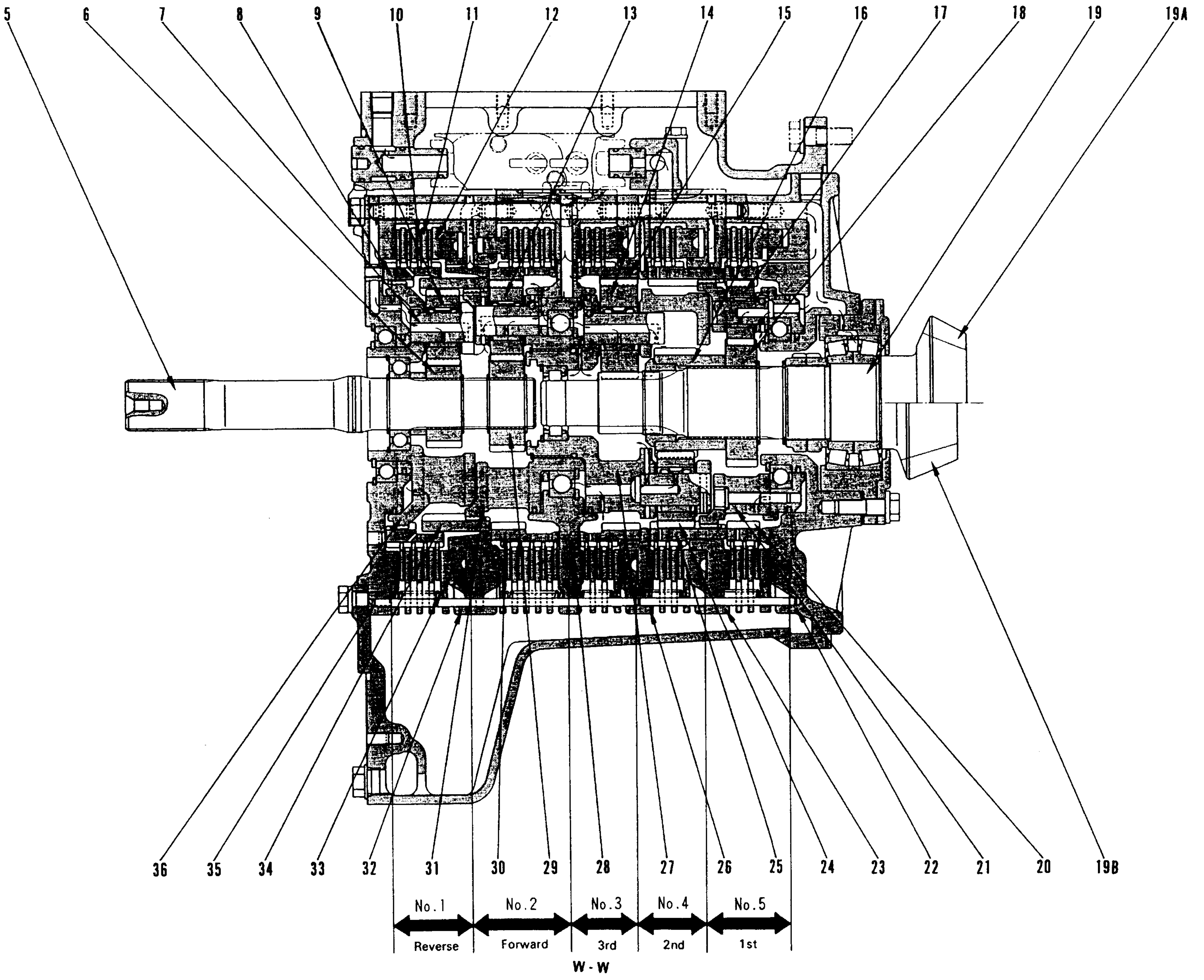
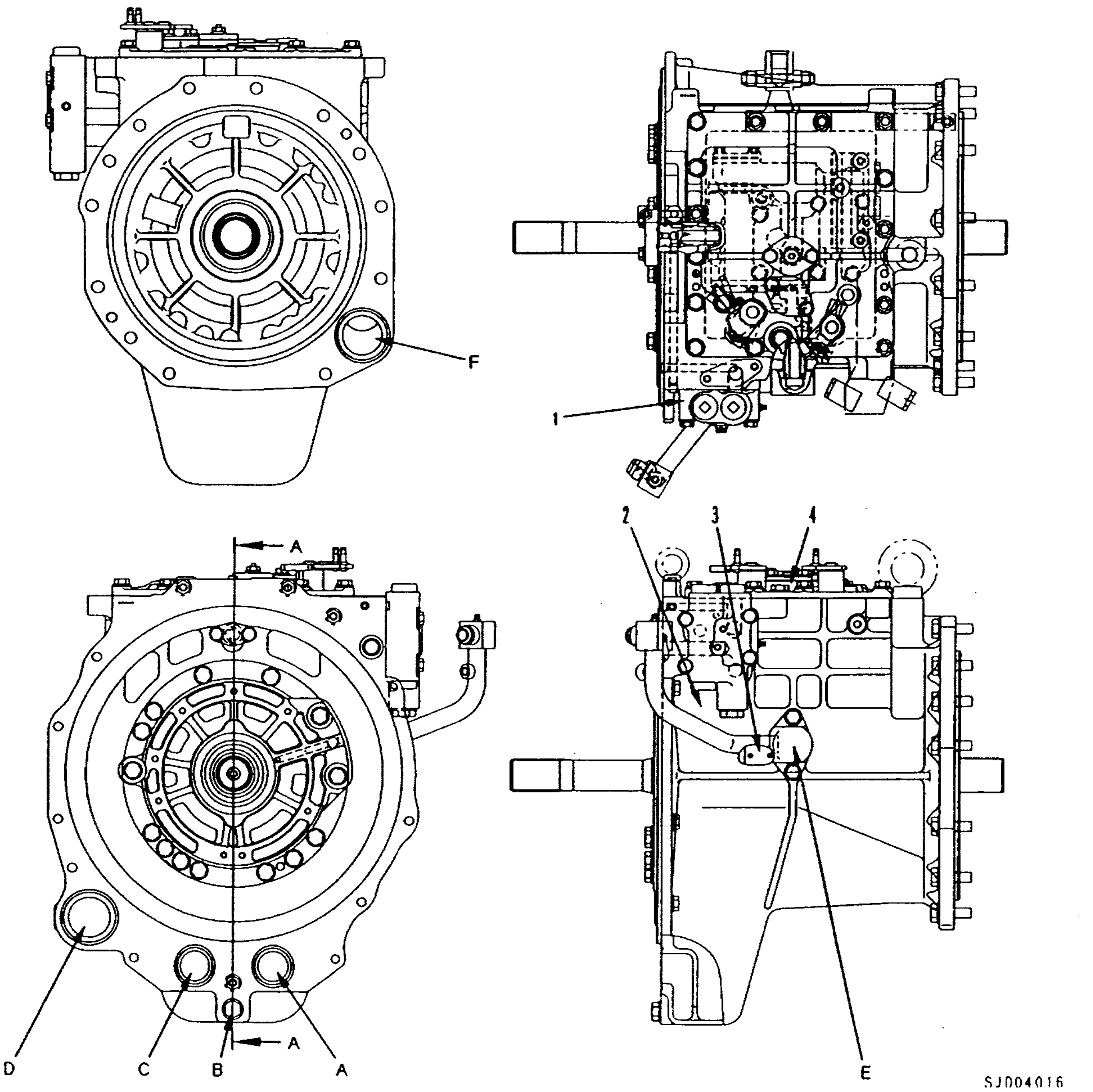


140F12041

1. Main relief valve
2. Transmission case
3. Lubrication relief valve
4. Transmission control valve, valve cover assembly
5. Input shaft
6. REVERSE sun gear (No. of teeth: 26)
7. Pinion shaft
8. REVERSE ring gear (No. of teeth: 75 (inside), 90 (outside))
9. REVERSE planet pinion (No. of teeth: 22)
10. Disc
11. Plate
12. Piston
13. FORWARD planet pinion (No. of teeth: 23)
14. 3rd planet pinion (No. of teeth: 30)
15. 3rd ring gear (No. of teeth: 76 (inside), 90 (outside))
16. 2nd sun gear (No. of teeth: 33)
17. 1st planet pinion (No. of teeth: 18)
18. 1st sun gear (No. of teeth: 39)
19. Output shaft (No. of teeth on 3rd sun gear portion: 17)
    - 19A. Bevel pinion (D60P, D65E, P: No. of teeth: 18)
    - 19B. Bevel pinion (D65EX,PX: No. of teeth: 14)
20. 1st ring gear (No. of teeth: 75 (inside), 90 (outside))
21. 1st carrier (No. of teeth: 75)
22. 1st clutch housing
23. 2nd clutch housing
24. 2nd planet pinion (No. of teeth: 21)
25. 2nd ring gear (No. of teeth: 75 (inside), 90 (outside))
26. 3rd clutch housing
27. 2nd, 3rd carrier
28. FORWARD clutch housing
29. FORWARD sun gear (No. of teeth: 29)
30. FORWARD ring gear (No. of teeth: 75 (inside), 90 (outside))
31. FORWARD carrier (No. of teeth: 70)
32. REVERSE clutch housing
33. Return spring
34. REVERSE ring gear (No. of teeth: 70)
35. Pin
36. REVERSE carrier (No. of teeth: 75)

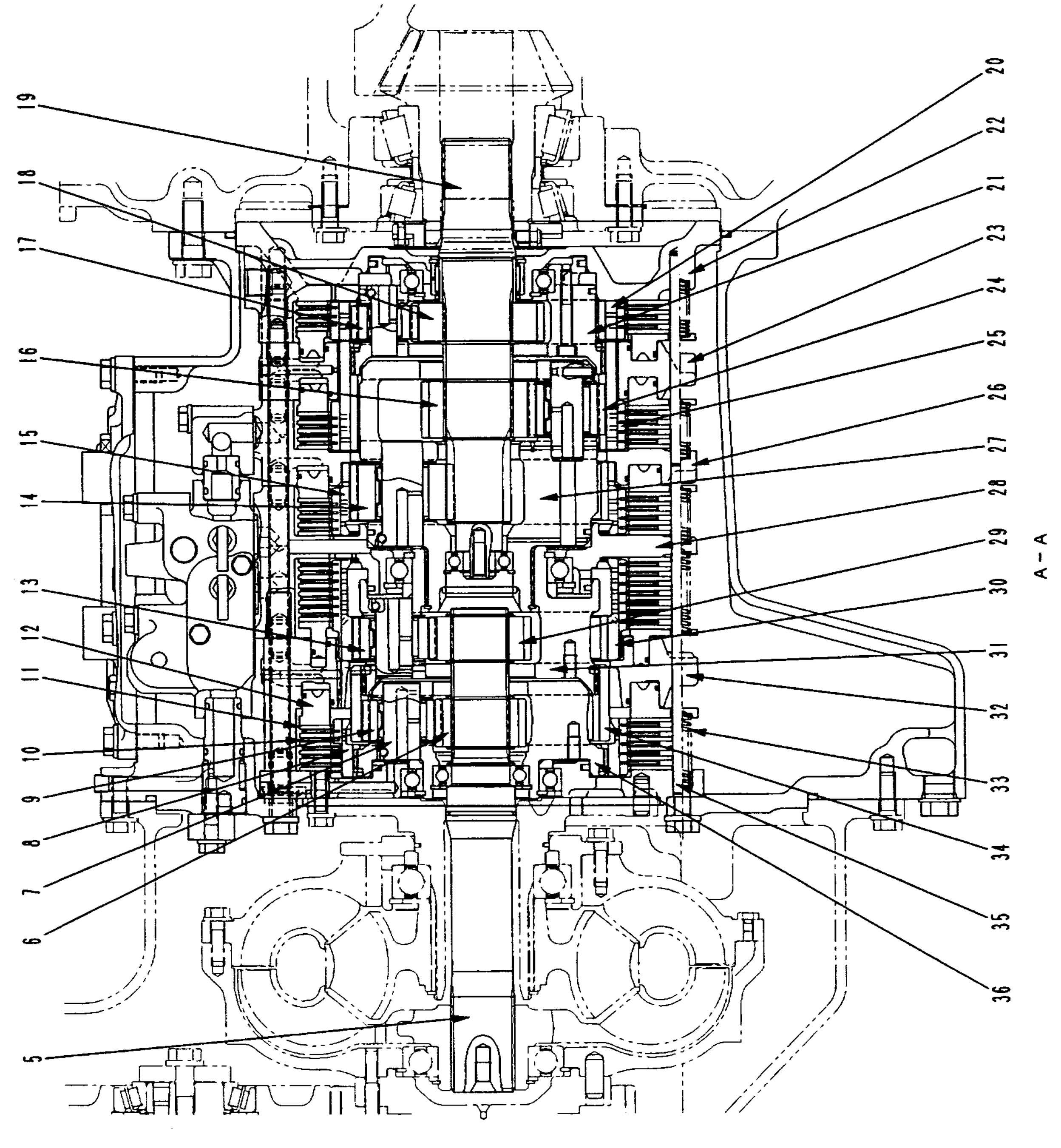
A. To FORWARD clutch
B. To REVERSE clutch
C. To 3rd clutch
D. To 2nd clutch
E. To 1st clutch
F. Scavenging pump suction port
G. Drain plug
H. From torque converter case to drain port for transmission case
I. Power train oil suction port
J. Transmission lubrication inlet port
K. Power train oil suction port

D65E, P-12 65001 –
D65EX, PX-12 65001 –



1. Main relief valve
2. Transmission case
3. Lubrication relief valve
4. Transmission control valve, valve cover assembly

A. Scavenging pump suction port
B. Drain plug
C. From torque converter case to drain port of transmission case
D. Power train oil suction port
E. Transmission lubrication inlet port
F. Power train oil suction port



014012

SJD04017

5. Input shaft
6. REVERSE sun gear (No. of teeth: 26)
7. Pinion shaft
8. REVERSE ring gear (No. of teeth: 75 (inside), 75 (outside))
9. REVERSE planet pinion (No. of teeth: 22)
10. Disc
11. Plate
12. Piston
13. FORWARD planet pinion (No. of teeth: 23)
14. 3rd planet pinion (No. of teeth: 30)
15. 3rd ring gear (No. of teeth: 76 (inside), 75 (outside))
16. 2nd sun gear (No. of teeth: 33)
17. 1st planet pinion (No. of teeth: 18)
18. 1st sun gear (no. of teeth: 39)
19. Output shaft (No. of teeth on 3rd sun gear portion: 17)
20. 1st ring gear (No. of teeth: 75 (inside), 75 (outside))
21. 1st carrier (No. of teeth: 75)
22. 1st clutch housing
23. 2nd clutch housing
24. 2nd planet pinion (No. of teeth: 21)
25. 2nd ring gear (No. of teeth: 75 (inside), 75 (outside))
26. 3rd clutch housing
27. 2nd, 3rd carrier
28. FORWARD clutch housing
29. FORWARD sun gear (No. of teeth: 29)
30. FORWARD ring gear (No. of teeth: 75 (inside), 75 (outside))
31. FORWARD carrier (No. of teeth: 70)
31. REVERSE clutch housing
33. Return spring
34. REVERSE ring gear (No. of teeth: 70)
35. Pin
36. REVERSE carrier (No. of teeth: 75)

OUTLINE

The transmission is equipped with a planetary type, "3-forward and 3-reverse speed" transmission which is a combined structure of a planetary gear mechanism and disc cluthes.

The rotational direction and the revolution of the transmission output shaft is selected by fixing two disc clutches out of five disc clutches by means of control valve operation.

No.1 clutch is fixed in reverse, No.2 clutch in forward, No.3 clutch in third speed, No.4 clutch in second speed, and No.5 clutch in first speed.

Any speed can by selected from three forward speeds and three reverse speeds by fixing either No.1 or No.2 clutch and one clutch amoung No.3, No.4, and No.5 clutches and by combining two of the above.

Speeds and operating clutches

Speed		Operating clutch
Forward	Neutral	No.5 clutch
	First speed	No.2 and No.5 clutches
	Second speed	No.2 and No.4 clutches
	Third speed	No.2 and No.3 clutches
Reverse	Neutral	No.5 clutch
	First speed	No.1 and No.5 clutches
	Second speed	No.1 and No.4 clutches
	Third speed	No.1 and No.3 clutches

014012

Number of discs and plates on each clutch

D65E, P-12 60001 – 65000
D65EX, PX-12 60001 – 65000

Clutch No.	Number of discs	Number of plates
No.1 clutch	4	3
No.2 clutch	5	4
No.3 clutch	3	2
No.4 clutch	3	2
No.5 clutch	3	2

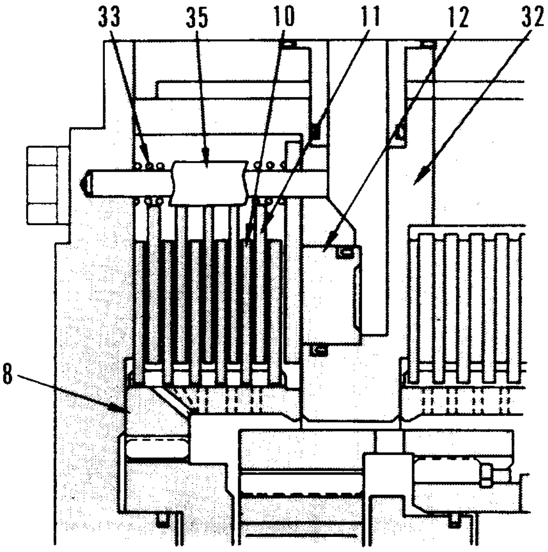
D65E, P-12 65001 and up
D65EX, PX-12 65001 and up

Clutch No.	Number of discs	Number of plates
No.1 clutch	5	6
No.2 clutch	7	8
No.3 clutch	4	5
No.4 clutch	4	5
No.5 clutch	3	4

OPERATION

1. FUNCTION OF PISTON

- To lock ring gear (8), the discs (10) and plates (11) are brought into close contact. The clutch consists of a clutch piston (12), clutch plates (11), clutch discs (10), pins (12) and piston return springs (33).
  The disc's internal teeth engage with the ring gear's external teeth.
  The plates, whose notch on the outside diameter engage with pins (35) on housing (32).



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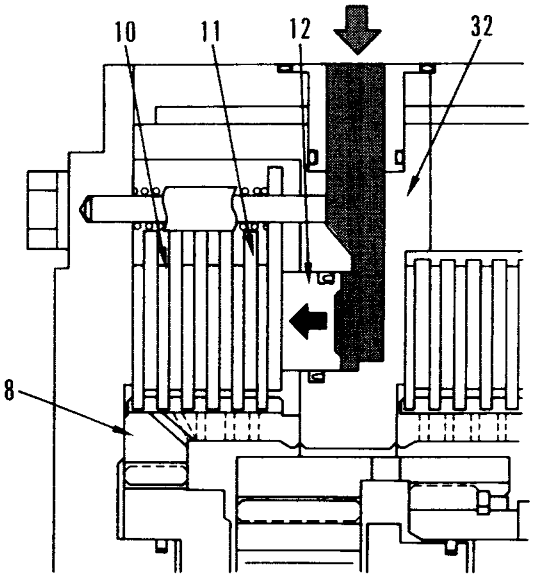
- **Clutch engaged (oil pressure is acting)**
  Oil from the control valve flows under pressure through the port in housing (32) to the piston (12). The piston presses clutch plates (11) and clutch discs (10) together, and the frictional force developed stops clutch discs (10) revolution, thus ring gear (8) meshing with the disc's internal teeth is locked.



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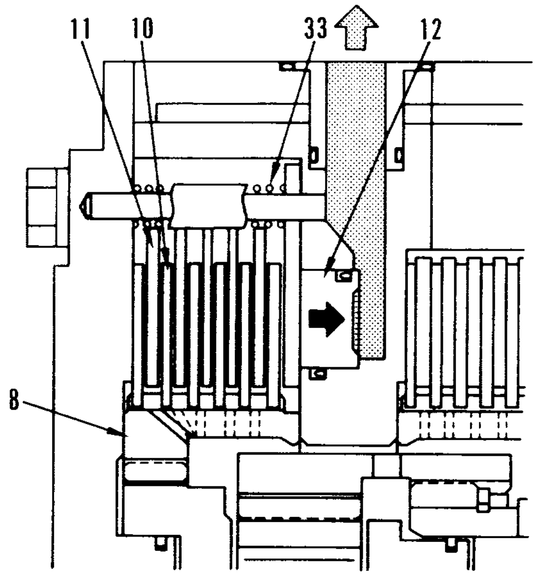
- **Clutch disengaged (oil pressure is not acting)**
  When the supply of pressure oil from the control valve is shut off, piston (12) returns to the initial position by the force of piston return spring (33), thus relieving the frictional force between plates (11) and disc (10) making the ring gear (8) free.



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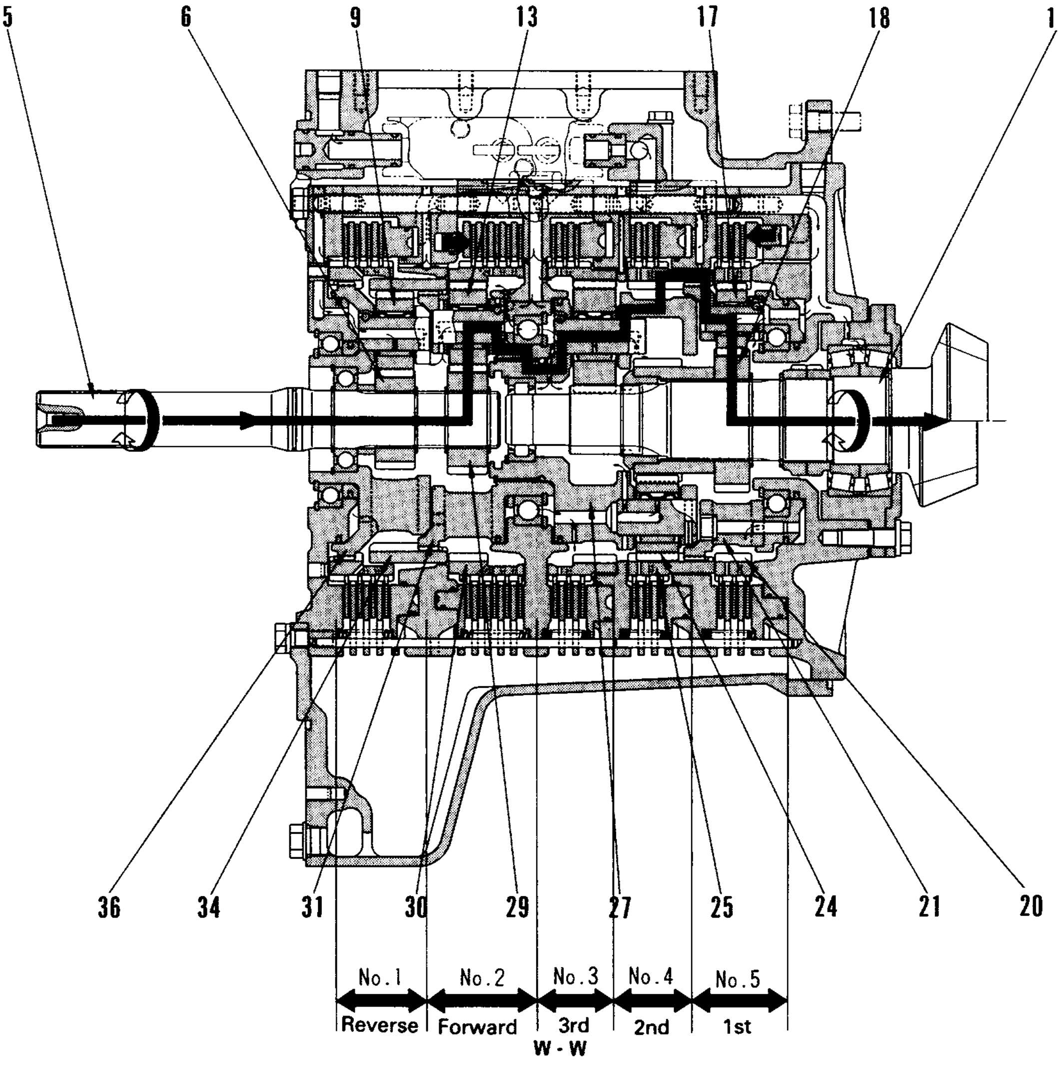

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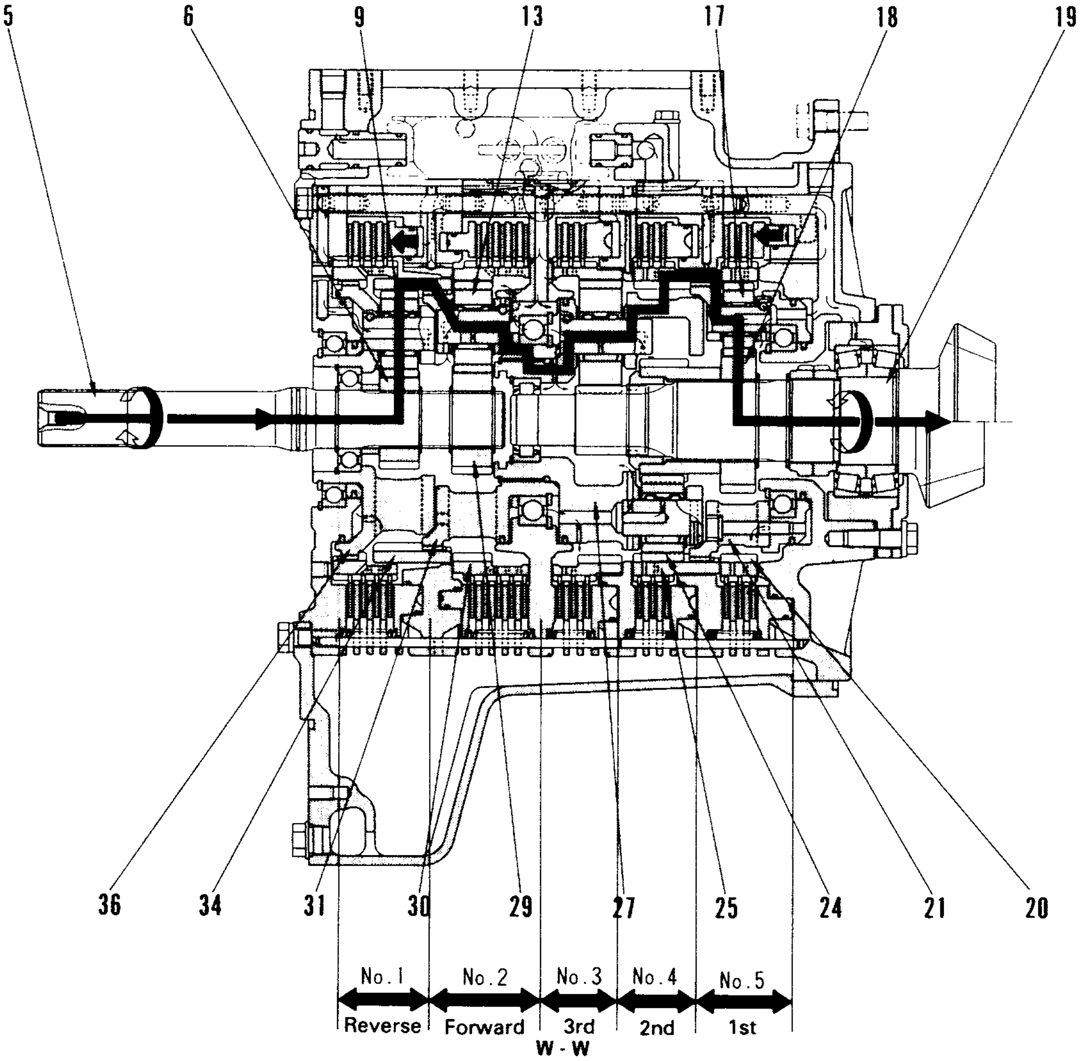
2. FORWARD 1st

- When FORWARD 1st is selected, No. 2 clutch and No. 5 clutch are engaged, and the motive force transmitted from the torque converter to input shaft (5) is transmitted to output shaft (19).
- No. 2 clutch is actuated by the oil pressure applied to the clutch piston, and fixes ring gear (30) in position. No. 5 clutch is actuated by the oil pressure applied to the clutch piston, and engages ring gear (20).
- The motive force from the torque converter is transmitted to input shaft (5), and the rotation of the input shaft passes through sun gear (29) and is transmitted to planet pinion (13).
- Ring gear (30) is fixed in position by No. 2 clutch, so the rotation of planet pinion (13) rotates carrier (31), which is on the inside of ring gear (30).
- Carrier (31) and carrier (27) are meshed by the spline and rotate as one part, so the rotation of carrier (31) passes through planet pinion (24) and is transmitted to ring gear (25).
- Carrier (21) is meshed with ring gear (25), so they rotate as one unit, and the rotation is transmitted to planet pinion (17).
- Ring gear (20) is fixed in position by No. 5 clutch, so the rotation of planet pinion (17) rotates sun gear (18) and this rotates output shaft (19).



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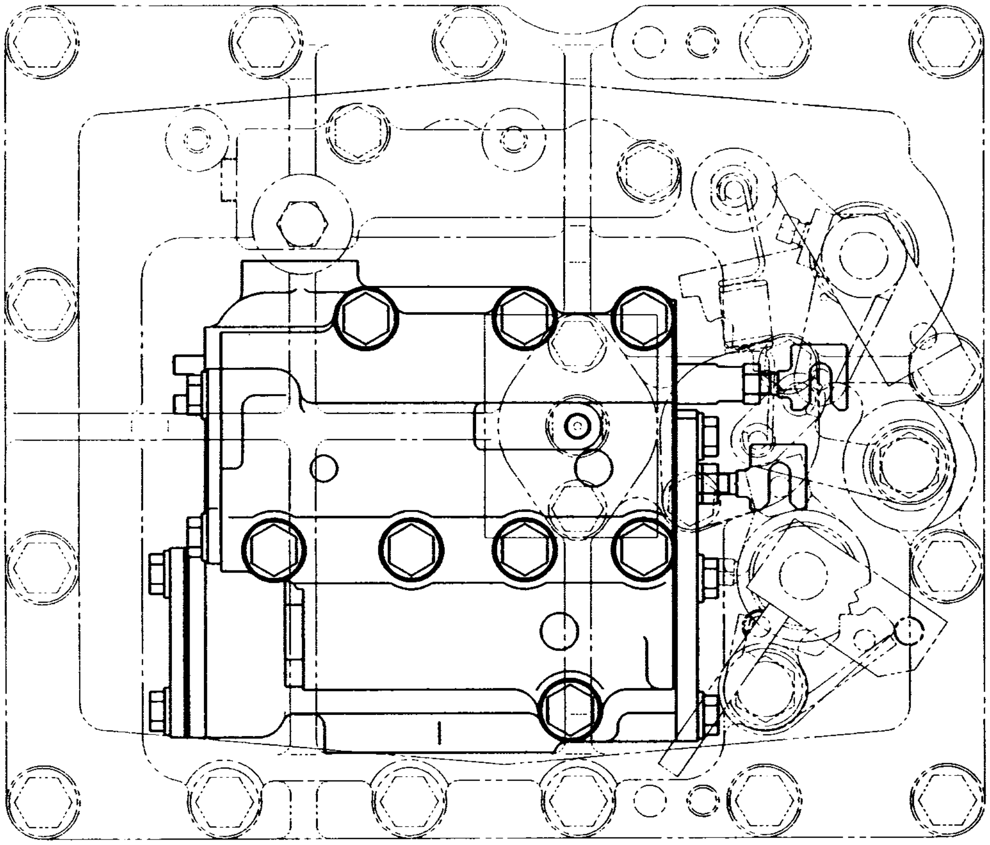
3. REVERSE 1st

- When REVERSE 1st is selected, No. 1 clutch and No. 5 clutch are engaged, and the motive force transmitted from the torque converter to input shaft (5) is transmitted to output shaft (19).
- No. 1 clutch is actuated by the oil pressure applied to the clutch piston, and fixes carrier (36) in position. No. 5 clutch is actuated by the oil pressure applied to the clutch piston, and engages ring gear (20).
- The motive force from the torque converter is transmitted to input shaft (5), and the rotation of the input shaft passes through sun gear (6) and is transmitted to planet pinion (9).
- Carrier (36) is fixed in position by No. 1 clutch, so the rotation of planet pinion (9) rotates ring gear (34).
  Ring gear (34) rotates in the opposite direction from the input shaft, and rotates carrier (31).
- Carrier (31) and carrier (27) are meshed by a spline and rotate as one part, so the rotation of carrier (31) passes through planet pinion (24) and is transmitted to ring gear (25)
- Carrier (21) is meshed with ring gear (25), so they rotate as one unit, and the rotation is transmitted to planet pinion (17).
- Ring gear (20) is fixed in position by No. 5 clutch, so the rotation of planet pinion (17) rotates sun gear (18) and this rotates output shaft (19).

TRANSMISSION CONTROL VALVE

D65E-12 60001 — 60650
D65E-12 60001 — 60685
D65EX-12 60001 — 60654
D65EX-12 60001 — 60688



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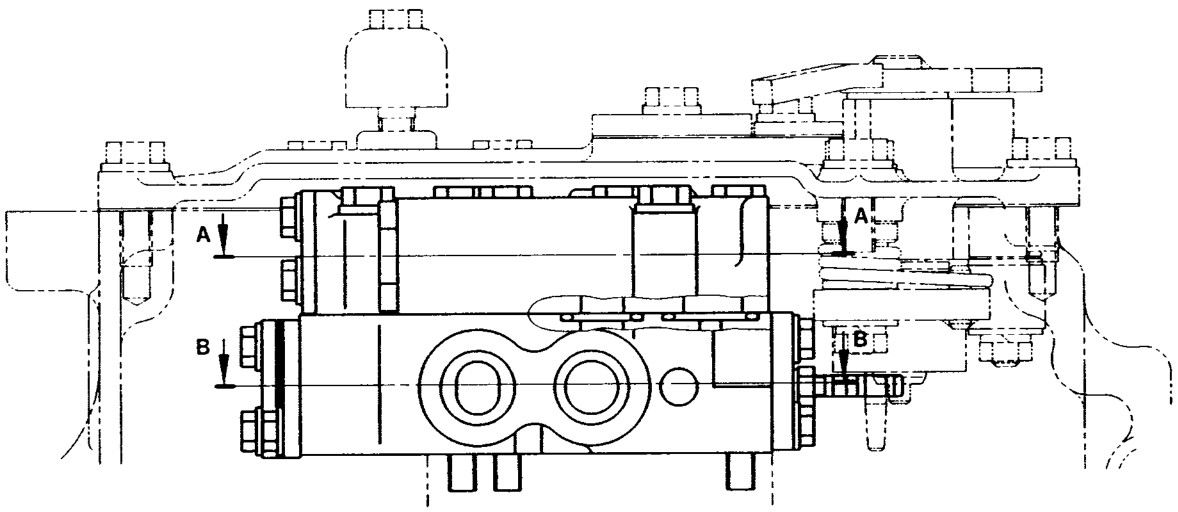

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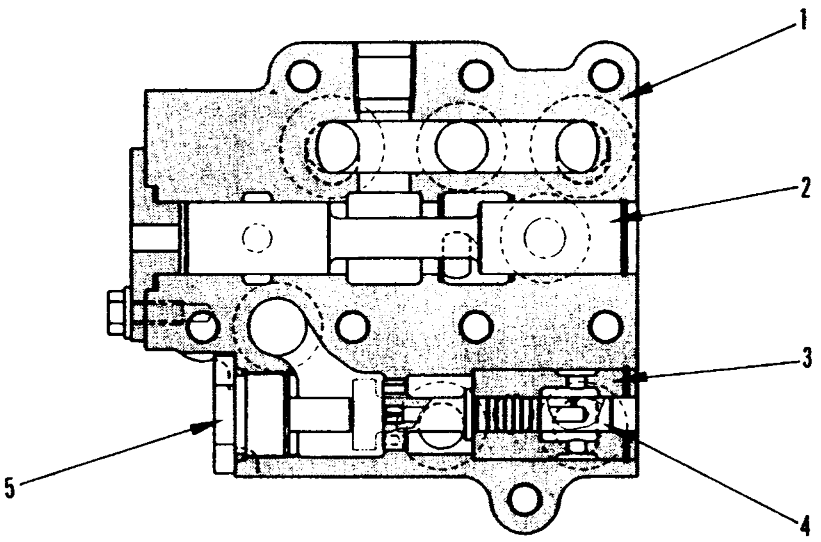
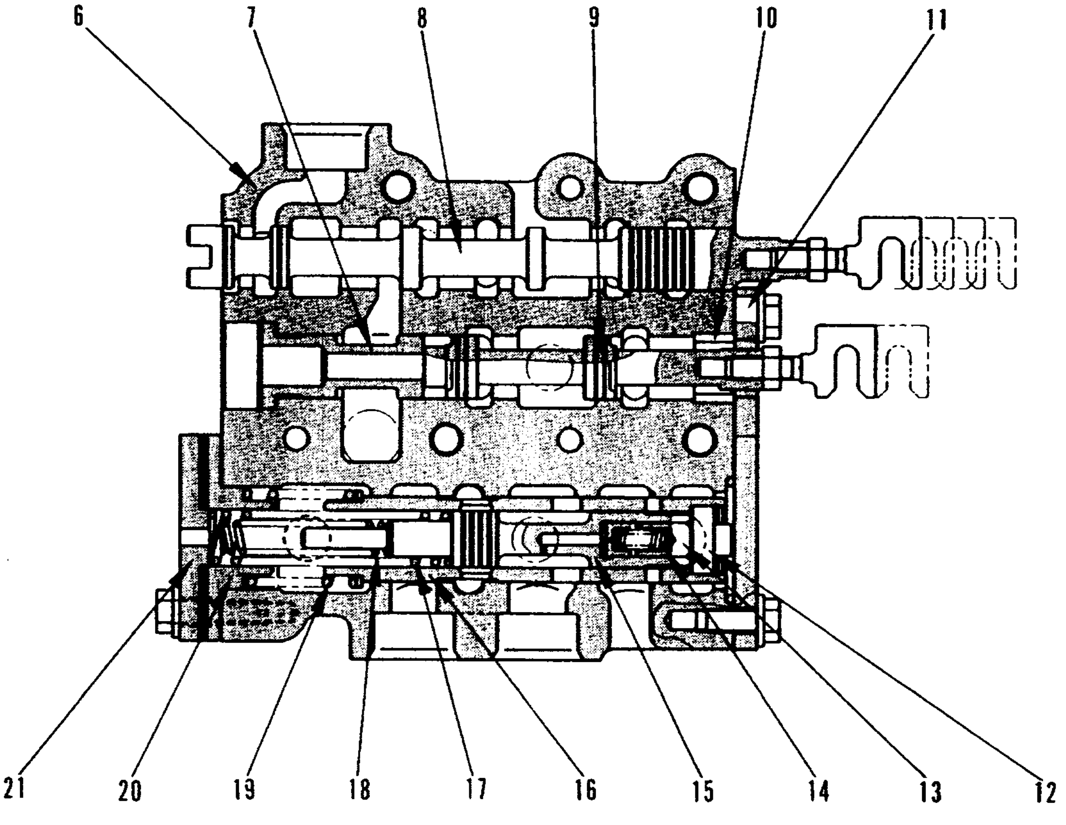


A - A

1. Valve body
2. Spacer
3. Quick return valve sleeve
4. Quick return valve
5. Plug
6. Valve body
7. Stopper
8. Speed valve spool
9. Directional valve spool
10. Collar
11. Cover
12. Stopper
13. Piston
14. Piston spring
15. Modulating valve spool
16. Modulating valve sleeve
17. Modulating valve spring (Large)
18. Modulating valve spring (Small)
19. Modulating valve spring
20. Stopper
21. Cover

014012



B - B

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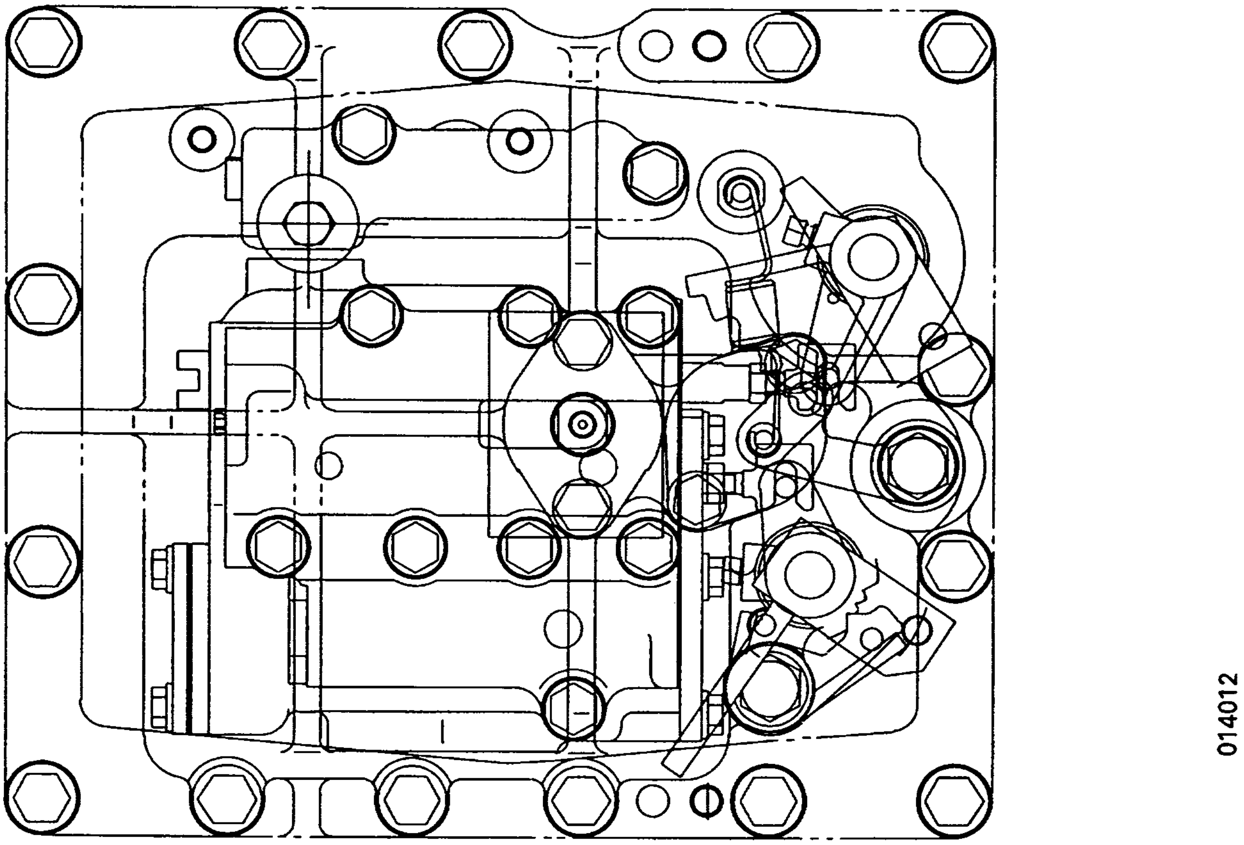
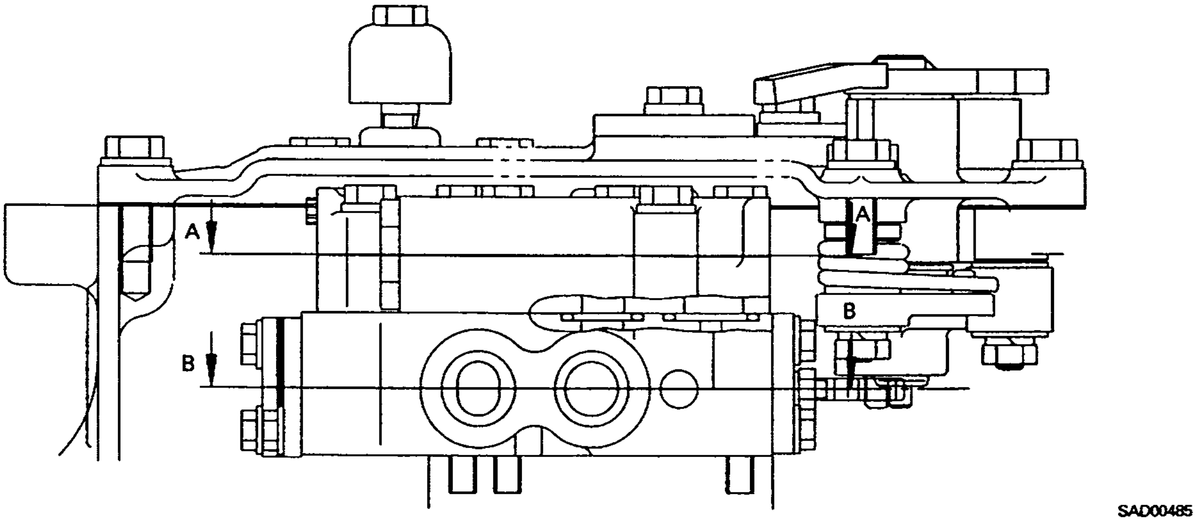
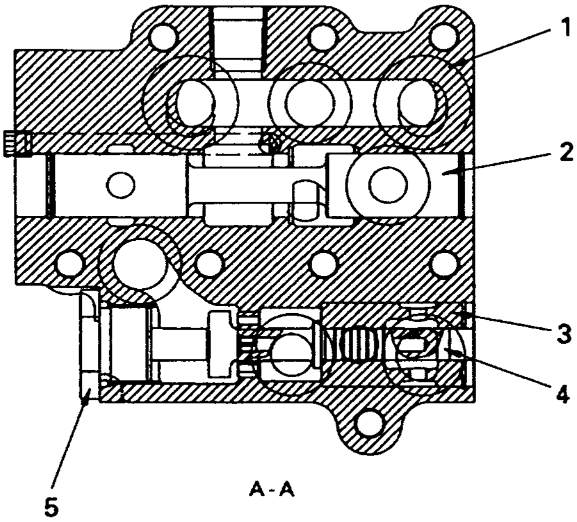
D65E-12	**60651 – 65000**
D65P-12	**60686 – 65000**
D65EX-12	**60655 – 65000**
D65PX-12	**60689 – 65000**



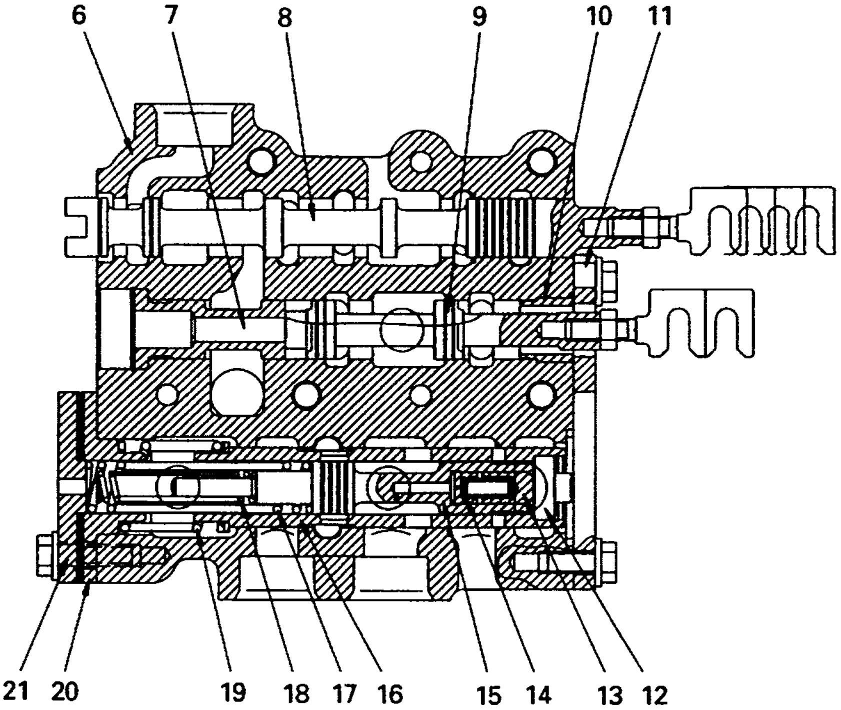




A-A

1. Valve body
2. Spacer
3. Quick return valve sleeve
4. Quick return valve
5. Plug
6. Valve body
7. Stopper
8. Speed valve spool
9. Directional valve spool
10. Collar
11. Cover
12. Stopper
13. Piston
14. Piston spring
15. Modulating valve spool
16. Modulating valve sleeve
17. Modulating valve spring (Large)
18. Modulating valve spring (Small)
19. Modulating valve spring
20. Stopper
21. Cover

014012



B-B

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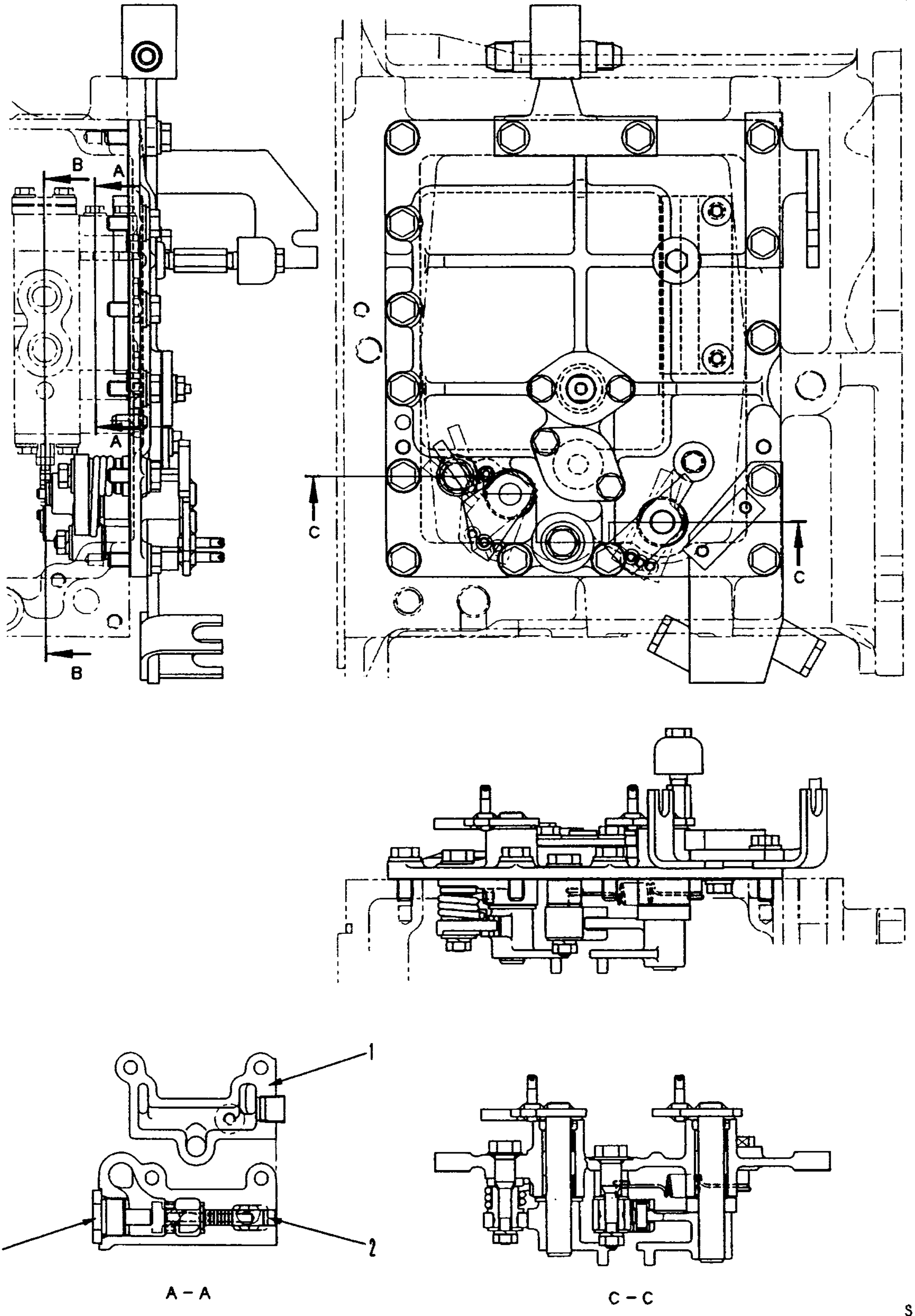
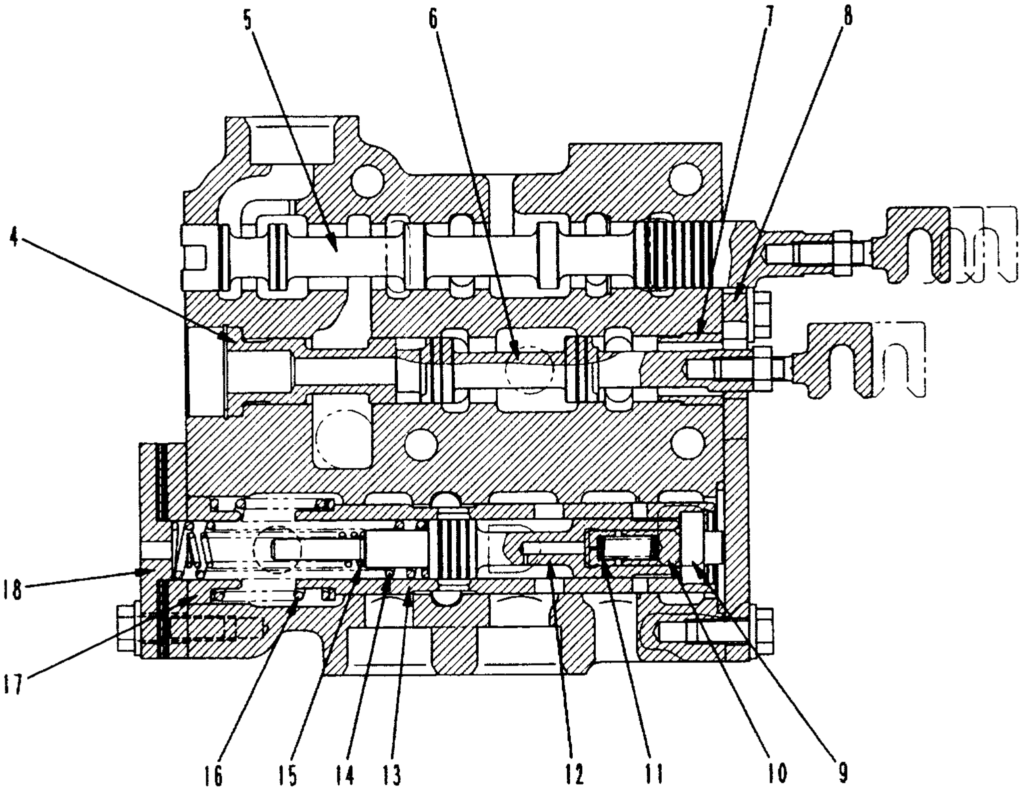


A – A

C – C

014012

SXD04018



B – B

SWD03343

1. Valve body
2. Quick return valve
3. Plug
4. Stopper
5. Speed valve spool
6. Directional valve spool
7. Collar
8. Cover
9. Stopper
10. Piston
11. Piston spring
12. Modulating valve spool
13. Modulating valve sleeve
14. Modulating valve spring (Large)
15. Modulating valve spring (Small)
16. Modulating valve spring
17. Stopper
18. Cover

MODULATING VALVE

OUTLINE

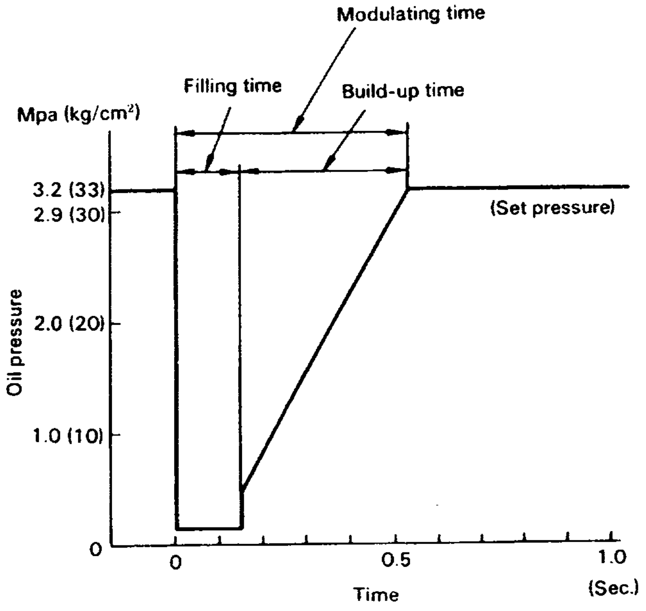
- The modulating valve consists of a modulating relief valve and a quick return valve, and acts to modulates the pressure.
- When the gear shift lever is operated to shift gear, the clutch is pushed into close contact by the piston. However, if high pressure is suddenly applied, the piston will suddenly engage the clutch. This will make the machine suddenly start, and it will receive an excessive shock.
- To prevent this, the modulating valve is installed. When the gear shift lever is operated to shift gear, the pressure on the piston gradually rises to the set pressure and the clutch is engaged smoothly. This allows the machine to start without any shock, thereby improving the durability of the power train and at the same time providing a comfortable ride for the operator.
- The figure shows the relationship between the time and the increase in the hydraulic pressure of the modulating valve.

  For example, when the gear is shifted from F1 and F2, the oil from the pump passes through the speed valve spool, flows to the second clutch and fills the circuit up to the clutch piston port.

  The time taken for the circuit to be filled up to the clutch piston port is called the "filling time", and the oil pressure during this time is 0 — 0.5MPa (0 — 5kg/cm^2.)

  When the circuit up to the clutch piston port is filled with oil, the oil pressure starts to rise.

  The time taken for the pressure to rise to the set pressure is called the "built-up time". The filling time and built-up time together are called the "modulating time".



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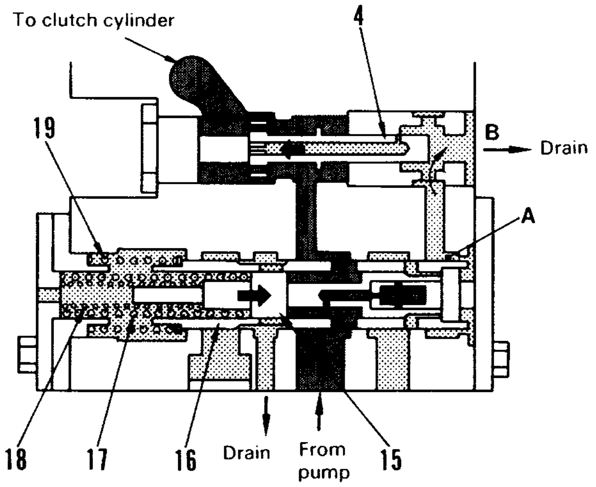
OPERATION

1. Immediately after shifting gear

When the gear shift lever is operated and the clutch is engaged, the passage from the pump to the clutch cylinder is opened and the oil flows into the clutch cylinder.

Quick return valve (4) uses the force of this flow and moves to the left in the direction of the arrow. It connects port **A** to drain port **B**, and releases the back pressure of modulating valve sleeve (16).

When this happens, modulating valve (15) and modulating valve sleeve (16) are pushed back to the right in the direction of the arrow by the reaction force of springs (17), (18), and (19).



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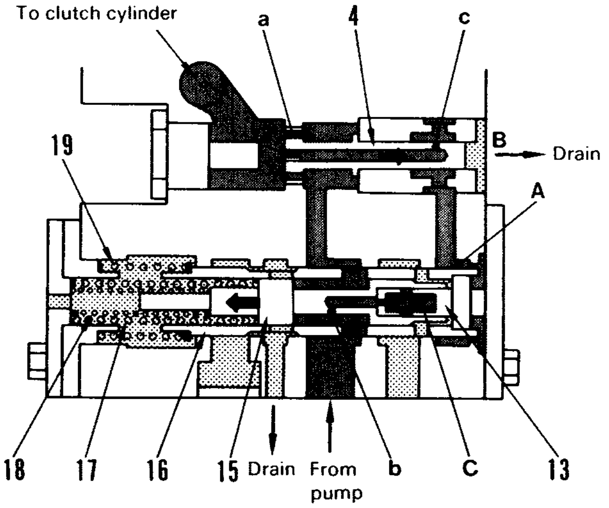
2. During rise in oil pressure

When the oil sent under force by the pump fills the circuit up to the clutch cylinder, the pressure starts to rise. The oil passing through orifice **a** of quick return valve (4) moves quick return valve (4) to the right in the direction of the arrow and closes the passage between port **A** and drain port **B**.

The oil also passes through orifice **b** in modulating valve (15), flows into port **C** and pushes piston (13).

When this happens, the reaction force causes modulating valve (15) to compress springs (17) and (18), and moves to the left in the direction of the arrow.

At ther same time, the oil passing through the port in the middle of quick return valve (4) passes through orifice **c**, flows to port **A**, and becomes the back pressure of valve sleeve (16). It then moves valve sleeve (16) to the left in the direction of the arrow and compresses spring (19).



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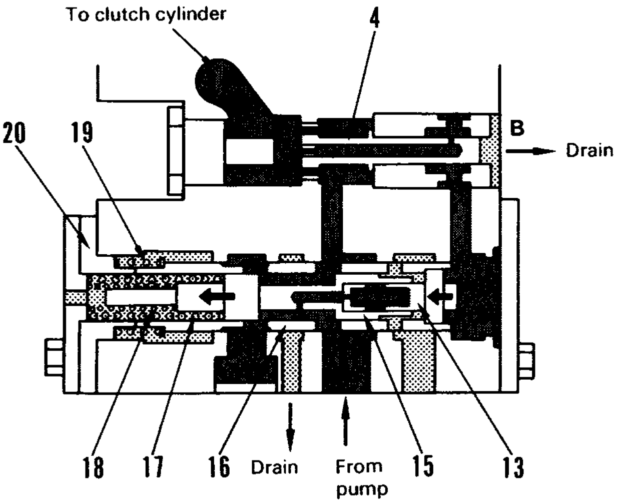
3. Completion of rise in pressure

As the pressure in the circuit rises, the back pressure of valve sleeve (16) rises, and valve sleeve (16) moves to the left in the direction of the arrow.

At the same time, as the pressure pushing piston (13) rises, modulating valve (15) is moved to the left in the direction of the arrow by the reaction force.

The above operation is repeated intermittently to increase the load on springs (17), (18), and (19), and the oil pressure rises gradually. Finally, valve sleeve (16) contacts stopper (20) and does not move any further, so this completes the rise in the oil pressure.



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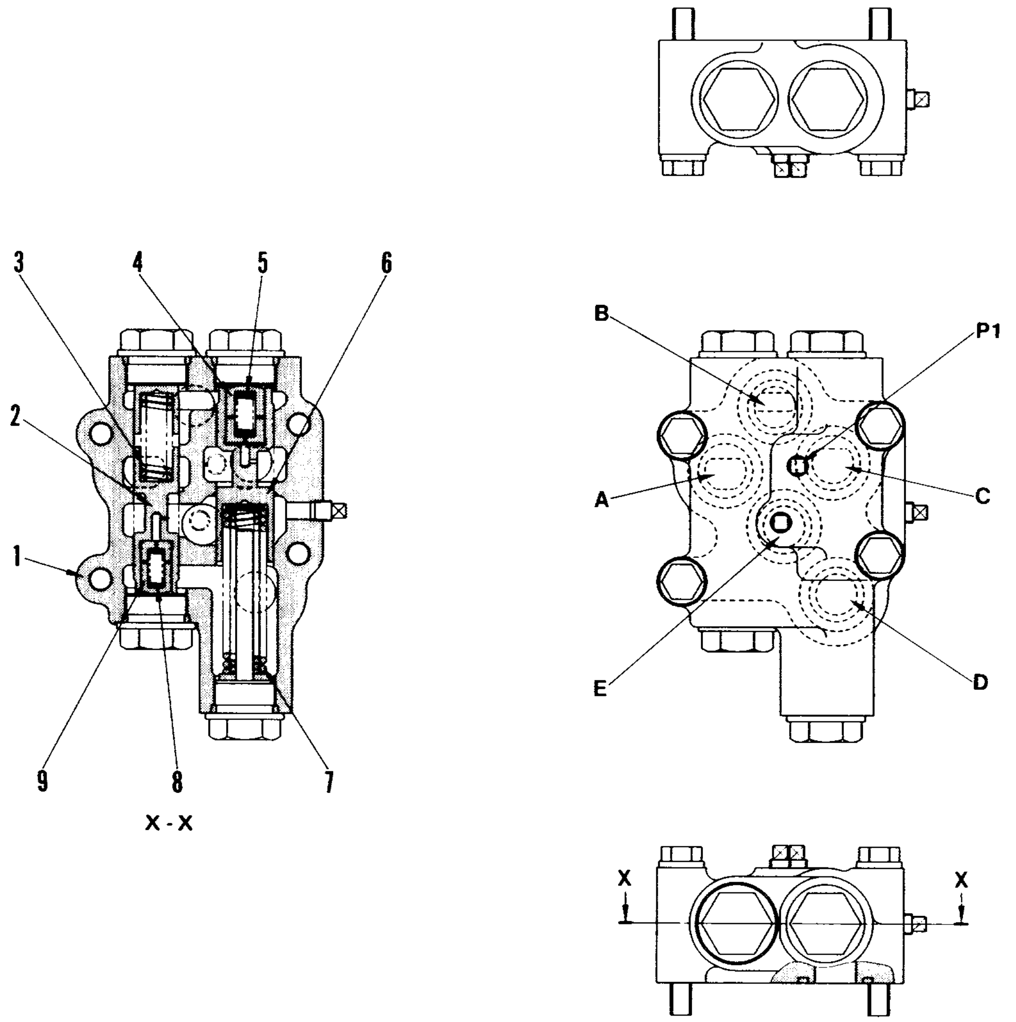
MAIN RELIEF VALVE



140F12053

1. Body
2. Torque converter relief valve
3. Valve spring
4. Piston
5. Piston spring
6. Main relief valve
7. Valve spring
8. Piston spring
9. Piston

A. Drain port (torque converter relief)
B. Drain port
C. From pump
D. Drain port
E. To torque converter
P1. Main relief pressure pick-up port

OUTLINE

1. **Main relief valve**
   Main relief valve (6) sets the specified pressures for the transmission, steering clutch and brake.
2. **Torque converter relief valve**
   Torque converter relief valve (2) is used to protect the torque converter from any abnormally high pressure. It relieves the circuit when the pressure at the torque converter inlet port goes above the set pressure.

Unit: MPa (Kg/cm^2)

	Specified pressure
Main relief pressure	3.2 (33.0)
Torque converter inlet port pressure	0.83 (8.5)

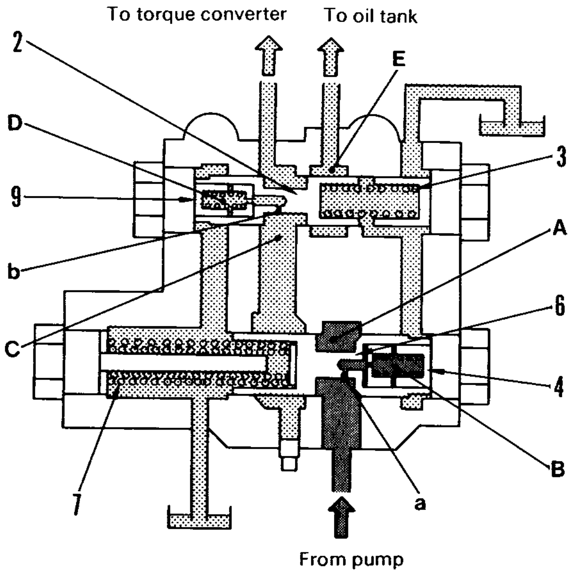
OPERATION OF MAIN RELIEF VALVE

- The oil from the power train pump passes through the oil filter, and enters port **A** of the main relief valve. It then passes through orifice **a** and enters port **B**.

  When the oil from the pump fills the circuit, the pressure starts to rise.
- When the pressure in the circuit rises, the oil entering port **B** pushes piston (4). The reaction force compresses spring (7), moves main relief valve (6) to the left in the direction of the arrow, and opens ports **A** and **C**.

  When this happens, the oil from the pump is relieved from port **A** to port **C**, and flows port **C** to the torque converter.

  The pressure of port **A** at this point is 3.2 MPa (33 kg/cm^2.)



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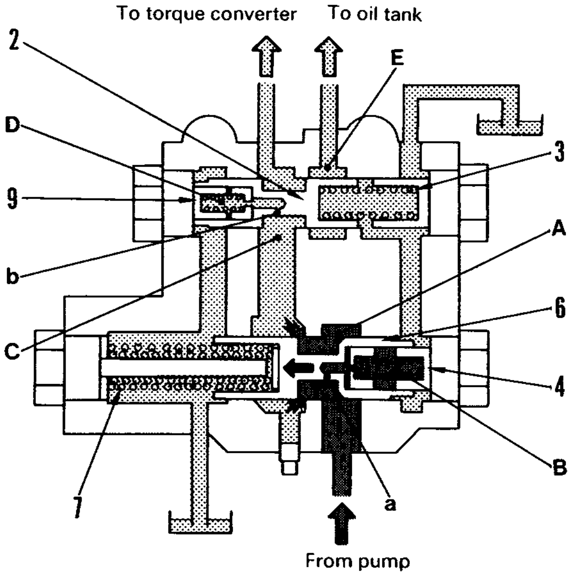
OPERATION OF TORQUE CONVERTER RELIEF VALVE

- The oil relief from the main relief valve flows into the torque converter from port **C**, and at the same time passes through orifice **b** and enters port **D**.

  When the oil fills the torque converter, the pressure starts to rise.
- If the pressure in the torque converter rises abnormally high, the oil entering port **D** pushes piston (9). The reaction force compresses spring (3), moves relief valve (2) to the right in the direction of the arrow, and opens ports **C** and **E**.

  When this happens, the oil and port **C** is relieved to port **E**, and is drained to the oil tank.

  The pressure of port **C** at this point is 0.83 MPa (8.5 kg/cm^2.)



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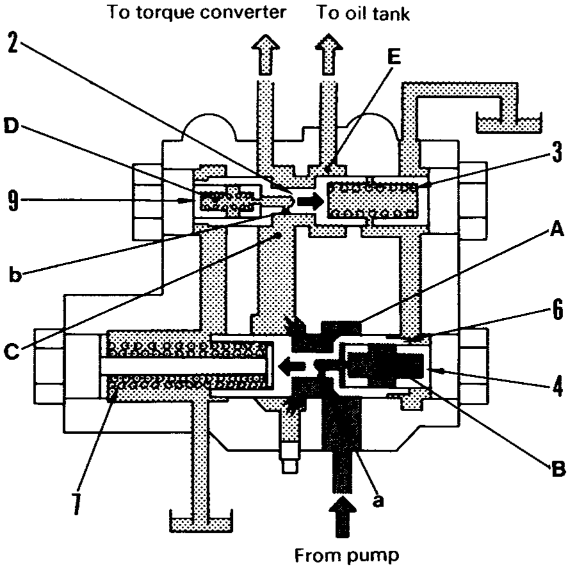

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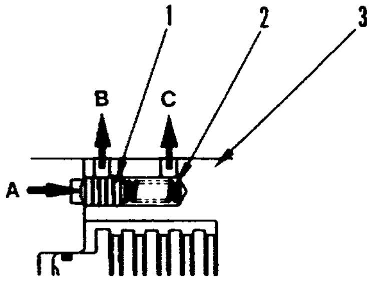
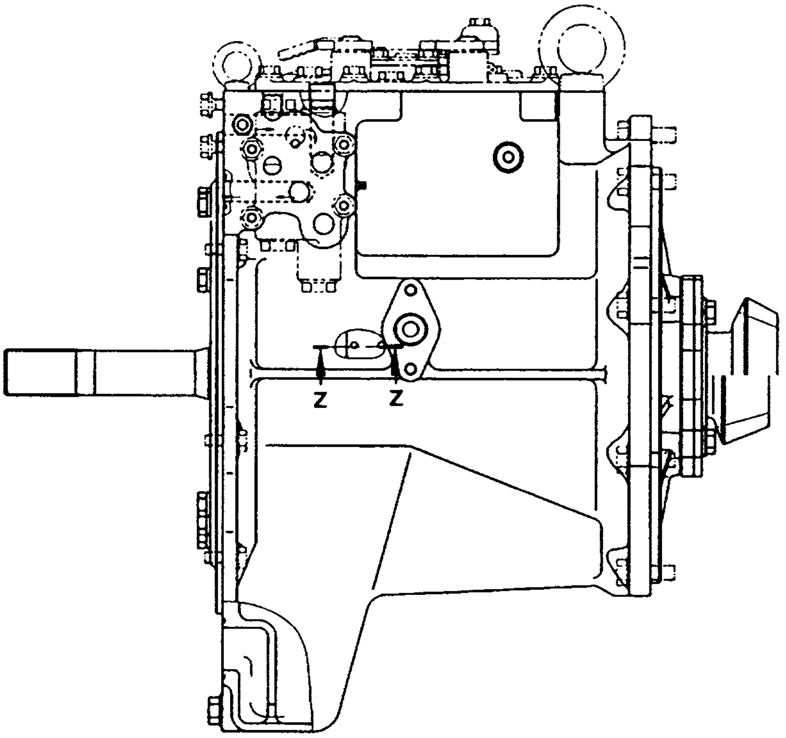
LUBRICATION RELIEF VALVE



Z - Z



140F12057

1. Piston
2. Spring
3. FORWARD clutch housing

A. From oil cooler
B. Drain
C. Drain

OUTLINE

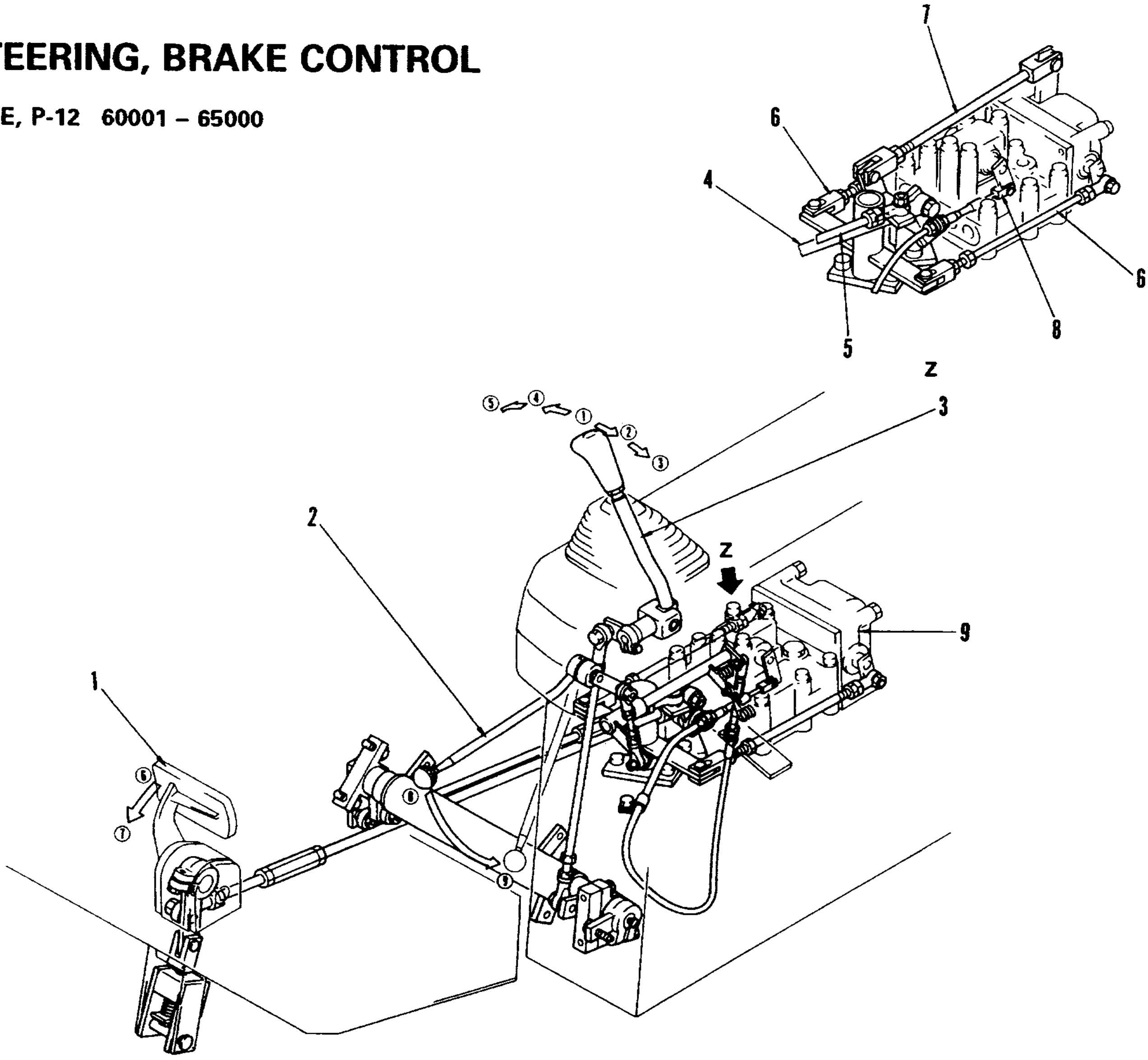
- The oil coming from the torque converter passes through the oil cooler built into the radiator lower tank, passes through the lubrication relief valve, and lubricates the transmission and PTO.
- The lubrication relief valve is installed on the left side of the FORWARD clutch housing, and prevents any abnormal pressure in the lubricating oil.

Unit: MPa (Kg/cm^2)

	Specified pressure
Pressure during normal operation	0.05 — 0.15 (0.5 — 1.5)
Cracking pressure	0.3 (0.3)

STEERING, BRAKE CONTROL

D65E, P-12 60001 – 65000



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Lever, pedal positions

① NEUTRAL
② Left clutch disengaged
③ Left clutch disengaged, left brake applied
④ Right clutch disengaged
⑤ Right clutch disengaged, right brake applied
⑥ Brake released
⑦ Brake applied
⑧ FREE
⑨ LOCK

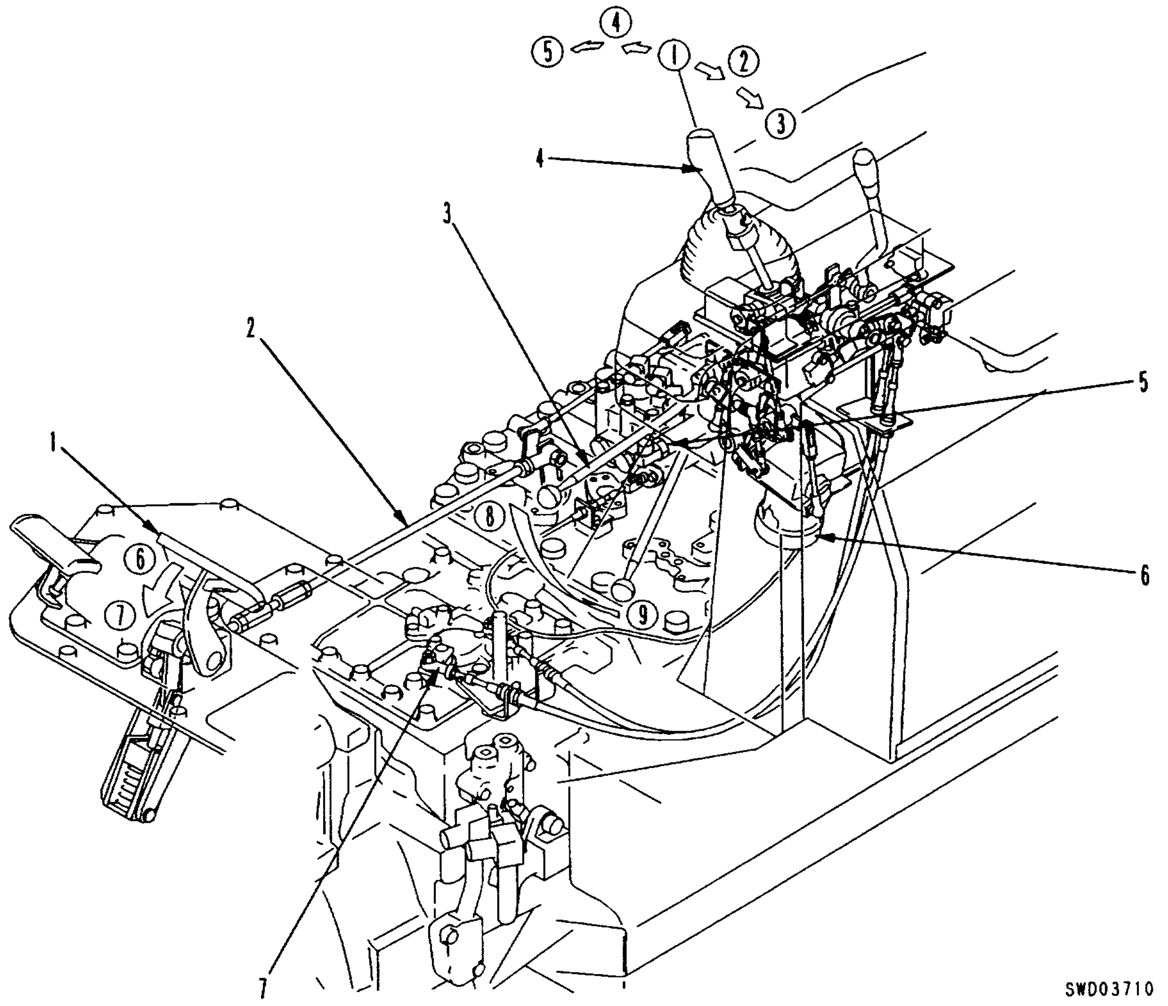
1. Brake pedal
2. Safety lever
3. Steering and directional lever
4. Rod (from brake pedal)
5. Rod (from steering lever)
6. Rod (steering)
7. Rod (brake)
8. Parking brake lever
9. Steering control valve

OUTLINE

- Steering and directional lever (3) operates the steering and brake through left and right rods (6).
  Brake pedal (1) operates only the brake through rod (7).
- Safety lever (2) is interconnected with parking brake lever (8) and acts also as the parking brake.
- If steering and directional lever (3) is operated slightly to the left, the left steering clutch is partially disengaged and the machine turns slowly to the left.
- If steering and directional lever (3) is operated fully to the left, the left steering clutch is completely disengaged and the left steering brake is applied, so the machine turns sharply to the left.

D65E, P-12 65001 and up

★ For details of the steering PPC valve, see PPC VALVE.



Positions of levers and pedals

① : Neutral
② : Left clutch [OFF]
③ : Left clutch [OFF]
Left brake [ON]
④ : Right clutch [OFF]
⑤ : Right clutch [OFF]
Right brake [ON]
⑥ : Brake [RLEASE]
⑦ : Brake [ON]
⑧ : Free
⑨ : Lock

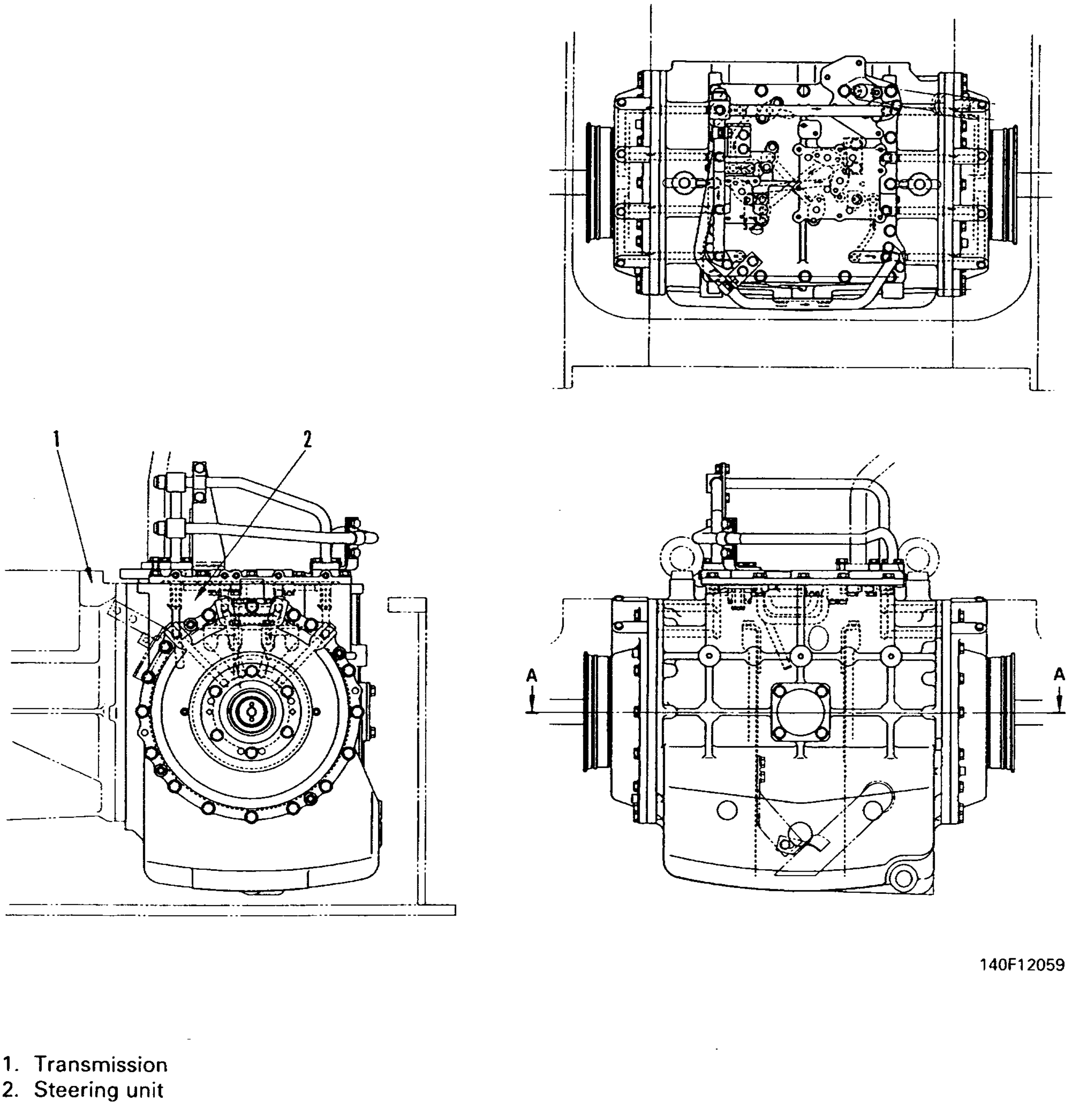
1. Brake pedal
2. Rod
3. Safety lever
4. Joystick
5. Brake valve
6. Steering PPC valve
7. Transmission control valve

OUTLINE

- Steering and forward-reverse lever (4) operates the steering and brake mechanisms through PPC valve (6). Brake pedal (1) operates only the brake through rod (2).
- Safety lever (3) is connected to brake valve (5) and used as the parking brake, too.
- If steering and forward-reverse lever (4) is leaned to the left a little, the left steering clutch is "half disengaged" and the machine turns to the left gently.
- If steering and forward-reverse lever (4) is leaned to the left end, the left steering clutch is "disengaged" completely and the left steering brake is turned "ON", then the machine turns to the left sharply.

BEVEL GEAR SHAFT, STEERING CLUTCH, STEERING BRAKE

D65E, P-12 60001 – 65000



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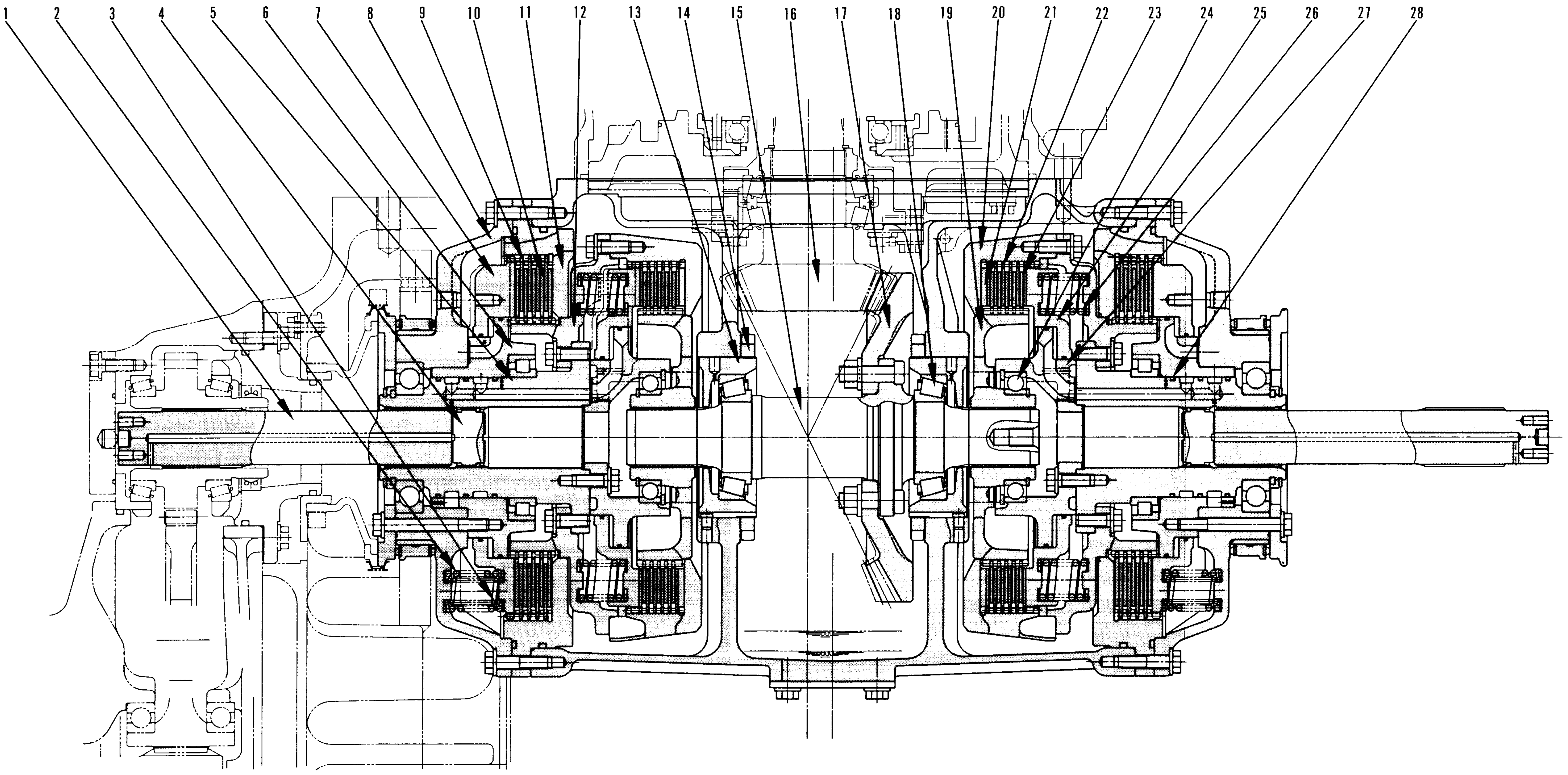
1. Transmission
2. Steering unit



A - A

140F12060

1. Output shaft	8. Brake cover	15. Bevel gear shaft	22. Clutch plate (each side: 6)
2. Brake spring (large)	9. Brake plate (each side: 4)	16. Bevel pinion	23. Clutch disc (each side: 5)
3. Brake spring (small)	10. Brake disc (each side: 5)	17. Bevel gear	24. Clutch support bearing
4. Stopper	11. Brake drum	18. Bevel gear shaft bearing	25. Clutch piston
5. Brake hub	12. Brake inner drum	19. Clutch inner drum	26. Clutch spring
6. Brake cage	13. Bevel gear shaft cage	20. Clutch outer drum	27. Clutch cage
7. Brake cylinder	14. Bevel gear shaft nut	21. Spacer	28. Seal ring

OUTLINE

Bevel gear shaft

- The power transmitted from the engine → torque converter (or main clutch) → transmission comes to the bevel pinion and bevel gear, which are meshed by the bevel gear shaft system. From here it is sent and right angles to the left and right by the bevel gear shaft, and the rotation speed is reduced at the same time.
- The bevel gear shaft system uses a spiral bevel gear for the bevel pinion and bevel gear, and lubrication is carried out by splash lubrication using oil from the power train scavenging pump.
- The bevel gear shaft system consists of the following parts: bevel gear (17) which is meshed with the bevel pinion, bevel gear shaft (15), bevel gear shaft bearing (18) and bevel gear shaft cage (13) which support the bevel gear shaft.

Steering clutch

- The steering clutch is a interconnected by a spline with the left and right bevel gear shafts. It acts to engage and disengage the power from the bevel gear shaft to the final drive, and to change the direction in which the machine turns.
- The steering clutches are a wet, multiple disc type, spring-boosted type. They are hydraulically operated by the steering valve which is actuated by operation of the steering lever, and they are interconnected with the brakes.
  Lubrication is carried out by a forced lubrication system in which the oil from the power train lubrication pump passes through a passage inside the steering case, enters the cover, hub, and cage, and is sent to the discs and plates.
- The steering clutches consist of the following parts: inner drum (19) which is joined by a spline to the bevel gear shaft, disc (23) which is meshed with the inner drum, plate (22) whose outside circumference is joined to the clutch drum by a spline, spacer (21), clutch outer drum (20), piston (25) ans spring (26) which press the discs and plates together, cage (27) which supports the parts, and bearing (24). Clutch outer drum (20) and cage (27) are joined to brake inner drum (12), and transmits the power from the bevel gear shaft through the brake hub to output shaft (1).

Steering brakes

- The steering brakes are joined to the left and right steering clutches, and stop the machine or change the direction of travel by applying braking force to the power from the steering clutches to the final drive.
- The steering brakes are a wet, multiple disc type, spring-boosted type. They are hydraulically operated by the steering valve which is actuated by operation of the brake pedal and steering lever, and they are interconnected with the clutches.
  Lubrication is carried out by a force lubrication system in which the oil from the power train lubrication pump and scavenging pump lubrication circuit passes through a passage inside the steering case, enters the brake cover and cage, and is sent to the discs and plates.
- When the engine is stopped, the steering brakes are applied without the brake pedal being pressed because the back pressure of the brake system drops and the brakes are applied. However, when the engine is started again, the pressure and the circuit rises and the brake is released, so the parking brake must always be locked.
- The steering brake consists of the following parts: clutch outer drum (20), clutch cage (27), inner drum (12) which is joined to brake hub (5), disc (10) which is meshed with the inner drum, plate (9) which is joined at the outside circumference to brake drum (11) by a spline, brake drum (11), piston (7) and springs (2) and (3) which press the discs and plates together, cage (6) which supports these parts, brake cover (8), and output shaft (1).
  Brake drum (11) and brake cover (8) are fixed to the steering case.
  Output shaft (1) is joined to the brake hub by a spline, and is stopped in the axial direction by stopper (4).

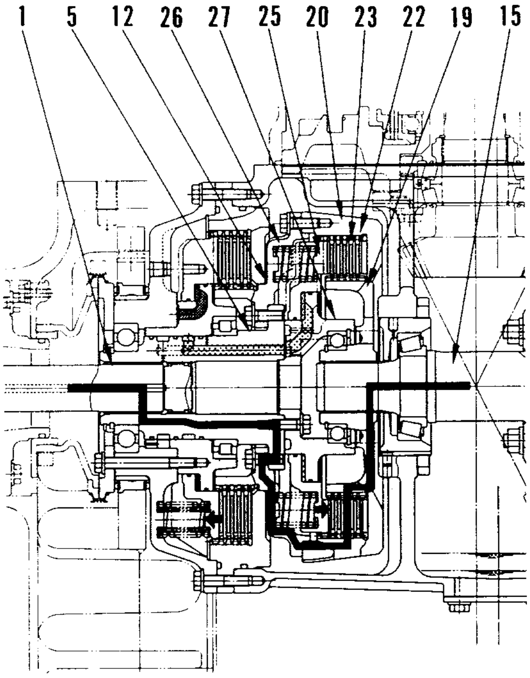
Operation of steering clutch

1. Steering clutch engaged

When the steering lever is at the neutral position, the steering valve is also at the neutral position, so there is no back pressure applied to piston (25).

In this condition, the piston is pushed to the right in the direction of the arrow by the tension of spring (26), ans pushes discs (23) and plates (22) against the stopper portion of clutch drum (20).

Therefore, the power from bevel gear shaft (15) passes from inner drum (19) through the discs and plates that are pushed together into tight contact, and is transmitted to clutch drum (20). From here it passes through brake inner drum (12) which forms one unit with the clutch drum, and brake hub (5), and is transmitted through output shaft (1) to the final drive.



140F12061

2. Steering clutch disengaged

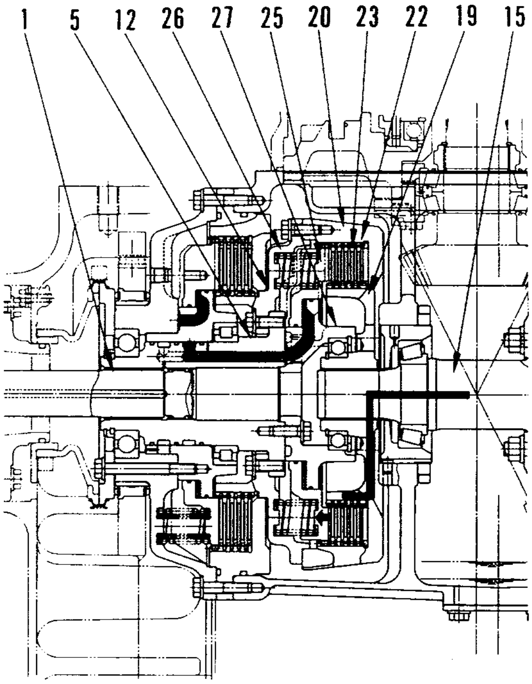
When the steering lever is pulled, the steering valve is switched, and oil enters the back portion of piston (25).

When the oil pressure rises, the oil pushes the piston to the left in the direction of the arrow, compresses spring (26), and releases the pressure pushing discs (23) and plates (22) together.

When this happens, the power from bevel gear shaft (15) rotates only inner drum (19) and the discs, so it is not transmitted beyond clutch drum (20). Therefore, it is not transmitted to the final drive.

When the steering lever is released, the steering valve opens the drain circuit, and piston (25) is returned to its original position by the pressure of spring (26). This returns the steering clutch to the condition in Section 1. "Steering clutch engaged".

When the left steering clutch is disengaged, power is transmitted only to the right steering clutch, so the machine turns to the left.



140F12062

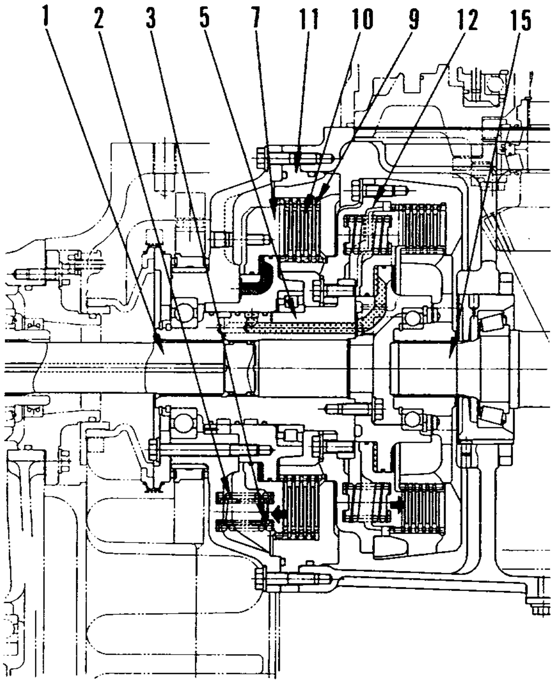
Operation of steering brakes

1. Steering brake released

When the steering lever and brake pedal are at the neutral position, the steering valve is also at the neutral position, so the steering clutch is engaged and oil enters the back-pressure port of steering brake piston (7).

When the oil pressure rises, the oil pushes the piston to the left in the direction of the arrow, compresses springs (2) and (3), and releases the pressure pushing discs (10) and plates (9) together.

When this happens, the power transmitted from bevel gear shaft (15) through the steering clutches to brake inner drum (12) is transmitted from hub (5) to output shaft (1), and goes to the final drive.



140F12063

2. Steering brake applied (steering lever operated)

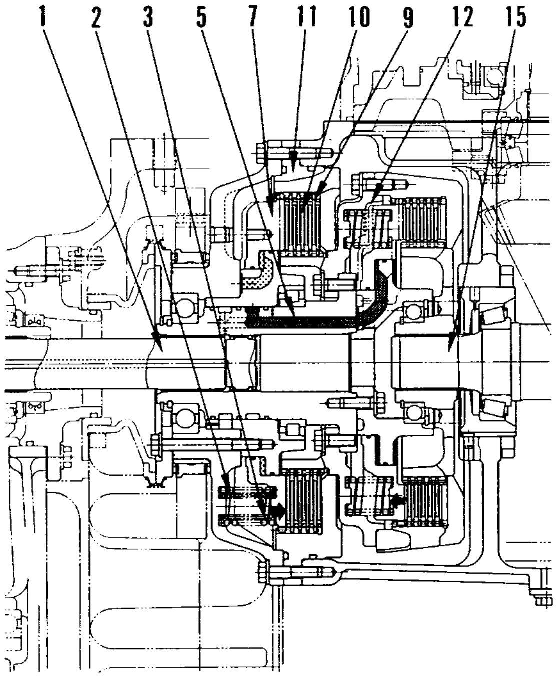
If the steering lever is operated fully, the steering valve switches and the steering clutch is disengaged. At the same time, the oil applying back pressure to piston (7) is connected to the drain circuit.

In this condition, the piston is pushed out to the right in the direction of the arrow by the tension of springs (2) and (3), so discs (10) and plates (9) are pressed against the stopper portion of brake outer drum (11).

The brake outer drum is joined to the steering case and is fixed in position.

Therefore, even if the steering clutch is disengaged, the rotation of brake inner drum (12) that is still rotating under inertia, that is the rotation of output shaft (1), is stopped because the discs and plates are pushed into contact together.

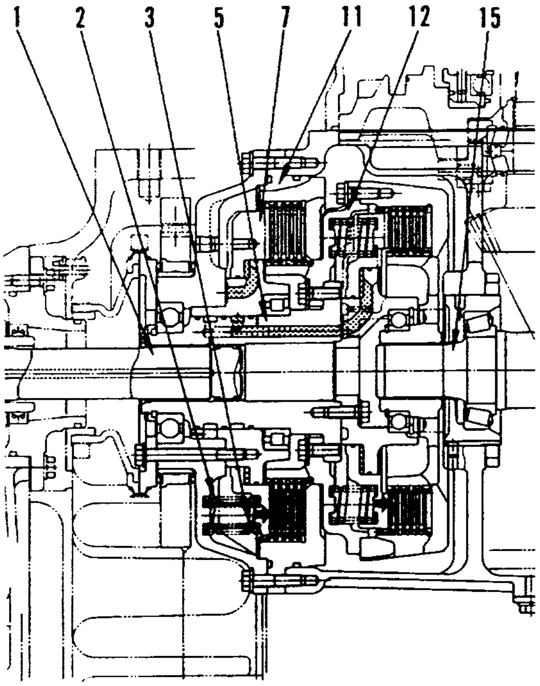
The hydraulic force applied to piston (7) can be controlled by the amount that the steering lever is operated, and the braking force can be adjusted, so the turning radius and time taken to turn can be controlled.



140F12064

3. Brake applied (steering lever at neutral, brake pedal depressed)

When the brake pedal is depressed, the steering valve switches, and the oil applying back pressure to piston (7) is connected to the drain circuit. The steering clutch remains engaged, so only the brake is actuated to stop the rotation of output shaft (1).

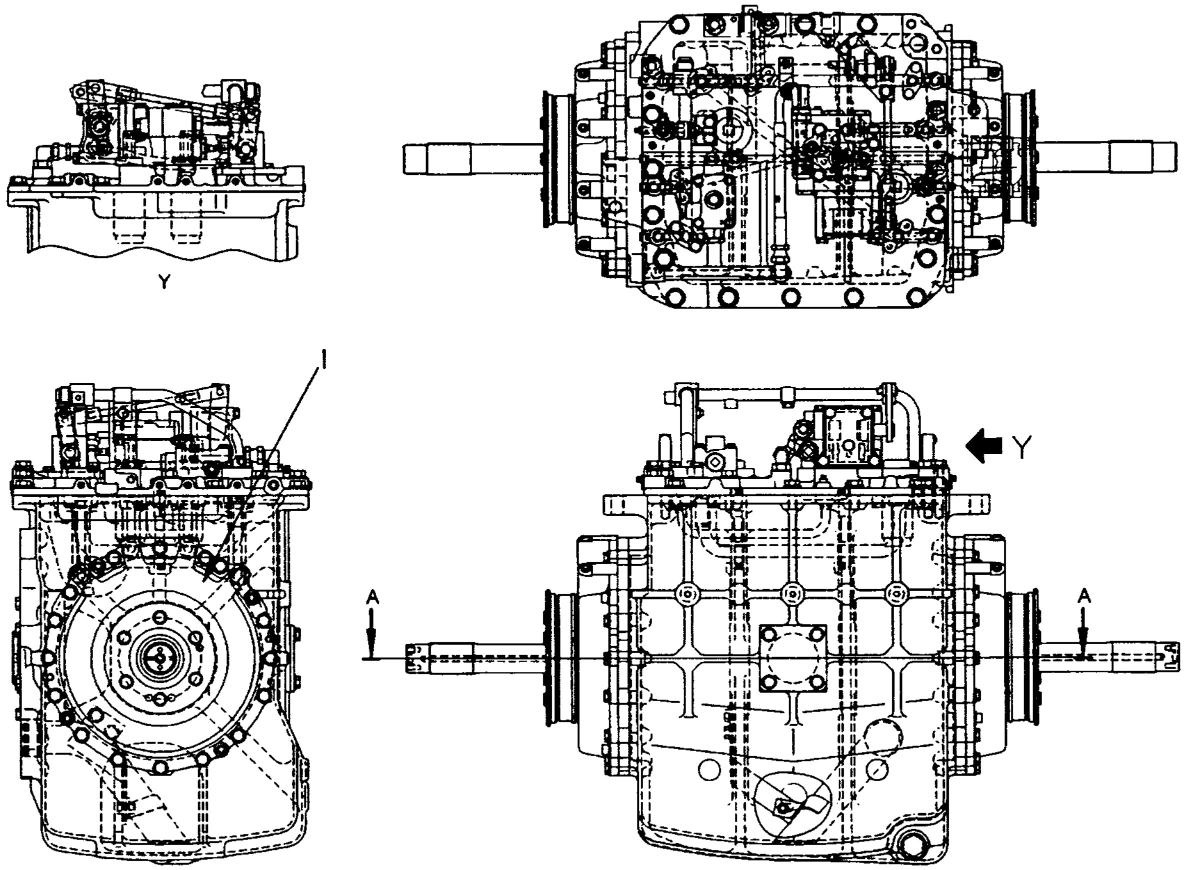


140F12065

BEVEL GEAR SHAFT, STEERING CLUTCH, STEERING BRAKE

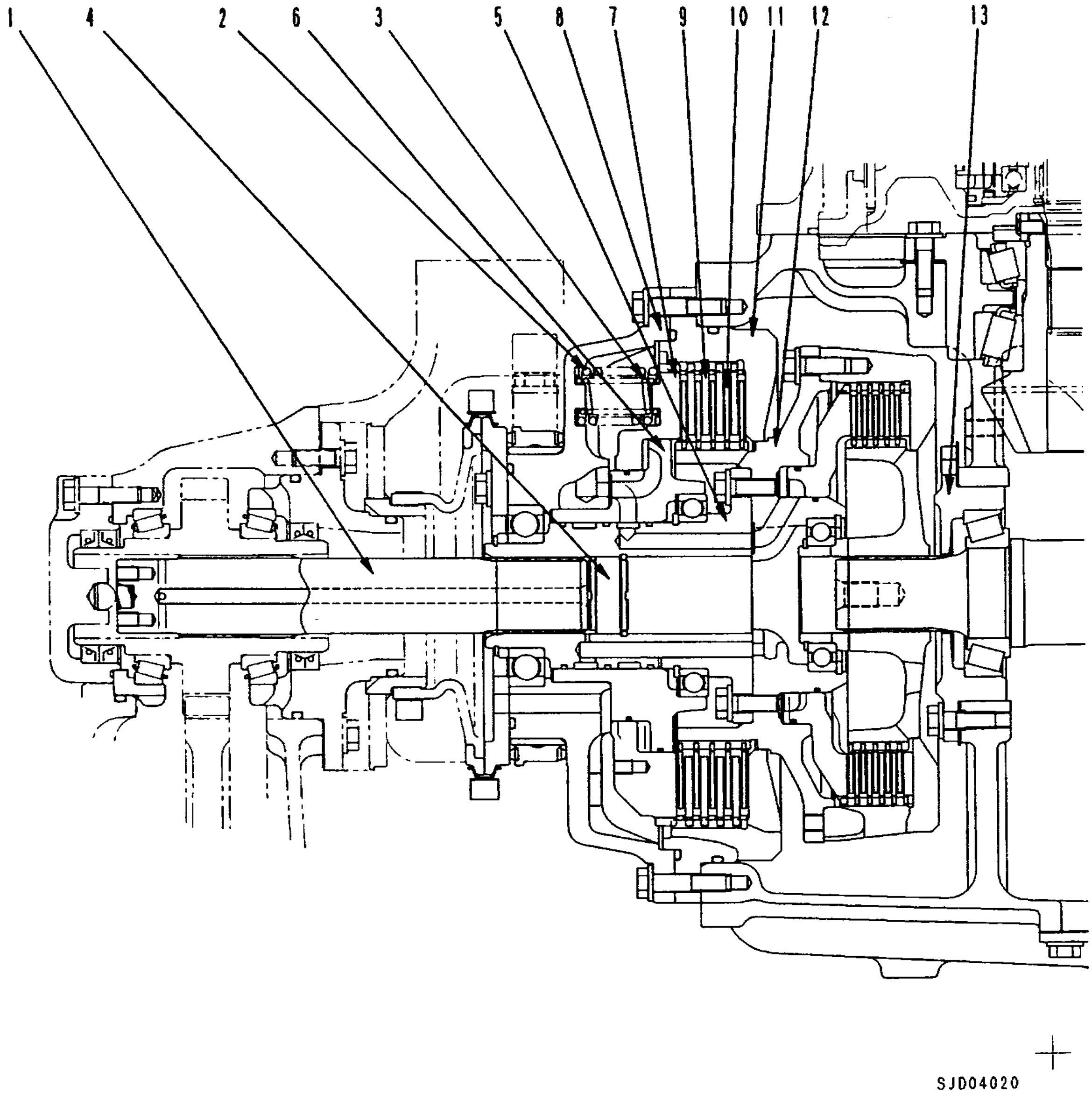
D65E, P-12 65001 and up

014012



SJD04019

1. Steering unit



1. Output shaft
2. Brake spring (large)
3. Brake spring (small)
4. Stopper
5. Brake hub
6. Brake cage
7. Brake piston
8. Brake cover
9. Brake plate (each side: 4)
10. Brake disc (each side: 5)
11. Brake drum
12. Brake inner drum
13. Bevel gear shaft cage

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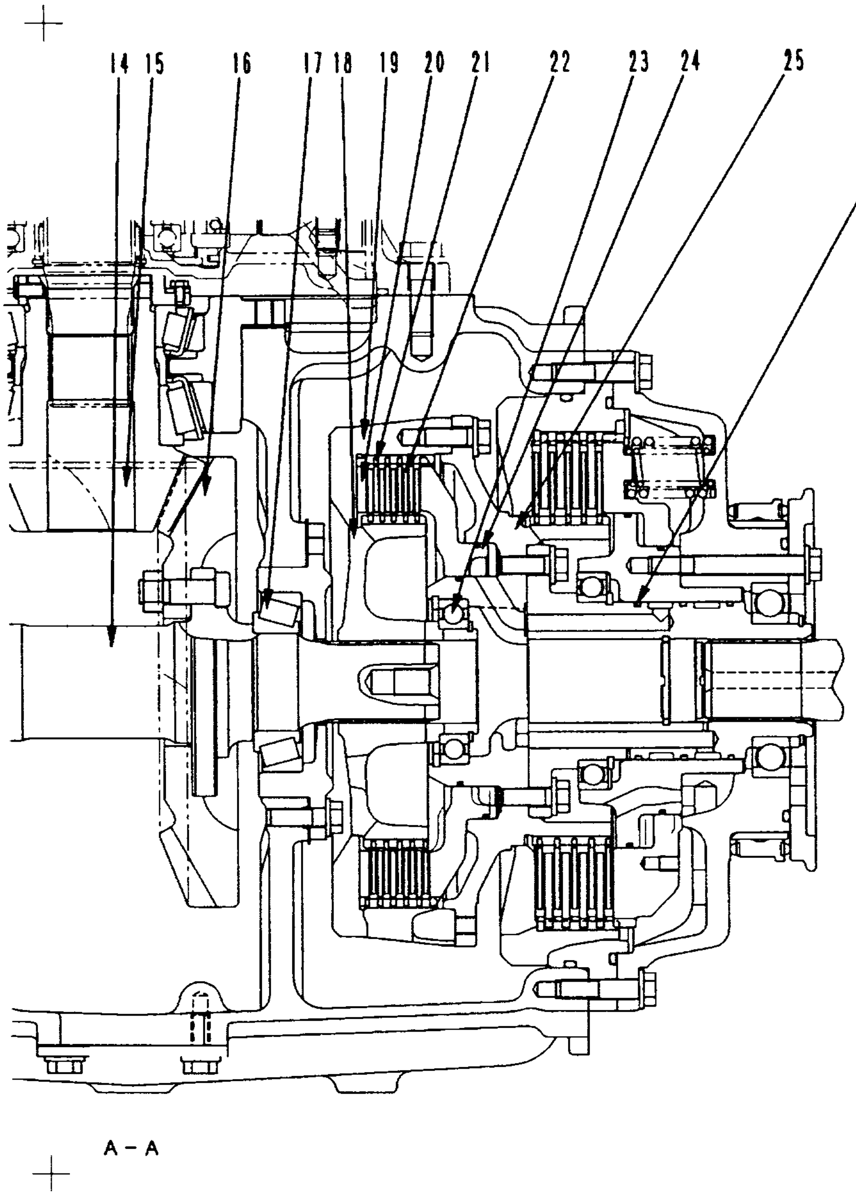


SJD04021

14. Bevel gear shaft
15. Bevel pinion
16. Bevel gear
17. Bevel gear shft bearing
18. Clutch inner drum
19. Clutch outer drum
20. Spacer
21. Clutch plate (each side: 4)
22. Clutch disc (each side: 5)
23. Clutch support bearing
24. Clutch piston
25. Clutch cage
26. Seal ring

014012

OUTLINE

Bevel gear shaft

- The engine power is transmitted through the torque converter (or main clutch) to the transmission. Then, the bevel gear shaft device engages the bevel pinion with the bevel gear to turn the engine power at right angles into the lateral direction and reduce the revolving speed.

- The bevel pinion and bevel gear of the bevel gear shaft device are spiral bevel gears, which are lubricated with oil splashed by the lubricating oil pump and scavenging pump.

- The bevel gear shaft device consists of bevel pinion (15), bevel gear (16), bevel gear shaft (14), bevel gear shaft bearing (17) to support the bevel gear shaft, and bevel gear shaft cage (13).

Steering clutches

- The steering clutches are connected to both bevel gear shafts respectively through the splines. They transmit and cut out the power of the bevel gear shafts to the final drives to change the turning direction of the machine.

- The steering clutches are wet-type multiple-disc hydraulic clutches. They are driven hydraulically together with the brakes by the steering PPC valve operated with the steering lever.
  The steering clutches are lubricated forcedly with oil supplied by the power train lubricating oil pump. The lubricating oil from the pump flows through the paths in the steering case, cover, hub, cage, disc, and plate.

- Each steering clutch consists of inner drum (18) connected to the bevel gear shaft by spline, disc (22) engaged with the inner drum, plate (21), the periphery of which is connected to the clutch drum by spline, spacer (20), clutch outer drum (19), piston (24) to press the disc and plate against each other, and cage (25) and bearing (23) to support these parts. Clutch outer drum (19) and cage (25) are connected to brake inner drum (12) and transmit the power from the bevel gear shaft through the brake hub to output shaft (1).

Steering brakes

- The steering brakes are connected to the steering clutches on both sides respectively. They control the power transmitted from the steering clutches to the final drives to change the turning direction of the machine and brake the machine.

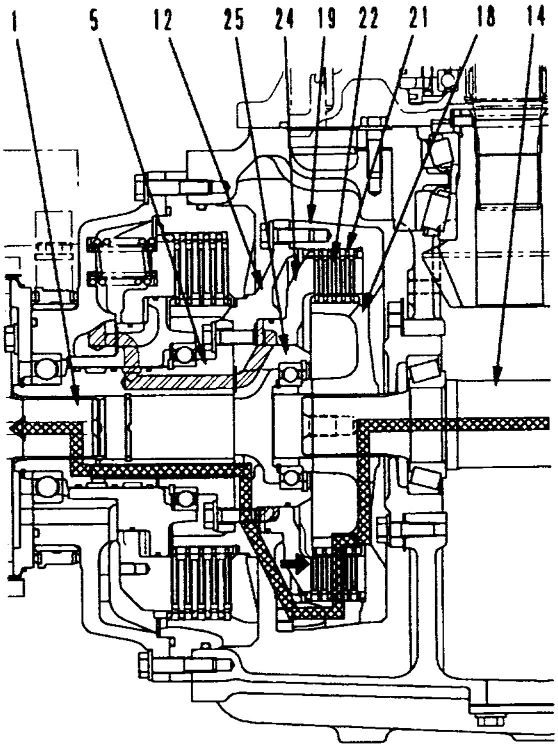
- The steering brakes are wet-type, multiple disc clutch-type, spring force brakes. They are driven hydraulically together with the clutches by the steering PPC valve operated with the steering lever.
  The steering brakes are lubricated forcedly with oil supplied by the power train lubricating oil pump and lubricating circuit of the scavenging pump. The lubricating oil flows through the paths in the steering case, brake cover, cage, disc, and plate.
  While the engine is stopped, even if the brake pedal is not pressed, the back pressure of the steering brake piston lowers and the brake is "applied". After the engine is started again, however, as the hydraulic pressure in the circuit rises, the brake is "released". Accordingly, the parking brake must be kept locked.

- Each steering brake consists of clutch outer drum (19), clutch cage (25), inner drum (12) connected to the brake hub (5), disc (10) engaged with the inner drum, plate (9), the periphery of which is connected to the brake drum (11) by spline, brake drum (11), piston (7) to press the disc and plate against each other, springs (2) and (3), and cage (6), brake cover (8), and output shaft (1) to support these parts.
  Brake drum (11) and brake cover (8) are fixed to the steering case.
  Output shaft (1) are connected to the brake hub by spline and fixed by stopper (4) in the axial direction.

014012

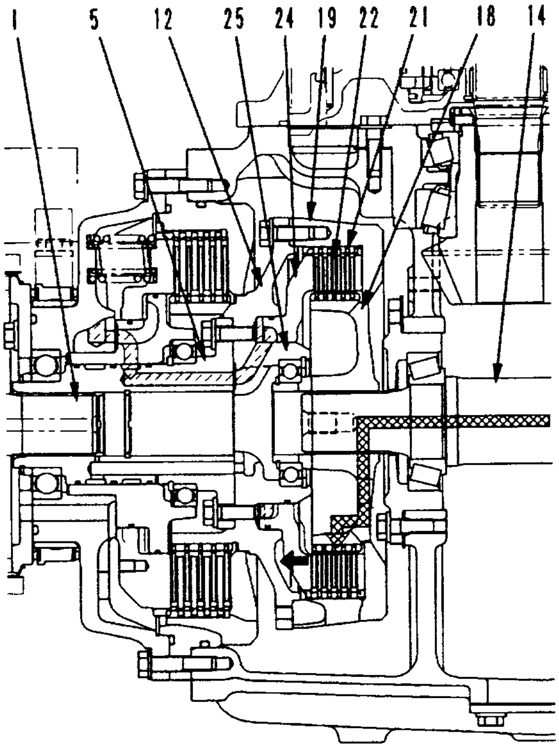
Operation of steering clutch

1. **When steering clutch is turned "ON"**
When the steering lever is at the "neutral" position, the steering PPC valve is also at the "neutral" position and the maximum hydraulic pressure is applied to piston (24).
Under this condition, the piston is pushed to the right by the hydraulic force as indicated by the arrow to press disc (22) and plate (21) against the stopper of clutch drum (19).
Accordingly, the power from bevel gear shaft (14) is transmitted through inner drum (18) and pressed disc and plate to clutch drum (19), then further transmitted through brake inner drum (12) and brake hub, which are fixed to the clutch drum, and output shaft (1) to the final drive.



SWD04022

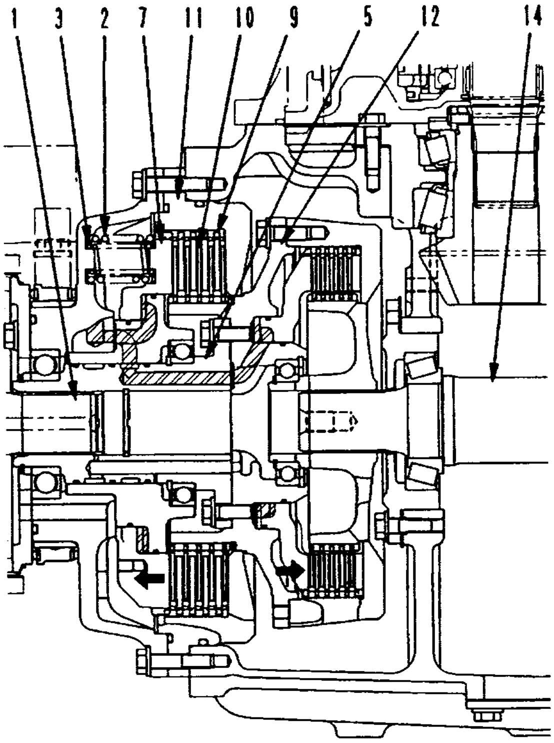
2. **When steering clutch is turned "OFF"**
If the steering lever is operated, the steering PPC valve is so changed that the drain circuit is opened, then the hydraulic pressure on the back of piston (25) starts lowering to 0.
As the hydraulic pressure lowers, the pressure on disc (22) and plate (21) lowers to 0. The power from bevel gear shaft (14) rotates only inner drum (18) and disc and is not transmitted to outer drum (19) and after parts, that is, it is not transmitted to the final drive.
If the steering lever is released, the steering PPC valve applies the maximum hydraulic pressure to piston (24) to turn "ON" the clutch as explained in 1 above. If the left steering clutch is turned "OFF", the power is transmitted to only the right steering clutch and the machine turns to the left consequently.



SWD04023

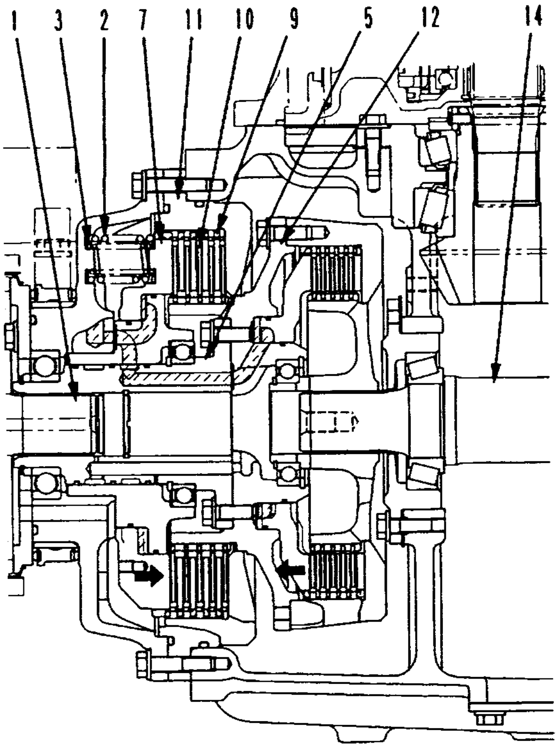
Operation of steering brake

1. **When steering brake is "released"**
   When the steering lever is at the "neutral" position and the brake pedal is at the "release" position, the steering PPC valve sets both steering clutch pressure and steering brake pressure to the maximum. Accordingly, the steering clutch is turned "ON" and oil flows in the back pressure port of piston (7) of the steering brake.
   As the hydraulic pressure rises, the oil pushes the piston to the left as indicated by the arrow to compress springs (2) and (3) to reduce the pressure on disc (10) and plate (9) to 0. Then, the power transmitted from bevel gear shaft (14) through the steering clutch to brake inner drum (12) is further transmitted through hub (5) and output shaft (1) to the final drive.



SWD04024

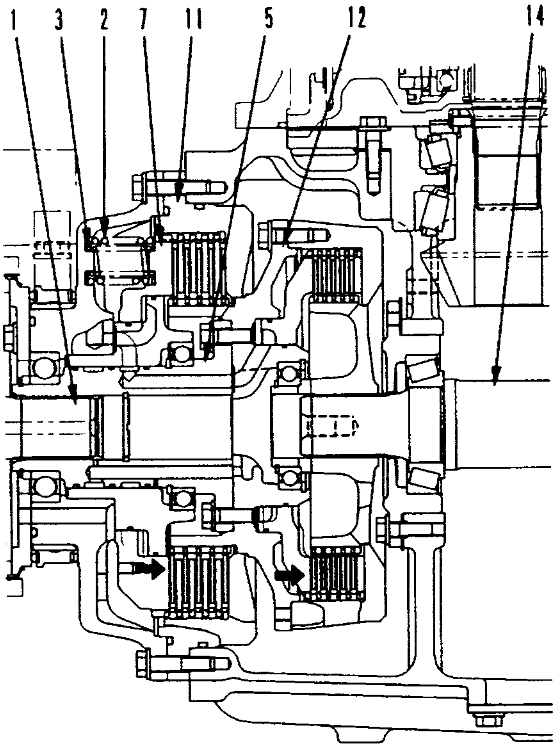
2. **When steering brake is turned "ON"**
   (When steering lever is "operated")
   If the steering lever is fully operated, the steering PPC valve so changes that the steering clutch is turned "OFF" and the hydraulic pressure on the back side of piston (7) is released into the drain circuit.
   Under this condition, the piston is pushed out to the right as indicated by the arrow by the tension of springs (2) and (3), then disc (10) and plate (9) are pressed against the stopper of brake outer drum (11).
   The brake outer drum is connected to the steering case and fixed.
   Accordingly, even if the steering clutch is turned "OFF", brake inner drum (12), or output shaft (1), which is revolving inertially stops as the disc and plate are fixed to each other.
   Since the braking force can be adjusted by controlling the hydraulic pressure on piston (7) with the steering lever, the turning radius and turning time can be controlled.



SWD04025

3. When brake is turned "ON" (When steering lever is at "neutral" position and brake pedal is "pressed")

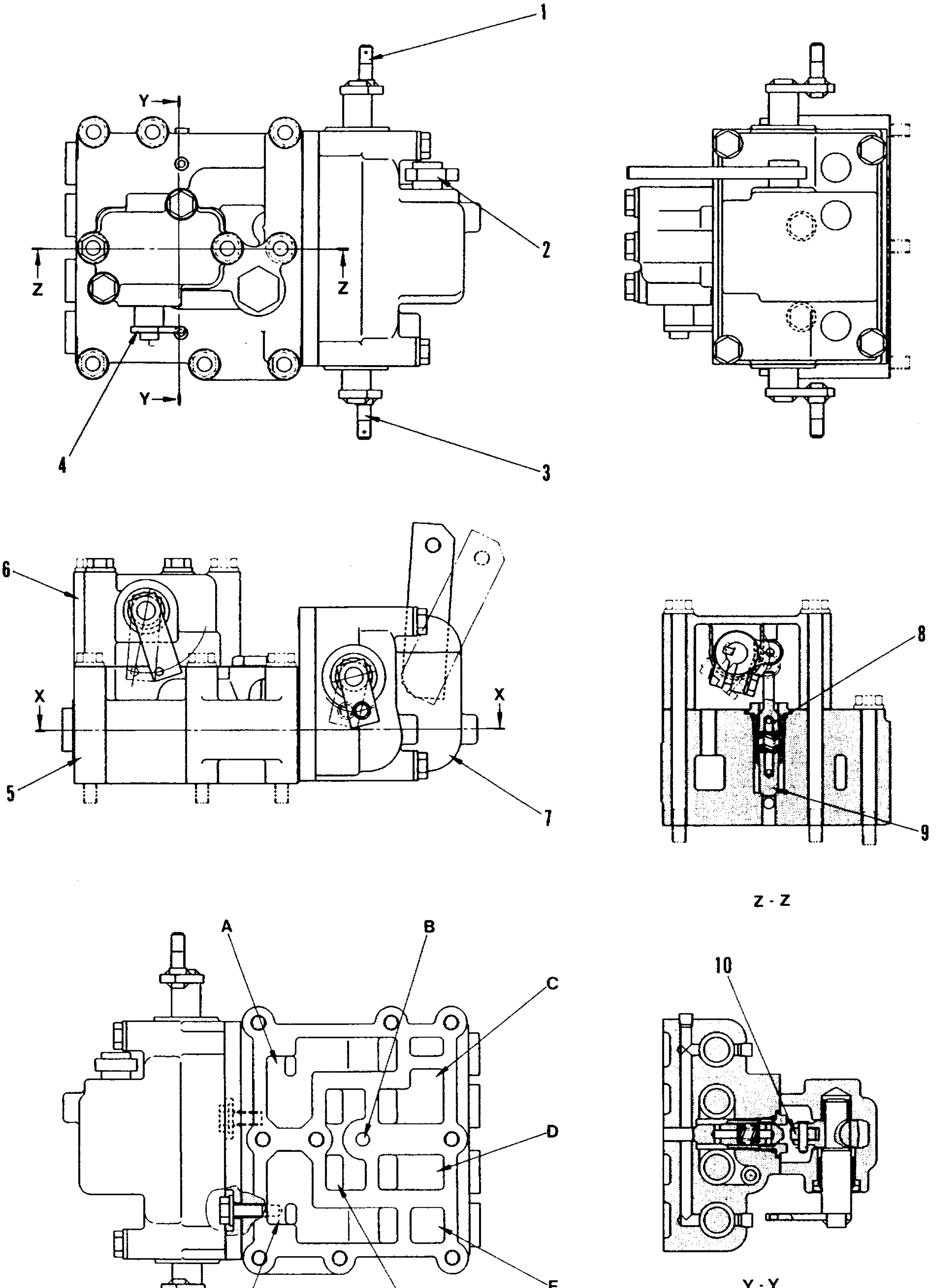
If the brake pedal is pressed, the brake valve so changes that the hydraulic pressure on the back side of piston (7) is released into the drain circuit, then only the brake operates with the steering clutch kept turned "ON" and output shaft (1) stops.



SWD04026

STEERING CONTROL VALVE

D65E, P-12 60001 – 65000



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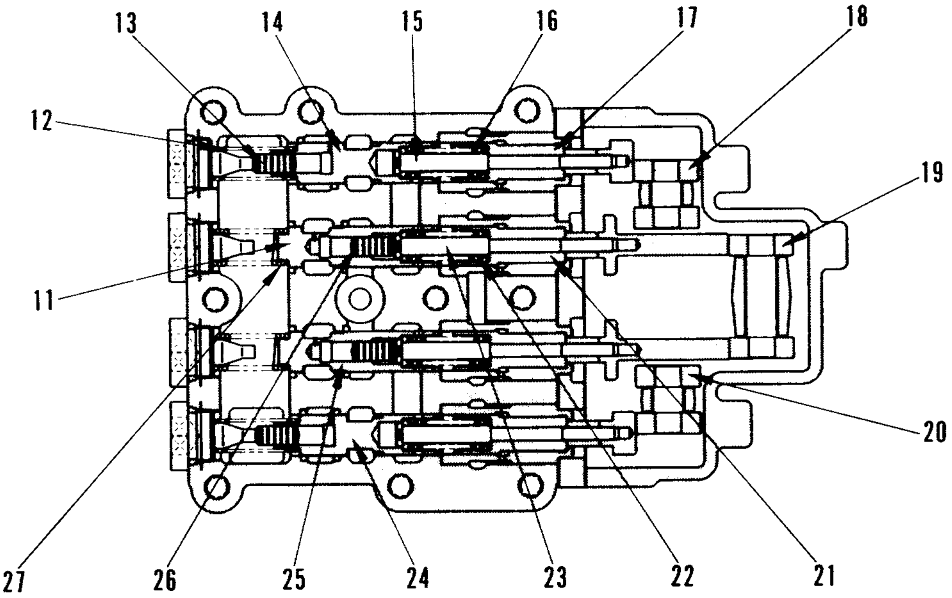


X - X

140F12067

1. Right steering lever
2. Brake lever
3. Left steering lever
4. Parking brake lever
5. Body
6. Cover
7. Cover
8. Parking brake valve
9. Check valve
10. Roller (parking brake)
11. Right brake valve
12. Valve spring (clutch valve)
13. Piston (clutch valve)
14. Right clutch valve
15. Bolt (clutch valve)
16. Modulating spring (clutch valve)
17. Guide (clutch valve)
18. Roller (right steering)
19. Roller (brake)
20. Roller (left steering)
21. Guide (brake valve)
22. Modulating spring (brake valve)
23. Bolt (brake valve)
24. Left clutch valve
25. Left brake valve
26. Piston (brake valve)
27. Valve spring (brake valve)

A. To right clutch
B. Port **P**
C. To right brake
D. To left brake
E. Clutch valve drain
F. Brake valve drain
G. To left clutch

014012

OUTLINE

- The steering control valve is in the circuit between the power train pump through the main relief valve and the steering clutch and brake piston. It consists of two sets of steering valves and brake valves.
- If the steering and directional lever is moved to the right or left, the steering clutch is disengaged. If the lever is moved further, the brake is applied.

  The machine can be turned gradually or sharply by adjusting the movement of the lever.

  If the brake pedal is depressed, left and right brakes are applied and the machine stops.

  The above operation is carried out by switching the steering control valve, which is interconnected with the lever and pedal.

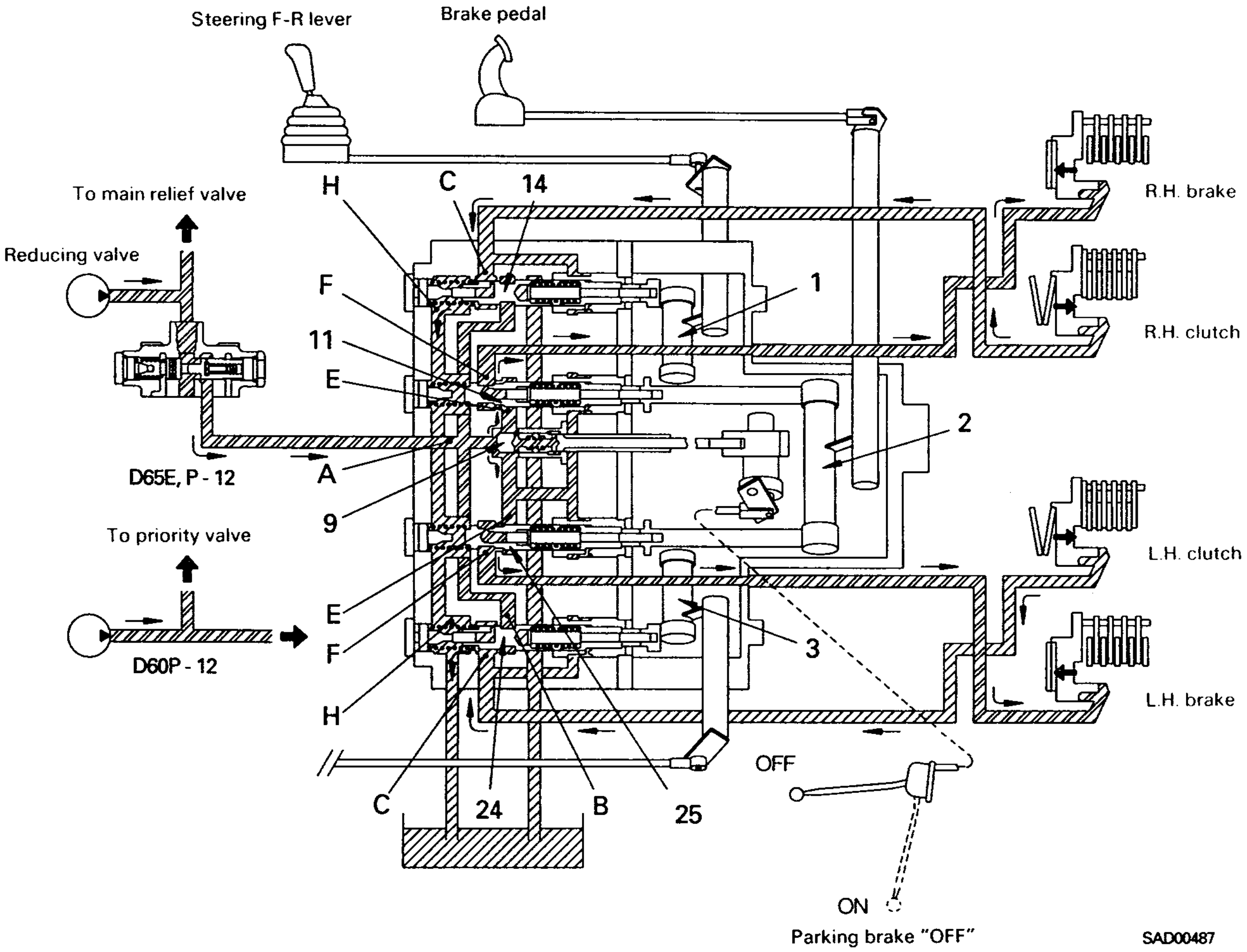
  The steering control valve sends oil from the power train pump to the steering clutch and brake, and operates the disc clutches.

Valve control

- The steering control valve is operated by left and right steering levers (1) and (3), which are interconnected with the steering and directional lever, and brake lever (2), which is interconnected with the brake pedal, and parking brake lever (4). Left and right steering levers (1) and (3) are interconnected with the steering valve and brake valve inside the steering control valve by a cam to carry out the control.

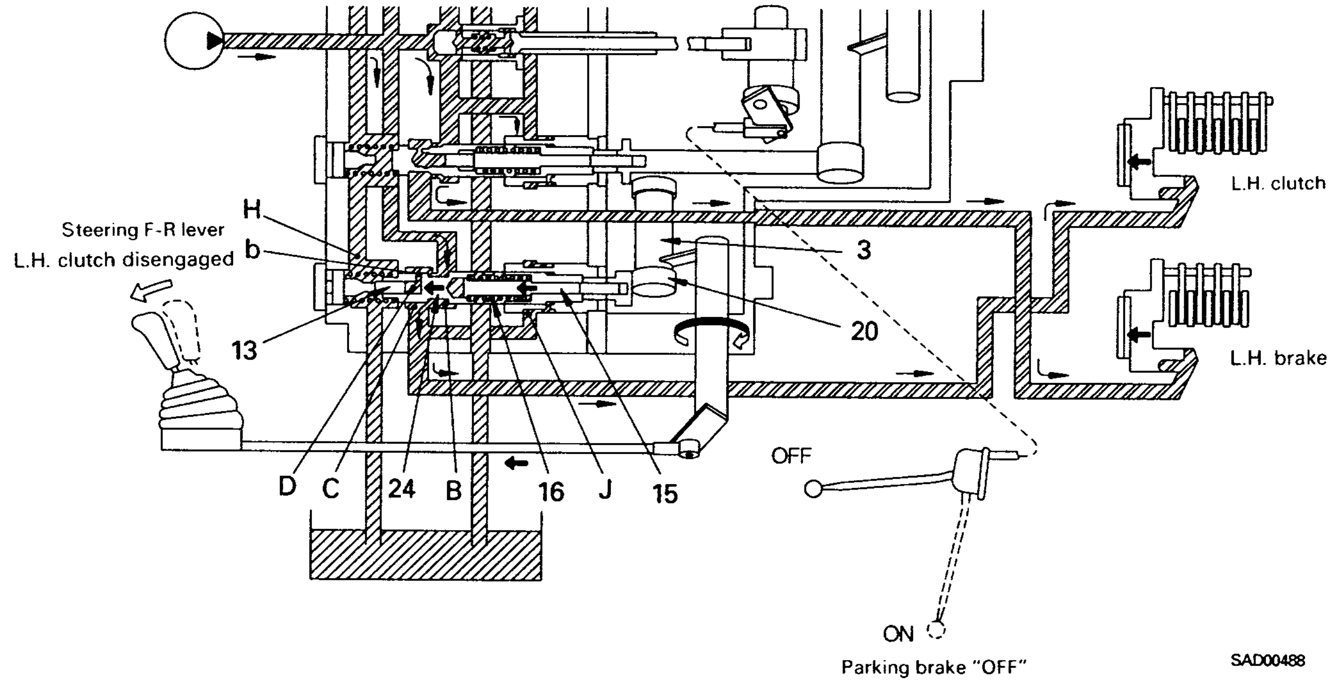
OPERATION

1. When steering and directional lever, brake pedal are at neutral (clutch engaged, brake released, parking brake OFF)



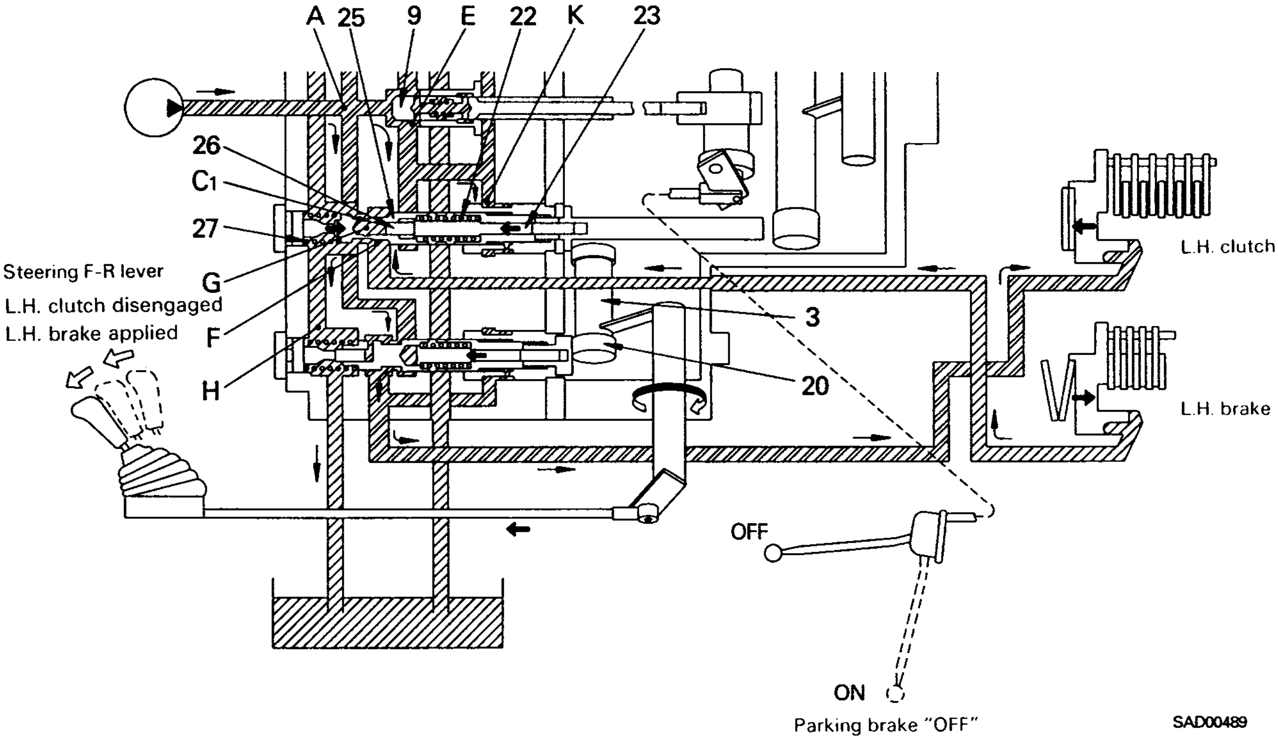
- When the steering and directional lever is at neutral and the brake pedal is released, levers (1), (2), and (3) are also at the neutral position, so the oil ports of each valve are opened or closed by the tension of the spring.
  The oil from the power train pump passes through the priority valve (D60P) or main relief valve (D65E,P) and enters port **A** of check valve (9).
- Some of the oil entering port **A** goes through port **B** of left and right steering valves (24) and (14), and stops.
- When this happens, the oil from the back pressure port of the clutch piston returns from port **C** to drain port **H**, and the clutch is engaged by the tension of the clutch spring.
  The rest of the oil pushes open check valve (9), enters port **E** of left and right brake valves (25) and (11), and flows from port **F** to the back pressure port of the brake piston. The piston waits for the pressure in the circuit to rise, then it moves to the left in the direction of the arrow, compresses the brake spring, and releases the brake.

2. When steering and directional lever is operated to left (left clutch disengaged, brake released, parking brake OFF)



- If the steering and directional lever is operated to the left, roller (20) of lever (3) pushes bolt (15) to the left in the direction of the arrow, and compresses modulating spring (16). The reaction force moves steering valve (24) to the left in the direction of the arrow.
  When this happens, the circuit between port **C** and drain port **H** is closed, and the circuit between ports **B** and **C** is opened.
- The oil from the power train pump enters port **C** from port **B**. Some of the oil flows to the clutch piston port to become the back pressure, and the rest of the oil passes through orifice **b** and enters port **D**.
  The oil entering port **D** pushes piston (13), and the reaction force compresses spring (16) and moves valve (24) to the right in the direction of the arrow. This closes the circuit between ports **B** and **C**, so the oil does not go beyond port **C**. The pressure is maintained but does not rise any further.
- If the steering and directional lever is operated further, the above operation is repeated, and when roller (20) of lever (3) reaches a position where it contacts bolt (23) of the brake valve, the pressure beyond port **C** rises to the set pressure 2.5 ± 0.1 MPa (25 ± 1 kg/cm^2) of the priority valve (D60P) or reducing valve (D65E,P), and the clutch is completely disengaged.
  The pressure beyond port **C** is determined by the tension of modulating spring (16), which changes the load in accordance with the amount that the steering and directional lever is moved.
  Therefore, if the steering and directional lever is moved only a short distance, the pressure beyond port **C** is set to a low level, and the clutch is partially disengaged; if the steering and directional lever is moved the full distance, the pressure beyond port **C** is set to a high level, and the clutch is completely engaged.
- Port **J** is connected to port **C**, and reduces the operating force of lever (3), which pushes out bolt (15) to the left in the direction of the arrow.
  However, the pressure of port **J**, (the booster pressure) follows the pressure of port **C** which changes in accordance with the amount that the steering and directional lever is moved, so the operating force of the steering and directional lever also changes.

3. When steering and directional lever is operated further to left (left clutch disengaged, left brake applied, parking brake OFF)



- If the steering and directional lever is operated further from the condition in Item 2, roller (20) of lever (3) pushes bolt (23) to the left in the direction of the arrow, and compresses modulating spring (22). The reaction force moves brake valve (25) to the left in the direction of the arrow. When this happens, the circuit between ports **E** and **F** is closed, and the circuit between port **F** and drain port **H** is opened.
- The oil from the power train pump flows from port **A**, pushes open check valve (9), enters port **E** and stops.

  Some of the oil flowing to the brake piston port and forming the back pressure is drained from port **F** to port **H**, and the rest of the oil passes from port **F** through orifice **c** and enters port **G**.

  However, if the oil beyond port **F** is drained to port **H** and the pressure drops, it enters port **G** and pushes piston (26). The reaction force pushing valve (25) to the left in the direction of the arrow becomes smaller, so valve (25) is moved to the right in the direction of the arrow by the tension of return spring (27). This closes the circuit between ports **F** and **H**, and the pressure beyond **F** is maintained to prevent it from dropping any further.

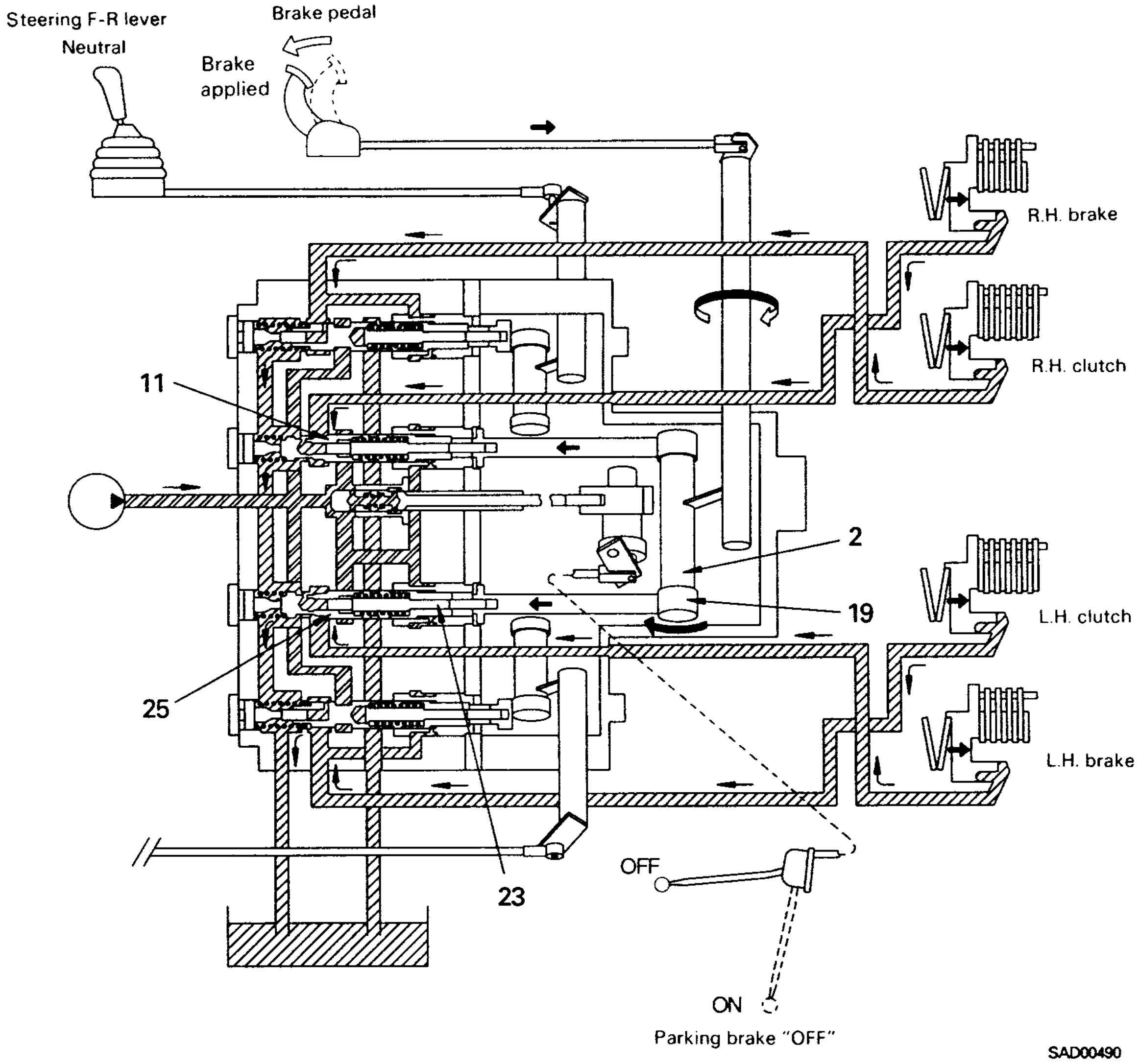
  If the steering and directional lever is operated further, the above operation is repeated, and when it is operated fully, the brake is applied completely.

  The pressure beyond port **F** is determined by the tension of return spring (27), which changes the load in accordance with the amount that the steering and directional lever is moved.

  Therefore, if the steering and directional lever is moved only a short distance, the pressure beyond port **F** is set to a high level, and the brake is partially applied; if the steering and directional lever is moved the full distance, the pressure beyond port **F** is set to a low level, and the brake is completely applied.

  Port **K** is connected to port **E**, and reduces the operating force of lever (3), which pushes out bolt (23) to the left in the direction of the arrow.

4. When brake pedal is depressed (clutch engaged, brake applied, parking brake OFF)



- When the brake pedal is depressed, the two rollers (19) of lever (2) push left and right bolts (23) to the left in the direction of the arrow, and left and right brake valves (25) and (11) are actuated in the same way as in Item 3.
  Therefore, the oil pressure is set according to the amount that the brake pedal is operated, and the braking force can be adjusted.
  The left and right steering levers are not being operated, so the clutch is still engaged.

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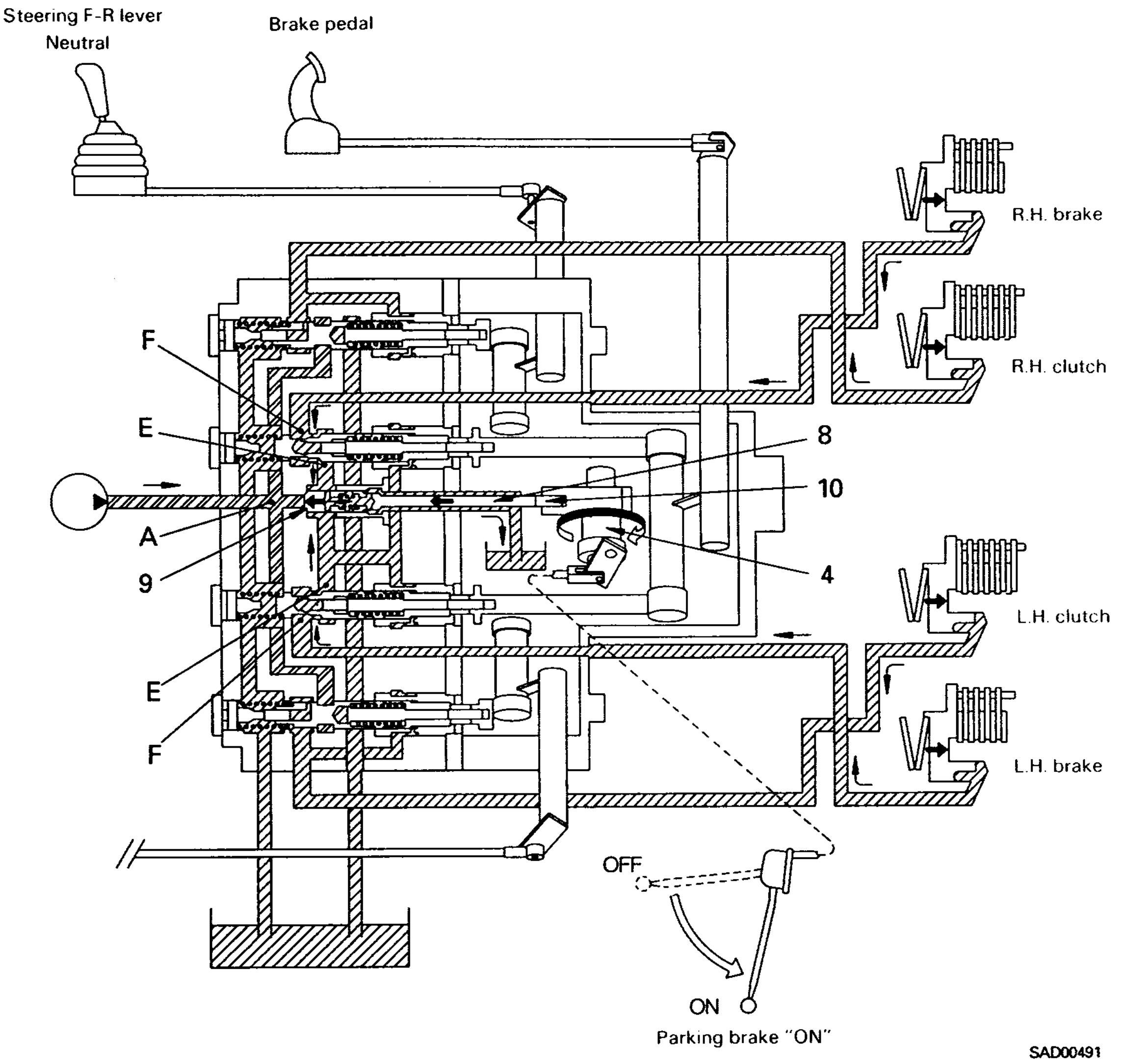
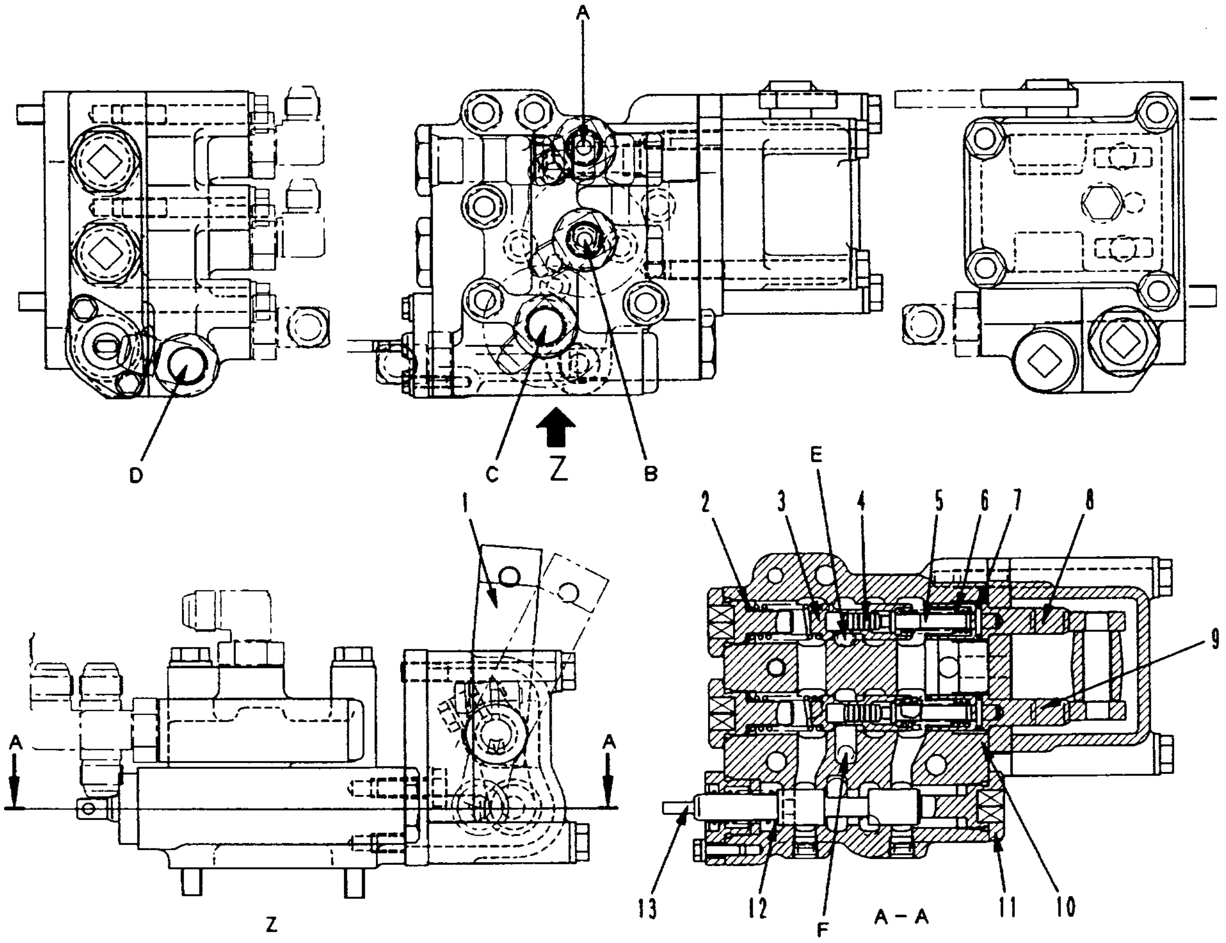
5. When parking brake is ON (clutch engaged, brake applied, steering and directional lever, brake pedal at neutral)



- When the brake lock lever is moved to the LOCK position, roller (10) of lever (4) pushes parking brake valve (8) to the left in the direction of the arrow. Check valve (9) is pushed by parking brake valve (8), and moves to the left in the direction of the arrow in the same way, and the circuit between port **A** and port **E** is closed. The oil which flow to the brake piston port and forms the back pressure passes from port **F** through port **E**, and is drained through check valve (9) and parking brake valve (8). Parking brake valve (8) is kept pushed in by lever (4) and roller (10), and is fixed in position, so the back pressure of the brake piston port continues to go down. The brake becomes completely applied, and it is kept in this condition.
- Even when the engine is started again, check valve (9) remains closed, so the brake is kept applied.

STEERING BRAKE VALVE

D65E, P-12 65001 and up



SXD04028

014012

1. Brake lever
2. Return spring
3. Valve
4. Piston
5. Shaft
6. Modulating spring
7. Guide
8. Right brake valve
9. Left brake valve
10. Body
11. Plug
12. Return spring
13. Parking brake valve

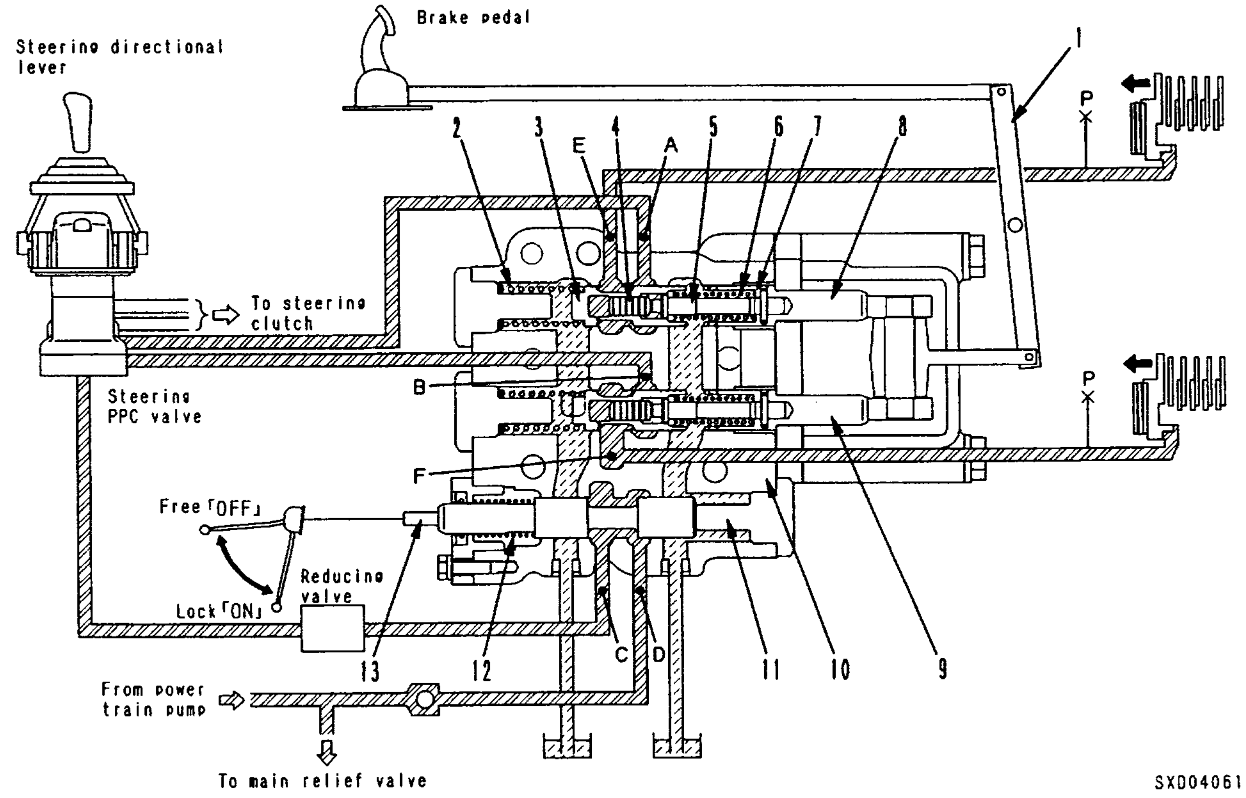
A. Port B1 (From PPC valve)
B. Port B2 (From PPC valve)
C. Port A (To PPC valve)
D. Port P (From pump)
E. Port Br (R) (To right brake)
F. Port Pr (L) (To left brake)

OUTLINE

- The oil from the power train pump is supplied through the parking brake valve built in the brake valve to the steering PPC valve.
- The parking brake valve is connected to the parking brake lever. If the hydraulic oil supplied to the brake piston is cut out and drained, the brake piston is pressed against the disc and plate by the spring force to turn "ON" the parking brake.
- The braking hydraulic pressure from the steering PPC valve is applied through the right and left brake valves to the brake piston.
- If the brake pedal is pressed, the oil flowing in the brake piston is cut out, then the brake piston is pushed by the spring force to press the disc and plate. Consequently, the brake is turned "ON".

Operation

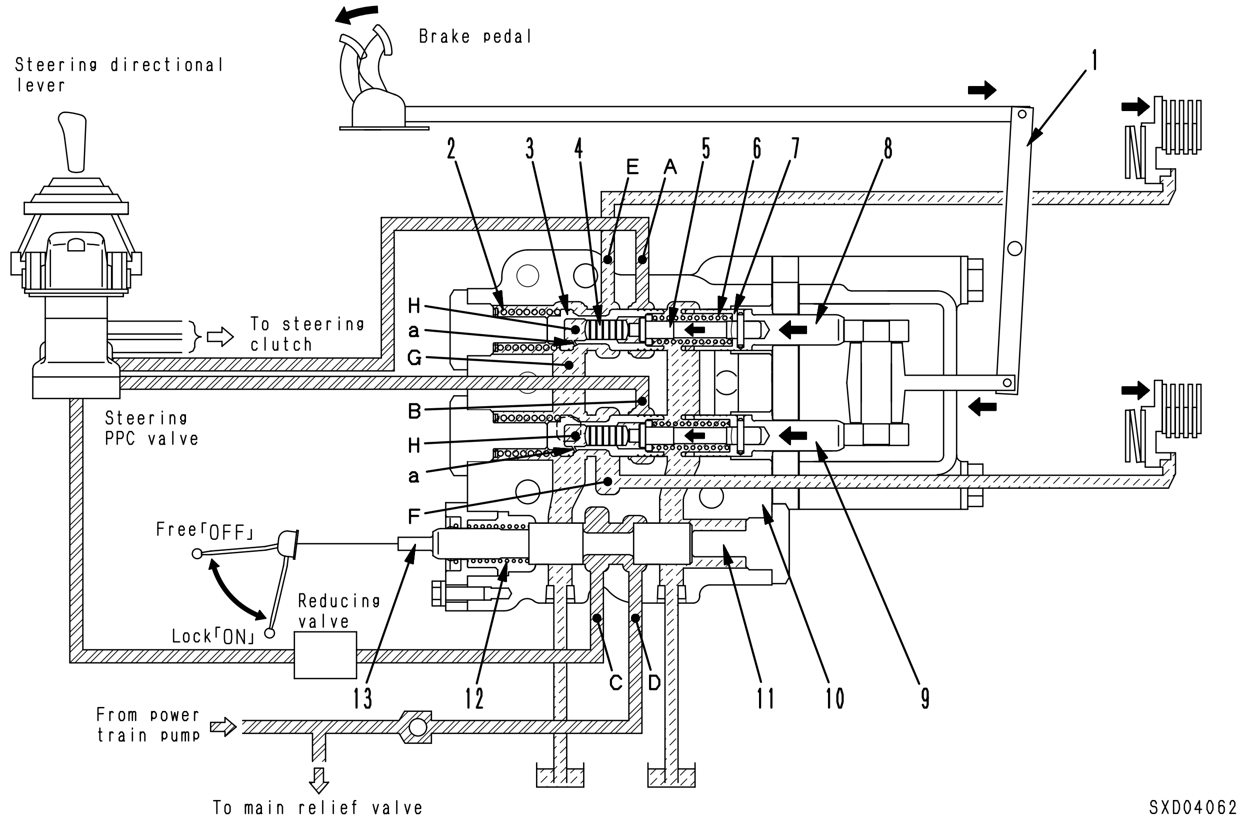
1. When brake is "released" (When parking brake is turned "OFF" and brake pedal is "released") Steering and forward-reverse lever is in "neutral".



- When the brake pedal is "released" (When it is not pressed), each port is opened or closed by the tension of the springs.
  The oil from the power train pump flows through the main relief valve, port D, and port C to the pressure reducing valve, where its pressure is reduced, then it flows into the steering PPC valve.

- The oil from the steering PPC valve flows through respective ports A and B of brake valves (8) and (9) on both sides and ports E and F into the back pressure port of the brake piston, then moves the piston in the direction of ← to compress the brake spring and "release" the brake. At this time, the hydraulic pressure is balanced at 2.45 MPa {25 kg/cm2}, which can be measured at pressure pickup port P.

2. When brake is turned "ON" (When parking brake is turned "OFF" and brake pedal is "pressed")



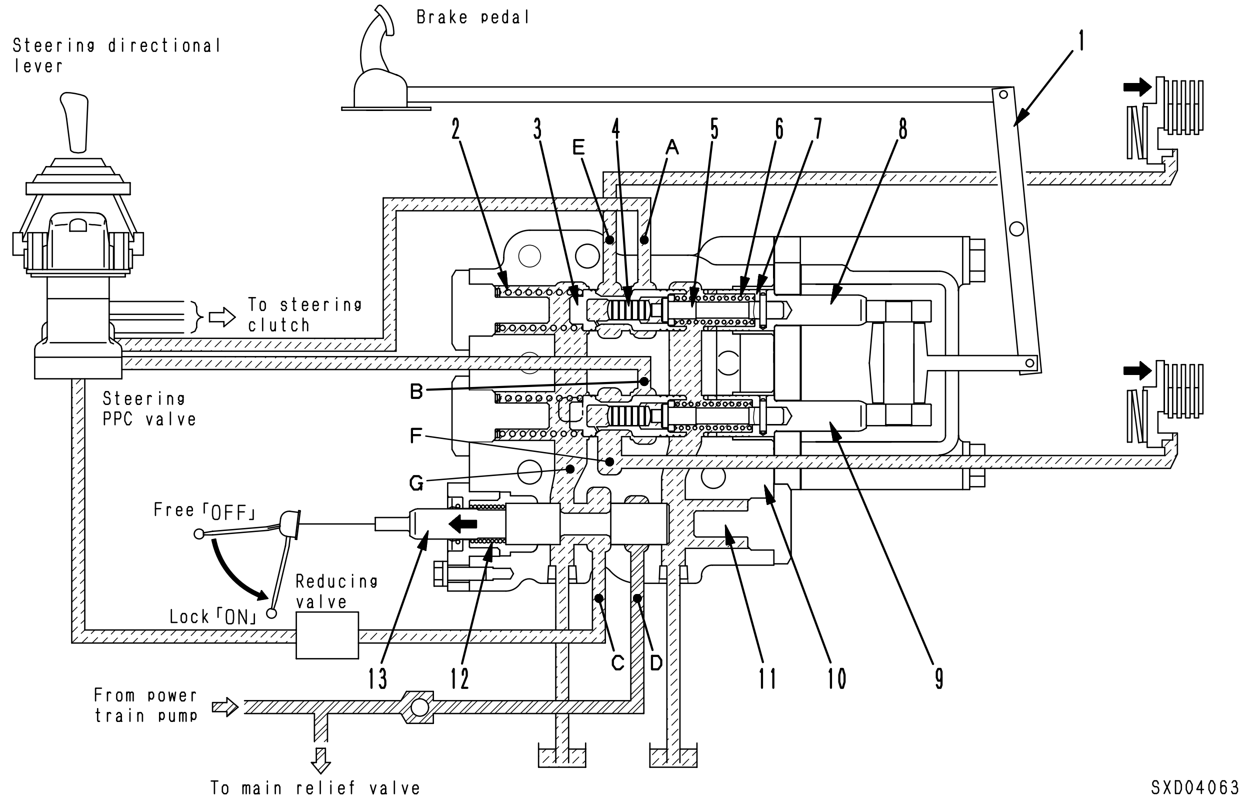
SXD04062

- If the brake pedal is pressed, guide (7) and shaft (5) are pressed in the direction of ← to compress modulating spring (6), then reaction force of modulating spring moves valve (3) in the direction of ←. At this time, ports **A**, **B**, **E**, and **F** are closed, and ports **E** and **F** and drain port **G** are opened. The oil from the power train pump flows through ports **D** and **C** and steering PPC valve and stops at ports **A** and **B**. **A** part of the oil which has flowed in the brake piston port and received the back pressure flows through ports **E** and **F** and drains through port **G**. The other part flows through ports **E** and **F** and orifice "a" to port **H**. If the oil after ports **E** and **D** is drained into port **G** and the hydraulic pressure lowers, the reaction force of the oil in port H to push piston (4) and valve (3) in the direction of ← lowers, too. As a result, valve (3) is moved in the direction of → by the tension of return spring (2) to close ports **E**, **F**, and **G** so that the hydraulic pressure after ports **E** and **F** will not lower any more.

- If the brake pedal is pressed further, the above operation is repeated. If the valve is moved to the stroke end, the brake is turned "ON" perfectly.

- The hydraulic pressure after ports **E** and **F** is determined by the tension of return spring (2) which changes the load according to the stroke of the brake pedal.
  Accordingly, if the stroke of the brake pedal is short, the hydraulic pressure after ports **E** and **F** is controlled high and the brake is "half applied". If the stroke is long, the hydraulic pressure is controlled low and the brake is turned "ON".

3. When parking brake is turned "ON" (When brake pedal is "released" and brake lock lever is at "LOCK" position)

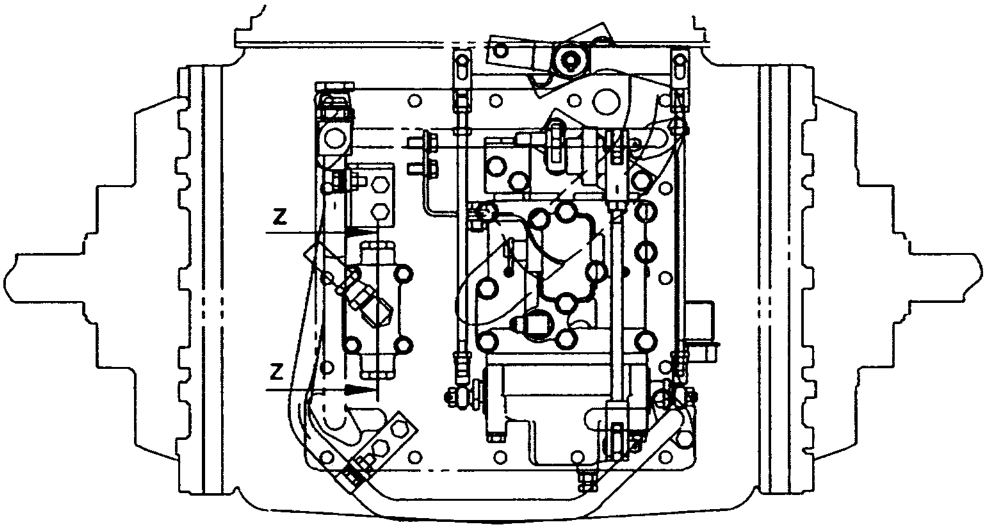


- If the brake lock lever (safety lever) is set (leaned) to the "LOCK" position, the parking brake valve (13) is pulled in the direction of ←. At this time, ports **D** and **C** are closed, and ports **C** and **G** are opened. The oil from the power train pump flows in port **D** and stops there.

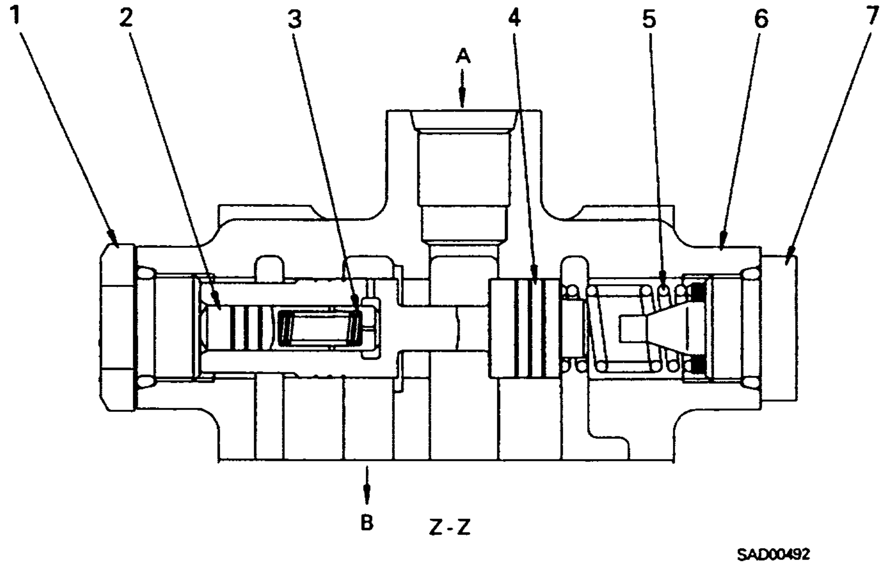
- The oil which has flowed in the brake piston port and received the back pressure drains from port **E** and **F** through port **A**, **B**, **C**, and **G**. Since parking brake valve (13) is kept pulled in the direction ←, the back pressure in the brake piston port keeps lowering, then the brake is turned "ON" perfectly and kept under this condition.
  When the engine is started again, this condition is still maintained.

REDUCING VALVE

D65E, P-12 60001 – 65000



014012



1. Orifice
2. Plug
3. Body
4. Spring
5. Spool
6. Spring
7. Spool
8. Plug

A. From main relief valve
B. To steering control valve

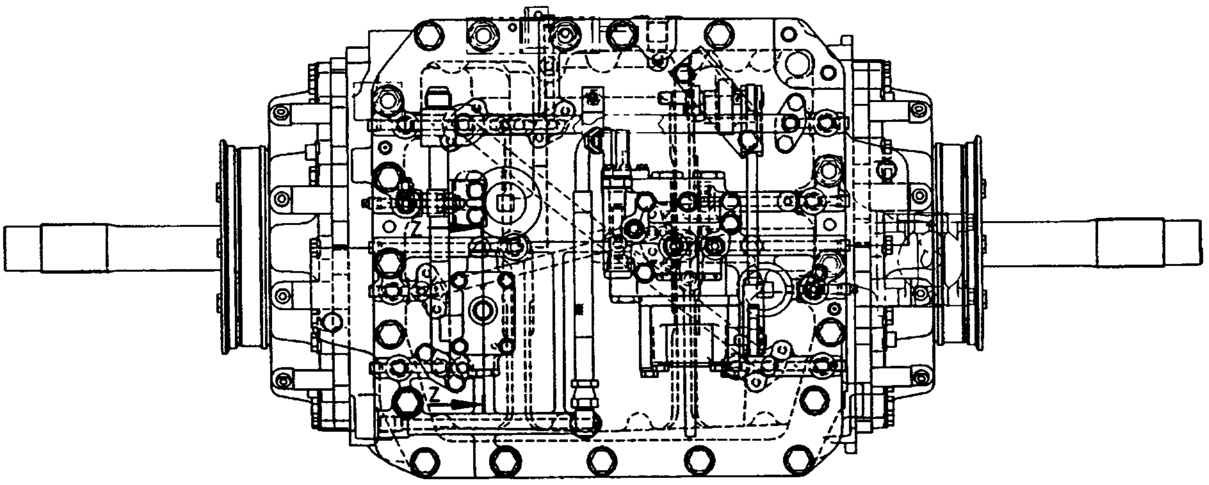
Outline

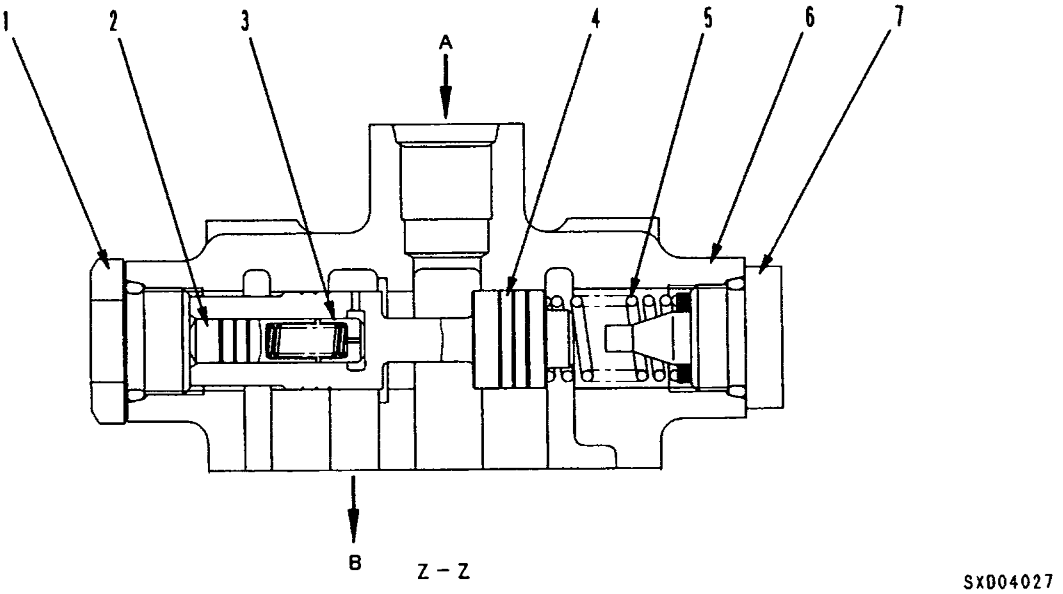
- The reducing valve is installed between the main relief valve and the steering control valve. The set pressure of the main relief valve is a high 3.2 MPa (33 kg/cm²) at rated, so the reducing valve lowers the oil pressure to the set pressure for the steering to protect the steering.

Unit: MPa (kg/cm²)

	Set pressure
Cracking pressure	2.5 (25)

D65E, P-12 65001 and up





1. Orifice
2. Plug
3. Body
4. Spring
5. Spool
6. Spring
7. Spool
8. Plug

A. From main relief valve
B. To PPC valve

OUTLINE

- The reducing valve is installed between the main relief valve and the steering control valve. The set pressure of the main relief valve is a high 3.24 to 3.43 MPa (33 to 35 kg/cm²) at rated, so the reducing valve lowers the oil pressure to the set pressure for the steering to protect the steering.

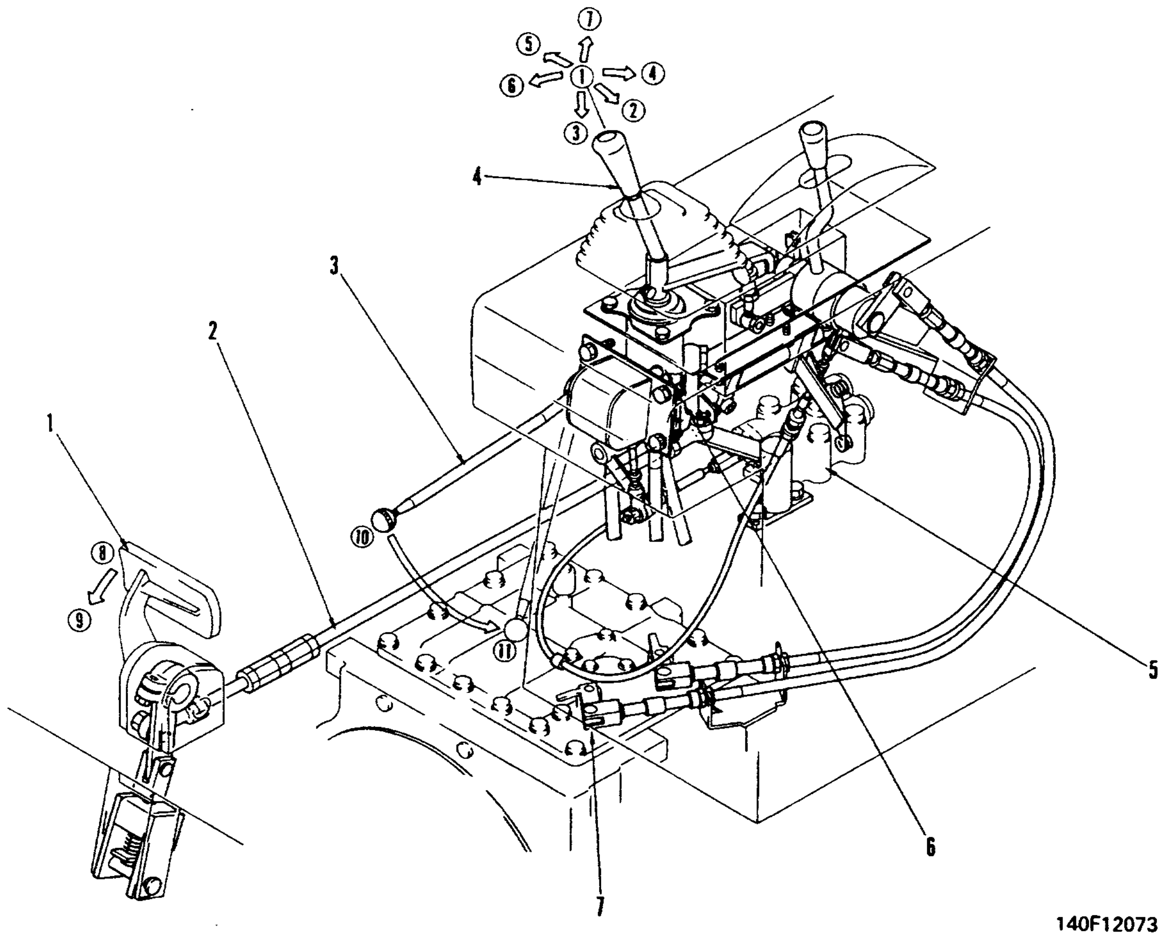
Unit: MPa (kg/cm²)

	Set pressure
Cracking pressure	2.45 (25)

STEERING AND BRAKE CONTROL

D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

★ For details of the steering PPC valve, see PPC VALVE.



140F12073

Lever positions
① NEUTRAL
② Left counterrotation turn
③ Left FORWARD turn
④ Left REVERSE turn
⑤ Right counterrotation turn
⑥ Right FORWARD turn
⑦ Right REVERSE turn
⑧ Brake released
⑨ Brake applied
⑩ FREE
⑪ LOCK

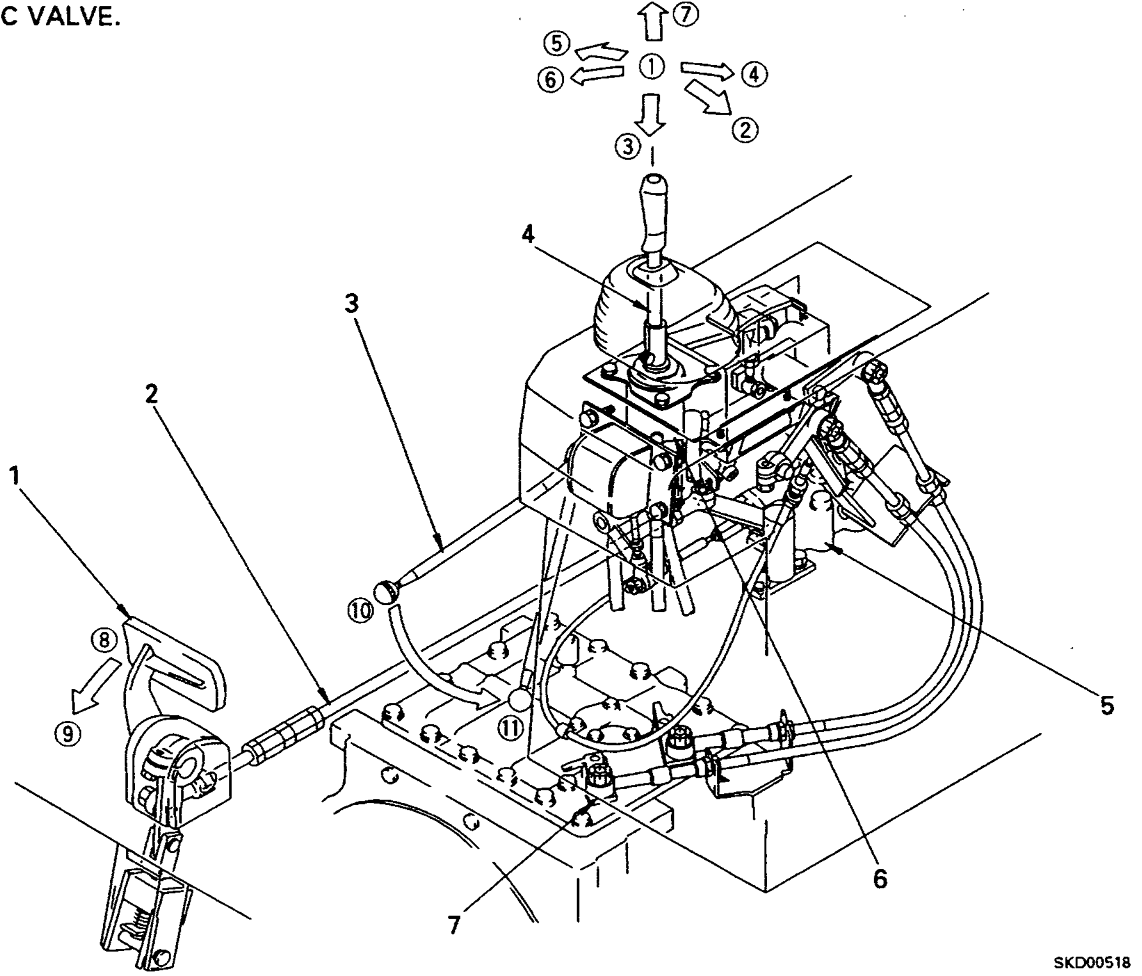
1. Brake pedal
2. Rod
3. Safety lever
4. Steering and directional lever
5. Brake valve
6. Steering PPC valve
7. Transmission control valve

OUTLINE
- Steering and directional lever (4) moves the spool of the main control valve through PPC valve (6), and actuates the HSS motor to operate the steering.
  Brake pedal (1) actuates the spool of brake valve (5), and applies the left and right brakes at the same time.
- Safety lever (3) is interconnected with brake valve (5) and also acts as the parking brake.
- If steering and directional lever (4) is moved to the forward position and is then moved slightly to the left, the machine will turn gradually to the left. If the lever is moved fully to the left, the machine will turn sharply to the left.
- If steering and directional lever (4) is placed at the neutral position and is moved to the left, the machine will carry out a counter-rotation turn to the left.

014012

D65EX-12 60942 – 65000
D65PX-12 60915 – 65000

★ For details of the steering PPC valve, see PPC VALVE.



Lever positions
① NEUTRAL
② Left counterrotation turn
③ Left FORWARD turn
④ Left REVERSE turn
⑤ Right counterrotation turn
⑥ Right FORWARD turn
⑦ Right REVERSE turn
⑧ Brake released
⑨ Brake applied
⑩ FREE
⑪ LOCK

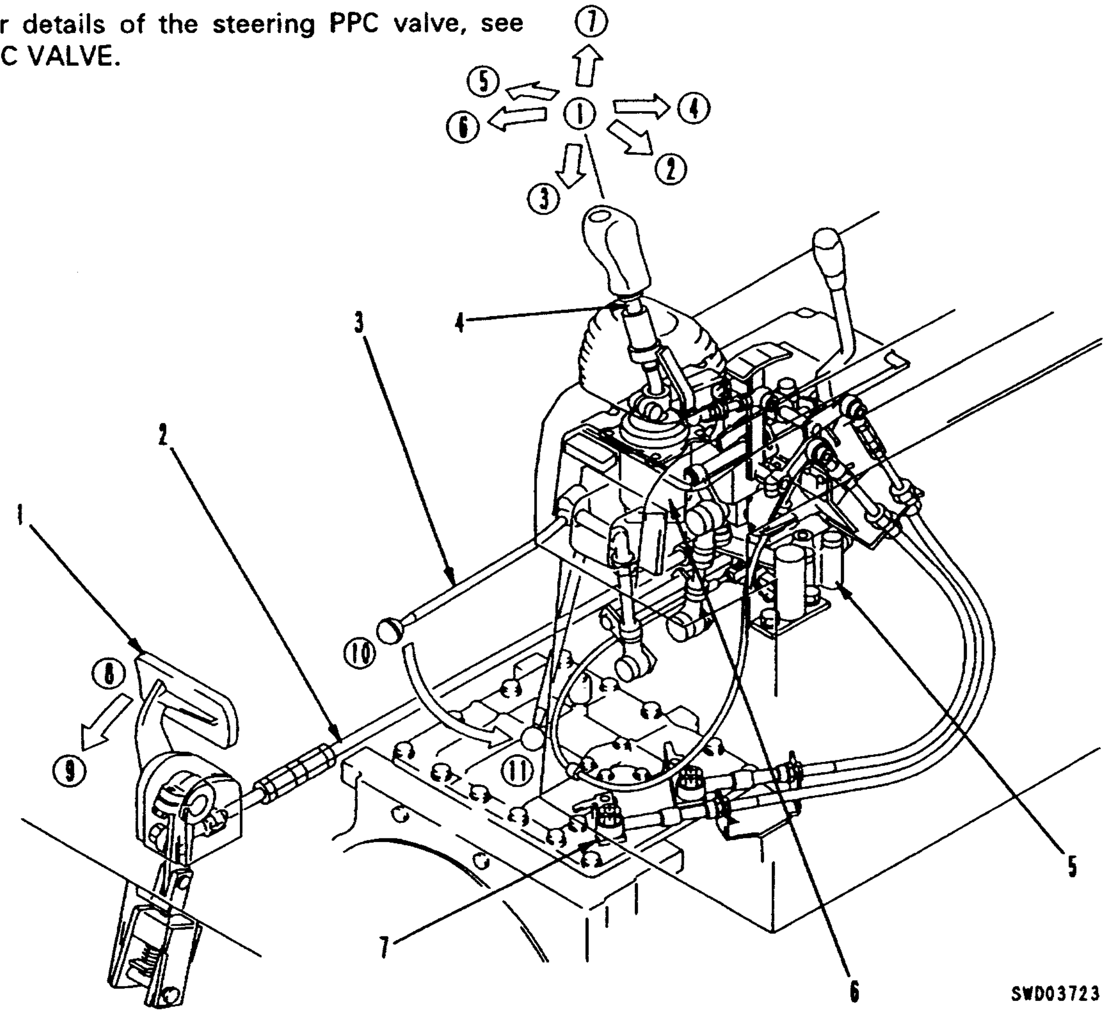
1. Brake pedal
2. Rod
3. Safety lever
4. Joystick (steering)
5. Brake valve
6. Steering PPC valve
7. Transmission control valve

OUTLINE

- Steering and directional lever (4) moves the spool of the main control valve through PPC valve (6), and actuates the HSS motor to operate the steering.
  Brake pedal (1) actuates the spool of brake valave (5), and applies the left and right brakes at the same time.
- Safety lever (3) is interconnected with brake valve (5) and also acts as the parking brake.
- If joystick (4) is moved to the forward position and is then moved slightly to the left, the machine will turn gradually to the left. If the lever is moved fully to the left, the machine will turn sharply to the left.
- If joystick (4) is placed at the neutral position and is moved to the left, the machine will carry out a counterrotation turn to the left.

D65EX-12 65001 and up
D65PX-12 65001 and up

★ For details of the steering PPC valve, see PPC VALVE.



Lever positions
① NEUTRAL
② Left counterrotation turn
③ Left FORWARD turn
④ Left REVERSE turn
⑤ Right counterrotation turn
⑥ Right FORWARD turn
⑦ Right REVERSE turn
⑧ Brake released
⑨ Brake applied
⑩ FREE
⑪ LOCK

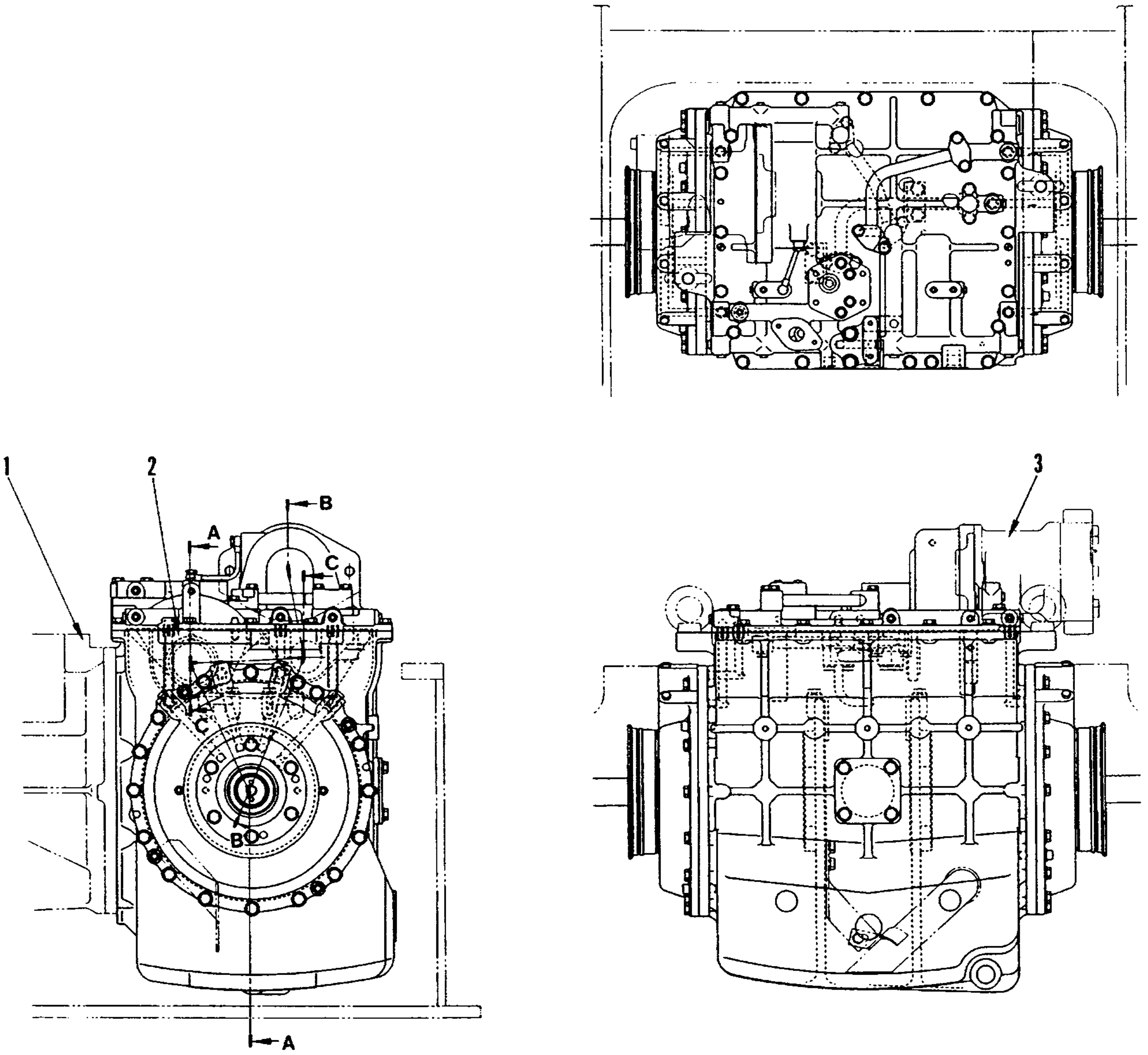
1. Brake pedal
2. Rod
3. Safety lever
4. Joystick (steering)
5. Brake valve
6. Steering PPC valve
7. Transmission control valve

OUTLINE

- Steering and directional lever (4) moves the spool of the main control valve through PPC valve (6), and actuates the HSS motor to operate the steering.
  Brake pedal (1) actuates the spool of brake valave (5), and applies the left and right brakes at the same time.
- Safety lever (3) is interconnected with brake valve (5) and also acts as the parking brake.
- If joystick (4) is moved to the forward position and is then moved slightly to the left, the machine will turn gradually to the left. If the lever is moved fully to the left, the machine will turn sharply to the left.
- If joystick (4) is placed at the neutral position and is moved to the left, the machine will carry out a counterrotation turn to the left.

BEVEL GEAR SHAFT, HSS STEERING AND BRAKE

D65EX, PX-12 60001 – 65000



014012

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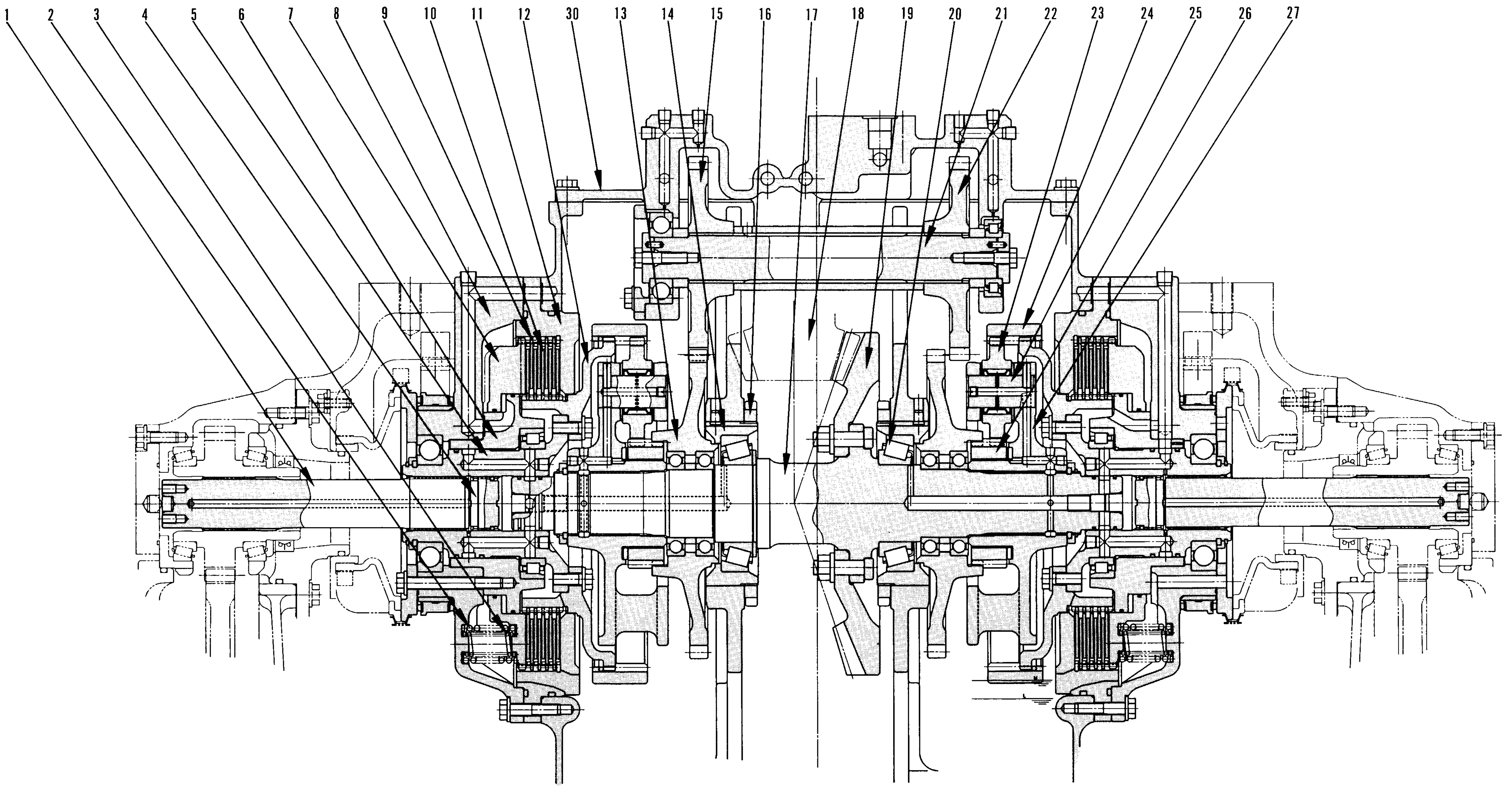
1. Transmission
2. HSS steering unit
3. HSS motor

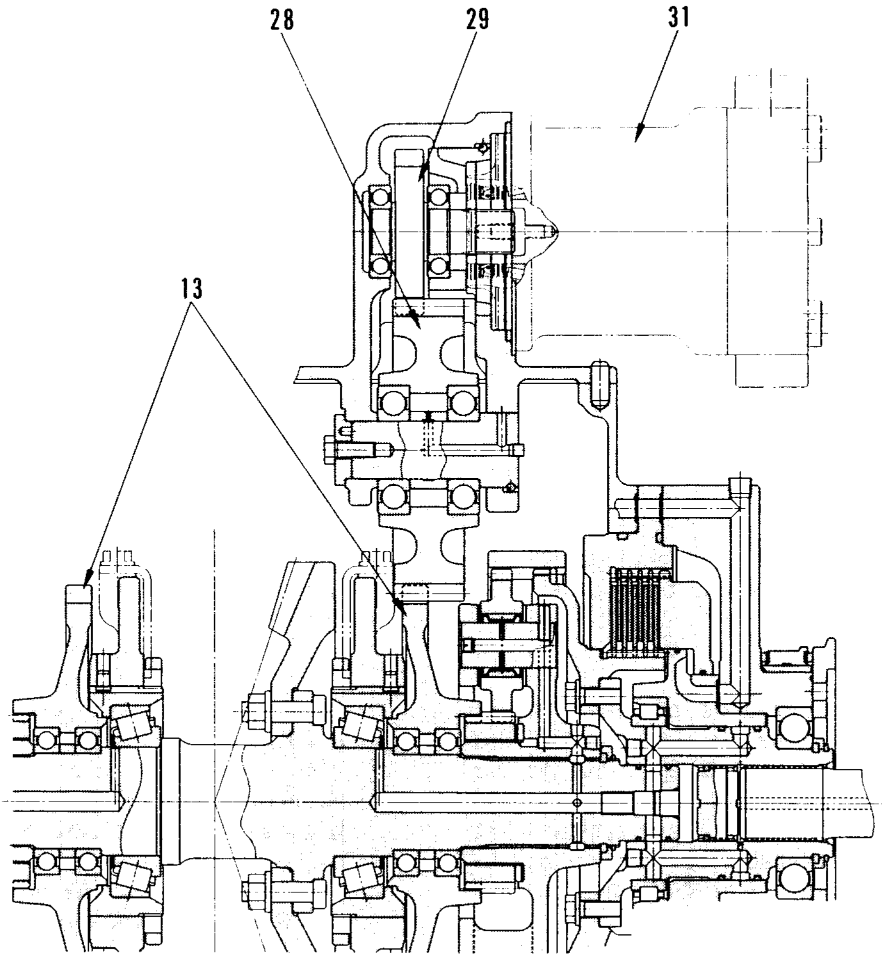
BEVEL GEAR SHAFT, HSS STEERING AND BRAKE



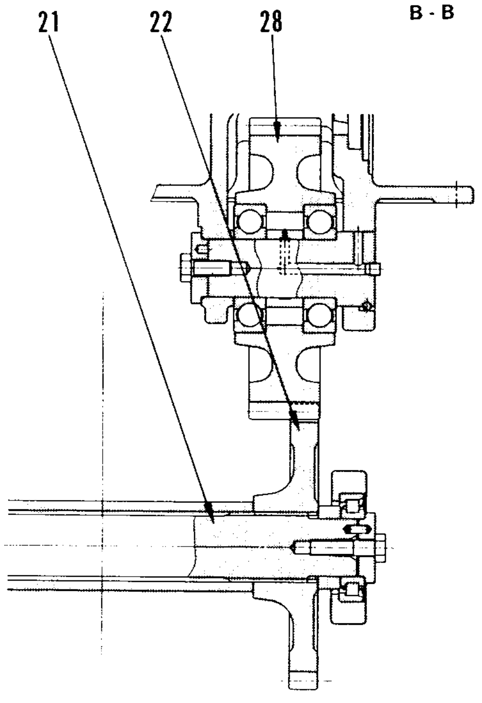
A - A

140F12075

1. Output shaft
2. Brake spring (large)
3. Brake spring (small)
4. Stopper
5. Brake hub
6. Brake cage
7. Brake cylinder
8. Brake cover
9. Brake plate (each side: 4)
10. Brake disc (each side: 5)
11. Brake drum
12. Brake inner drum
13. Gear A
14. Bevel gear shaft cage
15. Gear B
16. Bevel gear shaft nut
17. Bevel gear shaft
18. Bevel pinion (transmission)
19. Bevel gear
20. Bevel gear shaft bearing
21. Shaft
22. Gear C
23. Planet pinion
24. Ring gear
25. Planet shaft
26. Sun gear
27. Carrier
28. Gear D
29. Pinion
30. Cover
31. HSS motor



B - B



C - C

140F12076

014012

OUTLINE

Bevel gear shaft

- The power transmitted from the engine → torque converter → transmission comes to the bevel pinion and bevel gear, which are meshed by the bevel gear shaft system. From here it is sent at right angles to the left and right by the bevel gear shaft, and the rotation speed is reduced at the same time.
- The bevel gear shaft system uses a spiral bevel gear for the bevel pinion and bevel gear, and lubrication is carried out by splash lubrication using oil from the power train scavenging pump.
- The bevel gear shaft system consists of the following parts: bevel gear (19) which is meshed with the bevel pinion, bevel gear shaft (17), bevel gear shaft bearing (20) and bevel gear shaft cage (14) which support the bevel gear shaft.

HSS steering

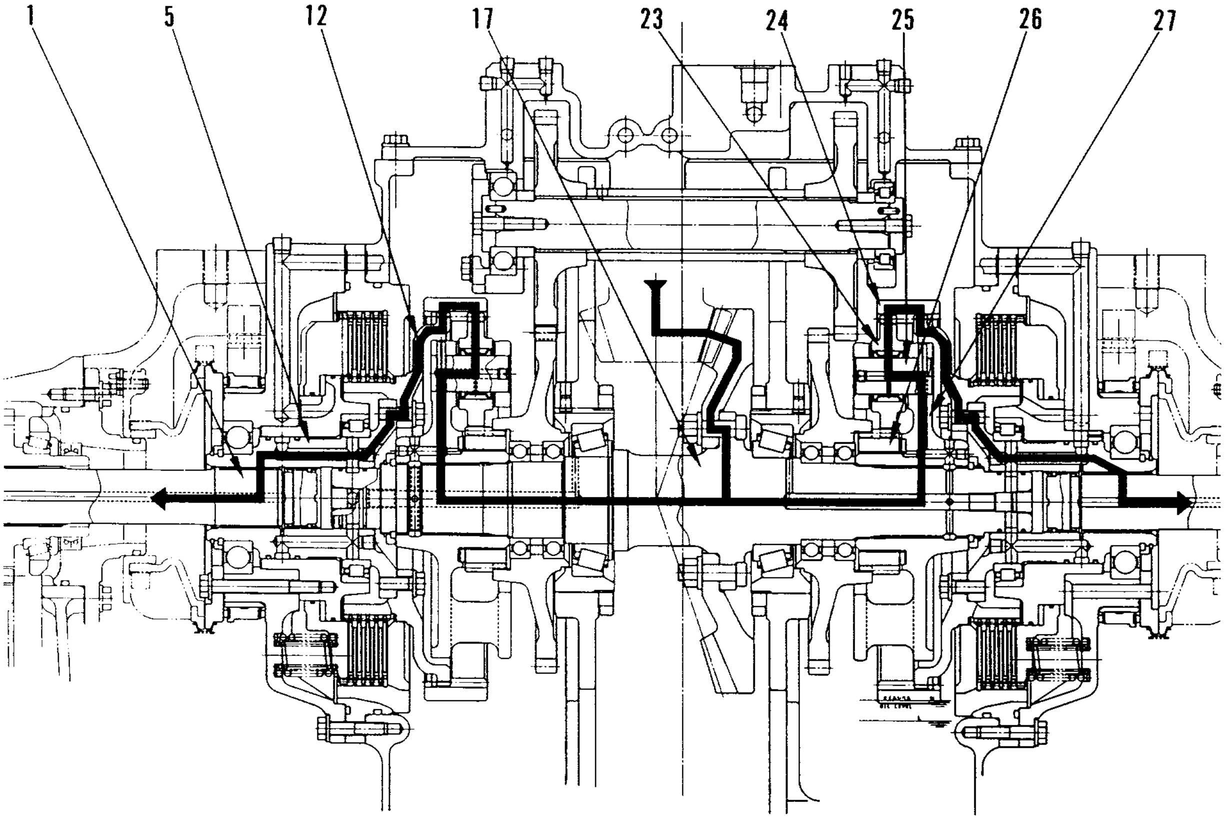
- The HSS steering consists of the following parts: the transfer portion that reverses the direction of rotation of the HSS motor to the left and right, and transfers the rotation to sun gear (26), and the planetary system that increases and decreases the power input to carrier (27) and sun gear (26), and outputs power to ring gear (24).
  The direction of turn of the machine is changed by stopping or reversing the direction of rotation of the HSS motor.
- The transfer portion uses a spur gear reduction system, and lubrication is carried out by splash lubrication using the oil from the power train scavenging pump circuit and lubrication pump.
- The lubrication of the planetary system is carried out by forced lubrication using the oil from the power train lubrication pump.
- The transfer portion consists of the following parts: pinion (29) which is joined to the HSS motor by a spline, gear **D** (28) which is meshed with the pinion, gear **C** (22) which is meshed with gear **D**, gear **B** (15) which is joined to shaft (21), gear **A** (13) which is held on the bevel gear shaft by a bearing and is meshed with gear **B** (15) and gear **D** (28), and cover (30) which supports these parts.
- The planetary system consists of sun gear (26), planet pinion (23), planet shaft (25), carrier (27) which is joined to the bevel gear shaft with a spline, and ring gear (24) which is joined to brake inner drum (12).

Brakes

- The brakes are used exclusively to brake the machine, and they apply braking force to the machine through output shaft (1) and brake hub (5) which is joined to brake inner drum (12).
- The brakes are a wet, multiple disc type, spring-boosted type. They are hydraulically operated by the steering valve which is actuated by operation of the brake pedal.
  Lubrication is carried out by a forced lubrication system in which the oil from the power train lubrication pump and scavenging pump circuit passes through a passage inside the steering case, enters the housing and cage, and is sent to the discs and plates.
- When the engine is stopped, the brakes are applied without the brake pedal being pressed because the back pressure of the brake system drops and the brakes are applied. However, when the engine is started again, the pressure and the circuit rises and the brake is released, so the parking brake must always be locked.
- The brakes consist of the following parts: ring gear (24), inner drum (12) which is joined to brake hub (5), disc (10) which is meshed with the inner drum, plate (9) which is joined at the outside circumference to brake drum (11) by a spline, brake drum (11), piston (7) and springs (2) and (3) which press the discs and plates together, cage (6) which supports these parts, brake cover (8), and output shaft (1).
  Brake drum (11) and brake cover (8) are fixed to the steering case.
  Output shaft (1) is joined to the brake hub by a spline, and is stopped in the axial direction by stopper (4).

Operation of HSS steering

1. Steering lever at neutral



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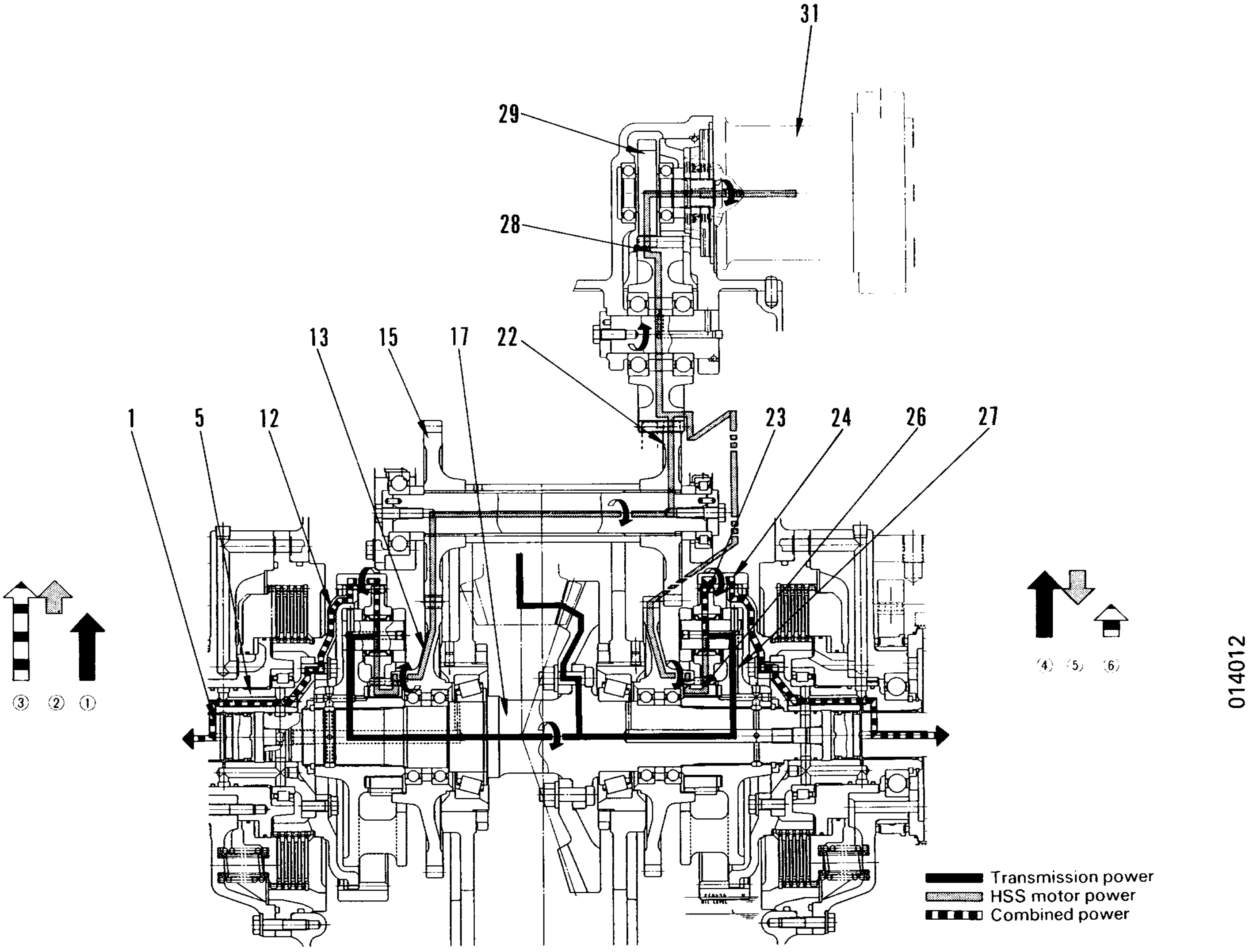
Traveling in a straight line
When the steering lever is at the neutral position, HSS motor (31) is stopped, and the rotation of the transfer gear and left and right sun gears (26) in the planetary system is also stopped.
In this condition, the power from bevel gear shaft (17) is input to carrier (27), and is transmitted to ring gear (24) through planet shaft (25) and planet pinion (23). It is then transmitted to output shaft (1) through brake inner drum (12) which forms one unit with the ring gear, and brake hub (5).
Therefore, the output speed on the left and right sides is the same, and the machine travels in a straight line.

Direction of rotation of HSS motor

Steering lever position	Left steering			Right steering			Neutral
Directional lever position	* Neutral	Forward	Reverse	* Neutral	Forward	Reverse	Any position
Direction of rotation of HSS motor as seen from left of machine	Counter-clockwise	Counter-clockwise	Clockwise	Clockwise	Clockwise	Counter-clockwise	Does no rotate

* Pivot turn

2. When steering lever is operated to right



① Transmission output speed
② Increase in speed from HSS motor
③ Left bevel gear shaft output speed (① + ②)

④ Transmission output speed
⑤ Decrease in speed from HSS motor
⑥ Right bevel gear shaft output speed (④ — ⑤)

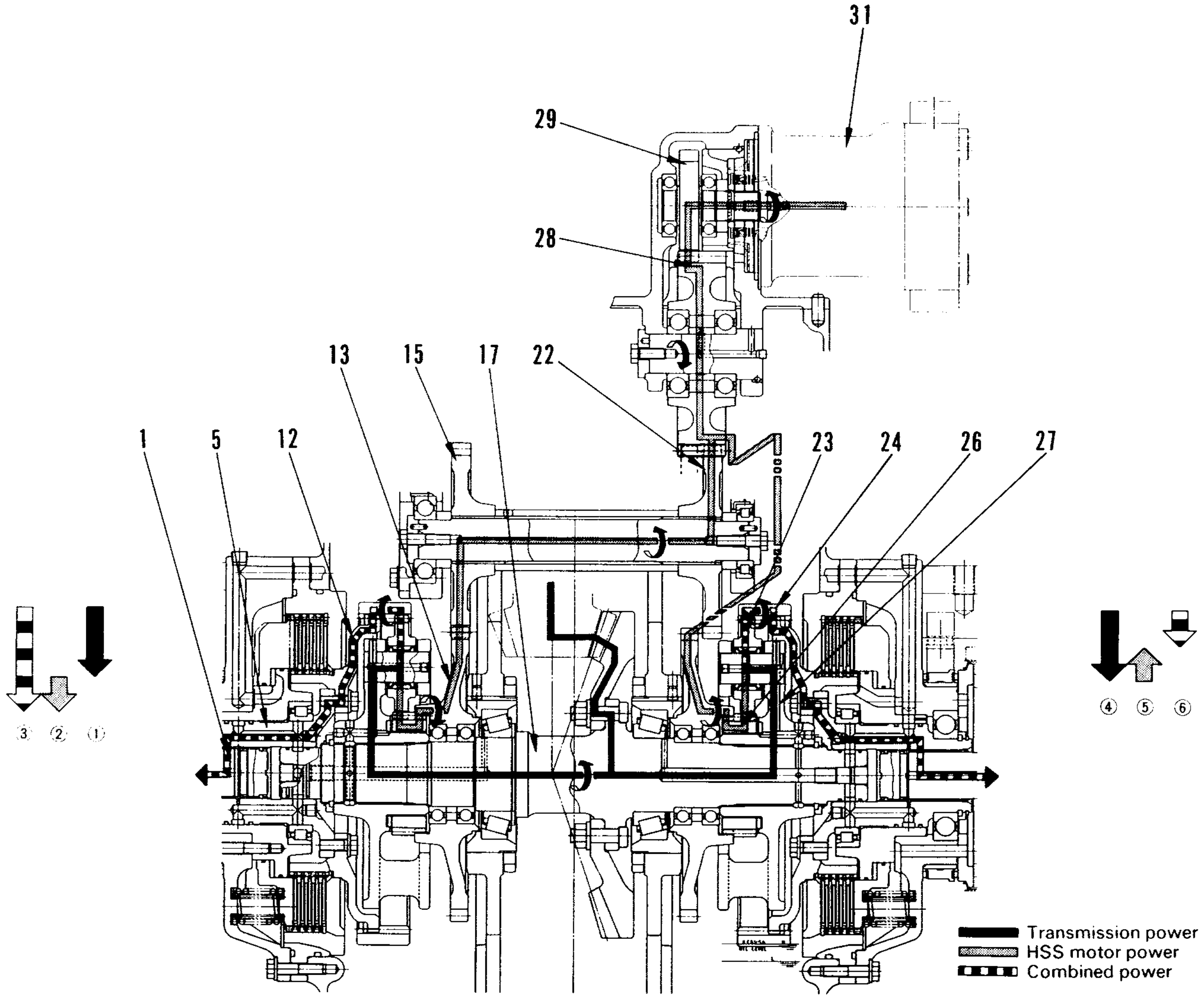
140F12078

Forward

If the steering lever is operated to the right when the machine is traveling forward, HSS motor (31) rotates clockwise as seen from the left side of the machine. At the same time, gear **A** (13) on the left side of the machine rotates counterclockwise as seen from the left side of the machine, while gear **A** (13) on the right side of the machine rotates clockwise as seen from the left side of the machine.

When the machine is traveling forward, bevel gear shaft (17) and carrier (27), which is interconnected with the bevel gear shaft, rotate clockwise as seen from the left side of the machine.

Therefore, considering the relationship of the rotating speed of the elements in the pairs of planetary gears, the rotating speed of ring gear (24) on the left side is faster than when traveling in a straight line by the amount of the power of HSS motor; on the other hand, the rotating speed of ring gear (24) on the right side is slower than when traveling in a straight line, so the machine turns in forward to the right, where the output speed is slower.



① Transmission output speed
② Increase in speed from HSS motor
③ Left bevel gear shaft output speed (① + ②)

④ Transmission output speed
⑤ Decrease in speed from HSS motor
⑥ Right bevel gear shaft output speed (④ — ⑤)

140F12079

Reverse

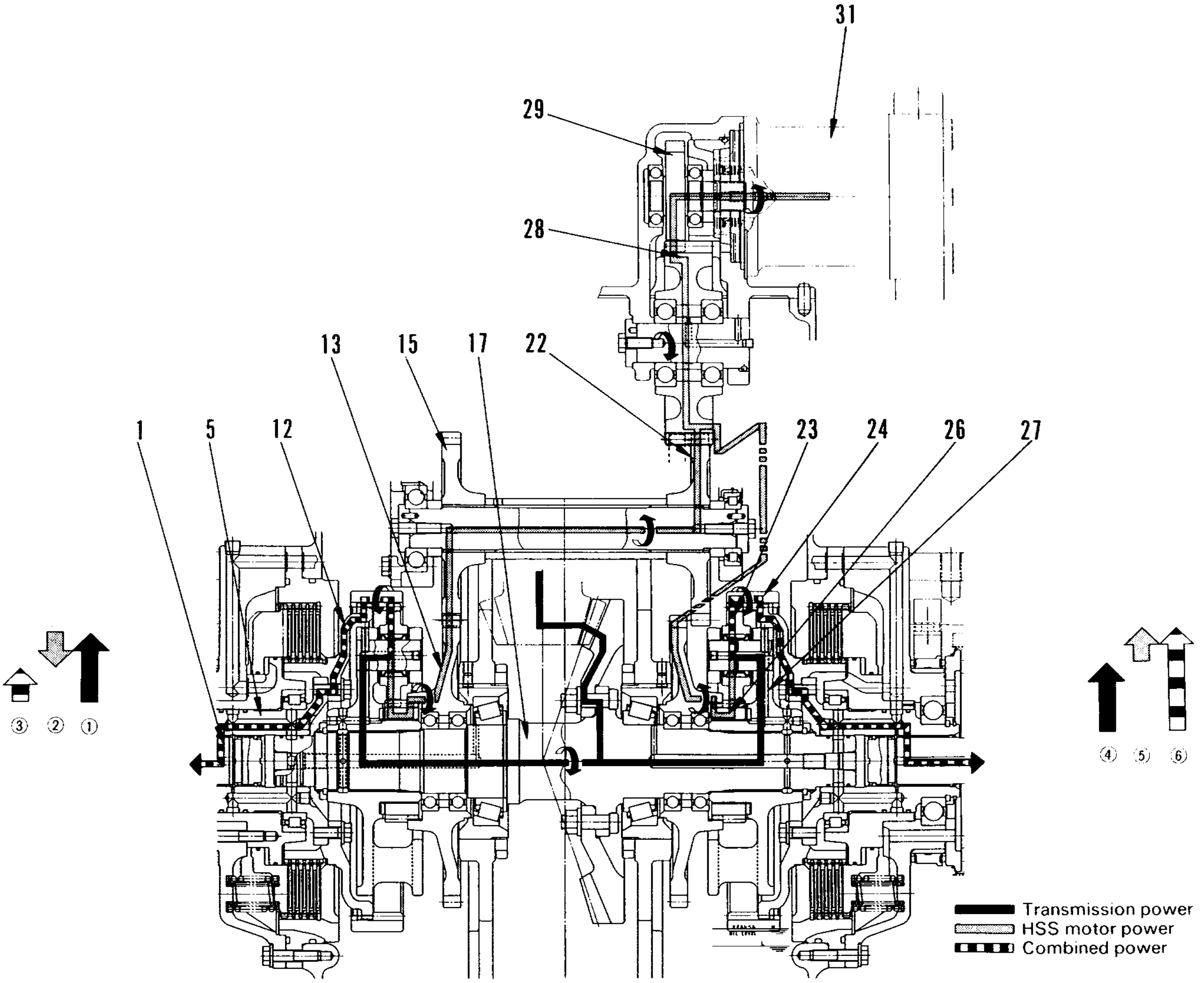
If the steering lever is operated to the right when the machine is traveling in reverse, the action of the selector valve makes HSS motor (31) rotate in the opposite direction when traveling forward. That is, the HSS motor rotates counterclockwise as seen from the left side of the machine.

At the same time, gear A (13) on the left side of the machine rotates clockwise as seen from the left side of the machine while gear A (13) on the right side of the machine rotates counterclockwise as seen from the left side of the machine.

When the machine is traveling in reverse, bevel gear shaft (17) and carrier (27) which is interconnected with the bevel gear shaft rotate counterclockwise as seen from the left side of the machine.

Therefore, considering the relationship of the rotating speed of the elements in the pairs of planetary gears, the rotating speed of ring gear (24) on the left side is faster (in the reverse direction) than when traveling in a straight line by the amount of the power of HSS motor; on the other hand, the rotating speed of ring gear (24) on the right side is slower than when traveling in a straight line, so the machine turns in reverse to the right, where the output speed is slower.

3. When steering lever is operated to left



① Transmission output speed
② Decrease in speed from HSS motor
③ Left bevel gear shaft output speed (① — ②)

④ Transmission output speed
⑤ Increase in speed from HSS motor
⑥ Right bevel gear shaft output speed (④ + ⑤)

140F12080

014012

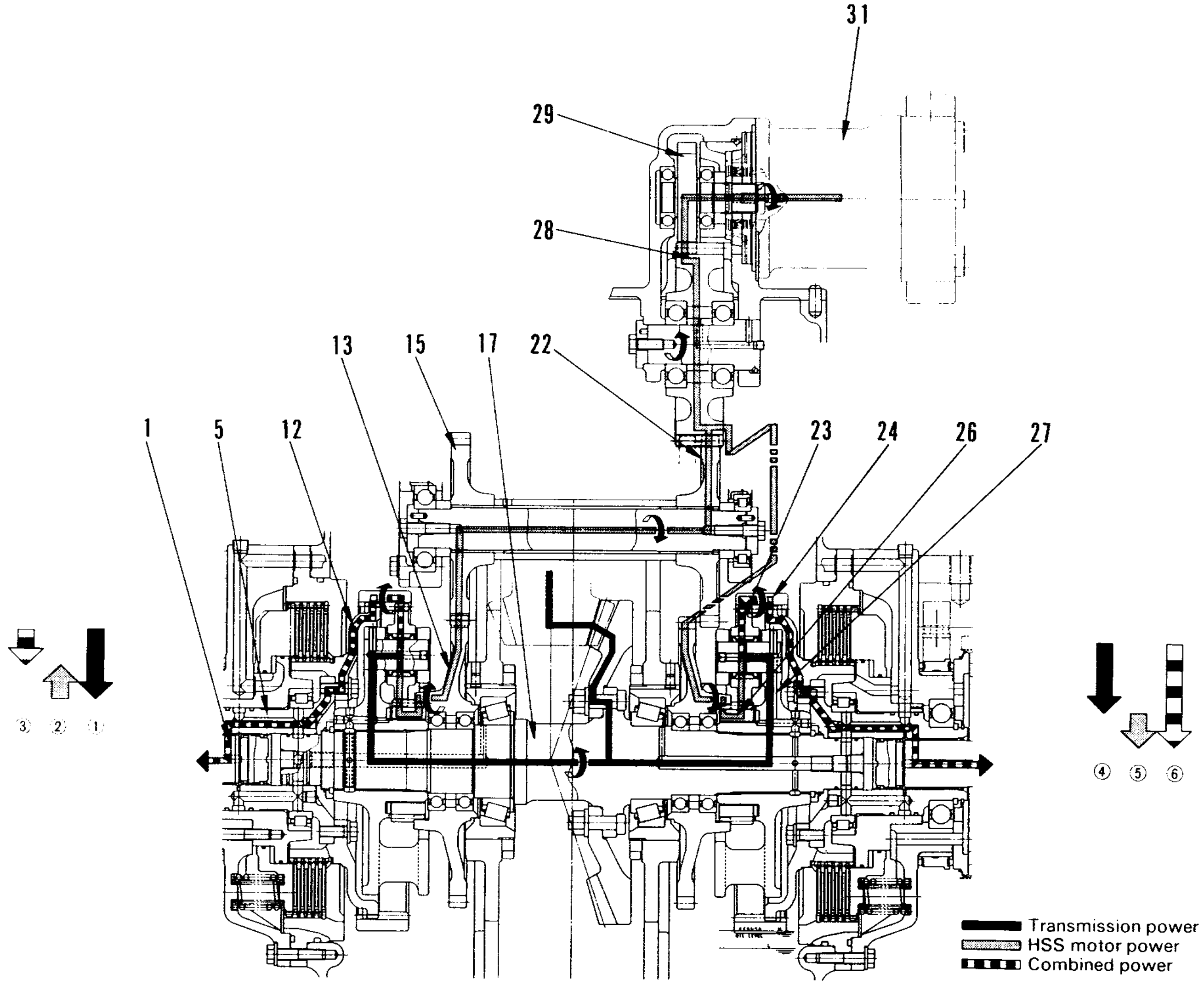
Forward

If the steering lever is operated to the left when the machine is traveling forward, HSS motor (31) rotates counterclockwise as seen from the left side of the machine.

At the same time, gear **A** (13) on the left side of the machine rotates clockwise as seen from the left side of the machine, while gear **A** (13) on the right side of the machine rotates counterclockwise as seen from the left side of the machine.

When the machine is traveling forward, bevel gear shaft (17) and carrier (27), which is interconnected with the bevel gear shaft, rotate clockwise as seen from the left side of the machine.

Therefore, considering the relationship of the rotating speed of the elements in the pairs of planetary gears, the rotating speed of ring gear (24) on the right side is faster than when traveling in a straight line by the amount of the power of HSS motor; on the other hand, the rotating speed of ring gear (24) on the left side is slower than when traveling in a straight line, so the machine turns in forward to the left, where the output speed is slower.



① Transmission output speed
② Decrease in speed from HSS motor
③ Left bevel gear shaft output speed (① — ②)

④ Transmission output speed
⑤ Increase in speed from HSS motor
⑥ Right bevel gear shaft output speed (④ + ⑤)

140F12081

Reverse

If the steering lever is operated to the left when the machine is traveling in reverse, the action of the selector valve makes HSS motor (31) rotate in the opposite direction from the traveling forward. That is, the HSS motor rotates counterclockwise as seen from the left side of the machine.

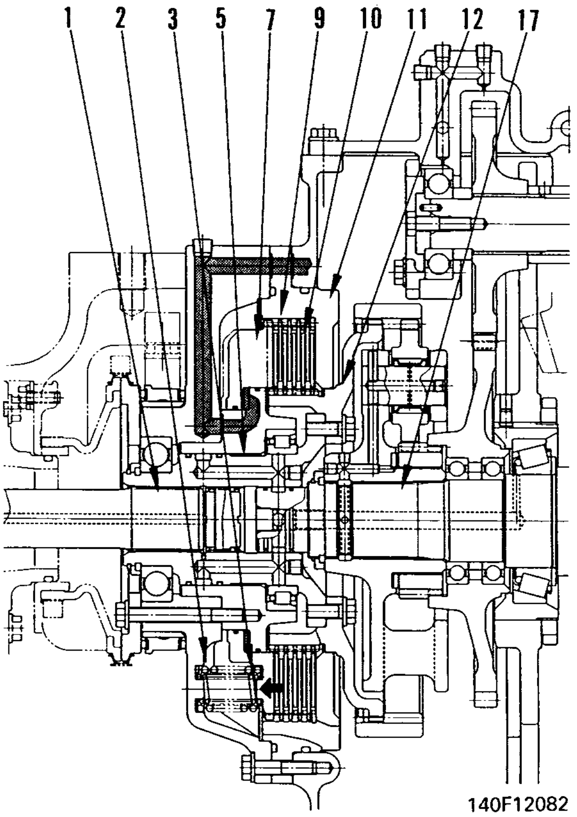
At the same time, gear **A** (13) on the left side of the machine rotates counterclockwise as seen from the left side of the machine while gear **A** (13) on the right side of the machine rotates clockwise as seen from the left side of the machine.

When the machine is traveling in reverse, bevel gear shaft (17) and carrier (27) which is interconnected with the bevel gear shaft rotate counterclockwise as seen from the left side of the machine.

Therefore, considering the relationship of the rotating speed of the elements in the pairs of planetary gears, the rotating speed of ring gear (24) on the right side is faster (in the reverse direction) than when traveling in a straight line by the amount of the power of HSS motor; on the other hand, the rotating speed of ring gear (24) on the left side is slower than when traveling in a straight line, so the machine turns in reverse to the left, where the output speed is slower.

Operation of brakes

1. **Brake released**
   When the brake is in the neutral position, the brake valve is also in the neutral position and oil enters the back-pressure port of brake piston (7).
   When the oil pressure rises, the oil pushes the piston to the left in the direction of the arrow, compresses springs (2) and (3), and releases the pressure pushing discs (10) and plates (9) together. When this happens, the power transmitted from bevel gear shaft (17) through the HSS steering to brake inner drum (12) is transmitted from hub (5) to output shaft (1), and goes to the final drive.



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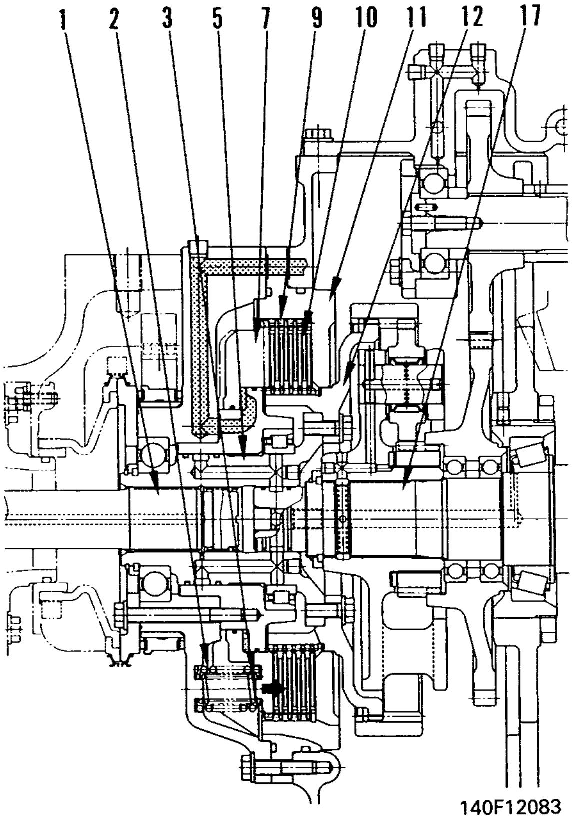
2. **Brake applied (brake pedal depressed)**
   If the brake pedal is depressed, the brake valve switches and the oil applying back pressure to piston (7) is connected to the drain circuit.
   In this condition, piston (7) is pushed out to the right in the direction of the arrow by the tension of springs (2) and (3), so discs (10) and plates (9) are pressed against the stopper portion of brake outer drum (11). The brake outer drum is joined to the steering case and is fixed in position.
   Therefore the rotation of brake inner drum (12), that is the rotation of output shaft (1), is stopped because the discs and plates are pushed into contact together.
   The hydraulic force applied to piston (7) can be controlled by the amount that the brake pedal is depressed, and the braking force can be adjusted.



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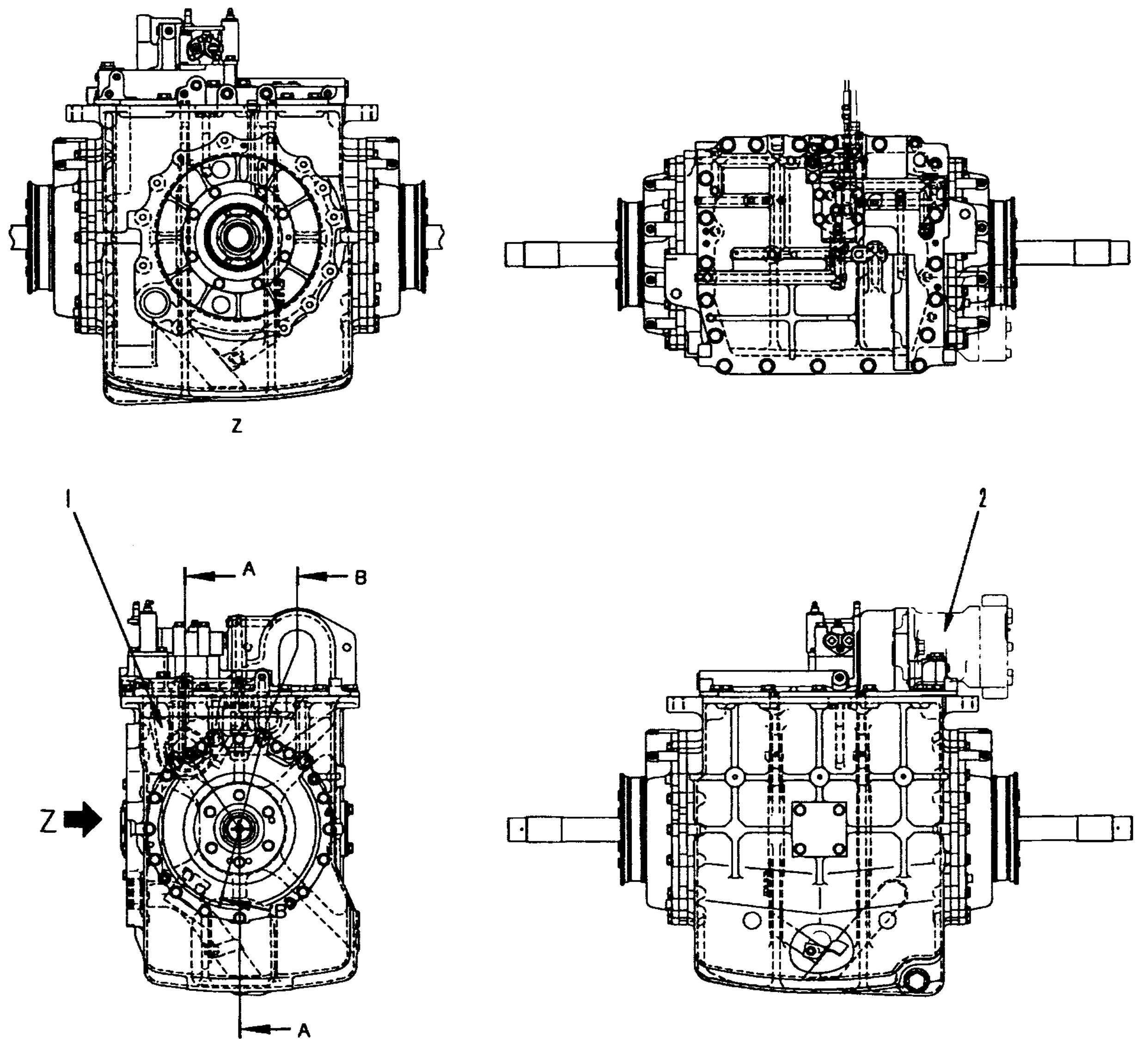
BEVEL GEAR SHAFT, HSS STERRING AND BRAKE

D65EX, PX-12 65001 and up



1. HSS steering unit
2. HSS motor

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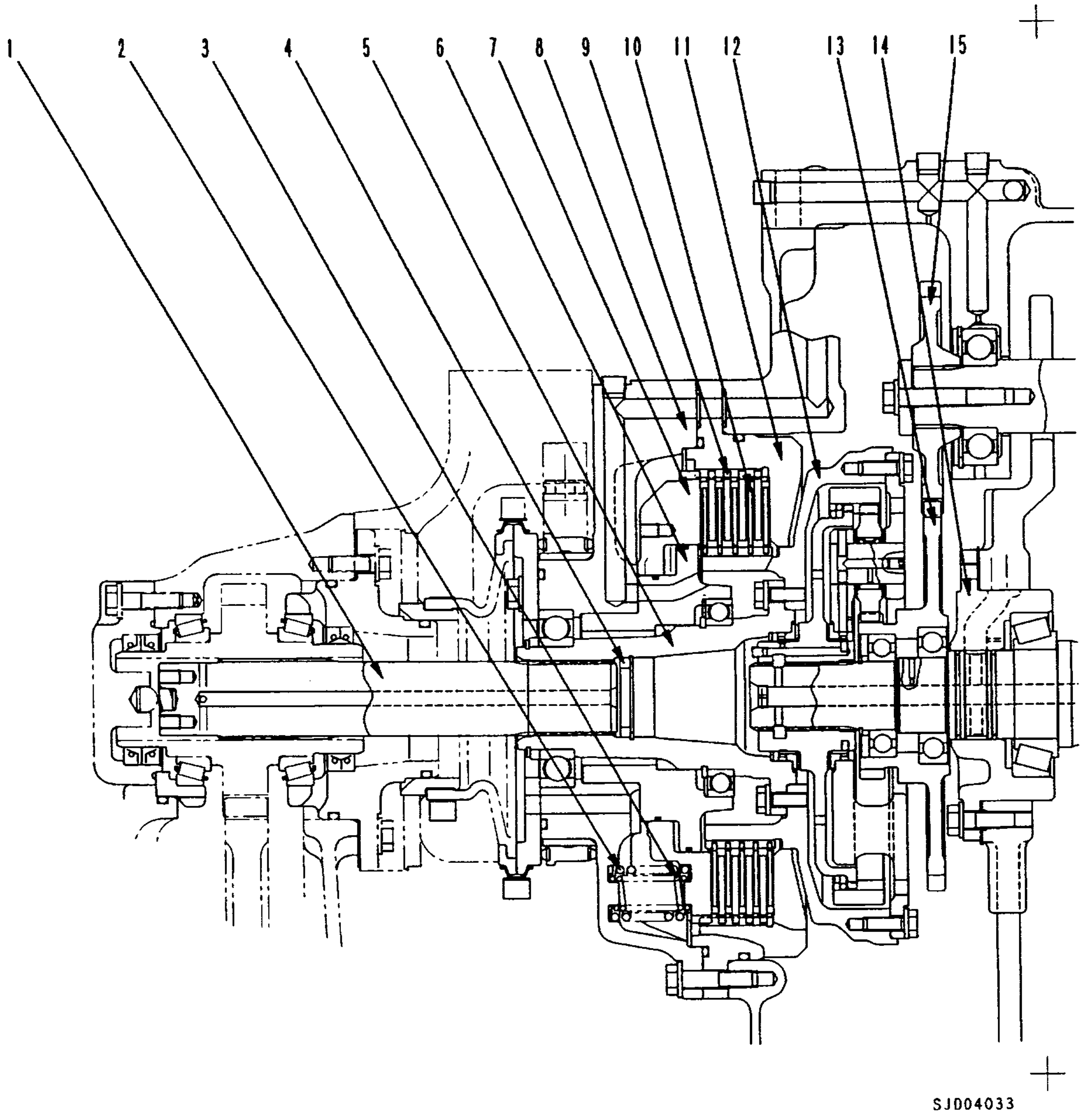
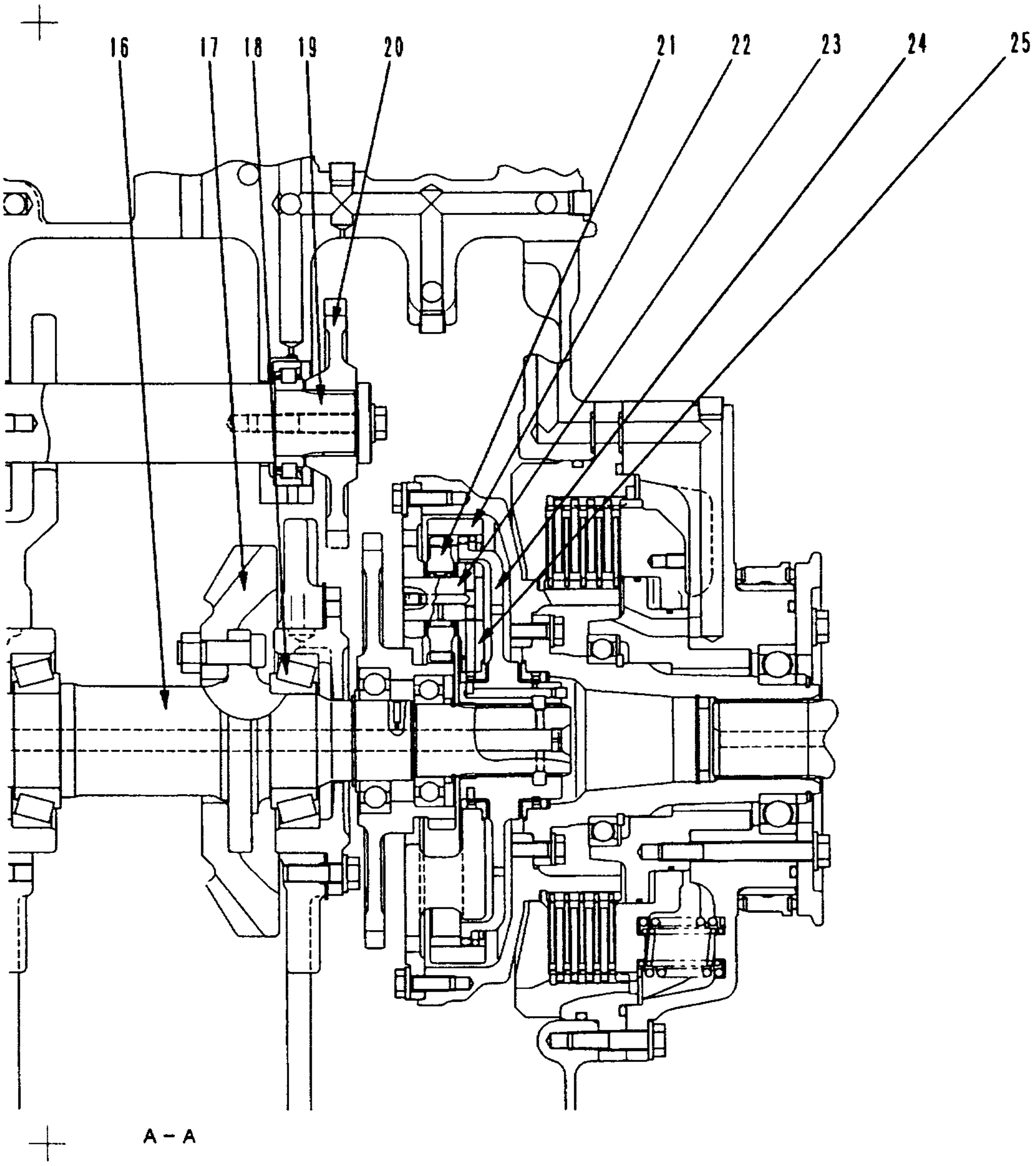
BEVEL GEAR SHAFT, HSS STEERING AND BRAKE

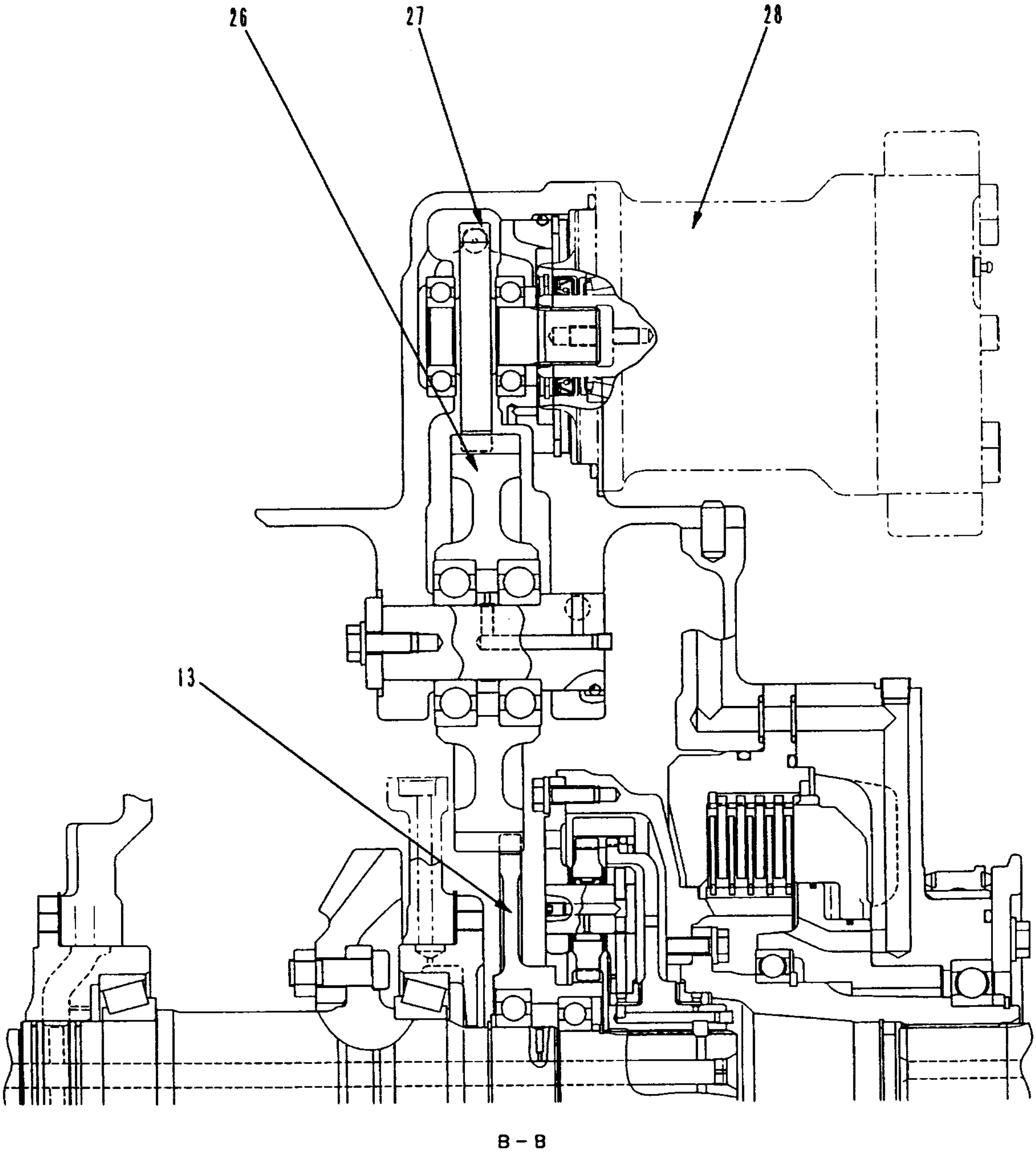


1. Output shaft
2. Brake spring (large)
3. Brake spring (small)
4. Stopper
5. Brake hub
6. Brake cage
7. Brake Piston
8. Brake cover
9. Brake plate (each side: 4)
10. Brake disc (each side: 5)
11. Brake drum
12. Brake inner drun
13. Gear A
14. Bevel gear shaft cage
15. Gear B



- 16. Bevel gear shaft
- 17. Bevel gear
- 18. Bevel gear shaft bearing
- 19. Shaft
- 20. Gear C
- 21. Planet pinion
- 22. Ring gear
- 23. Planet shaft
- 24. Ring gear hub
- 25. Carrier
- 26. Gear D
- 27. Pinion
- 28. HSS motor

014012



B – B

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OUTLINE

Bevel gear shaft

- The engine power is transmitted through the torque converter to the transmission. Then, the bevel gear shaft device engages the bevel pinion with the bevel gear to turn the engine power at right angles into the lateral direction and reduce the revolving speed.
- The bevel pinion and bevel gear of the bevel gear shaft device are spiral bevel gears, which are lubricated with oil splashed by the lubricating oil pump and scavenging pump.
- The bevel gear shaft device consists of bevel gear (17) meshed with the bevel pinion, bevel gear shaft (16), bevel gear shaft bearing (18) to support the bevel gear shaft, and bevel gear shaft cage (14).

HSS steering

- The HSS steering system consists of the transfer unit to reverse the revolution direction of the HSS motor and transmit it to gear A (13) and the planetary gear unit to increase or decrease the input for ring gear (22) and gear A (13) and output it to carrier (25). The turning direction of the machine is changed by stopping or reversing the revolution of the HSS motor.
- The transfer unit employs a spur gear speed reduction mechanism and is lubricated with oil splashed by the scavenging pump and lubricating oil pump.
- The planetary gear unit is lubricated forcedly with oil supplied by the scavenging pump and lubricating oil pump.
- The transfer unit consists of pinion (27) connected to the HSS motor by spline, gear D (26) meshed with the pinion, gear C (22) meshed with gear D, gear B (15) connected to shaft (19), gear A (13) supported by the bearing on the bevel gear shaft and meshed with gears B (15) and D (26), and cover to support these parts.
- The planetary gear unit consists of gear A (13), planet pinion (21), planet shaft (23), ring gear hub (24) connected to the bevel gear shaft and ring gear (22) by spline, and carrier (25) connected to brake inner drum (12).

Brake

- The brake is installed specially to brake the machine and connected to the brake inner drum (12).

- The brake is a wet-type, multiple disc clutch-type, spring force brake. It is driven hydraulically by the brake valve operated with brake pedal.
  The brake is lubricated forcedly with oil supplied by the power train lubricating oil pump and scavenging pump. The lubricating oil flows through the paths in the steering case, housing, cage, disc, and plate.
  While the engine is stopped, even if the brake pedal is not pressed, the back pressure of the brake piston lowers and the brake is "applied". After the engine is started again, however, as the hydraulic pressure in the circuit rises, the brake is "released". Accordingly, the parking brake must be kept locked.
  The brake consists of ring gear (22), inner drum (12) connected to brake hub (5), disc (10) meshed with the inner drum, plate (9), the periphery of which is connected to the brake drum (11) by spline, brake drum (11), piston (7) to press the disc and plate against each other, springs (2) and (3), and cage (6), brake cover (8), and output shaft (1) to support these parts.
  Brake drum (11) and brake cover (8) are fixed to the steering case.
  Output shaft (1) are connected to the brake hub by spline and fixed by stopper (4) in the axial direction.

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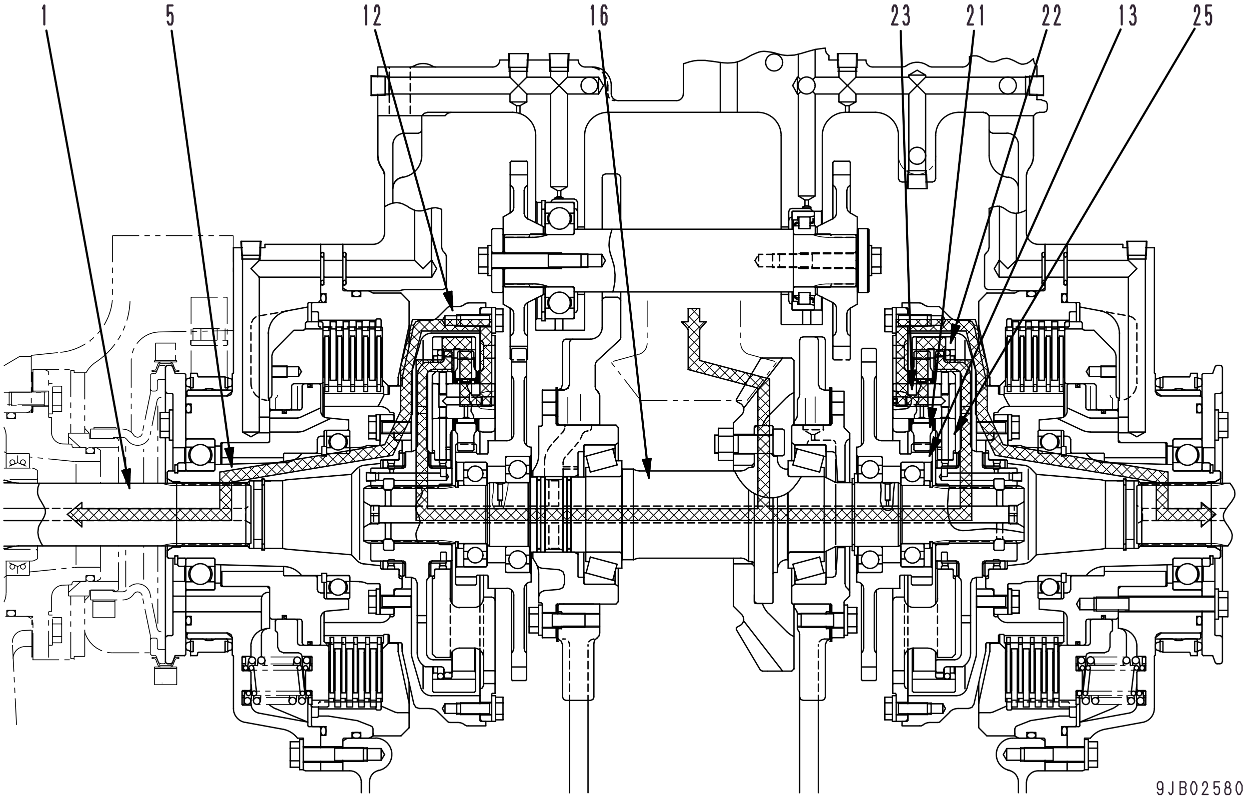
Operation of HSS steering

1. Steering lever at neutral



Traveling in the straight line

When the steering lever is at the neutral position, HSS motor is stopped, and the rotation of the transfer gear and left and right gears A (13) in the planetary system is also stopped.

In this condition, the power from bevel gear shaft (16) is input to carrier (25), and is transmitted to ring gear (22) through planet shaft (23) and planet pinion (21). It is then transmitted to output shaft (1) through brake inner drum (12), and brake hub (5).

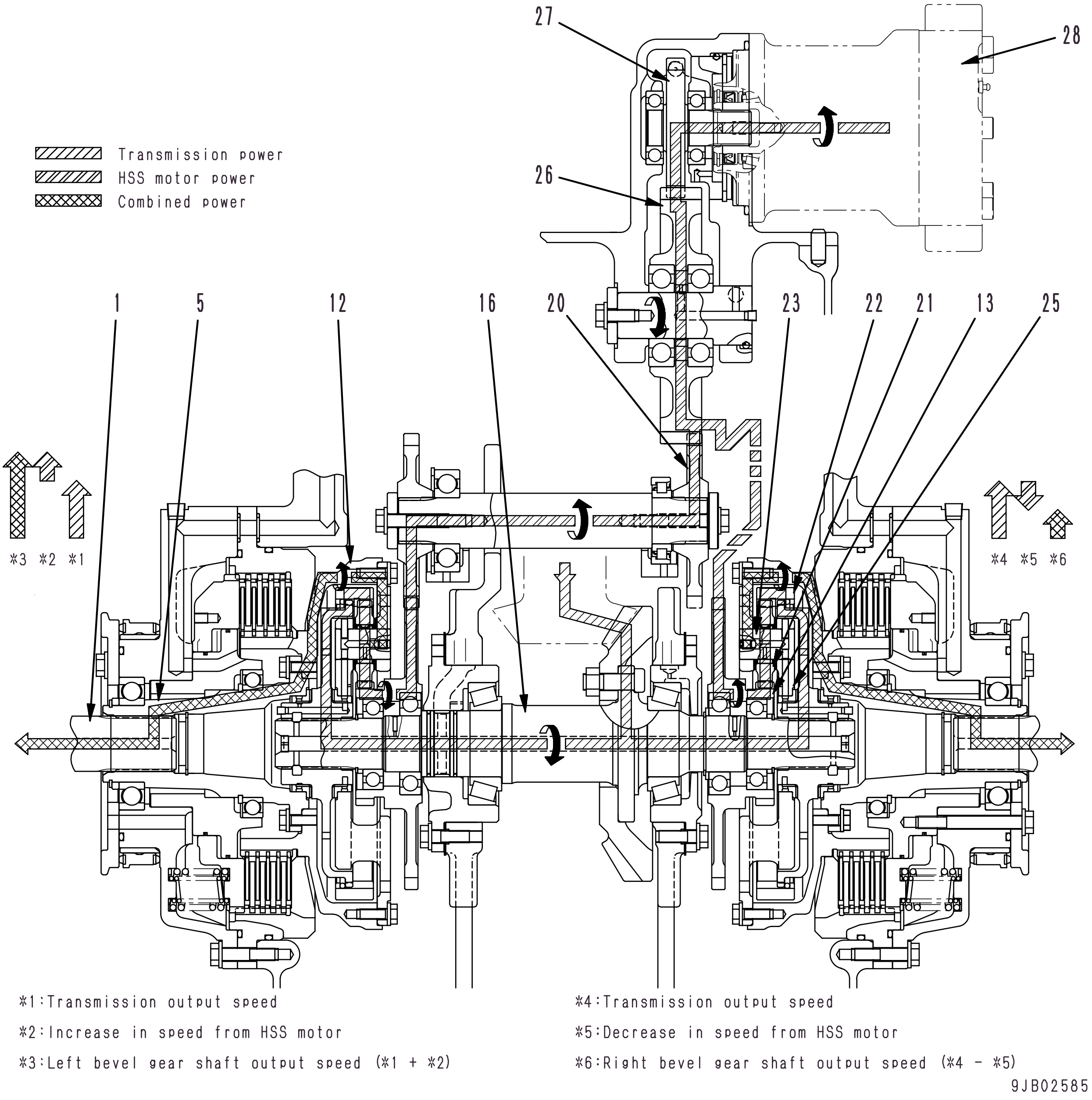
Therefore, the output speed on the left and right sides in the same, and the machine travles in a straight line.

Direction of rotation of HSS motor

Steering lever position	Left steering			Right steering			Neutral
Directional lever position	* Neutral	Forward	Reverse	* Neutral	Forward	Reverse	Any position
Direction of rotation of HSS motor as seen from left of machine	Clockwise	Clockwise	Counter-clockwise	Counter-clockwise	Counter-clockwise	Clockwise	Does not rotate

* Pivot turn

2. When steering lever is operated to right

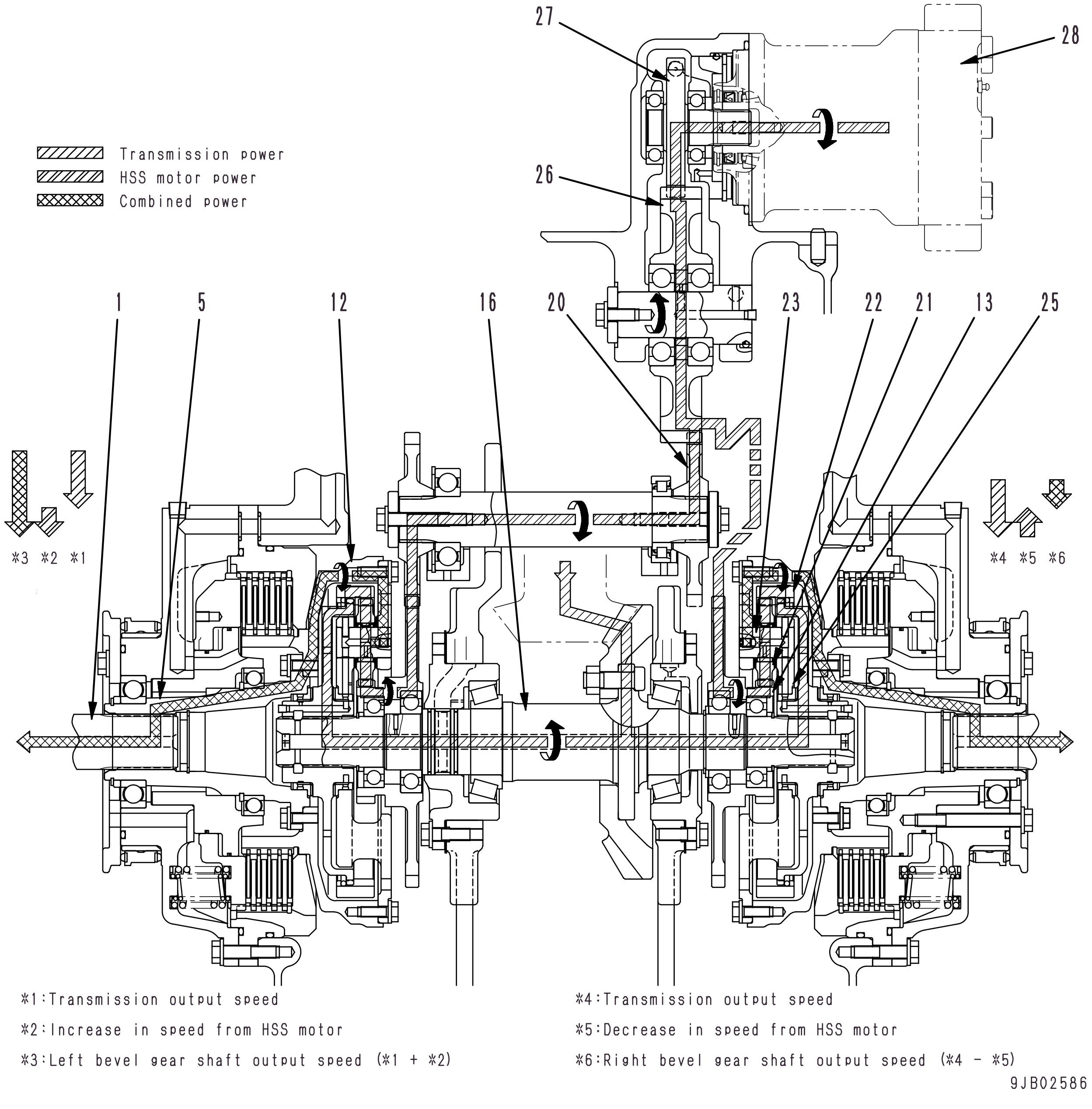


Forward

If the steering lever is operated to the right when the machine is traveling forward, HSS motor (28) rotates counterclockwise as seen from the left side of the machine. At the same time, gear A (13) on the left side of the machine rotates clockwise as seen from the left side of the machine, while gear A (13) on the right side of the machine rotates counterclockwise as seen from the left side of the machine.

When the machine is traveling forward, bevel gear shaft (16) and ring gear (22), which is interconnected with the bevel gear shaft, rotate clockwise as seen from the left side of the machine.

Therefore, considering the relationship of the rotating speed of the elements in the pairs of planetary gears, the rotating speed of ring gear (22) on the left side is faster than when traveling in a straight line by the amount of the power of HSS motor; on the other hand, the rotating speed of ring gear (22) on the right side is slower than when traveling in a straight line, so the machine turns in forward to the right, where the output speed is slower.



Reverse

If the steering lever is operated to the right when the machine is traveling in reverse, the action of the selector valve makes HSS motor (28) rotate in the opposite direction when traveling forward.

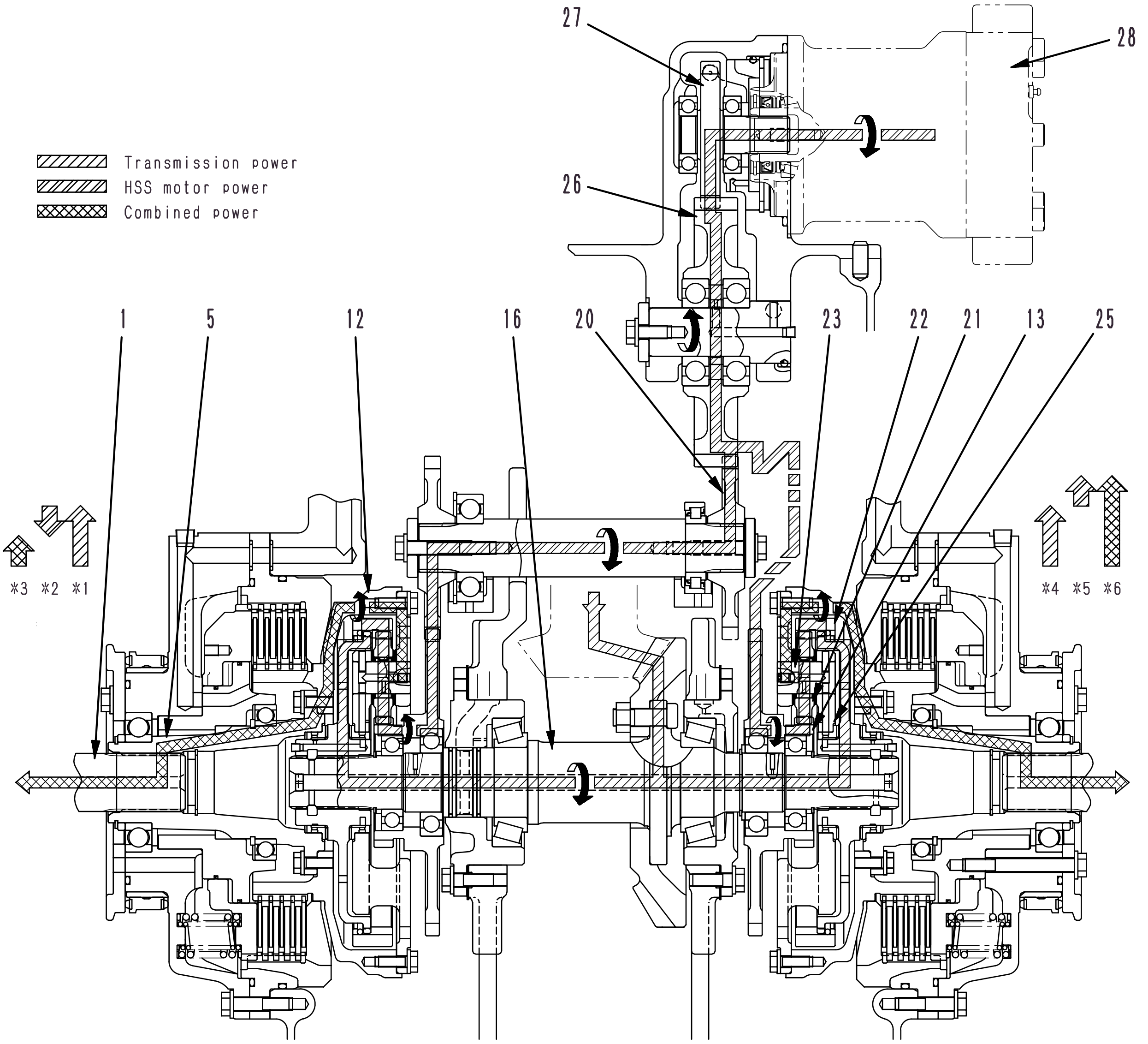
That is, the HSS motor rotates clockwise as seen from the left side of the machine.

At the same time, gear A (13) on the left side of the machine rotates counterclockwise as seen from the left side of the machine while gear A (13) on the right side of the machine rotates clockwise as seen from the left side of the machine.

When the machine is traveling in reverse, bevel gear shaft (16) and ring gear (22), which is interconnected with the bevel gear shaft, rotate counterclockwise as seen from the left side of the machine.

Therefore, considering the relationship of the rotating speed of the elements in the pairs of planetary gears, the rotating speed of ring gear (22) on the left side is faster (in the reverse direction) than when traveling in a straight line by the amount of the power of HSS motor; on the other hand, the rotating speed of ring gear (22) on the right side is slower than when traveling in a straight line, so the machine turns in reverse to the right, where the output speed is slower.

3. When steering lever is operated to left



*1:Transmission output speed
*2:Decrease in speed from HSS motor
*3:Left bevel gear shaft output speed (*1 − *2)

*4:Transmission output speed
*5:Increase in speed from HSS motor
*6:Right bevel gear shaft output speed (*4 + *5)

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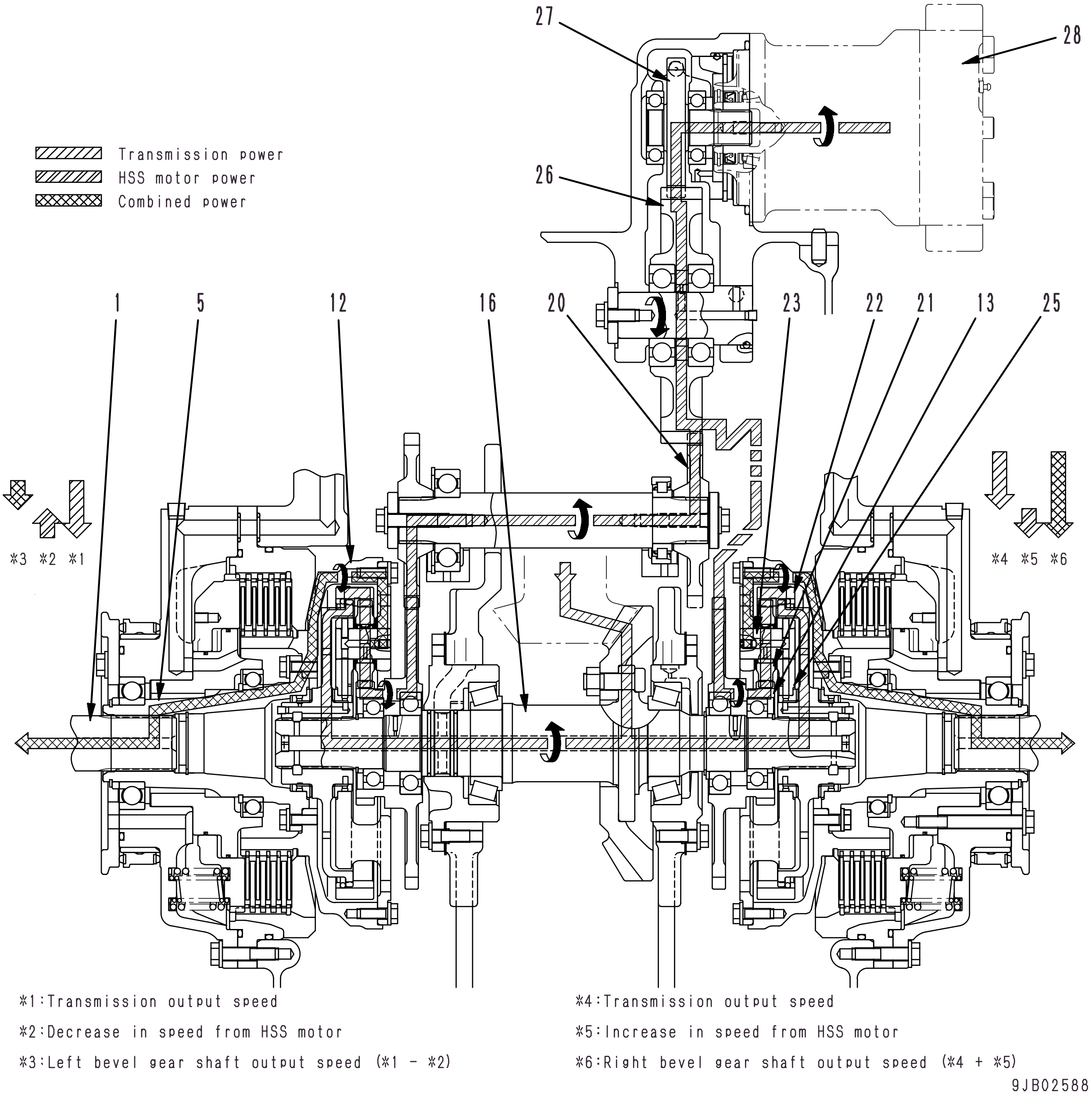
Forward

If the steering lever is operated to the left when the machine is traveling forward, HSS motor (28) rotates clockwise as seen from the left side of the machine.

At the same time, gear A (13) on the left side of the machine rotates counterclockwise as seen from the left side of the machine, while gear A (13) on the right side of the machine rotates clockwise as seen from the left side of the machine.

When the machine is traveling forward, bevel gear shaft (16) and ring gear (22), which is interconnected with the bevel gear shaft, rotate clockwise as seen from the left side of the machine.

Therefore, considering the relationship of the rotating speed of the elements in the pairs of planetary gears, the rotating speed of ring gear (22) on the right side is faster than when traveling in a straight line by the amount of the power of HSS motor; on the other hand, the rotating speed of ring gear (22) on the left side is slower than when traveling in a straight line, so the machine turns in forward to the left, where the output speed is slower.



Reverse

If the steering lever is operated to the left when the machine is traveling in reverse, the action of the selector valve makes HSS motor (28) rotate in the opposite direction from the traveling forward.

That is, the HSS motor rotates counterclockwise as seen from the left side of the machine.

At the same time, gear A (13) on the left side of the machine rotates clockwise as seen from the left side of the machine, while gear A (13) on the right side of the machine rotates counterclockwise as seen from the left side of the machine.

When the machine is traveling in reverse, bevel gear shaft (16) and ring gear (22), which is interconnected with the bevel gear shaft rotate counterclockwise as seen from the left side of the machine.

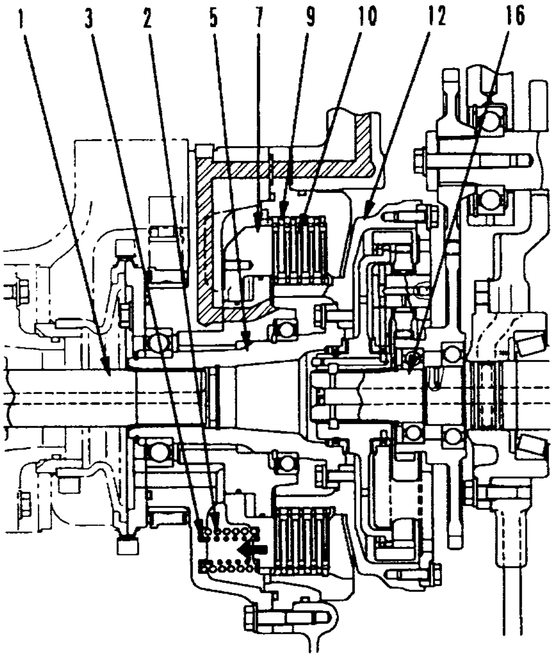
Therefore, considering the relationship of the rotating speed of the elements in the pairs of planetary gears, the rotating speed of ring gear (22) on the right side is faster (in the reverse direction) than when traveling in a straight line by the amount of the power of HSS motor; on the other hand, the rotating speed of ring gear (22) on the left side is slower than when traveling in a straight line, so the machine turns in reverse to the left, where the output speed is slower.

Operation of brakes

1. Brake released

When the brake is in the neutral position, the brake valve is also in the neutral position and oil enters the back-pressure port of brake piston (7).

When the oil pressure rises, the oil pushes the piston to the left in the direction of the arrow, compresses springs (2) and (3), and releases the pressure pushing discs (10) and plates (9) together. When this happens, the power transmitted from bevel gear shaft (16) through the HSS steering to brake inner drum (12) is transmitted from hub (5) to output shaft (1), and goes to the final drive.



SWD04041

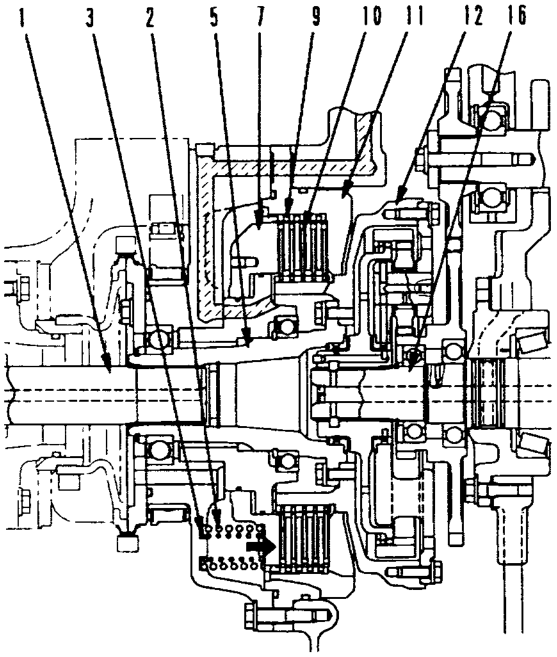
2. Brake applied (brake pedal depressed)

If the brake pedal is depressed, the brake valve switches and the oil applying back pressure to piston (7) is connected to the drain circuit.

In this condition, piston (7) is pushed out to the right in the direction of the arrow by the tension of springs (2) and (3), so discs (10) and plates (9) are pressed against the stopper portion of brake outer drum (11). The brake outer drum is joined to the steering case and is fixed in position.

Therefore, the rotation of brake inner drum (12), that is the rotation of output shaft (1), is stopped because the discs and plates are pushed into contact together.

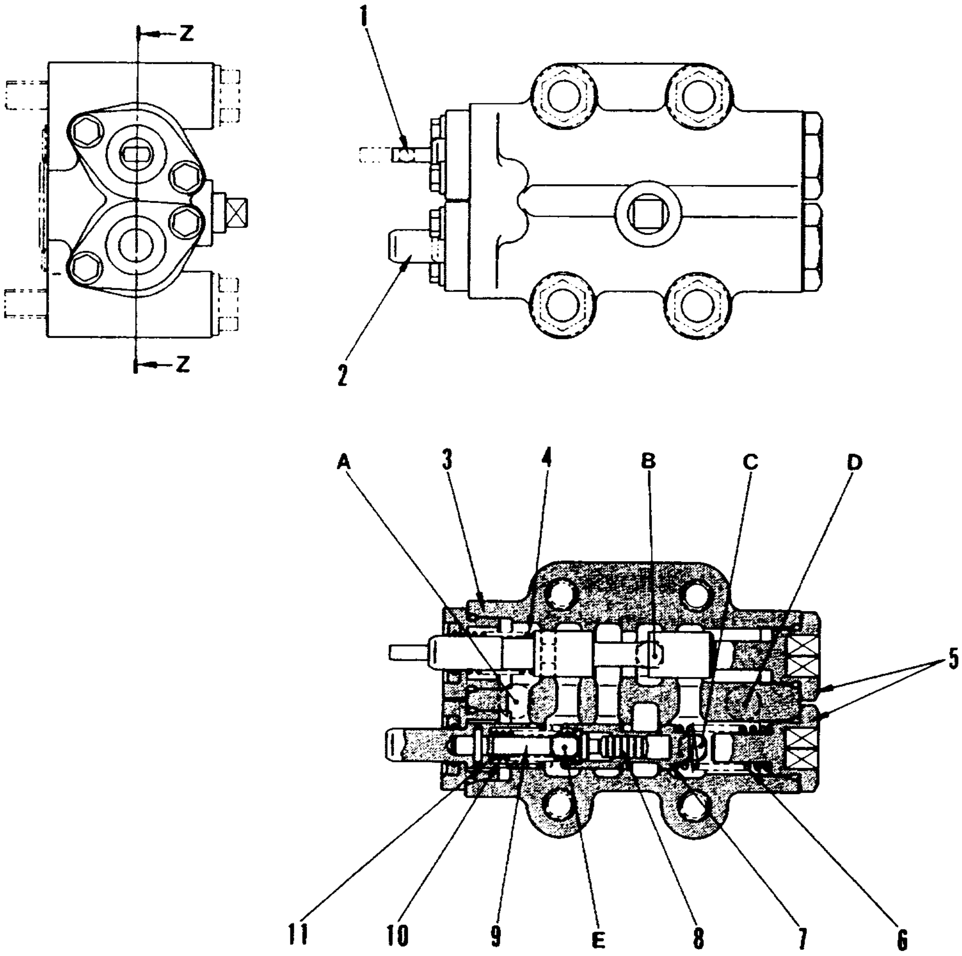
The hydraulic force applied to piston (7) cab be controlled by the amount that the brake pedal is depressed, and the braking force can be adjusted.



SWD04042

BEVEL GEAR SHAFT, HSS BRAKE VALVE

D65EX, PX-12



1. Parking brake valve
2. Main brake valve
3. Body
4. Return spring
5. Plug
6. Return spring
7. Valve
8. Piston
9. Shaft
10. Modulating spring
11. Guide

A. Port **Br** (R) (to right brake)
B. Port **P**
C. Port **T2** (main brake valve drain)
D. Port **Br** (L) (to left brake)
E. Port **T1** (parking brake valve drain)

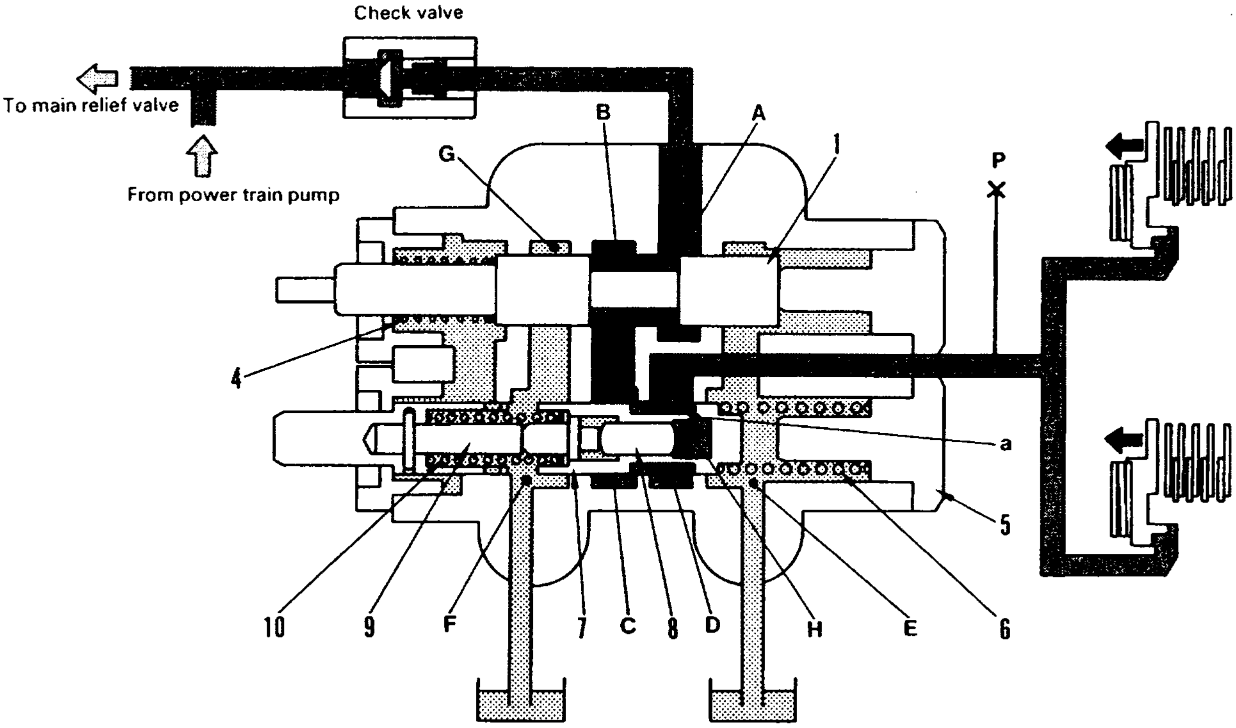
OUTLINE

- The brake valve is in the circuit between the power train pump through the main relief valve and the piston of the brake inside the HSS unit. It consists of the main brake valve and parking brake valve.
- When the brake pedal is depressed, the flow of oil to the brake piston is shut off, the brake piston pushes the disc and plate together under the force of the spring, and the brake is applied.

  In the case of the HSS, the brakes are used only for braking (the brakes have no connection with the steering control), so the left and right brakes are both applied at the same time.

OPERATION

1. When brake is released (parking brake OFF, brake pedal released)



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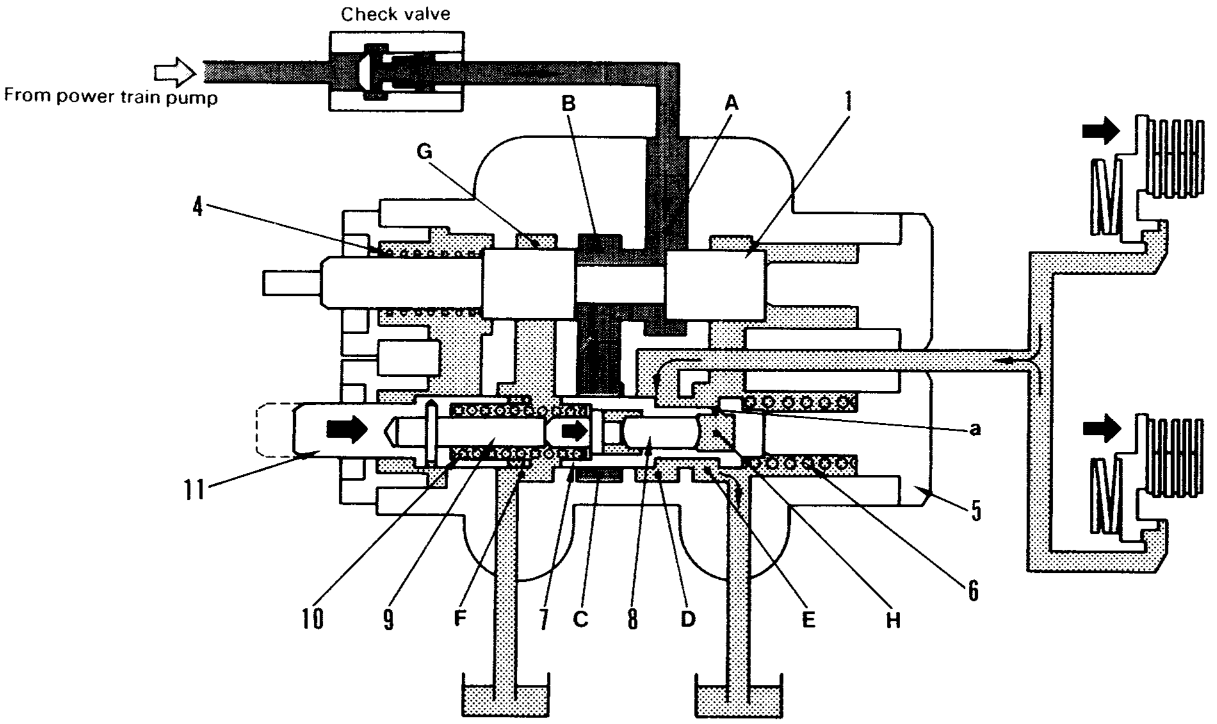
- When the brake pedal is at the released position (not depressed), the oil ports of each valve are opened or closed by the tension of the spring.
  The oil from the power train pump passes through the main relief valve, enters port **A**, then passes through ports **B**, **C**, and **D**, and flows to the back pressure port of the brake piston. It moves the piston to the left in the direction of the arrow, and compresses the brake spring to release the brake. The pressure at this point is balanced at 2.6 MPa (27 kg/ cm^2), and it can be measured at pressure detection port **P**.

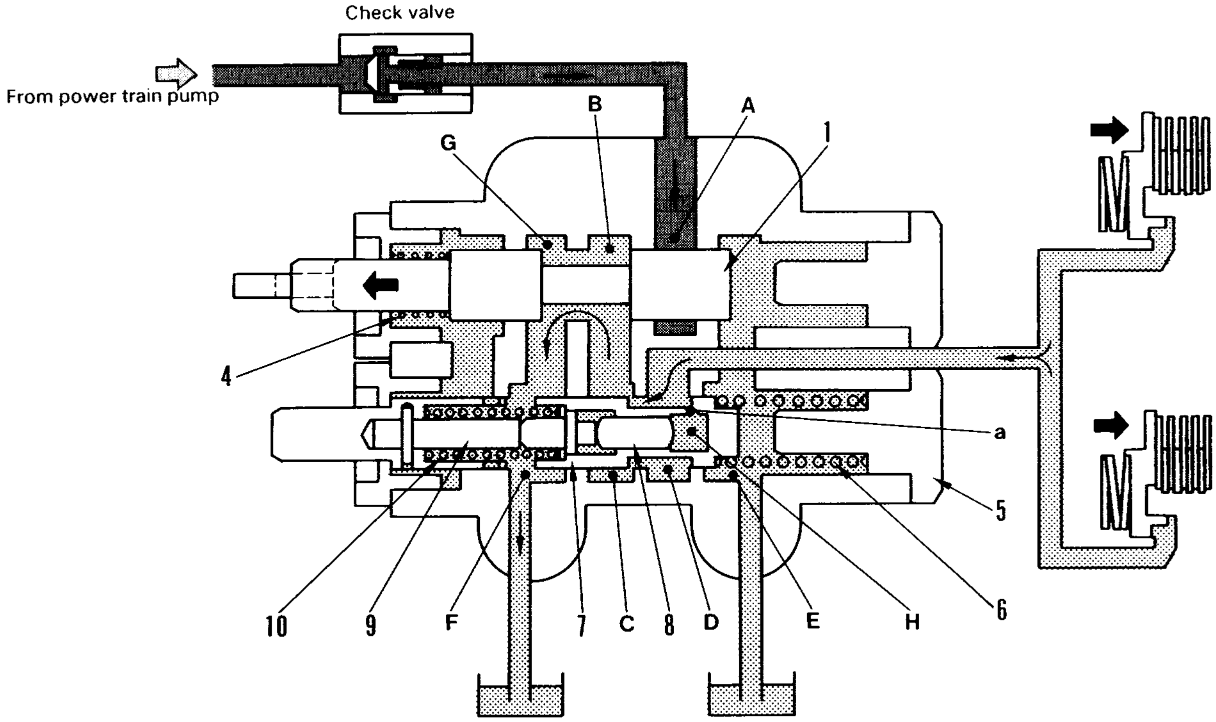
2. When brake is applied (parking brake OFF, brake pedal depressed)



140F12086

- When the brake pedal is depressed, guide (11) and shaft (9) are pushed to the right in the direction of the arrow, and modulating spring (10) is compressed. The reaction force moves brake valve (7) to the right in the direction of the arrow. When this happens, ports **C** and **D** are closed, and port **D** and drain port **E** are opened, so the oil from the power train pump enters port **A** and stops at port **C**. Some of the oil flowing into the brake piston port and forming the back pressure is drained from port **D** to port **E**, and the rest of the oil passes from port **D** through orifice **a** and enters port **H**. However, the oil beyond port **D** is drained to port **E**, so the oil pressure drops. The oil entering port **H** pushes piston (8) and the reaction force pushing brake valve (7) to the right in the direction of the arrow becomes smaller, so brake valve (7) is moved to the left in the direction of the arrow by the tension of return spring (6). This closes ports **D** and **E**, so the oil pressure beyond port **D** does not drop any further and is maintained at the same level.
- If the brake pedal is depressd further, the above operation is repeated, and when the valve reaches the end of its stroke, the brake is completely applied.
- The oil pressure beyond port **D** is determined by the tension of return spring (6), which changes the load according to the amount that the brake pedal is operated.
  Therefore, if the brake pedal is depressed only a short distance, the oil pressure beyond port **D** is set at a high level, and the brake is partially applied. If the brake pedal is depressed a large amount, the oil pressure is set at a low level and the brake is applied.

3. When parking brake is ON (brake pedal is released, brake lock lever at LOCK)



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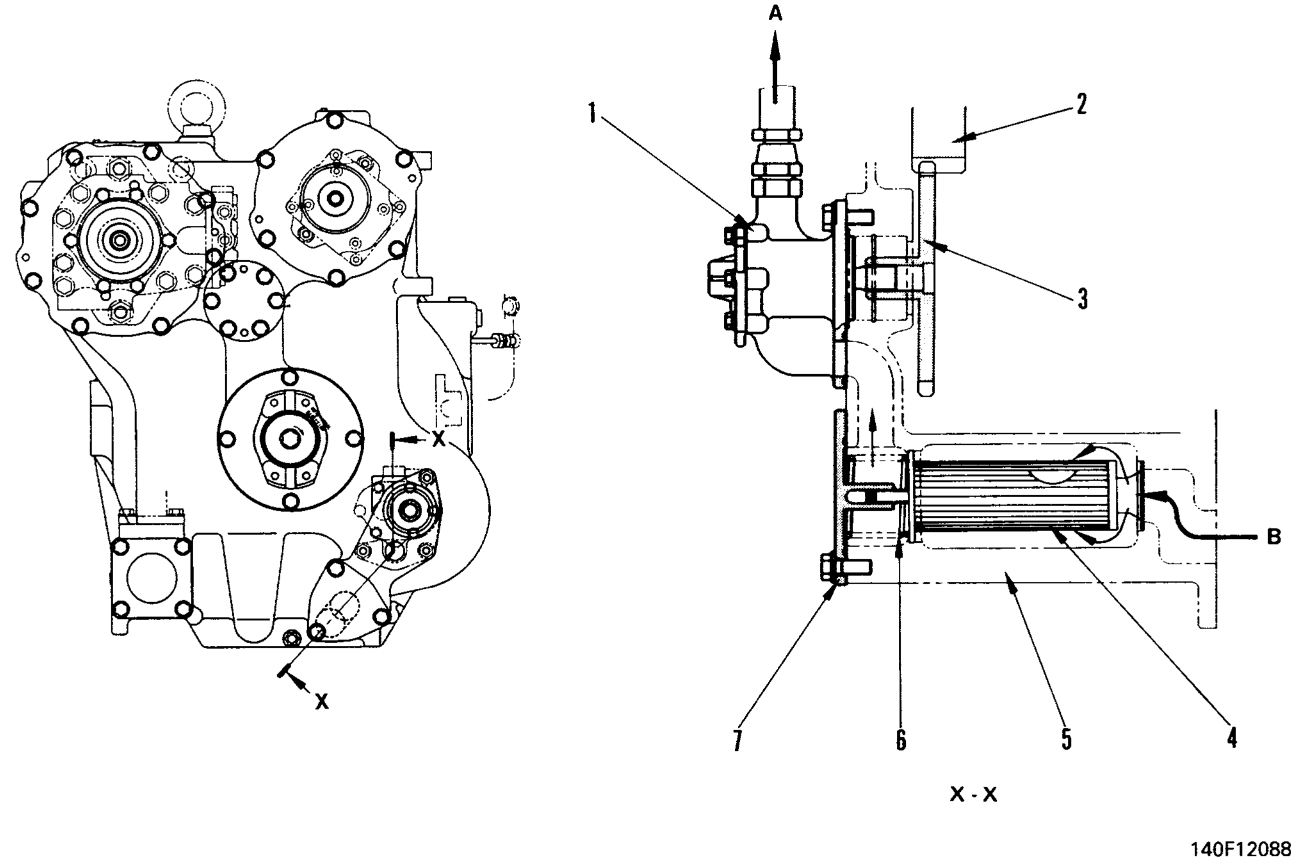
- If the brake lock lever (safety lever) is placed at the LOCK position, parking brake valve (1) is pulled to the left in the direction of the arrow. When this happens, port **A** and port **B** are closed, and port **B** and port **G** are opened. the oil from the power train pump enters port **A** and stops.
- The oil flowing to the brake piston port and forming the back pressure passes from port **D** to ports **C**, **B**, **G**, and **F**, and is drained. Parking brake valve (1) remains pulled to the left in the direction of the arrow and is fixed in position, so the back pressure of the brake piston port continues to drop. The brake is completely applied, and this condition is maintained.
  This condition is maintained even when the engine is started again.

SCAVENGING PUMP STRAINER

★ **The diagram shows D65E, P-12.**



1. Scavenging pump
2. PTO drive gear (No. of teeth: 62)
3. Scavenging pump drive gear (No. of teeth: 56)
4. Strainer
5. PTO case
6. Spring
7. Cover

A. To steering unit lubrication
B. From transmission case

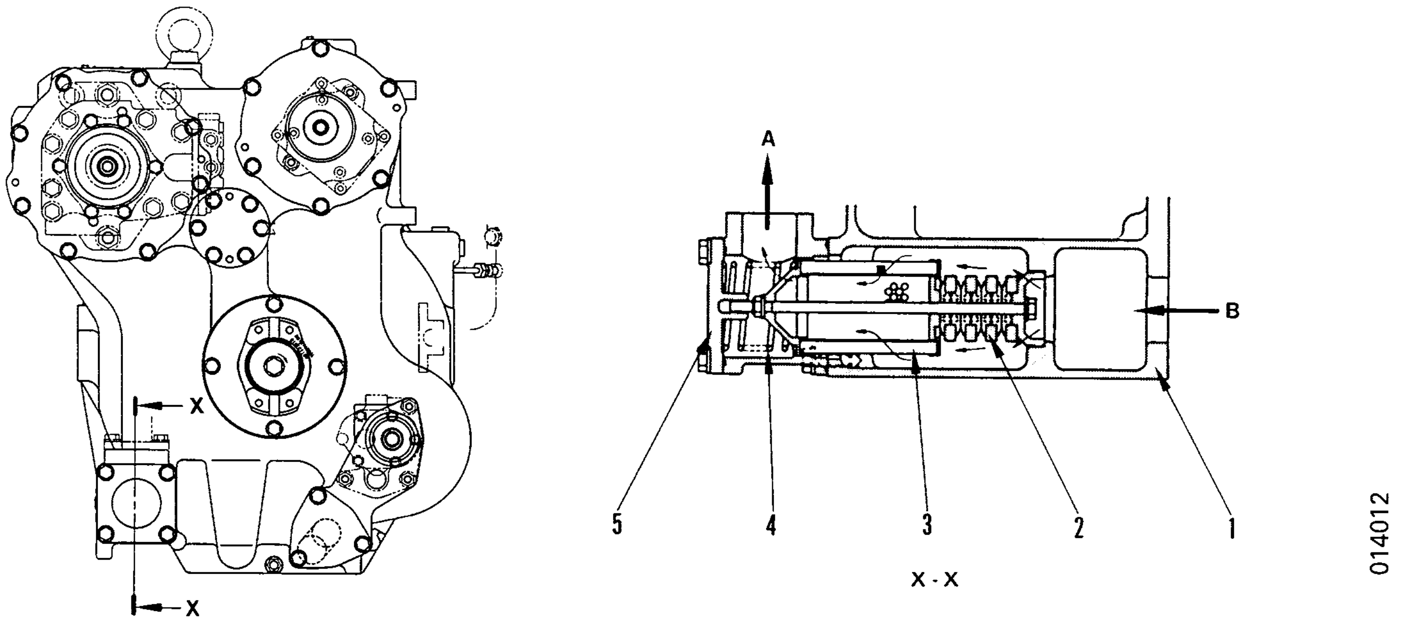
OUTLINE

- Scavenging pump (1) is driven by PTO drive gear (2). The oil sucked up from the transmission case is sent to the steering unit lubrication circuit.

	Capacity
Filtering particle size	100 mesh
Filtering area	1,520 cm^2

POWER TRAIN OIL STRAINER

★ The diagram shows the D65E, P-12.



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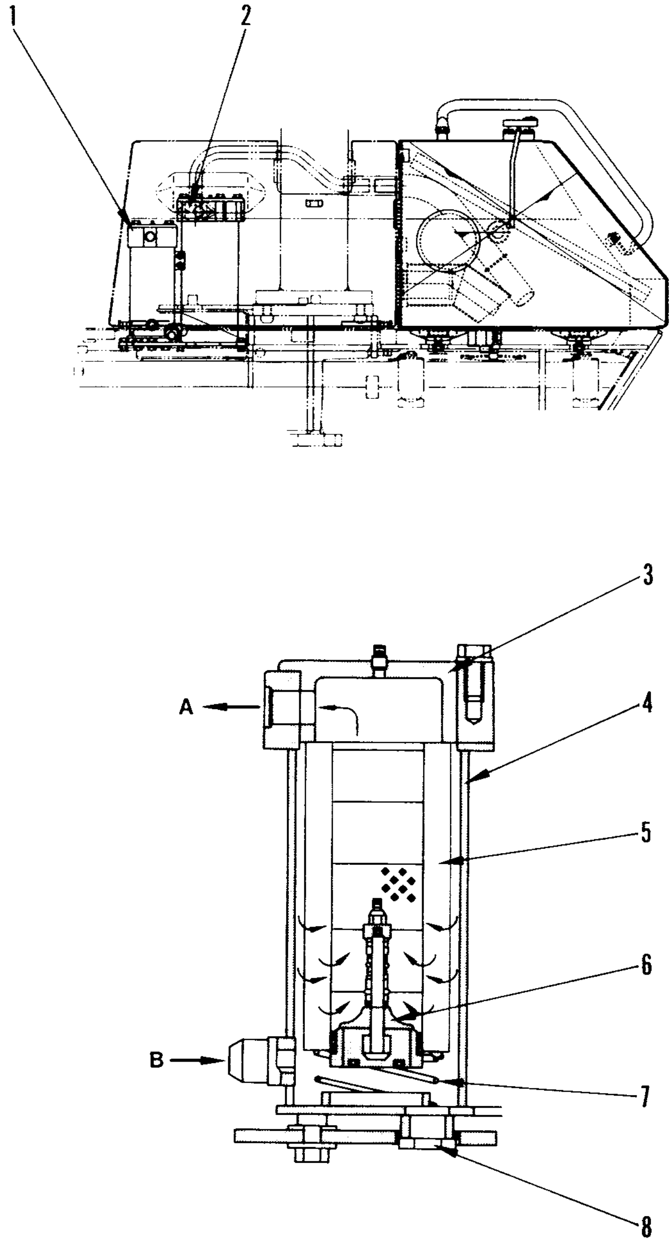
1. PTO case
2. Magnet ┐
3. Strainer ┘ Magnet assembly
4. Spring
5. Cover

A. To power train lubrication pump
B. From power train oil tank

	Capacity
Filtering particle size	100 mesh
Filtering area	2,100 cm^2
Pressure resistance	0.2 MPa (2.0 kg/cm^2)

POWER TRAIN OIL FILTER



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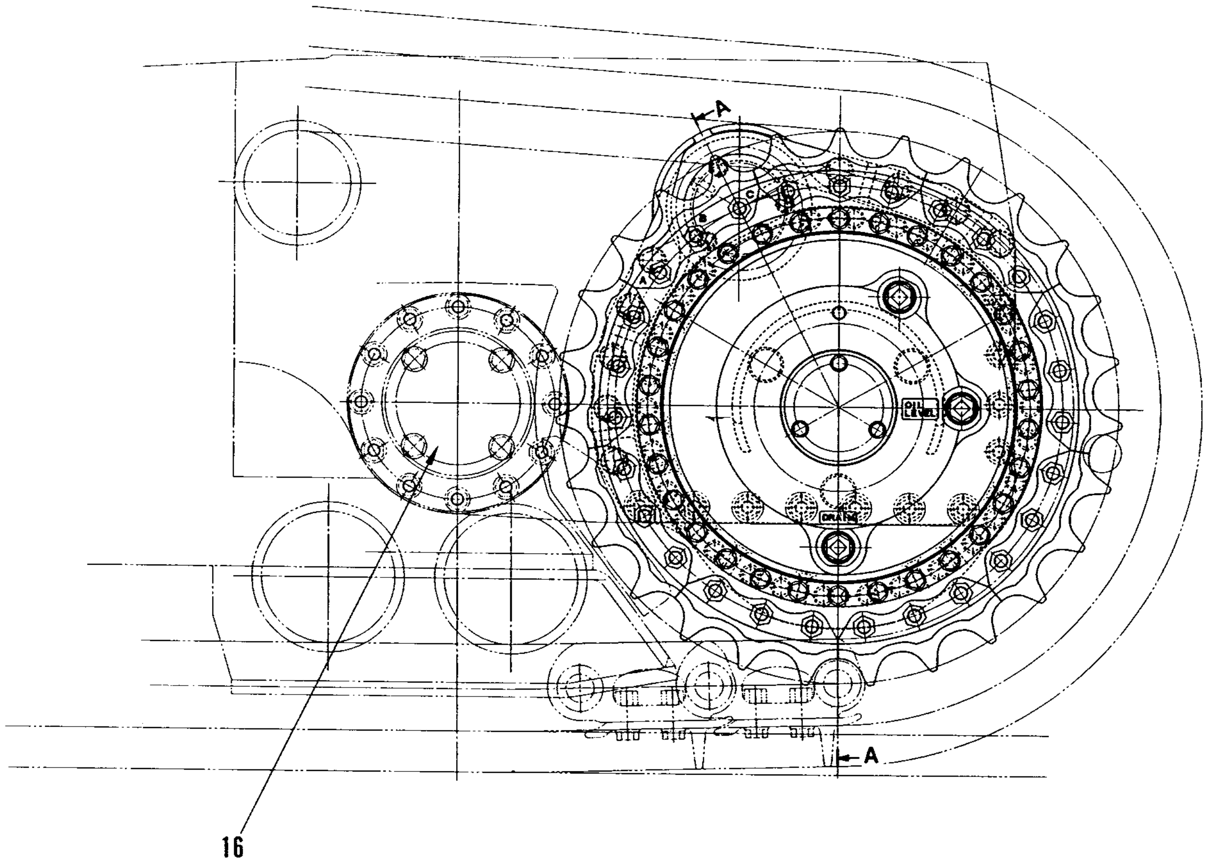
1. Power train oil filter
2. Hydraulic tank oil filter
3. Cover
4. Body
5. Element
6. Valve
7. Spring
8. Drain plug

A. To transmission case
B. From power train pump

	Capacity
Cracking pressure	0.15 ± 0.02 MPa (1.5 ± 0.2 kg/cm^2)
Filtering particle size	30 μm
Filtering area	5,400 cm^2
Filtering oil flow	95 ℓ/min

FINAL DRIVE



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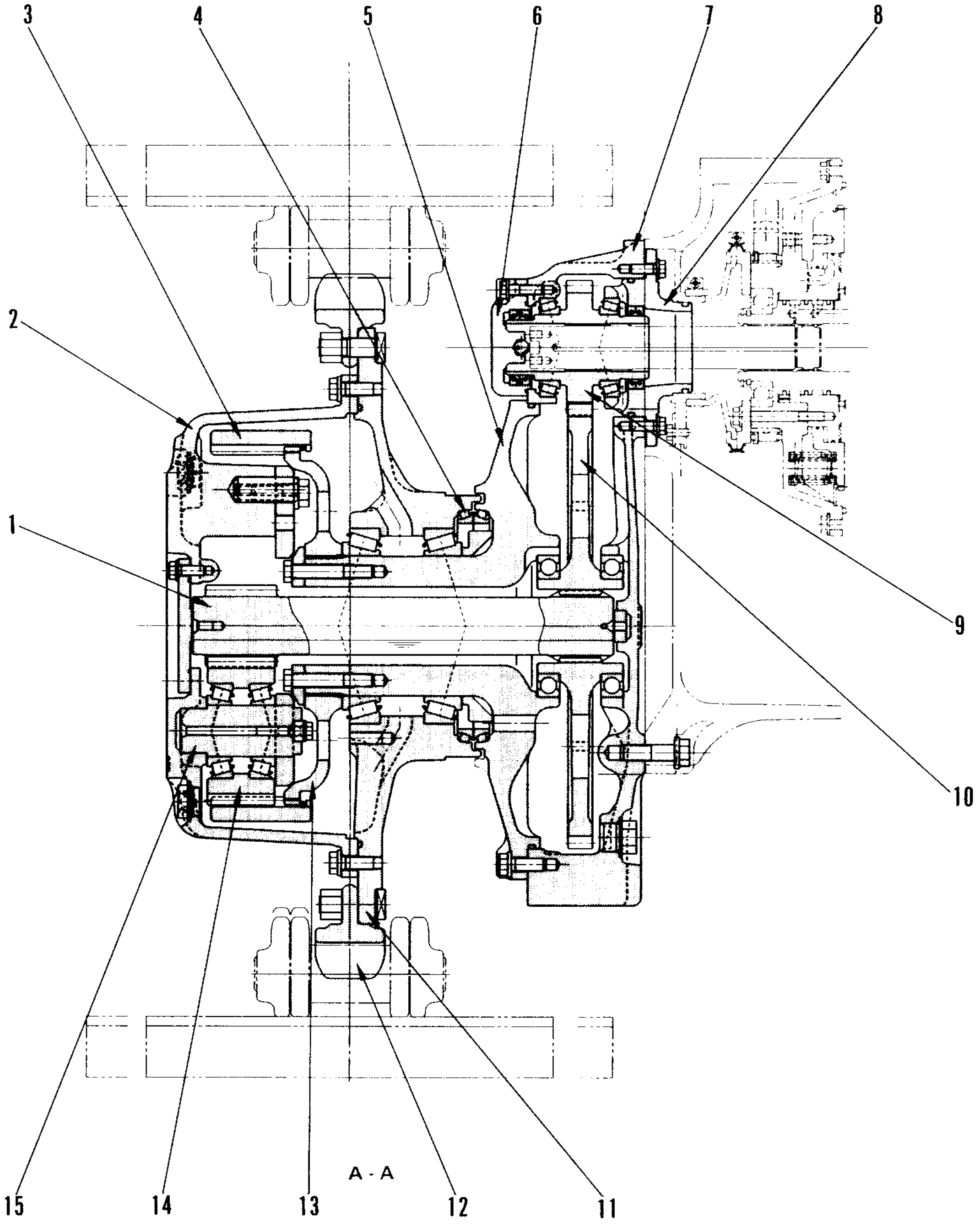
OUTLINE

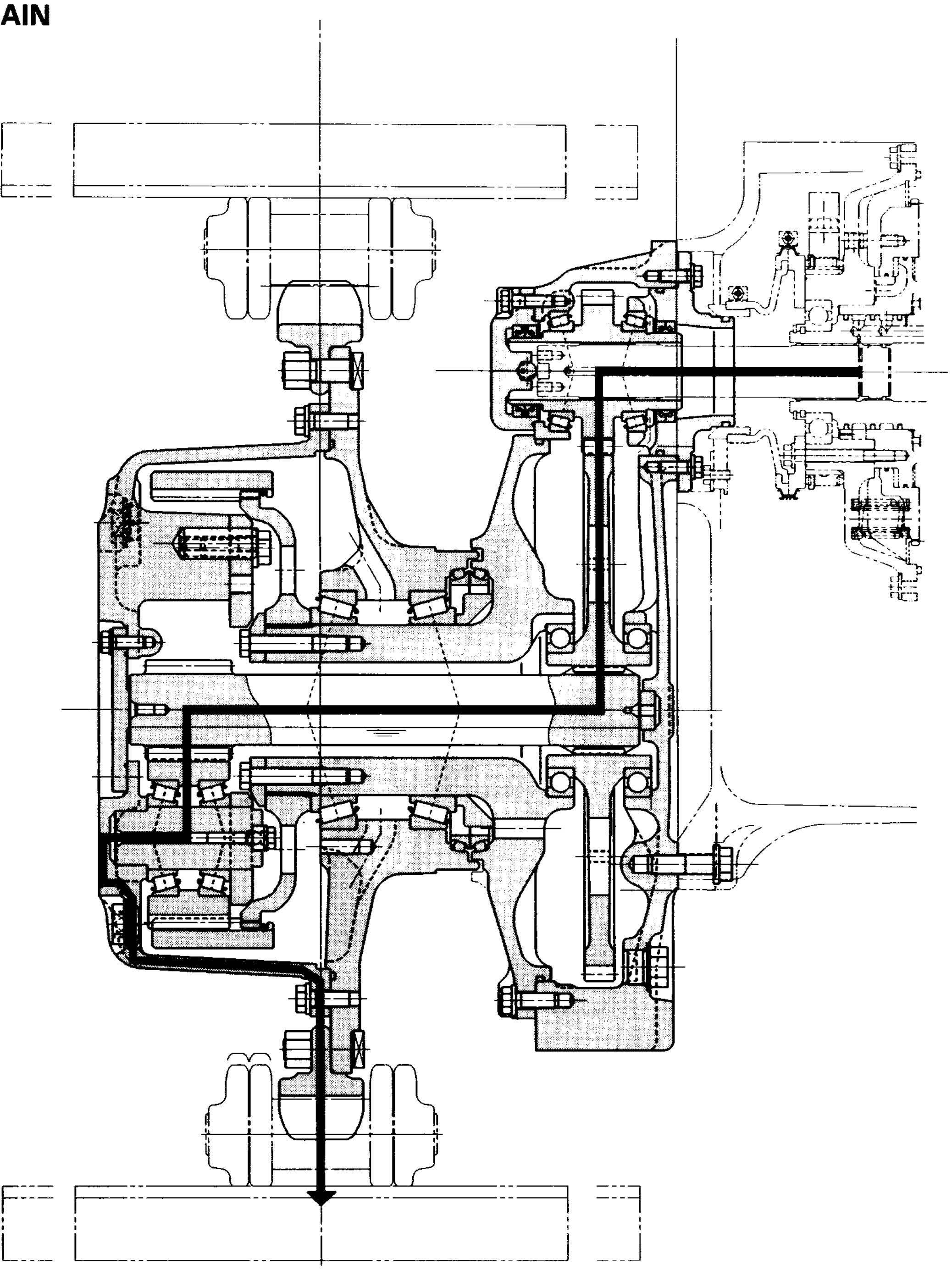
- The final drive uses a single-stage spur gear, single-stage planetary gear reduction system. Splash-type lubrication is carried out by the rotation of the gear.
  The final drive can be removed or installed as a unit.
- Floating seal (4) is installed to the rotating and sliding portion of the sprocket to prevent the entry of dirt or dust, or leakage of oil.



A - A

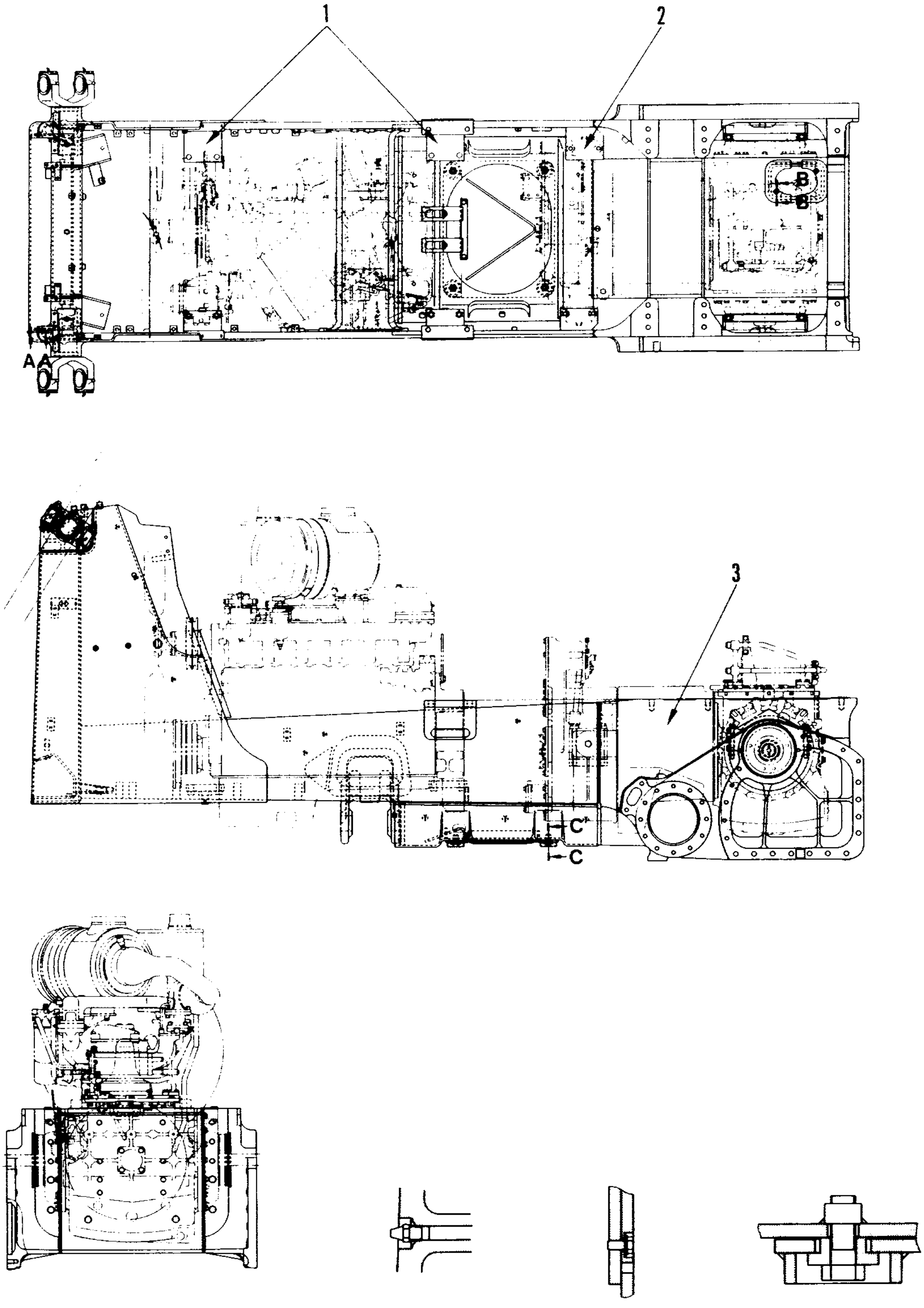
140F12092

1. Sun gear (No. of teeth: 13)
2. Carrier
3. Ring gear (No. of teeth: 68)
4. Floating seal
5. Cover
6. Cover
7. Final drive case
8. Bearing cage
9. No. 1 pinion (No. of teeth: 21)
10. No. 1 gear (No. of teeth: 78)
11. Sprocket hub
12. Sprocket teeth
13. Hub
14. Planet pinion (No. of teeth: 27)
15. Pinion shaft
16. Pivot shaft



- The motive force from the bevel gear shaft and steering clutch is transmitted to No. 1 pinion (9), and is then transmitted to sun gear (1) through No. 1 gear (10), which is meshed with the No. 1 pinion.
  The rotation of sun gear (1) is transmitted to planet pinion (14), but ring gear (3), which is meshed with the planet pinion, is fixed to cover (5), so the planet pinion rotates and moves in orbit around the sun gear along the ring gear.
  When this happens, the rotating force of sun gear (1) becomes the rotating force of carrier (2), which supports the planet pinion, and this is transmitted to sprocket hub (11).
  The direction of rotation of carrier (2) is the same as the direction of rotation of sun gear (1).
  The rotation force transmitted to sprocket hub (11) is transmitted to sprocket teeth (12).

MAIN FRAME



A - A

B - B

C - C

140F12094

1. Engine mount
2. Power train unit mount
3. Main frame assembly

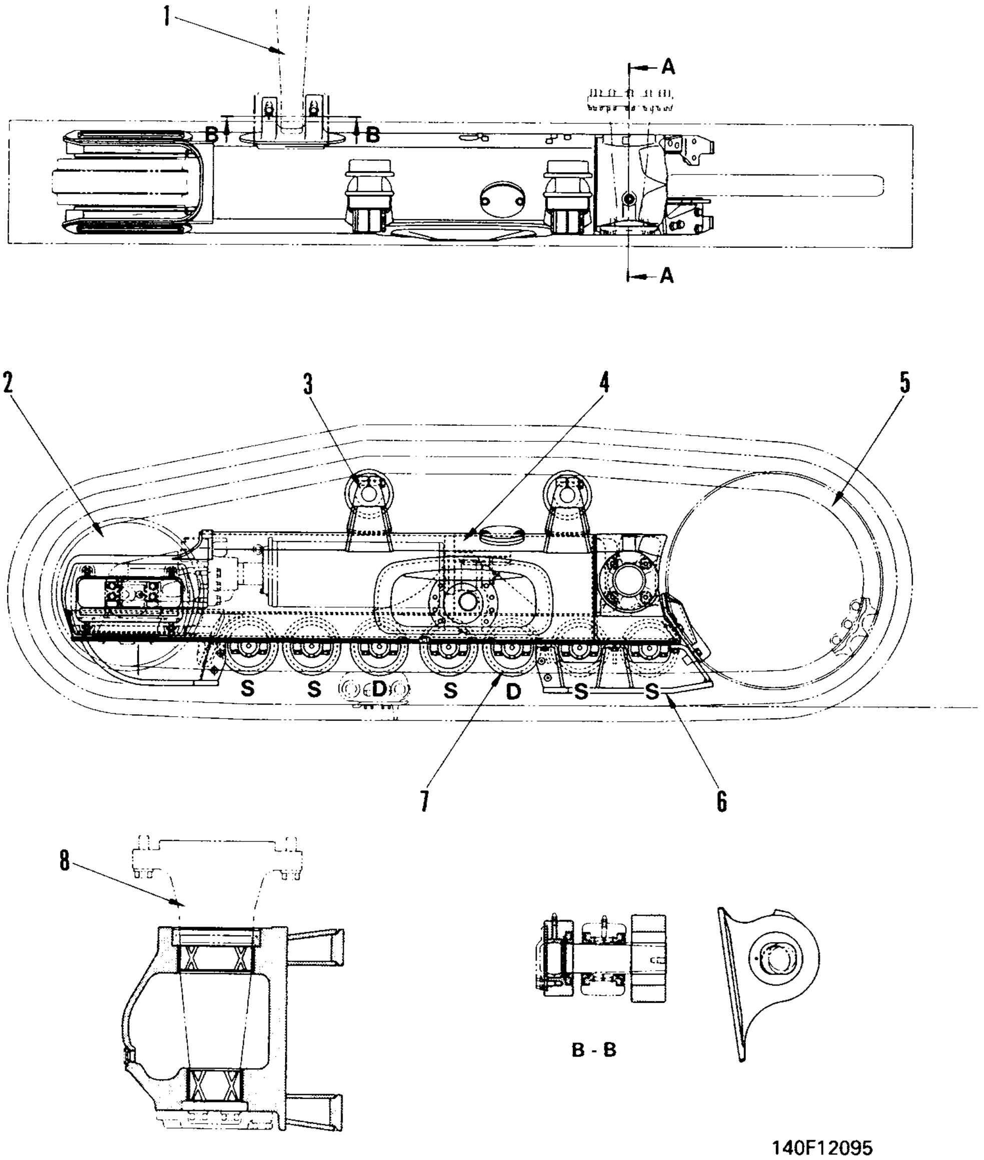
OUTLINE

- A hull–frame structure is used in which the radiator guard, main frame, and transmission underguard form one unit.

TRACK FRAME

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

★ The diagram shows the D65E-12, D65EX-12.



A - A

B - B

140F12095

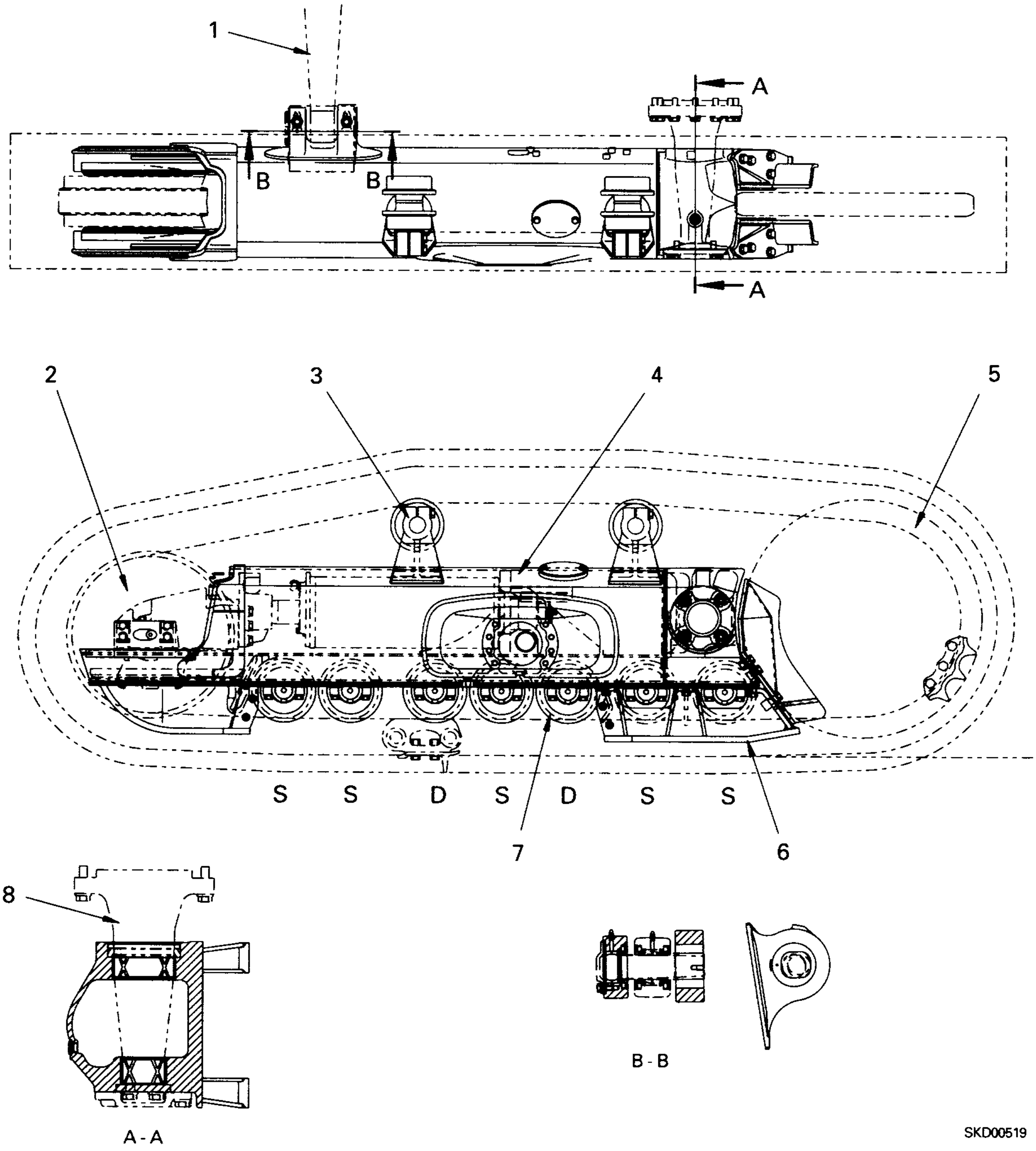
1. Equalizer bar
2. Idler
3. Carrier roller
4. Track frame
5. Sprocket
6. Track roller guard
7. Track roller
8. Pivot shaft

- Track roller

	Q'ty	Flange type and arrangement
D65E, D65EX	7	S,S,D,S,D,S,S
D65P, D65PX	8	S,S,D,S,S,D,S,S

D65E-12	**60948 and up**
D65P-12	**60891 and up**
D65EX-12	**60942 and up**
D65PX-12	**60915 and up**

★ The diagram shows the D65E-12, D65EX-12.



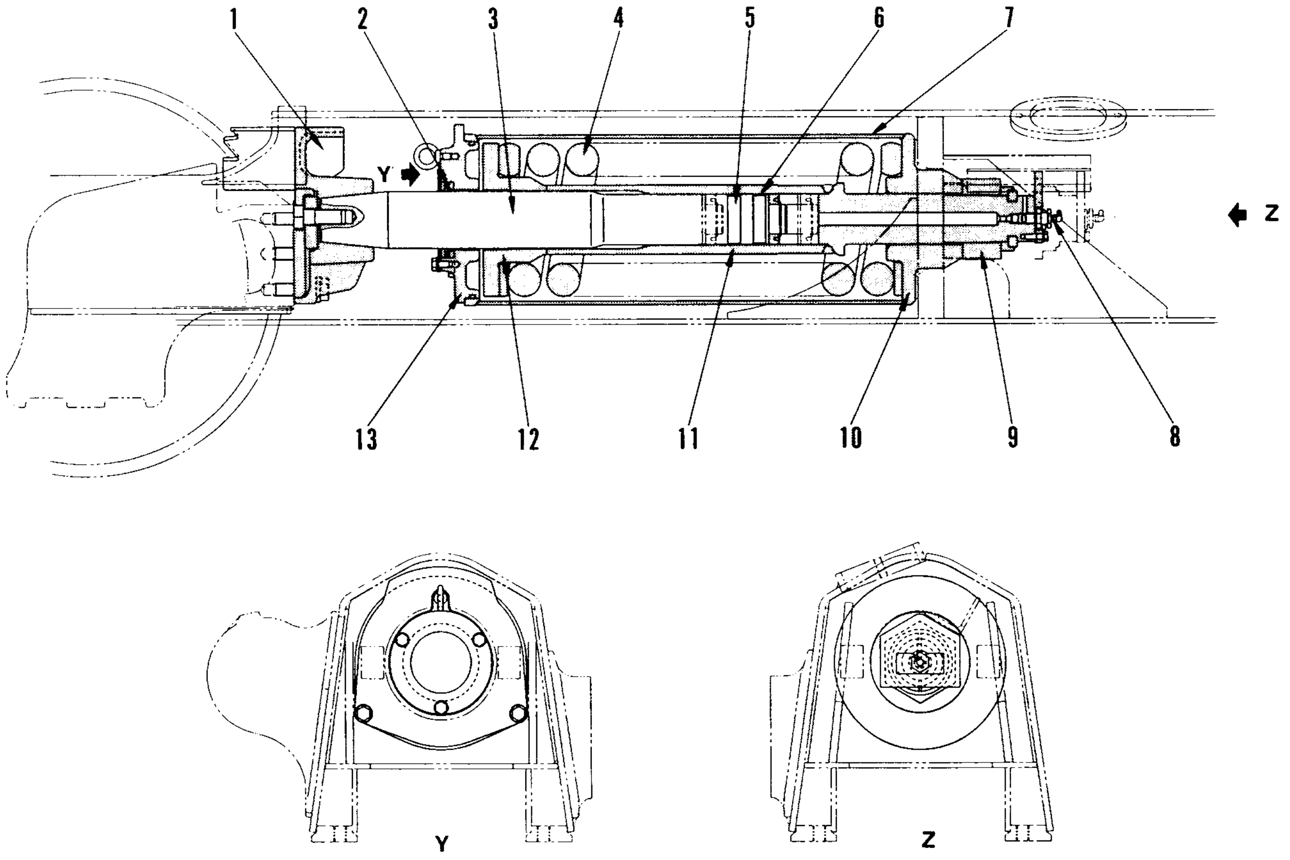
1. Equalizer bar
2. Idler
3. Carrier roller
4. Track frame
5. Sprocket
6. Track roller guard
7. Track roller
8. Pivot shaft

- Track roller

	Q'ty	Flange type and arrangement
D65E, D65EX	7	S,S,D,S,D,S,S
D65P, D65PX	8	S,S,D,S,S,D,S,S

RECOIL SPRING

D65E-12	**60001 – 60947**
D65P-12	**60001 – 60890**
D65EX-12	**60001 – 60941**
D65PX-12	**60001 – 60914**



014012

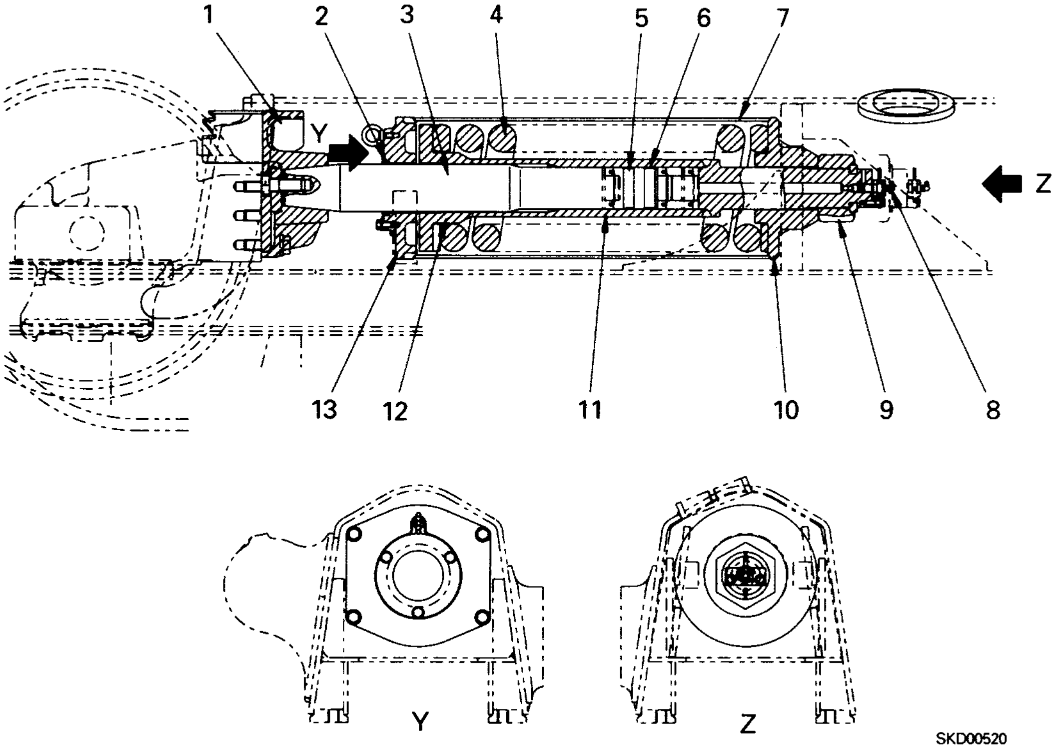
140F12096

1. Yoke
2. Dust seal
3. Rod
4. Recoil spring
5. Piston
6. Wear ring
7. Cab
8. Lubricator
9. Nut
10. Housing
11. Cylinder
12. Bushing
13. Holder

OUTLINE

- The recoil spring adjusts the track shoe tension by moving rod (3) backwards or forwards. The power of the recoil–spring is adjusted by releasing or adding grease through lubricator (8). Recoil spring (4) also acts to absorb any sudden impact shock that is brought to bear on the idler.

D65E-12	**60948 and up**
D65P-12	**60891 and up**
D65EX-12	**60942 and up**
D65PX-12	**60915 and up**



1. Yoke
2. Dust seal
3. Rod
4. Recoil spring
5. Piston
6. Wear ring
7. Cab
8. Lubricator
9. Nut
10. Housing
11. Cylinder
12. Bushing
13. Holder

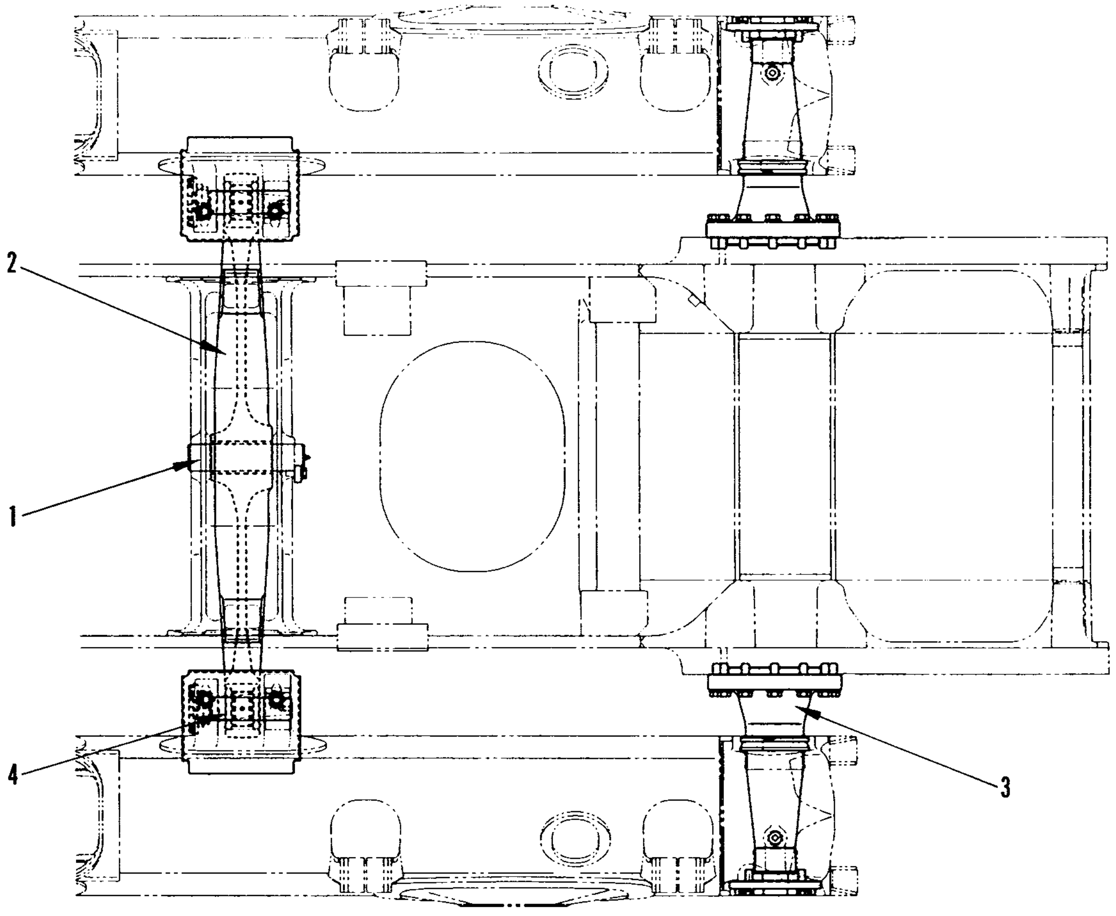
OUTLINE

- The recoil spring adjusts the track shoe tension by moving rod (3) backwards or forwards. The power of the recoil–spring is adjusted by releasing or adding grease through lubricator (8). Recoil spring (4) also acts to absorb any sudden impact shock that is brought to bear on the idler.

SUSPENSION

D65E-12	**60001 – 60947**
D65P-12	**60001 – 60890**
D65EX-12	**60001 – 60941**
D65PX-12	**60001 – 60914**

★ The diagram shows the D65E-12.



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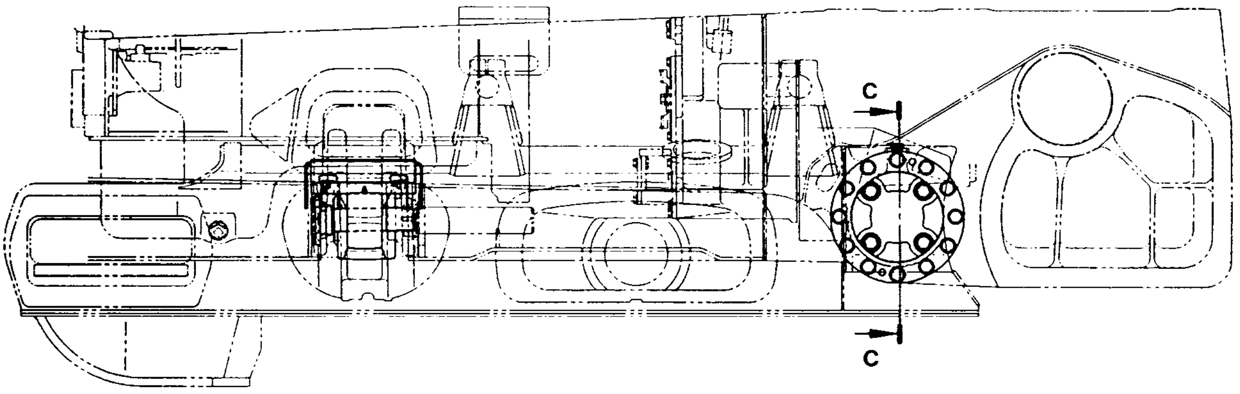
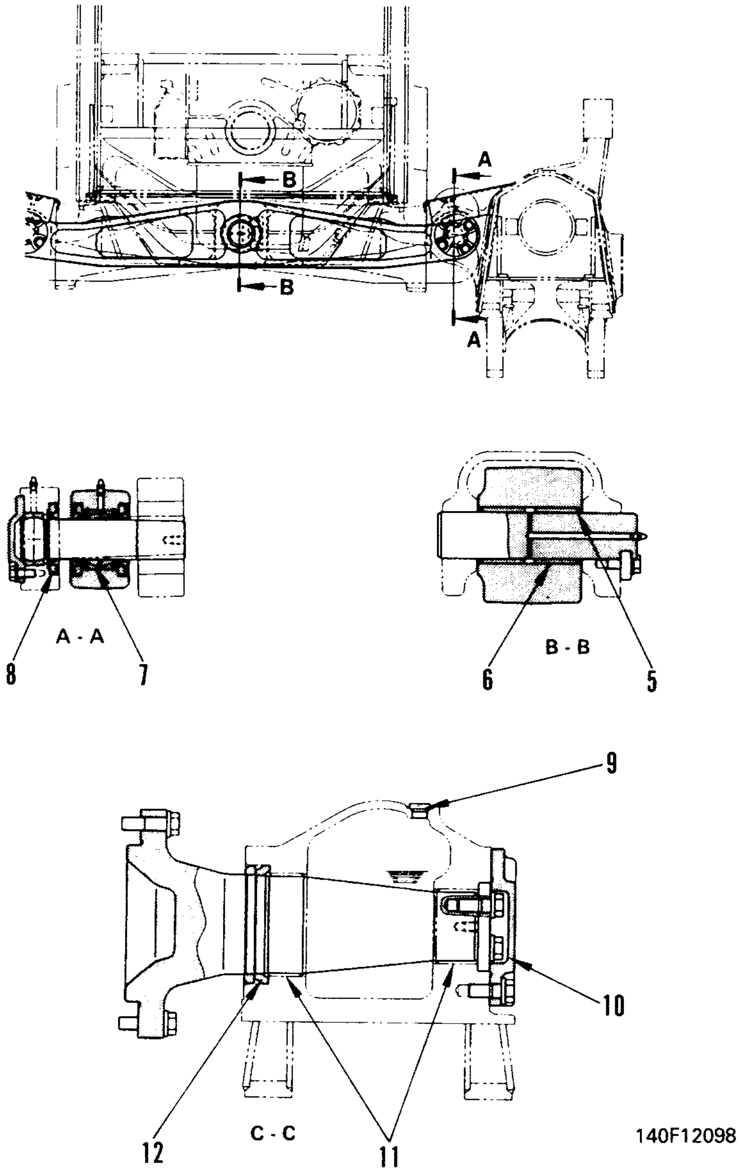


140F12097



1. Center pin
2. Equalizer bar
3. Pivot shaft
4. Side pin
5. Seal
6. Bushing
7. Bushing
8. Seal
9. Plug (for adding oil to pivot shaft)
10. Cover
11. Bushing
12. Seal

OUTLINE

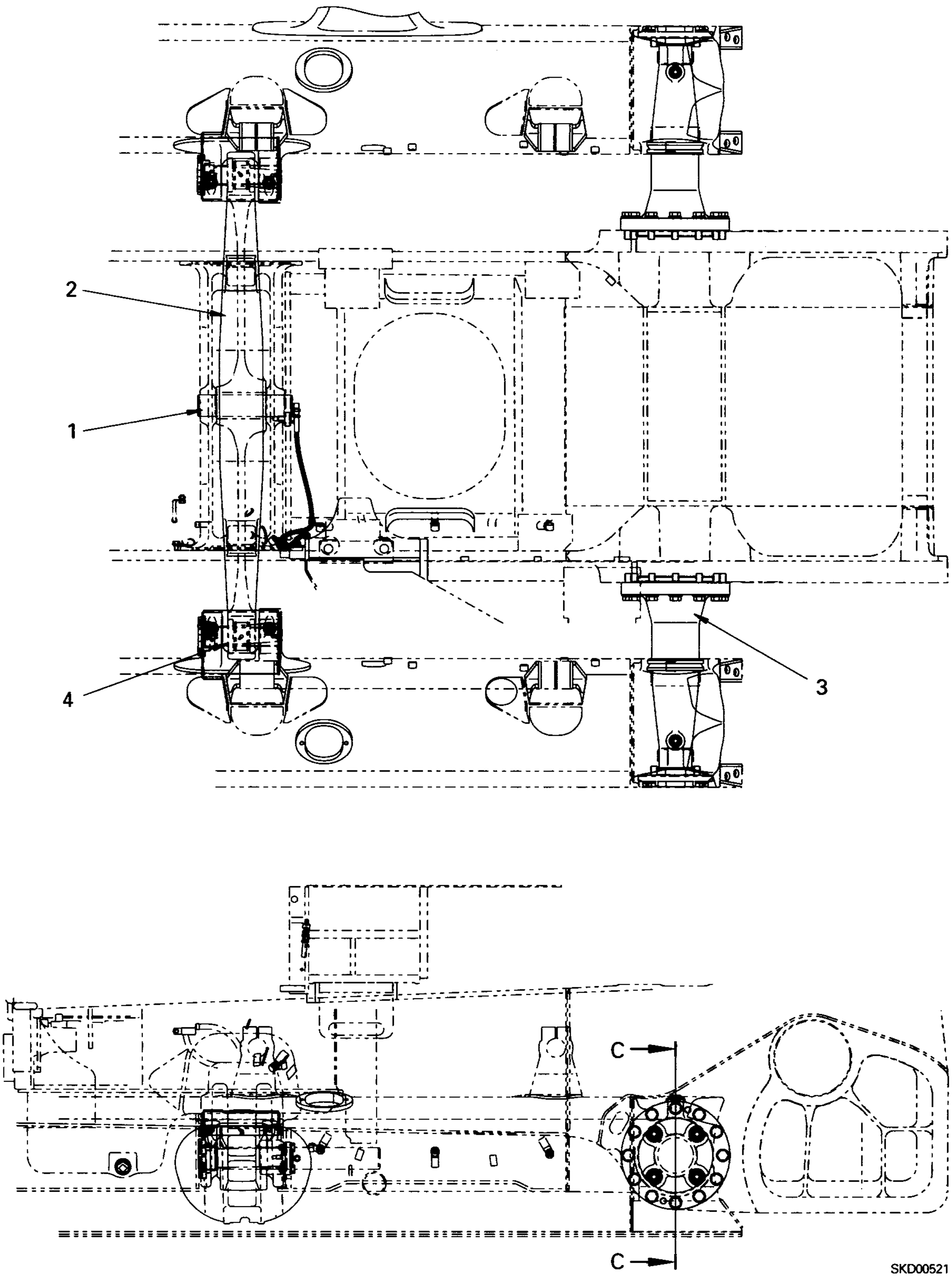
- The front of the track frame moves up and down with pivot shaft (3) at the rear forming the center of the movement. The equalizer bar moves up and down with center pin (1) forming the center of movement, and is connected to the left and right track frames by side pin (4).
- Amount of movement at center of equalizer bar side pin.

Unit: mm

	Up	Down
D65E, D65EX	72.6	72.6
D65P, D65PX	81.9	81.9

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

★ The diagram shows the D65E-12.



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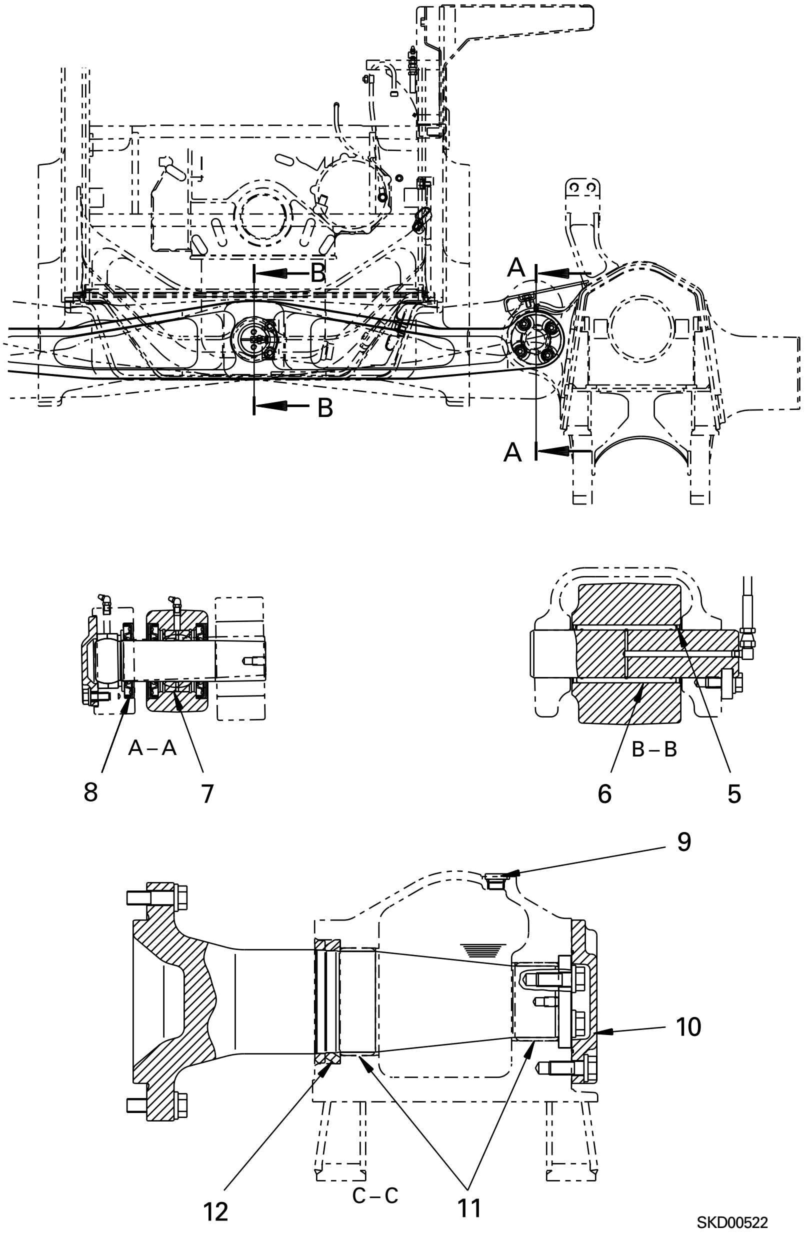


1. Center pin
2. Equalizer bar
3. Pivot shaft
4. Side pin
5. Seal
6. Bushing
7. Bushing
8. Seal
9. Plug (for adding oil to pivot shaft)
10. Cover
11. Bushing
12. Seal

OUTLINE

- The front of the track frame moves up and down with pivot shaft (3) at the rear forming the center of the movement. The equalizer bar moves up and down with center pin (1) forming the center of movement, and is connected to the left and right track frames by side pin (4).
- Amount of movement at center of equalizer bar side pin.

Unit: mm

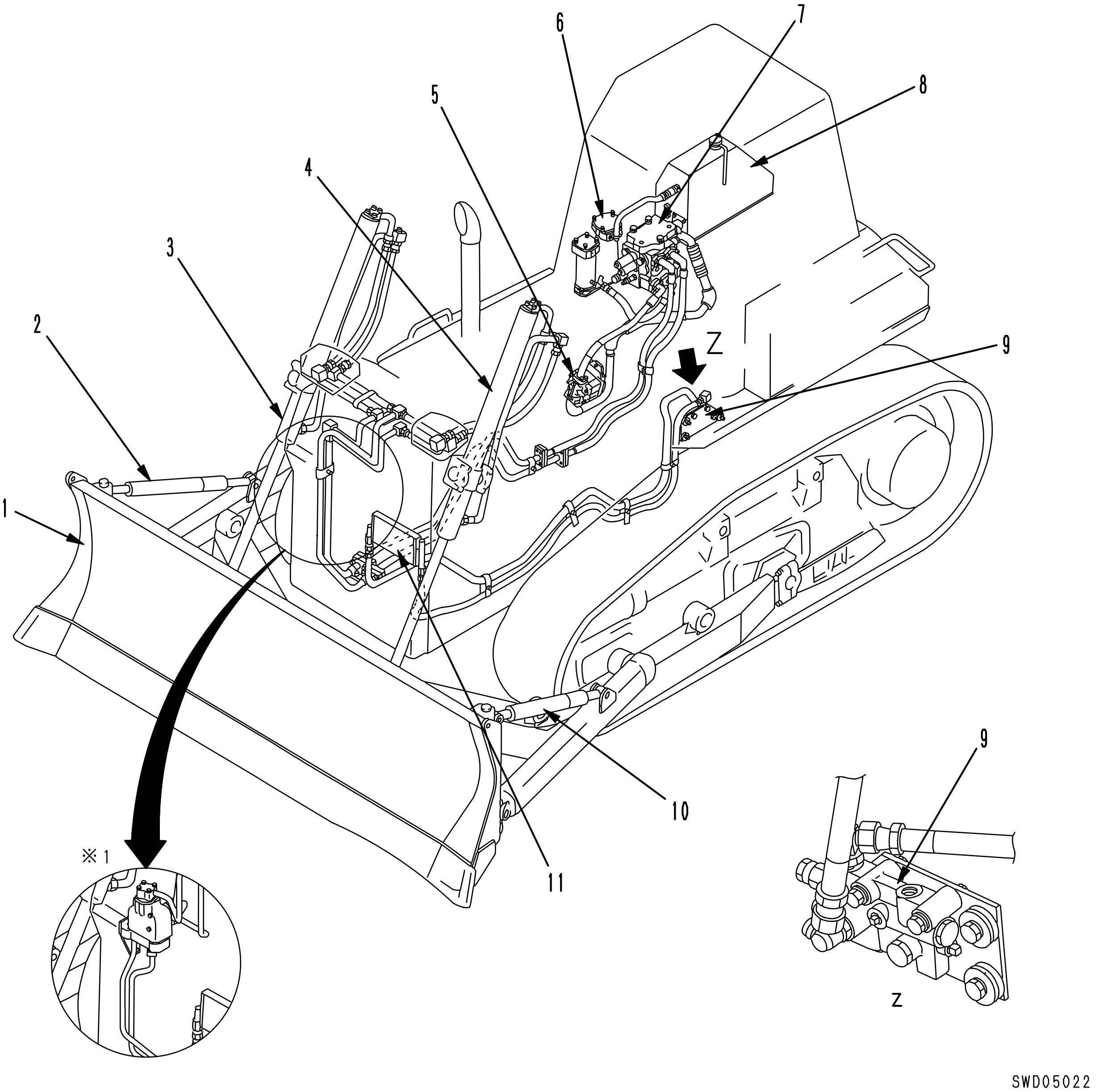
	Up	Down
D65E, D65EX	72.6	72.6
D65P, D65PX	81.9	81.9
D65EX (Wide gauge)	81.9	81.9

WORK EQUIPMENT HYDRAULIC PIPING DIAGRAM

ANGLEDOZER

D65E-12 60001-60947
D65EX-12 60001-60941

※1. Serial Numbers
D65E-12 60516 – 60947
D65EX-12 60516 – 60941

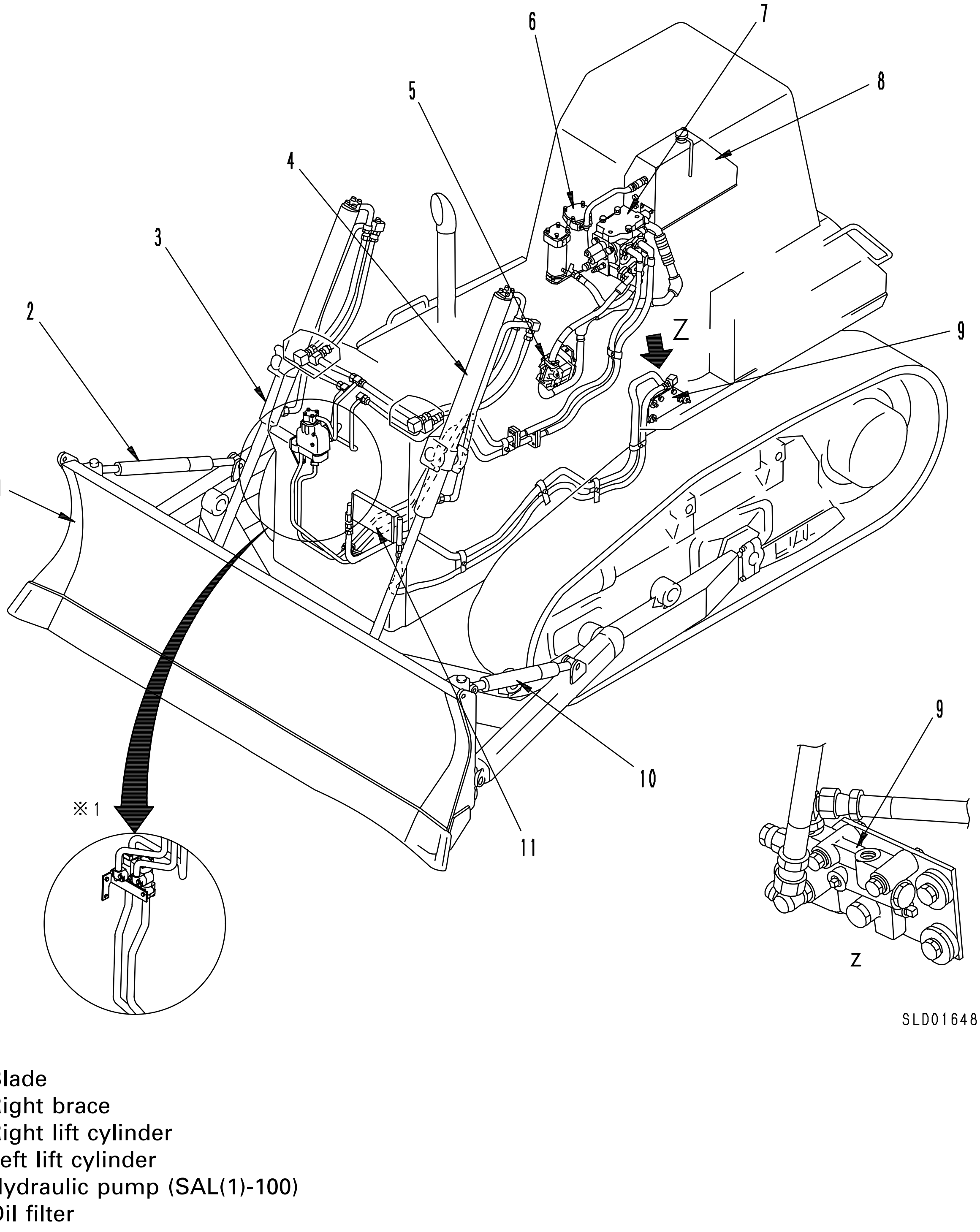


014012

1. Blade
2. Right brace
3. Right lift cylinder
4. Left lift cylinder
5. Hydraulic pump (SAL(1)-100)
6. Oil filter
7. Main control valve
8. Hydraulic tank
9. PPC charge valve
10. Left brace
11. Oil cooler

D65E-12 60948 and up
D65EX-12 60942 and up

※1. Serial Numbers
D65E-12 61441 and up
D65EX-12 61446 and up

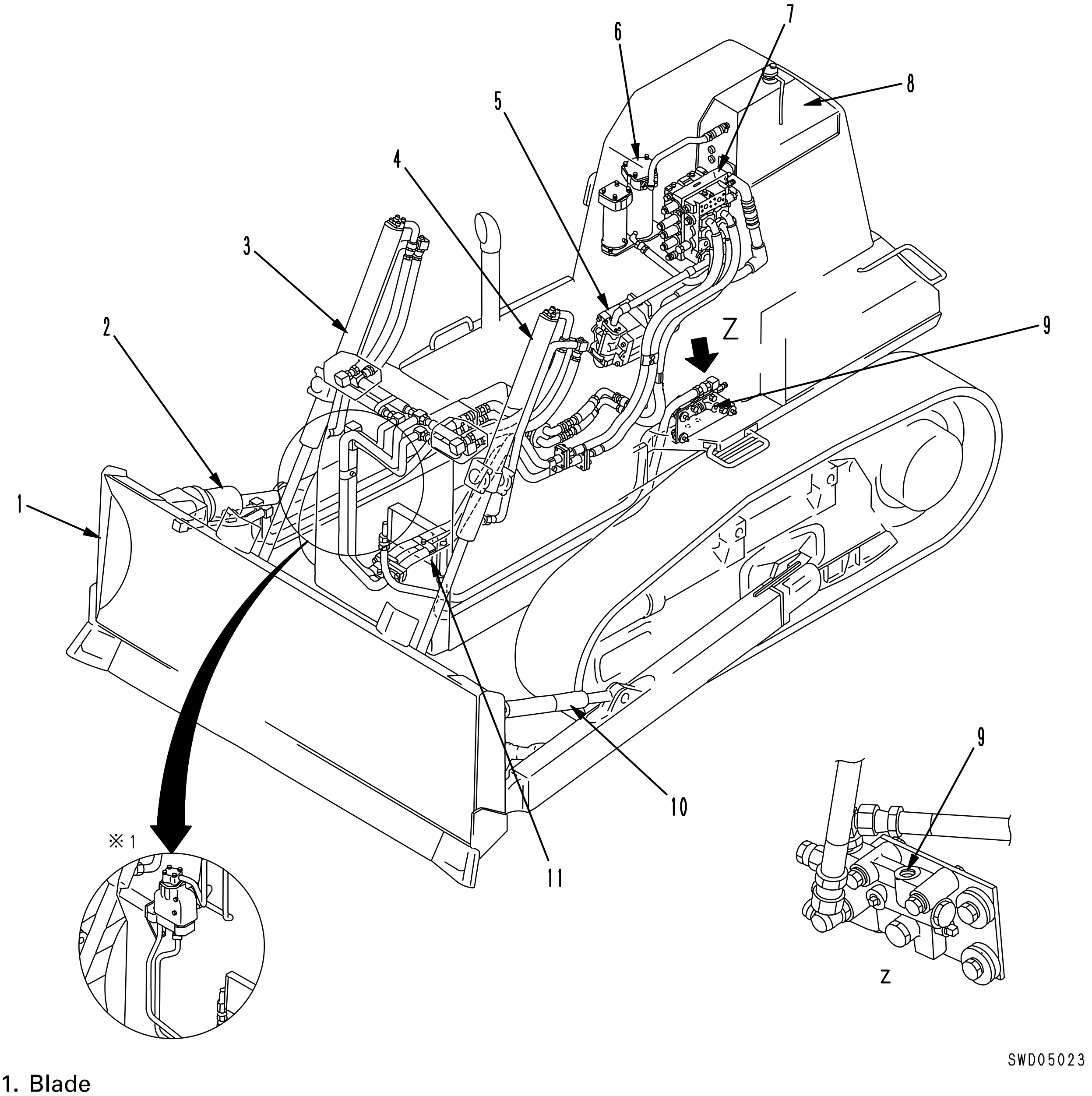


1. Blade
2. Right brace
3. Right lift cylinder
4. Left lift cylinder
5. Hydraulic pump (SAL(1)-100)
6. Oil filter
7. Main control valve
8. Hydraulic tank
9. PPC charge valve
10. Left brace
11. Oil cooler

STRAIGHT TILTDOZER

D65E-12 60001-60947
D65P-12 60001-60890
D65EX-12 60001-60941
D65PX-12 60001-60914

※1. Serial Numbers
D65E-12 60516 – 60947
D65P-12 60516 – 60890
D65EX-12 60516 – 60941
D65PX-12 60516 – 60914

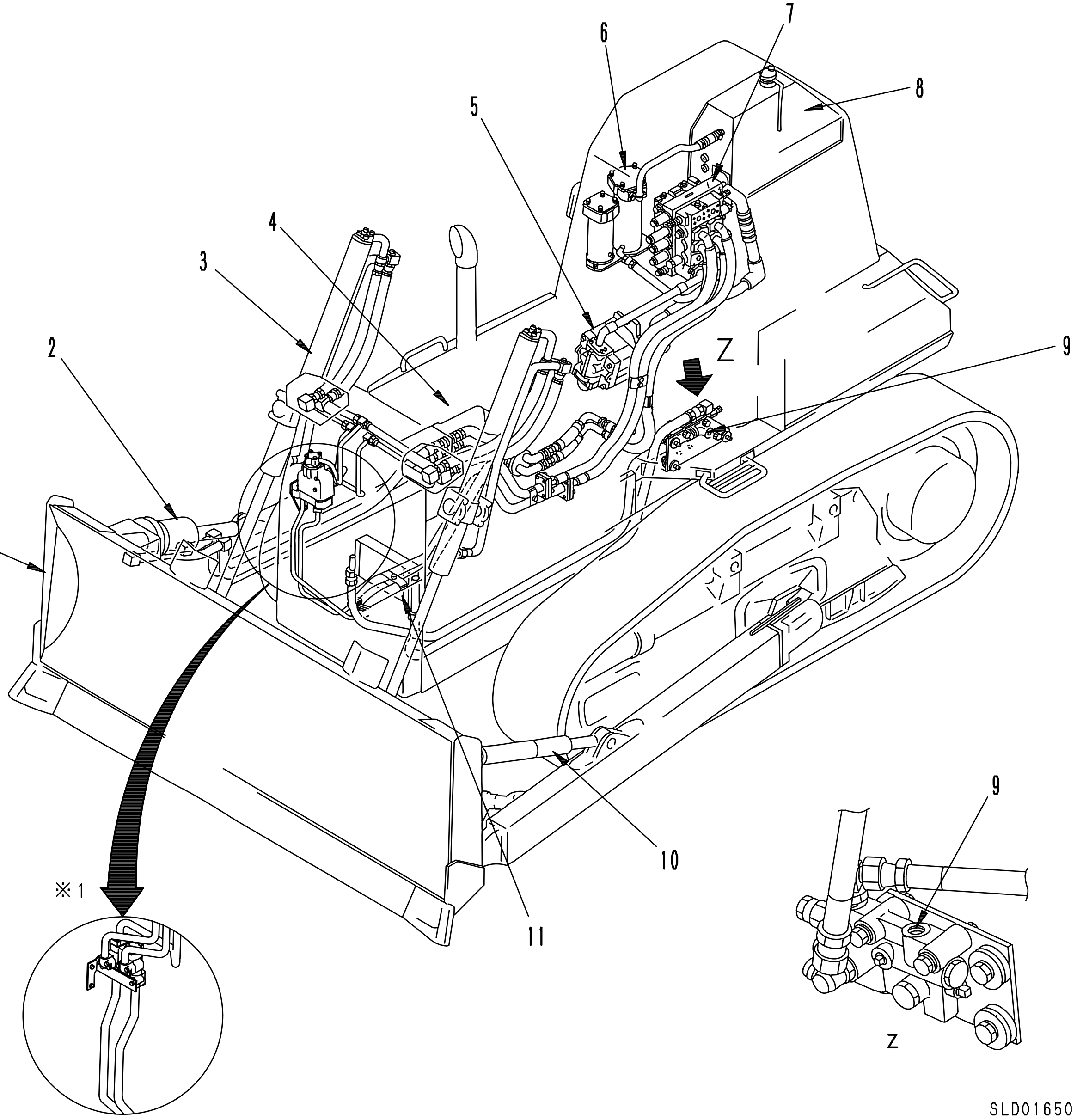


1. Blade
2. Tilt cylinder
3. Right lift cylinder
4. Left lift cylinder
5. Hydraulic pump (SAL(1)-100)
6. Oil filter
7. Main control valve
8. Hydraulic tank
9. PPC charge valve
10. Brace
11. Oil cooler

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

※1. Serial Numbers	
D65E-12	61441 and up
D65P-12	61365 and up
D65EX-12	61446 and up
D65PX-12	61369 and up

014012



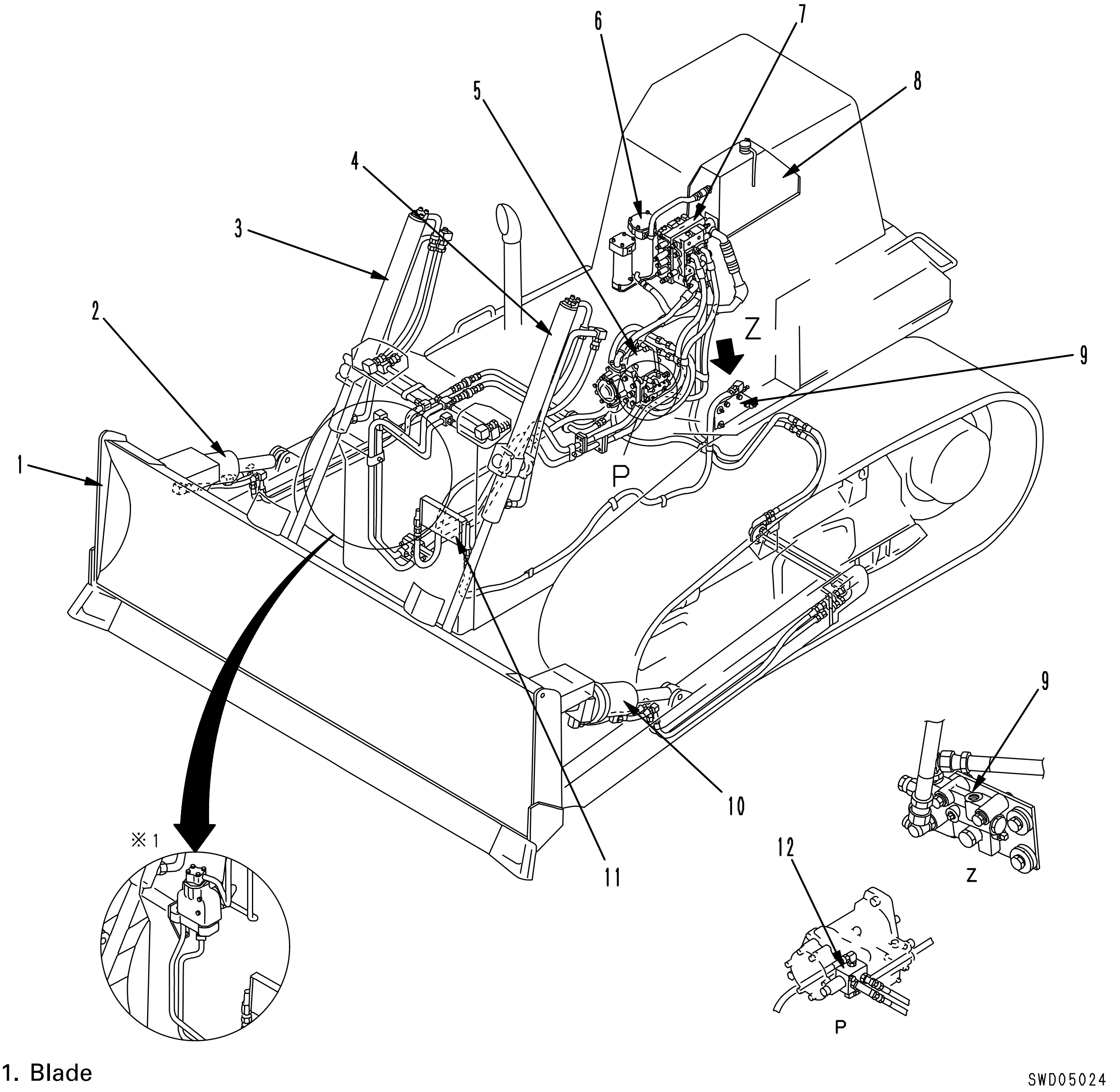
1. Blade
2. Tilt cylinder
3. Right lift cylinder
4. Left lift cylinder
5. Hydraulic pump (SAL(1)-100)
6. Oil filter
7. Main control valve
8. Hydraulic tank
9. PPC charge valve
10. Brace
11. Oil cooler

POWER PITCH DOZER

D65P-12 60001-60890
D65PX-12 60001-60914

※1. Serial Numbers
D65P-12 60516 – 60890
D65PX-12 60516 – 60914

★ The diagram shows the D65PX-12.



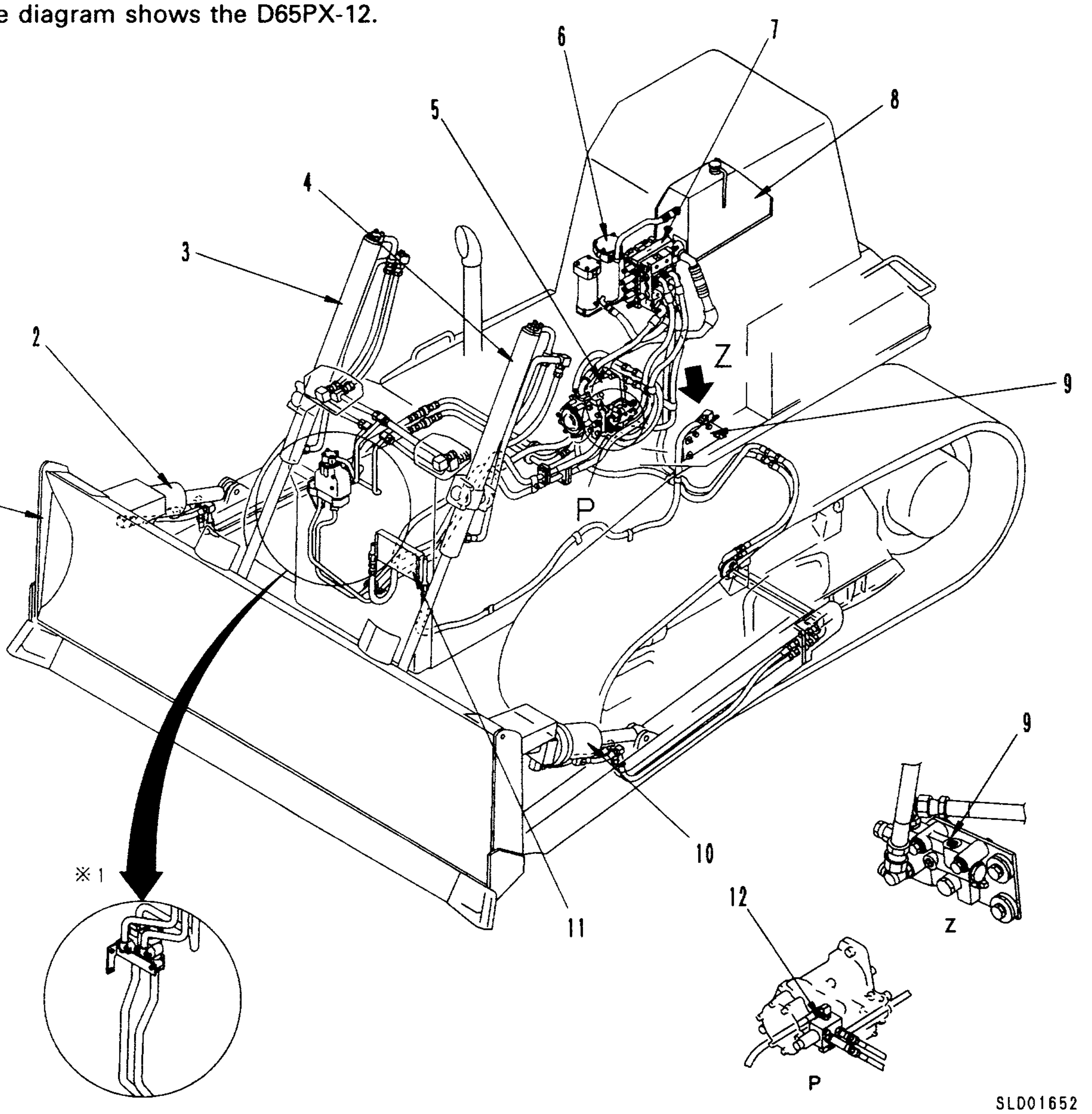
1. Blade
2. Pitch cylinder
3. Right lift cylinder
4. Left lift cylinder
5. Hydraulic HSS pump (HPV95)
6. Oil filter
7. Main control valve
8. Hydraulic tank
9. PPC charge valve
10. Tilt cylinder
11. Oil cooler
12. Tilt/pitch selector valve

014012

D65P-12 60891 and up
D65PX-12 60915 and up

※1. Serial Numbers
D65P-12 61365 and up
D65PX-12 61369 and up

★ The diagram shows the D65PX-12.

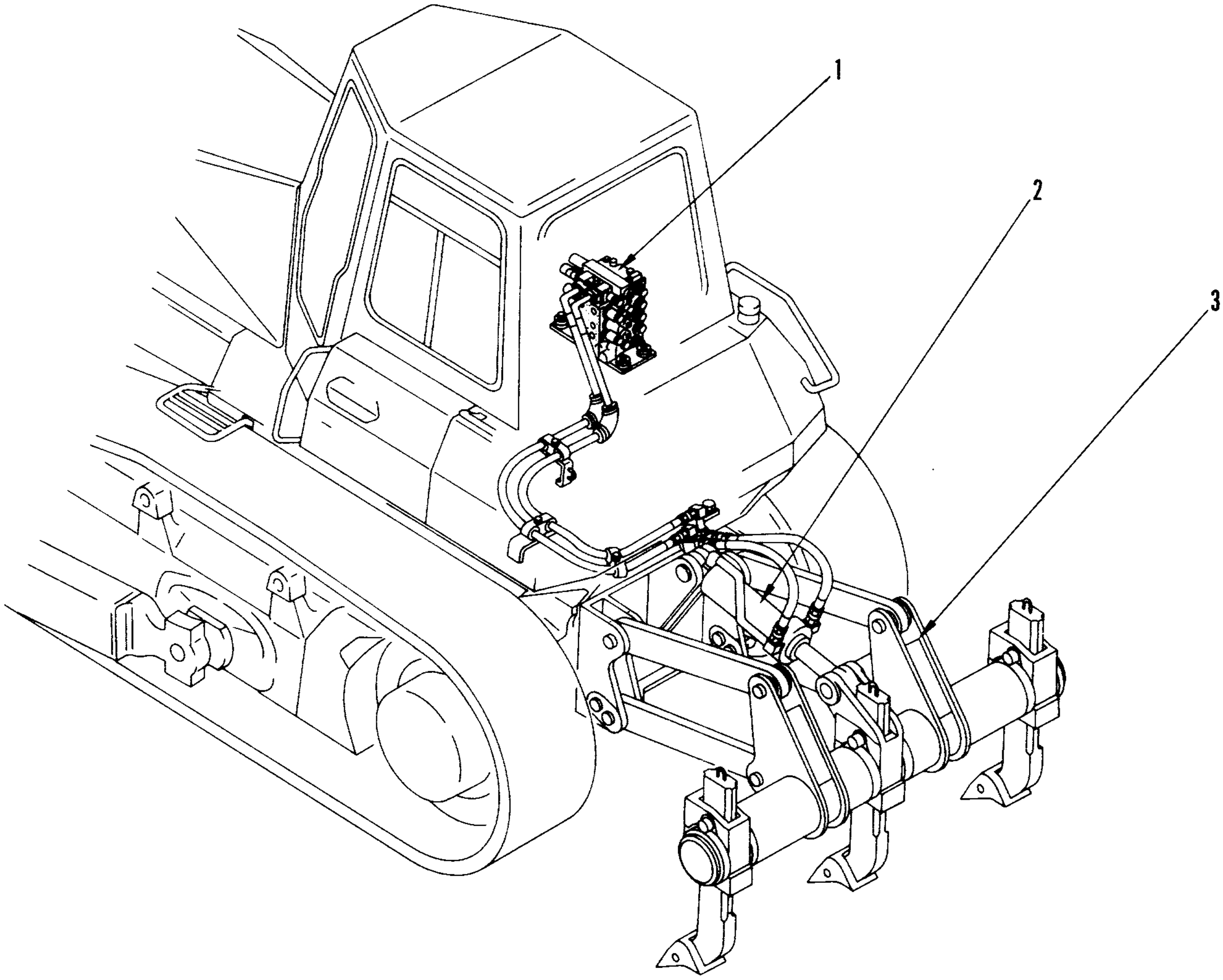


1. Blade
2. Pitch cylinder
3. Right lift cylinder
4. Left lift cylinder
5. Hydraulic, HSS pump (HPV95)
6. Oil filter
7. Main control valve
8. Hydraulic tank
9. PPC charge valve
10. Tilt cylinder
11. Oil cooler
12. Tilt/pitch selector valve

014012

RIPPER

D65E-12
D65EX-12



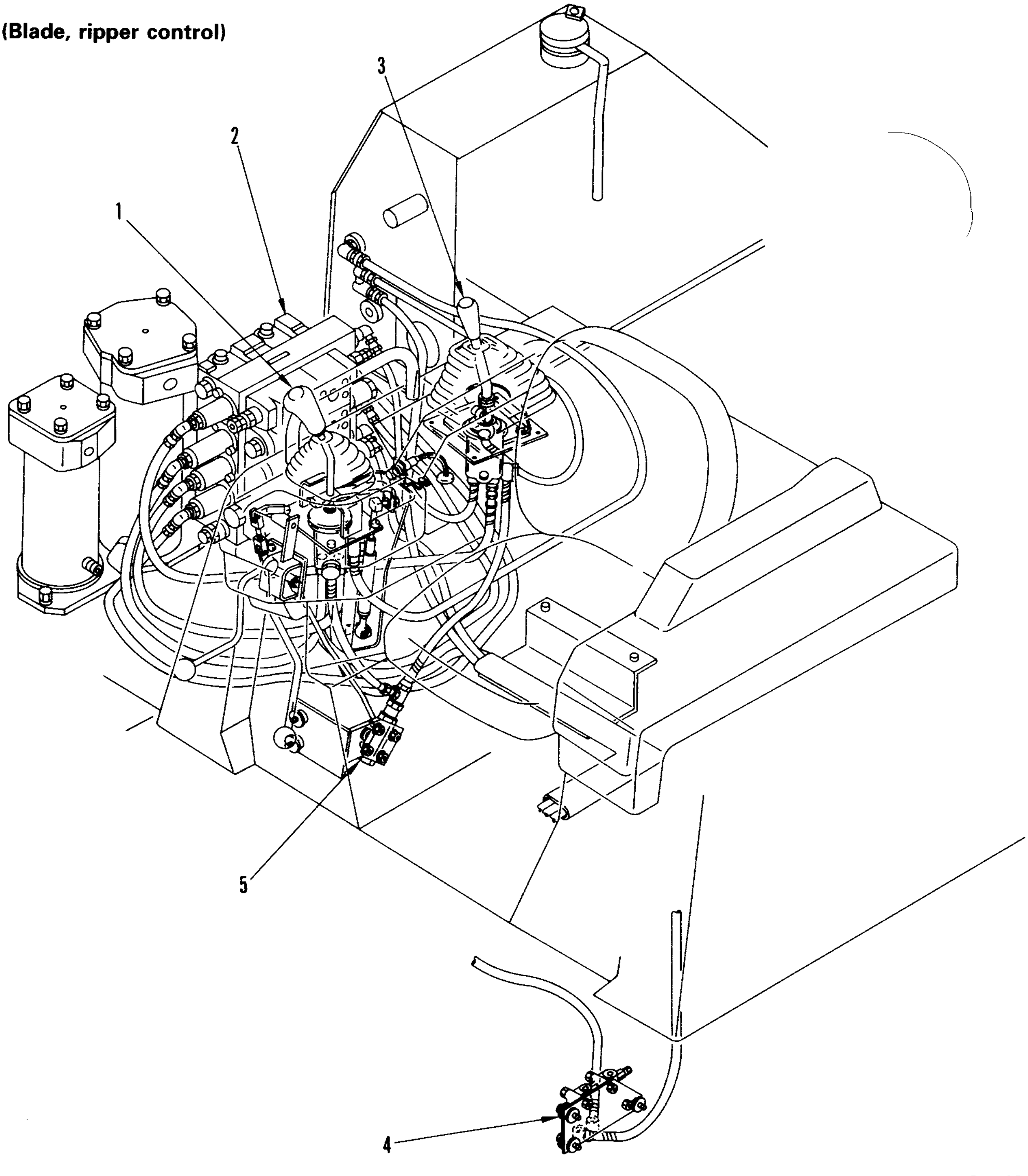
140F12102

1. Main control valve
2. Lift cylinder
3. Ripper assembly

PPC CONTROL PIPING DIAGRAM

D65E-12 60001 – 60947
D65P-12 60001 – 60890

(Blade, ripper control)



140F12103

1. Blade control lever
2. Main control valve
3. Ripper control lever (D65E-12 only)
4. PPC charge valve
5. PPC lock valve

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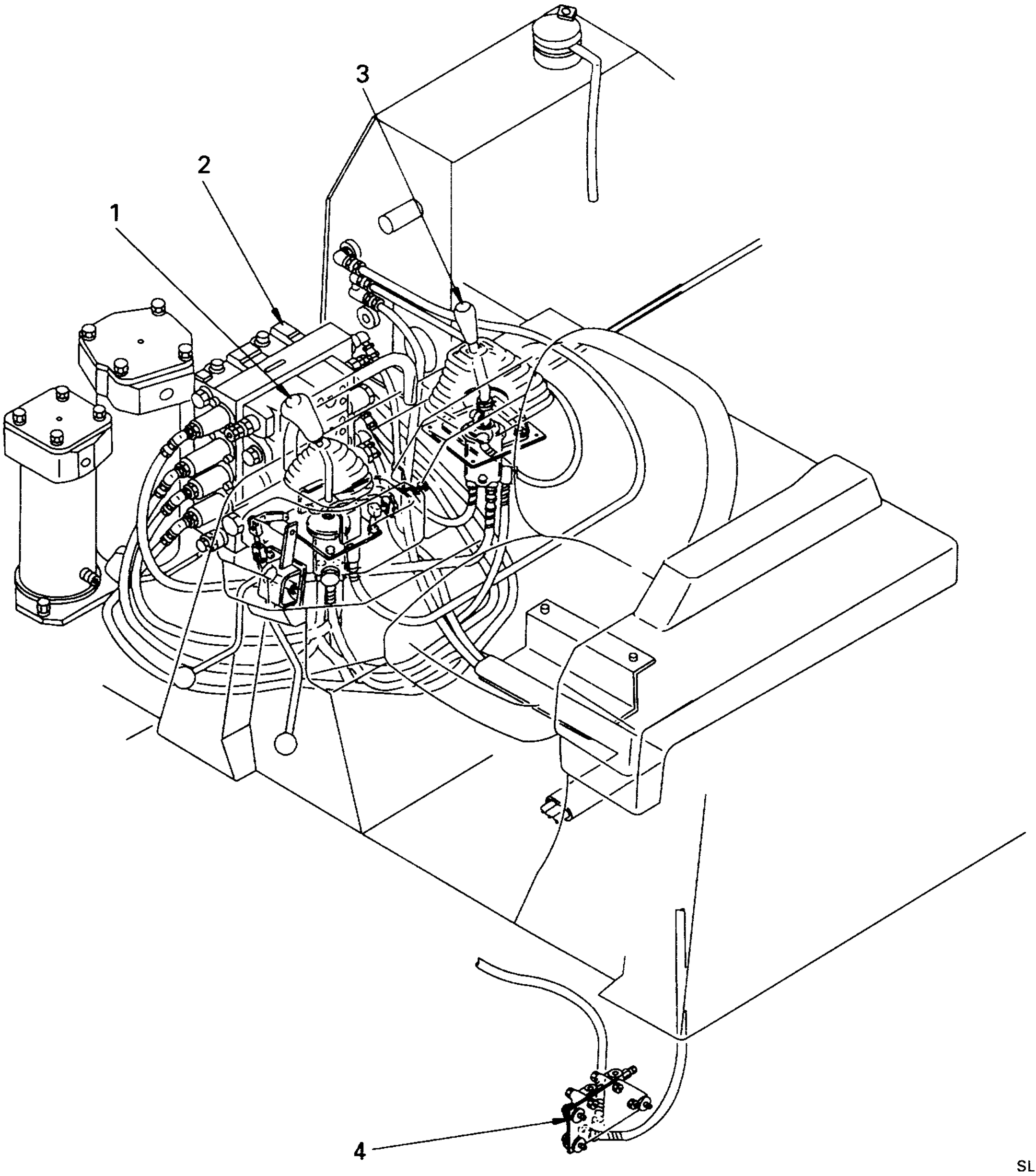
D65E-12 60948 and up
D65P-12 60891 and up

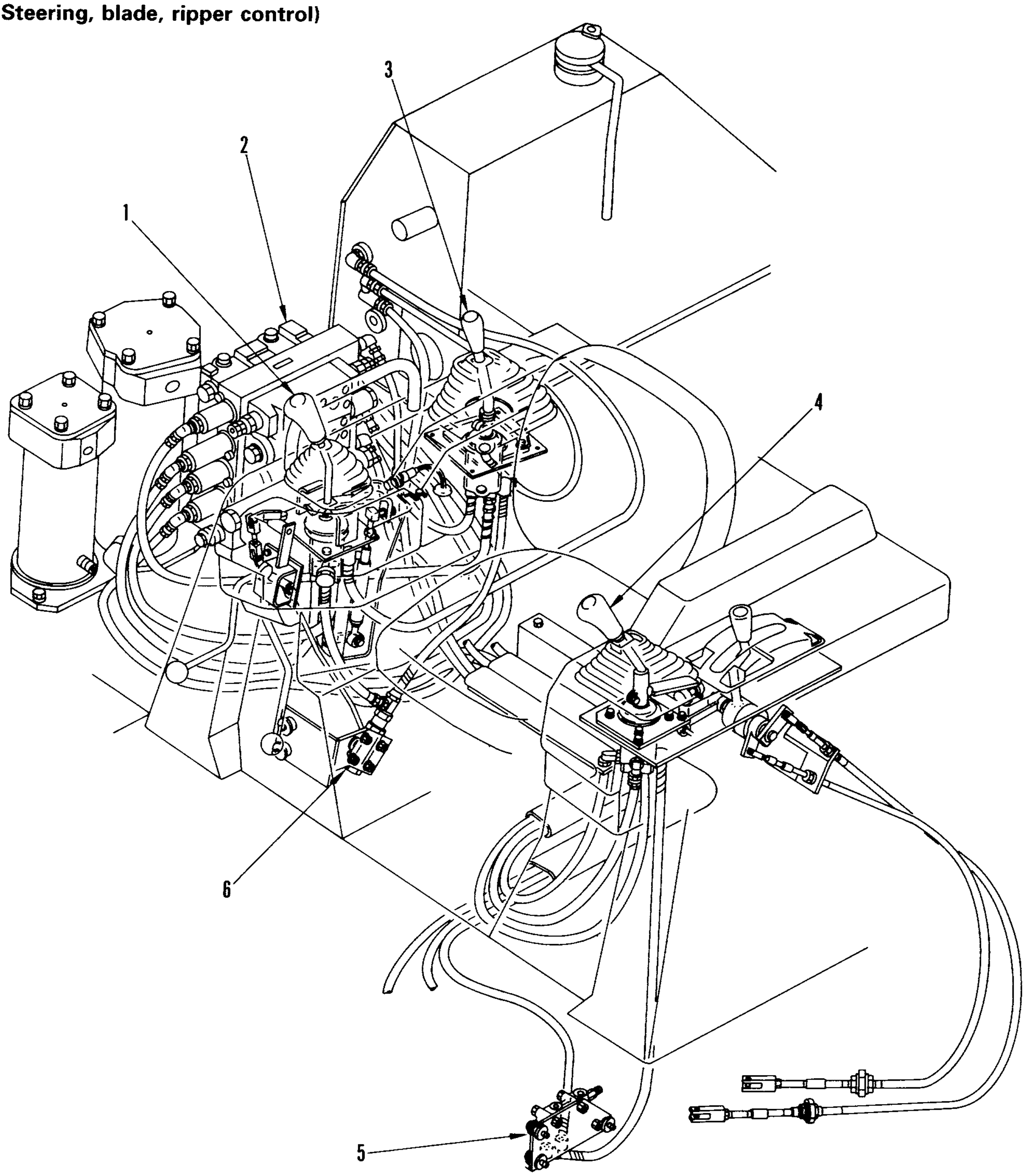
(Blade, ripper control)



1. Blade control lever
2. Main control valve
3. Ripper control lever (D65E-12 only)
4. PPC charge valve

D65EX-12 60001 – 60941
D65PX-12 60001 – 60914

(Steering, blade, ripper control)

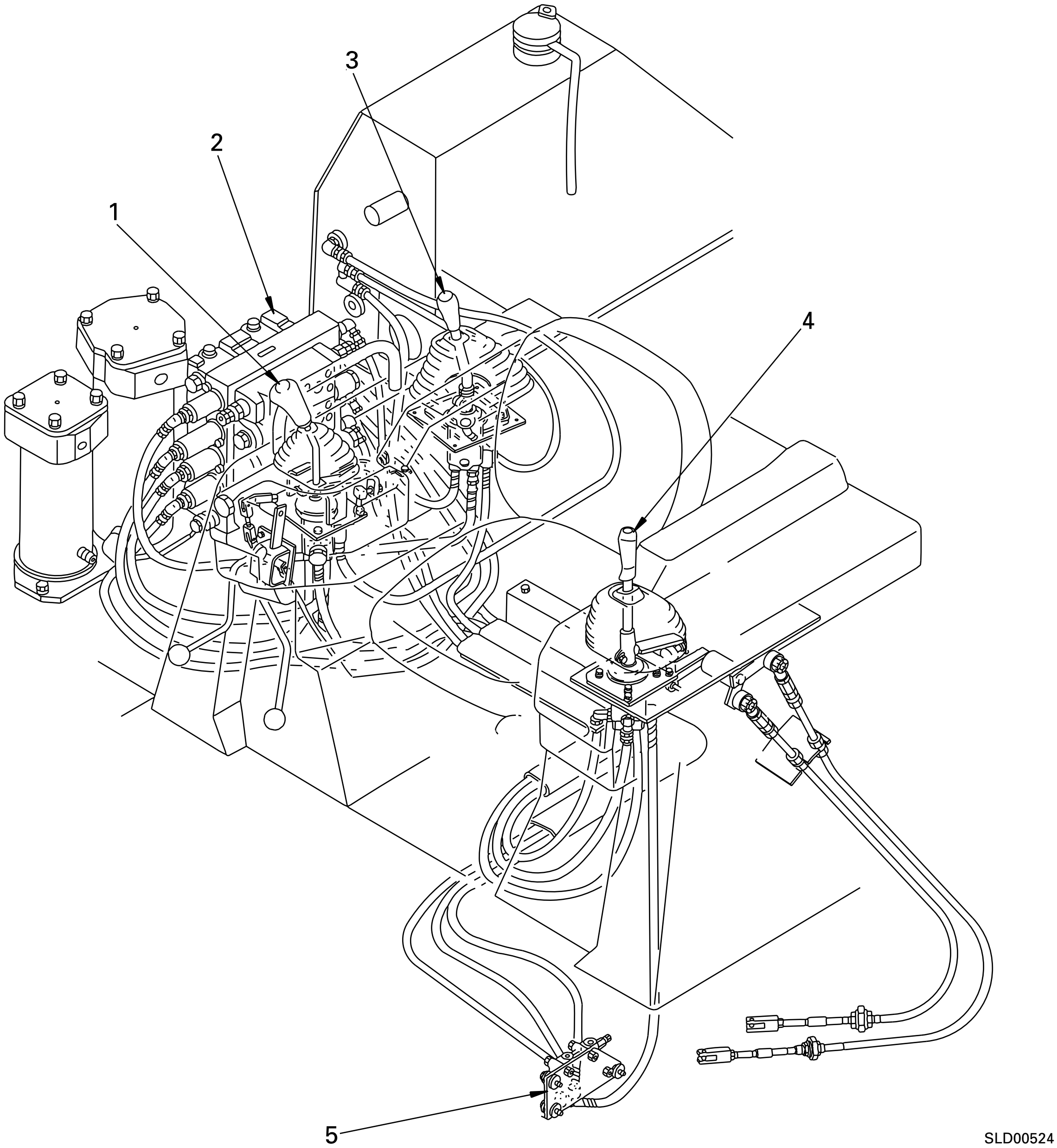


014012

1. Blade control lever
2. Main control valve
3. Ripper control lever (D65EX-12 only)
4. Steering and directional lever
5. PPC charge valve
6. PPC lock valve

D65EX-12 60942 – 65000
D65PX-12 60915 – 65000

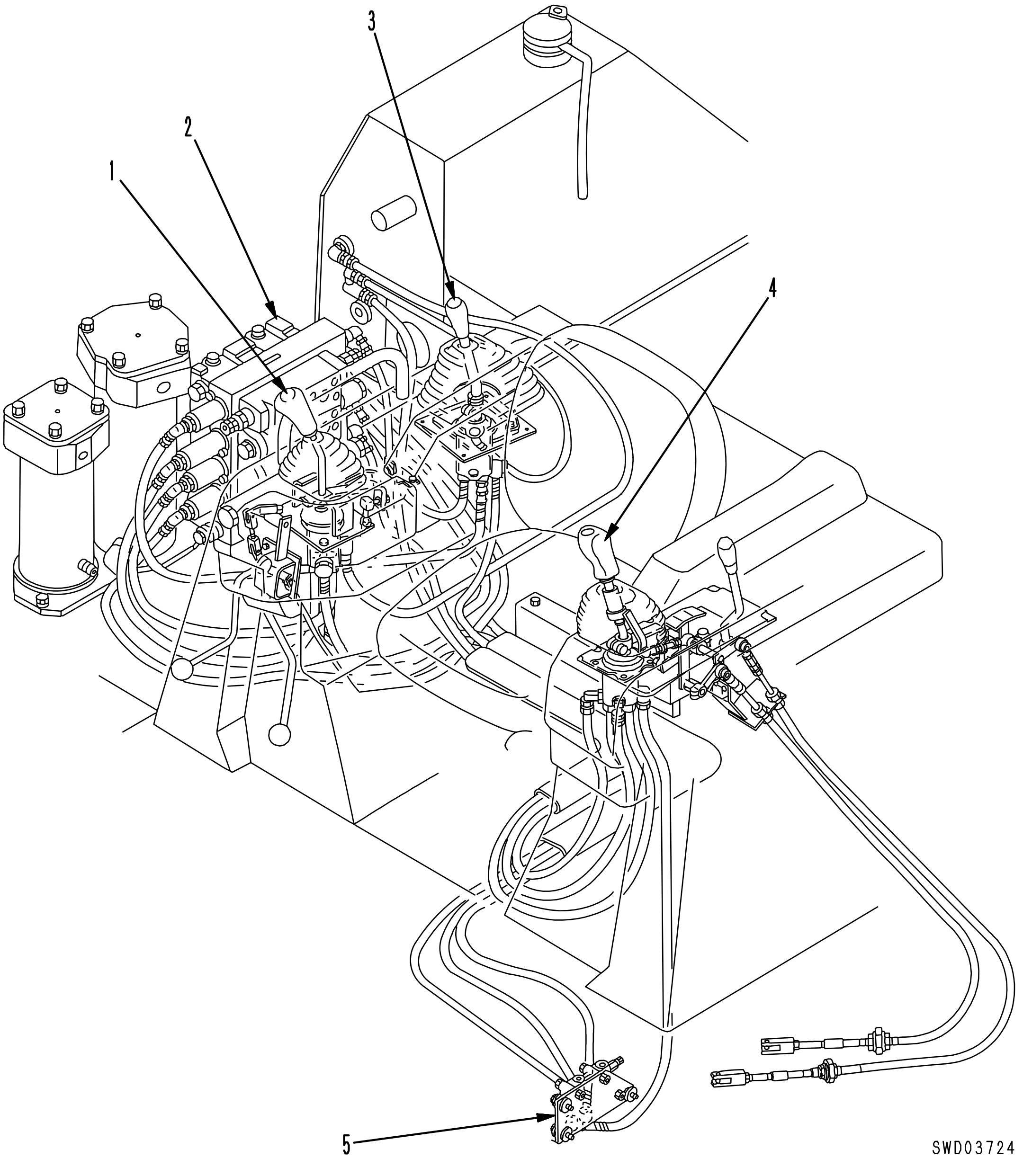
(Steering, blade, ripper control)



1. Blade control lever
2. Main control valve
3. Ripper control lever (D65EX-12 only)
4. Steering and directional lever
5. PPC charge valve

D65EX-12 65001 and up
D65PX-12 65001 and up

(Steering, blade, ripper control)

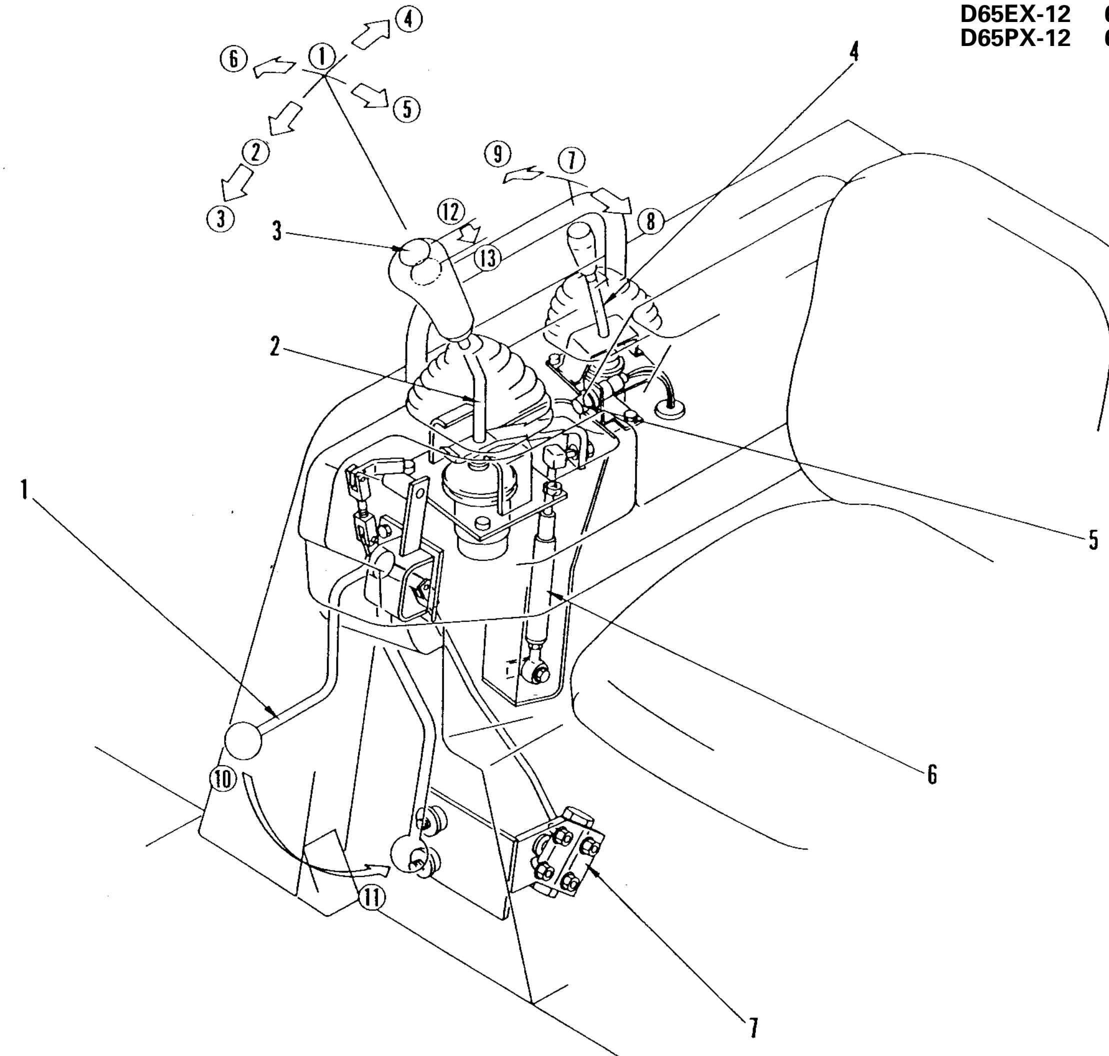


1. Blade control lever
2. Main control valve
3. Ripper control lever (D65EX-12 only)
4. Steering and directional lever
5. PPC charge valve

014012

WORK EQUIPMENT CONTROL

D65E-12	**60001 – 60947**
D65P-12	**60001 – 60890**
D65EX-12	**60001 – 60941**
D65PX-12	**60001 – 60914**



140F12105

Lever positions

① HOLD
② Blade LOWER
③ Blade FLOAT
④ Blade RAISE
⑤ Blade LEFT TILT/PITCH
⑥ Blade RIGHT TILT/PITCH
⑦ HOLD (D65E, EX only)
⑧ Ripper RAISE (D65E, EX only)
⑨ Ripper LOWER (D65E, EX only)
⑩ FREE
⑪ LOCK
⑫ Pitch selector switch OFF (D65P, PX only)
⑬ Pitch selector switch ON (D65P, PX only)

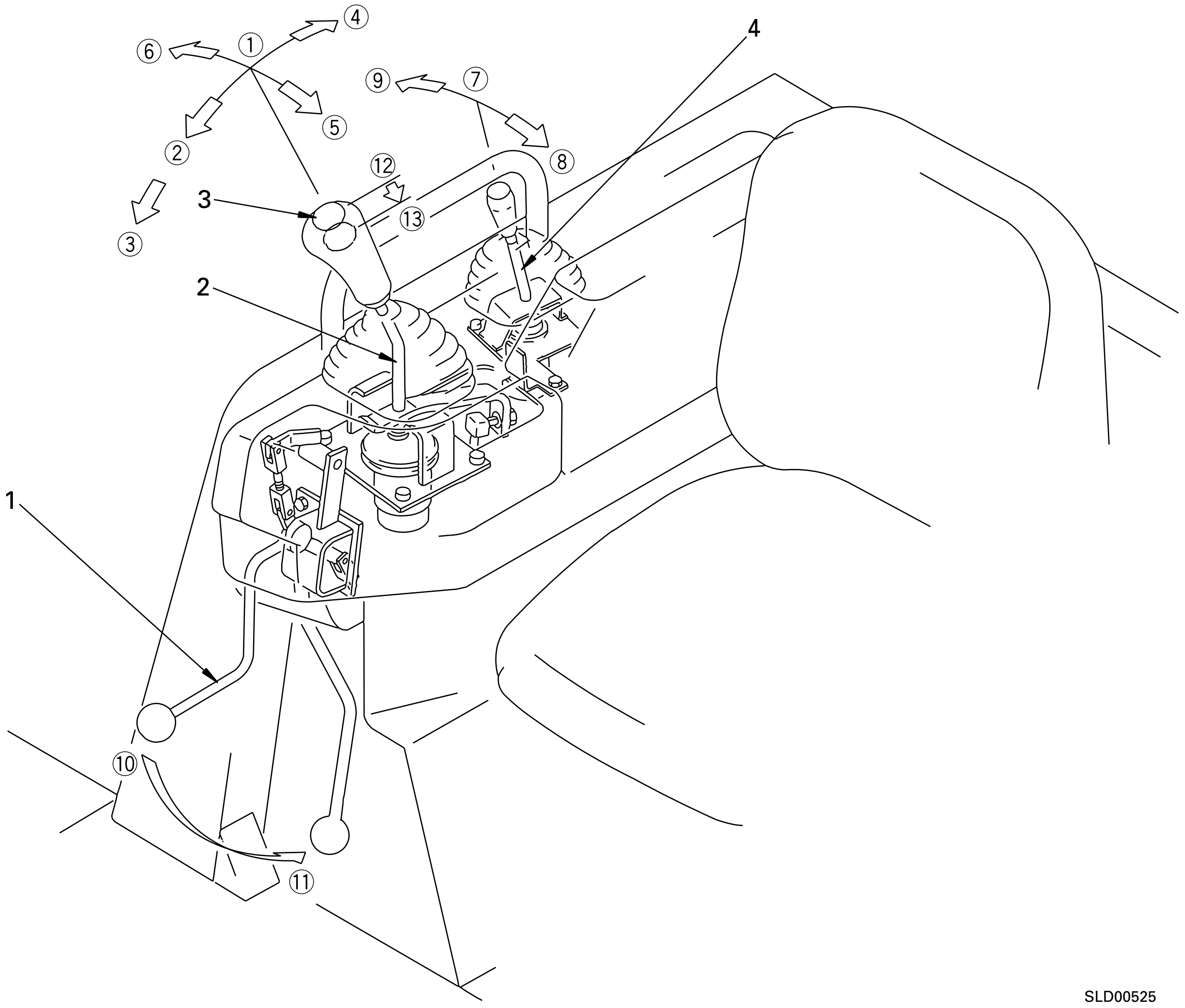
1. Safety lever
2. Blade control lever
3. Tilt/pitch selector button (D65P, PX only)
4. Ripper control lever (D65E, EX only)
5. Proximity switch
6. Detent (for holding lever)
7. PPC lock valve

OUTLINE

- The work equipment control uses a PPC method in which each spool in the control valve is moved by the PPC valve.
- If safety lever (1) is placed at the LOCK position, blade control lever (2) cannot be moved to the LOWER position from the HOLD position. Proximity swithc (5) is installed to prevent the engine from starting when the blade control lever is at the FLOAT position.
- Safety lever (1) is interconnected with PPC lock valve (7) and stops the oil in the PPC circuit when it is at the LOCK position.

014012

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up



Lever positions
- ① HOLD
- ② Blade LOWER
- ③ Blade FLOAT
- ④ Blade RAISE
- ⑤ Blade LEFT TILT/PITCH
- ⑥ Blade RIGHT TILT/PITCH
- ⑦ HOLD (D65E, EX only)
- ⑧ Ripper RAISE (D65E, EX only)
- ⑨ Ripper LOWER (D65E, EX only)
- ⑩ FREE
- ⑪ LOCK
- ⑫ Pitch selector switch OFF (D65P, PX only)
- ⑬ Pitch selector switch ON (D65P, PX only)

1. Safety lever
2. Blade control lever
3. Tilt/pitch selector button (D65P, PX only)
4. Ripper control lever (D65E, EX only)

OUTLINE
- The work equipment control uses a PPC method in which each spool in the control valve is moved by the PPC valve.
- If safety lever (1) is placed at the LOCK position, blade control lever (2) is fixed to the HOLD position and cannot be moved.

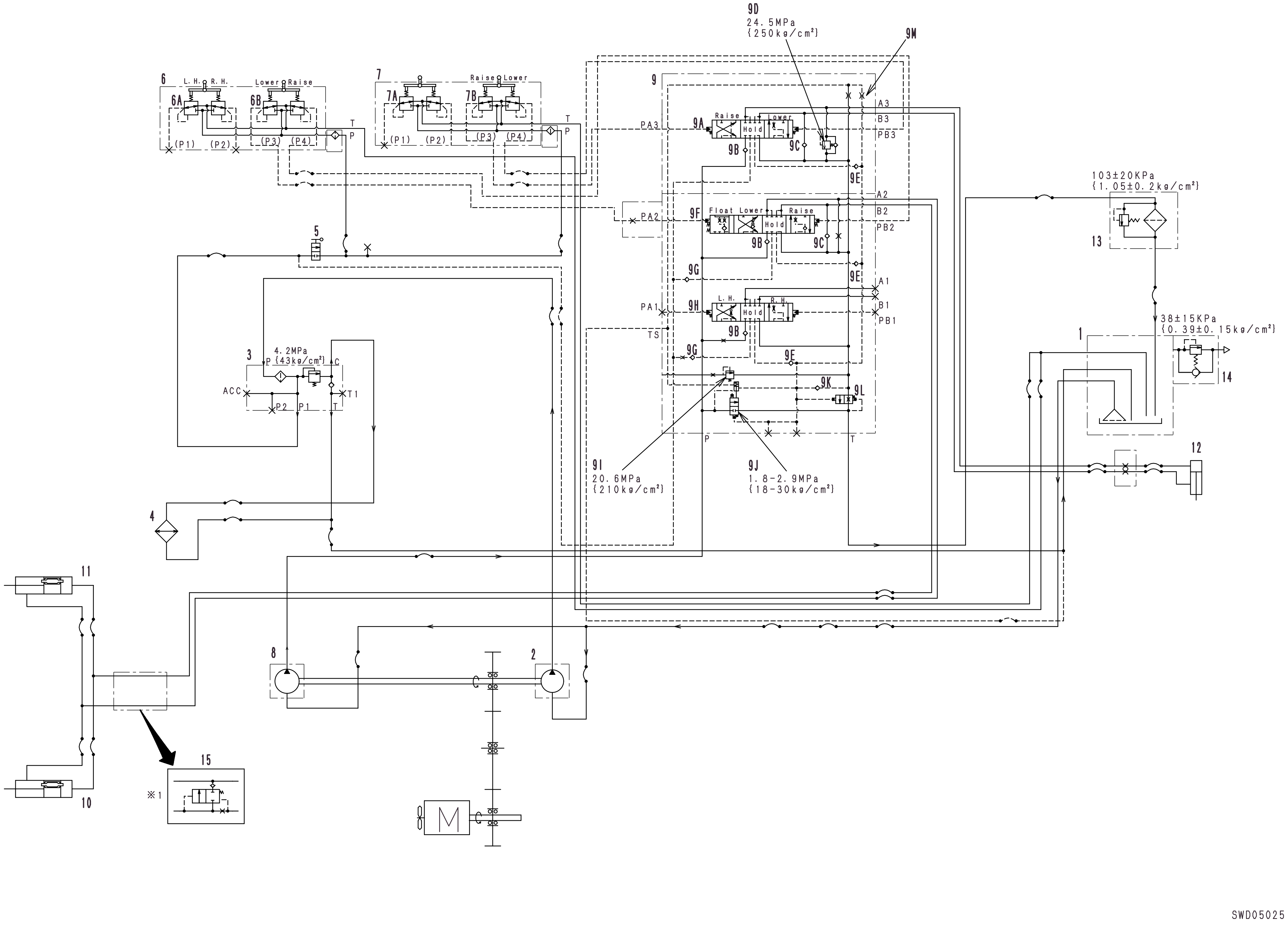
WORK EQUIPMENT HYDRAULIC CIRCUIT DIAGRAM

ANGLEDOZER (WITH RIPPER)

D65E-12 **60001 – 60947**
D65P-12 **60001 – 60890**

※1. Serial Numbers
D65E-12 60516 – 60947
D65P-12 60516 – 60890

★ The didagram shows the D65E-12.



1. Hydraulic tank
2. PPC pump (SBR(1)-010)
3. PPC charge valve
4. Oil cooler
5. PPC lock valve
6. Blade control PPC valve
    - 6A. Blade tilt
    - 6B. Blade lift
7. Ripper control PPC valve (D65E only)
    - 7A. —
    - 7B. Ripper lift
8. Hydraulic pump (SAL(3)-100)
9. Main control valve
    - 9A. Ripper valve (D65E only)
    - 9B. Load check valve
    - 9C. Suction valve
    - 9D. Suction safety valve (D65E only)
    - 9E. LS check valve
    - 9F. Blade lift valve
    - 9G. Preset check valve
    - 9H. Blade tilt valve
    - 9I. Main relief valve
    - 9J. Variable unload valve
    - 9K. Back pressure check valve
    - 9L. Back pressure valve
    - 9M. LS bypass valve
10. Left blade lift cylinder
11. Right blade lift cylinder
12. Ripper lift cylinder (D65E only)
13. Hydraulic filter
14. Breather
15. Suction valve

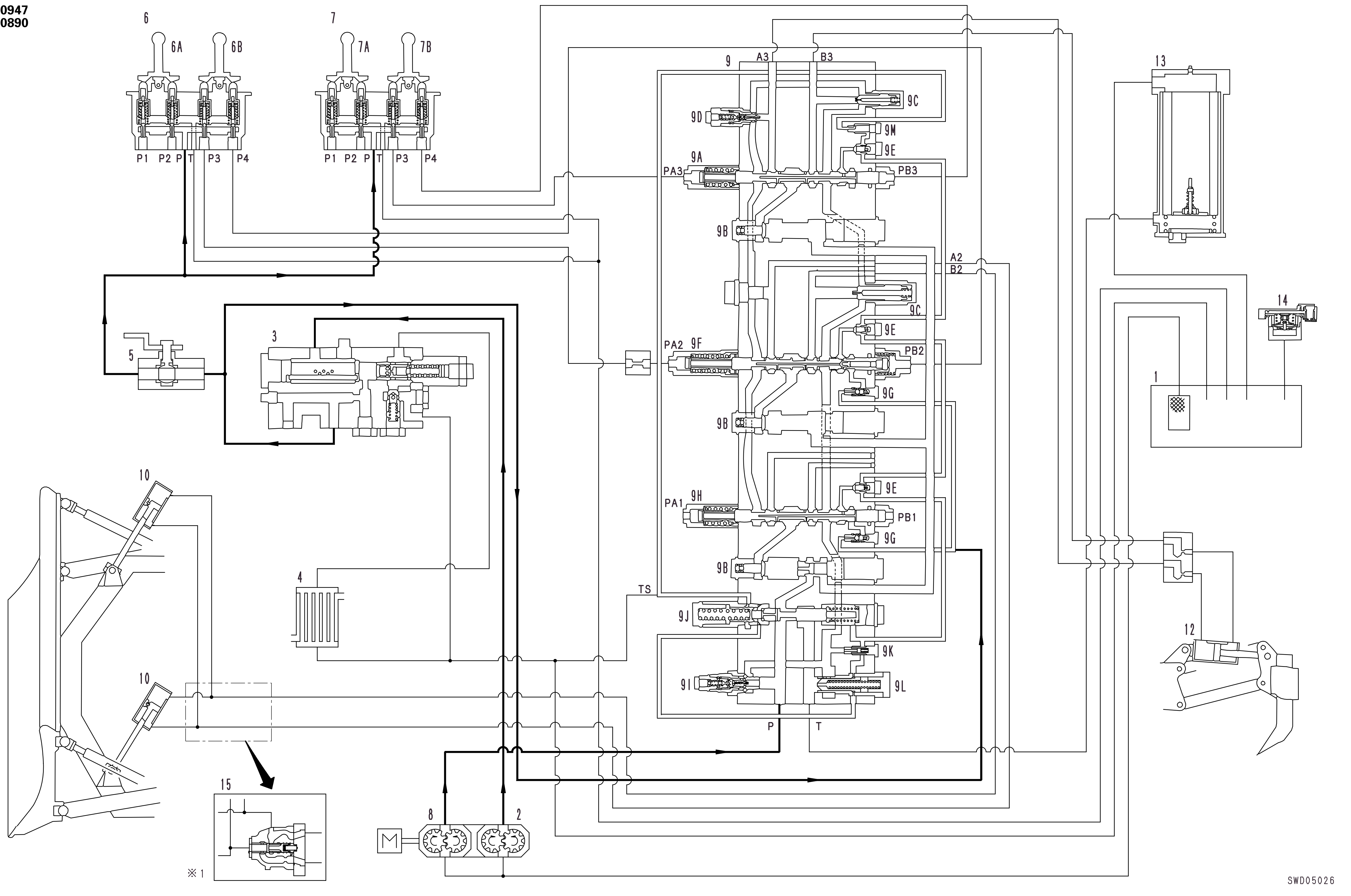
014012

WORK EQUIPMENT HYDRAULIC SYSTEM DIAGRAM

(Engine running, hydraulic control lever in "HOLD")

D65E-12 60001 – 60947
D65P-12 60001 – 60890

※1. Serial Numbers
D65E-12 60516 – 60947
D65P-12 60516 – 60890



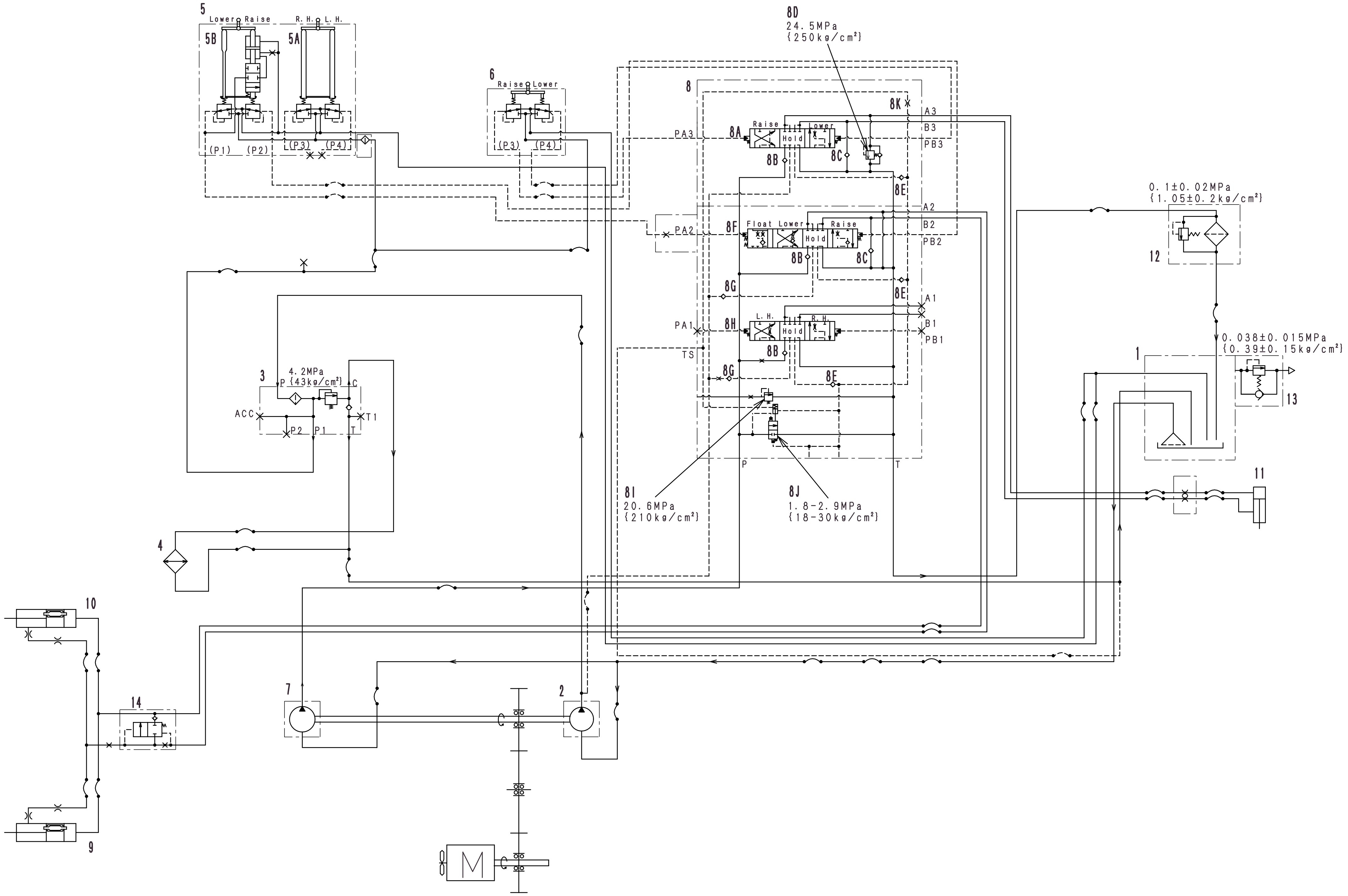
014012

WORK EQUIPMENT HYDRAULIC CIRCUIT DIAGRAM

ANGLEDOZER (WITH RIPPER)

D65E-12 **60948 and up**
D65P-12 **60891 and up**

★ The diagram shows the D65E-12.



SWD05027

1. Hydraulic tank
2. PPC pump (SBR(1)-010)
3. PPC charge valve
4. Oil cooler
5. Blade control PPC valve
   5A. Blade tilt
   5B. Blade lift
6. Ripper control PPC valve (D65E only)
7. Hydraulic pump (SAL(3)-080)
8. Main control valve
   8A. Ripper valve (D65E only)
   8B. Load check valve
   8C. Suction valve
   8D. Suction safety valve
   8E. LS check valve
   8F. Blade lift valve
   8G. Preset check valve
   8H. Blade tilt valve
   8I. Main relief valve
   8J. Variable unload valve
   8K. Back pressure check valva
   8L. Back pressure valve
   8M. LS bypass valve
9. Left blade lift cylinder
10. Right blade lift cylinder
11. Ripper lift cylinder (D65E only)
12. Hydraulic filter
13. Breather
14. Suction valve

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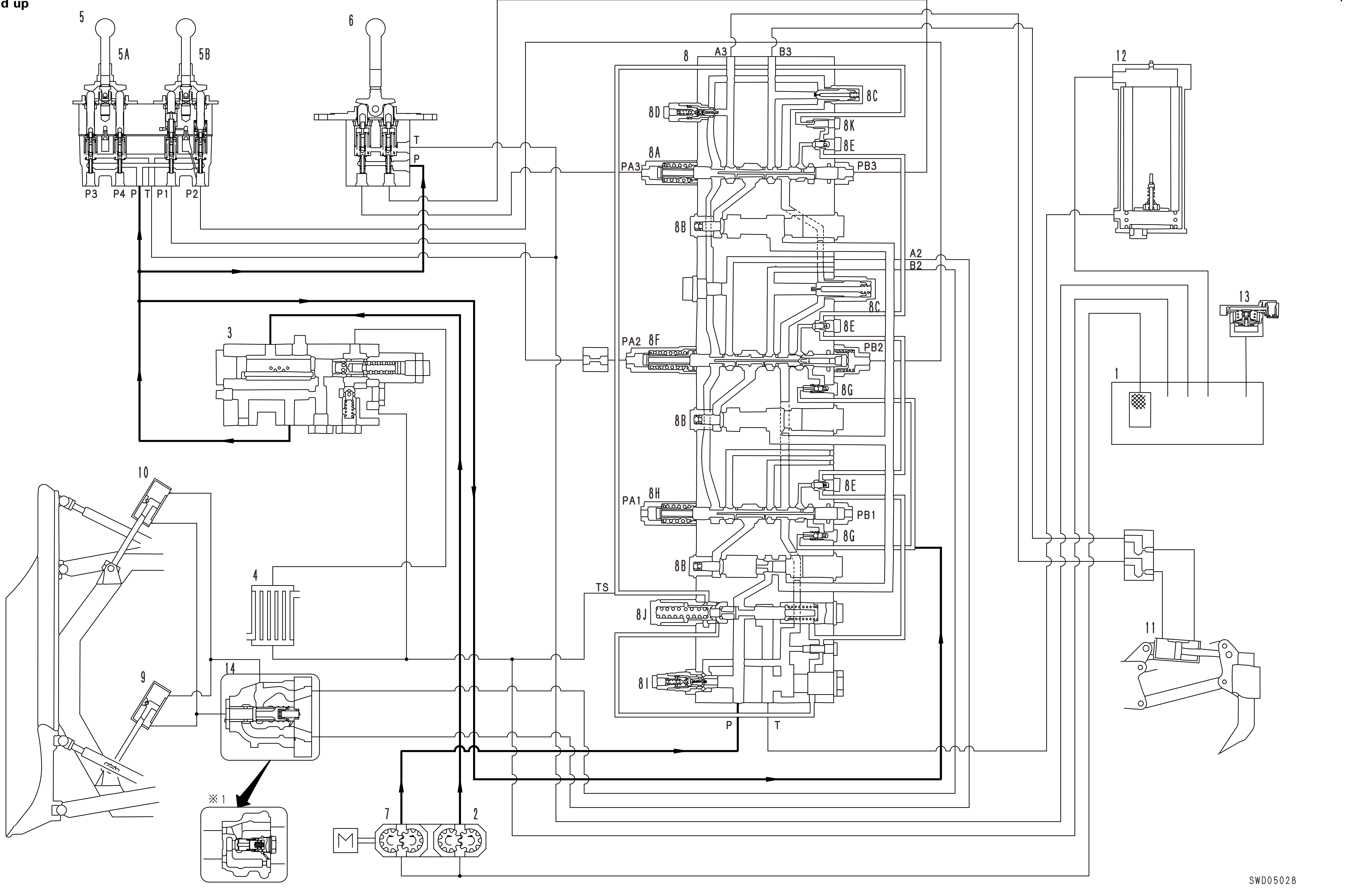
WORK EQUIPMENT HYDRAULIC SYSTEM DIAGRAM

(Engine running, hydraulic control lever in “HOLD”)

D65E-12 60948 and up
D65P-12 60891 and up

※1. Serial Numbers
D65E-12 61441 and up
D65P-12 61365 and up



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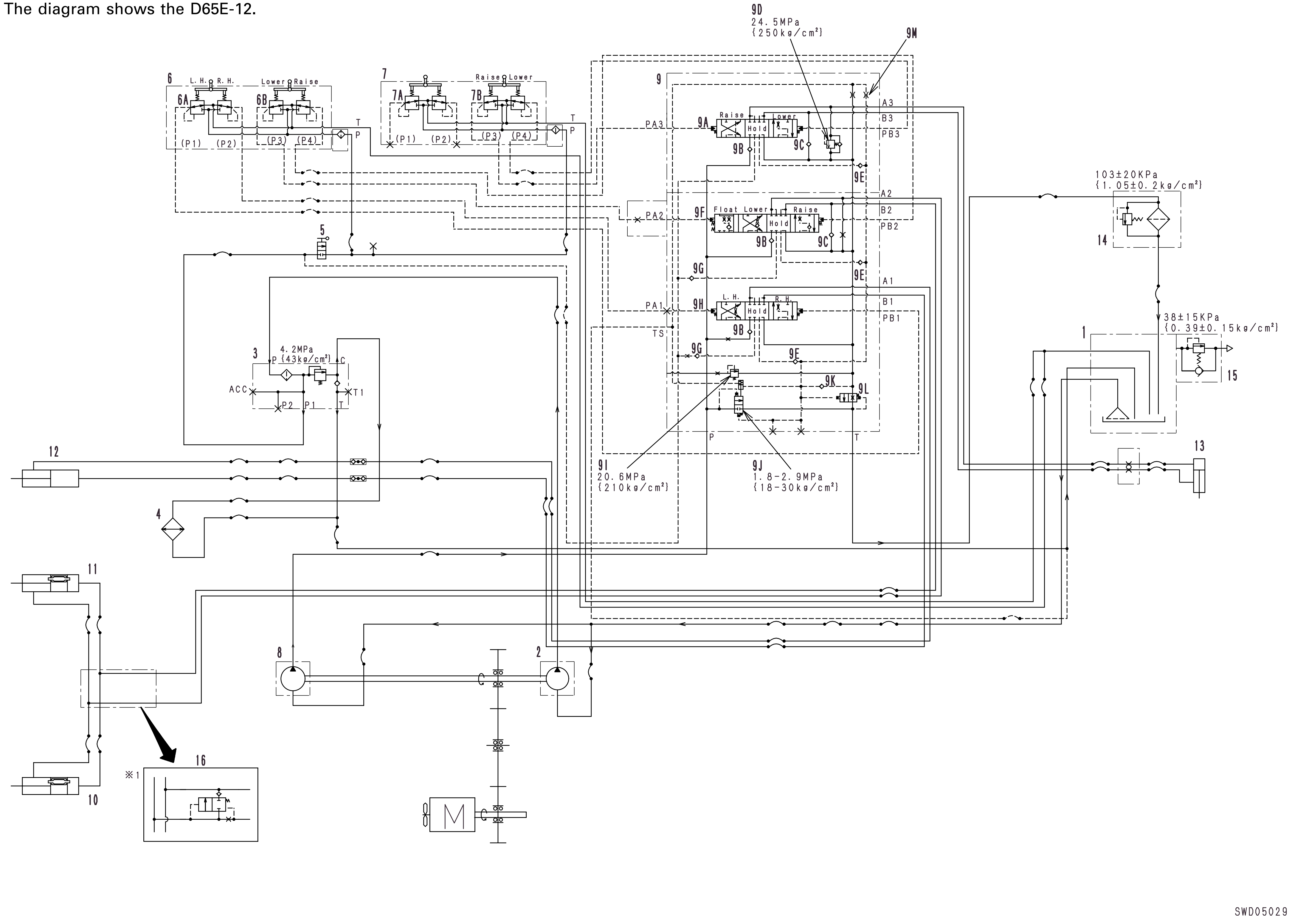
WORK EQUIPMENT HYDRAULIC CIRCUIT DIAGRAM

STRAIGHT TILTDOZER (WITH RIPPER)

D65E-12 **60001 – 60947**
D65P-12 **60001 – 60890**

※1. Serial Numbers
D65E-12 60516 – 60947
D65P-12 60516 – 60890

★ The diagram shows the D65E-12.



1. Hydraulic tank
2. PPC pump (SBR(1)-010)
3. PPC charge valve
4. Oil cooler
5. PPC lock valve
6. Blade control PPC valve
   - 6A. Blade lift
   - 6B. Blade tilt
7. Ripper control PPC valve (D65E only)
   - 7A. —
   - 7B. Ripper lift
8. Hydraulic pump (SAL(3)-100)
9. Main control valve
   - 9A. Ripper valve (D65E only)
   - 9B. Load check valve
   - 9C. Suction valve
   - 9D. Suction safety valve (D65E only)
   - 9E. LS check valve
   - 9F. Blade lift valve
   - 9G. Preset check valve
   - 9H. Blade tilt valve
   - 9I. Main relief valve
   - 9J. Variable unload valve
   - 9K. Back pressure check valve
   - 9L. Back pressure valve
   - 9M. LS bypass valve
10. Left blade lift cylinder
11. Right blade lift cylinder
12. Blade tilt cylinder
13. Ripper lift cylinder (D65E only)
14. Hydraulic filter
15. Breather
16. Suction valve

014012

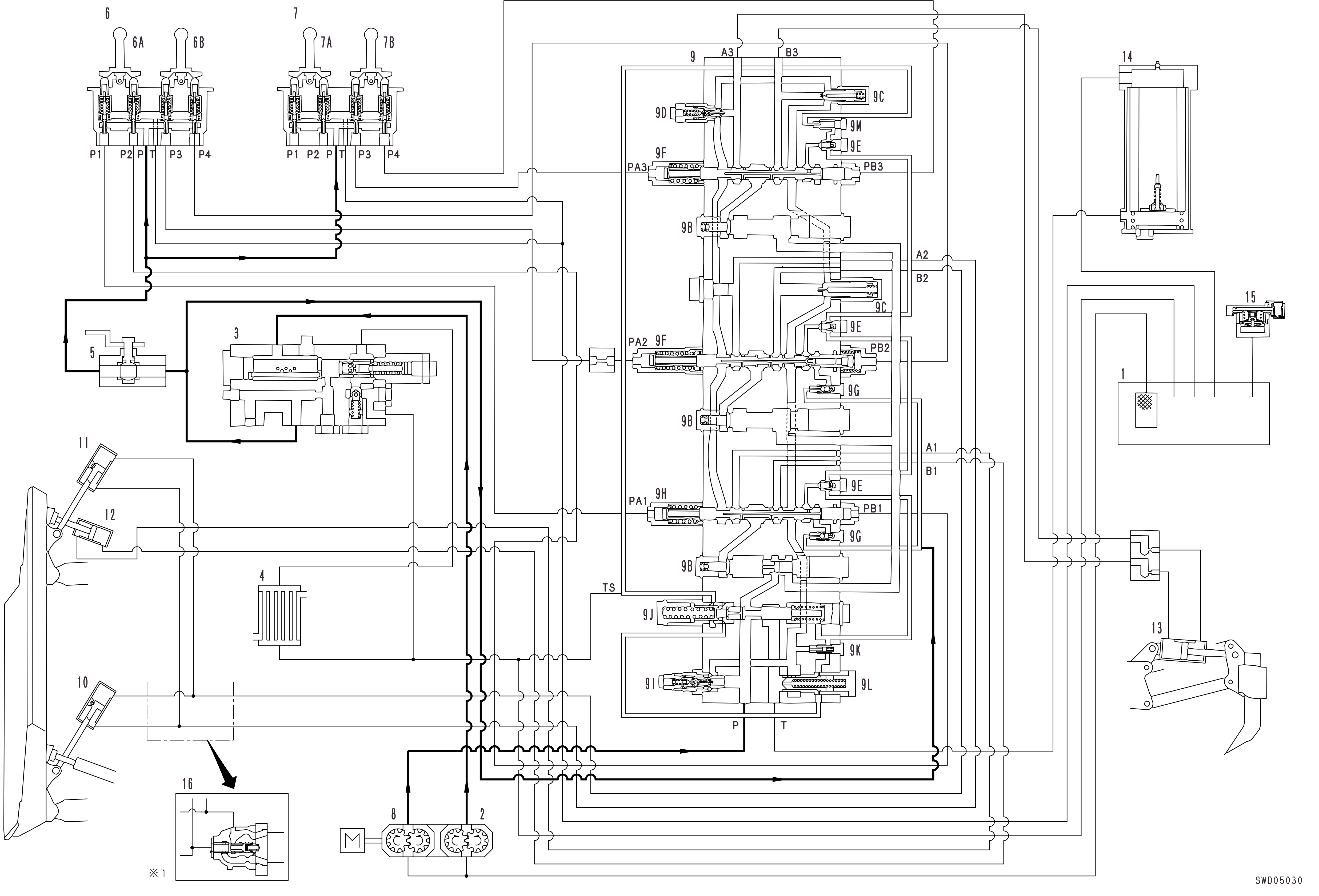
WORK EQUIPMENT HYDRAULIC SYSTEM DIAGRAM

(Engine running, hydraulic control lever in "HOLD")

D65E-12	**60001 – 60947**
D65P-12	**60001 – 60890**

※1. Serial Numbers

D65E-12	60516 – 60947
D65P-12	60516 – 60890



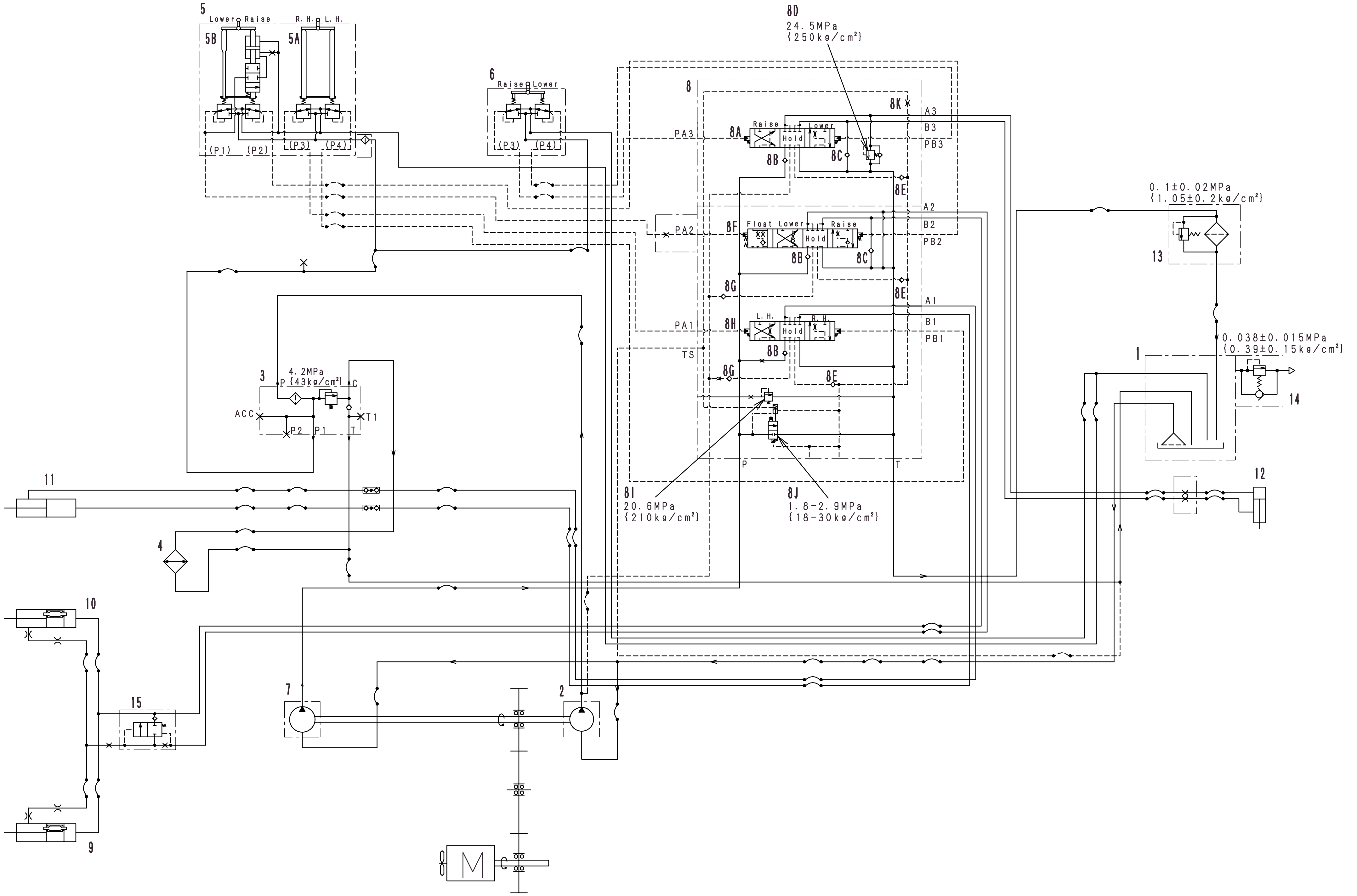
014012

WORK EQUIPMENT HYDRAULIC CIRCUIT DIAGRAM

STRAIGHT TILTDOZER (WITH RIPPER)

D65E-12 60948 and up
D65P-12 60891 and up

★ The diagram shows the D65E-12



SWD05031

1. Hydraulic tank
2. PPC pump (SBR(1)-010)
3. PPC charge valve
4. Oil cooler
5. Blade control PPC valve
   - 5A. Blade lift
   - 5B. Blade tilt
6. Ripper control PPC valve (D65E only)
7. Hydraulic pump (SAL(3)-080)
8. Main control valve
   - 8A. Ripper valve (D65E only)
   - 8B. Load check valve
   - 8C. Suction valve
   - 8D. Suction safety valve (D65E only)
   - 8E. LS check valve
   - 8F. Blade lift valve
   - 8G. Preset check valve
   - 8H. Blade tilt valve
   - 8I. Main relief valve
   - 8J. Variable unload valve
   - 8K. LS bypass valve
9. Left blade lift cylinder
10. Right blade lift cylinder
11. Blade tilt cylinder
12. Ripper lift cylinder (D65E only)
13. Hydraulic filter
14. Breather
15. Suction valve

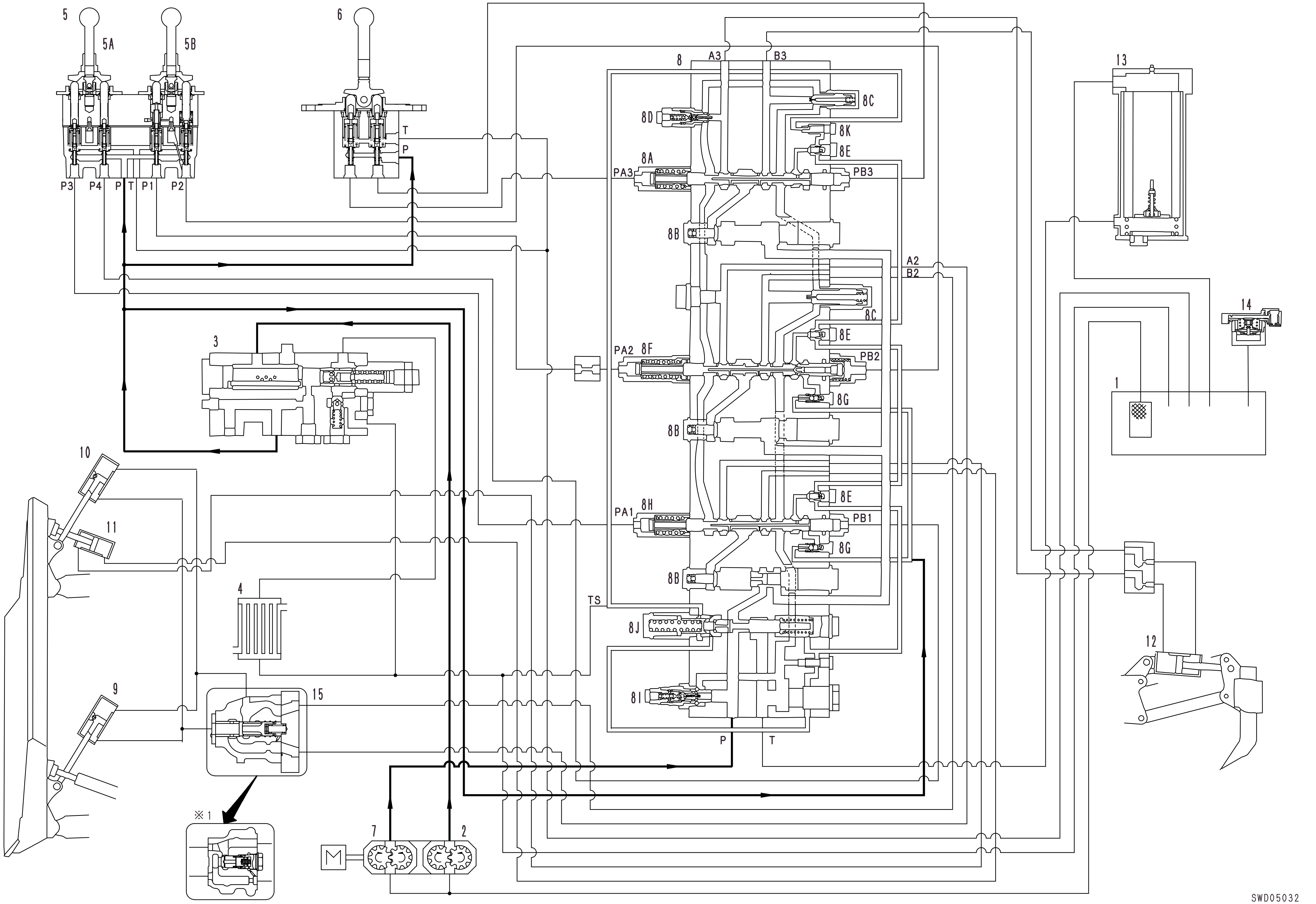
014012

WORK EQUIPMENT HYDRAULIC SYSTEM DIAGRAM

(Engine running, hydraulic control lever in "HOLD")

D65E-12 **60948 and up**
D65P-12 **60891 and up**

※1. Serial Numbers
D65E-12 61441 and up
D65P-12 61365 and up



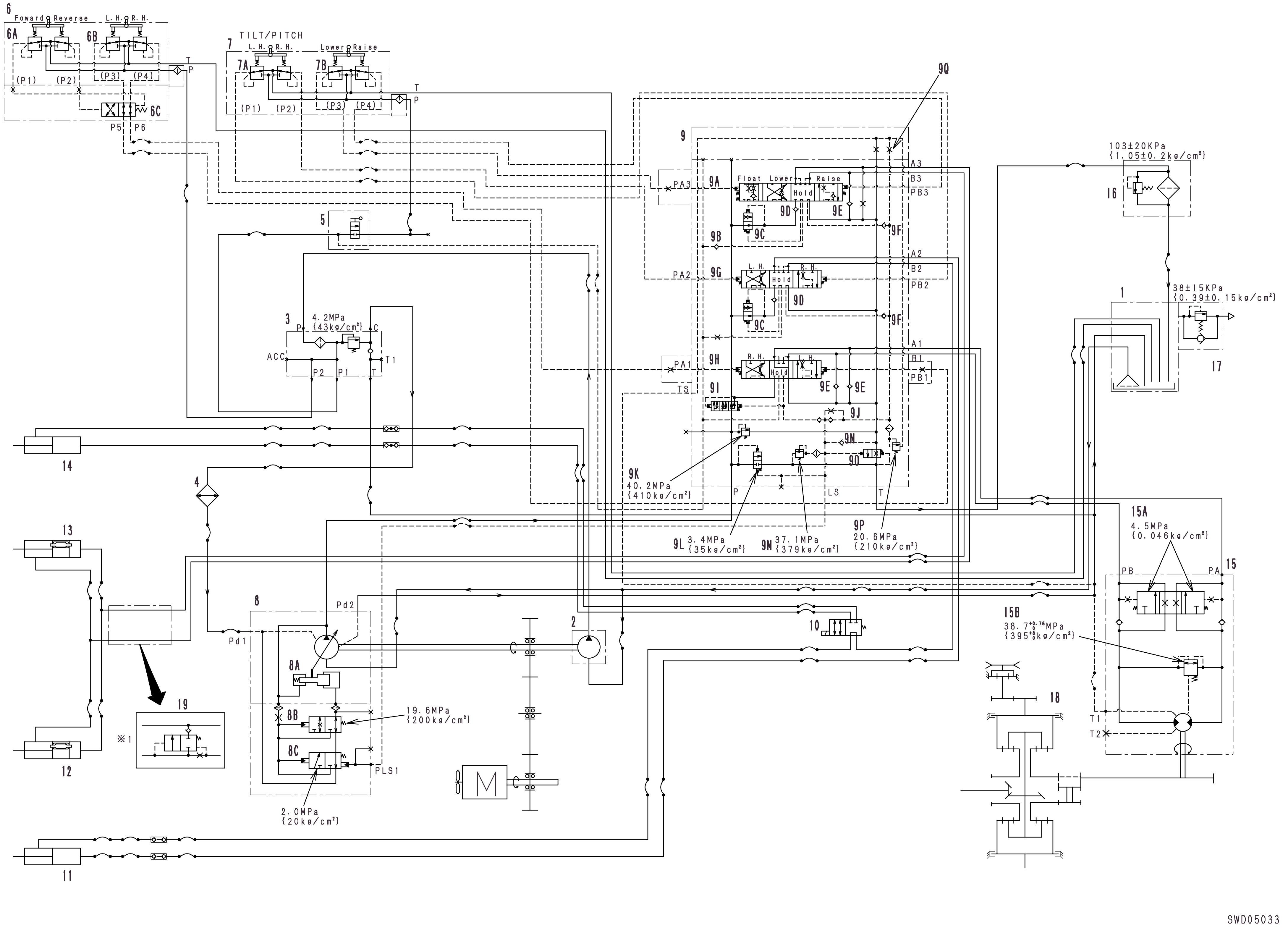
014012

STEERING AND WORK EQUIPMETN HYDRAULIC CIRCUIT DIAGRAM

POWER PITCH DOZER (WITHOUT RIPPER)

D65PX-12 60001 – 60914

※1. Serial Numbers
D65PX-12 60516 – 60914



1. Hydraulic tank
2. PPC pump (SBR(1)-010)
3. PPC charge valve
4. Oil cooler
5. PPC lock valve
6. Steering control PPC valve
   6A. Direction (for HSS)
   6B. Steering
   6C. Steering circuit selector valve
7. Blade control PPC valve
   7A. Blade tilt/pitch
   7B. Blade lift
8. Hydraulic, HSS pump (HPV95)
   8A. Servo cylinder
   8B. Variable throttle valve
   8C. LS valve
9. Main control valve
   9A. Blade lift valve
   9B. Preset check valve
   9C. Pressure compensation valve
   9D. Load check valve
   9E. Suction valve
   9F. LS check valve (for work equipment)
   9G. Blade tilt valve/Blade pitch valve
   9H. Steering valve
   9I. Steering priority valve
   9J. LS check valve (for steering valve)
   9K. Main relief valve
   9L. Unload valve
   9M. LS relief valve (for steering valve)
   9N. Back pressure check valve
   9O. Back pressure valve
   9P. LS relief valve (for work equipment valve)
   9Q. LS bypass valve
10. Pitch selector valve
11. Blade tilt cylinder
12. Left blade lift cylinder
13. Right blade lift cylinder
14. Blade pitch cylinder
15. HSS motor (HMF95)
   15A. Counterbalance valve
   15B. Safety valve
16. Hydraulic filter
17. Breather
18. HSS unit
19. Suction valve

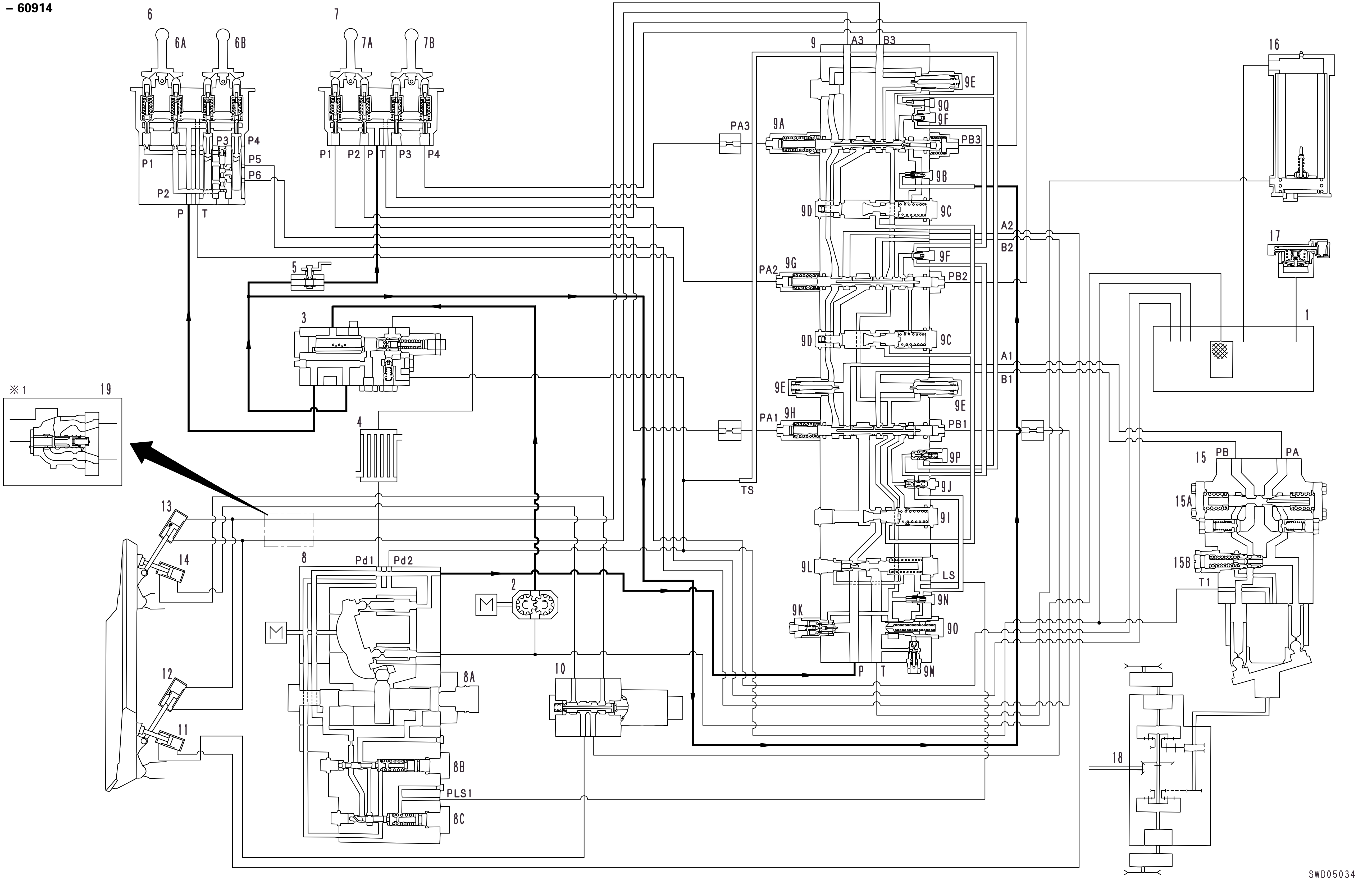
014012

STEERING AND WORK EQUIPMENT HYDRAULIC SYSTEM DIAGRAM

※1. Serial Numbers
D65PX-12 60516 – 60914

(Engine running, steering lever in "NEUTRAL", hydraulic control lever in "HOLD")

D65PX-12 60001 – 60914

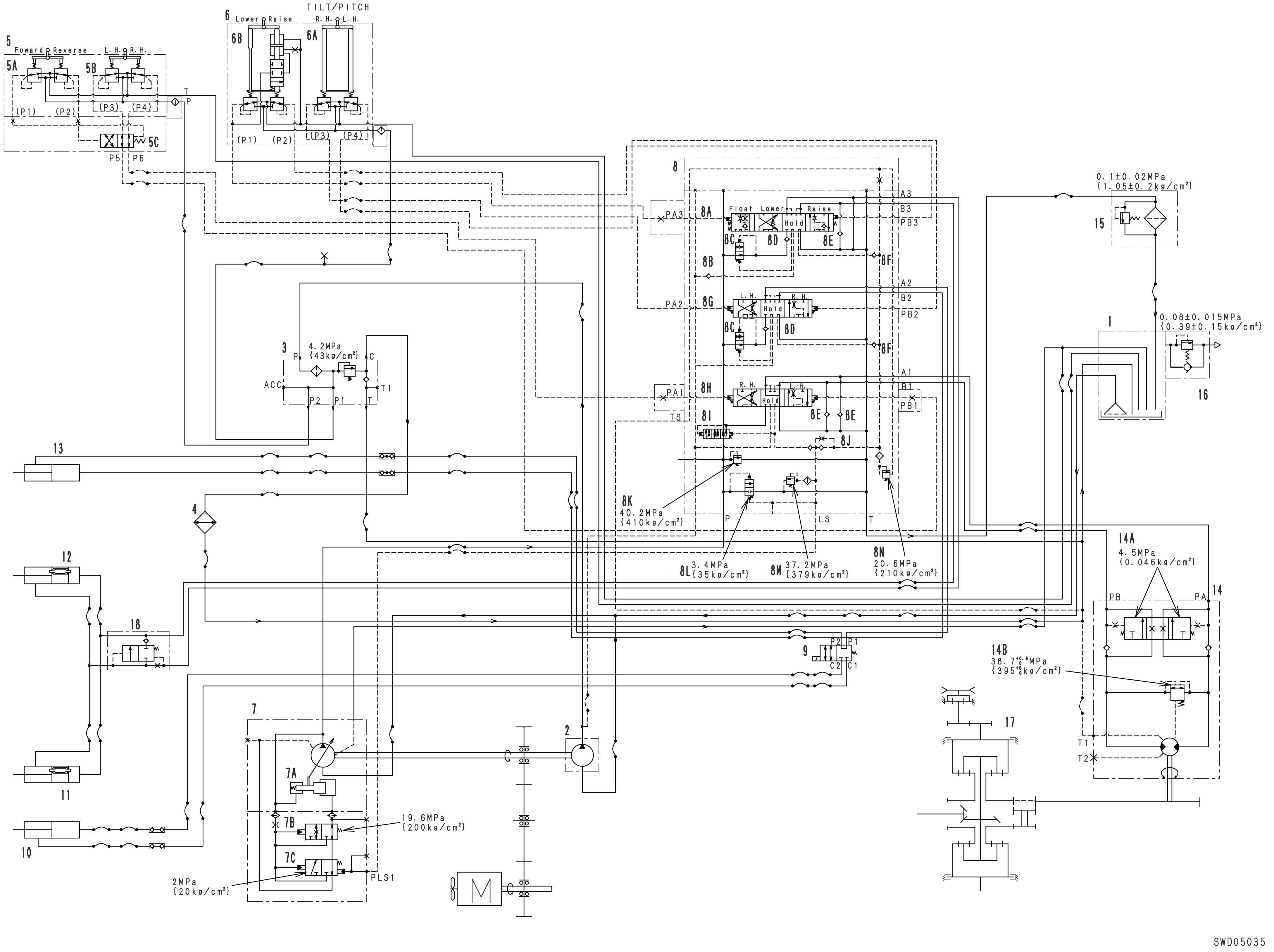


014012

STEERING AND WORK EQUIPMENT HYDRAULIC CIRCUIT DIAGRAM

POWER PITCH DOZER (WITHOUT RIPPER)

D65PX-12 60915 and up



1. Hydraulic tank
2. PPC pump (SBR(1)-010)
3. PPC charge valve
4. Oil cooler
5. Steering control PPC valve
    5A. Direction (for HSS)
    5B. Steering
    5C. Steering circuit selector valve
6. Blade control PPC valve
    6A. Blade tilt/pitch
    6B. Blade lift
7. Hydraulic, HSS pump (HPV95)
    7A. Servo cylinder
    7B. Variable throttle valve
    7C. LS valve
8. Main control valve
    8A. Blade lift valve
    8B. Preset check valve
    8C. Pressure compensation valve
    8D. Load check valve
    8E. Suction valve
    8F. LS check valve (for work equipment)
    8G. Blade tilt valve/Blade pitch valve
    8H. Steering valve
    8I. Steering priority valve
    8J. LS check valve (for steering valve)
    8K. Main relief valve
    8L. Unload valve
    8M. LS relief valve (for steering valve)
    8N. LS relief valve
    (for work equipment valve)
    8O. LS bypass valve
9. Pitch selector valve
10. Blade tilt cylinder
11. Left blade lift cylinder
12. Right blade lift cylinder
13. Blade pitch cylinder
14. HSS motor (HMF95)
    14A. Counterbalance valve
    14B. Safety valve
15. Hydraulic filter
16. Breather
17. HSS unit
18. Suction valve

014012

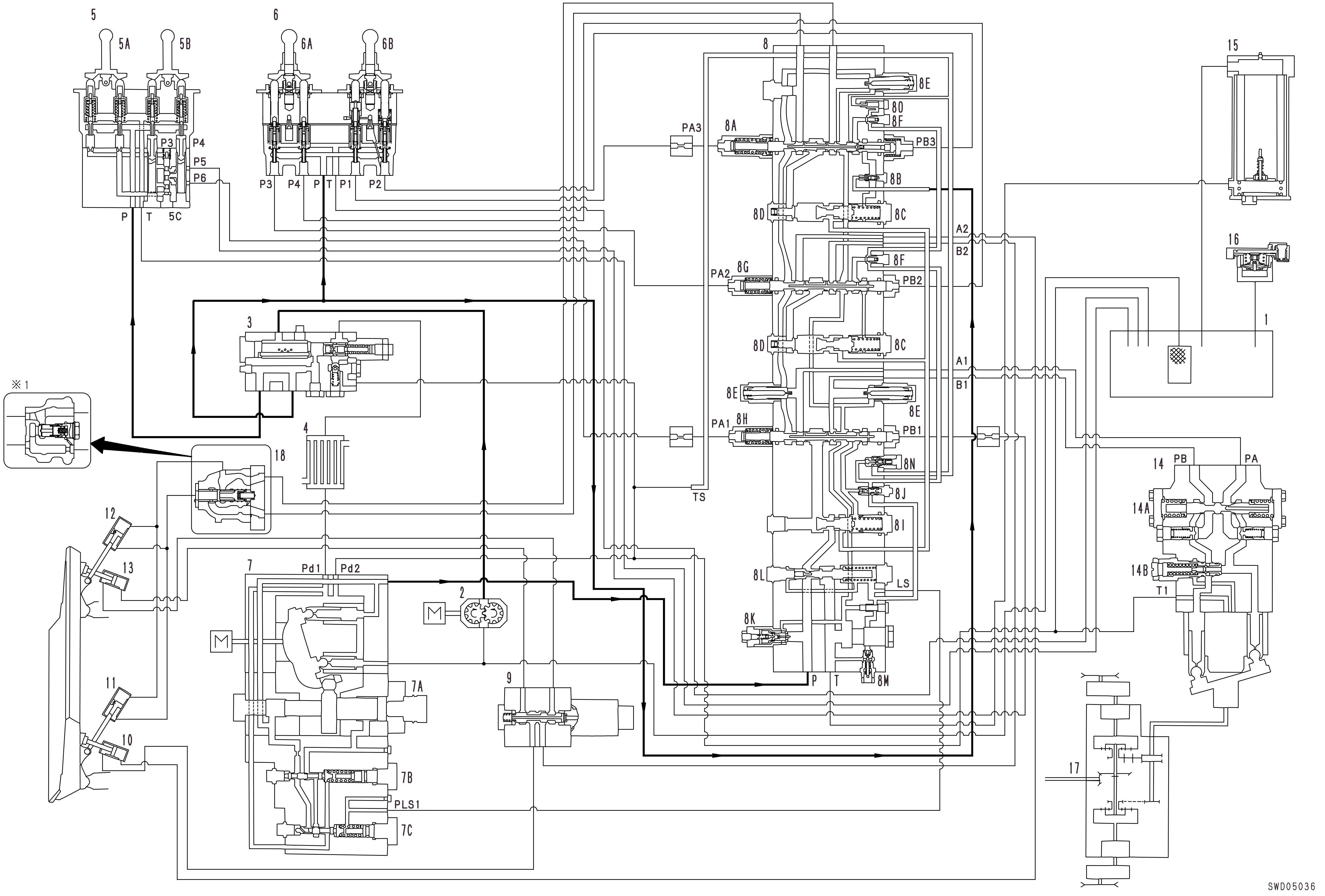
STEERING AND WORK EQUIPMETN HYDRAULIC SYSTSEM DIAGRAM

(Engine running, steering lever in “NEUTRAL”, hydraulic control lever in “HOLD”)

D65PX-12 60915 and up

※1. Serial Numbers
D65PX-12 61369 and up

014012

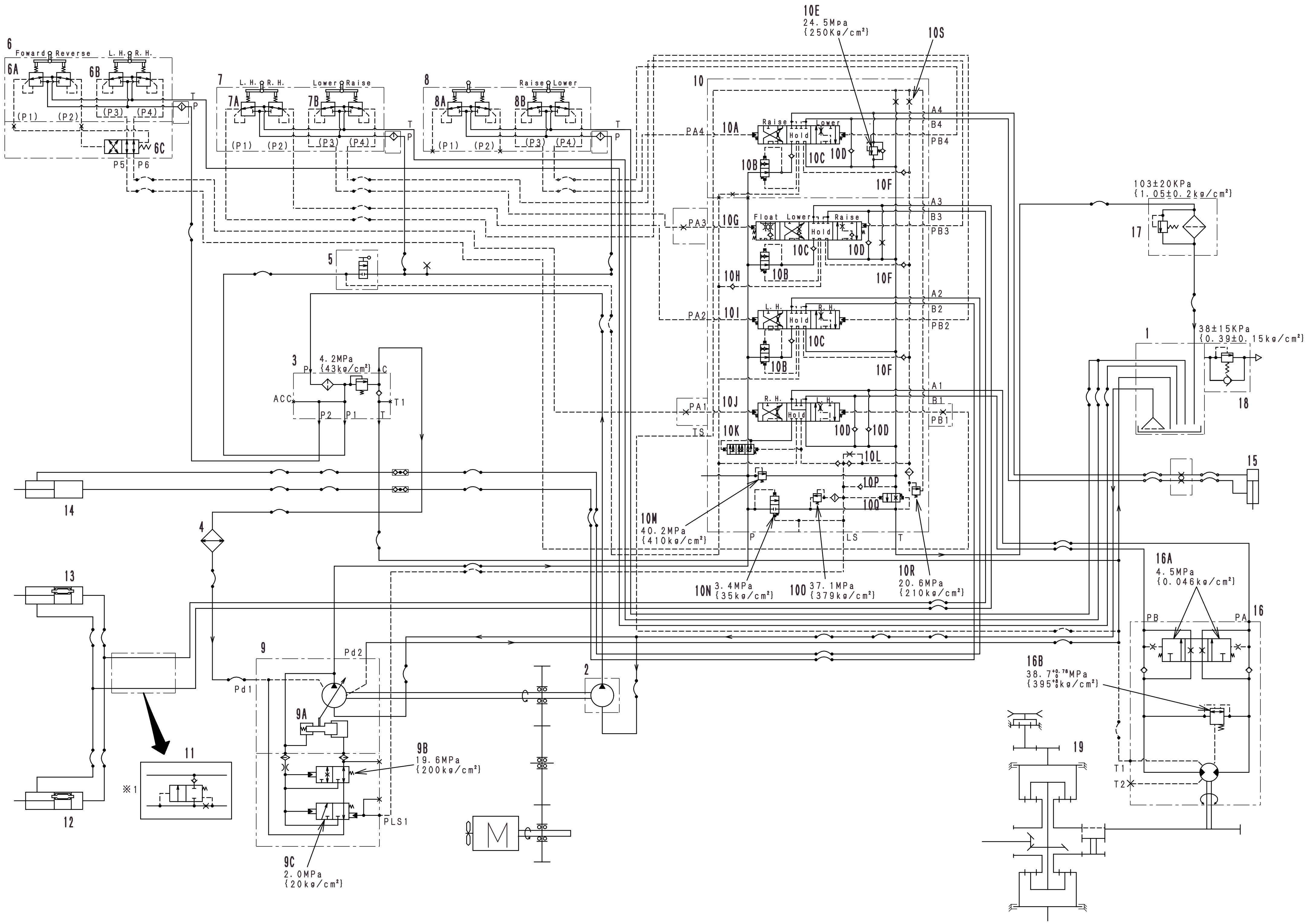


STEERING AND WORK EQUIPMETN HYDRAULIC CIRCUIT DIAGRAM

STRAIGHT TILT DOZER (WITH RIPPER)

D65EX-12 60001 – 60941

※7. Serial Numbers
D65EX-12 60516 – 60941



SWD05037

1. Hydraulic tank
2. PPC pump (SBR(1)-010)
3. PPC charge valve
4. Oil cooler
5. PPC lock valve
6. Steering control PPC valve
    6A. Direction (for HSS)
    6B. Steering
    6C. Steering circuit selector valve
7. Blade control PPC valve
    7A. Blade tilt
    7B. Blade lift
8. Ripper control PPC valve
    8A. –
    8B. Ripper lift
9. Hydraulic, HSS pump (HPV95)
    9A. Servo cylinder
    9B. Variable throttle valve
    9C. LS valve
10. Main control valve
    10A. Ripper valve
    10B. Pressure compensation valve
    10C. Load check valve
    10D. Suction valve
    10E. Suction safety valve
    10F. LS check valve (for work equipment)
    10G. Blade lift valve
    10H. Preset check valve
    10I. Blade tilt valve
    10J. Steering valve
    10K. Steering priority valve
    10L. LS check valve (for steering valve)
    10M. Main relief valve
    10N. Unload valve
    10O. LS relief valve (for steering valve)
    10P. Back pressure check valve
    10Q. Back pressure valve
    10R. LS relief valve (for work equipment valve)
    10S. LS bypass valve
11. Suction valve
12. Left blade lift cylinder
13. Right blade lift cylinder
14. Blade tilt cylinder
15. Ripper lift cylinder
16. HSS motor (HMF95)
    16A. Counterbalance valve
    16B. Safety valve
17. Hydraulic filter
18. Breather
19. HSS unit

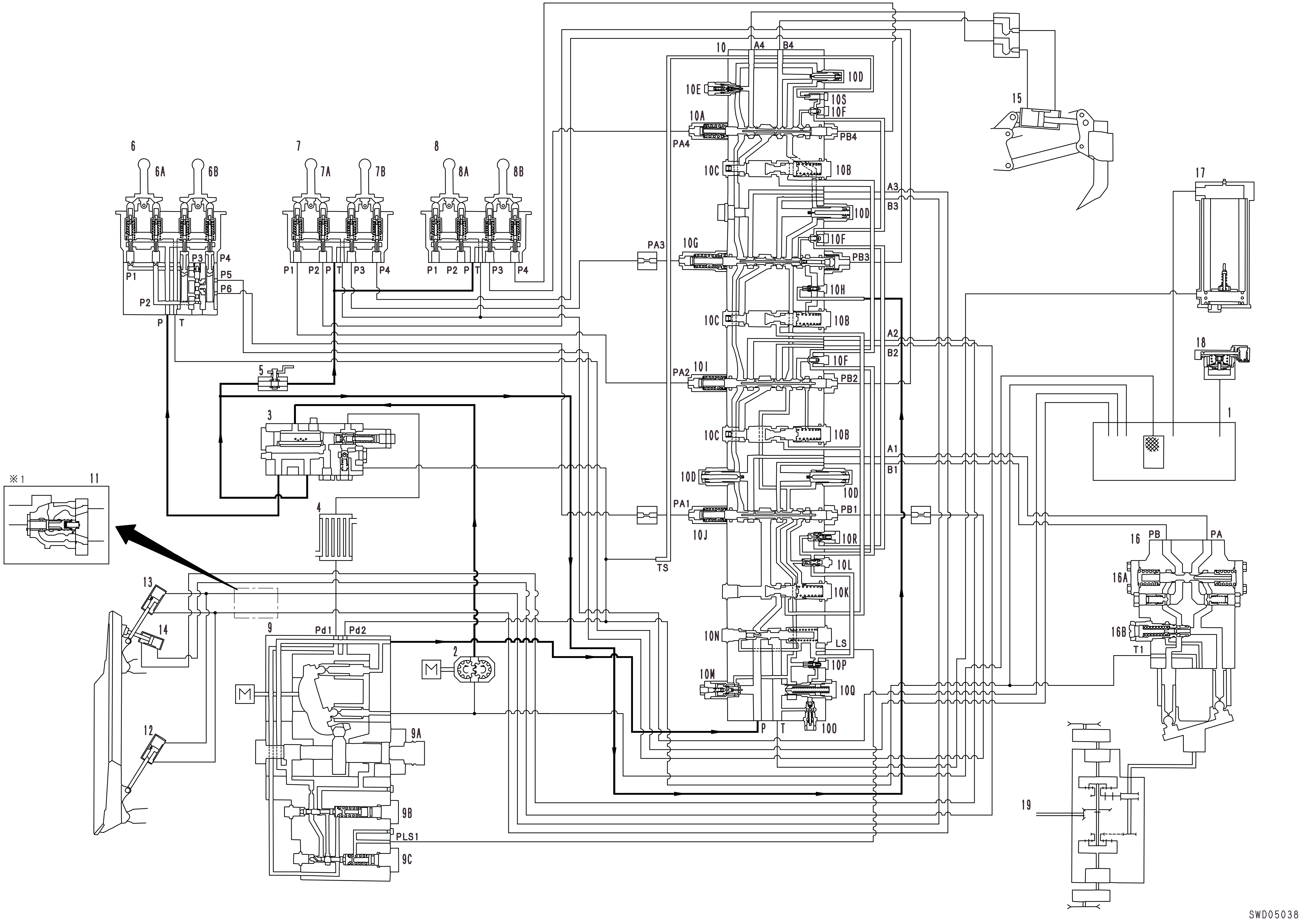
014012

STEERING AND WORK EQUIPMENT HYDRAULIC SYSTEM DIAGRAM

(Engine running, steering lever in "NEUTRAL", hydraulic control lever in "HOLD")

D65EX-12 60001 – 60941

※1. Serial Numbers
D65EX-12 60516 – 60941



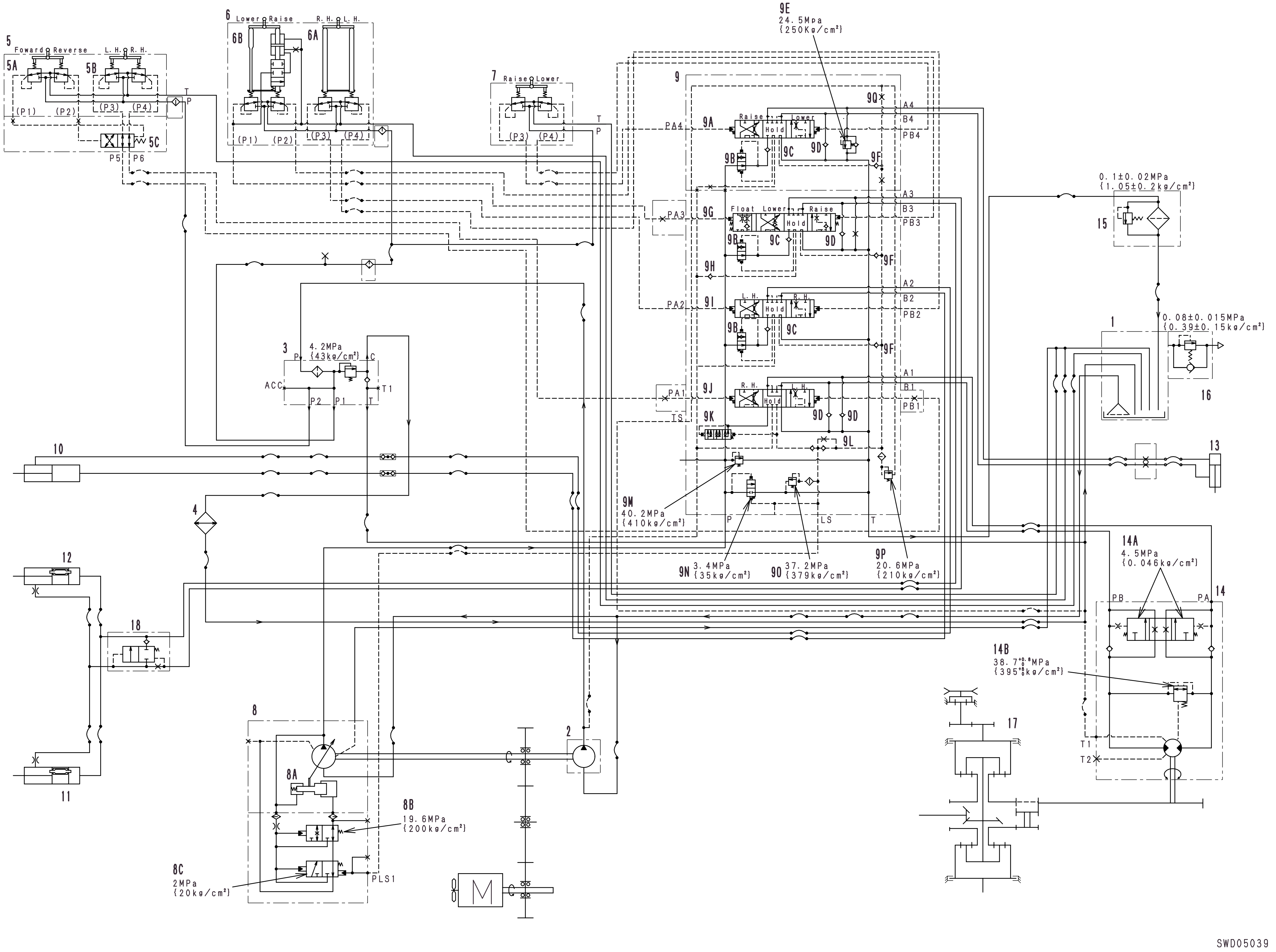
SWD05038

014012

STEERING AND WORK EQUIPMENT HYDRAULIC SYSTEM DIAGRAM

STRAIGHT TILT DOZER (WITH RIPPER)

D65EX-12 60942 and up



1. Hydraulic tank
2. PPC pump (SBR(1)-010)
3. PPC charge valve
4. Oil cooler
5. Steering control PPC valve
    - 5A. Direction (for HSS)
    - 5B. Steering
    - 5C. Steering circuit selector valve
6. Blade control PPC valve
    - 6A. Blade tilt
    - 6B. Blade lift
7. Ripper control PPC valve
8. Hydraulic, HSS pump (HPV95)
    - 8A. Servo cylinder
    - 8B. Variable throttle valve
    - 8C. LS valve
9. Main control valve
    - 9A. Ripper valve
    - 9B. Pressure compensation valve
    - 9C. Load check valve
    - 9D. Suction valve
    - 9E. Suction safety valve
    - 9F. LS check valve (for work equipment)
    - 9G. Blade lift valve
    - 9H. Preset check valve
    - 9I. Blade tilt valve
    - 9J. Steering valve
    - 9K. Steering priority valve
    - 9L. LS check valve (for steering valve)
    - 9M. Main relief valve
    - 9N. Unload valve
    - 9O. LS relief valve (for steering valve)
    - 9P. LS relief valve (for work equipment valve)
    - 9Q. LS bypass valve
10. Blade tilt cylinder
11. Left blade lift cylinder
12. Right blade lift cylinder
13. Ripper lift cylinder
14. HSS motor (HMF95)
    - 14A. Counterbalance valve
    - 14B. Safety valve
15. Hydraulic filter
16. Breather
17. HSS unit
18. Suction valve

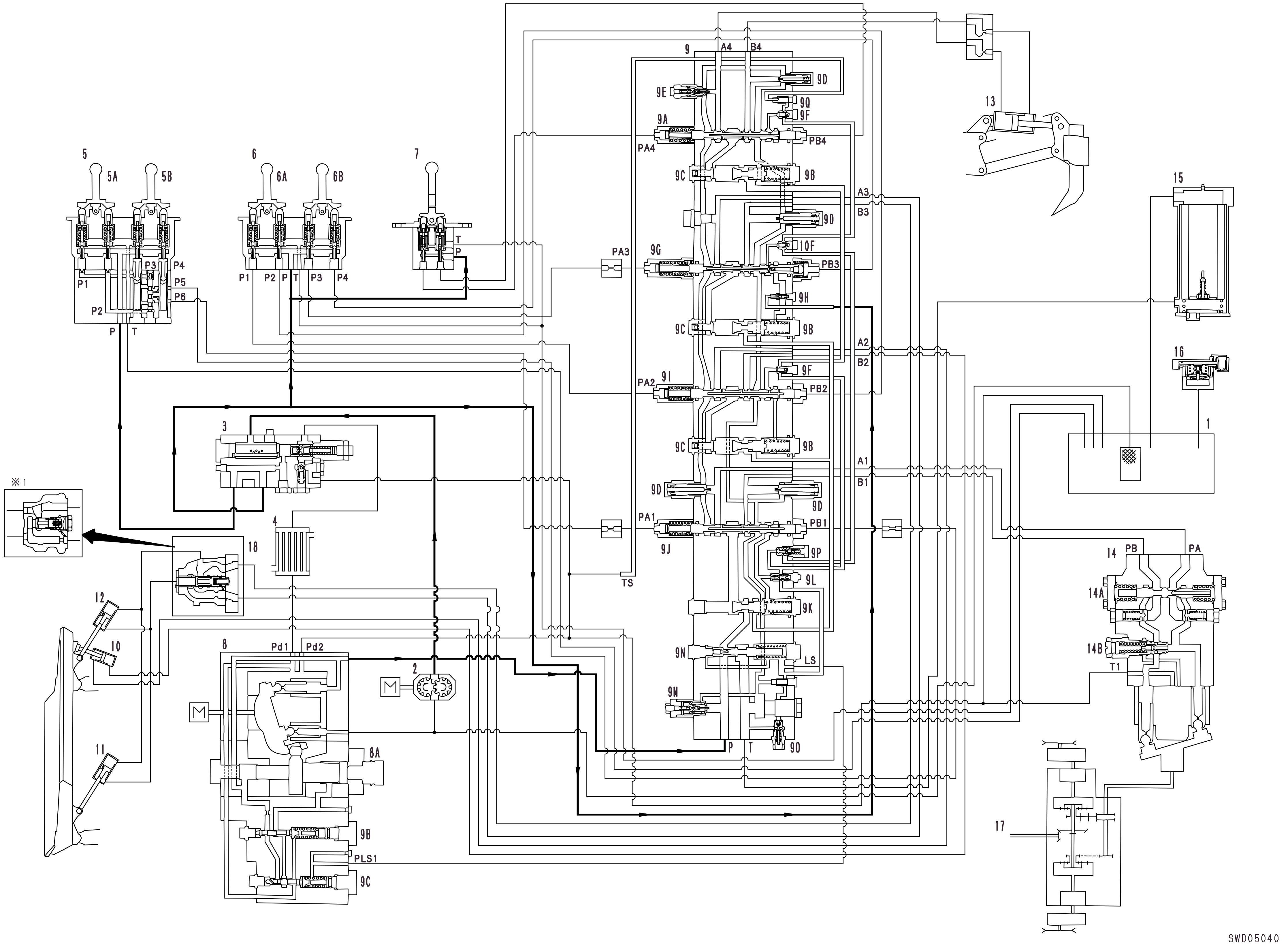
014012

STEERING AND WORK EQUIPMETN HYDRAULIC SYSTSEM DIAGRAM

(Engine running, steering lever in “NEUTRAL”, hydraulic control lever in “HOLD”)

D65EX-12 60942 and up

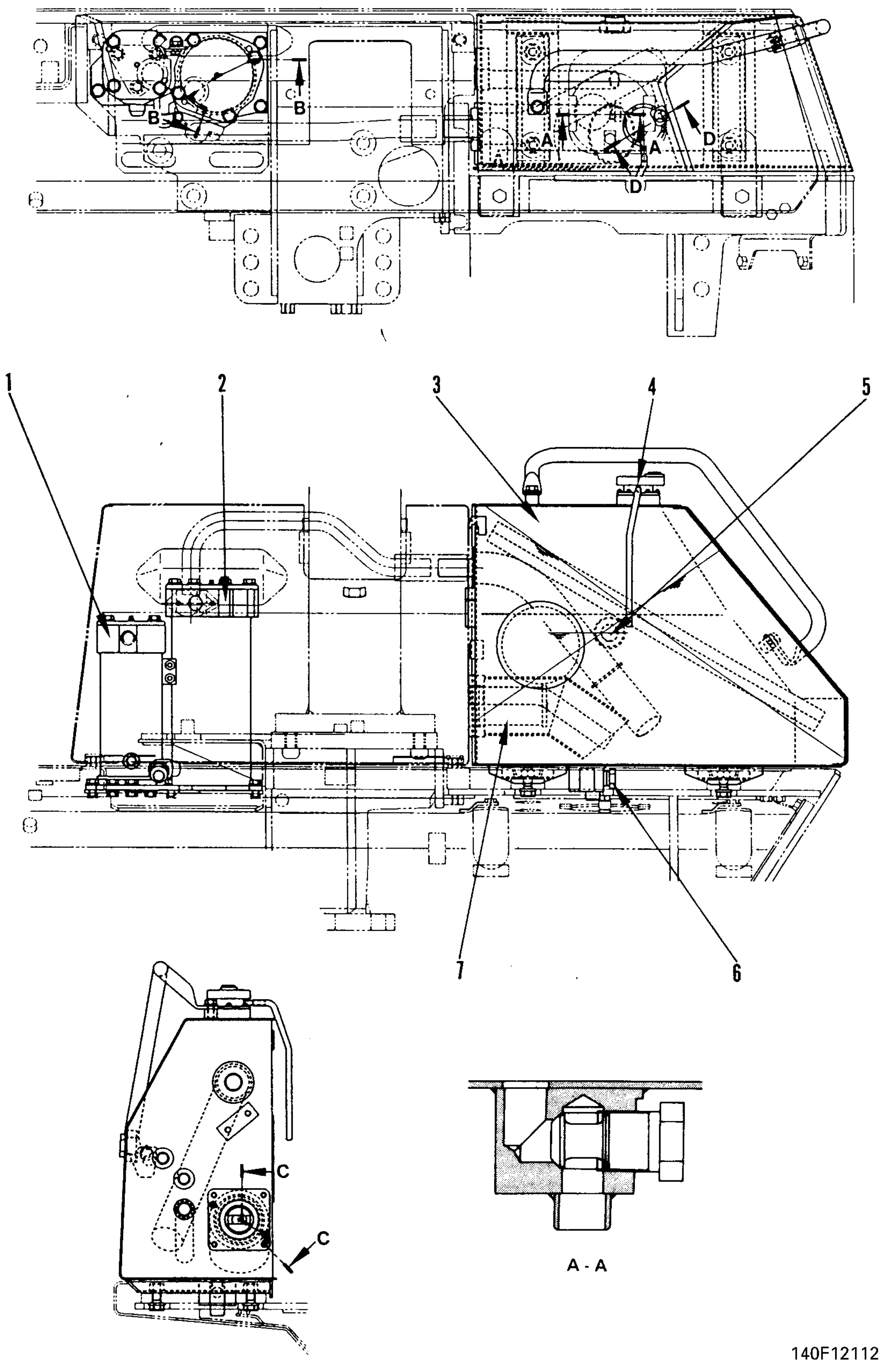
※1. Serial Numbers
D65EX-12 61446 and up



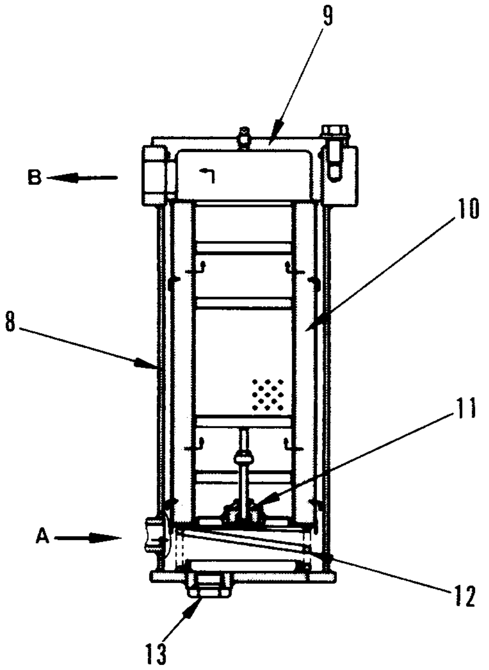
014012

HYDRAULIC TANK AND FILTER

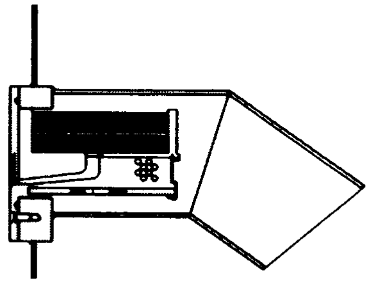
D65E-12	**60001 – 60947**
D65P-12	**60001 – 60890**
D65EX-12	**60001 – 60941**
D65PX-12	**60001 – 60914**



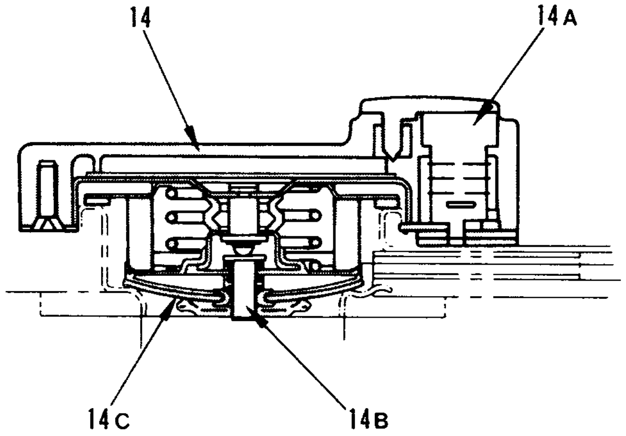
140F12112



B - B



C - C



D - D

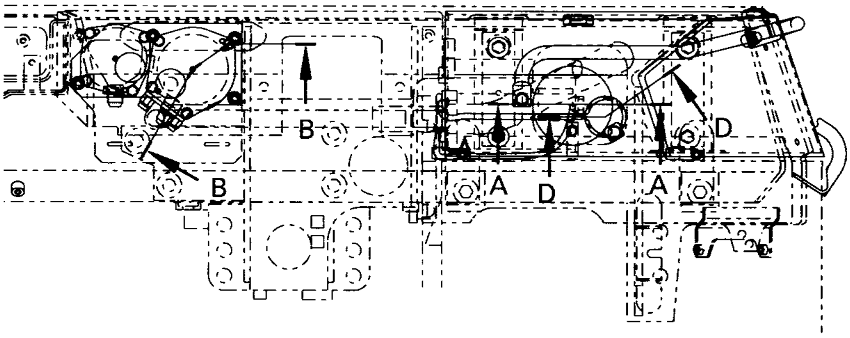
140F12113

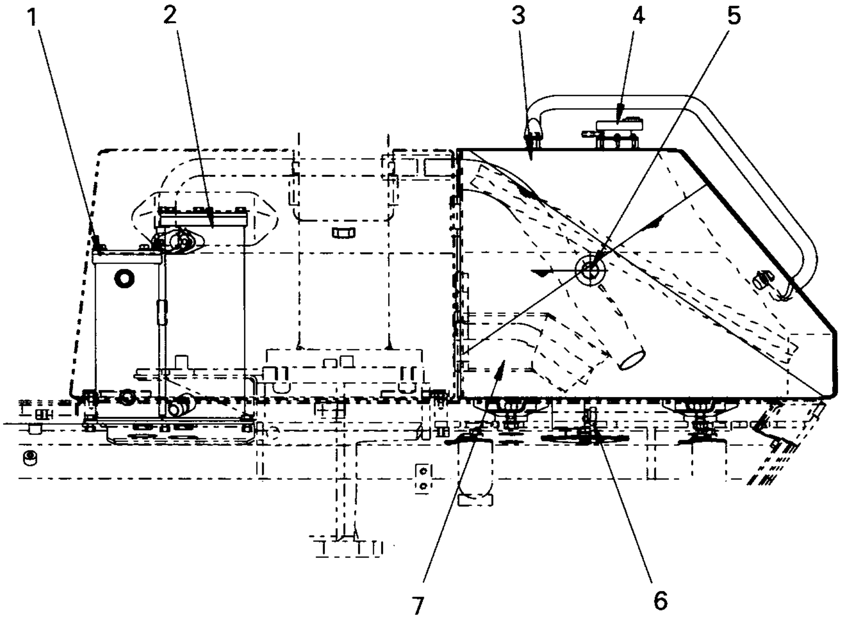
1. Power train oil filter
2. Hydraulic filter
3. Hydraulic tank
4. Cap
5. Sight gauge
6. Drain plug
7. Strainer
8. Hydraulic filter body
9. Cover
10. Element
11. Valve
12. Spring
13. Drain plug
14. Hydraulic tank filler cap
    14A. Key cylinder
    14B. Vacuum valve
    14C. Pressure valve

A. From control valve
B. To hydraulic tank

		Specified value
Capacity of hydraulic tank		73 ℓ
Hydraulic tank cap	Pressure valve cracking pressure	38 ± 15 KPa (0.39 ± 0.15 kg/cm^2)
	Vacuum valve actuation pressure	0 – 4.5 KPa (0 – 0.046 kg/cm^2)
Hydraulic filter	Cracking pressure	103 ± 20 KPa (1.05 ± 0.2 kg/cm^2)
	Filtering particle size	30 μm
	Filtering area	10,026 cm^2
	Oil flow	230 ℓ/min

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up





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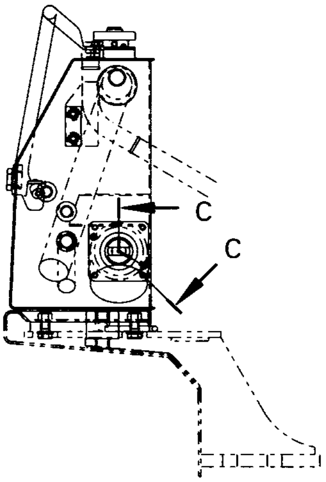
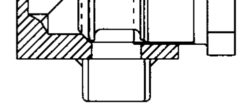
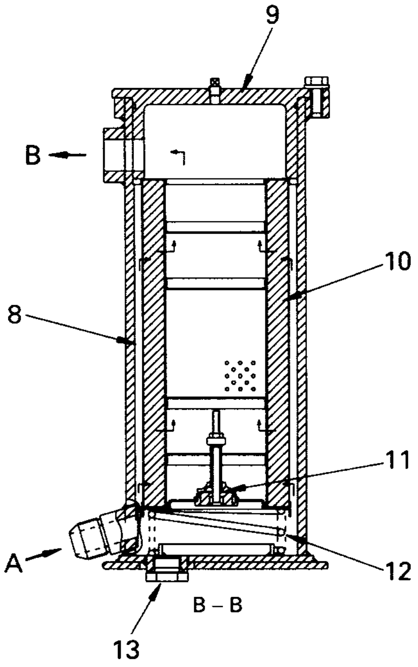
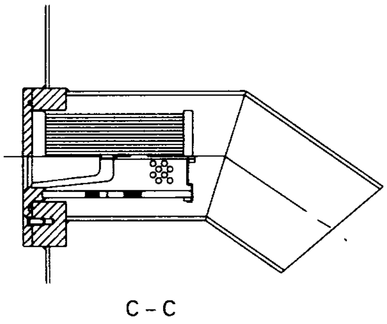


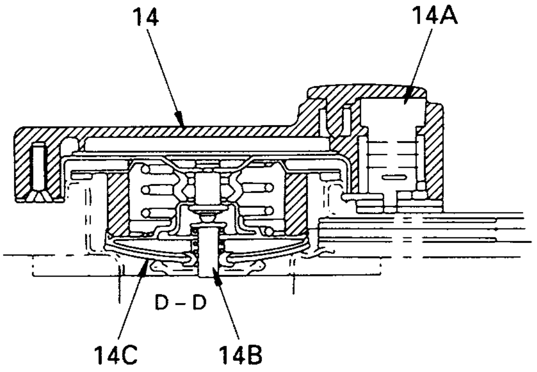


A-A

SKD00532







SKD00533

014012

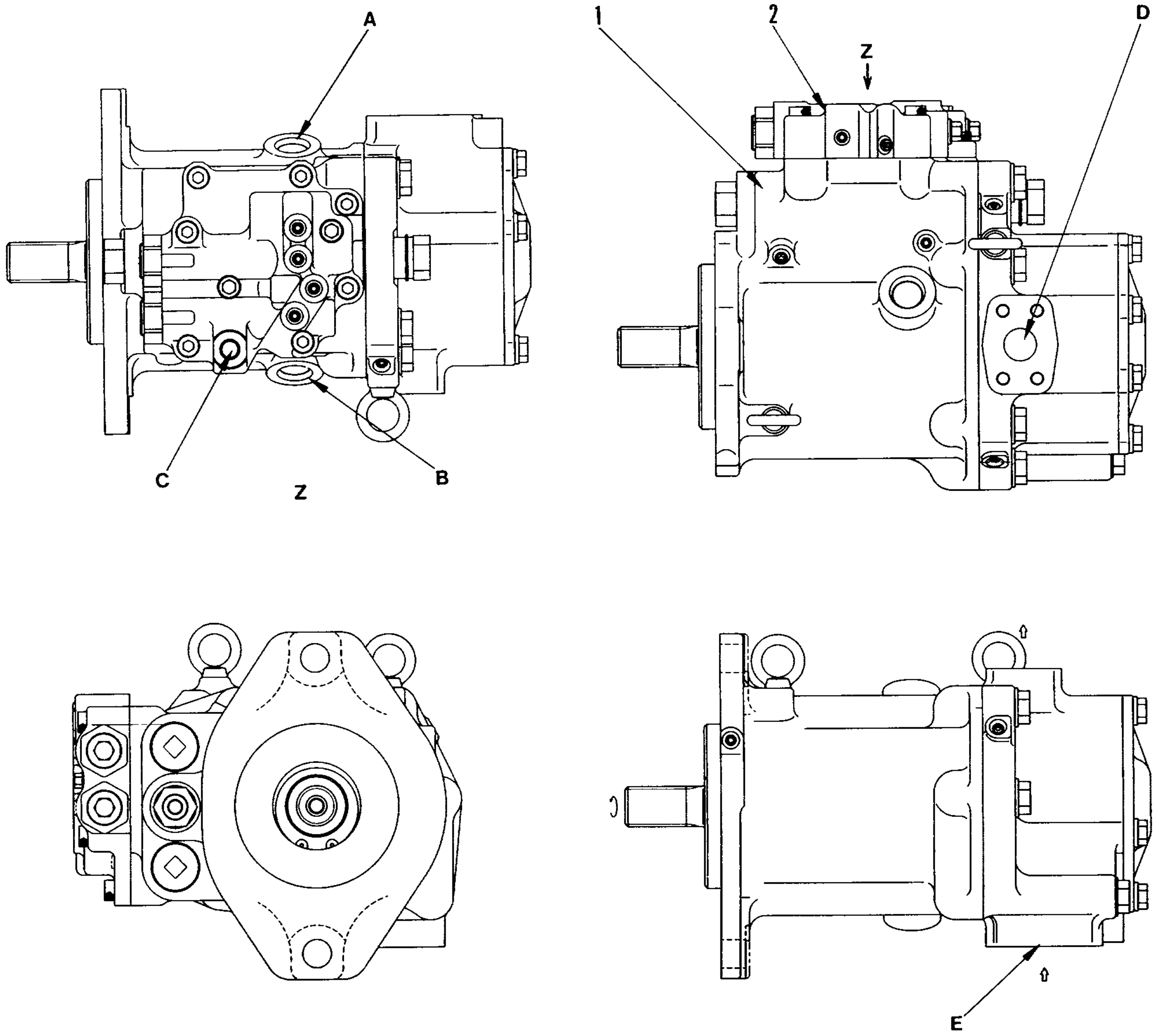
1. Power train oil filter
2. Hydraulic filter
3. Hydraulic tank
4. Cap
5. Sight gauge
6. Drain plug
7. Strainer
8. Hydraulic filter body
9. Cover
10. Element
11. Valve
12. Spring
13. Drain plug
14. Hydraulic tank filler cap
    - 14A. Key cylinder
    - 14B. Vacuum valve
    - 14C. Pressure valve

A. From control valve
B. To hydraulic tank

		Specified value
Capacity of hydraulic tank		73 ℓ
Hydraulic tank cap	Pressure valve cracking pressure	38 ± 15 KPa (0.39 ± 0.15 kg/cm^2)
	Vacuum valve actuation pressure	0 – 4.5 KPa (0 – 0.046 kg/cm^2)
Hydraulic filter	Cracking pressure	103 ± 20 KPa (1.05 ± 0.2 kg/cm^2)
	Filtering particle size	30 μm
	Filtering area	10,026 cm^2
	Oil flow	230 ℓ/min

HYDRAULIC, HSS PUMP

D65EX, PX-12



140F12114

1. Piston pump
2. LS valve

A. Port **Pd1** (from oil cooler)
B. Port **Pd2** (to hydraulic tank)
C. Port **PLS**
D. Port **PA** (discharge port)
E. Port **PS** (suction port)

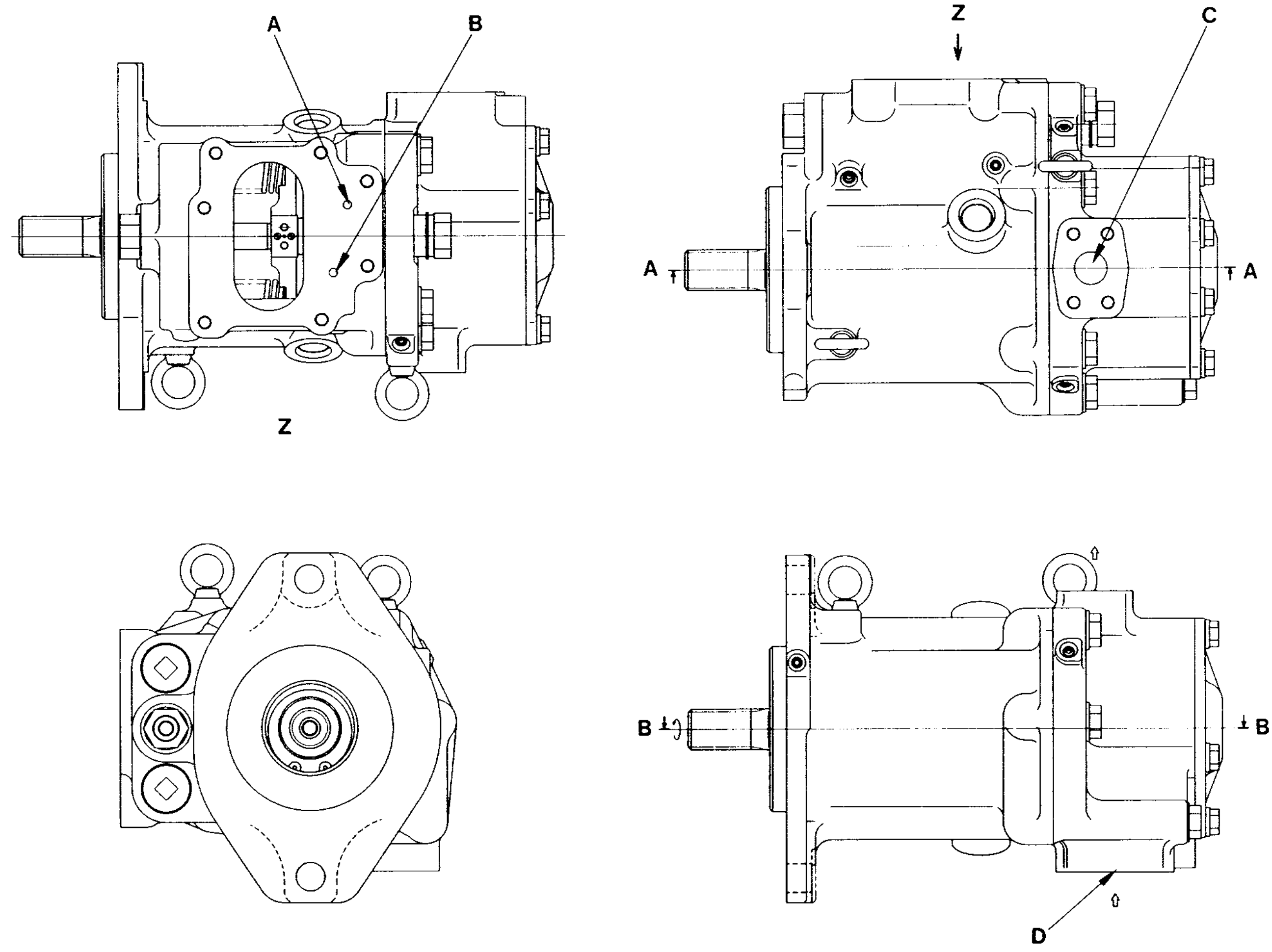
OUTLINE

This pump consists of a variable displacement swash plate type piston pump and LS valve.

014012

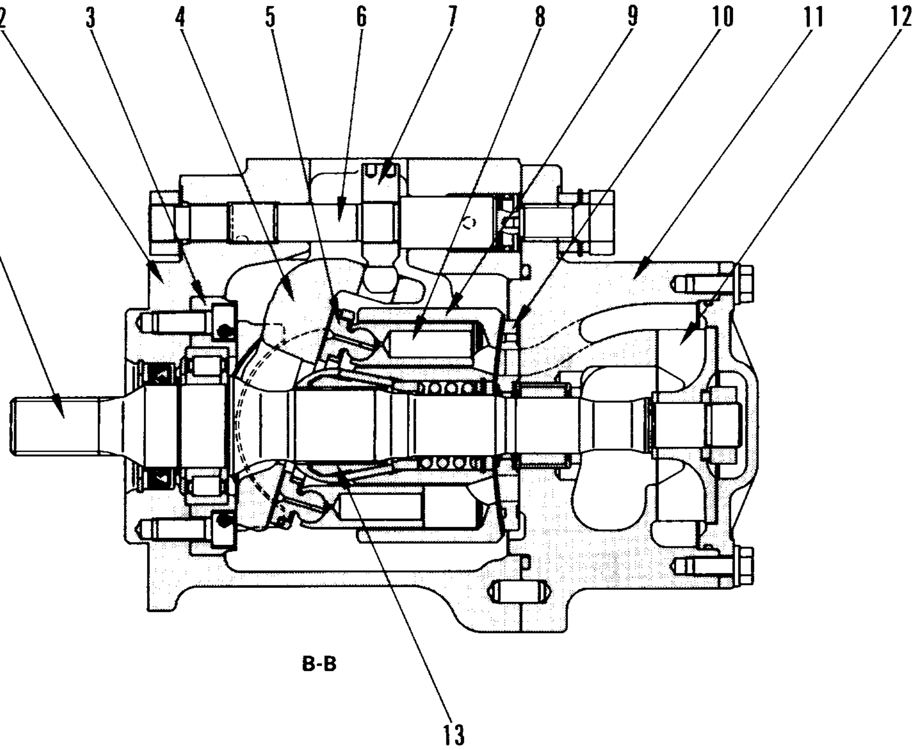
1. PISTON PUMP

HPV95



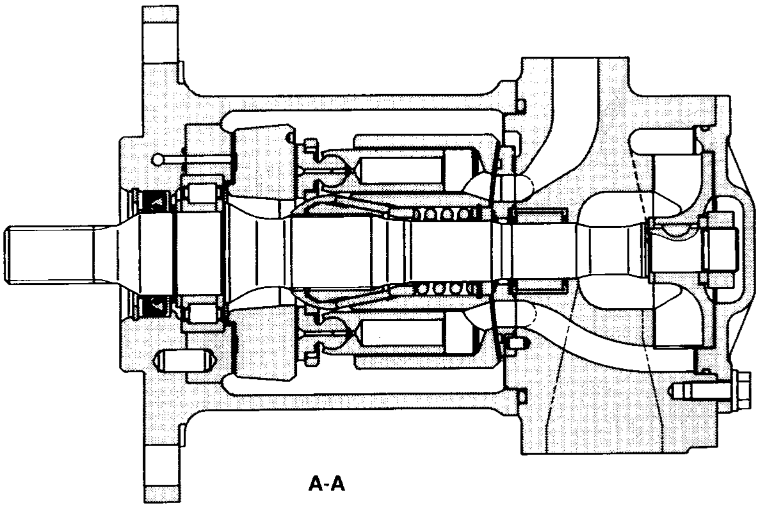
140F12115

A. Port **PNC**
B. Port **PP**
C. Port **PA** (discharge port)
D. Port **PS** (suction port)



B-B

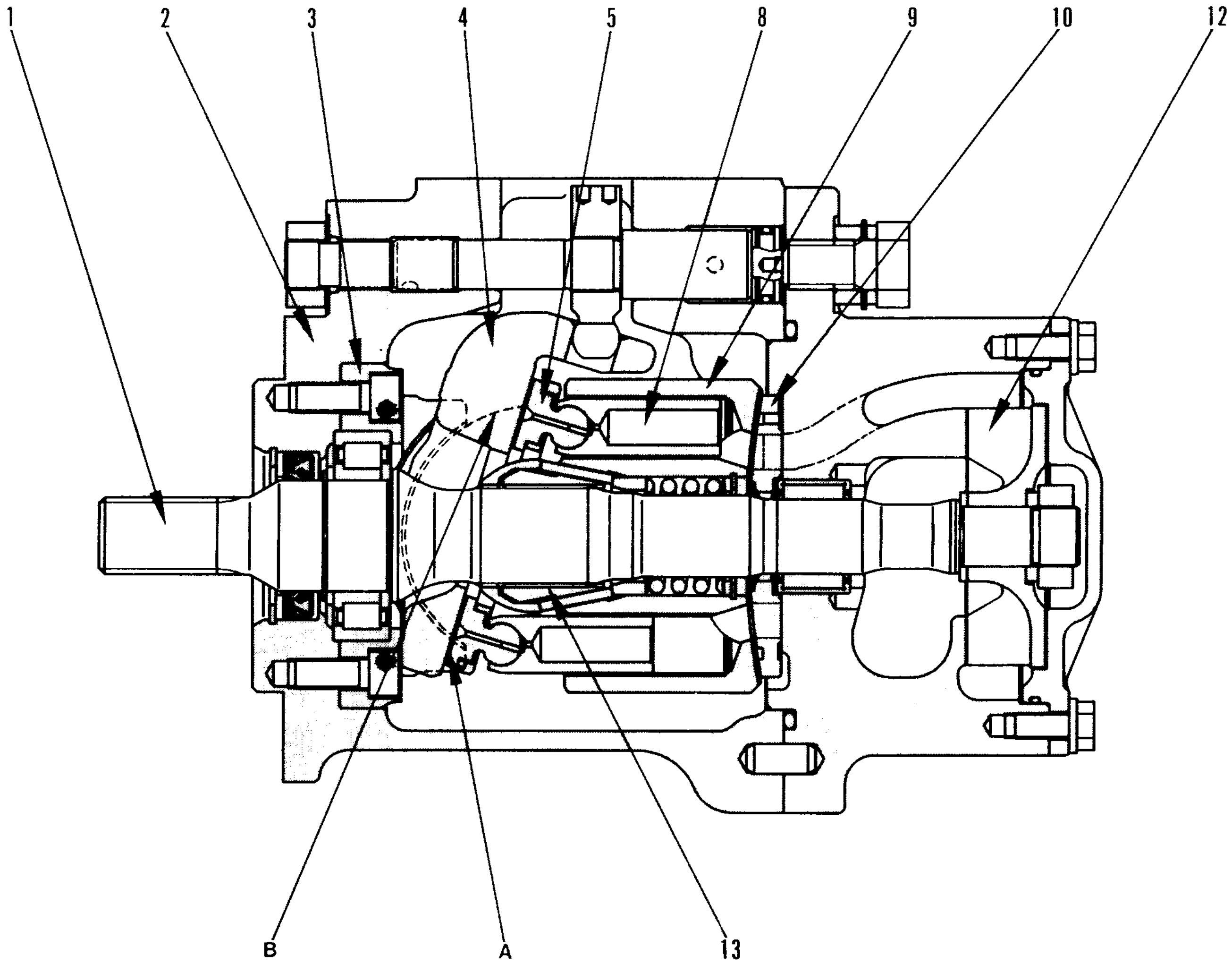
014012



A-A

140F12116

1. Shaft	8. Piston
2. Case	9. Cylinder block
3. Cradle	10. Valve plate
4. Rocker cam	11. End cap
5. Shoe	12. Impeller
6. Servo piston	13. Spline
7. Rod	



140F12117

OUTLINE

- The rotation and torque transmitted to the pump shaft is converted to hydraulic energy and pressurized oil is discharged according to the load.
- It is possible to change the discharge amount by changing the swash plate angle.

STRUCTURE

- Cylinder block (9) is supported to shaft (1) by a spline, and shaft (1) is supported by the front and rear bearings.
- The end of piston (8) has a concave ball shape and shoe (5) is caulked to it to form one unit. Piston (8) and shoe (5) form a spherical bearing.
- Rocker cam (4) holds plane **A**, and shoe (5) is always pressed against this surface as it slides in a circle.
  Rocker cam (4) forms a static bearing sending high pressure oil at cylindrical surface **B** of cradle (3), which is fixed to the case, and carries out a sliding movement.
- Piston (8) carries out motion relative to the axial direction inside each cylinder chamber of cylinder block (9).
- The cylinder block carries out rotation relative to valve plate (10) while sealing the pressurized oil, and this surface ensures that the hydraulic balance is maintained correctly. The oil inside each cylinder chamber of cylinder block (9) is sucked in and discharged through valve plate (10).
- Impeller (12) is fixed to shaft (1), and rotates together with the shaft. it makes it easier for the oil sucked in from the suction port to be sucked in and sends it into the cylinder chamber by centrifugal force.

014012

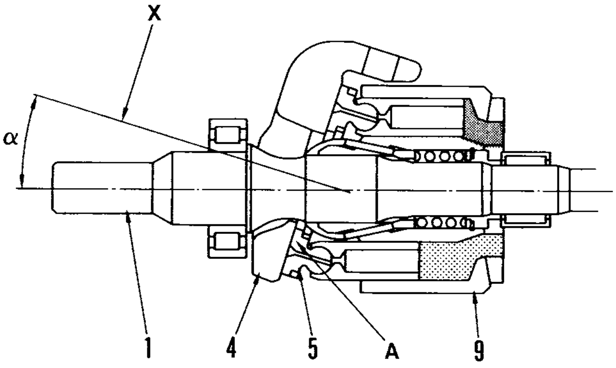
OPERATION

1. Operation of pump

Cylinder block (9) rotates together with shaft (1), and shoe (5) slides on plane **A**.

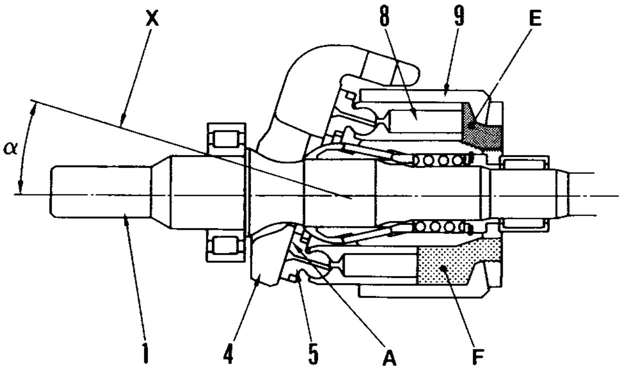
When this happens, rocker cam (4) moves along cylindrical surface **B**, so angle α of center line **X** of rocker cam (4) to the axial direction of cylinder block (9) changes.

This angle α is called the swash plate angle.



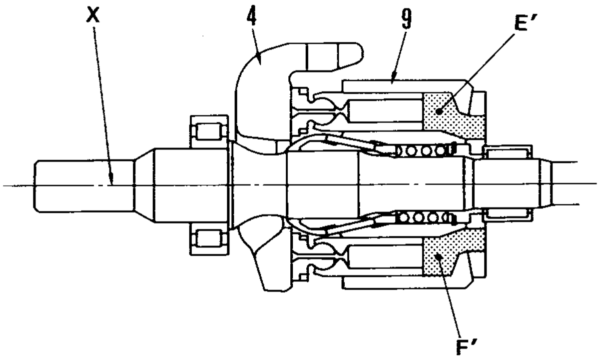
140F12118

(i) With swash plate angle a formed by the angle between center line **X** of rocker cam (4) to the axial direction of cylinder block (9), plane **A** acts as a cam for shoe (5).
In this way, piston (8) slides inside cylinder block (9), and as a result, a difference is generated between volumes **E** and **F** inside the cylinder block. The amount of suction and discharge is equal to difference **F — E**.
In other words, cylinder block (9) rotates, and the volume of chamber **E** becomes smaller, so oil is discharged during this process. At the same time, the volume of chamber **F** becomes larger and oil is sucked in as the volume increases.



140F12119

(ii) When center line **X** of rocker cam (4) is the same as the axial direction of cylinder block (7) (swash plate angle = 0), the difference between volumes **E'** and **F'** inside cylinder block (7) is 0, so no oil flows in or out, and no pumping is carried out.



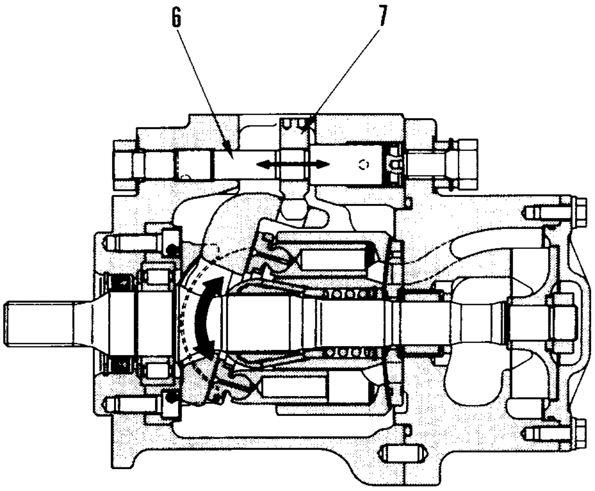
140F12120

2. Control of discharge amount

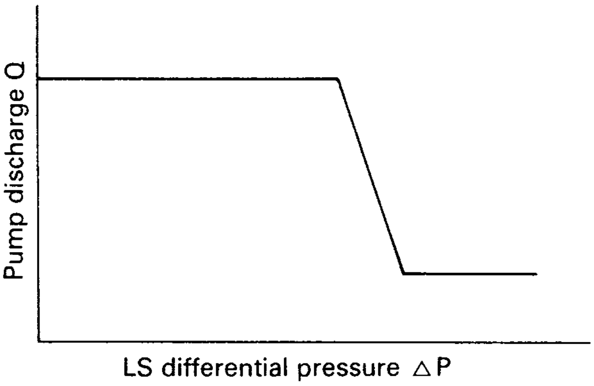
(i) If swash plate angle a becomes larger, the difference between volumes **E** and **F** becomes larger, and oil discharge **Q** is increased. Swash plate angle a is changed by servo piston (11). Servo piston (11) carries out reciprocal movement in a straight line (↔) according to the command from the **LS** valve. This straight-line movement is transmitted to rocker cam (4) through rod (12), and rocker cam (4), which is supported on the cylindrical surface by cradle (2) slides on the cylindrical surface.

(ii) The area receiving the pressure is different at the left and right sides of servo piston (11), and the chamber receiving the pressure at the small diameter piston end is always connected with main pump pressure **PP**. Output pressure **PNC** of the **LS** valve is applied to the chamber receiving the pressure at the large diameter piston end (which receives pressure of the pump). The movement of servo piston (11) is controlled by the relationship of the size of pump pressure **PP** and the pressure at the large diameter piston end, and the comparative size of the area at the large diameter piston end and small diameter piston end.

(iii) The movement of the servo piston is controlled by a valve called the **LS** valve.
Main pump pressure **PP** and pressure **PLS** (the **LS** pressure) from the control valve outlet port enter this valve.
The relationship between discharge volume Q and the difference in pressure (△P = **Pp** — **PLS**) (called the **LS** differential pressure) between main pump pressure **PP** and **LS** pressure **PLS** and is as shown in the diagram on the right.



140F12121



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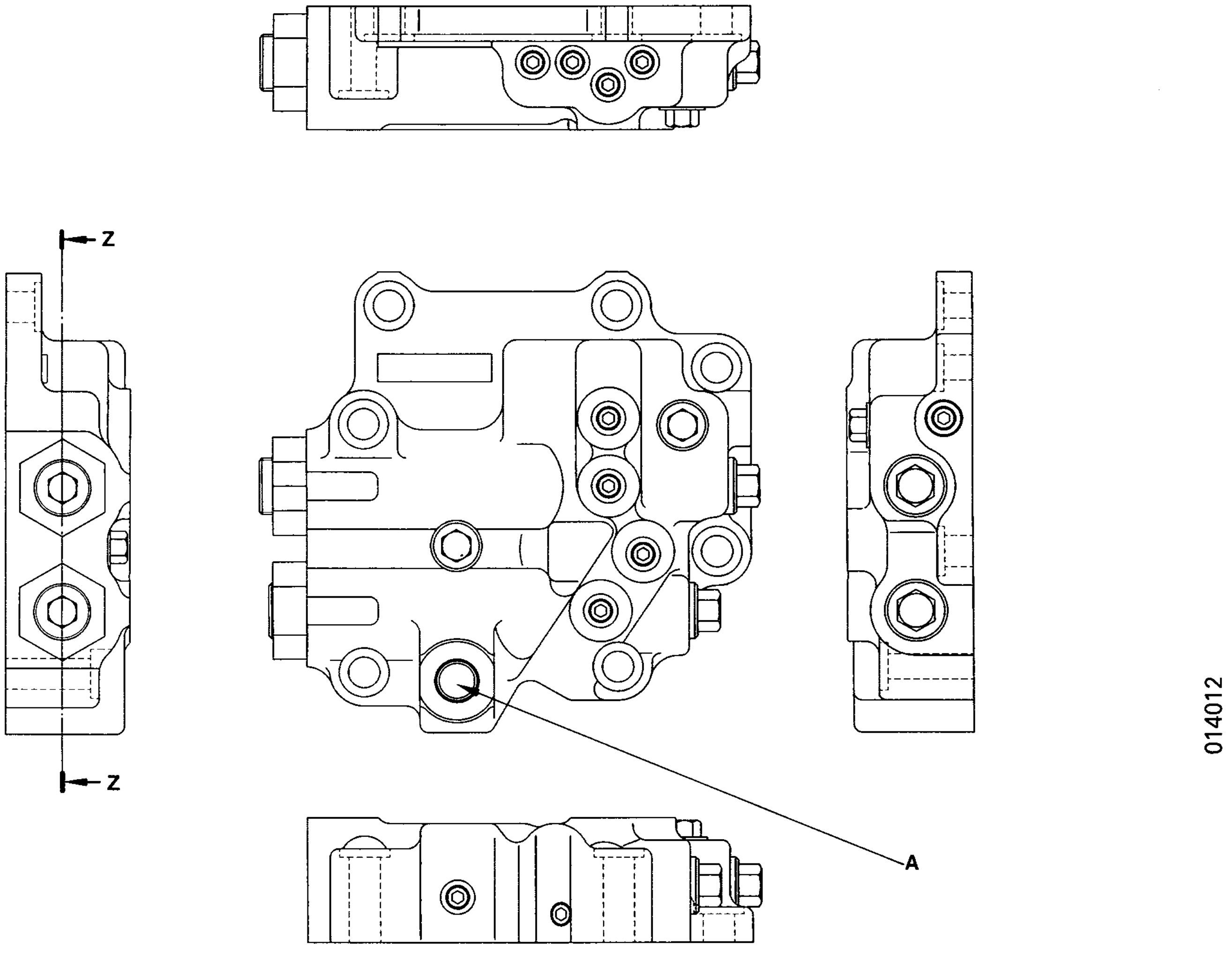
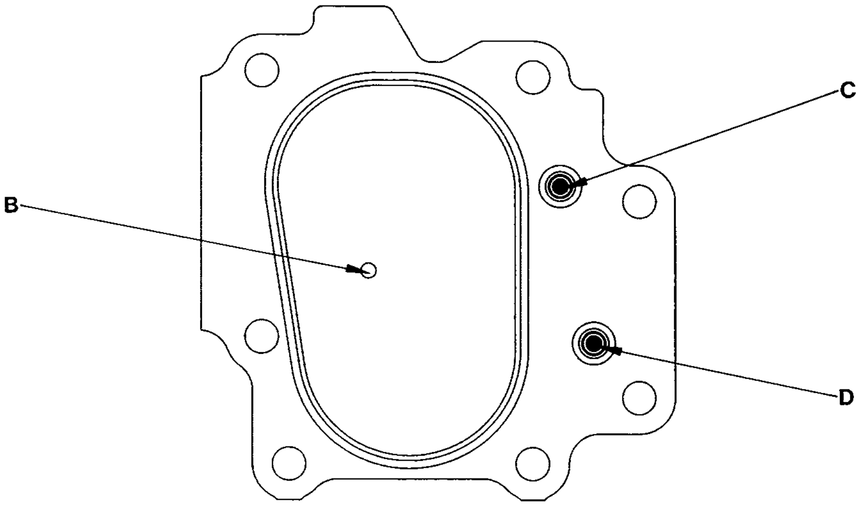
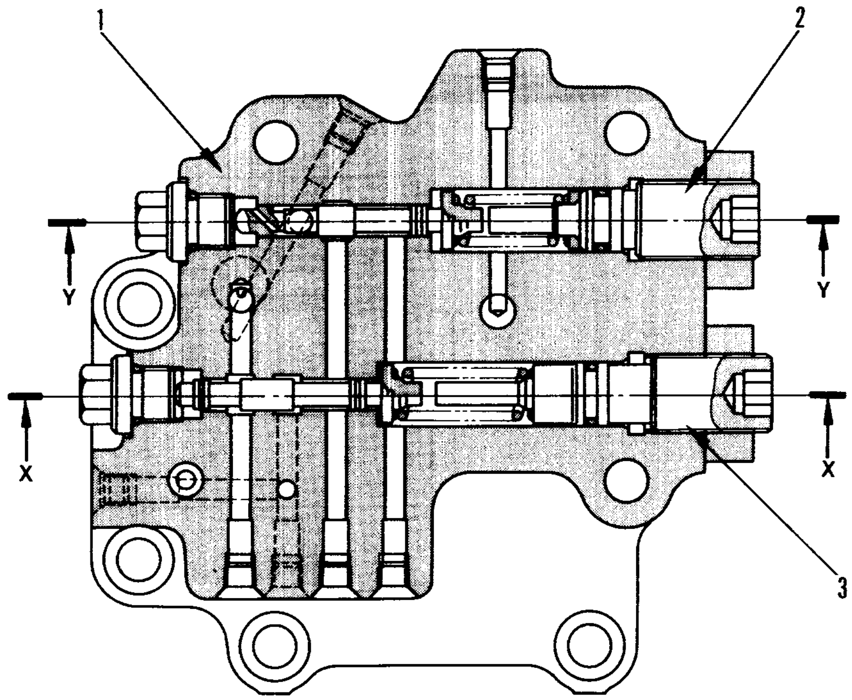
2. LS VALVE



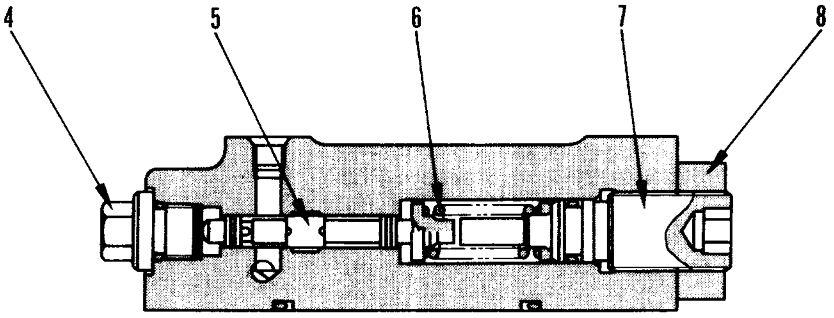


A. Port **PLS**
B. Port **PT**
C. Port **PP**
D. Port **PNC**

140F12123

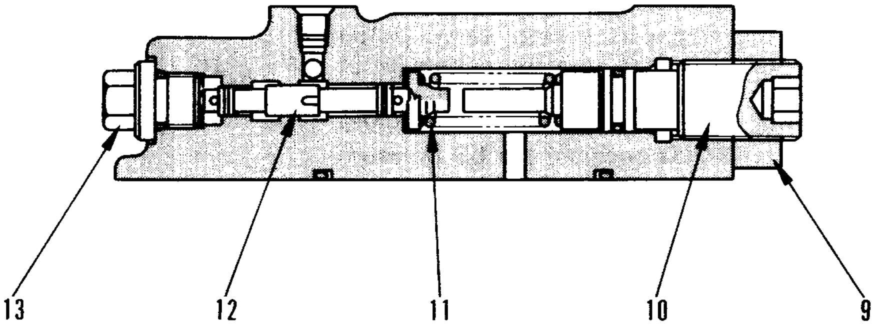


Z - Z



Y - Y

1. Valve body
2. **LS** valve
3. Variable throttle valve
4. Plug
5. Spool
6. Spring
7. Plug
8. Locknut
9. Locknut
10. Plug
11. Spring
12. Spool
13. Plug



X - X

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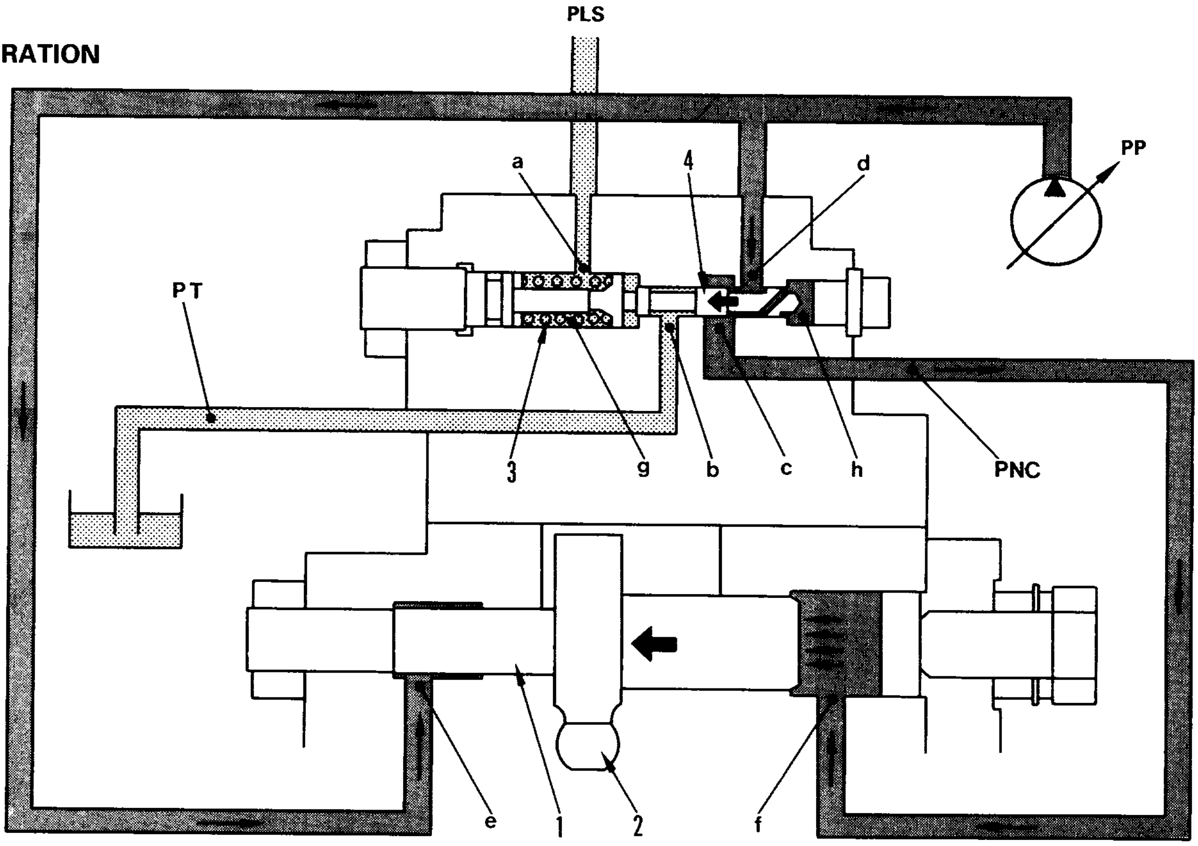
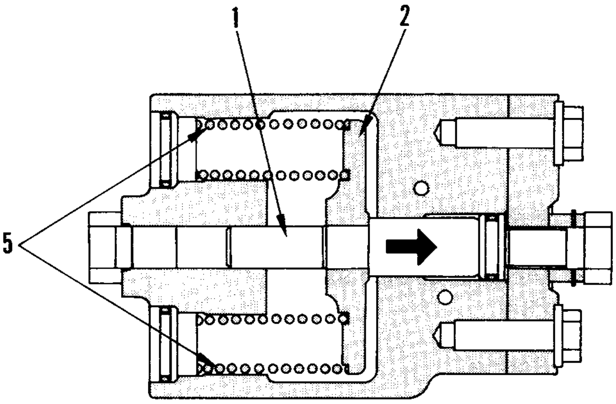
OPERATION

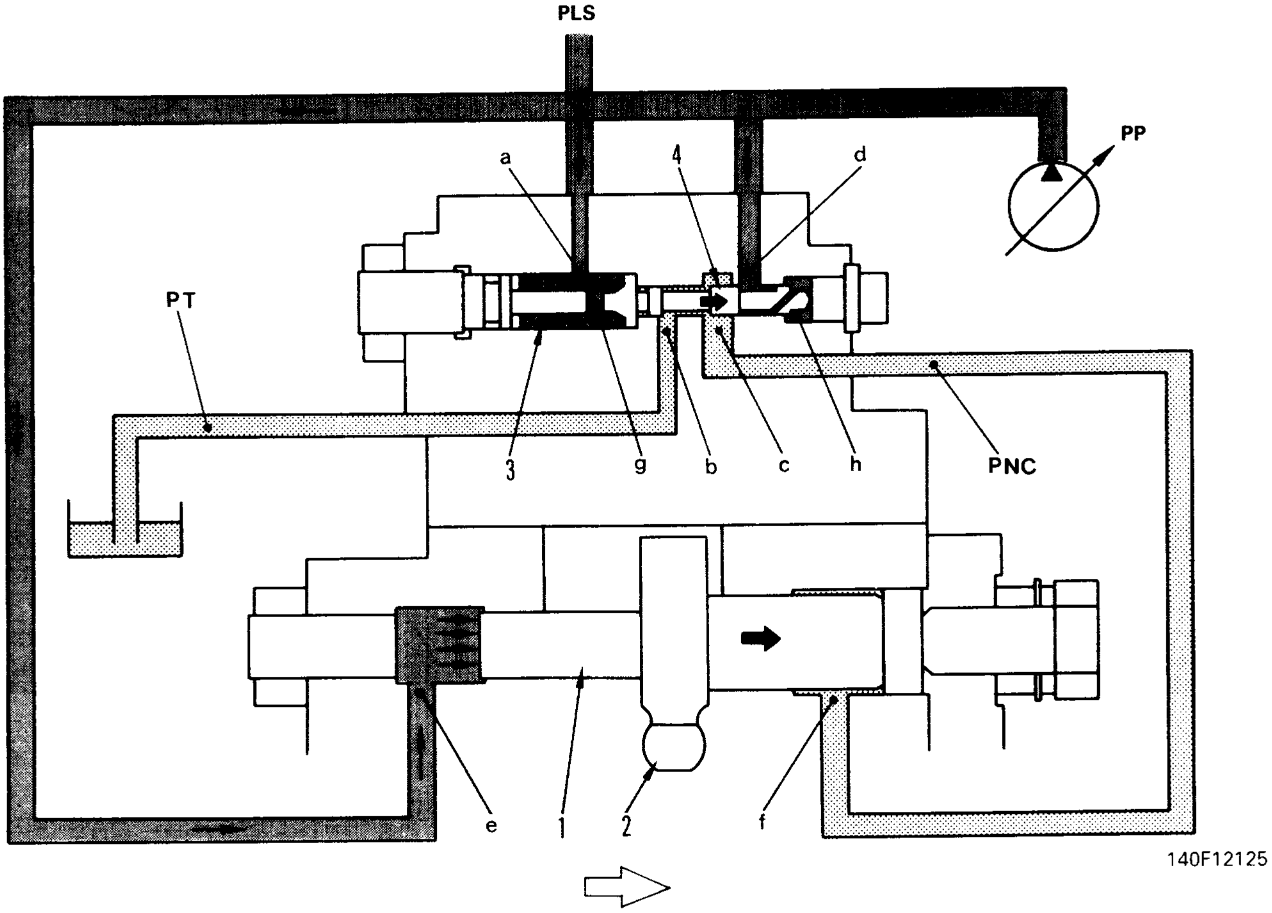


(1) Operation of LS valve

1) When control valve is at HOLD position

- The **LS** valve is a 3-way selector valve, and main pump pressure **PP** and pressure **PLS** (**LS** pressure) from the outlet port of the control valve are applied to each end.
  Spool (4) of this **LS** valve is pushed by the force of spring (3) from the end receiving the **LS** pressure, and the position of the spool (4) is determined by the **LS** pressure **PLS** + spring force **F** and the size of main pump pressure **PP**.
- Main pump pressure **PP** always flows to ports **d** and **e**. **LS** pressure **PLS** enters chamber **g** from port **a**.
  Before the engine is started, servo piston (1) is pushed to the right by spring (5) of rod (2). (See the diagram on the right)
- After the engine is started, if the control lever is at **HOLD** position, the **LS** pressure **PLS** is 0 MPa (0 kg/cm^2). (The circuit is connected to the drain circuit through the passage inside the control valve spool.)
  When this happens, spool (4) is pushed to the left, and port **d** and port **c** are connected. Pump pressure **PP** enters the large diameter piston end from port **f**, and the difference in area of piston (1) moves piston (1) to the left so that the swash plate angle becomes minimum.

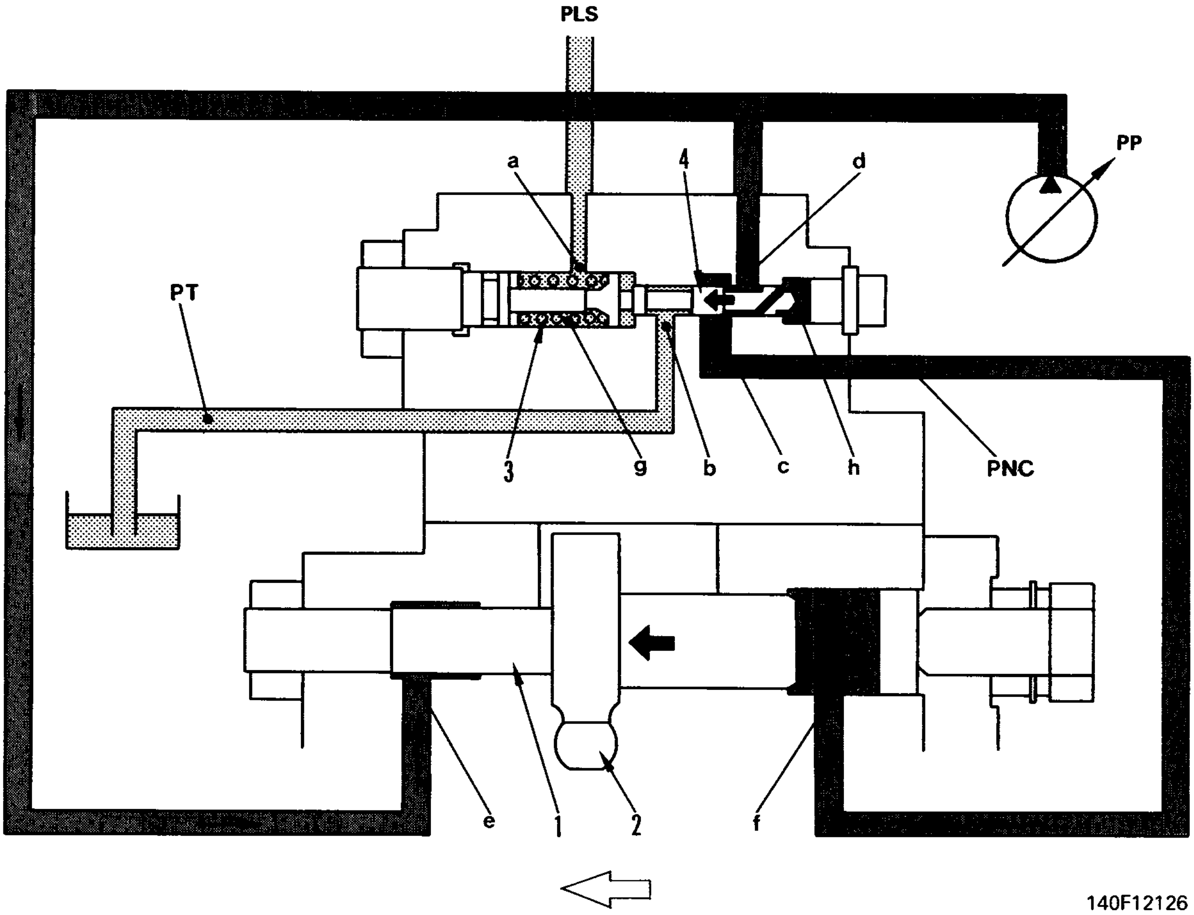




(Direction to make **Q** larger)

2) Movement in direction to increase pump discharge (to the right)

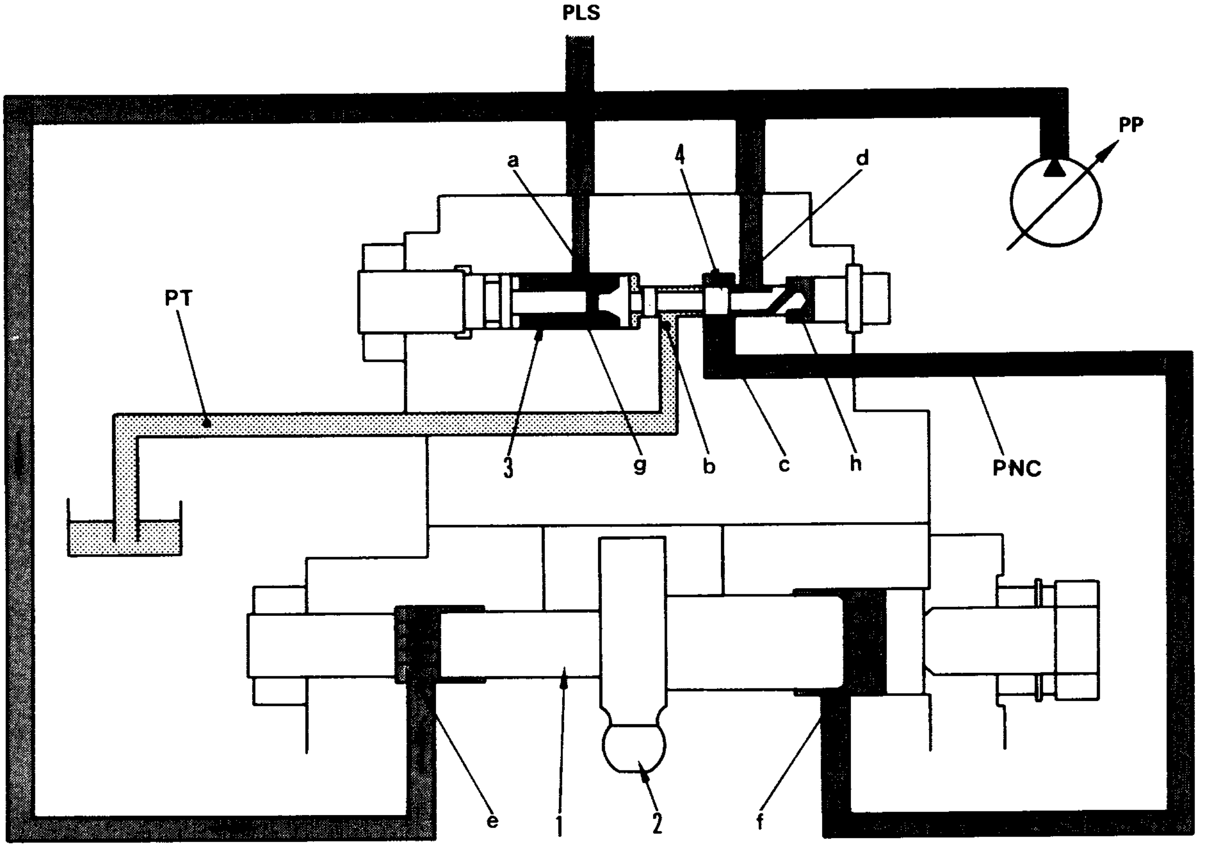
- When **LS** differential pressure △**PLS**, which is the difference in pressure between main pump pressure **PP** and **LS** pressure **PLS**, becomes smaller (for example, the area of opening of the control valve becomes larger and pump pressure **PP** is reduced), spool (4) is pushed to the right under the combined force of the **LS** pressure **PLS** and the force of spring (3). Main pump pressure **PP** enters chamber **h**. The combined force of spring (3) and the force of **LS** pressure **PLS** is greater than the force of main pump pressure **PP**, so spool (4) is pushed to the right.
- Because of the movement of spool (4), port **c** and port **b** are connected, and circuits **c** — **f** become drain pressure **PT**.
- Circuits **c** — **f**, which are the pressure of **f** port at the large diameter piston end of servo piston (1), become the drain pressure, so servo piston (1) is pushed from the small diameter piston end to the large diameter piston end. Rod (2) also moves to the right because of this movement, and changes the swash plate angle.



(Direction to make Q smaller)

3) Movement in direction to reduce pump discharge (to the left)

- The following explains the situation when servo piston (1) moves to the left (the direction to make the discharge amount smaller). If **LS** differential pressure △**PLS** becomes larger (for examble, the area of opening of the control valve becomes smaller and pump pressure **PP** increases), spool (4) is pushed to the left by pump pressure **PP**.
- Because of the movement of spool (4), main pump pressure **PP** flows into port **c**, and main pump pressure **PP** enters the large diameter piston end from port **f**.
- Main pump pressure **PP** also enters the small diameter piston end, but servo piston (1) is pushed from the large diameter piston end to the small diameter piston end because of the difference in area between the large diameter piston end and the small diameter piston end.
- As a result, rod (2) moves in the direction to make the swash plate angle smaller (to the left).



140F12127

4) When servo piston is balanced

- In the **LS** valve, if main pump pressure **PP** is balanced with the combined force of **LS** pressure **PLS** at chamber **g** and force **F** of spring (3), servo piston (1) stops at the intermediate position for the swash plate angle. (Force **F** of spring (3) converted to the hydraulic power: Approx. 2.0 MPa (20 kg/cm^2)
- If an **LS** pressure (main pump pressure — force of spring) that fulfills the above conditions for balancing enters ports **a**, main pump pressure **PP** entering from port **d** and combined force **F** of spring (3) and the force from **LS** pressure **PLS** are balanced, and pressure of a certain size enters port **f** from port **c**.
- When this happens, the force pushing the small diameter piston and the force pushing the large diameter piston are balanced, so servo piston (1) stops.
  In other words, the following condition is reached.
  Pump pressure **PP** × area receiving pressure at small diameter piston end = hydraulic pressure **PNC** at the large diameter piston end × area receiving pressure at large diameter piston end.
  The difference in area between the large diameter piston and small diameter piston is normally approx. 2:1, so the pressure at the large diameter piston end is approx. 1/2 of pump pressure **PP**.

(2) Operation of variable throttle valve

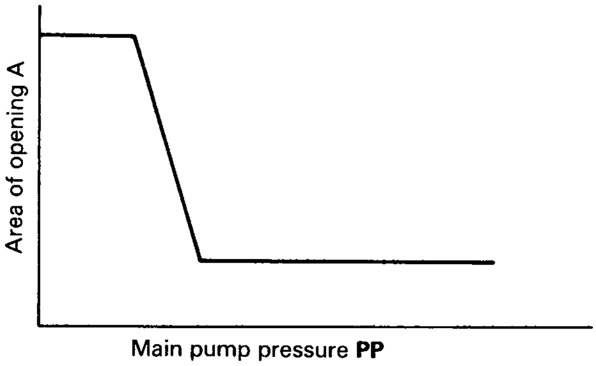
1) Properties of variable throttle valve

- Because the main pump controls its own pressure, there is a tendency for the response speed of the swash plate to be quick at high pressure and slow at low pressure.
  The variable throttle valve has been installed between the **LS** valve and the port at the large diameter end of the servo piston for the following reasons.

  ① To reduce the swash plate speed between MIN and MAX at high pressure; to reduce the impact force on the rod and other parts of the main pump; and to prevent excessive response.

  ② To prevent cavitation at the suction port caused by the sudden increase in the suction volume when changing from MIN to MAX.

- The characteristics of the variable throttle valve are as shown in the diagram below.
  It has the function and property of maintaining the response during operations at low pressure by making the area of the opening smaller at high pressure and the area of the opening larger at low pressure, and by preventing the above problems ① and ② at high pressure.



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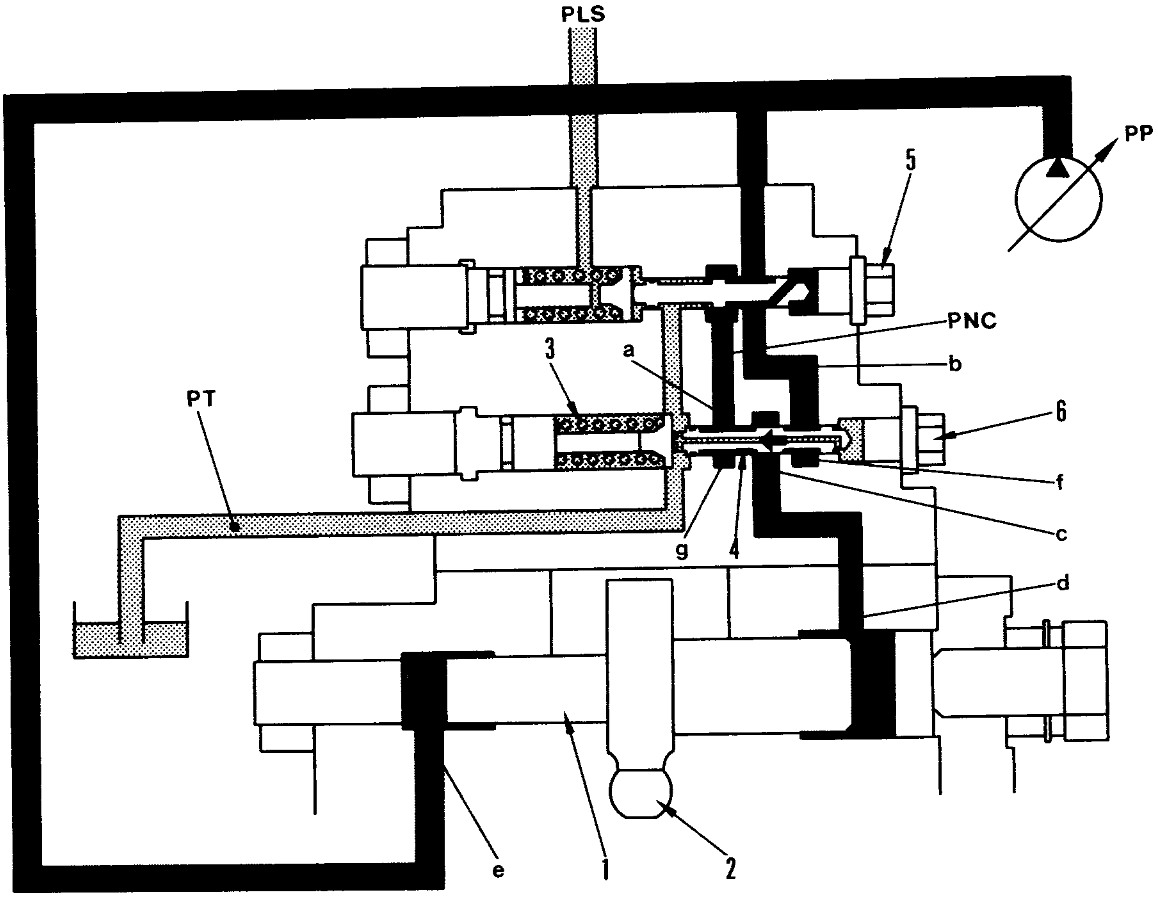

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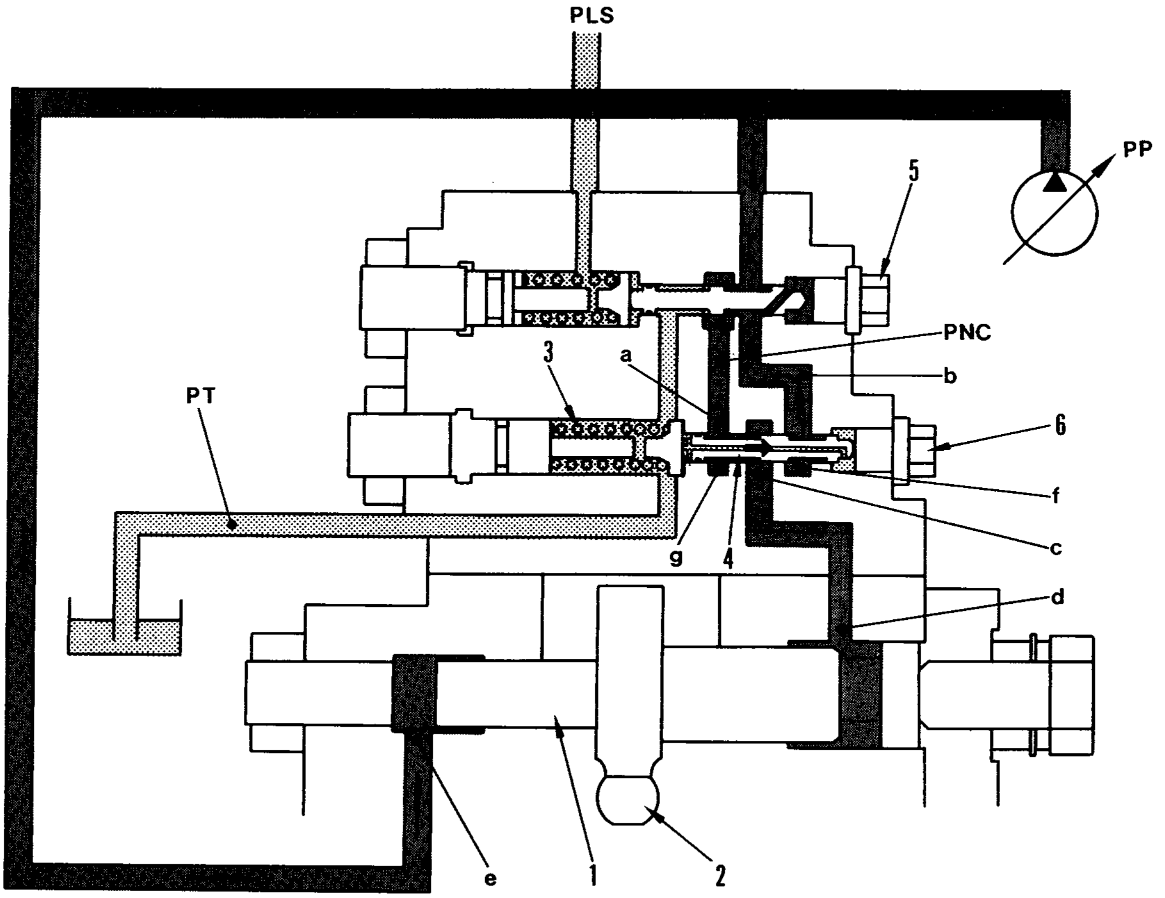
2) Pump discharge pressure at high pressure

- In the variable throttle valve (6), main pump pressure **PP** from **LS** valve (5) passes through port **b** and enters port **f**.
- When main pump pressure **PP** is high, if it is greater than the force of spring (3) because of the difference in area of the land portion diameters at both ends of chamber **f**, spool (4) is moved to the left.
- If spool (4) moves to the left, the area of the opening from port **a** to port **c** is throttled, so the flow of oil entering the large diameter end of servo piston (1) from port **d** is reduced and the speed of movement of servo piston (1) becomes slower.



140F12130A

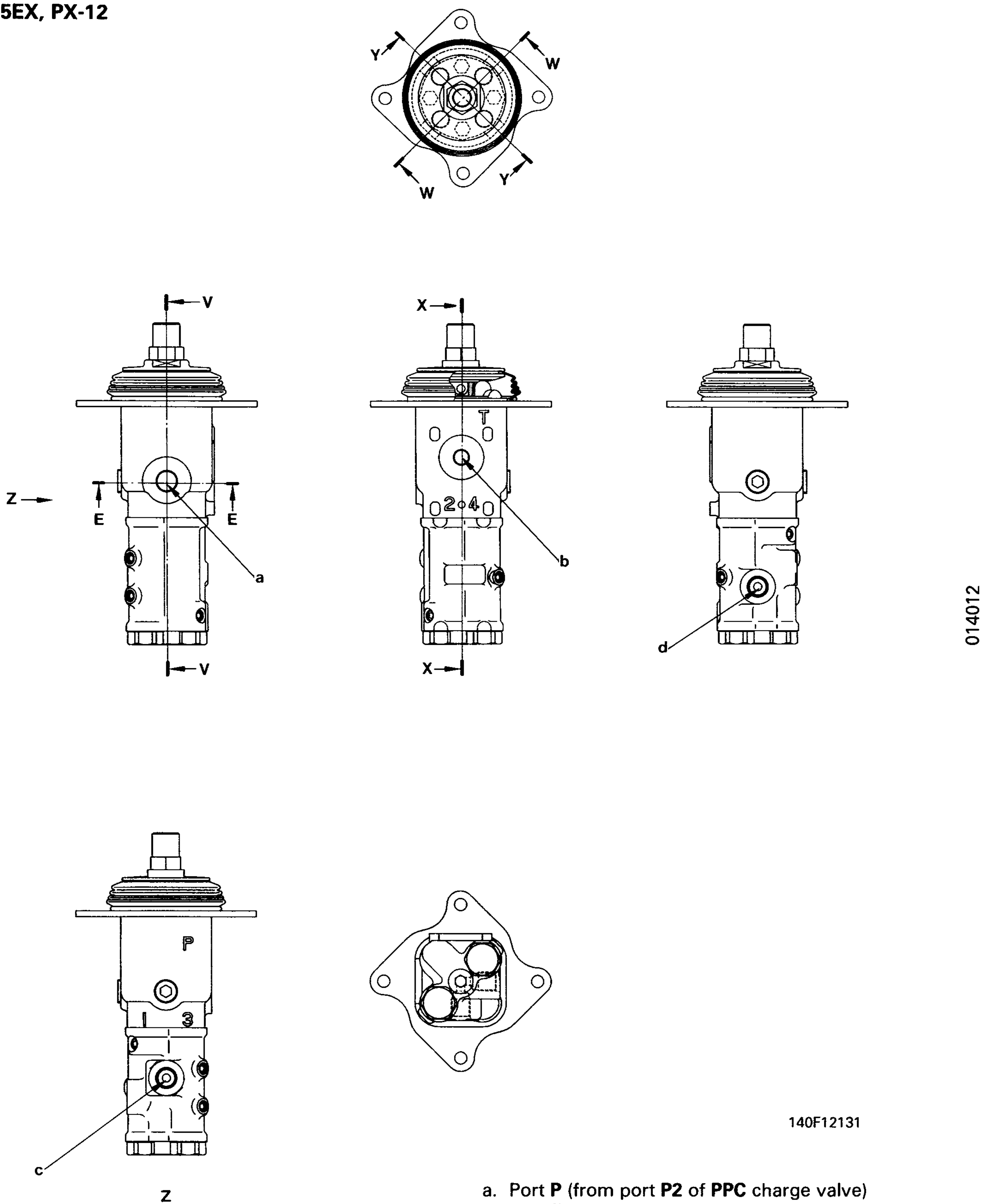
3) Pump discharge pressure at low pressure

- When main pressure **PP** is low, even if it enters chamber **f** from port **b**, the pressure is low, so it does not become greater than the force of spring (3), and spool (4) remains pushed to the right.
- The area of the opening from port **a** to port **c** becomes larger, so output pressure **PNC** from the **LS** valve (5) is transmitted as it is.

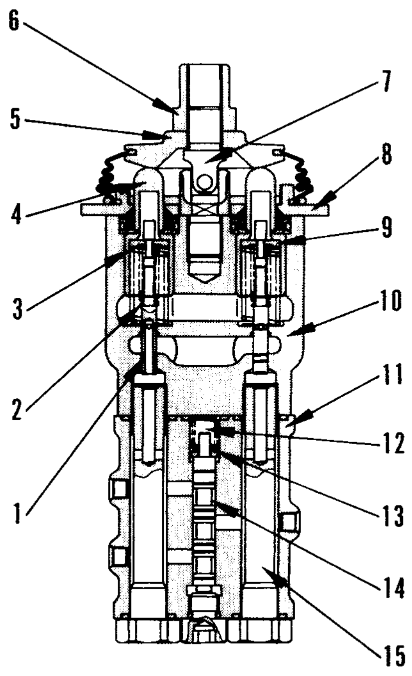
PPC VALVE

For steering (HSS motor) control

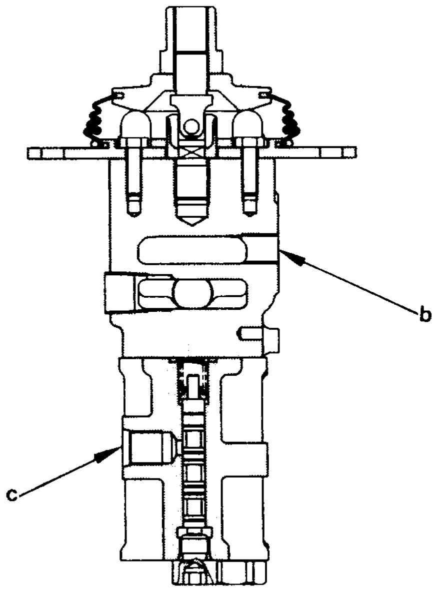
D65EX, PX-12



a. Port **P** (from port **P2** of **PPC** charge valve)
b. Port **T** (to tank)
c. Port **P5** (to port **PB1** of main valve)
d. Port **P6** (to port **PA1** of main valve)

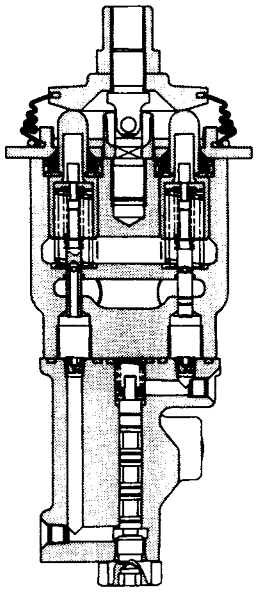


Y - Y

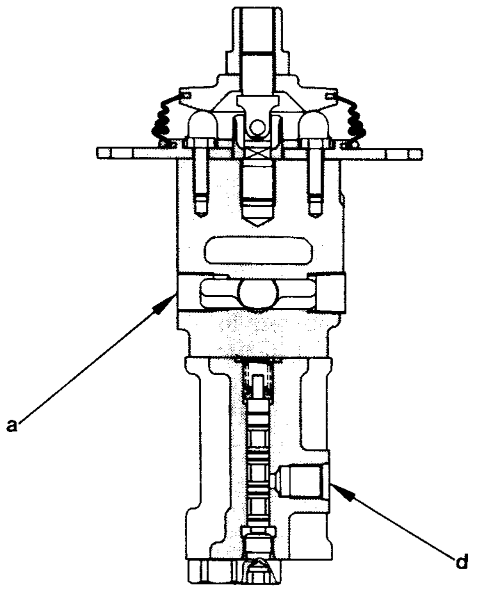


X - X

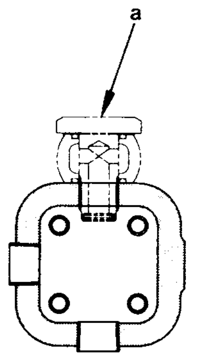
014012



W - W



V - V



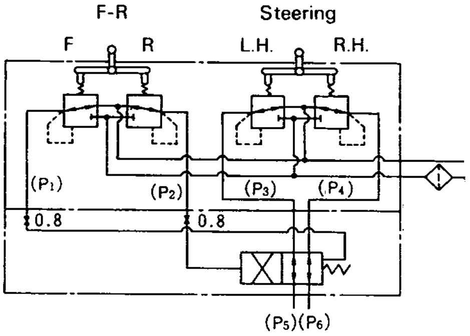
E - E

140F12132

1. Spool
2. Metering spring
3. Centering spring
4. Piston
5. Disc
6. Nut (for lever joint)
7. Joint
8. Plate
9. Retainer
10. Body
11. Block
12. Spring
13. Retainer
14. Spool
15. Bolt

OPERATION

- This **PPC** valve consists of the **PPC** valve and the selector valve, which changes the direction of rotation of the **HSS** motor.



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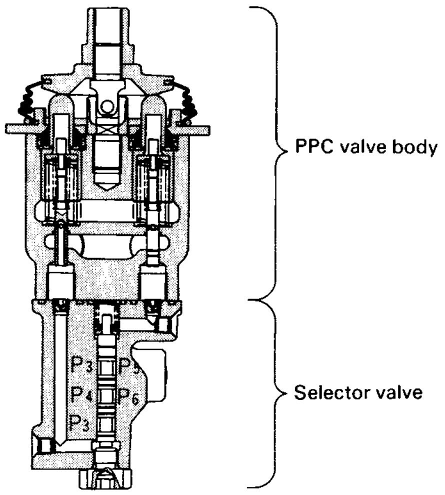
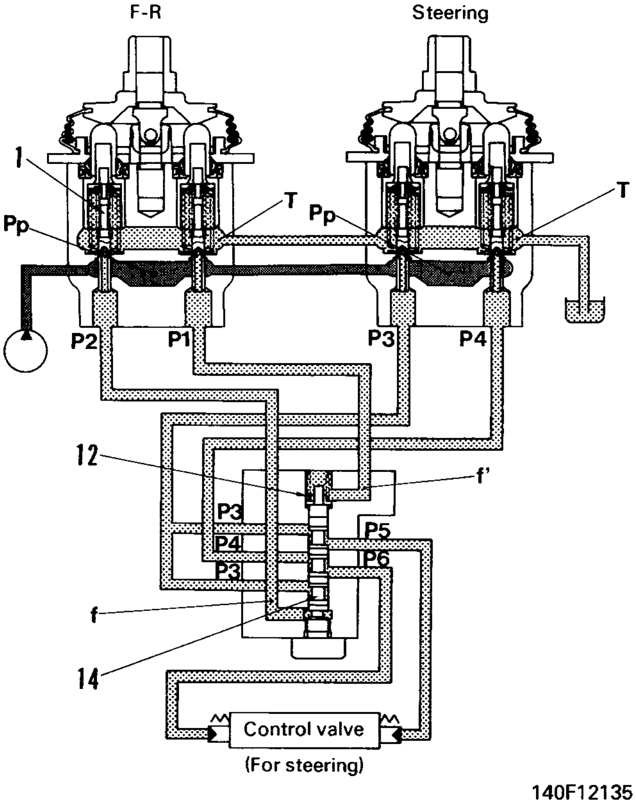


140F12134

1. Operation of selector valve

1) When lever is at NEUTRAL

When the directional lever is at the NEUTRAL position, chambers **f** and **f'** are connected to drain port **T**. Spool (14) is moved to the full down-stroke position by spring (12).
For this reason, port **P3** is connected to port **P5** and port **P4** is connected to port **P6**.



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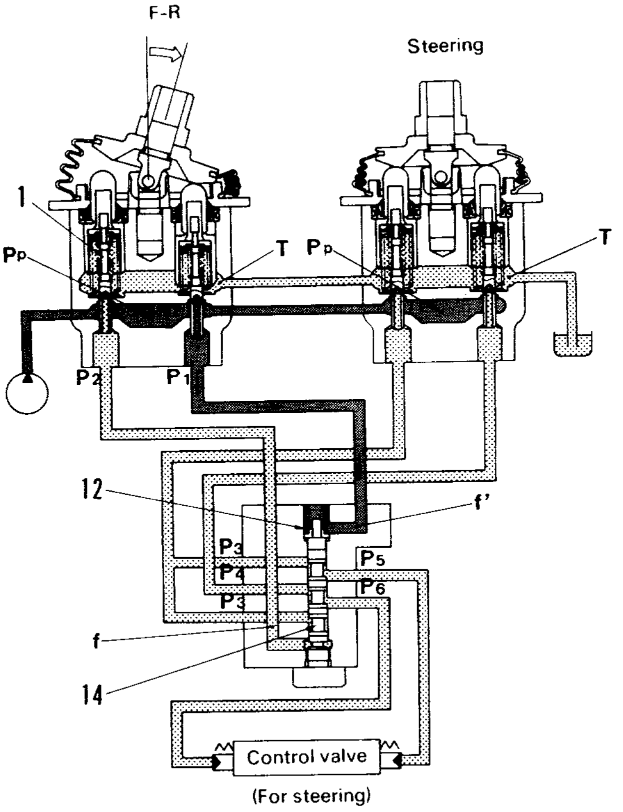
2) When directional lever is operated fully to port P1

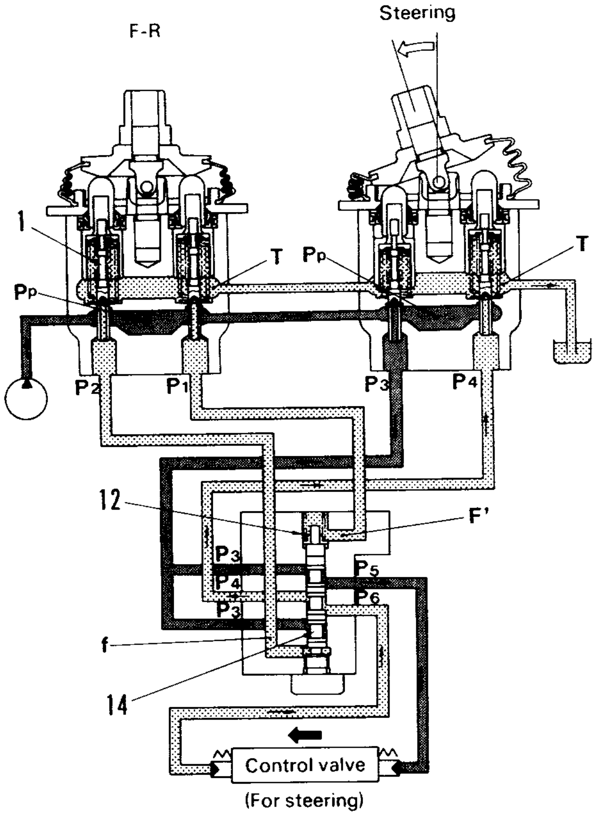
Spool (1) is pushed down, and chamber **f'** is connected with pump pressure chamber **PP**.
The pressure in chamber **f'** rises, but spool (14) is pushed down by spring (12) so it does not change its position.
For this reason, the connections of each port of the selector valve remain the same as in Item 1).



140F12136

3) When directional lever is at neutral or is operated fully to port P1, and steering lever is operated

If the steering lever is operated to port **P3**, spool (14) is at the bottom, so the oil at port **P3** flows to port **P5** and moves the control valve to the left. The oil at port **P6** passes through port **P4** and is drained to port **T**.

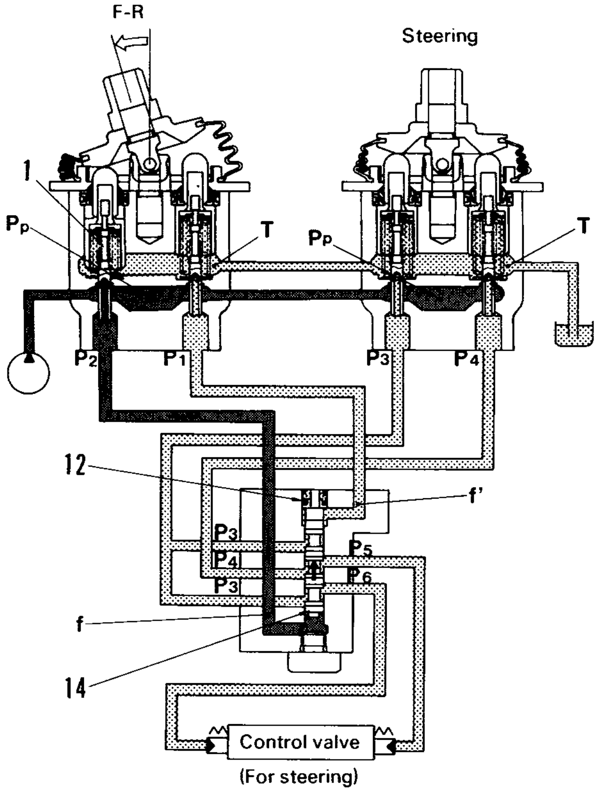


140F12137

4) When directional lever is operated fully to port P2

Spool (1) is pushed down, and chamber **f** is connected with pump pressure chamber **PP**. The pressure in chamber **f** rises, so spool (14) pushes against the tension of spring (12) and moves to the full up-stroke position.

For this reason, the flow of oil is switched in the opposite direction.

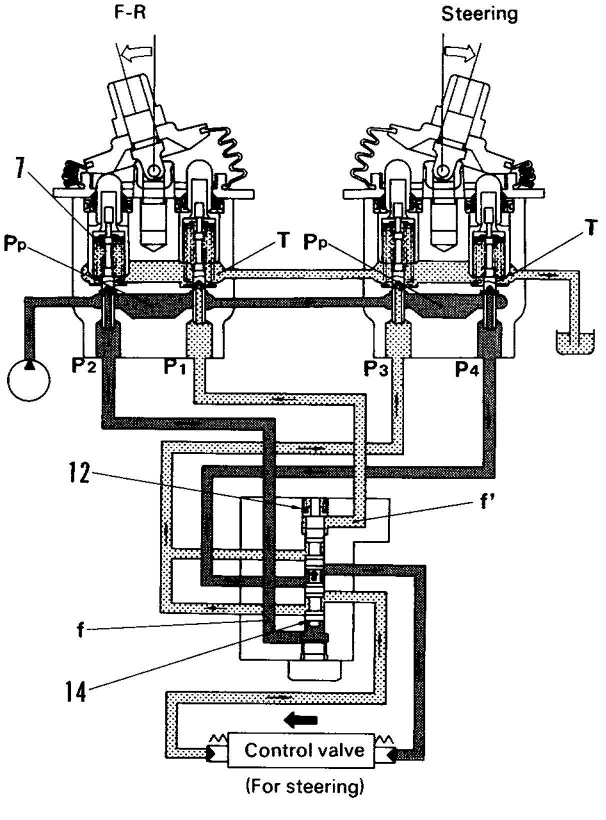


140F12138

5) When directional lever is operated fully to port P2, and steering lever is operated

The directional lever is at the condition in Item 4), so spool (14) is at the full up-stroke.

If the steering lever is now operated to port **P4**, spool (14) is the oil at port **P4** flows to port **P5** and moves the control valve to the left. The oil at port **P6** passes through port **P3** and is drained to port **T**.

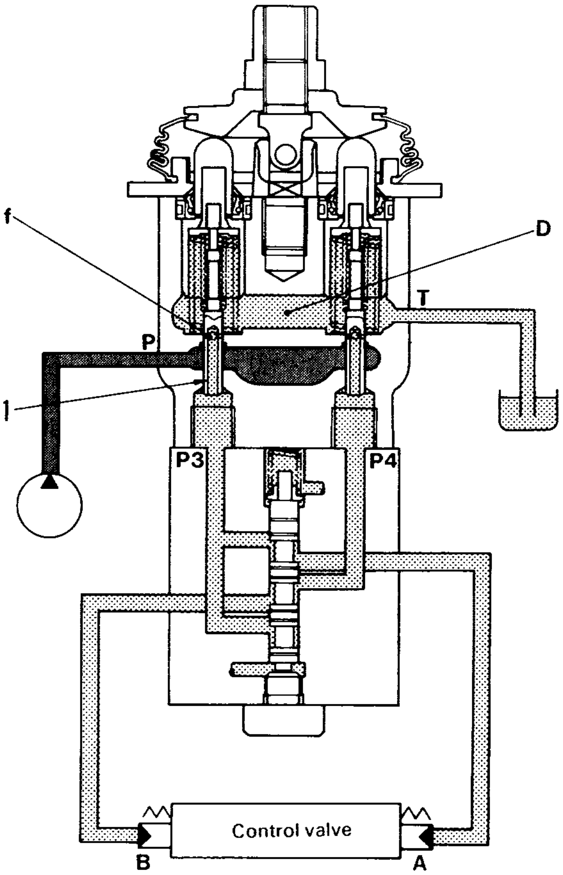


140F12139

2. Operation of PPC valve

1) At neutral

Ports **A** and **B** of the control valve and ports **P3** and **P4** of the PPC valve are connected to drain chamber **D** through fine control hole **f** in spool (1).



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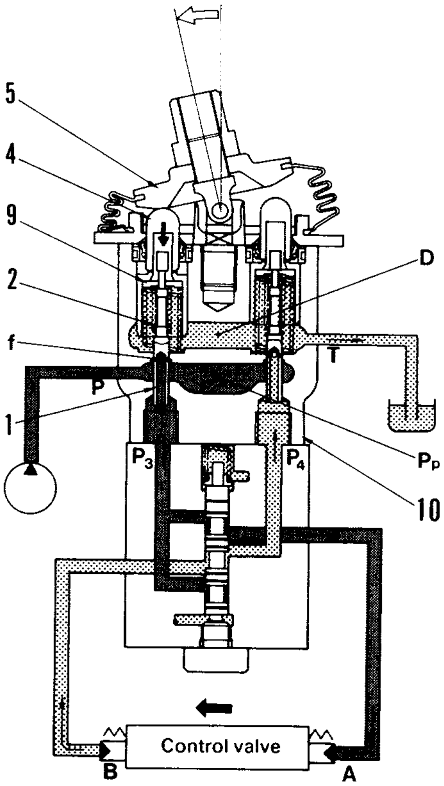
2) During fine control (neutral → fine control)

When piston (4) starts to be pushed by disc (5), retainer (9) is pushed; spool (1) is also pushed by metering spring (2), and moves down.
When this happens, fine control hole **f** is shut off from drain chamber **D**, and at almost the same time, it is connected to pump pressure chamber **PP**, so pilot pressure oil from the charging pump passes through fine control hole **f** and goes from port **P3** to port **A**.
When the pressure at port **P3** becomes higher, spool (1) is pushed back and fine control hole **f** is shut off from pump pressure chamber **PP**.
At almost the same time, it is connected to drain chamber **D** to release the pressure at port **P3**.
When this happens, spool (1) moves up or down so that the force of metering spring (2) is balanced with the pressure at port **P3**. The relationship in the position of spool (1) and body (10) (fine control hole **f** is at a point midway between drain hole **D** and pump pressure chamber **PP**) does not change until retainer (9) contacts spool (1).
Therefore, metering spring (2) is compressed proportionally to the amount of movement of the control lever, so the pressure at port **P3** also rises in proportion to the travel of the control lever.
In this way, the control valve spool moves to a position where the pressure in chamber **A** (the same as the pressure at port **P3**) and the force of the control valve spool return spring are balanced.



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3) During fine control (when control lever is returned)

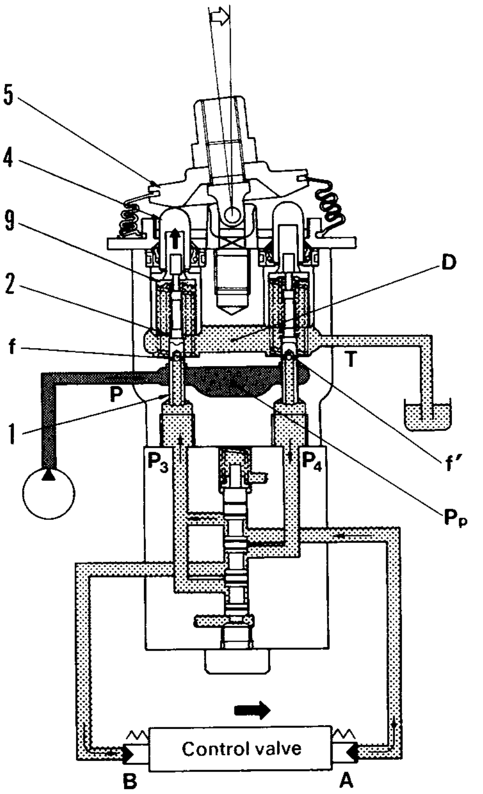
When disc (5) starts to be returned, spool (1) is pushed up by the force of centering spring (3) and the pressure at port **P3**.

When this happens, fine control hole **f** is connected to drain chamber **D** and the pressure oil at port **P3** is released.

If the pressure at port **P3** drops too far, spool (1) is pushed down by metering the spring (2), and fine control hole **f** is shut off from drain chamber **D**. At almost the same time, it is connected to pump pressure chamber **PP**, and the pump pressure is supplied until the pressure at port **P3** recovers to a pressure that corresponds to the lever position.

When the spool to the control valve returns, oil in drain chamber **D** flows in from fine control hole **f'** in the valve on the side that is not working.

The oil passes through port **P4** and enters chamber **B** to fill the chamber with oil.



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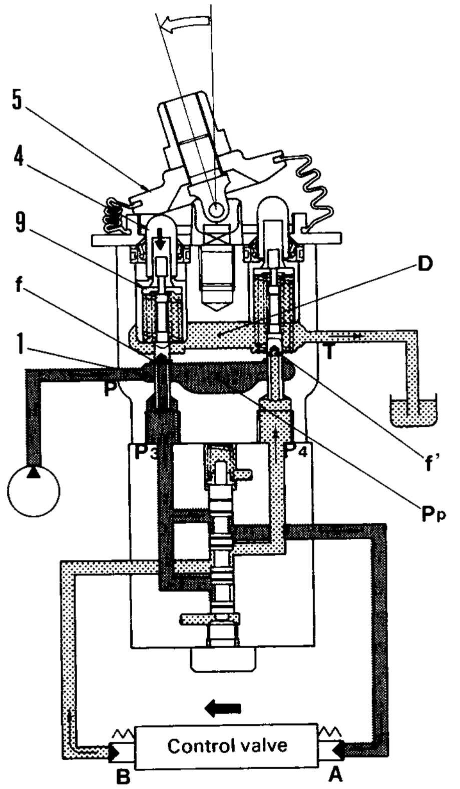
4) At full stroke

When disc (5) pushes down piston (4), and retainer (9) pushes down spool (1), fine control hole **f** is shut off from drain chamber **D**, and is connected with pump pressure chamber **PP**.

Therefore, the pilot pressure oil from the charging pump passes through fine control hole **f** and flows to chamber **A** from port **P3**, and pushes the control valve spool.

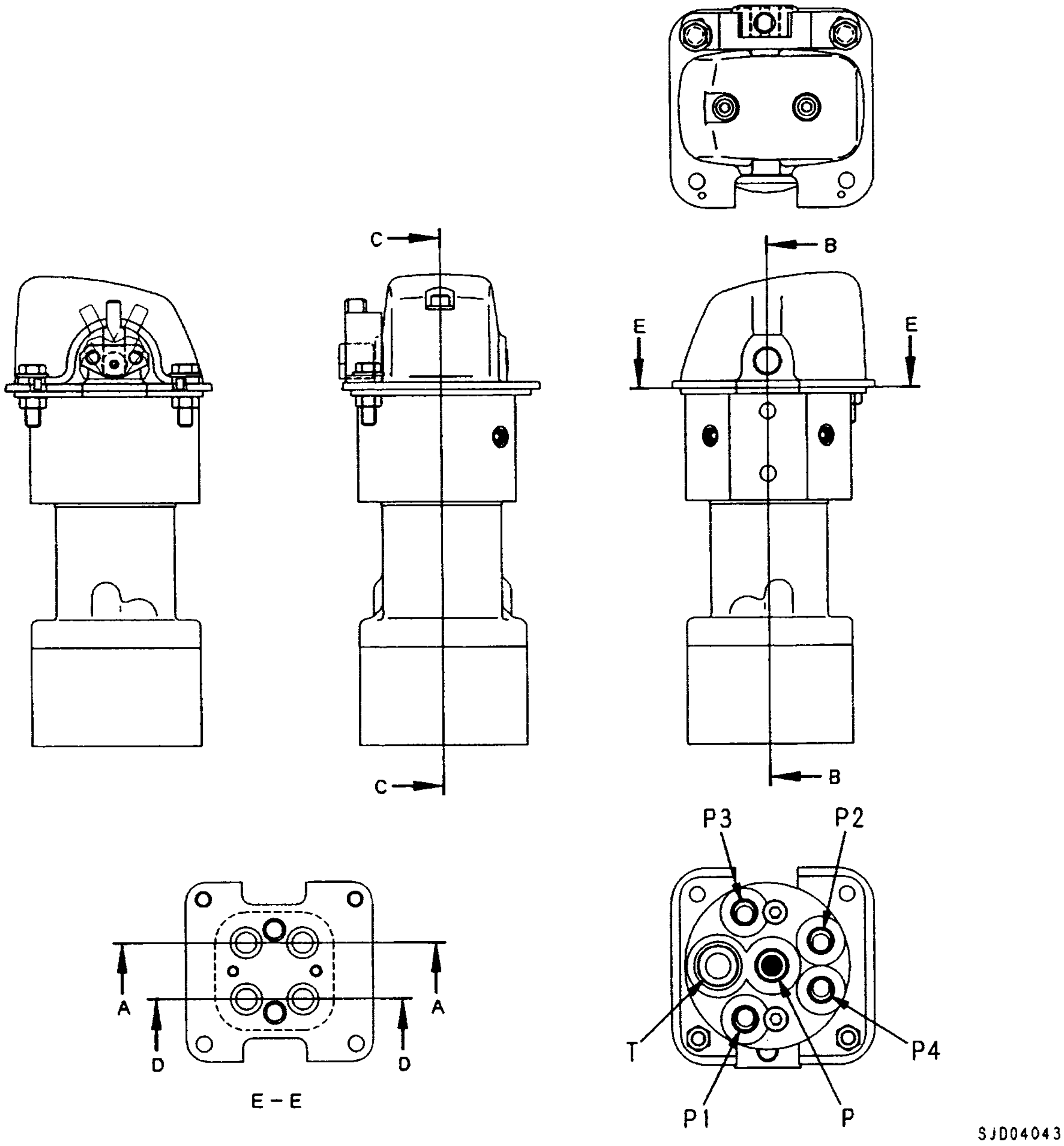
The oil returning from chamber **B** passes from port **P4** through fine control hole **f'** and flows to drain chamber **D**.



140F12143

PPC VALVE (FOR STEERING)

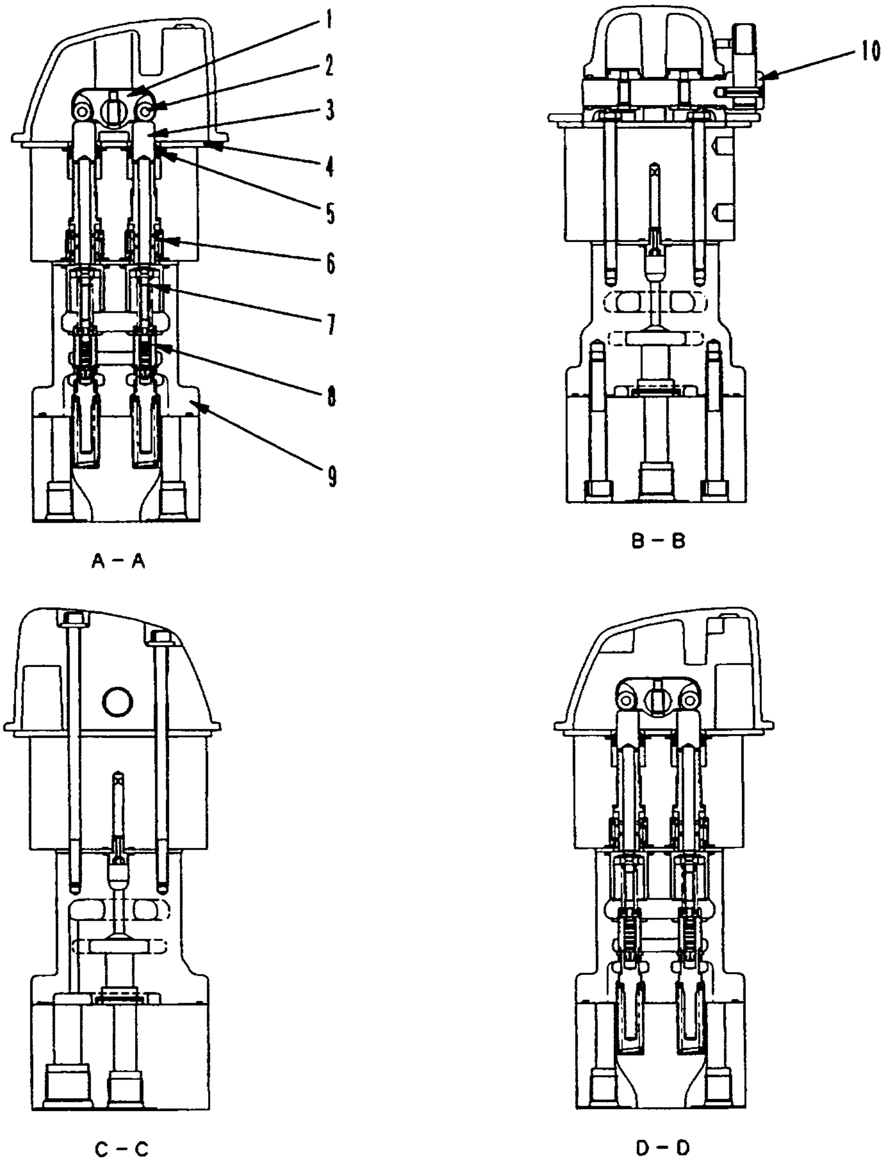
D65E, P-12 65001 and up



P. From power train pump
P1. To left steering brake piston
P2. To right steering clutch piston
P3. To right steering brake piston
P4. To left steering clutch piston
T. To transmission case

OUTLINE

- The steering PPC valve is in the circuit between the power train pump and steering clutch piston and brake piston.
- The steering PPC valve is connected to the steering lever. If the steering lever is leaned to the right or left (to turn the machine), the steering PPC valve operates to send the hydraulic oil to the steering clutch piston or brake piston.
- The turning speed can be controlled by adjusting the discharge of the steering PPC valve by the operating distance of the lever.

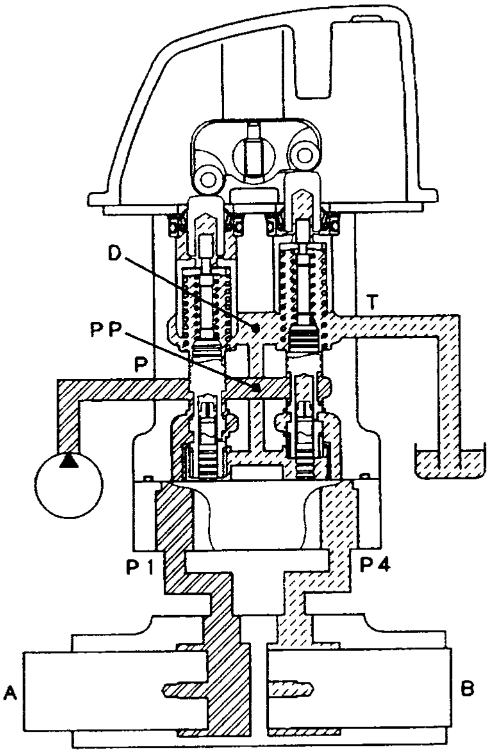


1. Link
2. Bearing
3. Piston
4. Plate
5. Seal
6. Centering spring
7. Metering spring
8. Valve
9. Body
10. Shaft

Operation of steering PPC valve

1. When in neutral

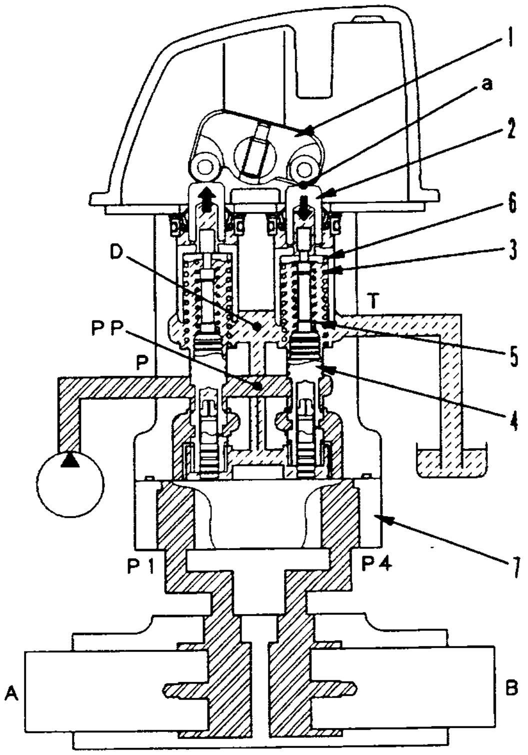
- Brake piston A is connected through port P1 of the PPC valve to pump pressure chamber PP.
  Clutch piston B is connected through port P4 of the PPC valve to drain port D.



SWD03726

2. When clutch is changed from neutral position to "OFF" position

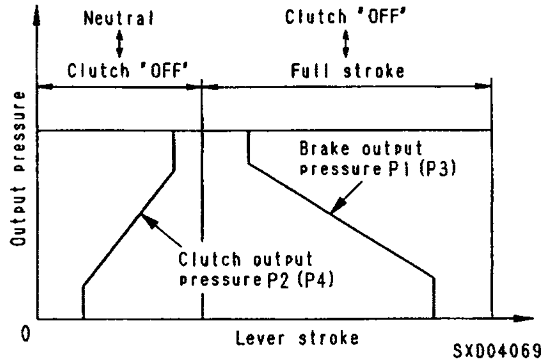
- If the lever is operated to set part "a" of link (1) down, piston (2) moves down, pushing centering spring (3). Then, valve (4) moves down, too, through metering spring (5).
- Just after the cut part of valve (4) is connected to pump pressure chamber PP by the above operation, it is isolated from drain chamber D and hydraulic oil is supplied to port P4.
- If the pressure in port P4 rises, valve (4) is pushed back up against metering spring (5) and its opening is connected to drain chamber D. Just after this operation, valve (4) is isolated from pump pressure chamber PP and the hydraulic oil in clutch piston B flows through port P4.
- By this operation, valve (4) moves up and down so that the force of metering spring (5) will be balanced with the pressure in port P4. The positional relationship between valve (4) and body (7) does not change until valve (4) touches retainer (6).
- Accordingly, metering spring (5) contracts in proportion to the operation stroke of the lever and the pressure in port P4 rises in proportion to the operation stroke of the lever. As a result, the pressure in clutch piston B becomes equal to that in port P4.
- If retainer (6) pushes down valve (4) further, port P4 is isolated from drain chamber D and connected to pump pressure chamber PP.

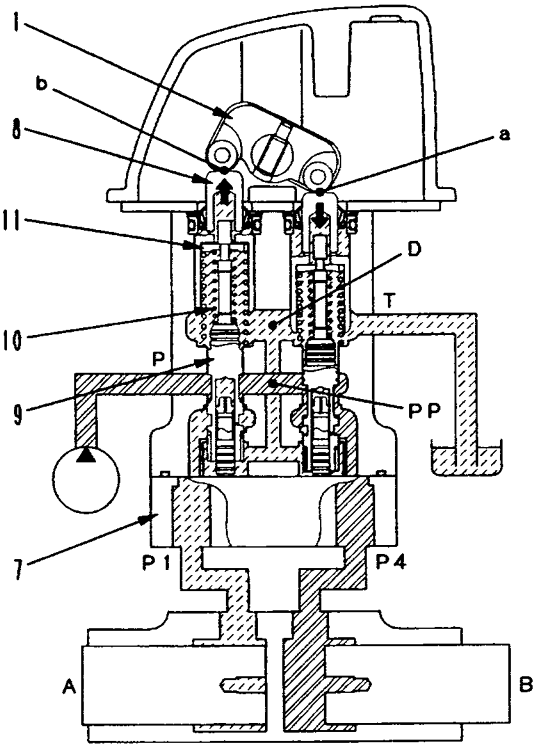


SWD03727

3. When clutch is changed from "OFF" position to stroke end (When brake is turned "ON")

- If part "a" of link (1) is further moved down (part "b" is raised) from the "OFF" position of the clutch, piston (8) rises and valve (9) also rises through metering spring (10).
- Just after the opening of valve (9) is connected to drain chamber D by the above operation, the cut part is isolated from pump pressure chamber PP and hydraulic oil in brake piston A flows through port P1 .
- As the pressure in port P1 lowers, valve (9) is pushed back down by metering spring (10) and the opening of valve (9) is isolated from the drain chamber and connected to pump pressure chamber PP almost simultaneously, then the hydraulic oil flows through port P1 into the brake piston.
- By this operation, valve (9) moves up and down so that the force of metering spring (10) will be balanced with the pressure in port P1. The positional relationship between valve (9) and body (7) does not change until retainer (11) touches valve (9).
- Accordingly, metering spring (10) expands in proportion to the operation stroke of the lever and the pressure in port P1 lowers in proportion to the operation stroke of the lever.
- As a result, the pressure in brake piston A becomes equal to that in port P1. If retainer (11) pushes up valve (9) further, port P1 is isolated from pump pressure chamber PP and connected to drain chamber D.



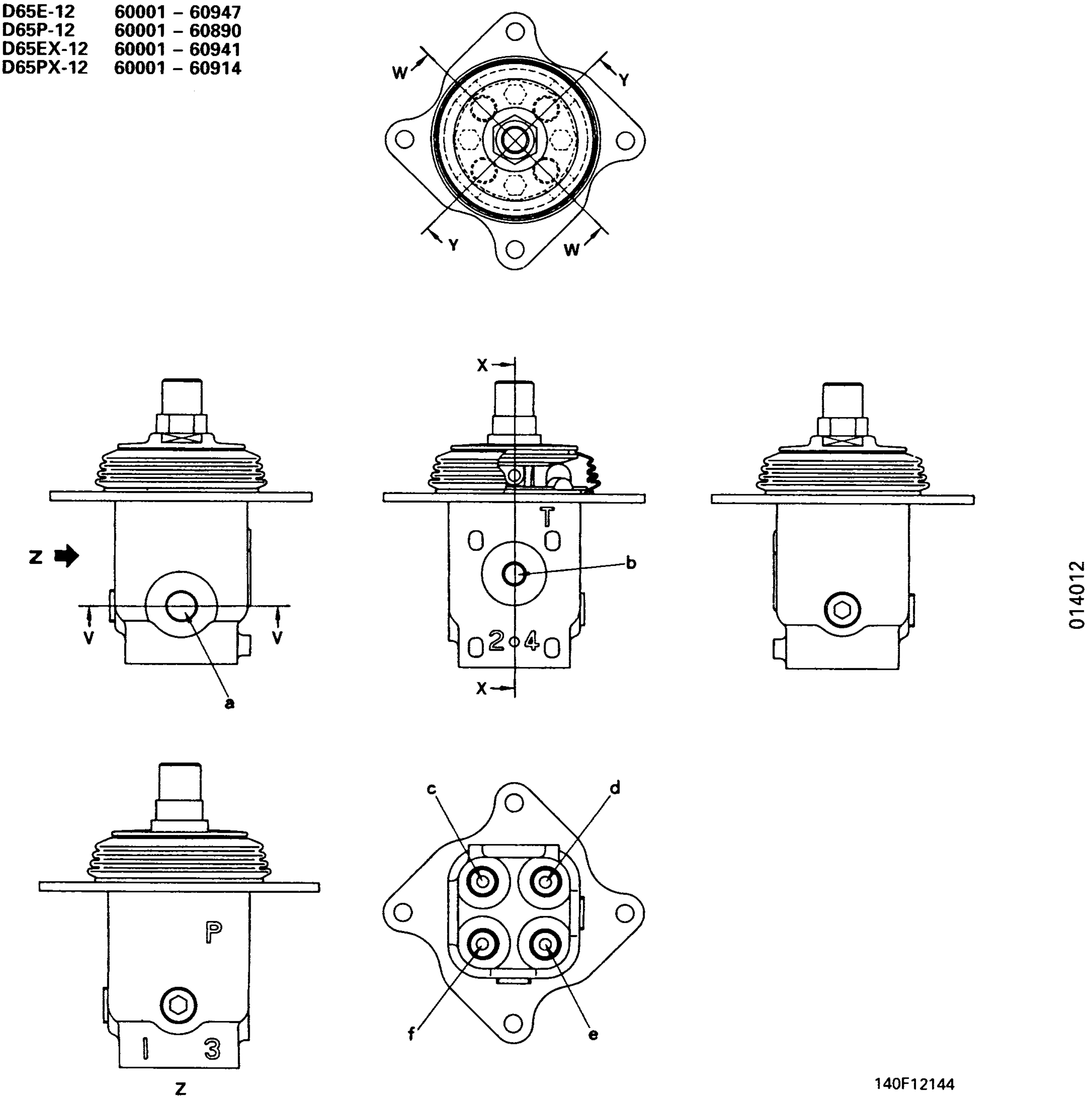


SWD03729

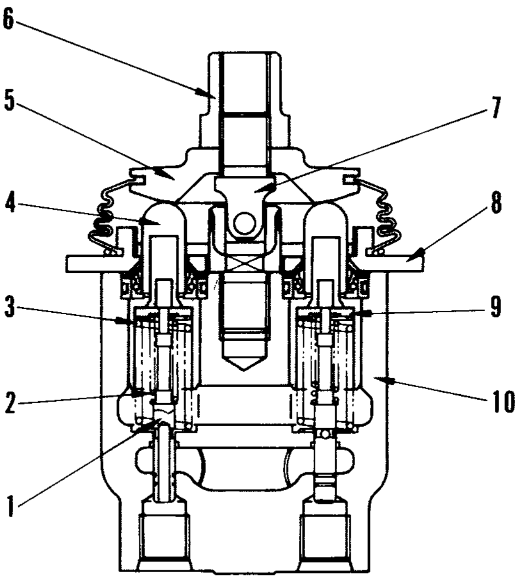
PPC VALVE

For blade lift, tilt and ripper

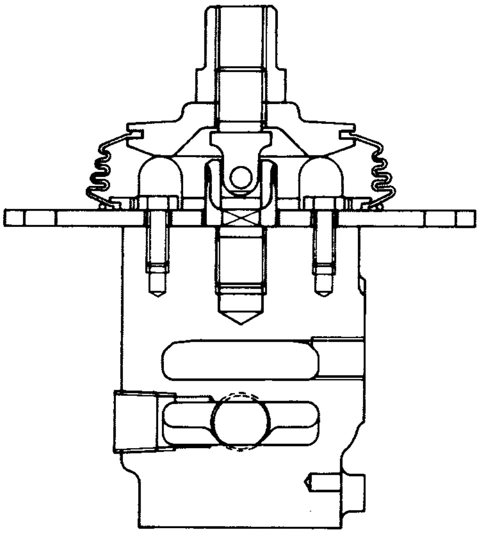
D65E-12	**60001 - 60947**
D65P-12	**60001 - 60890**
D65EX-12	**60001 - 60941**
D65PX-12	**60001 - 60914**



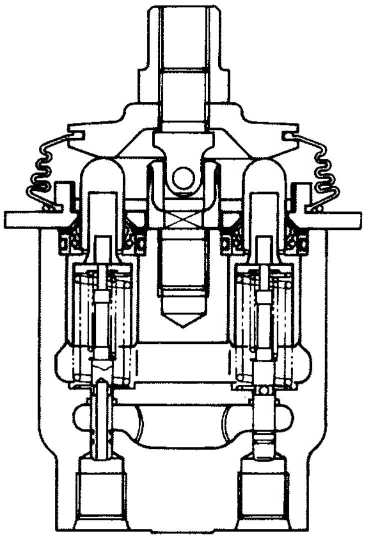
a. Port **P** (from port **P1** of PPC charge valve (through PPC lock valve))
b. Port **T** (to tank)
c. Port **P2** (to port **PA2** of blade tilt valve)
d. Port **P4** (to port **PB3** of blade lift valve)
e. Port **P1** (to port **PB2** of blade tilt valve)
f. Port **P3** (to port **PA3** of blade lift valve)



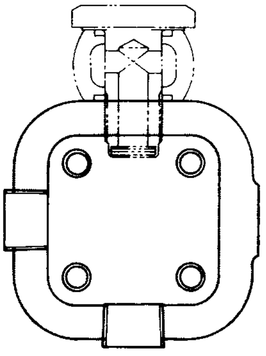
Y – Y



X – X



W – W



V – V

20TF01043

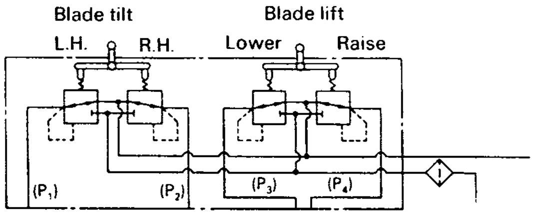
1. Spool
2. Metering spring
3. Centering spring
4. Piston
5. Disc
6. Nut (for lever joint)
7. Joint
8. Plate
9. Retainer
10. Body

OPERATION

1) At neutral

(i) PPC valve for blade lift

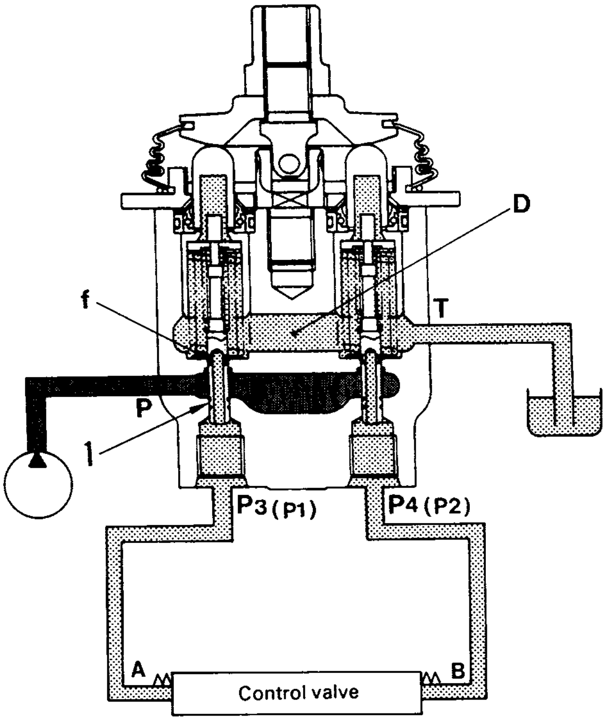
Ports **A** and **B** of the blade lift control valve, and ports **P3** and **P4** of the PPC valve are connected to drain chamber **D** through fine control hole **f** in spool (1).



140F12145

(ii) PPC valve for blade tilt, ripper

Ports **A** and **B** of the blade tilt control valve, and ports **P1** and **P2** of the PPC valve are connected to drain chamber **D** through fine control hole **f** in spool (1).



140F12146

2) During fine control (neutral → fine control)

When piston (4) starts to be pushed by disc (5), retainer (9) is pushed; spool (1) is also pushed by metering spring (2), and moves down.

When this happens, fine control hole **f** is shut off from drain chamber **D**, and at almost the same time, it is connected to pump pressure chamber **PP**, so pilot pressure oil from the charging pump passes through fine control hole **f** and goes from port **P1** to port **A**.

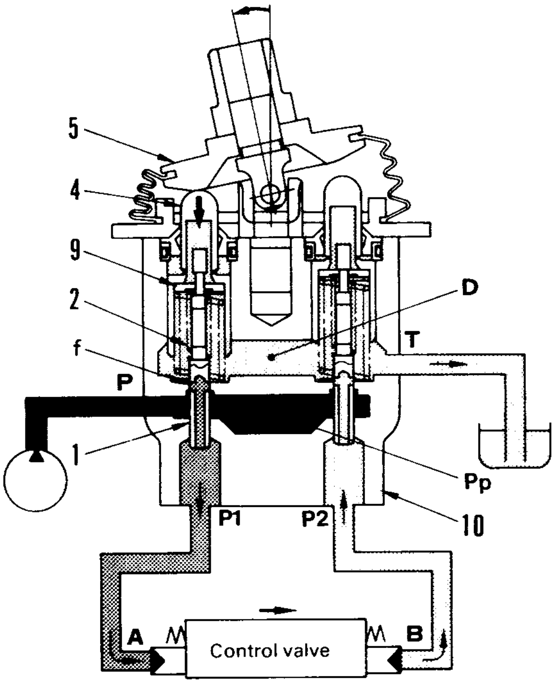
When the pressure at port **P1** becomes higher, spool (1) is pushed back and fine control hole **f** is shut off from pump pressure chamber **PP**.

At almost the same time, it is connected to drain chamber **D** to release the pressure at port **P1**.

When this happens, spool (1) moves up or down so that the force of metering spring (2) is balanced with the pressure at port **P1**. The relationship in the position of spool (1) and body (10) (fine control hole **f** is at a point midway between drain hole **D** and pump pressure chamber **PP**) does not change until retainer (9) contacts spool (1).

Therefore, metering spring (2) is compressed proportionally to the amount of movement of the control lever, so the pressure at port **P1** also rises in proportion to the travel in the control lever.

In this way the control valve spool moves to a position where the pressure in chamber **A** (the same as the pressure at port **P1**) and the force of the control valve spool return spring are balanced.



20TF01045

3) During fine control (when control lever is returned)

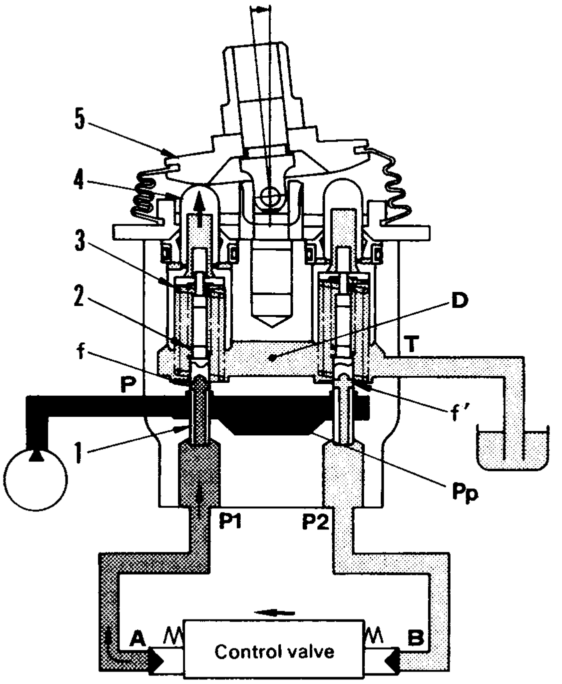
When disc (5) starts to be returned, spool (1) is pushed up by the force of centering spring (3) and the pressure at port **P1**.

When this happens, fine control hole **f** is connected to drain chamber **D** and the pressure oil at port **P1** is released.

If the pressure at port **P1** drops too far, spool (1) is pushed down by metering spring (2), and fine control hole **f** is shut off from drain chamber **D**. At almost the same time, it is connected to pump pressure chamber **PP**, and the pump pressure is supplied until the pressure at port **P1** recovers to a pressure that corresponds to the lever position.

When the spool of the control valve returns, oil in drain chamber **D** flows in from fine control hole **f'** in the valve on the side that is not working.

The oil passes through port **P2** and enters chamber **B** to fill the chamber with oil.



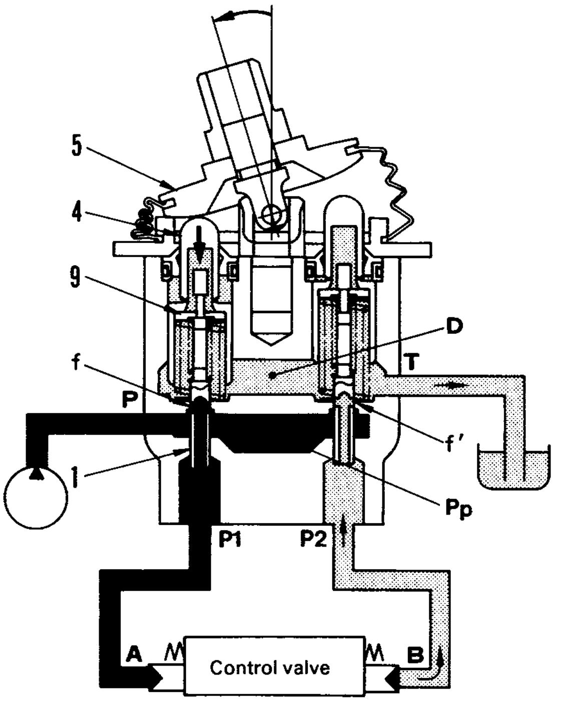
20TF01046

4) At full stroke

When disc (5) pushes down piston (4), and retainer (9) pushes down spool (1), fine control hole **f** is shut off from drain chamber **D**, and is connected with pump pressure chamber **PP**.

Therefore, the pilot pressure oil from the charging pump passes through fine control hole **f** and flows to chamber **A** from port **P1**, and pushes the control valve spool.

The oil returning from chamber **B** passes from port **P2** through fine control hole **f'** and flows to drain chamber **D**.



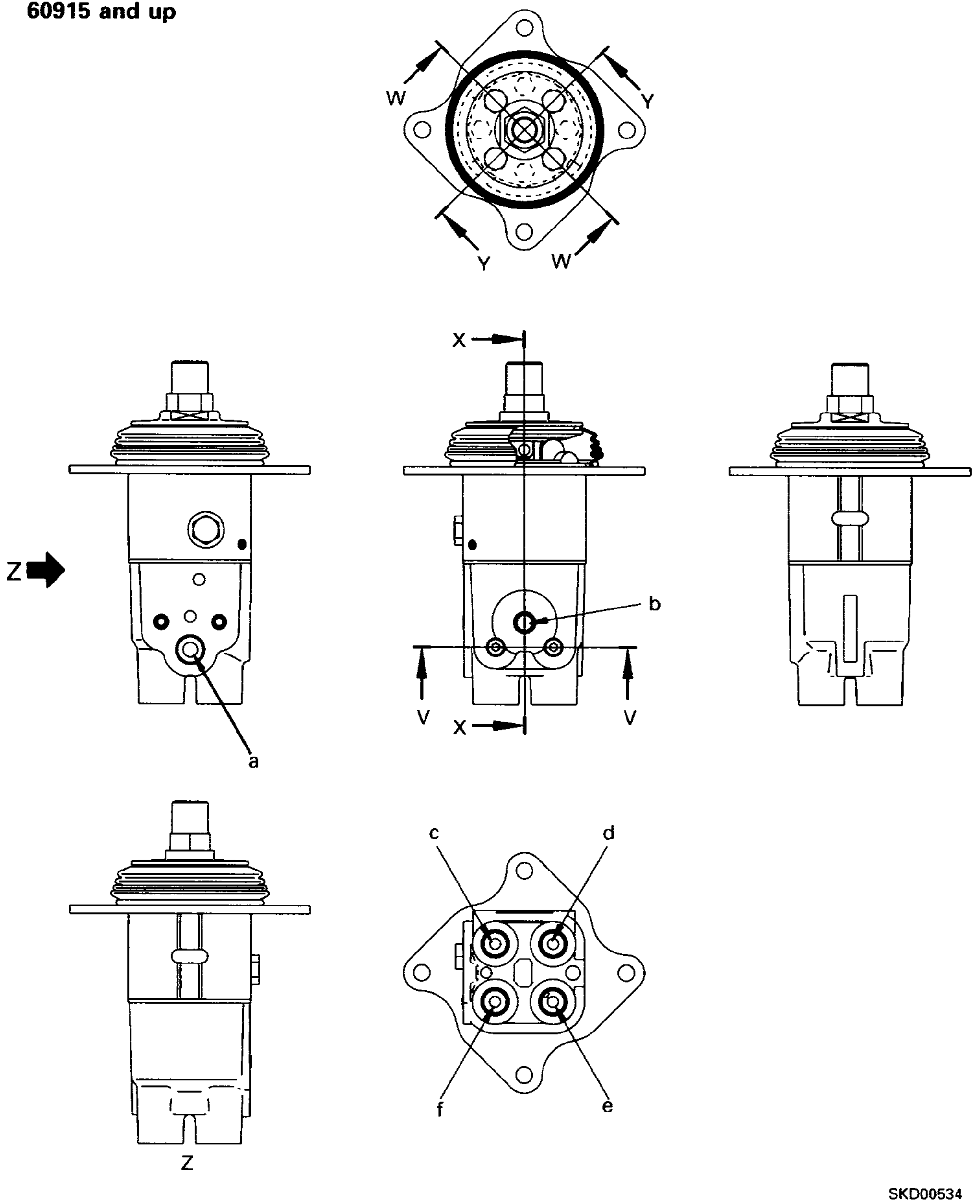
20TF01047

014012

PPC VALVE

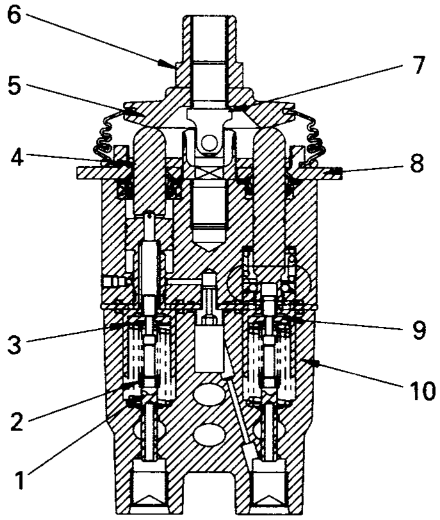
For blade lift, tilt and ripper

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

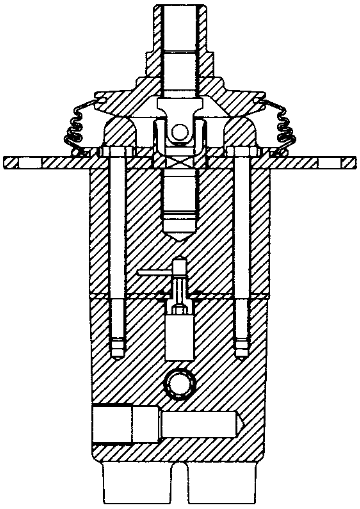


014012

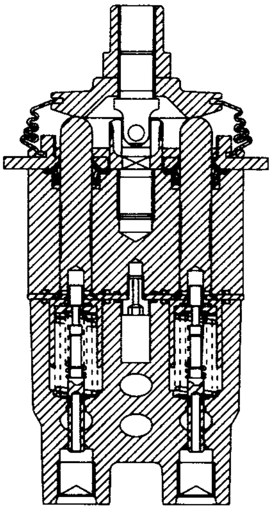
a. Port **P** (from port **P1** of PPC charge valve
b. Port **T** (to tank)
c. Port **P2** (to port **PB3** of blade lilt valve)
d. Port **P4** (to port **PB2** of blade tift valve)
e. Port **P1** (to port **PA3** of blade lilt valve)
f. Port **P3** (to port **PA2** of blade tift valve)



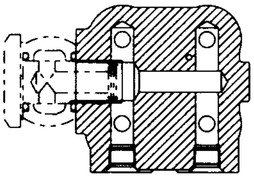
Y - Y



X - X



W - W



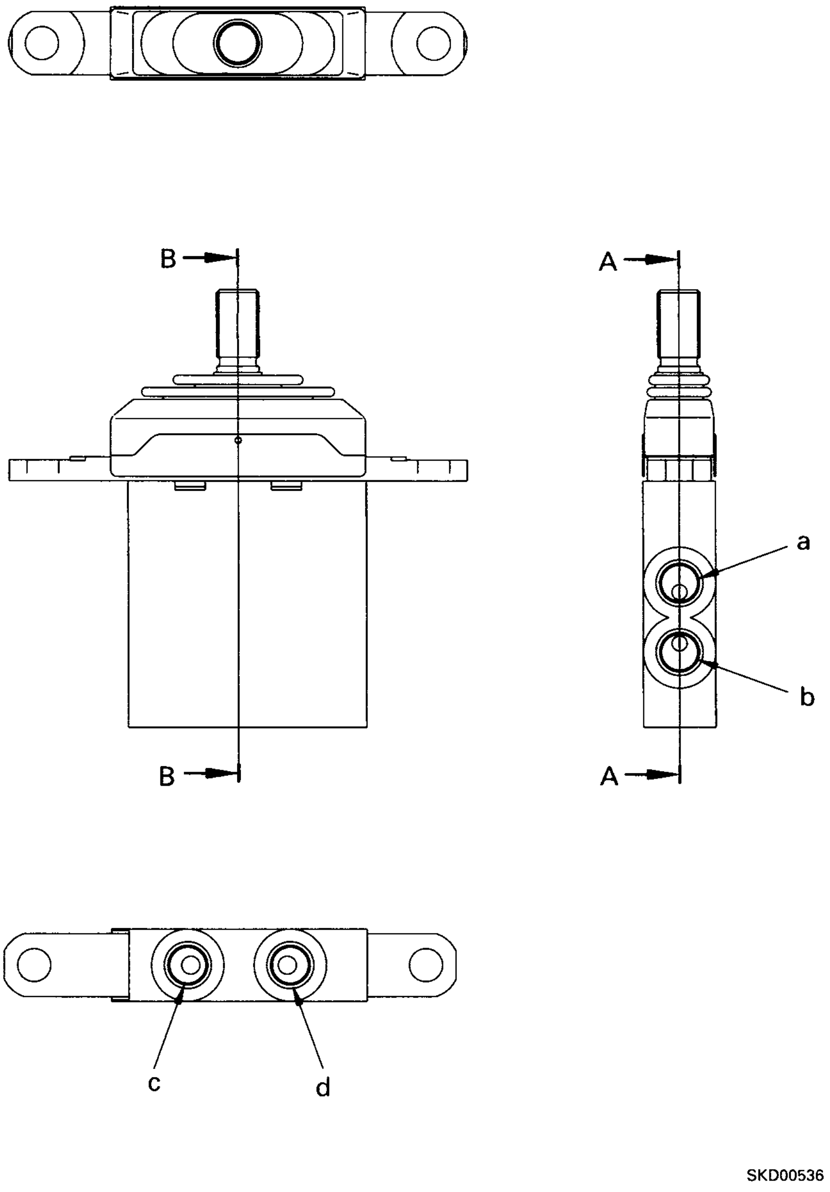
V - V

SKD00535

014012

1. Spool
2. Metering spring
3. Centering spring
4. Piston
5. Disc
6. Nut (for lever joint)
7. Joint
8. Plate
9. Retainer
10. Body

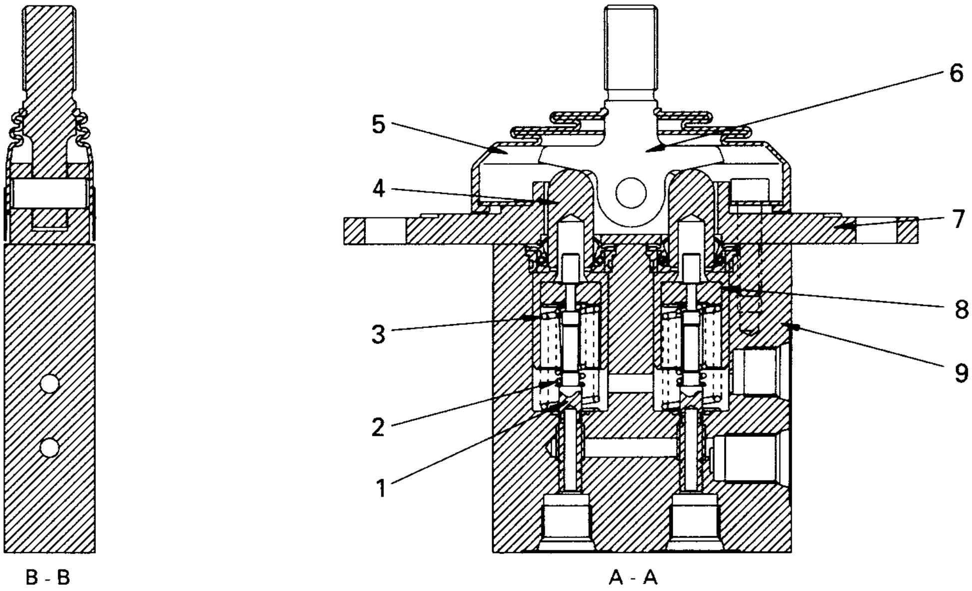
For ripper



014012

a. Port **T** (to tank)
b. Port **P** (from port **P1** of PPC charge valve)
c. Port **P3** (to port **PA3** of ripper lift valve)
d. Port **P4** (to port **PB3** of ripper lift valve)

014012



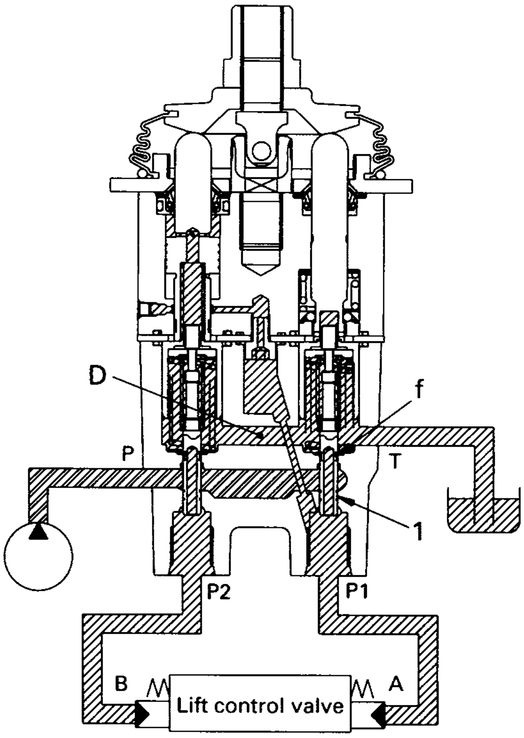
1. Spool
2. Metering spring
3. Centering spring
4. Piston
5. Disc
6. Joint
7. Plate
8. Retainer
9. Body

OPERATION

1) At nertral

(i) PPC valve for blade lift

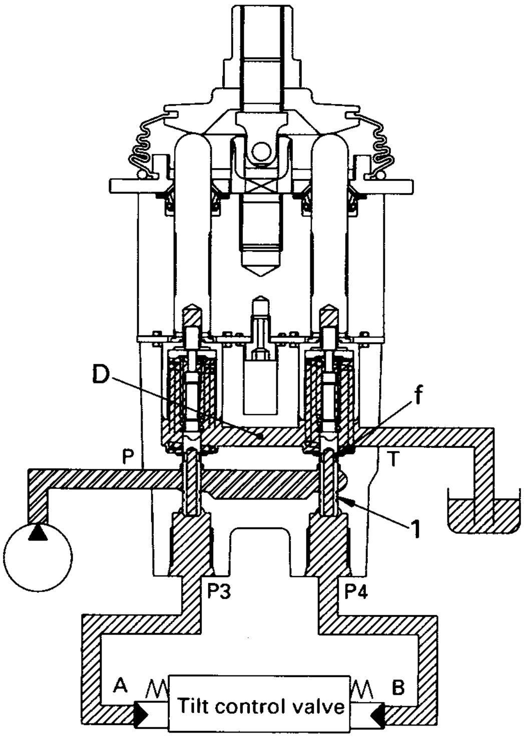
Ports **A** and **B** of the blade lift control valve, and ports **P1** and **P2** of the PPC valve are connected to drain chamber **D** through fine control hole **f** in spool (1).



SKD00538

(ii) PPC valve for blade tilt, ripper

Ports **A** and **B** of the blade tilt control valve, and ports **P3** and **P4** of the PPC valve are connected to drain chamber **D** through fine control hole **f** in spool (1).



SKD00539

2) **During fine control (neutral – fine control)**

When piston (4) starts to be pushed by disc (5), retainer (9) is pushed; spool (1) is also pushed by metering spring (2), and moves down.

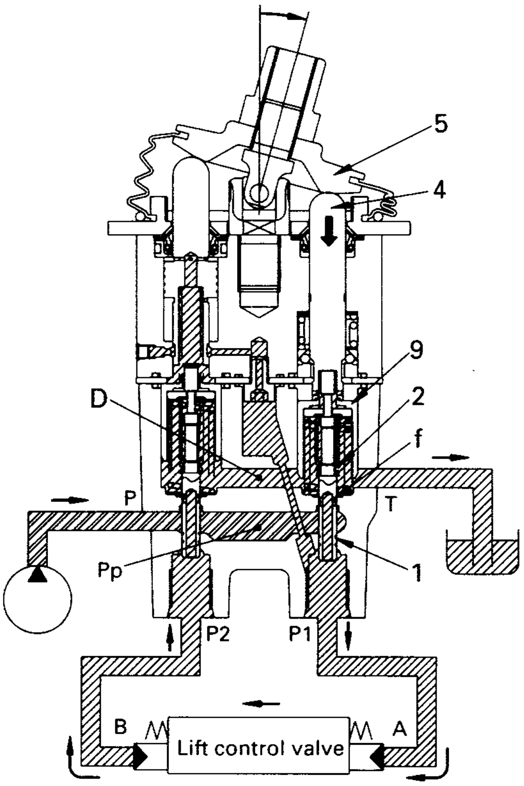
When this happens, fine control hole **f** is shut off from drain chamber **D**, and at almost the same time, it is connected to pump pressure chamber **PP**, so pilot pressure oil from the charging pump passes through fine control hole **f** and goes from port **P1** to port **A**.

When the pressure at port **P1** becomes higher, spool (1) is pushed back and fine control hole **f** is shut off from pump pressure chamber **PP**.

At almost the same time, it is coneced to drain chamber **D** to release the pressure at port **P1**.

When this happens, spool (1) moves up or down so that the force of metering spring (2) is balanced with the pressure at port **P1**. The relationship in the position of spool (1) and body (10) (fine control hole **f** is at a point midway between drain hole **D** and pump pressure chamber **PP**) does not change until retainer (9) contacts spool (1). Therefore, metering spring (2) is compressed proportionally to the amount of movement of the control lever, so the pressure at port **P1** also rises in proportion to the travel in the control lever.

In this way the control valve spool moves to a position where the pressure in chamber **A** (the same as the pressure at port **P1**) and the force of the control valve spool return spring are balanced.



SKD00540

3) During fine control (when control lever is returned)

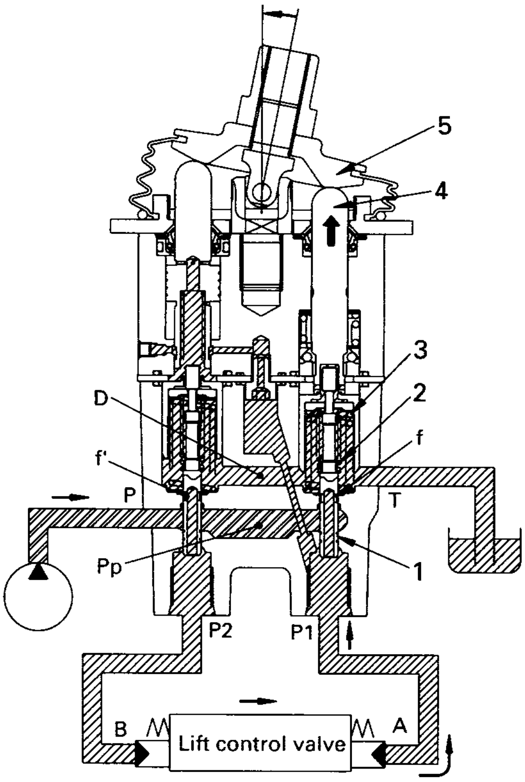
When disc (5) starts to be returned, spool (1) is pushed up by the force of centering spring (3) and the presure at port **P1**.

When this happens, fine control hole **f** is connected to drain chamber **D**, and the pressure oil at port **P1** is released.

If the pressure at port **P1** drops too far, spool (1) is pushed down by metering spring (2), and fine control hole **f** is shut off from drain chamber **D**. At almost the same time, it is connected to pump pressure chamber **PP**, and the pump pressure is supplied until the pressure at port **P1** recovers to a pressure that corresponds to the lever position.

When the spool of the control valve returns, oil in drain chamber **D** flows in from fine control hole **f'** in the valve on the side that is not working.

The oil passes through port **P2** and enters chamber **B** to fill the chamber with oil.



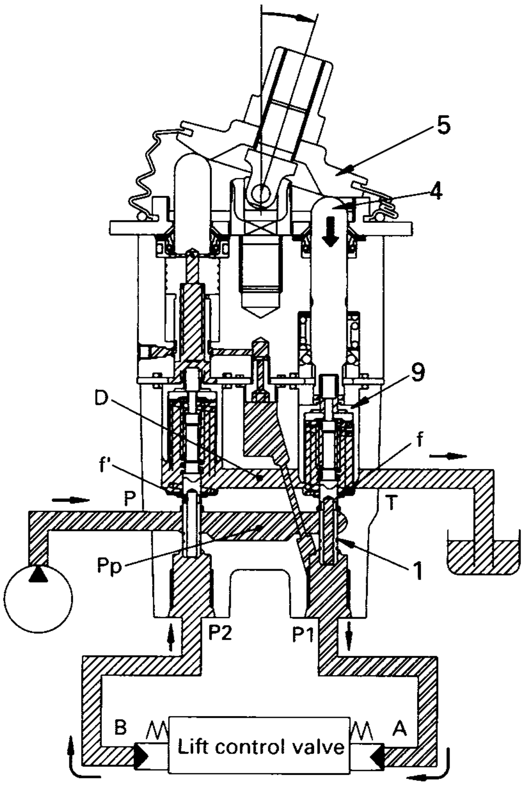
SKD00541

4) At full stroke

When disc (5) pushes down piston (4), and retainer (9) pushes down spool (1), fine control hole **f** is shut off from drain chamber **D**, and is connected with pump pressure chamber **PP**.

Therefore, the pilot pressure oil from the charging pump passes through fine control hole **f** and flows to chamber **A** from port **P1**, and pushes the control valve spool.

The oil returning from chamber **B** passes from port **P2** through fine control hole **f'** and flows to drain chamber **D**.

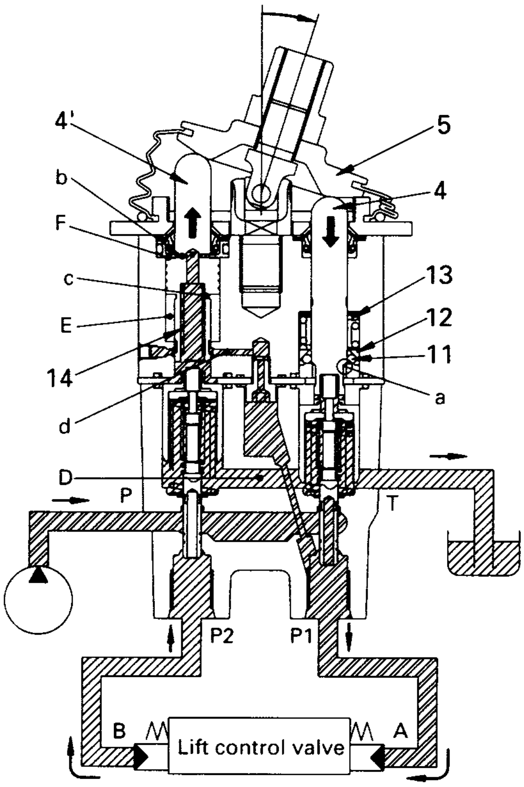


SKD00542

5) Blade operated to FLOAT

When piston (4) at port **P1** (LOWER side) is pushed by disc (5) and moves down, protrusion **a** of the piston contacts ball (11) during the downward stroke. (The detent starts to be actuated.)

If piston (4) is pushed further, ball (11) pushes up collar (12), which is being held by detent spring (13), and moves to the outside, so the ball passes over protrusion **a** of the piston. At this point, piston (4') at the opposite side is pushed up by spring (14). As a result, the oil inside chamber **F** flows through **b** and **c** and enters chamber **E**, and piston (4') follows disc (5). Passage **d** is interconnected with port **P1**, so it is under more or less the same pressure as port **P1**. Chamber **E** is normally interconnected with drain chamber **D**, but when ball (11) passes over protrusion **a** of the piston, passage **d** and chamber **E** (which were shut off) are interconnected and pressurized oil flows. At the same time, the control valve also moves to the FLOAT position, so the blade circuit is set to the FLOAT condition. The pressurized oil inside chamber **E** pushes up piston (4'), so even if the lever is released, it is held at the FLOAT position.



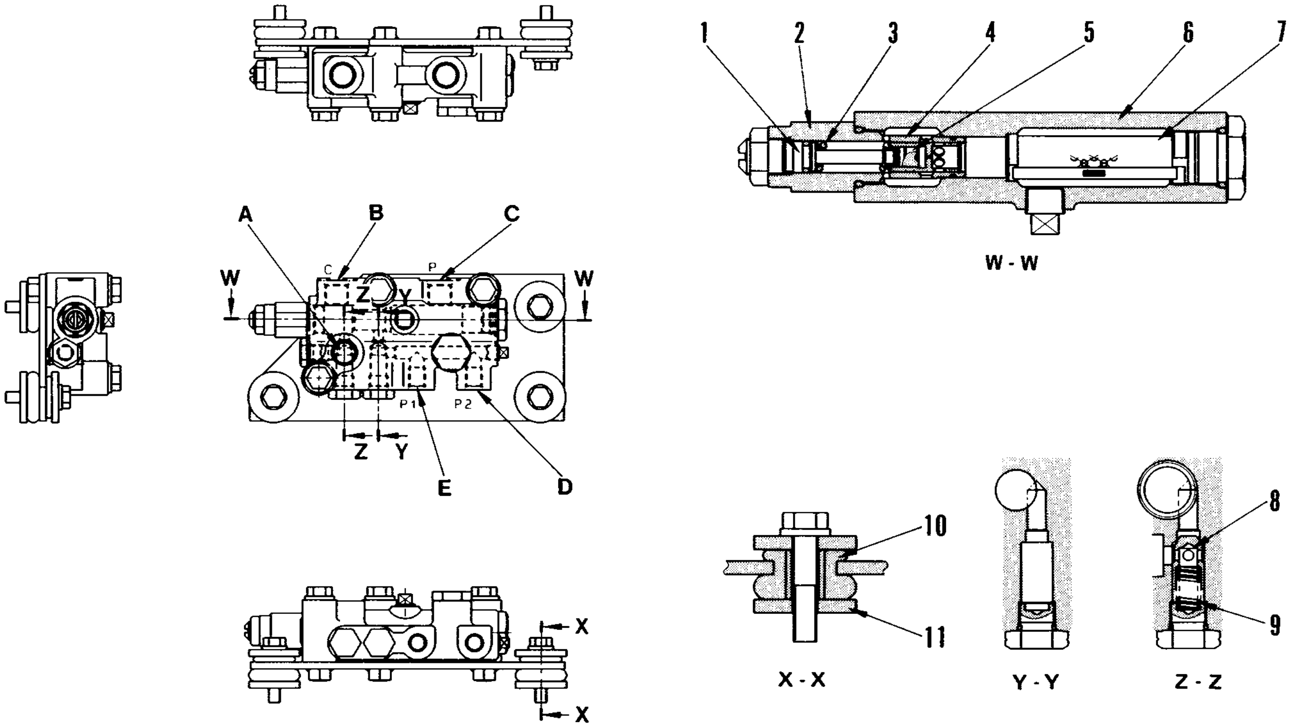
SKD00543

6) Blade released from FLOAT

When disc (5) is returned from the FLOAT position, it is pushed down by a force greater than the pressure of the oil in chamber **E**. For this reason, chamber **E** is shut off from passage **d** and is connected to the drain chamber. Therefore, the oil pressure inside chamber **E** is lost, and the FLOAT position is released.

014012

PPC CHARGE VALVE

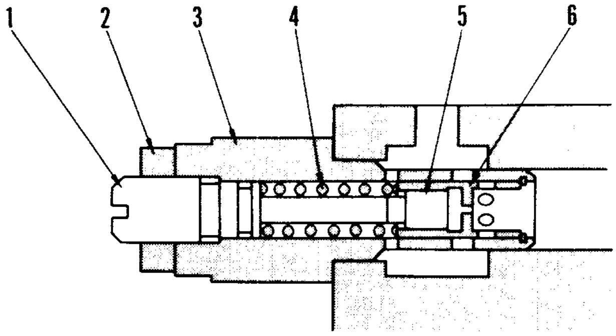


014012

1. Screw } Relief valve
2. Sleeve } Relief valve
3. Spring } Relief valve
4. Valve } Relief valve
5. Piston } Relief valve
6. Body
7. Strainer
8. Oil cooler bypass valve
9. Spring
10. Cushion
11. Collar

A. Port **T** (to tank)
B. Port **C** (to oil cooler)
C. Port **P** (from PPC pump)
D. Port **P2** (to steering PPC valve)
E. Port **P1** (to work equipment PPC valve)

		Capacity
Oil cooler bypass valve cracking pressure		0.5 ± 0.05 MPa (5 ± 0.5 kg/cm^2)
Relief valve	Cracking pressure	3.3 MPa (34 kg/cm^2)
	Set pressure	3.8 MPa (39 kg/cm^2) (at 24 ℓ/min)
Strainer	Filtering particle size	24 × 110 mesh
	Filtering area	62.2 cm^2



1. Adjustment screw
2. Locknut
3. Sleeve
4. Main valve spring
5. Pilot piston
6. Main valve

140F12148

OUTLINE

- The PPC charge valve acts to relieve the oil sent from the pump when the PPC valve is at NEUTRAL.

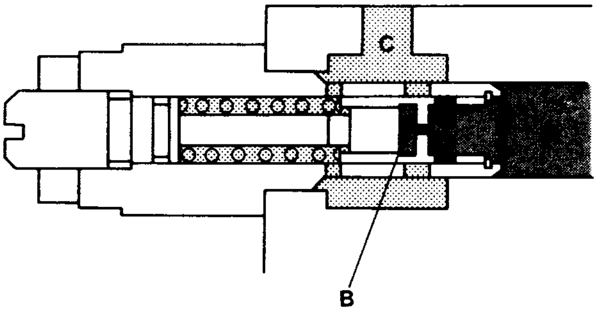
  It sets the maximum pressure for the circuit when it is being operated.

  Set pressure: 3.8 MPa (39 kg/cm²)
  (at 24 ℓ/min)

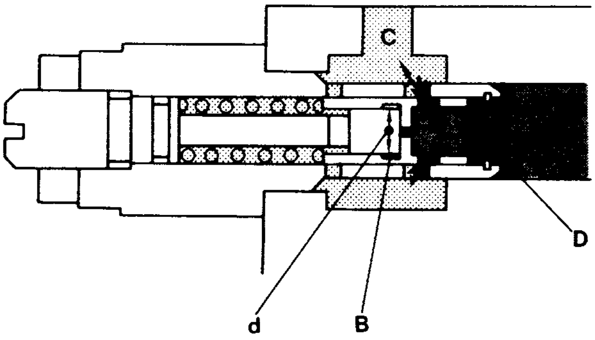
OPERATION

- Chamber **A** is connected to the pump circuit and chamber **C** is connected to the tank drain circuit. The oil passes through the orifice in the main valve and fills chamber **B**.

- When the pressure in chamber **A** rises, and the differential pressure [$\pi/4$ ($D^2 - d^2$) x pressure of chamber **A**] caused by the difference in the area of diameter **D** and **d** reaches the pressure set by the main valve spring, the main valve opens. The pressurized oil in chamber **A** then escapes to chamber **C**, so the pressure in chamber **A** drops.



140F12149

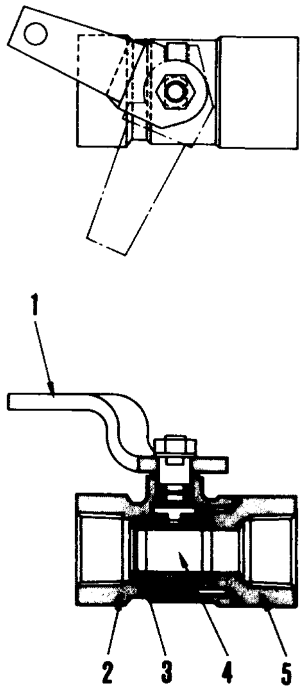


140F12150

014012

PPC LOCK VALVE

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914



F205C5018

1. Lever
2. Body
3. Seat
4. Ball
5. End cap

014012

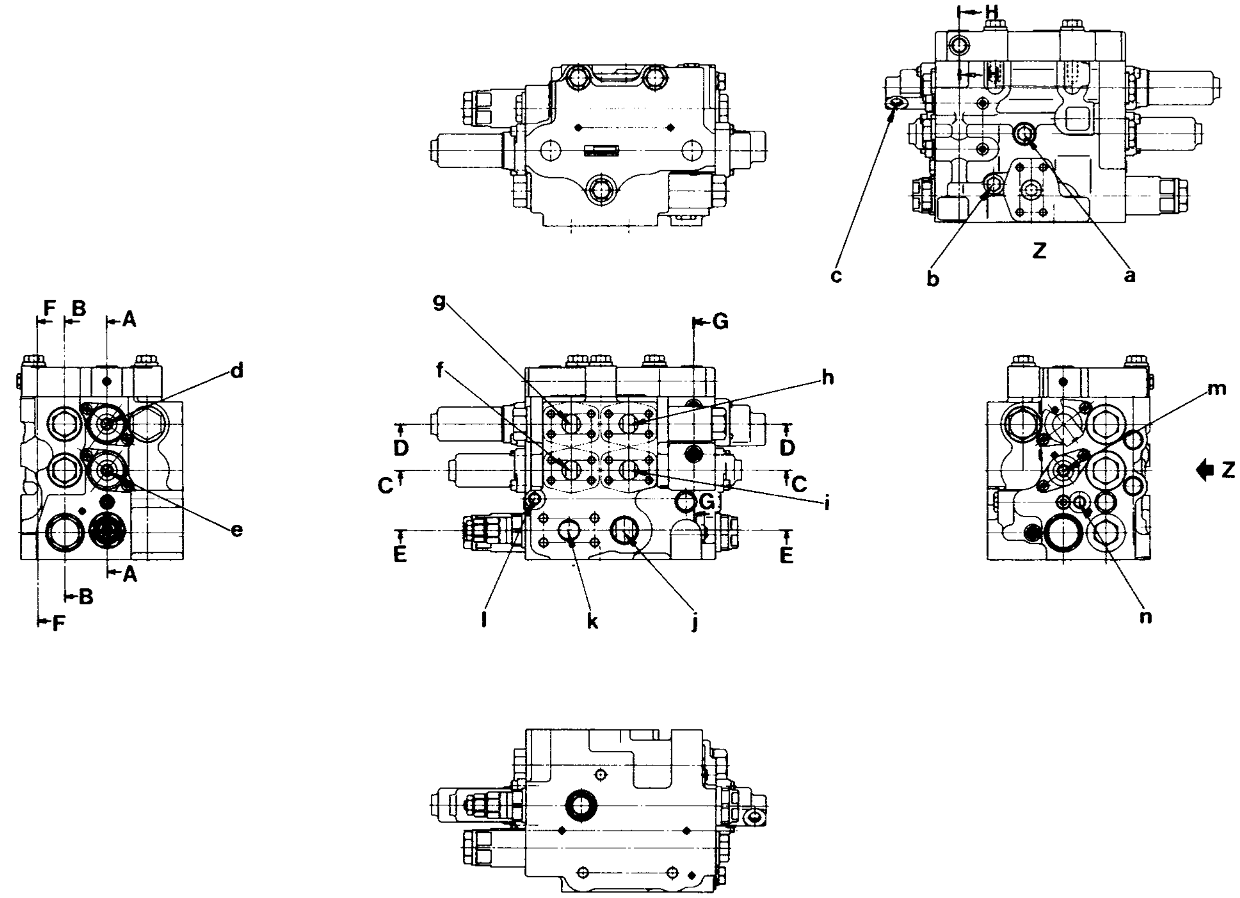
OUTLINE

- This is installed in the circuit between the PPC charge valve and the work equipment PPC valve in the PPC circuit. When the safety lever (for the blade control lever) is placed at the LOCK position, it stops the flow of oil in the PPC circuit.

MAIN CONTROL VALVE

(2-SPOOL VALVE: BLADE LIFT + TILT)

D65E-12 60001 - 60947
D65P-12 60001 - 60890

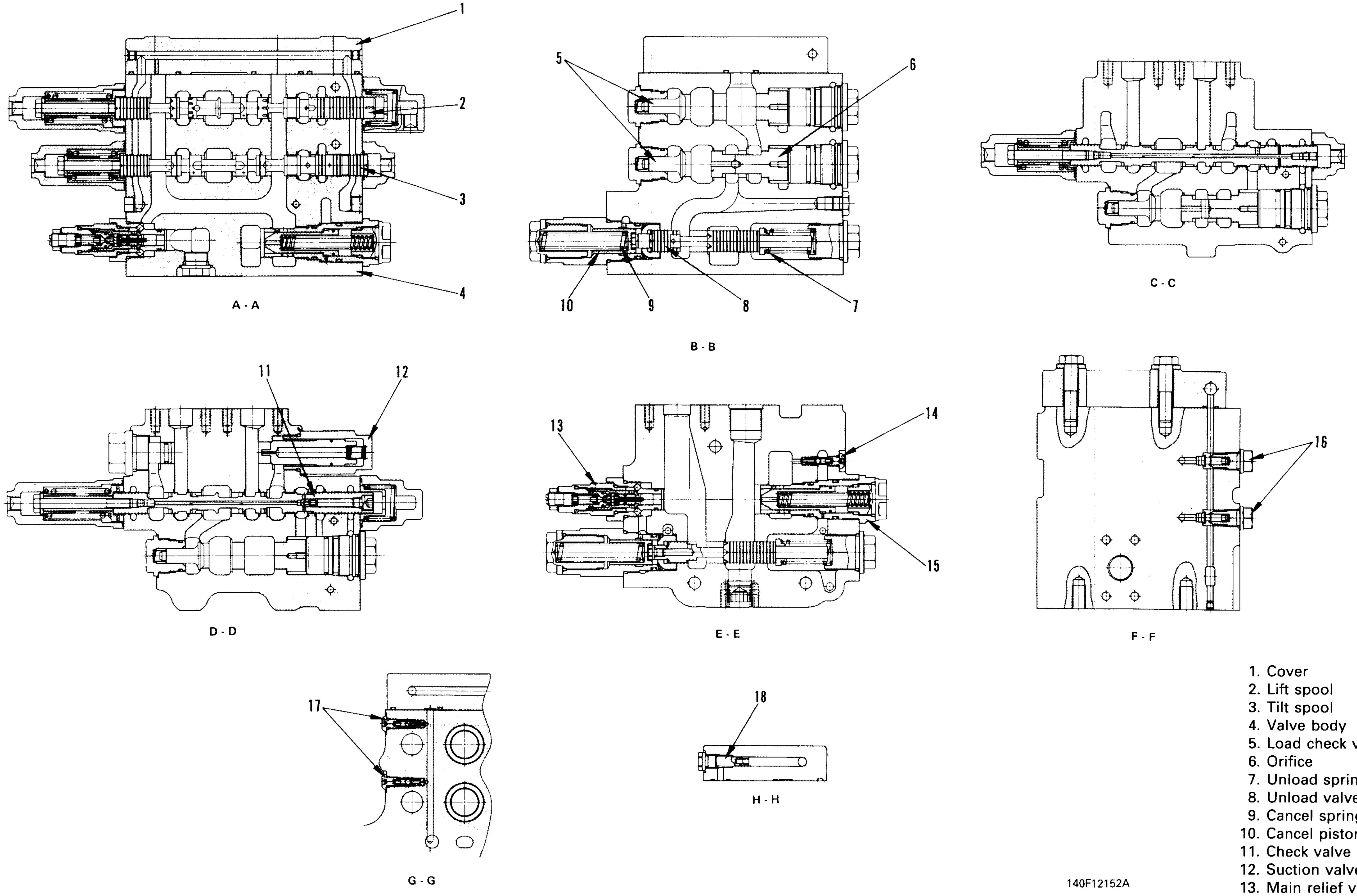


140F12151A

014012

- a. Port **PC** (pump pressure plug)
- b. Port **PLSC** (LS pressure plug)
- c. Port **PB2** (from PPC valve)
- d. Port **PA2** (from PPC valve)
- e. Port **PA1** (from PPC valve)
- f. Port **A1** (to tilt cylinder bottom)
- g. Port **A2** (to lilt cylinder head)
- h. Port **B2** (to lilt cylinder bottom)
- i. Port **B1** (to tilt cylinder head)
- j. Port **T** (to tank).
- k. Port **P** (from pump)
- l. Port **TS** (to tank)
- m. Port **PB1** (from PPC valve)
- n. Port **Pi** (from PPC pump)

014012

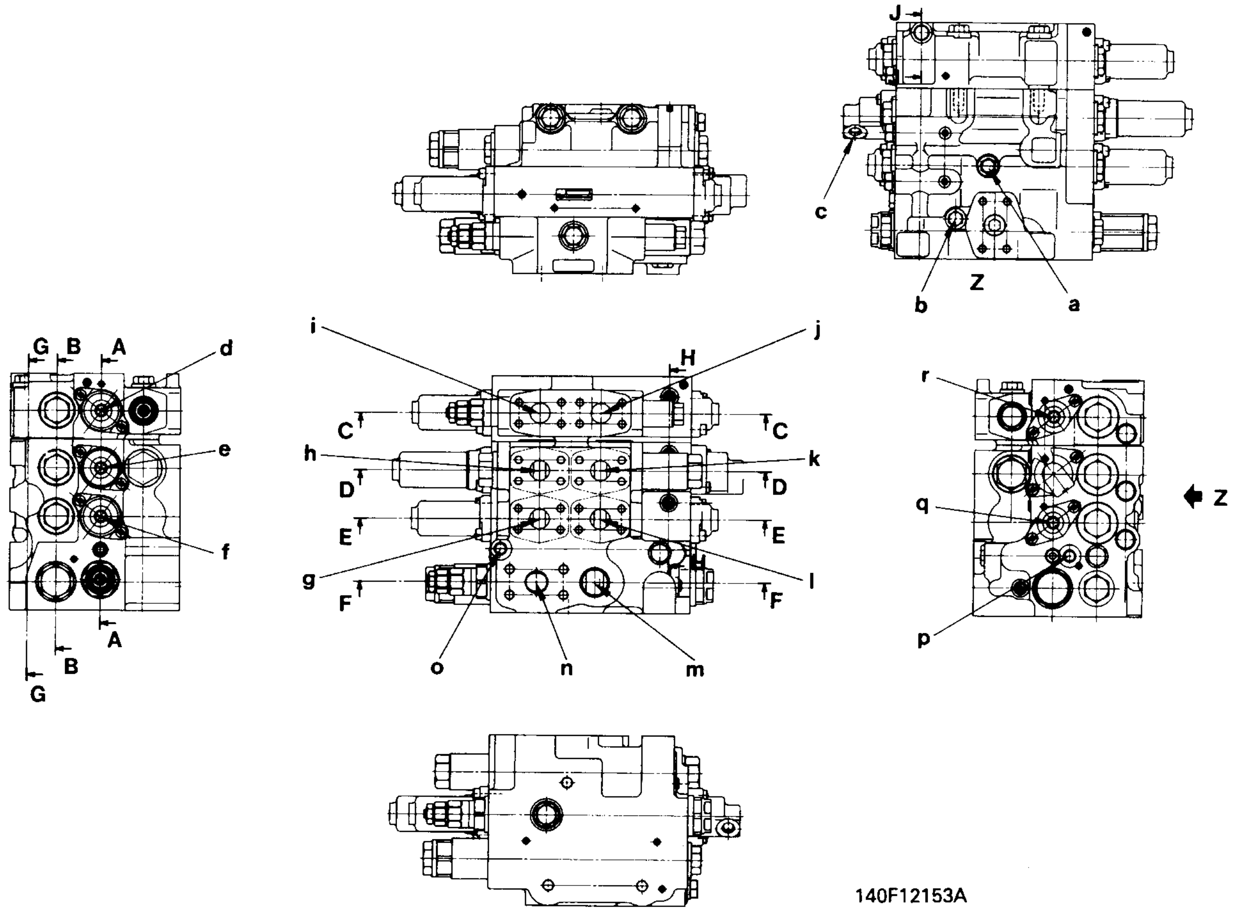


140F12152A

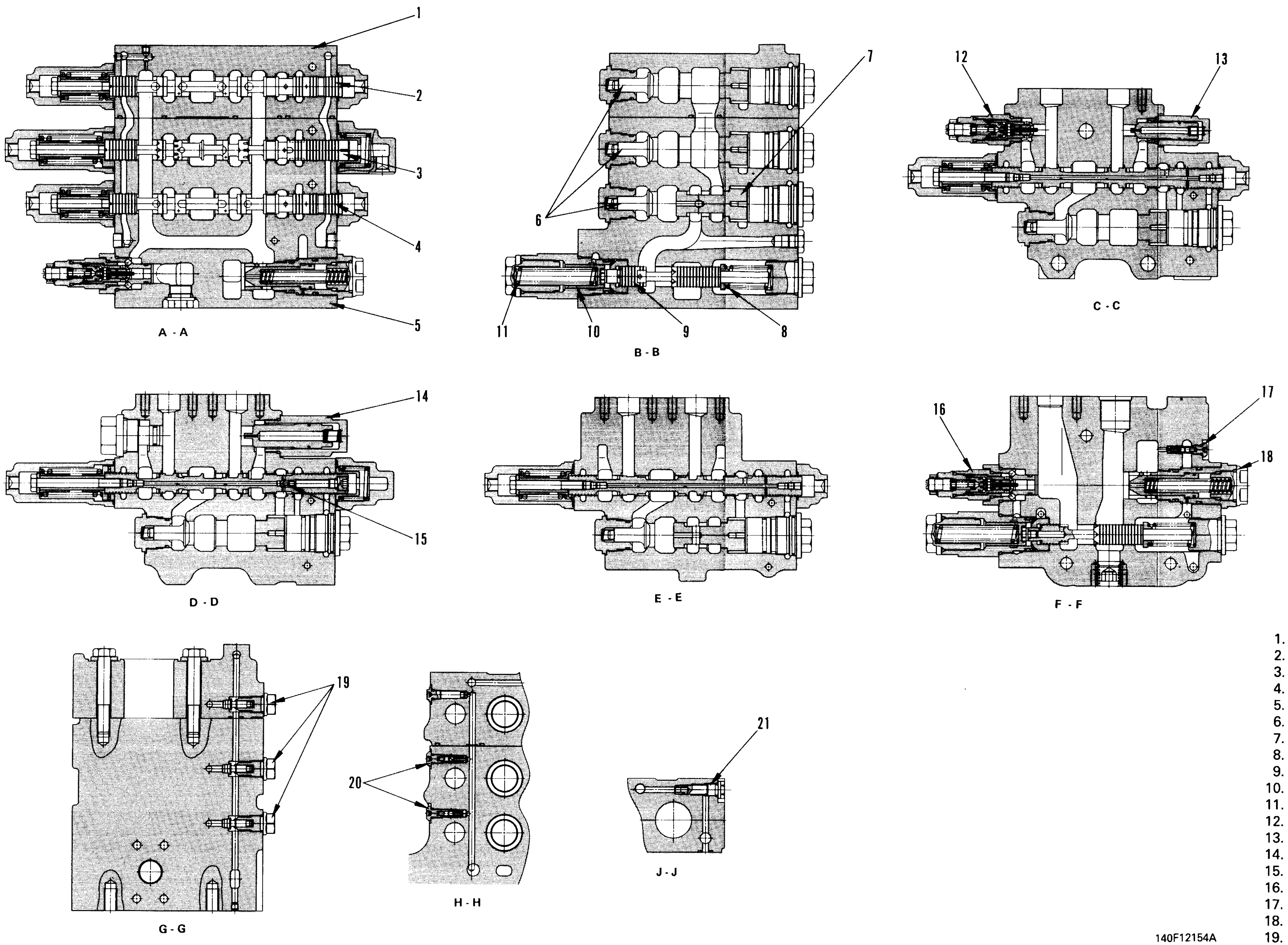
1. Cover
2. Lift spool
3. Tilt spool
4. Valve body
5. Load check valve
6. Orifice
7. Unload spring
8. Unload valve
9. Cancel spring
10. Cancel piston
11. Check valve (built into spool)
12. Suction valve
13. Main relief valve
14. Back pressure check valve
15. Back pressure valve
16. LS check valve
17. Preset check valve
18. LS bypass valve

(2 + 1 SPOOL VALVE: RIPPER LIFT + BLADE LIFT + TILT)

D65E-12 60001 – 60947



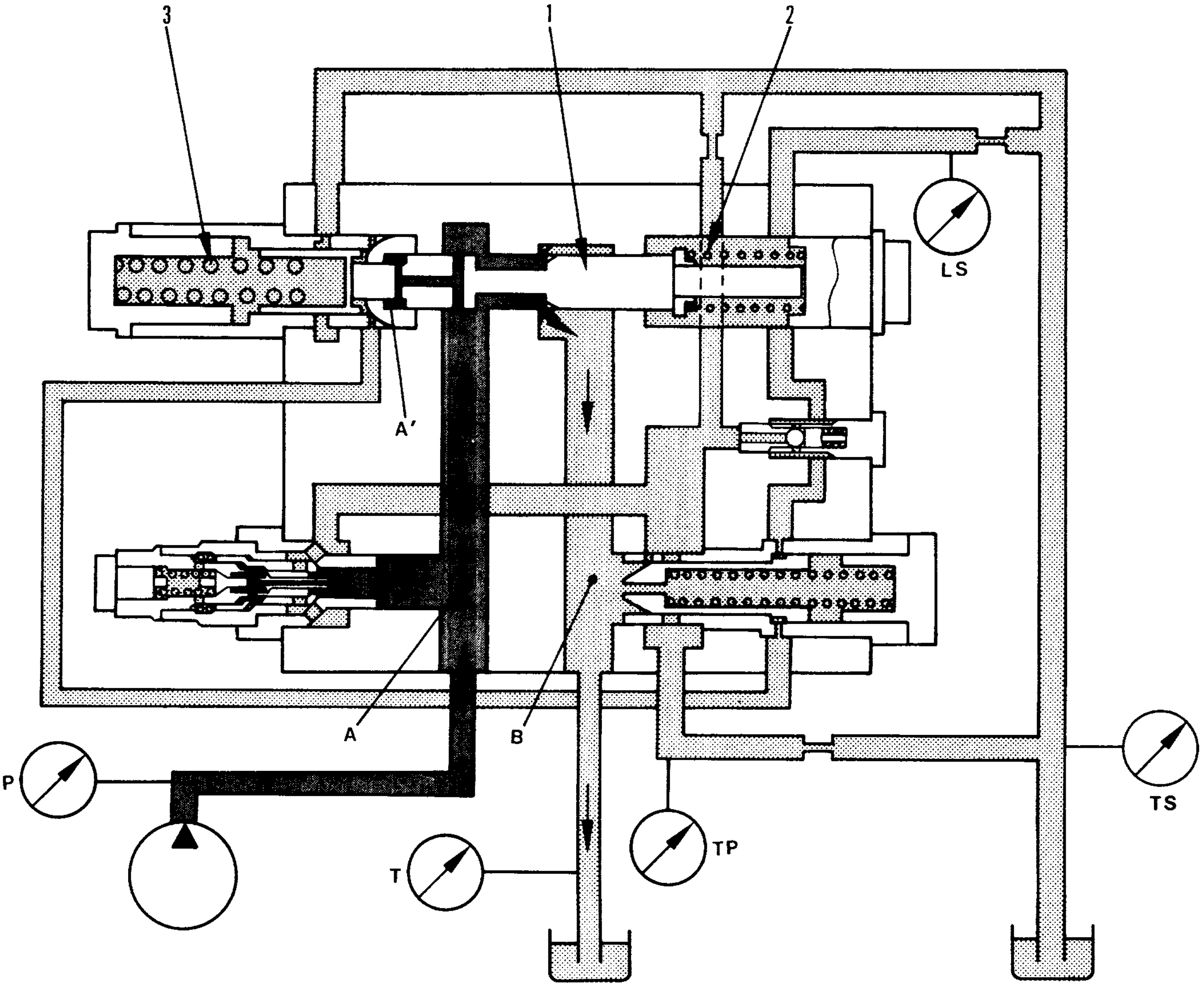
a. Port **PC** (pump pressure plug)
b. Port **PLSC** (LS pressure plug)
c. Port **PB2** (from PPC valve)
d. Port **PA3** (from PPC valve)
e. Port **PA2** (from PPC valve)
f. Port **PA1** (from PPC valve)
g. Port **A1** (to tilt cylinder bottom)
h. Port **A2** (to lilt cylinder head)
i. Port **A3** (to ripper cylinder bottom)
j. Port **B3** (to ripper cylinder head)
k. Port **B2** (to lift cylinder bottom)
l. Port **B1** (to tilt cylinder head)
m.Port **T** (to tank)
n. Port **P** (from pump)
o. Port **TS** (to tank)
p. Port **Pi** (from PPC pump)
q. Port **PB1** (from PPC valve)
r. Port **PB3** (from PPC valve)



014012

1. Valve block
2. Ripper spool
3. Lift spool
4. Tilt spool
5. Valve body
6. Load check valve
7. Orifice
8. Unload spring
9. Unload spool
10. Cancel piston
11. Cancel spring
12. Suction safety valve
13. Suction valve
14. Suction valve
15. Check valve (built into spool)
16. Main relief valve
17. Back pressure check valve
18. Back pressure valve
19. LS check valve
20. Preset check valve
21. LS bypass valve

OPERATION OF MAIN CONTROL VALVE



FUNCTION

When the work equipment control levers are at HOLD, the oil discharged from the pump is all unloaded, and the pressure loss of the valve is kept below 0.5 MPa (5kg/cm^2).

In this way, the pressure loss when the lever is at HOLD is small, so the heat loss is also small.

Proportional control is carried out by the unload valve, which controls the amount of oil sent to the cylinder to an amount that matches the opening of the spool.

The unload valve is controlled by the difference in pressure on both sides of the spool, so there is a little change in the oil flow caused by the load pressure. It also provides the function of pressure compensation.

OPERATION

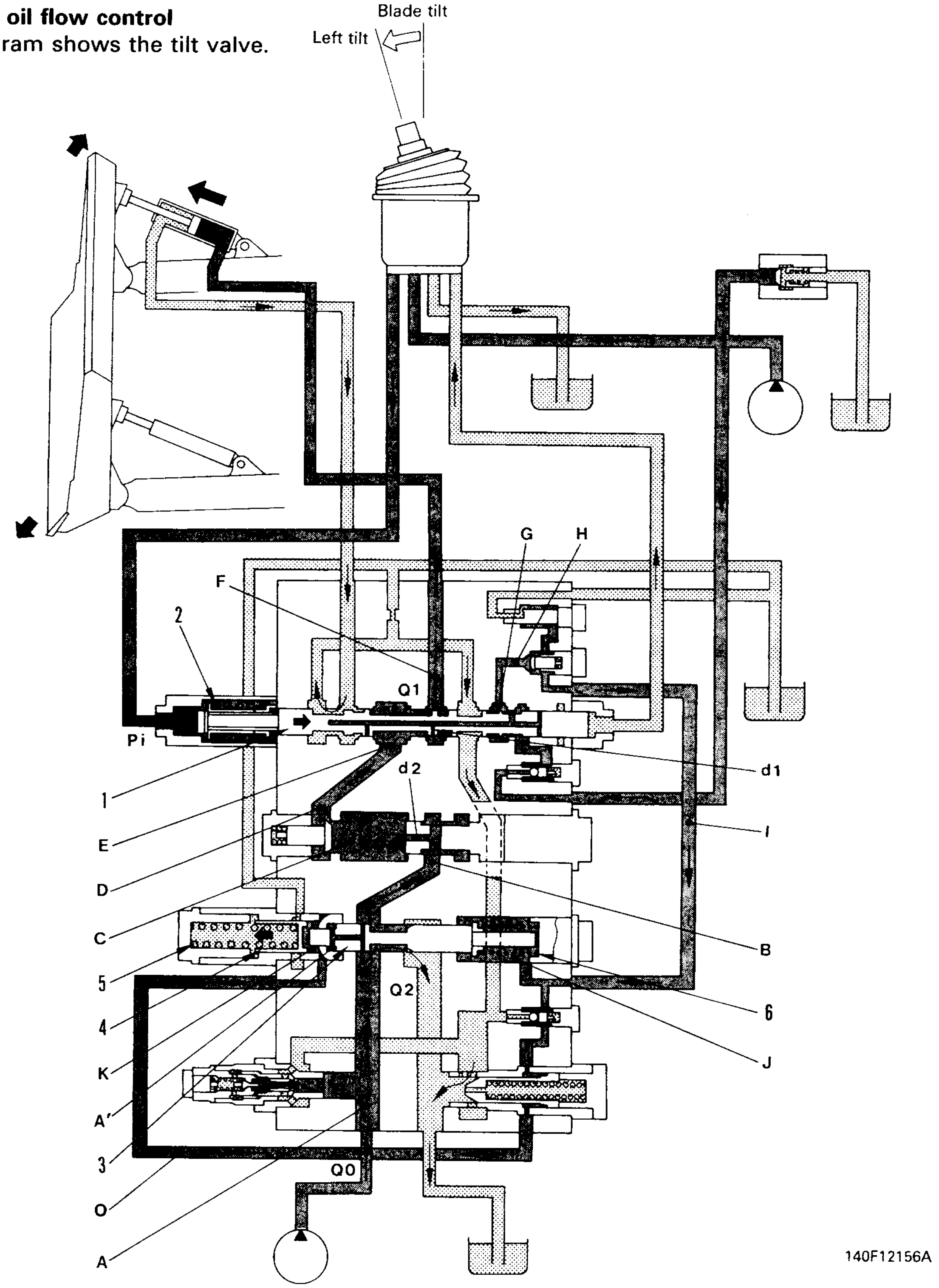
1. At HOLD (unload valve at low setting)

1) When the work equipment spool is at **HOLD**, **LS** circuit pressure **LS** = seal drain pressure **TS** (hydraulic leak pressure from valve)$\fallingdotseq$0 MPa (0 kg/cm^2), so unload spool (1) is balanced by the difference in load between load **F2** of spring (3) and load **F1** of spring (2) that is set to oppose pressure **P** which is sent to chamber **A'**.
   In other words, **AO** x **P** = **F1** – **F2** (**AO**: Area receiving pump pressure in chamber **A'**).
2) By making **F1** – **F2** smaller, it is possible to make pump pressure **P** smaller.
   When this is done, the area of the opening between ports **A** and **B** is determined, so the loss of pressure from **A** to **B** (**P** – **T**) can be kept more or less constant regardless of back pressure **Tp** between ports **A** and **B**.

2. Control of oil flow (unload valve at high setting) (Lift valve, tilt valve, ripper valve)

(1) Meter-in oil flow control

★ The diagram shows the tilt valve.



014012

- △**PLS** = Differential pressure between ports **A** and **J** = 1.8 – 2.9 MPa (18 – 30 kg/cm²)
- △**PLS'** = Differential pressure between ports **A** and **F**
- △**PLS** ≒ △ **PLS'**

- Because of the action of the unload valve, an amount of oil that matches the opening of the spool flows to the cylinder. (Proportional control)
- The unload valve is controlled by the difference in pressure on both sides of the spool, so the change in the amount of the oil flow caused by the load pressure is small (pressure compensation).

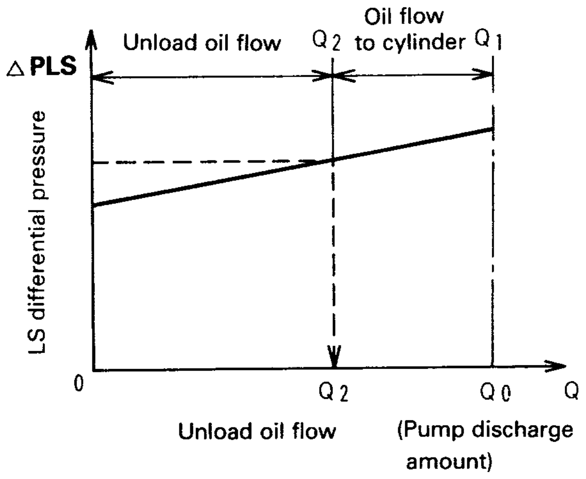
1) If the PPC valve output pressure **Pi** is sent to the spring chamber of spool (1), spool (1) pushes against spring (2) and moves to the right to a position where it balances with the load of the spring.

2) If spool (1) is actuated, the passage between ports **E** and **F** opens, so part of the oil flow discharged from the pump flows through ports **A**, **B**, **C**, **D**, **E**, and **F**, and then into the cylinder. But in this condition, almost all the oil discharged from the pump is unloaded.

3) At the same time, the pressure in chamber **F** flows into the passage inside the spool from **LS** throttle **d1**, then passes through ports **G**, **H**, and **I**, and is sent to spring chamber **J** of the unload valve. In addition, the pressure in chamber **A** (pump pressure) is sent to chamber **A'** of the unload valve, while the pressure in chamber **J** passes through **LS** passage **O** and is sent to chamber **K**.

4) When the oil in chamber **F** flows and the pressure rises, the pressures in chamber **J** and chamber **K** both rise at the same time. The pressure in chamber **K** pushes against the spring (5) and moves piston (4) to the left. Piston (4) is separated from unload spool (3), so the load of spring (5) does not act on unload spool (3).

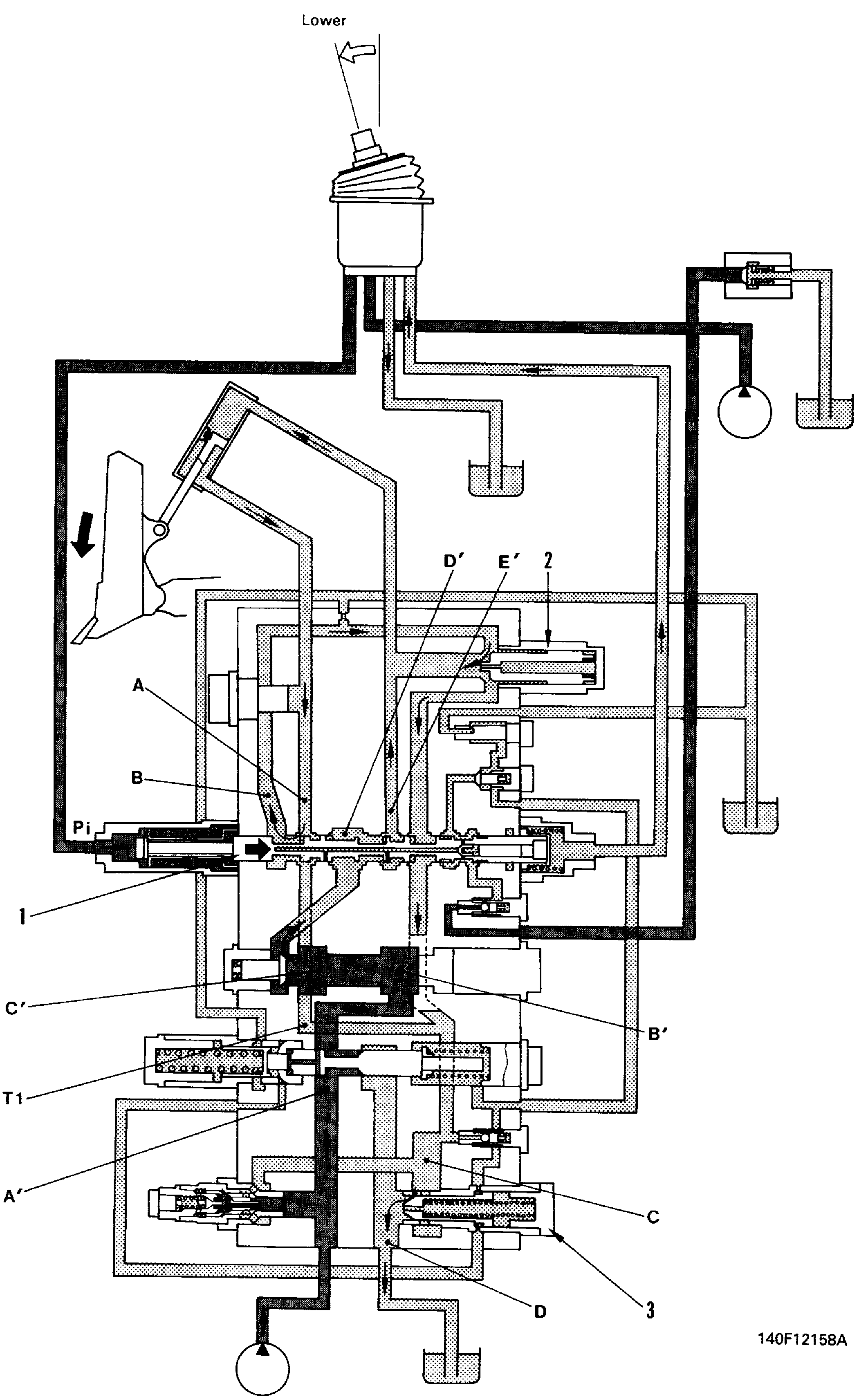
5) The unload valve is balanced by differential pressure △**PLS**, which is the difference in pressure between the pressures of chamber **A'** and chamber **J**, in other words, meter-in pressure loss (ports **A** – **K**) and the load of spring (6). At this balanced position, the unload oil flow of the unload valve is determined.
The portion of the oil discharged from the pump which is not unloaded is supplied to the tilt cylinder. The meter-in pressure loss is determined by the area of opening of spool (1), so an amount of oil that matches the area of opening of spool (1) flows to the tilt cylinder, regardless of the load pressure.



140F12157

★ Throttle **d2** is specially assembled to the tilt valve to adjust the oil flow.

(2) Meter-out control using downward movement of blade under own weight (blade control lever at LOWER)



140F12158A

- If the blade moves down under its own weight, the oil flow of return oil from cylinder is controlled by the area of the opening of main spool (1).

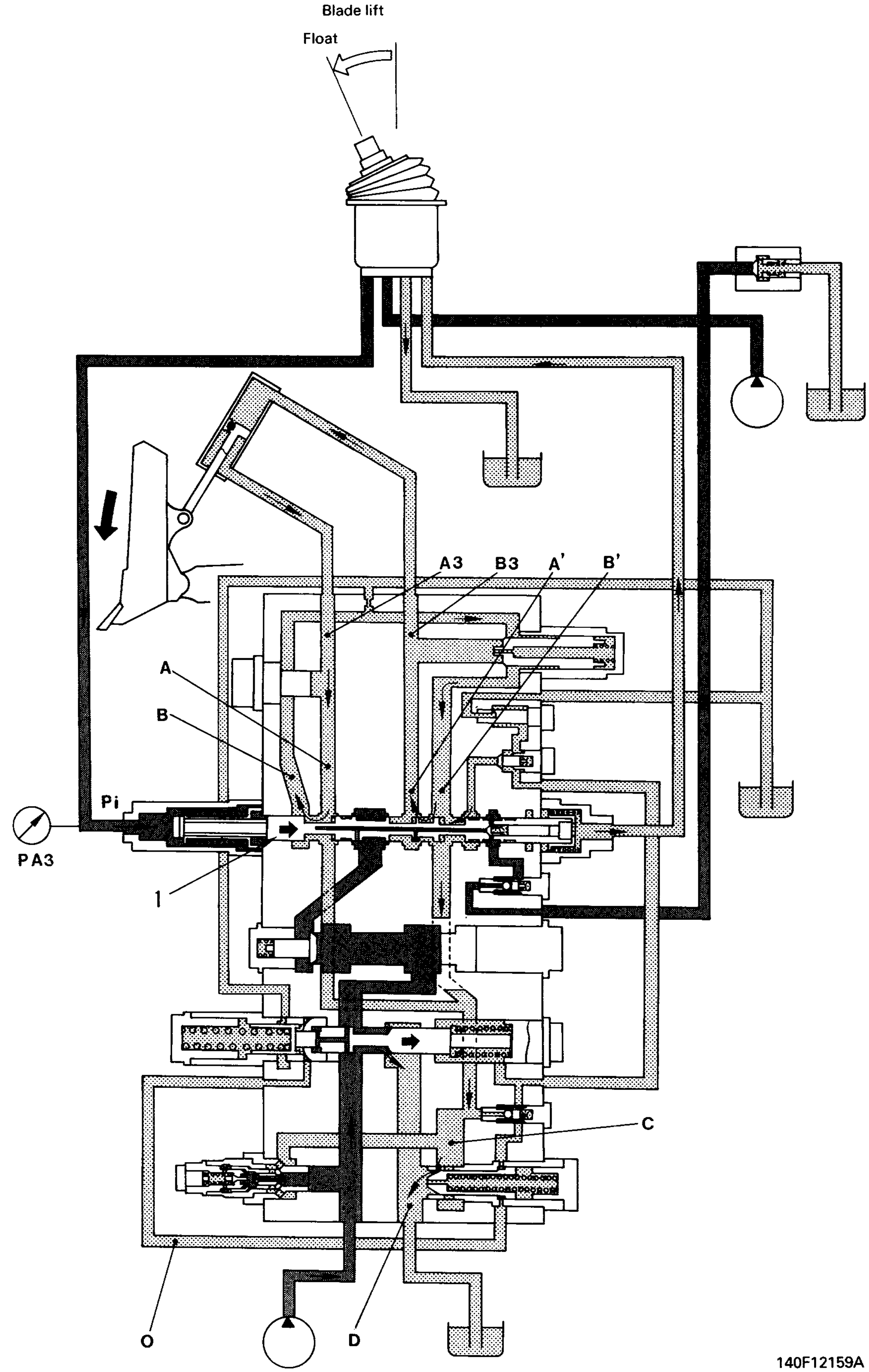
- Because of back-pressure valve (3), a back pressure that matches the oil flow is formed in drain circuit **T1** of the control valve, so oil is supplied to the cylinder bottom from suction valve (2) to prevent a vacuum from forming in the circuit.

1) When the spool port is opened by PPC output pressure **Pi**, because of the downward movement of the blade, the oil at the cylinder head passes through ports **A**, **B**, **C**, and **D**, and is drained to the tank. The flow of return oil from the lift cylinder is throttled by the area of the opening between ports **A** and **B**, so the lowering speed is controlled.

2) When the blade moves down under its own weight, there is no **LS** pressure, so the back pressure is formed in chamber **C** in accordance with the characteristics of back-pressure valve (3). The oil flowing from the cylinder head flows from the drain circuit, passes through suction valve (2), and is supplied to the bottom end of the cylinder.
   The oil discharged from the pump passes through ports **A'**, **B'**, **C'**, **D'**, and **E'**, and is supplied to the cylinder bottom.

★ For details of the vacuum prevention function, see 5. UNLOAD VALVE PRESET SYSTEM.

(3) Meter-out control using downward movement of blade under own weight (blade control lever at FLOAT)



140F12159A

- When the lift valve is at FLOAT, the cylinder port and drain port are connected to put the circuit in a no–load condition.
- When the lift valve is in the FLOAT condition, the pump circuit and cylinder ports **A3** and **B3** are separated so that the control valve can carry out other operations.

1) With the control lever at the FLOAT position, when pressure **PA3** reaches 3.4 MPa (35 kg/cm^2), lift spool (1) is at the maximum stroke FLOAT position.

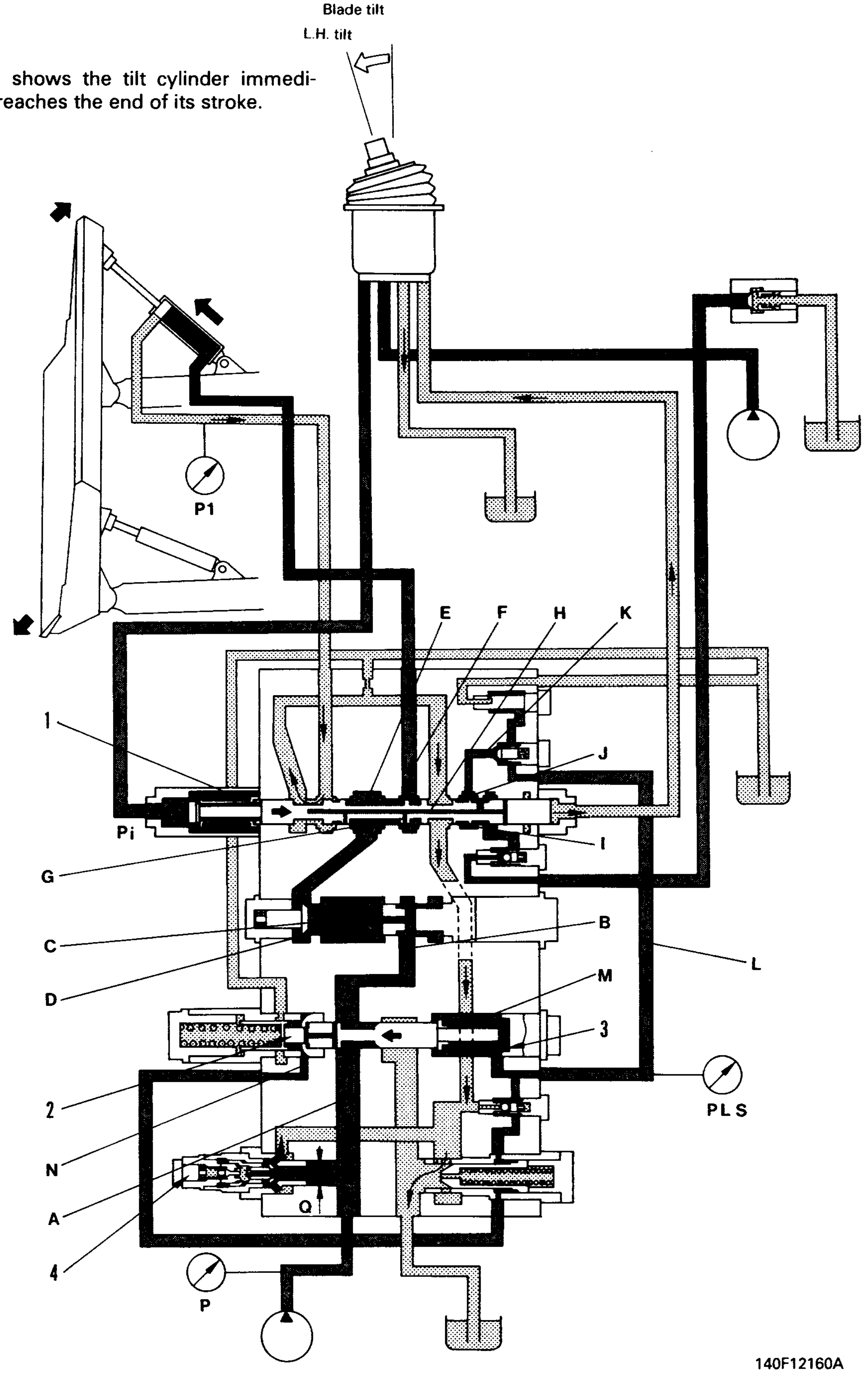
2) In this condition, ports **A3** and **B3** and **LS** circuit **O** are all connected to the drain circuit, so there is no load on the lift cylinder.

3) If the cylinder is driven by the weight of the blade, the oil passes from port **A3** through ports **A**, **B**, **B1**, and **A1**, and the rest of the oil passes through ports **C** and **D**, and is drained. When this happens, the oil flow is throttled by the area of opening between ports **A** and **B** of the spool, and the cylinder speed is controlled.

4) Pump circuit chamber **E** and ports **A3** and **B3** are separated, and the pump pressure is formed, so it is possible to carry out compound operations with the other control valves.

3. At relief

★ The diagram shows the tilt cylinder immediately after it reaches the end of its stroke.



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(1) If spool (1) moves to the right because of PPC output pressure **Pi**, the oil discharged from the pump flows through ports **A**, **B**, **C**, **D**, **E**, and **F**, and flows to the bottom end of the tilt cylinder.
When this happens, the pressure in chamber **F** is sent through **LS** sensing hole **G** through ports **H**, **I**, **J**, **K**, and **L**, and goes to ports **M** and **N** of unload spool (2).

(2) If the cylinder reaches the end of its stroke and it stops, the condition becomes **P** ≒ **P1** ≒ **PLS**, and unload spool (2) is pushed completely to the left by the load of spring (3), so the unload oil flow becomes 0.

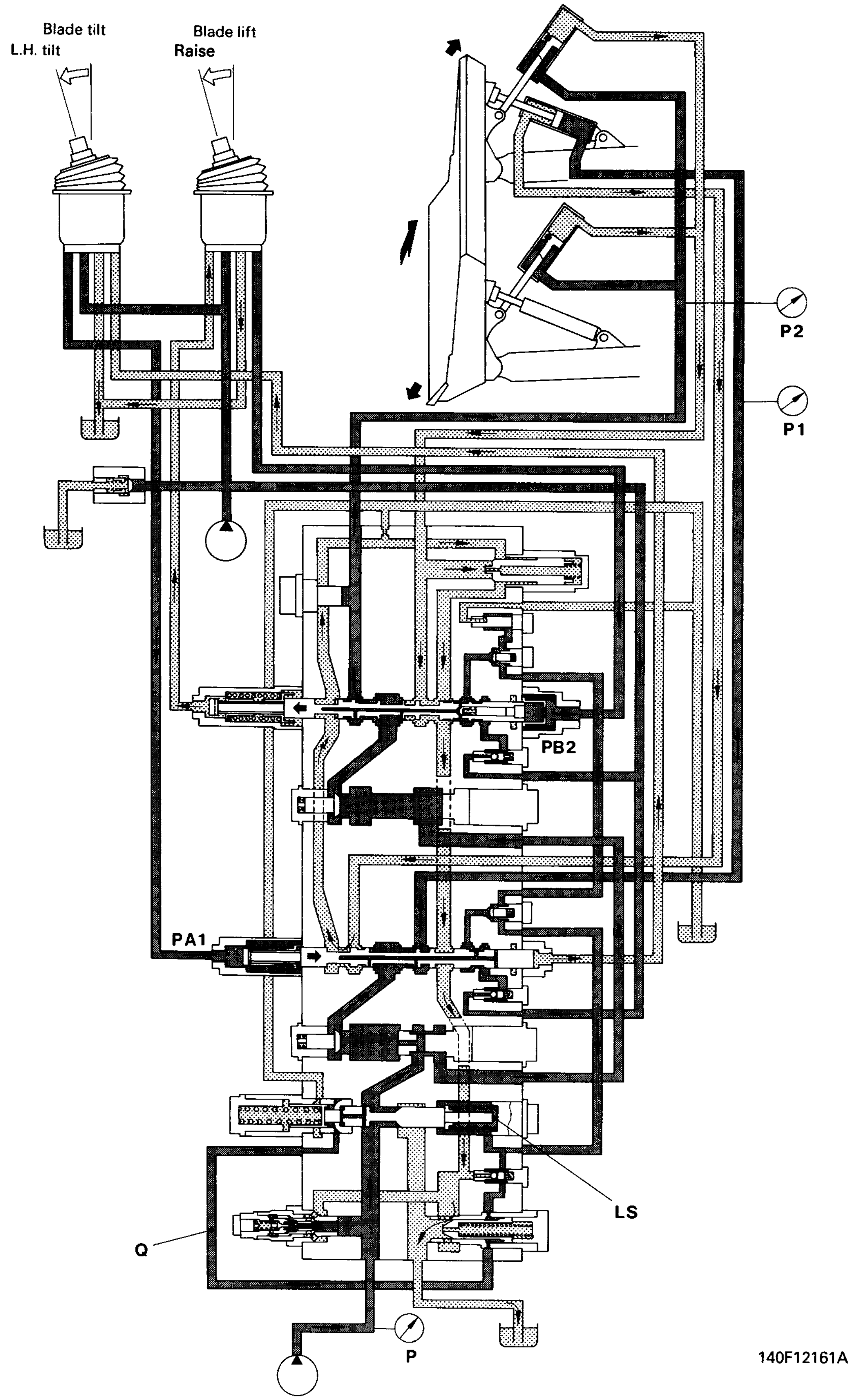
(3) In this condition, all the oil discharged by the pump tries to flow to the cylinder, but the cylinder piston is stopped, so the pressure in the pump circuit rises.

(4) If the pump pressure reaches the cracking pressure, relief valve (4) is actuated, so the maximum pressure in the pump circuit is set.

(5) Throttle **Q** of relief valve (4) is used to keep the peak pressure to the minimum.

4. Compound operations

★ The diagram shows the lift valve + tilt valve.



- It consists of a parallel circuit, so when compound operations are carried out, the oil flow is divided according to the size of each spool opening.

(1) The tilt valve and lift valve spools are actuated by PPC output pressure **PA1**, **PB2** and each spool is balanced at a position that matches its pilot pressure.

(2) When pressure **P1** ≦ pressure **P2**
Lift valve load pressure **P2** is sent to the unload valve **LS** chamber through **LS** passage **O**.

1) When unload valve does not reach fully closed position
When the discharge flow of oil from the pump is greater than the total of the oil flow demanded by the tilt valve and lift valve, an oil flow that matches the opening of the spool flows to both the tilt valve and lift valve.

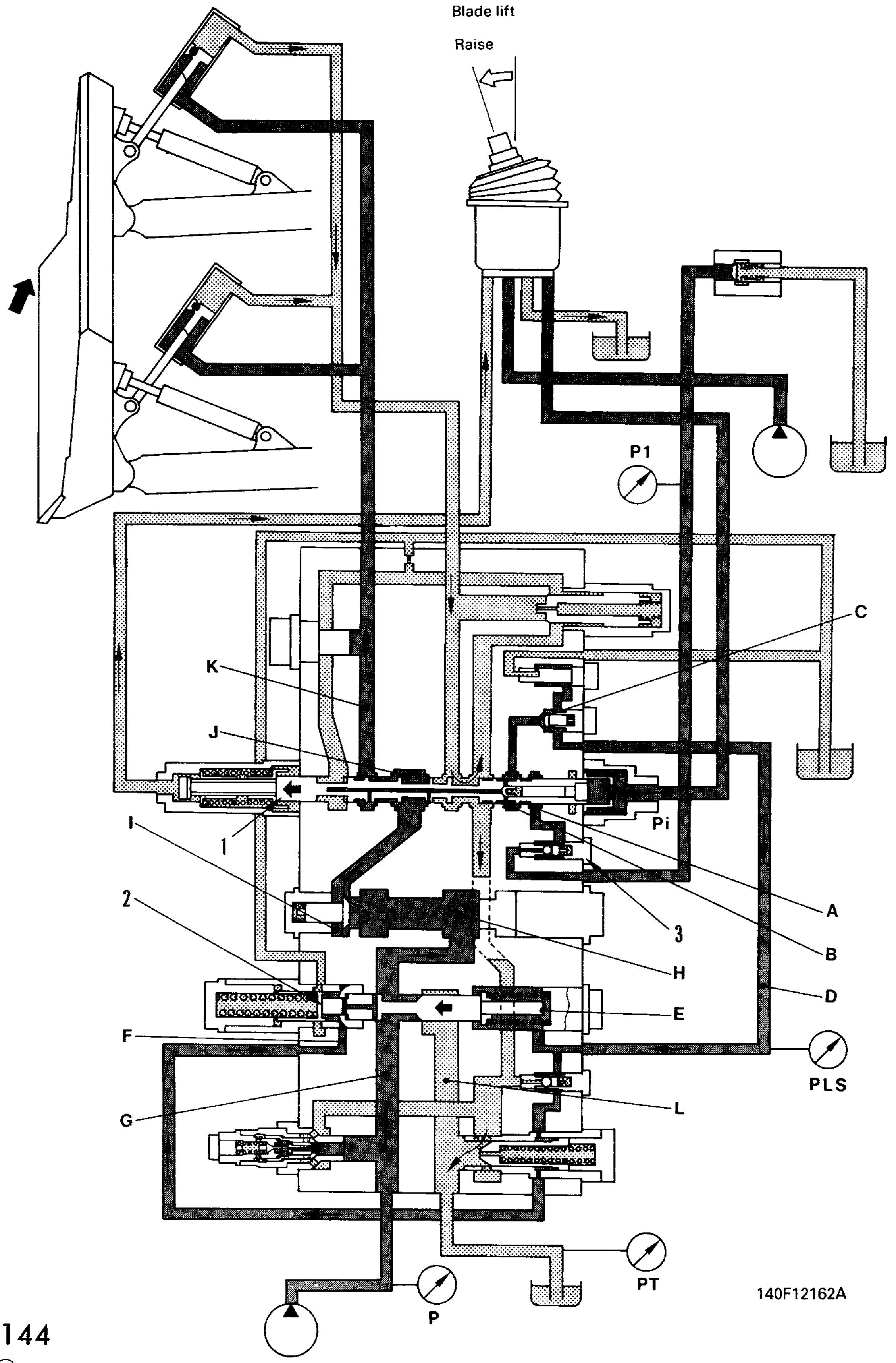
2) When unload valve is at fully closed position (there is no unload oil flow)
When the discharge flow of oil from the pump is smaller than the total of the oil flow demanded by the tilt valve and lift valve, the flow of oil to the tilt valve and lift valve is divided according to **P** — **P1** differential pressure and **P** — **P2** differential pressure. In other words, more oil flows to **P2** where the load is small.

★ In cases where the blade is raised in the air and the tilt valve and lift valve (for raise) are operated at the same time, the tilt valve load pressure is smaller than the lift valve load pressure, so the flow of oil to the tilt valve is given priority. In addition, the oil flow demanded by the tilt valve is smaller, so the condition is just as if priority was given to the oil flow for the tilt valve.

(3) When pressure **P1** = pressure **P2**
P — **P1** = **P** — **P2**, so an oil flow proportional to the size of the spool opening is distributed to each spool.

5. Unload valve preset system

(1) Lift valve



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- The response is improved at blade RAISE.

- At blade LOWER, all the oil discharged from the pump is supplied to the bottom end of the lift cylinder to prevent any vacuum from forming at the cylinder bottom.

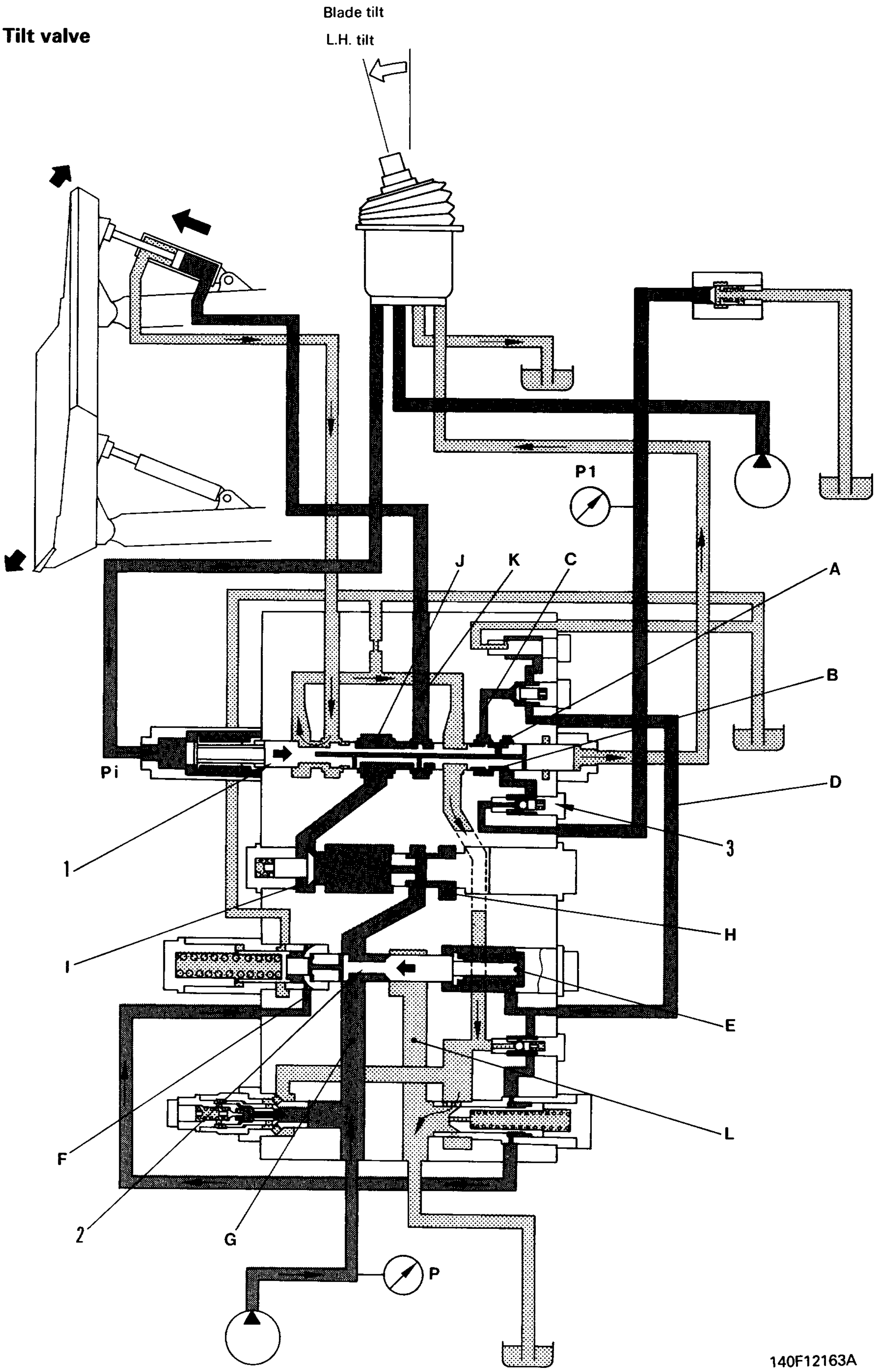
1) When spool (1) is switched by PPC output pressure **Pi**, basic pressure **P1** of the PPC valve goes through preset check valve (3) into the **LS** passage through ports **A**, **B**, **C**, **D**, **E**, and **F**. (Preset pressure: Min. 3.4 MPa (35 kg/cm^2))

2) Immediately after the spool is switched, pump pressure **P** is approx. 0.5 – 1.0 MPa (5 – 10 kg/cm^2), so unload spool (2) is pushed to the left. The opening between ports **G** and **L** is closed, and the oil discharged from the pump all flows through ports **G**, **H**, **I**, **J**, and **K** and is supplied to the lift cylinder, so the response is improved.

3) When the lift cylinder pressure rises and goes above the preset pressure, preset check valve (3) closes, so unload spool (2) returns to the original △**PLS** control.

4) In cases as with blade LOWER where the flow of oil from the pump cannot keep up with the blade lowering speed, if the load pressure is not reached, unload spool (2) is kept in the condition in Item 2) to make it possible to prevent a vacuum from forming in the cylinder.

(2) Tilt valve



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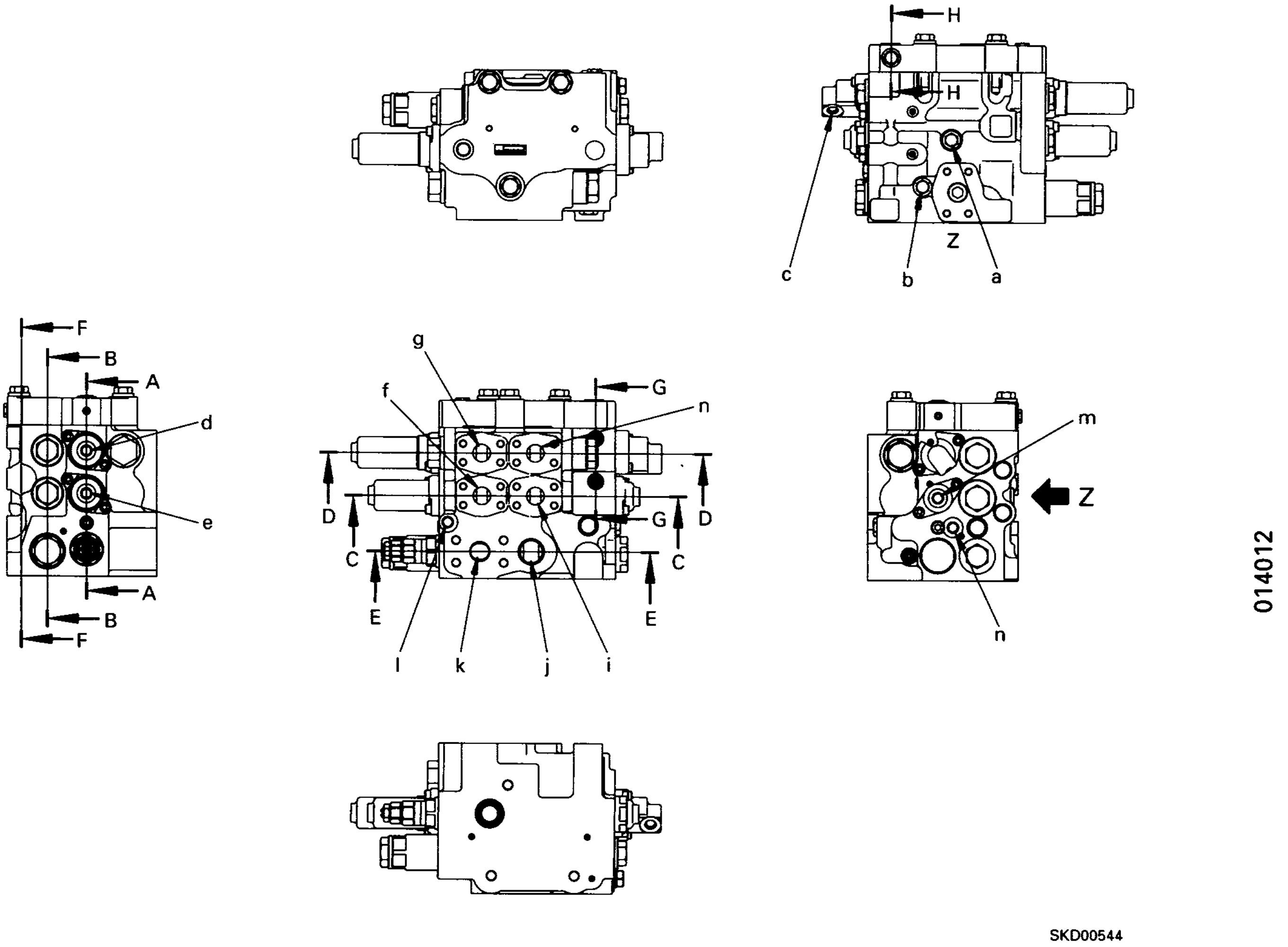
- The pressure is improved at blade TILT.

1) When spool (1) is switched by PPC output pressure **Pi**, basic pressure **P1** of the PPC valve goes through preset check valve (3) into the **LS** passage through ports **A**, **B**, **C**, **D**, **E**, and **F**. (Preset pressure: Min. 3.4 MPa (35 kg/cm^2)
2) Immediately after the spool is switched, pump pressuer **P** is approx. 0.5 – 1.0 MPa (5 – 10 kg/cm^2), so unload spool (2) is pushed to the left. The opening between ports **G** and **L** is closed, and the oil discharged from the pump all flows through ports **G**, **H**, **I**, **J**, and **K** and is supplied to the tilt cylinder, so the response is improved.
3) When the tilt cylinder pressure rises and goes above the preset pressure, preset check valve (3) closes, so unload spool (2) returns to the original △**PLS** conrol.

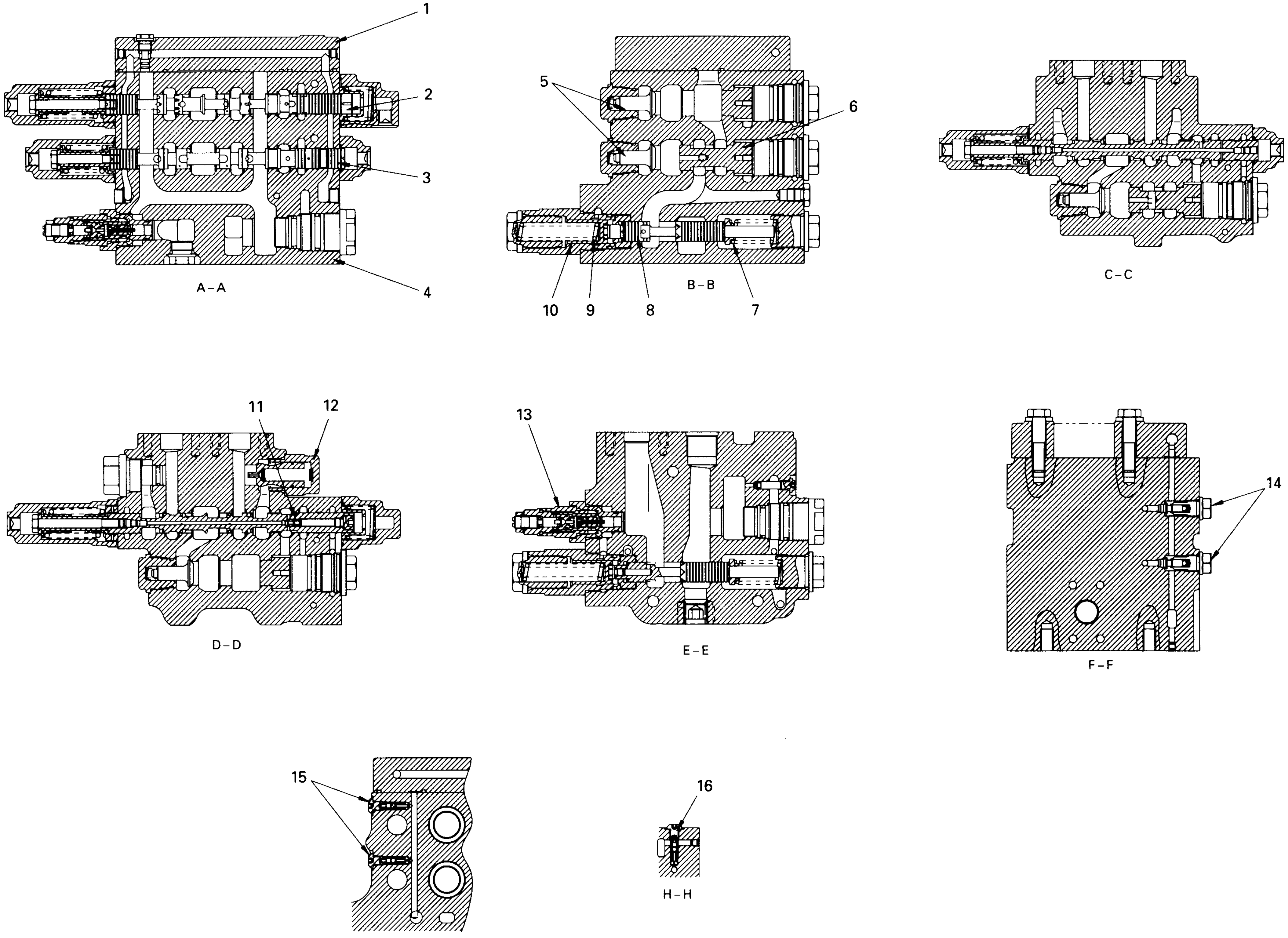
MAIN CONTROL VALVE

(2-SPOOL VALVE: BLADE LIFT + TILT)

D65E-12 60948 and up
D65P-12 60891 and up



a. Port **PC** (pump pressure plug)
b. Port **PLSC** (LS pressure plug)
c. Port **PB2** (from PPC valve)
d. Port **PA2** (from PPC valve)
e. Port **PA1** (from PPC valve)
f. Port **A1** (to tilt cylinder bottom)
g. Port **A2** (to lilt cylinder head)
h. Port **B2** (to lilt cylinder bottom)
i. Port **B1** (to tilt cylinder head)
j. Port **T** (to tank)
k. Port **P** (from pump)
l. Port **TS** (to tank)
m.Port **PB1** (from PPC valve)
n. Port **Pi** (from PPC pump)



A–A B–B C–C

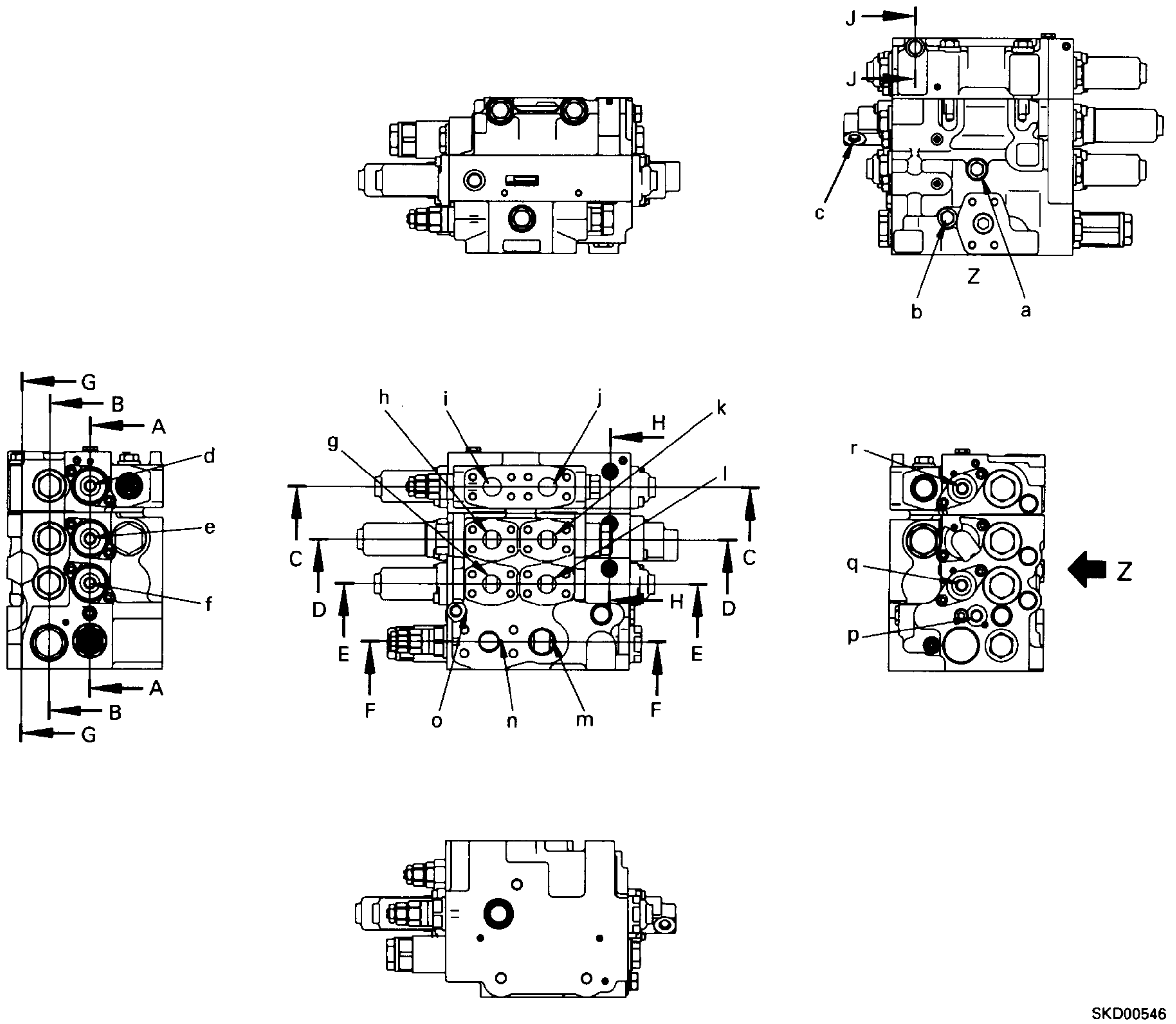
D–D E–E F–F

G–G H–H

1. Cover
2. Lift spool
3. Tilt spool
4. Valve body
5. Load check valve
6. Orifice
7. Unload spring
8. Unload valve
9. Cancel spring
10. Cancel piston
11. Check valve (built into spool)
12. Suction valve
13. Main relief valve
14. LS check valve
15. Preset check valve
16. LS bypass valve

(2 + 1 SPOOL VALVE: RIPPER LIFT + BLADE LIFT + TILT)

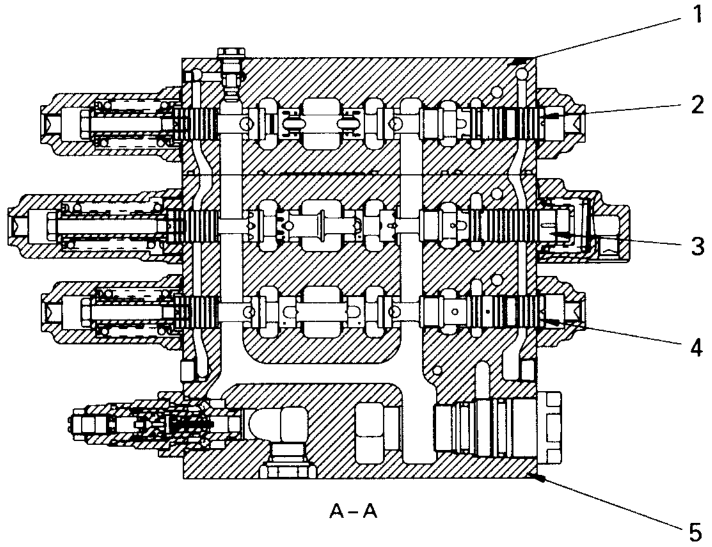
D65-12 60948 and up



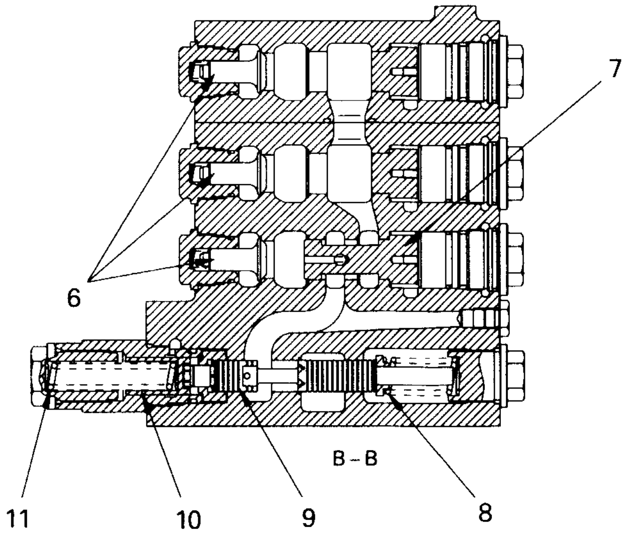
SKD00546

014012

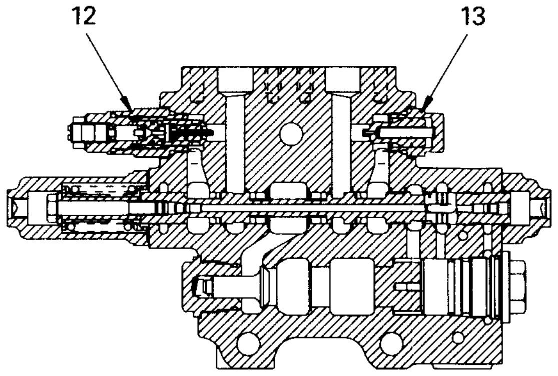
a. Port **PC** (pump pressure plug)
b. Port **PLSC** (LS pressure plug)
c. Port **PB2** (from PPC valve)
d. Port **PA3** (from PPC valve)
e. Port **PA2** (from PPC valve)
f. Port **PA1** (from PPC valve)
g. Port **A1** (to tilt cylinder bottom)
h. Port **A2** (to lilt cylinder head)
i. Port **A3** (to ripper cylinder bottom)
j. Port **B3** (to ripper cylinder head)
k. Port **B2** (to lift cylinder bottom)
l. Port **B1** (to tilt cylinder head)
m. Port **T** (to tank)
n. Port **P** (from pump)
o. Port **TS** (to tank)
p. Port **Pi** (from PPC pump)
q. Port **PB1** (from PPC valve)
r. Port **PB3** (from PPC valve)



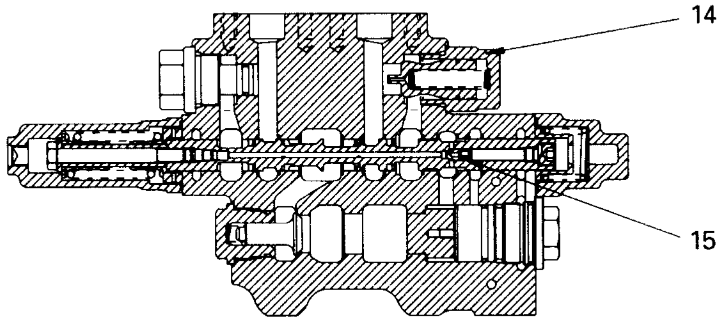
A–A



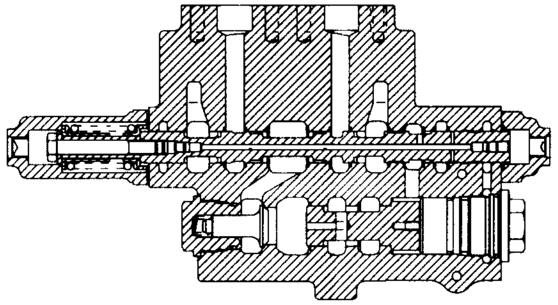
B–B



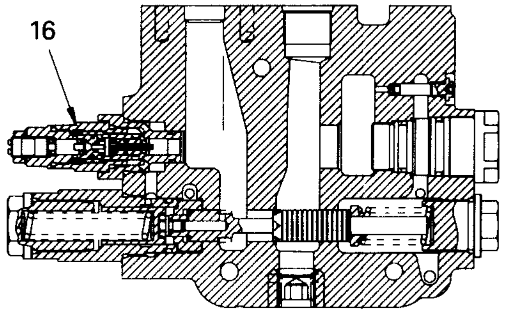
C–C



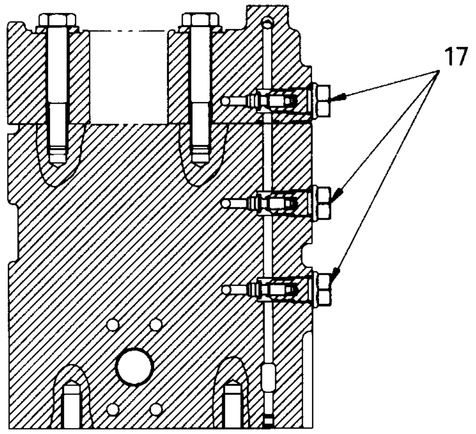
D–D



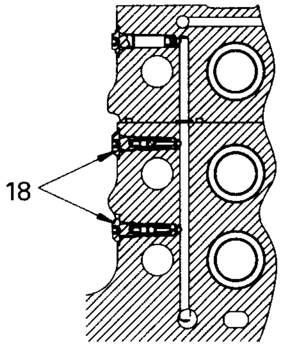
E–E



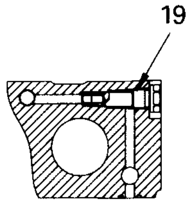
F–F



G–G



H–H



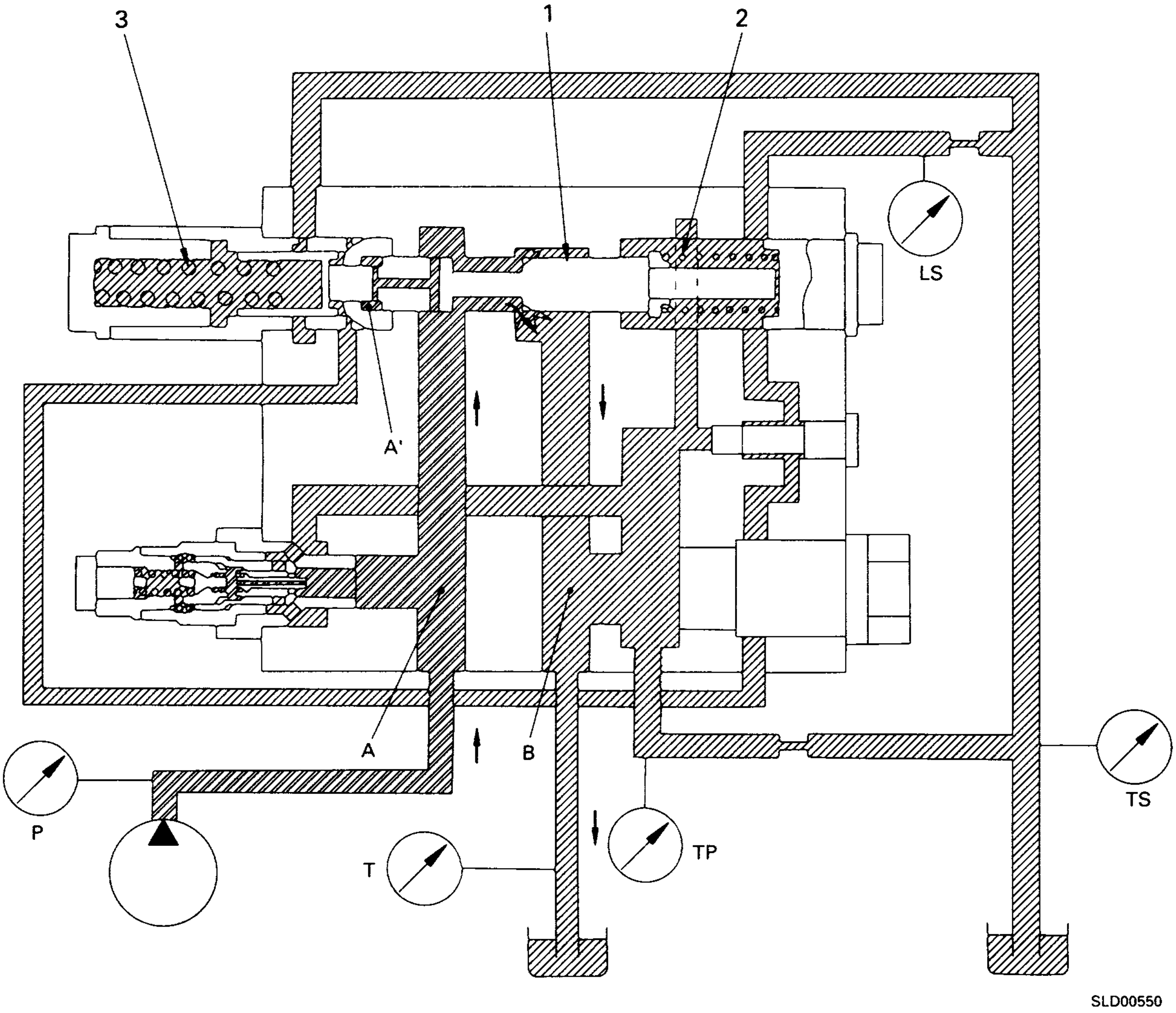
J–J

014012

SKD00547

1. Valve block
2. Ripper spool
3. Lift spool
4. Tilt spool
5. Valve body
6. Load check valve
7. Orifice
8. Unload spring
9. Unload spool
10. Cancel piston
11. Cancel spring
12. Suction safety valve
13. Suction valve
14. Suction valve
15. Check valve (built into spool)
16. Main relief valve
17. LS check valve
18. Preset check valve
19. LS bypass valve

OPERATION OF MAIN CONTROL VALVE



FUNCTION

- When the work equipment control levers are at HOLD, the oil discharged from the pump is all unloaded, and the pressure loss of the valve is kept below 0.5 MPa (5 kg/cm^2).
  In this way, the pressure loss when the lever is at HOLD is small, so the heat loss is also small.
- Proportional control is carried out by the unload valve, which controls the amount of oil sent to the cylinder to an amount that matches the opening of the spool.
- The unload valve is controlled by the difference in pressure on both sides of the spool, so there is a little change in the oil flow caused by the load pressure. It also provides the function of pressure compensation.

OPERATION

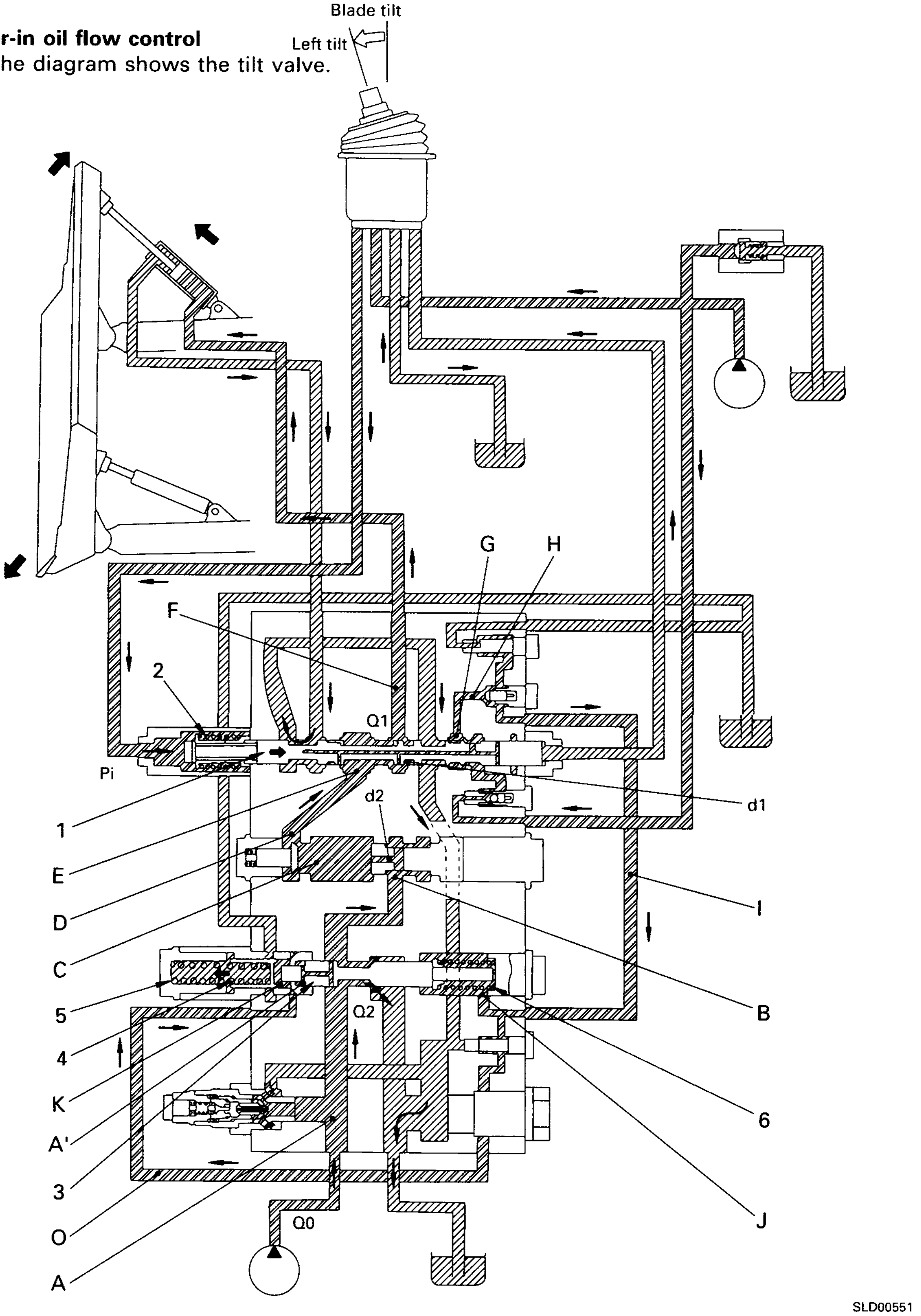
1. At HOLD (unload valve at low setting)

1) When the work equipment spool is at HOLD, **LS** circuit pressure **LS** = seal drain pressure **TS** (hydraulic leak pressure from valve) ≒ 0 MPa (0 kg/cm^2), so unload spool (1) is balanced by the difference in load between load **F2** of spring (3) and load **F1** of spring (2) that is set to oppose pressure **P** which is sent to chamber **A'**.
   In other words, **AO** x **P** = **F1** – **F2** (**AO**: Area receiving pump pressure in chamber **A'**).
2) By making **F1** – **F2** smaller, it is possible to make pump pressure **P** smaller.
   When this is done, the area of the opening between ports **A** and **B** is determined, so the loss of pressure from **A** to **B** (**P** – **T**) can be kept more or less constant regardless of back pressure **Tp** between ports **A** and **B**.

2. Control of oil flow (unload valve at high setting) (Lift valve, tilt valve, ripper valve)

(1) Meter-in oil flow control

★ The diagram shows the tilt valve.



- △**PLS** = Differential pressure between ports **A** and **J** = 1.8 – 2.9 MPa (18 – 30 kg/cm^2)
- △**PLS'** = Differential pressure between ports **A** and **F**
- △**PLS** ≒ △ **PLS'**

- Because of the action of the unload valve, an amount of oil that matches the opening of the spool flows to the cylinder. (Proportional control)
- The unload valve is controlled by the difference in pressure on both sides of the spool, so the change in the amount of the oil flow caused by the load pressure is small (pressure compensation).

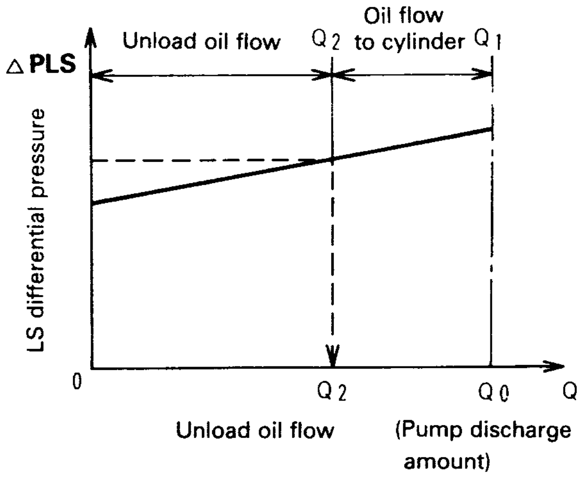
1) If the PPC valve output pressure **Pi** is sent to the spring chamber of spool (1), spool (1) pushes against spring (2) and moves to the right to a position where it balances with the load of the spring.

2) If spool (1) is actuated, the passage between ports **E** and **F** opens, so part of the oil flow discharged from the pump flows through ports **A**, **B**, **C**, **D**, **E**, and **F**, and then into the cylinder.
But in this condition, almost all the oil discharged from the pump is unloaded.

3) At the same time, the pressure in chamber **F** flows into the passage inside the spool from **LS** throttle **d1**, then passes through ports **G**, **H**, and **I**, and is sent to spring chamber **J** of the unload valve. In addition, the pressure in chamber **A** (pump pressure) is sent to chamber **A'** of the unload valve, while the pressure in chamber **J** passes through **LS** passage **O** and is sent to chamber **K**.

4) When the oil in chamber **F** flows and the pressure rises, the pressure in chamber **J** and chamber **K** both rise at the same time. The pressure in chamber **K** pushes against the spring (5) and moves piston (4) to the left. Piston (4) is separated from unload spool(3), so the load of spring (5) does not act on unload spool (3).

5) The unload valve is balanced by differential pressue △ **PLS**, which is the difference in pressure between the pressure of chamber **A'** and chamber **J**, in other words, metre-in pressuer loss (ports **A** – **K**) and the load of spring (6). At this balanced position, the unload oil flow of the unload valve is determined.
The portion of the oil discharged from the pump which is not unloaded is supplied to the tilt cylinder. The Meter-in pressure loss is determined by the area of opening of spool (1), so an amount of oil that matches the area of opening of spool (1) flows to the tilt cylinder, regardless of the load pressure.



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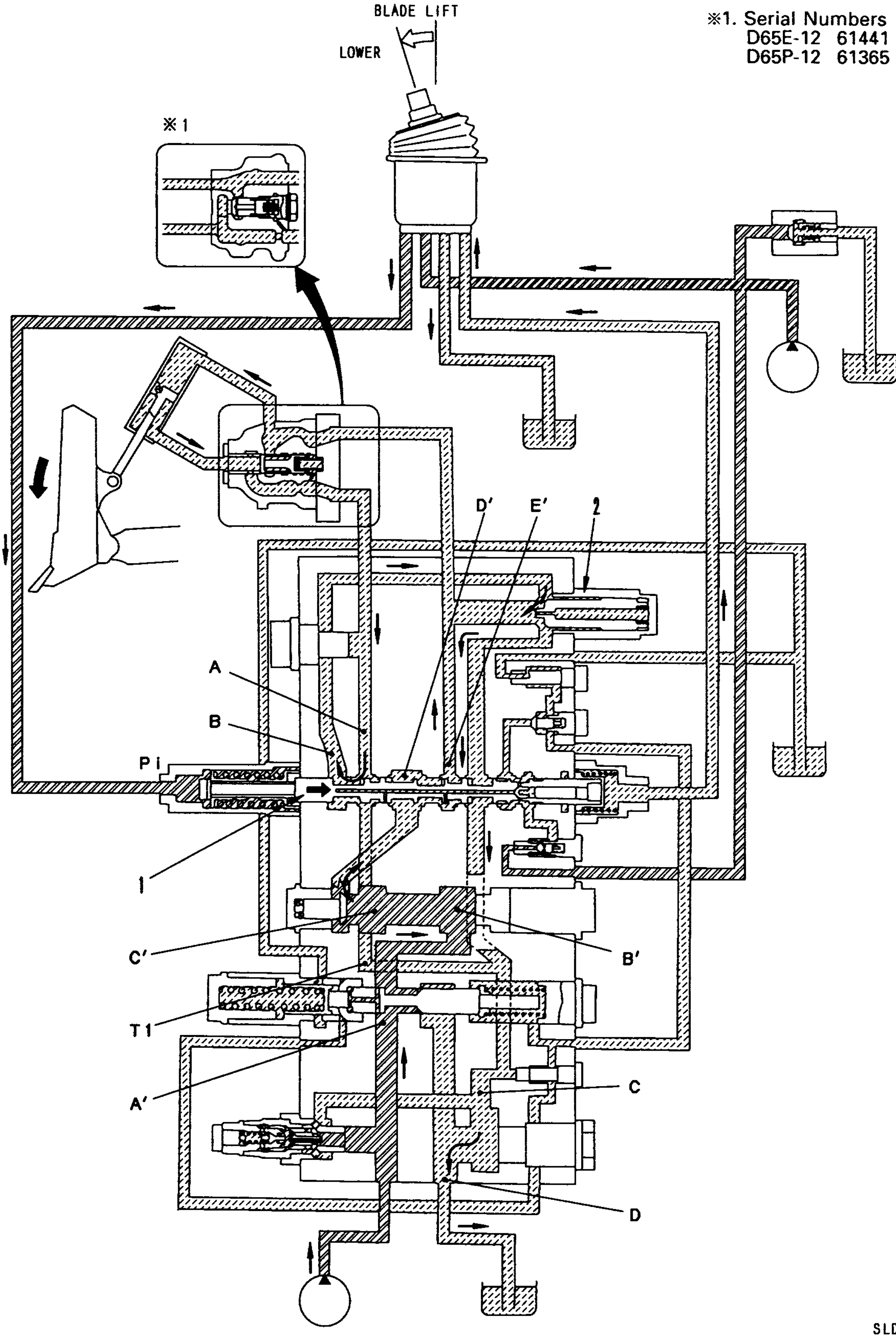
★ Throttle **d2** is specially assembled to the tilt valve to adjust the oil flow.

(2) Meter-out control using downward movement of blade under own weight (blade control lever at LOWER)

※1. Serial Numbers
D65E-12 61441 and up
D65P-12 61365 and up



014012

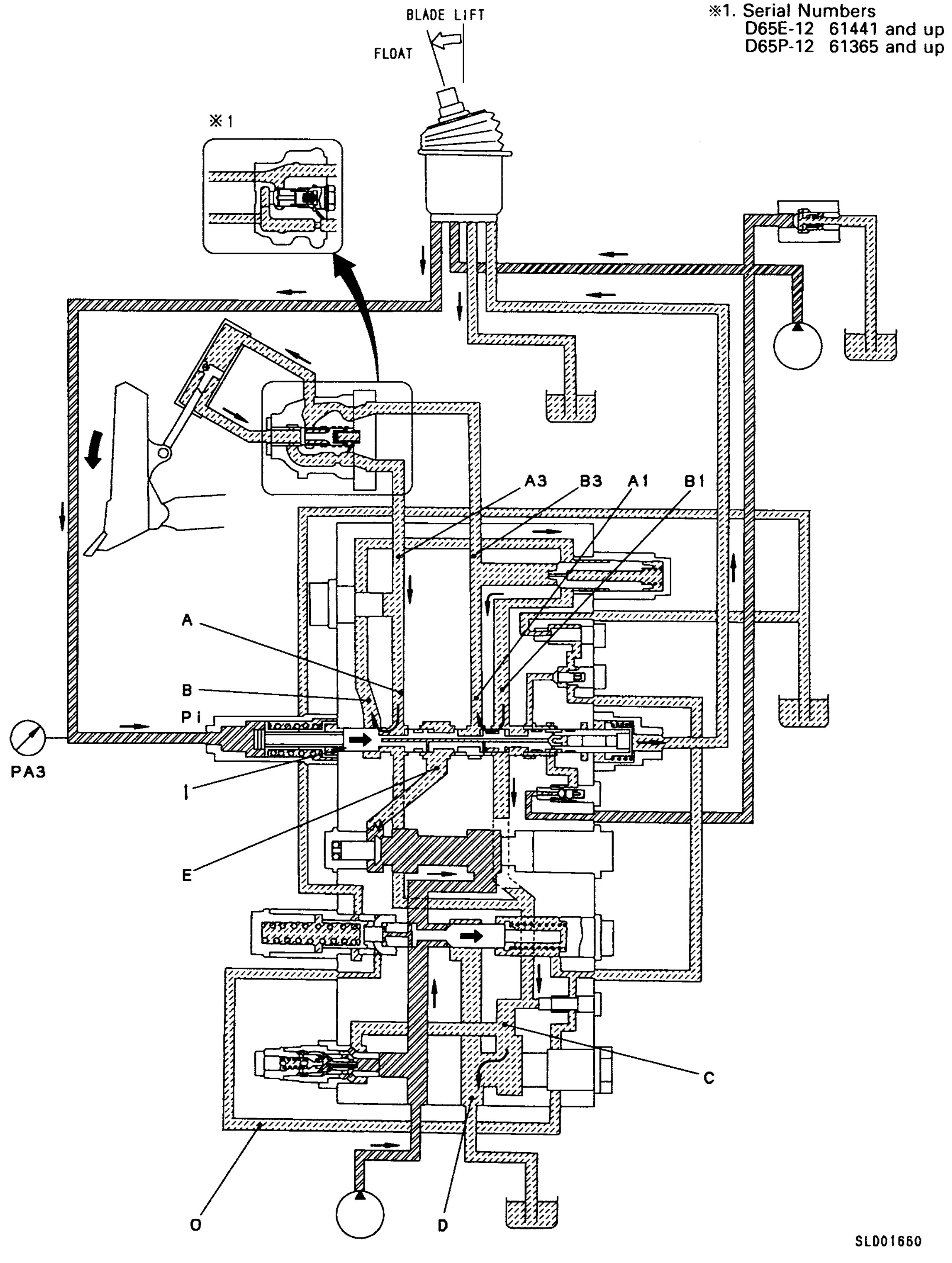
- If the blade moves down under its own weight, the oil flow of return oil from cylinder is controlled by the area of the opening of main spool (1).

1) When the spool port is opened by PPC output pressure **Pi**, because of the downward movement of the blade, the oil at the cylinder head passes through ports **A**, **B**, **C**, and **D**, and is drained to the tank. The flow of return oil from the lift cylinder is throttled by the area of the opening between ports **A** and **B**, so the lowering speed is controlled.

★ For details of the vacuum prevention function, see 5. UNLOAD VALVE PESET SYSTEM.

(3) Meter-out control using downward movement of blade under own weight (blade control lever at FLOAT)

※1. Serial Numbers
D65E-12 61441 and up
D65P-12 61365 and up



014012

- When the lift valve is at FLOAT, the cylinder port and drain port are connected to put the circuit in a no–load condition.
- When the lift valve is in the FLOAT condition, the pump circuit and cylinder ports **A3** and **B3** are separated so that the control valve can carry out other operations.

1) With the control lever at the FLOAT position, when pressure **PA3** reaches 3.4 MPa (35 kg/cm^2), lift spool (1) is at the maximum stroke FLOAT position.

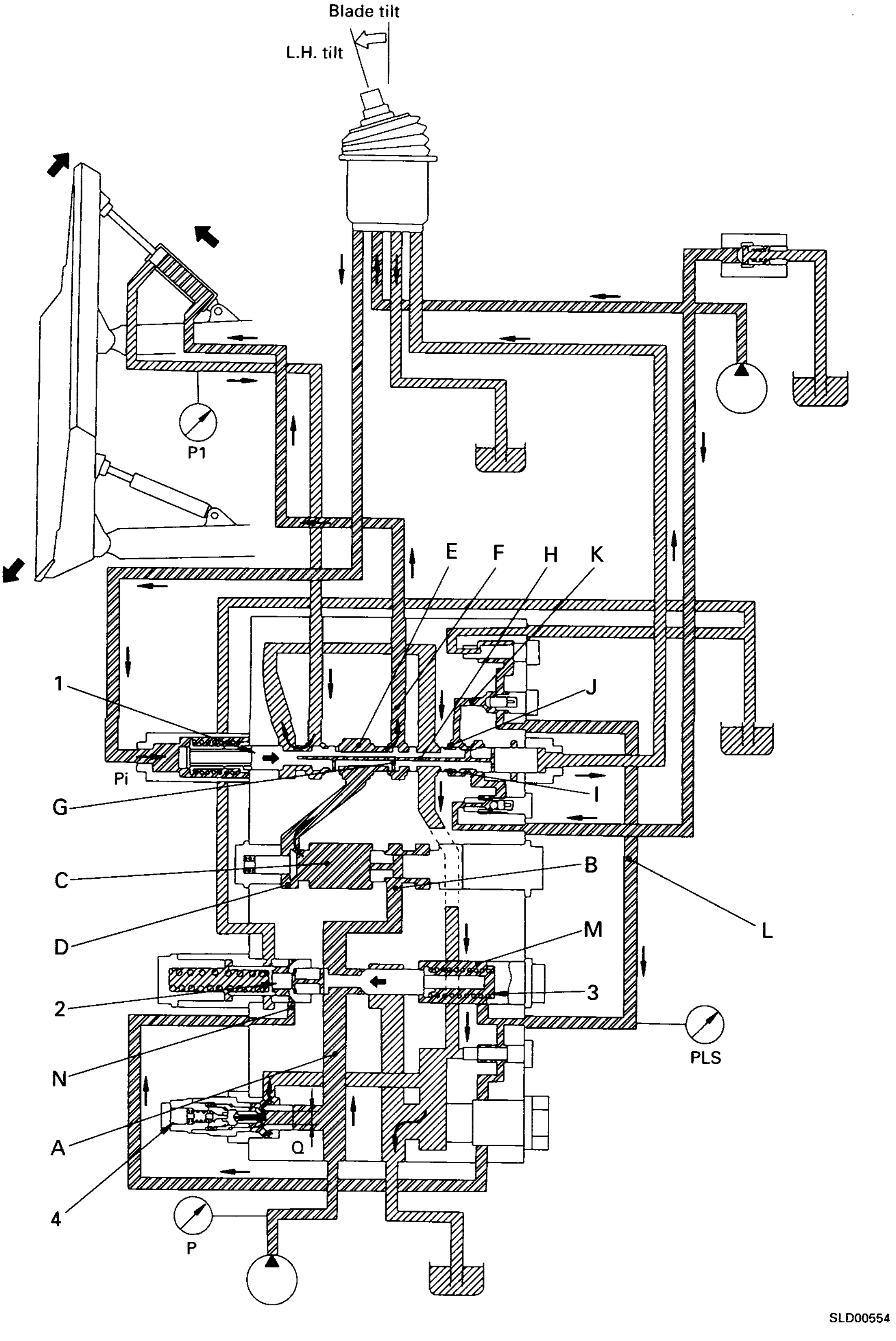
2) In this condition, ports **A3** and **B3** and **LS** circuit **O** are all connected to the drain circuit, so there is no load on the lift cylinder.

3) If the cylinder is driven by the weight of the blade, the oil passes from port **A3** through ports **A**, **B**, **B1**, and **A1**, and the rest of the oil passes through ports **C** and **D** and is drained. When this happens, the oil flow is throttled by the area of opening between ports **A** and **B** of the spool, and the cylinder speed is controlled.

4) Pump circuit chamber **E** and ports **A3** and **B3** are separated, and the pump pressure is formed, so it is possible to carry out compound operations with the other control valves.

3. At relief

★ The diagram shows the tilt cylinder immediately after it reaches the end of its stroke.



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(1) If spool (1) moves to the right because of PPC output pressure **Pi**, the oil discharged from the pump flows through ports **A**, **B**, **C**, **D**, **E** and **F**, and flows to the bottom end of the tilt cylinder.
When this happens, the pressure in chamber **F** is sent through **LS** sensing hole **G** through ports **H**, **I**, **J**, **K** and **L**, and goes to ports **M** and **N** of unload spool (2).

(2) If the cylinder reaches the end of its stroke and it stops, the condition becomes **P** ≒ **P1** ≒ **PLS**, and unload spool (2) is pushed completely to the left by the load of spring (3), so the unload oil flow becomes 0.

(3) In this condition, all the oil discharged by the pump tries to flow to the cylinder, but the cylinder piston is stopped, so the pressure in the pump circuit rises.

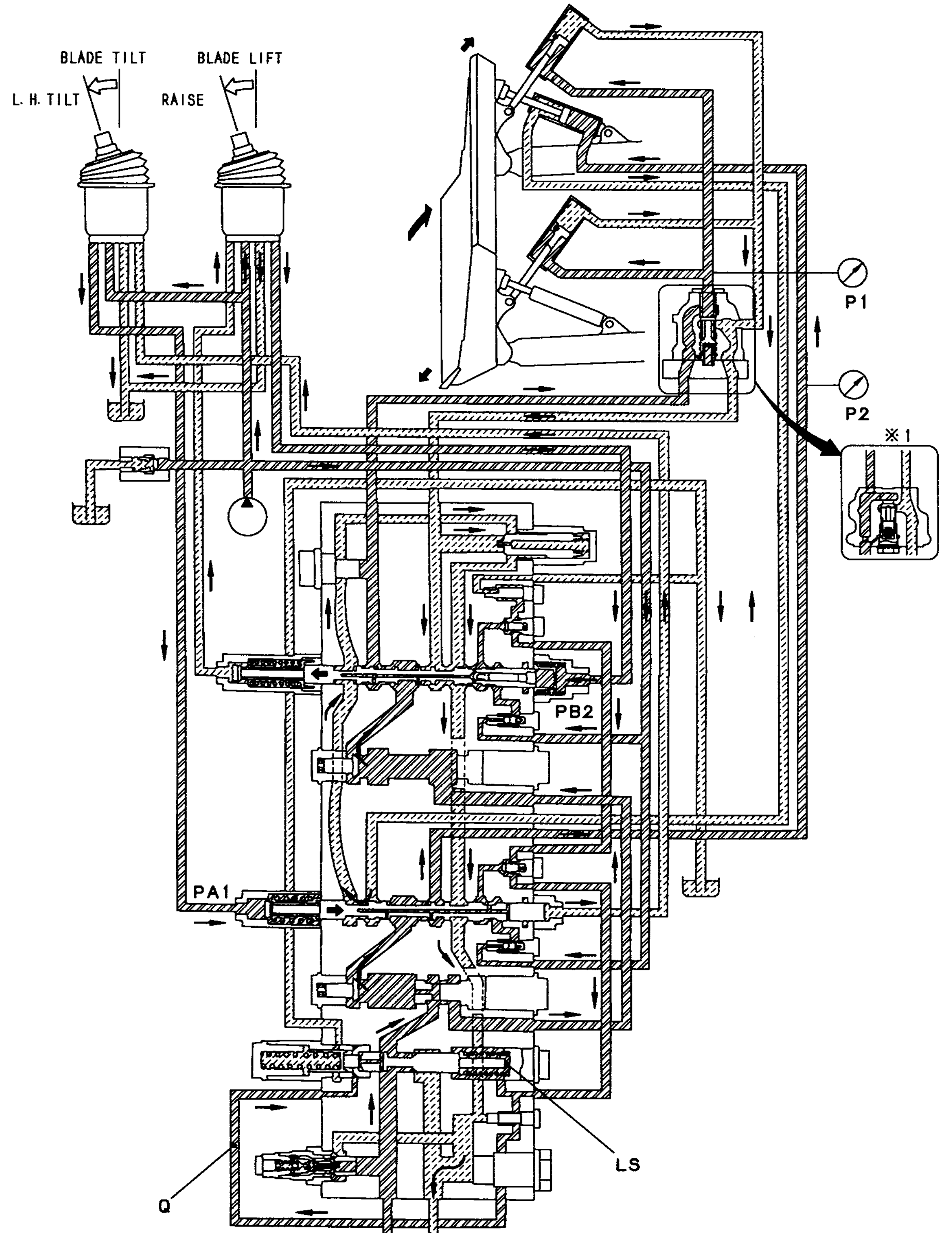
(4) If the pump pressure reaches the cracking pressure, relief valve (4) is actuated, so the maximum pressure in the pump circuit is set.

(5) Throttle **Q** of relief valve (4) is used to keep the peak pressure to the minimum.

4. Compound operations

★ The diagram shows the lift valve + tilt valve.

※1. Serial Numbers
D65E-12 61441 and up
D65P-12 61365 and up



014012

- It consists of a parallel circuit, so when compound operations are carried out, the oil flow is divided according to the size of each spool opening.

(1) The tilt valve and lift valve spools are actuated by PPC output pressure **PA1**, **PB2** and each spool is balanced at a position that matches its pilot pressure.

(2) When pressure **P1** ≦ pressure **P2**
Lift valve load pressure **P2** is sent to the unload valve **LS** chamber through **LS** passage **O**.

1) When unload valve does not reach fully closed position
When the discharge flow of oil from the pump is greater than the total of the oil flow demanded by the tilt valve and lift valve, an oil flow that matches the opening of the spool flows to both the tilt valve and lift valve.

2) When unload valve is at fully closed position (there is no unload oil flow)
When the discharge flow of oil from the pump is smaller than the total of the oil flow demanded by the tilt valve and lift valve, the flow of oil to the tilt valve and lift valve is divided according to **P** – **P1** diffferential pressure and **P** – **P2** differential pressure. In other words, more oil flows to **P2** where the load is small.

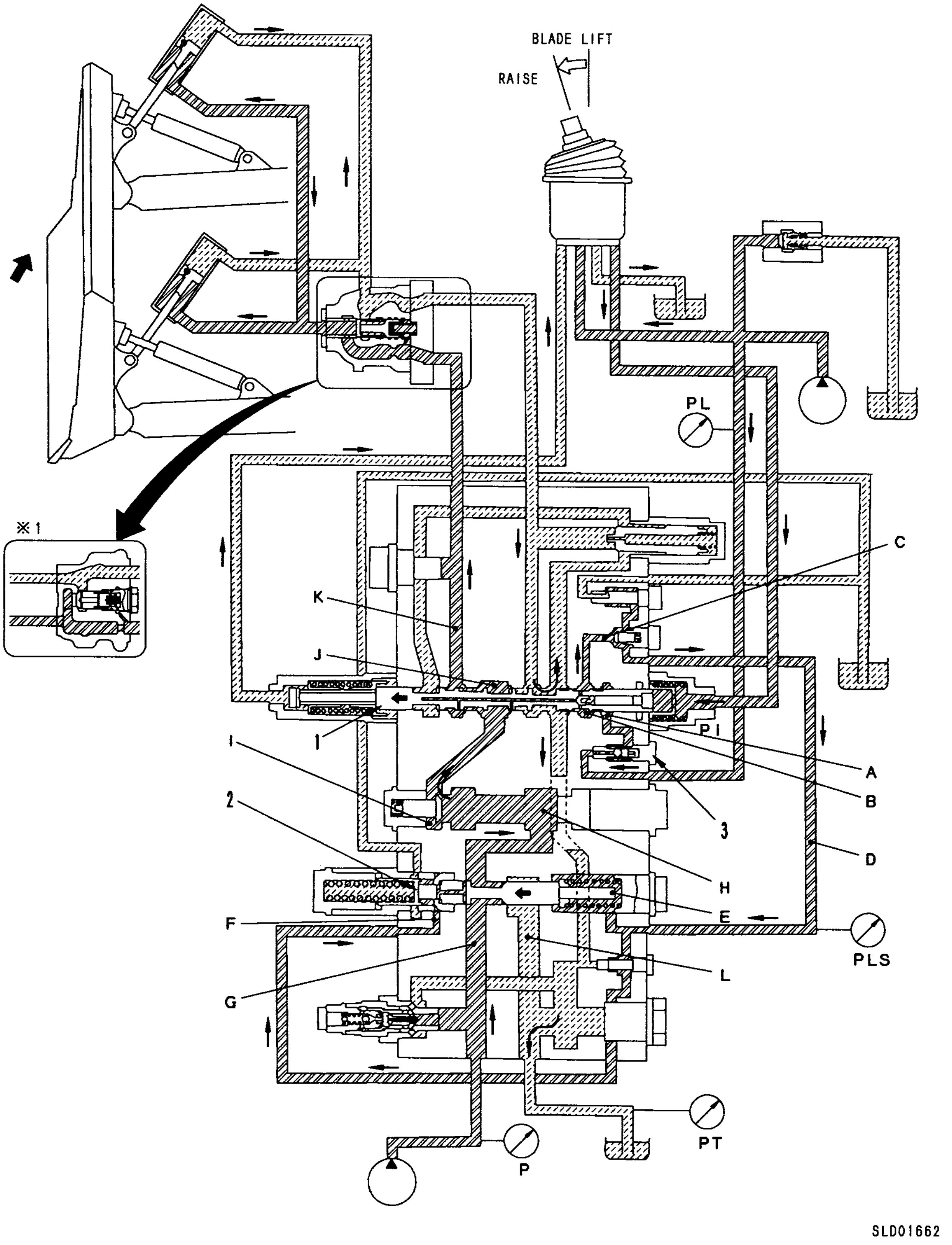
★ In cases where the blade is raised in the air and the tilt valve and lift valve (for raise) are operated at the same time, the tilt valve load pressure is smaller than the lift valve load pressure, so the flow of oil to the tilt valve is given priority. In addition, the oil flow demanded by the tilt valve is smaller, so the condition is just as if priority was given to the oil flow for the tilt valve.

(3) When pressure **P1** = pressure **P2**
P – **P1** = **P** – **P2**, so an oil flow proportional to the size of the spool opening is distributed to each spool.

5. Unload valve preset system

(1) Lift valve

※1. Serial Numbers
D65E-12 61441 and up
D65P-12 61365 and up



- The response is improved at blade RAISE.
- At blade LOWER, all the oil discharged from the pump is supplied to the bottom end of the lift cylinder to prevent any vacuum from forming at the cylinder bottom.

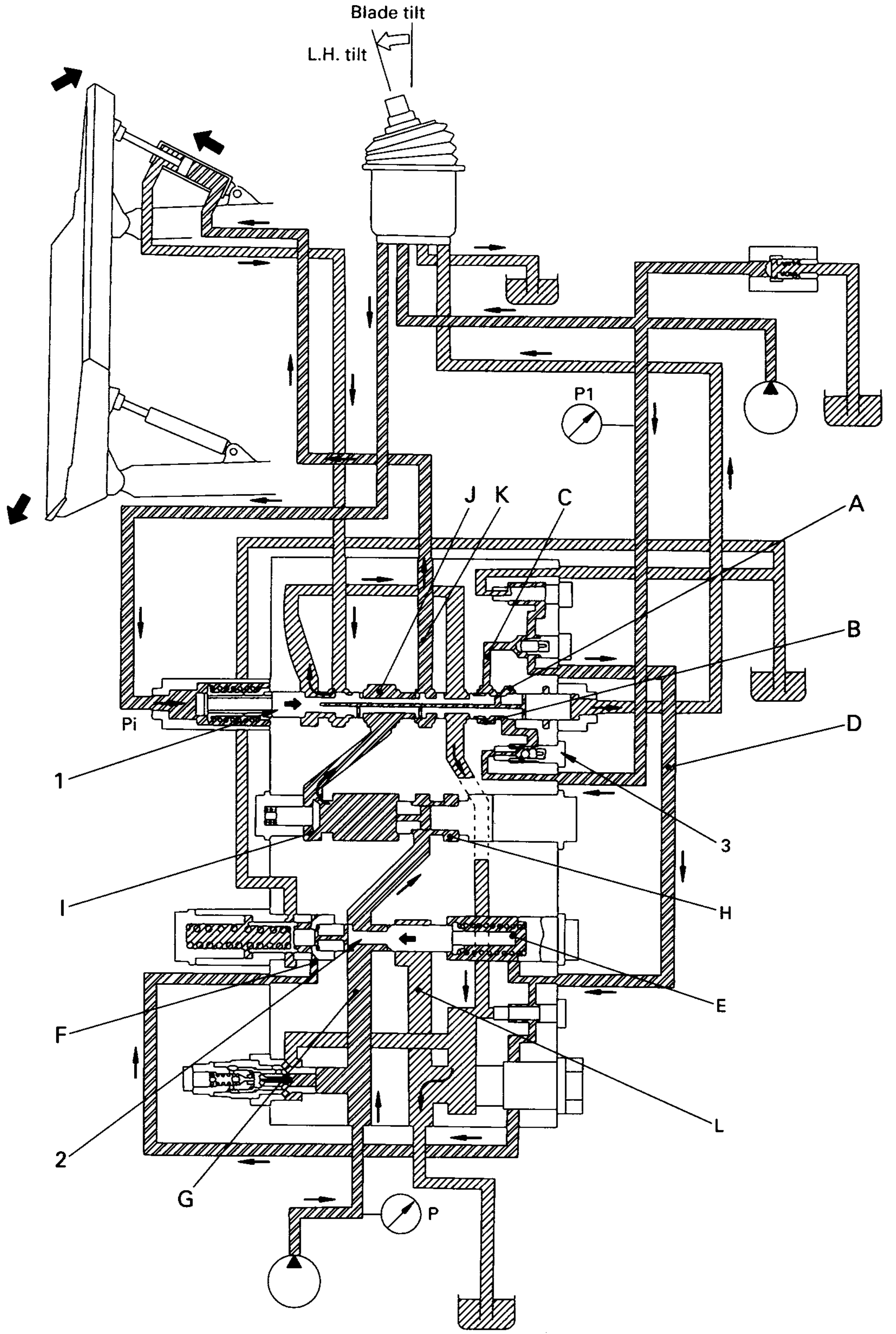
1) When spool (1) is switched by PPC output pressure **Pi**, basic pressure **P1** of the PPC valve goes through preset check valve (3) into the **LS** passage through ports **A**, **B**, **C**, **D**, **E** and **F**.
   (Preset pressure: Min. 3.4 MPa (35 kg/cm^2))

2) Immediately after the spool is switched, pump pressure **P** is approx. 0.5 – 1.0 MPa (5 – 10 kg/cm^2), so unload spool (2) is pushed to the left. The opening between ports **G** and **L** is closed, and the oil discharged from the pump all flows through ports **G**, **H**, **I**, **J** and **K** and is supplied to the lift cylinder, so the response is improved.

3) When the lift cylinder pressure rises and goes above the preset pressure, preset check valve (3) closes, so unload spool (2) returns to the original △**PLS** control.

4) In cases as with blade LOWER where the flow of oil from the pump cannnot keep up with the blade lowering speed, if the load pressure is not reached, unload spool (2) is kept in the condition in Item 2) to make it possible to prevent a vacuum from forming in the cylinder.

(2) Tilt valve



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SLD00557

- The response is improved at blade TILT.

1) When spool (1) is switched by PPC output pressure **Pi**, basic pressure **P1** of the PPC valve goes through preset check valve (3) into the **LS** passage through ports **A**, **B**, **C**, **D**, **E** and **F**.
   (Preset pressure: Min. 3.4 MPa (35 kg/cm^2))

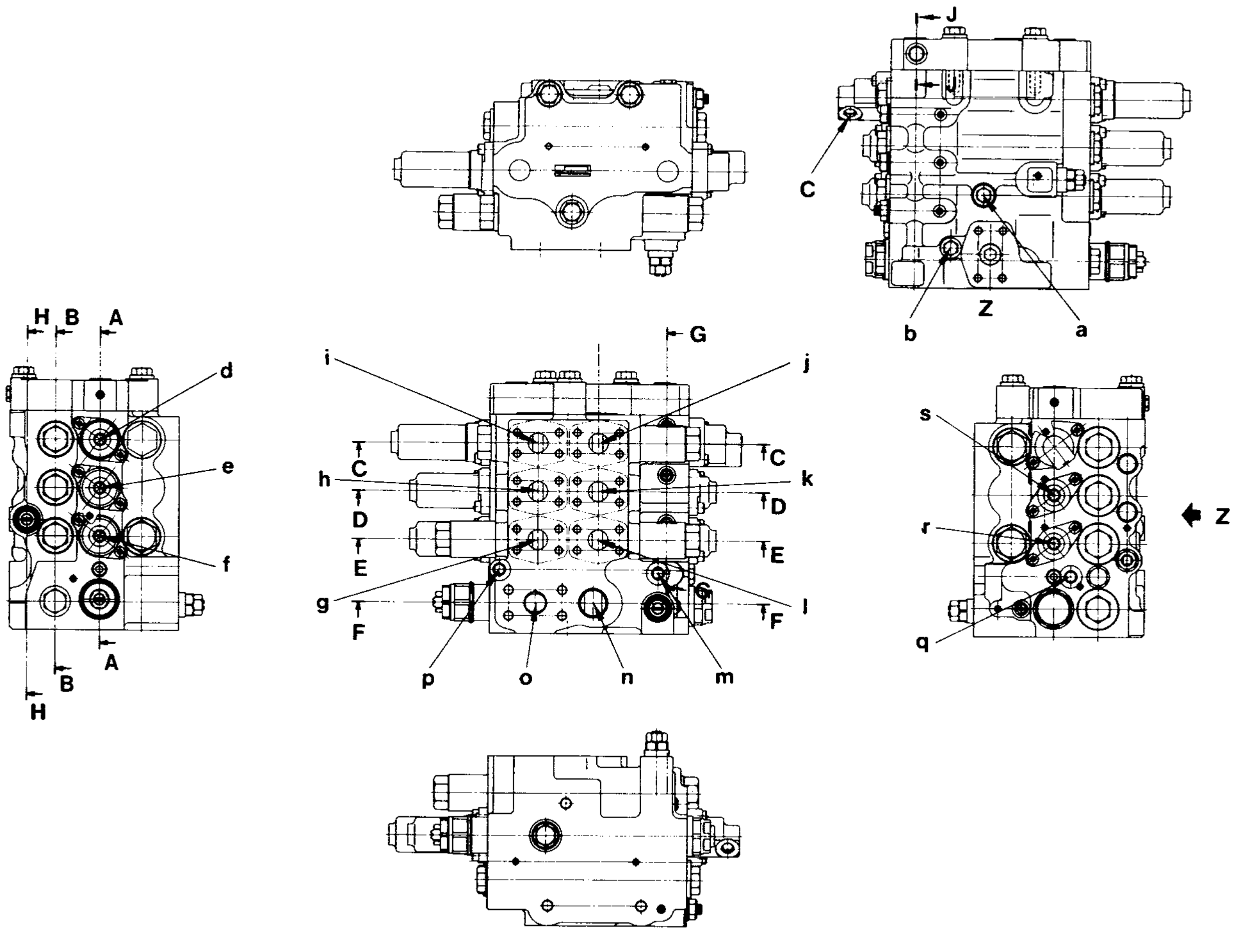
2) Immediately after the spool is switched, pump pressure **P** is approx. 0.5 – 1.0 MPa (5 – 10 kg/cm^2), so unload spool (2) is pushed to the left. The opening between ports **G** and **L** is closed, and the oil discharged from the pump all flows through ports **G**, **H**, **I**, **J**, and **K** and is supplied to the tilt cylinder, so the response is improved.

3) When the tilt cylinder pressure rises and goes above the preset pressure, preset check valve (3) closes, so unload spool (2) returns to the original △**PLS** control.

MAIN CONTROL VALVE

(3-SPOOL VALVE: BLADE LIFT + TILT + STEERING)

D65EX-12 60001 – 60941
D65PX-12 60001 – 60914



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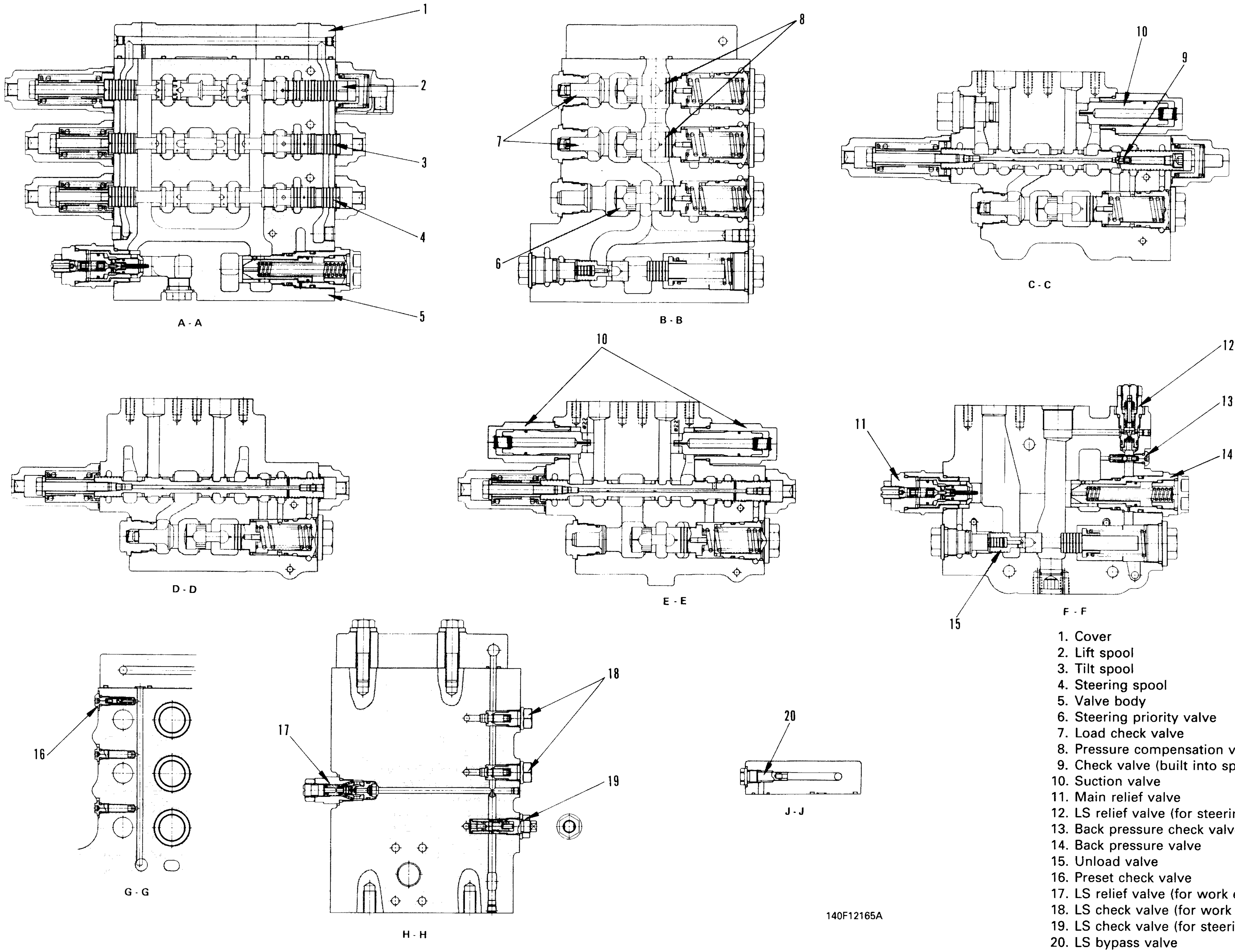
014012

a. Port **PC** (pump pressure plug)
b. Port **PLSC** (LS pressure plug)
c. Port **PB3** (from PPC valve)
d. Port **PA3** (from PPC valve)
e. Port **PA2** (from PPC valve)
f. Port **PA1** (from PPC valve)
g. Port **A1** (to HSS motor)
h. Port **A2** (to tilt cylinder bottom)
i. Port **A3** (to lift cylinder head)
j. Port **B3** (to lift cylinder bottom)
k. Port **B2** (to tilt cylinder head)
l. Port **B1** (to HSS motor)
m.Port **LS** (to pump LS valve)
n. Port **T** (to tank)
o. Port **P** (from pump)
p. Port **TS** (to tank)
q. Port **Pi** (from PPC pump)
r. Port **PB1** (from PPC valve)
s. Port **PB2** (from PPC pump)

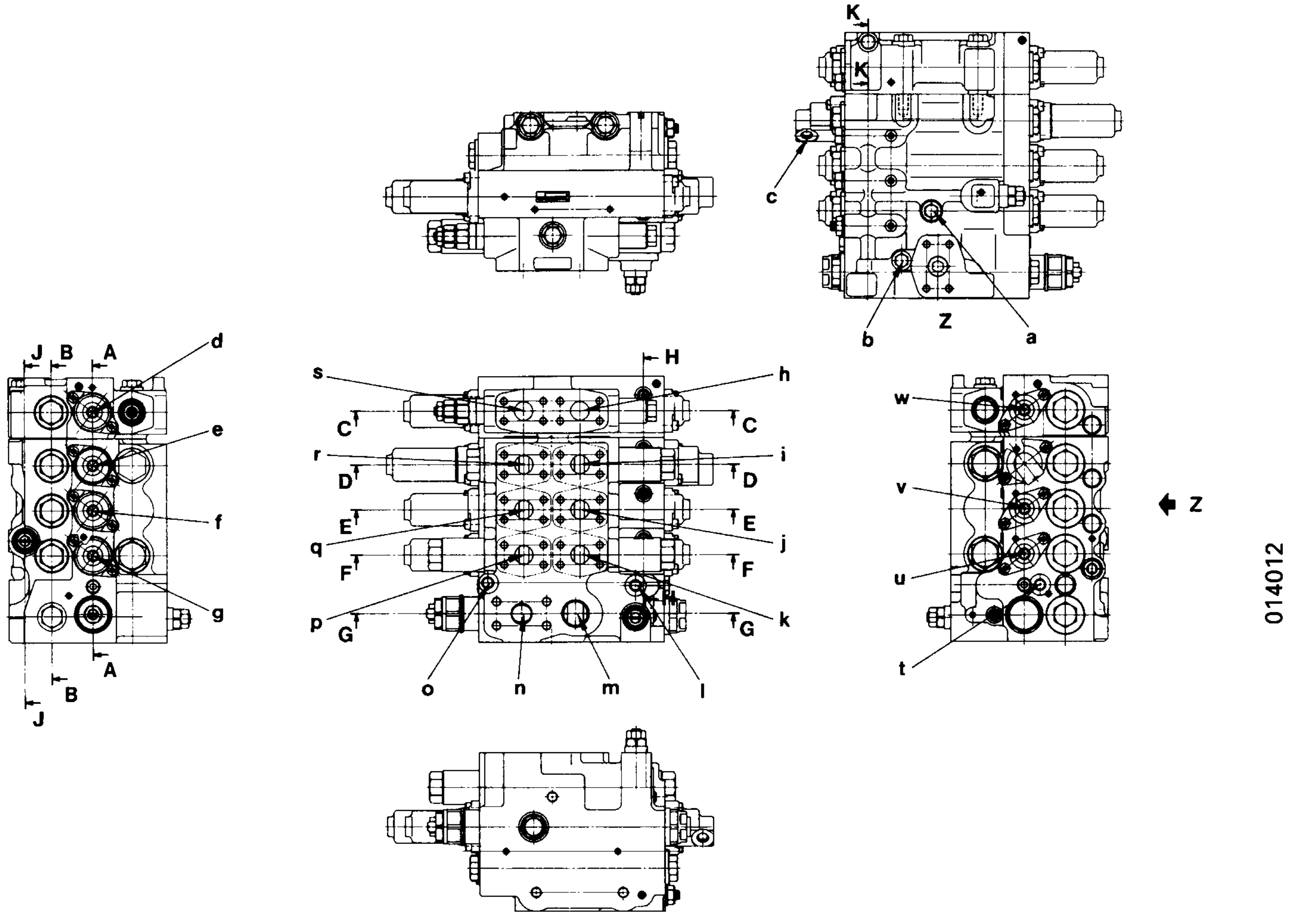


1. Cover
2. Lift spool
3. Tilt spool
4. Steering spool
5. Valve body
6. Steering priority valve
7. Load check valve
8. Pressure compensation valve
9. Check valve (built into spool)
10. Suction valve
11. Main relief valve
12. LS relief valve (for steering valve)
13. Back pressure check valve
14. Back pressure valve
15. Unload valve
16. Preset check valve
17. LS relief valve (for work equipment valve)
18. LS check valve (for work equipment valve)
19. LS check valve (for steering valve)
20. LS bypass valve

014012

(3 + 1 SPOOL VALVE: RIPPER + BLADE LIFT + TILT + STEERING)

D65EX-12 60001 – 60941



140F12166

a. Port **PC** (pump pressure plug)
b. Port **PLSC** (LS pressure plug)
c. Port **PB3** (from PPC valve)
d. Port **PA4** (from PPC valve)
e. Port **PA3** (from PPC valve)
f. Port **PA2** (from PPC valve)
g. Port **PA1** (from PPC valve)
h. Port **B4** (to ripper cylinder head)
i. Port **B3** (to lift cylinder bottom)
j. Port **B2** (to tilt cylinder head)
k. Port **B1** (to HSS motor)
l. Port **LS** (to pump LS valve)
m. Port **T** (to tank)
n. Port **P** (from pump)
o. Port **TS** (to tank)
p. Port **A1** (to HSS motor)
q. Port **A2** (to tilt cylinder bottom)
r. Port **A3** (to lift cylinder head)
s. Port **A4** (to ripper cylinder bottom)
t. Port **Pi** (from PPC pump)
u. Port **PB1** (from PPC valve)
v. Port **PB2** (from PPC valve)
w. Port **PB4** (from PPC valve)

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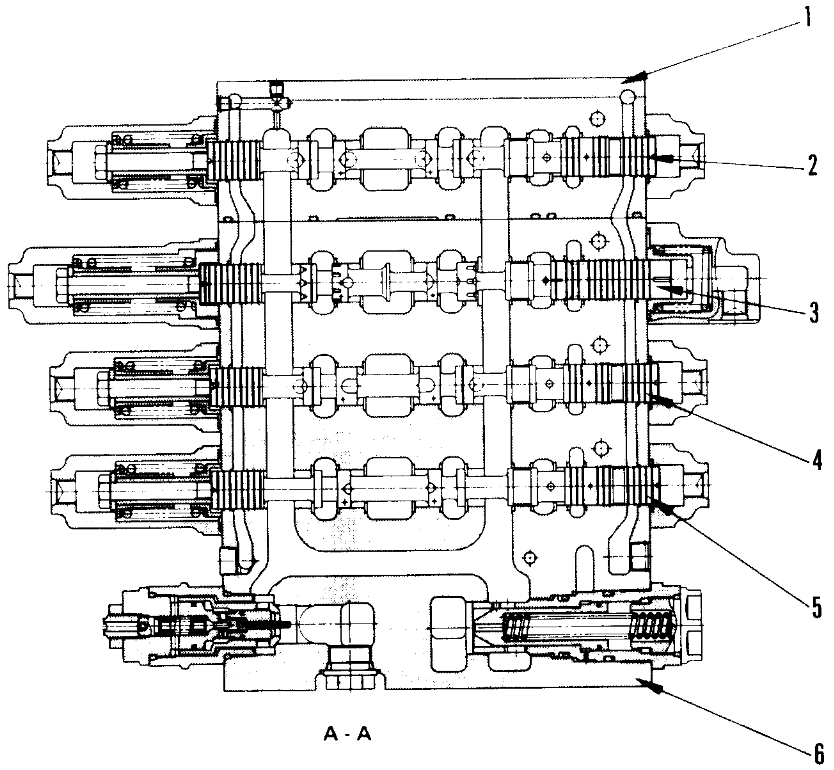
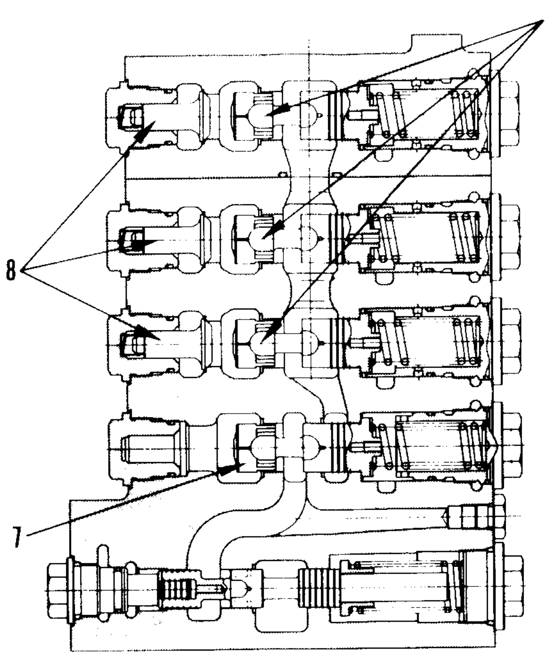
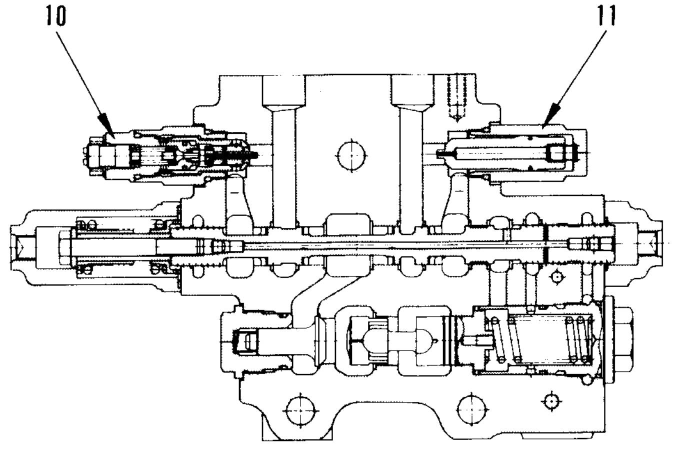


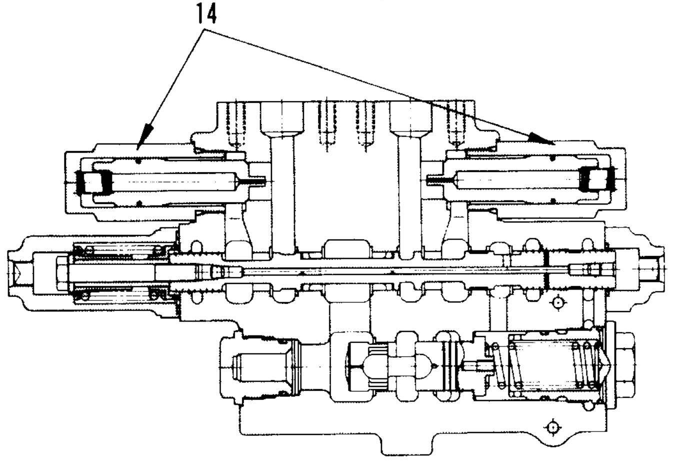
A - A



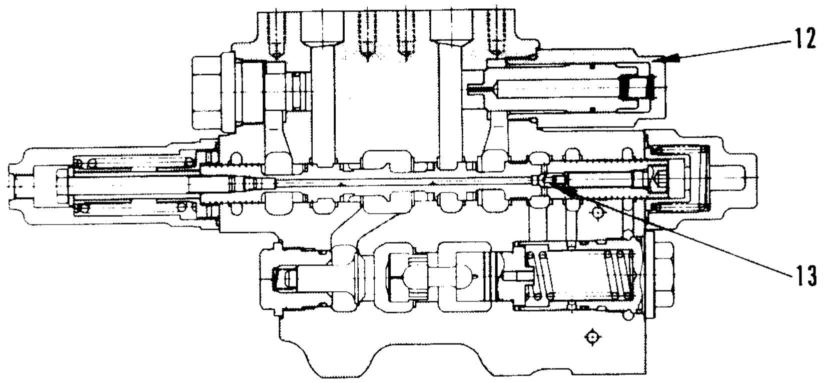
B - B



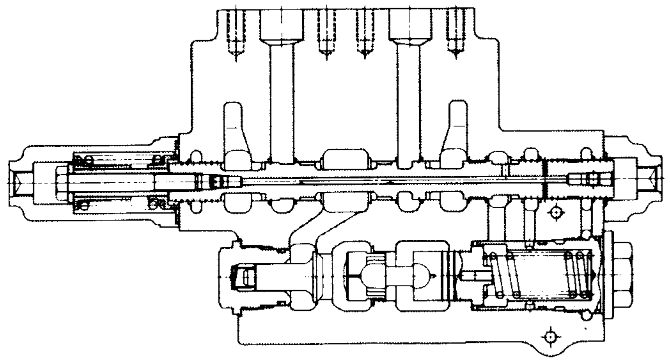
C - C



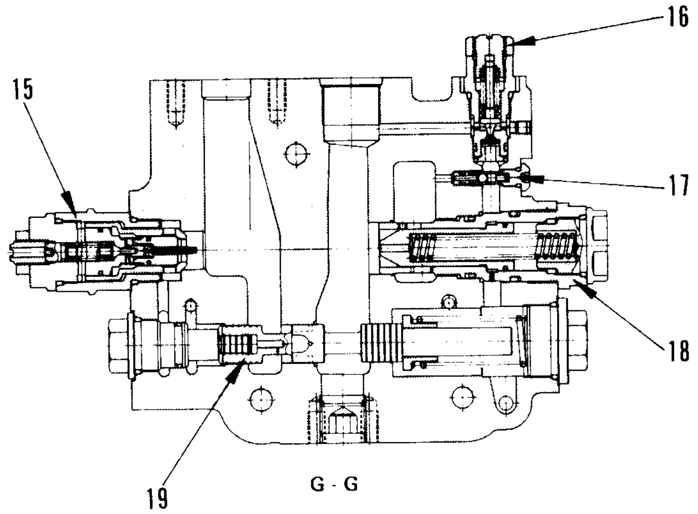
F - F



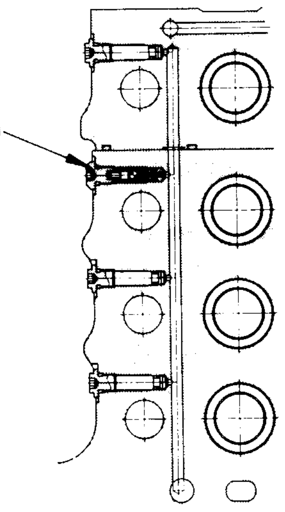
D - D



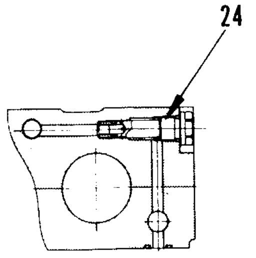
E - E



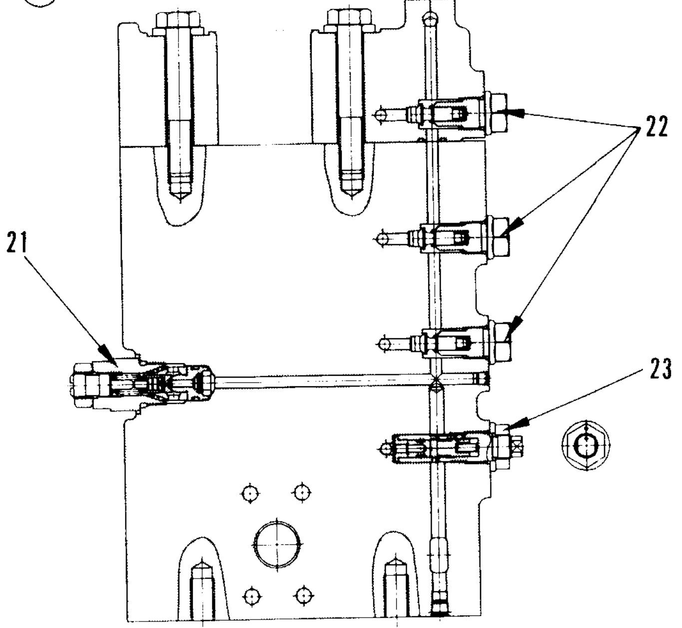
G - G



H - H



K-K



J - J

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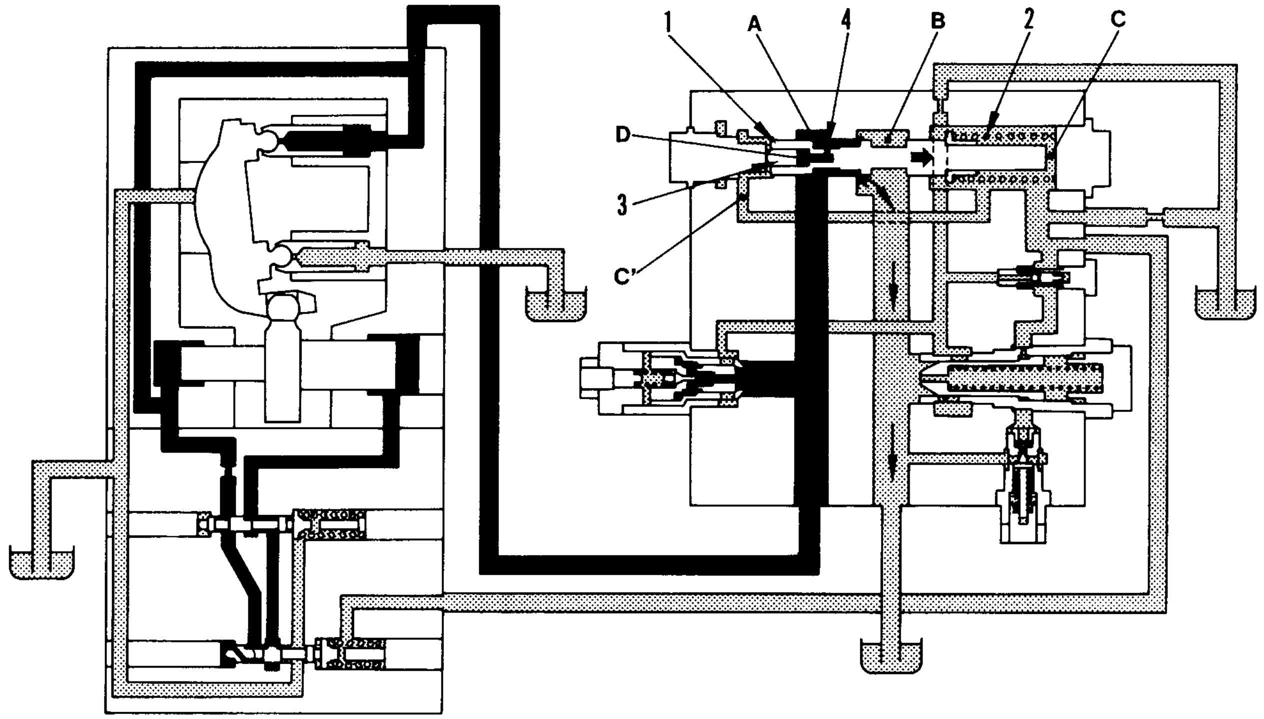
1. Cover
2. Ripper spool
3. Lift spool
4. Tilt spool
5. Steering spool
6. Valve body
7. Steering priority valve
8. Load check valve
9. Pressure compensation valve
10. Suction safety valve
11. Suction valve
12. Suction valve
13. Check valve (built into spool)
14. Suction valve
15. Main relief valve
16. LS relief valve (for steering valve)
17. Back pressure check valve
18. Back pressure valve
19. Unload valve
20. Preset check valve
21. LS relief valve (for work equipment valve)
22. LS check valve (for work equipment valve)
23. LS check valve (for steering valve)
24. LS bypass valve

OPERATION OF MAIN CONTROL VALVE



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014012

FUNCTION

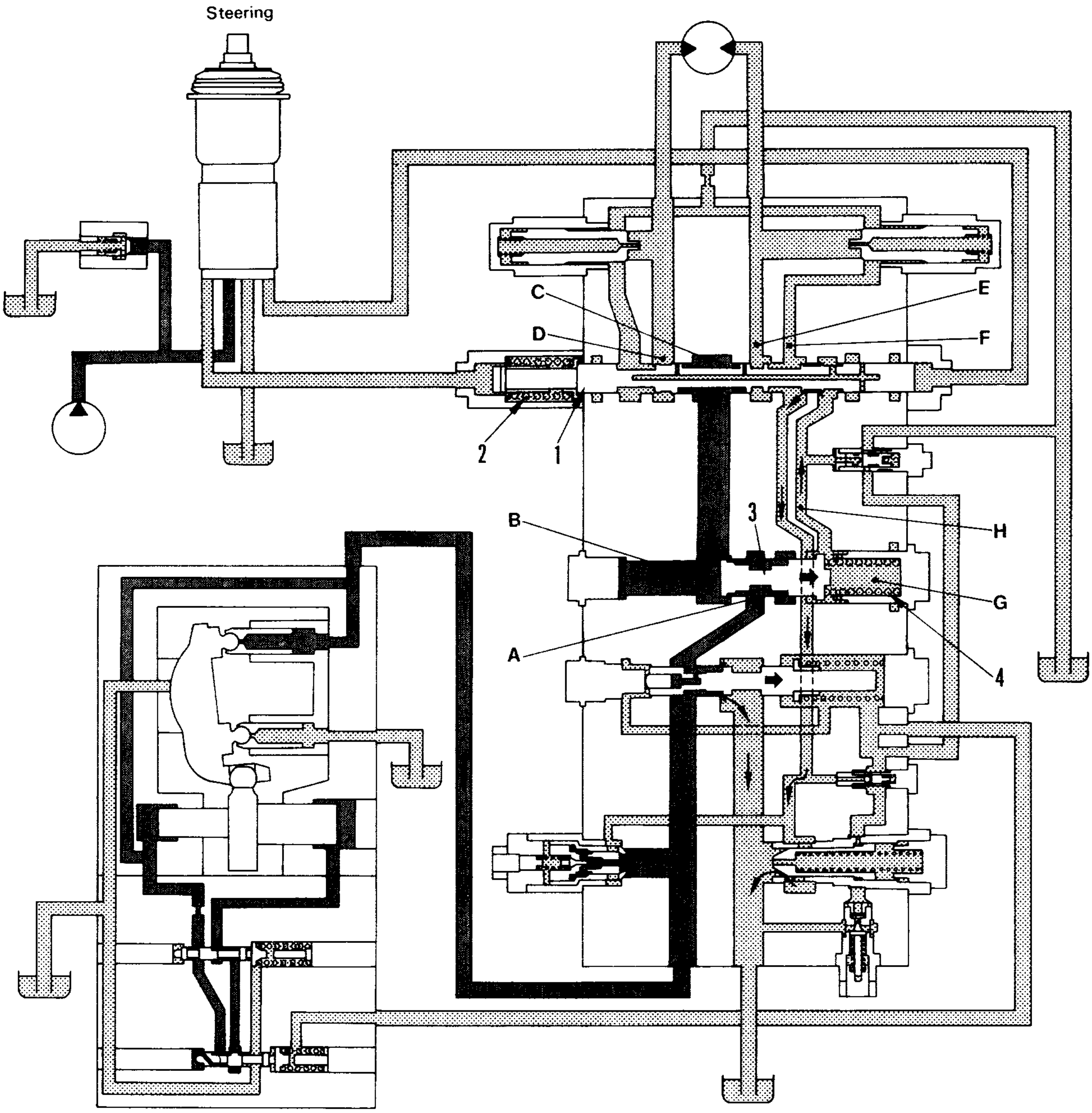
- When the main spool is at the HOLD position, it drains the express oil discharged by the pump, and prevents the pressure from being formed in the circuit from rising.

OPERATION

1. AT HOLD (OPERATION OF UNLOAD VALVE)

1) When the main spool is at the HOLD position, the pump pressure passes from chamber **A** through throttle (4) to chamber **D**. Chambers **C** and **C'** are connected to the drain circuit.
2) When oil is supplied from the pump, the pressure in chamber **D** rises, and spool (1) is pushed to the right by pressure **FO** which is determined by the cross-sectional area of piston (3) receiving the pressure.
3) When **FO** becomes larger than set load **FS** of spring (2), the spool moves to the right and connects the passage between chamber **A** and chamber **B**, so the oil from the pump is drained. Therefore, spool (1) is balanced at a position that matches the supply of oil from the pump.
   Actually, the amount of oil supplied from the pump is small, so the pressure in the circuit is almost the same as the set load of spring (2).

2. CONTROL OF OIL FLOW



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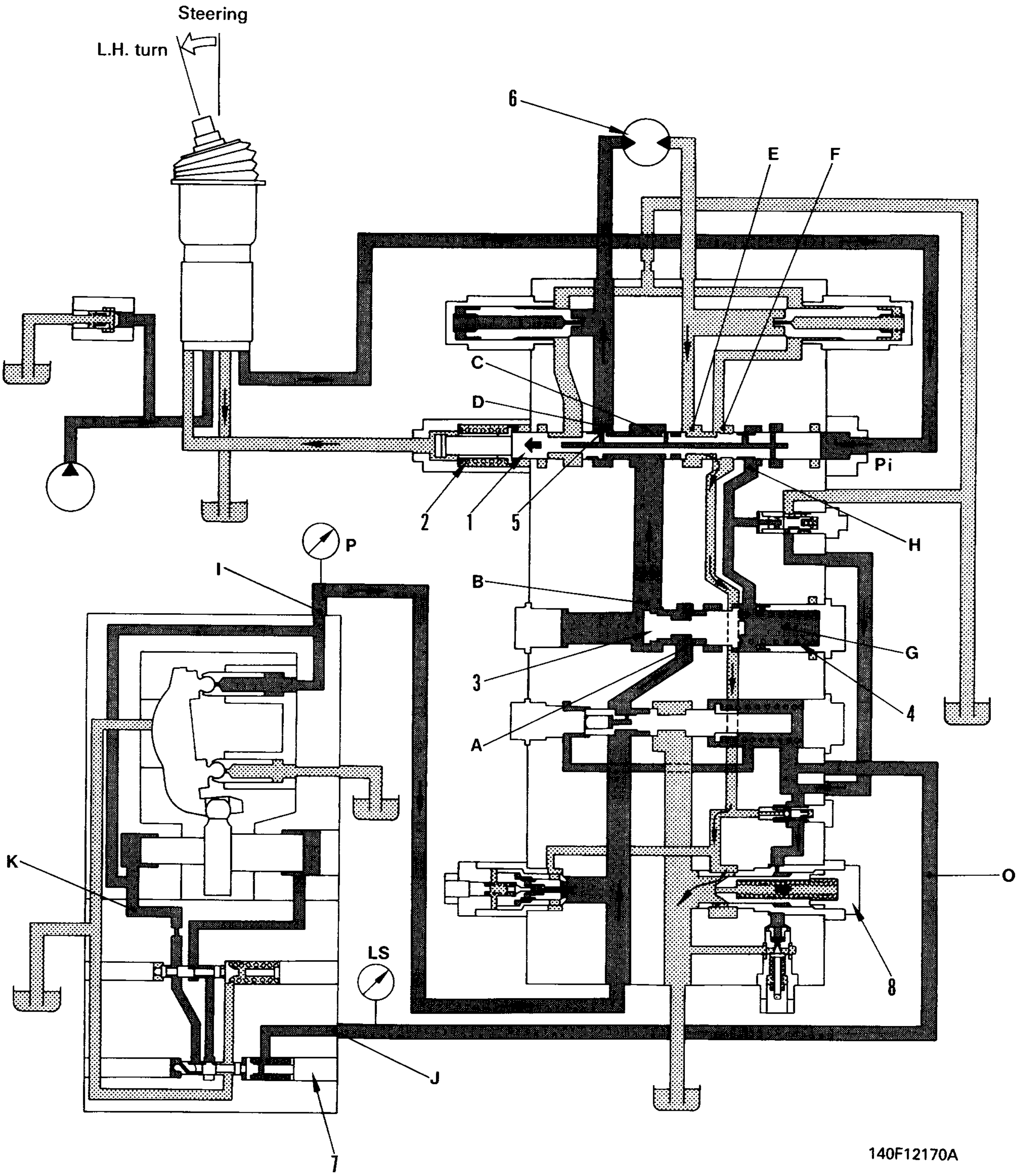
(1) Steering valve

- Use of the **CLSS** circuit (Closed Center Load Sensing System) makes it possible to control the oil flow by adjusting the area of opening of the spool driven by the PPC valve regardless of the load.

(1) At HOLD

When the spool is at the HOLD position, the pump pressure is sent from chamber **A** through the notch in spool (3) of the steering priority valve, and passes through chamber **B** to chamber **C**. Chamber **G** is drained through chamber **H** to chamber **F**. When this happens, the pump pressure is acting on the left end of spool (3) of the steering priority valve, so it pushes against the load of spring (4) and moves to the right to the maximum stroke position. In this condition, the area of the opening to spool (1) of the steering valve is at its minimum.



- △**PLS** = differential pressure between ports **K** and **J** = 2.0 MPa (20kg/cm^2)
- △**PLS'** = differential pressure between ports **I** and **D**
- △**PLS** ≒ △**PLS'**

2) When turning to left

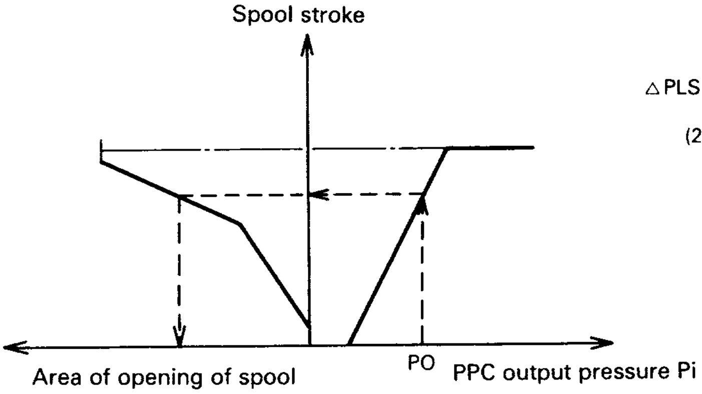
① When the steering lever is operated to turn the machine to the left, pilot pressure **Pi** acts on the right end of spool (1) through the PPC valve, and when the pressure becomes greater than the set load of spring (2), the spool starts to move to the left. It becomes balanced at a position that matches PPC output pressure **Pi**.

② Chamber **C** and chamber **D** are connected, and the oil from the pump flows through ports **A**, **B**, **C**, and **D** to HSS motor (6). At the same time, the load pressure in chamber **D** passes through **LS** orifice (5) and chamber **H**, and is sent to chamber **G**. It is also sent from the **LS** circuit **O** to pump servo valve (7).

③ The condition of the pressure of spool (3) is chamber **B** pressure ≒ chamber **C** pressure, and chamber **G** pressure ≒ chamber **D** pressure, so spool (3) is controlled by the differential pressure of spool (1) (chamber **C** pressure − chamber **D** pressure), and balances with spring (4).

In other words, if the oil flow is too large, the differential pressure of spool (1) becomes larger, so spool (3) moves in the direction to throttle the oil flow; on the other hand, if the oil flow is too small, spool (3) moves in the direction to increase the oil flow.

④ In addition, pump servo valve (7) is controlled so that the differential pressure between pump pressure **P** and **LS** pressure **LS** (**LS** differential pressure: △**PLS**) remains constant, so a suitable amount of oil flows to ensure that the loss of pressure at the control valve (△**PLS'**) is equal to △**PLS**. The loss of pressure in the control valve is determined by the area of the opening of the main spool, so the oil flow matches the opening of the spool.



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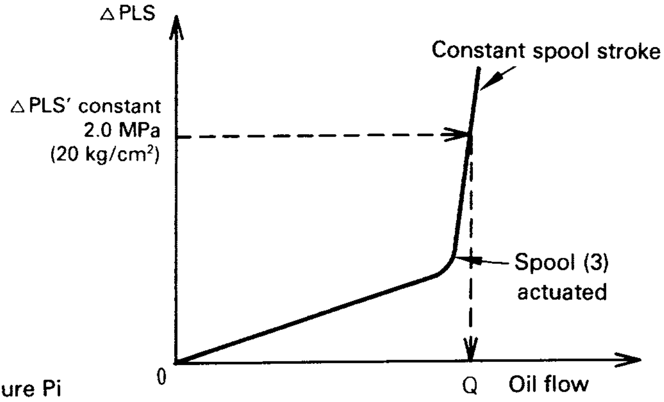

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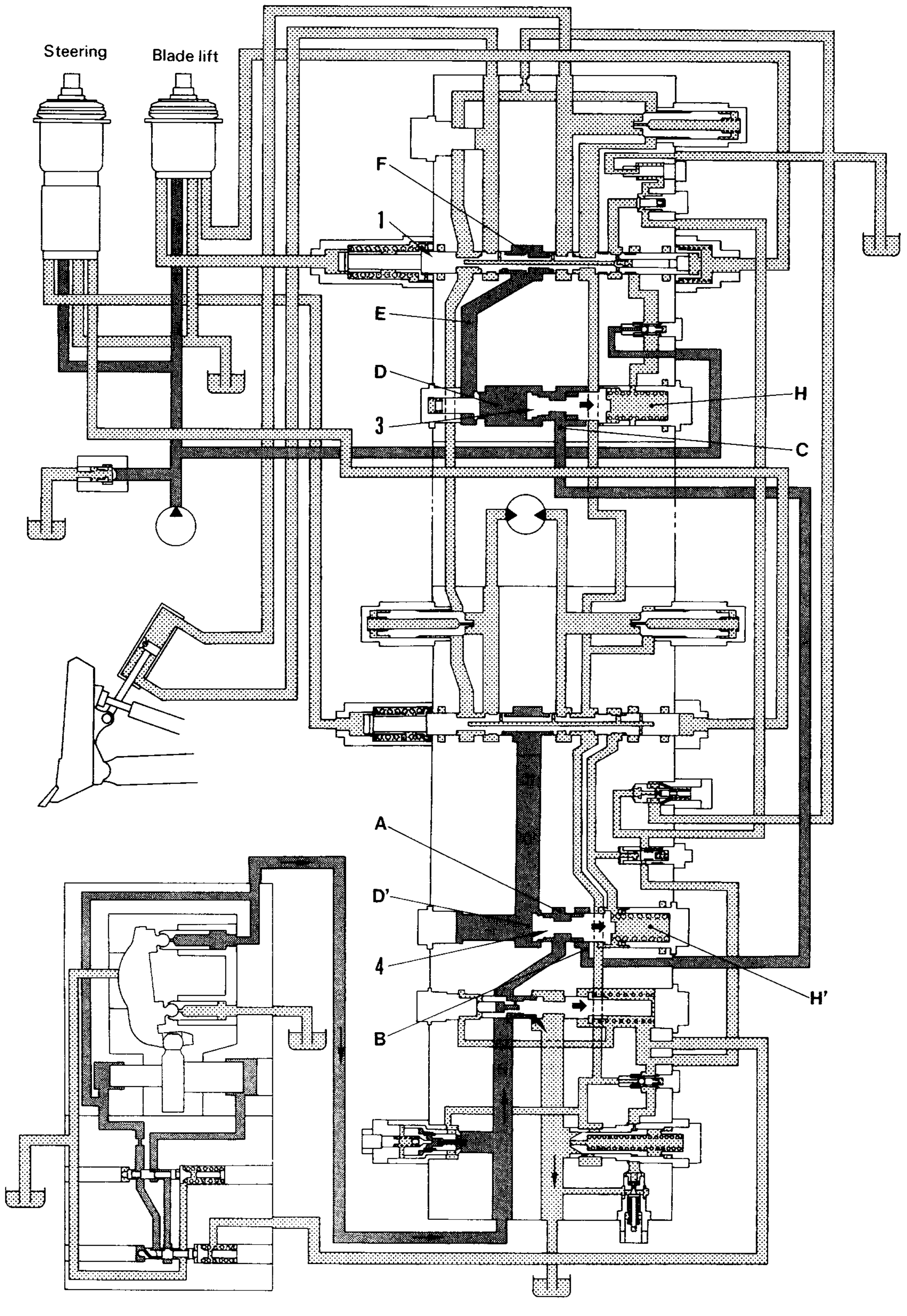
⑤ The return oil flow from the HSS motor passes through chamber **E** and chamber **F**, and is drained. (When this happens, back pressure valve (8) is opened to the maximum by the **LS** pressure.)

(2) Work equipment valve (tilt valve, lift valve, ripper valve)

★ The diagram shows the blade lift valve.



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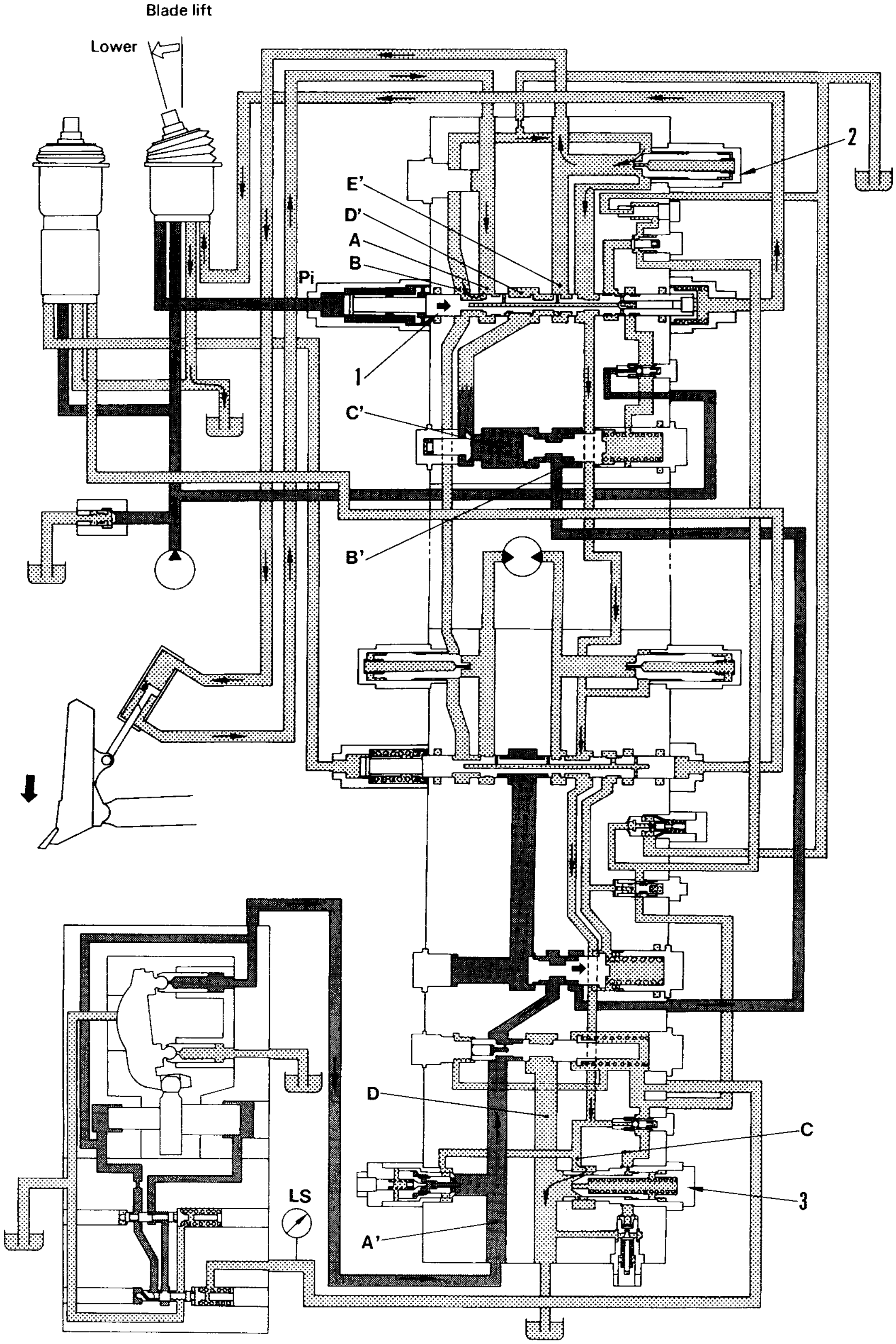
1) When spool (1) of the work equipment valve is at the HOLD position, the pump pressure (unload pressure) is sent to chambers **D** and **D'**. The pressure is not formed in chambers **H** and **H'**, so pressure compensation valve spool (3) and steering compensation valve spool (4) are pushed completely to the right.

2) The pump pressure passes through chambers **A** and **B** of steering priority valve (4), and is sent to chamber **C** of the main control valve. From here it goes through chamber **D** and chamber **E** to chamber **F**.

3) In the same way as for Item **(1) Steering valve,** the position of pressure compensation valve spool (3) is determined to match the opening of spool (1) of the work equipment valve, and the oil flow is determined so that the pressure loss of the control valve becomes equal to the differential pressure △**LS** of **LS** valve (7).

(3) Meter-out control when blade moves down under its own weight, and suction function using back-pressure valve (work equipment lever at LOWER)



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014012

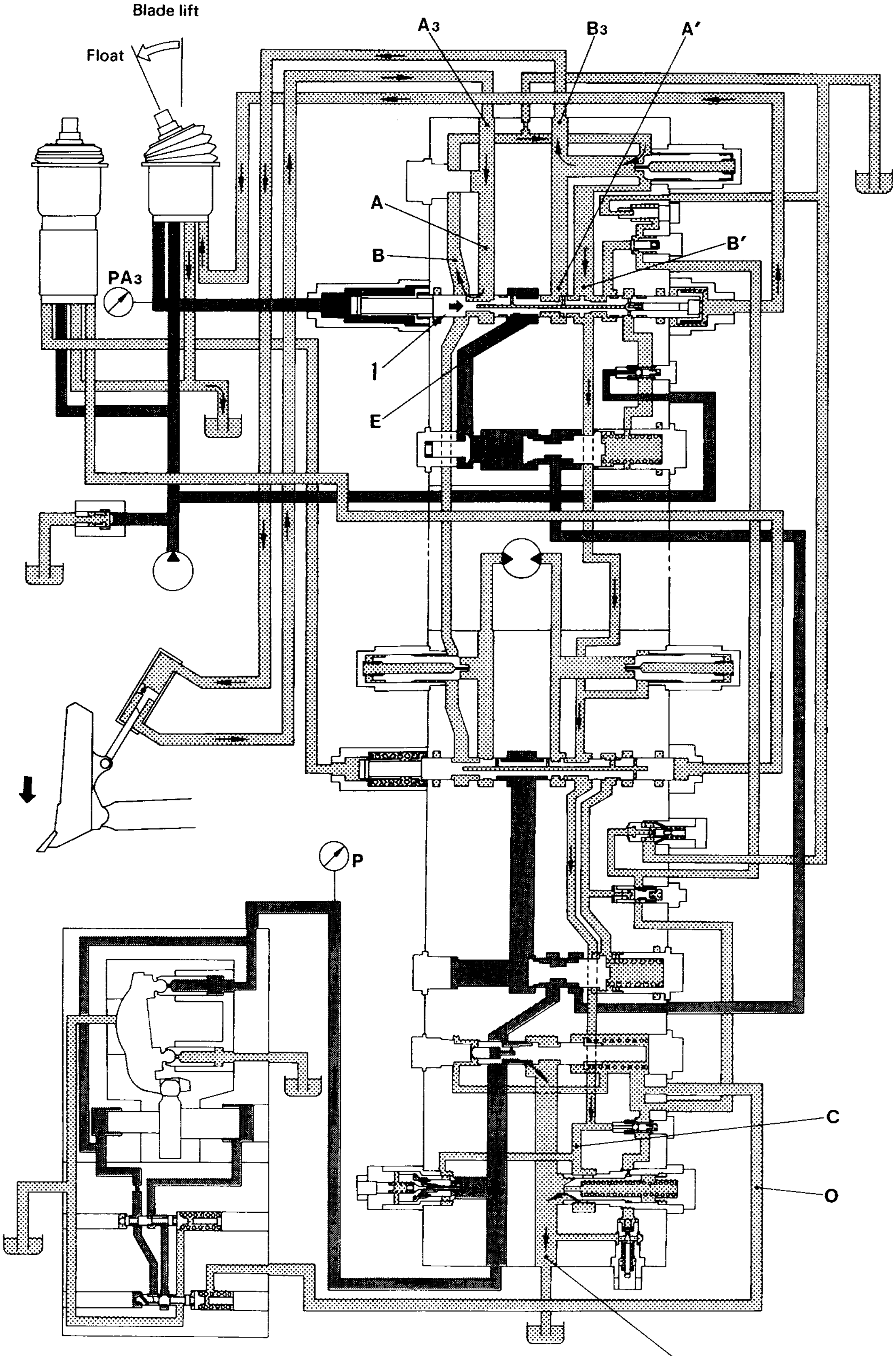
- If the blade moves down under its own weight, the oil flow of return oil from cylinder is controlled by the area of the opening of main spool (1).

- A back pressure that matches the oil flow is formed in drain passage **C** of the control valve by back-pressure valve (3), so oil is supplied to the cylinder from suction valve (2) to prevent a vacuum from forming in the circuit.

1) When the spool port is opened by PPC output pressure **Pi**, because of the weight of the blade, the oil at the cylinder head passes through ports **A**, **B**, **C**, and **D**, and is drained to the tank.
   When this happens, the flow of return oil from the lift cylinder is throttled by the area of opening between ports **A** and **B**, so the downward speed is controlled.

2) When the blade moves down under its own weight, **LS** pressure is not formed, so a back pressure that matches the valve characteristics of back-pressure valve (3) is formed in chamber **C**.
   The oil flowing from the cylinder head end passes from the drain circuit through suction valve (2) and is supplied to the bottom end of the cylinder.
   The oil discharged from the pump passes through ports **A'**, **B'**, **C'**, **D'**, and **E'**, and is supplied to the cylinder bottom.

(4) Meter-out control when blade moves down under its own weight (work equipment lever at FLOAT)



- When the lift valve is at FLOAT, the cylinder port and drain port are connected to put the circuit in a no-load condition.
- When the lift valve is in the FLOAT condition, the pump passage and cylinder ports **A3** and **B3** are separated so that the other control valves can be operated.

1) When the work equipment control lever is at the FLOAT position, if pressure **PA3** becomes 3.4 MPa (35 kg/cm^2) or more, lift spool (1) is moved to the maximum stroke position.

2) In this condition, ports **A3** and **B3** and the **LS** passage **O** are all connected to the drain circuit, so there is no load on the lift cylinder.

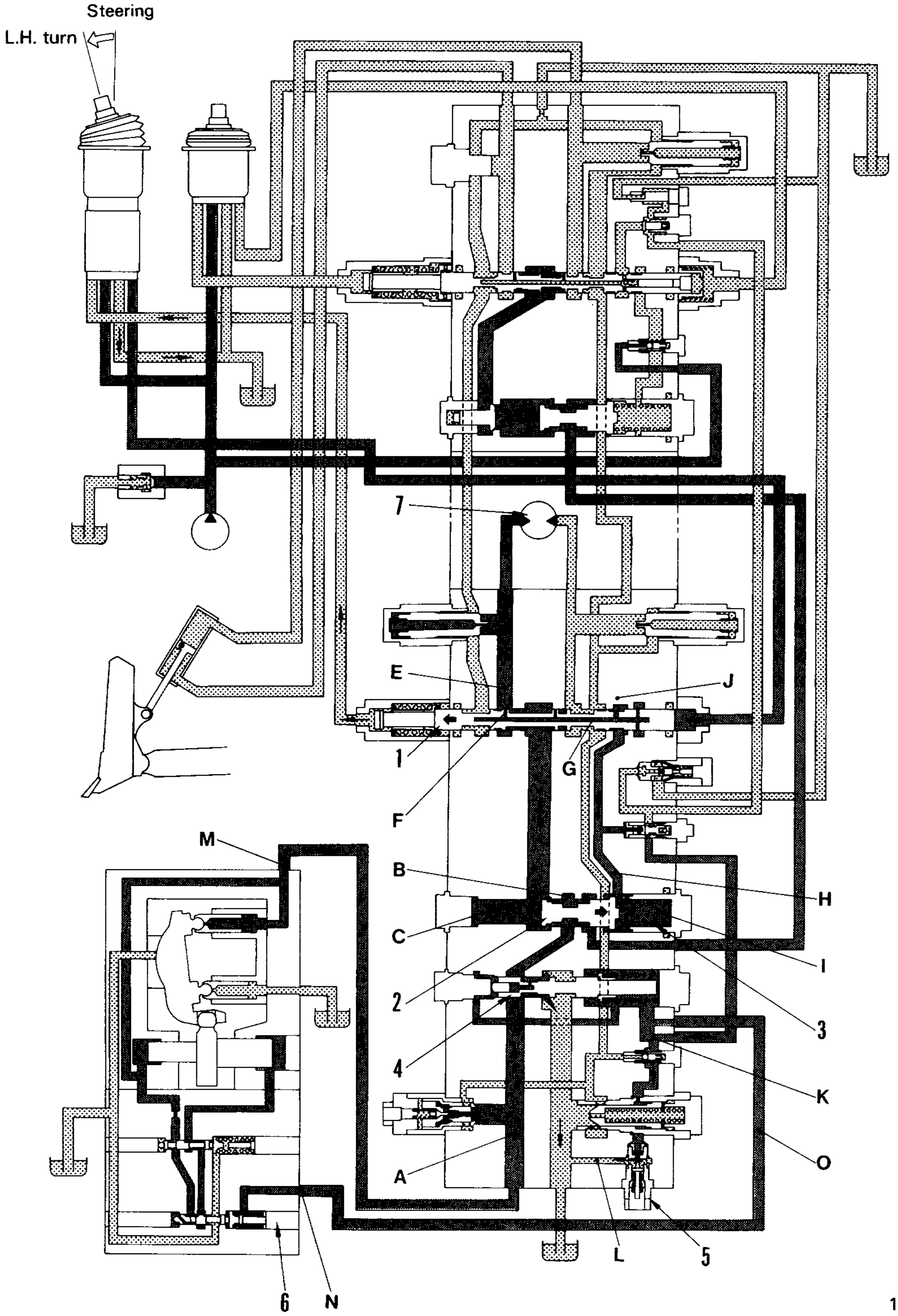
3) If the cylinder is driven by the weight of the blade, the oil entering from port **A3** flows to ports **A**, **B**, **B'** and **A'**, while the rest of the oil flows through ports **C** and **D**, and is drained. When this happens, the oil flow is throttled by the area of opening between ports **A** and **B** of spool (1), and the cylinder speed is controlled.

4) The pump circuit chamber **E** and ports **A3** and **B3** are separated, and pump pressure **P** is formed, so it is possible to carry out compound operations with other control valves.

3. AT RELIEF

(1) Steering valve

★ The diagram shows the condition at relief for steering **LS** relief valve (5).



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- △**P1** = △**P3** + △**P4** = Differential pressure between ports **M** and **E**
- △**P2** = Differential pressure between ports **E** and **N**
- △**P3** = Differential pressure between ports **M** and **B**
- △**P4** = Differential pressure between ports **B** and **E**
- △**LS** = △**P1** + △**P2** = Differential pressure between ports **M** and **N** = 2.0 MPa (20 kg/cm^2)

- It specifies the maximum pressure when the HSS is operated.

1) If the pressure of HSS motor (7) becomes higher, steering **LS** relief valve (5) will crack and oil will be drained from **LS** circuit **O**. (Ports **E**, **F**, **G**, **J**, **K**, and **L**)
As a result, there will be a drop in pressure in **LS** passage **O** starting from **LS** sensing hole **F**, and △**P2** will become larger.

2) For the same reason, if the pressure in chambers **H** and **I** drops, spool (2) will push against spring (3) and move to the right, and will make the opening between chambers **B** and **C** smaller, so the flow to chambers **B** and **C** will be throttled and △**P4** will become larger.

3) Because of the pump swash plate control, the system circuit is balanced at a circuit pressure which makes the pressure loss generated by the flow at steering **LS** relief valve (5) △P1 + △**P2** equal to **LS** differential pressure (△**LS**).
When this happens, pump **LS** valve (6) detects the differential pressure generated by **LS** relief valve (5), and moves the pump swash plate from the maximum to the minimum position. The pump swash plate is balanced at a position where the **LS** differential pressure is 2.0 MPa (20 kg/cm^2.)

4) When the pump is at the minimum swash plate angle (minimum oil flow), if the minimum oil flow is greater than **the LS relief oil flow + leakage at any part**, the pressure is confined in the pump circuit (between the pump and chambers **A** and **B**), so the **LS** differential pressure rises. If this differential pressure goes above the set pressure for unload valve (4), the unload valve is actuated to relieve the excess oil flow and balance the circuit.

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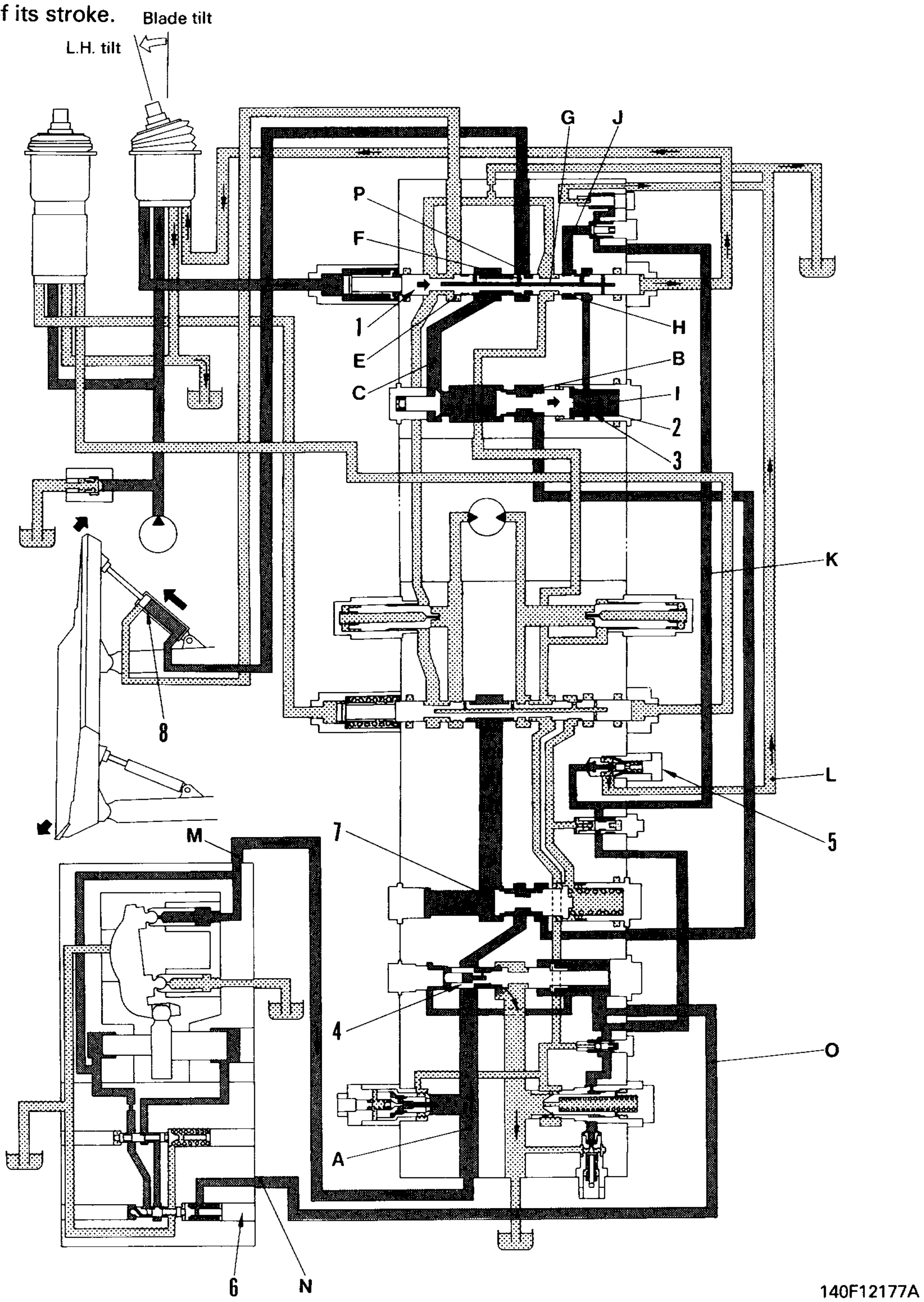
(2) Blade lift, tilt, ripper valve

★ The diagram shows the relief condition of work equipment **LS** relief valve (5) with the blade tilt at the end of its stroke.



- Δ **P1** = Δ **P3** + **P4** = Differential pressure between ports **M** and **P**
- Δ **P2** = Differential pressure between ports **P** and **N**
- Δ **P3** = Differential pressure between ports **M** and **B**
- Δ **P4** = Differential pressure between ports **B** and **P**
- Δ **LS** = Δ **P1** + Δ **P2** = Differential pressure between ports **M** and **N** = 2.0 MPa (20kg/cm^2)

1) If blade tilt valve (1) is moved, and the pressure of tilt cylinder (8) becomes higher, work equipment **LS** relief valve (5) will crack and oil will be drained from **LS** circuit **O**.
(Ports **E**, **F**, **G**, **J**, **K**, and **L**)
As a result, there will be a drop in pressure in **LS** passage **O** starting from **LS** sensing hole **F**, and △**P2** will become larger.

2) For the same reason, if the pressure in chambers **H** and **I** drops, spool (2) will push against spring (3) and move to the right, and will make the openibg between **B** and **C** smaller, so the flow between chambers **B** and **C** will be throttled and △**P4** will become larger.

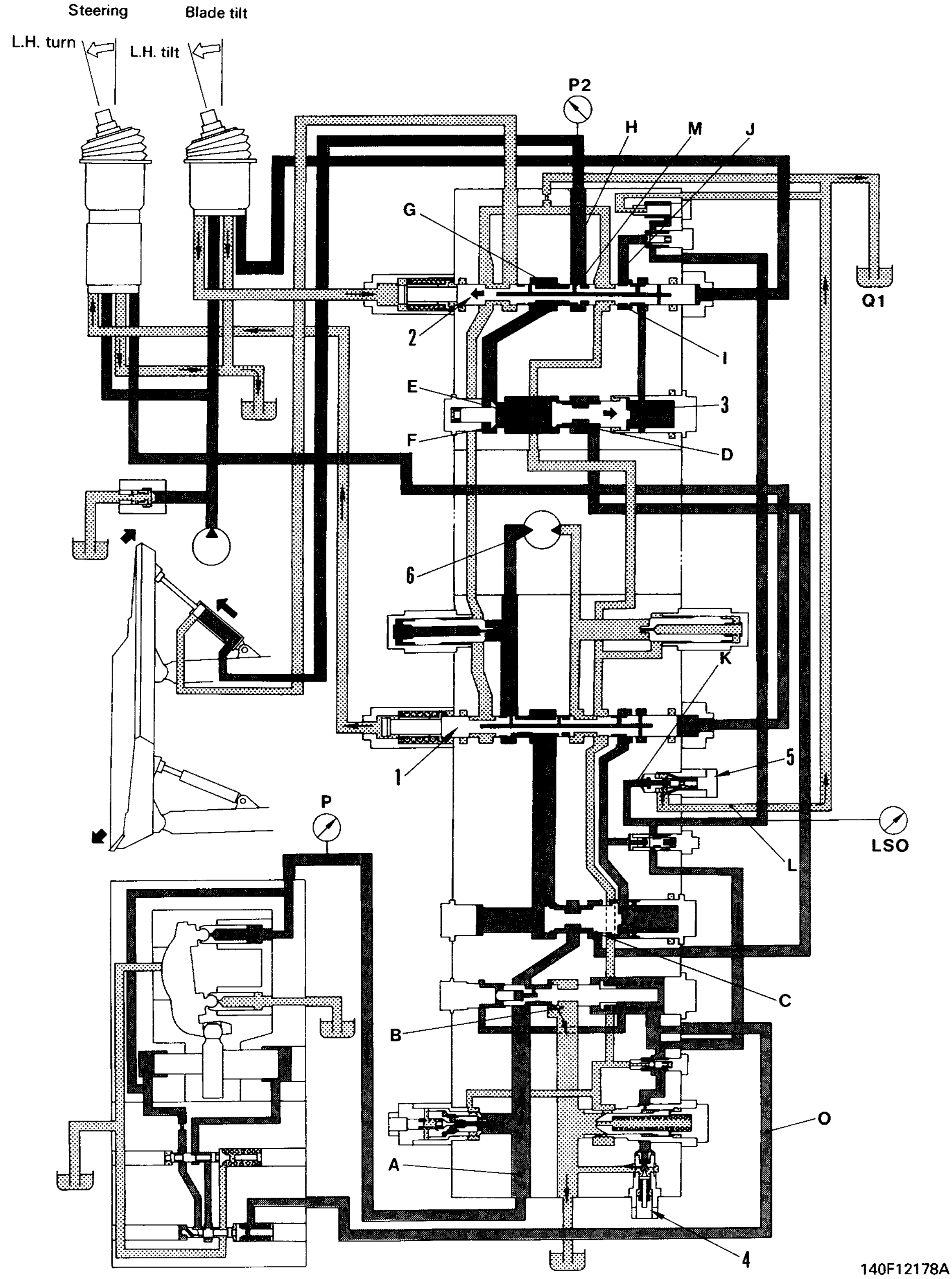
3) Because of the pump swash plate control, the system circuit is balanced at a circuit pressure which makes the pressure loss generated by the flow at work equipment **LS** relief valve (5) △**P1** + △**P2** equal to **LS** differential pressure (△**LS**).
When this happens, pump **LS** valve (6) detects the differential pressure generated by **LS** relief valve (5), and moves the pump swash plate from the maximum to the minimum position. The pump swash plate is balanced at a position where the **LS** differential pressure is 2.0 MPa (20 kg/cm^2).

4) When the pump is at the minimum swash plate angle (minimum oil flow), if the minimum oil flow is greater than **the LS relief oil flow + leakage at any part**, the pressure is confined in the pump circuit (between the pump, chamber **A** and chamber **B** through steering priority valve (7)), so the **LS** differential pressure rises. If this differential pressure goes above the set pressure for unload valve (4), the unload valve is actuated to relieve the excess oil flow and balance the circuit.

(3) Steering + work equipment valve (compound operations)

★ The diagram shows the relief condition of **LS** relief valves (4) and (5) at steering stall with the blade tilt at the end of its stroke.

- △ = **P** – **P2**
- △**PO** = Differential pressure between ports **H** and **K**
- Pressure **P2** = **LSO** + △**PO**



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- When steering valve (1) and work equipment valve (2) are relieved at the same time, the pump pressure is separated by pressure compensation valve (3) in the work equipment valve, and the port pressure is maintained at a constant value

1) If HSS motor (6) reaches the stall condition, the load pressure increases and **LS** relief valve (4) for the steering valve is actuated, so the system is cut off (for details, see Item **(1) Steering valve)**.

2) When this happens, the pump pressure is maintained at 38.2 MPa (390 kg/cm^2), and this is sent to chamber **G** of the work equipment valve.

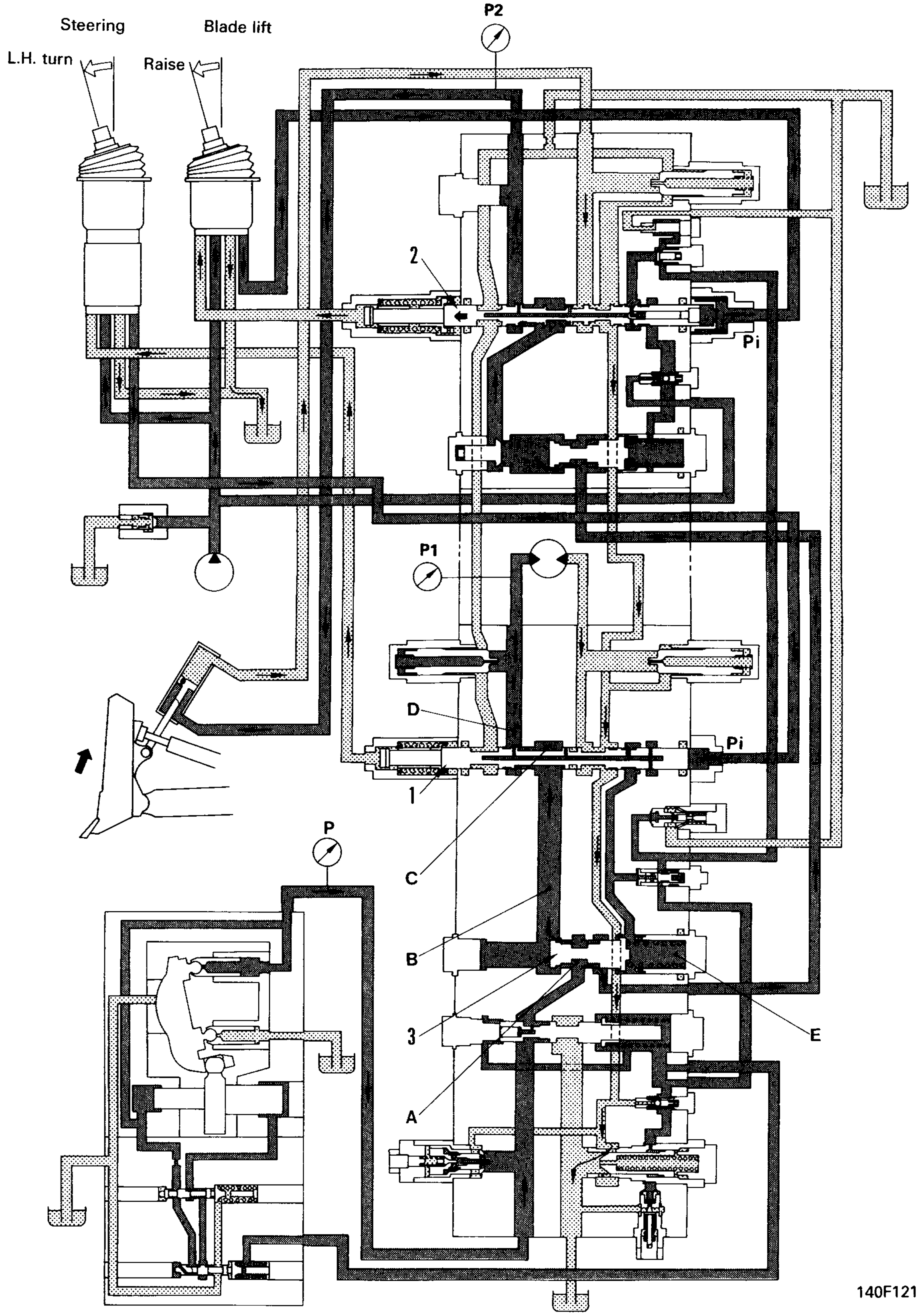
3) When work equipment valve (2) is operated and the load on the work equipment valve is greater, work equipment **LS** relief valve (5) is actuated, and drain oil flow **Q1** flows to **LS** circuit **O**. As a result, a differential pressure is generated on the left and right sides of pressure compensation valve (4) by **LS** throttle **M** of spool (2), and it moves the full stroke to the right. When this happens, the opening between chambers **D** and **E** is throttled to the minimum size (pump pressure separated).

4) Oil flow **Q1** is determined by pump pressure **P** and the total pressure loss $\triangle$(**P** − **LSO**) of ports **C**, **D**, **E**, **F**, **G**, **I**, **J**, and **K**. Furthermore, pressure **P2** (the pressure in chamber **H**) becomes the total (**LSO** + $\triangle$**PO**) of the circuit pressure loss of ports **H**, **I**, **J**, and **K**, and the set pressure of work equipment **LS** relief valve (5).

4. Compound operations

(1) Steering valve + work equipment valve

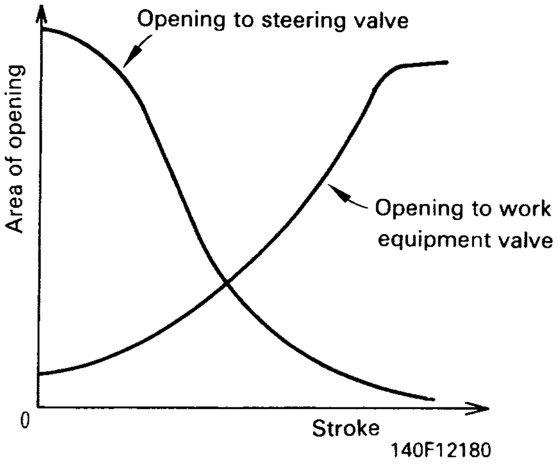
★ The diagram shows the condition when the steering and blade lift valve are operated at the same time.



- The steering valve is equipped with a steering priority valve (3), so if the steering valve and the downstream work equipment valve are operated at the same time, priority is given to the flow of oil to the steering valve, and the rest of the oil discharged from the pump goes to the work equipment valve.

1) When steering spool (1) is operated by PPC valve output pressure **Pi** and the oil flows, a differential pressure is created between chambers **C** and **D**. Steering priority valve (3) is controlled by this differential pressure, and at the same time, the pump swash plate angle is controlled at △**PLS** = 2.0 MPa (20 kg/cm²), and the flow of oil to the steering valve is fixed.
   See Item **2-(1) Steering valve**.

2) In this condition, if downstream blade lift valve (2) is operated, the pump pressure momentarily drops.
   At this point, the differential pressure between chambers **C** and **D** becomes smaller, and steering priority valve (3) is moved to the left by the pressure in chamber **E** in the direction to throttle the opening to the work equipment valve.
   At the same time, △**PLS** becomes smaller, so the pump swash plate angle moves in the maximum direction to supply an oil flow to make up the amount that the pressure drops.



3) When pump swash plate does not reach maximum angle
   When the maximum oil flow from the pump is greater than the sum of the flow demanded by the steering valve and work equipment valve, an amount of oil that matches the opening of steering spool (1) flows to the steering valve; an amount of oil decided by the pump pressure and load pressure and area of opening of the spool flows to the work equipment valve.

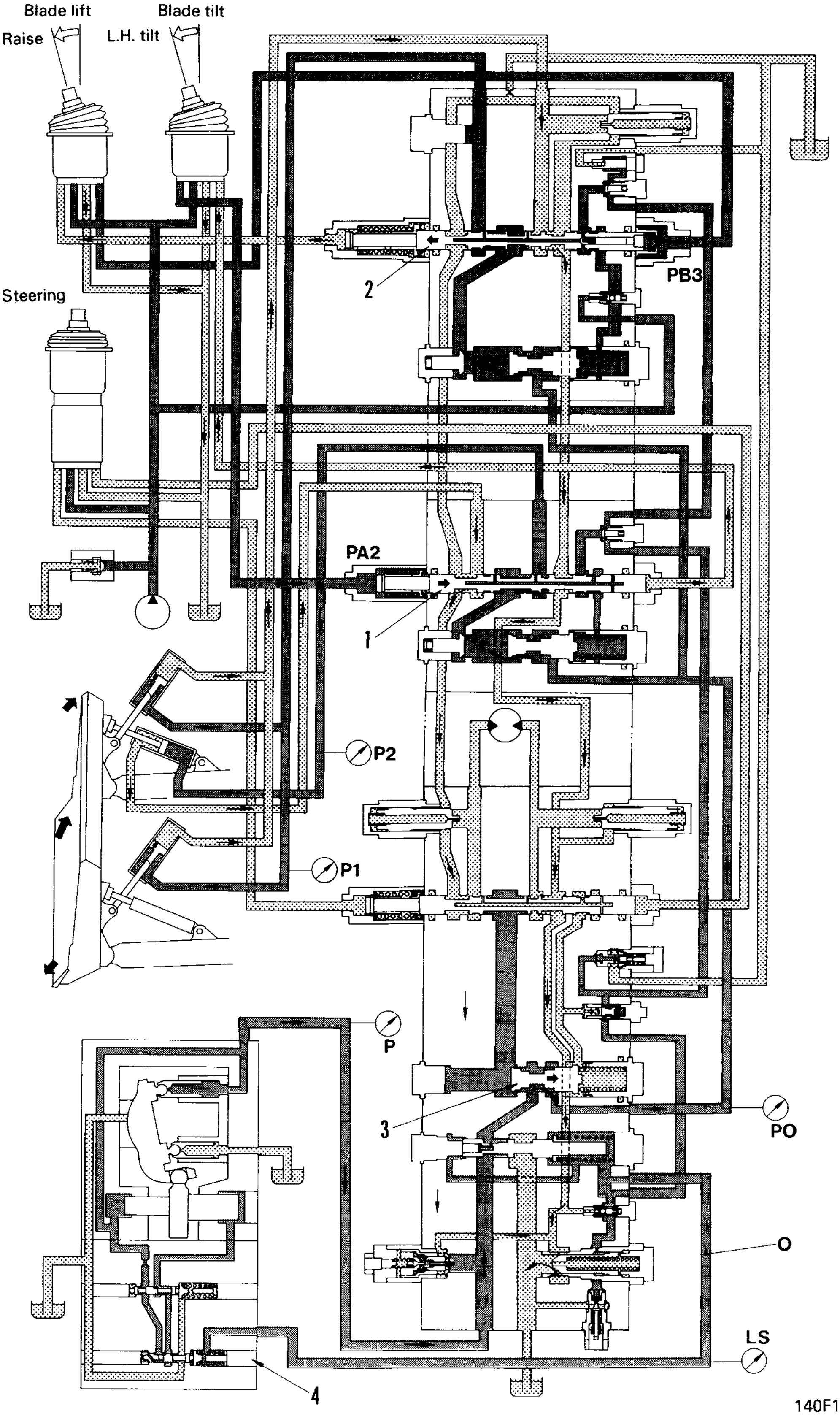
4) When pump swash plate is at maximum angle
   When the maximum flow of oil from the pump is smaller than the sum of the oil flow demanded by the steering valve and work equipment valve.

   ① When steering valve load ≦ work equipment valve load.
   - An amount of oil that matches the opening of steering spool (1) flows to the steering valve, and the remaining oil flows to the work equipment valve.

   ② When steering valve load > work equipment valve load
   - Pump pressure **P** is determined by the steering valve load, but in this condition, if the downstream work equipment valve where the load is smaller is operated, the difference in pressure will cause the oil to try to flow to the work equipment valve, so the pump pressure will drop.
   - When this happens, steering priority valve (3) increases the size of the opening to the steering system, while at the same time reducing the size of the opening to the work equipment in order to ensure the flow of oil to the steering system.
   - In this condition, the flow of oil is divided in proportion to the difference in pressure between differential pressure **P** – **P1** and differential pressure **P** – **P2**.
     The bigger **P1** – **P2** is, the smaller the flow of oil to the steering system becomes.

(2) Compound operation of work equipment valve

★ The diagram shows the condition when the blade lift and tilt valves are operated at the same time.



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- It consists of a parallel circuit, so when compound operations are carried out, the oil flow is divided according to the size of each spool opening.

1) When tilt spool (1) and lift spool (2) are at the **HOLD** position or are operated, steering priority valve (3) is pushed completely to the right, and the size of the opening to the downstream area is at its maximum.

2) Tilt spool (1) and lift spool (2) are actuated by PPC valve output pressure **PA2** and **PB3**, and each is balanced at a position that matches its own pilot pressure.

3) When pressure $\mathbf{P2} \leqq \mathbf{P3}$
Lift valve load pressure **P3** is sent to pump **LS** valve (4) through **LS** passage **O**.

   ① When pump swash plate does not reach maximum angle
   When the maximum flow of oil from the pump is greater than the total of the oil flow demanded by the tilt valve and lift valve, an oil flow that matches the opening of the spool flows to both the tilt valve and lift valve.

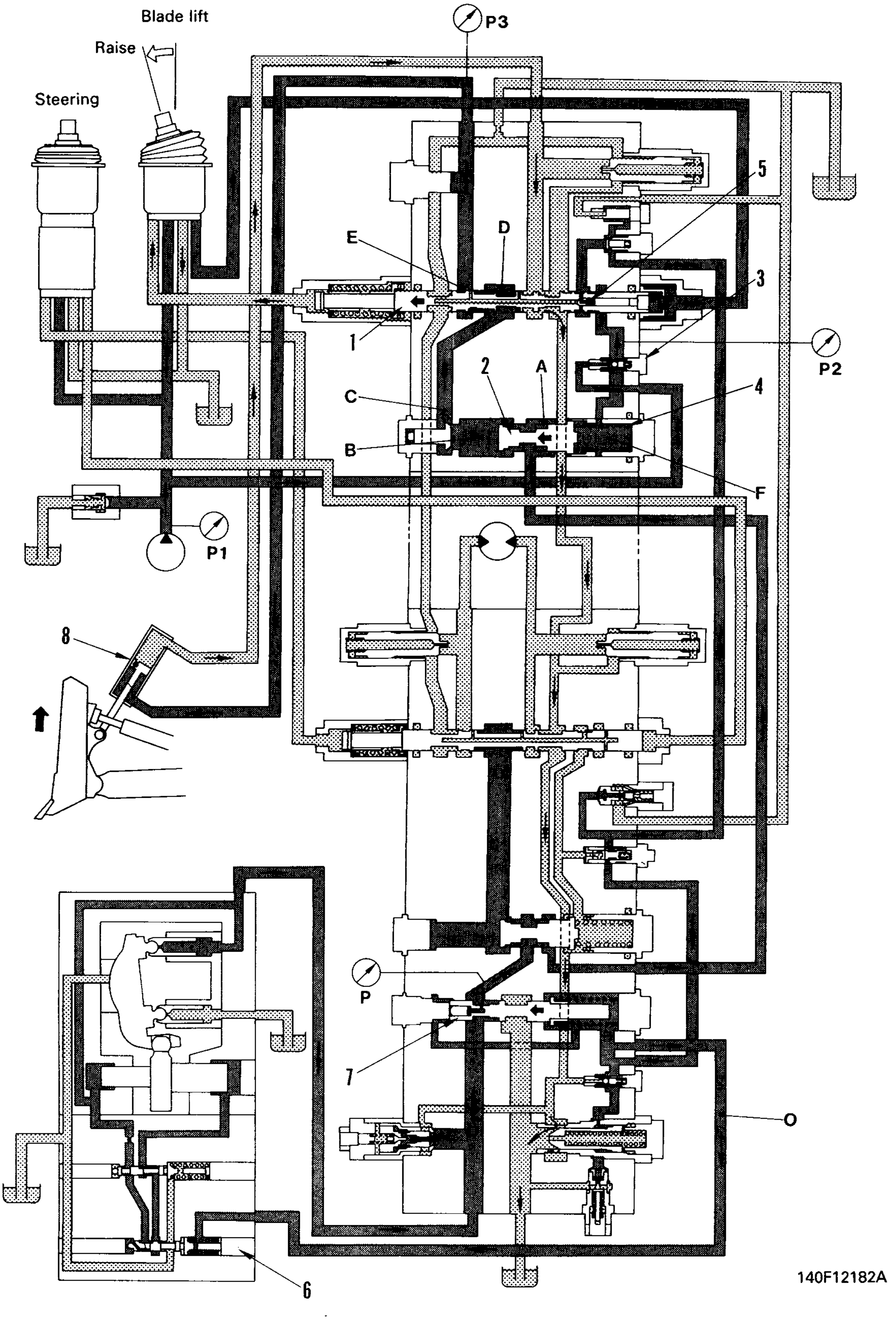
   ② When pump swash plate is at maximum angle
   When the maximum flow of oil from the pump is smaller than the total of the oil flow demanded by the tilt valve and lift valve, the flow of oil to the tilt valve and lift valve is divided according to differential pressure $\mathbf{PO} - \mathbf{P2}$ and differential pressure $\mathbf{PO} - \mathbf{P3}$. In other words, more oil flows to **P2** where the load is small.

   ★ In cases where the blade is raised in the air and the tilt valve and lift valve (for raise) are operated at the same time, the tilt valve load pressure is smaller than the lift valve load pressure, so the flow of oil to the tilt valve is given priority. In addition, the oil flow demanded by the tilt valve is smaller, so the condition is just as if priority was given to the oil flow for the tilt valve.

4) When pressure **P2** = pressure **P3**
$\mathbf{P} - \mathbf{P2} \fallingdotseq \mathbf{P} - \mathbf{P3}$, so an oil flow proportional to the size of the spool opening is distributed to each spool.

5. Unload valve preset system

★ The diagram shows the condition with preset check valve (3) open immediately after blade lift valve is operated.



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- This improves the response of the system including the pump swash plate and pressure compensation valve by sending the pilot pressure (basic pressure of PPC valve) to the **LS** circuit, and compensating the rise of the **LS** circuit pressure.

(1) When lift spool (1) is at the HOLD positon, pilot pressure **P1** (basic pressure of PPC valve) is sent through preset check valve (3) to the chamber **F** of the pressure compensation valve. This pressure is called preset pressure **P2**.
At the same time, unload pressure **P** is being sent to chamber **B**, but **P1** + **FO** > **P** (**FO**: load of spring (4)), so pressure compensation spool (2) moves to the left and the size of the opening between **A** and **B** becomes the maximum.

(2) When spool (1) is switched. Unload pressure **P** flows immediately through chamber **A**, **B**, **C** ,**D** and **E** to lift cylinder (8), so the pressure at the port starts to rise and the time lag becomes smaller.

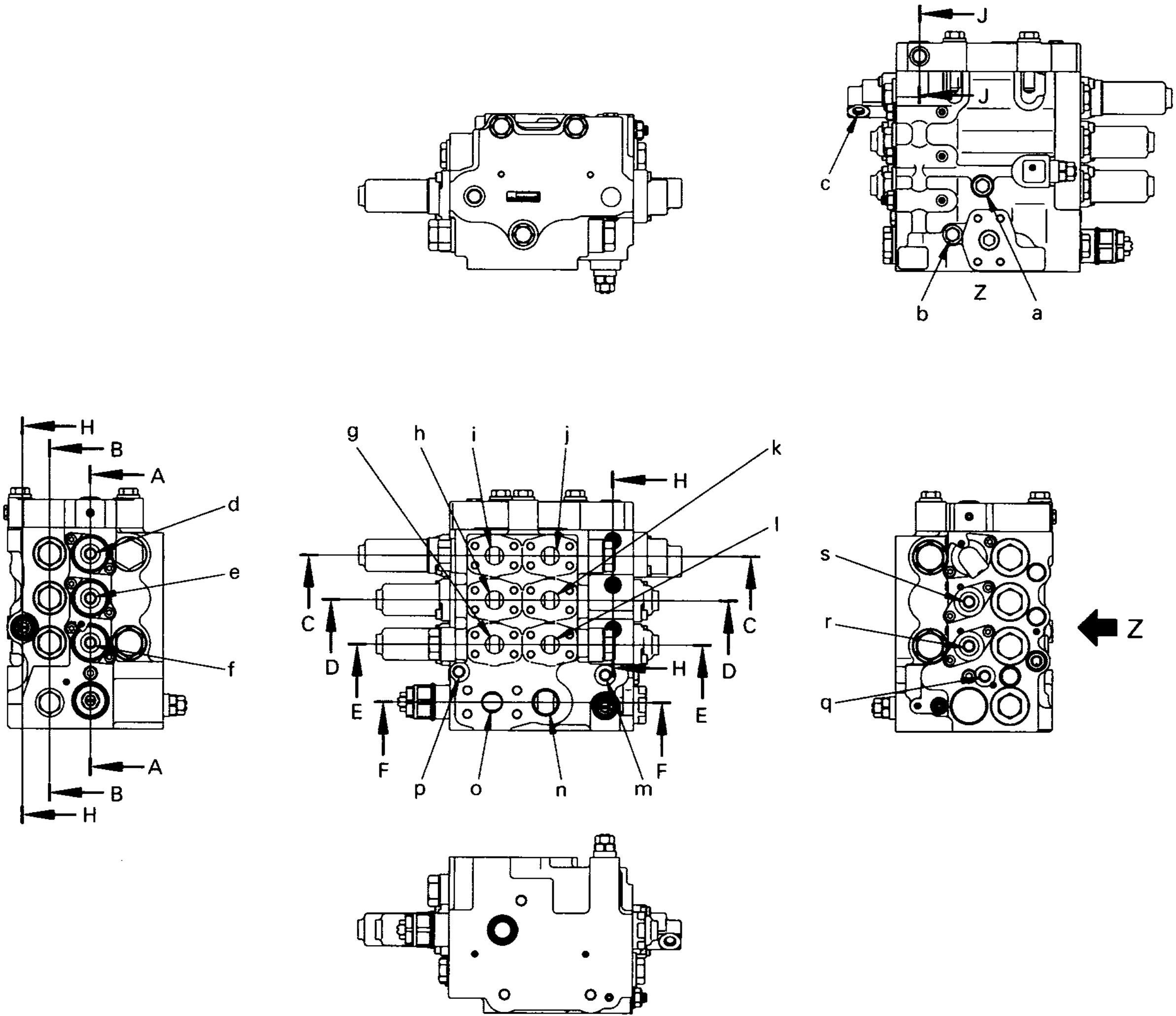
(3) At the same time, preset pressure **P2** is supplied to **LS** circuit **O** by the timing of the spool, and the pressure in the **LS** circuit rises. Because of this, unload valve (7) closes, and oil is sent further to pump **LS** valve (6) to improve the response of the pump swash plate angle. This makes it possible to reduce the response time for giving the necessary oil flow.
Check valve (5) is built into the spool to prevent preset pressure **P2** from venting in force from the cylinder port.

(4) When cylinder port pressure **P3** rises and becomes greater than preset pressure **P2**, it pushes up check valve (5), and oil is sent to chamber **F** of the pressure compensation valve and pump **LS** valve (6) to give the basic △**PLS** control.
When this happens, pressure **P3** at the cylinder port is prevented from entreing PPC pump circuit by preset check valve (3).

MAIN CONTROL VALVE

(3-SPOOL VALVE: BLADE LIFT + TILT + STEERING)

D65EX-12 60942 and up
D65PX-12 60915 and up



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a. Port **PC** (pump pressure plug)
b. Port **PLSC** (LS pressure plug)
c. Port **PB3** (from PPC valve)
d. Port **PA3** (from PPC valve)
e. Port **PA2** (from PPC valve)
f. Port **PA1** (from PPC valve)
g. Port **A1** (to HSS motor)
h. Port **A2** (to tilt cylinder bottom)
i. Port **A3** (to lift cylinder head)
j. Port **B3** (to lift cylinder bottom)
k. Port **B2** (to tilt cylinder head)
l. Port **B1** (to HSS motor)
m. Port **LS** (to pump LS valve)
n. Port **T** (to tank)
o. Port **P** (from pump)
p. Port **TS** (to tank)
q. Port **Pi** (from PPC pump)
r. Port **PB1** (from PPC valve)
s. Port **PB2** (from PPC pump)

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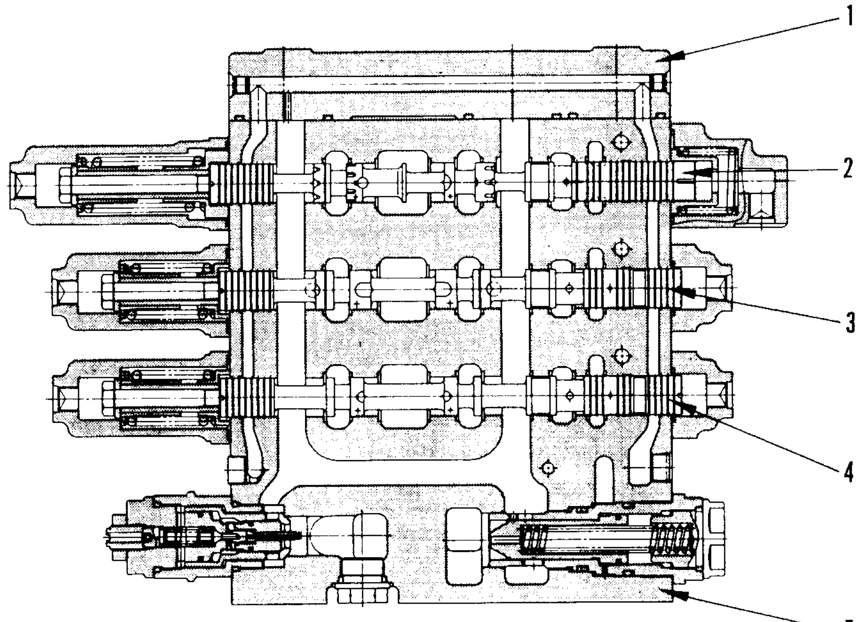
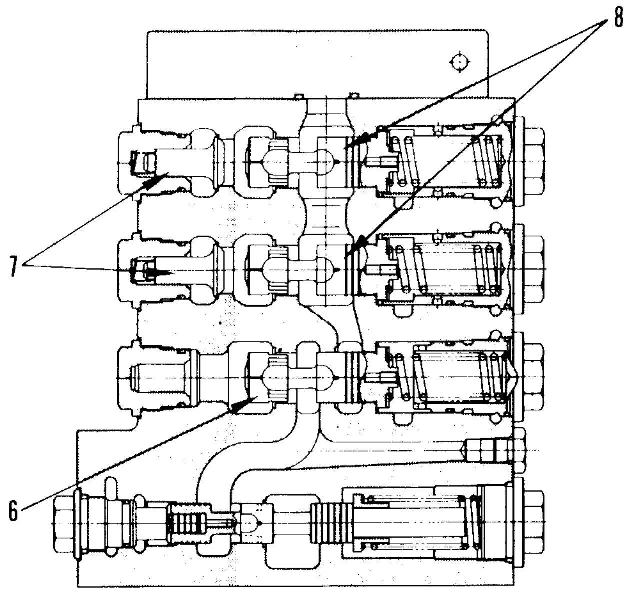
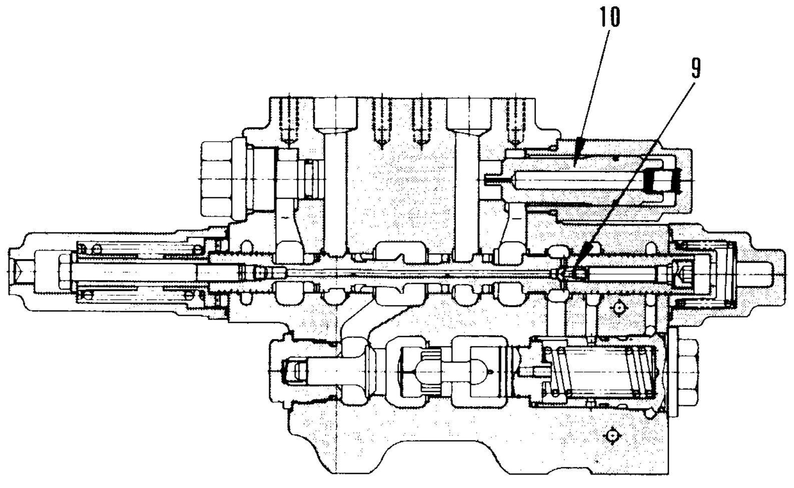


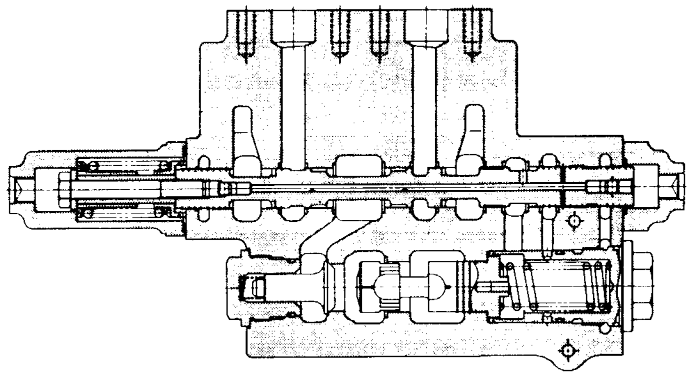
A - A



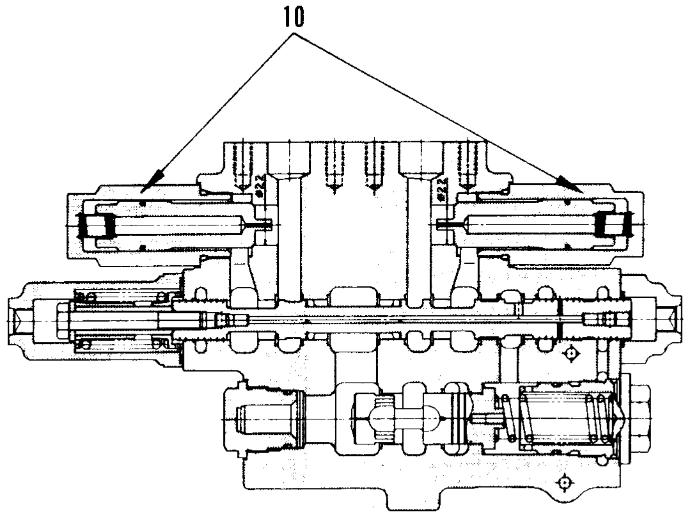
B - B



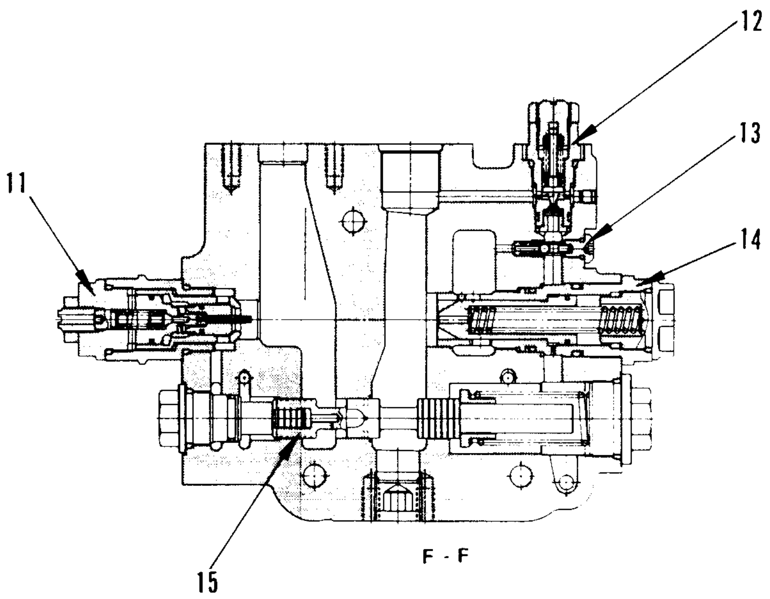
C - C



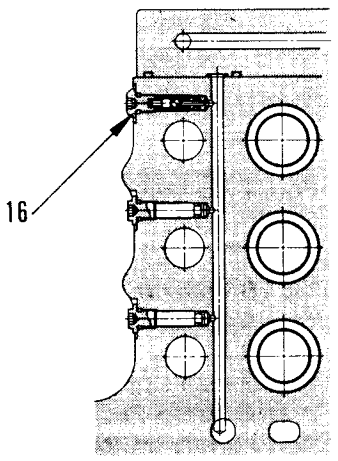
D - D



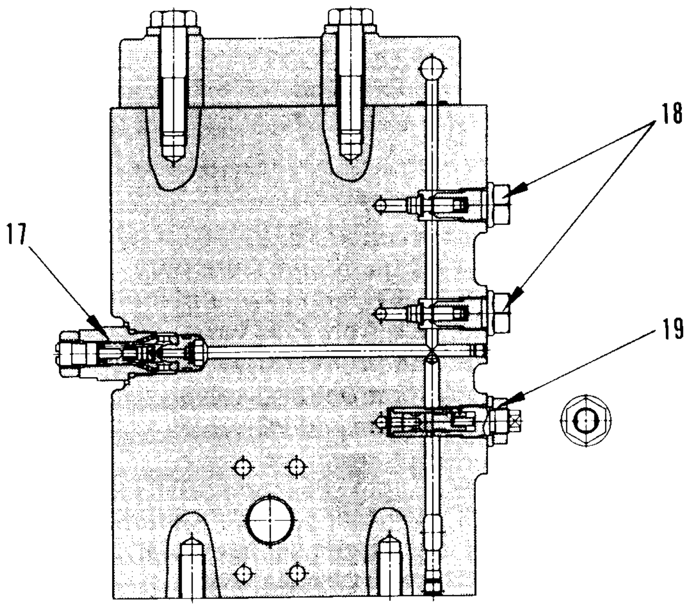
E - E



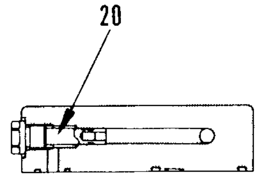
F - F



G - G



H - H



J - J

1. Cover
2. Lift spool
3. Tilt spool
4. Steering spool
5. Valve body
6. Steering priority valve
7. Load check valve
8. Pressure compensation valve
9. Check valve (built into spool)
10. Suction valve
11. Main relief valve
12. LS relief valve (for steering valve)
13. Back pressure check valve
14. Back pressure valve
15. Unload valve
16. Preset check valve
17. LS relief valve (for work equipment valve)
18. LS check valve (for work equipment valve)
19. LS check valve (for steering valve)
20. LS bypass valve

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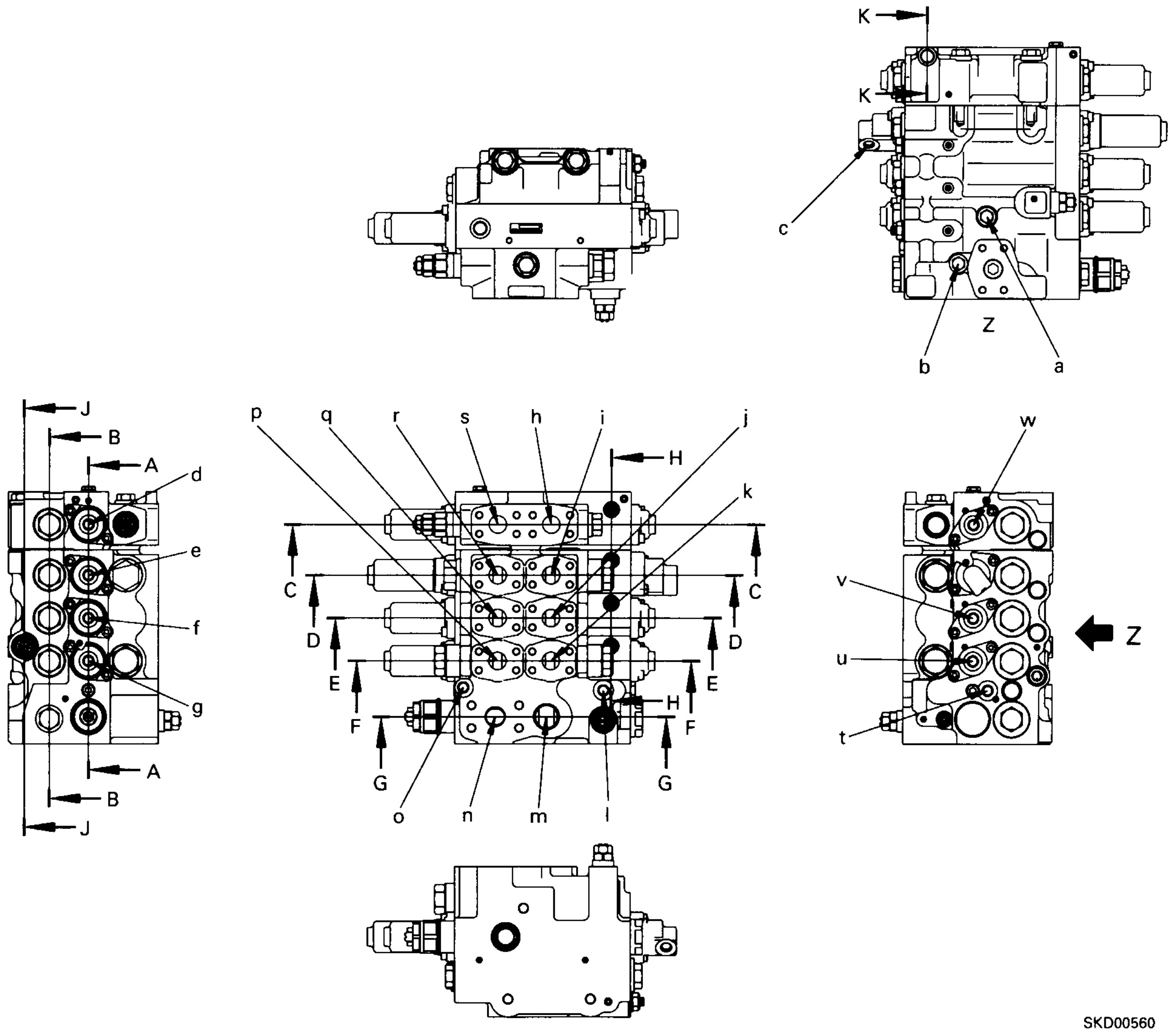
(3 + 1 SPOOL VALVE: RIPPER + BLADE LIFT + TILT + STEERING)

D65EX-12 60942 and up



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a. Port **PC** (pump pressure plug)
b. Port **PLSC** (LS pressure plug)
c. Port **PB3** (from PPC valve)
d. Port **PA4** (from PPC valve)
e. Port **PA3** (from PPC valve)
f. Port **PA2** (from PPC valve)
g. Port **PA1** (from PPC valve)
h. Port **B4** (to ripper cylinder head)
i. Port **B3** (to lift cylinder bottom)
j. Port **B2** (to tilt cylinder head)
k. Port **B1** (to HSS motor)
l. Port **LS** (to pump LS valve)
m. Port **T** (to tank)
n. Port **P** (from pump)
o. Port **TS** (to tank)
p. Port **A1** (to HSS motor)
q. Port **A2** (to tilt cylinder bottom)
r. Port **A3** (to lift cylinder head)
s. Port **A4** (to ripper cylinder bottom)
t. Port **Pi** (from PPC pump)
u. Port **PB1** (from PPC valve)
v. Port **PB2** (from PPC valve)
w. Port **PB4** (from PPC valve)

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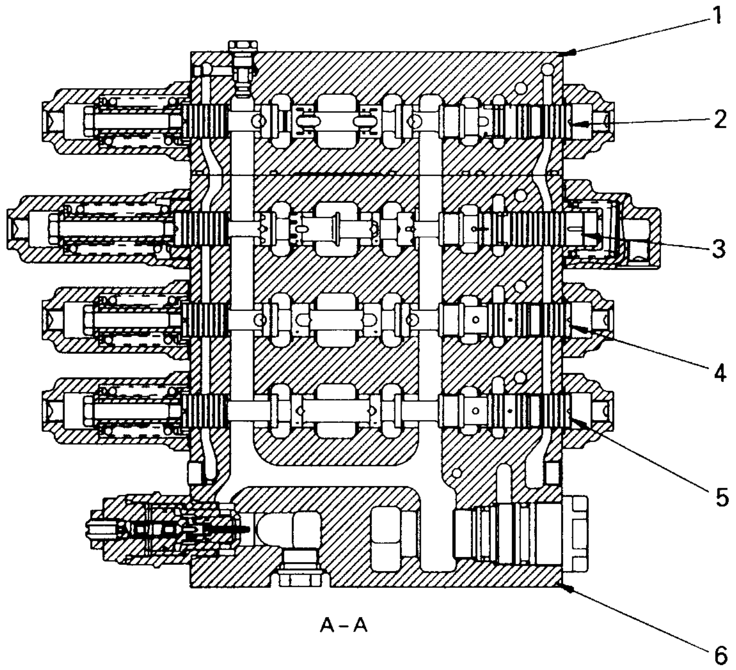
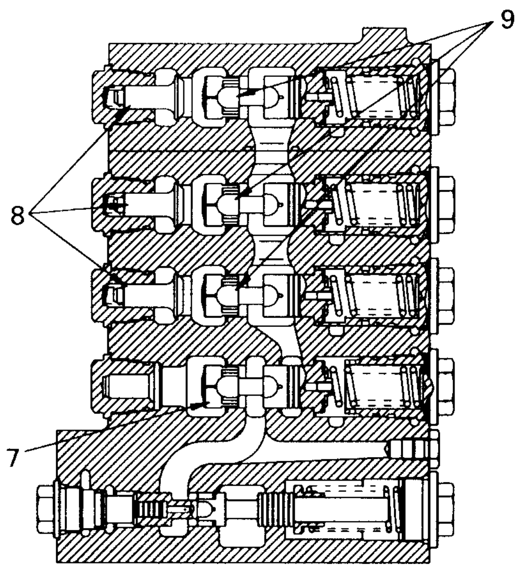
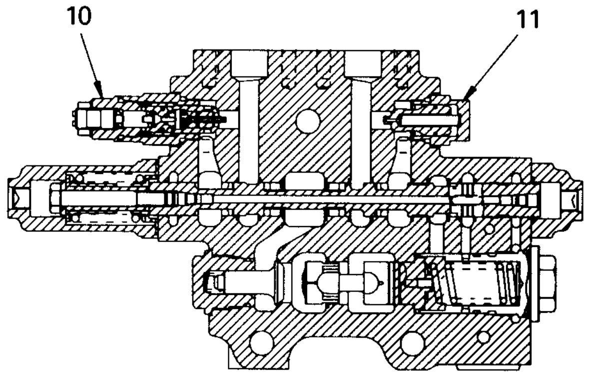


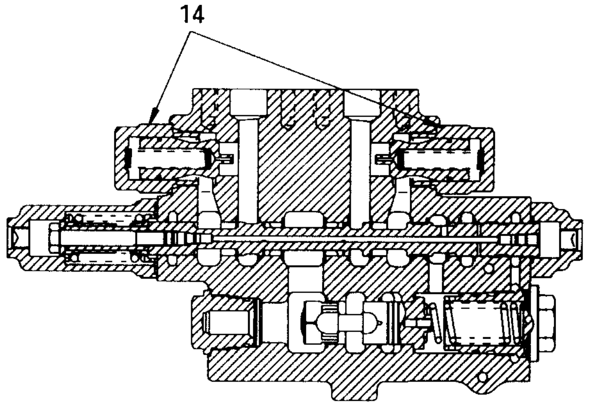
A – A



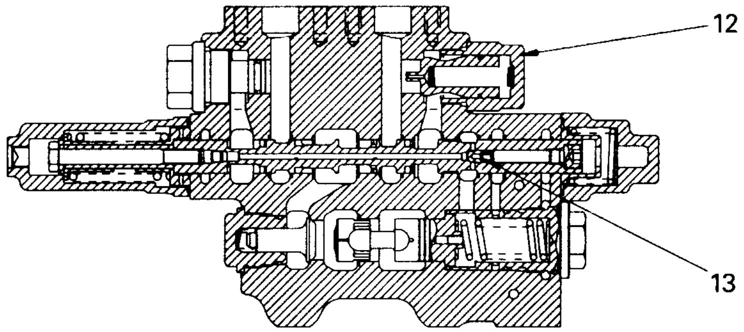
B – B



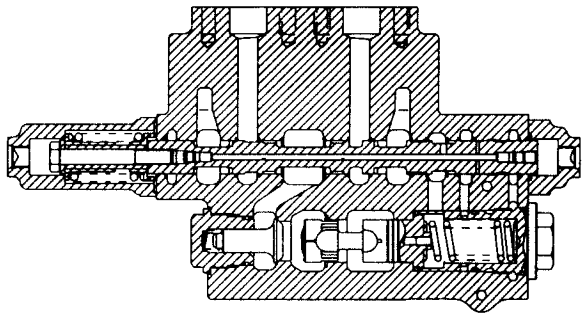
C – C



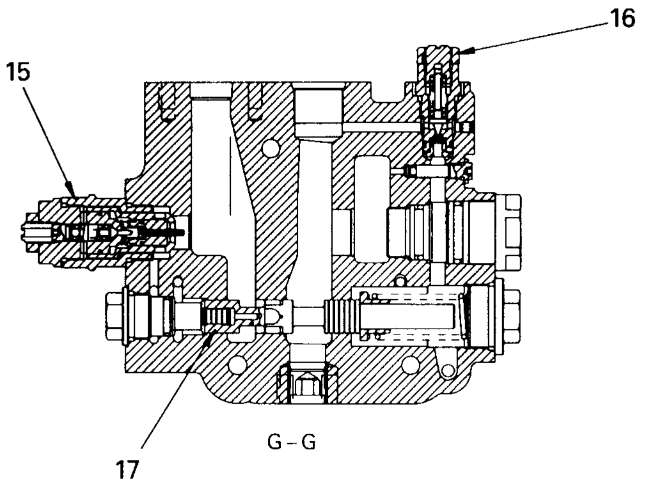
F – F



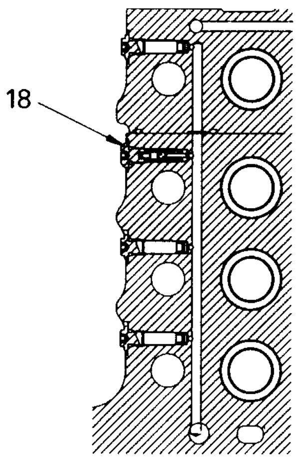
D – D



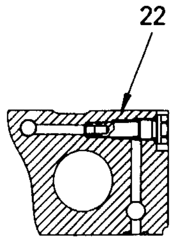
E – E



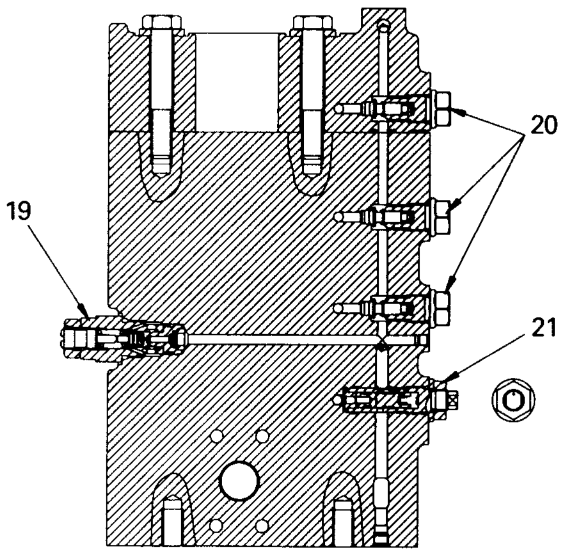
G – G



H – H



K – K

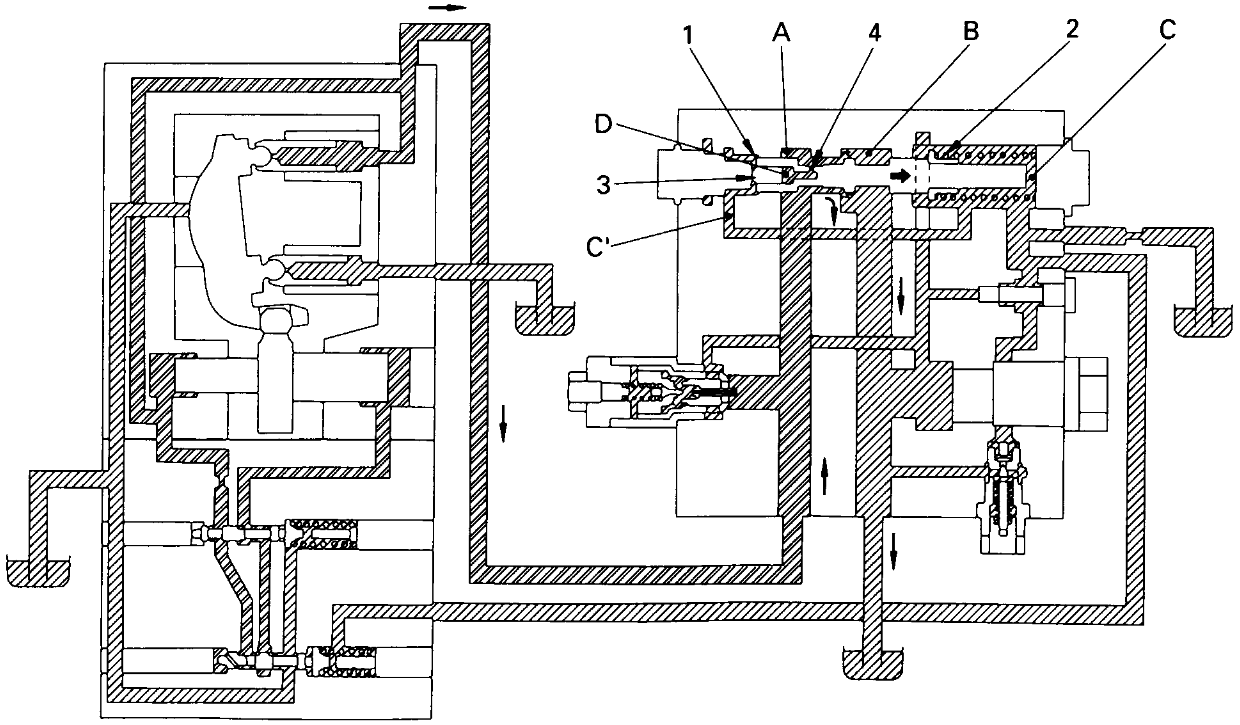


J – J

SKD00561

1. Cover
2. Ripper spool
3. Lift spool
4. Tilt spool
5. Steering spool
6. Valve body
7. Steering priority valve
8. Load check valve
9. Pressure compensation valve
10. Suction safety valve
11. Suction valve
12. Suction valve
13. Check valve (built into spool)
14. Suction valve
15. Main relief valve
16. **LS** relief valve (for steering valve)
17. Unload valve
18. Preset check valve
19. **LS** relief valve (for work equipment valve)
20. **LS** check valve (for work equipment valve)
21. **LS** check valve (for steering valve)
22. **LS** bypass valve

OPERATION OF MAIN CONTROL VALVE



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FUNCTION

- When the main spool is at the HOLD position, it drains the excess oil discharged by the pump, and prevents the pressure from being formed in the circuit from rising.

OPERATION

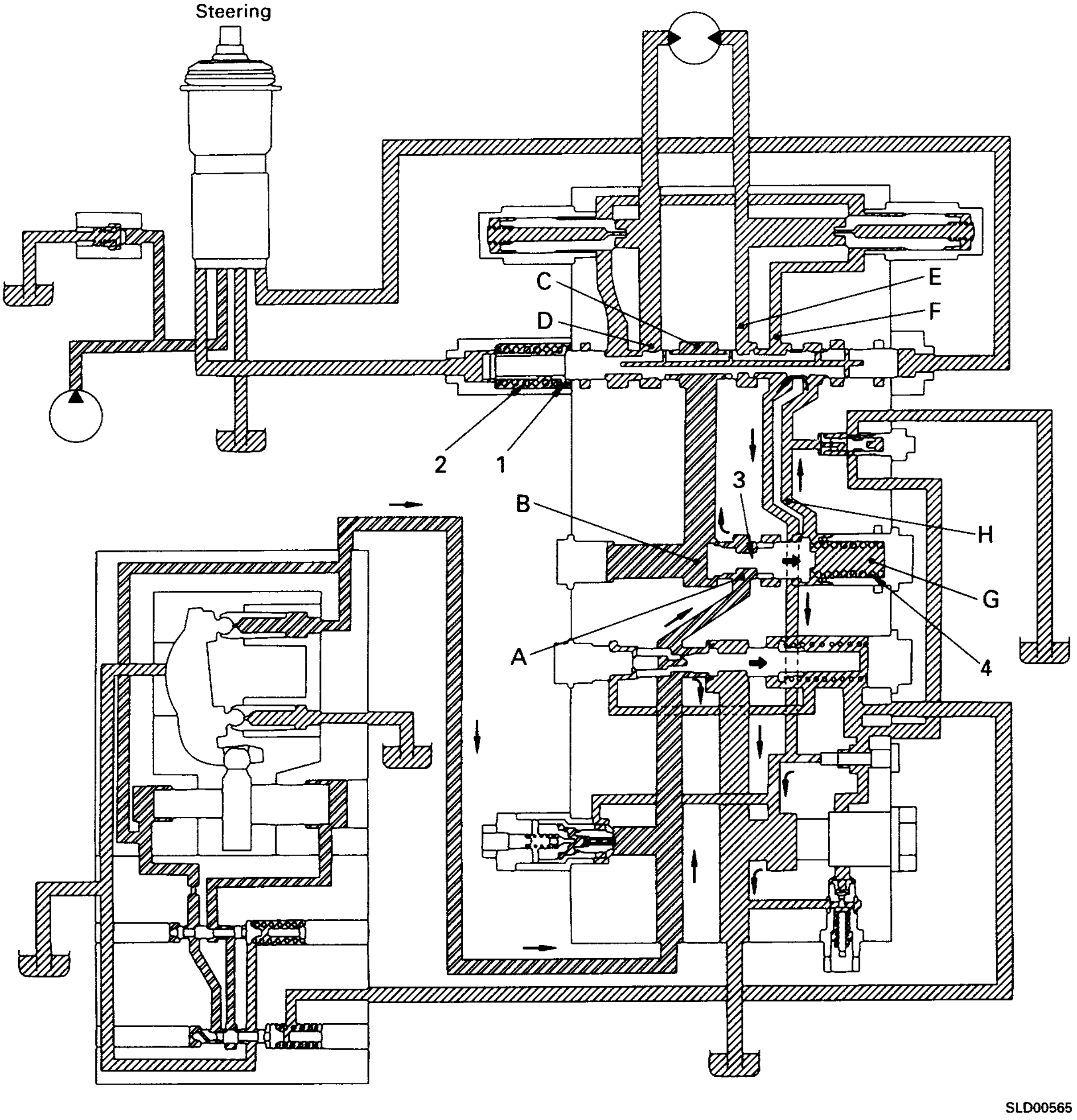
1. AT HOLD (OPERATION OF UNLOAD VALVE)

1) When the main spool is at the HOLD position, the pump pressure passes from chamber **A** through throttle (4) to chamber **D**. Chambers **C** and **C'** are connected to the drain circuit.

2) When oil is supplied from the pump, the pressure in chamber **D** rises, and spool (1) is pushed to the right by pressure **FO** which is determined by the cross–sectional area of piston (3) receiving the pressure.

3) When **FO** becomes larger than set load **FS** of spring (2), the spool moves to the right and connects the passage between chamber **A** and chamber **B**, so the oil from the pump is drained. Therefore, spool (1) is balanced at a position that matches the supply of oil from the pump.
Actually, the amount of oil supplied from the pump is small, so the pressure in the circuit is almost the same as the set load of spring (2).

2. CONTROL OF OIL FLOW



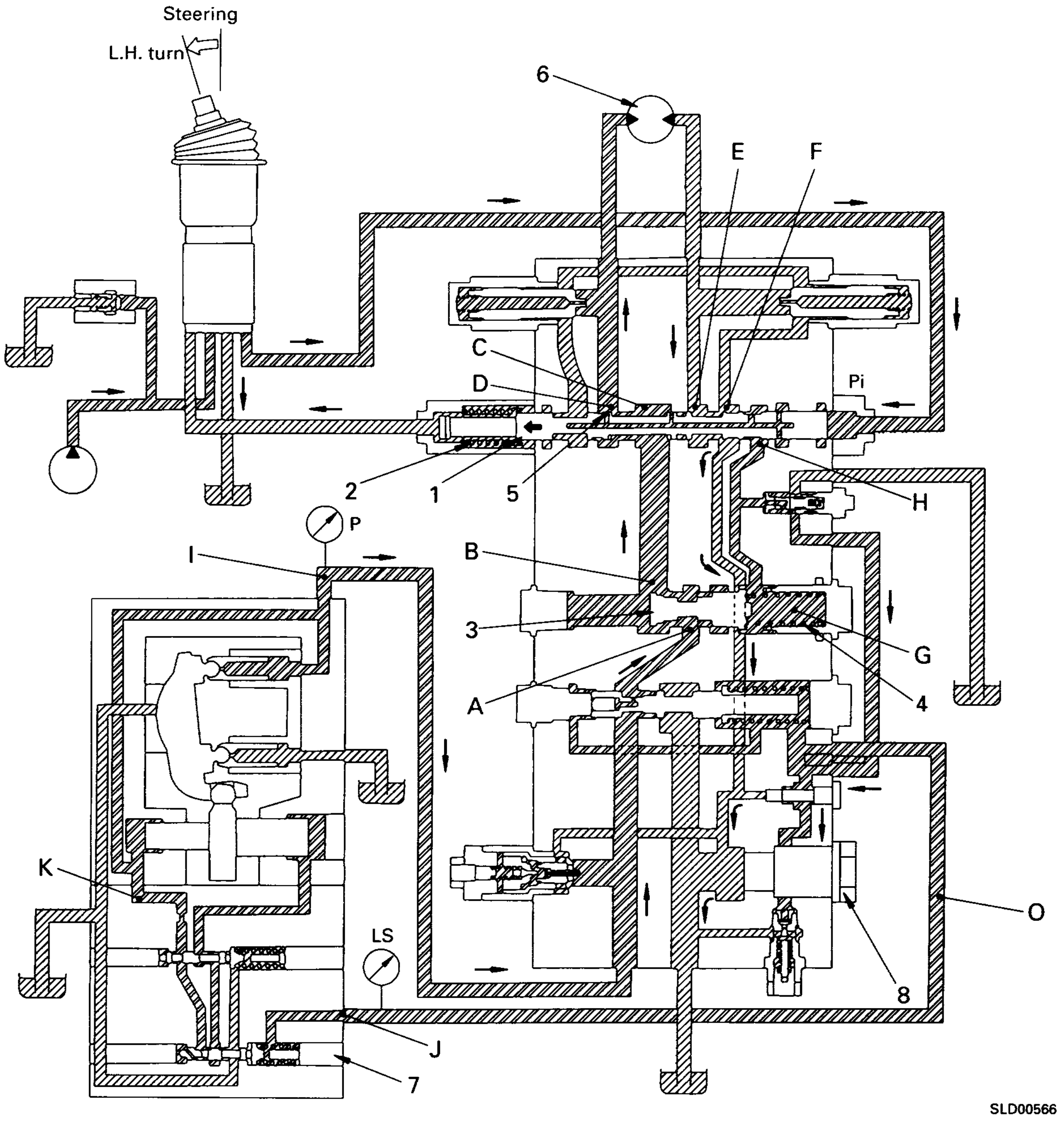
(1) Steering valve

- Use of the **CLSS** circuit (Closed Center Load Sensing System) makes it possible to control the oil flow by adjusting the area of opening of the spool driven by the PPC valve regardless of the load.

(1) At HOLD

When the spool is at the HOLD position, the pump pressure is sent from chamber **A** through the notch in spool (3) of the steering priority valve, and passes through chamber **B** to chamber **C**. Chamber **G** is drained through chamber **H** to chamber **F**.

When this happens, the pump pressure is acting on the left end of spool (3) of the steering priority valve, so it pushes against the load of spring (4) and moves to the right to the maximum stroke position. In this condition, the area of the opening to spool (1) of the steering valve is at its minimum.



- △**PLS** = Differential pressure between ports **K** and **J** = 2.0 MPa (20 kg/cm^2)
- △**PLS'** = Differential pressure between ports **I** and **D**
- △**PLS** ≒ △ **PLS'**

2) When turning to left

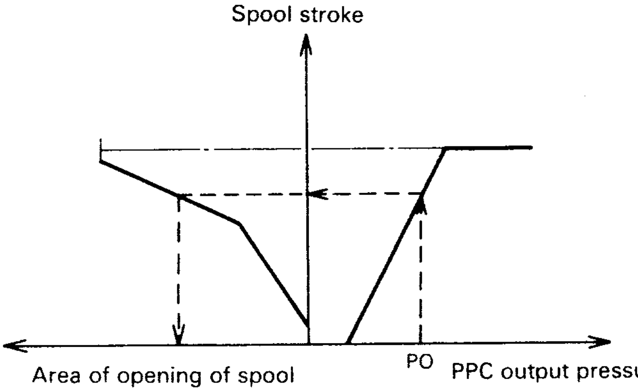
① When the steering lever is operated to turn the machine to the left, pilot pressure **Pi** acts on the right end of spool (1) through the PPC valve, and when the pressure becomes greater than the set load of spring (2), the spool starts to move to the left. It becomes balanced at a position that matches PPC output pressure **Pi**.

② Chamber **C** and chamber **D** are connected, and the oil from the pump flows through ports **A**, **B**, **C** and **D** to HSS motor (6). At the same time, the load pressure in chamber **D** passes through **LS** ofifice (5) and chamber **H**, and is sent to chamber **G**. It is also sent from the **LS** circuit **O** to pump servo valve (7).

③ The condition of the pressure of spool (3) is chamber **B** pressure ≒ chamber **C** pressure, and chamber **G** pressure ≒ chamber **D** pressure, so spool (3) is controlled by the differential pressure of spool (1) (chamber **C** pressure – chamber **D** pressure), and balances with spring (4).

In other words, if the oil flow is too large, the differential pressure of spool (1) becomes larger, so spool (3) moves in the direction to throttle the oil flow; on the other hand, if the oil flow is too small, spool (3) moves in the direction to increase the oil flow.

④ In addition, pump servo valve (7) is controlled so that the differential pressure between pump pressure **P** and **LS** pressure **LS** (**LS** differential pressure: △ **PLS**) remains constant, so a suitable amount of oil flows to ensure that the loss of pressure at the control valve (△ **PLS'**) is equal to △ **PLS**. The loss of pressure in the control valve is determined by the area of the opening of the main spool, so the oil flow matches the opening of the spool.



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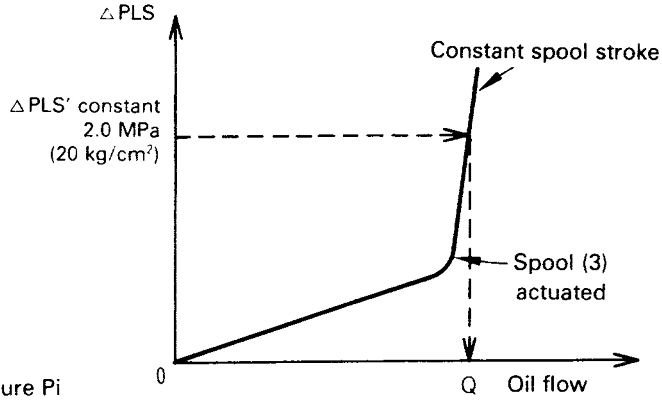

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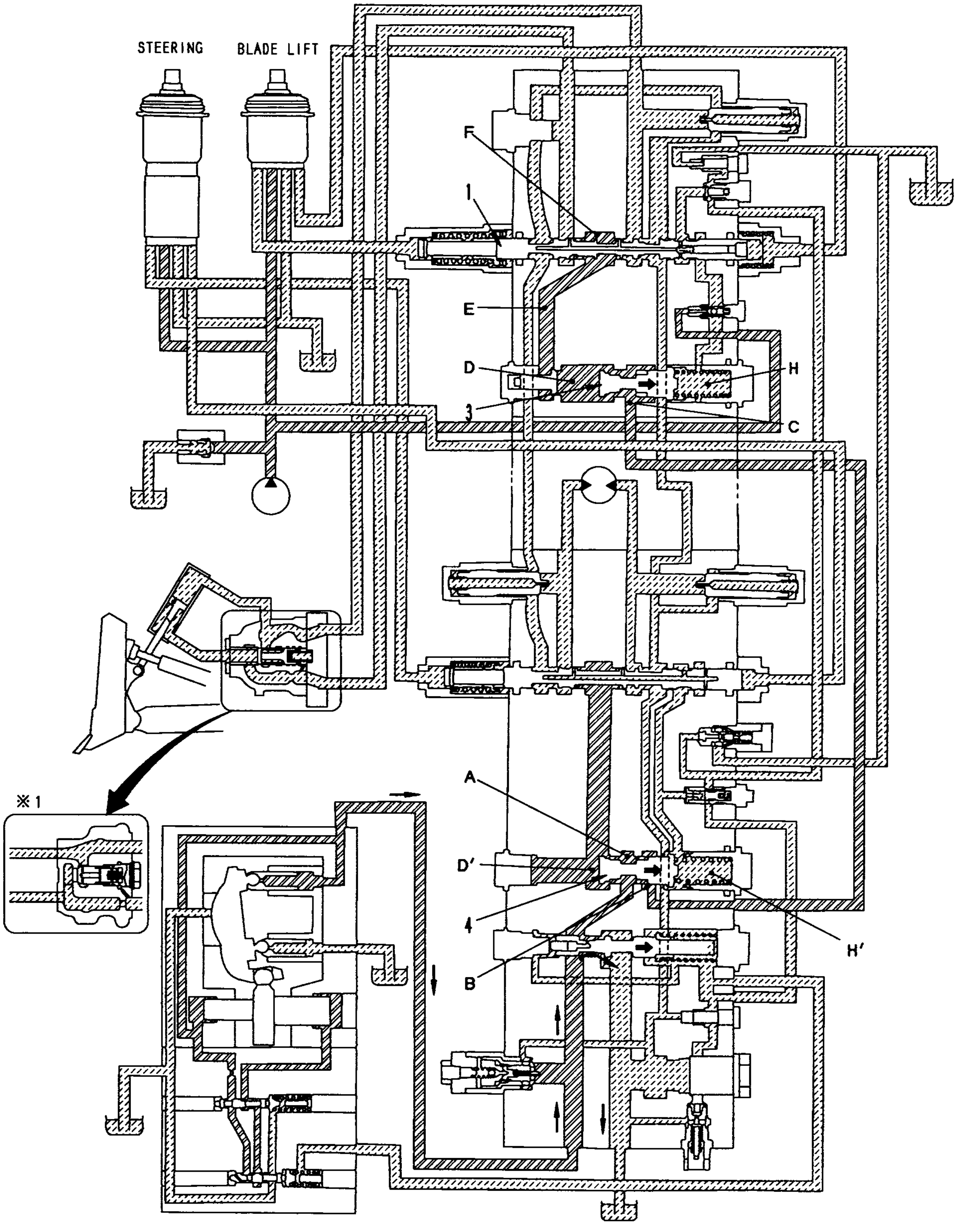
⑤ The return oil flow from the HSS motor passes through chamber **E** and chamber **F**, and is drained.

(2) Work equipment valve (tilt valve, lift valve, ripper valve)

★ The diagram shows the blade lift valve.

※1. Serial Numbers
D65EX-12 61446 and up
D65PX-12 61369 and up



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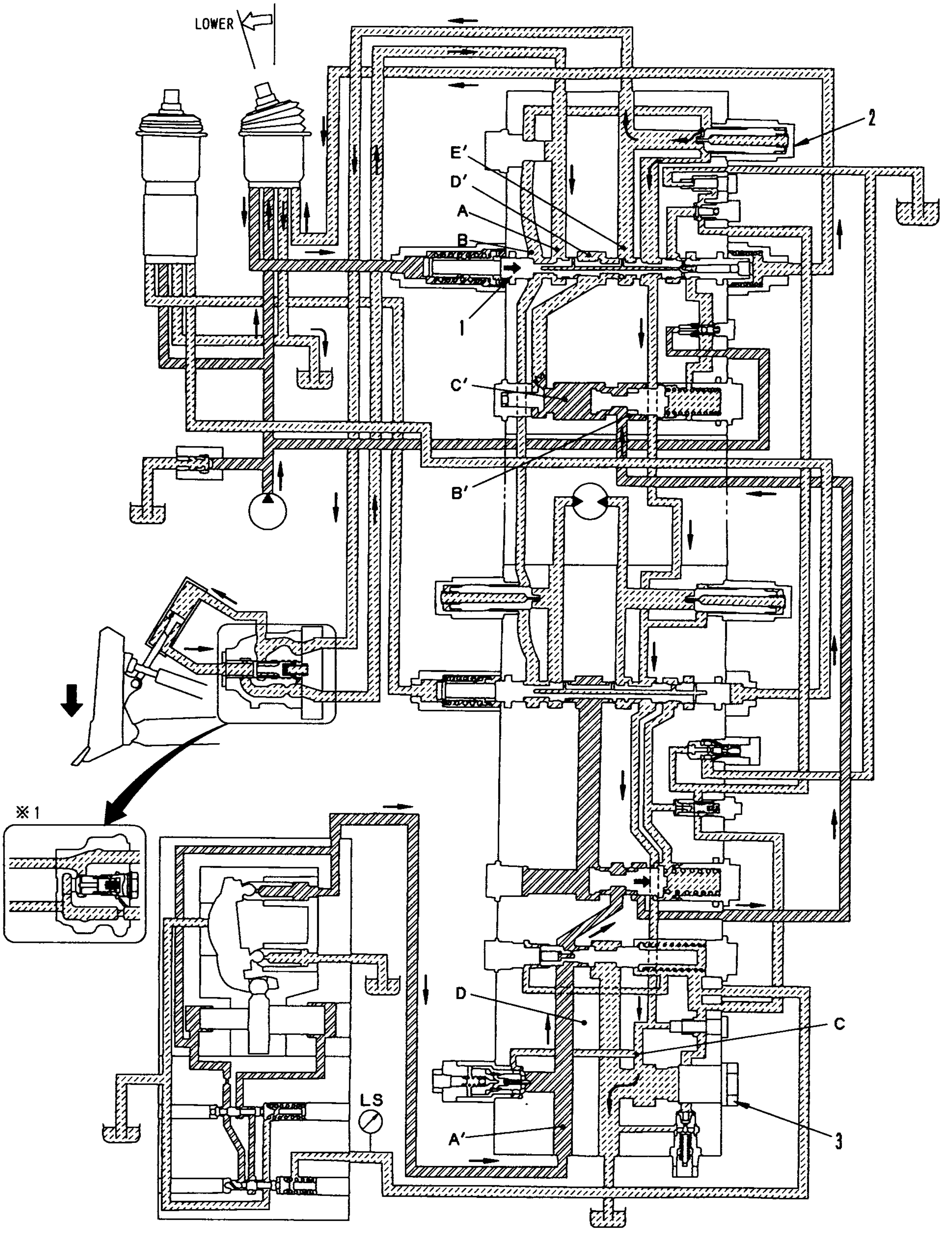
1) When spool (1) of the work equipment valve is at the HOLD position, the pump pressure (unload pressure) is sent to chambers **D** and **D'**. The pressure is not formed in chambers **H** and **H'**, so pressure compensation valve spool (3) and steering compensation valve spool (4) are pushed completely to the right.

2) The pump pressure passes through chambers **A** and **B** of steering priority valve (4), and is sent to chamber **C** of the main control valve. From here it goes through chamber **D** and chamber **E** to chamber **F**.

3) In the same way as for Item **(1) Steering valve**, the position of pressure compensation valve spool (3) is determined to match the opening of spool (1) of the work equipment valve, and the oil flow is determined so that the pressure loss of the control valve becomes equal to the differential pressure △**LS** of **LS** valve (7).

(3) Meter-out control when blade moves down under its own weight

※1. Serial Numbers
D65EX-12 61446 and up
D65PX-12 61369 and up



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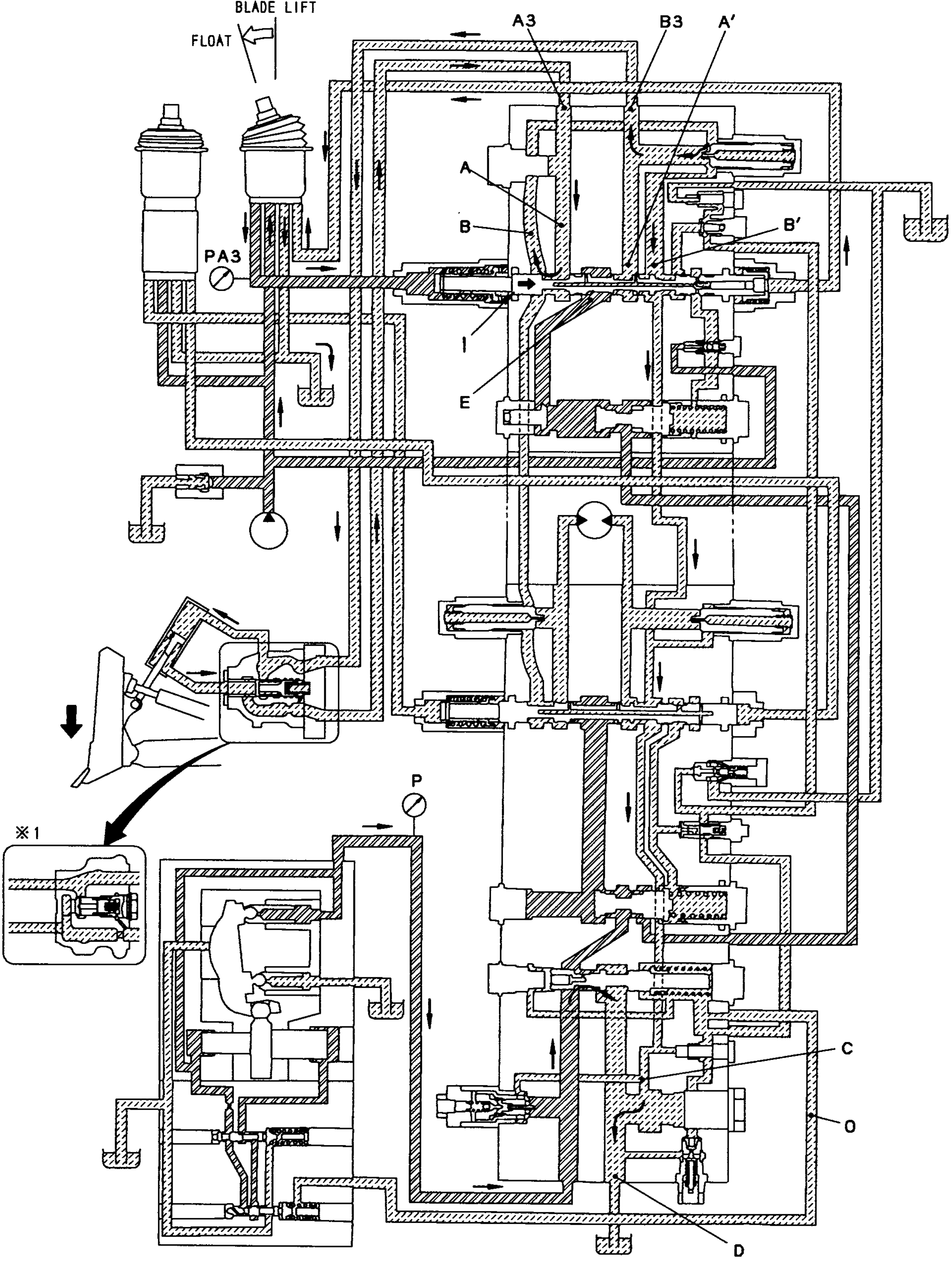
- If the blade moves down under its own weight, the oil flow of return oil from cylinder is controlled by the area of the opening of main spool (1).

1) When the spool port is opened by PPC output pressure **Pi**, because of the weight of the blade, the oil at the cylinder head passes through ports **A**, **B**, **C** and **D**, and is drained to the tank.
   When this happens, the flow of return oil from the lift cylinder is throttled by the area of opening between ports **A** and **B**, so the downward speed is controlled.

2) The oil flowing from the cylinder head end passes from the drain circuit through suction valve (2) and is supplied to the bottom end of the cylinder.
   The oil discharged from the pump passes through ports **A'**, **B'**, **C'**, **D'** and **E'**, and is supplied to the cylinder bottom.

(4) Meter-out control when blade moves down under its own weight (work equipment lever at FLOAT)

※1. Serial Numbers
D65EX-12 61446 and up
D65PX-12 61369 and up



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- When the lift valve is at FLOAT, the cylinder port and drain port are connected to put the circuit in a no–load condition.
- When the lift valve is in the FLOAT condition, the pump passage and cylinder ports **A3** and **B3** are separated so that the other control valves can be operated.

1) When the work equipment control lever is at the FLOAT position, if pressure **PA3** becomes 3.4 MPa (35 kg/cm^2) or more, lift spool (1) is moved to the maximum stroke position.

2) In this condition, ports **A3** and **B3** and the **LS** passage **O** are all connected to the drain circuit, so there is no load on the lift cylinder.

3) If the cylinder is driven by the weight of the blade, the oil entering from port **A3** flows to ports **A**, **B**, **B'** and **A'**, while the rest of the oil flows through ports **C** and **D**, and is drained.
When this happens, the oil flows is throttled by the area of opening between ports **A** and **B** of spool (1), and the cylinder speed is controlled.

4) The pump circuit chamber **E** and ports **A3** and **B3** are separated, and pump pressure **P** is formed, so it is possible to carry out compound operations with other control valves.

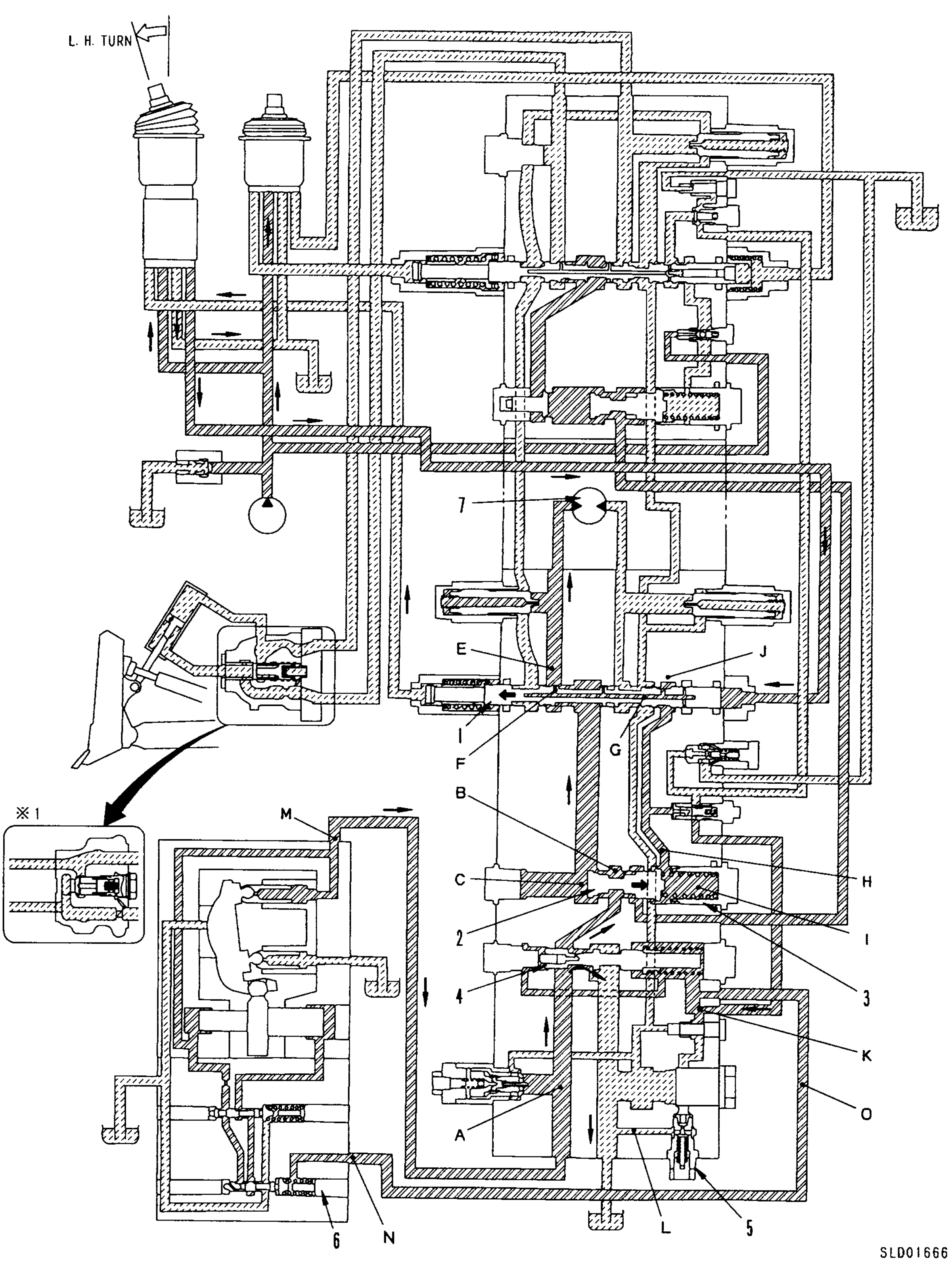
014012

3. AT RELIEF

(1) Steering valve

★ The diagram shows the condition at relief for steering **LS** relief valve (5).

※1. Serial Numbers
D65EX-12 61446 and up
D65PX-12 61369 and up



- △**P1** = △**P3** + △**P4** = Differential pressure between ports **M** and **E**
- △**P2** = Differential pressure between ports **E** and **N**
- △**P3** = Differential pressure between ports **M** and **B**
- △**P4** = Differential pressure between ports **B** and **E**
- △**LS** = △**P1** + △**P2** = Differential pressure between ports **M** and **N** = 2.0 MPa (20 kg/cm²)

014012

- If specifies the maximum pressure when the HSS is operated.

1) If the pressure of HSS motor (7) becomes higher, steering **LS** relief valve (5) will crack and oil will be drained from **LS** circuit **O**. (Ports **E**, **F**, **G**, **J**, **K** and **L**)
   As a result, there will be a drop in pressure in **LS** passage **O** starting from **LS** sensing hole **F**, and △**P2** will become larger.

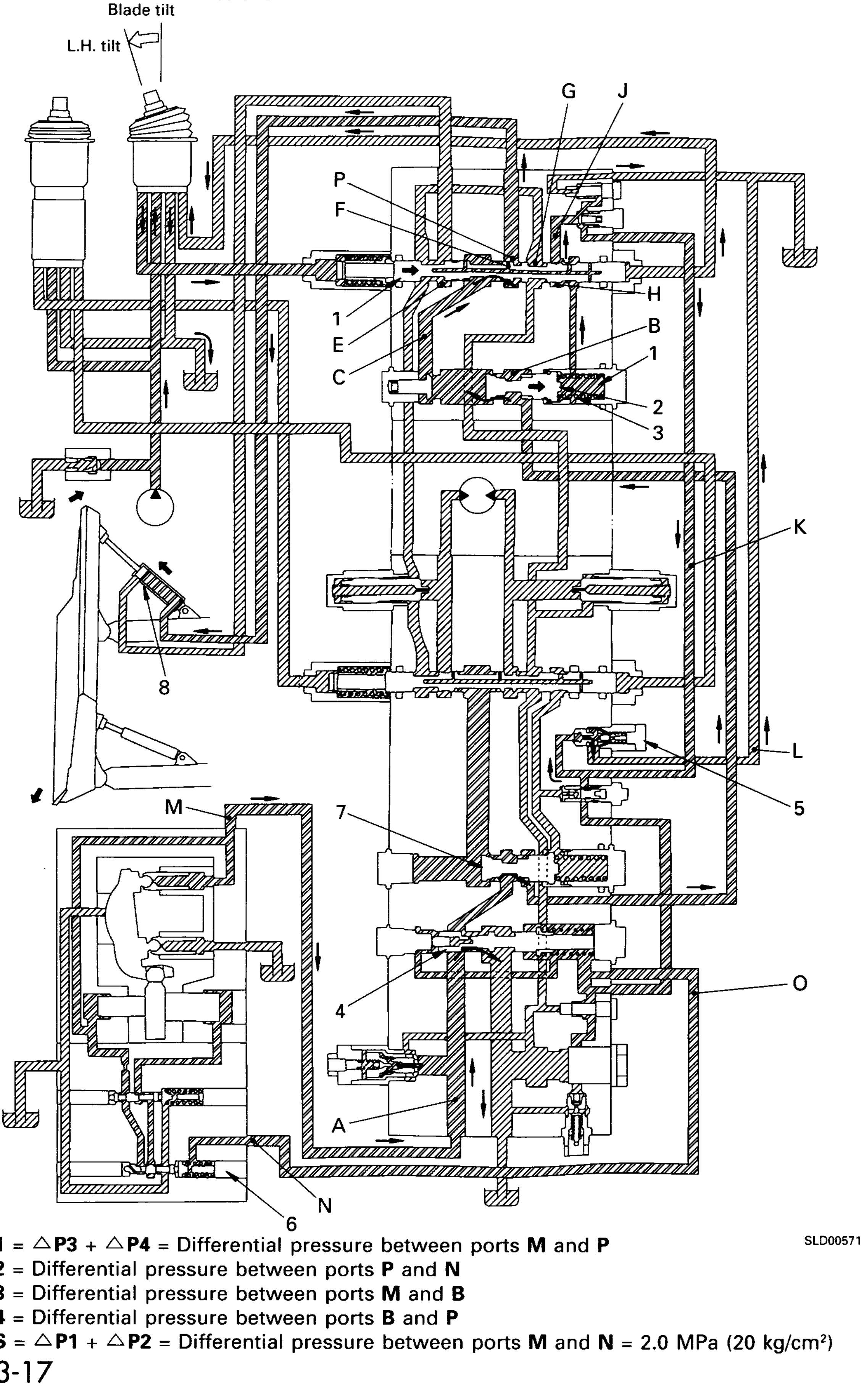
2) For the same reason, if the pressure in chambers **H** and **I** drops, spool (2) will push against spring (3) and move to the right, and will make the opening between chambers **B** and **C** smaller, so the flow to chambers **B** and **C** will be throttled and △**P4** will become larger.

3) Because of the pump swash plate control, the system circuit is balanced at a circuit pressure which makes the pressure loss generated by the flow at steering **LS** relief valve (5). △ **P1** + △ **P2** equal to **LS** differential pressure (△**LS**).
   When this happens, pump **LS** valve (6) detects the differential pressure generated by **LS** relief valve (5), and moves the pump swash plate from the maximum to the minimum position.
   The pump swash plate is balanced at a position where the **LS** differential pressure is 2.0 MPa (20 kg/cm^2.)

4) When the pump is at the minimum swash plate angle (minimum oil flow), if the minimum oil flow is greater than the **LS** relief oil flow + leakage at any part, the pressure is confined in the pump circuit (between the pump and chambers **A** and **B**), so the **LS** differential pressure rises. If this differential pressure goes above the set pressure for unload valve (4), the unload valve is actuated to releive the excess oil flow and balance the circuit.

(2) Blade lift, tilt, ripper valve

★ The diagram shows the relief condition of work equipment **LS** relief valve (5) with the blade tilt at the end of its stroke.



- △**P1** = △**P3** + △**P4** = Differential pressure between ports **M** and **P**
- △**P2** = Differential pressure between ports **P** and **N**
- △**P3** = Differential pressure between ports **M** and **B**
- △**P4** = Differential pressure between ports **B** and **P**
- △**LS** = △**P1** + △**P2** = Differential pressure between ports **M** and **N** = 2.0 MPa (20 kg/cm^2)

1) If blade tilt valve (1) is moved, and the pressure of tilt cylinder (8) becomes higher, work equipment **LS** relief valve (5) will crack and oil will be drained from **LS** circuit **O**.
(Ports **E**, **F**, **G**, **J**, **K** and **L**)
As a result, there will be a drop in pressure in **LS** passage **O** starting from **LS** sensing hole **F**, and △**P2** will become larger.

2) For the same reason, if the pressure in chambers **H** and **I** drops, spool (2) will push against spring (3) and move to the right, and will make the opening between chambers **B** and **C** smaller, so the flow between chambers **B** and **C** will be throttled and △**P4** will become larger.

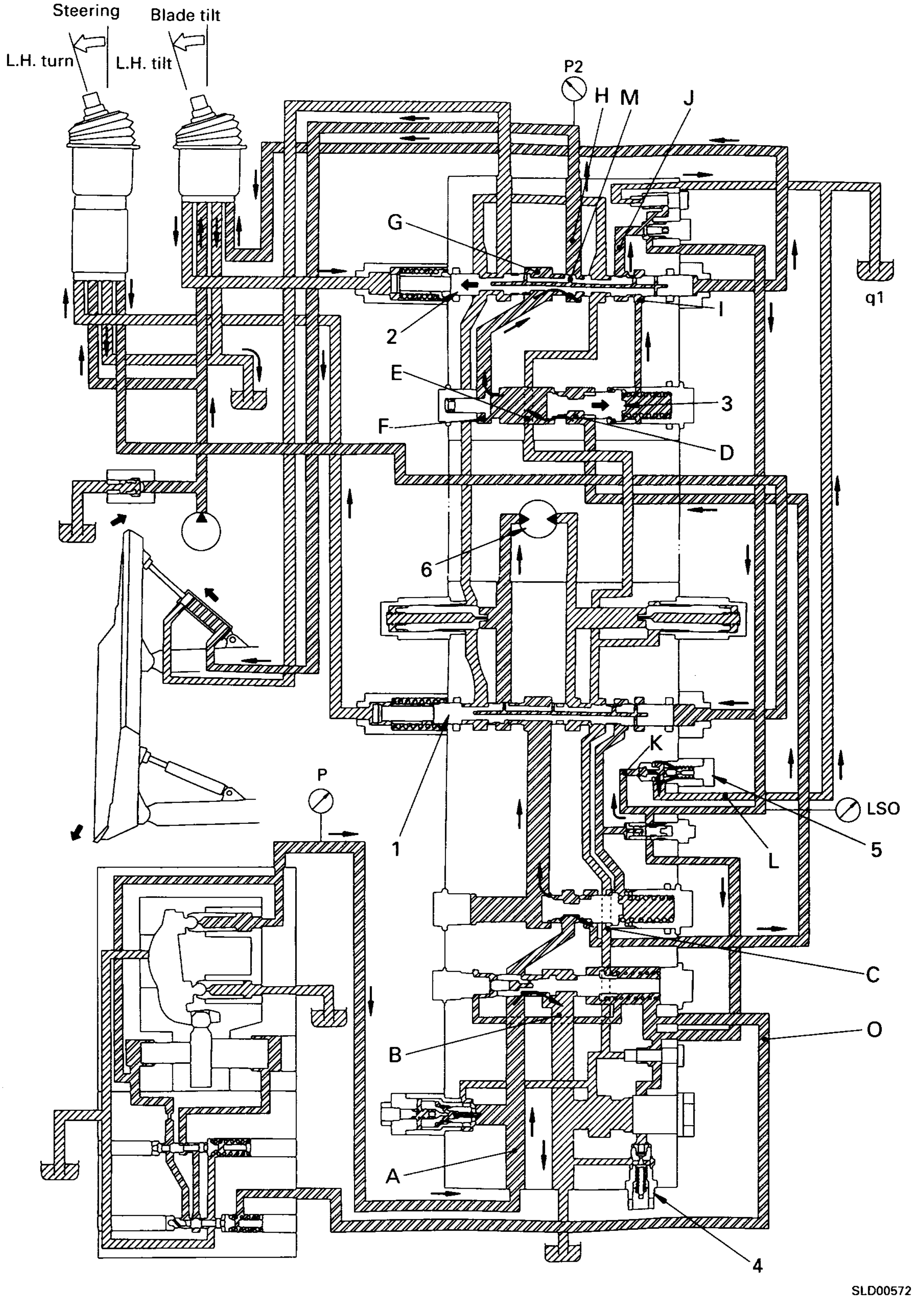
3) Because of the pump swash plate control, the system circuit is balanced at a circuit pressure which makes the pressure loss generated by the flow at work equipment **LS** relief valve (5) △ **P1** + △ **P2** equal to **LS** differential pressure (△**LS**).
When this happens, pump **LS** valve (6) detects the differential pressure generated by **LS** relief valve (5), and moves the pump swash plate from the maximum to the minimum position.
The pump swash plate is balanced at a position where the **LS** differential pressure is 2.0 MPa (20 kg/cm^2.)

4) When the pump is at the minimum swash plate angle (minimum oil flow), if the minimum oil flow is greater than the **LS** relief oil flow + leakage at any part, the pressure is confined in the pump circuit (between the pump and chambers **A** and **B** through steering priority valve (7)), so the **LS** differential pressure rises. If this differential pressure goes above the set pressure for unload valve (4), the unload valve is actuated to releive the excess oil flow and balance the circuit.

(3) Steering + work equipment valve (compound operations)

★ The diagram shows the relief condition of **LS** relief valves (4) and (5) at steering stall with the blade tilt at the end of its stroke.

- △= **P** – **P2**
- △**PO** = Differential pressure between ports **H** and **K**
- Pressure **P2** = **LSO** + △**PO**



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- When steering valve (1) and work equipment valve (2) are relieved at the same time, the pump pressure is separated by pressure compensation valve (3) in the work equipment valve, and the port pressure is maintained at a constant value.

1) If HSS motor (6) reaches the stall condition, the load pressure increases and **LS** relief valve (4) for the steering valve is actuated, so the system is cut off (for details, see Item **(1) Steering valve**).

2) When this happens, the pump pressure is maintained at 38.2 MPa (390 kg/cm^2), and this is sent to chamber **G** of the work equipment valve.

3) When work equipment valve (2) is ooperated and the load on the work equipment valve is greater, work equipment **LS** relief valve (5) is actuated, and drain oil flow **Q1** flows to **LS** circuit **O**. As a result, a differential pressure is generated on the left and right sides of pressure compensation valve (4) by **LS** throttle **M** of spool (2), and it moves the full stroke to the right. When this happens, the opening between chambers **D** and **E** is throttled to the minimum size (pump pressure separated).

4) Oil flow **Q1** is determined by pump pressure **P** and the total pressure loss △ (**P** – **LSO**) of ports **C**, **D**, **E**, **F**, **G**, **I**, **J** and **K**. Furthermore, pressure **P2** (the pressure in chamber **H**) becomes the total (**LSO** + △ **PO**) of the circuit pressure loss of ports **H**, **I**, **J** and **K**, and the set pressure of work equipment **LS** relief valve (5).

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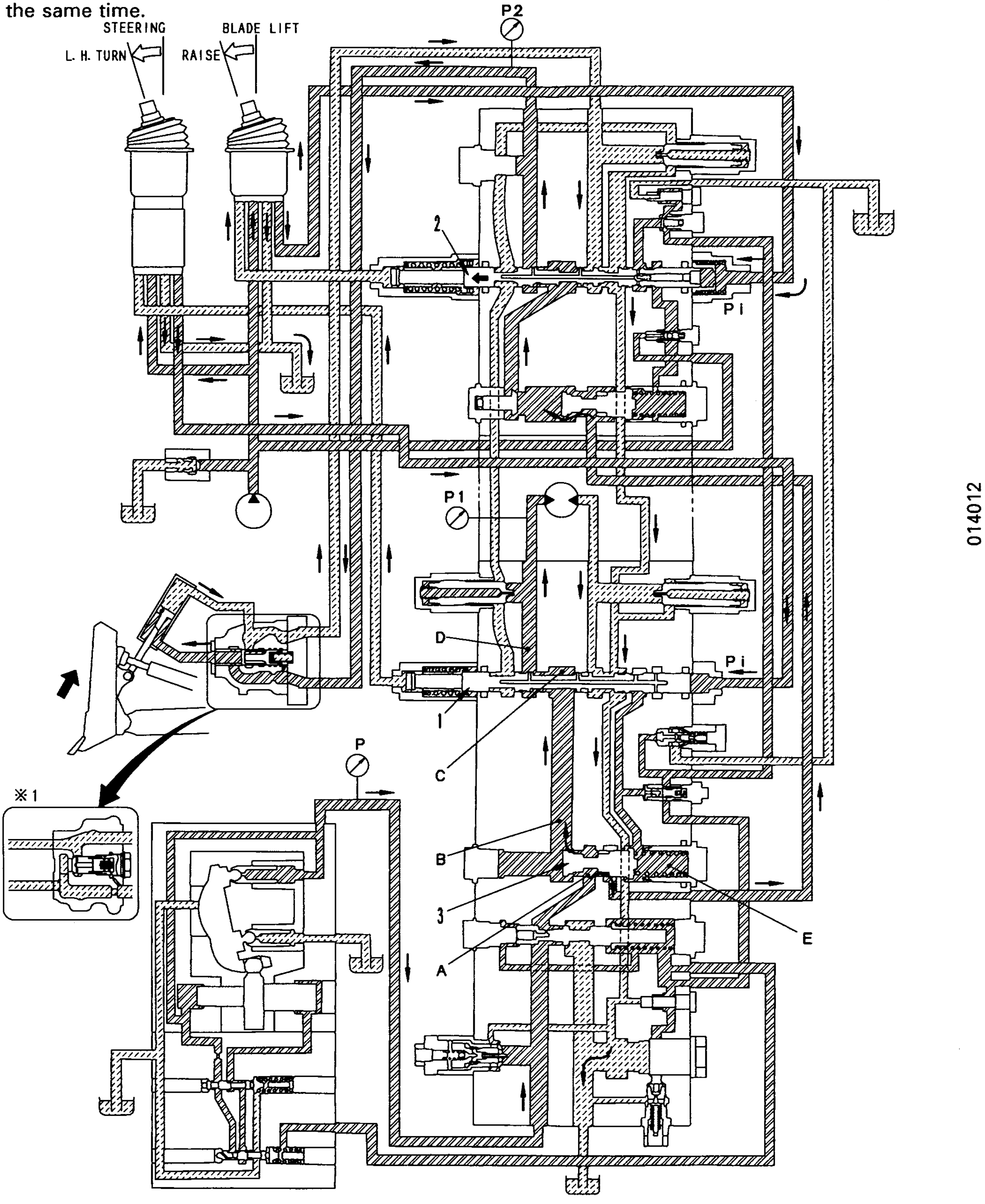
4. Compound operations

(1) Steering valve + work equipment valve

- ★ The diagram shows the condition when the steering and blade lift valve are operated at the same time.

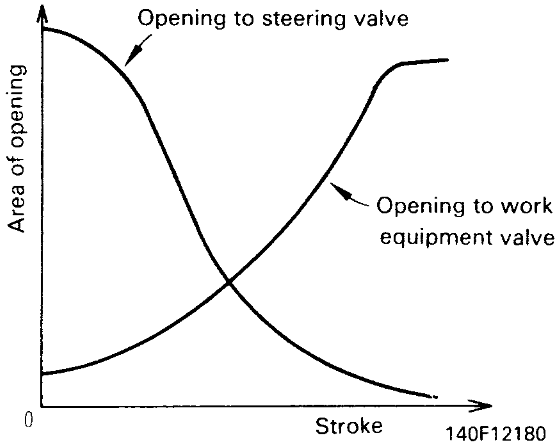
※1. Serial Numbers
D65EX-12 61446 and up
D65PX-12 61369 and up



- The steering valve is equipped with a steering priority valve (3), so if the steering valve and the downstream work equipment valve are operated at the same time, priority is given to the flow of oil to the steering valve, and the rest of the oil discharged from the pump goes to the work equipment valve.

1) When steering spool (1) is operated by PPC valve output pressure **Pi** and the oil flows, a differential pressure is created between chambers **C** and **D**. Steering priority valve (3) is controlled by this differential pressure, and at the same time, the pump swash plate angle is controlled at △**PLS** = 2.0 MPa (20 kg/cm^2), and the flow of oil to the steering valve is fixed.
See Item **2 – (1) Steering valve**.

2) In this condition, if downstream blade lift valve (2) is operated, the pump pressure momentarily drops .
At this point, the differential pressure between chambers **C** and **D** becomes smaller, and steering priority valve (3) is moved to the left by the pressure in chamber **E** in the direction to throttle the opening to the work equipment valve.
At the same time, △**PLS** becomes smaller, so the pump swash plate angle moves in the maximum direction to supply an oil flow to make up the amount that the pressures drops.



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3) When pump swash plate does not reach maximum angle
When the maximum oil flow from the pump is greater than the sum of the flow demanded by the steering valve and work equipment valve, an amount of oil that matches the opening of steering spool (1) flows to the steering valve; an amount of oil decided by the pump pressure and load pressure and area of opening of the spool flows to the work equipment valve.

4) When pump swash plate is at maximum angle
When the maximum flow of oil from the pump is smaller than the sum of the oil flow demanded by the steering valve and work equipment valve.

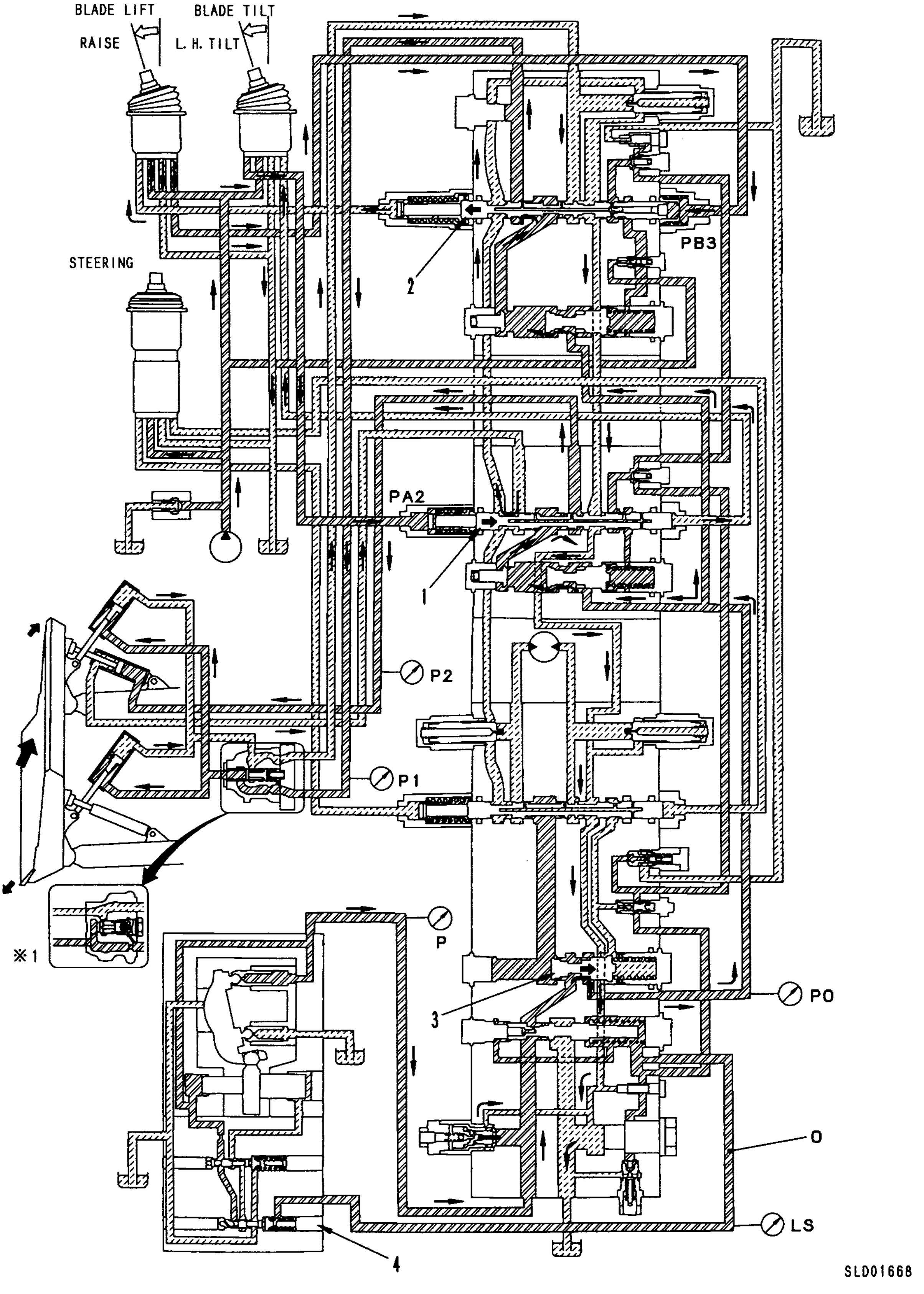
① When steering valve load ≤ work equipment valve load.
- An amount of oil that matches the opening of steering spool (1) flows to the steering valve, and the remaining oil flows to the work equipment valve.

② When steering valve load > work equipment valve load
- Pump pressure **P** is determined by the steering valve load, but in this condition, if the downstream work equipment valve where the load is smaller is operated, the difference in pressure will cause the oil to try to flow to the work equipment valve, so the pump pressure will drop.
- When this happens, steering priority valve (3) increases the size of the opening to the steering system, while at the same time reducing the size of the opening to the work equipment in order to ensure the flow of oil to the steering system.
- In this condition, the flow of oil is divided in proportion to the difference in pressure between differential pressure **P** – **P1** and differential pressure **P** – **P2**.
The bigger **P1** – **P2** is, the smaller the flow of oil to the steering system becomes.

(2) Compound operation of work equipment valve

★ The diagram shows the condition when the blade lift and tilt valves are operated at the same time.

※1. Serial Numbers
D65EX-12 61446 and up
D65PX-12 61369 and up



- It consists of a parallel circuit, so when compound operations are carried out, the oil flow is divided according to the size of each spool opening.

1) When tilt spool (1) and lift spool (2) are at the HOLD position or are operated, steering priority valve (3) is pushed completely to the right, and the size of the opening to the downstream area is at its maximum.

2) Tilt spool (1) and lift spool (2) are actuated by PPC valve output pressure **PA2** and **PB3**, and each is balanced at a position that matches its own pilot pressure.

3) When pressure **P2** ≦ **P3**
Lift valve load pressure **P3** is sent to pump **LS** valve (4) through **LS** passage **O**.

   ① When pump swash plate does not reach maximum angle
   When the maximum flow of oil from the pump is greater than the total of the oil flow demanded by the tilt valve and lift valve, an oil flow that matches the opening of the spool flows to both the tilt valve and lift valve.

   ② When pump swash plate is at maximum angle
   When the maximum flow of oil from the pump is smaller than the total of the oil flow demanded by the tilt valve and lift valve, the flow of oil to the tilt valve and lift valve is divided according to differential pressurse **PO** – **P2** and differential pressure **PO** – **P3**. In other words, more oil flows to **P2** where the load is small.

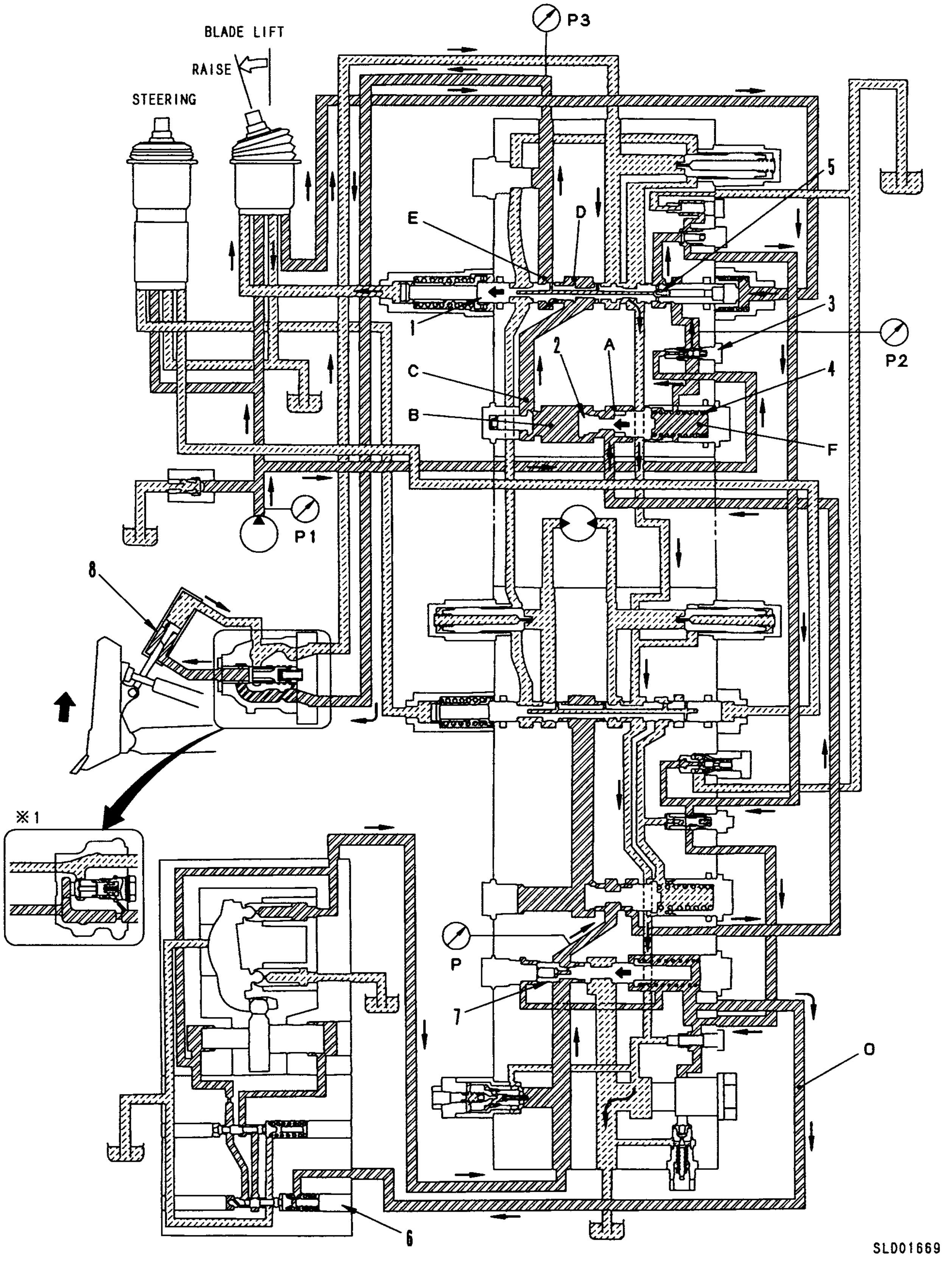
   ★ In cases where the blade is raised in the air and the tilt valve and lift valve (for raise) are operated at the same time, the tilt valve load pressure is smaller than the lift valve load pressure, so the flow of oil to the tilt valve is given priority. In addition, the oil flow demanded by the tilt valve is smaller, so the condition is just as if priority was given to the oil flow for the tilt valve.

4) When pressure **P2** = pressure **P3**
P – **P2** ≒ **P** – **P3**, so an oil flow proportional to the size of the spool opening is distributed to each spool.

5. Unload valve preset system

★ The diagram shows the condition with preset check valve (3) open immediately after blade lift valve is operated.

※1. Serial Numbers
D65EX-12 61446 and up
D65PX-12 61369 and up



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- This improves the response of the systsem including the pump swash plate and pressure compensation valve by sending the pilot presssure (basic pressure of PPC valve) to the **LS** circuit, and compensating the rise of the **LS** circuit pressure.

(1) When lift spool (1) is at the HOLD position, pilot pressure **P1** (basic pressure of PPC valve) is sent through preset check valve (3) to the chamber **F** of the pressure compensation valve. This pressure is called preset pressure **P2**.
At the same time, unload pressure **P** is being sent to chamber **B**, but **P1** + **FO** > **P** (**FO**: load of spring (4)), so pressure compensation spool (2) moves to the left and the size of the opening between **A** and **B** becomes the maximum.

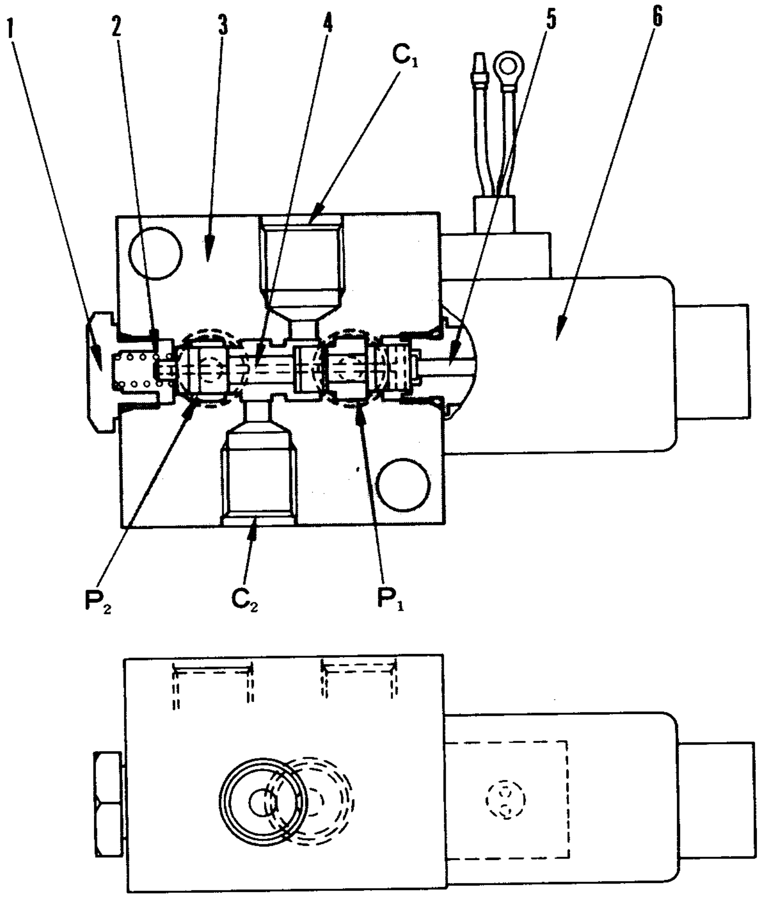
(2) When spool (1) is switched. Unload pressure **P** flows immediately through chambers **A**, **B**, **C**, **D** and **E** to lift cylinder (8), so the pressure at the port starts to rise and the time lag becomes smaller.

(3) At the same time, preset pressure **P2** is supplied to **LS** circuit **O** by the timing of the spool, and the pressure in the **LS** circuit rises. Because of this, unload valve (7) closes, and oil is sent further to pump **LS** valve (6) to improve the response of the pump swash plate angle.This makes it possible to reduce the response time for giving the necessary oil flow.
Check valve (5) is built into the spool to prevent preset pressure **P2** from venting in force from the cylinder port.

(4) When cylinder port pressure **P3** rises and becomes greater than preset pressure **P2**, it pushes up check valve (5), and oil is sent to chamber **F** of the pressure compensation valve and pump **LS** valve (6) to give the basic △**PLS** control.
When this happens, pressure **P3** at the cylinder port is prevented from entering the PPC pump circuit by preset check valve (3).

POWER PITCH SELECTOR VALVE

★ Applicable for power pitch dozer



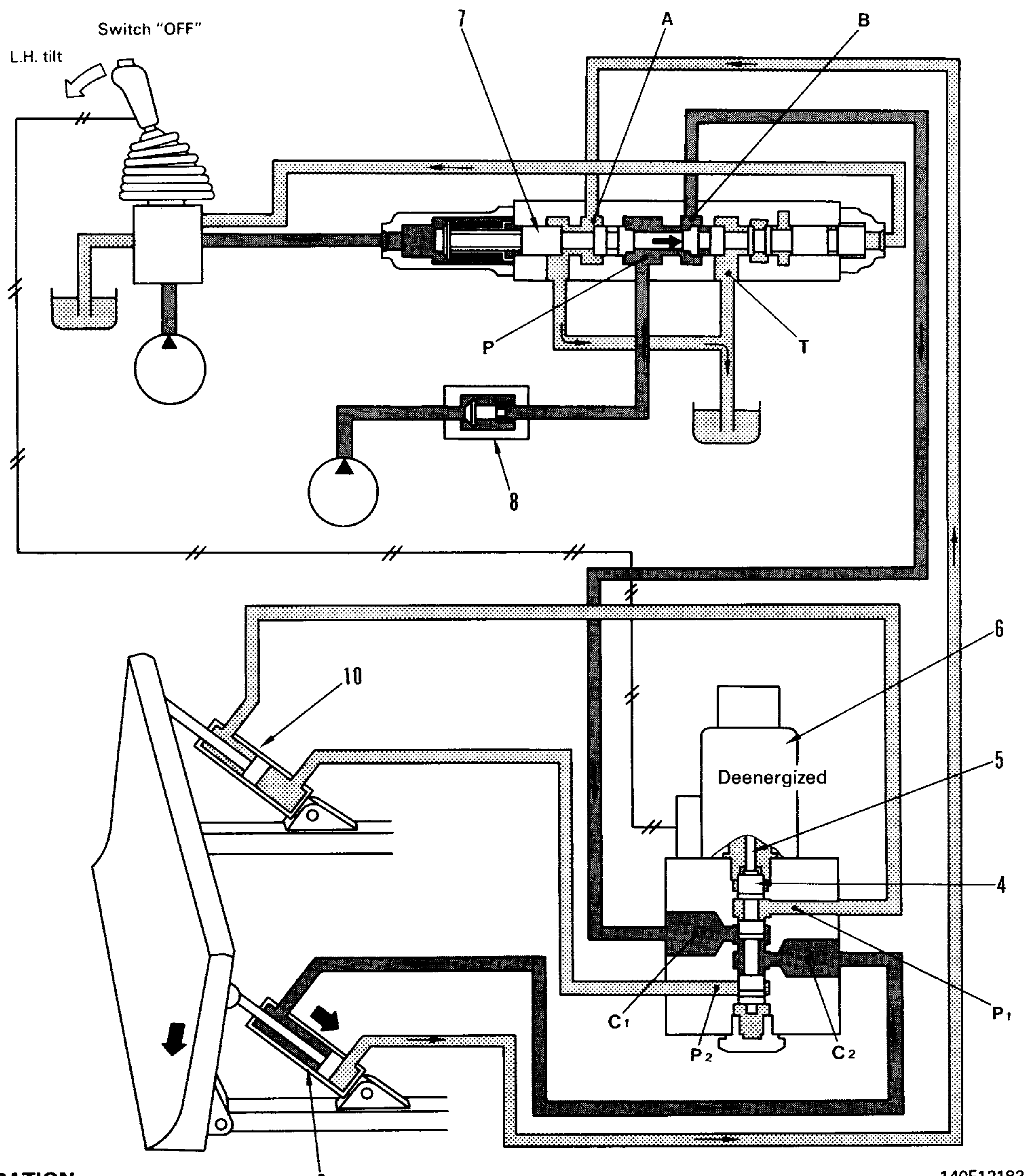
1. Plug
2. Return spring
3. Valve body
4. Spool
5. Push pin
6. Solenoid assembly

C1. To tilt valve
C2. To tilt cylinder head
P1. To pitch cylinder head
P2. To pitch cylinder bottom

OUTLINE

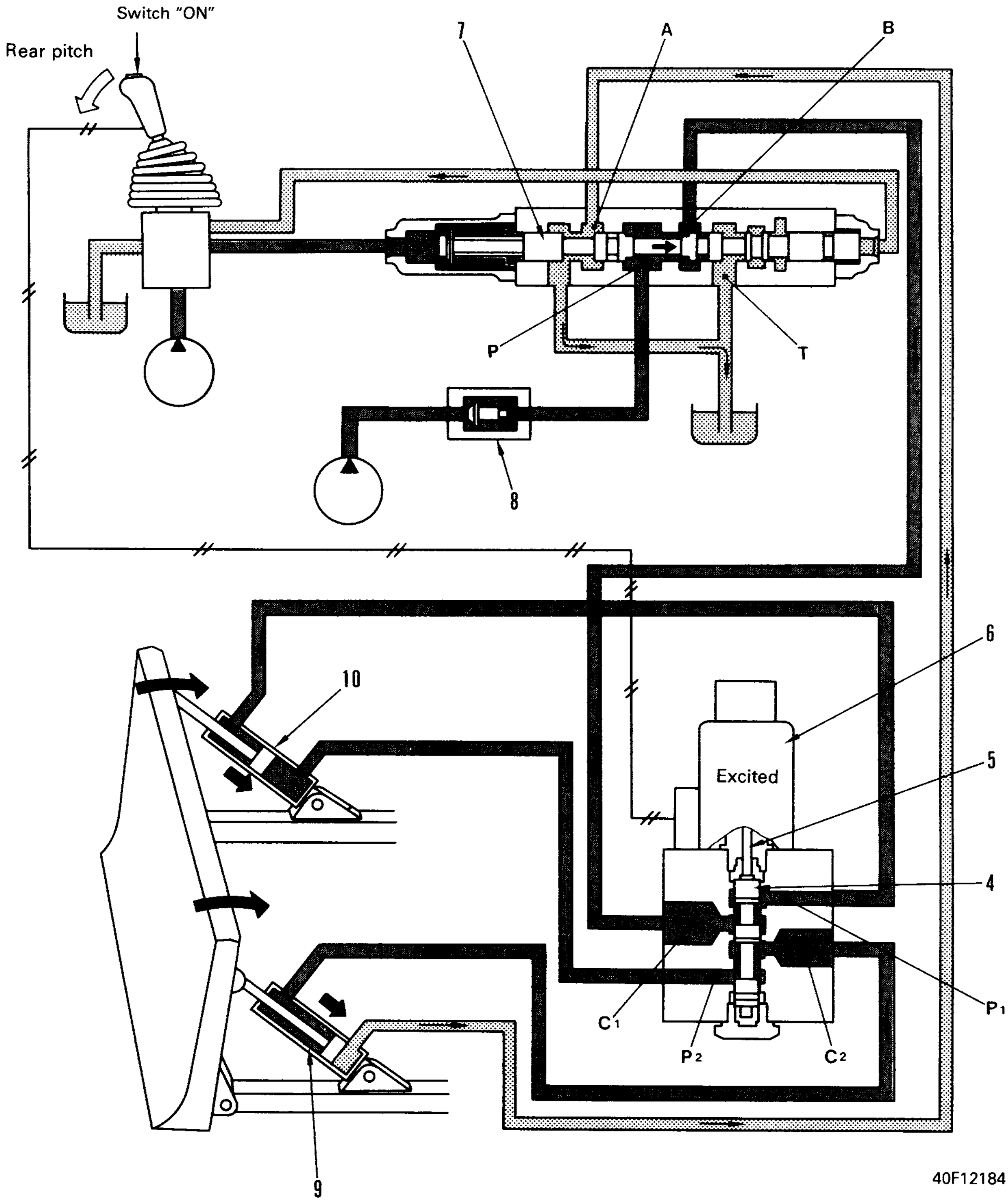
- The power pitch selector valve is in the circuit between the tilt control valve and the pitch cylinder (right side). When the switch on the knob of the work equipment control lever is operated, the oil flow to the pitch cylinder is switched.
  The power pitch dozer is designed so that the left tilt cylinder and right pitch cylinder are retracted or extended to angle the blade to the front or rear in order to give an angle to the blade that matches the type of soil.
  When the power pitch selector valve is turned OFF, the flow of oil to the pitch cylinder is cut, and the oil flows only to the tilt cylinder to make blade tilt operations possible.

	Left tilt	Right tilt	Forward pitch	Rear pitch
C1	From tilt valve	To tilt valve	To tilt valve	From tilt valve
C2	To tilt cylinder head	From tilt cylinder head	From tilt cylinder head	To tilt cylinder head
P1	—	—	From pitch cylinder head	To pitch cylinder head
P2	—	—	To pitch cylinder bottom	From pitch cylinder bottom



OPERATION

1. **Work equipment control lever at LEFT TILT Power pitch switch OFF**
   When the power pitch switch is not being operated, solenoid (6) is deenergized, so the circuit between ports **P1** and **C1** and between ports **P2** and **C2** are closed, and the circuit between port **C1** and **C2** is opened. In this condition, if the work equipment control lever is operated to LEFT TILT, tilt valve spool (7) moves to the right, and opens the circuit between ports **P** and **B** and ports **T** and **A**.
   When this happens, the oil from the pump pushes open check valve (8), enters port **P**, and then flows from port **B** to port **C1** of the pitch selector valve.
   The oil entering port **C1** then flows to port **C2** and enters the head end of tilt cylinder (9).
   At this point, the circuit to pitch cylinder (10) is closed by the pitch selector valve, so the oil flows only to the tilt cylinder. When the pressure in the circuit rises, the blade is tilted to the left.



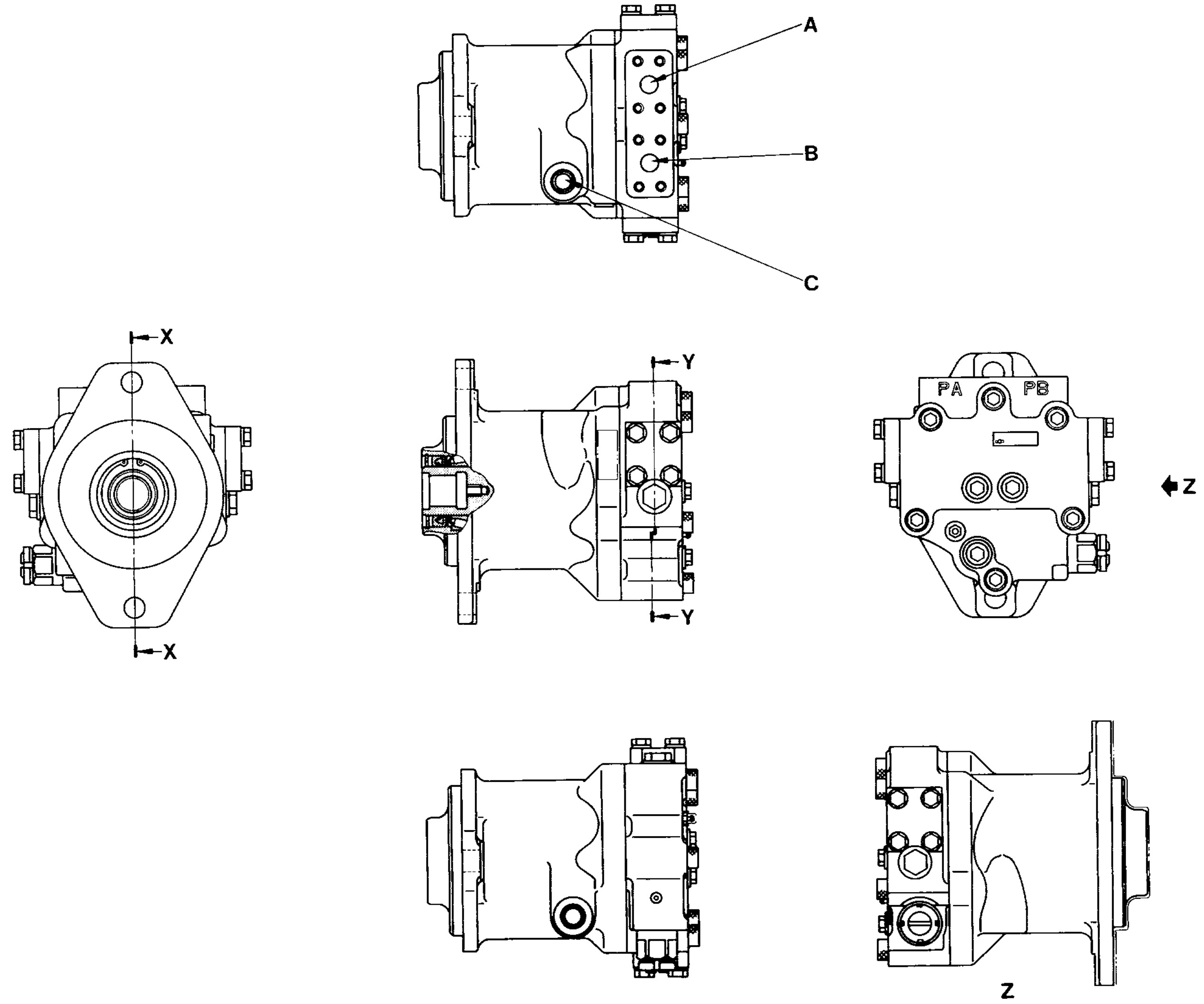
40F12184

014012

2. **Work equipment control lever at REAR PITCH**
Power pitch switch ON
When the power pitch switch is operated, solenoid (6) is excited, and push pin (5) pushes spool (4) down. When this happens, the circuits between ports **P1** and **C1** and ports **P2** and **C2** are opened.
In this condition, if the work equipment control lever is operated to REAR PITCH, tilt valve (1) is actuated in the same way as Item 1, and the oil from the pump flows from port **C1** of the pitch selector valve to port **P1**. It then enters the head end of pitch cylinder (10) and retracts the pitch cylinder.
When this happens, the oil pushed out from the bottom end of the pitch cylinder returns to port **P2** of the pitch selector valve, enters port **C2**, and then flows from port **C2** to the head end of tilt cylinder (9).
When the pressure in the circuit rises, cylinders (9) and (10) are retracted, and the blade is tilted back to the rear.

HSS MOTOR

D65EX, PX-12



140F12185

A. Port **PB** (from control valve)
B. Port **PA** (from control valve)
C. Port **T** (to tank)

- Specifications

Model	HMF95DT
Theoretical displacement capacity	96 cc/rev
Rated pressure	38.2 MPa (390 kg/cm^2)
Rated speed	1,908 rpm

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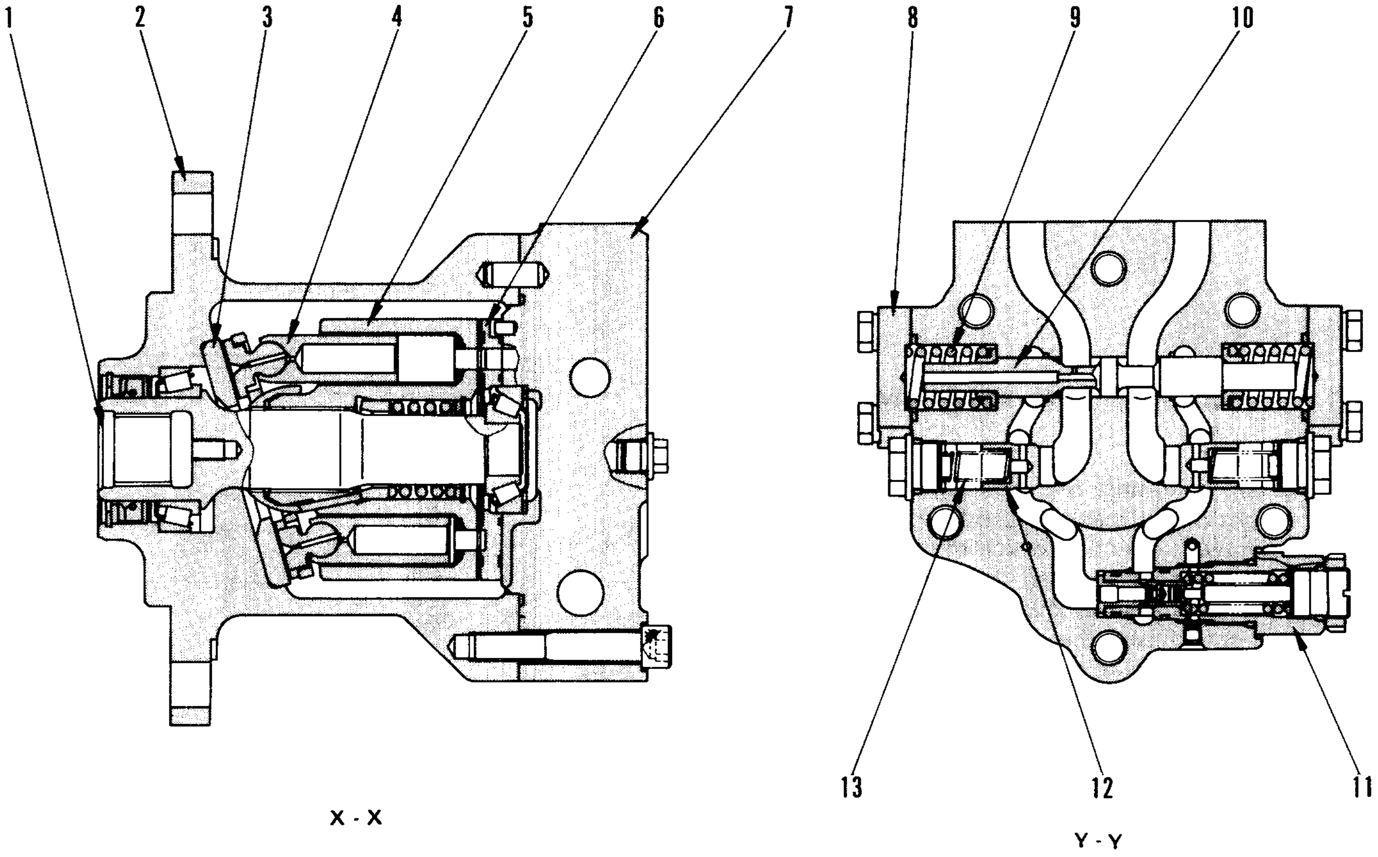


X - X

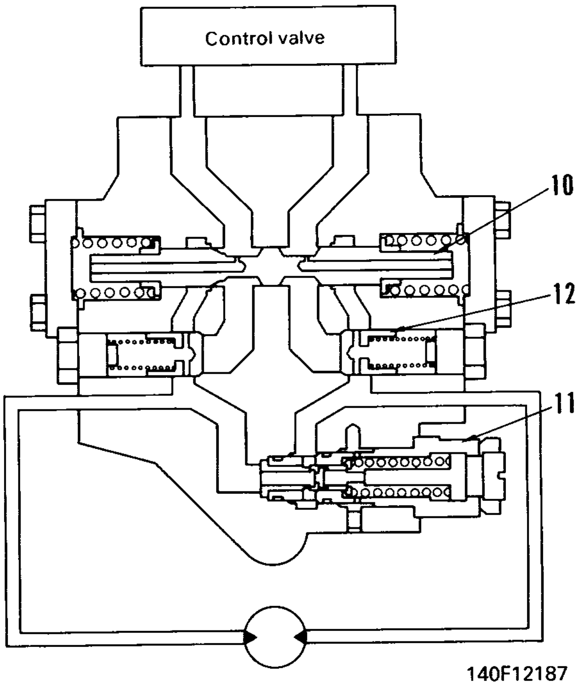
Y - Y

140F12186

1. Output shaft
2. Motor case
3. Thrust plate
4. Piston
5. Cylinder
6. Valve plate
7. End cover
8. Brake valve assembly
9. Spool return spring
10. Counterbalance valve
11. Safety valve
12. Check valve
13. Check valve spring

OPERATION OF BRAKE VALVE

- The brake valve consists of check valve (12), counterbalance valve (10), and safety valve (11), and forms a circuit such as that shown on the right.
- The function and operation of each component is as given below.



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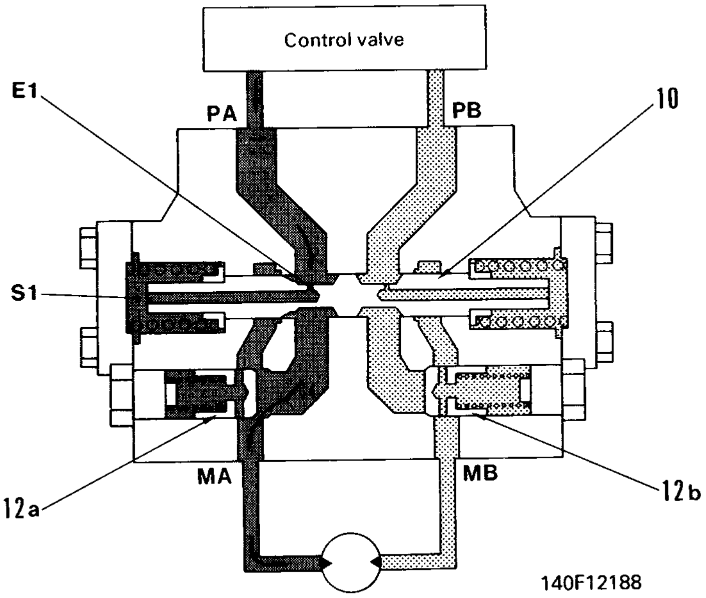
1. Counterbalance valve, check valve

FUNCTION

- When operating the steering on slopes, the weight of the machine produces a force in the downward direction which makes the machine try to turn faster than the speed of the HSS motor. Because of this, if the engine is run at low speed and the steering is operated, the HSS motor will overrun, and this will create an extremely dangerous condition.
  To prevent this, this valve is installed to carry out the steering in accordance with the engine speed (pump discharge volume).

Operation when oil is supplied

- When the steering lever is operated , the pressurized oil from the control valve is supplied to port **PA**. It pushes open check valve (12a), and flows from HSS motor inlet port **MA** to HSS motor outlet port **MB**.
  However, the outlet port side of the HSS motor is closed by check valve (12b) and spool (10), so the pressure at the side where the oil is being supplied rises.
- The pressurized oil at the side where the oil is being supplied flows from orifice **E1** of spool (10) into chamber **S1**. And when the pressure in chamber **S1** becomes greater than the spool switching pressure, spool (10) is pushed to the right.
  In this way, port **MB** and port **PB** are connected, so the outlet port side of the HSS motor is opened and the HSS motor starts to turn.



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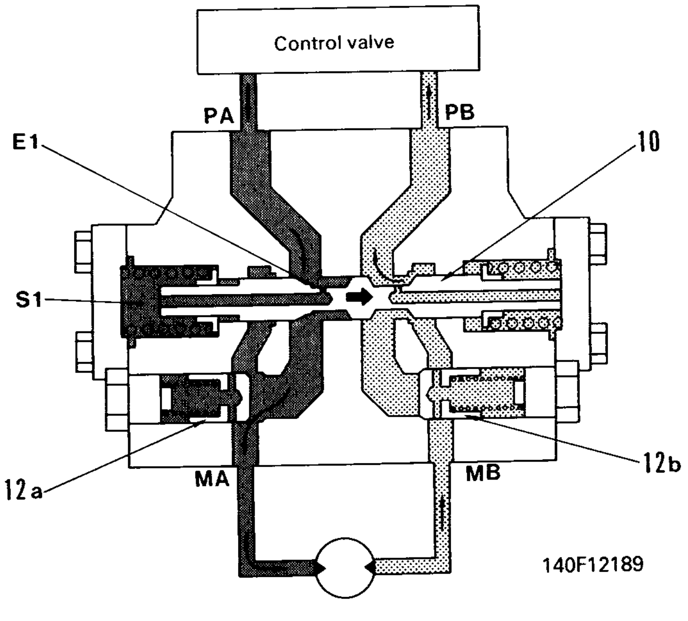

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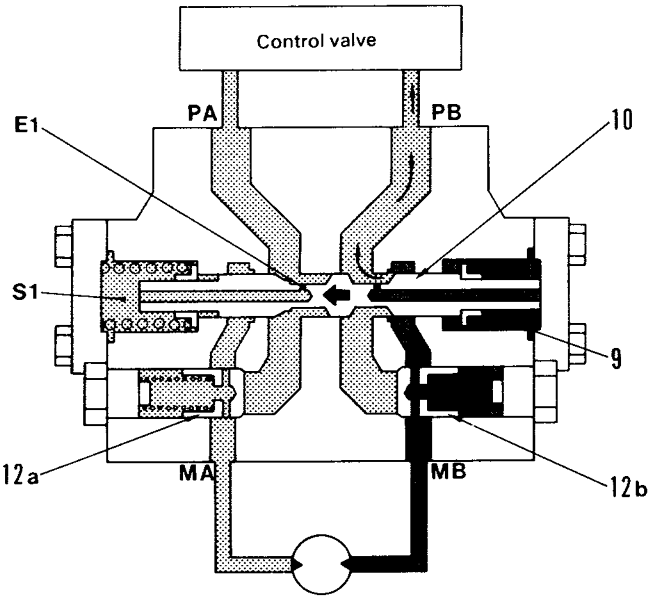
Action of brakes when operating steering on downhill slopes

- When the steering is operated on a downhill slopes, if the machine attempts to run away, the HSS motor will rotate under no load, and the oil pressure at the inlet port of the HSS motor will drop. This drop in pressure will pass through orifice **E1**, so the pressure in chamber **S1** will also drop.
  If the pressure in chamber **S1** drops below the spool switching pressure, spool (10) is pushed to the left in the direction of the arrow by spring (9), and outlet port **MB** is throttled.
  As a result, the pressure at the outlet port rises, and this creates a resistance to the rotation of the HSS motor which prevents the motor from overrunning.
  In other words, the spool moves to a position where it balances the pressure at outlet port **MB** with the force resulting from the weight of the machine and the pressure at the inlet port.
  In this way, it throttles the outlet port circuit and controls the motor to a speed that matches the amount of oil discharged from the pump.



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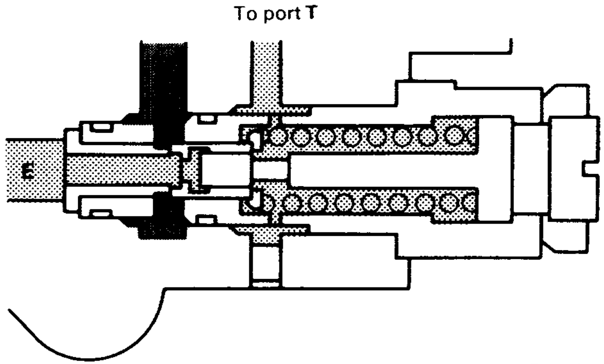
2. Safety valve

FUNCTION

- When the operation of the steering stops, counterbalance valve (10) closes the circuit at the inlet and outlet ports of the HSS motor, but the HSS motor continues to turn because of inertia. As a result, the pressure at the outlet port of the HSS motor becomes extremely high, and this will damage the HSS motor and the piping. The safety valve acts to release this abnormal pressure to the inlet port of the HSS motor to protect the equipment from damage.



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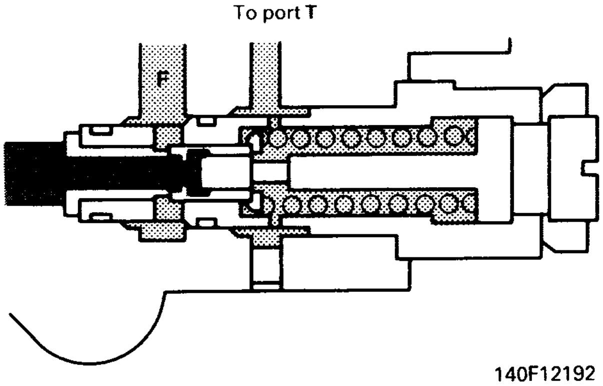
OPERATION

- When the operation of the steering is stopped, the check valve of the counterbalance valve closes chamber **E** (or chamber **F**) in the outlet port circuit, but the pressure at the outlet port side continues to rise because of inertia.



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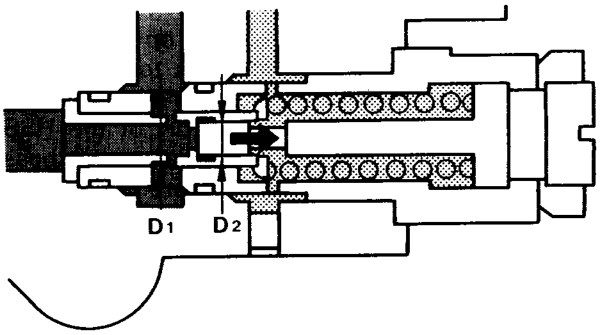
- If the pressure in chamber **E** (or chamber **F**) goes above the set pressure, the force of π/4 ($D1^2$-$D2^2$) × pressure resulting from the difference in area of **D1** and **D2** (or the force of π/4 ($D3^2$-$D2^2$) × pressure resulting from the difference in area of **D3** and **D1**) becomes greater than the force of the spring and moves the poppet to the right. The oil then flows to chamber **F** (or chamber **E**) in the circuit on the opposite side.



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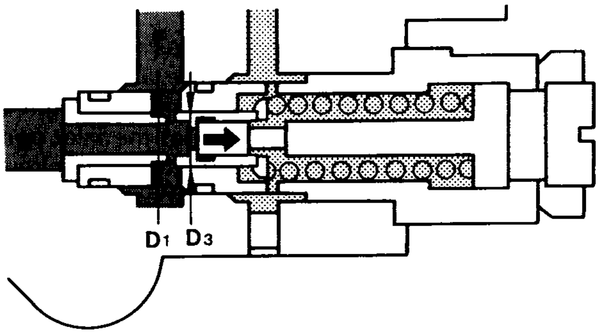

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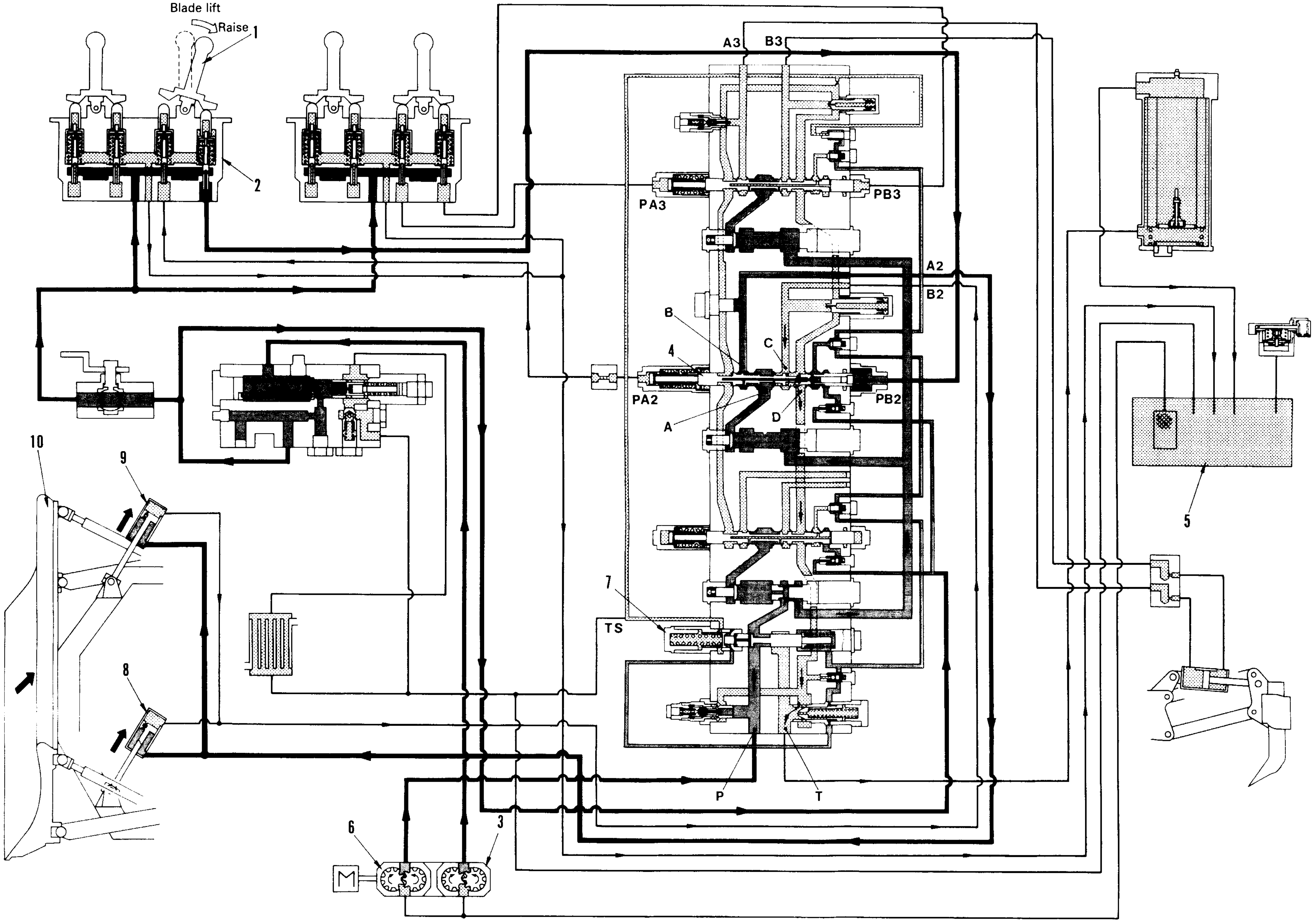
OPERATION OF STEERING, WORK EQUIPMENT CONTROL CIRCUIT

ANGLEDOZER (WITH RIPPER)

D65E-12	60001 – 60947
D65P-12	60001 – 60890
D65EX-12	60001 – 60941
D65PX-12	60001 – 60914

At blade RAISE

★ The diagram shows the D65E-12.



140F12195A

OPERATION

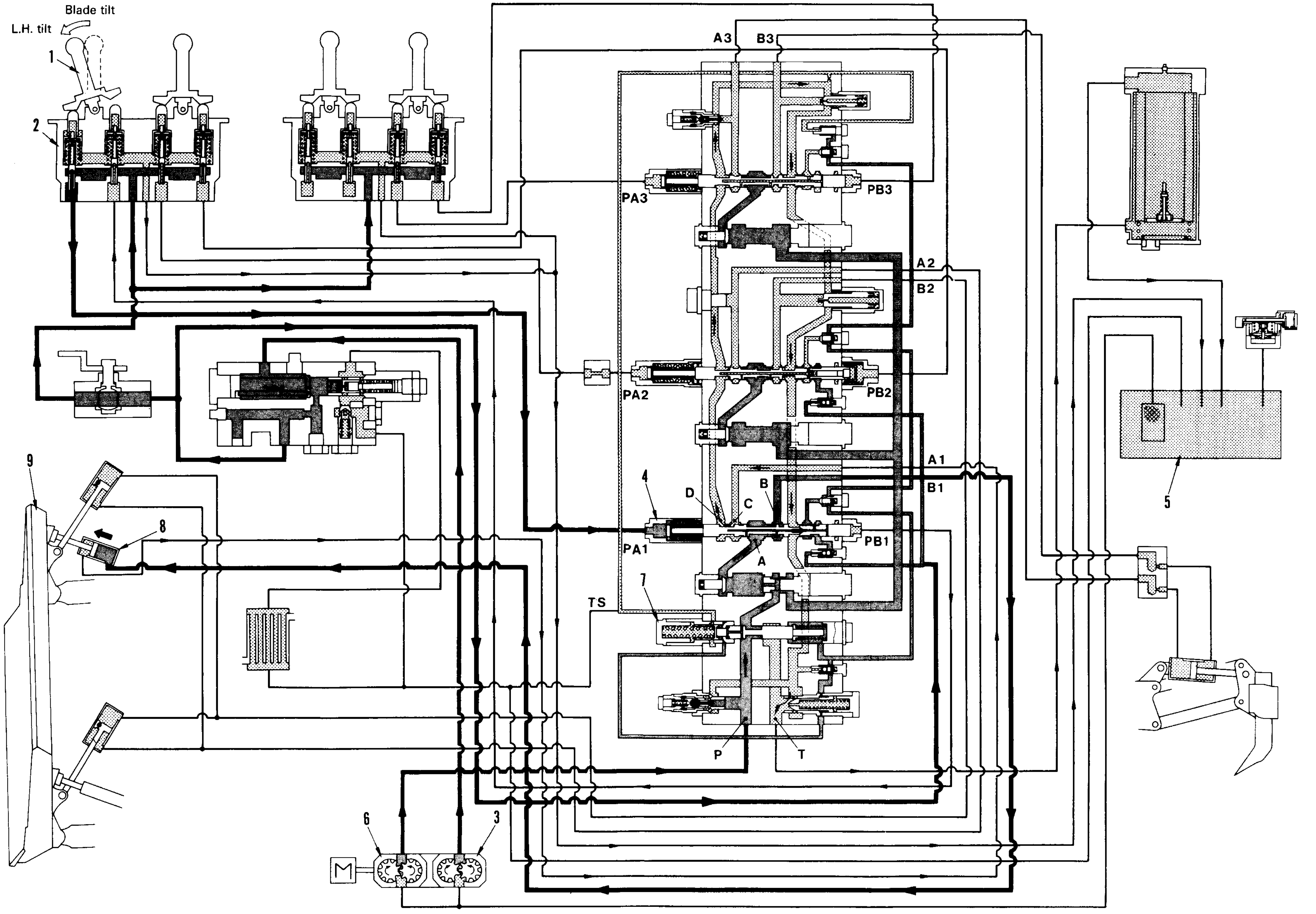
- When blade control lever (1) is operated to the RAISE position, the spool of PPC valve (2), which is directly connected to the lever, is moved.
  When this happens, the pilot pressure entering PPC valve (2) from PPC pump (3) is sent to port **PB2** of blade lift spool (4).
- This pilot pressure pushes spool (4) to the left, and connects ports **A** and **B** and ports **C** and **D**. The oil at port **PA2** passes through PPC valve (2) and is drained to hydraulic tank (5).
- When this happens, the pressurized oil from hydraulic pump (6) enters port **P**, passes through unload valve (7) and ports **A** and **B**, and goes to the head end of blade lift cylinders (8) and (9) to raise blade (10).
  At the same time, the oil at the cylinder bottom passes through ports **C**, **D** and **T**, and is drained to hydraulic tank (5).

STRAIGHT TILTDOZER (WITH RIPPER)

At blade LEFT TILT

★ The diagram shows the D65E-12.

D65E-12	60001 - 60947
D65P-12	60001 - 60890
D65EX-12	60001 - 60941
D65PX-12	60001 - 60914



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OPERATION

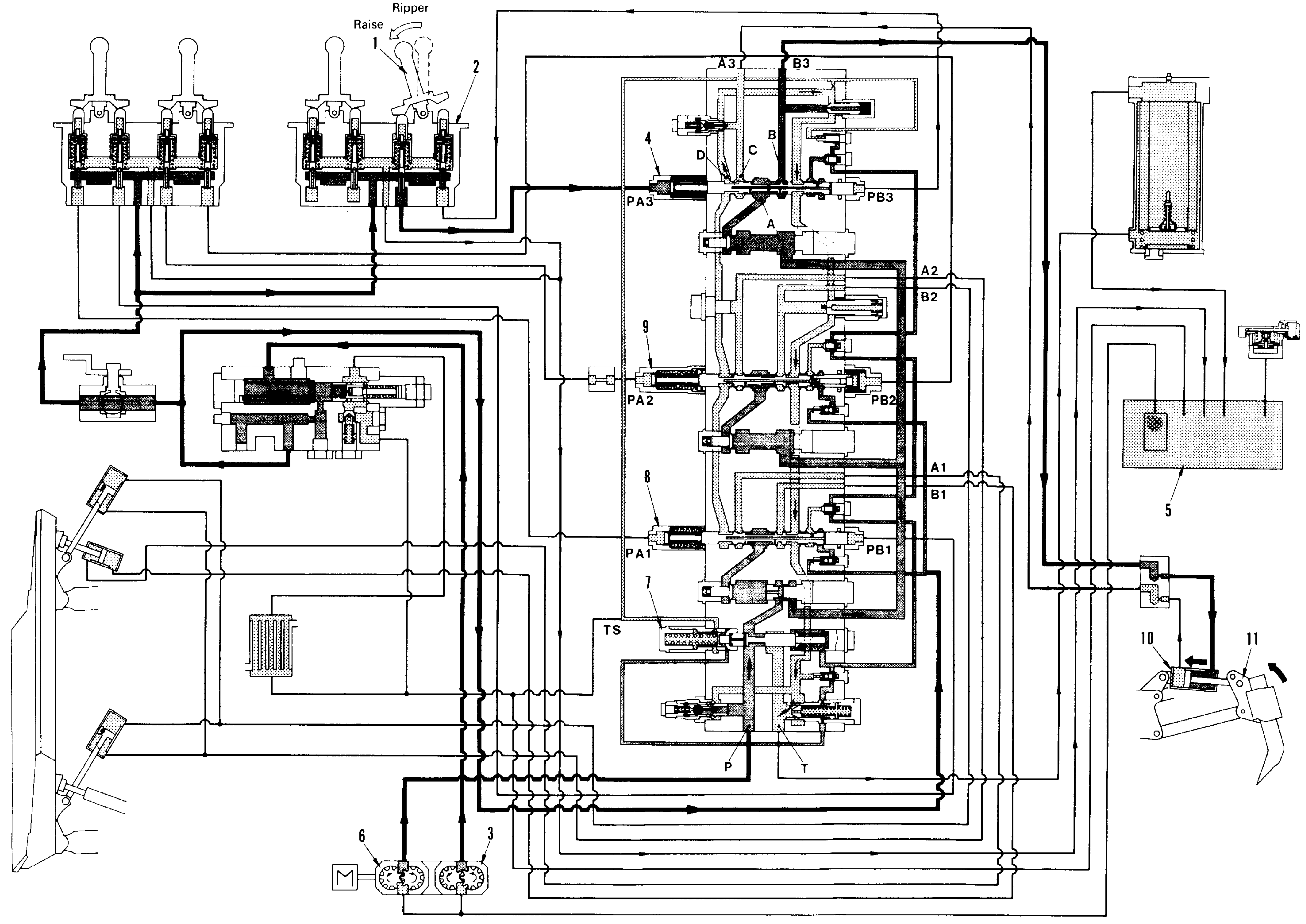
- When blade control lever (1) is operated to the LEFT TILT position, the spool of PPC valve (2), which is directly connected to the lever, is moved.
  When this happens, the pilot pressure entering PPC valve (2) from PPC pump (3) is sent to port **PA1** of blade lift spool (4).
- This pilot pressure pushes spool (4) to the right, and connects ports **A** and **B** and ports **C** and **D**. The oil at port **PB1** passes through PPC valve (2) and is drained to hydraulic tank (5).
- When this happens, the pressurized oil from hydraulic pump (6) enters port **P**, passes through unload valve (7) and ports **A** and **B**, and goes to the bottom end of blade tilt cylinder (8) to tilt blade (9) to the left.
  At the same time, the oil at the cylinder head passes through ports **C**, **D** and **T**, and is drained to hydraulic tank (5).

RIPPER

At ripper RAISE

D65E-12 60001 – 60947
D65EX-12 60001 – 60941

★ The diagram shows the D65E-12.



140F12197A

OPERATION

- When ripper control lever (1) is operated to the RAISE position, the spool of PPC valve (2), which is directly connected to the lever, is moved.
  When this happens, the pilot pressure entering PPC valve (2) from PPC pump (3) is sent to port **PA3** of ripper lift spool (4).
- This pilot pressure pushes spool (4) to the right, and connects ports **A** and **B** and ports **C** and **D**. The oil at port **PB3** passes through PPC valve (2) and is drained to hydraulic tank (5).
- When this happens, the pressurized oil from hydraulic pump (6) enters port **P**, passes through unload valve (7), tilt spool (8), blade lift spool (9), and ports **A** and **B**, and goes to the head end of ripper lift cylinder (10) to raise ripper (11).
  At the same time, the oil at the cylinder bottom passes through ports **C**, **D**, and **T**, and is drained to hydraulic tank (5).

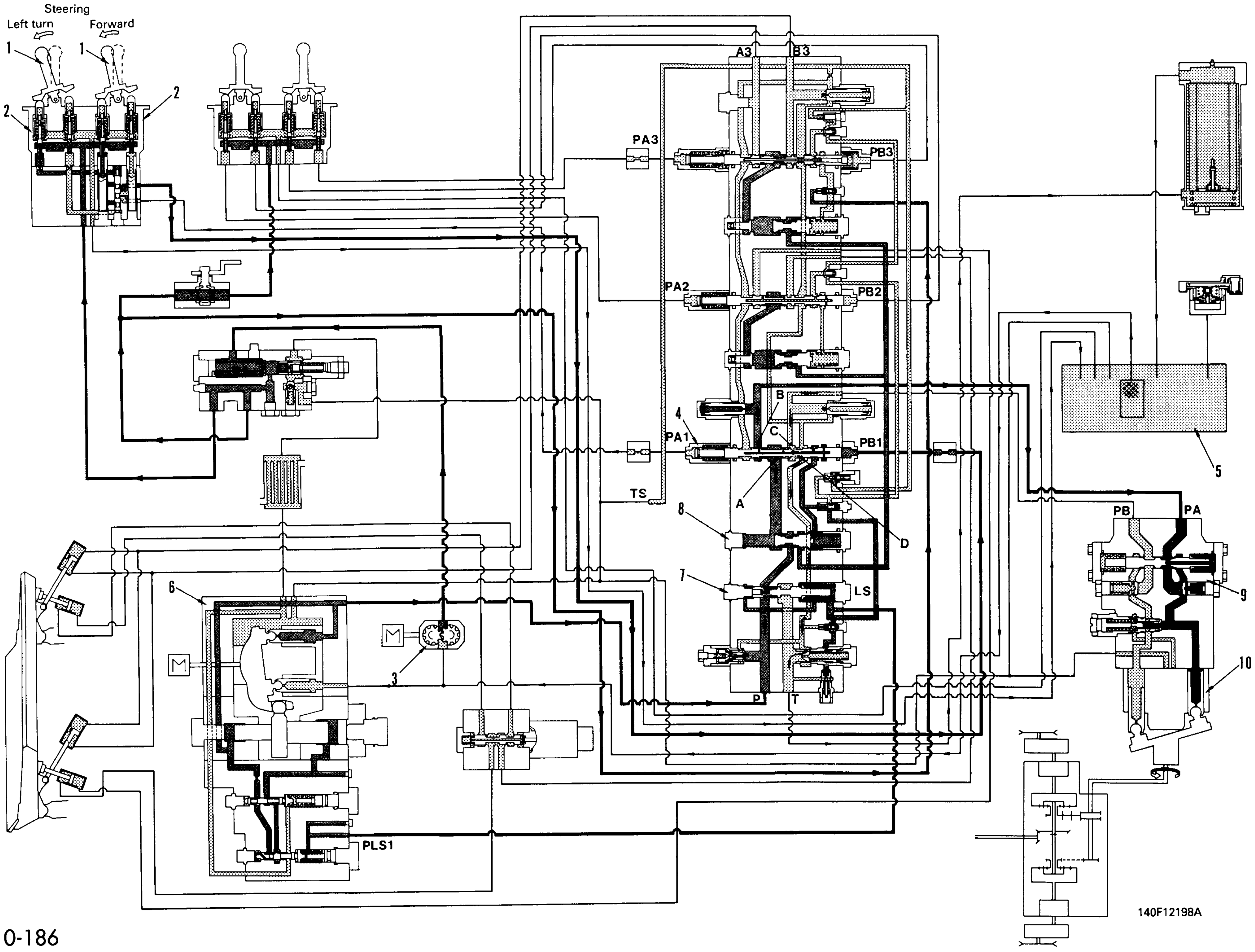
014012

STEERING

At FORWARD LEFT TURN

D65EX-12 60001 – 60941
D65PX-12 60001 – 60914

★ The diagram shows the D65E-12.



OPERATION

- When steering and directional lever (1) is operated to the FORWARD LEFT TURN position, the spool of PPC valve (2), which is directly connected to the lever, is moved. When this happens, the pilot pressure entering PPC valve (2) from PPC pump (3) is sent to port **PB1** of steering spool (4).
- This pilot pressure pushes spool (4) to the left, and connects ports **A** and **B** and ports **C** and **D**. The oil at port **PA1** passes through PPC valve (2) and is drained to hydraulic tank (5).
- When this happens, the pressurized oil from hydraulic, HSS pump (6) enters port **P**, passes through unload valve (7), steering priority valve (8), and ports **A** and **B**, and goes to port **PA** of the HSS motor assembly. It then passes through counterbalance valve (9) to rotate HSS motor (10). (Counterclockwise as seen from the left side of the machine)
At the same time, the oil at port **PB** passes through ports **C**, **D** and **T**, and is drained to hydraulic tank (5).

ANGLEDOZER (WITH RIPPER)

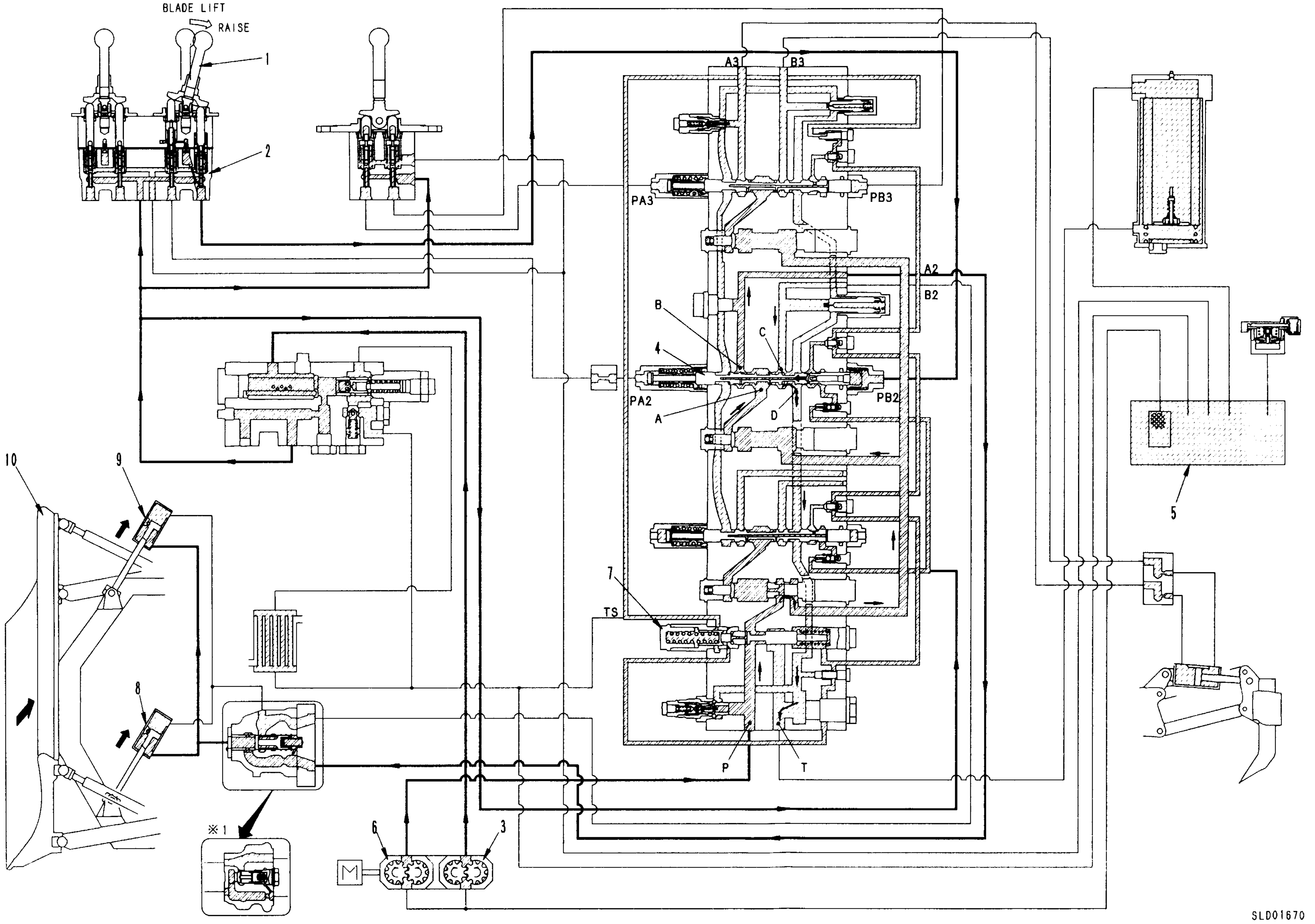
At blade RAISE

★ The diagram shows the D65E-12.

D65E-12	**60948 and up**
D65P-12	**60891 and up**
D65EX-12	**60942 and up**
D65PX-12	**60915 and up**

※1. Serial Numbers

D65E-12	61441 and up
D65P-12	61365 and up
D65EX-12	61446 and up
D65PX-12	61369 and up



OPERATION

- When blade control lever (1) is operated to the RAISE position, the spool of PPC valve (2), which is directly connected to the lever, is moved.
  When this happens, the pilot pressure entering PPC valve (2) from PPC pump (3) is sent to port **PB2** of blade lift spool (4).
- This pilot pressure pushes spool (4) to the left, and connects ports **A** and **B** and ports **C** and **D**. The oil at port **PA2** passes through PPC valve (2) and is drained to hydraulic tank (5).
- When this happens, the pressurized oil from hydraulic pump (6) enters port **P**, passes through unload valve (7) and ports **A** and **B**, and goes to the head end of blade lift cylinders (8) and (9) to raise blade (10).
  At the same time, the oil at the cylinder bottom passes through ports **C**, **D** and **T**, and is drained to hydraulic tank (5).

STRAIGHT TILTDOZER (WITH RIPPER)

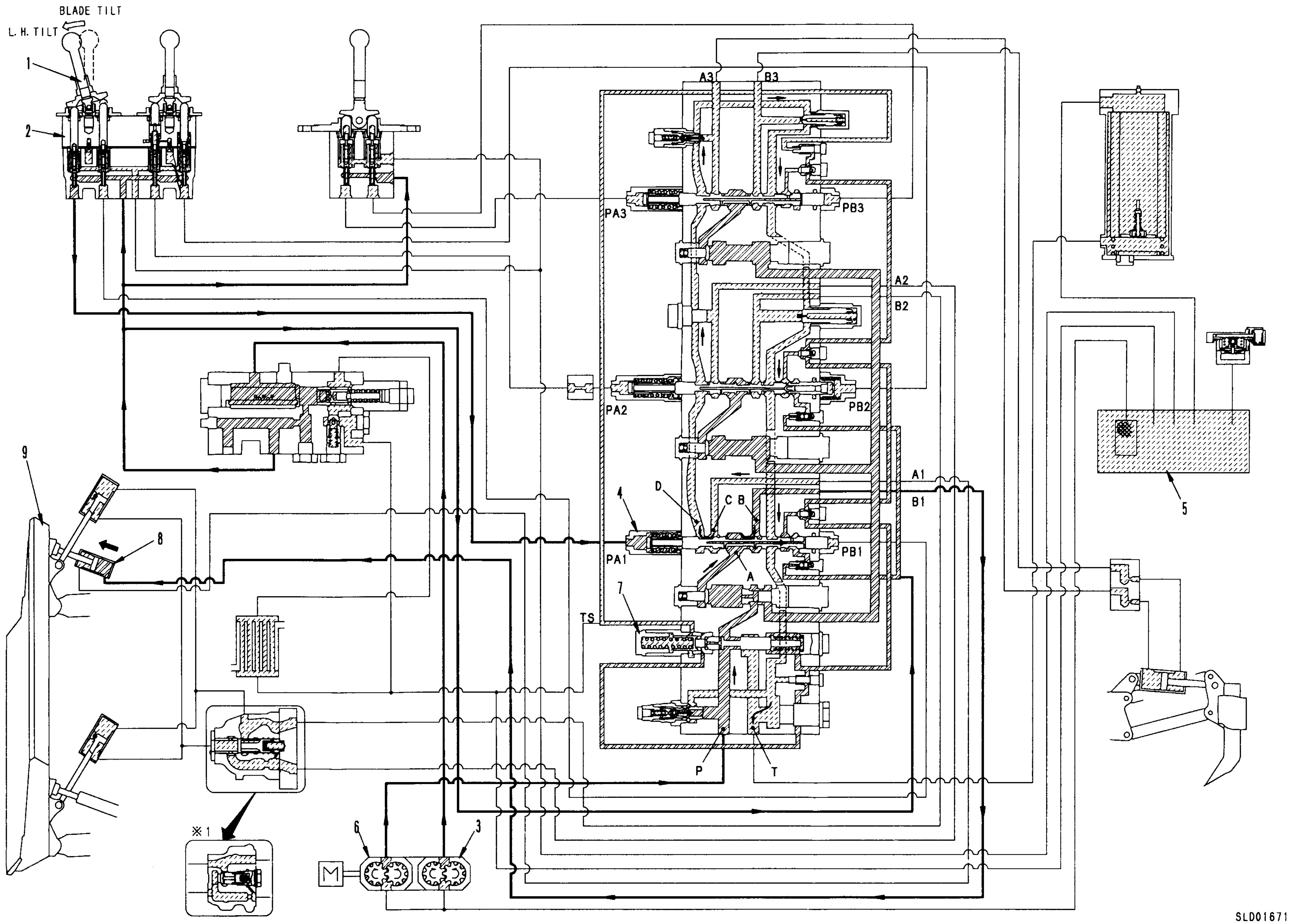
At blade LEFT TILT

★ The diagram shows the D65E-12.

D65E-12	**60948 and up**
D65P-12	**60891 and up**
D65EX-12	**60942 and up**
D65PX-12	**60915 and up**

※1. Serial Numbers

D65E-12	61441 and up
D65P-12	61365 and up
D65EX-12	61446 and up
D65PX-12	61369 and up



OPERATION

- When blade control lever (1) is operated to the LEFT TILT position, the spool of PPC valve (2), which is directly connected to the lever, is moved.
  When this happens, the pilot pressure entering PPC valve (2) from PPC pump (3) is sent to port **PA1** of blade tilt spool (4).
- This pilot pressure pushes spool (4) to the right, and connects ports **A** and **B** and ports **C** and **D**. The oil at port **PB1** passes through PPC valve (2) and is drained to hydraulic tank (5).
- When this happens, the pressurized oil from hydraulic pump (6) enters port **P**, passes through unload valve (7) and ports **A** and **B**, and goes to the bottom end of blade tilt cylinder (8) to tilt blade (9) to the left.
  At the same time, the oil at the cylinder head passes through ports **C**, **D** and **T**, and is drained to hydraulic tank (5).

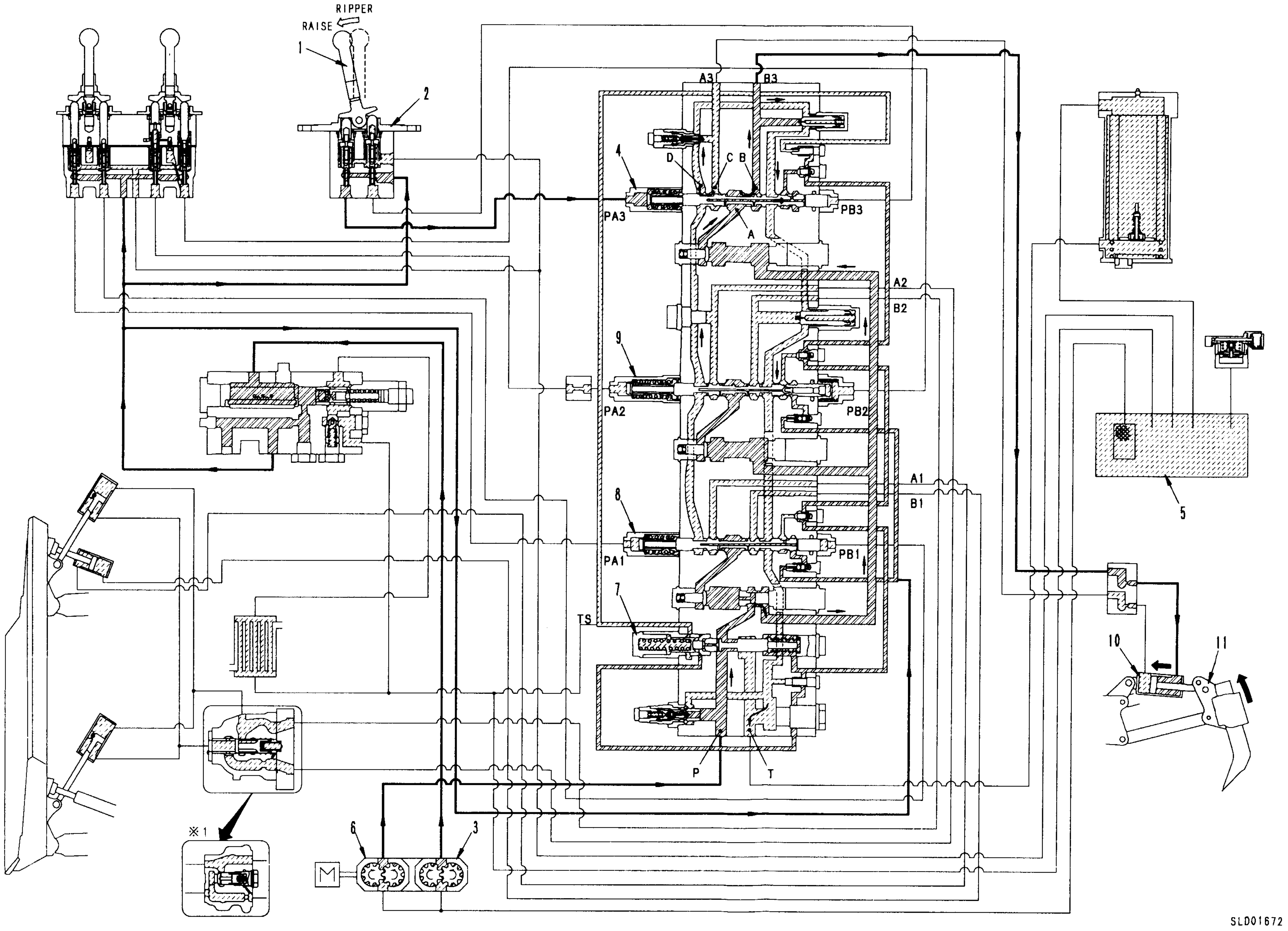
RIPPER

At ripper RAISE

D65E-12 60948 and up
D65EX-12 60942 and up

★ The diagram shows the D65E-12.

※1. Serial Numbers
D65EX-12 61446 and up
D65PX-12 61369 and up



OPERATION

- When ripper control lever (1) is operated to the RAISE position, the spool of PPC valve (2), which is directly connected to the lever, is moved.
  When this happens, the pilot pressure entering PPC valve (2) from PPC pump (3) is sent to port **PA3** of ripper lift spool (4).
- This pilot pressure pushes spool (4) to the right, and connects ports **A** and **B** and ports **C** and **D**. The oil at port **PB3** passes through PPC valve (2) and is drained to hydraulic tank (5).
- When this happens, the pressurized oil from hydraulic pump (6) enters port **P**, passes through unload valve (7), tilt spool (8), blade lift spool (9), and ports **A** and **B**, and goes to the head end of ripper lift cylinder (10) to raise ripper (11).
  At the same time, the oil at the cylinder bottom passes through ports **C**, **D** and **T**, and is drained to hydraulic tank (5).

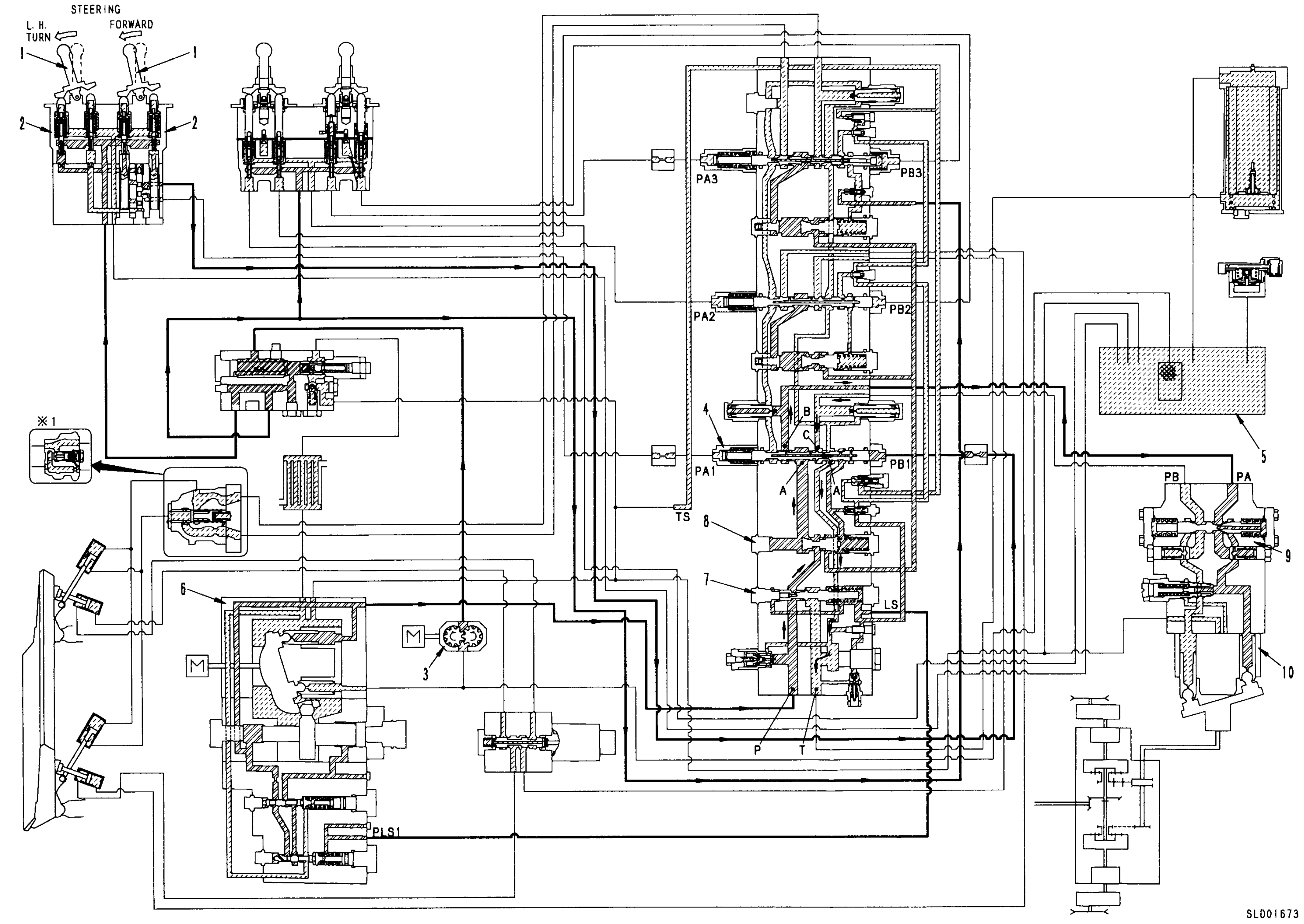
STEERING

At FORWARD LEFT TURN

D65EX-12 60942 and up
D65PX-12 60915 and up

★ The diagram shows the D65PX-12.

※1. Serial Numbers
D65EX-12 61446 and up
D65PX-12 61369 and up



OPERATION

- When steering and directional lever (1) is operated to the FORWARD LEFT TURN position, the spool of PPC valve (2), which is directly connected to the lever, is moved. When this happens, the pilot pressure entering PPC valve (2) from PPC pump (3) is sent to port **PB1** of steering spool (4).
- This pilot pressure pushes spool (4) to the left, and connects ports **A** and **B** and ports **C** and **D**. The oil at port **PA1** passes through PPC valve (2) and is drained to hydraulic tank (5).
- When this happens, the pressurized oil from hydraulic, HSS pump (6) enters port **P**, passes through unload valve (7), steering priority valve (8), and ports **A** and **B**, and goes to port **PA** of the HSS motor assembly. It then passes through counterbalance valve (9) to rotate HSS motor (10). (counterclockwise as seen from the left side of the machine)
At the same time, the oil at port **PB** passes through ports **C**, **D** and **T**, and is drained to hydraulic tank (5).

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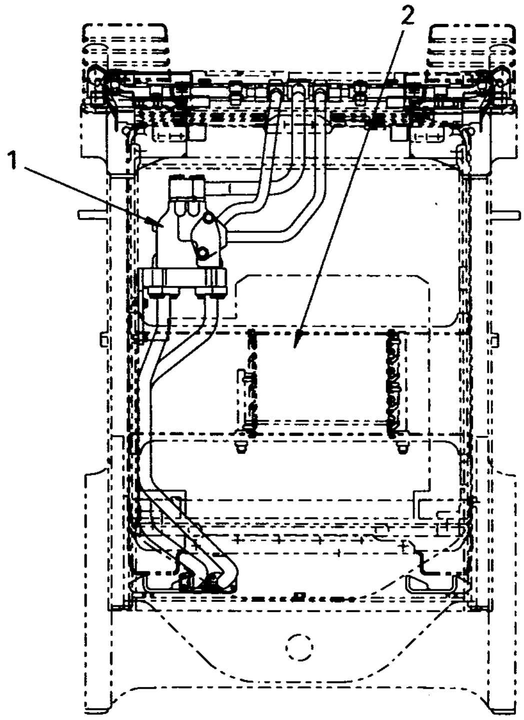
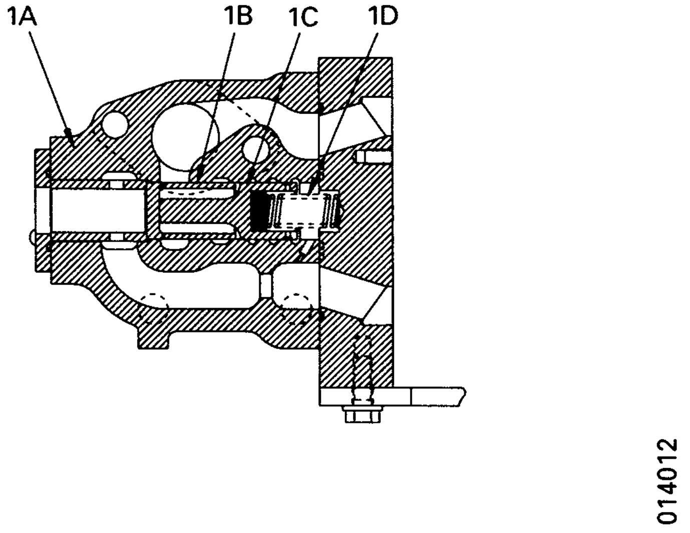
SUCTION VALVE

D65E-12 60948 – 61440
D65P-12 60891 – 61364
D65EX-12 60942 – 61445
D65PX-12 60915 – 61368





1. Suction valve assembly
   1A. Body
   1B. Spool
   1C. Check valve
   1D. Spring
2. Hydraulic oil cooler

OUTLINE

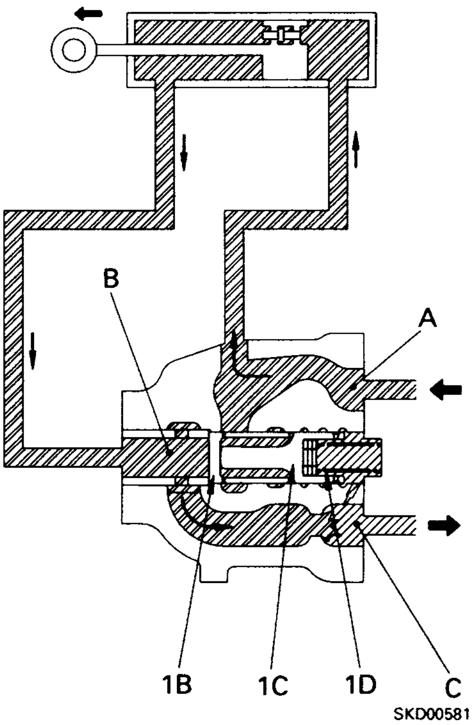
- Suction valve (1) is between the control valve and the blade lift cylinder. It acts to reduce the formation of any vacuum at the cylinder bottom when the blade is lowered, and also reduces the time lag before starting to dig. The lowering speed of the blade is more or less determined by the discharge amount from the pump, but the installation of a suction valve enables an even greater lowering speed.

OPERATION

1. Starting to lower

When the blade lever is moved to the LOWER position, the oil from the control valve enters the cylinder bottom from port **A** and pushes the piston.

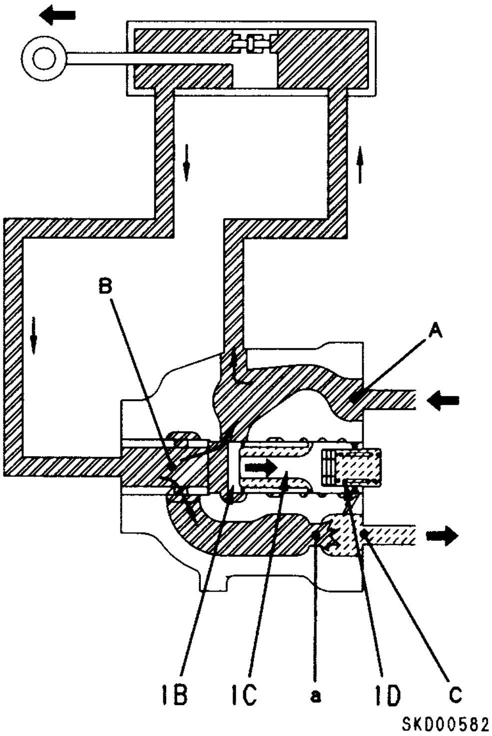
The oil at the cylinder head is pushed out by the piston, enters port **B**, then passes from port **C** through the control valve and flows to the hydraulic tank.



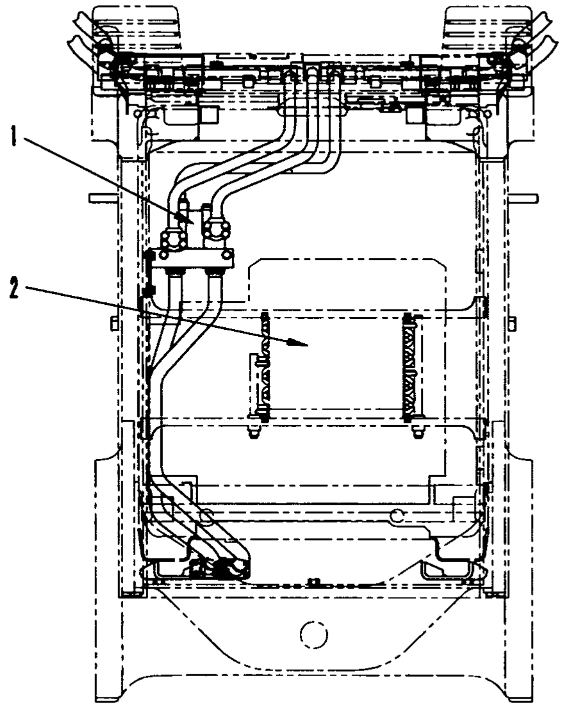
2. While lowering

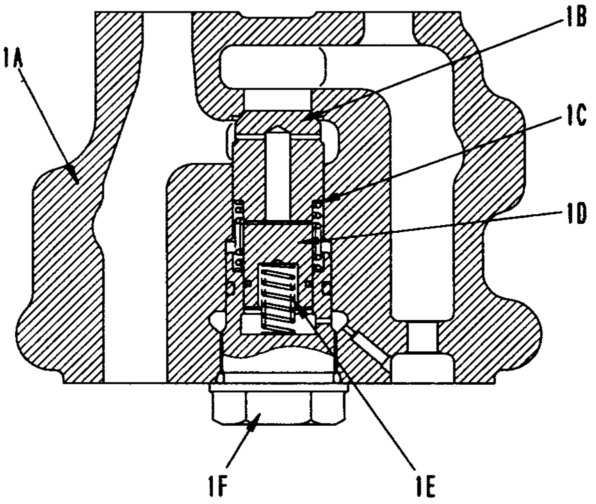
The oil pushed out from the cylinder head passes through port **B** and flows to port **C**. Orifice **a** is in the circuit between ports **B** and **C**, so the oil flow is throttled and a differential pressure is formed on both sides of the orifice. When the pressure at port **B** becomes greater than the tension of spring (1D), the spring is compressed, and spool (1C) and valve (1B) move to the right.

When this happens, the circuit between ports **A** and **B** open, and some of the oil flowing from the cylinder head to port **C** enters the passage to port **A**, which leads to the cylinder bottom, and merges with the oil from the control valve to flow to cylinder bottom. In this way, the lowering speed of the blade is increased by the amount of oil flowing to the cylinder bottom and the formation of a vacuum at the cylinder bottom is reduced.



D65E-12	**61441 and up**
D65P-12	**61365 and up**
D65EX-12	**61446 and up**
D65PX-12	**61369 and up**





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OUTLINE

- Suction valve (1) is between the control valve and the blade lift cylinder. It acts to reduce the formation of any vacuum at the cylinder bottom when the blade is lowered, and also reduces the time lag before starting to dig. The lowering speed of the blade is more or less determined by the discharge amount from the pump, but the installation of a suction valve enables an even greater lowering speed.

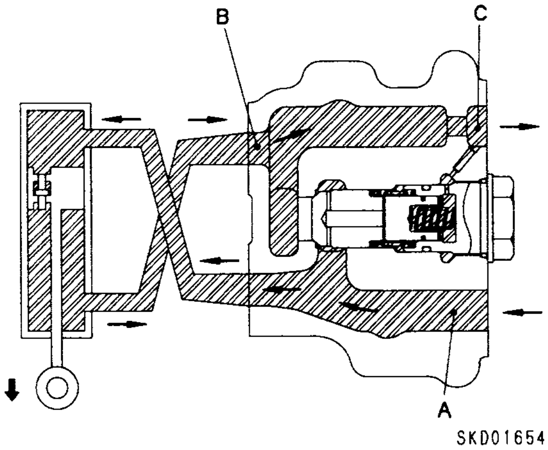
1. Suction valve assembly
   1A. Body
   1B. Valve
   1C. Spring
   1D. Piston
   1E. Spring
   1F. Plug
2. Hydraulic oil cooler

OPERATION

1. Starting to lower

When the blade lever is moved to the LOWER position, the oil from the control valve enters the cylinder bottom from port **A** and pushes the piston.

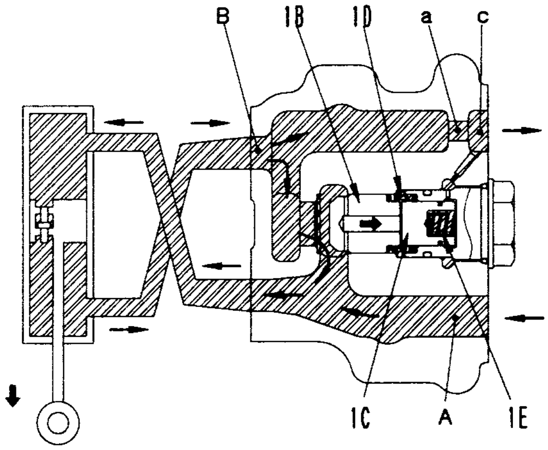
The oil at the cylinder head is pushed out by the piston, enters port **B**, then passes from port **C** through the control valve and flows to the hydraulic tank.



SKD01654

2. While lowering

The oil pushed out from the cylinder head passes through port **B** and flows to port **C**. Orifice **a** is in the circuit between ports **B** and **C**, so the oil flow is throttled and a differential pressure is formed on both sides of the orifice. When the pressure at port **B** becomes greater than the tension of spring (1D) and (1E), the spring is compressed, and piston (1C) and valve (1B) move to the right. When this happens, the circuit between ports **A** and **B** open, and some of the oil flowing from the cylinder head to port **C** enters the passage to port **A**, which leads to the cylinder bottom, and merges with the oil from the control valve to flow to cylinder bottom. In this way, the lowering speed of the blade is increased by the amount of oil flowing to the cylinder bottom and the formation of a vacuum at the cylinder bottom is reduced.



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014012

PISTON VALVE

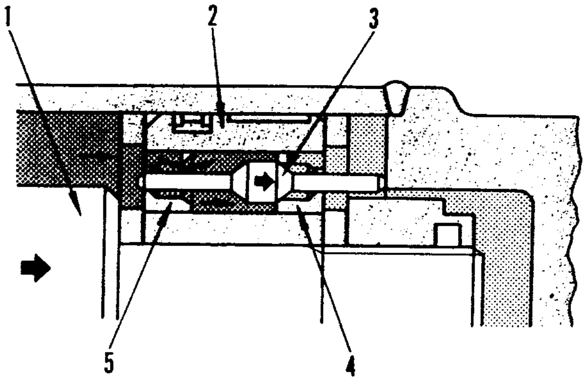
(BLADE LIFT CYLINDER)

OUTLINE

- The piston valve is installed on the piston in the blade lift cylinder. When the piston reaches its stroke end, the valve releases the oil from the hydraulic pump to reduce the oil pressure being exerted on the piston.
  In addition the piston valve relieves the shock which occurs when the piston comes into contact with the cylinder head or the bottom and serves to reduce the subsequent surge pressure in the cylinder by letting the oil escape from the cylinder before the piston reaches its stroke end.

OPERATION

1. **Piston valve CLOSED**
   Pressurized oil from the hydraulic pump acts on piston (2) and piston valve (3).
   The piston valve is pushed in the direction of the arrow until piston valve seat (4) comes into snug contact with the tapered section, thereby, this causing the pressure in the cylinder to rise and moving piston (2) in the direction of the arrow.



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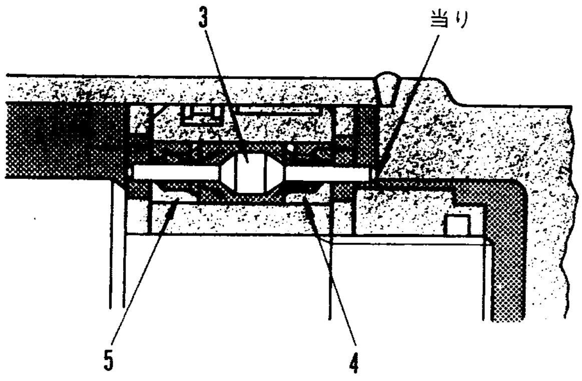
2. **Piston valve OPEN**
   Just before piston rod (1) reaches its stroke end, the front end of piston valve (3) comes into contact with the cylinder bottom (or the cylinder head) and is prevented from moving any further while piston (2) alone keeps on moving ahead.
   Then, the oil sealed within the piston valve on the cylinder head side will escape from piston valve seat (4), (5) so that the oil pressure in the cylinder is prevented from rising.



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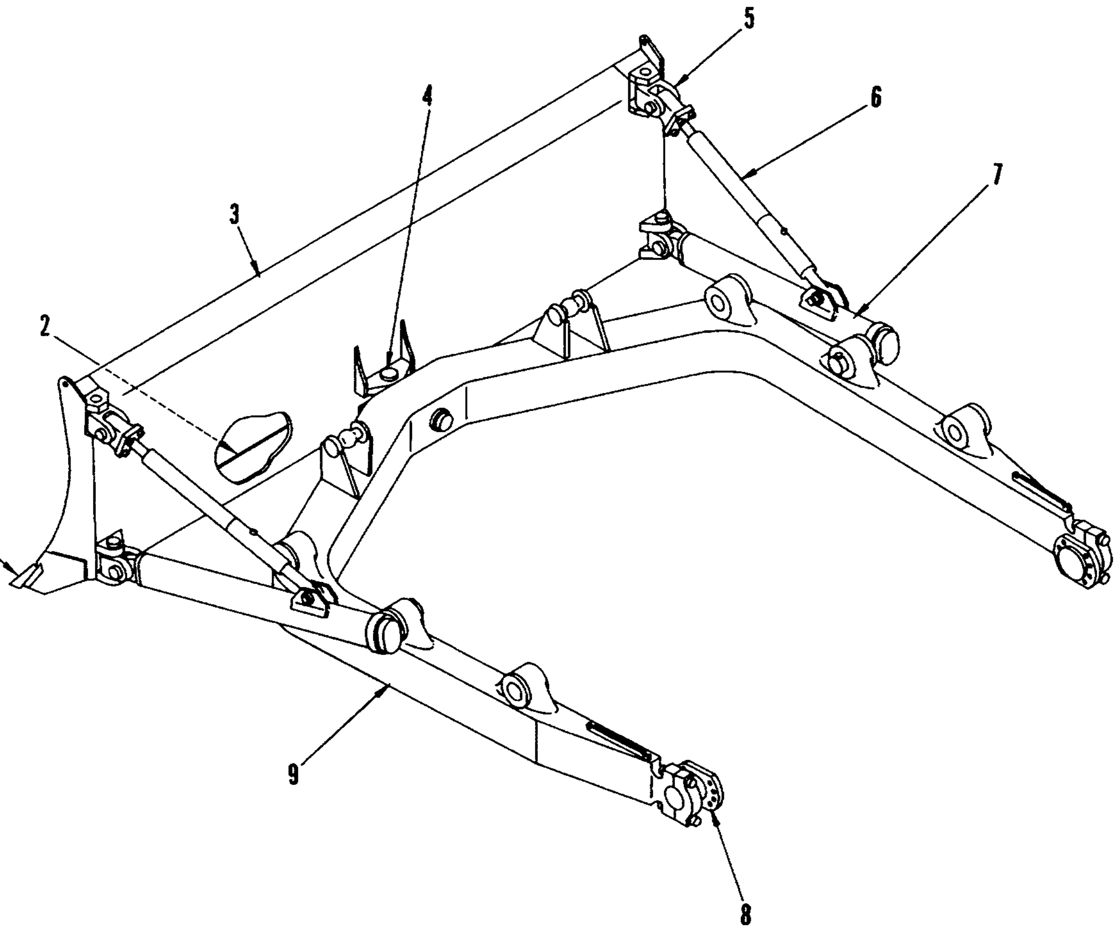
WORK EQUIPMENT

ANGLEDOZER



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014012

1. End bit
2. Cutting edge
3. Blade
4. Center shaft
5. Joint
6. Brace
7. Arm
8. Trunnion
9. C-frame

	Angledozer (E type)
Blade width (mm)	3,970
Blade height (mm)	1,120
Max. lifting height (mm)	1,180 (1,185)
Max. lowering depth (mm)	460 (450)
Max. tilt (mm)	400
Cutting edge angle (°)	55
Max. blade angle (°)	25

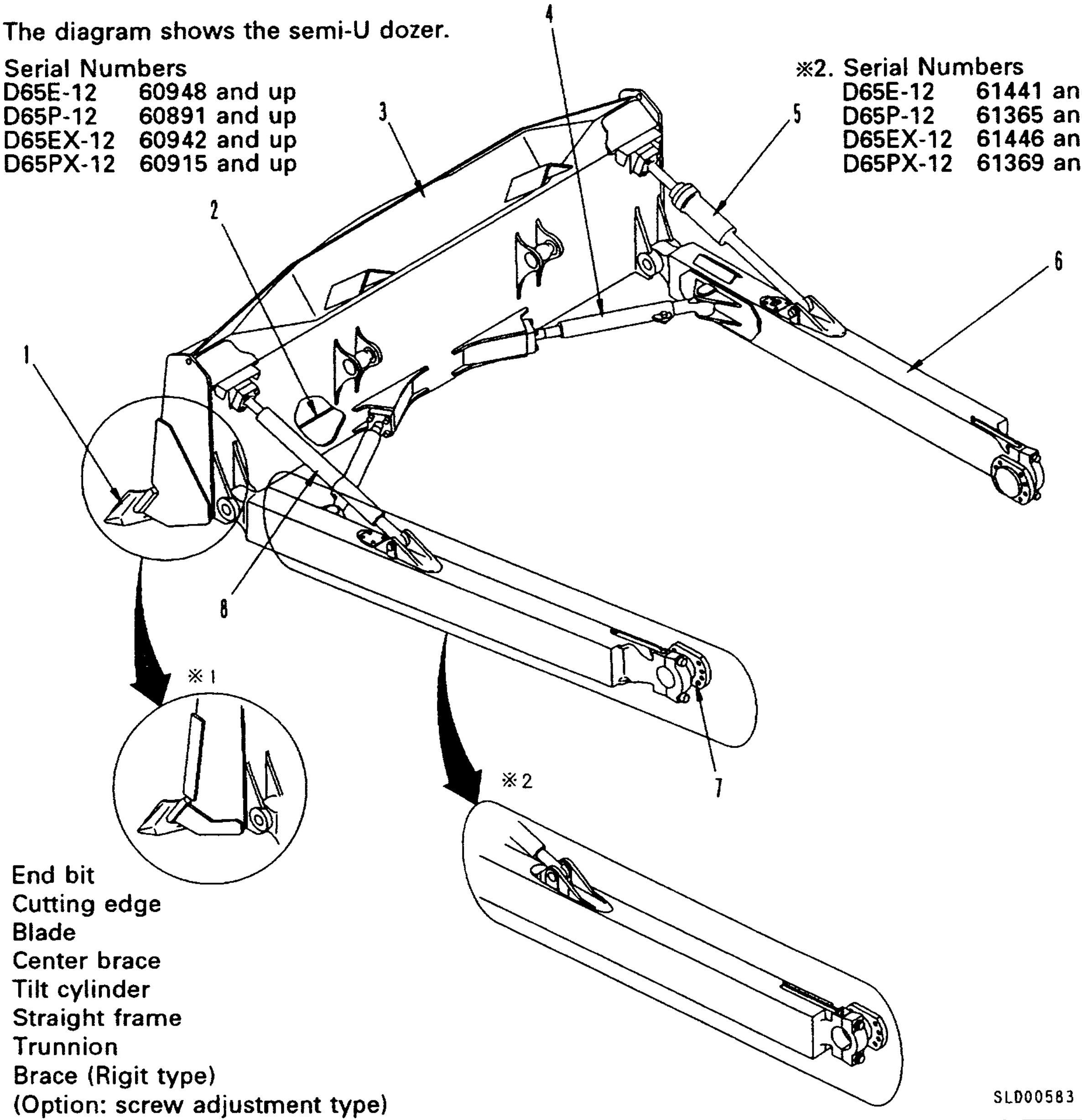
( ): Serial No. 65001 and up

STRAIGHT TILT DOZER

★ The diagram shows the semi-U dozer.

※1. Serial Numbers
D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

※2. Serial Numbers
D65E-12 61441 and up
D65P-12 61365 and up
D65EX-12 61446 and up
D65PX-12 61369 and up



1. End bit
2. Cutting edge
3. Blade
4. Center brace
5. Tilt cylinder
6. Straight frame
7. Trunnion
8. Brace (Rigit type)
   (Option: screw adjustment type)

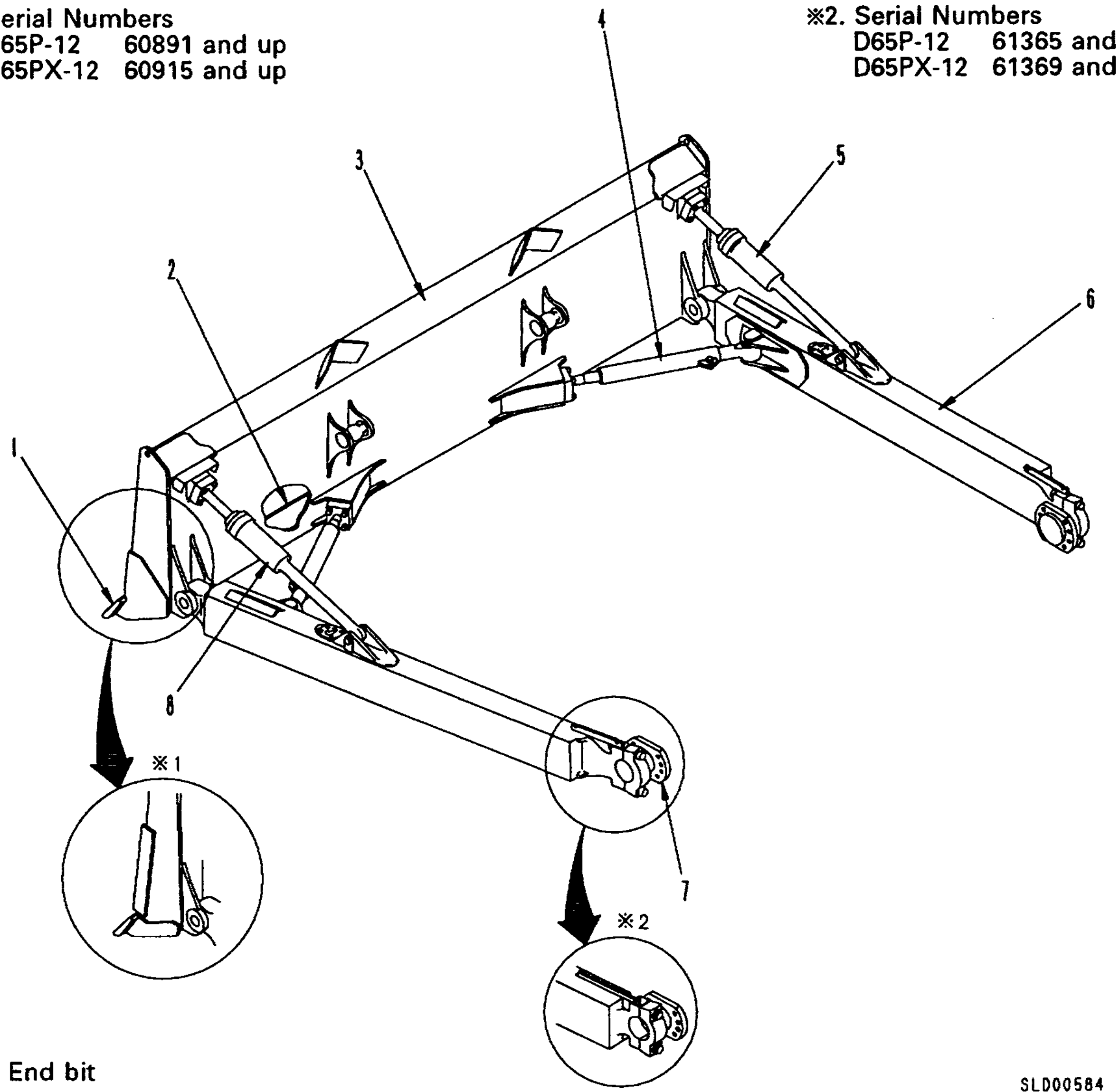
		Straight tilt dozer (type E)	Straight tilt dozer (type P)	Semi–U dozer (D65E.EX)
Blade width	mm	3,415	3,970	3,360 (※3,460)
Blade height	mm	1,225	1,110	1,425
Max. lifting height	mm	1,100 (※1,105)	1,200 (※1,205)	1,095 (※1,150)
Max. lowering depth	mm	450 (※440)	445 (※440)	450 (※440)
Max. tilt	mm	460 (870)	450 (890)	465 (855)
Cutting edge angle	deg.(°)	55	57	55
Range of cutting edge angle adjustment	deg.(°)	0 (± 7)	0 (± 7)	0 (± 7)
Position of tilt cylinder		Right	Right	Left

(   ): Value for machines with screw adjustment type tilt brace.
(※): Serial No. 65001 and up

POWER PITCH DOZER

※1. Serial Numbers
D65P-12 60891 and up
D65PX-12 60915 and up

※2. Serial Numbers
D65P-12 61365 and up
D65PX-12 61369 and up

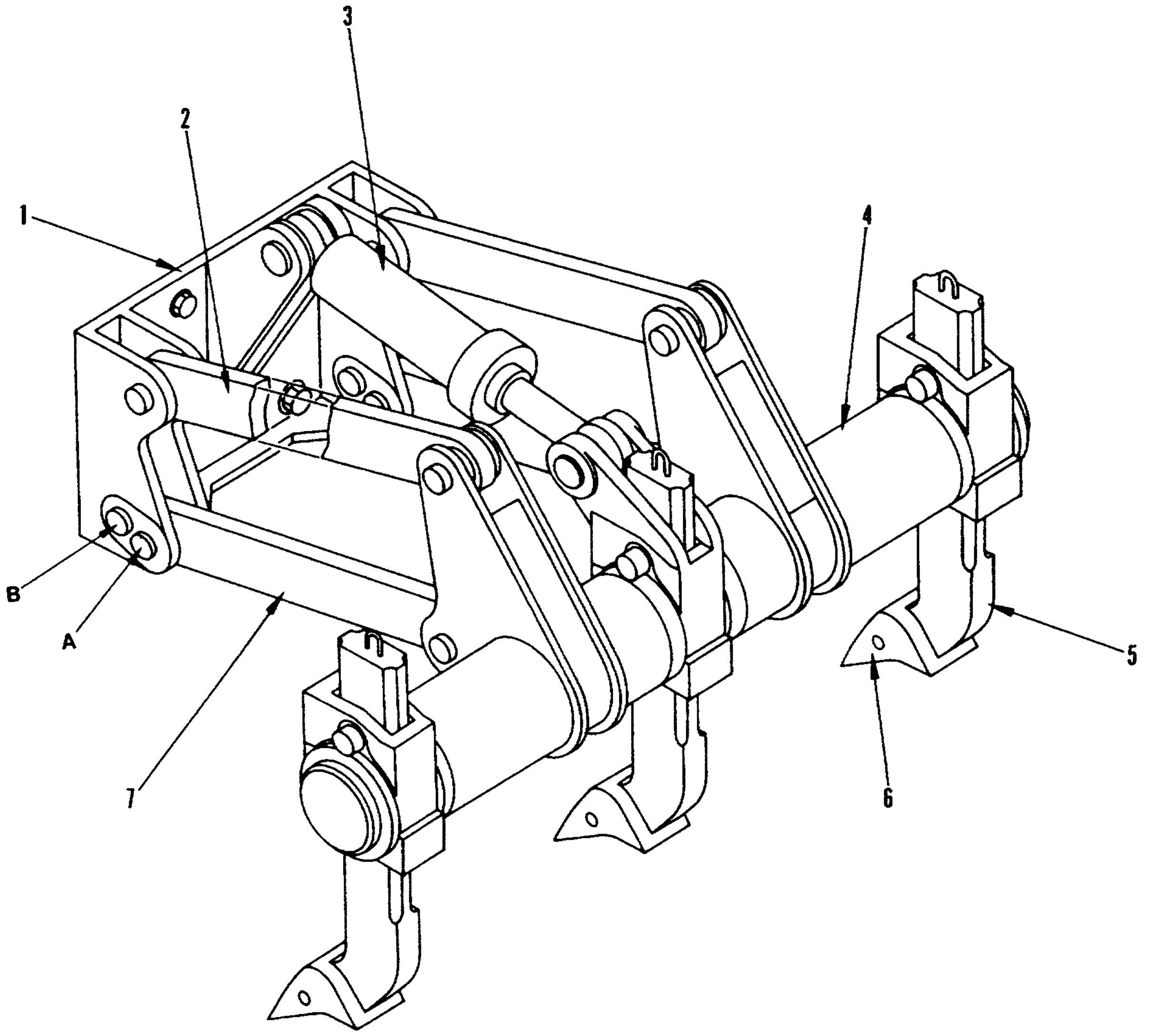


1. End bit
2. Cutting edge
3. Blade
4. Center brace
5. Pitch cylinder (R.H.)
6. Straight frame
7. Trunnion
8. Tilt cylinder (L.H.)

		Power pitch dozer (D65P.PX–12)
Blade width	mm	3,970
Blade height	mm	1,110
Max. lifting height	mm	1,200 (1,205)
Max. lowering depth	mm	445 (440)
Max. tilt	mm	890
Cutting edge angle	deg.(°)	57
Range of cutting edge adjustment angle	deg.(°)	+ 9, – 7
Position of tilt cylinder		Left
Position of pitch cylinder		Right

( ): Serial No. 65001 and up

RIPPER



1. Bracket
2. Upper link
3. Ripper cylinder
4. Beam
5. Shank
6. Point
7. Lower link

A. Position of pin hole ①
B. Position of pin hole ②

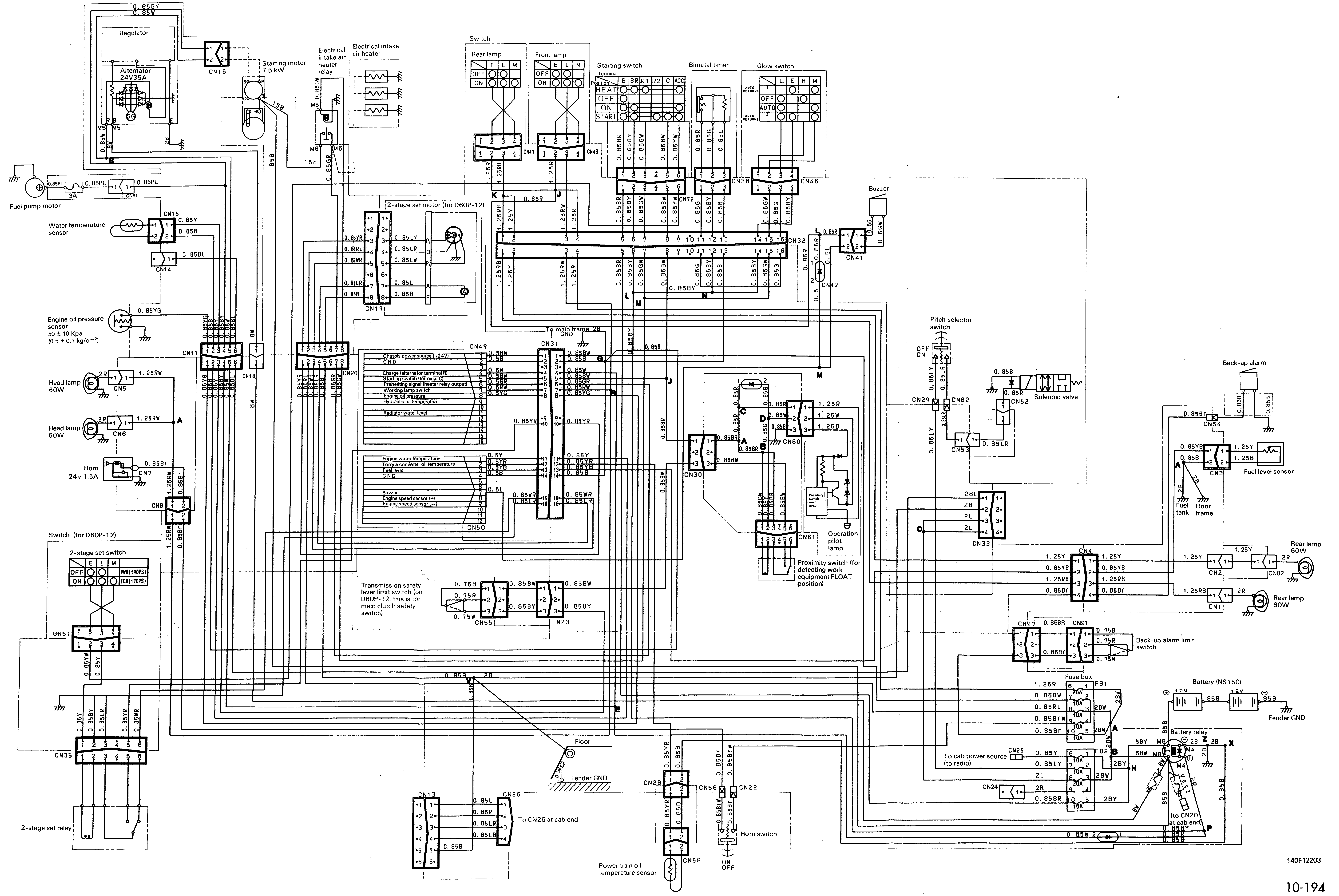
		Ripper (E type)
Max. lifting height of point (mm)		640 (645)
Max. lowering depth of point(mm)		595 (590)
Digging angle of point	Pin hole ① (deg)	55
	Pin hole ② (deg)	45
Shank position (mm) (to left or right from center)		950

( ): Serial No. 65001 and up

ELECTRICAL CIRCUIT DIAGRAM

D65E-12	60001-60947
D65P-12	60001-60890
D65EX-12	60001-60941
D65PX-12	60001-60914

Machines equipped with canopy



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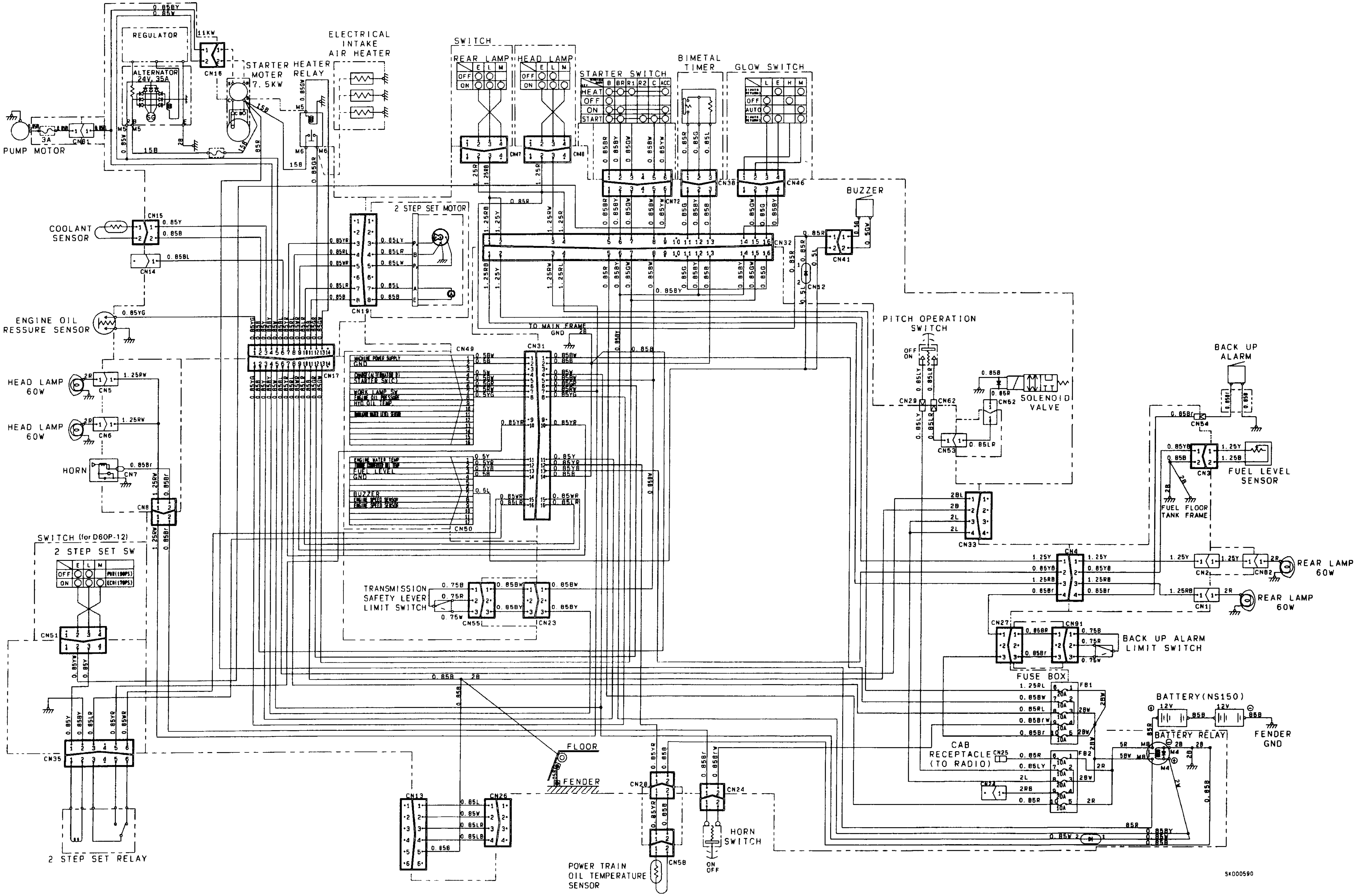
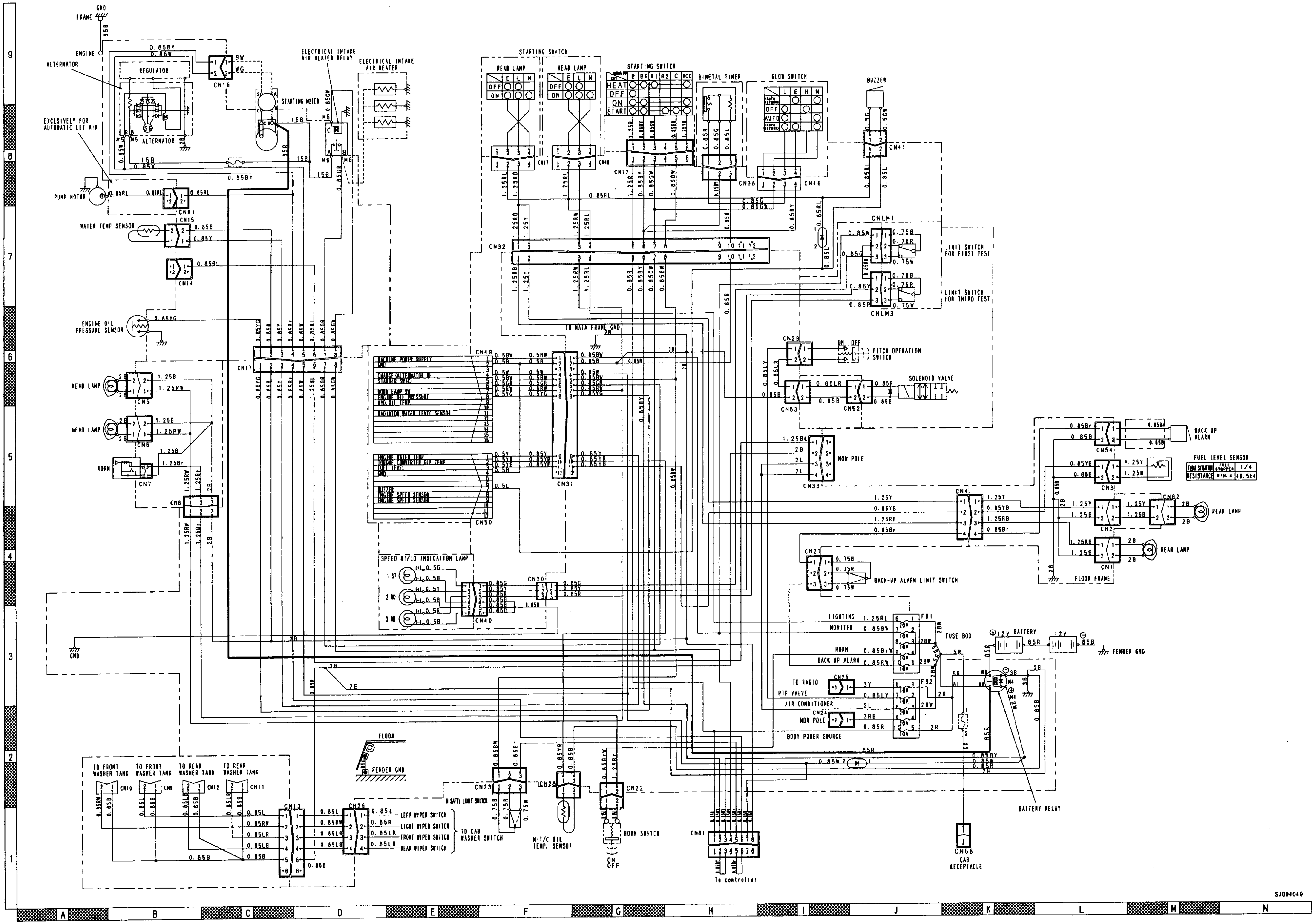
Machines equipped with canopy

D65E-12 60948 – 65000
D65P-12 60891 – 65000
D65EX-12 60942 – 65000
D65PX-12 60915 – 65000



Machines equipped with canopy

D65E-12	65001 and up	D65EX-12	65001 and up
D65P-12	65001 and up	D65PX-12	65001 and up



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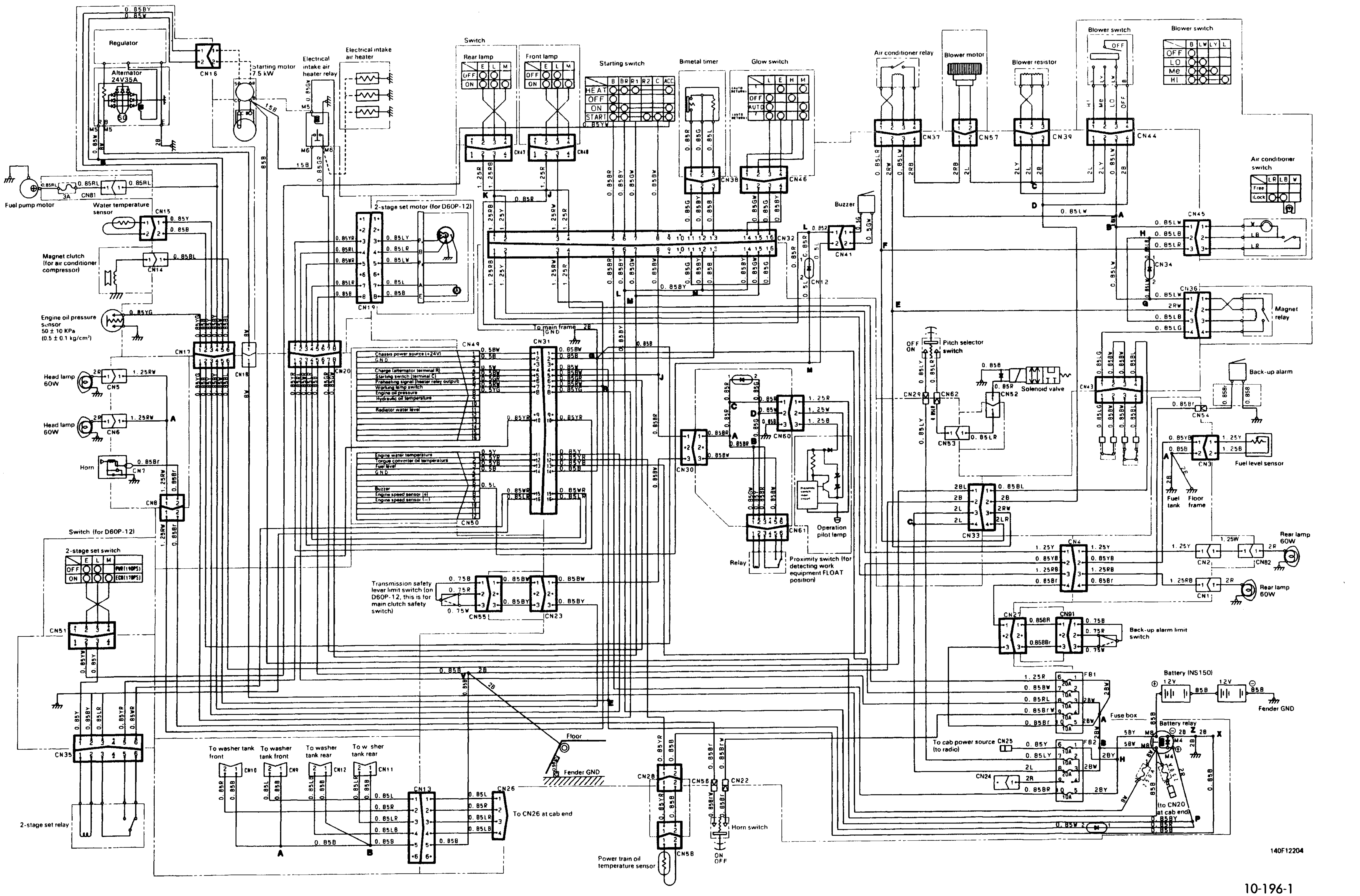
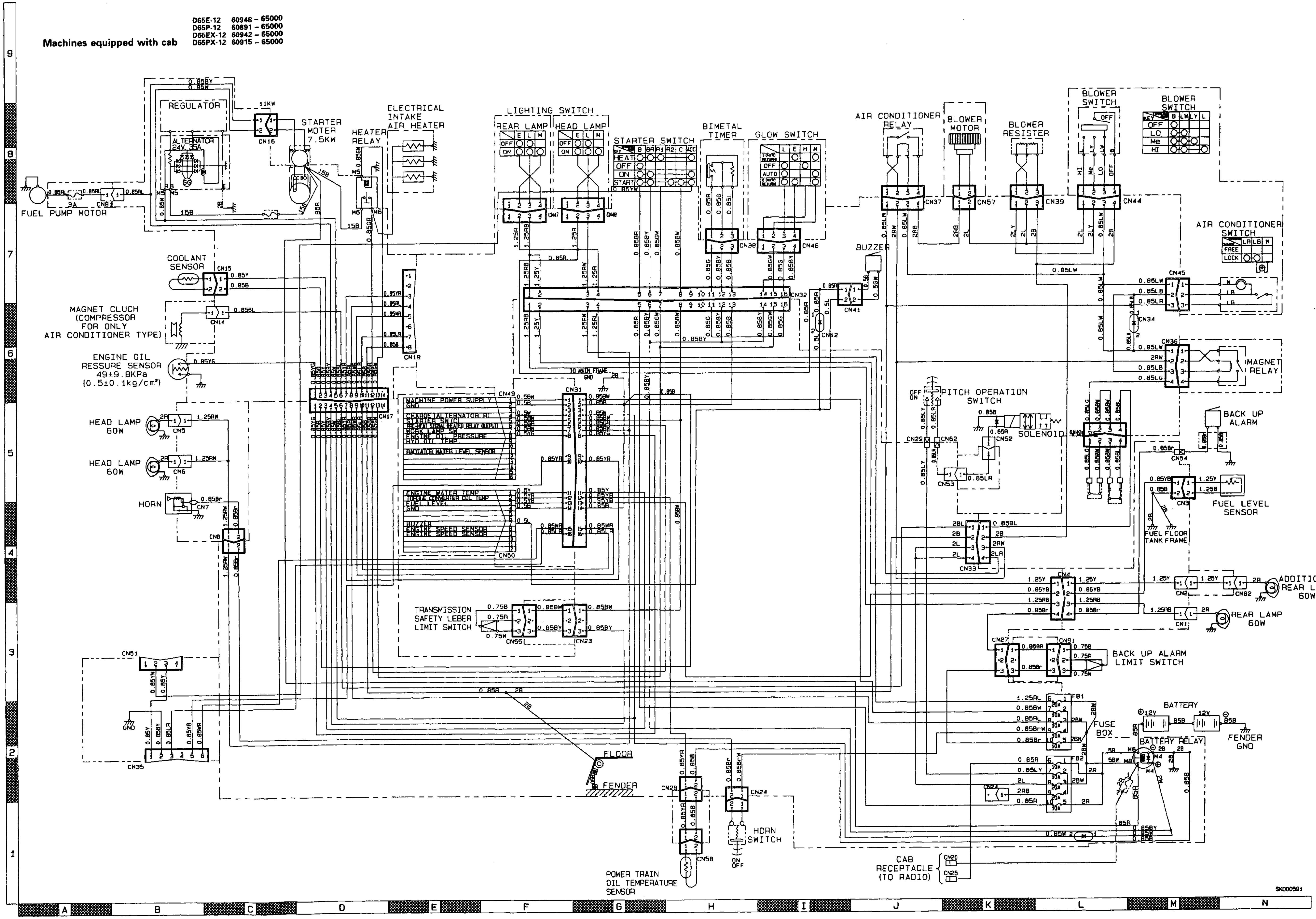
Machines equipped with cab

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914



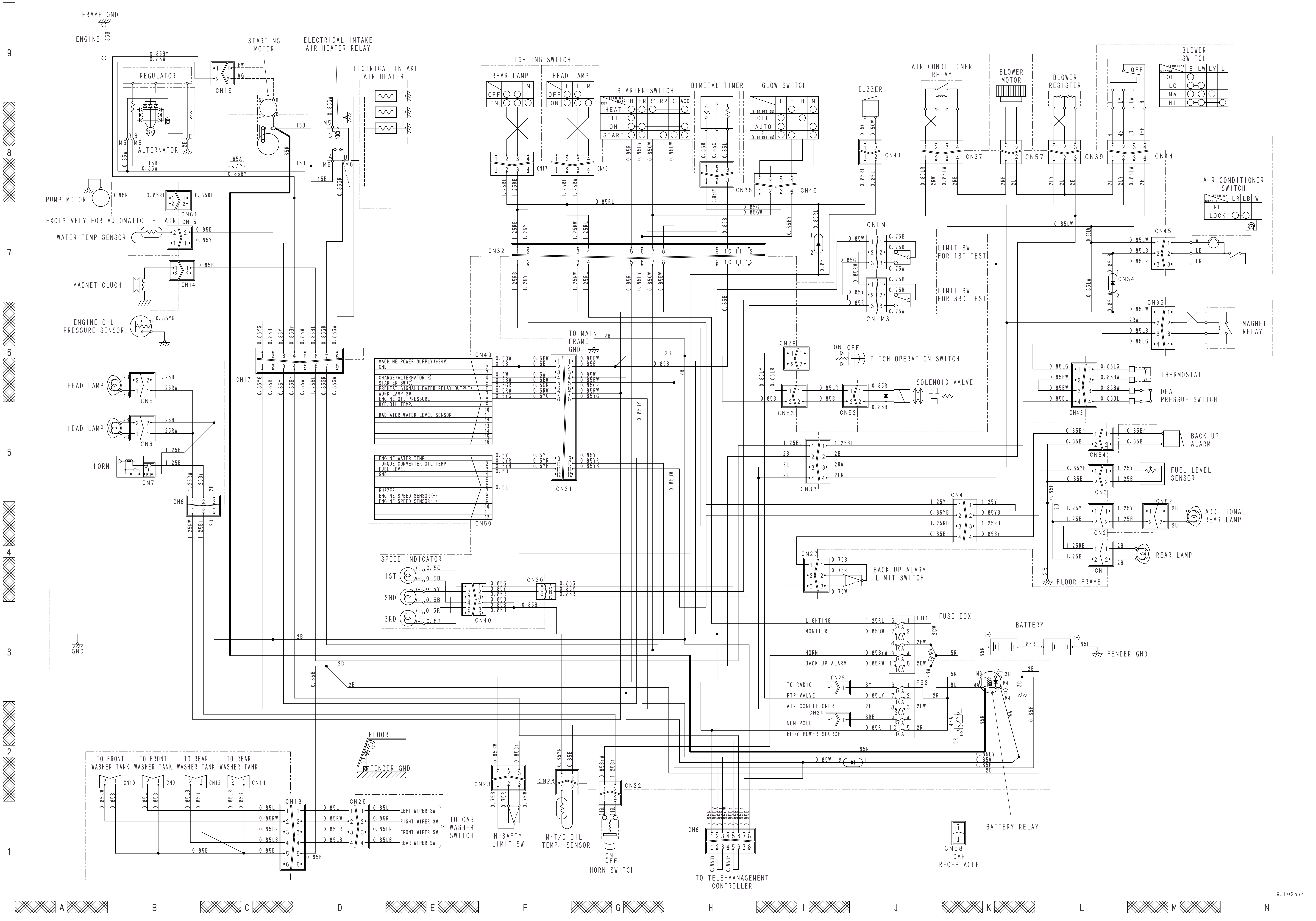
Machines equipped with cab

D65E-12 60948 – 65000
D65P-12 60891 – 65000
D65EX-12 60942 – 65000
D65PX-12 60915 – 65000



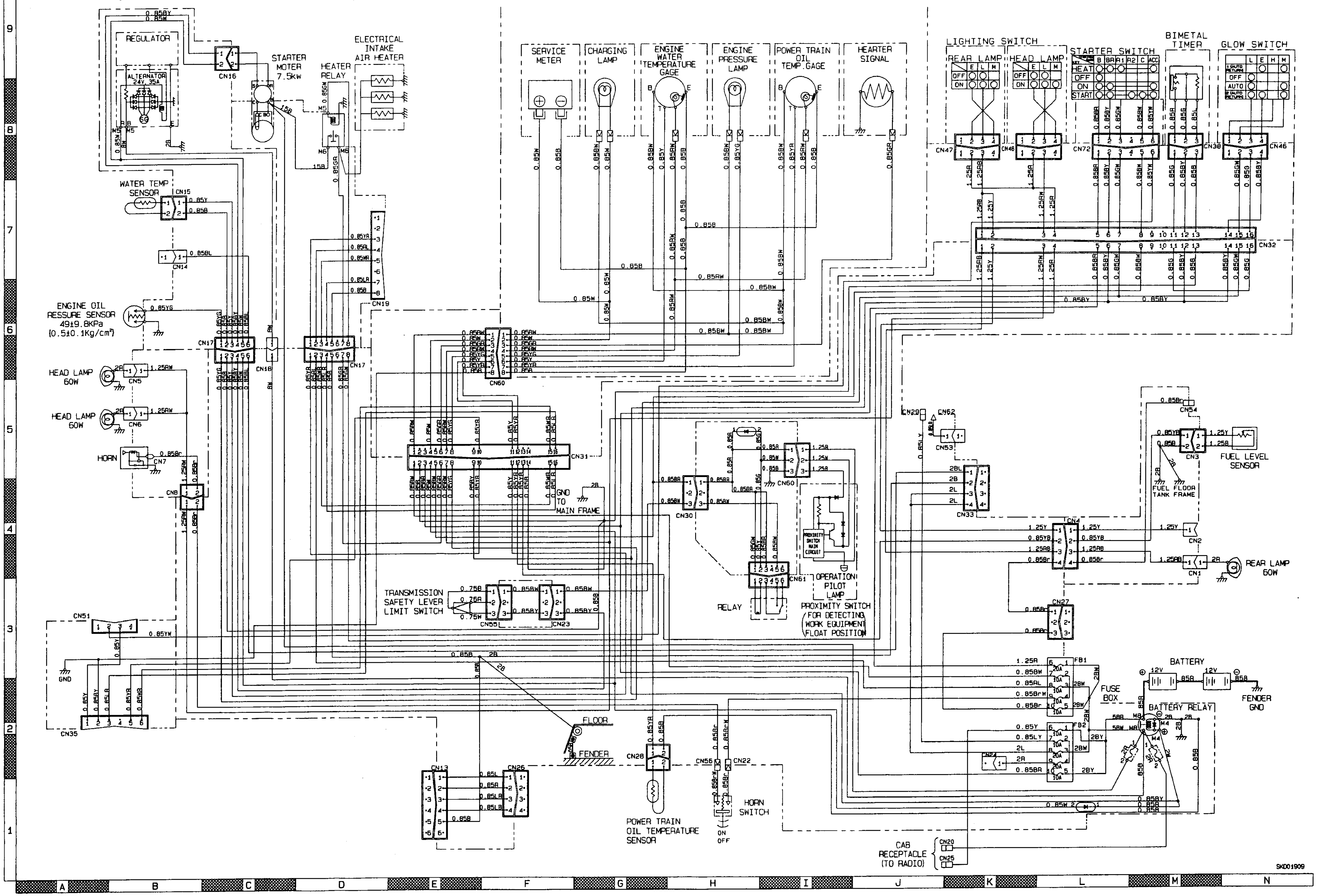
Machines with gauge type monitor panel (without cab)

D65E-12 60948 – 61440
D65P-12 60891 – 61364



Machines with gauge type monitor panel (without cab)

D65E-12 60001 - 60947
D65P-12 60001 - 60890



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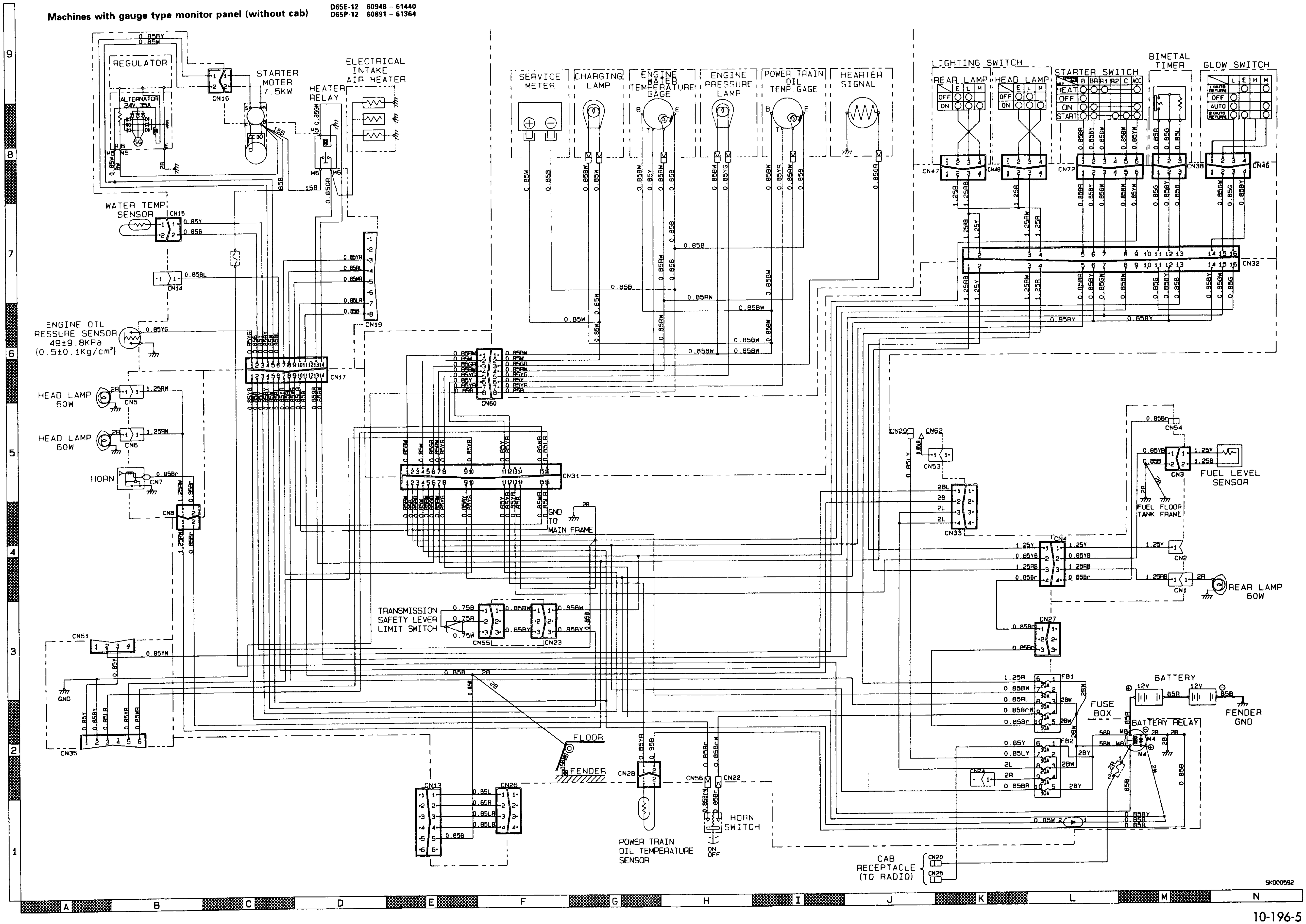
Machines with gauge type monitor panel (without cab)

D65E-12 60948 – 61440
D65P-12 60891 – 61364



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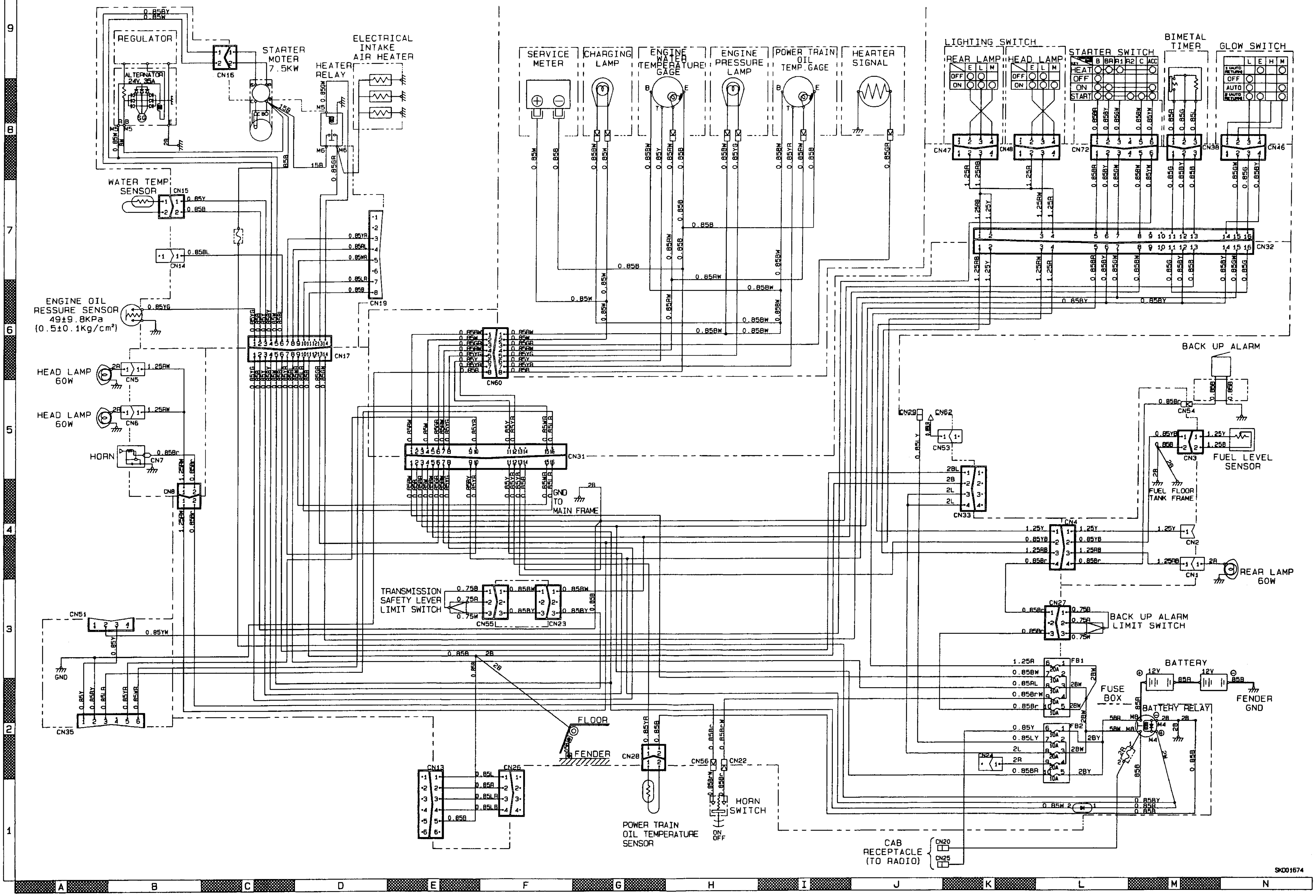
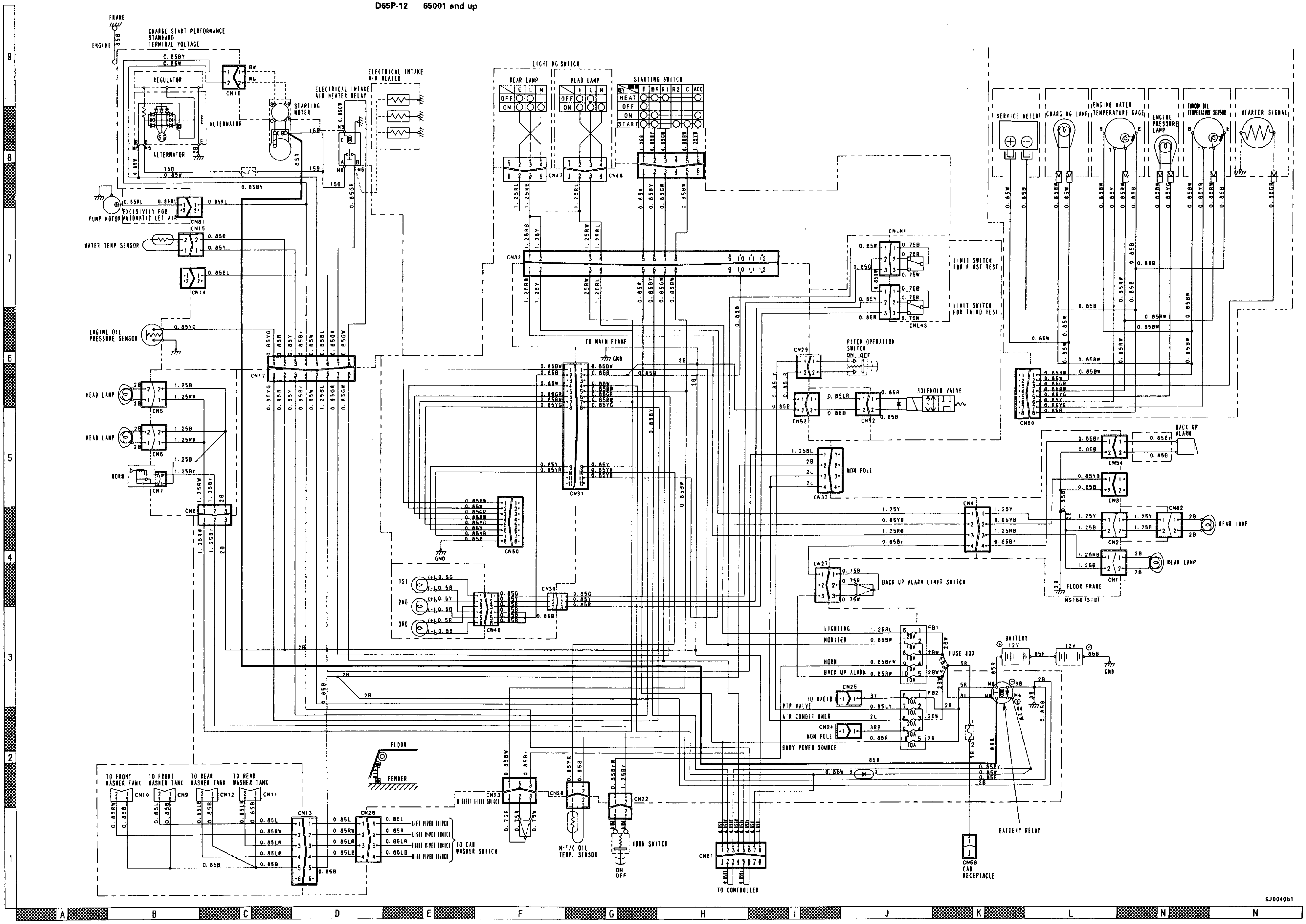
Machines with gauge type monitor panel (without cab)

D65E-12 61441 – 65000
D65P-12 61365 – 65000



Machines with gauge type monitor panel (without cab) D65E-12 65001 and up
D65P-12 65001 and up



Electric circuit diagram inside cab

D65E-12 60001 – 65000
D65P-12 60001 – 65000

D65EX-12 60001 – 65000
D65PX-12 60001 – 65000

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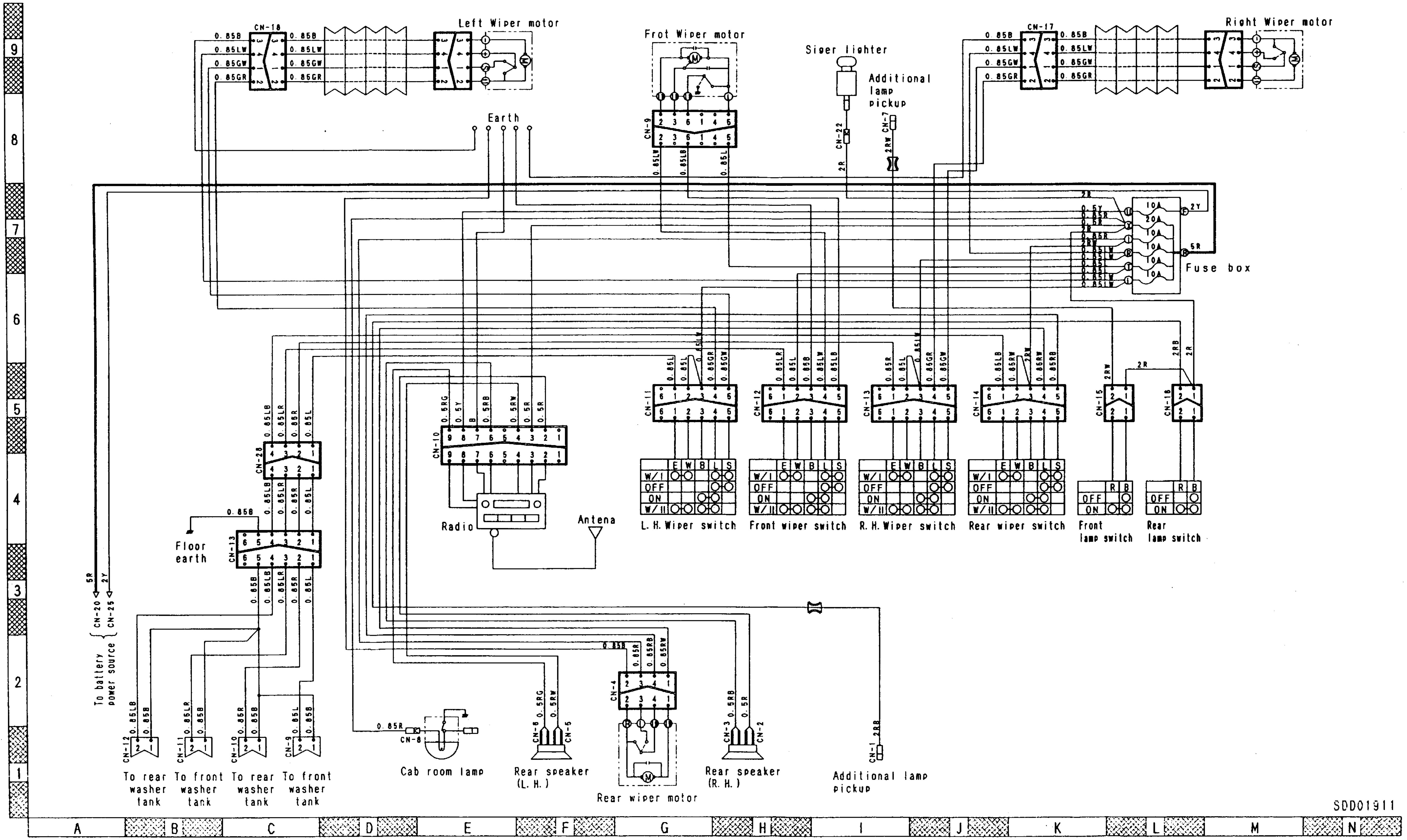
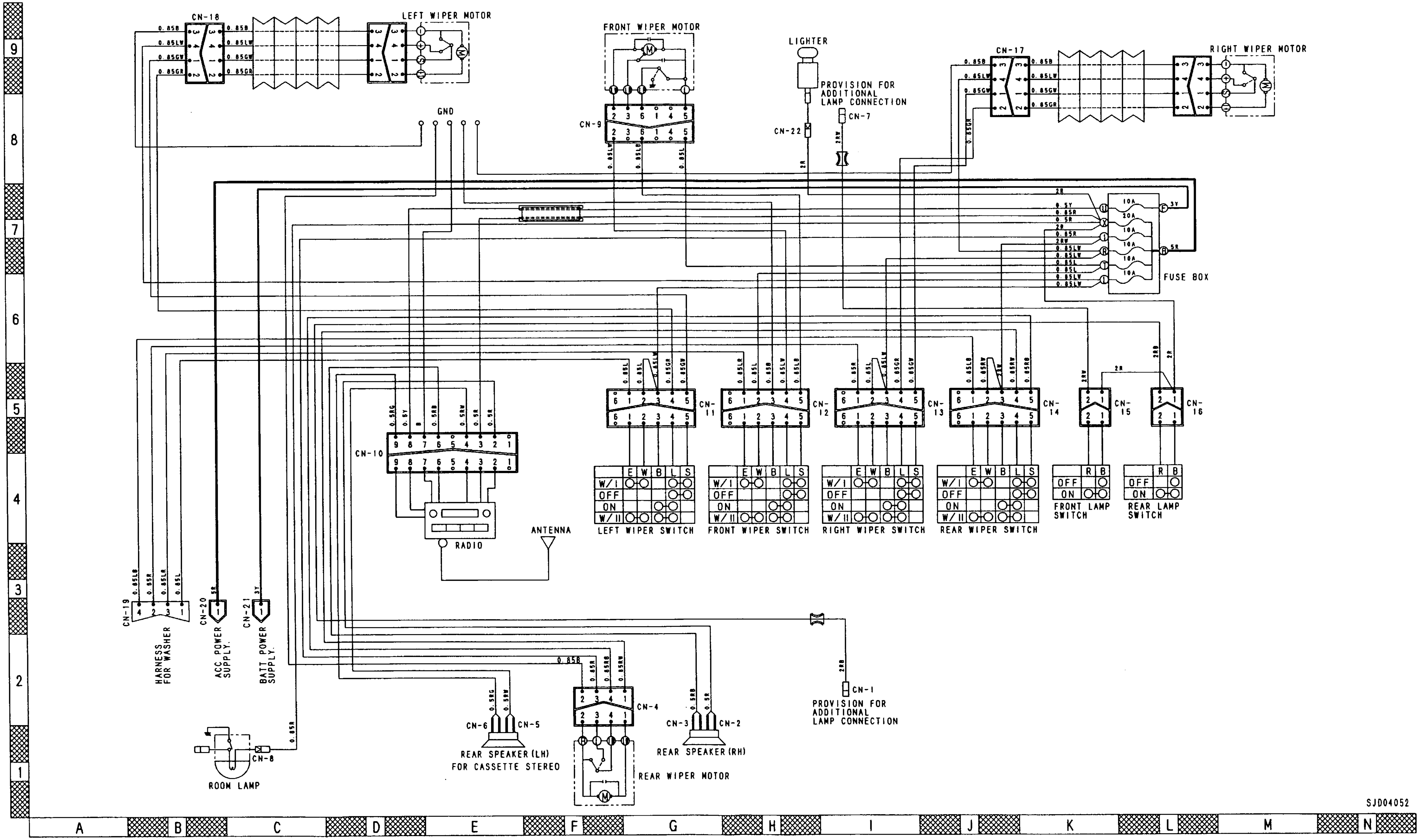


Electric circuit diagram inside cab

D65E-12 65001 and up **D65EX-12 65001 and up**
D65P-12 65001 and up **D65PX-12 65001 and up**



014012

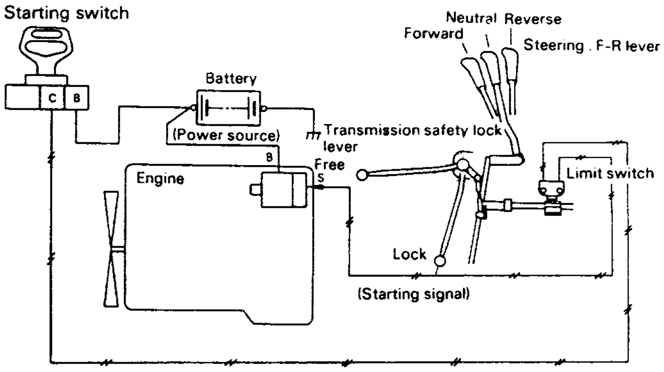
ENGINE CONTROL

SAFETY MECHANISM WHEN STARTING ENGINE

FOR TRANSMISSION SAFETY LOCK LEVER

FUNCTION

- There is a limit switch installed to the transmission safety lock lever, and if the lock lever is not placed at LOCK position, the starting circuit does not come ON, so the engine cannot be started.
- When the transmission safety lock lever is placed at the LOCK position, the steering and directional lever is automatically returned to the neutral position.



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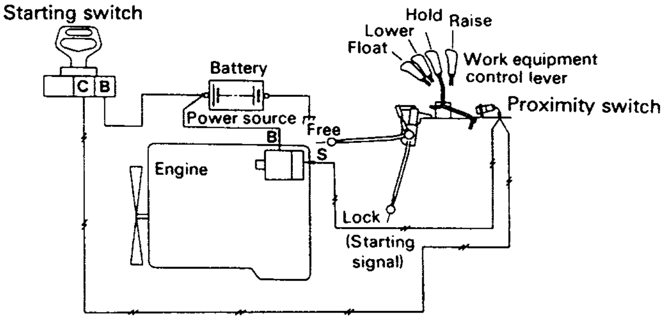
FOR WORK EQUIPMENT CONTROL LEVER

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

FUNCTION

- There is a detent at the FLOAT postion of the work equipment control lever, and this holds the control lever in position. It is dangerous if the engine is started when the work equipment control lever is at the FLOAT position, so a proximity switch is installed to detect when the lever is at the FLOAT position and to prevent the engine from being started.
- If the safety lock lever is placed at the LOCK position, the work equipment control lever is automatically returned to the HOLD position and the detection switch is canceled, so it becomes possible to start the engine.



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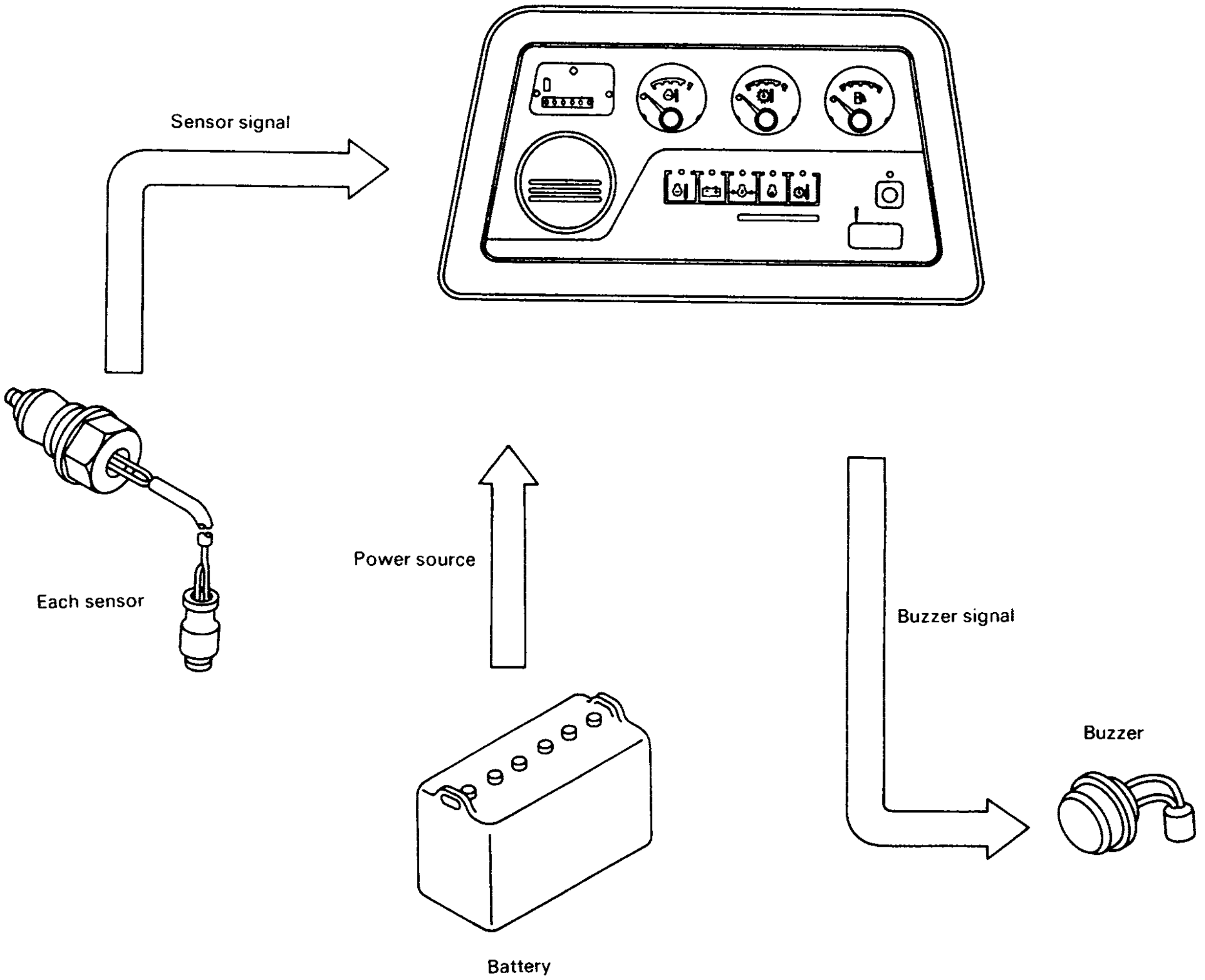
MACHINE MONITOR SYSTEM



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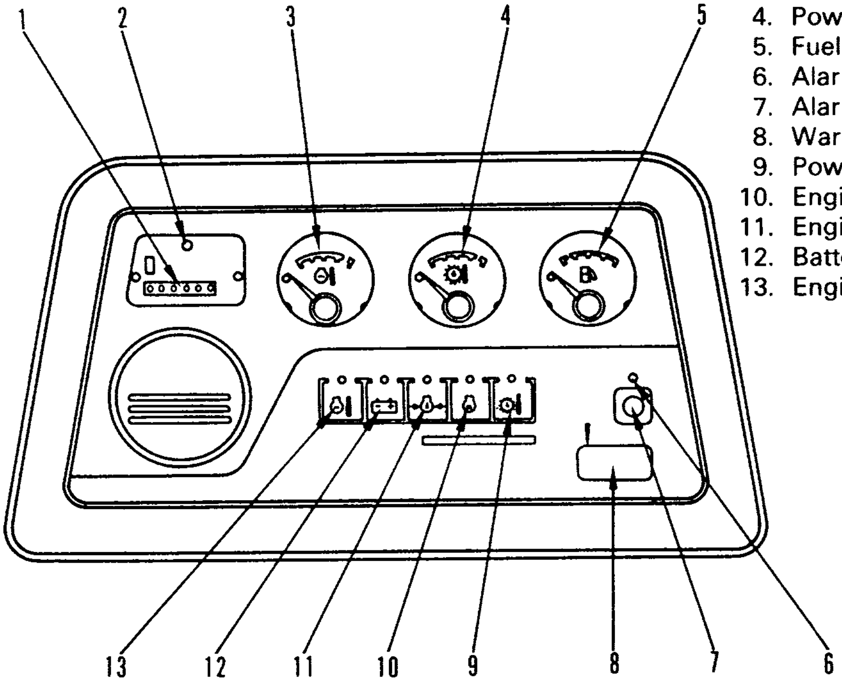
- The machine monitor system uses sensors installed at various part of the machine to observe the machine condition. It processes this information swiftly and displays it on the panel to keep the operator informed of the machine condition.
  The information displayed on the panel can be broadly divided into the following categories.

1. The monitor group, which informs the operator when there is any abnormality in the machine.
2. The gauge group (coolant temperature, power train oil temperature, fuel level), which always displays the condition of the machine.

- The machine monitor system consists of the monitor panel, sensors, warning buzzer and power source.
  The monitor panel and sensors are connected with wiring harnesses, and the power supply for the monitor panel is taken from the battery.
  If any abnormality occurs in the machine (detected by the sensor), the monitor and warning lamp flash and the buzzer sounds to protect the machine. The buzzer can be stopped temporarily by operating the cancel switch.

MONITOR PANEL



1. Service meter
2. Service meter indicator
3. Engine coolant temperature gauge
4. Power train oil temperature gauge
5. Fuel level gauge
6. Alarm buzzer cancel switch indicator
7. Alarm buzzer cancel switch
8. Warning lamp
9. Power train oil temperature caution lamp
10. Engine preheating indicator
11. Engine oil pressure caution lamp
12. Battery charge caution lamp
13. Engine coolant temperature caution lamp

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OUTLINE

- The monitor panel consists of the monitor group, which gives a warning if any abnormality occurs in the machine, and the service meter and gauge group, which displays the condition of the machine. The service meter and fuel level gauge are driven directly by a signal from the machine, but for the other items, a microcomputer installed in the panel processes the signal from various sensors and displays the result.
  The items displayed on the indicator type gauges and monitor portion are as shown in the table in MONITOR PANEL DISPLAY.

OPERATION

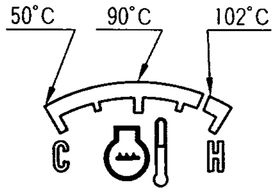
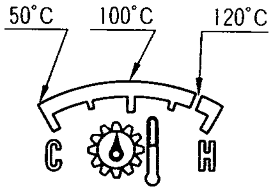
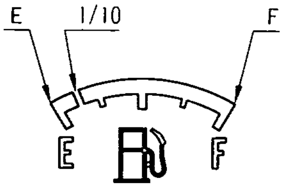
1. **Turning on power (turning starting switch to ON)**
   1) All caution monitor items light up for 3 seconds.
   2) The warning lamp lights up for 3 seconds and the alarm buzzer sounds for 1 second.

2. **CAUTION items**
   These light up or flash when there is any abnormality.
   The warning lamp and alarm buzzer flash or sound together depending on the item that is abnormal.

- The flashing interval for the monitor and warning lamp is approx. 0.8 seconds each repeated ON and OFF.

3. **Alarm buzzer cancel switch**
   If any abnormality is detected and alarm buzzer sounds, it is possible to stop the buzzer temporarily by pressing the buzzer cancel switch. In this case, the alarm buzzer cancel switch indicator lights up. If the cancel switch is pressed again after the buzzer has been stopped, the buzzer will sound again and the cancel indicator will go out. If another abnormality is detected when the buzzer has been temporarily stopped, the alarm buzzer will sound again and the cancel switch will go out.

Monitor panel display (gauge group)

Meter	Coolant temperature	Power train oil temperature	Fuel level
Gauge scale			

4. **Gauge display portion**
   These consists of analog type meters with an indicator. The coolant temperature and power train oil temperature gauges are driven by a microcomputer, and the area showing the normal operating range of the machine is made larger to make operations at the limit of the range easier.
   The red zone for the water and oil temperature is a warning area which uses a caution LED, caution lamp, and caution buzzer.

Connector terminal (signal table)

Connector No.	Connection	Connector No.	Connection
1-1	Power source 24V	2-1	Engine water temperature
1-2	GND	2-2	Power train oil temperature
1-3	—	2-3	Fuel level
1-4	Charge	2-4	GND
1-5	Starting switch (c)	2-5	Model selection 3
1-6	Preheating	2-6	—
1-7	Working lamp, lighting	2-7	Buzzer output
1-8	Engine oil pressure	2-8	—
1-9	—	2-9	—
1-10	—	2-10	—
1-11	—	2-11	—
1-12	—	2-12	—
1-13	Model selection 0		
1-14	Model selection 1		
1-15	Model selection 2		
1-16	—		

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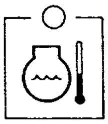
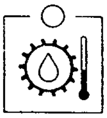
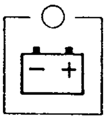
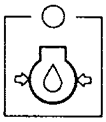
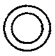
Monitor panel display (monitor group)

Display category	Symbol	Display item	Display range	LED lamp		Caution lamp display	Buzzer output	Remarks
				Display	Dis-play color			
Warning		Engine coolant temperature	Below 102°	Turn off	Red	Turn off	OFF	
			102°C — 107°C	Flashes		Flashes	OFF	
			Above 107°C	Flashes		Flashes	ON	
		Power train oil temperature	Below 120°	Turn off	Red	Turn off	OFF	
			120°—130°C	Flashes		Flashes	OFF	
			Above 130°C	Flashes		Flashes	ON	
		Battery charge	When there is defective charging (below 10V)	ON (when engine is stopped)	Red	Turn off	OFF	
				Flashes (when engine is running)		Flashes		
		Engine oil pressure	Below specified value	ON (when engine is stopped)	Red	Turn off	OFF	
				Flashes (when engine is running)		Flashes	ON	
Pilot		Preheating	When preheating	ON	Green	Turn off	OFF	
Service meter		Service meter	0—99999.9h	—	—	—	—	Time on the clock
		Service meter indicator	When service meter is running	Flashes when service meter is running	Green	—	—	
Switches		Buzzer cancel switch indicator	When buzzer is canceled	Flashes while buzzer remains canceled	Yellow	—	OFF	

Switches

Items	Actuation	Symbol
Buzzer cancel	OFF ◄—► ON	

SENSORS

- The signal from the sensor is input directly to the machine monitor panel.
- The engine oil pressure sensor signal is judged to be normal when the contacts are open and the signal wire is separated from the chassis ground.

Display category	Type of sensor	Sensor method	When normal	When abnormal
Caution	Engine oil pressure	Contact	OFF (open)	ON (closed)
	Engine coolant temperature	Resistance	—	—
	Power train oil temperature	Resistance	—	—
Gauge	Fuel level	Resistance	—	—

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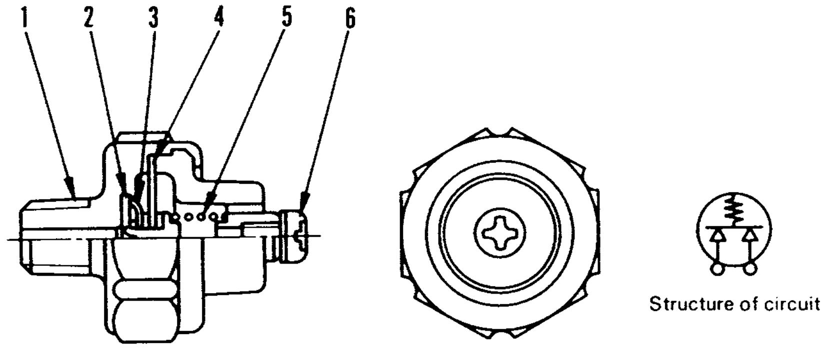
ENGINE OIL PRESSURE SENSOR



Structure of circuit

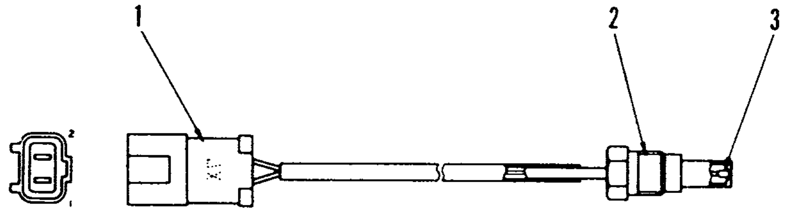
202F05175

1. Plug
2. Contact ring
3. Contact
4. Diaphragm
5. Spring
6. Thermistor

FUNCTION

- The engine oil pressure sensor is installed at the front on the left side of the cylinder block. When the engine oil pressure is above the specified value, diaphragm (4) bends, so contact (3) and contact ring (2) are separated and the circuit is turned OFF. When the engine oil pressure goes below the specified pressure, the curve of the diaphragm becomes smaller, so the contact and contact link come into contact and the circuit is turned ON. The monitor panel display and warning lamp flash, and the alarm buzzer sounds.

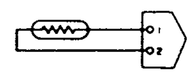
ENGINE COOLANT TEMPERATURE SENSOR
POWER TRAIN OIL TEMPERATURE SENSOR



1. Connector
2. Plug
3. Thermistor

FUNCTION

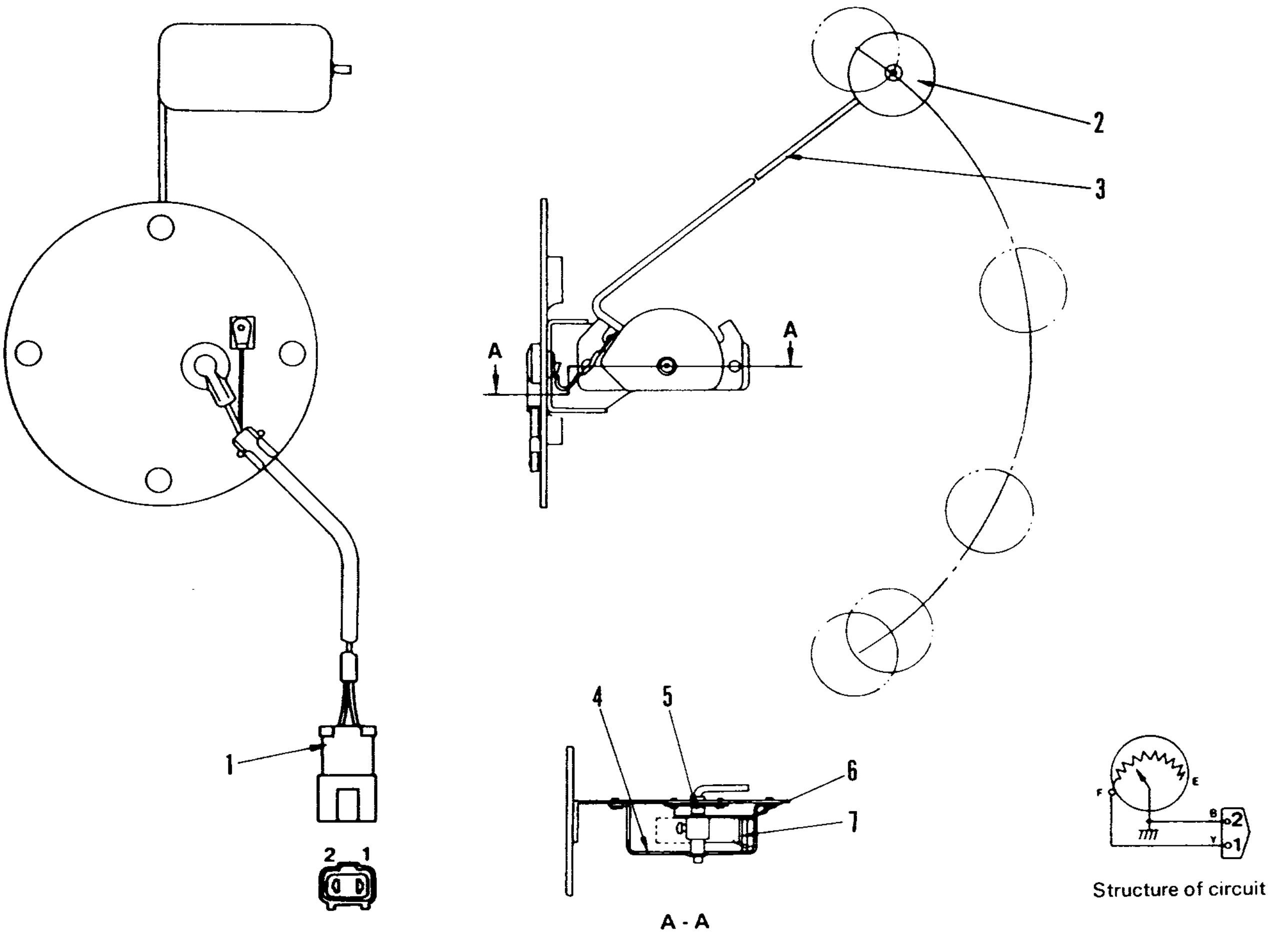
- The engine coolant temperature sensor is installed to the thermostat housing on the right side of the engine. It detects the temperature with thermistor (3) and sends a signal to the monitor panel.
  The monitor panel moves the gauge indicator to the range that corresponds to the signal, and if it is above the specified temperature, the monitor panel display and warning lamp flash, and the buzzer sounds.
- The power train oil temperature sensor is installed to the left side of the torque converter case, and operates in the same way as the engine water temperature sensor.



Structure of circuit

198F02046

FUEL LEVEL SENSOR



014012

1. Connector
2. Float
3. Arm
4. Body
5. Spring
6. Contact
7. Spacer

FUNCTION

- The fuel level sensor is installed to the center of the front face of the fuel tank. Float (2) moves up and down in accordance with the level of the remaining fuel.
  The movement of the float passes through arm (3), which actuates a variable resistance, and this sends a signal to the monitor panel to display the level of the remaining fuel.

20 TESTING AND ADJUSTING

★ The following precautions are necessary when using the STANDARD VALUE TABLE for testing and adjusting, or for troubleshooting.

1. The values in the table are for new machines, and are obtained for reference to values for new machines and the values when shipping from the factory. Therefore, they should be used as target values for judging the progress of wear, or when repairing the machine.
2. The values for judging failures are based on standards when shipping the machine from the factory, and on the results of various tests. These values should be used as reference together with the repair condition and operating record of the machine to make judgements on failures.
3. The values in the table should not be used for judging claims.

⚠ When carrying out testing, adjusting or troubleshooting, stop the machine on level ground, install the safety pins and block the tracks.

⚠ When working in groups, use agreed signals and do not allow unauthorized persons near the machine.

⚠ When checking the water level in the radiator, wait for the water to cool. Do not remove the radiator cap while the water is hot. Boiling water may spurt out.

⚠ Be careful not to get caught in rotating parts.

STANDARD VALUE TABLE FOR ENGINE

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

- **FOR ENGINE ON TEST BENCH**

Machine model				D65E-12	
Engine				6D125-1	
Classification	Item	Condition	Unit	Standard value	Permissible value
Performance	Engine speed	High idling speed Low idling speed	rpm rpm	2,100 ± 50 825 ± 25	2,100 ± 50 825 ± 25
	Necessary starting speed	0°C –20°C (with starting aid)	rpm rpm	Min. 100 Min. 85	— —
Intake and exhaust system	Intake resistance	At all speed	mmH_2O	Max. 300	762
	Intake pressure	At rated output	mm Hg	—	—
	Exhaust temperature	All speed (intake air temp.: 20°C)	°C	Max. 650	700
	Exhaust gas color	Quick acceleration (Low idling → High idling)	Bosch scale	Max. 5.0	6.0
		At rated output		Max. 2.0	3.0
		At high idling		Max. 1.0	2.0
	Valve clearance (When engine is hot or cold.)	Intake valve	mm	0.33	—
		Exhaust valve	mm	0.71	—
Engine body	Compression pressure (SAE30 oil)	Oil temperature: 40 — 60°C (Engine speed)	MPa (kg/cm²) (rpm)	Min. 3.3 (Min. 34) (200 — 250)	2.4 (24) (200 — 250)
	Blow-by pressure (SAE30 oil)	At rated output Water temperature: Min. 70°C	$mm H_2O$	Max. 50	100
Lubrication system	Oil pressure (Oil temperature: Min. 80°C)	At rated output SAE30 oil	MPa (kg/cm²)	0.3 — 0.5 (3.0 — 5.0)	0.21 (2.1)
		At rated output SAE 10W oil	MPa (kg/cm²)	0.25 — 0.45 (2.5 — 4.5)	0.18 (1.8)
		At low idling SAE30 oil	MPa (kg/cm²)	0.15 — 0.25 (1.5 — 2.5)	0.07 (0.7)
		At low idling SAE10W oil	MPa (kg/cm²)	0.10 — 0.20 (1.0 — 2.0)	0.07 (0.7)
	Oil temperature	All speed (oil in oil pan)	°C	90 — 110	120
	Oil consumption ratio	At continuous rated output (Ratio of fuel consumption)	%	Max. 0.5	1.0
Fuel system	Fuel injection pressure	Nozzle tester	MPa (kg/cm²)	$22.06^{+1.0}_{+0.5}$ (225^{+10}_{+5})	18.24 (186)
	Fuel injection timing	Before top dead center (B.T.D.C.)	degree	22 ± 1	22± 1
Cooling system	Radiator pressure valve	Opening pressure (Differential pressure)	MPa (kg/cm²)	0.09 ± 0.015 (0.9 ± 0.15)	0.09 ± 0.015 (0.9 ± 0.15)
	Fan speed	At rated engine speed	rpm	1,655 ± 50	1,655 ± 50
	Fan belt tension	Deflects when pushed with a force of 58.8 N (6 kg)	mm	10	8 — 12

★ The values given in the TESTING AND ADJUSTING DATA are NOT for adjustment of the output.
Do not use these values as a guide to change the setting of the fuel injection pump.

014012

Machine model				D65P, EX, PX-12	
Engine				S6D125-1	
Classification	Item	Condition	Unit	Standard value	Permissible value
Performance	Engine speed	High idling speed Low idling speed	rpm rpm	2,100 ± 50 825 ± 25	2,100 ± 50 825 ± 25
	Necessary starting speed	0°C –20°C (with starting aid)	rpm rpm	Min. 100 Min. 85	— —
Intake and exhaust system	Intake resistance	At all speed	mmH_2O	Max. 300	762
	Intake pressure	At rated output	mm Hg	Min. 600	480
	Exhaust pressure (Turbine inlet pressure)	At rated output	mmHg	Min. 500	400
	Exhaust temperature (Turbine inlet temp.)	All speed (intake air temp.: 20°C)	°C	Max. 630	700
	Exhaust gas color	Quick acceleration (Low idling → High idling)	Bosch scale	Max. 5.0	6.0
		At rated output		Max. 1.5	2.5
		At high idling		Max. 1.0	2.0
	Valve clearance (When engine is hot or cold.)	Intake valve	mm	0.33	—
		Exhaust valve	mm	0.71	—
Engine body	Compression pressure (SAE30 oil)	Oil temperature: 40 — 60°C (Engine speed)	MPa (kg/cm^2) (rpm)	Min. 3.1 (Min. 32) (200 — 250)	2.2 (22) (200 — 250)
	Blow-by pressure (SAE30 oil)	At rated output Water temperature: Min. 70°C	$mm H_2 0$	Max. 50	100
Lubrication system	Oil pressure (Oil temperature: Min. 80°C)	At rated output SAE30 oil	MPa (kg/cm^2)	0.3 — 0.5 (3.0 — 5.0)	0.21 (2.1)
		At rated output SAE10W oil	MPa (kg/cm^2)	0.25 — 0.45 (2.5 — 4.5)	0.18 (1.8)
		At low idling SAE30 oil	MPa (kg/cm^2)	0.15 — 0.25 (1.5 — 2.5)	0.07 (0.7)
		At low idling SAE10W oil	MPa (kg/cm^2)	0.10 — 0.20 (1.0 — 2.0)	0.07 (0.7)
	Oil temperature	All speed (oil in oil pan)	°C	90 — 110	120
	Oil consumption ratio	At continuous rated output (Ratio of fuel consumption)	%	Max. 0.5	1.0
Fuel system	Fuel injection pressure	Nozzle tester	MPa (kg/cm^2)	$22.06^{+1.0}_{+0.5}$ (225^{+10}_{+5})	18.24 (186)
	Fuel injection timing	Before top dead center (B.T.D.C.)	degree	24 ± 1	24± 1
Cooling system	Radiator pressure valve	Opening pressure (Differential pressure)	MPa (kg/cm^2)	0.09 ± 0.015 (0.9 ± 0.15)	0.09 ± 0.015 (0.9 ± 0.15)
	Fan speed	At rated engine speed	rpm	1,775 ± 53	1,775 ± 53
	Fan belt tension	Deflects when pushed with a force of 58.8 N (6 kg)	mm	10	8 — 12

★ The values given in the TESTING AND ADJUSTING DATA are NOT for adjustment of the output.
Do not use these values as a guide to change the setting of the fuel injection pump.

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

Machine model				D65E-12	
Engine				6D125-2	
Classification	Item	Condition	Unit	Standard value	Permissible value
Performance	Engine speed	High idling speed	rpm	2,100 ± 50	2,100 ± 50
		Low idling speed		825 ± 25	825 ± 25
	Necessary starting speed	0°C		Min. 100	—
		–20°C (with starting aid)		Min. 85	—
Intake and exhaust system	Intake resistance	At all speed	mmH$_2$O	Max. 300	762
	Intake pressure	At rated output	mm Hg	—	—
	Exhaust temperature	All speed (intake air temp.: 20°C)	°C	Max. 650	700
	Exhaust gas color	Quick acceleration (Low idling → High idling)	Bosch scale	Max. 5.0	6.0
		At rated output		Max. 2.0	3.0
		At high idling		Max. 1.0	2.0
	Valve clearance (when engine is hot or cold)	Intake valve	mm	0.33	—
		Exhaust valve		0.71	—
Engine body	Compression pressure (SAE30 oil)	Oil temperature: 40 – 60°C Engine speed: 200 – 250 rpm	MPa (kg/cm^2)	Min. 3.5 (Min. 36)	2.5 (26)
	Blow-by pressure (SAE30 oil)	At rated output Water temperature: Min 70°C	mmH$_2$O	Max. 50	100
Lubrication system	Oil pressure (Oil temperature: Min. 80°C)	At rated output (SAE30)	MPa (kg/cm^2)	0.3 – 0.5 (3.0 – 5.0)	0.21 (2.1)
		At rated output (SAE10W)		0.25 – 0.45 (2.5 – 4.5)	0.18 (1.8)
		At low idling (SAE30)		0.15 – 0.25 (1.5 – 2.5)	0.07 (0.7)
		At low idling (SAE10W)		0.10 – 0.20 (1.0 – 2.0)	0.07 (0.7)
	Oil temperature	All speed (oil in oil pan)	°C	90 – 110	120
	Oil consumption ratio	At continuous rated output (Ratio of fuel consumption)	%	Max. 0.5	1.0
Fuel system	Fuel injection pressure	Nozzle tester	MPa (kg/cm^2)	$22.06^{+1.0}_{+0.5}$ (225^{+10}_{+5})	18.24 (186)
	Fuel injection timing	Before top dead center (B.T.D.C.)	degree	16 ± 1	16 ± 1
Cooling system	Radiator pressure valve	Opening pressure (Differential pressure)	MPa (kg/cm^2)	0.09 ± 0.015 (0.9 ± 0.15)	0.09 ± 0.015 (0.9 ± 0.15)
	Fan speed	At rated engine speed	rpm	1,655 ± 50	1,655 ± 50
	Fan belt tension	Deflects when pushed with a force of 58.8 N (6 kg)	mm	10	8 – 12

★ The values given in the TESTING AND ADJUSTING DATA are NOT for adjustment of the output. Do not use these values as a guide to change the setting of the fuel injection pump.

014012

Machine model				D65P, EX, PX-12	
Engine				S6D125-2	
Classification	Item	Condition	Unit	Standard value	Permissible value
Performance	Engine speed	High idling speed Low idling speed	rpm	2,100 ± 50 825 ± 25	2,100 ± 50 825 ± 25
	Necessary starting speed	0°C -20°C (with starting aid)		Min. 100 Min. 85	— —
Intake and exhaust system	Intake resistance	At all speed	mmH$_2$0	Max. 300	762
	Intake pressure	At rated output	mmHg	Min. 600	480
	Exhaust pressure (Turbine inlet pressure)	At rated output	mmHg	Min. 500	400
	Exhaust temperature (Turbine inlet temp.)	All speed (intake air temp.: 20°C)	°C	Max. 630	700
	Exhaust gas color	Quick acceleration (Low idling → High idling) At rated output At high idling	Bosch scale	Max. 5.0 Max. 1.5 Max. 1.0	6.0 2.5 2.0
	Valve clearance (when engine is hot or cold)	Intake valve Exhaust valve	mm	0.33 0.71	— —
Engine body	Compression pressure (SAE30 oil)	Oil temperature: 40 – 60°C Engine speed: 200 – 250 rpm	MPa (kg/cm^2)	Min. 3.3 (Min. 34)	2.4 (24)
	Blow-by pressure (SAE30 oil)	At rated output Water temperature: Min 70°C	mmH$_2$0	Max. 50	100
Lubrication system	Oil pressure (Oil temperature: Min. 80°C)	At rated output (SAE30) At rated output (SAE10W) At low idling (SAE30) At low idling (SAE10W)	MPa (kg/cm^2)	0.3 – 0.5 (3.0 – 5.0) 0.25 – 0.45 (2.5 – 4.5) 0.15 – 0.25 (1.5 – 2.5) 0.10 – 0.20 (1.0 – 2.0)	0.21 (2.1) 0.18 (1.8) 0.07 (0.7) 0.07 (0.7)
	Oil temperature	All speed (oil in oil pan)	°C	90 – 110	120
	Oil consumption ratio	At continuous rated output (Ratio of fuel consumption)	%	Max. 0.5	1.0
Fuel system	Fuel injection pressure	Nozzle tester	MPa (kg/cm^2)	$22.06^{+1.0}_{+0.5}$ (225^{+10}_{+5})	18.24 (186)
	Fuel injection timing	Before top dead center (B.T.D.C.)	degree	13 ± 1	13 ± 1
Cooling system	Radiator pressure valve	Opening pressure (Differential pressure)	MPa (kg/cm^2)	0.09 ± 0.015 (0.9 ± 0.15)	0.09 ± 0.015 (0.9 ± 0.15)
	Fan speed	At rated engine speed	rpm	1,775 ± 53	1,775 ± 53
	Fan belt tension	Deflects when pushed with a force of 58.8 N (6 kg)	mm	10	8 – 12

★ The values given in the TESTING AND ADJUSTING DATA are NOT for adjustment of the output. Do not use these values as a guide to change the setting of the fuel injection pump.

• FOR ENGINE ON CHASSIS

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

Machine model			D65E-12	
Engine			6D125-1	
Check item	Conditions	Unit	Standard value	Permissible value
Engine speed	High idling Low idling At rated speed	rpm	2,100 ± 50 825 ± 25 1,950	2,100 ± 50 825 ± 25 —
Exhaust gas color	Sudden acceleration At high idling	Bosch index	Max. 5.0 Max. 1.0	6.0 2.0
Valve clearance	Intake valve (20°C) Exhaust valve (20°C)	mm	0.33 0.71	— —
Compression pressure	Oil temperature: 40 — 60°C ( ): Engine speed SAE30 oil	MPa (kg/cm^2) (rpm)	Min. 3.3 (Min. 34) (200 — 250)	2.4 (24) (200 — 250)
Blow-by pressure	(Water temperature inside operating range) At high idling, SAE30 oil	mmH_2O	Max. 50	100
Oil pressure	(Water temperature inside operating range)	MPa (kg/cm^2)		
	At high idling (SAE30)		0.3 — 0.5 (3.0 — 5.0)	0.21 (2.1)
	At low idling (SAE30)		Min. 0.15 (Min. 1.5)	0.07 (0.7)
	At high idling (SAE10W)		0.25 — 0.45 (2.5 — 4.5)	0.18 (1.8)
	At low idling (SAE10W)		Min. 0.1 (Min. 1.0)	0.07 (0.7)
Oil temperature	Whole speed range (inside oil pan)	°C	90 — 110	120
Fuel injection timing	Compression B.T.D.C.	degree	22 ± 1	22 ± 1
Fan belt tension	Slack when pushed with finger force of 58.8 N (6 kg)	mm	10	8 — 12

014012

Machine model			D65P, EX, PX-12	
Engine			S6D125-1	
Check item	Conditions	Unit	Standard value	Permissible value
Engine speed	High idling Low idling At rated speed	rpm	2,100 ± 50 825 ± 25 1,950	2,100 ± 50 825 ± 25 —
Exhaust temperature (Turbine inlet temp.)	All speed (intake air temp.: 20°C)	°C	Max. 630	700
Intake pressure	At rated output	mmHg	Min. 600	480
Exhaust gas color	Sudden acceleration At high idling	Bosch index	Max. 5.0 Max. 1.0	6.0 2.0
Valve clearance	Intake valve (20°C) Exhaust valve (20°C)	mm	0.33 0.71	— —
Compression pressure	Oil temperature: 40 — 60°C ( ): Engine speed SAE30 oil	MPa (kg/cm^2) (rpm)	Min. 3.1 (Min. 32) (200 — 250)	2.2 (22) (200 — 250)
Blow-by pressure	(Water temperature inside operating range) At high idling, SAE30 oil	mmH$_2$O	Max. 50	100
Oil pressure	(Water temperature inside operating range) At high idling (SAE30) At low idling (SAE30) At high idling (SAE10W) At low idling (SAE10W)	MPa (kg/cm^2)	0.3 — 0.5 (3.0 — 5.0) Min. 0.15 (Min. 1.5) 0.25 — 0.45 (2.5 — 4.5) Min. 0.1 (Min. 1.0)	0.21 (2.1) 0.07 (0.7) 0.18 (1.8) 0.07 (0.7)
Oil temperature	Whole speed range (inside oil pan)	°C	90 — 110	120
Fuel injection timing	Compression B.T.D.C.	degree	24 ± 1	24 ± 1
Fan belt tension	Slack when pushed with finger force of 58.8 N (6 kg)	mm	10	8 — 12

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

Machine model			D65E-12	
Engine			6D125-2	
Check item	Condition	Unit	Standard value	Permissible value
Engine speed	High idling Low idling At rated speed	rpm	2,100 ± 50 825 ± 25 1,950	2,100 ± 50 825 ± 25 —
Exhaust gas color	Sudden acceleration At high idling	Bosch index	Max. 5.0 Max. 1.0	6.0 2.0
Valve clearance	Intake valve (20°C) Exhaust valve (20°C)	mm	0.33 0.71	— —
Compression pressure	Oil temperature: 40 – 60°C Engine speed: 200 – 250 rpm SAE30 oil	MPa (kg/cm^2)	Min. 3.5 (Min. 36)	2.5 (26)
Blow-by pressure	(Water temperature inside operating range) At high idling, SAE30 oil	mmH$_2$O	Max. 50	100
Oil pressure	(Water temperature inside operating range)	MPa (kg/cm^2)		
	At high idling (SAE30)		0.3 – 0.5 (3.0 – 5.0)	0.21 (2.1)
	At low idling (SAE30)		Min. 0.15 (Min. 1.5)	0.07 (0.7)
	At high idling (SAE10W)		0.25 – 0.45 (2.5 – 4.5)	0.18 (1.8)
	At low idling (SAE10W)		Min. 0.1 (Min. 1.0)	0.07 (0.7)
Oil temperature	Whole speed range (inside oil pan)	°C	90 – 110	120
Fuel injection timing	Compression B.T.D.C.	degree	16 ± 1	16 ± 1
Fan belt tension	Slack when pushed with finger force of 58.8 N (6 kg)	mm	10	8 – 12

014012

Machine model			D65P, EX, PX-12	
Engine			S6D125-2	
Check item	Condition	Unit	Standard value	Permissible value
Engine speed	High idling	rpm	2,100 ± 50	2,100 ± 50
	Low idling		825 ± 25	825 ± 25
	At rated speed		1,950	—
Exhaust temperature (Turbine inlet temp.)	All speed (intake air temp.: 20°C)	°C	Max. 630	700
Intake pressure	At rated output	mmHg	Min. 600	480
Exhaust gas color	Sudden acceleration	Bosch index	Max. 5.0	6.0
	At high idling		Max. 1.0	2.0
Valve clearance	Intake valve (20°C)	mm	0.33	—
	Exhaust valve (20°C)		0.71	—
Compression pressure	Oil temperature: 40 – 60°C Engine speed: 200 – 250 rpm SAE30 oil	MPa (kg/cm^2)	Min. 3.3 (Min. 34)	2.4 (24)
Blow-by pressure	(Water temperature inside operating range) At high idling, SAE30 oil	mmH$_2$O	Max. 50	100
Oil pressure	(Water temperature inside operating range)	MPa (kg/cm^2)		
	At high idling (SAE30)		0.3 – 0.5 (3.0 – 5.0)	0.21 (2.1)
	At low idling (SAE30)		Min. 0.15 (Min. 1.5)	0.07 (0.7)
	At high idling (SAE10W)		0.25 – 0.45 (2.5 – 4.5)	0.18 (1.8)
	At low idling (SAE10W)		Min. 0.1 (Min. 1.0)	0.07 (0.7)
Oil temperature	Whole speed range (inside oil pan)	°C	90 – 110	120
Fuel injection timing	Compression B.T.D.C.	degree	13 ± 1	13 ± 1
Fan belt tension	Slack when pushed with finger force of 58.8 N (6 kg)	mm	10	8 – 12

STANDARD VALUE TABLE FOR CHASSIS

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

Classification	Check item	Measurement conditions		Unit	D65E-12	
					Standard value	Permissible value
Engine stall	Torque converter stall speed	• Engine oil pressure: within operating range • Engine oil temperature: within operating range • Power train oil temperature: 70 — 80°C • Hydraulic oil temperature: 45 — 55°C • No of speed range: F3		rpm	1,690 ± 100	1,570
Travel of control levers, pedals	Fuel control lever	• Center of lever knob	Engine: low idling → full throttle	mm	93 ± 20	93^{+40}_{-20}
			Engine: low idling → stop		43 ± 20	43^{+40}_{-20}
	Decelerator pedal	• Center of pedal			57 ± 10	57 ± 10
	Gear shift lever	• Engine stopped • Center of lever knob	Between each speed range		39 ± 6	39 ± 6
	Steering. F-R lever	• Engine stopped	N → F		73 ± 10	73 ± 10
		• Center of lever knob	N → R		65 ± 10	65 ± 10
		• Engine low idling • Center of lever knob	Full stroke LEFT turn		82 ± 15	82 ± 15
			Full stroke RIGHT turn		83 ± 15	83 ± 15
			Until steering clutch is fully disengaged		40	40
	Brake pedal	• Engine low idling • Center of pedal	Full stroke		79 ± 12	79 ± 12
	Blade control lever	• Engine low idling	HOLD → RAISE		81 ± 12	81 ± 12
		• Center of lever knob	HOLD → LOWER		58 ± 9	58 ± 9
		• Hydraulic oil temperature: 45 — 55°C	HOLD → LEFT TILT HOLD → RIGHT TILT		62 ± 10	62 ± 10
	Ripper control lever	• Engine low idling • Center of lever knob • Hydraulic oil temperature: 45 — 55°C	HOLD → RAISE		77 ± 12	77 ± 12
			HOLD → LOWER		65 ± 10	65 ± 10
Operating force of control levers, pedals	Fuel control lever	• Center of lever knob	Engine: low idling → full throttle	N (kg)	75.5 ± 29.4 (7.7 ± 3.0)	117.7 (12.0)
			Engine: full throttle → low idling		21.6 ± 9.8 (2.2 ± 1.0)	39.2 (4.0)
			Engine: low idling → stop		72.6 ± 19.6 (7.4 ± 2.0)	117.7 (12.0)
	Decelerator pedal	• Engine speed: low idling (825 ± 25 rpm) • Center of pedal			98.1 ± 29.4 (10 ± 3)	147.1 (15)
	Gear shift lever	• Engine stopped • Center of lever knob	1st → 2nd		32.4 ± 19.6 (3.3 ± 2.0)	58.8 (6.0)
			2nd → 3rd		39.2 ± 19.6 (4.0 ± 2.0)	58.8 (6.0)

014012

D65P-12		D65EX-12		D65PX-12			
Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value
1,770 ± 100	1,650	1,770 ± 100	1,650	1,770 ± 100	1,650		
93 ± 20	93^{+40}_{-20}	93 ± 20	93^{+40}_{-20}	93 ± 20	93^{+40}_{-20}		
43 ± 20	43^{+40}_{-20}	43 ± 20	43^{+40}_{-20}	43 ± 20	43^{+40}_{-20}		
57 ± 10	57 ± 10	57 ± 10	57 ± 10	57 ± 10	57 ± 10		
39 ± 6	39 ± 6	39 ± 6	39 ± 6	39 ± 6	39 ± 6		
73 ± 10	73 ± 10	66 ± 10	66 ± 10	66 ± 10	66 ± 10		
65 ± 10	65 ± 10	67 ± 10	67 ± 10	67 ± 10	67 ± 10		
82 ± 15	82 ± 15	78 ± 10	78 ± 10	78 ± 10	78 ± 10		
83 ± 15	83 ± 15	79 ± 10	79 ± 10	79 ± 10	79 ± 10		
40	40	—	—	—	—		
79 ± 12	79 ± 12	79 ± 12	79 ± 12	79 ± 12	79 ± 12		
81 ± 12	81 ± 12	81 ± 12	81 ± 12	81 ± 12	81 ± 12		
58 ± 9	58 ± 9	58 ± 9	58 ± 9	58 ± 9	58 ± 9		
62 ± 10	62 ± 10	62 ± 10	62 ± 10	62 ± 10	62 ± 10		
—	—	77 ± 12	77 ± 12	—	—		
—	—	65 ± 10	65 ± 10	—	—		
75.5 ± 29.4 (7.7 ± 3.0)	117.7 (12.0)	75.5 ± 29.4 (7.7 ± 3.0)	117.7 (12.0)	75.5 ± 29.4 (7.7 ± 3.0)	117.7 (12.0)		
21.6 ± 9.8 (2.2 ± 1.0)	39.2 (4.0)	21.6 ± 9.8 (2.2 ± 1.0)	39.2 (4.0)	21.6 ± 9.8 (2.2 ± 1.0)	39.2 (4.0)		
72.6 ± 19.6 (7.4 ± 2.0)	117.7 (12.0)	72.6 ± 19.6 (7.4 ± 2.0)	117.7 (12.0)	72.6 ± 19.6 (7.4 ± 2.0)	117.7 (12.0)		
98.1 ± 29.4 (10 ± 3)	147.1 (15)	98.1 ± 29.4 (10 ± 3)	147.1 (15)	98.1 ± 29.4 (10 ± 3)	147.1 (15)		
32.4 ± 19.6 (3.3 ± 2.0)	58.8 (6.0)	32.4 ± 19.6 (3.3 ± 2.0)	58.8 (6.0)	32.4 ± 19.6 (3.3 ± 2.0)	58.8 (6.0)		
39.2 ± 19.6 (4.0 ± 2.0)	58.8 (6.0)	39.2 ± 19.6 (4.0 ± 2.0)	58.8 (6.0)	39.2 ± 19.6 (4.0 ± 2.0)	58.8 (6.0)		

Classification	Check item	Measurement conditions		Unit	D65E-12	
					Standard value	Permissible value
Operating force of control levers, pedals	Steering ·F-R lever	• Engine stopped • Center of lever knob	N → F	N (kg)	29.4 ± 19.6 (3.0 ± 2.0)	49.0 (5.0)
			N → R		29.4 ± 19.6 (3.0 ± 2.0)	49.0 (5.0)
		• Engine low idling • Center of lever knob	Until steering clutch is fully disengaged		12.7 ± 9.8 (1.3 ± 1.0)	24.5 (2.5)
			Until machine turns when brake is applied		23.5 ± 9.8 (2.4 ± 1.0)	49.0 (5.0)
	Brake pedal	• Engine low idling • Center of pedal			451.0 ± 78.5 (46.0 ± 8.0)	588.4 (60.0)
	Blade control ever	• Engine low idling • Hydraulic oil temperature: 45 — 55°C • Center of lever knob	HOLD → RAISE		26.5 ± 9.8 (2.7 ± 1.0)	39.2 (4.0)
			HOLD → LOWER		23.5 ± 9.8 (2.4 ± 1.0)	39.2 (4.0)
			HOLD → LEFT TILT HOLD → RIGHT TILT		22.5 ± 9.8 (2.3 ± 1.0)	39.2 (4.0)
	Ripper control lever	• Engine low idling • Hydraulic oil temperature: 45 — 55°C • Center of lever knob	HOLD → RAISE		25.5 ± 9.8 (2.6 ± 1.0)	39.2 (4.0)
			HOLD → LOWER		20.6 ± 9.8 (2.1 ± 1.0)	39.2 (4.0)
Hydraulic oil pressure	Torque converter relief pressure (inlet)	• Power train oil temperature: 70 — 80°C	Engine: low idling	MPa (kg/cm^2)	$0.2^{+0.15}_{-0.1}$ ($2.0^{+1.5}_{-1.0}$)	$0.2^{+0.15}_{-0.1}$ ($2.0^{+1.5}_{-1.0}$)
			Engine: full throttle		0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)
	Torque converter outlet pressure		Engine: low idling		0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)
			Engine: full throttle		0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)
	Transmission main relief pressure		Engine: full throttle		3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)
	Transmission modulating pressure		Engine: full throttle		3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)
	Transmission lubrication pressure		Engine: full throttle		0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)
	Steering clutch operating pressure		Engine: low idling		2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)
			Engine: full throttle		2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)

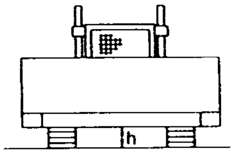
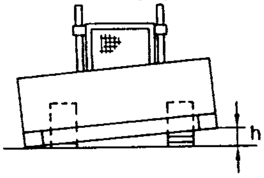
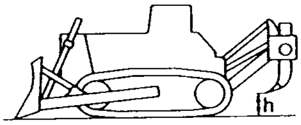
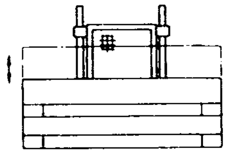
014012

D65P-12		D65EX-12		D65PX-12			
Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value
29.4 ± 19.6 (3.0 ± 2.0)	49.0 (5.0)	29.4 ± 19.6 (3.0 ± 2.0)	49.0 (5.0)	29.4 ± 19.6 (3.0 ± 2.0)	49.0 (5.0)		
29.4 ± 19.6 (3.0 ± 2.0)	49.0 (5.0)	29.4 ± 19.6 (3.0 ± 2.0)	49.0 (5.0)	29.4 ± 19.6 (3.0 ± 2.0)	49.0 (5.0)		
12.7 ± 9.8 (1.3 ± 1.0)	24.5 (2.5)	24.5 ± 9.8 (2.5 ± 1.0)	39.2 (4.0)	24.5 ± 9.8 (2.5 ± 1.0)	39.2 (4.0)		
23.5 ± 9.8 (2.4 ± 1.0)	49.0 (5.0)	—	—	—	—		
451.0 ± 78.5 (46.0 ± 8.0)	588.4 (60.0)	451.0 ± 78.5 (46.0 ± 8.0)	588.4 (60.0)	451.0 ± 78.5 (46.0 ± 8.0)	588.4 (60.0)		
26.5 ± 9.8 (2.7 ± 1.0)	39.2 (4.0)	26.5 ± 9.8 (2.7 ± 1.0)	39.2 (4.0)	26.5 ± 9.8 (2.7 ± 1.0)	39.2 (4.0)		
23.5 ± 9.8 (2.4 ± 1.0)	39.2 (4.0)	23.5 ± 9.8 (2.4 ± 1.0)	39.2 (4.0)	23.5 ± 9.8 (2.4 ± 1.0)	39.2 (4.0)		
22.5 ± 9.8 (2.3 ± 1.0)	39.2 (4.0)	22.5 ± 9.8 (2.3 ± 1.0)	39.2 (4.0)	22.5 ± 9.8 (2.3 ± 1.0)	39.2 (4.0)		
—	—	25.5 ± 9.8 (2.6 ± 1.0)	39.2 (4.0)	—	—		
—	—	20.6 ± 9.8 (2.1 ± 1.0)	39.2 (4.0)	—	—		
$0.2^{+0.15}_{-0.1}$ $(2.0^{+1.5}_{-1.0})$	$0.2^{+0.15}_{-0.1}$ $(2.0^{+1.5}_{-1.0})$	$0.2^{+0.15}_{-0.1}$ $(2.0^{+1.5}_{-1.0})$	$0.2^{+0.15}_{-0.1}$ $(2.0^{+1.5}_{-1.0})$	$0.2^{+0.15}_{-0.1}$ $(2.0^{+1.5}_{-1.0})$	$0.2^{+0.15}_{-0.1}$ $(2.0^{+1.5}_{-1.0})$		
0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)		
0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)		
0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)		
3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)	3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)	3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)		
3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)	3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)	3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)		
0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)		
2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)	—	—	—	—		
2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)	—	—	—	—		

Classification	Check item	Measurement conditions		Unit	D65E-12	
					Standard value	Permissible value
Hydraulic oil pressure	Load sensing pressure	- Hydraulic oil temperature: 45 — 55°C - Engine speed: full throttle	Steering	MPa (kg/cm^2)	—	—
			Work equipment		—	—
	Brake operating pressure	- Power train oil temperature: 70 — 80°C	Engine: low idling		2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)
			Engine: full throttle		2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)
	PPC valve relief pressure	- Hydraulic oil temperature: 45 — 55°C	Engine: full throttle		4.2 ± 0.3 (43.0 ± 3.0)	3.7 (38.0)
	Steering relief pressure		Engine: full throttle		—	—
	Blade lift relief pressure		Engine: low idling		Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)
			Engine: full throttle		20.6 ± 1.0 (210 ± 10)	17.6 (180)
	Blade tilt relief pressure		Engine: low idling		Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)
			Engine: full throttle		20.6 ± 1.0 (210 ± 10)	17.6 (180)
	Ripper lift relief pressure		Engine: low idling		Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)
			Engine: full throttle		20.6 ± 1.0 (210 ± 10)	17.6 (180)
HSS motor	Leakage from HSS motor	- Hydraulic oil temperature: 45 — 55°C - Steering lever: full - Gear shift lever: N - Brake pedal: depress - Engine: full throttle		ℓ/min.	—	—
Performance	Travel speed	- On level surface - Engine at full throttle - Engine water temperature: Inside operating range - Run up distance: 10 — 30 m - Measurement distance: 20 m	F 1st	km/h	3.4 ± 0.2	3.4 ± 0.2
			F 2nd		6.1 ± 0.3	6.1 ± 0.3
			F 3rd		9.6 ± 0.5	9.6 ± 0.5
			R 1st		4.6 ± 0.3	4.6 ± 0.3
			R 2nd		7.7 ± 0.4	7.7 ± 0.4
			R 3rd		11.7 ± 0.6	11.7 ± 0.6

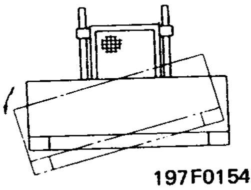
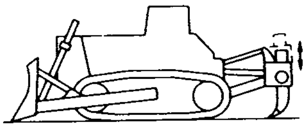
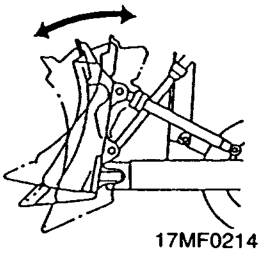
014012

D65P-12		D65EX-12		D65PX-12			
Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value
—	—	34.8 ± 2.0 (355 ± 20)	30.9 (315)	34.8 ± 2.0 (355 ± 20)	30.9 (315)		
—	—	21.6 ± 2.0 (220 ± 20)	17.6 (180)	21.6 ± 2.0 (220 ± 20)	17.6 (180)		
2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)	2.7 ± 0.1 (27.0 ± 1.0)	2.4 (24.0)	2.7 ± 0.1 (27.0 ± 1.0)	2.4 (24.0)		
2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)	2.7 ± 0.1 (27.0 ± 1.0)	2.4 (24.0)	2.7 ± 0.1 (27.0 ± 1.0)	2.4 (24.0)		
4.2 ± 0.3 (43.0 ± 3.0)	3.7 (38.0)	4.2 ± 0.3 (43.0 ± 3.0)	3.7 (38.0)	4.2 ± 0.3 (43.0 ± 3.0)	3.7 (38.0)		
—	—	36.8 ± 2.0 (375 ± 20)	32.8 (335)	36.8 ± 2.0 (375 ± 20)	32.8 (335)		
Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)		
20.6 ± 1.0 (210 ± 10)	17.6 (Min. 180)	23.5 ± 2.0 (240 ± 20)	19.6 (Min. 200)	23.5 ± 2.0 (240 ± 20)	19.6 (Min. 200)		
Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)		
20.6 ± 1.0 (210 ± 10)	17.6 (Min. 180)	23.5 ± 2.0 (240 ± 20)	19.6 (200)	23.5 ± 2.0 (240 ± 20)	19.6 (200)		
—	—	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	—	—		
—	—	23.5 ± 2.0 (240 ± 20)	19.6 (200)	—	—		
—	—	Max. 15	30	Max. 15	30		
3.4 ± 0.2	3.4 ± 0.2	3.4 ± 0.2	3.4 ± 0.2	3.4 ± 0.2	3.4 ± 0.2		
6.1 ± 0.3	6.1 ± 0.3	6.1 ± 0.3	6.1 ± 0.3	6.1 ± 0.3	6.1 ± 0.3		
9.6 ± 0.5	9.6 ± 0.5	9.6 ± 0.5	9.6 ± 0.5	9.6 ± 0.5	9.6 ± 0.5		
4.6 ± 0.3	4.6 ± 0.3	4.6 ± 0.3	4.6 ± 0.3	4.6 ± 0.3	4.6 ± 0.3		
7.7 ± 0.4	7.7 ± 0.4	7.7 ± 0.4	7.7 ± 0.4	7.7 ± 0.4	7.7 ± 0.4		
11.7 ± 0.6	11.7 ± 0.6	11.7 ± 0.6	11.7 ± 0.6	11.7 ± 0.6	11.7 ± 0.6		

Classification	Check item		Conditions		Unit	D65E-12	
						Standard value	Permissible value
Work equipment	Hydraulic drift	Blade lift	Posture of work equipment  197F01551 • Hydraulic oil temperature: 45 — 55°C • Engine stopped • Center of blade cutting edge; from height of 800 mm to ground		mm/15 min.	Max. 100	Max. 100
		Blade tilt	Posture of work equipment  140F12216 • Hydraulic oil temperature: 45 — 55°C • Engine low idling • Lowering amount of blade	LEFT TILT		Max. 200	Max. 200
				RIGHT TILT		Max. 200	Max. 200
		Ripper lift	Posture of work equipment  197F01554 • Hydraulic oil temperature: 45 — 55°C • Engine stopped • Ripper point: 500 mm above the ground			Max. 50	Max. 50
	Work equipment speed	Blade lift	Posture of work equipment  197F01547 • Hydraulic oil temperature: 45 — 55°C • Engine: full throttle • Blade: no load • From ground to maximum height	RAISE	Sec.	$2.6^{+0.2}_{-0.5}$	3.1
				LOWER		1.7 ± 0.2	2.0

014012

D65P-12		D65EX-12		D65PX-12			
Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value
Max. 100	Max. 100	Max. 100	Max. 100	Max. 100	Max. 100		
Max. 200	Max. 200	Max. 200	Max. 200	Max. 200	Max. 200		
Max. 200	Max. 200	Max. 200	Max. 200	Max. 200	Max. 200		
—	—	Max. 50	Max. 50	—	—		
$2.0^{+0.2}_{-0.5}$	2.5	$2.9^{+0.2}_{-0.5}$	3.4	$2.4^{+0.2}_{-0.5}$	2.9		
1.3 ± 0.2	1.6	1.7 ± 0.2	2.0	1.4 ± 0.2	1.7		

Classification		Check item	Conditions			Unit	D65E-12	
							Standard value	Permissible value
Work equipment	Work equipment speed	Blade tilt	Posture of work equipment  197F01548 • Engine: full throttle • Hydraulic oil temperature: 45 — 55°C • Blade: no load • Left tilt - Right tilt	LEFT TILT	Straight tilt	Sec.	2.3 ± 0.3	2.8
					Power tilt		—	—
				RIGHT TILT	Straight tilt		2.0 ± 0.3	2.5
					Power tilt		—	—
		Ripper lift	Posture of work equipment  197F01549 • Hydraulic oil temperature: 45 — 55°C • Shank set at bottom hole • From ground to maximum height	RAISE	Low idling		2.4 ± 0.2	2.9
					Full throttle		1.4 ± 0.2	1.9
				LOWER	Low idling		1.9 ± 0.2	2.4
					Full throttle		1.1 ± 0.2	1.6
		Pitch speed	Posture of work equipment  17MF02141 • Hydraulic oil temperature: 45 — 55°C • Blade: no load • Pitch dump — pitch back • Full throttle	Pitch dump			—	—
				Pitch back			—	—
		Blade time lag	• Engine: full throttle • Hydraulic oil temperature: 45 — 55°C • Lower the blade from the maximum height, and measure the time taken from the point when the blade touches the ground to the point where the idler is raised from the ground				Max. 1.7	Max. 2.0

014012

D65P-12		D65EX-12		D65PX-12			
Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value
2.3 ± 0.3	2.8	2.3 ± 0.3	2.8	2.3 ± 0.3	2.8		
2.0 ± 0.3	2.5	—	—	2.0 ± 0.3	2.5		
2.0 ± 0.3	2.5	2.0 ± 0.3	2.5	2.0 ± 0.3	2.5		
2.3 ± 0.3	2.8	—	—	2.3 ± 0.3	2.8		
—	—	2.4 ± 0.2	2.9	—	—		
—	—	1.4 ± 0.2	1.9	—	—		
—	—	1.9 ± 0.2	2.4	—	—		
—	—	1.1 ± 0.2	1.6	—	—		
3.5 ± 0.5	4.2	—	—	3.5 ± 0.5	4.2		
3.5 ± 0.5	4.2	—	—	3.5 ± 0.5	4.2		
Max. 1.7	Max. 2.0	Max. 1.7	Max. 2.0	Max. 1.7	Max. 2.0		

D65E-12 60948 – 65000
D65P-12 60891 – 65000
D65EX-12 60942 – 65000
D65PX-12 60915 – 65000

Classification	Check Item	Measurement conditions			Unit	D65E-12	
						Standard value	Permissible value
Engine stall	Torque converter stall speed	• Engine oil pressure: within operating range • Engine oil temperature: within operating range • Power train oil temperature: 70 – 80°C • Hydraulic oil temperature: 45 – 55°C • No. of speed range: F3			rpm	1,690 ± 100	1,570
Travel of control levers, pedals	Fuel control lever	• Center of lever knob	Engine: low idling → full throttle		mm	93 ± 20	93^{+40}_{-20}
			Engine: low idling → stop			43 ± 20	43^{+40}_{-20}
	Decelerator pedal	• Center of pedal				57 ± 10	57 ± 10
	Gear shift lever	• Engine stopped • Center of lever knob	Between each speed range		degree	15 ± 3	15 ± 3
	Steering F-R lever	• Engine stopped • Center of lever knob	N → F		mm	52 ± 10	52 ± 10
			N → R			48 ± 10	48 ± 10
		• Engine low idling • Center of lever knob	Full stroke	LEFT turn		90 ± 15	90 ± 15
				RIGHT turn		90 ± 15	90 ± 15
			Until steering clutch is fully disengaged			40	40
	Brake pedal	• Engine low idling • Center of pedal	Full stroke			79 ± 12	79 ± 12
	Blade control lever	• Engine low idling • Center of lever knob • Hydraulic oil temperature: 45 – 55°C	HOLD → RAISE			81 ± 12	81 ± 12
			HOLD → LOWER			58 ± 9	58 ± 9
			HOLD → LEFT TILT HOLD → RIGHT TILT			62 ± 10	62 ± 10
	Ripper control lever	• Engine low idling • Center of lever knob • Hydraulic oil temperature: 45 – 55°C	HOLD → RAISE			77 ± 12	77 ± 12
			HOLD → LOWER			65 ± 10	65 ± 10
Operating force of control levers, pedals	Fuel control lever	• Center of lever knob	Engine: low idling → full throttle		N (kg)	75.5 ± 29.4 (7.7 ± 3.0)	117.7 (12.0)
			Engine: full throttle → low idling			21.6 ± 9.8 (2.2 ± 1.0)	39.2 (4.0)
			Engine: low idling → stop			72.6 ± 19.6 (7.4 ± 2.0)	117.7 (12.0)
	Decelerator pedal	• Engine speed: low idling (825 ± 25 rpm) • Center of pedal				98.1 ± 29.4 (10 ± 3)	147.1 (15)
	Gear shift lever	• Engine stopped • Center of lever knob	1st → 2nd			2.5 ± 0.6 (0.24 ± 0.06)	4.9 (0.5)
			2nd → 1st			2.7 ± 0.6 (0.28 ± 0.06)	4.9 (0.5)
			2nd → 3rd			3.9 ± 1.0 (0.40 ± 0.1)	5.9 (0.6)
			3rd → 2nd			1.6 ± 0.4 (0.16 ± 0.04)	2.9 (0.3)

014012

D65P-12		D65EX-12		D65PX-12			
Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value
1,770 ± 100	1,650	1,770 ± 100	1,650	1,770 ± 100	1,650		
93 ± 20	93^{+40}_{-20}	93 ± 20	93^{+40}_{-20}	93 ± 20	93^{+40}_{-20}		
43 ± 20	43^{+40}_{-20}	43 ± 20	43^{+40}_{-20}	43 ± 20	43^{+40}_{-20}		
57 ± 10	57 ± 10	57 ± 10	57 ± 10	57 ± 10	57 ± 10		
15 ± 3	15 ± 3	15 ± 3	15 ± 3	15 ± 3	15 ± 3		
52 ± 10	52 ± 10	52 ± 10	52 ± 10	52 ± 10	52 ± 10		
48 ± 10	48 ± 10	48 ± 10	48 ± 10	48 ± 10	48 ± 10		
90 ± 15	90 ± 15	90 ± 15	90 ± 15	90 ± 15	90 ± 15		
90 ± 15	90 ± 15	90 ± 15	90 ± 15	90 ± 15	90 ± 15		
40	40	—	—	—	—		
79 ± 12	79 ± 12	79 ± 12	79 ± 12	79 ± 12	79 ± 12		
81 ± 12	81 ± 12	81 ± 12	81 ± 12	81 ± 12	81 ± 12		
58 ± 9	58 ± 9	58 ± 9	58 ± 9	58 ± 9	58 ± 9		
62 ± 10	62 ± 10	62 ± 10	62 ± 10	62 ± 10	62 ± 10		
—	—	77 ± 12	77 ± 12	—	—		
—	—	65 ± 10	65 ± 10	—	—		
75.5 ± 29.4 (7.7 ± 3.0)	117.7 (12.0)	75.5 ± 29.4 (7.7 ± 3.0)	117.7 (12.0)	75.5 ± 29.4 (7.7 ± 3.0)	117.7 (12.0)		
21.6 ± 9.8 (2.2 ± 1.0)	39.2 (4.0)	21.6 ± 9.8 (2.2 ± 1.0)	39.2 (4.0)	21.6 ± 9.8 (2.2 ± 1.0)	39.2 (4.0)		
72.6 ± 19.6 (7.4 ± 2.0)	117.7 (12.0)	72.6 ± 19.6 (7.4 ± 2.0)	117.7 (12.0)	72.6 ± 19.6 (7.4 ± 2.0)	117.7 (12.0)		
98.1 ± 29.4 (10 ± 3)	147.1 (15)	98.1 ± 29.4 (10 ± 3)	147.1 (15)	98.1 ± 29.4 (10 ± 3)	147.1 (15)		
2.5 ± 0.6 (0.24 ± 0.06)	4.9 (0.5)	2.5 ± 0.6 (0.24 ± 0.06)	4.9 (0.5)	2.5 ± 0.6 (0.24 ± 0.06)	4.9 (0.5)		
2.7 ± 0.6 (0.28 ± 0.06)	4.9 (0.5)	2.7 ± 0.6 (0.28 ± 0.06)	4.9 (0.5)	2.7 ± 0.6 (0.28 ± 0.06)	4.9 (0.5)		
3.9 ± 1.0 (0.40 ± 0.1)	5.9 (0.6)	3.9 ± 1.0 (0.40 ± 0.1)	5.9 (0.6)	3.9 ± 1.0 (0.40 ± 0.1)	5.9 (0.6)		
1.6 ± 0.4 (0.16 ± 0.04)	2.9 (0.3)	1.6 ± 0.4 (0.16 ± 0.04)	2.9 (0.3)	1.6 ± 0.4 (0.16 ± 0.04)	2.9 (0.3)		

Classification	Check Item	Measurement conditions		Unit	D65E-12	
					Standard value	Permissible value
Operating force of control levers, pedals	Steering F-R lever	• Engine stopped • Center of lever knob	N → F	N (kg)	32.4 ± 19.6 (3.3 ± 2.0)	49.0 (5.0)
			N → R		34.3 ± 19.6 (3.5 ± 2.0)	49.0 (5.0)
		• Engine low idling • Center of lever knob	Untill steering clutch is fully disengaged		12.7 ± 9.8 (1.3 ± 1.0)	24.5 (2.5)
			Until machine turns when brake is applied		29.4 ± 9.8 (3.0 ± 1.0)	49.0 (5.0)
	Brake pedal	• Engine low idling • Center of pedal			451.0 ± 78.5 (46.0 ± 8.0)	588.4 (60.0)
	Brake control lever	• Engine low idling • Hydraulic oil temperature: 45 - 55°C • Center of lever knob	HOLD → RAISE		26.5 ± 9.8 (2.7 ± 1.0)	39.2 (4.0)
			HOLD → LOWER		23.5 ± 9.8 (2.4 ± 1.0)	39.2 (4.0)
			HOLD → LEFT TILT HOLD → RIGHT TILT		22.5 ± 9.8 (2.3 ± 1.0)	39.2 (4.0)
	Ripper control lever	• Engine low idling • Hydraulic oil temperature: 45 - 55°C • Center of lever knob	HOLD → RAISE		25.5 ± 9.8 (2.6 ± 1.0)	39.2 (4.0)
			HOLD → LOWER		20.6 ± 9.8 (2.1 ± 1.0)	39.2 (4.0)
Hydraulic oil pressure	Torque converter relief pressure (inlet)	• Power train oil temperature: 70 - 80°C	Engine: low idling	MPa (kg/cm²)	$0.2^{+0.15}_{-0.1}$ $(2.0^{+1.5}_{-1.0})$	$0.2^{+0.15}_{-0.1}$ $(2.0^{+1.5}_{-1.0})$
			Engine: full throttle		0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)
	Torque converter outlet pressure		Engine: low idling		0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)
			Engine: full throttle		0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)
	Transmission main relief pressure		Engine: full throttle		3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)
	Transmission modulating pressure		Engine: full throttle		3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)
	Transmission lubrication pressure		Engine: full throttle		0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)
	Steering clutch operating pressure		Engine: low idling		2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)
			Engine: full throttle		2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)

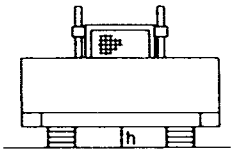
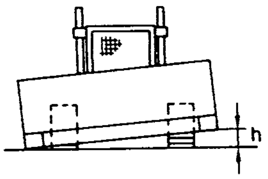
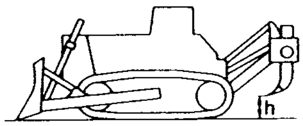
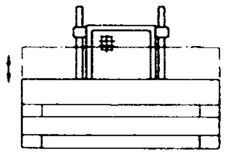
014012

D65P-12		D65EX-12		D65PX-12			
Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value
32.4 ± 19.6 (3.3 ± 2.0)	52.0 (5.3)	32.4 ± 19.6 (3.3 ± 2.0)	52.0 (5.3)	32.4 ± 19.6 (3.3 ± 2.0)	52.0 (5.3)		
34.3 ± 19.6 (3.5 ± 2.0)	53.9 (5.5)	34.3 ± 19.6 (3.5 ± 2.0)	53.9 (5.5)	34.3 ± 19.6 (3.5 ± 2.0)	53.9 (5.5)		
12.7 ± 9.8 (1.3 ± 1.0)	24.5 (2.5)	24.5 ± 9.8 (2.5 ± 1.0)	39.2 (4.0)	24.5 ± 9.8 (2.5 ± 1.0)	39.2 (4.0)		
29.4 ± 9.8 (3.0 ± 1.0)	49.0 (5.0)	—	—	—	—		
451.0 ± 78.5 (46.0 ± 8.0)	588.4 (60.0)	451.0 ± 78.5 (46.0 ± 8.0)	588.4 (60.0)	451.0 ± 78.5 (46.0 ± 8.0)	588.4 (60.0)		
26.5 ± 9.8 (2.7 ± 1.0)	39.2 (4.0)	26.5 ± 9.8 (2.7 ± 1.0)	39.2 (4.0)	26.5 ± 9.8 (2.7 ± 1.0)	39.2 (4.0)		
23.5 ± 9.8 (2.4 ± 1.0)	39.2 (4.0)	23.5 ± 9.8 (2.4 ± 1.0)	39.2 (4.0)	23.5 ± 9.8 (2.4 ± 1.0)	39.2 (4.0)		
22.5 ± 9.8 (2.3 ± 1.0)	39.2 (4.0)	22.5 ± 9.8 (2.3 ± 1.0)	39.2 (4.0)	22.5 ± 9.8 (2.3 ± 1.0)	39.2 (4.0)		
—	—	25.5 ± 9.8 (2.6 ± 1.0)	39.2 (4.0)	—	—		
—	—	20.6 ± 9.8 (2.1 ± 1.0)	39.2 (4.0)	—	—		
$0.2^{+0.15}_{-0.1}$ ($2.0^{+1.5}_{-1.0}$)	$0.2^{+0.15}_{-0.1}$ ($2.0^{+1.5}_{-1.0}$)	$0.2^{+0.15}_{-0.1}$ ($2.0^{+1.5}_{-1.0}$)	$0.2^{+0.15}_{-0.1}$ ($2.0^{+1.5}_{-1.0}$)	$0.2^{+0.15}_{-0.1}$ ($2.0^{+1.5}_{-1.0}$)	$0.2^{+0.15}_{-0.1}$ ($2.0^{+1.5}_{-1.0}$)		
0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)		
0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)		
0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)		
3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)	3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)	3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)		
3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)	3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)	3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)		
0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)		
2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)	—	—	—	—		
2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)	—	—	—	—		

Classification	Check Item	Measurement conditions		Unit	D65E-12	
					Standard value	Permissible value
Hydraulic oil pressure	Load sensing pressure	• Hydraulic oil temperature: 45 – 55°C • Engine speed: full throttle	Steering	MPa (kg/cm^2)	—	—
			Work equipment		—	—
	Brake operating pressure	• Power train oil temperature: 70 – 80°C	Engine: low idling		2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)
			Engine: full throttle		2.5 + 0.1 (25.0 ± 1.0)	2.2 (22.0)
	PPC valve relief pressure	• Hydraulic oil temperature: 45 – 55°C	Engine: full throttle		4.2 ± 0.3 (43.0 ± 3.0)	3.7 (38.0)
	Steering relief pressure		Engine: full throttle		—	—
	Blade lift relief pressure		Engine: low idling		Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)
			Engine: full throttle		20.6 ± 1.0 (210 ± 10)	17.6 (180)
	Blade tilt relief pressure		Engine: low idling		Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)
			Engine: full throttle		20.6 ± 1.0 (210 ± 10)	17.6 (180)
	Ripper lift relief pressure		Engine: low idling		Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)
			Engine: full throttle		20.6 ± 1.0 (210 ± 10)	17.6 (180)
HSS motor	Leakage from HSS motor	• Hydraulic oil temperature: 45 – 55°C • Steering lever: full • Gear shift lever: N • Brake pedal: depress • Engine: full throttle		ℓ/min.	—	—
Performance	Travel speed	• On level surface • Engine at full throttle • Engine water temperature: Inside operating range • Run up distance: 10 – 30 m • Measurement distance: 20 m	F 1st	km/h	3.4 ± 0.2	3.4 ± 0.2
			F 2nd		6.1 ± 0.3	6.1 ± 0.3
			F 3rd		9.6 ± 0.5	9.6 ± 0.5
			R 1st		4.6 ± 0.3	4.6 ± 0.3
			R 2nd		7.7 ± 0.4	7.7 ± 0.4
			R 3rd		11.7 ± 0.6	11.7 ± 0.6

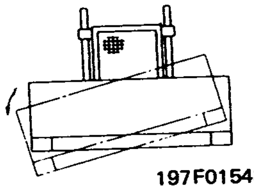
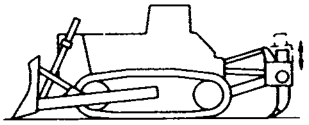
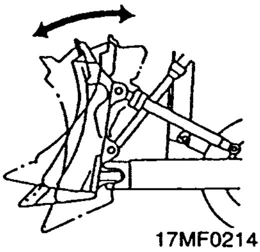
014012

D65P-12		D65EX-12		D65PX-12			
Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value
—	—	34.8 ± 2.0 (355 ± 20)	30.9 (315)	34.8 ± 2.0 (355 ± 20)	30.9 (315)		
—	—	21.6 ± 2.0 (220 ± 20)	17.6 (180)	21.6 ± 2.0 (220 ± 20)	17.6 (180)		
2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)	2.7 ± 0.1 (27.0 ± 1.0)	2.4 (24.0)	2.7 ± 0.1 (27.0 ± 1.0)	2.4 (24.0)		
2.5 + 0.1 (25.0 ± 1.0)	2.2 (22.0)	2.7 + 0.1 (27.0 ± 1.0)	2.4 (24.0)	2.7 + 0.1 (27.0 ± 1.0)	2.4 (24.0)		
4.2 ± 0.3 (43.0 ± 3.0)	3.7 (38.0)	4.2 ± 0.3 (43.0 ± 3.0)	3.7 (38.0)	4.2 ± 0.3 (43.0 ± 3.0)	3.7 (38.0)		
—	—	36.8 ± 2.0 (375 ± 20)	32.8 (335)	36.8 ± 2.0 (375 ± 20)	32.8 (335)		
Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)		
20.6 ± 1.0 (210 ± 10)	17.6 (Min. 180)	23.5 ± 2.0 (240 ± 20)	19.6 (Min. 200)	23.5 ± 2.0 (240 ± 20)	19.6 (Min. 200)		
Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)		
20.6 ± 1.0 (210 ± 10)	17.6 (Min. 180)	23.5 ± 2.0 (240 ± 20)	19.6 (200)	23.5 ± 2.0 (240 ± 20)	19.6 (200)		
—	—	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	—	—		
—	—	23.5 ± 2.0 (240 ± 20)	19.6 (200)	—	—		
—	—	Max. 15	30	Max. 15	30		
3.4 ± 0.2	3.4 ± 0.2	3.4 ± 0.2	3.4 ± 0.2	3.4 ± 0.2	3.4 ± 0.2		
6.1 ± 0.3	6.1 ± 0.3	6.1 ± 0.3	6.1 ± 0.3	6.1 ± 0.3	6.1 ± 0.3		
9.6 ± 0.5	9.6 ± 0.5	9.6 ± 0.5	9.6 ± 0.5	9.6 ± 0.5	9.6 ± 0.5		
4.6 ± 0.3	4.6 ± 0.3	4.6 ± 0.3	4.6 ± 0.3	4.6 ± 0.3	4.6 ± 0.3		
7.7 ± 0.4	7.7 ± 0.4	7.7 ± 0.4	7.7 ± 0.4	7.7 ± 0.4	7.7 ± 0.4		
11.7 ± 0.6	11.7 ± 0.6	11.7 ± 0.6	11.7 ± 0.6	11.7 ± 0.6	11.7 ± 0.6		

Classification	Check Item		Measurement conditions		Unit	D65E-12	
						Standard value	Permissible value
Work equipment	Hydraulic drift	Blade lift	Posture of work equipment  197F01551 • Hydraulic oil temperature: 45 – 55°C • Engine stopped • Center of blade cutting edge; from height of 800 mm to ground		mm/ 15 min.	Max. 100	Max. 100
		Blade tilt	Posture of work equipment  140F12216 • Hydraulic oil temperature: 45 – 55°C • Engine low idling • Lowering amount of blade	LEFT TILT		Max. 200	Max. 200
				RIGHT TILT		Max. 200	Max. 200
		Ripper lift	Posture of work equipment  197F01554 • Hydraulic oil temperature: 45 – 55°C • Engine stopped • Ripper point: 500 mm above the ground			Max. 50	Max. 50
	Work equipment speed	Blade lift	Posture of work equipment  197F01547 • Hydraulic oil temperature: 45 – 55°C • Engine: full throttle • Blade: no load • From ground to maximum height	RAISE	Sec.	$2.6^{+0.2}_{-0.5}$	3.1
				LOWER		2.0 ± 0.2	2.3

014012

D65P-12		D65EX-12		D65PX-12			
Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value
Max. 100	Max. 100	Max. 100	Max. 100	Max. 100	Max. 100		
Max. 200	Max. 200	Max. 200	Max. 200	Max. 200	Max. 200		
Max. 200	Max. 200	Max. 200	Max. 200	Max. 200	Max. 200		
—	—	Max. 50	Max. 50	—	—		
$2.4^{+0.2}_{-0.5}$	2.9	$2.6^{+0.2}_{-0.5}$	3.1	$2.4^{+0.2}_{-0.5}$	2.9		
1.7 ± 0.2	2.0	1.7 ± 0.2	2.0	1.4 ± 0.2	1.7		

Classification	Check Item		Measurement conditions			Unit	D65E-12	
							Standard value	Permissible value
Work equipment	Work equipment speed	Blade tilt	Posture of work equipment  197F01548 • Engine: full throttle • Hydraulic oil temperature: 45 – 55°C • Blade: no load • Left tilt – Right tilt	LEFT TILT	Straight tilt	Sec.	2.3 ± 0.3	2.8
					Power tilt		—	—
				RIGHT TILT	Straight tilt		2.0 ± 0.3	2.5
					Power tilt		—	—
		Ripper lift	Posture of work equipment  197F01549 • Hydraulic oil temperature: 45 – 55°C • Shank set at bottom hole • From ground to maximum height	RAISE	Low idling		2.4 ± 0.2	2.9
					Full throttle		1.4 ± 0.2	1.9
				LOWER	Low idling		1.9 ± 0.2	2.4
					Full throttle		1.1 ± 0.2	1.6
		Pitch speed	Posture of work equipment  17MF02141 • Hydraulic oil temperature: 45 – 55°C • Blade: no load • Pitch dump – pitch back • Full throttle		Pitch dump		—	—
					Pitch back		—	—
		Blade time lag	• Engine: full throttle • Hydraulic oil temperature: 45 – 55°C • Lower the blade from the maximum height, and measure the time taken from the point when the blade touches the ground to the point where the idler is raised from the ground				Max. 1.3	Max. 1.6

014012

D65P-12		D65EX-12		D65PX-12			
Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value
2.3 ± 0.3	2.8	2.3 ± 0.3	2.8	2.3 ± 0.3	2.8		
2.0 ± 0.3	2.5	—	—	2.0 ± 0.3	2.5		
2.0 ± 0.3	2.5	2.0 ± 0.3	2.5	2.0 ± 0.3	2.5		
2.3 ± 0.3	2.8	—	—	2.3 ± 0.3	2.8		
—	—	2.4 ± 0.2	2.9	—	—		
—	—	1.4 ± 0.2	1.9	—	—		
—	—	1.9 ± 0.2	2.4	—	—		
—	—	1.1 ± 0.2	1.6	—	—		
3.5 ± 0.5	4.2	—	—	3.5 ± 0.5	4.2		
3.5 ± 0.5	4.2	—	—	3.5 ± 0.5	4.2		
Max. 1.3	Max. 1.6	Max. 1.3	Max. 1.6	Max. 1.3	Max. 1.6		

D65E-12 65001 and up
D65P-12 65001 and up
D65EX-12 65001 and up
D65PX-12 65001 and up

Classification	Check Item	Measurement conditions		Unit	D65E-12	
					Standard value	Permissible value
Engine stall	Torque converter stall speed	• Engine oil pressure: within operating range • Engine oil temperature: within operating range • Power train oil temperature: 70 - 80°C • Hydraulic oil temperature: 45 - 55°C • No. of speed range: F3		rpm	1,690 ± 100	1,570
Travel of control levers, pedals	Fuel control lever	• Center of lever knob	Engine: low idling → full throttle	mm	102 ± 20	102^{+40}_{-20}
			Engine: low idling → stop		48 ± 20	48^{+40}_{-20}
	Decelerator pedal	• Center of pedal			57 ± 10	57 ± 10
	Gear shift lever	• Engine stopped • Center of lever knob	Between each speed range	degree	15 ± 3	15 ± 3
	Steering F-R lever	• Engine stopped	N → F	mm	52 ± 10	52 ± 10
		• Center of lever knob	N → R		48 ± 10	48 ± 10
		• Engine low idling • Center of lever knob	Full stroke LEFT turn		110 ± 15	110 ± 15
			Full stroke RIGHT turn		110 ± 15	110 ± 15
			Until steering clutch is fully disengaged		40	40
	Brake pedal	• Engine low idling • Center of pedal	Full stroke		79 ± 12	79 ± 12
	Blade control lever	• Engine low idling • Center of lever knob • Hydraulic oil temperature: 45 - 55°C	HOLD → RAISE		81 ± 12	81 ± 12
			HOLD → LOWER		58 ± 9	58 ± 9
			HOLD → LEFT TILT HOLD → RIGHT TILT		62 ± 10	62 ± 10
	Ripper control lever	• Engine low idling • Center of lever knob • Hydraulic oil temperature: 45 - 55°C	HOLD → RAISE		77 ± 12	77 ± 12
			HOLD → LOWER		65 ± 10	65 ± 10
Operating force of control levers, pedals	Fuel control lever	• Center of lever knob	Engine: low idling → full throttle	N (kg)	71.6 ± 29.4 (7.3 ± 3.0)	117.7 (12.0)
			Engine: full throttle → low idling		20.6 ± 9.8 (2.1 ± 1.0)	39.2 (4.0)
			Engine: low idling → stop		68.6 ± 19.6 (7.0 ± 2.0)	117.7 (12.0)
	Decelerator pedal	• Engine speed: low idling (825 ± 25 rpm) • Center of pedal			98.1 ± 29.4 (10 ± 3)	147.1 (15)
	Gear shift lever	• Engine stopped • Center of lever knob	1st → 2nd		2.5 ± 0.6 (0.24 ± 0.06)	4.9 (0.5)
			2nd → 1st		2.7 ± 0.6 (0.28 ± 0.06)	4.9 (0.5)
			2nd → 3rd		3.9 ± 1.0 (0.40 ± 0.1)	5.9 (0.6)
			3rd → 2nd		1.6 ± 0.4 (0.16 ± 0.04)	2.9 (0.3)

014012

D65P-12		D65EX-12		D65PX-12			
Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value
1,770 ± 100	1,650	1,770 ± 100	1,650	1,770 ± 100	1,650		
102 ± 20	102^{+40}_{-20}	102 ± 20	102^{+40}_{-20}	102 ± 20	102^{+40}_{-20}		
48 ± 20	48^{+40}_{-20}	48 ± 20	48^{+40}_{-20}	48 ± 20	48^{+40}_{-20}		
57 ± 10	57 ± 10	57 ± 10	57 ± 10	57 ± 10	57 ± 10		
15 ± 3	15 ± 3	15 ± 3	15 ± 3	15 ± 3	15 ± 3		
52 ± 10	52 ± 10	52 ± 10	52 ± 10	52 ± 10	52 ± 10		
48 ± 10	48 ± 10	48 ± 10	48 ± 10	48 ± 10	48 ± 10		
110 ± 15	110 ± 15	90 ± 15	90 ± 15	90 ± 15	90 ± 15		
110 ± 15	110 ± 15	90 ± 15	90 ± 15	90 ± 15	90 ± 15		
40	40	—	—	—	—		
79 ± 12	79 ± 12	79 ± 12	79 ± 12	79 ± 12	79 ± 12		
81 ± 12	81 ± 12	81 ± 12	81 ± 12	81 ± 12	81 ± 12		
58 ± 9	58 ± 9	58 ± 9	58 ± 9	58 ± 9	58 ± 9		
62 ± 10	62 ± 10	62 ± 10	62 ± 10	62 ± 10	62 ± 10		
—	—	77 ± 12	77 ± 12	—	—		
—	—	65 ± 10	65 ± 10	—	—		
71.6 ± 29.4 (7.3 ± 3.0)	117.7 (12.0)	71.6 ± 29.4 (7.3 ± 3.0)	117.7 (12.0)	71.6 ± 29.4 (7.3 ± 3.0)	117.7 (12.0)		
20.6 ± 9.8 (2.1 ± 1.0)	39.2 (4.0)	20.6 ± 9.8 (2.1 ± 1.0)	39.2 (4.0)	20.6 ± 9.8 (2.1 ± 1.0)	39.2 (4.0)		
68.6 ± 19.6 (7.0 ± 2.0)	117.7 (12.0)	68.6 ± 19.6 (7.0 ± 2.0)	117.7 (12.0)	68.6 ± 19.6 (7.0 ± 2.0)	117.7 (12.0)		
98.1 ± 29.4 (10 ± 3)	147.1 (15)	98.1 ± 29.4 (10 ± 3)	147.1 (15)	98.1 ± 29.4 (10 ± 3)	147.1 (15)		
2.5 ± 0.6 (0.24 ± 0.06)	4.9 (0.5)	2.5 ± 0.6 (0.24 ± 0.06)	4.9 (0.5)	2.5 ± 0.6 (0.24 ± 0.06)	4.9 (0.5)		
2.7 ± 0.6 (0.28 ± 0.06)	4.9 (0.5)	2.7 ± 0.6 (0.28 ± 0.06)	4.9 (0.5)	2.7 ± 0.6 (0.28 ± 0.06)	4.9 (0.5)		
3.9 ± 1.0 (0.40 ± 0.1)	5.9 (0.6)	3.9 ± 1.0 (0.40 ± 0.1)	5.9 (0.6)	3.9 ± 1.0 (0.40 ± 0.1)	5.9 (0.6)		
1.6 ± 0.4 (0.16 ± 0.04)	2.9 (0.3)	1.6 ± 0.4 (0.16 ± 0.04)	2.9 (0.3)	1.6 ± 0.4 (0.16 ± 0.04)	2.9 (0.3)		

Classification	Check Item	Measurement conditions		Unit	D65E-12	
					Standard value	Permissible value
Operating force of control levers, pedals	Steering F-R lever	• Engine stopped • Center of lever knob	N → F	N (kg)	32.4 ± 19.6 (3.3 ± 2.0)	52.0 (5.3)
			N → R		34.3 ± 19.6 (3.5 ± 2.0)	53.9 (5.5)
		• Engine low idling • Center of lever knob	Untill steering clutch is fully disengaged		19.6 ± 9.8 (2.0 ± 1.0)	34.3 (3.5)
			Until machine turns when brake is applied		33.3 ± 9.8 (3.4 ± 1.0)	53.9 (5.5)
	Brake pedal	• Engine low idling • Center of pedal			451.0 ± 78.5 (46.0 ± 8.0)	588.4 (60.0)
	Blade control lever	• Engine low idling • Hydraulic oil temperature: 45 – 55°C • Center of lever knob	HOLD → RAISE		26.5 ± 9.8 (2.7 ± 1.0)	39.2 (4.0)
			HOLD → LOWER		23.5 ± 9.8 (2.4 ± 1.0)	39.2 (4.0)
			HOLD → LEFT TILT HOLD → RIGHT TILT		22.5 ± 9.8 (2.3 ± 1.0)	39.2 (4.0)
	Ripper control lever	• Engine low idling • Hydraulic oil temperature: 45 – 55°C • Center of lever knob	HOLD → RAISE		25.5 ± 9.8 (2.6 ± 1.0)	39.2 (4.0)
			HOLD → LOWER		20.6 ± 9.8 (2.1 ± 1.0)	39.2 (4.0)
Hydraulic oil pressure	Torque converter relief pressure (inlet)	• Power train oil temperature: 70 – 80°C	Engine: low idling	MPa (kg/cm²)	$0.2^{+0.15}_{-0.1}$ $(2.0^{+1.5}_{-1.0})$	$0.2^{+0.15}_{-0.1}$ $(2.0^{+1.5}_{-1.0})$
			Engine: full throttle		0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)
	Torque converter outlet pressure		Engine: low idling		0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)
			Engine: full throttle		0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)
	Transmission main relief pressure		Engine: full throttle		3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)
	Transmission modulating pressure		Engine: full throttle		3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)
	Transmission lubrication pressure		Engine: full throttle		0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)
	Steering clutch operating pressure		Engine: low idling		2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)
			Engine: full throttle		2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)

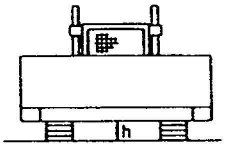
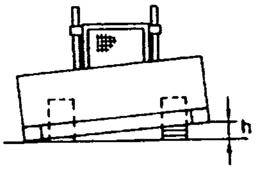
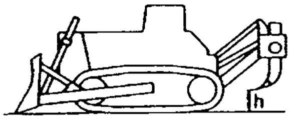
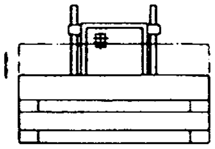
014012

D65P-12		D65EX-12		D65PX-12			
Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value
32.4 ± 19.6 (3.3 ± 2.0)	52.0 (5.3)	32.4 ± 19.6 (3.3 ± 2.0)	52.0 (5.3)	32.4 ± 19.6 (3.3 ± 2.0)	52.0 (5.3)		
34.3 ± 19.6 (3.5 ± 2.0)	53.9 (5.5)	34.3 ± 19.6 (3.5 ± 2.0)	53.9 (5.5)	34.3 ± 19.6 (3.5 ± 2.0)	53.9 (5.5)		
19.6 ± 9.8 (2.0 ± 1.0)	34.3 (3.5)	24.5 ± 9.8 (2.5 ± 1.0)	39.2 (4.0)	24.5 ± 9.8 (2.5 ± 1.0)	39.2 (4.0)		
33.3 ± 9.8 (3.4 ± 1.0)	53.9 (5.5)	—	—	—	—		
451.0 ± 78.5 (46.0 ± 8.0)	588.4 (60.0)	451.0 ± 78.5 (46.0 ± 8.0)	588.4 (60.0)	451.0 ± 78.5 (46.0 ± 8.0)	588.4 (60.0)		
26.5 ± 9.8 (2.7 ± 1.0)	39.2 (4.0)	26.5 ± 9.8 (2.7 ± 1.0)	39.2 (4.0)	26.5 ± 9.8 (2.7 ± 1.0)	39.2 (4.0)		
23.5 ± 9.8 (2.4 ± 1.0)	39.2 (4.0)	23.5 ± 9.8 (2.4 ± 1.0)	39.2 (4.0)	23.5 ± 9.8 (2.4 ± 1.0)	39.2 (4.0)		
22.5 ± 9.8 (2.3 ± 1.0)	39.2 (4.0)	22.5 ± 9.8 (2.3 ± 1.0)	39.2 (4.0)	22.5 ± 9.8 (2.3 ± 1.0)	39.2 (4.0)		
—	—	25.5 ± 9.8 (2.6 ± 1.0)	39.2 (4.0)	—	—		
—	—	20.6 ± 9.8 (2.1 ± 1.0)	39.2 (4.0)	—	—		
$0.2^{+0.15}_{-0.1}$ ($2.0^{+1.5}_{-1.0}$)	$0.2^{+0.15}_{-0.1}$ ($2.0^{+1.5}_{-1.0}$)	$0.2^{+0.15}_{-0.1}$ ($2.0^{+1.5}_{-1.0}$)	$0.2^{+0.15}_{-0.1}$ ($2.0^{+1.5}_{-1.0}$)	$0.2^{+0.15}_{-0.1}$ ($2.0^{+1.5}_{-1.0}$)	$0.2^{+0.15}_{-0.1}$ ($2.0^{+1.5}_{-1.0}$)		
0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)	0.75 ± 0.15 (7.5 ± 1.5)		
0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)	0.2 ± 0.1 (2.0 ± 1.0)		
0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)	0.45 ± 0.15 (4.5 ± 1.5)		
3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)	3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)	3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)		
3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)	3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)	3.3 ± 0.1 (34.0 ± 1.0)	3.0 (31.0)		
0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)	0.1 ± 0.05 (1.0 ± 0.5)		
2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)	—	—	—	—		
2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)	—	—	—	—		

Classification	Check Item	Measurement conditions		Unit	D65E-12	
					Standard value	Permissible value
Hydraulic oil pressure	Load sensing pressure	• Hydraulic oil temperature: 45 – 55°C • Engine speed: full throttle	Steering	MPa (kg/cm²)	—	—
			Work equipment		—	—
	Brake operating pressure	• Power train oil temperature: 70 – 80°C	Engine: low idling		2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)
			Engine: full throttle		2.5 + 0.1 (25.0 ± 1.0)	2.2 (22.0)
	PPC valve relief pressure	• Hydraulic oil temperature: 45 – 55°C	Engine: full throttle		4.2 ± 0.3 (43.0 ± 3.0)	3.7 (38.0)
	Steering relief pressure		Engine: full throttle		—	—
	Blade lift relief pressure		Engine: low idling		Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)
			Engine: full throttle		20.6 ± 1.0 (210 ± 10)	17.6 (180)
	Blade tilt relief pressure		Engine: low idling		Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)
			Engine: full throttle		20.6 ± 1.0 (210 ± 10)	17.6 (180)
	Ripper lift relief pressure		Engine: low idling		Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)
			Engine: full throttle		20.6 ± 1.0 (210 ± 10)	17.6 (180)
HSS motor	Leakage from HSS motor	• Hydraulic oil temperature: 45 – 55°C • Steering lever: full • Gear shift lever: N • Brake pedal: depress • Engine: full throttle		ℓ/min.	—	—
Performance	Travel speed	• On level surface • Engine at full throttle • Engine water temperature: Inside operating range • Run up distance: 10 – 30 m • Measurement distance: 20 m	F 1st	km/h	3.4 ± 0.2	3.4 ± 0.2
			F 2nd		6.1 ± 0.3	6.1 ± 0.3
			F 3rd		9.6 ± 0.5	9.6 ± 0.5
			R 1st		4.6 ± 0.3	4.6 ± 0.3
			R 2nd		7.7 ± 0.4	7.7 ± 0.4
			R 3rd		11.7 ± 0.6	11.7 ± 0.6

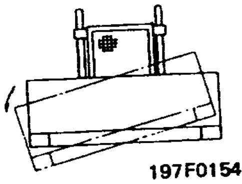
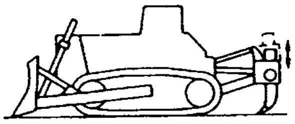
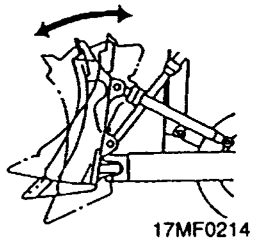
014012

D65P-12		D65EX-12		D65PX-12			
Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value
—	—	34.8 ± 2.0 (355 ± 20)	30.9 (315)	34.8 ± 2.0 (355 ± 20)	30.9 (315)		
—	—	21.6 ± 2.0 (220 ± 20)	17.6 (180)	21.6 ± 2.0 (220 ± 20)	17.6 (180)		
2.5 ± 0.1 (25.0 ± 1.0)	2.2 (22.0)	2.7 ± 0.1 (27.0 ± 1.0)	2.4 (24.0)	2.7 ± 0.1 (27.0 ± 1.0)	2.4 (24.0)		
2.5 + 0.1 (25.0 ± 1.0)	2.2 (22.0)	2.7 + 0.1 (27.0 ± 1.0)	2.4 (24.0)	2.7 + 0.1 (27.0 ± 1.0)	2.4 (24.0)		
4.2 ± 0.3 (43.0 ± 3.0)	3.7 (38.0)	4.2 ± 0.3 (43.0 ± 3.0)	3.7 (38.0)	4.2 ± 0.3 (43.0 ± 3.0)	3.7 (38.0)		
—	—	36.8 ± 2.0 (375 ± 20)	32.8 (335)	36.8 ± 2.0 (375 ± 20)	32.8 (335)		
Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)		
20.6 ± 1.0 (210 ± 10)	17.6 (Min. 180)	23.5 ± 2.0 (240 ± 20)	19.6 (Min. 200)	23.5 ± 2.0 (240 ± 20)	19.6 (Min. 200)		
Min. 15.7 (Min. 160)	Min. 15.7 (Min. 160)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)		
20.6 ± 1.0 (210 ± 10)	17.6 (Min. 180)	23.5 ± 2.0 (240 ± 20)	19.6 (200)	23.5 ± 2.0 (240 ± 20)	19.6 (200)		
—	—	Min. 19.6 (Min. 200)	Min. 19.6 (Min. 200)	—	—		
—	—	23.5 ± 2.0 (240 ± 20)	19.6 (200)	—	—		
—	—	Max. 15	30	Max. 15	30		
3.4 ± 0.2	3.4 ± 0.2	3.4 ± 0.2	3.4 ± 0.2	3.4 ± 0.2	3.4 ± 0.2		
6.1 ± 0.3	6.1 ± 0.3	6.1 ± 0.3	6.1 ± 0.3	6.1 ± 0.3	6.1 ± 0.3		
9.6 ± 0.5	9.6 ± 0.5	9.6 ± 0.5	9.6 ± 0.5	9.6 ± 0.5	9.6 ± 0.5		
4.6 ± 0.3	4.6 ± 0.3	4.6 ± 0.3	4.6 ± 0.3	4.6 ± 0.3	4.6 ± 0.3		
7.7 ± 0.4	7.7 ± 0.4	7.7 ± 0.4	7.7 ± 0.4	7.7 ± 0.4	7.7 ± 0.4		
11.7 ± 0.6	11.7 ± 0.6	11.7 ± 0.6	11.7 ± 0.6	11.7 ± 0.6	11.7 ± 0.6		

Classification	Check Item		Measurement conditions		Unit	D65E-12	
						Standard value	Permissible value
Work equipment	Hydraulic drift	Blade lift	Posture of work equipment  197F01551 • Hydraulic oil temperature: 45 – 55°C • Engine stopped • Center of blade cutting edge; from height of 800 mm to ground		mm/ 15 min.	Max. 100	Max. 100
		Blade tilt	Posture of work equipment  140F12216 • Hydraulic oil temperature: 45 – 55°C • Engine low idling • Lowering amount of blade	LEFT TILT		Max. 200	Max. 200
				RIGHT TILT		Max. 200	Max. 200
		Ripper lift	Posture of work equipment  197F01554 • Hydraulic oil temperature: 45 – 55°C • Engine stopped • Ripper point: 500 mm above the ground			Max. 50	Max. 50
	Work equipment speed	Blade lift	Posture of work equipment  197F01547 • Hydraulic oil temperature: 45 – 55°C • Engine: full throttle • Blade: no load • From ground to maximum height	RAISE	Sec.	$2.6^{+0.2}_{-0.5}$	3.1
				LOWER		2.0 ± 0.2	2.3

014012

D65P-12		D65EX-12		D65PX-12			
Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value	Standard value	Permissible value
Max. 100	Max. 100	Max. 100	Max. 100	Max. 100	Max. 100		
Max. 200	Max. 200	Max. 200	Max. 200	Max. 200	Max. 200		
Max. 200	Max. 200	Max. 200	Max. 200	Max. 200	Max. 200		
—	—	Max. 50	Max. 50	—	—		
$2.4^{+0.2}_{-0.5}$	2.9	$2.6^{+0.2}_{-0.5}$	3.1	$2.4^{+0.2}_{-0.5}$	2.9		
1.7 ± 0.2	2.0	1.7 ± 0.2	2.0	1.4 ± 0.2	1.7		

Classification	Check Item		Measurement conditions			Unit	D65E-12 Standard value	D65E-12 Permissible value
Work equipment	Work equipment speed	Blade tilt	Posture of work equipment  197F01548 • Engine: full throttle • Hydraulic oil temperature: 45 - 55°C • Blade: no load • Left tilt – Right tilt	LEFT TILT	Straight tilt	Sec.	2.3 ± 0.3	2.8
					Power tilt		—	—
				RIGHT TILT	Straight tilt		2.0 ± 0.3	2.5
					Power tilt		—	—
		Ripper lift	Posture of work equipment  197F01549 • Hydraulic oil temperature: 45 - 55°C • Shank set at bottom hole • From ground to maximum height	RAISE	Low idling		2.4 ± 0.2	2.9
					Full throttle		1.4 ± 0.2	1.9
				LOWER	Low idling		1.9 ± 0.2	2.4
					Full throttle		1.1 ± 0.2	1.6
		Pitch speed	Posture of work equipment  17MF02141 • Hydraulic oil temperature: 45 - 55°C • Blade: no load • Pitch dump – pitch back • Full throttle		Pitch dump		—	—
					Pitch back		—	—
		Blade time lag	• Engine: full throttle • Hydraulic oil temperature: 45 - 55°C • Lower the blade from the maximum height, and measure the time taken from the point when the blade touches the ground to the point where the idler is raised from the ground				Max. 1.3	Max. 1.6

014012

STANDARD VALUE TABLE FOR ELECTRICAL SYSTEM

<table>
<tr><th>Classification</th><th></th><th colspan="2">Check item</th><th>Connector No.</th><th>Inspection method</th><th>Judgement table</th><th>Measurement conditions</th></tr>
<tr><td rowspan="2">Monitor system</td><td rowspan="2">Monitor panel</td><td colspan="2">CHECK, CAUTION group
Buzzer signal

The voltage for H and L in the table are as follows.

※ 1 Engine oil pressure signal
H: 3.5 – 30 V
L: Approx. 0 V
※ 2 Starting signal
H: 3 – 30 V
L: Approx. 0 V

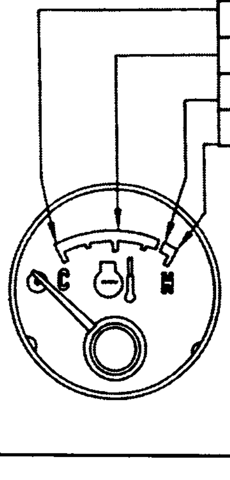
The starting signal is H once, but after that it becomes L. however , until the starting switch is turned , the starting signal is held in the memory inside the monitor panel as H.

※ 3 Alternator signal
H: 27.5 – 30 V
L: Max. 5 V

※ 4 Sensor signal
H: 3.5 – 30 V
L: Approx. 0 V</td><td colspan="3">If the condition is as shown in Tables 1 and 2, the monitor panel is normal.

Table 1 (CHECK, CAUTION group)
<table>
<tr><th rowspan="2">Signal / Monitor item</th><th colspan="3">Monitor auxiliary signal input</th><th rowspan="3">Monitor item sensor signal ※ 4</th><th rowspan="3">Monitor display</th></tr>
<tr><th>Engine oil pressure signal ※ 1</th><th>Starting signal ※ 2</th><th>Alternator signal ※ 3</th></tr>
<tr><th></th><th>CNP1(8)</th><th>CNP1(5)</th><th>CNP1(4)</th></tr>
<tr><td rowspan="2">Preheat CN49 ⑥</td><td colspan="2" rowspan="2">—</td><td rowspan="2">—</td><td>H</td><td>ON</td></tr>
<tr><td>L</td><td>OFF</td></tr>
<tr><td rowspan="2">Engine oil pressure CN49 ⑧</td><td>L</td><td rowspan="2">H</td><td rowspan="2">H</td><td rowspan="2">—</td><td>Flashing</td></tr>
<tr><td>H</td><td>OFF</td></tr>
<tr><td rowspan="2">Charge CN49 ④</td><td rowspan="2">H</td><td rowspan="2">H</td><td>L</td><td rowspan="2">—</td><td>Flashing</td></tr>
<tr><td>H</td><td>OFF</td></tr>
</table>

Table 2 (Buzzer signal)
<table>
<tr><td rowspan="2">A</td><td rowspan="2">CN49 ①–②
(+24 V input)</td><td>Starting switch ON
20 – 30 V</td></tr>
<tr><td>Starting switch OFF
0 V</td></tr>
<tr><td rowspan="2">B</td><td rowspan="2">CN50 ⑦ (Alarm buzzer output) – ④

Disconnect CN15 (coolant temperature sensor) ↔ Connect short connector to CN15</td><td>Remove connector CN15, and buzzer sounds, or the following cycle is repeated.
Over 20 V : 0.8 sec
3 V : 0.8 sec</td></tr>
<tr><td>When short connector is connected, buzzer stops or voltage is 20 – 30 V</td></tr>
</table>
</td><td>1) Start engine.
2) Insert T-adapter.</td></tr>
<tr><td>GAUGE group</td><td>Coolant temperature</td><td>CN15
① - ②</td><td>Measure resistance</td><td>
<table>
<tr><th>Coolant temperature</th><th>Resistance of sensor</th></tr>
<tr><td>50°</td><td>Approx. 17KΩ</td></tr>
<tr><td>90°C</td><td>Approx. 5KΩ</td></tr>
<tr><td>102°C</td><td>Approx. 3.7KΩ</td></tr>
<tr><td>120°C</td><td>Approx. 2.3KΩ</td></tr>
</table>

140F12217</td><td>1) Turn starting switch OFF and insert dummy resistance or measure resistance of sensor.
2) Turn starting switch ON, and check display.
3) Connect socket.</td></tr>
</table>

014012

<table>
<tr><th>Classification</th><th colspan="3">Check item</th><th>Connector No.</th><th>Inspection method</th><th>Judgement table</th><th>Measurement conditions</th></tr>
<tr><td rowspan="5">Monitor system</td><td rowspan="2">Monitor panel</td><td rowspan="2">GAUGE group</td><td>Power train temperature</td><td>CN58
① – ②</td><td>Measure resistance</td><td>
<table>
<tr><th>Power train temperature</th><th>Resistance of sensor</th></tr>
<tr><td>50°</td><td>Approx. 17KΩ</td></tr>
<tr><td>90°C</td><td>Approx. 3.8KΩ</td></tr>
<tr><td>120°C</td><td>Approx. 2.3KΩ</td></tr>
<tr><td>130°C</td><td>Approx. 1.8KΩ</td></tr>
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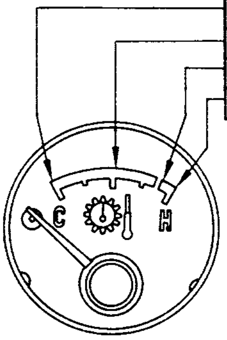

140F12218</td><td>1) Turn starting switch OFF and insert dummy resistance or measure resistance of sensor.
2) Turn starting switch ON, and check display.
3) Connect socket.</td></tr>
<tr><td>Fuel level</td><td>CN3
① – ②</td><td>Measure resistance</td><td>
<table>
<tr><th>Fuel level</th><th>Resistance of sensor</th></tr>
<tr><td>E</td><td>Approx. 82Ω</td></tr>
<tr><td>1/10</td><td>Approx. 70Ω</td></tr>
<tr><td>F</td><td>Approx. 12Ω</td></tr>
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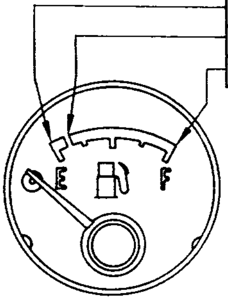


140F12219</td><td></td></tr>
<tr><td colspan="3">Coolant temperature sensor
(Coolant temperature gauge)
Power train temperature sensor
(Power train temerature gauge)</td><td>CN15
(Male)
CN58
(Male)</td><td>Measure resistance</td><td>The following results show that the sensor is normal
<table>
<tr><th>Ambient temperature</th><th>When normal</th></tr>
<tr><td>100°</td><td>Approx. 3.8KΩ</td></tr>
<tr><td>90°C</td><td>Approx. 5KΩ</td></tr>
<tr><td>35°C</td><td>Approx. 29KΩ</td></tr>
<tr><td>20°C</td><td>Approx. 52KΩ</td></tr>
<tr><td>10°C</td><td>Approx. 80kΩ</td></tr>
</table></td><td>1) Starting switch OFF
2) Disconnect CN15 (coolant temperature sensor)
3) Disconnect CN58 (Power train temperature sensor)</td></tr>
<tr><td colspan="3">Engine oil pressure sensor</td><td>—</td><td>Continuity check</td><td>The following results show that the sensor is normal
<table>
<tr><td>Engine oil pressure over 0.5 kg/cm²</td><td>No continuity</td></tr>
<tr><td>Engine oil pressure under 0.5 kg/cm²</td><td>Continuity</td></tr>
</table></td><td>1) Start engine</td></tr>
<tr><td colspan="3">Fuel level sensor
(Fuel level gauge)</td><td>CN3
(Male)</td><td>Measure resistance</td><td>The following results show that the sensor is normal
(Normal temperature 25°C)
<table>
<tr><th></th><th>CN3 (Male) ① – ②</th></tr>
<tr><td>Full</td><td>Approx. 12Ω or less</td></tr>
<tr><td>Empty</td><td>Approx. 85 – 110Ω</td></tr>
</table></td><td>1) Starting switch OFF</td></tr>
</table>

014012

Classification	Component	Connector No.	Inspection method	Judgement table	Measurement conditions
Monitor system	Alternator	Between alternator terminal R — chassis	Measure voltage	When engine is running (1/2 throttle or above): 27.5 — 29.5V ★ If the battery is old, or after starting in cold areas, the voltage may not rise for some time.	1) Start engine.

TOOL LIST FOR TESTING AND ADJUSTING

Test measurement item	Symbol		Part No.	Part Name	Remarks
Engine speed	A		799-203-8001	Multi-tachometer	Digital display: L: 60 – 2,000 rpm H: 60 –19,990 rpm
Water temperature, oil temperature, exhaust temperature	B		799-101-1500	Digital temperature Gauge	–99.9 – 1,299°C
			799-201-1110	Cable	Measure exhaust temperature
Oil pressure	C	1	799-101-5001	Hydraulic tester	Pressure gauge: 2.5, 5.9, 39.2, 58.8MPa (25, 60, 400, 600 kg/cm^2)
			790-261-1203	Digital hydraulic tester	Pressure gauge: 49 MPa (500 kg/cm^2)
			799-401-2320	Hydraulic gauge	1 MPa (10 kg/cm^2)
		2	790-261-1311	Adapter	–
			790-261-1321	Adapter	–
		3	790-261-1351	Elbow	–
Compression pressure	D	1	795-502-1590	Gauge assembly	0 – 6.9 MPa (0 – 70 kg/cm^2) Kit part No. 795-502-1205
		2	795-502-1360	Adapter	–
Blowdy pressure	E	1	799-201-1511	Tool	Kit part No. 799-201-1504
		2	799-201-1541	Gauge	
		3	799-201-1571	Tube	
		4	799-201-1450	Adapter	
Valve clearance	F		Commercially available	Feeler gauge	Intake valve: 0.33 mm exhaust valve: 0.71 mm
Exhaust color	G	1	799-201-9000	Handy smoke checker	Discoloration: 0 – 70 % (with standard color) (Discoloration × $\frac{1}{10}$ = Bosch index)
		2	Commercially available	Smoke meter	–
Boost pressure	H		799-401-2310	Pressure gauge	1,500 mm Hg
Operating force	I		79A-264-0090	Push-pull scale	0 – 490.3 Nm (0 – 50 kg)
			79A-264-0020	Push-pull scale	0 – 294.2 Nm (0 – 30 kg)
Stroke, hydraulic drift	J		Commercially available	Scale	–
Work equipment speed	K		Commercially available	Stopwatch	–

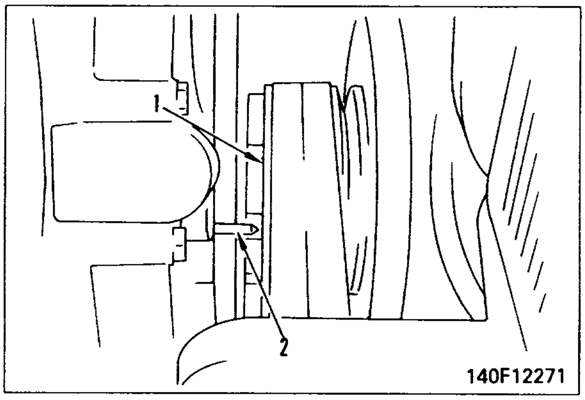
Test measurement item	Symbol	Part No.	Part Name	Remarks
Troubleshooting of wiring harness, sensor	L	799-601-2600	T-adapter box	Kit part No. T-adapter kit 799-601-7100
		799-601-7000	Adapter assembly	
		799-601-7190	Adapter	
		799-601-7010	Adapter	
		799-601-7080	Adapter	
Troubleshooting of voltage, resistance value	M	Commercially available	Tester	—
Measuring wear of sprocket tooth	P	791-427-1191	Wear gauge	D65E-12 60001-60947 D65P-12 60001-60890 D65EX-12 60001-60941 D65PX-12 60001-60914
		791-427-1220		D65E-12 60948 and up D65P-12 60891 and up D65EX-12 60942 and up D65PX-12 60915 and up

014012

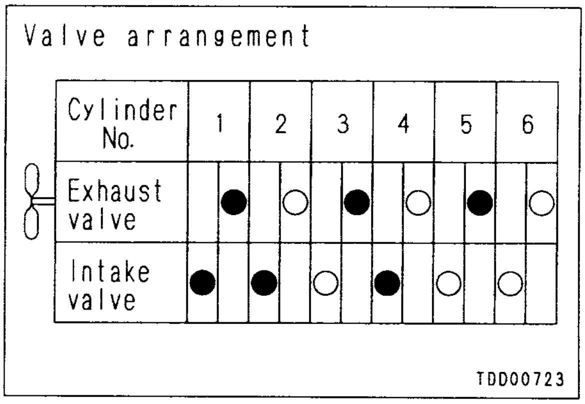
ADJUSTING VALVE CLEARANCE

1. Remove the cylinder head cover.
2. Rotate the crankshaft in the normal direction. While watching the movement of the intake valve of the No. 6 cylinder, bring the No. 1 cylinder into the top dead center position of the compression stroke and align the "1.6 TOP" mark on vibration damper (1) with pointer (2).

   ★ When the No. 1 cylinder comes near the top dead center of the compression stroke, the No. 6 intake valve will start to move (open).



3. Adjust the valve clearance for valves marked ● in the valve arrangement chart.
4. Rotate the crankshaft in the normal direction by one revolution and adjust the valve clearance for the remaining valves marked ○.



Valve arrangement

Cylinder No.	1	2	3	4	5	6
Exhaust valve	●	○	●	○	●	○
Intake valve	●	●	○	●	○	○

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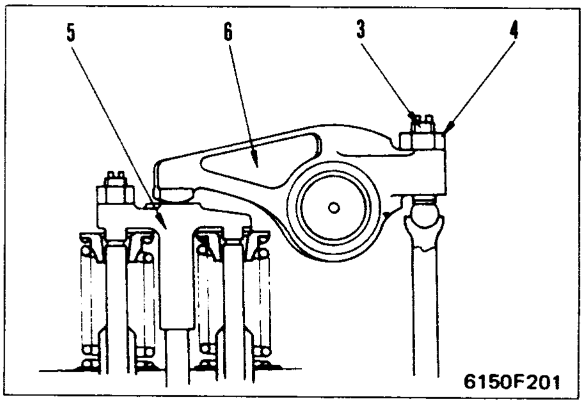
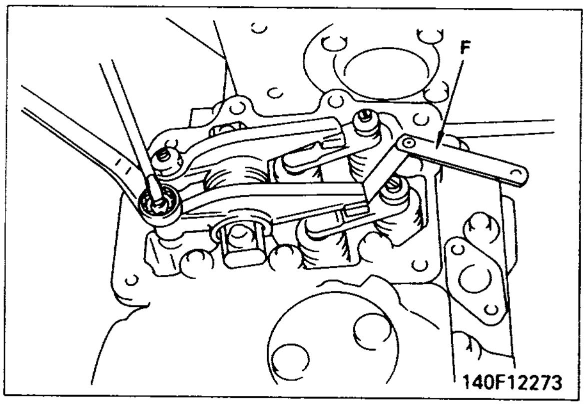
★ To adjust the valve clearance, loosen lock nut (4) on adjustment screw (3), insert feeler gauge **F** corresponding to the specified clearance between crosshead (5) and rocker arm (6), and adjust the clearance with the adjustment screw until the thickness gauge can slide lightly.



5. After the clearance is properly adjusted, tighten the lock nut to secure the adjustment screw.

   kgm Lock nut: **68.6 ± 4.9 Nm**
   (7 ± 0.5 kgm)

★ The engine firing order is 1 – 5 – 3 – 6 – 2 – 4.
★ Intake and exhaust valve clearances may be adjusted for each cylinder in the firing order by rotating the crankshaft 120° at a time in the normal direction.
★ For details about valve clearance, see STANDARD VALUE TABLE FOR ENGINE.



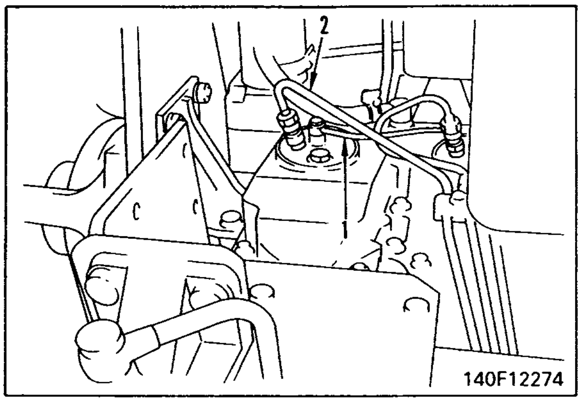
MEASURING COMPRESSION PRESSURE

MEASUREMENT PROCEDURE

⚠ While measuring the compression pressure, take care not burn yourself on the exhaust manifold or muffler, and be careful not to get caught in any revolving part of the engine.

★ Measure the compression pressure while the engine is warm.
(Oil temperature: 40 – 60°C)

1. Adjust the valve clearance properly. For details, see ADJUSTING VALVE CLEARANCE.



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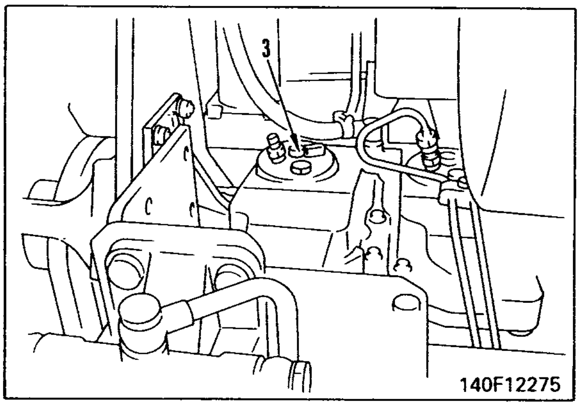
2. Remove spill tube (1) and disconnect fuel injection pipe (2).



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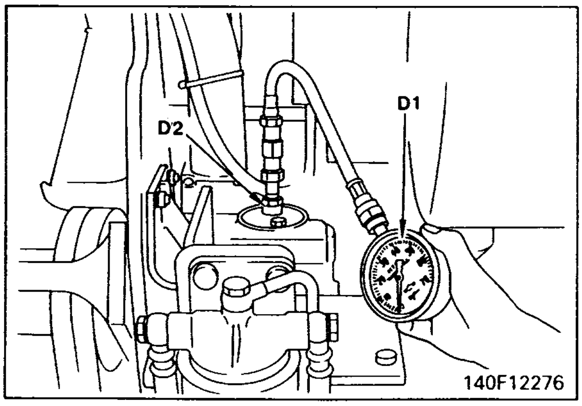
3. Remove nozzle holder assembly (3) for each cylinder.
   ★ Remove the nozzle holder assembly for prying it with two mounting bolts.
   ★ Take care not to let any dirt or foreign matter get into the cylinder.

4. Install adapter **D2** to the nozzle holder mounting section of the cylinder to be measured, and tighten the adapter to the specified torque.

   kgm Torque: **21.6 ± 2.9 Nm**
   (2.2 ± 0.3kgm)



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5. Connect compression gauge **D1** to the adapter.

6. Place the fuel control lever in NO INJECTION position, crank the engine with the starting motor, and read the gauge when the pointer is stabilized.

⚠ If you do not put the fuel control lever in NO INJECTION position, fuel will blow out.

★ Most compression leakage can be prevented by applying a small amount of oil to the mounting section of the adapter.

★ For the reference values of the compression pressure, see STANDARD VALUE TABLE FOR ENGINE.

014012

MEASURING BLOWBY

★ Raise the coolant temperature to the operating range before measuring.

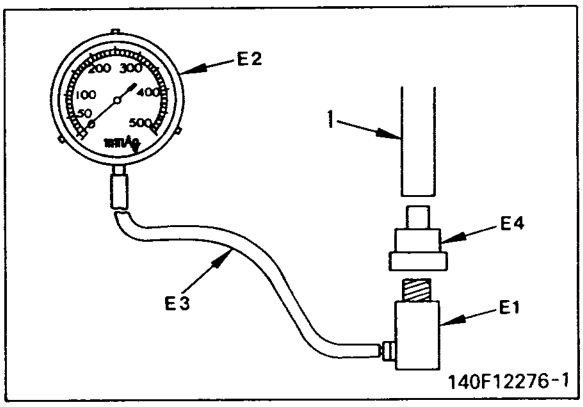
1. Install tools **E4**, **E1** to the tip of engine breather hose (1), then connect it to tools **E3**, **E2**.
2. Run the engine at rated output, and measure the blow-by pressure.

⚠ When measuring, be careful not to touch any hot parts or rotating parts.

★ The blow-by should be measured with the engine running at rated output.

- When measuring in the field, a similar value can be obtained at stall speed.
- If it is possible to check at rated output or stall speed, measure at high idling.
  In this case, the blow-by value will be about 80% of the value at rated output.

★ Blow-by varies greatly according to the condition of the engine. Therefore, if the blow-by value is considered abnormal, check for problems connected with defective blow-by, such as excessive oil consumption, defective exhaust gas color, and prematurely dirty or deteriorated oil.



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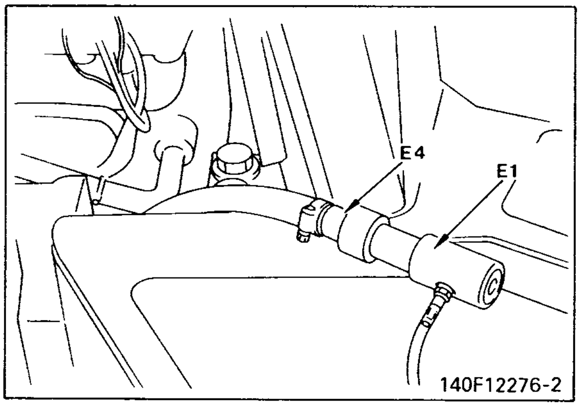

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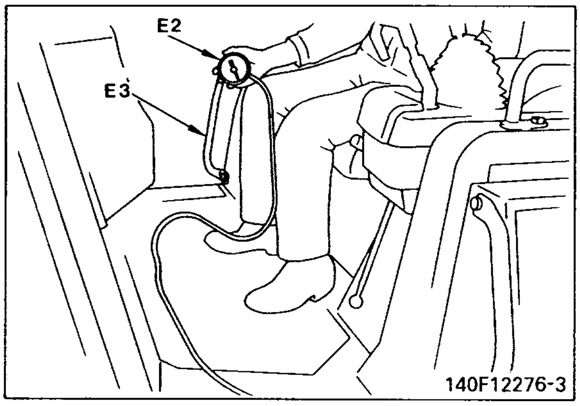


140F12276-3

ADJUSTING FUEL INJECTION TIMING

There are two methods for checking and adjusting the fuel injection timing of an injection pump.

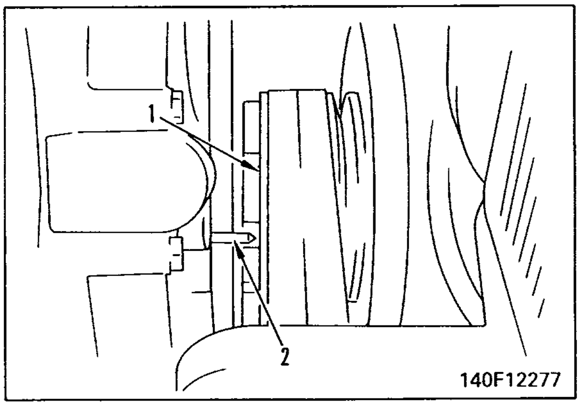
- The "MATCH MARK ALIGNMENT" method, which is used when the injection pump is installed to the original engine and the pump is not being repaired.
- The "DELIVERY VALVE" method, which is used when a repaired or replaced injection pump is installed to the engine.

★ Before inspecting and adjusting the fuel injection timing, bring the No. 1 cylinder piston to the top dead center of the compression stroke. For details, see ADJUSTING VALVE CLEARANCE.

CHECKING AND ADJUSTING BY THE MATCH MARK ALIGNMENT METHOD

1. With No. 1 cylinder piston at TOP position, rotate the crankshaft 30° to 40° in the reverse direction.

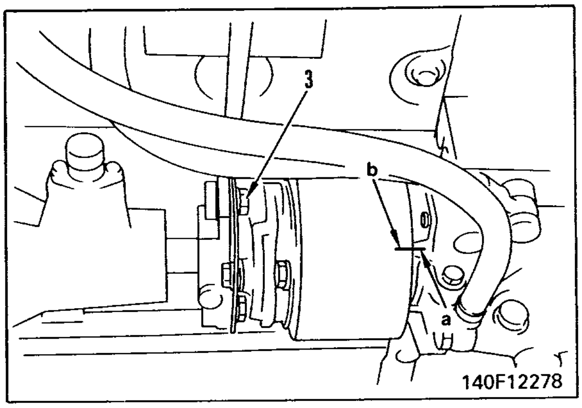
2. Align the injection timing stamp line on crankshaft damper (1) with pointer (2) by slowly rotating the crankshaft in the normal direction.



3. Confirm that stamp line **a** on the injection pump is aligned with stamp line **b** on the coupling.

   ★ If the stamp lines are out of alignment, loosen nut (3), align the stamp lines by shifting the coupling, and tighten the nut.

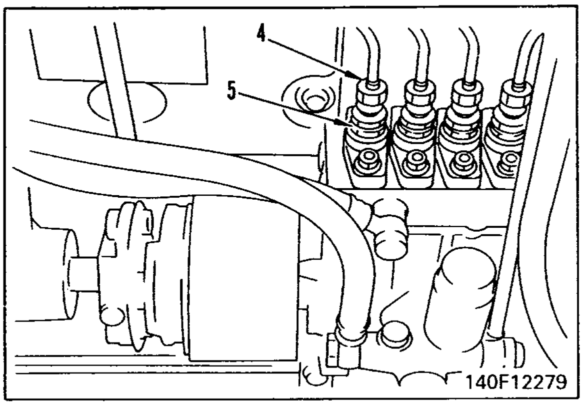
   Nut: **60.7 ± 2.0 Nm**
   (6.2 ± 0.2 kgm)



CHECKING AND ADJUSTING BY THE DELIVERY VALVE METHOD

1. Disconnect fuel injection pipe (4) for the No. 1 cylinder.

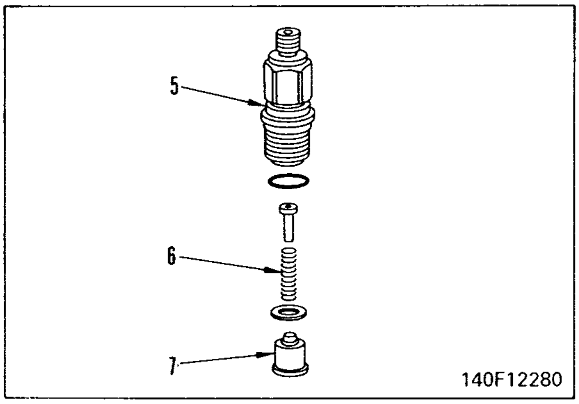
2. Remove delivery valve holder (5).



3. Remove spring (6) and delivery valve (7) from the delivery valve holder, and reassemble the delivery valve holder.

4. Place the fuel control lever in FULL position, slowly rotate the crankshaft in the normal direction while operating the priming pump, and observe the position when the fuel stops flowing out of the delivery valve holder.

5. In the position where the outflow of fuel stops, check the injection timing stamp line on the crankshaft damper to see if it is aligned with the pointer.
   - ★ If the injection timing stamp line passed through the pointer:
     The injection timing is late.
   - ★ If the injection timing stamp line did not reach the pointer:
     The injection timing is advanced.



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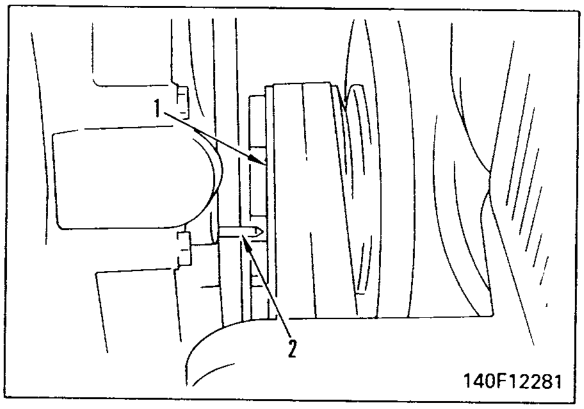
★ If the inspection shows that the injection timing is out of adjustment, adjust the fuel injection timing in the following manner.

★ After the checking and adjusting, be sure to reassemble the spring and the delivery valve.

1) Rotate the crankshaft 30° to 40° in the reverse direction, starting from TOP position in No. 1 cylinder.
2) Align the injection timing stamp line on damper (1) with pointer (2) by slowly rotating the crankshaft in the normal direction.
3) Loosen nut (3) on the injection pump mounting flange slot, and rotate the flange on the pump side little by little by operating the priming pump until no fuel flows out of the delivery valve holder.
4) Tighten the nut on the injection pump mounting flange slot.
   ★ Recheck the injection timing to see if it is properly adjusted.

   Nut: **60.7 ± 2.0 Nm**
   (6.2 ± 0.2 kgm)
5) Align match mark **a** with mark **b** and stamp the marks.



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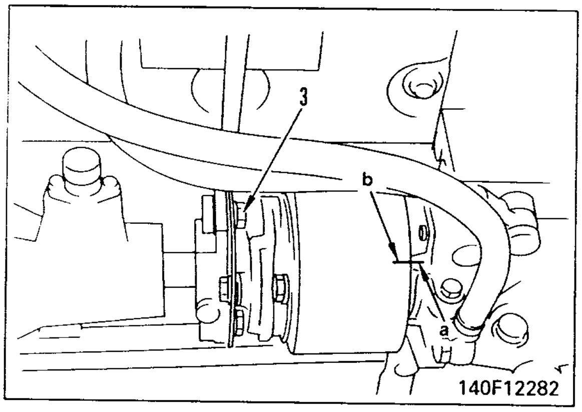


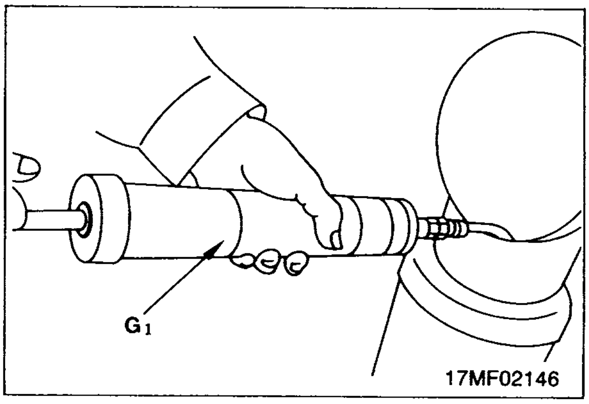
140F12282

MEASURING EXHAUST COLOR

- When measuring in the field where there is no air or electric power supply, use tool **G1**; when recording formal data, use tool **G2**.

★ Raise the coolant temperature to the operating range before measuring.

⚠ Be careful not to touch any hot parts when removing or installing the measuring tools.



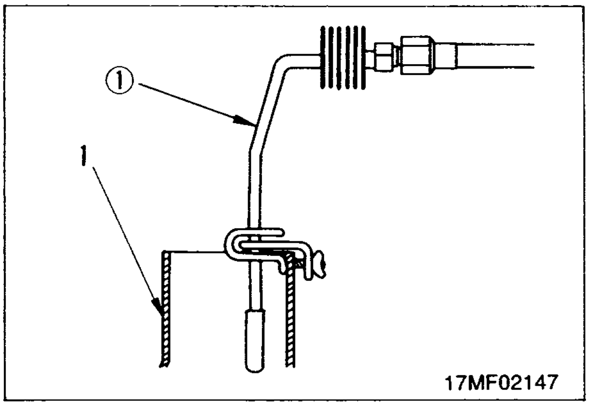
17MF02146

Measuring with G1

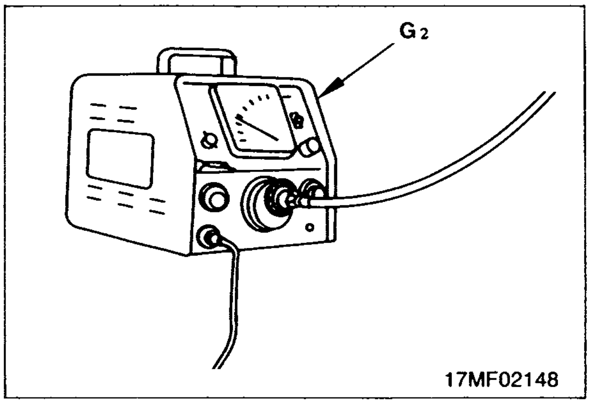
1) Install filter paper to tool **G1**.
2) Insert the exhaust gas suction port into the exhaust pipe, accelerate the engine suddenly, and operate the handle of tool **G1** at the same time to collect the exhaust gas on the filter paper.
3) Remove, the filter paper and compare it with the scale supplied to judge the condition.

Measuring with G2

1) Insert probe ① into the outlet port of the exhaust pipe (1), and tighten the clip to secure it to the exhaust pipe.
2) Connect the air hose and the socket of the probe hose accelerator switch to tool **G2**.
   ★ Keep the pressure of the air supply below 1.47 MPa (15kg/cm^2).
3) Connect the power cord to the AC100V socket.
   ★ When connecting the cord, check that the power switch of tool **G2** is OFF.
4) Loosen the cap nut of the suction pump, and fit the filter paper.
   ★ Fit the filter paper securely so that the exhaust gas cannot leak.
5) Turn the power switch of tool **G2** ON.
6) Accelerate the engine suddenly, and depress the accelerator pedal of tool **G2** at the same time to collect the exhaust gas color on the filter.
7) Place the filter paper used to catch the exhaust gas color on top of at least 10 sheets of unused filter paper inside the filter paper holder, and read the value shown.



17MF02147



17MF02148

MEASURING BOOST PRESSURE

⚠ Be careful not to touch any hot parts when removing or installing the measuring tools.

1. Remove boost pressure measurement plug (1) (PT1/8), then install the coupler inside oil pressure gauge kit **C**.

2. Connect the oil pressure measurement hose to the coupler and pressure gauge **H** (1500 mmHg).

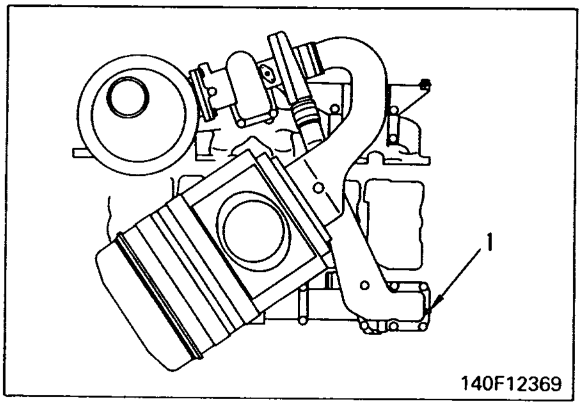
   ⚠ When measuring the pressure, be careful not to touch the rotating parts or hot parts.

   Note: Operate the engine speed at midrange or above, and use the self-seal portion of the gauge to bleed the oil inside the hose.

   - Insert the gauge about half way, repeat the action to open the self-seal portion, and bleed the oil.

   ★ If there is oil inside the hose, the gauge will no work, so always bleed the oil.

3. Run the engine at the rated speed and read the gauge indicator.



014012

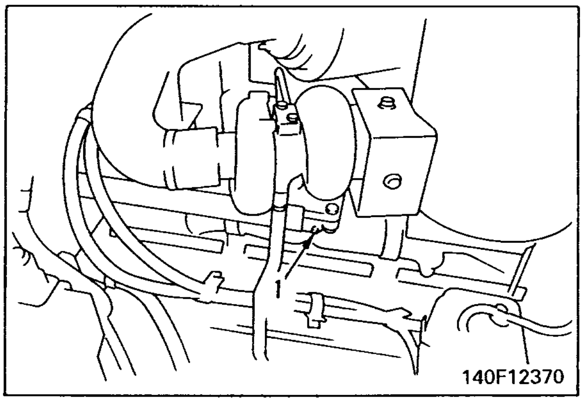
MEASURING EXHAUST TEMPERATURE

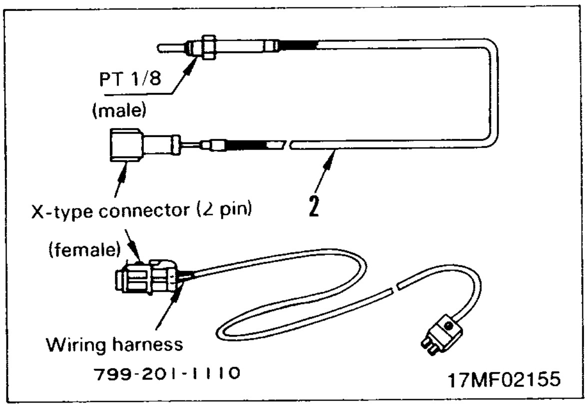
D65P, EX, PX-12

⚠ The temperature sensor is installed to the exhaust manifold, so if the machine is being operated, wait for the manifold temperature to drop before installing the sensor.

★ Raise the coolant temperature to the operating range before measuring.

1. Remove plug (1) from the exhaust manifold, and install temperature sensor (2).
   - Temperature sensor: 6215-11-8180 (cable length 610mm) or 6215-11-8170 (cable length 490mm)
2. Connect to digital temperature gauge **B** with the wiring harness.

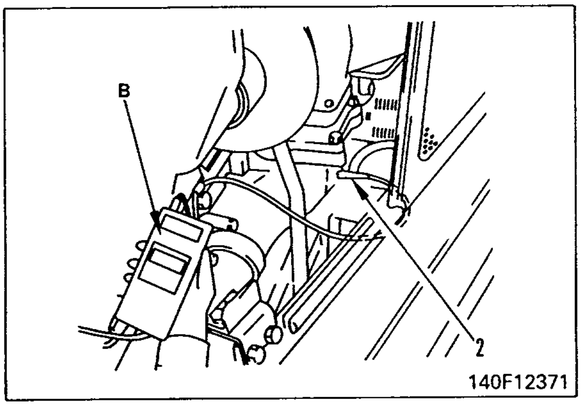




Measurement procedure

1. When measuring with the torque converter stalled
   ★ The conditions are only for torque converter stall, so when measuring to exhaust temperature, the core of the sensor will heat up and the torque converter will overheat before a stable value is obtained.
   1) Raise the exhaust temperature by using full stall (torque converter stall + hydraulic pump relief) (standard value: Approx. 650°C).
   2) In the above condition, cancel the hydraulic relief, and carry out only torque converter stall. (If the temperature starts to go down, or goes up without going down, repeat step 1) to raise the set temperature.)
   3) Note the stable temperature when the temperature starts to go down.

2. When measuring the maximum value for the exhaust temperature
   Carry out actual work and measure the maximum value during operation.
   ★ Use the peak mode (it can store the maximum value in memory) of the temperature gauge function.

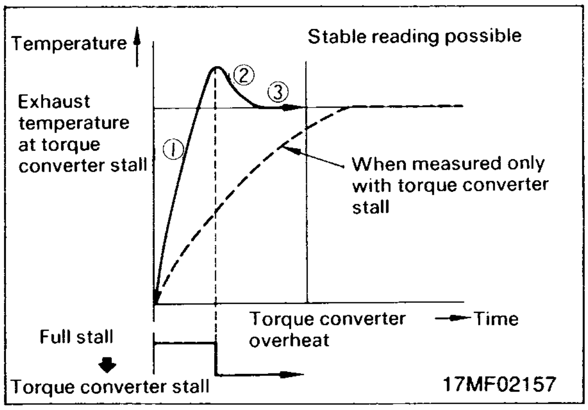


Note:

The exhaust temperature varies greatly according to the ambient temperature (temperature of the engine intake air), so if any abnormal value is obtained, carry out temperature compensation.

★ Compensation = Measured value + 2 (converted ambient temperature − ambient temperature)

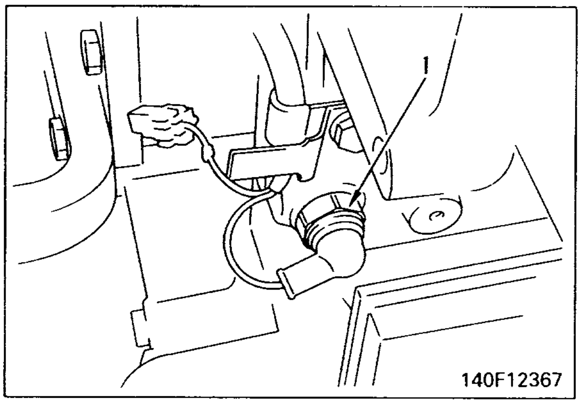
★ The converted ambient temperature is taken as 20°C.

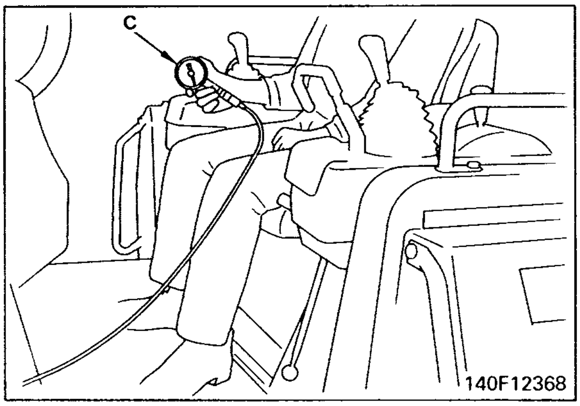


MEASURING ENGINE OIL PRESSURE

★ Raise the coolant temperature to the operating range before measuring.

1. Remove pressure measurement sensor (1), then install oil pressure gauge **C** [0.98 MPa (10 kg/cm^2)].
2. Start the engine, and measure the oil pressure at low idling and high idling.





MEASURING ENGINE SPEED

⚠ Be careful not to touch any hot parts when removing or installing the measuring tools.

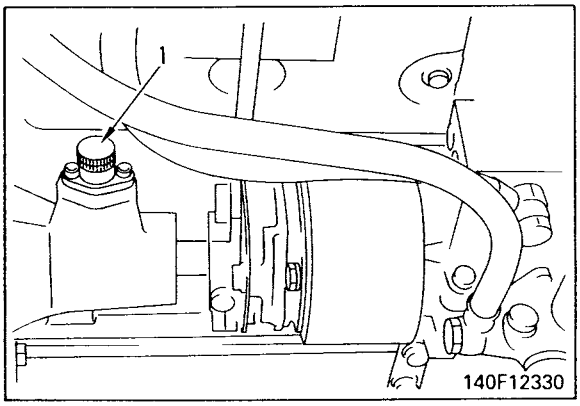
★ Measure the engine speed under the following conditions:
  1) Coolant temperature: Within operating range
  2) Power train oil temperature: 70 — 90°C
  3) Hydraulic temperature: 45 — 55°C

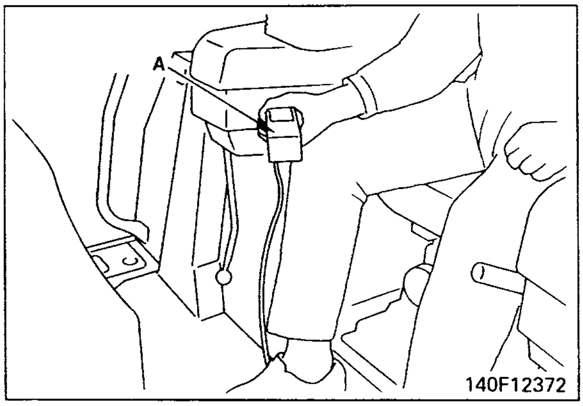
1. Remove cap (1) from the speed pick-up port, then install the adapter of tachometer **A**.
2. Connect tachometer **A** to the adapter with the cable.

   ⚠ When measuring the engine speed, be careful not to touch the rotating parts or hot parts.

3. Start the engine and measure the engine speed at high idling and low idling.

★ When measuring items other than above (torque converter stall), see the measurement procedure for each item.

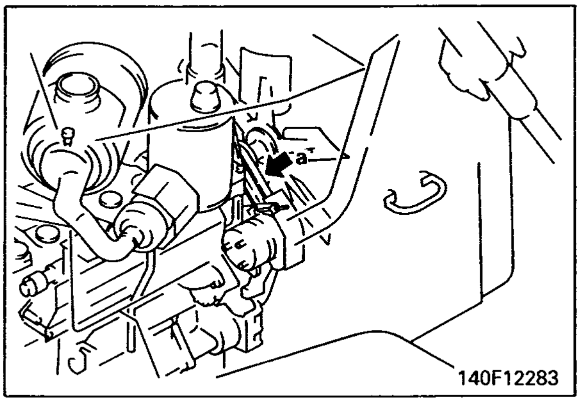




TESTING FAN BELT TENSION

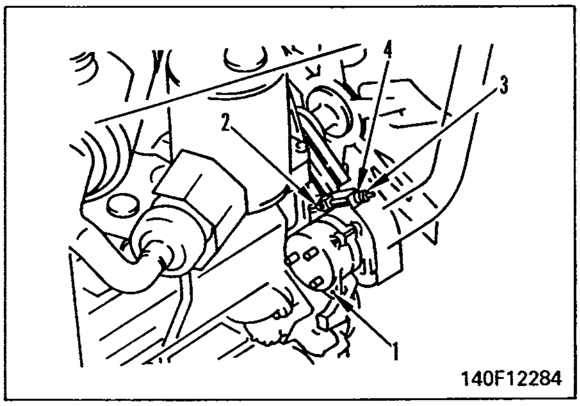
1. Testing fan belt tension

- Press the belt with a finger pressure of 6 kg at point midway between the fan pulley and alternator pulley, and measure the deflection.
  ★ Deflection of V-belt: Approx. 10mm



2. Adjusting belt

1) Loosen alternator mount bolt (1) and adjustment plate mounting bolt (2).
2) Loosen locknut (3), then tighten adjustment nut (4) to adjust the belt tension.
3) After adjusting the belt tension to the standard value, tighten locknut (3), then tighten adjustment plate mounting bolt (2) and alternator mount bolt (1).



MEASURING SPEED AT TORQUE CONVERTER STALL

★ Measure the stall speed under the following conditions.
- Coolant temperature: Within operating range
- Power train oil temperature: 70 — 90°C
- Hydraulic oil temperature: Min. 50°C

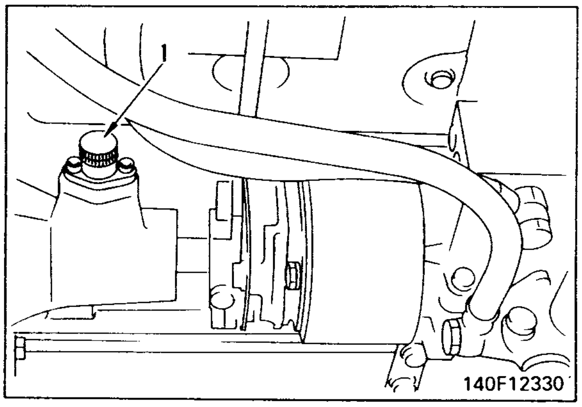
⚠ Make sure that there is no one near the machine before starting measurements.

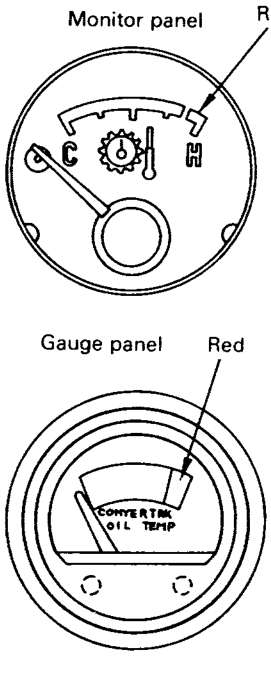
1. Remove cap (1) from the engine speed pick-up port, and install tachometer **A**.
2. Depress the brake pedal securely and place the gear shift lever at position **F3**.
3. Depress the decelerator pedal, then move the fuel control lever to the FULL position and run the engine at full throttle to stall the torque converter.
4. When the torque converter oil temperature gauge enters the red range, return the gear shift lever immediately to neutral and lower the oil temperature.
5. Repeat the above Steps 2 — 4 three times.
6. Repeat the procedure in Steps 2 — 4 to stall the torque converter.
7. Measure the engine speed at the moment the torque converter oil gauge enters the red range.

★ After completing the measurement, return the gear shift lever immediately to neutral and run the engine at full throttle to lower the oil temperature.

⚠ Precautions when relieving torque converter:

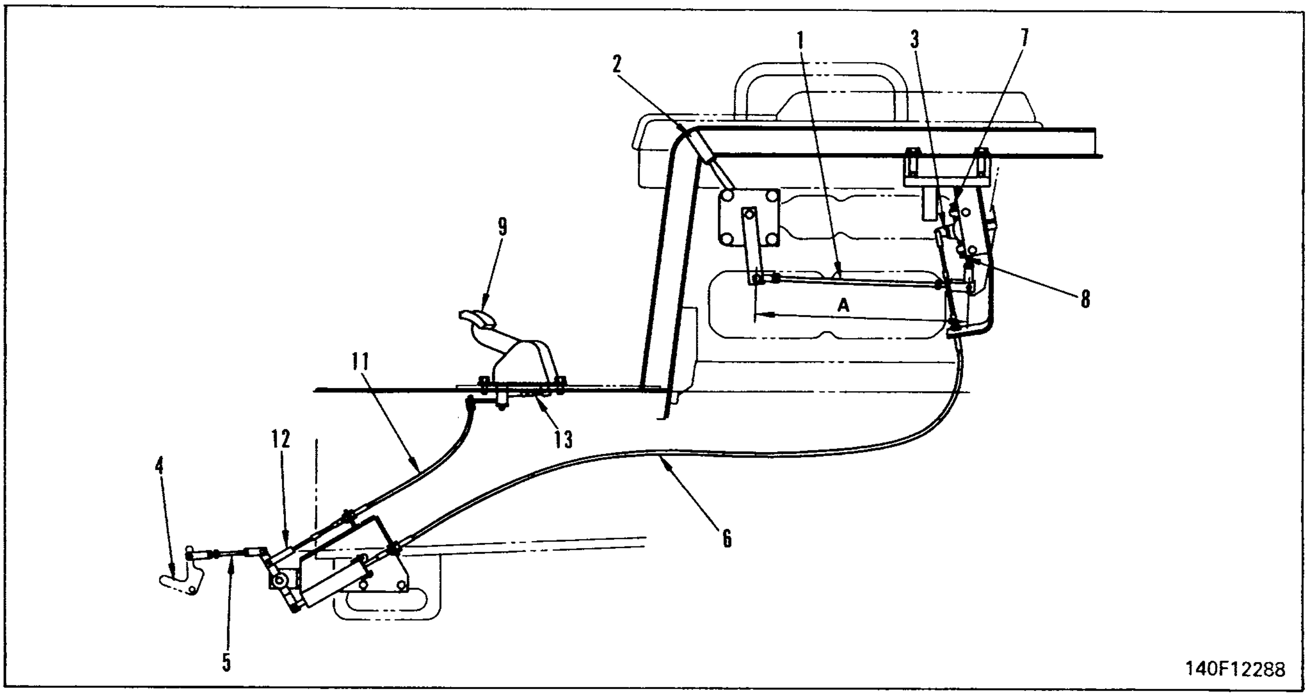
1) Depress the decelerator pedal before moving the fuel control lever to the FULL position.
2) Release the decelerator pedal gradually and run the engine at full throttle. For safety reasons, always keep your right foot near the decelerator pedal until the measurement operation has been completed.





ADJUSTING FUEL CONTROL LINKAGE

D65E-12 60001 – 60947
D65P-12 60001 – 60890
D65EX-12 60001 – 60941
D65PX-12 60001 – 60914



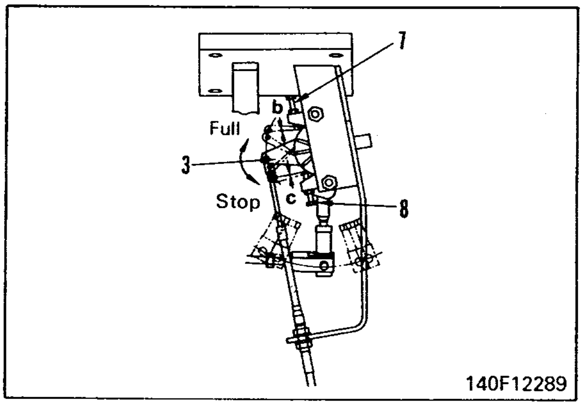
140F12288

1. Adjust the length of rod (1) to dimension **A**, then connect throttle lever (2) and lever assembly (3).
   ★ Dimension **A**: 468.5 mm

2. Set governor lever (4) of the fuel injection pump to the LOW IDLING position, align lever assembly (3) with the low idling detent position, then adjust rod (5) and connect cable (6).

3. Place governor lever (4) of the fuel injection pump at the FULL position, set clearance **b** between the lever of lever assembly (3) and stopper bolt (7) to 0, then turn stopper bolt (7) back two turns from this position and secure stopper bolt (7) in position.

4. Place governor lever (4) of the fuel injection pump at the STOP position, set clearance **c** between the lever of lever assembly (3) and stopper bolt (8) to 0, then secure stopper bolt (8) in position.



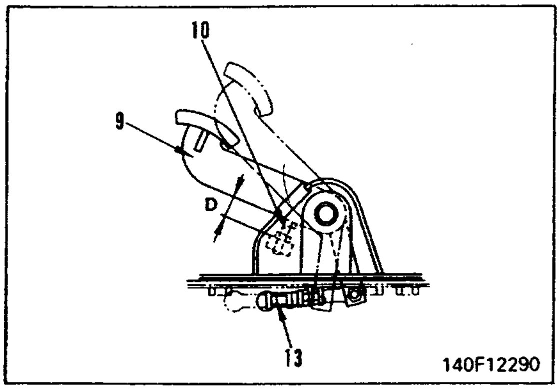
140F12289

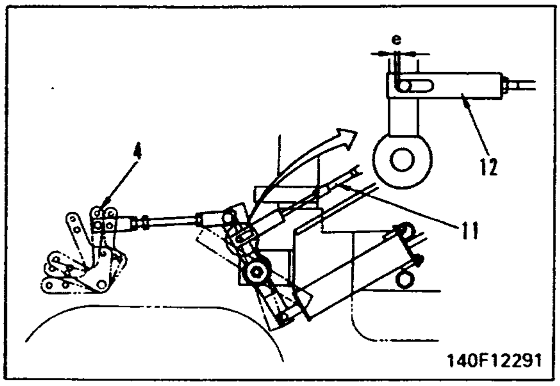
5. Adjust the height of stopper bolt (10) of decelerator pedal (9) to dimension **D**.
   ★ Stopper bolt height dimension **D**: 21 mm

6. Set governor lever (4) of the fuel injection pump to the LOW IDLING position, depress decelerator pedal (9) until it contacts stopper bolt (10), then connect cable (11), yoke (12), and rod (13).
   ★ Standard installed length of rod (13): 88.1 mm

7. In the condition in Step 5, adjust with cable (11) and yoke (12) so that clearance **e** at the oblong hole of yoke (12) is 0.
   ★ When doing this, check that governor lever (4) of the fuel injection pump does not move from the low idling position.

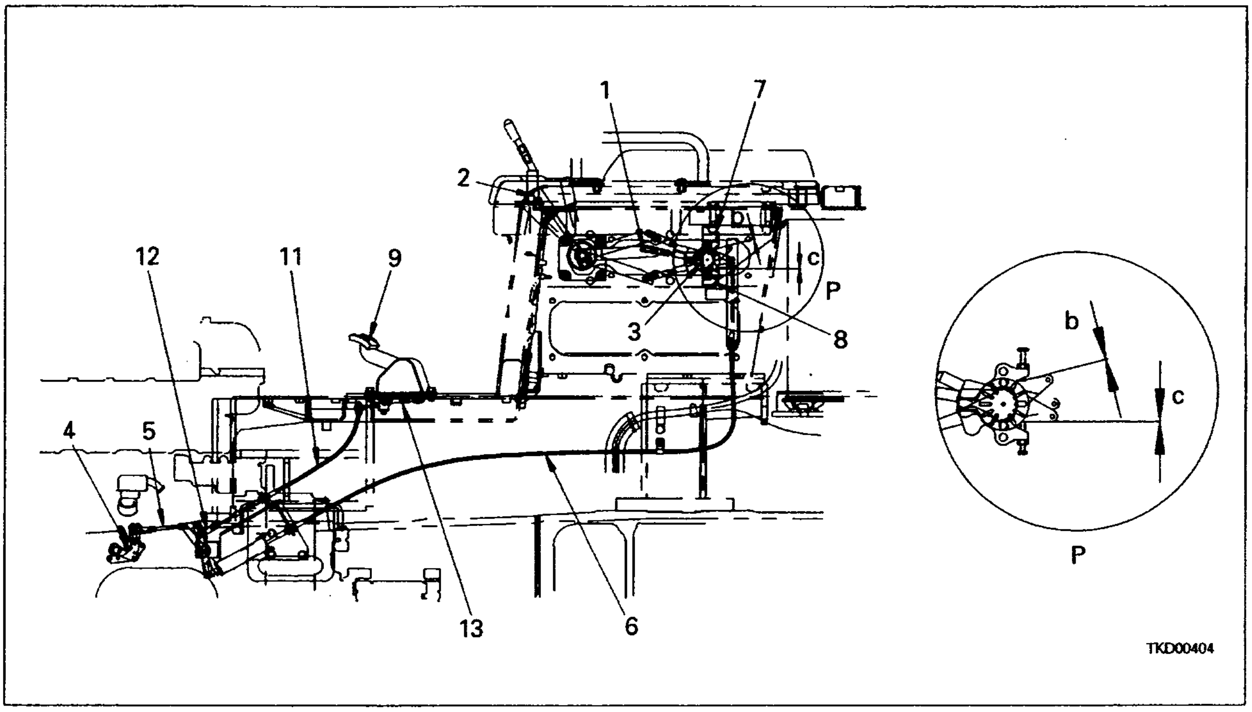
8. Start the engine, move throttle lever (2) to the FULL position, then depress decelerator pedal (9) until it contacts stopper bolt (10), and adjust the height of stopper bolt (10) so that the engine speed is 900 rpm.



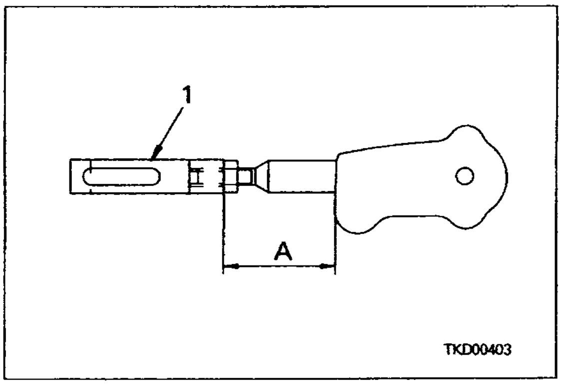


014012

D65E-12 60948 – 65000
D65P-12 60891 – 65000
D65EX-12 60942 – 65000
D65PX-12 60915 – 65000



1. Adjust the length of yoke (1) to dimension **A**, then connect throttle lever (2) and lever assembly (3).
   ★ Dimension **A**: 52.5 mm



2. Set governor lever (4) of the fuel injection pump to the LOW IDLING position, align lever assembly (3) with the low idling detent position, then adjust rod (5) and connect cable (6).

3. Place governor lever (4) of the fuel injection pump at the FULL position, set clearance **b** between the lever of the lever assembly (3) and stopper bolt (7) to 0, then turn stopper bolt (7) back two turns from this position and secure stopper bolt (7) in position.

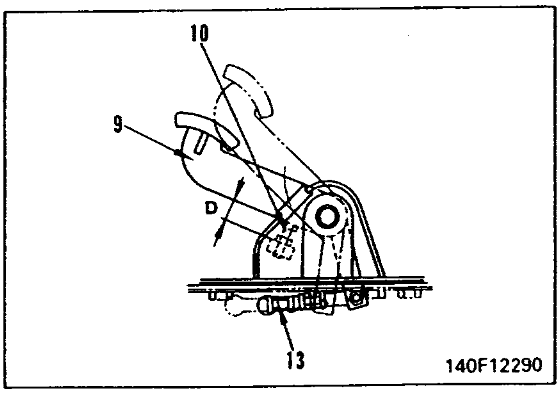
4. Place governor lever (4) of the fuel injection pump at the STOP position, set clearance **c** between the lever of lever assembly (3) and stopper bolt (8) to 0, then secure stopper bolt (8) in position.

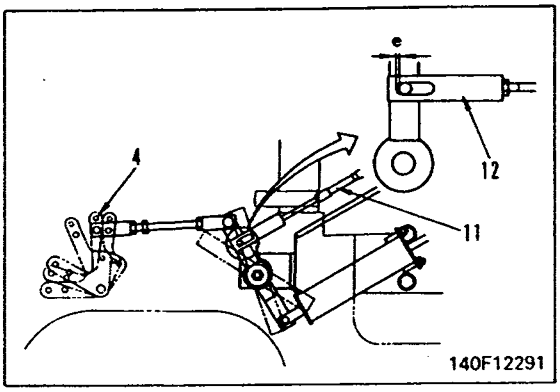
5. Adjust the height of stopper bolt (10) of decelerator pedal (9) to dimension **D**.
   - ★ Stopper bolt height dimension **D**: 21 mm

6. Set governor lever (4) of the fuel injection pump to the LOW IDLING position, depress decelerator pedal (9) until it contacts stopper bolt (10), then connect cable (11), yoke (12), and rod (13).
   - ★ Standard installed length of rod (13): 88.1 mm

7. In the condition in Step 5, adjust with cable (11) and yoke (12) so that clearance **e** at the oblong hole of yoke (12) is 0.
   - ★ When doing this, check that governor lever (4) of the fuel injection pump does not move from the low idling position.

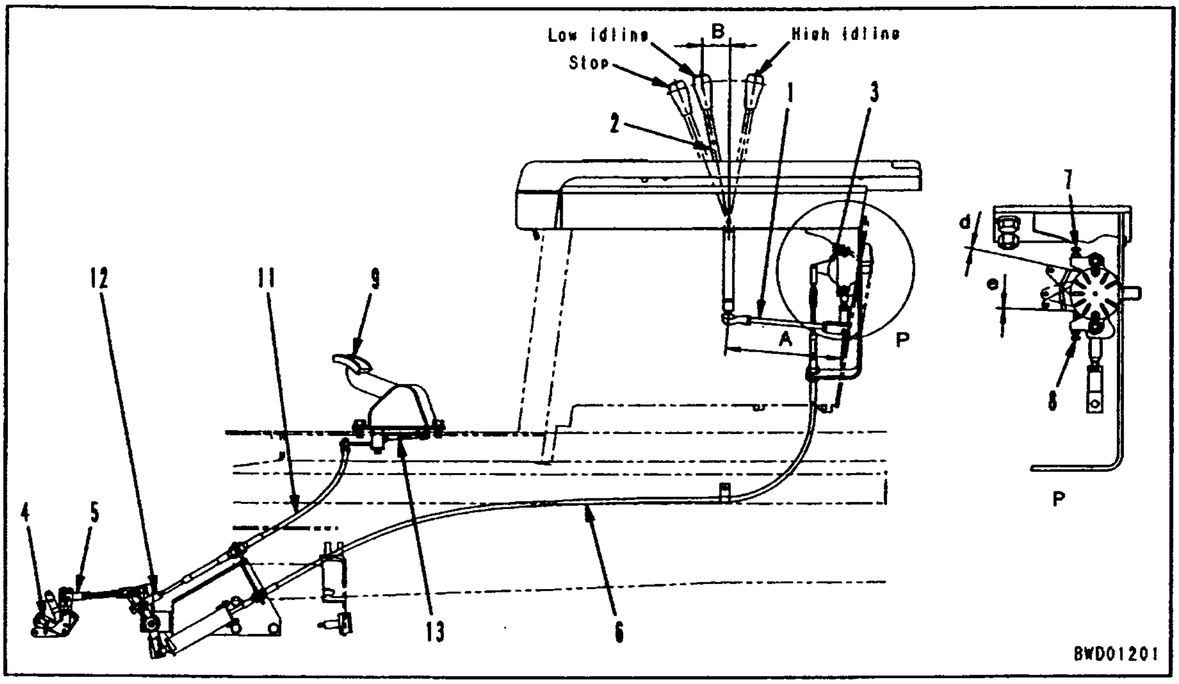
8. Start the engine, move throttle lever (2) to the FULL position, then depress decelerator pedal (9) until it contacts stopper bolt (10), and adjust the height of stopper bolt (10) so that the engine speed is 900 rpm.





014012

D65E-12 65001 and up
D65P-12 65001 and up
D65EX-12 65001 and up
D65PX-12 65001 and up



1. Adjust mounting dimension A of rod (1) so that throttle lever (2) will be at IDLING position when lever assembly (3) is set to the low idling detent position.

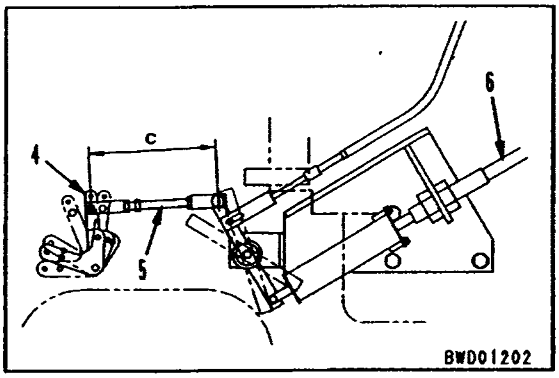
   ★ Dimension A of rod (1): 261.7 mm
   ★ Dimension B of throttle lever (2): 84 mm

2. Set governor lever (4) of the fuel injection pump to the LOW IDLING position, align lever assembly (3) with the low idling detent position, then adjust rod (5) and connect cable (6).

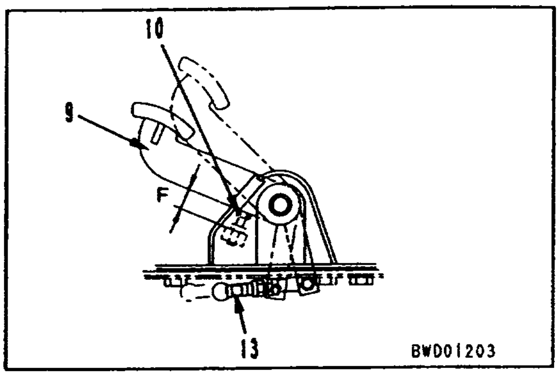
   ★ Dimension C of rod (5): 178 mm

3. Place governor lever (4) of the fuel injection pump at the HIGH IDLING position, set clearance d between the lever of the lever assembly (3) and stopper bolt (7) to 0, then turn stopper bolt (7) back two turns from this position and secure stopper bolt (7) in position.

4. Place governor lever (4) of the fuel injection pump at the STOP position, set clearance e between the lever of lever assembly (3) and stopper bolt (8) to 0, then secure stopper bolt (8) in position.



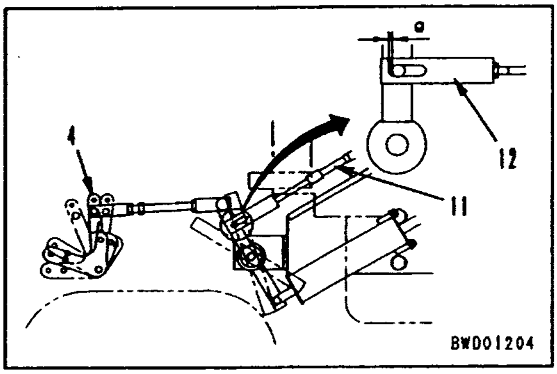
5. Adjust the height of stopper bolt (10) of decelerator pedal (9) to dimension F.
   ★ Stopper bolt height dimension F: 21 mm
6. Set governor lever (4) of the fuel injection pump to the LOW IDLING position, depress decelerator pedal (9) until it contacts stopper bolt (10), then connect cable (11), yoke (12), and rod (13).
   ★ Standard installed length of rod (13):
   88.1 mm



7. In the condition in Step 5, adjust with cable (11) and yoke (12) so that clearance g at the oblong hole of yoke (12) is 0.

   ★ When doing this, check that governor lever (4) of the fuel injection pump does not move from the low idling position.

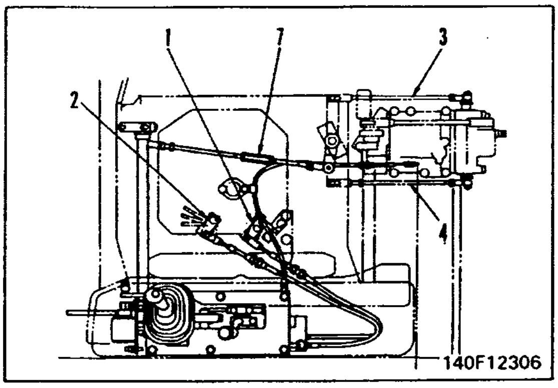
8. Start the engine, move throttle lever (2) to the HIGH IDLING position, then depress decelerator pedal (9) until it contacts stopper bolt (10) and adjust the height of stopper bolt (10) so that engine speed is 900 rpm.



014012

ADJUSTING STEERING AND DIRECTIONAL LEVER, GEAR SHIFT LEVER, PARKING BRAKE LEVER LINKAGE

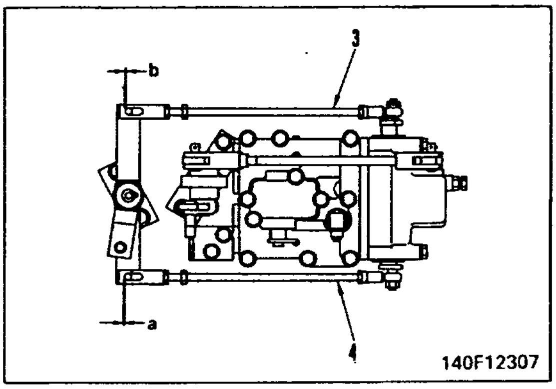
D65E-12 60001 – 60947
D65P-12 60001 – 60890



★ Tighten the locknut of the cable and rod securely, then bend the cotter pin securely.

★ Speed range selector lever (1) and directional selector lever (2) are installed to the transmission control valve, and the speed position and directional position are set by the detent inside the valve.

1. Adjusting steering linkage



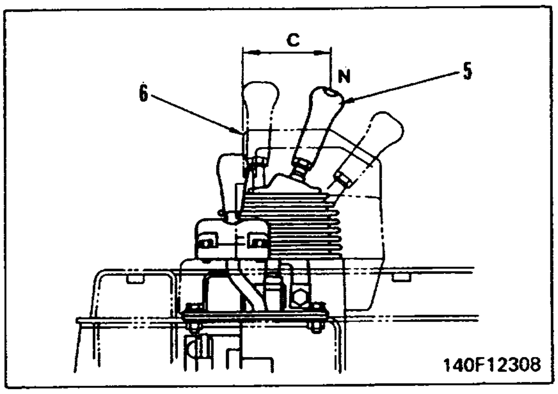
1) Connect rods (3) and (4).
   ★ Standard length of rod (3): 380 mm
   Standard length of rod (4): 375.2 mm

2) Pull both rods (3) and rod (4) at 9.8 – 19.6 N (1 – 2 kg) towards the front of the machine, and set lightly in contact with the clutch spool inside the steering valve.

3) In the condition in Step 2, the set clearance **a** at the oblong hole in the yoke of rod (4) to 0, then turn the turnbuckle of rod (3) to adjust clearance **b** of the oblong hole to 0.1 — 0.2 mm.

4) Connect all the steering linkages.

5) With steering and directional lever (5) at the N position, turn turnbuckle (7) to adjust so that the distance between the top center and the tip of handle (6) is dimension **C**.
   ★ Dimension **C**: 110 mm



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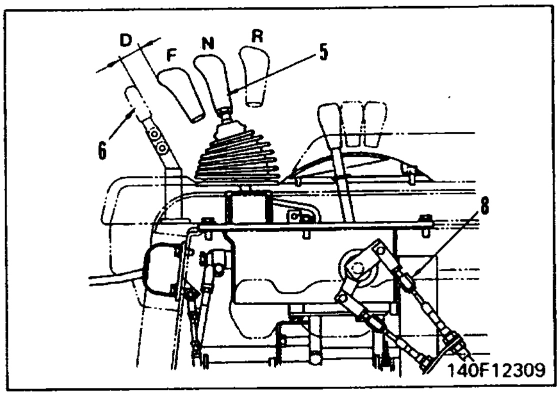
2. Adjusting directional linkage

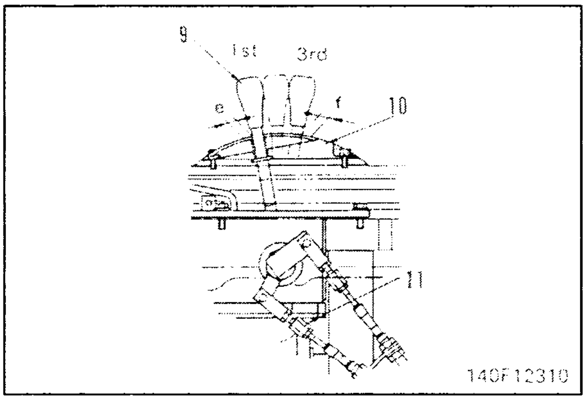


1) Connect all the directional linkages.

2) Set steering and directional lever (5) at the F position, then turn turnbuckle (8) to adjust so that the clearance from handle (6) is dimension **D**.
   ★ Dimension **D**: 40 mm

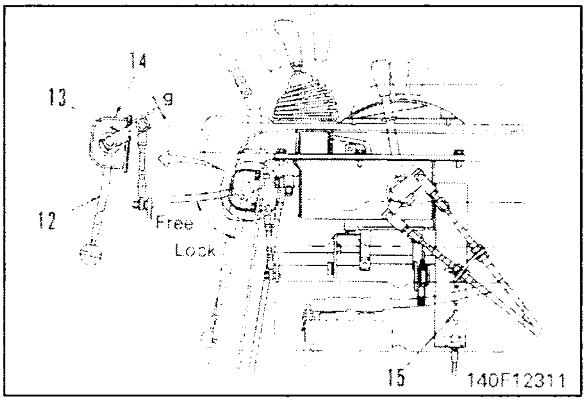
3. Adjusting gear shift linkages

1) Connect all the gear shift linkages.
2) Set gear shift lever (9) at the 1st and 3rd position, then turn turnbuckle (11) to adjust so that clearances **e** and **f** from the notch in slide cover (10) are equal.



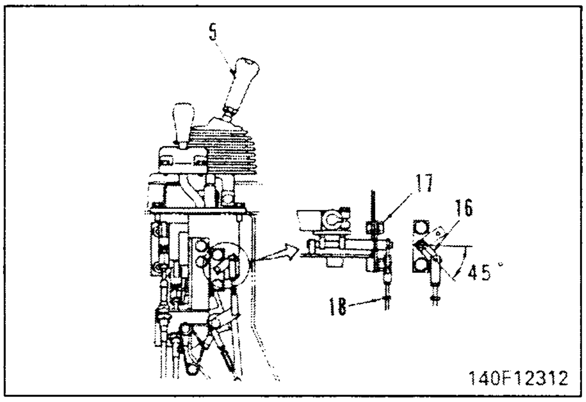
4. Adjusting parking brake lever

1) Set parking brake lever (12) at the FREE position, then connect the parking brake linkage.
2) With parking brake lever (12) at the LOCK position, turn turnbuckle (15) to adjust so that the clearance at the hole in bracket (14) and lever (13) is dimension **g**.
   ★ Clearance dimension **g**: 2 – 3 mm

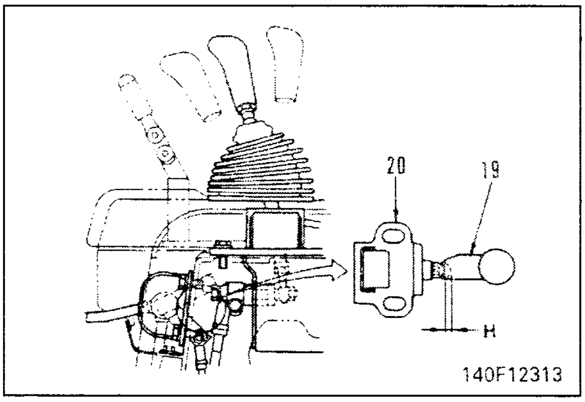


3) With lever (16) facing 45° down, loosen bolt (17) and adjust the mounting position of lever (16) so that the play in the forward and reverse direction of steering and direction lever (5) is within ±15 mm.

4) With parking brake lever (12) at the LOCK position, turn rod (18) and adjust so that lever (16) faces 45° downward.
   ★ After adjusting, place parking brake lever (12) at the FREE position, place steering and directional lever (5) securely in the F or R position, and apply the lock. Check that the steering and directional lever moves from the F or R position, to the N position.



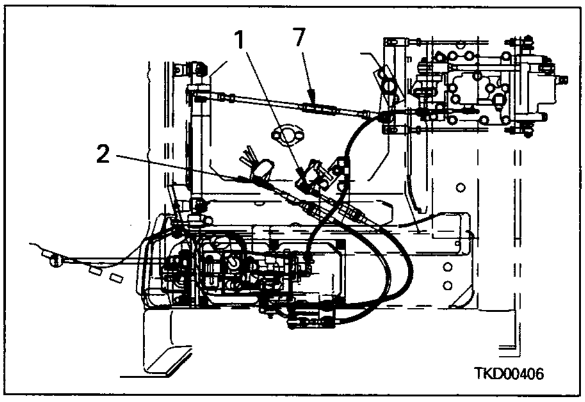
5) With parking brake lever (12) at the LOCK position, adjust the installed height **H** of the switch so that lever (19) pushes safety switch (20) into the set mark groove.
   ★ Installed height **H**: 2.8 mm
   ★ Check the brake oil pressure.
   FREE: Min. 2.2 MPa {22 kg/cm^2}
   (See STANDARD VALUE TABLE for brake pressure)
   LOCK: 0 MPa {0 kg/cm^2}
   ★ Check that the machine does not move by itself on a slope.



D65E-12 60948 - 65000
D65P-12 60891 - 65000

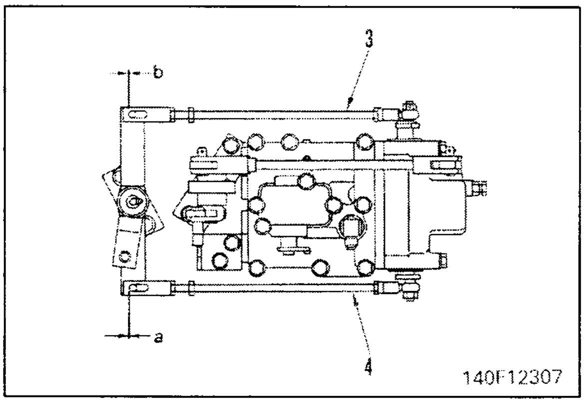
★ Tighten the locknut of the cable and rod securely, then bend the cotter pin securely.

★ Speed range selector lever (1) and directional selector lever (2) are installed to the transmission control valve, and the speed position and directional position are set by the detent inside the valve.



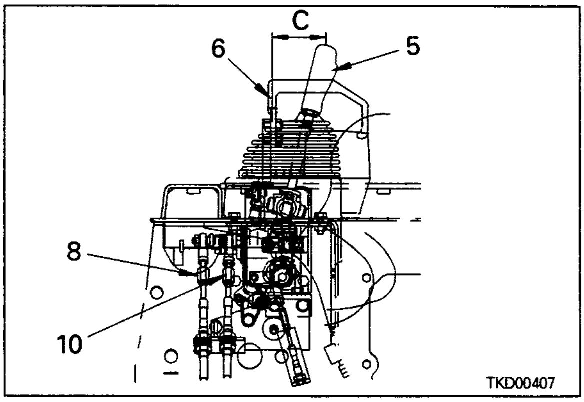
1. Adjusting steering linkage

1) Connect rods (3) and (4).
   - ★ Standard length of rod (3): 375.2
     Standard legth of rod (4): 375.2 mm
2) Pull both rods (3) and rod (4) at 9.8 – 19.6 N (1 – 2 kg) towards the front of the machine, and set lightly in contact with the clutch spool inside the steering valve.
3) In the condition in Step 2, the set clearance **a** at the oblong hole in the yoke of rod (4) to 0, then turn the turnbuckle of rod (3) to adjust clearance **b** of the oblong hole to 0.1 – 0.2 mm.
4) Connect all the steering linkages.
5) With steering and directional lever (5) at the **N** position, turn turnbuckle (7) to adjust so that the distance between the top center and the tip of handle (6) is dimension **C**.
   - ★ Dimension **C**: 100 mm



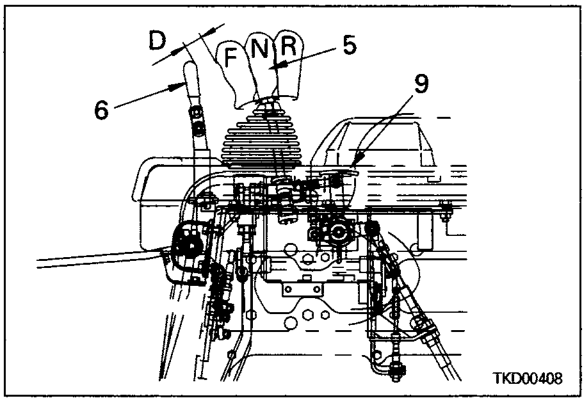
2. Adjusting directional linkage

1) Connect all the directional linkages.
2) Set steering and directional lever (5) at the **F** position, then turn turnbuckle (8) to adjust so that the clearance from handle (6) is dimension **D**.
   - ★ Dimension **D**: 37 mm



3. Adjusting speed lever linkage

1) Connect all the speed lever linkages, and adjust turnbuckle (10) so that the "2" display of display plate (9) is in the center of the hole in the "2nd" position.
2) Keep in the same condition as in Step 1) and install the knob so that the "2" display of knob (5) is at the front.



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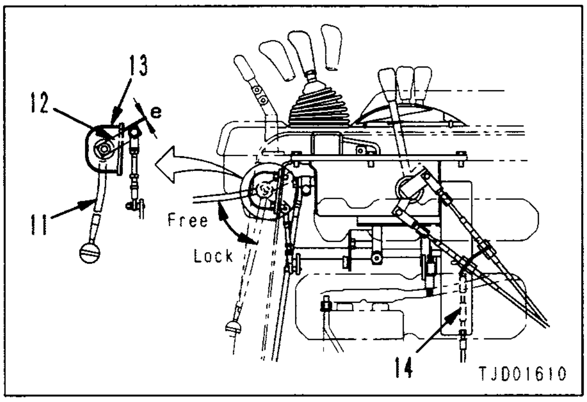
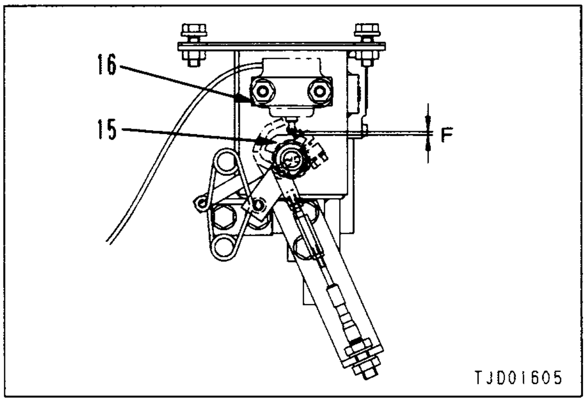
4. Adjusting parking brake lever

1) Set parking brake lever (11) at the FREE position, then connect the parking brake linkage.
2) With parking brake lever (11) at the LOCK position, turn turnbuckle (14) to adjust so that the clearance at the hole in bracket (13) and lever (12) is dimension **e**.
   - ★ Clearance dimension **e** : 2 – 3 mm
   - ★ After adjusting, set parking brake lever (11) to the FREE position and check that steering and directional lever (5) enters F and R positions securely. Then place the parking brake lever at the LOCK position and check that the steering and directional lever is returned from the F or R position to the N position.
3) With the parking brake lever at the LOCK position, adjust installed height **F** of the switch so that lever (15) pushes safety switch (16) into the set mark groove.
   - ★ Installed height **F**: 2.8 mm
   - ★ Check the brake oil pressure.
     FREE: Min. 2.2 MPa {22 kg/cm^2}
     (See STANDARD VALUE TABLE for brake pressure)
     LOCK: 0 MPa {0 kg/cm^2}
   - ★ Check that the machine does not move by itself on a slope.

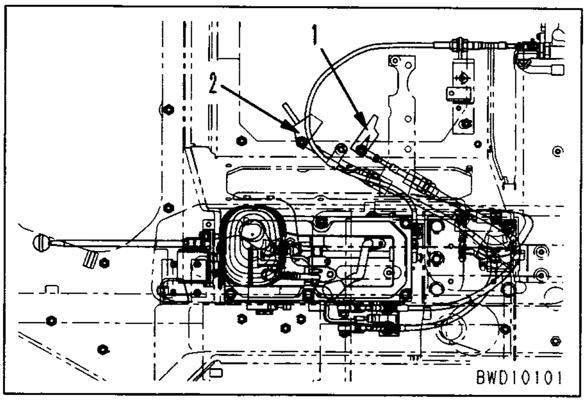




014012

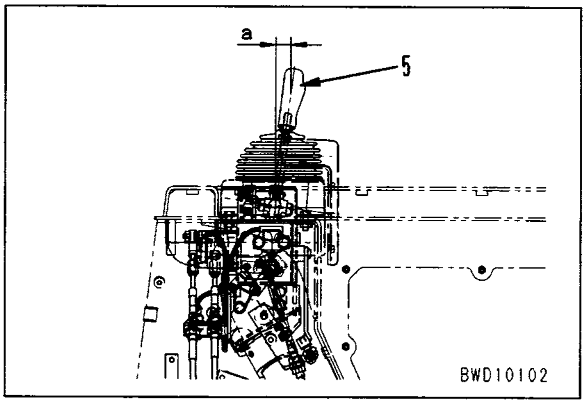
D65E-12 65001 and up
D65P-12 65001 and up

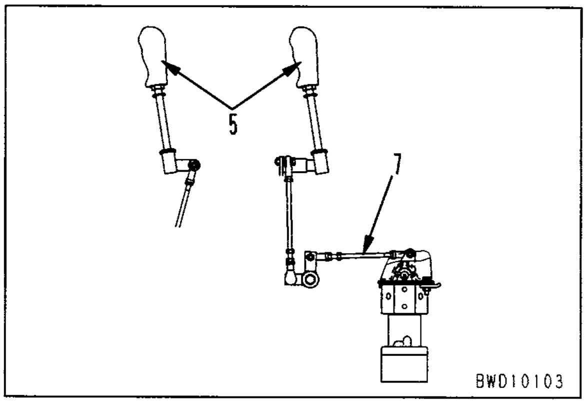
★ Tighten the rods and cable lock nuts securely and bend the cotter nut securely.
★ Speed selector lever (1) and directional selector lever (2) are installed to the transmission control valves. The speed position and directional position is determined by the detent inside the valve.



1. Adjusting steering linkage

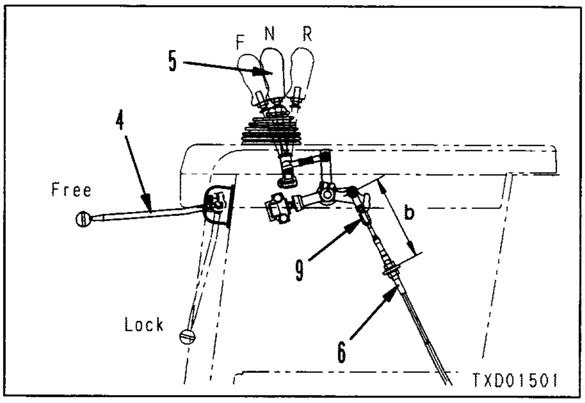
1) Turn turnbuckle (7) to adjust so that the distance between the center of the grip and the center of rotation of lever (5) is dimension **a** when steering and directional lever (5) is at the **N** position.
   - ★ Dimension **a**: 31.2 mm
   - ★ Standard length of turnbuckle (7): 205 mm

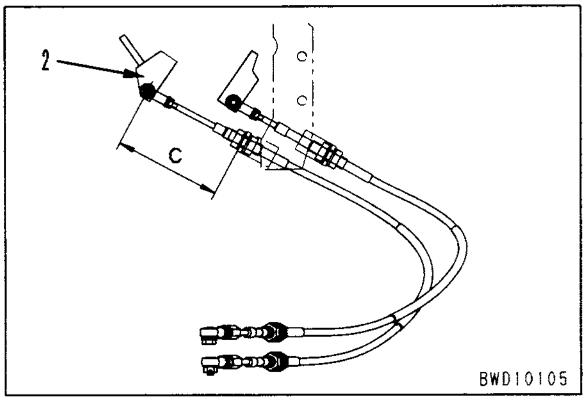




2. Adjusting directional linkage

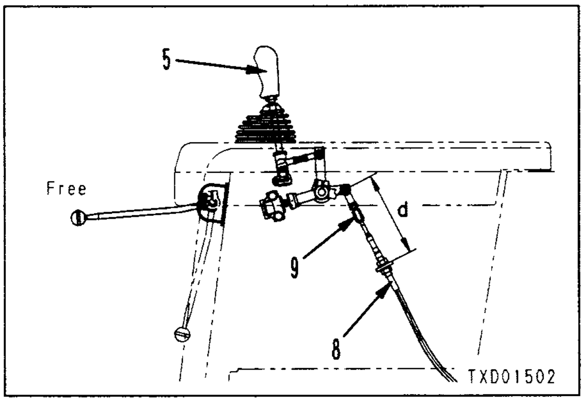
1) Set parking lever (4) to the LOCK position and directional lever (5) to the **N** position.
2) Set directional selector lever (2) at the valve end to the **N** position.
3) Install directional control cable (6).
   - i) Mounting dimension **b** at lever end: 205 mm
   - ii) Mounting dimension **c** at valve end: 156.5 mm
4) After installing the cable, turn turnbuckle (9) so that the directional lever matches the **N** position exactly.

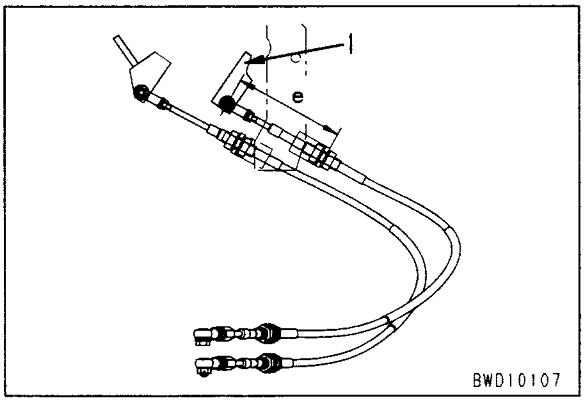




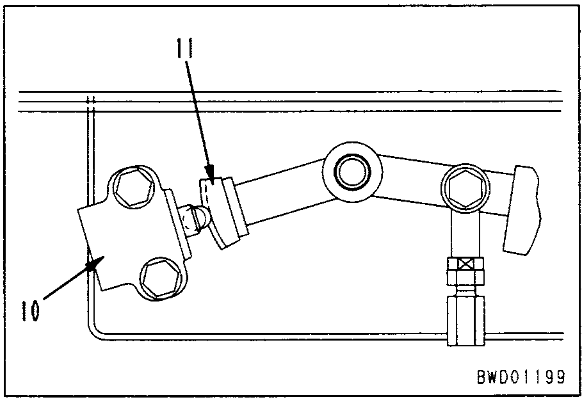
3. Adjusting speed linkage

1) Set speed lever (5) and the speed selector lever (1) at the valve end to position 2.
2) Install speed control cable (8).
   - i) Mounting dimension **d** at lever end: 205 mm
   - ii) Mounting dimension **e** at valve end: 162 mm
3) After installing the cable, turn turnbuckle (9) to adjust so that the speed lever shifts properly to each speed range when it is operated.





4) Adjusting limit switch (10)
   The tolerance between the center of the cam of lever (11) and the center of the roller of limit switch (10) must be less than 0.5 mm at position 2. (Two places)



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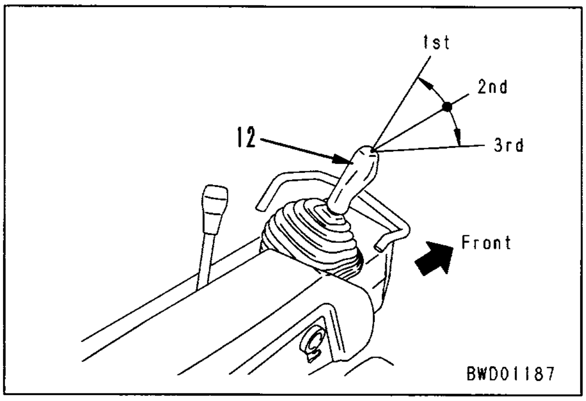
5) In the condition in Step 3), install knob (12) so that the "2" display on the knob is at the front.



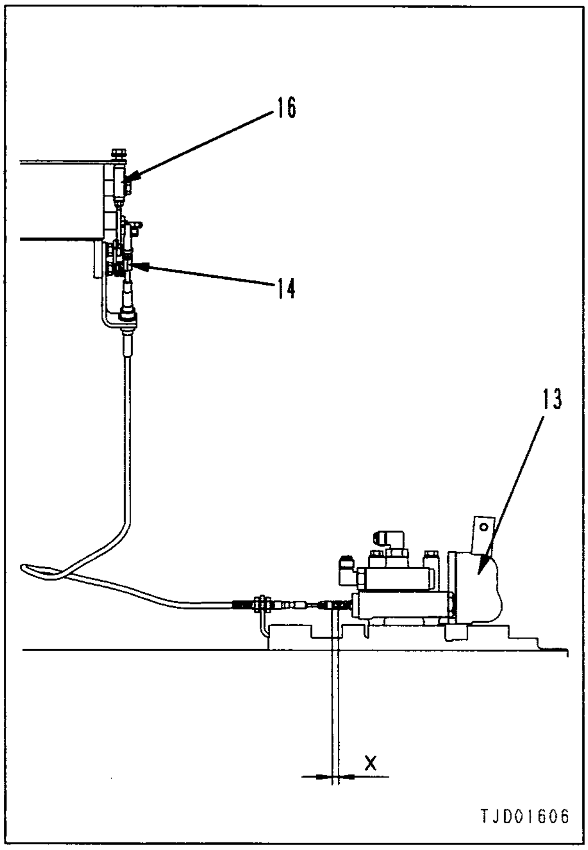
4. Adjusting parking brake lever

Turn rod (14) to adjust so that the spool of brake valve (13) moves **x** mm when the parking brake lever is set to the LOCK position.

- Stroke **x**: 10 mm

★ After adjusting, set the parking brake to the FREE position and check that the steering and directional lever enters the **F** and **R** positions securely. Then set the parking brake to the LOCK position and check that the steering and directional lever is returned from the **F** and **R** positions to the **N** position.

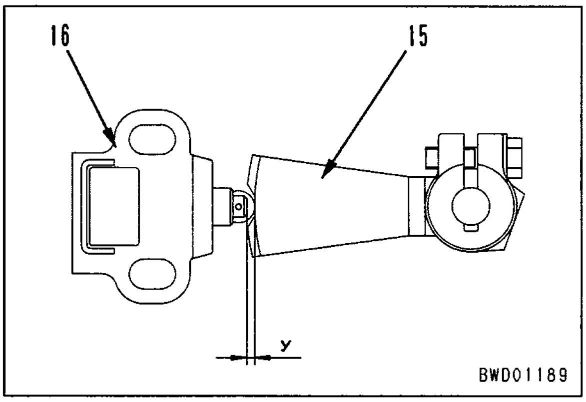
★ Check the brake oil pressure.
FREE: Min. 2.2 MPa {22 kg/cm²}
(See STANDARD VALUE TABLE for brake pressure)
LOCK: 0 MPa {0 kg/cm²}



5. Adjusting limit switch

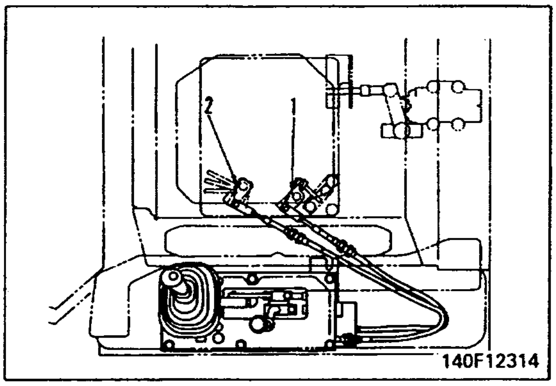
Adjust so that limit switch (16) moves a distance of **y** mm when lever (15) comes to the position where the limit switch is actuated.

- Distance **y**: 2.8 mm



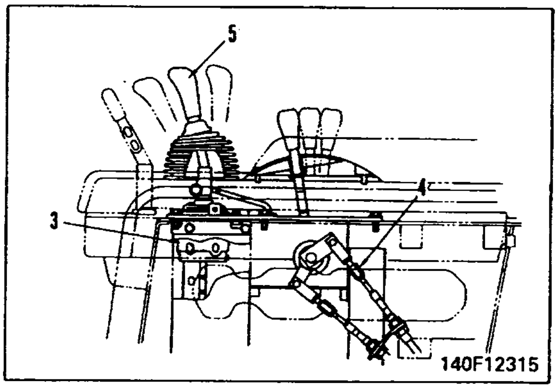
ADJUSTING DIRECTIONAL LEVER, GEAR SHIFT LEVER, PARKING BRAKE LINKAGE

D65EX-12 60001 - 60941
D65PX-12 60001 - 60914



★ Tighten the locknut of the cable and rod securely, then bend the cotter pin securely.

★ Speed range selector lever (1) and directional selector lever (2) are installed to the transmission control valve, and the speed position and directional position are set by the detent inside the valve.



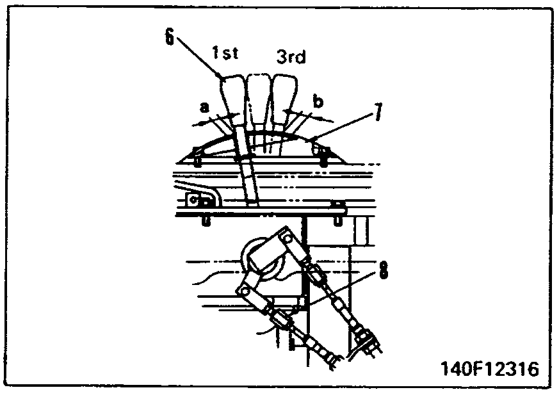
1. Adjusting directional linkage

1) Connect the directional lever linkage.

2) Set directional selector lever (2) at the N position, and turn turnbuckle (4) to adjust so that the lever of PPC valve (3) moves to the neutral position.

3) In the above condition, turn turnbuckle (4) one turn in the direction of shorten the distance.
   ★ The directional lever moves towards the front.

4) After adjusting, set directional lever (5) within the range of play of the N position and hold it fully at the R side to carry out a counterrotation turn. Check that the direction of the turn is the same as when traveling forward.



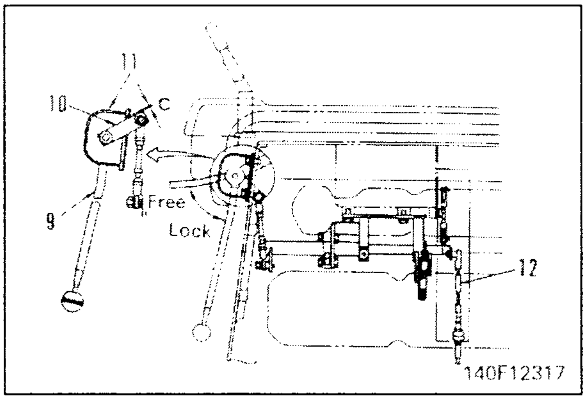
2. Adjusting gear shift linkage

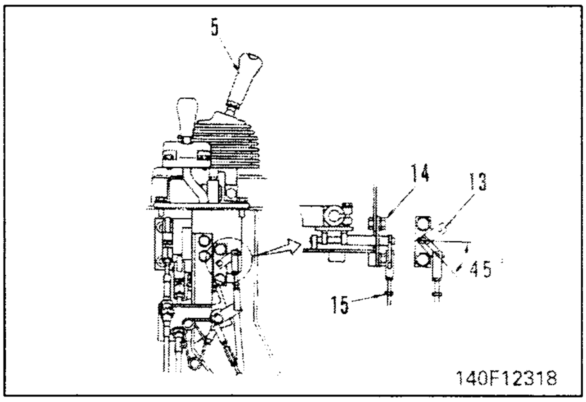
1) Connect the gear shift linkage.

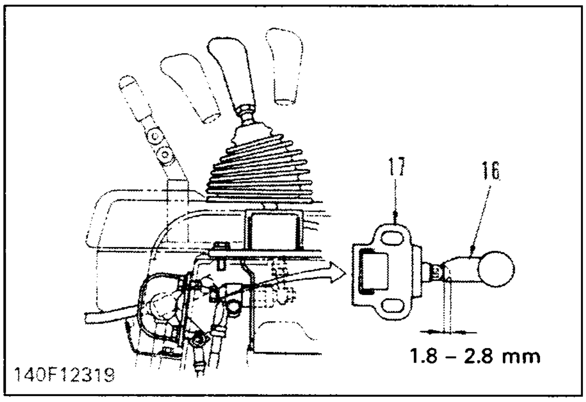
2) Set gear shift lever (6) at the 1st and 3rd position, then turn turnbuckle (8) to adjust so that clearances **a** and **b** from the notch in slide cover (7) are equal.

3. Adjusting parking brake lever

1) Set parking brake lever (9) at the FREE position and connect the parking brake linkage.
2) With parking brake lever (9) locked, turn turnbuckle (12) to adjust so that the clearance between the hole in bracket (11) and lever (10) is dimension **C**.
   - ★ Clearance dimension **C** : 2 – 3 mm
   - ★ Check the brake oil pressure.
     FREE: Min. 2.2 MPa {22 kg/cm²}
     (See STANDARD VALUE TABLE for brake pressure)
     LOCK: 0 MPa {0 kg/cm²}
   - ★ Check that the machine does not move by itself on a slope.
3) With the cam of lever (13) facing up, loosen bolt (14) and adjust the mounting position of lever (13) so that the play in the forward reverse direction of steering and directional lever (5) is within ±15 mm.
4) With parking brake lever (9) locked, turn rod (15) and adjust so that lever (13) faces 45° down.
5) After adjusting, place parking brake lever (9) in the FREE position, check that steering and directional lever (5) enters the F and R positions securely, and when the lock is applied, it returns from the F or R position to the N position.
6) With parking brake lever (9) locked, adjust the mounting height of safety switch (17) so that lever (16) pushes the switch into the set mark groove.







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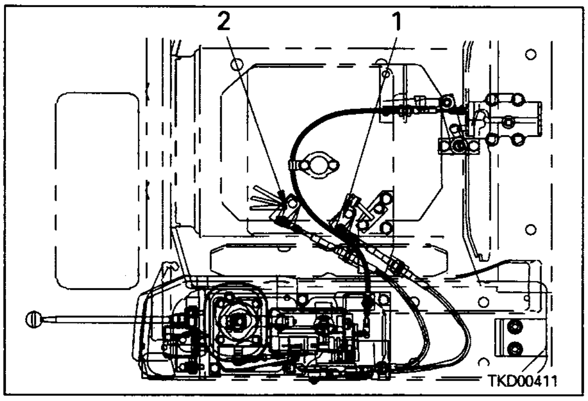
D65EX-12 60942 – 65000
D65PX-12 60915 – 65000

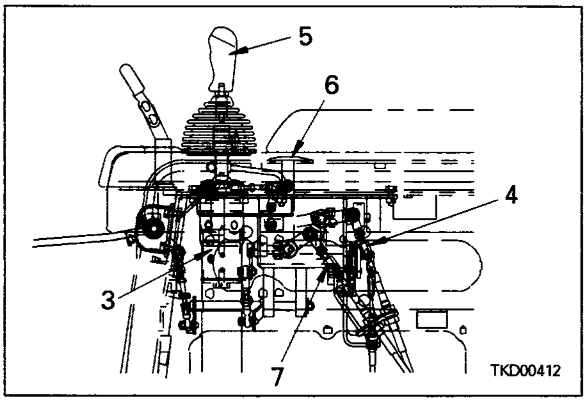
★ Tighten the locknut of the cable and rod securely, then bend the cotter pin securely.

★ Speed range selector lever (1) and directional selector lever (2) are installed to the transmission control valve, and the speed position and directional position are set by the detent inside the valve.



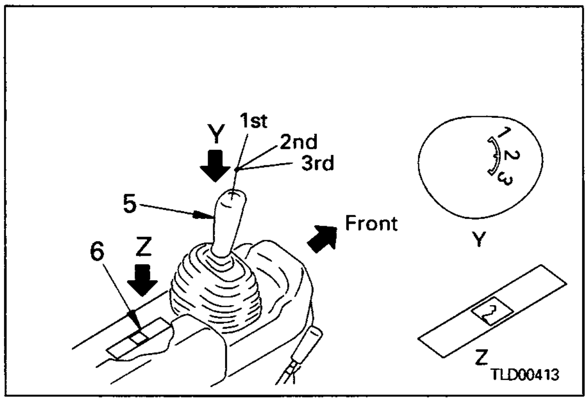
1. Adjusting directional linkage

1) Connect the directional lever linkages.
2) Set directional selector lever (2) at the N position, and turn turnbuckle (4) to adjust so that the lever of PPC valve (3) moves to the neutral position.
3) In the above condition, turn turnbuckle (4) one turn in the direction to shorten the distance.
   ★ The directional lever moves towards the front.
4) After adjusting, set directional lever (5) within the range of play of the N position and hold it fully at the R side to carry out a counter-rotation turn. Check that the direction of the turn is the same as when traveling forward.



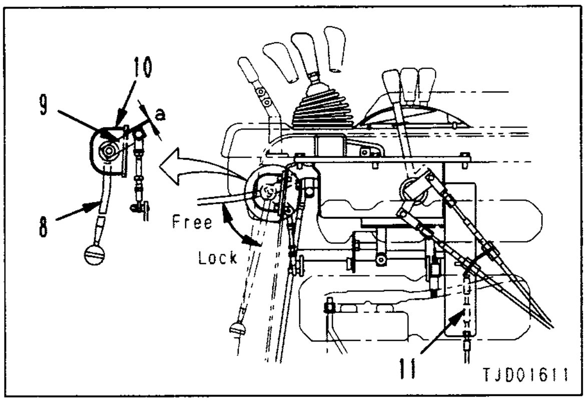
2. Adjusting speed lever linkage

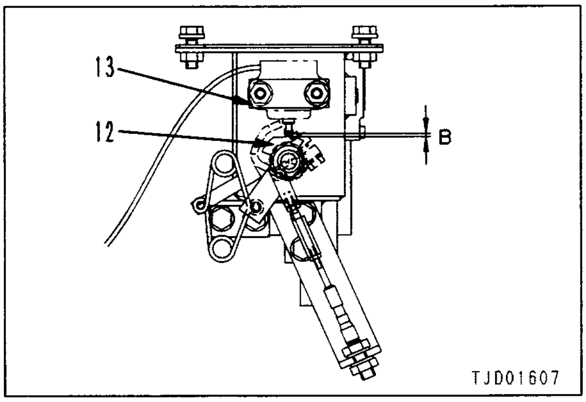
1) Connect all the speed lever linkages, and adjust turnbuckle (7) so that the "2" display of display plate (6) is in the center of the hole in the "2nd" position.
2) Keep in the same condition as in Step 1) and install the knob so that the "2" display of knob (5) is at the front.



3. Adjusting parking brake lever

1) Set parking brake lever (8) at the FREE position, then connect the parking brake linkage.
2) With parking brake lever (8) at the LOCK position, turn turnbuckle (11) to adjust so that the clearance at the hole in bracket (10) and lever (9) is dimension **a**.
   - ★ Clearance dimension **a** : 2 – 3 mm
   - ★ Check the brake oil pressure.
     FREE: Min. 2.4 MPa {24 kg/cm²}
     (See STANDARD VALUE TABLE for brake pressure)
     LOCK: 0 MPa {0 kg/cm²}
   - ★ Check that the machine does not move by itself on a slope.
   - ★ After adjusting, set parking brake lever (8) to the FREE position and check that the steering and directional lever (5) enters F and R positions securely. Then place the parking brake lever at the LOCK position and check that the steering and directional lever is returned from the F or R position to the N position.
3) With the parking brake lever (8) at the LOCK position, adjust installed height **B** of the switch so that lever (12) pushes safety switch (13) into the set mark groove.
   - ★ Installed height **B**: 2.8 mm





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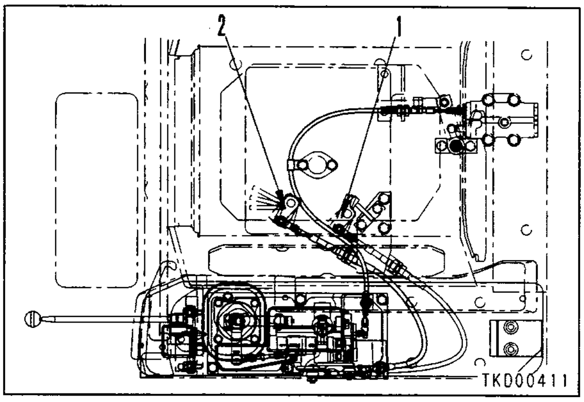
D65EX-12 65001 and up
D65PX-12 65001 and up

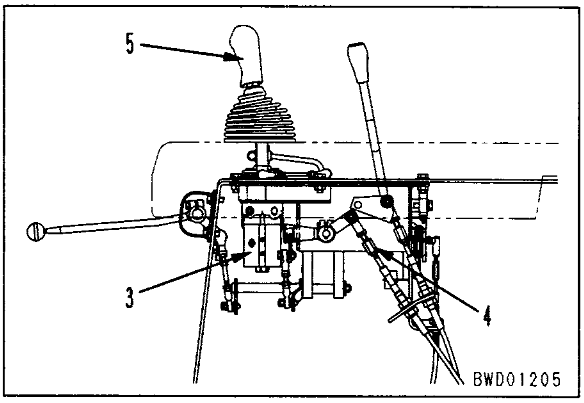
★ Tighten the locknut of the cable and rod securely, then bend the cotter pin securely.

★ Speed range selector level (1) and directional selector lever (2) are installed to the transmission control valve, and the speed position and directional position are set by the detent inside the valve.



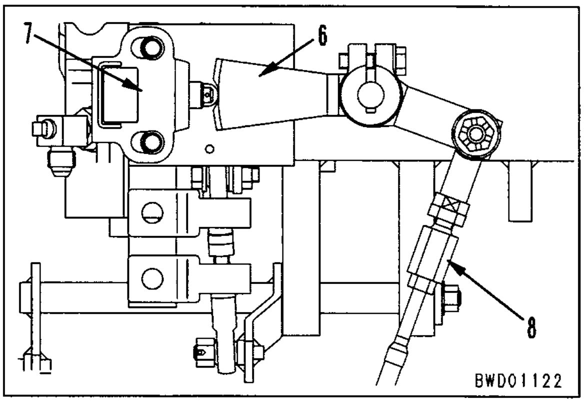
1. Adjusting directional linkage

1) Connect the directional lever linkages.
2) Set directional selector lever (2) at the N position, and turn turnbuckle (4) to adjust so the lever of PPC valve (3) moves to the neutral position.
3) In the above condition, turn turnbuckle (4) one turn in the direction to shorten the distance.
   ★ The directional lever moves towards the front.
4) After adjusting, set directional lever (5) within the range of play of the N position and hold it fully at the R side to carry out a counterrotation turn. Check that the direction of the turn is the same as when travelling forward.

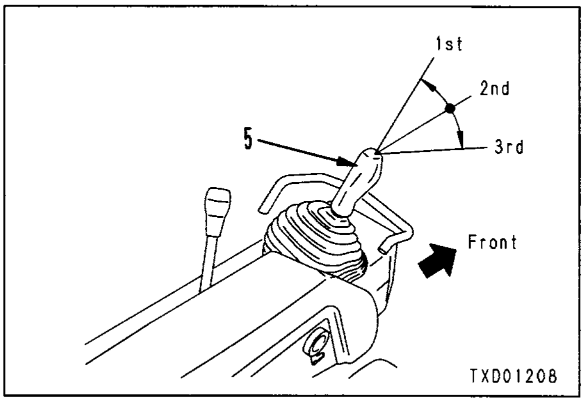


2. Adjusting gear shift lever linkage

1) Connect the all gear shift lever linkage and adjust turnbuckle (8) and limit switch (7) so that the cam of lever (6) will be aligned with the roller of the limit switch (7) when the gear shift lever is at the "2nd" position.



2) Under the condition of 1) above, install knob (5) with its mark "2" on the front side.



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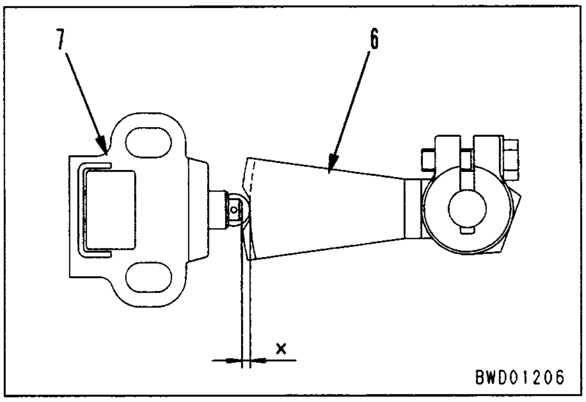
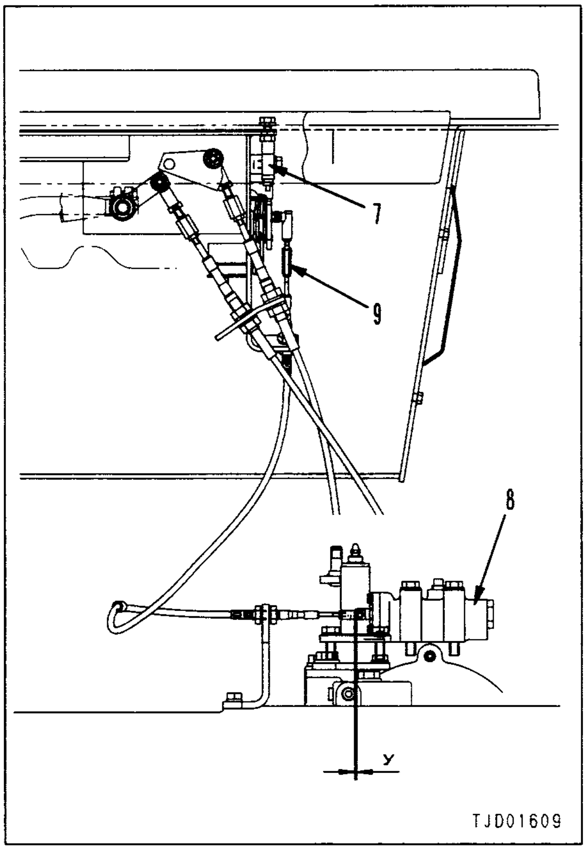
3. **Adjusting limit switch**
   Adjust limit switch (7) so that it will move by **x** mm when lever (6) is set to its actuating position.
   - Stroke **x**: 2.8 mm



4. **Adjust parking brake lever**
   Turn rod (9) so that spool of brake valve (8) will move by **y** mm when parking brake lever is set to the "LOCK" position.
   - Stroke **y**: 13 mm
     - ★ After adjusting, check that steering and forward/reverse lever (5) can be set to the F or R position securely when: the parking brake lever is at the "FREE" position, and the former lever returns to the "N" position from the F or R position when the latter lever is set to the "LOCK" position.
     - ★ Check the brake oil pressure.
       FREE: Min. 2.4 MPa {24 kg/cm^2}
       (See STANDARD VALUE TABLE for brake pressure)
       LOCK: 0 MPa {0 kg/cm^2}
     - ★ Check that the machine does not move by itself on a slope.



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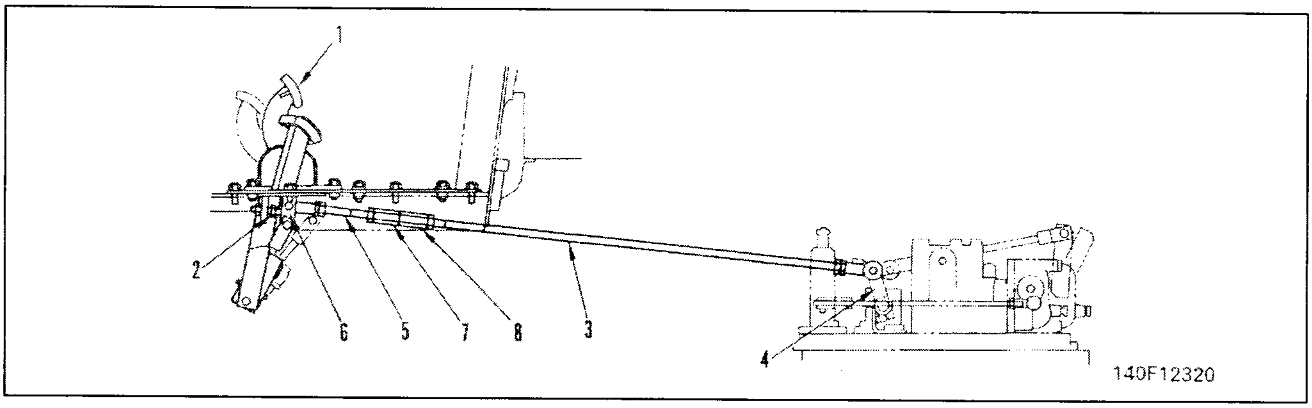
ADJUSTING BRAKE PEDAL LINKAGE

D65E-12 60001 - 65000
D65P-12 60001 - 65000



★ Tighten the locknut of the rod and cable securely, and bend the cotter pin securely.

1. Adjust height **b** of bumper (2) so that the travel of brake pedal (1) is dimention **a**.
   ★ Brake pedal travel dimention **a**: 77 mm
   ★ Standard height **b** of bumper: 24 mm

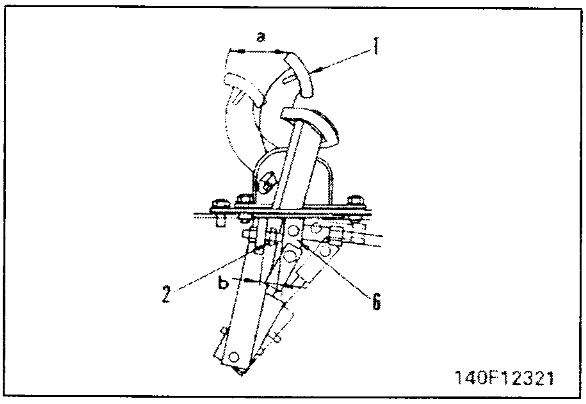
2. Adjust length of rod (3) to dimention **c**, and install to lever(4).
   ★ Dimention **c**: 850 mm

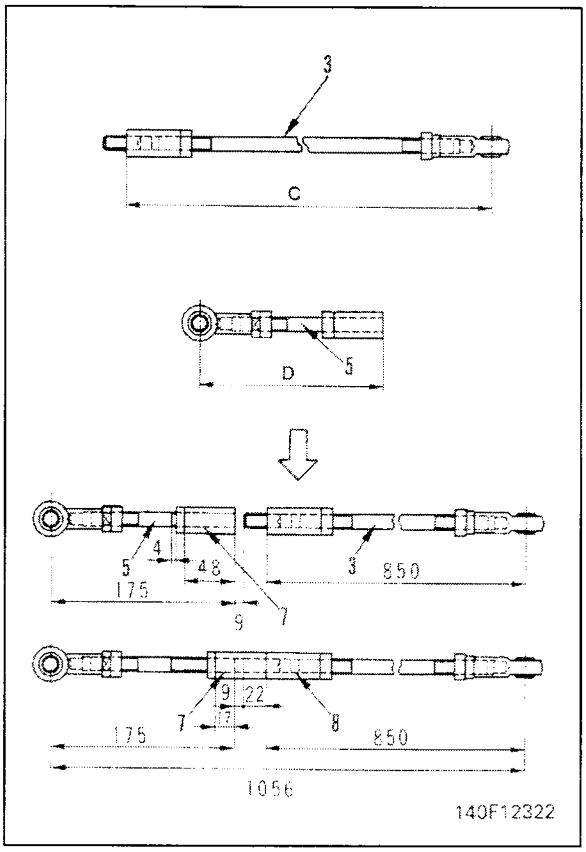
3. Adjust length of rod (5) to dimention **D**, and install to lever (6).
   ★ Dimention **D**: 175 mm

4. Push rod (3) towards the back of the machine with a force of 1 - 2 kg, and with it pushed lightly against the brake spool inside the steering valve, turn joint (7) only and connect rod (3) and rod (5).

5. With brake pedal (1) at the brake OFF position, adjust the length of the rod so that the play of brake pedal (1) at the center of the pedal is 3 - 8 mm.
   ★ Turn joint (7) and joint (8) at the same time in the same direction to adjust the length of the rod.

6. With brake pedal (1) at the brake OFF position, check that lever (6) is in contact with bumper (2).





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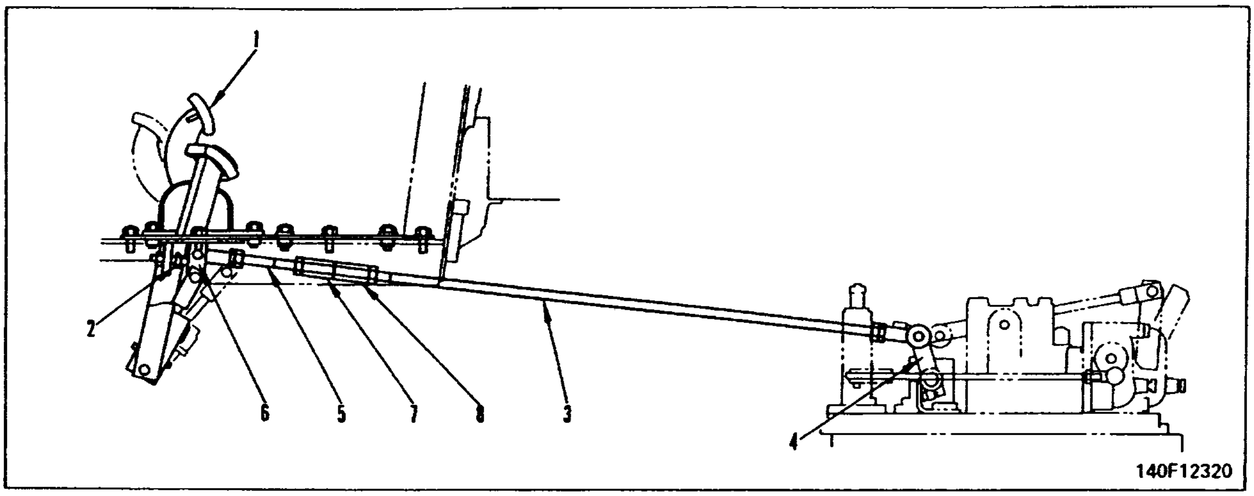
D65E-12 65001 and up
D65P-12 65001 and up



★ Tighten the locknut of the rod and cable securely, and bend the cotter pin securely.

1. Adjust height **b** of bumper (2) so that the travel of brake pedal (1) is dimension **a**.
   ★ Brake pedal travel dimension **a**: 77 mm
   ★ Standard height **b** of bumper: 24 mm

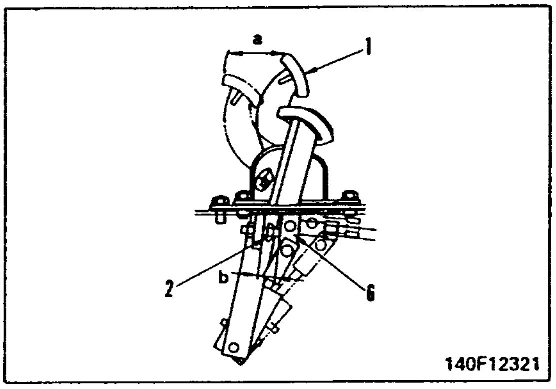
2. Adjust length of rod (3) to dimension **c**, and install to lever (4).
   ★ Dimension **c**: 828 mm

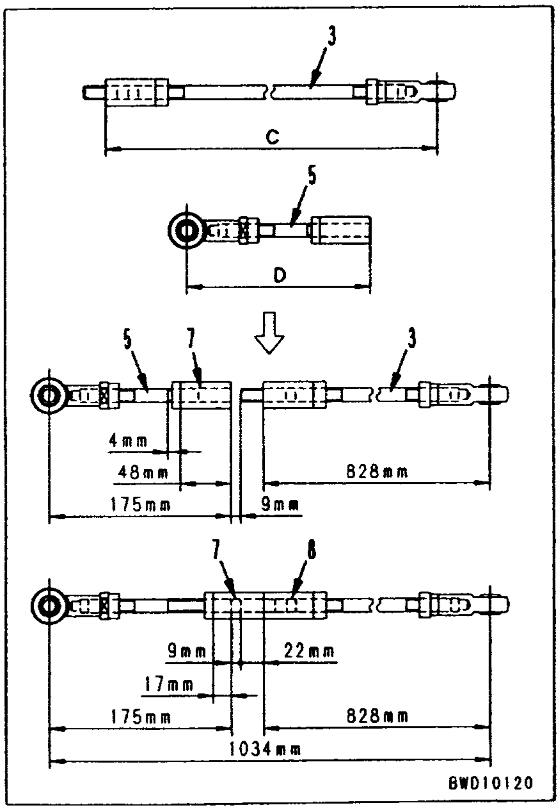
3. Adjust length of rod (5) to dimension **D**, and install to lever (6).
   ★ Dimension **D**: 175 mm

4. Push rod (3) towards the back of the machine with a force of 1 — 2 kg, and with it pushed lightly against the brake spool inside the steering valve, turn joint (7) only and connect rod (3) and rod (5).

5. With brake pedal (1) at the brake OFF position, adjust the length of the rod so that the play of brake pedal (1) at the center of the pedal is 3 — 8 mm.
   ★ Turn joint (7) and joint (8) at the same time in the same direction to adjust the length of the rod.

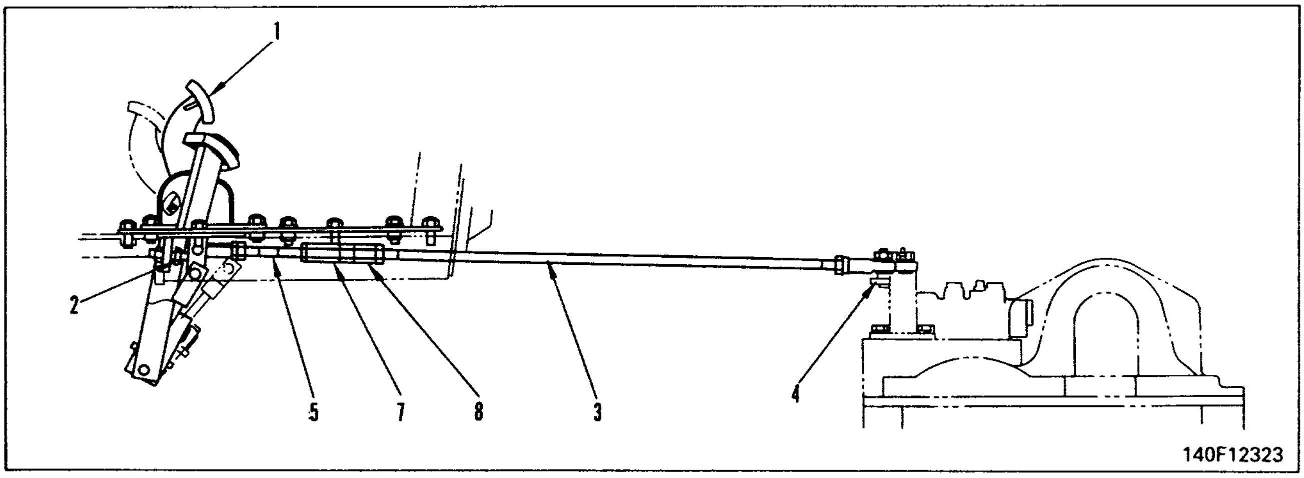
6. With brake pedal (1) at the brake OFF position, check that lever (6) is in contact with bumper (2).

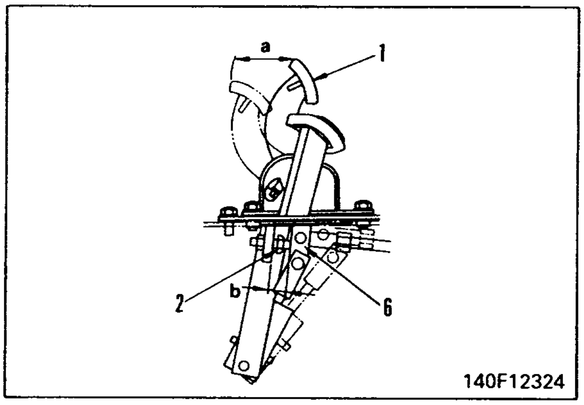




ADJUSTING BRAKE PEDAL LINKAGE

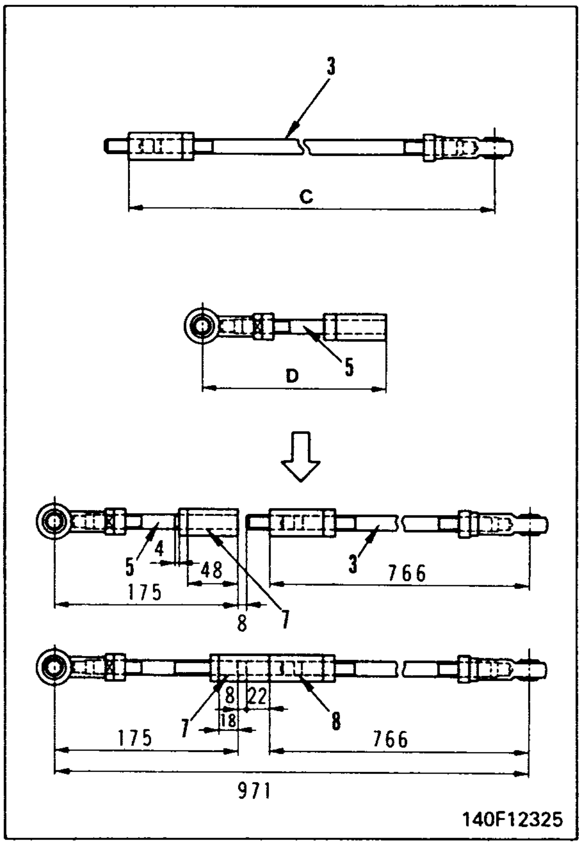
D65EX, PX-12





★ Tighten the locknut of the rod and cable securely, and bend the cotter pin securely.

1. Adjust height **b** of bumper (2) so that the travel of brake pedal (1) is dimension **a**.
    - ★ Brake pedal travel dimension **a**: 77 mm
    - ★ Standard height **b** of bumper: 24 mm
2. Adjust length of rod (3) to dimension **c**, and install to lever (4).
    - ★ Dimension **c**: 766 mm
3. Adjust length of rod (5) to dimension **D**, and install to lever (6).
    - ★ Dimension **D**: 175 mm
4. Push rod (3) towards the back of the machine with a force of 1 — 2 kg, and with it pushed lightly against the brake spool inside the steering valve, turn joint (7) only and connect rod (3) and rod (5).
5. With lever (6) in contact with bumper (2) adjust the length of the rod so that the play of brake pedal (1) at the center of the pedal is 3 — 8 mm.
    - ★ Turn joint (7) and joint (8) at the same time in the same direction to adjust the length of the rod.
6. With brake pedal (1) at the brake OFF position, check that lever (6) is in contact with bumper (2).



ADJUSTING WORK EQUIPMENT CONTROL LINKAGE

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

1. Extend detent assembly (1) until it reaches the end of the stroke (fits in the detent), install rod end (2) and joint (3), and adjust so that length is dimension **A**.
   ★ Dimension **A**: 257 mm

2. After adjusting, install detent assembly (1) to bracket (4).

3. Install work equipment control lever (5) to PPC valve (6), and adjust so that clearance **b** from the inspection window is 28 mm when the lever is at the neutral position.

4. Set work equipment control lever (5) to the end of the stroke for the FLOAT position, and connect detent assembly (1).

5. With the control lever at the FLOAT position, carry out the tilt operation and check that the detent does not come out.

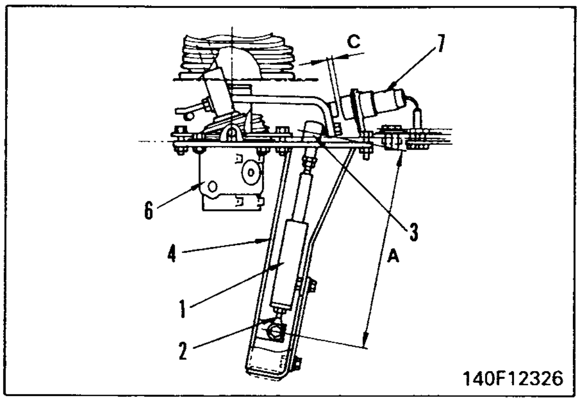
6. With work equipment control lever (5) at the FLOAT position, adjust the mounting position of proximity switch (7) so that clearance **c** from proximity switch (7) is 3 mm.

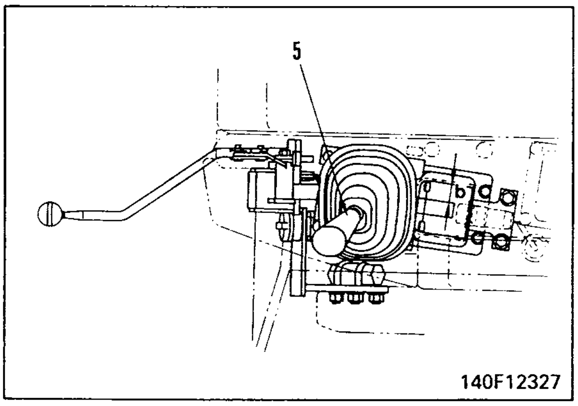
7. Set length of rod (8) to dimension **D**, then connect PPC lock valve (9) and work equipment lock lever (10).
   ★ Dimension **D**: 330 mm

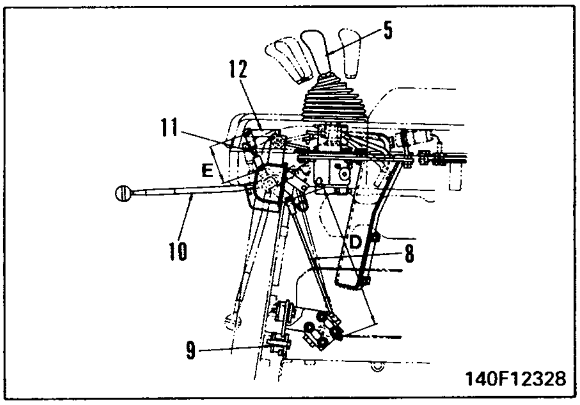
8. Set length of rod (11) to dimension **E**, and connect lever (12).
   ★ Dimension **E**: 88.5 mm

9. Move work equipment lock lever (10) from the FREE position to the LOCK position, and check that work equipment control lever (5) is returned from the FLOAT position to the HOLD position.

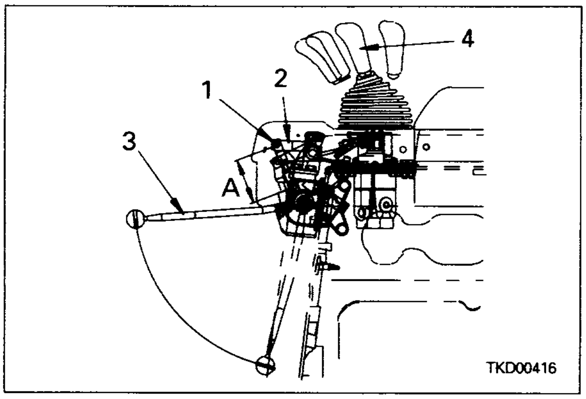
10. With work equipment lock lever (10) at the LOCK position, check that when work equipment control lever (5) is operated, work equipment lock lever (10) does not return to the FREE position.







D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up



1. Set length of rod (1) to dimension **A**, and connect lever (2).
   ★ Dimension **A**: 83.5 mm

2. Move work equipment lock lever (3) from the FREE position to the LOCK position, and check that work equipment control lever (4) is returned from the FLOAT position to the HOLD position.

3. With work equipment lock lever (3) at the LOCK position, check that when work equipment control lever (4) is operated, work equipment lock lever (3) does not return to the FREE position.

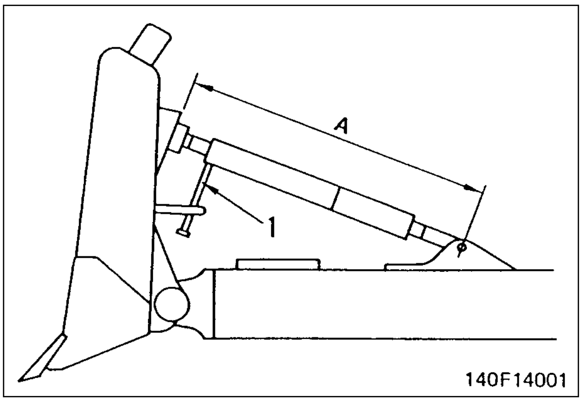
ADJUSTING STRAIGHT TILTDOZER

D65E-12
D60, 65P-12
D65EX, PX-12

★ Adjust as follows when installing after the blade has been removed or disassembled.

1. Adjusting amount of blade tilt

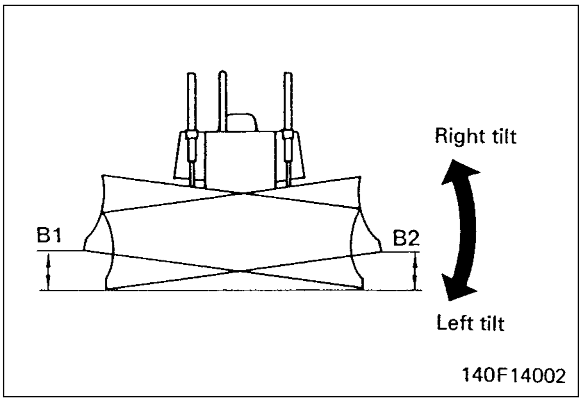
1) After installing the blade, adjust with handle (1) so that dimension **A** is as follows.
Dimention **A**: 1,150 mm



2) Adjust the amount of tilt on the left and right sides as follows.

Amount of tilt Unit: mm

Tilt position / Model	Right tilt **B1**	left tilt **B2**
D60, 65P-12 D65PX-12	455	455
D65E-12 D65EX-12	440	440



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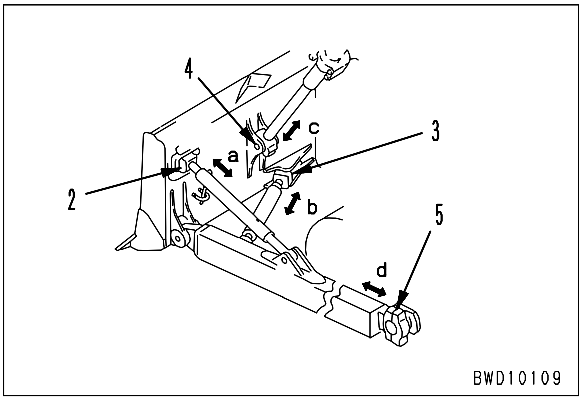
3) If the amount of tilt is not the same on the left and right, adjust as follows with handle (1) to make the tilt ununiform on the left and right sides.
- If **B2** > **B1**: Adjust slightly so that dimension **A** becomes shorter
- If **B2** < **B1**: Adjust slightly so that dimension **A** becomes longer

2. Procedure for adjusting shims when assembling blade

1) After assembling the blade, adjust the clearance at tilt portion (2), center portion (4) and trunnion portion (5) with shims.

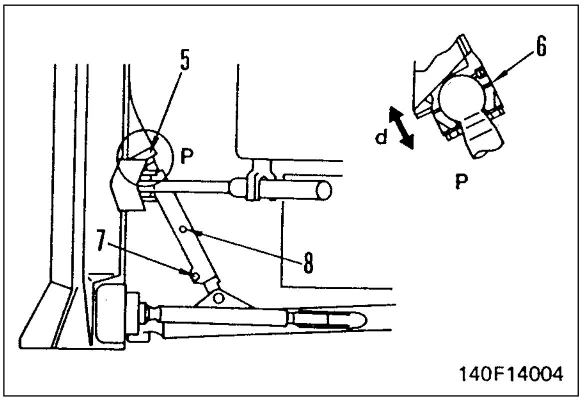


Shim adjustment

Place to adjust Item	Tilt portion (2)	Center portion (3)	Lift portion (4)	Trunnion portion (5)
Clearance	**a**	**b**	**c**	**d**
Standard clerance	0.2 – 0.5	0.2 – 0.5	0.2 – 0.5	0.2 – 1.0
Standard shim thickness	5	5	4	10

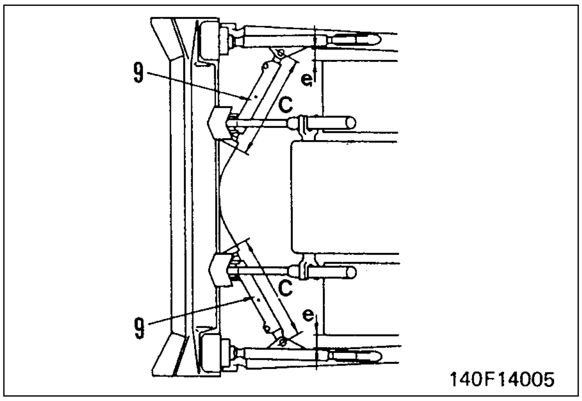
2) Grease each place to be adjusted, and check that it rotates smoothly.
Adjustment portions (2), (3), (4):
Grease (G2-L1)

3. Adjust center brace



1) Adjust with shim (6) so that clearance d of ball joint (5) is as shown below.
Clearance **d**: 0.2 – 0.5 mm

2) Loosen bolt (7).



3) Operate the blade control lever to raise the blade off the ground.
⚠ After doing this, lock the blade control lever securely with the safety lever.

4) Insert a bar in hole (8) of the center brace, and rotate it in the direction to increase the tension.
★ Adjust so that clearance **e** between the track and frame is uniform on the left and right.
★ Adjust the tension of center brace (9) with the blade raised above the ground, and tighten to the following tightening torque.
Center brace: **36.78 ± 12.26 Nm**
{3.75 ± 1.25 Nm}

5) Adjust dimension **C** of the center brace as follows.
Standard dimension **C**: 995 mm

ADJUSTING PPC VALVE

★ If there is excessive play in the work equipment or steering (D65EX, PX) lever, adjust as follows.

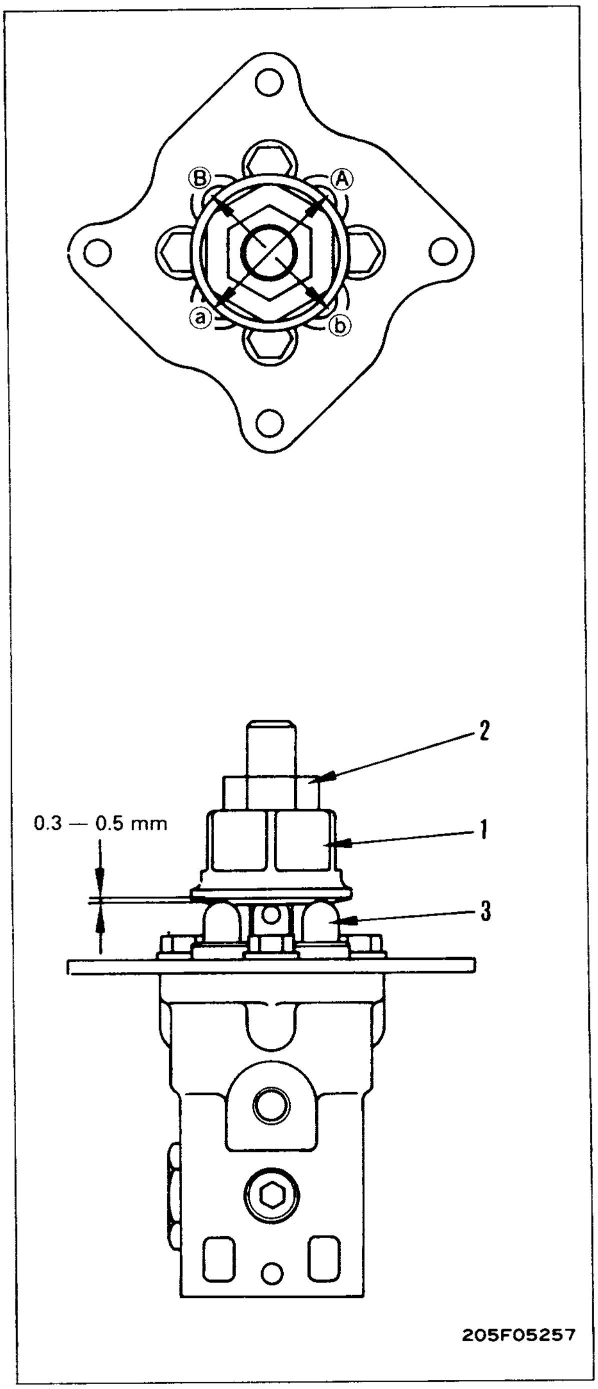
⚠ Lower the work equipment to the ground and stop the engine. Operate the control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.
Set the safety lock lever to the LOCK position.

1. Remove the boot, loosen the lever mounting bolt, then remove the lever.
2. Hold down disc (1), and loosen locknut (2).
3. Turn disc (1) and adjust the clearance.
   ★ Adjust the clearance with the disc as follows.
   - To DECREASE clearance, turn CLOCKWISE
   - To INCREASE clearance, turn COUNTERCLOCKWISE

   i) When adjusting the clearance, adjust four pistons (3) separetely. (Two pistons in the front-to-rear direction (**A** — **a**) and two pistons in the left-to-right direction (**B** — **b**).)
   ★ For the work equipment PPC valve, there are pistons only in the left-to-right direction (**B** – **b**).
   ii) Set disc (1) so that it contacts one of the pistons in the front-to-rear direction (**A** — **a**), then adjust the clearance between disc (1) and piston (3) on the opposite side to 0.3 — 0.5 mm.
   iii) After adjusting in the front-to-rear direction, adjust in the left-to-right direction (**B** — **b**).
   iv) If the clearance exceeds 0.5 mm, change the position of disc (1) or change the mounting position of piston (3), then check again.

   kgm Locknut: **112.8 ± 14.7 Nm**
   (11.5 ± 1.5 kgm)

   ★ If no clearance is made, even when the lever is at neutral, the work equipment will move, or the hydraulic drift will increase, so always provide a clearance.



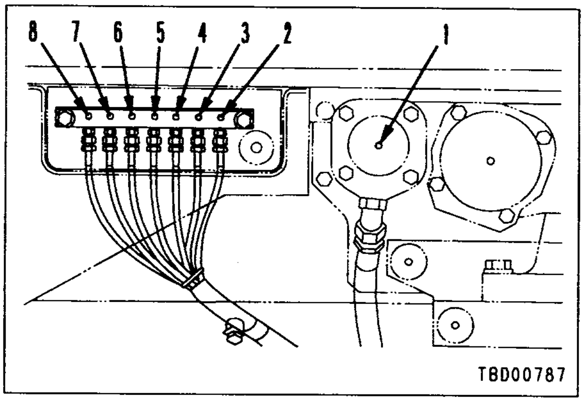
MEASURING POWER TRAIN OIL PRESSURE

D65E, P-12 (With central pressure detection)

⚠ Stop the machine on level ground, lower the work equipment to the ground and apply the parking brake.

★ When measuring the hydraulic pressure, remove all the sand and dirt from around the nipple and plug.

★ Raise the power train oil temperature to 70 – 80 °C before measuring.



- Refer to the diagram and table below to install oil pressure gauge **C** to the nipple for the circuit to be measured.

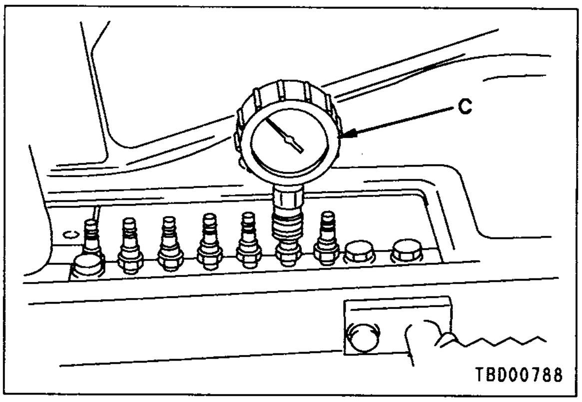


Table of centralized pressure pick-up port positions and gauges to use when measuring hydraulic pressure

No.	Measurement location	Gauge MPa{kg/cm²}
1	Transmission main relief pressure	5.9 {60}
2	Left brake actuating pressure	5.9 {60}
3	Right brake actuating pressure	5.9 {60}
4	Left clutch actuating pressure	5.9 {60}
5	Right clutch actuating pressure	5.9 {60}
6	Transmission modulating pressure	5.9 {60}
7	Torque converter inlet pressure	2.45 {25}
8	Torque converter outlet pressure	0.98 {10}

1. **Measuring torque converter oil pressure**
   Measuring torque converter inlet and outlet port pressure
   i) Install oil pressure gauge **C** to torque converter inlet pressure measurement nipple (7) and outlet pressure measurement nipple (8).
   ii) Set the gearshift lever at neutral, and measure the torque converter inlet port pressure and outlet port pressure with the engine at low idling and high idling.

2. **Measuring transmission oil pressure**

1) Measuring main relief pressure
   i) Install oil pressure gauge **C** to main relief pressure measurement nipple (1).
   ii) Set the F-R lever to the N position, and measure the main refief pressure with the engine at low idling and high idling.

2) Measuring modulating pressure (clutch circuit pressure)

i) Install oil pressure gauge **C** to modulating pressure measurement nipple (6).

Note: At the central pressure detection port, it is possible to measure the modulating pressure, but it is not possible to measure the modulating time. (The oil pressure pick-up hose is long and there is a time lag when measuring.)
When measuring the modulating time, install the oil pressure measurement nipple directly to the control valve.

★ Measure the hydraulic pressure when the clutch is actuated with the engine at low idling and high idling when the gearshift lever is operated to all the positions given below.

ii) With the F-R lever at the N position, measure the modulating pressure at each speed position.

iii) Place the gearshift lever at **F1**.
Measure the modulating pressure.

iv) Place the gearshift lever at **F2**.
Measure the modulating pressure.

v) Place the gearshift lever at **F3**.
Measure the modulating pressure.

★ For the following measurements, place the speed lever at position 3, and depress the foot brake securely before measuring.

vi)
- With the engine at low idling, place the F-R lever at the F position, and measure the modulating pressure.
- Run the engine at high idling, and stall the torque converter, then measure the modulating pressure.

Combination of speed range and clutches

Clutch No.	No.1 (R)	No.2 (F)	No.3 (3rd)	No.4 (2nd)	No.5 (1st)
F1		○			○
F2		○		○	
F3		○	○		
R1	○				○
R2	○			○	
R3	○		○		

014012

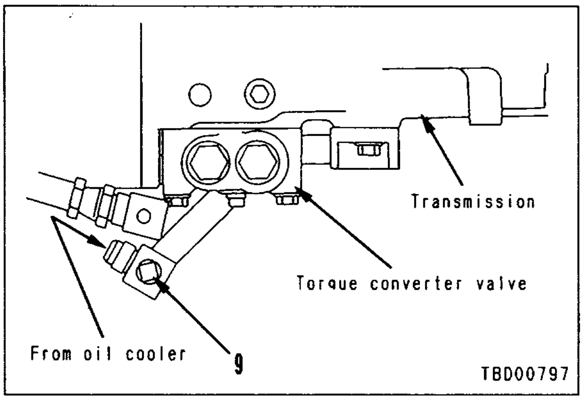
vii)
- With the engine at low idling, place the F-R lever at the R position, and measure the modulating pressure.
- Run the engine at high idling and stall the torque converter, then measure the modulating pressure.

⚠ Precautions when stalling the torque converter

1) Depress the decelerator pedal before pulling the fuel control lever to the FULL position.
2) Release the decelerator pedal to run the engine at high idling. However, for safety reasons, always keep your right foot on the decelerator pedal until the completion of the measurement operation.

3) Measuring transmission lubricating oil pressure
   i) Remove lubricating oil pressure measurement plug (9) (PT1/8), and install oil pressure gauge **C** [0.98 MPa {10 kg/cm²}].
   ii) Place the steering and directional lever at neutral, and measure the lubricating oil pressure with the engine at low idling and high idling.

Note: The oil pressure differs greatly between high temperature and low temperature, so warm up the oil throughly before measuring.
For details, see MEASURING ENGINE SPEED AT TORQUE CONVERTER STALL.



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3. Measuring steering clutch pressure

1) Install oil pressure gauge **C** to left nipple (4) and right nipple (5) for measuring the steering clutch pressure.
2) Place the steering and directional lever at the N position for direction, then operate it in the direction of steering fully to the inside or outside, and measure the oil pressure with the engine at low idling and high idling.

4. Measuring steering brake pressure

1) Install oil pressure gauge **C** to left nipple (2) and right nipple (3) for measuring the steering brake oil pressure.
2) Place the steering and directional lever at the N position for steering and direction, and measure the oil pressure with the engine at low idling and high idling.

★ Check at the same time that the hydraulic pressure is 0 MPa {0 kg/cm²} when the steering and directional lever is operated fully to the inside or outside, or the brake pedal is depressed, or the parking brake is placed at the LOCK position.

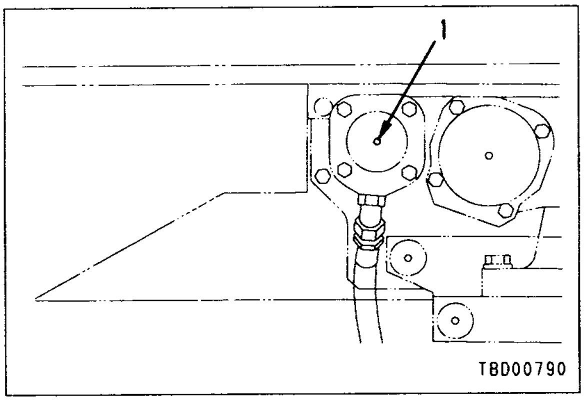
D65E, P-12 (Without central pressure detection)

⚠ Stop the machine on level ground, lower the work equipment to the ground and apply the parking brake.

★ When measuring the hydraulic pressure, remove all the sand and dirt from around the plug.

★ Raise the power train oil temperature to 70 – 80 °C before measuring.

- Remove the measurement plug from the circuit to be measured, and install the oil pressue gauge **C** referring to the diagram and table below.



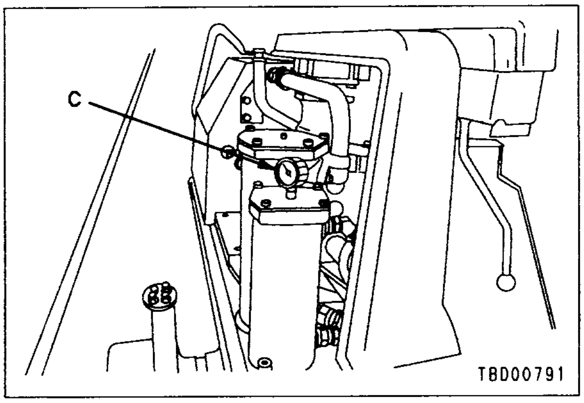


Table of pressure pick-up port positions and gauges to use when measuring hydraulic pressure

No.	Measurement location	Gauge MPa{kg/cm²}
1	Transmission main relief pressure	5.9 {60}
2	Left brake actuating pressure	5.9 {60}
3	Right brake actuating pressure	5.9 {60}
4	Left clutch actuating pressure	5.9 {60}
5	Right clutch actuating pressure	5.9 {60}
6	Transmission modulating pressure (※1)	5.9 {60}
7	Torque converter inlet pressure (※1)	2.45 {25}
8	Torque converter outlet pressure (※1)	0.98 {10}
9	Transmission lubricating oil pressure (※1)	0.98 {10}

1. **Measuring torque converter oil pressure**
   1) Measuring torque converter inlet and outlet port pressure (※1)
      i) Remove the torque converter inlet pressure measurement plug (7) and outlet pressure measurement plug (8), and install the oil pressure gauge **C**.
      ii) Set the gearshift lever at neutral, and measure the torque converter inlet port pressure and outlet port pressure with the engine at low idling and high idling.
2. **Measuring transmission oil pressure**
   1) Measuring main relief pressure (※2)
      i) Remove the main relief pressure measurement plug (1), and install the oil pressure gauge **C**.
      ii) Set the F-R lever to the N position, and measure the main relief pressure with the engine at low idling and high idling.

2) Measuring modulating pressure (※1) (clutch circuit pressure)

i) Remove the modulating pressure measurement plug (6), and install the oil pressure gauge **C**.

★ Measure the hydraulic pressure when the clutch is actuated with the engine at low idling and high idling when the gearshift lever is operated to all the positions given below.

ii) With the F-R lever at the N position, measure the modulating pressure at each speed position.

iii) Place the gearshift lever at **F1**. Measure the modulating pressure.

iv) Place the gearshift lever at **F2**. Measure the modulating pressure.

v) Place the gearshift lever at **F3**. Measure the modulating pressure.

★ For the following measurements, place the speed lever at position 3, and depress the foot brake securely before measuring.

vi)
- With the engine at low idling, place the F-R lever at the F position, and measure the modulating pressure.
- Run the engine at high idling, and stall the torque converter, then measure the modulating pressure.

Combination of speed range and clutches

Clutch No.	No.1 (R)	No.2 (F)	No.3 (3rd)	No.4 (2nd)	No.5 (1st)
F1		○			○
F2		○		○	
F3		○	○		
R1	○				○
R2	○			○	
R3	○		○		

014012

vii)
- With the engine at low idling, place the F-R lever at the R position, and measure the modulating pressure.
- Run the engine at high idling and stall the torque converter, then measure the modulating pressure.

⚠ Precautions when stalling the torque converter

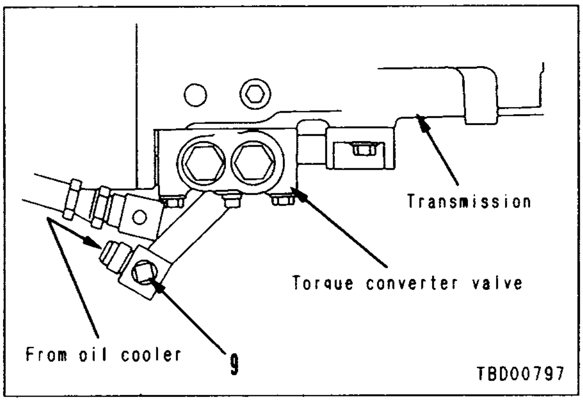
- Depress the decelerator pedal before pulling the fuel control lever to the FULL position.
- Release the decelerator pedal to run the engine at high idling. However, for safety reasons, always keep your right foot on the decelerator pedal until the completion of the measurement operation.

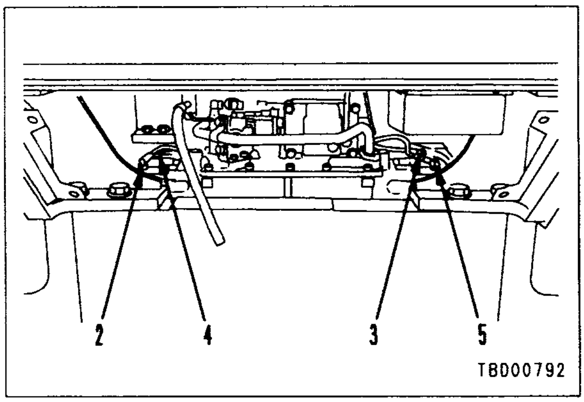
3) Measuring transmission lubricating oil pressure (※1)

i) Remove lubricating oil pressure measurement plug (9) (PT1/8), and install oil pressure gauge **C** [0.98 MPa {10 kg/cm²}].

ii) Place the steering and directional lever at neutral, and measure the lubricating oil pressure with the engine at low idling and high idling.

Note: The oil pressure differs greatly between high temperature and low temperature, so warm up the oil throughly before measuring.
For details, see MEASURING ENGINE SPEED AT TORQUE CONVERTER STALL.





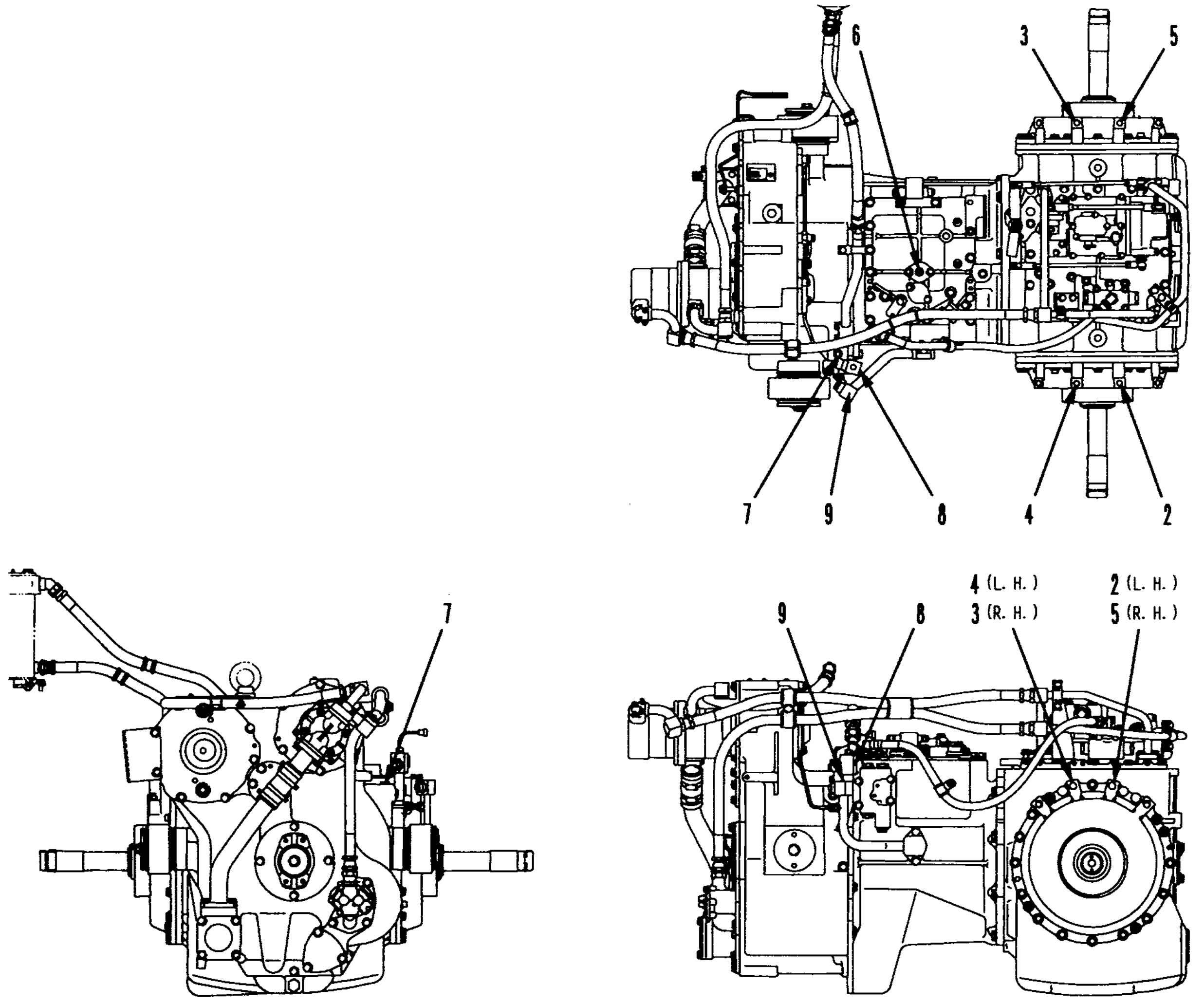
3. Measuring steering clutch pressure (※3)

1) Remove the left plug (4) and the right plug (5) for measuring the steering clutch pressure, and install the oil pressure gauge **C**.
2) Place the steering and directional lever at the N position for direction, then operate it in the direction of steering fully to the inside or outside, and measure the oil pressure with the engine at low idling and high idling.

4. Measuring steering brake pressure (※3)

1) Remove the left plug (2) and the right plug (3) for measuring the steering brake oil pressure, and install the oil pressure gauge **C**.
2) Place the steering and directional lever at the N position for steering and direction, and measure the oil pressure with the engine at low idling and high idling.

★ Check at the same time that the hydraulic pressure is 0 MPa {0 kg/cm²} when the steering and directional lever is operated fully to the inside or outside, or the brake pedal is depressed, or the parking brake is placed at the LOCK position.



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Condition of machine when measuring hydraulic pressure

Pressure pickup port No.	Remarks
2 – 5	Pressure can always be checked
6	Pressure can be checked only when power train unit is being overhauled
7	
8, 9	

※1: The pressure can be checked only when overhauling the power train unit.

※2: The pressure can be checked when the right side cover is removed.

※3: The pressure can be checked when the rear cover is removed.

MEASURING POWER TRAIN OIL PRESSURE

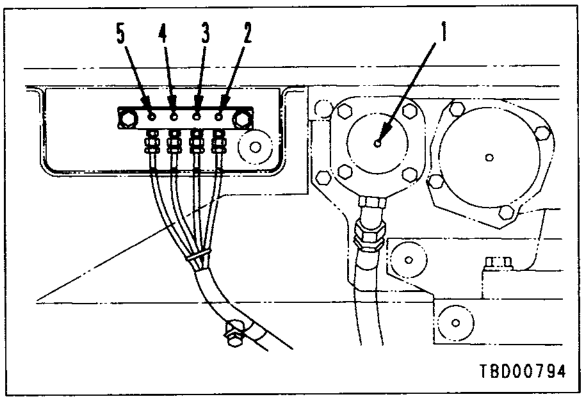
D65EX, PX-12 (With central pressure detection)

⚠ Stop the machine on level ground, lower the work equipment to the ground and apply the parking brake.

★ When measuring the hydraulic pressure, remove all the sand and dirt from around the nipple and plug.

★ Raise the power train oil temperature to 70 – 80 °C before measuring.

- Refer to the diagram and table below to install oil pressure gauge **C** to the nipple for the circuit to be measured.



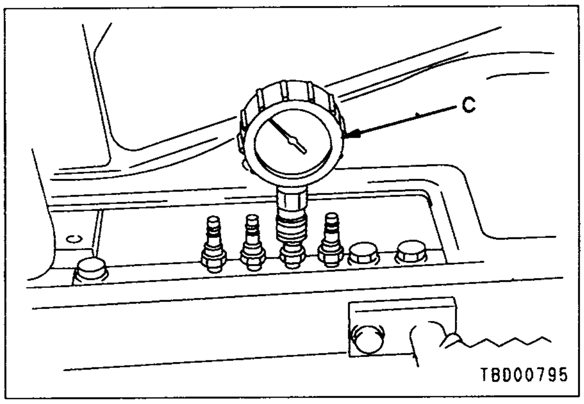


Table of centralized pressure pick-up port positions and gauges to use when measuring hydraulic pressure

No.	Measurement location	Gauge MPa{kg/cm²}
1	Transmission main relief pressure	5.9 {60}
2	Brake actuating pressure	5.9 {60}
3	Torque converter inlet pressure	2.5 {25}
4	Torque converter outlet pressure	0.98 {10}
5	Transmission modulating pressure	5.9 {60}

014012

1. **Measuring torque converter oil pressure**
   Measuring torque converter inlet port and outlet pressure
   i) Install oil pressure gauge **C** to torque converter inlet pressure measurement nipple (3) and outlet pressure measurement nipple (4).
   ii) Set the gearshift lever at neutral, and measure the torque converter inlet port pressure and outlet port pressure with the engine at low idling and high idling.

2. **Measuring transmission oil pressure**

1) Measuring main relief pressure
   i) Install oil pressure gauge **C** to main relief pressure measurement nipple (1).
   ii) Set the F-R lever to the N position, and measure the main refief pressure with the engine at low idling and high idling.

2) Measuring modulating pressure (clutch circuit pressure)

i) Install oil pressure gauge **C** to modulating pressure measurement nipple (5).
Note: At the central pressure detection port, it is possible to measure the modulating pressure, but it is not possible to measure the modulating time. (The oil pressure pick-up hose is long and there is a time lag when measuring.)
When measuring the modulating time, install the oil pressure measurement nipple directly to the control valve.

★ Measure the hydraulic pressure when the clutch is actuated with the engine at low idling and high idling when the gearshift lever is operated to all the positions given below.

ii) With the F-R lever at the N position, measure the modulating pressure at each speed position.

iii) Place the gearshift lever at **F1**.
Measure the modulating pressure.

iv) Place the gearshift lever at **F2**.
Measure the modulating pressure.

v) Place the gearshift lever at **F3**.
Measure the modulating pressure.

★ For the following measurements, place the speed lever at position 3, and depress the foot brake securely before measuring.

vi) • With the engine at low idling, place the F-R lever at the F position, and measure the modulating pressure.
- Run the engine at high idling and stall the torque converter, then measure the modulating pressure.

Combination of speed range and clutches

Clutch No.	No. 1 (R)	No. 2 (F)	No. 3 (3rd)	No. 4 (2nd)	No. 5 (1st)
F1		○			○
F2		○		○	
F3		○	○		
R1	○				○
R2	○			○	
R3	○		○		

014012

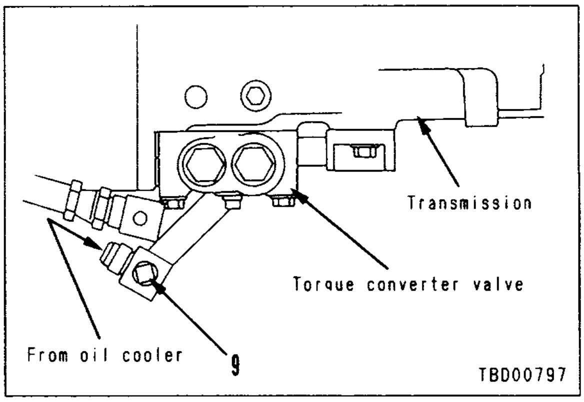
vii) • With the engine at low idling, place the F-R lever at the R position, and measure the modulating pressure.
- Run the engine at high idling and stall the torque converter, then measure the modulating pressure.

⚠ Precautions when stalling the torque converter

1) Depress the decelerator pedal before pulling the fuel control lever to the FULL position.
2) Release the decelerator pedal to run the engine at high idling. However, for safety reasons, always keep your right foot on the decelerator pedal until the completion of the measurement operation.

3) Measuring transmission lubricating oil pressure
   i) Remove lubricating oil pressure measurement plug (6) (PT1/8), and install oil pressure gauge **C** [0.98 MPa {10 kg/cm²}].
   ii) Place the steering and directional lever at neutral, and measure the lubricating oil pressure with the engine at low idling and high idling.

Note: The oil pressure differs greatly between high temperature and low temperature, so warm up the oil throughly before measuring.
For details, see MEASURING ENGINE SPEED AT TORQUE CONVERTER STALL.



3. Measuring steering brake pressure
1) Install oil pressure gauge **C** to brake pressure measurement nipple (2).
2) Place the steering and directional lever at the N position for steering and direction, and measure the oil pressure with the engine at low idling and high idling.

★ Check at the same time that the hydraulic pressure is 0 MPa {0 kg/cm²} when the brake pedal is depressed, or the parking brake is placed at the LOCK position.

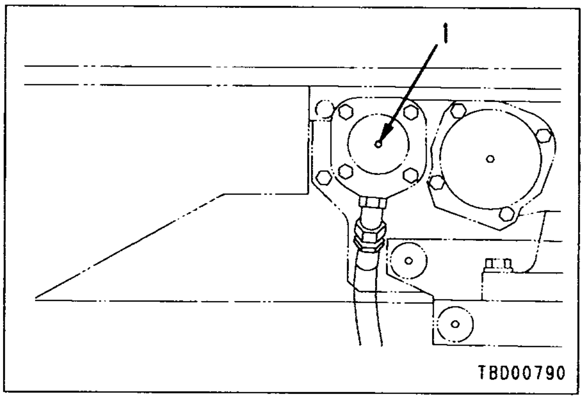
D65EX, PX-12 (Without central pressure detection)

⚠ Stop the machine on level ground, lower the work equipment to the ground and apply the parking brake.

★ When measuring the hydraulic pressure, remove all the sand and dirt from around the plug.

★ Raise the power train oil temperature to 70 – 80 °C before measuring.

- Remove the measurement plug from the circuit to be measured, and install the oil pressue gauge **C** referring to the diagram and table below.



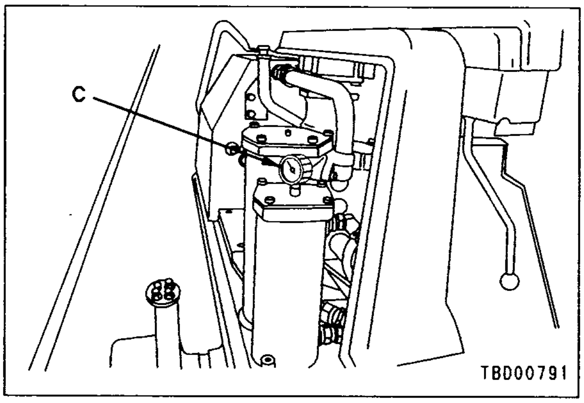


Table of pressure pick-up port positions and gauges to use when measuring hydraulic pressure

No.	Measurement location	Gauge MPa{kg/cm²}
1	Transmission main relief pressure	5.9 {60}
2	Brake actuating pressure	5.9 {60}
3	Torque converter inlet port pressure (※1)	2.5 {25}
4	Torque converter outlet port pressure (※1)	0.98 {10}
5	Transmission modulating pressure (※1)	5.9 {60}
6	Transmission lubricating oil pressure (※1)	0.98 {10}

1. Measuring torque converter oil pressure

1) Measuring torque converter inlet and outlet port pressure (※1)
   i) Remove the torque converter inlet pressure measurement plug (3) and outlet pressure measurement plug (4), and install the oil pressure gauge **C**.
   ii) Set the gearshift lever at neutral, and measure the torque converter inlet port pressure and outlet port pressure with the engine at low idling and high idling.

2. Measuring transmission oil pressure

1) Measuring main relief pressure (※2)
   i) Remove the main relief pressure measurement plug (1), and install the oil pressure gauge **C**.
   ii) Set the F-R lever to the N position, and measure the main relief pressure with the engine at low idling and high idling.

2) Measuring modulating pressure (※1) (clutch circuit pressure)

i) Remove the modulating pressure measurement plug (5), and install the oil pressure gauge **C**.

★ Measure the hydraulic pressure when the clutch is actuated with the engine at low idling and high idling when the gearshift lever is operated to all the positions given below.

ii) With the F-R lever at the N position, measure the modulating pressure at each speed position.

iii) Place the gearshift lever at **F1**. Measure the modulating pressure.

iv) Place the gearshift lever at **F2**. Measure the modulating pressure.

v) Place the gearshift lever at **F3**. Measure the modulating pressure.

★ For the following measurements, place the speed lever at position 3, and depress the foot brake securely before measuring.

vi) • With the engine at low idling, place the F-R lever at the F position, and measure the modulating pressure.
• Run the engine at high idling, and stall the torque converter, then measure the modulating pressure.

Combination of speed range and clutches

Clutch No.	No.1 (R)	No.2 (F)	No.3 (3rd)	No.4 (2nd)	No.5 (1st)
F1		○			○
F2		○		○	
F3		○	○		
R1	○				○
R2	○			○	
R3	○		○		

vii) • With the engine at low idling, place the F-R lever at the R position, and measure the modulating pressure.

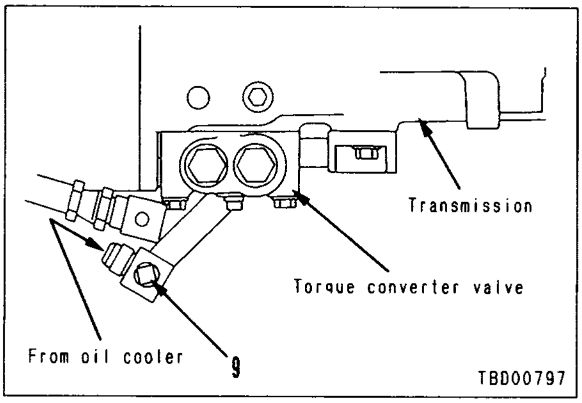
- Run the engine at high idling and stall the torque converter, then measure the modulating pressure.

⚠ Precautions when stalling the torque converter

- Depress the decelerator pedal before pulling the fuel control lever to the FULL position.
- Release the decelerator pedal to run the engine at high idling. However, for safety reasons, always keep your right foot on the decelerator pedal until the completion of the measurement operation.

3) Measuring transmission lubricating oil pressure (※1)
   i) Remove lubricating oil pressure measurement plug (6) (PT1/8), and install oil pressure gauge **C** [0.98 MPa {10 kg/cm²}].
   ii) Place the steering and directional lever at neutral, and measure the lubricating oil pressure with the engine at low idling and high idling.

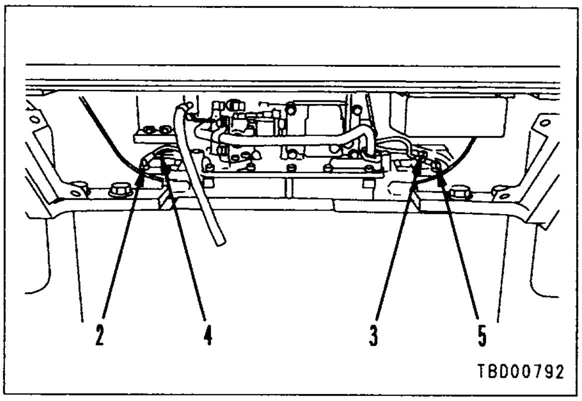
Note: The oil pressure differs greatly between high temperature and low temperature, so warm up the oil throughly before measuring.
For details, see MEASURING ENGINE SPEED AT TORQUE CONVERTER STALL.



3. Measuring brake oil pressure (※3)

1) Remove the plug (2) for measuring the brake oil pressure, and install the oil pressure gauge **C**.
2) Place the steering and directional lever at the N position for steering and direction, and measure the oil pressure with the engine at low idling and high idling.

★ Check at the same time that the hydraulic pressure is 0 MPa {0 kg/cm²} when the brake pedal is depressed, or the parking brake is placed at the LOCK position.



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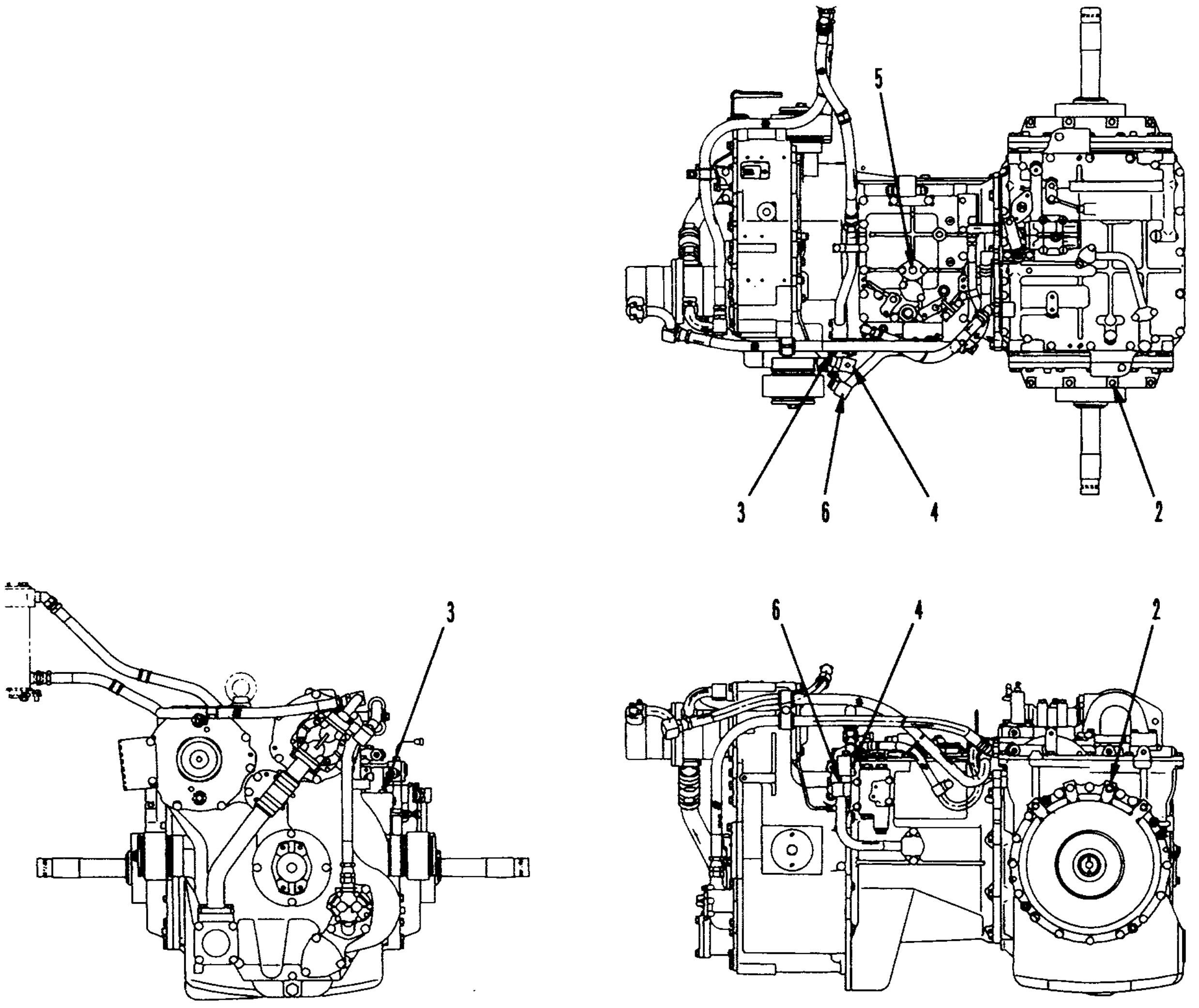


TBD00796

Condition of machine when measuring hydraulic pressure

Pressure pickup port No.	Remarks
2	Pressure can always be checked
3	Pressure can be checked only when power train unit is being overhauled
4, 6	
5	

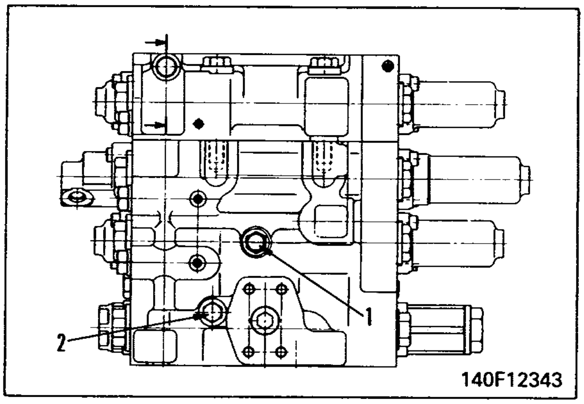
※1: The pressure can be checked only when overhauling the power train unit.
※2: The pressure can be checked when the right side cover is removed.
※3: The pressure can be checked when the rear cover is removed.

TESTING AND ADJUSTING WORK EQUIPMENT HYDRAULIC PRESSURE

D65E, P-12

⚠ Stop the machine on level ground, lower the work equipment to the ground and apply the parking brake.

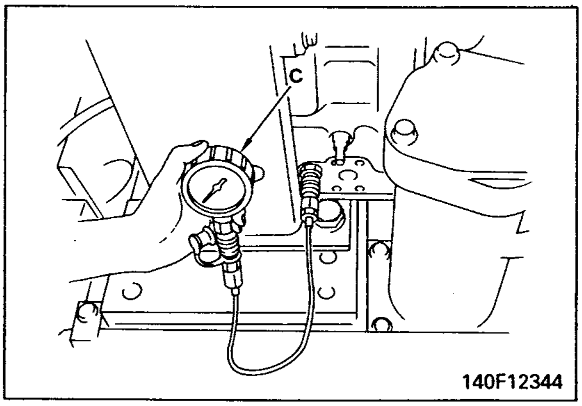
★ When installing the oil pressure gauge, remove all the sand and dirt from around the plug.



140F12343

1. **Measuring pressure**
   1) Remove work equipment main relief pressure measurement plug (1) and load sensing pressure measurement plug (2), then install oil pressure gauge **C** [39.2 MPa (400 kg/cm^2)].

   2) Operate the blade tilt cylinder to the end of its stroke to relieve the circuit, then measure the oil pressure with the engine at low idling and high idling.

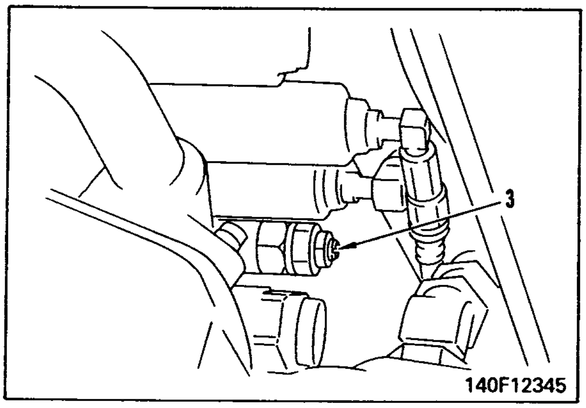


140F12344

2. **Adjusting main relief valve (3) pressure**
   - Loosen locknut (4), and turn adjustment screw (5) as follows to adjust.
     ★ TO RAISE pressure, turn CLOCKWISE
     TO LOWER pressure, turn COUNTER-CLOCKWISE
     ★ One turn of the adjustment screw adjusts the pressure by approx. 19.6 MPa (200 kg/cm^2).

   kgm Locknut: **34.3 ± 4.9 Nm**
   (3.5 ± 0.5 kgm)

   ★ After adjusting, check the main relief valve pressure.



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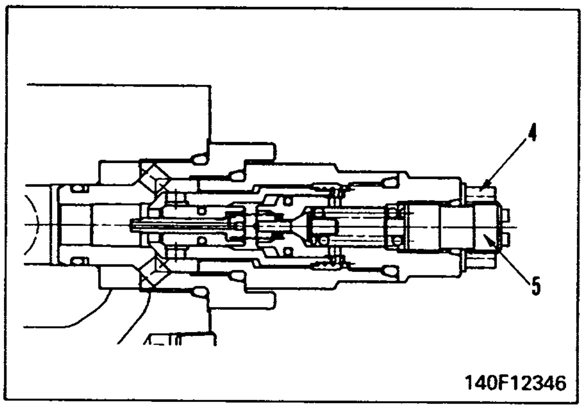


140F12346

TESTING AND ADJUSTING WORK EQUIPMENT, STEERING HYDRAULIC PRESSURE

D65EX, PX-12

⚠ Stop the machine on level ground, lower the work equipment to the ground and apply the parking brake.

★ When installing the oil pressure gauge, remove all the sand and dirt from around the plug.

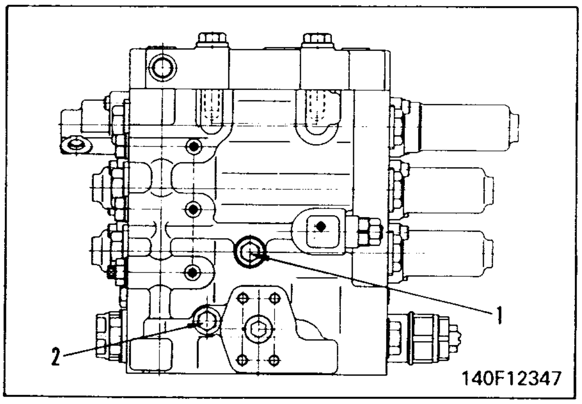
1. Measuring pressure

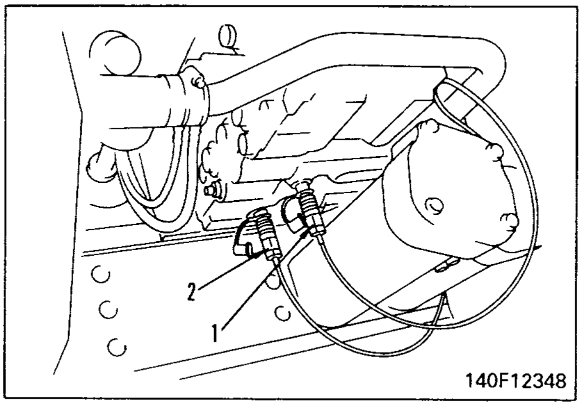
1) Remove pump discharge pressure measurement plug (1) and load sensing pressure measurement plug (2), then install oil pressure gauge **C** [Hydraulic pressure gauge: 39.2 MPa (400 kg/cm^2), steering pressure: 58.8 MPa (600 kg/cm^2)].

2) With the blade tilt cylinder at the end of its stroke, measure the work equipment hydraulic pressure when the circuit is relieved with the engine at low idling and high idling.

3) Measure the oil pressure when the lift cylinder circuit is relieved with the engine at low idling and high idling.
   ★ Fit a blind plug to the blade cylinder circuit when measuring.

4) With the gear shift lever at neutral, depress the brake pedal, operate the steering and directional lever fully to the left or right, and measure the steering pressure when the circuit is relieved with the engine at high idling.



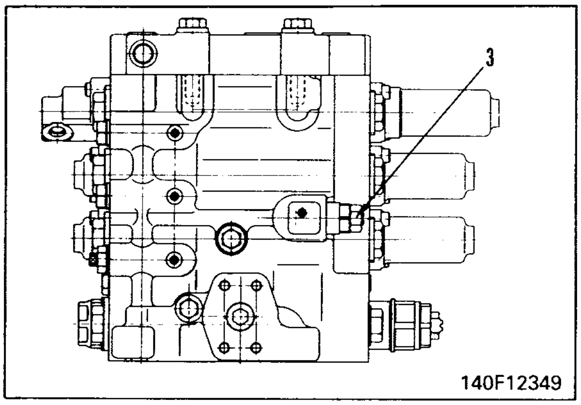


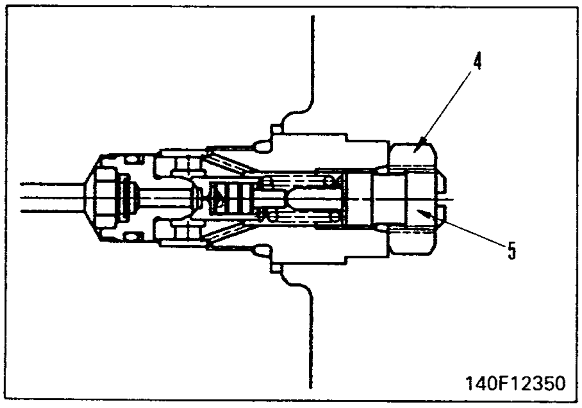
2. Adjusting work equipment load sensing relief valve (3) pressure

- Loosen locknut (4), and turn adjustment screw (5) as follows to adjust.
  ★ TO RAISE pressure, turn CLOCKWISE
  TO LOWER pressure, turn COUNTER-CLOCKWISE
  ★ One turn of the adjustment screw adjusts the pressure by approx. 17.6 MPa (179 kg/cm^2).

  kgm Locknut: **34.3 ± 4.9 Nm**
  (3.5 ± 0.5 kgm)

  ★ After adjusting, check the work equipment relief pressure and load sensing pressure again.

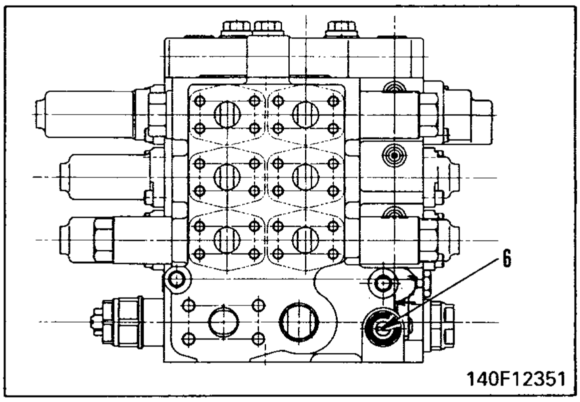


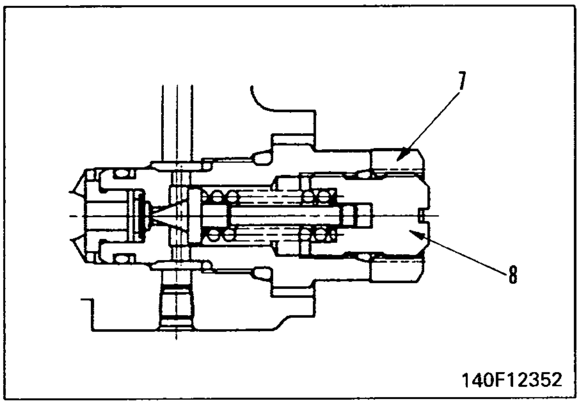


3. **Adjusting steering load sensing relief valve (6) pressure**
   - Loosen locknut (7), and turn adjustment screw (8) as follows to adjust.
     ★ TO RAISE pressure, turn CLOCKWISE
     TO LOWER pressure, turn COUNTER-CLOCKWISE
     ★ One turn of the adjustment screw adjusts the pressure by approx. 15.1 MPa (154 kg/cm^2).

     kgm Locknut: **73.6 ± 4.9 Nm**
     (7.5 ± 0.5kgm)

     ★ After adjusting, check the steering relief pressure and load sensing pressure again.





014012

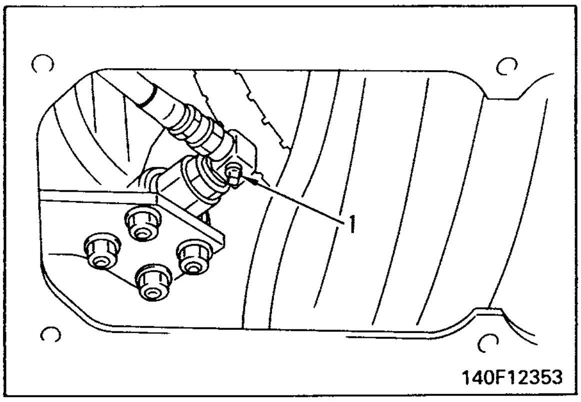
TESTING AND ADJUSTING CONTROL CIRCUIT PRESSURE

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

Measurement

★ Oil temperature when measuring: 45 — 55°C

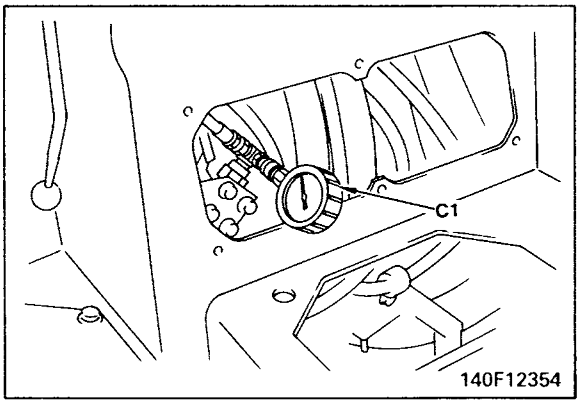
⚠ Lower the work equipment to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then set the safety lever at the LOCK position.



140F12353

1. Remove pressure pick-up plug (1), and install oil pressure gauge **C1** [(5.9 MPa (60 kg/cm^2)].
2. Set the safety lever at the FREE position, start the engine, and measure with the engine at full throttle.

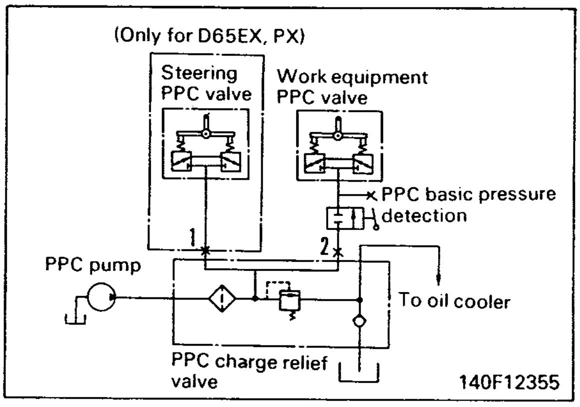
★ When checking the internal leakage of the components of the control circuit, block the following parts of the circuit with the parts below the table, and measure the relief pressure.



140F12354

No.	Portion of hydraulic circuit shut off	Component that can be checked
1	Inlet port of steering PPC valve (D65EX, PX only)	Steering PPC valve (D65EX, PX only)
2	Inlet port of work equipment PPC valve	Work equipment PPC valve
1 +2	Outlet port of PPC charge relief valve	PPC charge relief valve

★ Use the following parts to shut off the circuit.
Plug: 07040-11409
O-ring: 07002-10423



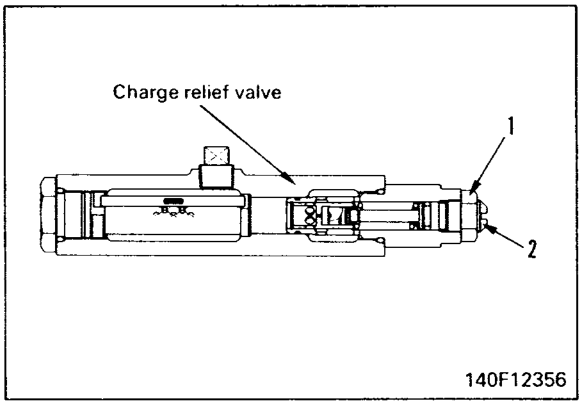
140F12355

Adjustment

1. Loosen locknut (1), then turn adjustment screw (2) to adjust.
   - ★ Turn the adjustment screw as follows.
     To INCREASE pressure, turn CLOCKWISE
     To DECREASE pressure, turn COUNTER-CLOCKWISE
   - ★ Amount of adjustment for one turn of adjustment screw: 0.77 MPa (7.8 kg/cm^2)

   Locknut: **64 ± 10 Nm**
   (6.5 ± 1.0 kgm)

   - ★ After adjusting, repeat the procedure in Item 1 to check again.



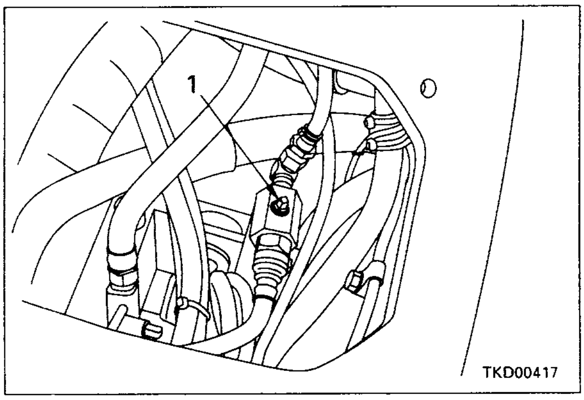
140F12356

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

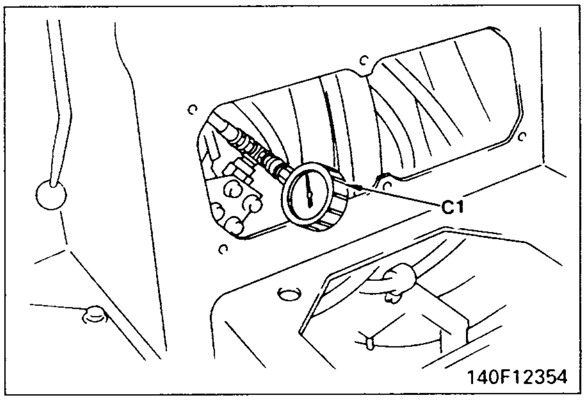
Measurement

★ Oil temperature when measuring: 45 – 55°C

⚠ Lower the work equipment to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then set the safety lever at the LOCK position.

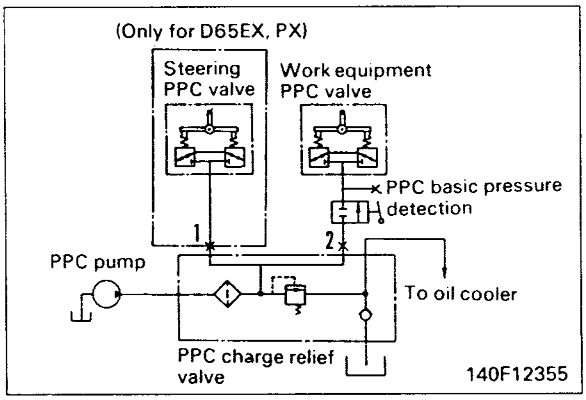


1. Remove pressure pick-up plug (1), and install oil pressure gauge **C1** [5.9 MPa (60 kg/cm^2)].
2. Set the safety lever at the FREE position, start the engine, and measure with the engine at full throttle.
   ★ When checking the internal leakage of the components of the control circuit, block the following parts of the circuit with the parts below the table, and measure the relief pressure.



No.	Portion of hydraulic circuit shut off	Component that can be checked
1	Inlet port of steering PPC valve (D65EX, PX only)	Steering PPC valve (D65EX, PX only)
2	Inlet port of work equipment PPC valve	Work equipment PPC valve
1 + 2	Outlet port of PPC charge relief valve	PPC charge relief valve

★ Use the following parts to shut off the circuit.
Plug: 07040-11409
O-ring: 07002-10423

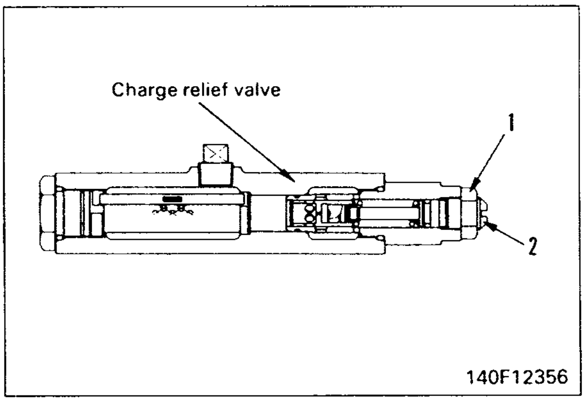


Adjustment

1. Loosen locknut (1), then turn adjustment screw (2) to adjust.
   ★ Turn the adjustment screw as follows.
   To INCREASE pressure, turn CLOCKWISE
   To DECREASE pressure, turn COUNTER-CLOCKWISE
   ★ Amount of adjustment for one turn of adjustment screw: 0.77 MPa (7.8 kg/cm^2)

   kgm Locknut: **64 ± 10 Nm (6.5 ± 1.0 kgm)**

   ★ After adjusting, repeat the procedure in Item 1 to check again.

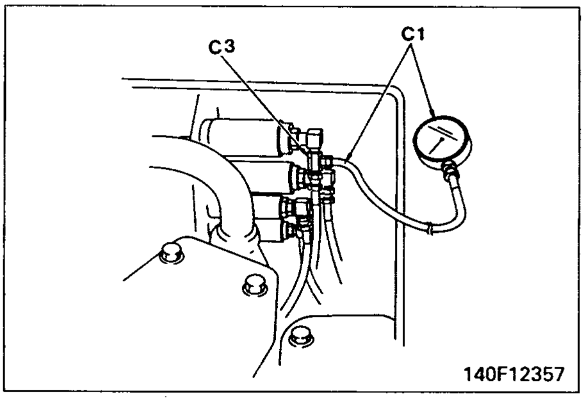


MEASURING OUTPUT PRESSURE OF PPC VALVE

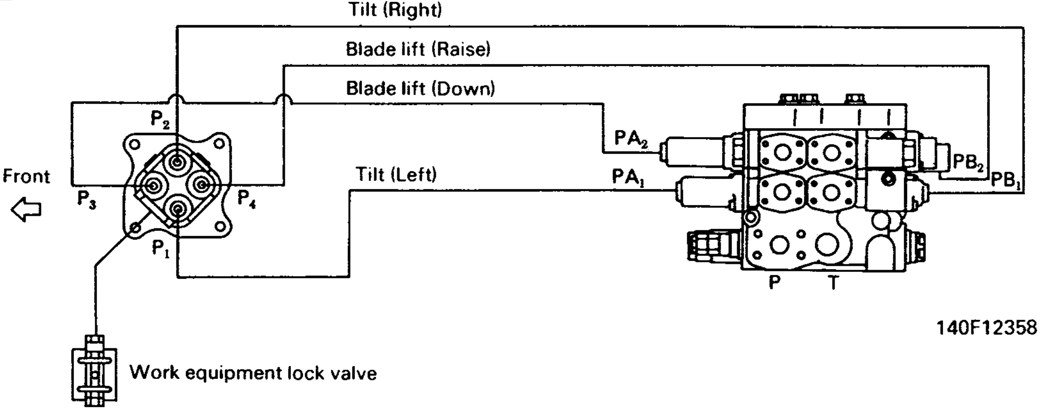
D65E-12 60001 – 60947
D65P-12 60001 – 60890
D65EX-12 60001 – 60941
D65PX-12 60001 – 60914

★ Oil temperature when measuring: 45 – 55°C

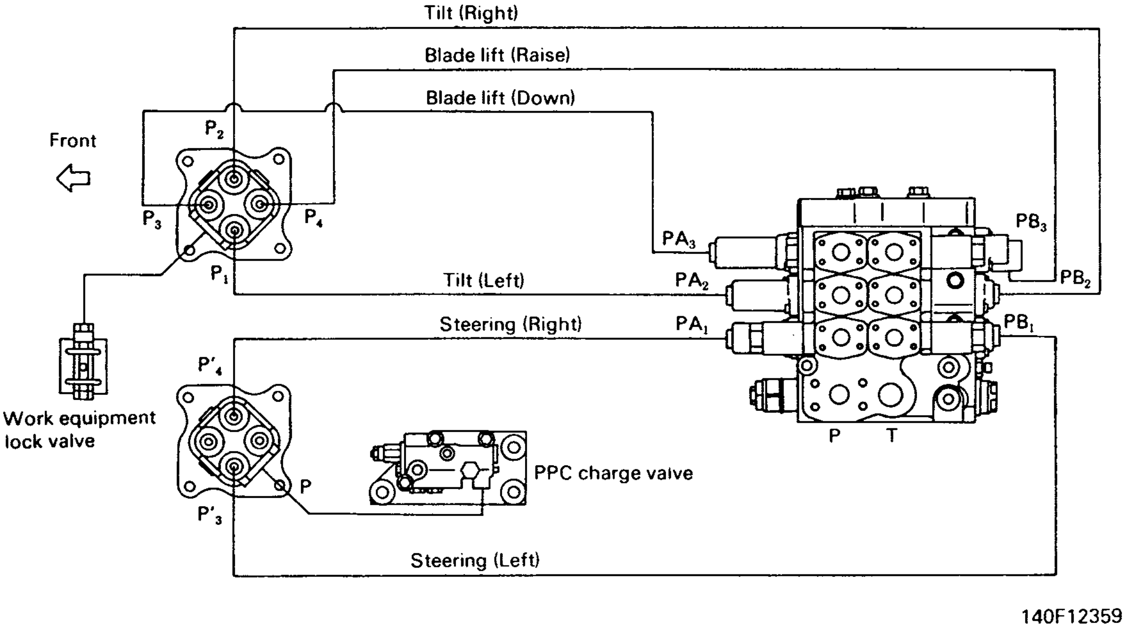
1. Disconnect the hose (see diagram below) from the circuit to be measured.
2. Install adapter **C3** to elbow end.
3. Install oil pressure gauge **C1** [5.9 MPa (60 kg/cm²)] to adapter **C3**.
4. Run the engine at high idling, operate the control lever for the circuit to be measured, and measure the hydraulic pressure.



1) D65E, P-12



2) D65EX, PX-12



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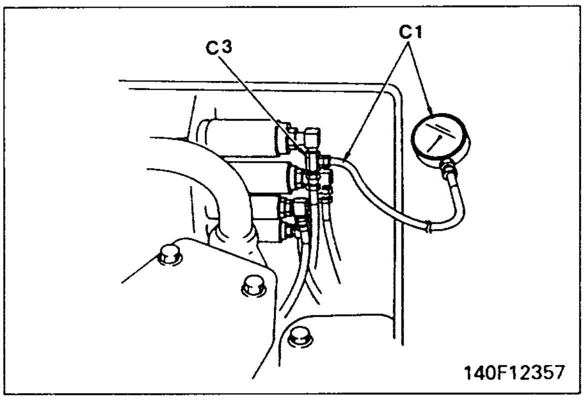
D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

★ Oil temperature when measuring: 45 – 55°C

1. Disconnect the hose (see diagram below) from the circuit to be measured.
2. Install adapter **C3** to elbow end.
3. Install oil pressure gauge **C1** [5.9 MPa (60 kg/cm^2)] to adapter **C3**.
4. Run the engine at high idling, operate the control lever for the circuit to be measured, and measure the hydraulic pressure.



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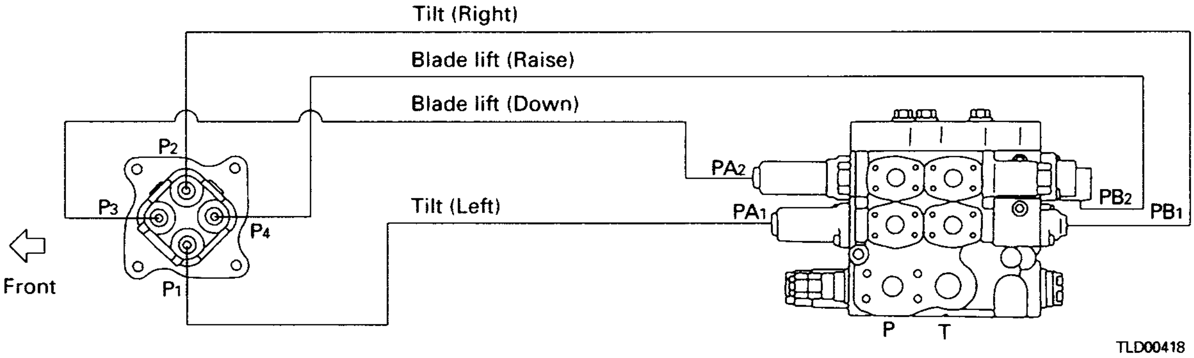
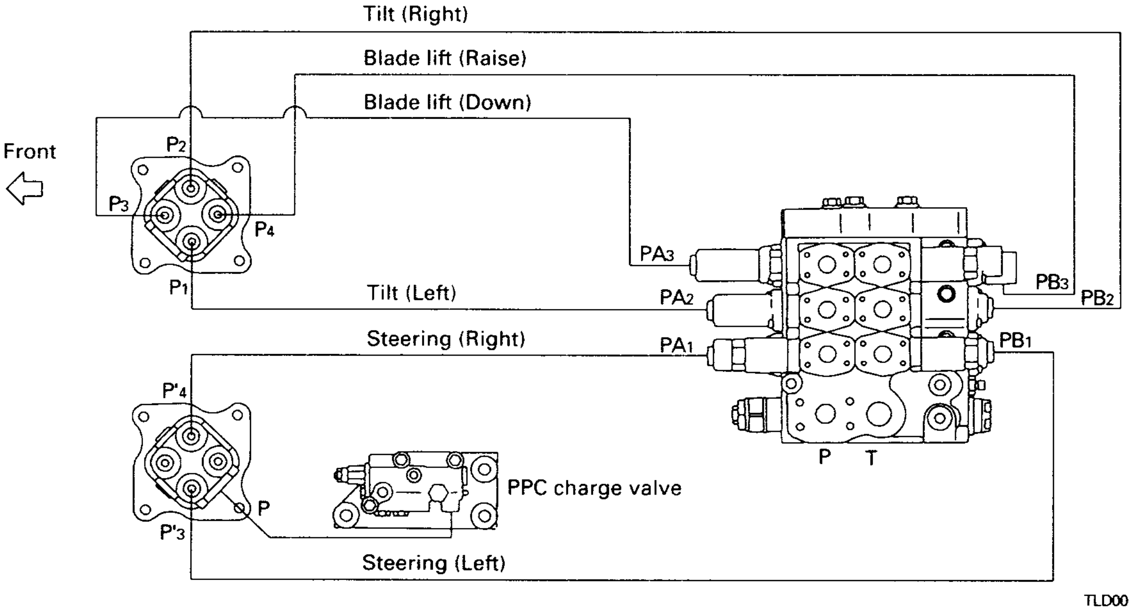
1) D65E, P-12

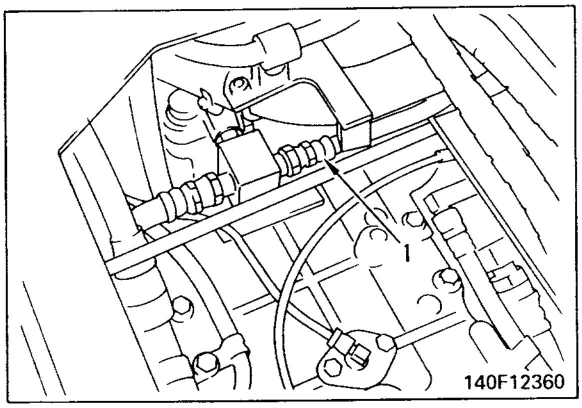


2) D65EX, PX-12



MEASURING OIL LEAKAGE FROM HSS MOTOR

D65EX, PX-12



★ Oil temperature when measuring: 45 — 55°C

★ Lower the work equipment to the ground and stop the engine.

⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Disconnect drain hose (1), then install a blind plug at the tank end.
2. Place the gear shift lever at the N position, and depress the brake pedal.
3. Operate the steering and directional lever fully to the left or right, relieve the HSS motor for one minute, and use a measuring cylinder to measure the amount of leakage.
   ★ Measure several times on both the left and right sides.

MEASURING LEAKAGE INSIDE CYLINDER

- If the hydraulic drift exceeds the standard value, check if the cause of the hydraulic drift is in the cylinder or in the control valve.

  ★ Oil temperature when measuring:
  45 — 55°C

014012

Measurement posture

1. **Blade tilt cylinder**
   - Fully extend the rod of the cylinder to be measured, and lower the tip of the blade to the ground.

2. **Ripper lift cylinder**
   - Remove the shank pin and extend the ripper lift cylinder fully.

★ The blade lift cylinder has a built-in piston valve, so measurement is impossible.

Mesuring

1) Disconnect the head piping, and block the piping at the chassis end with a blind plate.

   ⚠ Be careful not to disconnect the piping at the bottom end.

2) Start the engine, run the engine at high idling, and apply the relief pressure to the bottom end of the cylinder.
3) Wait for 30 seconds, then measure the amount of leakage over the next 1 minute.

BLEEDING AIR FROM HYDRAULIC CYLINDER

★ When operating the hydraulic cylinders for the first time after replacing or reassembling the cylinders or piping, always bleed the air from the hydraulic cylinders as follows:

1) Start engine and run at low idling for approx. 5 minutes.
2) Run the engine at low idling, and raise and lower the blade or ripper 4 — 5 times.
   ★ When operating the hydraulic cylinder, stop the piston rod 100 mm from the end of its stroke. Do not relieve the circuit under any circumstances.
3) Run the engine at high idling and repeat Step 2), then run the engine at low idling and operate the piston rod to the end of its stroke to relieve the circuit.

RELEASING REMAINING PRESSURE FROM HYDRAULIC CIRCUIT

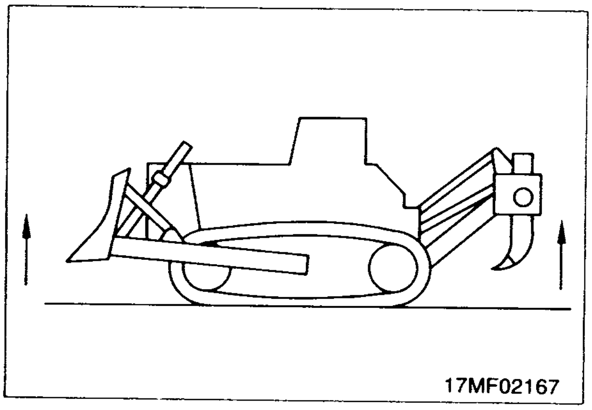
014012

⚠ There is no accumulator installed, so the remaining pressure in the piping between the control valve and hydraulic cylinder cannot be released by operating the control levers. When the above piping is removed, be careful of the following points.

1. Run the engine at low idling, operate the hydraulic cylinders as far as possible so that the pressure is not relieved at the end of the stroke, lower the work equipment to the ground, and stop the engine.
   ★ If the engine is stopped with the hydraulic circuit relieved and the hydraulic cylinder at the end of its stroke, do not carry out any work for 5 to 10 minutes.
2. When removing the piping, loosen the piping sleeve nut gradually to release the pressure remaining in the piping slowly, then remove the piping after the oil stops spurting out.

PROCEDURE FOR SIMPLE TEST OF STEERING BRAKE PERFORMANCE

★ Carry out the measurement under the following conditions.
- Coolant temperature: Within operating range
- Power train oil temperature: 70 — 90°C



1. Stop the machine on a flat road surface with the blade and ripper in the travel posture.
2. Run the engine at low idling, depress the brake pedal securely, and place the gearshift lever at **F2**.
3. Depress the decelerator pedal and pull the fuel control lever to the FULL position.
4. Release the decelerator pedal gradually, raise the engine speed to high idling, and check that the machine does not move.

⚠ During the measurement, keep your right foot on the decelerator pedal, and if the machine starts to move, quickly depress the decelerator pedal and return the gearshift lever to neutral.

Note: If this test is carried out in **F1**, an excessive load will be brought to bear on the brake. For this reason, never use **F1**; always use **F2**.

PROCEDURE FOR TESTING SENSORS

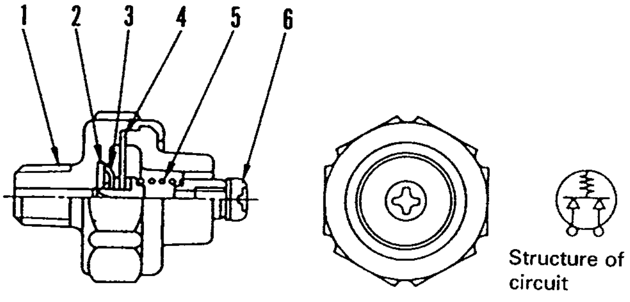
1. Engine oil pressure sensor

1) Stop the engine and turn the starting switch OFF.
2) With the sensor still installed to the engine, disconnect the wiring harness from the sensor.
3) Measure the resistance between the terminal and the chassis with the engine stopped and with the engine running.

★ Judgement

The following results show that the sensor is normal

Engine oil pressure over 0.5 kg/cm^2	No continuity
Engine oil pressure under 0.5 kg/cm^2	Continuity



1. Plug
2. Contact ring
3. Contact
4. Diaphragm
5. Spring
6. Terminal

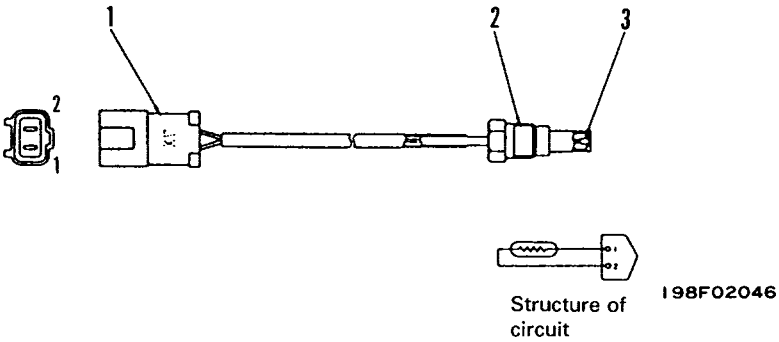
2. Coolant temperature, Power train oil temperature sensor

1) Stop the engine, turn the starting switch OFF, and remove the sensor from the engine or torque converter.
2) Measure the resistance between terminals 1 and 2 with the sensor at about the same temperature as the ambient temperature.

★ Judgement

The following results show that the sensor is normal

Ambient temperature	When normal
100°C	Approx. 3.8 KΩ
|	|
90°C	Approx. 5 KΩ
|	|
35°C	Approx. 29 KΩ
|	|
20°C	Approx. 52 KΩ
|	|
10°C	Approx. 80 KΩ



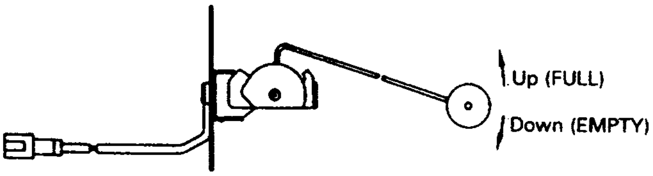
1. Connector
2. Plug
3. Thermistor

3. Fuel level sensor

1) Stop the engine and turn the starting switch OFF.
2) With the sensor still installed to the fuel tank, disconnect the wiring harness from the sensor.
3) Measure the resistance between terminals 1 and 2.

★ Judgement

Condition of fuel	When normal
Full	Approx. 12 Ω
Empty	Approx. 85 — 110Ω



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TESTING AND ADJUSTING "OPEN" AND "CLOSE" LOCK AND STEADY REST OF OPERATOR'S CAB DOOR

1. **Testing door lock**
   - Close the door and check the relationship between the operator's cab and door. If there is any fault, repair it.

   1) Check of condition
      i) Check the installed height of damper rubber (1). (Check both sides, 4 pieces on each.)
         - Stick adhesive tape ①, etc. to the contact face of damper rubber (1) and open and close the door 2 - 3 times. Then, check the contact face of adhesive tape ① against the operator's cab.

         Normal: When the door is closed, the damper rubber comes in contact lightly.

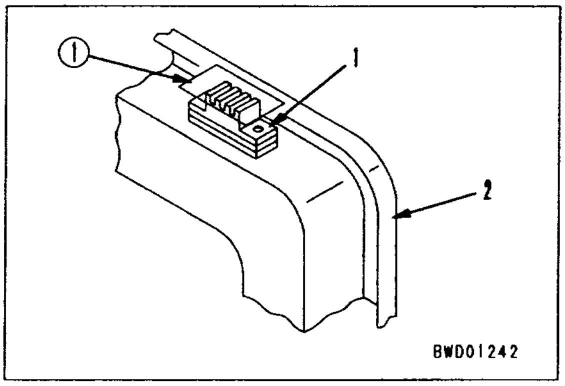
         Abnormal: When the door is closed, the damper rubber does not come in contact or comes in contact so strongly that the adhesive tape is removed.

      ii) Check the relationship between the door notch and striker (on both sides).
         - Close door (2) and check the engaging condition of latch (3) and striker (4).

           ★ Check deviation **a** of latch center **x** and striker center **y** from each other from the direction of **A**.

   2) Adjusting
      i) Adjusting height of damper rubber
         - Increase or decrease of shims (5) under damper rubber (1) to adjust the height of damper rubber (1) properly.

      ii) Adjusting height of latch and striker
         (1) Tighten the mounting bolt of striker (4) temporarily and open and close the door 2 - 3 times to align latch (3) and striker (4) with each other.
         (2) Check the engaging condition of latch (3) and striker (4).
         (3) Tighten the mounting bolt of striker (4) securely.



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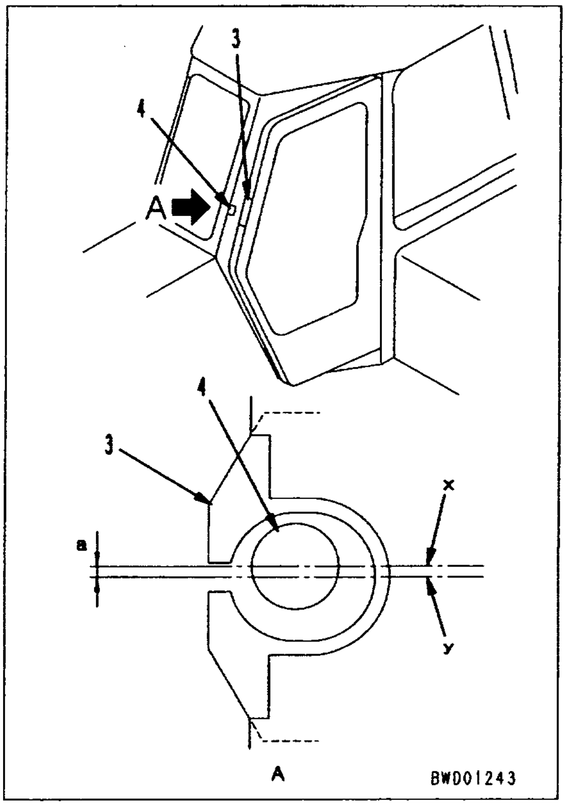

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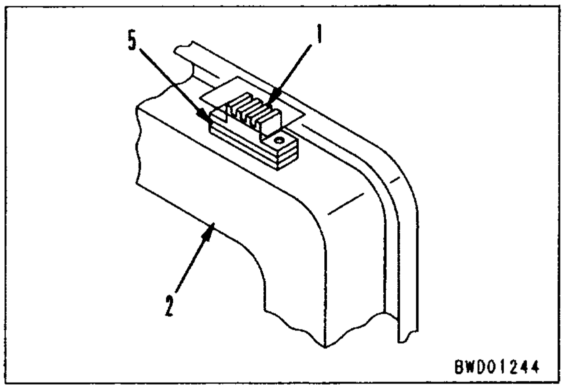


BWD01244

014012

(4) Open and close the door and check that it is locked and unlocked smoothly. If the door is not locked and unlocked smoothly (If the knob is heavy), perform the adjustment procedure from the first.

★ Operating effort of knob:
68.6 ± 19.6 N {7 ± 2 kg}

iii) Apply grease (GII-LI) to latch (3).

★ If latch (3) is not greased, the knob becomes heavy. Accordingly, apply grease sufficiently.

2. Testing open lock

- Lock the door open and check the relationship between the operator's cab and door. If there is any fault, repair it.

1) Check of condition

i) Check the relationship between open lock latch (3) and striker (4) from the direction of **B**.

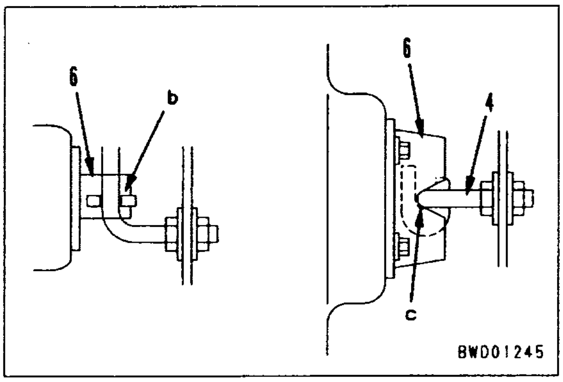
★ Check part **b** to see if the claw of latch (6) rides over the bent part of striker (4). (If normal, the claw does not ride over the bent part.)

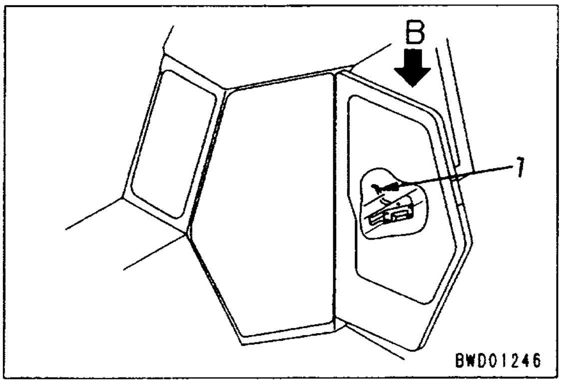
★ Check parts **c** and **b** to see if the body of latch (6) interferes with striker (4). (If normal, the latch does not interfere.)

ii) Check the installed height of the stopper rubber. (Check both sides, 4 pieces on each.)

(1) Lock the door (2) open and shake it in the forward and reverse directions to see if it has any play.

(2) Check that the operating effort of unlock lever (7) is not heavy.





2) Adjusting

i) Adjusting latch (6) and striker (4)

- Loosen the mounting nut of striker (4) and adjust striker (4) so that it will not interfere with or ride over latch (6), then tighten the nut. If interference cannot be eliminated by adjusting striker (4), loosen the mounting bolt of latch (6) and adjust latch (6).
  ★ Push the door. If it moves until clearance **d** is reduced to "0", project the stopper rubber in the pushing direction.

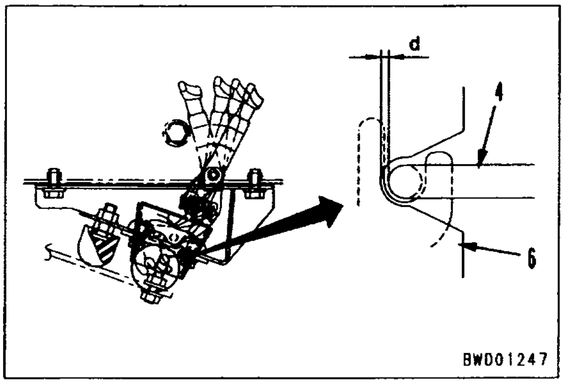
ii) Adjusting installed height of stopper rubber

(1) Loosen the locknut of the stopper rubber.

(2) If there is any play, project (heighten) the stopper rubber until the play is eliminated.

★ If the door is not locked easily or the unlock lever is heavy, return (lower) the stopper rubber in the range that the door does not have any play.

(3) Tighten the locknut.



014012

TROUBLESHOOTING

014012

POINTS TO REMEMBER WHEN TROUBLESHOOTING

⚠
- Stop the machine in a level place; and check that the safety pin, blocks, and parking brake are securely fitted.
- When carrying out the operation with two or more workers, keep strictly to the agreed signals, and do not allow any unauthorized person to come near.
- Be extremely careful not to touch any hot parts or to get caught in any rotating parts.
- When disconnecting wiring, always disconnect the negative (—) terminal of the battery first.

⚠
- When removing the plug from a location which is under pressure from oil, water, or air, always release the internal pressure first. When installing measuring equipment, be sure to connect it properly.
- The aim of troubleshooting is to pinpoint the basic cause of the failure, to carry out repairs swiftly, and to prevent reoccurrence of the failure.
  When carrying out troubleshooting, and important point is of course to understand the structure and function. However, a short cut to effective troubleshooting is to ask the operator various questions to form some idea of possible cases of the failure that would produce the reported symptoms.

1. When carrying out troubleshooting, do not hurry to disassemble the components.
   If components are disassembled immediately any failure occurs:
   - Parts that have no connection with the failure or other unnecessary parts will be disassembled.
   - It will become impossible to find the cause of the failure.

   It will also cause a waste of manhours, parts, or oil or grease, and at the same time, will also lose the confidence of the user or operator.
   For this reason, when carrying out troubleshooting, it is necessary to carry out thorough prior investigation and to carry out troubleshooting in accordance with the fixed procedure.

2. Points to ask user or operator
   1) Have any other problems occured apart from the problem that has been reported?
   2) Was there anything strange about the machine before the failure occurred?
   3) Did the failure occur suddenly, or were there problems with the machine condition before this?
   4) Under what conditions did the failure occur?
   5) Had any repairs been carried out before the failure?
      When were these repairs carried out?
   6) Has the same kind of failure occurred before?

3. Check before troubleshooting
   1) Check for symptoms of any abnormality in the machine.
   2) Check the CHECKS BEFORE STARTING items.
   3) Other inspection items.
   4) Other maintenance items can be checked externally, so check any item that is considered to be necessary.

4. Confirming failure
   - Confirm the extent of the failure yourself, and judge whether to handle it as a real failure or as a problem with the method of operation, etc.
     ★ When operating the machine to reenact the troubleshooting symptoms, do not carry out any investigation or measurement that may make the problem worse.

5. Troubleshooting
   - Use the results of the investigation and inspection in Items 2 — 4 to narrow down the causes of failure, then use the troubleshooting tables (matrix) to locate the position of the failure exactly.
     ★ The basic procedure for troubleshooting is as follows.
       1) Start from the simple points.
       2) Start from the most likely points.
       3) Investigate other related parts or information.

6. Measures to remove root cause of failure.
   - Even if the failure is repaired, if the root cause of the failure is not repaired, the same failure will occur again.
     To prevent this, always investigate why the problem occurred. Then, remove the root cause.

014012

SEQUENCE OF EVENTS IN TROUBLESHOOTING

Office, shop


TEW00180

Jobsite

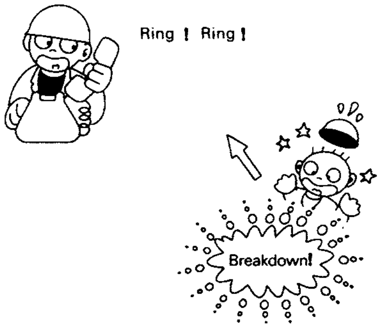

TEW00181

Step 1

Examination, confirmation of symptoms

1) When a request for repairs is received, first ask the following points.
   - Name of customer
   - Type, serial number of machine
   - Details of jobsite, etc.
2) Ask questions to gain an outline of the problem.
   - Condition of failure
   - Work being carried out at the time of the failure
   - Operating environment
   - Past history, details of maintenance, etc.


TEW00182

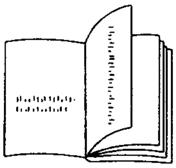


TEW00183

Step 2

Determining probable location of cause

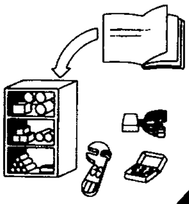
1) Look at the troubleshooting section of the shop manual to find locations of possible causes.


TEW00184

Step 3

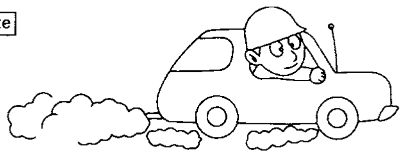
Preparation of troubleshooting tools

1) Look at the table of troubleshooting tools in the shop manual and prepare the necessary tools.
   - T-adapter
   - Hydraulic pressure gauge kit, etc.
2) Look in the parts book and prepare the necessary replacement parts.


TEW00186

Step 4

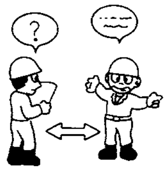
Go to jobsite


TEW00189

Step 5

Ask operator questions to confirm details of failure.

- Was there anything strange about the machine before the failure occurred?
- Did the failure occur suddenly?
- Had any repairs been carried out before the failure?


TEW00190

Step 6

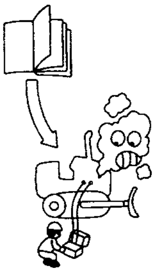
Re-enacting failure

- Drive and operate the machine to confirm the condition and judge if there is really a failure.

Step 7

- Pinpoint locations of failure (carry out troubleshooting)
- Decide action to take

1) Before starting troubleshooting, locate and repair simple failures.
   - Check before starting items
   - Other check items
2) See the Troubleshooting Section of the shop manual, select a troubleshooting flowchart that matches the symptoms, and carry out troubleshooting.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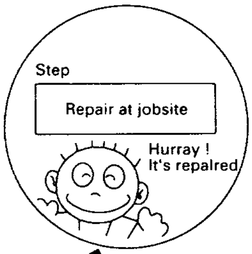

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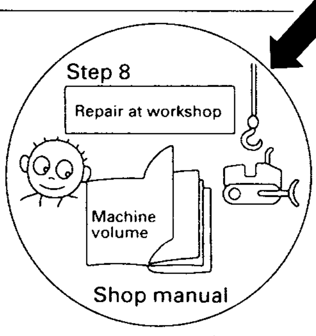


TEW00188

POINTS TO REMEMBER WHEN CARRYING OUT MAINTENANCE

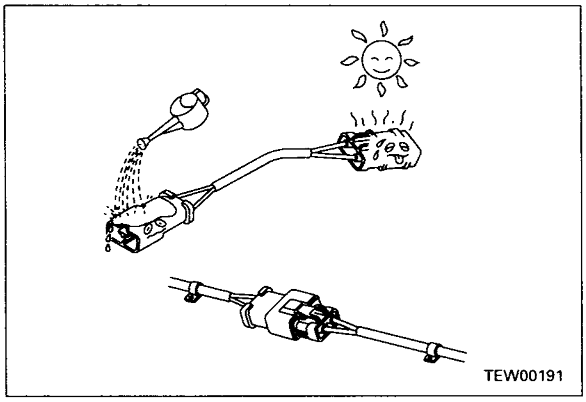
To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct operation, maintenance and inspection, troubleshooting, and repairs must be carried out. This section deals particularly with correct repair procedures for mechatronics and is aimed at improving the quality of repairs. For this purpose, it gives sections on "Handling electric equipment" and "Handling hydraulic equipment" (particularly gear oil and hydraulic oil).

1. POINTS TO REMEMBER WHEN HANDLING ELECTRIC EQUIPMENT

1) Handling wiring harnesses and connectors

Wiring harnesses consist of wiring connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protectors or tubes used for protecting the wiring.

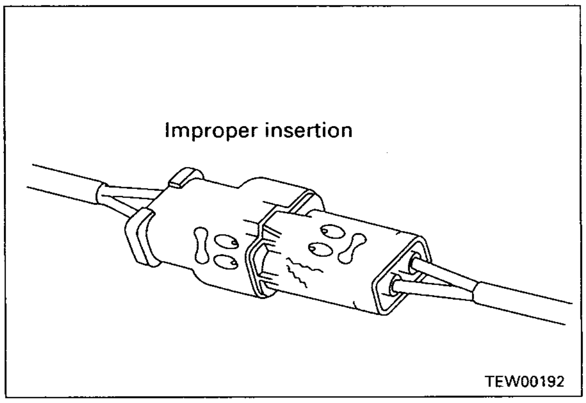
Compared with other electrical components fitted in boxes or cases, wiring harnesses are more likely to be affected by the direct effects of rain, water, heat, or vibration. Furthermore, during inspection and repair operations, they are frequently removed and installed again, so they are likely to suffer deformation or damage. For this reason, it is necessary to be extremely careful when handling wiring harnesses.


TEW00191

014012

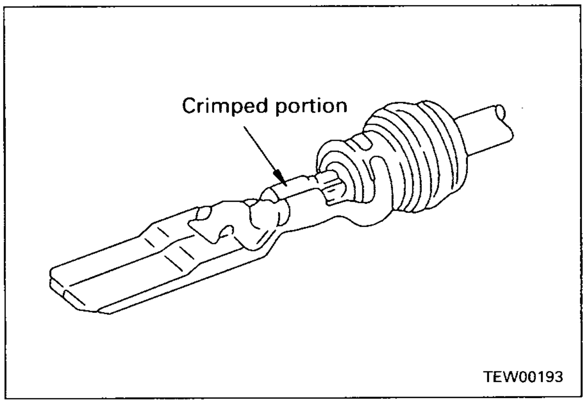
Main failures occurring in wiring harness

① Defective contact of connectors (defective contact between male and female)
Problems with defective contact are likely to occur because the male connector is not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned, or because there is corrosion or oxidization of the contact surfaces.



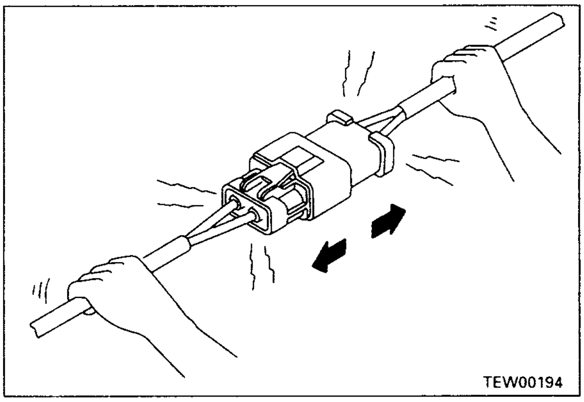
TEW00192

② Defective crimping or soldering of connectors
The pins of the male and female connectors are in contact at the crimped terminal or soldered portion, but if there is excessive force brought to bear on the wiring, the plating at the joint will peel and cause improper connection or breakage.

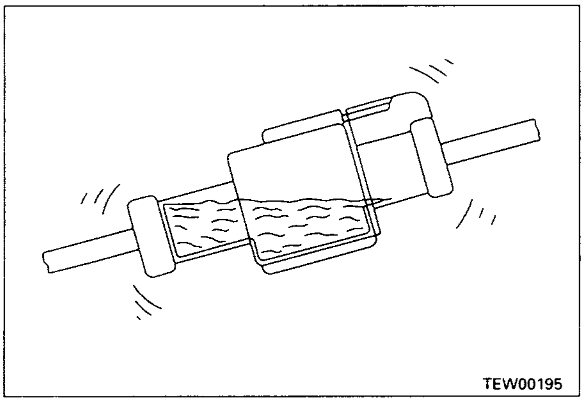


TEW00193

③ Disconnections in wiring
If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the crimping of the connector may separate, or the soldering may be damaged, or the wiring may be broken.


TEW00194

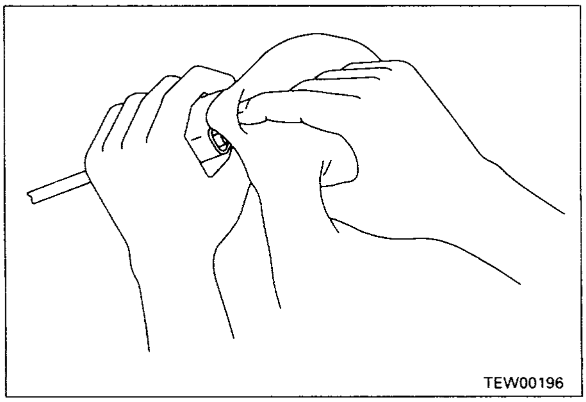
④ High-pressure water entering connector
The connector is designed to make it difficult for water to enter (drip-proof structure), but if high-pressure water is sprayed directly on the connector, water may enter the connector, depending on the direction of the water jet.
As already said, the connector is designed to prevent water from entering, but at the same time, if water does enter, it is difficult for it to be drained. Therefore, if water should get into the connector, the pins will be short-circuited by the water, so if any water gets in, immediately dry the connector or take other appropriate action before passing electricity through it.


TEW00195

⑤ Oil or dirt stuck to connector
If oil or grease are stuck to the connector and an oil film is formed on the mating surface between the male and female pins, the oil will not let the electricity pass, so there will be defective contact.
If there is oil or grease stuck to the connector, wipe it off with a dry cloth or blow it dry with compressed air and spray it with a contact restorer.

★ When wiping the mating portion of the connector, be careful not to use excessive force or deform the pins.

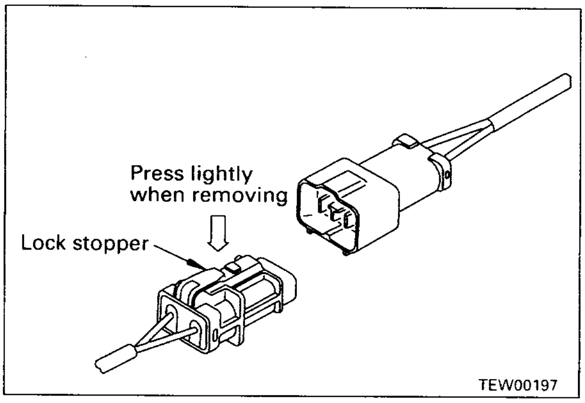
★ If there is oil or water in the compressed air, the contacts will become even dirtier, so remove the oil and water from the compressed air completely before cleaning with compressed air.


TEW00196

2) Removing, installing, and drying connectors and wiring harnesses

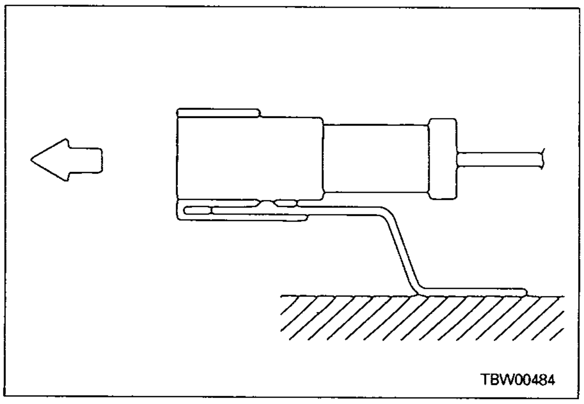
- **Disconnecting connectors**

① Hold the connectors when disconnecting.
When disconnecting the connectors, hold the connectors and not the wires. For connectors held by a screw, loosen the screw fully, then hold the male and female connectors in each hand and pull apart. For connectors which have a lock stopper, press down the stopper with your thumb and pull the connectors apart.
★ Never pull with one hand.



TEW00197

② When removing from clips
When removing a connector from a clip, pull the connector in a parallel direction to the clip.
★ If the connector is twisted up and down or to the left or right, the housing may break.



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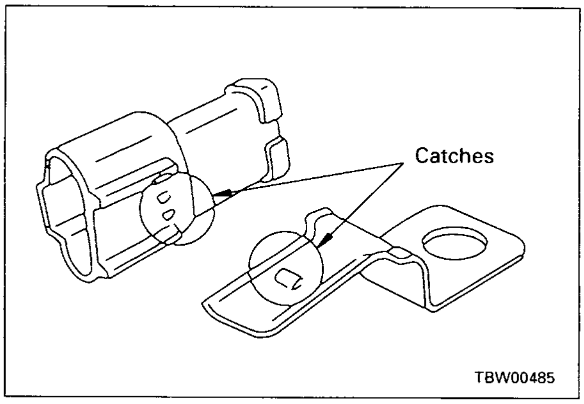
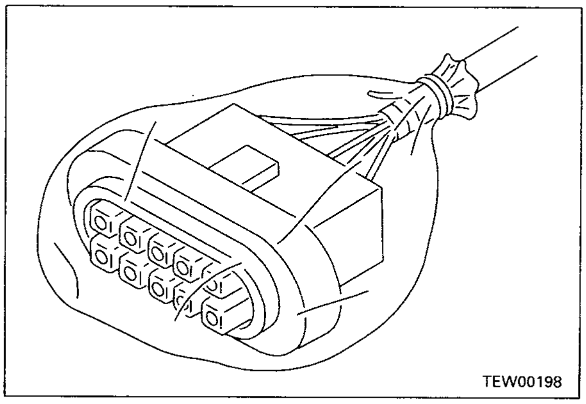


TBW00485

③ Action to take after removing connectors
After removing any connector, cover it with a vinyl bag to prevent any dust, dirt, oil, or water from getting in the connector portion.
★ If the machine is left disassembled for a long time, it is particularly easy for improper contact to occur, so always cover the connector.



TEW00198

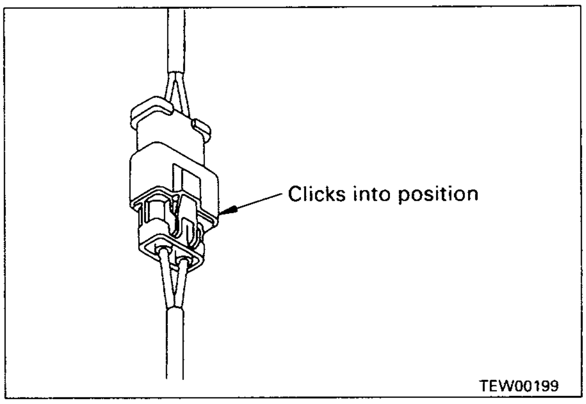
- **Connecting connectors**

① Check the connector visually.

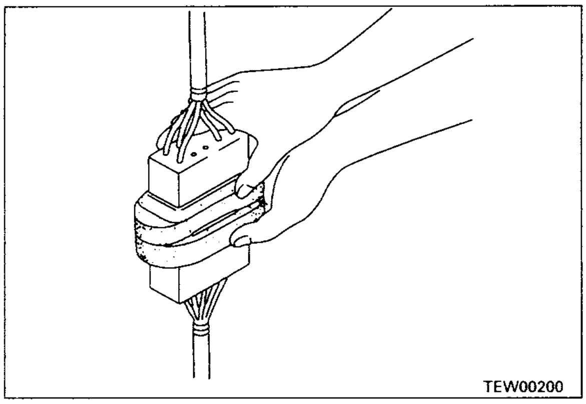
1) Check that there is no oil, dirt, or water stuck to the connector pins (mating portion).
2) Check that there is no deformation, defective contact, corrosion, or damage to the connector pins.
3) Check that there is no damage or breakage to the outside of the connector.

★ If there is any oil, water, or dirt stuck to the connector, wipe it off with a dry cloth. If any water has got inside the connector, warm the inside of the wiring with a dryer, but be careful not to make it too hot as this will cause short circuits.

★ If there is any damage or breakage, replace the connector.

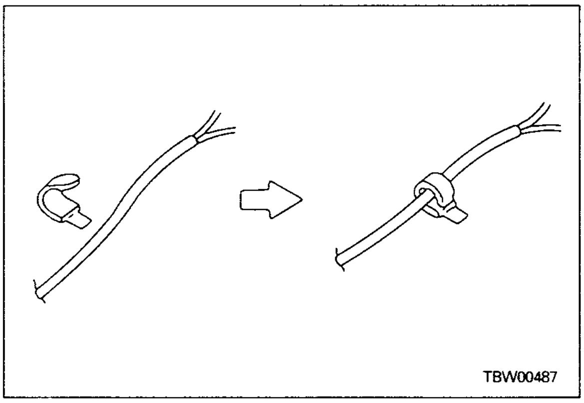


② Fix the connector securely.
Align the position of the connector correctly, then insert it securely.
For connectors with lock stopper, push in the connector until the stopper clicks into position.



③ Correct any protrusion of the boot and any misalignment of the wiring harness
For connectors fitted with boots, correct any protrusion of the boot. In addition, if the wiring harness is misaligned, or the clamp is out of position, adjust it to its correct position.

★ If the connector cannot be corrected easily, remove the clamp and adjust the position.



④ If the connector clamp has been removed, be sure to return it to its original position. Check also that there are no loose clamps.

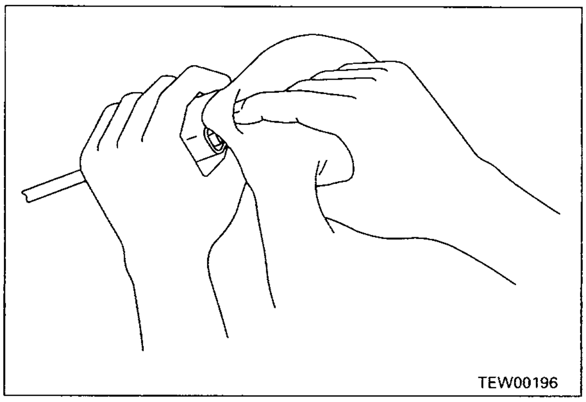
- **Drying wiring harness**

  If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high-pressure water or steam directly on the wiring harness.

  If water gets directly on the connector, do as follows.

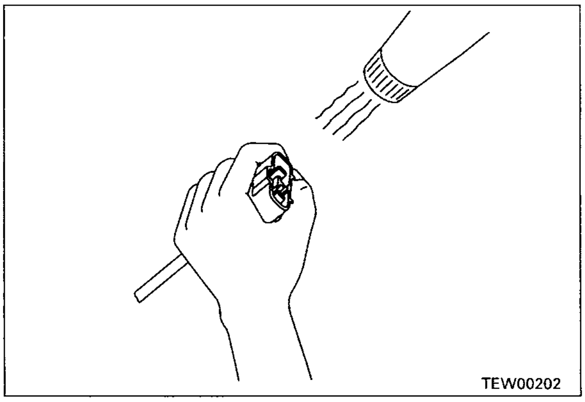
  ① Disconnect the connector and wipe off the water with a dry cloth.

  ★ If the connector is blown dry with compressed air, there is the risk that oil in the air may cause defective contact, so remove all oil and water from the compressed air before blowing with air.



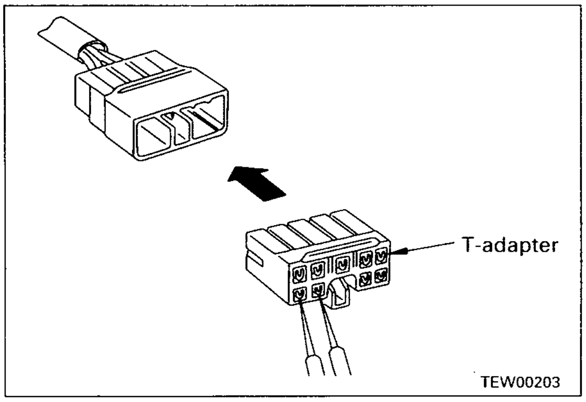
② Dry the inside of the connector with a dryer. If water gets inside the connector, use a dryer to dry the connector.

★ Hot air from the dryer can be used, but regulate the time that the hot air is used in order not to make the connector or related parts too hot, as this will cause deformation or damage to the connector.



③ Carry out a continuity test on the connector. After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.

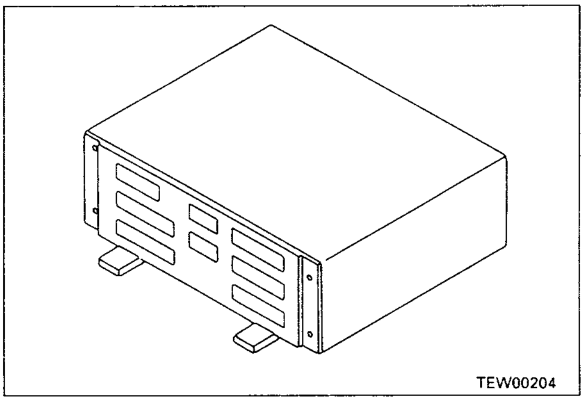
★ After completely drying the connector, blow it with contact restorer and reassemble.



3) Handling control box

① The control box contains a microcomputer and electronic control circuits. These control all of the electronic circuits on the machine, so be extremely careful when handling the control box.

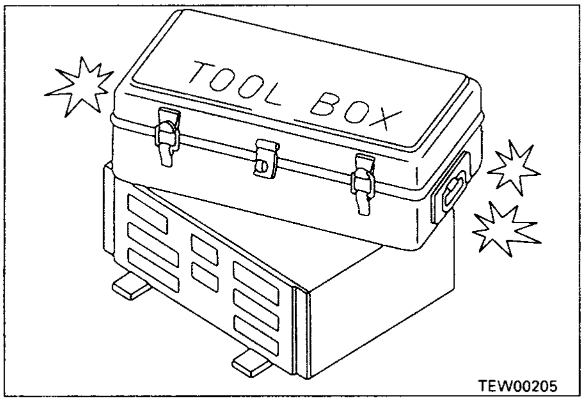
② Do not open the cover of the control box unless necessary.


TEW00204

③ Do not place objects on top of the control box.

④ Cover the control connectors with tape or a vinyl bag.
Never touch the connector contacts with your hand.

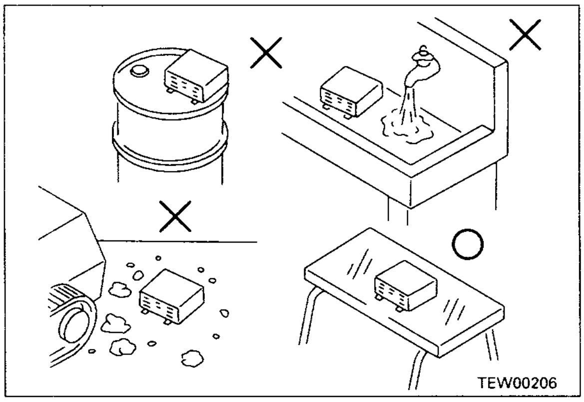
⑤ During rainy weather, do not leave the control box in a place where it is exposed to rain.



TEW00205

⑥ Do not place the control box on oil, water, or soil, or in any hot place, even for a short time.
(Place it on a suitable dry stand).

⑦ Precautions when carrying out arc welding
When carrying out arc welding on the body, disconnect all wiring harness connectors connected to the control box. Fit an arc welding ground close to the welding point.



TEW00206

2. Points to remember when troubleshooting electric circuits

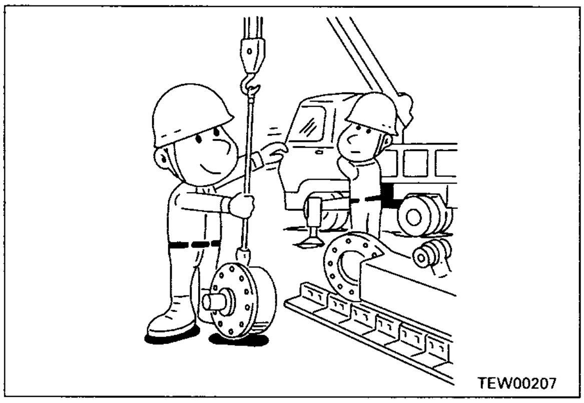
1) Always turn the power OFF before disconnecting or connect connectors.
2) Before carrying out troubleshooting, check that all the related connectors are properly inserted.
   ★ Disconnect and connect the related connectors several times to check.
3) Always connect any disconnected connectors before going on to the next step.
   ★ If the power is turned ON with the connectors still disconnected, unnecessary abnormality displays will be generated.
4) When carrying out troubleshooting of circuits (measuring the voltage, resistance, continuity, or current), move the related wiring and connectors several times and check that there is no change in the reading of the tester.
   ★ If there is any change, there is probably defective contact in that circuit.

3. POINTS TO REMEMBER WHEN HANDLING HYDRAULIC EQUIPMENT

With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

1) **Be careful of the operating environment.**
Avoid adding hydraulic oil, replacing filters, or repairing the machine in rain or high winds, or places where there is a lot of dust.

2) **Disassembly and maintenance work in the field**
If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to confirm the performance after repairs, so it is desirable to use unit exchange. Disassembly and main-tenance of hydraulic equipment should be carried out in a specially prepared dustproof workshop, and the performance should be confirmed with special test equipment.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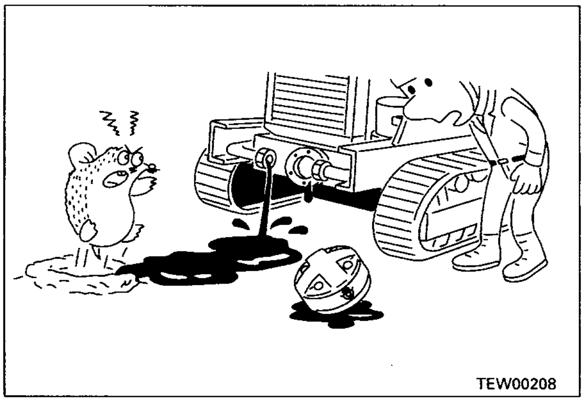
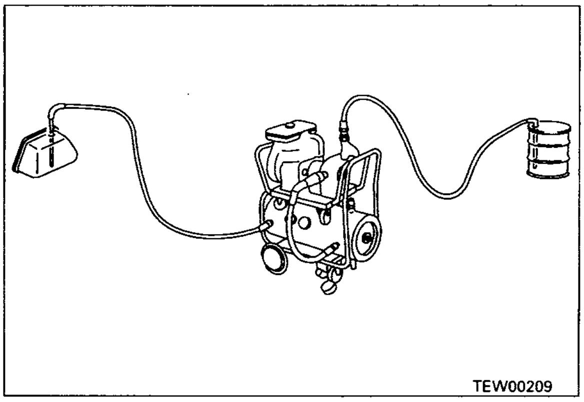
3) **Sealing openings**
After any piping or equipment is removed, the openings should be sealed with caps, tapes, or vinyl bags to prevent any dirt or dust from entering. If the opening is left open or is blocked with a rag, there is danger of dirt entering or of the surrounding area being made dirty by leaking oil so never do this.
Do not simply drain oil out on to the ground, collect it and ask the customer to dispose of it, or take it back with you for disposal.

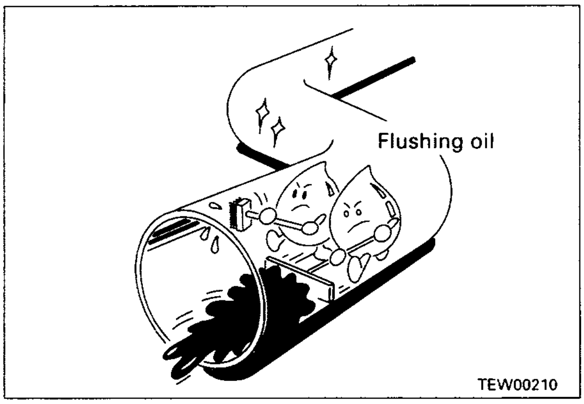

TEW00208

4) **Do not let any dirt or dust get in during refilling operations.**
Be careful not to let any dirt or dust get in when refilling with hydraulic oil. Always keep the oil filler and the area around it clean, and also use clean pumps and oil containers. If an oil cleaning device is used, it is possible to filter out the dirt that has collected during storage, so this is an even more effective method.


TEW00209

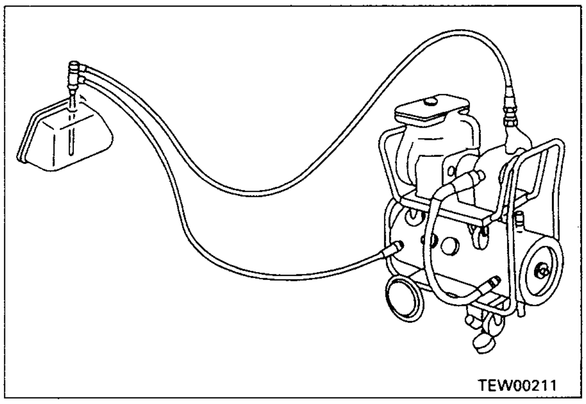
5) **Change hydraulic oil when the temperature is high.**
When hydraulic oil or other oil is warm, it flows easily. In addition, the sludge can also be drained out easily from the circuit together with the oil, so it is best to change the oil when it is still warm. When changing the oil, as much as possible of the old hydraulic oil must be drained out. (Do not drain the oil from the hydraulic tank; also drain the oil from the filter and from the drain plug in the circuit.) If any old oil is left, the contaminants and sludge in it will mix with the new oil and will shorten the life of the hydraulic oil.

6) **Flushing operations**
After disassembling and assembling the equipment, or changing the oil, use flushing oil to remove the contaminants, sludge, and old oil from the hydraulic circuit.
Normally, flushing is carried out twice: primary flushing is carried out with flushing oil, and secondary flushing is carried out with the specified hydraulic oil.



TEW00210

7) **Cleaning operations**
After repairing the hydraulic equipment (pump, control valve, etc.) or when running the machine, carry out oil cleaning to remove the sludge or contaminants in the hydraulic oil circuit.
The oil cleaning equipment is used to remove the ultrafine (about 3μ) particles that the filter built into the hydraulic equipment cannot remove, so it is an extremely effective device.



TEW00211

CHECKS BEFORE TROUBLESHOOTING

		Item	Judgement standard	Remedy
Checks before starting	Lubricating oil, cooling water	1. Check fuel level	—	Add fuel
		2. Check for dirt or water in fuel	—	Clean, drain
		3. Check hydraulic oil level	—	Add oil
		4. Check hydraulic oil strainer	—	Clean, drain
		5. Check power train oil level	—	Add oil
		6. Check engine oil level (level of oil in oil pan)	—	Add oil
		7. Check cooling water level	—	Add water
		8. Check condition of dust indicator	—	Clean or replace
	Electrical equipment	9. Check for loose or corroded battery terminals or wires	—	Tighten or replace
		10. Check for loose or corroded alternator terminals or wires	—	Tighten or replace
		11. Check for loose or cooroded starting motor terminals or wires	—	Tighten or replace
Other check items	Hydraulic machanical components	12. Check for abnormal noise or smell	—	Repair
		13. Check for oil leakage	—	Repair
		14. Bleed air from system	—	Bleed air
	Electrical components	15. Check battery voltage (engine stopped)	20 — 30 V	Replace
		16. Check level of battery electrolyte	—	Add or replace
		17. Check for discolored, burnt, or bare wiring	—	Replace
		18. Check for missing wiring clamps, hanging wires	—	Repair
		19. Checks for water leaking onto wiring (check carefully for water leakage at connectors and terminals)	—	Dry area around connector
		20. Check for broken or corroded fuses	—	Replace
		21. Check alternator voltage (engine running at over half throttle)	After running engine for several minutes 27.5 — 29.5 V	Replace
		22. Noise when battery relay is operated. (Turns starting switch ON — OFF)	—	Replace

014012

METHOD OF USING MATRIX TROUBLESHOOTING CHART

This troubleshooting chart is divided into three sections: **questions, check items, and troubleshooting.** The questions and check items are used to pinpoint high probability causes that can be located from the failure symptoms or simple inspection without using troubleshooting tools.

Next, troubleshooting tools or direct inspection are used to check the high probability causes to make final confirmation.

[Questions]

Sections Ⓐ + Ⓑ in the chart on the right corresponds to the items where answers can be obtained from the user. The items in Ⓑ are items that can be obtained from the user, depending on the user's level.

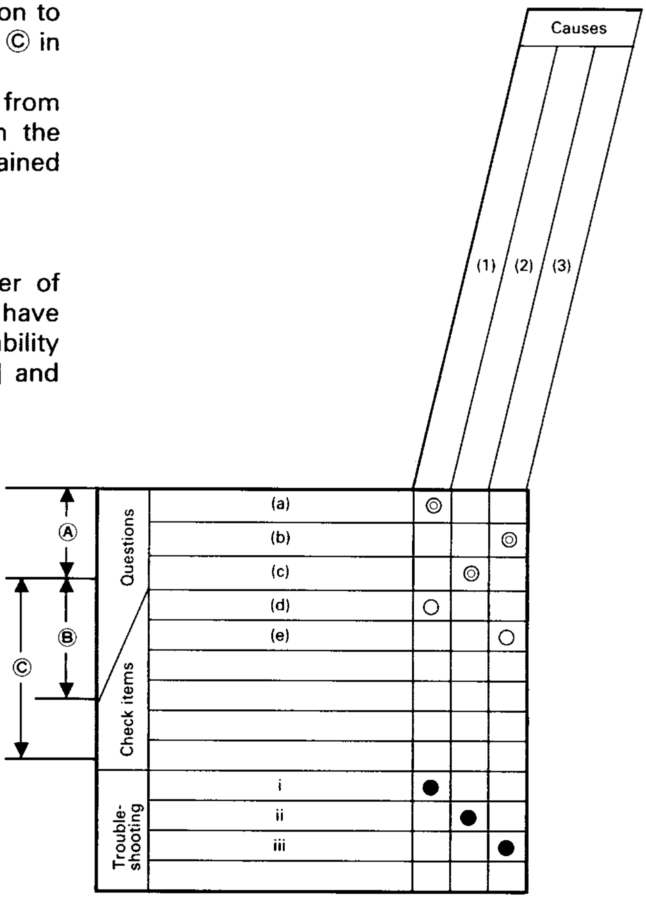
[Check items]

The serviceman carries out simple inspection to narrow down the causes. The items under Ⓒ in the chart on the right correspond to this.

The serviceman narrows down the causes from information Ⓐ that he has obtained from the user and the results of Ⓒ that he has obtained from his own inspection.

[Troubleshooting]

Troubleshooting is carried out in the order of probability, starting with the causes that have been marked as having the highest probability from information gained from **[Questions]** and **[Check items]**.



014012

The basic method of using the troubleshooting chart is as follows.

Items listed for **[Questions]** and **[Check items]** that have a relationship with the Cause items are marked with ○, and of these, causes that have a high probability are marked with ◎.

Check each of the **[Questions]** and **[Check items]** in turn, and marked the ○ or ◎ in the chart for items where the problem appeared. The vertical column (Causes) that has the highest number of points is the most probable cause, so start troubleshooting for that item to make final confirmation of the cause.

*1. For **[Confirm recent repair history]** in the **[Questions]** Section, ask the user, and mark the Cause column with △ to use as reference for locating the cause of the failure. However, do not use this when making calculations to narrow down the causes.

*2. Use the △ in the Cause column as reference for **[Degree of use (Operated for long period)]** in the **[Questions]** section as reference. As a rule, do not use it when calculating the points for locating the cause, but it can be included if necessary to determine the order for troubleshooting.

			Causes						
			Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)	
*1	Confirm recent repair history								
*2	Degree of use	Operated for long period		△	△	△			

014012

- **Example of troubleshooting when exhaust gas is black**

Let us assume that [Clogged air cleaner] is taken to be the cause of black exhaust gas. Three symptoms have causal relationship with this problem: [Exhaust gas slowly becomes black], [Power slowly became weaker], and [Dust indicator is red].

If we look from these three symptoms to find the causes, we find that there is a relationship with five causes. Let us explain here the method of using this causal relationship to pinpoint the most probable cause.

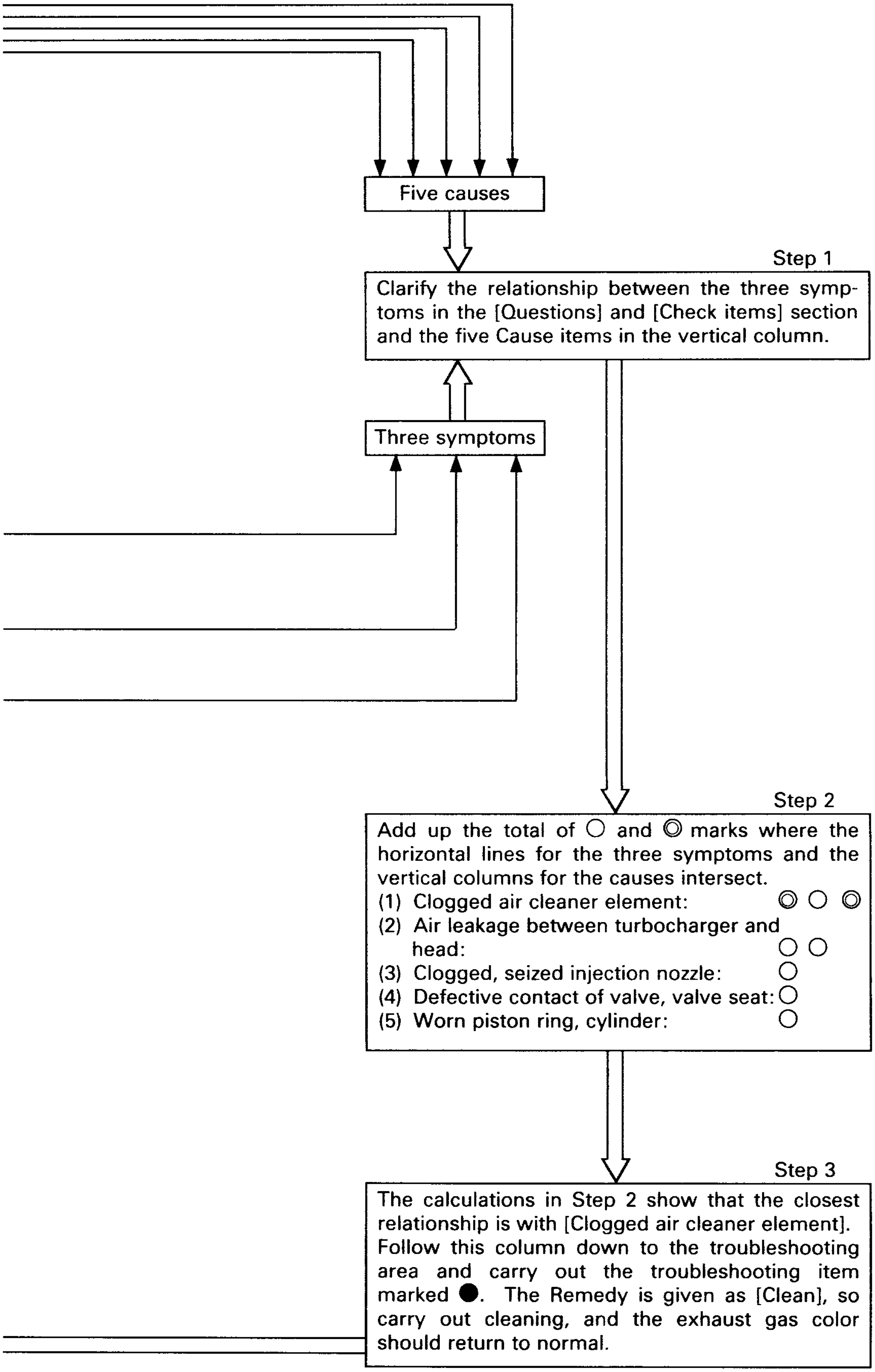
S-7 Exhaust gas is black (incomplete combustion)

General causes why exhaust gas is black

- Insufficient intake of air
- Improper condition of fuel injection
- Excessive injection of fuel

			Causes										
			Seized turbocharger, interference	**Clogged air cleaner element**	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)	Improper valve clearance	Crushed, clogged muffler	Leakage of air between turbocharger and head	Defective contact of valve, valve seat	Defective injection pump (rack, plunger seized)
Questions	Confirm recent repair history												
	Degree of use	Operated for long period		△	△	△						△	
	Color of exhaust gas	Suddenly became black	◎			○							○
		Gradually became black		◎		○					○		
		Blue under light load			◎								
	Engine oil must be added more frequently				◎								
	Power was lost	Suddenly	◎			○				○			○
		Gradually		○	○						○	○	
	Non-specified fuel has been used					○							○
Check items	Noise of interference is heard from around turbocharger		◎										
	Dust indicator is red			◎									
	Blow-by gas is excessive				◎								
	Engine pickup is poor and combustion is irregular		○			◎			○	○	○		○
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎							○
	Match marks on fuel injection pump are out of alignment						◎						
	Seal on injection pump has come off							◎					
	Clanging sound is heard from around cylinder head								◎				
	Exhaust noise is abnormal		○			○				◎			
	Muffler is crushed									◎			
	Leakage of air between turbocharger and head, loose clamp										◎		
Troubleshooting	When turbocharger is rotated by hand, it is found to be heavy		●										
	When air cleaner is inspected directly, it is found to be clogged			●									
	When compression pressure is measured, it is found to be low				●							●	
	Speed of some cylinders does not change when operating on reduced cylinders					●							
	When check is made using delivery method, injection timing is found to be incorrect						●						
	Injection pump test shows that injection amount is incorrect							●					
	When valve clearance is checked directly, it is found to be outside standard value								●				
	When muffler is removed, exhaust gas color returns to normal									●			
	When control rack is pushed, it is found to be heavy or does not return												●
	Remedy		Replace	**Clean**	Replace	Replace	Adjust	Adjust	Adjust	Replace	Repair	Replace	Replace

014012



Clarify the relationship between the three symptoms in the [Questions] and [Check items] section and the five Cause items in the vertical column.

Add up the total of ○ and ◎ marks where the horizontal lines for the three symptoms and the vertical columns for the causes intersect.

(1) Clogged air cleaner element: ◎ ○ ◎
(2) Air leakage between turbocharger and head: ○ ○
(3) Clogged, seized injection nozzle: ○
(4) Defective contact of valve, valve seat: ○
(5) Worn piston ring, cylinder: ○

The calculations in Step 2 show that the closest relationship is with [Clogged air cleaner element]. Follow this column down to the troubleshooting area and carry out the troubleshooting item marked ●. The Remedy is given as [Clean], so carry out cleaning, and the exhaust gas color should return to normal.

014012

METHOD OF USING TROUBLESHOOTING CHARTS

1. Category of troubleshooting code number

Troubleshooting code No.	Component
S–OO	Engine
H–OO	Power train, work equipment (Hydraulic, mechanical system)
E–OO	Electronic system
M–OO	Machine monitor

2. Method of using troubleshooting table

① Troubleshooting code number and problem

The top left of the troubleshooting chart gives the troubleshooting code number and the problem with the machine.

② Distinguishing condition

Even with the same problem, the method of troubleshooting may differ according to the model, component, or problem. In such cases, the troubleshooting chart is further divided into sections marked with small letters (for example, a)), so go to the appropriate section to carry out troubleshooting.

If the troubleshooting table is not divided into sections, start troubleshooting from the first check item.

③ Method of following troubleshooting chart

- Check or measure the item inside the box, and according to the answer follow either the YES line or the NO line to go to the next box. (Note: The number written at the top right corner of the box is an index number; it does not indicate the order to follow.)
- Following the YES or NO lines according to the results of the check or measurement will lead finally to the Cause column. Check the cause and take the action given in the Remedy column on the right.
- Below the box there are the methods for inspection or measurement, and the judgement values. If the judgement values below the box are correct or the answer to the question inside the box is YES, follow the YES line; if the judgement value is not correct, or the answer to the question is NO, follow the NO line.
- Below the box is given the preparatory work needed for inspection and measurement, and the judgement values. If this preparatory work is neglected, or the method of operation or handling is mistaken, there is danger that it may cause mistaken judgement, or the equipment may be damaged. Therefore, before starting inspection or measurement, always read the instructions carefully, and start the work in order form item 1).

④ General precautions

When using the troubleshooting chart, precautions that apply to all items are given at the top of the page and marked with ★. The precautions marked ★ are not given in the box, but must always be followed when carrying out the check inside the box.

⑤ Troubleshooting tools

When carrying out the troubleshooting, prepare the necessary troubleshooting tools. For details, see TOOLS FOR TESTING, ADJUSTING AND TROUBLESHOOTING.

⑥ Installation position, pin number

A diagram or chart is given for the connector type, installation position, and connector pin number connection table, so when carrying out troubleshooting, see this chart for details of the onnector pin number and location for details of the connector pin number and locations for inspection and measurement of wiring connector number OO appearing in the troubleshooting flow chart.

014012

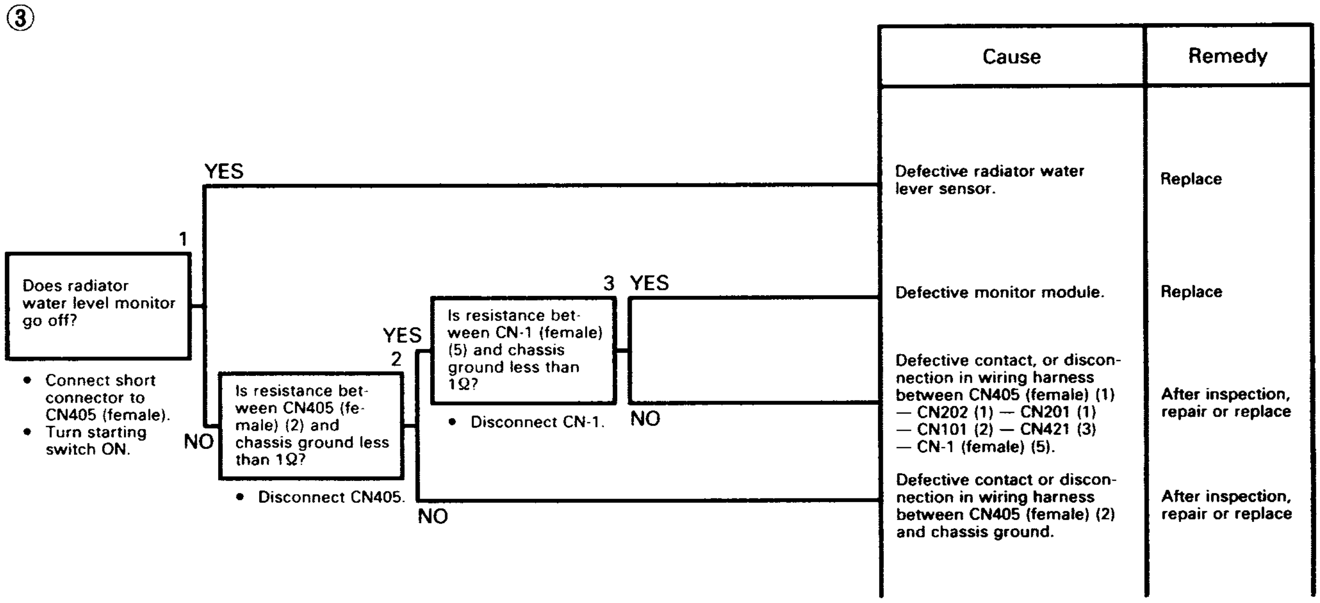
Example 1

① **M-3. When starting switch is ON (engine stopped), CHECK items shown abnormality**

② **a) Abnormality in radiator water level**

- **Radiator water level monitor flashes**

③



Cause	Remedy
Defective radiator water lever sensor.	Replace
Defective monitor module.	Replace
Defective contact, or disconnection in wiring harness between CN405 (female) (1) — CN202 (1) — CN201 (1) — CN101 (2) — CN421 (3) — CN-1 (female) (5).	After inspection, repair or replace
Defective contact or disconnection in wiring harness between CN405 (female) (2) and chassis ground.	After inspection, repair or replace

④ ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

TYPE OF CONNECTOR AND POSITION OF INSTALLATION

D65E-12 60001 - 60947 D65EX-12 60001 - 60941
D65P-12 60001 - 60890 D65PX-12 60001 - 60914

★ The ADDRESS column in this table shows the address in the connector position drawing (3-dimensional drawing).

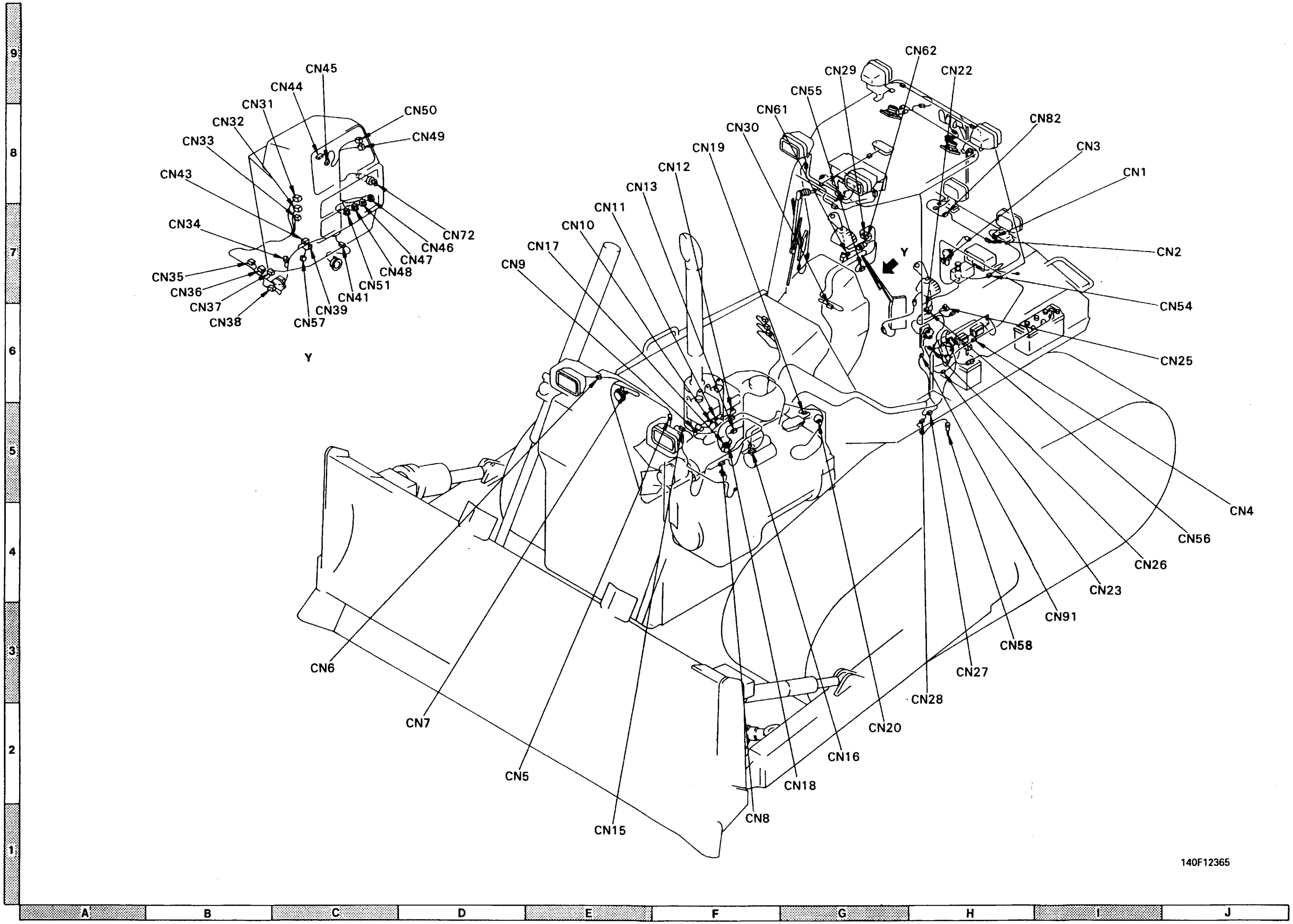
Connector No.	Connector type	No. of pins	Place of use	ADDRESS
CN1	M	1	Rear lamp	I-8
CN2	M	1	Rear lamp (additional)	I-7
CN3	X	2	Fuel lever sensor	I-8
CN4	X	4	Intermediate connector	J-4
CN5	M	1	Head lamp (left)	D-2
CN6	M	1	Head lamp (right)	C-3
CN7	KES	1	Horn	D-2
CN8	X	2	Intermediate connector	F-1
CN9	KES	2	Front washer tank (with cab)	D-7
CN10	KES	2	Front washer tank (with cab)	E-7
CN11	KES	2	Rear washer tank (with cab)	E-8
CN12	KES	2	Rear wsher tank (with cab)	F-8
CN13	SWP	6	Intermediate connector (with cab)	E-8
CN14	X	1	Air conditioner magnet clutch (with cab)	—
CN15	X	2	Coolant temperature sensor	E-1
CN16	X	2	Starting motor	G-2
CN17	SWP	6	Intermediate connector	E-7
CN18	L	1	Alternator	G-2
CN19	SWP	8	2 step set motor (Only D60)	F-8
CN20	SWP	8	Intermediate connector	G-2
CN22		1	Horn switch	H-9
CN23	X	3	Intermediate connector	I-4
CN24	—	—	—	—
CN25		1	Cab receptacle (to radio) (with cab)	I-6
CN26	KES	4	Cab washer switch (with cab)	I-4
CN27	X	3	Back up alarm limit switch	H-3
CN28	X	2	Intermediate connector	H-3
CN29		1	Pitch operation switch	G-9
CN30	X	3	Work equipment lock switch	F-8
CN31	SWP	16	Intermediate connector	B-9
CN32	SWP	16	Intermediate connector	B-8
CN33	X	4	Intermediate connector	B-8
CN35	—	6	2 step set relay (Only D60)	B-7
CN36	KES	4	Magnet relay (with cab)	B-7
CN37	KES	4	Air conditioner relay (with cab)	B-6
CN38	KES	3	Bimetal timer	B-6
CN39	KES	3	Blower resister (with cab)	C-6
CN41	M	2	Buzzer	C-7
CN43	KES	4	Thermostat, deal pressure switch (with cab)	B-8
CN44	KES	4	Blower switch (with cab)	C-9
CN45	KES	3	Air conditioner switch (with cab)	C-9
CN46	KES	4	Glow switch	D-7
CN47	KES	4	Lighting switch (Rear lamp)	D-7
CN48	KES	4	Lighting switch (Head lamp)	D-7
CN49	AMP040	16	Monitor panel	D-8
CN50	AMP040	12	Monitor panel	D-8
CN51	KES	4	2 step set switch (Only D60)	C-7
CN52	X	1	Pitch operation solenoid valve	—
CN53	X	1	Pitch operation solenoid valve	—
CN54		1	Back up alarm	I-7
CN55	X	3	Neutral safety switch	G-9
CN56		1	Horn switch	J-4
CN57	KES	2	Blower motor (with cab)	C-6
CN58	X	2	Power train oil temperature	H-3
CN60	X	3	Proximity switch	—
CN61	—	6	Neutral safety switch	F-8
CN62		1	Pitch operation switch	H-9
CN72	SWP	6	Starting switch (without cab)	D-7
CN81	X	1	Pump motor	—
CN82	KES	1	Rear lamp (additional)	I-8
CN91	X	3	Back up alarm limit switch	I-3

★ This table includes connectors that are not shown in the drawings.

★ CN52 and CN53 are exclusive for the D65P-12 and D65PX-12 power tilt, pitch dozer.

014012

CONNECTOR POSITION DRAWING



014012

TYPE OF CONNECTOR AND POSITION OF INSTALLATION

D65E-12 60948 – 65000
D65P-12 60891 – 65000
D65EX-12 60942 – 65000
D65PX-12 60915 – 65000

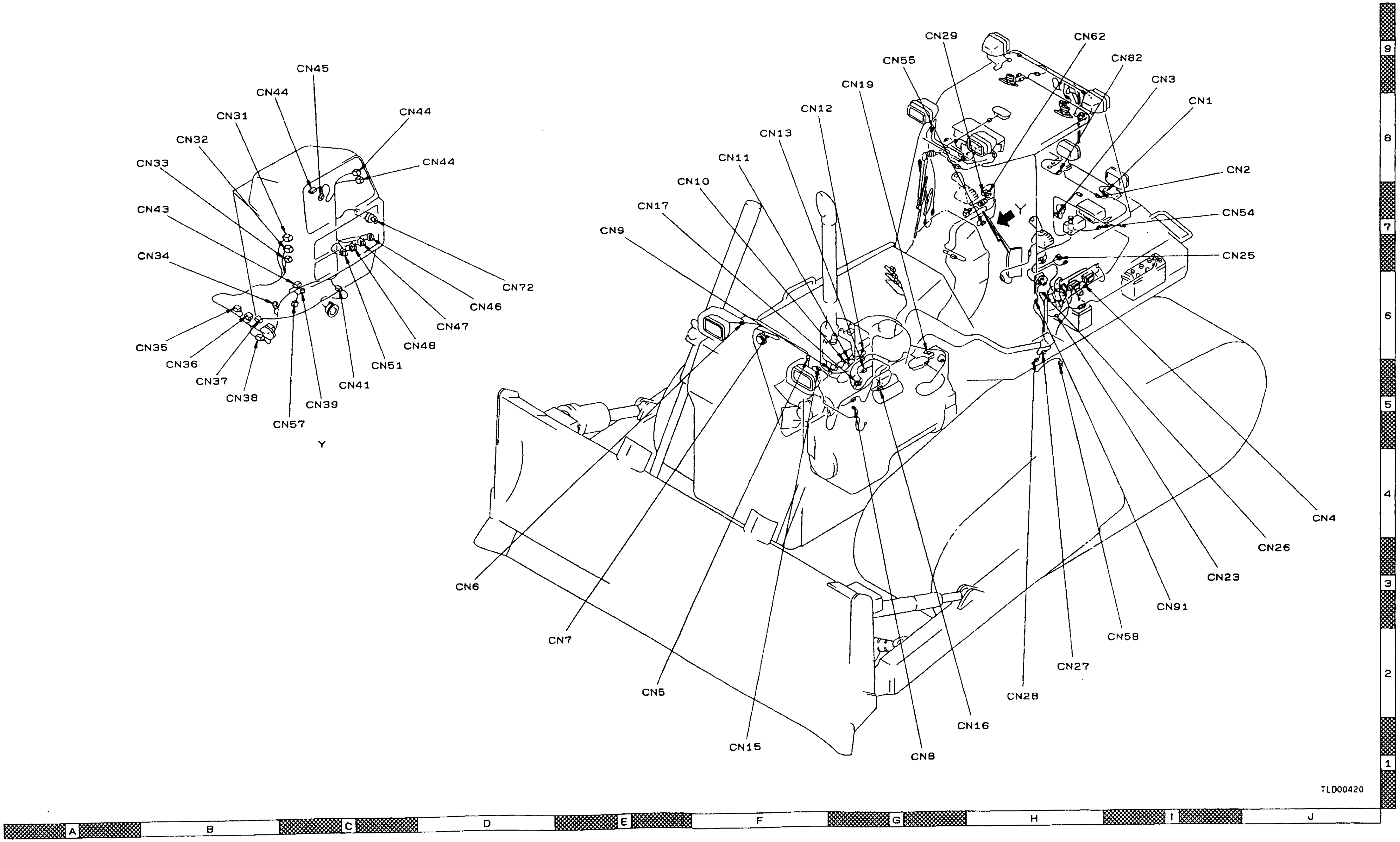
★ The ADDRESS column in this table shows the address in the connector position drawing (3-dimensional drawing).

Connector No.	Connector type	No. of pins	Place of use	ADDRESS
CN1	M	1	Rear lamp	I-8
CN2	M	1	Rear lamp (additional)	I-8
CN3	X	2	Fuel lever sensor	I-9
CN4	X	4	Intermediate connector	J-4
CN5	M	1	Head lamp (left)	E-2
CN6	M	1	Head lamp (right)	D-3
CN7	KES	1	Horn	E-2
CN8	X	2	Intermediate connector	G-1
CN9	KES	2	Front washer tank (with cab)	E-7
CN10	KES	2	Front washer tank (with cab)	E-8
CN11	KES	2	Rear washer tank (with cab)	F-8
CN12	KES	2	Rear wsher tank (with cab)	F-8
CN13	SWP	6	Intermediate connector (with cab)	F-8
CN14	X	1	Air conditioner magnet clutch (with cab)	—
CN15	X	2	Coolant temperature sensor	F-1
CN16	X	2	Starting motor	H-1
CN17	SWP	14	Intermediate connector	E-7
CN19	SWP	8	2 step set motor (Only D60)	G-9
CN23	X	3	Intermediate connector	I-3
CN24	X	2	Intermediate connector (for horn)	—
CN25		1	Cab receptacle (to radio) (with cab)	I-7
CN26	KES	4	Cab washer switch (with cab)	J-3
CN27	X	3	Back up alarm limit switch	H-2
CN28	X	2	Intermediate connector	H-2
CN29		1	Pitch operation switch	G-9
CN31	SWP	16	Intermediate connector	B-8
CN32	SWP	16	Intermediate connector	B-8
CN33	X	4	Intermediate connector	B-8
CN34	—	—	—	B-7
CN35	—	6	2 step set relay (Only D60)	B-6
CN36	KES	4	Magnet relay (with cab)	B-6
CN37	KES	4	Air conditioner relay (with cab)	B-5
CN38	KES	3	Bimetal timer	B-5
CN39	KES	3	Blower resister (with cab)	C-5
CN41	M	2	Buzzer	C-5
CN43	KES	4	Thermostat, deal pressure switch (with cab)	B-7
CN44	KES	4	Blower switch (with cab)	B-9 C-8
CN45	KES	3	Air conditioner switch (with cab)	C-9
CN46	KES	4	Glow switch	D-6
CN47	KES	4	Lighting switch (Rear lamp)	D-6
CN48	KES	4	Lighting switch (Head lamp)	D-6
CN49	AMP040	16	Monitor panel	—
CN50	AMP040	12	Monitor panel	—
CN51	KES	4	2 step set switch (Only D60)	C-6
CN52	X	1	Pitch operation solenoid valve	—
CN53	X	1	Pitch operation solenoid valve	—
CN54		1	Back up alarm	I-7
CN55	X	3	Neutral safety switch	G-9
CN57	KES	2	Blower motor (with cab)	C-5
CN58	X	2	Power train oil temperature	I-2
CN62		1	Pitch operation switch	H-9
CN72	SWP	6	Starting switch (without cab)	D-6
CN81	X	1	Pump motor	—
CN82	KES	1	Rear lamp (additional)	I-9
CN91	X	3	Back up alarm limit switch	I-3

★ This table includes connectors that are not shown in the drawings.

014012

CONNECTOR PISTON DRAWING



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D65E-12 65001 and up
D65P-12 65001 and up
D65EX-12 65001 and up
D65PX-12 65001 and up

★ The ADDRESS column in this table shows the address in the connector position drawing (3-dimensional drawing).

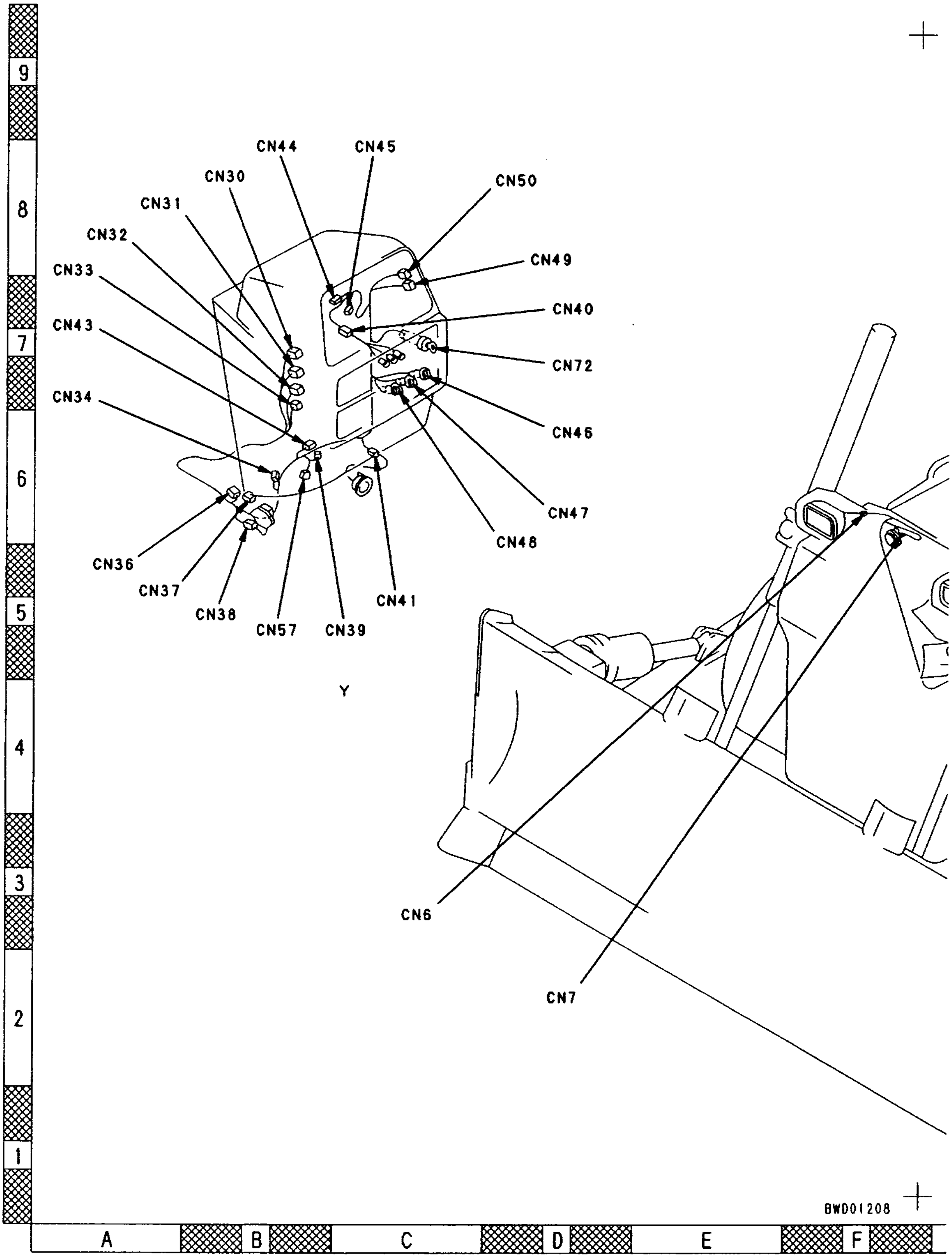
Connector No.	Connector type	No. of pins	Place of use	ADDRESS
CN1	DT	2	Rear lamp	K-8
CN2	DT	2	Rear lamp (additional)	L-8
CN3	DT	2	Fuel lever sensor	J-9
CN4	DT	4	Intermediate connector	L-5
CN5	DT	2	Head lamp (left)	G-8
CN6	DT	2	Head lamp (right)	C-3
CN7		2	Horn	D-2
CN8	DT	3	Intermediate connector	H-1
CN9	KES	2	Front washer tank (with cab)	H-1
CN10	KES	2	Front washer tank (with cab)	G-8
CN11	KES	2	Rear washer tank (with cab)	G-9
CN12	KES	2	Rear wsher tank (with cab)	H-9
CN13	SWP	6	Intermediate connector (with cab)	I-1
CN14	DT	2	Air conditioner magnet clutch (with cab)	—
CN15	DT	2	Coolant temperature sensor	G-1
CN16	DT	2	Starting motor	I-2
CN17	SWP	8	Intermediate connector	I-1
CN22	DT	2	Horn Switch	H-9
CN23	DT	3	Neutral safety switch	L-4
CN24	DTHD	1	Intermediate connector	—
CN25	DTHD	1	Cab receptacle (to radio) (with cab)	L-7
CN26	DT	4	Cab washer switch (with cab)	L-4
CN27	DT	3	Back up alarm limit switch	L-3
CN28	DT	2	Power train oil temperature	K-3
CN29	DT	2	Pitch operation switch	I-9
CN30	DT	3	Intermediate connector	B-8
CN31	SWP	12	Intermediate connector	A-8
CN32	SWP	12	Intermediate connector	A-8
CN33	DT	4	Intermediate connector	A-8

Connector No.	Connector type	No. of pins	Place of use	ADDRESS
CN34	—	—	★ Diode	A-7
CN36	KES	4	Magnet relay (with cab)	A-5
CN37	KES	4	Air conditioner relay (with cab)	A-5
CN38	DT	3	Bimetal timer	B-5
CN39	KES	3	Blower resister (with cab)	C-5
CN40	SWP	6	Speed indicator lamp	D-7
CN41	DT	2	Buzzer	C-5
CN43	KES	4	Thermostat, deal pressure switch (with cab)	A-7
CN44	KES	4	Blower switch (with cab)	B-8
CN45	KES	3	Air conditioner switch (with cab)	C-8
CN46	KES	4	Glow switch	D-6
CN47	KES	4	Lighting switch (Rear lamp)	D-6
CN48	KES	4	Lighting switch (Head lamp)	D-6
CN49	AMP040	15	Monitor panel	D-8
CN50	AMP040	12	Monitor panel	D-8
CN52	DT	2	Pitch operation solenoid valve	—
CN53	DT	2	Pitch operation solenoid valve	—
CN54	DT	2	Back up alarm	L-7
CN57	KES	2	Blower motor (with cab)	B-5
CN58	DT	1	Cab rereception	L-6
CN81	DT	2	Pump motor	—
CN82	DT	2	Rear lamp (additional)	J-9
CNLM1	DT	3	1st speed detection limit switch	L-6
CNLM3	DT	3	2nd speed detection limit switch	L-6

014012

★ This table includes connectors that are not shown in the drawings.

CONNECTOR POSITION DRAWING



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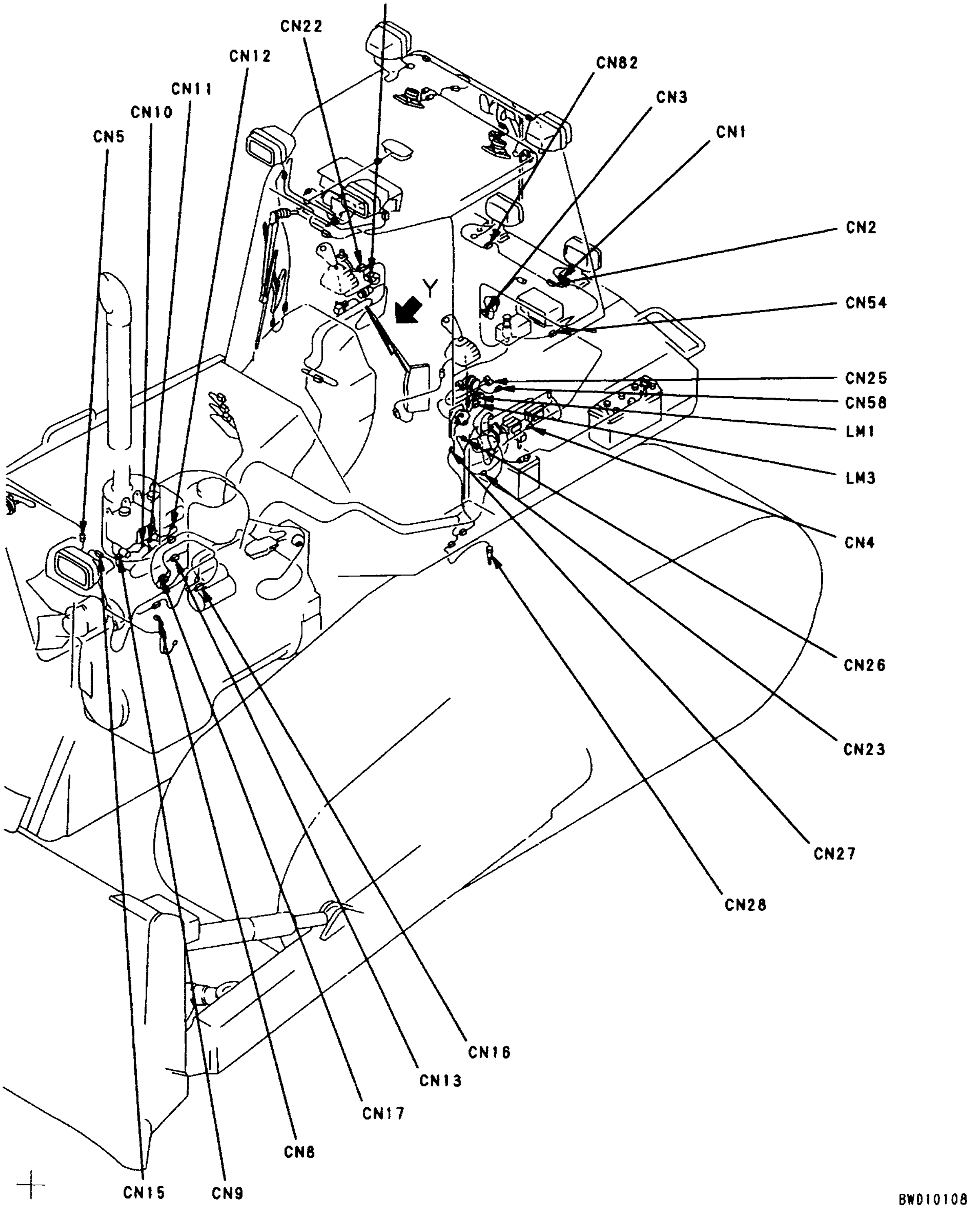
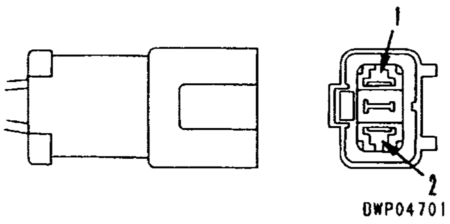
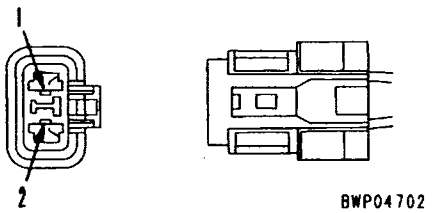
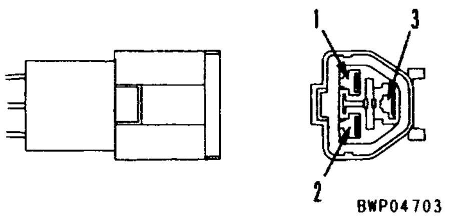
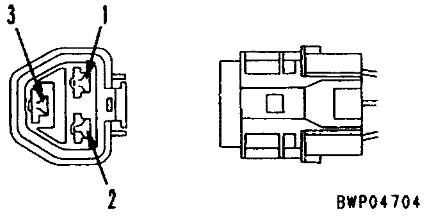
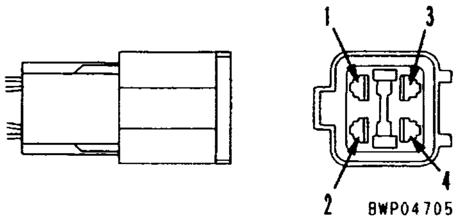
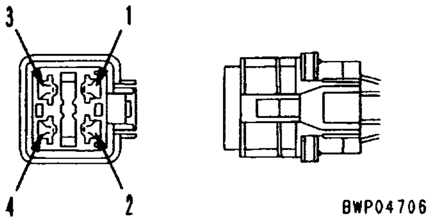

CN29
CN22
CN12
CN11
CN10
CN5
CN82
CN3
CN1
CN2
Y
CN54
CN25
CN58
LM1
LM3
CN4
CN26
CN23
CN27
CN28
CN16
CN13
CN17
CN8
CN15
CN9
BW010108

014012

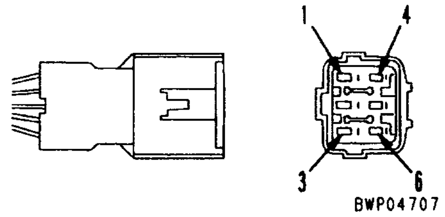
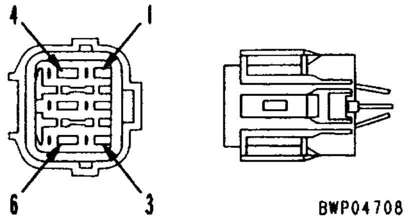
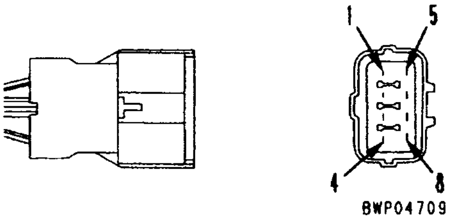
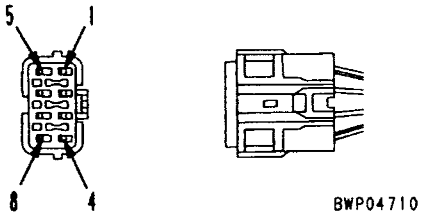
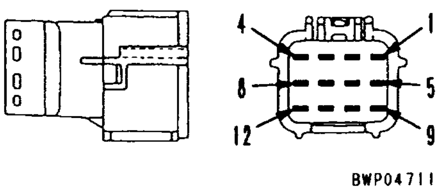
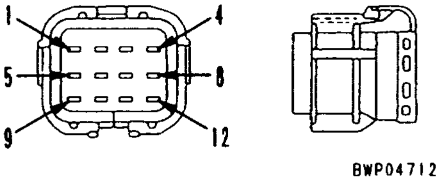
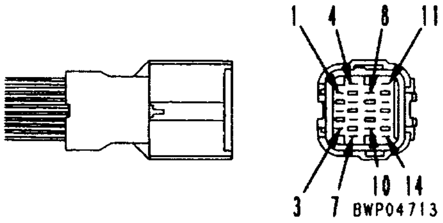
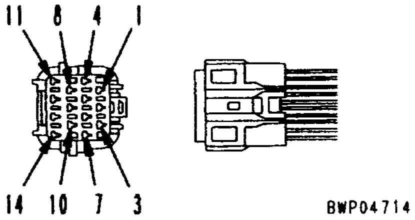
G
H
I
J
K
L

CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

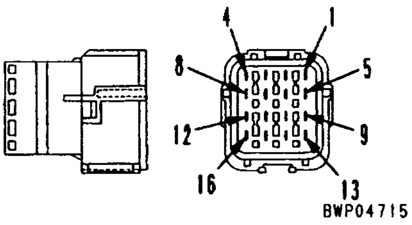
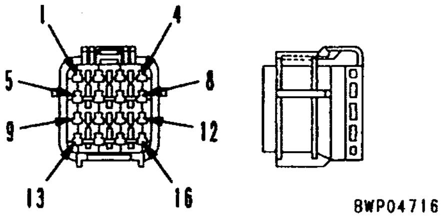
★ The terms male and female refer to the pins, while the terms male housing and female housing refer to the mating portion of the housing.

No. of pins	X type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
1	Part No.: 08055-00181	Part No.: 08055-00191	799-601-7010
2	 Part No.: 08055-00282	 Part No.: 08055-00292	799-601-7020
3	 Part No.: 08055-00381	 Part No.: 08055-00391	799-601-7030
4	 Part No.: 08055-00481	 Part No.: 08055-00491	799-601-7040
—	Terminal part No.: 79A-222-3370 • Electric wire size: 0.85 • Grommet: Black • Q'ty: 20	Terminal part No.: 79A-222-3390 • Electric wire size: 0.85 • Grommet: Black • Q'ty: 20	—
—	Terminal part No.: 79A-222-3380 • Electric wire size: 2.0 • Grommet: Red • Q'ty: 20	Terminal part No.: 79A-222-3410 • Electric wire size: 2.0 • Grommet: Red • Q'ty: 20	—

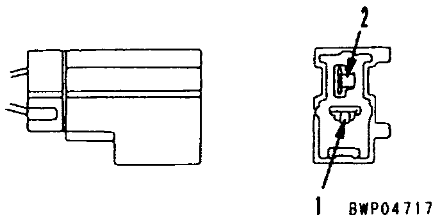
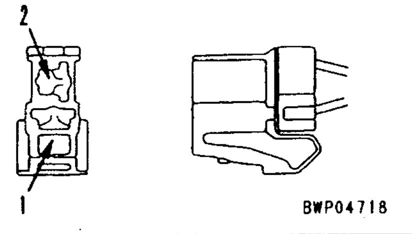
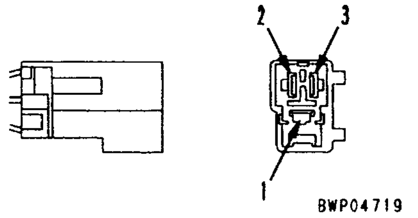
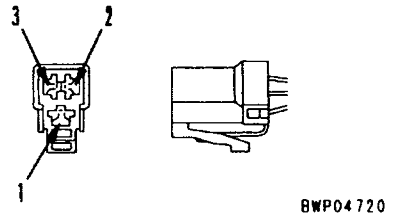
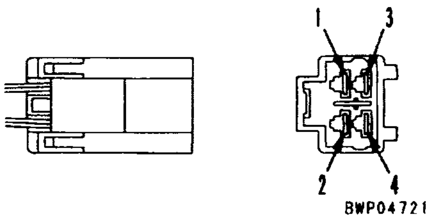
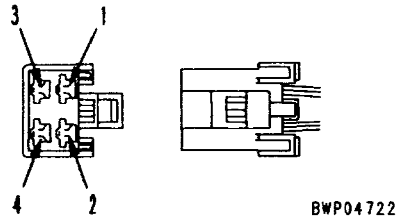
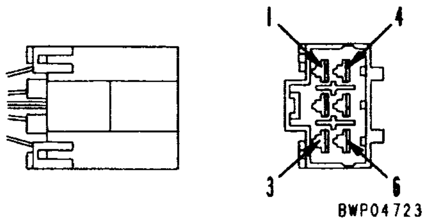
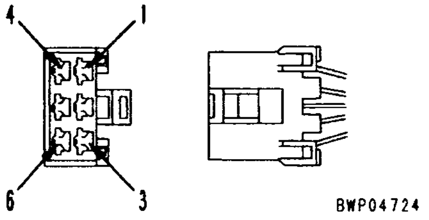
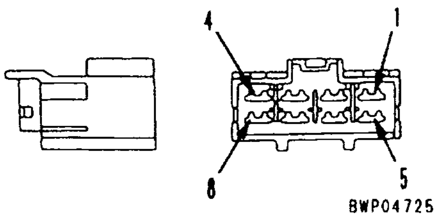
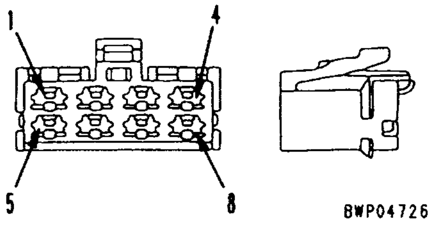
014012

No. of pins	SWP type connector		T-adapter Part No.
	Male (female housing)	Female (male housing)	
6			799-601-7050
	Part No.: 08055-10681	Part No.: 08055-10691	
8			799-601-7060
	Part No.: 08055-10881	Part No.: 08055-10891	
12			799-601-7310
	Part No.: 08055-11281	Part No.: 08055-11291	
14			799-601-7070
	Part No.: 08055-11481	Part No.: 08055-11491	

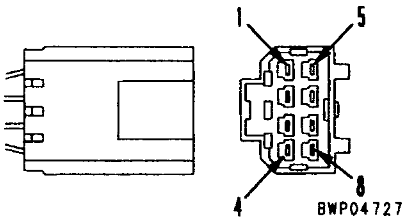
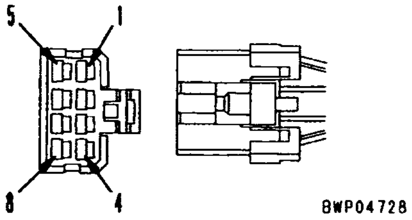
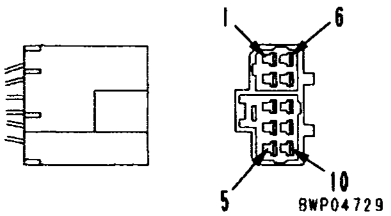
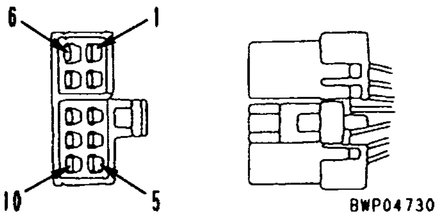
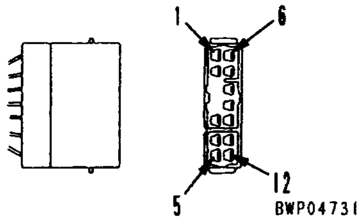
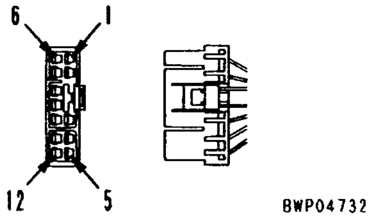
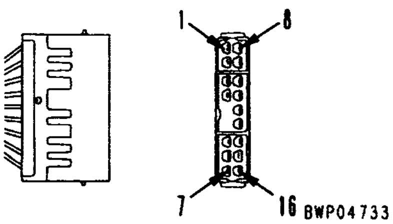
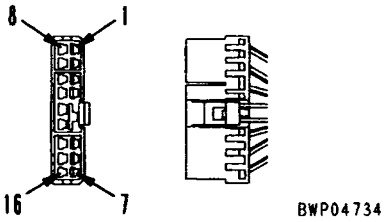
014012

No. of pins	X type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
16			799-601-7320
	Part No.: 08055-11681	Part No.: 08055-11691	
—	Terminal part No.: • Electric wire size: 0.85 • Grommet: Black • Q'ty: 20	Terminal part No.: • Electric wire size: 0.85 • Grommet: Black • Q'ty: 20	—
—	Terminal part No.: • Electric wire size: 1.25 • Grommet: Red • Q'ty: 20	Terminal part No.: • Electric wire size: 1.25 • Grommet: Red • Q'ty: 20	—

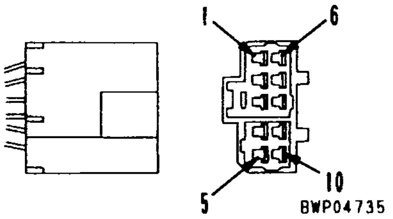
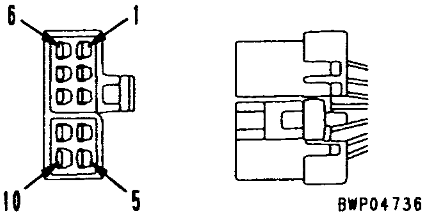
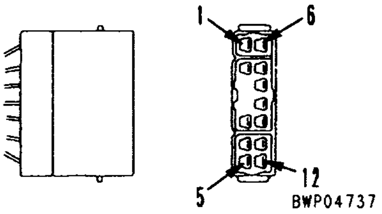
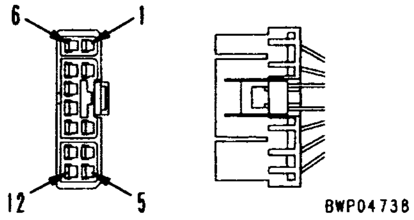
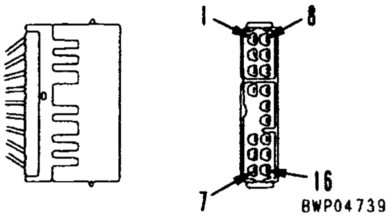
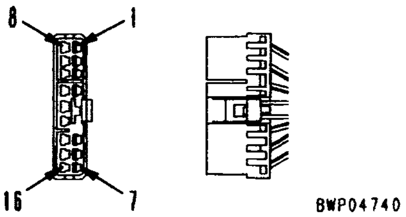
014012

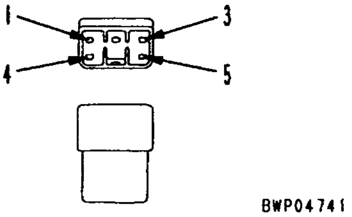
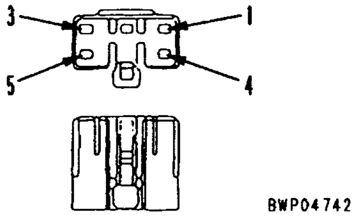
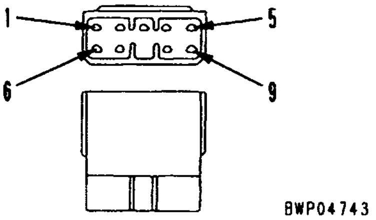
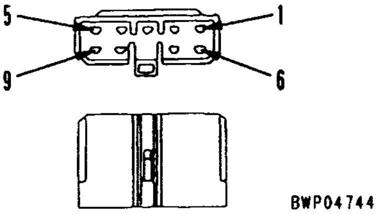
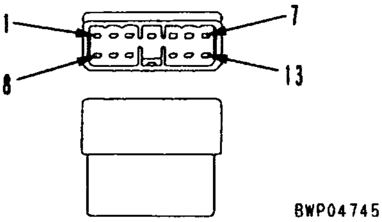
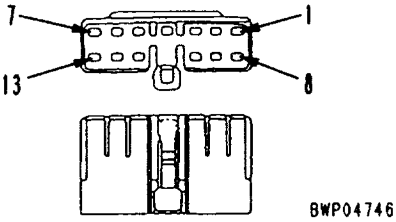
No. of pins	M type connector Male (female housing)	 Female (male housing)	 T-adapter Part No.
1	Part No.: 08056-00171	Part No.: 08056-00181	799-601-7080
2			799-601-7090
	Part No.: 08056-00271	Part No.: 08056-00281	
3			799-601-7110
	Part No.: 08056-00371	Part No.: 08056-00381	
4			799-601-7120
	Part No.: 08056-00471	Part No.: 08056-00481	
6			799-601-7130
	Part No.: 08056-00671	Part No.: 08056-00681	
8			799-601-7390
	Part No.: 08056-00871	Part No.: 08056-00881	

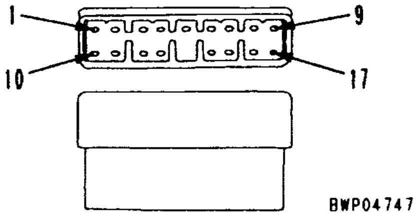
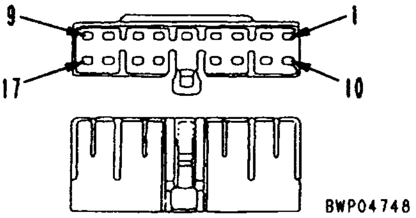
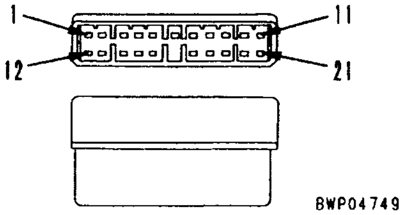
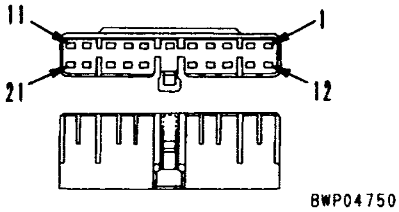
014012

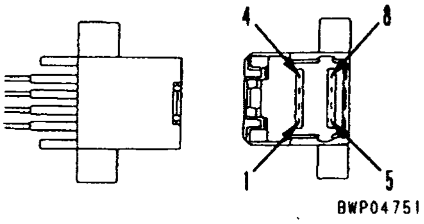
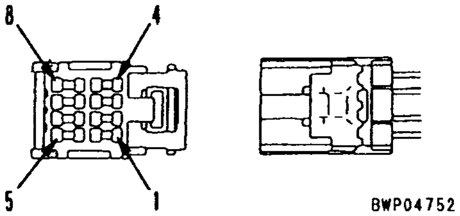
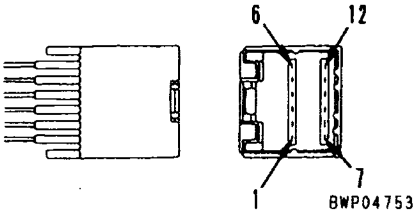
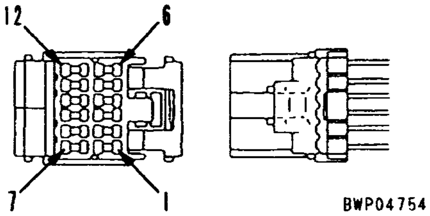
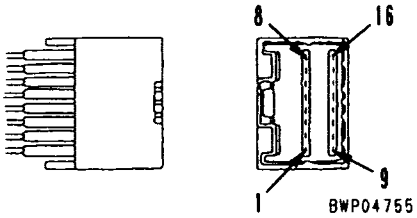
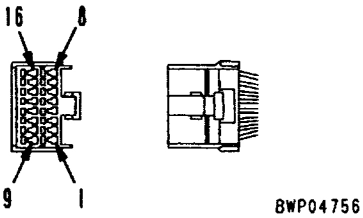
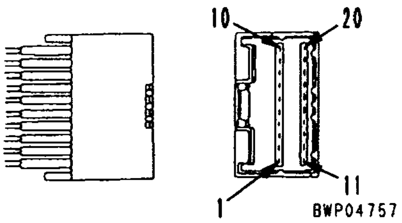
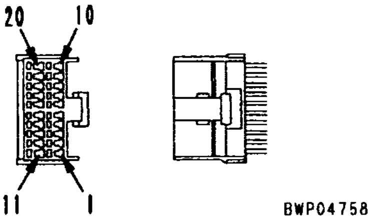
No. of pins	S type connector		T-adapter Part No.
	Male (female housing)	Female (male housing)	
8			799-601-7140
	Part No.: 080556-10871	Part No.: 08056-10881	
10 (White)			799-601-7150
	Part No.: 08056-11071	Part No.: 08056-11081	
12 (White)			799-601-7350
	Part No.: 08056-11271	Part No.: 08056-11281	
16 (White)			799-601-7330
	Part No.: 08056-11671	Part No.: 08056-11681	

014012

No. of pins	S type connector		T-adapter Part No.
	Male (female housing)	Female (male housing)	
10 (Blue)			—
	—	—	
12 (Blue)			799-601-7160
	Part No.: 08056-11272	Part No.: 08056-11282	
16 (Blue)			799-601-7170
	Part No.: 08056-11672	Part No.: 08056-11281682	

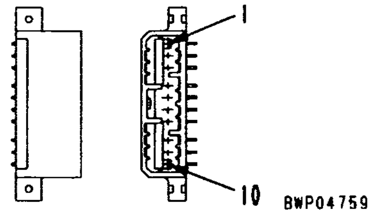
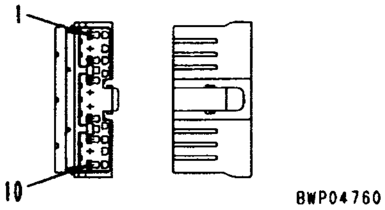
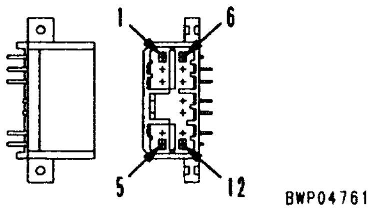
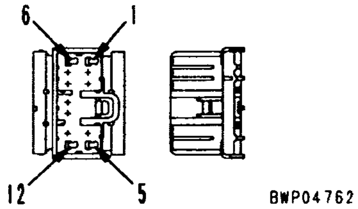
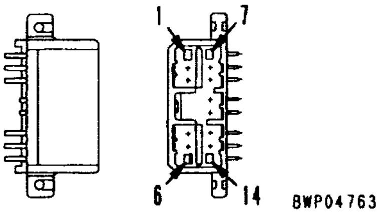
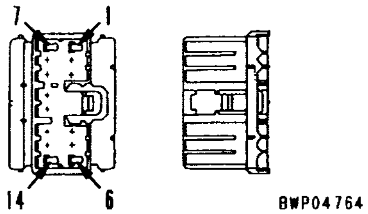
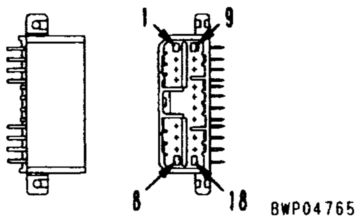
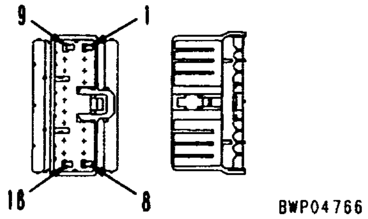
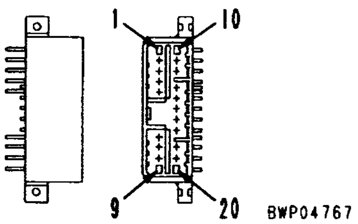
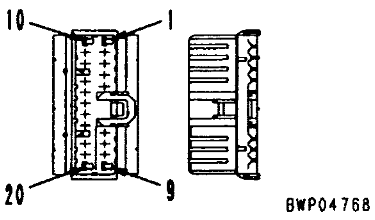
No. of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
7	Body part No.: 79A-222-2640 (Q'ty: 5)	Body part No.: 79A-222-2630 (Q'ty: 5)	—
11	Body part No.: 79A-222-2680 (Q'ty: 5)	Body part No.: 79A-222-2670 (Q'ty: 5)	—
5			799-601-2710
	Body part No.: 79A-222-2620 (Q'ty: 5)	Body part No.: 79A-222-2610 (Q'ty: 5)	
9			799-601-2950
	Body part No.: 79A-222-2660 (Q'ty: 5)	Body part No.: 79A-222-2650 (Q'ty: 5)	
13			799-601-2720
	Body part No.: 79A-222-2710 (Q'ty: 2)	Body part No.: 79A-222-2690 (Q'ty: 2)	

No. of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
17			799-601-2730
	Body part No.: 79A-222-2730 (Q'ty: 2)	Body part No.: 79A-222-2720 (Q'ty: 2)	
21			799-601-2740
	Body part No.: 79A-222-2750 (Q'ty: 2)	Body part No.: 79A-222-2740 (Q'ty: 2)	
	Terminal part No.: 79A-222-2770 (Q'ty: 50)	Body part No.: 79A-222-2760 (Q'ty: 50)	—

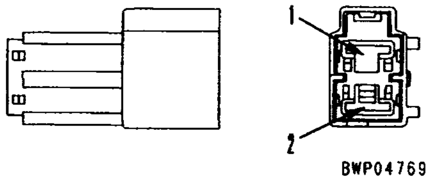
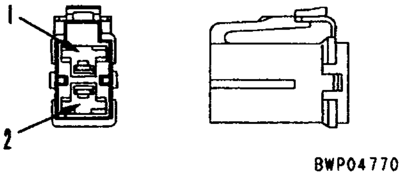
No. of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8			799-601-7180
	—	Housing part No.: 79A-222-3430 (Q'ty: 5)	
12			799-601-7190
	—	Housing part No.: 79A-222-3440 (Q'ty: 5)	
16			799-601-7210
	—	Housing part No.: 79A-222-3450 (Q'ty: 5)	
20			799-601-7220
	—	Housing part No.: 79A-222-3460 (Q'ty: 5)	

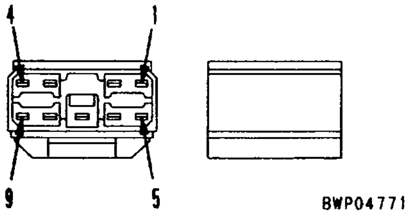
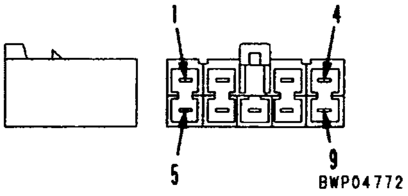
★ Terminal part No.: 79A-222-3470 (No relation with number of pins)

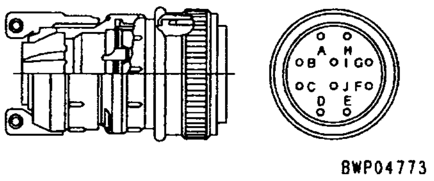
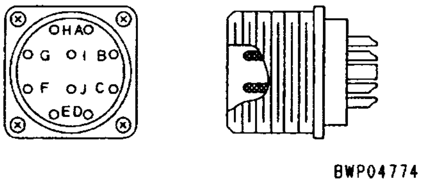
014012

No. of pins	AMP070 type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10			799-601-7510
	—	Part No.: 08195-10210	
10			799-601-7520
	—	Part No.: 08195-12210	
14			799-601-7530
	—	Part No.: 08195-14210	
18			799-601-7540
	—	Part No.: 08195-18210	
20			799-601-7550
	—	Part No.: 08195-10210	

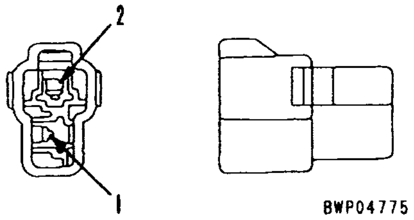
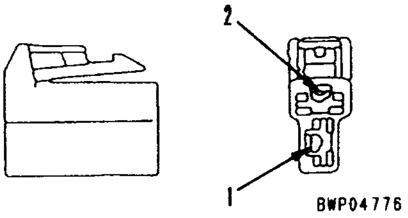
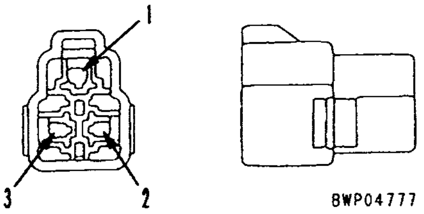
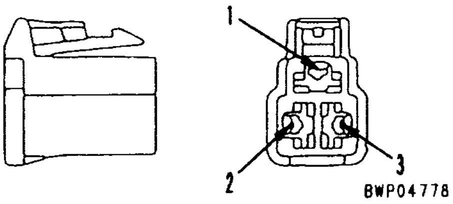
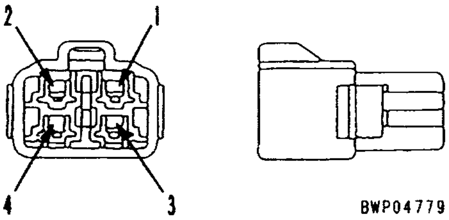
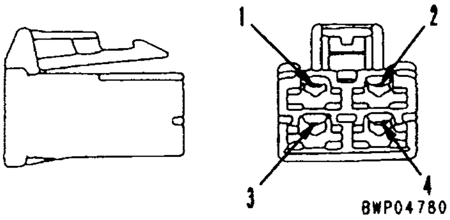
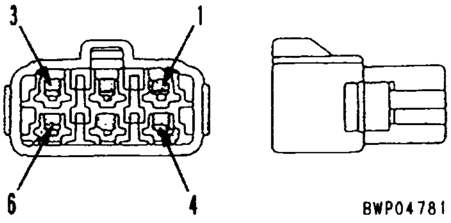
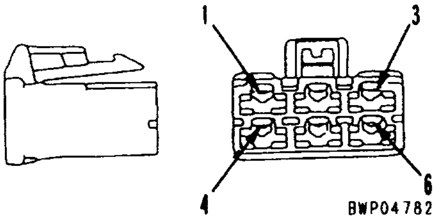
014012

No. of pins	L type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
2			—
	—	—	

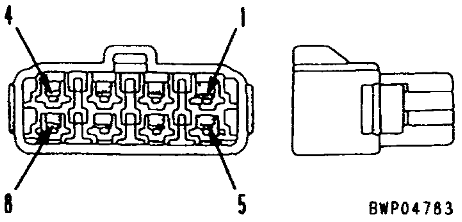
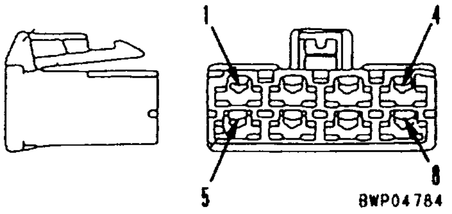
No. of pins	Connector for PA		
	Male (female housing)	Female (male housing)	T-adapter Part No.
9			—
	—	—	

No. of pins	Bendix MS connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10			799-601-3460
	—	—	

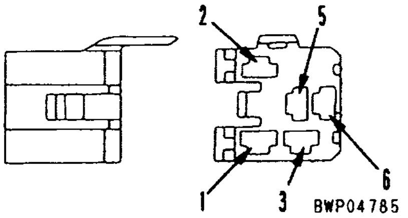
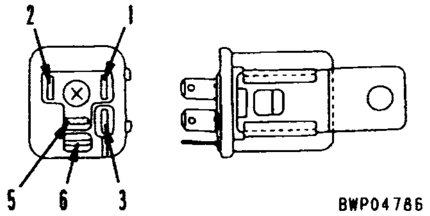
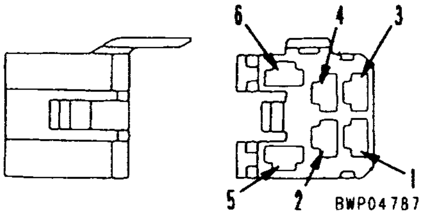
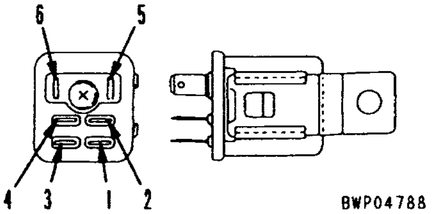
014012

No. of pins	KES 1 (Automobile) connector		T-adapter Part No.
	Male (female housing)	Female (male housing)	
2			—
	Part No.: 08027-10210 (Natural color) 08027-10220 (Black)	Part No.: 08027-10260 (Natural color) 08027-10270 (Black)	
3			—
	Part No.: 08027-10360	Part No.: 08027-10360	
4			—
	Part No.: 08027-10410 (Natural color) 08027-10420 (Black)	Part No.: 08027-10460 (Natural color) 08027-10470 (Black)	
6			—
	Part No.: 08027-10610 (Natural color) 08027-10620 (Black)	Part No.: 08027-10660 (Natural color) 08027-10670 (Black)	

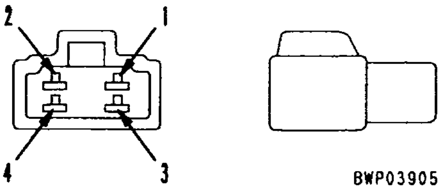
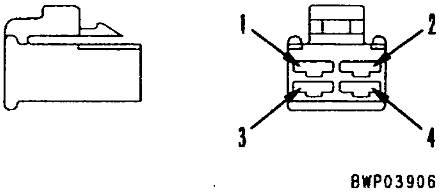
014012

No. of pins	KES 1 (Automobile) connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8			—
	Part No.: 08027-10810 (Natural color) 08027-10820 (Black)	Part No.: 08027-10860 (Natural color) 08027-10870 (Black)	

014012

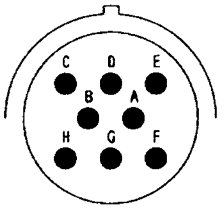
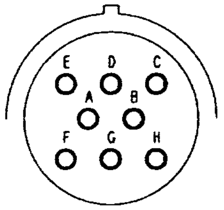
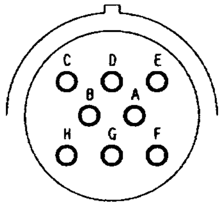
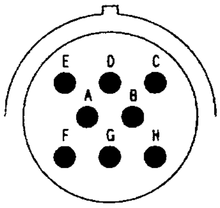
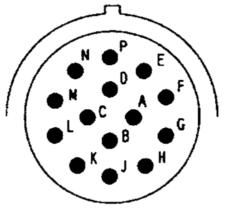
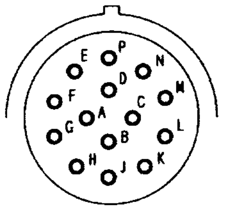
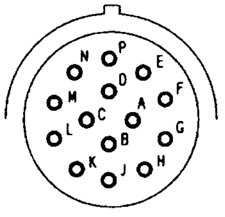
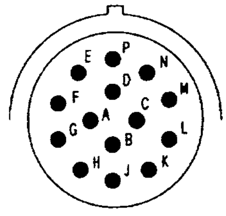
No. of pins	Connector for relay (Socket type)		T-adapter Part No.
	Male (female housing)	Female (male housing)	
5			799-601-7360
	—	—	
6			799-601-7370
	—	—	

014012

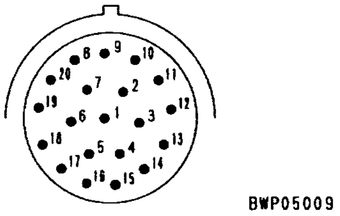
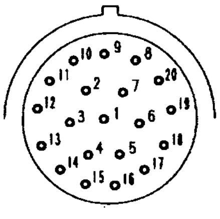
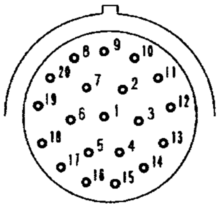
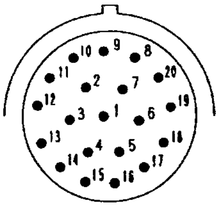
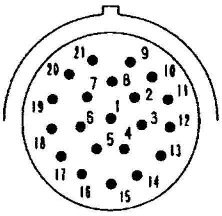
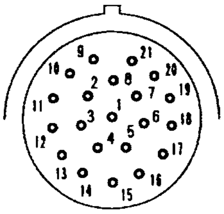
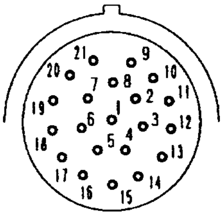
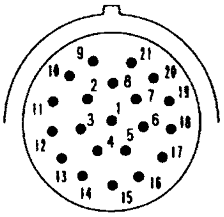
No. of pins	F type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
4			—
	—	—	

014012

[The pin No. is also marked on the connector (electric wire insertion end)]

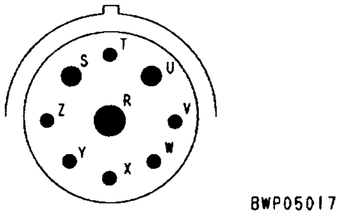
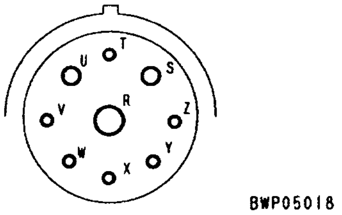
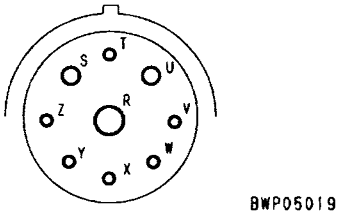
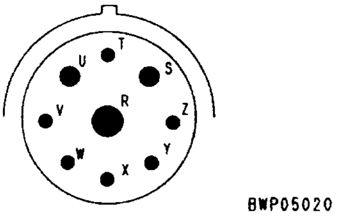
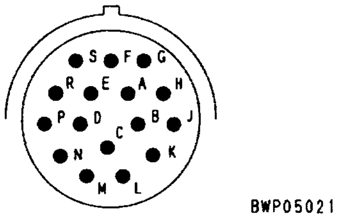
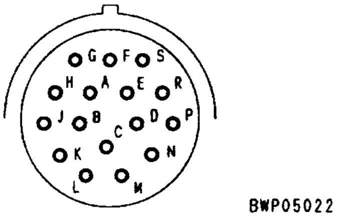
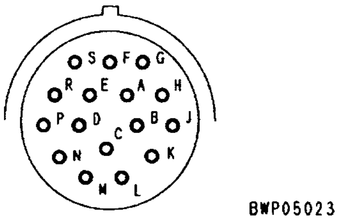
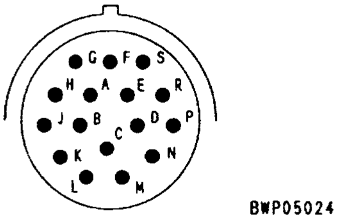
Type (shell size code)	HD30 Series connector		
	Body (Plug)	Body (receptacle)	T-adapter Part No.
18-8 (1)	Pin (male terminal)	Pin (female terminal)	799-601-9210
	 BWP05001	 BWP05002	
	Part No.: 08191-11201, 08191-11202, 08191-11205, 08191-11206	Part No.: 08191-14101, 08191-14102, 08191-14105, 08191-14106	
	Pin (female terminal)	Pin (male terminal)	799-601-9210
	 BWP05003	 BWP05004	
	Part No.: 08191-12201, 08191-12202, 08191-12205, 08191-12206	Part No.: 08191-13101, 08191-13102, 08191-13105, 08191-13106	
18-14 (2)	Pin (male terminal)	Pin (female terminal)	799-601-9220
	 BWP05005	 BWP05006	
	Part No.: 08191-21201, 08191-12202, 08191-21205, 08191-12206	Part No.: 08191-24101, 08191-24102, 08191-24105, 08191-24106	
	Pin (female terminal)	Pin (male terminal)	799-601-9230
	 BWP05007	 BWP05008	
	Part No.: 08191-22201, 08191-22202, 08191-22205, 08191-22206	Part No.: 08191-23101, 08191-23102, 08191-23105, 08191-23106	

[The pin No. is also marked on the connector (electric wire insertion end)]

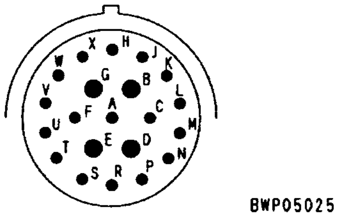
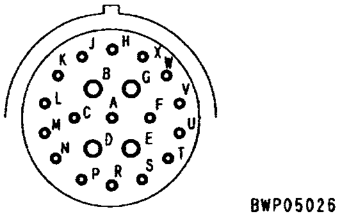
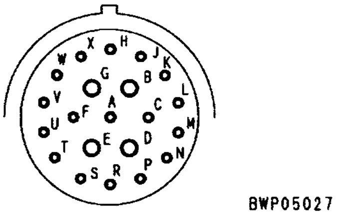
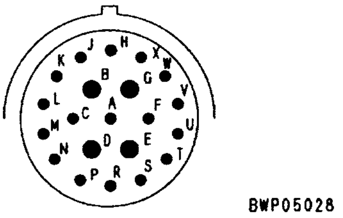
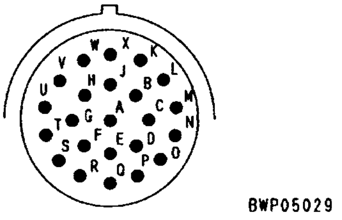
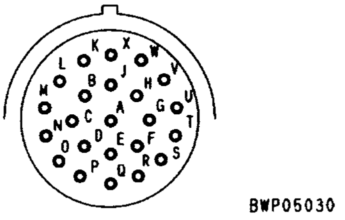
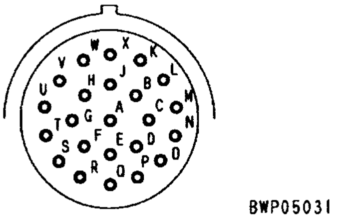
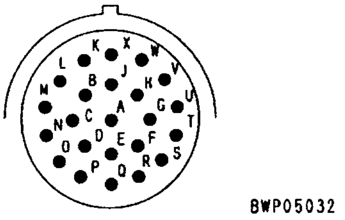
Type (shell size code)	HD30 Series connector		
	Body (Plug)	Body (receptacle)	T-adapter Part No.
18-20 (3)	Pin (male terminal)	Pin (female terminal)	799-601-9230
	 BWP05009	 BWP05010	
	Part No.: 08191-31201, 08191-31202	Part No.: 08191-34101, 08191-34102	
	Pin (female terminal)	Pin (male terminal)	799-601-9230
	 BWP05011	 BWP05012	
	Part No.: 08191-32201, 08191-32202	Part No.: 08191-33101, 08191-33102	
18-21 (4)	Pin (male terminal)	Pin (female terminal)	799-601-9240
	 BWP05013	 BWP05014	
	Part No.: 08191-41201, 08191-42202	Part No.: 08191-44101, 08191-44102	
	Pin (female terminal)	Pin (male terminal)	799-601-9240
	 BWP05015	 BWP05016	
	Part No.: 08191-42201, 08191-42202	Part No.: 08191-43101, 08191-43102	

014012

[The pin No. is also marked on the connector (electric wire insertion end)]

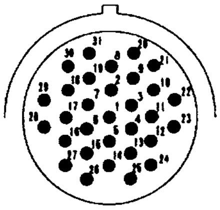
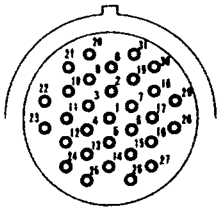
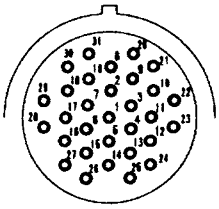
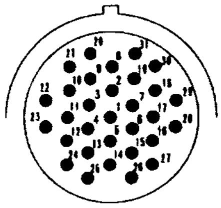
Type (shell size code)	HD30 Series connector		
	Body (Plug)	Body (receptacle)	T-adapter Part No.
24-9 (5)	Pin (male terminal)	Pin (female terminal)	799-601-9250
			
	Part No.: 08191-51201, 08191-51202	Part No.: 08191-54101, 08191-54102	
	Pin (female terminal)	Pin (male terminal)	799-601-9250
			
	Part No.: 08191-52201, 08191-52202	Part No.: 08191-53101, 08191-53102	
24-16 (6)	Pin (male terminal)	Pin (female terminal)	799-601-9260
			
	Part No.: 08191-61201, 08191-62202, 08191-61205, 08191-62206	Part No.: 08191-64101, 08191-64102, 08191-64105, 08191-64106	
	Pin (female terminal)	Pin (male terminal)	799-601-9260
			
	Part No.: 08191-62201, 08191-62202, 08191-62205, 08191-62206	Part No.: 08191-63101, 08191-63102, 08191-63105, 08191-63106	

[The pin No. is also marked on the connector (electric wire insertion end)]

Type (shell size code)	HD30 Series connector		T-adapter Part No.
	Body (Plug)	Body (receptacle)	
24-21 (7)	Pin (male terminal)	Pin (female terminal)	799-601-9270
			
	Part No.: 08191-71201, 08191-71202, 08191-17205, 08191-71206	Part No.: 08191-74101, 08191-74102, 08191-74105, 08191-74106	
	Pin (female terminal)	Pin (male terminal)	799-601-9270
			
	Part No.: 08191-72201, 08191-72202, 08191-72205, 08191-72206	Part No.: 08191-73101, 08191-73102, 08191-73105, 08191-73106	
24-22 (8)	Pin (male terminal)	Pin (female terminal)	799-601-9280
			
	Part No.: 08191-81201, 08191-81202, 08191-81203, 08191-81204, 08191-81205, 08191-81206	Part No.: 08191-84101, 08191-84102, 08191-84103, 08191-84104, 08191-84105, 08191-84106	
	Pin (female terminal)	Pin (male terminal)	799-601-9280
			
	Part No.: 08191-82201, 08191-82202, 08191-82203, 08191-82204, 08191-82205, 08191-82206	Part No.: 08191-83101, 08191-83102, 08191-83103, 08191-83104, 08191-83105, 08191-83106	

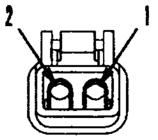
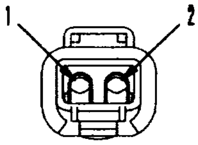
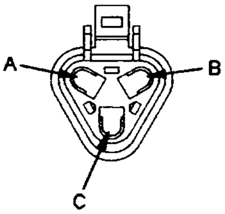
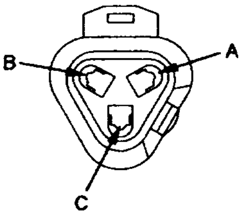
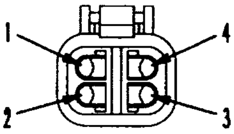
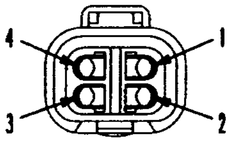
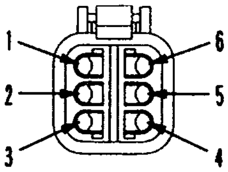
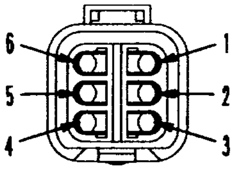
014012

[The pin No. is also marked on the connector (electric wire insertion end)]

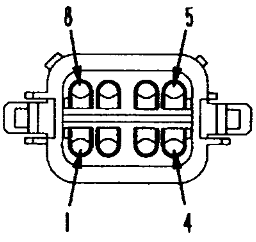
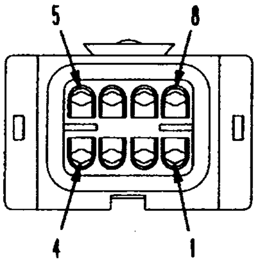
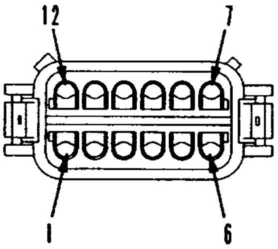
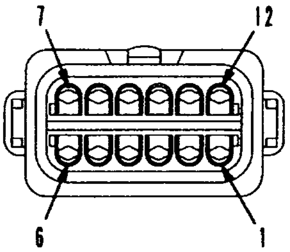
Type (shell size code)	HD30 Series connector		
	Body (Plug)	Body (receptacle)	T-adapter Part No.
24-31 (9)	Pin (male terminal)	Pin (female terminal)	799-601-9290
	 BWP05033	 BWP05034	
	Part No.: 08191-91203, 08191-91204, 08191-97205, 08191-91206	Part No.: 08191-94103, 08191-94104, 08191-94105, 08191-94106	
	Pin (female terminal)	Pin (male terminal)	799-601-9290
	 BWP05035	 BWP05036	
	Part No.: 08191-92203, 08191-92204, 08191-92205, 08191-92206	Part No.: 08191-93103, 08191-93104, 08191-93105, 08191-93106	

014012

[The pin No. is also marked on the connector (electric wire insertion end)]

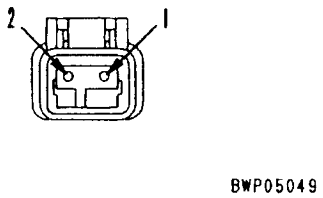
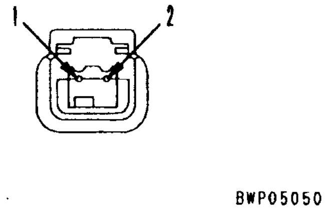
No. of pins	DT Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
2			799-601-9020
	Part No.: 08192-12200 (normal type) 08192-22200 (fine wire type)	Part No.: 08192-12100 (normal type) 08192-22100 (fine wire type)	
3			799-601-9030
	Part No.: 08192-13200 (normal type) 08192-23200 (fine wire type)	Part No.: 08192-13100 (normal type) 08192-23100 (fine wire type)	
4			799-601-9040
	Part No.: 08192-14200 (normal type) 08192-24200 (fine wire type)	Part No.: 08192-14100 (normal type) 08192-24100 (fine wire type)	
6			799-601-9050
	Part No.: 08192-16200 (normal type) 08192-26200 (fine wire type)	Part No.: 08192-16100 (normal type) 08192-26100 (fine wire type)	

[The pin No. is also marked on the connector (electric wire insertion end)]

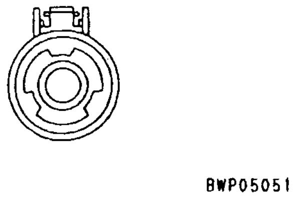
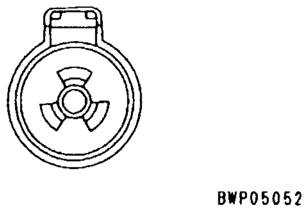
No. of pins	DT Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
8	 BWP05045	 BWP05046	8GR: 799-601-9060 8B: 799-601-9070 8G: 799-601-9080 8BR: 799-601-9090
	Part No.: 08192-1820□ (normal type) 08192-2820□ (fine wire type)	Part No.: 08192-1810□ (normal type) 08192-2810□ (fine wire type)	
10	 BWP05047	 BWP05048	12GR: 799-601-9110 12B: 799-601-9120 12G: 799-601-9130 12BR: 799-601-9140
	Part No.: 08192-1920□ (normal type) 08192-2920□ (fine wire type)	Part No.: 08192-1910□ (normal type) 08192-2910□ (fine wire type)	

014012

[The pin No. is also marked on the connector (electric wire insertion end)]

No. of pins	DTM Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
2			799-601-9010
	Part No.: 08192-02200	Part No.: 08192-02100	

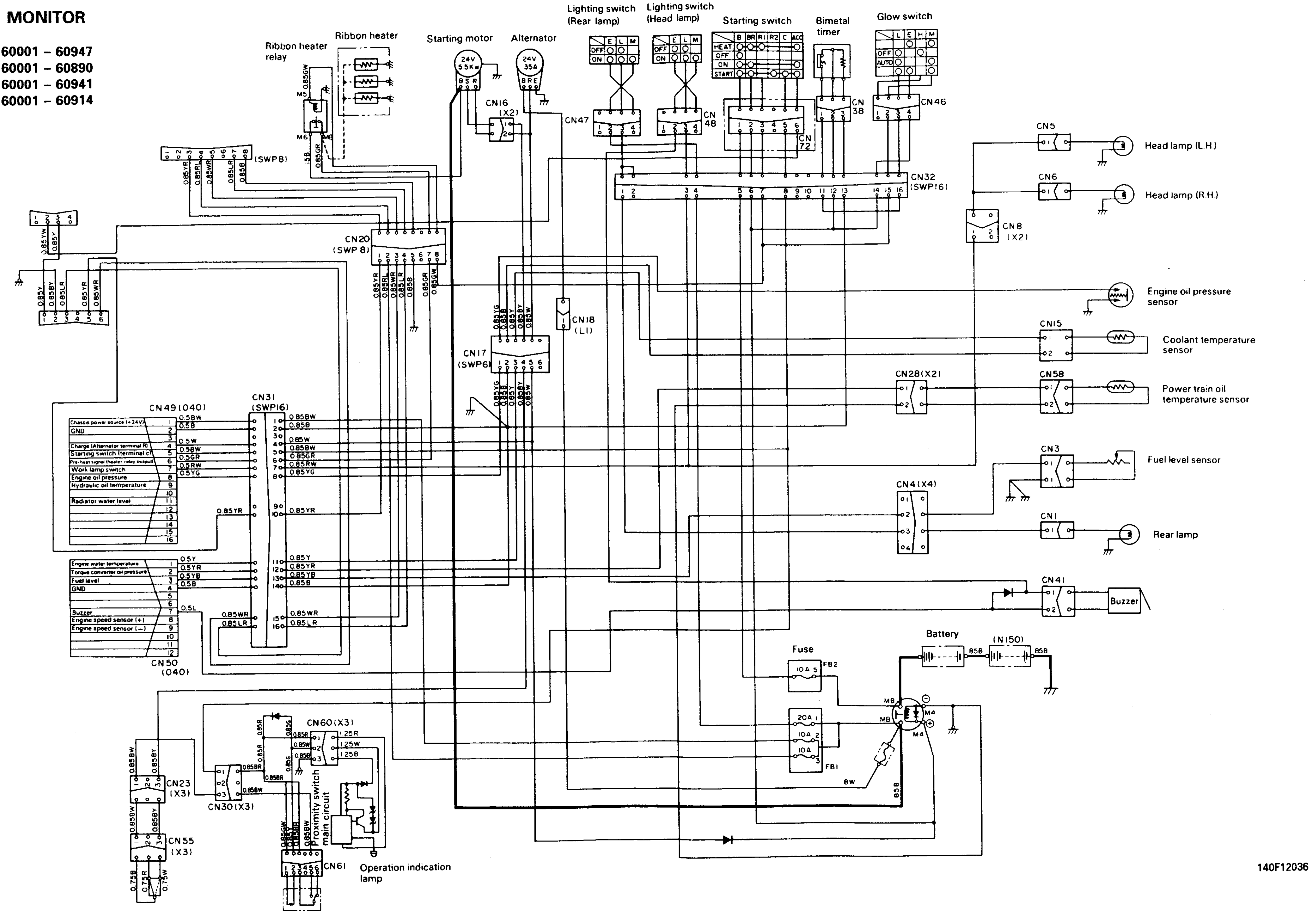
[The pin No. is also marked on the connector (electric wire insertion end)]

No. of pins	DTM Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
2			—
	Part No.: 08192-31200 (Contact size#12) 08192-41200 (Contact size#8) 08192-51200 (Contact size#4)	Part No.: 08192-31100 (Contact size#12) 08192-41100 (Contact size#8) 08192-51100 (Contact size#4)	

ELECTICAL CIRCUIT DIAGRAMS FOR EACH SYSTEM

MACHINE MONITOR

D65E-12	**60001 – 60947**
D65P-12	**60001 – 60890**
D65EX-12	**60001 – 60941**
D65PX-12	**60001 – 60914**

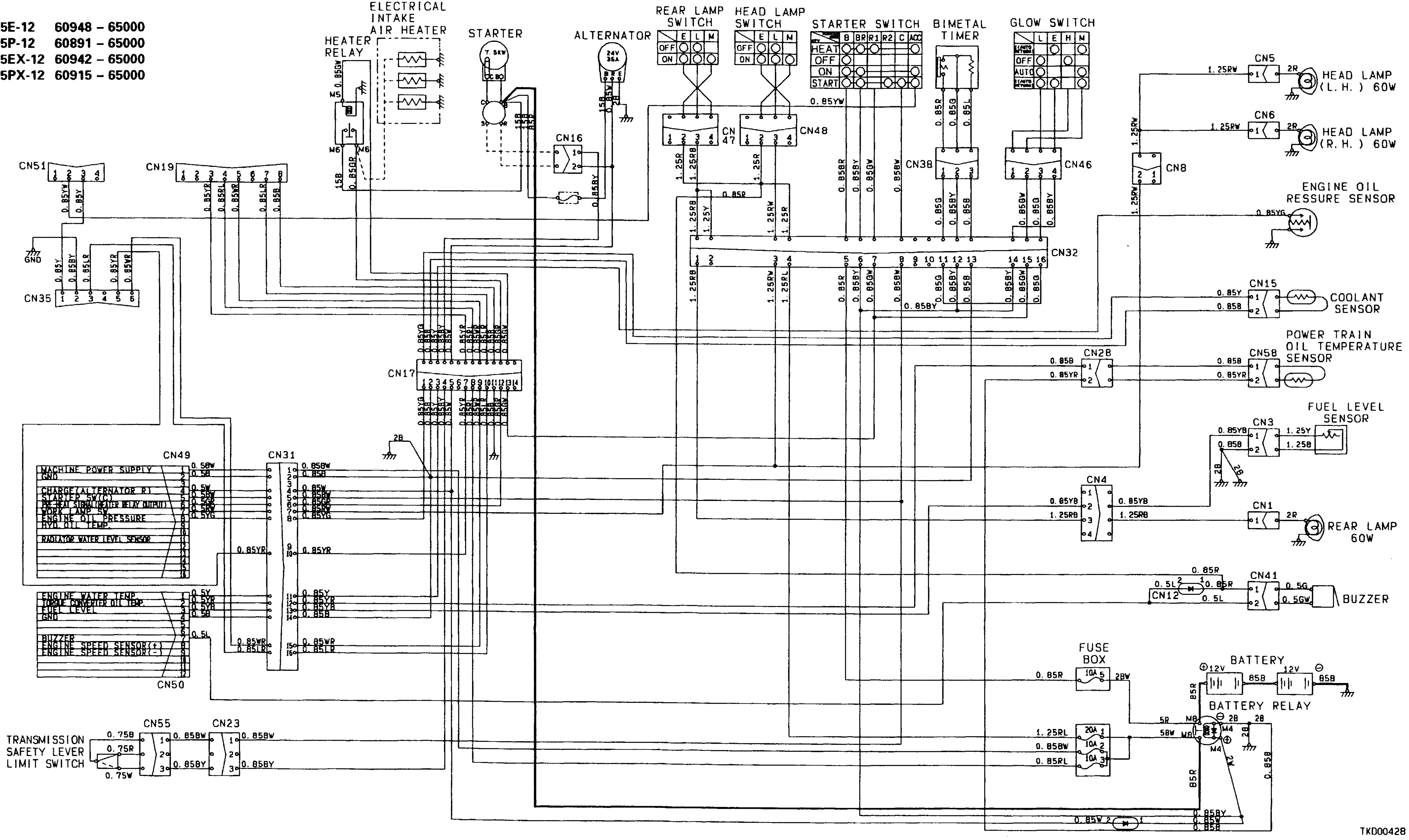


014012

MACHINE MONITOR

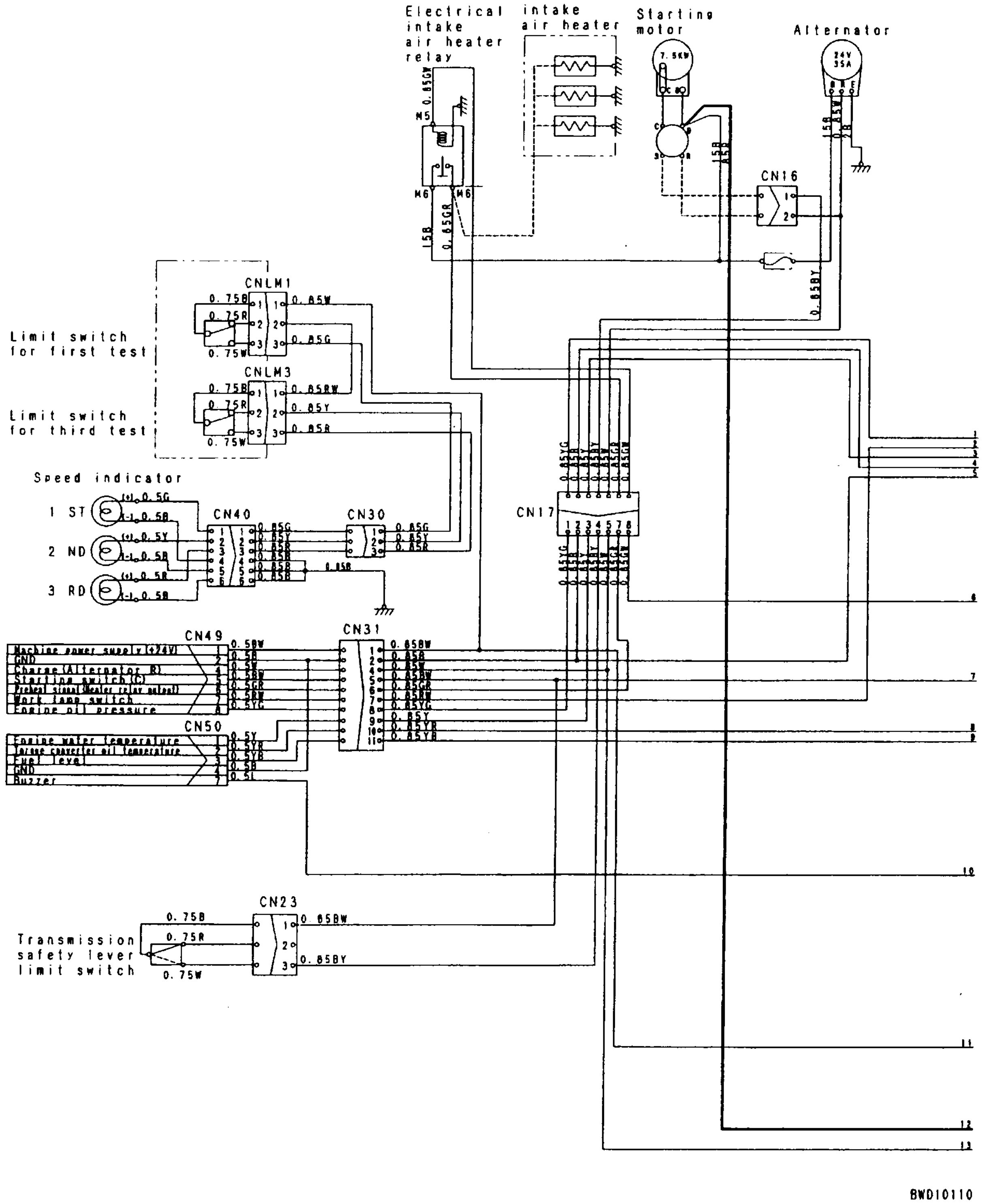
D65E-12	**60948 – 65000**
D65P-12	**60891 – 65000**
D65EX-12	**60942 – 65000**
D65PX-12	**60915 – 65000**

014012



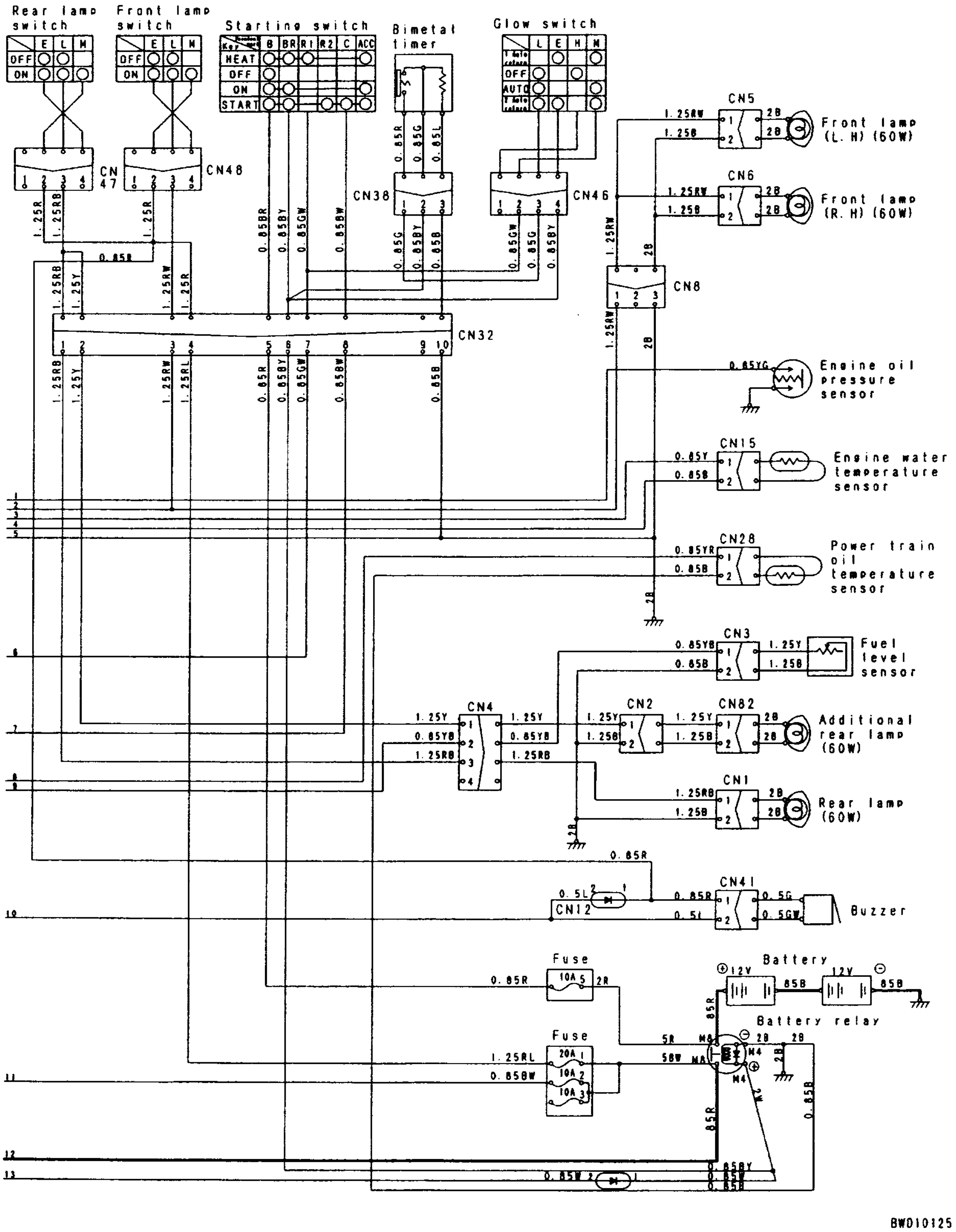
MACHINE MONITOR

D65E-12	**65001 and up**
D65P-12	**65001 and up**
D65EX-12	**65001 and up**
D65PX-12	**65001 and up**



014012

014012


Rear lamp switch
E L M
OFF
ON
Front lamp switch
E L M
OFF
ON
Starting switch
Key position
B BR R1 R2 C ACC
HEAT
OFF
ON
START
Bimetal timer
Glow switch
L E H M
OFF
AUTO
CN 47
CN48
CN38
CN46
CN32
CN5
CN6
CN8
CN15
CN28
CN3
CN4
CN2
CN82
CN1
CN41
CN12
1.25R
1.25RB
0.85R
1.25RW
1.25Y
0.85BR
0.85BY
0.85GW
0.85BW
0.85G
0.85L
0.85B
0.85GW
0.85G
0.85BY
1.25RW
1.25B
2B
1.25RL
0.85YG
0.85Y
0.85YR
0.85YB
1.25B
0.5L
0.5G
0.5GW
0.85W
Front lamp (L.H) (60W)
Front lamp (R.H) (60W)
Engine oil pressure sensor
Engine water temperature sensor
Power train oil temperature sensor
Fuel level sensor
Additional rear lamp (60W)
Rear lamp (60W)
Buzzer
Fuse
10A 5
2R
20A 1
10A 2
10A 3
Battery
12V
12V
85B
Battery relay
5R
5BW
M8
M4
M6
1
2
3
4
5
6
7
8
9
10
11
12
13
BWD10125

TROUBLESHOOTING OF ENGINE (S MODE)

014012

S-1 Starting performance is poor (Starting always takes time)

General causes why starting performance is poor

- Defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel
  (At ambient temperature of −10°C or below, use ASTM D975 No. 1, and −10°C or above, use ASTM D975 No. 2 diesel fuel.)

★ Battery charging rate.

Ambient temperature \ Charging rate	100%	90%	80%	75%	70%
20°C	1.28	1.26	1.24	1.23	1.22
0°C	1.29	1.27	1.25	1.24	1.23
−10°C	1.30	1.28	1.26	1.25	1.24

- The specific gravity should exceed the value for the charging rate of 70% in the above table.
- In cold weather the specific gravity must exceed the value for the charging rate of 75% in the above table.

Legend

○ : Possible causes (judging from Questions and check items)

◎ : Most probable causes (judging from Questions and Check items)

△ : Possible causes due to length of use (used for a long period)

● : Items to confirm the cause.

			Causes													
			Worn piston ring, cylinder	Defective contact of valve, valve seat	Clogged air cleaner element	Clogged fuel filter, strainer	Clogged feed pump strainer	Defective intake heater (ribbon type)	Defective regulator	Defective alternator	Defective or deteriorated battery	Defective injection nozzle	Defective injection timing	Defective injection pump (rack, plunger stuck)	Leakage, clogging, air in fuel system	Clogged fuel tank air breather hole
Questions	Confirm recent repair history															
	Degree of use	Operated for long period			△	△	△				△					
	Ease of starting	Gradually became worse	◎	◎	○	○	○									
		Starts when warm						◎			◎					
	Indicator lamp does not light up							◎								
	Engine oil must be added more frequently		◎													
	Replacement of filters has not been carried out according to operation manual				◎	◎	◎					○		○		
	Dust indicator is red				◎											
	Non-specified fuel has been used					○	○					○		○		
Check items	Battery charge lamp is ON								◎	◎						
	Starting motor cranks engine slowly										◎					
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low											◎				
	Engine does not pick up smoothly, and combustion is irregular		○	○								◎				
	Blow-by gas is excessive		◎													
	Match marks on fuel injection pump are out of alignment												◎			
	Mud is stuck to fuel tank cap															○
	When engine is cranked with starting motor, 1) Little fuel comes out even when injection pump sleeve nut is loosened													◎		
	2) Little fuel comes out even when fuel filter air bleed plug is loosened					◎	◎							◎		
	Leakage from fuel piping													○	◎	
	There is hunting from engine (rotation is irregular)					○	○								◎	○
Troubleshooting	When compression pressure is measured, it is found to be low		●	●												
	When air element is inspected directly, it is found to be clogged				●											
	When fuel filter, strainer are inspected directly, they are found to be clogged					●									●	
	When feed pump strainer is inspected directly, it is found to be clogged						●									
	Heater mount does not become warm							●								
	Voltage is 26 — 30V between alternator terminal B and terminal E with engine at low idling	Yes							●							
		No								●						
	Either specific gravity of electrolyte or voltage of battery is low										●					
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working.											●				
	When check is made using delivery method, injection timing is found to be incorrect												●			
	When control rack is pushed, it is found to be heavy or does not return (when blind plug at rear of pump is removed, it can be seen that plunger control sleeve does not move)													●		
	When fuel cap is inspected directly, it is found to be clogged															●
		Remedy	Replace	Repair	Clean	Clean	Clean	Replace	Replace	Replace	Replace	Replace	Adjust	Replace	Repair	Clean

014012

S-2 Engine does not start

① Engine does not turn

General causes why engine does not turn

- Internal parts of engine seized
  - ★ If internal parts of the engine are seized, carry out troubleshooting for "Engine stops during operations".
- Failure in power train
- Defective electrical system

Legend

○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

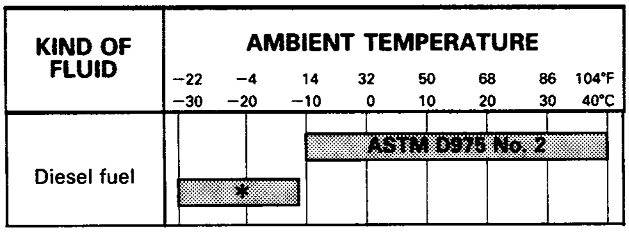
			Causes: Defective wiring of starting circuit	Defective or deteriorated battery	Defective starting motor	Broken ring gear	Defective safety relay or safety switch	Defective battery relay	Defective battery terminal connection	Defective fuel cut solenoid	Defective adjustment of engine stop motor wire	Defective engine stop motor	Defective starting switch
Questions	Confirm recent repair history												
	Degree of use	Operated for long period		△		△							
	Condition of horn when starting switch is turned ON	Horn does not sound	◎						○				○
		Horn sound level is low		◎									
Check items	When starting switch is turned to START, pinion moves out, but	Rotating speed is slow		◎									
		Makes grating noise			◎	◎							
		Soon disengages again					◎						
		Makes rattling noise and does not turn		○	○		○						
	When starting switch is turned to START, pinion does not move out		◎	○									○
	·When starting switch is turned to ON, there is no clicking sound		Carry out troubleshooting for defective wiring of starting circuit	○				◎					
	Battery terminal is loose								◎				
	When starting switch is turned to ON, linkage does not move									◎	◎	◎	
	When battery is checked, battery electrolyte is found to be low			○									
Troubleshooting	Specific gravity of electrolyte, voltage of battery is low			●									
	For the following conditions 1) — 5), turn the starting switch OFF, connect the cord, and carry out troubleshooting at ON												
	1) When terminal B and terminal C of starting switch are connected, engine starts												●
	2) When ternimal B and terminal C of starting motor are connected, engine starts				●								
	3) When terminal B and terminal C of safety relay are connected, engine starts						●						
	4) When terminal of safety switch and terminal B of starting motor are connected, engine starts						●						
	5) There is no 24V voltage between battery relay terminal b and terminal E							●					
	When ring gear is inspected directly, tooth surface is found to be chipped					●							
	Does not move even when fuel cut solenoid linkage is disconnected									●			
	Does not move even when engine stop motor linkage is disconnected										●	●	
		Remedy	—	Replace	Replace	Replace	Replace	Replace	Replace	Replace	Adjust	Replace	Replace

② Engine turns but no exhaust gas comes out (Fuel is not being injected)

General causes why engine turns but no exhaust gas comes out

- Supply of fuel impossible
- Supply of fuel is extremely small
- Improper selection of fuel (particularly in winter)

Standards for use of fuel



Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

		Causes: Broken injection pump drive shaft, key	Defective injection pump (rack, plunger seized)	Seized, broken feed pump piston	Clogged fuel filter, strainer	Clogged feed pump strainer	Lack of fuel	Clogged, leaking fuel piping	Clogged fuel tank air breather hole	Defective fuel cut solenoid	Defective engine stop motor	Improper fuel used
Questions	Confirm recent repair history											
	Degree of use: Operated for long period				△	△			△			
	Exhaust gas suddenly stops coming out (when starting again)	◎	◎	◎								
	Replacement of filters has not been carried out according to operation manual				◎	◎						
	Fuel tank is found to be empty						◎					
	There is leakage from fuel piping							◎				
	Mud is stuck to fuel tank cap								◎			
	When starting switch is turned ON, linkage does not move									◎	◎	
Check items	When fuel filter is drained, fuel does not come out											◎
	When engine is cranked with starting motor, 1) Injection pump coupling does not rotate	◎										
	2) No fuel comes out even when fuel filter air bleed plug is loosened	◎			○	○						○
	3) No fuel spurts out even when injection pipe sleeve nut is loosened	◎	◎	◎								
	Rust and water are found when fuel is drained				○	○						
Troubleshooting	Check injection pump directly	●										
	When control rack is pushed, it is found to be heavy, or does not return		●									
	Check feed pump directly			●								
	When fuel filter, strainer are inspected directly, they are found to be clogged				●							●
	When feed pump strainer is inspected directly, it is found to be clogged					●						
	When fuel cap is inspected directly, it is found to be clogged								●			
	Does not move even when fuel cut solenoid linkage is disconnected									●		
	Does not move even when engine stop motor linkage is disconnected										●	
	Remedy	Replace	Replace	Replace	Clean	Clean	Add	Repair	Repair	Replace	Replace	Replace

014012

③ Exhaust gas comes out but engine does not start (Fuel is being injected)

General causes why exhaust gas comes out but engine does not start

- Lack of rotating force due to defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

		Causes											
		Defective, broken valve system (valve, rocker lever, etc.)	Defective injection pump (rack, plunger stuck)	Worn piston ring, cylinder	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged air cleaner element	Defective intake heater (ribbon type)	Defective or deteriorated battery	Leakage, clogging, air in fuel system	Clogged injection nozzle, defective spray	Clogged fuel tank air breather hole	Improper fuel used
Questions	Confirm recent repair history												
	Degree of use: Operated for long period			△	△	△					△		
	Suddenly failed to start	◎	◎										
	When engine is cranked, abnormal noise is heard from around head	◎											
	Engine oil must be added more frequently			◎									
	Non-specified fuel has been used		○								○		
	Replacement of filters has not been carried out according to operation manual				◎	◎	◎						
	Rust is found when fuel is drained				◎	◎							
	Dust indicator is red						◎						
	Indicator lamp does not light up							◎					
	Starting motor cranks engine slowly								◎				
Check items	Mud is stuck to fuel tank cap											○	
	When fuel lever is placed at FULL position, it does not contact stopper		○										
	When engine is cranked with starting motor, 1) Little fuel comes out even when injection pump sleeve nut is loosened		◎										
	2) Little fuel comes out even when fuel filter air bleed plug is loosened				◎	◎							○
	There is leakage from fuel piping									◎			
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinder is low										◎		
	When fuel filter is drained, no fuel comes out												◎
Troubleshooting	Remove head cover and check directly	●											
	When control rack is pushed, it is found to be heavy, or does not return		●										
	When compression pressure is measured, it is found to be low			●									
	When fuel filter, strainer are inspected directly, they are found to be clogged				●								●
	When feed pump strainer is inspected directly, it is found to be clogged					●							
	When air element is inspected directly, it is found to be clogged						●						
	Heater mount does not become warm							●					
	Either specific gravity of electrolyte or voltage of battery is low								●				
	When feed pump is operated, there is no response, or pump is heavy									●			
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working.										●		
	When fuel cap is inspected directly, it is found to be clogged											●	
	Remedy	Replace	Replace	Replace	Clean	Clean	Clean	Repair	Replace	Repair	Clean	Clean	—

S-3 Engine does not pick up smoothly (Follow-up is poor)

General causes why engine does not pick up smoothly

- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Improper fuel used

Legend

○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes										
			Clogged air cleaner element	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged injection nozzle, defective spray	Seized injection pump plunger	Worn piston ring, cylinder	Seized turbocharger, interference	Improper valve clearance	Clogged fuel tank air breather hole	Clogged, leaking fuel piping	Defective contact of valve, valve seat
Questions	Confirm recent repair history												
	Degree of use	Operated for long period	△	△	△			△					△
	Replacement of filters has not been carried out according to operation manual		◎	◎	◎								
	Non-specified fuel is being used			◎	◎	◎	◎						
	Engine oil must be added more frequently							◎					
	Rust and water are found when fuel is drained			◎	◎								
	Dust indicator is red		◎										
	Noise of interference is heard from around turbocharger								◎				
Check items	Engine pick-up suddenly became poor					○			◎		○	○	
	Color of exhaust gas	Blue under light load						◎					
		Black	◎			◎			◎				○
	Clanging sound is heard from around cylinder head									◎			
	Mud is stuck to fuel tank cap										◎		
	There is leakage from fuel piping											◎	
	High idling speed under no load is normal, but speed suddenly drops when load is applied			◎	◎						○		
	There is hunting from engine (rotation is irregular)			○	◎	○					○		
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎	○						
	Blow-by gas is excessive							◎					
Troubleshooting	When air element is inspected directly, it is found to be clogged		●										
	When fuel filter, strainer are inspected directly, they are found to be clogged			●									
	When feed pump strainer is inspected directly, it is found to be clogged				●								
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working.					●							
	When control rack is pushed, it is found to be heavy, or does not return						●						
	When compression pressure is measured, it is found to be low							●					●
	When turbocharger is rotated by hand, it is found to be heavy								●				
	When valve clearance is checked directly, it is found to be outside standard value									●			
	When fuel cap is inspected directly, it is found to be clogged										●		
	When feed pump is operated, operation is too light or too heavy											●	
		Remedy	Clean	Clean	Clean	Repair	Replace	Replace	Replace	Adjust	Clean	Repair	Replace

014012

S-4 Engine stops during operations

General causes why engine stops during operations

- Seized parts inside engine
- Insufficient supply of fuel
- Overheating
  - ★ If there is overheating and insufficient output, carry out troubleshooting for overheating.
- Failure in power train
  - ★ If the engine stops because of a failure in the power train, carry out troubleshooting for the chassis.

Legend

○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

		Causes													
		Broken, seized piston, connecting rod	Broken, seized crankshaft bearing	Broken valve system (valve, rocker lever, etc.)	Broken, seized gear train	Broken pump auxiliary equipment	Broken fuel pump drive shaft, key	Lack of fuel	Clogged fuel filter, strainer	Clogged feed pump strainer	Broken, seized feed pump piston	Clogged, leaking fuel piping	Clogged fuel tank air breather hole	Defective injection pump (rack, plunger stuck)	Failure in chassis power train
Questions	Confirm recent repair history														
	Degree of use: Operated for long period								△	△					
	Condition when engine stopped: Abnormal noise was heard and engine stopped suddenly	◎	◎	◎	◎	◎	◎				○			○	◎
	Condition when engine stopped: Engine overheated and stopped	◎	○			○									
	Condition when engine stopped: Engine stopped slowly							◎	○	○					
	Condition when engine stopped: There was hunting and engine stopped							◎	○	○			○		
	Fuel gauge lamp lights up							◎							
	Fuel tank is found to be empty							◎							
	Replacement of filters has not been carried out according to operation manual								◎	◎					
	Non-specified fuel is being used								○	○	○			○	
Check items	When feed pump is operated, there is no response or it is heavy								○	○		◎			
	Mud is stuck to fuel tank cap												◎		
	Engine turns, but stops when transmission control lever is operated														◎
	Try to turn by hand using barring tool: Does not turn at all	◎	◎												Carry out troubleshooting in chassis volume
	Try to turn by hand using barring tool: Turns in opposite direction			◎											
	Try to turn by hand using barring tool: Moves amount of backlash				◎	◎									
	Try to turn by hand using barring tool: Shaft does not turn						◎								
	Rust and water are found when fuel is drained								◎	◎					
	Metal particles are found when oil is drained	◎	◎						○	○					
Troubleshooting	Remove oil pan and check directly	●	●												
	Remove head cover and check directly			●											
	When gear train is inspected, it does not turn				●										
	Turns when pump auxiliary equipment is removed					●									
	When fuel filter, strainer are inspected directly, they are found to be clogged								●						
	When feed pump strainer is inspected directly, it is found to be clogged									●					
	Check feed pump directly										●				
	When control rack is pushed, it is found to be heavy or does not return													●	
	Remedy	Replace	Replace	Replace	Replace	Replace	Replace	Add	Clean	Clean	Replace	Repair	Clean	Replace	—

S-5 Engine does not rotate smoothly (hunting)

General causes why engine does not rotate smoothly

- Air in fuel system
- Defective governor mechanism
- Defective engine throttle controller mechanism (engine throttle controller type)
  - ★ If there is no hunting when the engine throttle controller rod is disconnected, carry out troubleshooting for the electrical system.

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes									
			Defective operation of governor	Defective adjustment of governor	Defective operation of control rack	Low speed is too low	Lack of fuel	Clogged feed pump strainer	Clogged fuel filter, strainer	Clogged, air in circuit between fuel tank and feed pump	Clogged, air in circuit between feed pump and nozzle	Clogged fuel tank air breather hole
Questions	Confirm recent repair history											
	Degree of use	Operated for long period						△	△			
	Condition of hunting	Occurs at certain speed range	◎	◎	◎	○						
		Occurs at low idling	○			◎		○	○	○	○	
		Occurs even when speed is raised	○	○	○							○
		Occurs on slopes					◎					
	Fuel tank is found to be empty						◎					
	Replacement of filters has not been carried out according to operation manual							◎	◎			
	Rust is found when fuel is drained							○	○			
Check items	Leakage from fuel piping									◎	◎	
	When feed pump is operated,	1) No response, light, return is quick								◎	◎	
		2) No response, light, return is normal								◎		
	Engine speed sometimes rises too high		◎	◎								
	Engine is sometimes difficult to stop		◎		◎							
	Seal on injection pump has come off			◎		◎						
Troubleshooting	When governor lever is moved it is found to be stiff		●		●							
	When injection pump is tested, governor is found to be improperly adjusted			●								
	When control rack is pushed, it is found to be heavy, or does not return				●							
	When fuel cap is inspected directly, it is found to be clogged					●						●
	When feed pump strainer is inspected directly, it is found to be clogged							●				
	When fuel filter, strainer are inspected directly, they are found to be clogged								●			
		Remedy	Adjust	Adjust	Adjust	Adjust	Add	Claen	Clean	Repair	Repair	Clean

014012

S-6 Engine lacks output (no power)

General causes why engine lacks output

- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Improper fuel used
  (if non-specified fuel is used, output drops)
- Lack of output due to overheating
  - ★ If there is overheating and insufficient output, carry out troubleshooting for overheating.

Legend
○ : Possible causes (judging from Questions and check items)
 : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Clogged air cleaner element	Seized turbocharger, interference	Worn piston ring, cylinder	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged injection nozzle, defective spray	Seized injection pump plunger	Improper valve clearance	Defective contact of valve, valve seat	Bent fuel lever linkage, defective adjustment	Clogged, leaking fuel piping	Clogged fuel tank air breather hole
Questions	Confirm recent repair history													
	Degree of use	Operated for long period	△		△	△	△				△			
	Power was lost	Suddenly												
		Gradually	○		○	○	○	○			○			
	Engine oil must be added more frequently				◎									
	Replacement of filters has not been carried out according to operation manual		◎			◎	◎							
	Non-specified fuel is being used					◎	◎	◎	◎					
	Dust indicator is red													
	Color of exhaust gas	Black												
		Blue under light load			◎									
Check items	Noise of interference is heard from around turbocharger													
	Blow-by gas is excessive				◎									
	Engine pickup is poor and combustion is irregular							○					○	○
	High idling speed under no load is normal, but speed suddenly drops when load is applied					◎	◎							○
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low							◎	○					
	There is hunting from engine (rotation is irregular)					○	○						○	○
	Clanging sound is heard from around cylinder head									◎				
	High idling speed of engine is low								○			◎		
	Leakage from fuel piping												◎	
Troubleshooting	When air element is inspected directly, it is found to be clogged		●											
	When trobocharger is rotated by hand, it is found to be heavy			●										
	When compression pressure is measured, it is found to be low				●						●			
	When fuel filter, strainer are inspected directly, they are found to be clogged					●								
	When feed pump strainer is inspected directly, it is found to be clogged						●							
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working.							●						
	When control rack is pushed, it is found to be heavy, or does not return								●					
	When valve clearance is checked directly, it is found to be outside standard value									●				
	When lever is placed at FULL position, it does not contact stopper											●		
	When feed pump is operated, operation is too light or too heavy												●	
	When fuel cap is inspected directly, it is found to be clogged													●
		Remedy	Clean	Replace	Replace	Clean	Clean	Repair	Replace	Adjust	Replace	Adjust	Repair	Clean

014012

S-7 Exhaust gas is black (incomplete combustion)

General causes why exhaust gas is black

- Insufficient intake of air
- Improper condition of fuel injection
- Excessive injection of fuel

Legend

○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Siezed turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)	Improper valve clearance	Crushed, clogged muffler	Leakage of air between turbocharger and head	Defective contact of valve, valve seat	Defective injection pump (rack, plunger seized)
Questions	Confirm recent repair history												
	Degree of use	Operated for long period		△	△	△						△	
	Color of exhaust gas	Suddenly became black	◎			○							○
		Gradually became black		◎		○					○		
		Blue under light load			◎								
	Engine oil must be added more frequently				◎								
	Power was lost	Suddenly	◎			○				○			○
		Gradually		○	○						○	○	
	Non-specified fuel is being used					○							○
Check items	Noise of interference is heard from around turbocharger		◎										
	Dust indicator is red			◎									
	Blow-by gas is excessive				◎								
	Engine pickup is poor and combustion is irregular		○			◎			○	○	○		○
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎							○
	Match marks on fuel injection pump are out of alignment						◎						
	Seal on injection pump has come off							◎					
	Clanging sound is heard from around cylinder head								◎				
	Exhaust noise is abnormal		○			○				◎			
	Muffler is crushed									◎			
	Leakage of air between trubocharger and head, loose clamp										◎		

Troubleshooting	When turbocharger is rotated by hand, it is found to be heavy	●										
	When air cleaner is inspected directly, it is found to be clogged		●									
	When compression pressure is measured, it is found to be low			●							●	
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working.				●							
	When check is made using delivery method, injection timing is found to be incorrect					●						
	Injection pump test shows that injection amount is incorrect						●					
	When valve clearance is checked directly it is found to be outside standard value							●				
	When muffler is removed, exhaust gas color returns to normal								●			
	When control rack is pushed, it is found to be heavy, or does not return											●
	Remedy	Replace	Clean	Replace	Replace	Adjust	Adjust	Adjust	Replace	Repair	Replace	Replace

014012

S-8 Oil consumption is excessive (or exhaust gas is blue)

★ Do not run the engine at idling for more than 20 minutes continuously. (Both low and high idling)

General causes why oil consumption is excessive

- Abnormal combustion of oil
- External leakage of oil
- Wear of lubrication system

Legend
○ : Possible causes (judging from Questions and check items)
: Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes												
											Turbocharger				
			Broken piston ring	Worn piston ring, cylinder liner	Clogged breather or breather hose	Leakage from oil filter, oil cooler	Leakage from oil piping	Leakage from oil drain plug	Leakage from oil pan, cylinder head, etc.	Broken oil cooler	Worn seal at turbine end	Worn seal at blower end	Worn, broken rear seal, seal surface	Dust sucked in from intake system	Worn valve (stem, guide), broken seal
Questions	Confirm recent repair history														
	Degree of use	Operated for long period		△							△	△			△
	Oil consumption suddenly increased		◎							○					
	Engine oil must be added more frequently			◎						○					
	Engine oil becomes contaminated quickly		○	◎	○										
Questions / Check items	Exhaust gas is blue under light load		◎												
	Amount of blow-by gas	Abnormally excessive	◎									○			○
		None			◎										
Check items	Area around engine is dirty with oil					◎	◎	◎	◎						
	There is oil in engine cooling water									◎					
	When exhaust pipe is removed, inside is found to be dirty with oil										◎				○
	Inside of turbocharger intake pipe is dirty with oil											◎			
	Oil level in clutch or TORQFLOW transmission damper chamber rises												◎		
	Clamps for intake system are loose													◎	
Troubleshooting	When compression pressure is measured, it is found to be low		●	●											
	When breather element is inspected, it is found to be clogged with dirty oil				●										
	There is external leakage of oil from engine					●	●	●	●						
	Pressure-tightness test of oil cooler shows there is leakage									●					
	Excessive play of turbocharger shaft										●	●			
	Check rear seal directly												●		
	When intake manifold is removed, dust is found inside													●	
	When intake manifold is removed, inside is found to be dirty with oil														●
		Remedy	Replace	Replace	Clean	Repair	Repair	Repair	Repair	Replace	Replace	Replace	Repair	Repair	Repair

S-9 Oil becomes contaminated quickly

General causes why oil becomes contaminated quickly

- Intake of exhaust gas due to internal wear
- Clogging of lubrication passage
- Improper combustion
- Improper oil used
- Operation under excessive load

Legend

○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes: Worn piston ring, cylinder	Clogged breather, breather tube	Clogged oil filter	Worn valve, valve guide	Clogged oil cooler	Clogged turbocharger drain pipe	Defective seal at turbocharger turbine end	Defective safety valve	Exhaust gas is black
Questions	Confirm recent repair history										
	Degree of use	Operated for long period	△			△			△		
	Engine oil must be added more frequently		◎								
	Non-specified fuel is being used				○						
Check items	Color of exhaust gas	Blue under light load	◎								
		Black									◎
	Amount of blow-by gas	Abnormally excessive	◎			○		○	○		Carry out troubleshooting for "Exhaust is black".
		None		◎							
	Oil filter caution lamp stays on even when oil pressure rises				◎					○	
	When oil filter is inspected, metal particles are found		○		◎	○					
	When exhaust pipe is removed, inside is found to be dirty with oil					◎					
	Engine oil temperature rises quickly						◎				
Troubleshooting	When compression pressure is measured, it is found to be low		●			●					
	When breather element is inspected directly, it is found to be clogged with dirty oil, or hose is broken			●							
	When oil filter is inspected directly, it is found to be clogged				●						
	When oil cooler is inspected directly, it is found to be clogged						●				
	Turbocharger drain tube is clogged							●			
	Excessive play of turbocharger shaft								●		
	When safety valve is directly inspected, spring is found to be catching or broken									●	
		Remedy	Replace	Clean	Replace	Replace	Clean	Clean	Replace	Replace	—

014012

S-10 Fuel consumption is excessive

General causes why fuel consumption is excessive

- Leakage of fuel
- Improper condition of fuel injection
- Excessive injection of fuel

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

014012

			Causes							
			Defective injection pump (excessive injection)	Defective injection nozzle spray	Defective injection pump plunger	Improper fuel injection timing	External leakage from fuel piping, fuel filter	Leakage of fuel inside head cover	Defective oil seal inside feed pump (piston)	Defective adjustment of fuel lever linkage
Questions	Confirm recent repair history									
	Degree of use	Operated for long period		△	△				△	
	Condition of fuel consumption	More than for other machines of same model	◎			○				
		Gradually increased		○	○					
		Suddenly increased					○	○		
	Exhaust gas color	Black	◎	○		○				○
		White						○		
Check items	Seal on injection pump has come off		◎							
	There is irregular combustion			◎						
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low			◎	○					
	Match mark on injection pump is misaligned					◎				
	There is external leakage of fuel from engine						◎			
	Engine oil level rises and smells of diesel fuel		○					◎	◎	
	Engine low idling speed is high		○							◎

Troubleshooting	Injection pump test shows that injection amount is excessive	●							
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working.		●						
	When control rack is pushed, it is found to be heavy, or does not return			●					
	When check is made using delivery method, injection timing is found to be incorrect				●				
	Remove head cover and check directly						●		
	Remove feed pump and check directly							●	
	When engine speed is measured, low idling speed is found to be high								●
	Remedy	Adjust	Replace	Replace	Adjust	Repair	Repair	Repair	Adjust

S-11 Oil is in cooling water, or water spurts back, or water level goes down

General causes why oil is in cooling water

- Internal leakage in lubrication system
- Internal leakage in cooling system

Legend

○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes					
			Broken oil cooler core, O-ring	Broken head, head gasket	Insufficient protrusion of liner	Broken oil cooler for power train	Broken liner O-ring, holes caused by pitting	Internal cracks in cylinder block
Questions	Confirm recent repair history							
	Degree of use	Operated for long period	△				△	
	Oil level	Suddenly increased	○	○		○		
		Gradually increased					○	○
Check items	Hard water is being used as cooling water		○				○	
	Engine oil level has risen, oil is cloudy white		◎				○	○
	Excessive air bubbles inside radiator, spurts back			◎	◎			
	Hydraulic oil, torque converter, transmission oil is cloudy white					◎		
	When hydraulic oil, torque converter, transmission oil is drained, water is found					◎		

Trouble-shooting	Pressure-tightness test of oil cooler shows there is leakage	●			●		
	Pressure-tightness test of cylinder head shows there is leakage		●				
	Remove cylinder head and check directly			●			
	Remove oil pan and check directly					●	●
	Remedy	Replace	Replace	Replace	Replace	Replace	Replace

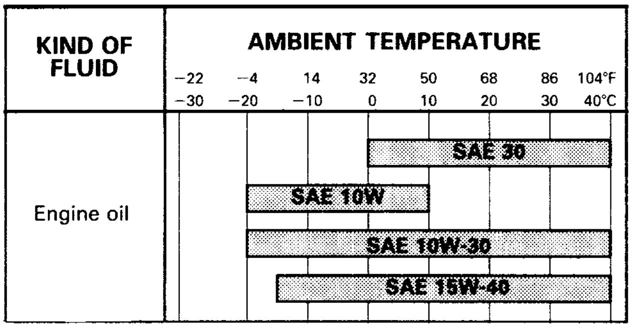
014012

S-12 Oil pressure lamp lights up (drop in oil pressure)

General causes why oil pressure lamp lights up

- Leakage, clogging, wear of lubricating system
- Defective oil pressure control
- Improper oil used (improper viscosity)
- Deterioration of oil due to overheating

★ Standards for engine oil selection



014012

Legend

○ : Possible causes (judging from Questions and check items)

◎ : Most probable causes (judging from Questions and Check items)

△ : Possible causes due to length of use (used for a long period)

● : Items to confirm the cause.

			Clogged oil filter	Worn bearing journal	Clogged strainer inside oil pan	Clogged, broken oil pipe inside oil pan	Broken suction pipe brazing	Defective oil pump	Insufficient oil in oil pan	Defective regulator valve	Defective relief valve	Leaking, crushed hydraulic piping	Defective oil level sensor	Defective oil pressure sensor	Water, fuel in oil
Questions	Confirm recent repair history														
	Degree of use	Operated for long period	△	△				△							
	Replacement of filters has not been carried out according to operation manual		◎												
	Caution lamp lights up		◎								○				
	Non-specified fuel has been used		○	○											
	Condition when oil pressure lamp lights up	Lights up at low idling		◎							○				
		Lights up at low, high idling			◎	◎	◎	◎	○	○	○				
		Lights up on slopes							◎						
		Sometimes lights up								◎	◎		○	○	
Check items	There is clogging, leakage from hydraulic piping (external)											◎			
	Oil level sensor lamp lights up								◎				◎		
	When oil level in oil pan is checked, it is found to be low								◎						
	Metal particles are found when oil is drained			◎											
	Metal particles are stuck to oil filter element			◎				○							
	Oil is cloudy white or smells of diesel oil														◎
Troubleshooting	When oil filter is inspected directly, it is found to be clogged		●	●											Carry out troubleshooting for "Oil level rises".
	Remove oil pan and check directly				●	●	●								
	Oil pump rotation is heavy, there is play							●							
	There is catching of relief valve or regulator valve, spring or valve guide is broken									●	●				
	When oil level sensor is replaced, oil pressure sensor lamp goes out												●		
	When oil pressure is measured, it is found to be within standard value													●	
		Remedy	Clean	Clean	Clean	Clean	Repair	Replace	Add	Adjust	Adjust	Repair	Replace	Replace	—

S-13 Oil level rises

★ If there is oil in the cooling water, carry out troubleshooting for "Oil is in cooling water".

General causes why oil level rises

- Water in oil (cloudy white)
- Fuel in oil (diluted, and smells of diesel fuel)
- Entry of oil from other component

Legend

○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes										
			Broken oil cooler core, O-ring	Defective nozzle holder sleeve	Broken head, head gasket (including precombustion chamber)	Clogged water pump breather hole, defective seal	Worn, damaged rear seal surface	Defective seal of pump or auxiliary equipment	Leakage of fuel from piping inside head cover	Defective part inside injection pump (flange type)	Defective thermostat seat	Damaged liner O-ring, holes made by pitting	Cracks inside cylinder block
Questions	Confirm recent repair history												
	Degree of use	Operated for long period		△		△	△	△				△	
	There is oil in radiator cooling water		◎	○	○							○	○
	Exhaust gas is white			◎					○		○		
	When engine is first started, drops of water come from muffler			◎									
Check items	Leave radiator cap open. When engine is run at idling, an abnormal number of bubbles appear, or water spurts back				◎							○	
	Water pump breather hole is clogged with mud					◎							
	When water pump breather hole is clean, water comes out					◎							
	Oil level goes down in clutch, TORQFLOW transmission, or damper chamber						◎						
	Oil level goes down in hydraulic tank							◎					
	Engine oil smells of diesel fuel								◎	◎	◎		
	Fuel is added more frequently								◎	◎	◎		
Troubleshooting	Pressure-tightness test of oil cooler shows there is leakage		●										
	Pressure-tightness test of cylinder head shows there is leakage			●									
	When compression pressure is measured, it is found to be low				●								
	Remove water pump and check directly					●							
	Check rear seal directly						●						
	When pump auxiliary equipment is removed, seal is found to be broken							●					
	Remove head cover and check directly								●				
	Remove injection pump and check directly									●			
	There is improper contact of thermostat seat valve										●		
	Remove oil pan and check directly											●	●
		Remedy	Replace	Replace	Replace	Replace	Repair	Replace	Repair	Replace	Repair	Replace	Replace

014012

S-14 Water temperature becomes too high (overheating)

General causes why water temperature becomes too high

- Lack of cooling water (deformation, damage of fan)
- Drop in heat dissipation efficiency
- Defective cooling circulation system
- Rise in oil temperature of power train
  - ★ Carry out troubleshooting for chassis.

Legend
○ : Possible causes (judging from Questions and check items)
 : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

014012

			Broken water pump	Clogged, crushed radiator fin	Clogged radiator core	Defective thermostat (does not open)	Defective water temperature gauge	Insufficient cooling water	Fan belt slipping, worn fan pulley	Clogged, broken oil cooler	Defective pressure valve	Broken head, head gasket	Damaged liner O-ring, holes made by pitting	Rise in torque converter oil temperature
Questions	Confirm recent repair history													
	Degree of use	Operated for long period		△	△							△	△	
	Condition of overheating	Suddenly overheated	◎					○	○					
		Always tends to overheat				○			○					
	Water temperature gauge	Rises quickly				◎		○						
		Does not go down from red range												
	Radiator water level sensor lights up							◎						
Check items	Fan belt whines under sudden load								◎					
	Cloudy white oil is floating on cooling water									◎				
	Cooling water flows out from overflow hose										◎			
	Excessive air bubbles inside radiator, water spurts back											◎		
	Engine oil level has risen, oil is cloudy white									○			◎	
	There is play when fan pulley is rotated													
	Radiator shroud, inside of underguard are clogged with dirt or mud													
	When light bulb is held behind radiator, no light passes through													
	Water is leaking because of cracks in hose or loose clamps							◎						
	Belt tension is found to be slack								◎					
	Power train oil temperature enters red range before engine water temperature													◎

		Broken water pump	Clogged, crushed radiator fin	Clogged radiator core	Defective thermostat (does not open)	Defective water temperature gauge	Insufficient cooling water	Fan belt slipping, worn fan pulley	Clogged, broken oil cooler	Defective pressure valve	Broken head, head gasket	Damaged liner O-ring, holes made by pitting	Rise in torque converter oil temperature
Troubleshooting	Temperature difference between top and bottom radiator tanks is excessive	●											Carry out troubleshooting for chassis
	Temperature difference between top and bottom radiator tanks is slight		●										
	When water filler port is inspected, the core is found to be clogged			●									
	When a function test is carried out on the thermostat, it does not open even at the cracking temperature				●								
	When water temperature is measured, it is found to be normal					●							
	When oil cooler is inspected directly, it is found to be clogged								●				
	When measurement is made with radiator cap tester, set pressure is found to be low									●			
	When compression pressure is measured, it is found to be low										●		
	Remove oil pan and check directly											●	
	Remedy	Replace	Repair	Repair	Replace	Replace	Add	Repair	Replace	Replace	Replace	Replace	—

S-15 Abnormal noise is made

★ Judge if the noise is an internal noise or an external noise.

General causes why abnormal noise is made

- Abnormality due to defective parts
- Abnormal combustion noise
- Air sucked in from intake system

Legend

○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes											
			Worn piston ring, cylinder liner	Seized turbocharger, interference	Missing, seized bushing	Clogged, seized injection nozzle	Defective injection pump (rack, plunger seized)	Defective injection pump (excessive injection)	Deformed fan, interference of fan belt	Improper adjustment of valve clearance	Broken valve system (valve, rocker lever, etc.)	Improper gear train backlash	Leakage of air between turbocharger and head	Defect inside muffler (dividing board out of position)
Questions	Confirm recent repair history													
	Degree of use	Operated for long period	△											
	Condition of abnormal noise	Gradually occurred	○						○					
		Suddenly occurred		○	○						○			
	Non-specified fuel is being used					○	○							
	Engine oil must be added more frequently		◎											
Check items	Color or exhaust gas	Blue under light load	◎											
		Black		◎						○			○	
	Metal particles are found in oil filter		◎		◎									
	Blow-by gas is excessive		◎											
	Noise of interference is heard from around turbocharger			◎										
	Engine pickup is poor and combustion is irregular					◎								
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎	○							
	Seal on injection pump has come off							◎						
	Abnormal noise is loud when accelerating engine					○	○	○	○	○		○		
	Clanging sound is heard from around cylinder head									◎	◎			
	Leakage of air between turbocharger and head, loose clamp												◎	
	Vibrating noise is heard from around muffler													◎

Troubleshooting	When compression pressure is measured, it is found to be low	●											
	When trubocharger is rotated by hand, it is found to be heavy		●										
	Remove gear cover and check directly			●							●		
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working.				●								
	When control rack is pushed, it is found to be heavy or does not return					●							
	Injection pump test shows that injection amount is incorrect						●						
	Fan is deformed, or belt is loose							●					
	When valve clearance is checked directly, it is found to be outside standard value								●				
	Remove cylinder head cover and check directly									●			
	When muffler is removed, abnormal noise disappers												●
	Remedy	Replace	Replace	Replace	Replace	Replace	Adjust	Repair	Adjust	Replace	Repair	Repair	Replace

014012

S-16 Vibration is excessive

★ If there is abnormal noise together with the vibration, carry out troubleshooting for "Abnormal noise is made".

General causes why vibration is excessive

- Defective parts (abnormal wear, breakage)
- Improper alignment
- Abnormal combustion

014012

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes								
			Worn connecting rod, main bearing	Worn balancer, cam bushing	Worn support pilot	Loose engine mounting bolts, broken cushion	Broken part inside output shaft (damper)	Misalignment between engine and power train	Improper gear train backlash	Valve system (valve, rocker lever, etc.) stuck	Defective injection pump (excessive injection)
Questions	Confirm recent repair history										
	Degree of use	Operated for long period	△	△	△	△					
	Condition of vibration	Suddenly increased					○			○	
		Gradually increased	○	○	○	○					
	Non-specified fuel has been used		○	○							
Check items	Metal particles are found in oil filter		◎	◎							
	Metal particles are found when oil is drained		◎	◎							
	Oil pressure is low at low idling		○	○							
	Vibration occurs at mid-range speed					○	○				
	Vibration follows engine speed				○	○	○	○	○		
	Exhaust gas is black									◎	○
	Seal on injection pump has come off										◎

Troubleshooting	Remove oil pan and check directly	●								
	Remove side cover and check directly		●							
	Check directly for worn support pilot, play			●						
	Check directly for loose engine mounting bolts, broken cushion				●					
	Check inside of output shaft (damper) directly					●				
	When radial runout, face runout are measured, they are found to be outside standard value						●			
	Remove front cover and check directly							●		
	Remove head cover and check directly								●	
	Injection pump test shows that injection amount is incorrect									●
	Remedy	Replace	Replace	Replace	Replace	Replace	Repair	Repair	Replace	Adjust

TROUBLESHOOTING OF HYDRAULIC, MECHANICAL SYSTEM (H MODE)

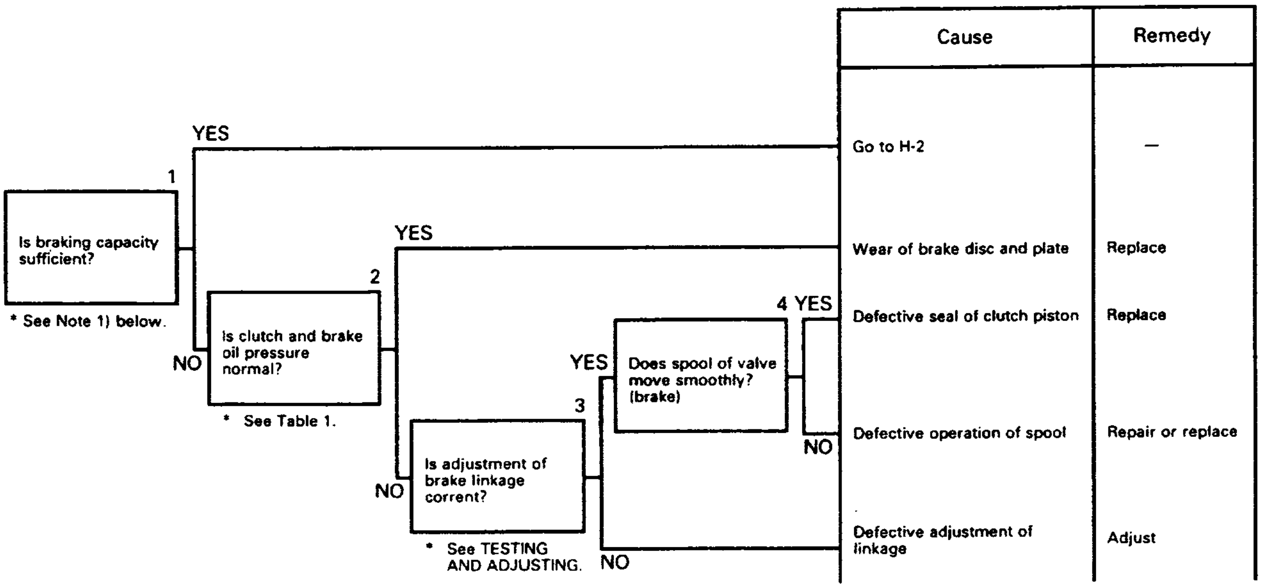
014012

TABLE OF FAILURE MODES AND CAUSES (HYDRAULIC, MECHANICAL SYSTEMS)

	Parts causing failure	Hydraulic system																				Mechanical system								Trouble-shooting	Applicable models
					Power train										Valve																
	Failure mode	PPC pump	PPC charge valve	PPC valve	Power train pump	Clutch valve	Brake valve	Main relief valve	Transmission valve	Hydraulic, HSS pump (EX, PX)	HSS motor (EX, PX)	Hydraulic pump	Strainer	Hydraulic cylinder	Spool	Main relief valve (EX, PX)	Main relief valve	LS relief valve (for steering)	LS relief valve (for work equipment)	Unload valve	Pressure compensation valve	Linkage	Steering clutch (disc, brake, etc.)	Brake clutch (disc, brake, etc.)	Internal parts of transmission	Internal parts of torque converter	Engine	Cooling system	Loose piping clamps, entry of air, oil leakage	If there is any abnormality, goto YES/NO Trouble-shooting Table H-OX	D65E-P→1 D65EX-PX→2 All models→A
1	Brake does not work					○	○															○	○	○						H-1	A
2	Machine does not turn (can travel in a straight line)					○	○															○	○	○						H-2	1
3	Turning speed is slow (cannot turn) or lacks power when turning			○							○				○	○		○			○									H-3	2
4	Overruns when turning					○	○															○	○	○						H-4	1
5	Can turn in only one direction (when steering and directional lever is operated)					○	○															○		○						H-5	1
6	Excessive time lag				○			○	○													○								H-6	2
7	Machine can travel in only one direction (forward or reverse)								○													○			○					H-7	2
8	Machine does not move (when engine is started and lever is shifted to 2nd or 3rd)				○	○	○	○	○													○	○	○	○	○				H-8	2
9	Machine does not move in any speed range				○	○	○	○	○													○	○	○	○	○				H-9	2
10	Power train oil temperature rises too high				○	○	○	○														○	○	○	○	○	○	○	○	H-10	2
11	Drawbar pull is weak, travel speed is slow				○	○	○	○	○													○	○	○	○	○				H-11	A
—																														—	—
13	Abnormal noise is generated from around hydraulic pump or hydraulic · HSS pump									○		○	○																○	H-13	A
14	Speed of all work equipment is slow	○	○	○								○					○			○										H-14	1
15	No work equipment moves	○	○									○					○			○										H-15	1
16	All work equipment lacks power	○	○	○								○					○			○										H-16	1
17	Turning speed and speed of all work equipment is slow	○	○	○						○						○				○										H-17	2
18	Machine cannot turn and no work equipment moves	○	○							○						○				○										H-18	2
19	Turning and all work equipment lacks power	○	○	○						○						○				○										H-19	2
20	Blade lifting speed is slow or lacks power			○											○				○		○								○	H-20	A
21	Blade tilt speed is slow or lacks power			○											○				○		○	○							○	H-21	A
22	Hydraulic drift of blade lift is excessive													○	○															H-22	A
23	Hydraulic drift of blade tilt is excessive													○	○															H-23	A

H-1 Brake does not work.

★ Check the oil level in the power train before carrying out troubleshooting.



Note: 1) Depress the brake pedal fully and set to R2 to set to the stall condition, then depress the decelerator pedal gradually from the SLOW possition to raise the engine speed to full throttle. The machine must not move off when this is done.

Table 1

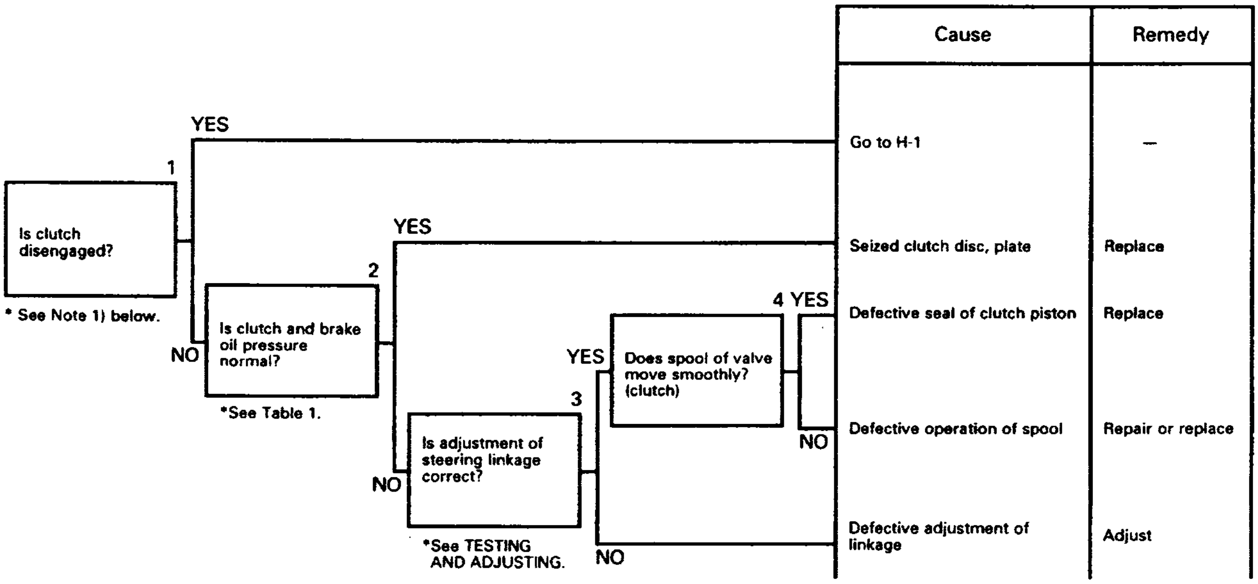
Unit: MPa (kg/cm²)

Conditions			D65E, P		D65EX, PX
			Hydraulic pressure (left, right)		Hydraulic pressure (left, right)
			Clutch	Brake	Brake
Brake pedal not depressed	Engine speed:	Full	0	Min. 2.2 (22)	Min. 2.4 (24)
		Low idling	0	Min. 2.2 (22)	Min. 2.4 (24)
Brake pedal depressed	Engine speed:	Full	0	0	0
		Low idling	0	0	0

H-2 Machine does not turn. (can travel in a straight line)

D65E-12 60001 - 65000
D65P-12 60001 - 65000

★ Check the oil level in the power train before carrying out troubleshooting.



Note: 1) Travel in F1 (R1) with the engine at low idling, and operate the steering and directional lever slowly to the left or right. The machine must stop or turn slowly.

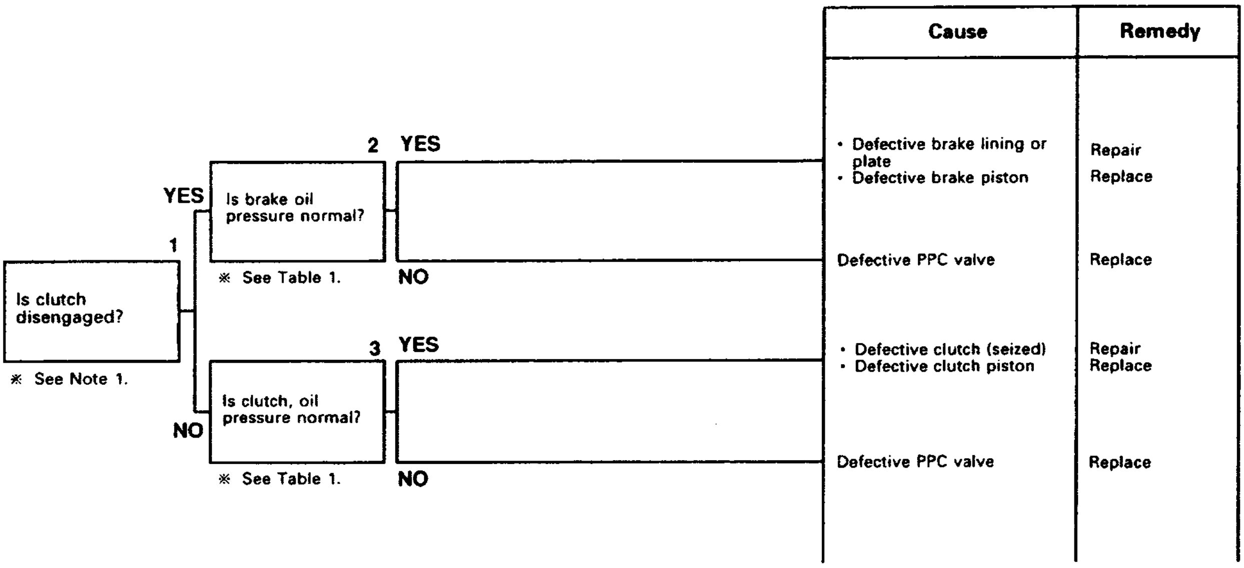
Table 1

Unit: MPa (kg/cm²)

Conditions				D65E, P	
				Hydraulic pressure	
				Clutch	Brake
Steering and directional lever not operated		Engine speed:	Full	0 (left, right)	Min. 2.2 (22) (left, right)
			Low idling	0 (left, right)	Min. 2.2 (22) (left, right)
Steering and directional lever operated	Operated to left	Engine speed:	Full	Right: 0 Left: Min. 2.2 (22)	Right: Min. 2.2 (22) Left: 0
			Low idling	Right: 0 Left: Min. 2.2 (22)	Right: Min. 2.2 (22) Left: 0
	Operated to right	Engine speed:	Full	Right: Min. 2.2 (22) Left: 0	Right: 0 Left: Min. 2.2 (22)
			Low idling	Right: Min. 2.2 (22) Left: 0	Right: 0 Left: Min. 2.2 (22)

D65E-12 65001 and up
D65P-12 65001 and up

★ Check the oil level in the power train before carrying out troubleshooting.



Note: 1) When traveling in F1 (R1) with the engine at low speed and the monolever is operated slowly to the left or right, the machine must turn slowly.

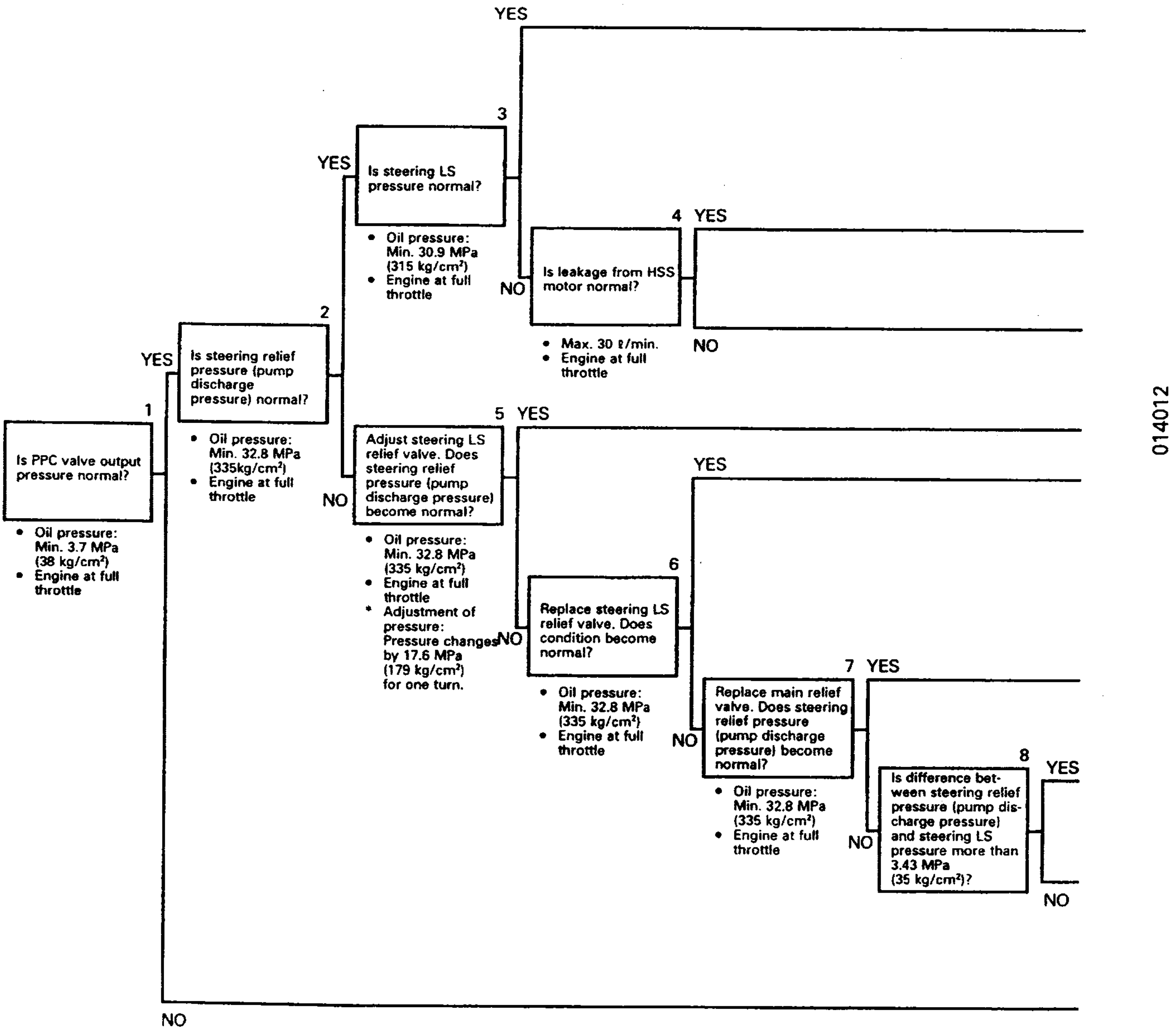
Table 1

Unit: MPa (kg/cm²)

Conditions				D65E, P	
				Hydraulic pressure	
				Clutch	Brake
Steering and directional lever not operated		Engine speed:	Full	0 (left, right)	Min. 2.2 (22) (left, right)
			Low idling	0 (left, right)	Min. 2.2 (22) (left, right)
Steering and directional lever operated	Operated to left	Engine speed:	Full	Right: 0 Left: Min. 2.2 (22)	Right: Min. 2.2 (22) Left: 0
			Low idling	Right: 0 Left: Min. 2.2 (22)	Right: Min. 2.2 (22) Left: 0
	Operated to right	Engine speed:	Full	Right: Min. 2.2 (22) Left: 0	Right: 0 Left: Min. 2.2 (22)
			Low idling	Right: Min. 2.2 (22) Left: 0	Right: 0 Left: Min. 2.2 (22)

H-3 Turning speed is slow (cannot turn) or lacks power when turning. D65EX, PX-12

★ Check the oil level in the hydraulic tank before carrying out troubleshooting.

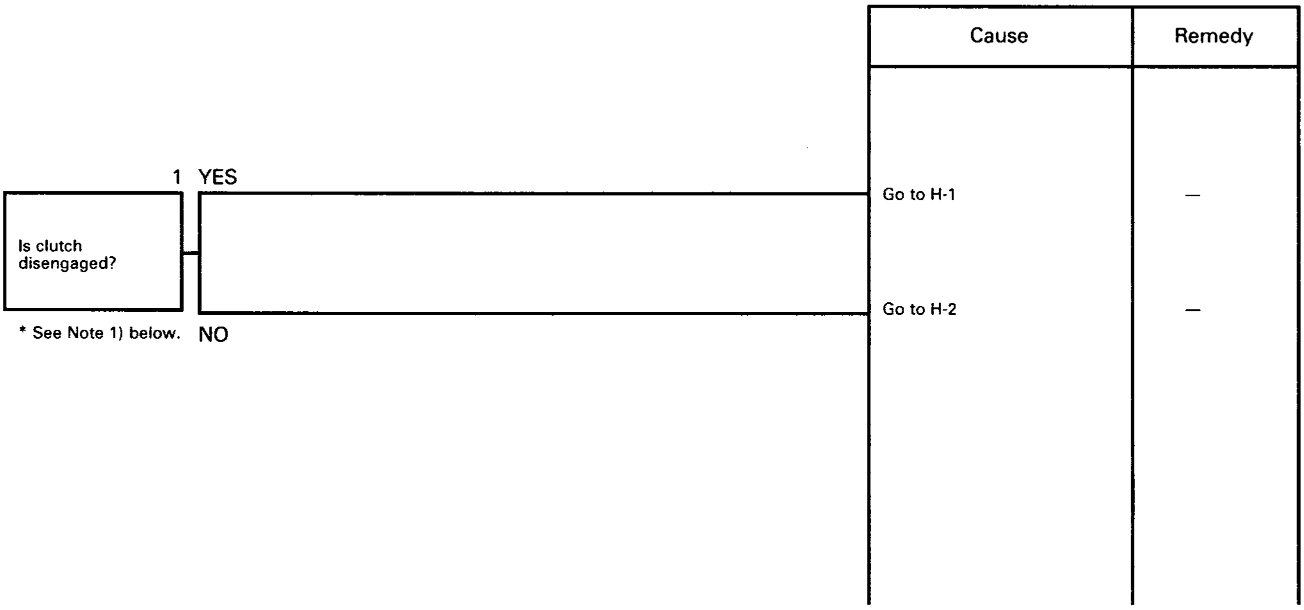


Cause	Remedy
Defective operation of steering pressure compensation valve	Correct or replace
Defective operation of steering control valve spool	Correct or replace
Defective HSS motor	Replace
Defective adjustment of steering LS relief valve	Adjust
Defective operation of steering LS relief valve	Correct or replace
Defective main relief valve	Replace
The confined pressure remaining in the LS circuit (LS bypass valve clogged with dirt or defective operation of LS check valve (for steering)	Correct or replace
• Defective operation of steering control spool twisted • Defective operation of unload valve spool • Defective operation of work equipment · HSS pump	Correct or replace
Defective operation of PPC valve	Correct or replace

014012

Note: 1) Check that there is no clogging by dust or any deterioration of the spring, then move the spool by hand and judge if the spool moves smoothly.

H-4 Overruns when turning
D65E, P-12



Note: 1) Travel in F1 (R1) with the engine at low idling, and operate the steering and directional lever slowly to the left or right. The machine must stop or turn slowly.

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H-5 Can turn in only one direction (when steering lever is operated)

D65E-12 60001 - 65000
D65P-12 60001 - 65000

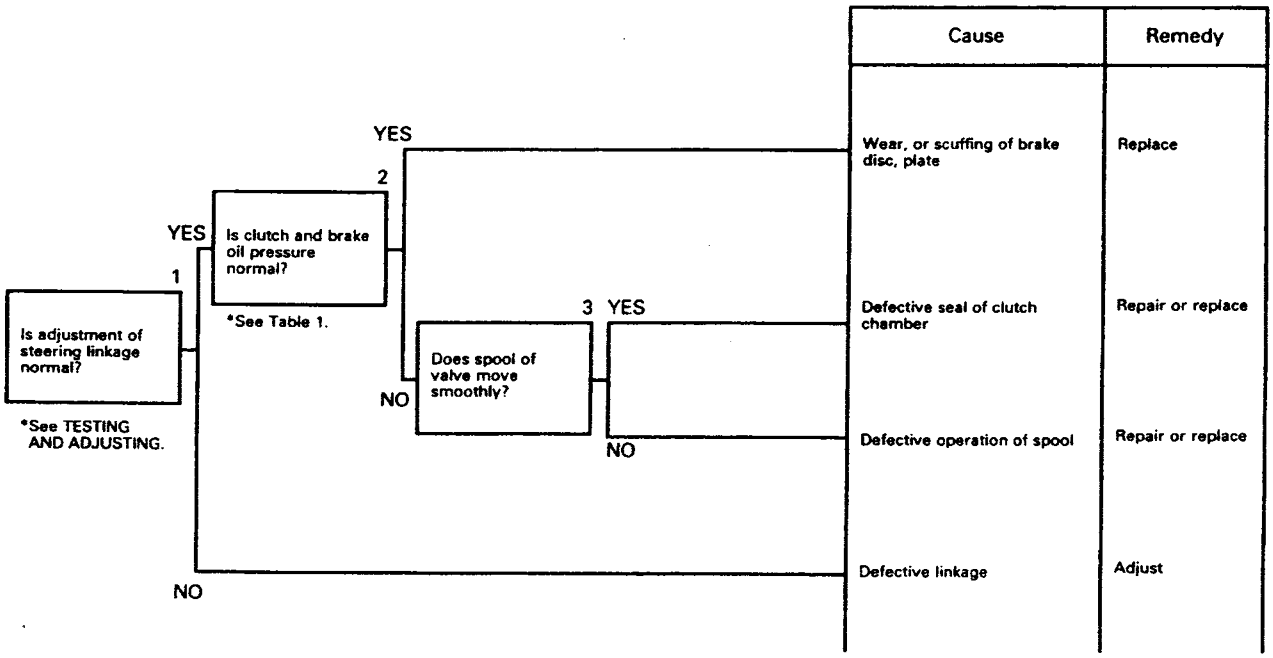

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Table 1

Unit: MPa (kg/cm²)

Conditions				D65E, P	
				Hydraulic pressure	
				Clutch	Brake
Steering and directional lever not operated		Engine speed:	Full	0 (left, right)	Min. 2.2 (22) (left, right)
			Low idling	0 (left, right)	Min. 2.2 (22) (left, right)
Steering and directional lever operated	Operated to left	Engine speed:	Full	Right: 0 Left: Min. 2.2 (22)	Right: Min. 2.2 (22) Left: 0
			Low idling	Right: 0 Left: Min. 2.2 (22)	Right: Min. 2.2 (22) Left: 0
	Operated to right	Engine speed:	Full	Right: Min. 2.2 (22) Left: 0	Right: 0 Left: Min. 2.2 (22)
			Low idling	Right: Min. 2.2 (22) Left: 0	Right: 0 Left: Min. 2.2 (22)

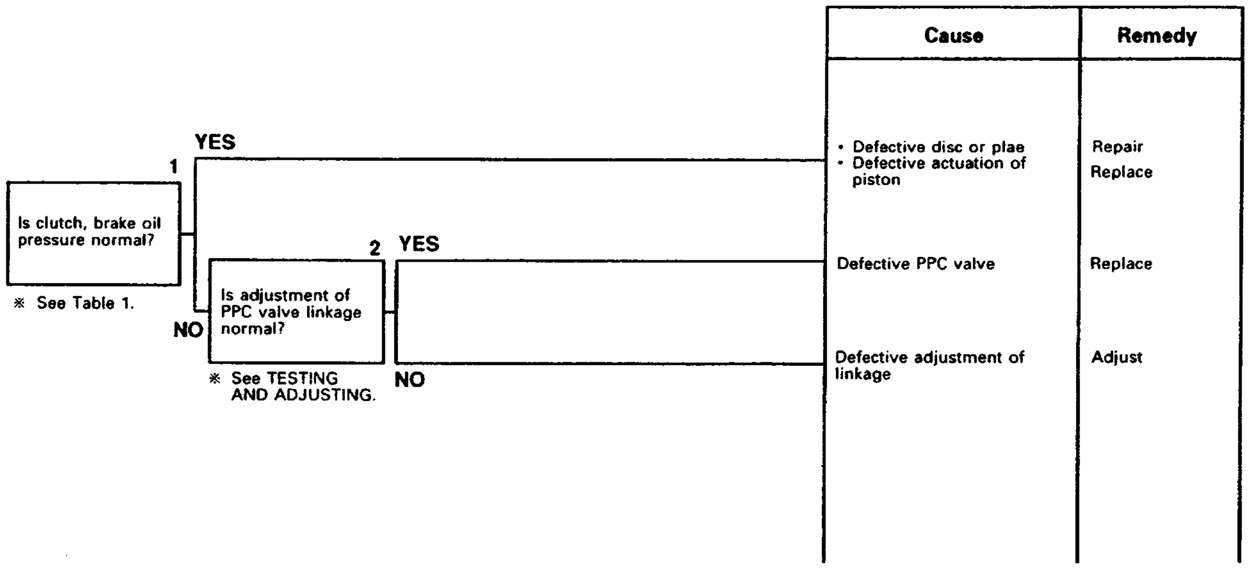
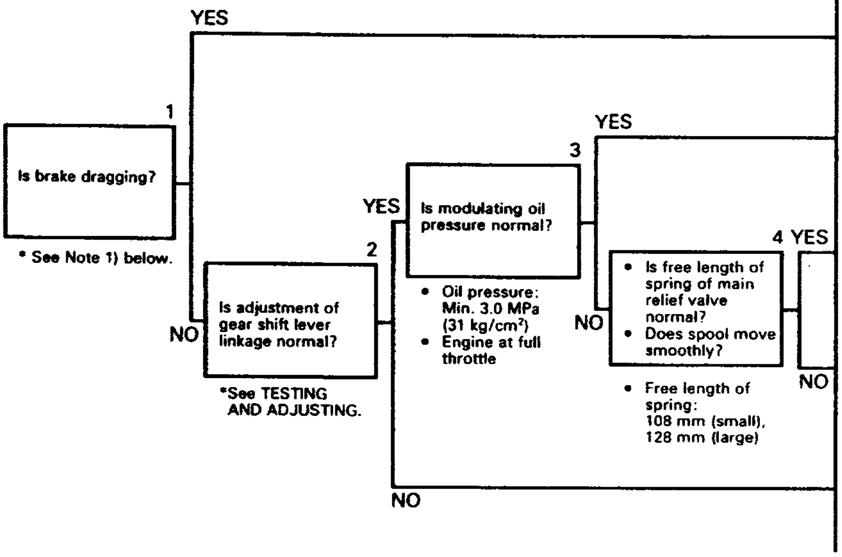


Table 1

Unit: MPa (kg/cm²)

Conditions				D65E, P	
				Hydraulic pressure	
				Clutch	Brake
Steering and directional lever not operated		Engine speed:	Full	0 (left, right)	Min. 2.2 (22) (left, right)
			Low idling	0 (left, right)	Min. 2.2 (22) (left, right)
Steering and directional lever operated	Operated to left	Engine speed:	Full	Right: 0 Left: Min. 2.2 (22)	Right: Min. 2.2 (22) Left: 0
			Low idling	Right: 0 Left: Min. 2.2 (22)	Right: Min. 2.2 (22) Left: 0
	Operated to right	Engine speed:	Full	Right: Min. 2.2 (22) Left: 0	Right: 0 Left: Min. 2.2 (22)
			Low idling	Right: Min. 2.2 (22) Left: 0	Right: 0 Left: Min. 2.2 (22)

H-6 Excessive time lag



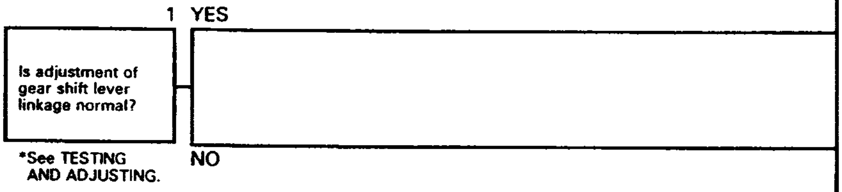
Cause	Remedy
Go to H-1	—
Defective transmission valve • Defective operation of spool	Repair or replace
Defective power train pump	Replace
Defective spring, clogged with dirt	Replace or clean
Defective adjustment of linkage	Adjust

014012

Note: 1) Stop the machine on level ground, run the engine at low idling, then shift to F2 and check if the machine moves (travels).

H-7 Machine can travel in only one direction (forward or reverse)

★ Conditions: Oil pressure is normal (Min. 3.0 MPa (31 kg/cm²)



Cause	Remedy
Defective part inside transmission or defective valve	Repair or replace
Defective adjustment of linkage	Adjust

H-8 Machine does not move (when engine is started and lever is shifted to 2nd or 3rd)

1) D65E, P-12

★ Check the oil level in the power train before carrying out troubleshooting.

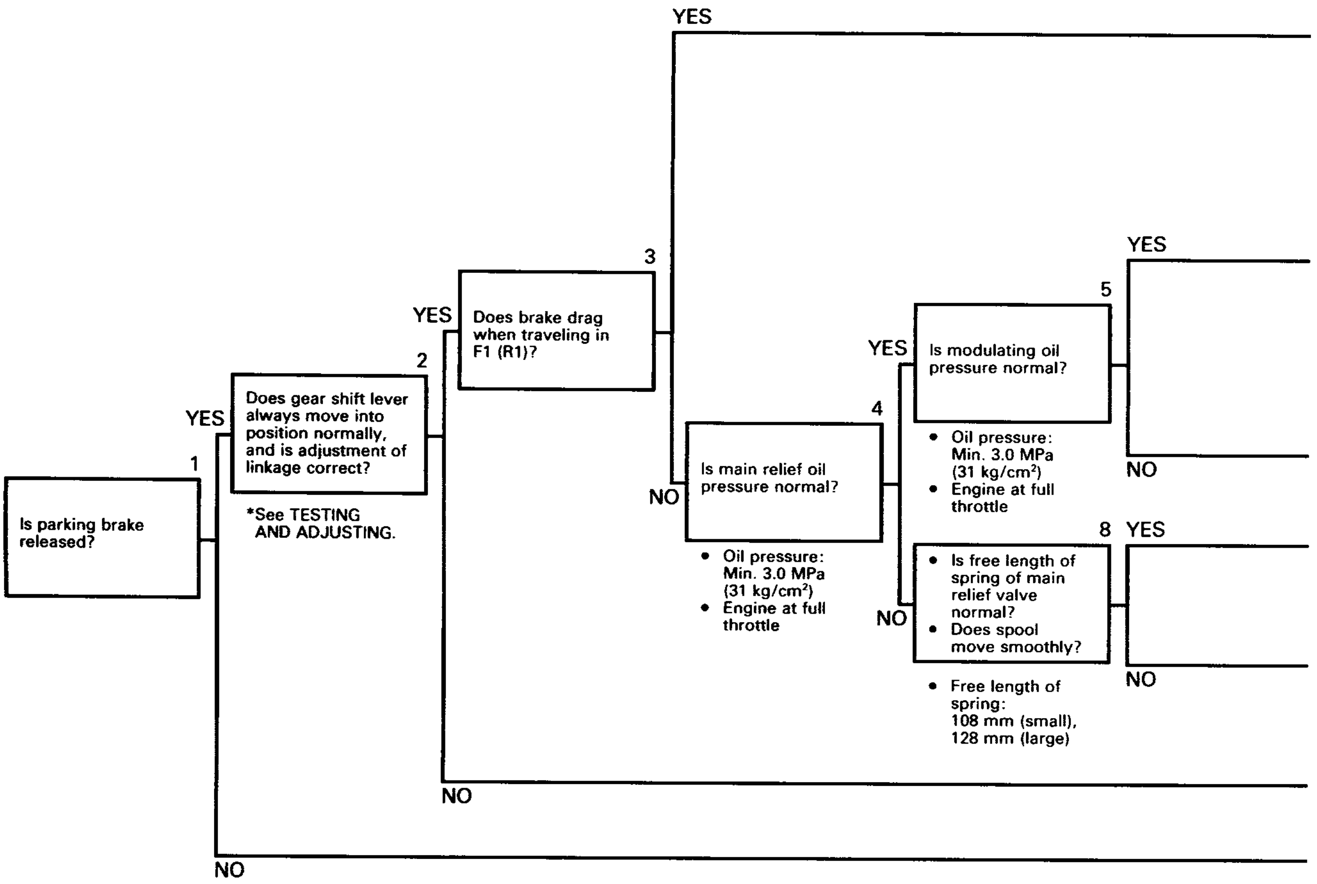
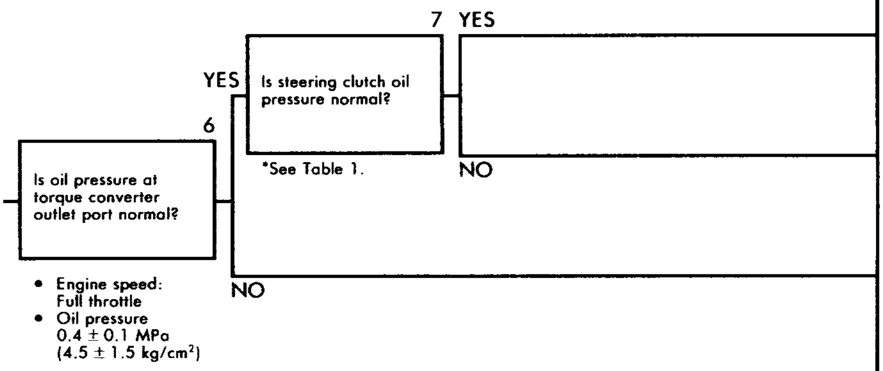


Table 1

Unit: MPa (kg/cm²)

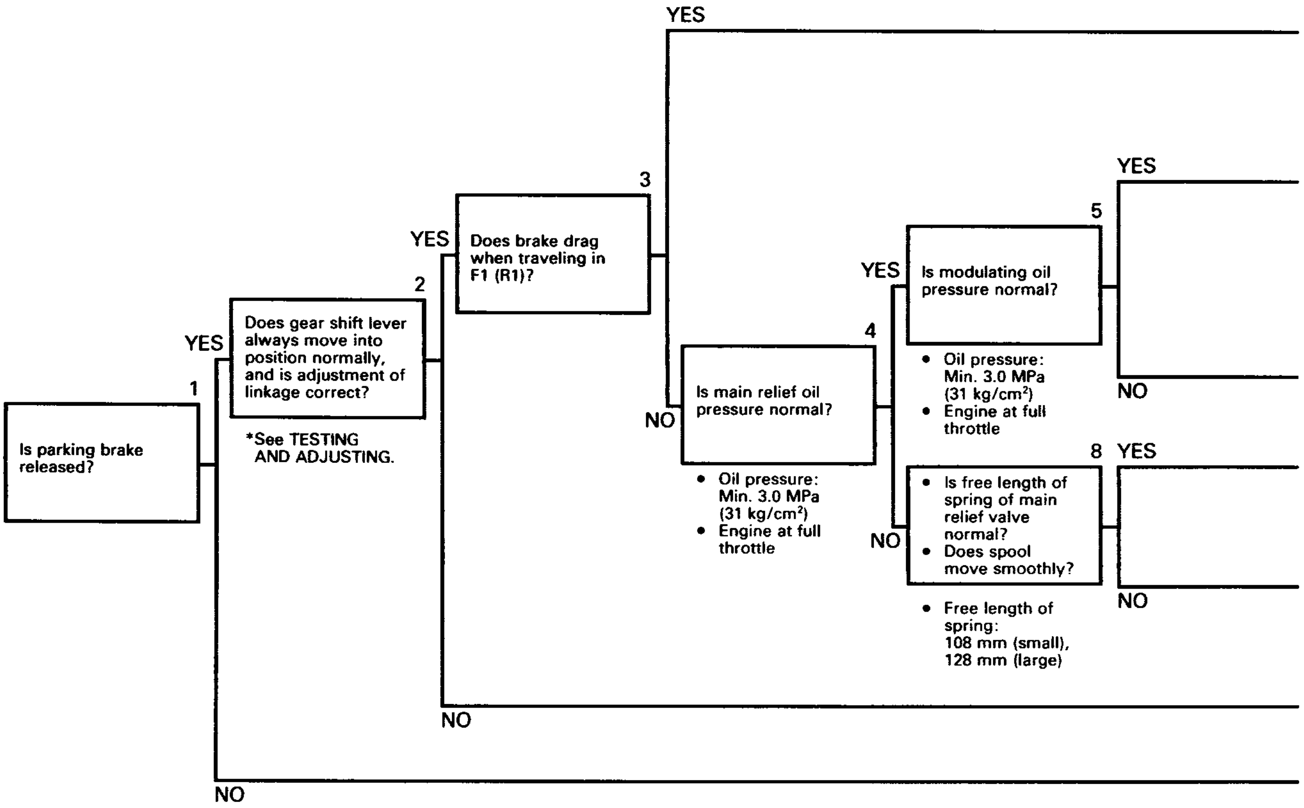
Conditions				D65E, P		D65EX, PX
				Hydraulic pressure		Hydraulic pressure
				Clutch	Brake	Brake
Steering and directional lever not operated		Engine speed:	Full	0 (left, right)	Min. 2.2 (22) (left, right)	Min. 2.4 (24) (left, right)
			Low idling	0 (left, right)	Min. 2.2 (22) (left, right)	Min. 2.4 (24) (left, right)
Steering and directional lever operated	Operated to left	Engine speed:	Full	Right: 0 Left: Min. 2.2 (22)	Right: Min. 2.2 (22) Left: 0	—
			Low idling	Right: 0 Left: Min. 2.2 (22)	Right: Min. 2.2 (22) Left: 0	—
	Operated to right	Engine speed:	Full	Right: Min. 2.2 (22) Left: 0	Right: 0 Left: Min. 2.2 (22)	—
			Low idling	Right: Min. 2.2 (22) Left: 0	Right: 0 Left: Min. 2.2 (22)	—



Cause	Remedy
Draggging brake (see H-1)	—
Defective part inside transmission	Repair or replace
Defective steering clutch (see H-2)	—
Defective part inside torque converter	Repair or replace
Defective transmission valve	Repair or replace
Defective power train pump	Replace
Defective spring, scuffing of spool, clogged with dirt	Repair or replace, clean
Defective adjustment of linkage	Adjust
Defective adjustment of parking brake linkage	Adjust
(See TESTING AND ADJUSTING)	

2) D65EX, PX-12

★ Check the oil level in the power train before carrying out troubleshooting.



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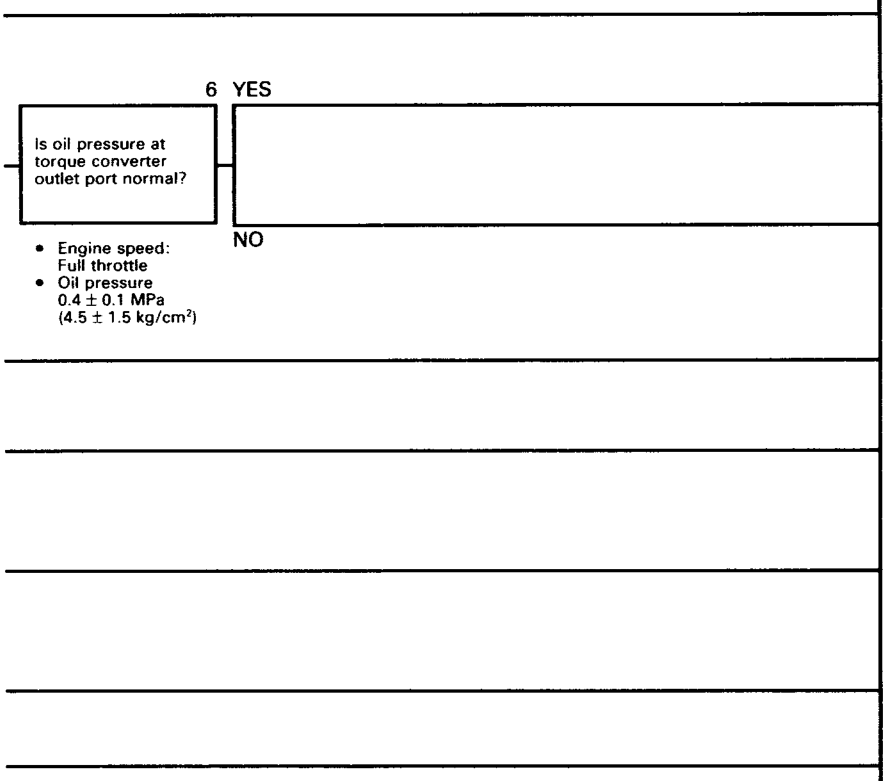

Cause	Remedy
Dragging brake (see H-1)	—
Defective part inside transmission	Repair or replace
Defective part inside torque converter	Repair or replace
Defective transmission valve	Repair or replace
Defective power train pump	Replace
Defective spring, scuffing of spool, clogged with dirt	Repair or replace, clean
Defective adjustment of linkage	Adjust
Defective adjustment of parking brake linkage (See TESTING AND ADJUSTING)	Adjust

014012

H-9 Machine does not move in any speed range

1) D65E, P-12

★ Check the oil level in the power train before carrying out troubleshooting.

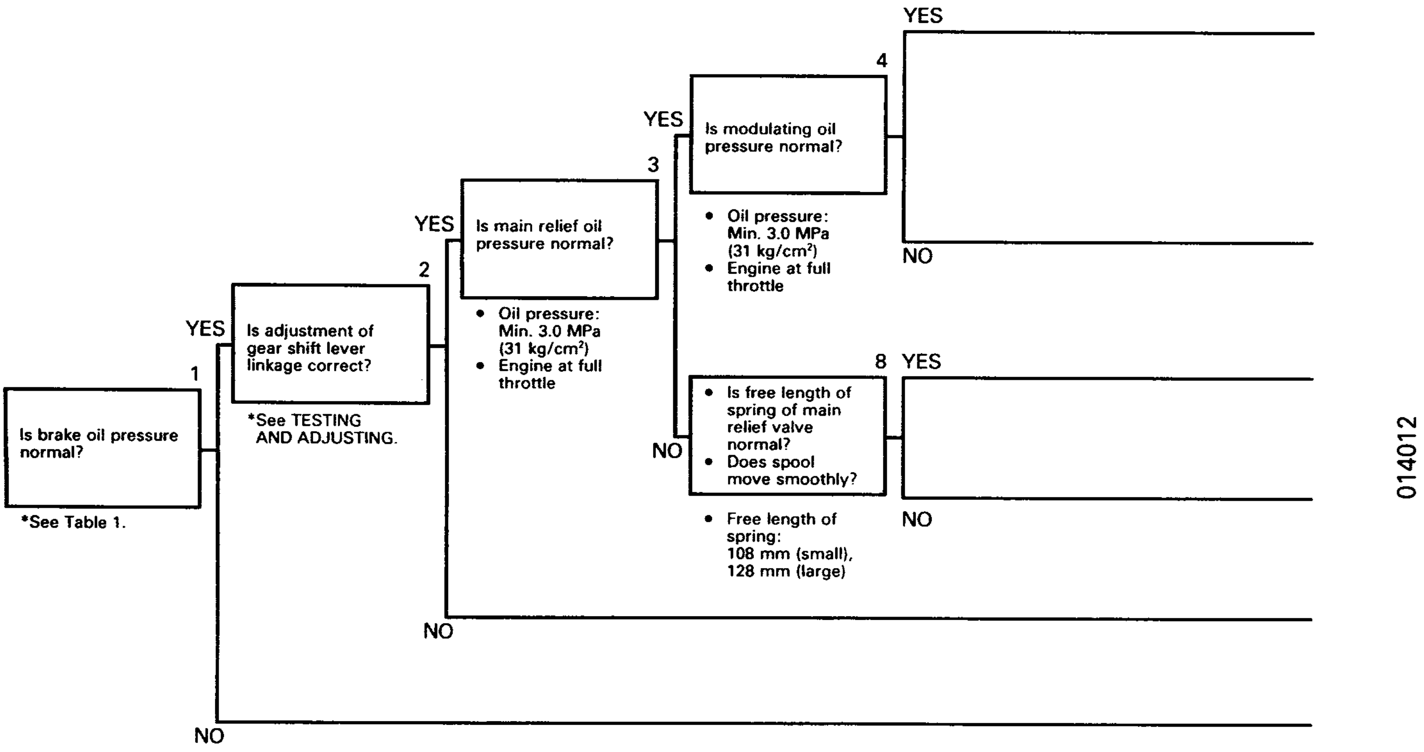

Table 1

Unit: MPa (kg/cm²)

Conditions			Hydraulic pressure (left, right)	
			Clutch	Brake
Brake pedal not depressed	Engine speed:	Full	0	Min. 2.2 (22)
		Low idling	0	Min. 2.2 (22)
Brake pedal depressed	Engine speed:	Full	0	0
		Low idling	0	0

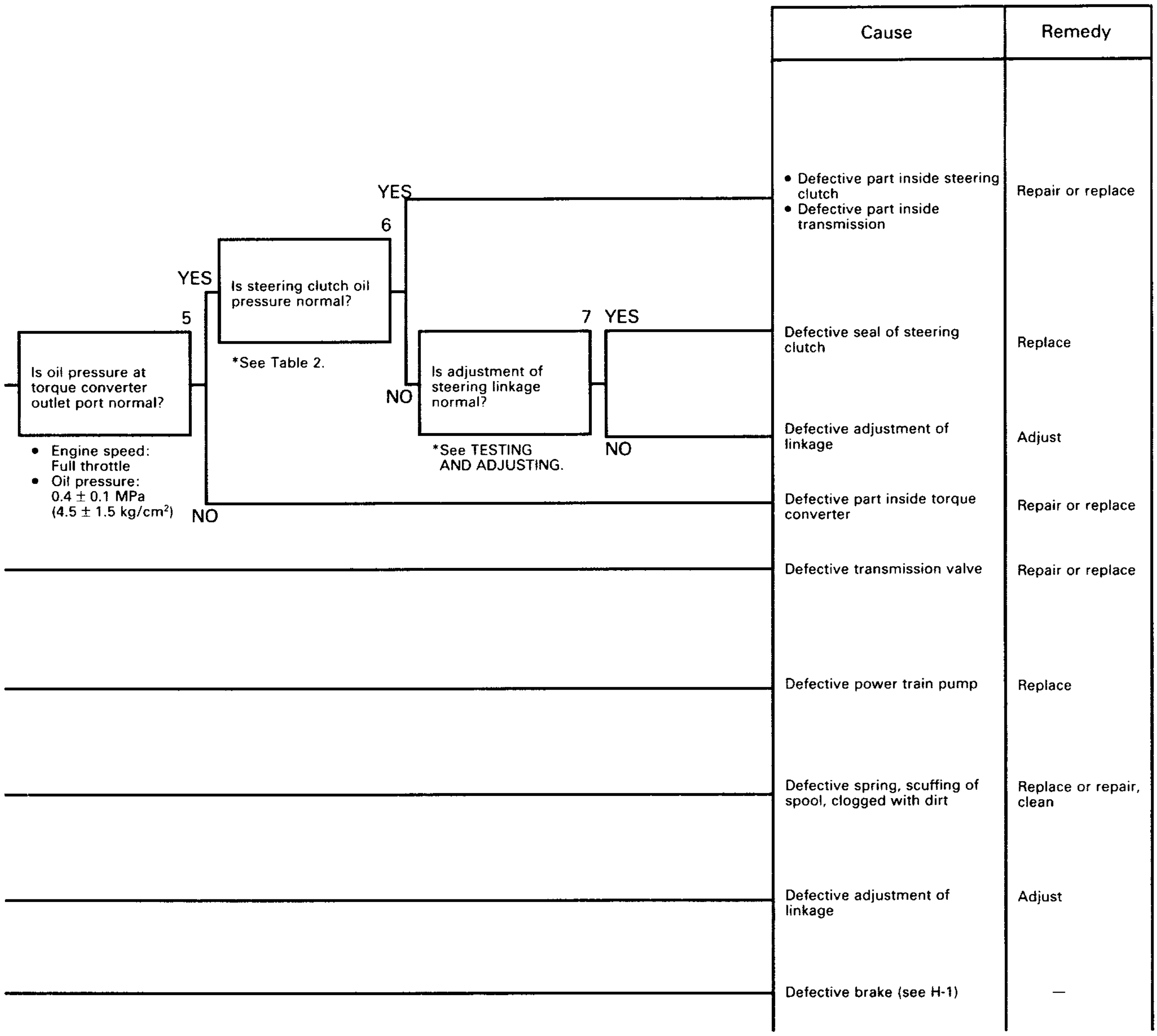

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Table 2

Unit: MPa (kg/cm²)

Conditions				Hydraulic pressure	
				Clutch	Brake
Steering and directional lever not operated		Engine speed:	Full	0 (left, right)	Min. 2.2 (22) (left, right)
			Low idling	0 (left, right)	Min. 2.2 (22) (left, right)
Steering and directional lever operated	Operated to left	Engine speed:	Full	Right: 0 Left: Min. 2.2 (22)	Right: Min. 2.2 (22) Left: 0
			Low idling	Right: 0 Left: Min. 2.2 (22)	Right: Min. 2.2 (22) Left: 0
	Operated to right	Engine speed:	Full	Right: Min. 2.2 (22) Left: 0	Right: 0 Left: Min. 2.2 (22)
			Low idling	Right: Min. 2.2 (22) Left: 0	Right: 0 Left: Min. 2.2 (22)

2) D65EX, PX-12

★ Check the oil level in the power train before carrying out troubleshooting.

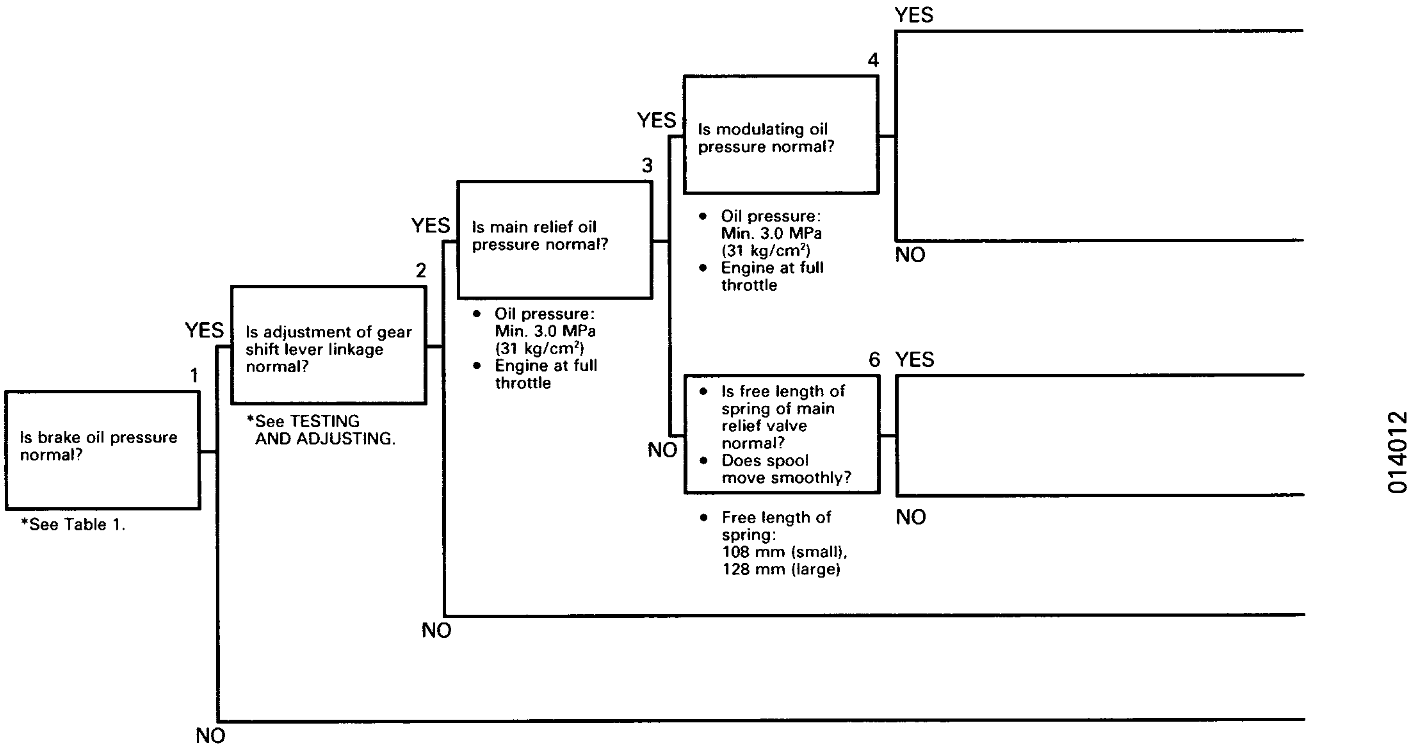
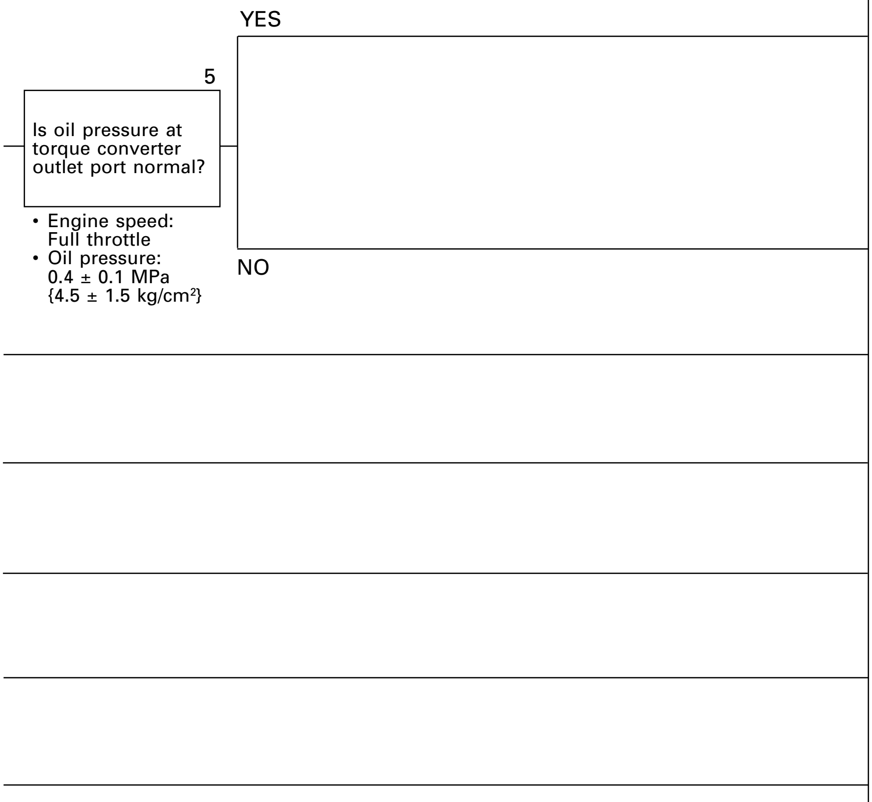


Table 1

Unit: MPa (kg/cm²)

Conditions			Hydraulic pressure (left, right)
			Brake
Brake pedal not depressed	Engine speed:	Full	Min. 2.4 (24)
		Low idling	Min. 2.4 (24)
Brake pedal depressed	Engine speed:	Full	0
		Low idling	0



Cause	Remedy
Defective part inside transmission	Repair or replace
Defective part inside torque converter	Repair or replace
Defective transmission valve	Repair or replace
Defective power train pump	Replace
Defective spring, scuffing of spool, clogged with dirt	Replace or repair, clean
Defective adjustment of linkage	Adjust
Defective brake (see H-1)	–

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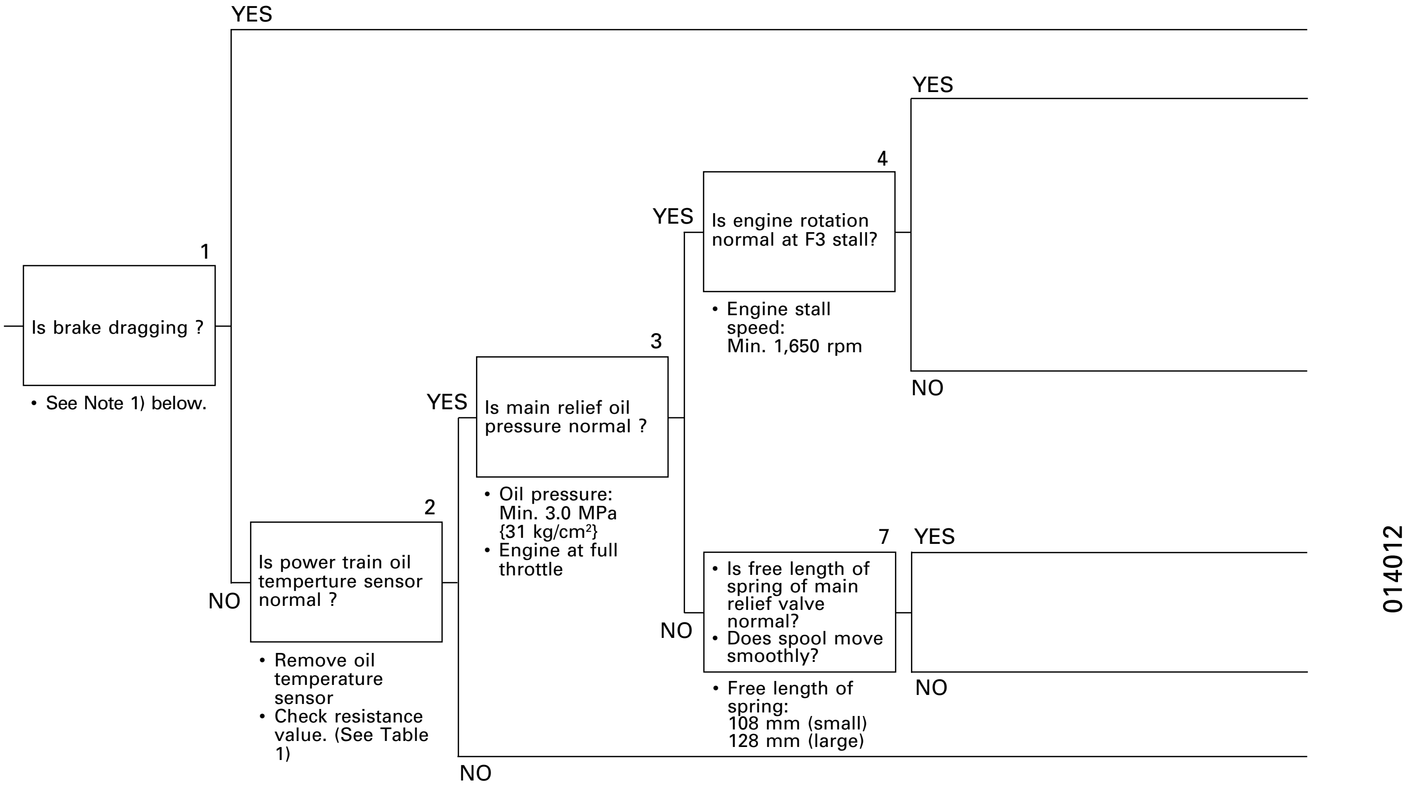
H-10 Power train oil temperature rises too high

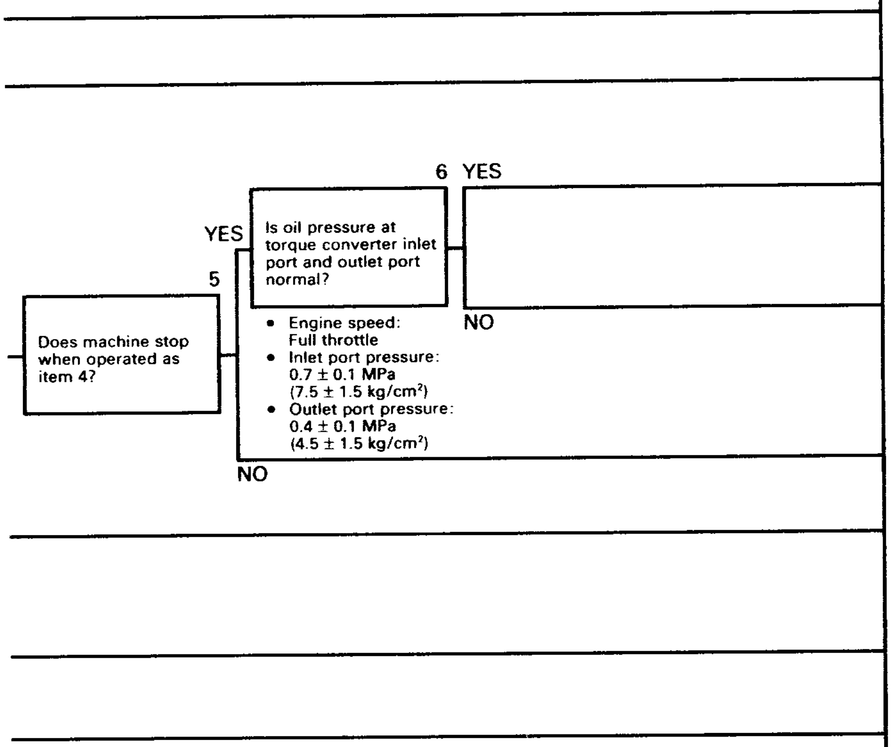
★ Check the oil level in the power train before carrying out troubleshooting.



Note: 1) Stop the machine on level ground, run the engine at low idling, then shift to F2 and check if the machine moves.

Table 1

Ambient temperature	When normal
100°C	Approx. 3.8 kΩ
I	I
90°C	Approx. 5 kΩ
I	I
35°C	Approx. 29 kΩ
I	I
20°C	Approx. 52 kΩ
I	I
10°C	Approx. 80 kΩ



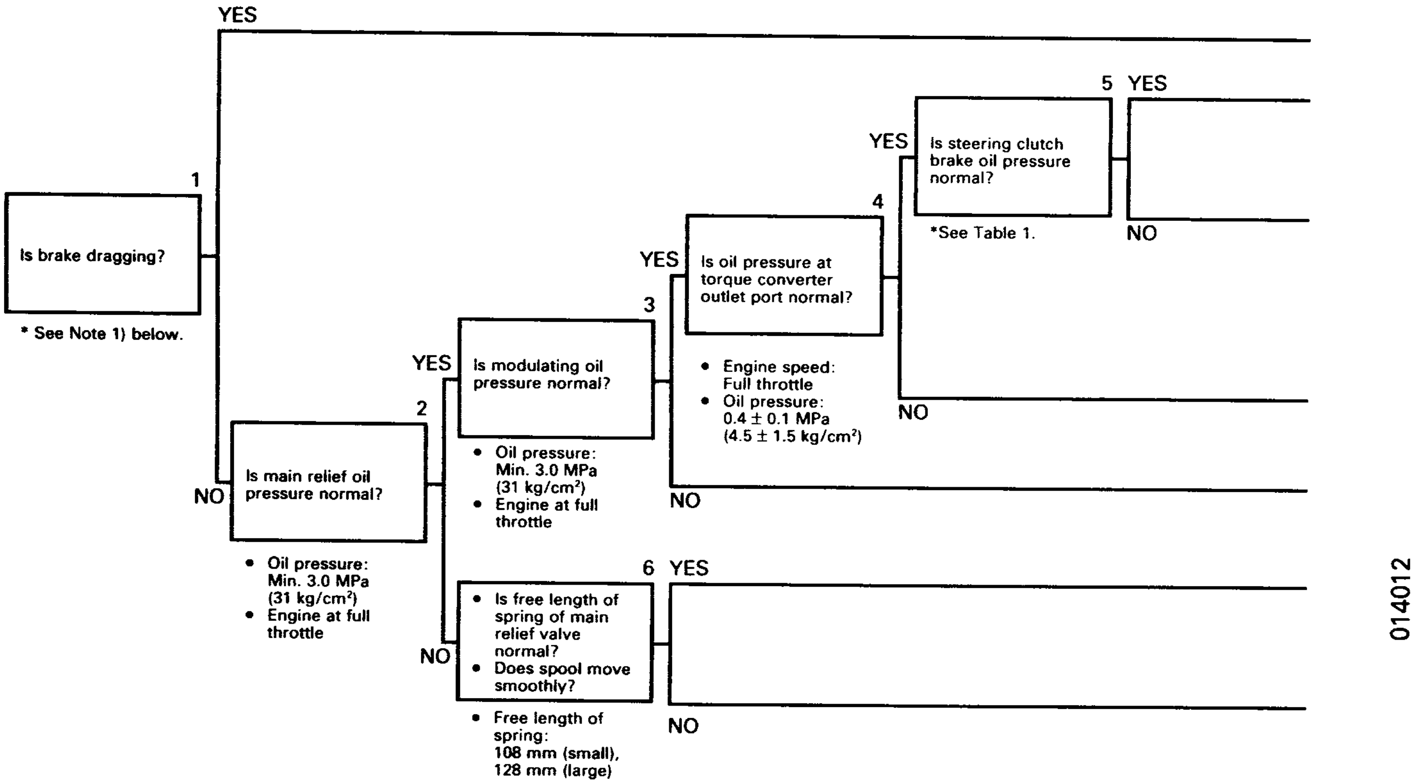
Cause	Remedy
Dragging brake (see H-1)	—
Defective coolant system (See Engine Volume)	—
Slipping transmission clutch or increase in engine output, or slipping steering clutch	Replace, adjust
Defective part inside torque converter	Replace or repair
Slipping brake disc	Replace or repair
Defective power train pump, air sucked in through joint in suction circuit	Replace, tighten
Defective spring, scuffing or spool, clogged with dirt	Replace or repair, clean
Defective power train oil temperature sensor	Replace

014012

H-11 Drawbar pull is weak, travel speed is slow.

1) D65E, P-12

★ Check the oil level in the power train before carrying out troubleshooting.



Note: 1) Stop the machine on level ground, run the engine at low idling, then shift to F2 and check if the machine moves (travels).

Table 1

Unit: MPa (kg/cm²)

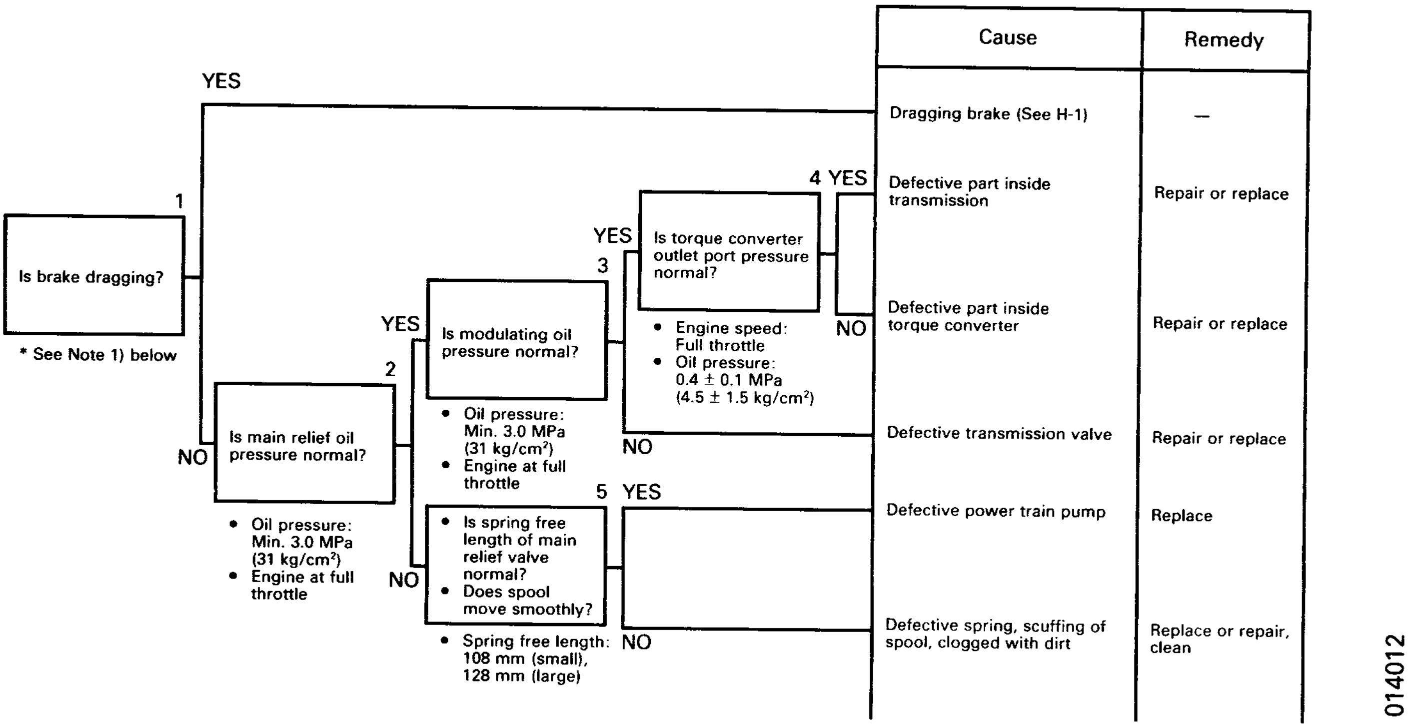
Conditions				Hydraulic pressure	
				Clutch	Brake
Steering and directional lever not operated		Engine speed:	Full	0 (left, right)	Min. 2.2 (22) (left, right)
			Low idling	0 (left, right)	Min. 2.2 (22) (left, right)
Steering and directional lever operated	Operated to left	Engine speed:	Full	Right: 0 Left: Min. 2.2 (22)	Right: Min. 2.2 (22) Left: 0
			Low idling	Right: 0 Left: Min. 2.2 (22)	Right: Min. 2.2 (22) Left: 0
	Operated to right	Engine speed:	Full	Right: Min. 2.2 (22) Left: 0	Right: 0 Left: Min. 2.2 (22)
			Low idling	Right: Min. 2.2 (22) Left: 0	Right: 0 Left: Min. 2.2 (22)

Cause	Remedy
Dragging brake (See H-1)	—
Defective part inside transmission	Repair or replace
Defective steering clutch (See H-2)	—
Defective part inside torque converter	Repair or replace
Defective transmission valve	Repair or replace
Defective power train pump	Replace
Defective spring, scuffing of spool, clogged with dirt	Replace or repair, clean

014012

2) D65EX, PX-12

★ Check the oil level in the power train before carrying out troubleshooting.

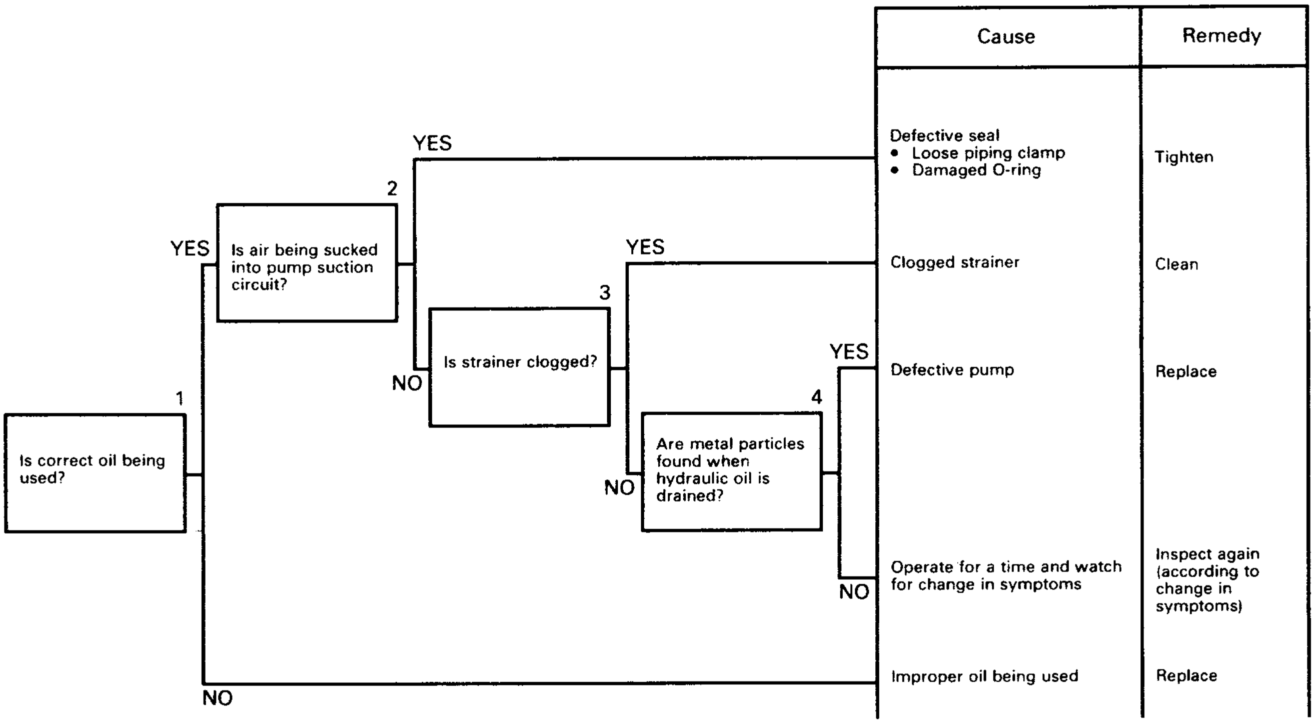


Note: 1) Stop the machine on level ground, run the engine at low idling, then shift to F2 and check if the machine moves (travels).

H-13 Abnormal noise is generated from around hydraulic pump or hydraulic, HSS pump

★ Hydraulic pump: D65E, P-12
Hydraulic, HSS pump: D65EX, PX-12

★ Check the oil level in the hydraulic tank before carrying out troubleshooting.



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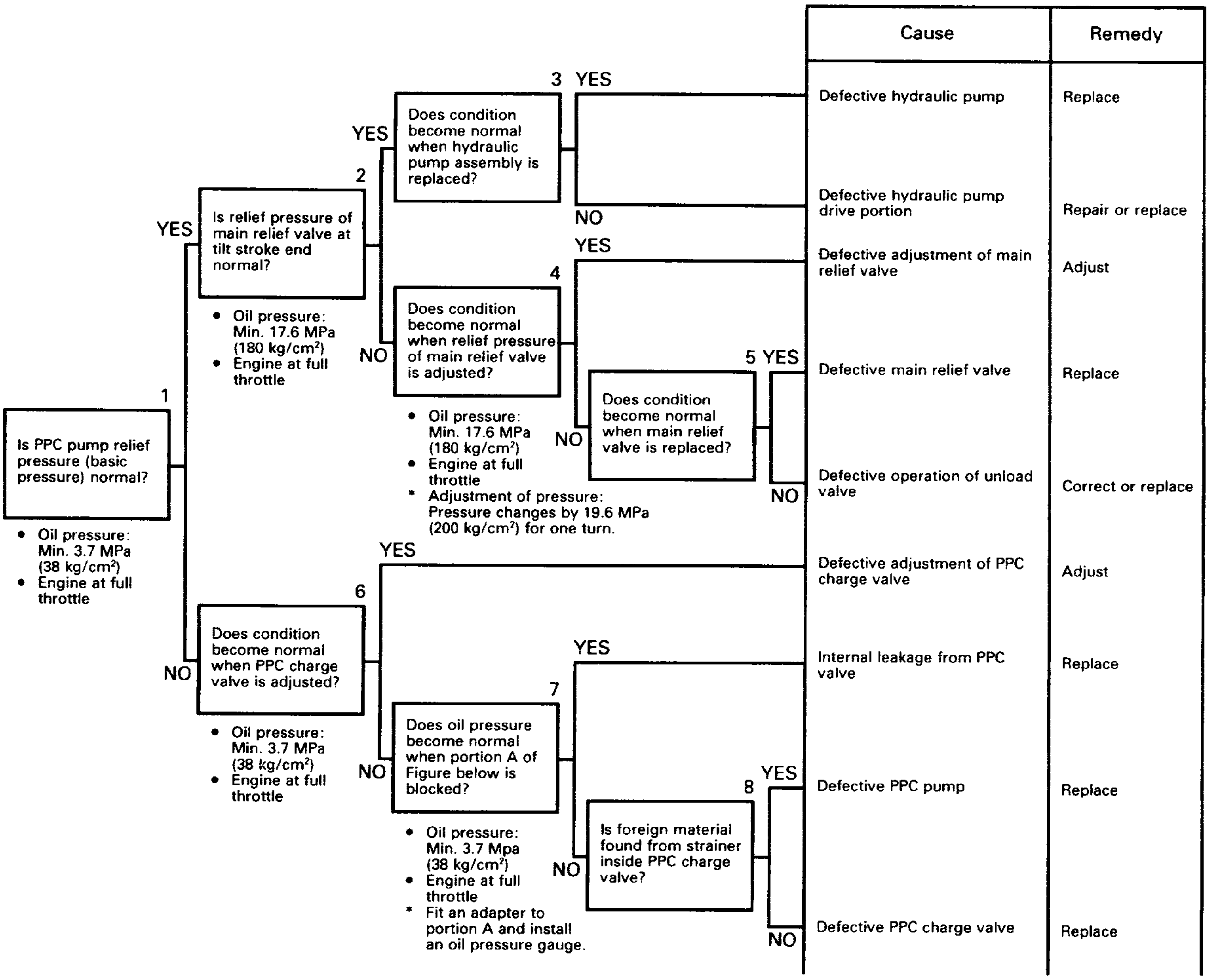
H-14 Speed of all work equipment is slow

D65E-12 60001 - 60947
D65P-12 60001 - 60890

★ Check the oil level in the hydraulic tank before carrying out troubleshooting.



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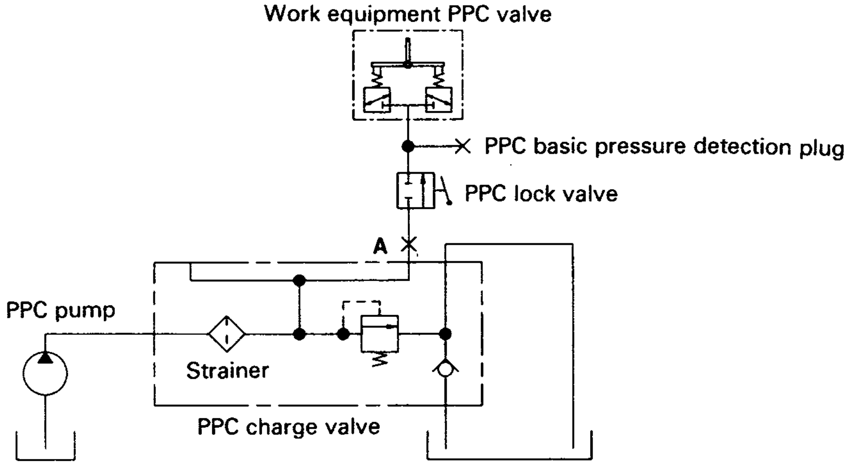
H-14 Related hydraulic circuit diagram



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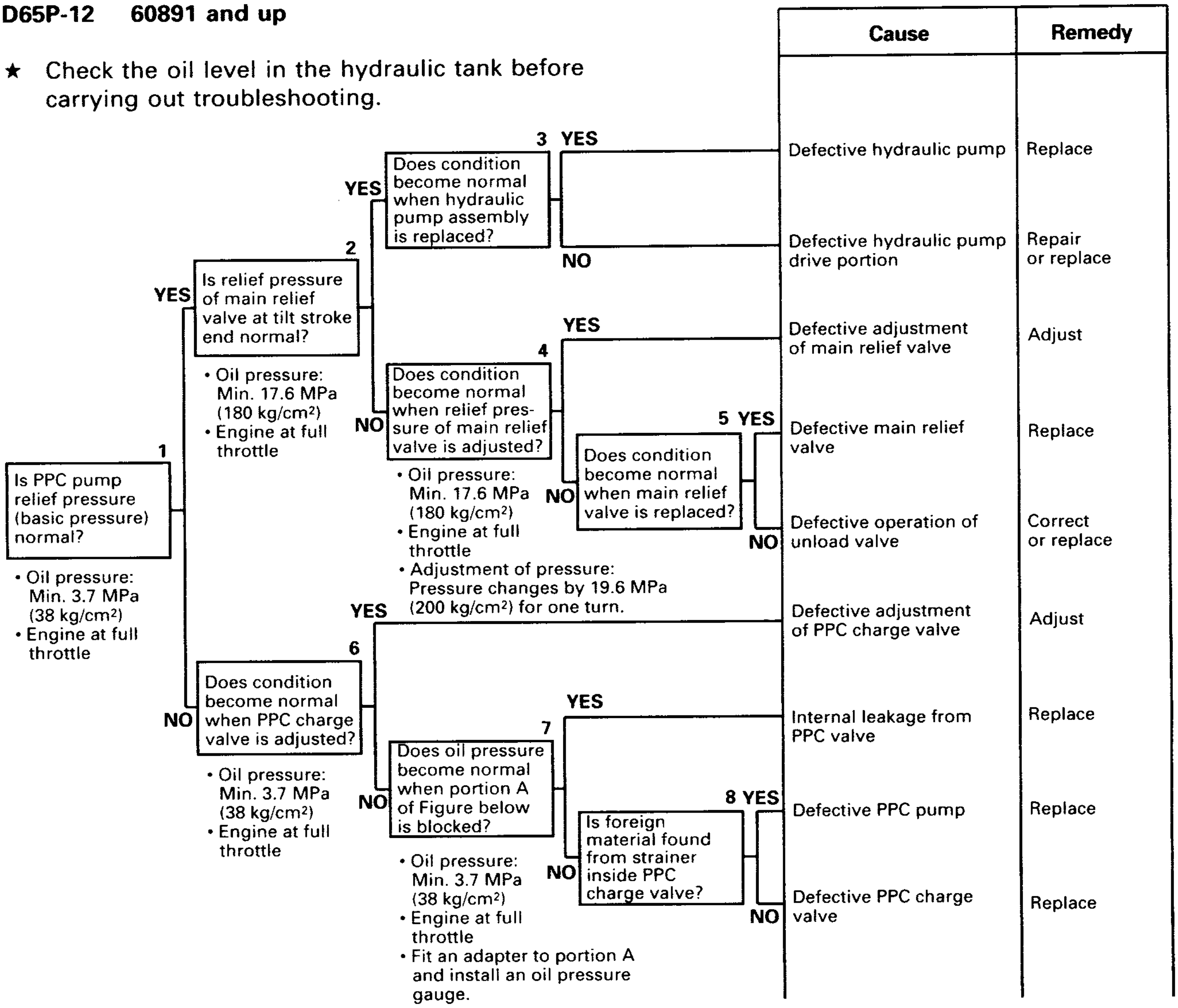
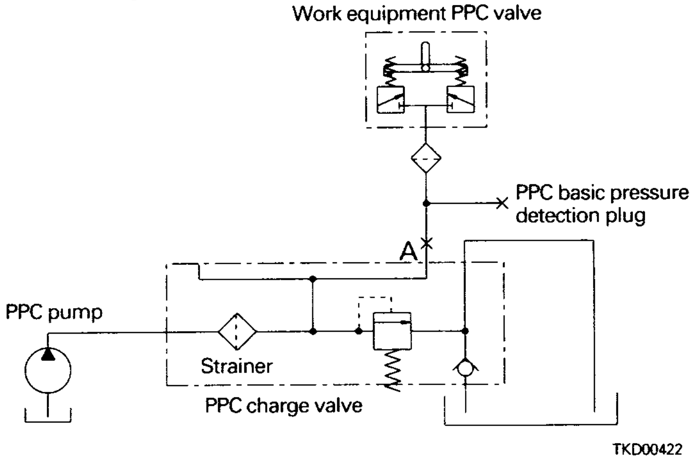
D65E-12 60948 and up
D65P-12 60891 and up

★ Check the oil level in the hydraulic tank before carrying out troubleshooting.



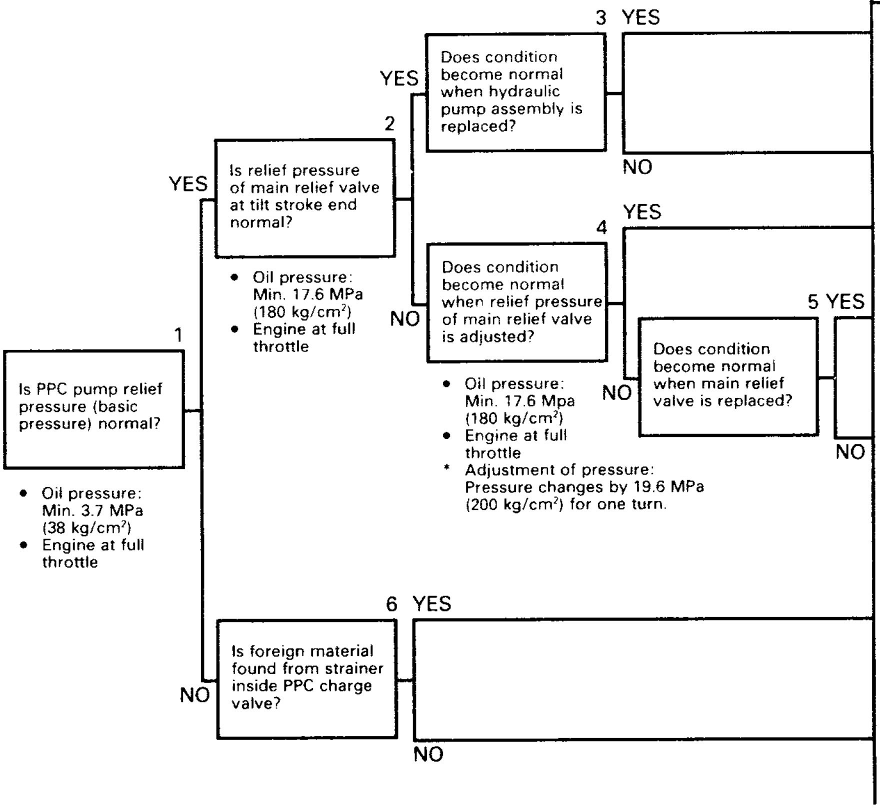
H-14 Related hydraulic circuit diagram



014012

H-15 No work equipment moves
D65E, P-12

★ Check the oil level in the hydraulic tank before carrying out troubleshooting.



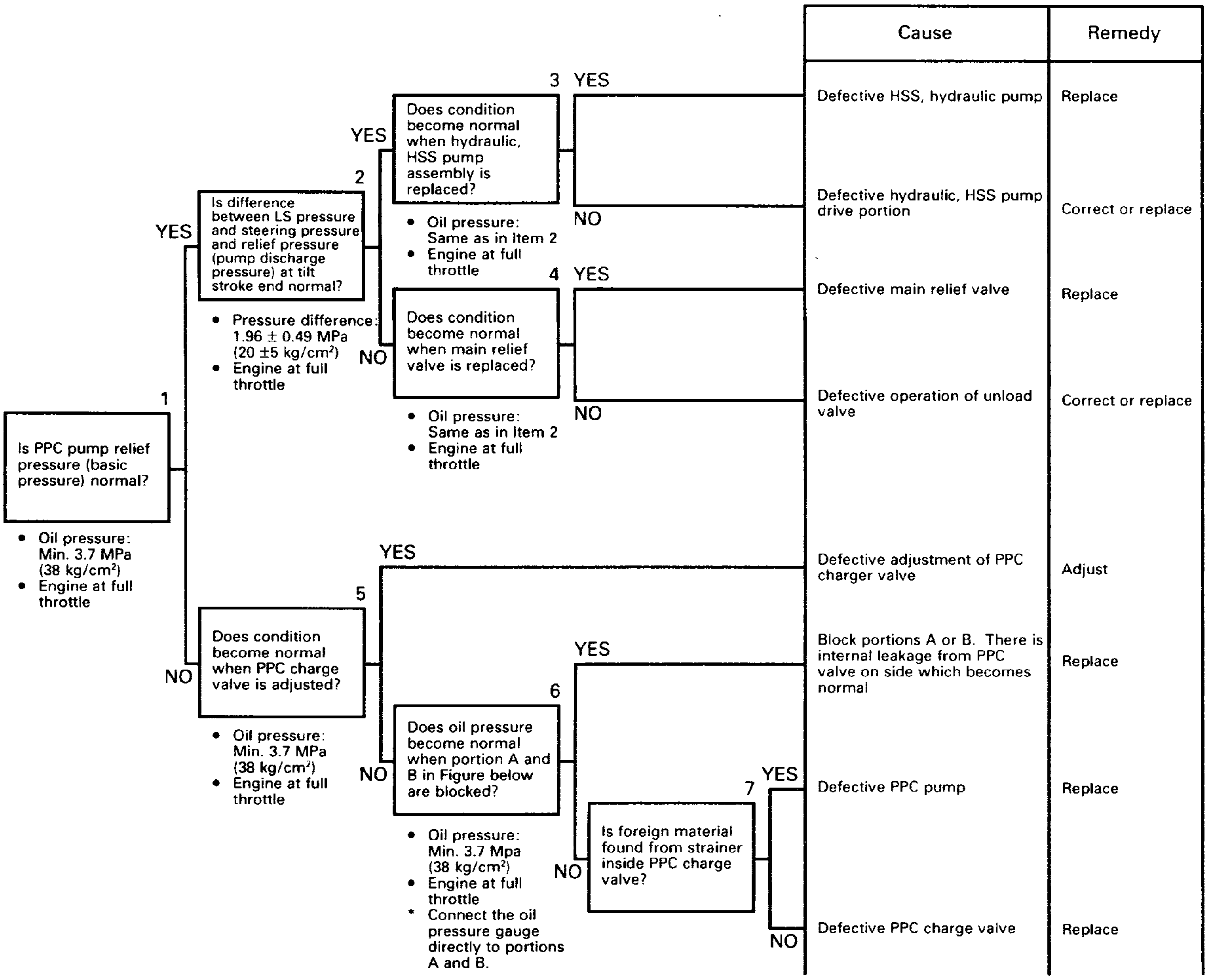
Cause	Remedy
Defective hydraulic pump	Replace
Defective hydraulic pump drive portion	Repair or replace
Defective adjustment of main relief valve	Adjust
Defective main relief valve	Replace
Defective operation of unload valve	Correct or replace
Defective PPC pump	Replace
Defective adjustment of PPC charge valve	Replace

H-16 All work equipment lacks power
D65E, P-12

★ Start troubleshooting from H-15 Item 2.

H-17 Turning speed and speed of all work equipment is slow

D65EX-12 60001 - 60941
D65PX-12 60001 - 60914



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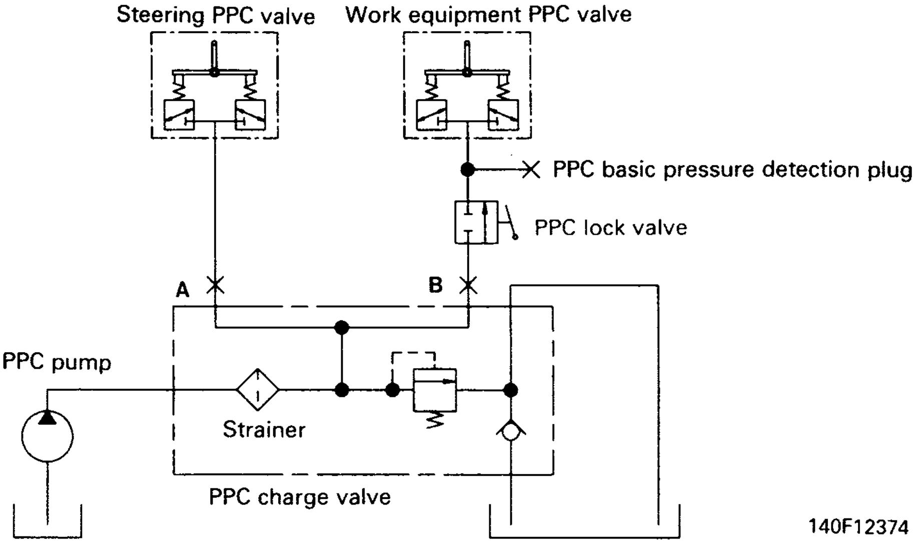
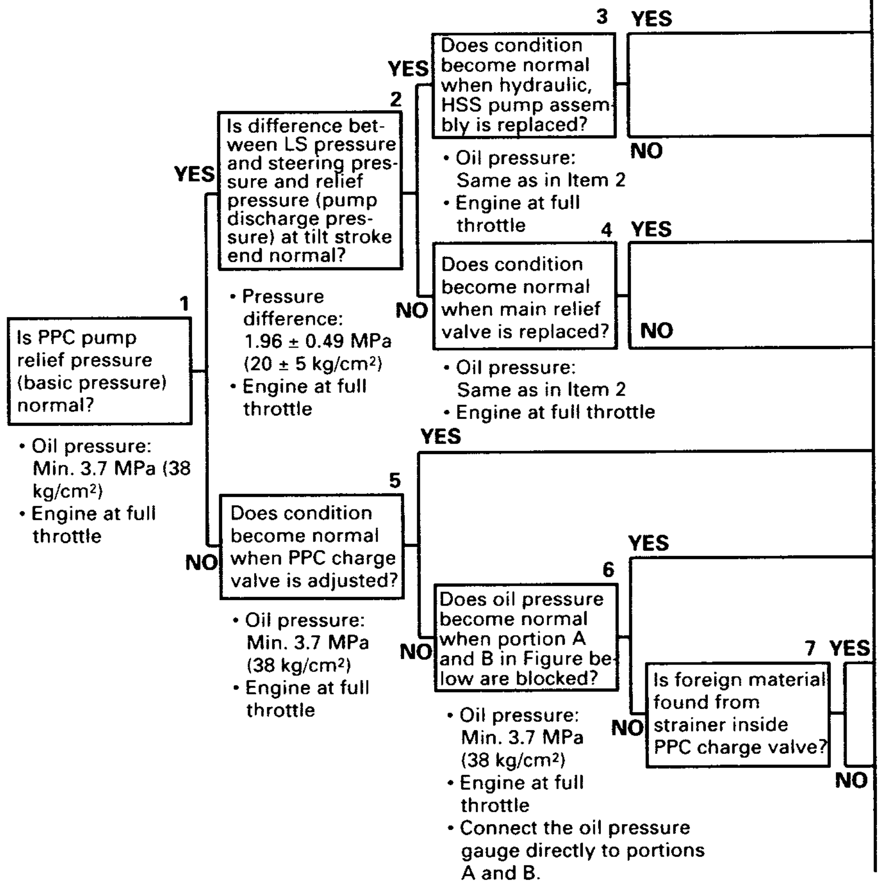
H-17 Related hydraulic circuit diagram

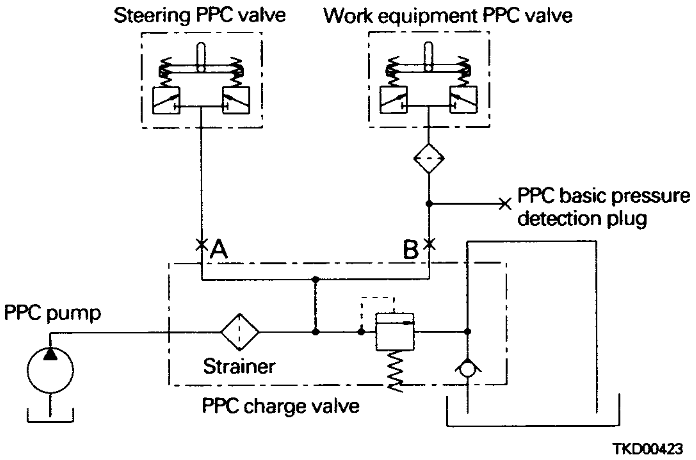


D65EX-12 60942 and up
D65PX-12 60915 and up



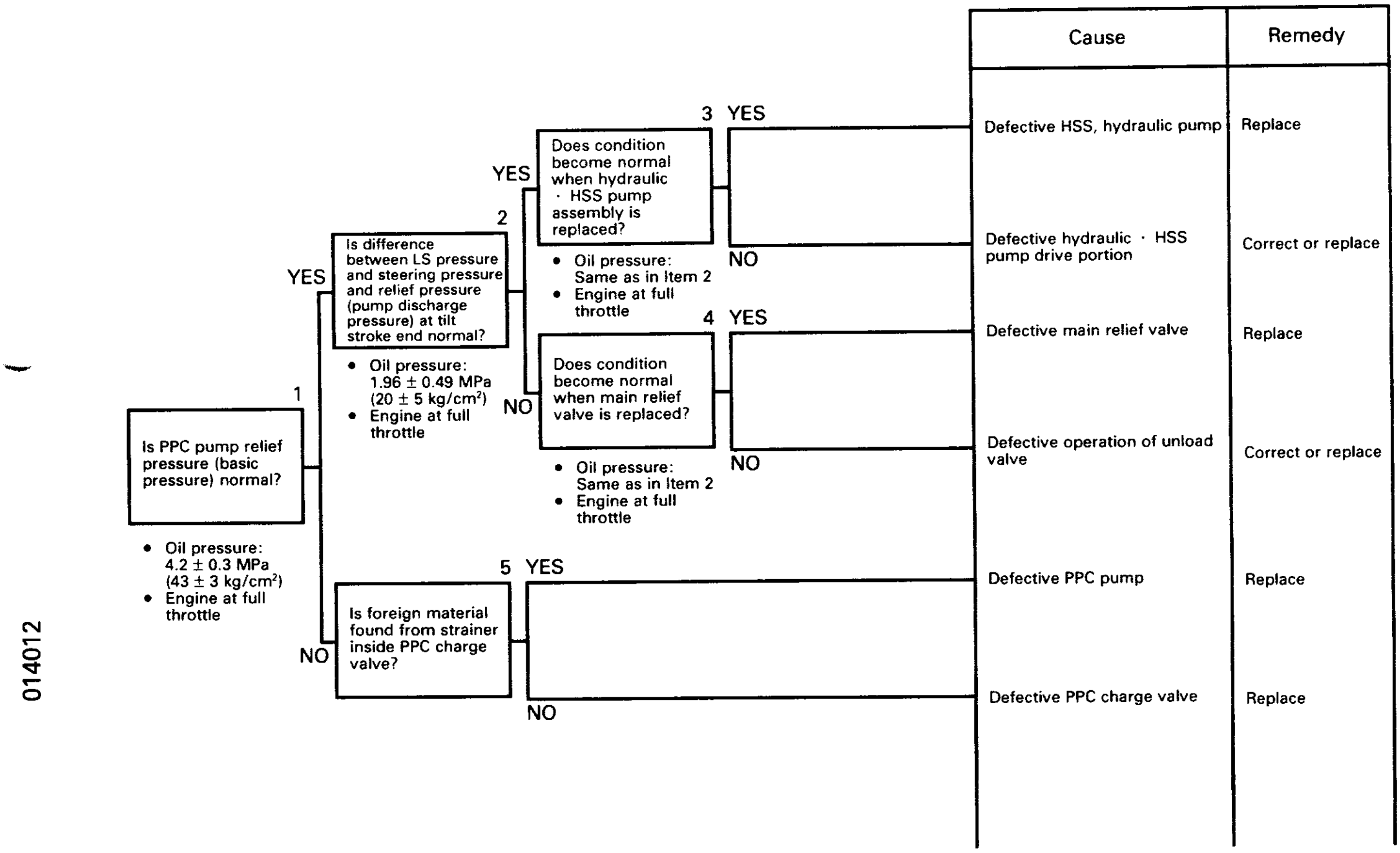
Cause	Remedy
Defective HSS, hydraulic pump	Replace
Defective hydraulic, HSS pump drive portion	Correct or replace
Defective main relief	Replace
Defective operation of unload valve	Correct or replace
Defective adjustment of PPC charger valve	Adjust
Block portions A or B. There is internal leakage from PPC valve on side which becomes normal.	Replace
Defective PPC pump	Replace
Defective PPC charge valve	Replace

H-17 Related hydraulic circuit diagram



H-18 Machine cannot turn and no work equipment moves D65EX, PX-12

★ Check the oil level in the hydraulic tank before carrying out troubleshooting.



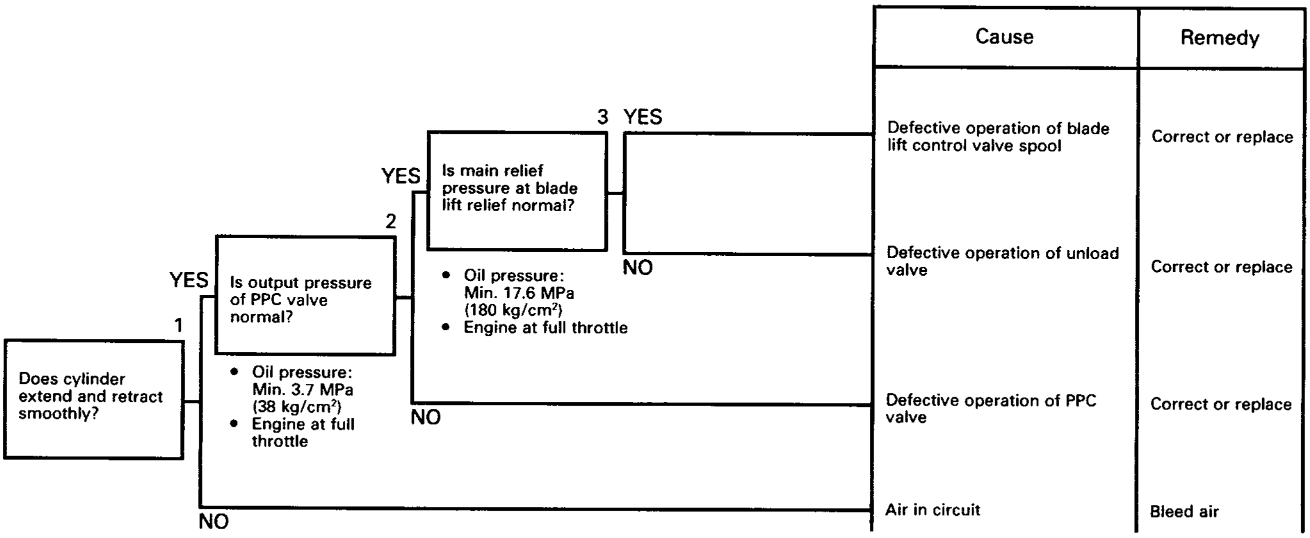
H-19 Turning and all work equipment lacks power D65EX, PX-12

★ Start troubleshooting from H-18 Item 2.

H-20 Blade lifting speed is slow or lacks power

★ When hydraulic drift of blade is normal.
★ Check the oil level in the hydraulic tank before carrying out troubleshooting.
★ Check if the blade has been modified.

1) D65E, P-12



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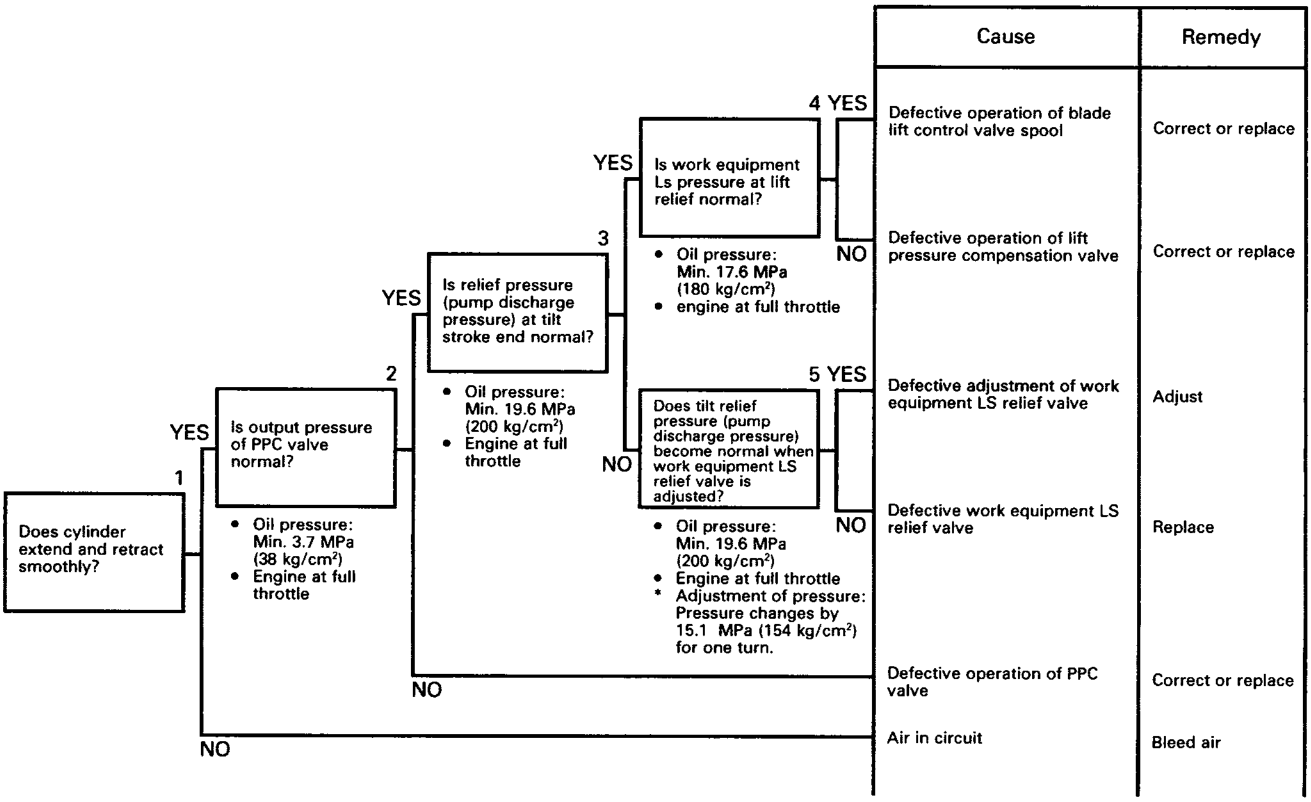
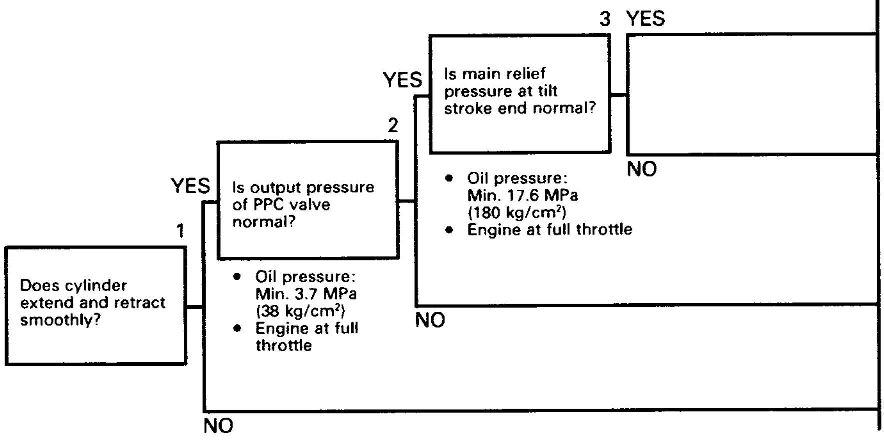
2) D65EX, PX-12



H-21 Blade tilt speed is slow or lacks power

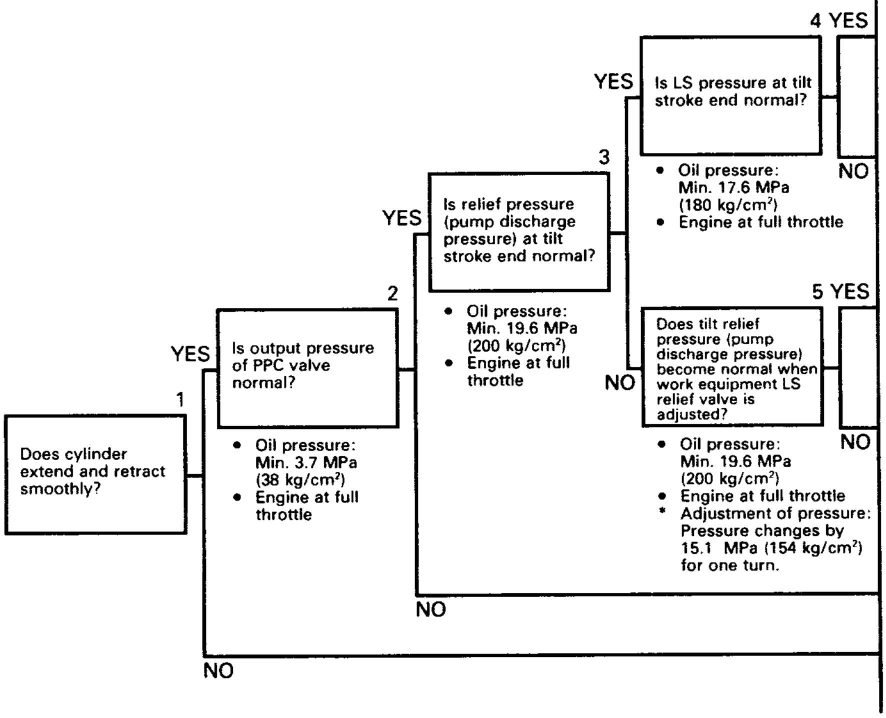
★ When hydraulic drift of tilt is normal.
★ Check the oil level in the hydraulic tank before carrying out troubleshooting.
★ Check if the blade has been modified.

1) D65E, P-12



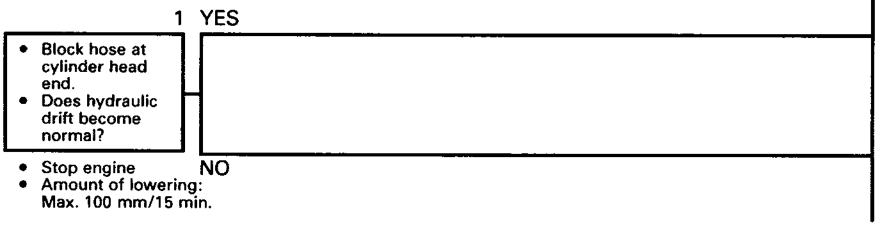
Cause	Remedy
Defective operation of blade tilt control valve spool	Correct or replace
Defective operation of unload valve	Correct or replace
Defective operation of PPC valve	Correct or replace
Air in circuit	Bleed air

2) D65EX, PX-12



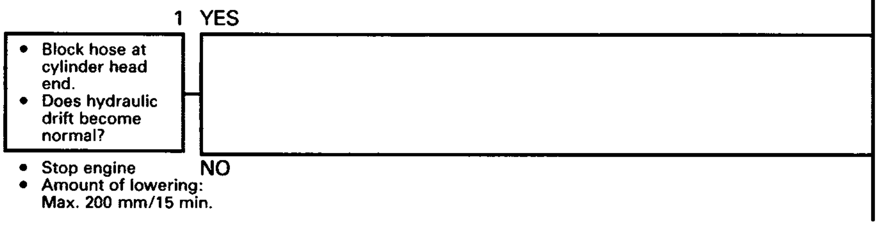
Cause	Remedy
Defective operation of blade tilt control valve spool	Correct or replace
Defective operation of tilt pressure compensation valve	Correct or replace
Defective adjustment of work equipment LS relief valve	Adjust
Defective work equipment LS relief valve	Replace
Defective operation of PPC valve	Correct or replace
Air in circuit	Bleed air

H-22 Hydraulic drift of blade lift is excessive



Cause	Remedy
Excessive leakage inside valve • Leakage inside blade lift valve	Replace
Excessive leakage inside cylinder • Defective piston seal	Replace

H-23 Hydraulic drift of blade tilt is excessive



Cause	Remedy
Excessive leakage inside valve • Leakage inside blade lift valve	Replace
Excessive leakage inside cylinder • Defective piston seal	Replace

014012

TROUBLESHOOTING OF ELECTRICAL SYSTEM (E MODE)

014012

TABLE OF FAILURE MODES AND CAUSES (ELECTRICAL SYSTEM)

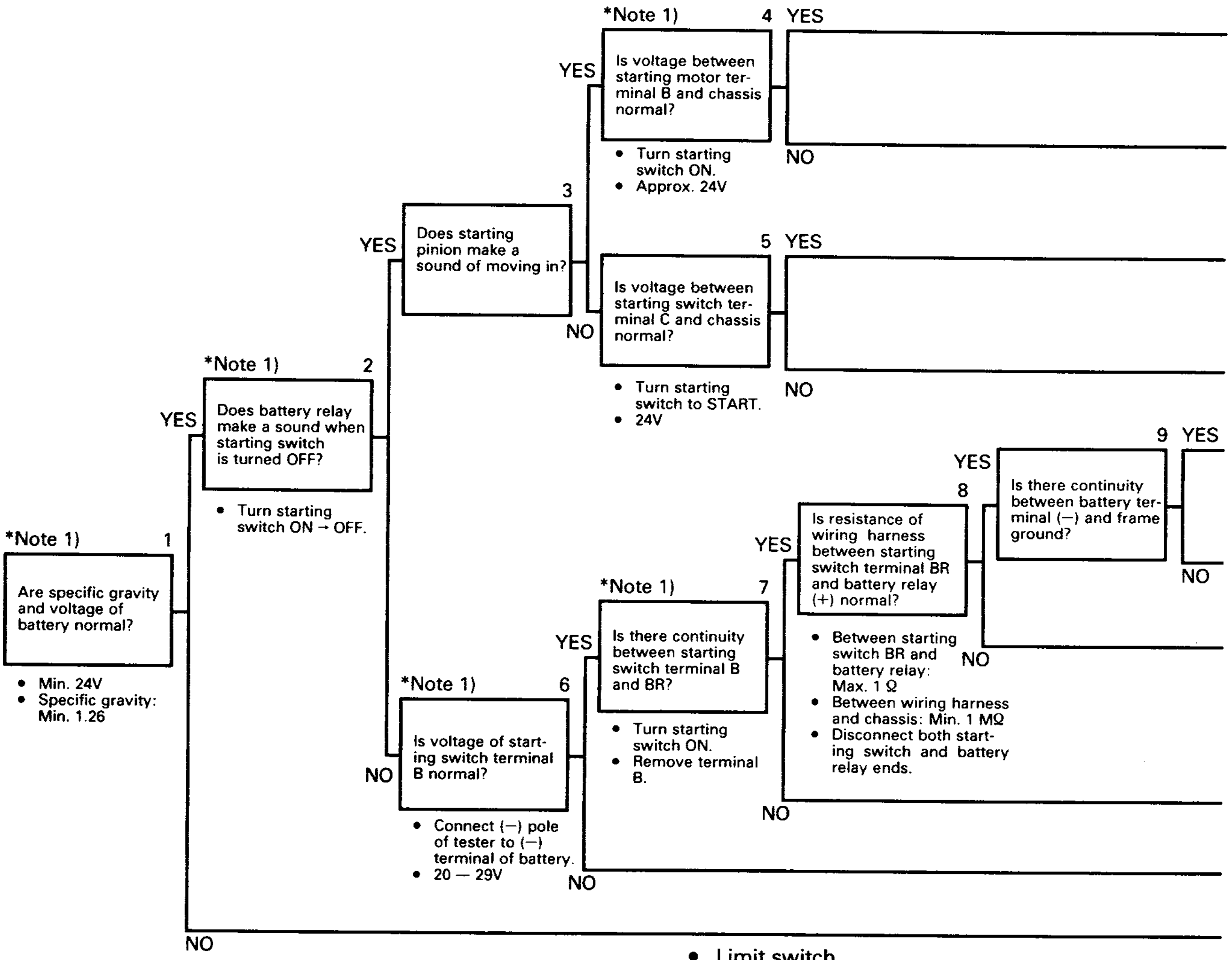
Parts causing failure Failure mode		Battery	Starting motor	Panel switch	Battery relay	Wiring harness	Heater signal	Lamp	Caution lamp	Hydraulic sensor	Air conditioner compressor	Air conditioner magnet relay	Blower motor	Air conditioner switch	Heater relay	Timer	Fuse	Wiper motor	Washer motor	Washer nozzle	Washer piping	Trouble-shooting If there is any abnormality, go to YES/NO Trouble-shooting Table E-OX
1	Starting motor is not cranked when starting switch is turned to ON	○	○	○	○																	E-1
2	Lamps do not light up (front lamps, rear lamps)	○		○	○	○		○														E-2
—																						—
4	Automatic preheating is not carried out when glow switch is turned to AUTO	○		○		○									○	○						E-4
5	Wiper does not work					○											○	○				E-5
6	No washer fluid is sprayed out					○													○	○	○	E-6
7	Air conditioner has no effect	○			○	○					○	○	○	○								E-7

014012

E-1 Starting motor is not cranked when starting switch is turned to ON.

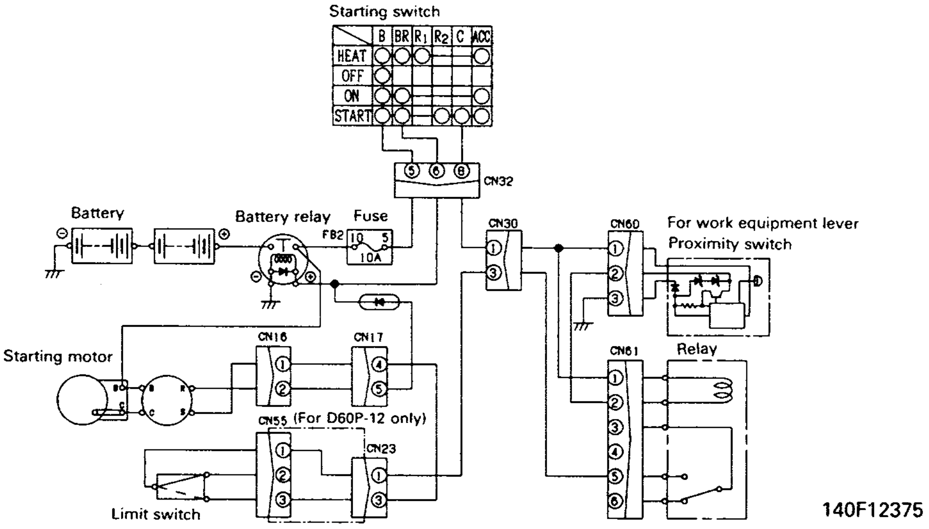
D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

★ Before carrying out troubleshooting, check that fuse FB2 No. 5 is normal.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.



E-1 Related electrical circuit diagram

- Limit switch
  Switch ON when Transmission lock lever at LOCK



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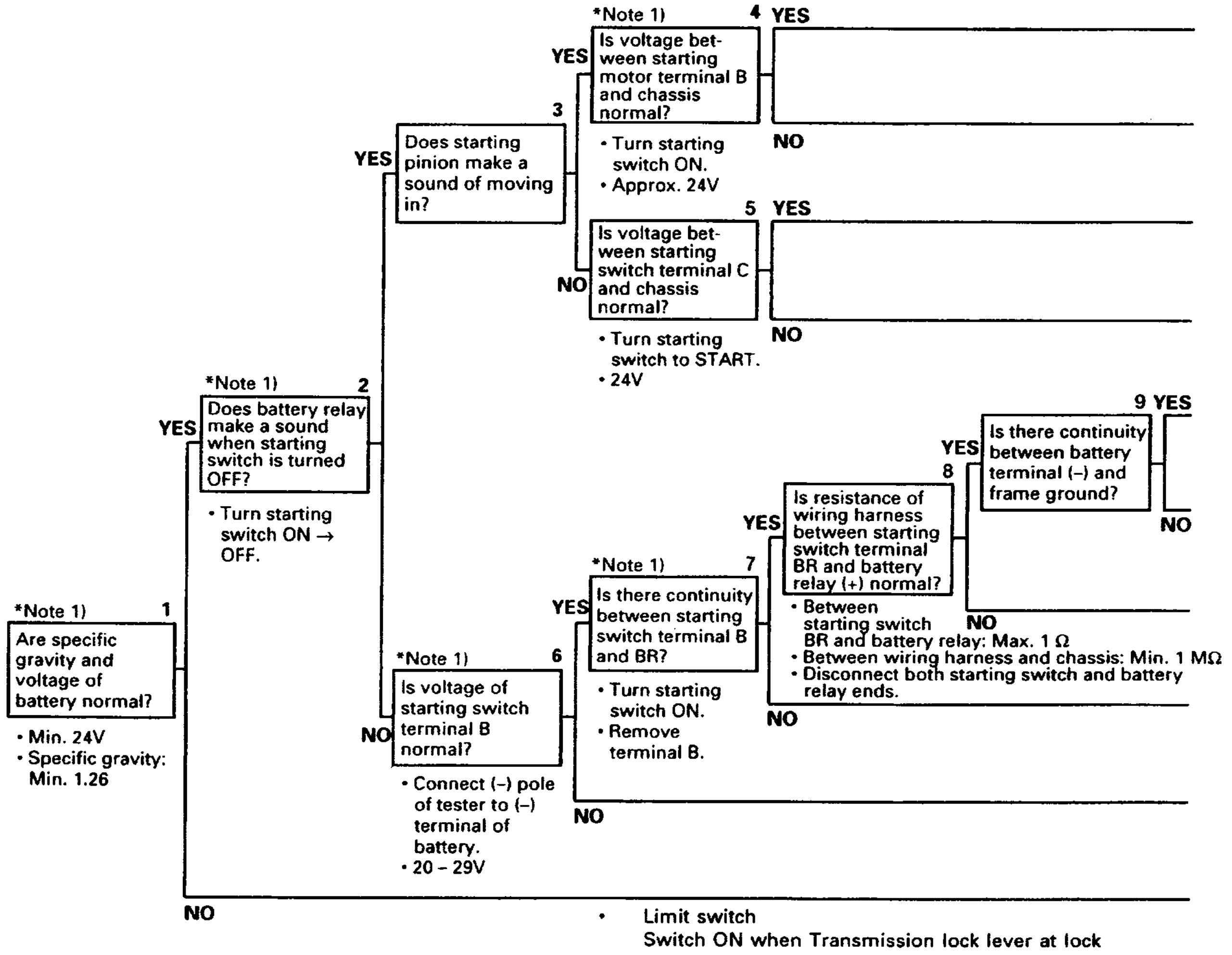
Cause	Remedy
Defective starting motor	Replace
Defective contact of wiring harness between battery terminal (+) and starting motor terminal B	Repair or replace
Defective contact, or disconnection in wiring harness between starting switch terminal C and starting motor terminal S, defective proximity switch, defective proximity switch relay, or defective limit switch	Repair or replace
Defective starting switch (between terminal B and C)	Replace
Defective battery relay	Replace
Defective contact or wiring harness between battery terminal (−) and frame ground	Repair or replace
Defective contact, or disconnection in wiring harness between starting switch terminal BR and battery relay terminal (+)	Repair or replace
Defective starting switch (between B and BR)	Repace
Defective contact, or disconnection in wiring harness between battery terminal (+) and starting switch terminal B	Repair or replace
Defective battery	Charge or replace

014012

Note: 1) If the lamps (front lamps, rear lamps) or horn circuit are normal, it is possible to check instead if the lamps light up normally or if the horn sounds normally.

D65E-12	**60948 – 65000**
D65P-12	**60891 – 65000**
D65EX-12	**60942 – 65000**
D65PX-12	**60915 – 65000**

- ★ Before carrying out troubleshooting, check that fuse FB2 No. 5 is normal.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.



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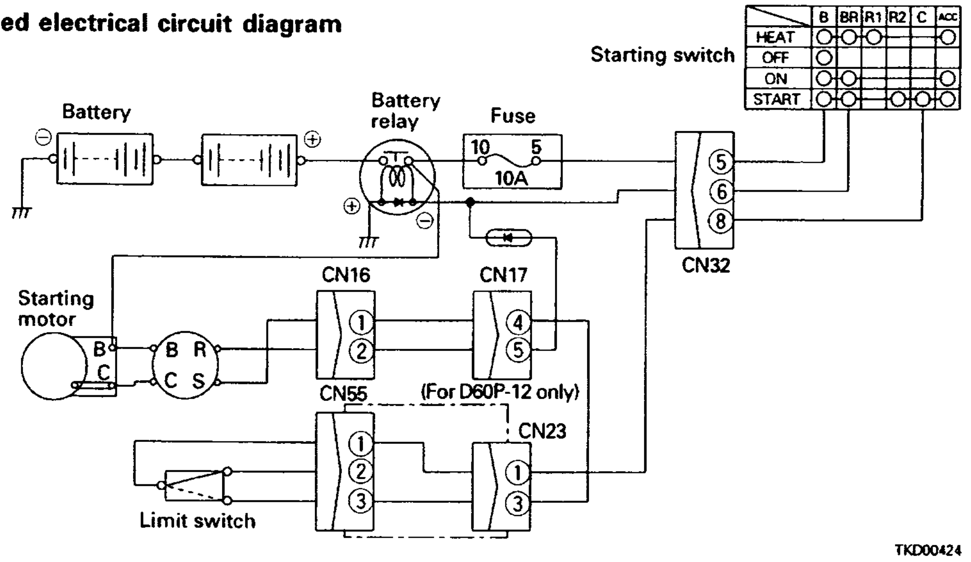
E-1 Related electrical circuit diagram



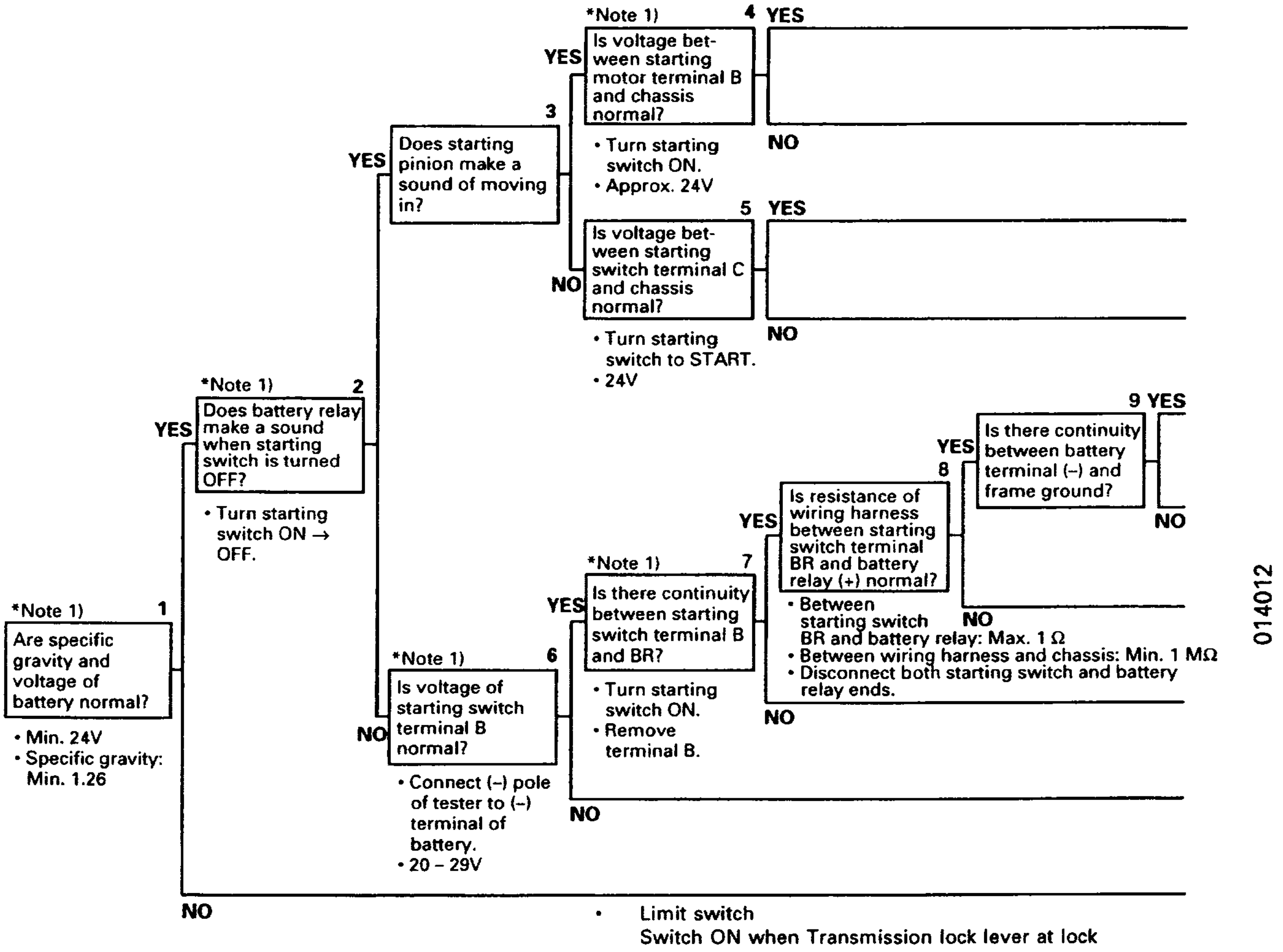
Cause	Remedy
Defective starting motor	Replace
Defective contact of wiring harness between battery terminal (+) and starting motor terminal B	Repair or replace
Defective contact, or disconnection in wiring harness between starting switch terminal C and starting motor terminal S	Repair or replace
Defective starting switch (between terminal B and C)	Replace
Defective battery relay	Replace
Defective contact or wiring harness between battery terminal (–) and frame ground	Repair or replace
Defective contact, or disconnection in wiring harness between starting switch terminal BR and battery relay terminal (+)	Repair or replace
Defective starting switch (between B and BR)	Replace
Defective contact, or disconnection in wiring harness between battery terminal (+) and starting switch terminal B	Repair or replace
Defective battery	Charge or replace

014012

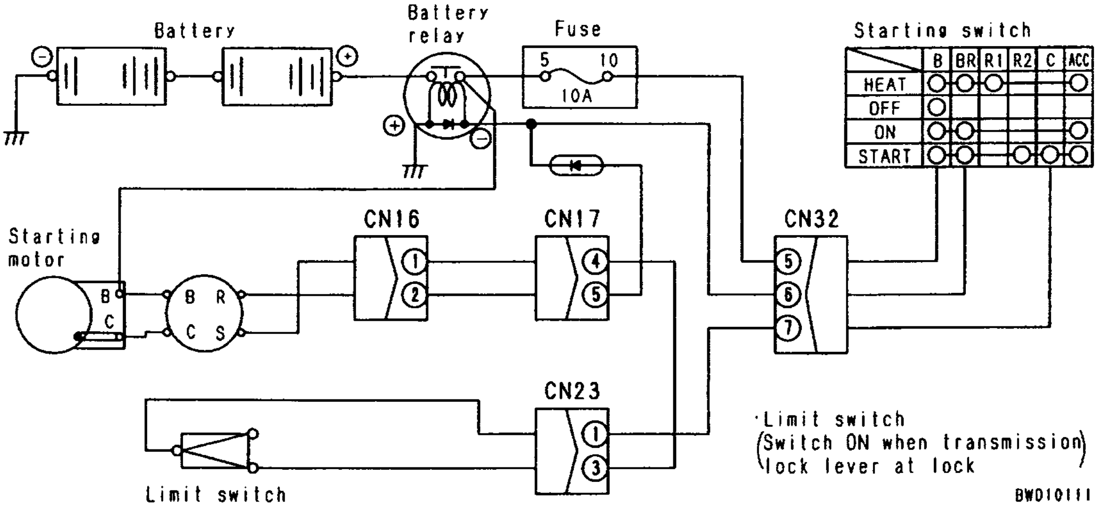
Note: 1) If the lamps (front lamps, rear lamps) or horn circuit are normal, it is possible to check instead if the lamps light up normally or if the horn sounds normally.

D65E-12 65001 and up
D65P-12 65001 and up
D65EX-12 65001 and up
D65PX-12 65001 and up

- ★ Before carrying out troubleshooting, check that fuse FB2 No. 5 is normal.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.



E-1 Related electrical circuit diagram



Cause	Remedy
Defective starting motor	Replace
Defective contact of wiring harness between battery terminal (+) and starting motor terminal B	Repair or replace
Defective contact, or disconnection in wiring harness between starting switch terminal C and starting motor terminal S	Repair or replace
Defective starting switch (between terminal B and C)	Replace
Defective battery relay	Replace
Defective contact or wiring harness between battery terminal (-) and frame ground	Repair or replace
Defective contact, or disconnection in wiring harness between starting switch terminal BR and battery relay terminal (+)	Repair or replace
Defective starting switch (between B and BR)	Replace
Defective contact, or disconnection in wiring harness between battery terminal (+) and starting switch terminal B	Repair or replace
Defective battery	Charge or replace

014012

Note: 1) If the lamps (front lamps, rear lamps) or horn circuit are normal, it is possible to check instead if the lamps light up normally or if the horn sounds normally.

E-2 Lamp do not light up

D65E-12 60001 - 65000
D65P-12 60001 - 65000
D65EX-12 60001 - 65000
D65PX-12 60001 - 65000

★ If the battery is normal
★ Before carrying out troubleshooting, check that fuse FB1 No. 6 is normal.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

a) Front lamps

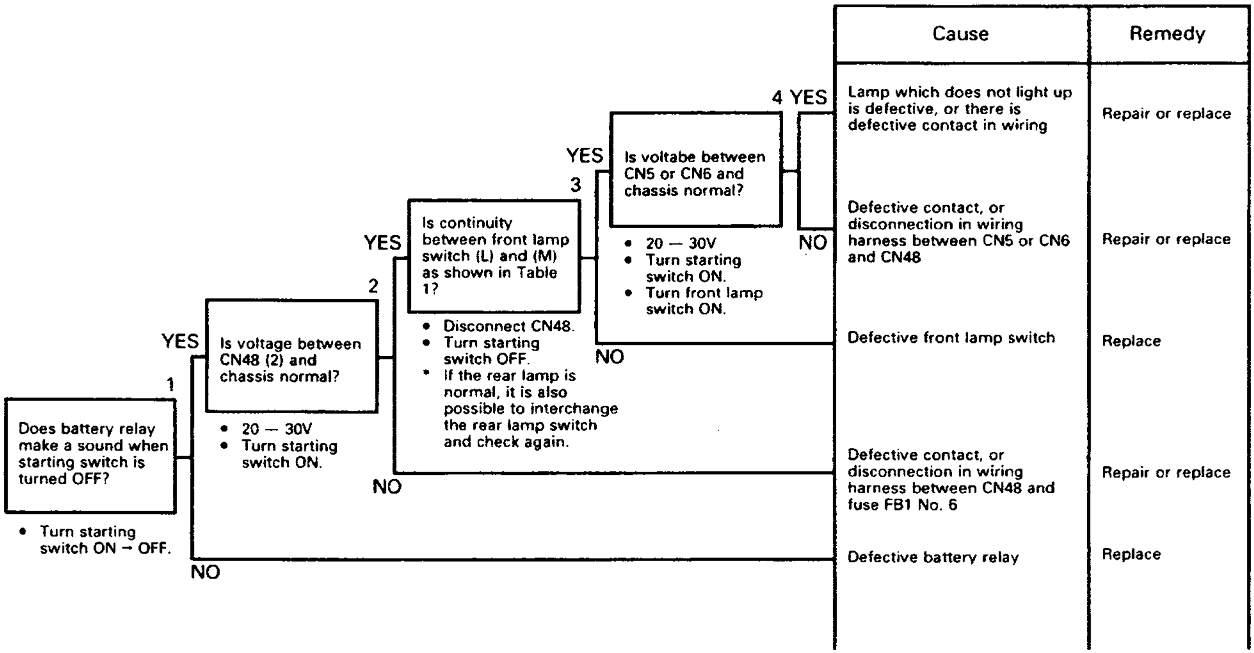


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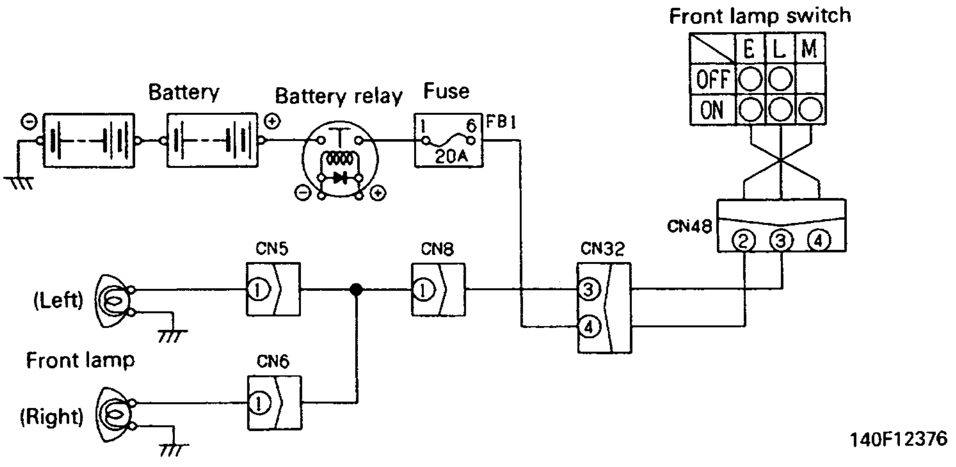
Table 1

	E	L	M
OFF	○	○	
ON	○	○	○

E-2 a) Related electrical circuit diagram



b) Rear lamps

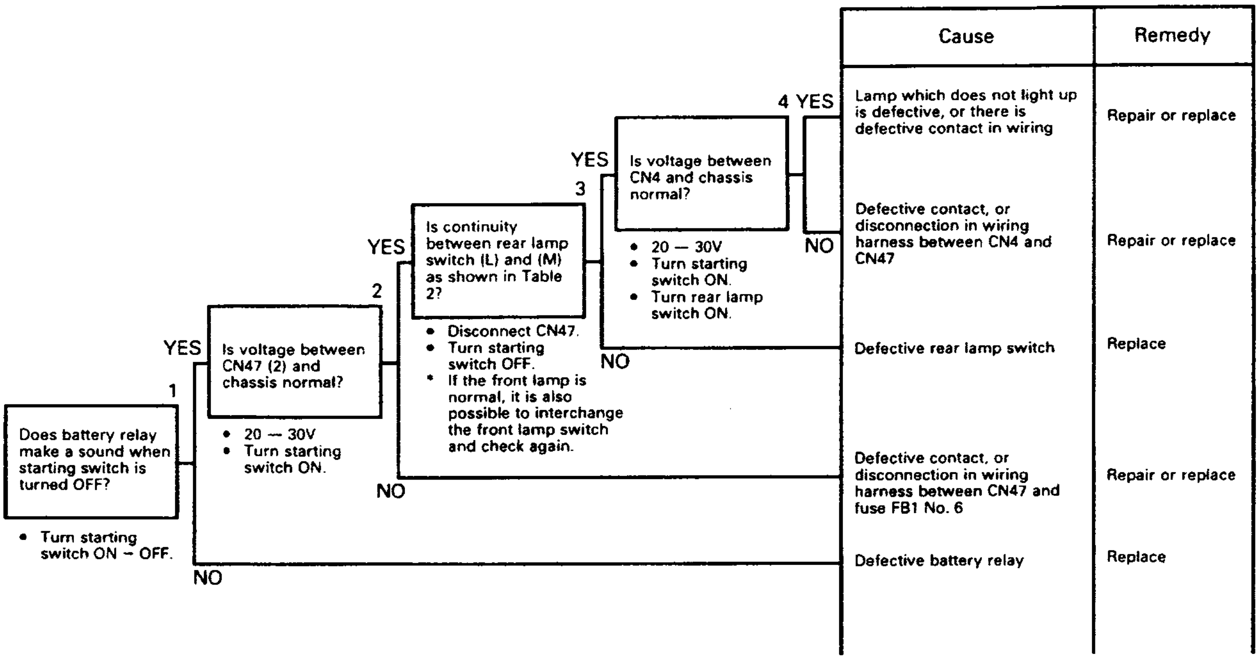
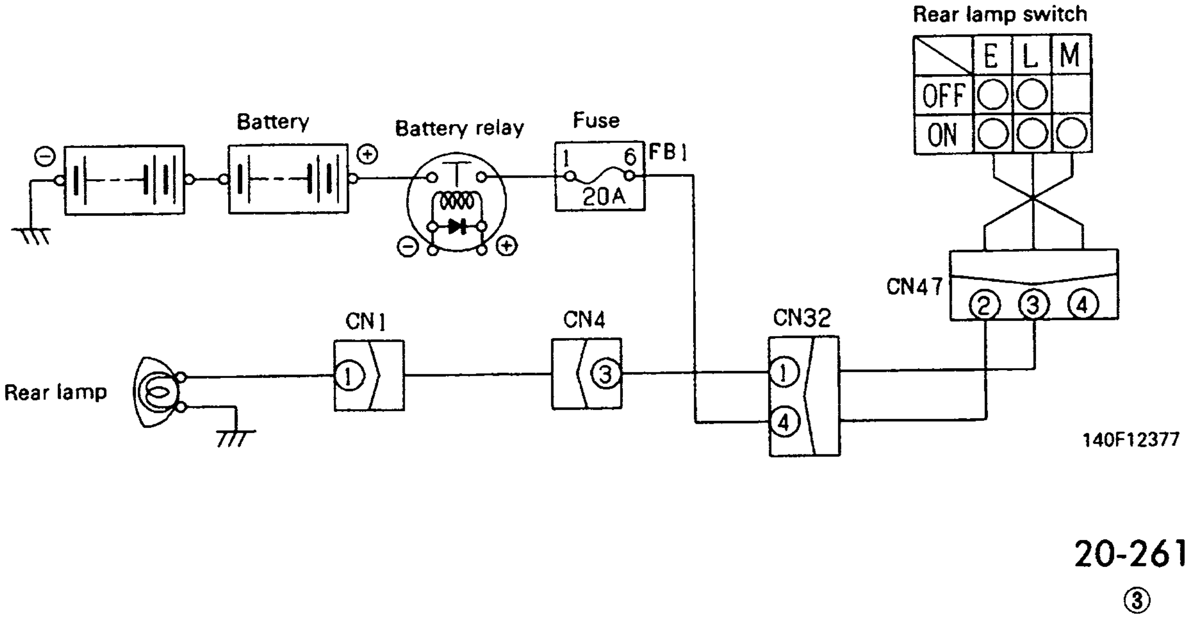


Table 2

	E	L	M
OFF	○–	–○	
ON	○–	–○–	–○

E-2 b) Related electrical circuit diagram



D65E-12 65001 and up
D65P-12 65001 and up
D65EX-12 65001 and up
D65PX-12 65001 and up

★ If the battery is normal
★ Before carrying out troubleshooting, check that fuse FB1 No. 6 is normal.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

a) Front lamps

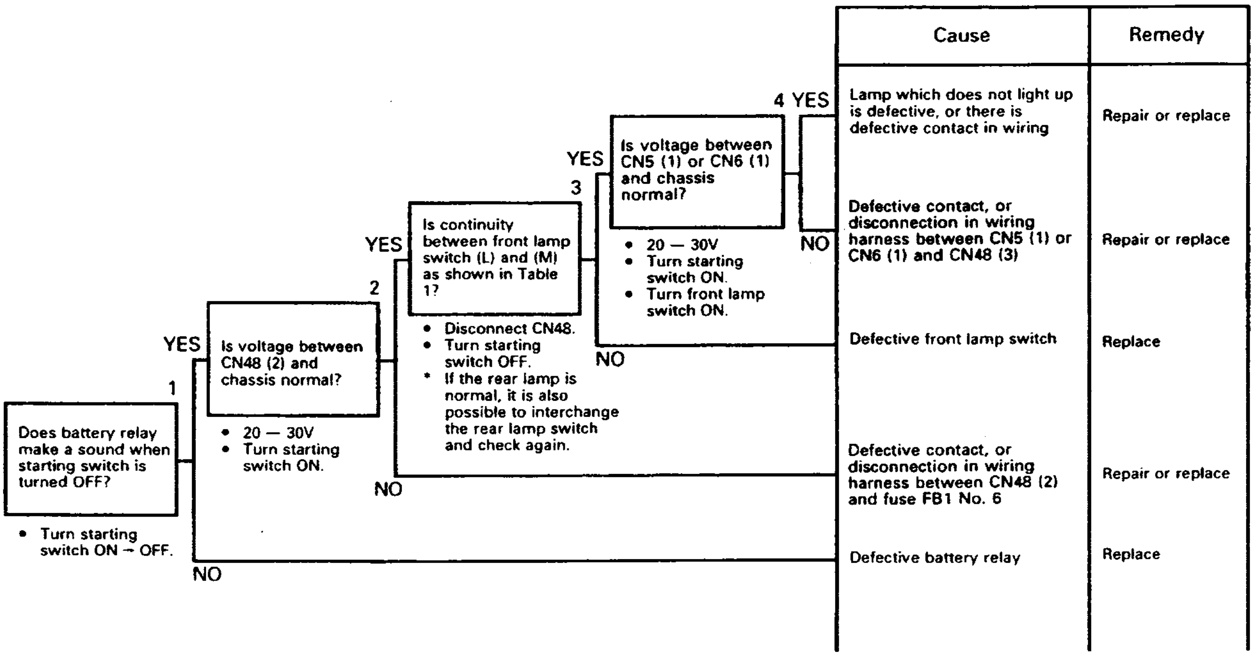


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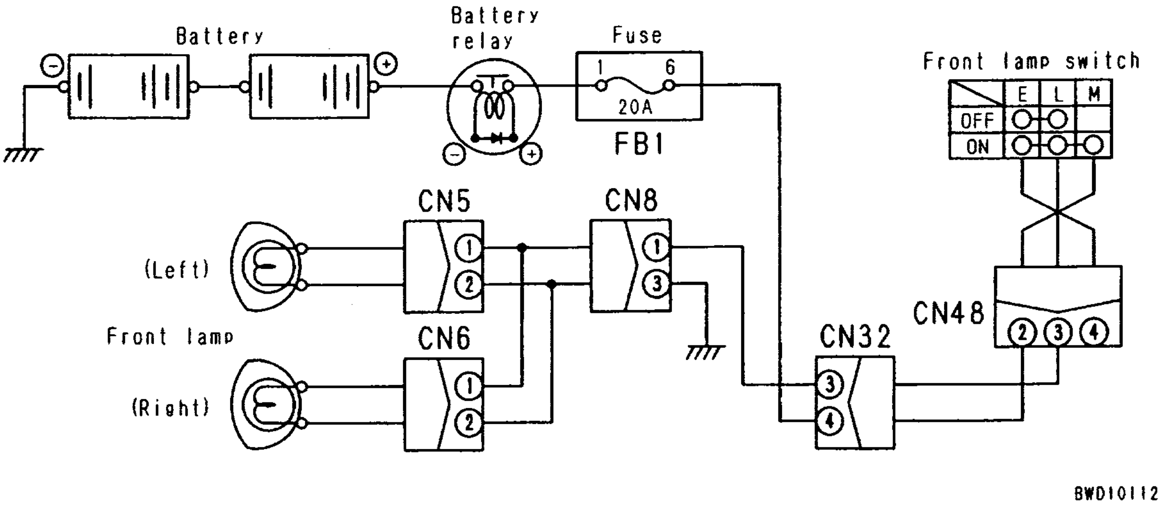
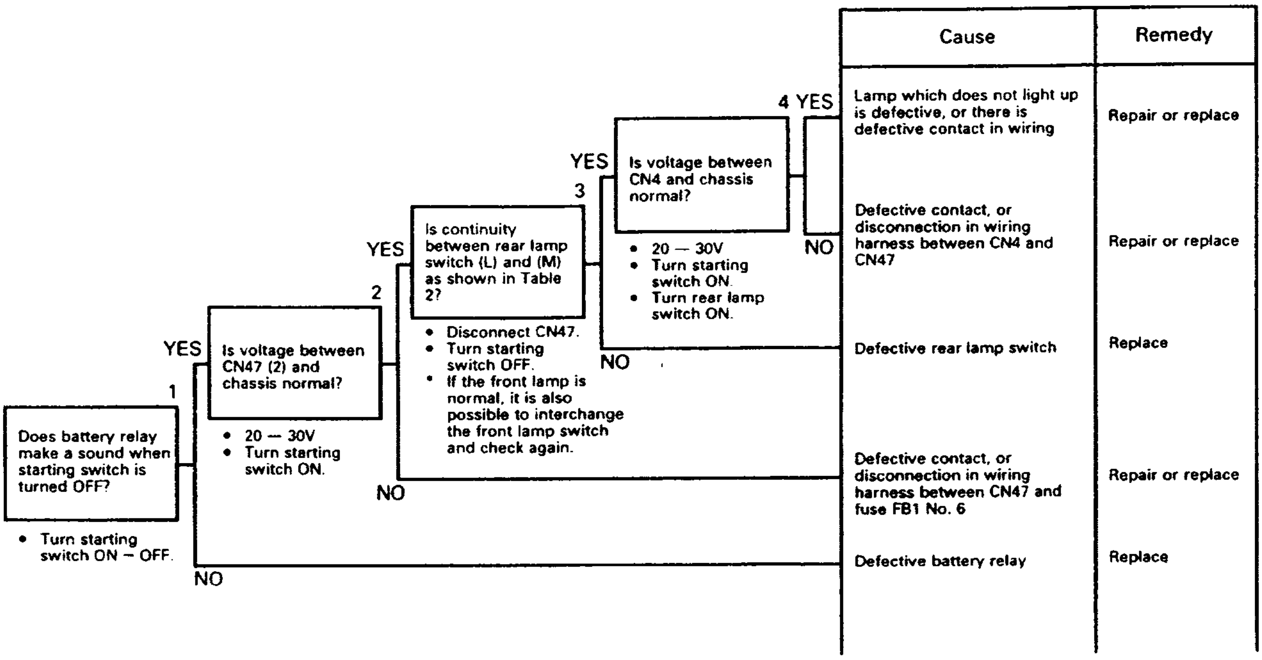
Table 1

	E	L	M
OFF	○	○	
ON	○	○	○

E-2 a) Related electrical circuit diagram



b) Rear lamps



1 Does battery relay make a sound when starting switch is turned OFF?
- Turn starting switch ON – OFF.

2 Is voltage between CN47 (2) and chassis normal?
- 20 — 30V
- Turn starting switch ON.

3 Is continuity between rear lamp switch (L) and (M) as shown in Table 2?
- Disconnect CN47.
- Turn starting switch OFF.
- If the front lamp is normal, it is also possible to interchange the front lamp switch and check again.

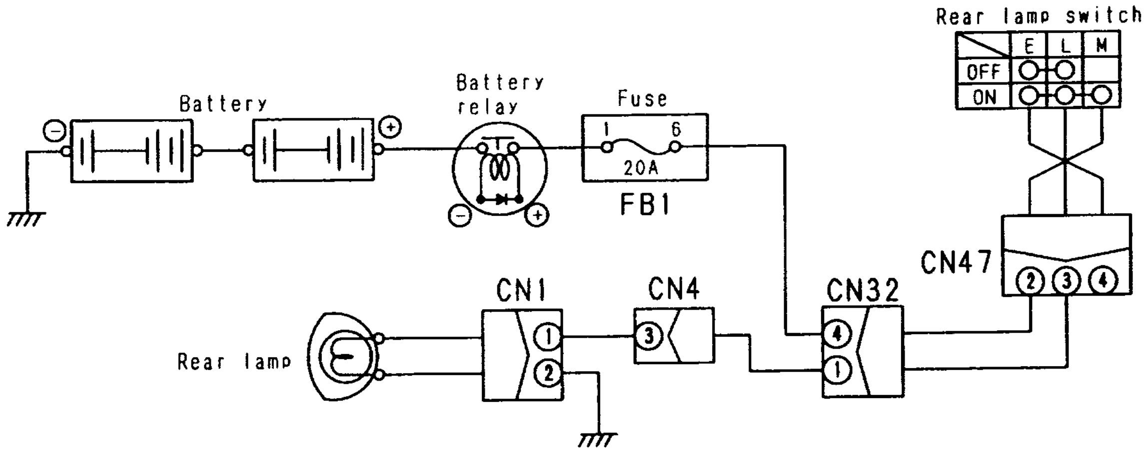
4 Is voltage between CN4 and chassis normal?
- 20 — 30V
- Turn starting switch ON.
- Turn rear lamp switch ON.

	Cause	Remedy
4 YES	Lamp which does not light up is defective, or there is defective contact in wiring	Repair or replace
4 NO	Defective contact, or disconnection in wiring harness between CN4 and CN47	Repair or replace
3 NO	Defective rear lamp switch	Replace
2 NO	Defective contact, or disconnection in wiring harness between CN47 and fuse FB1 No. 6	Repair or replace
1 NO	Defective battery relay	Replace

Table 2

	E	L	M
OFF	○—	○	
ON	○—	○—	○

E-2 b) Related electrical circuit diagram

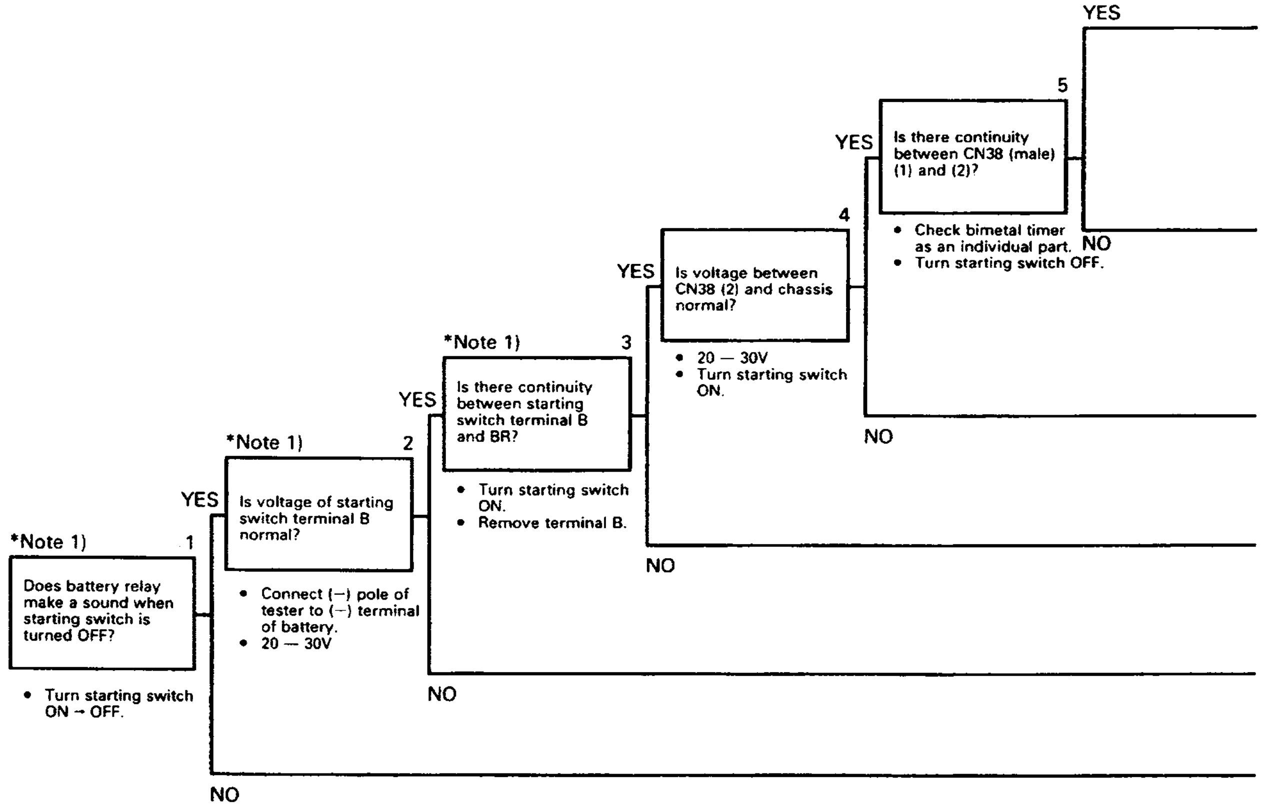


BWD10113

E-4 Automatic preheating is not carried out when glow switch is turned to AUTO

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

★ If the battery is normal.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.



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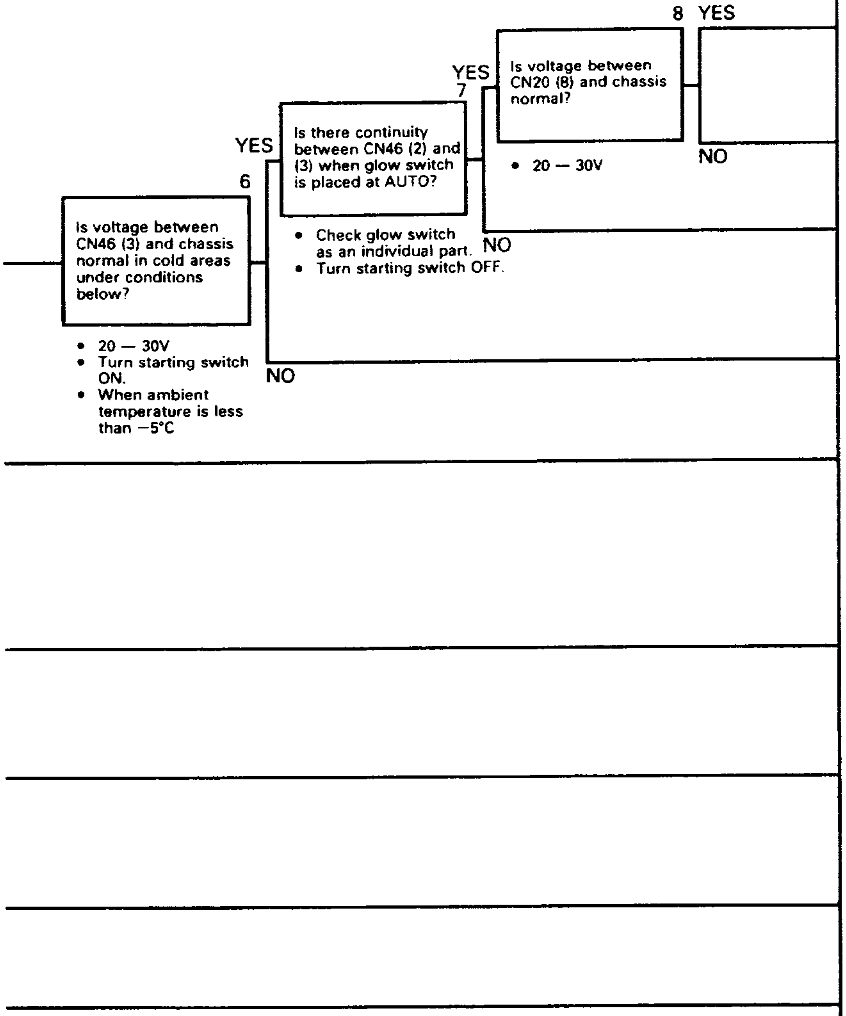
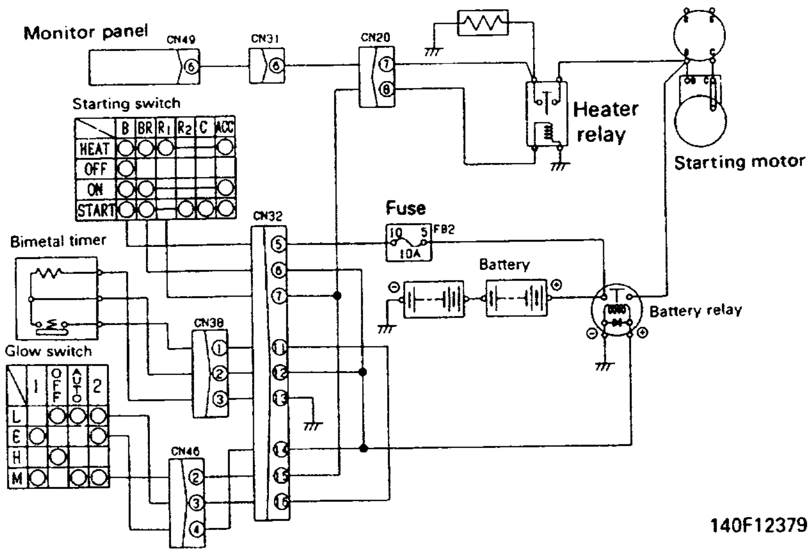
Note: 1) If the lamps (front lamps, rear lamps) or horn circuit are normal, it is possible to check instead if the lamps light up normally or if the horn sounds normally.



Cause	Remedy
Defective heater relay	Replace
Defective contact, or disconnection in wiring harness between CN46 (2) and CN20 (8)	Repair or replace
Defective glow switch	Replace
Defective contact, or disconnection in wiring harness between CN46 (3) and CN38 (1)	Repair or replace
Defective bimetal timer	Replace
Defective contact, or disconnection in wiring harness between starting switch terminal BR and CN38 (2)	Repair or replace
Defective starting switch	Replace
Defective contact, or disconnection in wiring harness between starting switch terminal B and battery relay	Repair or replace
Defective battery relay	Replace

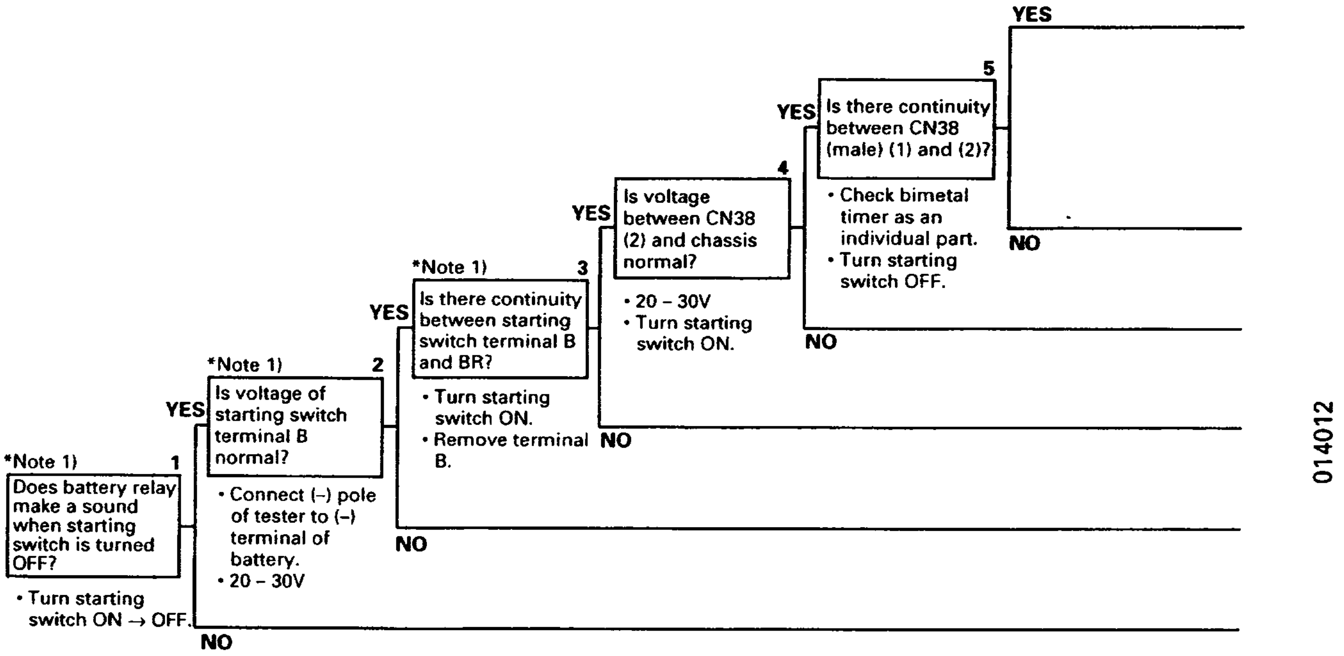
E-4 Related electrical circuit diagram



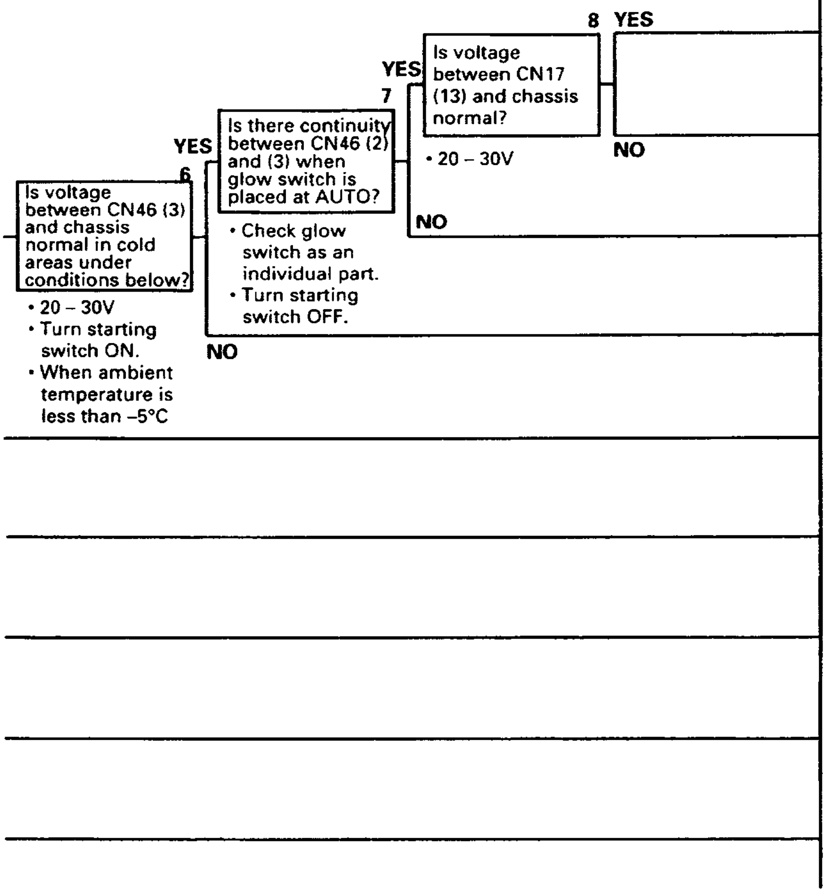
140F12379

D65E-12 60948 – 65000
D65P-12 60891 – 65000
D65EX-12 60942 – 65000
D65PX-12 60915 – 65000

★ If the battery is normal.
★ Before carrying out troubleshooting, check that all the related connector are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

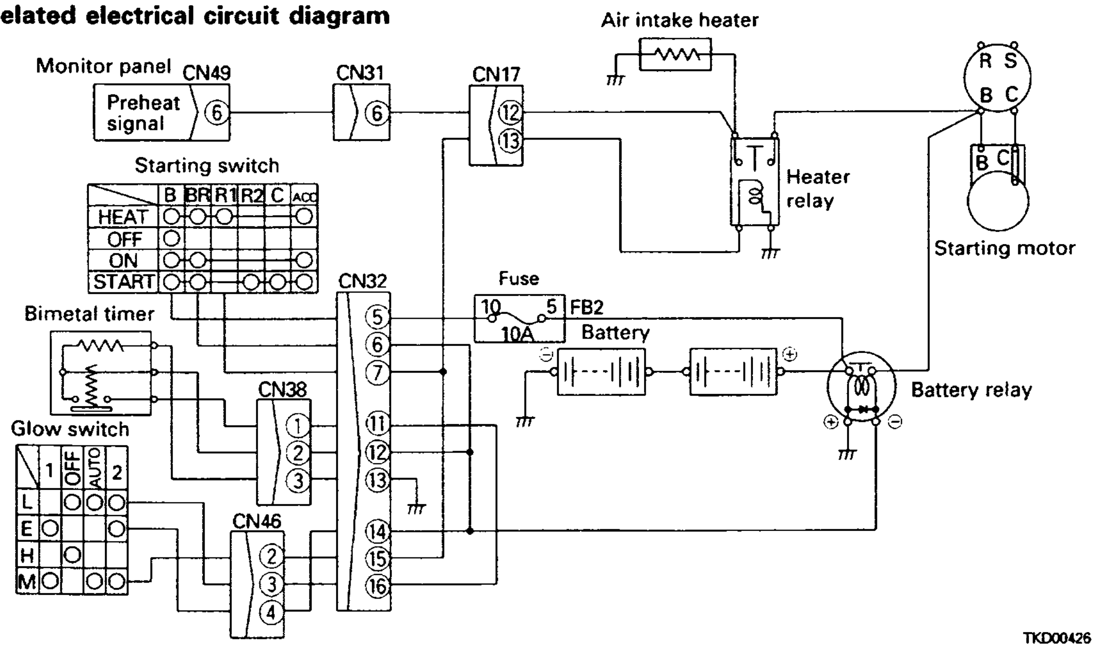


Note: 1) If the lamps (front lamps, rear lamps) or horn circuit are normal, it is possible to check instead if the lamps light up normally or if the horn sounds normally.



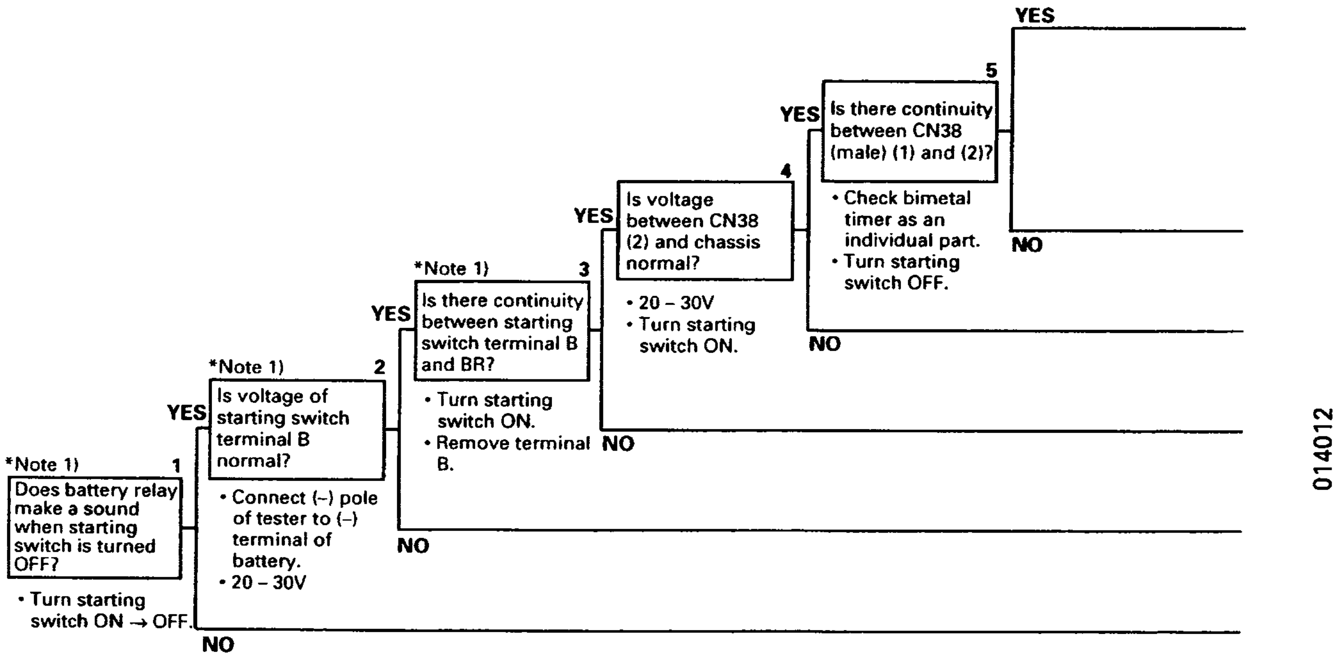
Cause	Remedy
Defective heater relay	Replace
Defective contact, or disconnection in wiring harness between CN46 (2) and CN17 (13)	Repair or replace
Defective glow switch	Replace
Defective contact, or disconnection in wiring harness between CN46 (3) and CN38 (1)	Repair or replace
Defective bimetal timer	Replace
Defective contact, or disconnection in wiring harness between starting switch terminal BR and CN38 (2)	Repair or replace
Defective starting switch	Replace
Defective contact, or disconnection in wiring harness between starting switch terminal B and battery relay	Repair or replace
Defective battery relay	Replace

E-4 Related electrical circuit diagram

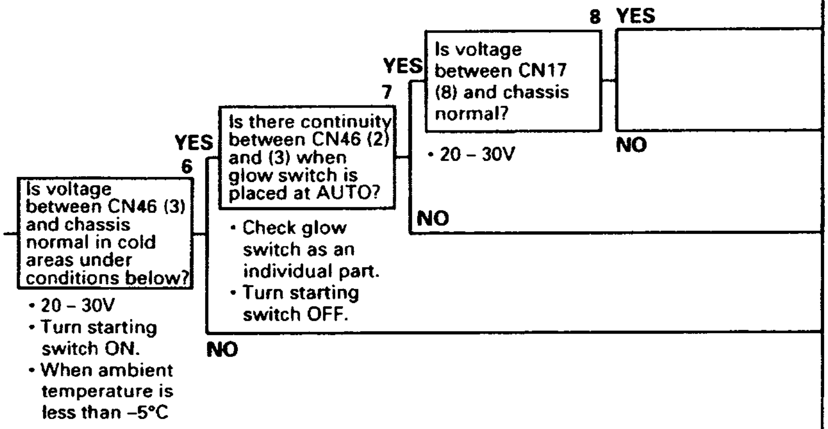


D65E-12 65001 and up
D65P-12 65001 and up
D65EX-12 65001 and up
D65PX-12 65001 and up

★ If the battery is normal.
★ Before carrying out troubleshooting, check that all the related connector are properly inserted.
★ Always connect any disconnected connectors before going on the next step.



Note: 1) If the lamps (front lamps, rear lamps) or horn circuit are normal, it is possible to check instead if the lamps light up normally or if the horn sounds normally.



Is voltage between CN46 (3) and chassis normal in cold areas under conditions below?

- 20 – 30V
- Turn starting switch ON.
- When ambient temperature is less than –5°C

6 Is there continuity between CN46 (2) and (3) when glow switch is placed at AUTO?

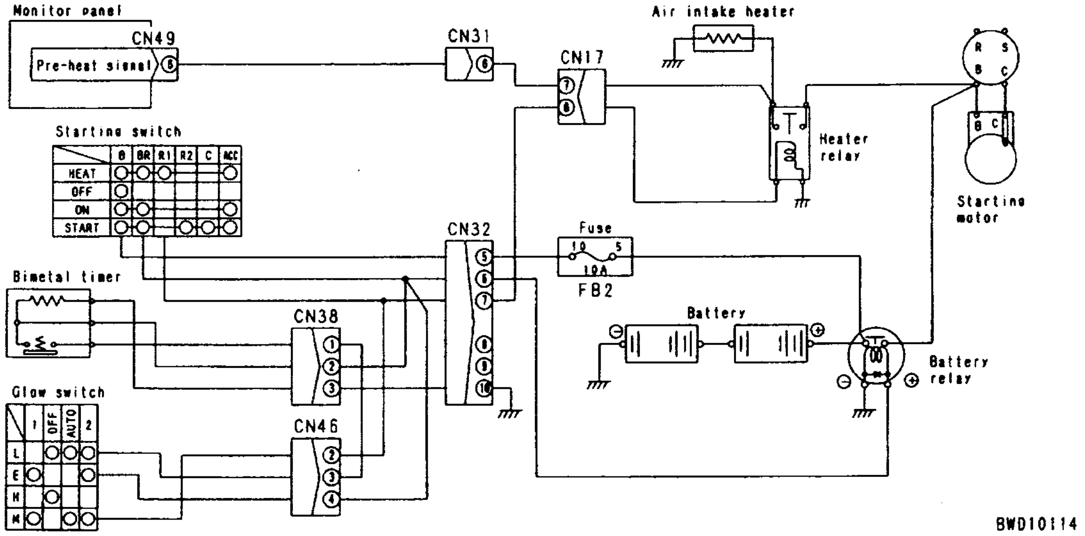
- Check glow switch as an individual part.
- Turn starting switch OFF.

7 Is voltage between CN17 (8) and chassis normal?

- 20 – 30V

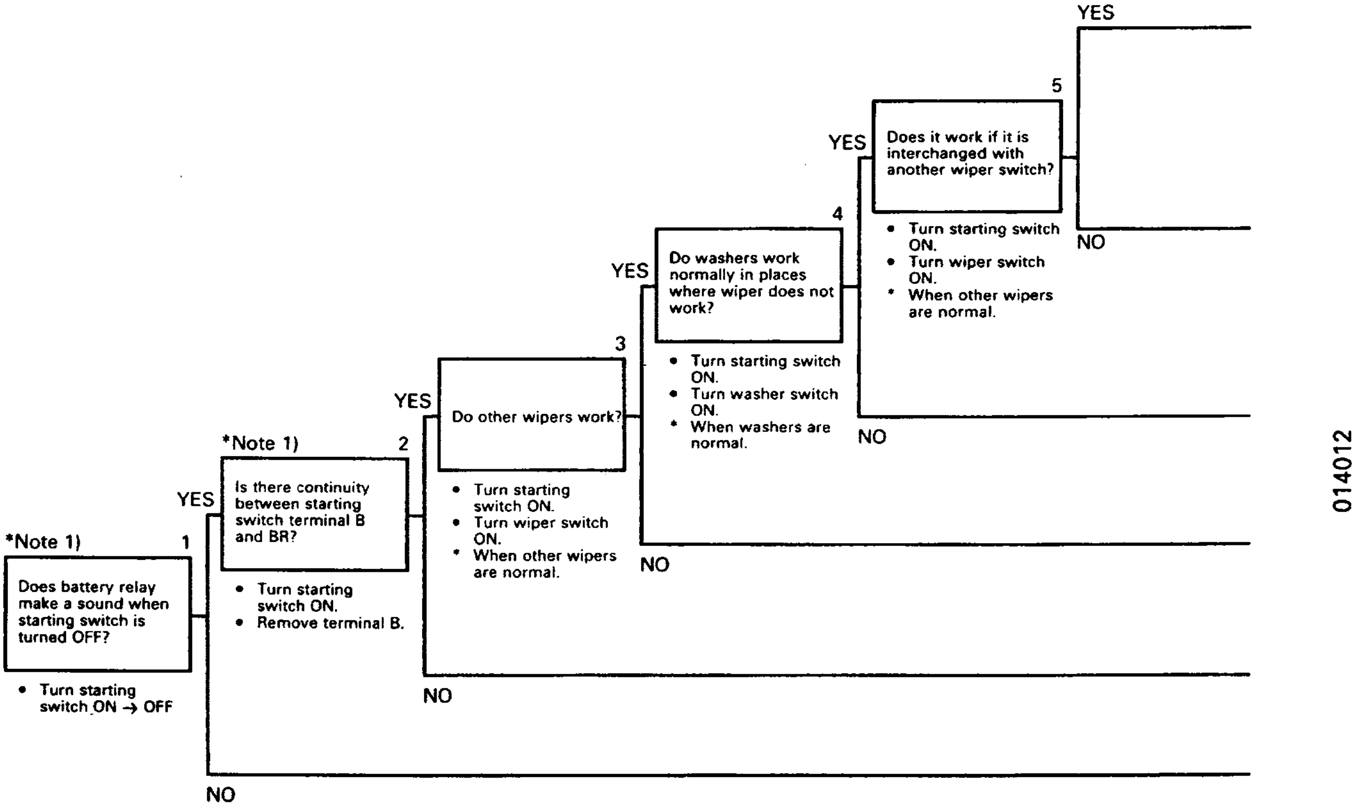
Cause	Remedy
Defective heater relay	Replace
Defective contact, or disconnection in wiring harness between CN46 (2) and CN17 (8)	Repair or replace
Defective glow switch	Replace
Defective contact, or disconnection in wiring harness between CN46 (3) and CN38 (1)	Repair or replace
Defective bimetal timer	Replace
Defective contact, or disconnection in wiring harness between starting switch terminal BR and CN38 (2)	Repair or replace
Defective starting switch	Replace
Defective contact, or disconnection in wiring harness between starting switch terminal B and battery relay	Repair or replace
Defective battery relay	Replace

E-4 Related electrical circuit diagram



E-5 Wiper does not work

★ If the battery is normal.
★ Before carrying out troubleshooting, check that the fuse for each wiper is normal.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.



Note: 1) If the lamps (front lamps, rear lamps) or horn circuit are normal, it is possible to check instead if the lamps light up normally or if the horn sounds normally.
2) This troubleshooting uses the left wiper as an example. For the other wipers, the connector corresponding to CN11 is shown in the table below.

Wiper	Left wiper	Front wiper	Right wiper	Rear wiper
Connector No.	CN11	CN12	CN13	CN14

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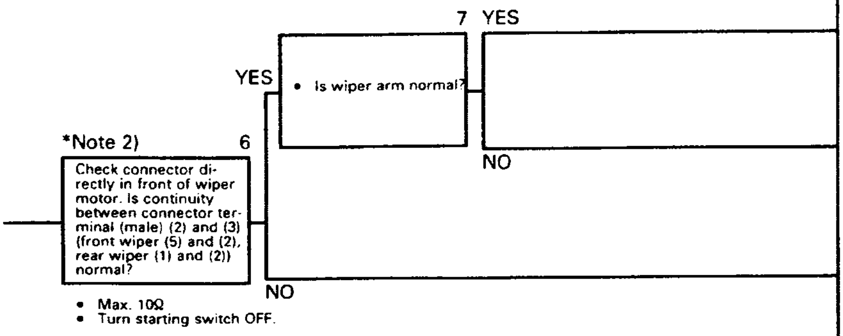
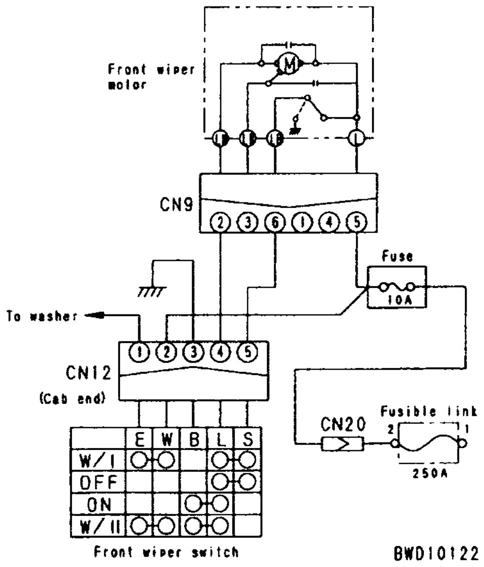


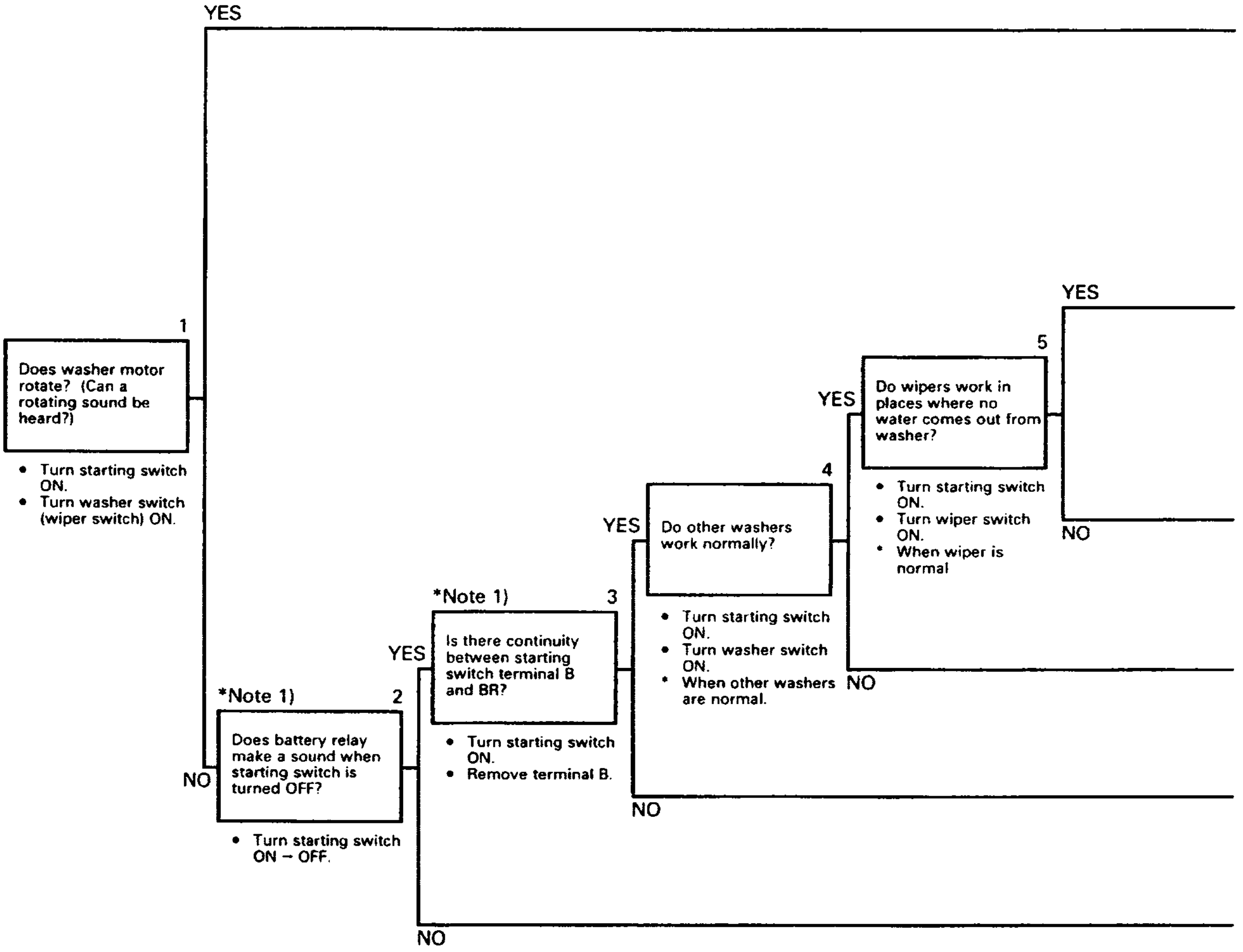
Cause	Remedy
Defective wiper motor	Replace
Defective wiper arm	Replace
*Note 2) Defective contact, or disconnection in wiring harness between CN11 (4) and connector (2) (directly in front of wiper motor)(front wiper: (5))	Repair or replace
Defective wiper switch	Replace
*Note 2) Defective contact, or disconnection in wiring harness between CN11 (3) at cab end and fuse at cab end	Repair or replace
Burned fusible link at cab end, or defective contact, or disconnection in wiring harness between battery relay and fuse box terminal B at cab end	Repair or replace
Defective starting switch	Replace
Defective battery relay	Replace

E-5 Related electrical circuit diagram



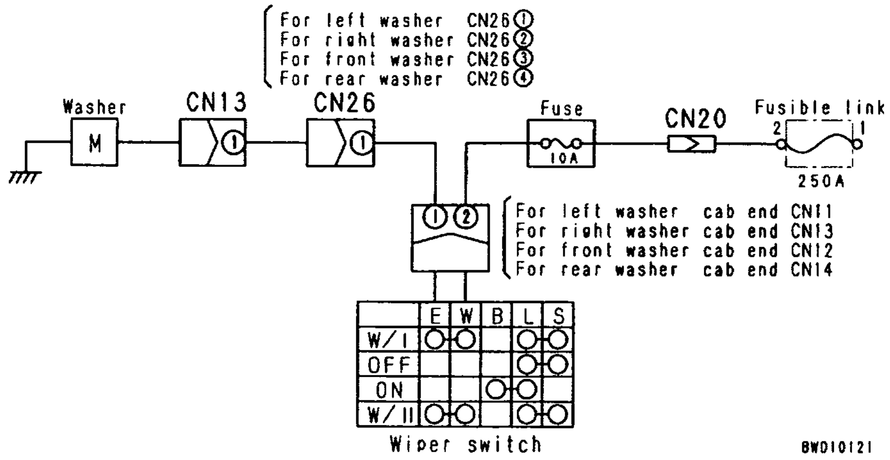
E-6 No washer fluid is sprayed out

★ If the battery is normal.
★ Before carrying out troubleshooting, check that the fuse for each wiper is normal.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.



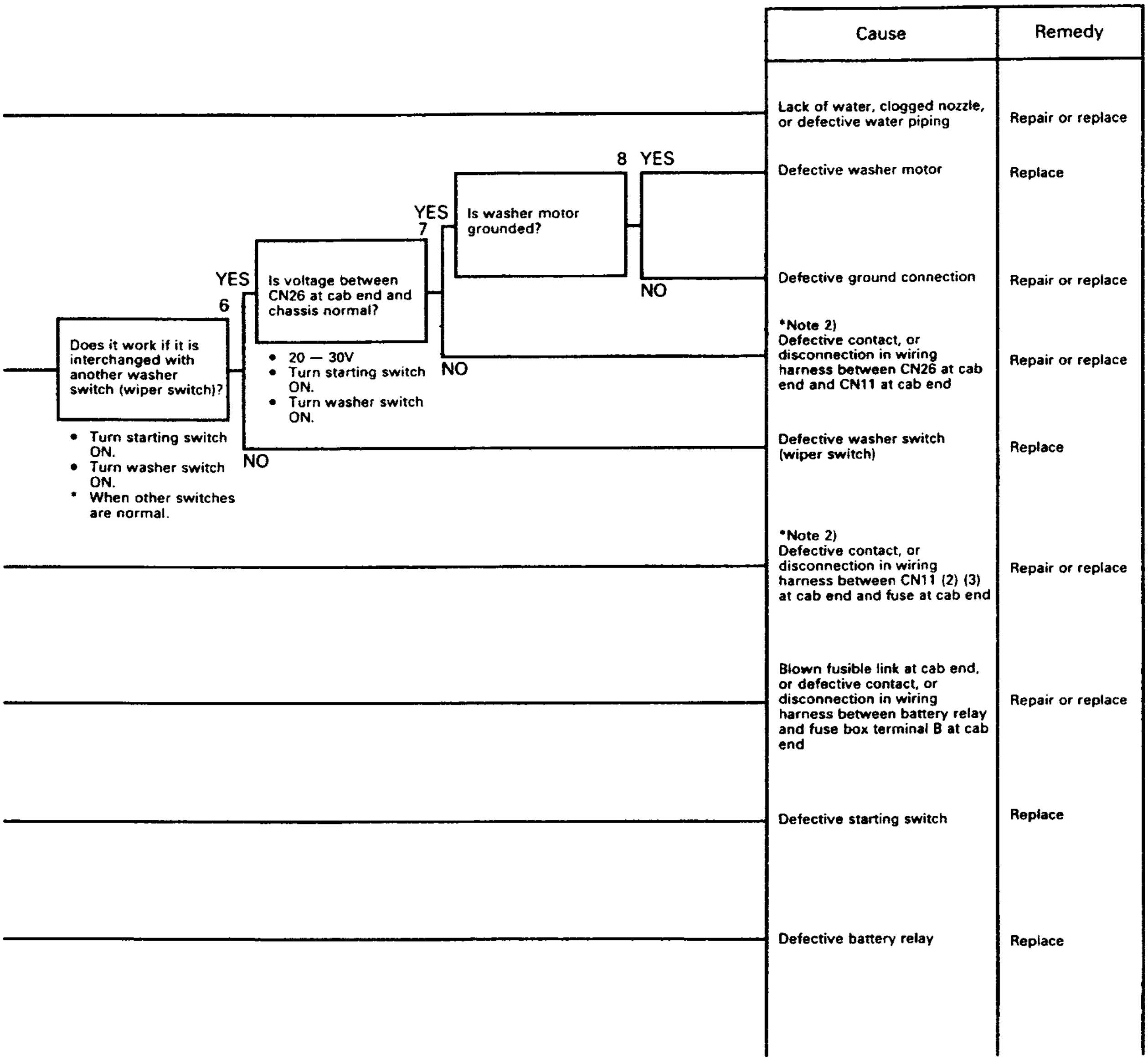
Note: 1) If the lamps (front lamps, rear lamps) or horn circuit are normal, it is possible to check instead if the lamps light up normally or if the horn sounds normally.

E-6 Related electrical circuit diagram



	E	W	B	L	S
W/I	○	○		○	○
OFF				○	○
ON			○	○	
W/II	○	○		○	○

Wiper switch



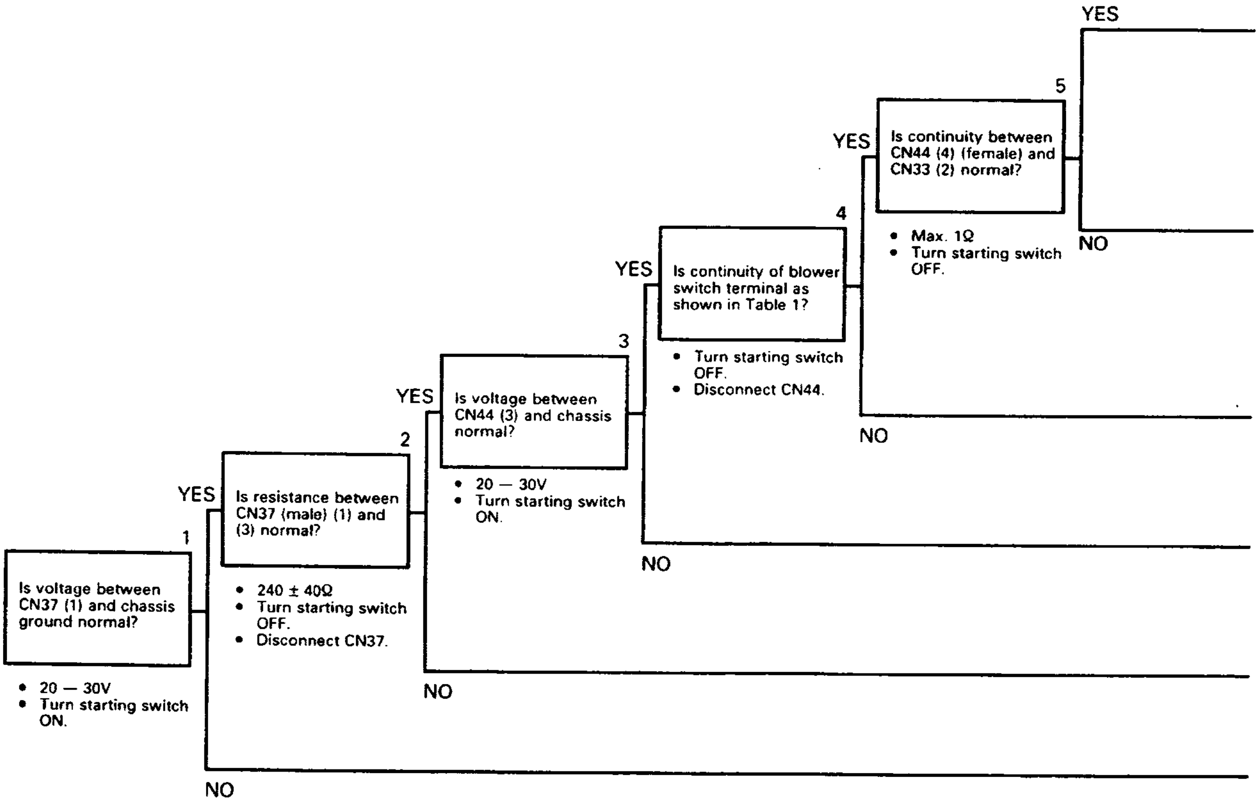
Note: 2) This troubleshooting uses the left washer as an example. For the other washers, the connector corresponding to CN11 is shown in the table below.

Wiper	Left washer	Front washer	Right washer	Rear washer
Connector No.	CN11	CN12	CN13	CN14

E-7 Air conditioner has no effect

★ If the battery and battery relay are normal.
★ Before carrying out troubleshooting, check that fuse FB2 No. 3 is normal.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

a) No air comes out



1 Is voltage between CN37 (1) and chassis ground normal?
- 20 — 30V
- Turn starting switch ON.

2 Is resistance between CN37 (male) (1) and (3) normal?
- 240 ± 40Ω
- Turn starting switch OFF.
- Disconnect CN37.

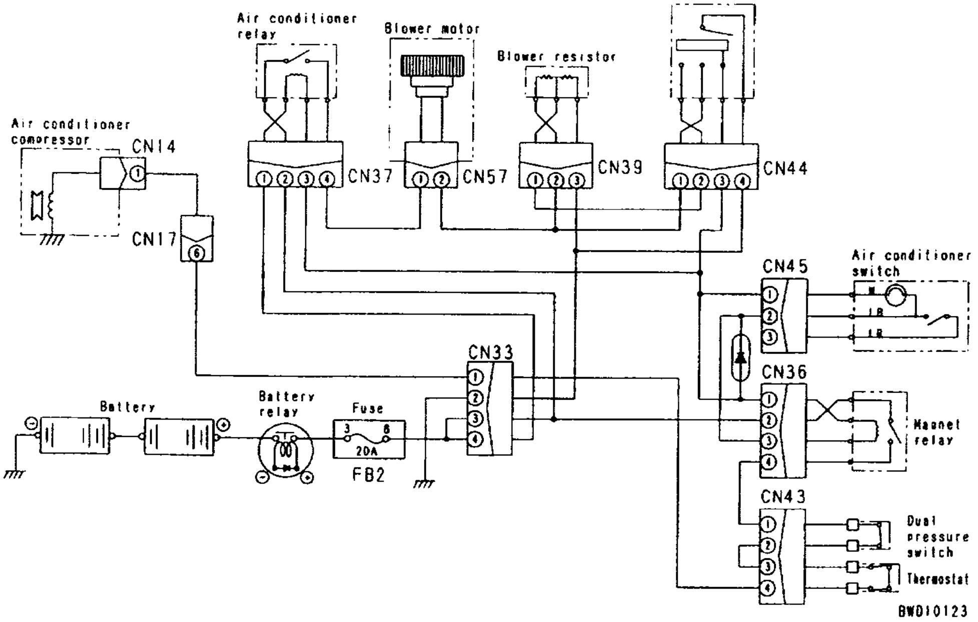
3 Is voltage between CN44 (3) and chassis normal?
- 20 — 30V
- Turn starting switch ON.

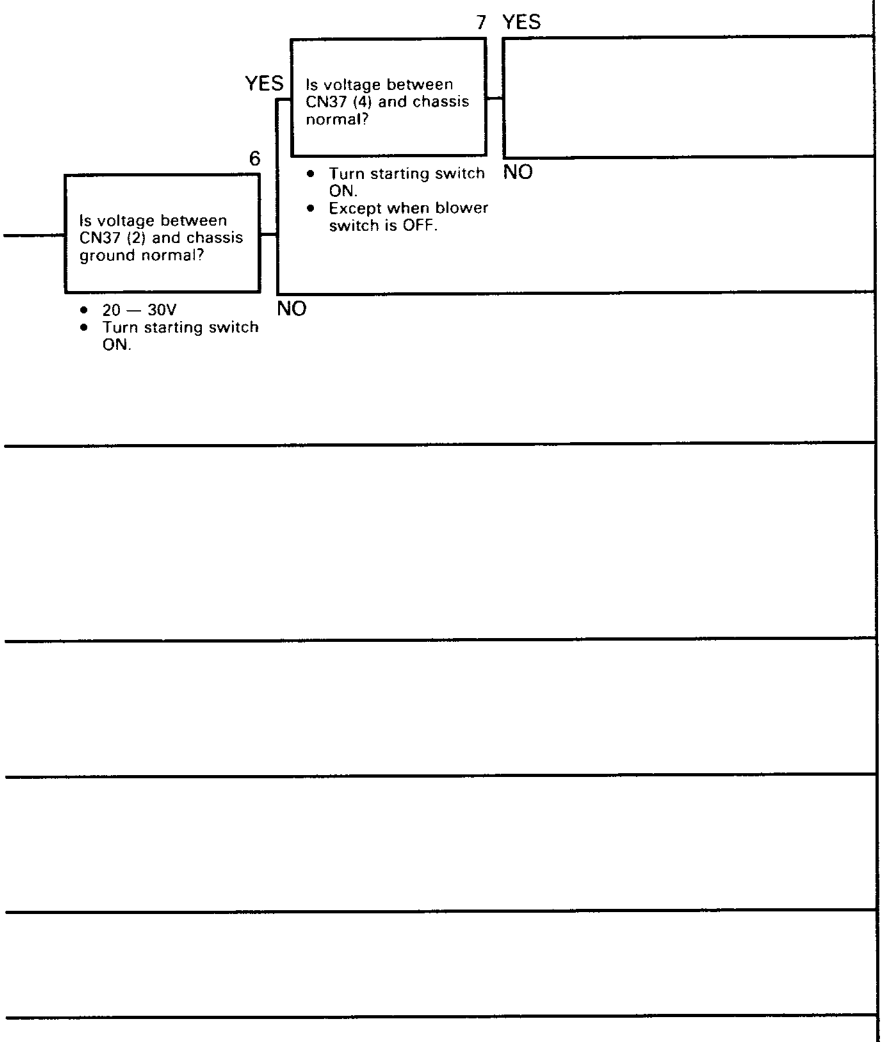
4 Is continuity of blower switch terminal as shown in Table 1?
- Turn starting switch OFF.
- Disconnect CN44.

5 Is continuity between CN44 (4) (female) and CN33 (2) normal?
- Max. 1Ω
- Turn starting switch OFF.

014012

E-7 Related electrical circuit diagram



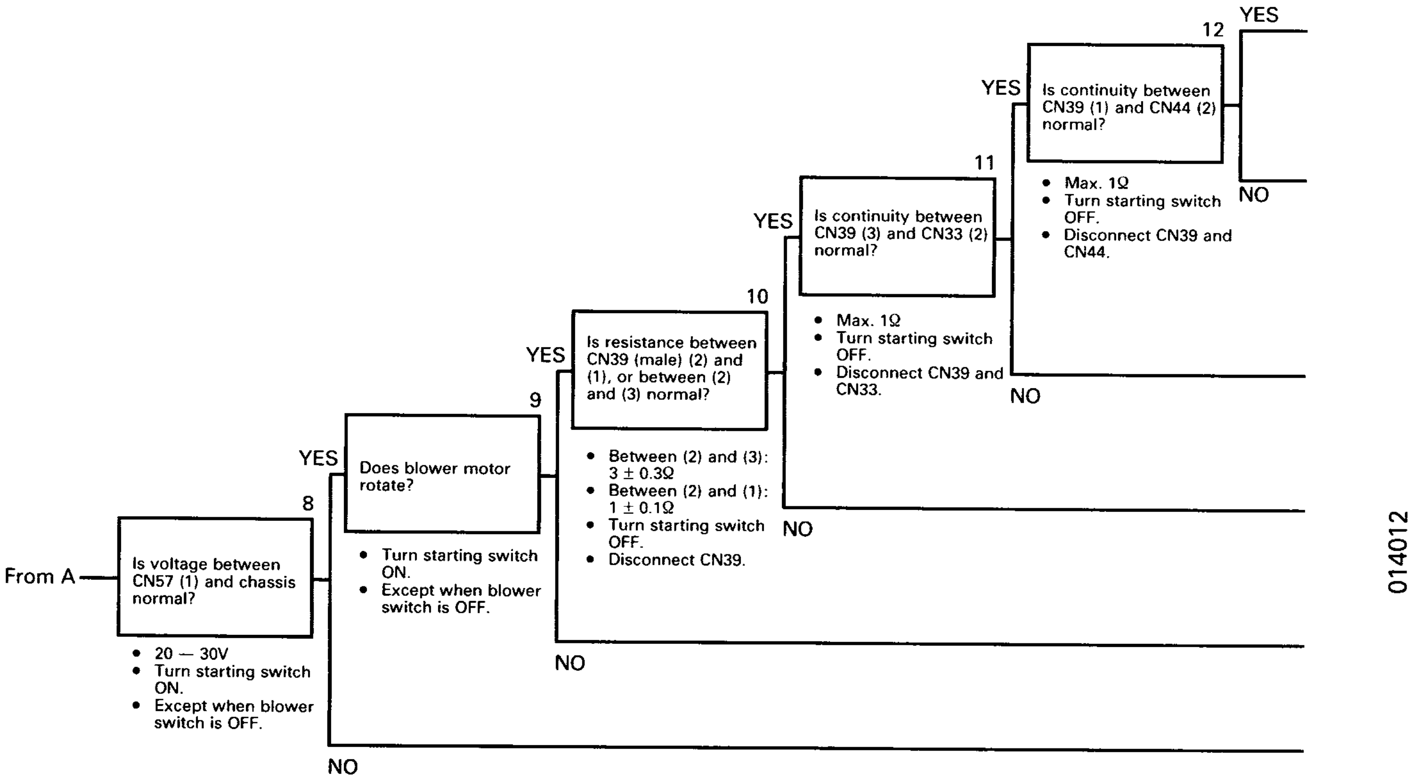


Cause	Remedy
Go to A	—
Defective air conditioner relay	Replace
Defective contact, or disconnection in wiring harness between fuse No. 8 and CN37 (2)	Repair or replace
Defective contact, or disconnection in wiring harness between CN44 (3) and CN33	Repair or replace
Defective blower switch	Replace
Defective contact, or disconnection in wiring harness between CN37 ③ and CN44 (3)	Repair or replace
Defective air conditioner relay	Replace
Defective contact, or disconnection in wiring harness between fuse No. 8 and CN37 (1)	Repair or replace

014012

Table 1

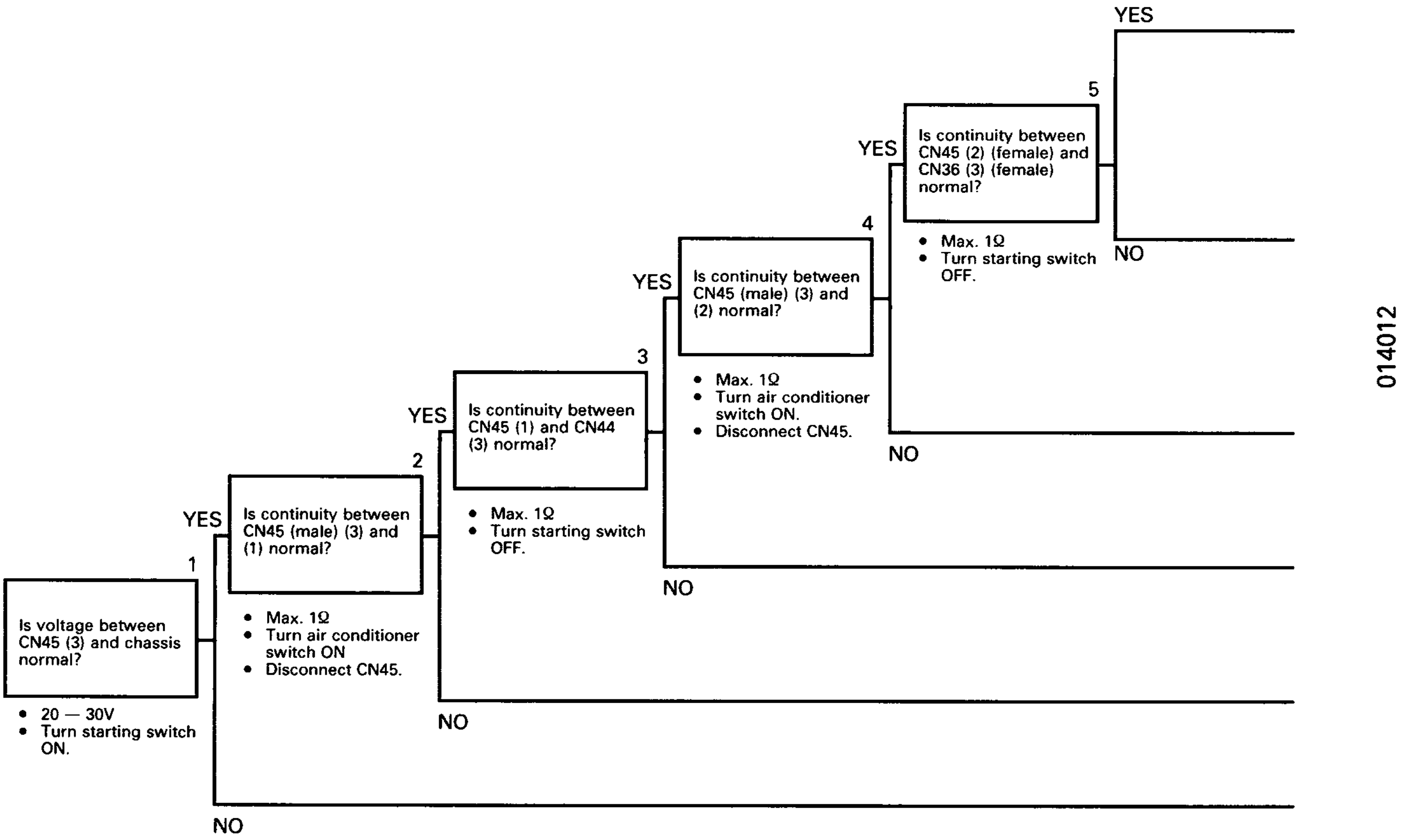
Terminal / Position	B	LW	LY	L
OFF	○			
LO	○	○		
ME	○	○	○	
HI	○	○		○

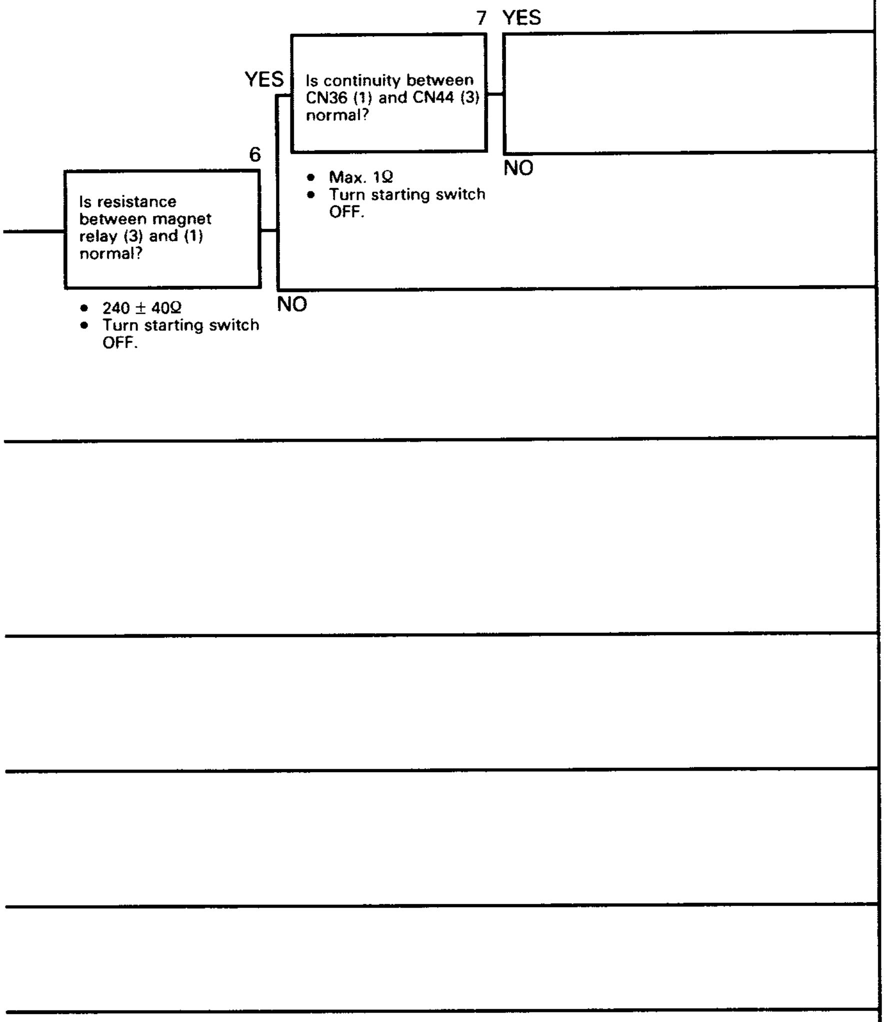

From A
8
Is voltage between CN57 (1) and chassis normal?
• 20 — 30V
• Turn starting switch ON.
• Except when blower switch is OFF.
YES
NO
9
Does blower motor rotate?
• Turn starting switch ON.
• Except when blower switch is OFF.
YES
NO
10
Is resistance between CN39 (male) (2) and (1), or between (2) and (3) normal?
• Between (2) and (3): 3 ± 0.3Ω
• Between (2) and (1): 1 ± 0.1Ω
• Turn starting switch OFF.
• Disconnect CN39.
YES
NO
11
Is continuity between CN39 (3) and CN33 (2) normal?
• Max. 1Ω
• Turn starting switch OFF.
• Disconnect CN39 and CN33.
YES
NO
12
Is continuity between CN39 (1) and CN44 (2) normal?
• Max. 1Ω
• Turn starting switch OFF.
• Disconnect CN39 and CN44.
YES
NO
014012

Cause	Remedy
Go to b)	–
Defective contact, or disconnection in wiring harness between CN39 and CN44.	Repair or replace
Defective contact, or disconnection in wiring harness between CN39 and CN33.	Repair or replace
Defective blower resistor	Replace
Defective blower motor	Replace
Defective contact, or disconnection in wiring harness between CN57 and CN37	Repair or replace

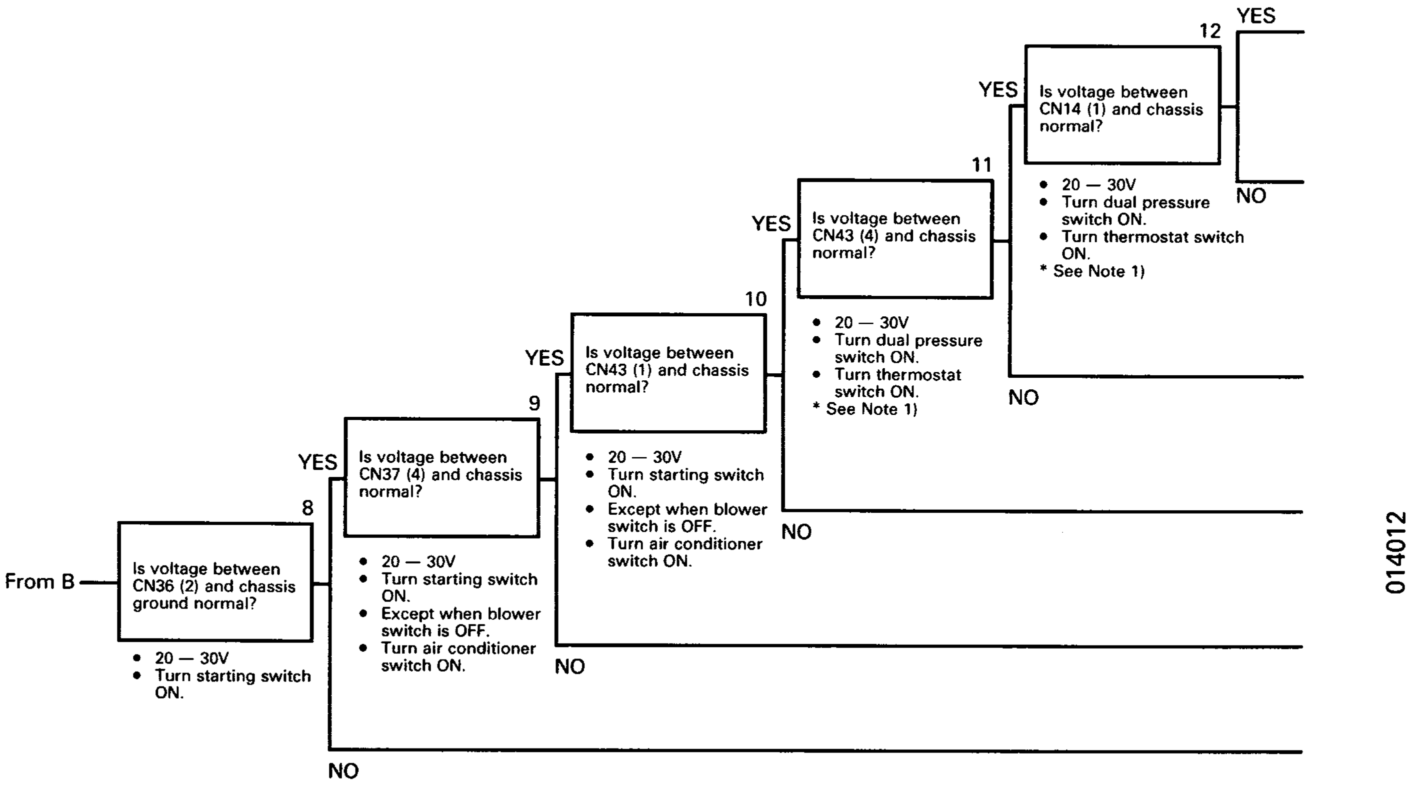
014012

b) Does not become cool





Cause	Remedy
Go to B	
Defective contact, or disconnection in wiring harness between CN36 (1) and CN44 (3)	Repair or replace
Defective magnet relay	Replace
Defective contact, or disconnection in wiring harness between CN45 and CN36	Repair or replace
Defective air conditioner switch	Replace
Defective contact, or disconnection in wiring harness between CN45 (1) and CN44 (3)	Repair or replace
Defective air conditioner switch	Replace
Defective contact, or disconnection in wiring harness between fuse FB2 No. 3 and CN45 (3)	Repair or replace



Note: 1) Dual switch ON—OFF switching pressure
Pressure in refrigerant circuit:

• High pressure side	OFF at 2.65 MPa (27 kg/cm^2) (when increasing) ON at 2.06 MPa (21 kg/cm^2) (when decreasing)
• Low pressure side	OFF at 0.21 MPa (2.1 kg/cm^2) (when decreasing) ON at 0.23 MPa (2.35 kg/cm^2) (when increasing)

Thermostat switch ON—OFF switching pressure
Evaporator discharge temperature:
OFF at above 1°C (when increasing)
ON at below 4.5°C (when decreasing)

Cause	Remedy
Defective air conditioner compressor	Rapair or replace
Defective contact, or disconnection in wiring harness between CN43 and CN14	Repair or replace
Defective dual pressure switch	Replace
Defective contact, or disconnection in wiring harness between CN36 and CN43	Repair or replace
Defective magnet relay	Replace
Defective contact, or disconnection in wiring harness between fuse No. 8 and CN36	Repair or replace

014012

TROUBLESHOOTING OF MACHINE MONITOR SYSTEM (M MODE)

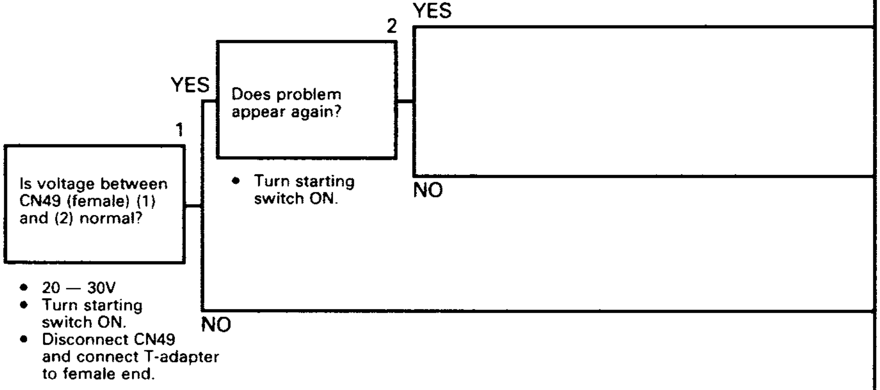
TABLE OF FAILURE MODES AND CAUSES (MACHINE MONITOR SYSTEM)

	Parts causing failure **Failure mode**		Sensors									Troubleshooting
		Power source	Engine coolant temperature	Power train oil temperature	Fuel level	Engine oil pressure	Starting motor system	Alternator system	Preheating system	Central alarm buzzer	Monitor panel	If there is any abnormality, go to YES/NO Troubleshooting Table M-OX
1	No display is given on monitor panel when starting switch is turned to ON	○									○	M-1
2	When starting switch is turned ON, all monitor panel lamps light up and do not go out										○	M-2
3	Preheating display is abnormal								○		○	M-3
4	CAUTION items light up or flash		○	○		○		○			○	M-4
5	Buzzer is abnormal									○	○	M-5
6	Warning lamp is abnormal										○	M-6
7	Gauge is abnormal		○	○	○						○	M-7
8	Service meter does not move after engine is started							○			○	M-8
9	Monitor panel lighting does not light up (front lamps are normal)										○	M-9

014012

M-1 No display is given on monitor panel when starting switch is turned to ON.

- ★ If the battery and battery relay are normal.
- ★ Before carrying out troubleshooting, check that fuse FB1 No. 2 is normal.
  (If it is blown, check for a short circuit in the wiring harness between CN49 (1) — CN31(1) — fuse FB1 No.2)
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

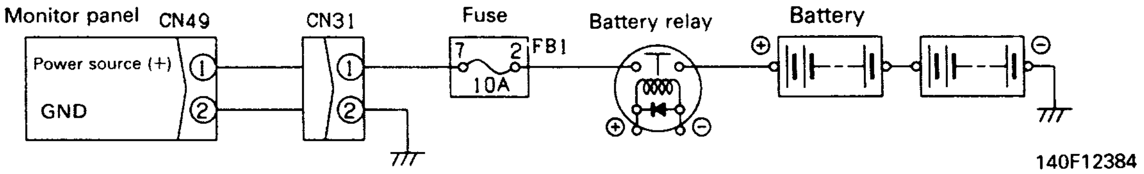


Cause	Remedy
Defective monitor panel	Replace
Good (problem is removed)	—
Defective contact, or disconnection in wiring harness between fuse FB1 No. 2 — CN31 (1) (2) — CN49 (1), (2) — chassis ground	Repair or replace

M-2 When starting switch is turned ON, all monitor panel lamps light up and do not go out.

Cause	Remedy
Defective monitor	Replace

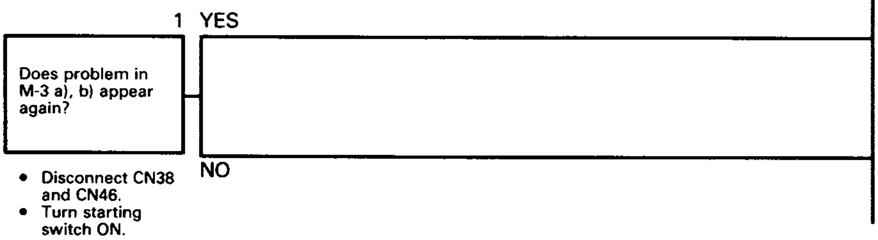
M-1, M-2 Related electrical circuit diagram



M-3 Preheating display is abnormal

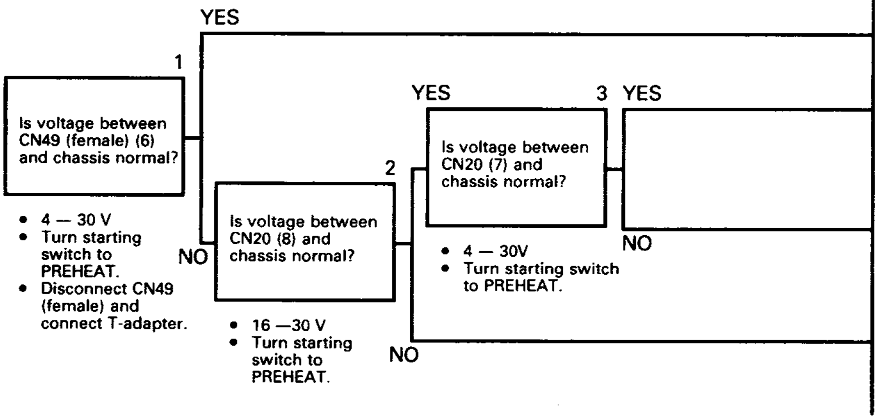
D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

★ If the battery and battery relay are normal.
★ Before carrying out troubleshooting, check that fuse FB2 No. 5 is normal.
(If it is blown, check for a short circuit in the wiring harness between electrical intake air heater relay — CN20(8) — CN32(7) — starting switch terminal R1, terminal B — CN32(5) — fuse, or between battery relay — CN32(6)(12)(14) — CN38(2), CN46(4).)



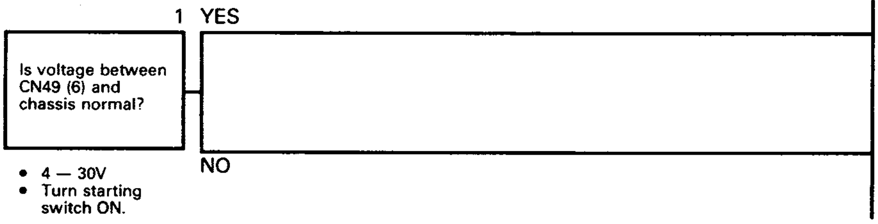
Cause	Remedy
Go to M-3, a), b)	—
Carry out troubleshooting of bimetal timer, glow switch. (Go to E-4)	—

a) Preheating monitor does not light up



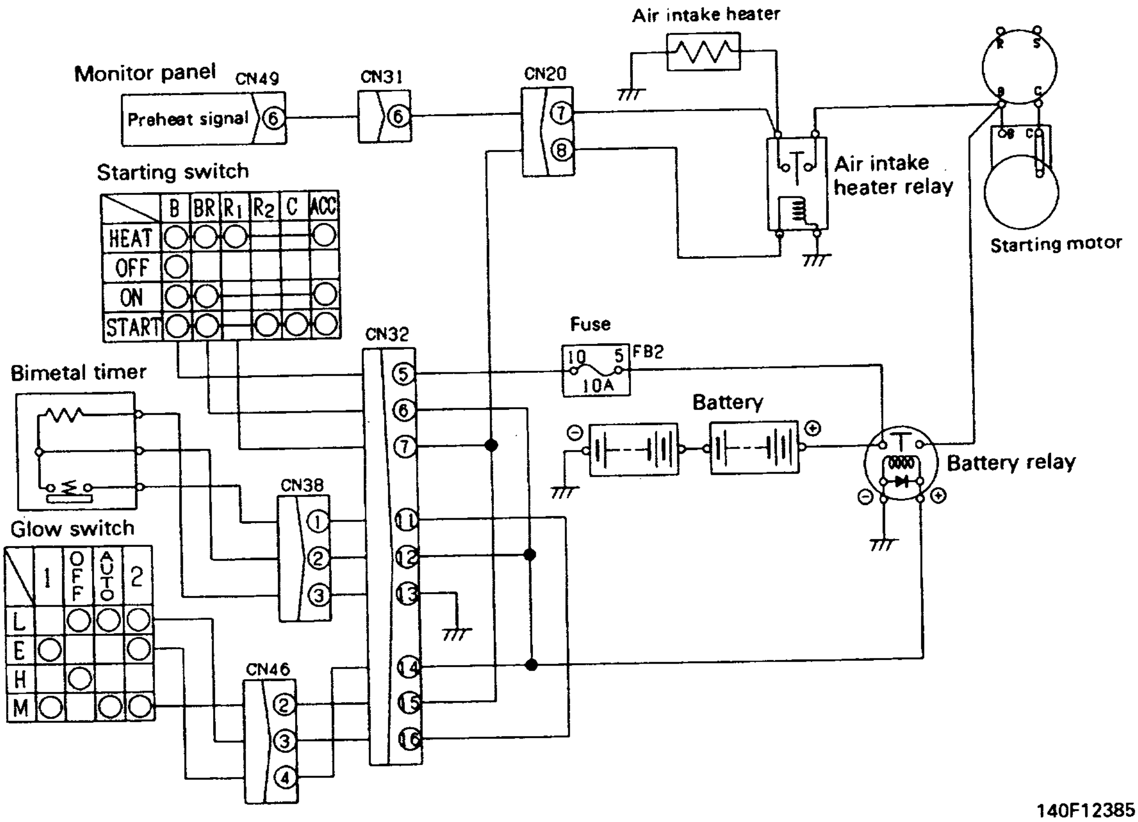
Cause	Remedy
Defective monitor panel	Replace
Disconnection in wiring harness between CN49 (6) — CN31 (6) — CN20 (7) — electrical intake air heater relay	Repair or replace
Defective electrical intake air heater relay	Replace
Defective contact, or disconnection in wiring harness between starting switch terminal R — electrical intake air heater relay — chassis	Repair or replace

b) Preheating monitor does not go out.



Cause	Remedy
Contact of +24V with wiring harness between CN49 (6) — CN31 (6) — CN20 (7) — electrical intake air heater relay, or between starting switch R1 — CN32 (7) — CN20 (8) — electrical intake air heater relay	Repair or replace
Defective monitor panel	Replace

M-3 a), b) Related electrical circuit diagram



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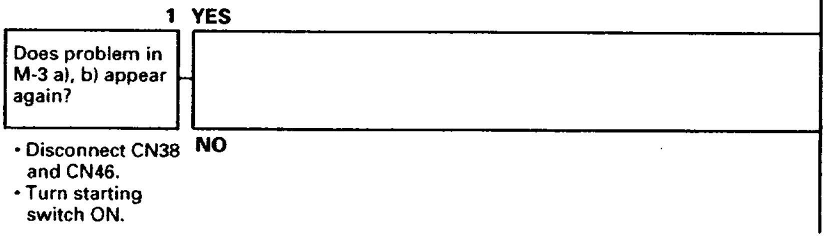
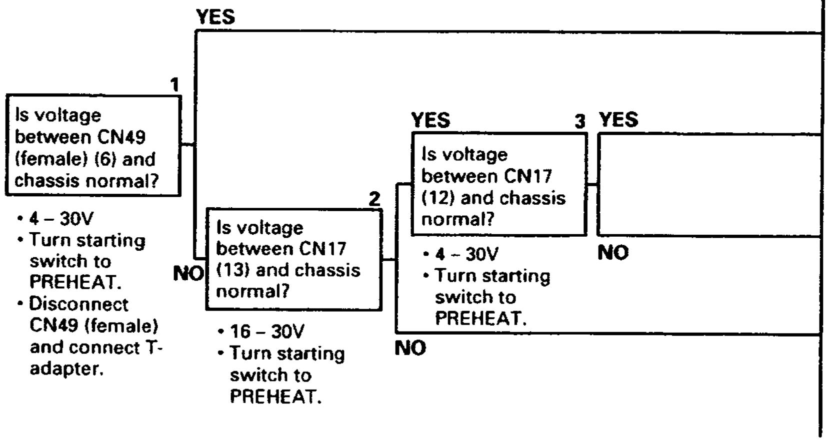
D65E-12 60948 – 65000
D65P-12 60891 – 65000
D65EX-12 60942 – 65000
D65PX-12 60915 – 65000

★ If the battery and battery relay are normal.
★ Before carrying out troubleshooting, check that fuse FB2 No. 5 is normal.
(If it is blown, check for a short circuit in the wiring harness between electrical intake air heater relay – CN17 (13) – CN32 (7) – starting switch terminal R1, terminal B – CN32 (5) – fuse, or between battery relay – CN32 (6) (12) (14) – CN38 (20, CN46 (4).)



Cause	Remedy
Go to M-3, a), b)	——
Carry out troubleshooting of bimetal timer, glow switch. (Go to E-4)	——

a) Preheating monitor does not light up.



Cause	Remedy
Defective monitor panel	Replace
Disconnection in wiring harness between CN49 (6) – CN31 (6) – CN17 (12) – electrical intake air heater relay	Repair or replace
Defective electrical intake air heater relay	Replace
Defective contact, or disconnection in wiring harness between starting switch terminal R – electrical intake air heater relay – chassis	Repair or replace

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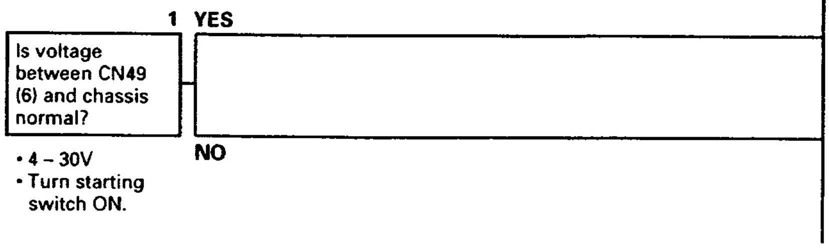
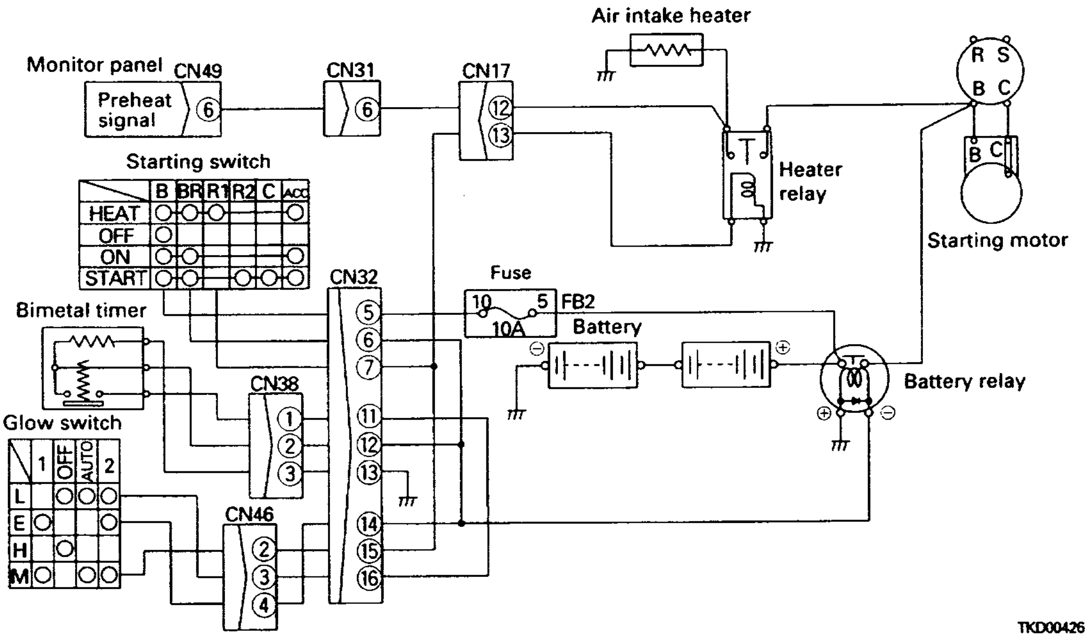
b) Preheating monitor does not go out.



Cause	Remedy
Contact of +24V with wiring harness between CN49 (6) – CN31 (6) – CN17 (12) – electrical intake air heater relay, or between starting switch R1 – CN32 (7) – CN17 (13) – electrical intake air heater relay	Repair or replace
Defective monitor panel	Replace

M-3 a), b) Related electrical circuit diagram

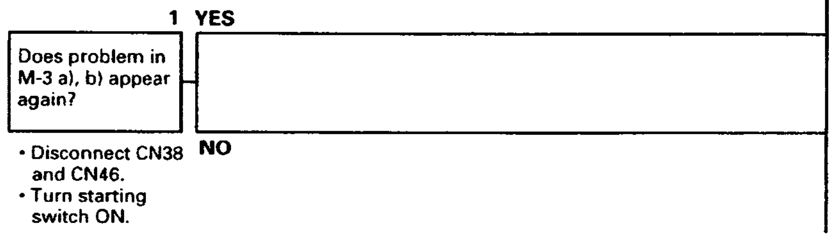


014012

D65E-12 65001 and up
D65P-12 65001 and up
D65EX-12 65001 and up
D65PX-12 65001 and up

★ If the battery and battery relay are normal.

★ Before carrying out troubleshooting, check that fuse FB2 No. 5 is normal.
(If it is blown, check for a short circuit in the wiring harness between electrical intake air heater relay – CN17 (13) – CN32 (7) – starting switch terminal R1, terminal B – CN32 (5) – fuse, or between battery relay – CN32 (6) (12) (14) – CN38 (20, CN46 (4).)



Cause	Remedy
Go to M-3, a), b)	——
Carry out troubleshooting of bimetal timer, glow switch. (Go to E-4)	——

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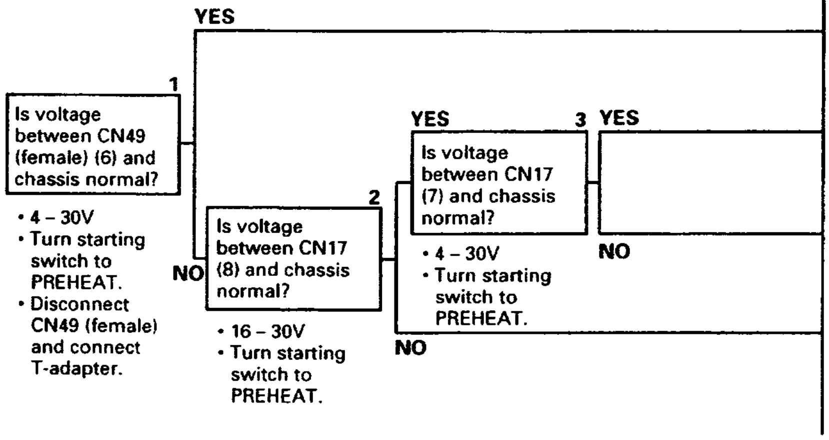
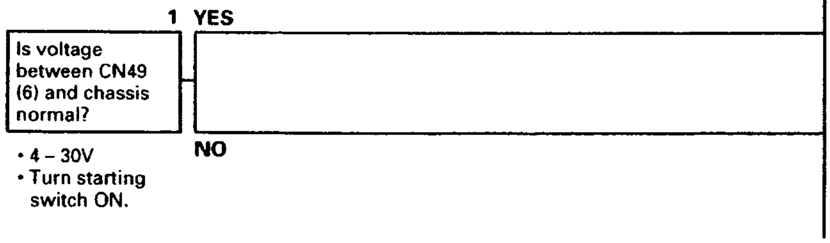
a) Preheating monitor does not light up.



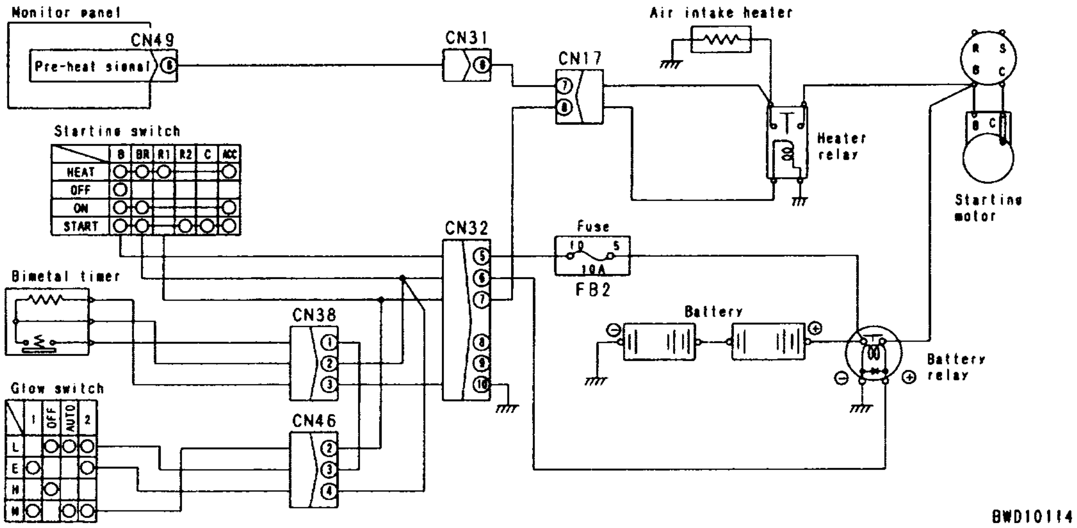
Cause	Remedy
Defective monitor panel	Replace
Disconnection in wiring harness between CN49 (6) – CN31 (6) – CN17 (7) – electrical intake air heater relay	Repair or replace
Defective electrical intake air heater relay	Replace
Defective contact, or disconnection in wiring harness between starting switch terminal R – electrical intake air heater relay – chassis	Repair or replace

b) Preheating monitor does not go out.



Cause	Remedy
Contact of +24V with wiring harness between CN49 (6) – CN31 (6) – CN17 (7) – electrical intake air heater relay, or between starting switch R1 – CN32 (7) – CN17 (8) – electrical intake air heater relay	Repair or replace
Defective monitor panel	Replace

M-3 a), b) Related electrical circuit diagram

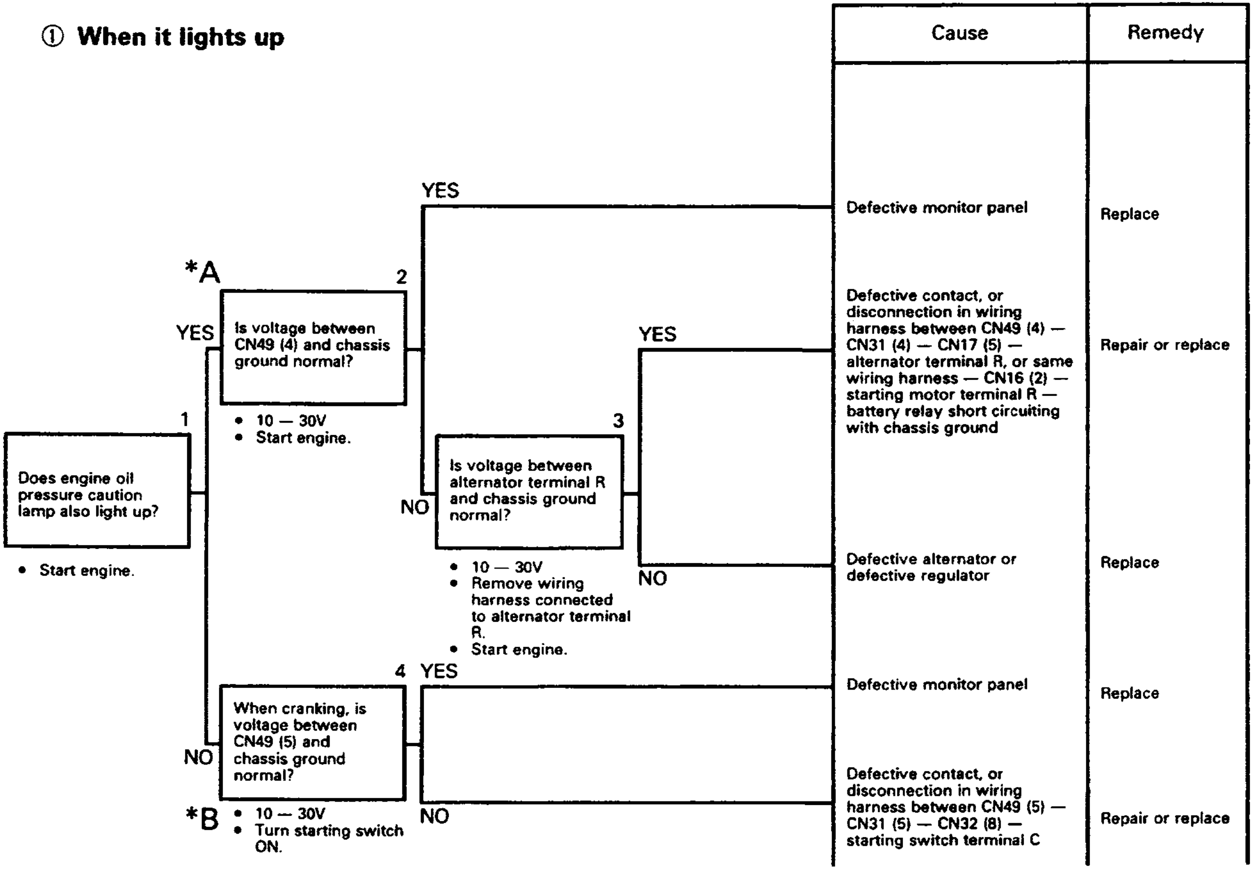


M-4 CAUTION items light up or flash

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

a) 🔋 (charge) lights up or flashes

① When it lights up



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② When it flashes

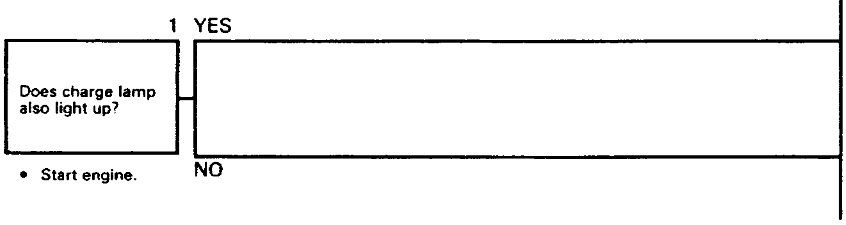
Start troubleshooting from the items in a) marked with *.

b) When starting switch is at ON and engine is started

(engine oil pressure lights up or flashes

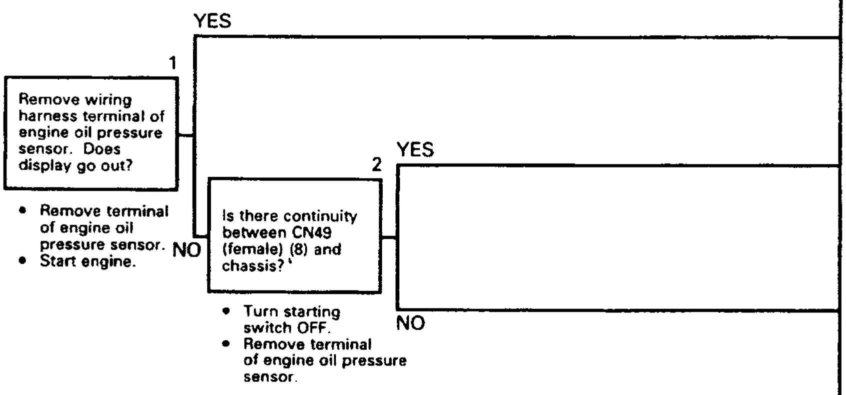
★ Check that the engine oil pressure is the specified value before starting troubleshooting.

① When it lights up



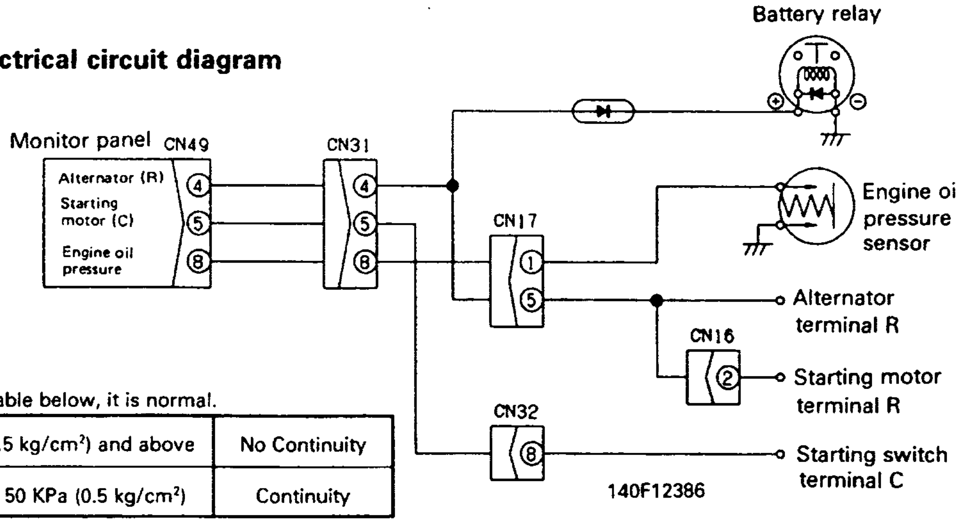
Cause	Remedy
Start troubleshooting from *A in M-4 a)	–
Start troubleshooting from *B in M-4 a)	–

② When it flashes



Cause	Remedy
Defective engine oil pressure sensor system	Check that contact, insertion of terminal are correct, carry out sensor check according to STANDARD VALUE TABLE, and replace
Contact of chassis ground with wiring harness between CN49 (8) — CN31 (8) — CN17 (1) — engine oil pressure sensor	Repair or replace
Defective monitor panel	Replace

M-4 a), b) Related electrical circuit diagram

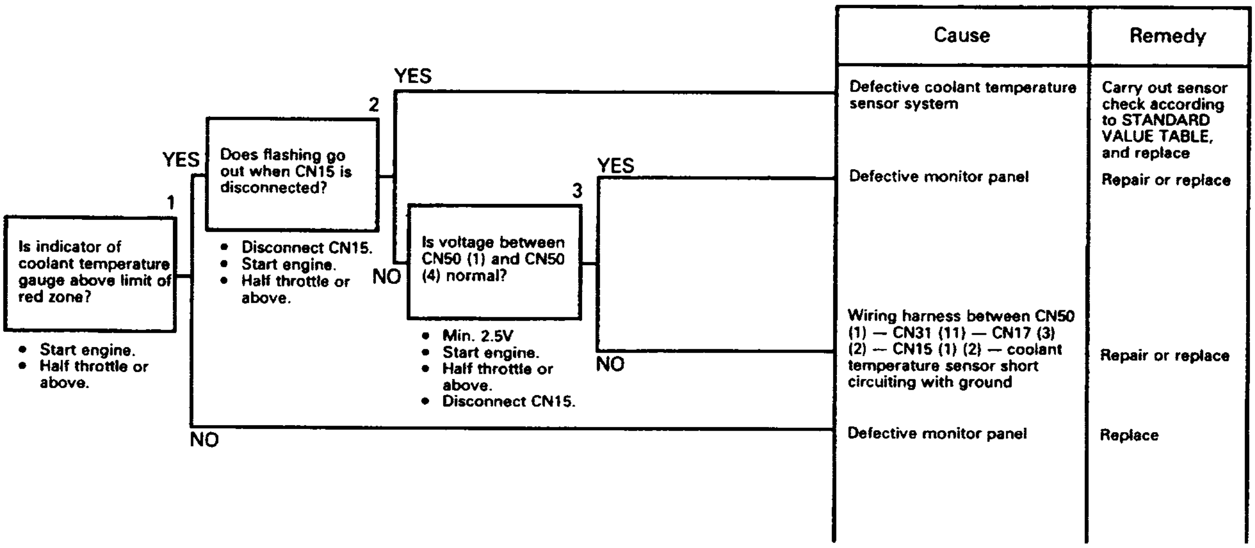


If the value is as shown in the table below, it is normal.

Engine oil pressure: 50 KPa (0.5 kg/cm²) and above	No Continuity
Engine oil pressure: Less than 50 KPa (0.5 kg/cm²)	Continuity

c) (coolant temperature) flashes

D65E-12 60001 – 65000
D65P-12 60001 – 65000
D65EX-12 60001 – 65000
D65PX-12 60001 – 65000



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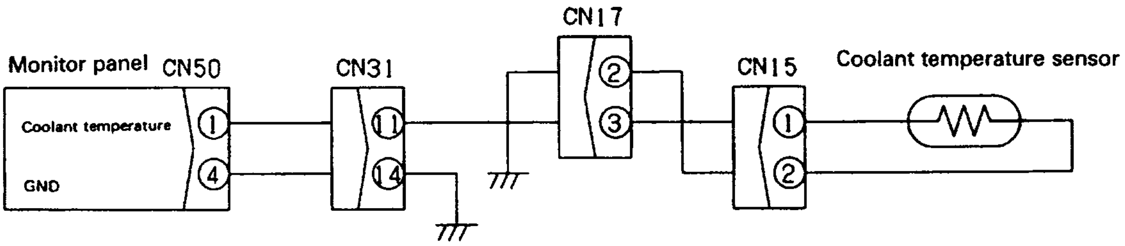
M-4 c) Related electrical circuit diagram



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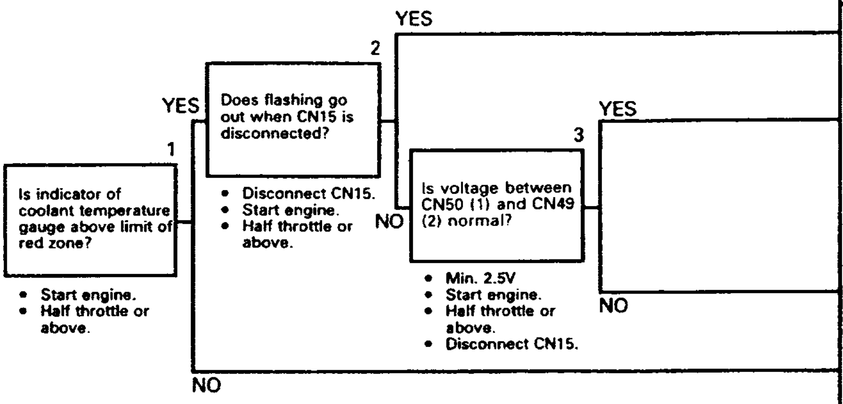
D65E-12 65001 and up
D65P-12 65001 and up
D65EX-12 65001 and up
D65PX-12 65001 and up



Cause	Remedy
Defective coolant temperature sensor system	Carry out sensor check according to STANDARD VALUE TABLE, and replace
Defective monitor panel	Repair or replace
Wiring harness between CN50 (1) - CN31 (9) - CN17 (3) (2) - CN15 (1) (2) - coolant temperature sensor short circuiting with ground	Repair or replace
Defective monitor panel	Replace

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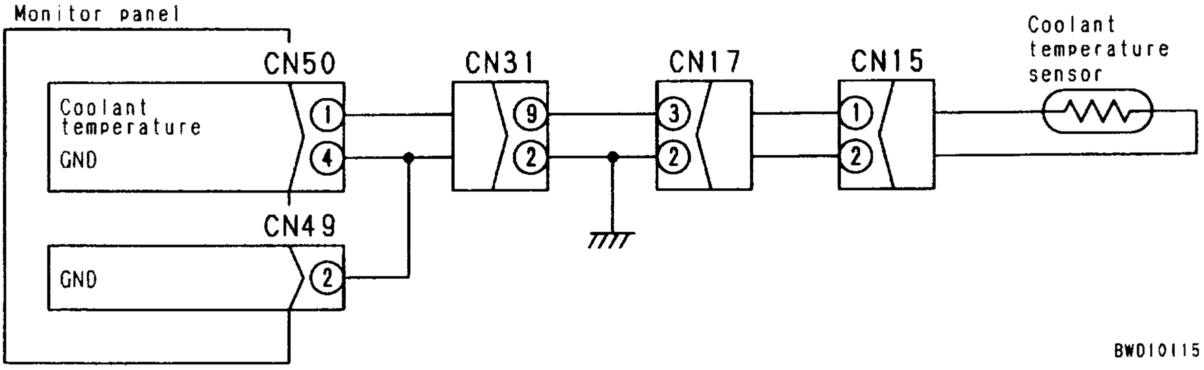
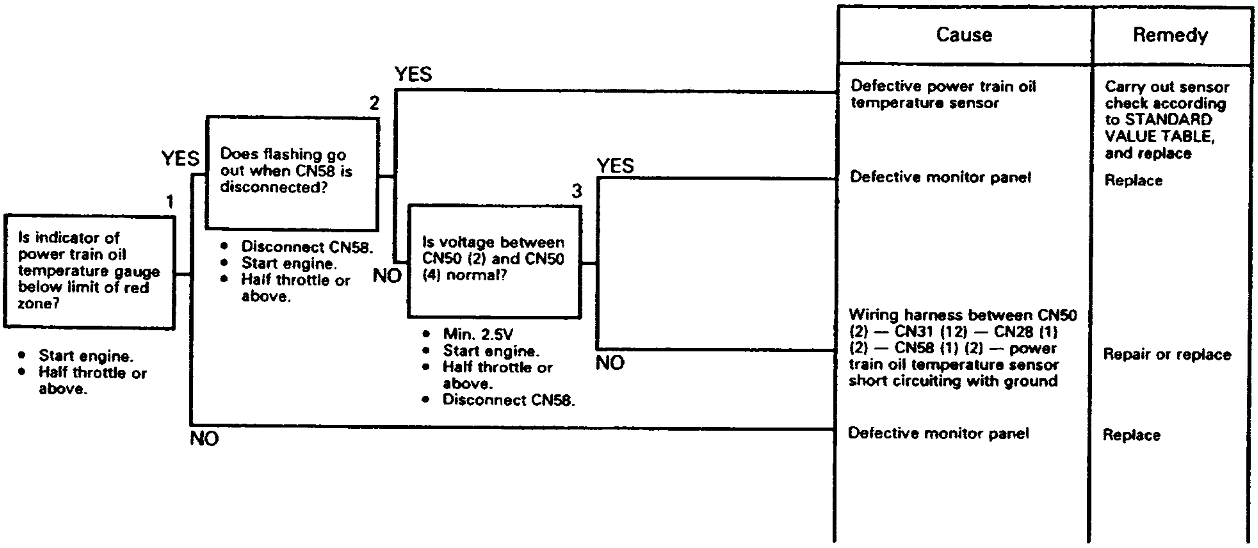
M-4 c) Related electrical circuit diagram



d) (power train oil temperature) flashes

D65E-12 60948 – 65000
D65P-12 60891 – 65000
D65EX-12 60942 – 65000
D65PX-12 60915 – 65000



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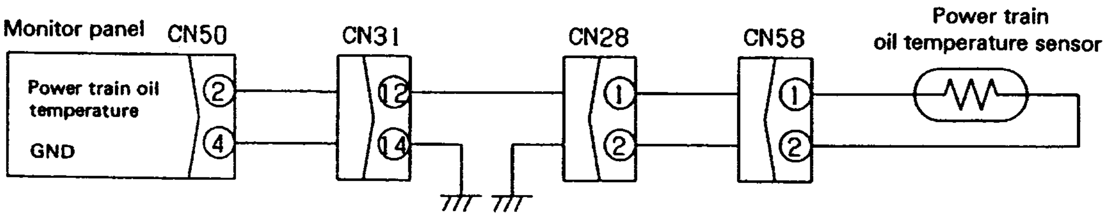
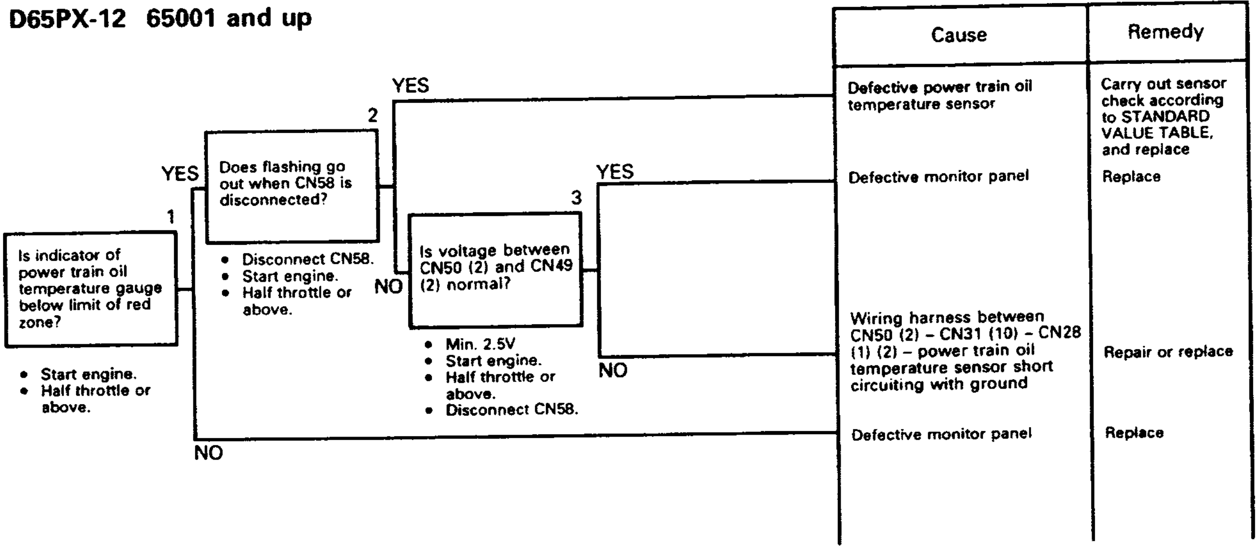
M-4 d) Related electrical circuit diagram



140F12388

D65E-12 65001 and up
D65P-12 65001 and up
D65EX-12 65001 and up
D65PX-12 65001 and up



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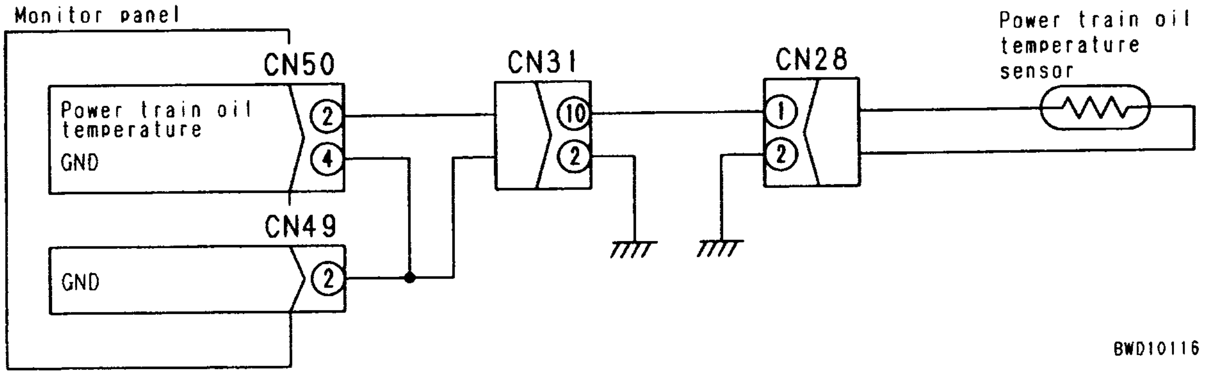
M-4 d) Related electrical circuit diagram



M-5 Buzzer is abnormal

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.
★ Of the caution items, only CHARGE does not have the alarm buzzer sound when there is an abnormality.

a) Caution item flashes but buzzer does not sound

1 When circuit between CN50 (female) (7) and chassis ground is connected, does buzzer sound?

- Ground CN50 (female) (7) to chassis.
- Turn starting switch ON.

	Cause	Remedy
YES	Defective monitor panel	Replace
NO	Defective contact, or disconnection in wiring harness between fuse FB1 No. 1 — CN32 (4) — CN41 (1)(2) — buzzer — CN50 (7), or defective buzzer	Repair or replace

b) Monitor display is normal, but buzzer sounds

1 When CN50 is removed, does buzzer stop?

- Remove CN50.
- Turn starting switch ON.

	Cause	Remedy
YES	Defective monitor panel	Replace
NO	Wiring harness between CN50 (7) and CN41 (2) short circuiting with ground, or defective buzzer	Repair or replace

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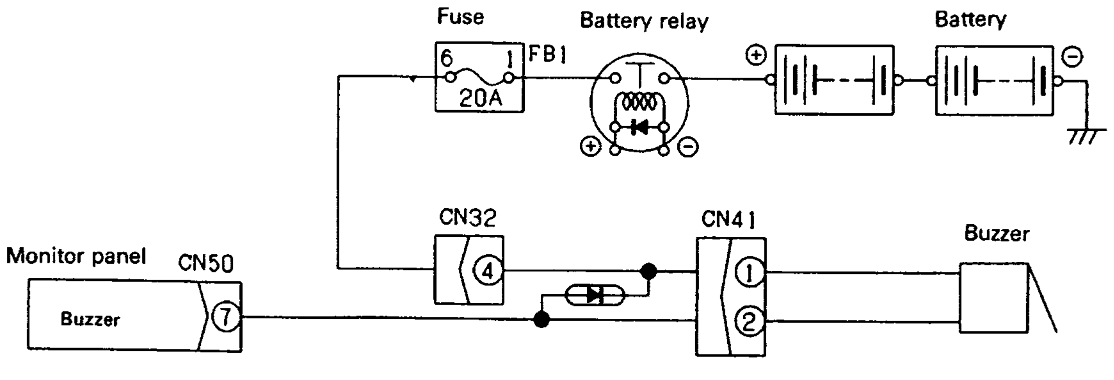
M-5 Related electrical circuit diagram



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M-6 Warning lamp is abnormal

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

a) Caution item flashing but lamp does not flash

★ When a visual check shows that the bulb is not blown.
(If it is blown, replace the lamp)

Cause	Remedy
Defective monitor panel	Replace

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b) Monitor display is normal but lamp flashes

Cause	Remedy
Defective monitor panel	Replace

M-7 Gauge is abnormal

D65E-12 60001 - 65000
D65P-12 60001 - 65000
D65EX-12 60001 - 65000
D65PX-12 60001 - 65000

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

a) Abnormality in engine coolant temperature gauge

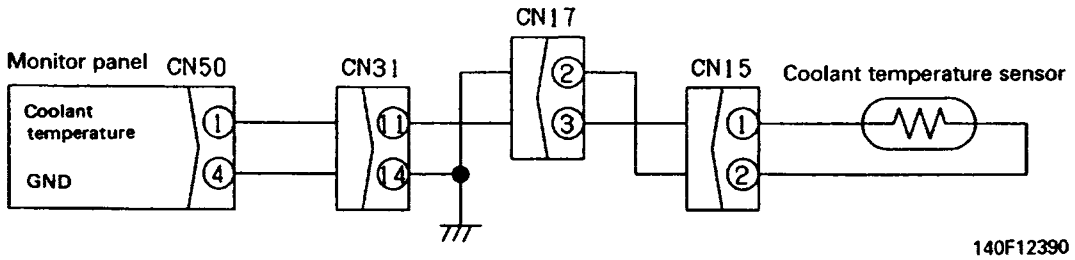
- The engine coolant temperature gauge shows an abnormally low temperature.

1 Connect short connector to CN15. Does indicator go completely to high temperature side, does caution lamp flash, and does buzzer sound?

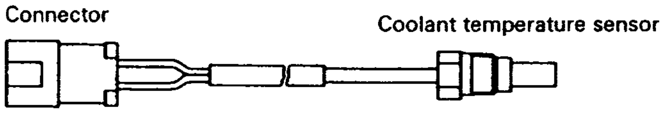
- Connect short connector to CN15 (female).
- Turn starting switch ON.

	Cause	Remedy
YES	Defective coolant temperature sensor system	Carry out sensor check according to STANDARD VALUE TABLE, and replace
NO	Defective contact, or disconnection in wiring harness between CN15 (1) — CN17 (3) — CN31 (11) — CN50 (1), or between CN15 (2) — CN17 (2) — CN31 (14) — CN50 (4) — chassis ground	Repair or replace

M-7 a) Related electrical circuit diagram



140F12390



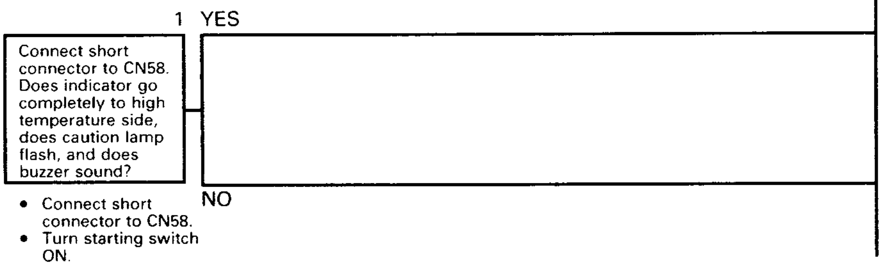
F19702218

If the condition is as shown in the table below, it is normal.

Ambient temperature	When normal
35° C | 20° C | 10° C	Approx. 29 k Ω | Approx. 52 k Ω | Approx. 80 k Ω

b) Abnormality in power train oil temperature gauge

- The power train oil temperature gauge shows an abnormally low temperature.



Cause	Remedy
Defective power train oil temperature sensor system	Carry out sensor check according to STANDARD VALUE TABLE, and replace
Defective contact, or disconnection in wiring harness between CN58 (1) — CN28 (1) — CN31 (12) — CN50 (2), or between CN58 (2) — chassis ground	Repair or replace

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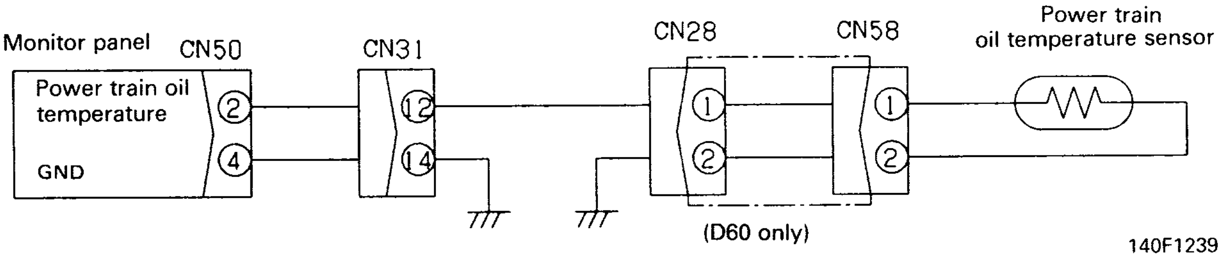
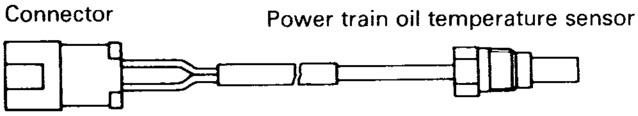
M-7 b) Related electrical circuit diagram



140F12391



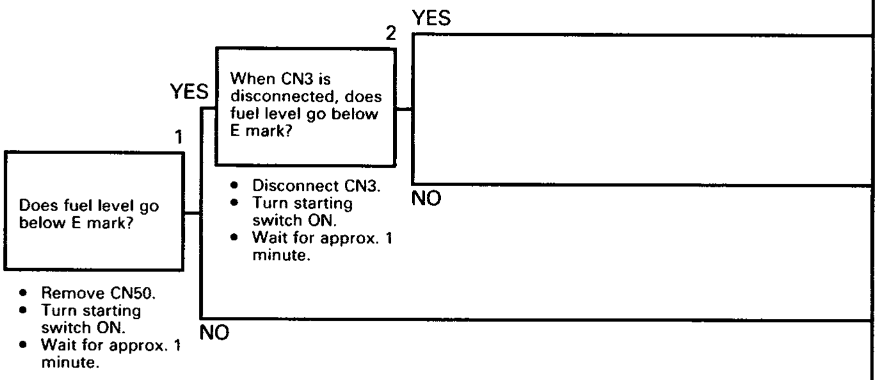
F19702218

If the condition is as shown in the table below, it is normal.

Ambient temperature	When normal
35° C I 20° C I 10° C	Approx. 29 k Ω I Approx. 52 k Ω I Approx. 80 k Ω

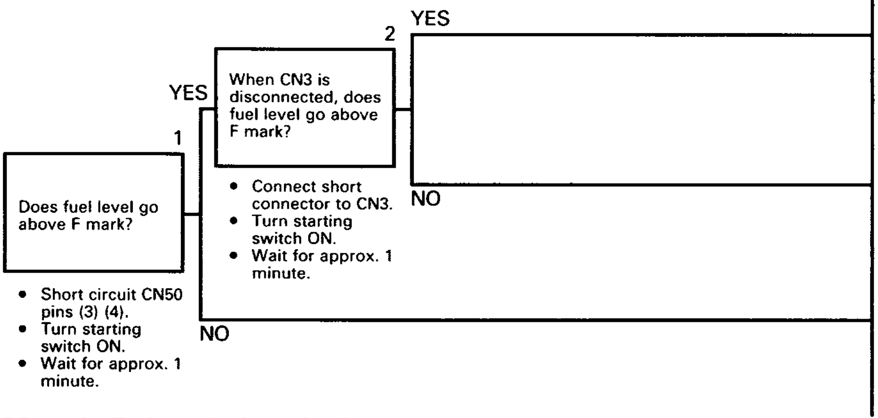
c) Abnormality in fuel level gauge

① Fuel level is always shown as FULL



Cause	Remedy
Defective fuel level sensor system	Carry out sensor check according to STANDARD VALUE TABLE, and replace
Wiring harness between CN3 (1) — CN4 (2) — CN31 (13) — CN50 (3) short circuiting with ground	Repair or replace
Defective monitor panel	Replace

② Fuel level is always shown as EMPTY



Cause	Remedy
Defective fuel level sensor system	Carry out sensor check according to STANDARD VALUE TABLE, and replace
Defective contact, or disconnection in wiring harness between CN3 (1) — CN4 (2) — CN31 (13) — CN50 (3), or between CN3 (2) and chassis ground	Repair or replace
Defective monitor panel	Replace

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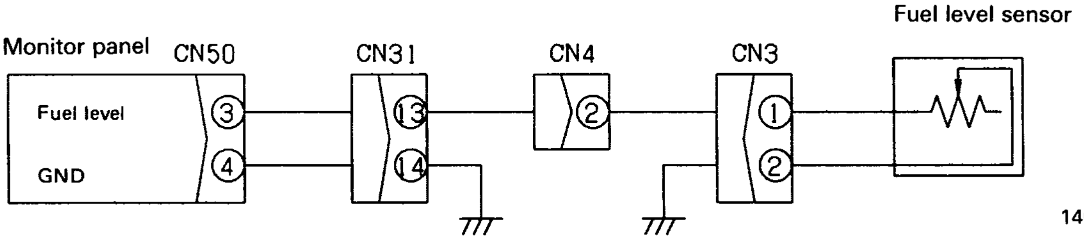
M-7 c) Related electrical circuit diagram



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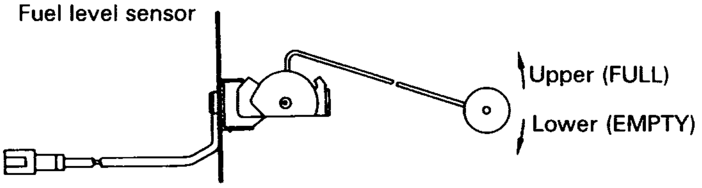


Upper stopper (FULL) position	Max. approx. 12Ω
Lower stopper (EMPTY) position	Approx. 85 — 110Ω

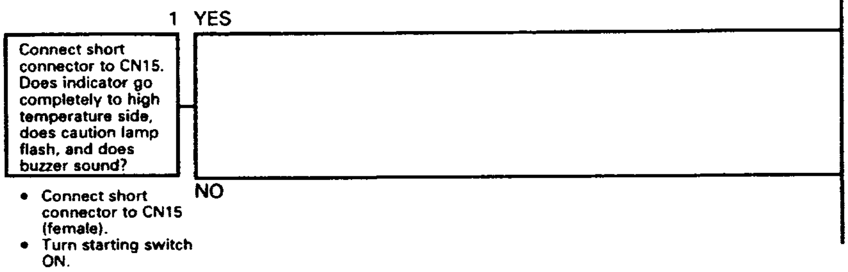
F91702223

D65E-12 65001 and up
D65P-12 65001 and up
D65EX-12 65001 and up
D65PX-12 65001 and up

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

a) Abnormality in engine coolant temperature gauge

- The engine coolant temperature gauge shows an abnormally low temperature.

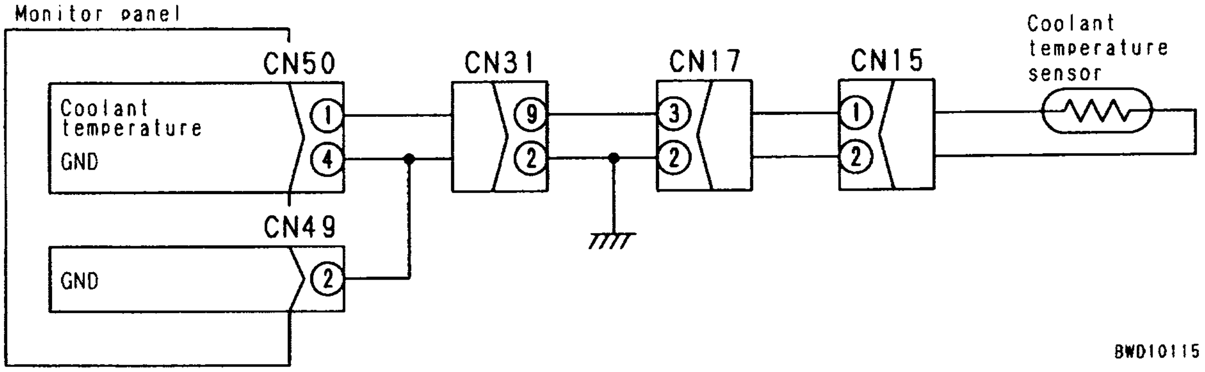


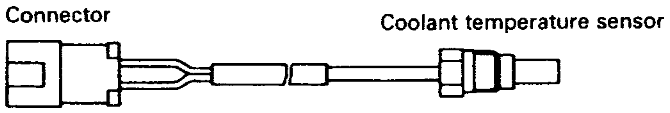
Connect short connector to CN15. Does indicator go completely to high temperature side, does caution lamp flash, and does buzzer sound?

- Connect short connector to CN15 (female).
- Turn starting switch ON.

Cause	Remedy
Defective coolant temperature sensor system	Carry out sensor check according to STANDARD VALUE TABLE, and replace
Defective contact, or disconnection in wiring harness between CN15 (1) - CN17 (3) - CN31 (9) - CN50 (1), or between CN15 (2) - CN17 (2) - CN31 (2) - CN50 (4) - chassis ground	Repair or replace

M-7 a) Related electrical circuit diagram





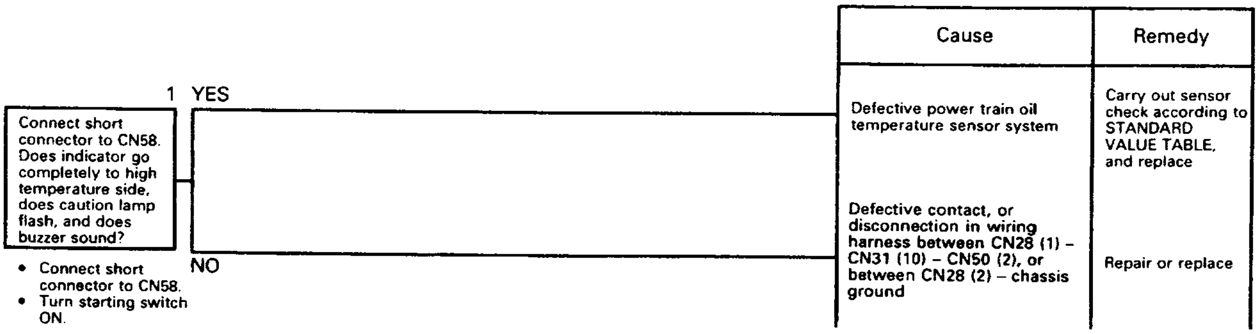
F19702218

If the condition is as shown in the table below, it is normal.

Ambient temperature	When normal
35° C	Approx. 29 kΩ
20° C	Approx. 52 kΩ
10° C	Approx. 80 kΩ

b) Abnormality in power train oil temperature gauge

- The power train oil temperature gauge shows an abnormally low temperature.



- Connect short connector to CN58.
- Turn starting switch ON.

	Cause	Remedy
YES	Defective power train oil temperature sensor system	Carry out sensor check according to STANDARD VALUE TABLE, and replace
NO	Defective contact, or disconnection in wiring harness between CN28 (1) – CN31 (10) – CN50 (2), or between CN28 (2) – chassis ground	Repair or replace

M-7 b) Related electrical circuit diagram

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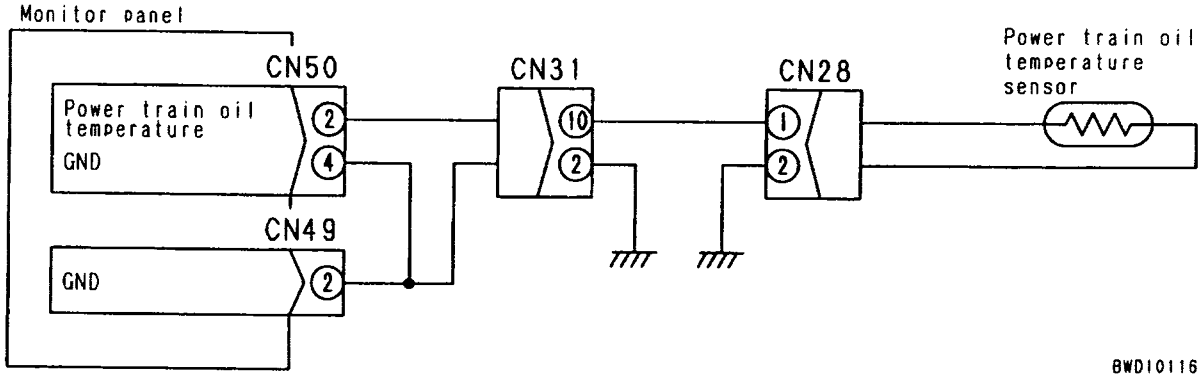

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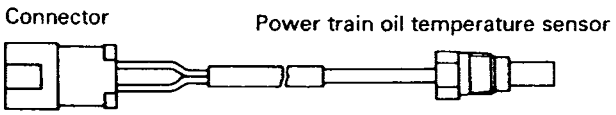

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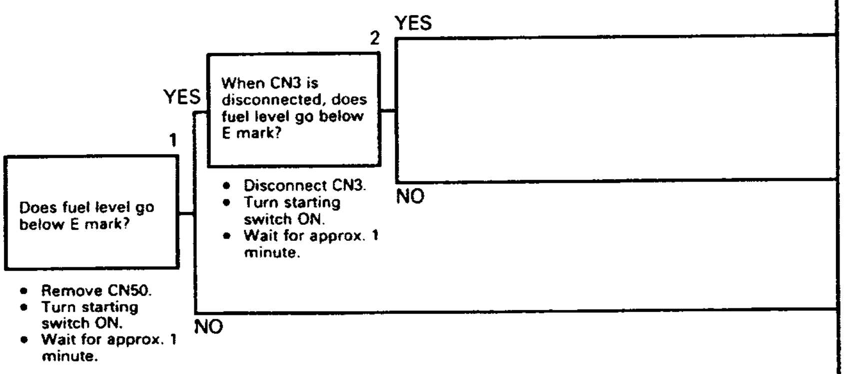
If the condition is as shown in the table below, it is normal.

Ambient temperature	When normal
35° C	Approx. 29 k Ω
20° C	Approx. 52 k Ω
10° C	Approx. 80 k Ω

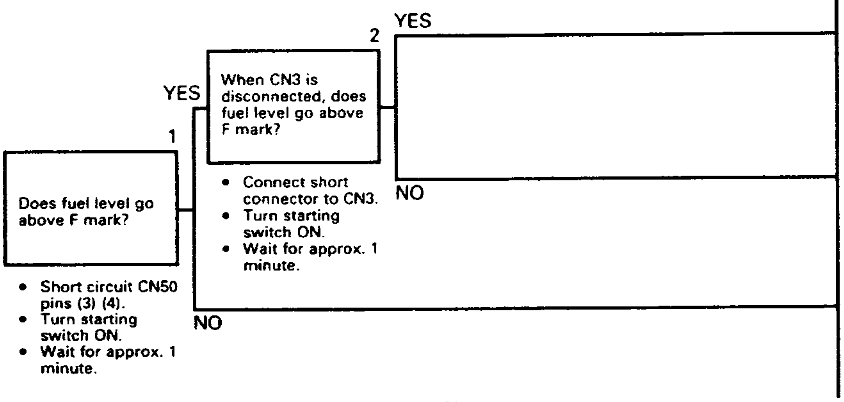
c) Abnormality in fuel level gauge

① Fuel level is always shown as FULL



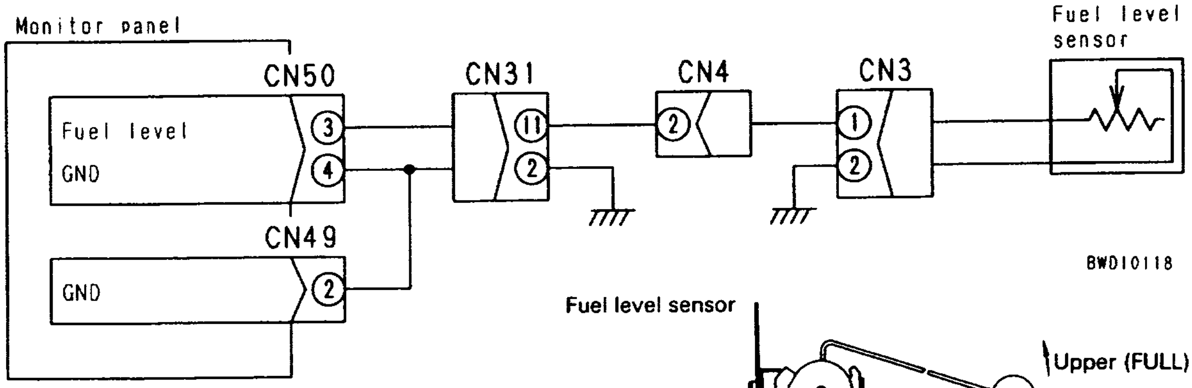
Cause	Remedy
Defective fuel level sensor system	Carry out sensor check according to STANDARD VALUE TABLE, and replace
Wiring harness between CN3 (1) - CN4 (2) - CN31 (11) - CN50 (3) short circuiting with ground	Repair or replace
Defective monitor panel	Replace

② Fuel level is always shown as EMPTY



Cause	Remedy
Defective fuel level sensor system	Carry out sensor check according to STANDARD VALUE TABLE, and replace
Defective contact, or disconnection in wiring harness between CN3 (1) - CN4 (2) - CN31 (11) - CN50 (3), or between CN3 (2) and chassis ground	Repair or replace
Defective monitor panel	Replace

M-7 c) Related electrical circuit diagram



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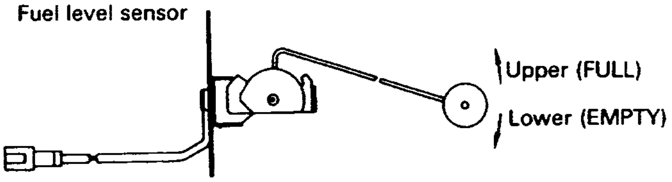
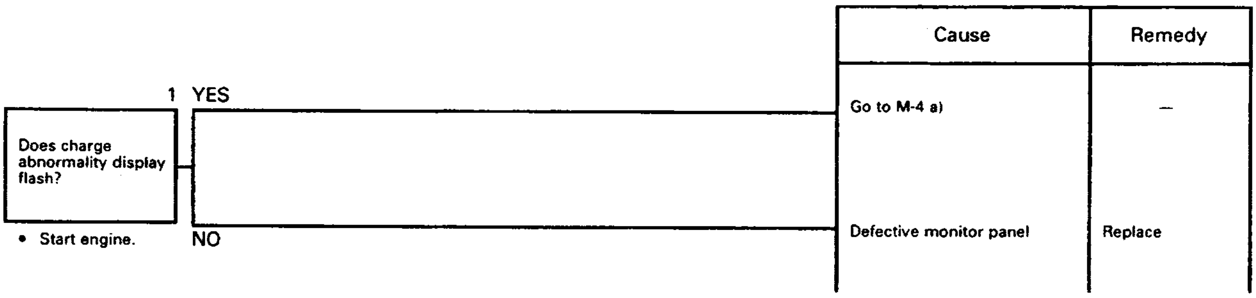


Upper stopper (FULL) position	Max. approx. 12Ω
Lower stopper (EMPTY) position	Approx. 85 — 110Ω

F91702223

M-8 Service meter does not move after engine is started

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.



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M-9 Monitor panel lighting does not light up (front lamps are normal)

D65E-12 60001 - 65000
D65P-12 60001 - 65000
D65EX-12 60001 - 65000
D65PX-12 60001 - 65000

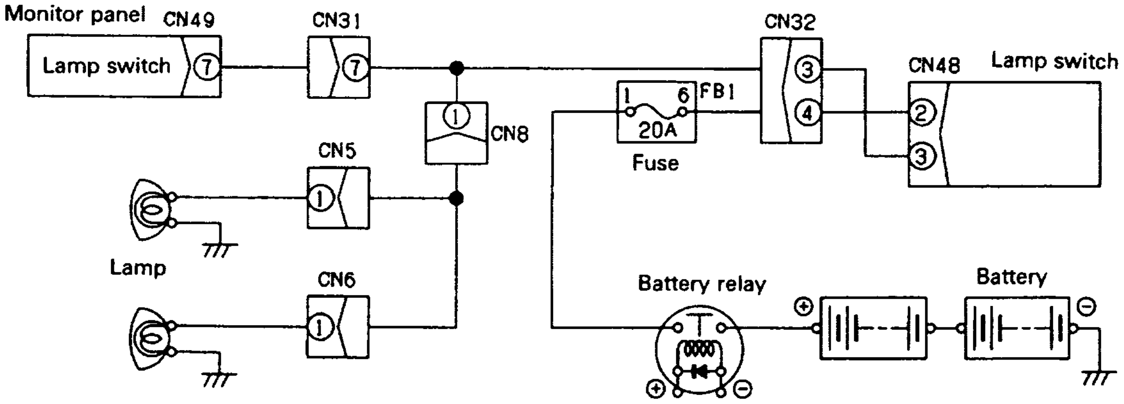
★ When a visual check shows that the bulb is not blown.
(If it is blown, replace the lamp)
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.
★ Before carrying out troubleshooting, check that fuse FB1 No. 1 is normal.
(If it is blown, check for a short circuit between fuse — CN32 (3)(4) — CN48 (3)(2) — CN5 (1), CN6 (1) — lamp)

1
Is voltage between CN49 (7) and chassis ground normal?

- 20 — 30V
- Turn starting switch ON.
- Turn front lamp switch ON.

	Cause	Remedy
YES	Defective monitor panel	Replace
NO	Defective contact, or disconnection in wiring harness between CN49 (7) — CN31 (7) — CN32 (3).	Repair or replace

M-9 Related electrical circuit diagram



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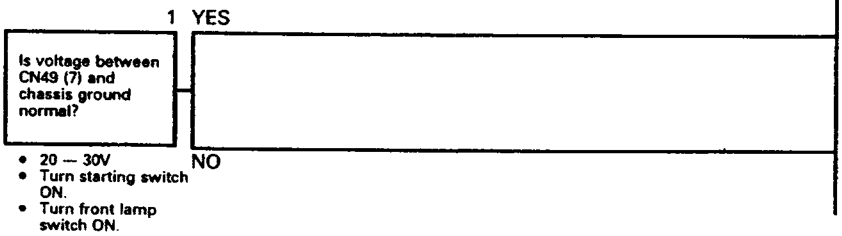
D65E-12 65001 and up
D65P-12 65001 and up
D65EX-12 65001 and up
D65PX-12 65001 and up

★ When a visual check shows that the bulb is not blown.
(If it is blown, replace the lamp)
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.
★ Before carrying out troubleshooting, check that fuse FB1 No. 1 is normal.
(If it is blown, check for a short circuit between fuse — CN32 (3)(4) — CN48 (3)(2) — CN5 (1), CN6 (1) — lamp)



Cause	Remedy
Defective monitor panel	Replace
Defective contact, or disconnection in wiring harness between CN49 (7) — CN31 (7) — CN32 (3).	Repair or replace

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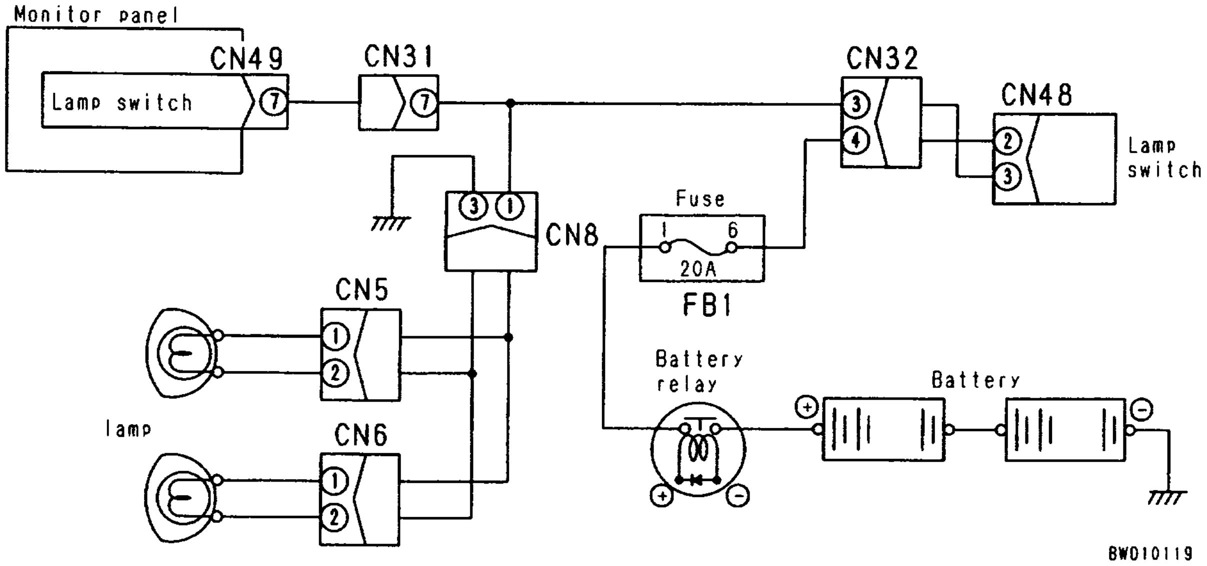
M-9 Related electrical circuit diagram



30 DISASSEMBLY AND ASSEMBLY

STARTING MOTOR

ALTERNATOR ASSEMBLY

ENGINE OIL COOLER CORE

FUEL INJECTION PUMP ASSEMBLY

WATER PUMP ASSEMBLY

TURBOCHARGER ASSEMBLY

NOZZLE HOLDER ASSEMBLY (D65P, EX, PX)

NOZZLE HOLDER ASSEMBLY (D65E)

THERMOSTAT ASSEMBLY

CYLINDER HEAD ASSEMBLY (D65P, EX, PX)

CYLINDER HEAD ASSEMBLY (D65E)

ENGINE FRONT SEAL

ENGINE REAR SEAL

AIR CONDITIONER COMPRESSOR ASSEMBLY

AIR CONDITIONER CONDENSER ASSEMBLY

FUEL TANK ASSEMBLY

RADIATOR ASSEMBLY

HYDRAULIC OIL COOLER ASSEMBLY

ENGINE ASSEMBLY (Cab specification)

ENGINE ASSEMBLY (Canopy specification)

DAMPER ASSEMBLY

POWER TRAIN UNIT ASSEMBLY (D65E, P)

POWER TRAIN UNIT ASSEMBLY (D65EX, PX)

POWER TRAIN UNIT (D65E, P)

POWER TRAIN UNIT (D65EX, PX)

TORQUE CONVERTER ASSEMBLY

PTO ASSEMBLY

TORQFLOW TRANSMISSION ASSEMBLY

STEERING CASE ASSEMBLY (D65E, P)

HSS ASSEMBLY (D65EX, PX)

TORQUE CONVERTER VALVE ASSEMBLY

TRANSMISSION CONTROL VALVE ASSEMBLY

STEERING CONTROL VALVE ASSEMBLY (D65E, P)

BRAKE VALVE ASSEMBLY (D65EX, PX)

REDUCING VALVE ASSEMBLY (D65E, P)

HSS MOTOR ASSEMBLY (D65EX, PX)

SCAVENGING PUMP ASSEMBLY

POWER TRAIN PUMP ASSEMBLY

FINAL DRIVE ASSEMBLY

TRACK FRAME ASSEMBLY

RECOIL SPRING ASSEMBLY

IDLER ASSEMBLY

TRACK ROLLER ASSEMBLY

CARRIER ROLLER ASSEMBLY (D65P, PX)

CARRIER ROLLER ASSEMBLY (D65E, EX)

TRACK SHOE

PIVOT SHAFT ASSEMBLY

EQUALIZER BAR ASSEMBLY

EQUALIZER BAR SIDE BUSHING

SEGMENT TEETH

WORK EQUIPMENT PUMP ASSEMBLY (D65E, P)

HSS, WORK EQUIPMENT PUMP ASSEMBLY (D65EX, PX)

PPC PUMP ASSEMBLY

MAIN CONTROL VALVE ASSEMBLY

MAIN RELIEF VALVE

PPC VALVE ASSEMBLY

PPC CHARGE RELIEF VALVE ASSEMBLY

SUCTION VALVE

BLADE LIFT CYLINDER ASSEMBLY

BLADE TILT CYLINDER ASSEMBLY

HYDRAULIC CYLINDER ASSEMBLY
(BLADE LIFT, BLADE TILT CYLINDER)

WORK EQUIPMENT ASSEMBLY

RIPPER VALVE ASSEMBLY (OPT.)

ROPS GUARD

OPERATOR'S CAB ASSEMBLY

CANOPY ASSEMBLY

DASHBOARD ASSEMBLY

MONITOR ASSEMBLY

FLOOR FRAME ASSEMBLY (D65E, P)

FLOOR FRAME ASSEMBLY (D65EX, PX)

METHOD OF USING MANUAL

1. When removing or installing unit assemblies

(1) When removing or installing a unit assembly, the order of work and techniques used are given for the removal operation; the order of work for the installation operation is not given.

(2) Any special techniques applying only to the installation procedure are marked ※1, and the same mark is placed after the relevant step in the removal procedure to indicate which step in the installation procedure it applies to.

(Example)

REMOVAL OF ○ ○ ○ ASSEMBLY	Title of operation
⚠	Precautions related to safety when carrying out the operation
1. XXXX (1)	Step in operation
★	Technique or important point to remember when removing XXXX (1).
2. △ △ △ (2):	※1 Indicates that a technique is listed for use during installation
3. □ □ □ □ assembly (3)	
💧	See Lubricant and Coolant Table
INSTALLATION OF ○ ○ ○ ASSEMBLY	Title of operation
• Carry out installation in the reverse order to removal.	
※1	Technique used during installation
★	Technique or important point to remember when installing △ △ △ (2).
• Adding water, oil	Step in operation
★	Point to remember when adding water or oil
🛢	Quantity of filling oil and water

2. General precautions when carrying out installation or removal (disassembly or assembly) of units are given together as PRECAUTION WHEN CARRYING OUT OPERATION, so be sure to follow these precautions when carrying out the operation.

3. Listing of special tools

(1) For details of the description, part number, and quantity of any tools (**A_1**, etc.) that appear in the operation procedure, see the SPECIAL TOOLS LIST given in this manual.

PRECAUTIONS WHEN CARRYING OUT OPERATION

[When carrying out removal or installation (disassembly or assembly) of units, be sure to follow the general precautions given below when carrying out the operation.]

1. Precautions when carrying out removal work

- If the coolant contains antifreeze, dispose of it correctly.
- After disconnecting hoses or tubes, cover them or fit blind plugs to prevent dirt or dust from entering.
- When draining oil, prepare a container of adequate size to catch the oil.
- Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.
- To prevent any excessive force from being applied to the wiring, always hold the connectors when disconnecting the connectors
- Fit wires and hoses with tags to show their installation position to prevent any mistake when installing.
- Check the number and thickness of the shims, and keep in a safe place.
- When raising components, be sure to use lifting equipment of ample strength.
- When using forcing screws to remove any components, tighten the forcing screws alternately.
- Befor removing any unit, clean the surrounding area and fit a cover to prevent any dust or dirt from entering after removal.

★ **Precautions when handling piping during disassembling**

Fit the following blind plugs into the piping after disconnecting it during disassembly operations.

1) Hoses and tubes using sleeve nuts

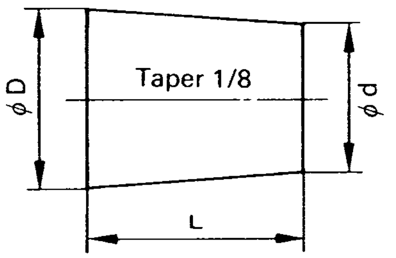
Nominal number	Plug (nut end)	Sleeve nut (elbow end) Use the two items below as a set
02	07376-50210	07221-20210 (Nut), 07222-00210 (Plug)
03	07376-50315	07221-20315 (Nut), 07222-00312 (Plug)
04	07376-50422	07221-20422 (Nut), 07222-00414 (Plug)
05	07376-50522	07221-20522 (Nut), 07222-00515 (Plug)
06	07376-50628	07221-20628 (Nut), 07222-00616 (Plug)
10	07376-51034	07221-21034 (Nut), 07222-01018 (Plug)
12	07376-51234	07221-21234 (Nut), 07222-01219 (Plug)

2) Split flange type hoses and tubes

Nominal number	Flange (hose end)	Sleeve head (tube end)	Split flange
04	07379-00400	07378-10400	07371-30400
05	07379-00500	07378-10500	07371-30500

3) If the part is not under hydraulic pressure, the following corks can be used.

Nominal number	Part number	Dimensions		
		D	d	L
06	07049-00608	6	5	8
08	07049-00811	8	6.5	11
10	07049-01012	10	8.5	12
12	07049-01215	12	10	15
14	07049-01418	14	11.5	18
16	07049-01620	16	13.5	20
18	07049-01822	18	15	22
20	07049-02025	20	17	25
22	07049-02228	22	18.5	28
24	07049-02430	24	20	30
27	07049-02734	27	22.5	34



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2. Precautions for installation operations

- Tighten all bolts and nuts (sleeve nuts) to the specified (KES) torque.
- Install the hoses without twisting or interference.
- Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
- Bend the cotter pin or lock plate securely.
- When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2 — 3 drops of adhesive.
- When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
- Clean all parts, and correct any damage, dents, burrs, or rust.
- Coat rotating parts and sliding parts with engine oil.
- When press fitting parts, coat the surface with antifriction compound (LM-P).
- After fitting snap rings, check that the snap ring is fitted securely in the ring groove.
- When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
- When using eyebolts, check that there is no deformation or deterioration, screw them fully, and align the direction of the hook.
- When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.

★ When operating the hydraulic cylinders for the first time after reassembling cylinders, pumps and other hydraulic equipment removed for repair, always bleed the air as follows:

1. Start the engine and run at low idling.
2. Operate the work equipment control lever to operate the hydraulic cylinder 4 — 5 times, stopping 100 mm from the end of its stroke.
3. Next, operate the hydraulic cylinder 3 — 4 times to the end of its stroke.
4. After doing this, run the engine at normal speed.
   ★ When using the machine for the first time after repair or long storage, follow the same procedure.

014012

3. Precautions when completing the operations

- If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the water level again.
- If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- If the piping or hydraulic equipment, such as hydraulic cylinders, pumps, or motors, have been removed for repair, always bleed the air from the system after reassembling the parts.
  ★ For details, see TESTING AND ADJUSTING, Bleeding air.
- Add the specified amount of grease (molybdenum disulphide grease) to the work equipment related parts.

SPECIAL TOOL LIST

Contents of work	Symbol		Part No.	Name	Q'ty	Remarks
Engine	A		790-331-1110	Wrench	1	Tightening of cylinder head
Disassembly, assembly of direct transmission assembly	B	1	790-501-5000	Unit repair stand	1	
			790-901-2110	Bracket	1	
			793-310-2141	Plate	1	
		2	791-346-1300	Wrench	1	Removal, installation of round nut
		3	796-730-2140	Wrench	1	Measurement of starting torque
			01010-30616	Bolt	2	
			795-630-1803	Torque wrench	1	
Disassembly, assembly of TORQFLOW transmission	C	1	790-102-2302	Wrench assembly	1	Removal, installation of round nut
		2	791-415-1300	Puller assembly	1	Installation of snap ring
		3	799-301-1600	Oil leak tester	1	Operation check of clutch piston
Disassembly, assembly of HSS assembly	D	1	791-422-1320	Hanger 60001–65000	1	Removal, installation of brake assembly
			791-422-1320	Hanger 65001–		
		2	790-100-1371	Wrench 60001–65000	1	Adjustment of pre-load on tapered roller bearing of bevel gear shaft
		3	790-302-1500	Spanner kit 65001–		
		4	796-730-2140	Wrench 65001–		
Disassembly, assembly of steering case assembly	E	1	791-422-1310	Hanger 60001–65000	1	Removal, installation of clutch brake assembly
			791-422-1320	Hanger 65001–	1	
		2	790-100-1340	Wrench 60001–65000	1	Adjustment of pre-load on tapered roller bearing of bevel gear shaft
		3	790-302-1500	Spanner kit 65001–	1	
Disassembly, assembly of final drive assembly	F	1	790-337-1032	Lifting tool	1	Removal, installation of final drive assembly
			791-427-1090	Plate	1	
			01010-51635	Bolt	2	
		2	792-520-2120	Installer	1	Installation of floating seal
		3	791-427-1100	Remover assembly	1	Pulling out of sprocket hub bearing
			790-101-2102	Puller	1	
			790-101-1102	Pump	1	
		4	791-427-1200	Installer assembly	1	Press fitting of sprocket hub bearing
			790-101-2102	Puller	1	
			790-101-1102	Pump	1	

014012

Contents of work	Symbol		Part No.	Name	Q'ty	Remarks
Undercarriage	G	1	791-685-8005	Compressor B	1	Disassembly, assembly of recoil spring assembly
			791-635-3160	Extension	1	
			790-201-2780	Spacer	1	
			790-201-2790	Spacer	1	
			790-101-1102	Pump	1	
			790-101-1600	Cylinder	1	
		2	796-230-1110	Installer	1	Installation of carrier roller floating seal
		3	791-515-1520	Installer	1	For installation of track roller floating seal
		4	791-515-1520	Installer	1	For installation of idler floating seal
		5	791-430-1200	Installer assembly	1	For press fitting pivot shaft ring
			790-101-2102	Puller	1	
			790-101-1102	Pump	1	
		6	791-450-1100	Remover assembly	1	For removal of equalizer bar center pin
			790-101-2102	Puller	1	
			790-101-1102	Pump	1	
		7	791-601-1000	Oil pump	1	Filling with oil for idler, track roller and carrier roller, checking for air leakage
Disassembly and assembly of hydraulic cylinder assembly	H	1	790-502-2000	Repair stand	1	For disassembly and assembly of hydraulic cylinder assembly
			790-502-1003	Repair stand	1	
			790-101-1102	Pump	1	
		2	790-330-1100	Multi-wrench	1	For removal and installation of round head
		3	790-302-1270	Socket	1	For removal and installation of nylon nut
			790-302-1280	Socket	1	
			790-302-1340	Socket	1	
		4	790-720-1000	Expander	1	For installation of piston ring
		5	796-720-1650	Ring	1	Lift
			07281-01029	Clamp	1	
			796-720-1660	Ring	1	Angle
			07281-01159	Clamp	1	
			796-720-1680	Ring	1	Tilt, pitch, ripper
			7281-01589	Clamp	1	

014012

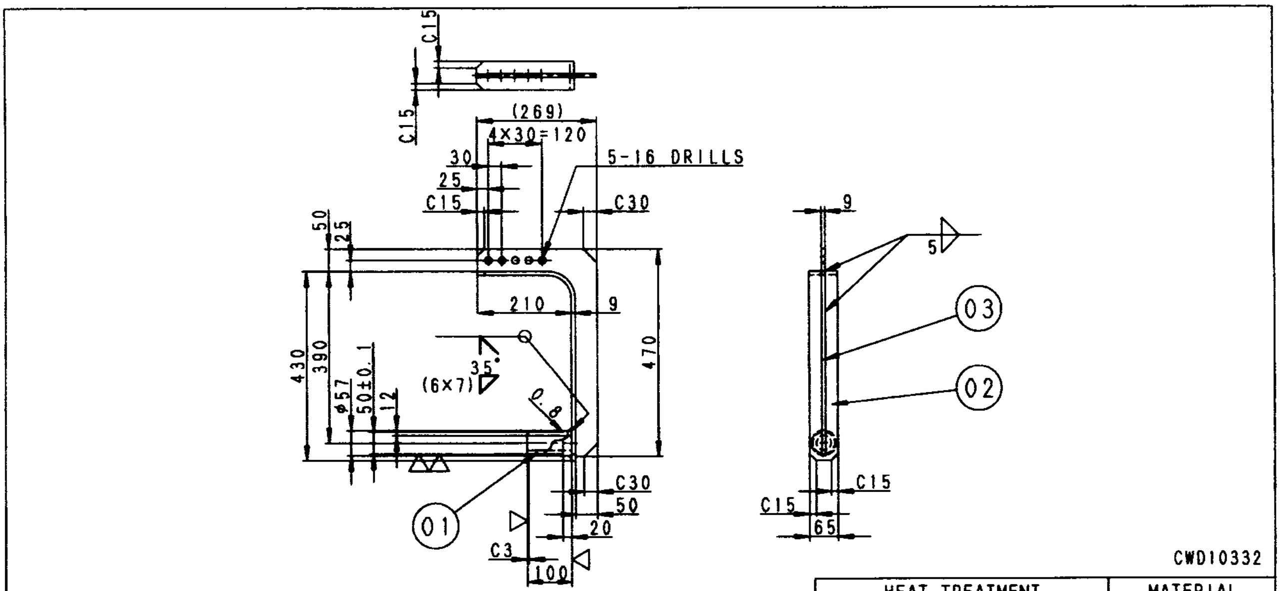
Contents of work	Symbol		Part No.	Name	Q'ty	Remarks
Disassembly and assembly of hydraulic cylinder assembly	H	6	790-201-1780	Push tool	1	Angle For installation of piston ring
			790-201-1791	Push tool	1	Lift
			790-201-1811	Push tool	1	Tilt, pitch, ripper
		7	790-101-5021	Grip	1	For press fitting dust seal Kit Part No. 790-201-1500
			01010-50816	Bolt	1	
			790-201-1620	Plate	1	Ripper, tilt, pitch
			790-201-1610	Plate	1	Lift
			790-201-1590	Plate	1	Angle
Removal, installation of engine rear seal	I	1	795-931-1100	Seal puller assembly	1	Removal of rear seal
		2	795-931-1210	Sealing jig	1	Press fitting of rear seal
			01050-31645	Bolt	3	
			01050-31625	Bolt	3	
		3	795-931-1220	Sealing jig	1	
			01050-31645	Bolt	3	
			01050-31625	Bolt	3	
Removal of pin plug of lubricated track link	W		791-646-7531	Remover	1	
Cleaning of pin of lubricated track link	X		791-660-7460	Brush	1	For washing pin
Installation of pin plug of lubricated track link	Y		791-432-1110	Push tool	1	For large plug
			791-646-7550	Bar	1	
			791-646-7560	Guide	1	
	Z		791-932-1110	Push tool	1	For small plug
			791-646-7523	Bar	1	
			791-646-7590	Guide	1	
Installation of seal of lubricated track link	KA		791-432-1120	Push tool	1	For F3 type seal
Air tightness check of lubricated track link	KB		790-701-3000	Checker	1	
Filling of lubricated track link with oil	KC		791-646-8002	Lubricator	1	
Track link remover	KD	1	791-635-3110	Frame	1	
			791-635-3160	Extension	1	
			791-635-3170	Nut	4	
			791-635-3180	Screw	2	
			791-635-3190	Screw	1	
			791-645-3510	Adapter	1	
			791-646-3260	Pusher	1	

Contents of work	Symbol		Part No.	Name	Q'ty	Remarks
Track link remover	KD	2	790-101-1102	Pump	1	
			790-101-1300	Cylinder	1	980 KN (100 tons)
		3	790-105-2300	Jack	1	196 KN (20 tons)
			790-101-1102	Pump	1	
Track link installer	KE	1	791-645-3520	Adapter	1	
			791-432-1210	Spacer	1	
		2	791-432-1110	Push tool	1	For large plug
			791-646-7550	Bar	1	
			791-646-7560	Guide	1	
		3	791-432-1120	Installer	1	F3 Type seal
		4	791-645-3540	Guide	1	
		5	791-635-3110	Frame	1	Pin installer
			791-635-3160	Extension	1	
			791-635-3170	Nut	4	
			791-635-3180	Screw	2	
			791-635-3190	Screw	1	
			791-645-3510	Adapter	1	
			791-645-3520	Adapter	1	
			791-645-3530	Pusher	1	
			791-432-1210	Spacer	1	
			791-432-1220	Spacer	1	
		6	791-635-3110	Frame	1	Bushing installer
			791-635-3160	Extension	1	
			791-635-3170	Nut	4	
			791-635-3180	Screw	2	
			791-635-3190	Screw	1	
			791-645-3520	Adapter	1	
			791-645-3540	Guide	1	
			791-645-3550	Pusher	1	
		7	790-101-1102	Pump	1	
			790-105-2300	Jack	1	196 KN (20 tons)
		8	791-646-3270	Guide	1	Pin installer

Contents of work	Symbol		Part No.	Name	Q'ty	Remarks
Track link installer	KE	9	791-635-3110	Frame	1	Pin installer
			791-635-3160	Extension	1	
			791-635-3170	Nut	4	
			791-635-3180	Screw	2	
			791-635-3190	Screw	1	
			791-645-3510	Adapter	1	
Track link remover & installer	KF		791-645-3500	Remover & Installer	1	
			790-101-1102	Pump	1	
			790-101-1300	Cylinder	1	980 KN (100 tons)
			790-105-2300	Jack	1	196 KN (20 tons)
			791-432-1210	Spacer	1	
			791-432-1220	Spacer	1	

SPECIAL TOOL SKETCH

E1, D1 Hanger



SYM.	PART NAME	MATERIAL	QTY/SET	MASS (kg)	REMARKS
03	PLATE	SS400P	1	2.32	t9
02	PLATE	SS400F	1	2.8	65×t9
01	BOSS	STKM13A	1	0.96	φ57×t12

HEAT TREATMENT ----	MATERIAL WELD
PART NAME HANGER	Q' TY 1
791T-422-1320 △	

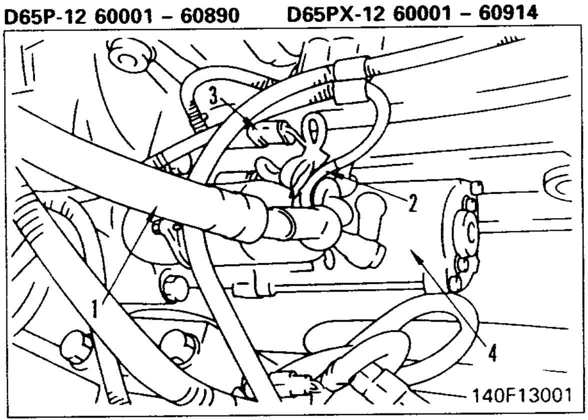
014012

REMOVAL OF STARTING MOTOR ASSEMBLY

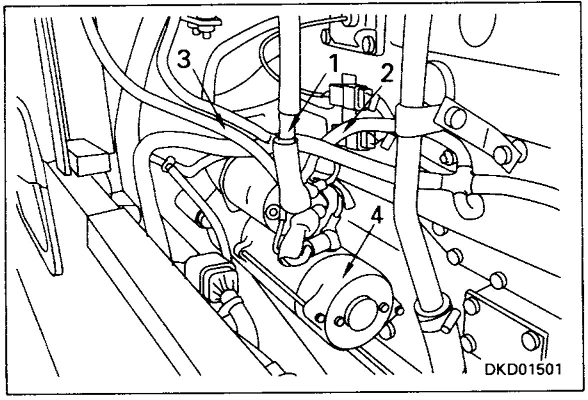
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Open top right side cover and remove bottom side cover.
    - On machines with the cab specification, the washer tank is installed inside the bottom right side cover, so disconnect the hose and connector, then remove the bottom side cover.
2. Disconnect wiring (1) and (2).
3. Disconnect connector (3).
4. Remove starting motor assembly (4).

D65E-12 60001 – 60947 **D65EX-12 60001 – 60941**
D65P-12 60001 – 60890 **D65PX-12 60001 – 60914**



D65E-12 60948 and up **D65EX-12 60942 and up**
D65P-12 60891 and up **D65PX-12 60915 and up**



INSTALLATION OF STARTING MOTOR ASSEMBLY

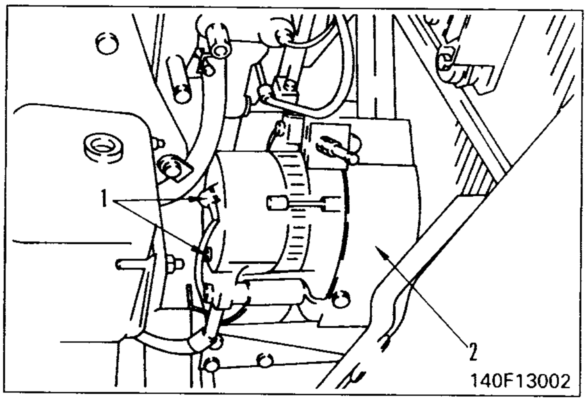
- Carry out installation in the reverse order to removal.

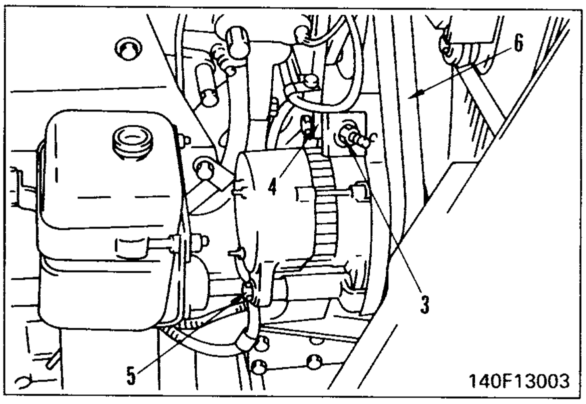
REMOVAL OF ALTERNATOR ASSEMBLY

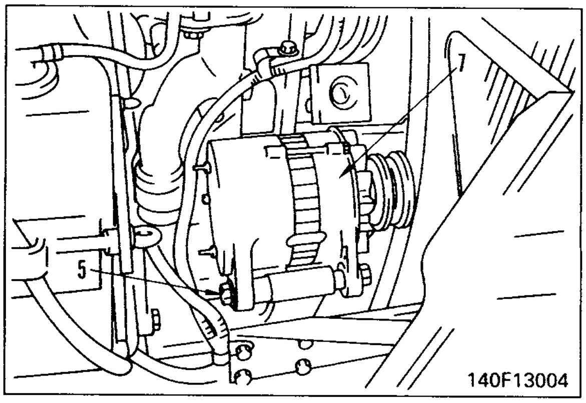
D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Open top right side cover and remove bottom side cover.
   - On machines with cab specification, the washer tank is installed inside the bottom right side cover, so disconnect the hose and connector, then remove the bottom side cover.
2. Disconnect wiring (1).
3. Remove cover (2).
4. Remove locknut (3), then remove rod (4).
5. Loosen mounting bolt and nut (5), and remove 2 fan belts (6). ※1
6. Remove mounting bolt and nut, then remove alternator assembly (7).







INSTALLATION OF ALTERNATOR ASSEMBLY

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

- Carry out installation in the reverse order to removal.

※1

Adjusting tension of alternator belt

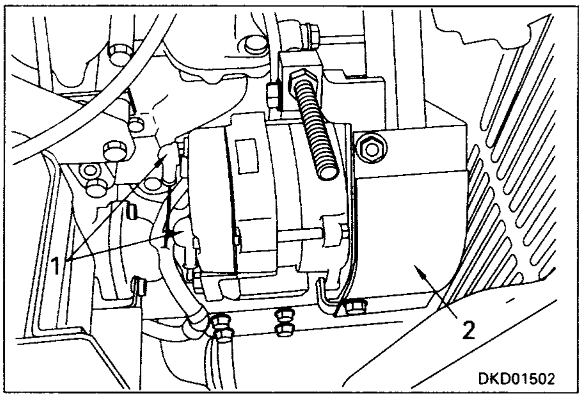
★ Adjust the tension of the alternator belt. For details, see TESTING AND ADJUSTING.

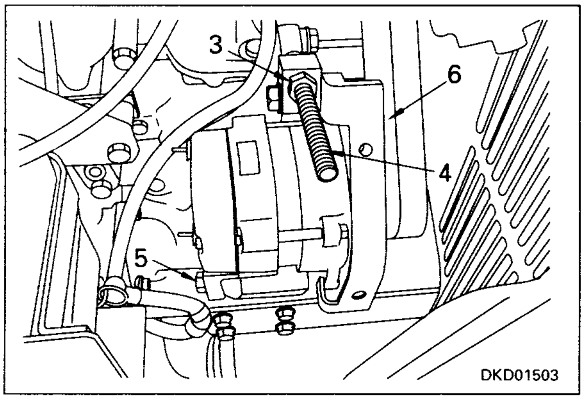
REMOVAL OF ALTERNATOR ASSEMBLY

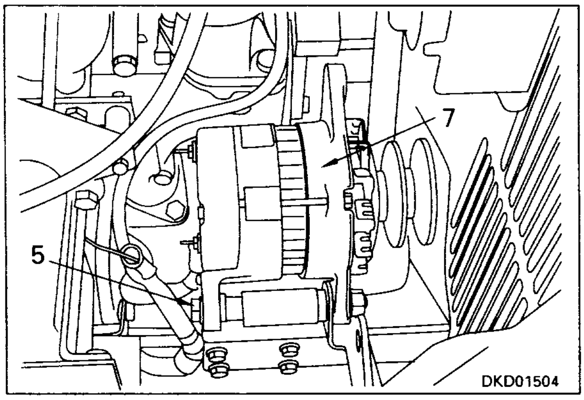
D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Open top right side cover and remove bottom side cover.
   - On machines with cab specification, the washer tank is installed inside the bottom right side cover, so disconnect the hose and connector, then remove the bottom side cover.
2. Disconnect wiring (1).
3. Remove cover (2).
4. Remove locknut (3), then remove rod (4).
5. Loosen mounting bolt and nut (5), and remove 2 fan belts (6). ※ 1
6. Remove mounting bolt and nut, then remove alternator assembly (7).







INSTALLATION OF ALTERNATOR ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

- Carry out installation in the reverse order to removal.

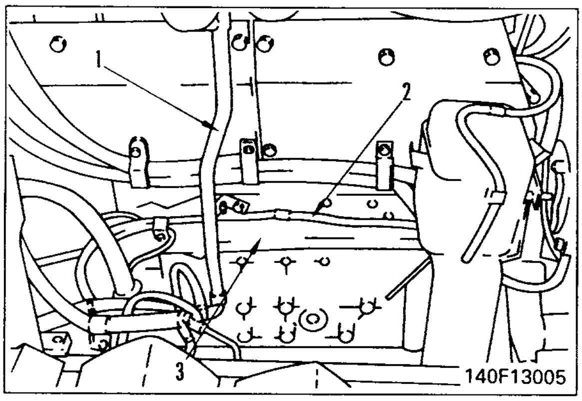
※ 1

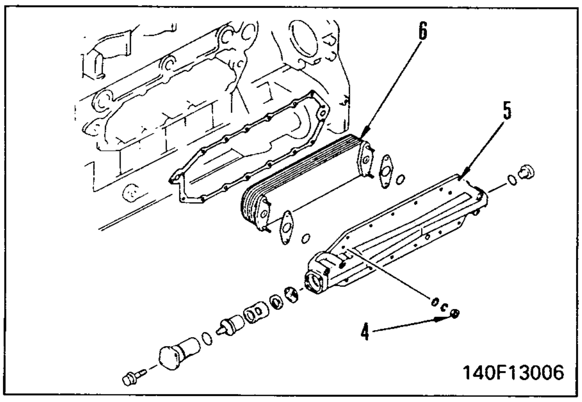
Adjusting tension of alternator belt

★ Adjust the tension of the alternator belt. For details, see TESTING AND ADJUSTING.

REMOVAL OF ENGINE OIL COOLER CORE

1. Drain cooling water.
2. Open top right side cover and remove bottom side cover.
   ★ On machines with the cab specification, the washer tank is installed inside the bottom right side cover, so disconnect the hose and connector, then remove the bottom side cover.
3. Remove turbocharger outlet tube (1). (Only for machines equipped with turbocharger)
4. Disconnect 3 clamps of wiring (2).
5. Remove oil cooler assembly (3).
6. Remove nut (4), then remove cooler core (6) from cover (5). ※1





INSTALLATION OF ENGINE OIL COOLER CORE

- Carry out installation in the reverse order to removal.

※1

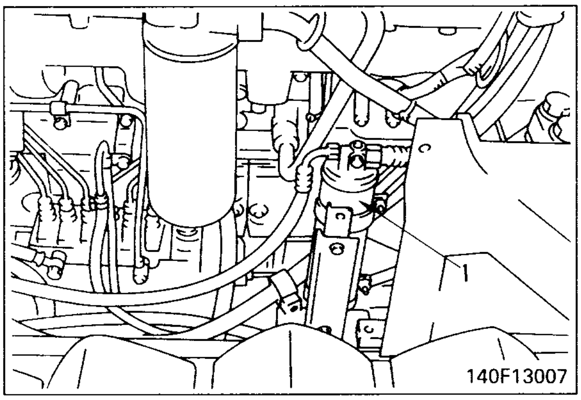
Cooler core mounting nut:
43.1 ± 15.7 Nm (4.4 ± 1.6 kgm)

- **Refilling with water**
  ★ Add water through water filler to the specified level.
  Run the engine to circulate the water through the system. Then check the water level again.

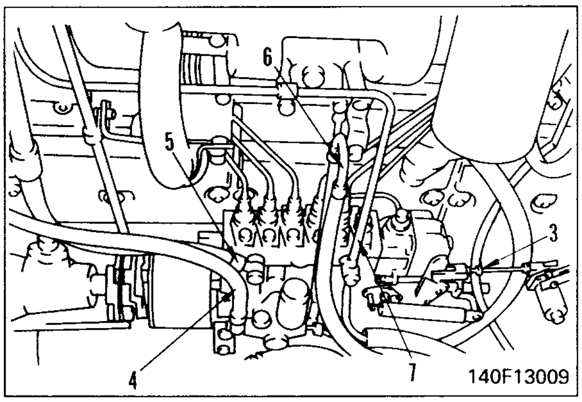
REMOVAL OF FUEL INJECTION PUMP ASSEMBLY

★ Close the fuel supply valve.

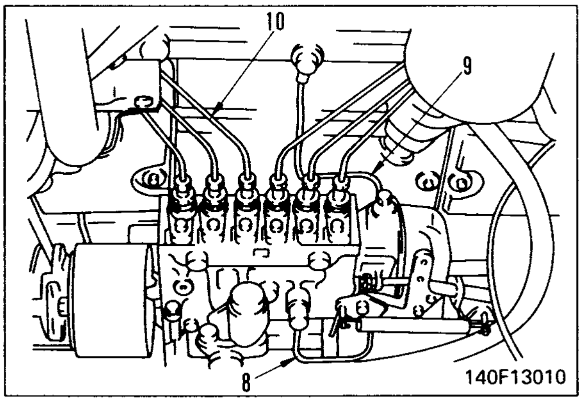
1. Open top left side cover and remove bottom side cover.
2. Move air conditioner receiver tank (1) together with bracket and move towards top. (Cab specification machine only)
   ★ Do not disconnect the air conditioner hose.



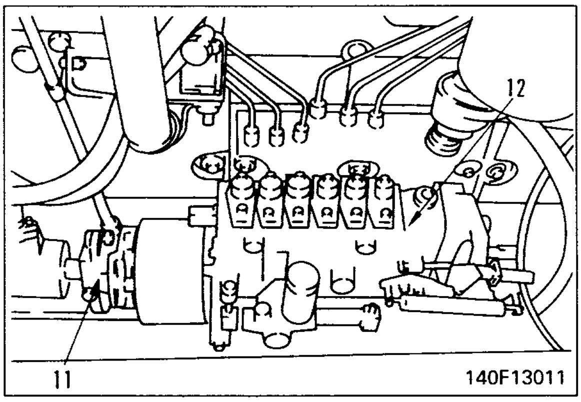
3. Disconnect fuel control rod (3). ※1
4. Disconnect fuel hoses (4) and (5). ※2
5. Disconnect fuel supply tube (6) and fuel return tube (7). ※3
   ★ Mark the position of the tube clamp.
   ★ If the fuel tank is full, fuel will flow out when tube (7) is disconnected, so after disconnecting it, bend the hose and tie it with string.



6. Remove lubrication tubes (8) and (9). ※4
7. Disconnect 6 fuel injection tubes (10). ※5



8. Remove 2 lock bolts (11) of laminated coupling and cross coupling. ※6
   ★ Before removing the bolt, mark the mounting position of the laminated coupling and cross coupling.
9. Remove fuel injection assembly (12). ※7



INSTALLATION OF FUEL INJECTION PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

★ Connect the rod.
For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

※2, ※3

kgm Hose, tube mounting joint bolt:
17.2 ± 2.5 Nm
(1.75 ± 0.25 kgm)

※4

kgm Tube mounting joint bolt
(large): **29.4 ± 4.9 Nm**
(3.0 ± 0.5 kgm)
(small): **(22.1 ± 2.5 Nm)**
(2.25 ± 0.25 kgm)

※5

kgm Injection tube sleeve nut:
23.5 ± 1.0 Nm
(2.4 ± 0.1 kgm)

※6

kgm Laminated coupling mounting bolt:
61.2 ± 2.5 Nm
(6.25 ± 0.25 kgm)

※7

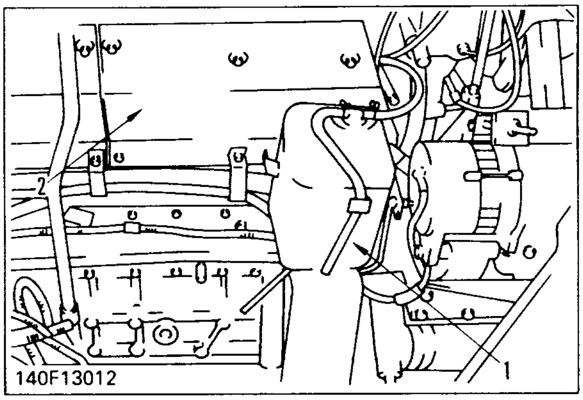
★ Install the fuel injection pump.
For details, see TESTING AND ADJUSTING, Testing and adjusting of fuel injection timing.

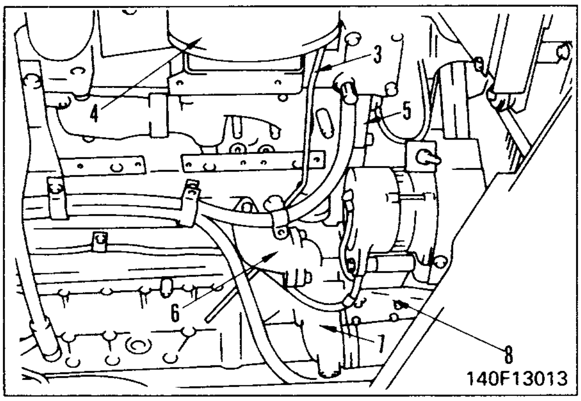
kgm Fuel injection pump mounting bolt:
29.4 ± 4.9 Nm
(3.0 ± 0.5 kgm)

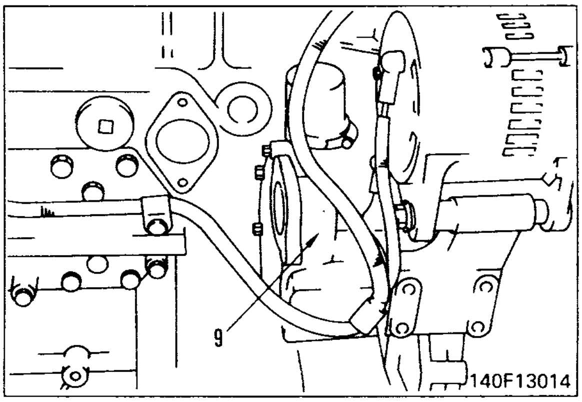
REMOVAL OF WATER PUMP ASSEMBLY

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

1. Drain cooling water.
2. Open top right side cover and remove bottom side cover.
   - On machines with the cab specification, the washer tank is installed inside the bottom right side cover, so disconnect the hose and connector, then remove the bottom side cover.
3. Disconnect hose, and remove reserve tank (1) together with bracket.
4. Remove safety cover (2).
5. Remove muffler drain pipe (3).
   ★ When removing the muffler drain pipe, loosen the mounting bolt of muffler (4), then lift up to remove.
6. Remove connectors (5) and (6).
7. Disconnect connector (7).
8. Remove bracket (8).
9. Remove water pump assembly (9). ※1







INSTALLATION OF WATER PUMP ASSEMBLY

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

- Carry out installation in the reverse order to removal.

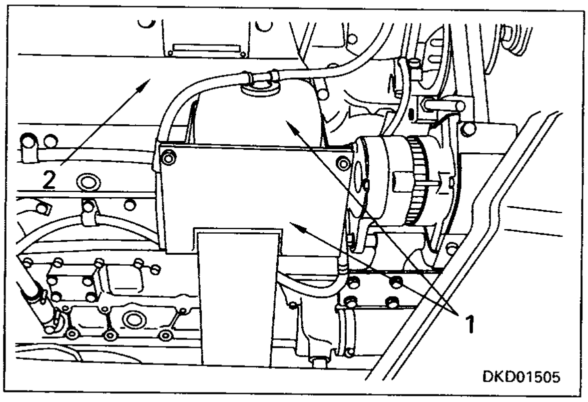
※1

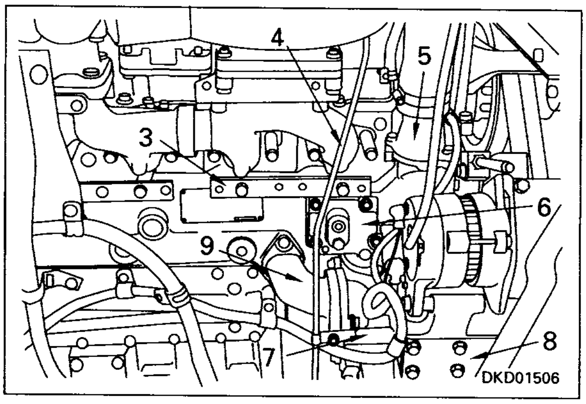
kgm Water pump mounting bolt:
66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

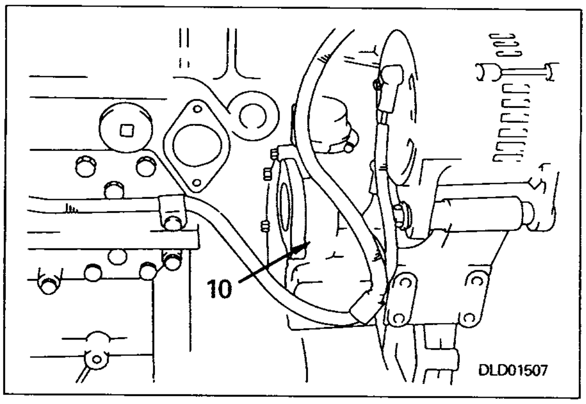
- **Refilling with water**
  ★ Add water through water filler to the specified level.
  Run the engine to circulate the water through the system. Then check the water level again.

REMOVAL OF WATER PUMP ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up







1. Drain cooling water.
2. Open top right side cover and remove bottom side cover.
   - On machines with the cab specification, the washer tank is installed inside the bottom right side cover, so disconnect the hose and connector, then remove the bottom side cover.
3. Disconnect hose, and remove reserve tank (1) together with bracket.
4. Remove safety cover (2).
5. Remove bracket (3).
6. Remove muffler drain pipe (4).
7. Disconnect water pump outlet connector (5).
8. Remove thermostat housing (6).
9. Disconnect water pump inlet connector (7).
10. Remove bracket (8).
11. Remove connector (9).
12. Remove water pump assembly (10). ※1

INSTALLATION OF WATER PUMP ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

- Carry out installation in the reverse order to removal.

※1

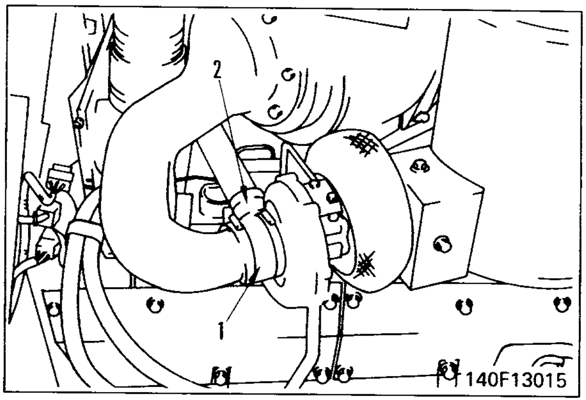
kgm Water pump mounting bolt:
66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

- **Refilling with water**
  ★ Add water through water filler to the specified level.
  Run the engine to circulate the water through the system. Then check the water level again.

REMOVAL OF TURBOCHARGER ASSEMBLY

1. Open top right side cover and remove bottom side cover.
   - On machines with the cab specification, the washer tank is installed inside the bottom right side cover, so disconnect the hose and connector, then remove the bottom side cover.

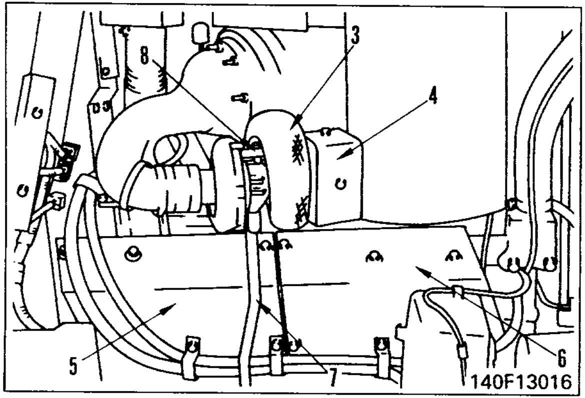
2. Disconnect hoses (1) and (2).



3. Remove safety covers (3), (4), (5) and (6).

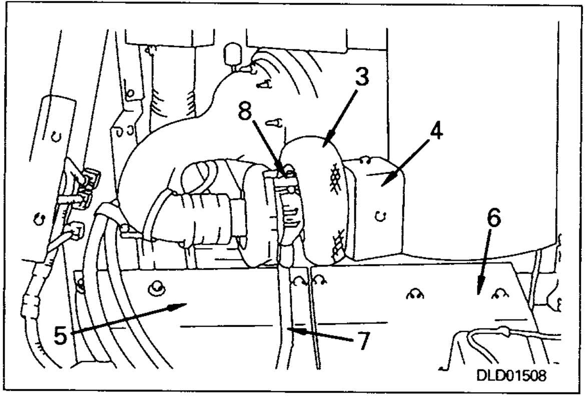
4. Disconnect turbocharger inlet tube (7) and outlet tube (8).

D65E-12 60001 - 60947 **D65EX-12 60001 - 60941**
D65P-12 60001 - 60890 **D65PX-12 60001 - 60914**



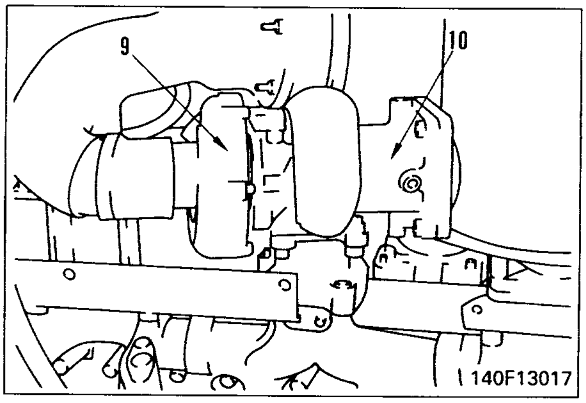
5. Remove turbocharger assembly (9) toghther with connector (10).

D65E-12 60948 and up **D65EX-12 60942 and up**
D65P-12 60891 and up **D65PX-12 60915 and up**



INSTALLATION OF TURBOCHARGER ASSEMBLY

- Carry out installation in the reverse order to removal.



014012

REMOVAL OF NOZZLE HOLDER ASSEMBLY

D65P, EX, PX

1. Remove left and right engine side covers, then remove hood (1). ※ 1

   ⚠ When disconnecting the connecting pin of the damper and side cover, use a lever block to support the rod portion of the damper, then remove the pin, taking care not to let it fly out.

   kg Engine side cover (each): **25 kg**

   kg Hood: **55 kg**

2. Remove air cleaner assembly (2). (No. 3 and 4 only)
3. Remove intake connector (3). (No. 5 and 6 only)
4. Remove spill pipe (4). ※ 2
5. Disconnect fuel injection pipe (5) of nozzle holder to be removed. ※ 3
6. Remove nozzle holder assembly (6). ※ 4
   ★ Be careful not to let any dirt or dust enter the nozzle holder assembly mount.

INSTALLATION OF NOZZLE HOLDER ASSEMBLY

D65P, EX, PX

- Carry out installation in the reverse order to removal.

※ 1

kgm Hood mounting bolt:
276.9 ± 31.9 Nm (28.25 ± 3.25 kgm)

※ 2

kgm Spill pipe mounting joint bolt:
24.5 ± 4.9 Nm (2.5 ± 0.5 kgm)

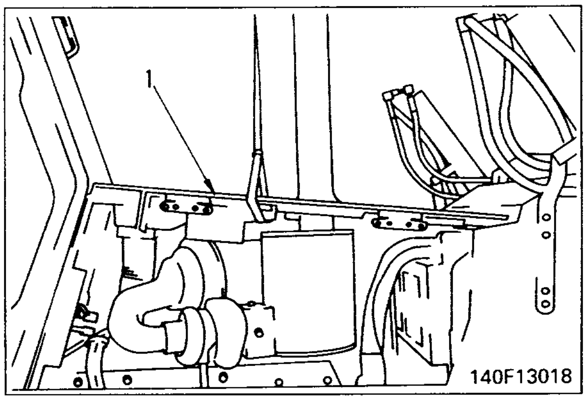
※ 3

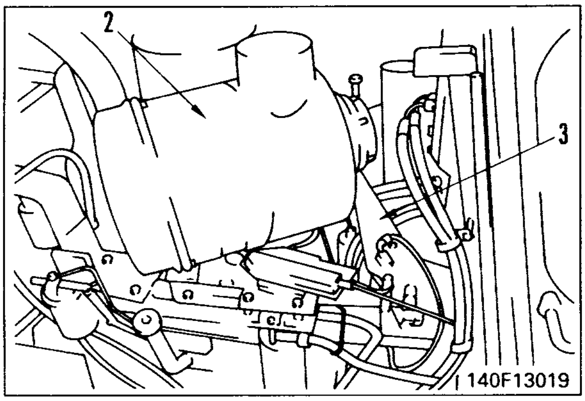
kgm Fuel injection mounting sleeve nut:
23.5 ± 1.0 Nm (2.4 ± 0.1 kgm)

※ 4

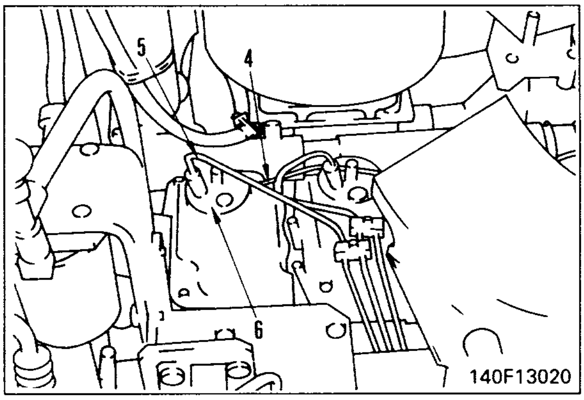
★ Tighten the mounting bolts of the nozzle holder uniformly in turn.

kgm Nozzle holder assembly mounting bolt: **21.6 ± 2.9 Nm (2.2 ± 0.3 kgm)**

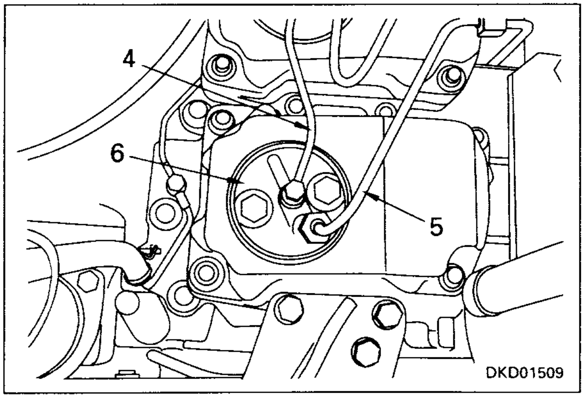




D65P-12 60001 - 60890 **D65EX-12 60001 - 60941**
D65PX-12 60001 - 60914



D65P-12 60891 and up **D65EX-12 60942 and up**
D65PX-12 60915 and up

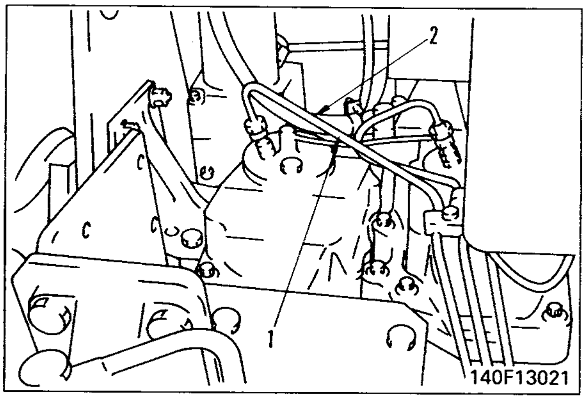


REMOVAL OF NOZZLE HOLDER ASSEMBLY

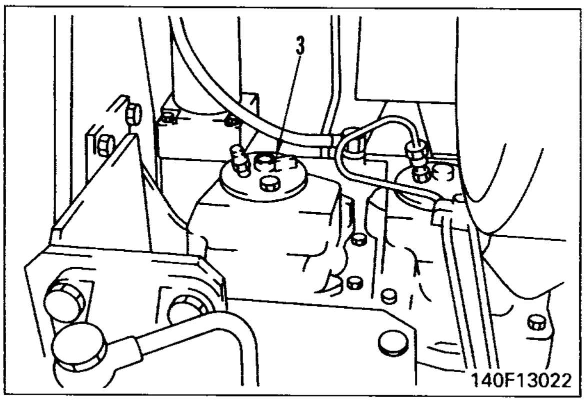
D65E

1. Remove left and right engine side covers.
2. Remove spill pipe (1). ※ 1
3. Disconnect fuel injection pipe (2) of nozzle holder to be removed. ※ 2
4. Remove nozzle holder assembly (3). ※ 3
   ★ Be careful not to let any dirt or dust enter the nozzle holder assembly mount.

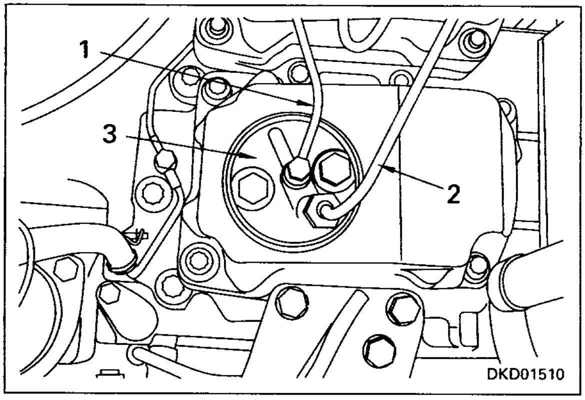
D65E-12 60001 - 60947



D65E-12 60001 - 60947



D65E-12 60948 and up



INSTALLATION OF NOZZLE HOLDER ASSEMBLY

D65E

- Carry out installation in the reverse order to removal.

※ 1

kgm Spill pipe mounting joint bolt:
24.5 ± 4.9 Nm (2.5 ± 0.5 kgm)

※ 2

kgm Fuel injection mounting sleeve nut:
23.5 ± 1.0 Nm (2.4 ± 0.1 kgm)

※ 3

★ Tighten the mounting bolts of the nozzle holder uniformly in turn.

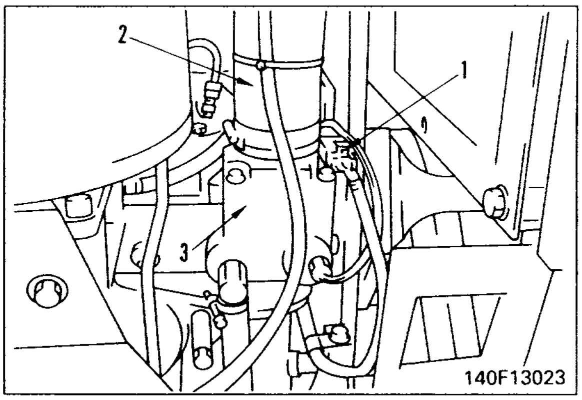
kgm Nozzle holder assembly mounting bolt:
21.6 ± 2.9 Nm (2.2 ± 0.3 kgm)

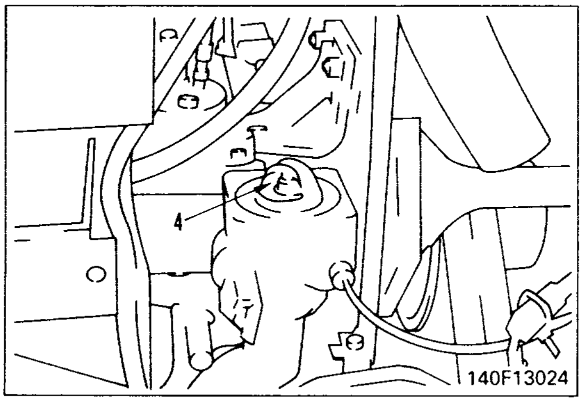
014012

REMOVAL OF THERMOSTAT ASSEMBLY

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

1. Drain cooling water.
2. Open top right side cover.
3. Remove water temperature sensor connector (1) from clip.
4. Disconnect radiator inlet hose (2).
5. Remove cover (3).
6. Remove thermostat assembly (4).





014012

INSTALLATION OF THERMOSTAT ASSEMBLY

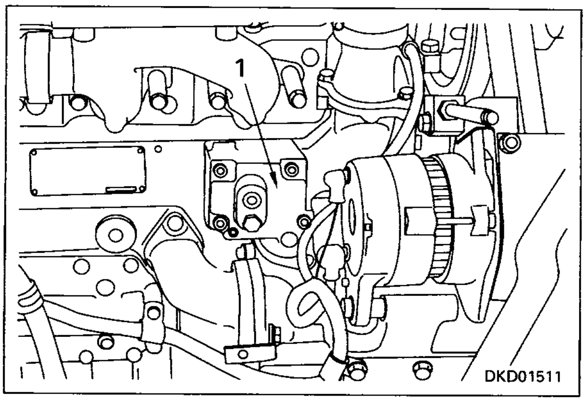
D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

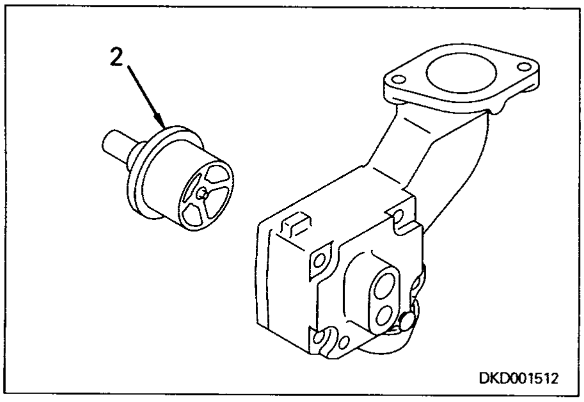
- Carry out installation in the reverse order to removal.
- **Refilling with water**
  ★ Add water through water filler to the specified level.
  Run the engine to circulate the water through the system. Then check the water level again.

REMOVAL OF THERMOSTAT ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

1. Remove thermostat housing (1).
   For details, see REMOVAL OF WATER PUMP ASSEMBLY.
2. Remove thermostat (2) from housing.





014012

INSTALLATION OF THERMOSTAT ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

- Carry out installation in the reverse order to removal.
- **Refilling with water**
  ★ Add water through water filler to the specified level.
  Run the engine to circulate the water through the system. Then check the water level again.

REMOVAL OF CYLINDER HEAD ASSEMBLY

D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

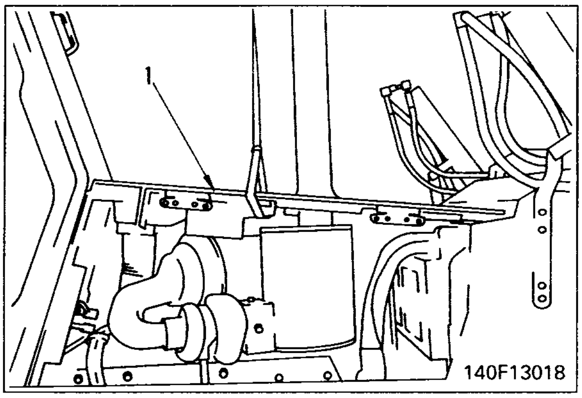
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Drain cooling water.
2. Remove left and right engine side covers, then remove hood (1).

   ⚠ When disconnecting the connecting pin of the damper and side cover, use a lever block to support the rod portion of the damper, then remove the pin, taking care not to let it fly out.

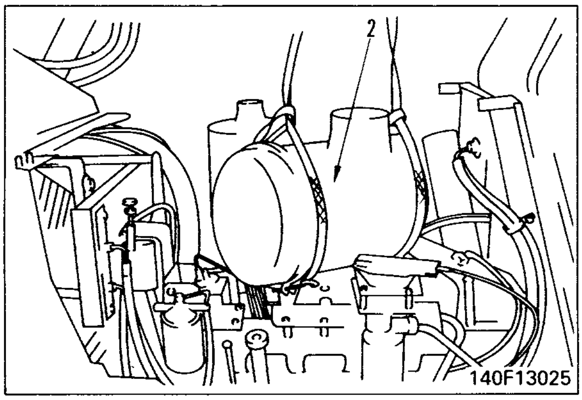
   kg Engine side cover (each): **25 kg**

   kg Hood: **55 kg**

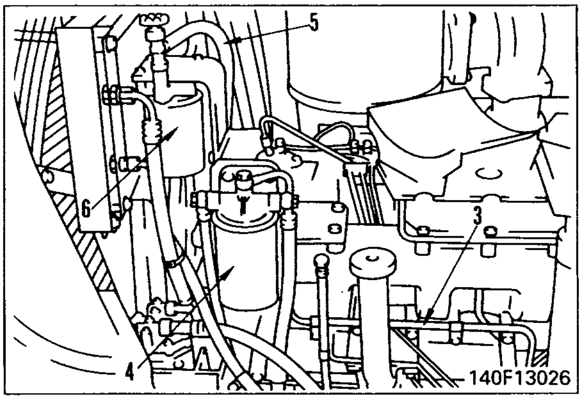


3. Remove bottom left and right engine side covers.
   - On machines with the cab specification, the washer tank is installed inside the bottom right side cover, so disconnect the hose and connector, then remove the bottom side cover.
4. Remove band, then remove air cleaner assembly (2) together with connector.

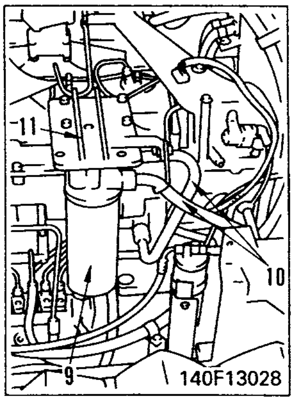
   kg Air cleaner assembly: **30 kg**



5. Disconnect fuel return tube (3), and remove fuel filter assembly (4), then move it towards track shoe. ※1
   ★ If the fuel tank is full, fuel will flow out when tube (3) is disconnected, so after disconnecting it, bend the hose and tie it with string.
6. Disconnect hose (5), and remove corrosion resistor (6) together with bracket.

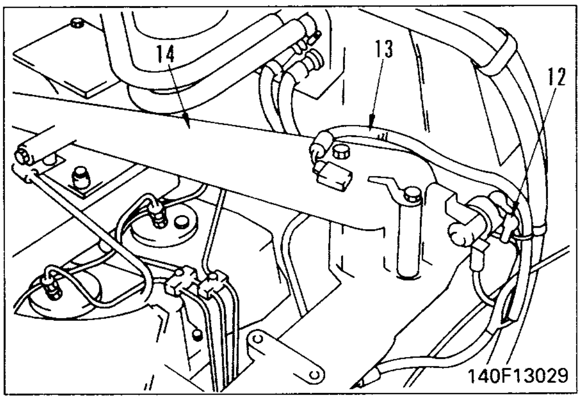


7. Remove engine oil filter (9) together with pipe (10) and bracket (11).



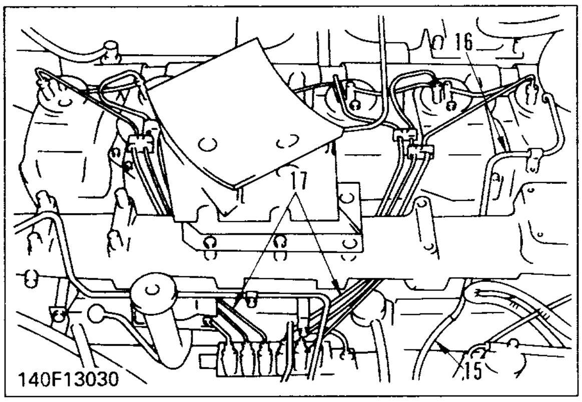
8. Disconnect electrical intake air heater wiring (12).

9. Remove wiring (13), then remove connector (14).



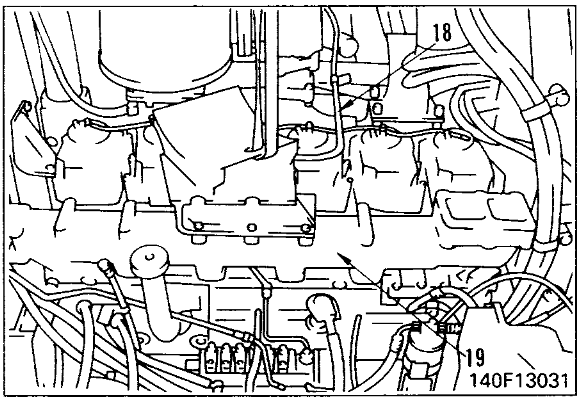
10. Disconnect hose (15), then remove fuel return tube (16).

11. Remove 6 fuel injection pipes (17). ※2



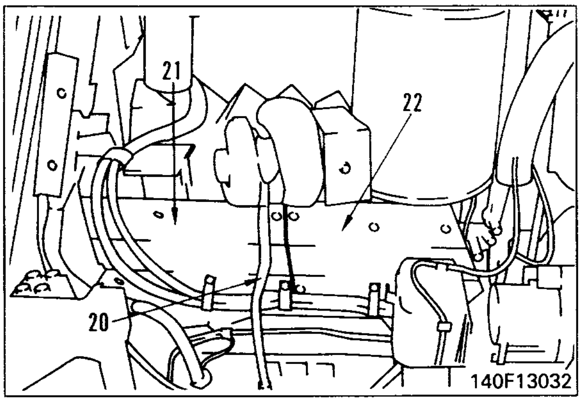
12. Disconnect turbocharger inlet tube (18).

13. Sling intake manifold (19), and remove mounting bolts, then remove together with tube (18).
    ★ Mark the mounting position of each spacer and tube clamp before removing.

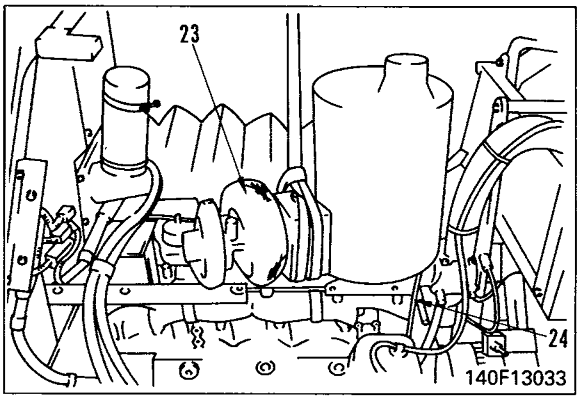


14. Remove turbocharger outlet tube (20).

15. Remove safety covers (21) and (22).



16. Sling muffler and exhaust manifold assembly (23), and remove mounting bolts, then remove. ※3
Remove muffler drain pipe (24).

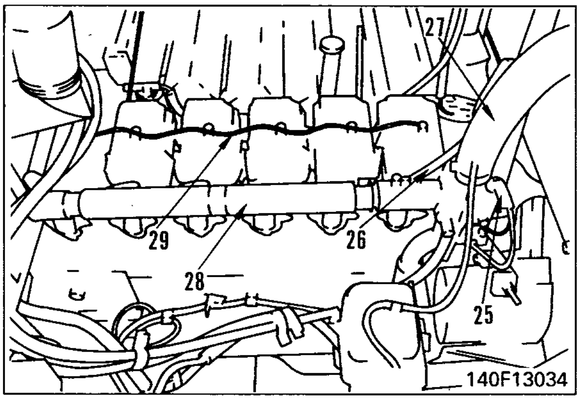


17. Disconnect wiring connector (25) of water temperature sensor from clip.

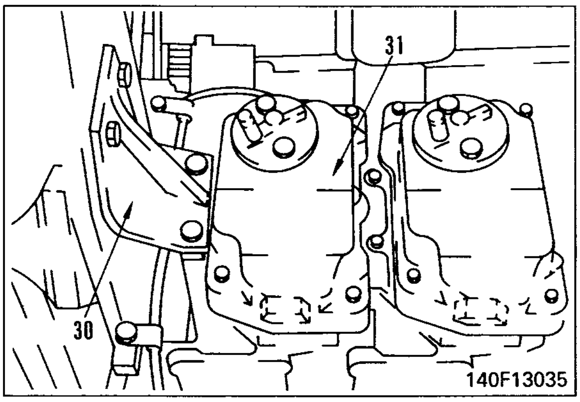
18. Disconnect aeration hose (26) and radiator inlet hose (27).

19. Remove water manifold assembly (28).

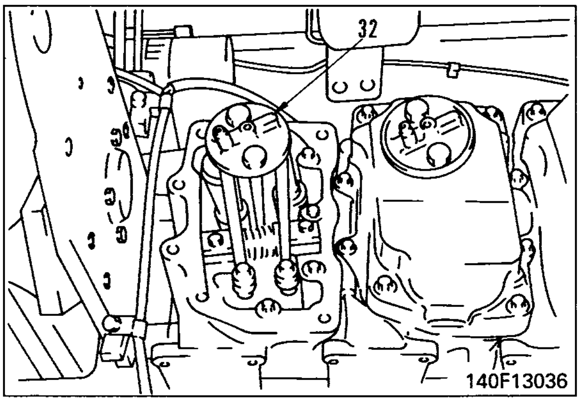
20. Remove spill pipe (29). ※4



21. Remove bracket (30), then remove cylinder head cover (31). ※5
   - Remove bracket (30) only for No. 1 cylinder head.



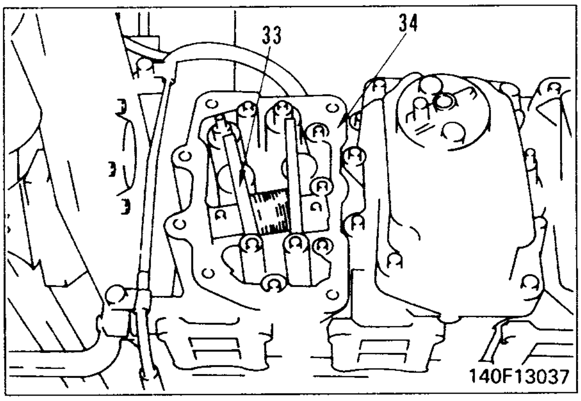
22. Remove nozzle holder assembly (32). ※6



23. Remove rocker arm assembly (33). ※ 7

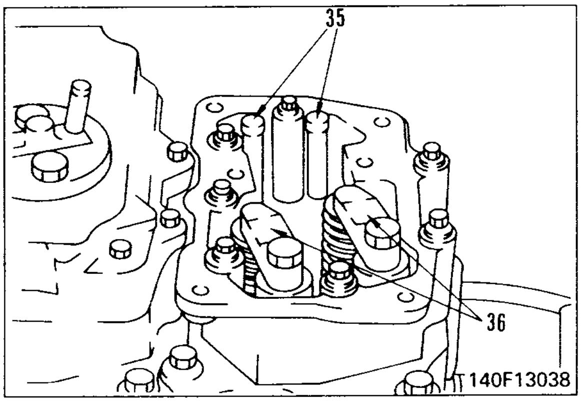
★ Loosen the locknut and turn the adjustment screw back 2 – 3 turns.

24. Remove rocker arm housing (34). ※ 8



25. Remove push rod (35).

26. Remove crosshead (36). ※ 9



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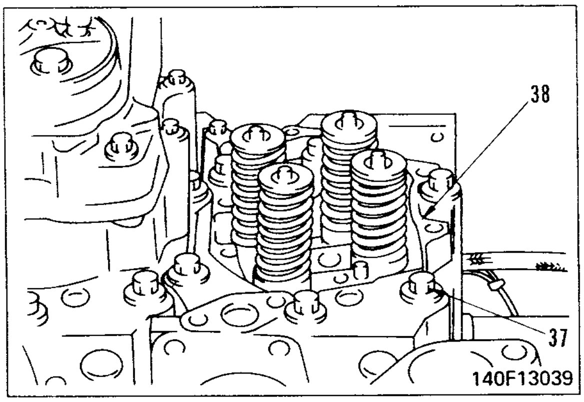
27. Remove head bolt (37), then remove cylinder head (38). ※ 10



INSTALLATION OF CYLINDER HEAD ASSEMBLY

D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

- Carry out installation in the reverse order to removal.

※ 1

kgm Fuel return tube mounting joint bolt:
29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)

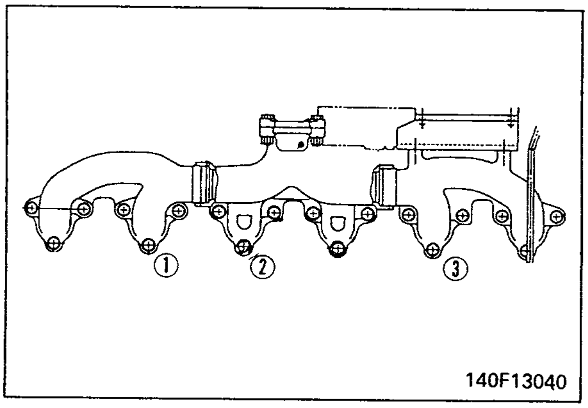
※ 2

kgm Fuel injection pipe mounting sleeve nut:
29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)

※ 3

★ Screw in the manifold mounting bolts 2 – 3 threads by hand, tighten bolts: ① – ③, and after that tighten the other bolts.

kgm Manifold mounting bolt:
66.2 ± 7.4 Nm (6.8 ± 0.8 kgm)



※ 4

kgm Spill pipe mounting joint bolt:
24.5 ± 4.9 Nm (2.5 ± 0.5 kgm)

※ 5

kgm Head cover mounting bolt:
9.8 ± 1.0 Nm (1.0 ± 0.1 kgm)

※ 6

★ Tighten the mounting bolts of the nozzle holder uniformly in turn.

kgm Nozzle holder mounting bolt:
21.6 ± 2.9 Nm (2.2 ± 0.3 kgm)

※ 7

★ Check that the ball of the adjustment screw is fitted properly into the socket of the push rod.

★ Adjust the valve clearance.
For details, see TESTING AND ADJUSTING, Adjusting valve clearance.

kgm Rocker arm assembly mounting bolt:
66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

kgm Lock nut: **66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)**

※ 8

kgm Rocker arm housing mounting bolt: **66.2 ± 7.4 Nm**
(6.75 ± 0.75 kgm)

※ 9

★ Adjust the crosshead as follows.
i) Loosen locknut, then turn adjustment screw back.
ii) Press down lightly on top of crosshead, then tighten adjustment screw.
iii) When adjustment screw contacts valve stem, tighten a further 20°.
iv) Tighten locknut to hold in position.

kgm Locknut: **66.2 ± 7.4 Nm**
(6.75 ± 0.75 kgm)

※ 10

- ★ If any rust is found that exceeds an area of 5 mm square on the shaft or thread of the bolt, replace the head bolts with new parts.
- ★ Check that there is no dirt or dust on the cylinder head mounting surface or inside the cylinder.
- ★ When installing the gasket, check that the grommet has not come out of position.
- ★ Coat the bolt thread, seat surface, and seat surface of the cylinder head hole with molybdenum disulphide (LM-P).
- ★ Screw in the cylinder head mounting bolts 2 - 3 turns by hand, then tighten in the order shown in the diagram.

Mounting bolt:

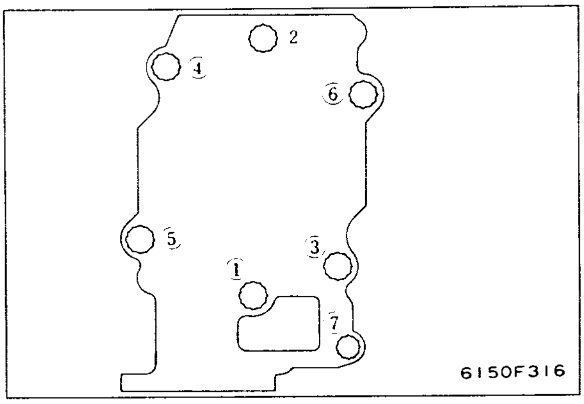
Anti-friction compound (LM-P)

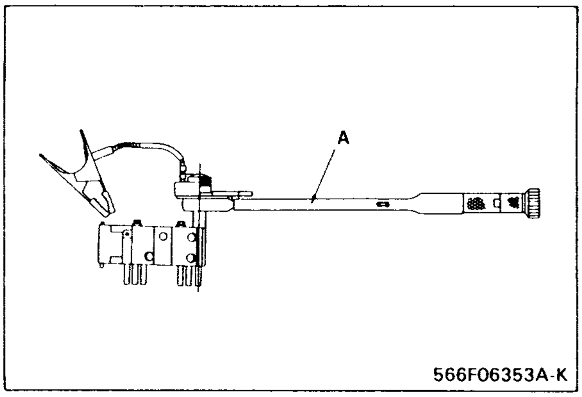
kgm Cylinder head mounting bolt:

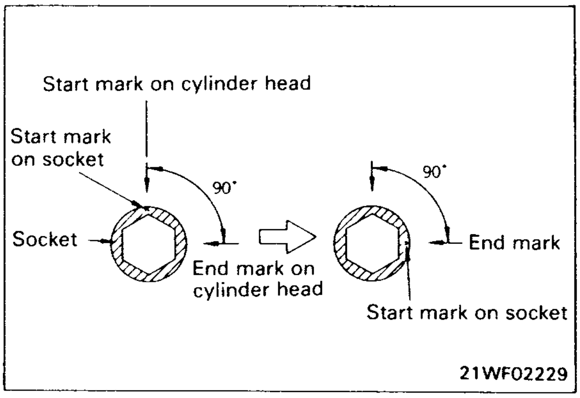
1st Step:	Tighten to 68.6 ± 9.8 Nm (7 ± 1 kgm)
2nd Step:	Tighten to 107.9 ± 4.9 Nm (11 ± 0.5 kgm)
3rd Step:	1. When using tool **A**: • Using an angle tightening wrench, tighten the bolt a further $90^{\circ}{}^{+30^{\circ}}_{0}$. 2. When not using tool **A**: 1) Using the angle of the bolt head as the base, make a start mark on the cylinder head and socket. 2) Make an end mark at a position $90^{\circ}{}^{+30^{\circ}}_{0}$ from the start mark. 3) Tighten so that the start mark on the socket is aligned with the end mark made at $90^{\circ}{}^{+30^{\circ}}_{0}$ on the cylinder head.

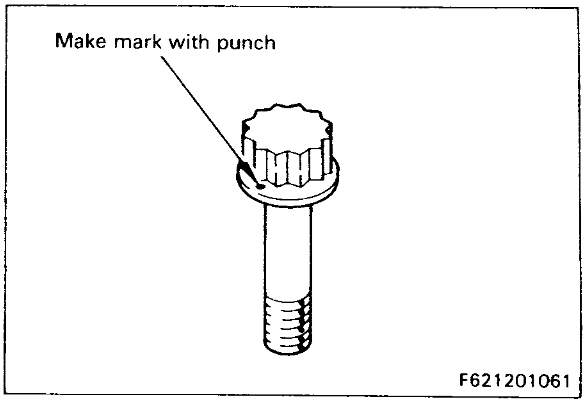
- ★ After tightening, make one punch mark on the bolt head to indicate the number of times that the bolt has been used.
  - If any bolt has five punch marks, do not reuse it. Replace it with a new bolt.

- **Refilling with water**
  - ★ Add water through water filler to the specified level.
    Run the engine to circulate the water through the system. Then check the water level again.







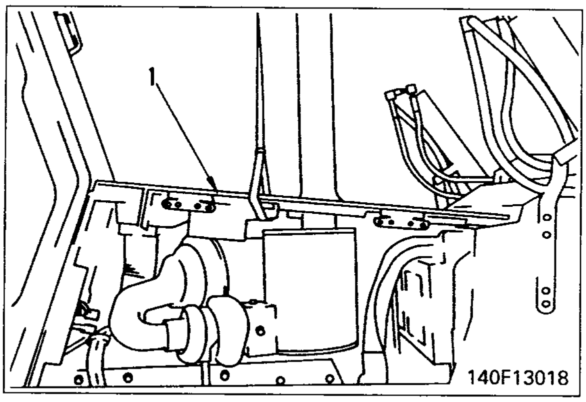


REMOVAL OF CYLINDER HEAD ASSEMBLY

D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Drain cooling water.

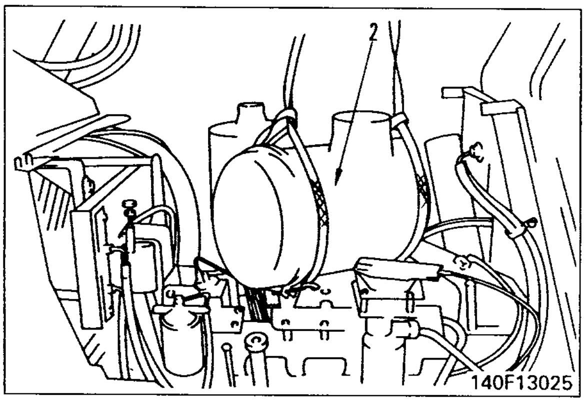


2. Remove left and right engine side covers, then remove hood (1).

   ⚠ When disconnecting the connecting pin of the damper and side cover, use a lever block to support the rod portion of the damper, then remove the pin, taking care not to let it fly out.

   kg Engine side cover (each): **25 kg**

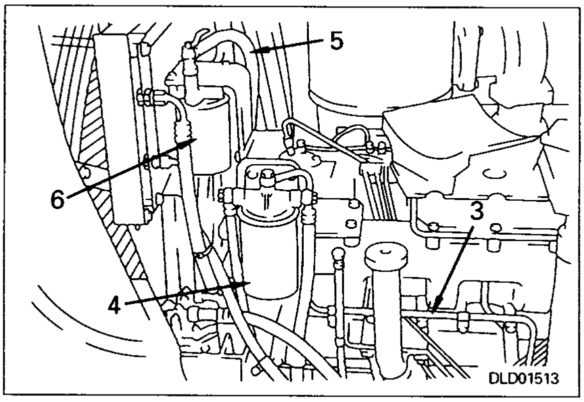
   kg Hood: **55 kg**



3. Remove bottom left and right engine side covers.
   - On machines with the cab specification, the washer tank is installed inside the bottom right side cover, so disconnect the hose and connector, then remove the bottom side cover.

4. Remove band, then remove air cleaner assembly (2) together with connector.

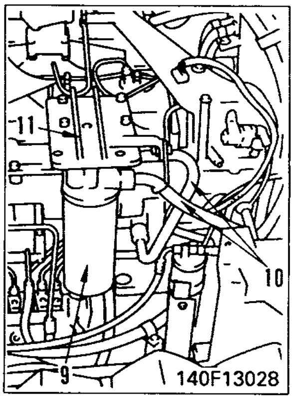
   kg Air cleaner assembly: **30 kg**



5. Disconnect fuel return tube (3), and remove fuel filter assembly (4), then move it towards track shoe. ※1
   ★ If the fuel tank is full, fuel will flow out when tube (3) is disconnected, so after disconnecting it, bend the hose and tie it with string.

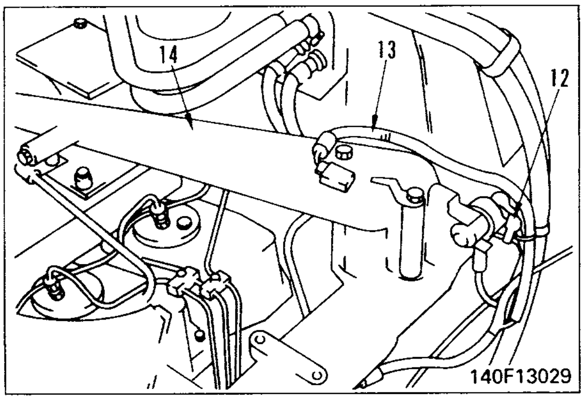
6. Disconnect hose (5), and remove corrosion resistor (6) together with bracket.

7. Remove engine oil filter (9) together with pipe (10) and bracket (11).



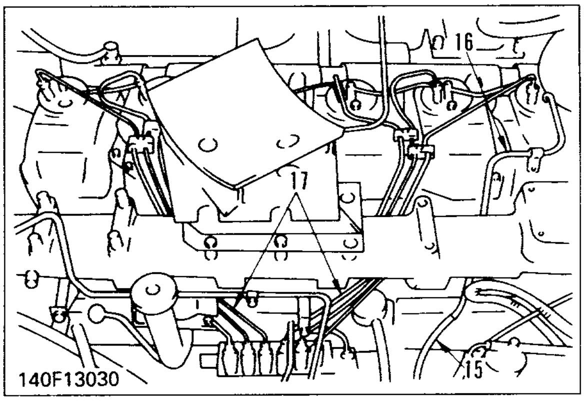
8. Disconnect electrical intake air heater wiring (12).

9. Remove wiring (13), then remove connector (14).



10. Disconnect hose (15), then remove fuel return tube (16).

11. Remove 6 fuel injection pipes (17). ※ 2



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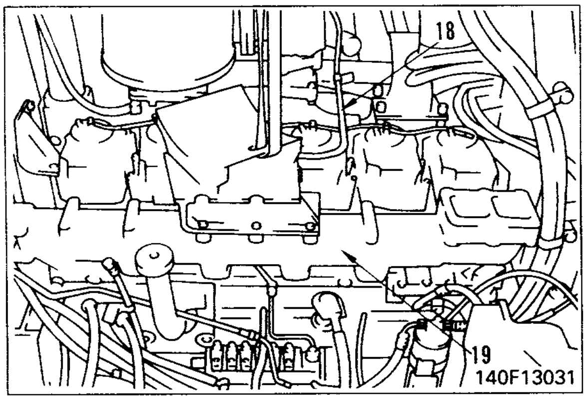
12. Disconnect turbocharger inlet tube (18).

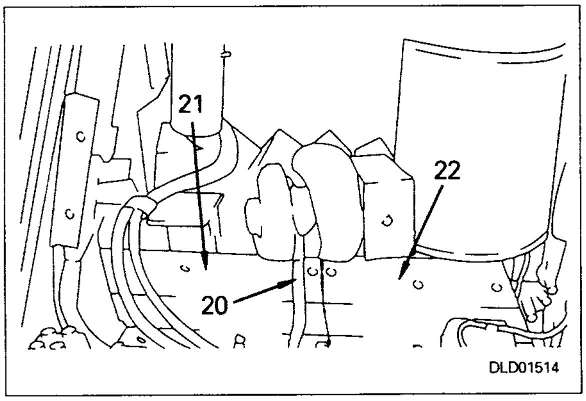
13. Sling intake manifold (19), and remove mounting bolts, then remove together with tube (18).

★ Mark the mounting position of each spacer and tube clamp before removing.

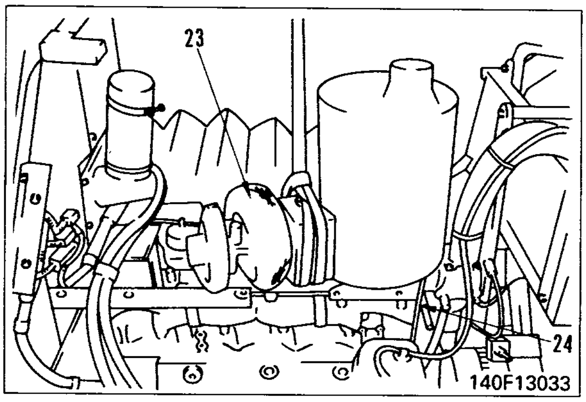


14. Remove turbocharger outlet tube (20).

15. Remove safety covers (21) and (22).

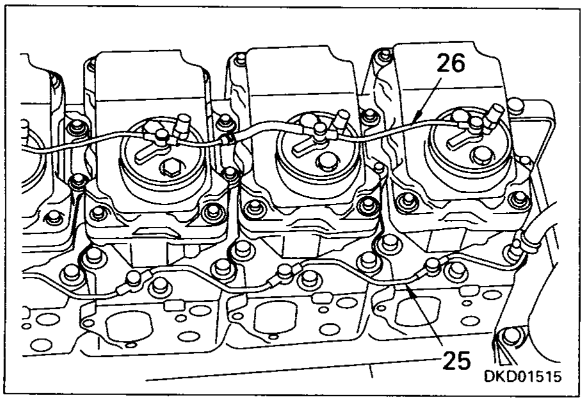


16. Sling muffler and exhaust manifold assembly (23), and remove mounting bolts, then remove. Remove muffler drain pipe (24). ※ 3



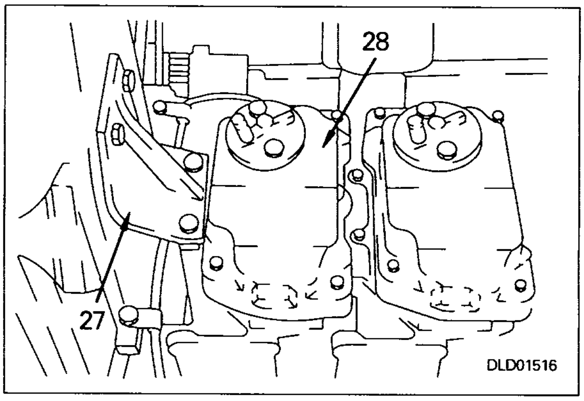
17. Remove aeration tube (25).

18. Remove spill pipe (26). ※ 4

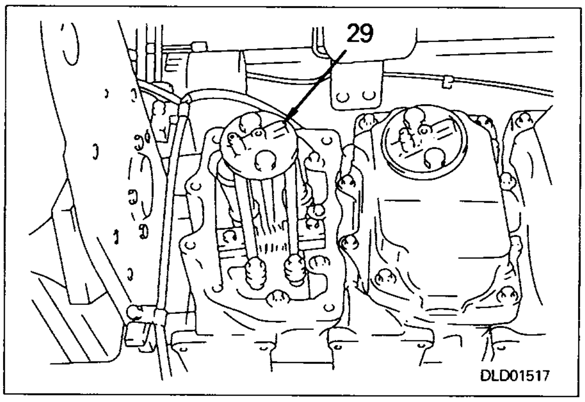


19. Remove bracket (27), then remove cylinder head cover (28). ※ 5

- Remove bracket (27) only for No. 1 cylinder head.



20. Remove nozzle holder assembly (29). ※ 6

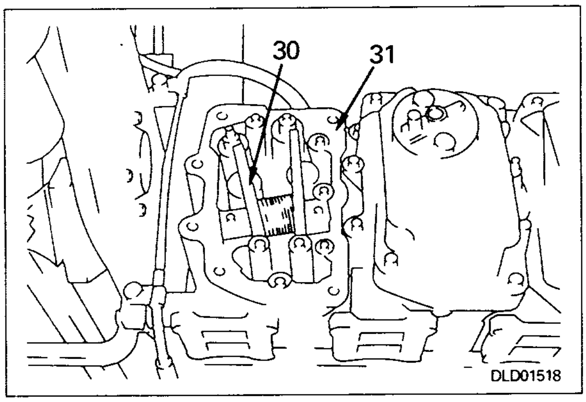


014012

21. Remove rocker arm assembly (30). ※ 7

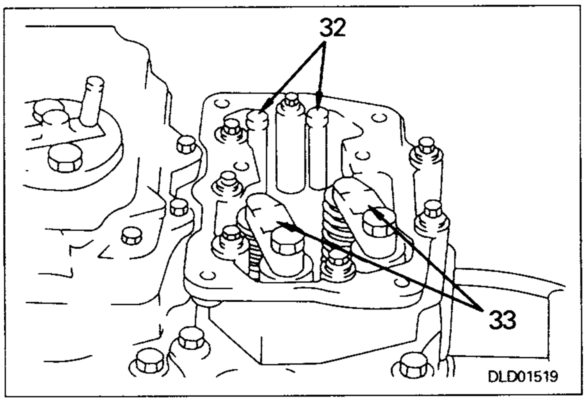
★ Loosen the locknut and turn the adjustment screw back 2 – 3 turns.

22. Remove rocker arm housing (31). ※ 8



23. Remove push rod (32).

24. Remove crosshead (33). ※ 9



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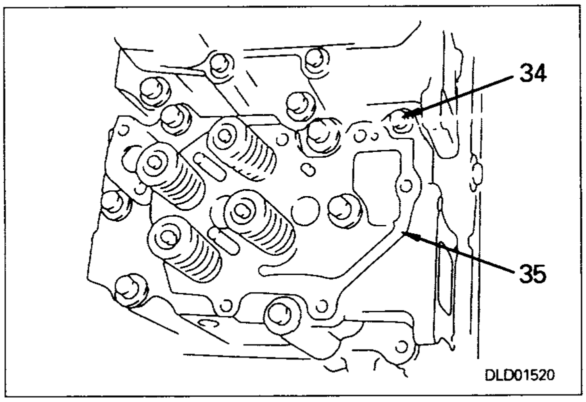
25. Remove head bolt (34), then remove cylinder head (35). ※ 10



INSTALLATION OF CYLINDER HEAD ASSEMBLY

D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

- Carry out installation in the reverse order to removal.

※ 1

kgm Fuel return tube mounting joint bolt:
29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)

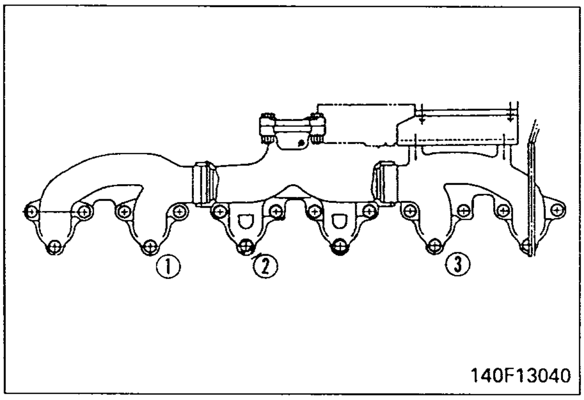
※ 2

kgm Fuel injection pipe mounting sleeve nut:
29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)

※ 3

★ Screw in the manifold mounting bolts 2 – 3 threads by hand, tighten bolts: ① – ③, and after that tighten the other bolts.

kgm Manifold mounting bolt:
66.2 ± 7.4 Nm (6.8 ± 0.8 kgm)



※ 4

kgm Spill pipe mounting joint bolt:
24.5 ± 4.9 Nm (2.5 ± 0.5 kgm)

※ 5

kgm Head cover mounting bolt:
9.8 ± 1.0 Nm (1.0 ± 0.1 kgm)

※ 6

★ Tighten the mounting bolts of the nozzle holder uniformly in turn.

kgm Nozzle holder mounting bolt:
21.6 ± 2.9 Nm (2.2 ± 0.3 kgm)

※ 7

★ Check that the ball of the adjustment screw is fitted properly into the socket of the push rod.

★ Adjust the valve clearance.
For details, see TESTING AND ADJUSTING, Adjusting valve clearance.

kgm Rocker arm assembly mounting bolt:
66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

kgm Lock nut: **66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)**

※ 8

kgm Rocker arm housing mounting bolt: **66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)**

※ 9

★ Adjust the crosshead as follows.
i) Loosen locknut, then turn adjustment screw back.
ii) Press down lightly on top of crosshead, then tighten adjustment screw.
iii) When adjustment screw contacts valve stem, tighten a further 20°.
iv) Tighten locknut to hold in position.

kgm Locknut: **66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)**

014012

※10

- ★ If any rust is found that exceeds an area of 5 mm square on the shaft or thread of the bolt, replace the head bolts with new parts.
- ★ Check that there is no dirt or dust on the cylinder head mounting surface or inside the cylinder.
- ★ When installing the gasket, check that the grommet has not come out of position.
- ★ Coat the bolt thread, seat surface, and seat surface of the cylinder head hole with molybdenum disulphide (LM-P).
- ★ Screw in the cylinder head mounting bolts 2 – 3 turns by hand, then tighten in the order shown in the diagram.

Mounting bolt:
Anti-friction compound (LM-P)

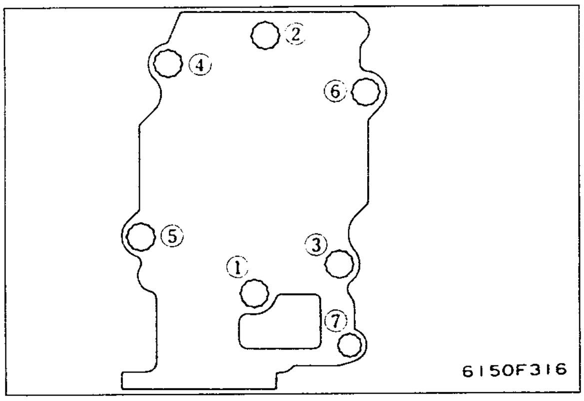
kgm Cylinder head mounting bolt:

1st Step: Tighten to 7 ± 1 kgm
2nd Step: Tighten to 11 ± 0.5 kgm
3rd Step: 1. When using tool **A**:
- Using an angle tightening wrench, tighten the bolt a further $90^{\circ}{}^{+30^{\circ}}_{0}$.

2. When not using tool **A**:
1) Using the angle of the bolt head as the base, make a start mark on the cylinder head and socket.
2) Make an end mark at a position $90^{\circ}{}^{+30^{\circ}}_{0}$ from the start mark.
3) Tighten so that the start mark on the socket is aligned with the end mark made at $90^{\circ}{}^{+30^{\circ}}_{0}$ on the cylinder head.

- ★ After tightening, make one punch mark on the bolt head to indicate the number of times that the bolt has been used.
  - If any bolt has five punch marks, do not reuse it. Replace it with a new bolt.

- **Refilling with water**
  - ★ Add water through water filler to the specified level.
    Run the engine to circulate the water through the system. Then check the water level again.



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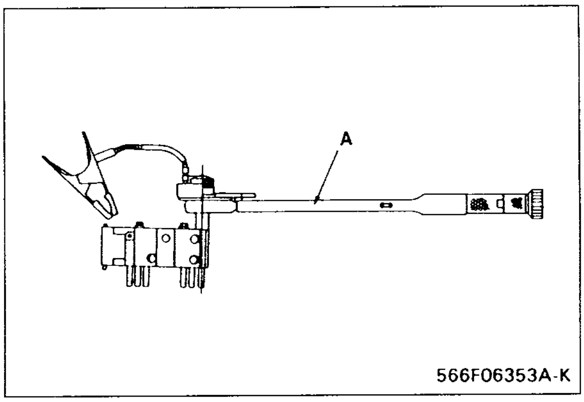

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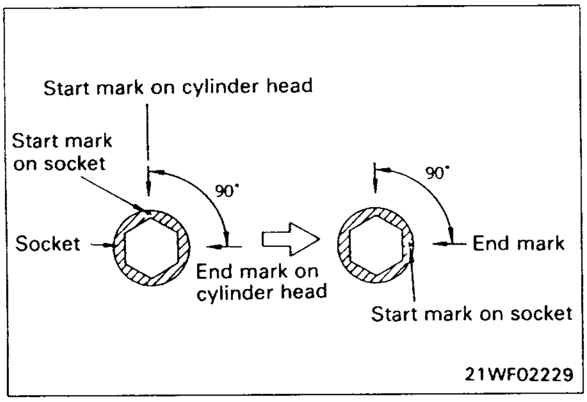

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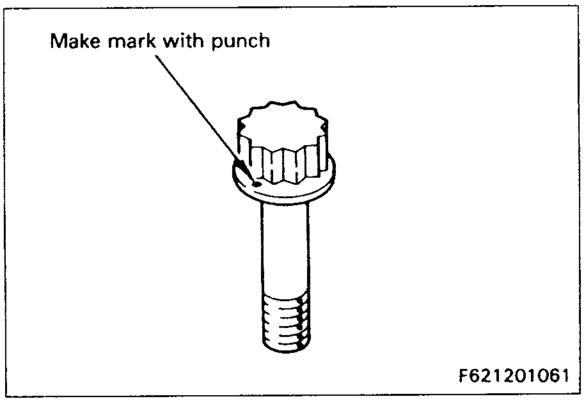

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REMOVAL OF CYLINDER HEAD ASSEMBLY

D65E-13 60001 - 60947

⚠ Disconnect the cable from the negative (–) terminal of the battery.

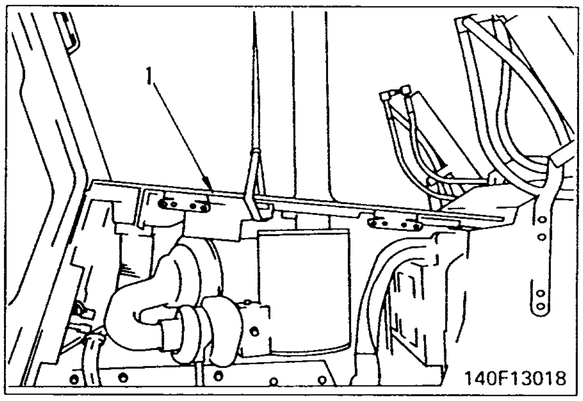
1. Drain cooling water.
2. Remove left and right engine side covers, then remove hood (1).

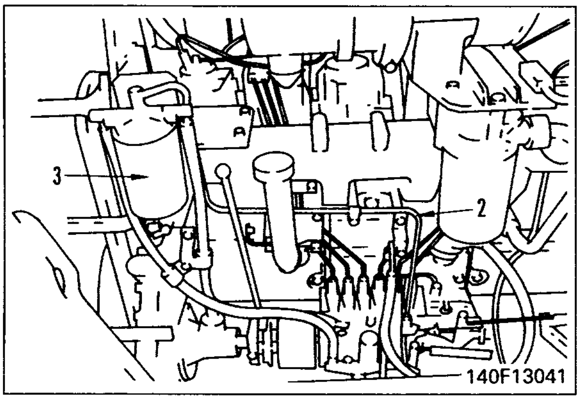
   ⚠ When disconnecting the connecting pin of the damper and side cover, use a lever block to support the rod portion of the damper, then remove the pin, taking care not to let it fly out.

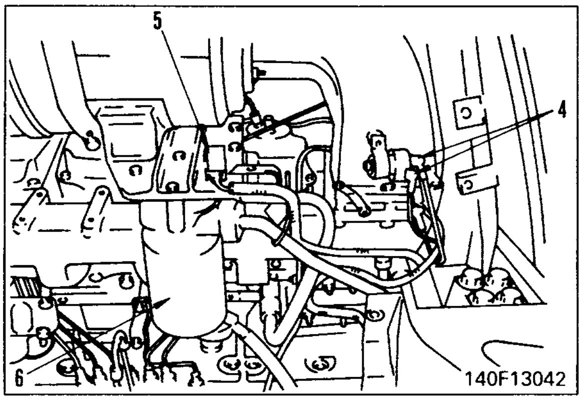
   kg Engine side cover (each): **25 kg**

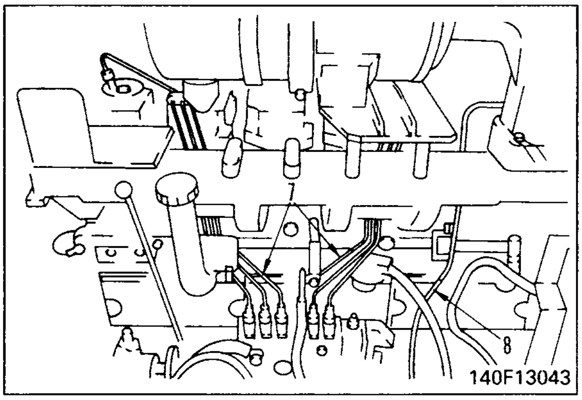
   kg Hood: **55 kg**

3. Remove bottom left and right engine side covers.
   - On machines with the cab specification, the washer tank is installed inside the bottom right side cover, so disconnect the hose and connector, then remove the bottom side cover.
4. Disconnect fuel return tube (2), and remove fuel filter assembly (3), then move it towards track shoe. ※ 1
   ★ If the fuel tank is full, fuel will flow out when tube (2) is disconnected, so after disconnecting it, bend the hose and tie it with string.
5. Disconnect electrical intake air heater wiring (4) and wiring connector (5).
6. Remove oil filter assembly (6) together with piping.
7. Remove 6 fuel injection pipes (7). ※ 2
8. Disconnect fuel return hose (8).









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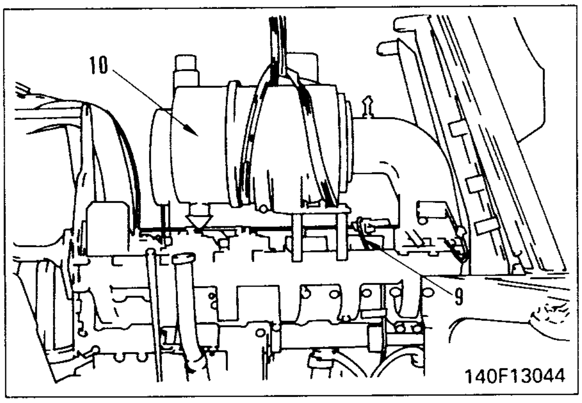
9. Disconnect tube (9).

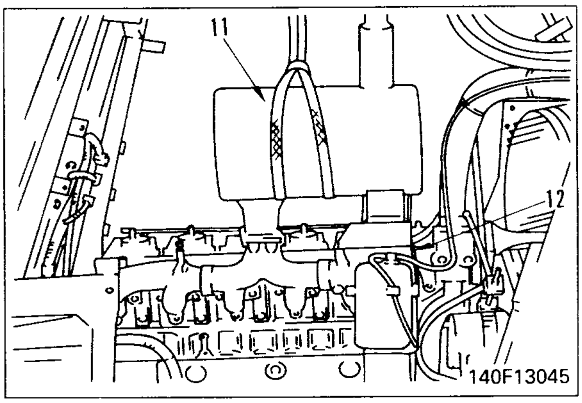
10. Sling air cleaner and intake manifold (10), and remove mounting bolts, then remove together with tube (9).
    ★ Mark the mounting position of each spacer and tube clamp before removing.



11. Remove safety covers.

12. Sling muffler and exhaust manifold assembly (11), and remove mounting bolts, then remove assembly. ※3

13. Remove muffler drain pipe (12).

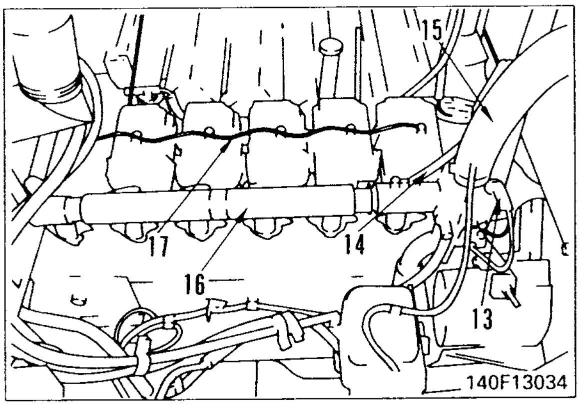


14. Disconnect wiring connector (13) of water temperature sensor from clip.

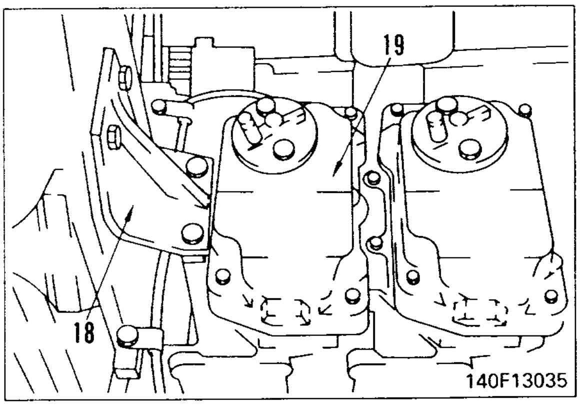
15. Disconnect aeration hose (14) and radiator inlet hose (15).

16. Remove water manifold assembly (16).

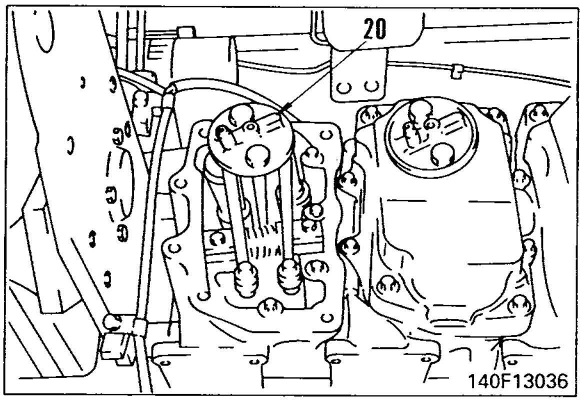
17. Remove spill pipe (17). ※4



18. Remove bracket (18), then remove cylinder head cover (19). ※5
    - Remove bracket (18) only for No. 1 cylinder head.

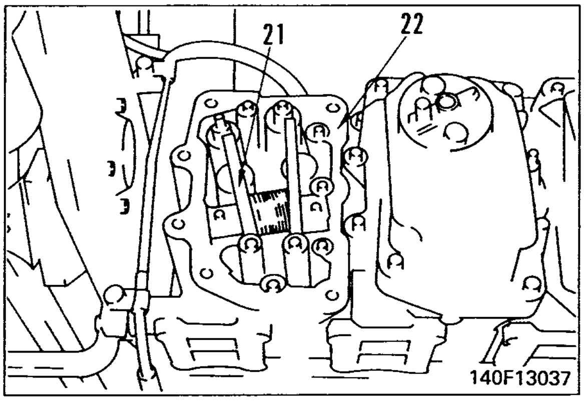


19. Remove nozzle holder assembly (20). ※6



20. Remove rocker arm assembly (21). ※7
    ★ Loosen the locknut and turn the adjustment screw back 2 — 3 turns.

21. Remove rocker arm housing (22). ※8



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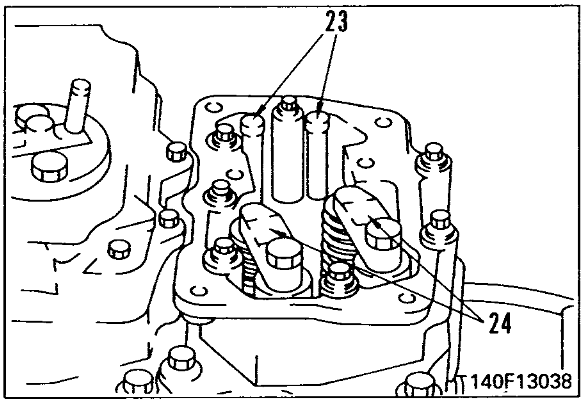
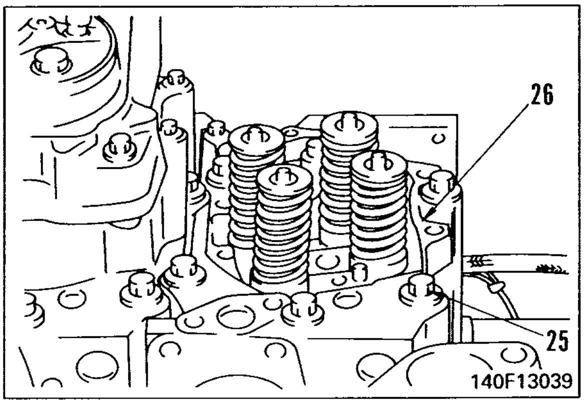
22. Remove push rod (23).

23. Remove crosshead (24). ※9



24. Remove head bolt (25), then remove cylinder head (26). ※10



INSTALLATION OF CYLINDER HEAD ASSEMBLY

D65E-12 60001 – 60947

- Carry out installation in the reverse order to removal.

※ 1

kgm Fuel return tube mounting joint bolt:
29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)

※ 2

kgm Fuel injection pipe mounting sleeve nut:
29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)

※ 3

★ Screw in the manifold mounting bolts 2 – 3 threads by hand, tighten bolts: ① – ③, and after that tighten the other bolts.

kgm Manifold mounting bolt:
66.2 ± 7.4 Nm (6.8 ± 0.8 kgm)

※ 4

kgm Spill pipe mounting joint bolt:
24.5 ± 4.9 Nm (2.5 ± 0.5 kgm)

※ 5

kgm Head cover mounting bolt:
9.8 ± 1.0 Nm (1.0 ± 0.1 kgm)

※ 6

★ Tighten the mounting bolts of the nozzle holder uniformly in turn.

kgm Nozzle holder mounting bolt:
21.6 ± 2.9 Nm (2.2 ± 0.3 kgm)

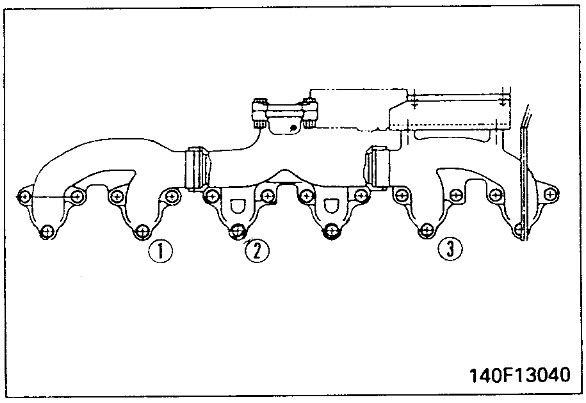
※ 7

★ Check that the ball of the adjustment screw is fitted properly into the socket of the push rod.

★ Adjust the valve clearance.
For details, see TESTING AND ADJUSTING, Adjusting valve clearance.

kgm Rocker arm assembly mounting bolt:
66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

kgm Lock nut: **66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)**



※ 8

kgm Rocker arm housing mounting bolt: **66.2 ± 7.4 Nm**
(6.75 ± 0.75 kgm)

※ 9

★ Adjust the crosshead as follows.

i) Loosen locknut, then turn adjustment screw back.
ii) Press down lightly on top of crosshead, then tighten adjustment screw.
iii) When adjustment screw contacts valve stem, tighten a further 20°.
iv) Tighten locknut to hold in position.

kgm Locknut: **66.2 ± 7.4 Nm**
(6.75 ± 0.75 kgm)

[※10]

- ★ If any rust is found that exceeds an area of 5 mm square on the shaft or thread of the bolt, replace the head bolts with new parts.
- ★ Check that there is no dirt or dust on the cylinder head mounting surface or inside the cylinder.
- ★ When installing the gasket, check that the grommet has not come out of position.
- ★ Coat the bolt thread, seat surface, and seat surface of the cylinder head hole with molybdenum disulphide (LM-P).
- ★ Screw in the cylinder head mounting bolts 2 – 3 turns by hand, then tighten in the order shown in the diagram.

Mounting bolt:
Anti-friction compound (LM-P)

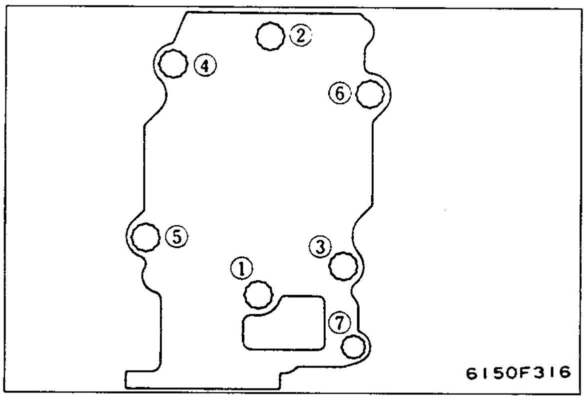
kgm Cylinder head mounting bolt:

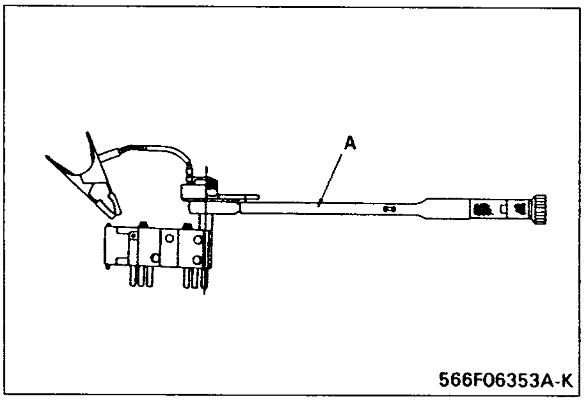
1st Step: Tighten to 68.6 ± 9.8 Nm
(7 ± 1 kgm)
2nd Step: Tighten to 107.9 ± 4.9 Nm
(11 ± 0.5 kgm)
3rd Step: 1. When using tool **A**:
- Using an angle tightening wrench, tighten the bolt a further $90^{\circ}{}^{+30^{\circ}}_{0}$.

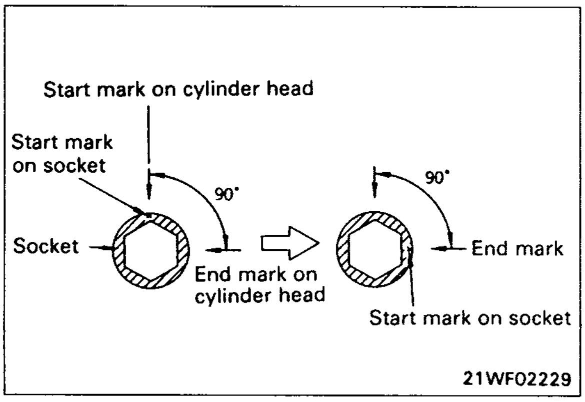
2. When not using tool **A**:
1) Using the angle of the bolt head as the base, make a start mark on the cylinder head and socket.
2) Make an end mark at a position $90^{\circ}{}^{+30^{\circ}}_{0}$ from the start mark.
3) Tighten so that the start mark on the socket is aligned with the end mark made at $90^{\circ}{}^{+30^{\circ}}_{0}$ on the cylinder head.

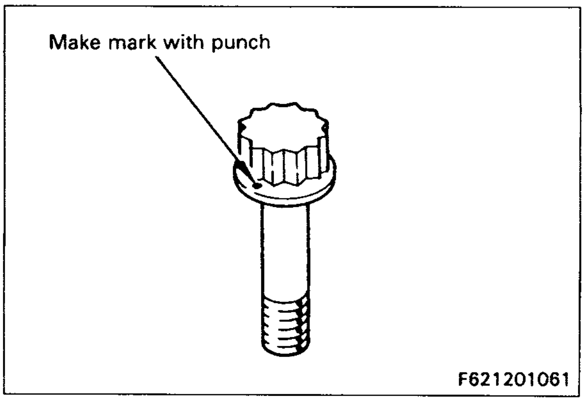
- ★ After tightening, make one punch mark on the bolt head to indicate the number of times that the bolt has been used.
  - If any bolt has five punch marks, do not reuse it. Replace it with a new bolt.

- **Refilling with water**
  - ★ Add water through water filler to the specified level.
    Run the engine to circulate the water through the system. Then check the water level again.









REMOVAL OF CYLINDER HEAD ASSEMBLY

D65E-13 60948 and up

⚠ Disconnect the cable from the negative (–) terminal of the battery.

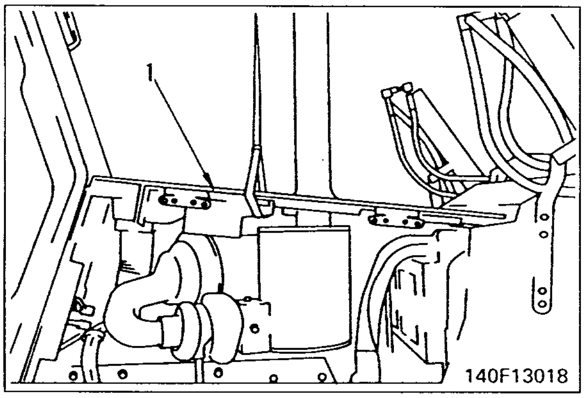
1. Drain cooling water.

2. Remove left and right engine side covers, then remove hood (1).

   ⚠ When disconnecting the connecting pin of the damper and side cover, use a lever block to support the rod portion of the damper, then remove the pin, taking care not to let it fly out.

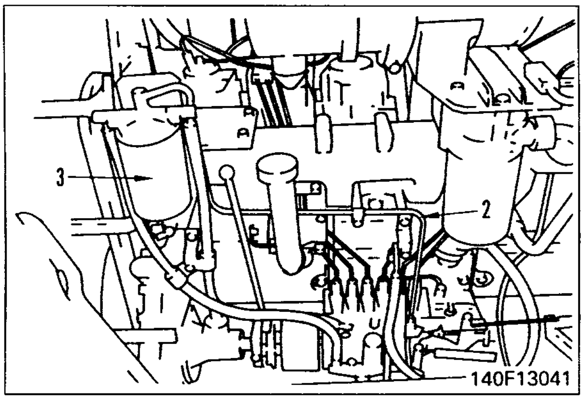
   kg Engine side cover (each): **25 kg**

   kg Hood: **55 kg**



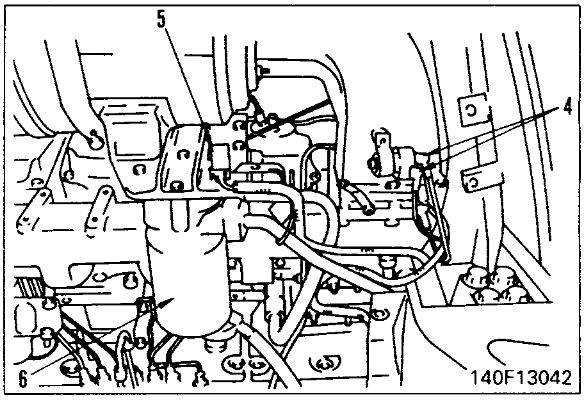
3. Remove bottom left and right engine side covers.
   - On machines with the cab specification, the washer tank is installed inside the bottom right side cover, so disconnect the hose and connector, then remove the bottom side cover.

4. Disconnect fuel return tube (2), and remove fuel filter assembly (3), then move it towards track shoe. ※1
   ★ If the fuel tank is full, fuel will flow out when tube (2) is disconnected, so after disconnecting it, bend the hose and tie it with string.



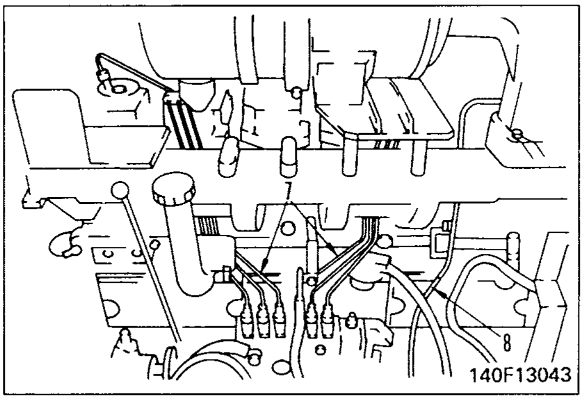
5. Disconnect electrical intake air heater wiring (4) and wiring connector (5).

6. Remove oil filter assembly (6) together with piping.



7. Remove 6 fuel injection pipes (7). ※2

8. Disconnect fuel return hose (8).



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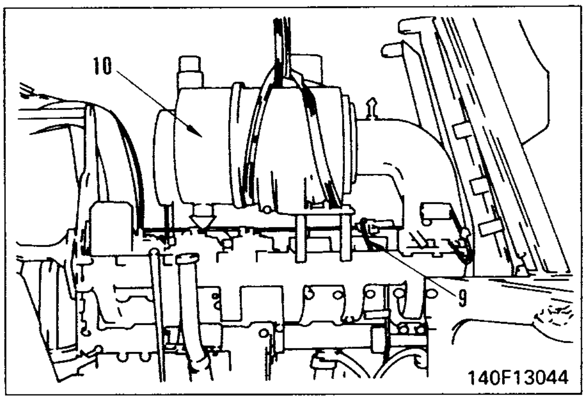
9. Disconnect tube (9).

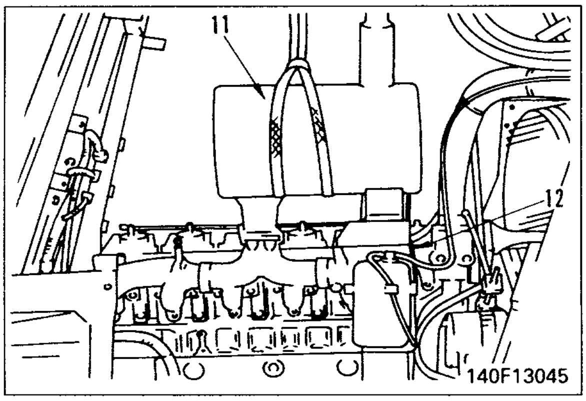
10. Sling air cleaner and intake manifold (10), and remove mounting bolts, then remove together with tube (9).
    ★ Mark the mounting position of each spacer and tube clamp before removing.



11. Remove safety covers.

12. Sling muffler and exhaust manifold assembly (11), and remove mounting bolts, then remove assembly. ※ 3

13. Remove muffler drain pipe (12).



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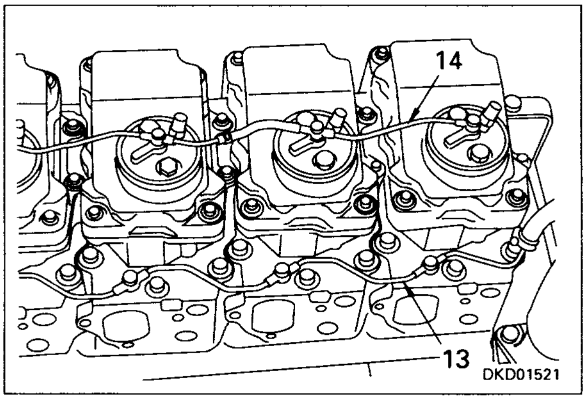
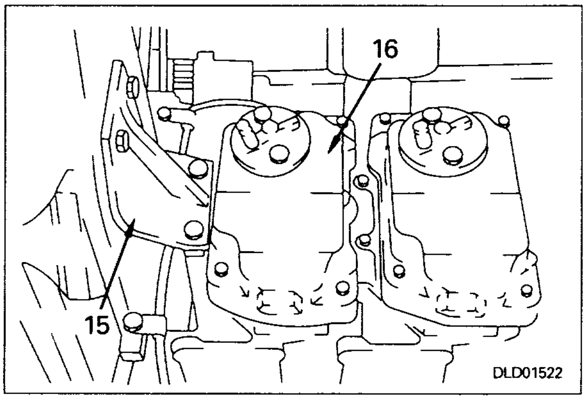
14. Remove aeration tube (13).

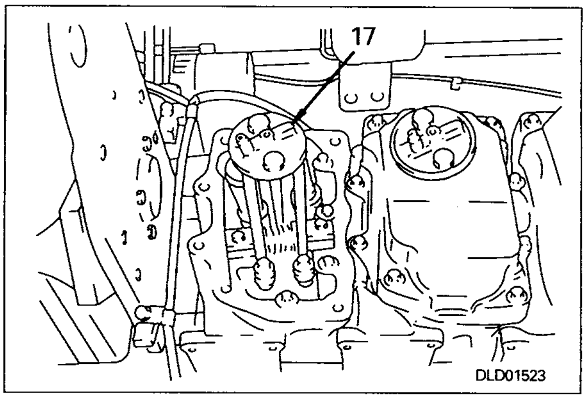
15. Remove spill pipe (14). ※ 4



16. Remove bracket (15), then remove cylinder head cover (16). ※ 5
    - Remove bracket (15) only for No. 1 cylinder head.



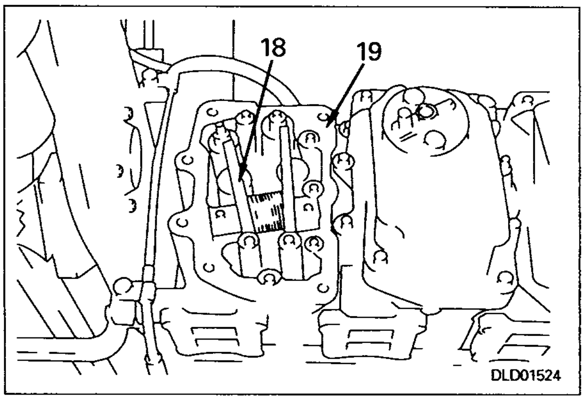
17. Remove nozzle holder assembly (17). ※ 6



18. Remove rocker arm assembly (18). ※ 7

★ Loosen the locknut and turn the adjustment screw back 2 – 3 turns.

19. Remove rocker arm housing (19). ※ 8



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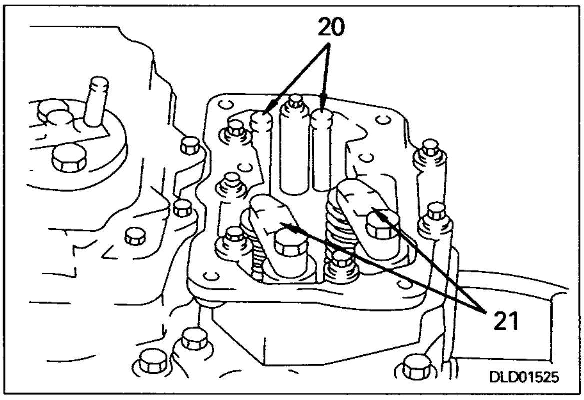
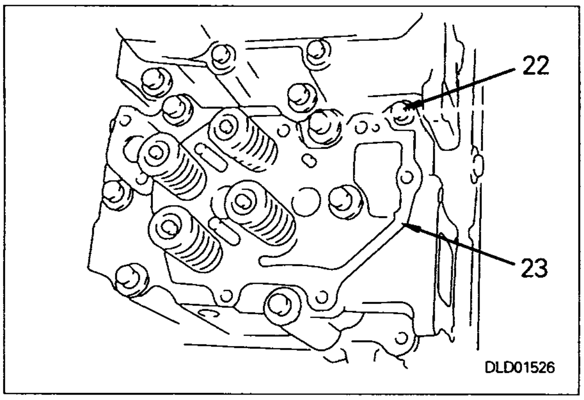
20. Remove push rod (20).

21. Remove crosshead (21). ※ 9



22. Remove head bolt (22), then remove cylinder head (23). ※ 10



INSTALLATION OF CYLINDER HEAD ASSEMBLY

D65E-12 60948 and up

- Carry out installation in the reverse order to removal.

※ 1

Fuel return tube mounting joint bolt: **29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)**

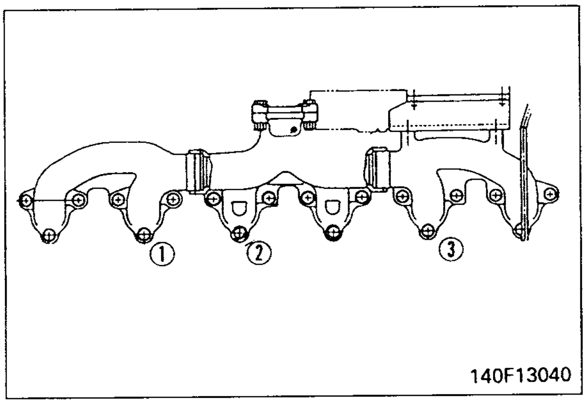
※ 2

Fuel injection pipe mounting sleeve nut: **29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)**

※ 3

★ Screw in the manifold mounting bolts 2 – 3 threads by hand, tighten bolts: ① – ③, and after that tighten the other bolts.

Manifold mounting bolt: **66.2 ± 7.4 Nm (6.8 ± 0.8 kgm)**



※ 4

Spill pipe mounting joint bolt: **24.5 ± 4.9 Nm (2.5 ± 0.5 kgm)**

※ 5

Head cover mounting bolt: **9.8 ± 1.0 Nm (1.0 ± 0.1 kgm)**

※ 6

★ Tighten the mounting bolts of the nozzle holder uniformly in turn.

Nozzle holder mounting bolt: **21.6 ± 2.9 Nm (2.2 ± 0.3 kgm)**

※ 7

★ Check that the ball of the adjustment screw is fitted properly into the socket of the push rod.

★ Adjust the valve clearance. For details, see TESTING AND ADJUSTING, Adjusting valve clearance.

Rocker arm assembly mounting bolt: **66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)**

Lock nut: **66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)**

※ 8

Rocker arm housing mounting bolt: **66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)**

※ 9

★ Adjust the crosshead as follows.

i) Loosen locknut, then turn adjustment screw back.
ii) Press down lightly on top of crosshead, then tighten adjustment screw.
iii) When adjustment screw contacts valve stem, tighten a further 20°.
iv) Tighten locknut to hold in position.

Locknut: **66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)**

※10

- ★ If any rust is found that exceeds an area of 5 mm square on the shaft or thread of the bolt, replace the head bolts with new parts.
- ★ Check that there is no dirt or dust on the cylinder head mounting surface or inside the cylinder.
- ★ When installing the gasket, check that the grommet has not come out of position.
- ★ Coat the bolt thread, seat surface, and seat surface of the cylinder head hole with molybdenum disulphide (LM-P).
- ★ Screw in the cylinder head mounting bolts 2 – 3 turns by hand, then tighten in the order shown in the diagram.

Mounting bolt:

Anti-friction compound (LM-P)

kgm Cylinder head mounting bolt:

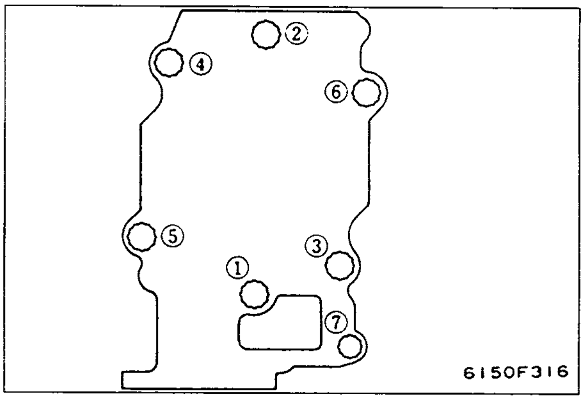
1st Step: Tighten to 68.6 ± 9.8 Nm (7 ± 1 kgm)

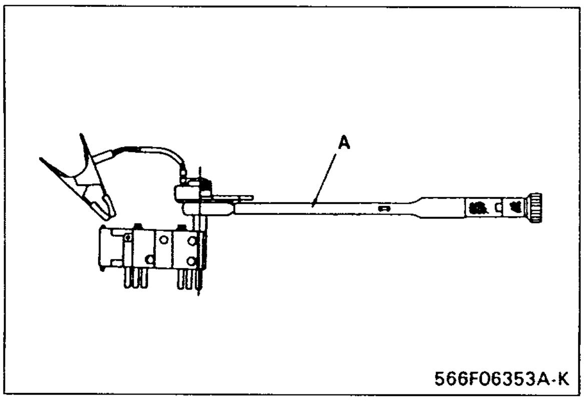
2nd Step: Tighten to 107.9 ± 4.9 Nm (11 ± 0.5 kgm)

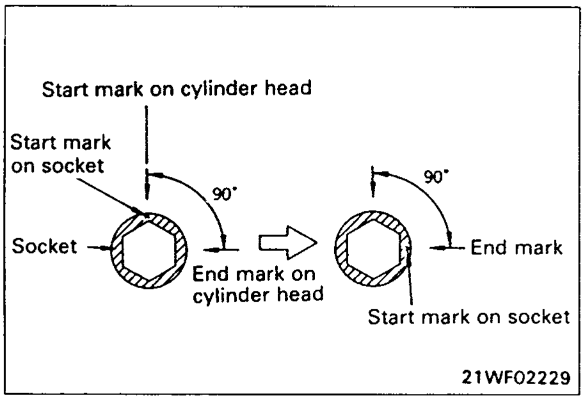
3rd Step:
1. When using tool **A**:
   - Using an angle tightening wrench, tighten the bolt a further $90^{\circ}{}^{+30^{\circ}}_{0}$.
2. When not using tool **A**:
   1) Using the angle of the bolt head as the base, make a start mark on the cylinder head and socket.
   2) Make an end mark at a position $90^{\circ}{}^{+30^{\circ}}_{0}$ from the start mark.
   3) Tighten so that the start mark on the socket is aligned with the end mark made at $90^{\circ}{}^{+30^{\circ}}_{0}$ on the cylinder head.

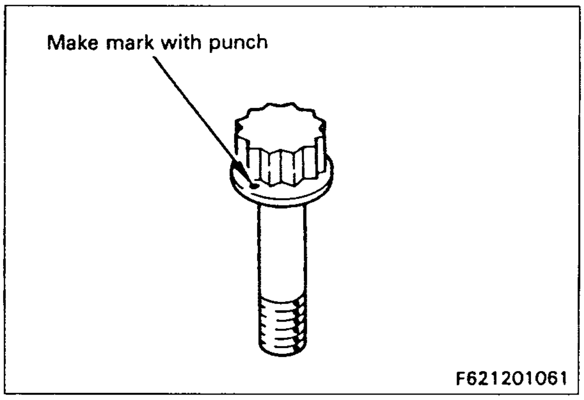
- ★ After tightening, make one punch mark on the bolt head to indicate the number of times that the bolt has been used.
  - If any bolt has five punch marks, do not reuse it. Replace it with a new bolt.

- **Refilling with water**
  - ★ Add water through water filler to the specified level.
    Run the engine to circulate the water through the system. Then check the water level again.







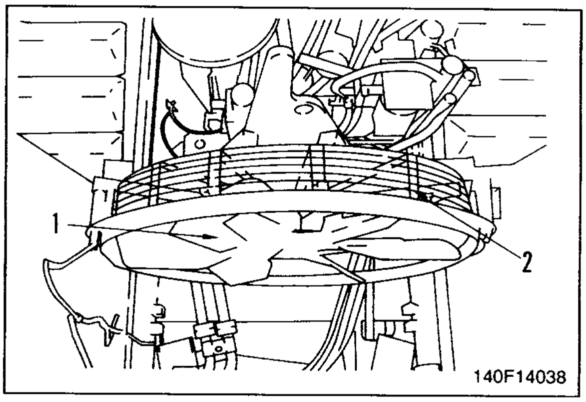


REMOVAL OF ENGINE FRONT SEAL

1. Remove radiator assembly.
   For details, see REMOVAL OF RADIATOR ASSEMBLY.

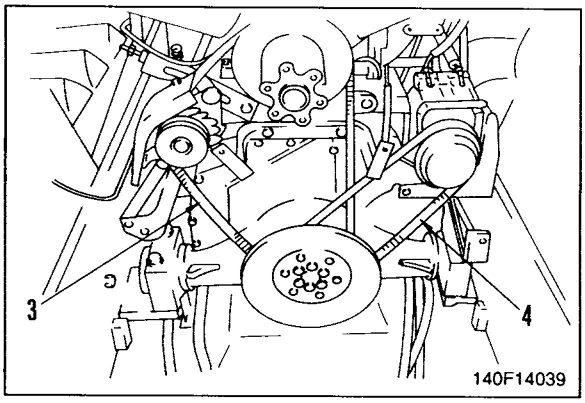
2. Remove fan (1).

3. Remove fan guard and shroud assembly (2).



4. Loosen mounting bolt of alternator assembly, adjustment plate mounting bolt, and adjustment bolt, and remove alternator and fan drive belt(3). ※1

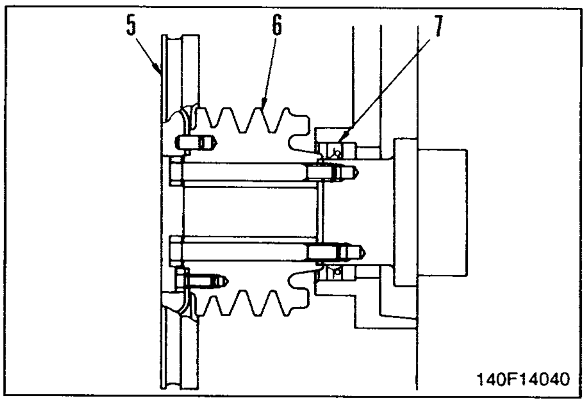
5. Loosen air conditioner compressor mounting bolts and adjustment bolt, then remove air conditioner drive belt (4). ※2



6. Remove damper (5). ※3

7. Remove pulley (6). ※4

8. Remove front oil seal (7). ※5
   ★ When removing the front oil seal, be extremely careful not to damage the crankshaft.



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INSTALLATION OF ENGINE FRONT SEAL

- Carry out installation in the reverse order to removal.

※1

★ Adjust the fan belt tension.
For details, see TESTING AND ADJUSTING, Testing and adjusting fan belt tension

※2

★ Adjust the air conditioner compressor belt tension.
For details, see TESTING AND ADJUSTING, Testing and adjusting air conditioner compressor belt tension.

※3

Damper mounting bolt:
110.25 ± 12.25 Nm
(11.25 ± 1.25 kgm)

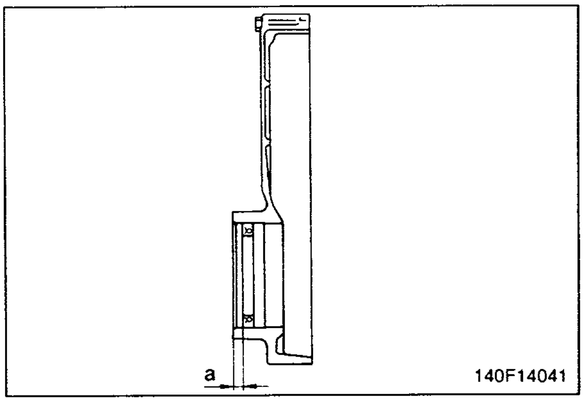
※4

Pulley mounting bolt:
276.85 ± 31.85 Nm
(28.25 ± 3.25 kgm)

※5

★ Oil seal press-fitting tolerance **a**: 11^{+1}_{0} mm

Lip of oil seal (fill 50 — 80% of space at lip): **Grease (G2-LI)**

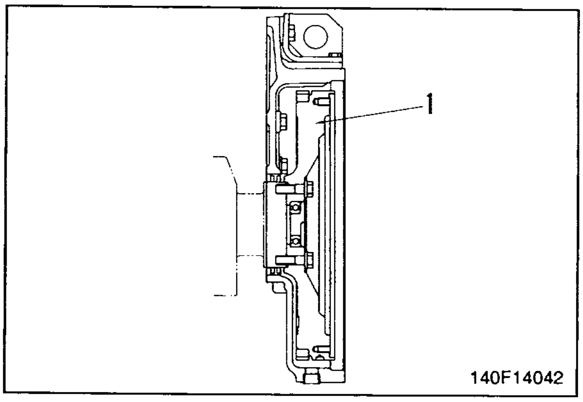


REMOVAL OF ENGINE REAR SEAL

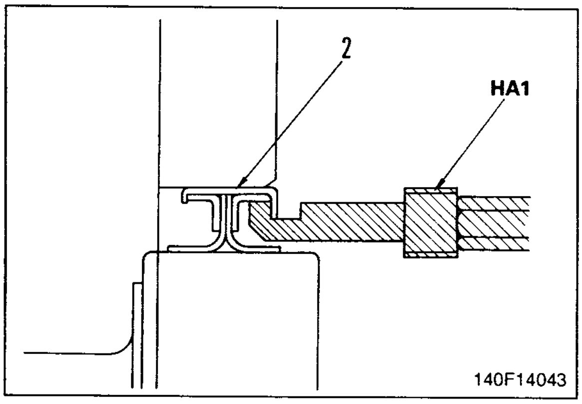
1. Remove damper assembly.
   For details, see REMOVAL OF DAMPER ASSEMBLY.

2. Using eyebolts, sling flywheel (1), and remove mounting bolts, then remove. ※1

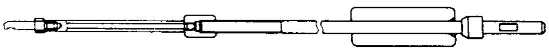
   ⚠ The flywheel pilot is shallow and it may come off suddenly, so be careful not to get your fingers caught.



3. Hook puller tip of tool **HA1** to metal ring of seal (2), and use impact force of a slide hammer to pull out. ※2
   - ★ Before pulling out, knock the oil seal in slightly. This separates the seal from the housing and makes it easier to pull out the seal.
   - ★ Be extremely careful not to damage the crankshaft.
   - ★ Do not use a drill. The metal powder will get inside the engine.

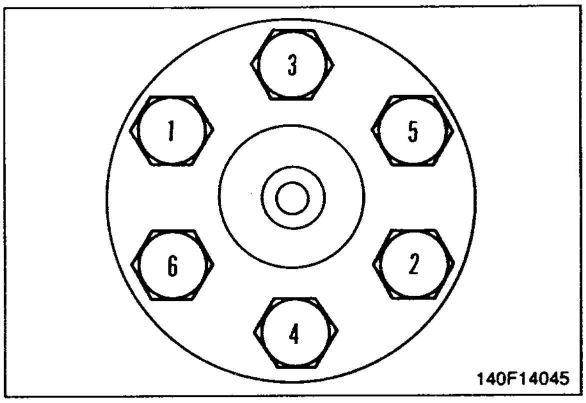


Tool **HA1**: Seal puller assembly



INSTALLATION OF ENGINE REAR SEAL

- Carry out installation in the reverse order to removal.



※1

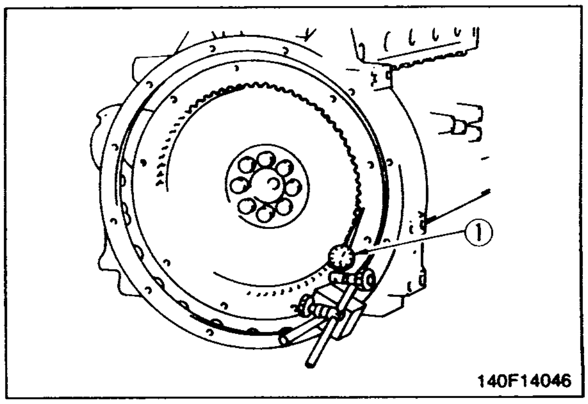
★ When tightening the flywheel mounting bolts, follow the order on the diagram and use the procedure below.

Flywheel mounting bolt thread: **Lubricating oil (EO30)**

Flywheel mounting bolt:
1st step: **147 ± 19.6 Nm (15 ± 2.0 kgm)**
2nd step: **289.1 ± 19.6 Nm (29.5 ± 2.0 kgm)**

- Using dial gauge ①, measure radial and face runout of flywheel.

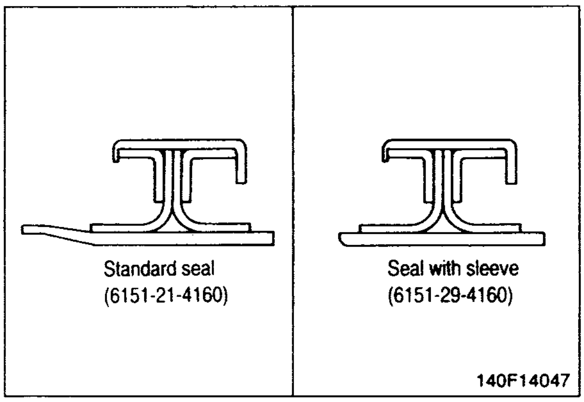
Face runout: 0.2 mm
Radial runout: 0.15 mm



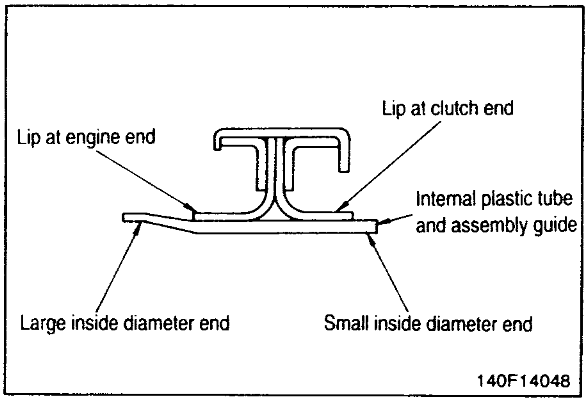
※2

★ With the Teflon seal (lay down lip seal), check the condition of the wear of the shaft, select either a standard seal or a seal with a sleeve, then assemble the seal.

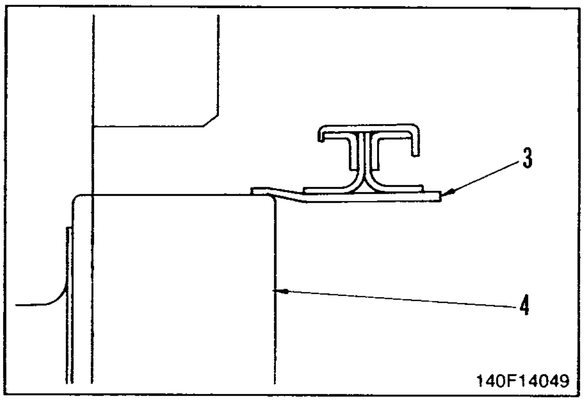
The condition of wear is judged by the smoothness (no deformation can be felt when touched with the flat of a finger, depth of wear less than 10 μm). If there are no scratches, assemble a standard seal; in all other cases, assemble a seal with a sleeve.



- **Procedure for assembling standard seal**
  - ★ Before assembling the seal, check that there are no scratches, burrs, flashes, or rust on the housing, lip sliding surface, or at the corner of the end face of the crankshaft.
  - ★ When assembling the seal, do not coat the shaft and seal lip with oil or grease, and wipe off all the oil from the shaft.
  - ★ Do not remove the internal plastic tube from the standard seal until assembling the seal.

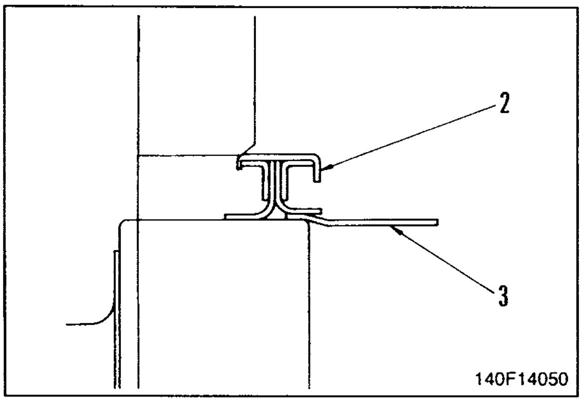


1) Put large inside diameter end of internal plastic tube (3) in contact with end of crankshaft (4).
   ★ Be particularly careful to assemble facing in the correct direction.

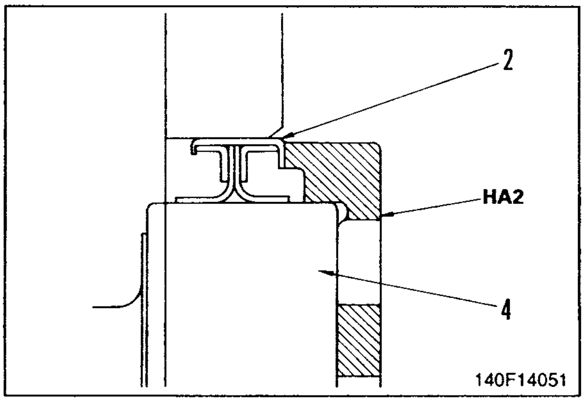


2) Hold metal ring of seal (2) with both hands and push in with force.

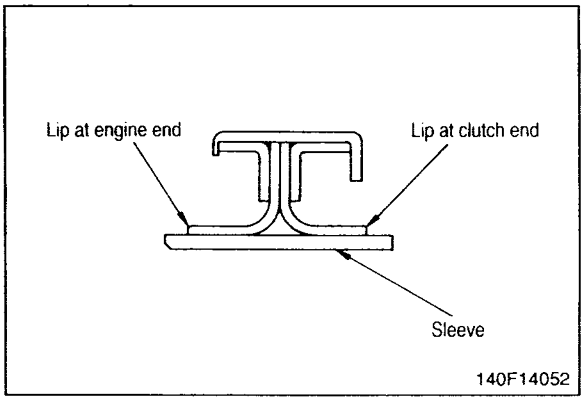
3) After pushing seal in, remove internal plastic cylinder (3).
   ★ When removing, be careful not to damage the seal lip.



4) Tighten bolts of tool **HA2** uniformly until end face of tool **HA2** contacts end face of crankshaft (4) to press fit seal (2).
   ★ When press fitting the seal, be extremely careful not to damage the lip at the clutch end when setting the tool.
   ★ After press fitting the seal, remove all the remains of the red sealant on the outside circumference.

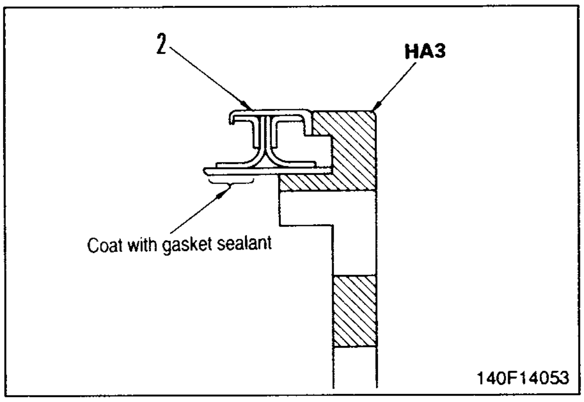


- **Assembly procedure for seal with sleeve**
  ★ Before assembling the seal, check that there are no scratches, burrs, flashes, or rust on the housing, lip sliding surface, or at the corner of the end face of the crankshaft.
  ★ When assembling the seal, do not coat the shaft and the area between the sleeve and seal lip with oil or grease, and wipe off all the oil from the crankshaft.
  ★ Always handle the seal and sleeve as a set. Never disassemble it.



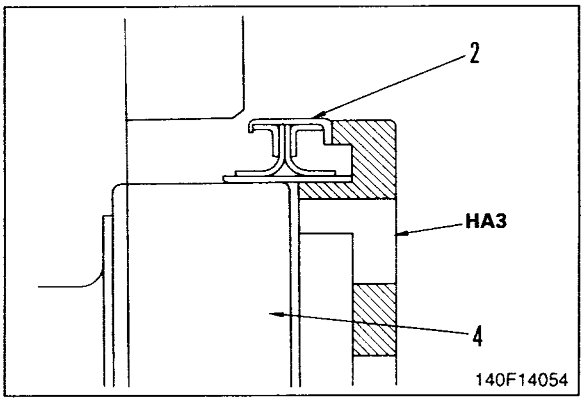
1) Set sleeve/seal (2) to tool **HA3**.

Inside surface of sleeve: **Gasket sealant (LG-7)**

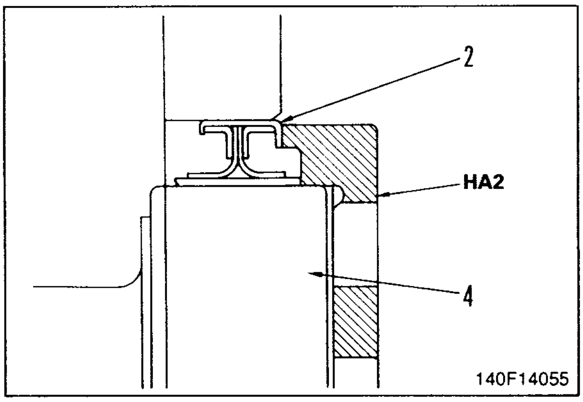


2) Put sleeve of seal in contact with end face of crankshaft, then tighten bolts of tool **HA3** uniformly until end face of tool **HA3** contacts end face of crankshaft (4) to press fit sleeve/seal (2).

3) Remove tool **HA3** and install tool **HA2**.



4) Tighten bolts of tool **HA2** uniformly until end face of tool **HA2** contacts end face of crankshaft (4) to press fit sleeve/seal (2).
★ After press fitting the seal, remove all the remains of the red sealant on the outside circumference.



REMOVAL OF AIR CONDITIONER COMPRESSOR ASSEMBLY

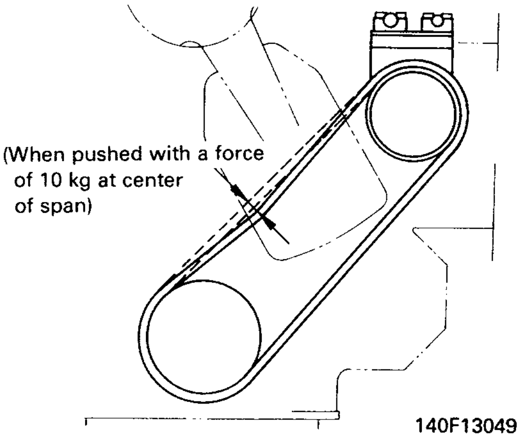
1. Disconnect hoses (1) and (2), and wiring connector (3) (CN14). ※1
2. Loosen lock bolts (4) and (5), and adjustment bolt (6), then remove V-belt (7). ※2
3. Remove lock bolts (4) and (5), then remove compressor assembly (8) together with bracket.

INSTALLATION OF AIR CONDITIONER COMPRESSOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

★ Adjust the tension of the V-belt for the compressor pulley as follows.



※2

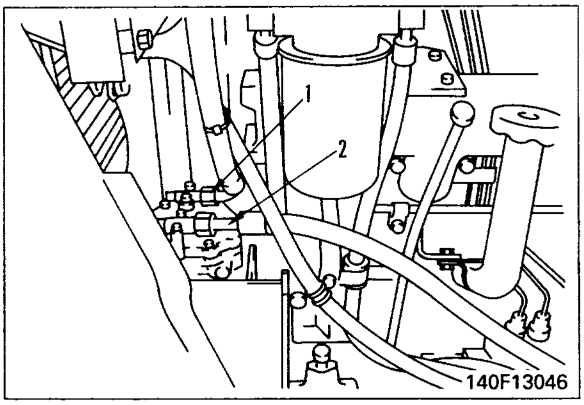
★ Install the hoses without twisting.

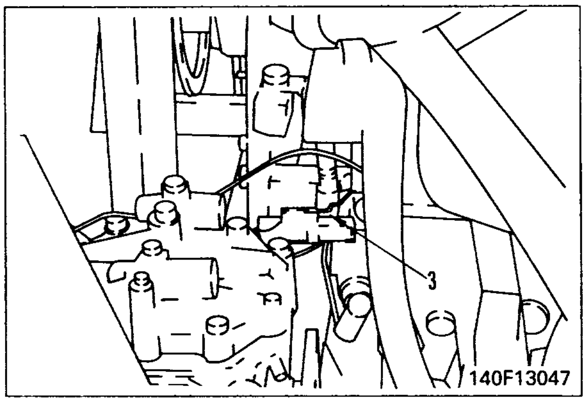
★ When installing each hose, be careful not to let dirt, dust, or water get into the hose.

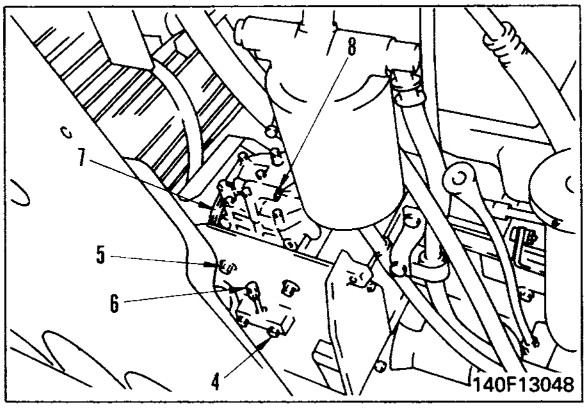
★ After assembling the whole cooler cycle, charge with 1000 ± 100 g of air conditioner refrigerant (R-12) from the compressor.

kgm The tightening torque for the unified thread of the air conditioner gas piping shall be as follows.

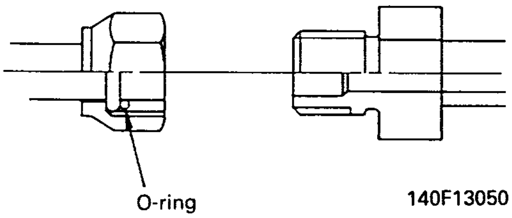
Thread diameter	Tightening torque N · m (kgm)
$\frac{3}{4}$ — 16 UNF	19.6 — 24.5 (2 — 2.5)
$\frac{9}{16}$ — 18 UNF	11.8 — 14.7 (1.2 — 1.5)
$\frac{7}{8}$ — 14 UNF	29.4 — 24.5 (3 — 3.5)





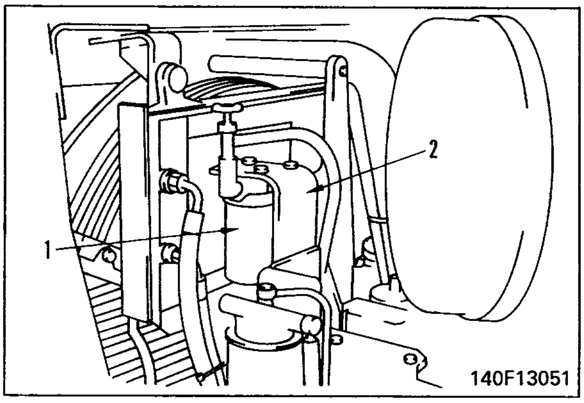


★ Check that there are O-rings at the connections of the cooler piping before assembling. Coat the O-ring well with compressor oil (Shell Suniso G or 5G).



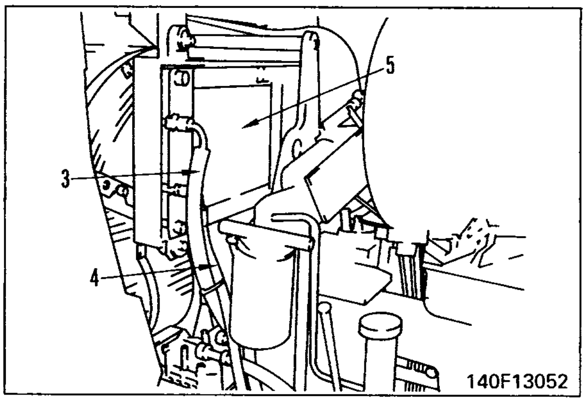
REMOVAL OF AIR CONDITIONER CONDENSER ASSEMBLY

1. Remove corrosion assembly (1) from bracket (2), and move towards side. (Except D65E)



140F13051

2. Disconnect hoses (3) and (4), and remove condenser assembly (5). ※1
   ★ Release the air conditioner gas completely, then disconnect.



140F13052

INSTALLATION OF AIR CONDITIONER CONDENSER ASSEMBLY

- Carry out installation in the reverse order to removal.

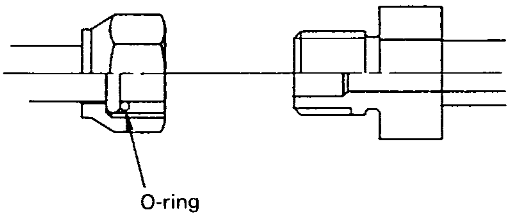
※1

★ Install the hoses without twisting.
★ When installing each hose, be careful not to let dirt, dust, or water get into the hose.
★ After assembling the whole cooler cycle, charge with 1000 ± 100 g of air conditioner refrigerant (R-12) from the air compressor.

kgm The tightening torque for the unified thread of the air conditioner gas piping shall be as follows.

Thread diameter	Tightening torque N · m (kgm)
$\frac{3}{4}$ — 16 UNF	19.6 — 24.5 (2 — 2.5)
$\frac{9}{16}$ — 18 UNF	11.8 — 14.7 (1.2 — 1.5)
$\frac{7}{8}$ — 14 UNF	29.4 — 24.3 (3 — 3.5)

★ Check that there are O-rings at the connections of the cooler piping before assembling. Coat the O-ring well with compressor oil (Shell Suniso G or 5G).



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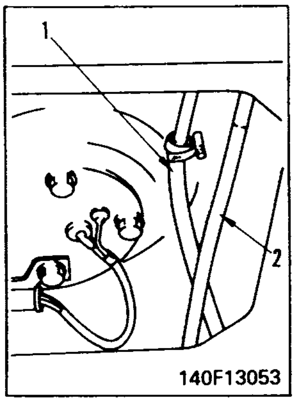
REMOVAL OF FUEL TANK ASSEMBLY

D65E-12 60001 — 60270
D65P-12 60001 — 60391
D65EX-12 60001 — 60275
D65PX-12 60001 — 60396

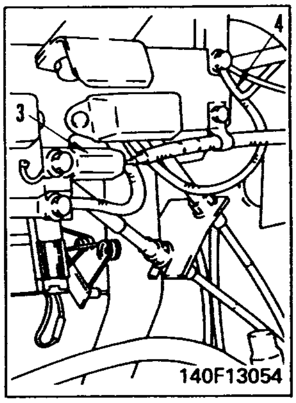
⚠ Disconnect the cable from the negative (−) terminal of the battery.

1. Remove seal installed to operator's seat frame.

2. Remove cover, and disconnect fuel return hoses (1) and (2).
   ★ If the fuel tank is full, fuel will flow out when the hose is disconnected, so drain the fuel to a point where it will not flow out.



140F13053



140F13054

D65E, P-12

3. Open battery side cover, and disconnect wiring connector (3) and ground connection (4).

D65EX, PX-12

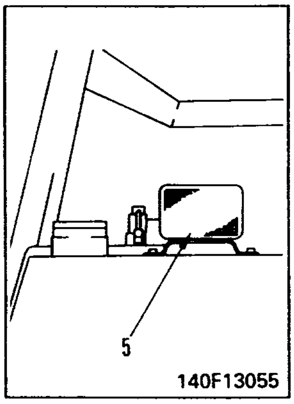
3. Remove battery side cover, and disconnect wiring connector (3) and ground connection (4). Remove one battery at side of fuel tank.

4. Disconnect wiring and remove rear lamp (5).

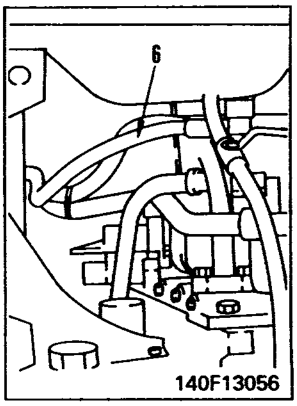
5. Remove chassis rear cover.

6. Close fuel supply valve, and disconnect hose (6).

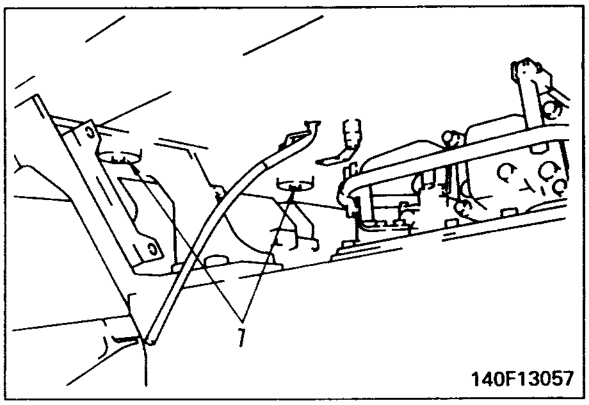
7. Open cover at fender side, then remove left and right fuel tank mount bolts (7). ※1



140F13055



140F13056



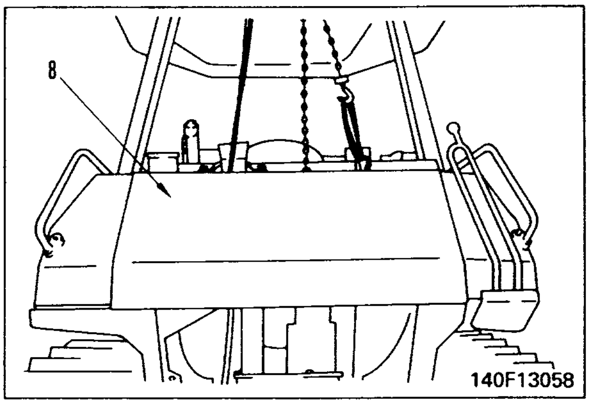
140F13057

D65E, P-12

8. Set lifting tool in position, raise fuel tank assembly (8), then remove bracket (9), and move fuel tank assembly to a position where it can be removed from floor frame. ※2

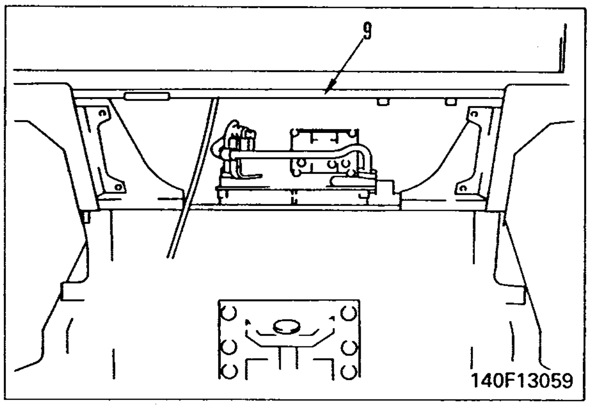
D65EX, PX-12

8. 1) Set lifting tool in position, raise fuel tank assembly (8), then move to left. (Move to a position where the HSS motor flange portion can be seen from the right side of the fuel tank.)



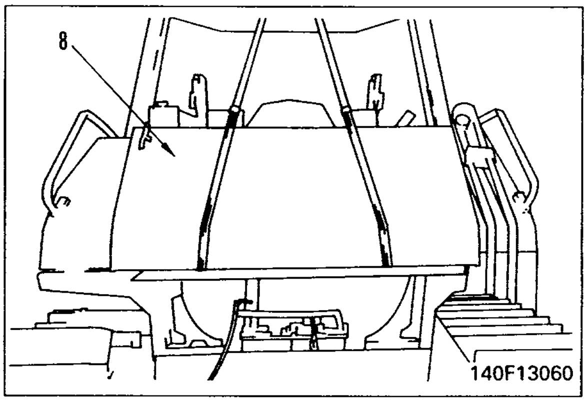
140F13058

2) Remove bracket (9) and move fuel tank assembly (8) to a position where it can be removed from floor frame. ※2



9. Adjust position of sling rope, and remove fuel tank assembly (8).

kg Fuel tank assembly: **Approx. 400 kg (when full)**



INSTALLATION OF FUEL TANK ASSEMBLY

D65E-12 60001 — 60270
D65P-12 60001 — 60391
D65EX-12 60001 — 60275
D65PX-12 60001 — 60396

- Carry out installation in the reverse order to removal.

※1

★ Make the clearance uniform between the fuel tank and left and right covers, then tighten the mounting bolts.

※2

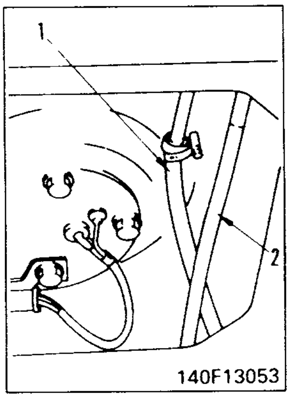
kgm Bracket mounting bolt:
110.3 ± 12.3 Nm
(11.25 ± 1.25 kgm)

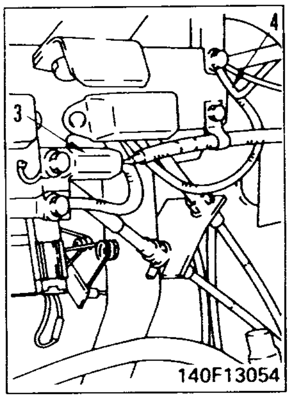
014012

REMOVAL OF FUEL TANK ASSEMBLY

D65E-12 60271 - 60947
D65P-12 60392 - 60890
D65EX-12 60276 - 60941
D65PX-12 60397 - 60914

⚠ Disconnect the cable from the negative (–) terminal of the battery.





1. Remove seal installed to operator's seat frame.

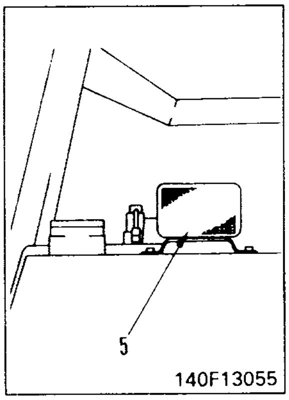
2. Remove cover, and disconnect fuel return hoses (1) and (2).
   ★ If the fuel tank is full, fuel will flow out when the hose is disconnected, so drain the fuel to a point where it will not flow out.

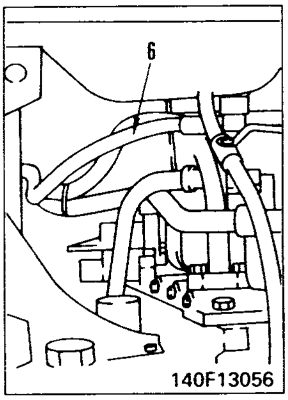
D65E, P-12

3. Open battery side cover, and disconnect wiring connector (3) and ground connection (4).

D65EX, PX-12

3. Remove battery side cover, and disconnect wiring connector (3) and ground connection (4). Remove one battery at side of fuel tank.



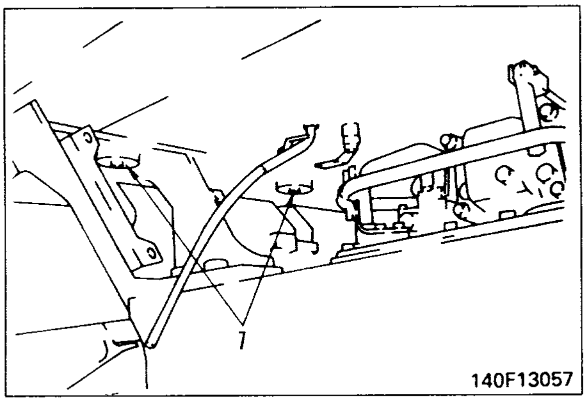


4. Disconnect wiring and remove rear lamp (5).

5. Remove chassis rear cover.

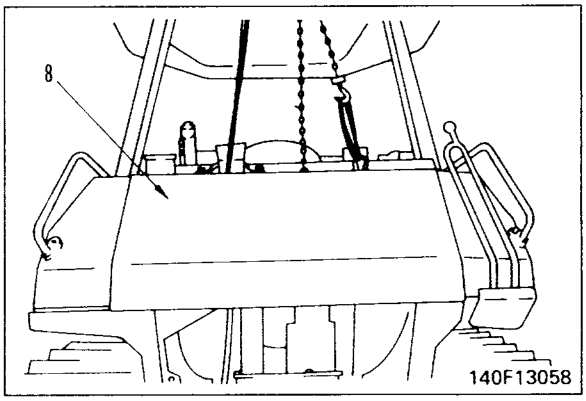
6. Close fuel supply valve, and disconnect hose (6).

7. Open cover at fender side, then remove left and right fuel tank mount bolts (7). ※1



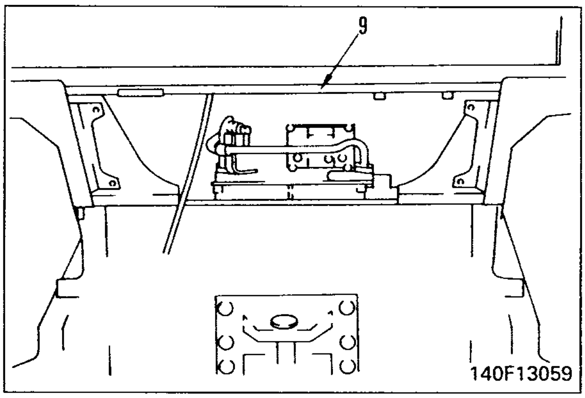
D65E, P-12

8. 1) Remove bracket (9).
   2) Set lifting tool in position, raise fuel tank assembly (8), and move fuel tank assembly to a position where it can be removed from floor frame. ※2



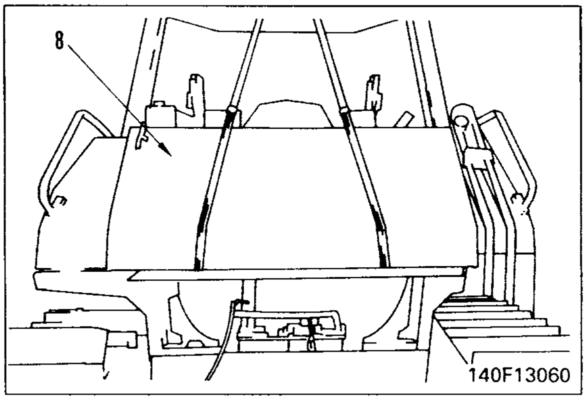
D65EX, PX-12

8. 1) Remove bracket (9).
   2) Set lifting tool in position, raise fuel tank assembly (8), then move to left. (Move to a position where the HSS motor flange portion can be seen from the right side of the fuel tank.) ※2



9. Adjust position of sling rope, and remove fuel tank assembly (8).

kg Fuel tank assembly: **Approx. 400 kg (when full)**



INSTALLATION OF FUEL TANK ASSEMBLY

D65E-12 60271 - 60947
D65P-12 60392 - 60890
D65EX-12 60276 - 60941
D65PX-12 60397 - 60914

- Carry out installation in the reverse order to removal.

※1

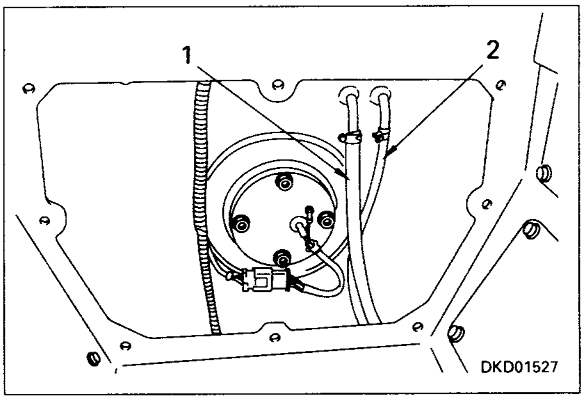
★ Make sure clearance uniform between the fuel tank and left and right covers, then tighten the mounting bolts.

※2

kgm Bracket mounting bolt: **110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)**

REMOVAL OF FUEL TANK ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up



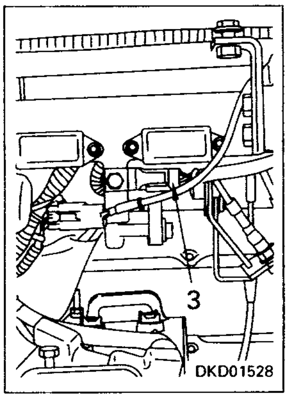
⚠ Disconnect the cable from the negative (–) terminal of the battery.

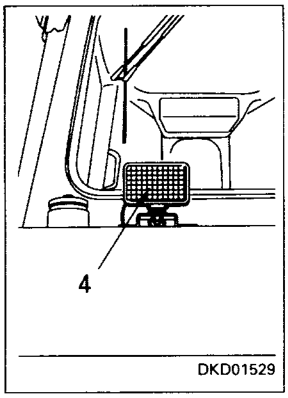
1. Remove seal installed to operator's compartment frame.

2. Remove cover, then disconnect fuel return hoses (1) and (2).
   ★ If the fuel tank is full, fuel will flow out when the hoses are disconnected, so drain the fuel to a point where the fuel will not flow out.

3. Open battery cover and remove wiring connector (3) (CN4).

4. Disconnect wiring, then remove rear lamp (4).

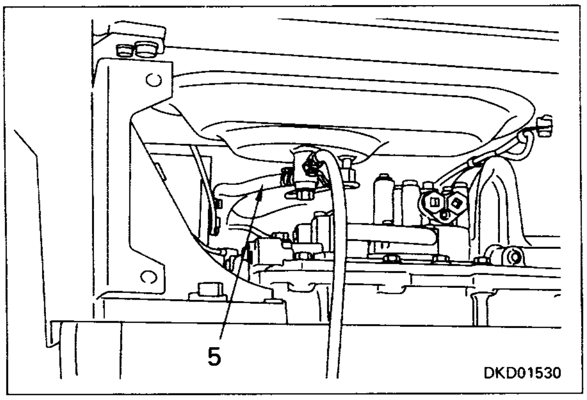




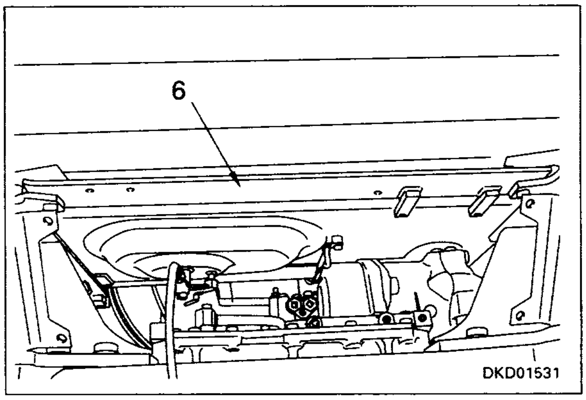
014012

5. Remove cover at rear of machine.

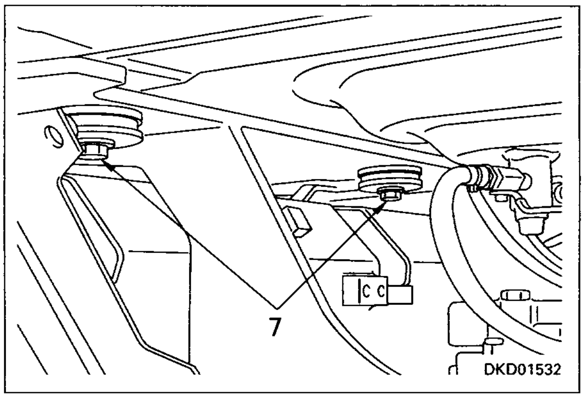
6. Close fuel supply valve, then disconnect hose (5).



7. Remove bracket (6). ※ 1

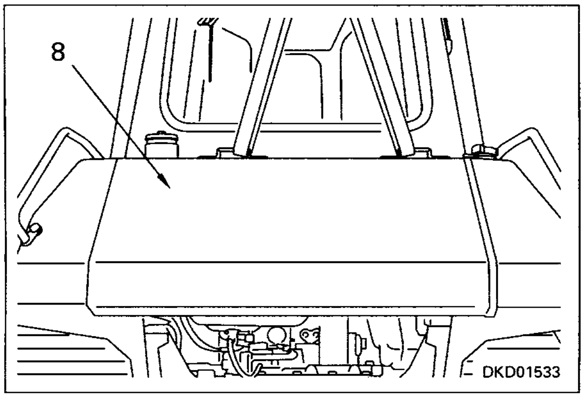


8. Remove cover at fender side, then remove left and right fuel tank mounting bolts (7). ※2



9. Set lifting tool to rear lamp mounting bracket, then lift fuel tank assembly (8), and move to rear to remove.

kg Fuel tank assembly: **Approx. 400 kg (when fuel tank is full)**



INSTALLATION OF FUEL TANK ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

- Carry out installation in the reverse order to removal.

※1

kgm Bracket mounting bolt: **110 ± 12.3 Nm (11.25 ± 1.25 kgm)**

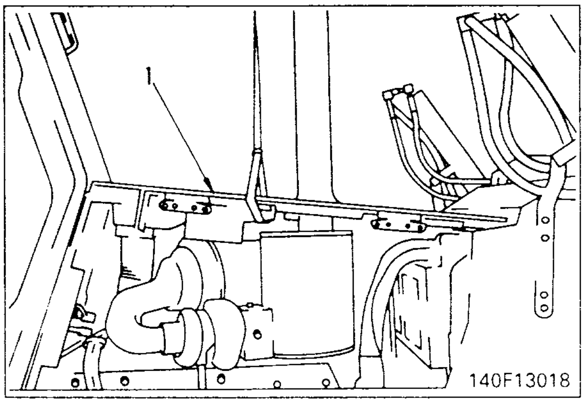
※2

★ Make the clearance between the fuel tank and the left and right covers uniform, and tighten the mounting bolts.

REMOVAL OF RADIATOR ASSEMBLY

⚠ Disconnect the cable from the negative (−) terminal of the battery.

⚠ Lower the work equipment to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.



1. Drain cooling water.

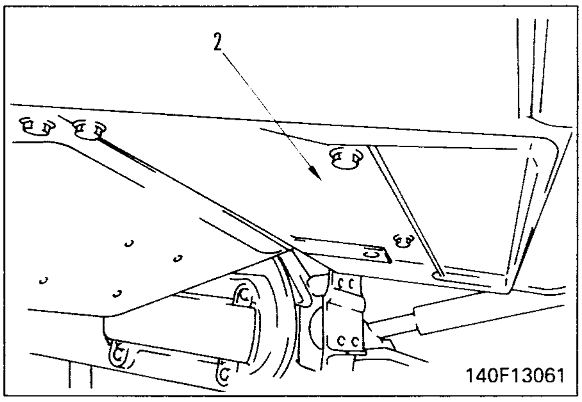
2. Remove left and right engine covers, then remove hood (1). ※1

   ⚠ When disconnecting the connecting pin of the damper and side cover, use a lever block to support the rod portion of the damper, then remove the pin, taking care not to let it fly out.

   kg Engine side cover (each): **25 kg**

   kg Hood: **55 kg**

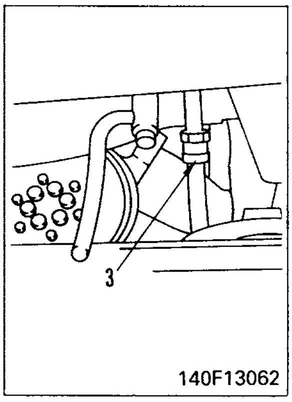
3. Remove cover (2).

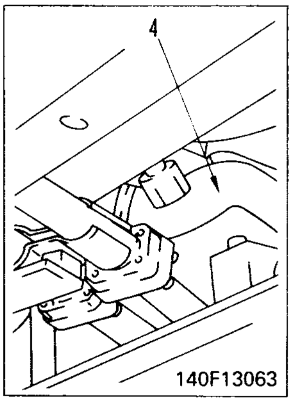


014012

4. Disconnect left and right power train oil cooler hoses (3).
   ★ Fit blind plugs to prevent dirt or dust from getting into the piping.

5. Remove radiator outlet hose (4). ※2

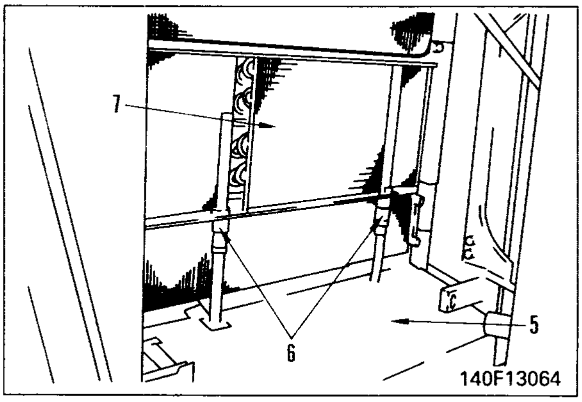




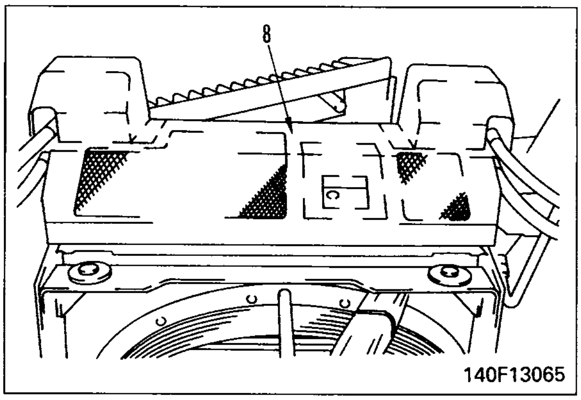
6. Open front mask.

7. Remove baffle (5).

8. Disconnect hydraulic oil cooler hose (6), and remove hydraulic oil cooler assembly (7).

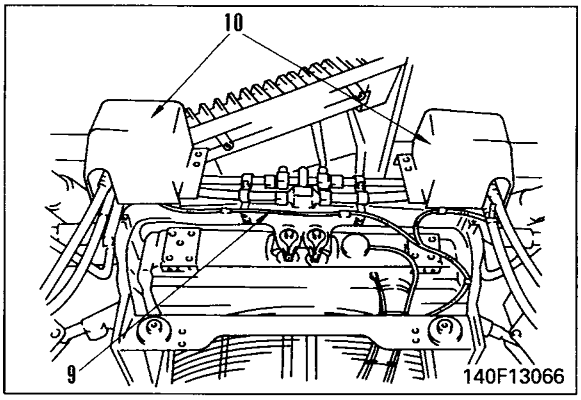


9. Remove radiator top cover (8).



10. Disconnect front lamp wiring (9) and horn wiring.

11. Remove front lamp assembly (10).

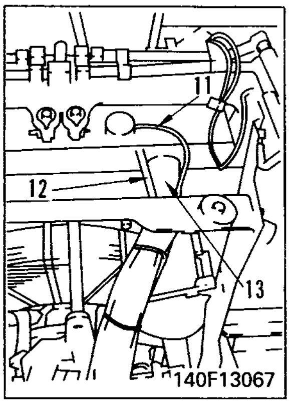


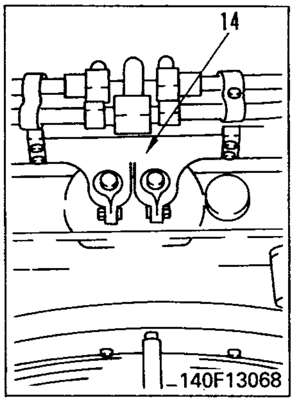
12. Disconnect hose (11) between radiator and reserve tank.

13. Disconnect aeration hose (12). ※3

14. Remove radiator inlet hose (13). ※4

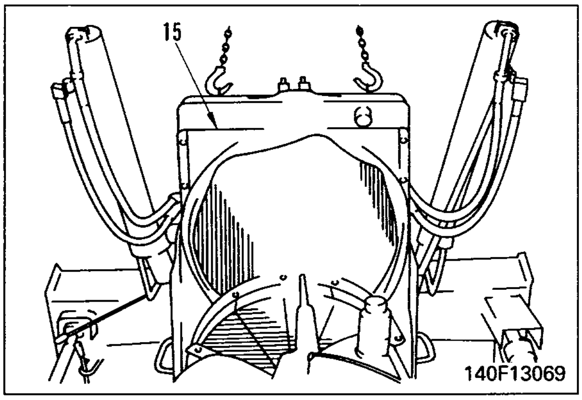
15. Remove bracket (14).





16. Remove 2 radiator bottom mount bolts, and raise radiator assembly (15) slowly, then remove.
★ When removing the radiator, be extremely careful not to damage the seal or radiator core.

kg Radiator assembly: **45 kg**



INSTALLATION OF RADIATOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

kgm Hood mounting bolt: **276.9 ± 31.9 Nm**
(28.25 ± 3.25 kgm)

※2, ※4

kgm Radiator outlet and inlet hose clamp:
5.9 ± 0.5 Nm (60 ± 5 kgcm)

※3

kgm Aeration hose clamp: **2.9 ± 0.5 Nm**
(30 ± 5 kgcm)

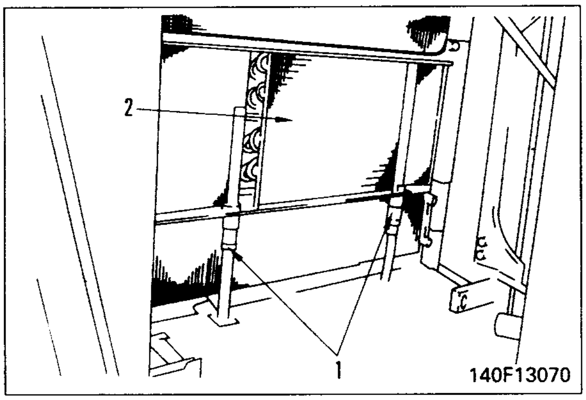
- **Refilling with water**
  ★ Add water through water filler to the specified level.
  Run the engine to circulate the water through the system. Then check the water level again.

- **Refilling with oil (hydraulic tank, power train case)**
  ★ Add engine oil through oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

REMOVAL OF HYDRAULIC OIL COOLER ASSEMBLY

⚠ Lower the work equipment to the ground and stop the engine. Then release the pressure inside the circuit. For details, see TESTING AND ADJUSTING, removing remaining pressure from hydraulic circuit.

1. Open radiator grill.
2. Disconnect hose (1).
   ★ Fit blind plugs to prevent dirt or dust from getting into the piping.
3. Remove hydraulic oil cooler assembly (2).



INSTALLATION OF HYDRAULIC OIL COOLER ASSEMBLY

- Carry out installation in the reverse order to removal.

- **Refilling with oil (hydraulic tank)**
  ★ Add engine oil through oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

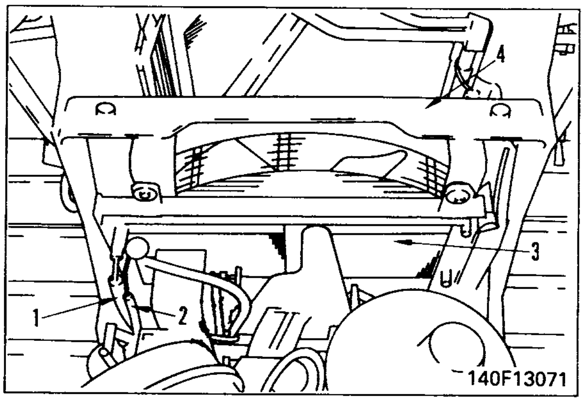
REMOVAL OF ENGINE ASSEMBLY (Cab specification)

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

⚠ Disconnect the cable from the negative (–) terminal of the battery.

★ Close the fuel supply valve of the fuel tank.

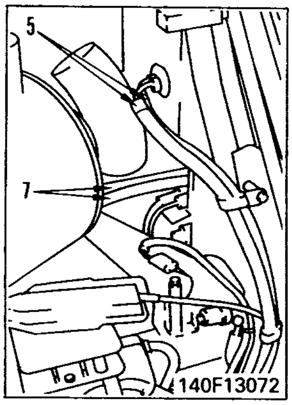
1. Remove radiator assembly.
   For details, see REMOVAL OF RADIATOR ASSEMBLY.

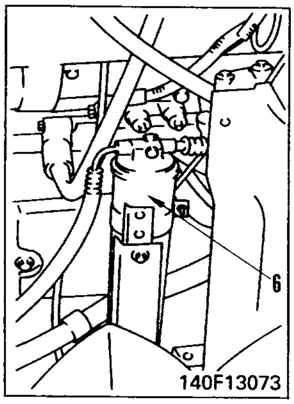


2. Disconnect air conditioner hoses (1) and (2), then remove air conditioner (3) together with bracket (4). ※1
   ★ Discharge the air conditioner gas completely before disconnecting the hoses.

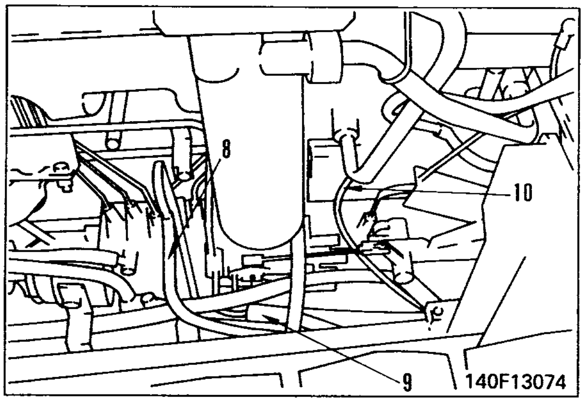
3. Disconnect air conditioner hose (5), and remove receiver tank (6) together with bracket then move towards engine. ※2

4. Disconnect heater hose (7).



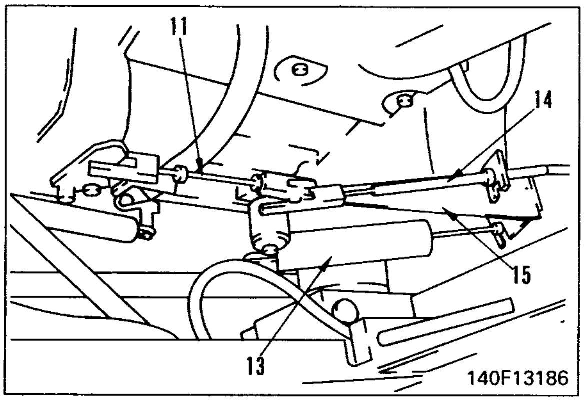


5. Disconnect fuel supply hose (8), fuel return hose (9), and spill hose (10).
   ★ If the fuel tank is full, fuel will flow out when hoses (9) and (10) are disconnected, so after disconnecting them, bend the hoses and tie them with string.



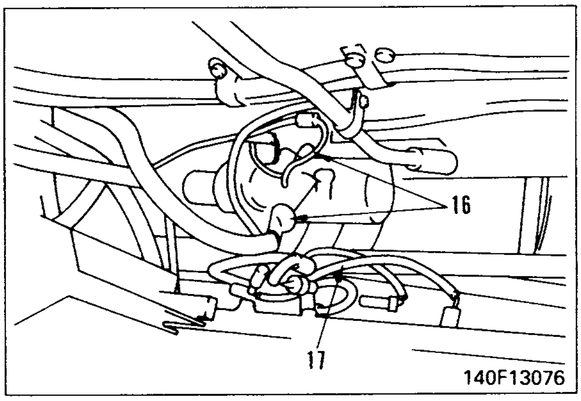
6. Disconnect fuel control rods (11) and (13), and cable (14). ※3

7. Remove bracket (15).



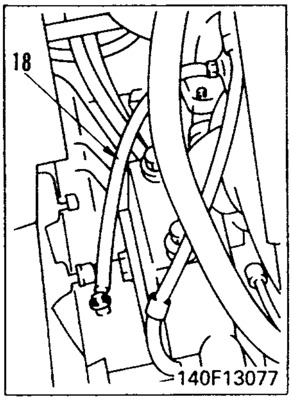
8. Disconnect starting motor wiring (16).

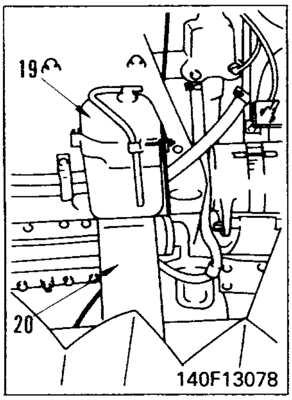
9. Disconnect CN17, CN18, and CN20 of central wiring connector (17).



10. Disconnect ground connection (18).

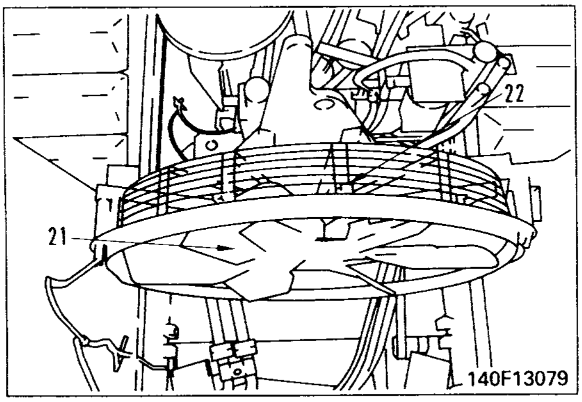
11. Remove reserve tank (19) together with bracket (20).



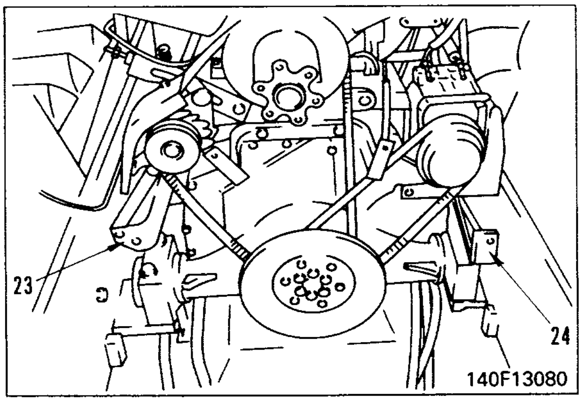


12. Remove fan (21).

13. Remove fan guard and shroud assembly (22).

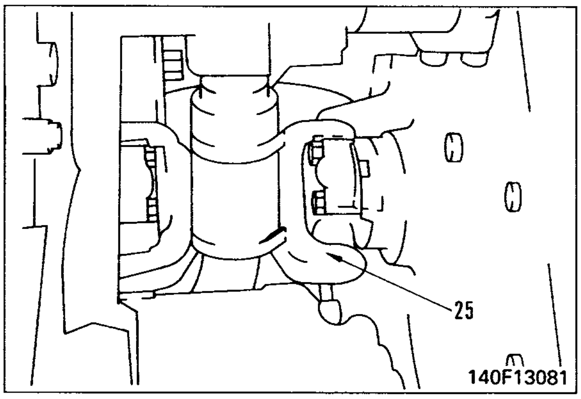


14. Remove brackets (23) and (24).

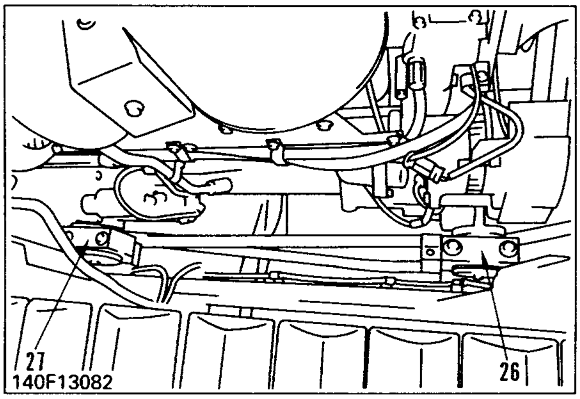


15. Open chassis bottom cover, and disconnect universal joint (25) at damper end. ※ 4

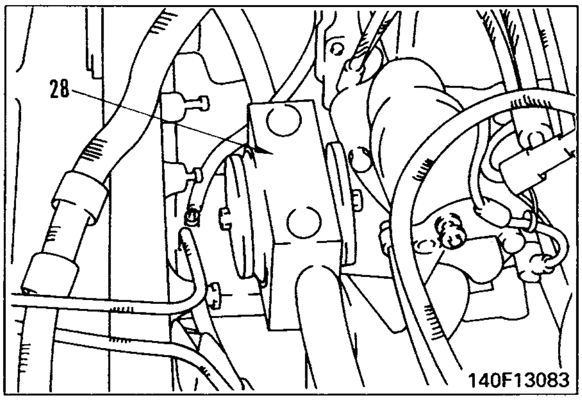
⚠ The bottom cover weighs 26 kg, so support it with a transmission jack before removing the mounting bolts.



16. Remove left and right engine mount bolts at front (26) and rear (27).



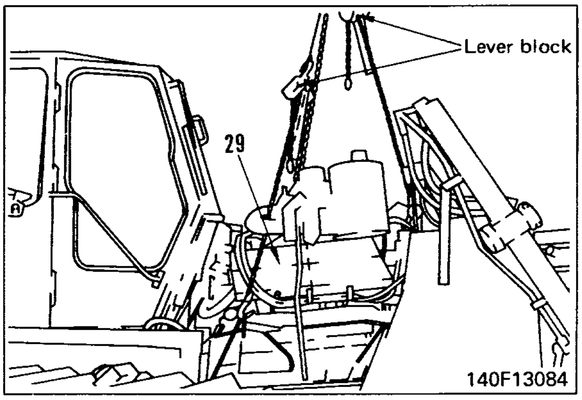
17. Fit wire around mount at left and right at rear of engine, and use a lever block to raise engine assembly, then remove engine mount cap (28) at rear right.



18. Move engine assembly (29) towards front of machine, and gradually lift it off.

★ When removing the engine assembly, be extremely careful not to damage the wiring or hoses.

kg Engine assembly: **1400 kg**



014012

INSTALLATION OF ENGINE ASSEMBLY (Cab specification)

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

- Carry out installation in the reverse order to removal.

※ 1, ※ 2

★ Install the hoses without twisting.

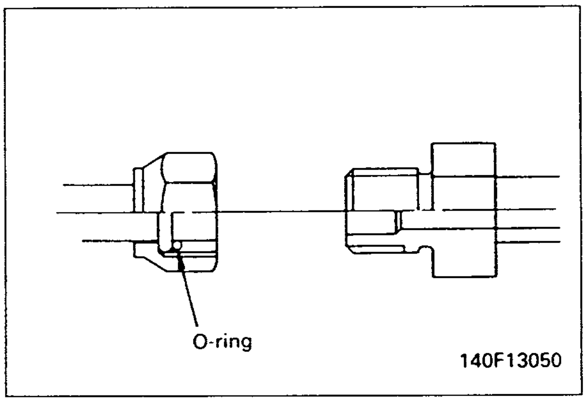
★ When installing the hoses for the cooler circuit, be careful not to let dirt, dust, or water get into the hoses.

★ After assembling the whole cooler cycle, charge with 1000 ± 100g of air conditioner refrigerant (R-12) from the air conditioner compressor.

kgm The tightening torque for the unified thread of the air conditioner gas piping shall be as follows.

Thread diameter	Tightening torque (Nm (kgm))
3/4 - 16 UNF	19.6 - 24.5 (2 - 2.5)
9/16 - 18 UNF	11.8 - 14.7 (1.2 - 1.5)
7/8 - 14 UNF	29.4 - 24.3 (3 - 3.5)

★ Check that there are O-rings at the connections of the cooler piping before assembling. Coat the O-ring well with compressor oil (Shell Suniso G or 5G).



※ 3

★ Adjust the rod and cable.
For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

※ 4

Universal joint mounting bolt thread:
Thread tightener (LT-2)

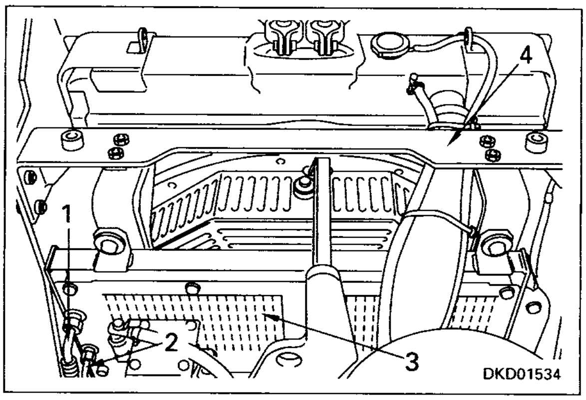
kgm Universal joint mounting bolt:
110.5 ± 12.3 Nm (11.25 ± 1.25 kgm)

REMOVAL OF ENGINE ASSEMBLY (Cab specification)

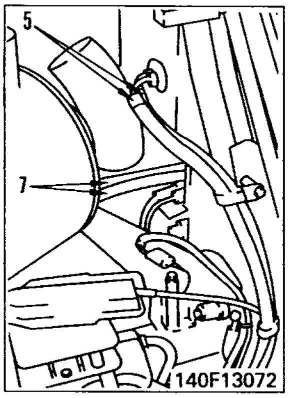
D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

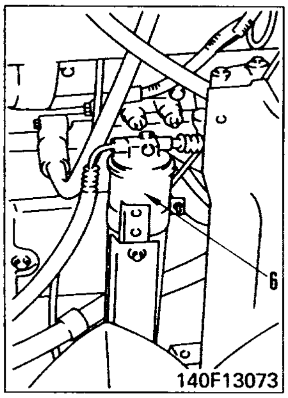
⚠ Disconnect the cable from the negative (–) terminal of the battery.

★ Close the fuel supply valve of the fuel tank.

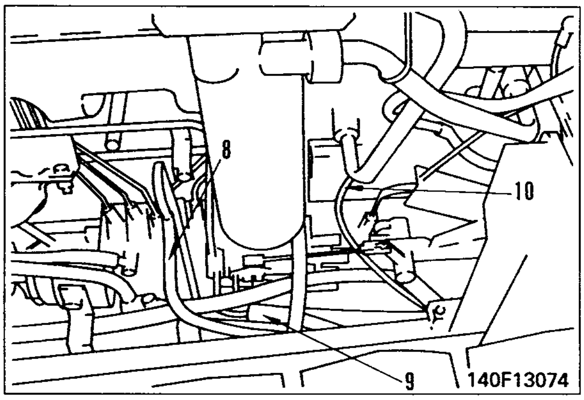


1. Remove radiator assembly.
   For details, see REMOVAL OF RADIATOR ASSEMBLY.
2. Disconnect air conditioner hoses (1) and (2), then remove air conditioner (3) together with bracket (4). ※1
   ★ Discharge the air conditioner gas completely before disconnecting the hoses.
3. Disconnect air conditioner hose (5), and remove receiver tank (6) together with bracket then move towards engine. ※2
4. Disconnect heater hose (7).

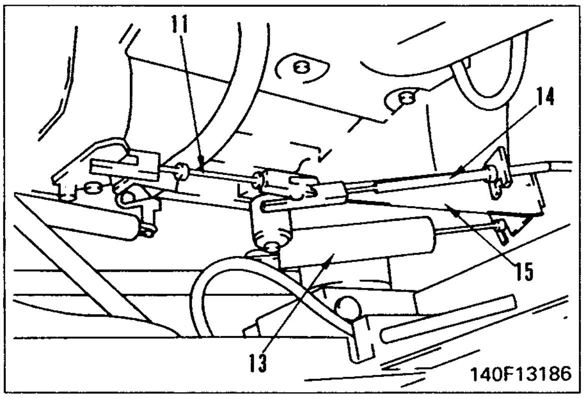




5. Disconnect fuel supply hose (8), fuel return hose (9), and spill hose (10).
   ★ If the fuel tank is full, fuel will flow out when hoses (9) and (10) are disconnected, so after disconnecting them, bend the hoses and tie them with string.

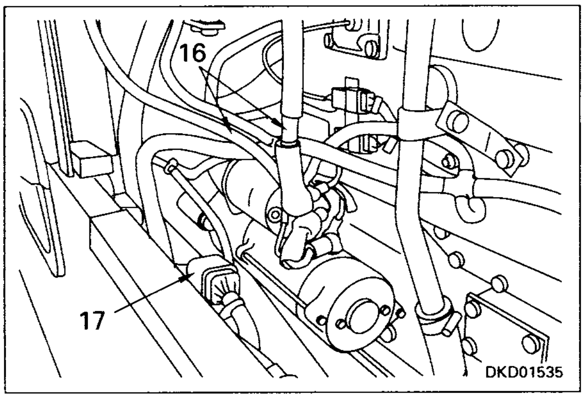


6. Disconnect fuel control rods (11) and (13), and cable (14). ※3
7. Remove bracket (15).



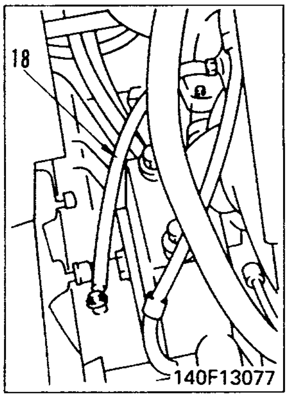
8. Disconnect starting motor wiring (16).

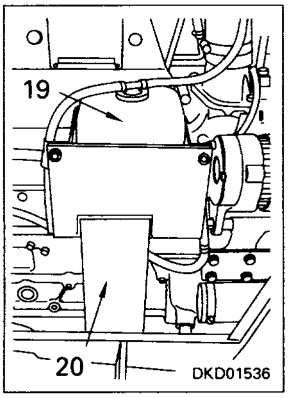
9. Disconnect wiring connector (17).



10. Disconnect ground connection (18).

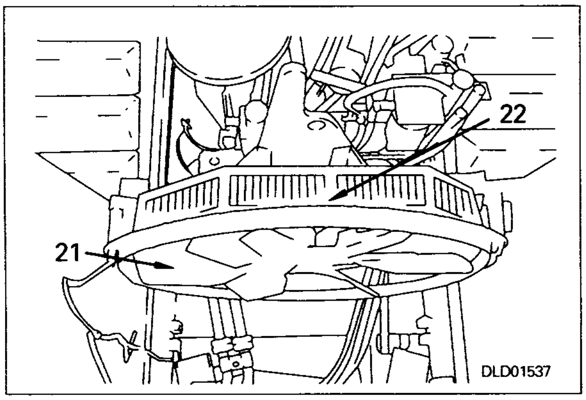
11. Remove reserve tank (19) together with bracket (20).



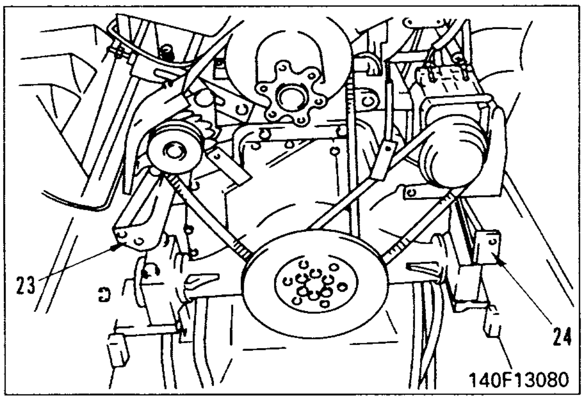


12. Remove fan (21).

13. Remove fan guard and shroud assembly (22).



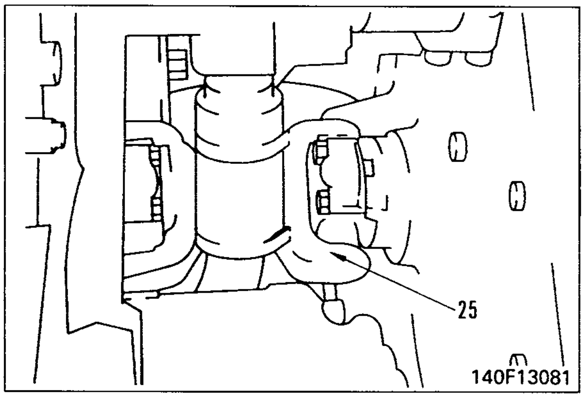
14. Remove brackets (23) and (24).



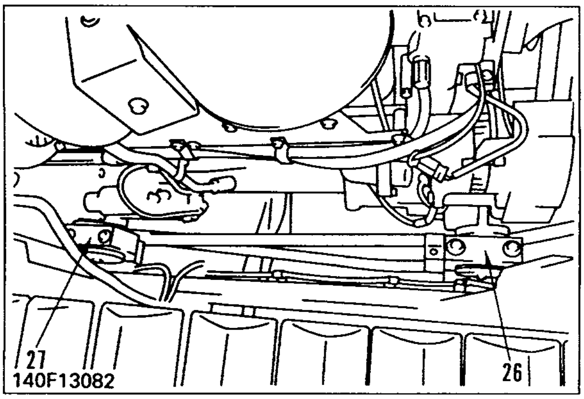
014012

15. Open chassis bottom cover, and disconnect universal joint (25) at damper end. ※ 4

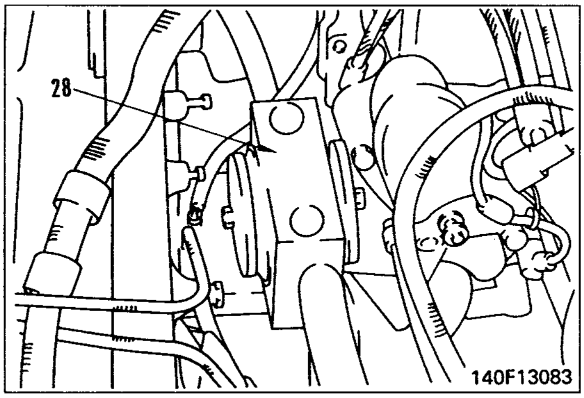
⚠ The bottom cover weights 26 kg, so support it with a transmission jack before removing the mounting bolts.



16. Remove left and right engine mount bolts at front (26) and rear (27).

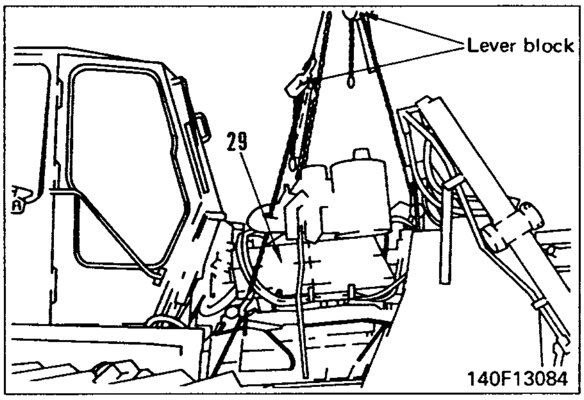


17. Fit wire around mount at left and right at rear of engine, and use a lever block to raise engine assembly, then remove engine mount cap (28) at rear right.



18. Move engine assembly (29) towards front of machine, and gradually lift it off.
    - ★ When removing the engine assembly, be extremely careful not to damage the wiring or hoses.

kg Engine assembly: **1400 kg**



INSTALLATION OF ENGINE ASSEMBLY (Cab specification)

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

- Carry out installation in the reverse order to removal.

※1, ※2

★ Install the hoses without twisting.

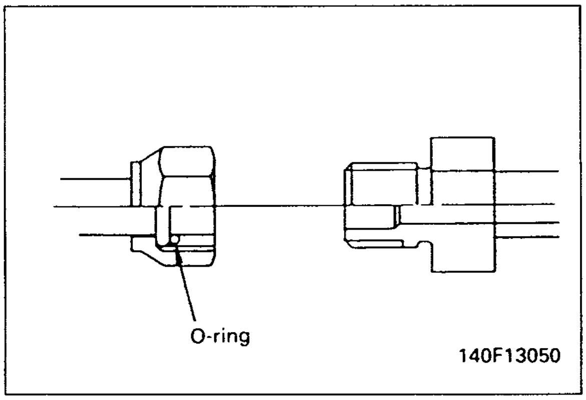
★ When installing the hoses for the cooler circuit, be careful not to let dirt, dust, or water get into the hoses.

★ After assembling the whole cooler cycle, charge with 1000 ± 100g of air conditioner refrigerant (R-12) from the air conditioner compressor.

kgm The tightening torque for the unified thread of the air conditioner gas piping shall be as follows.

Thread diameter	Tightening torque (Nm (kgm))
3/4 - 16 UNF	19.6 - 24.5 (2 - 2.5)
9/16 - 18 UNF	11.8 - 14.7 (1.2 - 1.5)
7/8 - 14 UNF	29.4 - 24.3 (3 - 3.5)

★ Check that there are O-rings at the connections of the cooler piping before assembling. Coat the O-ring well with compressor oil (Shell Suniso G or 5G).



※3

★ Adjust the rod and cable.
For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

※4

Universal joint mounting bolt thread:
Thread tightener (LT-2)

kgm Universal joint mounting bolt:
110.5 ± 12.3 Nm (11.25 ± 1.25 kgm)

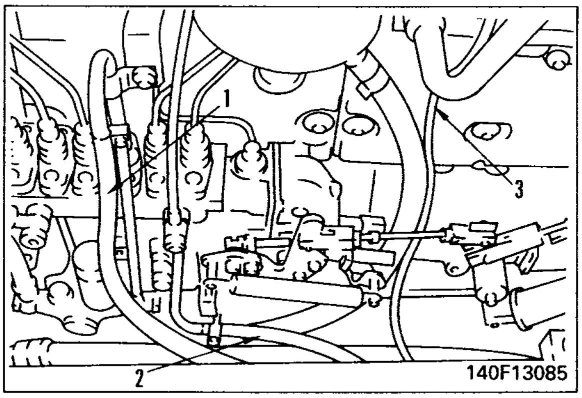
REMOVAL OF ENGINE ASSEMBLY (Cab specification)

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

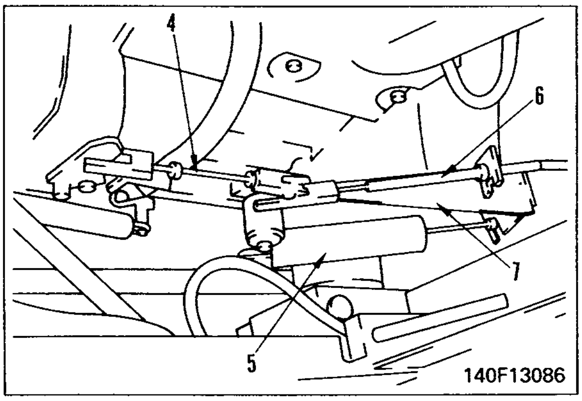
⚠ Disconnect the cable from the negative (–) terminal of the battery.

★ Close the fuel supply valve of the fuel tank.

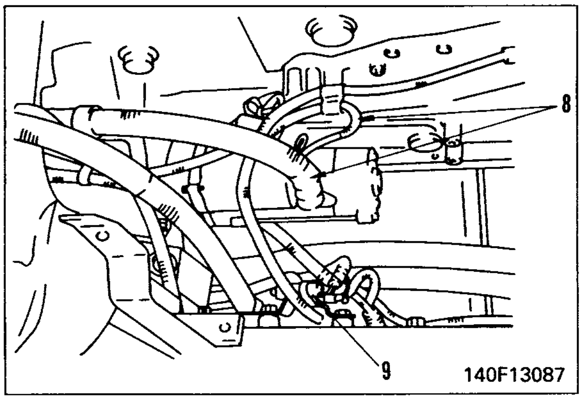
1. Remove radiator assembly.
   For details, see REMOVAL OF RADIATOR ASSEMBLY.



2. Disconnect fuel supply hose (1), fuel return hose (2), and spill hose (3).
   ★ If the fuel tank is full, fuel will flow out when hoses (2) and (3) are disconnected, so after disconnecting them, bend the hoses and tie them with string.

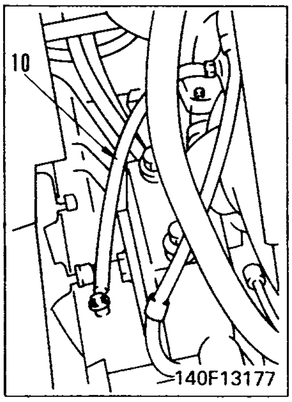


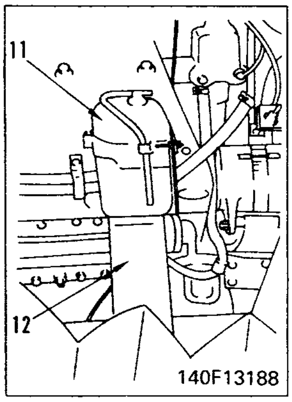
3. Disconnect fuel control rods (4) and (5), and cable (6), then remove bracket (7). ※1



4. Disconnect starting motor wiring (8).

5. Disconnect CN17, CN18, and CN20 of central wiring connector (9).



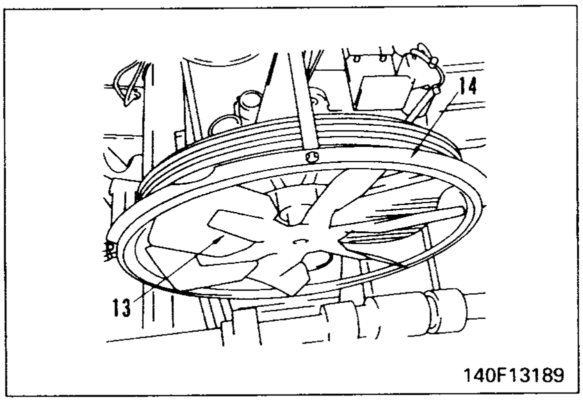


6. Disconnect ground connection (10).

7. Remove reserve tank (11) together with bracket (12).

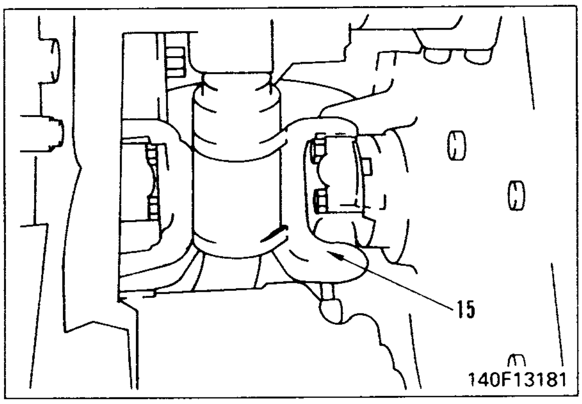
8. Remove fan (13).

9. Remove shroud (14).

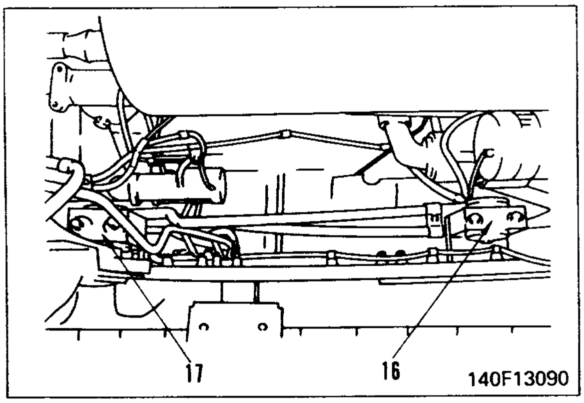


10. Open chassis bottom cover, and disconnect universal joint (15) at damper end. ※ 2

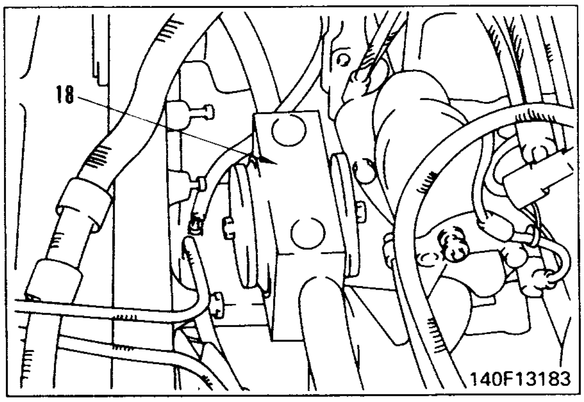
⚠ The bottom cover weight 26 kg, so support it with a transmission jack before removing the mounting bolts.



11. Remove left and right engine mount bolts at front (16) and rear (17).



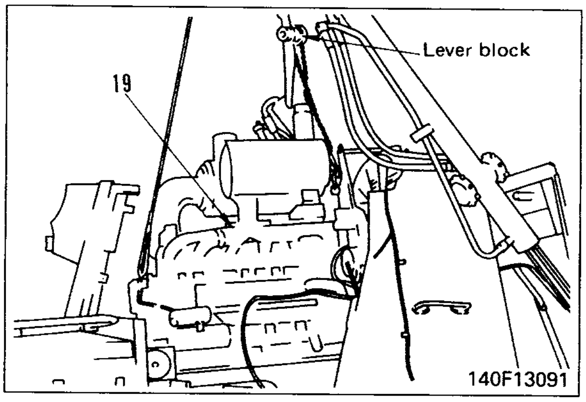
12. Use a lever block to raise engine assembly horizontally, then remove engine mount cap (18) at rear right.



13. Move engine assembly (19) towards front of machine, and gradually lift it off.

★ When removing the engine assembly, be extremely careful not to damage the wiring or hoses.

kg Engine assembly: **1300 kg**



INSTALLATION OF ENGINE ASSEMBLY (Canopy specification)

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

- Carry out installation in the reverse order to removal.

※ 1

★ Adjust the rod and cable. For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

※ 2

Universal joint mounting bolt thread:
Thread tightener (LT-2)

kgm Universal joint mounting bolt:
110.5 ± 12.3 Nm (11.25 ± 1.25 kgm)

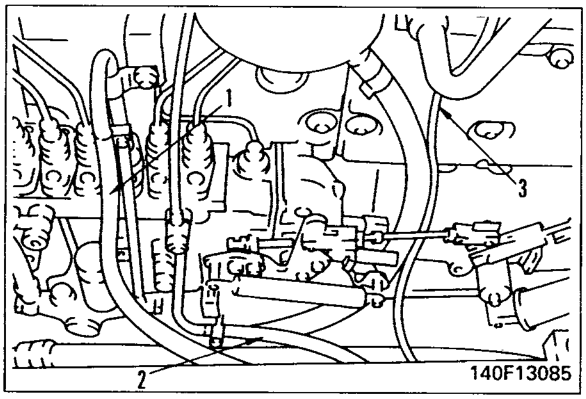
014012

REMOVAL OF ENGINE ASSEMBLY (Canopy specification)

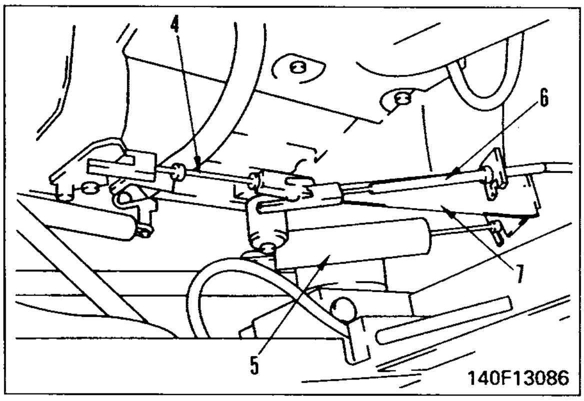
D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

⚠ Disconnect the cable from the negative (–) terminal of the battery.

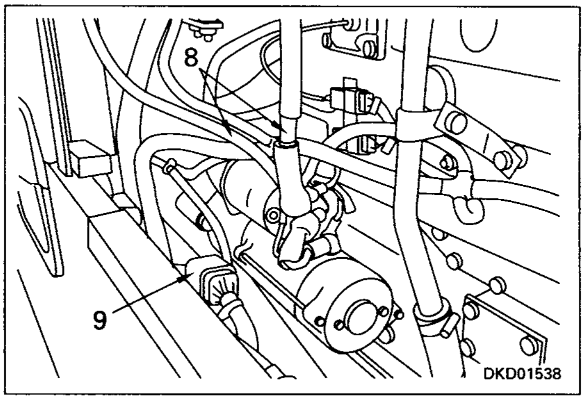
★ Close the fuel supply valve of the fuel tank.



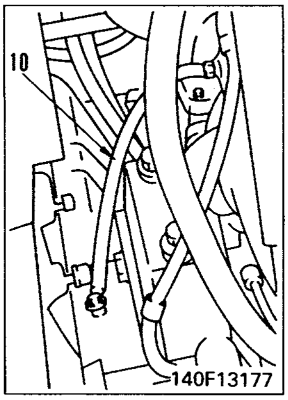
1. Remove radiator assembly.
   For details, see REMOVAL OF RADIATOR ASSEMBLY.
2. Disconnect fuel supply hose (1), fuel return hose (2), and spill hose (3).
   ★ If the fuel tank is full, fuel will flow out when hoses (2) and (3) are disconnected, so after disconnecting them, bend the hoses and tie them with string.
3. Disconnect fuel control rods (4) and (5), and cable (6), then remove bracket (7). ※1

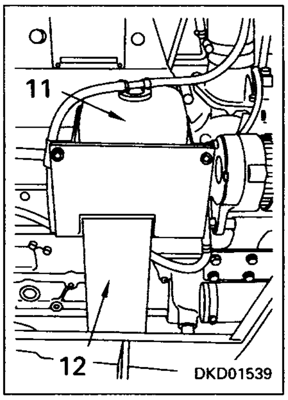


4. Disconnect starting motor wiring (8).
5. Disconnect wiring connector (9).



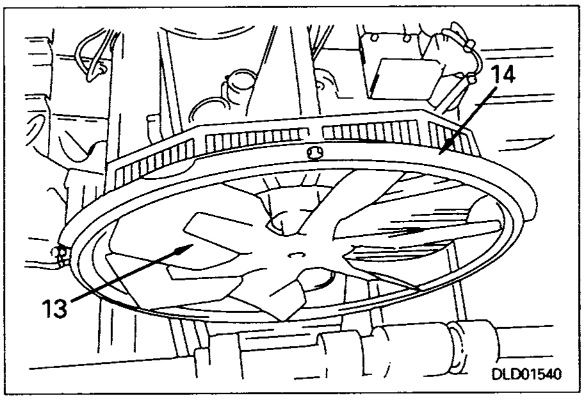
6. Disconnect ground connection (10).
7. Remove reserve tank (11) together with bracket (12).





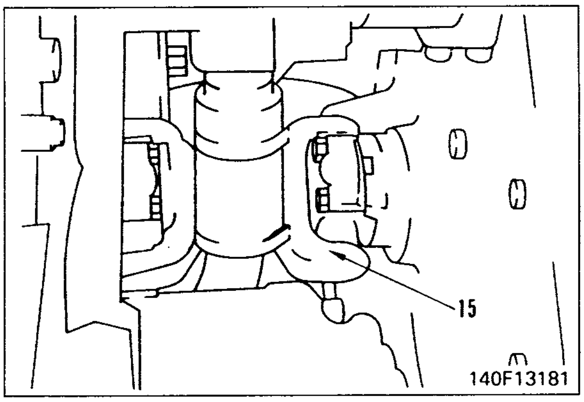
8. Remove fan (13).

9. Remove shroud (14).

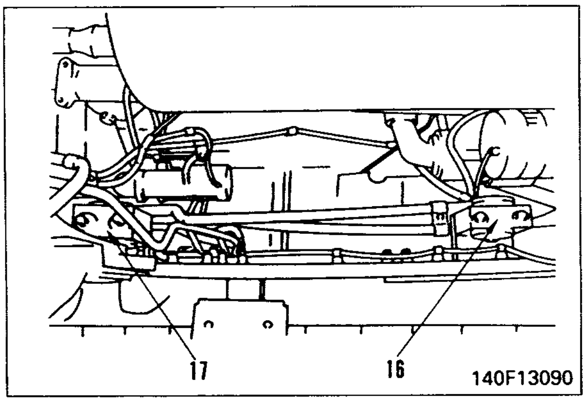


10. Open chassis bottom cover, and disconnect universal joint (15) at damper end. ※ 2

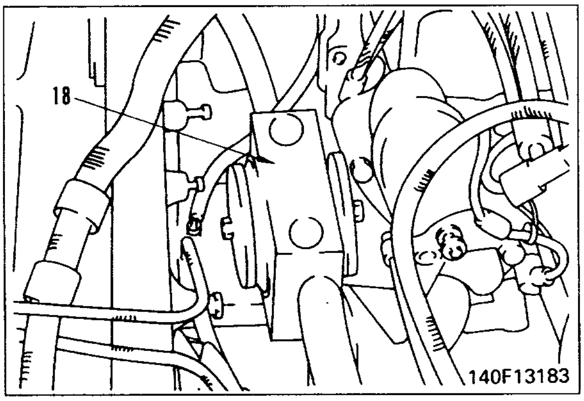
⚠ The bottom cover weight 26 kg, so support it with a transmission jack before removing the mounting bolts.



11. Remove left and right engine mount bolts at front (16) and rear (17).

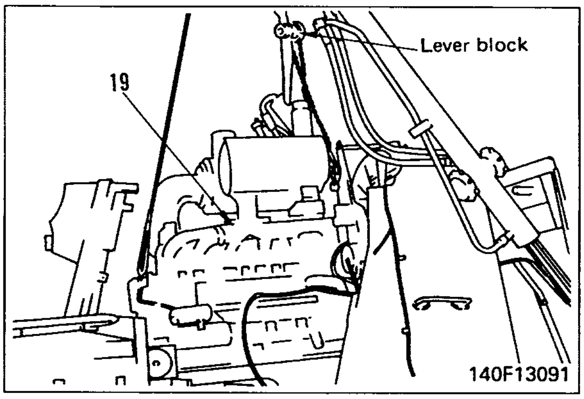


12. Use a lever block to raise engine assembly horizontally, then remove engine mount cap (18) at rear right.



13. Move engine assembly (19) towards front of machine, and gradually lift it off.
    ★ When removing the engine assembly, be extremely careful not to damage the wiring or hoses.

    kg Engine assembly: **1300 kg**



INSTALLATION OF ENGINE ASSEMBLY (Canopy specification)

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

- Carry out installation in the reverse order to removal.

※1

★ Adjust the rod and cable. For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

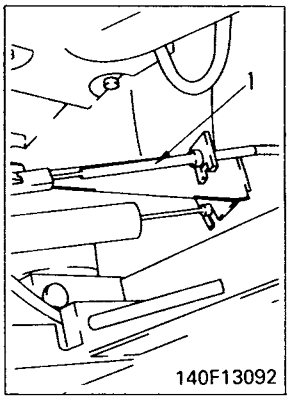
※2

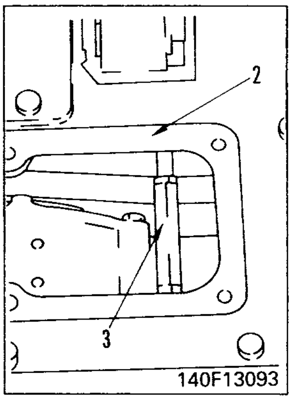
Universal joint mounting bolt thread:
Thread tightener (LT-2)
kgm Universal joint mounting bolt:
110.5 ± 12.3 Nm (11.25 ± 1.25 kgm)

014012

REMOVAL OF DAMPER ASSEMBLY

1. Disconnect deceleration cable (1) at engine end.
2. Remove cover of plate (2), and disconnect brake rod (3) at turnbuckle portion.
   ★ Measure the installed dimension of the rod before disconnecting the turnbuckle.

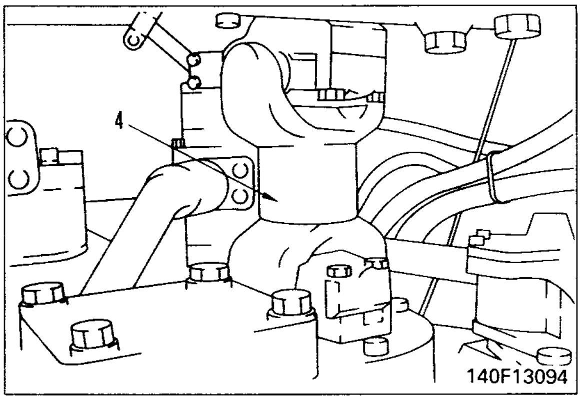




3. Remove plate (2).
4. Remove chassis bottom cover.

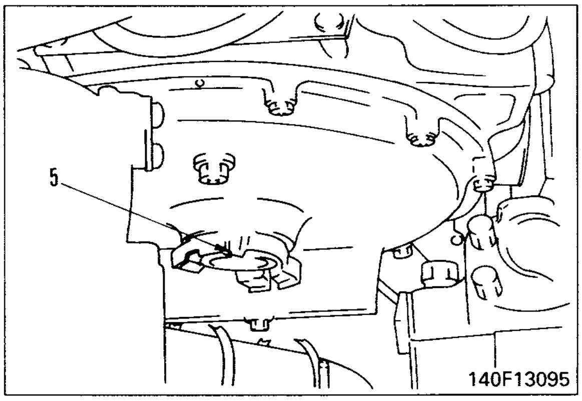
   ⚠ The bottom cover weights 26 kg, so support it with a transmission jack before removing the mounting bolts.

5. Sling universal joint (4), and remove mounting bolts, then remove universal joint.



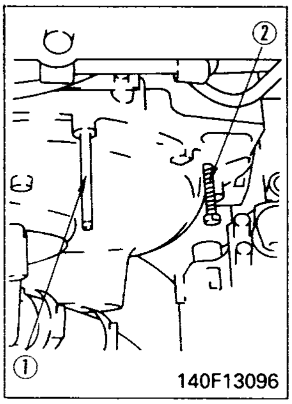
6. Remove coupling (5).
7. Remove drain plug of damper, and drain oil.

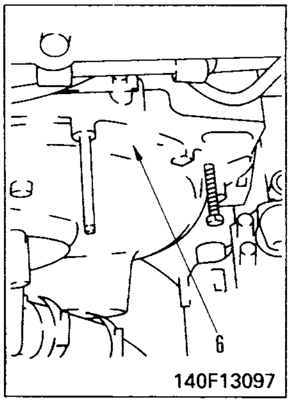
   Damper: **Approx. 1.7 ℓ**



8. Removing damper cover
   1) Remove mounting bolts, then set guide bolt ① in position, and use forcing screw ② to pull out pilot portion of damper cover assembly (6) to a point where it can be removed from flywheel housing.
   2) Sling damper cover assembly (6), remove forcing screw ②, then use guide bolt ① to move damper cover to center position, and remove from under chassis.

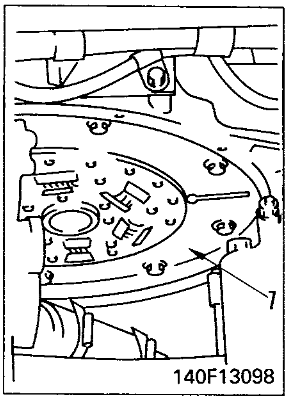
   kg Damper cover: **30 kg**

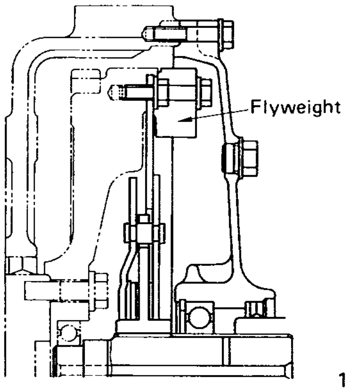




014012

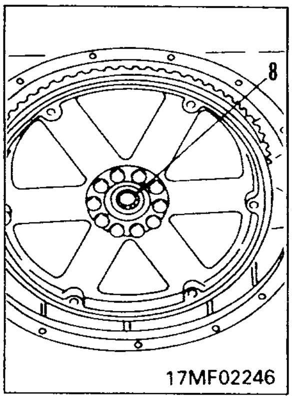
9. Remove damper (7).
   ★ For the direct drive machine, damper (7) and the flyweight are tightened together, so remove them as one unit.



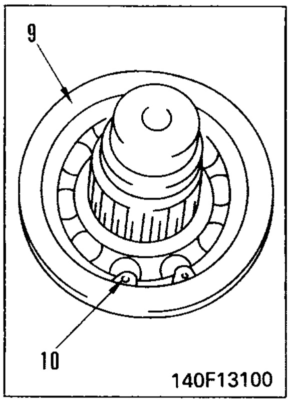


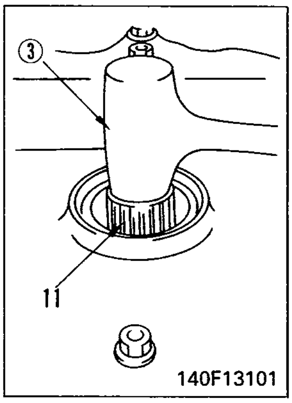
140F13099

10. Remove bearing (8) from flywheel.

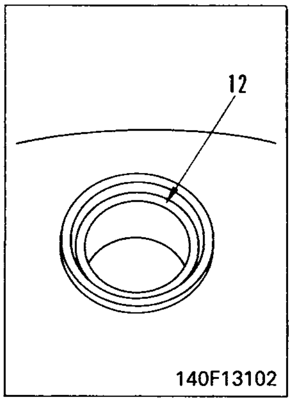


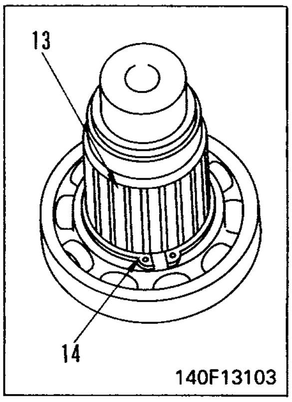
- **Disassembly of damper cover**
  1) Remove snap ring (10) from damper cover (9).
  2) Turn over damper cover, and set on block, then knock out shaft assembly (11) with plastic hammer ③.



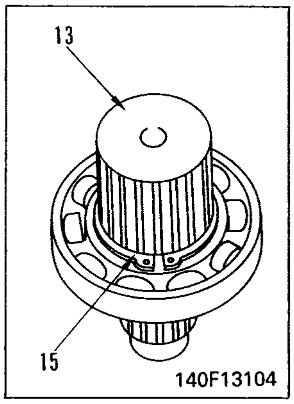


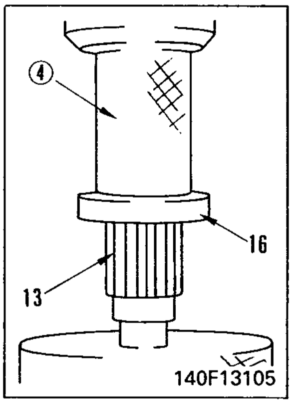
  3) Remove oil seal (12) from damper cover.
  4) Remove snap rings (14) and (15) from shaft (13).





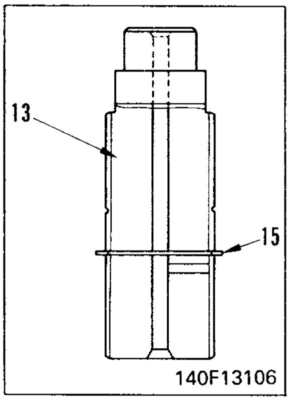
  5) Using push tool ④, pull out bearing (16) from shaft (13) with press.



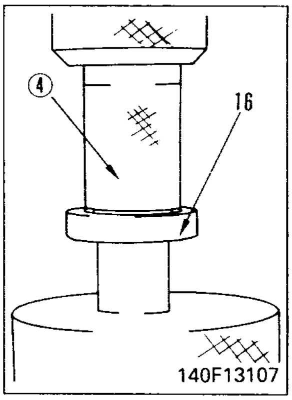


INSTALLATION OF DAMPER ASSEMBLY

- **Assembly of damper cover**
  1) Install snap ring (15) to shaft (13).
  2) Using push tool ④, press fit bearing (16) with press.

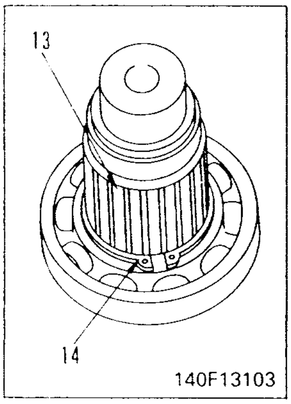


140F13106

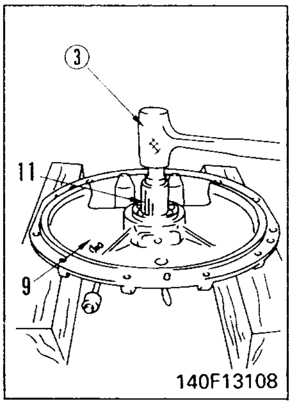


140F13107

  3) Install snap ring (14) to shaft (13).
     ★ Check that the snap ring is fitted securely in the groove of the shaft.
  4) Set damper cover (9) on block, and knock in shaft assembly (11) with plastic hammer ③.



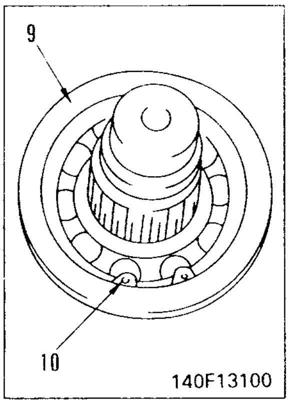
140F13103



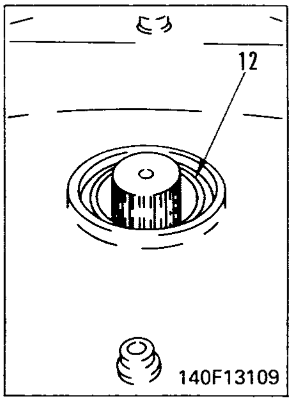
140F13108

  5) Install snap ring (10) to damper cover (9).
     ★ Check that the snap ring is fitted securely in the groove.
  6) Turn over damper cover, and install oil seal (12).

     Lip of oil seal: **Grease (G2-LI)**



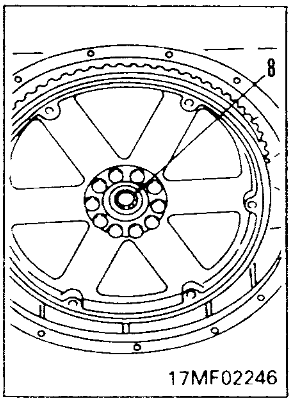
140F13100



140F13109

1. Install bearing (8) to flywheel.

Fill gap at shaded portion of Fig. a with approx. 70 g of grease (G2-LI).



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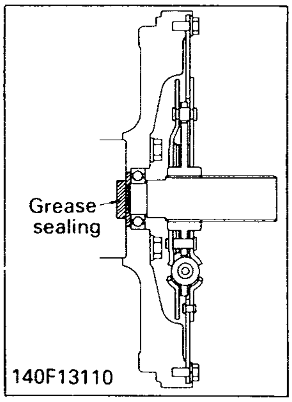
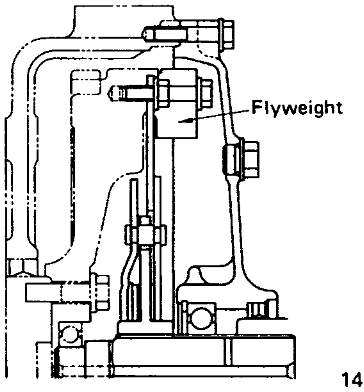


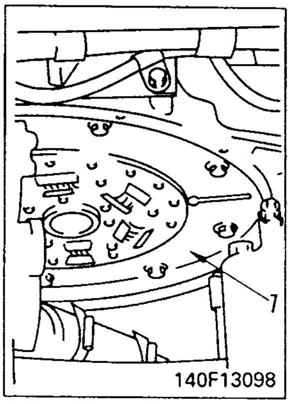
140F13110

2. Install damper (7) and flyweight (direct drive machine only)

Mounting bolt: **110.4 ± 13.3 Nm (11.3 ± 1.3 kgm)**



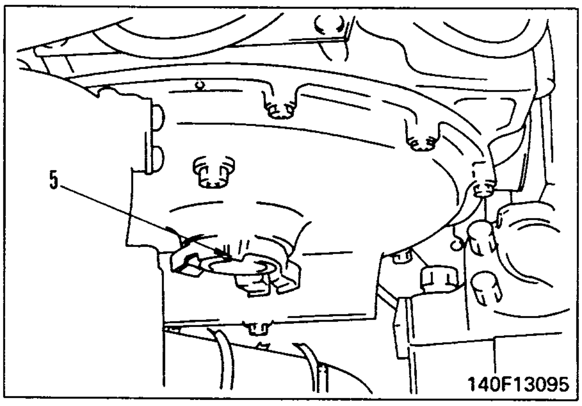
140F13099



140F13098

140F13111

3. Installation of damper cover
   1) Raise damper cover assembly (6), align with position of flywheel housing, then install guide bolt ① and align position of mounting bolt holes.
   2) Push in damper cover (6) and tighten mounting bolts.



140F13095

4. Install coupling (5).

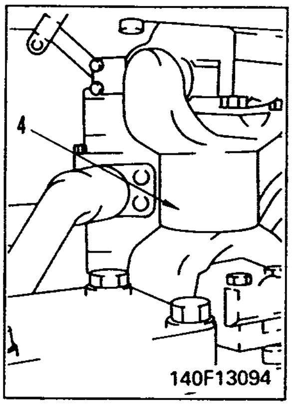
5. Refill damper with oil.

Damper: **Approx. 1.7 ℓ**

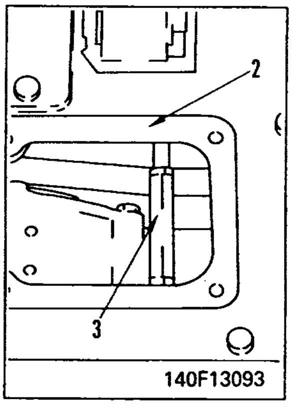
6. Raise universal joint (4) and install.

Mounting bolt: **Thread tightener (LT-2)**

Mounting bolt: **110.4 ± 12.3 Nm (11.3 ± 1.3 kgm)**



140F13094

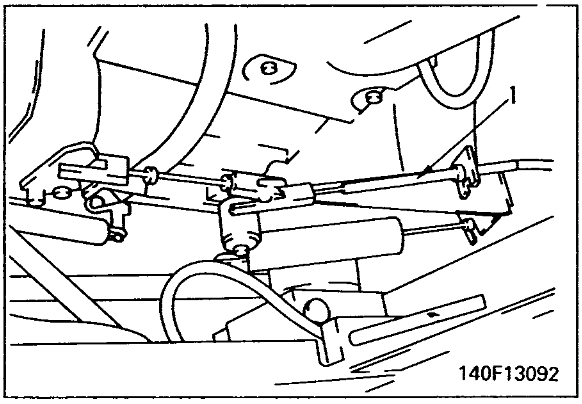


140F13093

7. Install plate (2) and connect turnbuckle of brake rod (3).
   ★ Adjust the rod. For details, see TESTING AND ADJUSTING, Adjusting brake pedal linkage.

8. Install deceleration cable (1).
   ★ Adjust the cable. For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

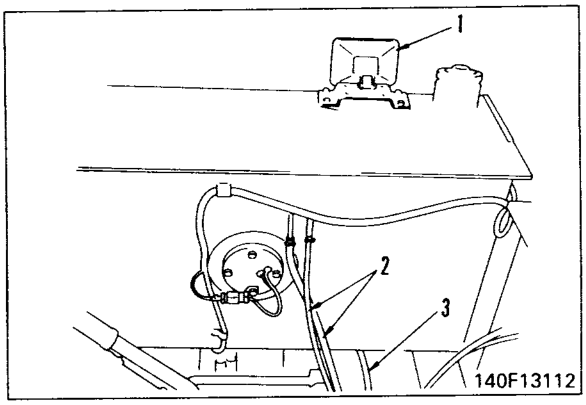
9. Using transmission jack, install chassis bottom cover.



140F13092

REMOVAL OF POWER TRAIN UNIT ASSEMBLY

D65E, P



1. Drain oil.

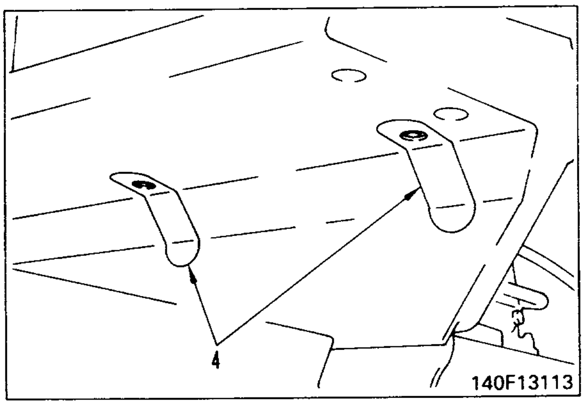
   Hydraulic tank: **Approx. 55 ℓ**

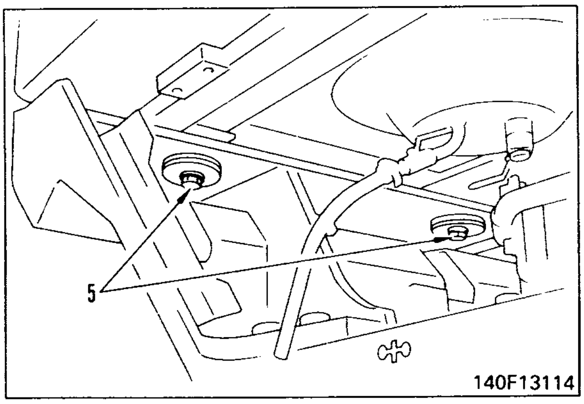
2. Remove floor frame assembly.
   For details, see REMOVAL OF FLOOR FRAME ASSEMBLY.

3. Remove rear lamp (1).

4. Disconnect fuel return hose (2) and fuel supply hose (3). ※1

5. Remove fuel tank mount bolt cover (4), then remove 4 mount bolts (5).





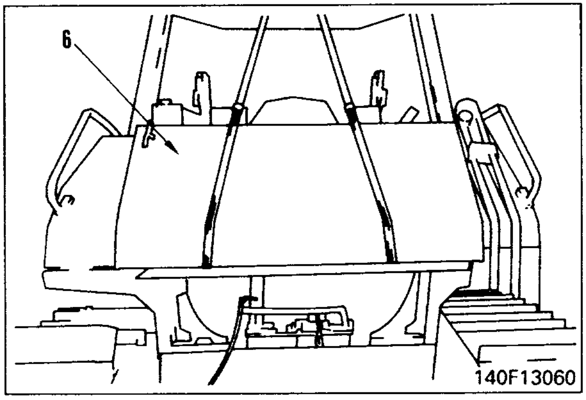
014012

D65E-12 60001 - 60947
D65P-12 60001 - 60890

6. Lift off fuel tank assembly (6).
   ★ Raise the rear of the tank slightly, fit the sling rope around the tank at two places, then lift it off.

   Fuel tank assembly: **120 kg (when empty)**
   Approx. 400 kg (when full)

D65E-12 60001 - 60947
D65P-12 60001 - 60890

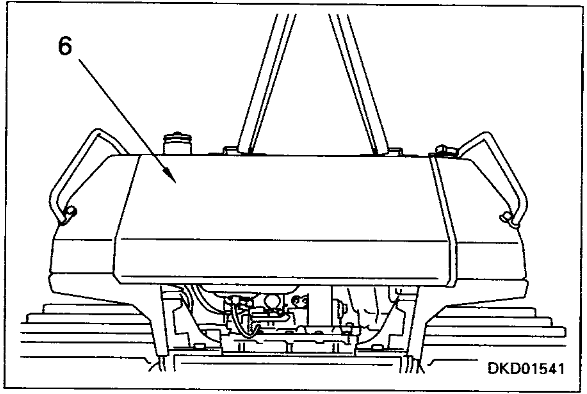


D65E-12 60948 and up
D65P-12 60891 and up

6. Lift off fuel tank assembly (6).

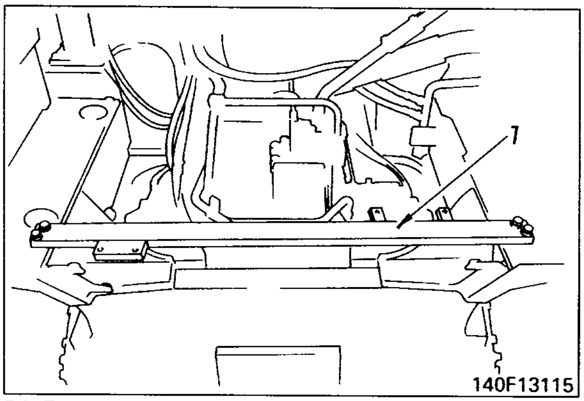
kg Fuel tank assembly: **120 kg (when empty)**
Approx. 400 kg (when full)

D65E-12 60948 and up
D65P-12 60891 and up

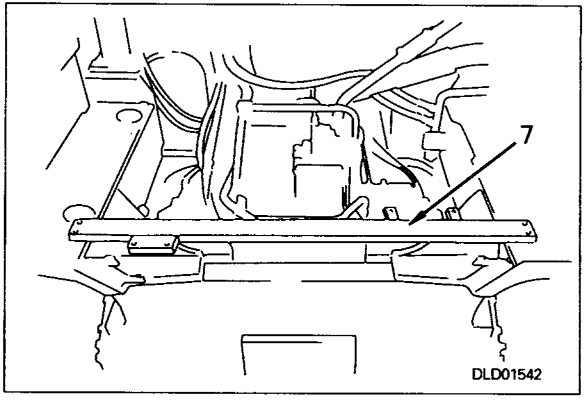


7. Remove bar (7). ※2

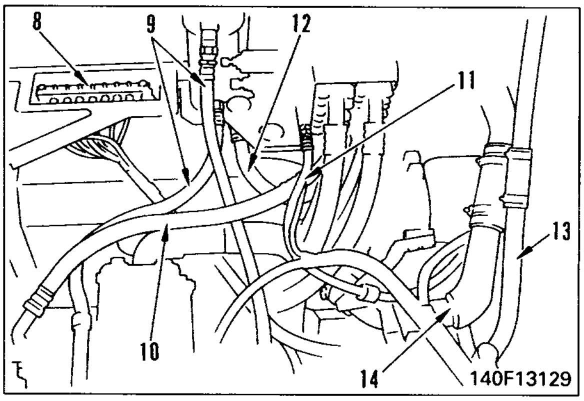
D65E-12 60001 - 60947
D65P-12 60001 - 60890



D65E-12 60948 and up
D65P-12 60891 and up

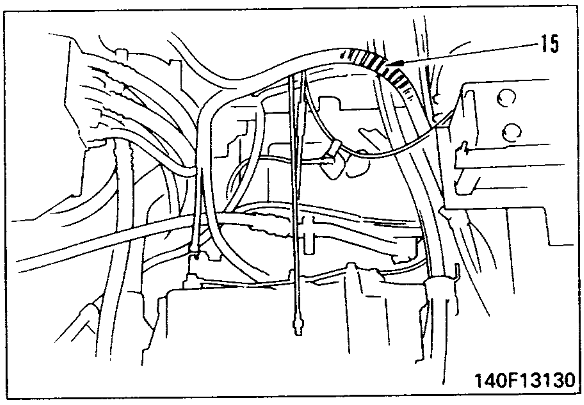


8. Remove top cover of central pressure detection port, then remove bracket (8) from frame.
9. Disconnect 2 power train filter outlet and inlet hoses (9).
10. Disconnect work equipment pump outlet hose (10).
11. Disconnect hose (11) at tube end.
12. Remove pipe (12), power train oil supply pipe (13), and suction pipe (14).

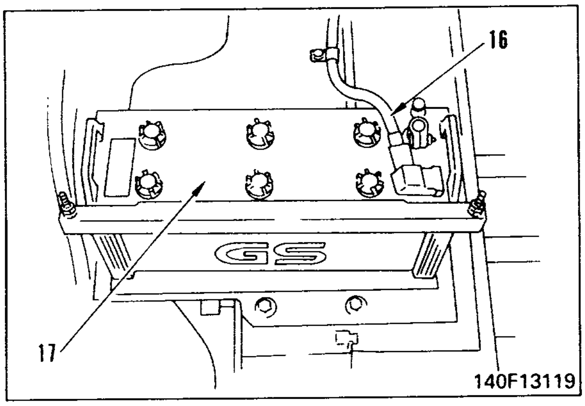


014012

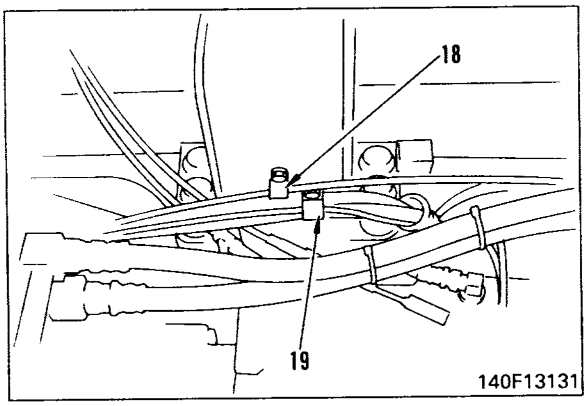
13. Remove PPC hoses (15) (set of 3).



14. Remove terminal wiring (16) and battery (17), then remove pedestal.

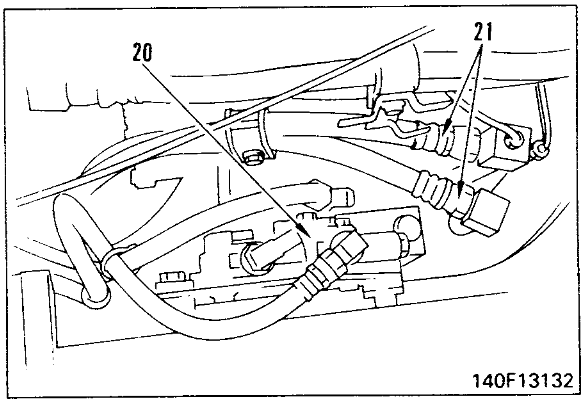


15. Remove fuel control cable clamp (18) and fuel hose clamp (19), then move to side so that cable and hose are not in the way.



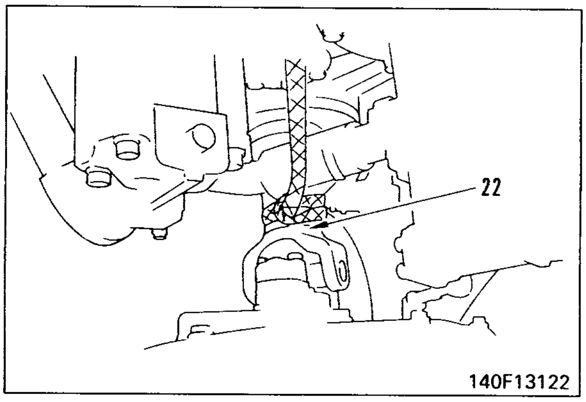
16. Remove PPC charge relief valve assembly (20) together with mount, and move towards engine.

17. Disconnect power train cooler hose (21).



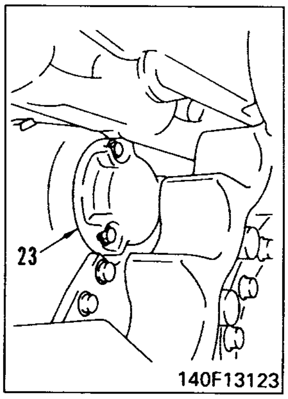
014012

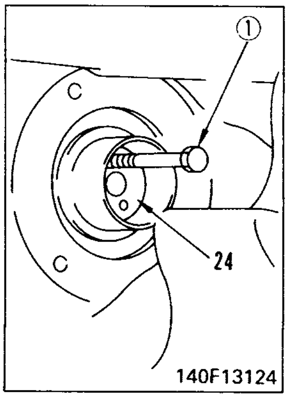
18. Remove universal joint (22). ※ 3



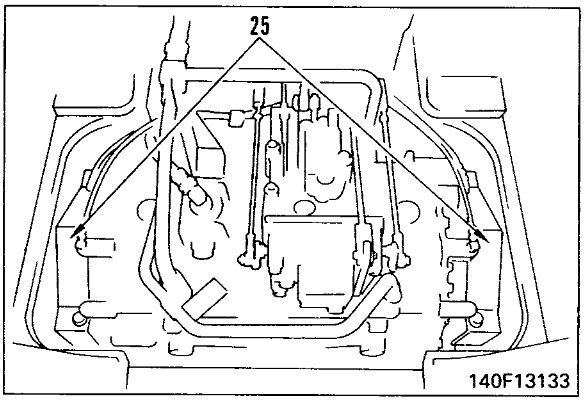
19. Remove final drive shaft cover (23), then use bolt ① to pull drive shaft (24) out to a position where spline portion at steering case end comes out.

★ If the shaft will not come out, move the sprocket (use a jack to push up the shoe grouser from the ground), and adjust to a position where the shaft can be removed. Then pull the shaft out.

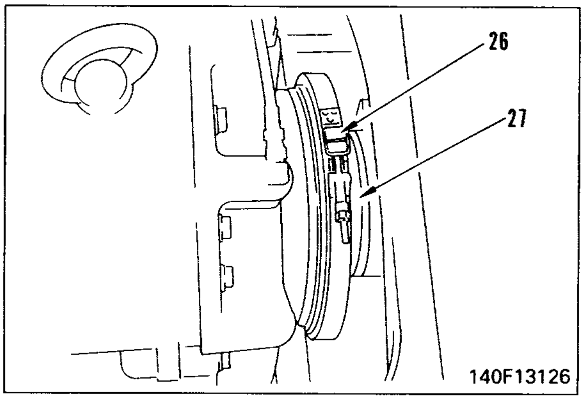




20. Remove mount caps (25) at both ends of steering case together with cover.

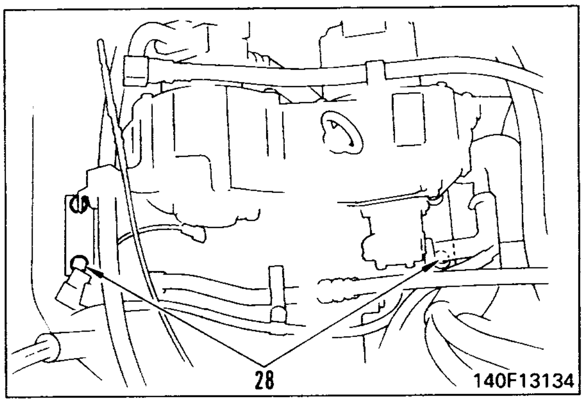


21. Loosen coupling clamp (26), then move seal (27) slightly towards outside (open). ※ 4



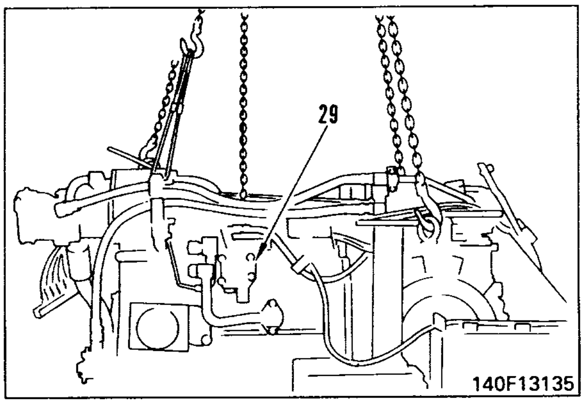
014012

22. Remove front mount bolts (28).



23. Lift off power train unit assembly (29).
- ★ Check that all wiring and piping has been disconnected before removing the power train unit assembly

kg Power train unit assembly: **1600 kg**



INSTALLATION OF POWER TRAIN UNIT ASSEMBLY

D65E, P

- Carry out installation in the reverse order to removal.

※ 1

kgm Fuel return hose (large) clamp:
3.3 ± 0.49 Nm (34 ± 5 kgcm)
kgm Fuel return hose (small) clamp:
0.2 ± 0.049 Nm (2 ± 0.5 kgcm)

※ 2

kgm Bar mounting bolt: **926.1 ± 102.9 Nm (94.5 ± 10.5 kgm)**

※ 3

Universal joint mounting bolt:
Thread tightener (LT-2)
kgm Universal joint mounting bolt:
110.25 ± 12.25 Nm (11.25 ± 1.25 kgm)

※ 4

★ Clamp the angled portion of the coupling seal securely, and assemble so that the clamp thread is parallel with the set surface of the cap mount.
kgm Coupling clamp nut:
6.615 ± 1.715 Nm (0.675 ± 0.175 kgm)

- **Refilling with oil**
  ★ Add oil through oil filler to the specified level.
  Run the engine to circulate the oil through the system.
  Then check the oil level again.

REMOVAL OF POWER TRAIN UNIT ASSEMBLY

D65EX, PX

1. Drain oil.

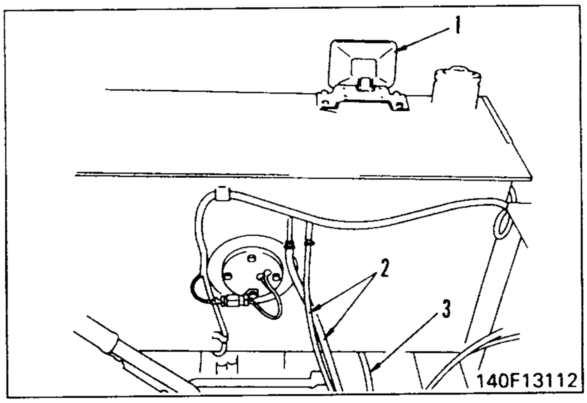
   Hydraulic tank: **Approx. 55 ℓ**

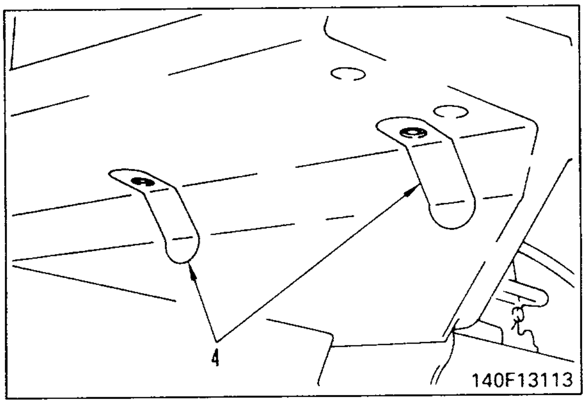
2. Remove floor frame assembly.
   For details, see REMOVAL OF FLOOR FRAME ASSEMBLY.

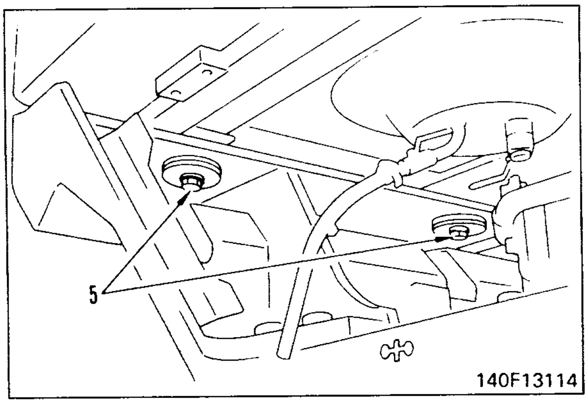
3. Remove rear lamp (1).

4. Disconnect fuel return hose (2) and fuel supply hose (3). ※ 1

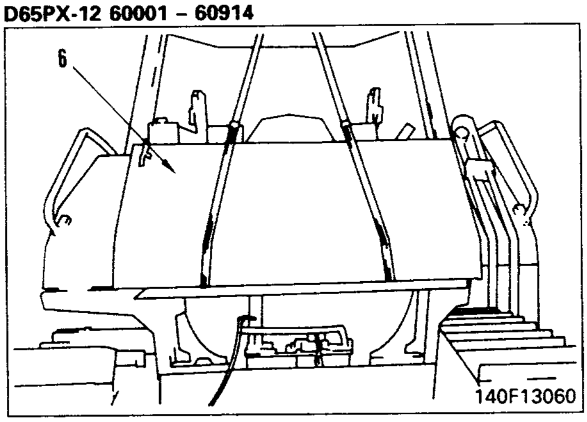
5. Remove fuel tank mount bolt cover (4), then remove 4 mount bolts (5).







D65EX-12 60001 - 60941
D65PX-12 60001 - 60914



D65EX-12 60001–60941
D65PX-12 60001–60914

6. Lift off fuel tank assembly (6).
   - ★ Raise the rear of the tank slightly, fit the sling rope around the tank at two places, then lift off.

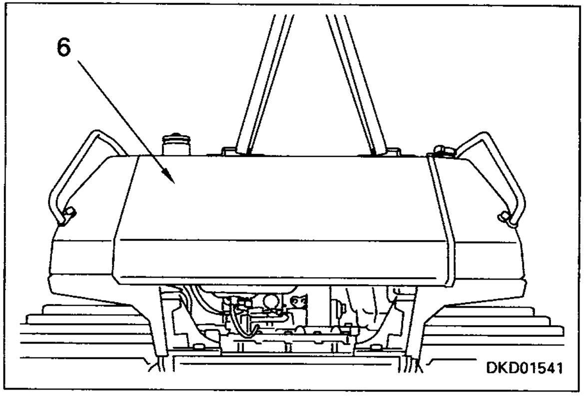
   Fuel tank assembly: **120 kg (when empty)**
   Approx. 400 kg (when full)

D65EX-12 60942 and up
D65PX-12 60915 and up

6. Lift off fuel tank assembly (6).

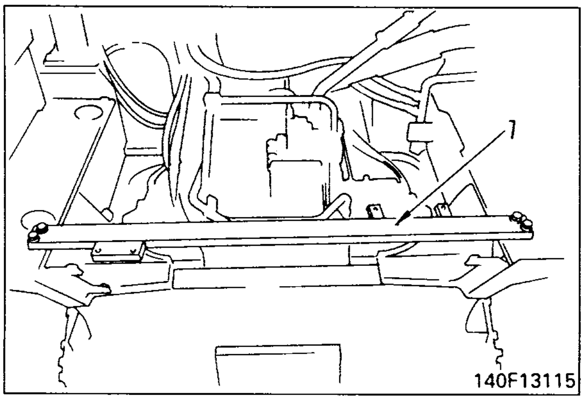
kg Fuel tank assembly: **120 kg (when empty)**
Approx. 400 kg (when full)

D65EX-12 60942 and up
D65PX-12 60915 and up

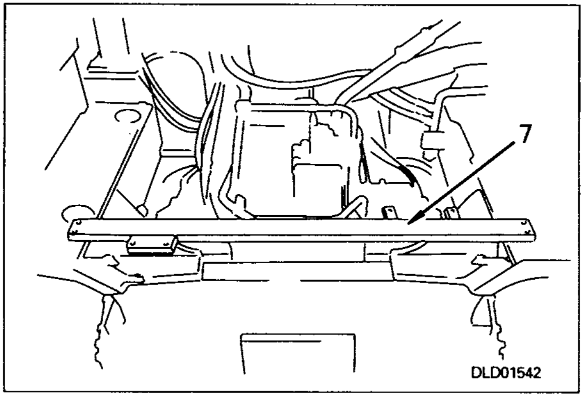


7. Remove bar (7). ※ 2

D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

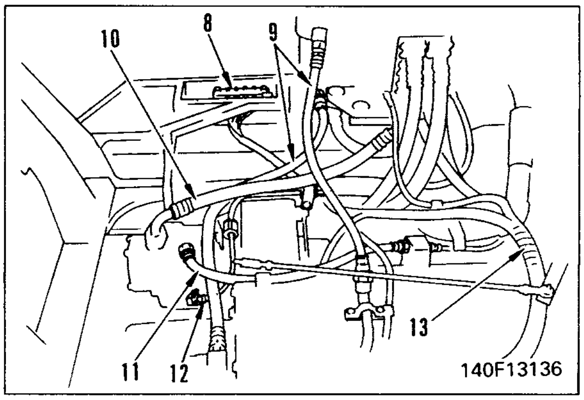


D65EX-12 60942 and up
D65PX-12 60915 and up



014012

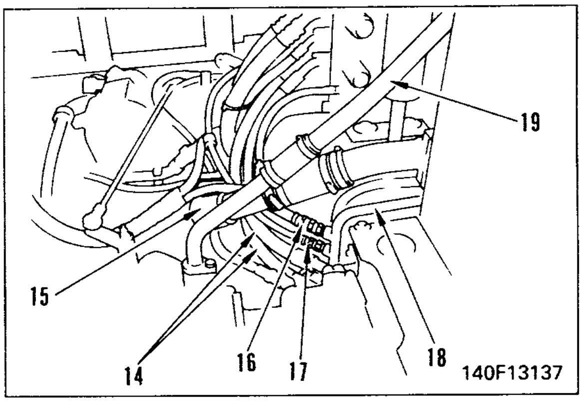
8. Remove top cover of central pressure detection port, the remove bracket (8) from frame.
9. Disconnect 2 power train filter outlet and inlet houses (9).
10. Disconnect HSS and hydraulic pump outlet hoses (10) and (11).
11. Disconnect hose (12) at valve end.
12. Remove PPC hoses (13) (set of 3).



13. Remove 2 HSS motor hoses (14) and HSS and hydraulic pump suction pipe (15) together with hose.

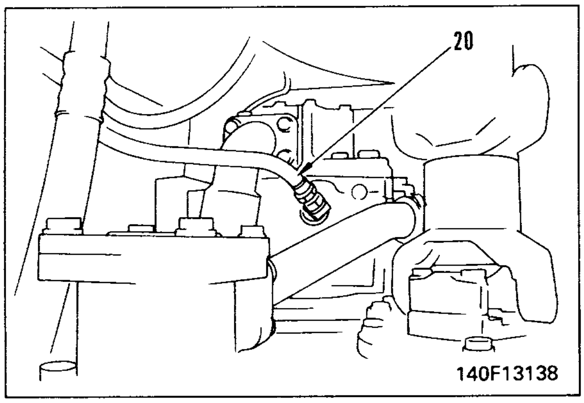
14. Disconnect hoses (16) and (17), and remove tube (18).

15. Remove power train oil supply pipe (19).



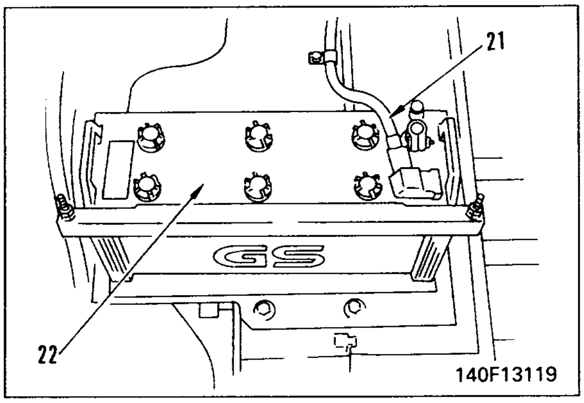
140F13137

16. Disconnect HSS pump bottom hose (20).



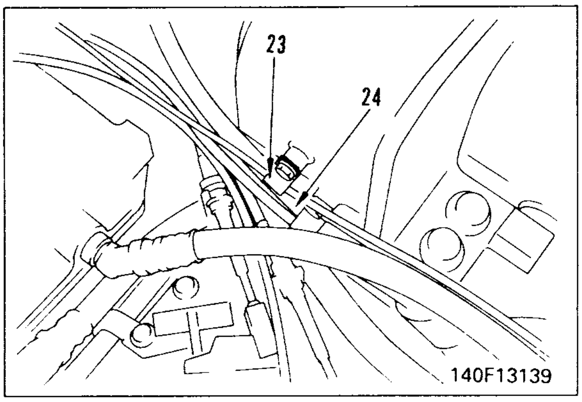
140F13138

17. Remove terminal wiring (21) and battery (22), then remove pedestal.



140F13119

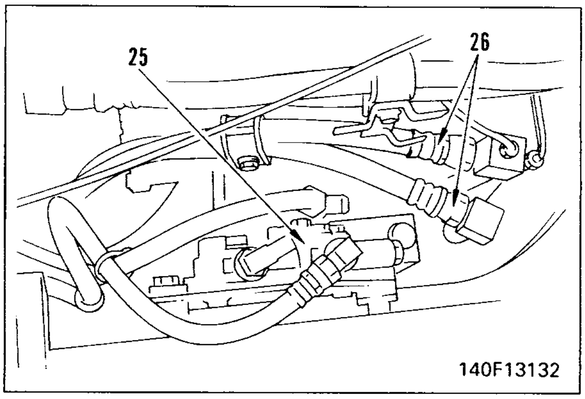
18. Remove fuel control cable clamp (23) and fuel hose clamp (24), then move to side so that cable and hose are not in the way.



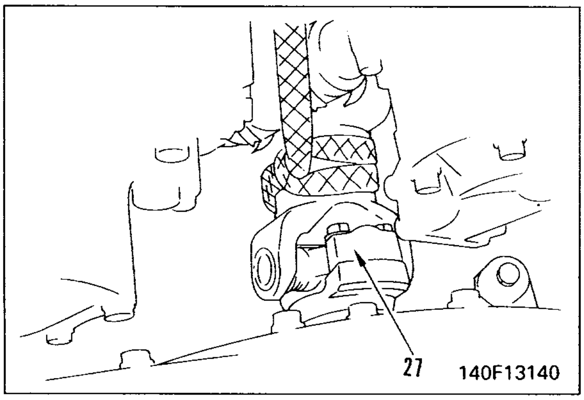
140F13139

19. Remove PPC charge relief valve assembly (25) together with mount, and move towards engine.

20. Disconnect power train cooler hose (26).

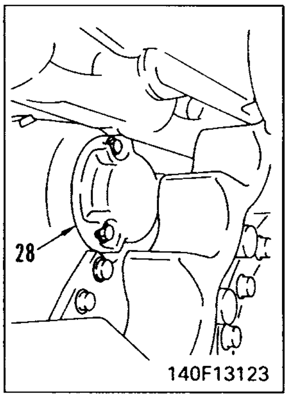


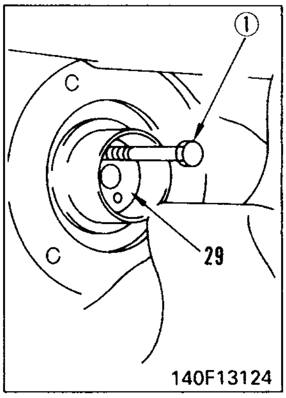
21. Remove universal joint (27). ※ 3



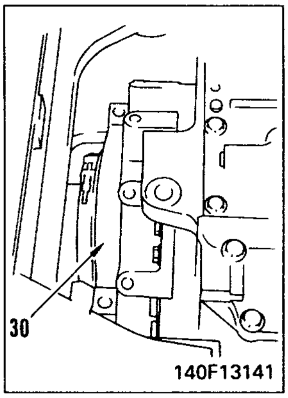
22. Remove final drive shaft cover (28), then use bolt ① to pull drive shaft (29) out to a position where spline portion at steering case end comes out.

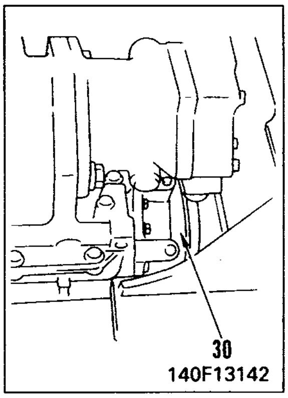
★ If the shaft will not come out, move the sprocket (use a jack to push up the shoe grouser from the ground), and adjust to a position where the shaft can be removed. Then pull the shaft out.



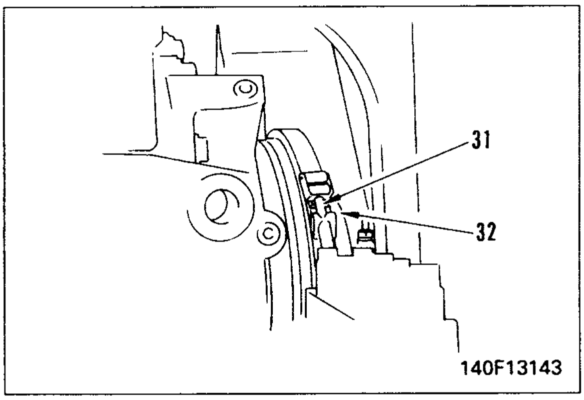


23. Remove mount caps (30) at both ends of steering case together with cover.



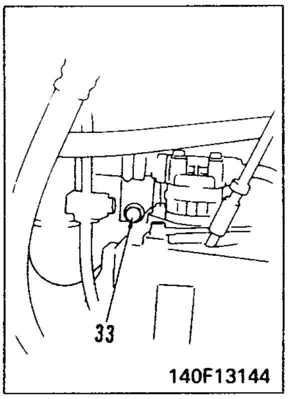


24. Loosen coupling clamp (31), then move seal (32) slightly towards outside (open). ※4

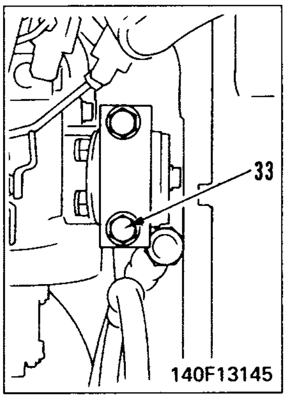


140F13143

25. Remove front mount bolts (33).



140F13144

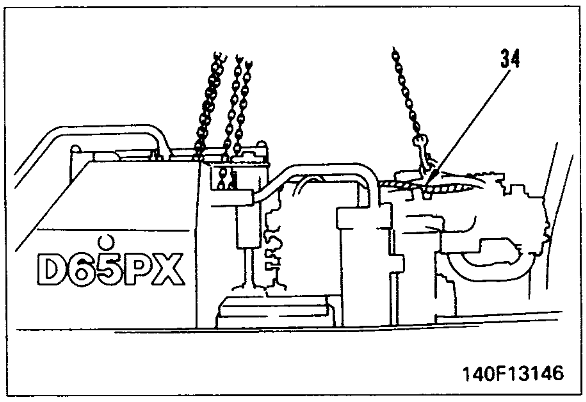


140F13145

26. Lift off power train unit assembly (34).

★ Check that all wiring and piping has been disconnected before removing the power train unit assembly.

kg Power train unit assembly: **1700 kg**



140F13146

INSTALLATION OF POWER TRAIN UNIT ASSEMBLY

D65EX, PX

- Carry out installation in the reverse order to removal.

※1

Fuel return hose (large) clamp:
3.3 ± 0.49 Nm (34 ± 5 kgcm)

Fuel return hose (small) clamp:
0.2 ± 0.049 Nm (2 ± 0.5 kgcm)

※2

Bar mounting bolt:
926.1 ± 102.9 Nm (94.5 ± 10.5 kgm)

※3

Universal joint mounting bolt:
Thread tightener (LT-2)

Universal joint mounting bolt:
110.25 ± 12.25 Nm (11.25 ± 1.25 kgm)

※4

★ Clamp the angled portion of the coupling seal securely, and assemble so that the clamp thread is parallel with the seat surface of the cap mount.

Coupling clamp nut:
6.615 ± 1.715 Nm
(0.675 ± 0.175 kgm)

- **Refilling with oil**

★ Add oil through oil filler to the specified level.
Run the engine to circulate the oil through the system.
Then check the oil level again.

SEPARATION OF POWER TRAIN UNIT

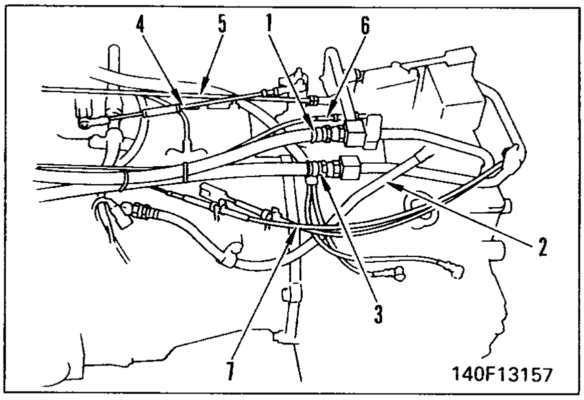
D65E, P

1. Remove drain plugs of steering case and transmission case, and drain oil from case.

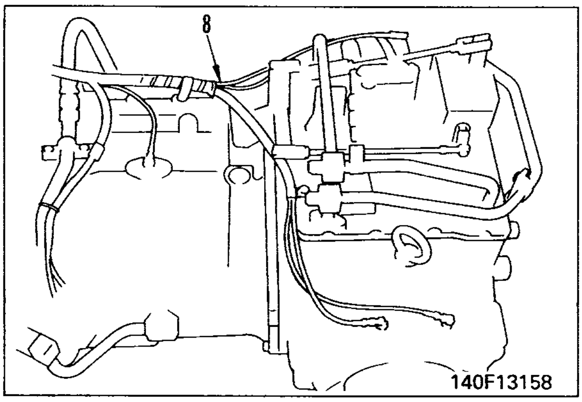
   Power train case: **Approx. 50 ℓ**

2. Remove hoses (1), (2) and (3).

3. Remove brake rods (4) and (5), and cables (6) and (7). ※1

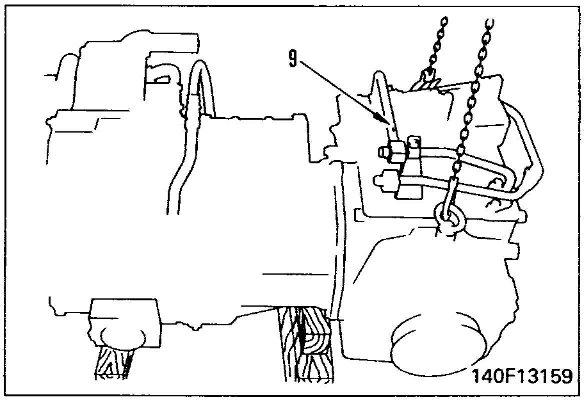


4. Remove pressure detection hose (8).



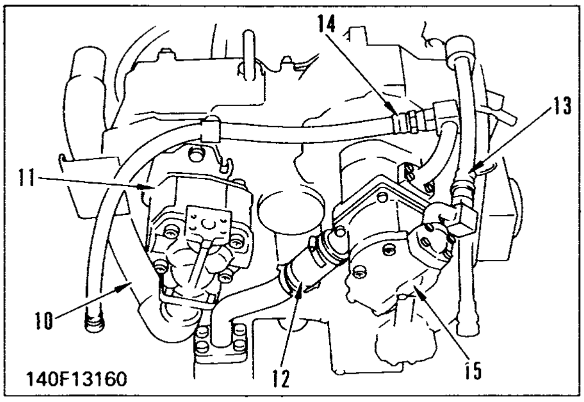
5. Sling steering case assembly (9), then remove mounting bolts, and disconnect from transmission case. ※2

   Steering case assembly: **800 kg**



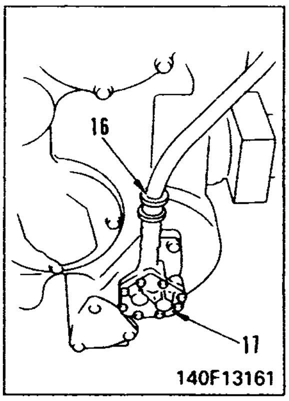
6. Remove suction tube (10), then remove hydraulic pump assembly (11).

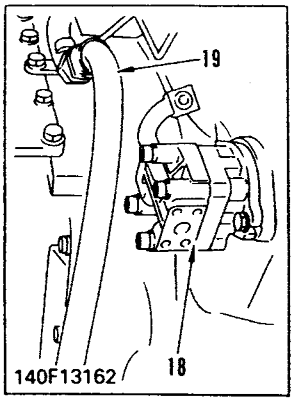
7. Remove suction tube (12) and outlet hoses (13) and (14), then remove tandem pump assembly (15).



8. Remove hose (16), then remove scavenging pump assembly (17).

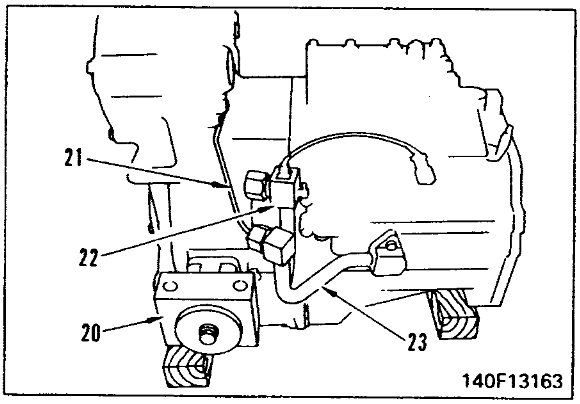
9. Remove PPC pump (18) and hose (19).





10. Remove left and right mounts (20).

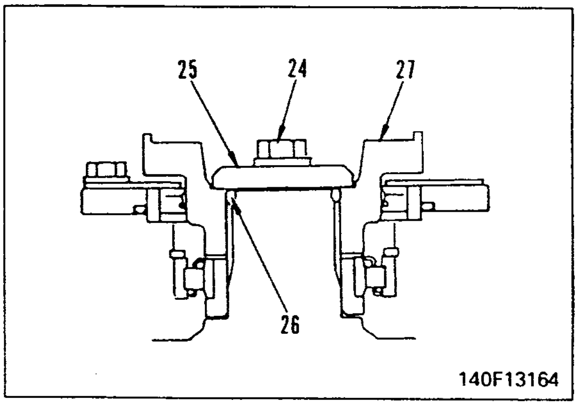
11. Disconnect tubes (21), and remove tubes (22) and (23).



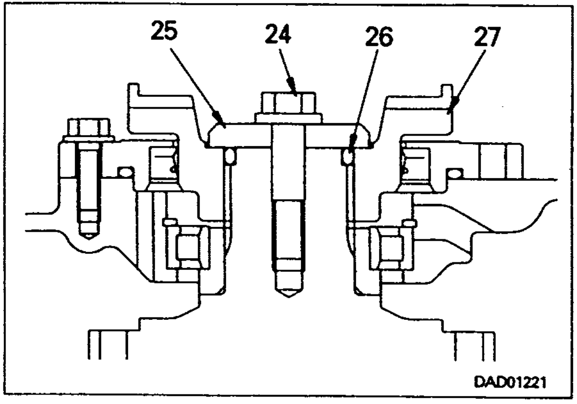
12. Set torque converter and transmission assembly with torque converter at top.

13. Remove bolt (24), then remove holder (25), O-ring (26), and coupling (27). ※3

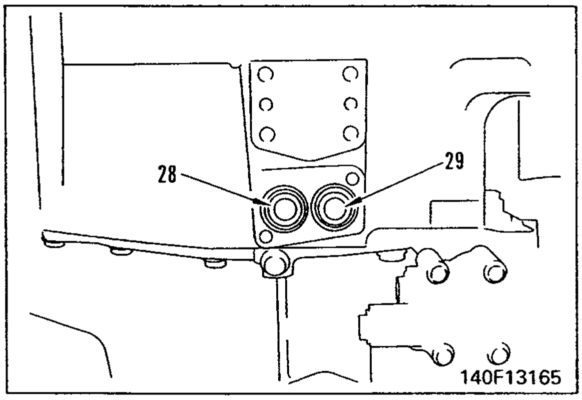
D65E-12 60001 — 60650
D65P-12 60001 — 60685



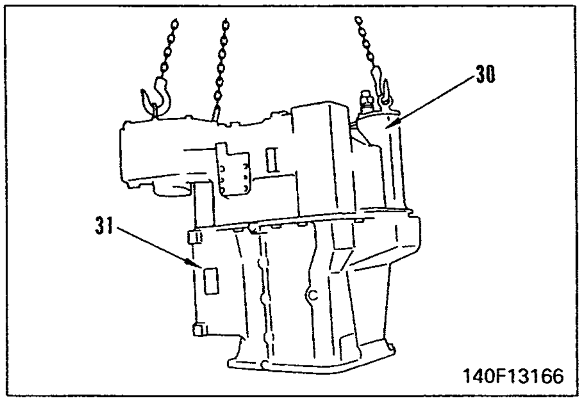
D65E-12 60651 and up
D65P-12 60686 and up



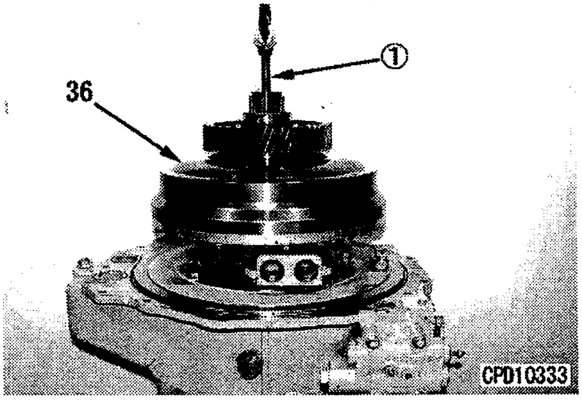
14. Remove sleeves (28) and (29).



15. Sling PTO assembly (30), then remove mounting bolts, and disconnect from transmission assembly (31).



16. Only for serial No. 65001 and up
Remove the 10 mounting bolts and lift off torque converter assembly (36), using eyebolts ①.



CONNECTION OF POWER TRAIN UNIT

D65E, P

- Carry out connection in the reverse order to separation.

※ 1

★ Bend the cotter pin securely.

※ 2

For details of adjusting the backlash and tooth contact between the bevel gear and bevel pinion, see ASSEMBLY OF TORQFLOW TRANSMISSION ASSEMBLY.

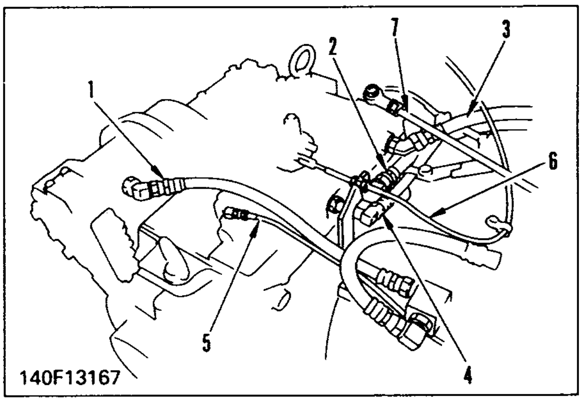
※ 3

Mounting bolt: **Thread tightener (LT-2)**

Mounting bolt: **276.05 ± 31.85 Nm (28.25 ± 3.25 kgm)**

SEPARATION OF POWER TRAIN UNIT

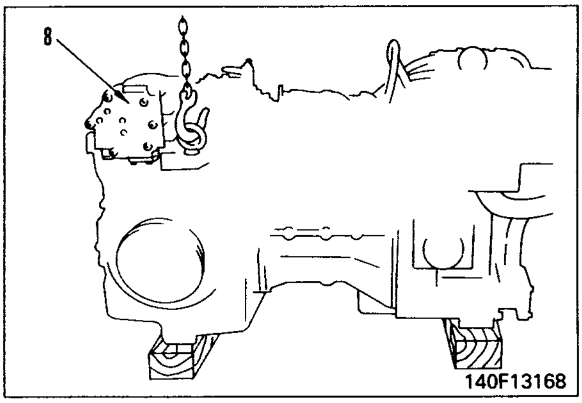
D65EX, PX



1. Remove drain plugs of HSS case and transmission case, and drain oil from case.

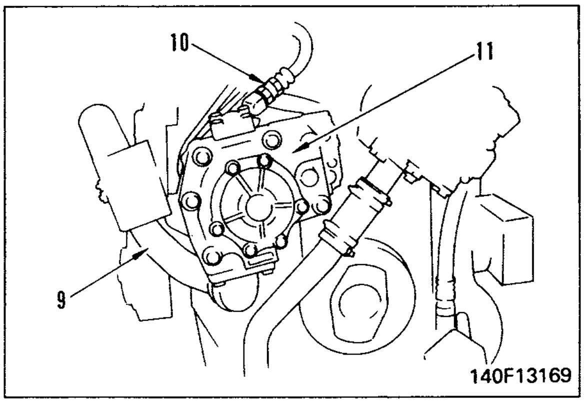
   Power train case: **Approx. 50** ℓ

2. Remove hoses (1), (2), (3), (4), and (5).
3. Remove brake cables (6). ※1
4. Remove brake rod (7). ※2



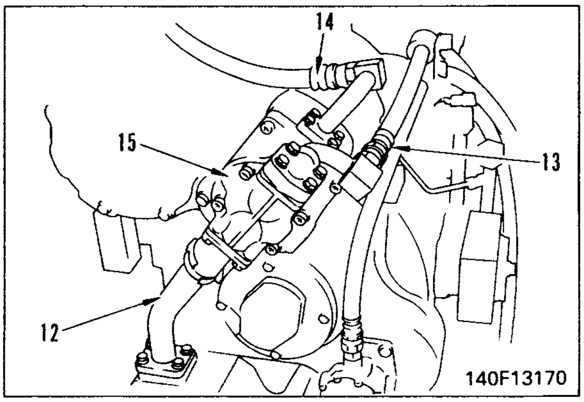
5. Sling HSS assembly (8), then remove mounting bolts, and disconnect from transmission case. ※3

   kg HSS assembly: **75 kg**



6. Remove suction tube (9) and drain hose (10), then remove piston pump assembly (11).

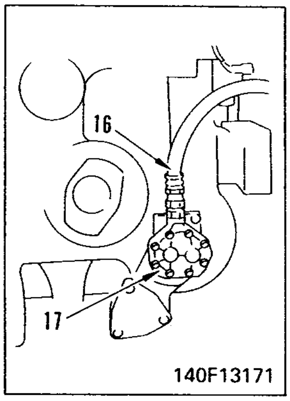
   kg Piston pump assembly: **65 kg**

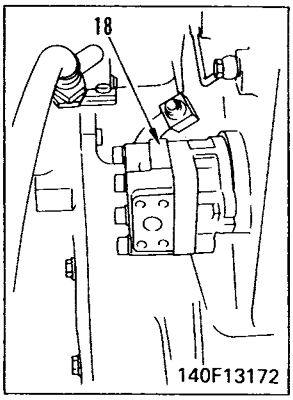


7. Remove suction tube (12) and outlet hoses (13) and (14), then remove tandem pump assembly (15).

8. Remove hose (16), then remove scavenging pump assembly (17).

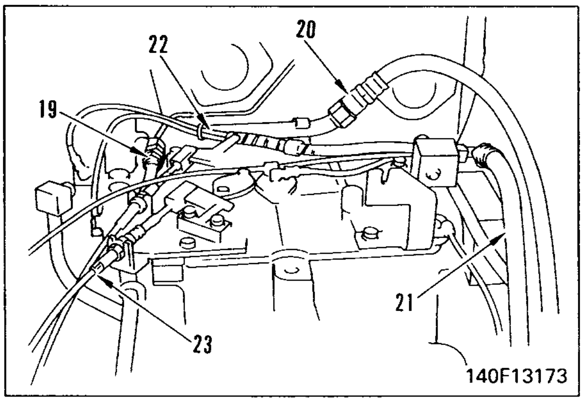
9. Remove PPC pump assembly (18).





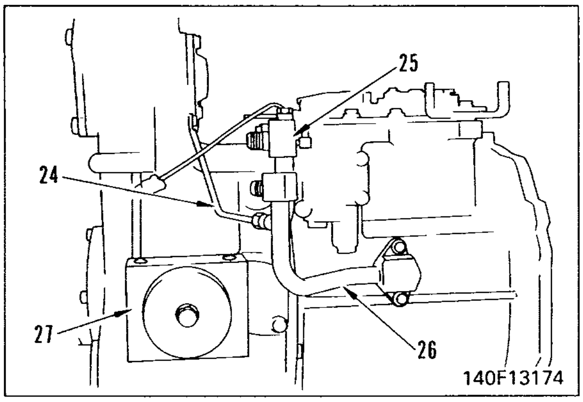
10. Remove hoses (19), (20), and (21), and 3 pressure detection hoses (22).

11. Remove 2 transmission control cables (23).



12. Disconnect tube (24), and remove tubes (25) and (26).

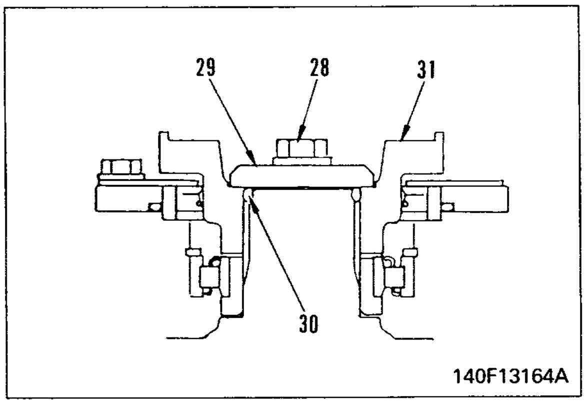
13. Remove left and right mount assembly (27).



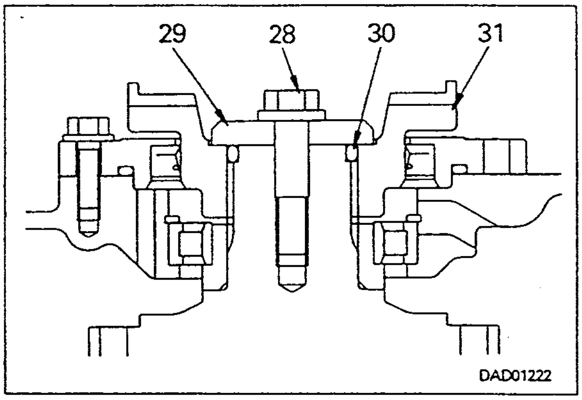
14. Set torque converter and transmission assembly with torque converter at top.

15. Remove bolt (28), then remove holder (29), O-ring (30), and coupling (31). ※4

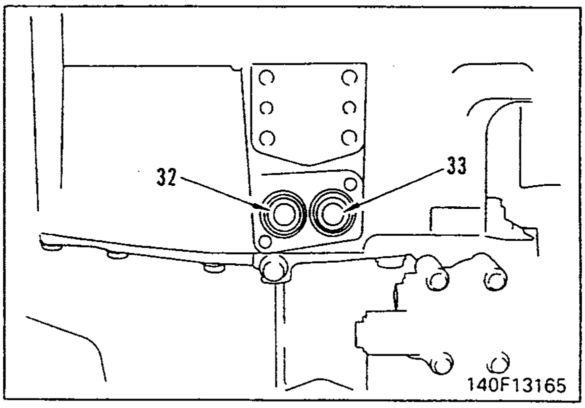
D65EX-12 60001 — 60654
D65PX-12 60001 — 60688



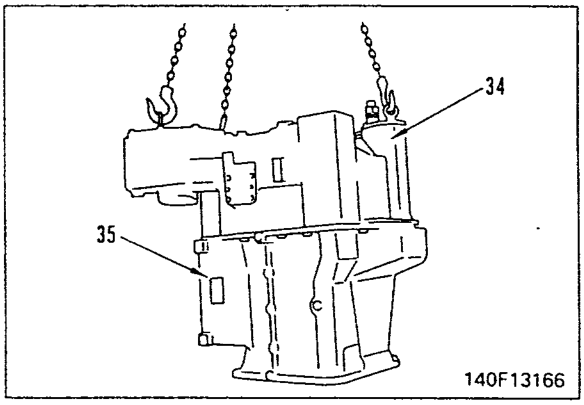
D65EX-12 60655 and up
D65PX-12 60689 and up



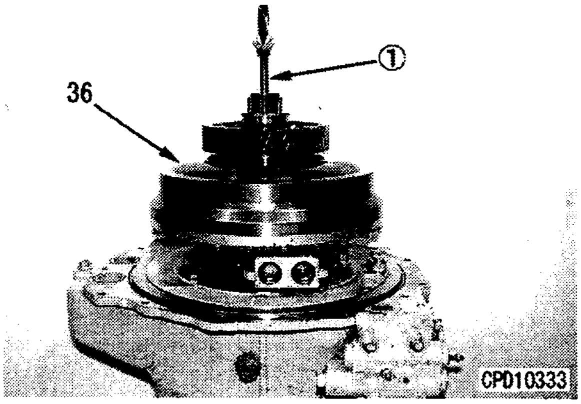
16. Remove sleeves (32) and (33).



17. Sling PTO assembly (34), then remove mounting bolts, and disconnect from transmission assembly (35).
    ★ The torque converter assembly remains with the transmission assembly.
    kg Torque converter, PTO assembly: **500 kg**



18. Only for serial No. 65001 and up
    Remove the 10 mounting bolts and lift off torque converter assembly (36), using eyebolts ①.



CONNECTION OF POWER TRAIN UNIT

D60EX, PX

- Carry out connection in the reverse order to separation.

※ 1

★ Bend the cotter pin securely.

※ 2

For details of adjusting the backlash and tooth contact between the bevel gear and bevel pinion, see ASSEMBLY OF TORQFLOW TRANSMISSION ASSEMBLY.

※ 3

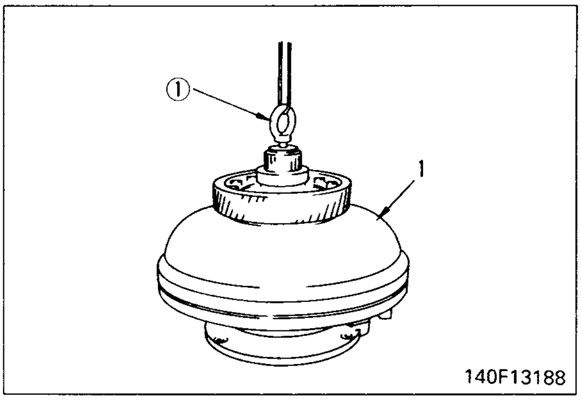
Mounting bolt: **Thread tightener (LT-2)**

Mounting bolt: **276.05 ± 31.85 Nm (28.25 ± 3.25 kgm)**

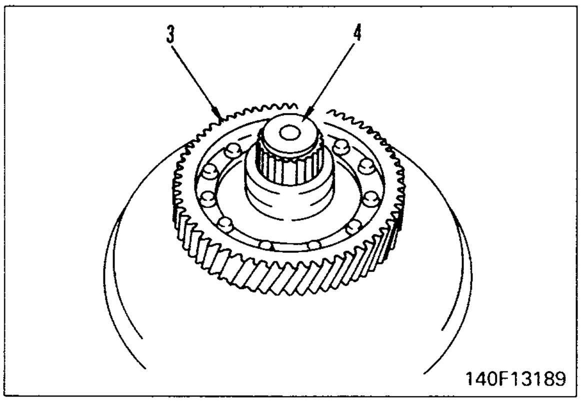
014012

DISASSEMBLY OF TORQUE CONVERTER ASSEMBLY

1. **Case, turbine assembly**
   Remove 24 bolts from below, then remove eyebolts ①, and remove case and turbine assembly (1).



2. **Gear, input shaft**
   Remove gear (3) and input shaft (4).



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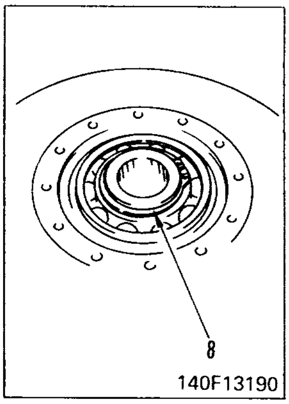
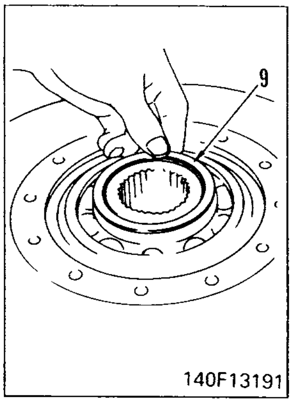
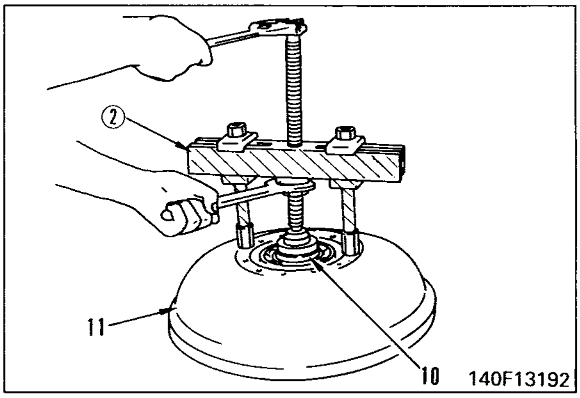
3. **Case**
   1) Remove snap ring (8).
   2) Remove spacer (9).

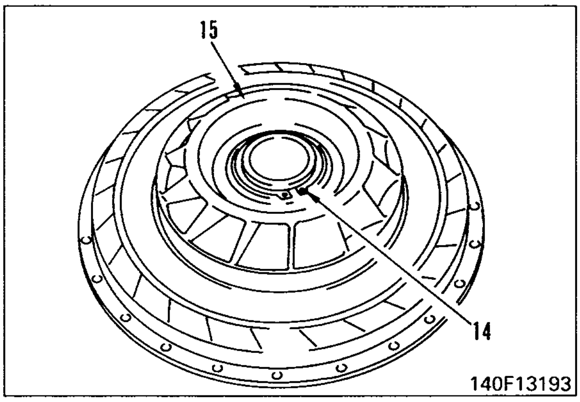




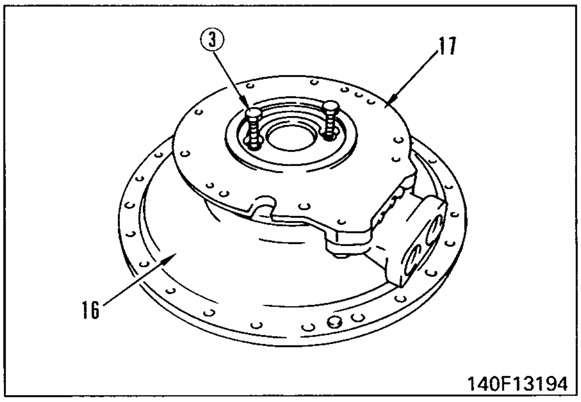
3) Using puller ②, disconnect case assembly (10) from turbine (11).



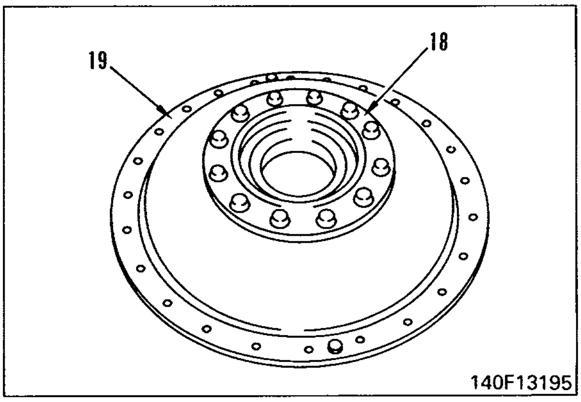
4. **Stator**
Remove snap ring (14), then remove stator (15).



5. **Pump assembly**
   1) Using forcing screws ③ from stator shaft end, remove pump assembly (16) from stator shaft (17).



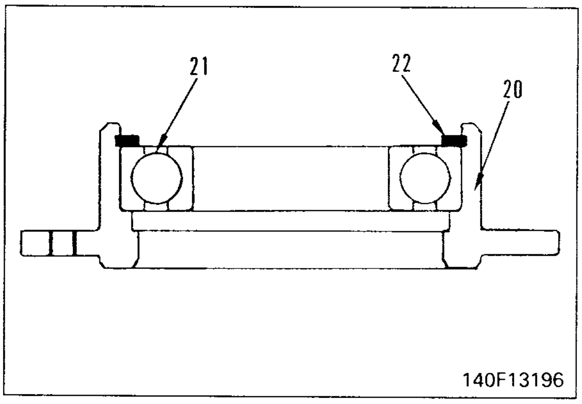
   2) Pull out cage (18) from pump (19).



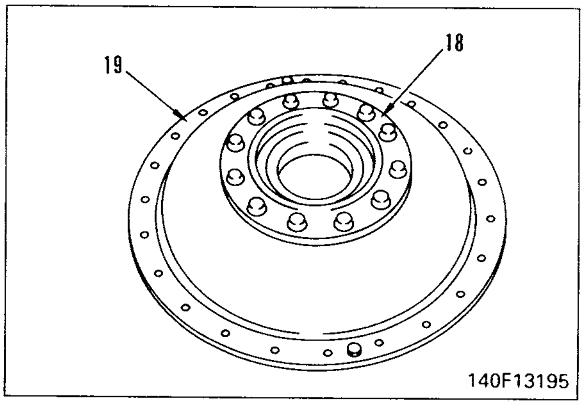
ASSEMBLY OF TORQUE CONVERTER ASSEMBLY

★ Clean all parts, and check for dirt or damage before installing.
★ Put a drop of engine oil on the rotating portion of the bearing, then rotate it several times.
★ Check that the snap ring is fitted securely in the groove.
★ Coat the seal ring thinly with grease (G2-LI).

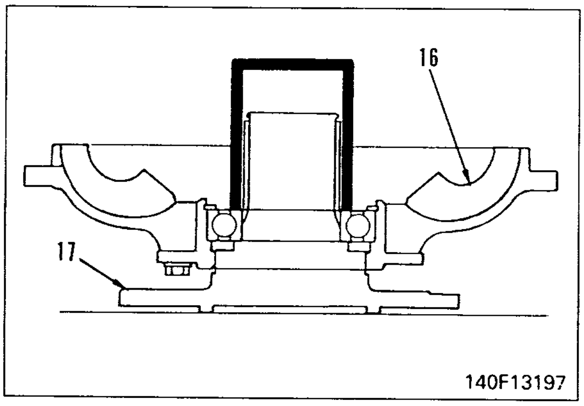
1. **Pump assembly**
   1) Press fit bearing (21) to cage (20), and install snap ring (22).



   2) Install cage (18) to pump (19).

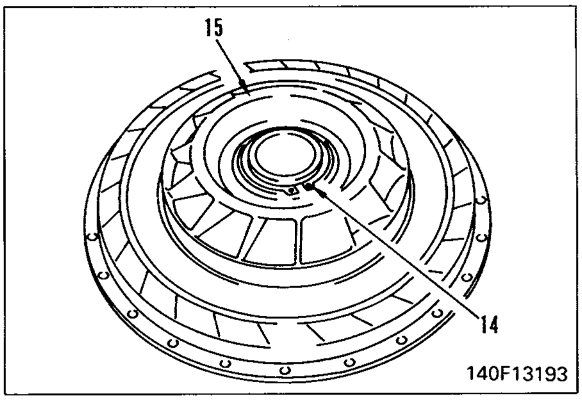


   3) Install pump assembly (16) to stator shaft (17).
      ★ Push the inner race side of the bearing to press fit.
      ★ After press fitting the bearing, put a small drop of engine oil on it and rotate it at least 10 times.



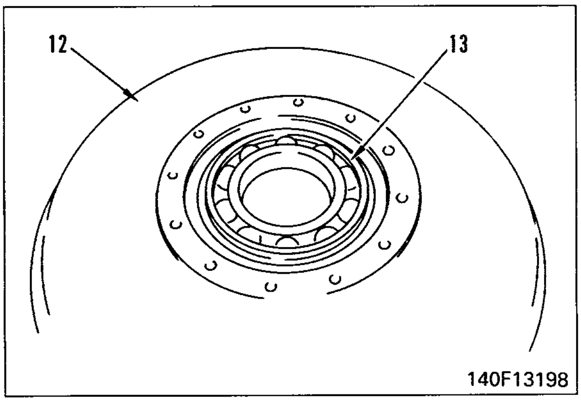
2. Stator

1) Install stator (15).
2) Install snap ring (14).

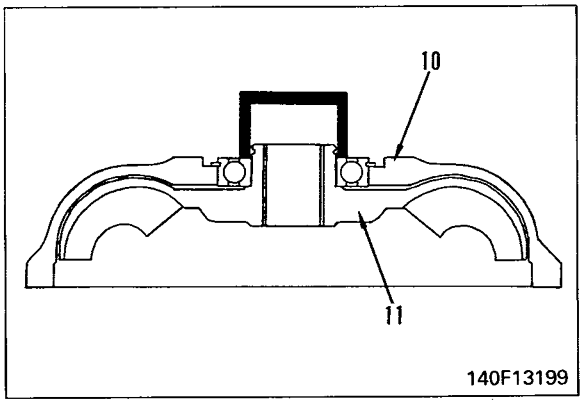


3. Case

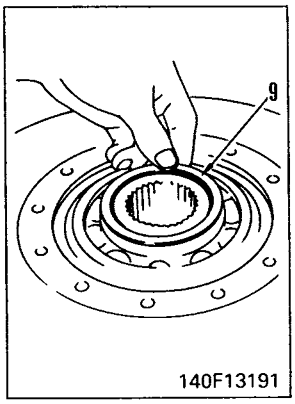
1) Install bearing (13) to case (12).

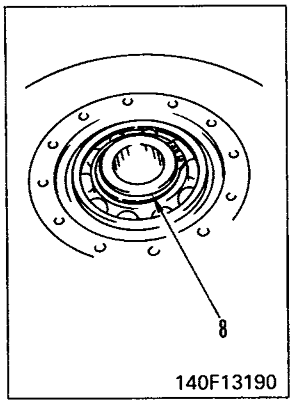


2) Push inner race side of bearing, and install case assembly (10) to boss portion of turbine (11).



3) Install spacer (9).
4) Install snap ring (8).





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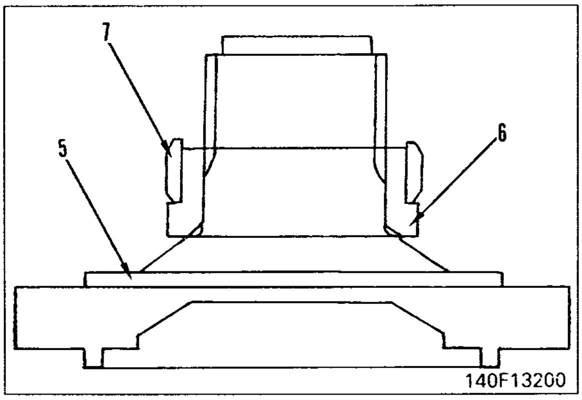
4. Gear, input shaft

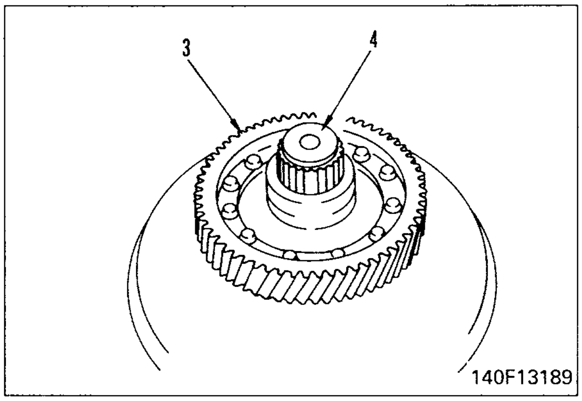
1) Press fit inner race (7) to collar (6).
2) Install collar (6) to input shaft (5).



3) Install input shaft (4) and gear (3).

Mounting bolt:
Thread tightener (LT-2)

kgm Mounting bolt:
66.15 ± 7.35 Nm (6.75 ± 0.75 kgm)



5. Case, turbine assembly

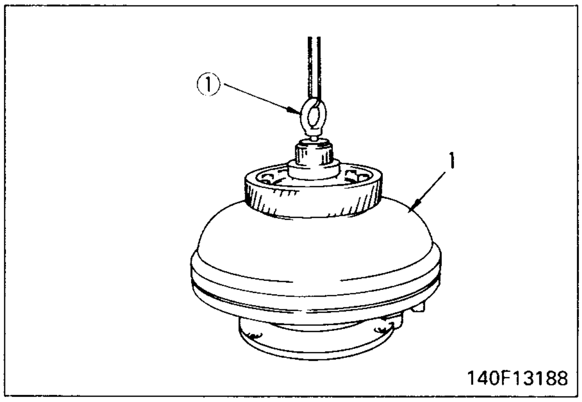
1) Using eyebolts ①, align groove of case with drain plug, and install case and turbine assembly (1).

Mounting bolt:
Thread tightener (LT-2)

kgm Mounting bolt:
53.9 ± 4.9 Nm (5.5 ± 0.5 kgm)

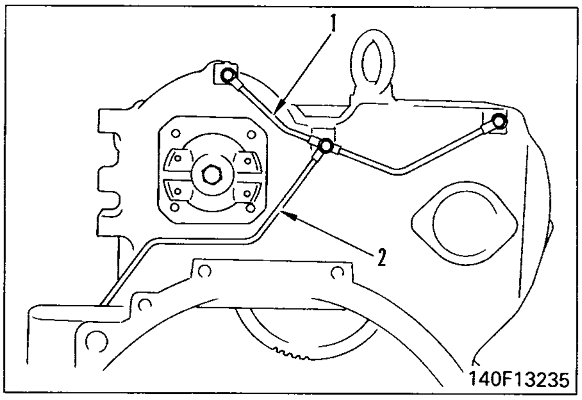
2) Install drain plug.

kgm Drain plug:
7.35 ± 1.47 Nm (0.75 ± 0.15 kgm)

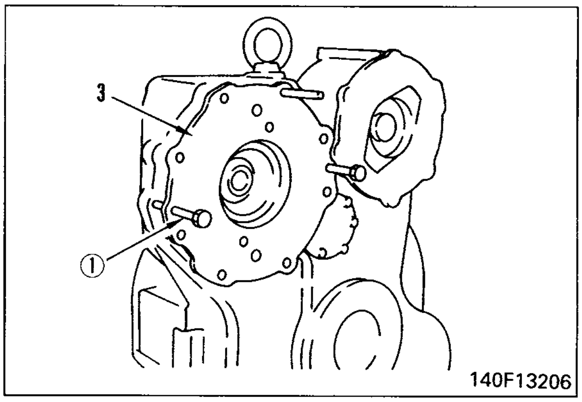


DISASSEMBLY OF PTO ASSEMBLY

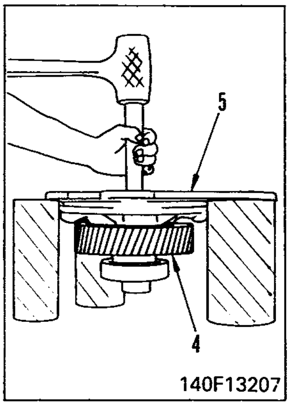
1. **Lubrication tubes**
   Remove lubrication tubes (1) and (2).

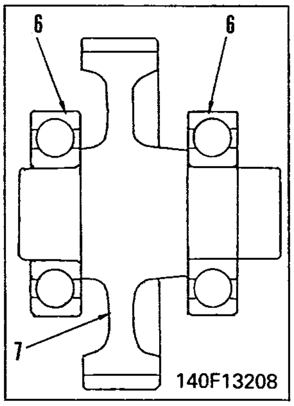


2. **Cover assembly (right)**
   1) Remove mounting bolts, then using forcing screws ①, remove cover assembly (3).

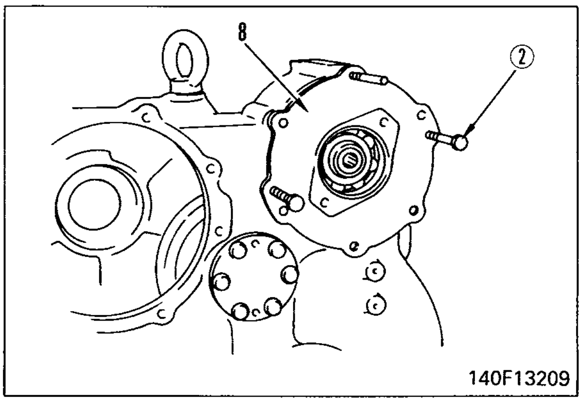


   2) Knock out gear assembly (4) from cover (5) and remove.
   3) Remove bearing (6) from gear (7).



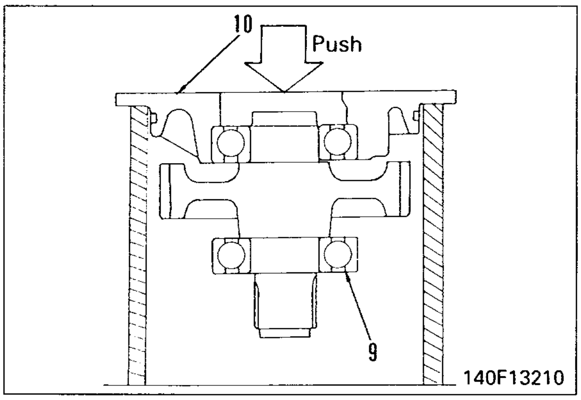


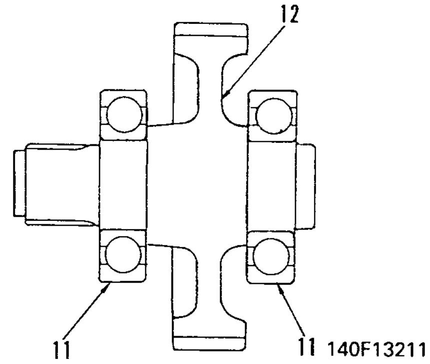
3. **Cover assembly (left)**
   1) Remove mounting bolts, then using forcing screws ②, remove cover assembly (8).



2) Knock out gear assembly (9) from cover (10).

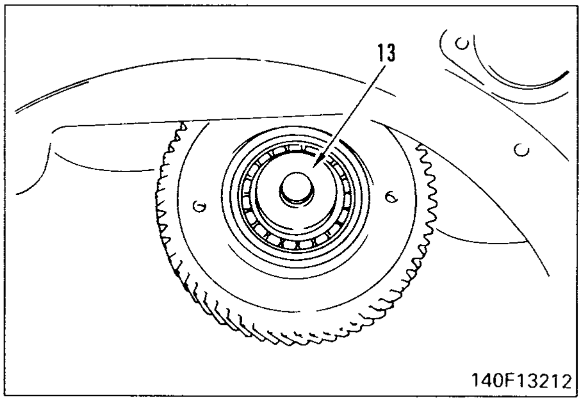
3) Remove bearing (11) from gear (12).





4. Idler gear

1) Remove mounting bolts, then remove plate (13).



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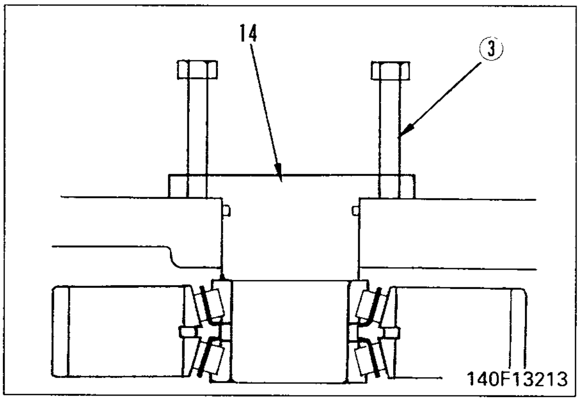
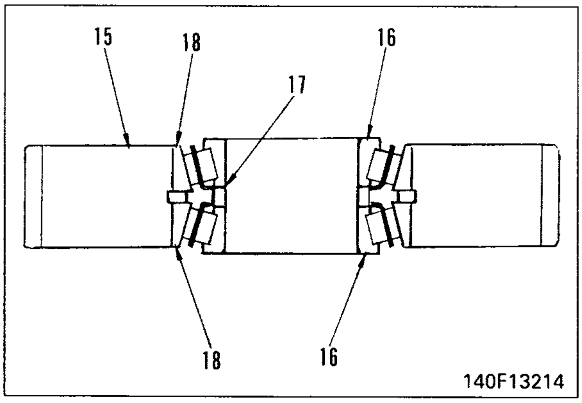
2) Remove mounting bolts, and using forcing screws ③, remove shaft (14).



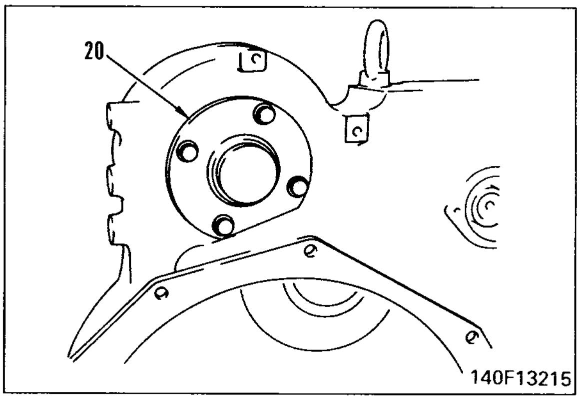
3) Remove bearing (16) and spacer (17) from gear (15).
   - ★ If these parts are to be used again, do not change the sets. Put them in sets with the outer race and keep them in a safe place.

4) Remove outer race (18) from gear (15).



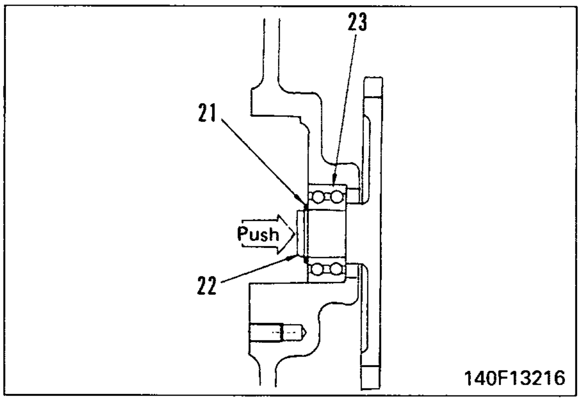
5. Cover

Remove cover (20).

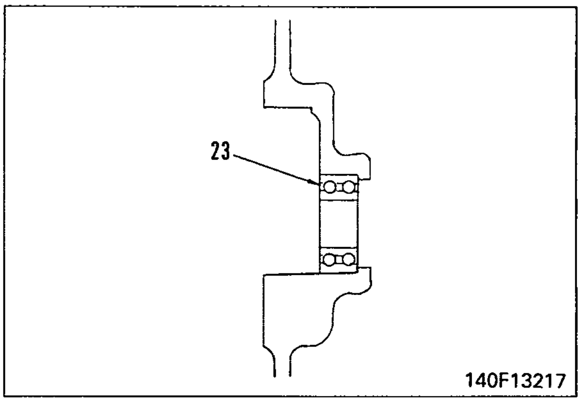


6. Scavenging pump drive gear

1) Remove snap ring (21).
2) Knock out gear (22) from snap ring side.

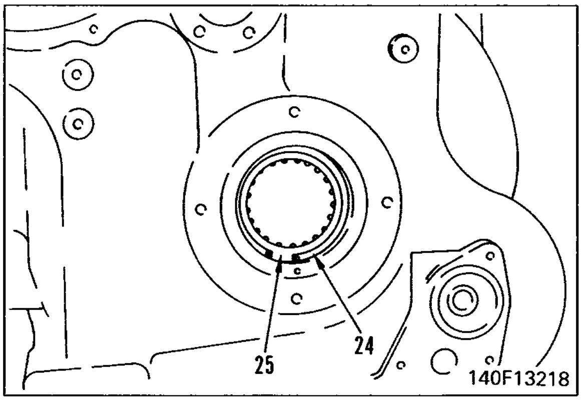


3) Remove bearing (23).



7. Input shaft bearing

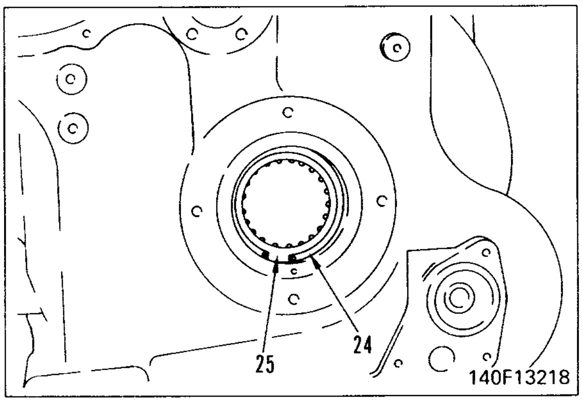
Remove snap ring (24), then remove bearing (25).



ASSEMBLY OF PTO ASSEMBLY

★ Clean all parts, and check for dirt or damage before installing.
★ Put a drop of engine oil on the rotating portion of the bearing, then rotate it several times.
★ Check that the snap ring is fitted securely in the groove.

1. **Input shaft bearing**
   Press fit bearing (25), and install snap ring (24).



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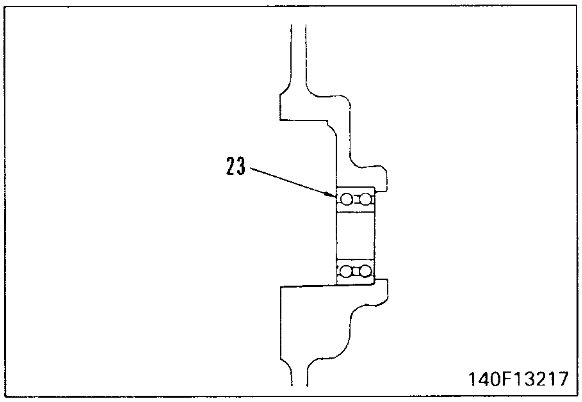
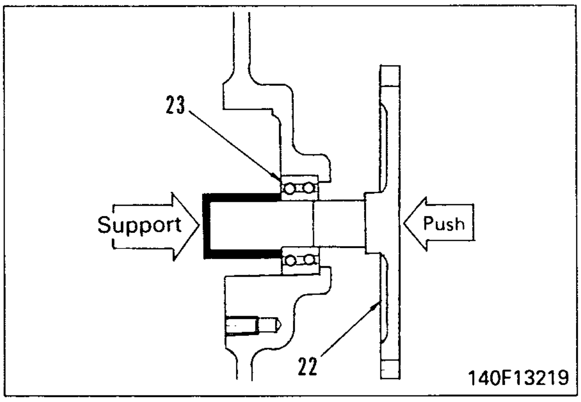
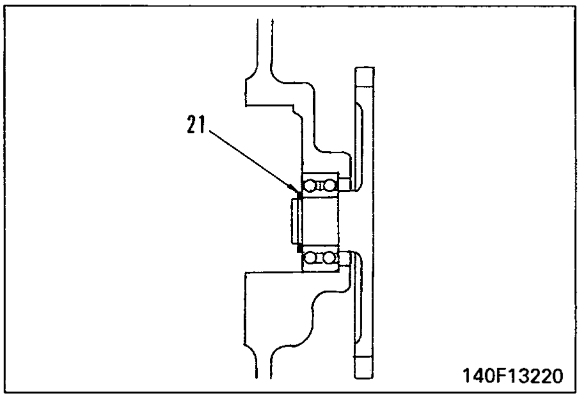
2. **Scavenging pump drive gear**
   1) Install bearing (23).



   2) Support inner race end of bearing (23), and install gear (22) to bearing.



3) Install snap ring (21).

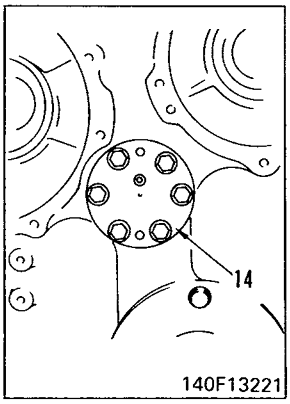


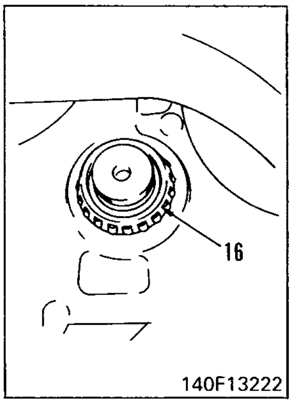
3. Idler gear

1) Install shaft (14).

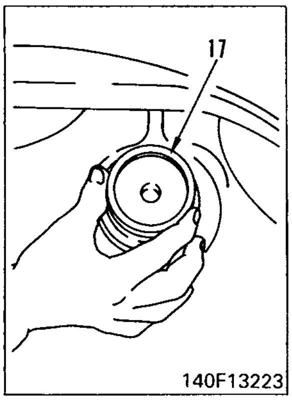
kgm Mounting bolt:
110.35 ± 12.25 Nm (11.25 ± 1.25 kgm)

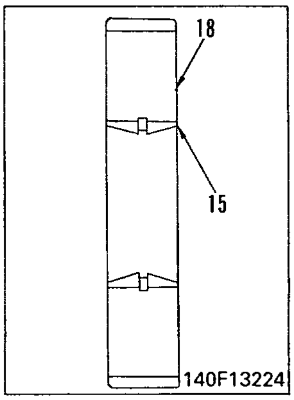
2) Install bearing (16).



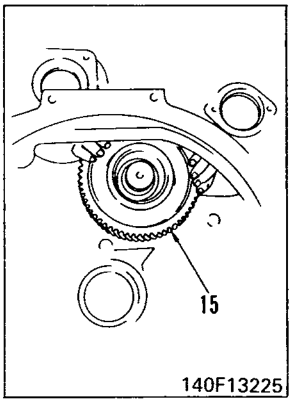


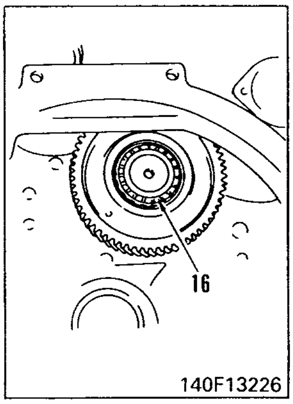
3) Install spacer (17).
4) Install outer race (18) to gear (15).





5) Install gear (15).
6) Install bearing (16).
★ Press fit inner race side.

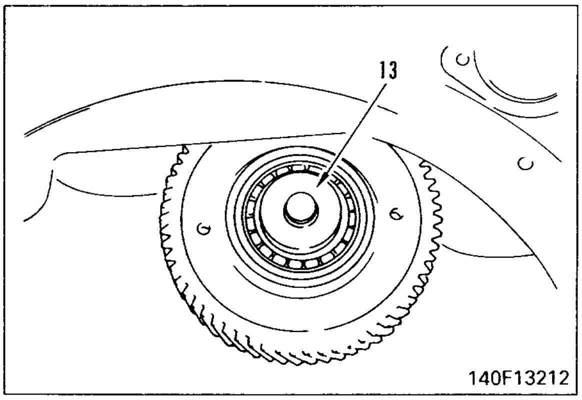




7) Fit plate (13) and tighten bolts.

Mounting bolt: **Thread tightener (LT-2)**

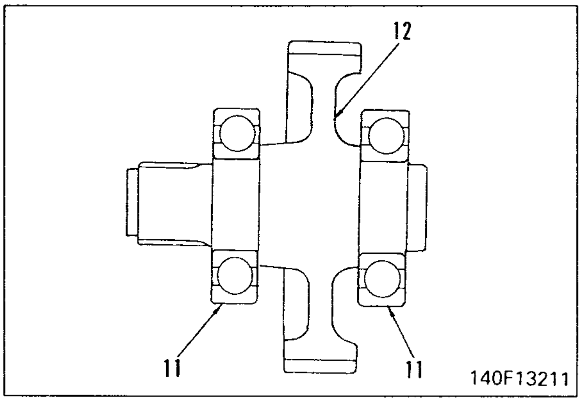
Mounting bolt: **176.5 ± 19.6 Nm (18 ± 2 kgm)**



140F13212

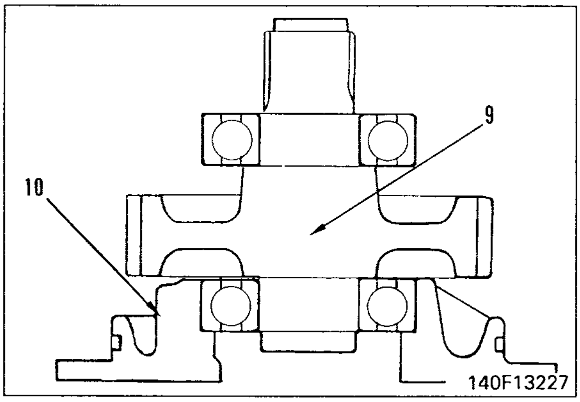
4. Cover assembly (left)

1) Install bearing (11) to gear (12).



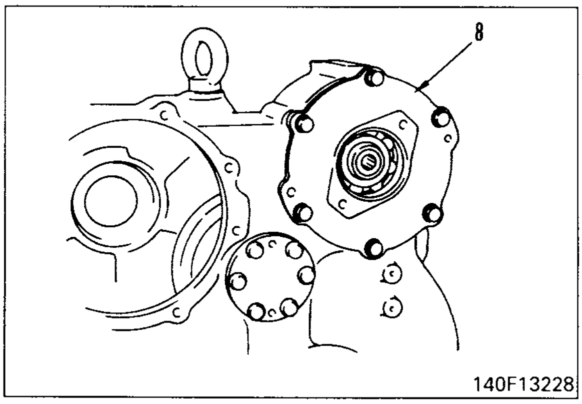
140F13211

2) Install gear assembly (9) to cover (10).



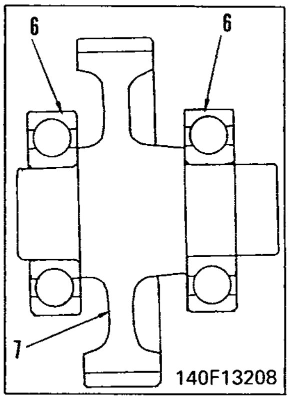
140F13227

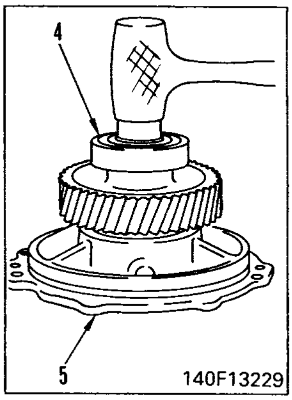
3) Mesh idler gear, and install cover assembly (8).



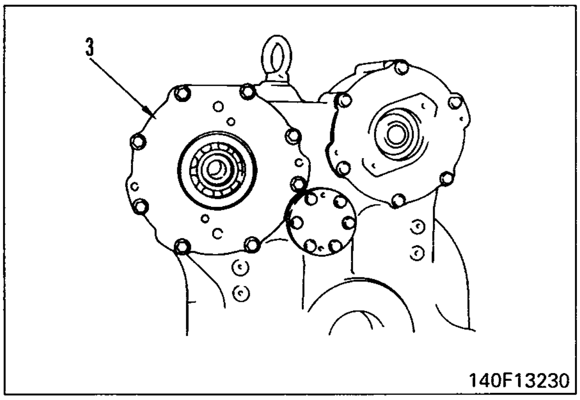
140F13228

5. **Cover assembly (right)**
   1) Install bearing (6) to gear (7).
   2) Install gear assembly (4) to cover (5).

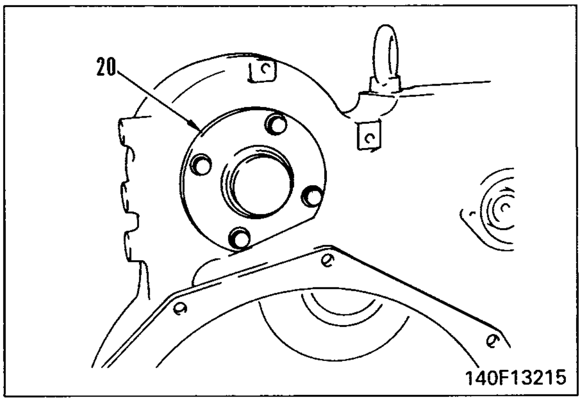




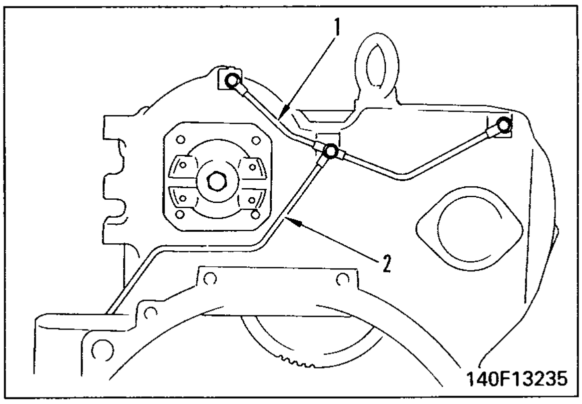
   3) Mesh idler gear, install cover assembly (3).



6. **Cover**
   Install cover (20).



7. **Lubrication tubes**
   Install lubrication tubes (2) and (1).

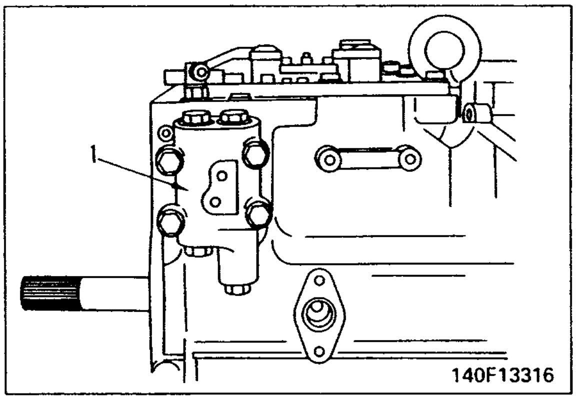


014012

DISASSEMBLY OF TORQFLOW TRANSMISSION ASSEMBLY

Serial No. 60001 – 65000

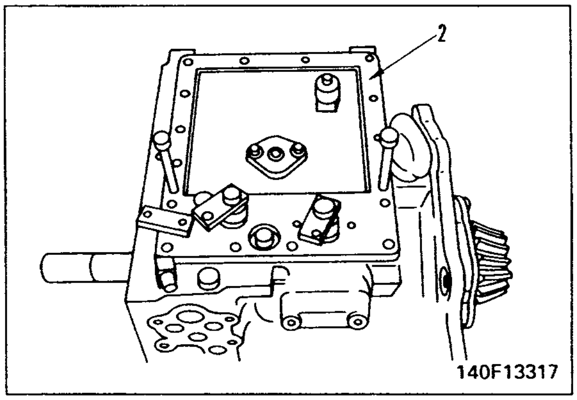
★ After removing the discs and plates, keep them in a flat place to prevent them from being distorted.



140F13316

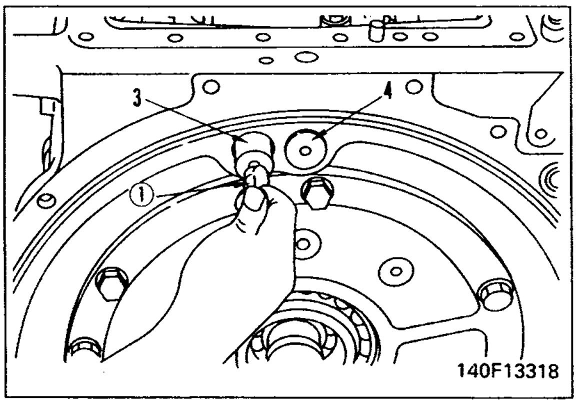
1. **Relief valve assembly**
   Remove relief valve assembly (1).

2. **Control valve assembly**
   1) Remove cover assembly (2).



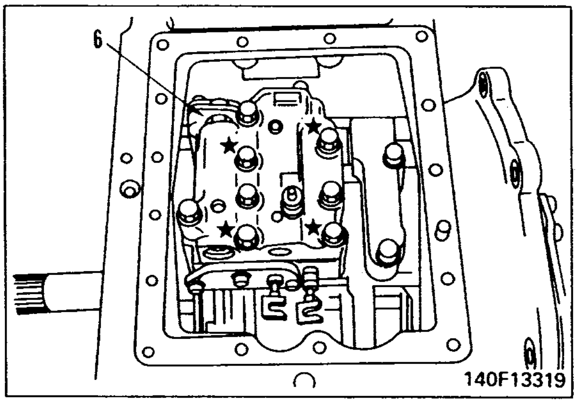
140F13317

   2) Using forcing screws ①, remove sleeves (3) and (4).



140F13318

   3) Remove control valve assembly (6).
      ★ Do not remove the bolts marked ★.



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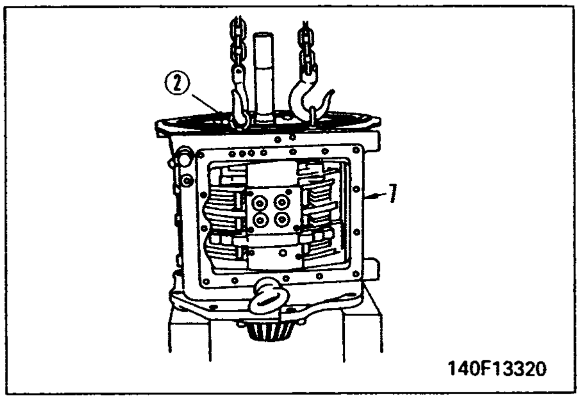
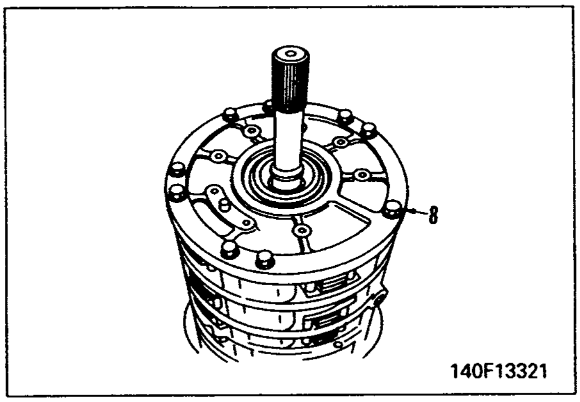
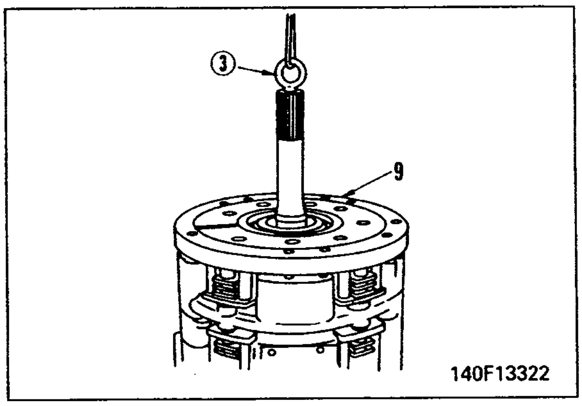
3. **Transmission case**
   1) Remove mounting bolts from both sides.
   2) Using eyebolts ②, remove transmission case (7).



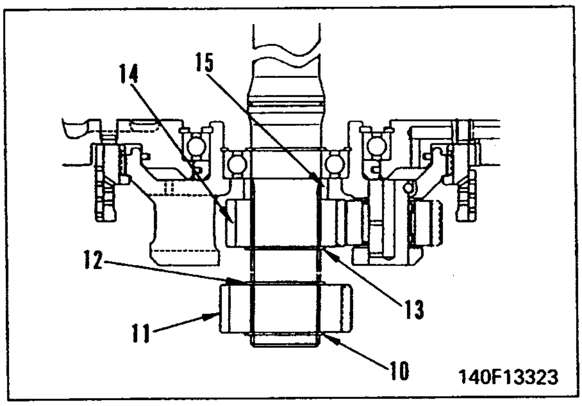
4. **Tie bolt**
   Remove tie bolt (8).



5. **Input shaft, front plate, No. 1 carrier assembly**
   1) Using eyebolts ③, remove input shaft, front plate, and No. 1 carrier assembly (9).



   2) Disassemble input shaft, front plate, and No. 1 carrier assembly as follows.
      i) Remove snap ring (10), then remove No. 2 sun gear (11) and snap ring (12).
      ii) Remove snap ring (13), then remove No. 1 sun gear (14) and collar (15).



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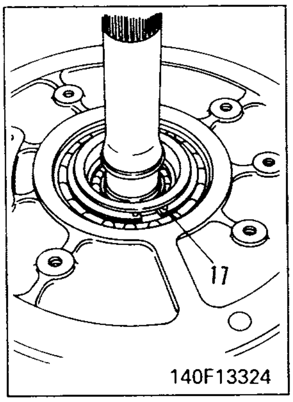
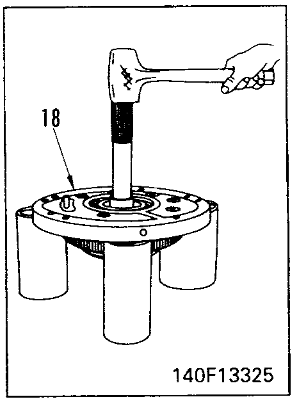
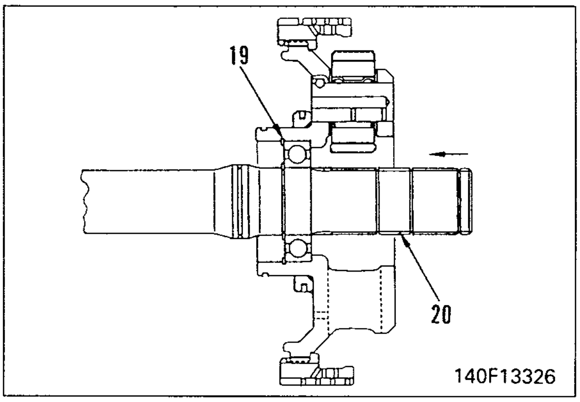
iii) Remove snap ring (17).

iv) Knock out input shaft from torque converter end, and remove front cover (18).





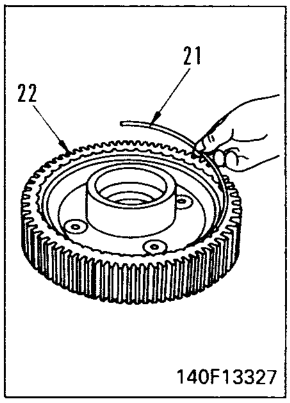
v) Remove snap ring (19), then knock out input shaft (20) to torque converter end and remove.

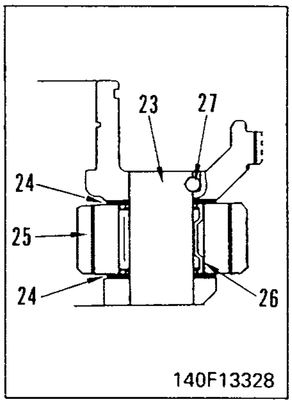


vi) Remove snap ring (21), then remove No. 1 ring gear (22).

vii) Pull out shaft (23), and remove thrust washer (24), gear (25), bearing (26), and ball (27).

★ Be careful not to lose the ball.

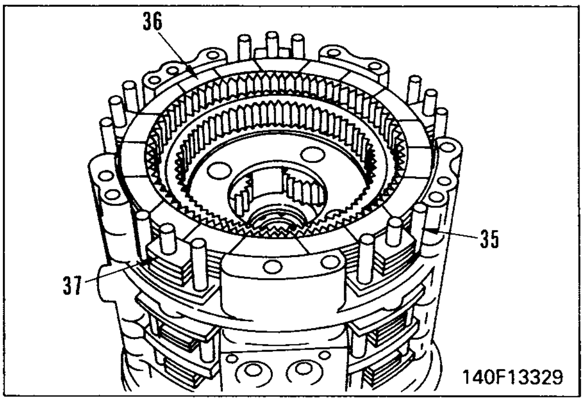




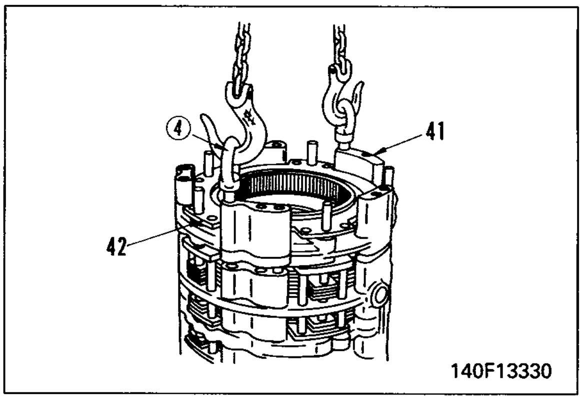
6. No. 1 disc, plate, spring

1) Remove spring (35).

2) Remove disc (36) and plate (37).



7. **No. 1 housing assembly**
   1) Using eyebolts ④, remove No. 1 housing assembly (41).
   2) Remove piston (42) from housing.



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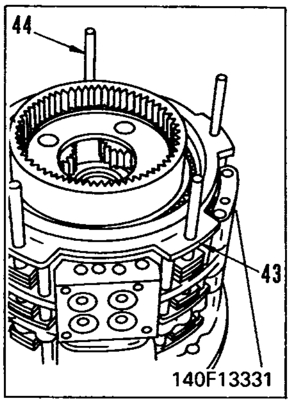
8. **No. 2 piston**
   Remove No. 2 piston (43).

9. **Guide pin**
   Remove guide pin (44).

10. **No. 2 disc, plate, spring**
    1) Remove spring (45) for No. 2 and 3.
    2) Remove disc (46) and plate (47).



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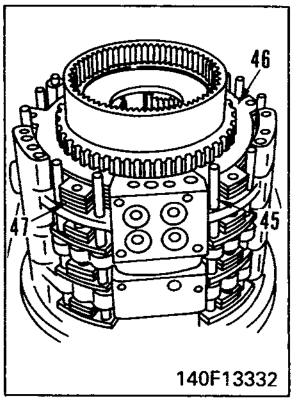

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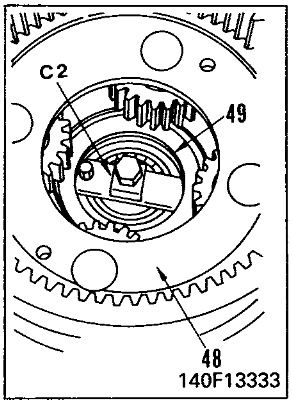
11. **No. 2 housing, No. 2 carrier assembly**
    1) Using tool **C2**, push up No. 3 carrier (48), then remove snap ring (49).
    2) Using eyebolts ⑤, remove No. 2 housing and No. 2 carrier assembly (50).



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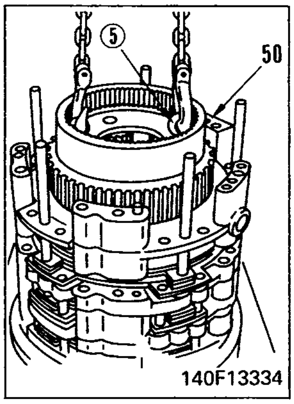

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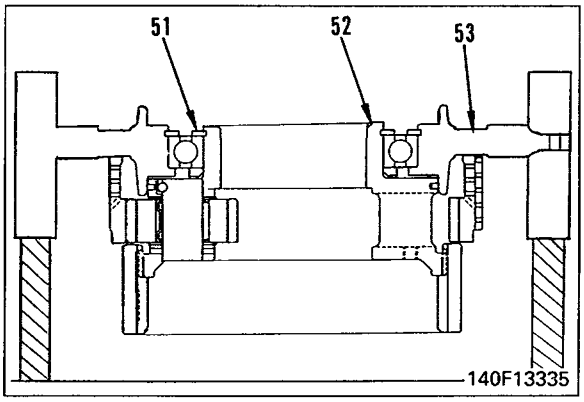
    3) Disassemble No. 2 housing and No. 2 carrier assembly as follows.
       i) Remove snap ring (51), and pull out No. 2 carrier assembly (52) from No. 2 housing (53).



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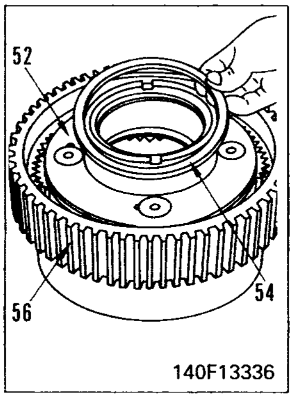
ii) Remove spacer (54) from No. 2 carrier assembly (52).
iii) Remove No. 2 ring gear (56).
iv) Pull out shaft (57), and remove thrust washer (58), gear (59), bearing (60), and ball (61).



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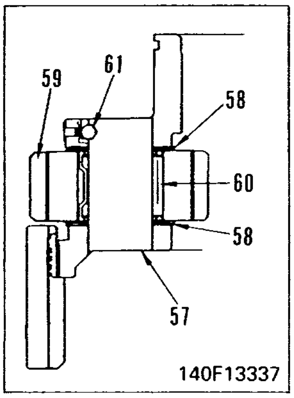

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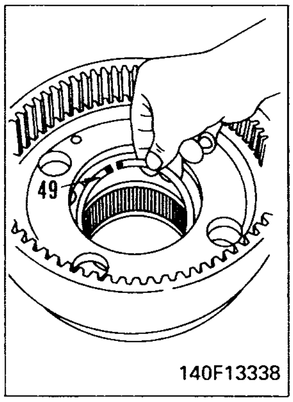
v) Remove snap ring (49).
vi) Remove snap ring (63), then remove ring gear (64).



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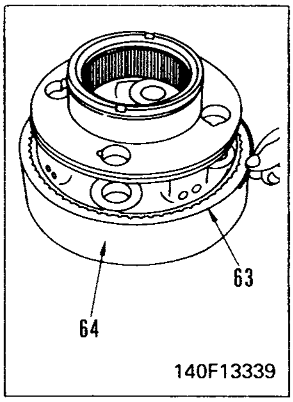

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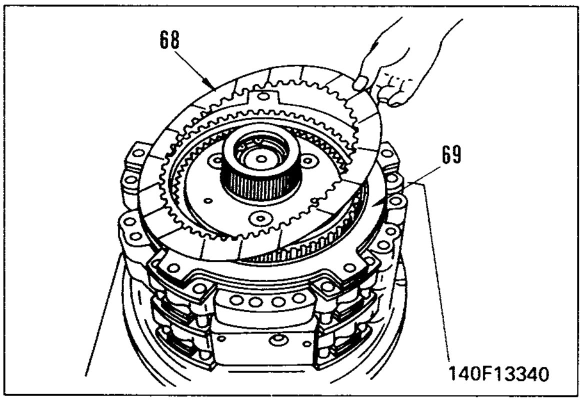
12. No. 3 disc, plate

Remove disc (68) and plate (69).



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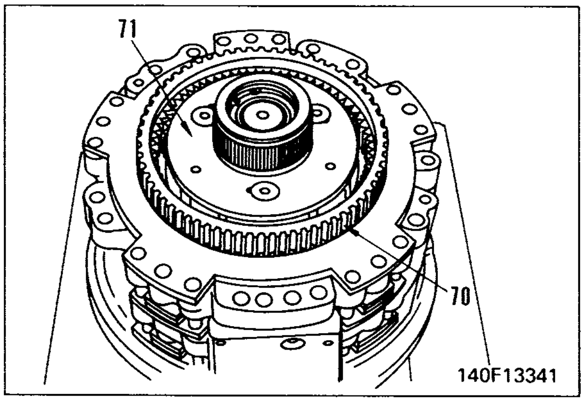
13. No. 3 ring gear

Remove No. 3 ring gear (70).

14. No. 3, 4 carrier assembly

1) Remove No. 3 and 4 carrier assembly (71).



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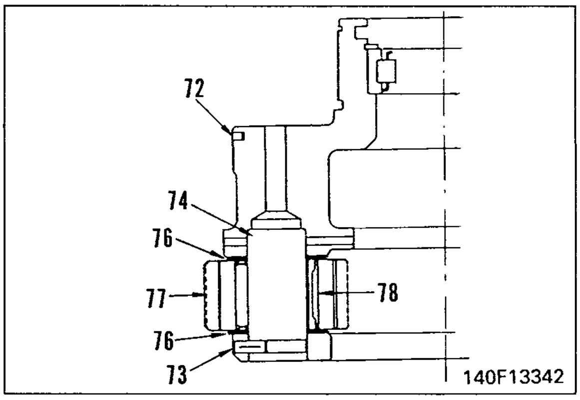
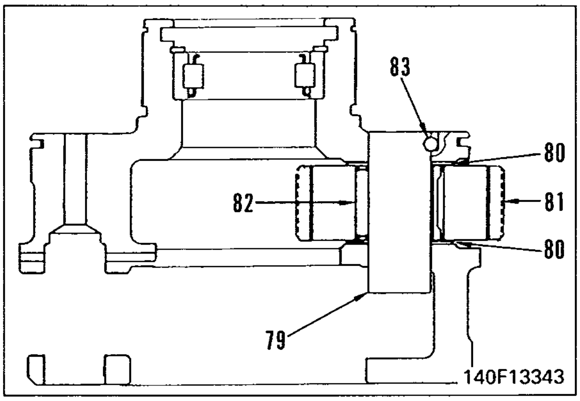
2) Disassemble No. 3 and 4 carrier assembly as follows.
   i) Remove seal ring (72).
   ii) Knock pin (73) into shaft (74).
   iii) Knock out shaft (74) from No. 3 carrier end.
   iv) Remove thrust washer (76), No. 4 planetary gear (77), and bearing (78).
   ★ Remove the pin from the shaft.

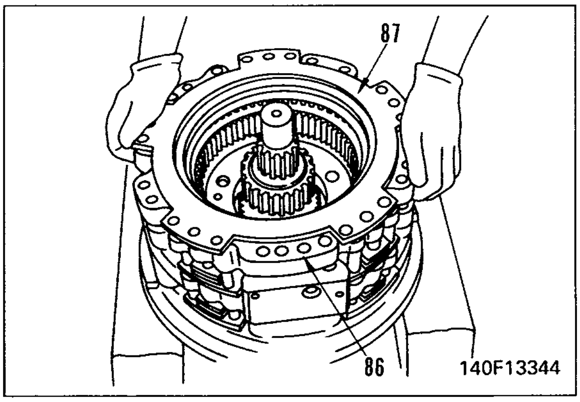


   v) Knock out shaft (79), and remove thrust washer (80), No. 3 planetary gear (81), bearing (82), and ball (83).
   ★ Be careful not to lose the ball.



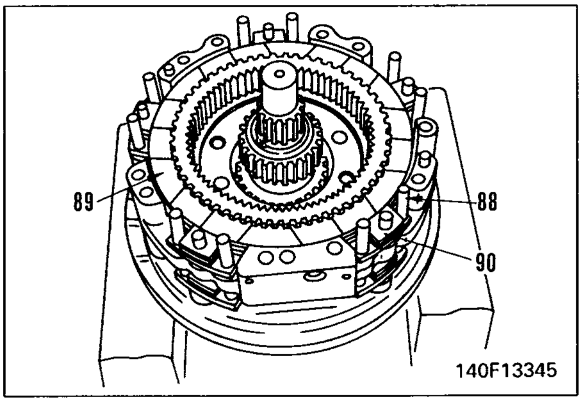
15. No. 3 housing

1) Remove No. 3 housing (86).
2) Remove No. 3 piston (87).



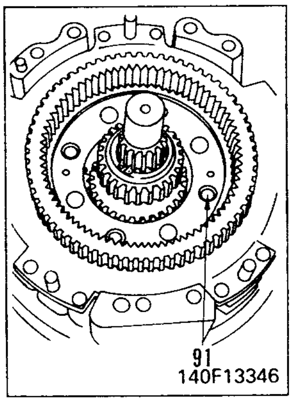
16. No. 4 disc, plate, spring

1) Remove spring (88).
2) Remove disc (89) and plate (90).



17. No. 5 carrier, No. 4 ring gear assembly

1) Remove mounting bolts (91).
2) Remove No. 5 carrier and No. 4 ring gear assembly (92).



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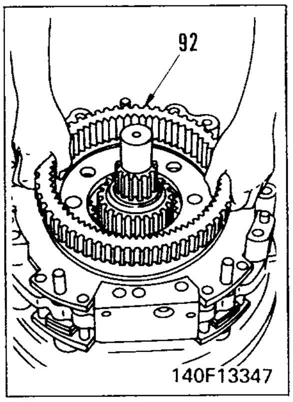

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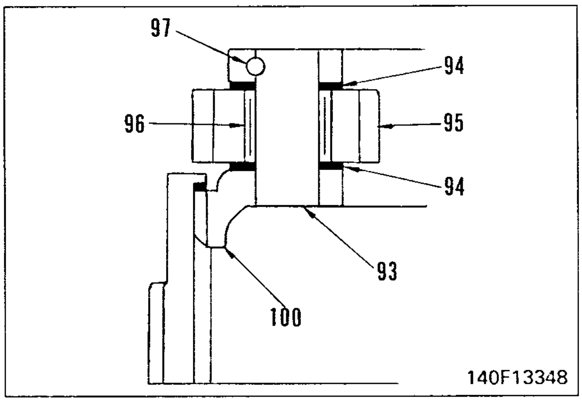
3) Disassemble No. 5 carrier and No. 4 ring gear assembly as follows.
   i) Knock out shaft (93), and remove thrust washer (94), gear (95), bearing (96), and ball (97).
      ★ Be careful not to lose the ball.



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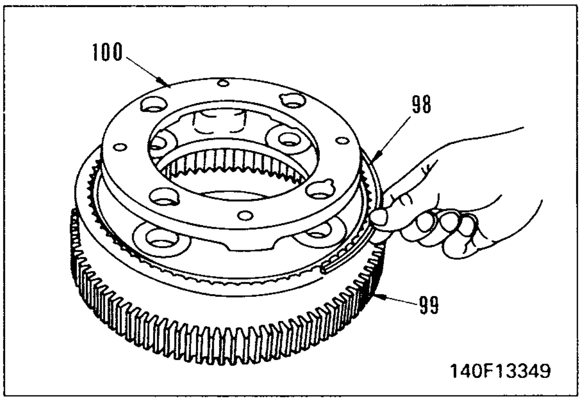
   ii) Remove snap ring (98), then remove No. 4 ring gear (99) from carrier (100).



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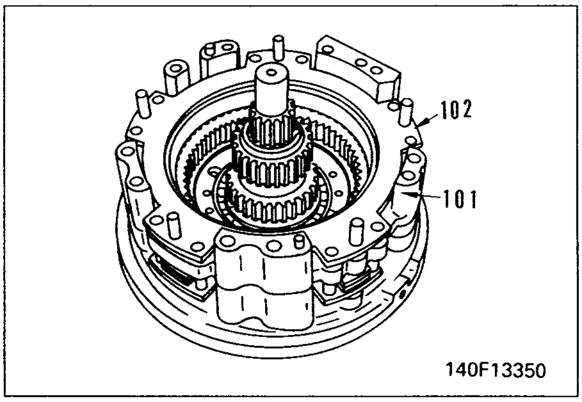
18. No. 4 housing assembly

1) Remove No. 4 housing assembly (101).
2) Remove No. 4 piston (102).



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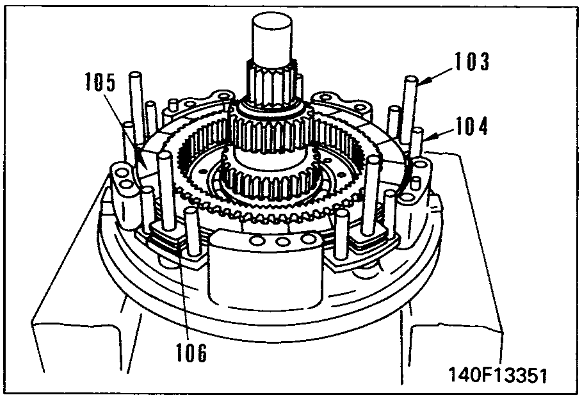
19. Guide pin
Remove guide pin (103).

20. No. 5 disc, plate, spring
1) Remove spring (104).
2) Remove disc (105) and plate (106).



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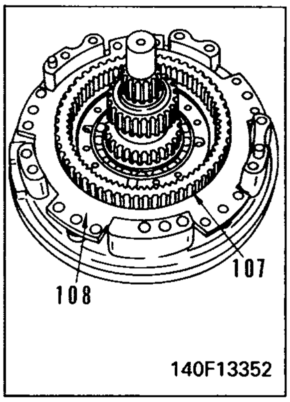
21. No. 5 ring gear
Remove No. 5 ring gear (107).

22. No. 5 piston
Remove No. 5 piston (108).

23. Collar
1) Remove snap ring (109).



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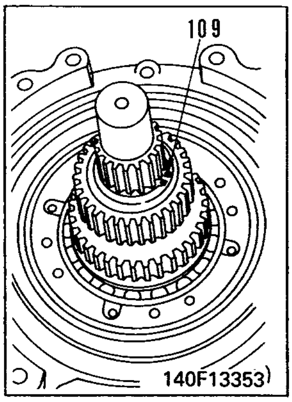

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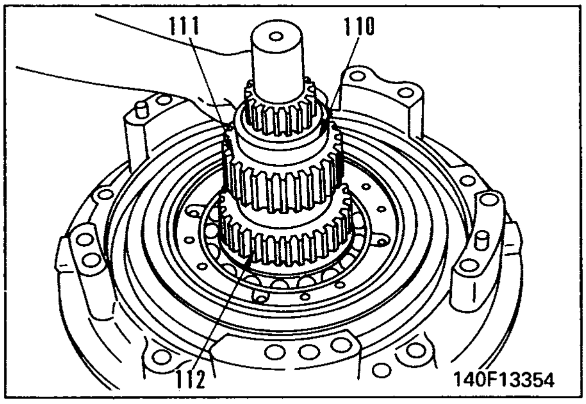
2) Remove collar (110).

24. No. 4 sun gear
Remove No. 4 sun gear (111).

25. No. 5 sun gear
Remove No. 5 sun gear (112).



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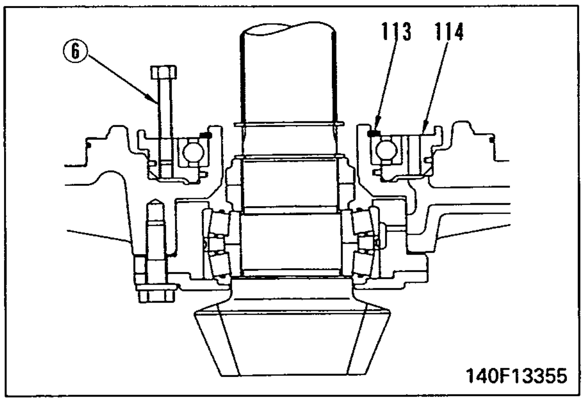
26. Cage (for securing No. 5 cage)
1) Remove snap ring (113).
2) Using forcing screw ⑥, remove cage (114).



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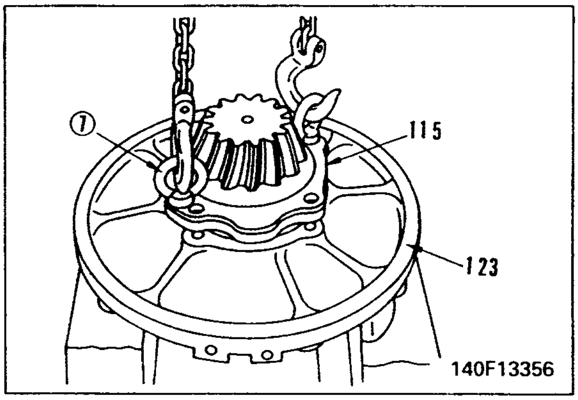
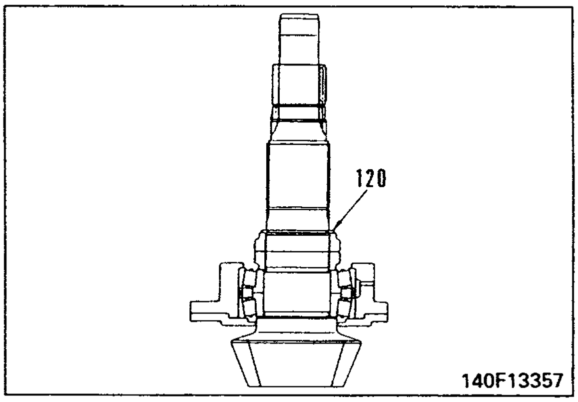
27. Bevel pinion assembly

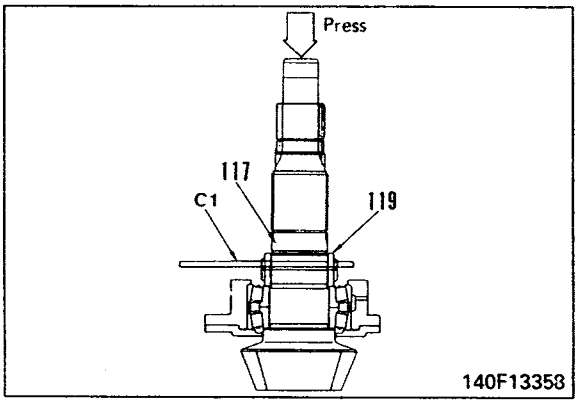
1) Using eyebolts ⑦, remove bevel pinion assembly (115) from case (123).
   ★ Check the number and thickness of the shims, and keep in a safe place.



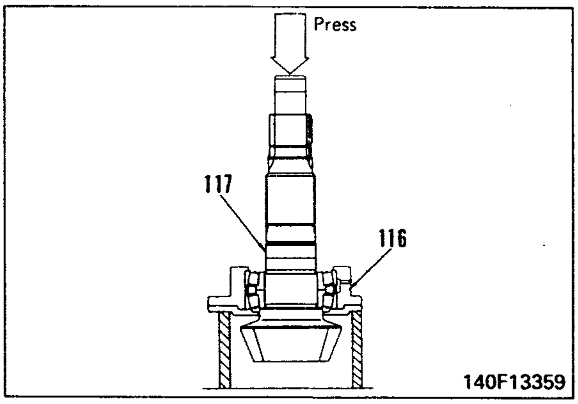
2) Remove snap ring (120).



3) Press bevel pinion (117) with press, then using tool **C1**, remove nut (119).



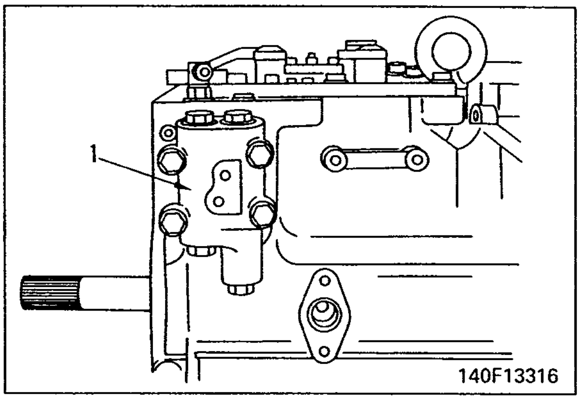
4) Support cage (116), and push end face of shaft, then remove bevel pinion (117) from cage.



Serial No. 65001 and up

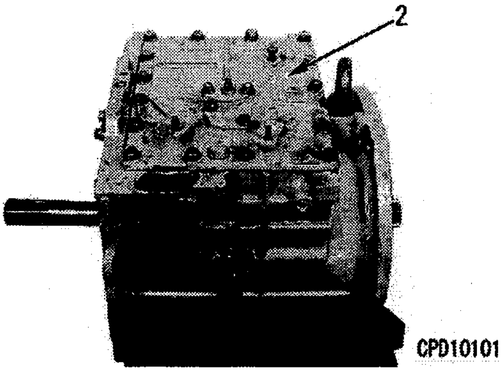
★ Store the removed discs and plates on a level place so that they will not be warped

1. Relief valve assembly
   Remove relief valve assembly (1).



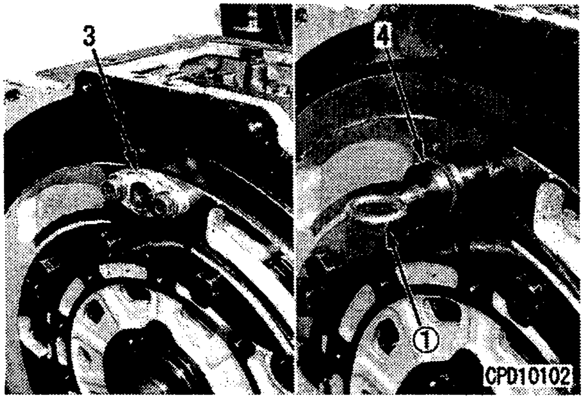
2. Control valve assembly

   1) Remove cover assembly (2).

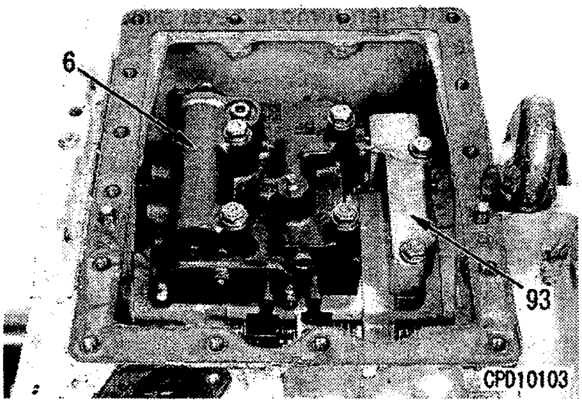


   2) Remove flange (3).

   3) Using eyebolt ①, remove sleeve (4).

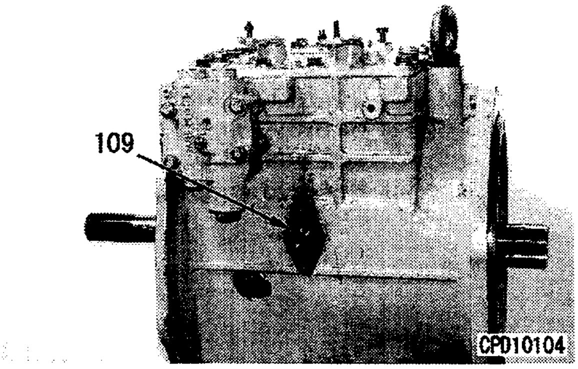


   4) Remove control valve assembly (6) and block (93).

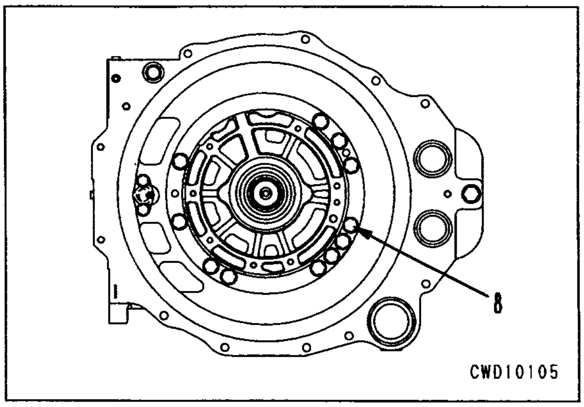


3. Transmission case

1) Remove sleeve (109).



2) Set the transmission assembly on the blocksecurely with the torque converter side up.
3) Remove 11 tie bolts (8) (used to secure the transmission case).



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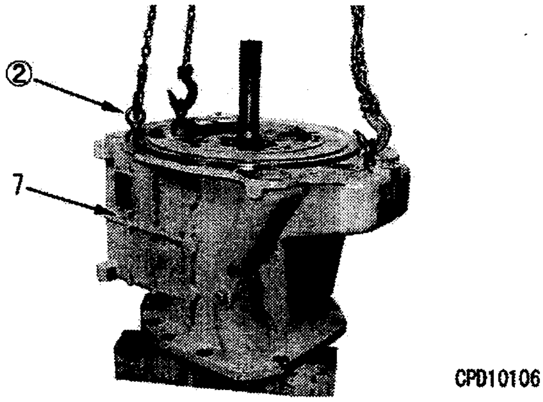
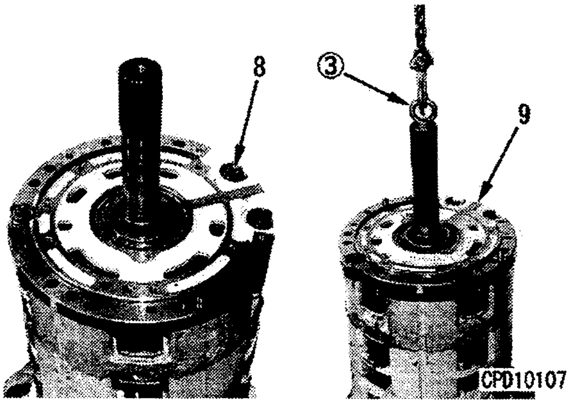
4) Using eyebolts②, remove transmission case (7).
   ★ Hang the transmission case vertically by using a lever block.

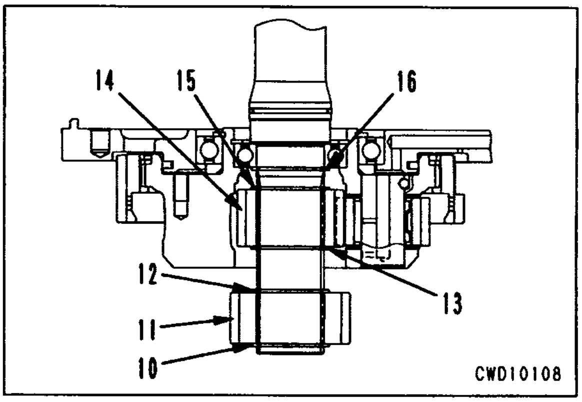


4. Input shaft/Front plate/No. 1 carrier assembly

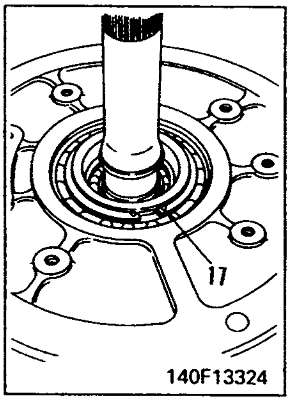
1) Remove remaining 3 tie bolts (8).
2) Using eyebolts ③, remove input shaft/front plate/No. 1 carrier assembly (9).

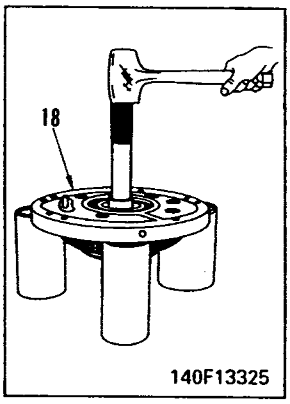


2) Disassemble the input shaft/front plate/ No. 1 carrier assembly according to the following procedure.
   i) Remove snap ring (10), No. 2 sun gear (11), and snap ring (12).
   ii) Remove snap ring (13) and No. 1 sun gear (14).
   iii) Remove snap rings (15) and (16).



   iv) Remove snap ring (17).
   v) Drive out the input shaft from the torque converter side and remove front cover (18).





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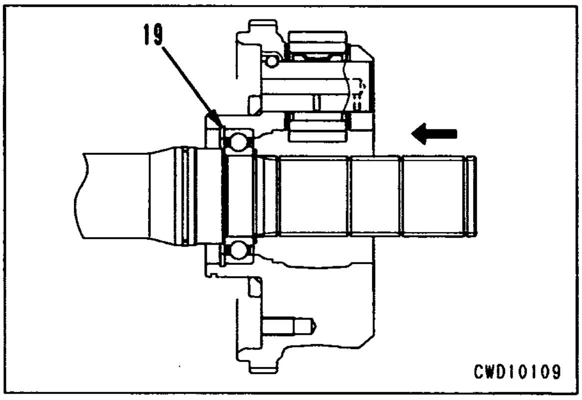
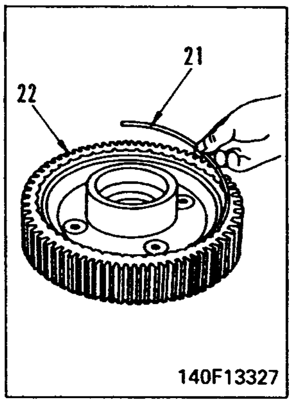
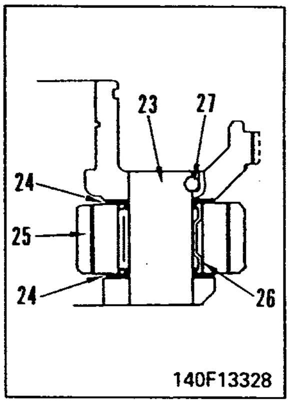
   vi) Remove snap ring (19), then remove input shaft (20) by driving it out to the torque converter side.



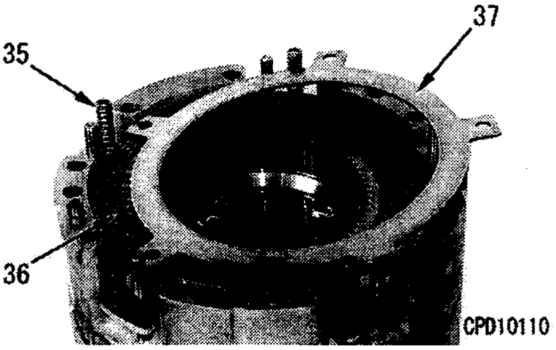
   vii) Remove snap ring (21) and No. 1ring gear (22).
   viii) Pull out shaft (23) and remove thrust washer (24), gear (25), bearing (26), and ball (27).
   ★ Take care not to lose the ball.





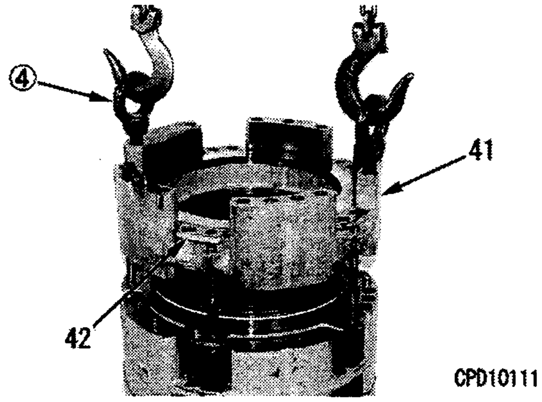
5. No. 1 discs, plates, and springs

1) Remove springs (35).
2) Remove discs (36) and plates (37).



6. No. 1 housing assembly

1) Using eyebolts ④, remove No. 1 housing assembly (41).
2) Remove piston (42) from the housing.



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7. No. 2 piston

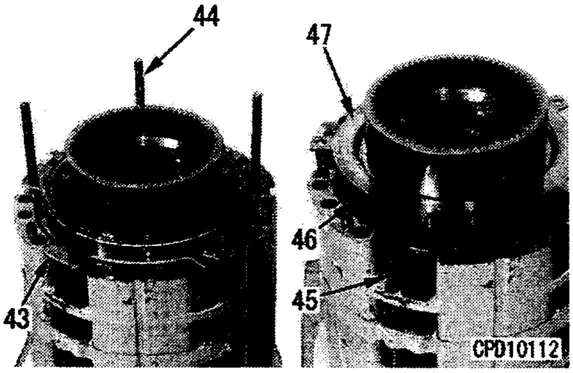
Remove No. 2 piston (43).

8. Guide pin

Remove guide pin (44).

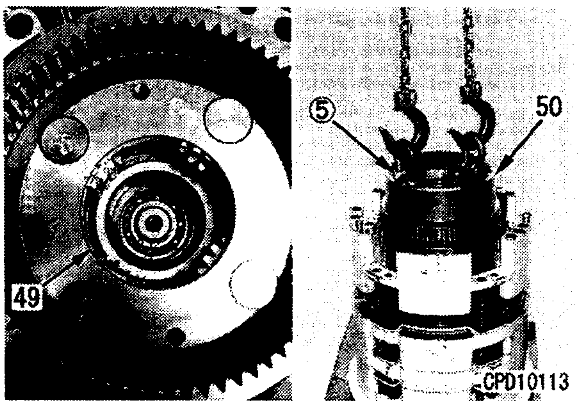
9. No. 2 discs, plates, and springs

1) Remove No. 2 clutch springs (45).
2) Remove discs (46) and plates (47).

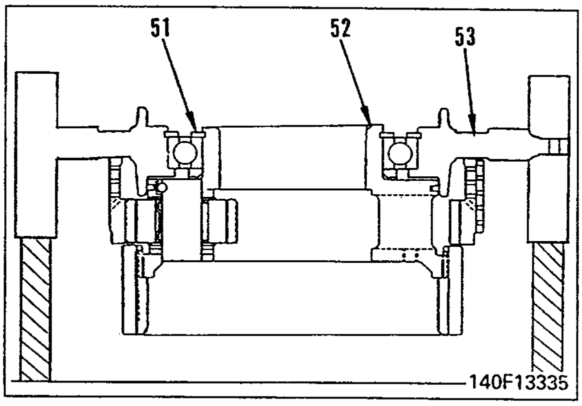


10. No. 2 housing and No. 2 carrier assembly

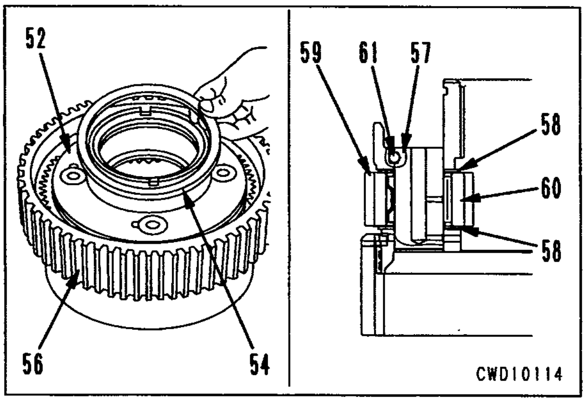
1) Push up the output shaft lightly from underside.
2) Remove snap ring (49).
3) Using eyebolts ⑤, remove No. 2 housing and No. 2 carrier assembly (50).



3) Disassemble No. 2 housing and No. 2 carrier assembly according to the following procedure.
   i) Remove snap ring (51) and pull No. 2 carrier assembly (52) out of No. 2 housing (53).



   ii) Remove spacer (54) from No. 2 carrier assembly (52).
   iii) Remove No. 2 ring gear (56).
   iv) Pull out shaft (57) and remove thrust washer (58), gear (59), bearing (60), and ball (61).



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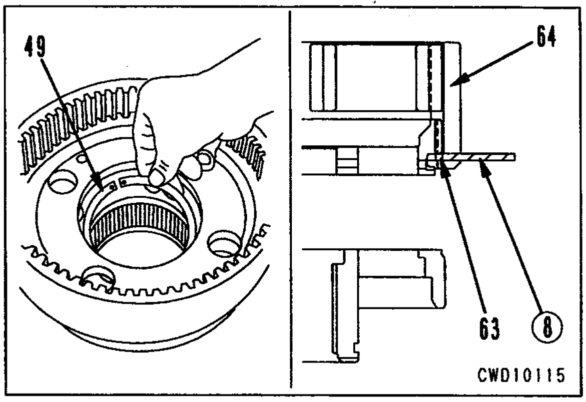
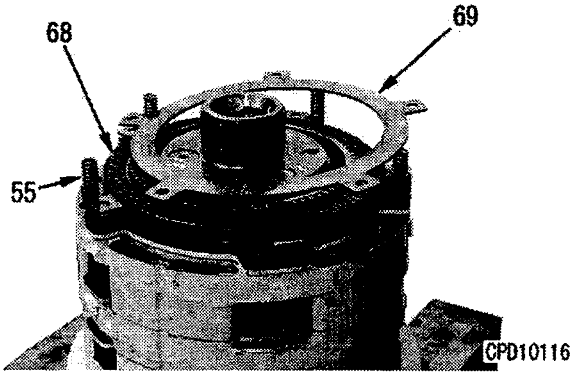
   v) Remove snap ring (49).
   vi) Remove snap ring (63) and ring gear (64).
      ★ Contract snap ring (63) by inserting round rods ⑧ finer than 3mm in 2 diagonal holes of 4 on the ring gear and pull out ring gear (64).



11. No. 3 discs, plates, and springs
1) Remove No. 3 springs (55).
2) Remove No. 3 discs (68) and plates (69).

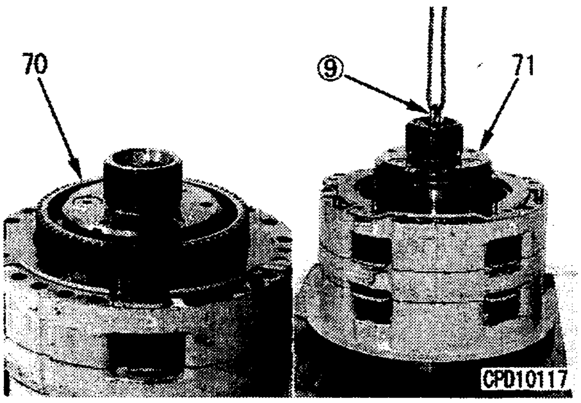


12. No. 3 ring gear

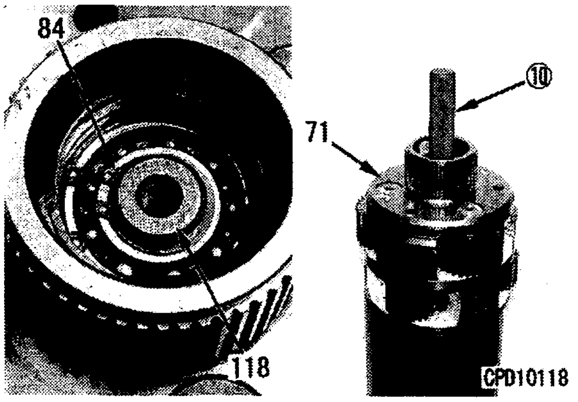
Remove No. 3 ring gear (70).

13. No. 3 and No. 4 carriers and output shaft assembly

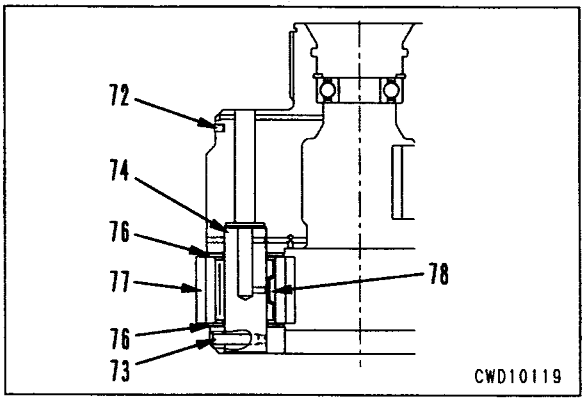
1) Using eyebolts ⑨, remove No. 3 and No. 4 carriers and output shaft assembly (71).



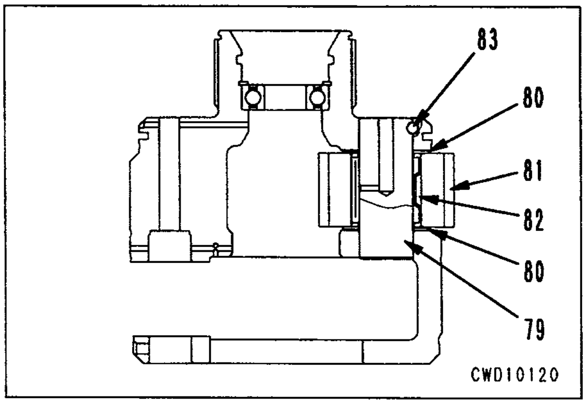
2) Disassemble No. 3 and No. 4 carriers and output shaft assembly according to the following procedure.
   - i) Remove snap ring (84), then remove output shaft assembly (118) from No. 3 and No. 4 carriers (71) with push tool ⑩.



   - ii) Remove seal ring (72).
   - iii) Drive pin (73) into shaft (74).
   - iv) Drive out shaft (74) from No. 3 carrier side.
   - v) Remove thrust washer (76), No. 4 planetary gear (77), and bearing (78).
     ★ Pull the pin out of the shaft.



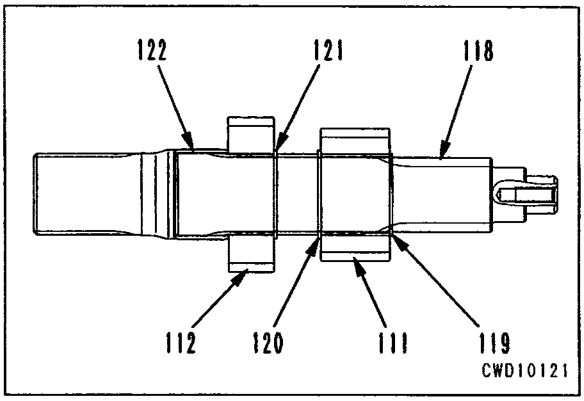
   - vi) Drive out shaft (79) and remove thrust washer (80), No. 3 planetary gear (81), bearing (82), and ball (83).
     ★ Take care not to lose the ball.



vii) Remove snap ring (119), then remove No. 4 sun gear (111) from output shaft (118).

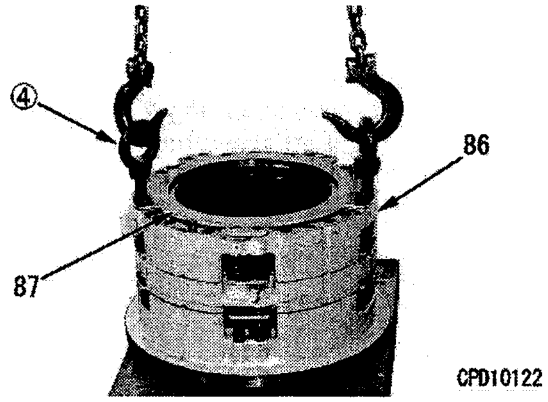
viii) Remove snap rings (120) and (121), then remove No. 5 sun gear (112) from the output shaft.

ix) Remove inner race (122) from the bearing.



14. No. 3 housing

1) Using eyebolt ④, remove housing (86).
2) Remove No. 3 piston (87).



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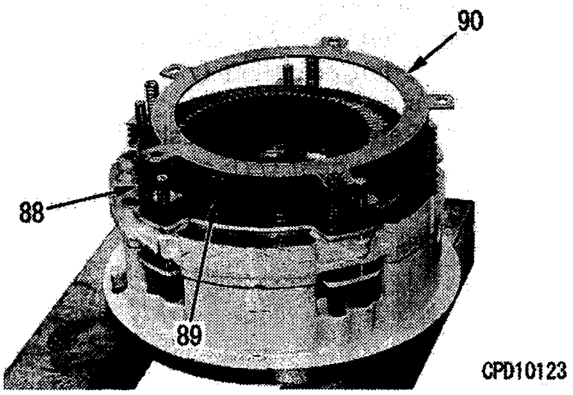
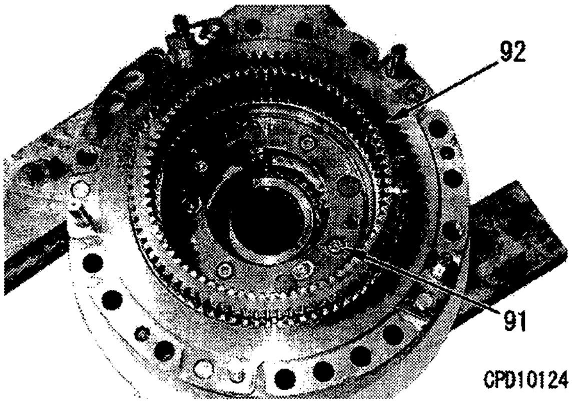
15. No. 4 discs, plates, and springs

1) Remove springs (88).
2) Remove discs (89) and plates (90).

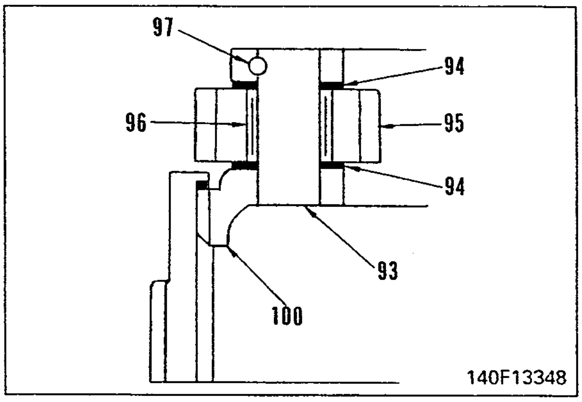


16. No. 5 carrier and No. 4 ring gear assembly

1) Remove 4 mounting bolts (91).
2) Remove No. 5 carrier and No. 4 ring gear assembly (92).



3) Disassemble No. 5 carrier and No. 4 ring gear assembly according to the following procedure.
   i) Drive out shaft (93) and remove thrust washer (94), gear (95), bearing (96), and ball (97).
      ★ Take care not to lose the ball.



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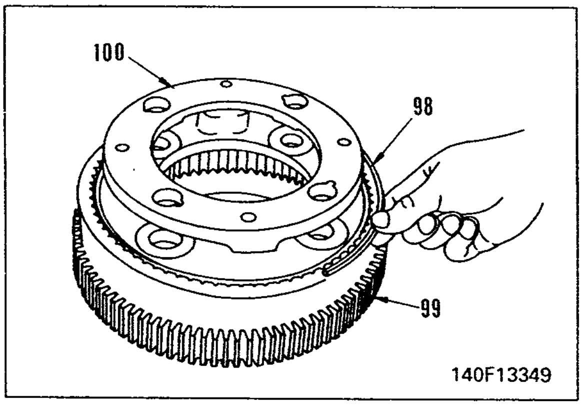
   ii) Remove snap ring (98), then remove No. 4 ring gear (99) from carrier (100).



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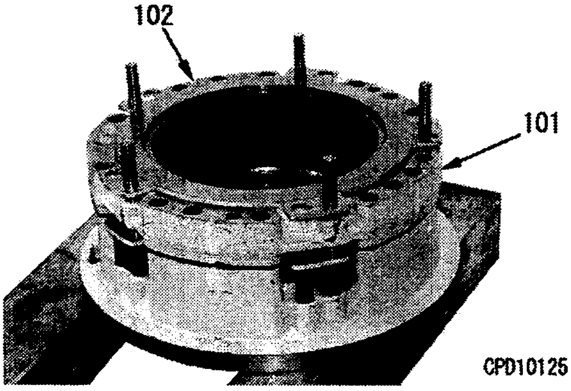
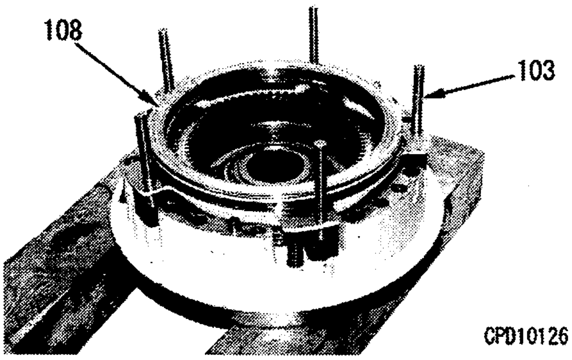
17. No. 4 housing assembly
1) Remove No. 4 housing assembly (101).
2) Remove No. 4 piston (102).



CPD10125

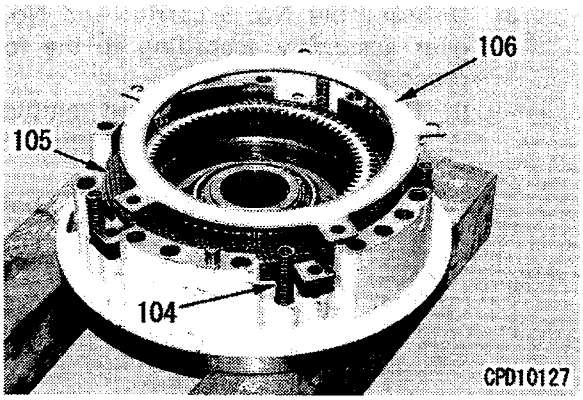
18. Guide pin and No. 5 piston
Remove guide pin (103) and No. 5 piston (108).



CPD10126

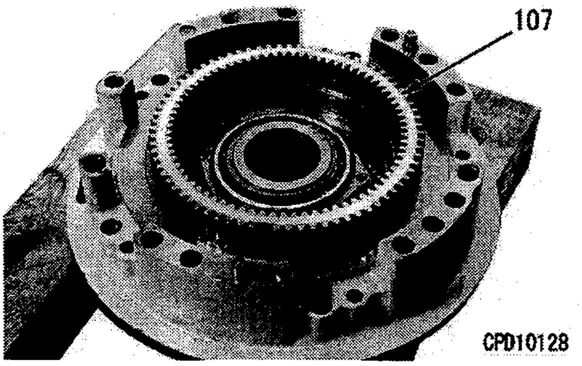
19. No. 5 discs, plates, and springs

Remove springs (104), discs (105), and plates (106).



20. No. 5 ring gear

Remove No. 5 ring gear (107).



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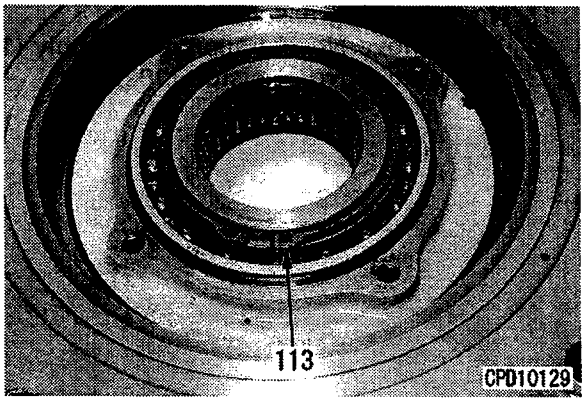
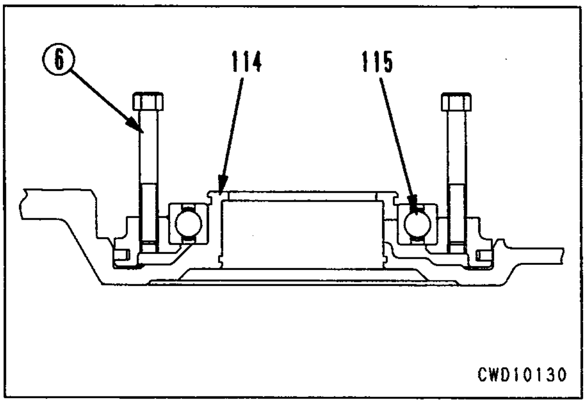
21. Cage (For fixing No. 5 carrier)

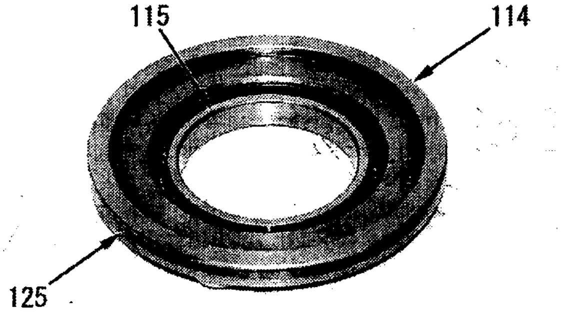
1) Remove snap ring (113).
2) Using forcing screws ⑥, remove cage (114)and bearing (115) as a unit.
3) Remove seal ring (125) from cage (114).
4) Remove bearing (115) from cage (114).



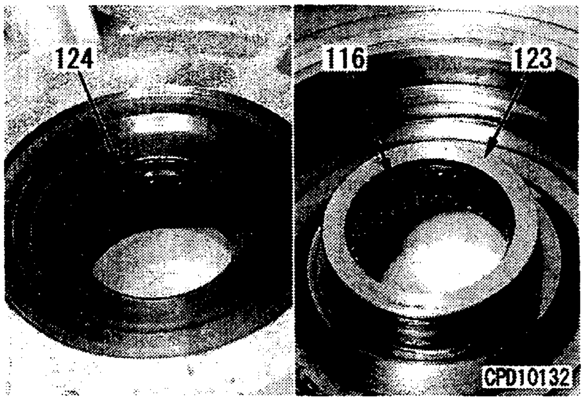


22. Output shaft bearing

1) Remove snap ring (124).
2) Remove bearing (116) from housing (123).



CPD10131



014012

ASSEMBLY OF TORQFLOW TRANSMISSION ASSEMBLY

Serial No. 60001 – 65000

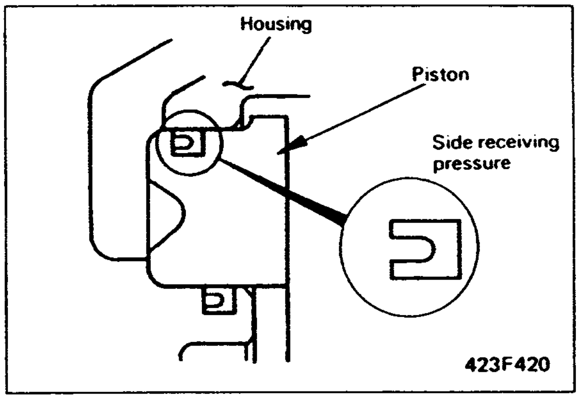
- **Precautions when assembling**

★ Clean all parts, and check for dirt or damage before assembling.

★ Coat the sliding surfaces of all parts with engine oil before installing.

★ Assemble the piston seal ring so that the side receiving the pressure faces the housing as shown in the diagram.

★ When installing the metal seal ring, coat it with grease (G2-LI), and install it uniformly so that it is not offset to one side.

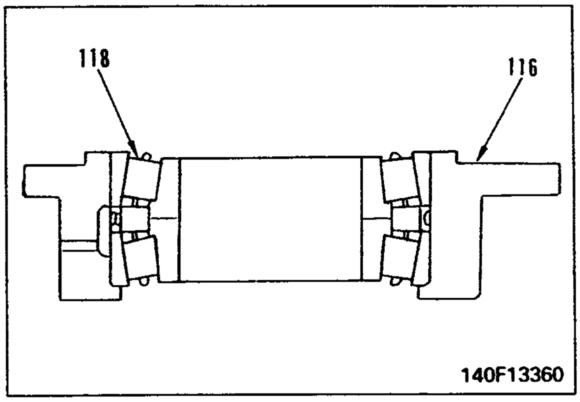


1. Bevel pinion assembly

1) Assemble bevel pinion assembly as follows.

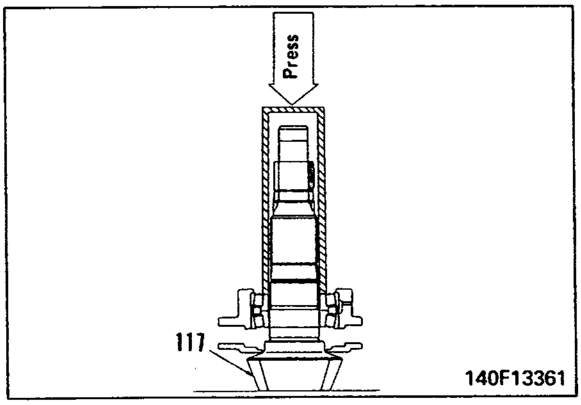
i) Install bearing (118) to cage (116).

★ The bearing is a bearing set, so be careful not to change the sets when assembling.



ii) Install bevel pinion (117) to inner race end of bearing.

★ Support the bevel pinion side, and press fit the inner race side of the bearing.

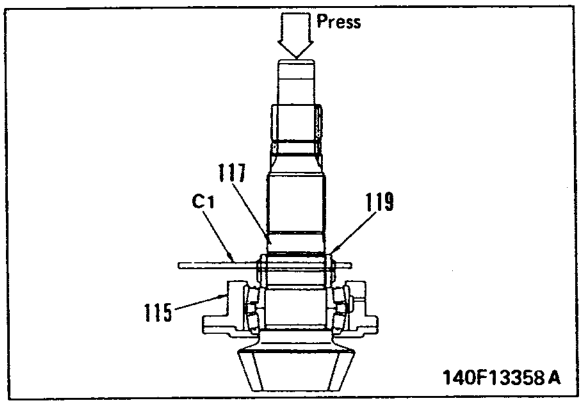


iii) Press bevel pinion assembly (115) with press, then using tool **C1**, tighten nut (119).

★ Tighten until the first nut is securely in contact with the inner race, then tighten the second nut to the specified tightening torque.

kgm Second nut:

367.7 ± 24.52 Nm
(37.5 ± 2.5 kgm)



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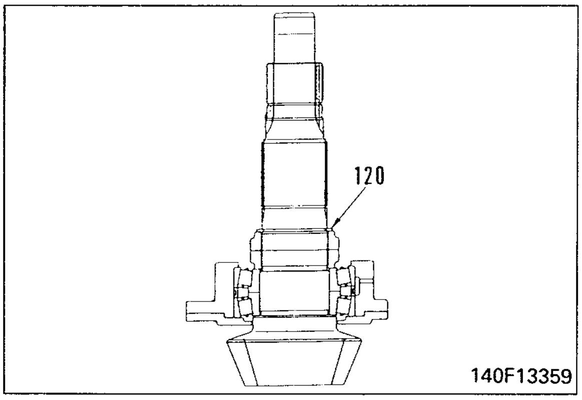
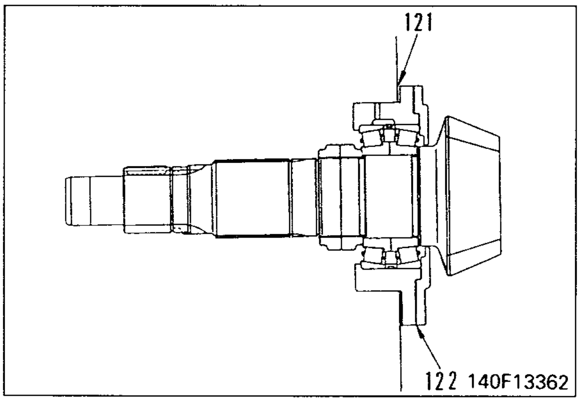
iv) Install snap ring (120).

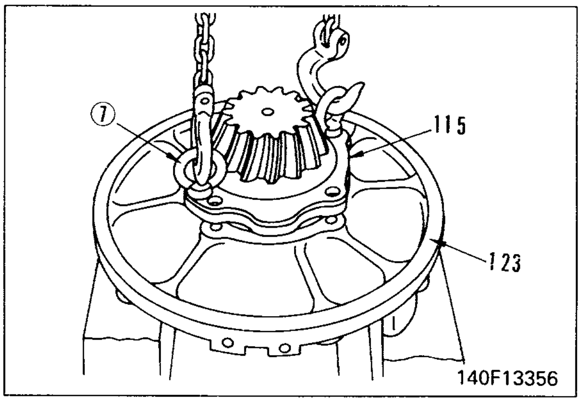


2) Assemble removed shims (121) and (122), then using eyebolts ⑦, install bevel pinion assembly (115) to case (123).

Mounting bolt:
Thread tightener (LT-2)

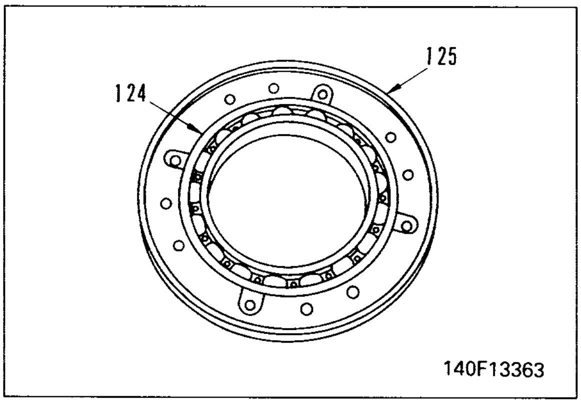


★ Adjust the thickness of shim (122) as follows.
   i) With the shim at the cover side removed, push the cover towards the case, and rotate the shaft several times to settle the bearing.
   ii) Keep the cover pushed, and tap the cover several times with a plastic hammer.
   iii) Measure the clearance between the cover and cage at two places around the circumference.
   iv) Select a shim so that the thickness is clearance − 0.05 — 0.15 mm.

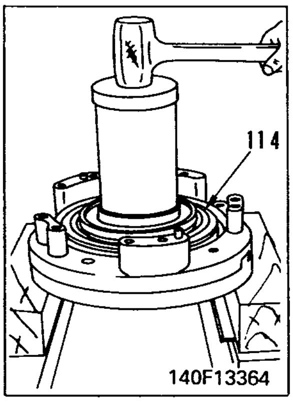


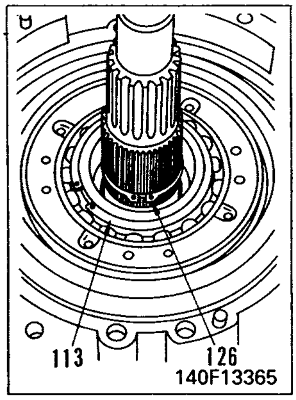
2. Cage (for securing No. 5 carrier)

1) Press fit bearing (124) to cage (125).



2) Fit seal ring to cage and case end, then install cage assembly (114).
★ Press fit the inner race of the bearing.
3) Install snap ring (113).

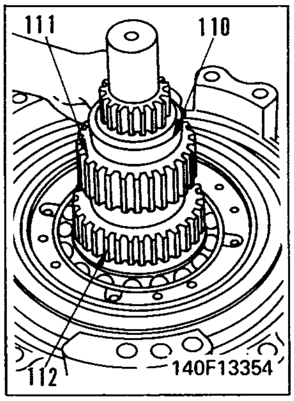


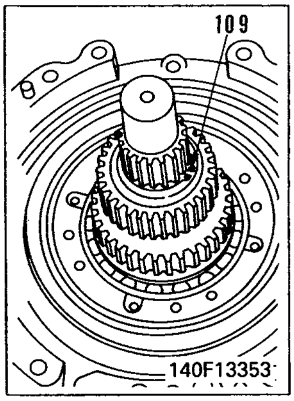


3. No. 5 sun gear
1) Install snap ring (126).

2) Install No. 5 sun gear (112).

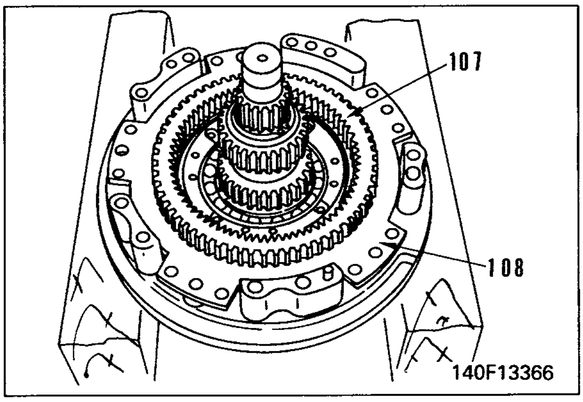
4. No. 4 sun gear
1) Install No. 4 sun gear (111).
2) Install collar (110).
3) Install snap ring (109).





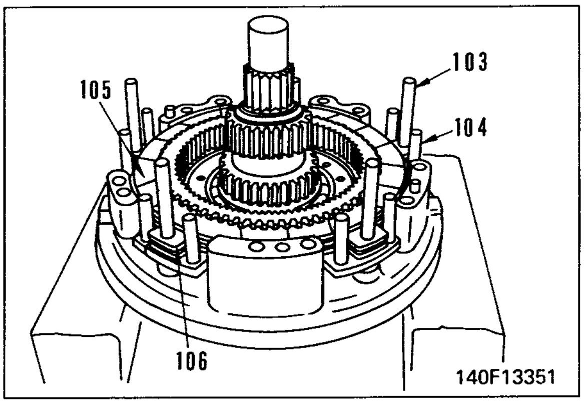
5. No. 5 ring gear
Install No. 5 ring gear (107).

6. No. 5 piston
Fit seal ring and install No. 5 piston (108).



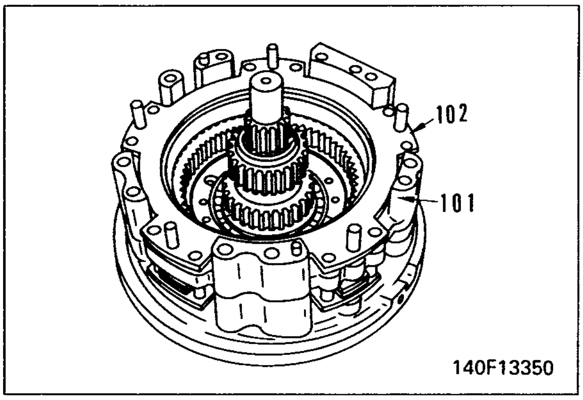
7. Guide pin
Install guide pin (103).

8. No. 5 discs, plates, spring
1) Install discs (105) and plates (106).
★ Discs: 3; Plates: 2
2) Install spring (104).
★ Free length of spring: 59 mm



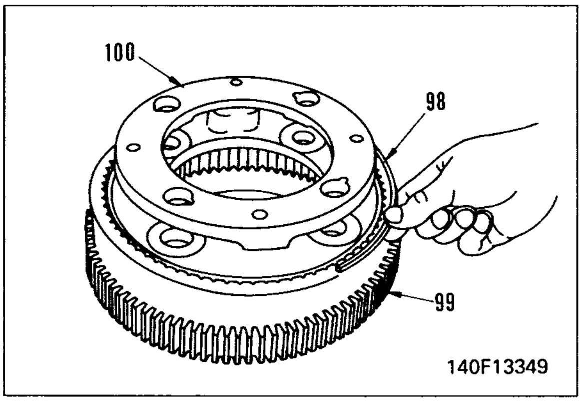
9. No. 4 housing assembly

1) Fit seal ring and install No. 4 piston (102).
2) Install No. 4 housing (101).
   ★ Check that the springs are fitted securely into the groove.

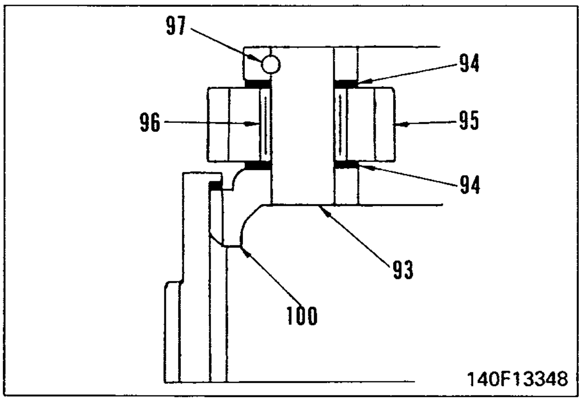


10. No. 5 carrier, No. 4 ring gear assembly

1) Assemble No. 5 carrier assembly as follows.
   i) Set No. 4 ring gear (99) to carrier (100), and install snap ring (98).



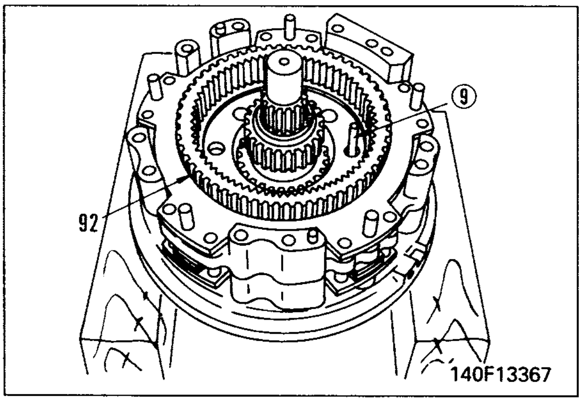
   ii) Assemble bearing (96) to gear (95), put thrust washer (94) in contact on both sides, and set to carrier.
   iii) Fit ball (97) and install shaft (93).



2) Using guide bolt ⑨, install No. 5 carrier and No. 4 ring gear assembly (92).

Mounting bolt:
Thread tightener (LT-2)

kgm Mounting bolt:
66 ± 7.4 Nm (6.75 ± 0.75 kgm)



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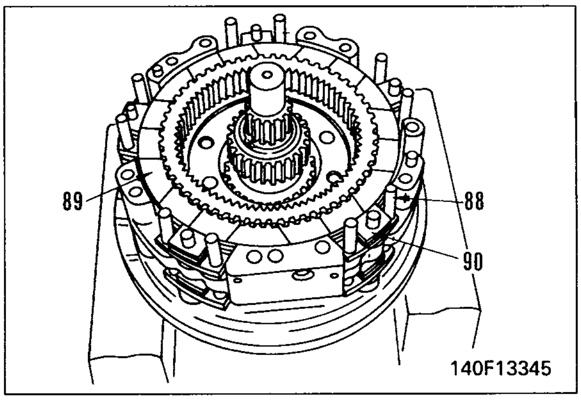
11. No. 4 discs, plates, spring

Install No. 4 discs (89), plates (90), and spring (88).

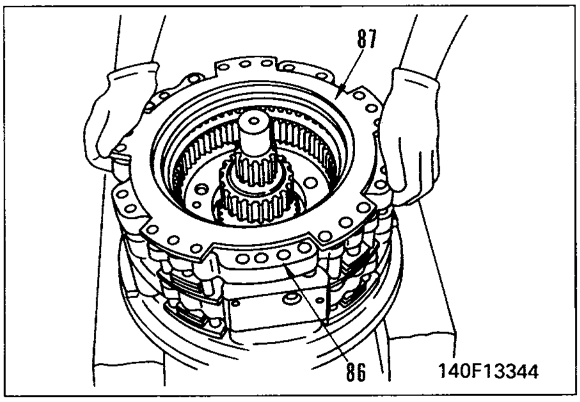
★ Discs: 3; plates: 2

★ Free length of spring: 59 mm



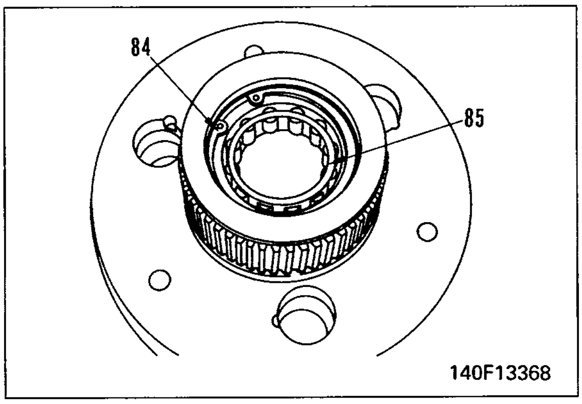
12. No. 3 housing assembly

1) Fit seal ring and install No. 3 piston (87).
2) Install No. 3 housing (86).
   ★ Check that the spring is fitted securely in the groove.

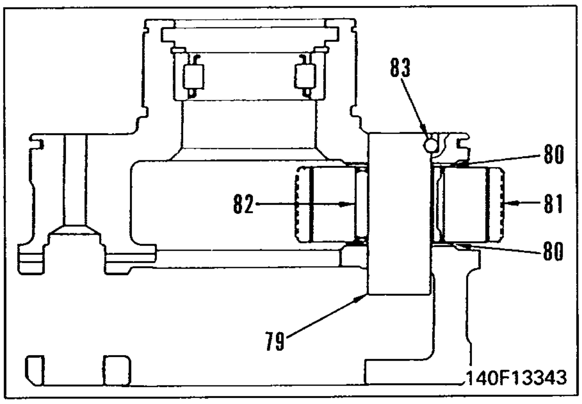


13. No. 3, 4 carrier assembly

1) Assemble No. 3 and 4 carrier assembly as follows.
   i) Press fit bearing (85), and install snap ring (84).



   ii) Assemble bearing (82) to No. 3 planetary gear (81), put thrust washer (80) in contact on both sides, and set to carrier.
   iii) Fit ball (83) and install shaft (79).

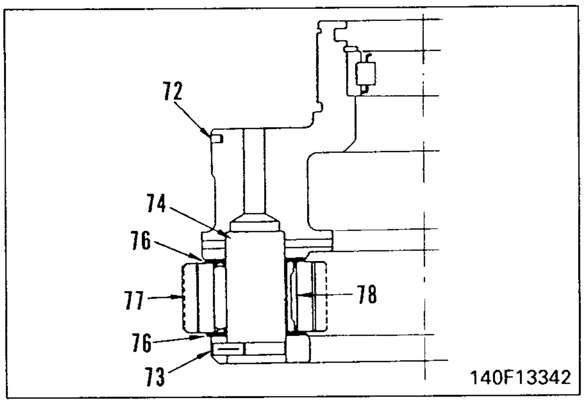


iv) Assemble bearing (78) to No. 4 planetary gear (77), put thrust washer (76) in contact on both sides, and set to carrier.

v) Align pin hole of shaft with pin hole of carrier, and install shaft (74).

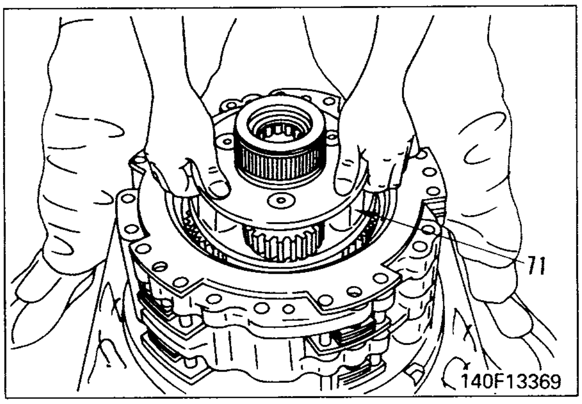
vi) Check that pin holes are aligned, then knock in pin (73).

vii) Install seal ring (72).



2) Align sun gear and ring gear, and install No. 3 and 4 carrier assembly (71).

★ Be careful not to get your fingers caught.



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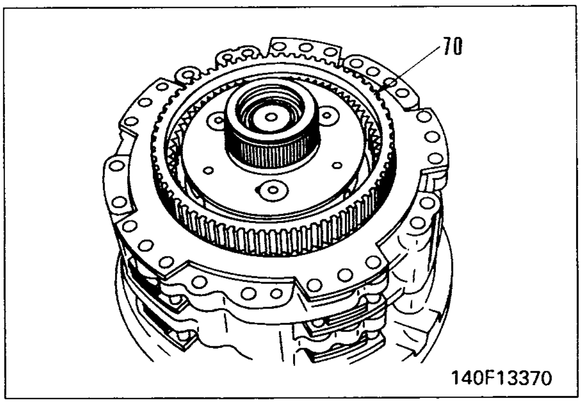
14. No. 3 ring gear

Install No. 3 ring gear (70).

★ Set the gear so that the side with a notch in the outside teeth faces down.



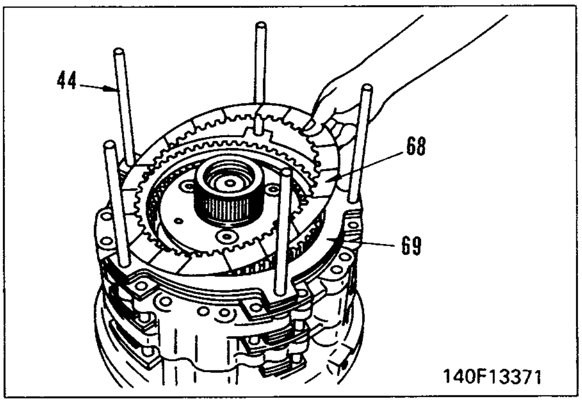
15. Guide pin

Install guide pin (44).

16. No. 3 discs, plates

Install No. 3 discs (68) and plates (69).

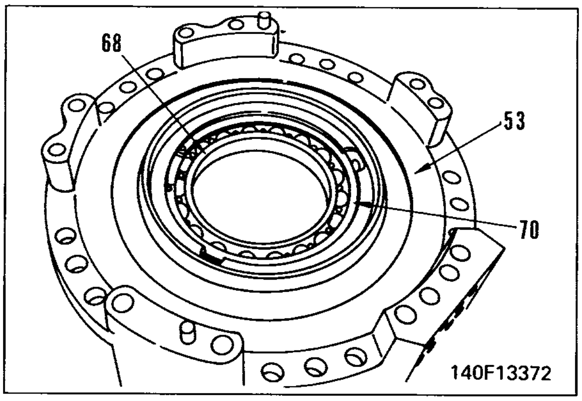
★ Discs: 3; plates: 2



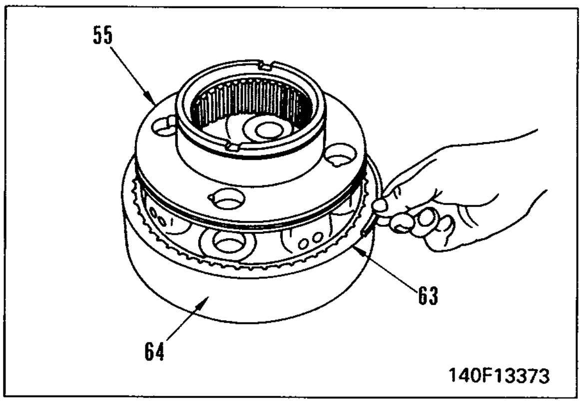
17. No. 2 housing, No. 2 carrier assembly

1) Assemble No. 2 housing as follows.

i) Press fit bearing (68) to No. 2 housing (53), and install snap ring (70).



ii) Set ring gear (64) to No. 3 carrier (55), and install snap ring (63).



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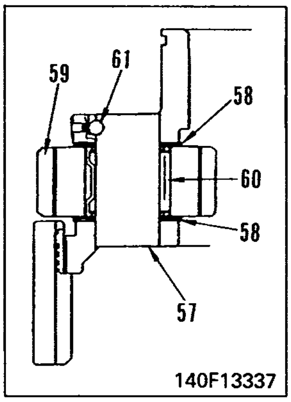
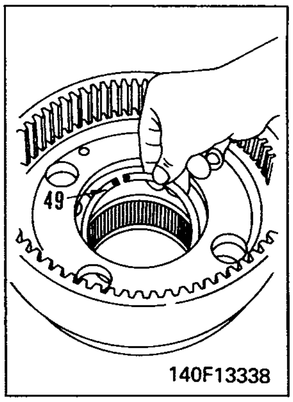
iii) Assemble bearing (60) to gear (59), put thrust washer (58) in contact on both sides, and set to carrier.

iv) Fit ball (61) and install shaft (57).

★ When two gears are assembled, assemble snap ring (49).



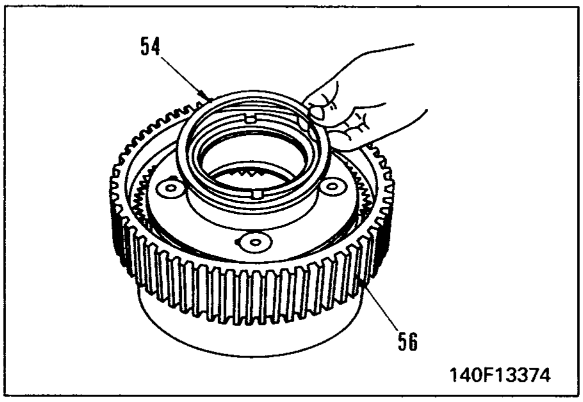


v) Install seal ring.

vi) Install No. 2 ring gear (56).

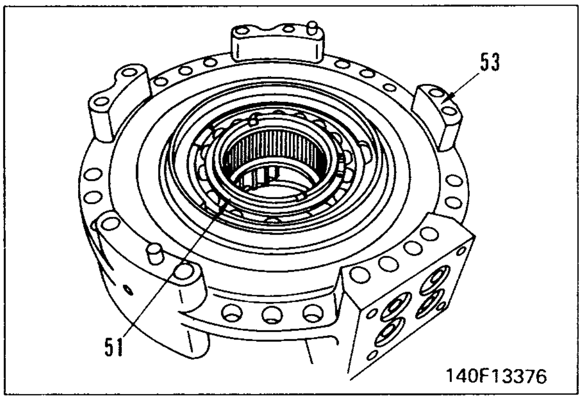
vii) Install spacer (54).

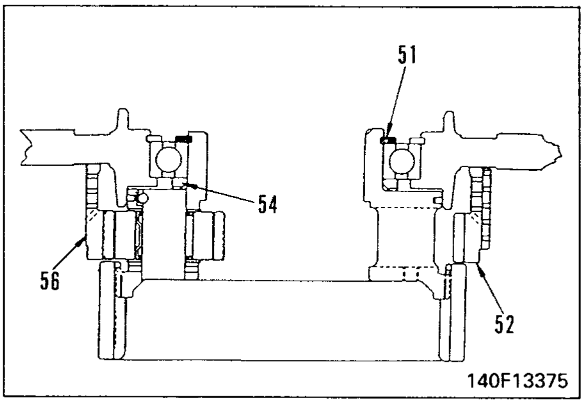
★ Install with the cut on the inside facing the carrier.

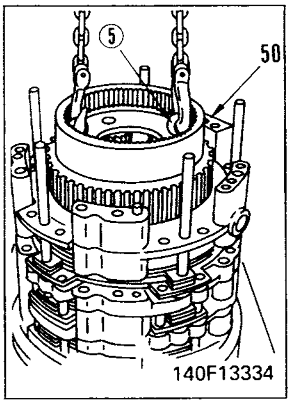


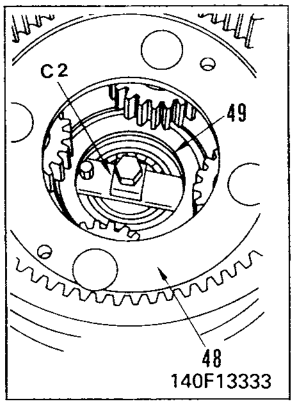
viii) Install No. 2 housing (53) to carrier assembly (52).
★ Press fit the inner race of the housing bearing.

ix) Install snap ring (51).



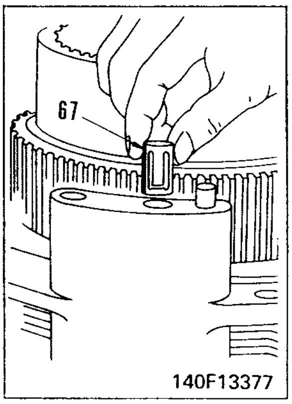


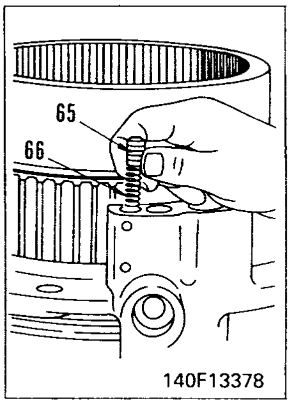




2) Using eyebolts ⑤, install No. 2 housing and No. 2 carrier assembly (50).

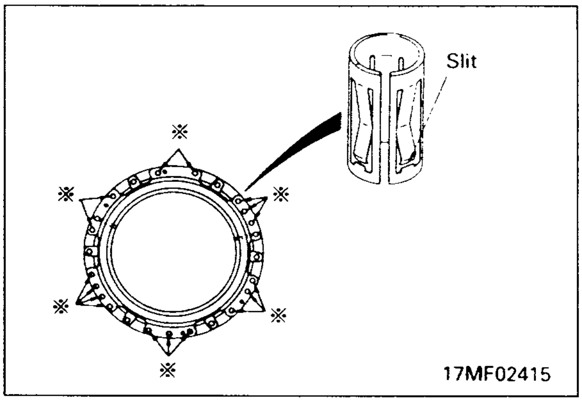
3) Using tool **C2**, push up No. 3 carrier (48), and install snap ring (49).





4) Install sleeve (67).
★ When the sleeve has been removed, install to the bolt holes marked ※ in the diagram with the slits at the bottom.

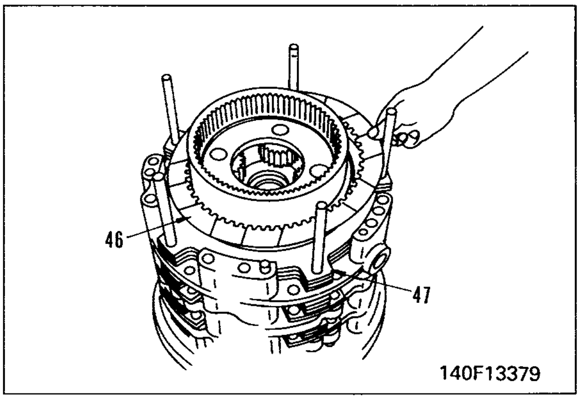
5) Fit spring (66) and install valve (65).



18. No. 2 discs, plates

Install No. 2 discs (46) and plates (47).

★ Discs: 5; plates: 4

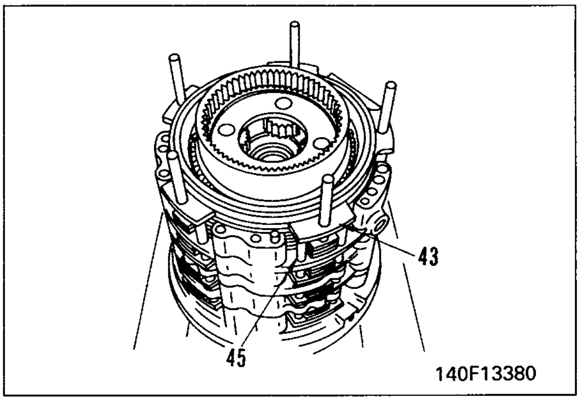


19. Spring for No. 3 and 2 housings

Install spring (45).

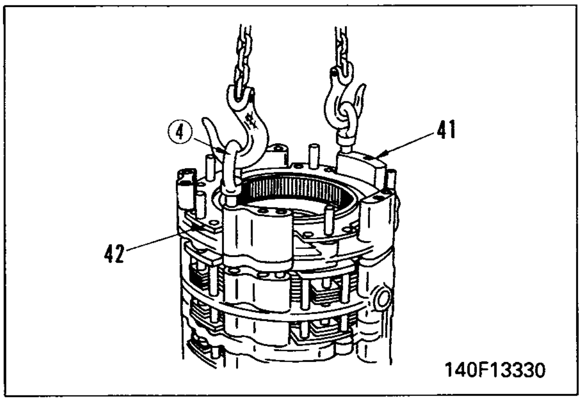
20. No. 2 piston

Fit seal ring, then align spring with spring groove, and install No. 2 piston (43).



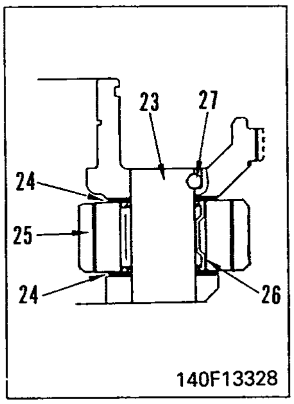
21. No. 1 housing assembly

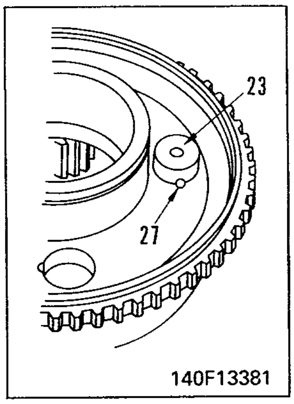
1) Fit seal ring, and install No. 1 piston (42).
2) Using eyebolts ④, align with No. 2 piston, and install No. 1 housing assembly (41).
   ★ Push in the housing and tap the dowel pin portion.



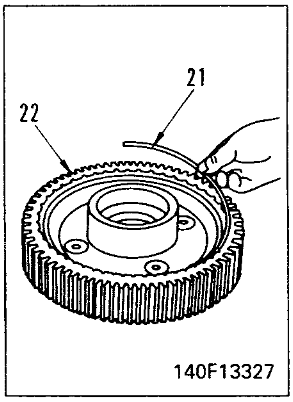
22. Input shaft, No. 1 carrier assembly

1) Assemble input shaft and No. 1 carrier assembly as follows.
   i) Assemble bearing (26) to gear (25), put thrust washer (24) in contact on both sides, and set to carrier.
   ii) Fit ball (27) and install shaft (23).





iii) Set No. 1 ring gear (22) to No. 1 carrier, and install snap ring (21).
iv) Fit snap ring (38) to input shaft (20), and press fit bearing (39).



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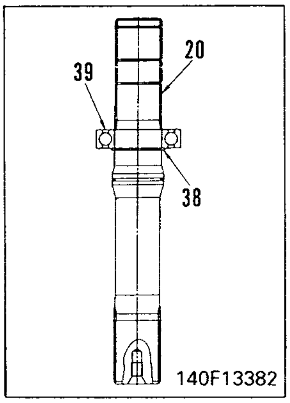

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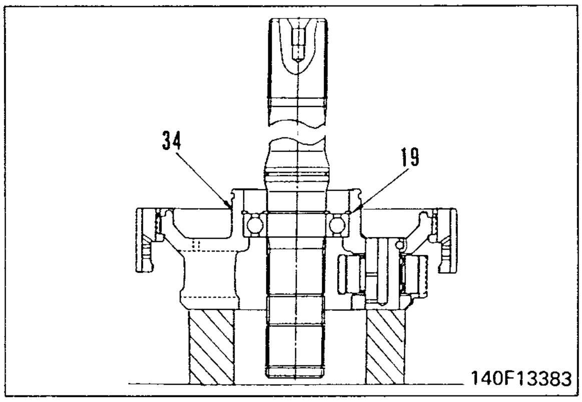
v) Install input shaft (20) to No. 1 carrier assembly (34), then install snap ring (19).



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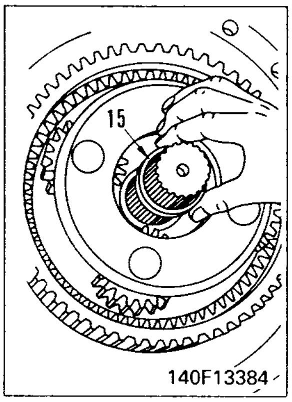
vi) Install collar (15).
vii) Install No. 1 sun gear (14).



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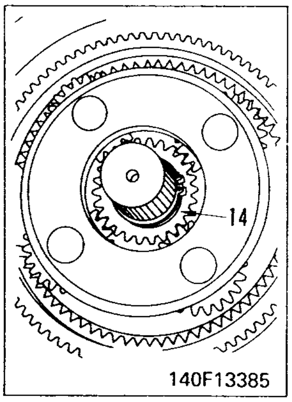

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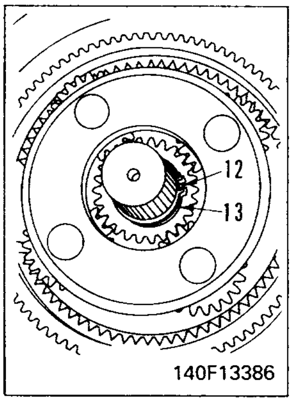
viii) Install snap rings (13) and (12).
ix) Install No. 2 sun gear (11), then install snap ring (10).



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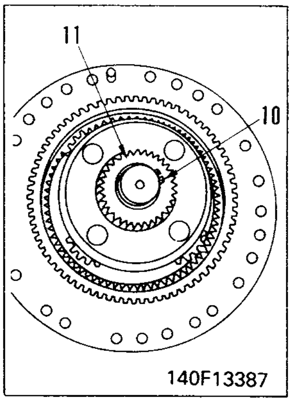

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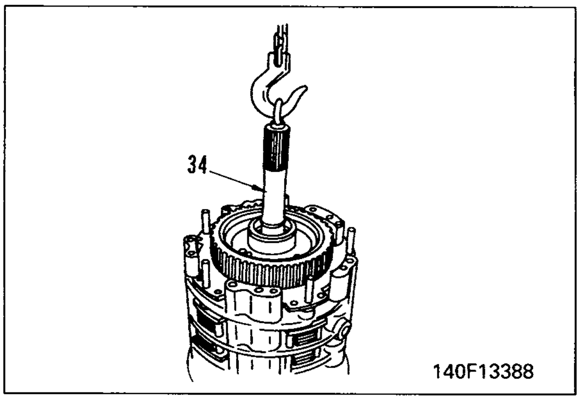
2) Raise input shaft No. 1 carrier assembly (34), align meshing of No. 2 sun gear and No. 1 planetary gear, then install.

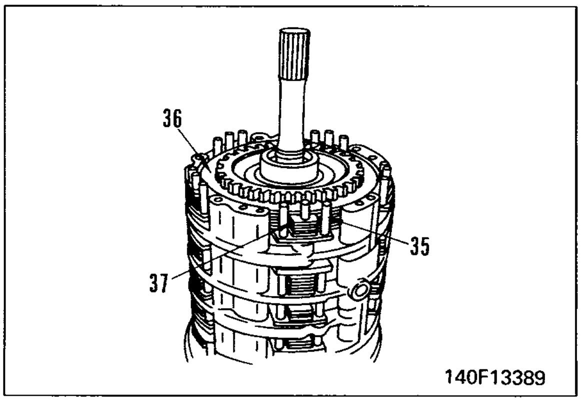


23. No. 1 discs, plates, spring

Install discs (36), plates (37), and spring (35).

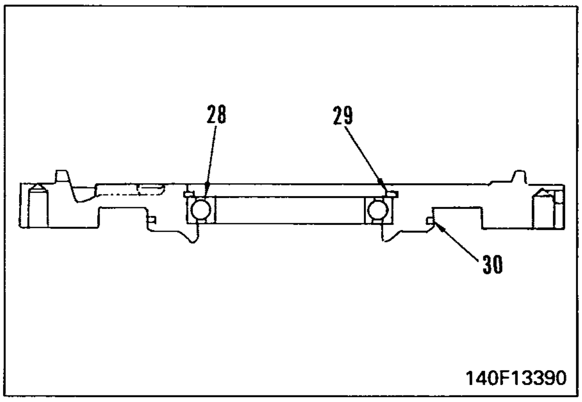
★ Discs: 4; plates: 3

★ Free length of spring: 59 mm

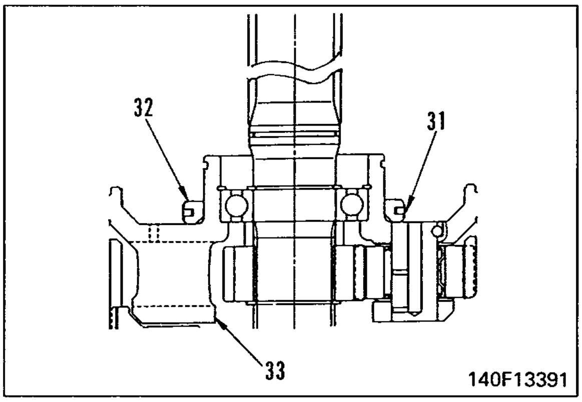


24. Front plate

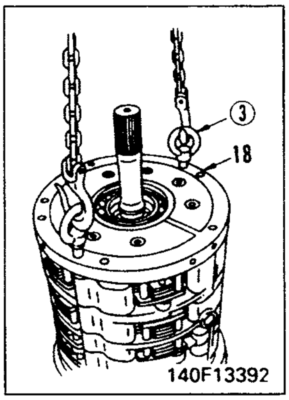
1) Assemble the following parts to front plate.
   i) Press fit bearing (28) and install snap ring (29).
   ii) Install seal ring (30).

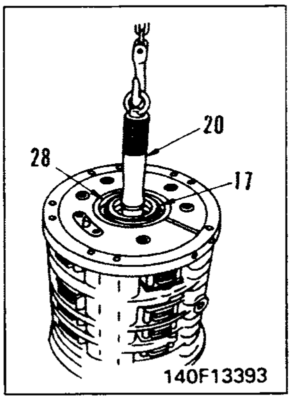


2) Fit seal ring (31) and install collar (32) to No. 1 carrier (33).



3) Using eyebolts ③, align front cover (18) with guide pin and spring, then install.
4) Press fit inner race of bearing (28) to input shaft (20), then install snap ring (17).
   ★ Check that the spring is fitted securely in the cover.

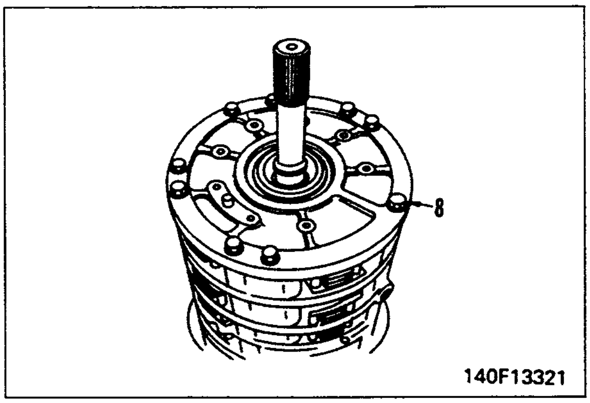




25. Tie bolt

Install 3 tie bolts (8).

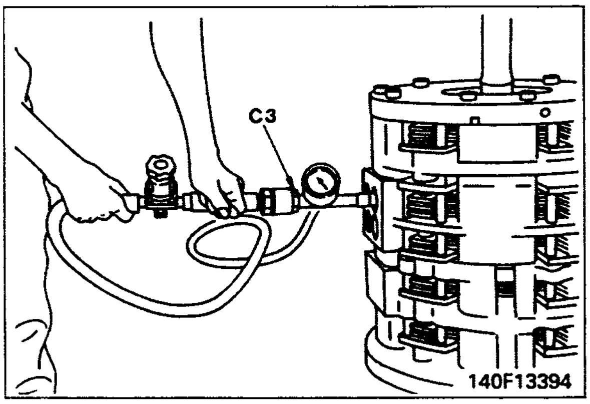
kgm Tie bolt: **166.7 ± 9.8 Nm {17 ± 1 kgm}**



26. Checking operation of piston

Using tool **C3**, check operation and stroke of each piston.

Piston	Standard stroke (mm)	
	Serial No. 60001 – 65000	Serial No. 65001 and up
No. 1	5	5
No. 2	5	7
No. 3	5.5	4
No. 4	4.5	4
No. 5	4.5	3

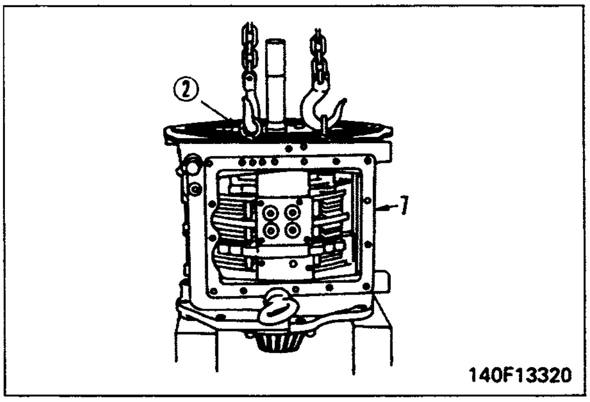


27. Transmission case

Fit O-ring, then using eyebolts ②, install transmission case (7), then install remaining 11 tie bolts.

Mounting bolt: **Gasket sealant (LG-5)**

kgm Tie bolt: **166.7 ± 9.8 Nm {17 ± 1 kgm}**

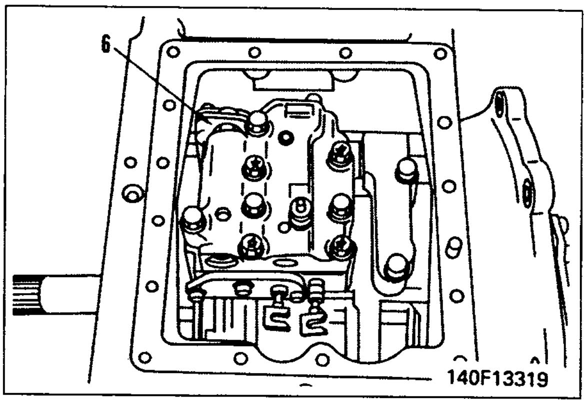


28. Control valve

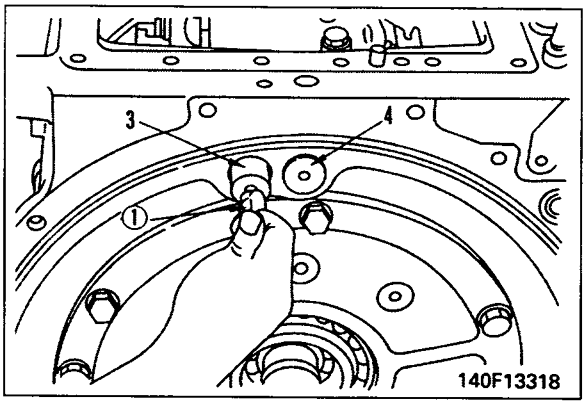
1) Face transmission to side.
2) Fit O-ring and install control valve assembly (6).

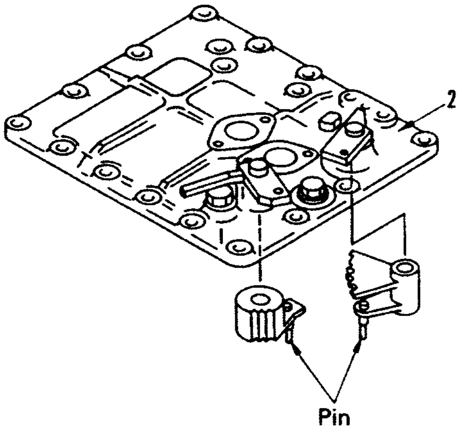
Mounting bolt:

49 ± 4.9 Nm {5 ± 0.5 kgm}



3) Fit O-ring, and using eyebolts ①, install sleeves (4) and (3).
   ★ Fit the O-ring for sleeve (3) at the tip only.
4) Align yoke of spool (5) with pin position of cover assembly (2).





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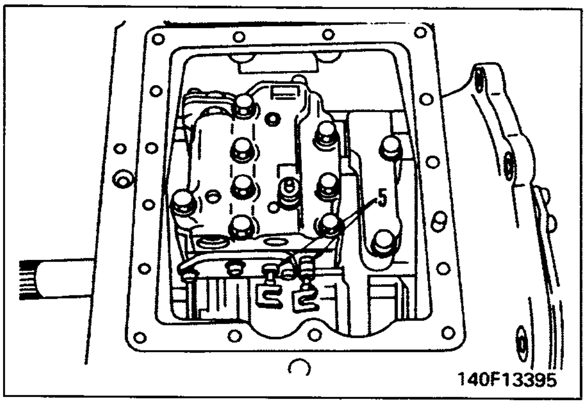
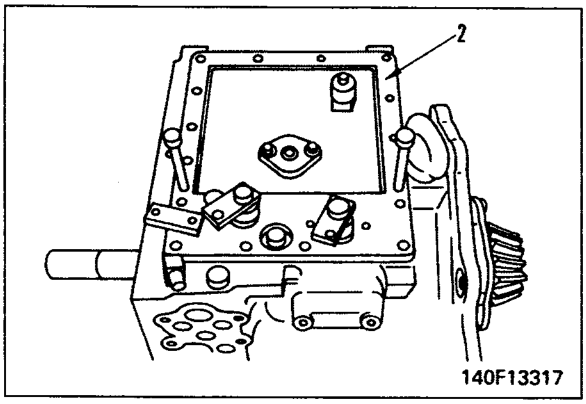
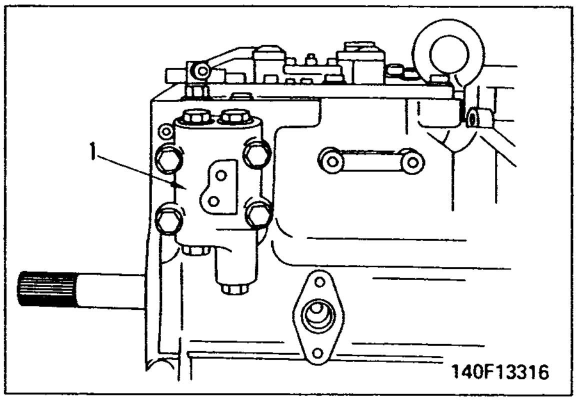


5) Fit gasket, then check through inspection window that pin and yoke are meshed, and install cover assembly (2).
   ★ Tap the dowel pin portion lightly with a plastic hammer to fit the cover completely, then tighten the bolts.



29. Relief valve
Install relief valve assembly (1).

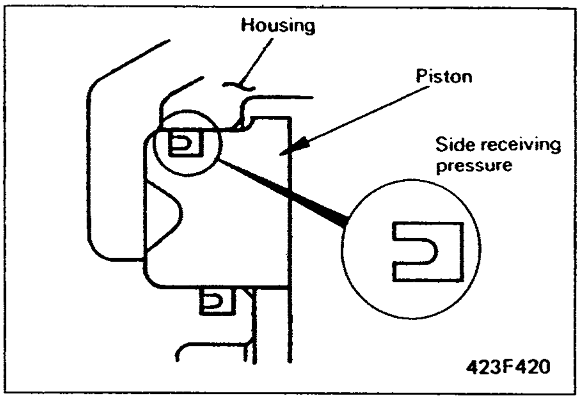
kgm Mounting bolt:
49 ± 4.9 Nm (5 ± 0.5 kgm)



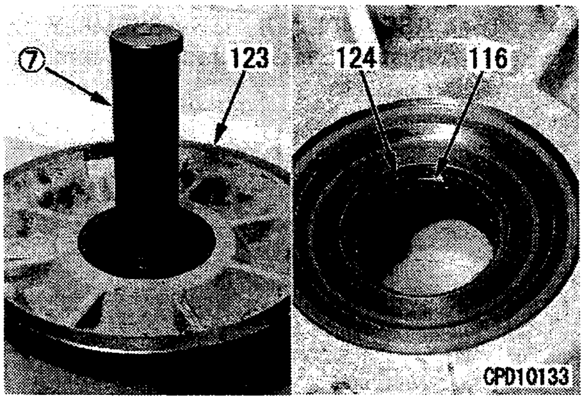
30. Adjusting tooth contact and backlash
★ See ASSEMBLY OF HSS ASSEMBLY, Step 4, Adjusting backlash and tooth contact.

Serial No. 65001 and up

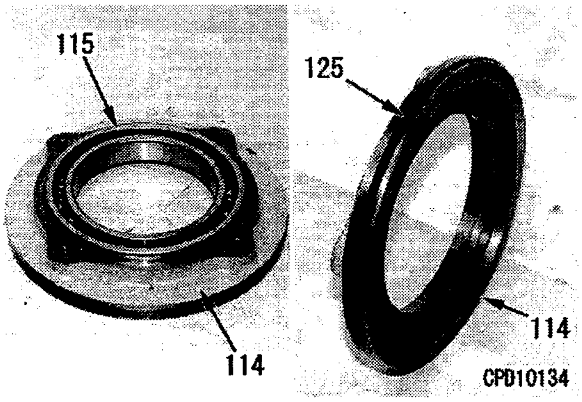
- Precautions for assembly
  - ★ Clean the all parts and check them for dirt or damage before installing.
  - ★ Coat the sliding surfaces of each part with engine oil before installing.
  - ★ Install the seal ring of each piston with the pressure receiving side directed to the housing as shown in the figure.
  - ★ Apply grease (G2-LI) to each seal ring and install it evenly.



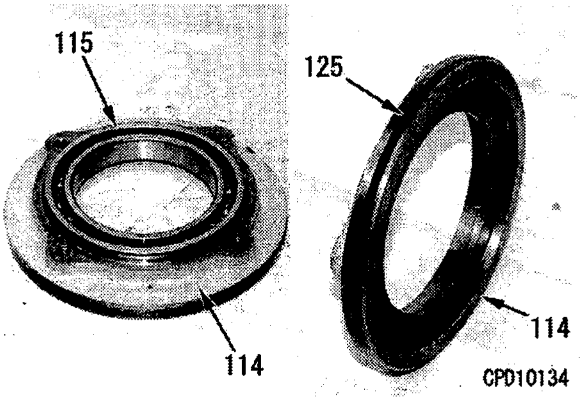
1. **Output shaft bearing**
   1) Install bearing (116) to housing (123) with push tool ⑦.
   2) Install snap ring (124).



2. **Cage (For fixing No. 5 carrier)**
   1) Install bearing (115) to cage (114) with the push tool.
   2) nstall seal ring (125) to cage (114).



   3) Install cage (114) to housing (123) with push tool ⑪.
      - ★ Press fit the inner race side of bearing (115).
   4) Install snap ring (113).



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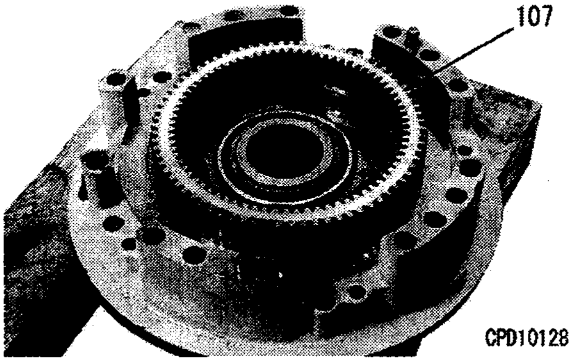
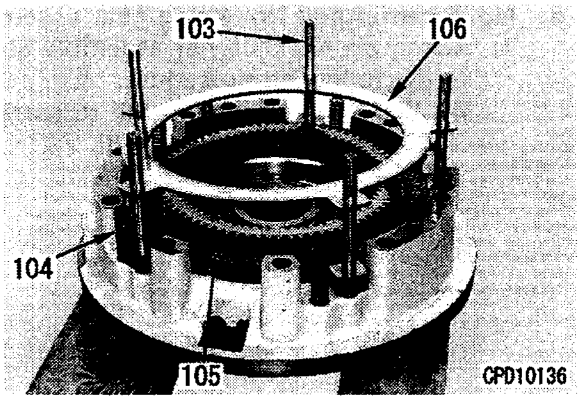
3. **No. 5 ring gear**
   Install No. 5 ring gear (107).



4. **Guide pin**
   Install guide pin (103).



5. **No. 5 discs, plates, and springs**
   1) Install discs (105) and plates (106) alternately.
      ★ Discs: 3 pieces, Plates: 4 pieces
   2) Install springs (104).
      ★ Free length of spring: 59 mm

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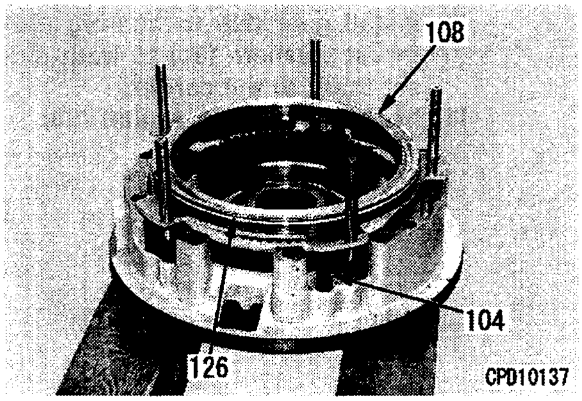
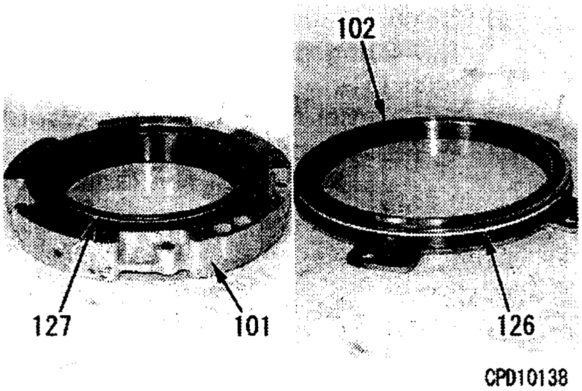
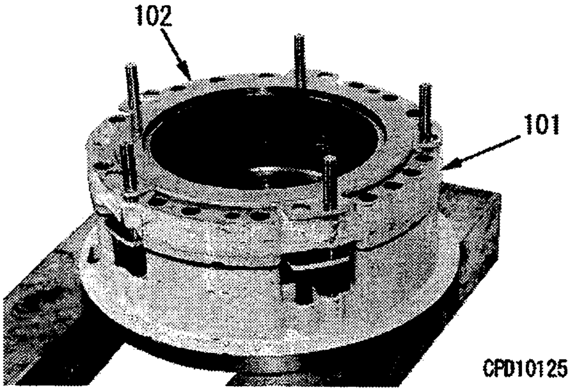
6. **No. 5 piston**
   1) Install sear ring (126) to No. 5 piston (108).
      ★ Take care of the pressure receiving side of the seal ring.
   2) Install No. 5 piston (108), matching it to springs (104).
      ★ Check that the springs are fitted securely in the grooves of the piston.



7. **No. 4 housing**
   1) Install seal ring (127) to No. 4 housing.
      ★ Take care of the pressure receiving side of the seal ring.
   2) Install seal ring (126) to No. 4 piston (102).
      ★ Take care of the pressure receiving side of the seal ring.

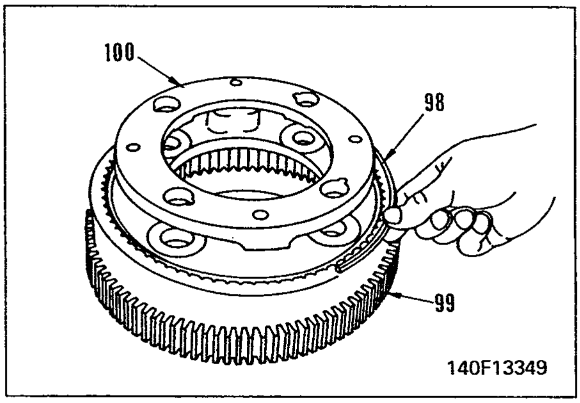


3) Install No. 4 piston (102) to No. 4 housing (101).
4) Install No. 4 housing (101), matching it to No. 5 piston.

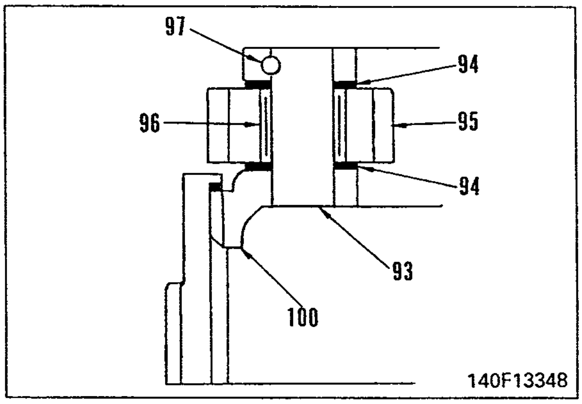


8. No. 5 carrier and No. 4 ring gear assembly

1) Assemble No. 5 carrier assembly according to the following procedure.
   i) Set No. 4 ring gear (99) to carrier (100) and install snap ring (98).



   ii) Install gear (95) to bearing (96) and fit thrust washers (94) to both sides, then set them to the carrier.
   iii) Install ball (97) and shaft (93).

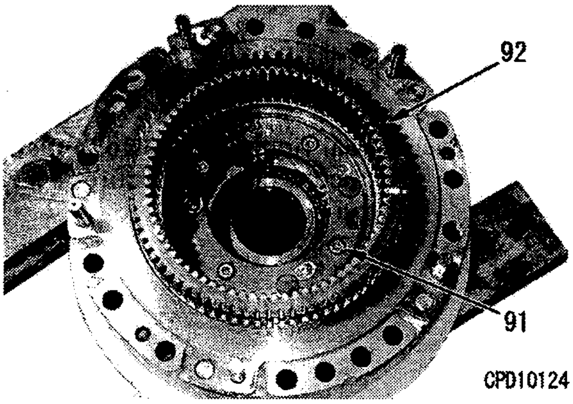


2) Using a guide bolt, install No. 5 carrier and No. 4 ring gear assembly (92) and tighten bolts (91).

   Mounting bolt: **Adhesive (LT-2)**

   Mounting bolt:

   30.9 +_ 3.4 Nm {3.14 +_ 0.35 kgm}



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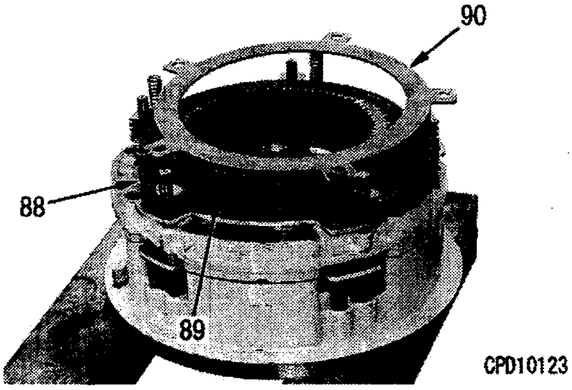
9. No. 4 discs, plates, and springs

Install No. 4 discs (89), plates (90), and springs (88).

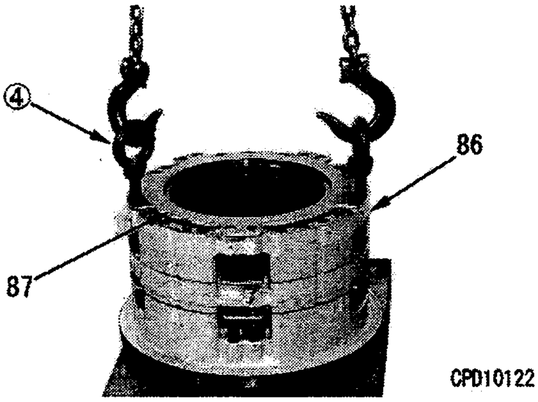
- ★ Discs: 4 pieces, Plates: 5 pieces
- ★ Free length of spring: 59 mm



CPD10123

10. No. 3 housing assembly

1) Install the seal ring to No. 3 housing.
2) Install the seal ring and No. 3 piston (87).
   - ★ For installation of the seal ring, see assembly step 7.
3) Using eyebolts ④, install No. 3 housing (86).
   - ★ Check that the springs are fitted securely in the grooves.



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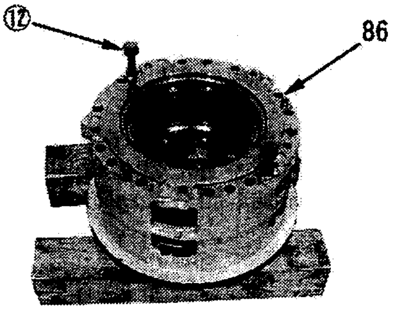
4) Using forcing screws ⑫, tighten No. 3 housing (86) and insert the dowel pin in the housing securely.



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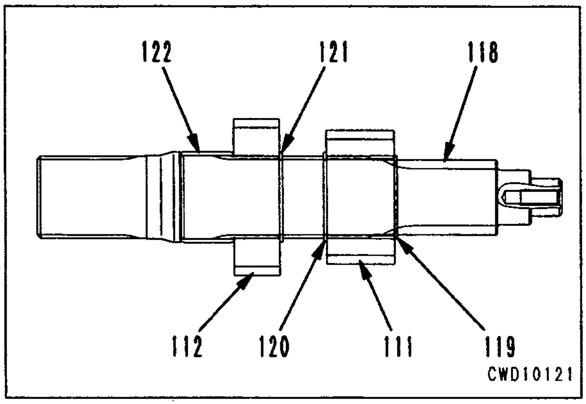
11. No. 3 carrier and output shaft assembly

1) Assemble the output shaft according to the following procedure.
   - i) nstall inner race (122) to output shaft (118).
   - ii) Install No. 5 sun gear (112) and snap rings (121) and (120).
   - iii) Install No. 4 sun gear (111) and snap ring (119).



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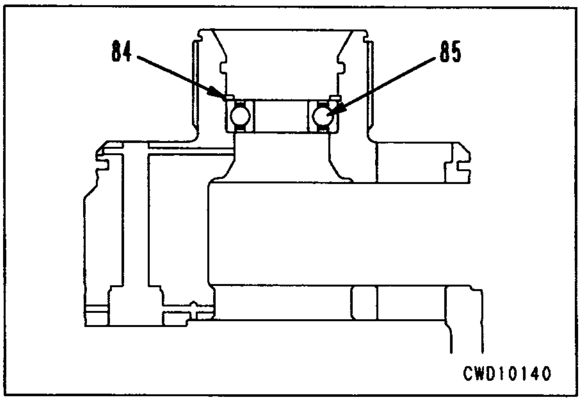
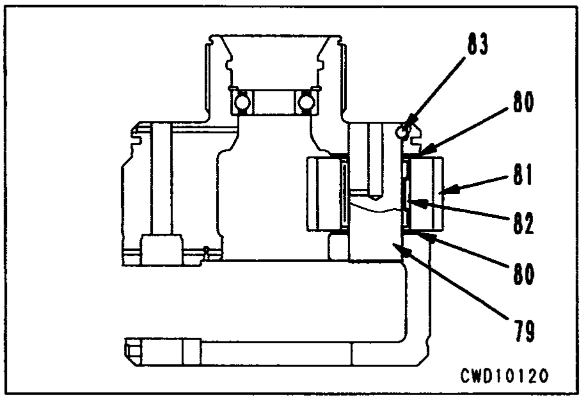
2) Assemble No. 3 and No. 4 carrier assemblies according to the following procedure.
   i) Press fit bearing (85) to No. 3 carrier and install snap ring (84).



   ii) Install bearing (82) to No. 3 planetary gear (81) and fit thrust washers (80) to both sides, then set them to the carrier.
   iii) Install ball (83) and shaft (79).



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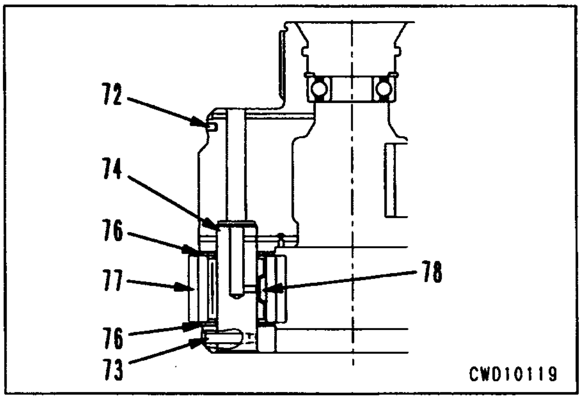
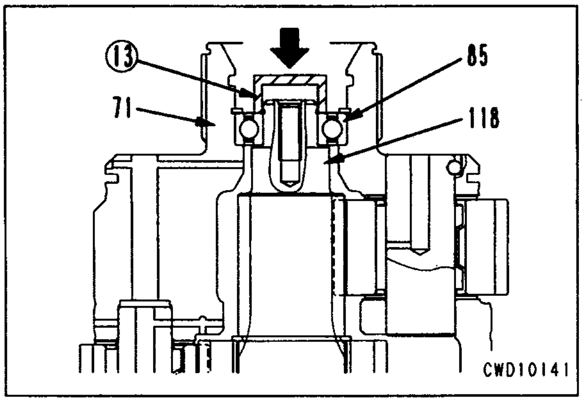
   iv) Install bearing (78) to No. 4 planetary gear (77) and fit thrust washers (76) to both sides, then set them to the carrier.
   v) Install shaft (74), matching the pin hole of the shaft to the pin hole of the carrier.
   vi) Check that the pin holes are matched to each other and drive in pin (73).
   vii) Install seal ring (72).



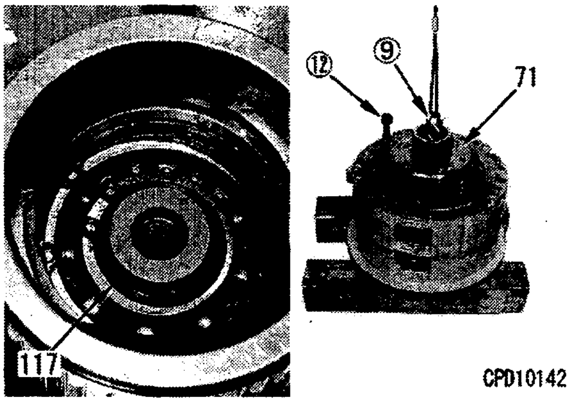
   viii) Set No. 3 and No. 4 carrier assemblies (71) to output shaft (118). Push the inner race side of bearing (85) with push tool ⑬and install output shaft (118) to the carrier assembly.



ix) Install snap ring (117).

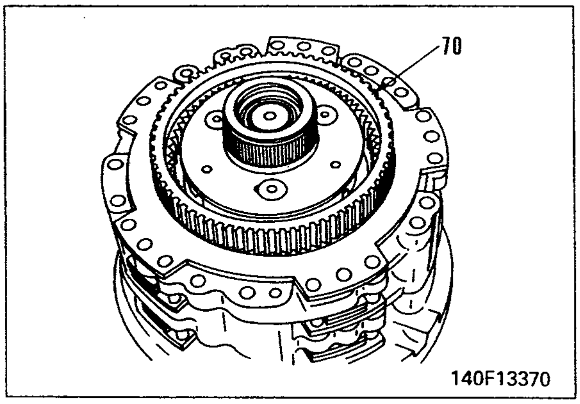
3) Using eyebolts ⑨, install No. 3 and No. 4 carriers and output shaft assembly (71).

4) Remove forcing screws ⑫.



12. No. 3 ring gear

Install No. 3 ring gear (70).



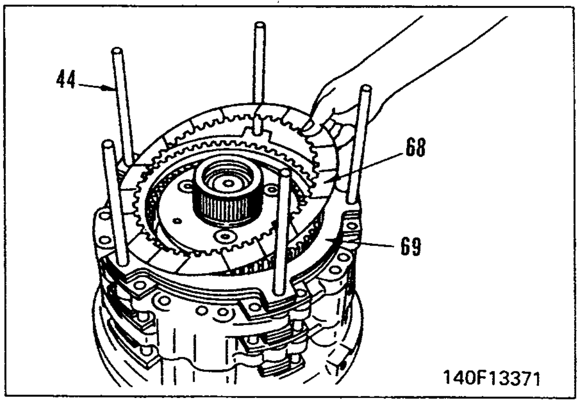
13. Guide pin

Install guide pin (44).

14. No. 3 discs and plates

Install No. 3 discs (68) and plates (69).

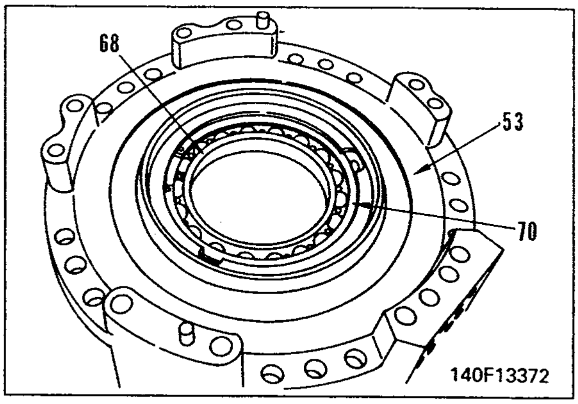
★ Discs: 4 pieces, Plates: 5 pieces



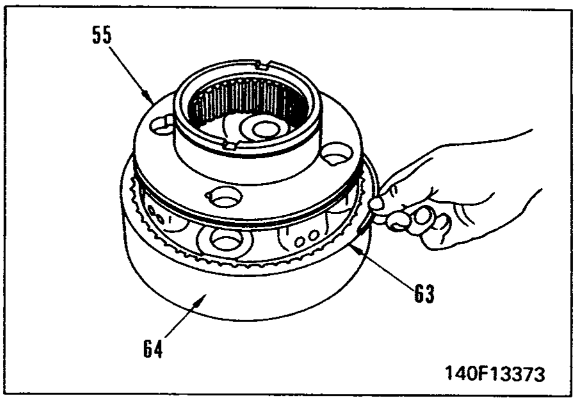
15. No. 2 housing and No. 2 carrier assembly

1) Assemble No. 2 housing according to the following procedure.

   i) Press fit bearing (68) to No. 2 housing (53) and install snap ring (70).



ii) Set ring gear (64) to No. 2 carrier (55) and install snap ring (63).



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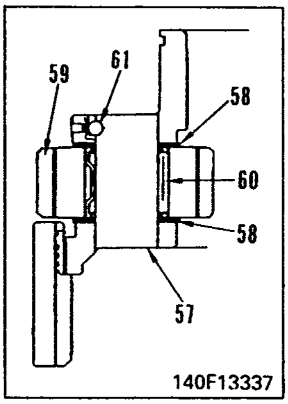
iii) Install bearing (60) to gear (59) and fit thrust washers (58) to both sides, then set them to the carrier.

iv) Install ball (61) and shaft (57).

★ After assembling 2 gear sets, install snap ring (49).



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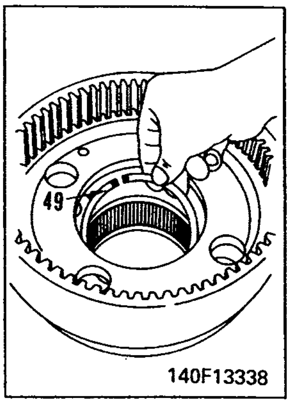

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v) Install the seal ring.

vi) Install No. 2 ring gear (56).

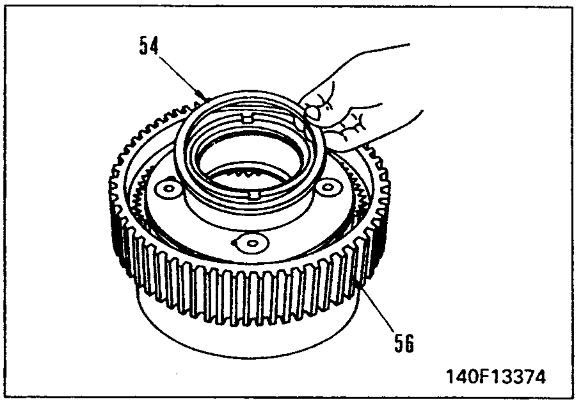
vii) Install spacer (54).

★ Install the spacer with the cut inside end directed to the carrier.

viii)Install No. 2 housing (53) to carrierassembly (52).

★ Press fit the inner race side of the housing bearing.

ix) Install snap ring (51).



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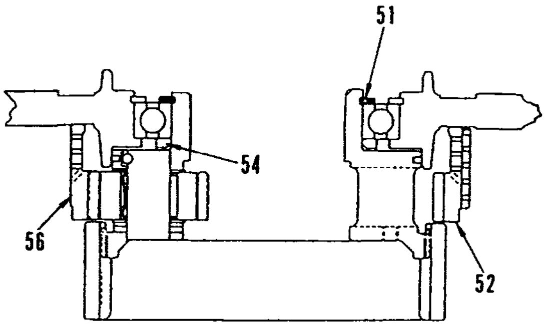

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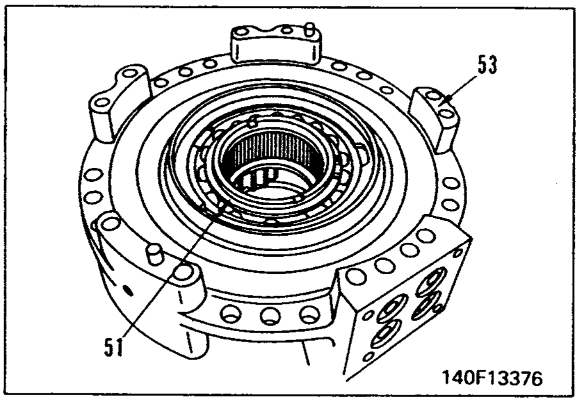

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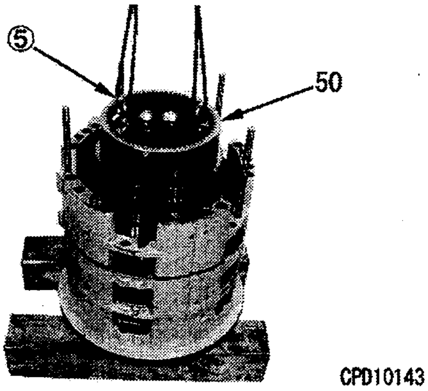
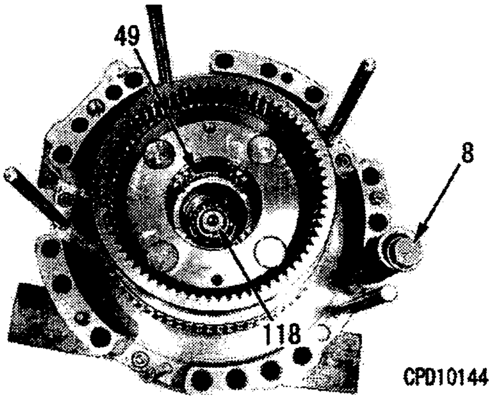
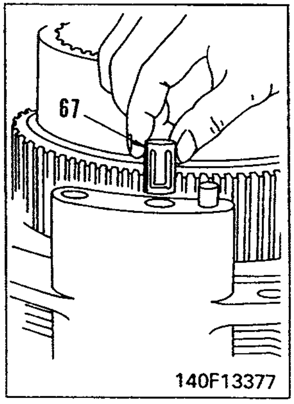
2) Using eyebolts ⑤, install No. 2 housing and No. 2 carrier assembly (50).

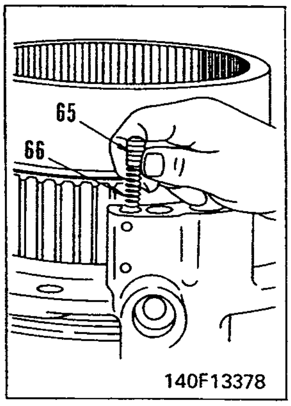


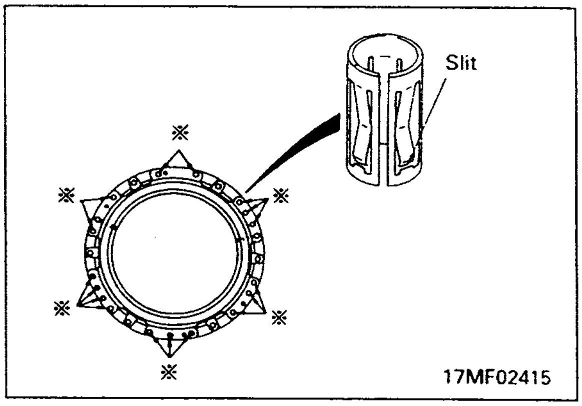
3) Clamp No. 2 housing with tie bolts (8) and a pipe and push the dowel pin in the housing securely.
4) Push up output shaft (118) lightly from underside and install snap ring (49).



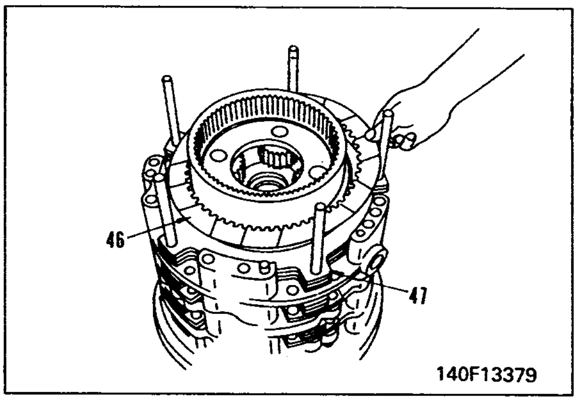
5) Using tool **C2**, push up No. 3 carrier (48) and install snap ring (49).
6) Install sleeve (67).
   ★ If the sleeve has been removed, install it to the bolt hole marked * in the figure with the slit side down.
7) Install spring (66) and valve (65).





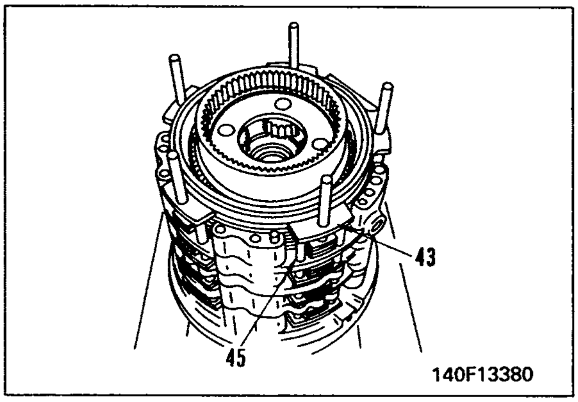


16. No. 2 discs and plates
Install No. 2 discs (46) and plates (47).
★ Discs: 7 pieces, Plates: 8 pieces

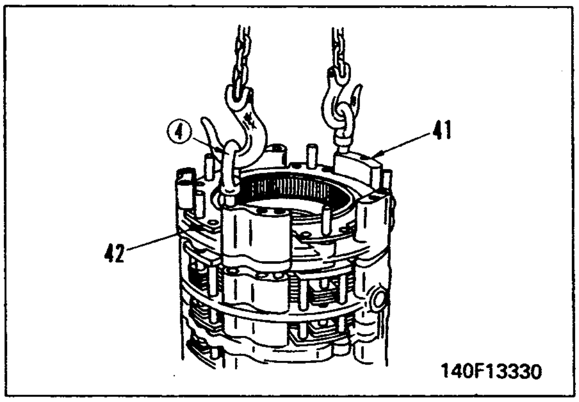


17. Springs for No. 3 and No. 2 housings
Install springs (45).
★ Free length of spring: 69.5 mm

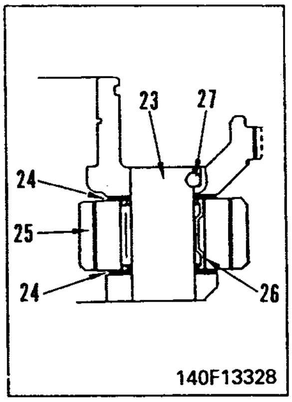
18. No. 2 piston
Install the seal ring and No. 2 piston (43), matching the spring to the spring groove.

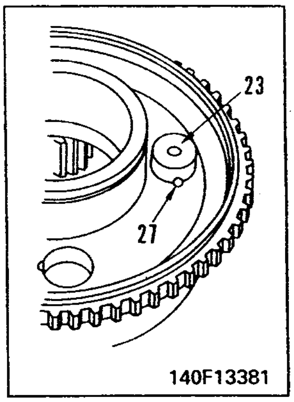


19. No. 1 housing assembly
1) Fit the seal ring and No. 1 piston (42).
2) Using eyebolts ④, install No. 1 housing assembly (41), matching it to No. 2 piston.
★ Press the housing and hit the dowel pin.



20. Input shaft and No. 1 carrier assembly
1) Assemble the input shaft and No. 1 carrier assembly according to the following procedure.
i) Install bearing (26) to gear (25) and fit thrust washers (24) to both sides, then set them to the carrier.
ii) Install ball (27) and shaft (23).





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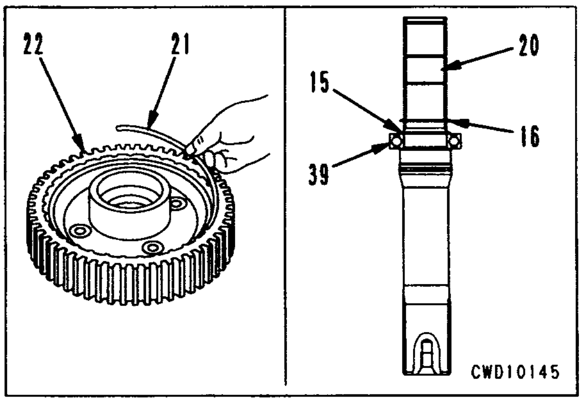
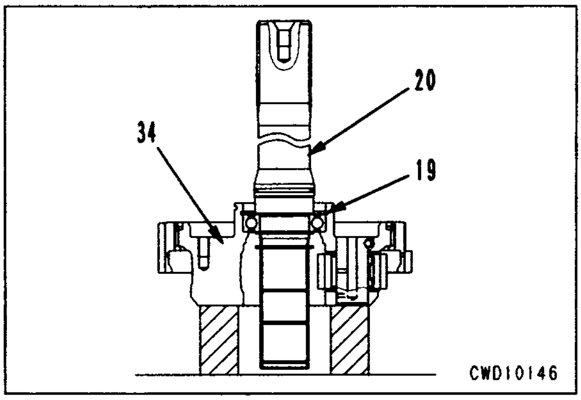
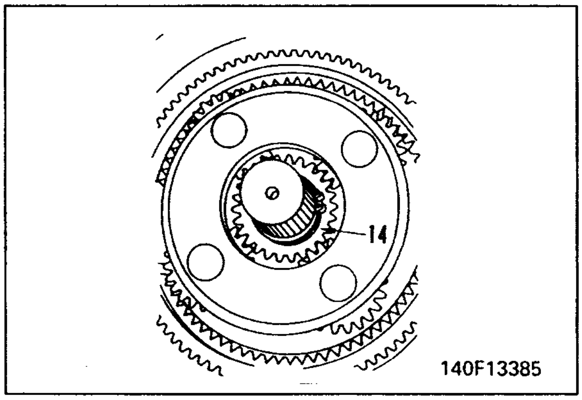
iii) Set No. 1 ring gear (22) to No. 1 carrier and install snap ring (21).
iv) Press fit bearing (39) to input shaft (20).
v) Install snap rings (15) and (16) to the input shaft.

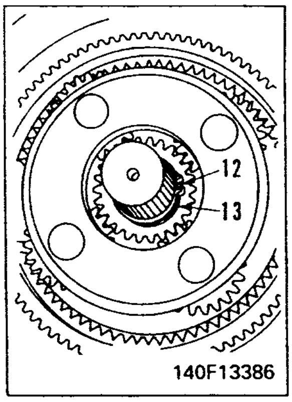


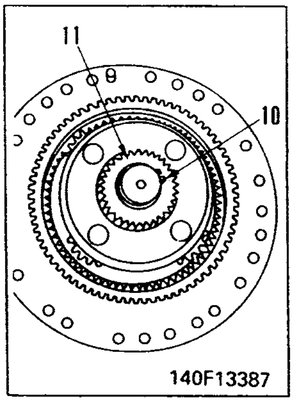


vi) Install No. 1 sun gear (14).

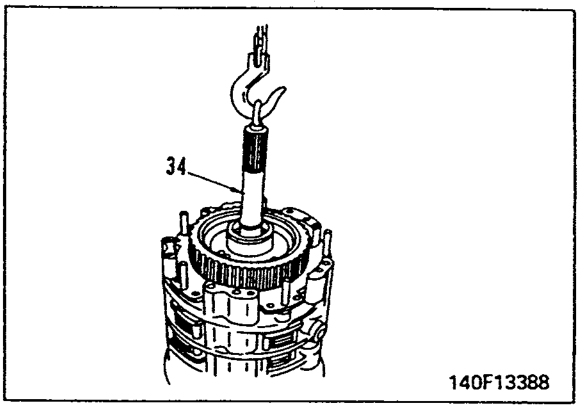


vii) Install snap rings (13) and (12).
viii) Install No. 2 sun gear (11) and snap ring (10).





2) Sling and install input shaft and No. 1 carrier assembly (34), meshing No. 2 sun gear with No. 1 planetary gear.

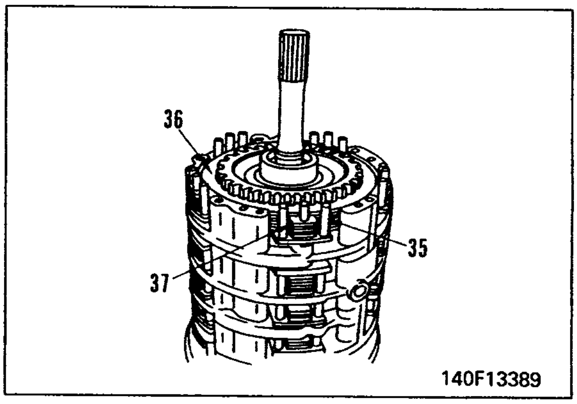


21. No. 1 discs, plates, and springs

Install discs (36), plates (37), and springs (35).

★ Disc: 5 pieces, Plates: 6 pieces

★ Free length of spring: 69.5 mm



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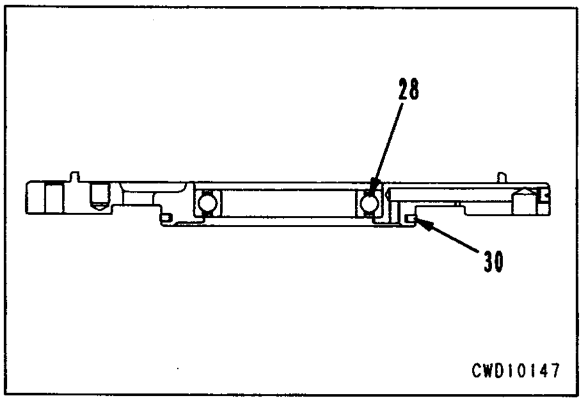
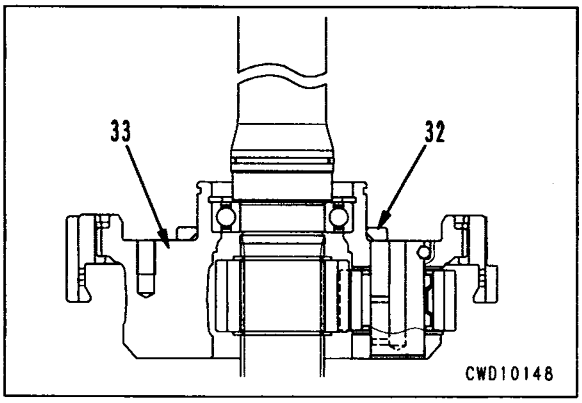
22. Front plate

1) Install the following parts to the front plate.
   - i) Press fit bearing (28).
   - ii) Install seal ring (30).



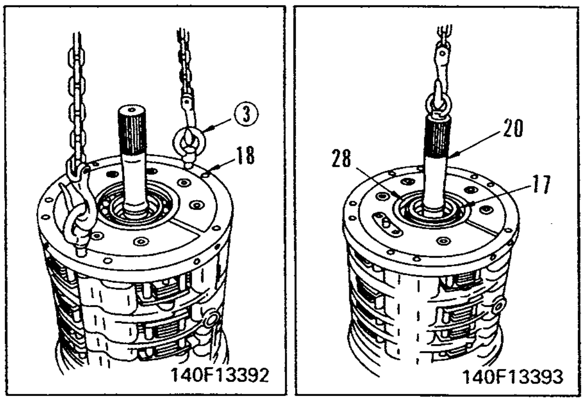
2) Install collar (32) to No. 1 carrier (33).



3) Using eyebolts ③, install front plate (18), matching it to the guide pin and spring.

4) Press fit the inner race side of bearing (28) to input shaft (20) and install snap ring (17).

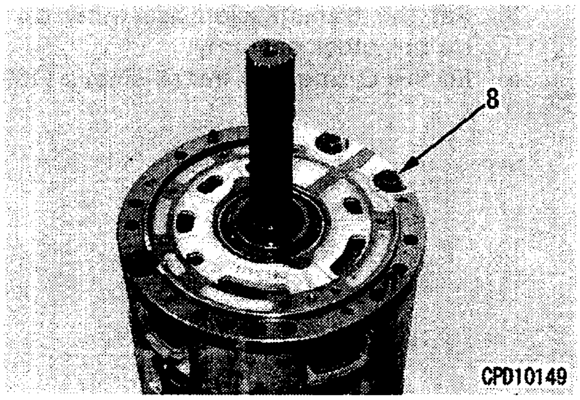
★ Check that the spring is fitted to the cover securely.



23. Tie bolts

Install tie bolts (8).

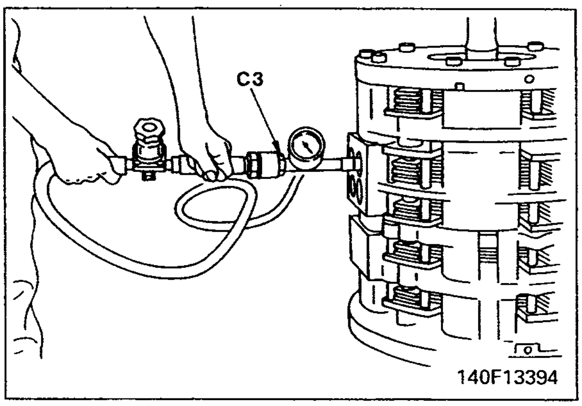
kgm Tie bolt: **17 +_ 1 kgm**



24. Operation check of piston

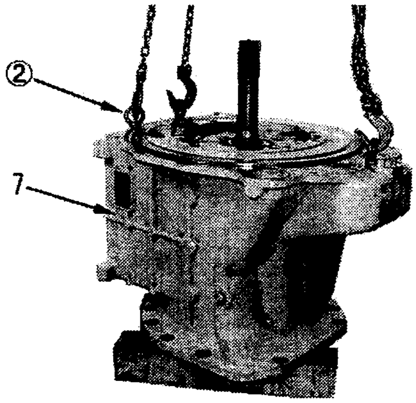
Using tool **C3**, check the operating condition and stroke of each piston.

Piston	Standard stroke (mm)
No1	5
No2	7
No3	4
No4	4
No5	3

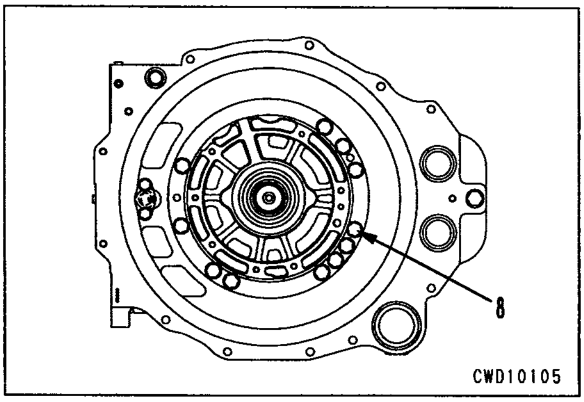


25. Transmission case

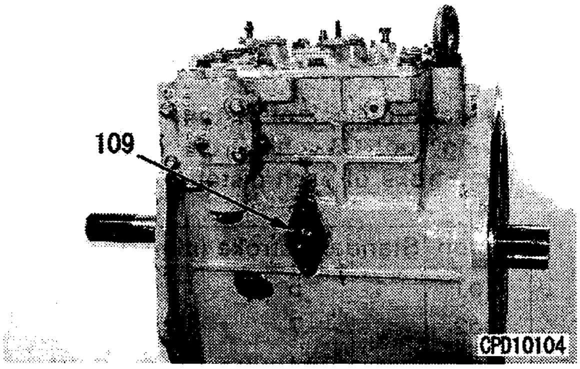
1) Fit the O-ring and install transmission case (7), using eyebolts ②.



2) Tighten 11 tie bolts (8) (to secure the transmission).
kgm Tie bolt: **166.6 ± 9.8 Nm {17 ± 1 kgm}**

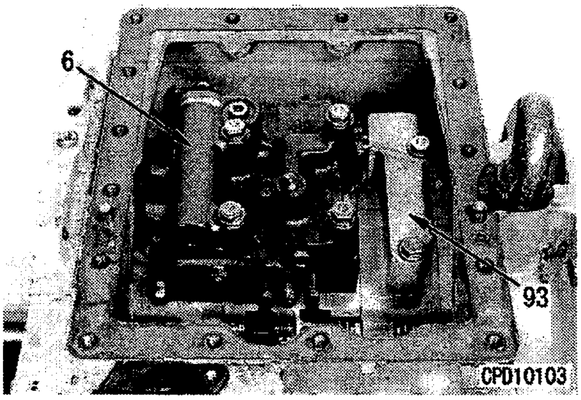


3) Set the transmission assembly on its side on the block securely.
4) Fit the O-ring and install sleeve (109).

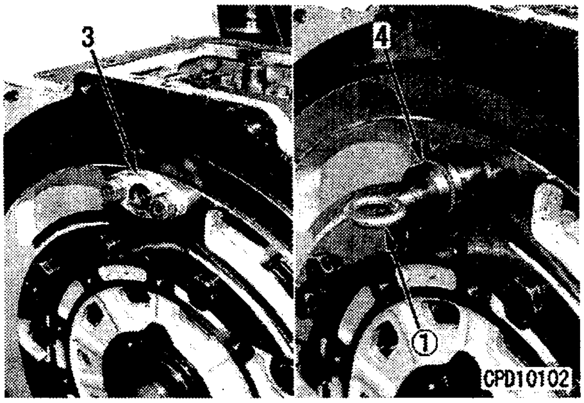


26. Control valve assembly

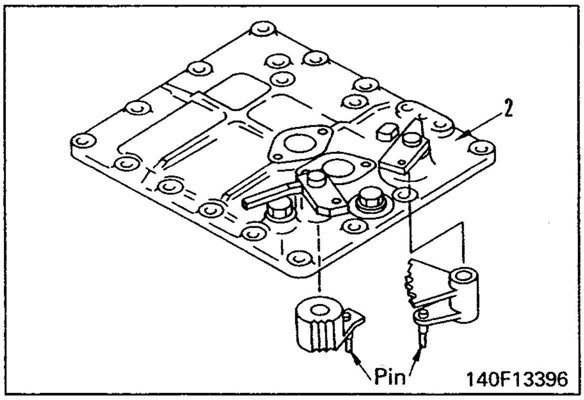
1) Fit the O-ring and install control valve assembly (6) and block (93).
kgm Mounting bolt:
49 ± 4.9 Nm {5 ± 0.5 kg/cm²}



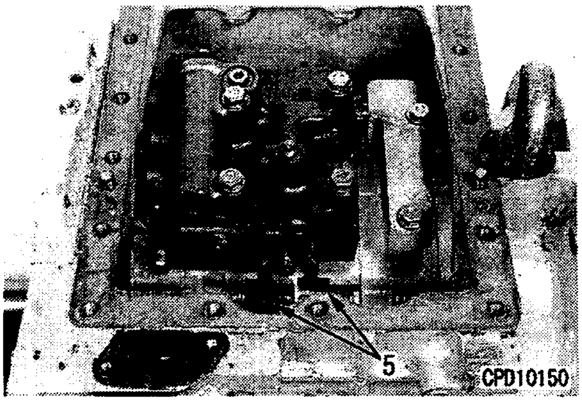
2) Fit the O-ring and install sleeve (4), using eyebolts ①.
3) Install flange (3).

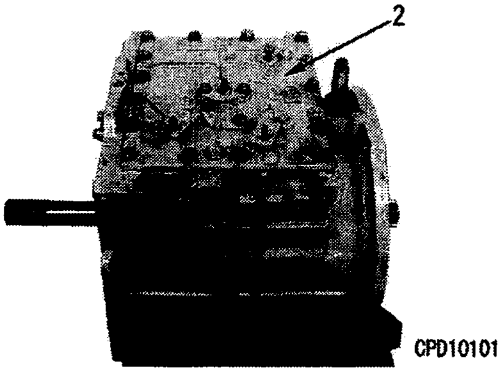


4) Set the yoke of spool (5) to the positions of the pins of the forward-reverse lever and gear shift lever of cover assembly (2).
   - ★ Measure the distance from the holes for the cover assembly mounting bolts, then position the yoke.

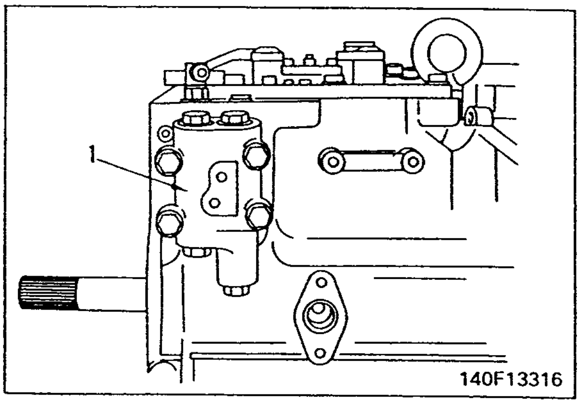


5) Fit the gasket and insert cover assembly (2) in the dowel pin lightly, checking the engagement of the pins and yoke through the clearance between the case and cover.
   - ★ Move the forward-reverse lever and gear shift lever to check that the pins and yoke are engaged securely, then insert the cover in the dowel pin to the end and tighten the bolts.
   - ★ If the pins are not engaged with the yoke, remove the cover and repeat the above procedure again.





27. Relief valve assembly
Install relief valve assembly (1).



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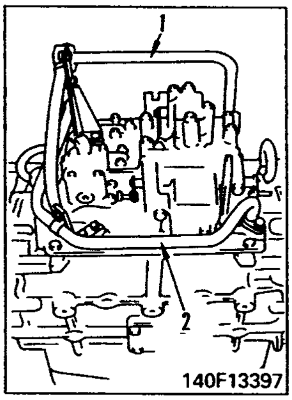
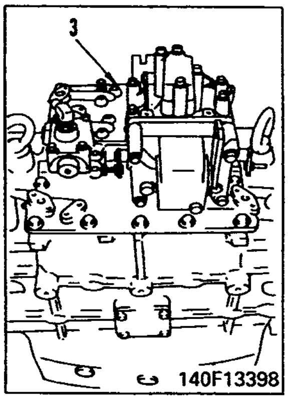
DISASSEMBLY OF STEERING CASE ASSEMBLY

Serial No. 60001 – 65000

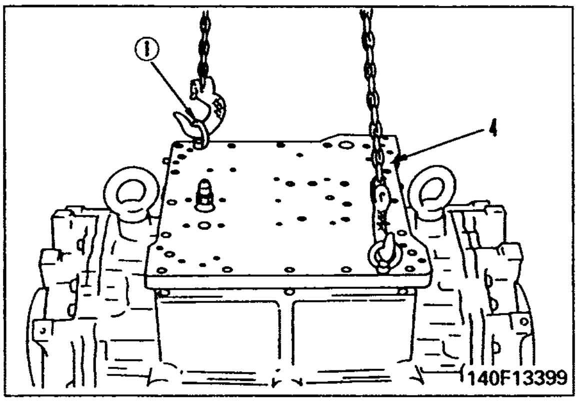
1. **Piping**
   Remove tubes (1) and (2).



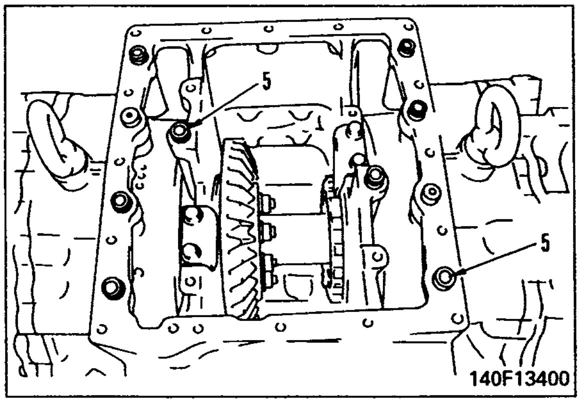
2. **Steering valve assembly**
   Lift off steering valve assembly (3).



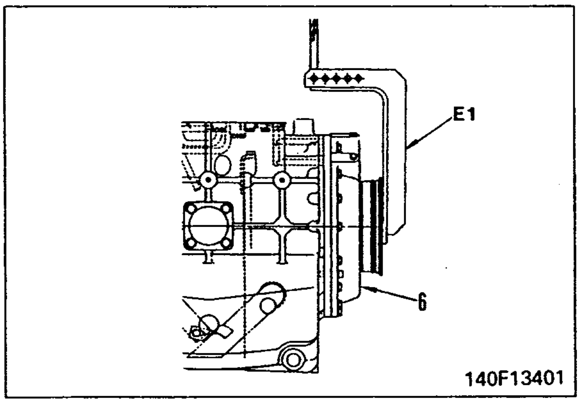
3. **Cover**
   1) Using eyebolts ①, remove cover (4).



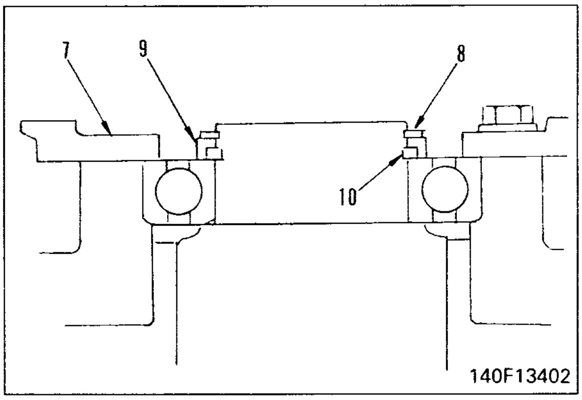
   2) Remove 10 sleeves (5).



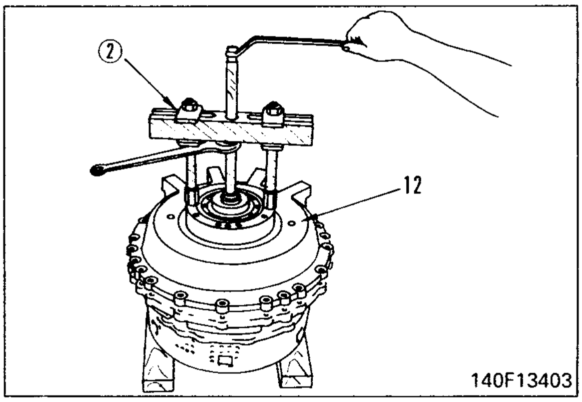
4. **Clutch, brake assembly**
   1) Remove mounting bolts, and using tool **E1**, remove clutch and brake assembly (6).
      ★ Do not remove the hexagon socket head bolts.



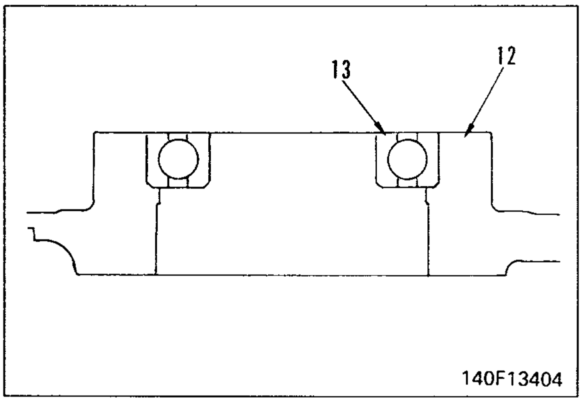
- **Disassembly of clutch, brake assembly**
  1) Disassembly of brake assembly
     i) Remove flange (7).
     ii) Remove snap ring (8), then remove spacers (9) and (10).



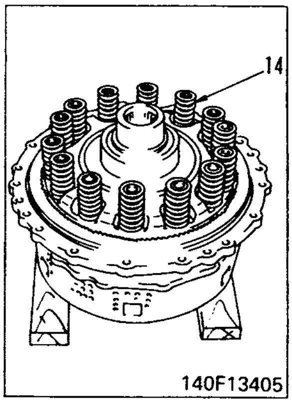
iii) Set puller ② in position, and remove 4 hexagon socket head bolts, then remove cover (12).
★ The bearing inner race will come out.

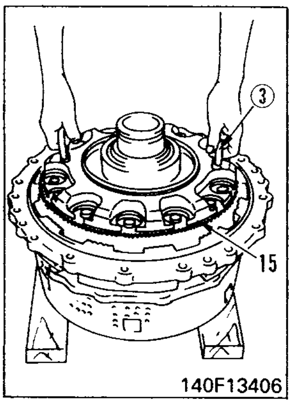


iv) Remove bearing (13) from cover (12).

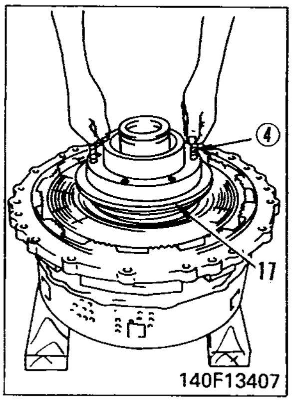


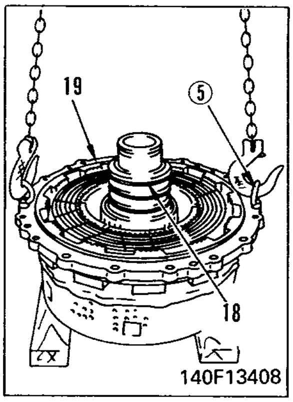
v) Remove spring (14).
vi) Using eyebolts ③, remove piston (15).





vii) Using eyebolts ④, remove cage (17).
viii) Remove seal ring (18) from hub.
ix) Using eyebolts ⑤, remove drum (19) together with discs and plates.

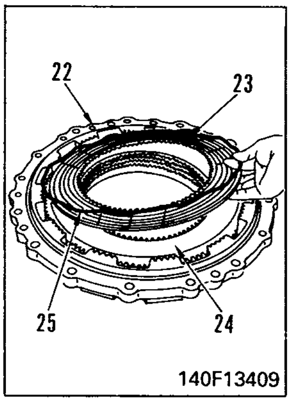


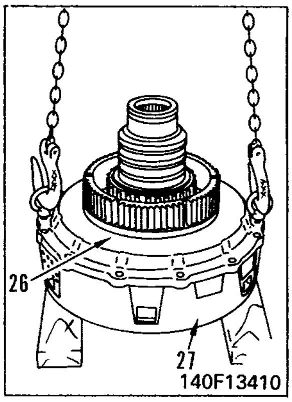


x) Remove discs (23), plates (24), and spring (25) from drum (22).

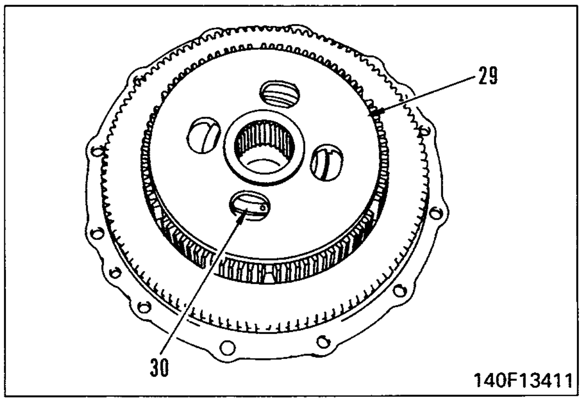
2) Clutch assembly

i) Remove mounting bolts holding to clutch outer drum (27), then remove drum and hub assembly (26) from clutch.

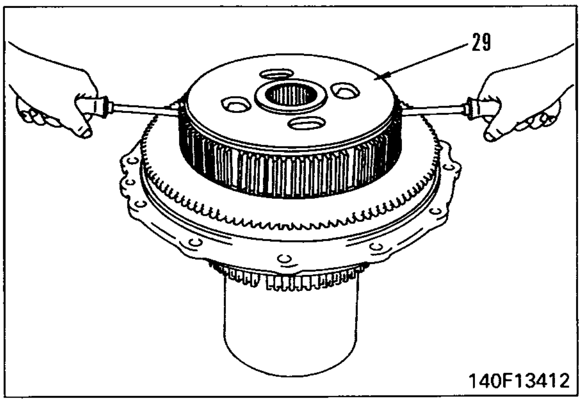




ii) Remove snap ring (30) of bearing from inner drum (29) side.
★ Remove it from the ring groove, then fit it into the groove in the inner drum.



iii) Remove inner drum (29).
★ Twist off, taking care not to damage the area between the plate and drum.



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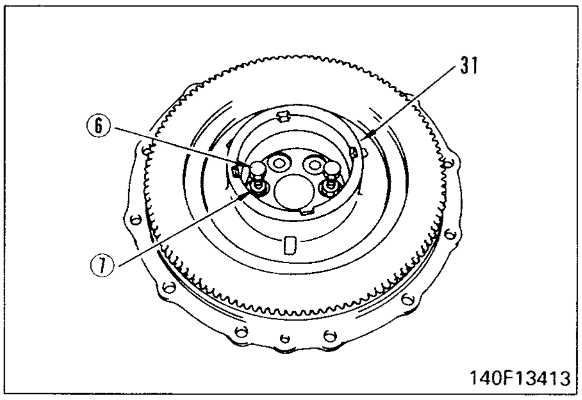
iv) Replace 2 mounting bolts of piston (31) with bolts ⑥ and nuts ⑦, then remove remaining bolts.



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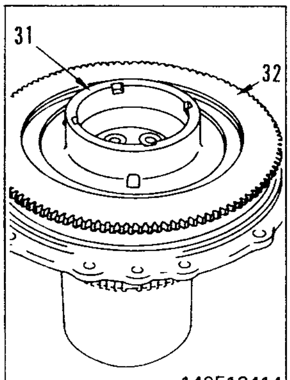
v) Loosen nut slowly, and remove piston (31) and plate (32).
vi) Remove spring (34).



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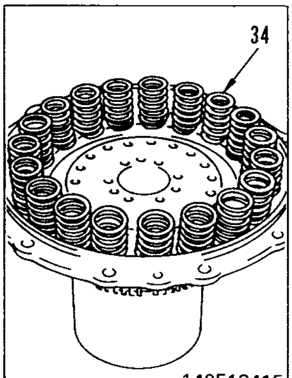

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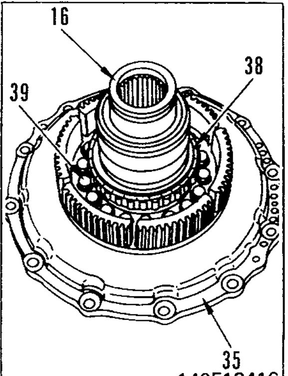
vii) Remove bearing (38).
viii) Remove mounting bolts (39), then remove brake hub (35) from hub (16).
ix) Remove stopper (33) from hub (16).



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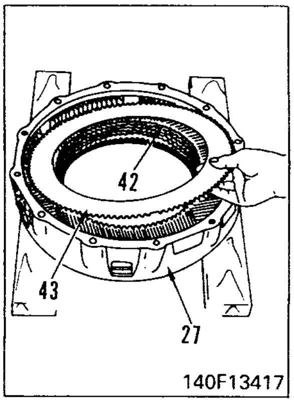

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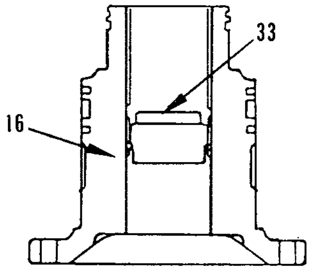

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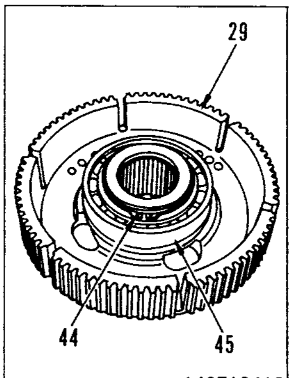
x) Remove discs (42) and plates (43) from clutch outer drum (27).
xi) Remove snap ring (44), then remove bearing (45) from inner drum (29).
xii) Remove snap ring (30) from inner drum (29).



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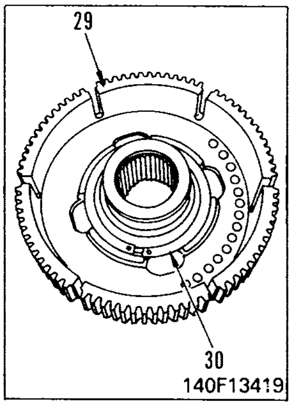

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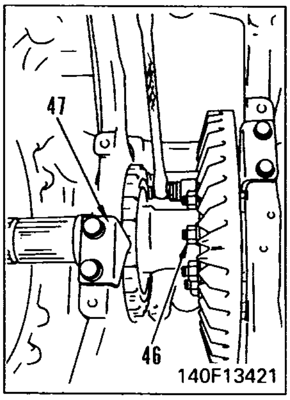
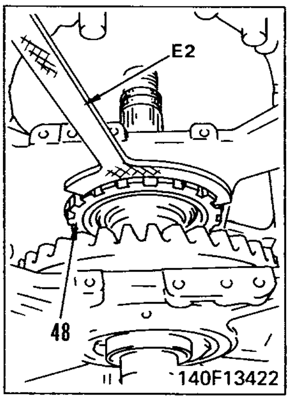
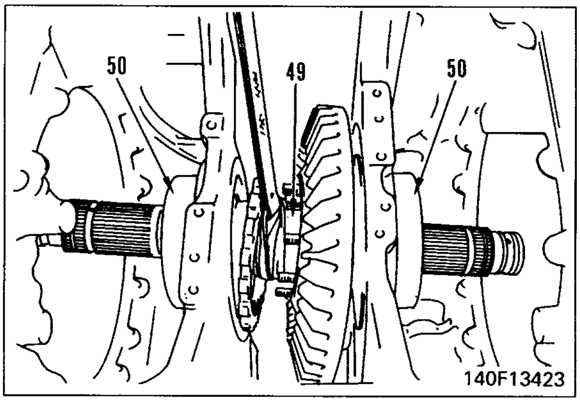
5. Bevel gear shaft, bevel gear assembly

1) Remove nuts (46) of bevel gear mounting bolts.
2) Remove lock plate (47).
3) Using tool **E2**, loosen ring nut (48), and remove from cage.

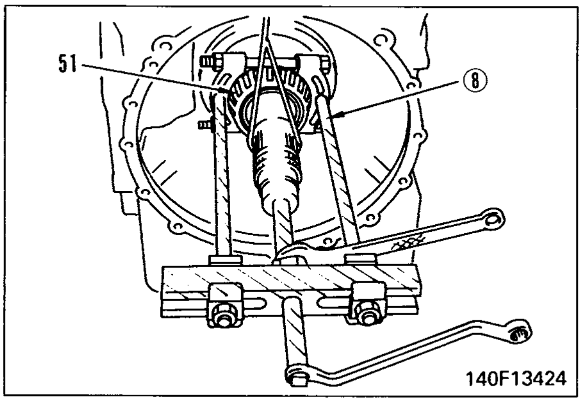




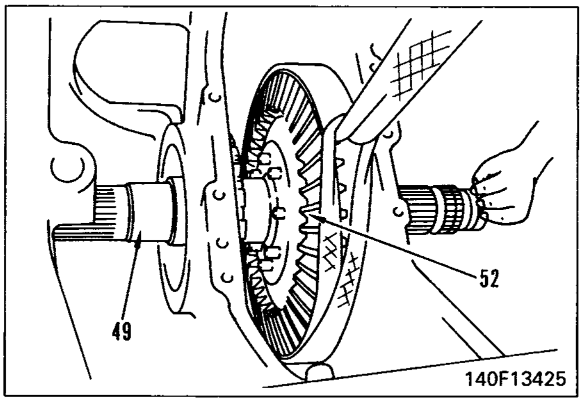
4) Raise bevel gear shaft (49), and remove cage (50).



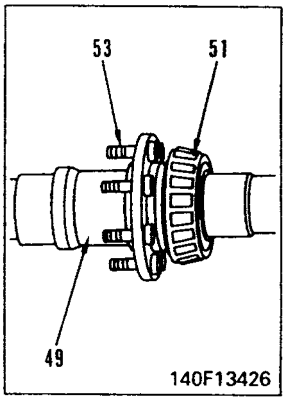
5) Move bevel gear shaft fully to left, then using bearing puller ⑧, remove bearing (51).

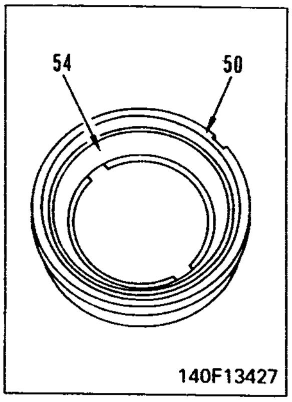


6) Raise bevel gear (52), and pull out bevel gear shaft (49) towards right side.
7) Remove bevel gear (52).



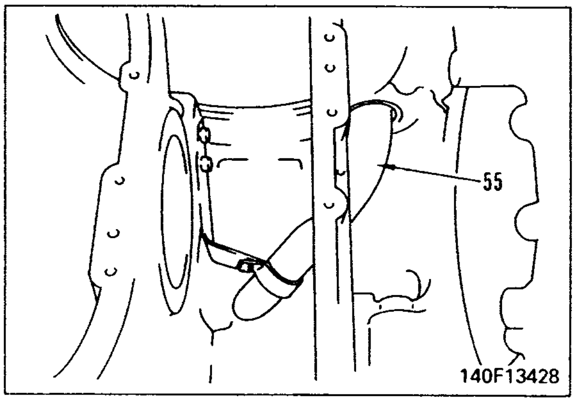
8) Remove bearing (51) from bevel gear shaft (49).
9) Remove bolt (53).
10) Remove outer race (54) from cage (50).





6. Suction tube

Remove suction tube (55).



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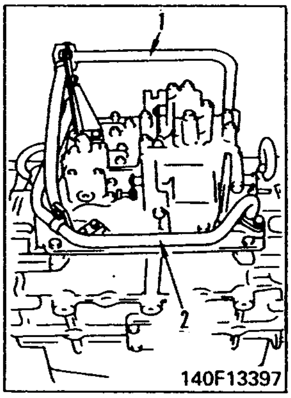
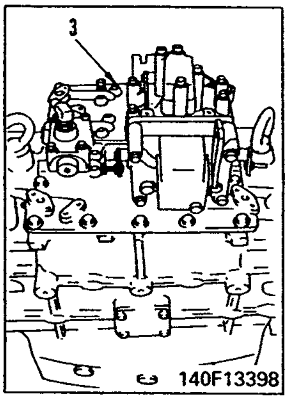
Serial No. 65001 and up

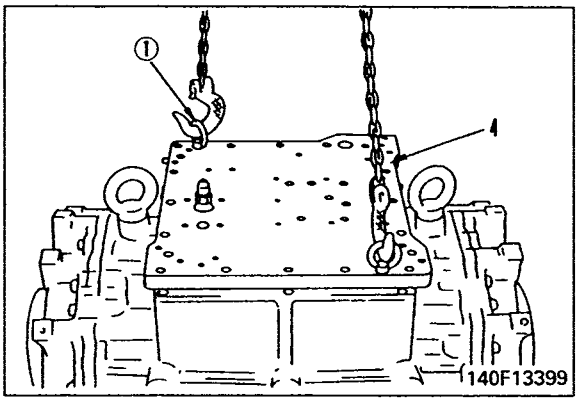
1. **Piping**
   Remove tubes (1) and (2).



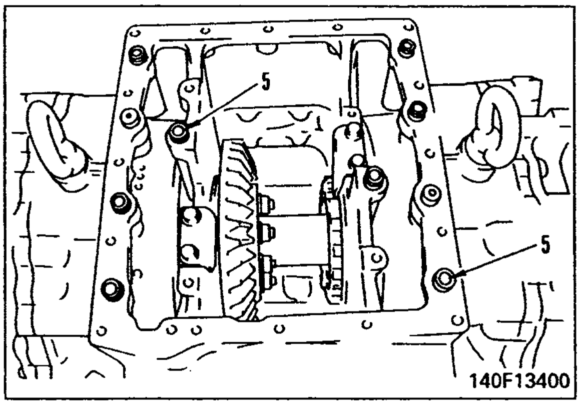


2. **Steering valve assembly**
   Lift off steering valve assembly (3).

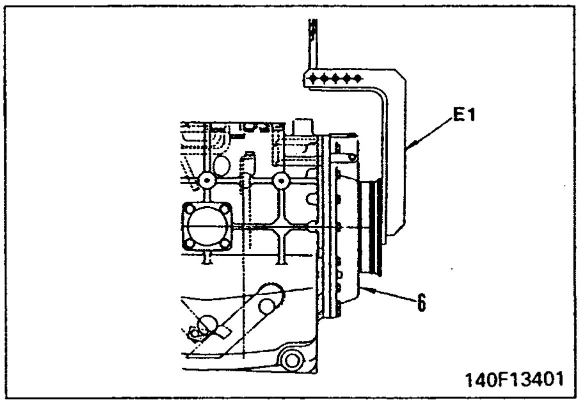
3. **Cover**
   1) Using eyebolts ①, remove cover (4).



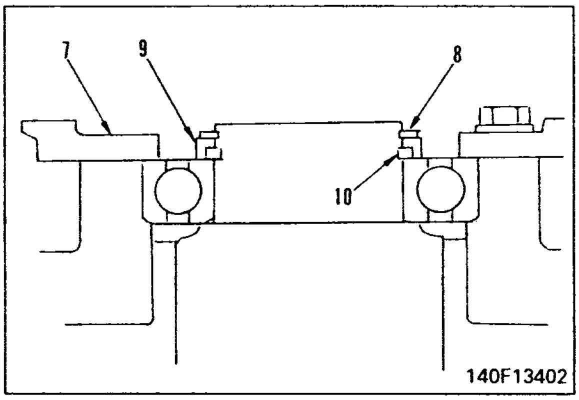
   2) Remove 9 sleeves (5) and (6).



4. **Clutch, brake assembly**
   1) Remove mounting bolts, and using tool **E1**, remove clutch and brake assembly (6).
      ★ Do not remove the hexagon socket head bolts.



- **Disassembly of clutch, brake assembly**
  1) Disassembly of brake assembly
     i) Remove flange (7).
     ii) Remove snap ring (8), then remove spacers (9) and (10).



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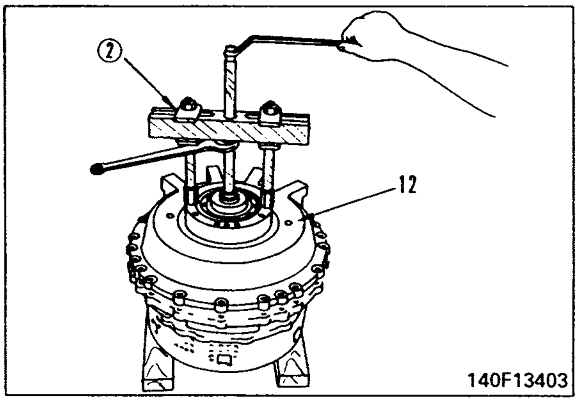
     iii) Set puller ② in position, and remove 4 hexagon socket head bolts, then remove cover (12).
       ★ The bearing inner race will come out.

       ★ Remove bolts after cover is removed.



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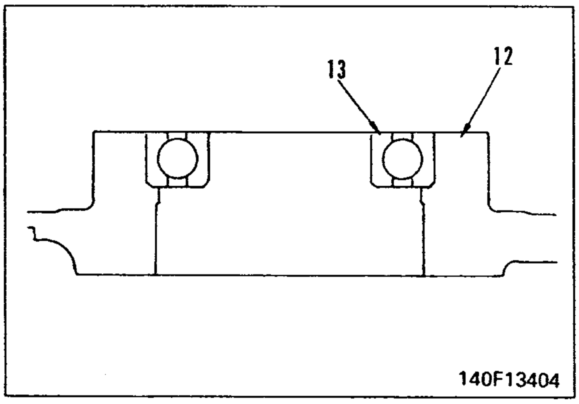
     iv) Remove bearing (13) from cover (12).



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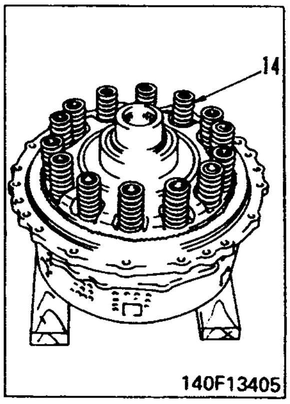
     v) Remove spring (14).
     vi) Using eyebolts ③, remove piston (15).



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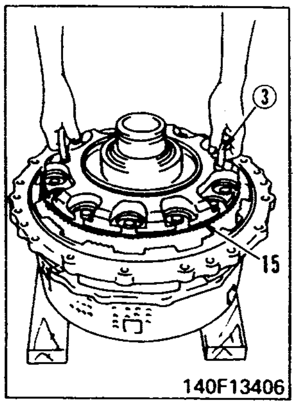

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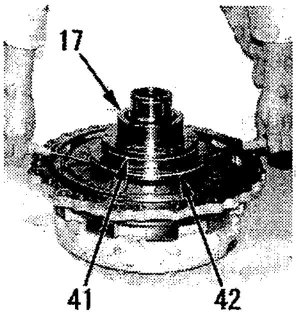
vii) Push up and remove cage (17), taking care not to damage the discs.
iix) Remove seal rings (41) and (42) from the cage.
ix) Using eyebolts 5, remove drum (19), discs, and plates as a unit.
x) Remove 3 seal rings (18) from the hub.



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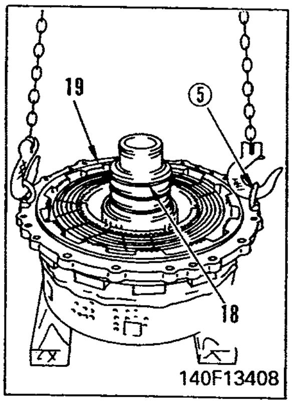
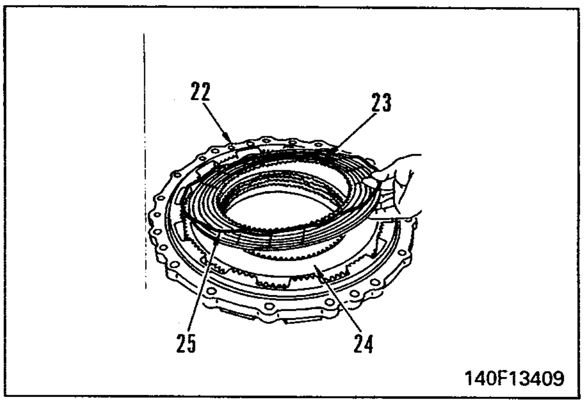
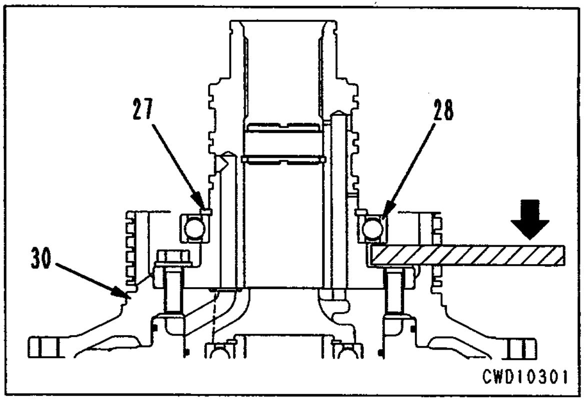


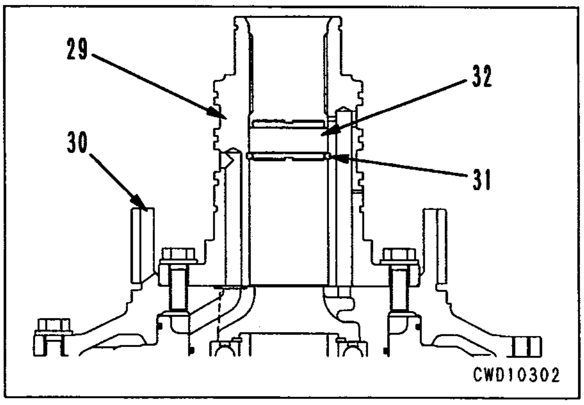
xi) Remove discs (23), plates (24), and springs (25) from the drum.



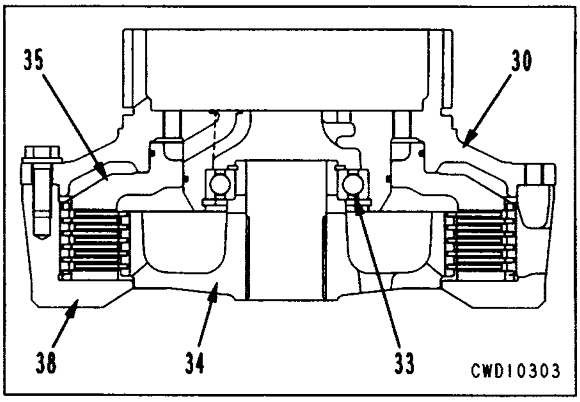
xii) Remove snap ring (27) and bearing (28).
★ Pry up the bearing through the cut part of hub (30).



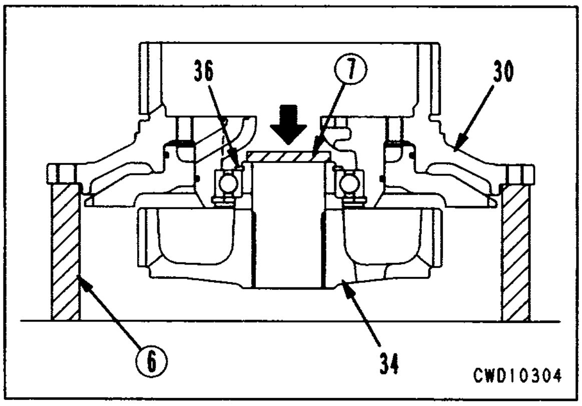
xiii)Remove 18 mounting bolts and hub (29) from hub (30).
ivx)Remove snap ring (31) and stopper (32) from hub (29).



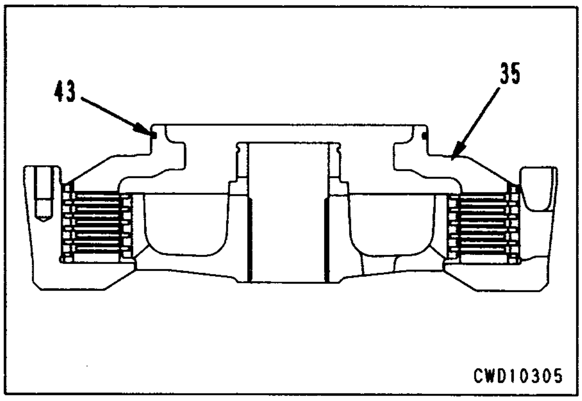
3) Disassembly of clutch assembly
   - i) Remove the mounting bolts, hub (30), bearing (33), hub (34), and piston (35).



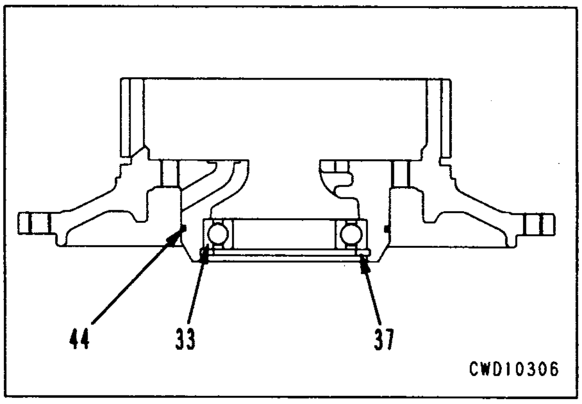
   - ii) Set hub (30) on block ⑥ and remove snap ring (36).
   - iii) Remove hub (34) from hub (30) by pushing it with push tool⑦.



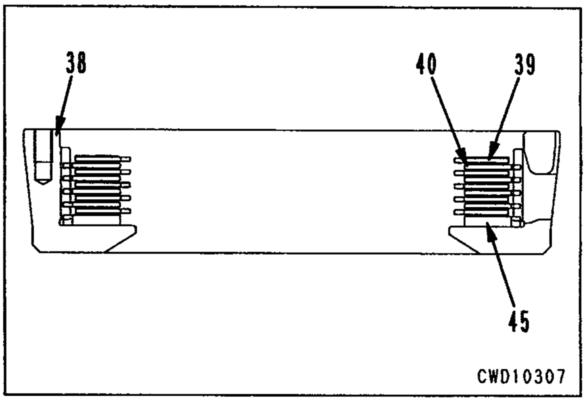
   - iv) Remove piston (35) and seal ring (43).



   - v) Remove snap ring (37) and bearing (33).
   - vi) Remove seal ring (44).

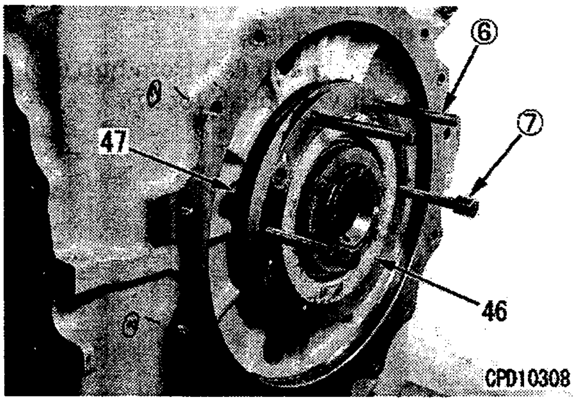


vii) Remove discs (39) and plates (40) and (45) from drum (38).



5. Bevel pinion assembly

1) Remove the mounting bolts.
2) Using guide bolts ⑥ and ⑨ and forcing screws ⑦ and ⑩, remove bevel pinion assembly (46) and shim (47).
   ★ Check the quantity and thickness of the shims and store them.



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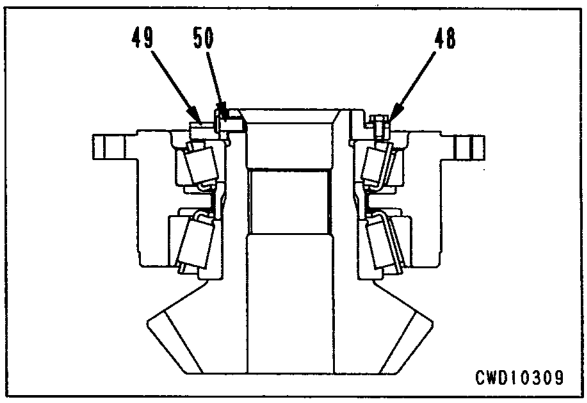
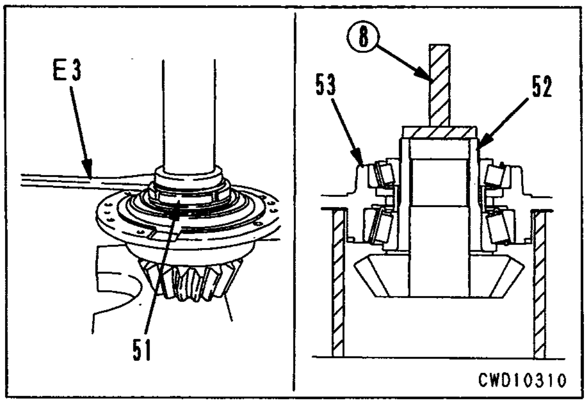
3) Disassembly of bevel pinion assembly.
   i) Unbend bent lock (48) and remove the bolt, lock (48), plate (49), and pin (50).

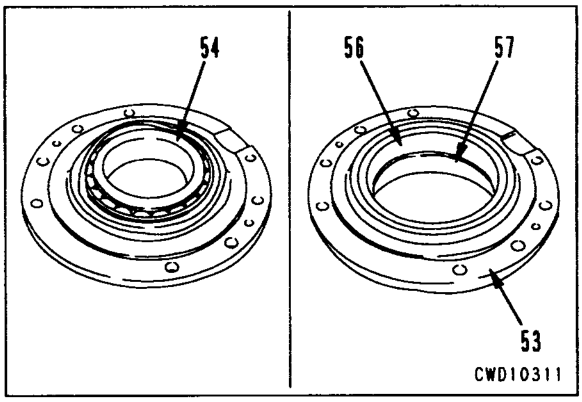


   ii) Secure the pinion with a press and remove nut (51) with tool E3.
   iii) Using push tool ⑧, remove bevel pinion (52) from cage (53).

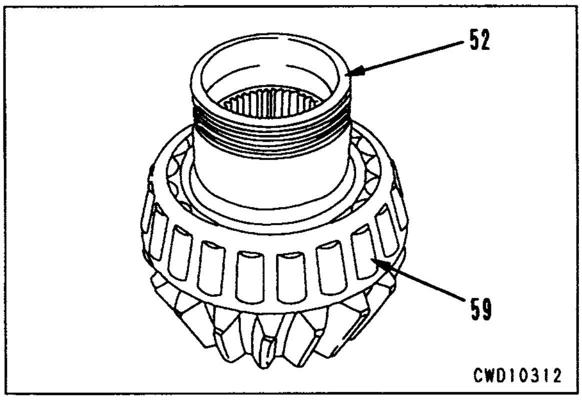


iv) Remove bearing (54).

v) Remove outer races (56) and (57) from cage (53).



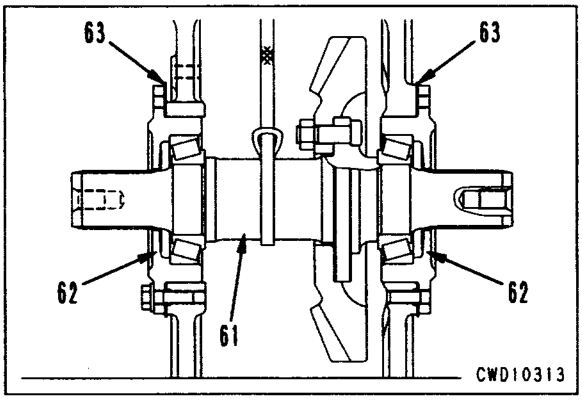
vi) Remove bearing (59) from bevel pinion (52).



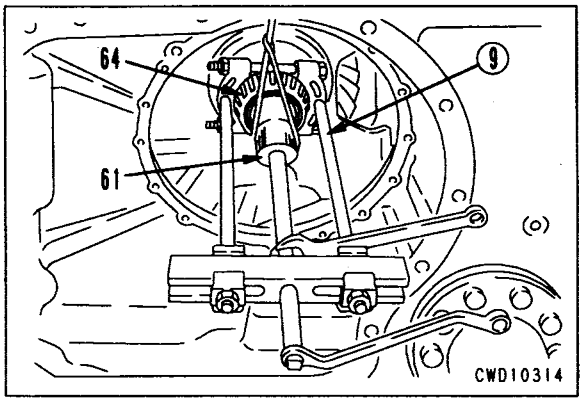
6. Bevel gear shaft and bevel gear

1) Sling bevel gear and shaft assembly (61) temporarily.

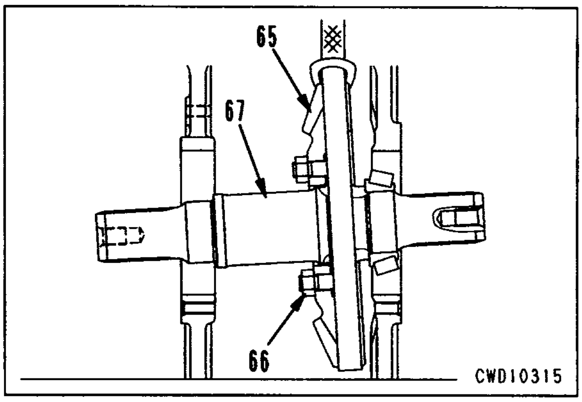
2) Remove cage assembly (62).
   - ★ Check the thickness, quantity, and positions of shims (63).



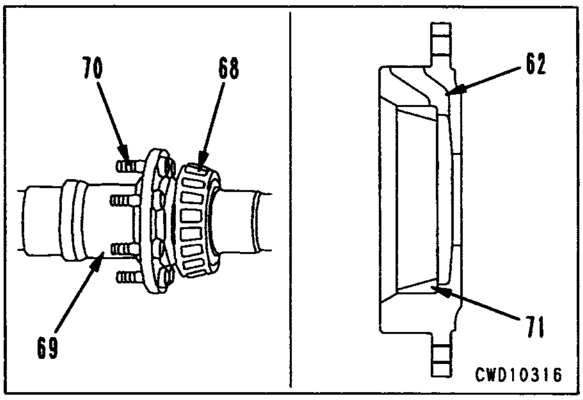
3) Move bevel gear and shaft assembly (61) to the left end and remove bearing (64) with puller ⑨.
   - ★ Remove only the bearing on the left side of the machine.



4) Sling bevel gear (65) and remove mounting nut (66) and pull out bevel gear shaft assembly (67) to the right side of the machine.



5) Remove bearing (68) from bevel gear shaft (69).
6) Remove bolts (70).
7) Remove outer race (71) from cage (62).



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ASSEMBLY OF STEERING CASE ASSEMBLY

D65E, P

Serial No. 60001 – 65000

- **Precautions when assembling**

★ Clean all parts, and check for dirt or damage before assembling.

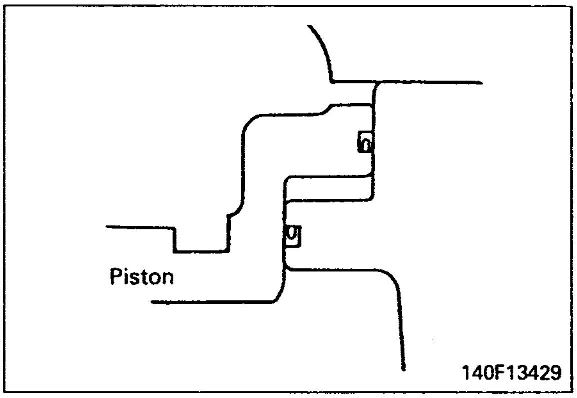
★ Put a drop of engine oil on the rotating portion of the bearing, then rotate it several times.

★ Coat the sliding surfaces of all parts with engine oil before installing.

★ Assemble the piston seal ring with the side receiving the pressure facing the housing, coat it with grease (G2-LI), then install it uniformly so that it is not offset to one side.

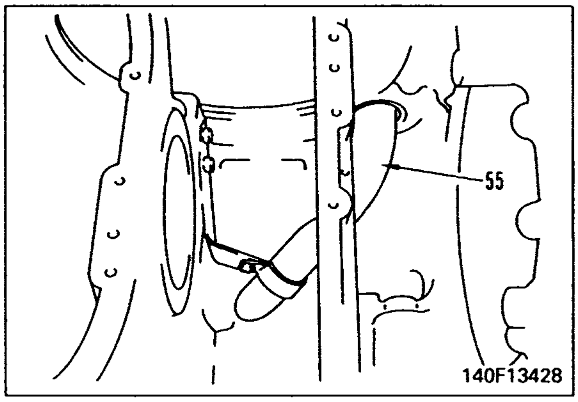
Rotating seal ring: Fix with grease (G2-LI), and be extremely careful that it does not get caught when assembling it.

★ Check that the snap ring is fitted securely in the groove.



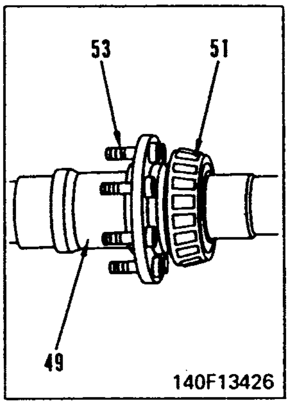
1. Suction tube

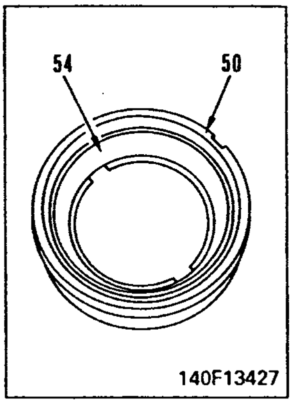
Install suction tube (55).

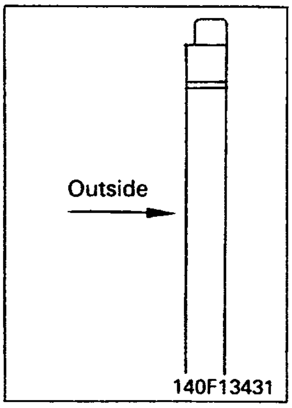


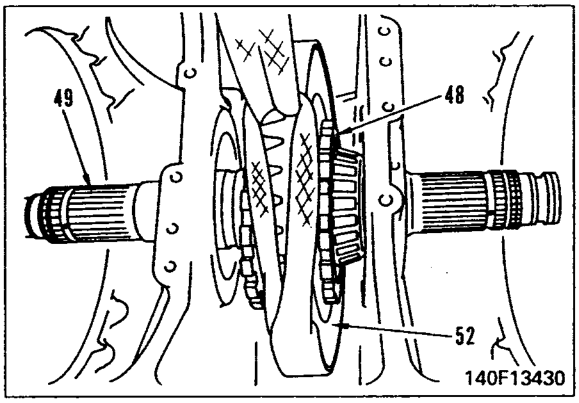
2. Bevel gear shaft, bevel gear assembly

1) Install bolt (53) to bevel gear shaft (49).
2) Shrink fit bearing (51).
3) Install outer race (54) to cage (50).
4) Raise bevel gear (52) and set in case.
   ★ Set with the tooth surface on the inside.
5) Set ring nuts (48) to both sides of bevel gear (52), align bolt with bevel gear, then install bevel gear shaft (49) from right side.
   ★ Install the ring nut with the cut side facing the outside.









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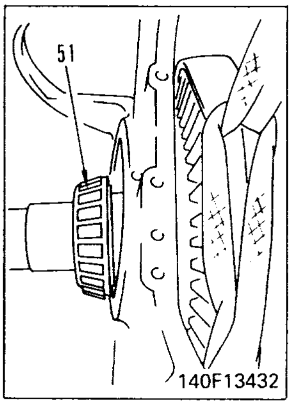
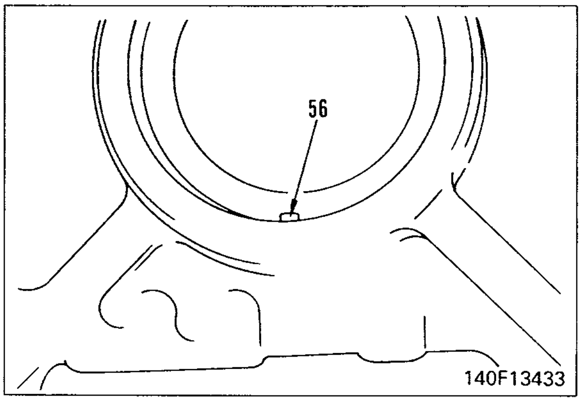
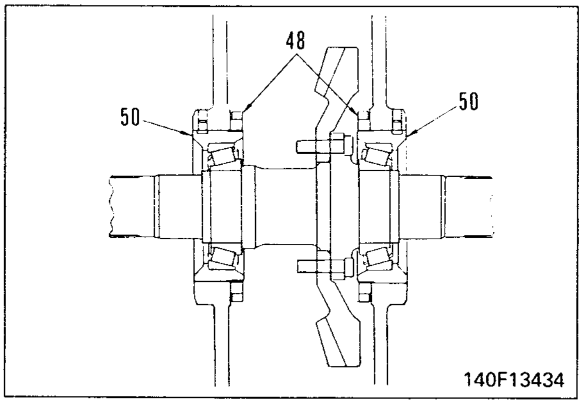
6) Shrink fit bearing (51).



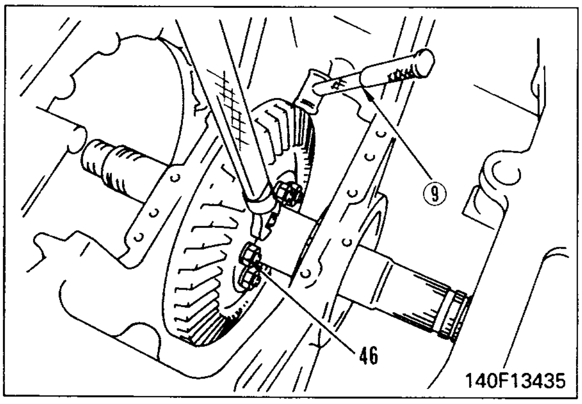
7) Align with pin (56) of cage, install cage (50), then tighten ring nut (48) temporarily.





8) Tighten bevel gear mounting nut (46).
★ Stop the gear from turning with plastic hammer ⑨ or some soft object.

Nut:
245.2 ± 29.4 Nm (25 ± 3 kgm)



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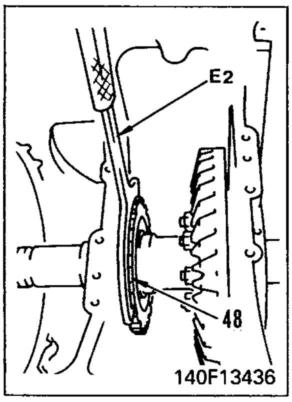
3. Adjusting preload

1) Using tool **E2**, tighten ring nut (48).
2) Put push-pull scale ⑪ in contact with tip of bevel gear tooth, and measure rotating torque of bevel gear shaft.
   - ★ Rotating torque:
     12.7 – 17.2 Nm (1.3 – 1.75 kgm)
     At tip of bevel gear tooth:
     78.5 – 107.9 N (8 – 11 kg)
   - ★ Rotate the bevel gear 2 – 3 times before measuring the rotating torque.
   - ★ If the rotating torque is too low, tighten the ring nut.
     If it is too high, loosen the ring nut.



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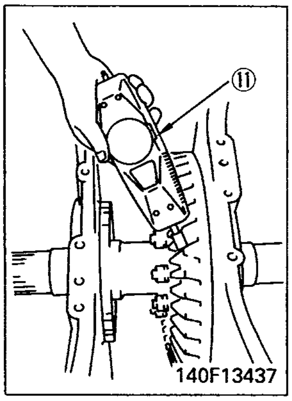

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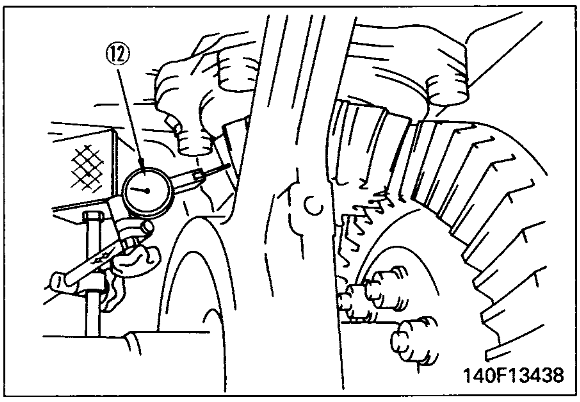
4. Adjusting backlash, tooth contact

1) Install transmission assembly.
2) Adjusting backlash
   Put probe of dial gauge ⑫ at 90° in contact with the tip of the bevel gear tooth face, hold the bevel pinion in place, and measure the reading when the bevel gear is moved forward and backward.
   - ★ Standard value for backlash:
     0.2 – 0.28 mm
   - ★ Measure the backlash at a minimum of three places on opposite sides.
   - If the measurement shows that the backlash is not within the standard value, adjust as follows.
   - ★ Turn the ring nuts to adjust. In order to maintain the preload that was adjusted above, loosen the ring nut on one side, then tighten the ring nut on the opposite side by the same amount.
   - When backlash is too small
     Loosen the right ring nut and tighten the left ring nut to move the bevel gear in direction **A**.
   - When backlash is too large
     Loosen the left ring nut and tighten the right ring nut to move the bevel gear in direction **B**.



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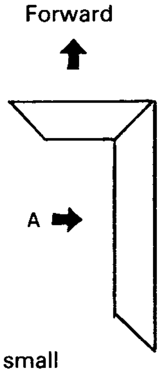
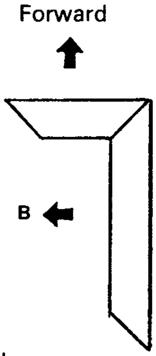


★ Backlash is too small 140F13439



★ Backlash is too large 140F13440

014012

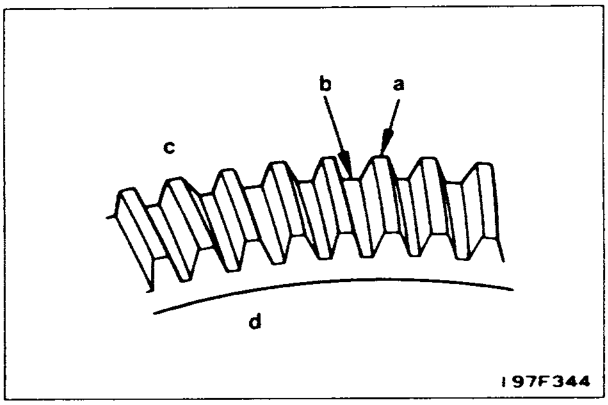
3) Checking tooth contact

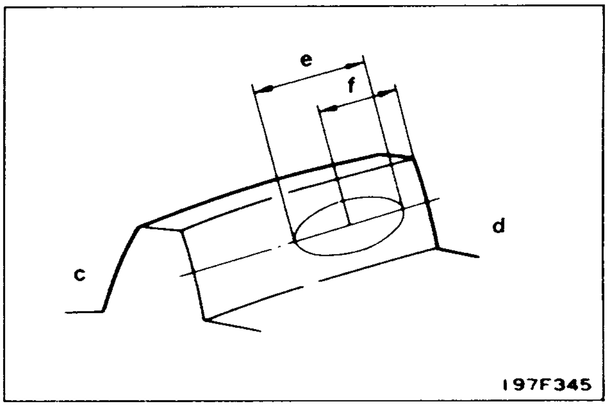
Testing

i) Coat the tooth face of the bevel pinion lightly with red lead (minimum). Rotate the bevel gear forward and backward and inspect the pattern left on the teeth.

ii) Tooth contact should be checked with no load on the bevel pinion. If should be in the center of the tooth height. The tooth contact pattern should be located 20 to 40% from the small end "**d**", and should cover 30 to 75% of the lengthe of the tooth.
In addition, there should be no strong contact at the addendum "**a**" or dedendum "**b**" (tip or root of the gear teeth) or at the big end "**c**" and small end "**d**".
★ If the gears are adjusted to this pattern, the tooth contact will be correct when load is applied.

a: Addendum	d: Small end
b: Dedendum	e: Width contact
c: Big end	f: Center of tooth contact



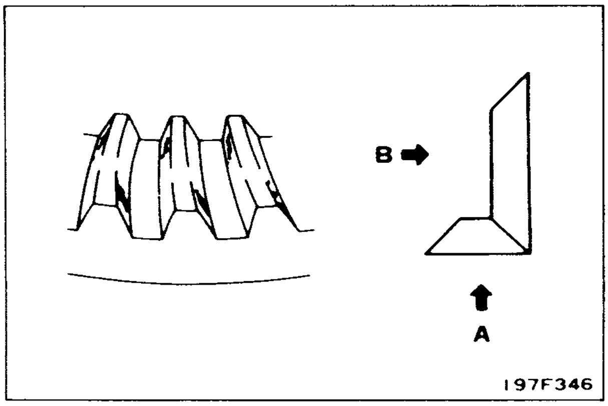


Adjustment

If the result of the inspection shows that the correct tooth contact is not being obtained, adjust again as follows:

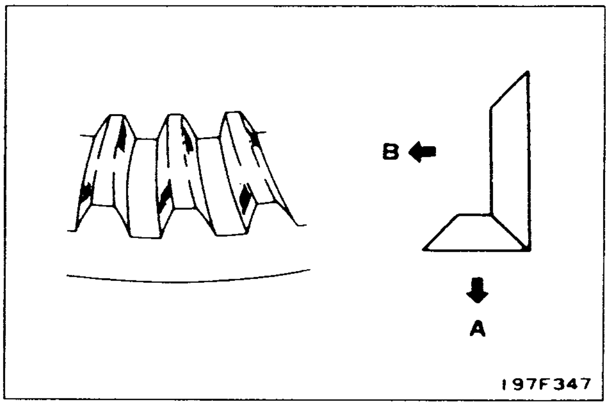
i) If bevel pinion is too far from center line of bevel gear. Contact is at the small end of the convex tooth face of the bevel gear and at the big end of the concave tooth face.
- Correct as follows.
  Adjust the shim thickness at the bevel pinion end, and move the bevel pinion in direction **A**.
  Or, move the bevel gear in direction **B** and check the tooth contact pattern and backlash again.

★ When adjusting the shim thickness at the bevel pinion end, remove the transmission assembly first.



ii) If bevel pinion is too close to center line of bevel gear.
Contact is at the small end of the concave tooth face of the bevel gear and the big end of the convex tooth face.
- Procedure for adjustment
  Adjust the thickness of the shims at the bevel pinion to move the bevel pinion in direction **A**.
  Adjust the shim thickness at the bearing cage of the bevel gear shaft to move the bevel gear in direction **B**. Check the tooth contact pattern and backlash again.

★ When adjusting the amount that the bevel gear moves in or out, do not change the preload of the bearing. Adjust by loosening the ring nut on one side and tightening the nut on the other side by the same amount.



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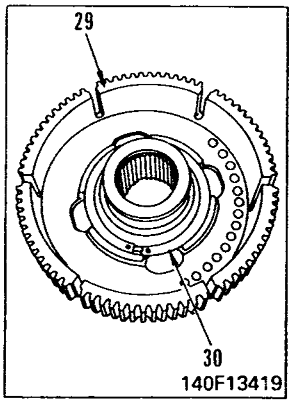
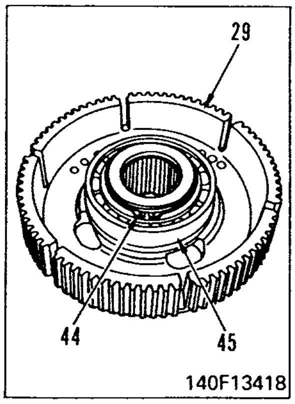
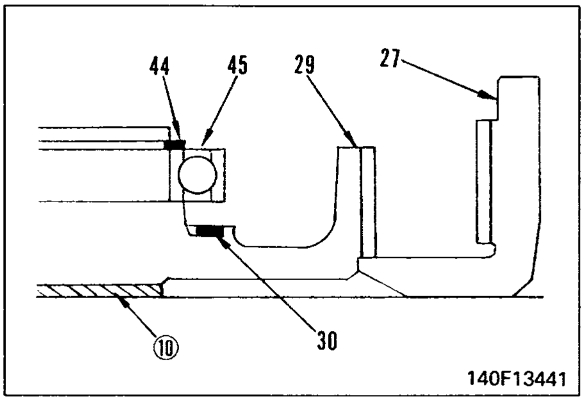
5. Clutch, brake assembly

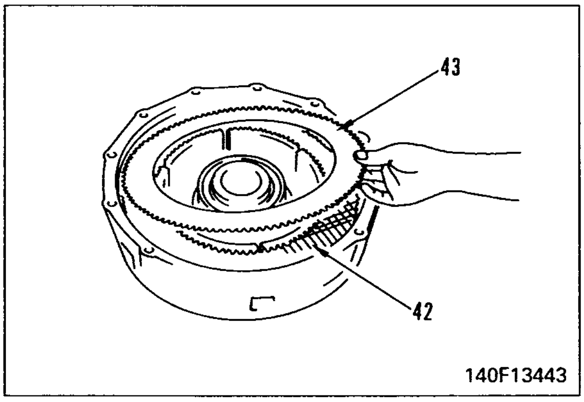
- **Assembly of clutch, brake assembly**
  1) Assembly of clutch assembly
     i) Fit snap ring (30) in groove of clutch inner drum (29).
     ii) Using push tool, press fit bearing (45) to inner drum (29), then install snap ring (44).
     iii) Set inner drum (29) to clutch outer drum (27).
     ★ The cage is press fitted to the inner drum from the rear, so align with the height of the outer drum and mesh block ⑩.

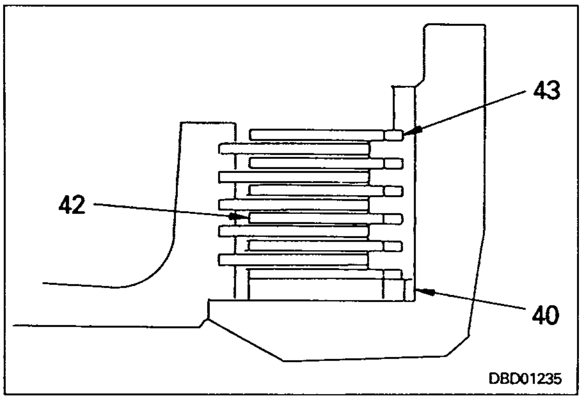




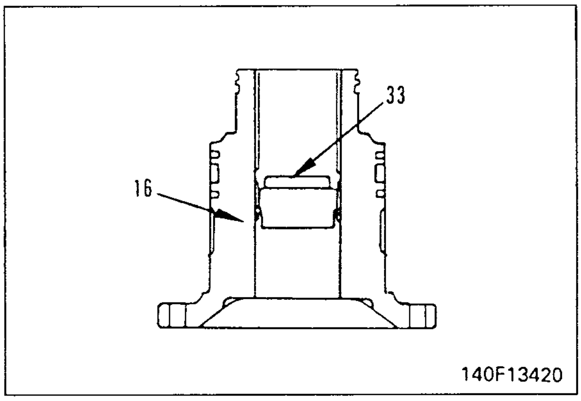


iv) Assemble discs (42), and plates (43) and (40) in the order shown in the diagram.
★ Discs: 5; plate (40): 1; plate (43): 6

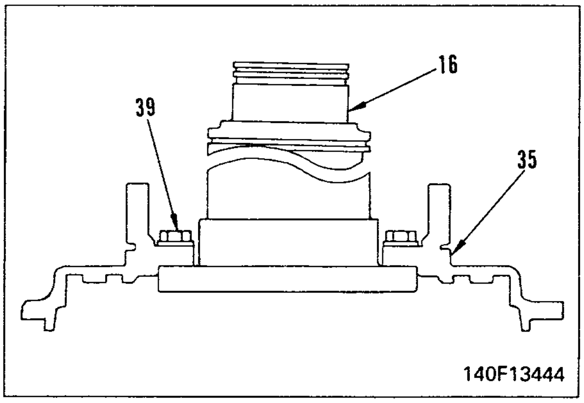




v) Install stopper (33) to hub (16).

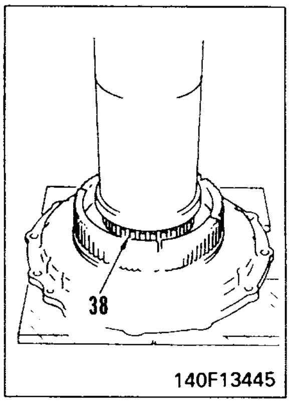


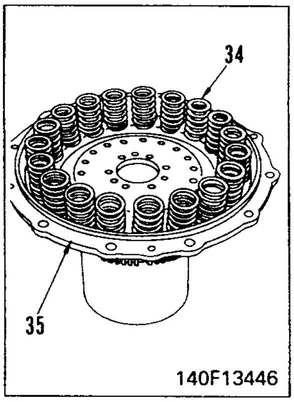
vi) Set brake hub (35) to hub (16), and tighten bolts (39).



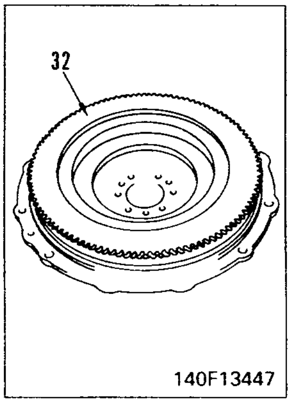
vii) Using push tool, install bearing (38) to hub.

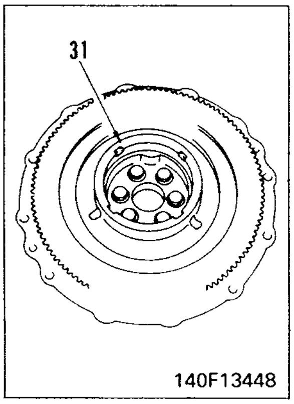
viii) Turn over piston and hub assembly, and install spring (34) to brake hub (35).



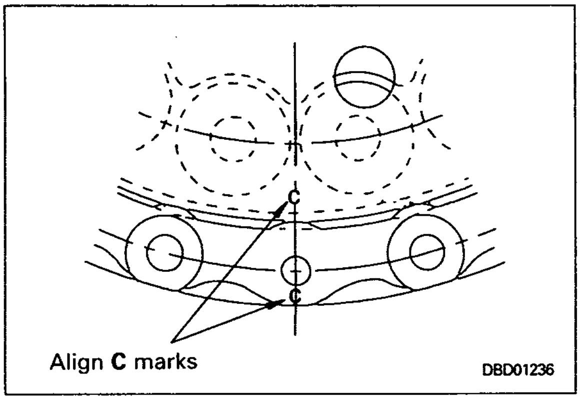


ix) Fit seal ring, then align clutch plate (32) with spring, and set in position.



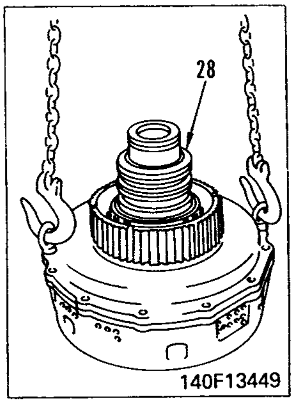


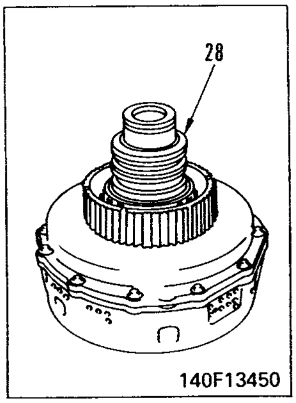
- ★ Align the match marks **C** when installing.
- ★ Align the springs securely with the groove.



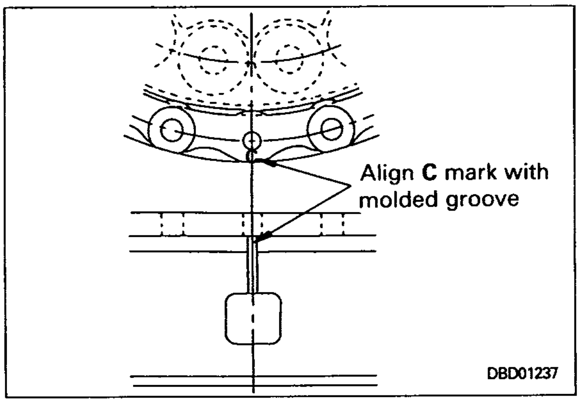
x) Fit seal ring set piston (31) to hub, then tighten bolts uniformly.
- ★ The bolt holes are aligned at only one place.

xi) Set brake hub assembly (28) in position on clutch assembly, then tighten mounting bolts.

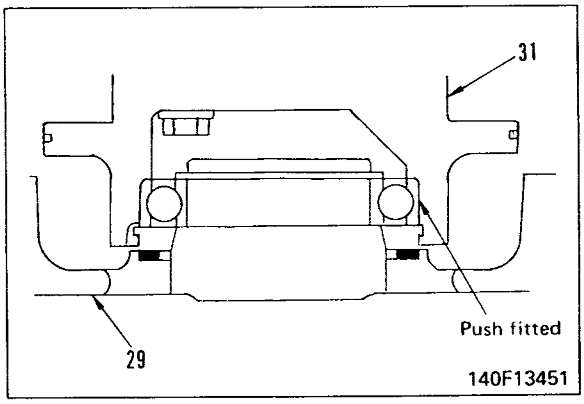




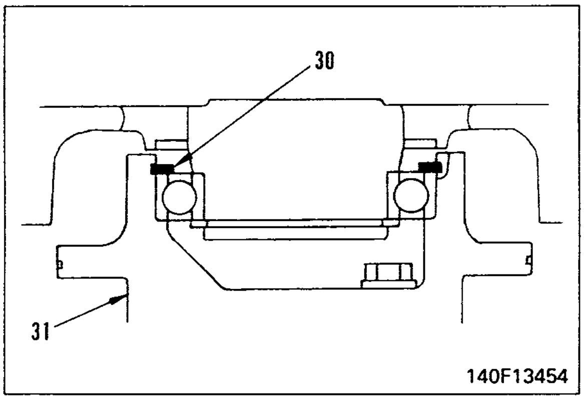
- ★ Align the match mark **C** on the brake hub with the molded groove in the clutch outer drum.

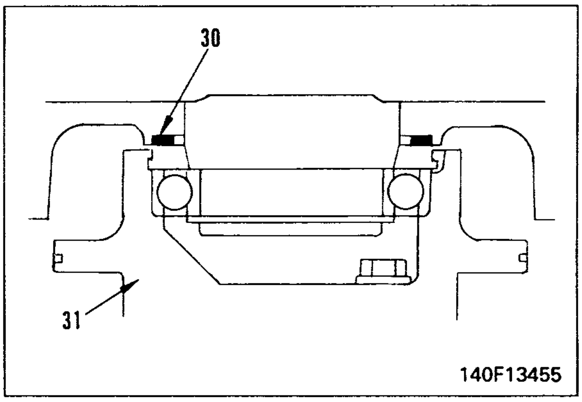


- ★ The outer race of the bearing of inner drum (29) is press fitted to piston (31).



xii) Turn over brake hub and clutch assembly, then install snap ring (30) to piston (31).
★ Remove it from the inner drum and install it to the piston.





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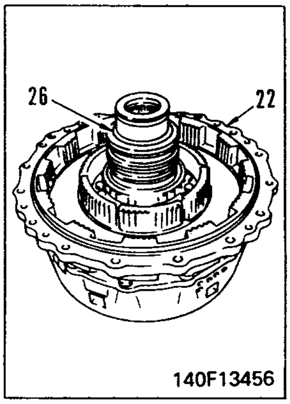
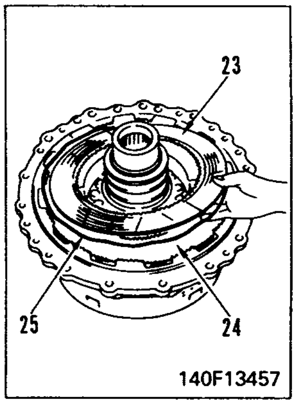
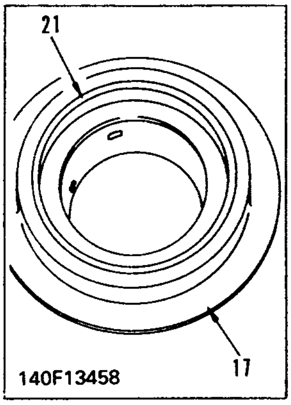
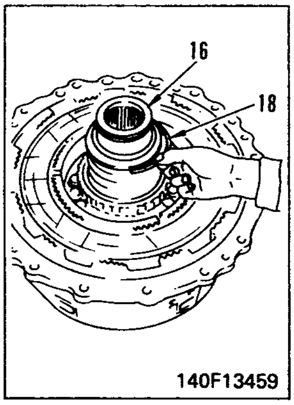
2) Assembly of brake assembly
i) Set brake drum (22) to drum and hub assembly (26).
ii) Install discs (23), plates (24), and spring (25).
★ Discs: 5; plates: 4





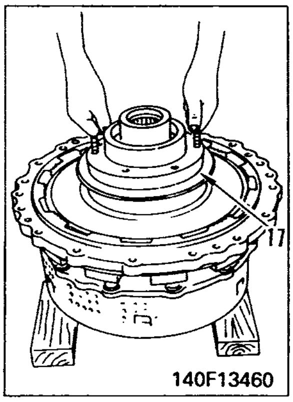
iii) Using push tool, install outer race (21) to cage (17).
iv) Install seal ring (18) to hub (16).





v) Fit seal ring and install cage (17) to hub.
  - ★ Align the oil holes in the cage visually with the oil holes in the drum at 4 places.

vi) Install seal ring to piston (15).



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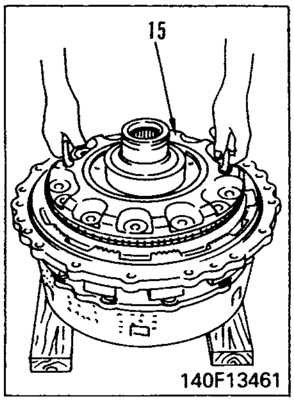

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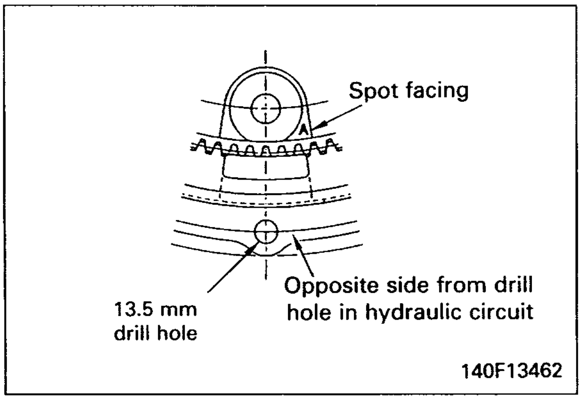
vii) Align center of spot facing stamped with **A** mark on piston (15) with "13.5 mm drill hole" on drum (opposite side from oil hole), and set in position.



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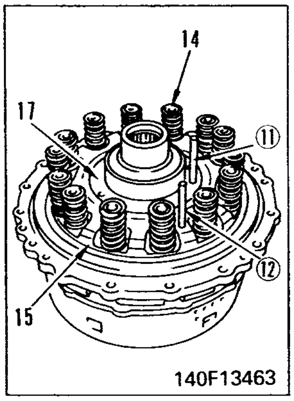
viii) Install spring (14).

ix) Install guide bolts ⑪ and ⑫ to piston (15) and cage (17).
  - ★ Guide bolt ⑫ is for aligning the brake release bolt hole.

x) Install bearing (13) to cover (12).



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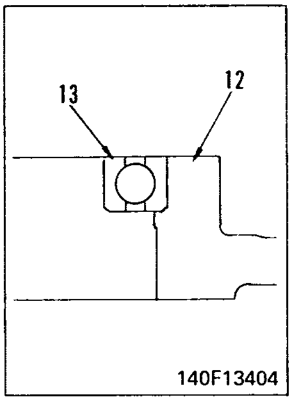

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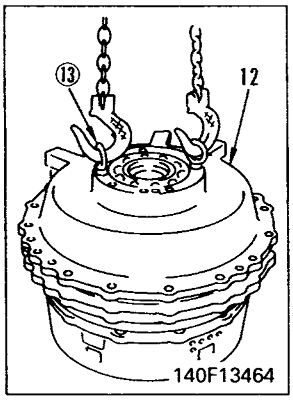
xi) Using eyebolts ⑬, align with guide bolt, then set cover (12) in position.
  - ★ Check that the spring is fitted securely into both the piston and cover.

xii) Compress spring with bolt ⑭ and nut ⑮, and at the same time press fit inner race of bearing to hub (16).



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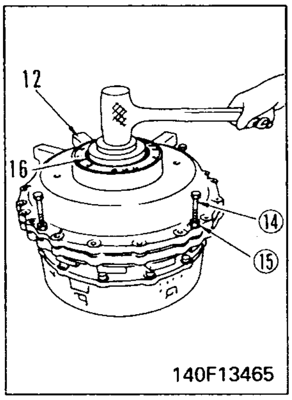

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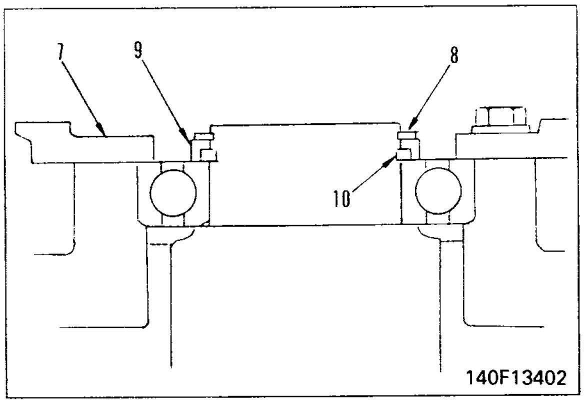
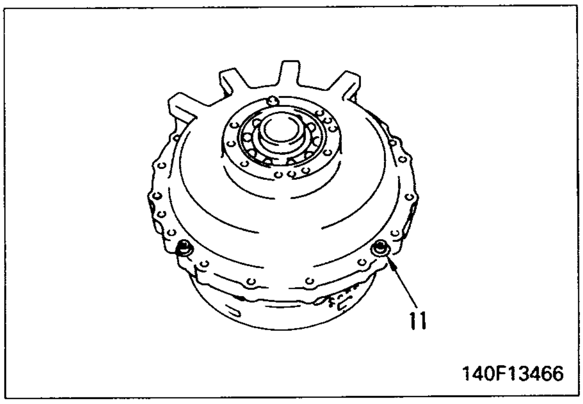
xiii) Fit spacer (10) and install spacer (9) and snap ring (8).

xiv) Install flange (7).



xv) Remove bolt and nut used to compress spring, then install 4 bolts (11).



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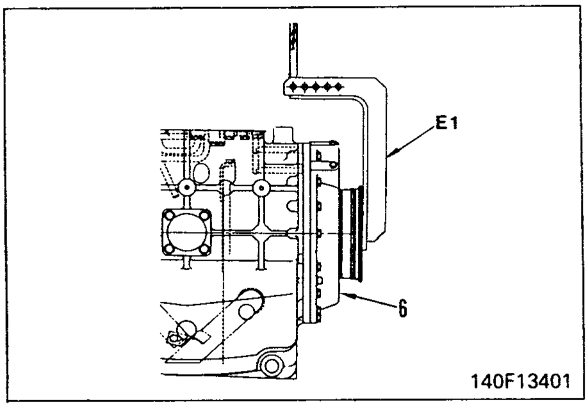
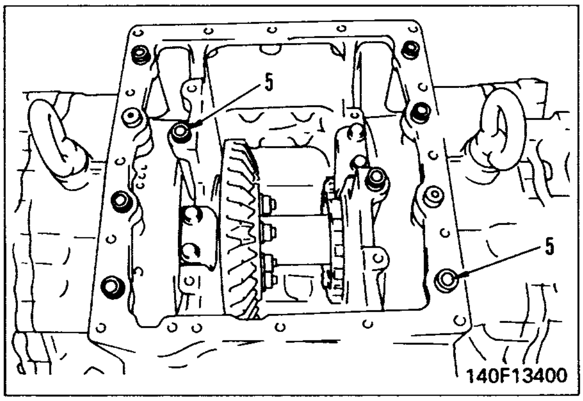
3) Using tool **E1**, install clutch and brake assembly (6).



6. Cover

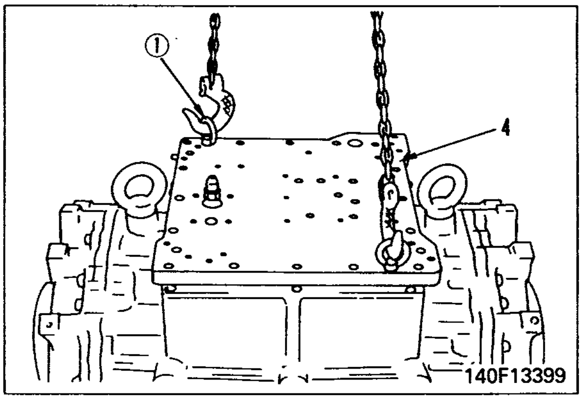
1) Install 10 sleeves (5).



2) Using eyebolts ①, install cover (4).

Mating surface:
Gasket sealant (LG-4)

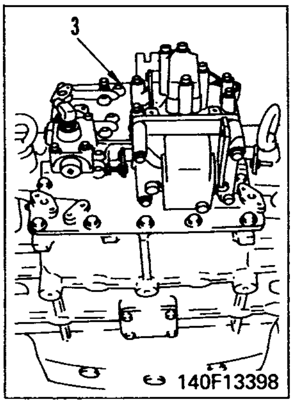
★ Coat both surfaces.

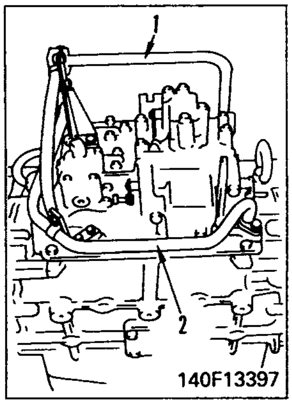


7. **Steering valve assembly**
   Raise steering valve assembly (3) and install.

   Mounting bolt:
   49 ± 4.9 Nm (5 ± 0.5 kgm)

8. **Piping**
   Install tubes (2) and (1).





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Serial No. 65001 and up

- **Precautions when assembling**

★ Clean all parts, and check for dirt or damage before assembling.

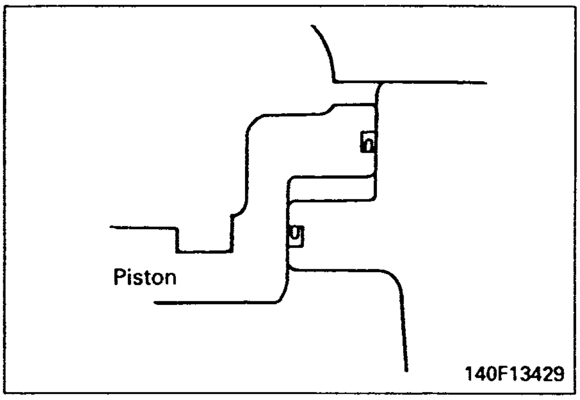
★ Put a drop of engine oil on the rotating portion of the bearing, then rotate it several times.

★ Coat the sliding surfaces of all parts with engine oil before installing.

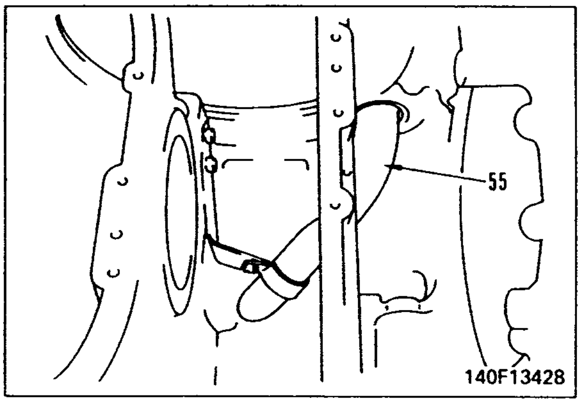
★ Assemble the piston seal ring with the side receiving the pressure facing the housing, coat it with grease (G2-LI), then install it uniformly so that it is not offset to one side.

Rotating seal ring: Fix with grease (G2-LI), and be extremely careful that it does not get caught when assembling it.

★ Check that the snap ring is fitted securely in the groove.



1. **Suction tube**
   Install suction tube (55).



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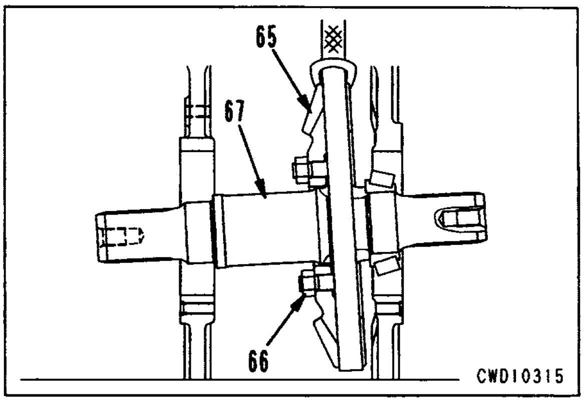
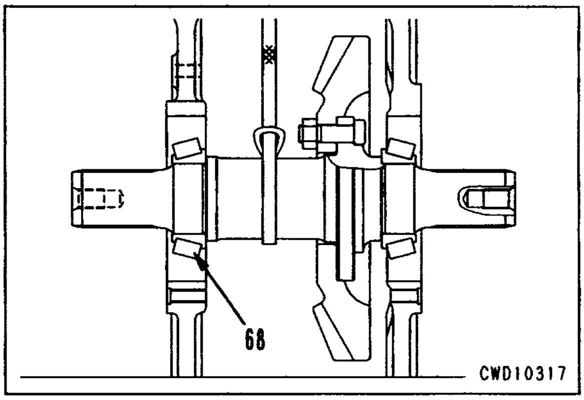
2. **Bevel gear shaft, bevel gear assembly**
   1) Install bolt (53) to bevel gear shaft (49).
   2) Shrink fit bearing (51).
   3) Install outer race (54) to cage (50).
   4) Raise bevel gear (52) and set in case.
      ★ Set with the tooth surface on the inside.

5) Insert bevel gear shaft (67) in bevel gear (65) slung at the center of the case from the right side of the machine.
   - ★ Tighten mounting nut (66) temporarily in advance.



6) Heat bearing (68) with a bearing heater, etc. and install it to the left side of the bevel gear shaft by shrink fit.
   - ★ If the bearing temperature is raised too high, the hardness of the heat-treated part lowers. Accordingly, do not raise the bearing temperature more than 120°C.
   - ★ After installing the bearing, drop engine oil onto its rotating parts and rotate it several turns.ß
   - ★ Check that the clearance at the bearing end is 0.03 mm or less.

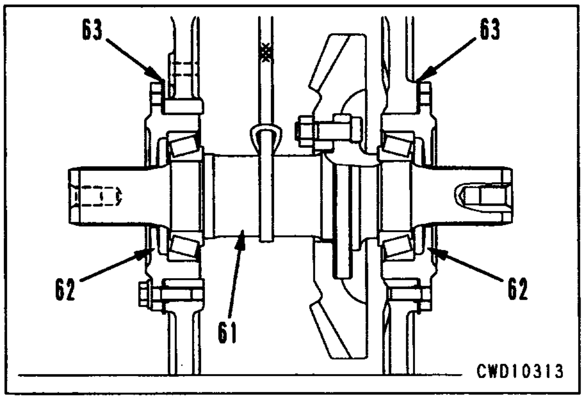


7) Install cage (62) to bevel gear and shaft assembly (61).
   - ★ Install shims (63) of the thickness and quantity recorded when removed.
   - • Standard shim thickness: 1.5 mm
   - • Varieties of shim thickness: 0.2 mm, 0.3 mm, 0.5 mm

   kgm Mounting bolt:
   98.1 - 122.6 Nm {10 - 12.5 kgm}

8) Tighten the bevel gear mounting nut securely.
   - ★ Place a plastic hammer, etc. between the bevel gear and case to lock them.

   kgm Mounting bolt:
   245 - 309 Nm {25 - 31.5 kgm}



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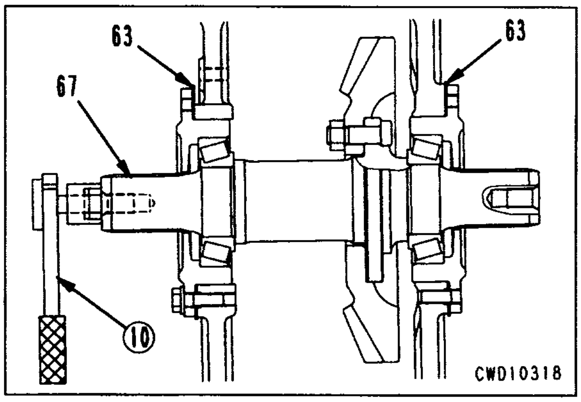
9) Adjusting pre-load
   ★ Adjust the pre-load with the bevel pinion assembly removed.
   i) Rotate the bevel gear and shaft assembly several turns to fit the bearing.
   ii) Install the bolt to the end of bevel gear shaft (67) and measure the rotation torque with torque wrench ⑩.
      - Standard rotation torque:
        10.3 - 14.7 Nm {1.05 - 1.5 kgm}

      If the rotation torque is lower than the standard value, reduce the quantity of shims (63) in step 7. If the former is higher, increase the latter.



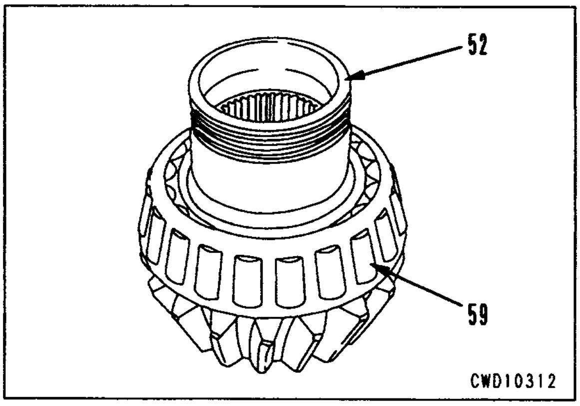
3. Bevel pinion assembly

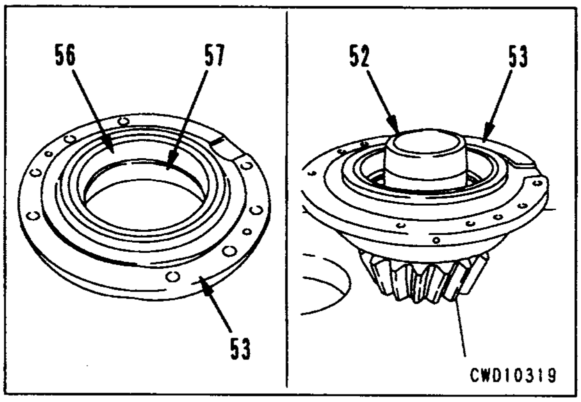
1) Assembly of bevel pinion
   i) Using the push tool, press fit bearing (59) to bevel pinion (52).
   ii) Using the push tool, press fit outer races (56) and (57) to cage (53).
   iii) Place bevel pinion (52) on the press stand and set cage (53).
   iv) Press fit bearing (54) to cage (53) with the press.
   v) Secure the pinion with the press and tighten locknut (51) with tool E3.

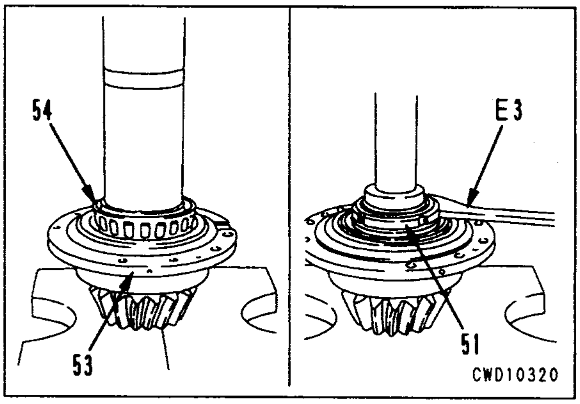
      Locknut: **Adhesive (LT-2)**

      Locknut:
      392 - 441 Nm {40 - 45 kgm}

   vi) After tightening the nut, return it until 1 pin hole on it (8 places) is matched to 1 pin hole on the pinion shaft (5 places).
      ★ Return the nut by 0 - 9°C.
      ★ Tighten the nut, turning the cage.
      ★ After tightening the nut, check that the bevel pinion rotates smoothly.







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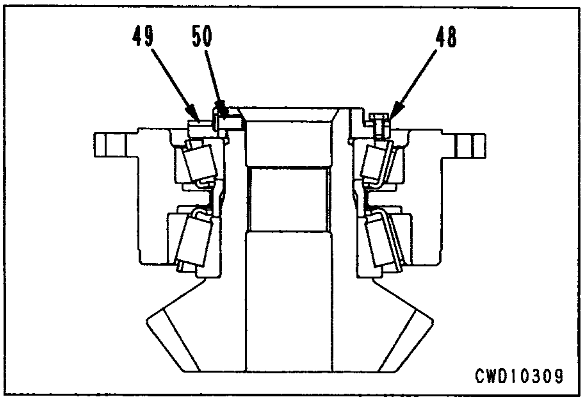
vii) Install pin (50), plate (49), and lock (48), then tighten the bolt.

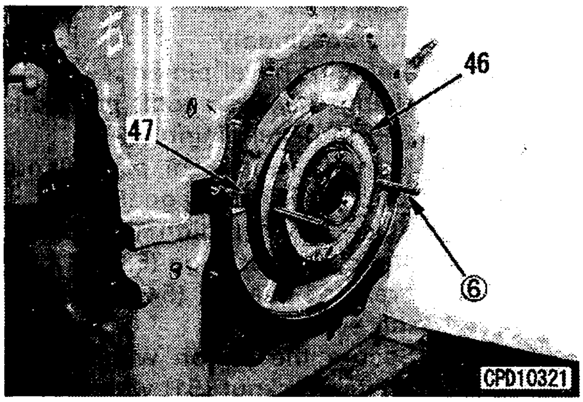
viii)Bend lock (48) securely.



4) Using guide bolt ⑥, install shims (47) and bevel pinion assembly (46).

★ Install shims of the thickness and quantity recorded when removed.

- Standard shim thickness: 2 mm
- Varieties of shim thickness: 0.2 mm, 0.3 mm, 1.0 mm



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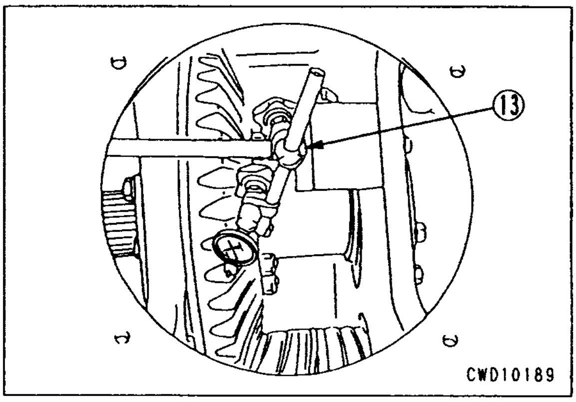
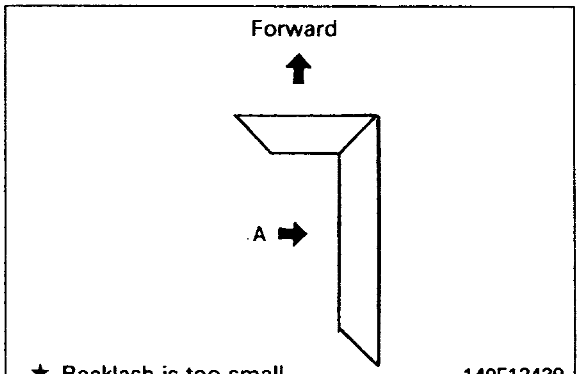
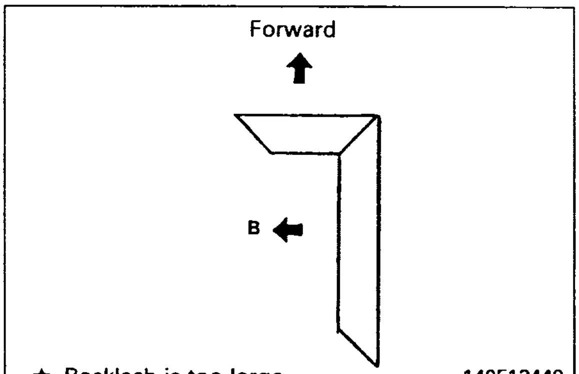
4. Adjusting backlash, tooth contact

1) Install transmission assembly.
2) Adjusting backlash
   Put probe of dial gauge ⑬ at 90° in contact with the tip of the bevel gear tooth face, hold the bevel pinion in place, and measure the reading when the bevel gear is moved forward and backward.
   - ★ Standard value for backlash:
     0.2 – 0.28 mm
   - ★ Measure the backlash at a minimum of three places on opposite sides.
   - If the measurement shows that the backlash is not within the standard value, adjust as follows.
   - ★ Turn the ring nuts to adjust. In order to maintain the preload that was adjusted above, loosen the ring nut on one side, then tighten the ring nut on the opposite side by the same amount.
   - When backlash is too small
     Loosen the right ring nut and tighten the left ring nut to move the bevel gear in direction **A**.
   - When backlash is too large
     Loosen the left ring nut and tighten the right ring nut to move the bevel gear in direction **B**.





★ Backlash is too small 140F13439



★ Backlash is too large 140F13440

3) Checking tooth contact

Testing

i) Coat the tooth face of the bevel pinion lightly with red lead (minimum). Rotate the bevel gear forward and backward and inspect the pattern left on the teeth.

ii) Tooth contact should be checked with no load on the bevel pinion. If should be in the center of the tooth height. The tooth contact pattern should be located 20 to 40% from the small end "**d**", and should cover 30 to 75% of the lengthe of the tooth.
In addition, there should be no strong contact at the addendum "**a**" or dedendum "**b**" (tip or root of the gear teeth) or at the big end "**c**" and small end "**d**".
★ If the gears are adjusted to this pattern, the tooth contact will be correct when load is applied.

a: Addendum d: Small end
b: Dedendum e: Width contact
c: Big end f: Center of tooth contact

Adjustment

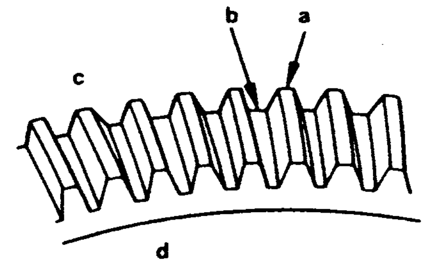
If the result of the inspection shows that the correct tooth contact is not being obtained, adjust again as follows:

i) If bevel pinion is too far from center line of bevel gear. Contact is at the small end of the convex tooth face of the bevel gear and at the big end of the concave tooth face.
- Correct as follows.
Adjust the shim thickness at the bevel pinion end, and move the bevel pinion in direction **A**.
Or, move the bevel gear in direction **B** and check the tooth contact pattern and backlash again.

★ When adjusting the shim thickness at the bevel pinion end, remove the transmission assembly first.

ii) If bevel pinion is too close to center line of bevel gear.
Contact is at the small end of the concave tooth face of the bevel gear and the big end of the convex tooth face.
- Procedure for adjustment
Adjust the thickness of the shims at the bevel pinion to move the bevel pinion in direction **A**.
Adjust the shim thickness at the bearing cage of the bevel gear shaft to move the bevel gear in direction **B**. Check the tooth contact pattern and backlash again.

★ When adjusting the amount that the bevel gear moves in or out, do not change the preload of the bearing. Adjust by loosening the ring nut on one side and tightening the nut on the other side by the same amount.



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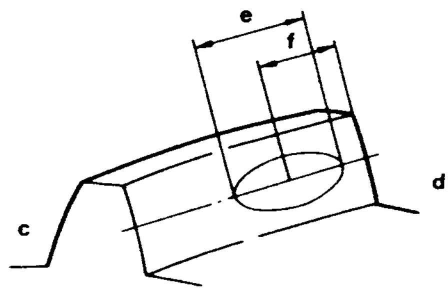

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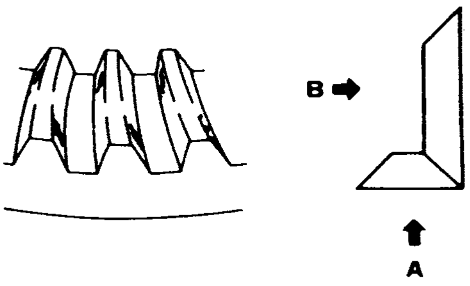

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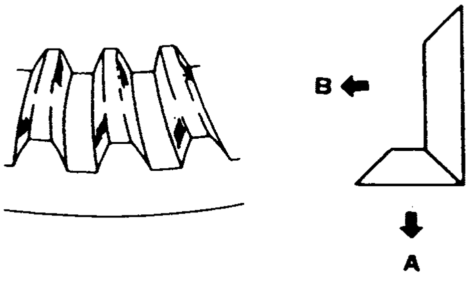

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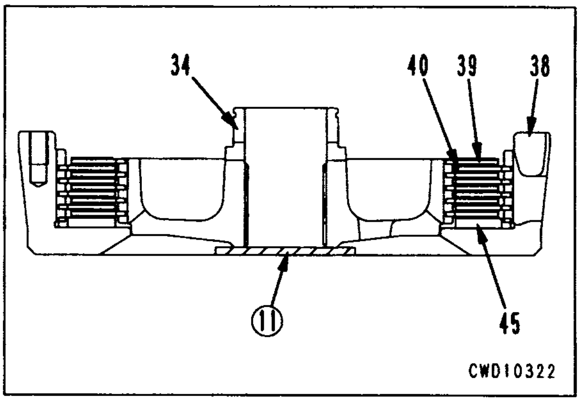
- ★ Install shims of the same total thickness to both sides.
- iii) When adjustment is finished, tighten the mounting bolts of the cage and bevel pinion assembly to the specified torque.

  kgm Mounting bolts of cage and bevel pinion assembly:
  98 - 123 Nm {10 - 12.5 kgm}



5. **Clutch and brake assembly**

- Assembly of clutch and brake assembly
  1) Assembly of clutch assembly
     - i) Set hub (34) on drum (38).
       - ★ Since the cage is to be fitted to the hub later, place block (11) to set the hub to the height of the drum.
     - ii) Install plate (45), disc (39), and plate (40).
       - ★ Discs: 5 pieces, Plate (45): 1 piece, Plates (40): 4 pieces
     - iii) Install seal ring (43) and piston (35).

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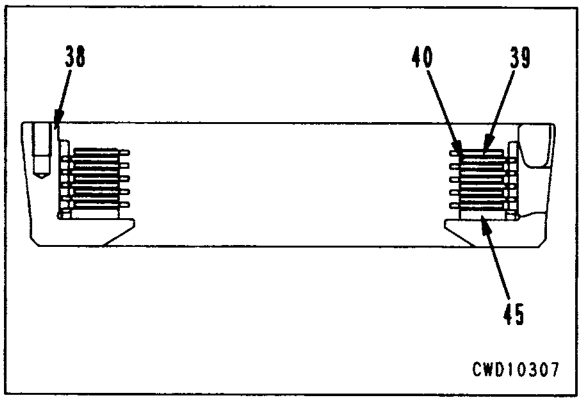
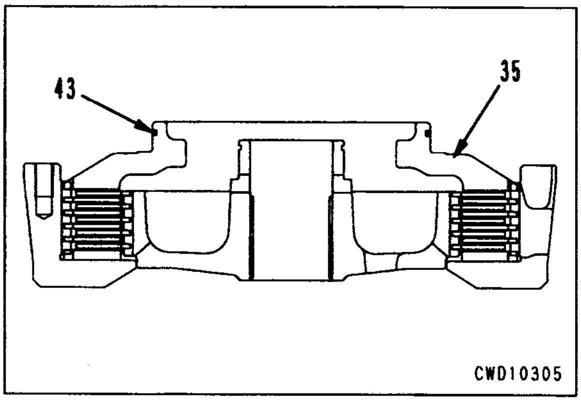
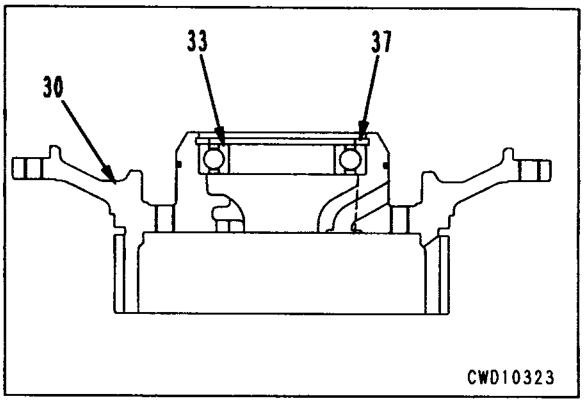




iv) Press fit bearing (33) to hub (30) and install snap ring (37).



CWD10323

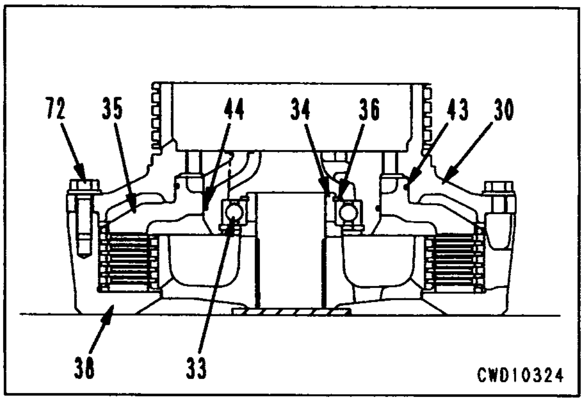
v) Install seal ring (44) to hub (30), then set them to clutch drum (38).
  - ★ Set the seal ring and hub, matching them to piston (35) and hub (34).
  - ★ Take care that seal rings (43) and (44) will not be caught.

vi) Tighten bolt (72) and press fit bearing (33) to hub (34).

kgm Mounting bolt:

98 - 123 Nm {10 - 12.5 kgm}

vii) Press fit bearing (33) completely and install snap ring (36) from the side of hub (30).



CWD10324

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2) Assembly of brake assembly

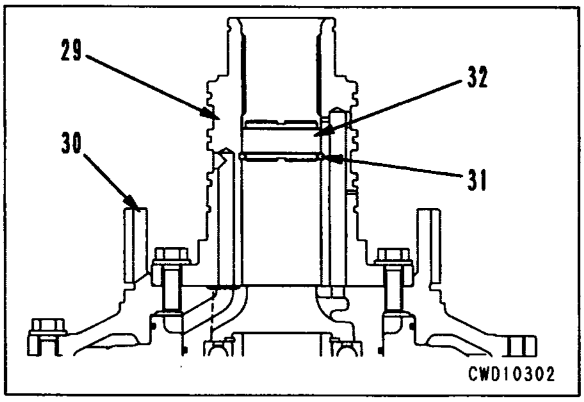
i) Install stopper (32) to hub (29), then install snap ring (31).

ii) Install the O-ring and set hub (29) to hub (30) and tighten 18 mounting bolts.

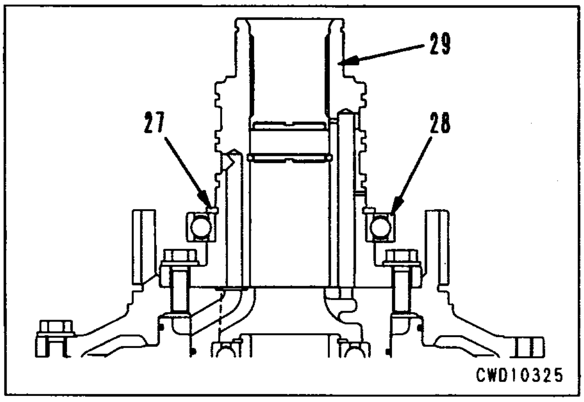
kgm Mounting bolt:

98 - 123 Nm {10 - 12.5 kgm}

iii) Install bearing (28) to hub (29), then install snap ring (27).

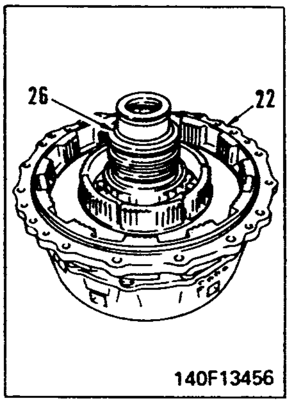


CWD10302



CWD10325

iv) Set brake drum (22) to drum and hub assembly (26).
Install discs (23), plates (24), and springs (25).
★ Discs: 5 pieces, Plates: 4 pieces



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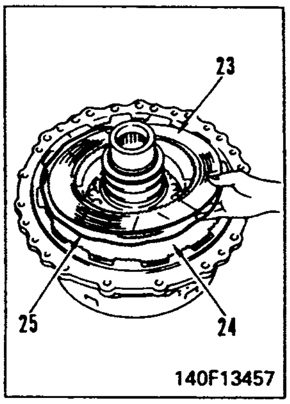

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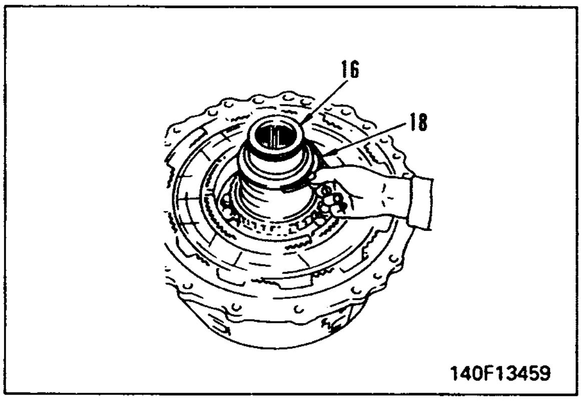
v) Install seal ring (18) to hub (16).



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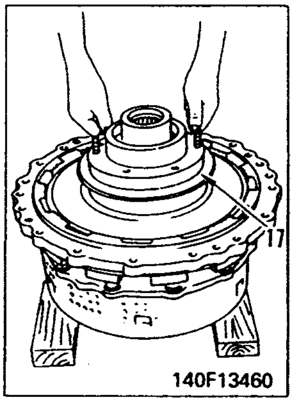
vi) Install seal ring, then install cage (17) to the hub.
★ Roughly match the oil holes on the cage to the 4 oil holes on the drum.
★ Press fit the cage to the outer race side of the bearing.

vii) Install the seal ring and set piston (15), matching the center of the spot-face having the match mark to the drilled hole "13.5 in diameter" (on the opposite side of the side hole).



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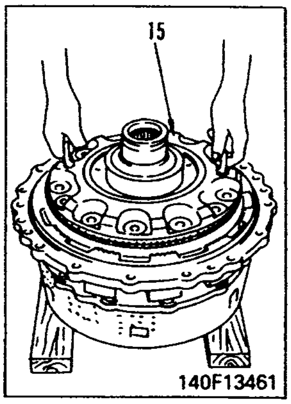

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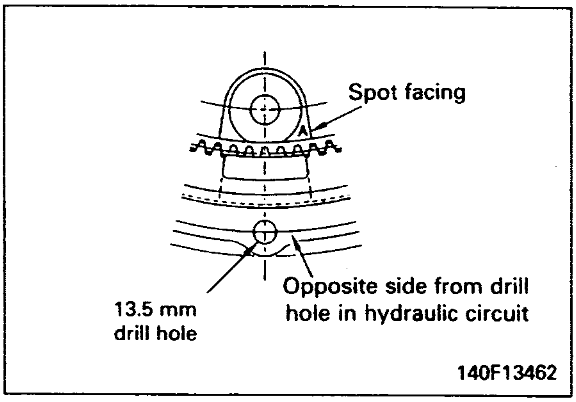

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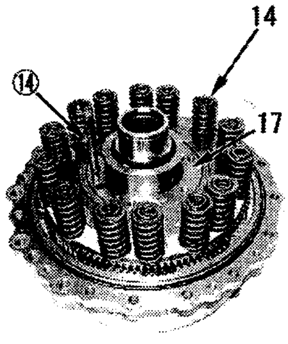
viii)Install spring (14).
ix) Install guide bolt ⑭ to cage (17).
x) Install bearing (13) to cover (12).



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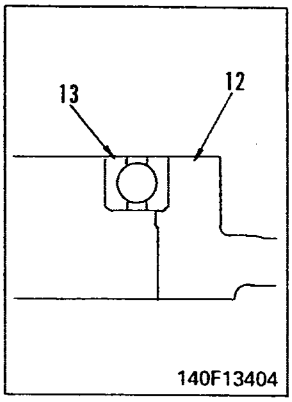

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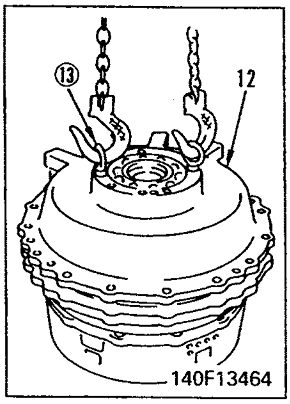
xi) Using eyebolts ⑬ and matching to the guide bolt, set cover (12).
★ Check that the spring is fitted securely to both of the piston and cover.
xii) Compressing the spring with forcing screws ⑭ and nuts ⑮, press fit the inner race side of the bearing to hub (16).



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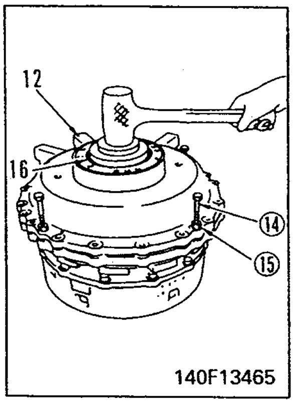

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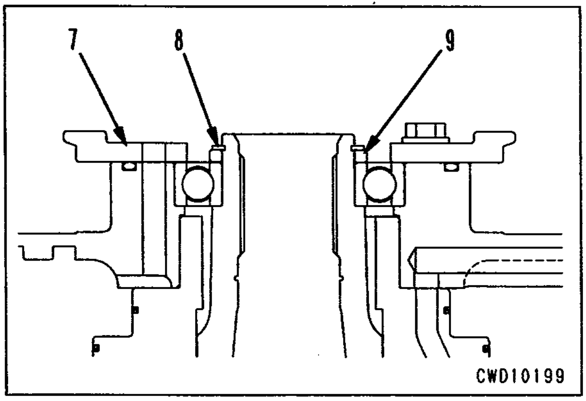
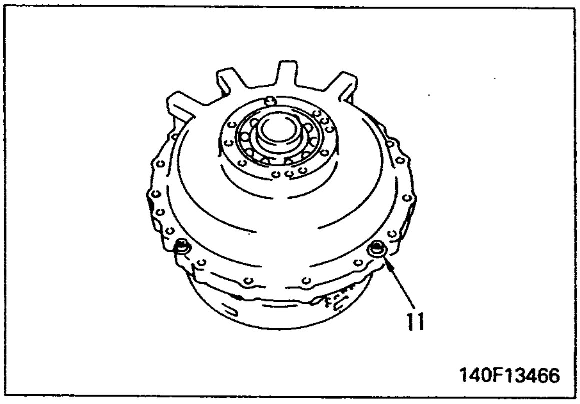
xiii) Install spacer (9) and snap ring (8).
xiv) Install flange (7).



CWD10199

xv) Remove the bolts and nuts used to compress the spring, then install 4 bolts (11).



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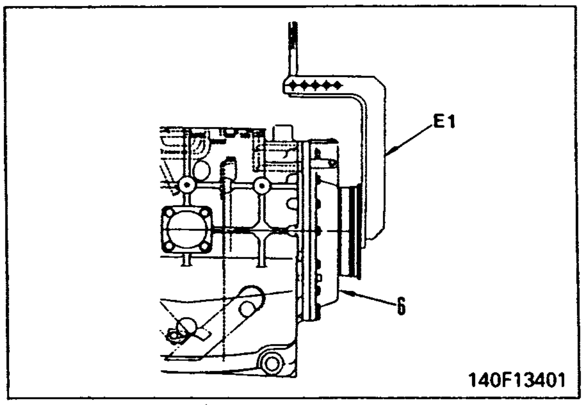
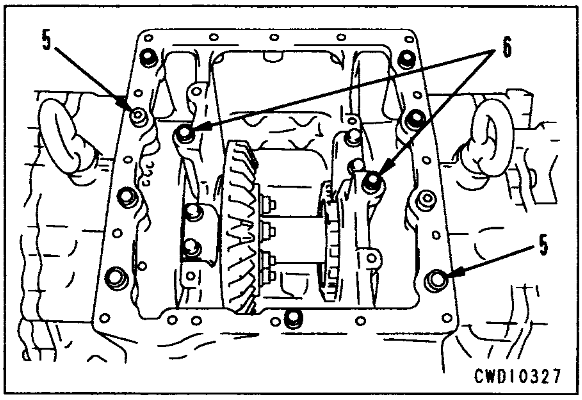
3) Using tool **E1**, install clutch and brake assembly (6).

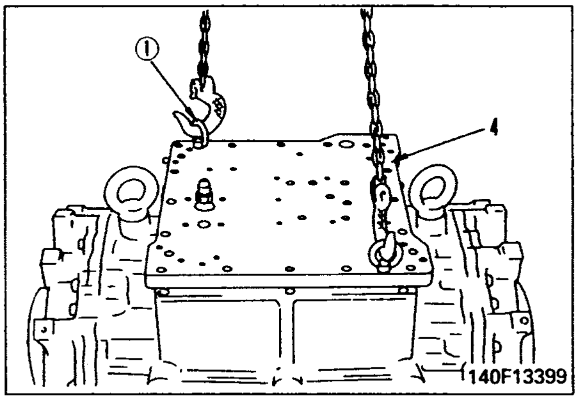


6. Cover

1) Install 2 sleeves (6) and 9 sleeves (5).

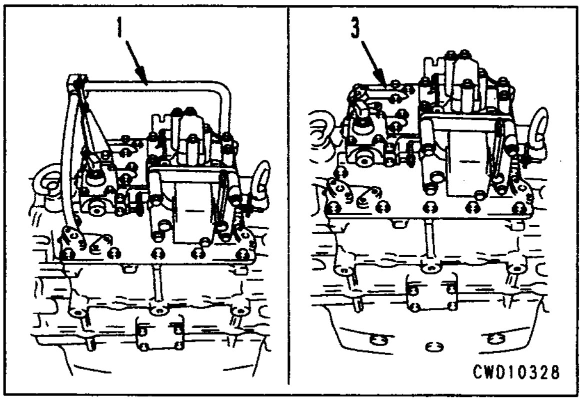


2) Using eyebolts ①, install cover (4).
Mating face: **Gasket sealant (LG-6)**
★ Apply gasket sealant to both mating faces of the case and cover.
★ Apply gasket sealant to each mating face without breakage.



Steering valve assembly
Sling and install steering valve assembly (3).
Mounting bolt: **44.1 - 53.9 Nm {4.5 - 5.5 kgm}**

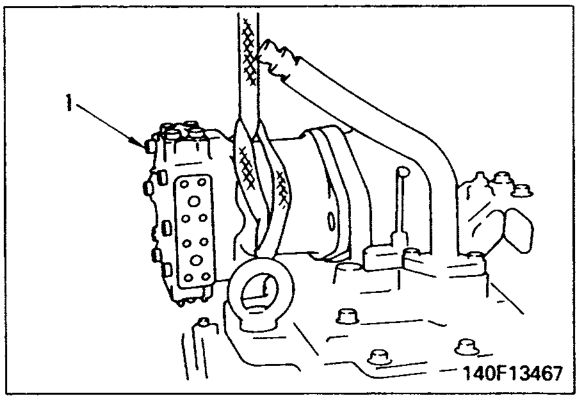
Piping
Remove tube (1).



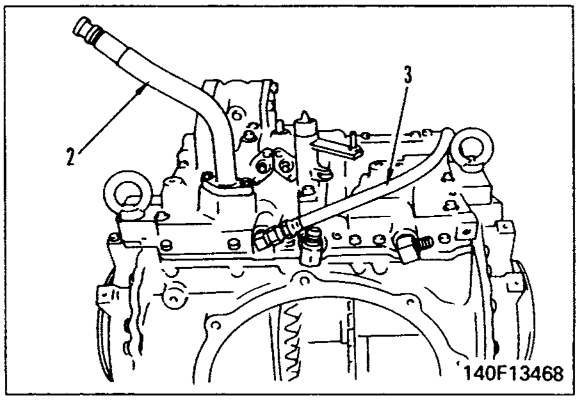
DISASSEMBLY OF HSS ASSEMBLY

D65EX, PX
Serial No. 60001 - 65000

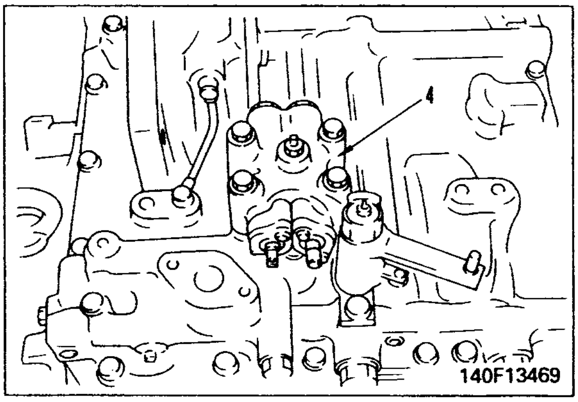
1. **Motor assembly**
   Lift off motor assembly (1).



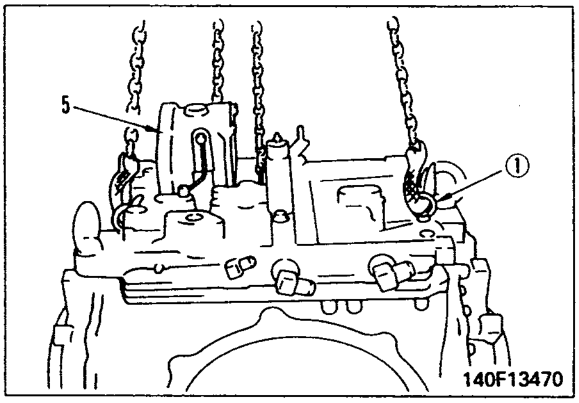
2. **Oil filler, hose**
   Remove oil filler (2) and hose (3).



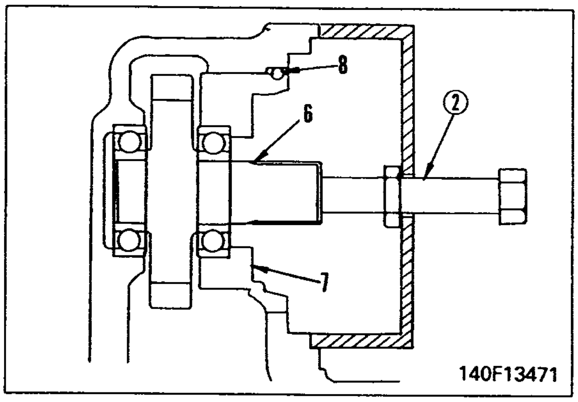
3. **Brake valve assembly**
   Remove brake valve assembly (4).



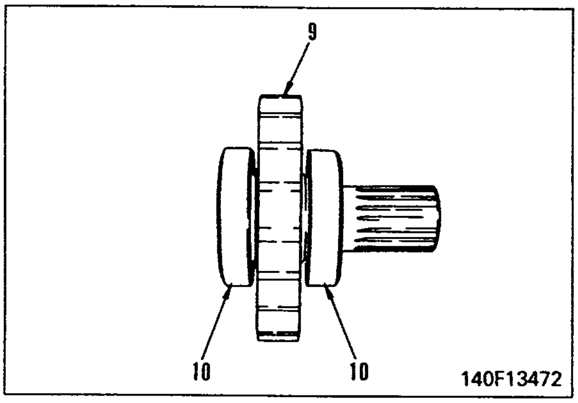
4. **Cover assembly**
   Using eyebolts ①, remove cover assembly (5).



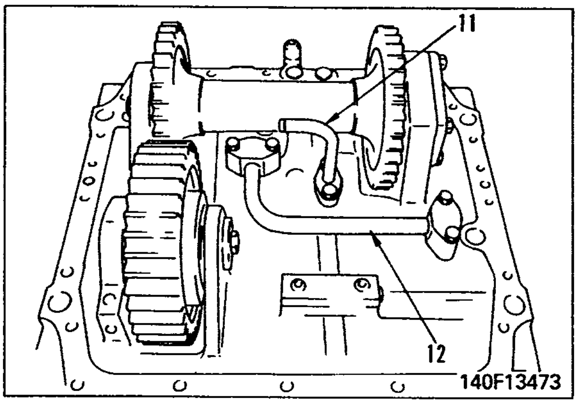
- **Disassembly of cover assembly**
  1) Input gear assembly
     i) Using puller ②, pull out gear assembly (6), then remove cage (7), ball (8), and gear assembly (6).



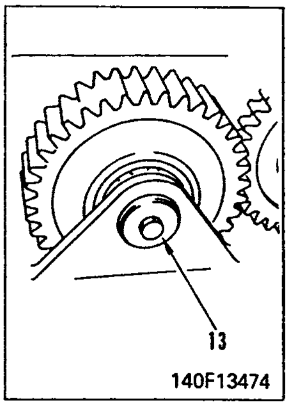
     ii) Remove bearing (10) from gear (9).

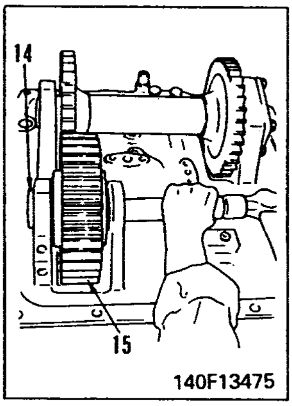


  2) Remove tubes (11) and (12).



  3) Intermediate gear
     i) Remove bolts, then remove holder (13).
     ii) Knock out shaft (14) from bolt end, then remove gear (15).
     ★ Be careful not to lose the ball.





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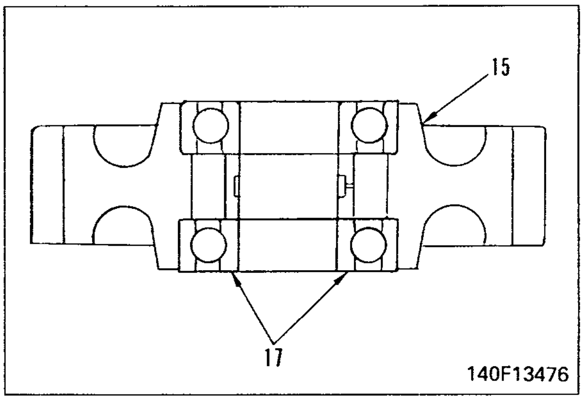
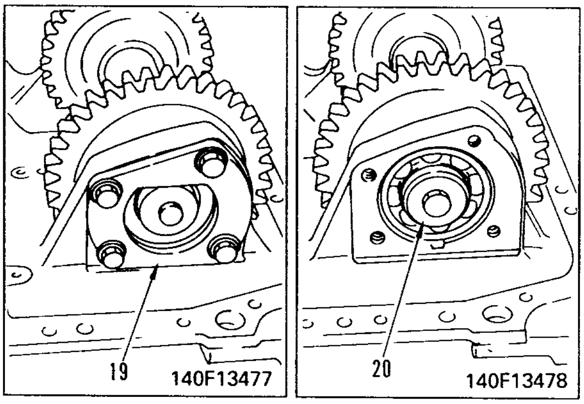
iii) Remove bearing (17) from gear (15).



4) Left carrier drive gear assembly
   i) Remove cover (19).
   ii) Remove bolts, then remove holder (20).



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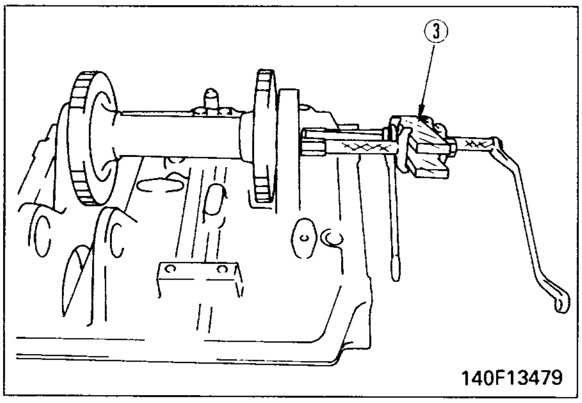
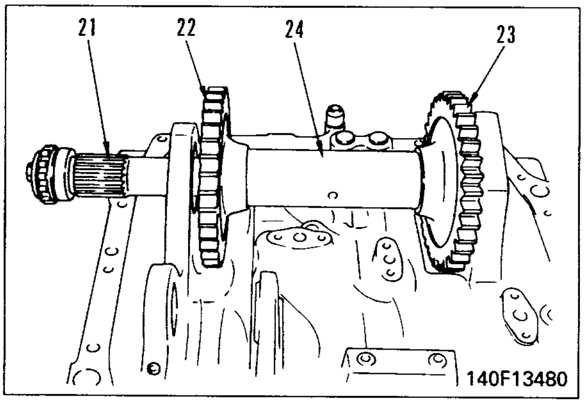
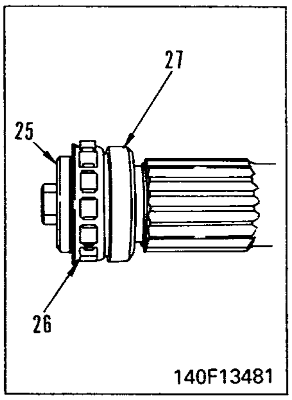
iii) Using puller ③, push out shaft.

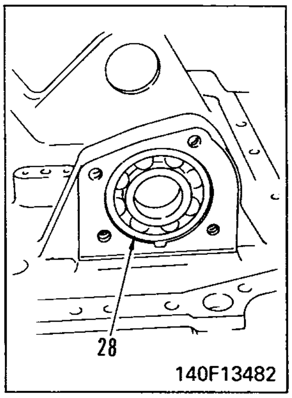


iv) Pull out shaft (21), then remove gears (22) and (23), and collar (24).

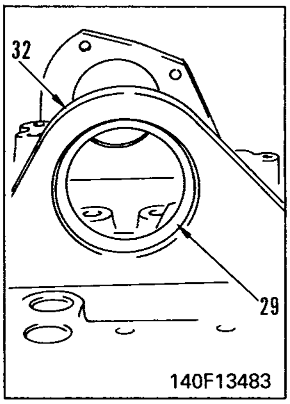


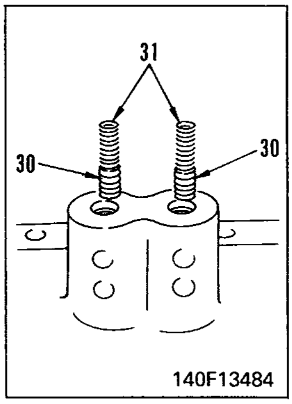
v) Remove bolts, then remove holder (25).
vi) Remove bearing (26), then remove collar (27).
vii) Remove bearing (28).





Viii) Remove outer race (29) from cover (32).
5) Remove plug, then remove spring (30) and valve (31).





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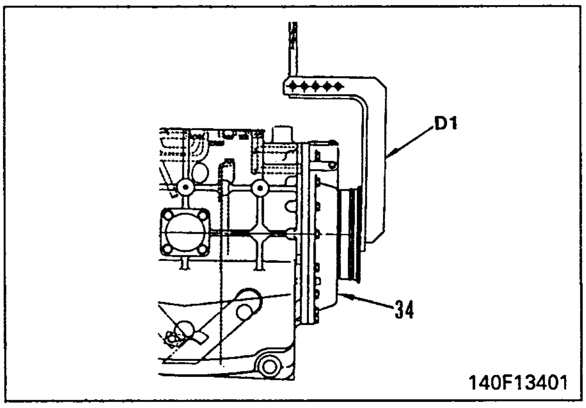
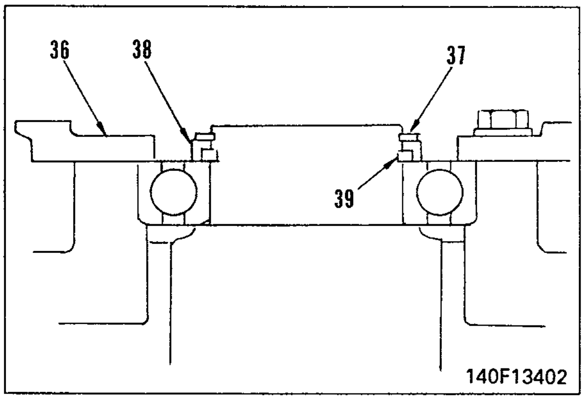
5. Brake assembly

1) Remove mounting bolts, then using tool **D1**, remove brake assembly (34).
   ★ Do not remove the 4 hexagon socket head bolts.

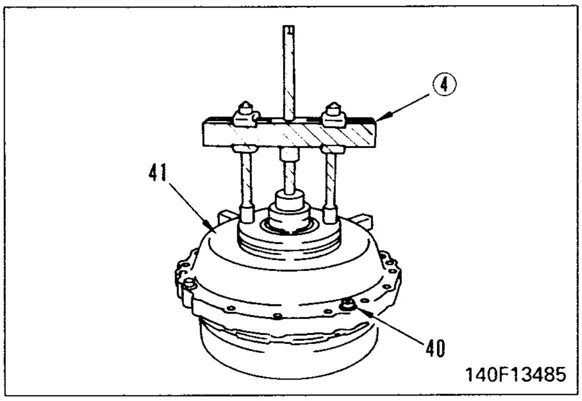


- **Disassembly of brake assembly**

1) Remove flange (36).
2) Remove snap ring (37), then remove spacers (38) and (39).



3) Set puller ④ in position, remove 4 hexagon socket head bolts (40), then remove cover (41).
   ★ The bearing inner race will come out.



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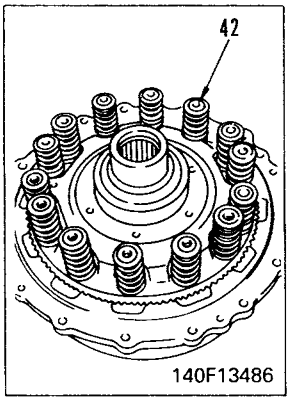
4) Remove spring (42).
5) Using eyebolt ⑤, remove piston (43).



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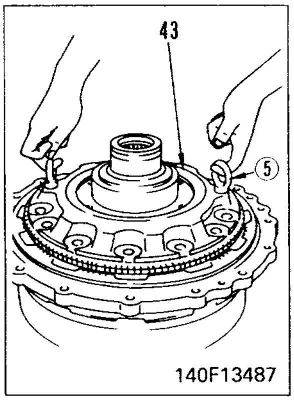

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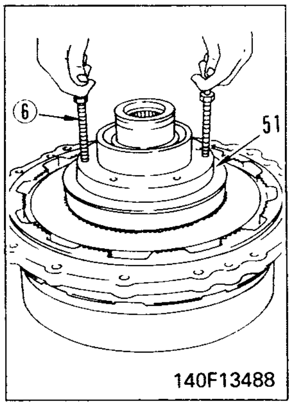
6) Using eyebolts ⑥, remove cage (51).
7) Using eyebolts ⑦, remove drum (45) together with disc and plate.



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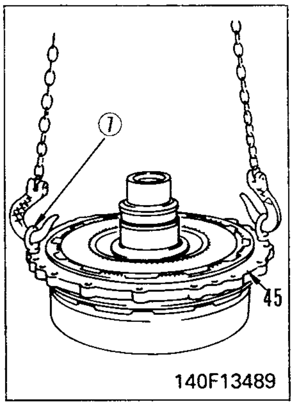

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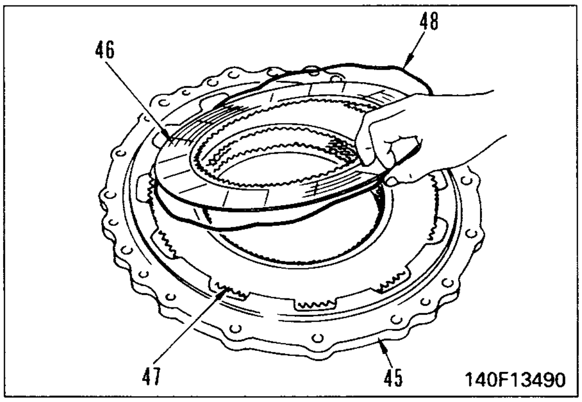
8) Remove disc (46), plate (47), and spring (48) from drum (45).



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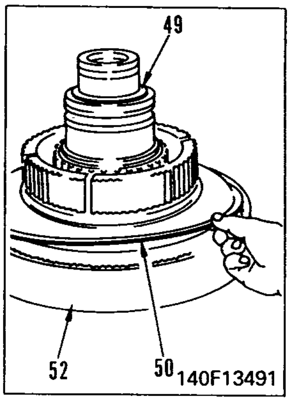
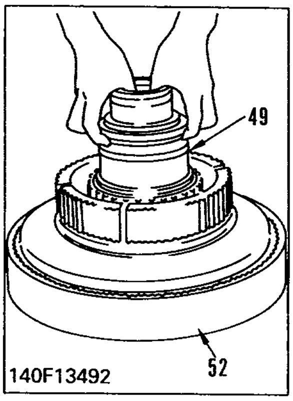
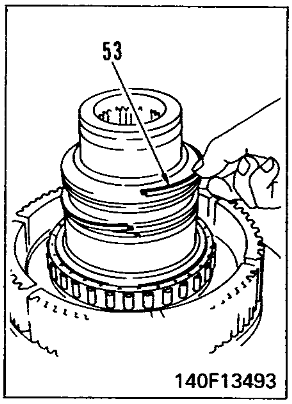
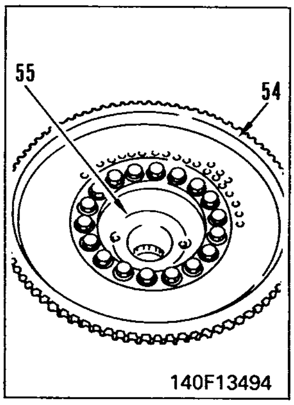
9) Remove snap ring (50), then pull up hub assembly (49), and remove ring gear (52).



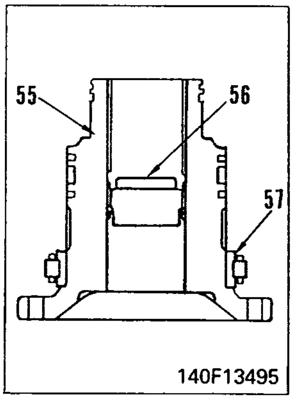


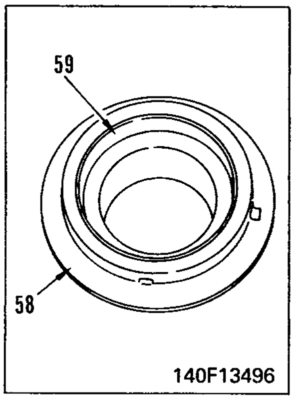
10) Remove seal ring (53) from hub.
11) Remove bolts, and disconnect hub (54) from hub (55).





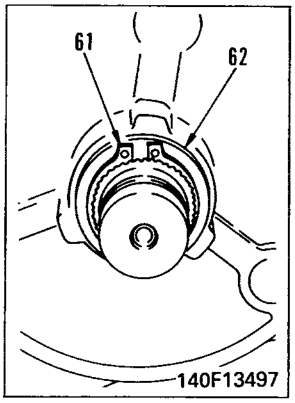
12) Remove stopper (56) and bearing (57) from hub (55).
13) Remove outer race (59) from cage (58).

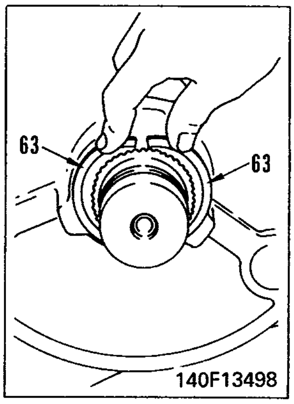




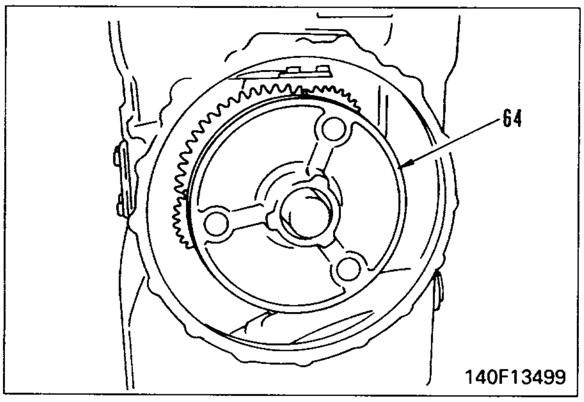
6. Carrier assembly

1) Remove snap ring (61).
2) Remove collar (62).
3) Remove collar (63).





4) Pull out carrier assembly (64) and remove.
   ★ When the carrier is pulled out, support the carrier and be careful not to get your fingers caught between the carrier and the case.



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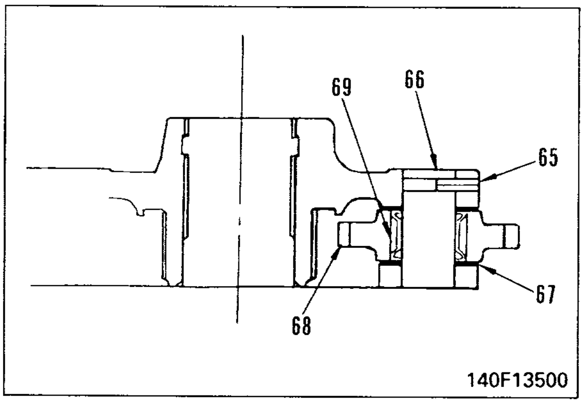
5) Disassemble carrier assembly as follows.
   i) Knock roll pin (65) into shaft.
   ii) Pull out shaft (66), then remove thrust washer (67), gear (68), and bearing (69).
   iii) Remove roll pin from shaft.



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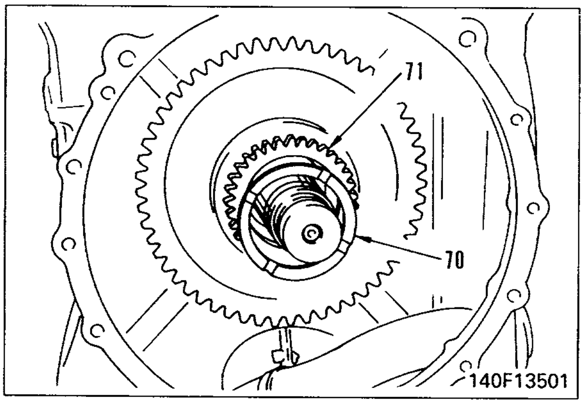
7. Sun gear

Remove thrust washer (70).

★ If it stays in position and does not come out together with the carrier, remove sun gear (71).



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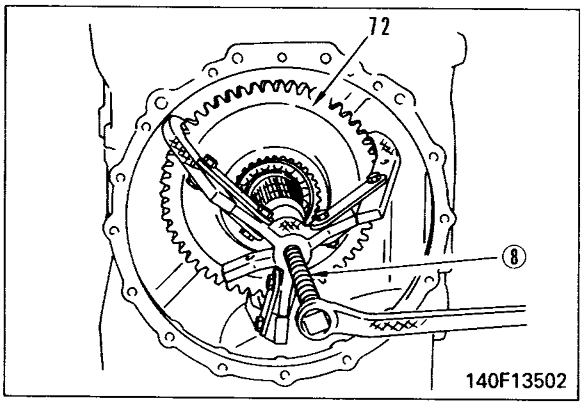
8. Gear

1) Using gear puller ⑧, remove gear (72).



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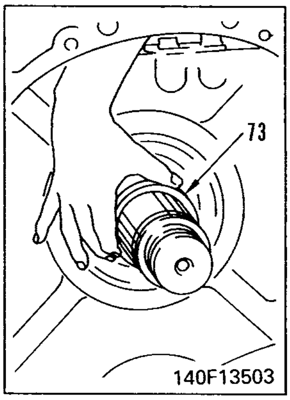
2) Remove collar (73).
3) Using bearing puller, remove bearing (74).



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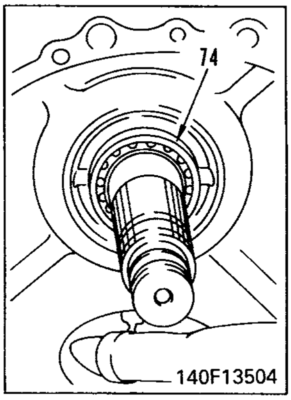

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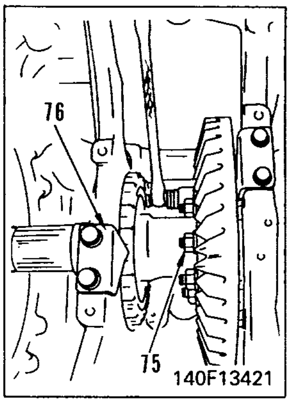
9. Bevel gear shaft, bevel gear assembly

1) Remove nuts (75) of bevel gear mounting bolts.
2) Remove lock plate (76).
3) Using tool **D2**, loosen ring nut (77), then remove from cage.



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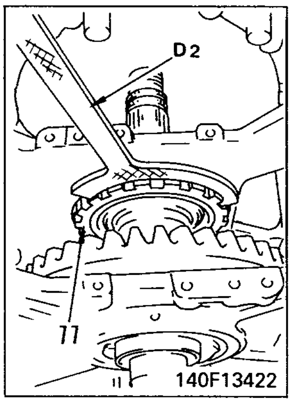

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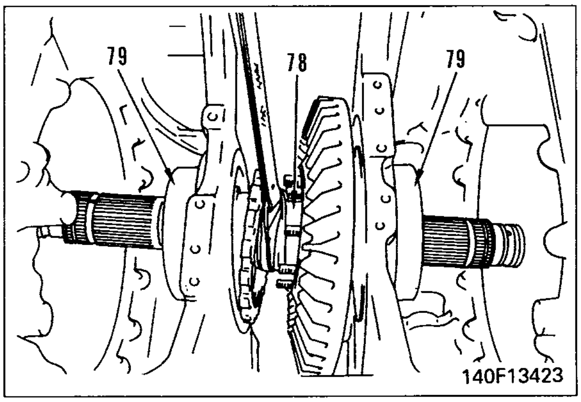
4) Raise bevel gear shaft (78), and remove cage (79).



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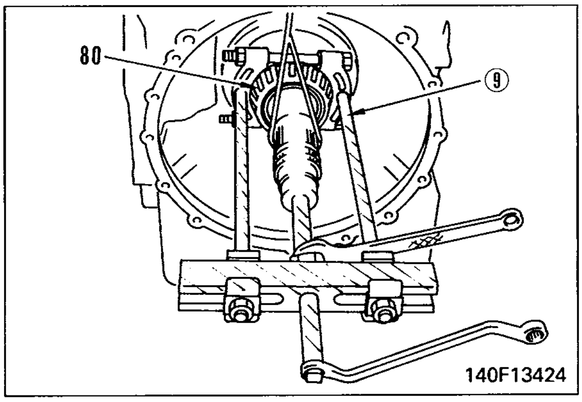
5) Move bevel gear shaft fully to left, then using bearing puller ⑨, remove bearing (80).



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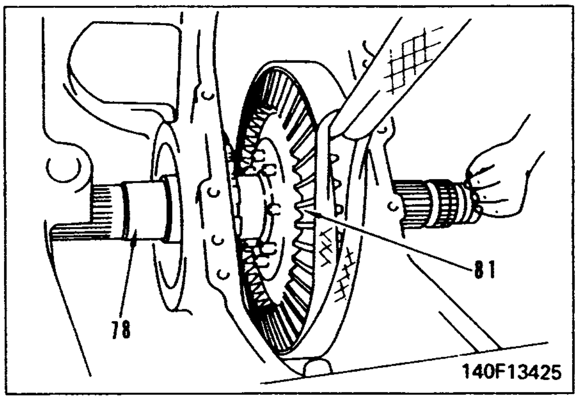
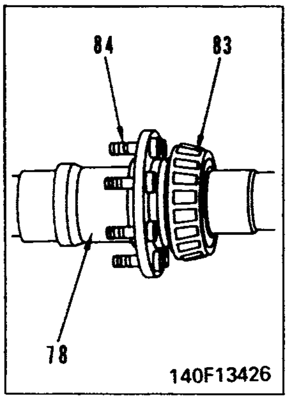
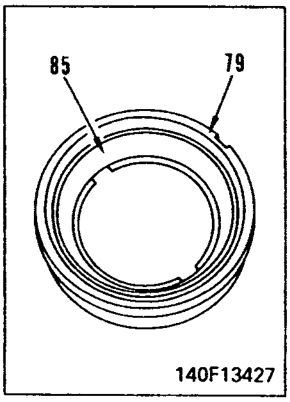
6) Raise bevel gear (81), and pull out bevel gear shaft (78) to right.
7) Remove bevel gear (81).



8) Remove bearing (83) from bevel gear shaft (78).
9) Remove bolts (84).
10) Remove outer race (85) from cage (79).





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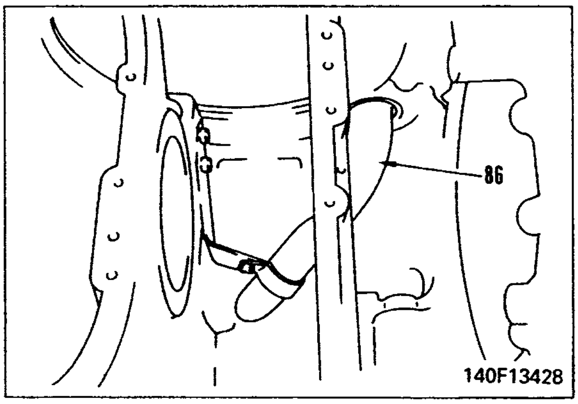
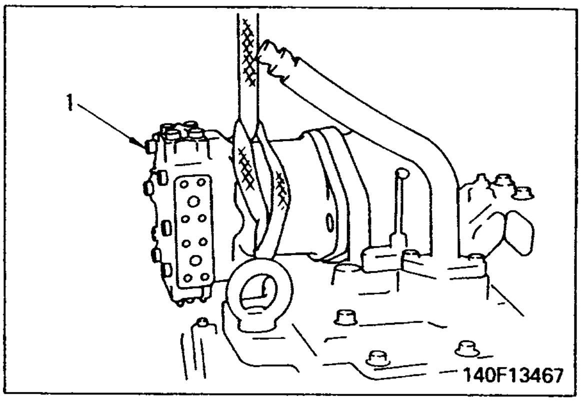
10. Suction tube
Remove suction tube (86).

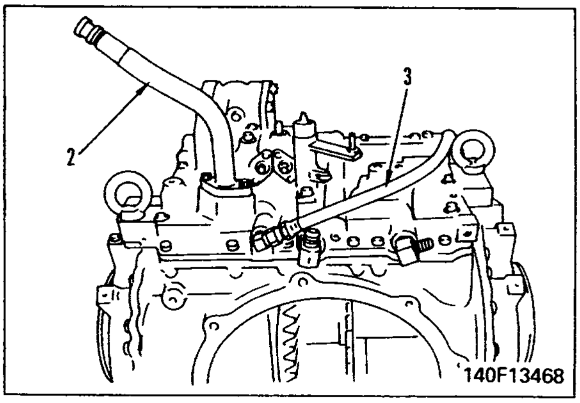


Serial No. 65001 and up

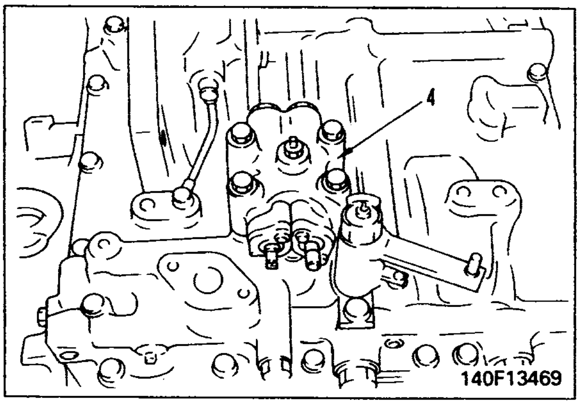
1. **Motor assembly**
   Lift off motor assembly (1).



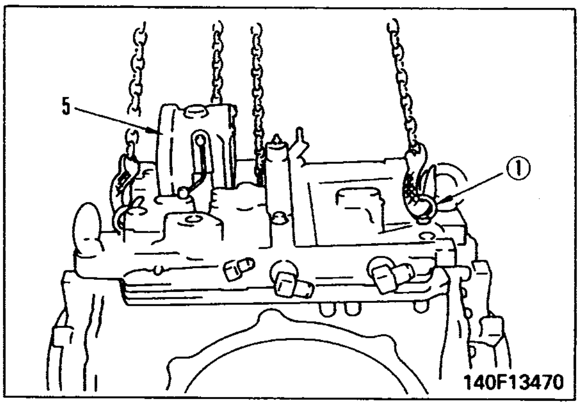
2. **Oil filler, hose**
   Remove oil filler (2) and hose (3).



3. **Brake valve assembly**
   Remove brake valve assembly (4).



4. **Cover assembly**
   Using eyebolts ①, remove cover assembly (5).



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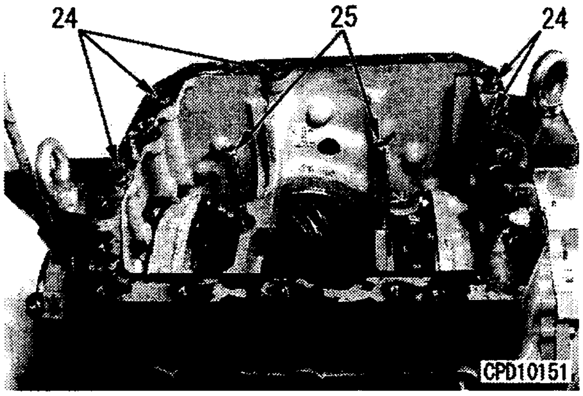
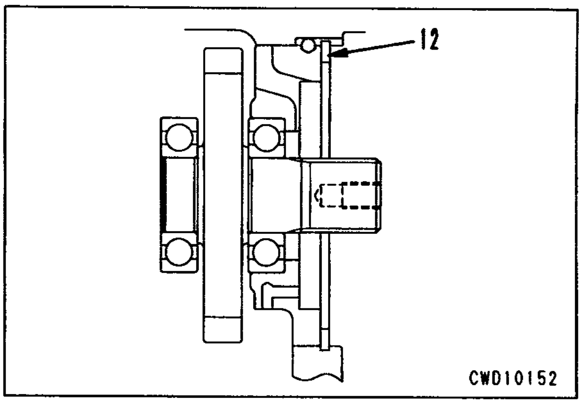
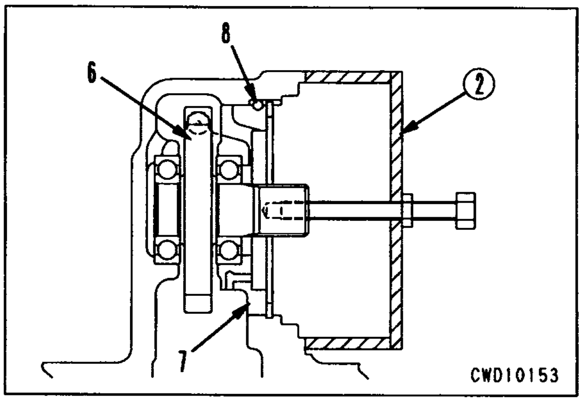
2) Remove 5 sleeves (24) and 2 sleeves (25) from the HSS case.



- **Disassembly of cover assembly**
  1) Input gear assembly
     i) Remove snap ring (12).



     ii) Pull out gear assembly (6) and cage (7) as a unit with puller ②, then remove gear assembly (6) from cage (7).
     ★ Take care not to lose ball (8).



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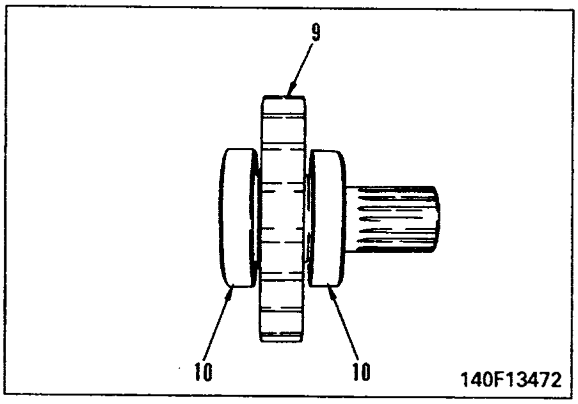
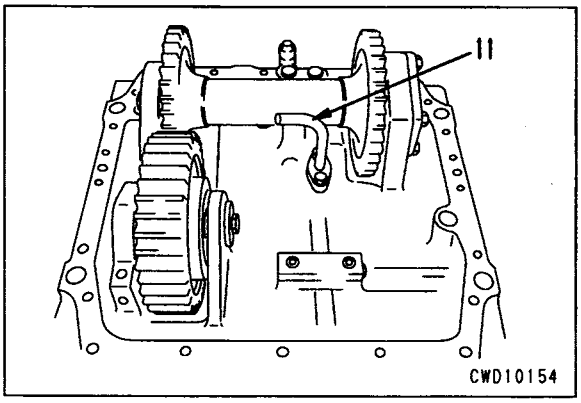
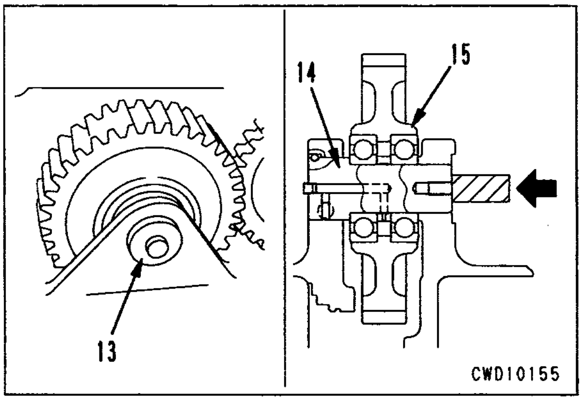
     iii) Remove bearing (10) from gear (9).



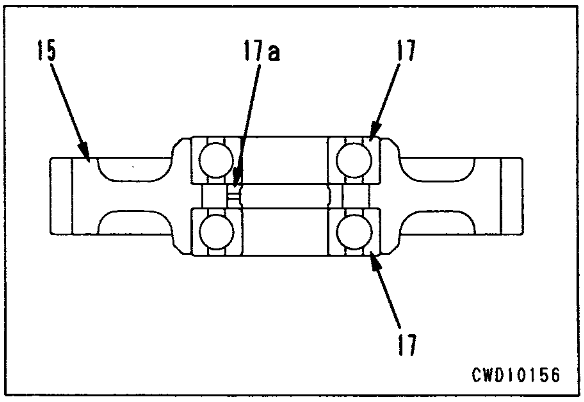
  2) Intermediate gear assembly
     i) Remove tube (11).



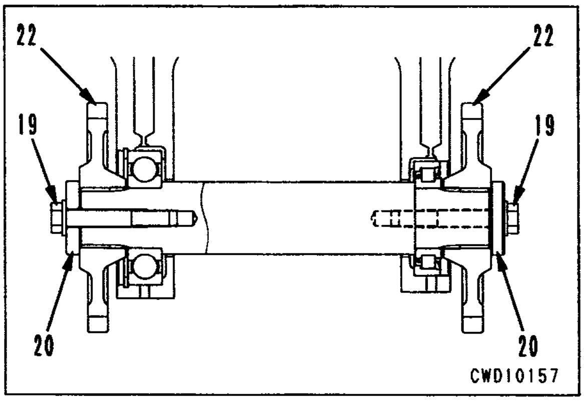
ii) Remove the bolt and holder (13).
iii) Drive out shaft (14) from the bolt side and remove gear (15).
★ Take care not to lose the ball.



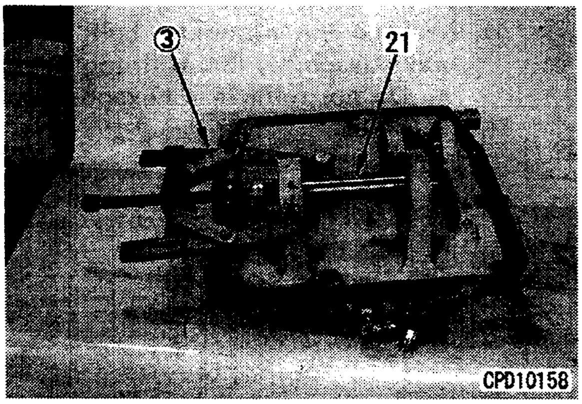
iv) Remove bearing (17) and spacer (17a) from gear (15).



3) Left carrier drive gear
i) Remove bolt (19) and holder (20).
ii) Remove gear (22).

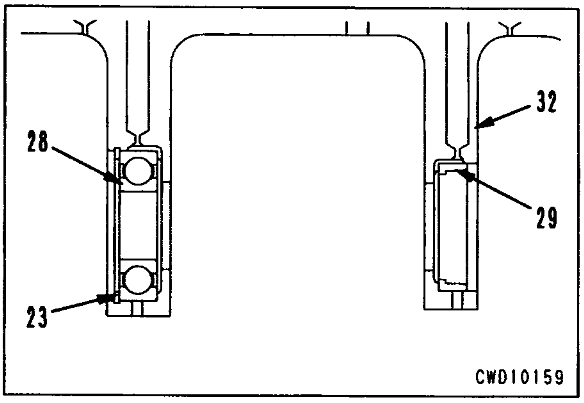


iii) Using gear puller ③, push out shaft (21).

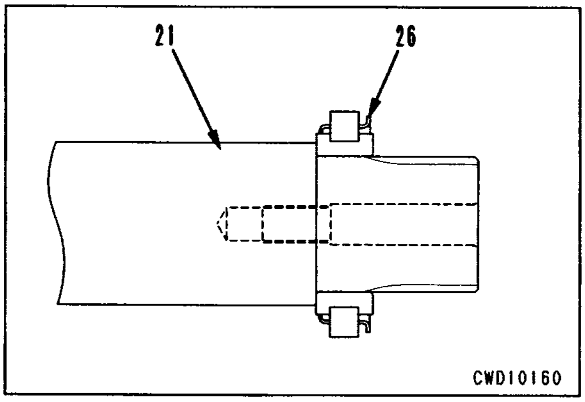


iv) Remove snap ring (23), then remove bearing (28) from cover (32).

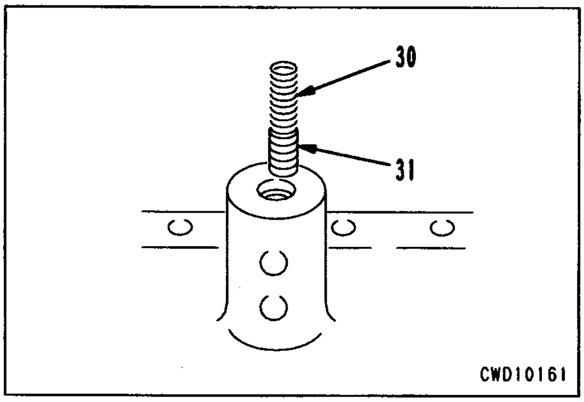
v) Remove outer race (29) from cover (32).



vi) Remove bearing (26) from shaft (21).

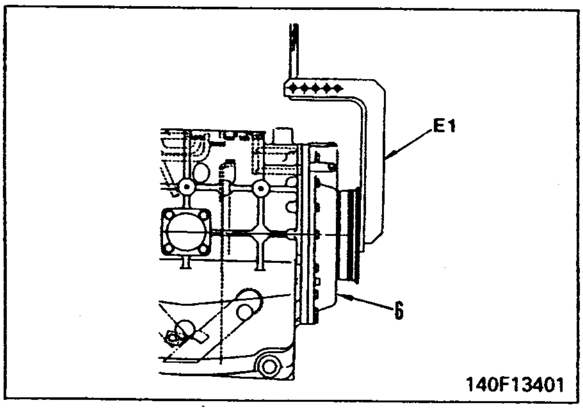


4) Remove the plug, spring (30), and valve (31).

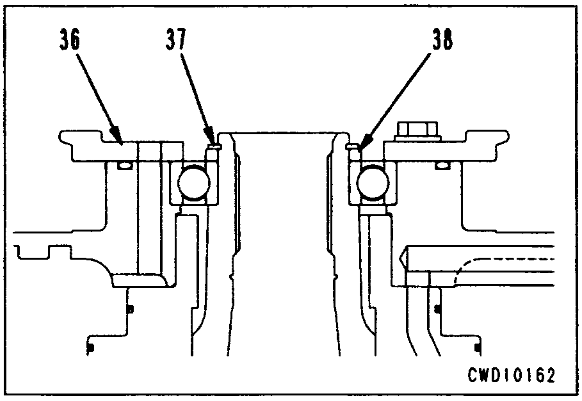


5. Brake and carrier assembly

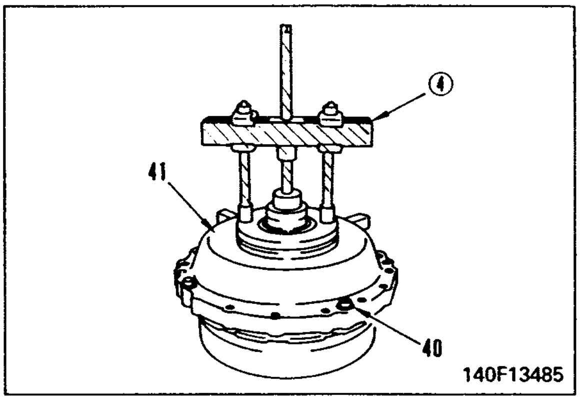
1) Remove the mounting bolt, then remove brake assembly (34) with tool **D1**.
   - ★ Do not remove 4 hexagon socket head bolts.



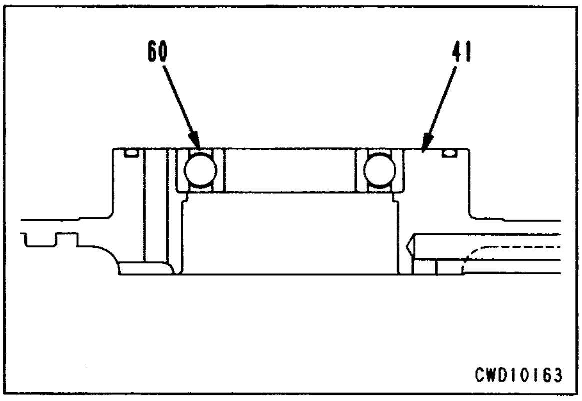
- **Disassembly of brake assembly**
  1) Remove flange (36).
  2) Remove snap ring (37) and space (38).



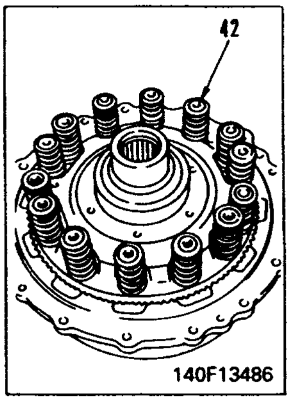
3) Set puller ④ and loosen 4 hexagon socket head bolts and remove cover (41).
   ★ The inner race side of the bearing comes out.
   ★ Do not remove bolts (40) until cover (41) comes off.

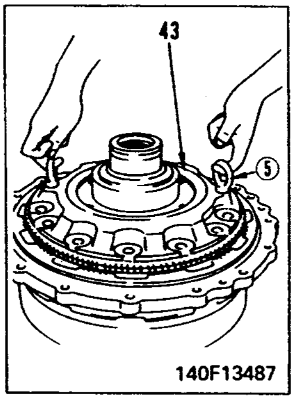


4) Remove bearing (60) from cover (41).



5) Remove spring (42).
6) Using eyebolts ⑤, remove piston (43).





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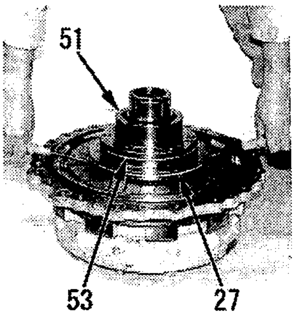
7) Push up and remove cage (51), taking care not to damage the disc.
8) Remove seal rings (53) and (27) from cage (51).
9) Using eyebolts ⑦, remove drum (45), discs, and plates as a unit.



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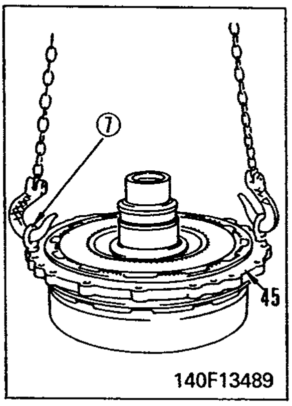

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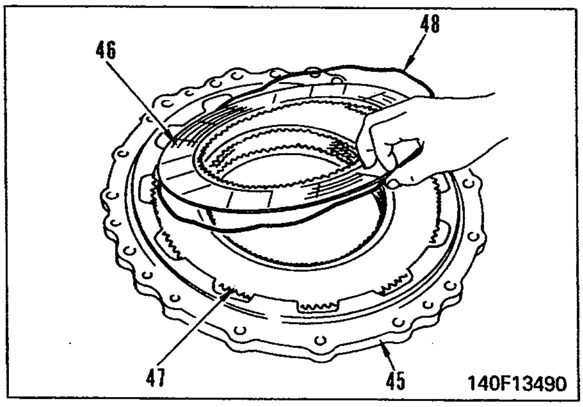
10) Remove discs (46), plates (47), and springs (48) from drum (45).



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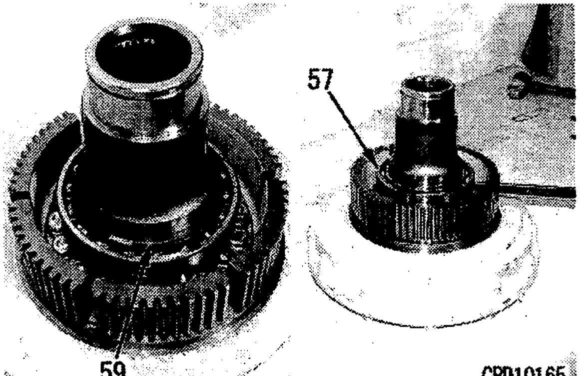
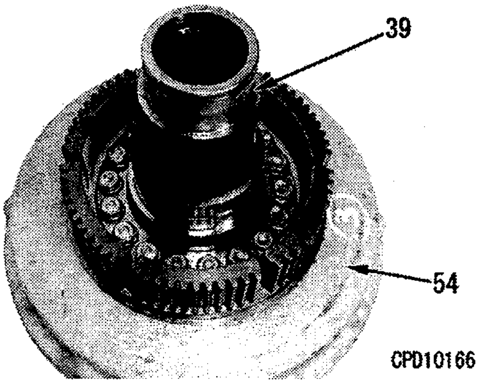
11) Remove snap ring (59) and bearing (57).
   ★ Pry up the bearing from the cut of the hub.



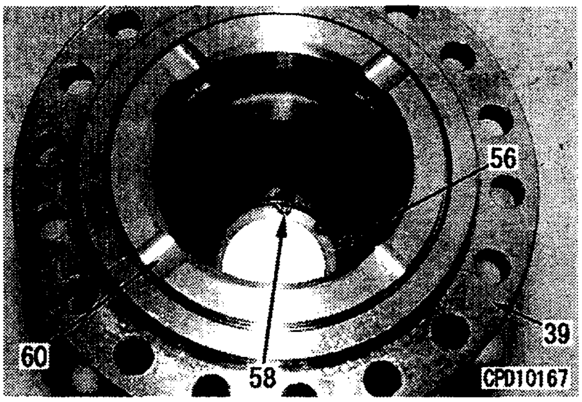
CPD10165

12) Remove 18 mounting bolts, then remove hub (39) from hub (54).

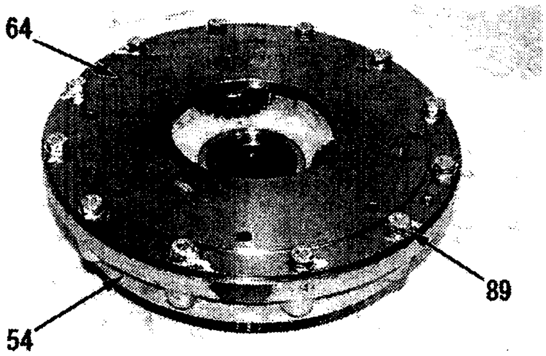


CPD10166

13) Remove bushing (60) from hub (39).
14) Remove snap ring (58), then remove stopper (56) from the hub.

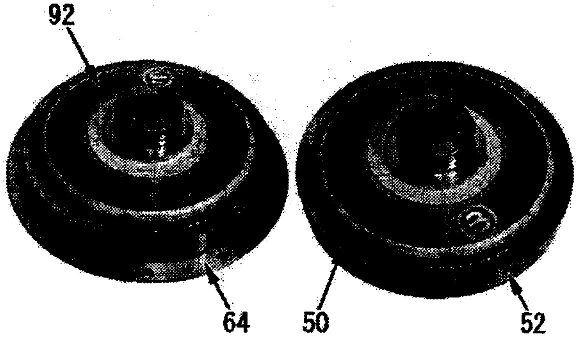


- **Disassembly of carrier assembly**
  1) Turn over the hub and carrier assembly and remove bolts (89), then remove carrier assembly (64) from hub (54).



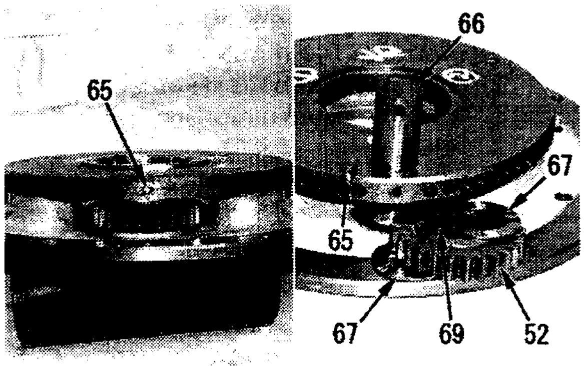
CPD10168

2) Remove hub (92) from carrier assembly (64), then remove snap ring (50) and ring gear (52).



CPD10169

3) Drive roll pin (65) into the shaft.
4) Pull out shaft (66) and remove gear (52), thrust washer (67), and bearing (69).
   ★ Pull roll pin (65) out of the shaft.



CPD10170

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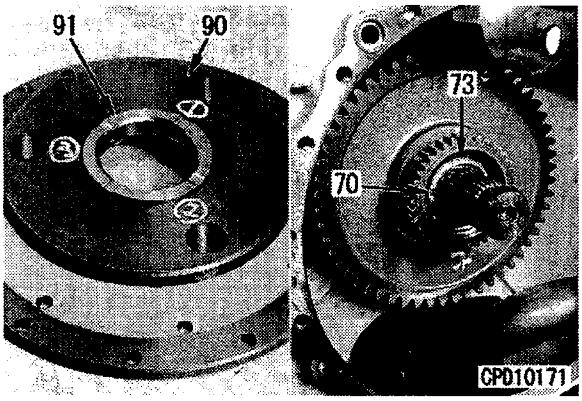
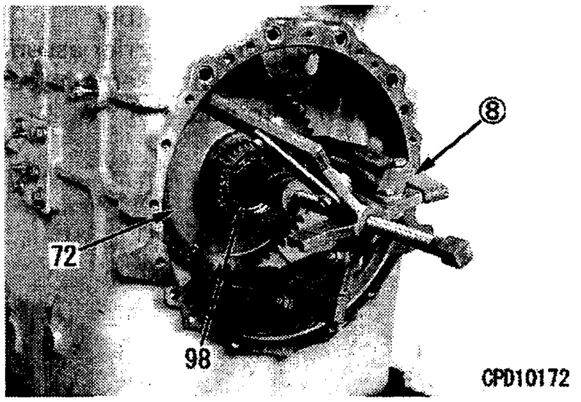
5) Remove bushing (91) from carrier (90).



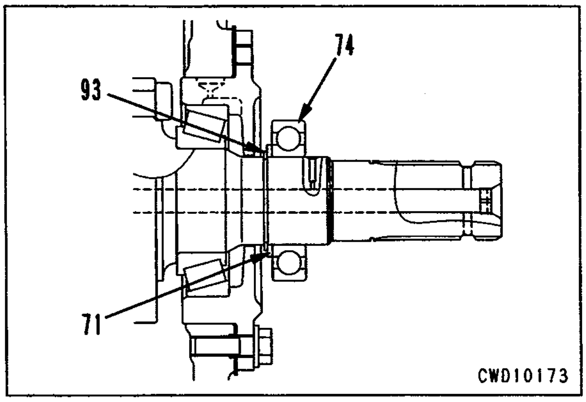
6. Sun gear

1) Remove snap ring (70) and collar (73).

2) Using gear puller ⑧, remove sun gear (72) and bearing (98).

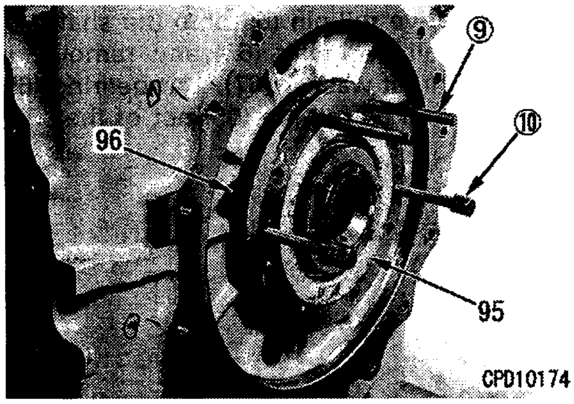


3) Using the bearing race puller, remove bearing (74).
4) Remove collar (71).
5) Remove snap ring (93).
   ★ Only the right side of the machine.

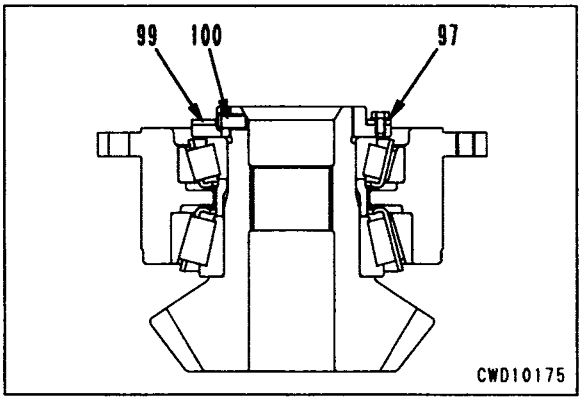


7. Bevel pinion assembly

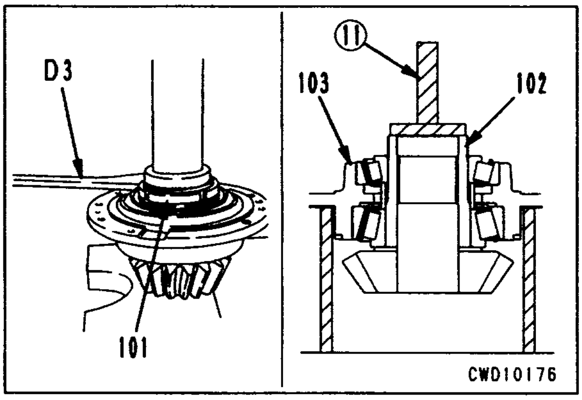
1) Remove the mounting bolts.
2) Using guide bolts ⑨ and forcing screws ⑩, remove bevel pinion assembly (95) and shim (96).
   ★ Check the quantity and thickness of the shims and store them.



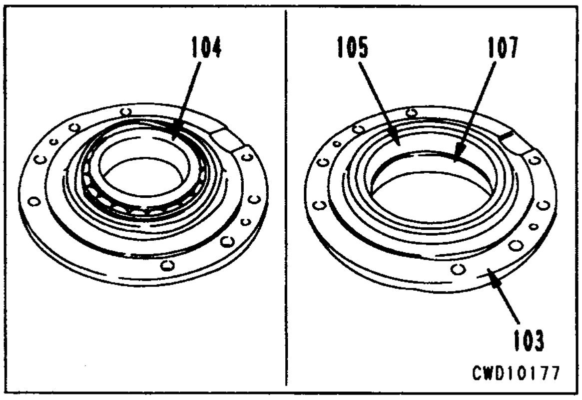
3) Disassembly of bevel pinion assembly
   i) Unbend bent lock (97) and remove the bolt, lock (97), plate (99), and pin (100).



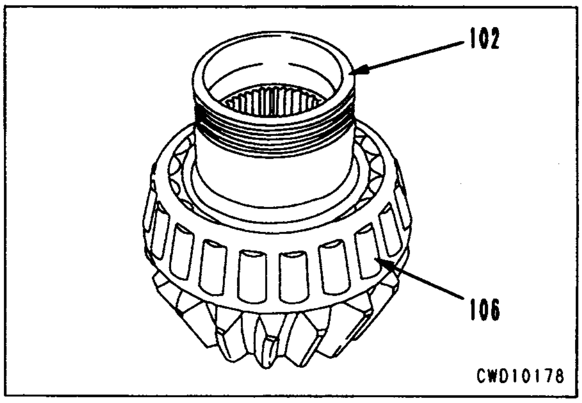
   ii) Secure the pinion with a press and remove nut (101) with tool **D3**.
   iii) Using push tools ⑪, remove bevel pinion (102) from cage (103).



   iv) Remove bearing (104).
   v) Remove outer races (105) and (107) from cage (103).

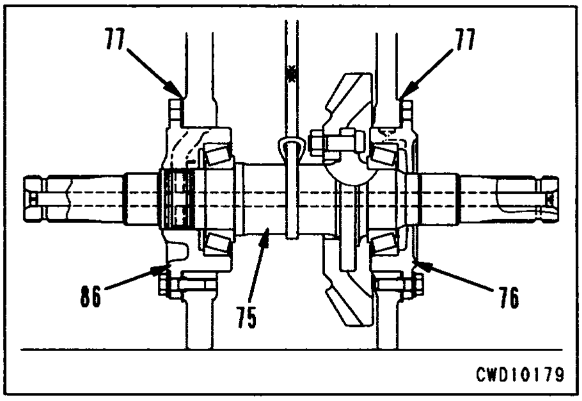


   vi) Remove bearing (106) from bevel pinion (102).

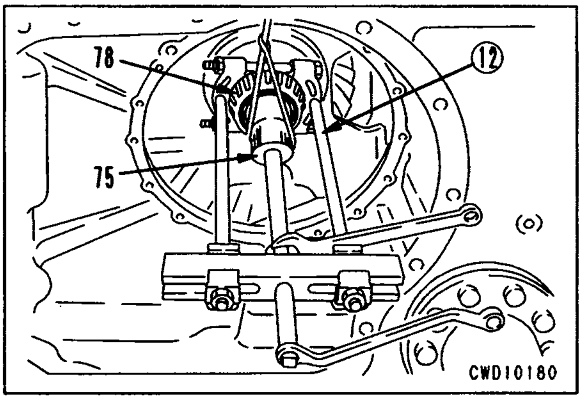


8. Bevel gear shaft and bevel gear

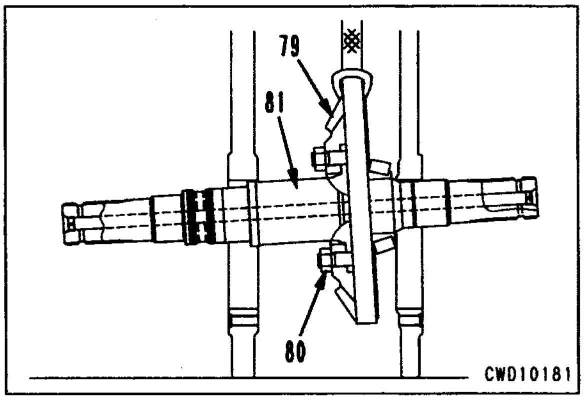
1) Sling bevel gear and shaft assembly (75) temporarily.
2) Remove cage assemblies (76) and (86).
   - ★ Check the thickness, quantity, and positions of shims (77).
   - ★ Since both cages are different from each other, make marks on them.



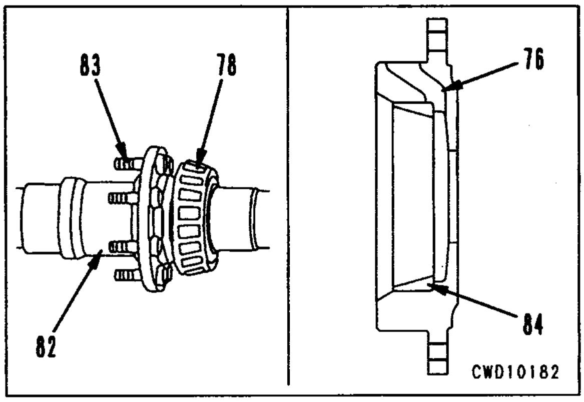
3) Move bevel gear and shaft assembly (75) to the left end and remove bearing (78) with puller ⑫.
   - ★ Remove only the bearing on the left side of the machine.



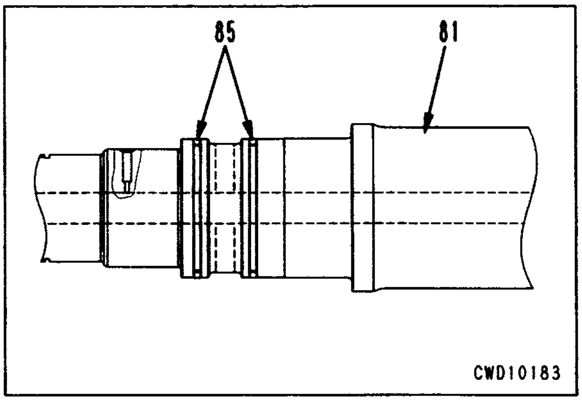
4) Sling bevel gear (79) and remove mounting nut (80) and pull out bevel gear shaft assembly (81) to the right side of the machine.



5) Remove bearing (78) from bevel gear shaft (82).
6) Remove bolts (83).
7) Remove outer race (84) from cage (76).



8) Remove seal ring (85) from bevel gear shaft (81).



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ASSEMBLY OF HSS ASSEMBLY

D65EX, PX

Serial No. 60001 – 65000

- **Precautions when assembling**

★ Clean all parts, and check for dirt or damage before assembling.

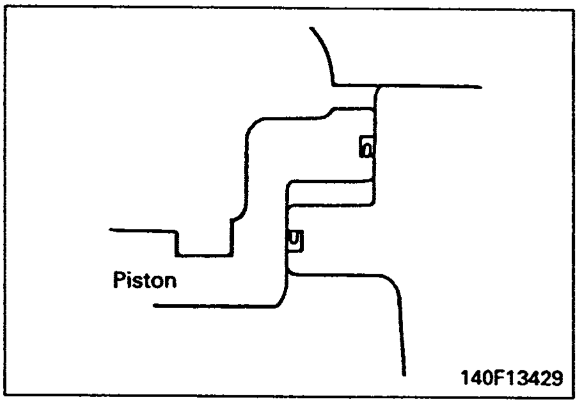
★ Put a drop of engine oil on the rotating portion of the bearing, then rotate it several times.

★ Coat the sliding surfaces of all parts with engine oil before installing.

★ Assemble the piston seal ring with the side receiving the pressure facing the housing, coat it with grease (G2-LI), then install it uniformly so that it is not offset to one side.

Rotating seal ring: Fix with grease (G2-LI), and be extremely careful that it does not get caught when assembling it.

★ Check that the snap ring is fitted securely in the groove.



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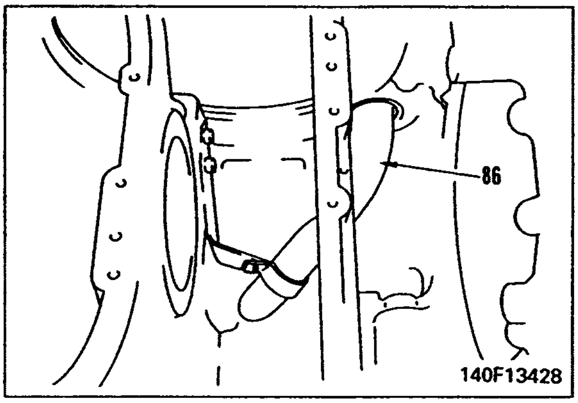
1. Suction tube

Install suction tube (86).



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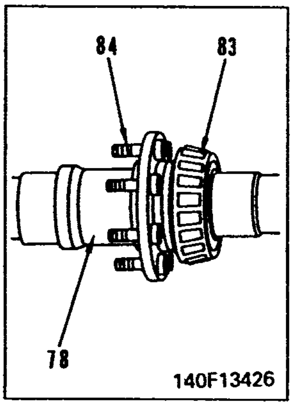
2. Bevel gear shaft, bevel gear assembly

1) Install bolt (84) to bevel gear shaft (78).
2) Shrink fit bearing (83).
3) Install outer race (85) to cage (79).
4) Raise bevel gear (81) and set in case.
   ★ Set with the tooth surface on the inside.
5) Set ring nuts (77) to both sides of bevel gear (81), align bolt with bevel gear, then install bevel gear shaft (78) from right side.
   ★ Install the ring nut with the cut side facing the brake.



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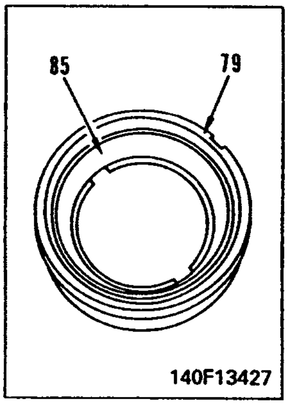

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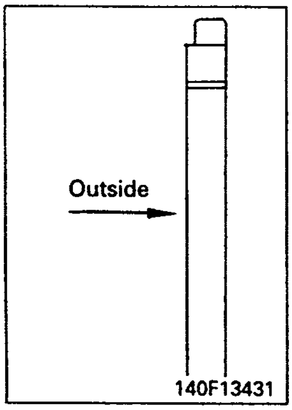

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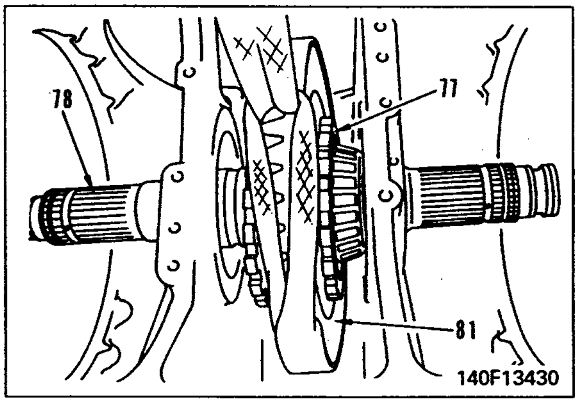

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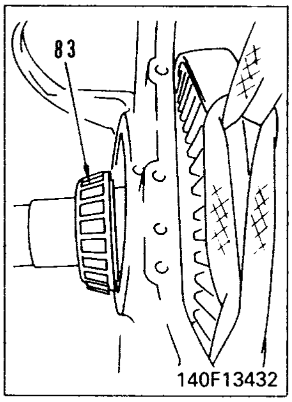
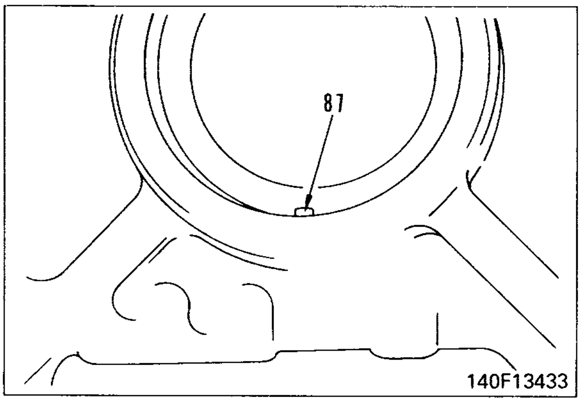
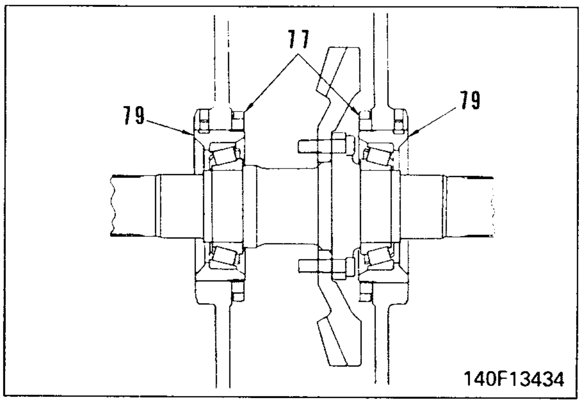
6) Shrink fit bearing (83).



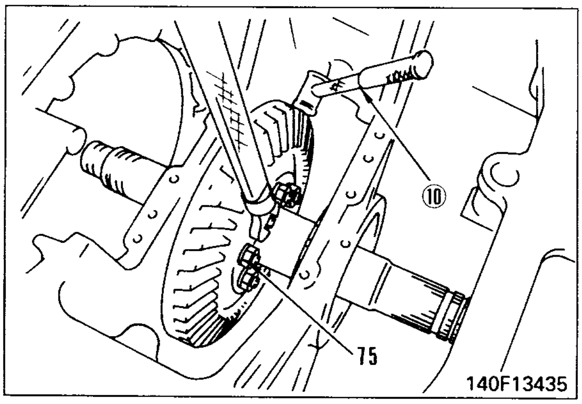
7) Align with pin (87) of cage, install cage (79), then tighten ring nut (77) temporarily.





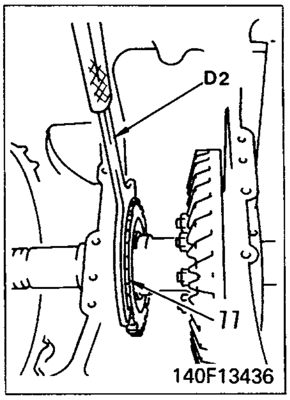
8) Tighten bevel gear mounting nut (75).
★ Stop the gear from turning with plastic hammer ⑩ or some soft object.

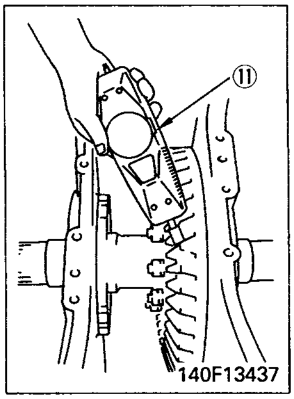
kgm Nut:
245.2 ± 29.4 Nm (25 ± 3 kgm)



3. Adjusting preload

1) Using tool **D2**, tighten ring nut (77).
2) Put push-pull scale ⑪ in contact with tip of bevel gear tooth, and measure rotating torque of bevel gear shaft.
   ★ Rotating torque:
   14.7 – 19.6 Nm (1.5 – 2.0 kgm)
   At tip of bevel gear tooth:
   78.5 – 107.9 N (8 – 11 kg)
   ★ Rotate the bevel gear 2 – 3 times before measuring the rotating torque.
   ★ If the rotating torque is too low, tighten the ring nut.
   If it is too high, loosen the ring nut.

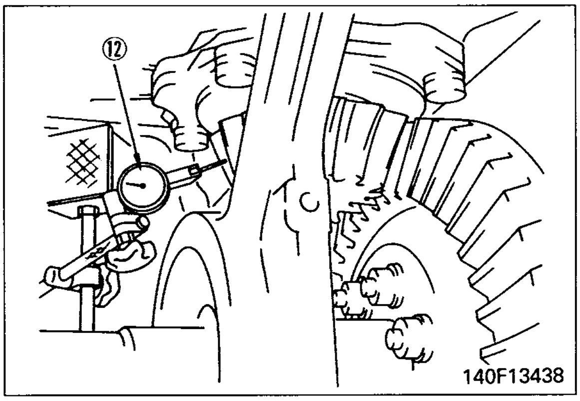


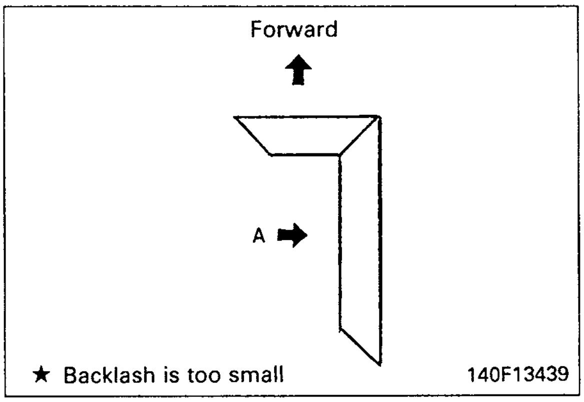


4. Adjusting backlash, tooth contact

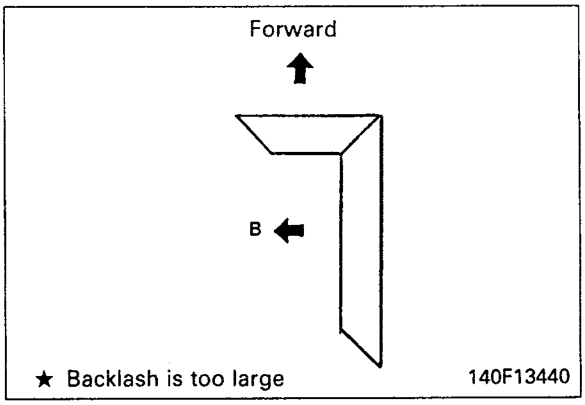
1) Install transmission assembly.
2) Adjusting backlash
   Put probe of dial gauge ⑫ at 90° in contact with the tip of the bevel gear tooth face, hold the bevel pinion in place, and measure the reading when the bevel gear is moved forward and backward.
   ★ Standard value for backlash:
   0.3 – 0.4 mm
   ★ Measure the backlash at a minimum of three places on opposite sides.
   - If the measurement shows that the backlash is not within the standard value, adjust as follows.

   ★ Turn the ring nuts to adjust. In order to maintain the preload that was adjusted above, loosen the ring nut on one side, then tighten the ring nut on the opposite side by the same amount.
   - When backlash is too small
     Loosen the right ring nut and tighten the left ring nut to move the bevel gear in direction **A**.
   - When backlash is too large
     Loosen the left ring nut and tighten the right ring nut to move the bevel gear in direction **B**.





★ Backlash is too small



★ Backlash is too large

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3) Checking tooth contact

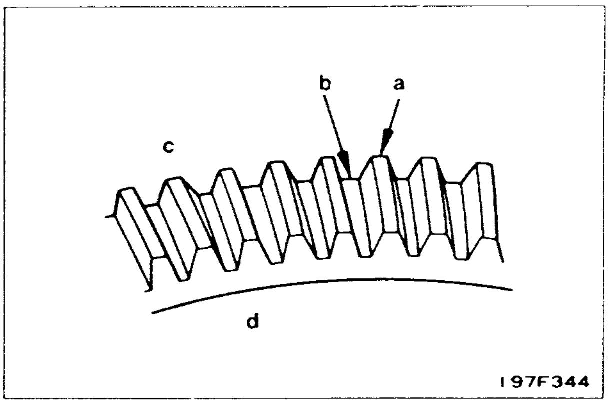
Testing

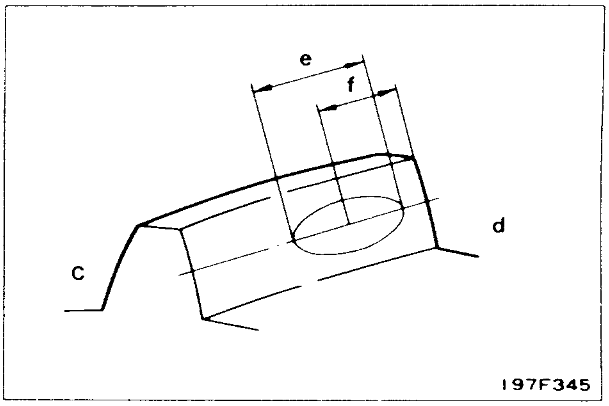
i) Coat the tooth face of the bevel pinion lightly with red lead (minimum). Rotate the bevel gear forward and backward and inspect the pattern left on the teeth.

ii) Tooth contact should be checked with no load on the bevel pinion. If should be in the center of the tooth height. The tooth contact pattern should be located 20 to 40% from the small end "**d**", and should cover 30 to 75% of the lengthe of the tooth.
In addition, there should be no strong contact at the addendum "**a**" or dedendum "**b**" (tip or root of the gear teeth) or at the big end "**c**" and small end "**d**".

★ If the gears are adjusted to this pattern, the tooth contact will be correct when load is applied.

a: Addendum
b: Dedendum
c: Big end
d: Small end
e: Width contact
f : Center of tooth contact





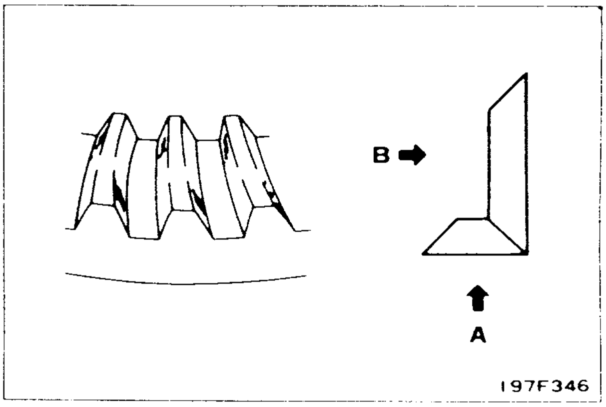
Adjustment

If the result of the inspection shows that the correct tooth contact is not being obtained, adjust again as follows:

i) If bevel pinion is too far from center line of bevel gear. Contact is at the small end of the convex tooth face of the bevel gear and at the big end of the concave tooth face.

- Correct as follows.
  Adjust the shim thickness at the bevel pinion end, and move the bevel pinion in direction **A**.
  Or, move the bevel gear in direction **B** and check the tooth contact pattern and backlash again.

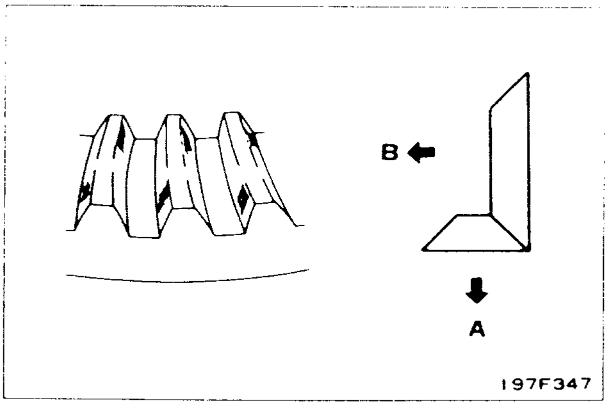
★ When adjusting the shim thickness at the bevel pinion end, remove the transmission assembly first.



ii) If bevel pinion is too close to center line of bevel gear.
Contact is at the small end of the concave tooth face of the bevel gear and the big end of the convex tooth face.

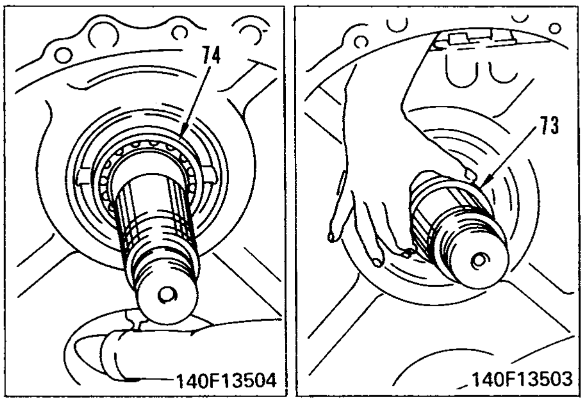
- Procedure for adjustment
  Adjust the thickness of the shims at the bevel pinion to move the bevel pinion in direction **A**.
  Adjust the shim thickness at the bearing cage of the bevel gear shaft to move the bevel gear in direction **B**. Check the tooth contact pattern and backlash again.

★ When adjusting the amount that the bevel gear moves in or out, do not change the preload of the bearing.
Adjust by loosening the ring nut on one side and tightening the nut on the other side by the same amount.



5. Gear

1) Shrink fit bearing (74).
2) Install collar (73).



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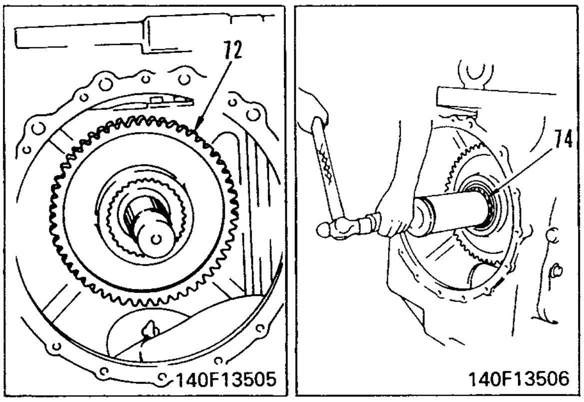
3) Install gear (72).
4) Using push tool, install bearing (74).



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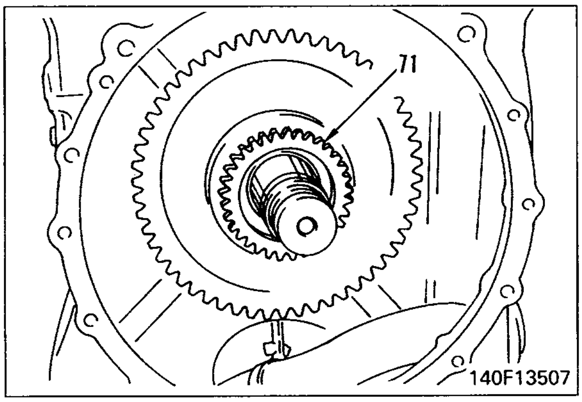
6. Sun gear

Install sun gear (71).



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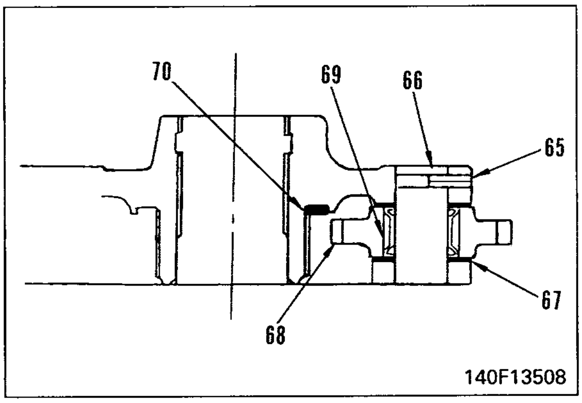
7. Carrier assembly

1) Assemble carrier assembly as follows.
   - i) Assemble bearing (69) to gear (68), put thrust washer (67) in contact on both sides, and set to carrier.
   - ii) Align with roll pin hole, and install shaft (66).
   - iii) Install roll pin (65).
   - iv) Install thrust washer (70).



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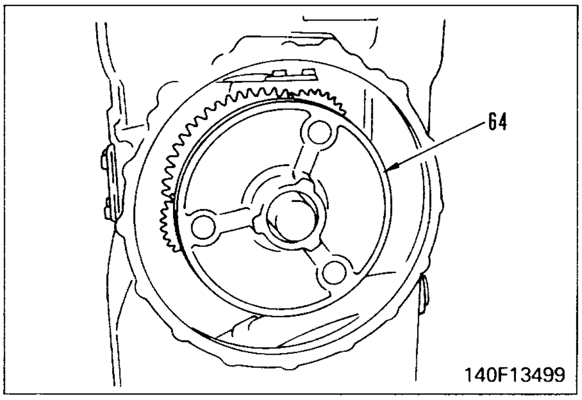
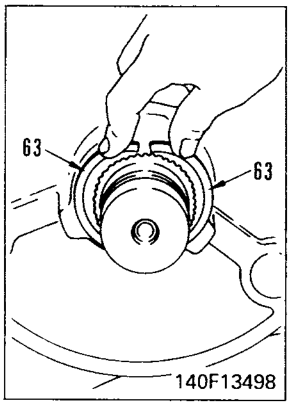
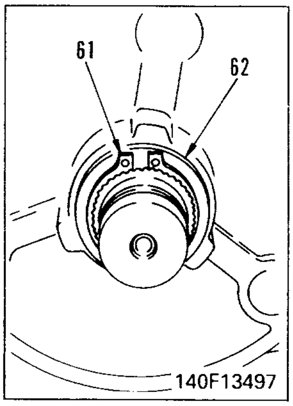
2) Install carrier assembly (64).



3) Install collar (63).
4) Install collar (62).
5) Install snap ring (61).





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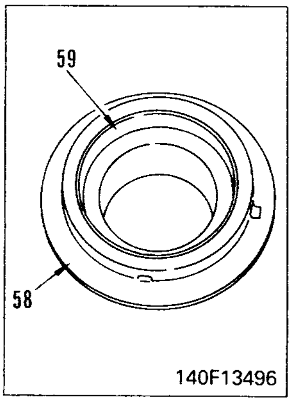
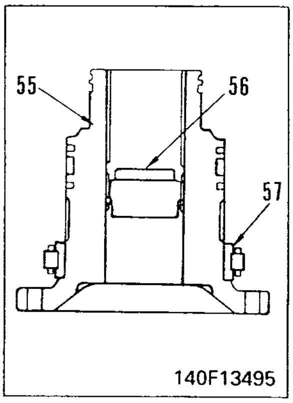
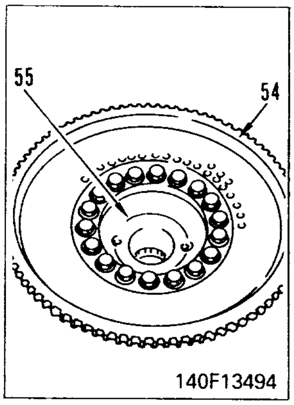
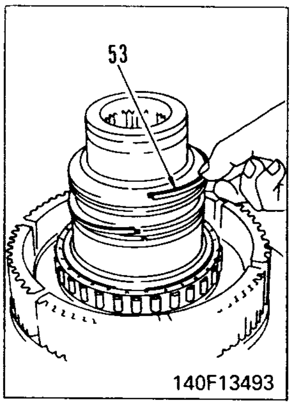
- **Assembly of brake assembly**
  1) Install outer race (59) to cage (58).
  2) Press fit bearing (57) to hub (55).
  3) Install stopper (56).



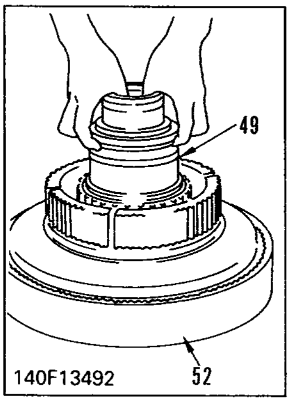


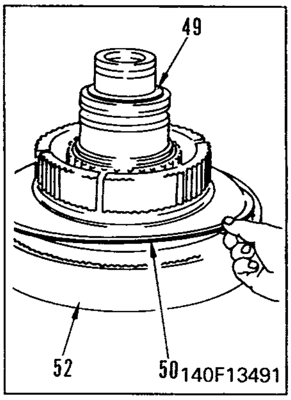
4) Connect hub (55) and hub (54).
5) Install seal ring (53).



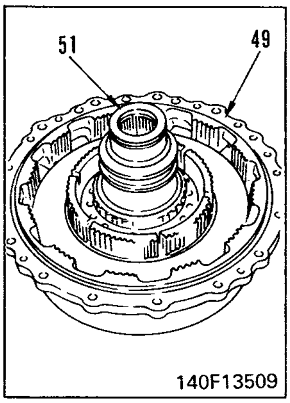


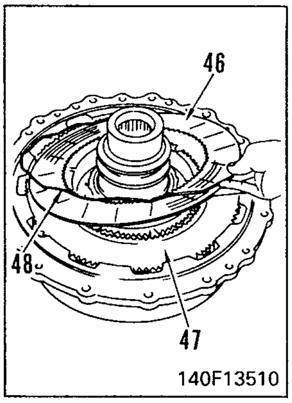
6) Set hub assembly (49) to ring gear (52), and install snap ring (50).



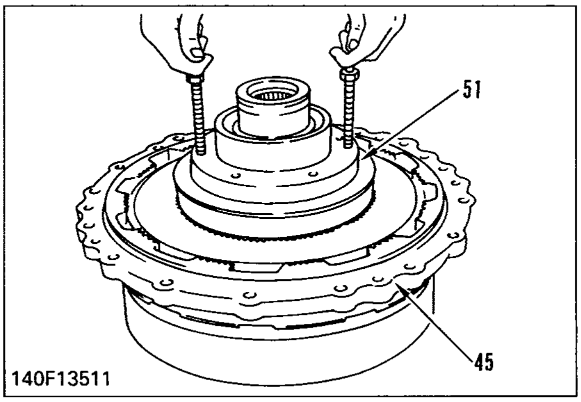


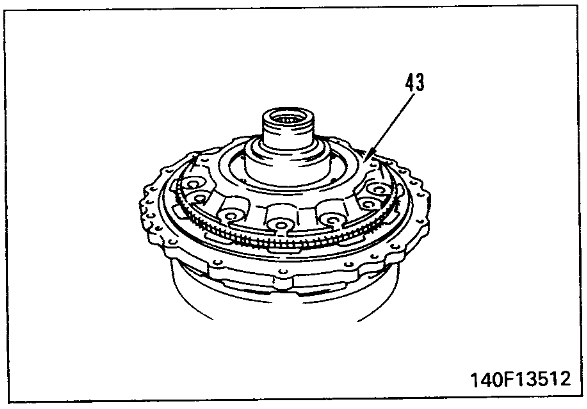
7) Set drum (49) to hub assembly (51).
8) Install disc (46), plate (47), and spring (48).

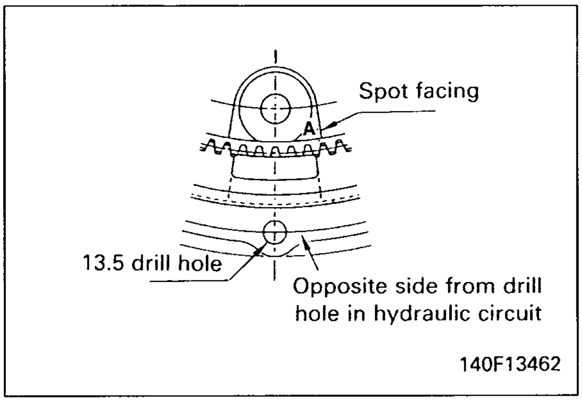




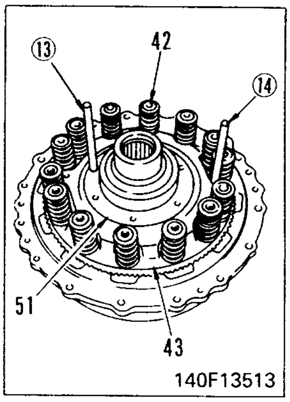
9) Fit seal ring, then using eyebolts, align oil holes between case (51) and drum (45), and install.
★ Align the drill holes in the hub hydraulic circuit visually with the drill holes in the drum hydraulic circuit at 4 places.
10) Install seal ring to piston, then using eyebolts, align center of spot facing stamped with **A** mark on piston (43) with "13.5 drill hole" on drum (opposite side from oil hole), and install.







11) Install spring (42).
12) Install guide bolts ⑬ and ⑭ to piston (43) and cage (51).
    ★ Guide bolt ⑭ is for aligning the brake release bolt hole.
13) Install bearing (60) to cover (41).



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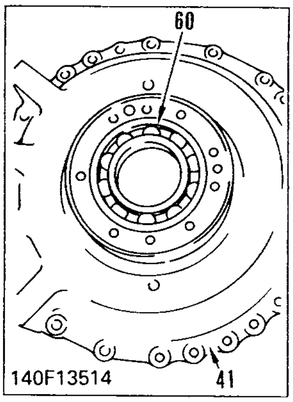

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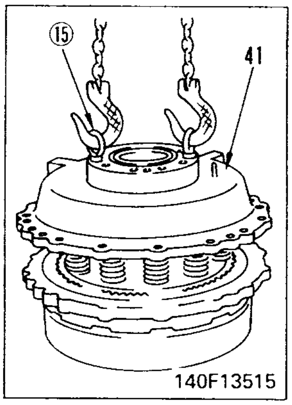
14) Using eyebolts ⑮, align with guide bolt, then set cover (41) in position.
    ★ Check that the spring is fitted securely into both the piston and cover.
15) Compress spring with bolt ⑰ and nut ⑯, and at the same time press fit inner race of bearing to hub assembly.
16) Fit spacer (39) and install spacer (38) and snap ring (37).
17) Install flange (36).
18) Remove bolt and nut used to compress spring, then install 4 bolts (40).



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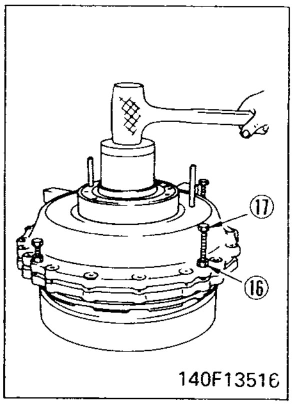

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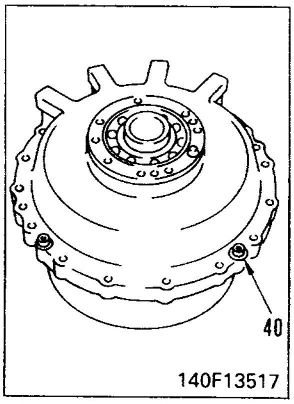

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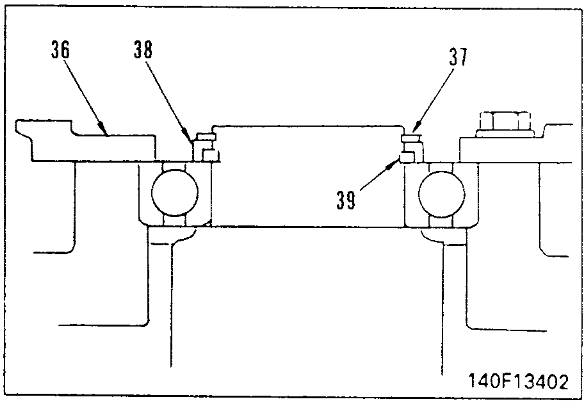

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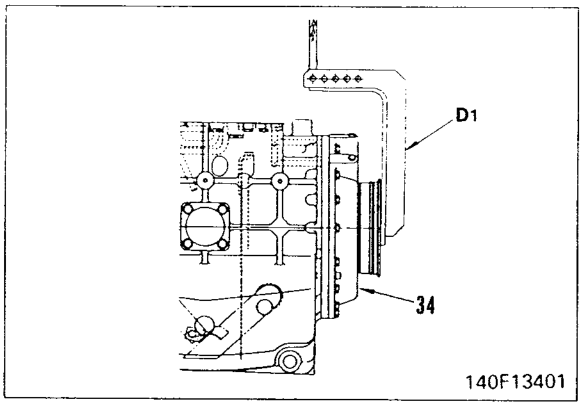
8. Brake assembly

1) Make protrusion of seal ring from shaft at carrier end uniform.
2) Using tool **D1**, install brake assembly (34).



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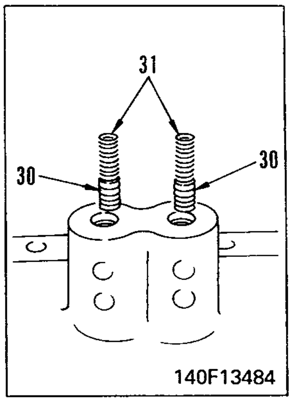
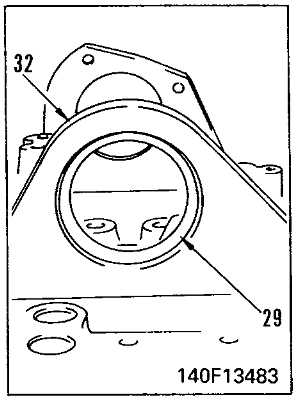
- **Assembly of cover assembly**
  1) Assemble valve (31) and spring (30), and tighten plug.
  2) Left carrier drive gear
     i) Install outer race (29) to cover (32).

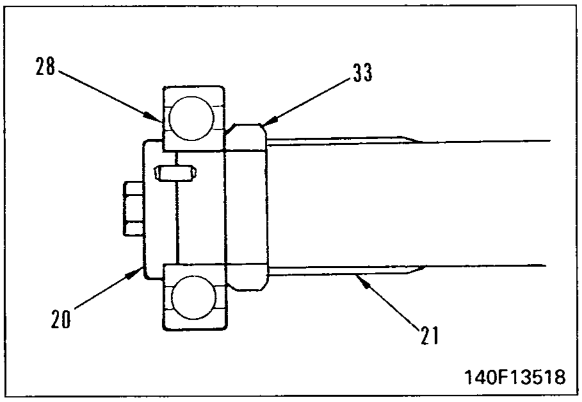




ii) Assemble collar (33), then press fit bearing (28) to shaft (21), and install holder (20).

iii) Pass shaft (21) through cover, then assemble gears (22) and (23), and collar (24).

iv) Press fit outer race portion of bearing (28) to cover.



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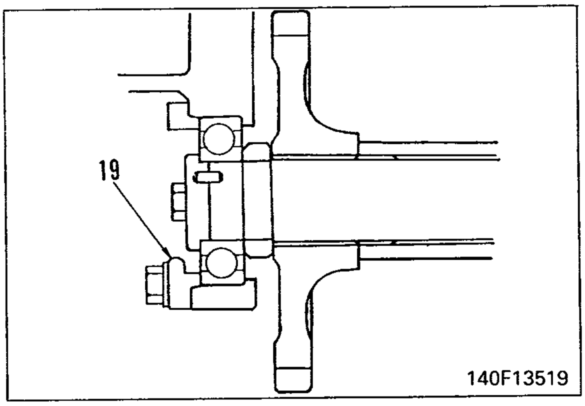
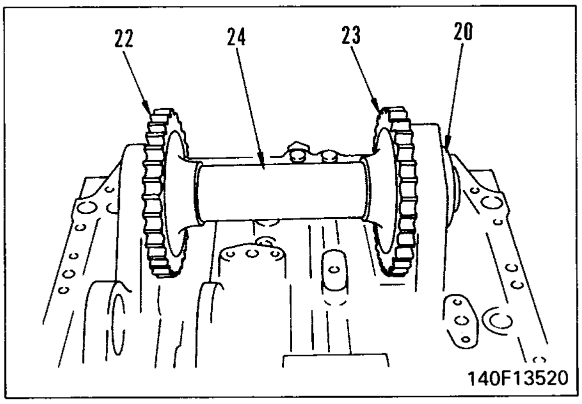


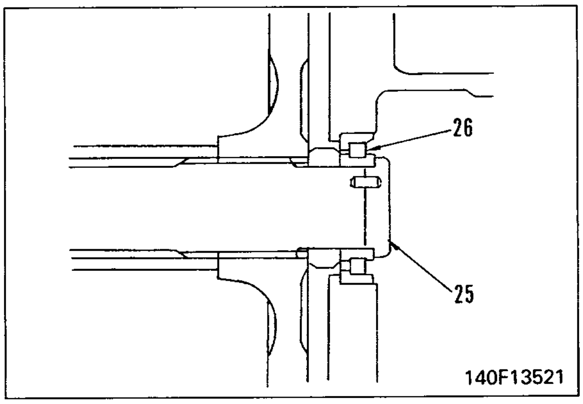


v) Install cover (19).

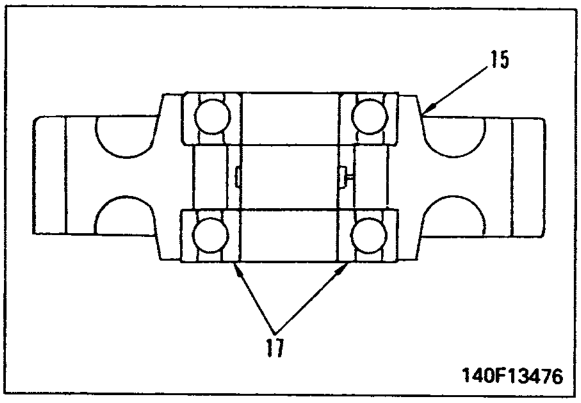
vi) Press fit bearing (26).

★ Press fit the inner race to the shaft.

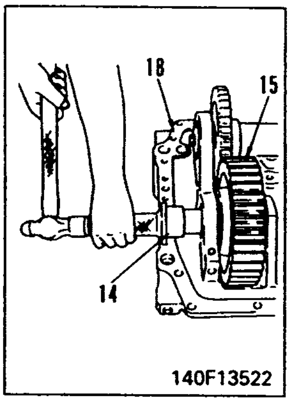
vii) Fit holder (25) and tighten bolt.

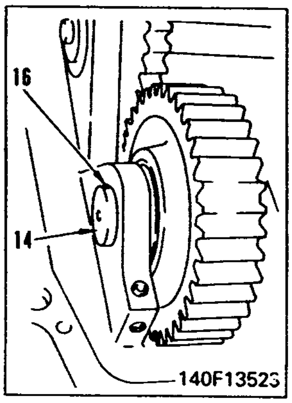


3) Intermediate gear
   i) Install bearing (17) to gear (15).

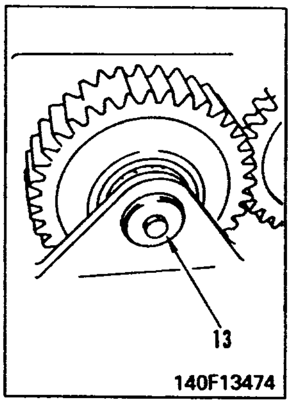


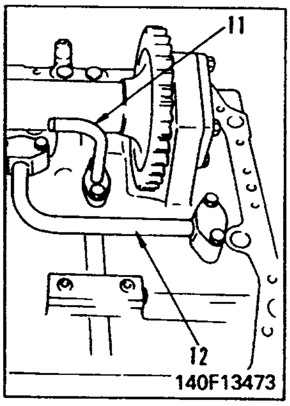
   ii) Set gear (15) to case (18).
   iii) Align ball mounting hole and knock in shaft (14) to point where ball goes in.
   iv) Fit ball (16) and knock in completely.



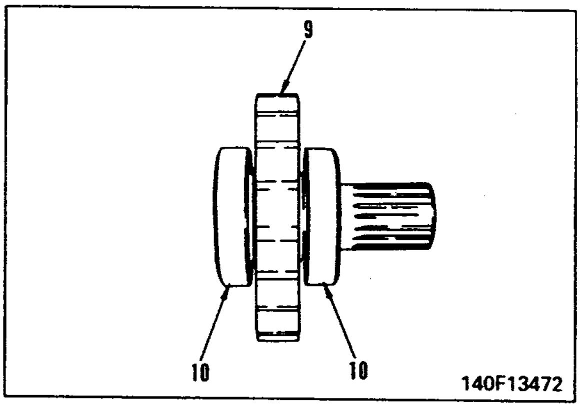


   v) Install holder (13).
4) Install tubes (12) and (11).





5) Input gear assembly
   i) Install bearing (10) to gear (9).



- **D65EX, PX, serial No. 65001 and up**
- Precautions for assembly

★ Clean the all parts and check them for dirt or damage before installing.

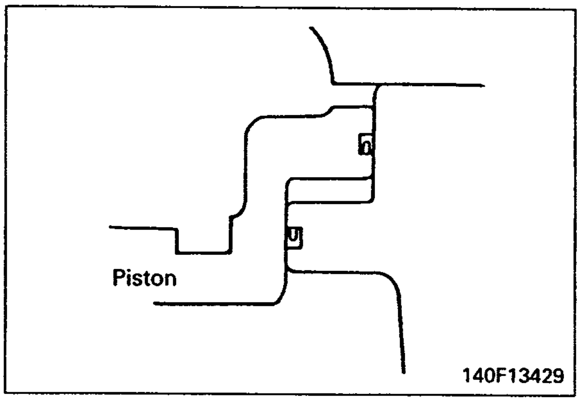
★ Drop engine oil onto the rotating parts of each bearing and rotate it several turns.

★ Coat the sliding parts with engine oil before installing.

★ Apply grease (G2-LI) to each piston seal ringand install it evenly, with the pressure receivingside directed to the housing.

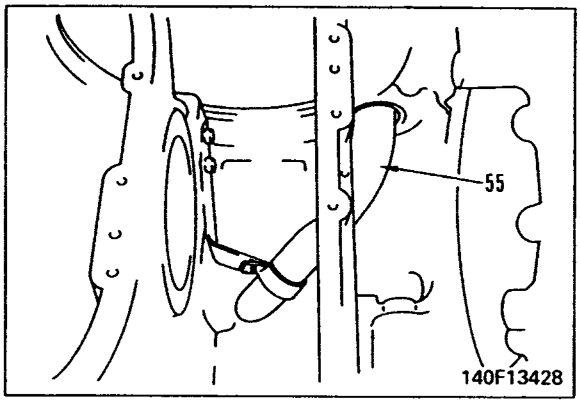
Rotary seal ring: Fix each seal ring with grease(G2-LI)and install it very carefully not to catch it in the parts.

★ Check that the snap rings are fitted securely in the grooves.



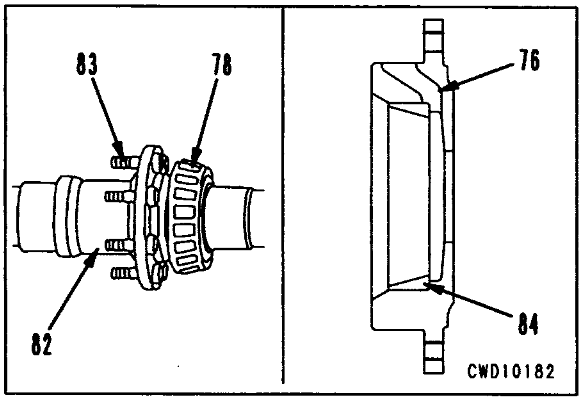
1. Suction tube

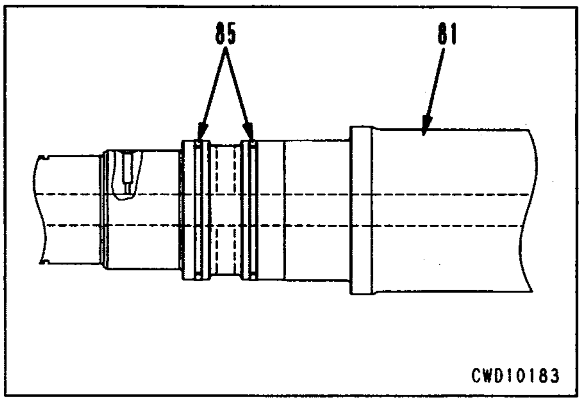
Install suction tube (55).



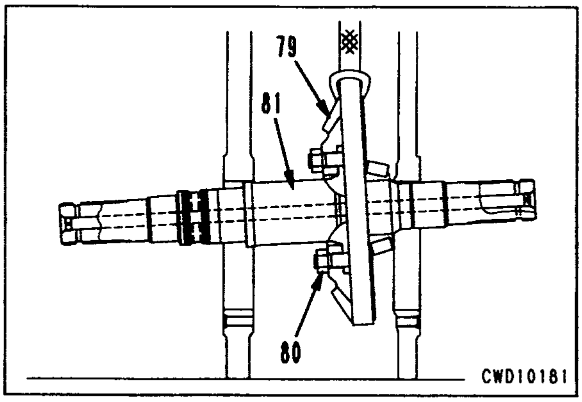
2. Bevel gear shaft and bevel gear assembly

1) Install bolt (83) to bevel gear shaft (82)
2) Heat bearing (78) with a bearing heater, etc. and install it to the right side of the bevel gear shaft by shrink fit.
   - ★ If the bearing temperature is raised too high, the hardness of the heat-treated part lowers. Accordingly, do not raise the bearing temperature more than 120°C.
   - ★ After installing the bearing, drop engine oil onto its rotating parts and rotate it several turns.
   - ★ Check that the clearance at the bearing end is 0.03 mm or less.
3) Install outer race (84) to cages (76) and (86).
4) Install seal ring (85) to bevel gear shaft (81).

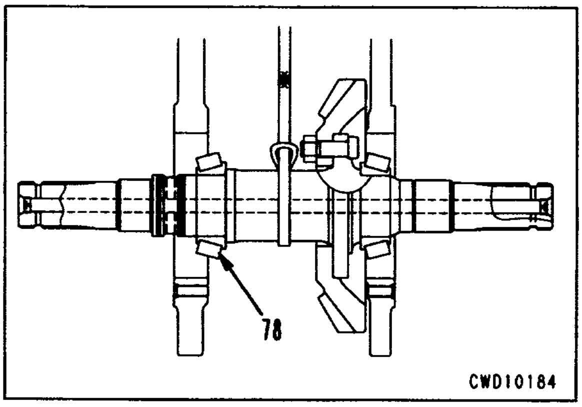




5) Insert bevel gear shaft (81) in bevel gear (79) slung at the center of the case from the right side of the machine.
   ★ Tighten mounting nut (80) temporarily in advance.



6) Heat bearing (78) with a bearing heater, etc. and install it to the left side of the bevel gear shaft by shrink fit.
   ★ If the bearing temperature is raised too high, the hardness of the heat-treated part lowers. Accordingly, do not raise the bearing temperature more than 120°C.
   ★ After installing the bearing, drop engine oil onto its rotating parts and rotate it several turns.
   ★ Check that the clearance at the bearing end is 0.03 mm or less.

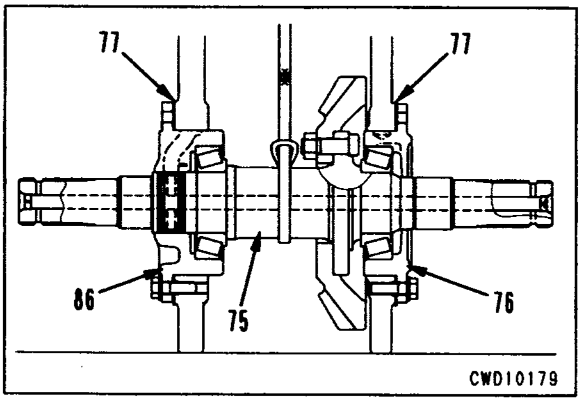


7) Install cages (76) and (86) to bevel gear and shaft assembly (75).
   ★ Since both cages are different from each other, take care not to mistake them.
   ★ Install shims (77) of the thickness and quantity recorded when removed.
   - Standard shim thickness: 1.5 mm
   - Varieties of shim thickness: 0.2 mm, 0.3 mm, 0.5 mm

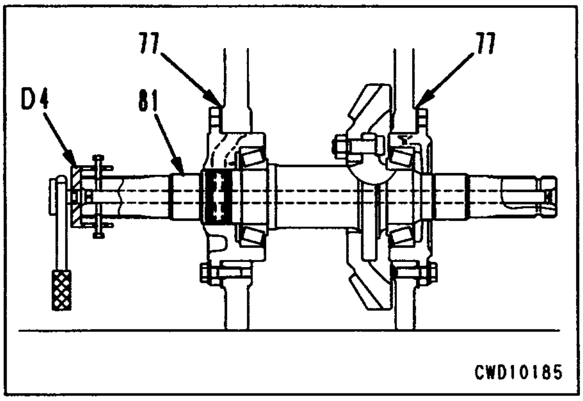
   🔧 Mounting bolt:
   98.1 - 122.6 Nm {10 - 12.5 kgm}

8) Tighten the bevel gear mounting nut securely.
   ★ Place a plastic hammer, etc. between the bevel

   🔧 Mounting nut:
   245 - 309 Nm {25 - 31.5}

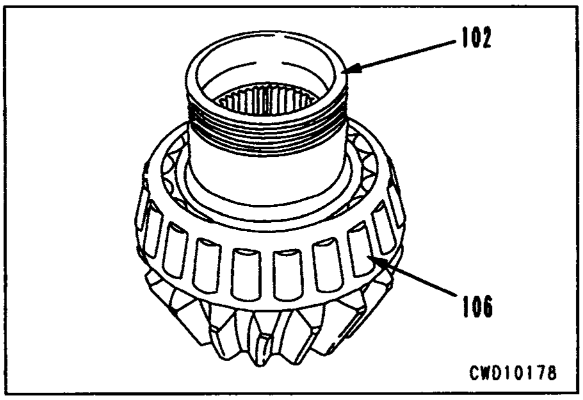


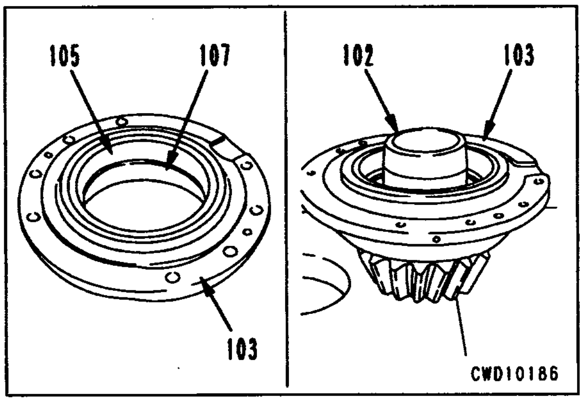
9) Adjusting pre-load
   - ★ Adjust the pre-load with the bevel pinion assembly removed.
   - i) Rotate the bevel gear and shaft assembly several turns to fit the bearing.
   - ii) Install tool **D4** to the end of bevel gear shaft (81) and measure the rotation torque with a torque wrench.
     - Standard rotation torque:
       10.3 - 14.7 Nm {1.05 - 1.5 kgm}
       If the rotation torque is lower than the standard value, reduce the quantity of shims (77) in step 7. If the former is higher, increase the latter.

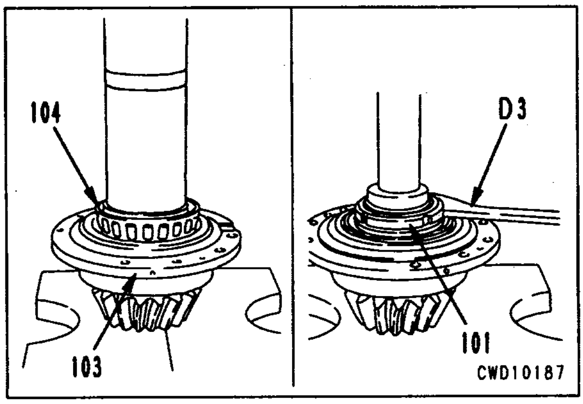


3. Bevel pinion assembly

1) Assembly of bevel pinion
   - i) Using the push tool, press fit bearing (106) to bevel pinion (102).
   - ii) Using the push tool, press fit outer races (105) and (107) to cage (103).
   - iii) Place bevel pinion (102) on the press stand and set cage (103).
   - iv) Press fit bearing (104) to cage (103) with the press.
   - v) Secure the pinion with the press and tighten locknut (101) with tool D3.
     - Locknut: **Adhesive (LT-2)**
     - Locknut:
       392 - 441 Nm {40 - 45 kgm}
     - ★ Return the nut by 0 - 9°.
     - ★ Tighten the nut, turning the cage.
     - ★ After tightening the nut, check that the bevel pinion rotates smoothly.







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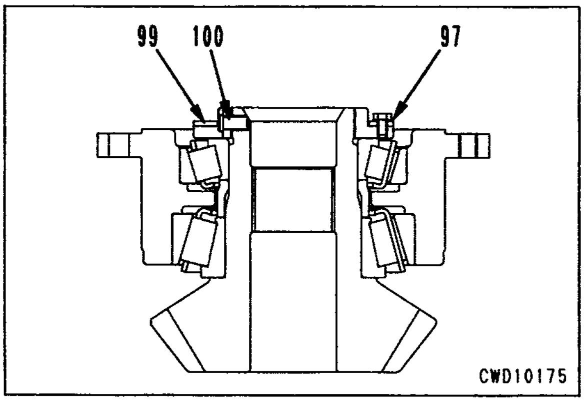
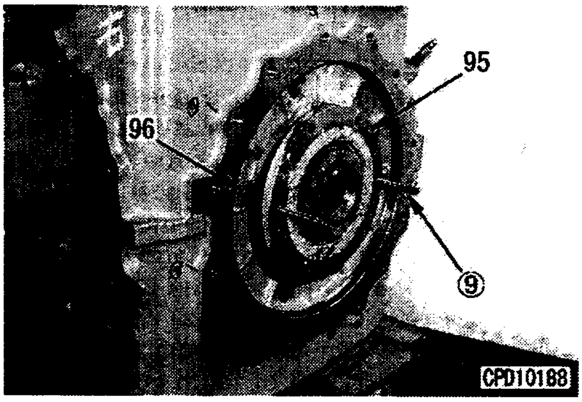
vii) Install pin (100), plate (99), and lock (97), then tighten the bolt.

viii) Bend lock (97) securely.



4) Using guide bolt ⑨, install shims (96) and bevel pinion assembly (95).
   - ★ Install shims of the thickness and quantity recorded when removed.
     - Standard shim thickness: 2 mm
     - Varieties of shim thickness: 0.2 mm, 0.3 mm, 1.0 mm

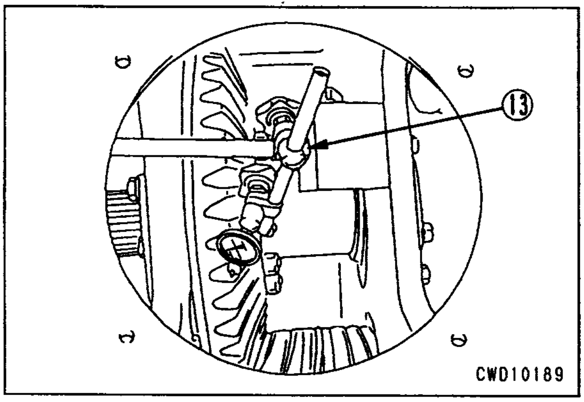


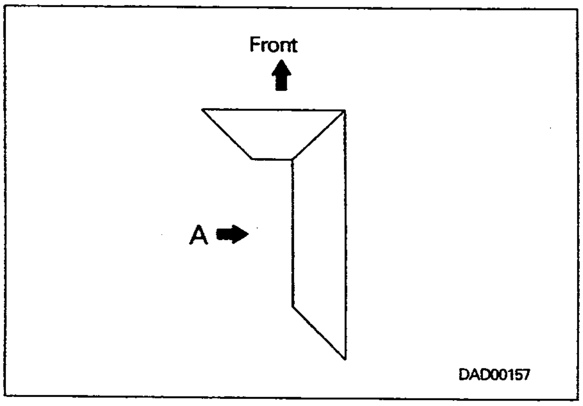
4. Adjusting backlash and tooth contact

1) Adjusting backlash

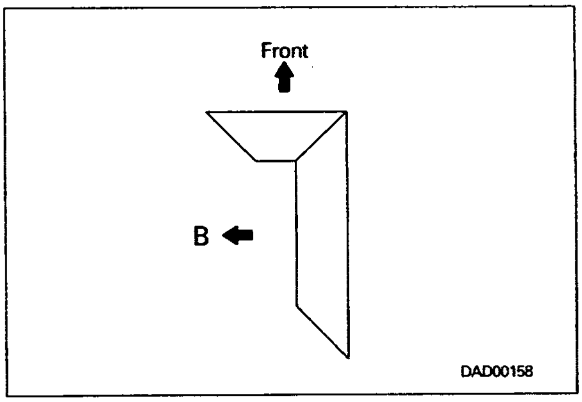
Apply the probe of dial gauge ⑬ to the tooth tip at the end of the bevel gear at right angles. Fix the bevel pinion and move the bevel gear forward and backward, and read the value at this time.

- ★ Standard backlash: 0.2 - 0.28 mm
- ★ Measure the backlash diagonally at 3 or more places.
- If the measured backlash is out of the standard range, adjust it according to the following procedure.
- ★ Adjust the backlash by increasing or decreasing the thickness of both shims (77). Do not change the total thickness of both shims so that the pre-load will not change. (If the thickness of the shim on one side is increased, decrease the thickness of the other side, and vice versa.)
- When backlash is insufficient
  Decrease the thickness of the shim on the right side of the machine body and increase the thickness on the left side by the same quantity. (Move the bevel gear in direction A.)

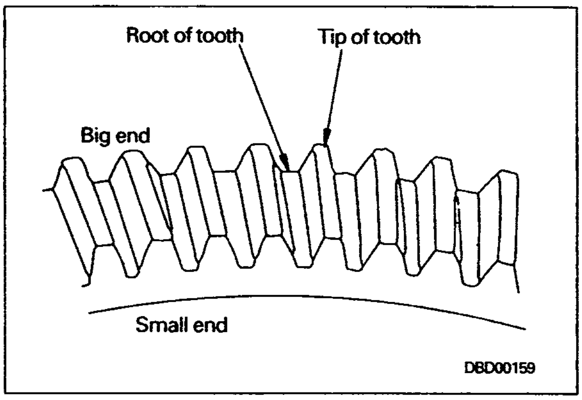


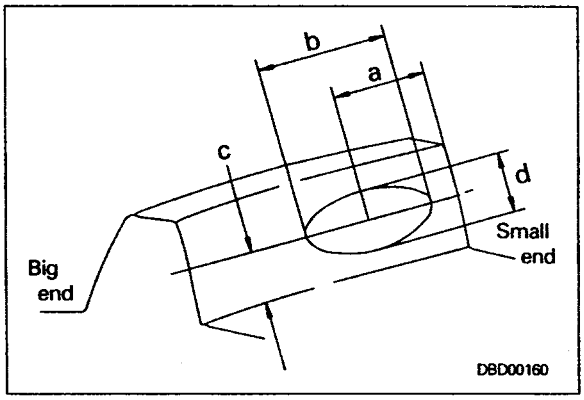


- When backlash is too large
  Decrease the thickness of the shim on the left side of the machine body and increase the thickness on the right side by the same quantity. (Move the bevel gear in direction B.)



2) Adjusting tooth contact
   Testing
   i) Apply red lead thinly to the tooth surfaces of the bevel gear and turn the bevel gear in the forward and reverse directions, then check the tooth contact pattern on the bevel gear.
   ii) The tooth contact must be as follows (The standard distance is measured from the tooth tip of the bevel pinion.)
      a) Center of tooth contact: 20 - 40% of face width (from small end)
      b) Width of tooth contact: 30 - 50% of face width
      c) Center of tooth contact: 35 - 65% of tooth depth (from bottom)
      d) Width of tooth contact: 60 - 80% of tooth depth
   ★ If the bevel gear and bevel pinion are adjusted in this way, their teeth come in contact with each other correctly when they are loaded.

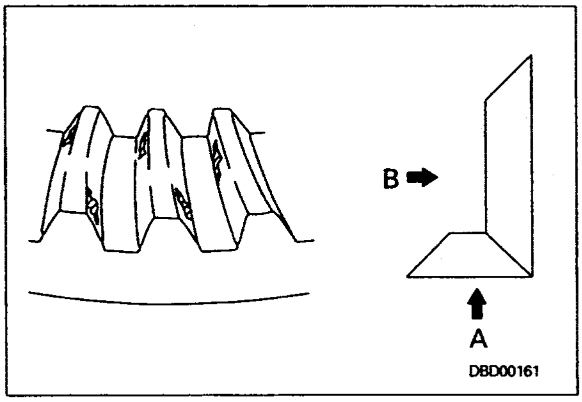




Adjusting
If the tooth contact pattern is not proper, adjust the tooth contact according to the following procedure.

i) If the bevel pinion is too far from the center line of the bevel gear, the contact is at the small end of the bevel gear tooth faces curved outward and at the large end of the bevel gear tooth faces curved inward.

- In this case, adjust the tooth contact according to the following procedure.
  Adjust the thickness of the shims on the bevel pinion side to move the bevel pinion in direction A. Move the bevel gear in direction B, then check the tooth contact pattern and backlash again.



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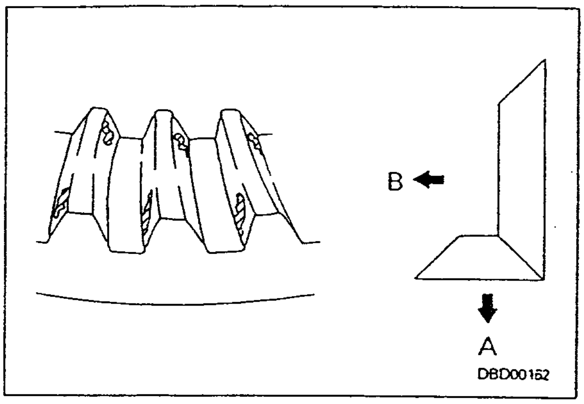
ii) If the bevel pinion is too close to the center line of the bevel gear, contact is at the large end of the bevel gear tooth faces curved outward and the small end of the bevel gear tooth faces curved inward.

- In this case, adjust the tooth contact according to the following procedure. Adjust the thickness of the shims on the bevel pinion side to move the bevel pinion in direction A. Move the bevel gear in direction B, then check the tooth contact pattern and backlash again.

★ Do not change the total thickness of the shims on both sides.

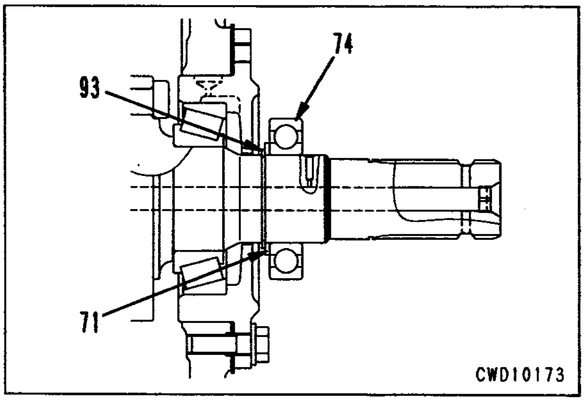
iii) When adjustment is finished, tighten the mounting bolts of the cage and bevel pinion assembly to the specified torque.

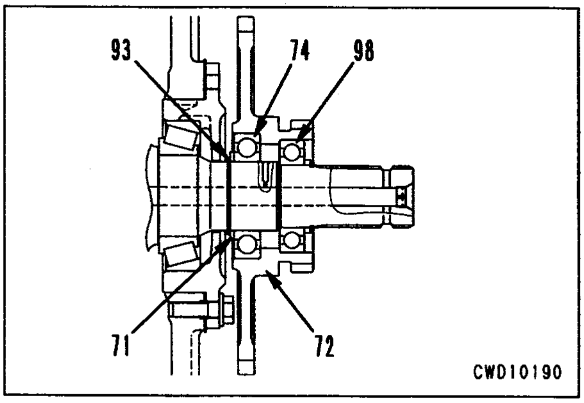
kgm Mounting bolts of cage and bevel pinion assembly:
98 - 123 Nm {10 - 12.5 kgm}



5. Sun gear

1) Install snap ring (93) to the shaft.
   ★ Perform this work for only right side of the machine.
2) Install collar (71).
3) Install bearing (74) with the push tool.
4) Install sun gear (72).
5) Install bearing (98) with the push tool.
   ★ Press fit the inner race and outer race simultaneously.



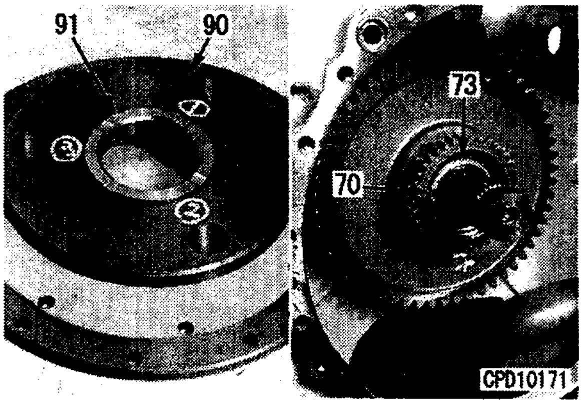


6) Install collar (73) and snap ring (70).

6. Brake and carrier assembly

- Assembly of carrier assembly

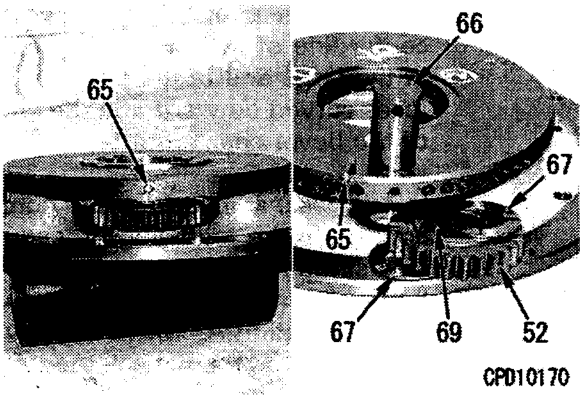
1) Install bushing (91) to carrier (90).



2) Install bearing (69) to gear (52). Fit thrust washers (67) to top and bottom of the bearing, then set them to the carrier

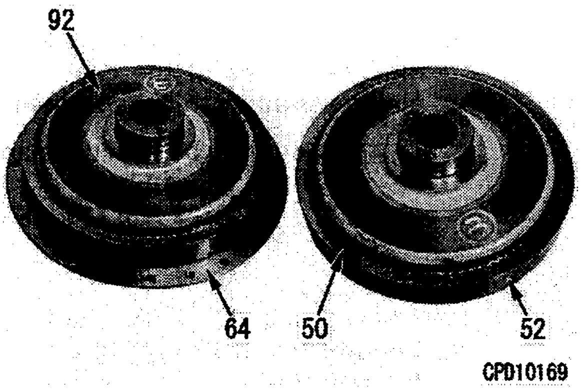
3) Install shaft (66), matching the inside of the thrust washers and bearing to the shaft hole of the carrier.
   ★ Match the roll pin hole accurately.

4) Install roll pin (65).

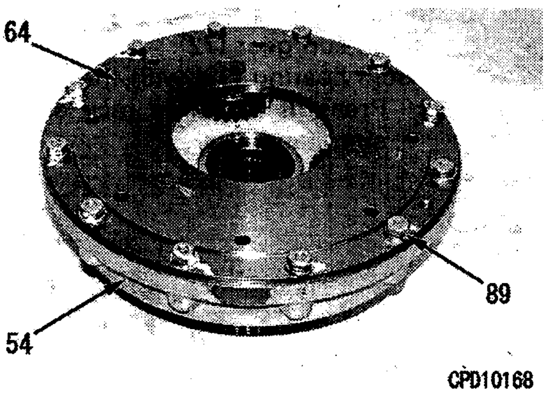


5) Set hub (92) to ring gear (52) and install snap ring (50).

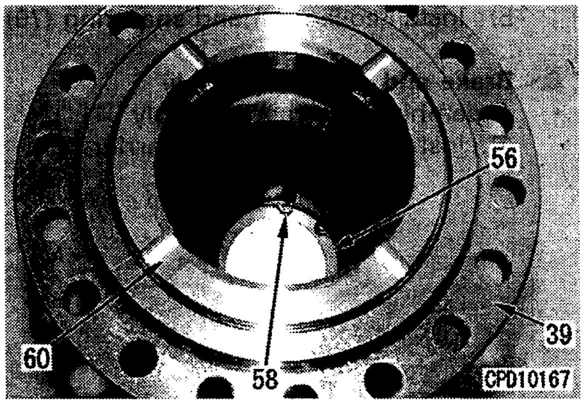
6) Install hub (92) to carrier assembly (64).



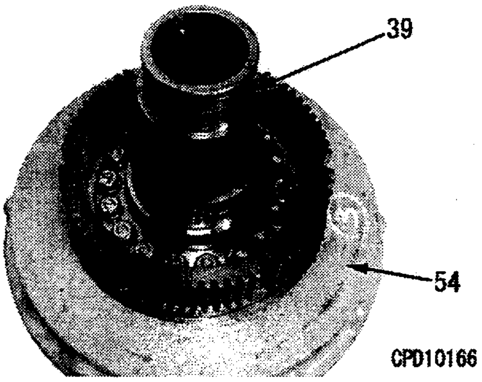
7) Install hub and carrier assembly (64) to hub (54) and tighten bolts (89).
   kgm Mounting bolt:
   59 - 74 Nm {6 - 7.5 kgm}



- Assembly of brake assembly
  1) Install stopper (56) to the hub, then install snap ring (58).
  2) Install bushing (60) to hub (39).

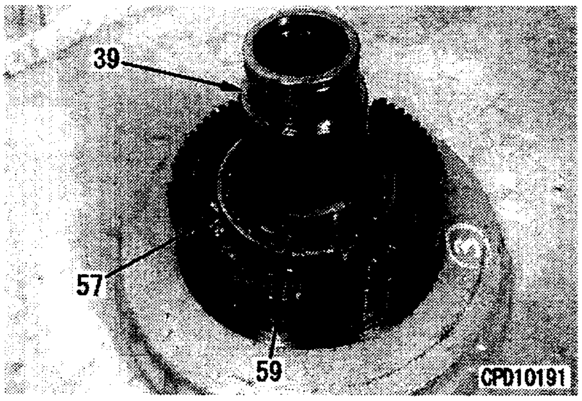


3) Install hub (39) to hub (54) with 18 mounting bolts.
   kgm Mounting bolt:
   59 - 74 Nm {6 - 7.5 kgm}



CPD10166

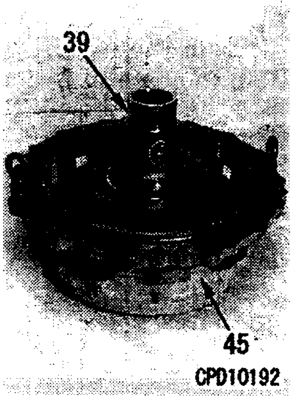
4) Install bearing (57) to hub (39).
5) Install snap ring (59).



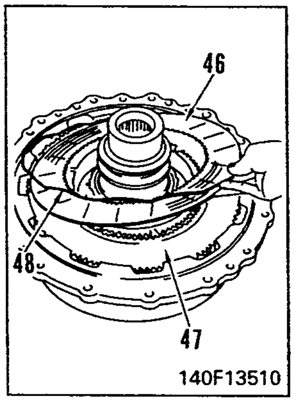
CPD10191

014012

6) Set brake drum (45) to hub (39).
7) Install discs (46), plates (47), and springs (48).



CPD10192



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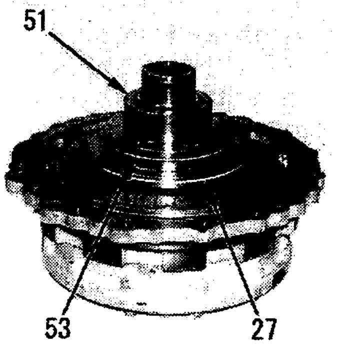
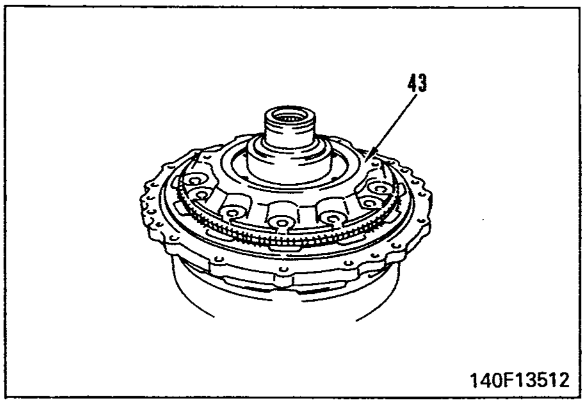
8) Install seal rings (27) and (53) and cage (51).
   ★ Roughly match the oil holes on the cage to the 4 oil holes on the drum.
   ★ Press fit the cage to the outer race side of the bearing.



CPD10193

9) Install the seal ring to piston (43).

10) Install piston (43), matching the center of the spot-face having the match mark to the drilled hole "13.5 in diameter" (on the opposite side of the side hole).



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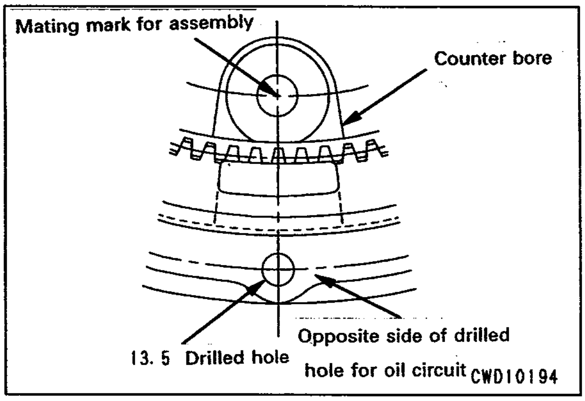
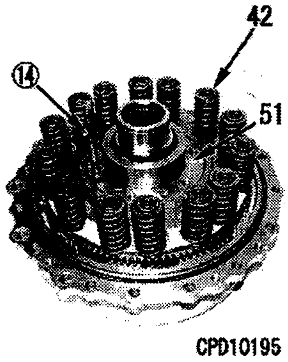


CWD10194

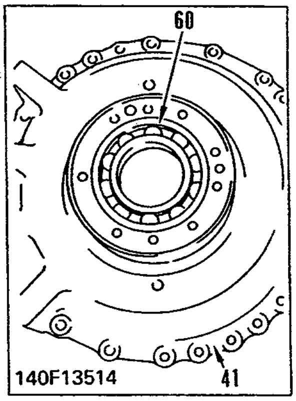
11) Install spring (42).

12) Install guide bolt ⑭ to cage (51).

13) Install bearing (60) to cover (41).



CPD10195



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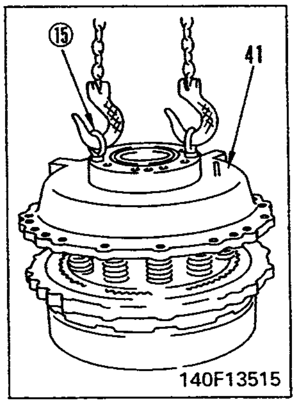
14) Using eyebolts ⑮ and matching to the guide bolt, set cover (41).

★ Check that the spring is fitted securely to both of the piston and case.

15) Compressing the spring with forcing screws ⑰ and nuts ⑯, press fit the inner race side of the bearing to the hub assembly.



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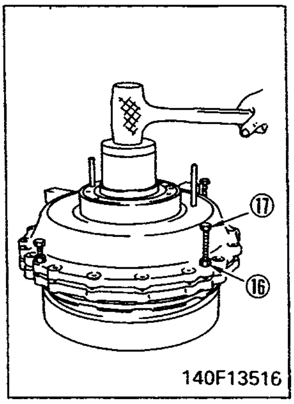

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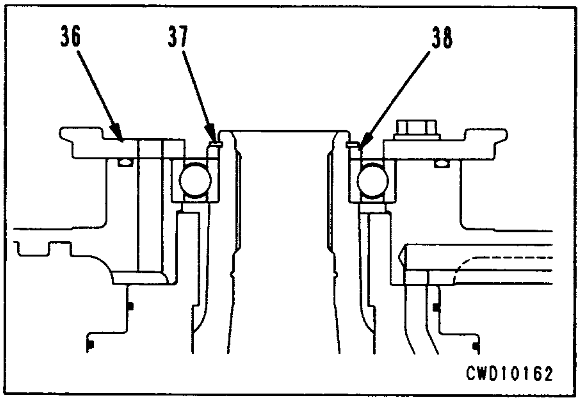
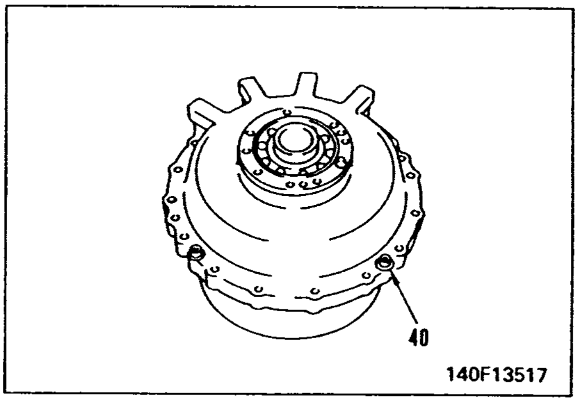
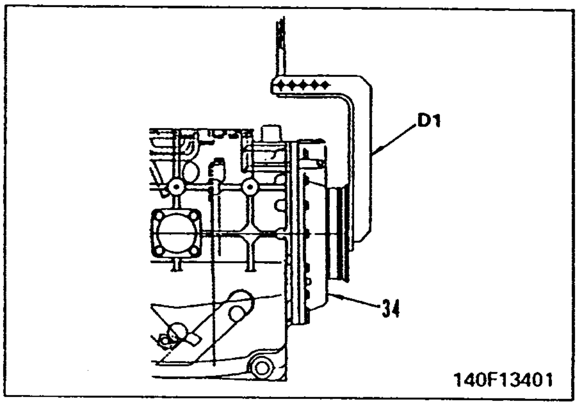
16) Install spacer (38) and snap ring (37).
17) Install flange (36).



18) Remove the bolts and nuts used to compress the spring, then install 4 bolts (40).

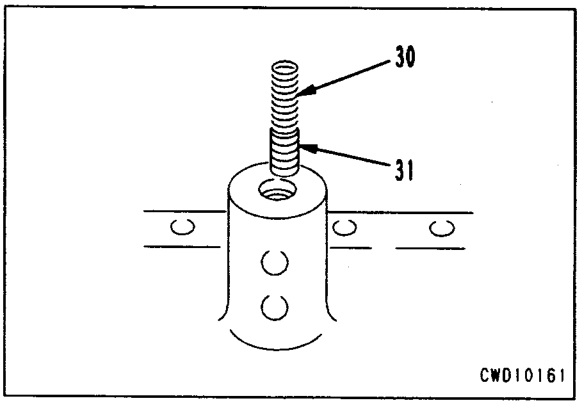


19) Brake and carrier assembly
   i) Equalize the projection of the seal rings from the shaft on the carrier side.
   ii) Using tool **D1**, install brake and carrier assembly (34).



7. **Cover assembly**

- Assembly of cover assembly
  1) Install valve (31) and spring (30) to the cover, then install the plug.



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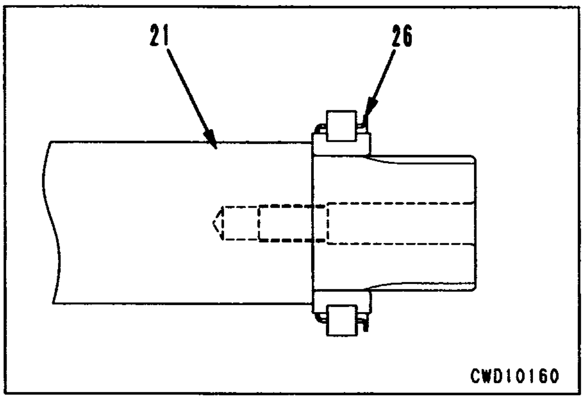
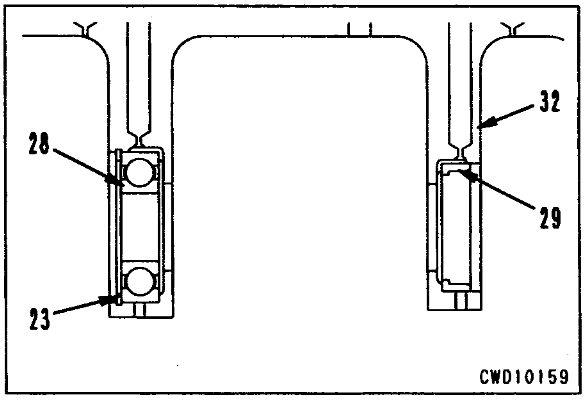
2) Left carrier drive gear

i) Press fit bearing (26) to shaft (21).



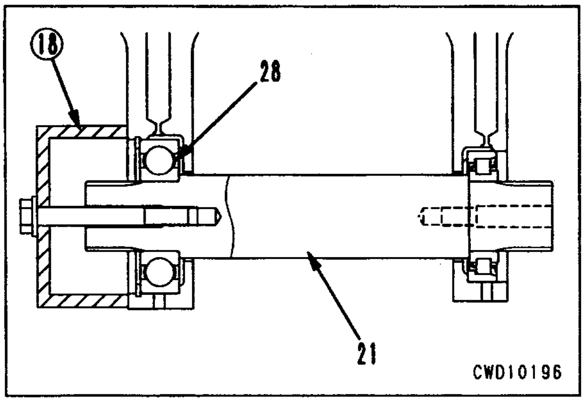
ii) Install outer race (29) to cover (32).

iii) Press fit bearing (28) to cover (32), then install snap ring (23).



iv) Using puller H, press fit shaft (21) to the inner race side of bearing (28).

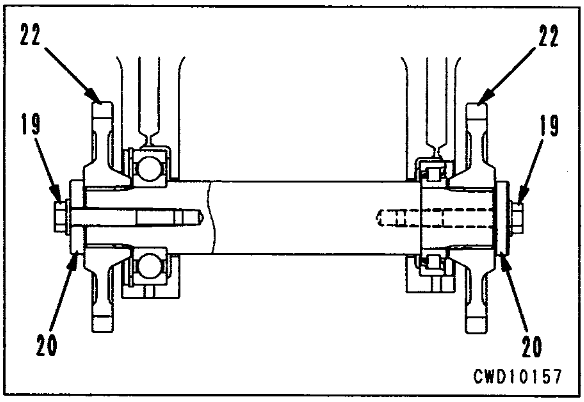
★ Replace the bolt with one having different length.



v) Install gear (22).

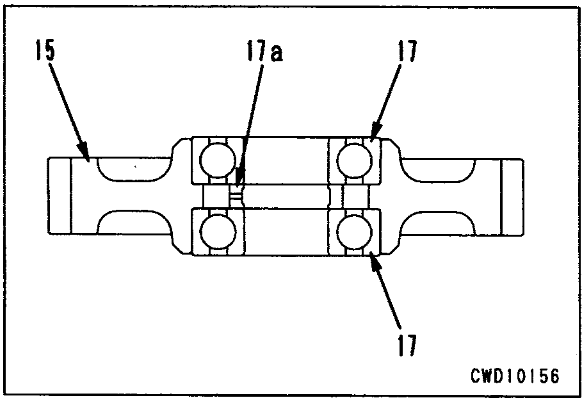
vi) Install holder (20) and tighten bolt (19).

kgm Mounting bolt:
98 - 123 Nm {10 - 12.5 kgm}



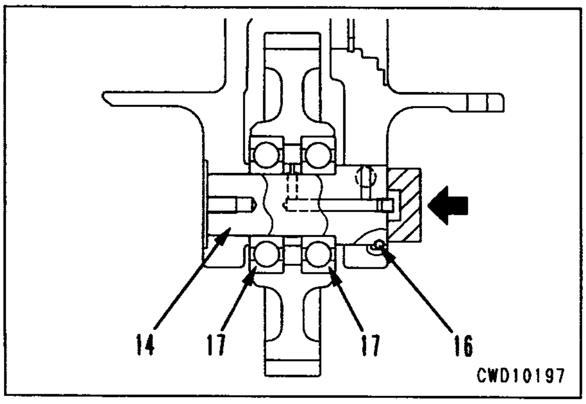
3) Intermediate gear assembly

i) Install bearing (17) and spacer (17a) to gear (15).



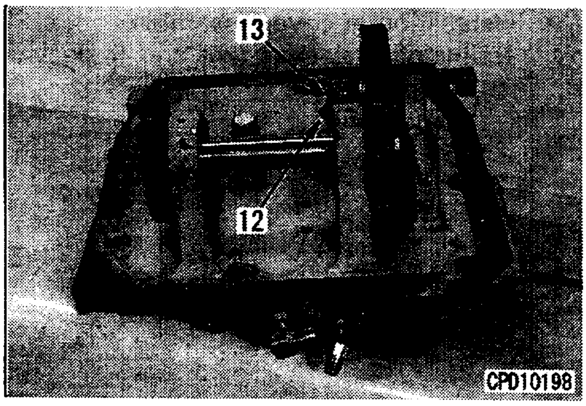
ii) Press fit shaft (14) to the inner race side of bearing (17). Fit ball (16) halfway and press fit completely.

★ Before the shaft enters the cover, position the ball accurately.

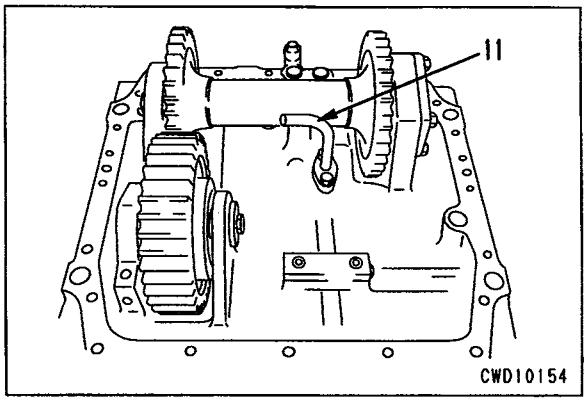


iii) Install holder (13) and tighten bolt (12).

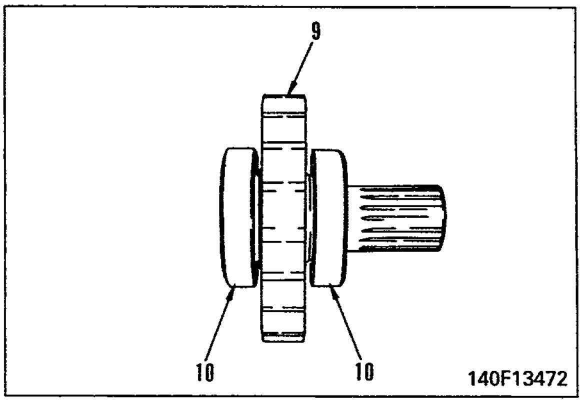
kgm Mounting bolt:
98 - 123 Nm {10 - 12.5 kgm}



iv) Install tube (11).

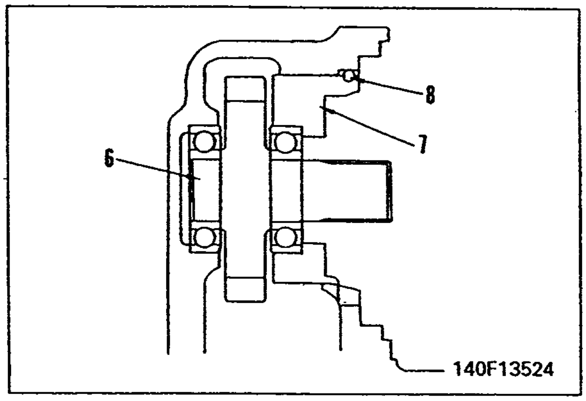


5) Input gear assembly
   i) Install bearing (10) to gear (9).



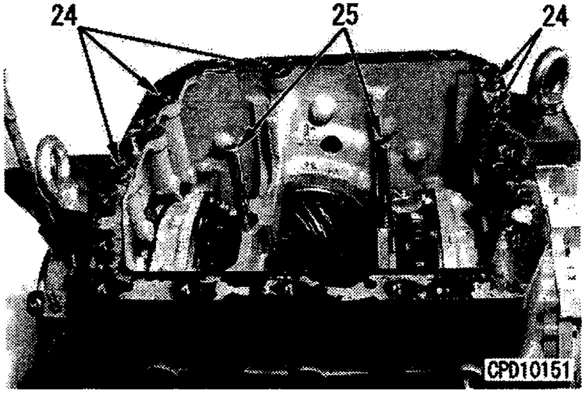
ii) Install gear assembly (6).

iii) Install cage (7) and ball (8), matching them to the hole for ball (8).



- Installation of cover assembly

1) Install 2 sleeves (25) and 5 sleeves (24) to the HSS case.



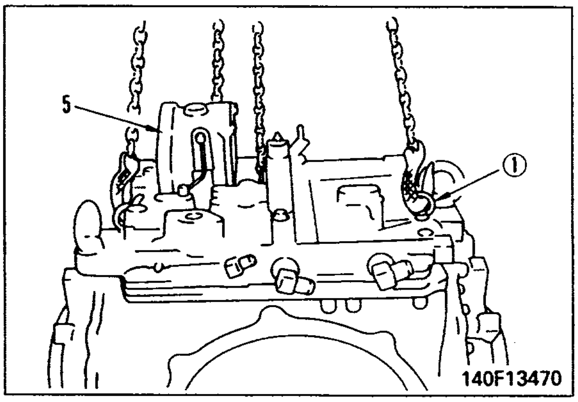
2) Using eyebolts ①, install cover assembly (5).

Mating face of cover:

Gasket sealant (LG-6)

★ Apply gasket sealant to both mating faces of the case and cover.

★ Apply gasket sealant to each mating face without breakage.

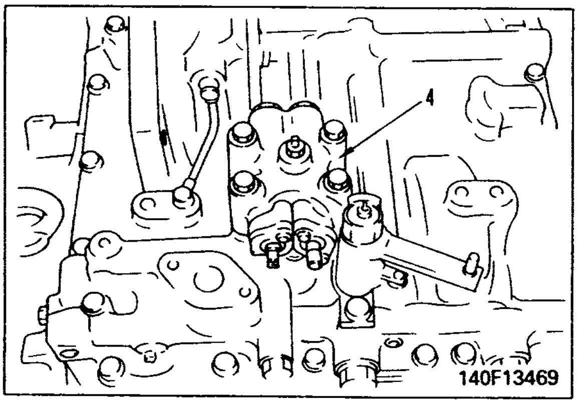


8. Brake valve assembly

Install brake valve assembly (4).

Mounting bolt:

44.1 - 53.9 Nm {4.5 - 5.5 kgm}



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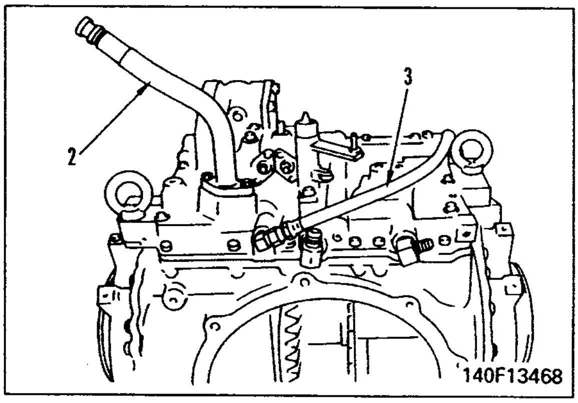
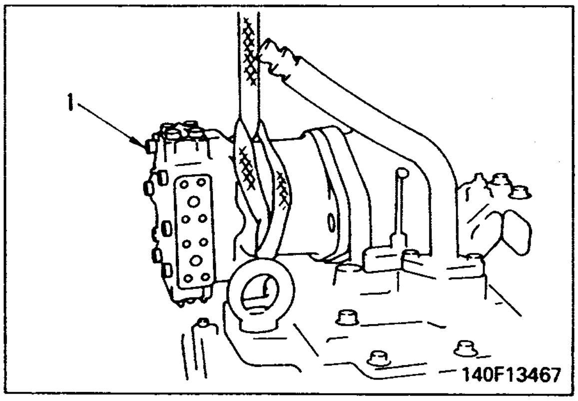
9. Oil filler and hose

Install oil filter (2) and hose (3).



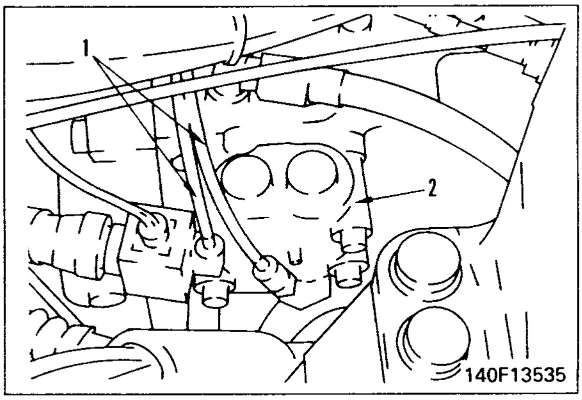
10. Motor assembly

Sling and install motor assembly (1).



REMOVAL OF TORQUE CONVERTER VALVE ASSEMBLY

1. Remove floor frame assembly.
   For details, see REMOVAL OF FLOOR FRAME ASSEMBLY.
2. Disconnect 2 pressure dectection hoses (1).
3. Remove torque converter main relief valve assembly (2). ※1



INSTALLATION OF TORQUE CONVERTER VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

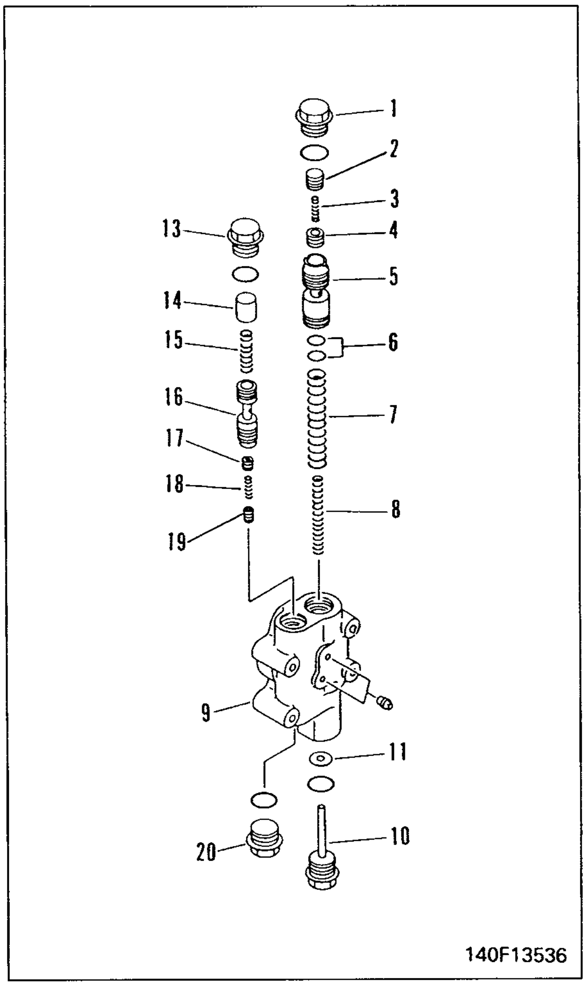
※1

kgm Main relief valve mounting bolt:
49 ± 4.9 Nm (5.0 ± 0.5 kgm)

014012

DISASSEMBLY OF TORQUE CONVERTER VALVE ASSEMBLY

1. Remove plug (1), then remove valve (2), spring (3), valve (4), valve (5), shim (6), and springs (7) and (8) from valve body (9).
   ★ Check the number and thickness of the shims, and keep in a safe place.
2. Remove plug (10), then remove washer (11).
3. Remove plug (13), then remove guide (14), spring (15), spool (16), valve (17), spring (18), and valve (19).
4. Remove plug (20).



ASSEMBLY OF TORQUE CONVERTER VALVE ASSEMBLY

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. Assemble spring (15) and guide (14) to spool (16).
2. Assemble valve (19), spring (18), and valve (17), then assemble in valve body (9), and install plugs (20) and (13).
3. Assemble washer (11) and springs (8) and (7) to plug (10), and install to valve body (9).
4. Assemble valve (2), spring (3), and valve (4), the assemble in valve (5), and assemble shim (6) on opposite side.
   ★ Check the thickness and number of shims, then assemble them.
   Standard shim thickness: 3 mm
5. Assemble valve (5) to valve body (9), then install plug (1).
6. Tighten plugs (10) and (1).

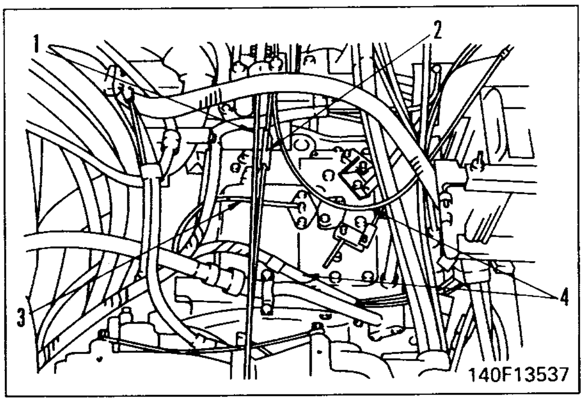
014012

REMOVAL OF TRANSMISSION CONTROL VALVE ASSEMBLY

1. Remove floor frame assembly.
   For details, see REMOVAL OF FLOOR FRAME ASSEMBLY.

2. Remove brake rod (1) and steering rod (2). ※1

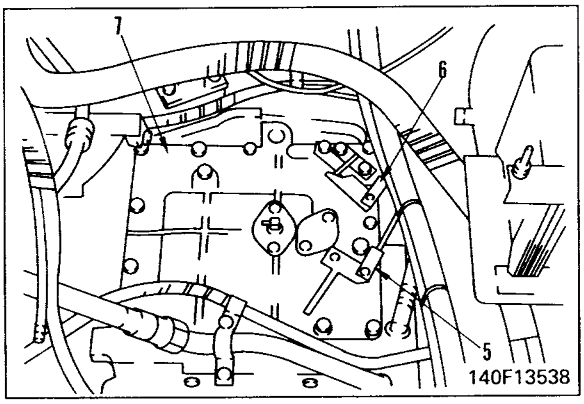
3. Disconnect pilot hose (3), and remove cable clamp (4).

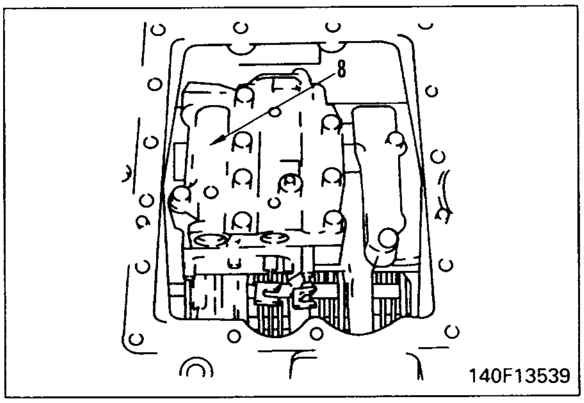


4. Disconnect directional cable (5) and speed cable (6). ※2

5. Remove mounting bolts, then using forcing screws, remove valve cover (7). ※3

6. Remove transmission control valve assembly (8). ※4
   ★ The length of the mounting bolts is different, so mark them clearly.





INSTALLATION OF TRANSMISSION CONTROL VALVE

- Carry out installation in the reverse order to removal.

※1

★ Adjust the steering lever and brake pedal.
For details, see TESTING AND ADJUSTING.

※2

★ Adjust the directional lever and speed lever.
For details, see TESTING AND ADJUSTING.

※3

★ Look through the inspection hole in the cover to check that the lever and yoke are meshed, then tighten the mounting bolts.

★ When installing the cover, tap it with a plastic hammer.
If the dowel pin portion does not fit, remove the cover, mesh the lever and yoke again, then install.

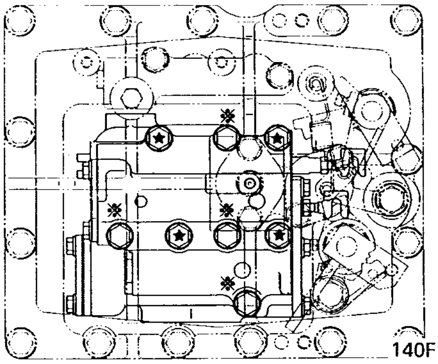
※4

★ There are two types of mounting bolt, so check the mounting position when installing them.

★ Mounting bolt: ※ = 4 bolts
★ = 4 bolts

kgm Mounting bolt:
49.0 ± 4.9 Nm (5.0 ± 0.5 kgm)

Removal and installation of transmission control valve



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DISASSEMBLY OF TRANSMISSION CONTROL VALVE ASSEMBLY

D65E-12 Serial No. 60001 — 60650
D65P-12 Serial No. 60001 — 60685
D65EX-12 Serial No. 60001 — 60654
D65PX-12 Serial No. 60001 — 60688

1. **Disassembly of quick return valve**
   1) Remove cover (2) from valve body (1).
   2) Pull out spacer (3), and remove ring (4).
   3) Remove plug (5), pull out valve (6) and sleeve (7), then remove snap ring (8).

2. **Disassembly of speed valve**
   1) Remove spool assembly (10) from valve body (9).
   2) Loosen nut (11), and disconnect spool (12) and yoke (13).

3. **Disassembly of directional valve, modulation valve**
   1) Remove snap ring (14), then remove stopper (15).
   2) Loosen nut (16), and remove yoke (17).
   3) Remove cover (18), shim (19), and spacer (20), then remove spring (21), washer (22), and springs (23) and (24).
   4) Remove cover (25).
   5) Remove collar (26) and spool (27).
   6) Remove valve assembly (28).
   7) Remove snap ring (29), stopper (30), valve (31), spring (32), valve (33), and valve (34) from valve assembly (28).

ASSEMBLY OF TRANSMISSION CONTROL VALVE ASSEMBLY

D65E-12 Serial No. 60001 — 60650
D65P-12 Serial No. 60001 — 60685
D65EX-12 Serial No. 60001 — 60654
D65PX-12 Serial No. 60001 — 60688

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. **Assembly of directional valve, modulation valve**
   1) Assemble valves (34) and (33), spring (32), and valve (31) to valve (28), fit stopper (30), then install snap ring (29).
   2) Assemble valve assembly (28) to body (9), then assemble springs (24) and (23), washer (22), and spring (21) from opposite side, and install spacer (20).
   3) Install shim (19) and cover (18).
      ★ Standard shim thickness: 2.5 mm
   4) Install spool (27) and collar (26) to body (9), then install cover (25).
   5) Assemble stopper (15), and install snap ring (14).
   6) Assemble nut (16) to yoke (17), and install to valve (27).

      kgm Locknut:
      30.9 ± 3.4 Nm (3.2 ± 0.35 kgm)

      ★ Dimension **a** for mounting yoke:
      29.1 mm

2. **Assembly of speed valve**
   1) Assemble nut (11) to yoke (13), and install to spool (12).

      kgm Locknut:
      30.9 ± 3.4 Nm (3.2 ± 0.35 kgm)

   2) Assemble spool assembly (10) to body (9).

3. **Assembly of quick return valve**
   1) Install plug (5) to body (1), assemble valve (6) and sleeve (7), then install snap ring (8).
   2) Assemble spacer (3) to body (1), then fit snap ring (4) and install cover (2).

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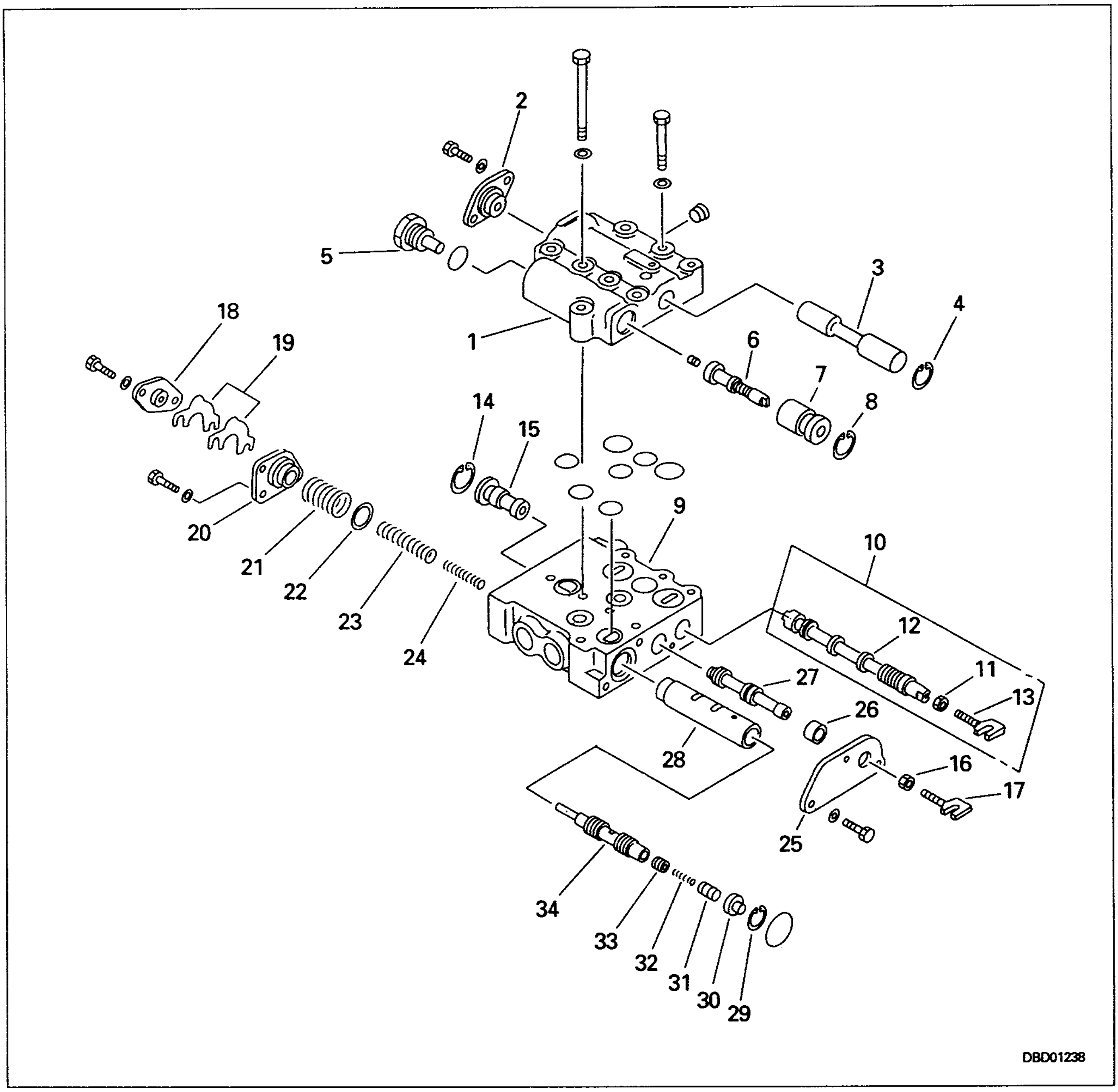

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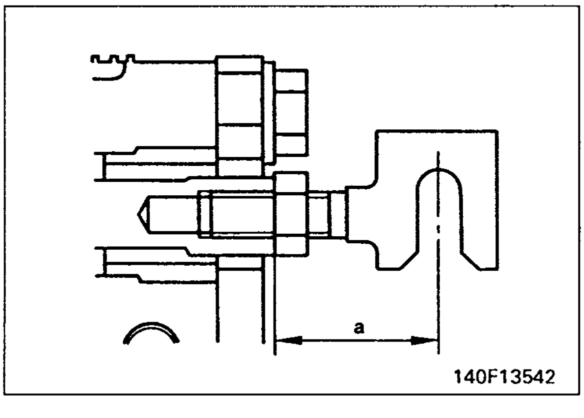

a
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DISASSEMBLY OF TRANSMISSION CONTROL VALVE ASSEMBLY

D65E-12 Serial No. 60651 and up
D65P-12 Serial No. 60686 and up
D65EX-12 Serial No. 60655 and up
D65PX-12 Serial No. 60689 and up

1. **Disassembly of quick return valve**
   1) Remove snap ring (2) from valve body (1).
   2) Pull out spacer (3), and remove snap ring (4).
   3) Remove plug (5), pull out valve (6) and sleeve (7), then remove snap ring (8).

2. **Disassembly of speed valve**
   1) Remove spool assembly (10) from valve body (9).
   2) Loosen nut (11), and disconnect spool (12) and yoke (13).

3. **Disassembly of directional valve, modulation valve**
   1) Remove snap ring (14), then remove stopper (15).
   2) Loosen nut (16), and remove yoke (17).
   3) Remove cover (18), shim (19), and spacer (20), then remove spring (21), washer (22), and springs (23) and (24).
   4) Remove cover (25).
   5) Remove collar (26) and spool (27).
   6) Remove valve assembly (28).
   7) Remove snap ring (29), stopper (30), valve (31), spring (32), valve (33), and valve (34) from valve assembly (28).

ASSEMBLY OF TRANSMISSION CONTROL VALVE ASSEMBLY

D65E-12 Serial No. 60651 and up
D65P-12 Serial No. 60686 and up
D65EX-12 Serial No. 60655 and up
D65PX-12 Serial No. 60689 and up

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. **Assembly of directional valve, modulation valve**
   1) Assemble valves (34) and (33), spring (32), and valve (31) to valve (28), fit stopper (30), then install snap ring (29).
   2) Assemble valve assembly (28) to body (9), then assemble springs (24) and (23), washer (22), and spring (21) from opposite side, and install spacer (20).
   3) Install shim (19) and cover (18).
      ★ Standard shim thickness: 2.5 mm
   4) Install spool (27) and collar (26) to body (9), then install cover (25).
   5) Assemble stopper (15), and install snap ring (14).
   6) Assemble nut (16) to yoke (17), and install to valve (27).

      kgm Locknut:
      30.9 ± 3.4 Nm (3.2 ± 0.35 kgm)

      ★ Dimension **a** for mounting yoke:
      29.1 mm

2. **Assembly of speed valve**
   1) Assemble nut (11) to yoke (13), and install to spool (12).

      kgm Locknut:
      30.9 ± 3.4 Nm (3.2 ± 0.35 kgm)

   2) Assemble spool assembly (10) to body (9).

3. **Assembly of quick return valve**
   1) Install plug (5) to body (1), assemble valve (6) and sleeve (7), then install snap ring (8).
   2) Assemble spacer (3) to body (1), then fit snap rings (4) and (2).

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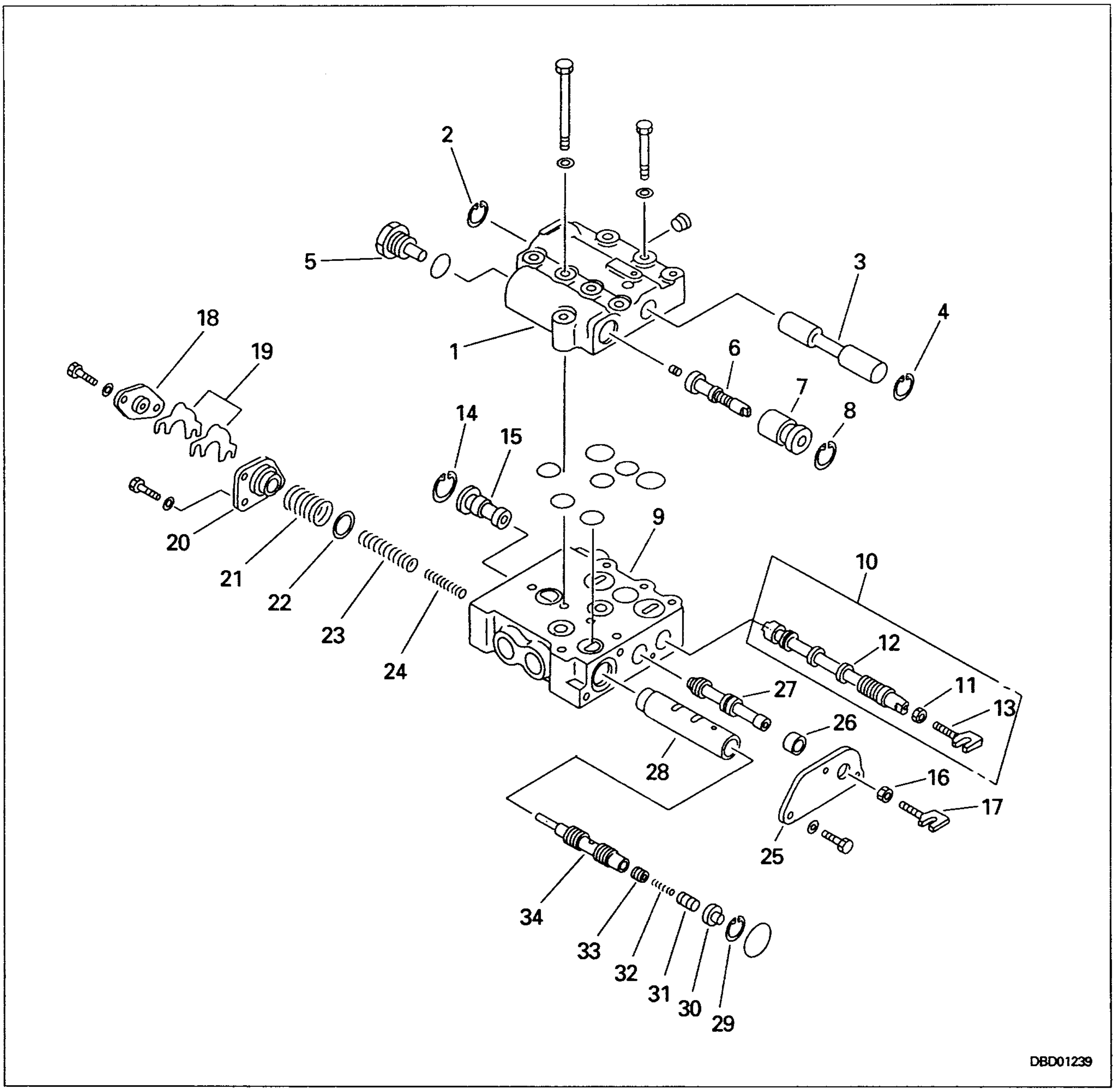
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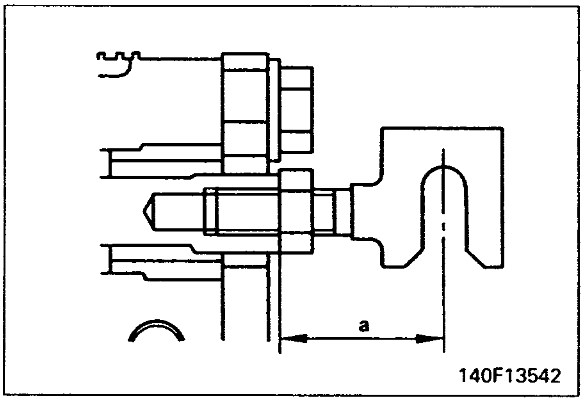
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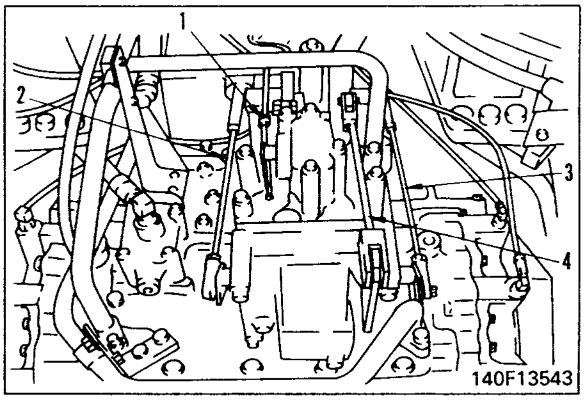
REMOVAL OF STEERING CONTROL VALVE ASSEMBLY

D65E, P

1. Remove fuel tank assembly.
   For details, see REMOVAL OF FUEL TANK ASSEMBLY.



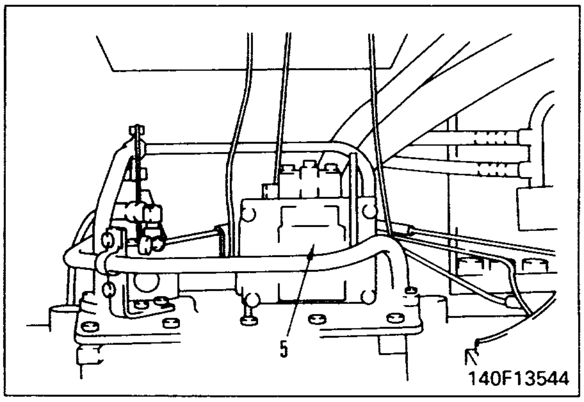
2. Disconnect wire cable (1) and rods (2) and (3). ※1

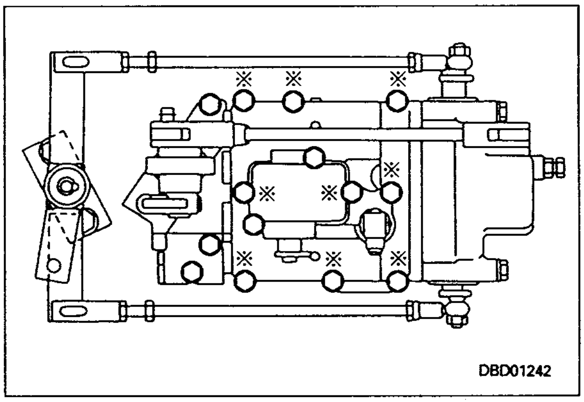
3. Remove rod (4). ※2

4. Lift off valve assembly (5). ※3

   kg Steering valve assembly: **27 kg**

   ★ When removing the steering valve, remove the bolts marked ※ in the diagram below.





INSTALLATION OF STEERING CONTROL VALVE ASSEMBLY

D65E, P

- Carry out installation in the reverse order to removal.

※1, ※2

★ Adjust each rod.
For details, see TESTING AND ADJUSTING, Adjusting steering control linkage.

※3

kgm Mounting bolt:
49.1 ± 5.0 Nm (5.0 ± 0.5 kgm)

- **Refilling with oil (power train case)**

★ Add oil through water filler to the specified level.
Run the engine to circulate the oil through the system.
Then check the oil level again.

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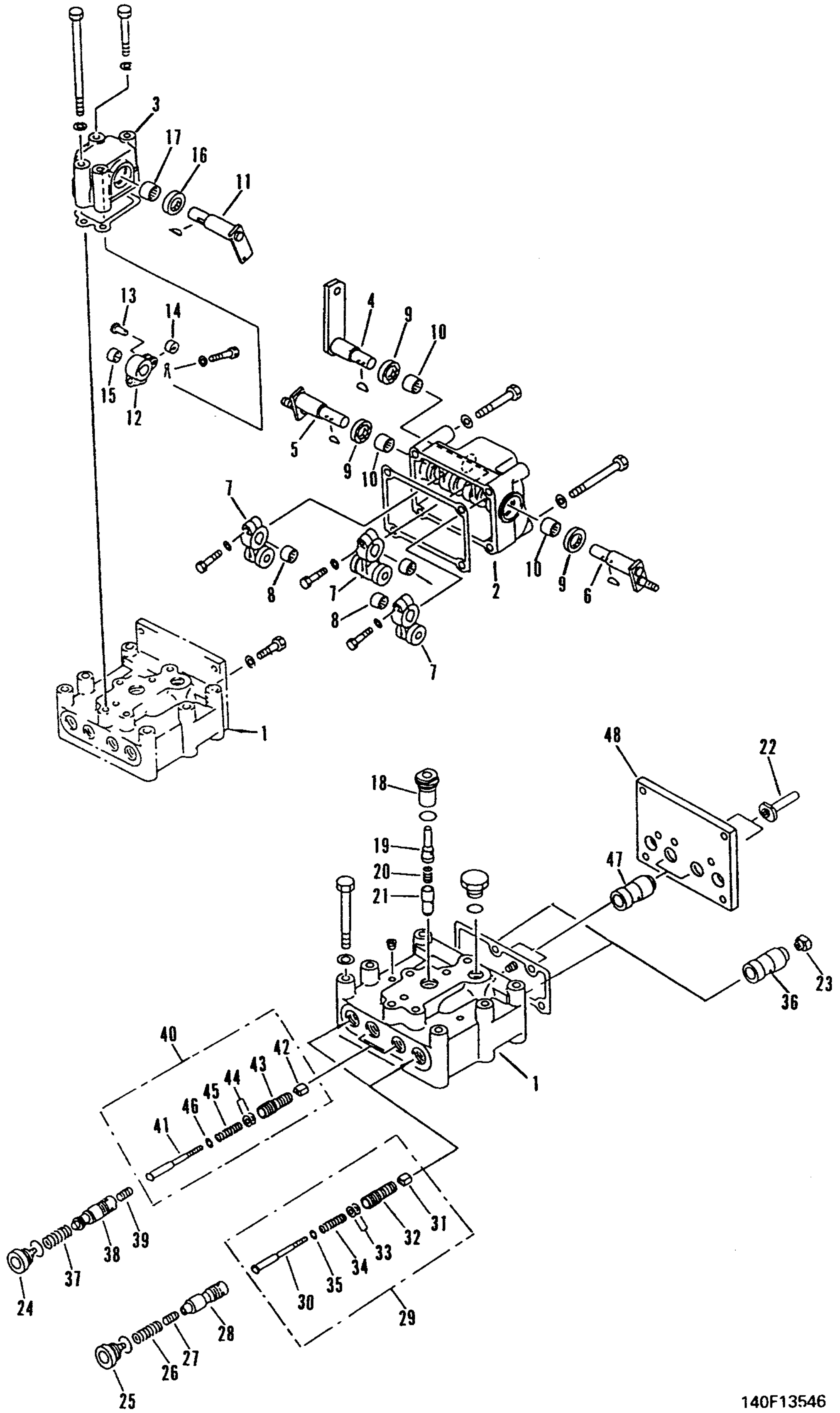
DISASSEMBLY OF STEERING CONTROL VALVE ASSEMBLY

D65E, P



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1. Disconnect lever cases (2) and (3) from valve assembly (1).

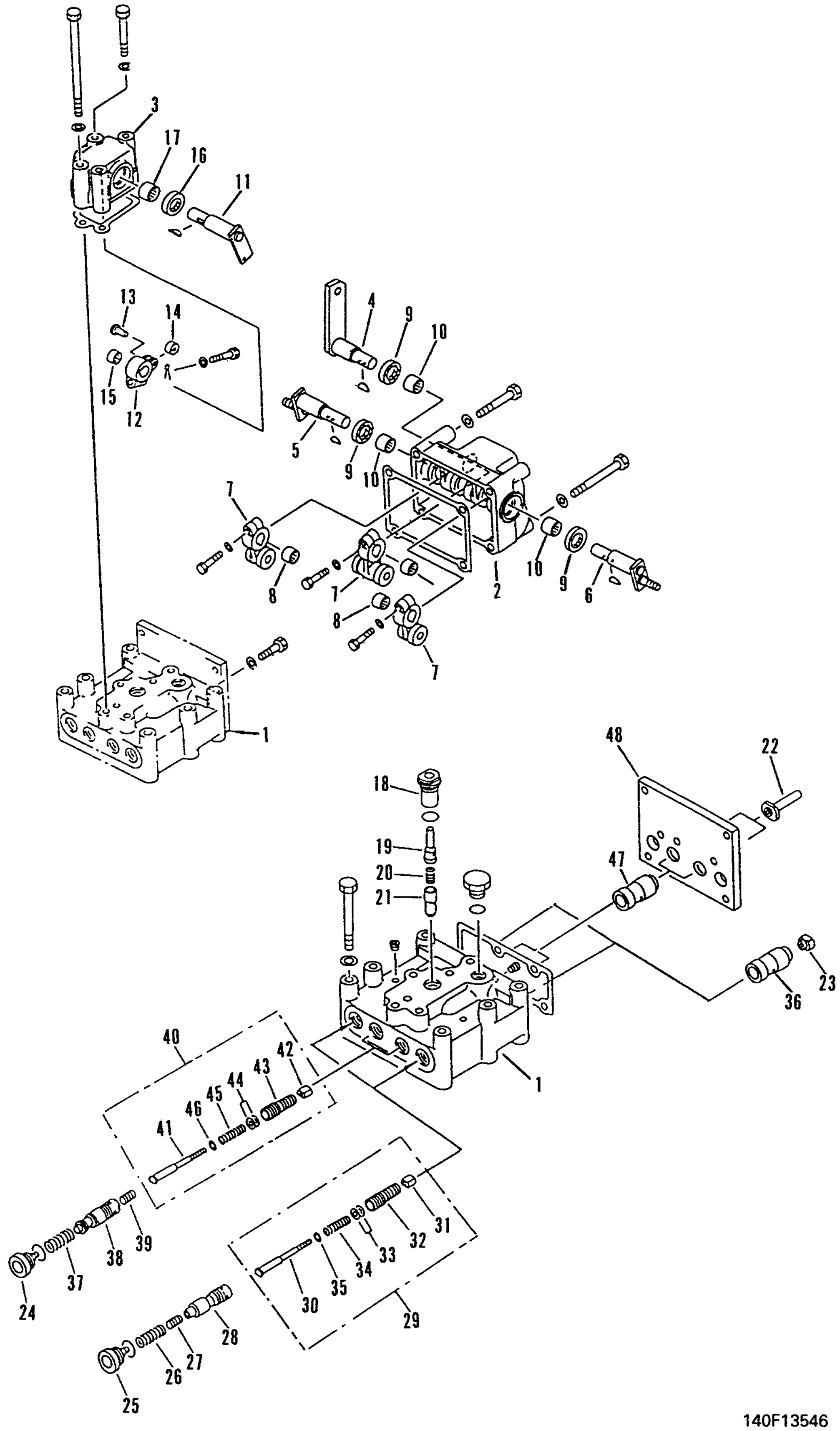
2. Disassembly of lever case (2).
   1) Remove levers (4), (5) and (6).
      ★ Be careful not to lose the keys.
   2) Remove lever assembly (7).
   3) Remove bearing (8) from lever assembly (7).
   4) Remove seal (9) from case (2), then remove bearing (10).

3. Disassembly of lever case (3).
   1) Remove lever (11).
      ★ Be careful not to lose the key.
   2) Remove lever assembly (12), then remove pin (13) and roller (14).
   3) Remove bearing (15).
   4) Remove seal (16) and bearing (17) from case (3).

4. Disassembly of valve assembly
   1) Remove body (18), then remove valve (19), spring (20), and valve (21).
   2) Remove nuts (22) and (23), then remove cover (48).
   3) Remove plugs (24) and (25).
   4) Disassembly of right clutch, left clutch valve
      i) Push in valve from lever case mount end, and remove spring (26), piston (27), valve (28), and valve assembly (29).
      ii) Remove nut (31) from bolt (30), then remove guide (32), shim (33), spring (34), and guide (35).
         ★ Check the number and thickness of the shims, and keep in a safe place.
      iii) Remove cylinder (36) from body (1).
   5) Disassembly of right brake, left brake valve
      i) Push in valve from lever case mounting end, and remove spring (37), valve (38), piston (39), and valve assembly (40).
      ii) Remove nut (42) from bolt (41), then remove guide (43), shim (44), spring (45), and guide (46).
         ★ Check the number and thickness of the shims, and keep in a safe place.
      iii) Remove cylinder (47) from body (1).

ASSEMBLY OF STEERING CONTROL VALVE ASSEMBLY

D65E, P



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★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. **Assembly of valve assembly**
   1) Assembly of right brake, left brake valve
      i) Assemble guide (46), spring (45), shim (44), and guide (43) to bolt (41), and install nut (42).
         ★ Check the thickness and number of shims, then assemble them.
         Standard shim thickness: 0.5 mm

         kgm Nut:
         13.3 ± 1.5 Nm (1.35 ± 0.15 kgm)
      ii) Install cylinder (47) to body (1).
      iii) Assemble valve assembly (40), piston (39), valve (38), and spring (37) to body (1), and install.
      iv) Fit O-ring to plug (24) and install to body.

         kgm Plug:
         68.6 ± 9.8 Nm (7 ± 1 kgm)
   2) Assembly of right clutch, left clutch valve
      i) Assemble guide (35), spring (34), shim (33), and guide (32) to bolt (30), and install nut (31).
         ★ Check the thickness and number of shims, then assemble them.
         Standard shim thickness: 0.5 mm

         kgm Nut:
         13.3 ± 1.5 Nm (1.35 ± 0.15 kgm)
      ii) Install cylinder (36) to body (1).
      iii) Assemble valve assembly (29), valve (28), piston (27), and spring (26) to body (1), and install.
      iv) Fit O-ring to plug (25) and install to body.
   3) Install cover (48), then install nuts (23) and (22).

      kgm Nut:
      13.3 ± 1.5 Nm (1.25 ± 0.15 kgm)
   4) Assemble valve (21), spring (20), and valve (19) to body (1), then fit O-ring to body (18) and install.

2. **Assembly of lever case (3)**
   1) Install case (3), bearing (17), and seal (16).
   2) Assemble roller (14) to lever assembly (12), and install pin (13).
   3) Install bearing (15) to lever assembly (12), then assemble lever (11).
      ★ Assemble the keys securely.

3. **Install lever case (3) to body (1).**

4. **Assembly of lever case (2)**
   1) Install bearing (10) and oil seal (9) to case (2).
   2) Install bearing (8) to lever assembly (7), then install levers (6), (5), and (4).
      ★ Install the keys securely in levers (6), (5), and (4).
   3) Install lever case (2) to valve body (1).

REMOVAL OF BRAKE VALVE ASSEMBLY

D65EX, PX

1. Remove operator's seat, then remove chassis rear cover.

   kg Operator's seat: **35 kg**

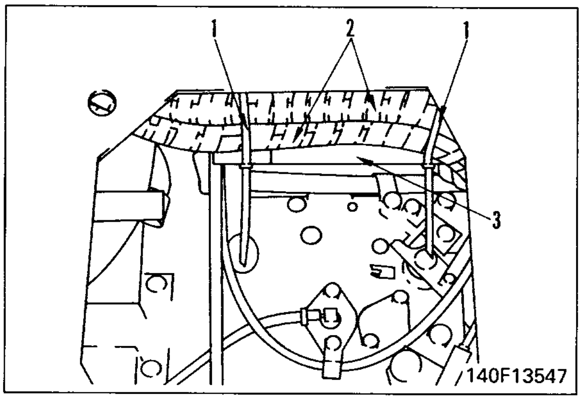
2. Cut band (1), then move 2 PPC hoses (2) towards engine, and remove bracket (3).

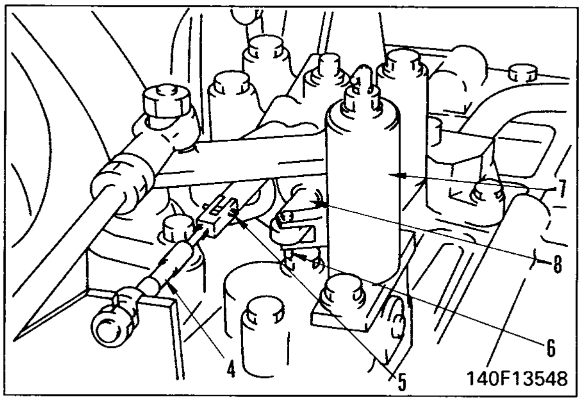
3. Loosen locknut of cable (4), then pull out pin (5) and disconnect cable (4). ※1

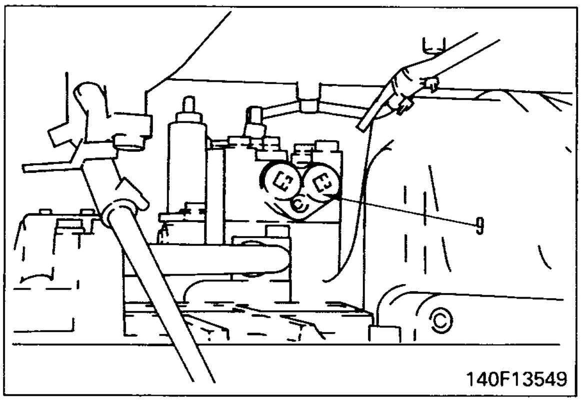
   ★ Measure installed dimension **a** of the cable before disconnecting the cable.

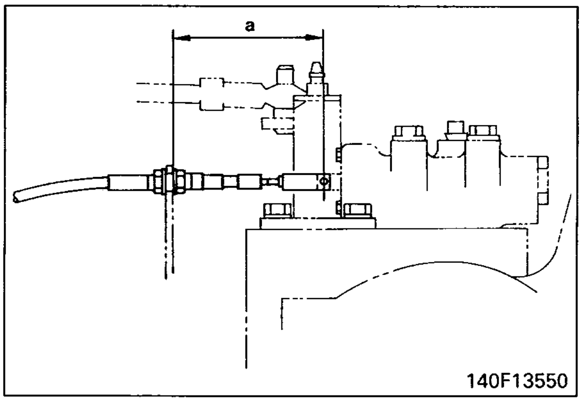
4. Pull out pin (6), and disconnect lever (7) and spool (8). ※2

5. Remove brake valve (9). ※3









INSTALLATION OF BRAKE VALVE ASSEMBLY

D65EX, PX

- Carry out installation in the reverse order to removal.

※1

★ Bend the cotter pin securely after installing.

★ After installing, afjust the parking brake lever. For details, see ADJUSTING PARKING BRAKE LEVER.

※2

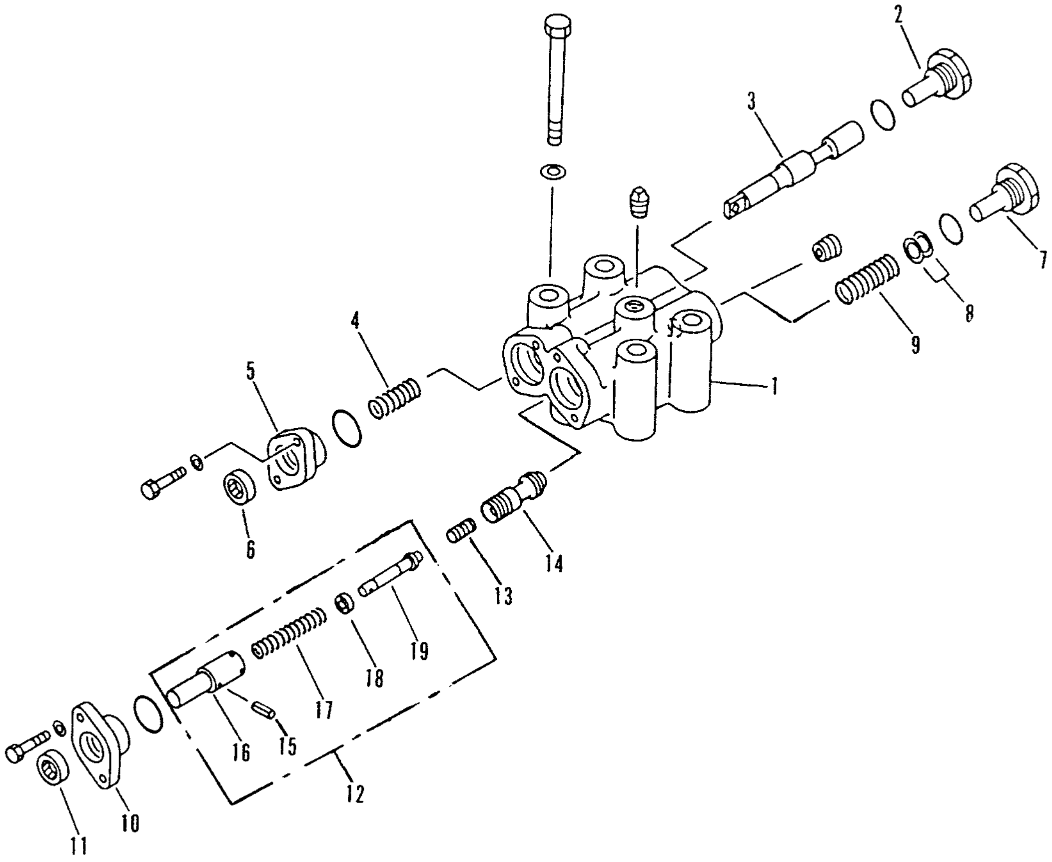
★ Bend the cotter pin securely after installing.

※3

kgm Mounting bolt:
49 ± 4.9 Nm (5 ± 0.5 kgm)

DISASSEMBLY OF BRAKE VALVE ASSEMBLY

D65EX, PX



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1. Remove plug (2) from valve body (1).
2. Remove spool (3) and spring (4).
3. Remove cover (5), then remove seal (6) from cover.
4. Remove plug (7), then remove shim (8) and spring (9).
   ★ Check the number and thickness of the shims, and keep in a safe place.
5. Remove cover (10), then remove seal (11) from cover.
6. Remove guide assembly (12), piston (13), and valve (14).
7. Disassembly of guide assembly (12).
   1) Remove roll pin (15) from guide (16).
   2) Remove spring (17), guide (18), and shaft (19).

ASSEMBLY OF BRAKE VALVE ASSEMBLY

D65EX, PX

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. **Assembly of guide assembly**
   1) Assemble guide (18) and spring (17) to shaft (19), then assemble to guide (16).
   2) Install roll pin (15).
      ★ Install the roll pin in the direction shown in Fig. **a**.

2. Assemble valve (14), piston (13), and guide assembly (12), and install in body (1).

3. Assemble seal (11) and O-ring to cover (10), then install to body.

   Lip of oil seal: **Grease (G2-LI)**

4. Assemble O-ring, shim (8), and spring (9) to plug (7), then install to body (1).
   ★ Check the thickness and number of shims, then assemble them.
   Standard shim thickness: 1.5 mm

   Plug: **68.7 ± 9.9 Nm (7 ± 1 kgm)**

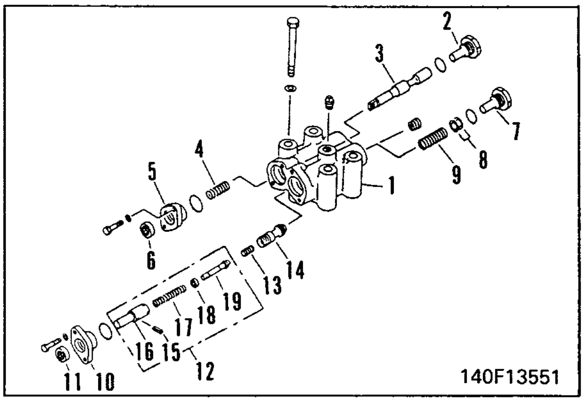
5. Assemble spool (3) in body (1), then fit O-ring to plug (2) and install.

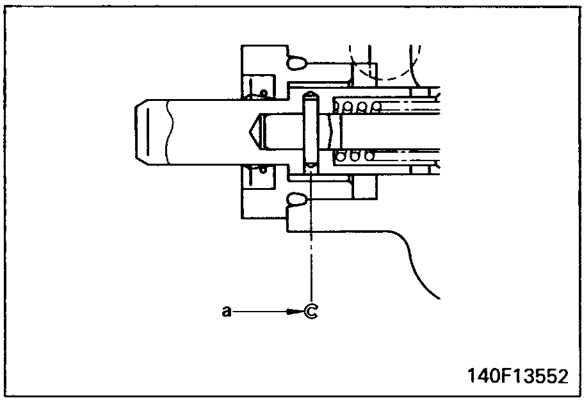
   Plug: **68.7 ± 9.9 Nm (7 ± 1 kgm)**

6. Assemble spring (4).

7. Assemble seal (6) to cover (5), then fit O-ring and install to body (1).

   Lip of seal: **Grease (G2-LI)**

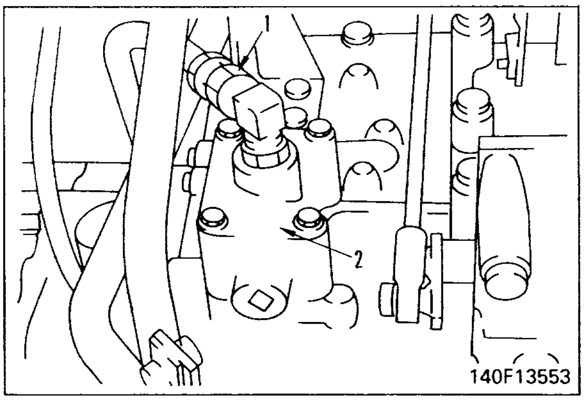




REMOVAL OF REDUCING VALVE ASSEMBLY

D65E, P

1. Remove chassis rear cover.
2. Disconnect hose (1).
3. Remove reducing valve (2). ※1



INSTALLATION OF REDUCING VALVE ASSEMBLY

D65E, P

- Carry out installation in the reverse order to removal.

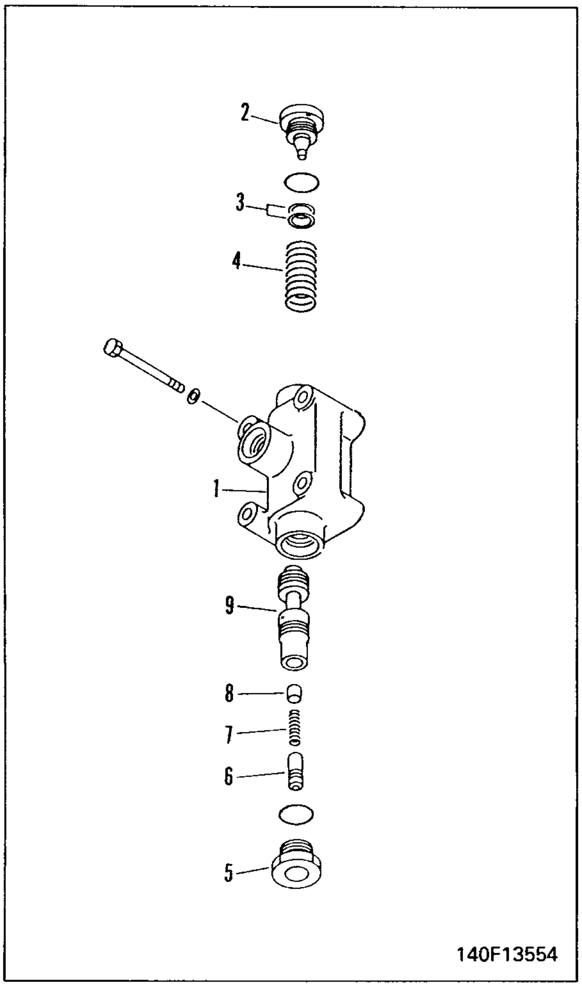
※1

kgm Mounting bolt:
30.9 ± 3.5 Nm (3.2 ± 0.4 kgm)

DISASSEMBLY OF REDUCING VALVE

D65E, P

1. Remove plug (2) from body (1), then remove shim (3) and spring (4).
   ★ Check the number and thickness of the shims, and keep in a safe place.
2. Remove plug (5) from body (1), then remove sleeve (6), spring (7), valve (8), and spool (9).



ASSEMBLY OF REDUCING VALVE

D65E, P

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. Assemble spool (9), valve (8), spring (7), and sleeve (6), and install in body (1).
2. Fit O-ring to plug (5) and install to body (1).
3. Assemble shim (3) and spring (4) to plug (2), then assemble to body (1).
   ★ Check the thickness and number of shims, then assemble them.
   Standard shim thickness: 3 mm
   Amount of change in oil pressure for one shim (t: 0.5): 58.8 kPa (0.6 kg/cm^2)
   ★ Assemble spring (4) securely to spool (9).
4. Tighten plugs (2) and (5) to standard torque.
   kgm Plug: **68.6 ± 9.8 Nm (7 ± 1 kgm)**

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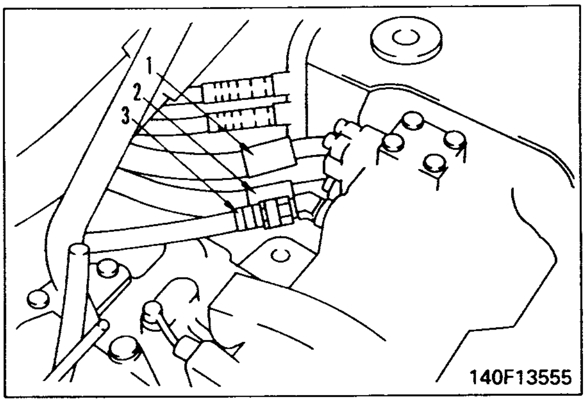
REMOVAL OF HSS MOTOR ASSEMBLY

D65EX, PX

1. Remove fuel tank assembly.
   For details, see REMOVAL OF FUEL TANK ASSEMBLY.

2. Disconnect hoses (1), (2), and (3).

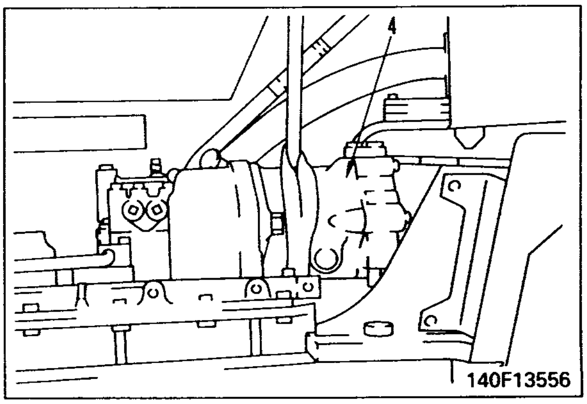
3. Lift off HSS motor assembly (4).
   kg HSS motor: **45 kg**



INSTALLATION OF HSS MOTOR ASSEMBLY

D65EX, PX

- Carry out installation in the reverse order to removal.



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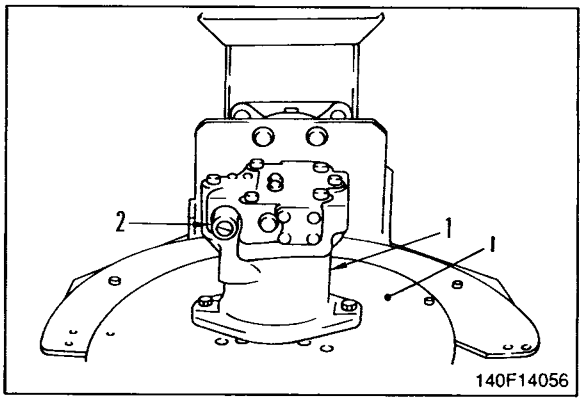
DISASSEMBLY OF HSS MOTOR ASSEMBLY

D65EX, PX

1. **End cover assembly**
   1) Set motor assembly (1) to tool I.
      ★ After setting motor assembly (1) to tool I, loosen safety valve (2), plug (11), and mounting bolts of cover (7).
   2) Remove end cover assembly (3).
   3) Disassembly of end cover assembly
      i) Remove outer race (4), spacer (5), and dowel pin (6) from end cover assembly (3).
      ii) Remove safety valve (2).
      iii) Remove plate (7), then remove O-ring, spring (8), retainer (9), and spool (10).
      iv) Remove plug (11), then remove spring (12) and valve (13).



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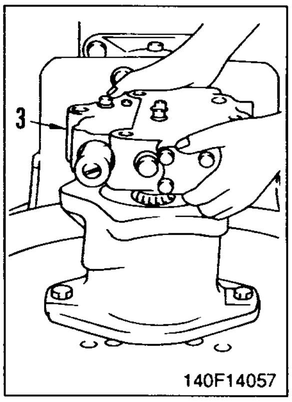

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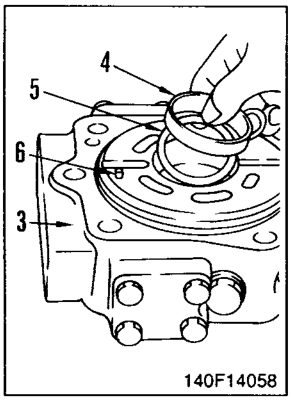

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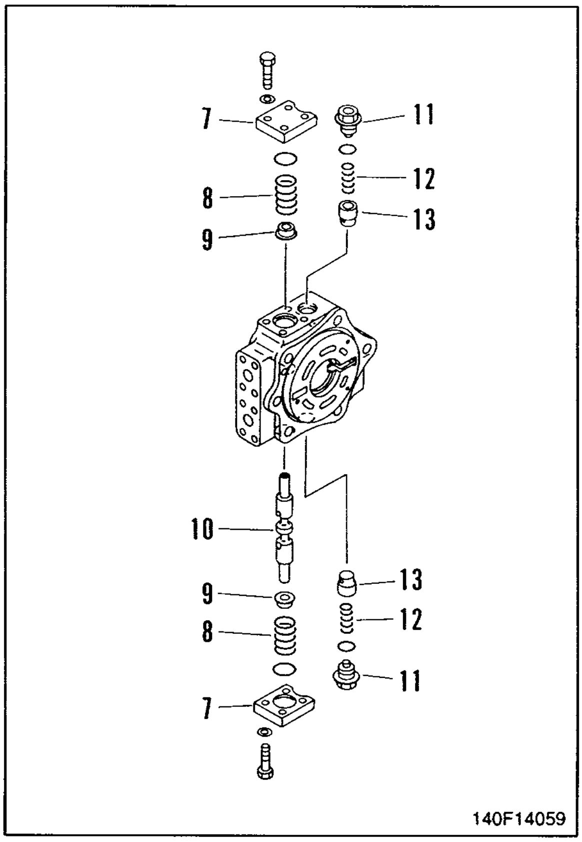

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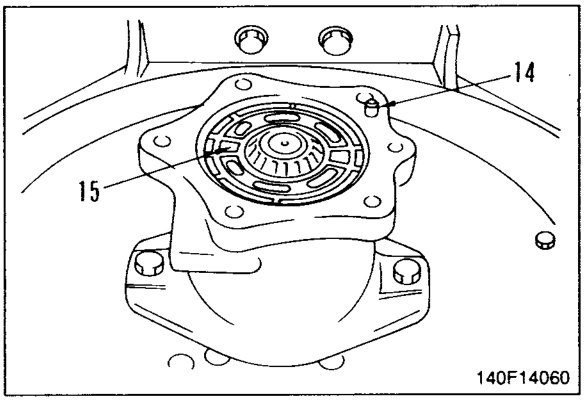
2. Cylinder block, piston assembly

1) Remove dowel pin (14), then remove valve plate (15).
   ★ Check the mounting direction of valve plate (15).



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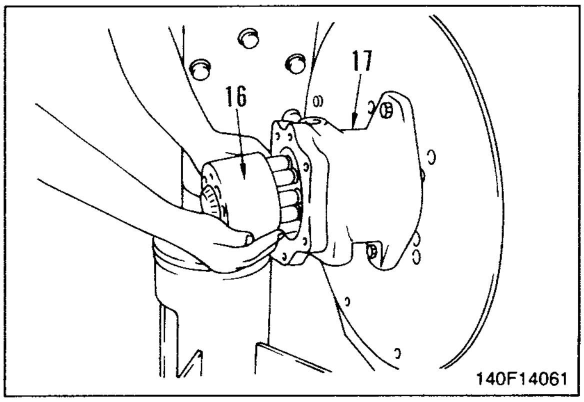
2) Turn over tool **I** 90°, then remove cylinder block and piston assembly (16) from motor case (17).
   ★ Tap the end face of the shaft of the cylinder block and piston assembly with a plastic hammer, and remove.



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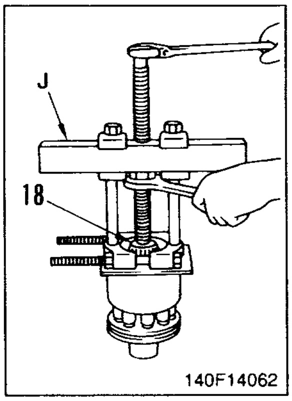
3) Disassembly of cylinder block, piston assembly
   i) Using tool **J**, pull out sub bearing (18).
      ★ To prevent damage to the valve plate contact surface, set a protective sheet between the valve plate contact surface of the cylinder block and the bearing puller, then remove bearing (18).
   ii) Pull out cylinder block (19) from piston and shaft assembly (20).



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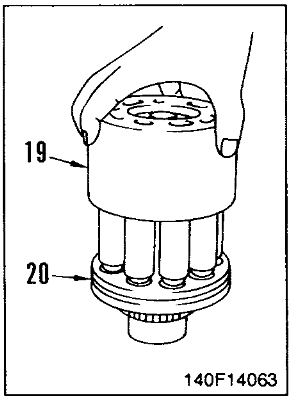

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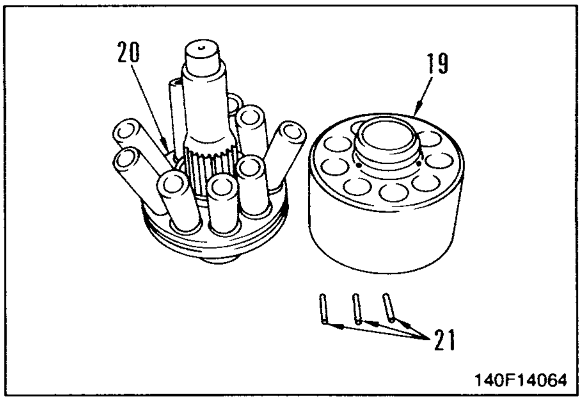
      ★ When removing cylinder block (19), preload pin (21) may fall out, so be careful not to lose it.



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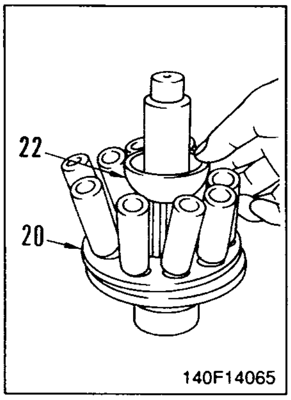
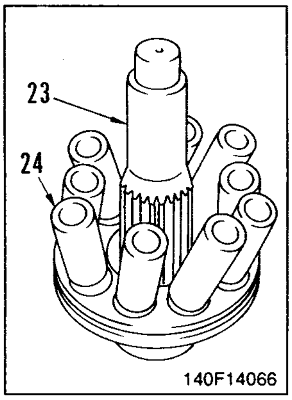
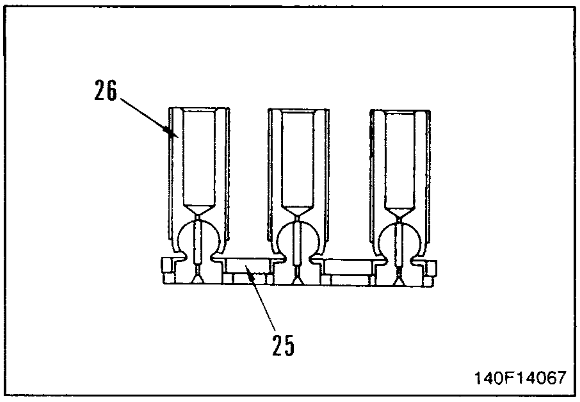
4) Disassembly of piston, shaft assembly
   i) Remove retainer guide (22) from piston and shaft assembly (20).
   ii) Remove piston assembly (24) from shaft (23).





iii) Pull out piston (26) from retainer shoe (25).



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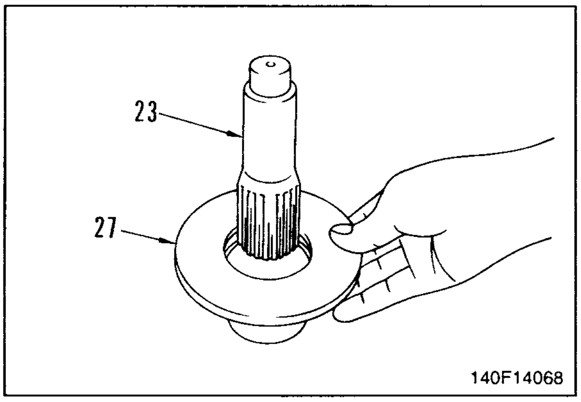
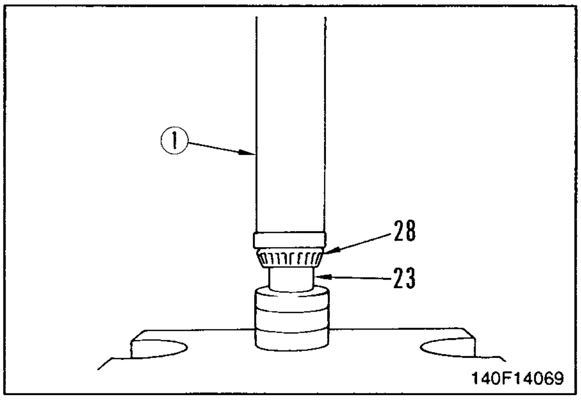
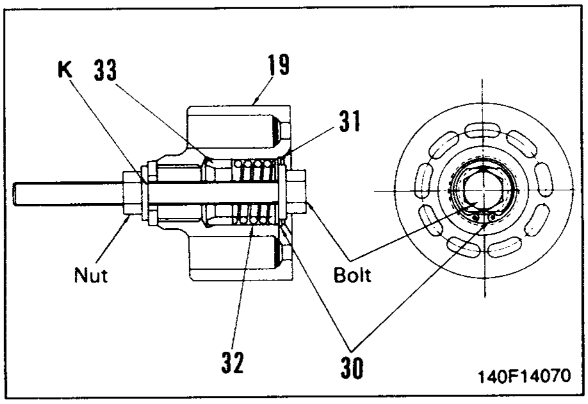
iv) Remove plate (27) from shaft (23).



v) Using push tool ①, push bearing (28) with press and remove from shaft (23).



5) Disassembly of cylinder block
   i) Set tool **K** to cylinder block.
   ii) Hold bolt of tool **K** with wrench, tighten nut and compress spring (32), then remove snap ring (30).
   iii) Loosen nut of tool **K** gradually to loosen tension of spring (32), then remove tool **K**.



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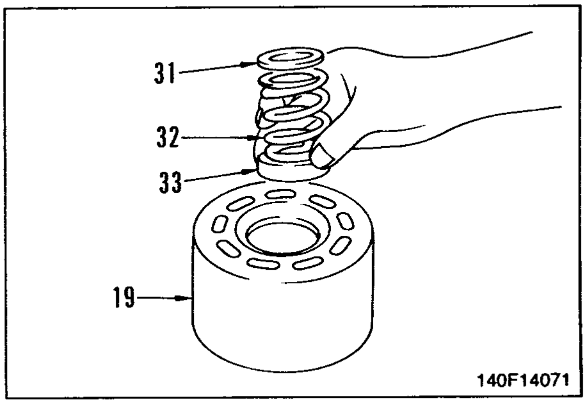
   iv) Remove spacer (31), spring (32), and spacer (33) from cylinder block (19).
      ★ Check the mounting direction of spacer (33).



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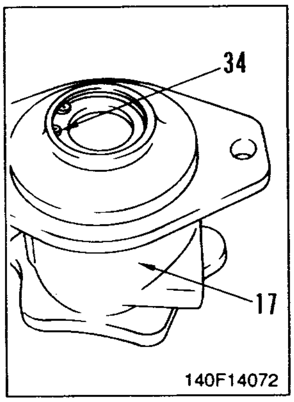
3. Motor case assembly

1) Remove snap ring (34) from motor case (17).
2) Remove spacer (35).



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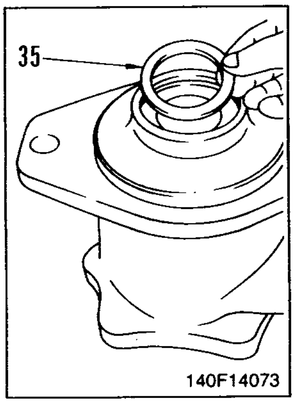

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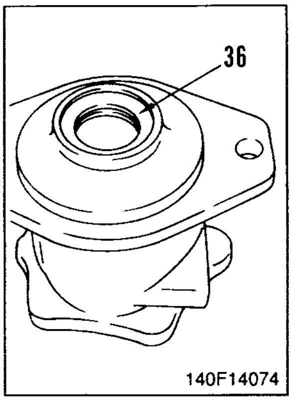
3) Remove oil seal (36).
4) Remove outer race (37) from motor case (17).



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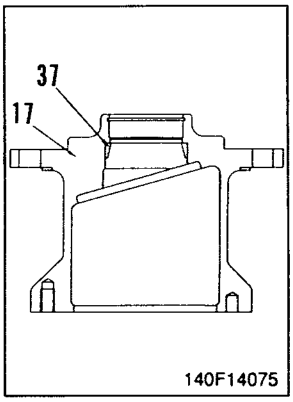

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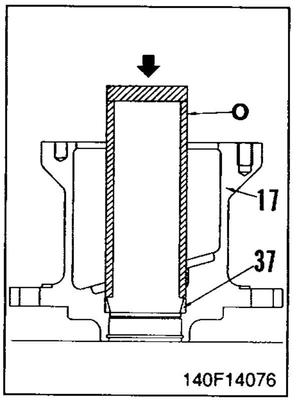
ASSEMBLY OF HSS MOTOR ASSEMBLY

★ Clean all parts, and check for dirt or damage.
★ Coat the sliding surfaces of all parts with engine oil (EO10-CD) before installing.

1. **Motor case**
   1) Using tool **O**, press fit outer race (37) to motor case (17).
   2) Using tool **L**, install oil seal (36) to motor case (17).

      Lip of oil seal: **Grease (G2-LI)**

   3) Fit spacer (35) and install snap ring (34).
      ★ Check that the snap ring is securely fitted into the groove.



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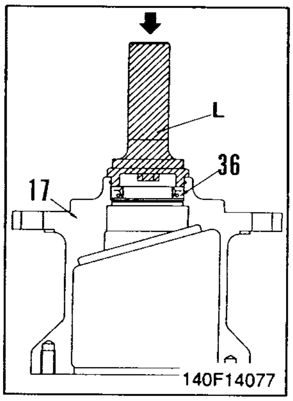

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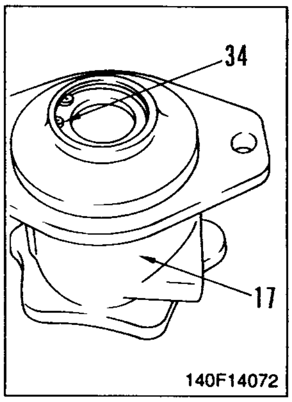

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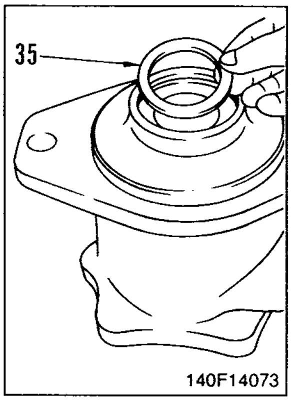

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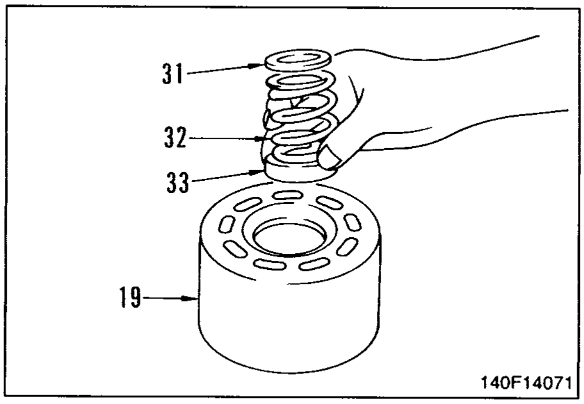
2. **Cylinder block, piston assembly**
   1) Assembly of cylinder block
      i) Assemble spacer (33), spring (32), spacer (31) to cylinder block (19).
         ★ Assemble spacer (33) with the inside taper facing down.



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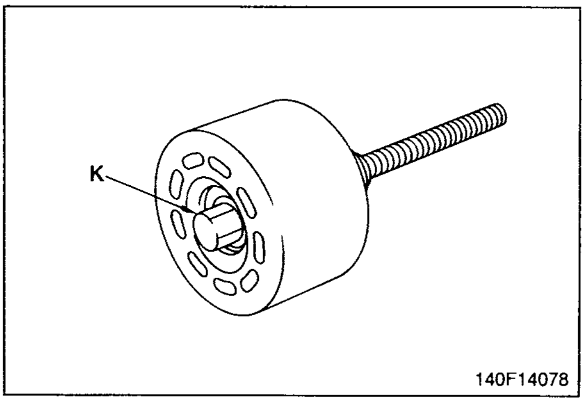
      ii) Set tool **K** to cylinder block (19).
      iii) Hold bolt of tool **K** with wrench, tighten nut and compress spring (29), then install snap ring (30).
         ★ Check that the snap ring is securely fitted into the groove.
      iv) Remove tool **K**.



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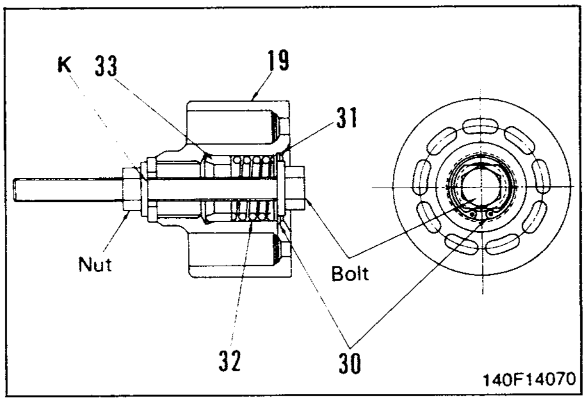
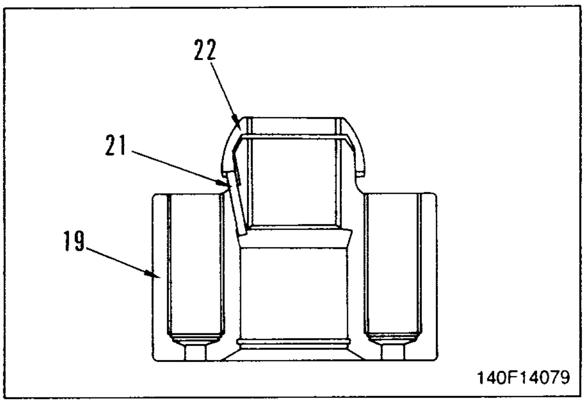


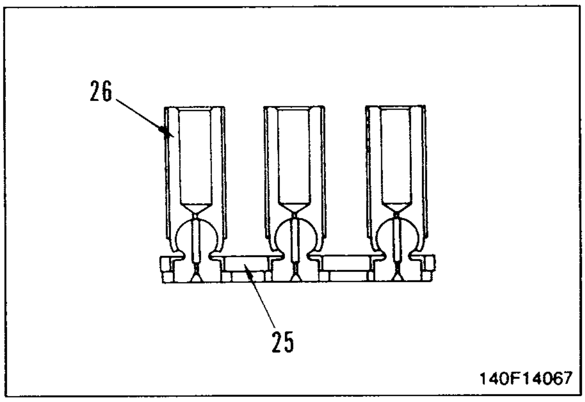
v) Assemble 3 preload pins (21) to cylinder block (19).
★ To prevent preload pins (21) from falling out, coat the pins with grease (G2-LI).

vi) Assemble retainer guide (22) to cylinder block (19).

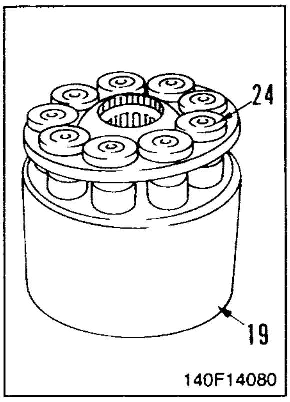


2) Piston assembly

- Assemble piston (26) to retainer shoe (25).

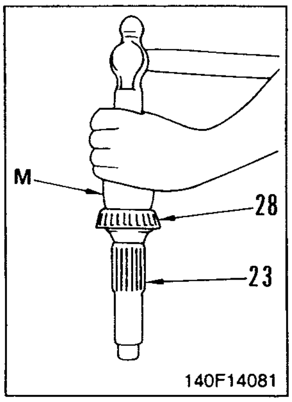


3) Assemble piston assembly (24) to cylinder block (19).

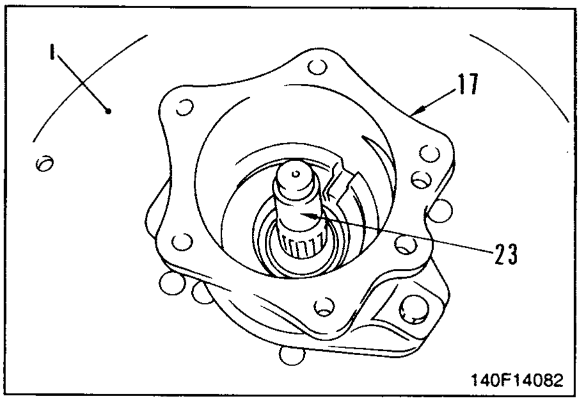


3. Shaft

1) Using tool **M**, press fit bearing (28) to shaft (23).

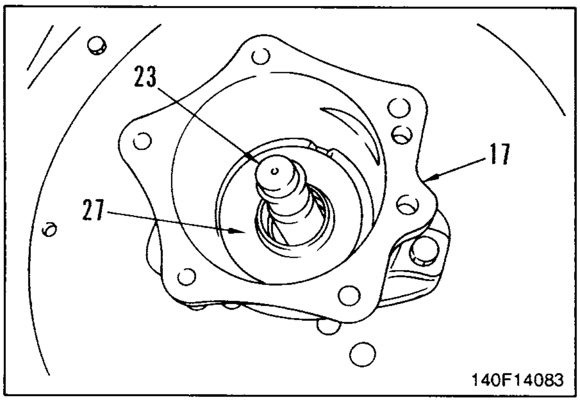


2) Set motor case (17) to tool **I**, and install shaft (23).

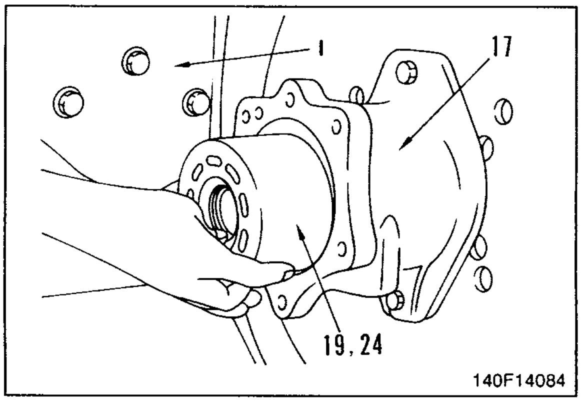


4. Cylinder block, piston, bearing, end cover

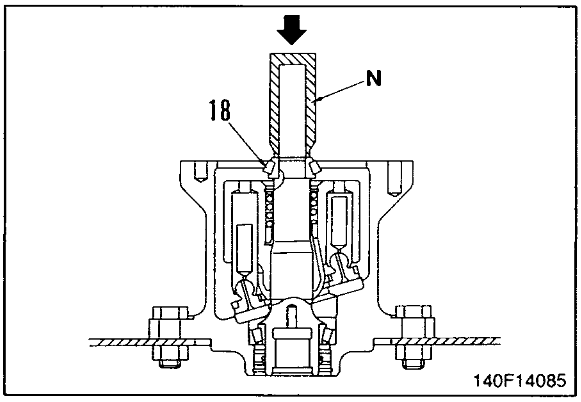
1) Assemble plate (27) to shaft (23) installed to motor case (17).



2) Turn over tool **I** 90°, and assemble cylinder block (19) and piston assembly (24) to motor case (17).



3) Turn over tool **I** 90°, then use tool **N** to press fit sub bearing (18).



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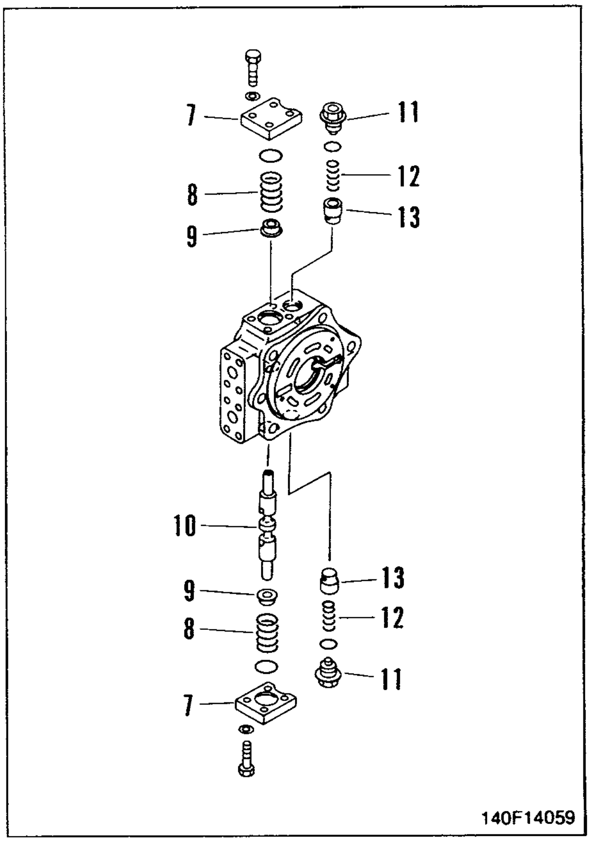
4) Assembly of end cover
   i) Assemble spool (10) to end cover (3), then fit retainer (9), spring (8), and O-ring, and install cover (7).

kgm Mounting bolt: **66.5 ± 7.5 Nm (6.8 ± 0.8 kgm)**

   ii) Fit valve (13) and spring (12) to end cover (3), and install plug (11).

kgm Plug: **166.5 ± 19.5 Nm (17 ± 2 kgm)**



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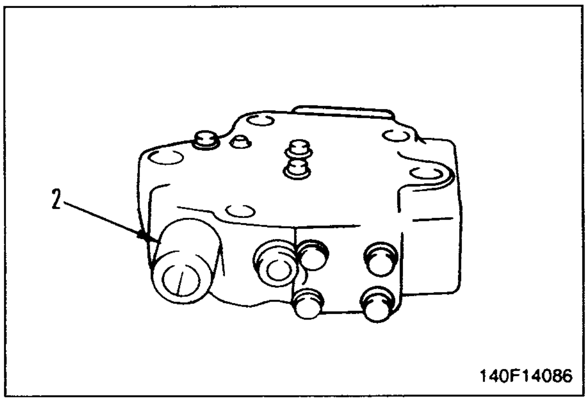
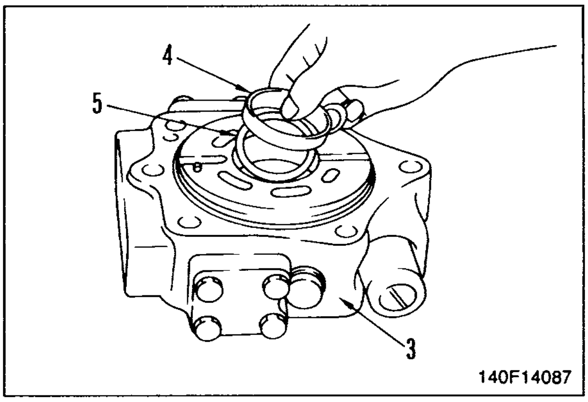
   iii) Fit safety valve (2) and tighten temporarily.



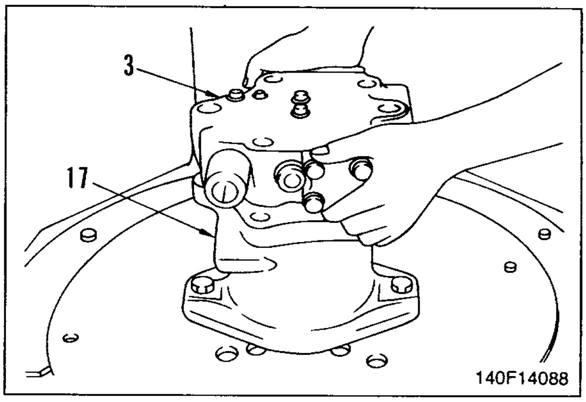
5. **Adjustment of end play**
- Adjust end play as follows.

1) Assemble spacer (5) and outer race (4) to end cover (3).
   ★ For spacer (5), assemble the part that was removed during disassembly.

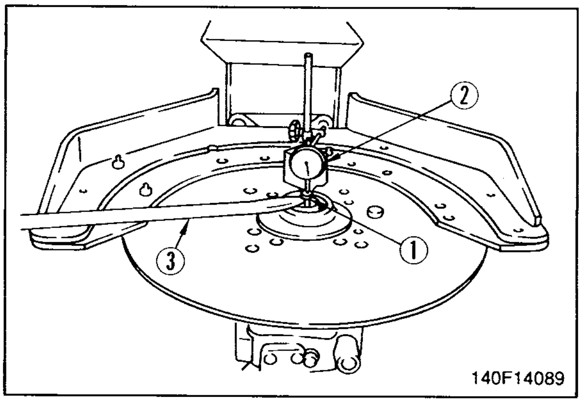


2) Install end cover (3) to motor case (17).

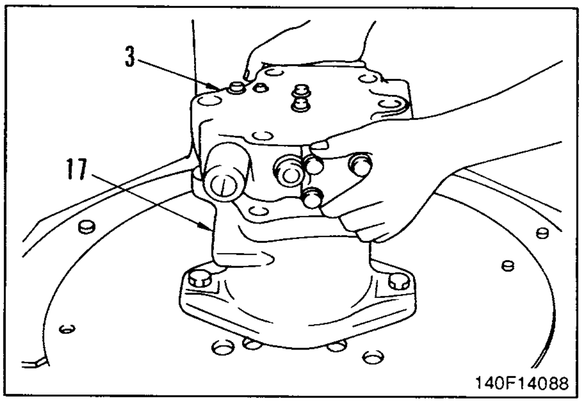
kgm Mounting bolt: **176.5 ± 19.5 Nm**
(18 ± 2 kgm)



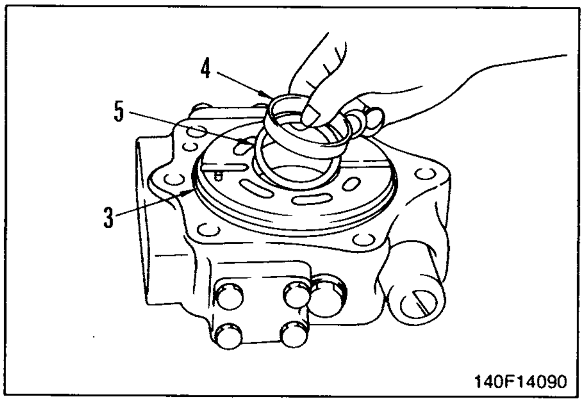
3) Turn over tool **I** 180°, and set bolt ① and dial gauge ② to shaft.
4) Using lever ③, move shaft in axial direction, and measure movement of shaft in axial direction (end play).
★ End play: 0.05 — 0.25 mm



5) If end play is not within standard value, adjust again as follows.
   i) Remove end cover (3) from motor case (17).



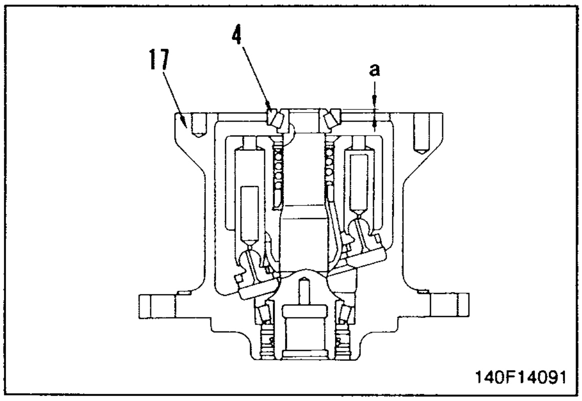
   ii) Remove outer race (4) and spacer (5) from end cover (3).



iii) Set outer race (4) to bearing (18), measure dimension **a** between end face of outer race and case (17), then use formula below to obtain dimension **b** of spacer (5).
b = 3.8 − **a**

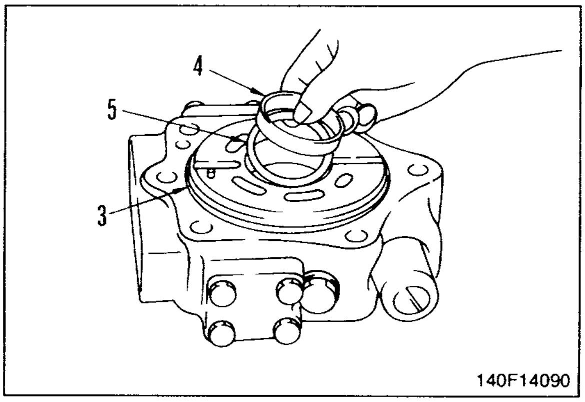
iv) From result of formula in Step iii), select spacer (5) from table below.

Dimension **b** (mm)	1.57 – 1.69	1.70 – 1.79	1.80 – 1.89	1.90 – 1.99	2.00 – 2.09	2.10 – 2.23
Selected spacer part no.	708-7L – 12220	708-7L – 12230	708-7L – 12240	708-7L – 12250	708-7L – 12260	708-7L – 12270



v) Assemble selected spacer (5) and outer race (4) to end cover (3), then install to motor case (17).

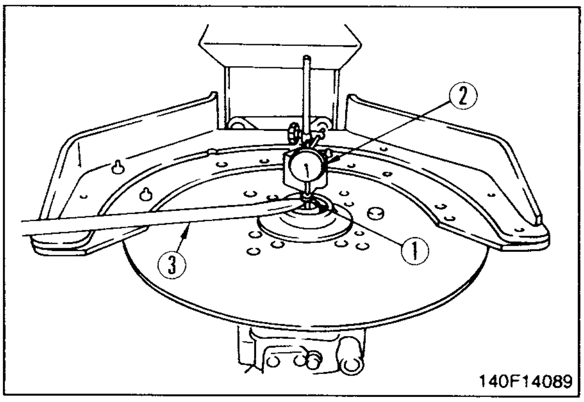
kgm Mounting bolt: **176.5 ± 19.5 Nm (18 ± 2 kgm)**



vi) Turn over tool **I** 180°, and set bolt ① and idal gauge ② to shaft.

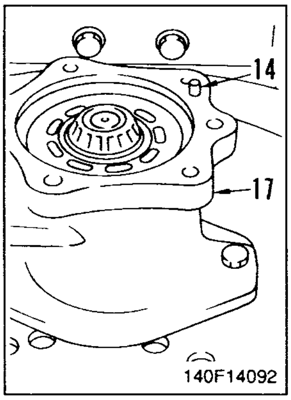
vii) Using lever ③, move shaft in axial direction, and measure movement of shaft in axial direction (end play).
★ End play: 0.05 — 0.25 mm

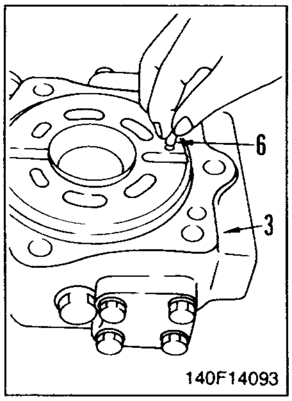
viii) After completing measurement, turn over tool **I** 180°, and remove end cover (3).

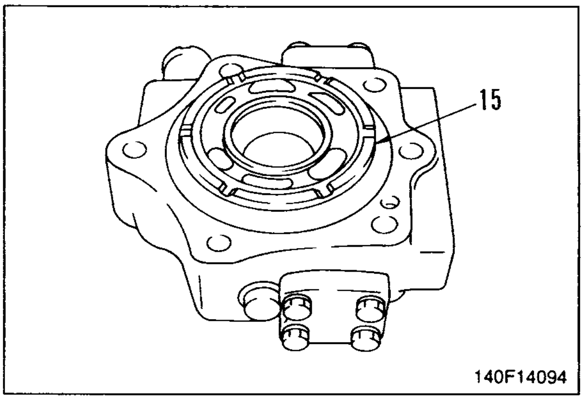


6. End cover, valve plate, safety valve

1) Install dowel pin (14) to motor case (17).
2) Fit dowel pin (6) to end cover (3), and assemble valve plate (15).
★ Coat with engine oil and set valve plate in close contact.





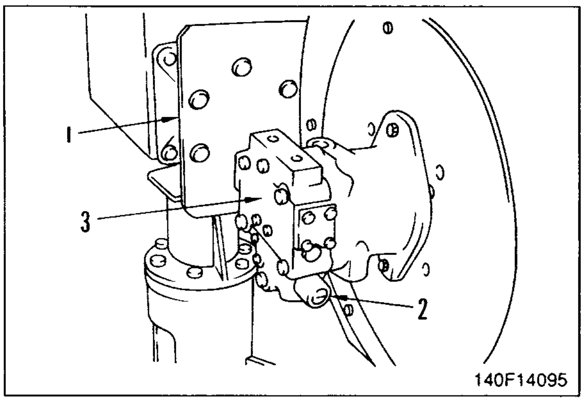


3) Turn over tool **I** 90°, and install end cover (3).

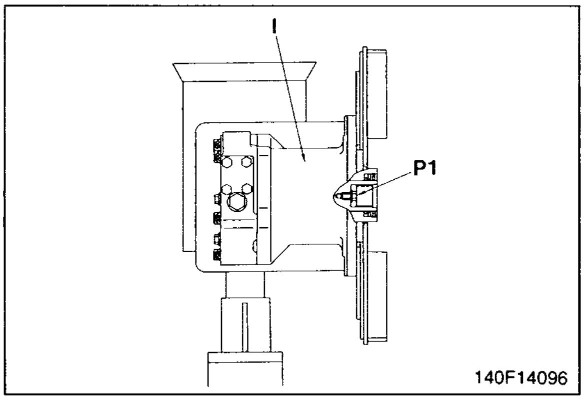
kgm Mounting bolt: **176.5 ± 19.5 Nm**
(18 ± 2 kgm)

4) Tighten safety valve (2) to specified torque.

kgm Safety valve: **225 ± 29 Nm**
(26 ± 3 kgm)

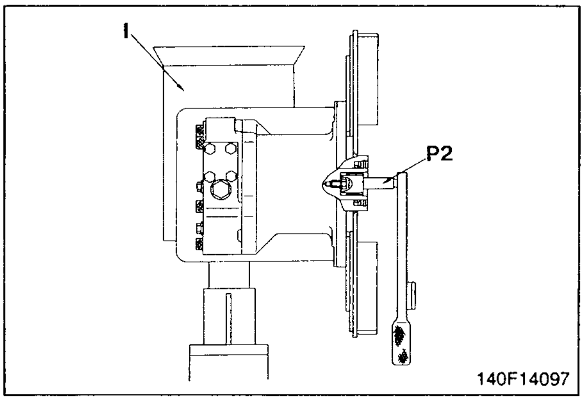


7. **Measuring rotating torque**
   - After assembling, measure rotating torque of shaft.
   1) Set tool **P1** to motor assembly (1).

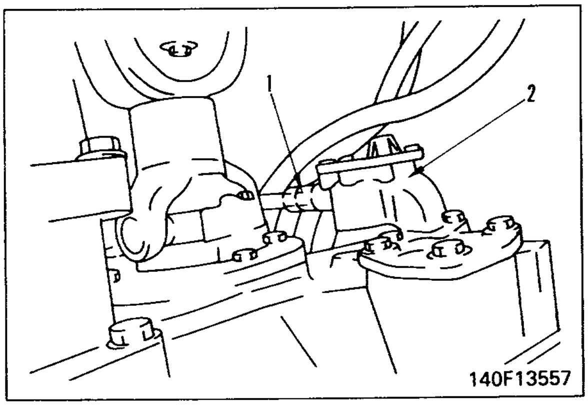


2) Using tool **P2**, rotate shaft at approx. 1 turn/3 — 5 sec, and measure rotating torque.
   ★ Rotating torque: 17.65 — 34.32 Nm
   (1.8 — 3.5 kgm)
   ★ There must be no variation in the rotating torque.

8. After measuring rotating torque, remove motor assembly (1) from tool **I**.



REMOVAL OF SCAVENGING PUMP ASSEMBLY



1. Drain oil.

   Power train: **Approx. 70 ℓ**

2. Remove undercover.

   ⚠ The bottom cover weighs 26 kg, so support it with a transmission jack before removing the mounting bolts.

3. Disconnect hose (1).

4. Remove scavenging pump assembly (2).

INSTALLATION OF SCAVENGING PUMP ASSEMBLY

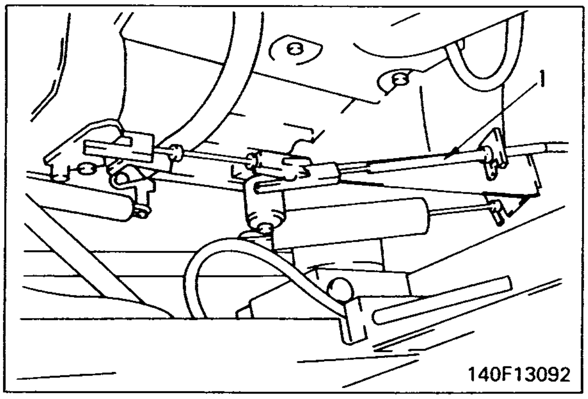
- Carry out installation in the reverse order to removal.
- **Refilling with oil**

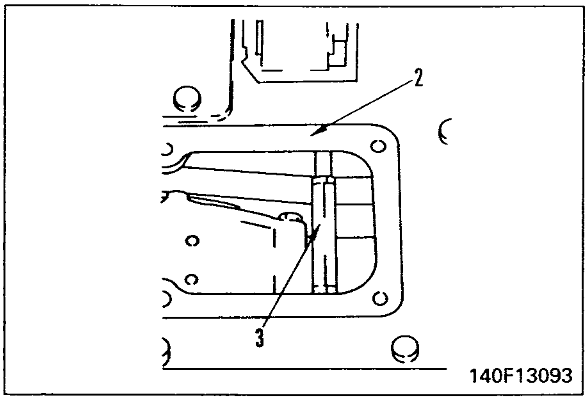
★ Add oil through oil filler to the specified level.
Run the engine to circulate the oil through the system.
Then check the oil level again.

014012

REMOVAL OF POWER TRAIN PUMP ASSEMBLY

1. Disconnect deceleration cable (1) at engine end. [※1]
2. Remove cover of plate (2), and disconnect brake rod (3) at turnbuckle portion [※2]
   ★ Measure the installed length of the rod before disconnecting the turnbuckle.
3. Remove plate (2).
4. Disconnect hose (4).
5. Open chassis bottom cover, and disconnect tube (5).
   ⚠ The bottom cover weights 26 kg, so support it with a transmission jack before removing the mounting bolts.
6. Lift off power train pump assembly (6).





INSTALLATION OF POWER TRAIN PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

[※1]

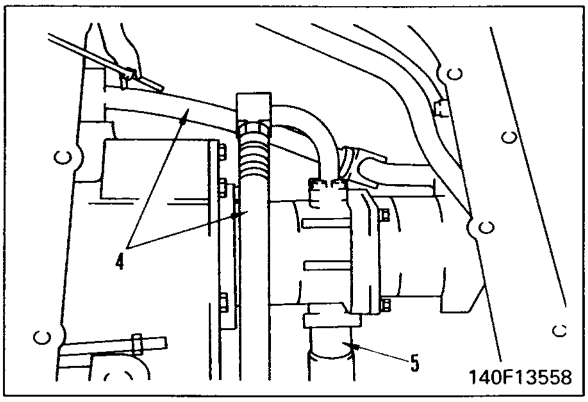
★ Adjust the cable.
For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

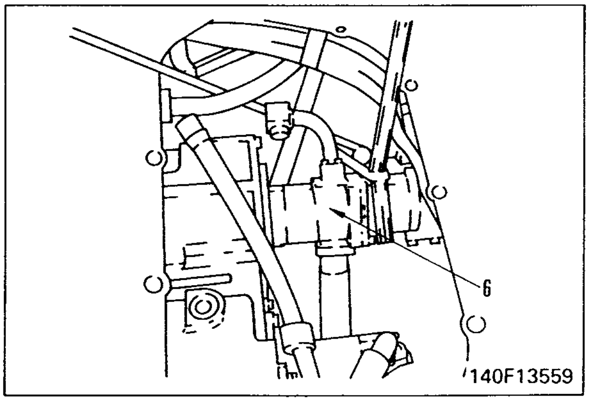
[※2]

★ Adjust the rod.
For details, see TESTING AND ADJUSTING, Adjusting brake pedal linkage.

- **Refilling with oil (power train case)**

★ Add oil through oil filler to the specified level.
Run the engine to circulate the oil through the system.
Then check the oil level again.





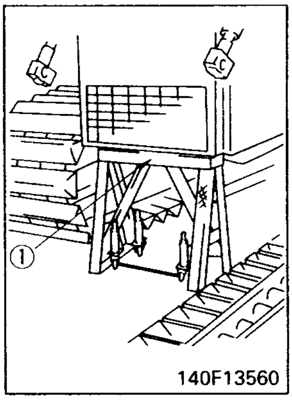
REMOVAL OF FINAL DRIVE ASSEMBLY

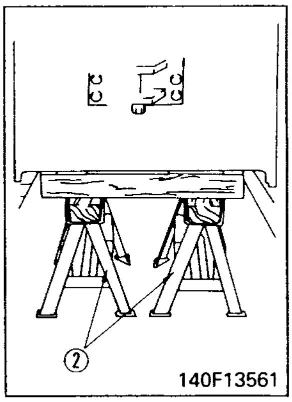
1. Remove track shoe assembly.
   For details, REMOVAL OF TRACK SHOE ASSEMBLY.
2. Using jack (50 ton), jack up chassis, then set stands ① and ② (height: Approx. 900 mm) under front frame and steering case.

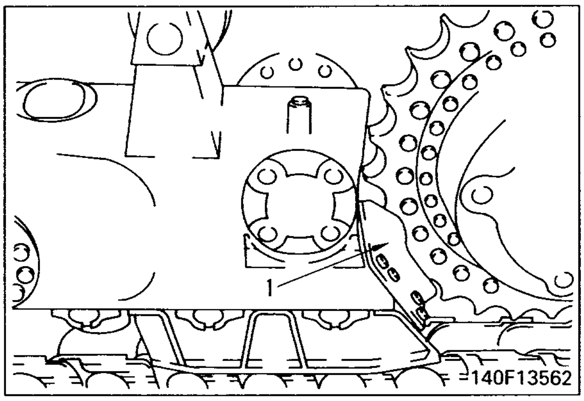
   ⚠ Set the stands in position securely.
3. Drain oil from final drive case.

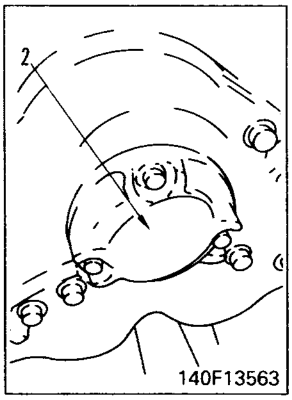
   Final drive case:
   Approx. 24 ℓ (each)(D65E, EX)
   Approx. 27 ℓ (each)(65P, PX)
4. Remove bracket (1). ※1
5. Remove cover (2). ※2
6. Use bolt ③ to pull drive shaft (3) out to a position where spline portion comes out.
   - ★ If the shaft will not come out, move the sprocket (use a jack to push up the shoe grouser from the ground), and adjust to a position where the shaft can be removed. Then pull the shaft out.
7. Leave 2 or 3 of 11 inside mounting bolts (4) and 9 outside mounting bolts in position at top, and remove remaining mounting bolts. ※3
8. Remove 2 cover mounting bolts from final drive case, then set tool **F1** and lever block (1/2 t) in position, and sling final drive assembly (5). ※4
9. Remove remaining bolts, then move case to outside to remove.
   - ★ Operate the lever block and use a bar to make a uniform gap at the mating face of the final drive case assembly and case, then remove.

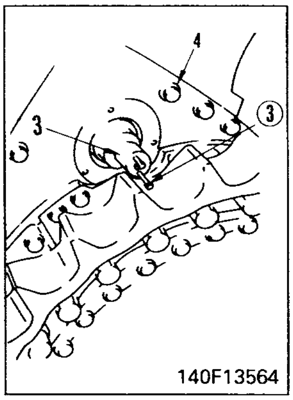
   kg Final drive assembly:
   800 kg (D65E, EX)
   830 kg (65P, PX)
10. Remove drive shaft (3).

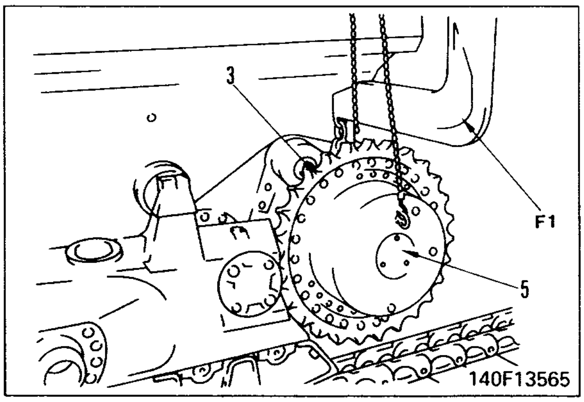












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INSTALLATION OF FINAL DRIVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

Thread of bracket mounting bolt:
Thread tightener (LT-2)

※2

★ Be careful not to damage the seal when installing.

kgm Cover mounting bolt:
110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)

※3

kgm Final drive assembly mounting bolt:
549 ± 59 Nm (56 ± 6 kgm)

※4

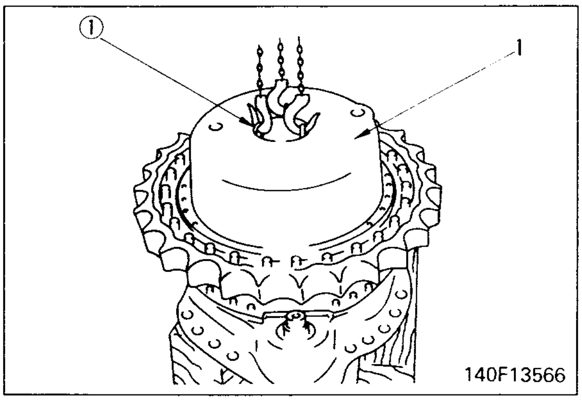
kgm Cover mounting bolt:
277 ± 32 Nm (28.25 ± 3.25 kgm)

014012

DISASSEMBLY OF FINAL DRIVE ASSEMBLY

1. **Carrier assembly**
   1) Remove cover.
   2) Remove mounting bolts, and using eyebolts ①, remove carrier assembly (1).

- **Disassembly of carrier assembly**
  1) Remove lock plate (2).
  2) Using forcing screws ②, remove plate (3) together with gear assembly (4).
  3) Remove gear assembly (4) from plate (3).
     ★ If gear assembly (4) remains in position when the plate is removed, use puller ③ to remove it.
  4) Support gear (5), then push shaft (6) and remove bearing (7).
  5) Remove bearing (7) from shaft (6).
  6) Remove outer race (8) from gear (5).



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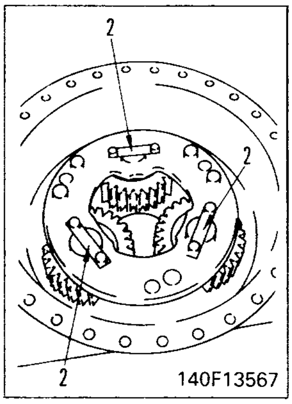

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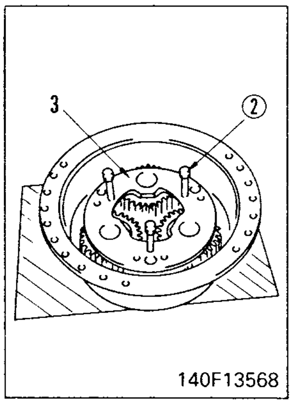

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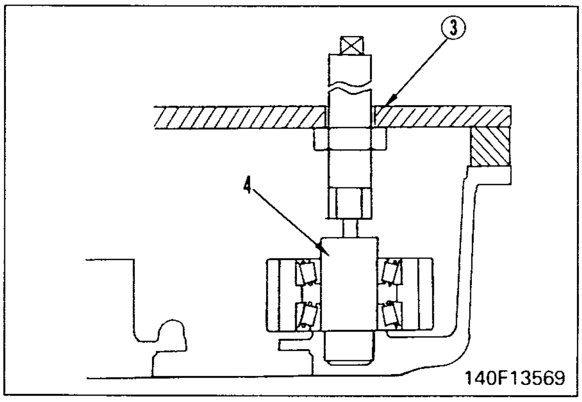

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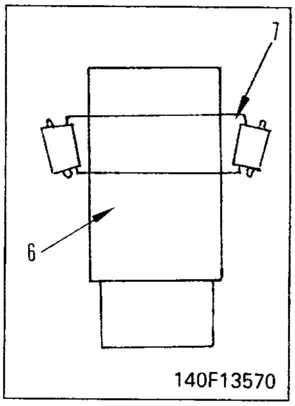

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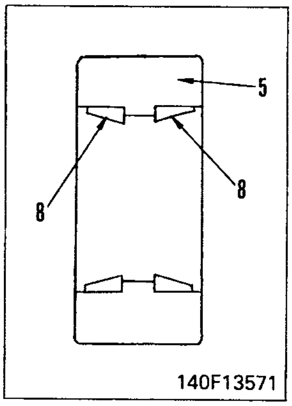

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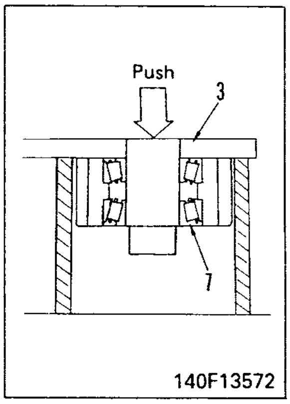

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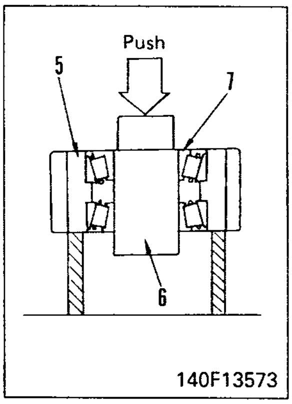
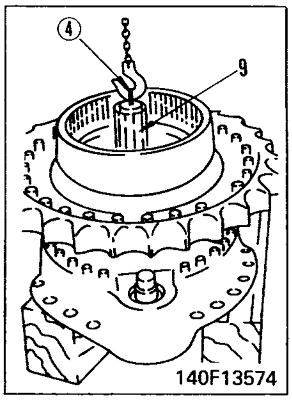


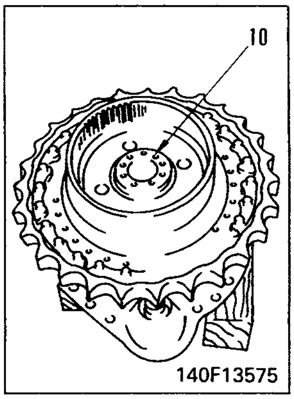
140F13573

2. Using eyebolts ④, remove shaft (9).

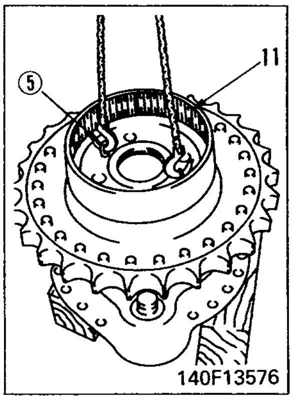
3. Ring gear, housing assembly

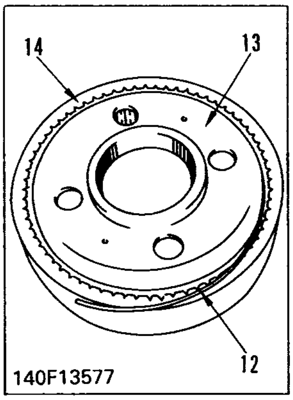
1) Remove holder (10).





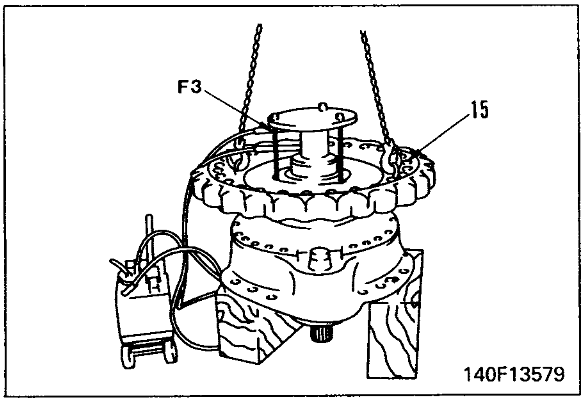
2) Using eyebolts ⑤, remove ring gear and hub assembly (11).
3) Remove snap ring (12), then remove ring gear (14) from hub (13).

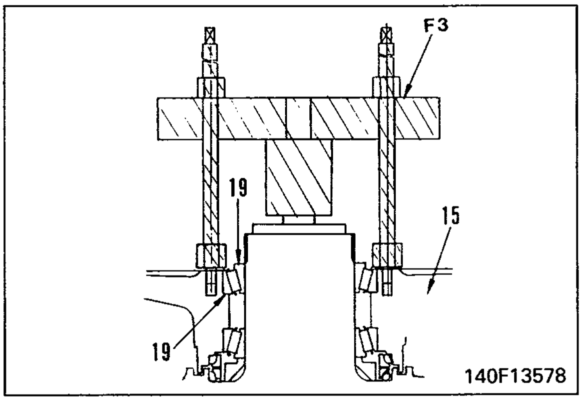




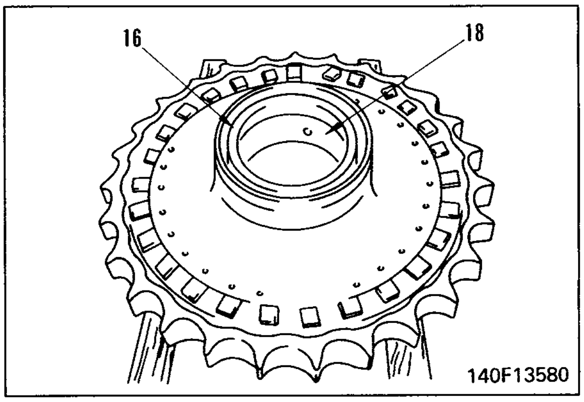
4. Sprocket, hub assembly

1) Fit eyebolts, pull out sprocket and hub assembly (15) with tool **F3**, and remove.
   ★ Bearing (19) will come out at the same time.



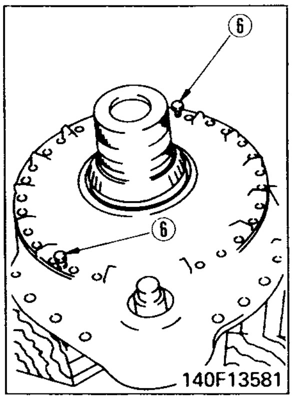


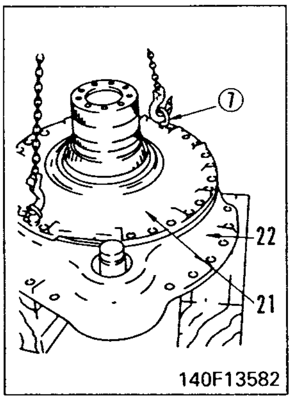
2) Remove floating seal (16).
   ★ If it is to be used again, be careful not to damage the seal surface and keep it in a safe place.
3) Remove outer race (18).



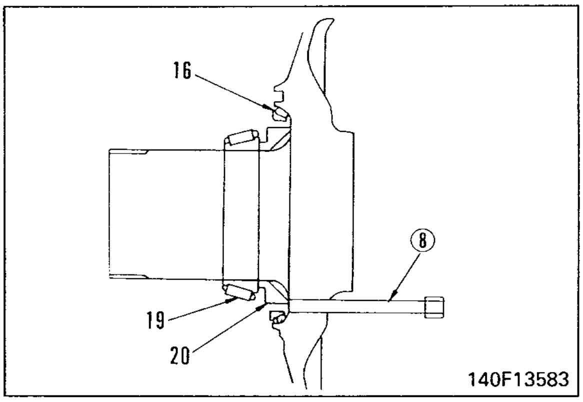
5. Cover assembly

1) Using forcing screws ⑥, pull out cover assembly (21) from case (22), then replace with eyebolts ⑦, and remove.



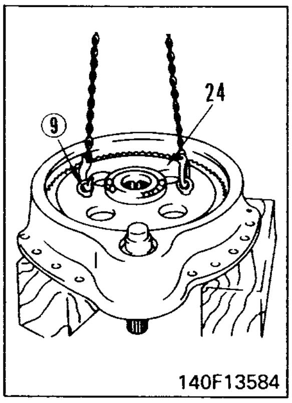


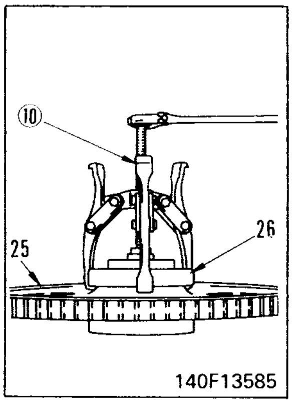
2) Remove floating seal (16).
   ★ If it is to be used again, be careful not to damage the seal surface and keep it in a safe place.
3) Using forcing screws ⑧, remove spacer (20) and bearing (19) from cover.



6. Gear assembly

1) Using eyebolts ⑨, remove gear assembly (24) from case.
2) Using puller ⑩, remove bearing (26) from gear assembly (25).



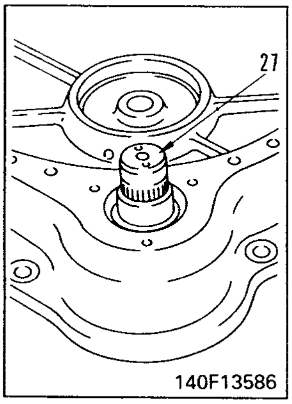


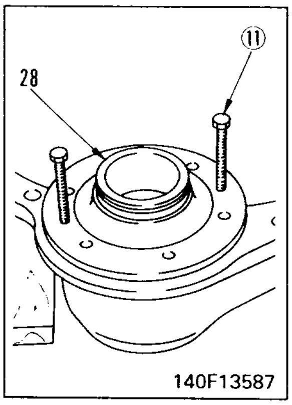
7. Output shaft

Remove output shaft (27).

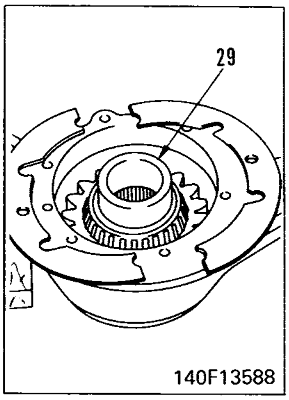
8. Pinion assembly

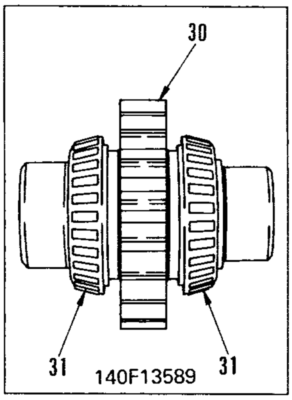
1) Using forcing screws ⑪, remove cage (28).
   ★ Check the number and thickness of the shims, and keep in a safe place.



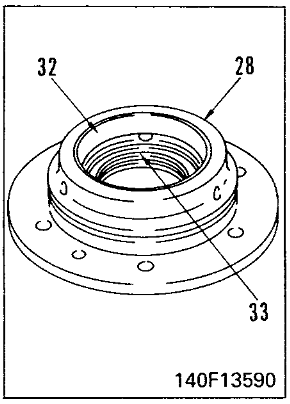


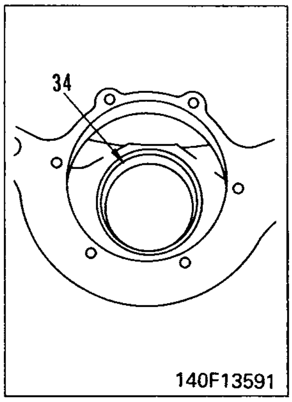
2) Remove pinion assembly (29).
3) Remove bearing (31) from pinion (30).





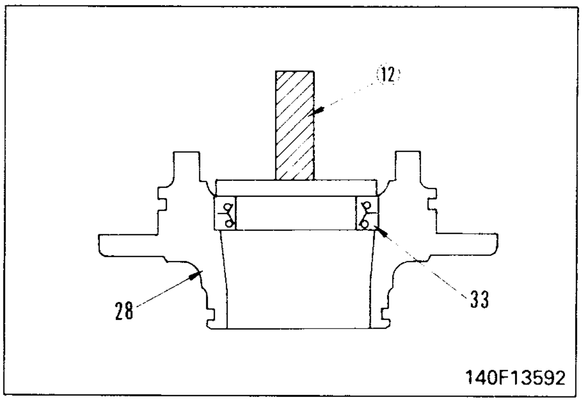
4) Remove outer race (32) and oil seal (33) from cage (28).
5) Remove outer race (34) from case.





ASSEMBLY OF FINAL DRIVE ASSEMBLY

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.



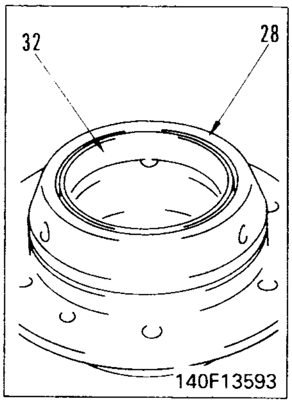
140F13592

1. Pinion assembly

1) Using push tool ⑫, install oil seal (33) to cage (28).

Lip of oil seal: **Grease (G2-LI)**

2) Install outer race (32) to cage (28).
3) Install outer race (34) to case.



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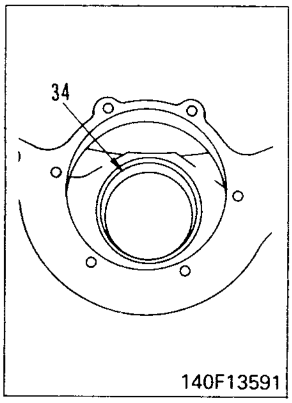
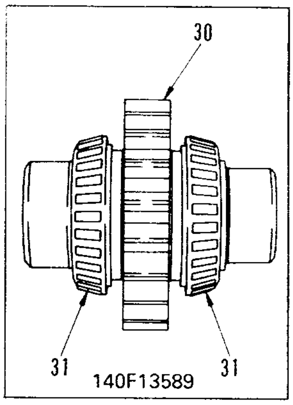


140F13591

4) Install bearing (31) to pinion (30).



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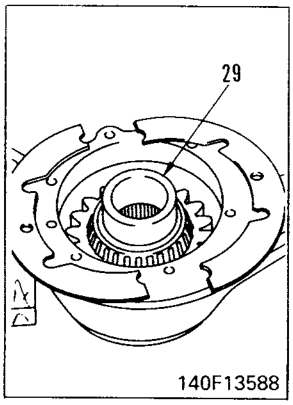

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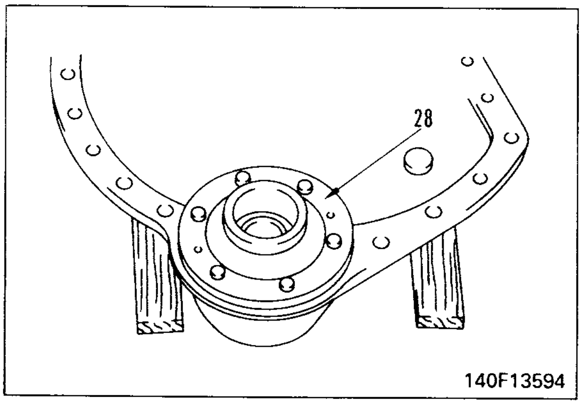
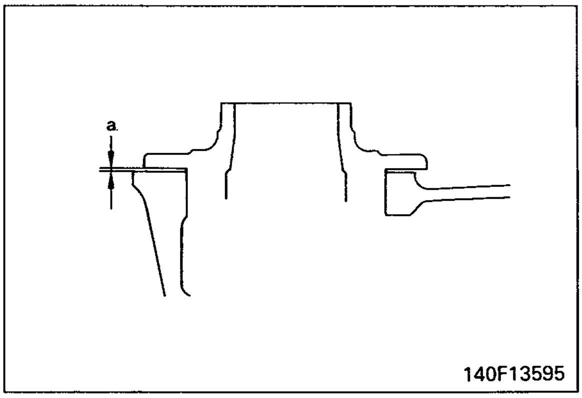
5) Install pinion assembly (29).
   ★ Install so that the part with the small outside diameter is facing the outside.
6) Assemble shim, the install cage (28).



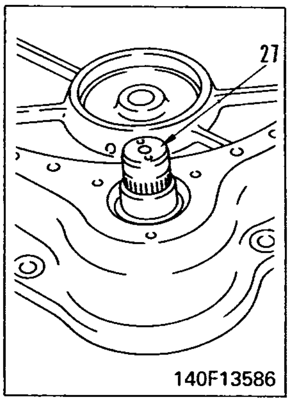
140F13594

★ Select the shim thickness to be assmbled as follows.
  i) Install pinion without fitting O-ring to cage.
  ii) Hold cage down by hand, and use a clearance gauge to measure clearance between gauge and case at 2 places on the circumference.
  iii) Select shim to give a thickness of measured clearance **a** + 0 — 0.1 mm.
    ★ If the clearance is 0, check that the rotating torque of the pinion is at least 0.98 Nm (0.1 kgm).



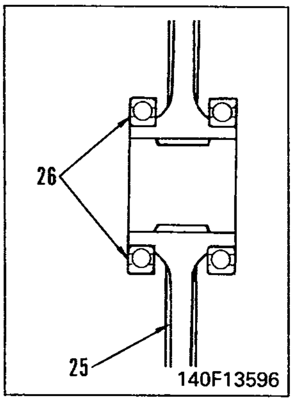
140F13595

2. Output shaft
Install output shaft (27).



140F13586

3. Gear assembly
1) Install bearing (26) to gear (25).



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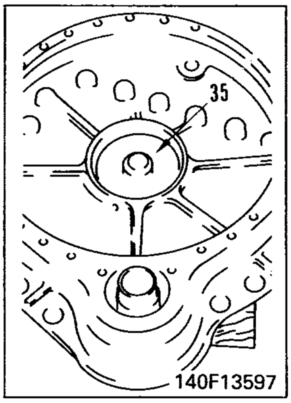
014012

2) Install thrust washer (35) to case.
3) Using eyebolts ⑨, install gear assembly (24).



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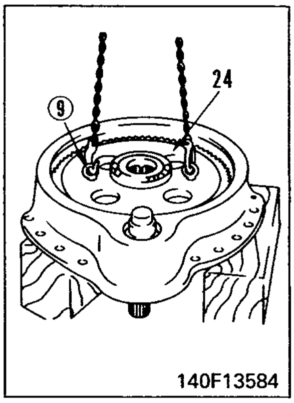
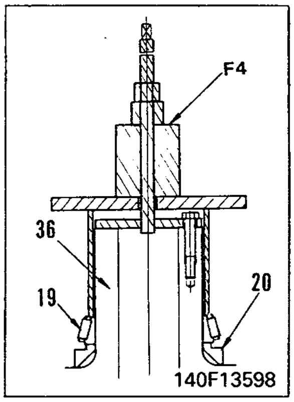


140F13584

4. Cover assembly
1) Install spacer (20) to cover (36).
2) Using tool **F4**, press fit bearing (19).
  ★ A press can be used instead of the puller.
3) Using tool **F2**, install floating seal.
  ★ Remove all oil and grease from the O-ring and O-ring contact surface, and dry before installing.
  ★ After installing the floating seal, check that the angle of the seal is less than 1 mm.



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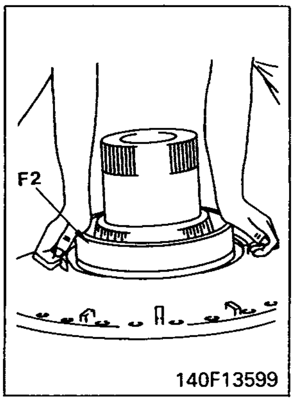

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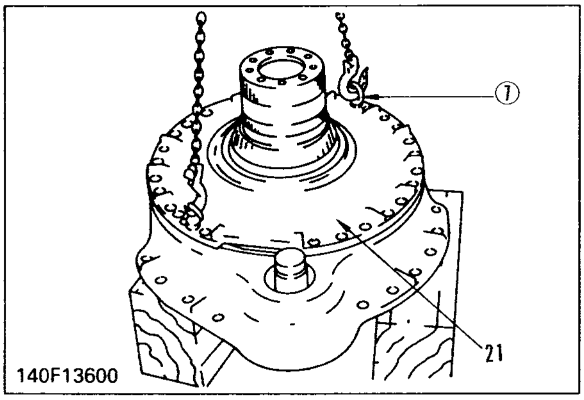
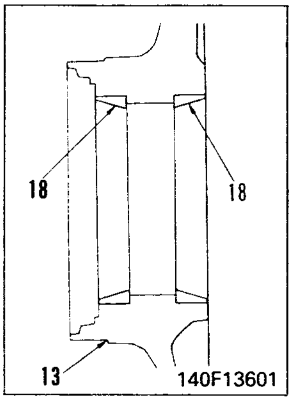
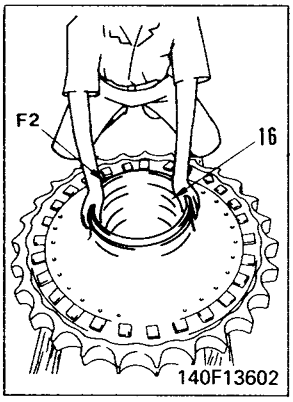
4) Using eyebolts ⑦, install cover assembly (21) to case, then tighten mounting bolts.



5. Sprocket, hub assembly

1) Install outer race (18) to hub (13).
2) Using tool **F2**, install floating seal (16).
   - ★ Remove all oil and grease from the O-ring and O-ring contact surface, and dry before installing.
   - ★ After installing the floating seal, check that the angle of the seal is less than 1 mm.
3) Check that there is no dirt or dust on sliding surface of floating seal, then coat thinly with engine oil.





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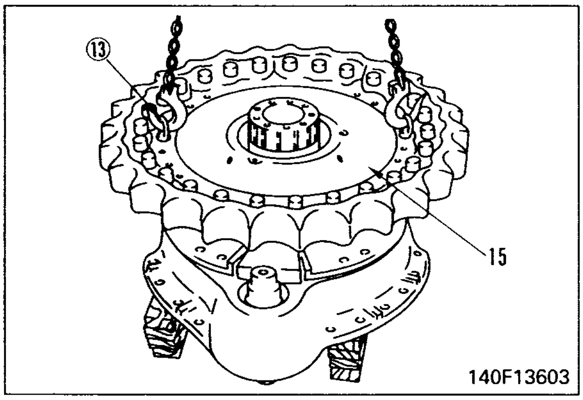
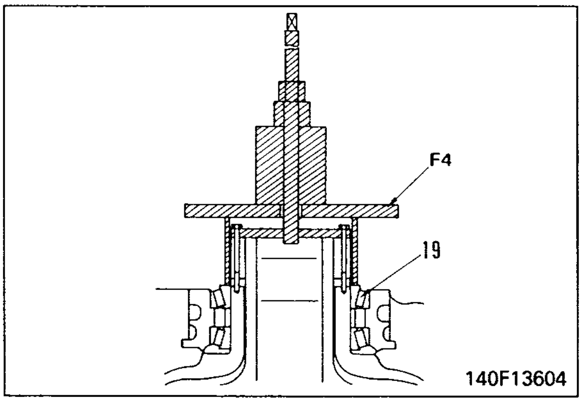
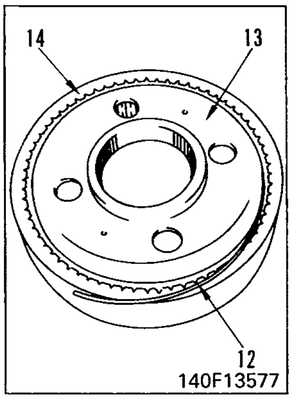
4) Using eyebolts ⑬, set sprocket and hub assembly (15) in cover.



5) Using tool **F4**, rotate sprocket and hub assembly, and press fit bearing (19).
   - ★ Press fit to a point which does not give any preload.



6) Set hub (13) to ring gear (14), and install snap ring (12).
7) Using eyebolts ⑤, install ring gear and hub assembly (11).



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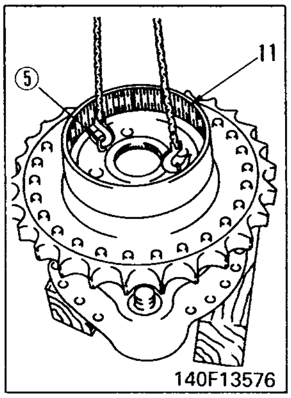
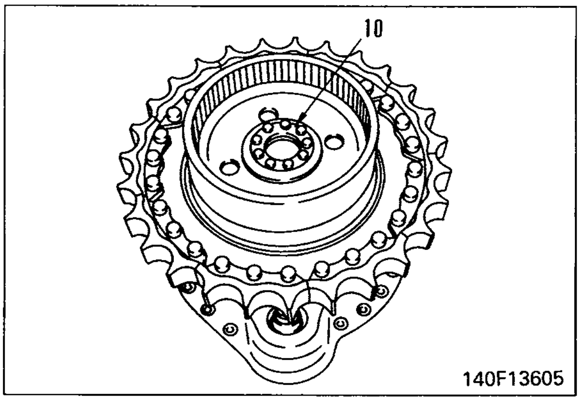


140F13576

8) Set holder (10) in position.
- The bearings are set right, so there is no need to adjust them, but in order to check that there are no defective parts, measure the preload as follows.
  i) With no preload given to the bearings, measure the rotating torque of the sprocket hub, and take this as **a** Nm (kgm).
  ★ Measure the sliding resistance of the floating seal first.
  ii) Rotate the sprocket and tighten the plate holder bolt to 245.2 — 308.9 Nm (25 — 31.5 kgm).
  iii) After tightening the bolt, check that the rotating torque is **a** + (0 — 61.7) Nm [**a** + (0 — 6.3) kgm.]



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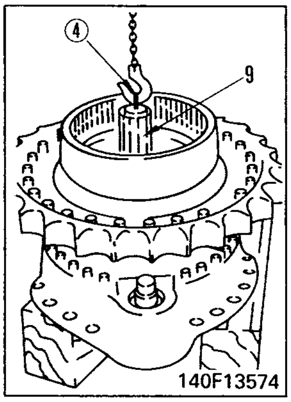
014012

6. Shaft
Using eyebolts ④, install shaft (9).

7. Carrier assembly
1) Press fit outer race (8) to planetary gear (5).
   ★ The bearing is set right, so be careful not to change the combination when installing.



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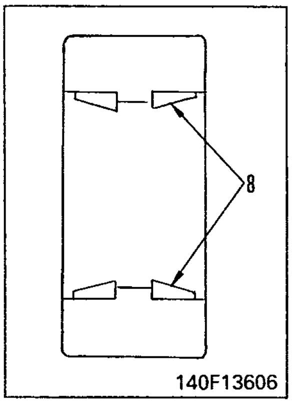

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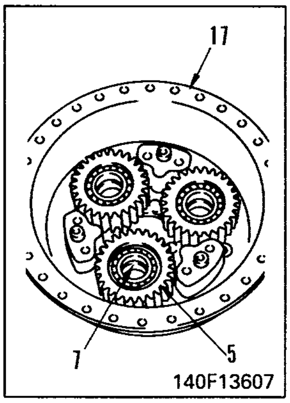
2) Assemble 2 bearings (7) to gear (5), and set to carrier (17).
   ★ Center with the shaft hole.
3) Align with dowel pin and install plate (3).

kgm Mounting bolts:
549.2 ± 58.8 Nm (56 ± 6 kgm)



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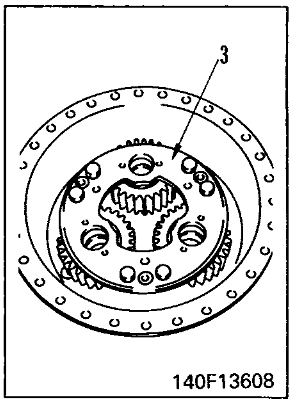

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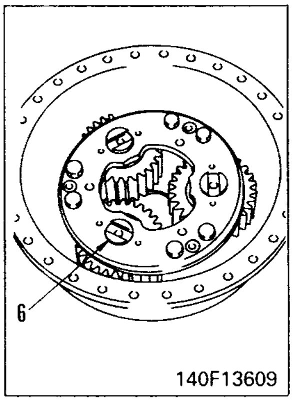
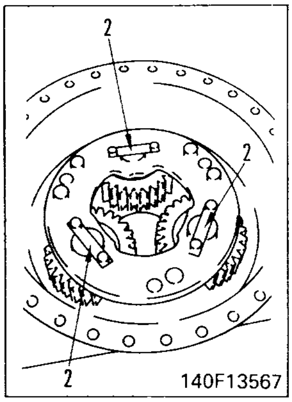
4) Expand fit shaft (6).
   ★ leave in dry ice for approx. 30 minutes.
5) Install lock plate (2).

   kgm Mounting bolt:
   110.4 ± 12.3 Nm (11.25 ± 1.25 kgm)

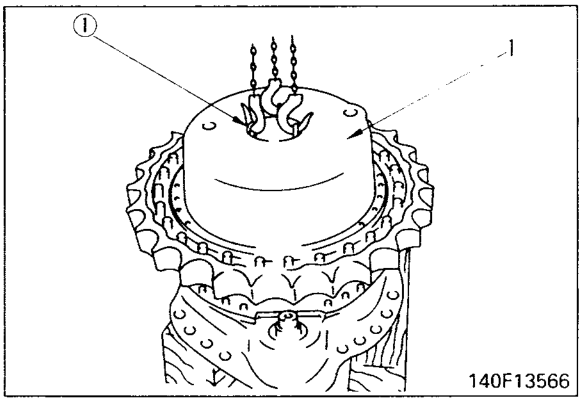




6) Using eyebolts ①, install carrier assembly (1).

   kgm Mounting bolts:
   276.05 ± 31.85 Nm (28.25 ± 3.25 kgm)

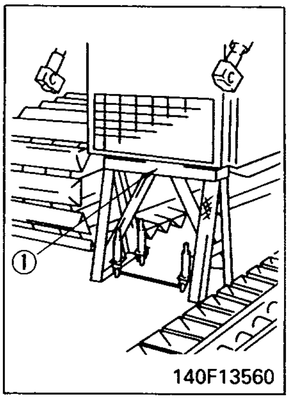
7) Install cover.



REMOVAL OF TRACK FRAME ASSEMBLY

1. Remove track shoe assembly.
   For details, REMOVAL OF TRACK SHOE ASSEMBLY.

2. Using jack (50 ton), jack up chassis, then set stands ① and ② (height: Approx. 900 mm) under front frame and steering case.



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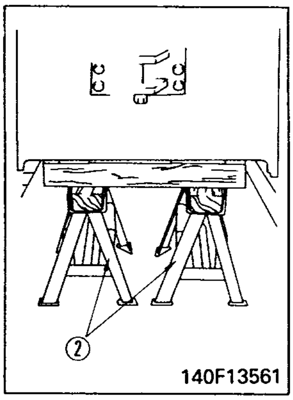

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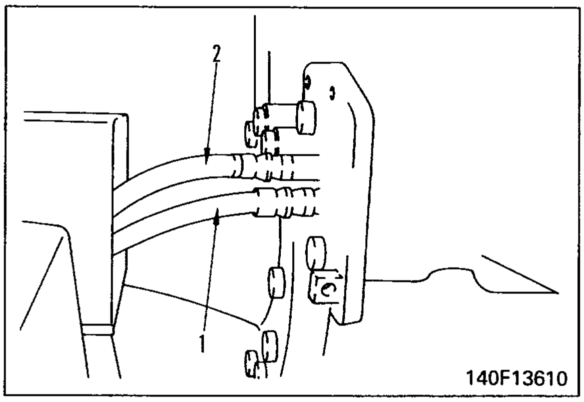
3. Remove tilt cylinder hose protection cover, then disconnect hoses (1) and (2). (On inside of track frame on right side of chassis).



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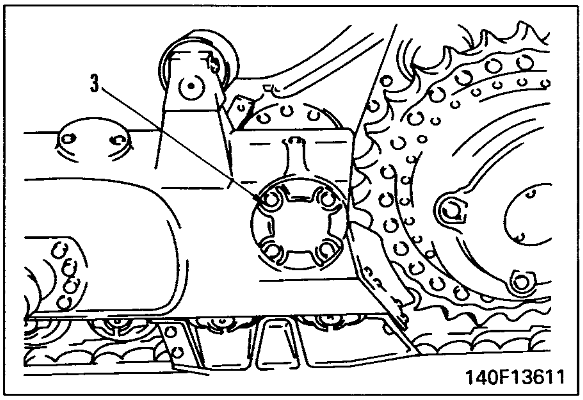
4. Remove pivot shaft cover (3). ※1

5. Remove equalizer bar side pin (4). ※2
   ★ Sling the track frame assembly, remove cover (5) and outside bushing (6), then knock out the pin and remove inside bushing (7).
   ★ When knocking out the pin, catch the inside bushing and be careful not to drop it.

6. Remove pivot shaft bolt (8) and plate (9), then lift off track frame assembly (10). ※3
   ★ Sling the carrier roller at its center. This makes it possible to balance it and raise it horizontally.
   ★ Oil will leak from the pivot chamber, so prepare a container to catch it.

kg Track frame assembly:
1600 kg (D65E, EX)
1800 kg (D65P, PX)

Pivot chamber: **Approx. 4.5 ℓ**



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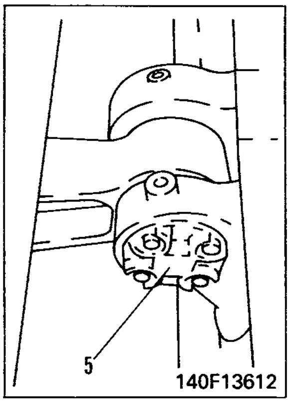

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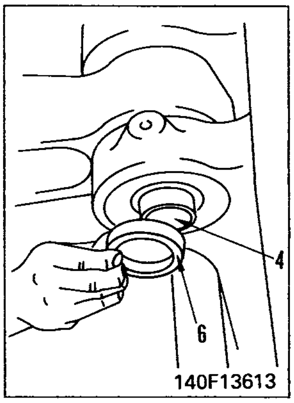

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INSTALLATION OF TRACK FRAME ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

Mounting bolt of pivot shaft cover: **549 ± 56 Nm (56 ± 6 kgm)**

※ 2

Inside cover: **Fill with grease (G2-LI)**

★ Do not forget to assemble the bushing.

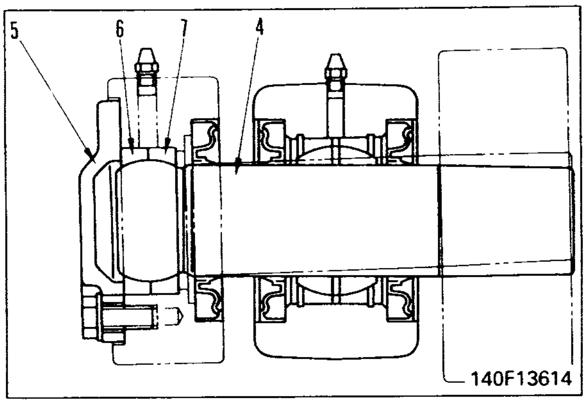
※ 3

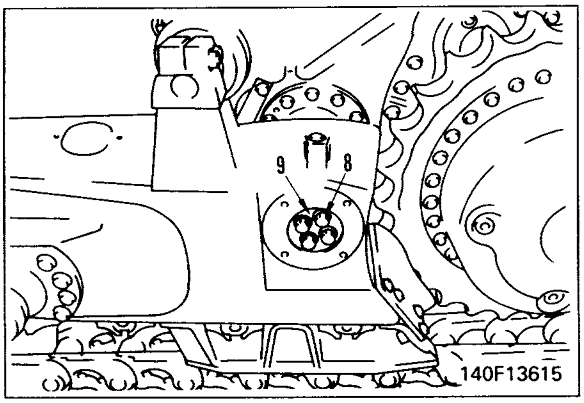
★ Coat track frame face **a** of the pivot shaft insertion portion with oil (EO-30CD).

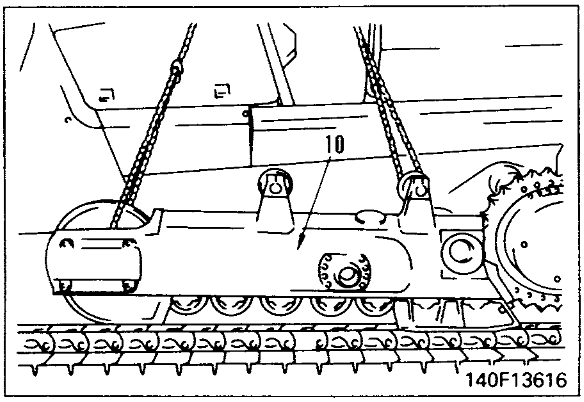
Plate mounting bolt: **549 ± 59 Nm (56 ± 6 kgm)**

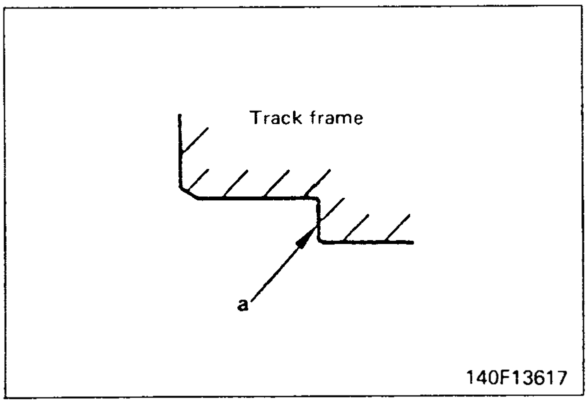
Pivot chamber: **Approx. 4.5 ℓ**

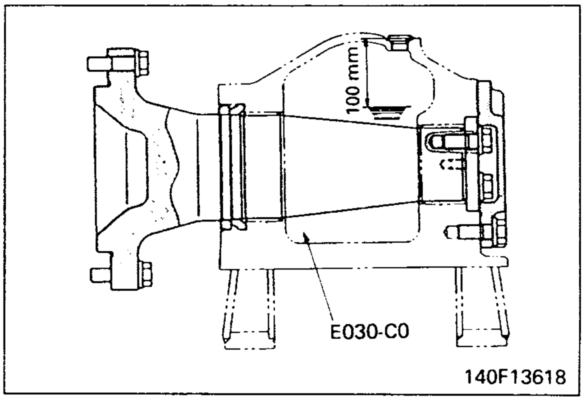
★ Fill the pivot chamber with oil up to a point 100 mm from the oil filler plug.











014012

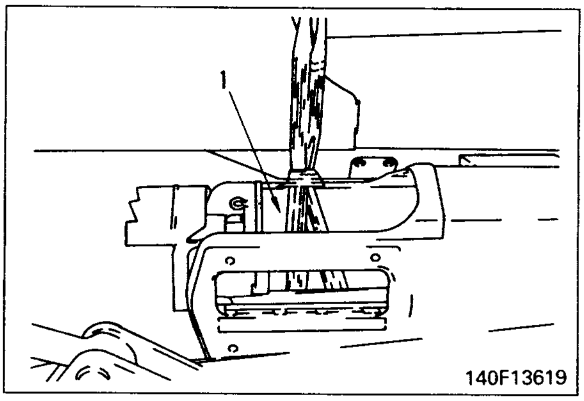
REMOVAL OF RECOIL SPRING ASSEMBLY

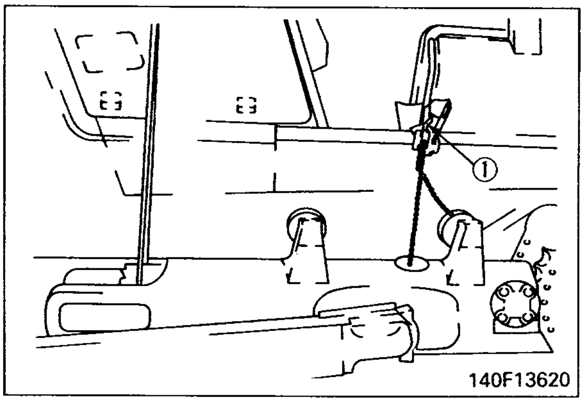
D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

1. Remove idler assembly.
   For details, see REMOVAL OF IDLER ASSEMBLY.

2. Lift off recoil spring assembly (1). ※1

   kg Recoil spring assembly: **260 kg**





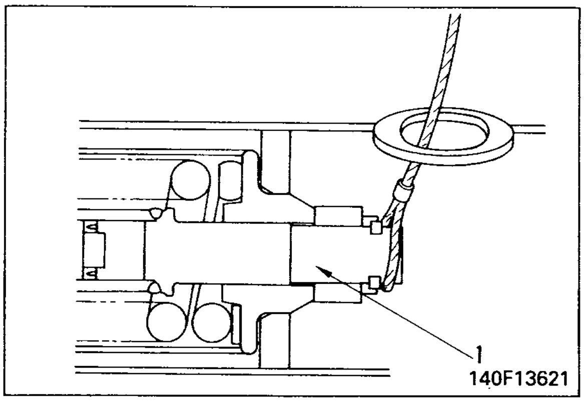
INSTALLATION OF RECOIL SPRING ASSEMBLY

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

- Carry out installation in the reverse order to removal.

※1

★ When assembling the recoil spring assembly inside the track frame, use lever block ① to sling the top and make it horizontal, then push in the recoil spring and set it in the frame.



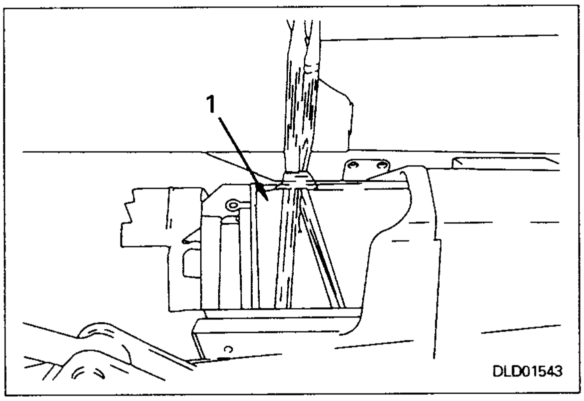
014012

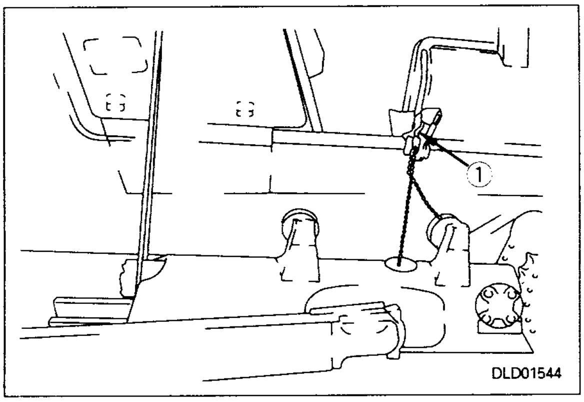
REMOVAL OF RECOIL SPRING ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

1. Remove idler assembly.
   For details, see REMOVAL OF IDLER ASSEMBLY.
2. Lift off recoil spring assembly (1). ※1

   kg Recoil spring assembly: **260 kg**





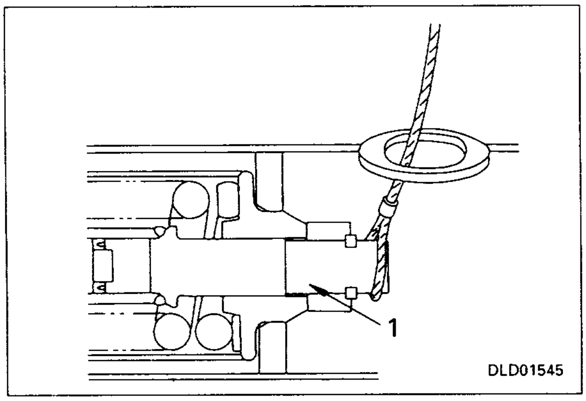
INSTALLATION OF RECOIL SPRING ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

- Carry out installation in the reverse order to removal.

※1

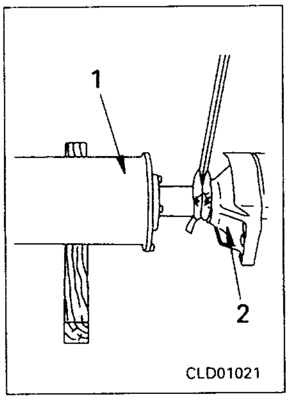
★ When assembling the recoil spring assembly inside the track frame, use lever block ① to sling the top and make it horizontal, then push in the recoil spring and set it in the frame.

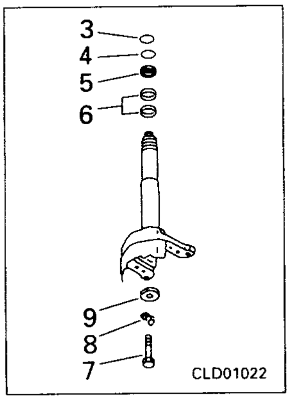


DISASSEMBLY OF RECOIL SPRING ASSEMBLY

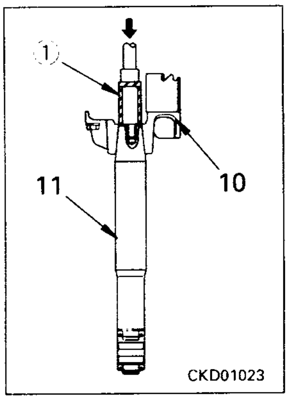
D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

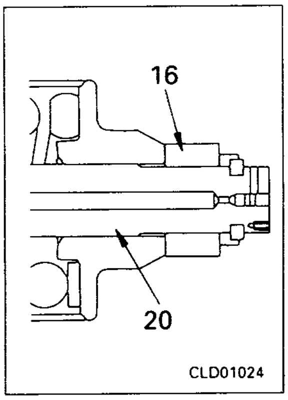
1. Remove yoke and piston assembly (2) from recoil spring assembly (1).





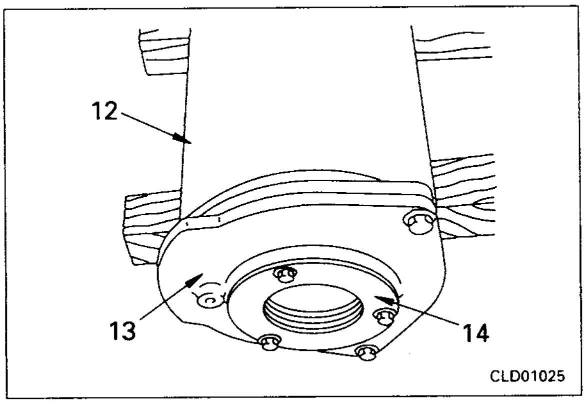
2. **Disassembly of yoke, piston assembly**
   1) Remove snap ring (3), then remove ring (4), packing (5), and rings (6).
   2) Remove bolt (7), then remove plate (8) and washer (9).
   3) Using push tool ①, remove piston (11) from yoke (10) with press.
- If cylinder (20) has not been damaged, or nut (16) at the tip of the shaft has not fallen off, disassemble as follows.



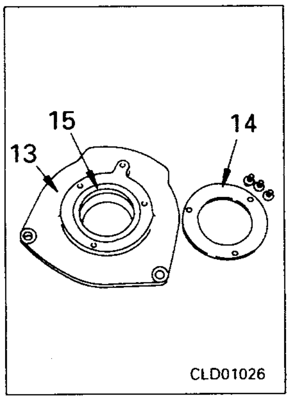


3. Remove holder (13) from case (12) of recoil spring.

   ⚠ To prevent danger, never stand in front of or behind the recoil spring assembly.



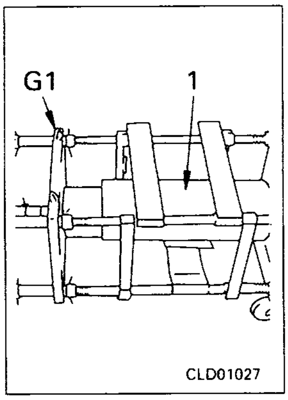
4. **Disassembly of holder**
   1) Remove cover (14) from holder (13).
   2) Remove seal (15) from holder (13).



5. Set recoil spring assembly (1) to tool **G1**.

   ⚠ The spring is under a high installed load, so be careful to set it correctly.

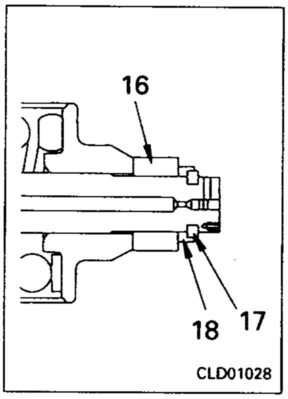
   ★ Installed load of spring: **189.9 kN (19,370 kg)**



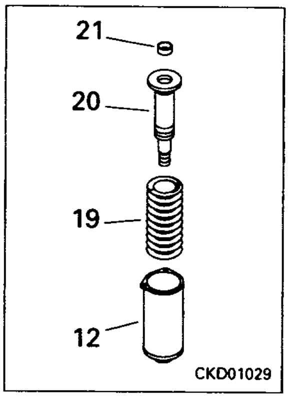
6. Apply hydraulic pressure slowly, compress spring, and tighten nut (16) until spacer (17) comes out, then take out spacers (17) and (18), and remove nut (16).

7. Gradually release hydraulic pressure to remove tension of spring.

8. Remove spring (19) and cylinder (20) from case (12), then remove bushing (21) from cylinder (20).



CLD01028

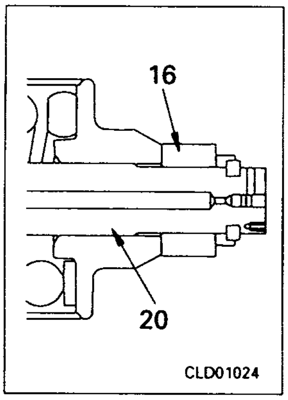


CKD01029

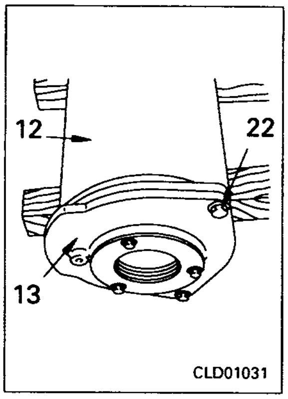
⚠ If cylinder (20) has been damaged, or nut (16) at the tip of the shaft has fallen off, there is danger that the recoil spring may fly off to the front when mounting bolts (22) of holder (13) are removed. For this reason, disassemble as follows.

⚠ When disconnecting holder (13) and case (12), do not stand in front of or behind the recoil spring assembly until safety has been confirmed and the recoil spring has been removed.

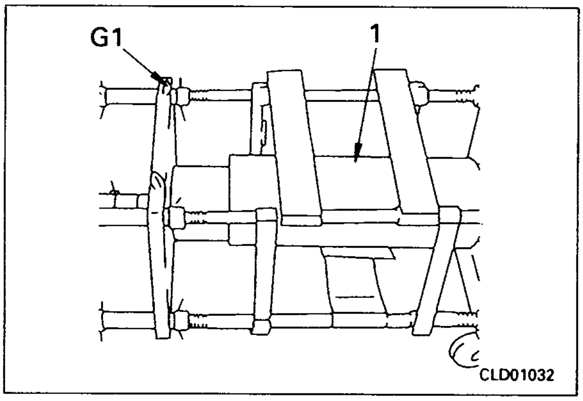
1) Set recoil spring assembly (1) to tool **G1**.
   ⚠ The spring is under a high installed load, so be careful to set it correctly.
   ★ Installed load of spring:
   189.9 kN {19,370 kg}
2) Apply hydraulic pressure slowly and secure recoil spring assembly.
3) Maintain condition in Step 2), and remove mounting bolts (22) of holder (13).
4) Gradually release hydraulic pressure to remove tension of spring.



CLD01024



CLD01031



CLD01032

ASSEMBLY OF RECOIL SPRING ASSEMBLY

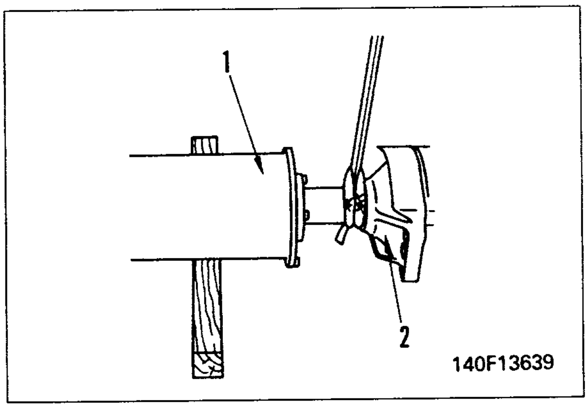
D65E-12	60001 - 60947
D65P-12	60001 - 60890
D65EX-12	60001 - 60941
D65PX-12	60001 - 60914

1. Press fit bushing (21) to cylinder (20), and assemble case (12), spring (19), and cylinder (20) temporarily, then set to tool **G1**.

   ⚠ The spring is under a high installed load, so be careful to set all parts correctly.
2. Apply hydraulic pressure slowly, compress spring, and set so that installed length of the spring is the standard value.
   - ★ When compressing the spring, be careful not to damage the thread. Use lever block ② and carry out centering before compressing the spring.
   - ★ Installed length of spring: **634 mm**
3. Install nut (16), then install spacers (18) and (17).
4. Gradually release hydraulic pressure to completely remove tension of spring, then remove recoil spring assembly (1) from tool **G1**.
5. **Assembly of holder**

   Assemble seal (15) to holder (13), then install cover (14).

   Lip of seal: **Grease (G2-LI)**
6. Install holder (13) to case (12) of recoil spring.
7. **Assembly of yoke, piston assembly**
   1) Using push tool ①, press fit piston (11) to yoke (10).
   2) Assemble washer (9) and plate (8), and tighten bolt (7).
      - ★ Bend the plate securely.
   3) Fit ring (6), packing (5), and ring (4), and install snap ring (3).
8. Assemble yoke and piston assembly (2) to recoil spring assembly (1).



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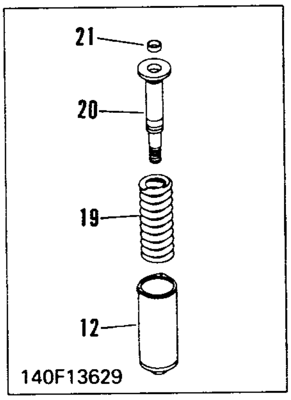

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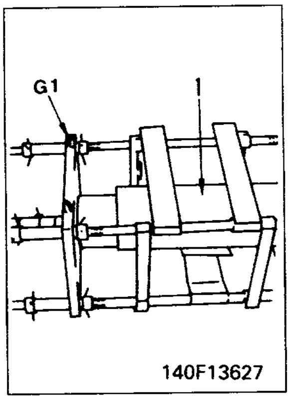

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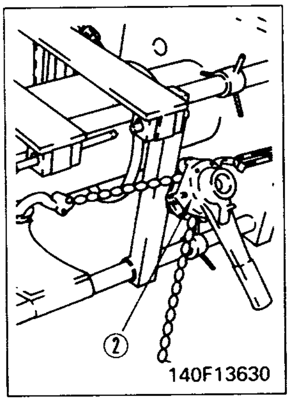

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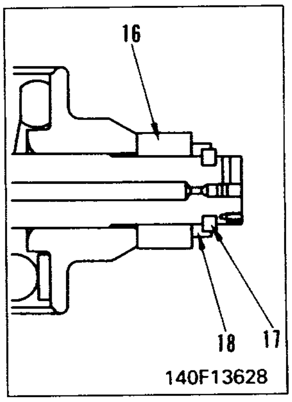

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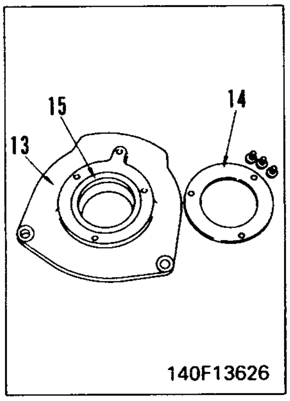

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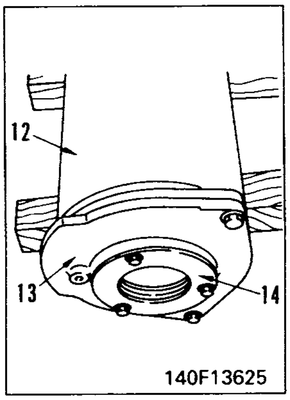

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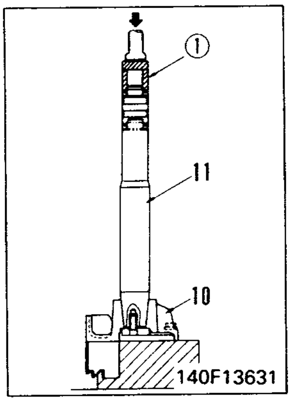

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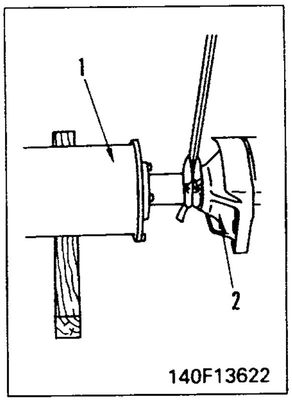
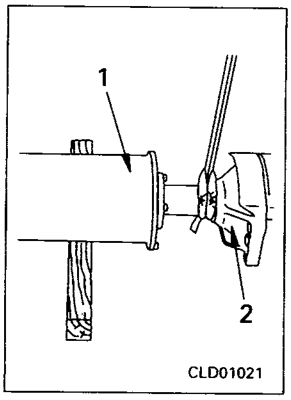


140F13622

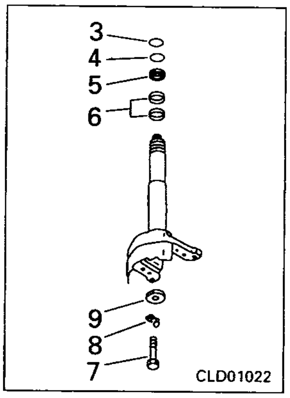
DISASSEMBLY OF RECOIL SPRING ASSEMBLY

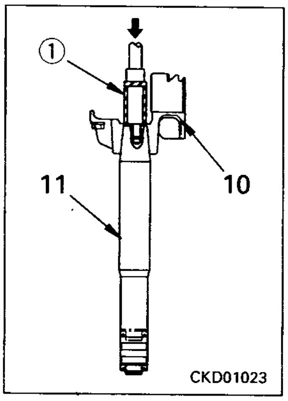
D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

1. Remove yoke and piston assembly (2) from recoil spring assembly (1).



2. **Disassembly of yoke, piston assembly**
   1) Remove snap ring (3), then remove ring (4), packing (5), rings (6).
   2) Remove bolt (7), then remove plate (8) and washer (9).
   3) Using push tool ①, remove piston (11) from yoke (10) with press.

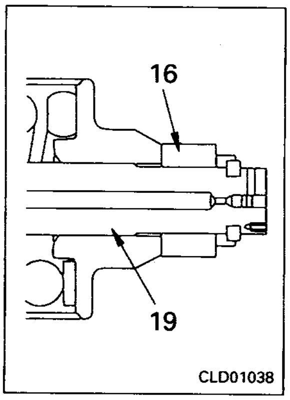




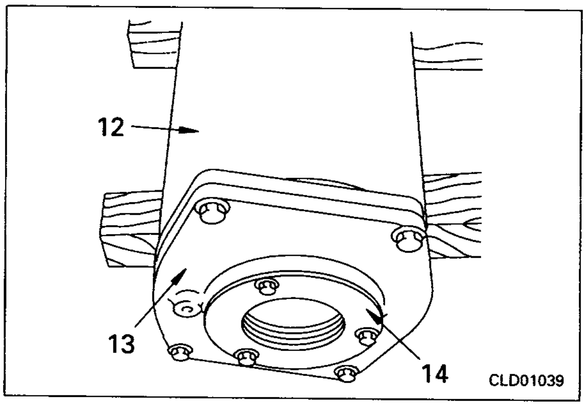
- If cylinder (19) has not been damaged, or nut (16) at the tip of the shaft has not fallen off, disassemble as follows.

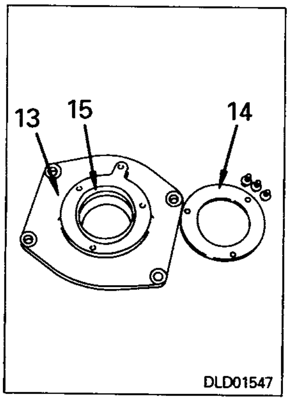
3. Remove holder (13) from case (12) of recoil spring.

⚠ To prevent danger, never stand in front of or behind the recoil spring assembly.



4. **Disassembly of holder**
   1) Remove cover (14) from holder (13).
   2) Remove seal (15) from holder (13).

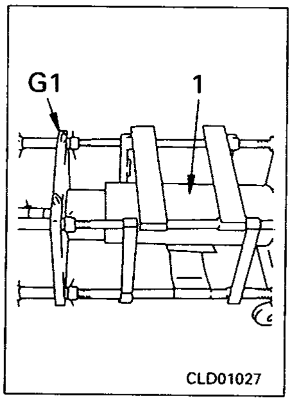




5. Set recoil spring assembly (1) to tool **G1**.

⚠ The spring is under a high installed load, so be careful to set it correctly.

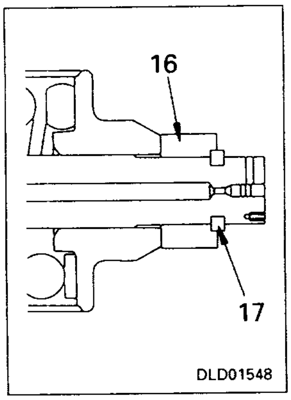
★ Installed load of spring:
189.9 kN {19,370 kg}

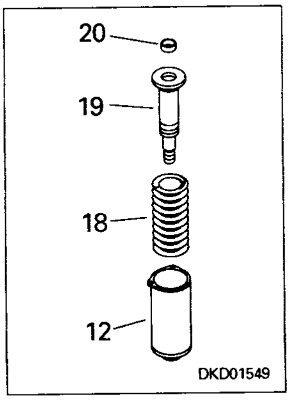


6. Apply hydraulic pressure slowly, compress spring, and tighten nut (16) until spacer (17) comes out, then take out spacer (17) and remove nut (16).

7. Gradually release hydraulic pressure to remove tension of spring.

8. Remove spring (18) and cylinder (19) from case (12), then remove bushing (20) from cylinder (19).



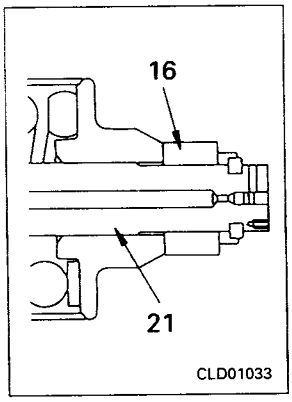


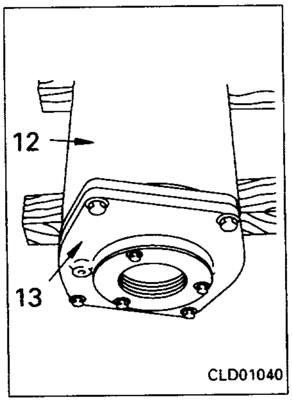
014012

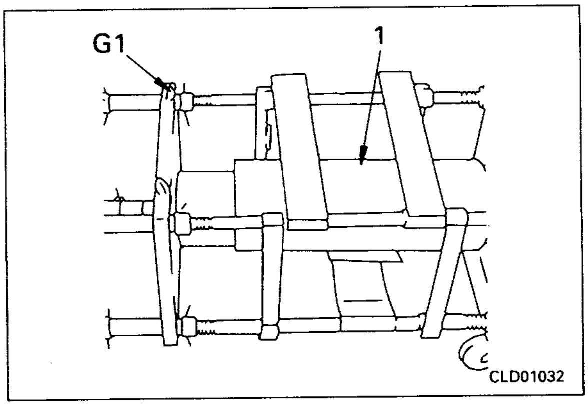
⚠ If cylinder (19) has been damaged, or nut (16) at the tip of the shaft has fallen off, there is danger that the recoil spring may fly off to the front when mounting bolts (21) of holder (13) are removed. For this reason, disassemble as follows.

⚠ When disconnecting holder (13) and case (12), do not stand in front of or behind the recoil spring assembly until safety has been confirmed and the recoil spring has been removed.

1) Set recoil spring assembly (1) to tool **G1**.
   ⚠ The spring is under a high installed load, so be careful to set it correctly.
   ★ Installed load of spring:
   189.9 kN {19,370 kg}
2) Apply hydraulic pressure slowly and secure recoil spring assembly.
3) Maintain condition in Step 2), and remove mounting bolts (21) of holder (13).
4) Gradually release hydraulic pressure to remove tension of spring.





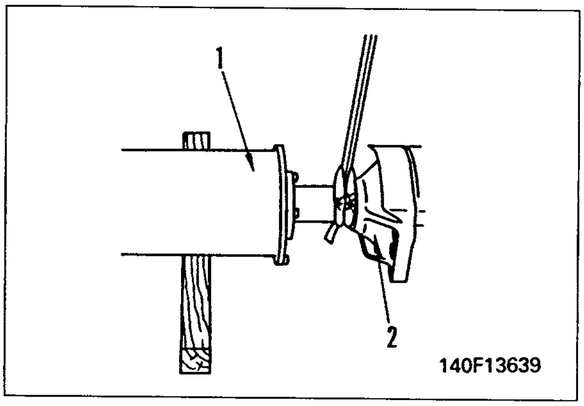


ASSEMBLY OF RECOIL SPRING ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

1. Press fit bushing (20) to cylinder (19), and assemble case (12), spring (18), and cylinder (19) temporarily, then set to tool **G1**.

   ⚠ The spring is under a high installed load, so be careful to set all parts correctly.
2. Apply hydraulic pressure slowly, compress spring, and set so that installed length of the spring is the standard value.
   - ★ When compressing the spring, be careful not to damage the thread. Use lever block ② and carry out centering while compressing the spring.
   - ★ Installed length of spring: **634 mm**
3. Install nut (16), then install spacer (17).
4. Gradually release hydraulic pressure to completely remove tension of spring, then remove recoil spring assembly (1) from tool **G1**.
5. **Assembly of holder**
   Assemble seal (15) to holder (13), then install cover (14).
   Lip of seal: **Grease (G2-LI)**
6. Install holder (13) to case (12) of recoil spring.
7. **Assembly of yoke, piston assembly**
   1) Using push tool ①, press fit piston (11) to yoke (10).
   2) Assemble washer (9) and plate (8), and tighten bolt (7).
      - ★ Bend the plate securely.
   3) Fit ring (6), packing (5), and ring (4), and install snap ring (3).
8. Assemble yoke and piston assembly (2) to recoil spring assembly (1).



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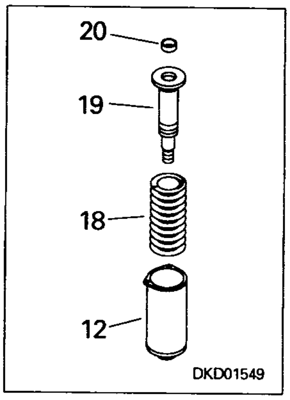

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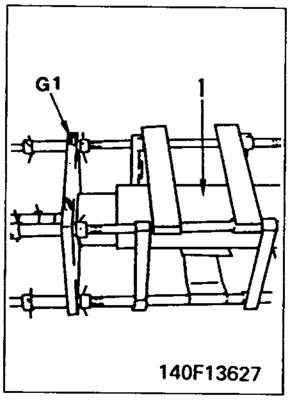

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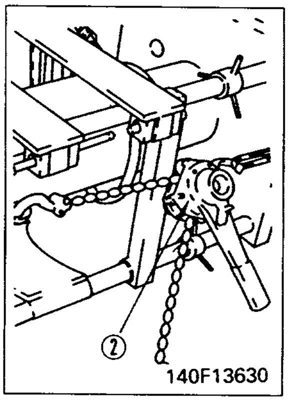

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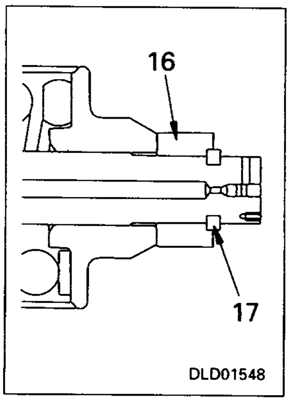
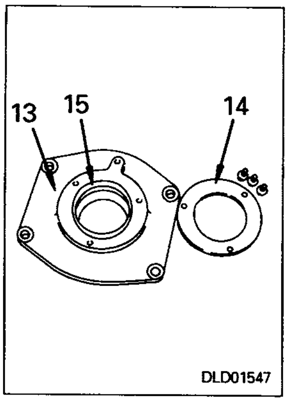


DLD01548



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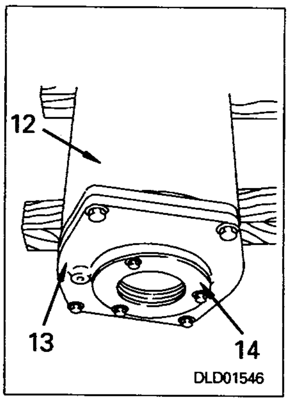

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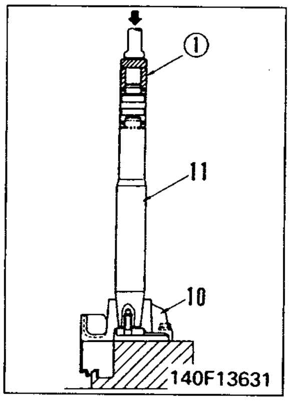

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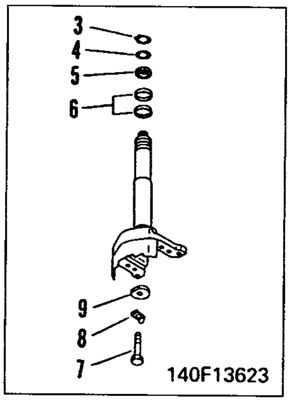

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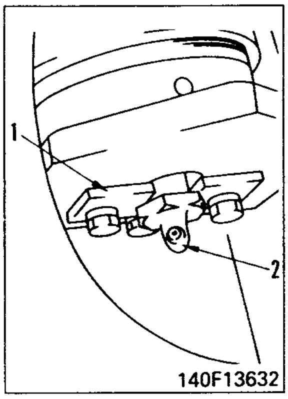
REMOVAL OF IDLER ASSEMBLY

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

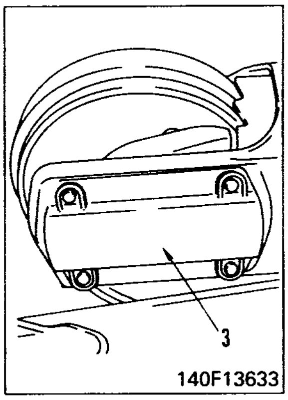
1. Remove track shoe assembly.
   For details, see REMOVAL OF TRACK SHOE ASSEMBLY.

2. Remove lock plate (1), then remove lubricator (2).

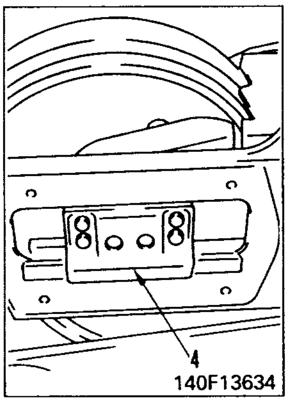
   ⚠ The inside of the recoil spring cylinder is under negative pressure, so if the lubricator is not removed, the yoke will be pulled back into the cylinder when the yoke and idler support are disconnected.
   ⚠ To prevent danger, never stand in front of or behind the recoil spring assembly.

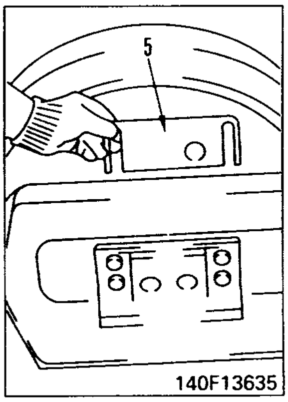


3. Remove left and right cover (3).

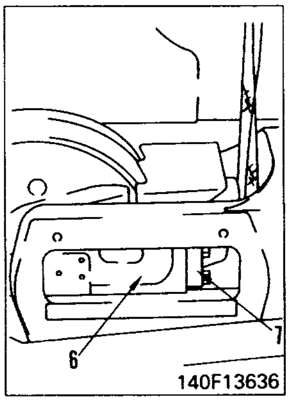


4. Remove left and right guide plate (4). ※ 1
   ★ Remove shim (5), check the number and thickness, and keep in a safe place.



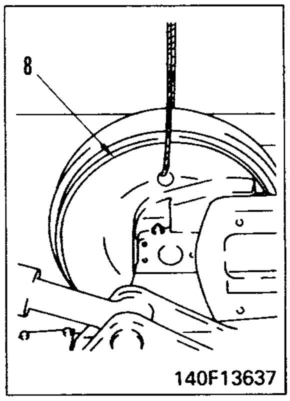


5. Raise idler assembly and pull out, then remove mounting bolts of support (6) and yoke (7).



6. Lift off idler assembly (8).

   kg Idler: **Approx. 200 kg**



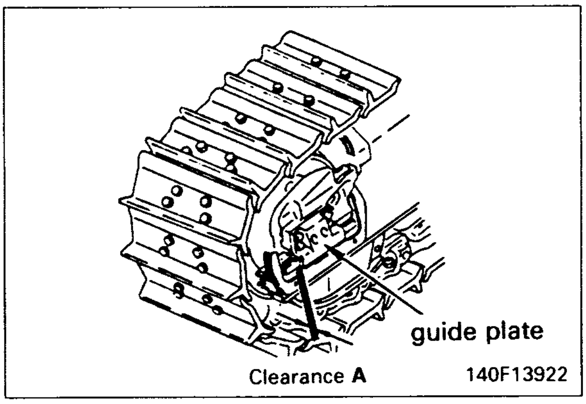
INSTALLATION OF IDLER ASSEMBLY

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

- Carry out installation in the reverse order to removal.

※ 1

★ Standard shim thickness: **4 mm**
★ Adjust the shim thickness so that clearance **A** between the track frame and guide plate is 0.5 – 1.0 mm.
Thread of guide plate mounting bolt:
Thread tightener (LT-2)

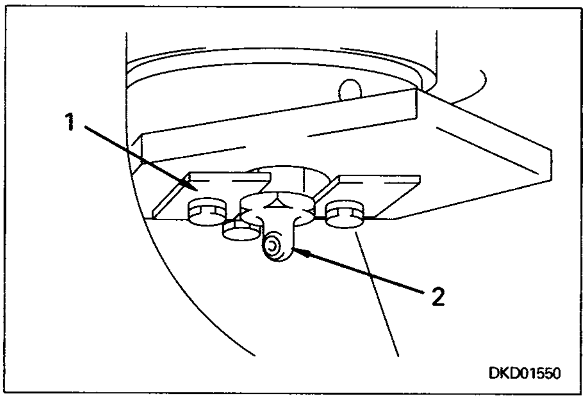


REMOVAL OF IDLER ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

1. Remove track shoe assembly.
   For details, see REMOVAL OF TRACK SHOE ASSEMBLY.

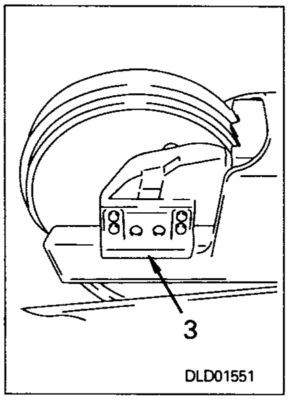
2. Remove lock plate (1), then remove lubricator (2).

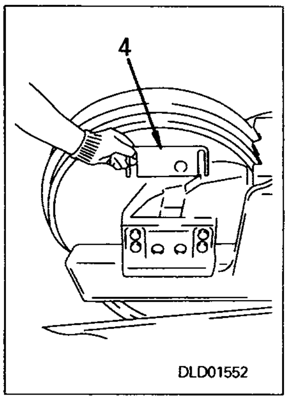


⚠ The inside of the recoil spring cylinder is under negative pressure, so if the lubricator is not removed, the yoke will be pulled back into the cylinder when the yoke and idler support are disconnected.

⚠ To prevent danger, never stand in front of or behind the recoil spring assembly.

3. Remove left and right guide plate (3). ※1
   ★ Remove shim (4), check the number and thickness, and keep in a safe place.

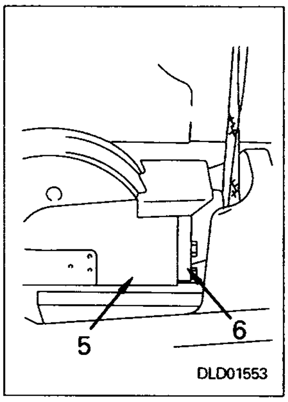


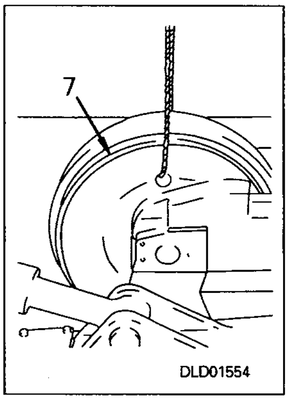


4. Raise idler assembly and pull out, then remove mounting bolts of support (5) and yoke (6).

5. Lift off idler assembly (7).

   Idler: **Approx. 200 kg**





INSTALLATION OF IDLER ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

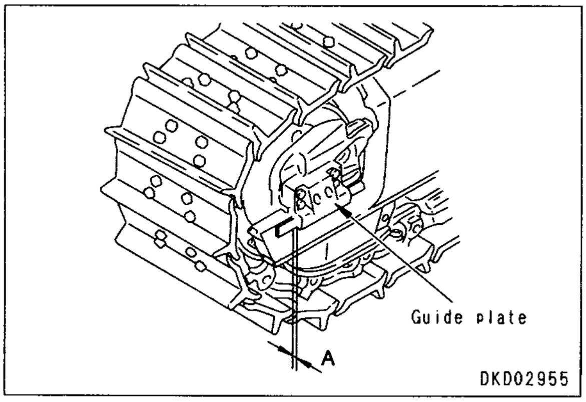
- Carry out installation in the reverse order to removal.

※1

★ Standard shim thickness: **4 mm**

★ Adjust the shim thickness so that clearance **A** between the track frame and guide plate is 0.5 – 1.0 mm.

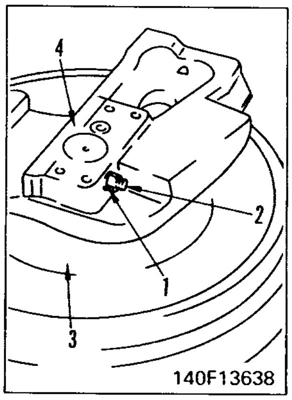
Thread of guide plate mounting bolt:
Thread tightener (LT-2)



014012

DISASSEMBLY OF IDLER ASSEMBLY

1. Remove nut (1), then knock out bolt (2) from nut end.



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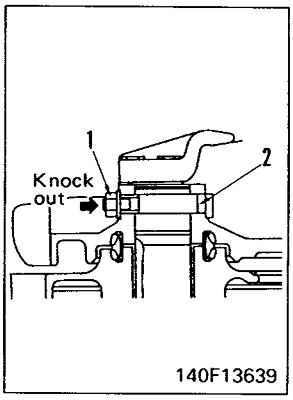

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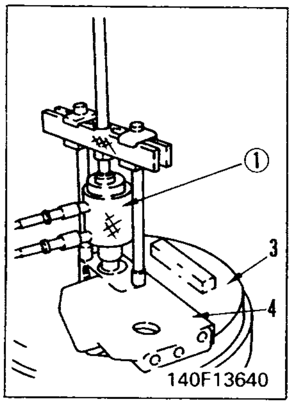
2. Using push-puller ①, pull out support (4) from idler (3).
3. Remove floating seals (5) from support (4).



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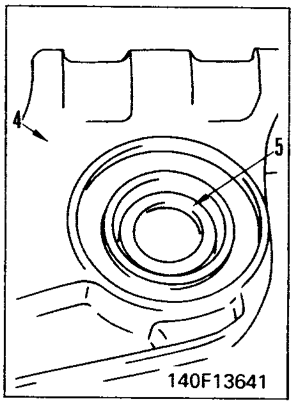

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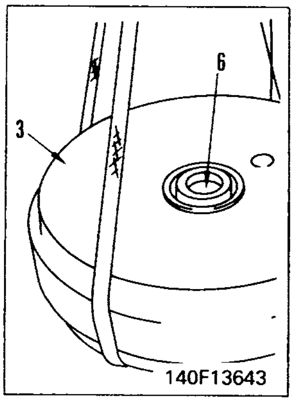
4. Raise idler (3) and pull out shaft and support assembly (6).
5. Remove floating seals (7) and (8) from idler (3).



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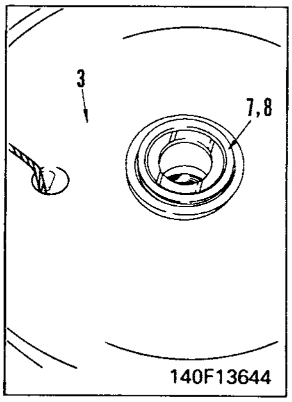

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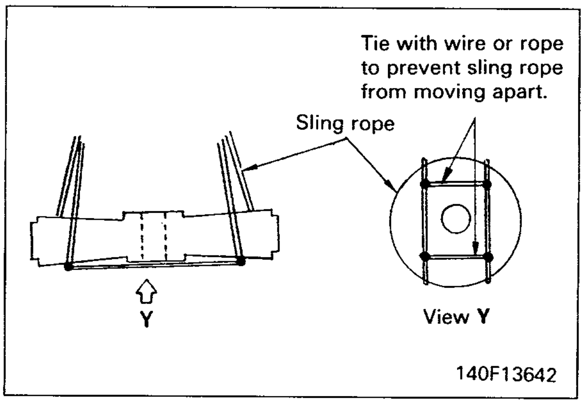

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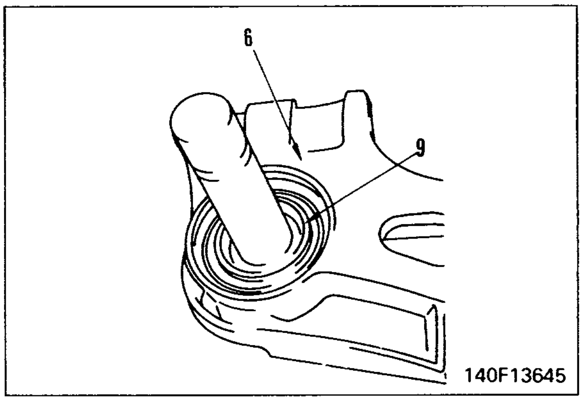
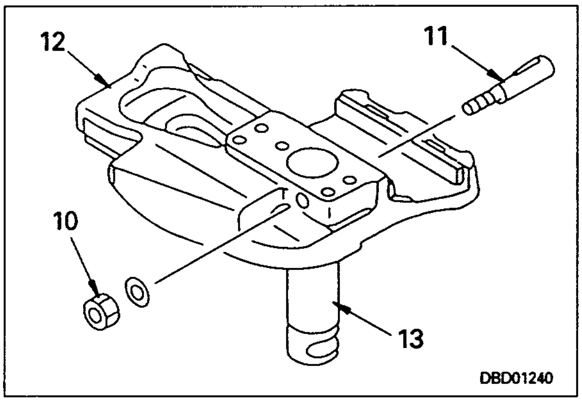
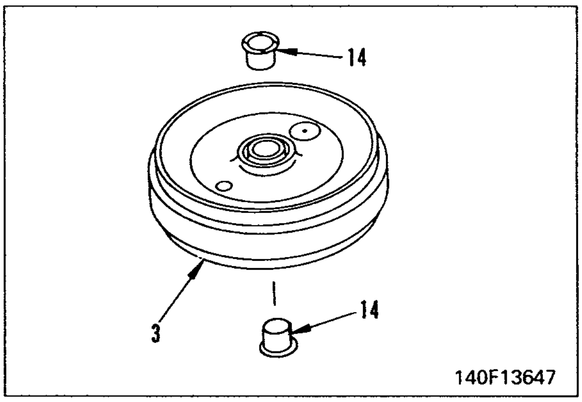
6. Remove floating seal (9) from shaft and support assembly (6).



7. Remove nut (10), and knock out bolt (11) from nut end.
8. Use push-puller ① in the same way as in Step 2), and remove shaft (13) from support (12).

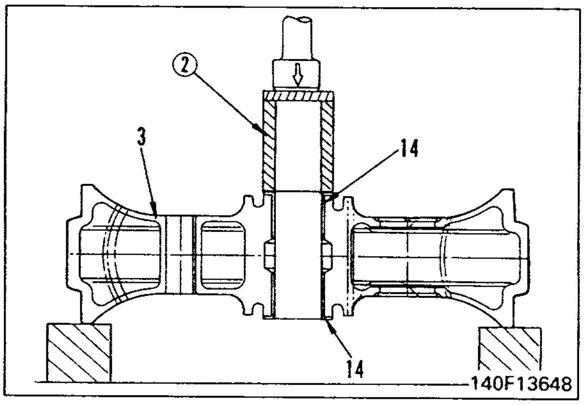


9. Remove 2 bushings (14) from idler (3).



ASSEMBLY OF IDLER ASSEMBLY

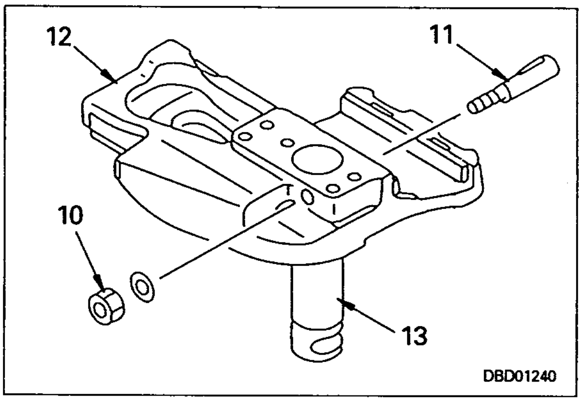
1. Using push tool ②, press fit bushing (14) to idler (3).



2. Fit O-ring to shaft (13), and assemble to support (12).
   ★ When assembling the shaft, align the shaft and support groove.

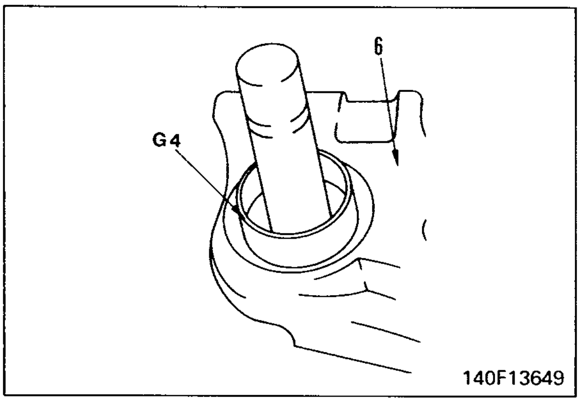
3. Knock bolt (11), and tighten nut (10).

   Bolt: **Thread tightener (LT-2)**

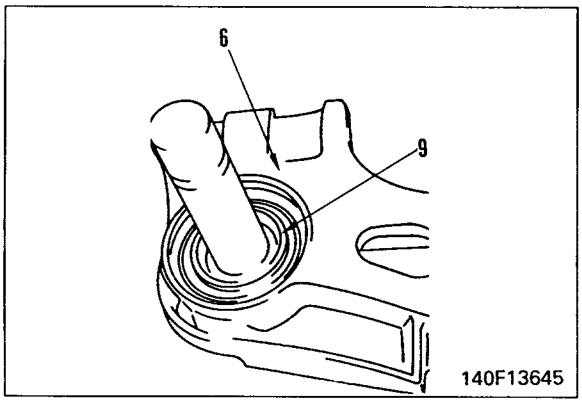


4. Using tool **G4**, install floating seal (9) to shaft and support assembly (6), then assemble O-ring to shaft.
   ★ When assembling the floating seal, clean the thick line portion (O-ring and O-ring contact surface), remove all oil and grease, and dry it.


140F13650

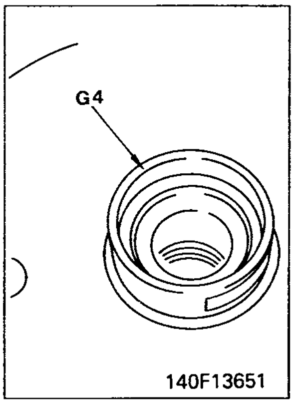


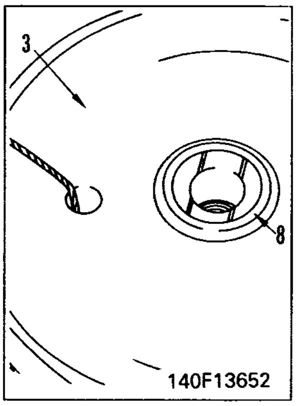
014012



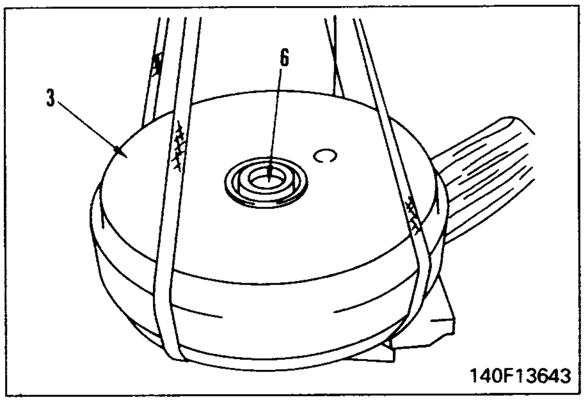
5. Using tool **G4**, assemble floating seal (8) to idler (3).
   ★ When assembling the floating seal, clean the thick line portion (O-ring and O-ring contact surface), remove all oil and grease, and dry it.


140F13650





6. Raise idler (3) and assemble to shaft and support assembly (6).



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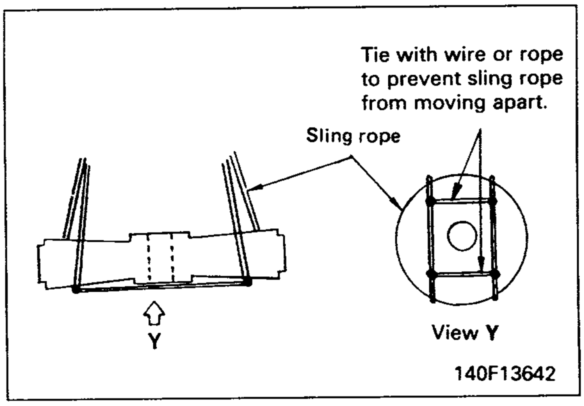

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014012

7. Using tool **G4**, assemble floating seal (7) to idler (3).
   ★ When assembling the floating seal, clean the thick line portion (O-ring and O-ring contact surface), remove all oil and grease, and dry it.

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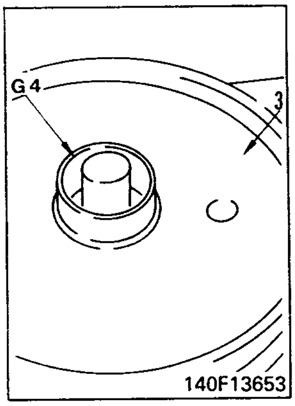

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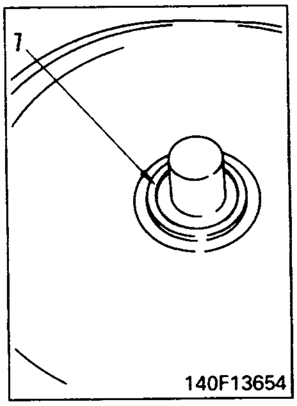

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8. Refill idler with oil.

   Idler: **150 cc (EO-30)**

9. Using tool **G4**, assemble floating seal (5) to support (4).
   ★ When assembling the floating seal, clean the thick line portion (O-ring and O-ring contact surface), remove all oil and grease, and dry it.

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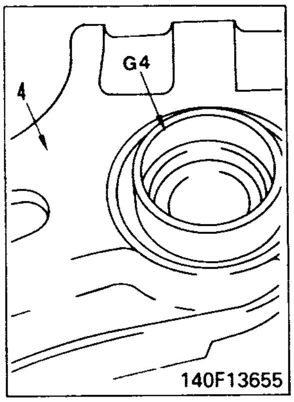

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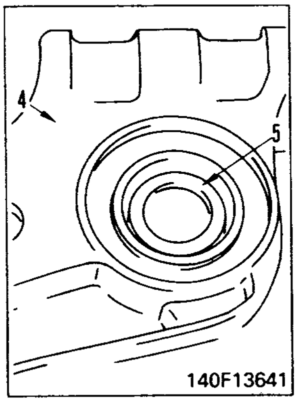

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For normal oil supply method

10. Remove plug (15) from support (4), then add specified amount of engine oil through oil filler port.

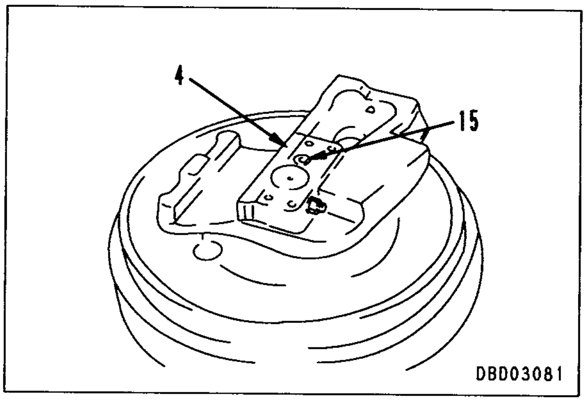
D65E-12	**60001 – 60947**
D65P-12	**60001 – 60890**
D65EX-12	**60001 – 60941**
D65PX-12	**60001 – 60914**

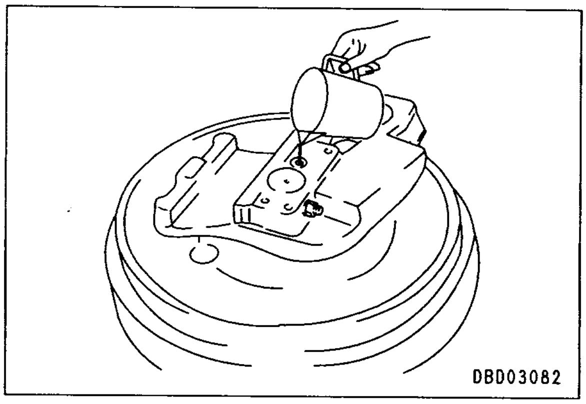
Idler: **Approx. 150 cc (EO30-CD)**

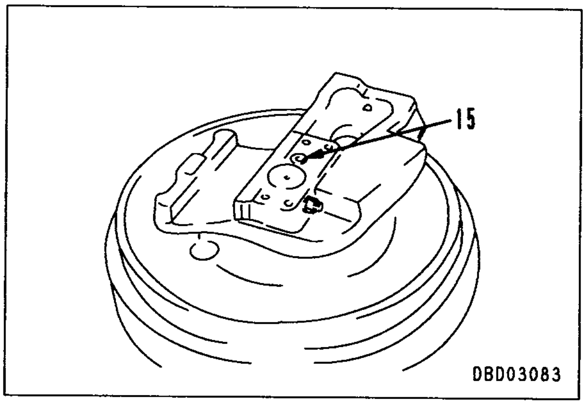
D65E-12	**60948 and up**
D65P-12	**60891 and up**
D65EX-12	**60942 and up**
D65PX-12	**60915 and up**

Idler: **Approx. 250 cc (EO30-CD)**

11. After adding oil, install plug (15) to support (4).

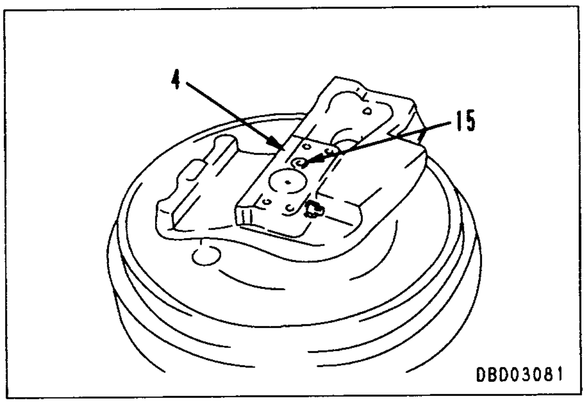




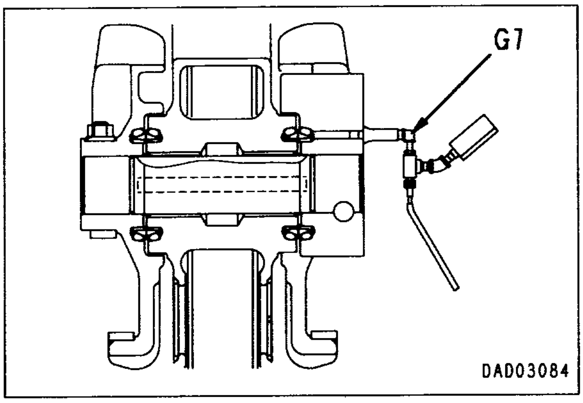


For vacuum oil supply method

10. Remove plug (15) from support (4).



11. Using tool **G7**, apply standard pressure to idler oil filler port and check for leakage of air from seal.
    ★ Standard air pressure: 1 kg/cm^2
    ★ Method of checking
    Hold standard pressure for 10 sec and check that gauge indicator does not go down.



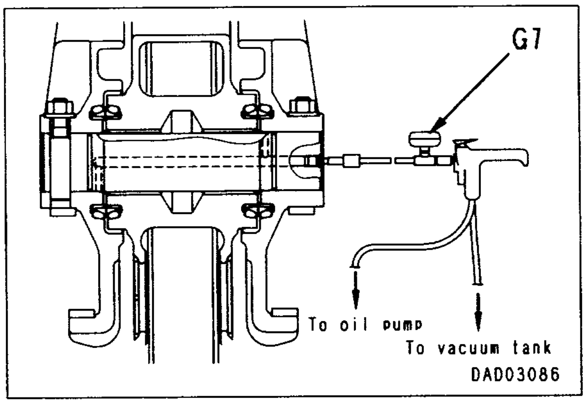
12. Using tool **G7**, fill idler assembly with oil, then tighten plug (15).

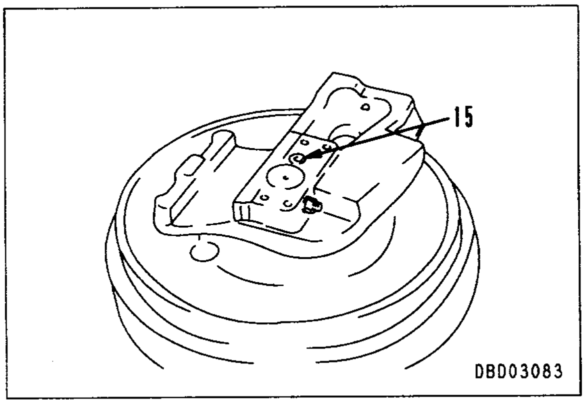
D65E-12	**60001 – 60947**
D65P-12	**60001 – 60890**
D65EX-12	**60001 – 60941**
D65PX-12	**60001 – 60914**

Idler: **Approx. 150 cc (EO30-CD)**

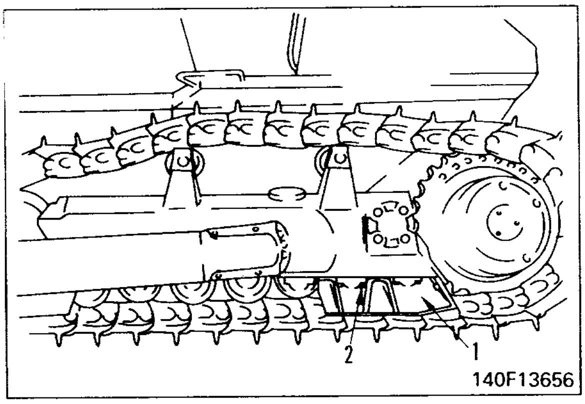
D65E-12	**60948 and up**
D65P-12	**60891 and up**
D65EX-12	**60942 and up**
D65PX-12	**60915 and up**

Idler: **Approx. 250 cc (EO30-CD)**





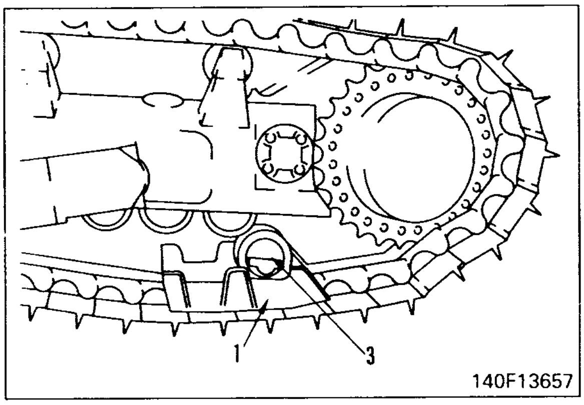
REMOVAL OF TRACK ROLLER ASSEMBLY



1. Loosen track shoe tension.
   For details, see REMOVAL OF TRACK SHOE ASSEMBLY.
2. Remove mounting bolts of track roller guard (1). ※1
3. Remove track roller mounting bolts (2).
4. Start engine, and operate blade, ripper, and hydraulic jack to jack up machine.

   ⚠ After jacking up the machine, set blocks on top of the track shoes and lock the work equipment control levers and brake lock lever.
5. Remove track roller assembly (3). ※2

   kg Track roller assembly: (W) **60 kg**
   (S) **55 kg**



INSTALLATION OF TRACK ROLLER ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

Thread of roller guard mounting bolt:
Thread tightener (LT-2)

※2

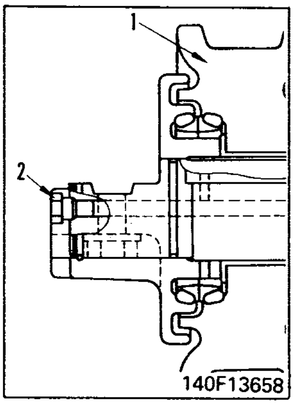
Thread of track roller mounting bolt:
Thread tightener (LT-2)

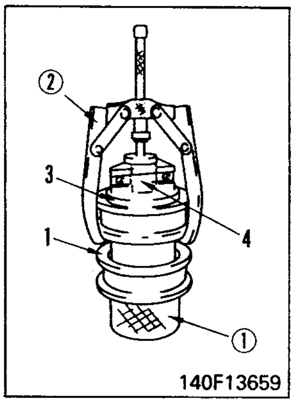
kgm Track roller mounting bolt:
385 ± 42 Nm
(39.3 ± 9.3 kgm)

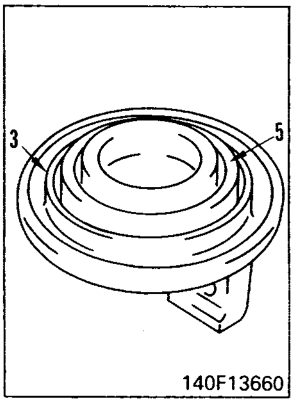
★ Install so that the oil plug is on the outside of the chassis.

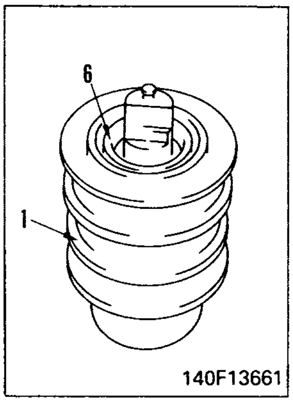
DISASSEMBLY OF TRACK ROLLER ASSEMBLY

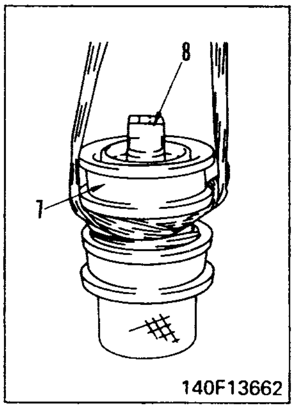
1. Remove plug (2) from roller assembly (1) and drain oil.
2. Set roller assembly (1) on block ①, then using push puller ②, push in collar (3), pull out lock (4), and remove collar (3).
3. Remove floating seal (5) from collar (3).
4. Remove floating seal (6) from roller assembly (1).
5. Raise roller (7) and pull out from shaft assembly (8).
6. Remove floating seal (9) from roller (7).
7. Remove floating seal (10) from shaft assembly (8).
8. Remove lock pin (11), then remove collar (13) from shaft (12).
9. Remove floating seal (14) from collar (13).
10. Remove bushing (15) from roller (7), then turn over, and remove bushing (16).

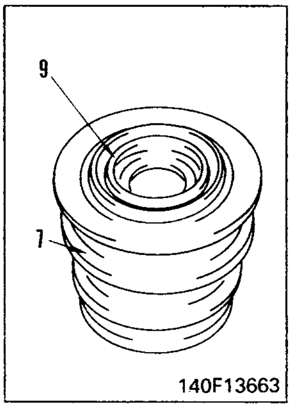


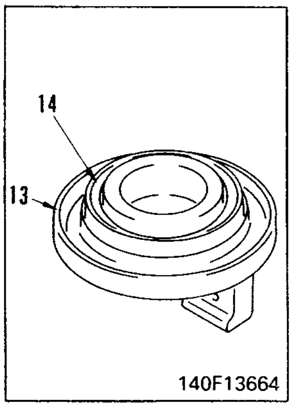


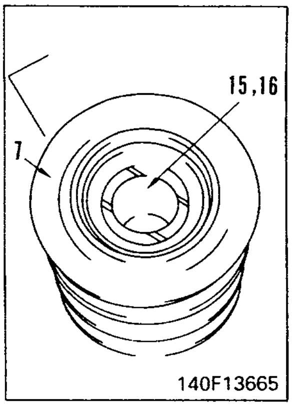


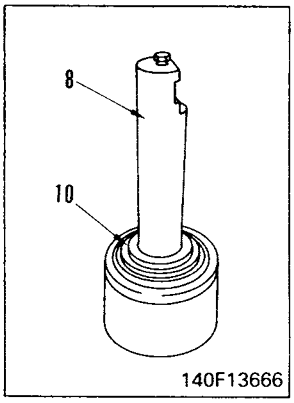


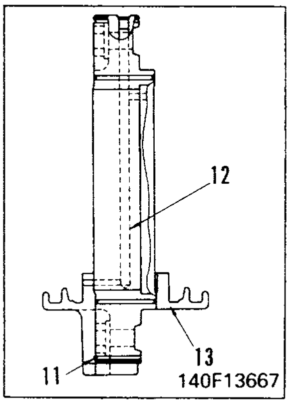








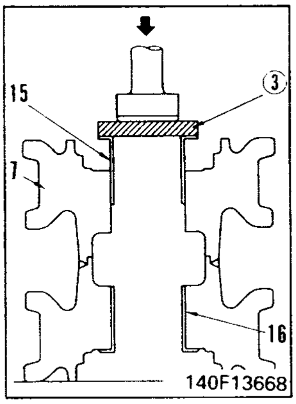




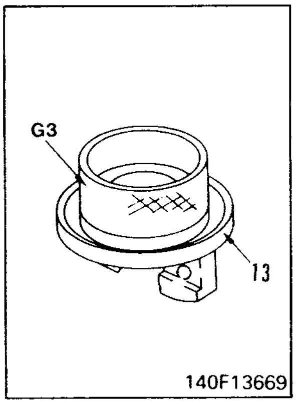
014012

ASSEMBLY OF TRACK ROLLER ASSEMBLY

1. Using push tool ③, press fit bushings (16) and (15) to roller (7).



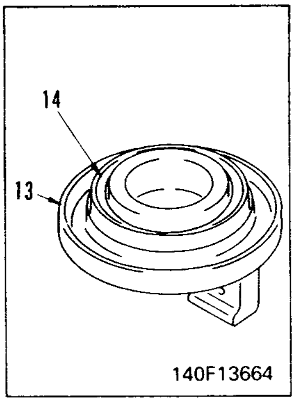
140F13668



140F13669

2. Using tool **G3**, install floating seal (14) to collar (13).
   ★ When assembling the floating seal, clean the thick line portion (O-ring and O-ring contact surface), remove all oil and grease, and dry it.


140F13650



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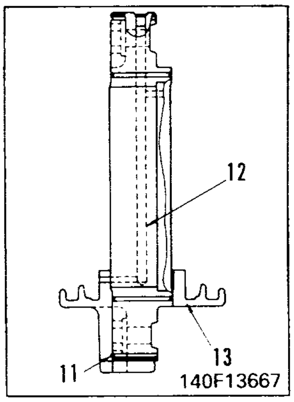


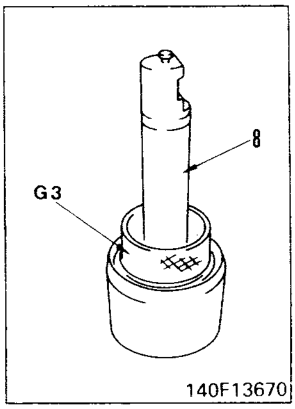
140F13667

014012

3. Fit O-ring to shaft (12), assemble collar (13), then install lock pin (11).

4. Using tool **G3**, install floating seal (10) to shaft assembly (8).
   ★ When assembling the floating seal, clean the thick line portion (O-ring and O-ring contact surface), remove all oil and grease, and dry it.


140F13650



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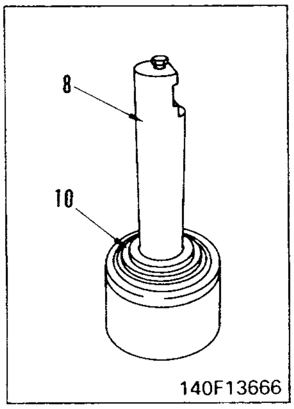
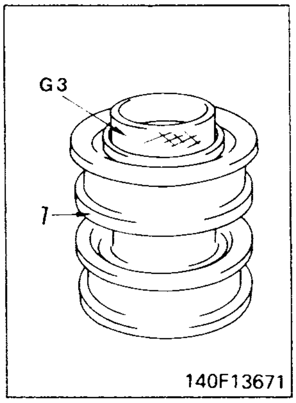


140F13666

5. Using tool **G3**, install floating seal (9) to roller (7).
   ★ When assembling the floating seal, clean the thick line portion (O-ring and O-ring contact surface), remove all oil and grease, and dry it.


140F13650



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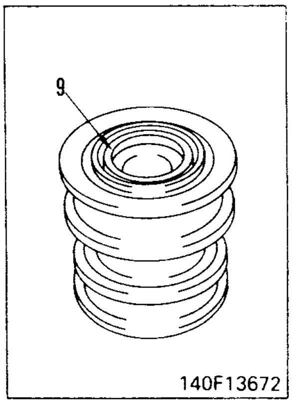
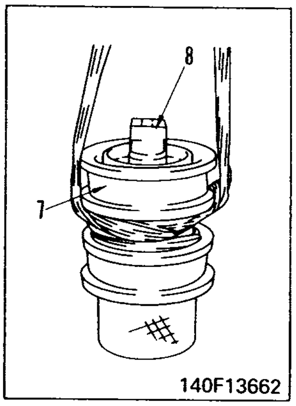


140F13672

6. Raise roller (7) and assemble to shaft assembly (8).

7. Using tool **G3**, install floating seal (6).
   ★ When assembling the floating seal, clean the thick line portion (O-ring and O-ring contact surface), remove all oil and grease, and dry it.

140F13650



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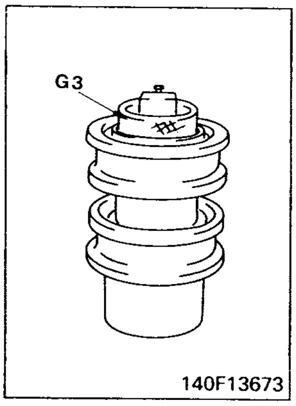


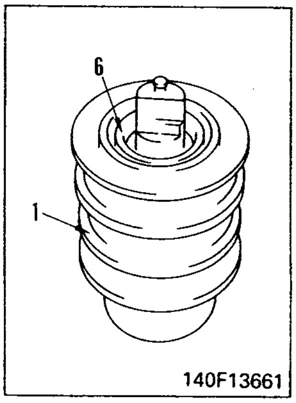
140F13673

8. Using tool **G3**, install floating seal (5) to collar (3).
   ★ When assembling the floating seal, clean the thick line portion (O-ring and O-ring contact surface), remove all oil and grease, and dry it.

9. Refill roller with oil.

   Roller: **320 cc (GO140)**

140F13650



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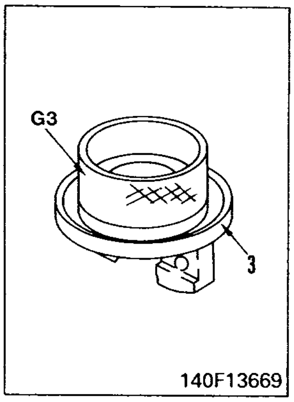
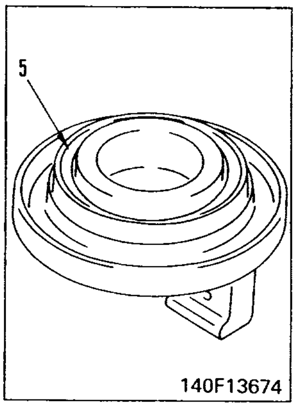
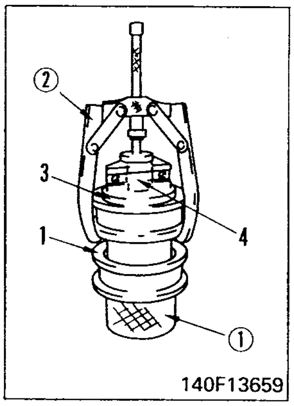


140F13669

10. Fit O-ring to shaft and assemble collar (3), then using push puller ②, push in collar (3), and install lock (4).



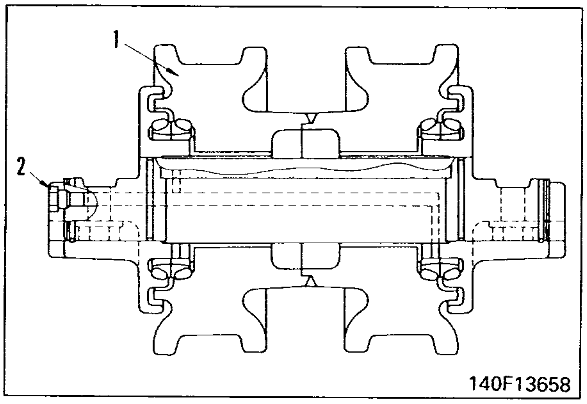
140F13674



140F13659

11. Check oil level and tighten plug (2) to roller assembly (1).

   Plug: **117.6 ± 19.6 Nm**
   (12 ± 2 kgm)



140F13658

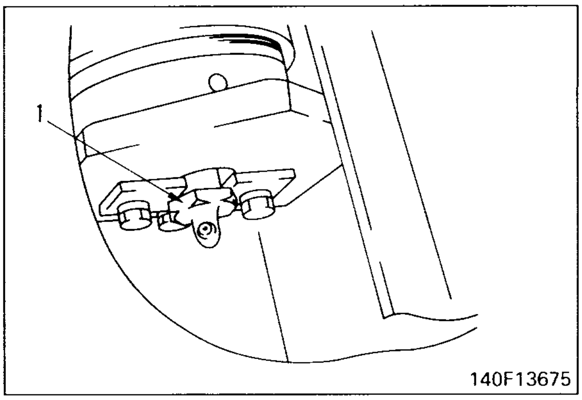
REMOVAL OF CARRIER ROLLER ASSEMBLY

D65P, PX

1. Remove top cover of track frame, and loosen lubricator (1) to loosen track shoe tension.

   ⚠ Never loosen lubricator (1) more than one turn.

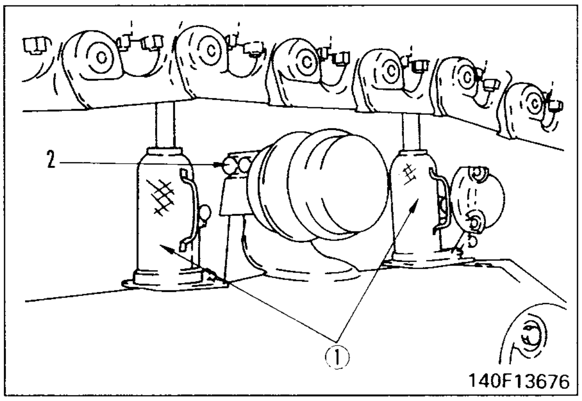
   ★ If the track tension is not relieved when the lubricator is loosened, move the machine backwards and forwards.



140F13675

2. Using hydraulic jack ①, raise track shoe.
3. Remove mounting bolts (2).
4. Pass rope ② through hole in link, fit it around carrier roller (3) to support carrier, then loosen rope gradually, and pull out carrier (3) from support (4). ※1

   kg Carrier roller: **30 kg**



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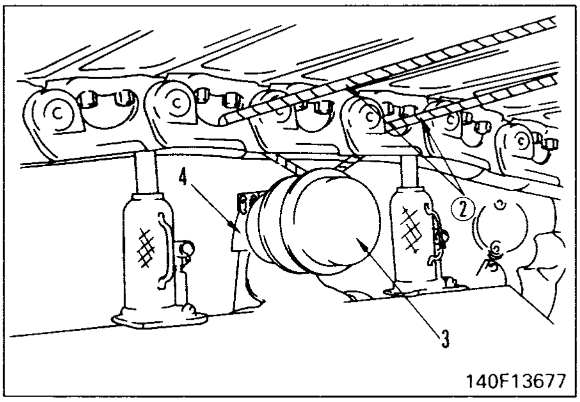


140F13677

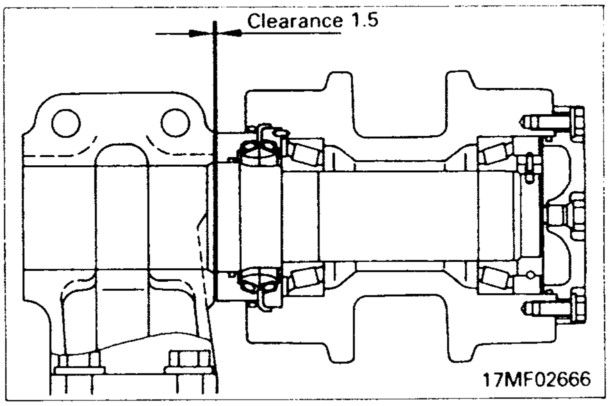
INSTALLATION OF CARRIER ROLLER ASSEMBLY

D65P, PX

- Carry out installation in the reverse order to removal.

※1

When installing the carrier roller to the support, leave the clearance shown in the diagram.



17MF02666

Support mounting bolt:
Thread tightener (LT-2)

- Adjust the tension of the track shoe assembly.
  For details, see TESTING AND ADJUSTING, Adjusting tension of track shoe assembly.

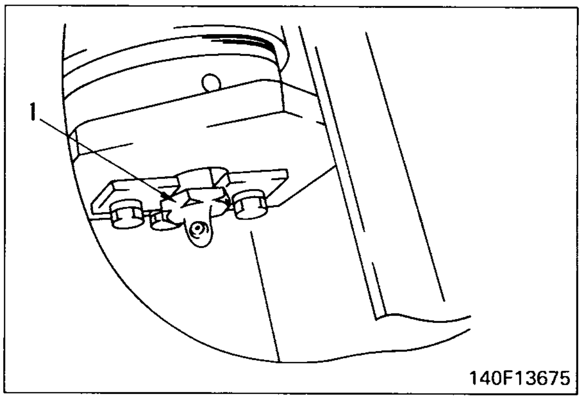
REMOVAL OF CARRIER ROLLER ASSEMBLY

D65E, EX

1. Remove top cover of track frame, and loosen lubricator (1), then loosen track shoe tension.

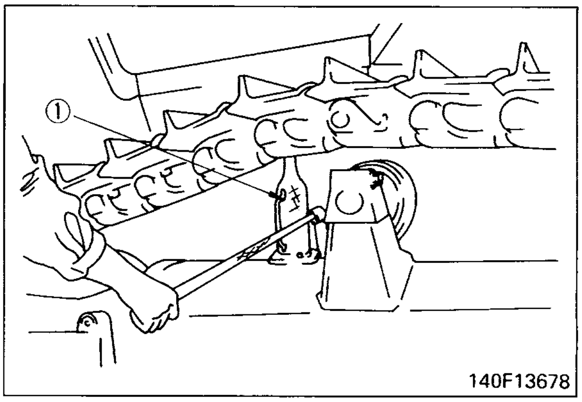
   ⚠ Never loosen lubricator (1) more than one turn.

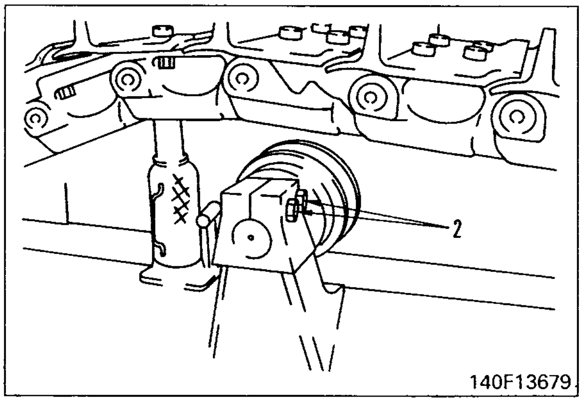
   ★ If the track tension is not relieved when the lubricator is loosened, move the machine backwards and forwards.

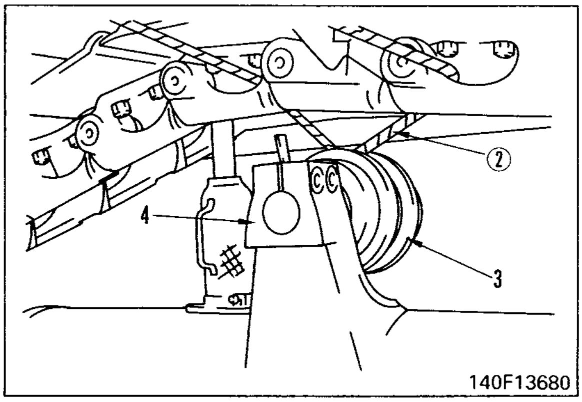


2. Using hydraulic jack ①, raise track shoe.
3. Remove mounting bolts (2).
4. Pass rope ② through hole in link, fit it around carrier roller (3) to support carrier, then loosen rope gradually, and pull out carrier (3) from support (4). ※1

   kg Carrier roller: **30 kg**







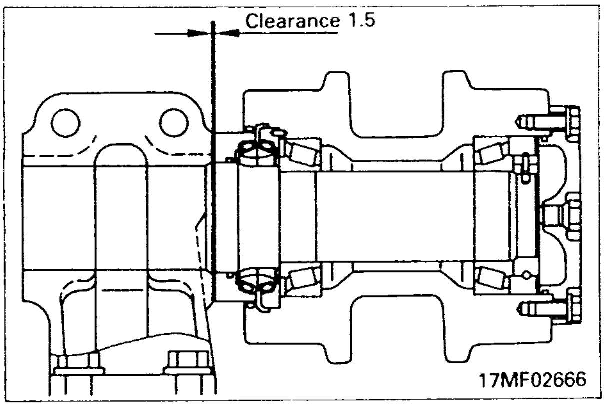
INSTALLATION OF CARRIER ROLLER ASSEMBLY

D65E, EX

- Carry out installation in the reverse order to removal.

※1

When installing the carrier roller to the support, leave the clearance shown in the diagram.

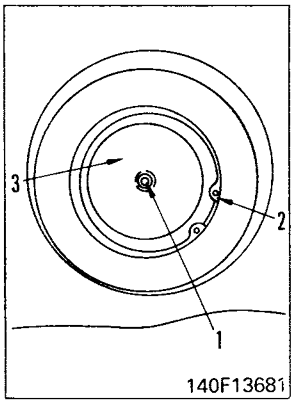


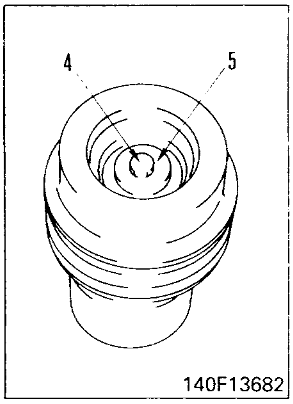
Support mounting bolt:
Thread tightener (LT-2)

- Adjust the tension of the track shoe assembly.
  For details, see TESTING AND ADJUSTING, Adjusting tension of track shoe assembly.

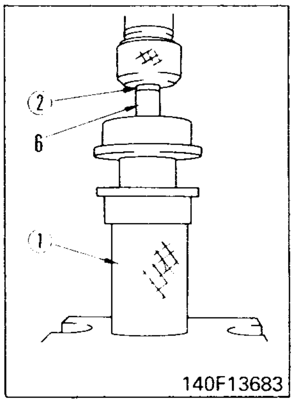
DISASSEMBLY OF CARRIER ROLLER ASSEMBLY

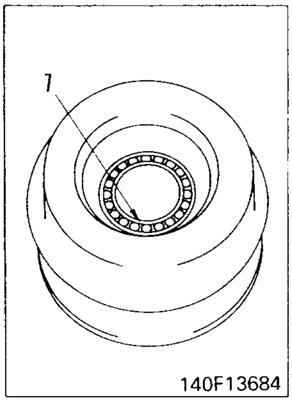
1. Remove plug (1) and drain oil.
2. Remove snap ring (2), then remove cover (3).
3. Remove bolt (4), then remove spacer (5).



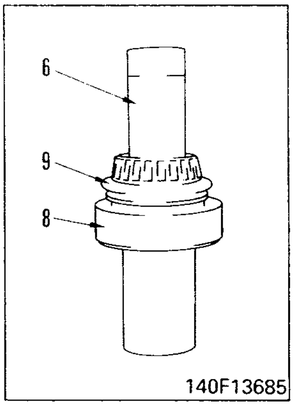


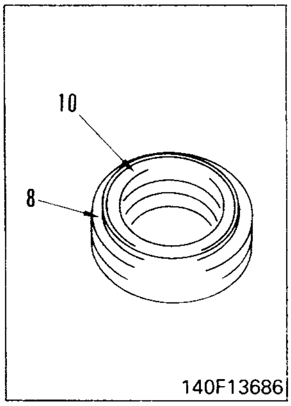
4. Set carrier roller on block ①, then using push tool ②, pull out shaft assembly (6) with a press, and remove bearing (7).



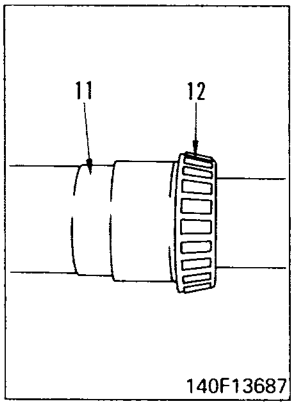


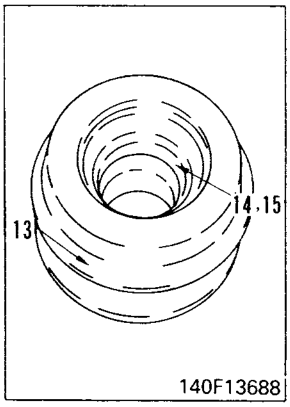
5. **Disassembly of shaft assembly**
   1) Remove collar (8) from shaft assembly (6).
   2) Remove floating seal (9).
   3) Remove floating seal (10) from coller (8).
   4) Remove bearing (12) from shaft (11).





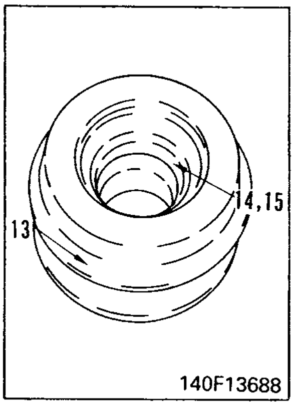
6. Remove outer race (14) from roller (13), then turn over and remove outer race (15).





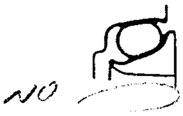
ASSEMBLY OF CARRIER ROLLER ASSEMBLY

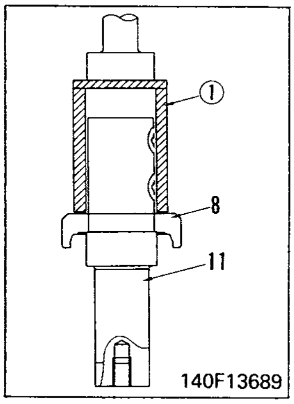
1. Press fit outer races (15) and (14) to roller (13).



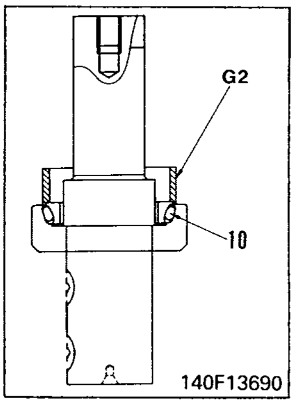
140F13688

2. **Assembly of shaft assembly**
   1) Using push tool ①, press fit collar (8) to shaft (11).
   2) Using tool **G2**, assemble floating seal (10).
      ★ When assembling the floating seal, clean the thick line portion (O-ring and O-ring contact surface), remove all oil and grease, and dry it.



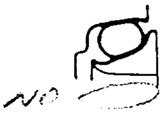


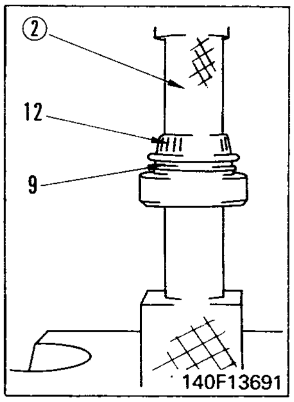
140F13689



140F13690

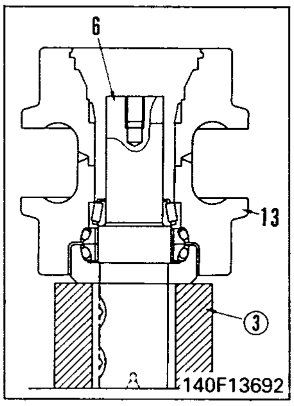
   3) Assemble floating seal (9), then using push tool ②, press fit bearing (12).
      ★ When assembling the floating seal, clean the thick line portion (O-ring and O-ring contact surface), remove all oil and grease, and dry it.





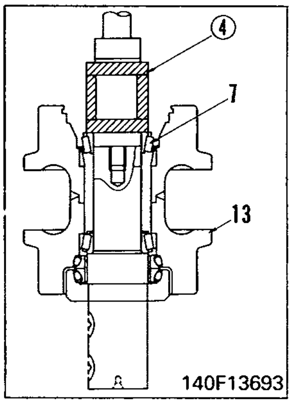
140F13691

3. Set shaft assembly (6) on block ③, and assemble roller (13).



140F13692

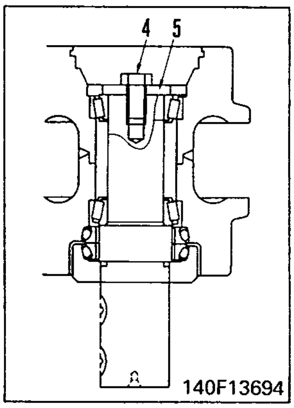
4. Assemble bearing (7), then using push tool ④, press fit.
   ★ Rotate the roller when press fitting the bearing, and press fit until the rotation of the roller starts to become heavy.



140F13693

5. Install spacer (5) with bolts (4).

   Bolt: **277 ± 32 Nm**
   (28.3 ± 3.3 kgm)

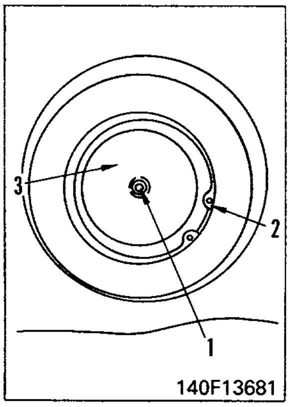


140F13694

6. Refill carrier roller with oil.

   Carrier roller: **240 cc (GO140B)**

7. Fit O-ring to cover (3) and install to roller, then install snap ring (2).



140F13681

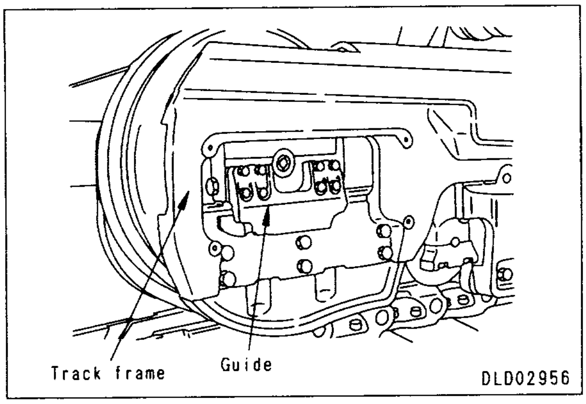
8. Check oil level and tighten plug (1).

CHECKING BEFORE REMOVAL OF TRACK SHOE ASSEMBLY

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

⚠ In some cases, it may be extremely dangerous to remove the track shoe assembly. To prevent danger, carry out the following checks before removing the track shoe assembly.

- **Checks before starting**
  1) Loosen the lubricator at the adjustment cylinder, remove the grease, move the machine backwards and forwards a short distance, and check that the track tension is relieved. If the track tension is not relieved and the track shoe assembly remains tense, there may be an abnormality inside the track frame (the recoil spring cylinder is broken, or the nut at the end of shaft has fallen off).
     ⚠ Never loosen the lubricator more than one turn.
  2) Check that there is no interference between the track frame and the guide shown in the diagram. If there is any interference (when progress of link pitch elongation is extreme), there are cases where it is impossible to know if there is any abnormality inside the track frame.

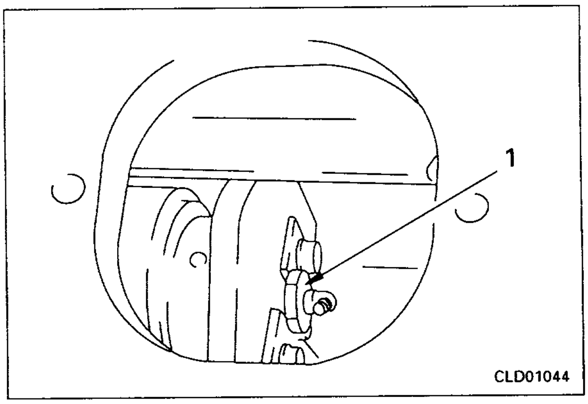


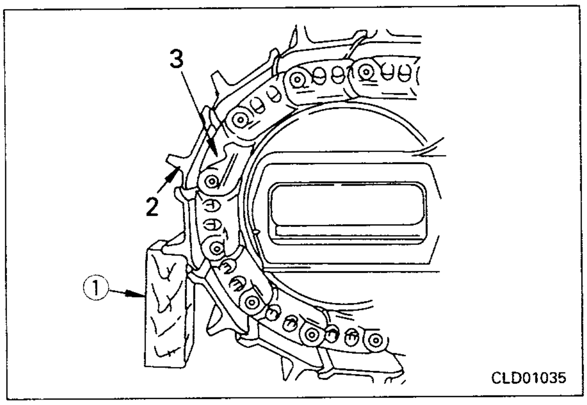
REMOVAL OF TRACK SHOE ASSEMBLY (NORMAL)

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

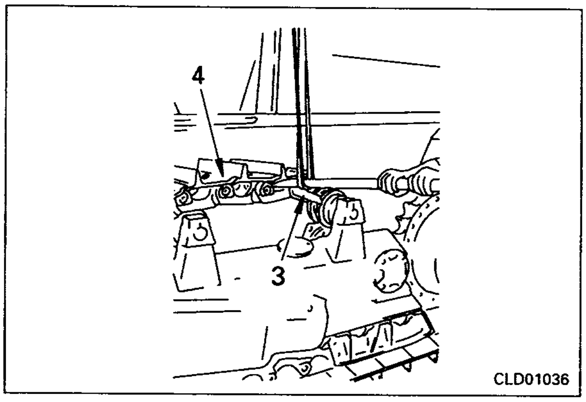
★ If CHECKING BEFORE REMOVAL OF TRACK SHOE ASSEMBLY shows that there is no abnormality, do as follows.

1. Remove work equipment assembly.
   For details, see REMOVAL OF WORK EQUIPMENT ASSEMBLY.
2. Loosen lubricator (1) and relieve tension of track shoe assembly. ※1
   ⚠ The recoil spring cylinder is under extremely high internal pressure. Never loosen lubricator (1) more than one turn.
   If the track is not relieved by loosening the lubricator, move the machine backwards and forwards.
3. Using block ①, adjust position of master link so that it is perpendicular.
4. Remove mounting bolts, then remove track shoe (2). ※2





5. Disconnect master link (3), then guide tip of track link with a crane, move machine towards rear slowly, and lay out track shoe assembly (4).



REMOVAL OF TRACK SHOE ASSEMBLY (WHEN THERE IS ABNORMALITY INSIDE TRACK FRAME)

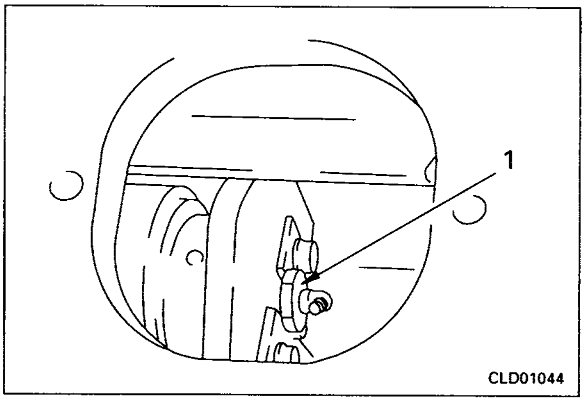
D65E-12 60001 – 60947
D65P-12 60001 – 60890
D65EX-12 60001 – 60941
D65PX-12 60001 – 60914

★ When CHECKING BEFORE REMOVAL OF TRACK SHOE ASSEMBLY shows any abnormality, do as follows.

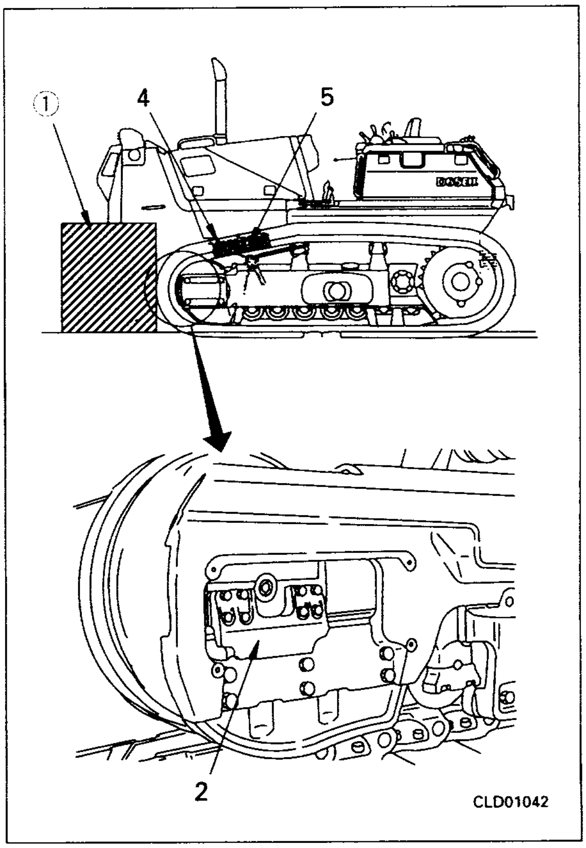
⚠ If there is any abnormality inside the track frame, there is danger that the track shoe assembly may spring back when it is removed or that the idler may spring out when the track shoe assembly is removed. This may lead to serious injury, so remove the track shoe assembly as follows.

⚠ If there is any interference or abnormal catching around the idler assembly, examine carefully and remove the problem before starting.

1. Remove work equipment assembly.
   For details, see REMOVAL OF WORK EQUIPMENT ASSEMBLY.
2. Loosen lubricator (1) of adjustment cylinder, then move machine backwards and forwards to remove grease. ※1
   ⚠ Never loosen the lubricator more than one turn.
   ★ Check that all the grease has been removed.



3. Drive slowly forward to put track shoe at idler end in contact with large block ① or a wall (if another large bulldozer of the same capacity as the machine being repaired is available, put in contact with the blade). Stop machine when recoil spring bends and track shoe also bends, then apply brake. When doing this, set so that master link is between idler and front carrier roller. For safety reasons, fit a lever block between carrier roller support and link.
4. Remove idler guide (2).
   ⚠ Always remove the idler guide without fail at this point.
   If the track shoe is opened without removing idler guide (2), it will move to the front when it opens, and idler guide (2) will be pushed against the track frame. If the idler guide is removed in this condition, the idler yoke assembly will fly out to the front.
5. Remove shoe (4), then disconnect master link (5). ※ 2
   ⚠ Be extremely careful to ensure safety when disconnecting the track shoe.
6. Move machine towards rear slowly, and lay out track shoe assembly.



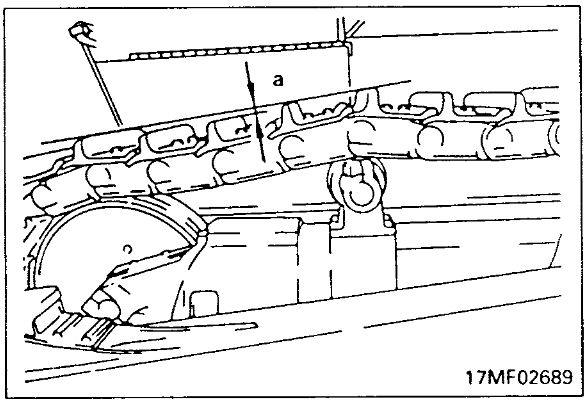
INSTALLATION OF TRACK SHOE ASSEMBLY

D65E-12	**60001 - 60947**
D65P-12	**60001 - 60890**
D65EX-12	**60001 - 60941**
D65PX-12	**60001 - 60914**

- Carry out installation in the reverse order to removal.

※ 1

★ When adjusting the track shoe tension, set dimension **a** to 25 ± 5 mm.

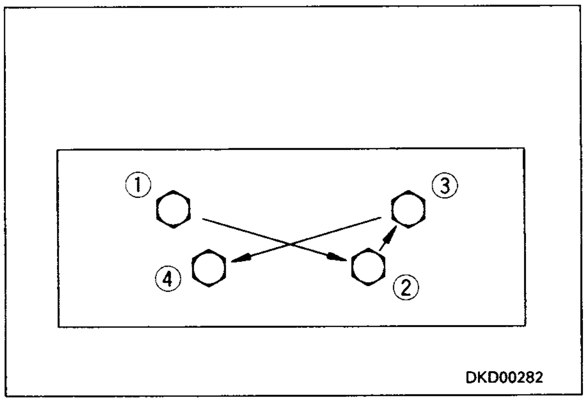


※ 2

★ Tighten the shoe bolts in the order shown in the diagram.

Shoe bolt :
Anti-friction compound (LM-P)

Shoe bolt (master link):
Initial torque :
343.2 ± 39.2 Nm (35 ± 4 kgm)
Tightening angle : **180^{0}_{-20}°**

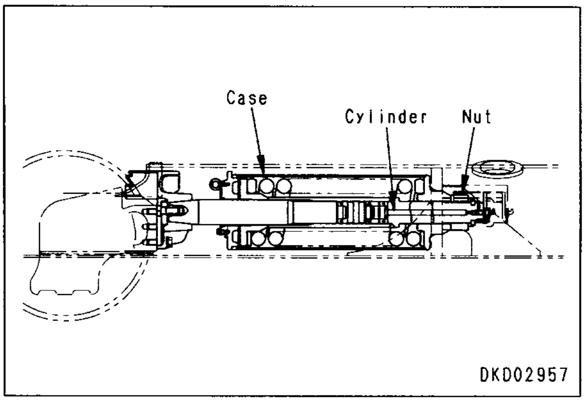


CHECKING BEFORE REMOVAL OF TRACK SHOE ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

⚠ In some cases, it may be extremely dangerous to remove the track shoe assembly. To prevent danger, carry out the following checks before removing the track shoe assembly.

- **Checks before starting**
  1) Loosen the lubricator at the adjustment cylinder, remove the grease, move the machine backwards and forwards a short distance, and check that the track tension is relieved. If the track tension is not relieved and the track shoe assembly remains tense, there may be an abnormality inside the track frame (the recoil spring cylinder is broken, or the nut at the end of shaft has fallen off).
     ⚠ Never loosen the lubricator more than one turn.



REMOVAL OF TRACK SHOE ASSEMBLY (NORMAL)

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

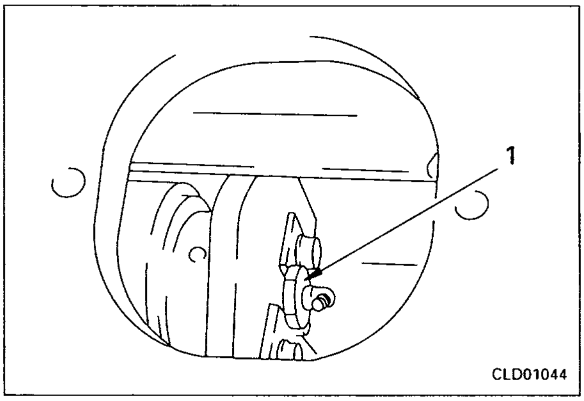
★ If CHECKING BEFORE REMOVAL OF TRACK SHOE ASSEMBLY shows that there is no abnormality, do as follows.

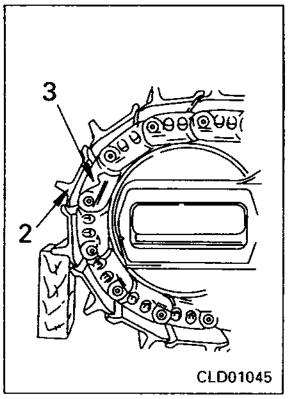
1. Set master link in position.
   ★ Set a block (height: approx. 300 mm) so that the master link is approx. 500 mm from the ground at the front.

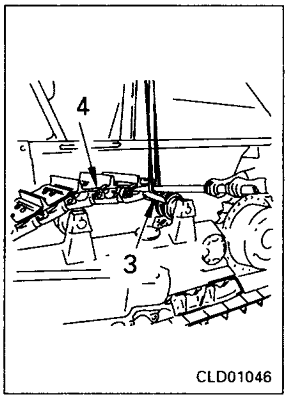
2. Relieve track shoe tension. ※1
   ⚠ Never loosen lubricator (1) more than one turn.
   ★ If the track is not relieved by loosening the lubricator, move the machine backwards and forwards.

3. Remove mounting bolts of track shoe (2) and master link (3). ※2

4. Raise tip of master link, move machine forwards slowly, and lay out track shoe assembly (4).







REMOVAL OF TRACK SHOE ASSEMBLY (WHEN THERE IS ABNORMALITY INSIDE TRACK FRAME)

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

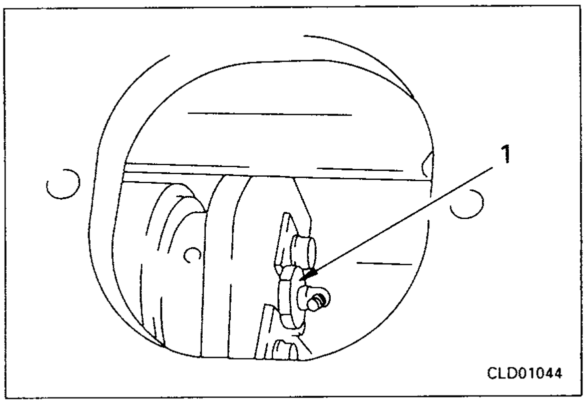
★ When CHECKING BEFORE REMOVAL OF TRACK SHOE ASSEMBLY shows any abnormality, do as follows.

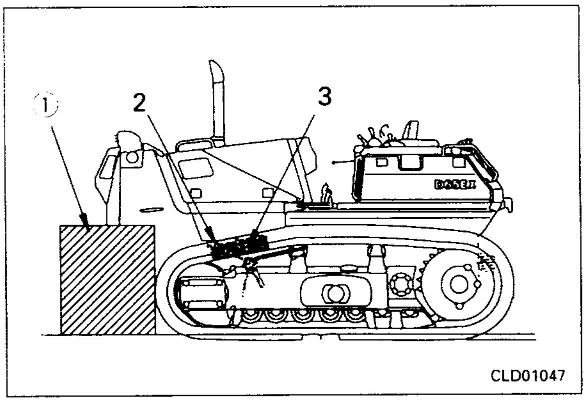
⚠ If there is any abnormality inside the track frame, there is danger that the track shoe assembly may spring back when it is removed or that the idler may spring out when the track shoe assembly is removed. This may lead to serious injury, so remove the track shoe assembly as follows.

⚠ If there is any interference or abnormal catching around the idler assembly, examine carefully and remove the problem before starting.

1. Remove work equipment assembly.
   For details, see REMOVAL OF WORK EQUIPMENT ASSEMBLY.
2. Loosen lubricator (1) of adjustment cylinder, then move machine backwards and forwards to release grease. ※1
   ⚠ Never loosen the lubricator more than one turn.
   ★ Check that all the grease has been removed.
3. Drive slowly forward to put track shoe at idler end in contact with large block ① or a wall (if another large bulldozer of the same capacity as the machine being repaired is available, put in contact with the blade). Stop machine when recoil spring bends and track shoe also bends, then apply brake. When doing this, set so that master link is between idler and front carrier roller. For safety reasons, fit a lever block between carrier roller support and link.
   - Remove shoe (2), then disconnect master link (3). ※2

   ⚠ Be extremely careful to ensure safety when disconnecting the track shoe.
   - Move machine towards rear slowly, and lay out track shoe assembly.





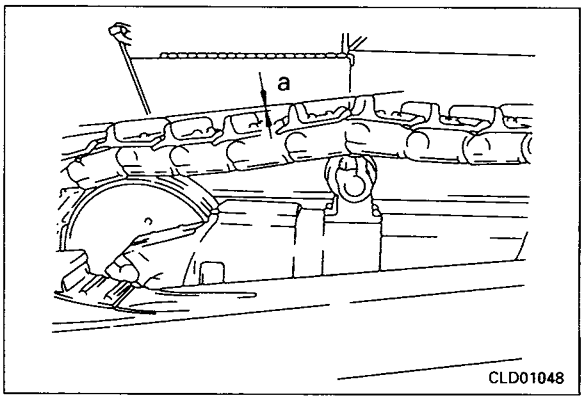
INSTALLATION OF TRACK SHOE ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

- Carry out installation in the reverse order to removal.

※ 1

★ When adjusting the track shoe tension, set dimension **a** to 25 ± 5 mm.



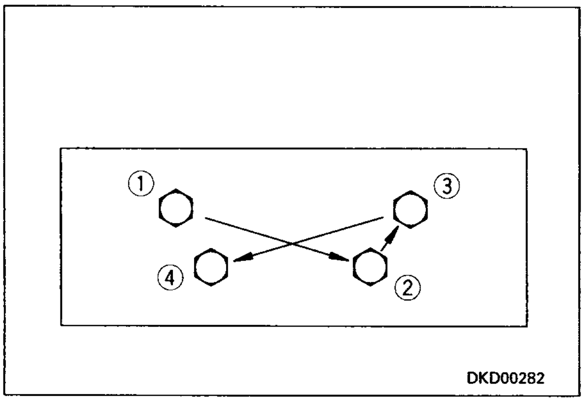
※ 2

★ Tighten the shoe bolts in the order shown in the diagram.

Shoe bolt :
Anti-friction compound (LM-P)

Shoe bolt (master link):
Initial torque :
343.2 ± 39.2 Nm (35 ± 4 kgm)

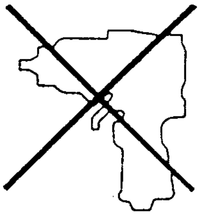
Tightening angle : **180^{0}_{-20}°**



OVERALL DISASSEMBLY OF TRACK SHOE

▲ This section describes only for the lubricated track link.

1. **Shoe (master link portion)**
   Set the track assembly on a flat floor with the shoe facing up, then remove the shoe bolt at the master link, and remove the shoe.
   ★ Do not use an impact wrench when loosening the master link bolt.



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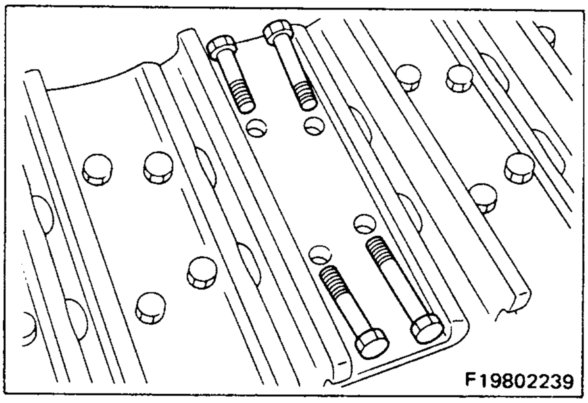
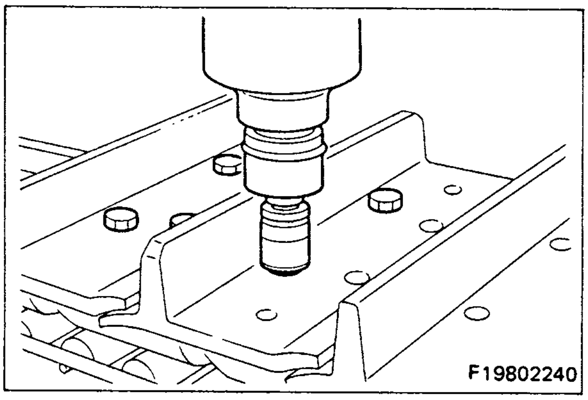


2. **Disassembly into 1/4 parts**
   Because of the weight of the track assembly, if the 1/2 assembly is too large and there are problems with disassembly and assembly work, divide into 1/4 assemblies.
3. **Shoe (regular link portion)**
   Raise the track assembly and set it on the floor with the shoe facing up, then use a shoe bolt impact wrench to remove the shoes.
   ★ When moving the track assembly, be careful not to damage the master link portion.
   ★ If a gas cutter has to be used to remove the shoe nut, to prevent deterioration of the seal due to the heat, keep the temperature of the seal portion below 80°C, and take action to prevent welding spatter from entering the gap between the links.



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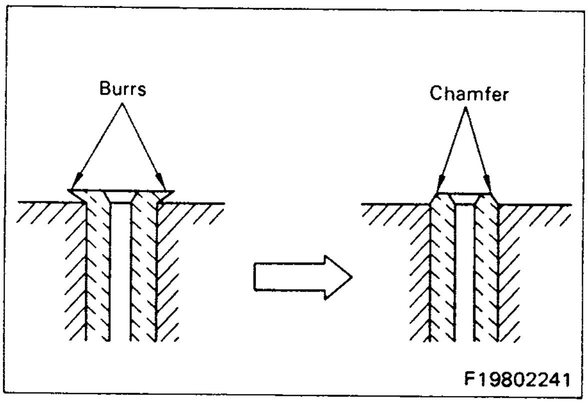
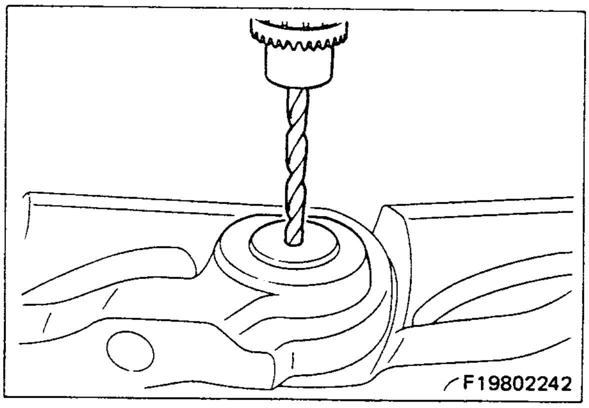
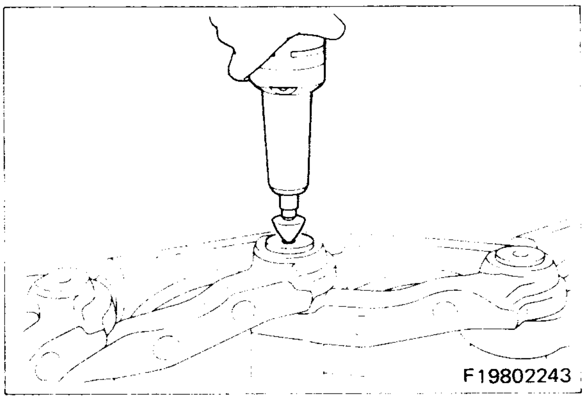
4. **Draining oil**
   Before disassembling the link assembly, drain the oil from inside the pin and take precautions so that the link press does not become dirty with oil.
   ★ Before disassembling, if it is judged that it is necessary to rebuild the track as a dry type track, the following work need not be carried out.
   1) Set the link assembly on a flat floor with the large plug side facing up, then chamfer the burrs on the end face of the pin with a grinder.
      ★ If the track is disassembled with burrs still at the end face of the pin, the pin press fitting hole of the link will be scratched, and this will cause leakage from the pin press-fitting portion after rebuilding.
   2) Using a drill (ø10mm), make a hole in the large plug, then remove the large plug.
      ★ If any dirt or deteriorated oil is stuck to the pin hole, drill through with a longer drill to remove it. When doing this, be careful not to damage the oil hole.



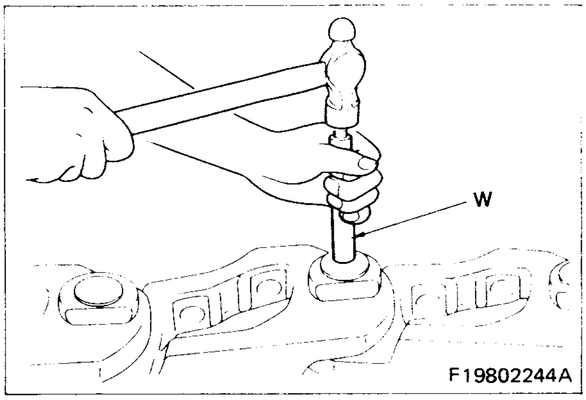


3) After removing the large plug, use a baby grinder (angle of grinder tip: 45° — 60°), and chamfer the pin hole so that the plug is not damaged when the plug is knocked in.



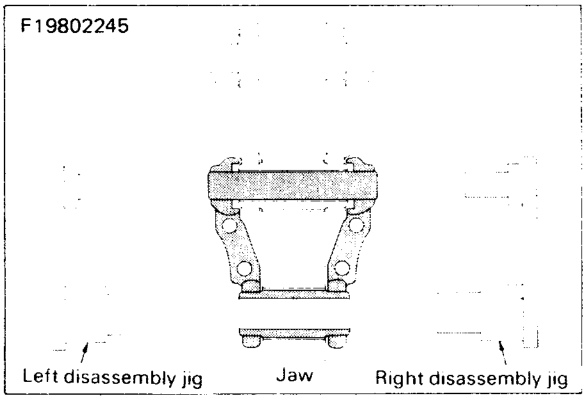
4) Turn over the link assembly so that the small plug side is facing up, remove the burrs at the end face of the pin with a grinder, then use tool **W** to knock the small plug to the inside.
   ★ If the small plug hole is blocked with burrs, grind with a grinder until the hole can be seen completely.

5) Using a drill (ø10 mm), chamfer the small plug hole.
6) Blow with compressed air to remove the metal particles when draining the oil inside the pin or removing the burrs, then wash the link assembly with high-pressure water or steam.

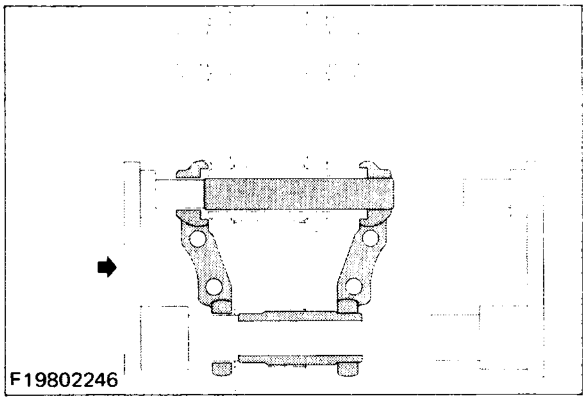


5. Disassembly of link

1) Set the link assembly on a link press, then hit with a hammer so that the bushing and jaw are in tight contact.
   ★ If the link tread and outside diameter of the bushing are worn, adjust the height of the shoe or guide plate, and center the disassembly jig with the pin and bushing center to prevent damage to the link hole when disassembling.
   ★ If the centering is not carried out properly, the link hole may be damaged, the pin may break, or the bushing may crack during disassembly.

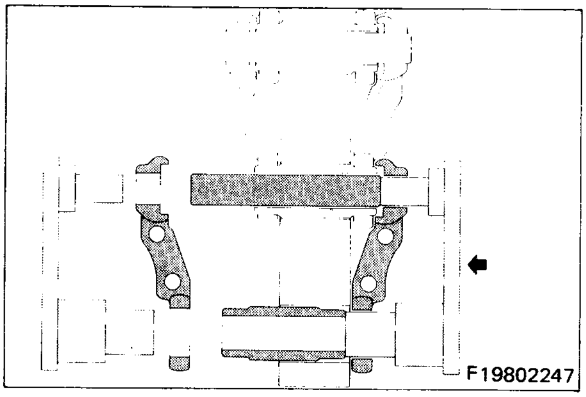


2) Operate the left cylinder and remove the left link and pin and bushing press-fitting portion at the same time.
   ★ Check the removal force of the pin and bushing, and use this value as reference to judge if it is possible to obtain the necessary pin and bushing press-fitting force when turning and reassembling.
   ★ Do not push the disassembly jig inside more than is necessary as the spacer may break.



3) Return the left cylinder, then operate the right cylinder and remove the right link and pin and bushing press-fitting portion at the same time.

4) Return the right cylinder, remove the left and right links, pins, bushings, and spacers, then feed the following set for one link assembly into the jaw.
   - ★ To decide if the seal can be used again, carry out inspection when the seal is still installed to the link, so do not remove the seal from the link.
   - ★ If the oil is remaining, this can be used as a guide line for reuse of the seal, so mark such links or seals.
   - ★ If the end face of the bushing and seal surface are damaged, it will cause oil leakage, so be extremely careful when handling.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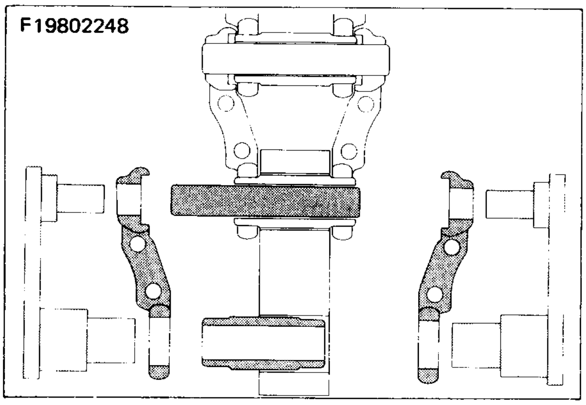
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6. Inspection

Check the following items to determine if the part can be reused as a lubricated track or as a grease-filled track. Carry out a comprehensive check to determine if the link assembly can be rebuilt as a lubricated track or as a grease-filled track.

⚠ When making judgements about reuse of parts, see Shop manual "Guidance for Reusable Parts".

1) Check the pins, bushing, links and spacers visually for damage, and carry out a color check or use a flaw detector to check parts that are suspected of being damaged. Any part that is cracked must not be used again, so scrap it.
2) Check the external appearance of the seal and the end face of the bushing visually to determine if they can be used again.
   - ★ If only the bushing is replaced with a new part, the worn or damaged part of the seal lip contacts the end face of the bushing directly, so it may not be able to carry out its sealing function. For this reason, always replace the seal together with the bushing, or rebuild as a grease-filled track.

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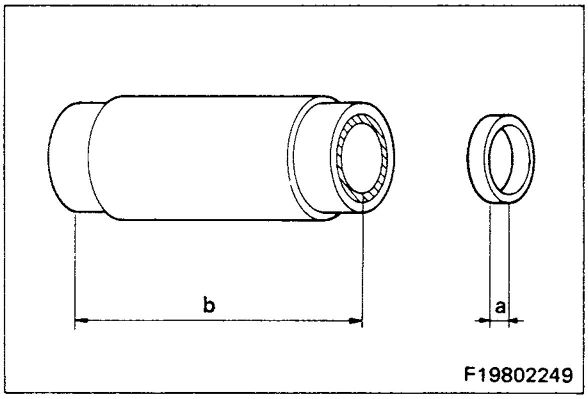
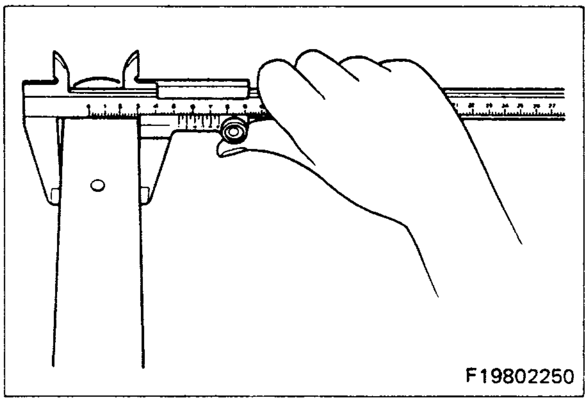
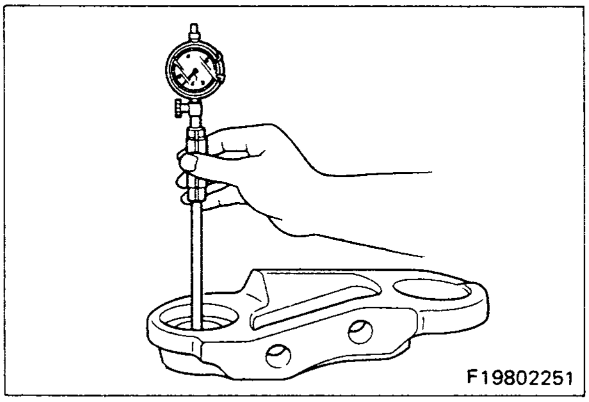
3) Using calipers, measure spacer thickness **a** and overall length **b** of the sliding portion of the bushing and spacer. Check if it is possible to obtain the specified seal mounting dimension when reassembling.
   - ★ If the amount of wear of the spacer and bushing is greater than the specified amount, the assembly precision of the seal portion cannot be guaranteed, so replace with new parts, or rebuild as a grease-filled track.

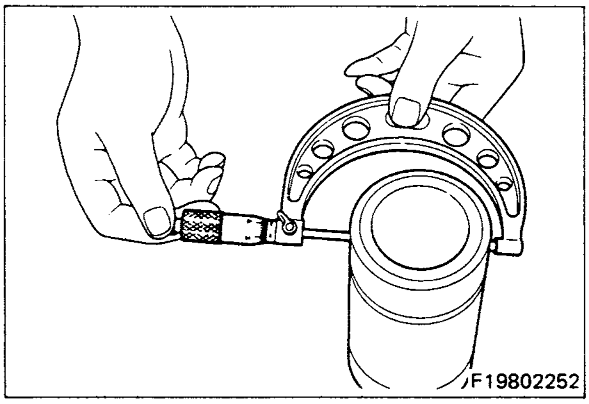


4) Using a micrometer, cylinder gauge, and calipers, measure the outside diameter of the pin and the inside diameter of the bushing at the worn portion, and judge if the parts can be used again.
   - ★ If the amount of wear is greater than the specified amount, there will be play during travel, and it will also cause the oil to become dirty, so replace with new parts or rebuild as a grease-filled track.
   - ★ For details of the dimensions when making judgement, see MAINTENANCE STANDARDS.



5) Using a micrometer and cylinder gauge, measure the outside diameter of the pin and bushing press-fitting portion, and the inside diameter of the pin and bushing press-fitting portion of the link to determine if the permitted interference can be obtained. However, when rebuilding as a lubricated track, check the standard interference for the pin and link.
   - ★ If the permitted interference can not be obtained, replace with new parts or replace with an oversize part.
   - ★ For details of the dimensions when making judgement, see MAINTENANCE STANDARDS.





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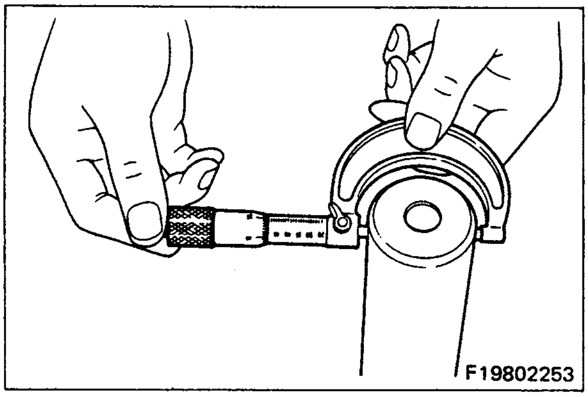
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PRECAUTIONS FOR STORAGE

1) To prevent rust of the counterbore portion of the link, leave the seal installed to the link and be careful not to damage the seal lip during storage.
2) Coat the pin and bushing press-fitting portion, shoe mating surface, and master link mating surface of the link with rust prevention oil to prevent rust.
3) Coat the whole circumference of the pins, bushings, and spacers with rust prevention oil to prevent rust, and be particularly careful not to damage the end face of the bushing during storage.

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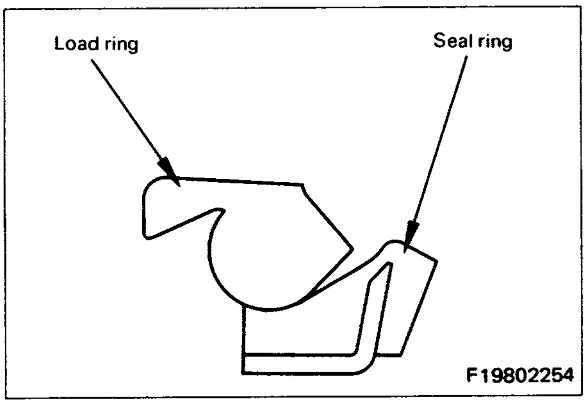
OVERALL ASSEMBLY OF TRACK SHOE

1. WHEN REBUILDING AS LUBRICATED TRACK

1. Preparatory work

1) Washing seal assembly
   - Machines equipped with F3 type seals
     Remove the seal assembly from the link, then separate into the seal ring and load ring, and clean the parts.
     ★ The seal ring and load ring deteriorate easily when brought into contact with cleaning agent (trichlene, etc.), so wash the parts quickly.
     After cleaning, wipe the parts with a clean cloth to remove all the cleaning agent.



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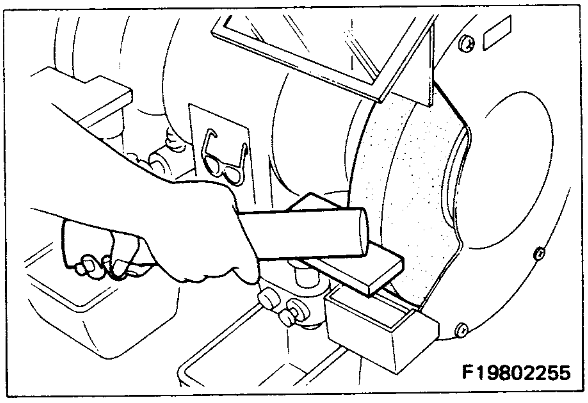
2) When reusing the pin, chamfer the corner of the end face smooth with a grinder. Remove any protruding parts stuck to the press-fitting portion with a grinder.
   ★ If the corner of the end face has become sharp due to wear, there will be scuffing when press fitting and this will cause oil leakage.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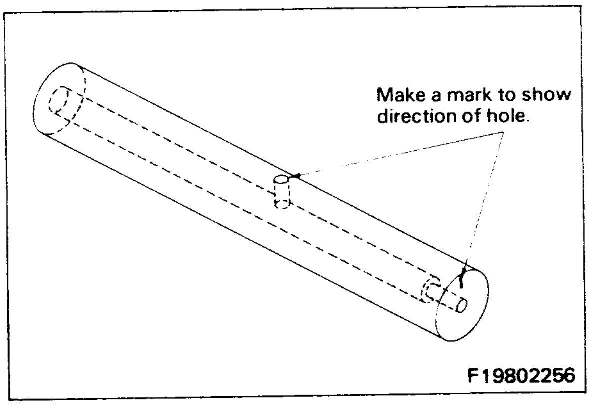
3) Make a mark on the end face at the small plug end to show the direction of the side hole (hole in the radial direction) in the pin when assembling.
   ★ When rebuilding the pin, assemble in the same direction as when the part is new (side hole on the link tread side).



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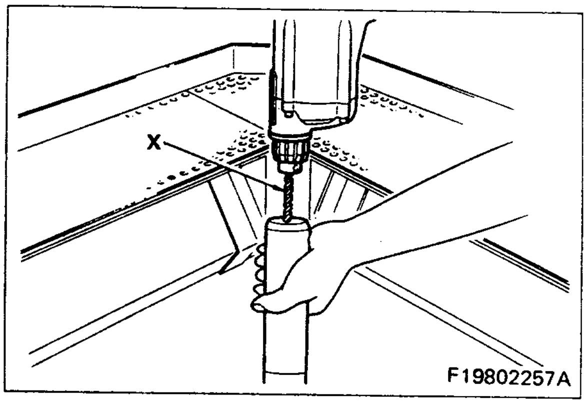
4) If the link, pin, bushing, or spacer are dirty, wash them. Remove any protruding parts stuck to the link and bushing with grinder.
   - ★ These parts easily rust, so wash them immediately before assembly.
   - ★ Use tool **X** to wash the pin hole.
   - ★ Do not polish or carry out any other treatment of the end face of the bushing as this causes the oil leakage.

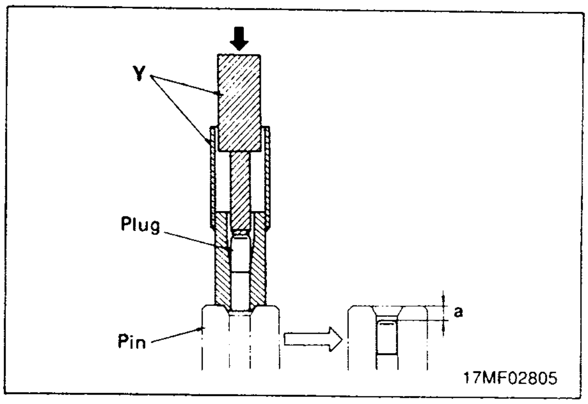


5) Use tool **Y** to knock the large plug into the pin.
   i) Insert plug into hole in guide through plug insertion window. (Coat the plug with oil.)
   ii) Push bar by hand and insert the plug as far as it will go.
   iii) Push plug with bar, and push guide itself against pin.
   iv) Hit in bar with a hammer.

   ★ Dimension **"a"** to knock in the plug from end face of pin: 6 ± 2 mm

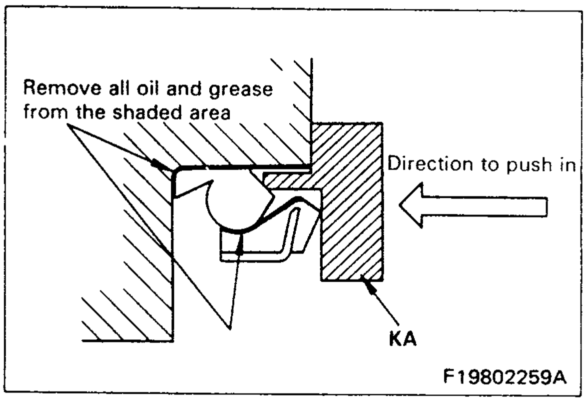
   ★ If there is no more place to chamfer at the pin hole because of wear, use a baby grinder (angle of grinder tip: 45 — 60°) to carry out chamfering.

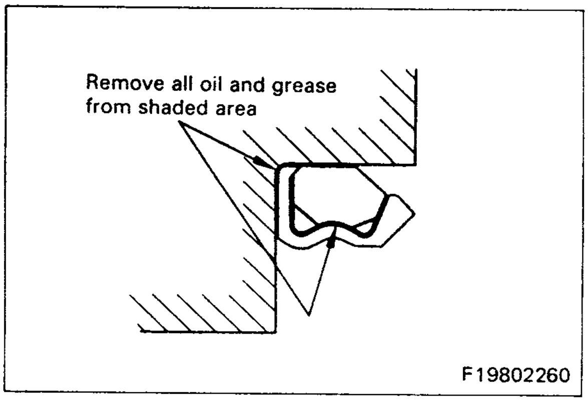
   ★ Coat the outside circumference of the plug with GO140B and knock in the smaller diameter part first.



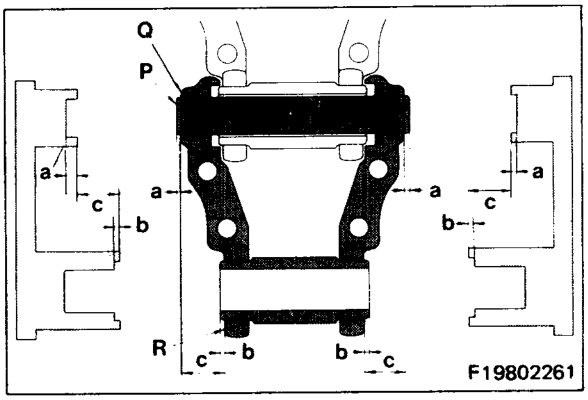
6) Installation of seal assembly
   - Machines equipped with F3 type seal
     Clean the link counterbore, then use tool **KA** to push the seal in fully to the bottom.

     ⚠ If there is oil stuck to the link counterbore and seal assembly, the seal will rotate and its sealing performance will drop, so do not coat with oil. In addition, be careful not to let oil get into the counterbore portion of the seal when pushing in.

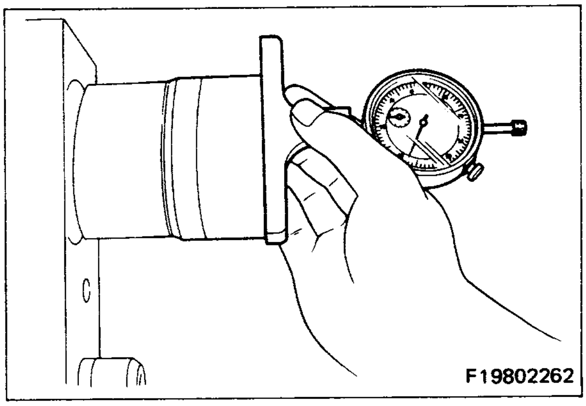




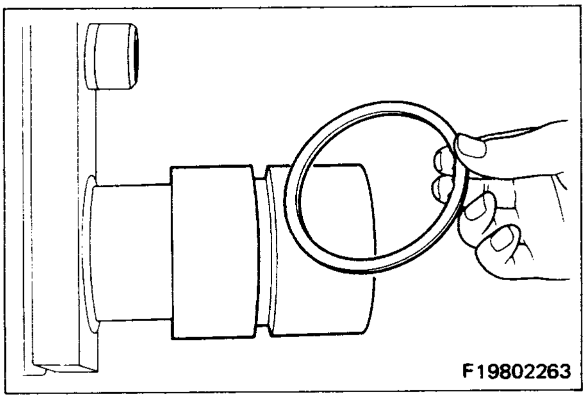
7) In order to keep the protrusion of the pin and bushing constant and the installation dimensions of the steel within the specified value during assembly, adjust the press-fitting jig dimensions of the link press
   ★ For details of the standard dimensions, see PRESS-FITTING JIG DIMENSION TABLE FOR LINK PRESS.



   ★ To leave a small space for the pin when assembling, ensure that the dimension (dimension **a**') is greater than dimension "**a**" at the pin pushing portion of the left press-fitting jig.
   When assembling in order ① left link press fitting, ② right link press fitting, provide the extra space for the pin on the right press-fitting jig.



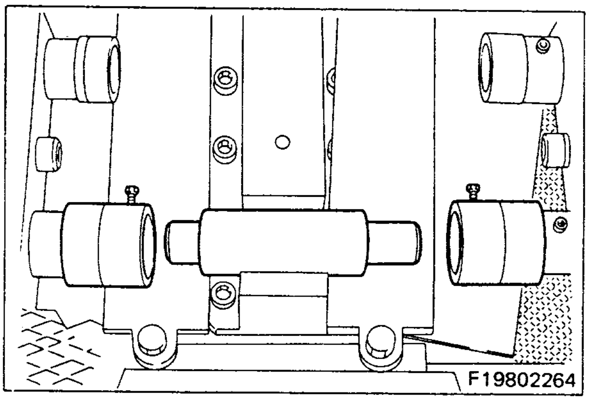
   ★ If the end face of the pin (portion **P**) or the end face of the link (portion **Q**, **R**) are worn, add the amount of wear to the standard dimension when adjusting the dimension of the press-fitting jig so that the amount of protrusion of the left and right pin and bushing is uniform.



8) Adjust the relief pressure of the link press to make sure that the pushing force of the press does not exceed the specified value.
   ★ If the pushing force is too strong, excessive force will be brought to bear on the spacer, and it will be pushed against the bushing. This will cause the spacer to break or will cause abnormal wear between the spacer and bushing end face.
   ★ If the interference at the press-fitting portion is different from when the part is new, as when reusing a pin or bushing, measure several of the press-fitting portions, and use the value below to determine the set pushing force according to the average interference.
   ★ Set pushing force of pin and bushing:
   588 KN (60 ton)
   Set pushing force ≒ 1.8 × average pushing force
   (Adjust the relief pressure of link press to fix the set pushing force)

2. Assembly of link

1) Use a clean brush to coat the area between the pin and bushing with oil (GO140B), set in position, then set in front of the jaw of the link press.
   ★ When reusing (turning) the bushing, set the worn surface on the outside circumference of the bushing facing the shoe mounting surface of the link (facing up on the link press).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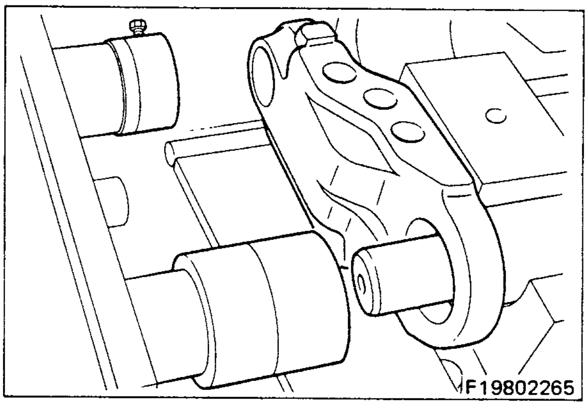
2) Set the left and right bushing end master link with the shoe mounting surface facing up, then press fit to the bushing.
   ★ When doing this, use the pin end master link as a support.
   ★ Bushing press fitting force:
   49 — 147 KN (5 — 15 ton)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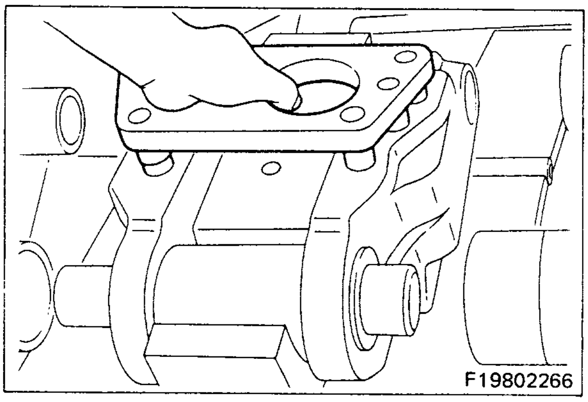
3) Using a shoe bolt hole pitch gauge, press fit until the distance between the shoe bolt holes of the left and right link is the specified value.
   ★ Use compressed air to remove all metal particles from burrs while press fitting the bushing.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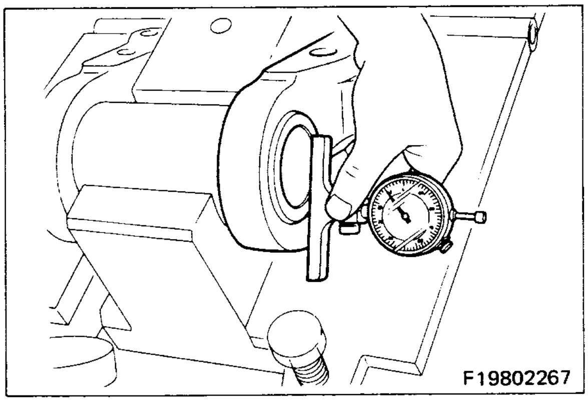
4) Turn over the master link, and check that the left and right master links have been press fitted in parallel.

5) Measure the amount of protrusion of the left and right bushings with a depth gauge.
   ★ Adjust the press-fitting jig for the link press so that the protrusion of the left and right bushings is uniform.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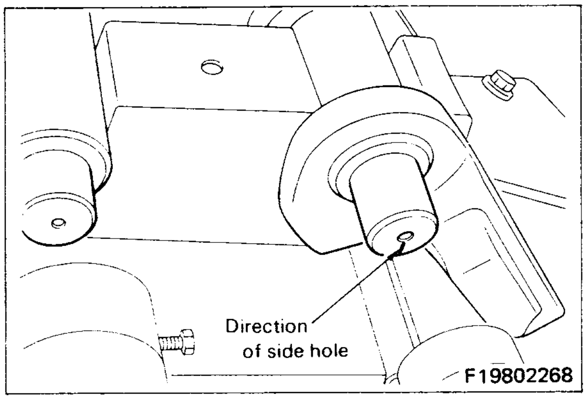
6) Feed the master link portion, then set the pin and bushing in position.
   ★ When reusing the pin, assemble so that the side hole is on the link tread side in the same way as when the part is new. If the parts are not assembled facing the specified direction, the strength may drop, so mark the direction of the side hole clearly on the end face to prevent any mistake during assembly.
   ★ Align the large plugs so that they are on the left side facing the link press when assembling.



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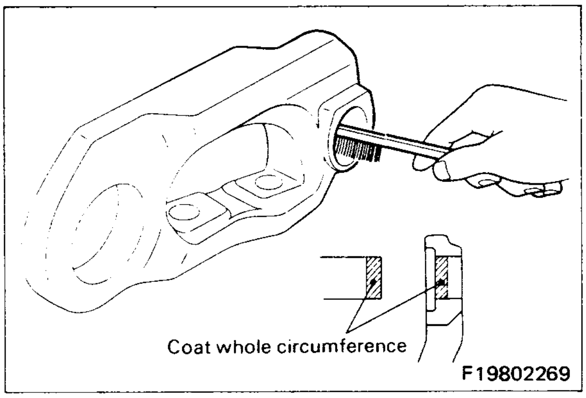
7) To prevent oil from leaking out from scuff marks on the pin press-fitting portion, coat the pin press-fitting hole in the link and the outside diameter of the pin press-fitting portion with gasket sealant (198-32-19890).



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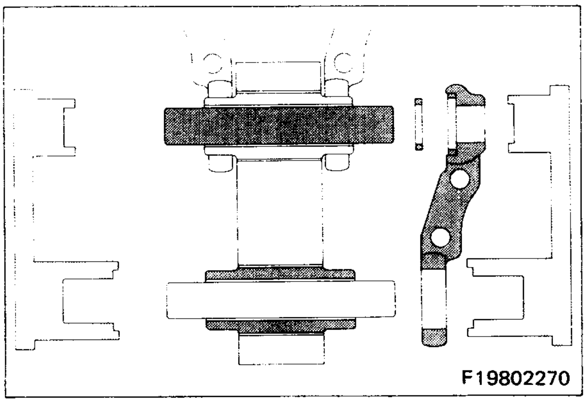
8) Set the right link in position and install the spacer to the pin.
   ★ Check that there is no dirt or dust stuck to the seal surface and bushing end face, then use a clean cloth or brush to coat with oil (GO140B).
   ★ Wipe the spacer with a clean cloth, then install it.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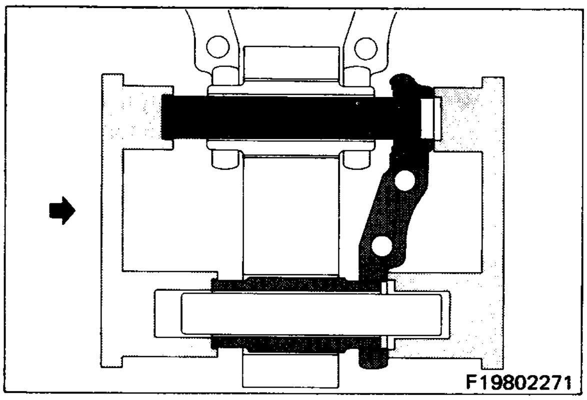
9) Using the right jig as the receiving end and the left jig as the pushing end, press fit the pin and bushing at the same time.
   - ★ When press fitting, the seal may come off the link due to the play, so press fit smoothly. If the seal comes off the link, stop the press-fitting operation and fit the seal correctly on the link, then start the press-fitting operation again.
   - ★ Pin and bushing press fitting force:
     196 — 392 KN (20 — 40 ton)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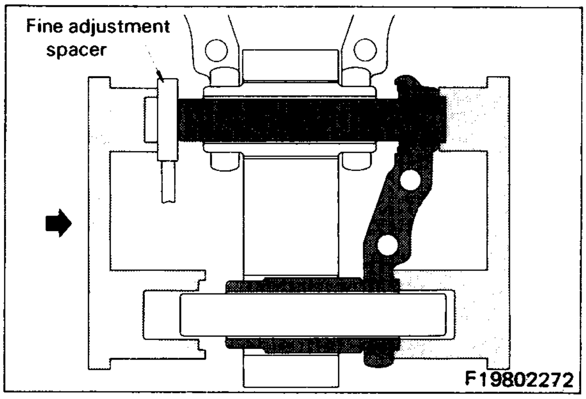
10) Using a fine adjustment spacer, press fit so that the end face of the pin is in tight contact with the bottom of the receiving jig..
   - ★ Adjust the depth of lthe hole in the receiving jig so that the protrusion of the left and right pins is uniform.



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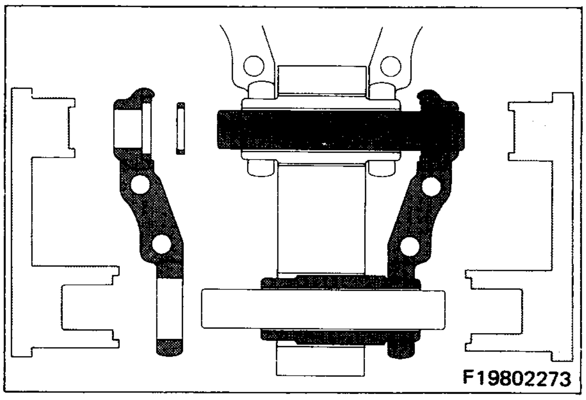
11) Set the left link in position and install the spacer to the pin.
   - ★ Coat with oil in the same way as when installing the right link.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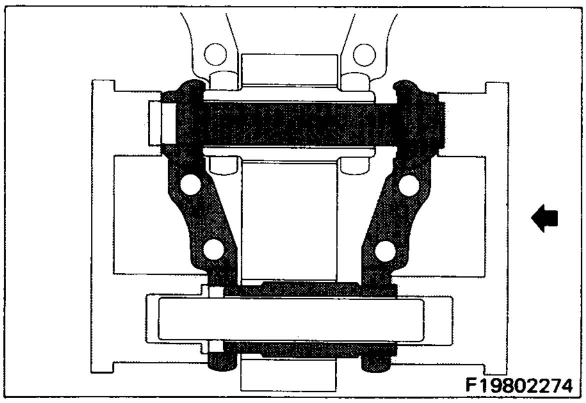
12) Using the left jig as the receiving end and the right jig as the pushing end, press fit the left link.
   - ★ When press fitting, be careful that the left and right seal and spacer do not come out of position.
   - ★ Provide enough space on the left jig so that the end face of the pin does not contact the bottom of the jig.
   - ★ Link press fitting force:
     196 — 392 KN (20 — 40 ton)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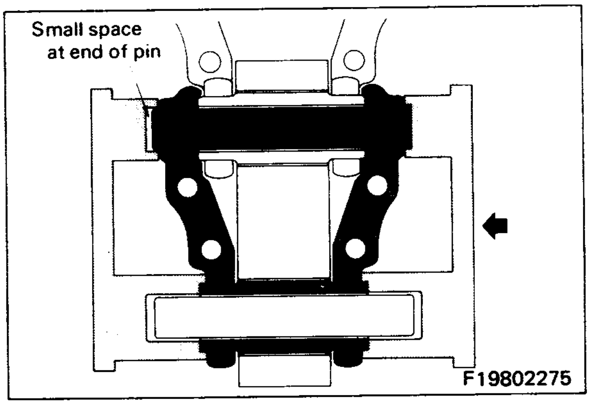
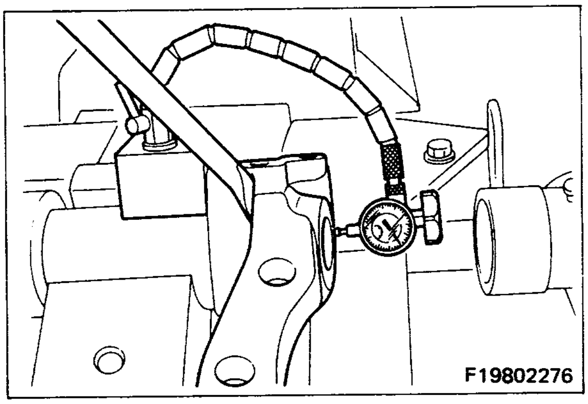
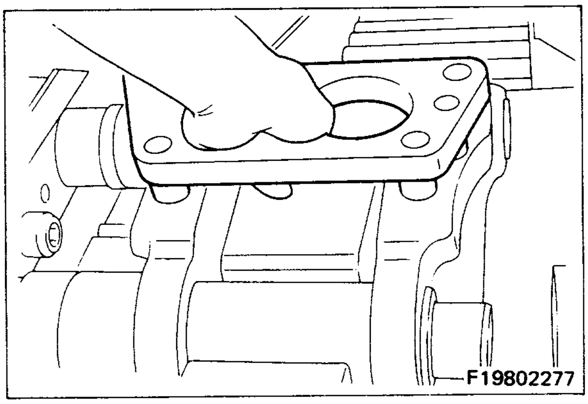
13) Press fit the link, spacer, and bushing so that they are each in tight contact.
- ★ It is impossible to check from outside if they are in tight contact, so control the hydraulic force of the link press and set the relief pressure to a constant value. Then apply hydraulic force and push in until this pressure is reached.
  For details of the setting for the relief pressure, see "Preparatory work".
- ★ Check that neighboring links rotate together.



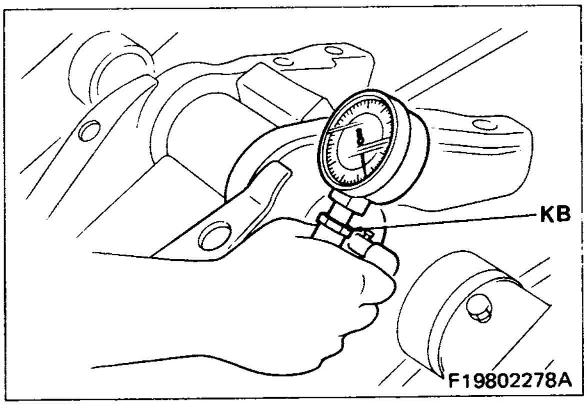
14) After assembling each link, use a dial gauge and pinch bar to measure the end play from the link previously assembled, to check that the link is assembled within the specified value.
- ★ If the end play does not come within 0 — 0.13mm even when applying the pushing force until the relief valve is actuated, raise the relief pressure setting gradually to adjust.
- ★ Adjust the relief pressure setting carefully and be sure not to raise the pushing force of the link press higher than necessary.



15) Using a shoe bolt hole pitch gauge, check that the distance between the shoe bolt holes is within the standard value.
- ★ If the distance between the shoe bolt holes is greater than the specified value, disassemble and check for any abnormality, then press fit again.
- ★ If the distance between the shoe bolt holes is smaller than the specified value, and the shoe cannot be installed, the wear of the spacer or bushing end face is probably greater than the repair limit, so disassemble and replace with a new part.
- ★ If the end play is too large, the sealing performance will drop, so set the end play to a small value.



16) After assembling each link, use tool **KB** to remove the air from inside the pin, and check the sealing performance.
- ★ Hold the space inside the pin at a vacuum of 695 ± 15 mmHg for 5 seconds and check that there is no change in pressure.
  If the pressure changes, disassemble and check the seal for any abnormality, then assemble again.

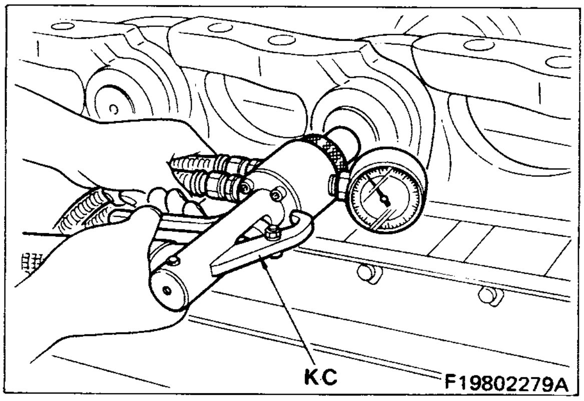


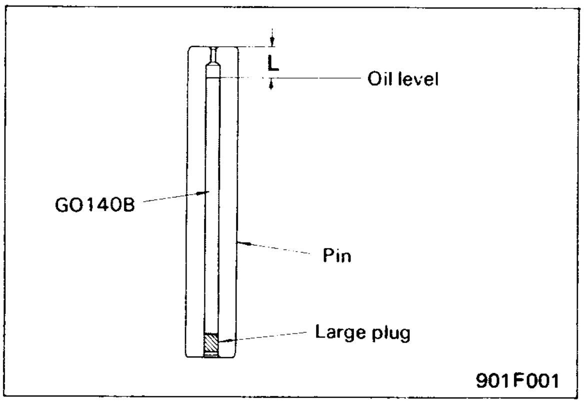
17) Assemble the pin end master link as the final link.
    ★ Check that the left and right master links are press fitted in parallel.

3. **Filling with oil**

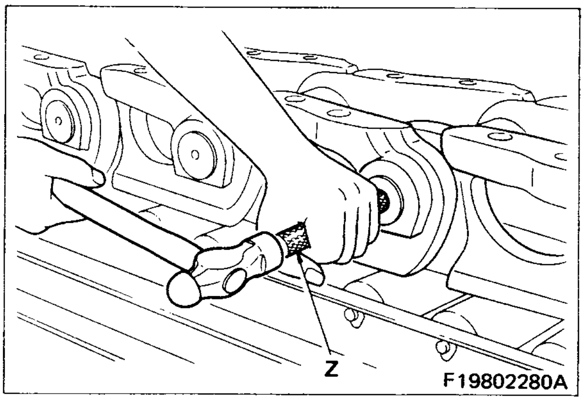
   After completion of assembly of the link assembly, fill the pin hole with oil.

   1) Using tool **KC**, remove the air inside the pin from the small plug hole, set to a vacuum of 695 ± 15 mmHg, then fill with oil (GO140B) until the pressure is 0.2 — 0.3 MPa (2 — 3 kg/cm^2).
      ★ In cold or extremely cold areas, instead of GO140B, fill with Komatsu genuine oil (150-09-19270) which has excellent low temperature qualities.
      ★ Be careful not to raise the oil pressure too high as this will have an adverse effect on the seal.
      ★ To determine the oil amount, set the small plug end at the top (stand the link assembly on its side), leave for 30 minutes, then charge with oil so that depth **L** of the space at the pin hole is within the specified value below.
      Specified value of **L**: 30 — 50 mm



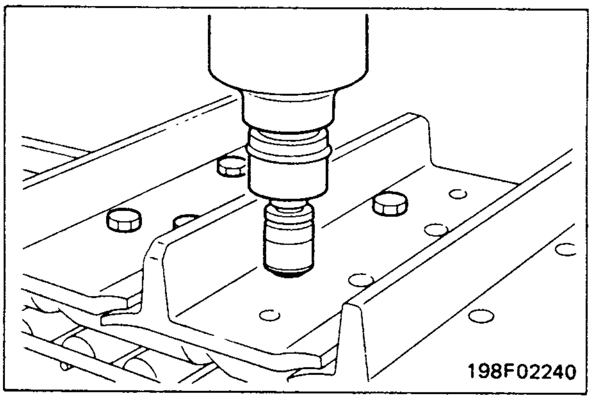


   2) After completion of filling with oil, use tool **Z** to knock in the small plug to the specified position.
      ★ Coat the outside circumference of the small plug with GO140B.
      ★ Knock in the plug to the depth given below.
      Depth to drive from end face:
      2.5 ± 1 mm



4. **Shoe (regular link portion)**
Set the link assembly on the bed, then use a shoe bolt impact wrench and torque wrench to install the shoe.

Shoe bolt (regular link):
Initial tightening torque:
392.3 ± 39.2 Nm (40 ± 4 kgm)
Tightening angle: **120 ± 10°**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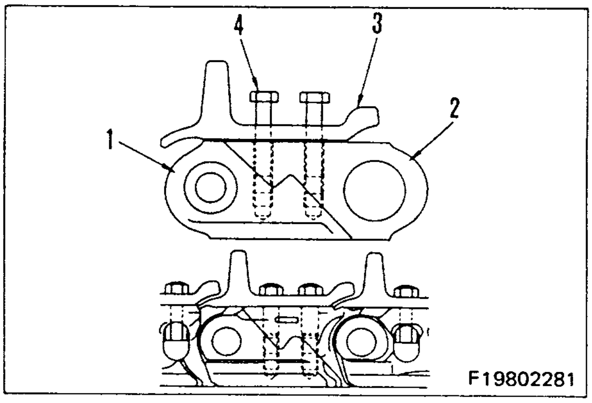
5. **Connecting to make 1/2 assembly**
Set two completely assembled portions of track on a flat surface in a straight line with the shoes facing up. Pull master link (1) at the pin end to master link (2) at the bushing end, and set at the mating surfaces. Then put shoe (3) on top, check that shoe bolt (4) goes in easily by hand, and connect the two parts.



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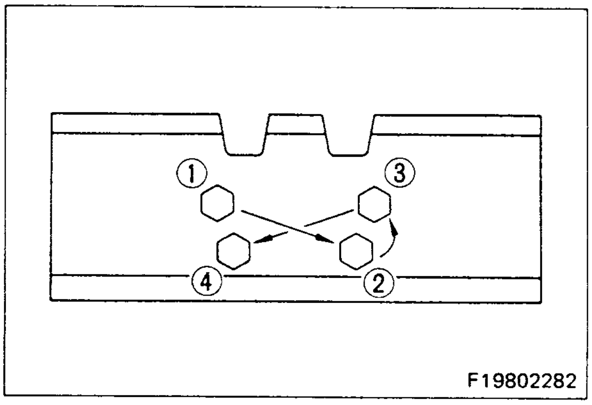
Mounting bolt:
Anti-friction compound (LM-P)

Shoe bolt (master link):
Initial tightening torque:
343.2 ± 39.2 Nm (35 ± 4 kgm)
Tightening angle: **180 $^{0}_{-20}$°**

★ When tightening, tighten in order ① — ④.
★ Do not use an impact wrench for the master link mounting bolt.



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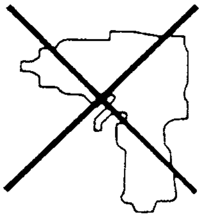
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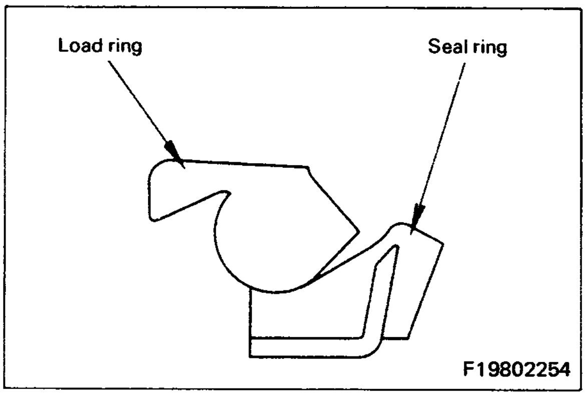
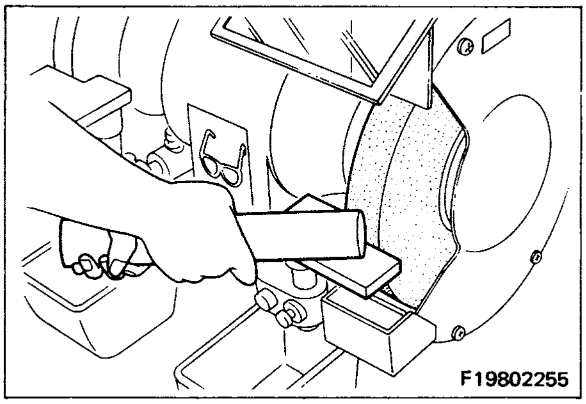
2. WHEN REBUILDING AS GREASE-FILLED TRACK

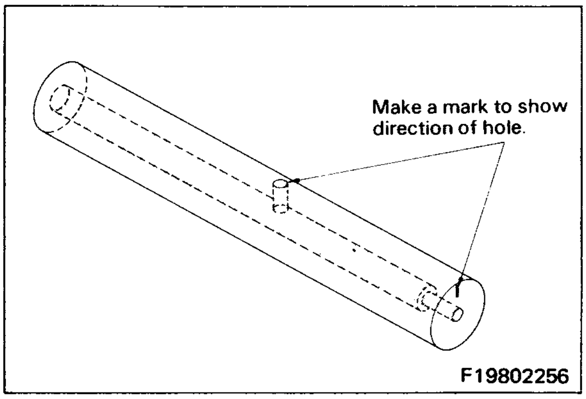


1. **Preparatory work**
   1) Washing seal assembly
      - Machines equipped with F3 type seals Remove the seal assembly from the link, then separate into the seal ring and load ring, and clean the parts.
        ★ The seal ring and load ring deteriorate easily when brought into contact with cleaning agent, so wash the parts quickly.
        After cleaning, wipe the parts with a clean cloth to remove all the cleaning agent.

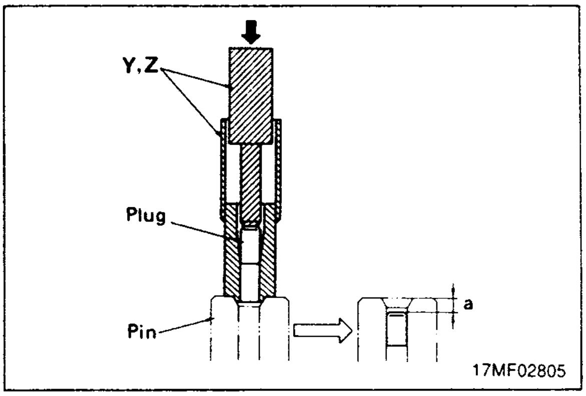
   2) When reusing the pin, chamfer the corner of the end face smooth with a grinder so that press fitting can be carried out smoothly.



   3) Make a mark on the end face at the small plug end to show the direction of the side hole (hole in the radial direction) in the pin when assembling.
      ★ When reusing the pin, assemble in the same direciton as when the part is new (side hole on the link tread side).



4) Use tools **Y** and **Z** to knock the large and small plug into the pin.
   - i) Insert plug into hole in guide through plug insertion window. (Coat the plug with oil.)
   - ii) Push bar by hand and insert the plug as far as it will go.
   - iii) Push plug with bar, and push guide itself against pin.
   - iv) Hit in bar with a hammer.

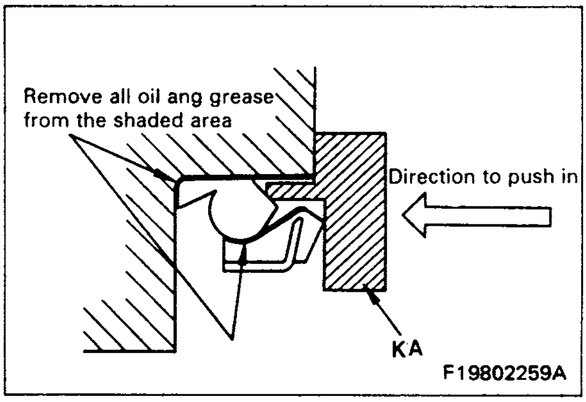


★ Dimension **"a"** to knock in the plug from end face of pin: Small plug: 2.5 ± 1 mm
Large plug: 6 ± 2 mm

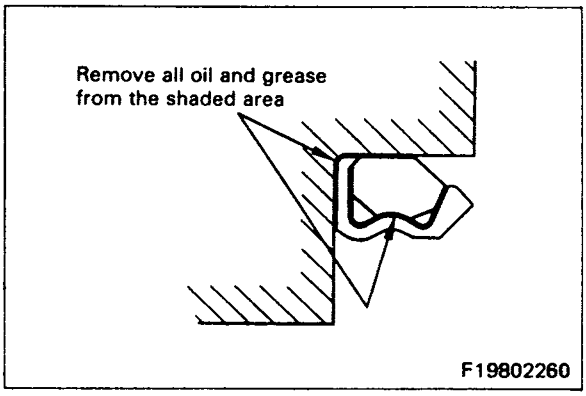
★ If the plug is not removed from the pin during disassembly, it can be used as it is.

5) Clean any part where outside diameter of the pin, front face of the spacer, end face or inside diameter of the bushing are dirty.

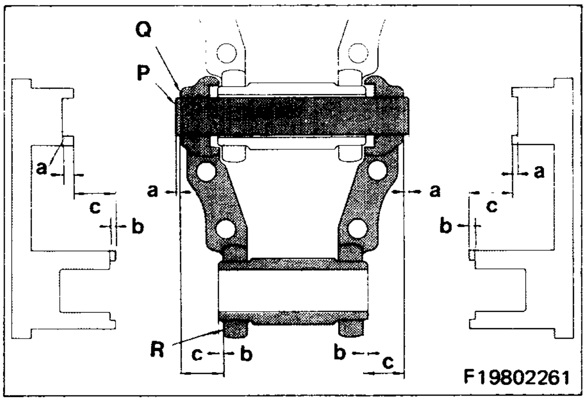
6) Coat the outside diameter of the pin and the front face of the spacer with grease.



7) Installation of seal assembly
   - Machines equipped with F3 type seal
     Clean the link counterbore, then use tool **KA** to push the seal in fully to the bottom.
     ★ If there is grease stuck to the link counterbore and seal assembly, the seal will rotate and its sealing performance will drop, so do not coat with grease.
   - Machines equipped with W7 type seal
     When reusing the link and replacing the seal with a new part, clean the link counterbore, then push the seal in fully to the bottom.
     ★ If there is grease stuck to the link counterbore and seal assembly, the seal will rotate and its sealing performance wil drop, so do not coat with grease.

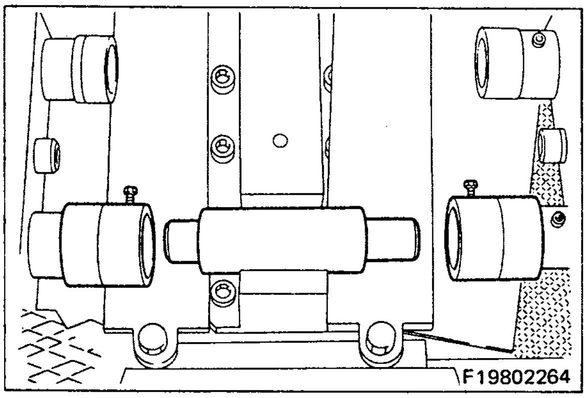


8) In order to keep the protrusion of the pin and bushing constant and the installation dimensions of the steel within the specified value during assembly, adjust the press-fitting jig dimensions of the link press.
   ★ For details of the standard dimensions, see PRESS-FITTING JIG DIMENSION TABLE FOR LINK PRESS.
   ★ If the end face of the pin (portion **P**) or the end face of the link (portions **Q**, **R**) are worn, add the amount of wear to the standard dimension when adjusting the dimension of the press-fitting jig so that the amount of protrusion of the left and right pin and bushing is uniform.

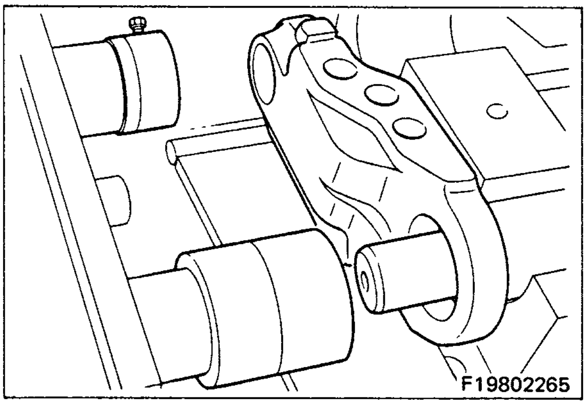


2. Assembly of link

1) Coat the area between the pin and bushing with lithium grease (G2-LI), set in position, then set in front of the jaw of the link press.
   - ★ When reusing (turning) the bushing, set the worn surface on the outside circumference of the bushing facing the shoe mounting surface of the link (facing up on the link prss).

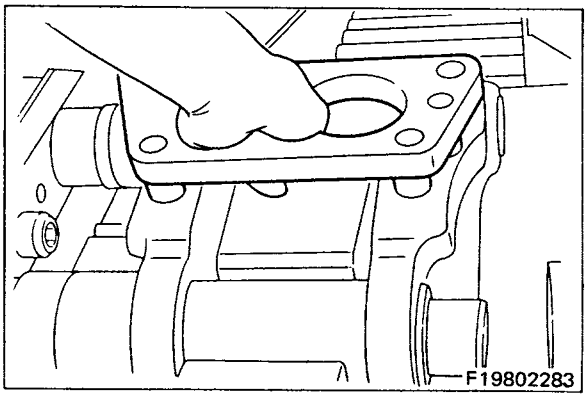


2) Set the left and right bushing end master link with the shoe mounting surface facing up, then press fit to the bushing.
   - ★ When doing this, use the pin end master link as a support.
   - ★ Bushing press fitting force:
     49 — 147 KN (5 — 15 ton)

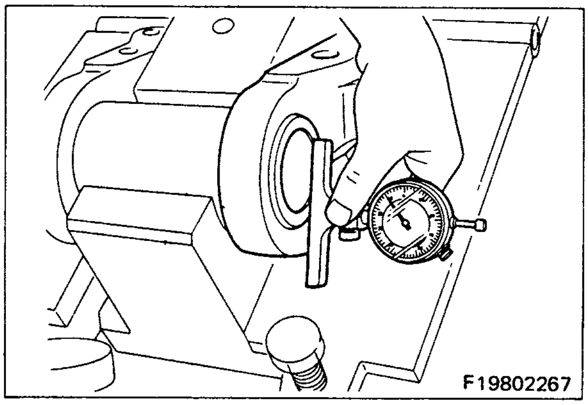


3) Using a shoe bolt hole pitch gauge, press fit until the distance between the shoe bolt holes of the left and right link is the specified value.
   - ★ Use compressed air to remove all metal particles from burrs while press fitting the bushing.

4) Turn over the master link, and check that the left and right master links have been press fitted in parallel.



5) Measure the amount of protrusion of the left and right bushings with a depth gauge.
   - ★ Adjust the press-fitting jig for the link press so that the protrusion of the left and right bushings is uniform.



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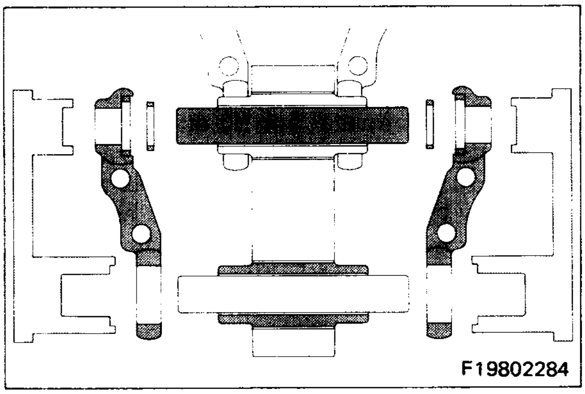
6) Feed the master link portion, then set the pin and bushing in position.
   - ★ When reusing the pin, assemble so that the side hole is on the link tread side in the same way as when the part is new. If the parts are not assembled facing the specified direction, the strength may drop, so mark the direction of the side hole clearly on the end face to prevent any mistake during assembly.
   - ★ If the outside diameter of the pin is worn, assemble so that the face that is not worn is on the pulling side. However, in this case, also assemble so that the side hole faces the tread surface of the link.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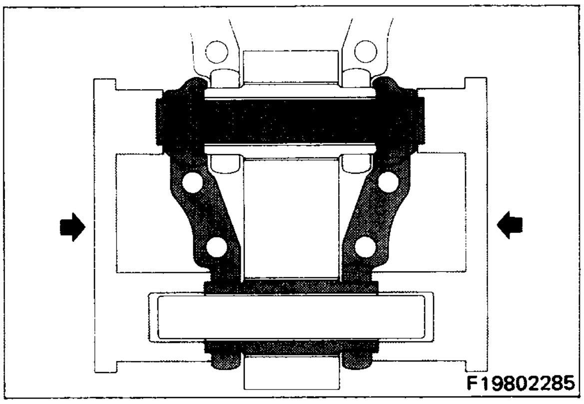
7) Set the left and right links in position, then operate the left and right pushing jigs to press fit the pin and bushing at the same time.
   - ★ When press fitting, the seal may come off the link due to the play, so press fit smoothly. If the seal comes off the link, stop the press-fitting operation and fit the seal correctly on the link, then start the press-fitting operation again.
   - ★ Set pushing force of pin and bushing: 588 KN (60 ton)
     Set pushing force ≒ 1.8 × average pushing force
     (Adjust the relief pressure of link press to fix the set pushing force)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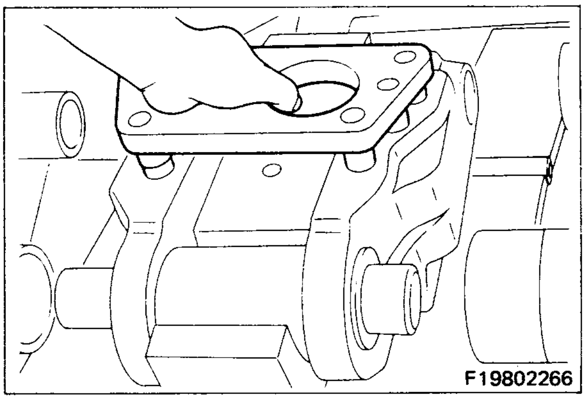
8) Using a shoe bolt hole pitch gauge, check that the distance between the shoe bolt holes is within the standard value.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9) Assemble the pin end master link as the final link.
   - ★ Check that the left and right master links are press fitted in parallel.

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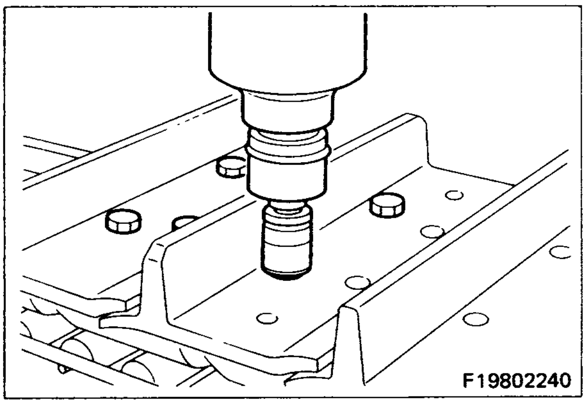
3. Shoe (regular link portion)

Set the link assembly on the bed, then use a shoe bolt impact wrench and torque wrench to install the shoe.

kgm Shoe bolt (regular link):
Initial tightening torque:
392.3 ± 39.2 Nm (40 ± 4 kgm)
Tightening angle: **120 ± 10°**


F19802240

4. Connecting to make 1/2 assembly

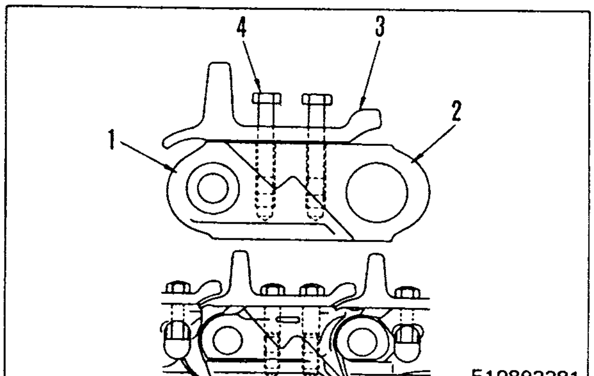
Set two completely assembled portions of track on a flat surface in a straight line with the shoes facing up. Pull master link (1) at the pin end to master link (2) at the bushing end, and set at the mating surfaces. Then put shoe (3) on top, check that shoe bolt (4) goes in easily by hand, and connect the two parts.

Mounting bolt:
Anti-friction compound (LM-P)

Shoe bolt (master link):
Initial tightening torque:
343.2 ± 39.2 (35 ± 4 kgm)
Tightening angle: **$180^{\ 0}_{-20}$°**

★ When tightening, tighten in order ① — ④.

★ Do not use an impact wrench for the master link mounting bolt.



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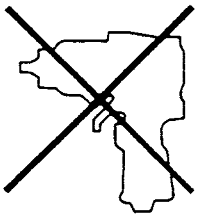

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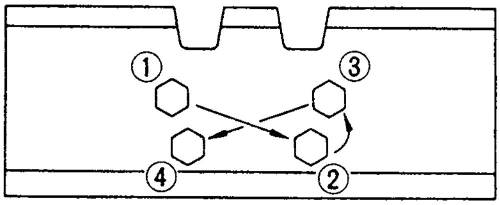

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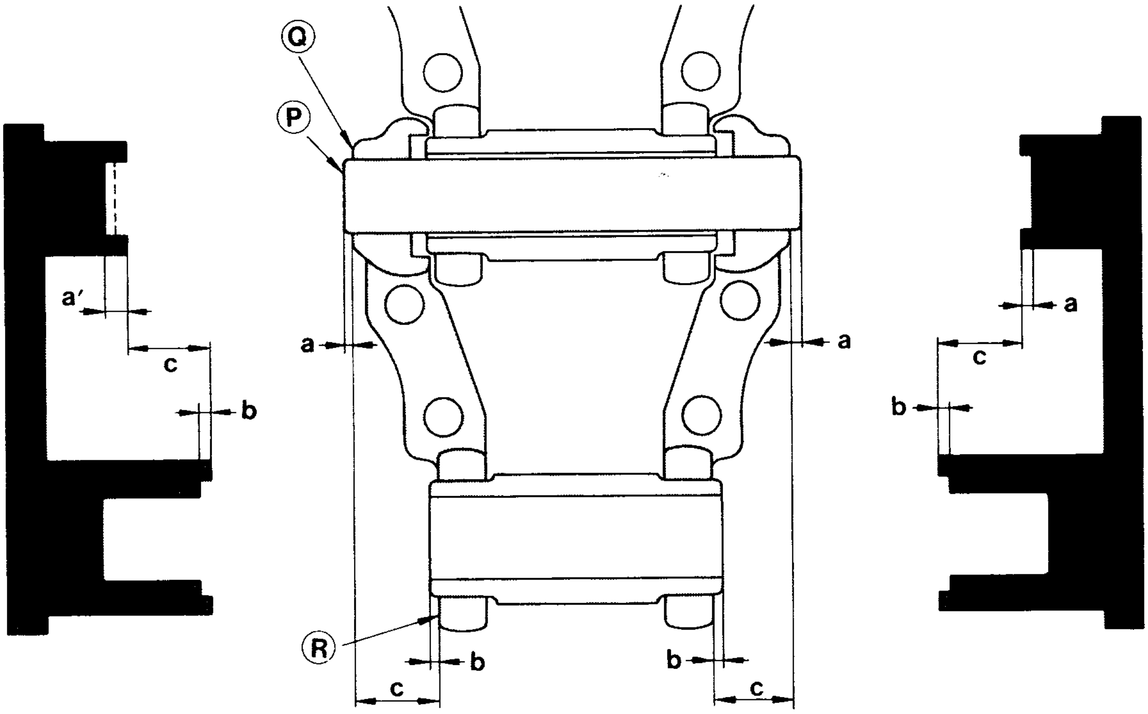
014012

PRESS-FITTING JIG DIMENSION TABLE FOR LINK PRESS



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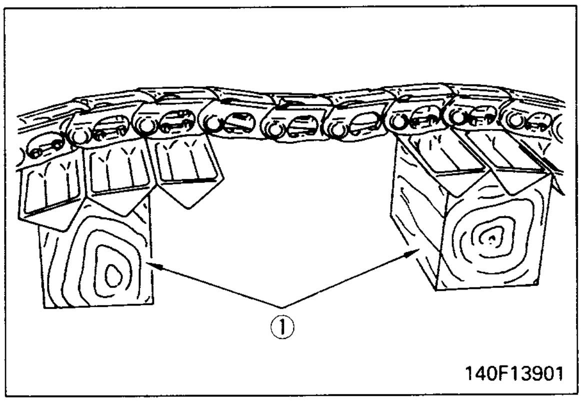
Unit: mm

Jig dimension		
a	b	c
3.0	3.05 ± 0.13	42.6

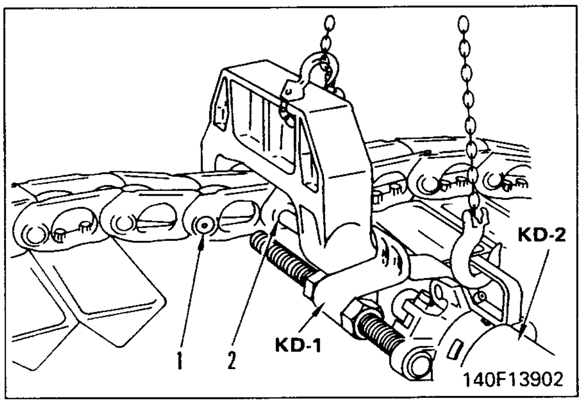
014012

FIELD DISASSEMBLY OF ONE LINK

1. **Positioning track shoe assembly**
   Set track shoe assembly on block ① (height: approx. 300 mm).

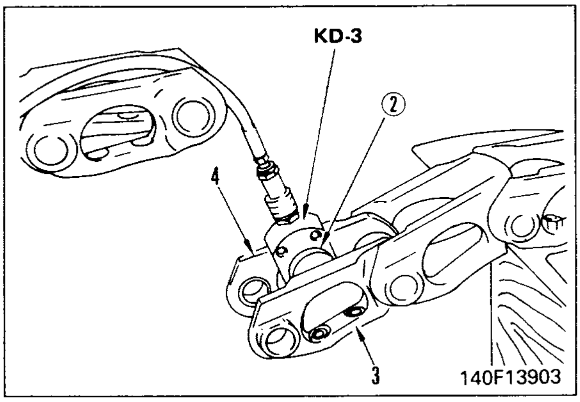


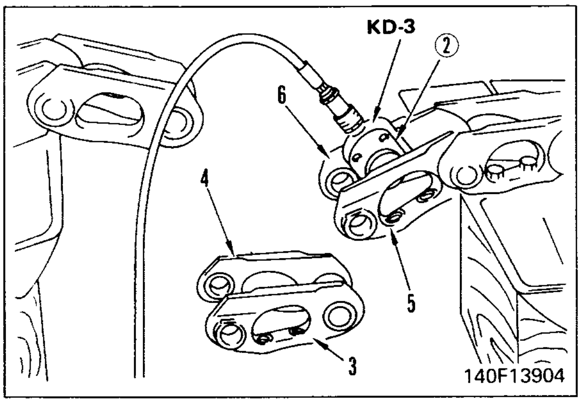
2. **Pins**
   Using tool **KD-1** (frame, extension, nut, screw, screw, adapter, pusher), and tool **KD-2** (pump, cylinder), remove pins (1) and (2).
   ★ If the tip of the pin or the side of the link are unevenly worn, correct with a hand grinder to ensure that the part is at a right angle to tool **KD-1**.



3. **Links**
   1) Put tool **KD-3** and spacer ② of the dimensions given below in contact with the tread of links (3) and (4).
      ★ Set tool **KD-3** as close to the tip of the link as possible.
   2) Apply hydraulic pressure slowly to the puller until the tip of the link opens 6 — 8 mm, then disconnect the link.
      ★ There is danger that the bushing will come out, so do not apply more hydraulic pressure than necessary.
      ★ If an electric pump is used, there is danger that more hydraulic pressure will be applied than necessary, so always use a hand pump.
   3) Disconnect links (5) and (6) in the same way.

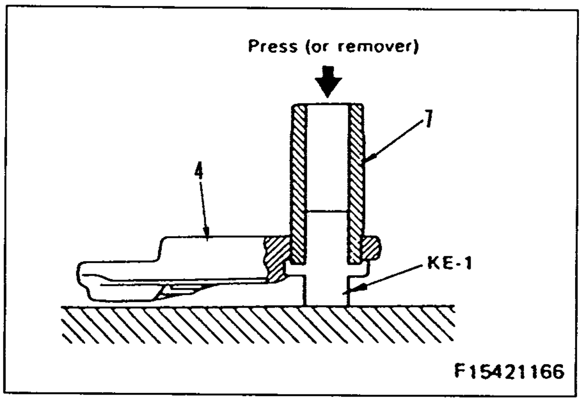
   Dimensions of spacer ②: 55 mm × 47 mm
   (Outside diameter × thickness)



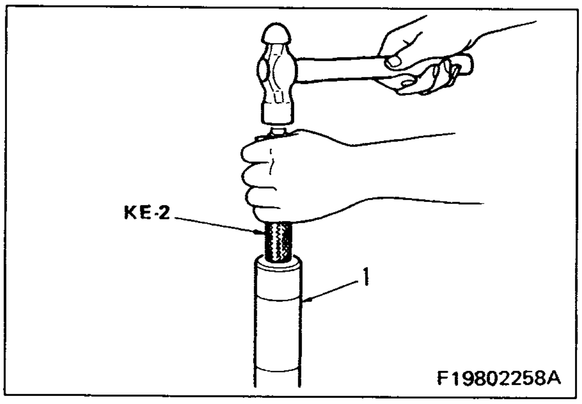


FIELD ASSEMBLY OF ONE LINK

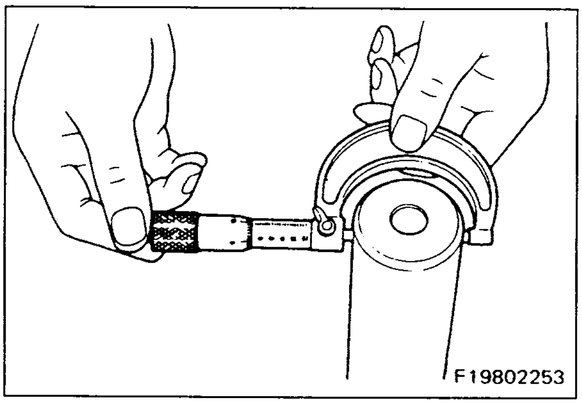
1. **Bushing**
   Put tool **KE-1** in contact with the end face of link (4), and press fit bushing (7).
   ★ Always use a new bushing.
   ★ Bushing press fitting force:
   49 — 147 KN (5 — 15 ton)



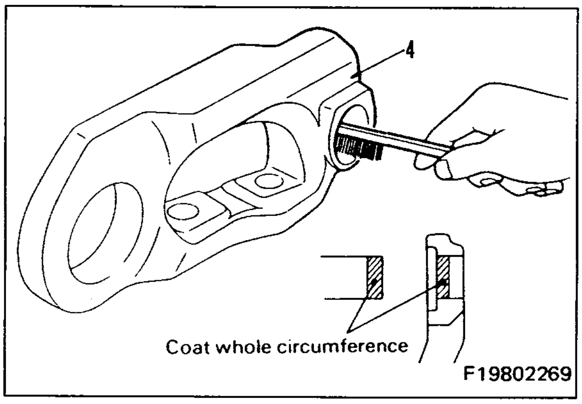
2. **Pins**
   1) Using tool **KE-2**, knock a large plug into the oil hole of pin (1).
      ★ Always use a new pin.



   2) To determine the pushing pressure when carrying out the final assembly, measure the outside diameter of the pin with a micrometer, and note down the measurement.

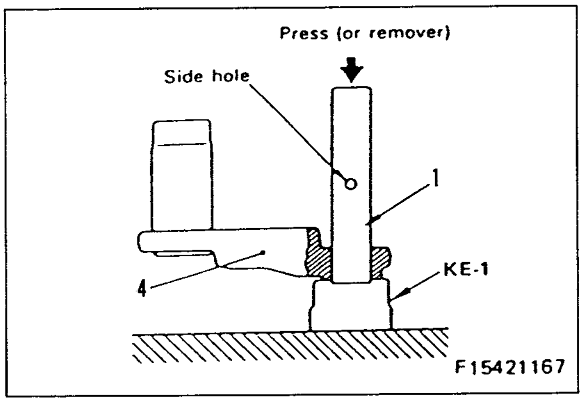


   3) Coat the press-fitting hole for the pin in link (4) with gasket sealant (198-32-19890).
      ★ If the link is used again, finish the press-fitting hole for the pin smoothly with sandpaper.



014012

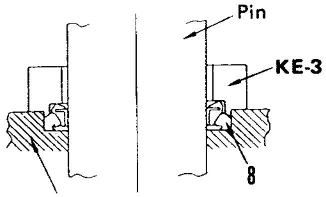
4) Put tool **KE-1** in contact with the end face of link (4), and press fit pin (1).
   - ★ Press fit so that the side hole in the pin is on the same side as the link tread.
   - ★ Pin press fitting force:
     147 — 245 KN (15 — 25 ton)
   - ★ Always use a new pin.



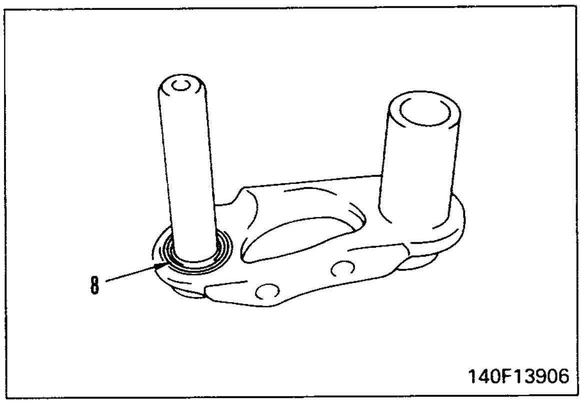
F15421167

3. Seal

Install seal (8) with tool **KE-3**.
- ★ Check that there is no oil on the contact surface of the link and seal.
- ★ Carry out steps 1 ~ 3 in the repair shop beforehand.



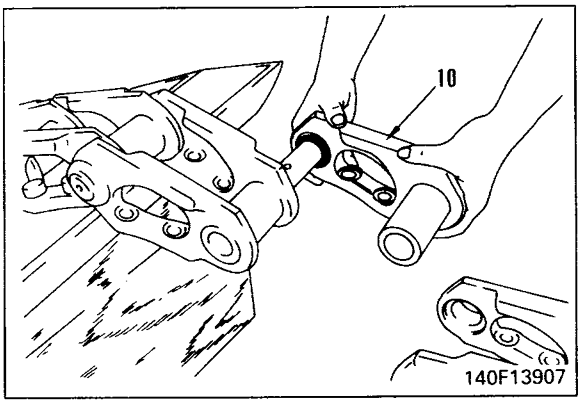
140F13905



140F13906

4. Link sub-assembly

1) Install link sub-assembly (10).
   - ★ Check that there is no dirt or dust stuck to the surface of the seal or the end face of the bushing, then coat with oil (GO140B) using a clean cloth or small brush.



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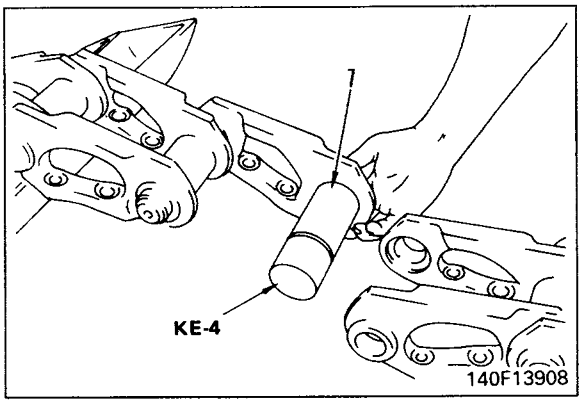
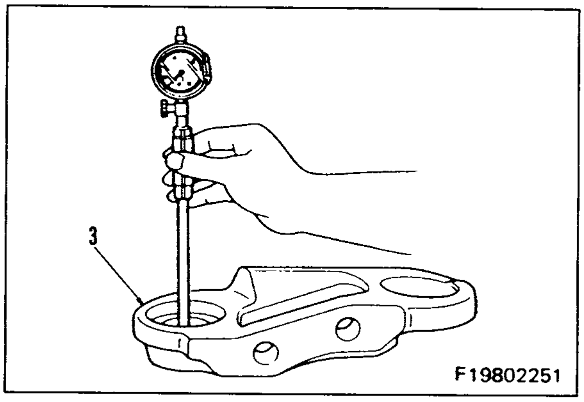
2) Install tool **KE-4** (guide used when press fitting link) to bushing (7).



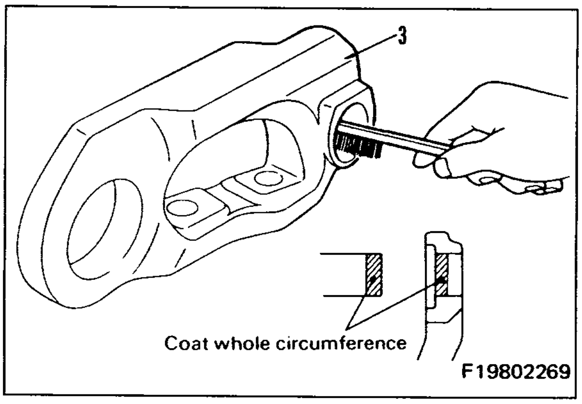
140F13908

5. Link

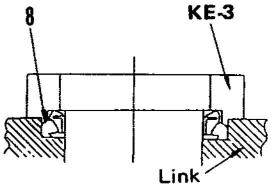
1) To determine the pushing pressure when carrying out the final assembly, measure the dimensions of the press-fitting hole for the pin in link (3) with a cylinder gauge, and note down the measurement.



2) Coat the press-fitting hole for the pin in link (3) with gasket sealant (198-32-19890).
   ★ If the link is used again, finish the press-fitting hole for the pin smoothly with sandpaper.



3) Install seal (8) with tool **KE-3**.
   ★ Check that there is no oil on the contact surface of the link and seal.
   ★ Check that there is no dirt or dust stuck to the surface of the seal or the end face of the bushing, then coat with oil (GO140B) using a clean cloth or small brush.



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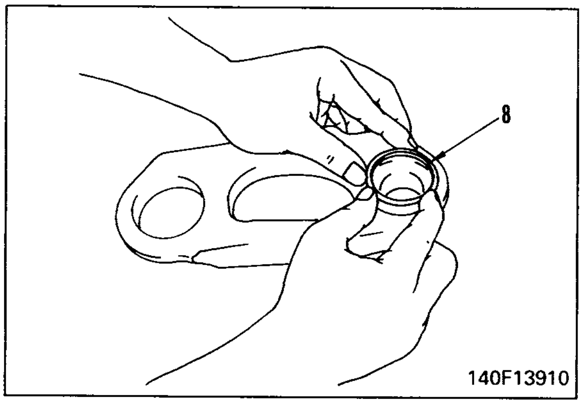
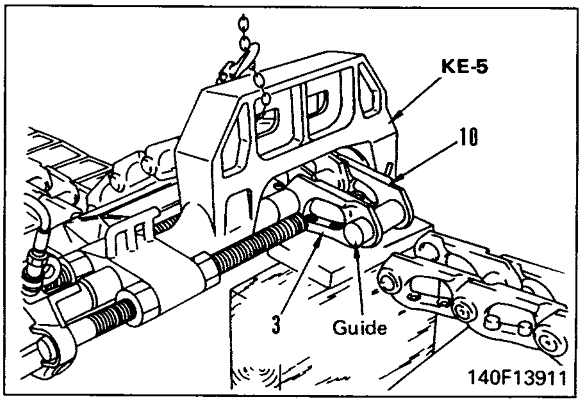
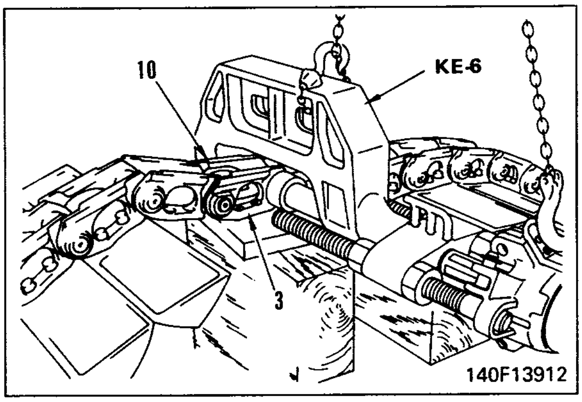


4) Using tool **KE-5**, press fit pin portion of link (3) to link sub-assembly (10).
   ★ Pin press fitting force:
   294 — 490 KN (30 — 50 ton)



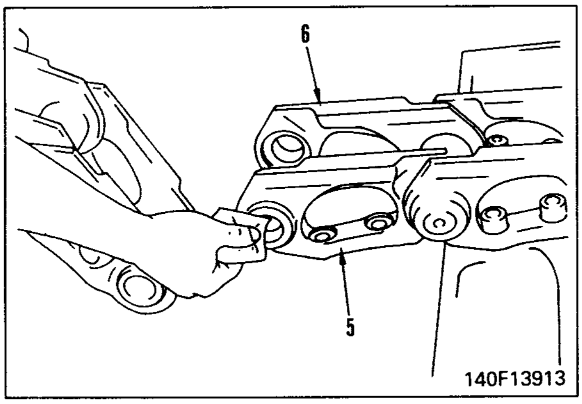
5) Using tool **KE-6**, press fit bushing portion of link (3) to link sub-assembly (10).
   - ★ To prevent the use of any excessive force, press fit the pin portion and bushing portion gradually in turn.
   - ★ Pin and bushing press fitting force: 196 — 392 KN (20 — 40 ton)



140F13912

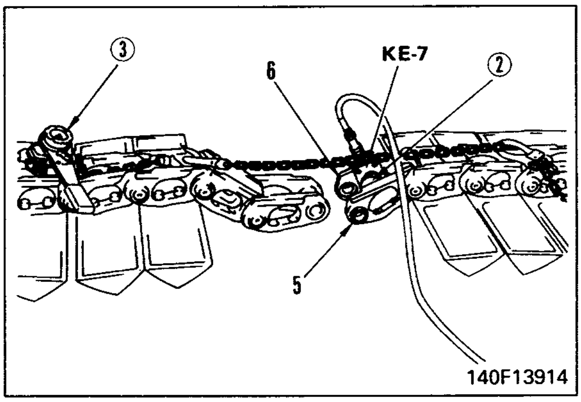
6. Connecting link

1) Finish the inside surface of the press-fitting hole for the pin in links (5) and (6) smoothly with sandpaper.



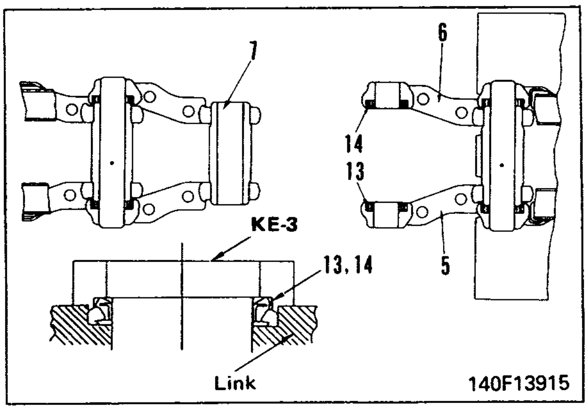
140F13913

2) Remove block ①, and lower the track shoe assembly to the ground.
3) Set lever block ③ to the left and right link assemblies as shown in the fig., then put tool **KE-7** and spacer ② in contact with the tread of links (5) and (6).
   - ★ Set tool **KE-7** as close to the tip of the link as possible.



140F13914

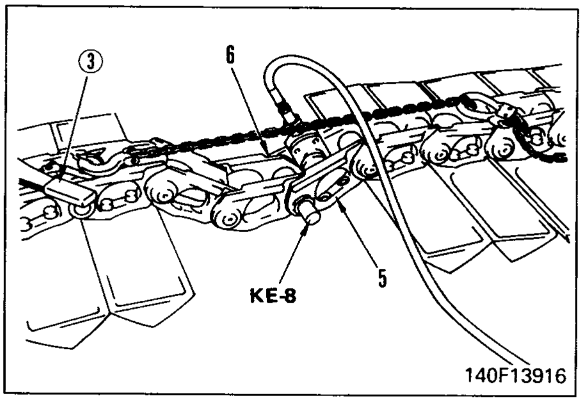
4) Using tool **KE-3**, install seals (13) and (14) to links (5) and (6).
   - ★ Always use new seals.
   - ★ Check that there is no oil on the contact surface of the link and seal.
   - ★ Check that there is no dirt or dust stuck to the surface of the seal or the end face of bushing (7), then coat with oil (GO140B) using a clean cloth or small brush.



140F13915

5) Apply hydraulic pressure slowly to the puller until the tips of links (5) and (6) open 6 — 8 mm.
   ★ There is danger that the bushing will come out, so do not apply more hydraulic pressure than necessary.
   ★ If an electric pump is used, there is danger that more hydraulic pressure will be applied than necessary, so always use a hand pump.

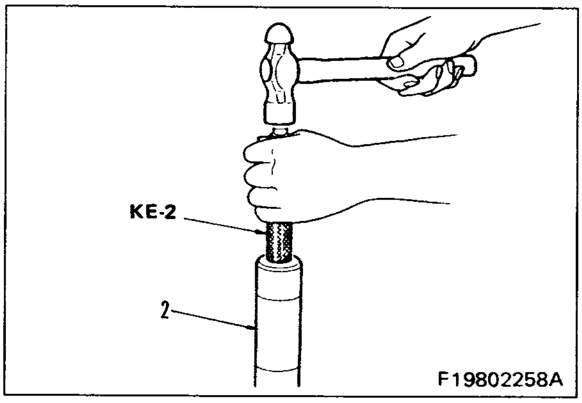
6) Operate lever block ③, align the centers of the link hole and bushing hole, and connect the links with tool **KE-8** (guide pin).
   ★ Operate the lever block ③ slowly and be careful not to damage the seal or get sand stuck to the seal surface.



7. Pin

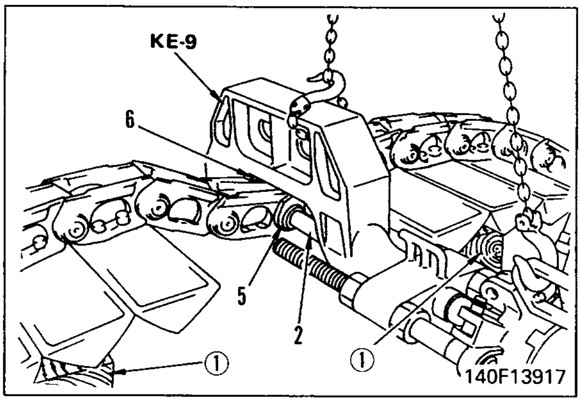
1) Using tool **KE-2**, knock a large plug into the oil hole of pin (2).
   ★ Always use a new pin.

2) To determine the pushing pressure when carrying out the final assembly, measure the outside diameter of pin (2) with a micrometer, and note down the measurement.



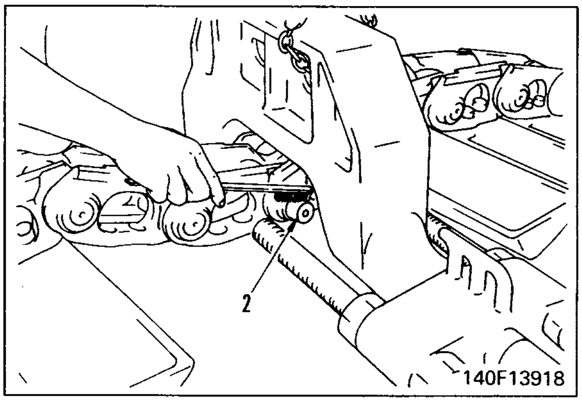
3) Set the track shoe assembly on block ① again.

4) Using tool **KE-9**, press fit pin (2) to links (5) and (6).
   ★ Press fit so that the side hole in the pin is on the same side as the link tread.
   ★ Bushing press fitting force:
   49 — 147 KN (5 — 15 ton)



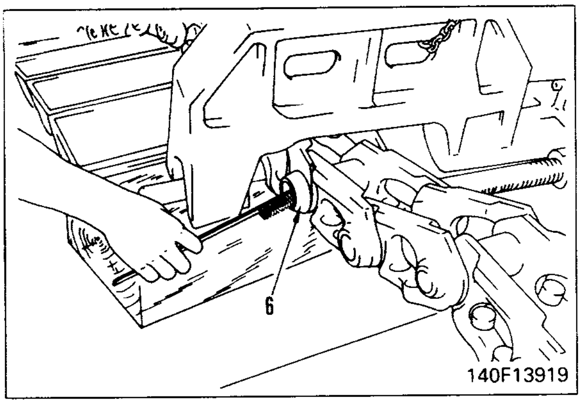
5) Temporarily stop press fitting when there is 15 — 20 mm left for press fitting pin (2).

6) Coat the remaining press-fitting portion of pin (2) with gasket sealant (198-32-19890).



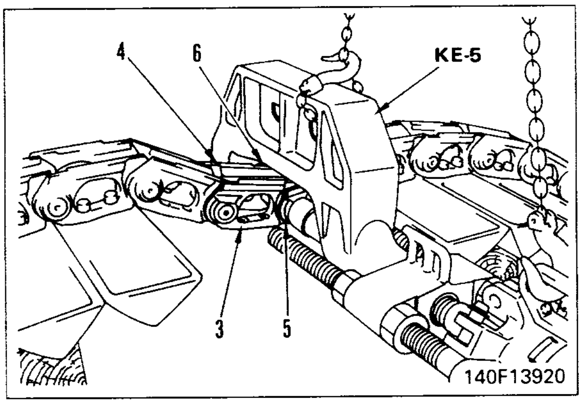
7) Coat the press-fitting hole for the pin in link (6) with gasket sealant (198-32-19890), then continue to press fit pin (2).

8) Using tool **KE-5**, apply the specified pressure to links (3) and (4) and links (5) and (6).
   - ★ Set pushing force of pin and bushing:
     588 KN (60 ton)
     Set pushing force ≒ 1.8 × average pushing force
     (Adjust the relief pressure of link press to fix the set pushing force)



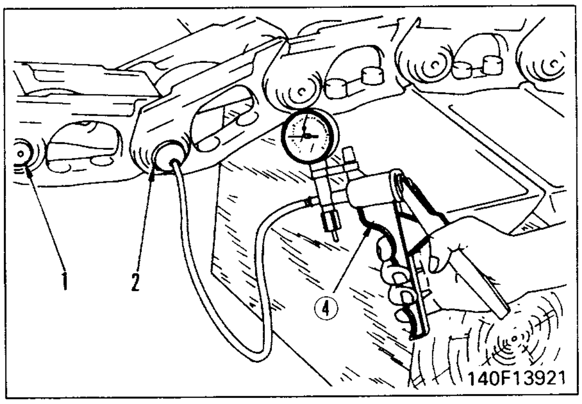
8. Vacuum test

Using hand vacuum pump ④, remove the air from the small plug hole at the end face of pins (1) and (2) and check the sealing performance.
- ★ Check that the airtightness is maintained for 5 seconds at a negative pressure of 695 ± 15 mmHg.

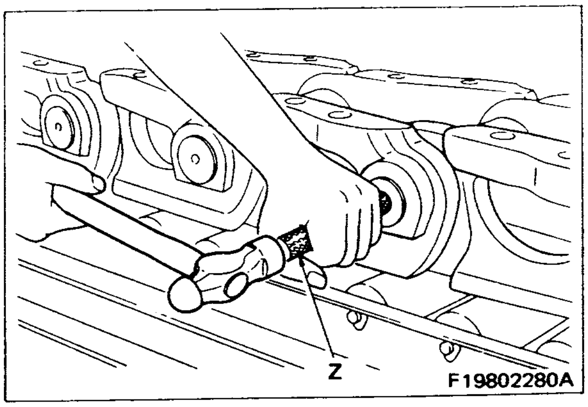


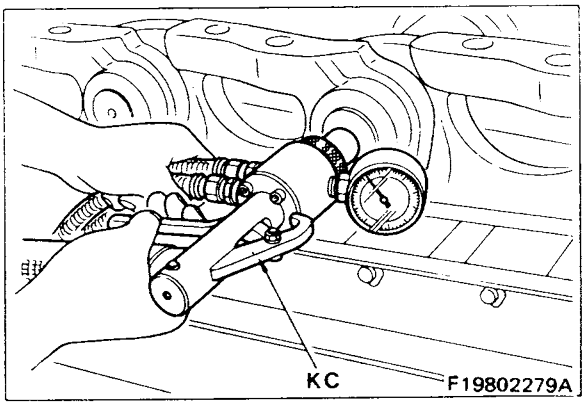
9. Charging with oil

1) Using tool **KC**, charge with oil (GO140B) through the small plug hole in the pin.
   - ★ Be careful not to raise the pressure too high when charging with oil. This will have an adverse effect on the seal.
   - ★ Take into consideration the expansion of the oil under heat, and be careful not to charge with too much oil.



2) Using tool **Z**, knock in the small plug quickly.
   - ★ Coat the outside circumference of the small plug with GO140B.
   - ★ Knock in the plug to the depth given below.
     Depth to drive from end face:
     2.5 ± 1 mm

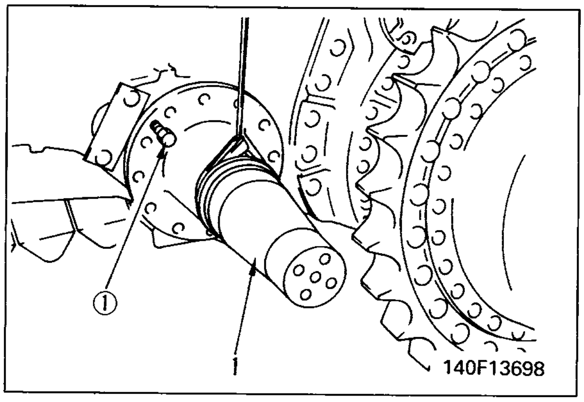


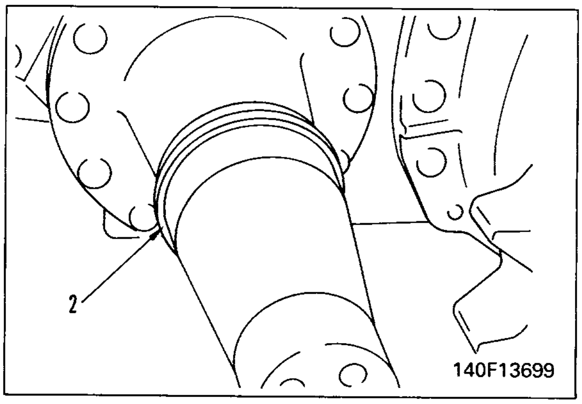


REMOVAL OF PIVOT SHAFT ASSEMBLY

1. Remove track frame assembly.
   For details, see REMOVAL OF TRACK FRAME ASSEMBLY.
2. Sling pivot shaft assembly (1).
3. Remove mounting bolts, then using forcing screws ①, raise pivot shaft assembly and pull out. ※1

   kg Pivot shaft assembly:
   90 kg (D65E, EX)
   100 kg (D65P, PX)
4. Remove seal (2). ※2
5. Remove ring (3). ※3





INSTALLATION OF PIVOT SHAFT ASSEMBLY

- Carry out installation in the reverse order to removal.

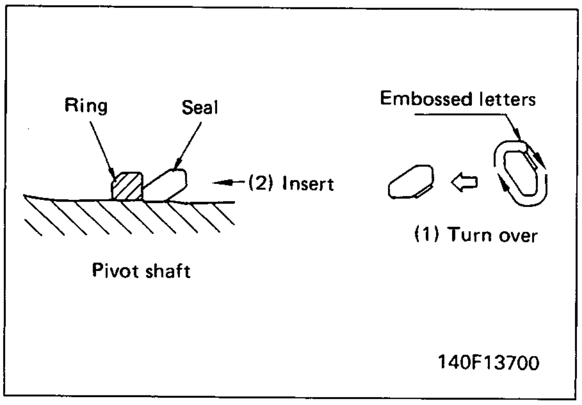
※1

kgm Pivot shaft mounting bolt:
549 ± 59 Nm (56 ± 6 kgm)

※2

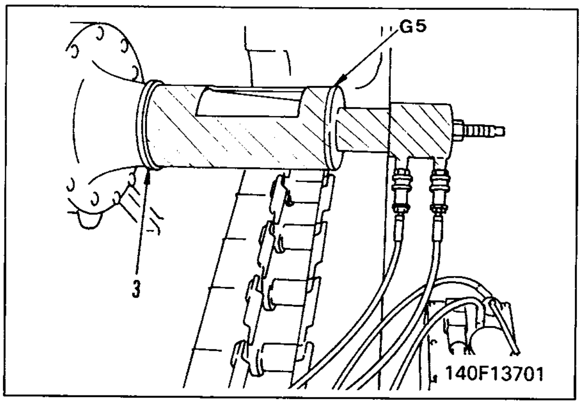
★ Assemble the seal as follows (see diagram on right)
1) Turn over the seal so that the embossed letters on the seal are on the inside.
2) With the seal turned over, insert the seal on the shaft.

★ When inserting the seal, be careful not to damage the surface.



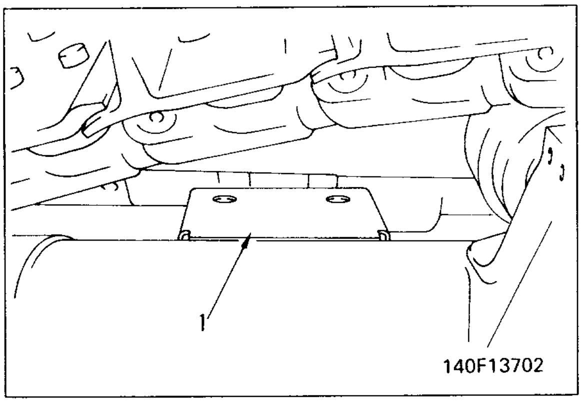
※3

★ Press fit ring (3) using tool **G5**.
★ Press fitting force: 1.9 ton

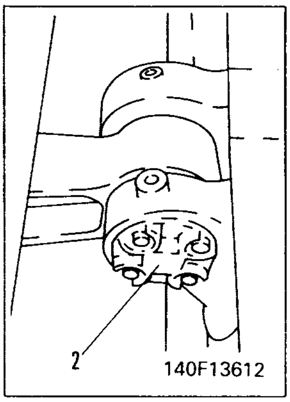


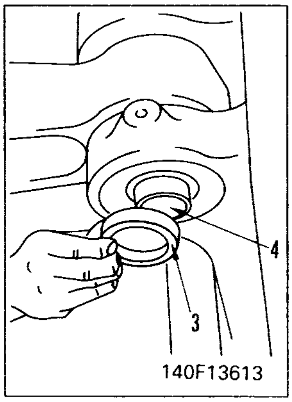
REMOVAL OF EQUALIZER BAR ASSEMBLY

1. Remove side pin top cover (1).
2. Set jack (50 ton) under bottom of radiator and jack up, then raise work equipment and set stand ① (approx. 800 mm) in position.
   ★ Set at a height where the center pin can be removed.

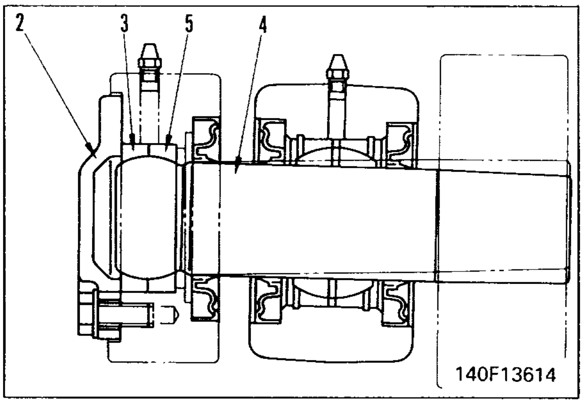


3. Remove cover (2) of equalizer bar side pin, take out outer bushing (3) and side pin (4), then remove inner bushing (5). $\boxed{※1}$
   ★ Use the jack to make fine adjustment of the height, and when the pin moves easily, tap the pin out and remove it.

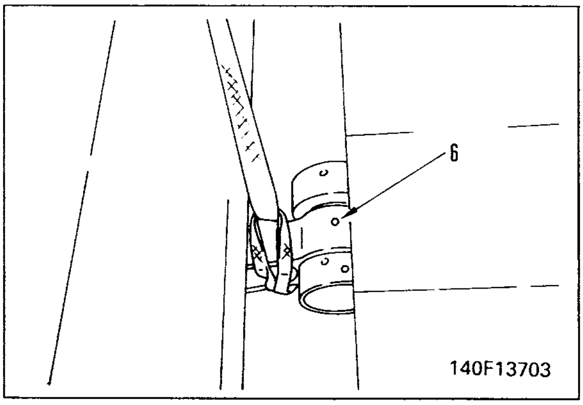




4. Sling equalizer bar assembly (6) with crane and chain block.
5. Remove lock plate (7), then using tool **G6**, pull out center pin (8). $\boxed{※2}$
   ⚠ Do not operate the hydraulic circuit from the front or under the puller. Stand as far away as possible when operating it.



6. Operate chain block and crane and remove equalizer bar assembly (6).
   kg Equalizer bar assembly:
   130 kg (D65E, EX)
   150 kg (D65P, PX)
   ⚠ After removing the equalizer bar assembly, do not lower the machine.



INSTALLATION OF EQUALIZER BAR ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

Inside cover: **Fill with grease (G2-LI)**

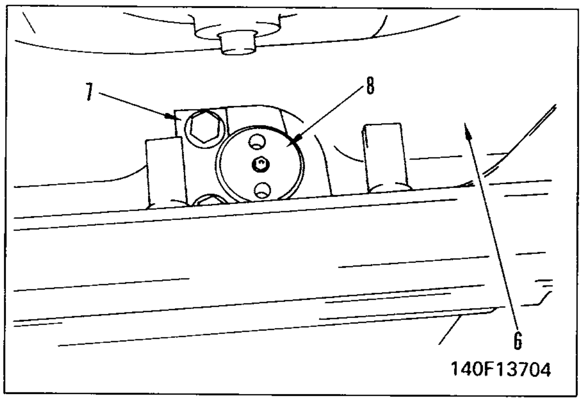
Between bushing and seal of equalizer bar side pin:
Fill with grease (G2-LI)

※2

Connection of pin and bushing:
Coat with grease (G2-LI)

Frame boss:
Coat with anti-friction compoung (LM-P)

Between bushings:
Coat with grease (G2-LI)



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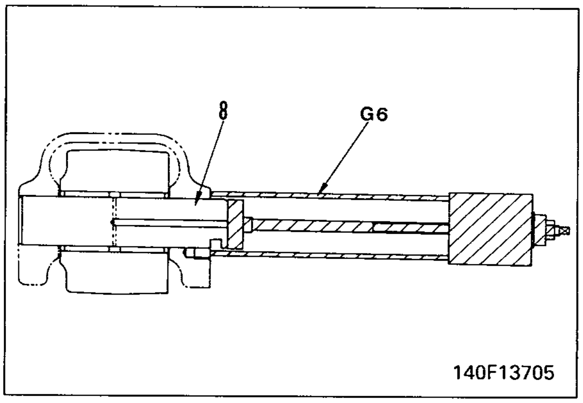

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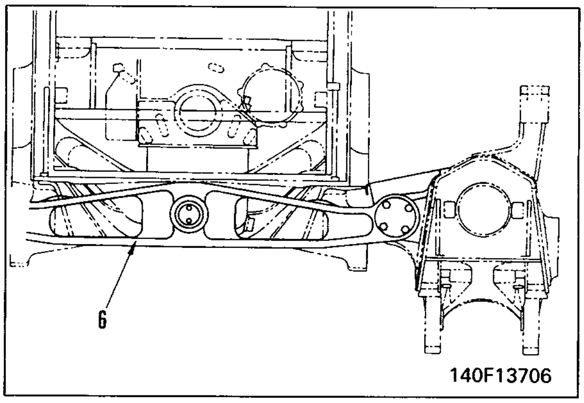

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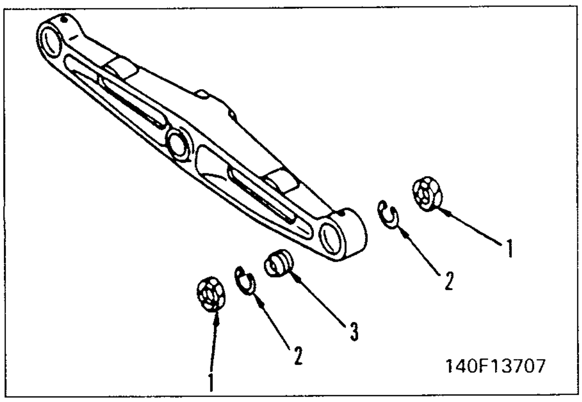
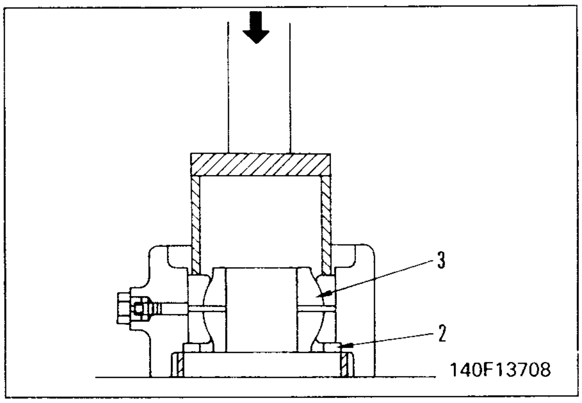
REMOVAL OF EQUALIZER BAR SIDE BUSHING

1. Remove equalizer bar assembly.
   For details, see REMOVAL OF EQUALIZER BAR ASSEMBLY.
2. Remove seal (1).
3. Remove ring (2).
4. Remove spherical bushing (3).



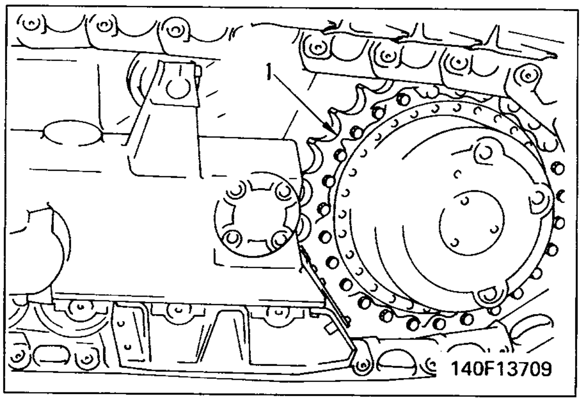
INSTALLATION OF EQUALIZER BAR SIDE BUSHING

1. Install ring (2) to one side.
2. Press fit spherical bushing (3) with a press.
   ★ Press fitting force: 1.6 ton
3. Install ring (2) to opposite side.
4. Install seal (1).
   Between bushing and seal:
   Fill with grease (G2-LI)
5. Install equalizer bar assembly.
   For details, see INSTALLATION OF EQUALIZER BAR ASSEMBLY.



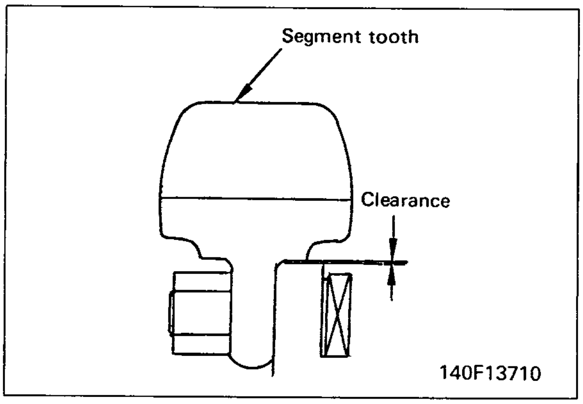
REMOVAL OF SEGMENT TEETH

1. Stop machine at position where it is easy to remove teeth (midway between shoe and track frame).
2. Remove mounting bolts, then remove teeth (1). ※1



INSTALLATION OF SEGMENT TEETH

- Carry out installation in the reverse order to removal.

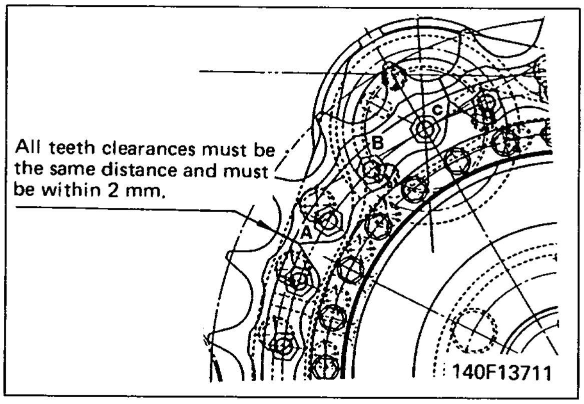


※1

★ Install the teeth to give the following clearances around the circumference of the teeth hub.
Position of bolt **A**, **C**: 0 mm
Position of bolt **B**: 0 — 0.5 mm

Thread of teeth mounting bolt:
Thread tightener (LT-2)

kgm Teeth mounting nut
931 ± 98 Nm (95 ± 10 kgm)

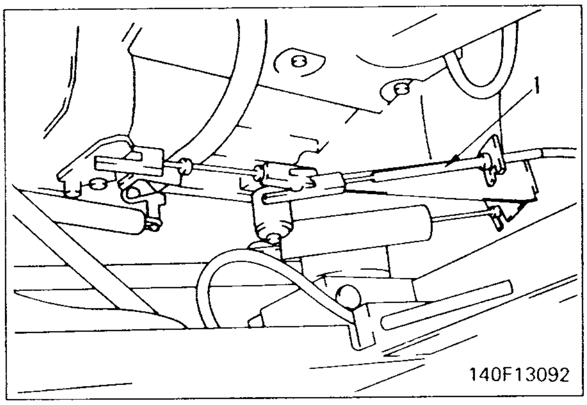

All teeth clearances must be the same distance and must be within 2 mm.

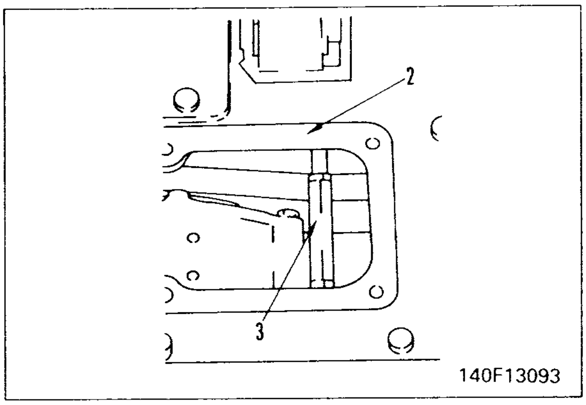
REMOVAL OF WORK EQUIPMENT PUMP ASSEMBLY

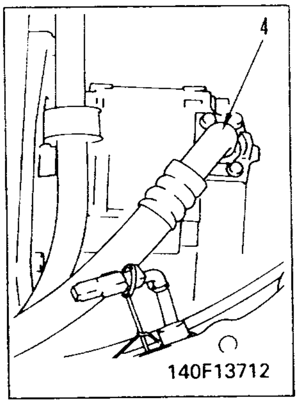
D65E, P

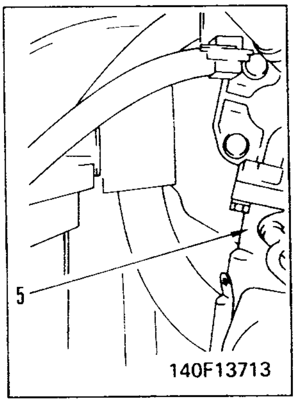
⚠ Lower the work equipment to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

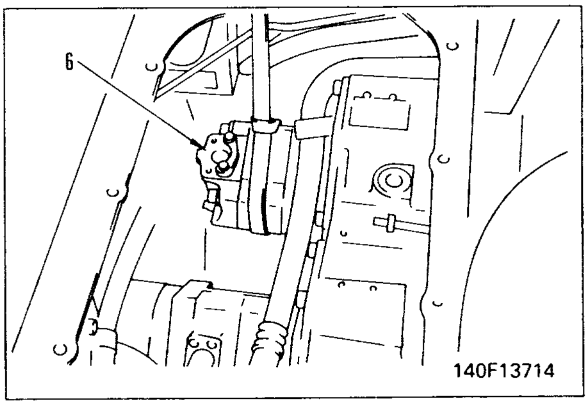
1. Drain oil.
   Hydraulic tank: **Approx. 55 ℓ**
2. Remove chassis bottom cover.
   ⚠ The bottom cover weights 26 kg, so support it with a transmission jack before removing the mounting bolts.
3. Disconnect deceleration cable (1) at engine end. ※1
4. Remove cover of plate (2), and disconnect brake rod (3) at turnbuckle.
   ★ Measure the installed dimension of the rod before disconnecting the turnbuckle. ※2
5. Remove plate (2).
6. Disconnect hose (4) and tube (5).
7. Lift off pump assembly (6).











INSTALLATION OF WORK EQUIPMENT PUMP ASSEMBLY

D65E, P

- Carry out installation in the reverse order to removal.

※1

★ Adjust the cable.
For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

※2

★ Adjust the rod.
For details, see TESTING AND ADJUSTING, Adjusting brake pedal linkage.

- **Refilling with oil (hydraulic tank)**

★ Add oil through oil filler to the specified level. Run the engine to circulate the oil through the system.
Then check the oil level again.

REMOVAL OF HSS, WORK EQUIPMENT PUMP ASSEMBLY

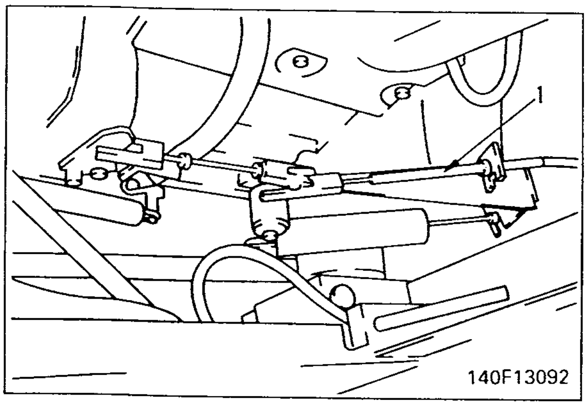
D65EX, PX

⚠ Lower the work equipment to the ground and release the pressure inside the circuit. For details, see TESTING AND ADJUSTING, Releasing pressure from hydraulic circuit.

1. Drain oil.

   Hydraulic tank: **Approx. 55 ℓ**

2. Remove undercover.
3. Disconnect deceleration cable (1) at engine end.



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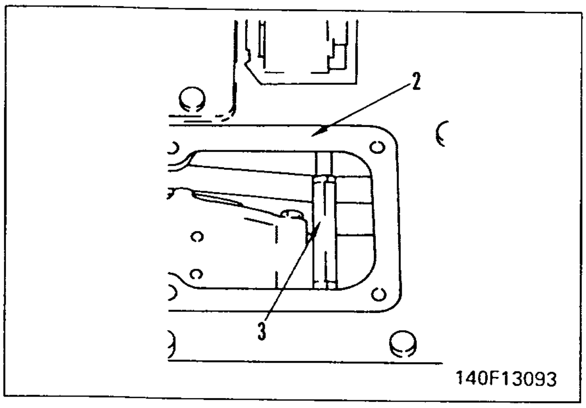
4. Remove cover of plate (2), and disconnect brake rod (3) at turnbuckle.
   ★ Measure the installed dimension of the rod before disconnecting the turnbuckle.
5. Remove plate (2).



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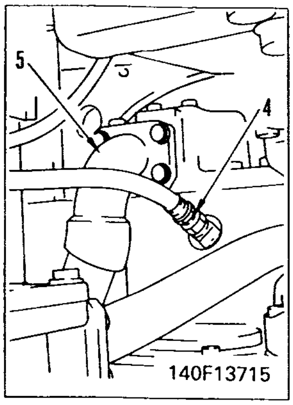
6. Disconnect hose (4) and tube (5) from bottom of chassis.
7. Disconnect hoses (6), (7), (8), and (9).
8. Lift off HSS and hydraulic pump assembly (10).

   kg HSS, hydraulic pump assembly: **75 kg**



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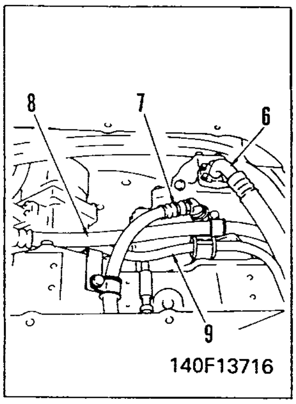

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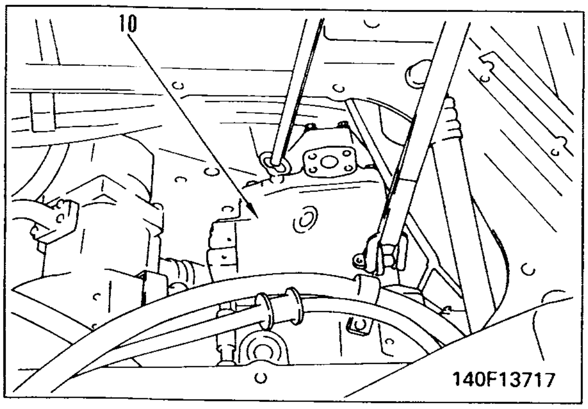

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INSTALLATION OF HSS, WORK EQUIPMENT PUMP ASSEMBLY

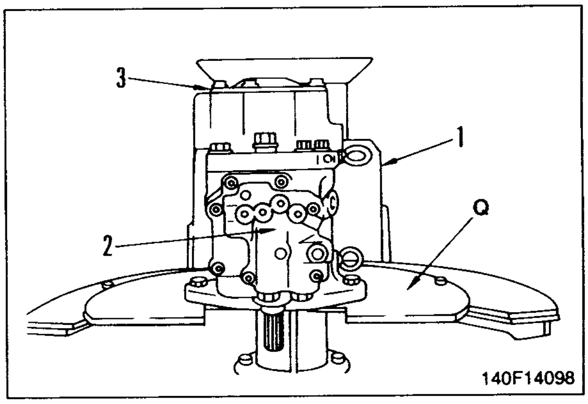
D65EX, PX

- Carry out installation in the reverse order to removal.
- **Refilling with oil**

★ Add oil through oil filler to the specified level.
Run the engine to circulate the oil through the system.
Then check the oil level again.

DISASSEMBLY OF HSS, WORK EQUIPMENT PUMP ASSEMBLY

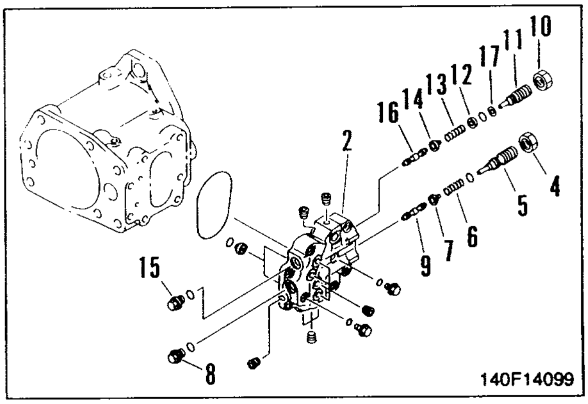
D65EX, PX



1. Set pump assembly to tool **Q**.

2. **Valve assembly, cover**
   1) Remove valve (2) and cover (3) from pump assembly (1).
   2) Disassembly of valve assembly

   - Variable throttle valve
     i) Loosen nut (4), remove plug (5), then remove spring (6) and seat (7), and pull out spool (9).
     ii) Remove plug (8).
     iii) Remove nut (4) and O-ring from plug (5).



   - LS valve
     i) Loosen nut (10), remove plug (11), then remove seat (12), spring (13), and seat (14).
     ii) Remove plug (15), and pull out spool (16).
     iii) Remove backup ring (17) and O-ring from plug (11).

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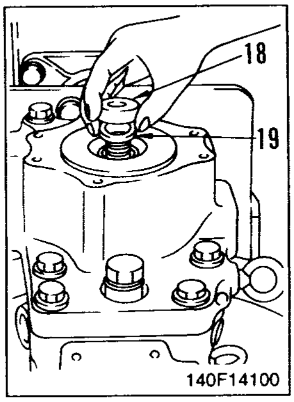
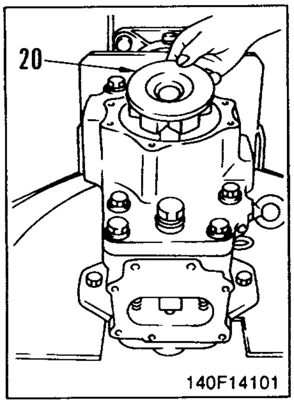
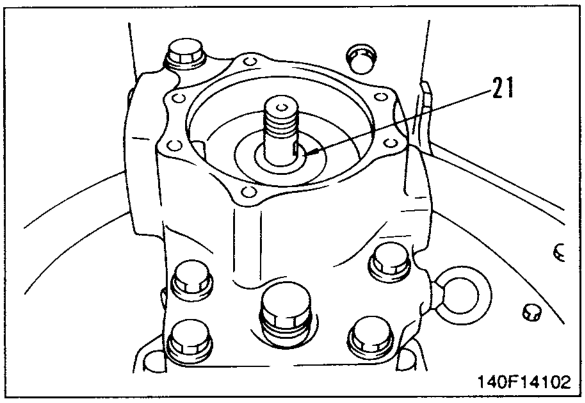


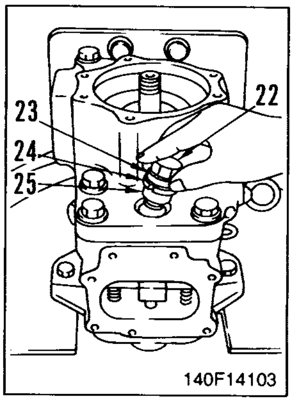


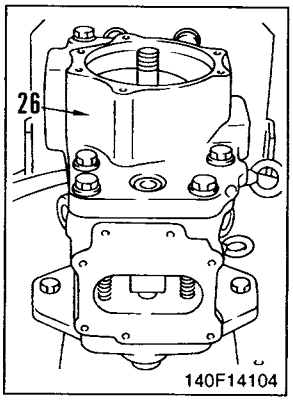
3. **Impeller, washer**
   1) Remove nut (18), then remove spacer (19).
   2) Remove impeller (20), then remove key and washer (21).
      ★ Be careful not to lose the key.



4. End cap, valve plate

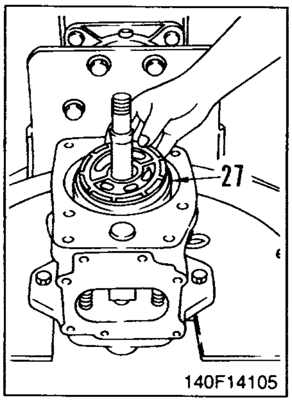
1) Remove bolt (22), washer (23), shim (24), and spacer (25).
2) Remove end cap (26).
   ★ The valve plate may be stuck to the end cap, so be careful not to drop it.
3) Remove valve plate (27).

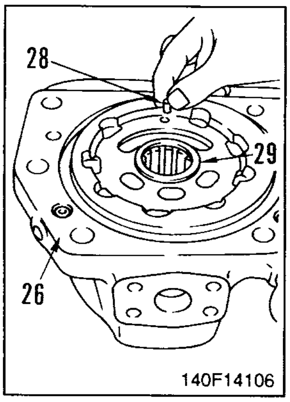




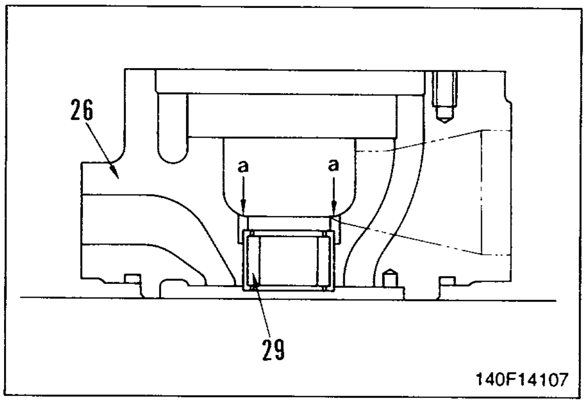
- Disassembly of end cap

1) Remove dowel pin (28) from end cap (26).
2) Remove bearing (29).





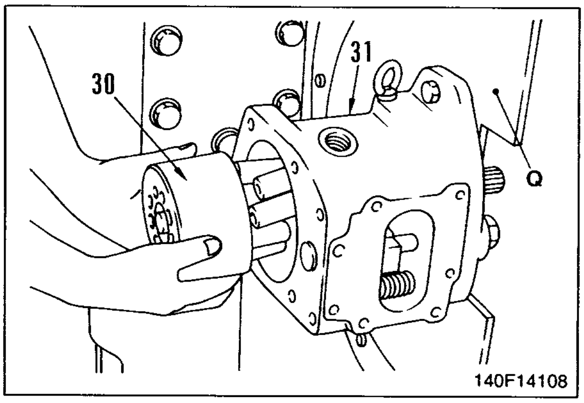
★ When removing bearing (29), use the two pushing holes **a** shown in the diagram on the right, and push out with a hydraulic press.



5. Cylinder block, piston assembly

Turn over tool **Q** 90°, and remove cylinder block and piston assembly (30) from pump case (31).

★ The cylinder block and piston assembly or retainer may come off separately, so be careful not to drop them.



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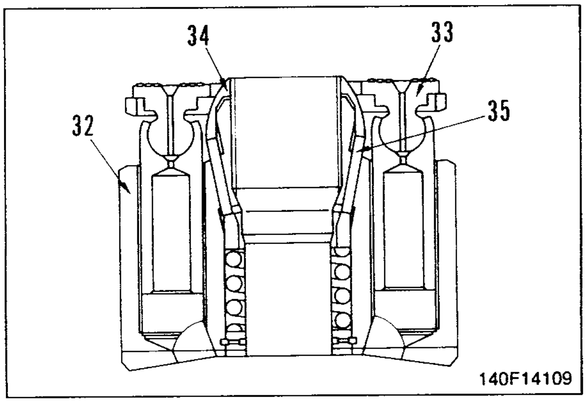
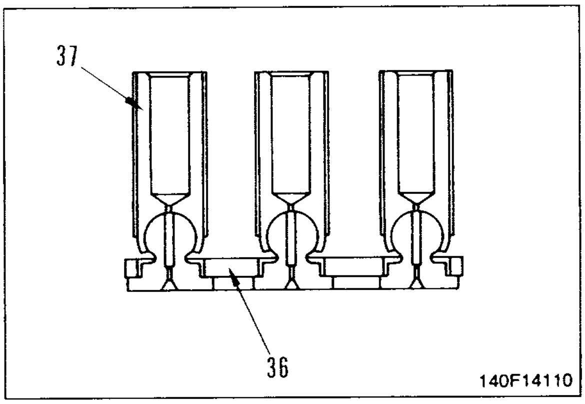
- Disassembly of cylinder block, piston assembly

1) Pull out piston assembly (33) from cylinder block (32), and remove retainer guide (34).
   ★ When removing the piston assembly from the cylinder block, preload pin (35) may fall out, so be careful not to lose it.

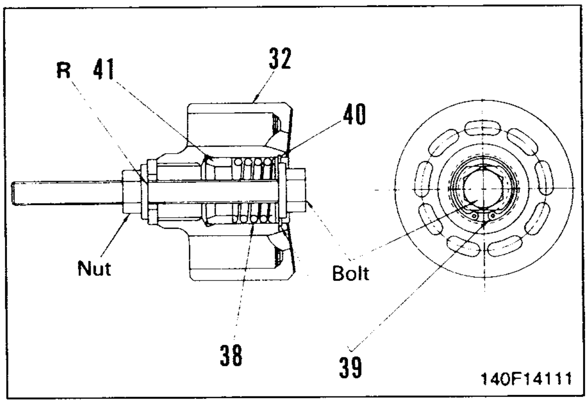


- Disassembly of piston assembly
  Pull out piston (37) from retainer shoe (36).



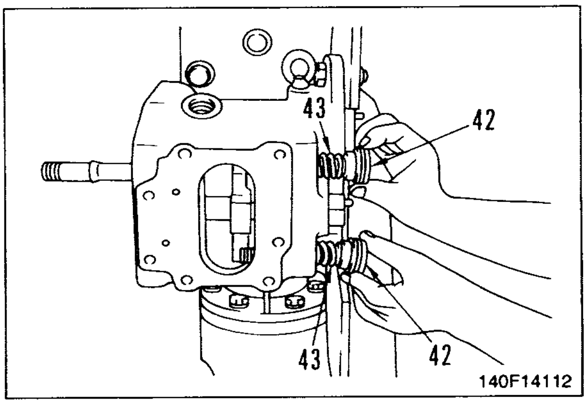
- Disassembly of cylinder block

1) Set tool **R** to cylinder block (32).
   Hold bolt of tool **R** with wrench, tighten nut, then tighten spring (39), and remove snap ring (38).
2) Loosen nut of tool **R** gradually to loosen tension of spring (39), then remove tool **R**.
3) Remove spacer (40), spring (39), and spacer (41) from cylinder block (32).
   ★ Check the direction of assembly of spacer (41).

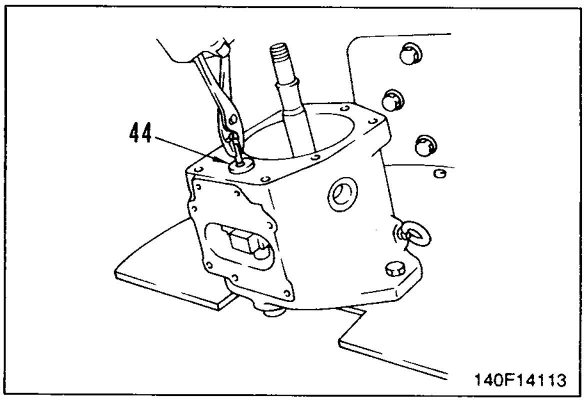


6. Servo piston assembly

1) Remove plug (42), then remove spring (43).



2) Using bolt (6 mm), remove stopper (44).



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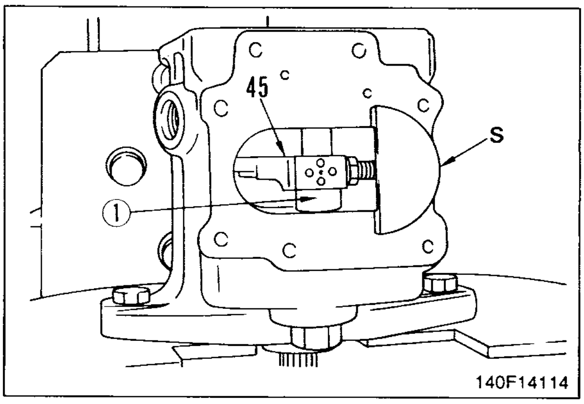
3) Set tool **S** in position, and assemble spacer ① under rod (45).
4) Lift up rocker cam (47) slightly, move to side so that width across flats of rocker cam separates from width across flats of cradle, and loosen piston (46).



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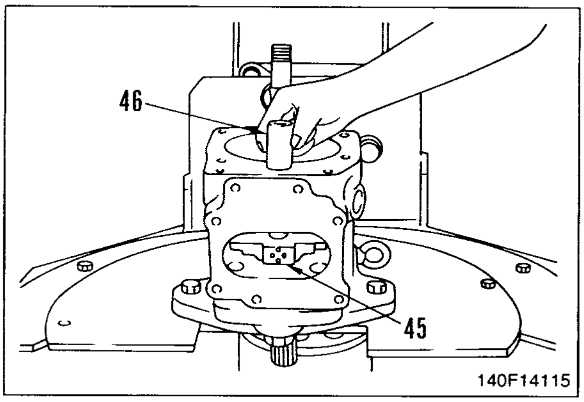
5) Remove piston (46), then remove rod (45).
   ★ Check the mounting direction of rod (45).



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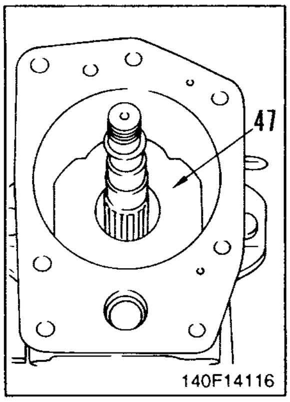
7. **Shaft, cradle assembly**
   1) Remove rocker cam (47).
   2) Remove 4 bolts (48), then remove shaft and cradle assembly (49).



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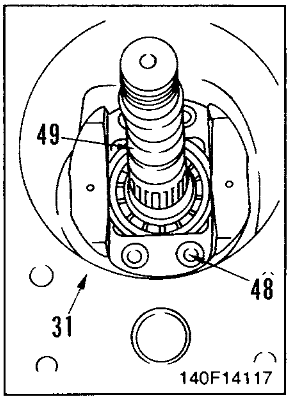

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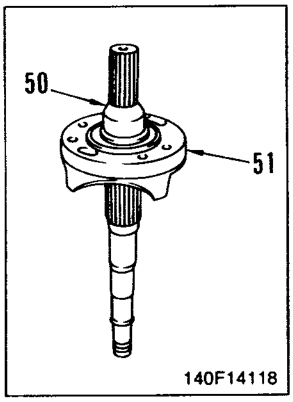
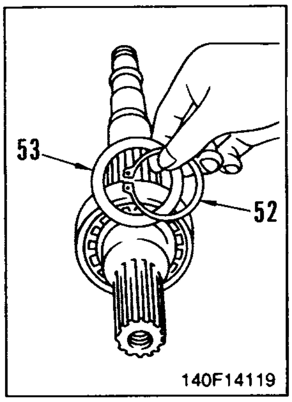
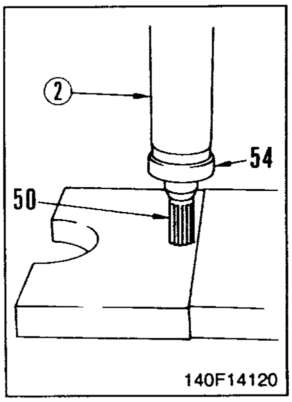
- Disassembly of shaft, cradle assembly

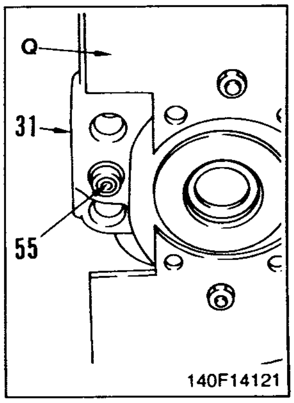
1) Push cradle (51) with a hydraulic press, taking care that it is not at an angle, and remove from shaft (50).
2) Remove snap ring (52), then remove washer (53).





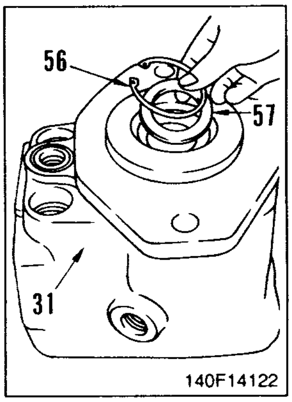
3) Using push tool ②, pull out bearing (54) from shaft (50).
    - ★ Bearing (54) divides into two parts (flange and bearing), so be careful not to lose either part.
    - ★ Check the direction of assembly of the bearing.

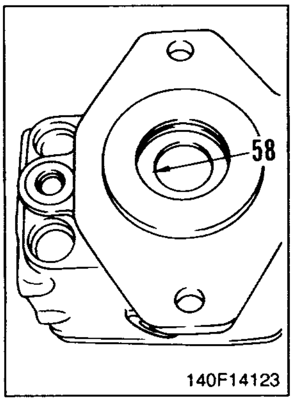




8. Disassembly of pump case

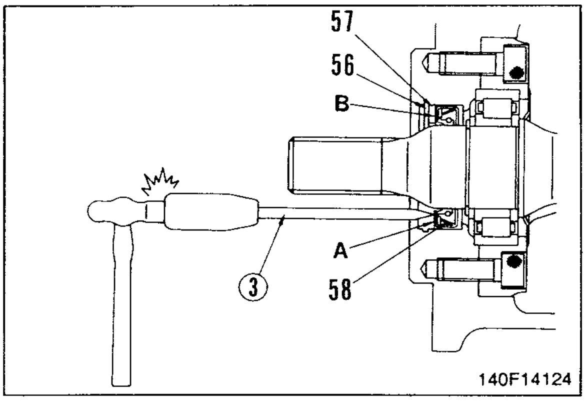
1) Loosen nut of swash plate adjustment screw (55), remove screw (55), then remove pump case (31) from tool **Q**.
    - ★ Before loosening the nut, measure the dimension between the end face of the case and the end face of screws.
2) Remove snap ring (56) from pump case (31), then remove spacer (57).
3) Remove oil seal (58).





9. When replacing oil seal only (there is no need to disassemble), replace oil seal as follows.

1) Remove snap ring (56) and spacer (57).
2) Hit end of bar ③ with a hammer to pierce oil seal (58) to the core, then twist to remove.
    - ★ Hit at a point close to the middle of the inside and outside diameter of the oil seal, and twist at two places on opposite sides as shown by **A** and **B** in the diagram. This makes it easier to remove.
    - ★ Be careful not to damage the shaft.



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ASSEMBLY OF HSS, WORK EQUIPMENT PUMP ASSEMBLY

D65EX, PX

★ Clean all parts, and check for dirt or damage.
★ Coat the sliding surfaces of all parts with engine oil (EO10-CD) before installing.

★ Always inspect the following parts before assembling.

i) Check the contact between the cradle and rocker arm (see the procedure for inspecting the contact).
ii) Check the contact between the cylinder block and valve plate (see the procedure for inspecting the contact).

1. Shaft, cradle assembly

- Assembly of shaft and cradle assembly

1) Assemble flange to shaft (50), then use push tool ① to press fit bearing (54).

   Press-fitting surface of bearing:
   Grease (G2-LI)

   ★ When press fitting the bearing, push the end face of the inner race of the bearing with push tool ①.

2) Assemble washer (53) and install snap ring (52).

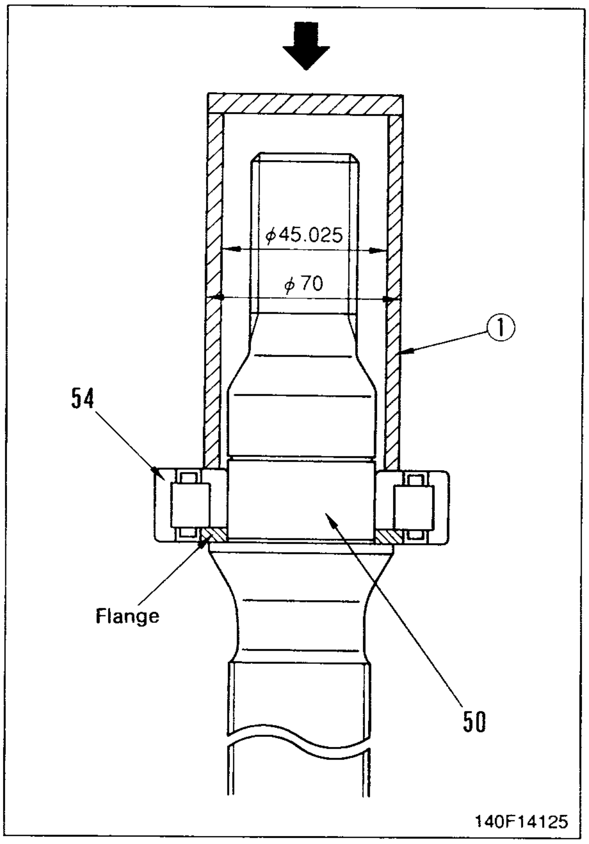
   ★ Method of selecting fixed washer (53)

   i) After press fitting bearing (54) to shaft (50), assemble washer removed during assembly.
   ii) After assembling washer (53), measure dimension **a** of clearance between end face of washer (53) and snap ring groove.

      ★ Dimension **a** of clearance:
      1.45 — 1.6 mm

   iii) If dimension **a** of clearance is not within standard value given above, select washer from table below and assemble.

Washer Part No.	Washer thickness (mm)
708-2E-12160	3.1
708-2E-12170	3.0
708-2E-12180	2.9
708-2E-12190	2.8



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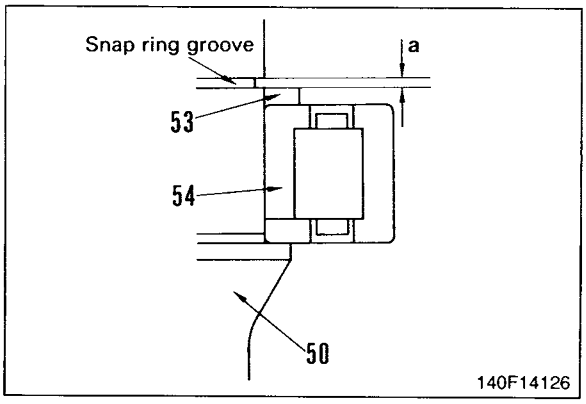

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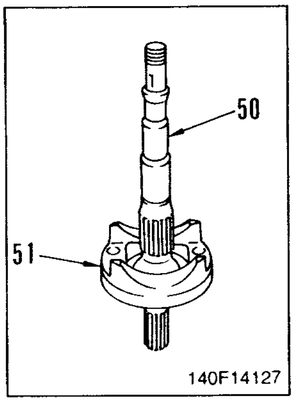
3) Press fit cradle (51) to shaft (50) with hydraulic press to make shaft and cradle assembly (49).
4) Set pump case (30) to tool **Q**.
5) Fit dowel pin and O-ring to bottom of inside of pump case (31), then install shaft and cradle assembly (49).

Mounting bolt: **110.3 ± 12.3 Nm**
(11.3 ± 13 kgm)



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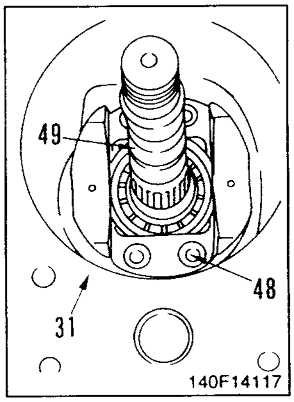

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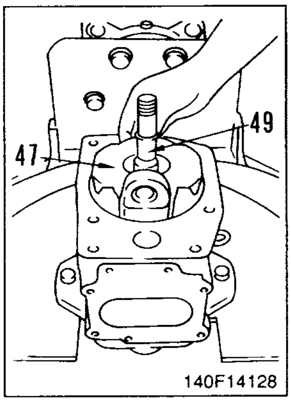
2. **Rocker cam**
Assemble rocker cam (47) to shaft and cradle assembly (49).

3. **Piston**
1) Assemble spherical part of rod (45) to rocker cam (47).
★ When assembling the rod, set the seat of the spring facing down.



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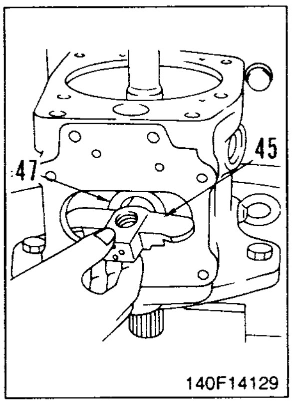
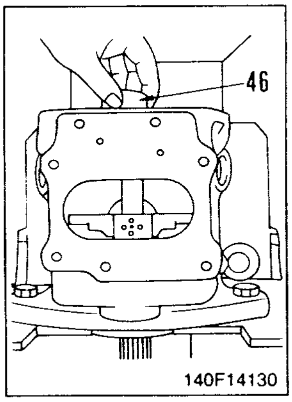


140F14129

2) Fit piston (46) and set tool **S** in position, and set spacer ② under rod (45), then tighten piston (46).
★ Before tightening piston (46), lift up rocker arm (47) slightly, and move to side so that width across flats of rocker cam separates from width across flats of cradle.
(This is to prevent damage to the rocker cam and cradle when tightening the piston.)

Piston:
Thread tightener (Loctite 648)

Piston: **318.5 ± 24.5 Nm**
(32.5 ± 2.5 kgm)



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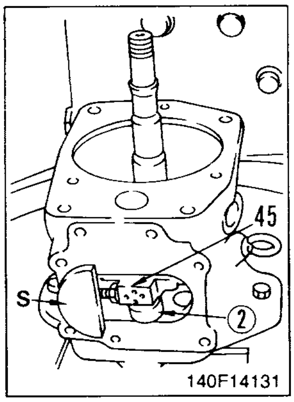

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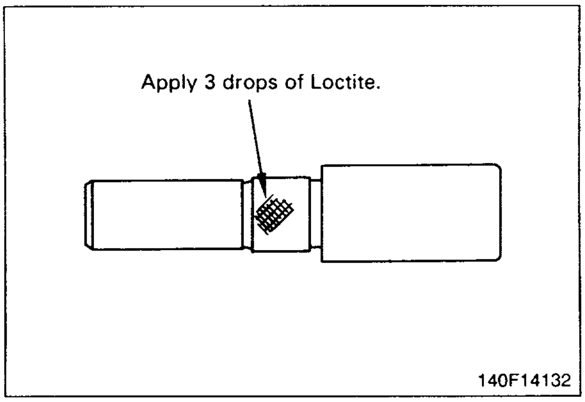
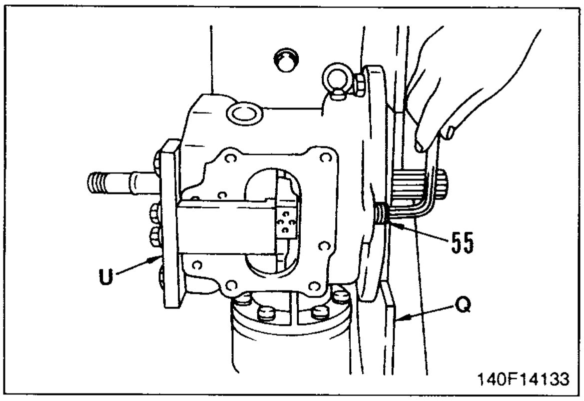

Apply 3 drops of Loctite.

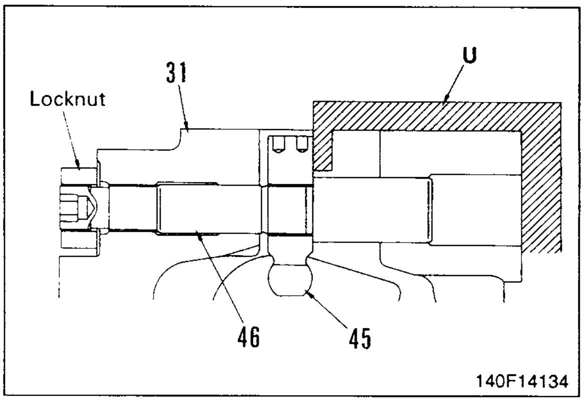
140F14132

3) Positioning of minimum swash plate angle
   - i) After setting tool **U**, turn over tool **Q** 90°.
   - ii) Tighten screw (55) until it contacts piston (46), tighten locknut, then remove tool **U**.

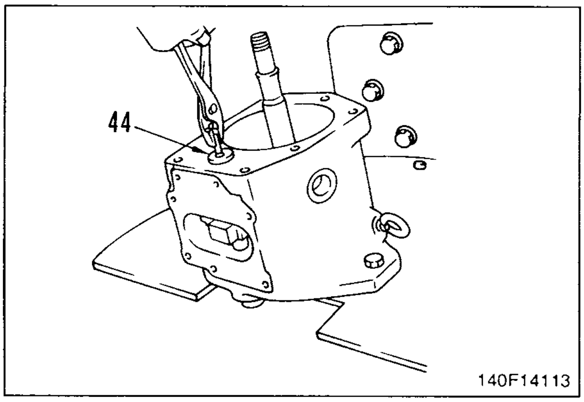
     kgm Screw: **6.4 ± 1.5 Nm**
     (0.7 ± 0.2 kgm)

     kgm Locknut: **157 ± 10 Nm**
     (16 ± 1 kgm)
   - iii) After completing assembly, check minimum flow on test bench.





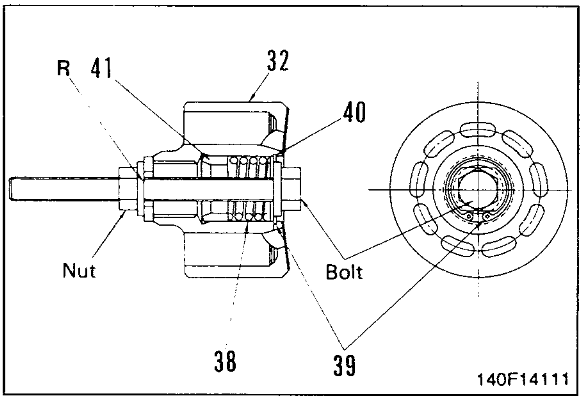
4) Assemble backup ring and O-ring to stopper (44), then install to case.



4. Cylinder clock, piston assembly

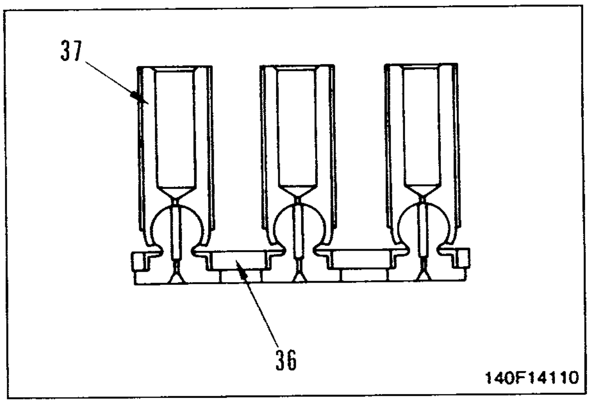
- Assembly of cylinder block

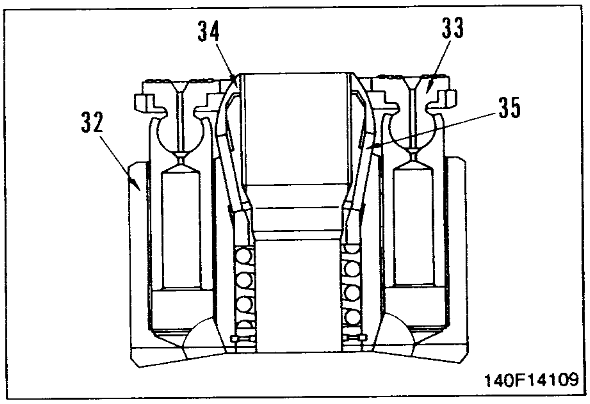
1) Assemble spacer (41), spring (38), and spacer (40) to cylinder block (32).
   ★ Assemble spacer (41) with the inside taper facing down.
2) Set tool **R** to cylinder block (32).
3) Hold bolt of tool **R** with wrench, tighten nut, then compress spring (38), and install snap ring (39).
   ★ Check that the snap ring is securely fitted into the groove.
4) Remove tool **R**.



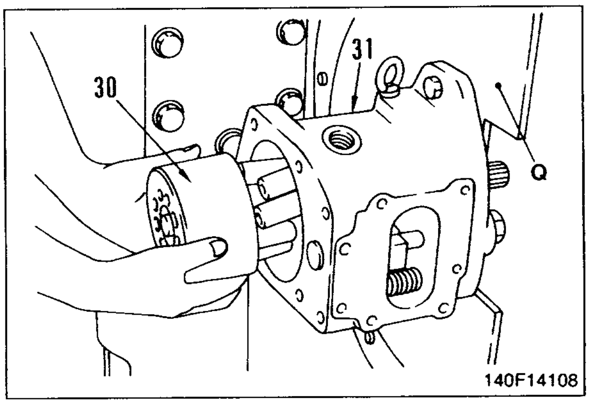
- Assembly of piston assembly
  Assemble piston (37) to retainer shoe (36).

5) Assemble 3 preload pins (35) to cylinder block (32).
   ★ To prevent preload pins (35) from falling out, coat the pins with grease (G2-LI).
6) Assemble retainer guide (34) to cylinder block (32), then assemble piston assembly (33), and make cylinder block and piston assembly (30).



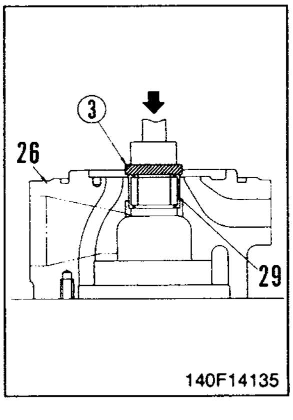


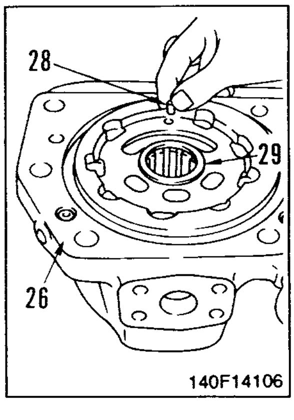
7) Install cylinder block and piston assembly (30) to pump case (31).
   ★ Before installing the cylinder block and piston assembly, assemble the width across flats of the rocker cam to the cradle securely.



5. End cap assembly

1) Assembly of end cap assembly
   i) Using push tool ③, press fit bearing (29) to end cap (26).
   ii) Install dowel pin (28) to end cover.

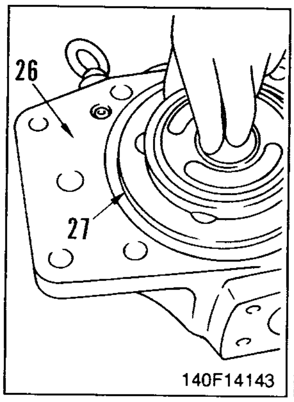




2) Assemble valve plate (27) to end cap (26), and install to pump case.

Mating surface of pump case: **Gasket sealant (LG-7 or LG-5 (Loctite 572, 575))**

Mounting bolt: **176.4 ± 19.6 Nm (18 ± 2 kgm)**



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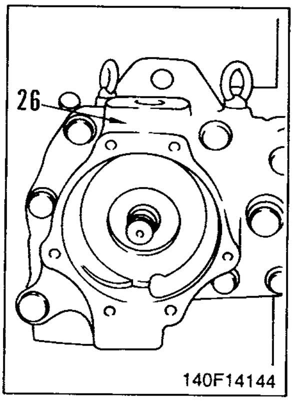

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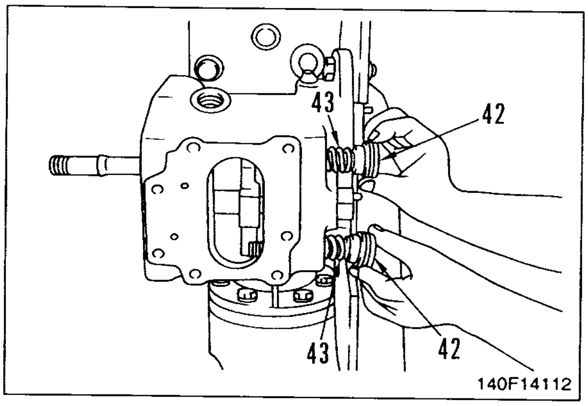
6. Spring, plug

Assemble spring (43), and install plug (42).

Plug: **107.8 ± 14.7 Nm (11 ± 1.5 kgm)**



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7. Positioning of maximum swash plate angle

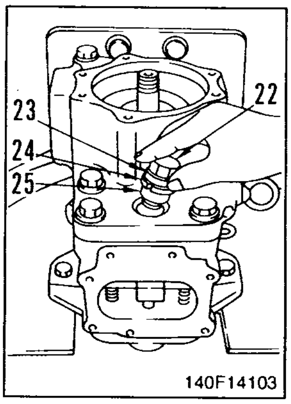
1) Install spacer (25), shim (24), washer (23), and bolt (22) to end cap (26).

★ For maximum swash plate angle positioning shim (24), assemble the shim that was removed during disassembly of a standard shim from the table below.

Shim part No.	Thickness (mm)	Standard number of shims in set
708-2L-24170	0.1	2
708-2L-24180	0.2	2
708-2L-24190	0.5	2

Bolt (22): **156.8 ± 9.8 Nm (16 ± 1 kgm)**

2) After completion of assembly of HSS pump, carry out a performance test on the test bench and make final adjustment of shim.



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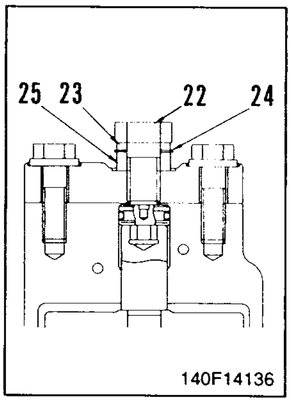

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8. Impeller, cover

1) Adjusting clearance between impeller and end cap

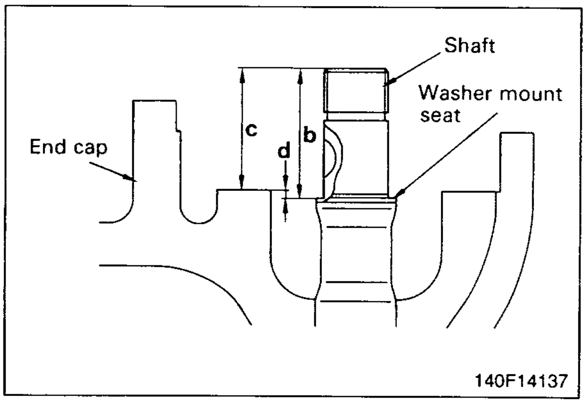
i) With shaft pushed down as shown in diagram, measure shaft washer mount seat dimension **b** from end face of shaft and case end face dimension **c** from end face of shaft.

ii) Obtain thickness of washer using formula below, then select washer (23) and assemble.

★ **b − c = d**

Washer thickness = **d** + 0.4 — 0.6 mm (or measure **d** directly)

★ Therefore, a clearance of 0.4 — 0.6 mm is formed at portion **d**.



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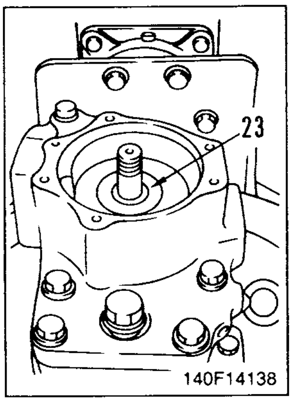
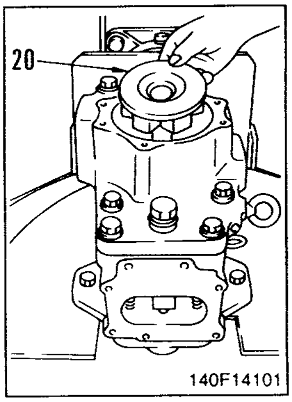
Washer Part No.	Washer thickness (mm)
708-1E-11650	2.7
708-1E-11660	3.0
708-1E-11670	3.3
708-1E-11680	3.6





2) Assemble key to shaft, and install impeller (20).
   ★ After installing the impeller, check that the key is securely assembled to the shaft and impeller.

3) Fit spacer (19) and tighten nut (18).

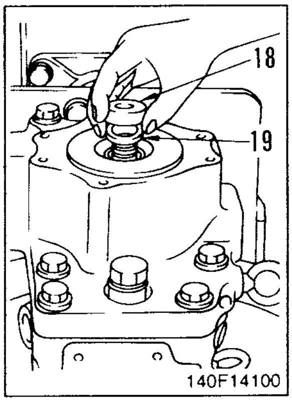
   Nut: **Thread tightener**
   (Loctite 648 (79A-129-9110))

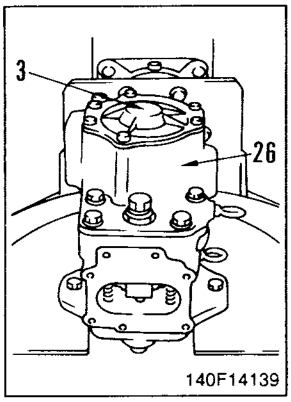
   Nut: **176.4 ± 19.6 Nm**
   (18 ± 2 kgm)

4) Fit O-ring to cover (3), install to end cap (26).

   Mating surface of end cover:
   Gasket sealant
   (LG-7 or LG-5 (Loctite 572, 575))

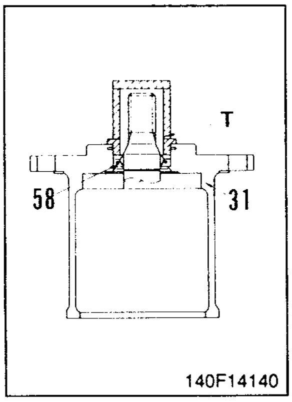
   Mounting bolt: **66.2 ± 7.4 Nm**
   (6.8 ± 0.8 kgm)

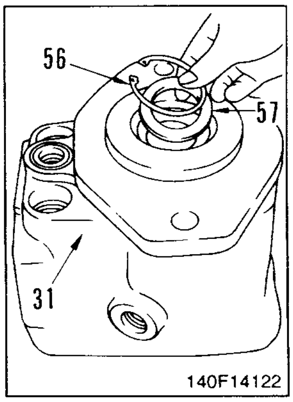




9. Installation of oil seal

1) Check that there are no burrs or flashes on corner of shaft.
2) Using tool **T**, install oil seal (58) to pump case (31).
3) Fit spacer (57) and install snap ring (56).



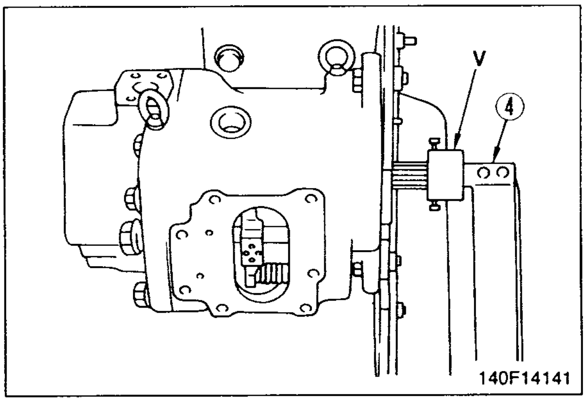


10. Measuring rotating torque of pump assembly

1) Set tool **V** to pump shaft spline portion.
2) Set torque wrench ④ to tool **V**, rotate shaft at approx. 1 turn/3 — 5 sec, and measure rotating torque.
   ★ There must be no variation in the rotating torque.

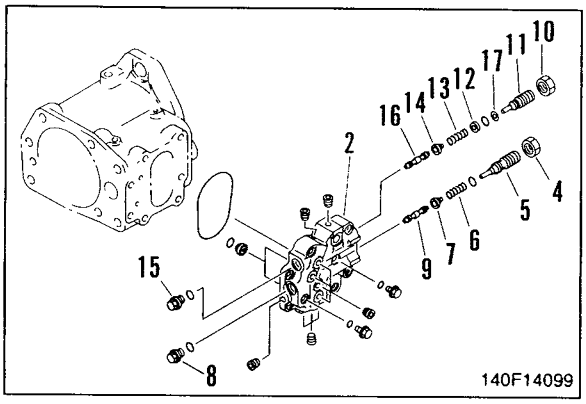
   Rotating torque: **0 — 24.5 Nm**
   (0 — 2.5 kgm)

   ★ If there is any abnormality in the rotating torque, disassemble again and investigate.



11. Valve assembly

1) Assemble of valve assembly (2)



- LS valve
  - i) Assemble spool (16) to body (2), then fit O-ring to plug (15) and install.

    kgm Plug: **39 ± 5 Nm**
    (4 ± 0.5 kgm)
  - ii) Fit O-ring and backup ring (17) to plug (11), and assemble seat (12), spring (13), and seat (14), tighten to body (2), then install nut (10).

    kgm Nut: **147 ± 29 Nm**
    (15 ± 3 kgm)
- Variable throttle valve
  - i) Assemble spool (9) to body (2), then fit O-ring to plug (8), and install.
    ★ Spool (9) cannot be assembled from plug (8) side.

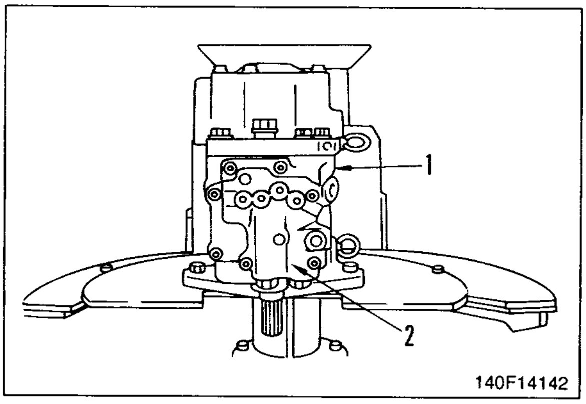
    kgm Plug: **39 ± 5 Nm**
    (4 ± 0.5 kgm)
  - ii) Fit O-ring to plug (5) and assemble spring (6) and seat (7), tighten to body, then install nut (4).

    kgm Nut: **147 ± 29 Nm**
    (15 ± 3 kgm)

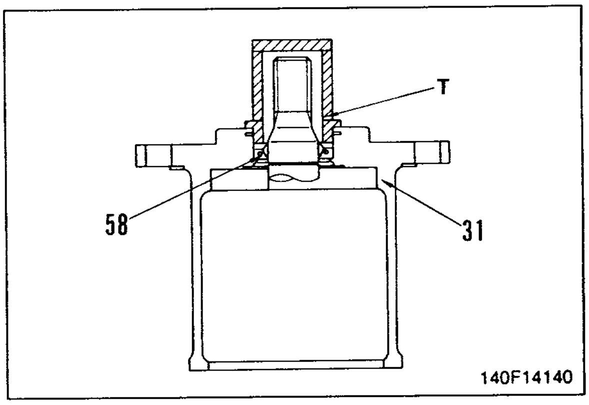
2) After completing assembly of valve assembly (2), carry out a bench test of valve assembly as an individual part to test adjustment and performence.

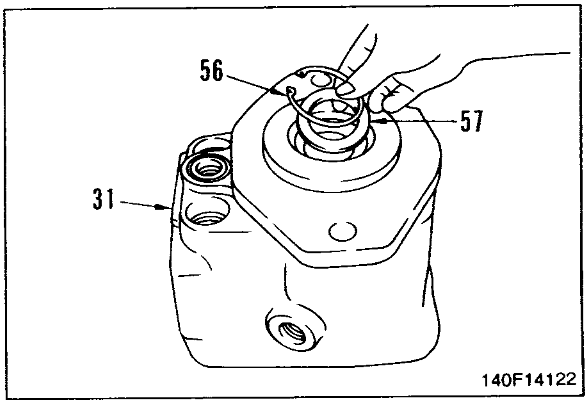
3) Fit O-ring to valve assembly (2), and install to pump (1).

kgm Mounting bolt: **66.2 ± 7.4 Nm**
(6.8 ± 0.8 kgm)



12. **When replacing oil seal only (there is no need to carry out assembly operation), replace oil seal as follows.**
    1) Using tool **T**, press fit oil seal (58).
       ★ Check that there are no burrs or flashes on the corner of the shaft.
    2) Assemble spacer (57), and install snap ring (56).





014012

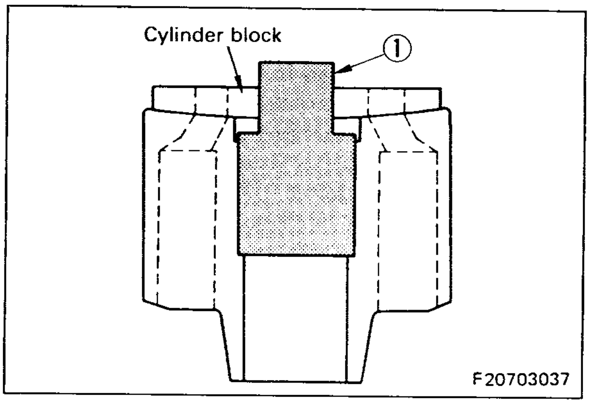
CHECKING CONTACT BETWEEN CYLINDER BLOCK AND VALVE PLATE, AND ROCKER CAM AND CRADLE

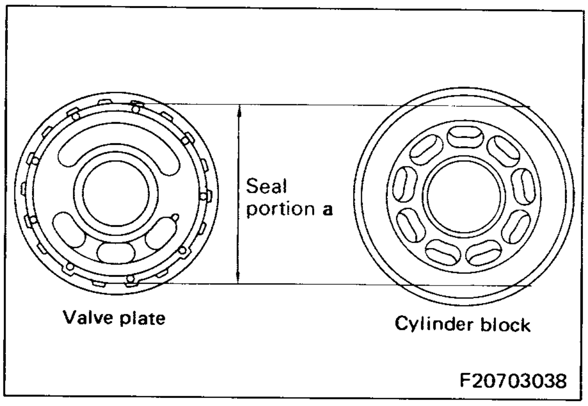
1. Checking contact between cylinder block and valve plate

1) Make a centering tool ① for the cylinder block and valve plate.
   ★ The tool can be made of a soft material such as plastic or bakelite.
2) Remove grease from the parts to be checked.
   ★ Do not wipe with a cloth.
3) Set the tool in position, and coat the cylinder block side with inspection paint.
   ★ Apply the paint thinly.
4) Put the valve plate on top, push with a force of 39.2 — 49.0 N (4 — 5 kg), then rotate valve plate 2 to 3 times.
5) Remove the valve plate, transfer the contact surface to tape, and check the contact surface.

★ The standards for the contact surface of seal portion **a** are as follows.

Valve plate	Min. 80%
Cylinder block	Min. 80%





2. Checking contact between rocker cam and cradle

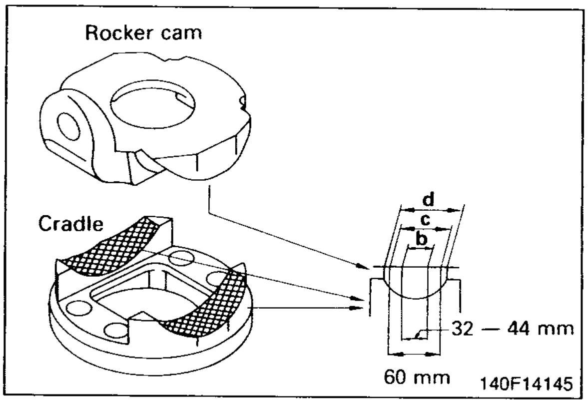
1) Remove grease from the parts to be checked.
   ★ Do not wipe with a cloth.
2) Set the tool in position, and coat the cradle side with inspection paint.
   ★ Apply the paint thinly.
3) Put the rocker cam on top, push with a force of 39.2 — 49.0 N (4 — 5 kg) and move 2 — 3 times from the stopper contact position to the maximum angle.
4) Remove the rocker cam, transfer the contact surface to tape, and check the contact surface.

★ The standard for the contact surface are as follows.

Pump model: HPV95

Measurement range	Position		
	(b) Center portion 32 — 44 mm	(c) Portion **b** — 60 mm	(d) Outside of parts except portion **c**
Contact surface	Over 90%	50 — 90%	Under 50%

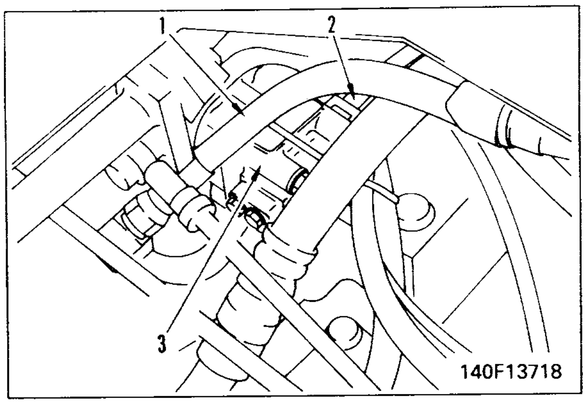
★ If there is no contact at the center but only at the outside, the contact is no good.



Reference:

- If the contact is not within the contact standard value, when carrying, always lap both parts together.
- Parts with scratches cannot be reused.

REMOVAL OF PPC PUMP ASSEMBLY



1. Drain hydraulic oil.

   Hydraulic tank: **55 ℓ**

2. Remove operator's seat assembly, then remove right side cover.

   Operator's seat assembly: **35 kg**

3. Disconnect hoses (1) and (2).
4. Remove PPC valve pump assembly (3).

INSTALLATION OF PPC PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.
- **Refilling with oil (hydraulic tank)**
  ★ Add oil through oil filler to the specified level. Run the engine to circulate the oil through the system.
  Then check the oil level again.

REMOVAL OF MAIN CONTROL VALVE ASSEMBLY

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

★ This section gives the procedure for disassembly and assembly using the 2-spool valve as an example.

⚠ Lower the work equipment to the ground and release the pressure inside the circuit. For details, see TESTING AND ADJUSTING, Releasing pressure from hydraulic circuit.

1. Drain hydraulic oil.

   Hydraulic tank: **Approx. 55 ℓ**

2. Remove operator's seat assembly, then remove inside cover.

   kg Operator's seat assembly: **35 kg**

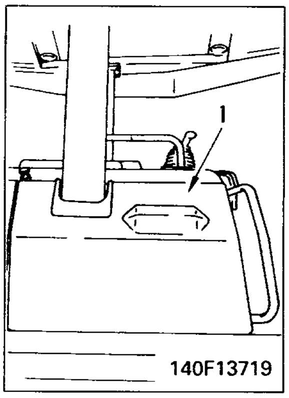
3. Remove cover (1).
4. Remove tube (2), and disconnect 3 hoses (2), then lift off hydraulic oil filter case assembly (4).

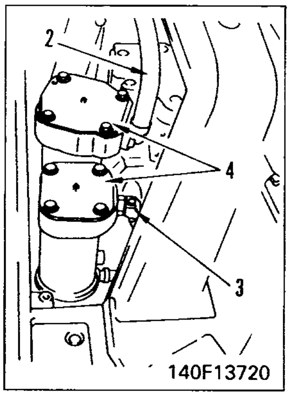
   kg Hydraulic oil filter case: **32 kg**

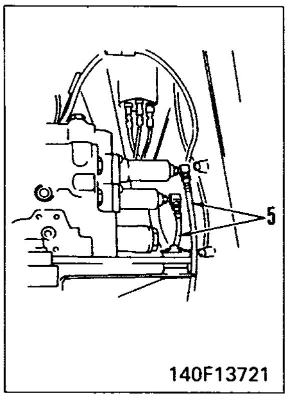
   ★ Drain the oil from the plug at the bottom of the filter case before removing the tube, hose, and hydraulic filter case.

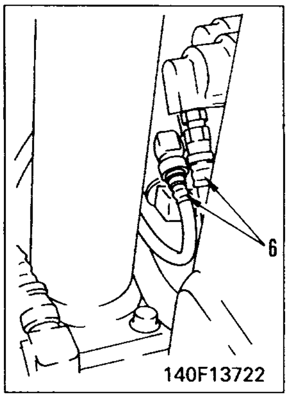
5. Disconnect 2 PPC hoses (5).
6. Disconnect 3 PPC hoses (6).
7. Remove 2 covers at operator's seat end, then disconnect 2 hoses (7) and 5 hoses (8).
8. Lift off main control valve assembly (9).

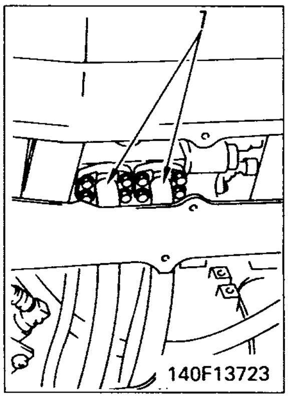
   kg Main control valve assembly: **85 kg**

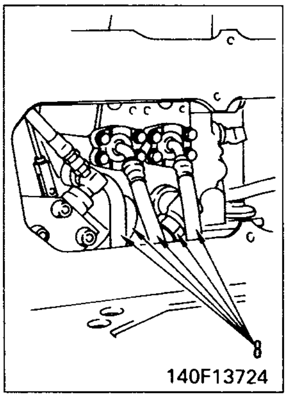


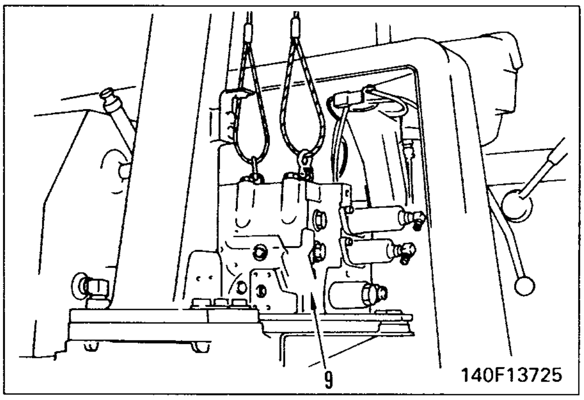












INSTALLATION OF MAIN CONTROL VALVE ASSEMBLY

D65E-12 60001 - 60947
D65P-12 60001 - 60890
D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

- Carry out installation in the reverse order to removal.
- **Refilling with oil (hydraulic tank)**

  ★ Add oil through oil filler to the specified level.
  Run the engine to circulate the oil through the system.
  Then check the oil level again.

014012

REMOVAL OF MAIN CONTROL VALVE ASSEMBLY

2-SPOOL: BLADE LIFT + TILT

D65E-12 60948 and up
D65P-12 60891 and up

⚠ Lower the work equipment to the ground and release the pressure inside the circuit. For details, see TESTING AND ADJUSTING, Releasing pressure from hydraulic circuit.

1. Drain hydraulic oil.

   Hydraulic tank: **Approx. 55 ℓ**

2. Remove operator's seat assembly, then remove inside cover.

   kg Operator's seat assembly: **35 kg**

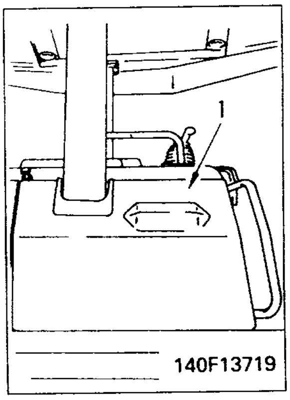
3. Remove cover (1).
4. Remove tube (2), and disconnect 3 hoses (2), then lift off hydraulic oil filter case assembly (4).

   kg Hydraulic oil filter case: **32 kg**

   ★ Drain the oil from the plug at the bottom of the filter case before removing the tube, hose, and hydraulic filter case.

5. Disconnect 2 PPC hoses (5).
6. Disconnect 3 PPC hoses (6).
7. Remove 2 covers at operator's seat end, then disconnect 2 hoses (7) and 5 hoses (8).
8. Lift off main control valve assembly (9).

   kg Main control valve assembly: **85 kg**



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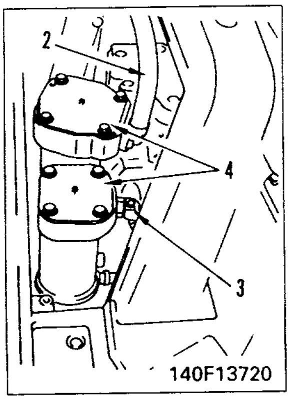

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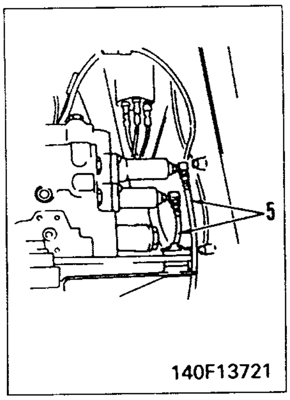

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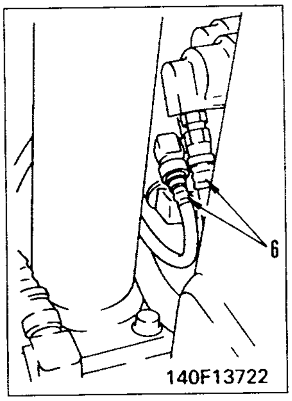

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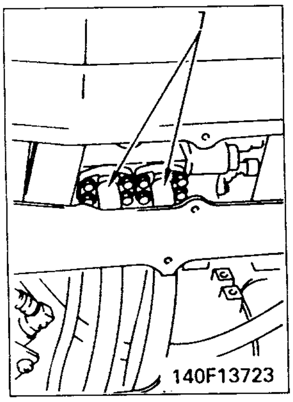

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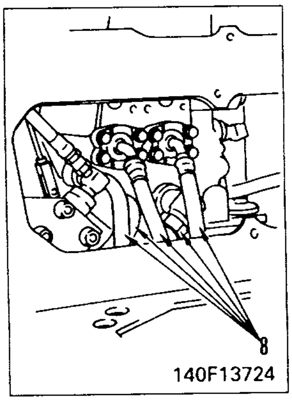

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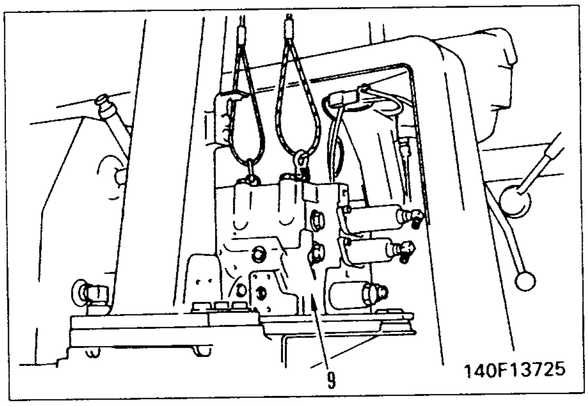

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INSTALLATION OF MAIN CONTROL VALVE ASSEMBLY

2-SPOOL: BLADE LIFT + TILT

D65E-12 60948 and up
D65P-12 60891 and up

- Carry out installation in the reverse order to removal.
- **Refilling with oil (hydraulic tank)**

  ★ Add oil through oil filler to the specified level. Run the engine to circulate the oil through the system.
  Then check the oil level again.

REMOVAL OF MAIN CONTROL VALVE ASSEMBLY

3-SPOOL: BLADE LIFT + TILT + STEERING

D65EX-12 60942 and up
D65PX-12 60915 and up

⚠ Lower the work equipment to the ground and release the pressure inside the circuit. For details, see TESTING AND ADJUSTING, Releasing pressure from hydraulic circuit.

1. Drain hydraulic oil.

   Hydraulic tank: **Approx. 55 ℓ**

2. Remove ROPS guard. For details, see REMOVAL OF ROPS GUARD.
3. Remove operator's seat assembly, then remove inside cover.

   Operator's seat assembly: **35 kg**

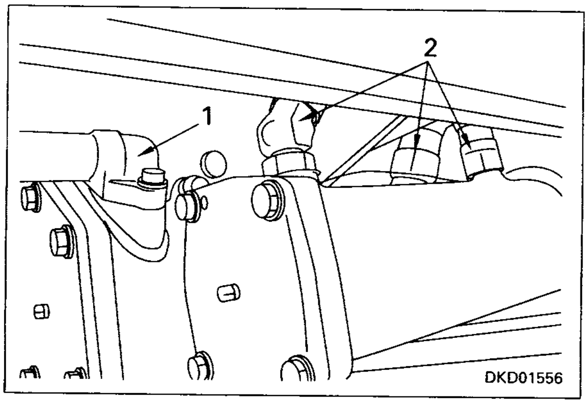
4. Remove tube (1), and disconnect 3 hoses (2), then lift off hydraulic oil filter case assembly (3).

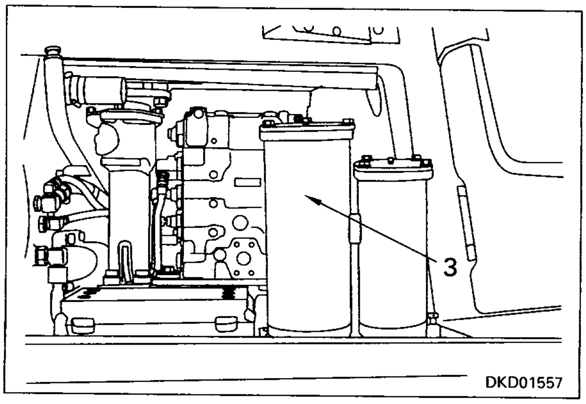
   Hydraulic oil filter case: **32 kg**

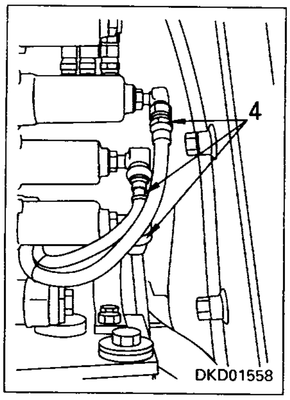
   ★ Drain the oil from the plug at the bottom of the filter case before removing the tube, hose, and hydraulic filter case.

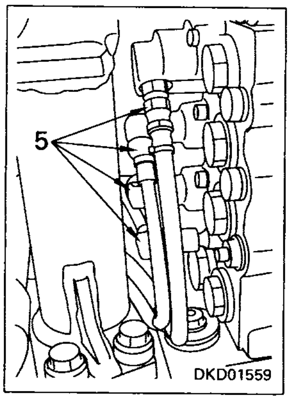
5. Disconnect 3 PPC hoses (4) and 4 PPC hoses (5).
6. Disconnect 4 hoses (6) between the lift, tilt cylinders and the main control valve.
7. Disconnect 2 hoses (7) between the HSS motor and the main control valve.
8. Disconnect hose (8) between the LS valve and the main control valve.
9. Disconnect hose (9) between the tank and the main control valve.
10. Disconnect hose (10) between the pump and the main control valve.
11. Lift main control valve assembly (11).

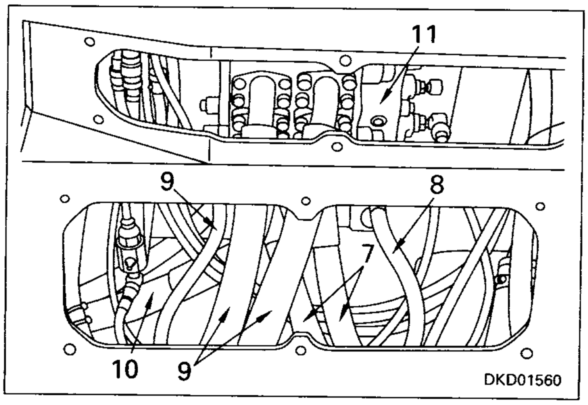
    Main control valve assembly: **110 kg**











INSTALLATION OF MAIN CONTROL VALVE ASSEMBLY

3-SPOOL: BLADE LIFT + TILT + STEERING

D65EX-12 60942 and up
D65PX-12 60915 and up

- Carry out installation in the reverse order to removal.
- **Refilling with oil (hydraulic tank)**

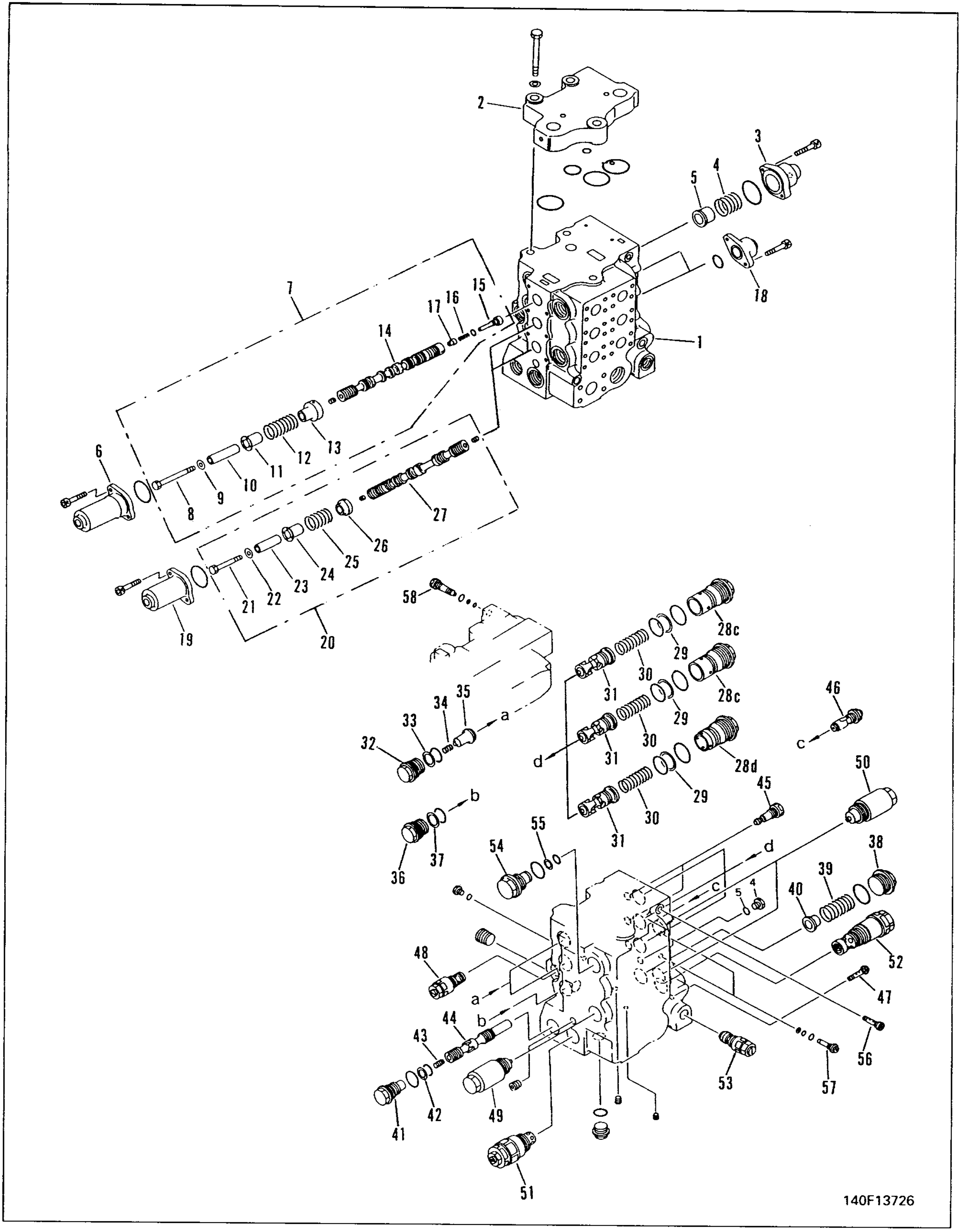
  ★ Add oil through oil filler to the specified level. Run the engine to circulate the oil through the system.
  Then check the oil level again.

DISASSEMBLY OF MAIN CONTROL VALVE ASSEMBLY

(3-SPOOL VALVE)

D65E-12 60001 - 60947 **D65EX-12 60001 - 60941**
D65P-12 60001 - 60890 **D65PX-12 60001 - 60914**

★ The diagram shows 3-spool valve for D65EX, PX-12.



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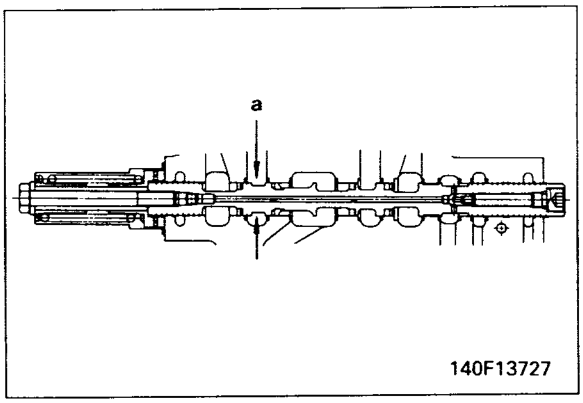
★ This section gives the procedure for disassembly using the 3-spool valve as an example.

1. Remove cover (2) from valve body (1).
2. Disassembly of blade lift valve spool
   1) Remove case (3), then remove spring (4) and retainer (5).
   2) Remove case (6), pull out spool assembly (7) until portion **a** comes out, then hold portion **a** with wrench (width across flats: 14 mm), and loosen bolt (8).
      ★ Be careful not to damage or bend the spool. If there is danger of such damage to the spool, remove spool assembly (7) before starting the operation.
   3) Pull out spool assembly (7) from body.
   4) Remove bolt (8), then remove washer (9), spacer (10), retainer (11), spring (12), and retainer (13) from spool (14).
   5) Remove plug (15), spring (16), and valve (17) from spool (14).



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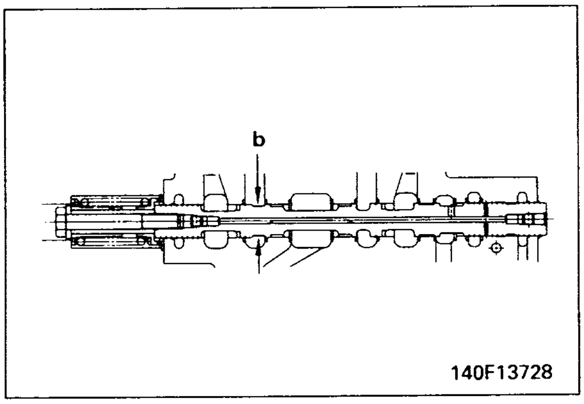
3. Disassembly of blade tilt, steering valve spool
   1) Remove cases (18) and (19).
   2) Pull out spool assembly (20) until portion **b** comes out, then hold portion **b** with wrench (width across flats: 14 mm), and loosen bolt (21).
   ★ Be careful not to damage or bend the spool. If there is danger of such damage to the spool, remove spool assembly (20) before starting the operation.
   3) Pull out spool assembly (20) from body.
   4) Remove bolt (21), then remove washer (22), spacer (23), retainer (24), spring (25), and retainer (26) from spool (27).



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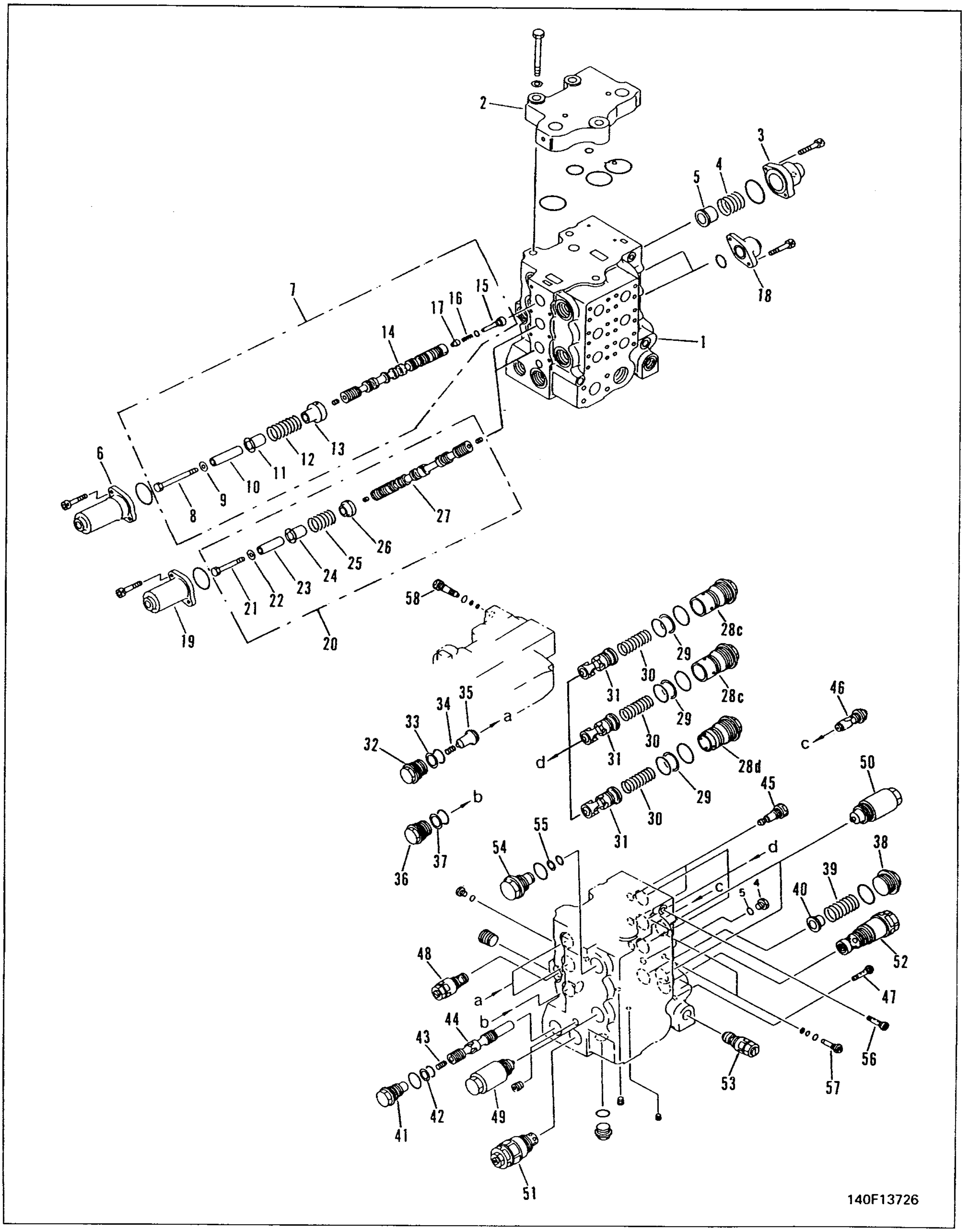
4. Disassembly of pressure compensation spool, steering priority spool
   1) Remove plug (28), then remove ring (29), spring (30), and spool (31).
   2) Remove plug (32), then remove ring (33), spring (34), and valve (35).
   3) Remove plug (36) and ring (37).
5. Disassembly of unload spring
   1) Remove plug (38), then remove spring (39) and retainer (40).
   2) Remove plug (41), then remove ring (42), piston (43), and spool (44).
6. Remove check valves (45), (46), and (47).
7. Remove relief valve (48), suction valves (49) and (50), suction and safety valve (51), valve (52), and main relief valve (53) from body.
   ★ Do not disassemble the suction and safety valve.
8. Remove plug (54), then remove ring (55).
9. Remove valve (56), and plugs (57) and (58).

ASSEMBLY OF MAIN CONTROL VALVE ASSEMBLY

(3-SPOOL VALVE) **D65E-12 60001 – 60947** **D65EX-12 60001 – 60941**
D65P-12 60001 – 60890 **D65PX-12 60001 – 60914**

★ The diagram shows 3-spool valve for D65EX, PX-12.

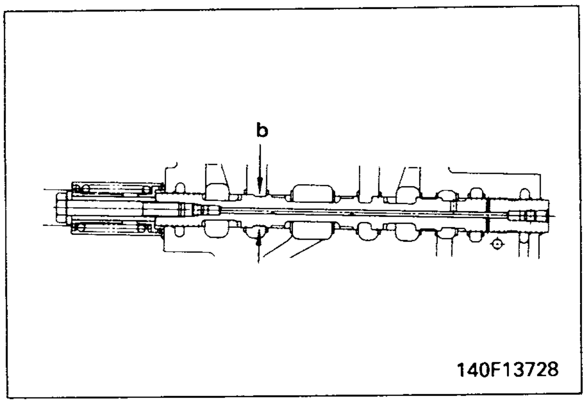


014012

★ This section gives the procedure for assembly using the 3-spool valve as an example.

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. Assemble O-ring and ring to plugs (58) and (57), and install to body.
   kgm Plug (58): **34.3 ± 4.9 Nm (3.5 ± 0.5 kgm)**
   kgm Plug (57): **23.6 ± 4.0 Nm (2.4 ± 0.4 kgm)**
2. Install valve (56) to body.
   kgm Valve: **23.6 ± 4.0 Nm (2.4 ± 0.4 kgm)**
3. Fit ring (55) and O-ring to plug (54) and install to body.
   kgm Plug: **186.4 ± 9.8 Nm (19 ± 1 kgm)**
4. Install main relief valve (53), valve (52), safety and suction valve (51), suction valves (50) and (49), and relief valve (48) to body.
   kgm Main relief valve (53):
   68.7 ± 9.9 Nm (7 ± 1 kgm)
   kgm Valve (52): **127.5 ± 19.6 Nm (13 ± 2 kgm)**
   kgm Safety and suction valve (51):
   186.4 ± 9.8 Nm (19 ± 1 kgm)
   kgm Suction valves (50), (49):
   186.4 ± 9.8 Nm (19 ± 1 kgm)
   kgm Relief valve (48):
   68.7 ± 9.9 Nm (7 ± 1 kgm)
5. Install check valves (47), (46), and (45).
   kgm Check valve (47):
   23.6 ± 4.0 Nm (2.4 ± 0.4 kgm)
   kgm Check valves (46), (45):
   68.7 ± 9.9 Nm (7 ± 1 kgm)
6. Assembly of unload spool
   1) Assemble O-ring and ring (42) to plug (41) and install to body.
   kgm Plug (41): **107.9 ± 14.7 Nm (11 ± 1.5 kgm)**
   2) Assemble piston (43), retainer (40), and spring (39) to spool (44) and assemble to body, then install plug (38).
   kgm Plug (38): **419.3 ± 46.6 Nm (42.8 ± 4.8 kgm)**
7. Assembly of pressure compensation spool, steering priority spool
   1) Assemble O-ring and ring 37) to plug (36) and install to body.
   kgm Plug (36): **152.1 ± 24.6 Nm (15.5 ± 2.5 kgm)**
   2) Install O-ring and ring (29) to plug (28d), assemble spring (30) and spool (31), then install to body.
   kgm Plug (28d):
   321.2 ± 46.6 Nm (32.8 ± 4.8 kgm)
   3) Fit O-ring and ring (33) to plug (32) and assemble spring (34) and valve (35), the install to body.
   kgm Plug (32):
   152.1 ± 24.6 Nm (15.5 ± 2.5 kgm)
   4) Install O-ring and ring (29) to plug (28c), assemble spring (30) and spool (31), then install to body.
   kgm Plug (28c):
   321.2 ± 46.6 Nm (32.8 ± 4.8 kgm)



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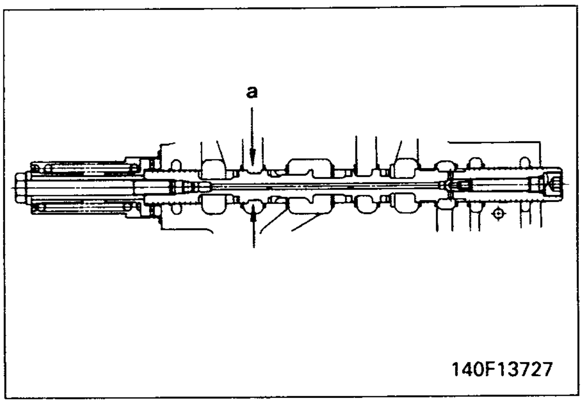

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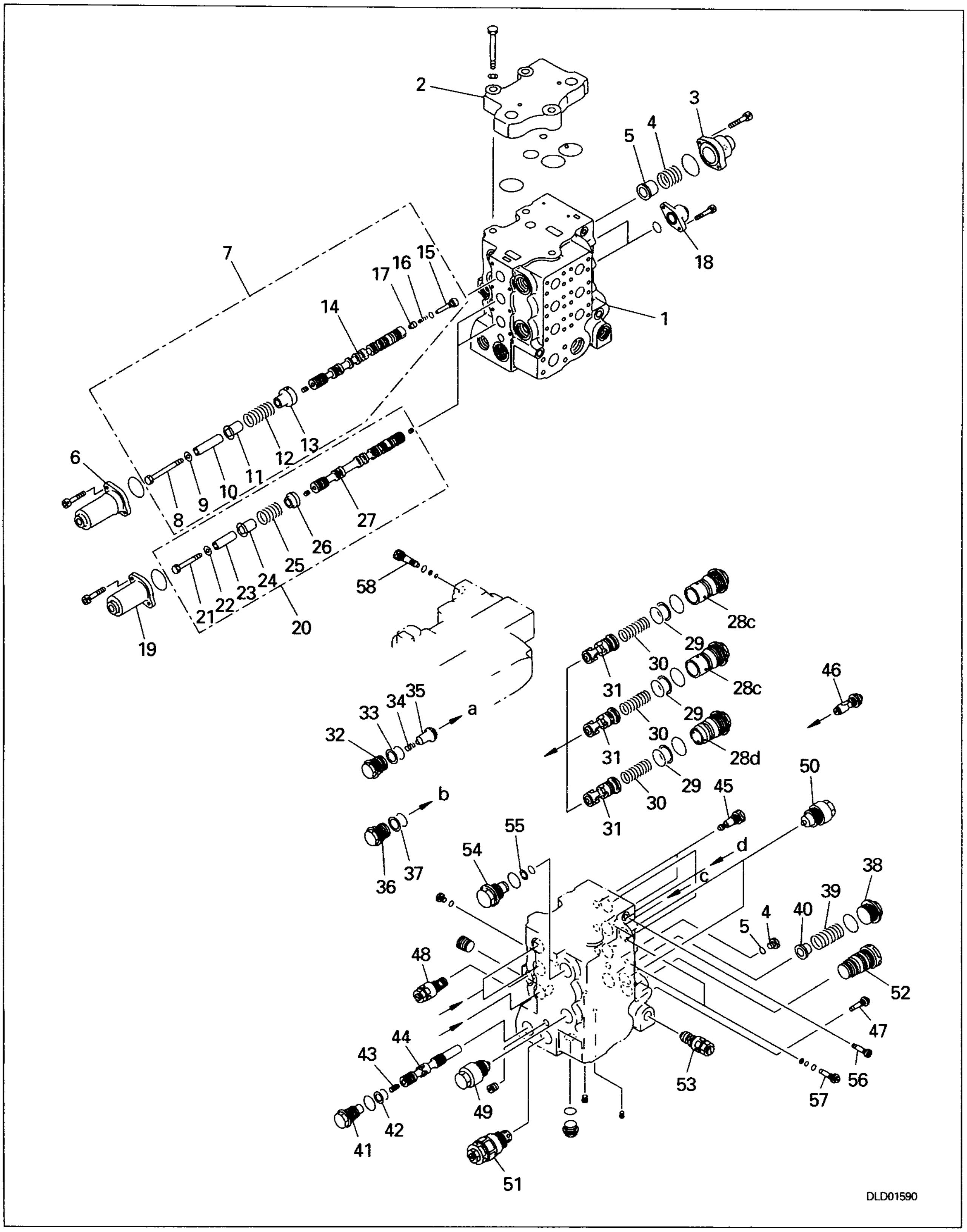
8. Assembly of blade tilt, steering valve spool
   1) Assemble washer (22), spacer (23), retainer (24), spring (25), and retainer (26) to bolt (21), and install to spool (27).
   2) Push spool assembly (20) into body to a point where a wrench can hold portion **b** of spool, hold spool with wrench and tighten bolt (21), then assemble in body.
   kgm Bolt (21):
   66.2 ± 7.4 Nm (6.8 ± 0.8 kgm)
   3) Install cases (19) and (18).
9. Assembly of blade lift valve spool
   1) Install valve (17), spring (16), and plug (15) to spool (14).
   kgm Plug (15):
   23.6 ± 4.0 Nm (2.4 ± 0.4 kgm)
   2) Assemble washer (9), spacer (10), retainer (11), spring (12), and retainer (13) to bolt (8), and install to spool (14).
   3) Push spool assembly (7) into body to a point where a wrench can hold portion **a** of spool, hold spool with wrench and tighten bolt (8), then assemble in body.
   kgm Bolt (8):
   66.2 ± 7.4 Nm (6.8 ± 0.8 kgm)
   4) Install case (6).
   5) Assemble spring (4) and retainer (5) to case (3), and install to body.
10. Install cover (2) to body (1).

DISASSEMBLY OF MAIN CONTROL VALVE ASSEMBLY

(3-SPOOL VALVE)	**D65E-12**	**60948 and up**	**D65EX-12**	**60942 and up**
	D65P-12	**60891 and up**	**D65PX-12**	**60915 and up**

★ The diagram shows 3-spool valve for D65EX, PX-12.



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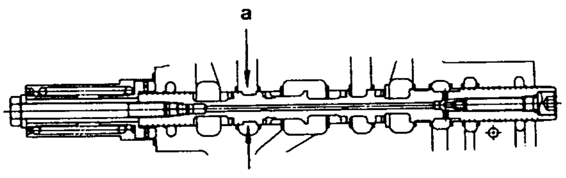
★ This section gives the procedure for disassembly using the 3-spool valve as an example.

1. Remove cover (2) from valve body (1).
2. Disassembly of blade lift valve spool
   1) Remove case (3), then remove spring (4) and retainer (5).
   2) Remove case (6), pull out spool assembly (7) until portion **a** comes out, then hold portion **a** with wrench (width across flats: 14 mm), and loosen bolt (8).
      ★ Be careful not to damage or bend the spool. If there is danger of such damage to the spool, remove spool assembly (7) before starting the operation.
   3) Pull out spool assembly (7) from body.
   4) Remove bolt (8), then remove washer (9), spacer (10), retainer (11), spring (12), and retainer (13) from spool (14).
   5) Remove plug (15), spring (16), and valve (17) from spool (14).
3. Disassembly of blade tilt, steering valve spool
   1) Remove cases (18) and (19).
   2) Pull out spool assembly (20) until portion **b** comes out, then hold portion **b** with wrench (width across flats: 14 mm), and loosen bolt (21).
   ★ Be careful not to damage or bend the spool. If there is danger of such damage to the spool, remove spool assembly (20) before starting the operation.
   3) Pull out spool assembly (20) from body.
   4) Remove bolt (21), then remove washer (22), spacer (23), retainer (24), spring (25), and retainer (26) from spool (27).
4. Disassembly of pressure compensation spool, steering priority spool
   1) Remove plug (28), then remove ring (29), spring (30), and spool (31).
   2) Remove plug (32), then remove ring (33), spring (34), and valve (35).
   3) Remove plug (36) and ring (37).
5. Disassembly of unload spring
   1) Remove plug (38), then remove spring (39) and retainer (40).
   2) Remove plug (41), then remove ring (42), piston (43), and spool (44).
6. Remove check valves (45), (46), and plug (47).
7. Remove relief valve (48), suction valves (49) and (50), suction and safety valve (51), plug (52), and main relief valve (53) from body.
   ★ Do not disassemble the suction and safety valve.
8. Remove plug (54), then remove ring (55).
9. Remove valve (56), and plugs (57) and (58).



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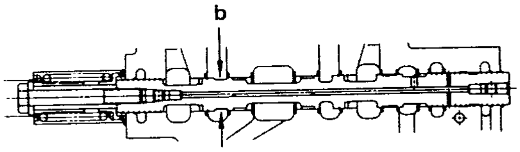

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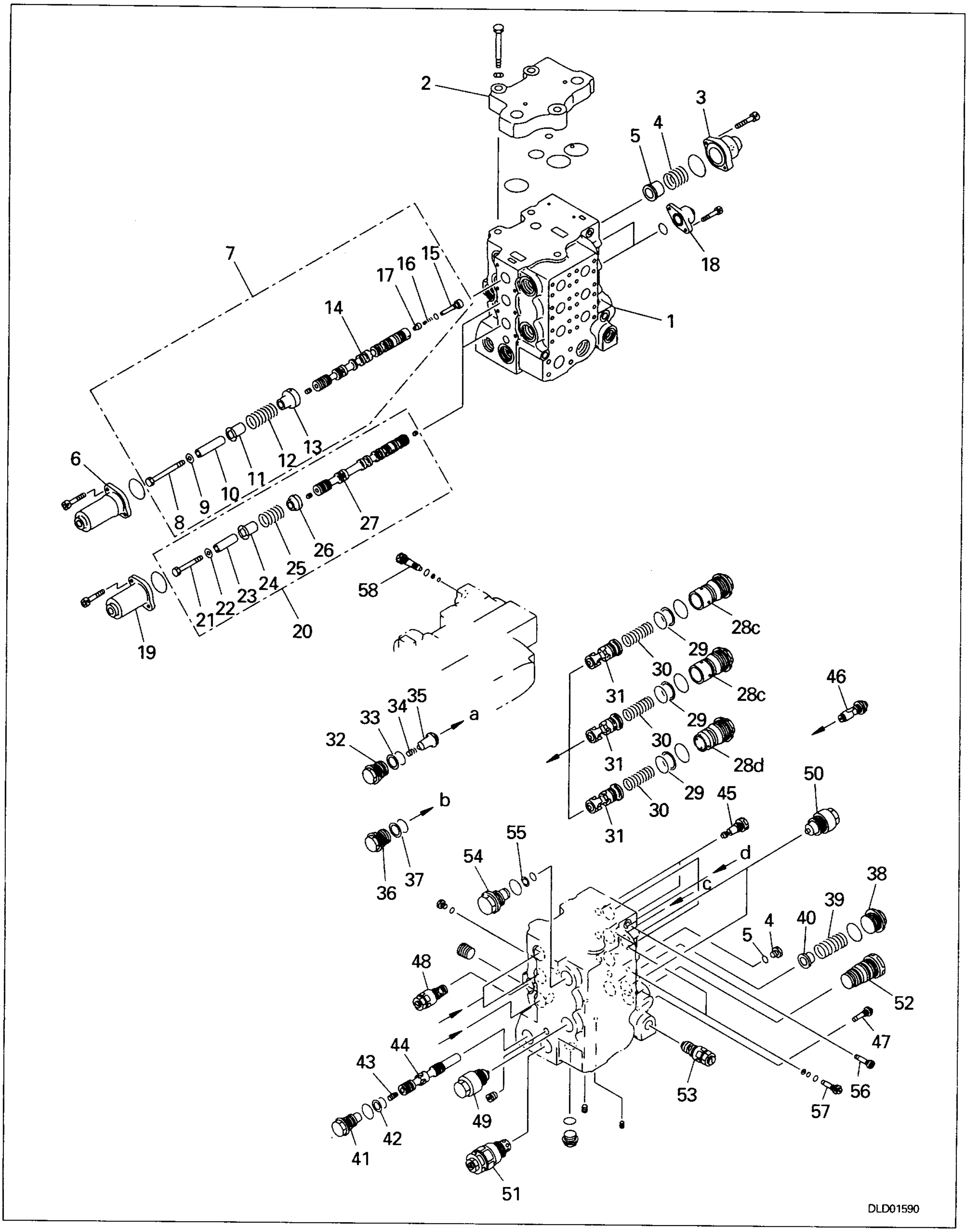
ASSEMBLY OF MAIN CONTROL VALVE ASSEMBLY

(3-SPOOL VALVE)	D65E-12	60948 and up	D65EX-12	60942 and up
	D65P-12	60891 and up	D65PX-12	60915 and up

★ The diagram shows 3-spool valve for D65EX, PX-12.



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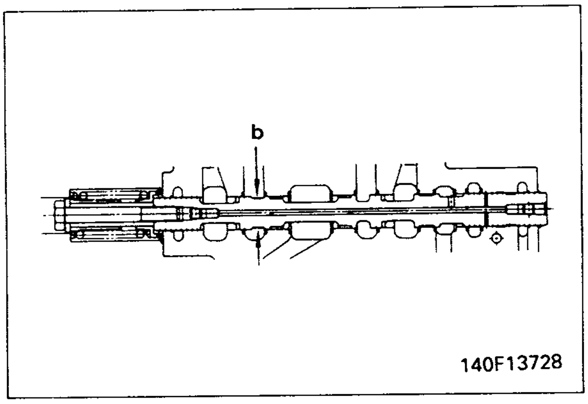
★ This section gives the procedure for assembly using the 3-spool valve as an example.

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. Assemble O-ring and ring to plugs (58) and (57), and install to body.
   kgm Plug (58): **34.3 ± 4.9 Nm (3.5 ± 0.5 kgm)**
   kgm Plug (57): **23.6 ± 4.0 Nm (2.4 ± 0.4 kgm)**
2. Install valve (56) to body.
   kgm Valve: **23.6 ± 4.0 Nm (2.4 ± 0.4 kgm)**
3. Fit ring (55) and O-ring to plug (54) and install to body.
   kgm Plug: **186.4 ± 9.8 Nm (19 ± 1 kgm)**
4. Install main relief valve (53), plug (52), safety and suction valve (51), suction valves (50) and (49), and relief valve (48) to body.
   kgm Main relief valve (53):
   68.7 ± 9.9 Nm (7 ± 1 kgm)
   kgm Plug (52): **127.5 ± 19.6 Nm (13 ± 2 kgm)**
   kgm Safety and suction valve (51):
   186.4 ± 9.8 Nm (19 ± 1 kgm)
   kgm Suction valves (50), (49):
   186.4 ± 9.8 Nm (19 ± 1 kgm)
   kgm Relief valve (48):
   68.7 ± 9.9 Nm (7 ± 1 kgm)
5. Install plug (47) and check valves (46) and (45).
   kgm Plug (47): **23.6 ± 4.0 Nm (2.4 ± 0.4 kgm)**
   kgm Check valves (46), (45):
   68.7 ± 9.9 Nm (7 ± 1 kgm)
6. Assembly of unload spool
   1) Assemble O-ring and ring (42) to plug (41) and install to body.
   kgm Plug (41): **107.9 ± 14.7 Nm (11 ± 1.5 kgm)**
   2) Assemble piston (43), retainer (40), and spring (39) to spool (44) and assemble to body, then install plug (38).
   kgm Plug (38): **419.3 ± 46.6 Nm (42.8 ± 4.8 kgm)**
7. Assembly of pressure compensation spool, steering priority spool
   1) Assemble O-ring and ring 37) to plug (36) and install to body.
   kgm Plug (36): **152.1 ± 24.6 Nm (15.5 ± 2.5 kgm)**
   2) Install O-ring and ring (29) to plug (28d), assemble spring (30) and spool (31), then install to body.
   kgm Plug (28d):
   321.2 ± 46.6 Nm (32.8 ± 4.8 kgm)
   3) Fit O-ring and ring (33) to plug (32) and assemble spring (34) and valve (35), the install to body.
   kgm Plug (32): **152.1 ± 24.6 Nm (15.5 ± 2.5 kgm)**
   4) Install O-ring and ring (29) to plug (28c), assemble spring (30) and spool (31), then install to body.
   kgm Plug (28c):
   321.2 ± 46.6 Nm (32.8 ± 4.8 kgm)



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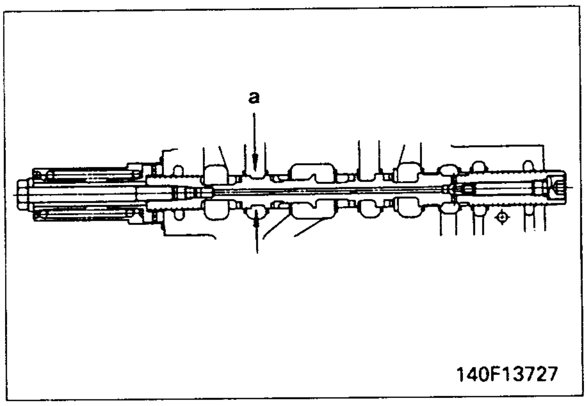

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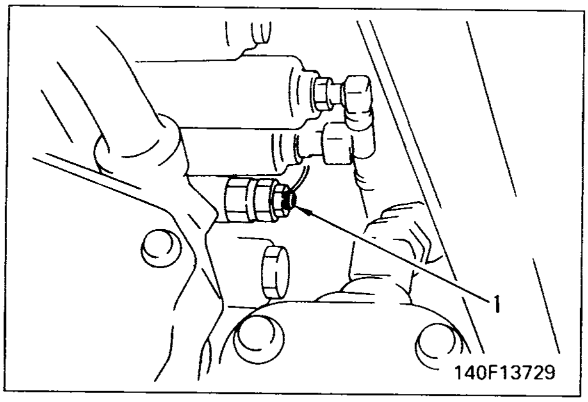
8. Assembly of blade tilt, steering valve spool
   1) Assemble washer (22), spacer (23), retainer (24), spring (25), and retainer (26) to bolt (21), and install to spool (27).
   2) Push spool assembly (20) into body to a point where a wrench can hold portion **b** of spool, hold spool with wrench and tighten bolt (21), then assemble in body.
   kgm Bolt (21):
   66.2 ± 7.4 Nm (6.8 ± 0.8 kgm)
   3) Install cases (19) and (18).
9. Assembly of blade lift valve spool
   1) Install valve (17), spring (16), and plug (15) to spool (14).
   kgm Plug (15):
   23.6 ± 4.0 Nm (2.4 ± 0.4 kgm)
   2) Assemble washer (9), spacer (10), retainer (11), spring (12), and retainer (13) to bolt (8), and install to spool (14).
   3) Push spool assembly (7) into body to a point where a wrench can hold portion **a** of spool, hold spool with wrench and tighten bolt (8), then assemble in body.
   kgm Bolt (8):
   66.2 ± 7.4 Nm (6.8 ± 0.8 kgm)
   4) Install case (6).
   5) Assemble spring (4) and retainer (5) to case (3), and install to body.
10. Install cover (2) to body (1).

REMOVAL OF MAIN RELIEF VALVE

⚠ Lower the work equipment to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Remove right bodywork cover.
2. Remove relief valve (1) ※ 1



INSTALLATION OF MAIN RELIEF VALVE

- Carry out installation in the reverse order to removal.

※ 1

kgm Relief valve: **186.3 ± 9.8 Nm (19 ± 1 kgm)**

REMOVAL OF PPC VALVE ASSEMBLY

FOR WORK EQUIPMENT

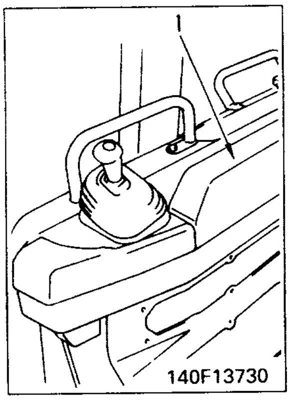
D65E-12	**60001 - 60947**
D65P-12	**60001 - 60890**
D65EX-12	**60001 - 60941**
D65PX-12	**60001 - 60914**

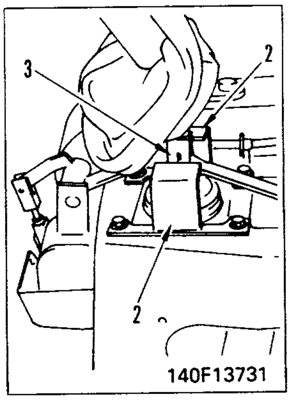
⚠ Lower the work equipment to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

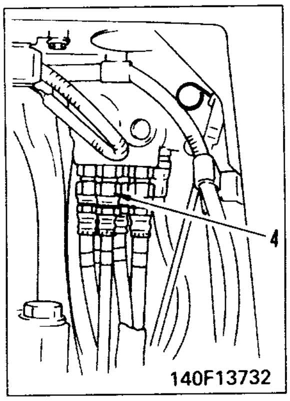
1. Remove operator's seat assembly, then remove 2 inside covers, and open chassis outside cover.

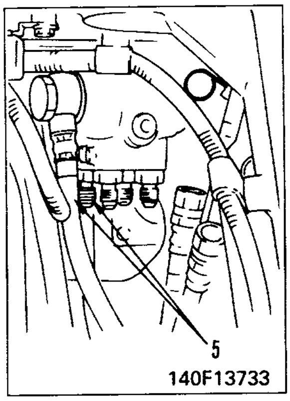
   kg Operator's seat assembly: **35 kg**

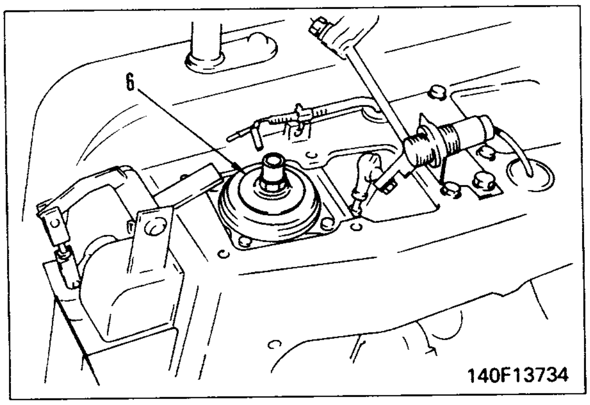
2. Remove cover (1).
3. Remove 2 brackets (2), then loosen lock bolt of lever (3), and pull out lever (3).
4. Disconnect 4 PPC hoses (4). ※1
5. Disconnect 2 hoses (5). ※2
   ★ When disconnecting hose (5), remove the mounting bolts of the PPC valve assembly, then rotate the PPC valve assembly to the point where it is easiest to disconnect the hoses.
6. Remove PPC valve assembly (6).











INSTALLATION OF PPC VALVE ASSEMBLY

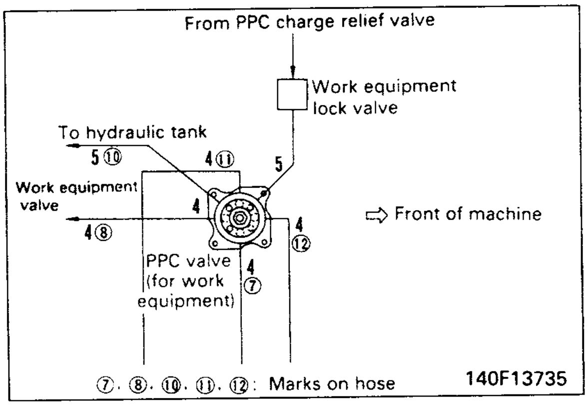
FOR WORK EQUIPMENT

D65E-12	**60001 - 60947**
D65P-12	**60001 - 60890**
D65EX-12	**60001 - 60941**
D65PX-12	**60001 - 60914**

- Carry out installation in the reverse order to removal.

※1, ※2
★ When connecting the PPC hoses, see the diagram and be careful not to mistake the connections.

- **Refilling with oil (hydraulic tank)**
  ★ Add oil through oil filler to the specified level. Run the engine to circulate the oil through the system.
  Then check the oil level again.



REMOVAL OF PPC VALVE ASSEMBLY

FOR WORK EQUIPMENT

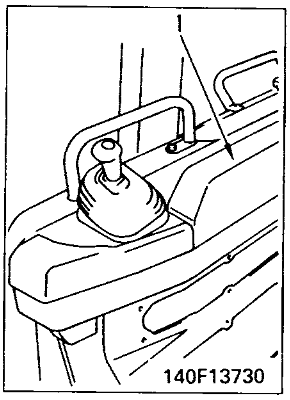
D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

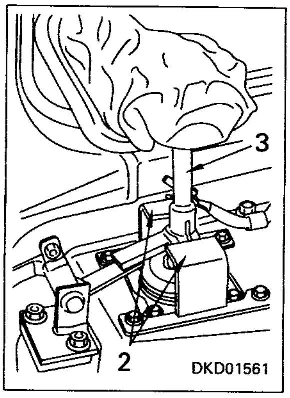
⚠ Lower the work equipment to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

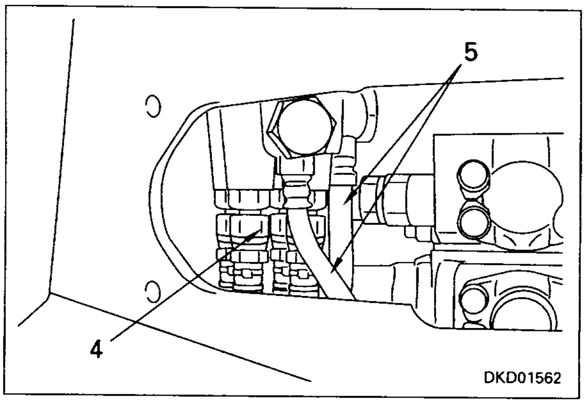
1. Remove operator's seat assembly, then remove 2 inside covers, and open chassis outside cover.

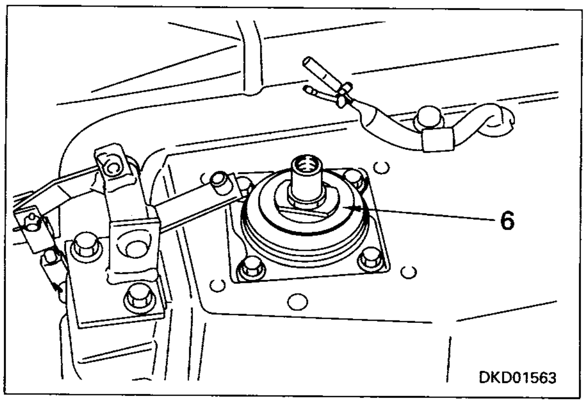
   kg Operator's seat assembly: **35 kg**

2. Remove top cover of work equipment control valve.
3. Disconnect connector, then remove cover (1).
4. Remove 2 brackets (2), then loosen lock bolt of lever (3), and pull out lever (3).
5. Disconnect 4 PPC hoses (4). ※1
6. Disconnect 2 hoses (5). ※2
   ★ When disconnecting hose (5), remove the mounting bolts of the PPC valve assembly, then rotate the PPC valve assembly to the point where it is easiest to disconnect the hoses.
7. Remove PPC valve assembly (6).









INSTALLATION OF PPC VALVE ASSEMBLY

FOR WORK EQUIPMENT

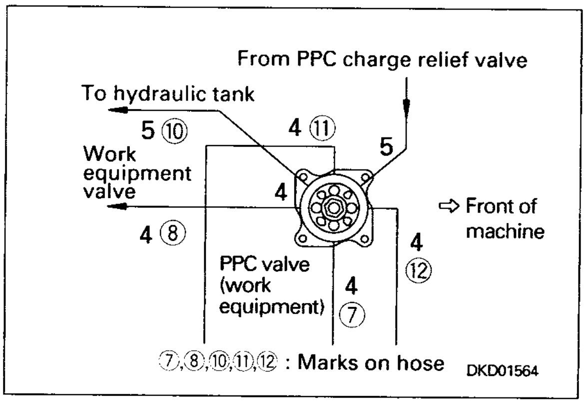
D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

- Carry out installation in the reverse order to removal.

※1, ※2

★ When connecting the PPC hoses, see the diagram and be careful not to mistake the connections.

- **Refilling with oil (hydraulic tank)**
  ★ Add oil through oil filler to the specified level. Run the engine to circulate the oil through the system.
  Then check the oil level again.



REMOVAL OF PPC VALVE ASSEMBLY

D65EX-12 60001 – 60941
D65PX-12 60001 – 60914

FOR STEERING

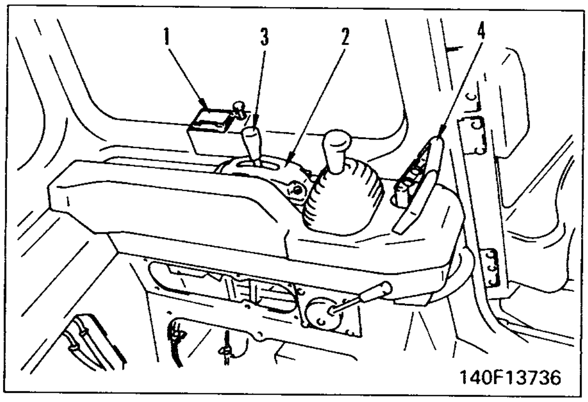
1. Remove chassis outside cover.

   kg Cover: **45 kg**

2. Remove operator's seat, then remove inside cover.

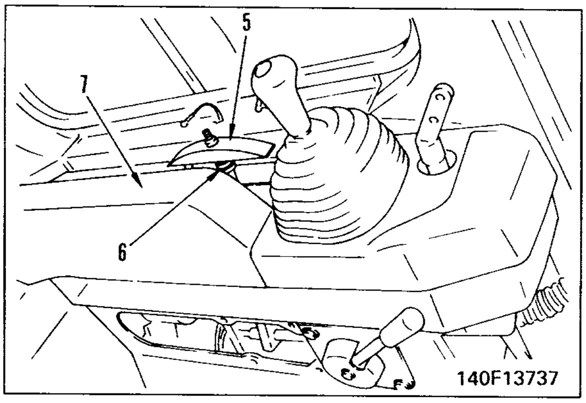
   kg Operator's seat assembly: **35 kg**

3. Remove ashtray box (1), cover (2) for speed lever, knob (3), and handrail (4).



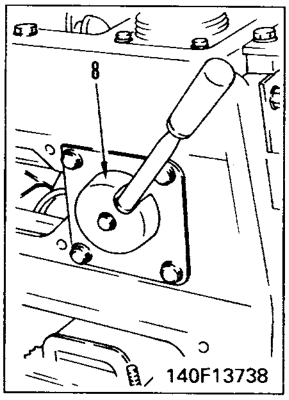
4. Remove cover (5) and spring (6).

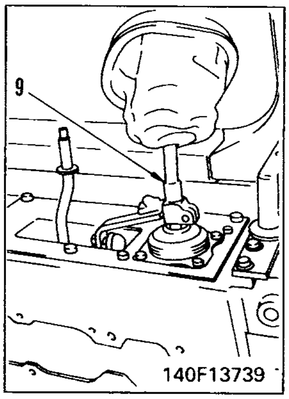
5. Remove cover (7).
   ★ Remove the steering boot from cover (7) and roll it up.



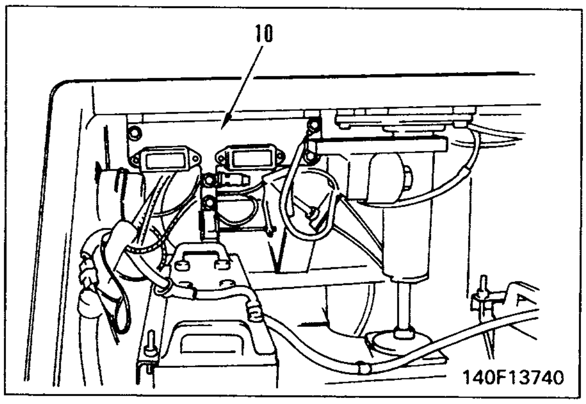
6. Remove fuel control lever assembly (8). ※1

7. Remove steering control lever (9).



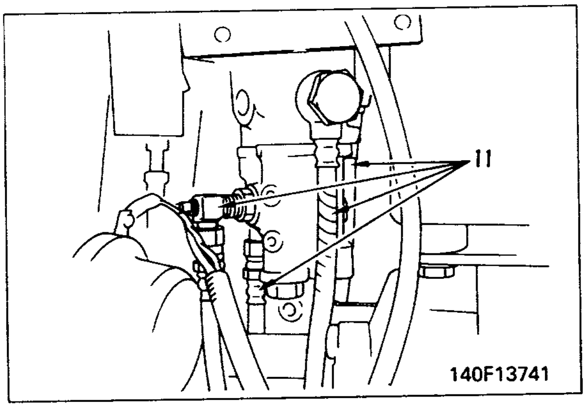


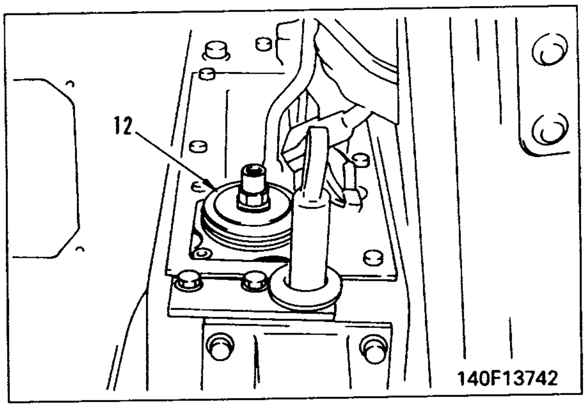
8. Remove fire prevention cover, then remove fuse box together with bracket (10).



9. Disconnect 4 PPC valve assembly mounting houses (11). ※ 2
   ★ Mark the hoses with tabs to prevent any mistake when assembling the hoses.

10. Remove PPC valve assembly (12).





INSTALLATION OF PPC VALVE ASSEMBLY

D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

FOR STEERING

- Carry out installation in the reverse order to removal.

※ 1

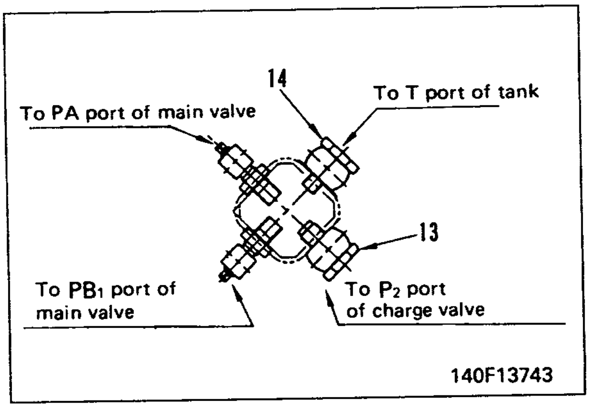
★ Adjust the cable.
For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

※ 2

★ Connect the PPC hoses as shown in the diagram

Hose mount joint bolt (13):
39.2 ± 4.9 Nm (4.0 ± 0.5 kgm)

Hose mount joint bolt (14):
29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)



REMOVAL OF PPC VALVE ASSEMBLY

D65EX-12 60942 and up
D65PX-12 60915 and up

FOR STEERING

1. Remove cover on outside of chassis.

   kg Cover: **45 kg**

2. Remove operator's seat, then remove inside cover.

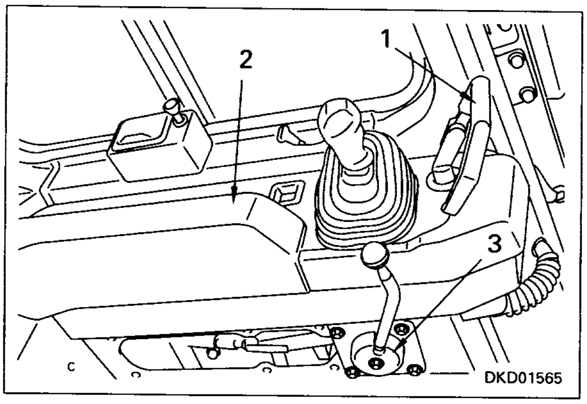
   kg Operator's seat assembly: **35 kg**

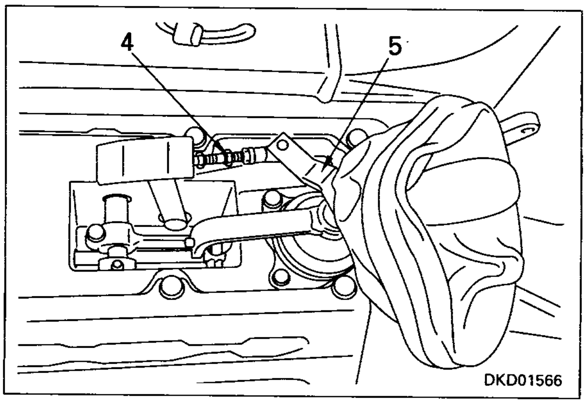
3. Remove hand rail (1).

4. Remove cover (2).
   ★ Remove steering boot from cover (2), then move up.

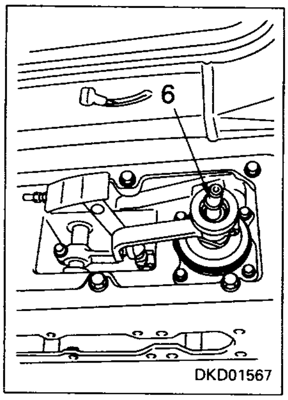
5. Remove fuel control lever assembly (3). ※1

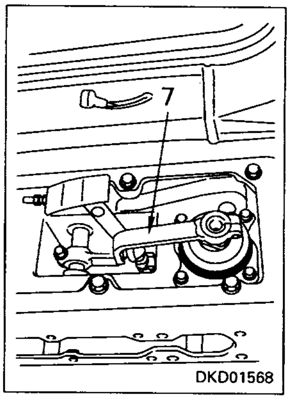
6. Disconnect rod (4), then remove joystick (5).





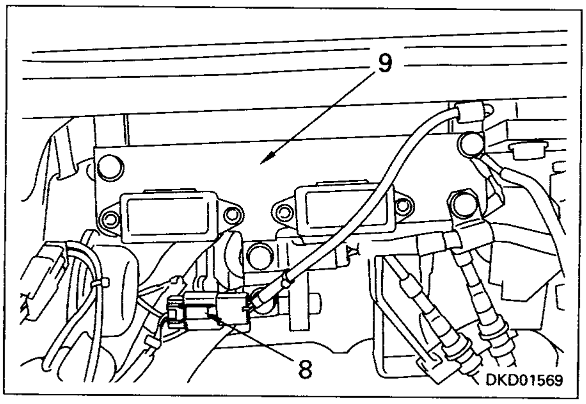
7. Loosen locknut, then turn shaft (6) and remove.
   ★ Move the PPC lever to the inside, then turn the shaft to remove.
   ★ Before removing the shaft, note the mounting position of the shaft and PPC valve.





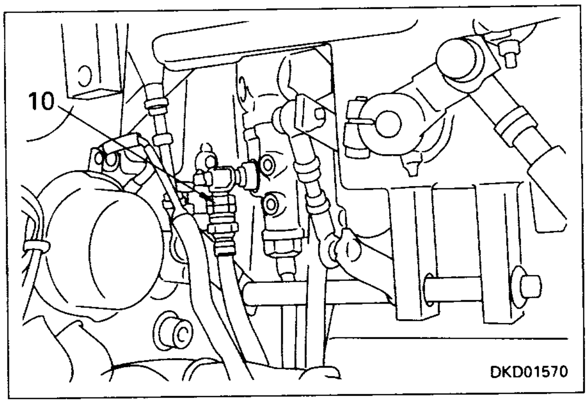
8. Loosen lock bolt, disconnect lever (7), then remove key.

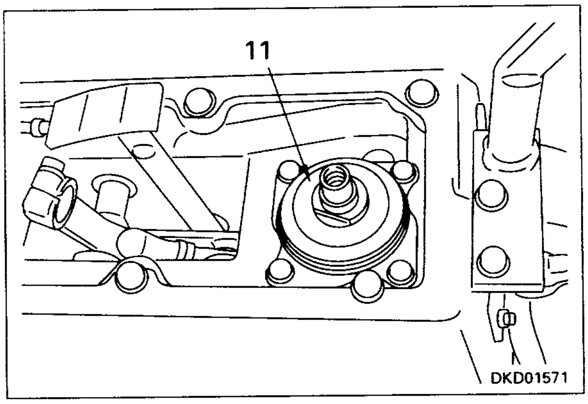
9. Disconnect wiring connector (CN23) (8), then remove fuse box together with bracket (9).



9. Disconnect 4 PPC valve assembly mounting houses (10). ※2
   - ★ Mark the hoses with tabs to prevent any mistake when assembling the hoses.

10. Remove PPC valve assembly (11).





INSTALLATION OF PPC VALVE ASSEMBLY

D65EX-12 60942 and up
D65PX-12 60915 and up

FOR STEERING

- Carry out installation in the reverse order to removal.

014012

※1

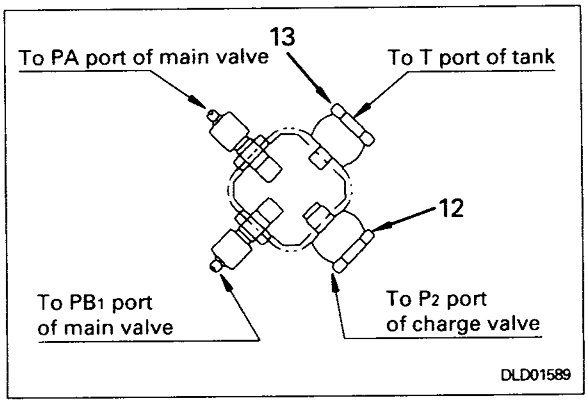
★ Adjust the cable.
For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

※2

★ Connect the PPC hoses as shown in the diagram

kgm Hose mount joint bolt (12):
39.2 ± 4.9 Nm (4.0 ± 0.5 kgm)

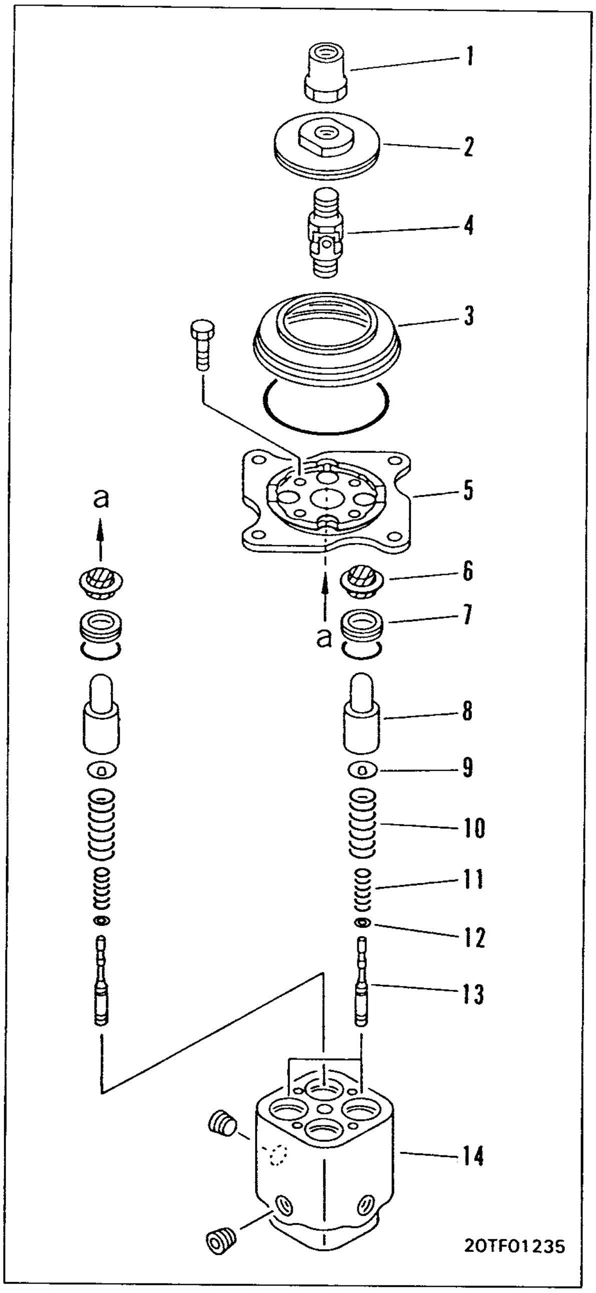
kgm Hose mount joint bolt (13):
29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)



DISASSEMBLY OF PPC VALVE ASSEMBLY

FOR WORK EQUIPMENT

1. Remove nut (1), then remove disc (2) and boot (3).
2. Remove joint (4), then remove plate (5).
3. Remove seal (6) and collar (7).
4. Pull out piston (8), and remove retainer (9), springs (10) and (11), and shim (12).
   ★ Spring (10) consists of two sets of two types of spring with different installed loads, so check the installation position (hydraulic port) and fit tags to prevent mistakes when installing.
5. Pull out valve (13) from body (14).



ASSEMBLY OF PPC VALVE ASSEMBLY

FOR WORK EQUIPMENT

1. Assemble valve (13) to body (14).
2. Assemble shim (12) and spring (11) to valve (13).
3. Assemble spring (10), retainer (9), and piston (8).
   ★ Spring (10) consists of spring with a different number of coils for each hydraulic port. The number of coils and position of use are as follows.

Port	Number of coils on spring
P1, P2	11
P3, P4	9

   ★ The position of each port is stamped on the bottom of the valve body.

   Piston: **Grease (LG-2)**

   ★ When assembling piston (8), coat the outer circumference of the piston and the inner circumference of the body hole with grease.

4. Fit O-ring to collar (7), then assemble in body (14), and install seal (6).
5. Install plate (5).

   Mounting bolt:
   13.3 ± 1.5 Nm (2.7 ± 0.5 kgm)

6. Install joint (4).

   Sliding portion of joint:
   Grease (LG-2)

   Joint: **Thread tightener (LT-2)**

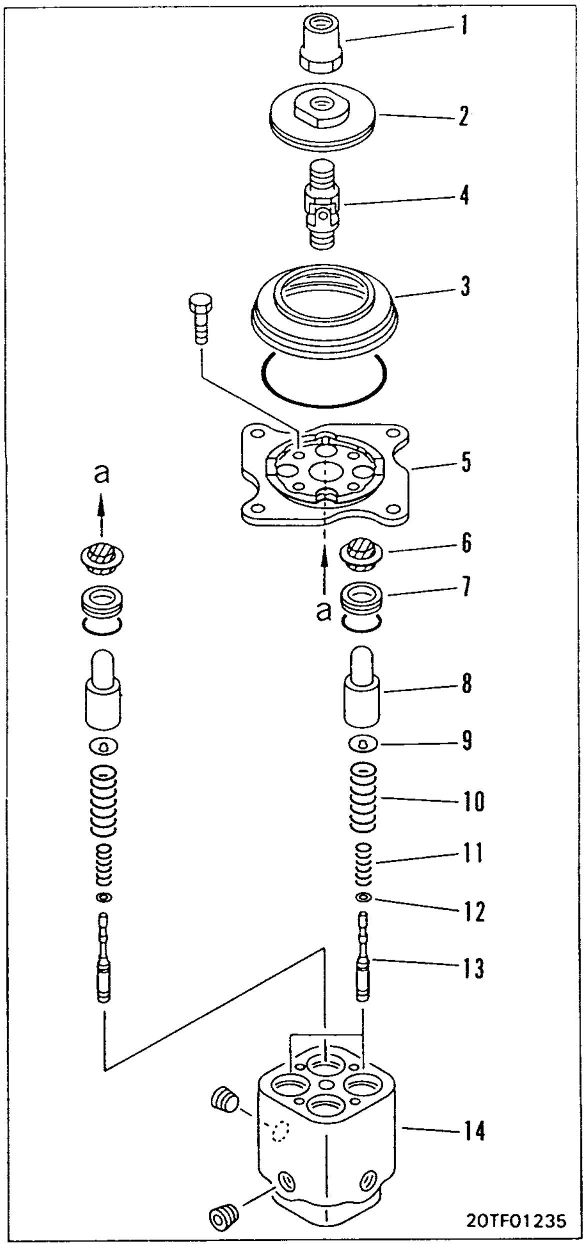
   Joint:
   44.1 ± 4.9 Nm (4.5 ± 0.5 kgm)

   ★ Keep strictly to the standard value for the tightening torque of the joint.

7. Assemble disc (2) with boot (3), and tighten with nut (1).

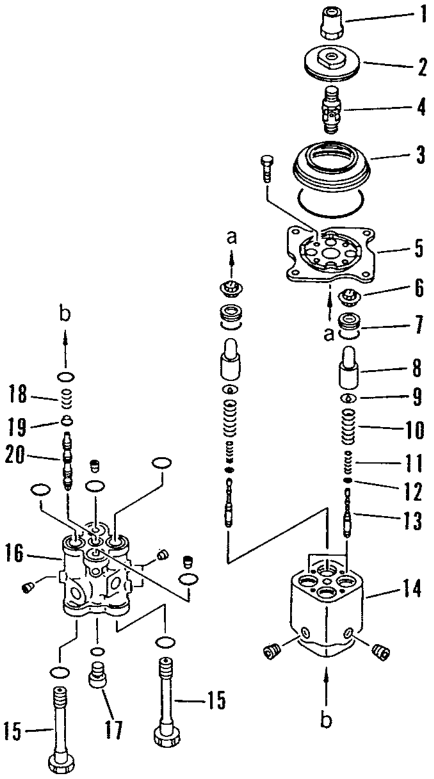
   Nut:
   112.8 ± 14.7 Nm (11.5 ± 1.5 kgm)

   ★ After assembling the disc, adjust the assembled height of the disc. For details, see TESTING AND ADJUSTING, Adjusting PPC valve.



DISASSEMBLY OF PPC VALVE ASSEMBLY

D65EX, PX FOR STEERING



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014012

1. Remove nut (1), then remove disc (2) and boot (3).

2. Remove joint (4), then remove plate (5).

3. Remove seal (6) and collar (7).

4. Pull out piston (8), and remove retainer (9), springs (10) and (11), and shim (12).
   ★ Spring (10) consists of two sets of two types of spring with different installed loads, so check the installation position (hydraulic port) and fit tags to prevent mistakes when installing.

5. Pull out valve (13) from body (14).

6. Remove bolt (15), then remove block (16).

7. Remove plug (17).

8. Remove spring (18), spacer (19), and spool (20).

ASSEMBLY OF PPC VALVE ASSEMBLY

D65EX, PX FOR STEERING

1. Assemble spool (20), spacer (19), and spring (18) to block (16), and fit O-ring.
2. Fit O-ring to block (16) and install to body (14) with bolt (15).

   Block mating surface: **Gasket (LG-6)**

   Bolt: **66.2 ± 7.4 Nm**
   (6.8 ± 0.8 kgm)
3. Fit O-ring to plug (17) and install to block.

   Plug: **17.2 ± 2.5 Nm**
   (1.8 ± 0.3 kgm)
4. Assemble valve (13) to body (14).
5. Assemble shim (12) and spring (11) to valve (13).
6. Assemble spring (10), retainer (9), and piston (8).

   ★ Spring (10) consists of spring with a different number of coils for each hydraulic port. The number of coils and position of use are as follows.

Port	Number of coils on spring
P1, P2	11
P3, P4	9

   ★ The position of each port is stamped on the bottom of the valve body.

   Piston: **Grease (LG-2)**

   ★ When assembling piston (8), coat the outer circumference of the piston and the inner circumference of the body hole with grease.
7. Fit O-ring to collar (7), then assemble in body (14), and install seal (6).
8. Install plate (5).

   Mounting bolt: **13.3 ± 1.5 Nm**
   (2.7 ± 0.5 kgm)
9. Install joint (4).

   Sliding portion of joint: **Grease (LG-2)**

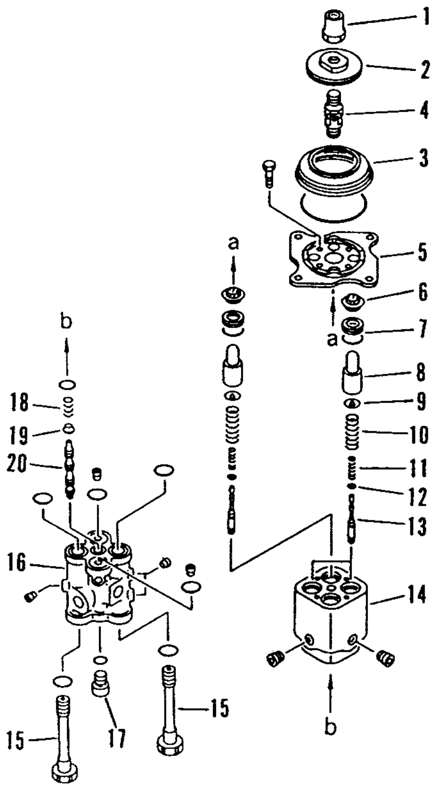
   Joint: **Thread tightener (LT-2)**

   Joint: **44.1 ± 4.9 Nm**
   (4.5 ± 0.5 kgm)

   ★ Keep strictly to the standard value for the tightening torque of the joint.
10. Assemble disc (2), with boot (3), and tighten with nut (1).

    Nut: **112.8 ± 14.7 Nm**
    (11.5 ± 1.5 kgm)

    ★ After assembling the disc, adjust the assembled height of the disc. For details, see TESTING AND ADJUSTING, Adjusting PPC valve.



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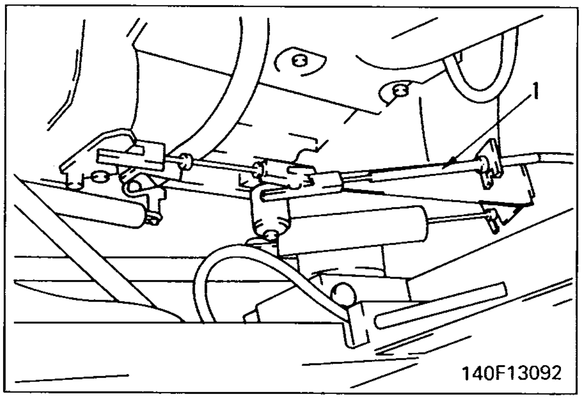
REMOVAL OF PPC CHARGE RELIEF VALVE ASSEMBLY

⚠ Lower the work equipment to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Disconnect deceleration cable (1) at engine end. ※1



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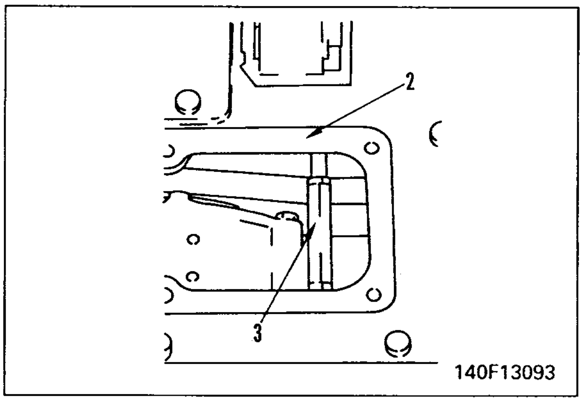
2. Remove cover of plate (2), and disconnect brake rod (3) at turnbuckle. ※2
   ★ Measure the installed dimension of the rod before disconnecting the turnbuckle.



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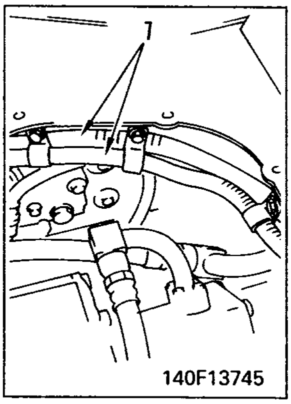
3. Remove plate (2).
4. Remove 3 clamps of wiring harness (7).
5. Disconnect 2 hoses (4).
6. Disconnect 3 hoses (5).
7. Remove PPC charge relief valve assembly (6).



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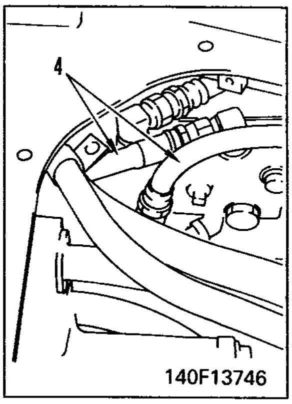

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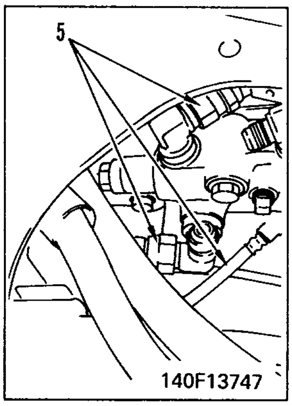

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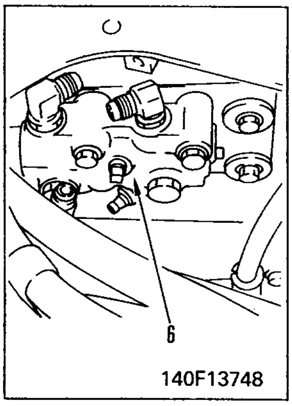


140F13748

INSTALLATION OF PPC CHARGE RELIEF VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

★ Adjust the cable.
For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

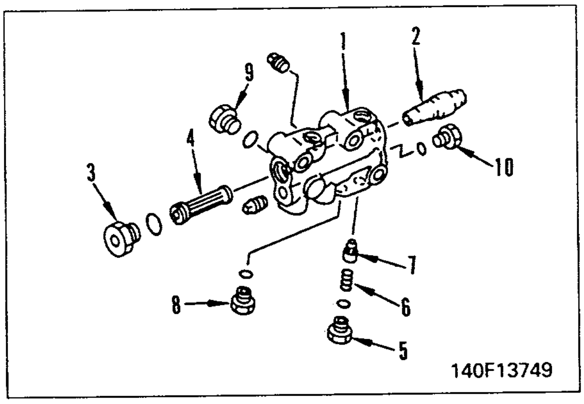
※2

★ Adjust the rod.
For details, see TESTING AND ADJUSTING, Adjusting brake pedal linkage.

- **Refilling with oil (hydraulic tank)**
  ★ Add oil through oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

DISASSEMBLY OF PPC CHARGE RELIEF VALVE ASSEMBLY

1. Remove relief valve (2) from vale body (1).
2. Remove plug (3), then remove strainer (4).
3. Remove plug (5), then remove spring (6) and poppet (7).
4. Remove plugs (8), (9), and (10).



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ASSEMBLY OF PPC CHARGE RELIEF VALVE ASSEMBLY

014012

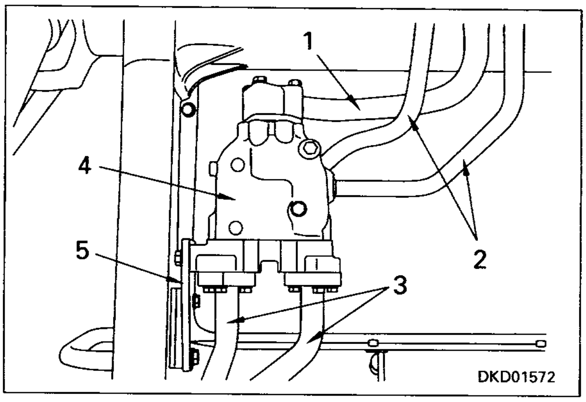
★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. Fit O-rings to plugs (10), (9), and (8) and install to body (1).
2. Assemble poppet (7) and spring (6) to body (1), then install plug (5).
3. Assemble strainer (4) to body (1), then install plug (3).
4. Install relief valve (2) to valve body (1).
   kgm Relief valve: **54 ± 5 Nm (5.5 ± 0.5 kgm)**

REMOVAL OF SUCTION VALVE ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

⚠ Lower the work equipment completely to the ground, then release the remaining pressure inside the circuit.
For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.



1. Open front mask.
2. Disconnect tubes (1), (2), and (3).
3. Remove suction valve assembly (4) together with bracket (5).

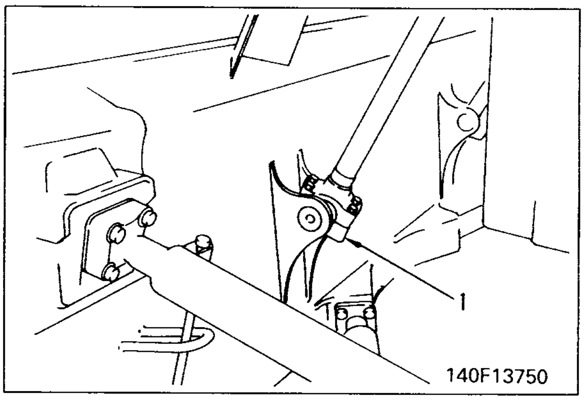
INSTALLATION OF SUCTION VALVE ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

014012

- Carry out installation in the reverse order to removal.
- **Refilling with oil (hydraulic tank)**
  ★ Add oil through oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

REMOVAL OF BLADE LIFT CYLINDER ASSEMBLY



⚠ Lower the work equipment completely to the ground and stop the engine.

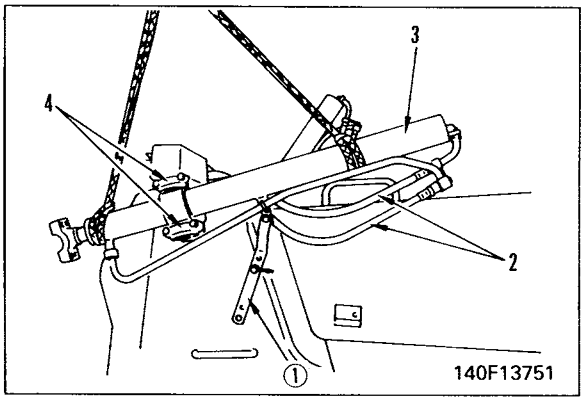
1. Sling head of lift cylinder assembly, and remove cap (1). ※1
   ★ Check the number and thickness of the shims, and keep in a safe place.

   ⚠ Start the engine and retract the piston rod fully. Tie the rod with wire to prevent it from coming out.

2. Install lift cylinder to lock bracket ①, and disconnect hose (2).

   ⚠ Release the remaining pressure from hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing pressure from hydraulic circuit.
   ★ Fit blind plugs to prevent dirt or dust from getting into the piping.

3. Sling cylinder assembly (3), and remove cap (4), then remove cylinder assembly. ※2



kg Blade lift cylinder assembly: **100 kg**

INSTALLATION OF BLADE LIFT CYLINDER ASSEMBLY

- Carry out installation in the reverse order to removal.

※1
★ Standard shim thickness: **5 mm**

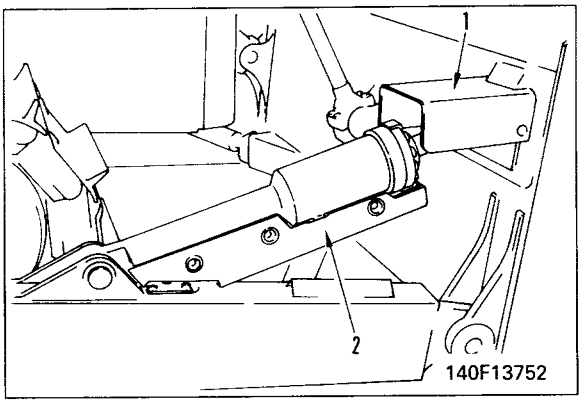
※2
Yoke: **Grease (G2-LI)**

- **Bleeding air**
  Bleed the air from the cylinder.
  For details, see TESTING AND ADJUSTING.

- **Refilling with oil (hydraulic tank)**
  ★ Add oil through oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

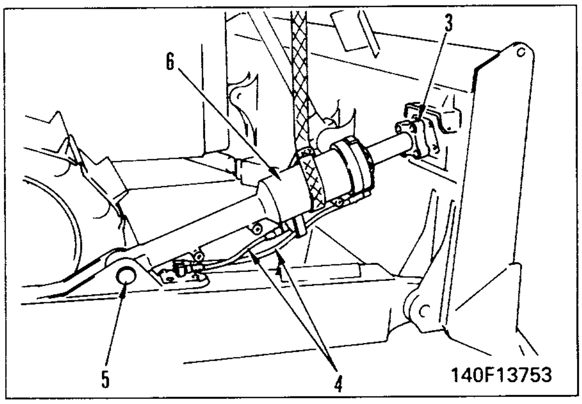
REMOVAL OF BLADE TILT CYLINDER ASSEMBLY

⚠ Lower the work equipment completely to the ground and stop the engine.



1. Remove cylinder protection cover (1) and hose protection cover (2).
2. Sling tilt cylinder assembly, remove bolts, then disconnect cap (3), and remove shim. ※1
   - ★ Check the number and thickness of the shims, and keep in a safe place.

⚠ Start the engine and retract the piston rod fully. Tie the rod with wire to prevent it from coming out.



3. Disconnect 2 hoses (4).

⚠ Release the remaining pressure from hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing pressure from hydraulic circuit.
   - ★ Fit blind plugs to prevent dirt or dust from getting into the piping.

4. Remove lock bolt, then pull out pin (5), and lift off cylinder assembly (6). ※2
   - ★ When lifting, be careful not to damage the hoses at the bottom end.

kg Blade tilt cylinder assembly: **75 kg**

INSTALLATION OF BLADE TILT CYLINDER ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

★ Standard shim thickness: **5 mm**

※2

Yoke: **Grease (G2-LI)**

- **Bleeding air**
  Bleed the air from the cylinder.
  For details, see TESTING AND ADJUSTING.

- **Refilling with oil (hydraulic tank)**
  ★ Add oil through oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

DISASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY
(BLADE LIFT, BLADE TILT CYLINDER)

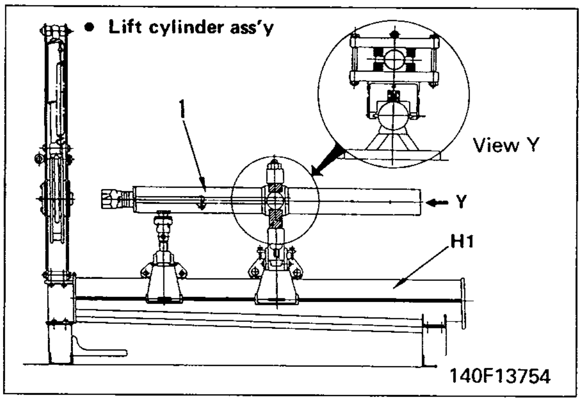
1. Remove tube from cylinder assembly.
2. Set cylinder assembly (1) to tool **H1**.
3. **Piston rod assembly**

- Lift cylinder

1) Using tool **H2**, disconnect cylinder head assembly (2).
2) Pull out piston rod assembly (3).
   ★ Place an oil container under the cylinder to catch the oil.

- Tilt cylinder

1) Remove mounting bolts, and disconnect cylinder head assembly (4).
2) Pull out piston rod assembly (5).
   ★ Place an oil container under the cylinder to catch the oil.



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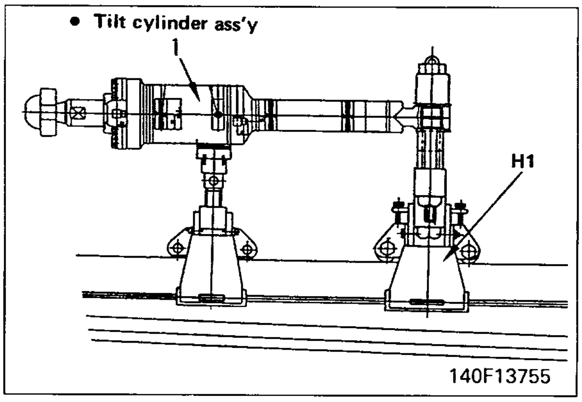

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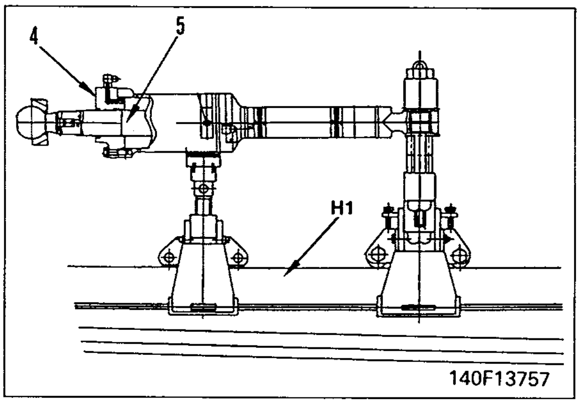

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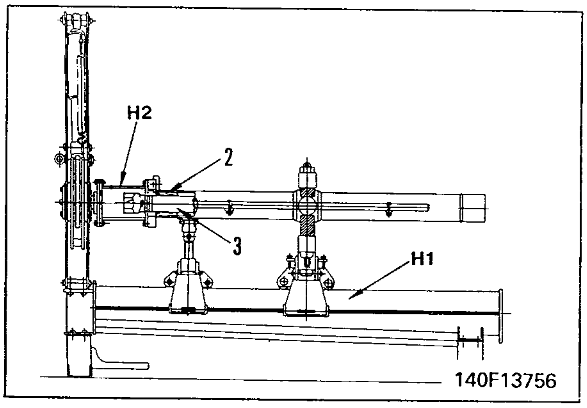

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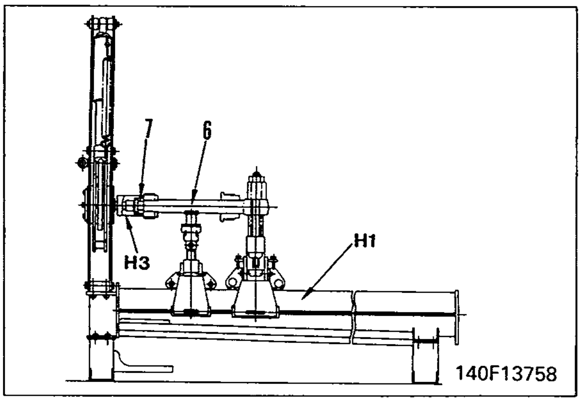
4. **Piston, head assembly**

- Lift, tilt cylinder

1) Set piston rod assembly (6) to tool **H1**.
2) Using tool **H3**, remove nut (7).

Cylinder	Width across flats of nut
Lift cylinder	50 mm
Tilt cylinder	80 mm



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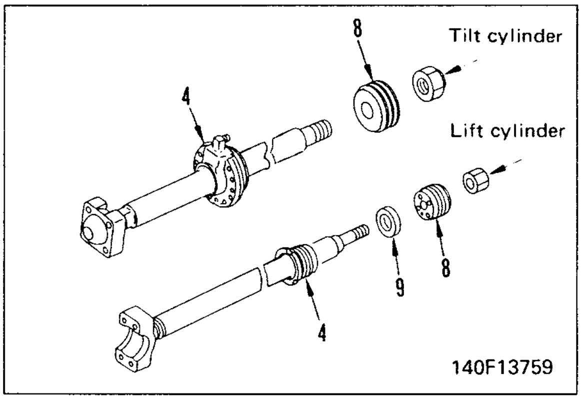
3) Remove piston assembly (8) and slider (9).
   ★ The slider is installed only to the lift cylinder.

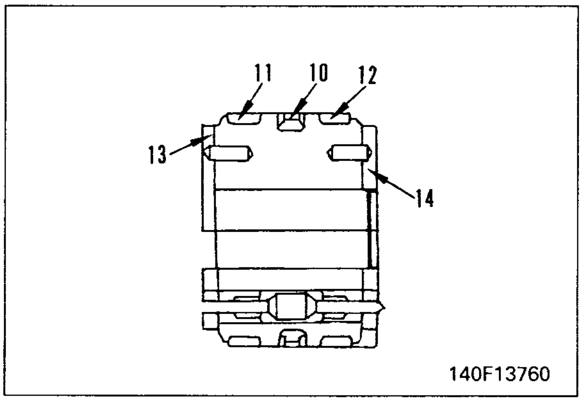
4) Remove cylinder head assembly (4).



5. Disassembly of piston assembly

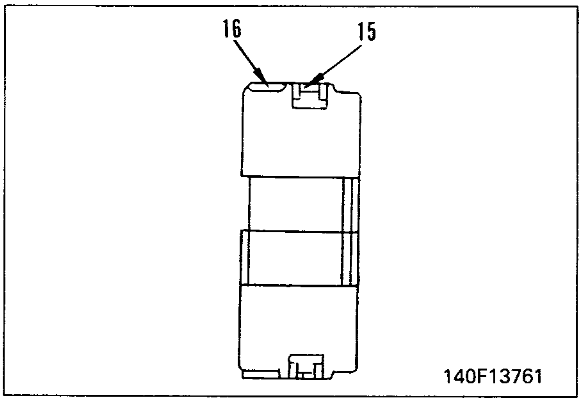
- Lift cylinder

1) Remove piston ring (10) and wear rings (11) and (12).
2) Remove retainers (13) and (14) from piston assembly.
   ★ Do not remove the piston valve and valve seat installed to the piston.



- Tilt cylinder

Remove piston ring (15) and wear ring (16).



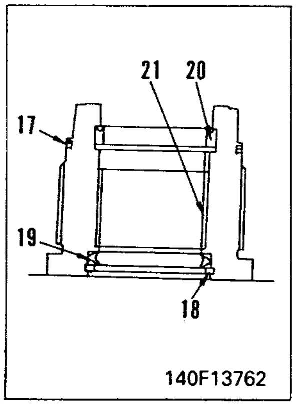
6. Disassembly of head assembly

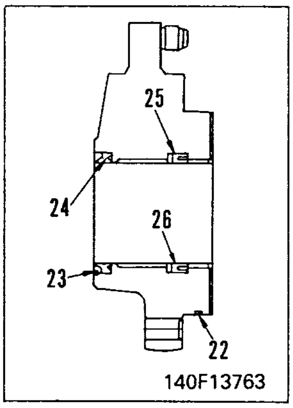
- Lift cylinder

1) Remove O-ring and backup ring (17).
2) Remove snap ring (18), then remove dust seal (19).
3) Remove rod packing (20).
4) Remove bushing (21).

- Tilt cylinder

1) Remove O-ring and backup ring (22).
2) Remove snap ring (23), then remove dust seal (24).
3) Remove rod packing (25).
4) Remove bushing (26).





ASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY
(BLADE LIFT, TILT CYLINDER)

★ Be careful not to damage the packings, dust seals, or O-rings when assembling.

1. **Assembly of head assembly**
   - Tilt cylinder

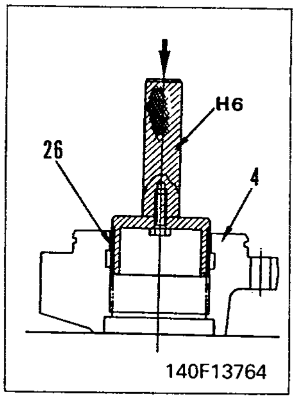
   1) Using tool **H6**, press fit bushing (26) to head (4).
   2) Using tool **H7**, assemble dust seal (24), and install snap ring (23).
   3) Install rod packing (25), then install O-ring and backup ring (22).

   - Lift cylinder

   1) Using tool **H6**, press fit bushing (21) to head (4).
   2) Using tool **H7**, assemble dust seal (19), and install snap ring (18).
   3) Install rod packing (20), then install O-ring and backup ring (17).

2. **Assembly of piston assembly**
   - Tilt cylinder

   1) Using tool **H4**, expand piston ring (15).
      ★ Set the piston ring on tool **H4** and turn the handle 8 — 10 times to expand the ring.
   2) Remove piston ring (15) from tool **H4**, and install to piston.
   3) Using tool **H5**, compress piston ring (15).
   4) Install wear ring (16).



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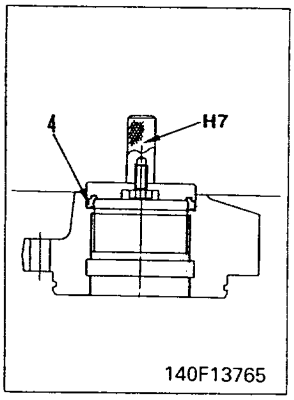

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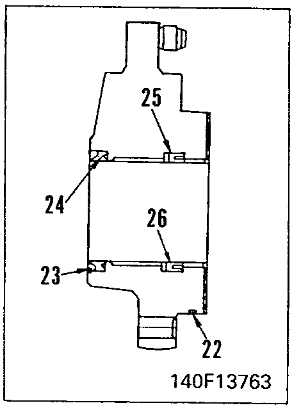

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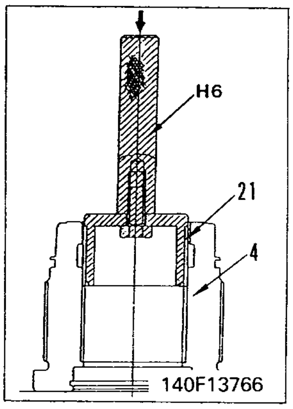

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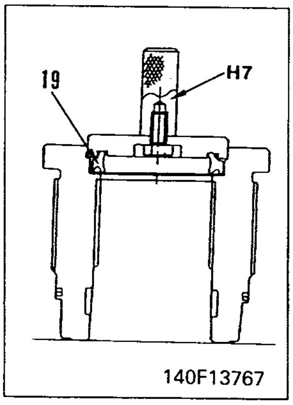

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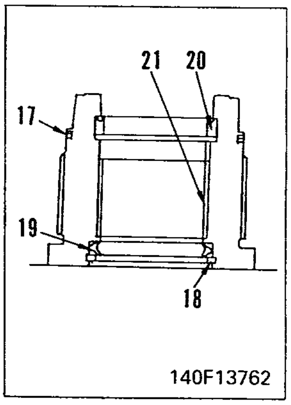

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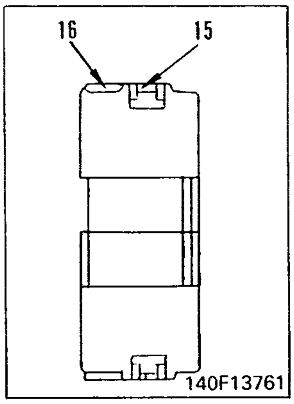

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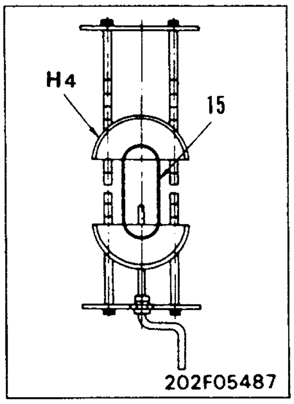

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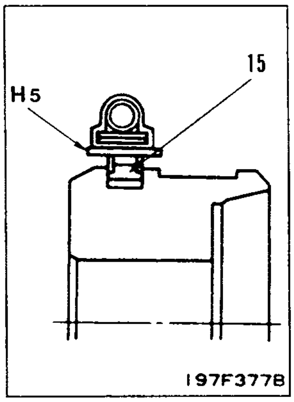

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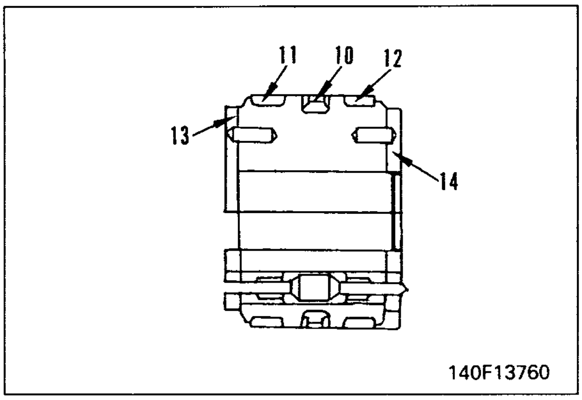
- Lift cylinder

1) Install retainers (14) and (13) to piston.
2) Using tool **H4**, expand piston ring (10).
   ★ Set the piston ring on tool **H4** and turn the handle 8 — 10 times to expand the ring.
3) Remove piston ring (10) from tool **H4**, and install to piston.
4) Using tool **H5**, compress piston ring (10).
5) Install wear rings (12) and (11).

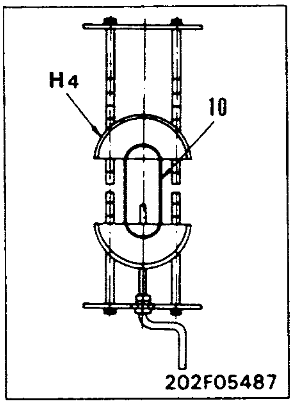


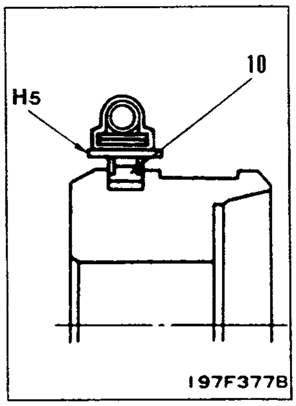
3. Piston, head assembly

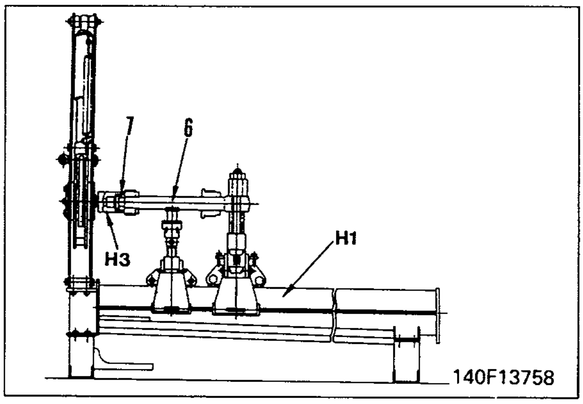
1) Set cylinder rod to tool **H1**.
2) Assemble cylinder head (4) to rod.
3) Fit slider (9) and intall piston assembly (8), then using tool **H3**, tighten nut (7).
   ★ The slider (9) is installed only to the lift cylinder.

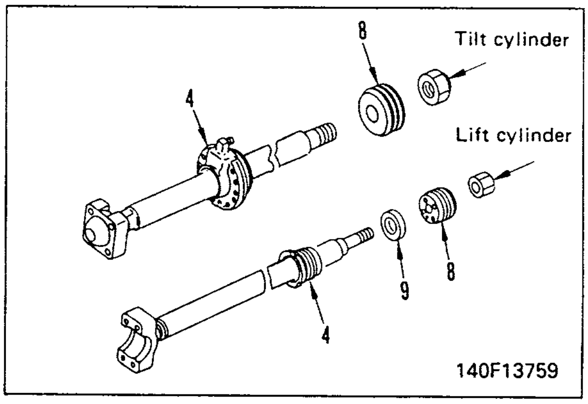
Nut:
Thread tightener (Loctite No. 262)

Cylinder	Width across flats	Tightening torque
Lift cylinder	50	1079 ± 108 Nm (110 ± 11 kgm)
Tilt cylinder	80	3972 ± 397 Nm (405 ± 40.5 kgm)







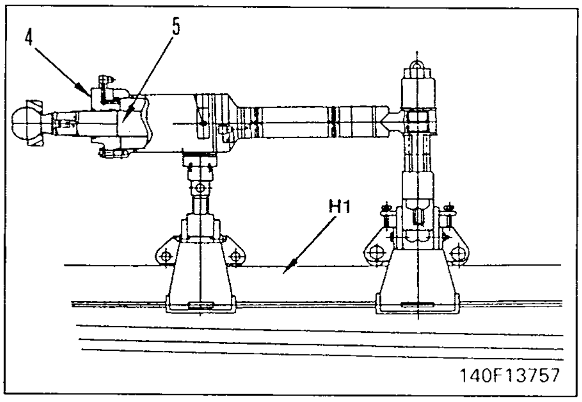


4. Piston rod assembly

- Tilt cylinder

1) Set cylinder to tool **H1**.
2) Assemble piston rod assembly (5) to cylinder.
3) Install cylinder head (4).

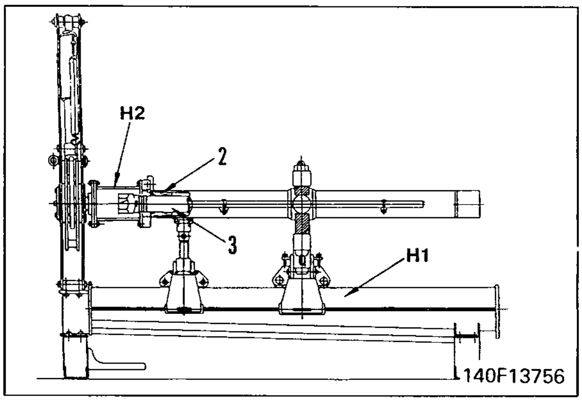
kgm Mounting bolt: **162 ± 17.4 Nm**
(16.5 ± 1.5 kgm).



- Lift cylinder

1) Set cylinder to tool **H1**.
2) Assemble piston rod assembly (3) to cylinder.
3) Using tool **H2**, install cylinder head (2).

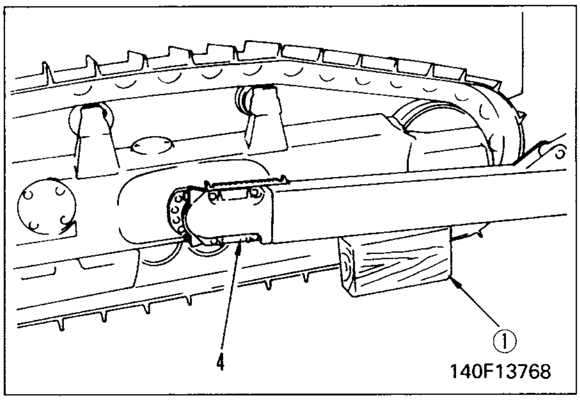
kgm Cylinder head: **735 ± 73.5 Nm**
(75 ± 7.5 kgm)



5. Tube

Install tube to cylinder assembly.

REMOVAL OF WORK EQUIPMENT ASSEMBLY



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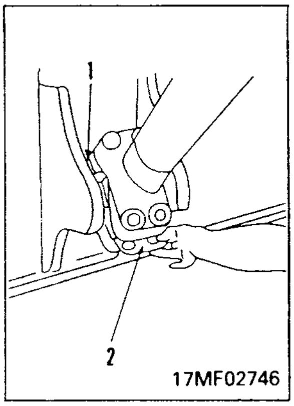
⚠ Stop the machine on a firm, level place, and lower the work eqiupment to the ground. Then put blocks ① securely under the straight frame on the left and right.

1. Remove cap (1). ※1
   ★ Check the number and thickness of the shims (2), and keep in a safe place.

2. Sling blade lift cylinder (3), start engine and retract piston rod fully, then fit cylinder lock plate to secure to guard.
   ★ Tie the rod with wire to prevent it from coming out.
   ★ Repeat Steps 1 to 2 to disconnect the cylinder on the other side from the blade.

⚠ Release the remaining pressure from hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing pressure from hydraulic circuit.
Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.



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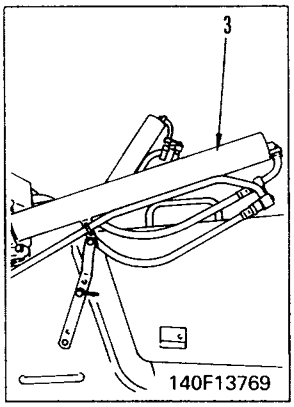

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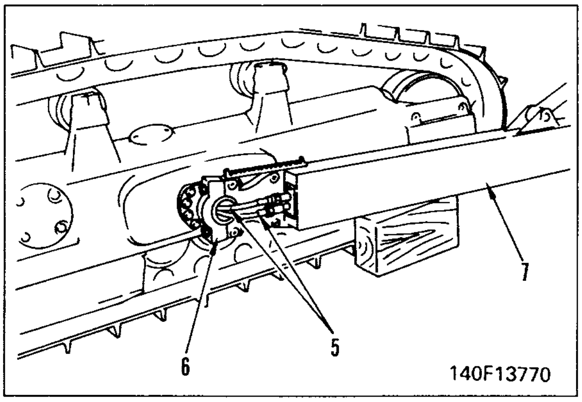
3. Remove right cover (4).

4. Disconnect hose (5).
   ★ Fit a blind plug to prevent dirt or dust from entering the piping.

5. Remove left and right trunnion caps (6).

6. Remove work equipment assembly (7). ※2
   ★ Start engine and drive machine slowly in reverse to disconnect blade assembly from trunnion on track frame.



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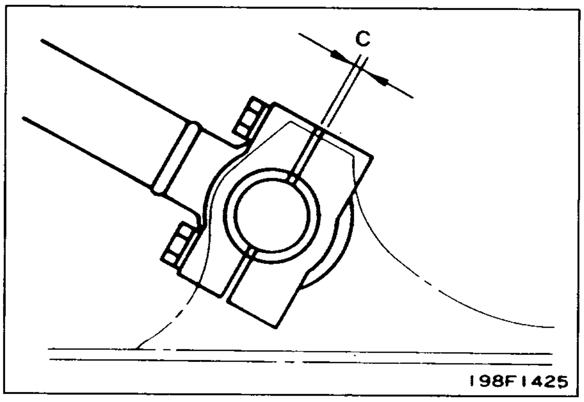
INSTALLATION OF WORK EQUIPMENT ASSEMBLY

- Carry out installation in the reverse order to removal.



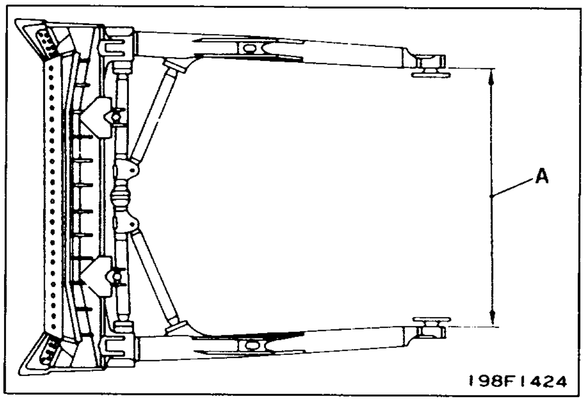
※1

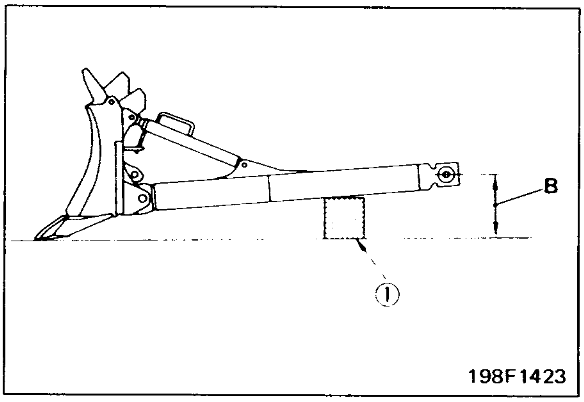
★ Adjust so that play **C** of the spherical portion in the axial direction is within 0.5 mm, but can still rotate smoothly.
★ Standard shim thickness: **5 mm**

※2

★ Adjust with a block ① so that the height and width of the left and right straight frames are dimensions **A** and **B** as shown below.

D65E D65EX	Dimensions **A**: Approx. 2600 mm Dimensions **B**: Approx. 422 mm
D65P D65PX	Dimensions **A**: Approx. 3136 mm Dimensions **B**: Approx. 522.5 mm





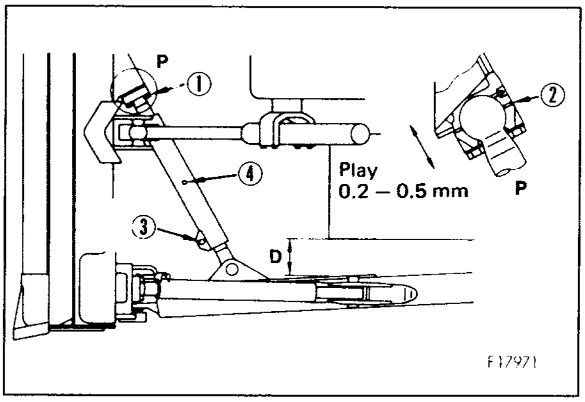
★ Adjust the tension of the center brace as follows.

1) Adjust with shim ② so that play of ball joint ① is 0.2 — 0.5 mm.
2) Loosen bolt ③.
3) Operate blade control lever, and raise blade slightly.

   ⚠ After completing the operation, lock the blade control lever securely with the safety lever.

4) Insert bar in hole ④ of center brace, and turn in direction of thrust.

   ★ Adjust so that clearance **D** between the track and frame is uniform on the left and right sides.



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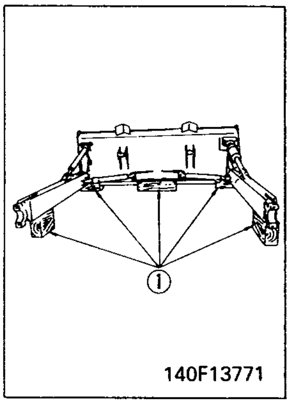
DISASSEMBLY OF WORK EQUIPMENT ASSEMBLY

⚠ Insert blocks ① at 5 places under the left and right straight frames, bottom of the blade, and under the center brace mount, then set the blade assembly securely in position.

1. Remove covers (1) and (2), and sling tilt cylinder (3), then disconnect hose (4).



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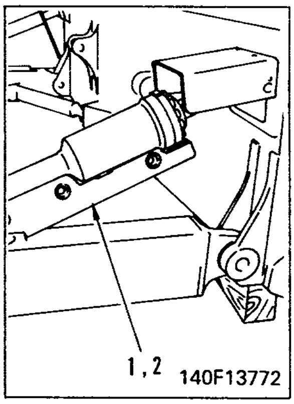

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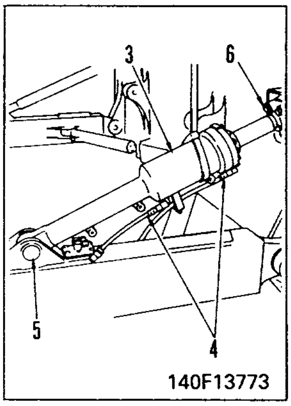
2. Pull out pin (5), and remove bolt (6), then remove tilt cylinder assembly (3).
   ★ There are shims at the spherical surface of the tilt cylinder, so check the number and thickness of the shims, and keep in a safe place.
   Standard shim thickness: **5 mm**

   kg Tilt cylinder: **75 kg**

3. Raise right center brace (7), and pull out pin (8), then disconnect from straight frame.



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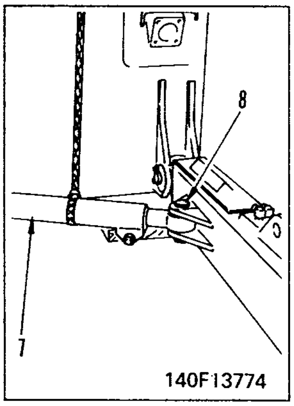

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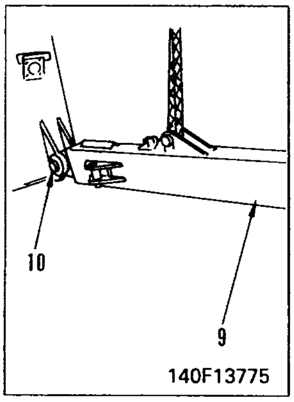
4. Sling right straight frame (9), and pull out pin (10), then lift off right straight frame (9).

   kg Straight frame: **255 kg**

5. Remove bearing (11) from straight frame (9).



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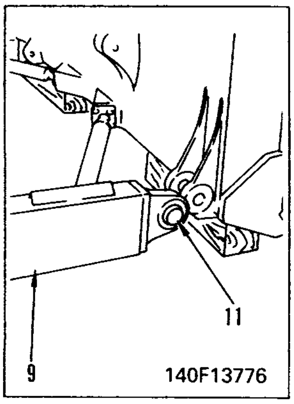

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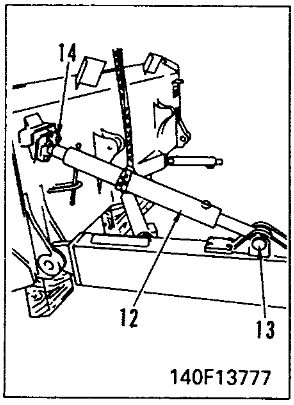
6. Sling tilt brace (12), pull out pin (13), then remove bolt (14), and lift off tilt brace (12).
   ★ There are shims at the spherical surface of the tilt brace, so check the number and thickness of the shims, and keep in a safe place.
   Standard shim thickness: **5 mm**

   kg Brace: **45 kg**

7. Sling left center brace (15), and pull out pin (16), then disconnect from straight frame (17).



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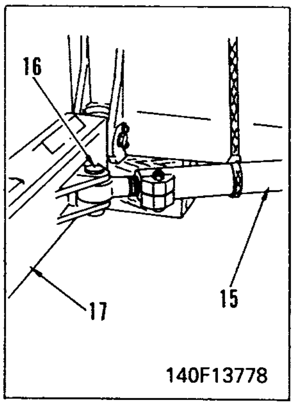

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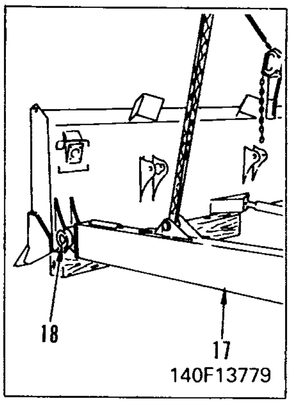
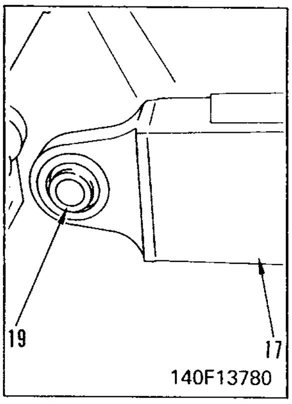
8. Sling left straight frame (17), and pull out pin (18), then lift off left straight frame.

kg Straight frame: **255 kg**

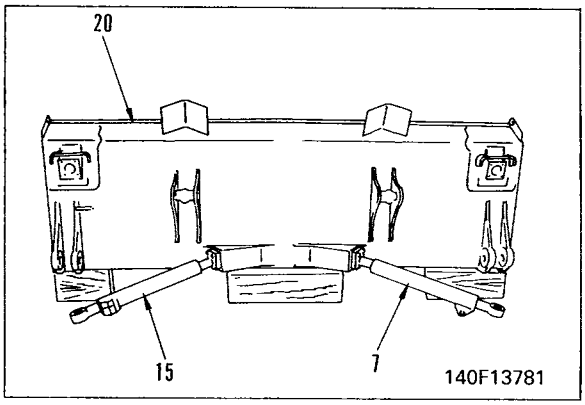
9. Remove bearing (19) from straight frame (17).





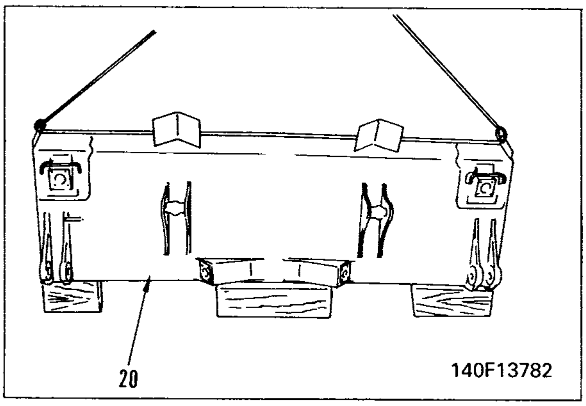
10. Lift off center braces (7) and (15) from blade (20).
   ★ There are shims at the spherical surface of the center brace, so check the number and thickness of the shims, and keep in a safe place.
   Standard shim thickness: **5 mm**

   kg Center brace: **30 kg**



11. Raise blade (20) and turn blade over.

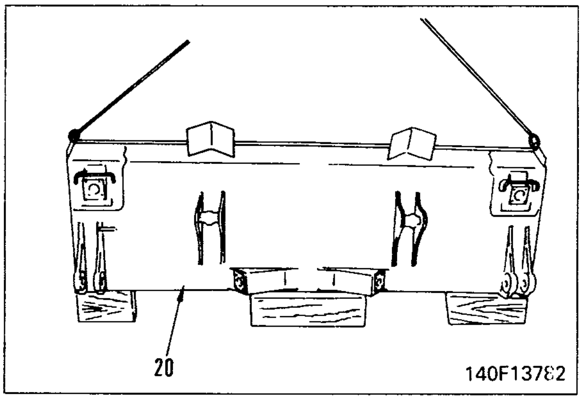
kg Blade: **1920 kg (D65P, PX)**
Blade: **1890 kg (D65E, EX)**



ASSEMBLY OF WORK EQUIPMENT ASSEMBLY

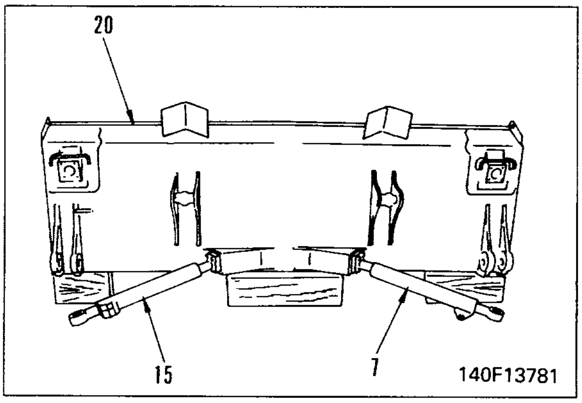
1. Raise blade (20) and set on block ①.

   kg Blade: **1920 kg (D65P, PX)**
   Blade: **1890 kg (D65E, EX)**



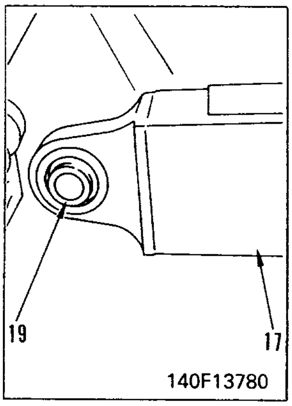
2. Raise center braces (15) and (7) and install to blade (20).
   ★ Check the thickness and number of shims that were removed, and assemble them in the same place.
   Standard shim thickness: **5 mm**

   Spherical surface of center brace:
   Grease (G2-LI)



3. Assemble bearing (19) to left straight frame (17).

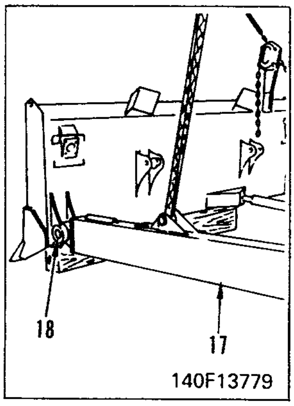
   Bearing outer surface, inside:
   Grease (G2-LI)



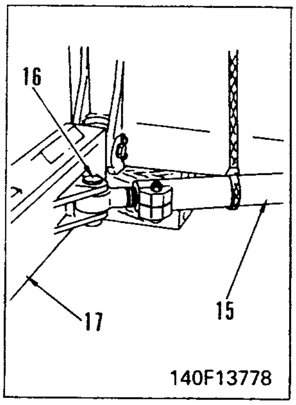
4. Raise left straight frame (17), assemble to blade (20), then install pin (18), and set block under straight frame.

   Pin: **Grease (G2-LI)**

   kg Straight frame: **255 kg**



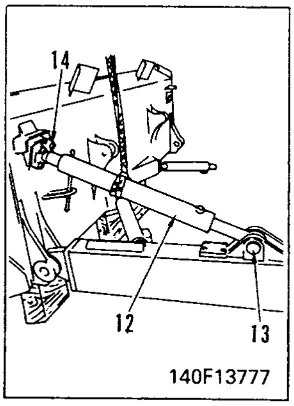
5. Sling left center brace (15), and assemble to straight frame (17), then install pin (16).



6. Sling tilt brace (12), and install pin (13), then assemble shim, and tighten with bolt (14).
   ★ Check the thickness and number of shims that were removed, and assemble them in the same place.
   Standard shim thickness: **5 mm**

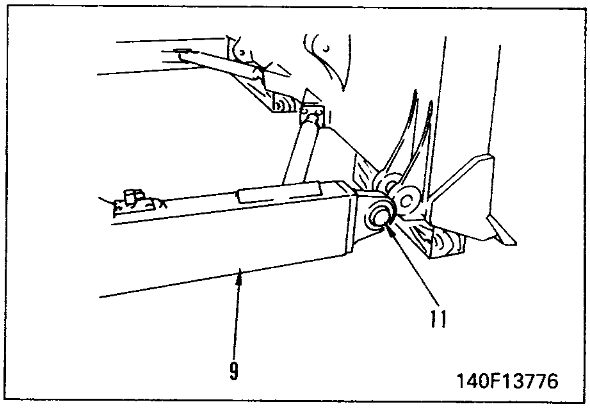
   Spherical surface of tilt brace:
   Grease (G2-LI)

   Pin: **Grease (G2-LI)**



7. Assemble bearing (11) to straight frame (9).

   Bearing outer surface, inside:
   Grease (G2-LI)



8. Sling right straight frame (9), assemble to blade, then install pin (10), and set block under straight frame.

   Pin: **Grease (G2-LI)**

   kg Straight frame: **255 kg**

9. Sling right center brace (7), and assemble to straight frame, then install pin (8).

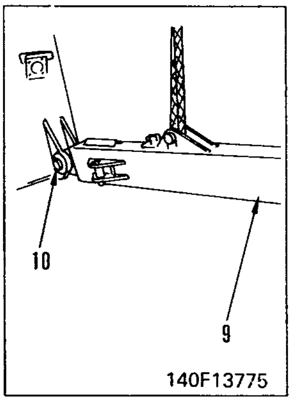
   Pin: **Grease (G2-LI)**

10. Sling tilt cylinder (3), and install pin (5), then assemble shim to spherical surface at cylinder rod end and tighten with bolt (6).
    ★ Check the thickness and number of shims that were removed, and assemble them in the same place.
    Standard shim thickness: **5 mm**

    Pin: **Grease (G2-LI)**

    kg Tilt cylinder: **75 kg**

11. Connect hose (4) and install covers (2) and (1).



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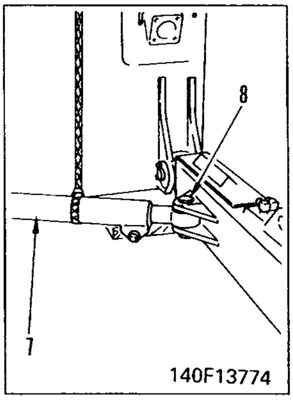

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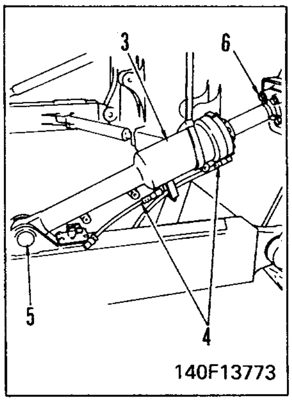

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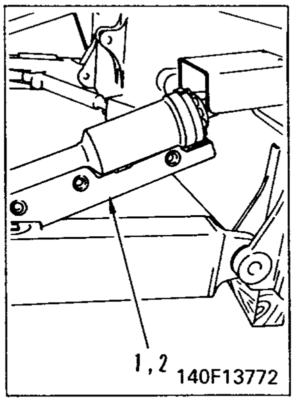
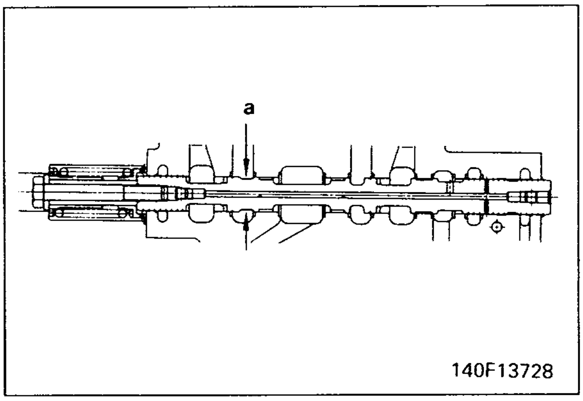


140F13772

DISASSEMBLY OF RIPPER VALVE ASSEMBLY (OPT.)

1. Remove case (2) from valve body (1).

2. **Disassembly of spool assembly**
   1) Remove case (3), pull out spool assembly (4) until portion **a** comes out, then hold portion **a** with wrench (width across flats: 14 mm), and loosen bolt (5).
      ★ Be careful not to damage or bend the spool. If there is danger of such damage to the spool, remove spool assembly (4) before starting the operation.
   2) Pull out spool assembly (4) from body.
   3) Remove bolt (5), then remove washer (6), spacer (7), retainer (8), spring (9), and retainer (10) from spool (11).



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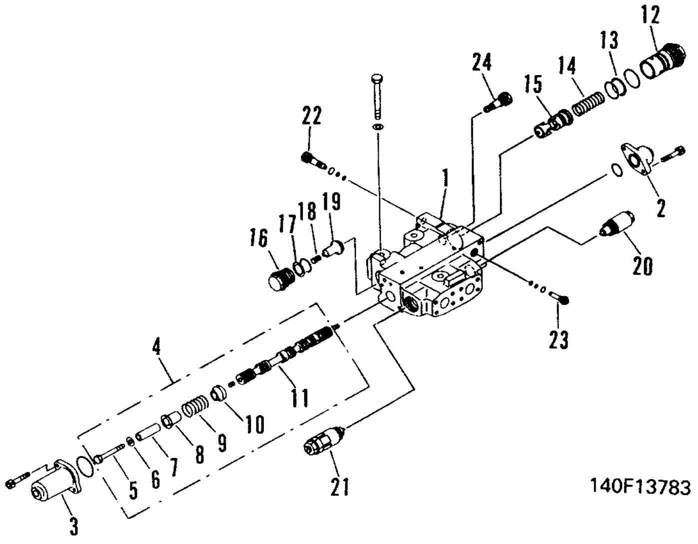
3. **Disassembly of pressure compensation spool**
   1) Remove plug (12), then remove ring (13), spring (14), and spool (15).
   2) Remove plug (16), then remove ring (17), spring (18), and valve (19).

4. Remove suction valve (20) and suction and safety valve (21).

5. Remove plugs (22) and (23), and check valve (24).



140F13783

ASSEMBLY OF RIPPER VALVE ASSEMBLY (OPT.)

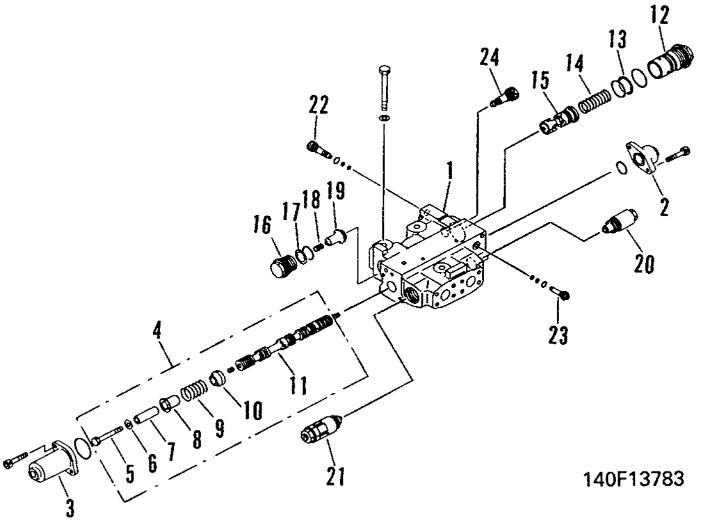
★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. Install check valve (24) and plugs (23) and (22).

   Check valve: **68.7 ± 9.9 Nm**
   (7 ± 1 kgm)

   Plug (23): **23.6 ± 4.0 Nm**
   (2.4 ± 0.4 kgm)

   Plug (22): **34.3 ± 4.9 Nm**
   (3.5 ± 0.5 kgm)



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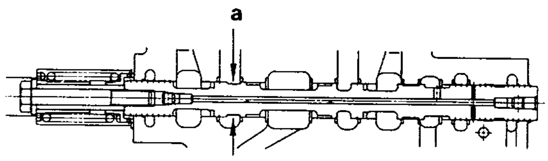
2. Install suction and safety valve (21) and suction valve (20) to body.

   Suction and safety valve:
   147 ± 9.8 Nm
   (15 ± 1 kgm)

   Suction valve: **68.7 ± 9.9 Nm**
   (7 ± 1 kgm)



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3. **Assembly of pressure compensation spool**
   1) Assemble ring (17), O-ring, spring (18), and valve (19) to plug (16), and install to body.

      Plug (16): **152.1 ± 24.6 Nm**
      (15.5 ± 2.5 kgm)

   2) Fit O-ring and ring (13) to plug (12), then assemble spring (14) and spool (15), and install to body.

      Plug (12): **321.2 ± 46.6 Nm**
      (32.8 ± 4.8 kgm)

4. **Assembly of spool assembly**
   1) Assemble washer (6), spacer (7), retainer (8), spring (9), and retainer (10) to bolt (5), and install to spool (11).
   2) Push spool assembly (4) into body to a point where a wrench can hold portion **a** of spool, then hold spool with wrench and tighten bolt (5).

      Bolt (5): **66.2 ± 7.4 Nm**
      (6.8 ± 0.8 kgm)

   3) Push spool assembly (4) into body.
   4) Fit O-rings to cases (3) and (2), and install to body (1).

REMOVAL OF ROPS GUARD

1. Remove left and right bodywork covers.

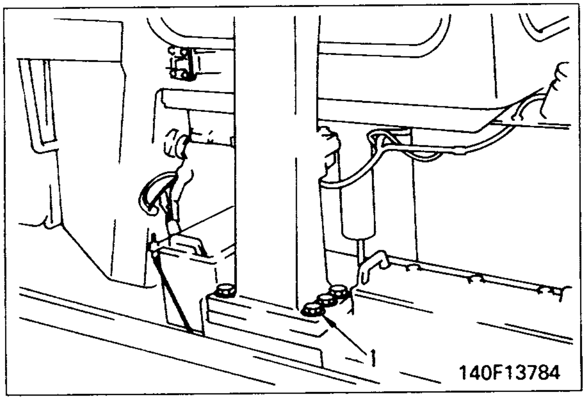
   kg Left cover: **45 kg**

2. Sling ROPS guard (2) and remove 12 mounting bolts (1). ※1

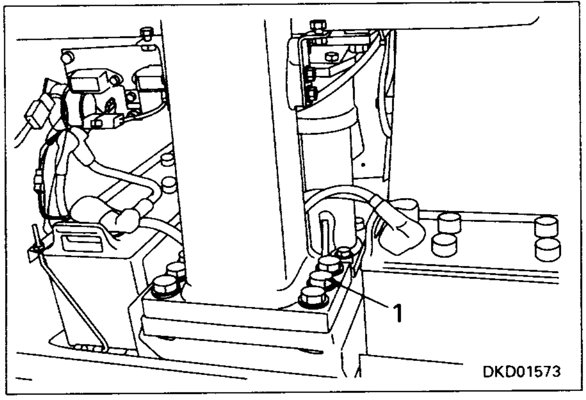
3. Lift off ROPS guard (2).

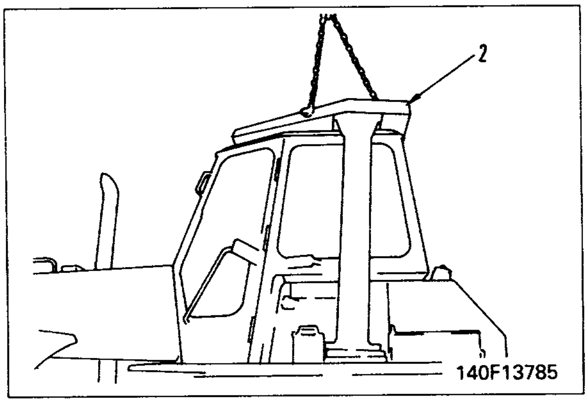
   kg ROPS guard: **300 kg**

D65E-12 60001 - 60947 D65EX-12 60001 - 60941
D65P-12 60001 - 60890 D65PX-12 60001 - 60914



D65E-12 60948 and up D65EX-12 60942 and up
D65P-12 60891 and up D65PX-12 60915 and up





INSTALLATION OF ROPS GUARD

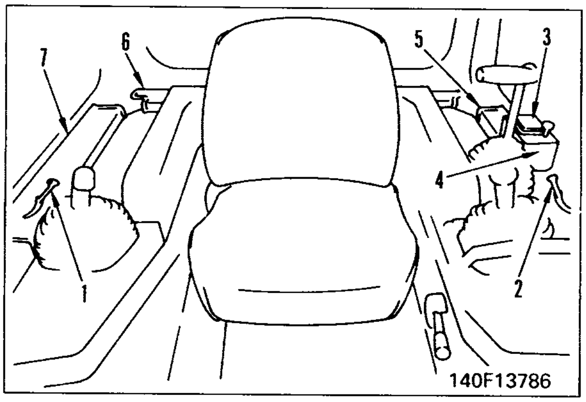
- Carry out installation in the reverse order to removal.

※1

kgm ROPS guard mounting bolt:
926.1 ± 102.9 Nm (94.5 ± 10.5 kgm)

014012

REMOVAL OF OPERATOR'S CAB ASSEMBLY

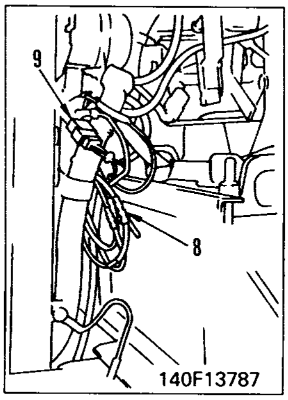


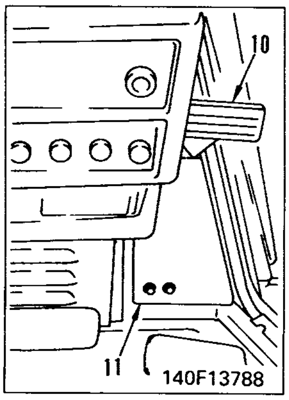
1. Remove ROPS guard. (ROPS guard specification)
   For details, see REMOVAL OF ROPS GUARD.

2. Remove knobs (1) and (2).

3. Remove ashtray (3), then remove box (4).

4. Remove covers (5), (6), and (7).

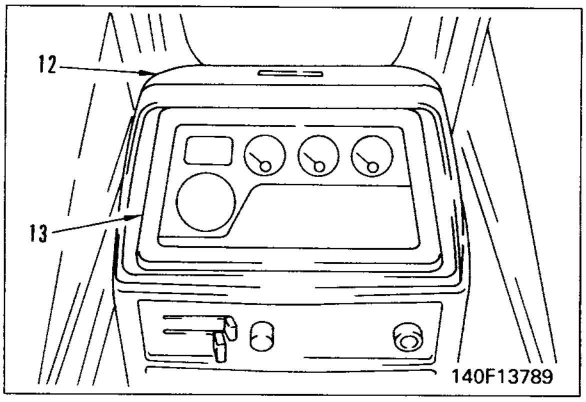




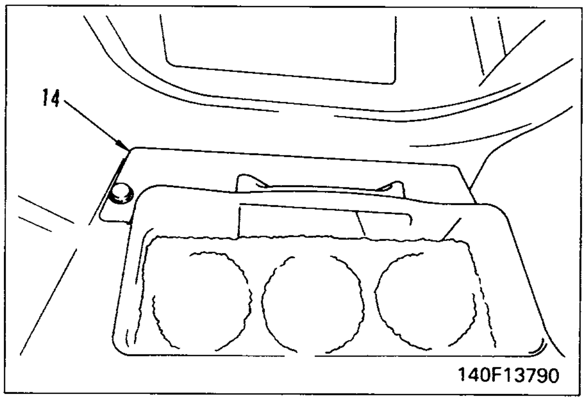
5. Disconnect 4 washer hoses (8), and wiring connector (9) of CN19, CN20, and CN21, then pull out inside cab.
   ★ Mark the position of the connections for the washer hoses before disconnecting them.

6. Remove left and right brackets (10), then remove left and right covers (11).

014012

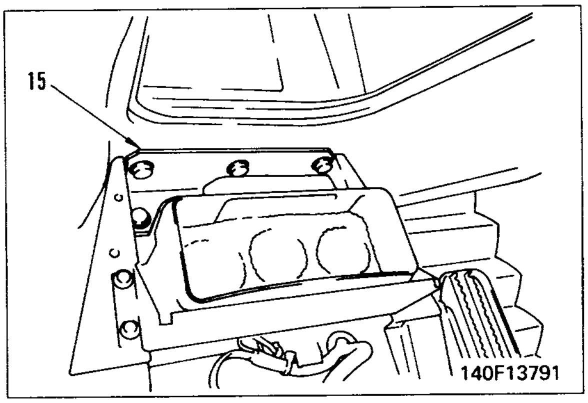


7. Remove cover (12), then remove monitor assembly (13).

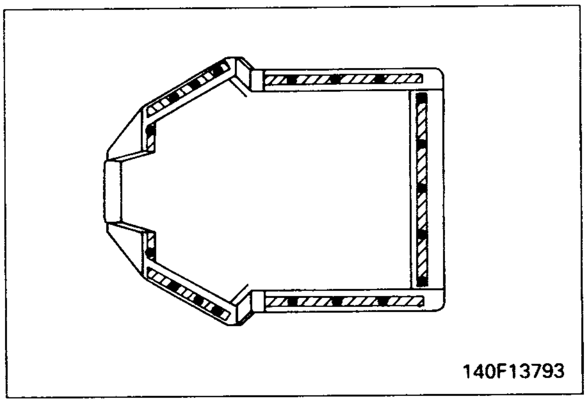


8. Remove plate (14).

9. Remove bracket (15).

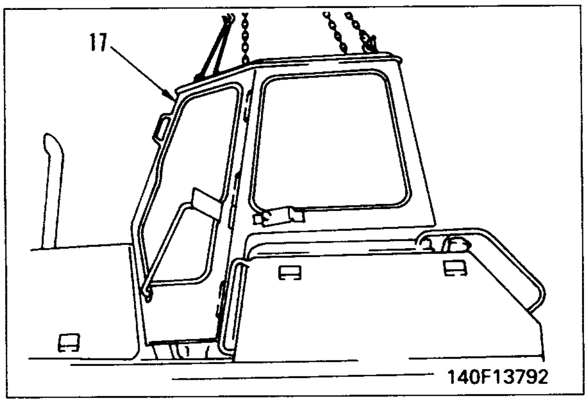


10. Remove cab mounting bolts marked ●.



11. Raise cab assembly (17) gradually and remove.

kg Cab assembly: **250 kg**



INSTALLATION OF OPERATOR'S CAB ASSEMBLY

- Carry out installation in the reverse order to removal.

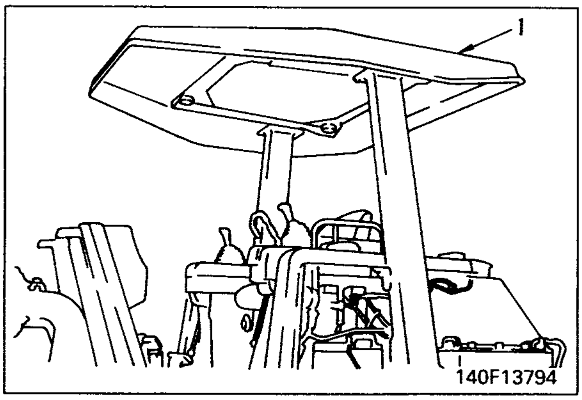
014012

REMOVAL OF CANOPY ASSEMBLY

1. Remove operator's seat left side cover and right side cover.

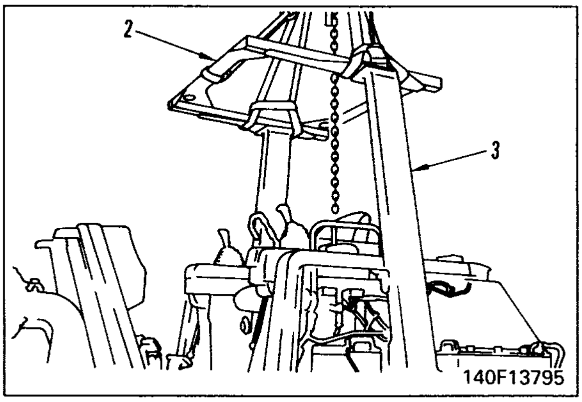
   kg Left side cover: 45 kg

2. Remove roof (1).



3. Lift off canopy bracket (2) together with pole (3).
   ※ 1

   kg Canopy bracket, pole assembly: **120 kg**



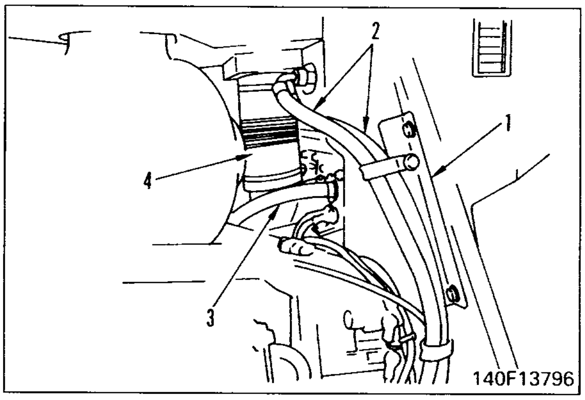
INSTALLATION OF CANOPY ASSEMBLY

- Carry out installation in the reverse order to removal.

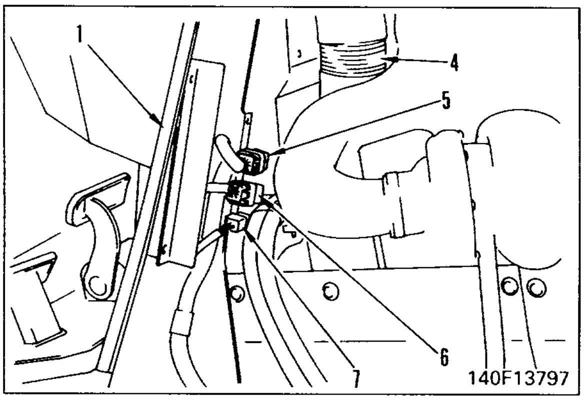
※ 1

kgm Canopy, pole mounting bolt:
926.1 ± 102.9 Nm (94.5 ± 10.5 kgm)

REMOVAL OF DASHBOARD ASSEMBLY

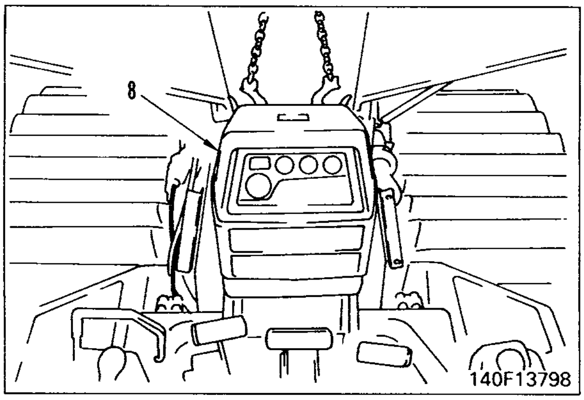


1. Remove operator's cab assembly.
   For details, see REMOVAL OF OPERATOR'S CAB ASSEMBLY. (Operator cab specification only)
2. Open engine side cover, and remove side covers (1) of dashboard on both sides.
3. Disconnect 2 air conditioner hoses (2) (air conditioner specification), 2 heater hoses (3), and intake hose (4). (Operator cab specification only) ※1



4. Disconnect intermediate connectors (5), (6), and (7) (CN31, 32, 33).
5. Lift off dashboard assembly (8).

kg Dashboard assembly: **75 kg**



INSTALLATION OF DASHBOARD ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

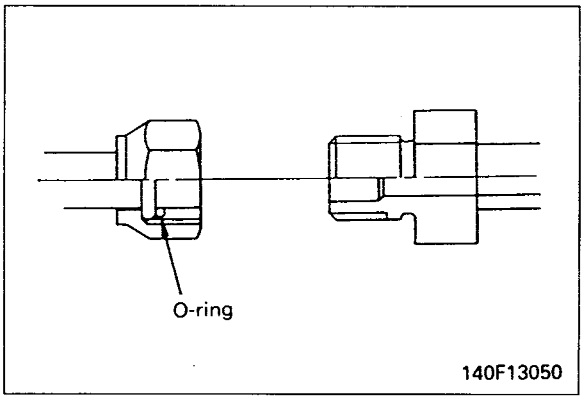
★ Install the hoses without twisting.

★ When installing the hoses for the cooler circuit, be careful not to let dirt, dust, or water get into the hoses.

★ After assembling the whole cooler cycle, charge with 1000 ± 100 g of air conditioner refrigerant (R-12) from the air conditioner compressor.

kgm The tightening torque for the unified thread of the air conditioner gas piping shall be as follows.

Thread diameter	Tightening torque (Nm (kgm))
3/4 - 16 UNF	19.6 - 24.5 (2 - 2.5)
9/16 - 18 UNF	11.8 - 14.7 (1.2 - 1.5)
7/8 - 14 UNF	27.4 - 24.3 (3 - 3.5)

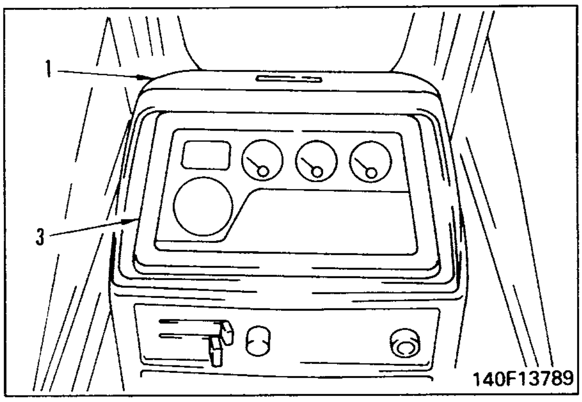


★ Check that there are O-rings at the connections of the cooler piping before assembling. Coat the O-ring well with compressor oil (Shell Suniso G or 5G).

REMOVAL OF MONITOR ASSEMBLY

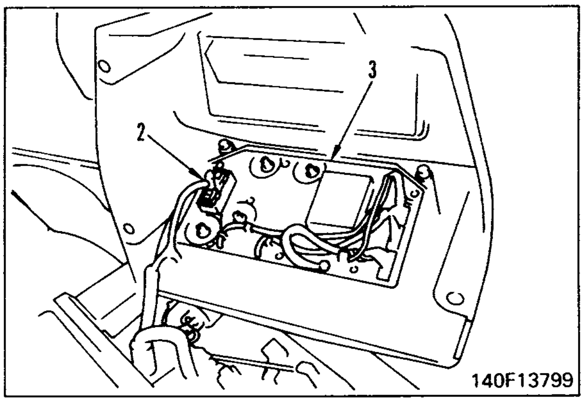
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Open cover (1), and disconnect connector (2), then remove monitor assembly (3).



INSTALLATION OF MONITOR ASSEMBLY

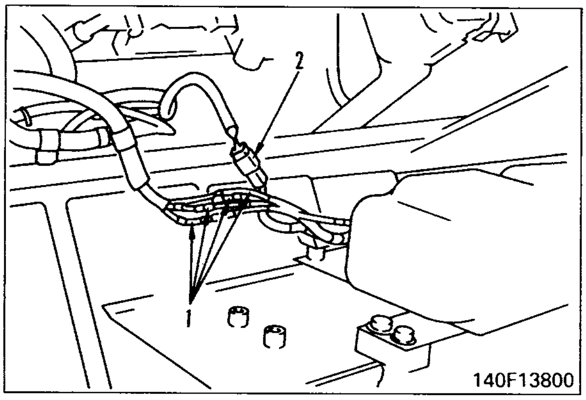
- Carry out installation in the reverse order to removal.



REMOVAL OF FLOOR FRAME ASSEMBLY

D65E-12 60001 – 60947
D65P-12 60001 – 60890

1. Remove operator's cab assembly or canopy assembly.
   For details, see REMOVAL OF OPERATOR CAB ASSEMBLY (operator's cab specification), or REMOVAL OF CANOPY ASSEMBLY (canopy specification).



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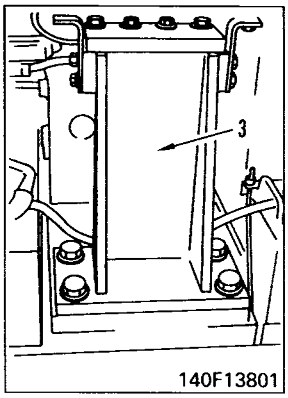
2. Remove engine right side cover.
   ★ For the cab specification machine, disconnect washer hose (1) and wiring harness (2).

3. Remove operator's seat left side cover and right side cover.

   kg Left side cover: **45 kg**



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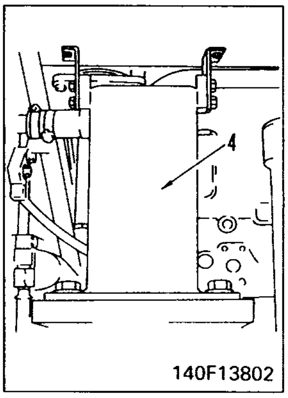

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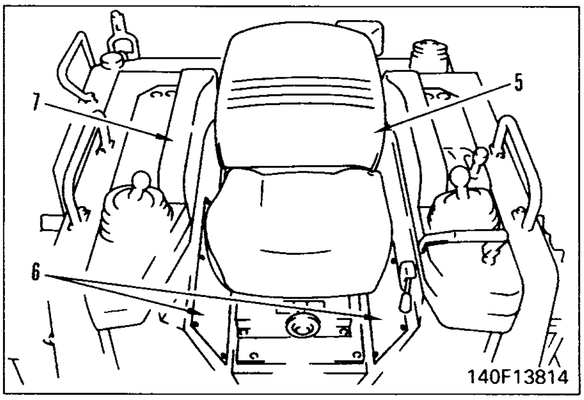
4. Remove fender side mount brackets (3) and (4). (Cab specification only)

5. Remove operator's seat assembly (5).

   kg Operator's seat assembly: **35 kg**

6. Remove 3 operator's seat side covers (6).



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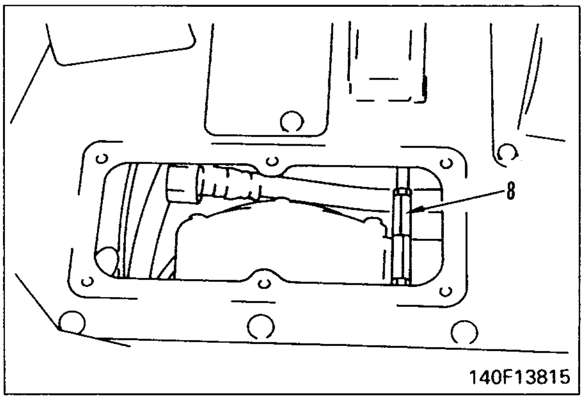
7. Remove right armrest (7).
   ★ Two of the bolts at the inside top of the right side suspension are tightened from the top, so remove this armrest.

8. Remove dashboard assembly.
   For details, see REMOVAL OF DASHBOARD ASSEMBLY.

9. Remove floor plate.

10. Disconnect brake rod (8). ※1



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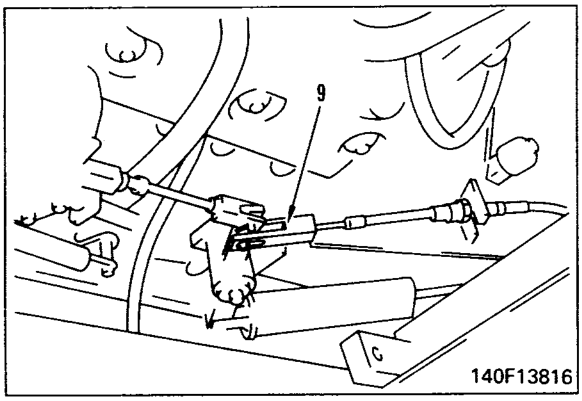
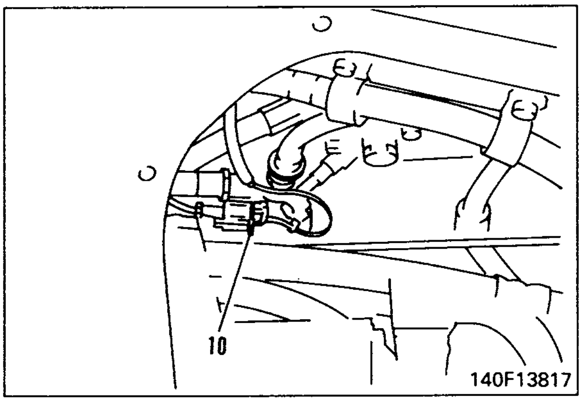
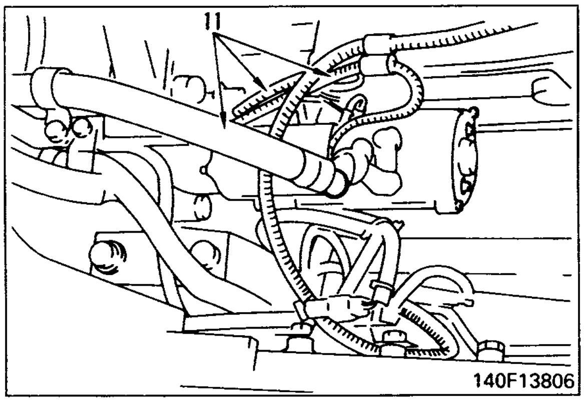
11. Disconnect deceleration pedal linkage (9) (at engine end). ※2



12. Disconnect torque converter oil temperature sensor connector (10) (CN28).

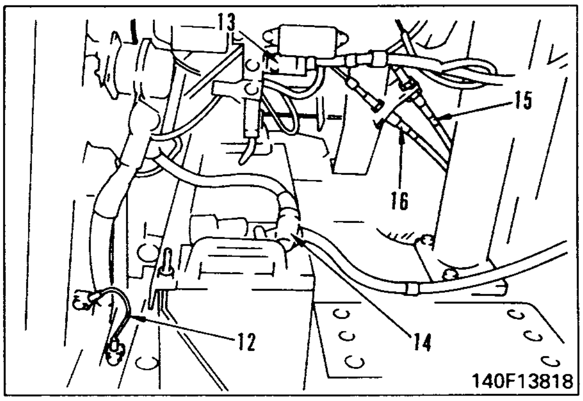


13. Disconnect starting motor wiring (11).



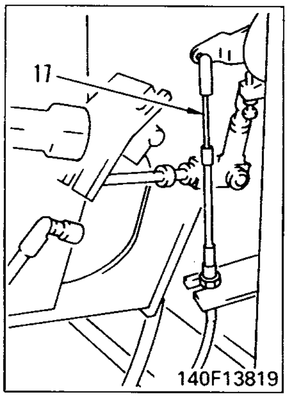
14. Disconnect floor frame ground connection (12), fuel level sensor, connector (13) (CN4) for rear lamp, and (+) terminal (14) of front battery.

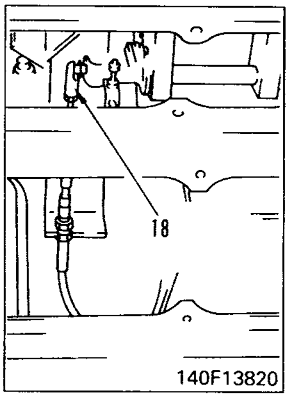
15. Disconnect directional control cable (15) and speed cable (16) ※3



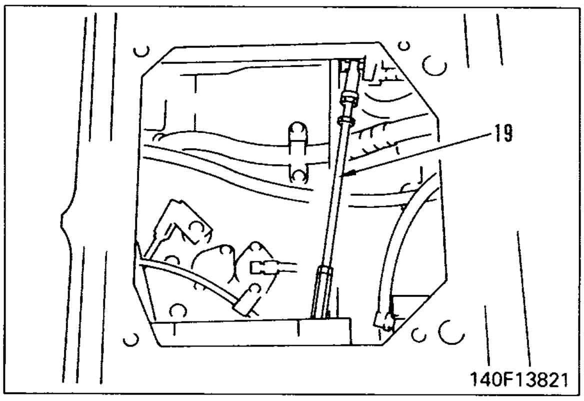
16. Disconnect fuel control cable (17) at lever end. ※ 4

17. Disconnect parking lever (safety lock lever) control cable (18) at lever end. ※ 5

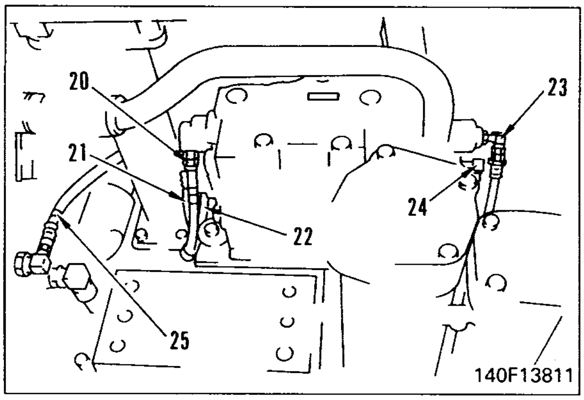


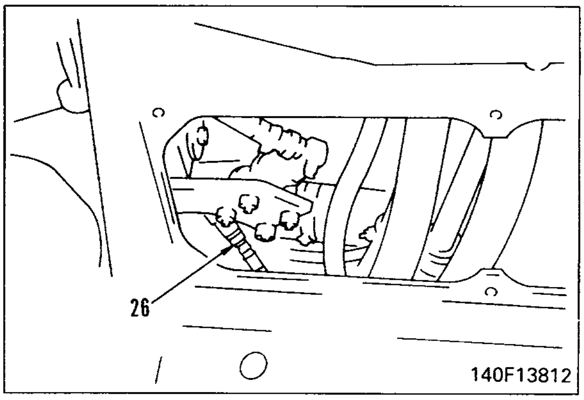


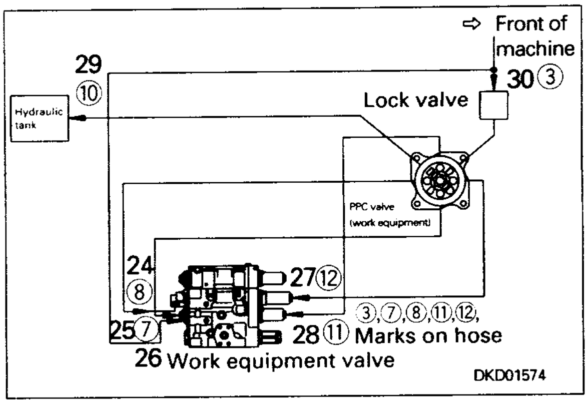
18. Disconnect steering rod (19). ※ 6



19. Disconnect pilot hoses (20), (21), (22), (23), (24), (25), and (26).

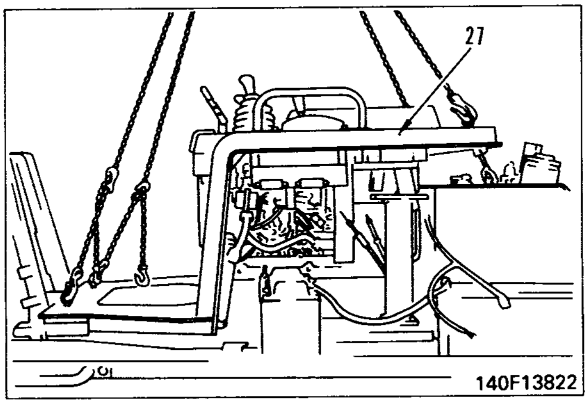






20. Lift off floor frame assembly (27). ※7
    - ★ For the rear right suspension, remove 4 bolts at the top, and for the rear left suspension, remove 4 bolts at the bottom.
    - ★ Be careful not to damage the control cable or rod and wiring when removing.

kg Floor frame assembly: **350 kg**



014012

INSTALLATION OF FLOOR FRAME ASSEMBLY

D65E-12 60001 – 60947
D65P-12 60001 – 60890

- Carry out installation in the reverse order to removal.

※1
- ★ Adjust the rod when connecting it.
  For details, see TESTING AND ADJUSTING, Adjusting brake pedal linkage.

※2
- ★ Insert the stopper for the yoke connecting pin securely.
- ★ Adjust the cable when connecting the rod.
  For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

※3
- ★ Insert the stopper for the yoke connecting pin securely.
- ★ Adjust the cable when connecting it.
  For details, see TESTING AND ADJUSTING, Adjusting directional linkage and Adjusting speed linkage.

※4
- ★ Insert the stopper for the yoke connecting pin securely.
- ★ Adjust the cable when connecting it.
  For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

※5
- ★ Insert the stopper for the yoke connecting pin securely.
- ★ Adjust the cable when connecting the rod.
  For details, see TESTING AND ADJUSTING, Adjusting parking brake lever.

※6
- ★ Adjust the rod when connecting it.
  For details, see TESTING AND ADJUSTING, Adjusting directional linkage.

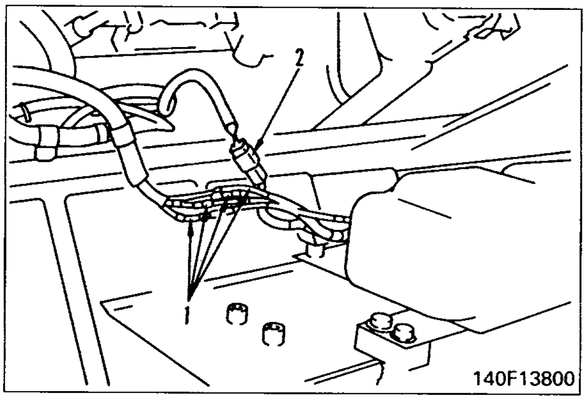
※7

kgm Front mount bolt: **548.8 ± 58.8 Nm (56 ± 6 kgm)**

kgm Suspension bolt: **110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)**

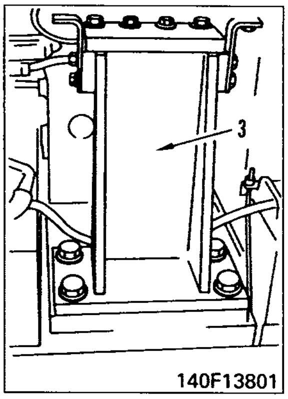
REMOVAL OF FLOOR FRAME ASSEMBLY

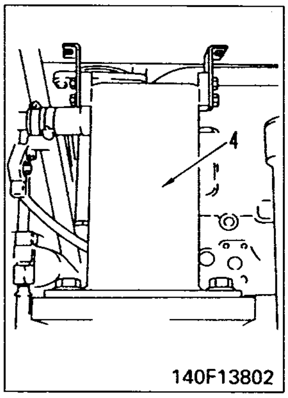
D65E-12 60948 and up
D65P-12 60891 and up



1. Remove operator's cab assembly or canopy assembly.
   For details, see REMOVAL OF OPERATOR CAB ASSEMBLY (operator's cab specification), or REMOVAL OF CANOPY ASSEMBLY (canopy specification).

2. Remove engine right side cover.
   ★ For the cab specification machine, disconnect washer hose (1) and wiring harness (2).





3. Remove operator's seat left side cover and right side cover.

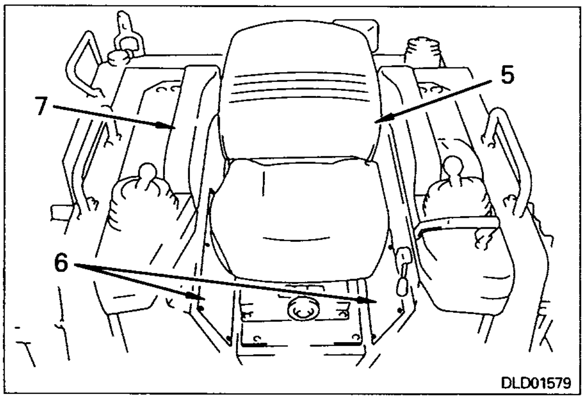
   kg Left side cover: **45 kg**

4. Remove fender side mount brackets (3) and (4). (Cab specification only)

5. Remove operator's seat assembly (5).

   kg Operator's seat assembly: **35 kg**

014012



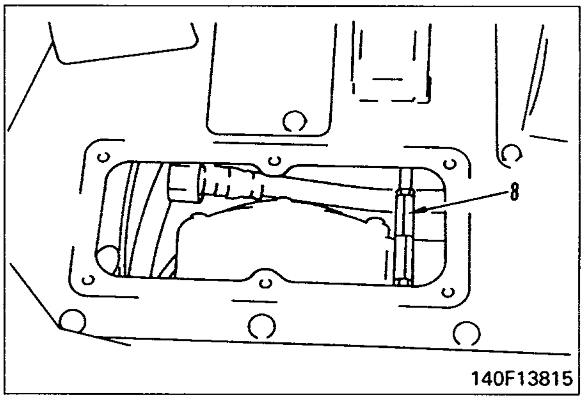
6. Remove 3 operator's seat side covers (6).

7. Remove right armrest (7).
   ★ Two of the bolts at the inside top of the right side suspension are tightened from the top, so remove this armrest.

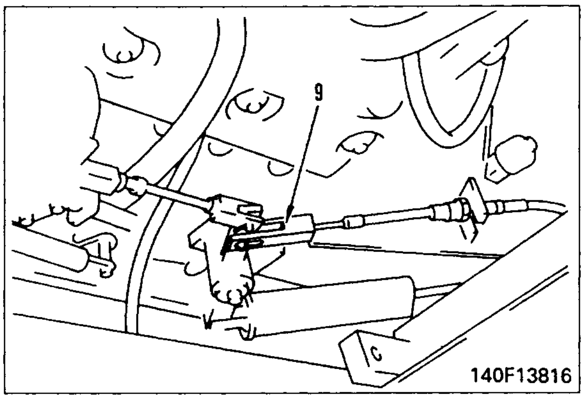
8. Remove dashboard assembly.
   For details, see REMOVAL OF DASHBOARD ASSEMBLY.

9. Remove floor plate.

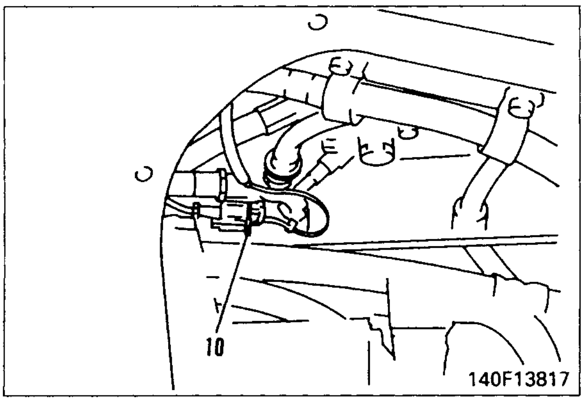
10. Disconnect brake rod (8). ※1



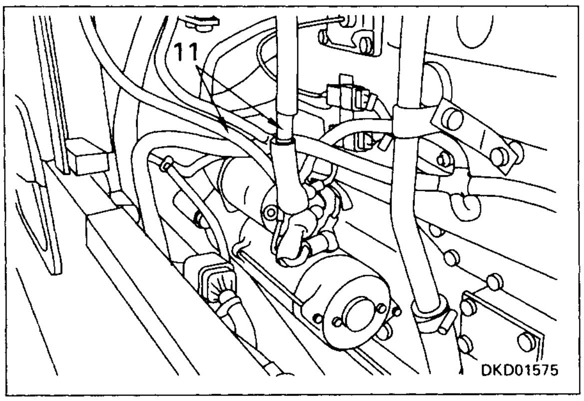
11. Disconnect deceleration pedal linkage (9) (at engine end). ※ 2



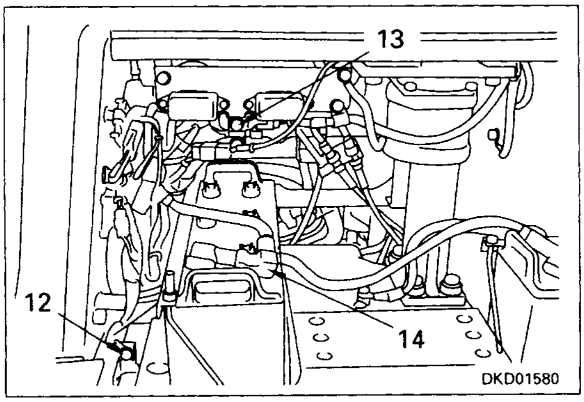
12. Disconnect torque converter oil temperature sensor connector (10) (CN28).



13. Disconnect starting motor wiring (11) and connector.



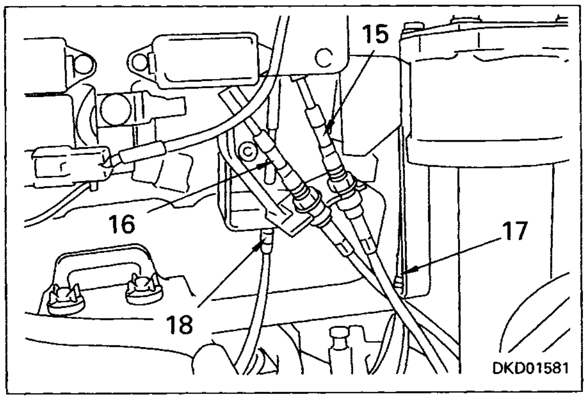
14. Disconnect floor frame ground connection (12), fuel level sensor, connector (13) (CN4) for rear lamp, and (+) terminal (14) of front battery.



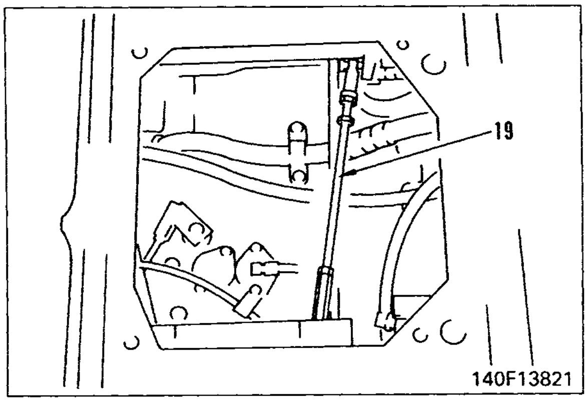
15. Disconnect directional control cable (15) and speed cable (16) ※ 3

16. Disconnect fuel control cable (17) at lever end. ※ 4

17. Disconnect parking lever (safety lock lever) control cable (18) at lever end. ※ 5

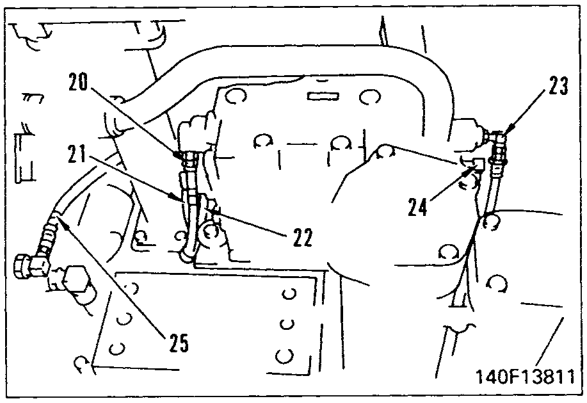


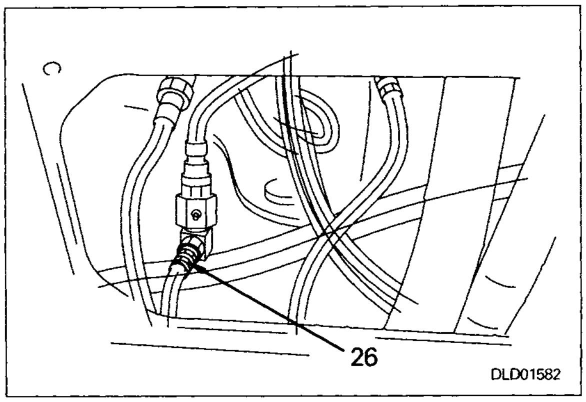
18. Disconnect steering rod (19). ※ 6

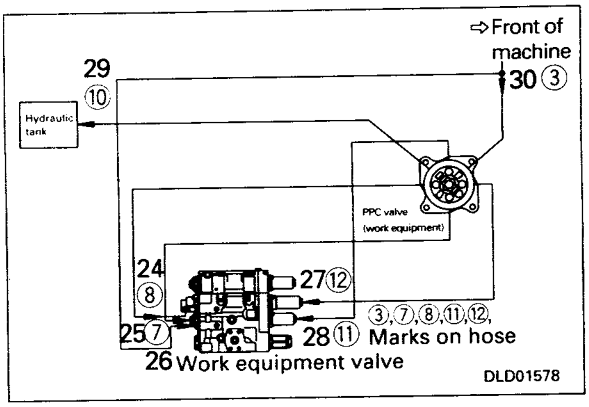


014012

19. Disconnect pilot hoses (20), (21), (22), (23), (24), (25), and (26).

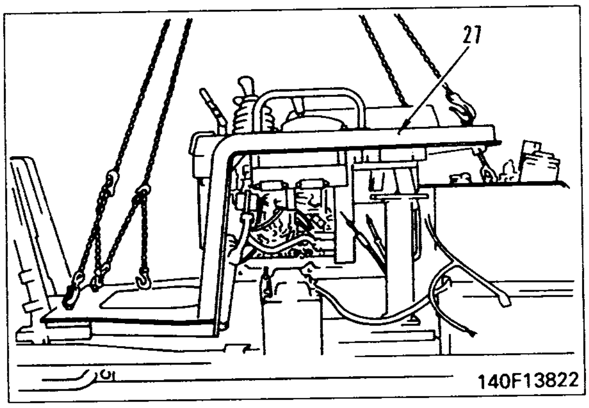






20. Lift off floor frame assembly (27). ※7
    - ★ For the rear right suspension, remove 4 bolts at the top, and for the rear left suspension, remove 4 bolts at the bottom.
    - ★ Be careful not to damage the control cable or rod and wiring when removing.

kg Floor frame assembly: **350 kg**



INSTALLATION OF FLOOR FRAME ASSEMBLY

D65E-12 60948 and up
D65P-12 60891 and up

- Carry out installation in the reverse order to removal.

※1
- ★ Adjust the rod when connecting it.
  For details, see TESTING AND ADJUSTING, Adjusting brake pedal linkage.

※2
- ★ Insert the stopper for the yoke connecting pin securely.
- ★ Adjust the cable when connecting the rod.
  For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

※3
- ★ Insert the stopper for the yoke connecting pin securely.
- ★ Adjust the cable when connecting it.
  For details, see TESTING AND ADJUSTING, Adjusting directional linkage and Adjusting speed linkage.

※4
- ★ Insert the stopper for the yoke connecting pin securely.
- ★ Adjust the cable when connecting it.
  For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

※5
- ★ Insert the stopper for the yoke connecting pin securely.
- ★ Adjust the cable when connecting the rod.
  For details, see TESTING AND ADJUSTING, Adjusting parking brake lever.

※6
- ★ Adjust the rod when connecting it.
  For details, see TESTING AND ADJUSTING, Adjusting directional linkage.

※7

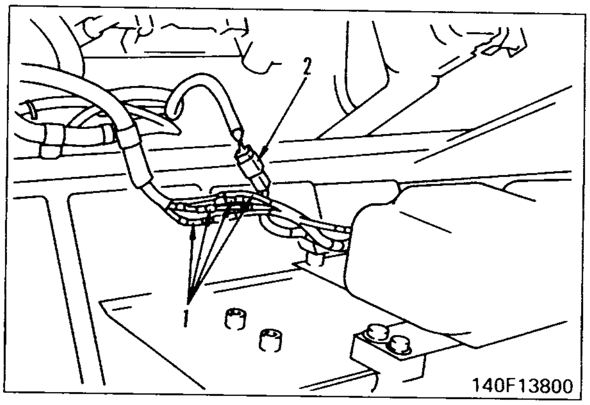
kgm Front mount bolt: **548.8 ± 58.8 Nm (56 ± 6 kgm)**

kgm Suspension bolt: **110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)**

REMOVAL OF FLOOR FRAME ASSEMBLY

D65EX-12 60001 - 60941
D65PX-12 60001 - 60914

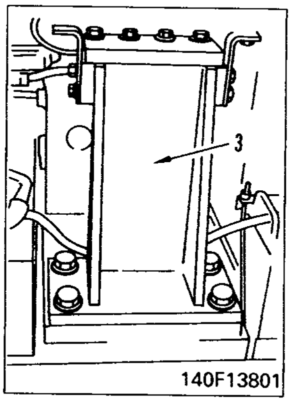
1. Remove operator's cab assembly or canopy assembly.
   For details, see REMOVAL OF OPERATOR CAB ASSEMBLY (operator's cab specification), or REMOVAL OF CANOPY ASSEMBLY (canopy specification).



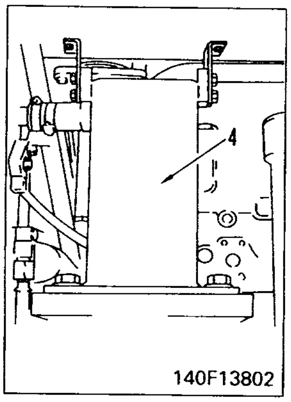
140F13800

2. Remove engine right side cover.
   ★ For the cab specification machine, disconnect washer hose (1) and wiring harness (2).
3. Remove operator's seat left side cover and right side cover.

   kg Left side cover: **45 kg**



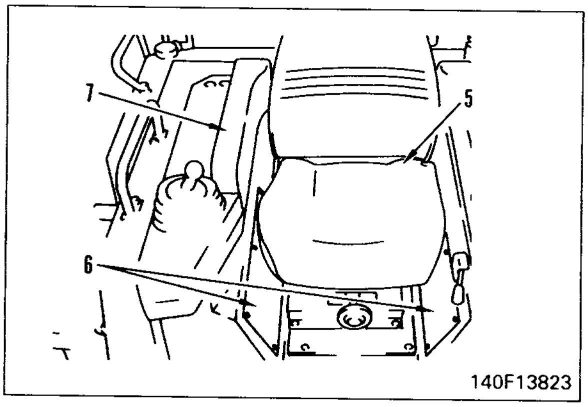
140F13801



140F13802

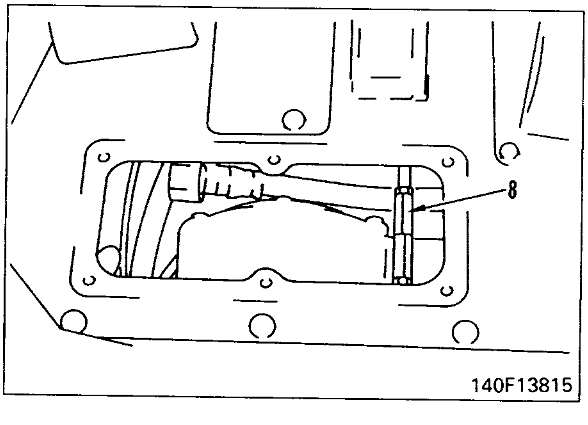
4. Remove fender side mount brackets (3) and (4). (Cab specification only)
5. Remove operator's seat assembly (5).

   kg Operator's seat assembly: **35 kg**



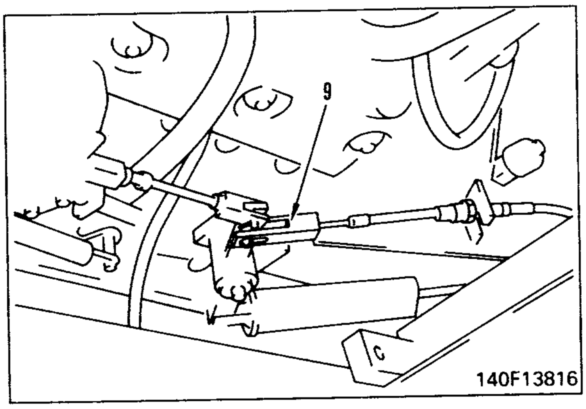
140F13823

6. Remove 3 operator's seat side covers (6).
7. Remove right armrest (7).
   ★ Two of the bolts at the inside top of the right side suspension are tightened from the top, so remove this armrest.
8. Remove dashboard assembly.
   For details, see REMOVAL OF DASHBOARD ASSEMBLY.
9. Remove floor plate.
10. Disconnect brake rod (8). ※ I

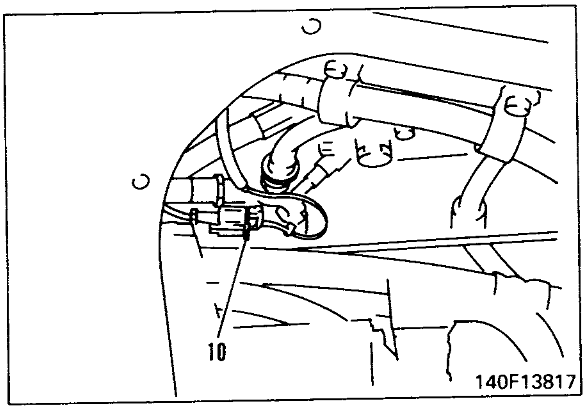


140F13815

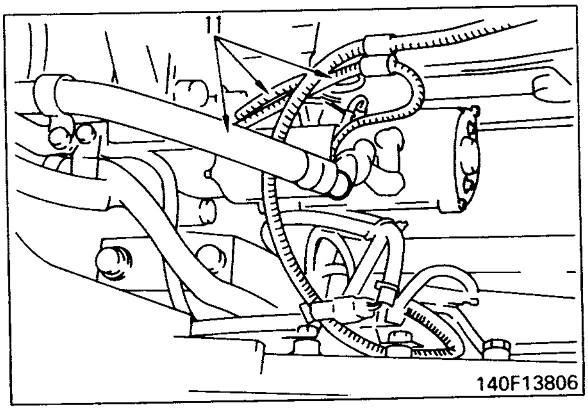
11. Disconnect deceleration pedal linkage (9) (at engine end). ※ 2



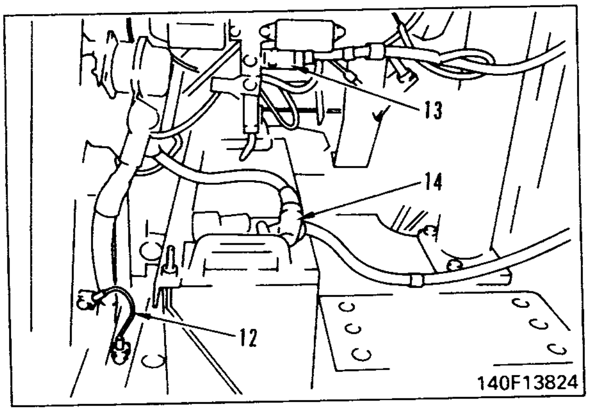
12. Disconnect torque converter oil temperature sensor connector (10) (CN28).



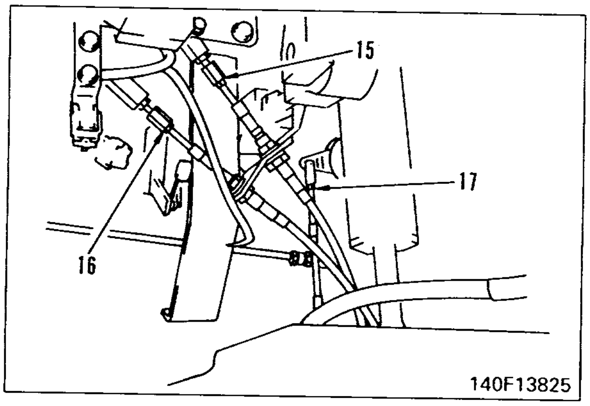
13. Disconnect starting motor wiring (11) .



14. Disconnect floor frame ground connection (12), fuel level sensor, connector (13) (CN4) for rear lamp, and (+) terminal (14) of front battery.

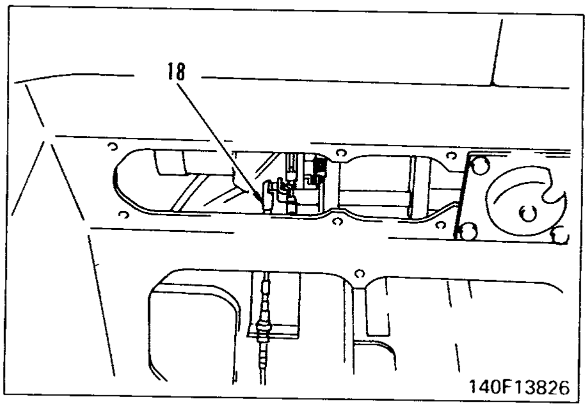


15. Disconnect directional control cable (15) and speed cable (16) ※ 3

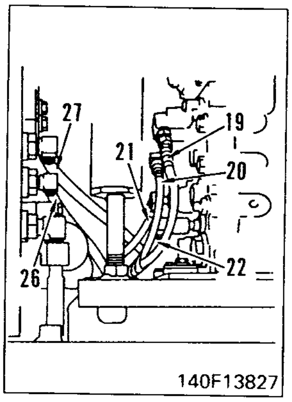


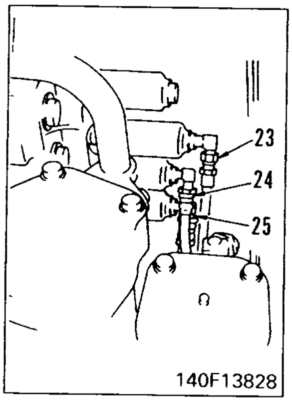
16. Disconnect fuel control cable (17) at lever end. ※ 4

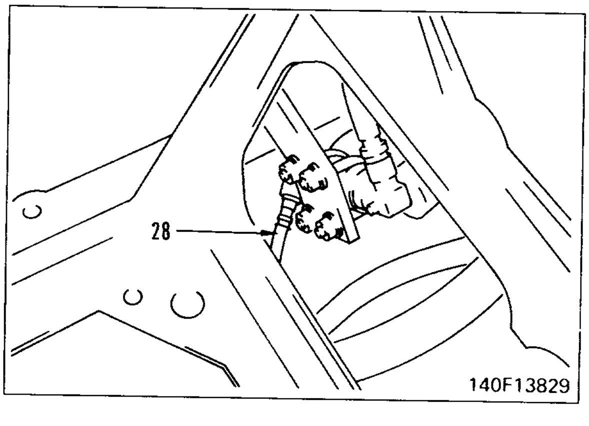
17. Disconnect parking lever (safety lock lever) control cable (18) at lever end. ※ 5



18. Disconnect pilot hoses (19), (20), (21), (22), (23), (24), (25), (26), (27) and (28).





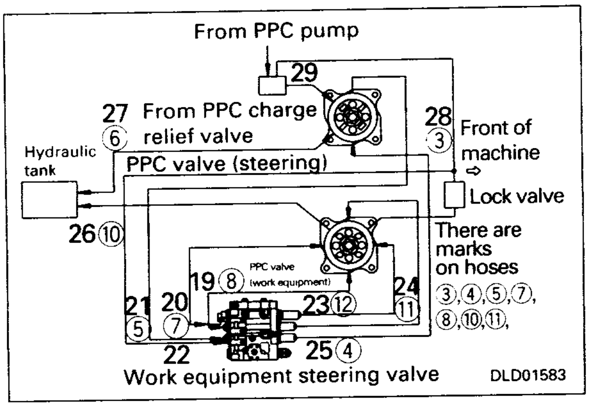


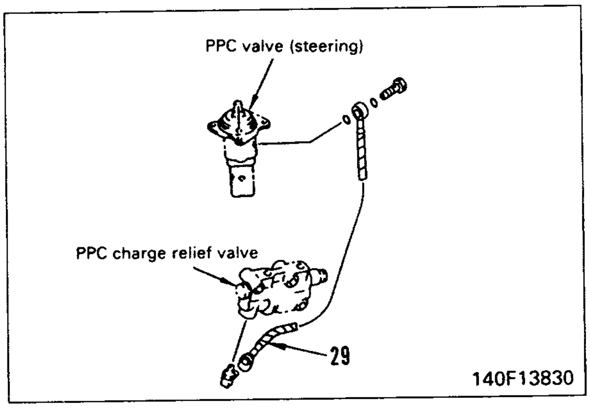
19. Disconnect steering pilot hose (29).

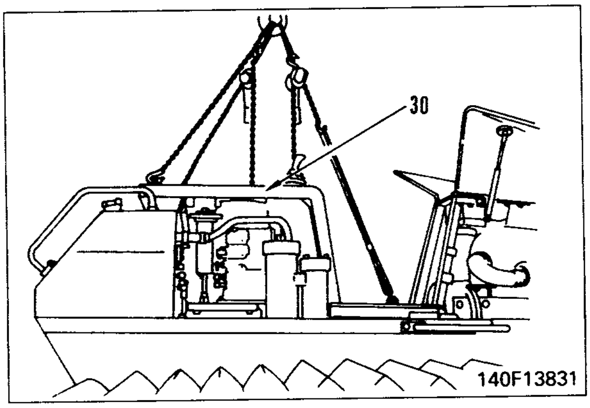
20. Lift off floor frame assembly (27). ※6

- ★ For the rear right suspension, remove 4 bolts at the top, and for the rear left suspension, remove 4 bolts at the bottom.
- ★ Be careful not to damage the control cable or rod and wiring when removing.

kg Floor frame assembly: **350 kg**







INSTALLATION OF FLOOR FRAME ASSEMBLY

D65EX-12 60001 – 60941
D65PX-12 60001 – 60914

- Carry out installation in the reverse order to removal.

※1

★ Adjust the rod when connecting it.
For details, see TESTING AND ADJUSTING, Adjusting brake pedal linkage.

※2

★ Insert the stopper for the yoke connecting pin securely.

★ Adjust the cable when connecting the rod.
For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

※3

★ Insert the stopper for the yoke connecting pin securely.

★ Adjust the cable when connecting it.
For details, see TESTING AND ADJUSTING, Adjusting directional linkage and Adjusting speed linkage.

※4

★ Insert the stopper for the yoke connecting pin securely.

★ Adjust the cable when connecting it.
For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

※5

★ Insert the stopper for the yoke connecting pin securely.

★ Adjust the cable when connecting the rod.
For details, see TESTING AND ADJUSTING, Adjusting parking brake lever.

※6

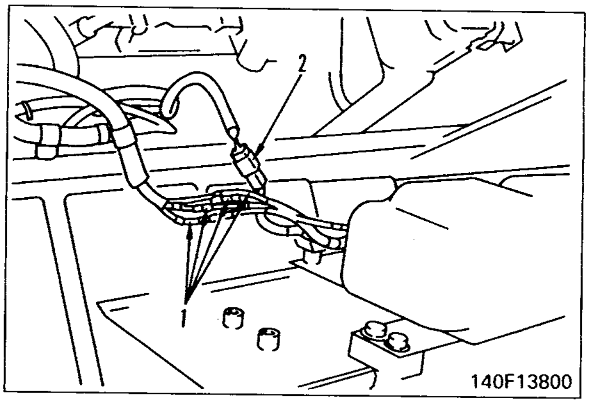
kgm Front mount bolt: **548.8 ± 58.8 Nm (56 ± 6 kgm)**

kgm Suspension bolt: **110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)**

REMOVAL OF FLOOR FRAME ASSEMBLY

D65EX-12 60942 and up
D65PX-12 60915 and up

1. Remove operator's cab assembly or canopy assembly.
   For details, see REMOVAL OF OPERATOR CAB ASSEMBLY (operator's cab specification), or REMOVAL OF CANOPY ASSEMBLY (canopy specification).

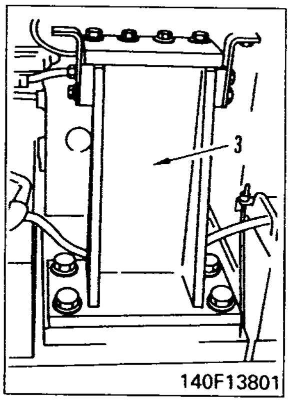


140F13800

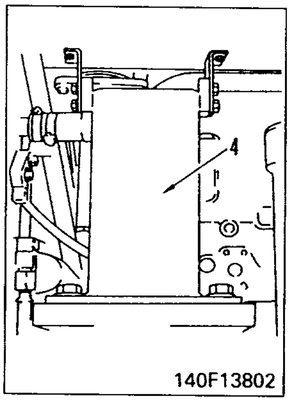
2. Remove engine right side cover.
   ★ For the cab specification machine, disconnect washer hose (1) and wiring harness (2).

3. Remove operator's seat left side cover and right side cover.

   kg Left side cover: **45 kg**



140F13801



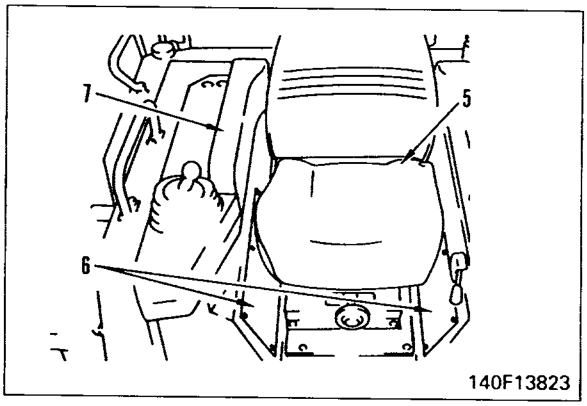
140F13802

4. Remove fender side mount brackets (3) and (4). (Cab specification only)

5. Remove operator's seat assembly (5).

   kg Operator's seat assembly: **35 kg**

6. Remove 3 operator's seat side covers (6).



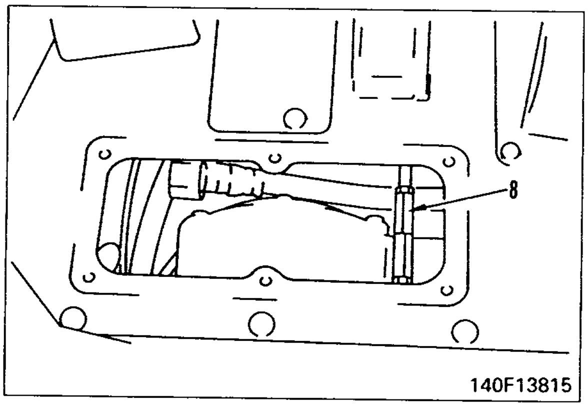
140F13823

7. Remove right armrest (7).
   ★ Two of the bolts at the inside top of the right side suspension are tightened from the top, so remove this armrest.

8. Remove dashboard assembly.
   For details, see REMOVAL OF DASHBOARD ASSEMBLY.

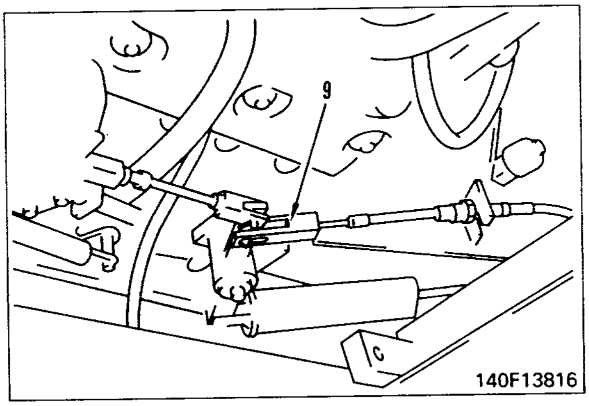
9. Remove floor plate.

10. Disconnect brake rod (8). ※1

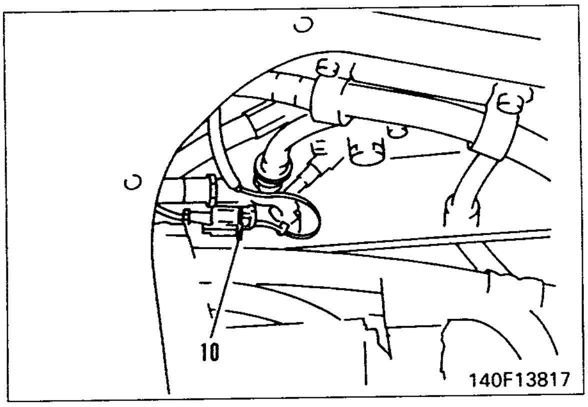


140F13815

11. Disconnect deceleration pedal linkage (9) (at engine end). ※ 2



12. Disconnect torque converter oil temperature sensor connector (10) (CN28).



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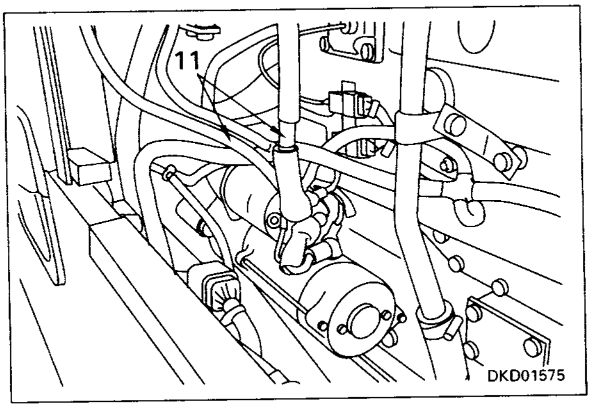
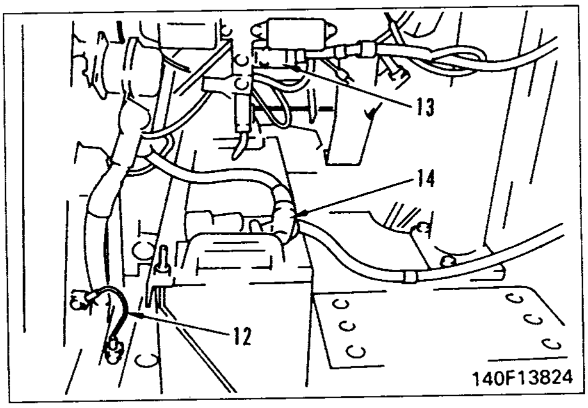
13. Disconnect starting motor wiring (11) .

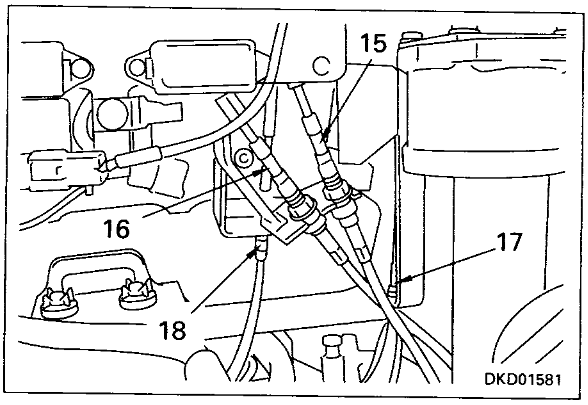


14. Disconnect floor frame ground connection (12), fuel level sensor, connector (13) (CN4) for rear lamp, and (+) terminal (14) of front battery.

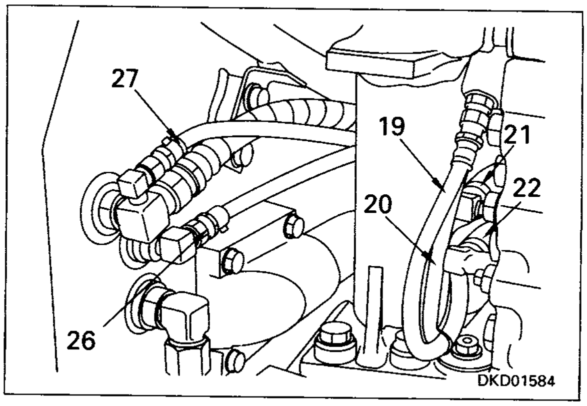


15. Disconnect directional control cable (15) and speed cable (16) ※ 3

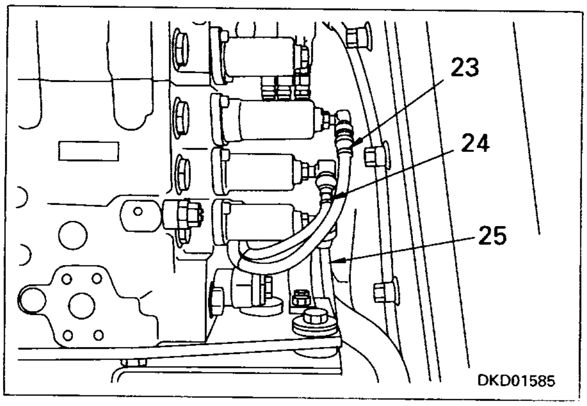
16. Disconnect fuel control cable (17) at lever end. ※ 4

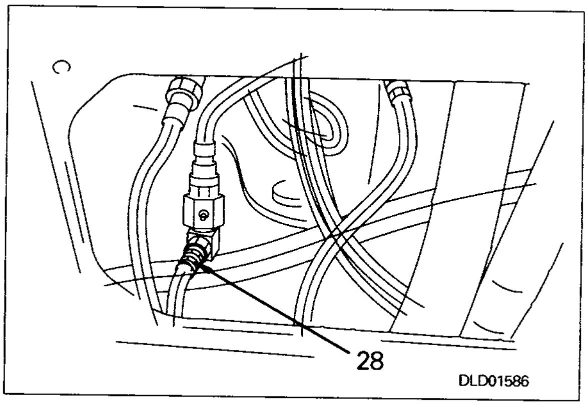


17. Disconnect parking lever (safety lock lever) control cable (18) at lever end. ※ 5



18. Disconnect pilot hoses (19), (20), (21), (22), (23), (24), (25), (26), (27) and (28).





19. Disconnect steering pilot hose (29).

20. Lift off floor frame assembly (27). ※ 6

- ★ For the rear right suspension, remove 4 bolts at the top, and for the rear left suspension, remove 4 bolts at the bottom.
- ★ Be careful not to damage the control cable or rod and wiring when removing.

kg Floor frame assembly: **350 kg**

INSTALLATION OF FLOOR FRAME ASSEMBLY

D65EX-12 60942 and up
D65PX-12 60915 and up

- Carry out installation in the reverse order to removal.

※ 1

- ★ Adjust the rod when connecting it.
  For details, see TESTING AND ADJUSTING, Adjusting brake pedal linkage.

※ 2

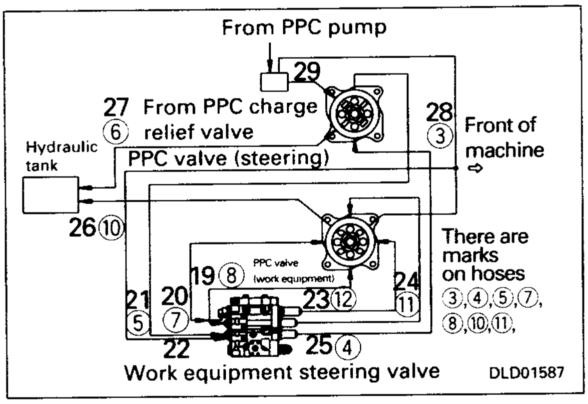
- ★ Insert the stopper for the yoke connecting pin securely.
- ★ Adjust the cable when connecting the rod.
  For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

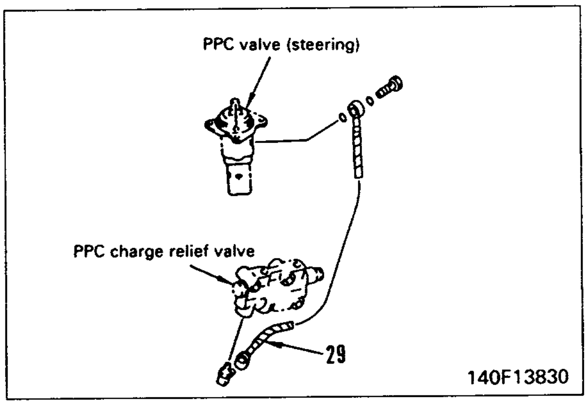
※ 3

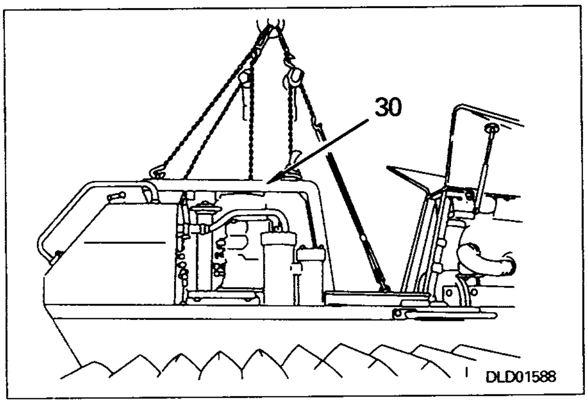
- ★ Insert the stopper for the yoke connecting pin securely.
- ★ Adjust the cable when connecting it.
  For details, see TESTING AND ADJUSTING, Adjusting directional linkage and Adjusting speed linkage.

※ 4

- ★ Insert the stopper for the yoke connecting pin securely.
- ★ Adjust the cable when connecting it.
  For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.







※ 5

- ★ Insert the stopper for the yoke connecting pin securely.
- ★ Adjust the cable when connecting the rod.
  For details, see TESTING AND ADJUSTING, Adjusting parking brake lever.

※ 6

kgm Front mount bolt: **548.8 ± 58.8 Nm (56 ± 6 kgm)**

kgm Suspension bolt: **110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)**

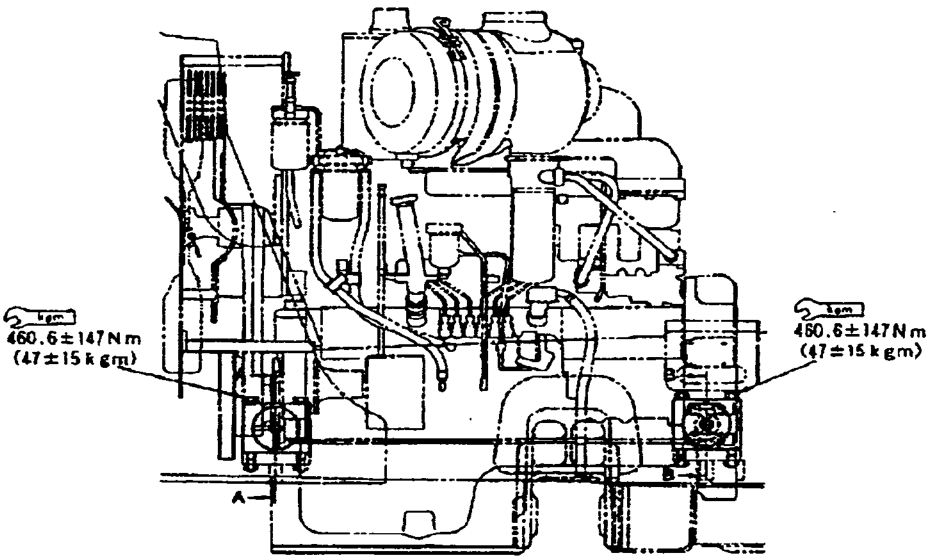
40 MAINTENANCE STANDARD

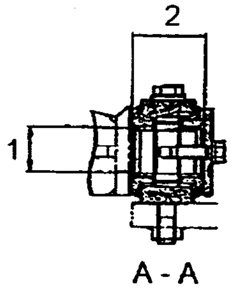
PPC valve

014012

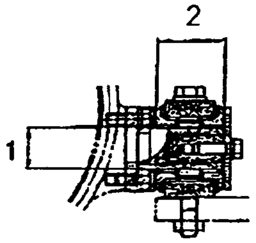
ENGINE MOUNT

WITH MOUNT RUBBER





A - A



B -B

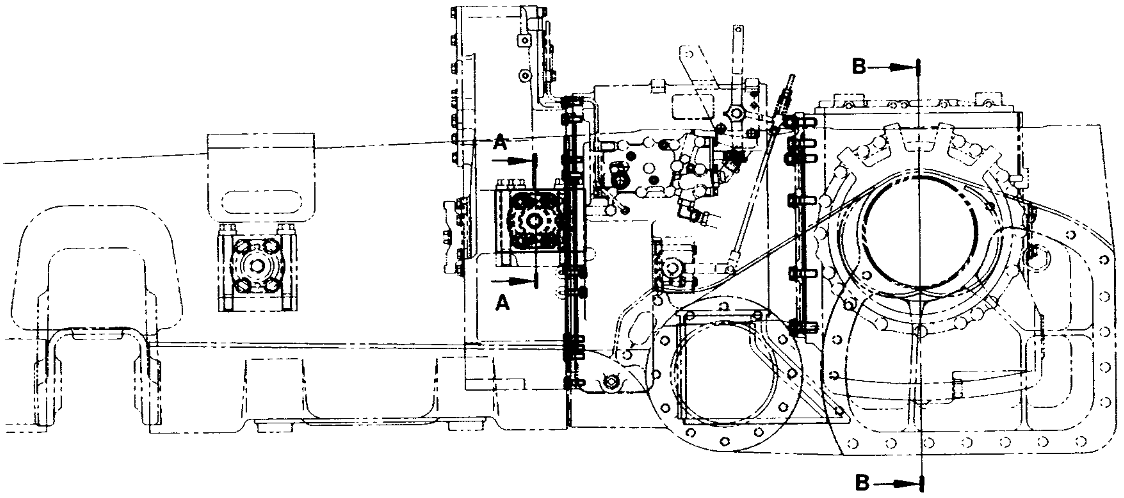
140F12216A

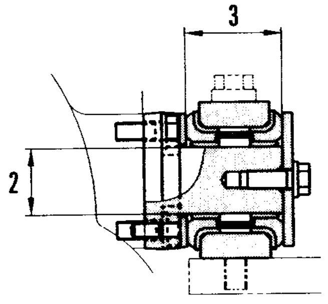
140F12216B

Unit:mm

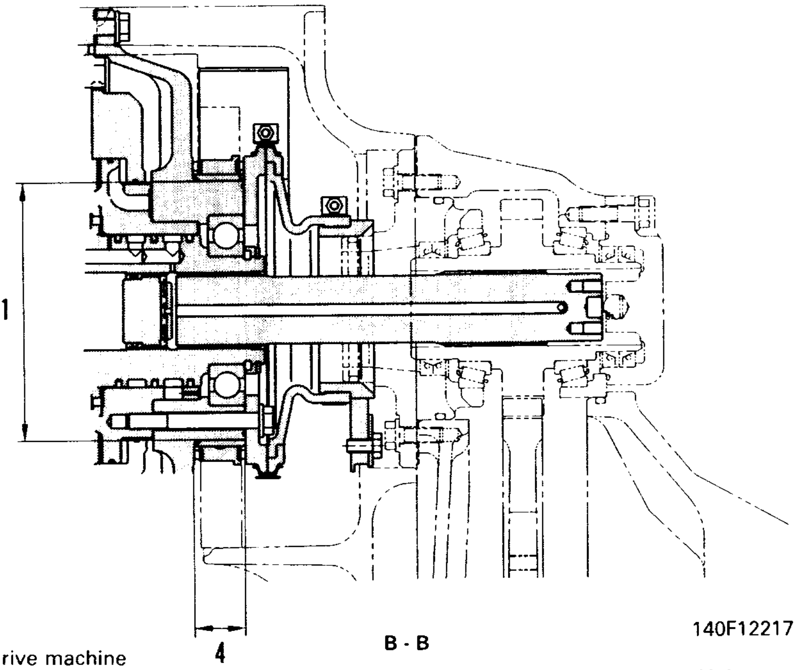
No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between bracket and cushion	60	−0.1 −0.3	+0.046 0	0.1 — 0.346	0.4	Replace
2	Free height of mount rubber	Standard size		Repair limit			
		90		88			

POWER TRAIN UNIT MOUNT





A - A



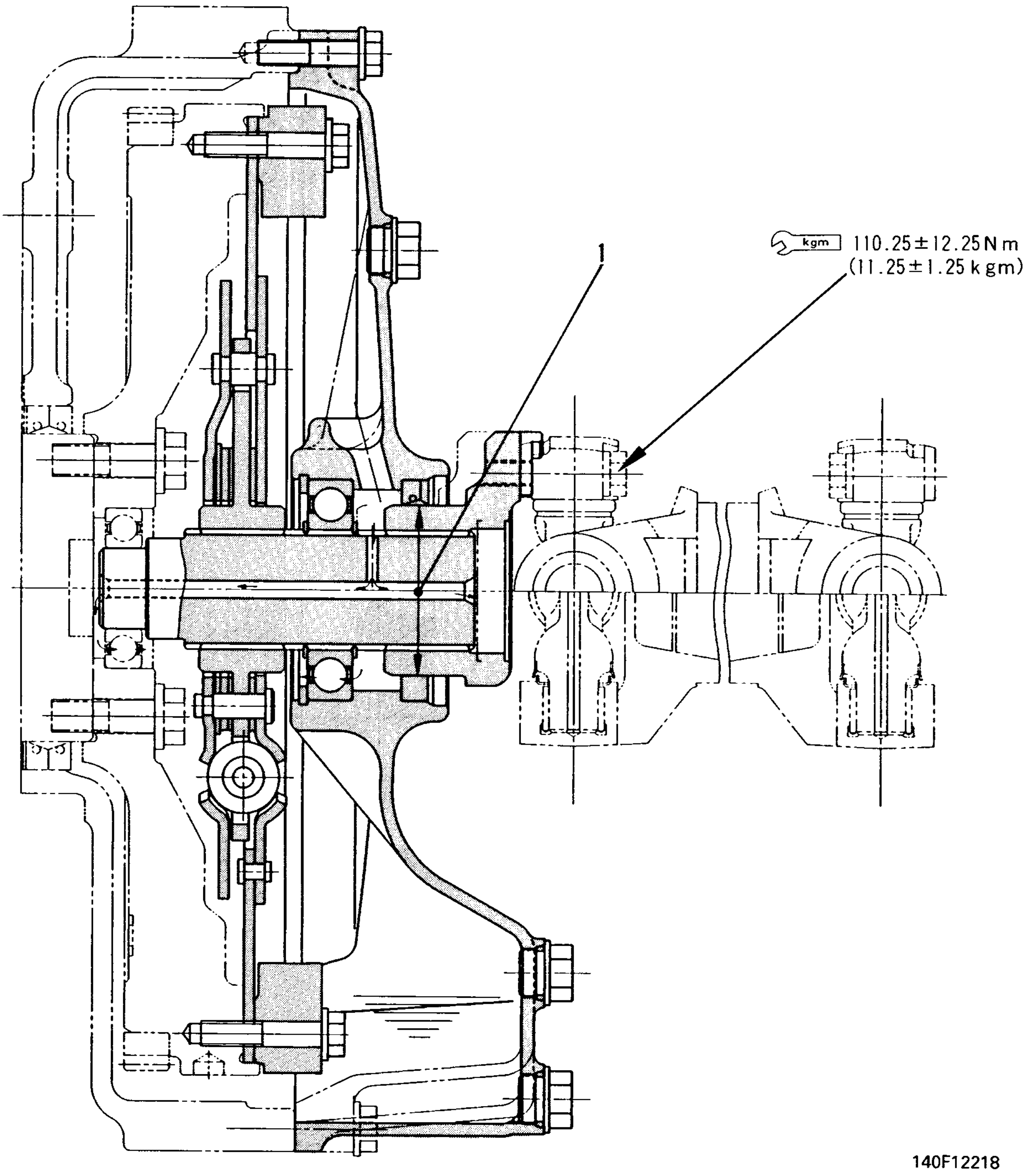
B - B

140F12217

★ This diagram shows the condition of the direct drive machine (D60P-12).

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Interference between steering case and bushing	204	+0.096 +0.050	+0.046 0	−0.096 — − 0.004	Max. 0	Replace
2	Clearance between bracket and cushion	60	−0.1 −0.3	+0.046 0	0.1 — 0.346	0.4	
3	Free height of front mount rubber	Standard size			Repair limit		
		90			88		
4	Free height of rear mount rubber	43			41		

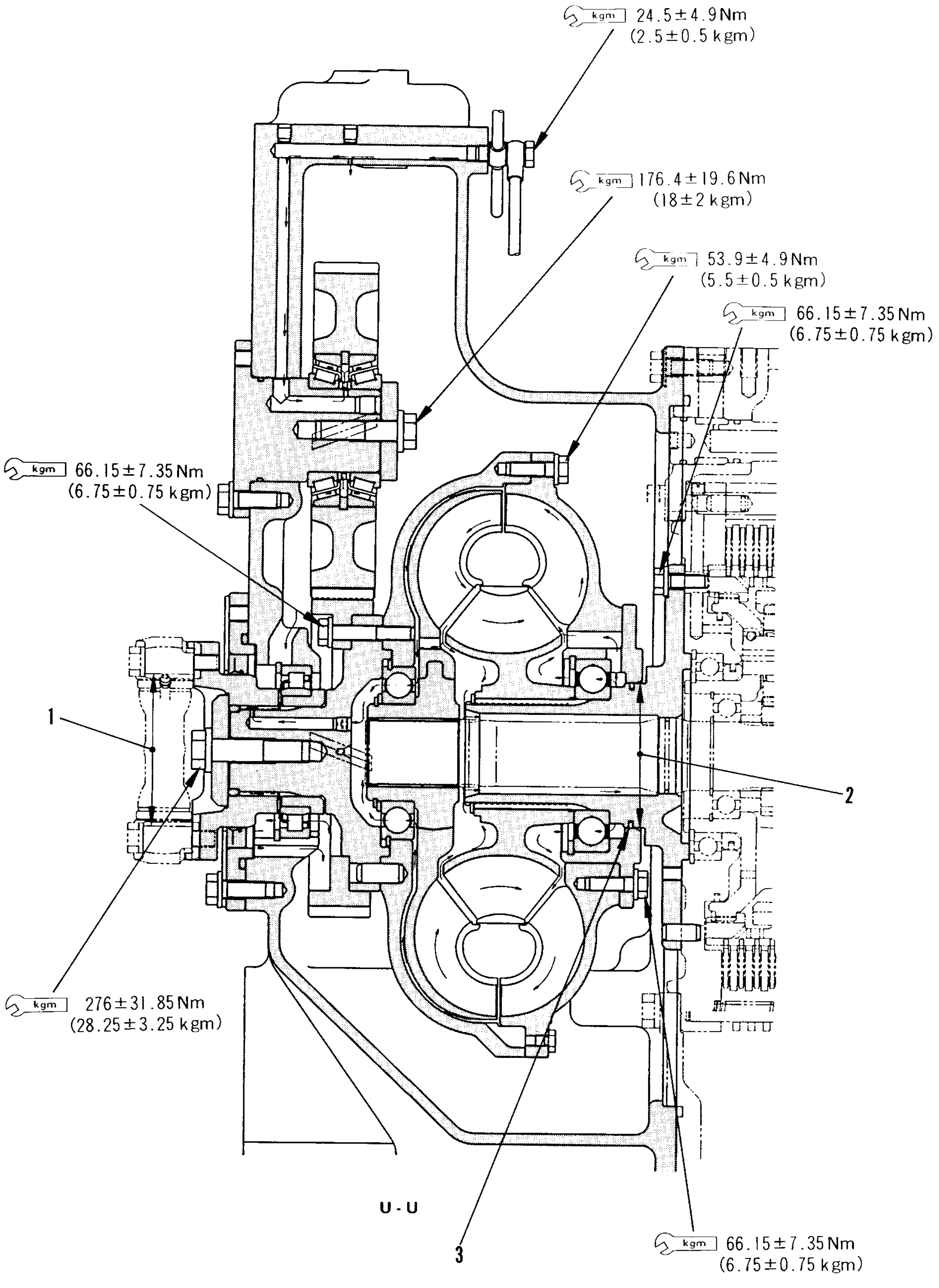


140F12218

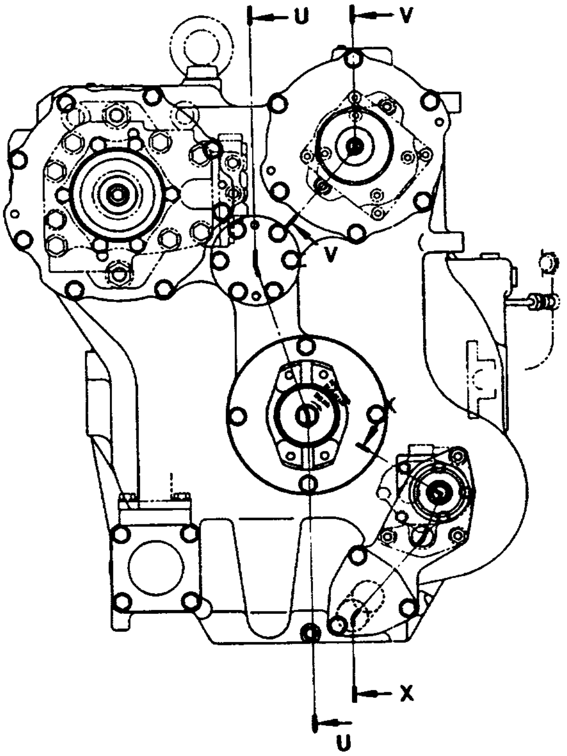
Unit: mm

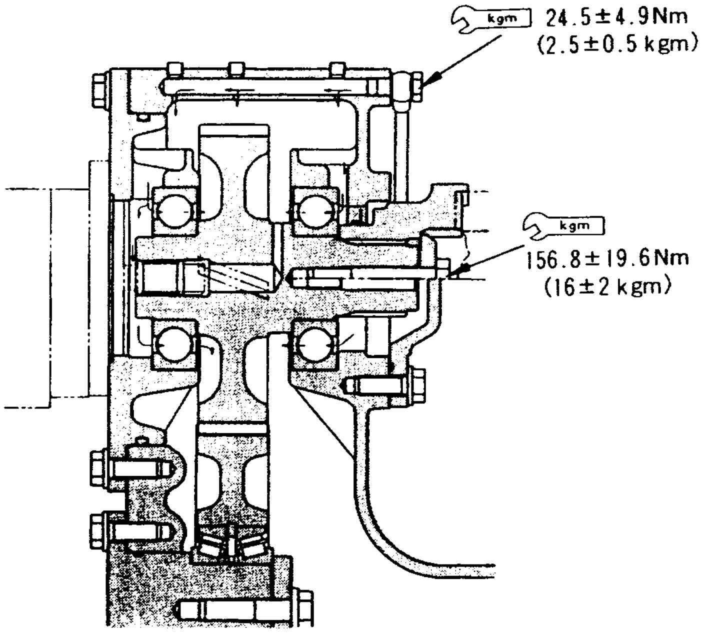
No.	Check item	Criteria			Remedy
		Standard size	Tolerance	Repair limit	
1	Outside diameter of oil seal contact surface of coupling	85	0 −0.087	84.8	Correct or replace
—	Face runout, radial runout of coupling	Face runout: Max.1.0 (at ø148.38), Radial runout: Max. 1.5 (When damper output shaft and transmission input shaft are rotated at the same time.)			Adjust

TORQUE CONVERTER, PTO

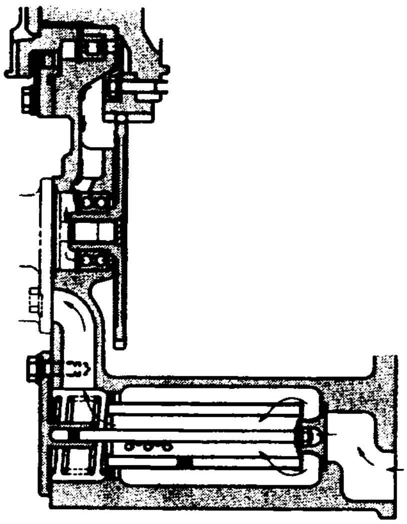


140F12225





V · V



X · X

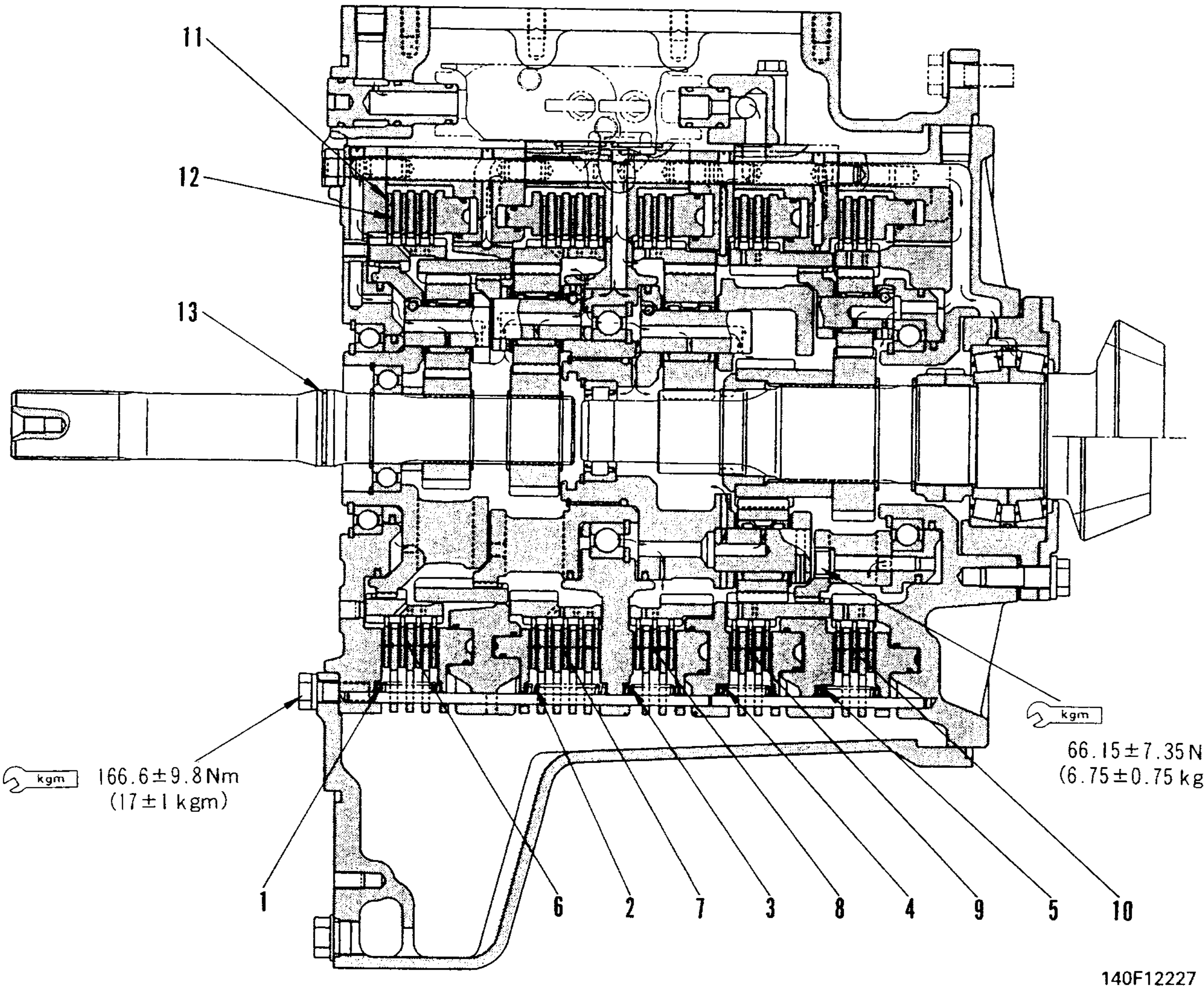
140F12226

Unit: mm

No.	Check item	Criteria			Remedy
		Standard size	Tolerance	Repair limit	
1	Outside diameter of oil seal contact surface of coupling	110	0 −0.087	109.8	Repair hard chrome plating or replace
2	Inside diameter of seal ring contact surface of retainer	105	+0.035 0	105.5	
		Standard size		Repair limit	
3	Wear of stator shaft seal ring	Width: 3 Height: 4		Width: 2.7 Height: 3.6	Replace

TRANSMISSION

D65E, P-12 60001 – 65000
D65EX, PX-12 60001 – 65000



166.6±9.8Nm
(17±1 kgm)

66.15±7.35Nm
(6.75±0.75 kgm)

140F12227

014012

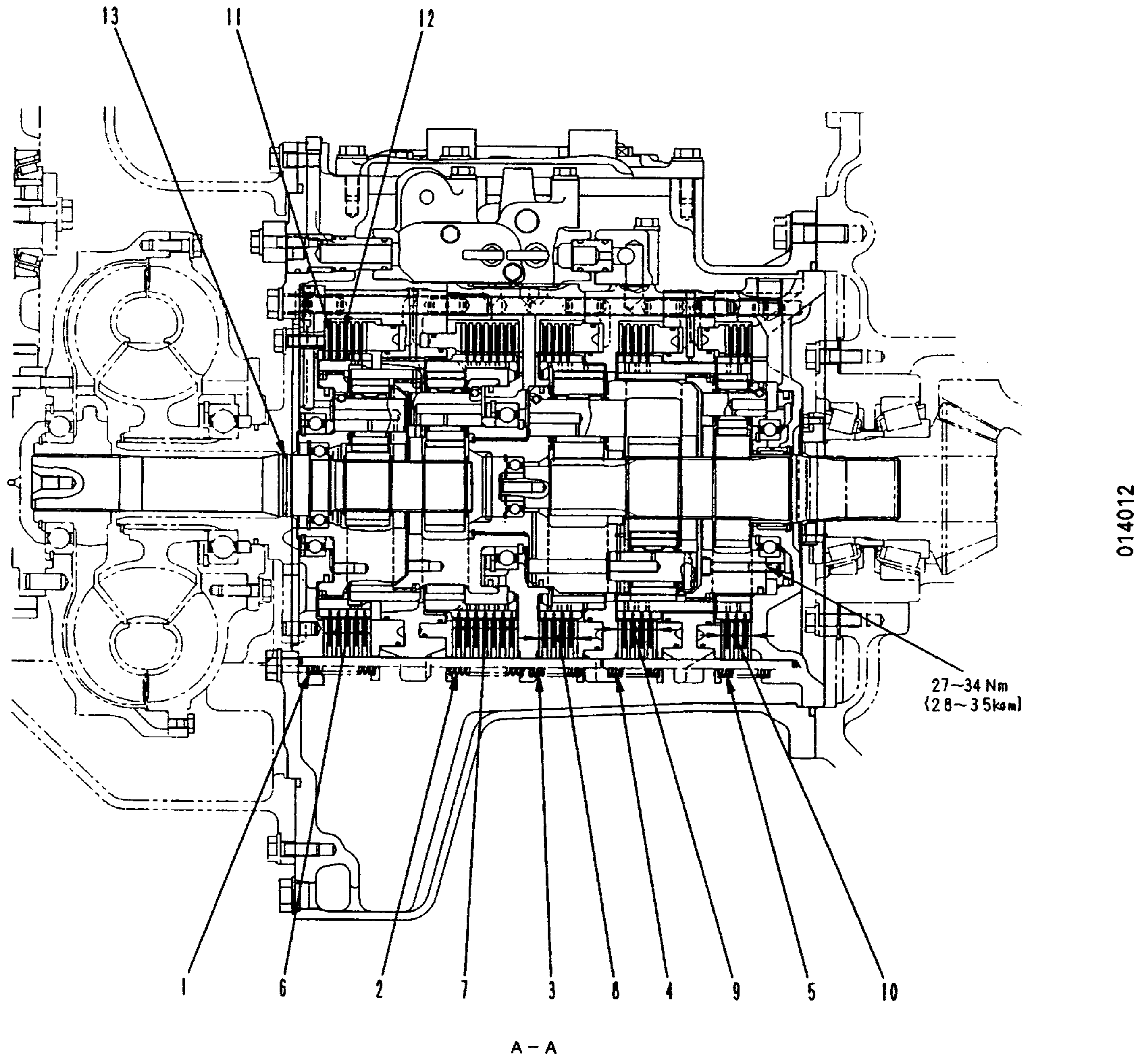
014012

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
1	No. 1 clutch spring (×10)	59.0	47.5	112.8 N (11.5 kg)	55.5	96.1 N (9.8 kg)	Replace
2	No. 2 clutch spring (×10)	69.5	58	248.1 N (25.3 kg)	65.3	210.8 N (21.5 kg)	
3	No. 3 clutch spring (×10)	54	40	98.1 N (10.0 kg)	50.8	83.4 N (8.5 kg)	
4	No. 4 clutch spring (×10)	54	40.5	93.2 N (9.5 kg)	50.8	79.4 N (8.1 kg)	
5	No. 5 clutch spring (×10)	54	45	65.7 N (6.7 kg)	50.8	55.9 N (5.7 kg)	

No.	Check item	Standard size	Tolerance	Repair limit	Remedy
6	Total assembled thickness of No. 1 clutch	40	± 0.3	37.9	
7	Total assembled thickness of No. 2 clutch	50	± 0.3	47.3	
8	Total assembled thickness of No. 3 clutch	30.5	± 0.2	28.9	
9	Total assembled thickness of No. 4 clutch	29.5	± 0.2	27.9	
10	Total assembled thickness of No. 5 clutch	29.5	± 0.2	27.9	
11	Thickness of No. 1 — 5 clutch discs	5.0	± 0.1	4.5	
12	Thickness of No. 1 — 5 clutch plates	5.0	± 0.1	4.5	
13	Wear of seal ring on transmission input shaft	Width: 3.0 Thickness: 2.3	Width: $^{-0.01}_{-0.03}$ Thickness: ± 0.10	Width: 2.7 Thickness: 2.2	

D65E, P-12 65001 and up
D65EX, PX-12 65001 and up



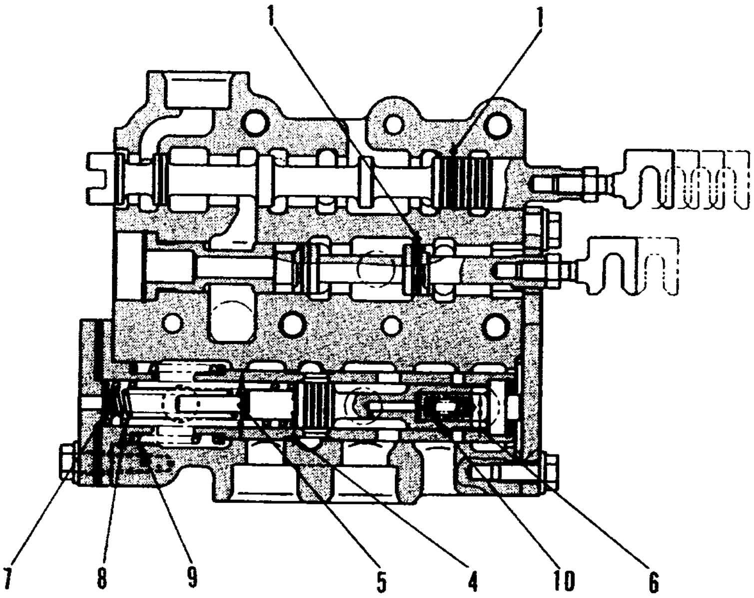
SJD04045

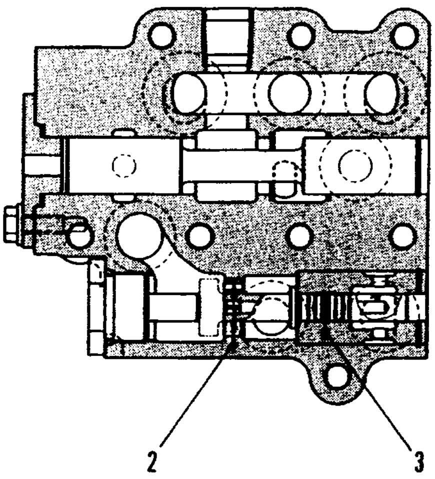
Unit: mm

<table>
<tr><th rowspan="3">No.</th><th rowspan="3">Check item</th><th colspan="6">Criteria</th><th rowspan="3">Remedy</th></tr>
<tr><th colspan="3">Standard size</th><th colspan="3">Repair limit</th></tr>
<tr><th>Free length</th><th>Installed length</th><th>Installed load</th><th colspan="2">Free length</th><th>Installed load</th></tr>
<tr><td>1</td><td>No.1 clutch spring (X10)</td><td>69.5</td><td>58.7</td><td>233 N
{23.8 kg}</td><td colspan="2">65.3</td><td>198 N
{20.2 kg}</td><td rowspan="13">Replace</td></tr>
<tr><td>2</td><td>No. 2 clutch spring (X10)</td><td>69.5</td><td>63.6</td><td>127 N
{13.0 kg}</td><td colspan="2">65.3</td><td>109 N
{11.1 kg}</td></tr>
<tr><td>3</td><td>No. 3 clutch spring (X10)</td><td>59</td><td>44.1</td><td>146 N
{14.9 kg}</td><td colspan="2">55.5</td><td>125 N
{12.7 kg}</td></tr>
<tr><td>4</td><td>No. 4 clutch spring (X10))</td><td>59</td><td>44.5</td><td>142 N
{14.5 kg}</td><td colspan="2">55.5</td><td>121 N
{12.3 kg}</td></tr>
<tr><td>5</td><td>No. 5 clutch spring (X10)</td><td>59</td><td>44.3</td><td>144 N
{14.7 kg}</td><td colspan="2">55.5</td><td>123 N
{12.5 kg}</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Total assembled thickness of No. 1 clutch</td><th colspan="2">Standard size</th><th colspan="2">Tolerance</th><th colspan="2">Repair limit</th></tr>
<tr><td colspan="2">36.2</td><td colspan="2">± 0.3</td><td colspan="2">32.2</td></tr>
<tr><td>7</td><td>Total assembled thickness of No. 2 clutch</td><td colspan="2">49.4</td><td colspan="2">± 0.4</td><td colspan="2">43.8</td></tr>
<tr><td>8</td><td>Total assembled thickness of No. 3 clutch</td><td colspan="2">29.6</td><td colspan="2">± 0.3</td><td colspan="2">26.4</td></tr>
<tr><td>9</td><td>Total assembled thickness of No. 4 clutch</td><td colspan="2">29.6</td><td colspan="2">± 0.3</td><td colspan="2">26.4</td></tr>
<tr><td>10</td><td>Total assembled thickness of No. 5 clutch</td><td colspan="2">23.0</td><td colspan="2">± 0.3</td><td colspan="2">20.6</td></tr>
<tr><td>11</td><td>Thickness of No. 1 – 5 clutch discs</td><td colspan="2">3.4</td><td colspan="2">± 0.1</td><td colspan="2">2.6</td></tr>
<tr><td>12</td><td>Thickness of No. 1 – 5 clutch plates</td><td colspan="2">3.2</td><td colspan="2">± 0.1</td><td colspan="2">2.9</td></tr>
<tr><td>13</td><td>Wear of seal ring on transmission input shaft</td><td colspan="2">Width: 3.0
Thickness: 2.3</td><td colspan="2">Width: $^{-0.01}_{-0.03}$
Thickness: ± 0.10</td><td colspan="2">Width: 2.7
Thickness: 2.2</td></tr>
</table>

TRANSMISSION CONTROL VALVE

D65E-12 60001 — 60650
D65P-12 60001 — 60685
D65EX-12 60001 — 60654
D65PX-12 60001 — 60688





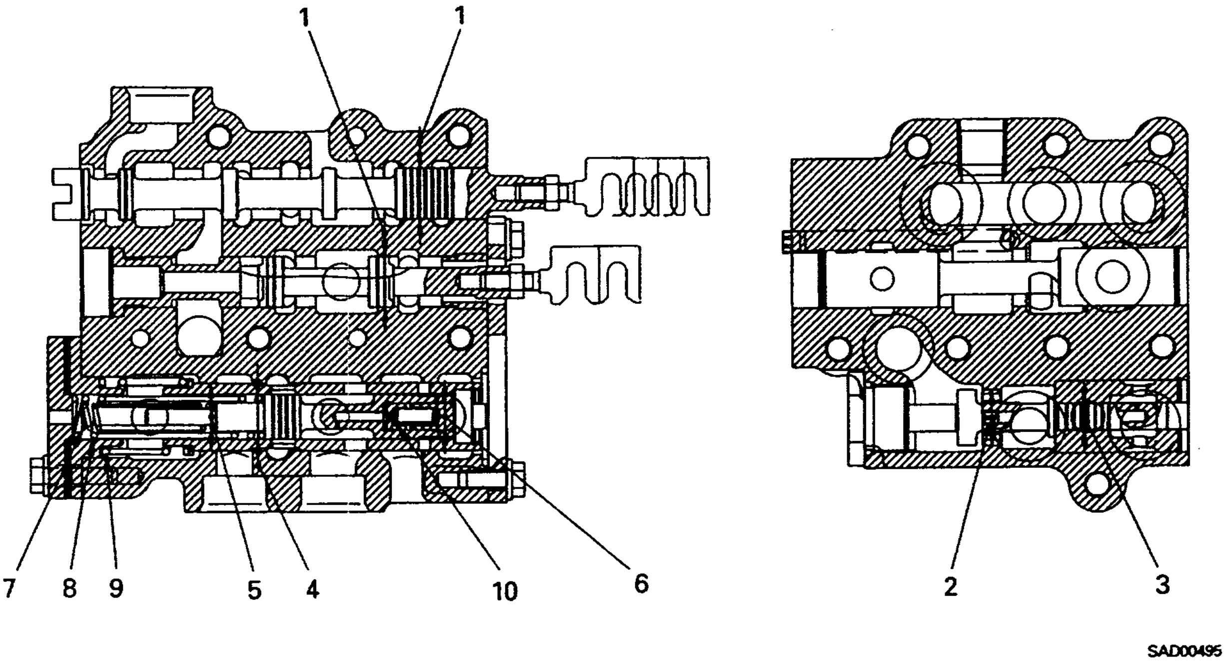
140F12228

014012

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between speed valve, directional valve and valve body	22	−0.035 −0.045	+0.013 0	0.035 — 0.058	0.08	Replace
2	Clearance between quick return valve and valve body	25	0 −0.1	+0.033 0	0 — 0.133	0.16	
3	Clearance between quick return valve and sleeve	12	−0.035 −0.045	+0.011 0	0.035 — 0.056	0.08	
4	Clearance between modulating valve and sleeve	20	−0.035 −0.045	+0.013 0	0.035 — 0.058	0.08	
5	Clearance between modulating valve sleeve and valve body	30	−0.035 −0.045	+0.013 0	0.035 — 0.058	0.08	
6	Clearance between modulating valve and piston	12	−0.020 −0.030	+0.018 0	0.020 — 0.048	0.07	
		Standard size			Repair limit		
		Free length × O.D.	Installed length	Installed load	Free length	Installed load	
7	Modulating valve spring (inner)	59 × 12	46.6	129.7 N (13.2 kg)	57.2	122.5 N (12.5 kg)	
8	Modulating valve spring (outer)	84.5 ×19.4	67.5	237.1 N (24.2 kg)	82	225.5 N (23.0 kg)	
9	Modulating valve spring	52 × 34.2	21	266.7 N (27.2 kg)	50.4	253.0 N (25.8 kg)	
10	Modulating valve piston spring	26 × 7.3	20	4.9 N (0.5 kg)	25.2	4.6 N (0.47 kg)	

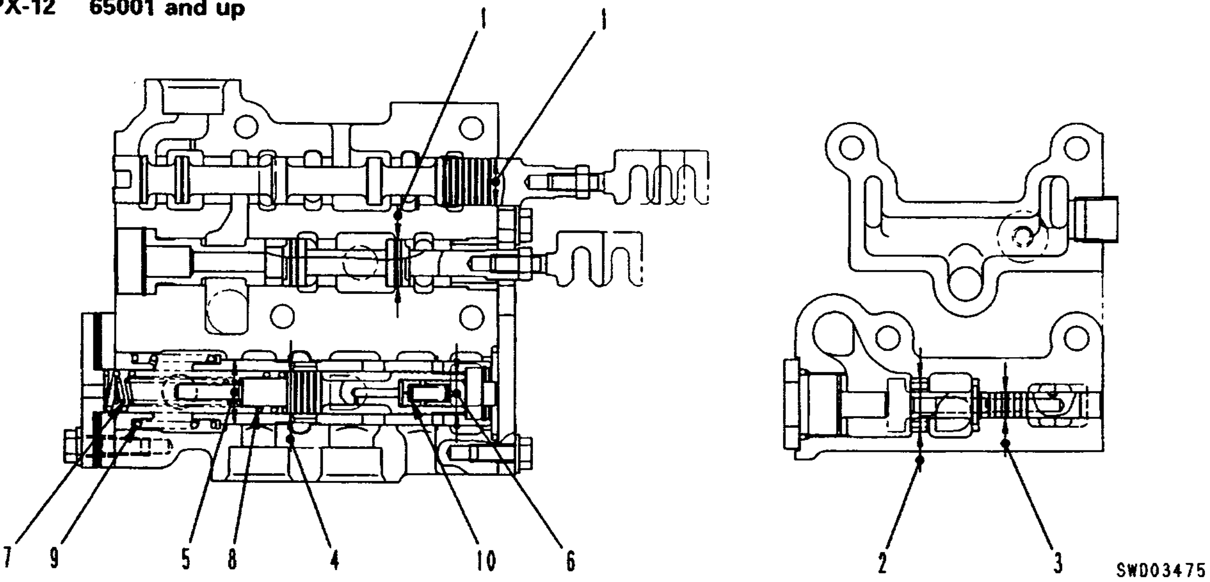
D65E-12 60651 – 65000
D65P-12 60686 – 65000
D65EX-12 60655 – 65000
D65PX-12 60689 – 65000



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between speed valve, directional valve and valve body	22	−0.035 −0.045	+0.013 0	0.035 — 0.058	0.08	Replace
2	Clearance between quick return valve and valve body	25	0 −0.1	+0.033 0	0 — 0.133	0.16	
3	Clearance between quick return valve and sleeve	12	−0.035 −0.045	+0.011 0	0.035 — 0.056	0.08	
4	Clearance between modulating valve and sleeve	20	−0.035 −0.045	+0.013 0	0.035 — 0.058	0.08	
5	Clearance between modulating valve sleeve and valve body	30	−0.035 −0.045	+0.013 0	0.035 — 0.058	0.08	
6	Clearance between modulating valve and piston	12	−0.020 −0.030	+0.018 0	0.020 — 0.048	0.07	
7	Modulating valve spring (inner)	Standard size			Repair limit		
		Free length × O.D.	Installed length	Installed load	Free length	Installed load	
		59 × 12	46.6	129.7 N (13.2 kg)	57.2	122.5 N (12.5 kg)	
8	Modulating valve spring (outer)	84.5 ×19.4	67.5	237.1 N (24.2 kg)	82	225.5 N (23.0 kg)	
9	Modulating valve spring	52 × 34.2	21	266.7 N (27.2 kg)	50.4	253.0 N (25.8 kg)	
10	Modulating valve piston spring	26 × 7.3	20	4.9 N (0.5 kg)	25.2	4.6 N (0.47 kg)	

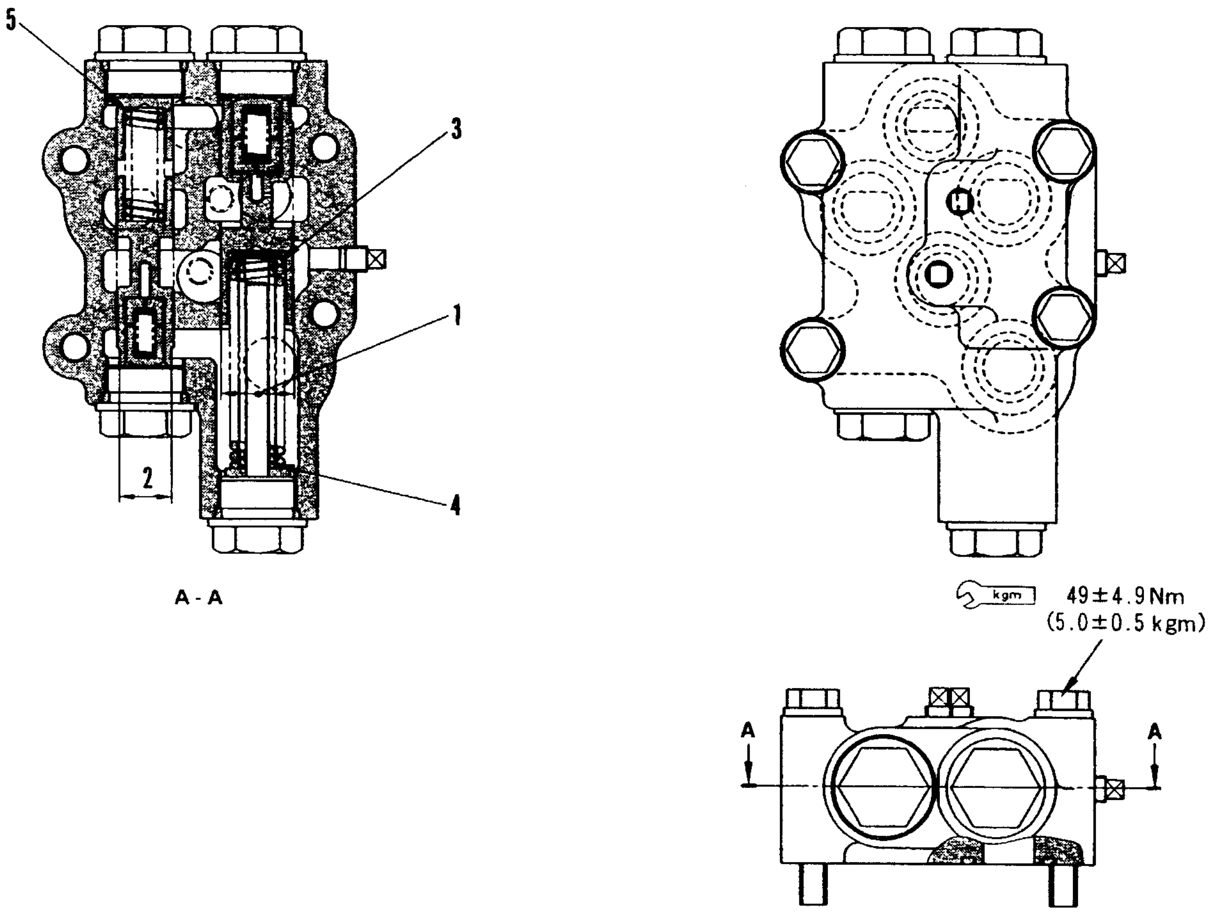
D65E-12 **65001 and up**
D65P-12 **65001 and up**
D65EX-12 **65001 and up**
D65PX-12 **65001 and up**



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between speed valve, directional valve and valve body	22	–0.035 –0.045	+0.013 0	0.035 – 0.058	0.08	Replace
2	Clearance between quick return valve and valve body	25	0 –0.1	+0.033 0	0 – 0.133	0.16	
3	Clearance between quick return valve and sleeve	12	–0.035 –0.045	+0.011 0	0.035 – 0.056	0.08	
4	Clearance between modulating valve and sleeve	20	–0.035 –0.045	+0.013 0	0.035 – 0.056	0.08	
5	Clearance between modulating valve sleeve and valve body	30	–0.035 –0.045	+0.013 0	0.035 – 0.058	0.08	
6	Clearance between modulating valve and piston	12	–0.020 –0.030	+0.018 0	0.020 – 0.048	0.07	
		Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
7	Modulating valve spring (inner)	59 x 12	46.6	129N {13.2 kg}	57.2	123N {12.5 kg}	
8	Modulating valve spring (outer)	84.5 x 19.4	67.6	237N {24.2 kg}	82	226N {23.0 kg}	
9	Modulating valve spring	52 x 34.2	21	267N {27.2 kg}	50.4	253N {25.8 kg}	
10	Modulating valve piston spring	26 x 7.3	20	4.9N {0.5 kg}	25.2	4.6N {0.47 kg}	

MAIN RELIEF VALVE



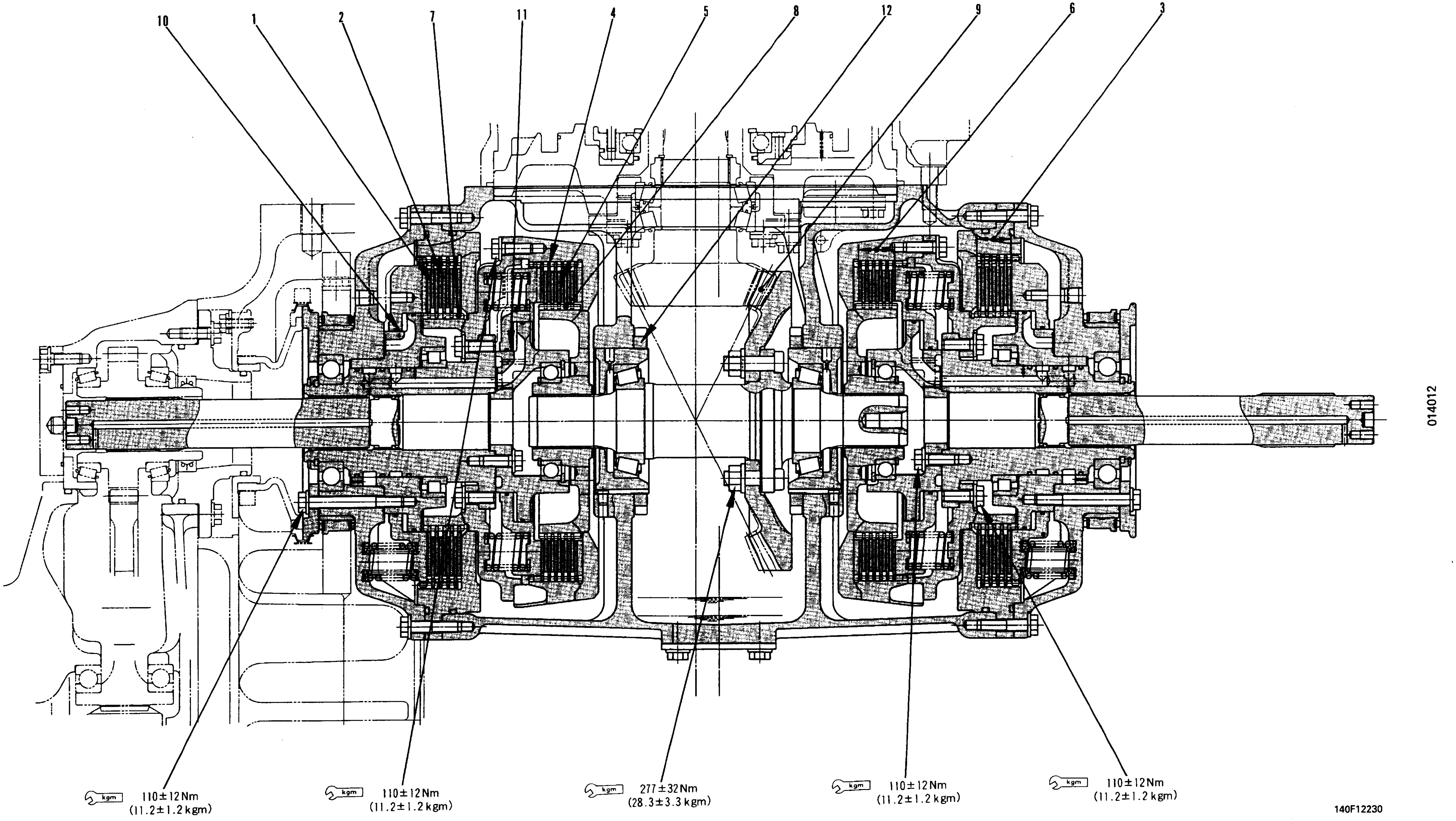
140F12229

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between main relief valve and valve body	28	−0.035 −0.045	+0.013 0	0.035 — 0.058	0.08	Replace
2	Clearance between torque converter relief valve and valve body	22	−0.035 −0.045	+0.013 0	0.035 — 0.058	0.08	
		Standard size			Repair limit		
3	Main relief valve spring (outer)	Free length	Installed length	Installed load	Free length	Installed load	
		128	75.3	509.0 N (51.9 kg)	124.2	483.5 N (49.3 kg)	
4	Main relief valve spring (inner)	108	75.3	402.1 N (41 kg)	104.8	382.5 N (39 kg)	
5	Torque converter relief valve spring	50	42	153.0 N (15.6 kg)	48.5	145.1 N (14.8 kg)	

BEVEL GEAR SHAFT, STEERING CLUTCH, STEERING BRAKE

D65E, P-12 60001 – 65000

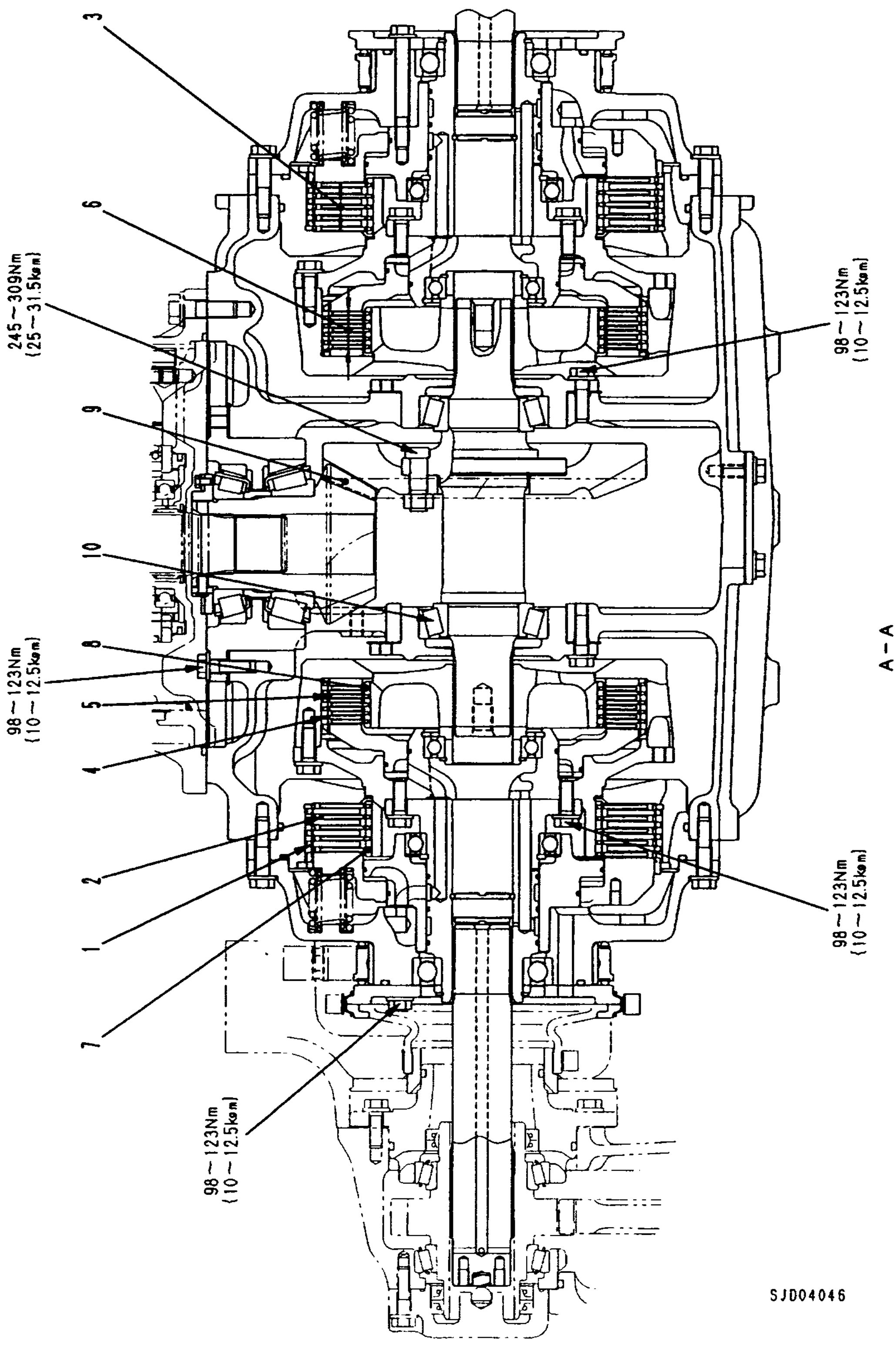


Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="4">1</td><td rowspan="2">Thickness of brake plate</td><td colspan="2">Standard size</td><td colspan="3">Repair limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="2">2.9</td><td colspan="3">2.6</td></tr>
<tr><td rowspan="2">Distortion of brake plate</td><td colspan="2">Tolerance</td><td colspan="3">Repair limit</td><td rowspan="2">Correct or replace</td></tr>
<tr><td colspan="2">less than 0.15</td><td colspan="3">0.3</td></tr>
<tr><td rowspan="4">2</td><td rowspan="2">Thickness of brake disc</td><td colspan="2">Standard size</td><td colspan="3">Repair limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="2">5.2</td><td colspan="3">4.9</td></tr>
<tr><td rowspan="2">Distortion of brake disc</td><td colspan="2">Tolerance</td><td colspan="3">Repair limit</td><td rowspan="2">Correct or replace</td></tr>
<tr><td colspan="2">less than 0.25</td><td colspan="3">0.4</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Total assembled thickness of brake plates and discs</td><td colspan="2">Standard size</td><td colspan="3">Repair limit</td><td rowspan="4">Replace</td></tr>
<tr><td colspan="2">37.6</td><td colspan="3">34.9</td></tr>
<tr><td rowspan="4">4</td><td rowspan="2">Thickness of clutch plate</td><td colspan="2">Standard size</td><td colspan="3">Repair limit</td></tr>
<tr><td colspan="2">2.6</td><td colspan="3">2.3</td></tr>
<tr><td rowspan="2">Distortion of clutch plate</td><td colspan="2">Tolerance</td><td colspan="3">Repair limit</td><td rowspan="2">Correct or replace</td></tr>
<tr><td colspan="2">less than 0.15</td><td colspan="3">0.3</td></tr>
<tr><td rowspan="4">5</td><td rowspan="2">Thickness of clutch disc</td><td colspan="2">Standard size</td><td colspan="3">Repair limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="2">4.7</td><td colspan="3">4.4</td></tr>
<tr><td rowspan="2">Distortion of clutch disc</td><td colspan="2">Tolerance</td><td colspan="3">Repair limit</td><td rowspan="2">Correct or replace</td></tr>
<tr><td colspan="2">less than 0.32</td><td colspan="3">0.4</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Total assembled thickness of clutch plates and discs</td><td colspan="2">Standard size</td><td colspan="3">Repair limit</td><td rowspan="4">Replace</td></tr>
<tr><td colspan="2">39.1</td><td colspan="3">35.8</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Backlash of brake disc and brake inner drum</td><td colspan="2">Standard clearance</td><td colspan="3">Clearance limit</td></tr>
<tr><td colspan="2">0.3 — 0.7</td><td colspan="3">1.0</td></tr>
<tr><td>8</td><td>Backlash of clutch disc</td><td colspan="2">0.3 — 0.7</td><td colspan="3">1.0</td><td>Adjust</td></tr>
<tr><td>9</td><td>Backlash of bevel gear and pinion</td><td colspan="2">0.20 — 0.28</td><td colspan="3">0.45</td><td>Adjust or replace</td></tr>
<tr><td rowspan="3">10</td><td rowspan="3">Seal ring contact surface of small diameter portion of brake piston</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="4">Replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>200</td><td>−0.100
−0.172</td><td>+0.072
0</td><td>0.100 — 0.244</td><td>—</td></tr>
<tr><td>11</td><td>Seal ring contact surface of small diameter portion of clutch piston</td><td>155</td><td>−0.085
−0.148</td><td>+0.063
0</td><td>0.085 — 0.211</td><td>—</td></tr>
<tr><td>12</td><td>Preload of taper roller bearing for bevel gear shaft</td><td colspan="5">Tighten bevel gear shaft nut 5 notches.
Reference when assembling new bearing:
Starting torque: 12.7 — 17.2 Nm (1.3 — 1.76 kgm)
Load at tip of bevel gear teeth: 78.5 — 107.9 N (8.0 — 11.0 kg)</td><td>Adjust</td></tr>
</table>

014012

D65E, P-12 65001 and up



014012

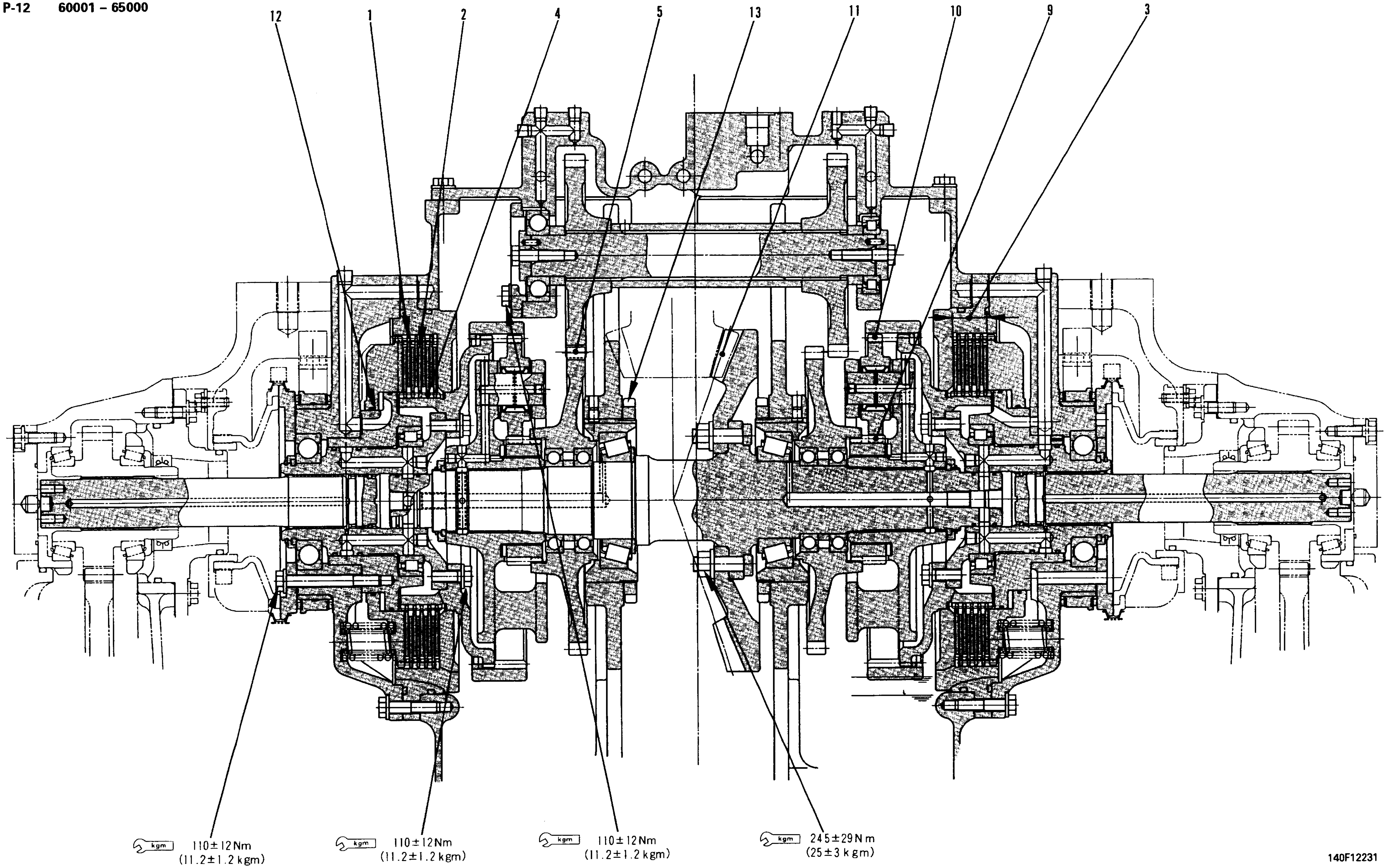
014012

Unit: mm

No.	Check item	Criteria		Remedy
1	Thickness of a brake plate	Standard size	Repair limit	Replace
		5.0	4.7	
	Distortion of brake plate	Tolerance	Repair limit	Correct or replace
		less than 0.15	0.3	
2	Thickness of brake disc	Standard size	Repair limit	Replace
		5.2	4.9	
	Distortion of brake disc	Tolerance	Repair limit	Correct or replace
		less than 0.25	0.4	
3	Total assembled thickness of brake plates and discs	Standard size	Repair limit	Replace
		46.0	43.3	
4	Thickness of clutch plate	Standard size	Repair limit	
		2.9	2.6	
	Distortion of clutch plate	Tolerance	Repair limit	Correct or replace
		less than 0.15	0.3	
5	Thickness of clutch disc	Standard size	Repair limit	Replace
		4.7	4.4	
	Distortion of clutch disc	Tolerance	Repair limit	Correct or replace
		less than 0.32	0.4	
6	Total assembled thickness of clutch plates and discs	Standard size	Repair limit	Replace
		35.1	32.4	
7	Backlash of brake disc and brake inner drum	Standard clearance	Clearance limit	
		0.3 – 0.7	1.0	
8	Backlash of clutch disc	0.3 – 0.7	1.0	
9	Backlash of bevel gear and pinion	0.20 – 0.28	0.45	Adjust
10	Preload of taper roller bearing for bevel gear shaft	If starting torque is below 9.8 Nm {1.0 kgm}, adjust pre-load. After pre-load is adjusted, starting torque must be 10.3 – 14.7 Nm {1.05 – 1.5 kgm}.		Adjust

BEVEL GEAR SHAFT, HSS STEERING, BRAKE (1/2)

D65E, P-12 **60001 – 65000**



140F12231

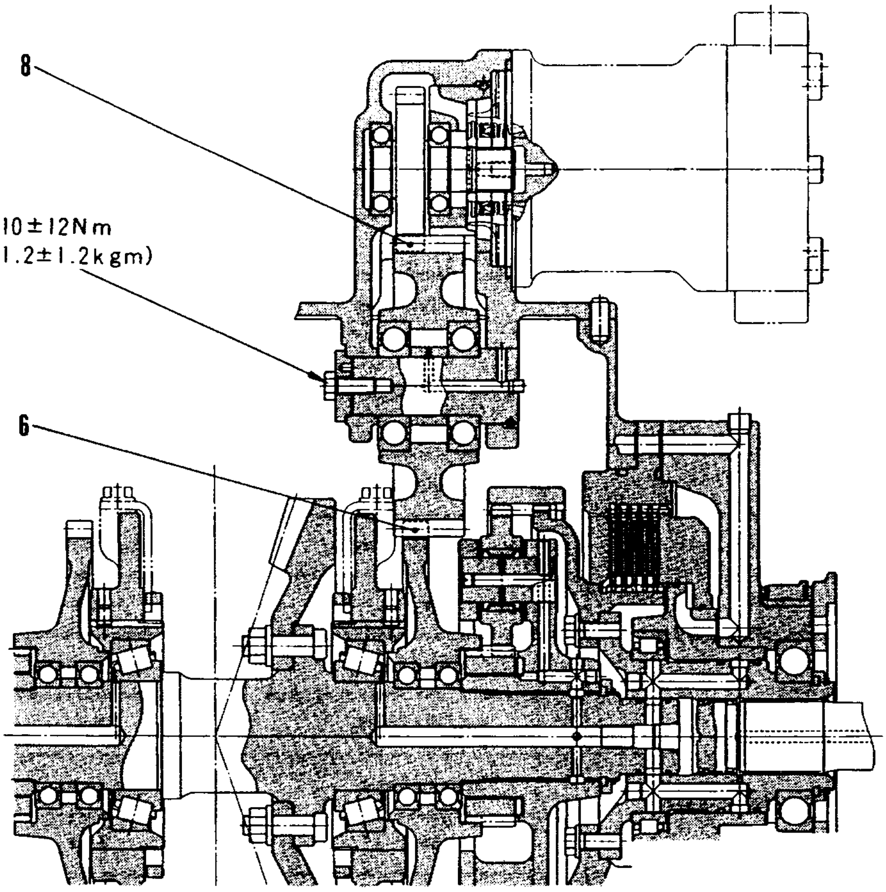
014012

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="4">1</td><td rowspan="2">Thickness of brake plate</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="3">2.9</td><td colspan="2">2.6</td></tr>
<tr><td rowspan="2">Distortion of brake plate</td><td colspan="3">Tolerance</td><td colspan="2">Repair limit</td><td rowspan="2">Correct or replace</td></tr>
<tr><td colspan="3">less than 0.15</td><td colspan="2">0.3</td></tr>
<tr><td rowspan="4">2</td><td rowspan="2">Thickness of brake disc</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="3">5.2</td><td colspan="2">4.9</td></tr>
<tr><td rowspan="2">Distortion of brake disc</td><td colspan="3">Tolerance</td><td colspan="2">Repair limit</td><td rowspan="2">Correct or replace</td></tr>
<tr><td colspan="3">less than 0.25</td><td colspan="2">0.4</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Total assembled thickness of brake plates and discs</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="10">Replace</td></tr>
<tr><td colspan="3">37.6</td><td colspan="2">34.9</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Backlash of brake disc and brake inner drum</td><td colspan="3">Standard clearance</td><td colspan="2">Clearance limit</td></tr>
<tr><td colspan="3">0.3 — 0.7</td><td colspan="2">1.0</td></tr>
<tr><td>5</td><td>Backlash between gear A and gear B</td><td colspan="3">0.26 — 0.64</td><td colspan="2">0.80</td></tr>
<tr><td>6</td><td>Backlash between gear A and gear D</td><td colspan="3">0.21 — 0.51</td><td colspan="2">0.70</td></tr>
<tr><td>7</td><td>Backlash between gear C and gear D</td><td colspan="3">0.25 — 0.63</td><td colspan="2">0.80</td></tr>
<tr><td>8</td><td>Backlash between gear D and pinion</td><td colspan="3">0.19 — 0.48</td><td colspan="2">0.70</td></tr>
<tr><td>9</td><td>Backlash between sun gear and planet pinion</td><td colspan="3">0.12 — 0.39</td><td colspan="2">0.60</td></tr>
<tr><td>10</td><td>Backlash between planet pinion and ring gear</td><td colspan="3">0.17 — 0.52</td><td colspan="2">0.70</td></tr>
<tr><td>11</td><td>Backlash between bevel gear and pinion</td><td colspan="3">0.25 — 0.33</td><td colspan="2">0.50</td><td>Adjust or replace</td></tr>
<tr><td rowspan="3">12</td><td rowspan="3">Seal ring contact surface of small diameter portion of brake piston</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>200</td><td>−0.100
−0.172</td><td>+0.072
0</td><td>0.100 — 0.244</td><td>—</td></tr>
<tr><td>13</td><td>Preload of taper roller bearing for bevel gear shaft</td><td colspan="5">Tighten bevel gear shaft nut 5 notches.
Reference when assembling new bearing:
Starting torque: 14.7 — 19.6 Nm (1.5 — 2.0 kgm)
Load at tip of bevel gear teeth: 78.5 — 107.9 N (8.0 — 11.0 kg)</td><td>Adjust</td></tr>
</table>

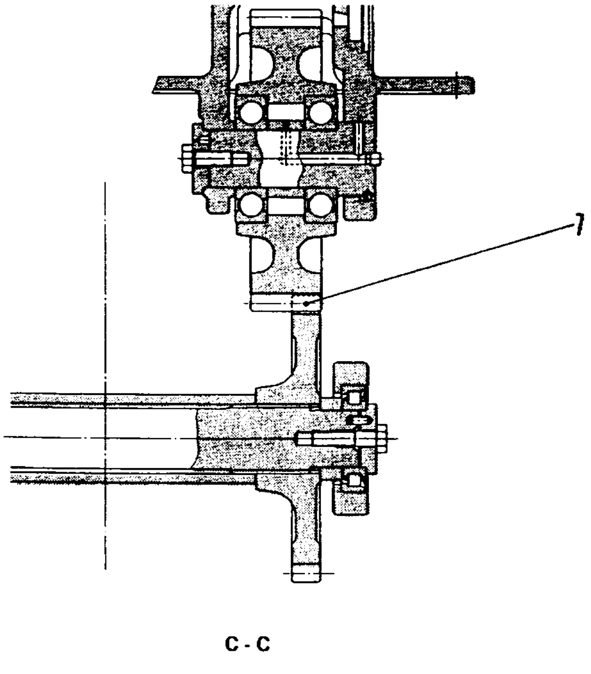
BEVEL GEAR SHAFT, HSS STEERING, BRAKE (2/2)

D65EX, PX-12 60001 – 65000



B - B

014012



C - C

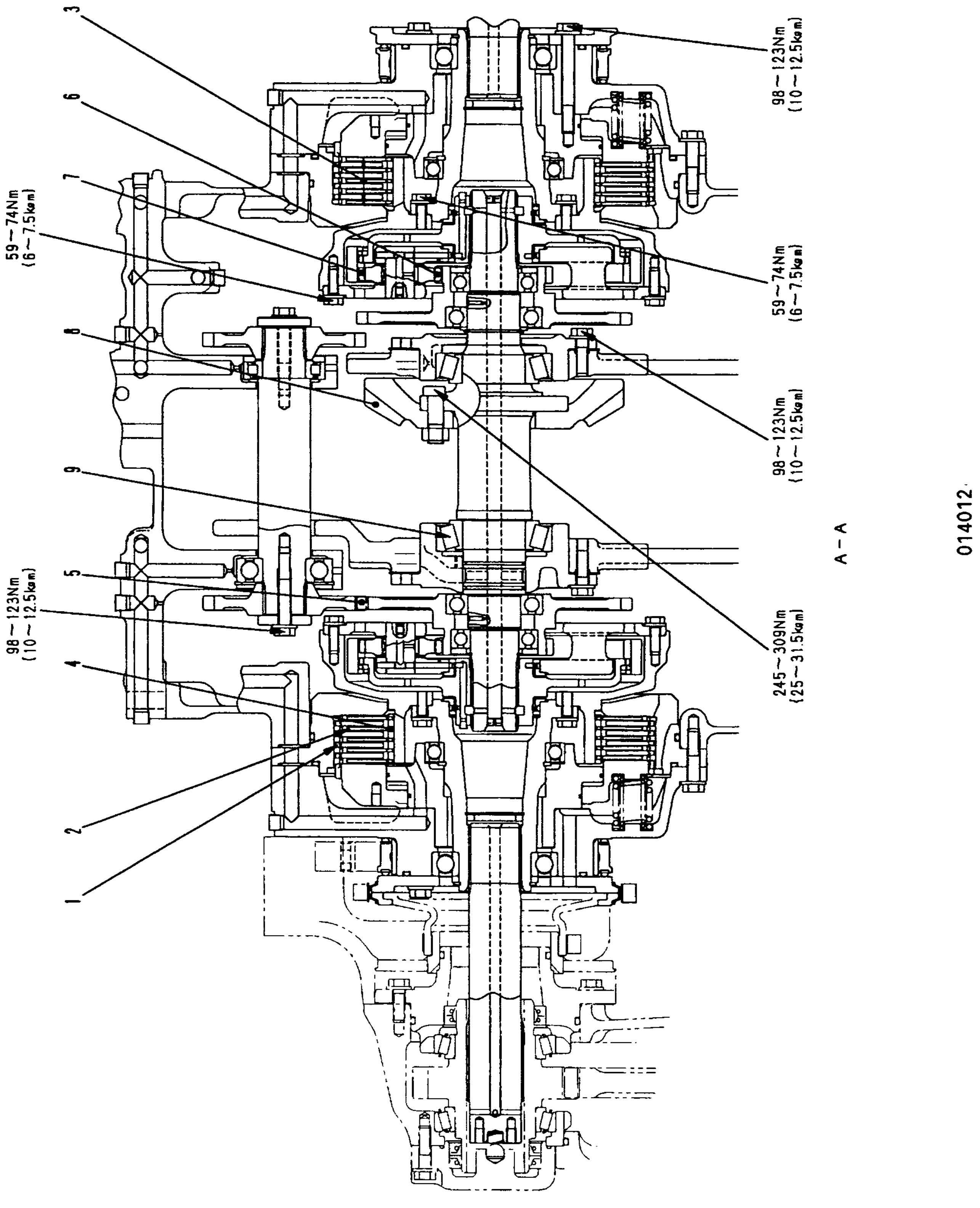
140F12232

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td>1</td><td>Thickness of brake plate</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td>Replace</td></tr>
<tr><td></td><td></td><td colspan="3">2.9</td><td colspan="2">2.6</td><td></td></tr>
<tr><td></td><td>Distortion of brake plate</td><td colspan="3">Tolerance</td><td colspan="2">Repair limit</td><td>Correct or replace</td></tr>
<tr><td></td><td></td><td colspan="3">less than 0.15</td><td colspan="2">0.3</td><td></td></tr>
<tr><td>2</td><td>Thickness of brake disc</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td>Replace</td></tr>
<tr><td></td><td></td><td colspan="3">5.2</td><td colspan="2">4.9</td><td></td></tr>
<tr><td></td><td>Distortion of brake disc</td><td colspan="3">Tolerance</td><td colspan="2">Repair limit</td><td>Correct or replace</td></tr>
<tr><td></td><td></td><td colspan="3">less than 0.25</td><td colspan="2">0.4</td><td></td></tr>
<tr><td>3</td><td>Total assembled thickness of brake plates and discs</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td>Replace</td></tr>
<tr><td></td><td></td><td colspan="3">37.6</td><td colspan="2">34.9</td><td></td></tr>
<tr><td>4</td><td>Backlash of brake disc and brake inner drum</td><td colspan="3">Standard clearance</td><td colspan="2">Clearance limit</td><td></td></tr>
<tr><td></td><td></td><td colspan="3">0.3 — 0.7</td><td colspan="2">1.0</td><td></td></tr>
<tr><td>5</td><td>Backlash between gear A and gear B</td><td colspan="3">0.26 — 0.64</td><td colspan="2">0.80</td><td></td></tr>
<tr><td>6</td><td>Backlash between gear A and gear D</td><td colspan="3">0.21 — 0.51</td><td colspan="2">0.70</td><td></td></tr>
<tr><td>7</td><td>Backlash between gear C and gear D</td><td colspan="3">0.25 — 0.63</td><td colspan="2">0.80</td><td></td></tr>
<tr><td>8</td><td>Backlash between gear D and pinion</td><td colspan="3">0.19 — 0.48</td><td colspan="2">0.70</td><td></td></tr>
<tr><td>9</td><td>Backlash between sun gear and planet pinion</td><td colspan="3">0.12 — 0.39</td><td colspan="2">0.60</td><td></td></tr>
<tr><td>10</td><td>Backlash between planet pinion and ring gear</td><td colspan="3">0.17 — 0.52</td><td colspan="2">0.70</td><td></td></tr>
<tr><td>11</td><td>Backlash between bevel gear and pinion</td><td colspan="3">0.25 — 0.33</td><td colspan="2">0.50</td><td>Adjust or replace</td></tr>
<tr><td>12</td><td>Seal ring contact surface of small diameter portion of brake piston</td><td>Standard size</td><td colspan="2">Tolerance</td><td>Standard clearance</td><td>Clearance limit</td><td>Replace</td></tr>
<tr><td></td><td></td><td></td><td>Shaft</td><td>Hole</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>200</td><td>−0.100
−0.172</td><td>+0.072
0</td><td>0.100 —
0.244</td><td>—</td><td></td></tr>
<tr><td>13</td><td>Preload of taper roller bearing for bevel gear shaft</td><td colspan="5">Tighten bevel gear shaft nut 5 notches.
Reference when assembling new bearing:
Starting torque: 14.7 — 19.6 Nm (1.5 — 2.0 kgm)
Load at tip of bevel gear teeth: 78.5 — 107.9 N (8.0 — 11.0 kg)</td><td>Adjust</td></tr>
</table>

BEVEL GEAR SHAFT, HSS STEERING, BRAKE (1/2)

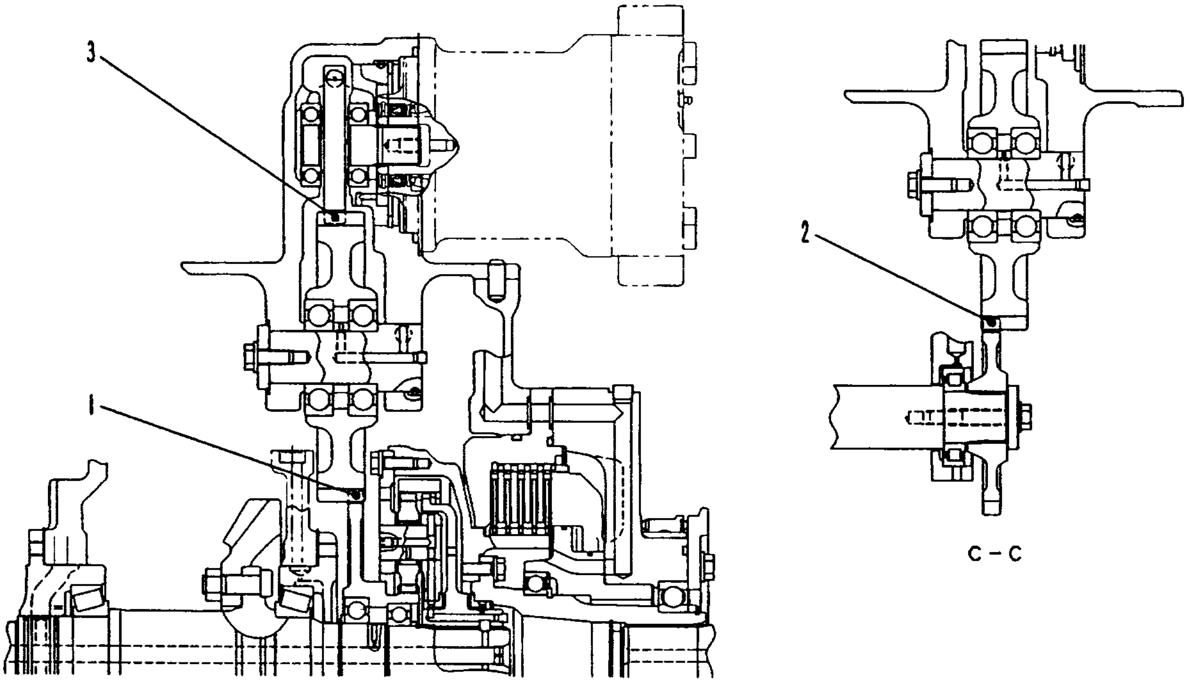
D65EX, PX-12 65001 and up



SJD04047

Unit: mm

No.	Check item	Criteria		Remedy
1	Thickness of brake plate	Standard size	Repair limit	Replace
		5.0	4.7	
	Distortion of brake plate	Tolerance	Repair limit	Correct or replace
		less than 0.15	0.3	
2	Thickness of brake disc	Standard size	Repair limit	Replace
		5.2	4.9	
	Distortion of brake disc	Tolerance	Repair limit	Correct or replace
		less than 0.25	0.4	
3	Total assembled thickness of brake plates and discs	Standard size	Repair limit	Replace
		46.0	43.3	
4	Backlash of brake disc and brake inner drum	Standard clearance	Clearance limit	
		0.06 – 0.65	–	
5	Backlash between gear A and gear B	0.09 – 0.64	–	
6	Backlash between sun gear and planet pinion	0.14 – 0.35	–	
7	Backlash between planet pinion and ring gear	0.15 – 0.38	–	
8	Backlash between bevel gear and pinion	0.20 – 0.28	0.45	
9	Preload of taper roller bearing for bevel gear shaft	If starting torque is below 9.8 Nm {1.0 kgm}, adjust pre-load. After pre-load is adjusted, starting torque must be 10.3 – 14.7 Nm {1.05 – 1.5 kgm}.		Adjust



B – B

C – C

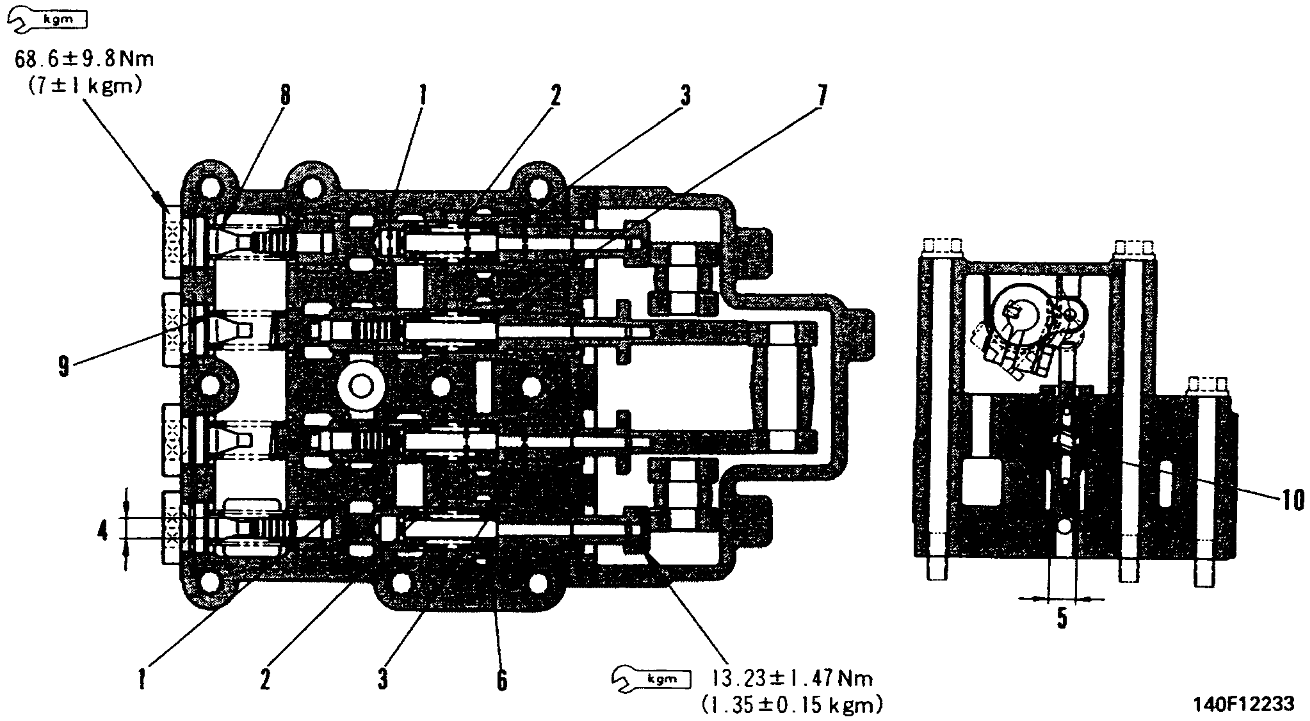
SJD04048

Unit: mm

No.	Check item	Criteria		Remedy
		Standard clearance	Clearance limit	
1	Backlash between gear A and gear D	0.09 – 0.64	—	Replace
2	Backlash between gear C and gear D	0.15 – 0.49	—	
3	Backlash between gear D and pinion	0.10 – 0.40	—	

STEERING CONTROL VALVE

D65E, P-12 60001 - 65000

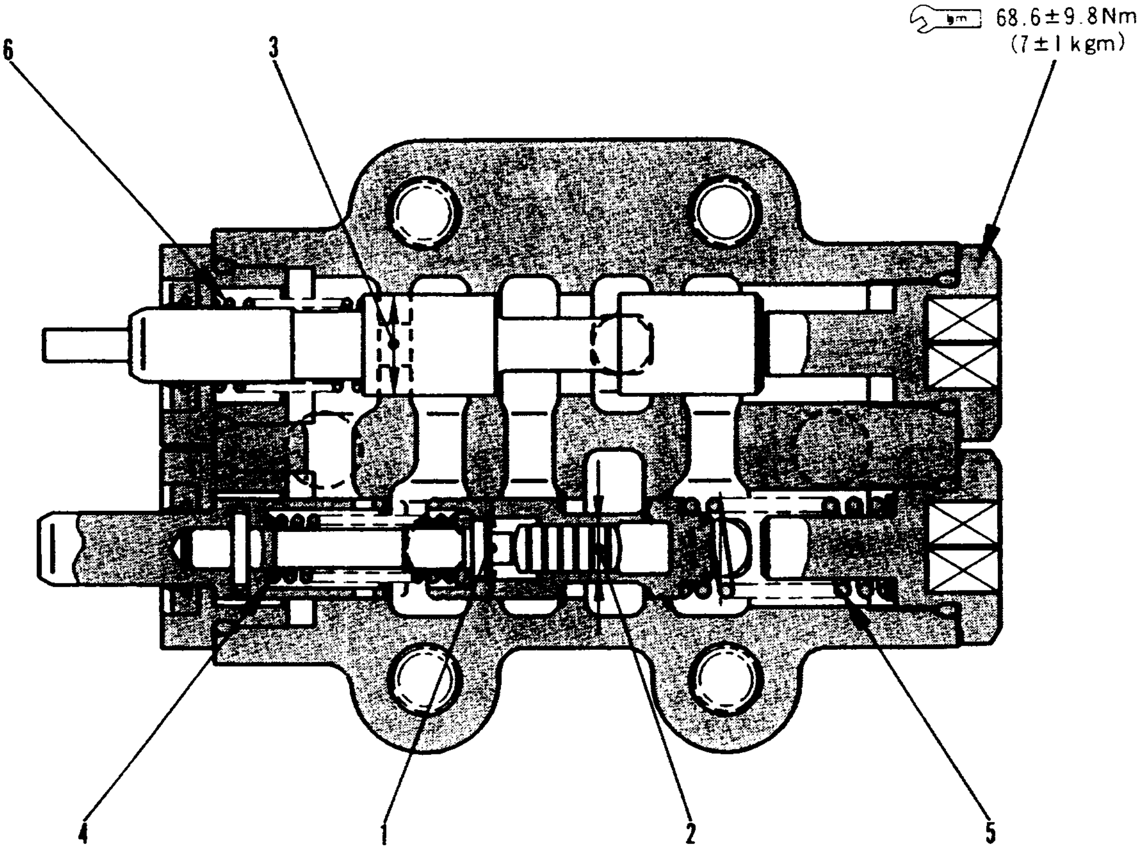


Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between clutch, brake valve and valve body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		19	−0.020 −0.030	+0.013 0	0.020 — 0.043	0.06	
2	Clearance between clutch, brake valve sleeve and guide	18.35	−0.034 −0.043	+0.013 0	0.034 — 0.056	0.08	
3	Clearance between clutch, brake valve sleeve and guide	16	−0.034 −0.043	+0.011 0	0.034 — 0.054	0.07	
4	Clearance between clutch, brake valve and piston	9	−0.03 −0.04	+0.015 0	0.03 — 0.055	0.08	
5	Clearance between parking brake valve and body	16	−0.016 −0.034	+0.043 0	0.016 — 0.077	0.10	
6	Clutch modulating spring	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		48	37	69.04 N (7.04 kg)	46.6	65.7 N (6.7 kg)	
7	Brake modulating spring	41	37	30.08 N (3.069 kg)	40.0	28.4 N (2.9 kg)	
8	Clutch valve return spring	70.5	39.5	29.55 N (3.015 kg)	68.4	28.4 N (2.9 kg)	
9	Brake valve return spring	51	35	166.98 N (17.039 kg)	49.5	158.9 N (16.2 kg)	
10	Parking brake valve spring	28	15	1.66 N (0.169 kg)	27.2	1.56 N (0.16 kg)	

BEVEL GEAR SHAFT, HSS BRAKE VALVE

D65EX, PX-12



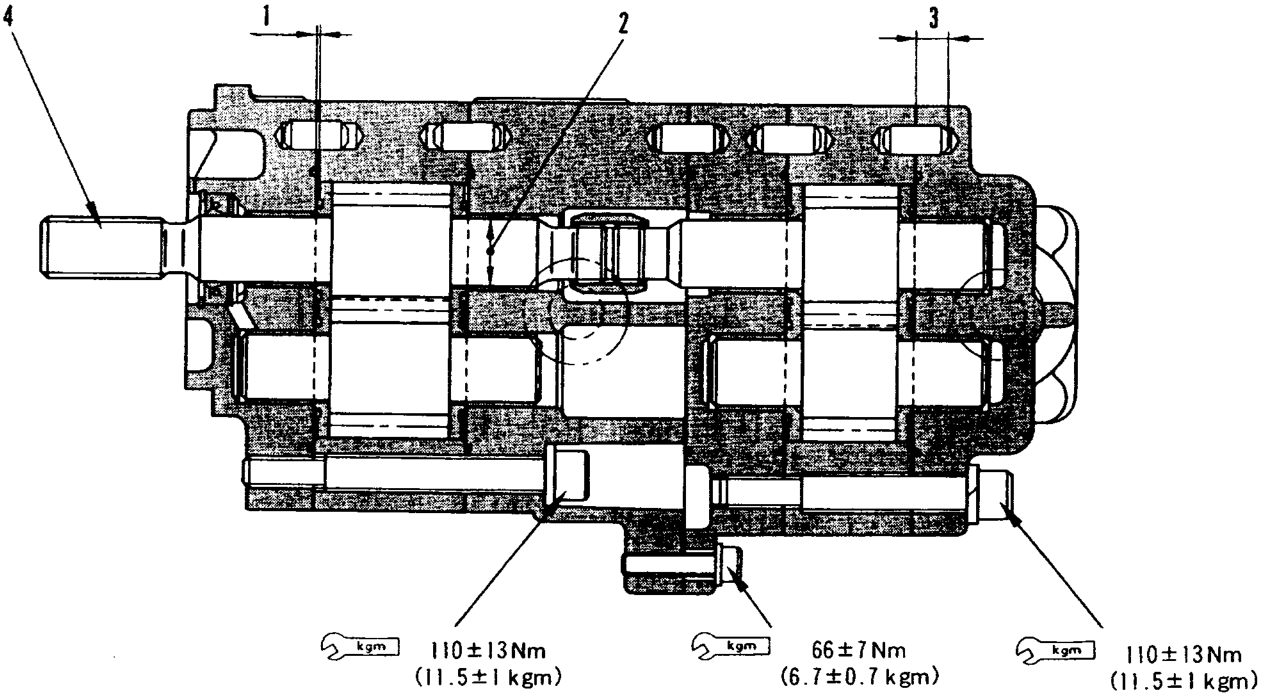
140F12235

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between brake valve and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		19	−0.020 −0.030	+0.021 0	0.020 — 0.051	0.07	
2	Clearance between brake valve and piston	9	−0.03 −0.04	+0.015 0	0.03 — 0.055	0.08	
3	Clearance between parking brake valve and body	19	−0.034 −0.043	+0.013 0	0.034 — 0.056	0.08	
4	Brake modulating spring	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		48	36	75.32 N (7.68 kg)	46.6	71.6 N (7.3 kg)	
5	Brake valve return spring	52	39	146.61 N (14.96 kg)	50.4	139.3 N (14.2 kg)	
6	Parking brake valve return spring	36.5	28.5	16.7 N (1.7 kg)	35.4	15.7 N (1.6 kg)	

POWER TRAIN, LUBRICATION PUMP

- **SAL(2)-045 + 045**



140F12234

014012

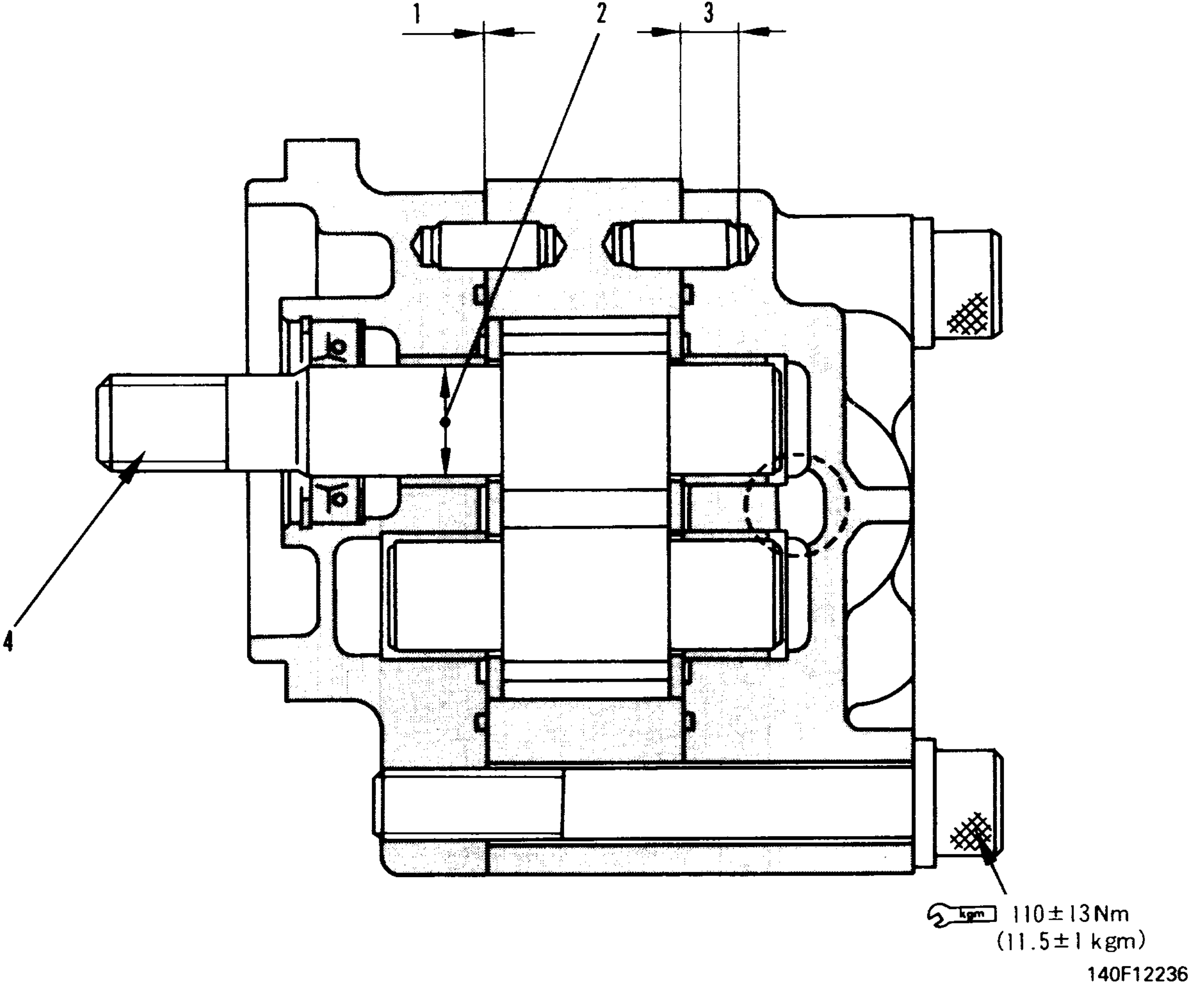
Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="12">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Clearance between gear case and side plate</td><td colspan="6">Standard clearance</td><td colspan="6">Clearance limit</td><td rowspan="5">Replace</td></tr>
<tr><td colspan="6">0.10 — 0.15</td><td colspan="6">0.19</td></tr>
<tr><td>2</td><td>Clearance between inside diameter of plain bearing and outside diameter of gear shaft</td><td colspan="6">0.060 — 0.125</td><td colspan="6">0.20</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Depth for hitting in pin</td><td colspan="4">Standard size</td><td colspan="4">Tolerance</td><td colspan="4">Repair limit</td></tr>
<tr><td colspan="4">12</td><td colspan="4">0
−0.5</td><td colspan="4">—</td></tr>
<tr><td>4</td><td>Spline shaft rotating torque</td><td colspan="12">5.8 — 13.8 Nm
(0.6 — 1.4 kgm)</td><td></td></tr>
<tr><td rowspan="2">—</td><td rowspan="2">Discharge amount
(oil: EO10-CD,
oil temperature: 45 — 55°C)</td><td colspan="3">Speed (rpm)</td><td colspan="3">Discharge pressure</td><td colspan="3">Standard discharge amount (ℓ/min)</td><td colspan="3">Discharge amount limit (ℓ/min)</td><td rowspan="2">—</td></tr>
<tr><td colspan="3">3,000</td><td colspan="3">2.9 MPa
(30 kg/cm²)</td><td colspan="3">126</td><td colspan="3">115</td></tr>
</table>

PPC PUMP

D65E-12 60001 — 60947
D65P-12 60001 — 60890
D65EX-12 60001 — 60941
D65PX-12 60001 — 60914

- **SBR(1)-010**



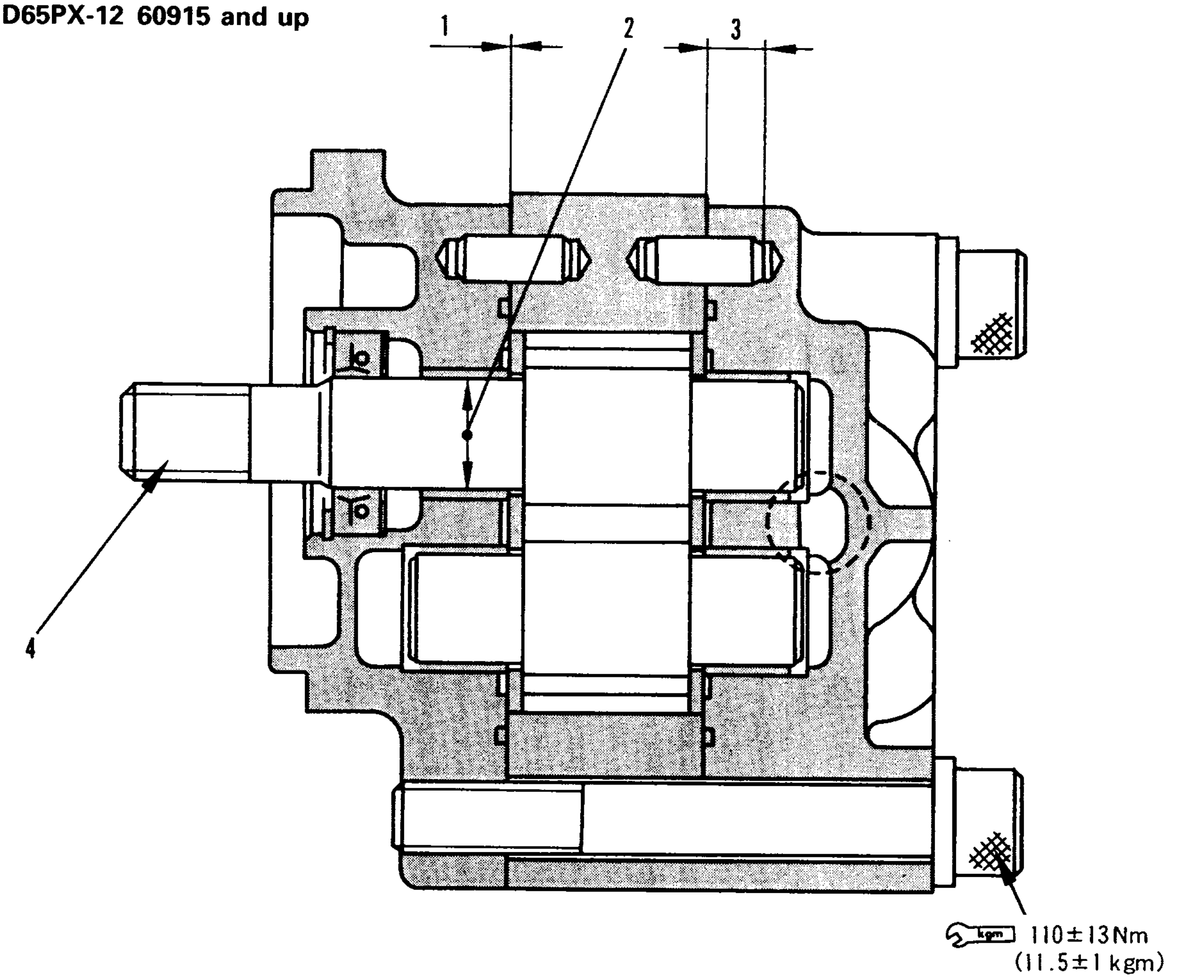
014012

Unit: mm

No.	Check item	Criteria				Remedy
1	Clearance between gear case and side plate	Standard clearance		Clearance limit		Replace
		0.10 — 0.15		0.19		
2	Clearance between inside diameter of plain bearing and outside diameter of gear shaft	0.060 — 0.119		0.20		
3	Depth for hitting in pin	Standard size	Tolerance	Repair limit		
		10	0 -0.5	—		
4	Spline shaft rotating torque	2.0 — 4.9 Nm (0.2 — 0.5 kgm)				—
—	Discharge amount (Oil: EO10-CD Oil temperature: 45 – 55°C)	Speed (rpm)	Discharge pressure	Standard discharge amount (ℓ/min)	Discharge amount limit (ℓ/min)	—
		3,500	2.9 MPa (30 kg/cm^2)	35	31	

- **SBR(1)014**

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up



110±13Nm
(11.5±1 kgm)

140F12236

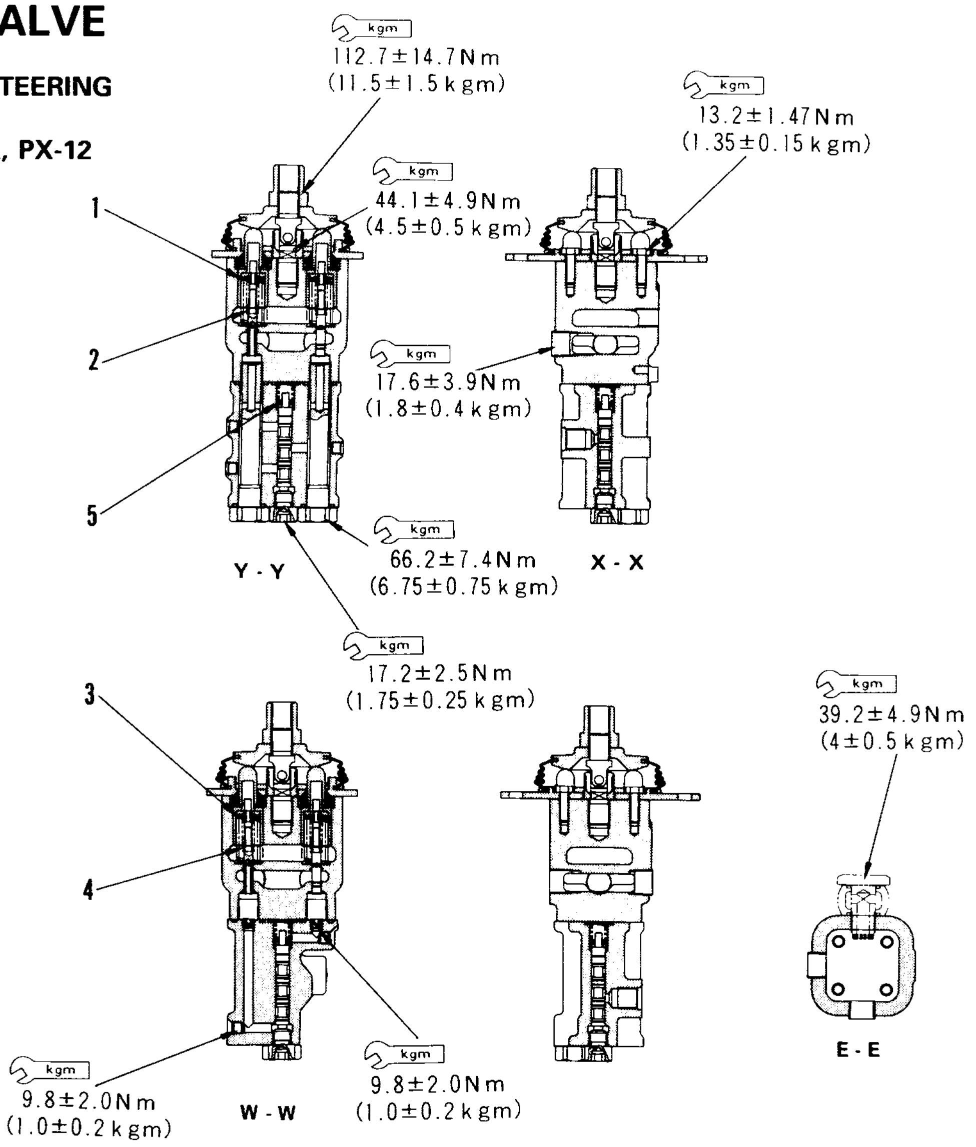
Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="12">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Clearance between gear case and side plate</td><td colspan="6">Standard clearance</td><td colspan="6">Clearance limit</td><td rowspan="6">Replace</td></tr>
<tr><td colspan="6">0.10 — 0.15</td><td colspan="6">0.19</td></tr>
<tr><td>2</td><td>Clearance between inside diameter of plain bearing and outside diameter of gear shaft</td><td colspan="6">0.060 — 0.119</td><td colspan="6">0.20</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Depth for hitting in pin</td><td colspan="4">Standard size</td><td colspan="4">Tolerance</td><td colspan="4">Repair limit</td></tr>
<tr><td colspan="4">10</td><td colspan="4">0
-0.5</td><td colspan="4">—</td></tr>
<tr><td>4</td><td>Spline shaft rotating torque</td><td colspan="12">2.0 — 4.9 Nm
(0.2 — 0.5 kgm)</td><td>—</td></tr>
<tr><td rowspan="2">—</td><td rowspan="2">Discharge amount
(Oil: EO10-CD
Oil temperature: 45 – 55°C)</td><td colspan="3">Speed (rpm)</td><td colspan="3">Discharge pressure</td><td colspan="3">Standard discharge amount (ℓ/min)</td><td colspan="3">Discharge amount limit (ℓ/min)</td><td rowspan="2">—</td></tr>
<tr><td colspan="3">3,500 rpm</td><td colspan="3">2.9 MPa
(30 kg/cm²)</td><td colspan="3">48</td><td colspan="3">42</td></tr>
</table>

PPC VALVE

- **FOR STEERING**

D65EX, PX-12



140F12237

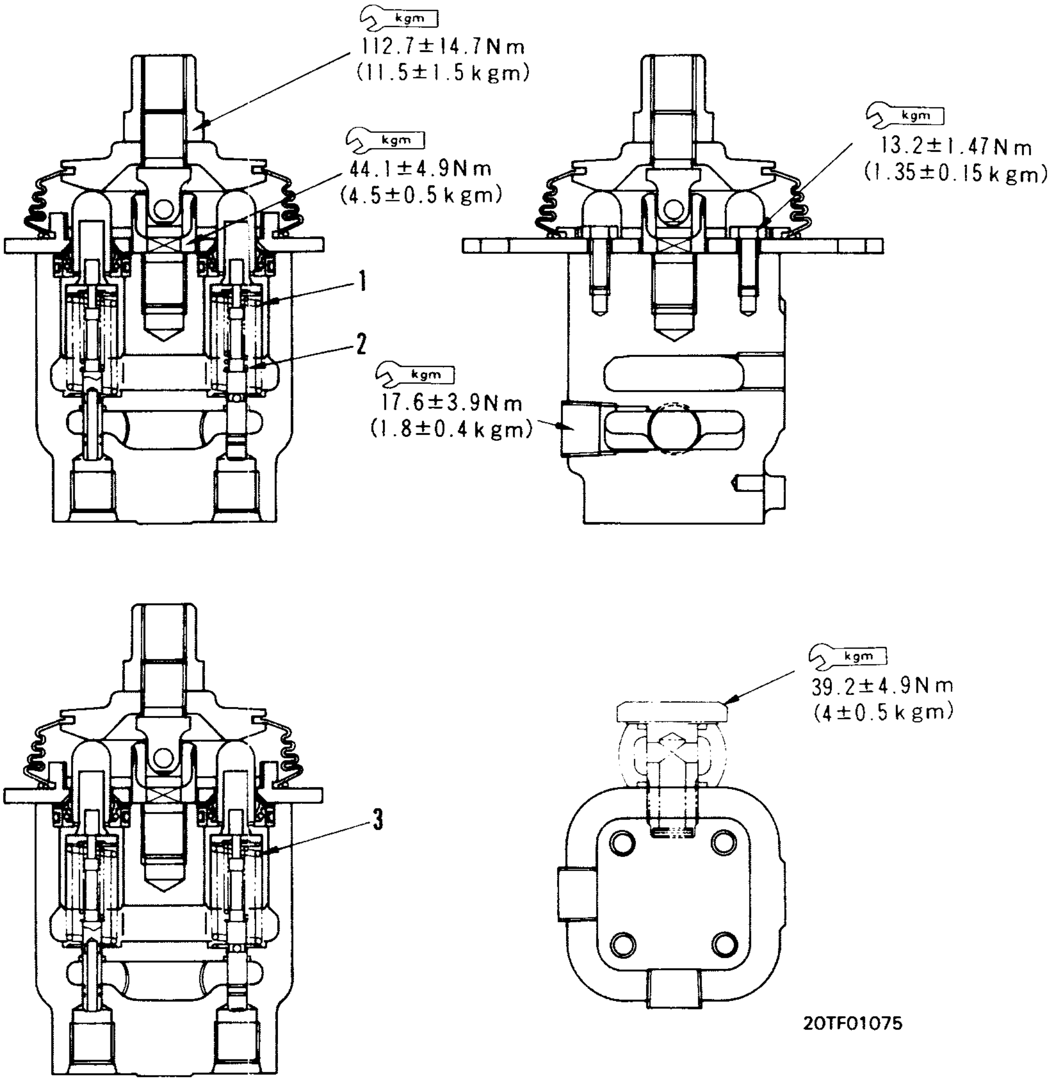
014012

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length X O.D.	Installed length	Installed load	Free length	Installed load	
1	Centering spring (for P3, P4)	50.1 X 15.5	34	55.9 N (5.7 kg)	—	45.1 N (4.6 kg)	If there is any damage or deformation, replace spring
2	Metering spring (for P3, P4)	26.6 X 7.5	24.9	16.7 N (1.7 kg)	—	13.7 N (1.4 kg)	
3	Centering spring (for P1, P2)	50.5 X 15.5	34	14.7 N (1.5 kg)	—	11.8 N (1.2 kg)	
4	Metering spring (for P1, P2)	39.2 X 8.15	24.9	16.7 N (1.7 kg)	—	13.7 N (1.4 kg)	
5	Return spring	21.1 X 10	15	13.7 N (1.4 kg)	—	10.8 N (1.1 kg)	

- **FOR BLADE LIFT, BLADE TILT, RIPPER LIFT**

D65E-12 60001 — 60947 **D65EX-12 60001 — 60941**
D65P-12 60001 — 60890 **D65PX-12 60001 — 60914**



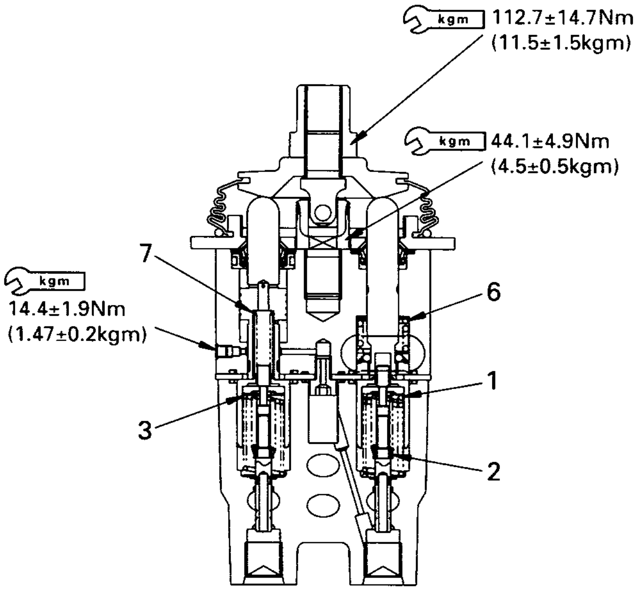
20TF01075

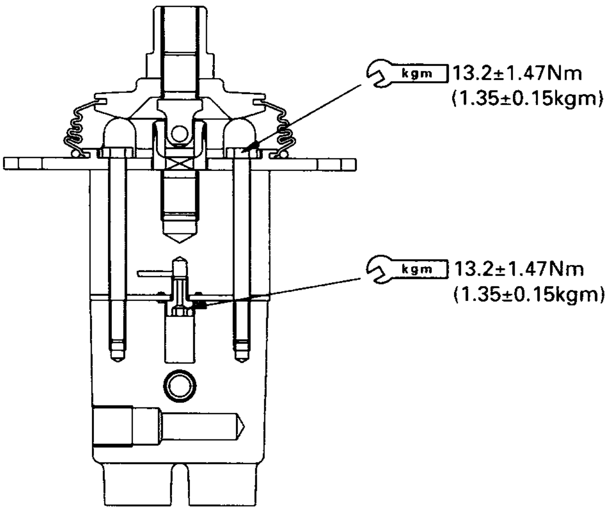
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length X O.D.	Installed length	Installed load	Free length	Installed load	
1	Centering spring (for P3, P4)	50.4 X 15.5	34	55.9 N (5.7 kg)	—	45.1 N (4.6 kg)	If there is any damage or deformation, replace spring
2	Metering spring	26.6 X 7.5	24.9	16.7 N (1.7 kg)	—	13.7 N (1.4 kg)	
3	Centering spring (for P1, P2)	50.1 X 15.5	34	71.6 N (7.3 kg)	—	56.9 N (5.8 kg)	

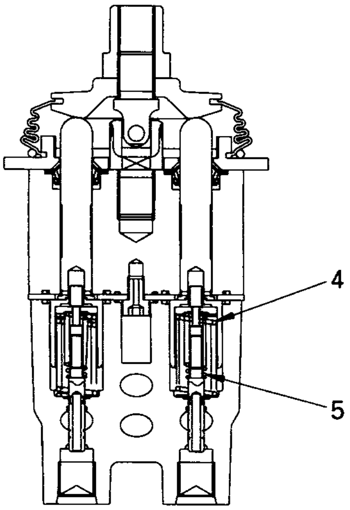
• FOR BLADE LIFT, BLADE TILT

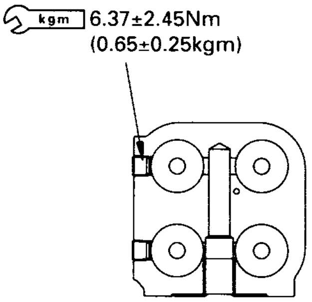
D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

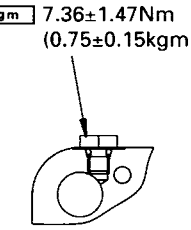


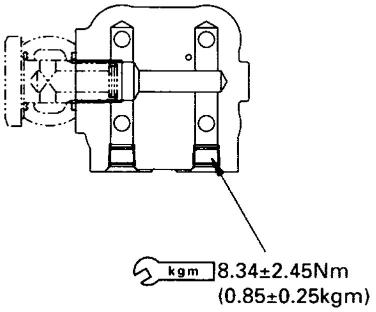


014012









SKD00595

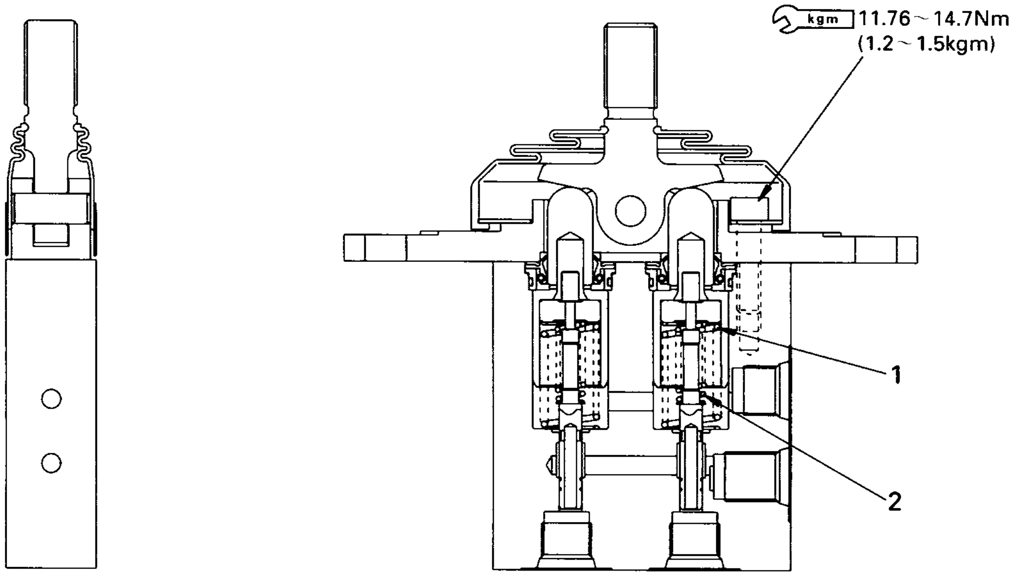
014012

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length X O.D.	Installed length	Installed load	Free length	Installed load	
1	Centering spring (for P1)	52.06 X 15.5	31.9	135.2 N (13.8 kg)	—	112 N (11.4 kg)	If there is any damage or deformation, replace spring
2	Metering spring (for P1, P2)	27.23 X 8.14	24.9	16.7 N (1.7 kg)	—	13.7 N (1.4 kg)	
3	Centering spring (for P2)	50.35 X 15.5	31.9	62.8 N (6.4 kg)	—	50 N (5.1 kg)	
4	Centering spring (for P3, P4)	50.05 X 15.5	31.9	80.8 N (8.24 kg)	—	64.6 N (6.59 kg)	
5	Metering spring (for P3, P4)	26.53 X 8.15	24.9	16.7 N (1.7 kg)	—	13.7 N (1.4 kg)	
6	Detent spring (for P1)	20.39 X 19.5	13.1	159.3 N (16.25 kg)	—	127 N (13 kg)	
7	Detent spring (for P2)	45.36 X 7.5	26	38.42 N (3.92 kg)	—	30.8 N (3.14 kg)	

- **FOR RIPPER LIFT**

D65E-12 60948 and up
D65EX-12 60942 and up



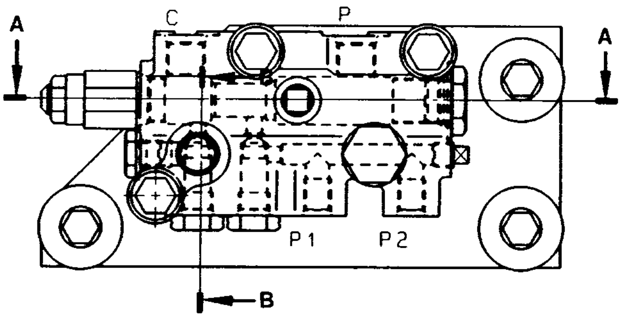
SKD00596

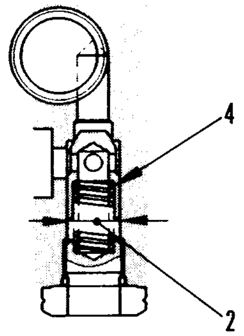
014012

Unit: mm

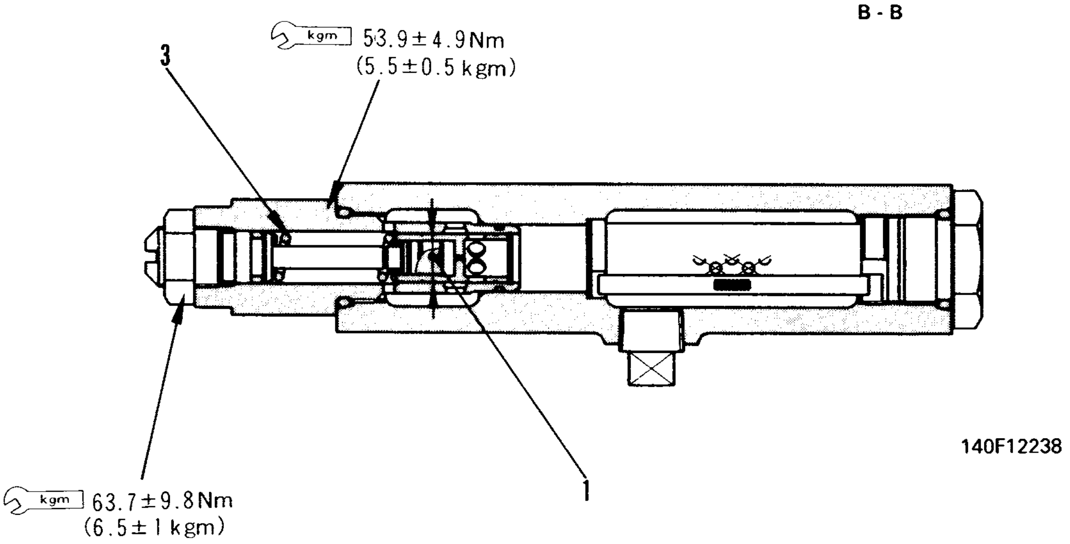
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length X O.D.	Installed length	Installed load	Free length	Installed load	
1	Centering spring (for P1, P2)	33.9 X 15.3	28.4	124.5 N (12.7 kg)	—	105.8 N (10.8 kg)	If there is any damage or deformation, replace spring
2	Metering spring (for P1, P2)	22.7 X 5.1	22	16.7 N (1.7 kg)	—	13.7 N (1.4 kg)	

PPC CHARGE VALVE





B - B



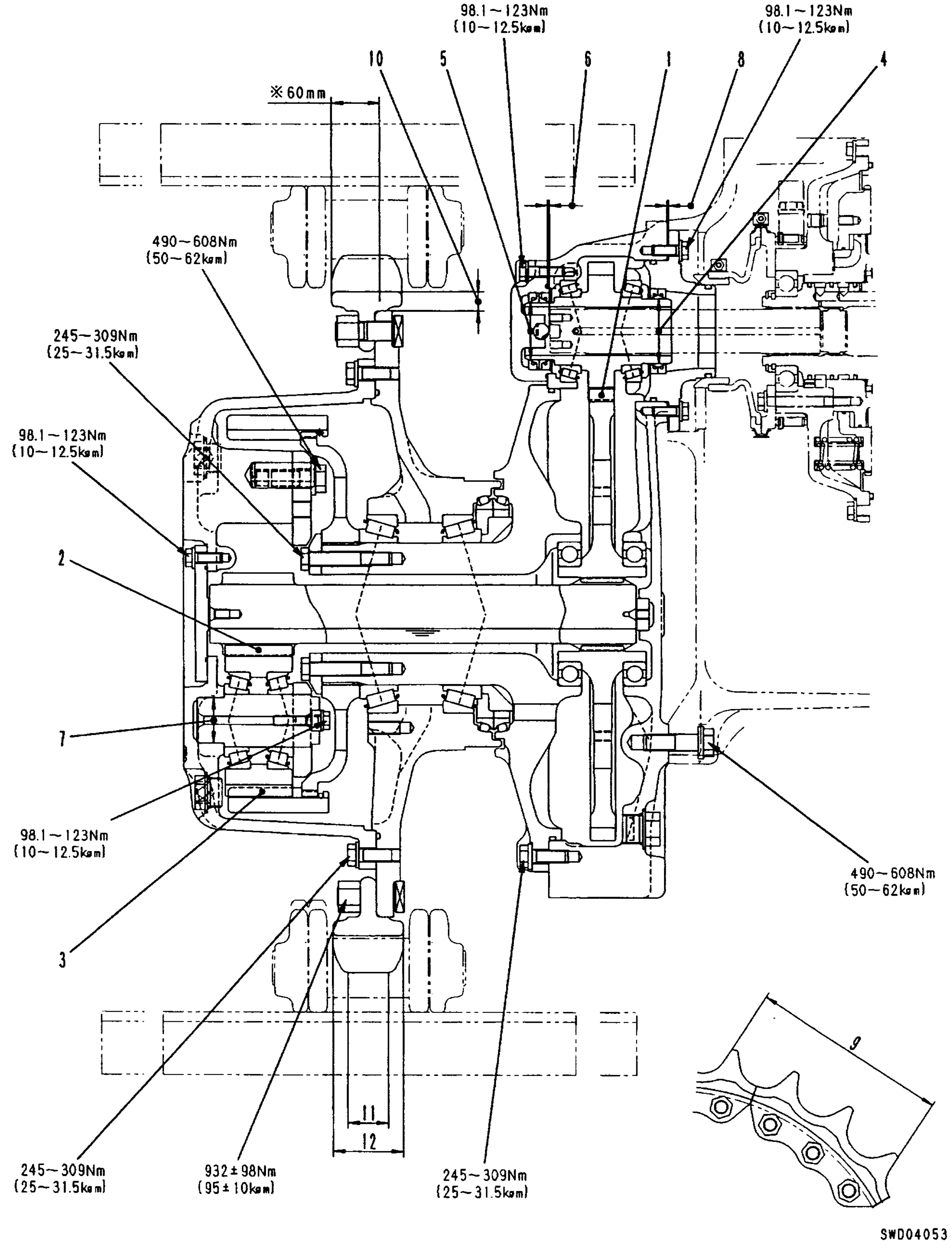
A - A

014012

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between relief valve and sleeve	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		13	-0.040 -0.061	+0.018 0	0.040 — 0.079	0.10	
2	Clearance between check valve and body	14	-0.032 -0.059	+0.027 0	0.032 — 0.086	0.11	
3	Relief valve spring	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		39.3	33.1	21.6 N (22.0 kg)	38.1	205.0 N (20.9 kg)	
4	Check valve spring	26.2	19.1	37.3 N (3.8 kg)	25.4	35.3 N (3.6 kg)	

FINAL DRIVE



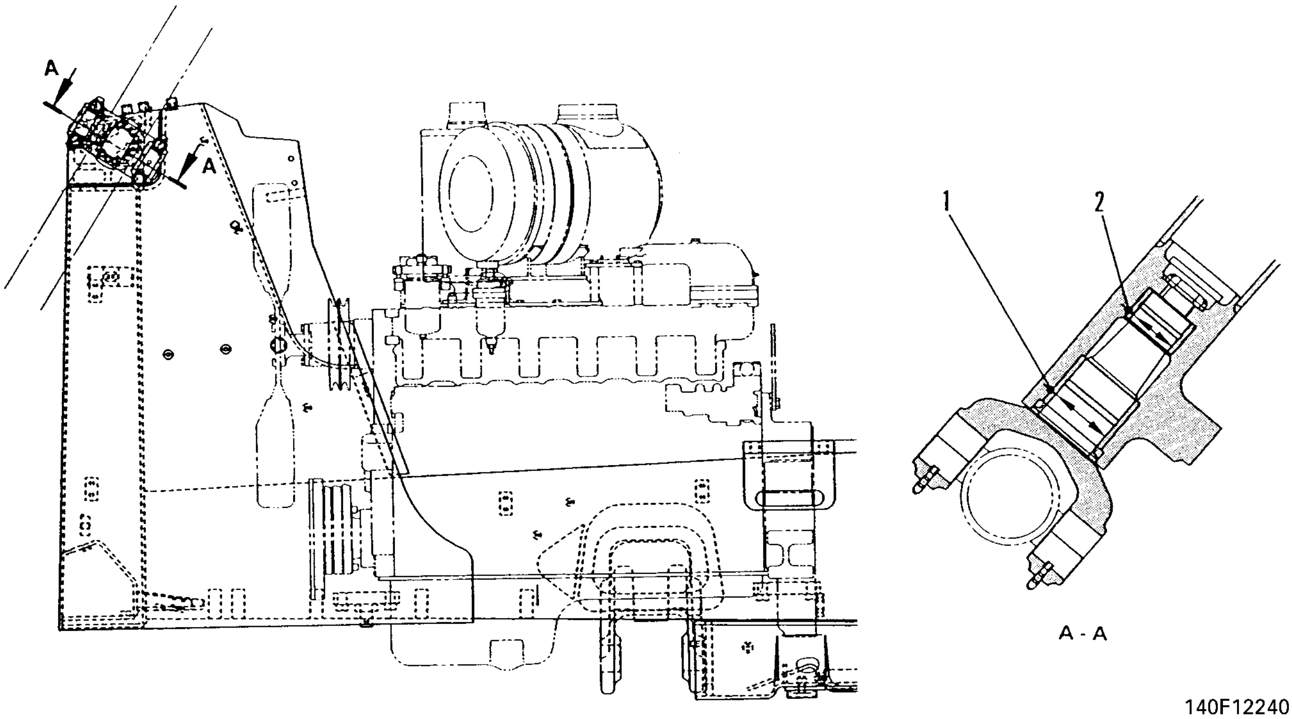
014012

Unit: mm

No.	Check item	Criteria					Remedy
1	Backlash between No. 1 pinion and No. 1 gear	Standard clearance			Clearance limit		Replace
		0.23 — 0.61			1.0		
2	Backlash between sun gear and planet pinion	0.18 — 0.45			1.0		
3	Backlash between planet pinion and ring gear	0.23 — 0.67			1.0		
4	Outside diameter of oil seal contact surface No.1 pinion	Standard size			Repair limit		
		80			79.9		
5	Outside diameter of oil seal contact surface of No. 1 pinion	70			69.9		
6	Height of ball of shaft and cover	3			1.5		
7	Interference between pinion shaft and carrier	Standard size	Tolerance		Standard interference	Interference limit	
			Shaft	Hole			
		56	+0.051 +0.032	+0.030 0	–0.002 — –0.051	–0.002	
8	Clearance of No. 1 pinion in axial direction	0 — 0.1 (standard shim thickness: 1.5)					Adjust
9	Wear of sprocket tooth surface	Standard size			Repair limit		Add metal or replace
		317			299		
10	Wear of sprocket tooth bottom (Dimensions for ultrasonic test)	26			17		
11	Wear of width of sprocket teeth tip	60			50		
12	Wear of width of sprocket teeth root	87			77		

※: Measuring point for ultrasonic test

HULL FRAME



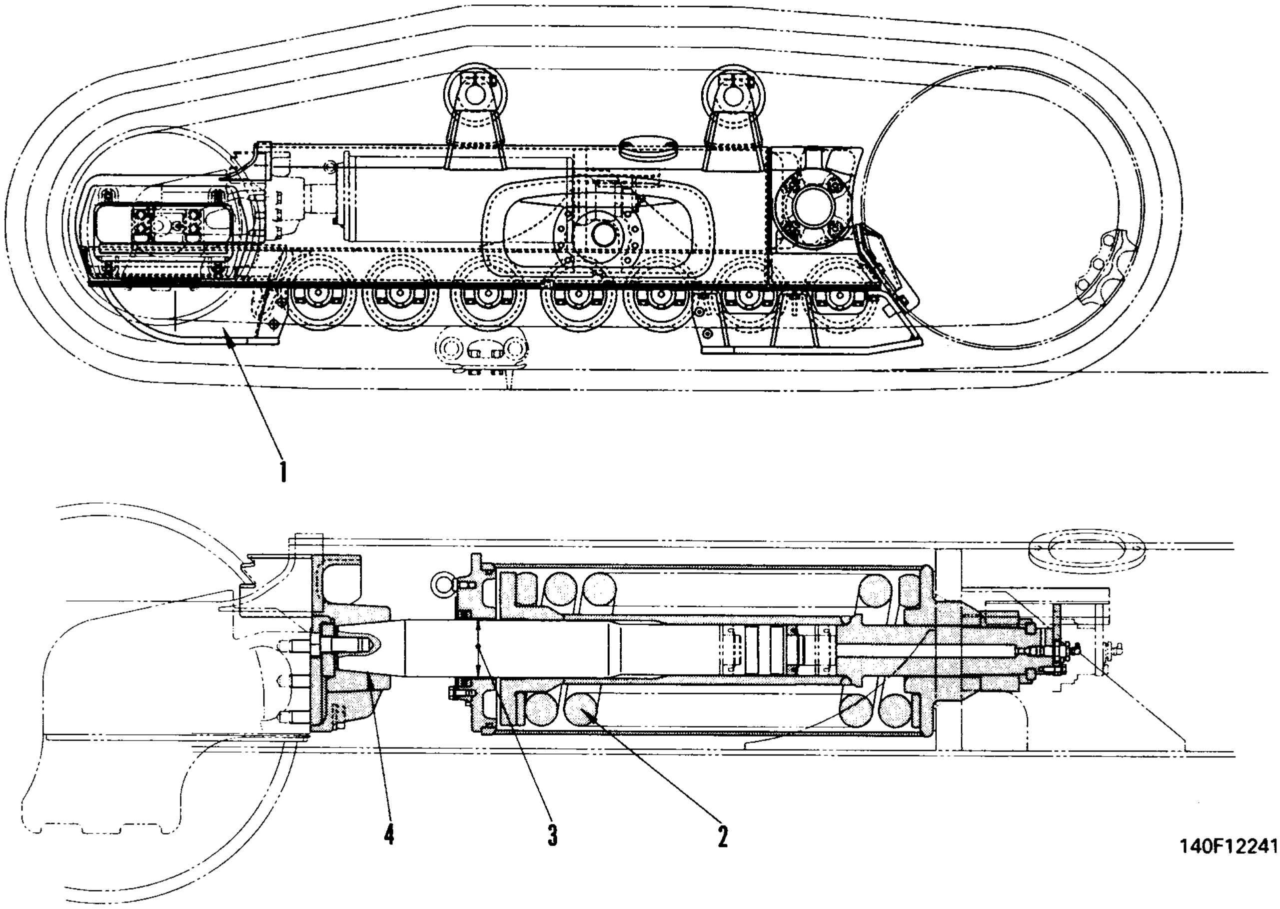
140F12240

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between cylinder yoke and bushing (outer)	85	–0.036 –0.090	+0.207 +0.120	0.156 — 0.297	0.5	Replace bushing
2	Clearance between cylinder yoke and bushing (inner)	65	–0.030 –0.076	+0.174 +0.100	0.130 — 0.250	0.5	

TRACK FRAME, RECOIL SPRING

D65E-12 60001 — 60947 **D65EX-12 60001 — 60941**
D65P-12 60001 — 60890 **D65PX-12 60001 — 60914**

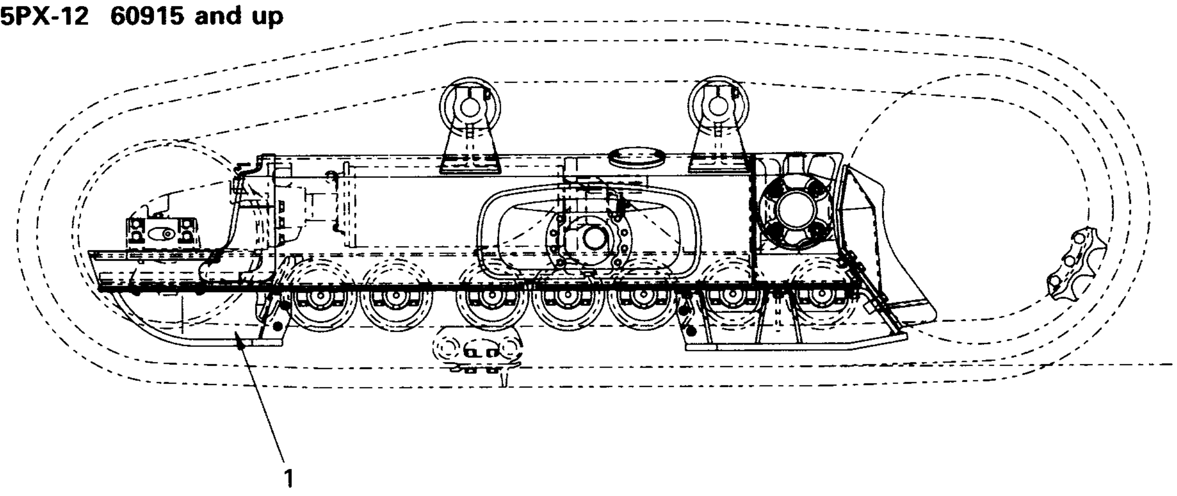


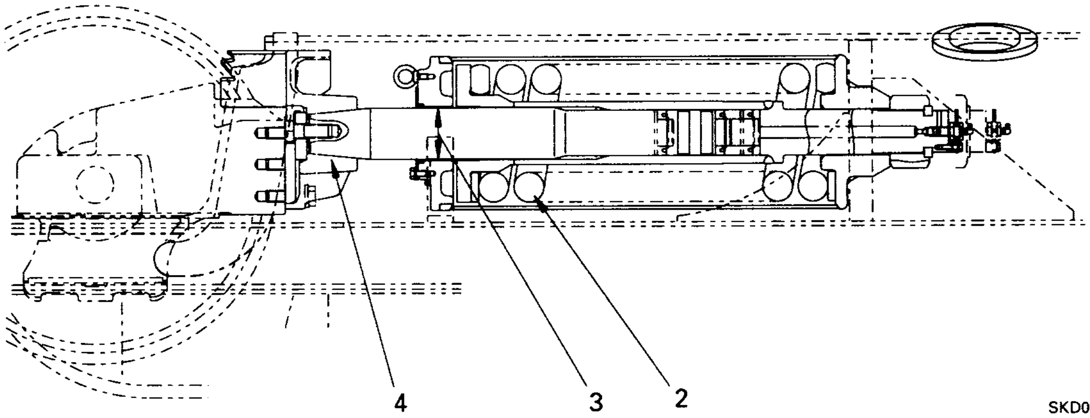
★ The diagram shows the D65E-12, D65EX-12.

Unit: mm

No.	Check item	Criteria					Remedy
1	Deformation of track frame	Item		Repair limit			Correct
		Curvature Twisting Opening of idler portion		7 (for length of 3,000) 3 (for length of 300) 5			
2	Recoil spring	Standard size			Repair limit		Replace
		Free length X O.D.	Installed length	Installed load	Free length	Installed load	
		795 X 241	634	189.83 KN (19,370 kg)	775	168.94 KN (17,239 kg)	
3	Clearance between adjustment cylinder and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		90	−0.120 −0.207	+0.270 +0.061	0.181 — 0.477	1.0	
4	Press-fitting force for idler yoke	392 KN (40 ton)					Adjust

D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up





SKD00597

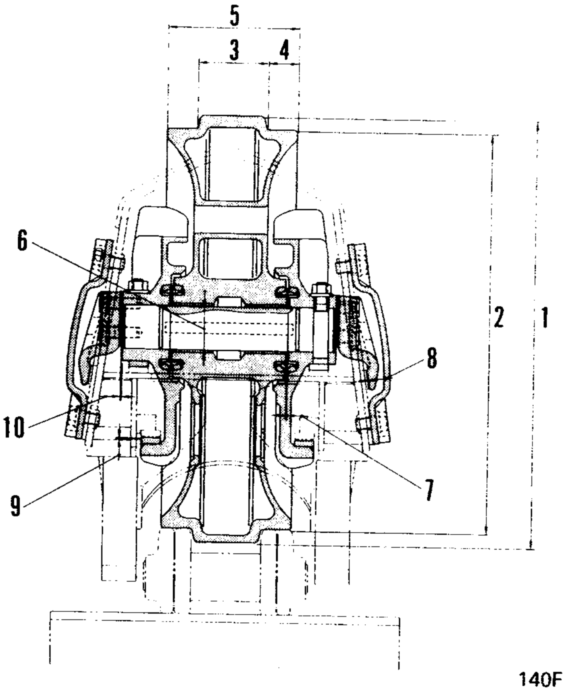
★ The diagram shows the D65E-12, D65EX-12.

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Deformation of track frame</td><td colspan="2">Item</td><td colspan="3">Repair limit</td><td rowspan="2">Correct</td></tr>
<tr><td colspan="2">Curvature
Twisting
Opening of idler portion</td><td colspan="3">7 (for length of 3,000)
3 (for length of 300)
5</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length X O.D.</td><td>Installed length</td><td>Installed load</td><td>Free length</td><td>Installed load</td></tr>
<tr><td>795 X 241</td><td>634</td><td>189.83 KN (19,370 kg)</td><td>775</td><td>168.94 KN (17,239 kg)</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Clearance between adjustment cylinder and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>90</td><td>–0.120
–0.207</td><td>+0.270
+0.061</td><td>0.181 — 0.477</td><td>1.0</td></tr>
<tr><td>4</td><td>Press-fitting force for idler yoke</td><td colspan="5">392 KN (40 ton)</td><td>Adjust</td></tr>
</table>

IDLER

D65E-12 60001 — 60947
D65P-12 60001 — 60890
D65EX-12 60001 — 60941
D65PX-12 60001 — 60914

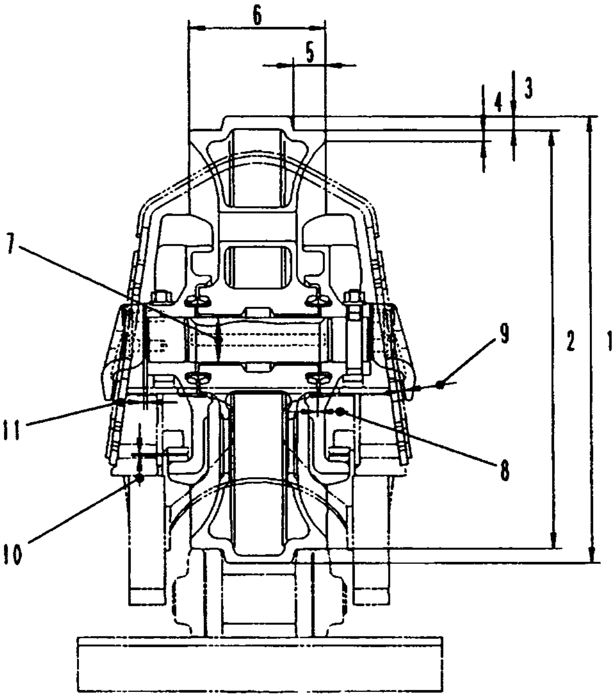


140F12242

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="6">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of protruding portion of idler</td><td colspan="3">Standard clearance</td><td colspan="3">Repair limit</td><td rowspan="6">Add metal or replace</td></tr>
<tr><td colspan="3">630</td><td colspan="3">—</td></tr>
<tr><td>2</td><td>Outside diameter of idler tread</td><td colspan="3">590</td><td colspan="3">570</td></tr>
<tr><td>3</td><td>Width of protruding portion of idler</td><td colspan="3">101</td><td colspan="3">97</td></tr>
<tr><td>4</td><td>Width of idler tread</td><td colspan="3">44.5</td><td colspan="3">48.5</td></tr>
<tr><td>5</td><td>Overall width of idler</td><td colspan="3">190</td><td colspan="3">186</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Clearance between shaft and bushing</td><td rowspan="2">Standard size</td><td colspan="3">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td colspan="2">Hole</td></tr>
<tr><td>65</td><td>-0.250
-0.350</td><td colspan="2">+0.142
-0.008</td><td>0.242 — 0.492</td><td>1.5</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Play in axial direction</td><td colspan="3">Standard clearance</td><td colspan="3">Clearance limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="3">0.26 — 0.66</td><td colspan="3">1.5</td></tr>
<tr><td>8</td><td>Clearance between guide plate and frame plate</td><td colspan="3">1.0</td><td colspan="3">3.0</td><td>Adjust shim or replace</td></tr>
<tr><td>9</td><td>Clearance between support and frame plate</td><td colspan="3">2.0</td><td colspan="3">5.0</td><td>Replace</td></tr>
<tr><td>10</td><td>Standard thickness of side plate shim</td><td colspan="6">4.0</td><td>Adjust</td></tr>
</table>

D65E-12	**60948 and up**
D65P-12	**60891 and up**
D65EX-12	**60942 and up**
D65PX-12	**60915 and up**



SWD04054

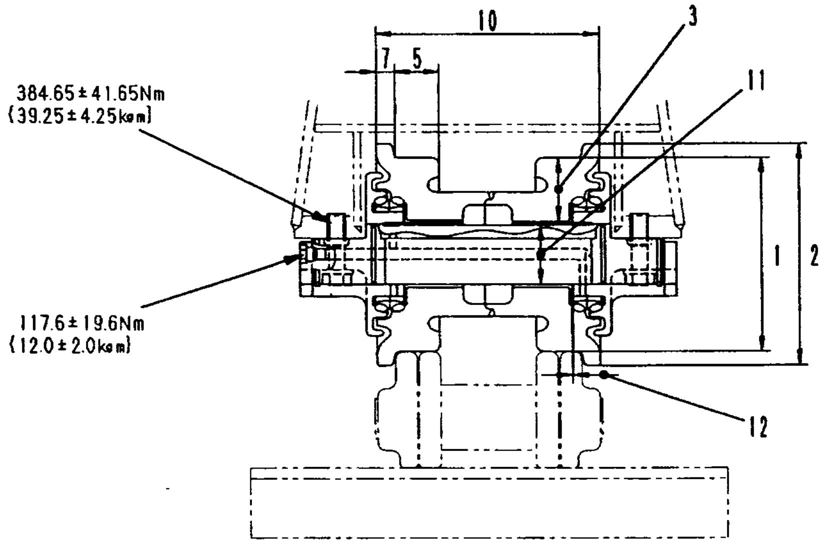
014012

014012

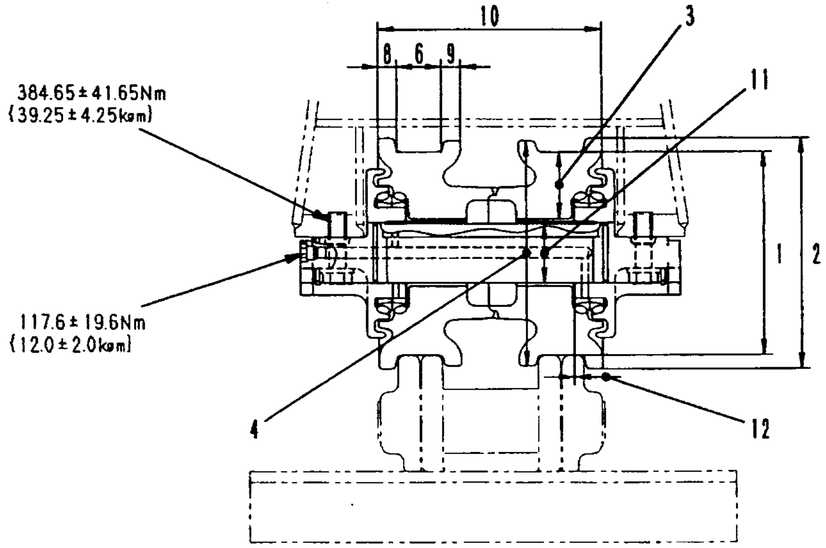
Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of protruding portion of idler</td><td colspan="3">Standard clearance</td><td colspan="2">Repair limit</td><td rowspan="7">Add metal or replace</td></tr>
<tr><td colspan="3">630</td><td colspan="2">—</td></tr>
<tr><td>2</td><td>Outside diameter of idler tread</td><td colspan="3">590</td><td colspan="2">570</td></tr>
<tr><td>3</td><td>Depth of tread</td><td colspan="3">20</td><td colspan="2">30</td></tr>
<tr><td>4</td><td>Thickness of tread</td><td colspan="3">15</td><td colspan="2">5</td></tr>
<tr><td>5</td><td>Width of idler tread</td><td colspan="3">44.5</td><td colspan="2">48.5</td></tr>
<tr><td>6</td><td>Overall width of idler</td><td colspan="3">190</td><td colspan="2">186</td></tr>
<tr><td rowspan="3">7</td><td rowspan="3">Clearance between shaft and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>65</td><td>−0.250
−0.350</td><td>+0.142
−0.008</td><td>0.242 — 0.492</td><td>1.5</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Play in axial direction</td><td colspan="3">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="3">0.26 — 0.66</td><td colspan="2">—</td></tr>
<tr><td>9</td><td>Clearance between guide plate and frame plate</td><td colspan="3">1.0</td><td colspan="2">—</td><td>Adjust shim or replace</td></tr>
<tr><td>10</td><td>Clearance between support and frame plate</td><td colspan="3">2.0</td><td colspan="2">—</td><td>Replace</td></tr>
<tr><td>11</td><td>Standard thickness of side plate shim</td><td colspan="5">4.0</td><td>Adjust</td></tr>
</table>

TRACK ROLLER



Single flange



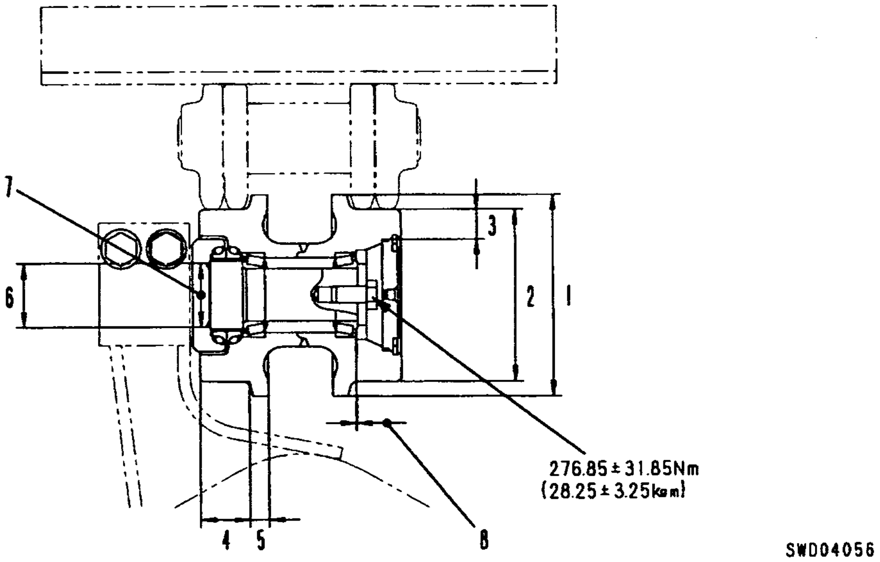
Double flange

014012

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of track roller tread</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="11">Add metal or replace</td></tr>
<tr><td colspan="3">210</td><td colspan="2">174</td></tr>
<tr><td>2</td><td>Outside diameter of flange (outside)</td><td colspan="3">240</td><td colspan="2">—</td></tr>
<tr><td>3</td><td>Thickness of tread</td><td colspan="3">69</td><td colspan="2">51</td></tr>
<tr><td>4</td><td>Outside diameter of flange (inside) (double flange)</td><td colspan="3">236</td><td colspan="2">—</td></tr>
<tr><td>5</td><td>Width of track roller tread (single flange)</td><td colspan="3">47</td><td colspan="2">—</td></tr>
<tr><td>6</td><td>Width of track roller tread (double flange)</td><td colspan="3">47.7</td><td colspan="2">—</td></tr>
<tr><td>7</td><td>Width of flange (single flange)</td><td colspan="3">19.5</td><td colspan="2">13.5</td></tr>
<tr><td>8</td><td>Width of flange (outside of double flange)</td><td colspan="3">19.5</td><td colspan="2">13.5</td></tr>
<tr><td>9</td><td>Width of flange (inside of double flange)</td><td colspan="3">19.5</td><td colspan="2">13.5</td></tr>
<tr><td>10</td><td>Overall width of track roller</td><td colspan="3">235</td><td colspan="2">—</td></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Clearance between shaft and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>65</td><td>−0.250
−0.350</td><td>+0.143
−0.007</td><td>0.243 — 0.493</td><td>—</td></tr>
<tr><td rowspan="2">12</td><td rowspan="2">Play in axial direction</td><td colspan="3">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="3">0.26 — 0.66</td><td colspan="2">1.5</td></tr>
</table>

CARRIER ROLLER

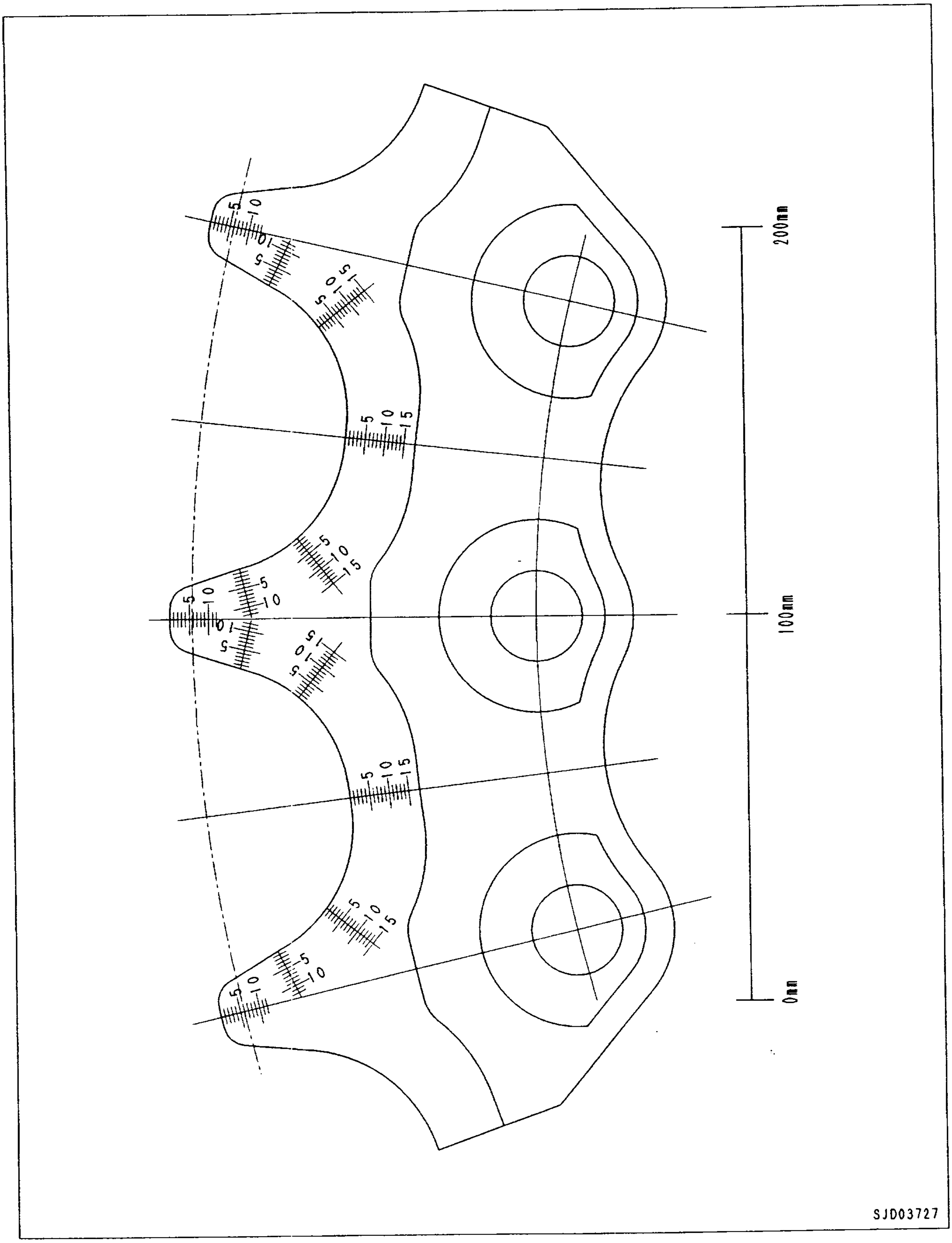


Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of flange</td><td colspan="2">Standard size</td><td colspan="3">Repair limit</td><td rowspan="6">Add metal or replace</td></tr>
<tr><td colspan="2">215</td><td colspan="3">—</td></tr>
<tr><td>2</td><td>Outside diameter of carrier roller tread</td><td colspan="2">185</td><td colspan="3">163</td></tr>
<tr><td>3</td><td>Thickness of tread</td><td colspan="2">37.5</td><td colspan="3">26.5</td></tr>
<tr><td>4</td><td>Width of carrier roller tread</td><td colspan="2">49.5</td><td colspan="3">—</td></tr>
<tr><td>5</td><td>Width of flange</td><td colspan="2">21</td><td colspan="3">15</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Clearance between shaft and support</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="9">Replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>61</td><td>-0.1
-0.2</td><td>+0.300
0</td><td>0.1 — 0.5</td><td>—</td></tr>
<tr><td rowspan="3">7</td><td rowspan="3">Interference between shaft and seal guard</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td><td rowspan="2">Interference limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>61.5</td><td>+0.15
+0.13</td><td>+0.030
0</td><td>0.1 — 0.15</td><td>—</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Play of roller in axial direction</td><td colspan="2">Standard clearance</td><td colspan="3">Clearance limit</td></tr>
<tr><td colspan="2">0 — 0.32</td><td colspan="3">—</td></tr>
</table>

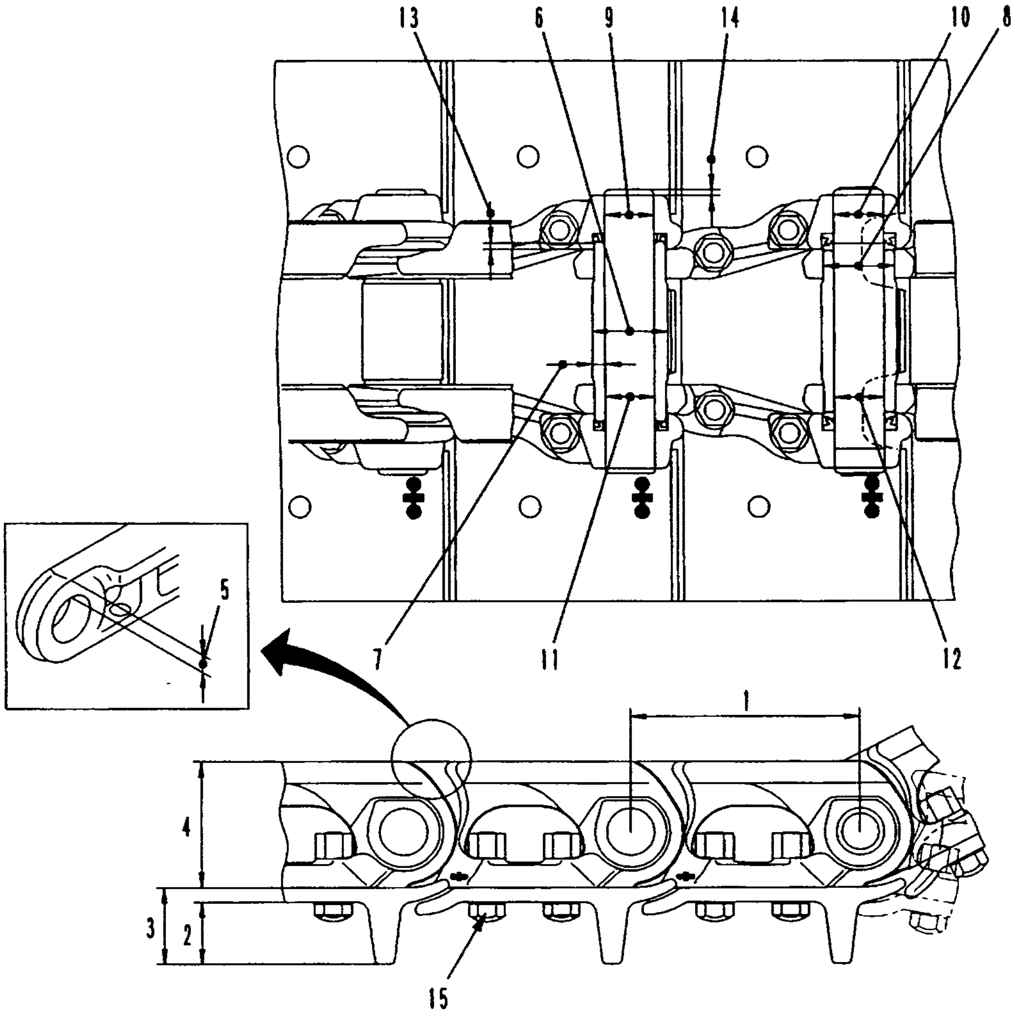
014012

SPROCKET TOOTH PROFILE



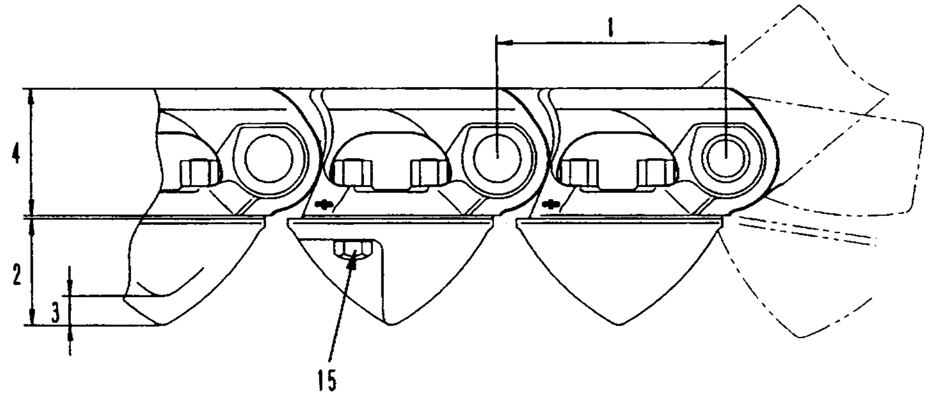
※ The above drawing is reduced to 70%. Enlarge it to 141% to return it to the full scale and make a copy on an OHP sheet.

TRACK SHOE (DRY TYPE)



SWD04057

SWAMP SHOE



SWD04058

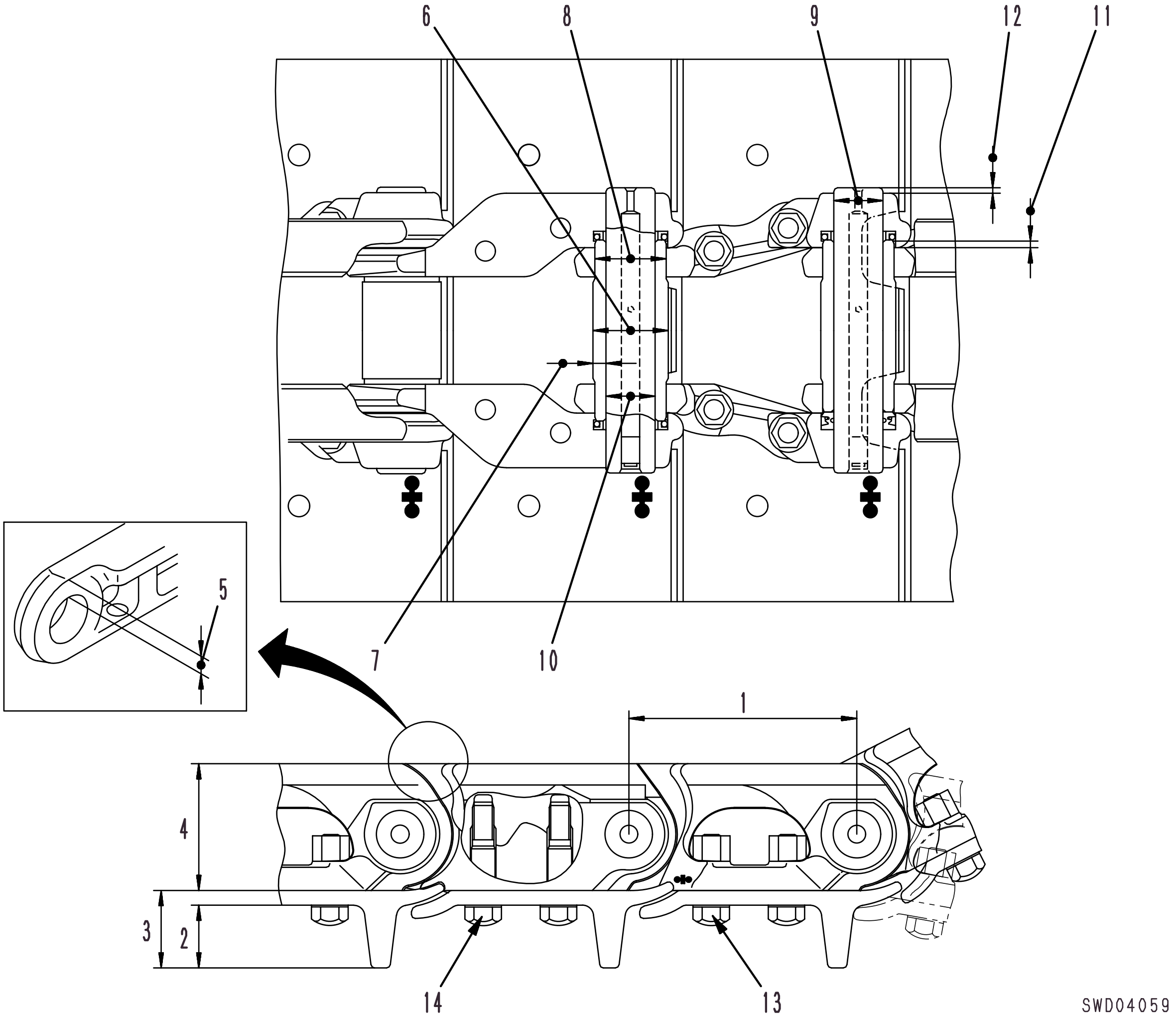
Unit: mm

No.	Check item		Criteria		Remedy
			Standard size	Repair limit	
1	Link pitch		203.45	206.45	Turn or replace
2	Height of grouser	Single	65.0	25.0	Add metal or lug or replace
		Swamp shoe	109.5	94.5	
3	Thickness of grouser	Single	77	37	
		Swamp shoe	20	5	
4	Height of link		132.0	119.5	
5	Thickness of link (Fitting part of bushing)		44.8	32.3	
6	Outside diameter of bushing		73.0	69.0 (During heavy-duty work) 67.0 (During light-duty work)	Turn or replace
7	Thickness of bushing		14.2	9.9 (During heavy-duty work) 7.9 (During light-duty work)	

No.	Check item	Standard size	Tolerance		Standard interference	Interference limit	Remedy
			Shaft	Hole			
8	Interference between bushing and link	66.5	+0.404 +0.304	+0.074 0	0.230 — 0.404	—	Replace
9	Interference between master pin and link	44.4	+0.270 +0.240	+0.086 +0.024	0.154 — 0.246	—	
10	Interference between regular pin and link	44.4	+0.435 +0.285	+0.086 +0.024	0.199 — 0.411	—	
11	Clearance between master pin and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
		44.4	–0.050 –0.150	+0.830 +0.430	0.480 — 0.980	—	
12	Clearance between regular pin and bushing	44.4	+0.435 +0.285	+1.115 +0.615	0.180 — 0.830	—	

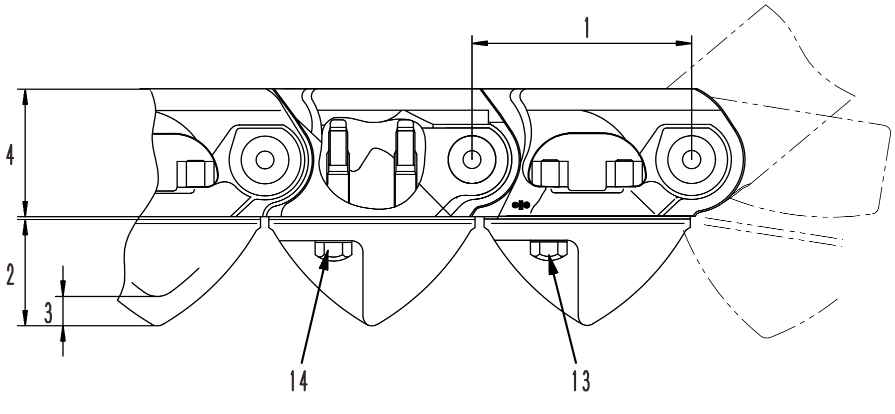
No.	Check item	Criteria		Remedy
13	Protrusion of bushing	5.25		Adjust
14	Protrusion of pin	2.95		
15	Tightening torque for shoe bolt	Initial tightening torque	Tightening angle	Tighten or replace
		539 ± 49 Nm {55 ± 5 kgm}	120 ± 10°	

TRACK SHOE (LUBRICATED TYPE)



SWD04059

SWAMP SHOE



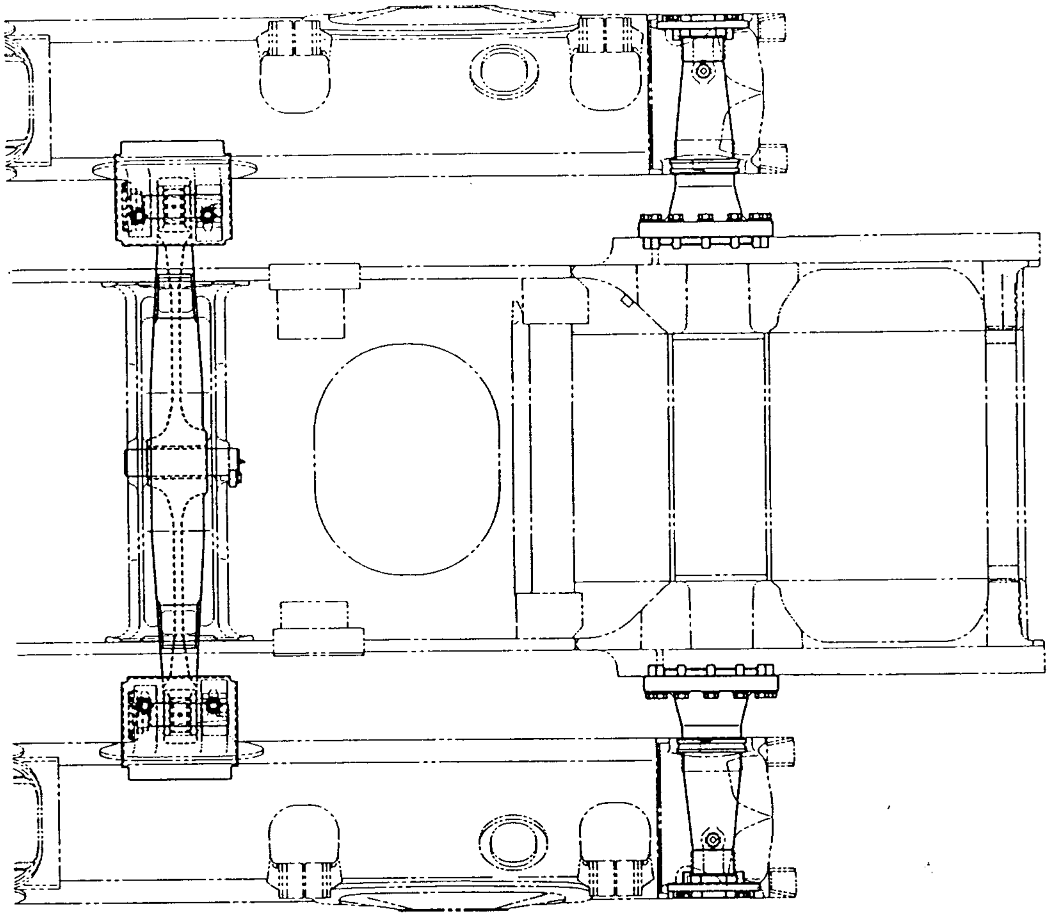
SWD04060

Unit: mm

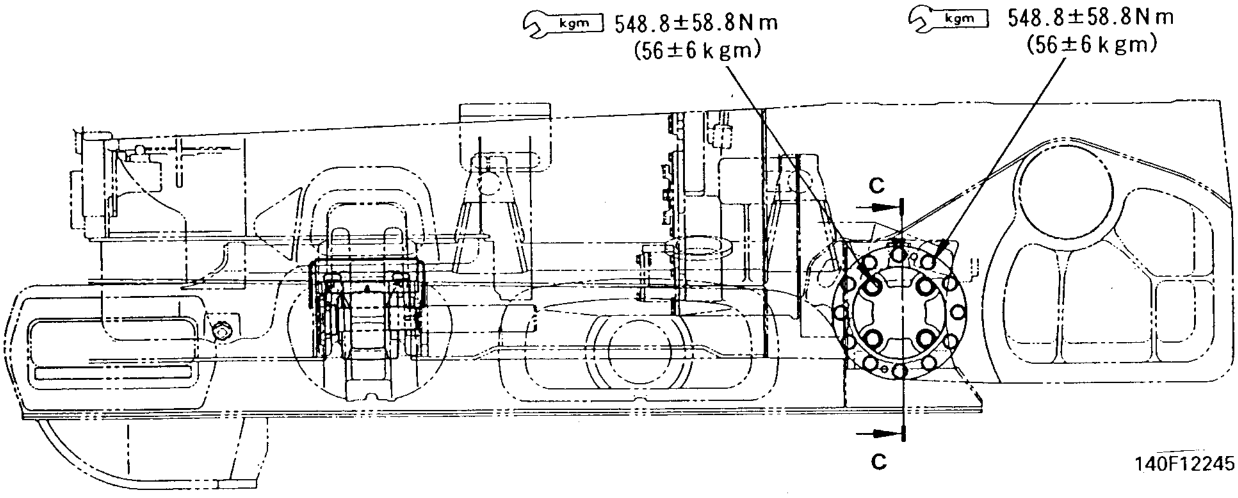
<table>
<tr><th>No.</th><th colspan="2">Check item</th><th colspan="8">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td colspan="2" rowspan="2">Link pitch</td><td colspan="4">Standard clearance</td><td colspan="4">Repair limit</td><td rowspan="2">Turn
or replace</td></tr>
<tr><td colspan="4">203.45</td><td colspan="4">206.45</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Height of grouser</td><td>Single</td><td colspan="4">65.0</td><td colspan="4">25.0</td><td rowspan="6">Add metal
or lug
or replace</td></tr>
<tr><td>Swamp shoe</td><td colspan="4">109.5</td><td colspan="4">94.5</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Thickness of grouser</td><td>Single</td><td colspan="4">77</td><td colspan="4">37</td></tr>
<tr><td>Swamp shoe</td><td colspan="4">20</td><td colspan="4">5</td></tr>
<tr><td>4</td><td colspan="2">Height of link</td><td colspan="4">132.0</td><td colspan="4">119.5</td></tr>
<tr><td>5</td><td colspan="2">Thickness of link (Fitting part of bushing)</td><td colspan="4">44.8</td><td colspan="4">32.3</td></tr>
<tr><td>6</td><td colspan="2">Outside diameter of bushing</td><td colspan="4">73.0</td><td colspan="4">67.0 (During heavy-duty work)
63.0 (During light-duty work)</td><td rowspan="2">Turn
or replace</td></tr>
<tr><td>7</td><td colspan="2">Thickness of bushing</td><td colspan="4">14.2</td><td colspan="4">7.9 (During heavy-duty work)
3.9 (During light-duty work)</td></tr>
<tr><td rowspan="3">8</td><td colspan="2" rowspan="3">Interference between bushing and link</td><td rowspan="2">Standard size</td><td colspan="4">Tolerance</td><td colspan="2" rowspan="2">Standard interference</td><td rowspan="2">Interference limit</td><td rowspan="7">Replace</td></tr>
<tr><td colspan="2">Shaft</td><td colspan="2">Hole</td></tr>
<tr><td>66.5</td><td colspan="2">+0.404
+0.304</td><td colspan="2">+0.074
0</td><td colspan="2">0.230 — 0.404</td><td>—</td></tr>
<tr><td>9</td><td colspan="2">Interference between pin and link</td><td>44.4</td><td colspan="2">+0.435
+0.285</td><td colspan="2">+0.086
+0.024</td><td colspan="2">0.199 — 0.411</td><td>—</td></tr>
<tr><td rowspan="3">10</td><td colspan="2" rowspan="3">Clearance between pin and bushing</td><td rowspan="2">Standard size</td><td colspan="4">Tolerance</td><td colspan="2" rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td></tr>
<tr><td colspan="2">Shaft</td><td colspan="2">Hole</td></tr>
<tr><td>44.6</td><td colspan="2">+0.235
+0.085</td><td colspan="2">+0.915
+0.415</td><td colspan="2">0.180 — 0.830</td><td>—</td></tr>
<tr><td>11</td><td colspan="2">Protrusion of bushing</td><td colspan="8">3.05</td><td rowspan="2">Adjust</td></tr>
<tr><td>12</td><td colspan="2">Protrusion of pin</td><td colspan="8">2.95</td></tr>
<tr><td rowspan="2">13</td><td colspan="2" rowspan="2">Tightening torque for regular shoe bolt</td><td colspan="2">Standard size</td><td colspan="4">Tightening angle</td><td colspan="2">Lower limit torque</td><td rowspan="3">Tighten
or replace</td></tr>
<tr><td colspan="2">539 ± 49 Nm
{55 ± 5 kgm}</td><td colspan="4">120 ± 10°</td><td colspan="2">—</td></tr>
<tr><td>14</td><td colspan="2">Tightening torque for master link connecting bolt</td><td colspan="2">343 ± 39.2 Nm
{35 ± 4 kgm}</td><td colspan="4">$180^{\ 0}_{-20^\circ}$</td><td colspan="2">784.6 Nm
{80 kgm}</td></tr>
</table>

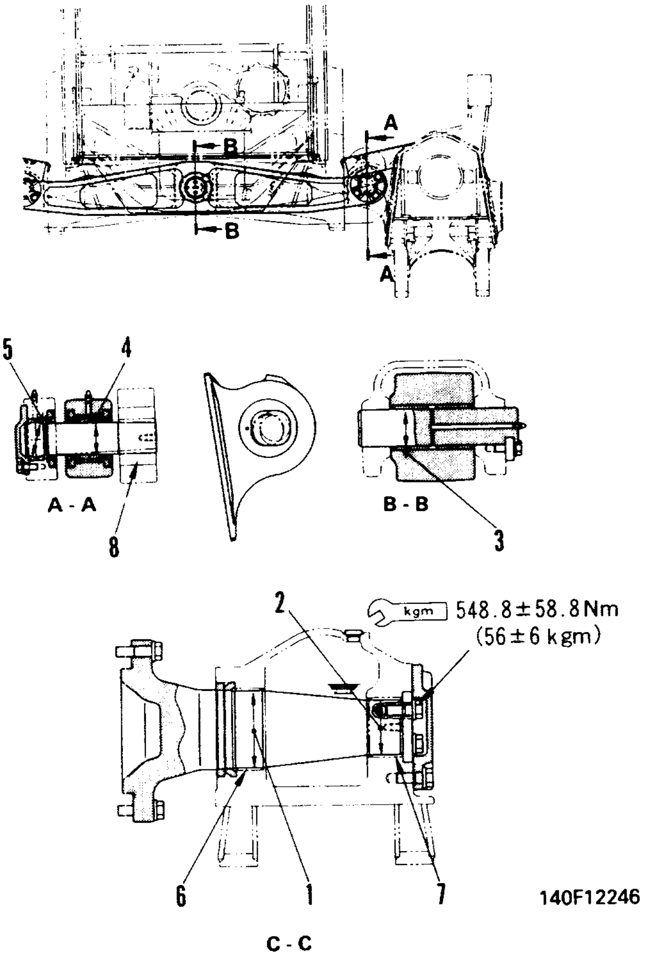
SUSPENSION

D65E-12	**60001 – 60947**
D65P-12	**60001 – 60890**
D65EX-12	**60001 – 60941**
D65PX-12	**60001 – 60914**



014012

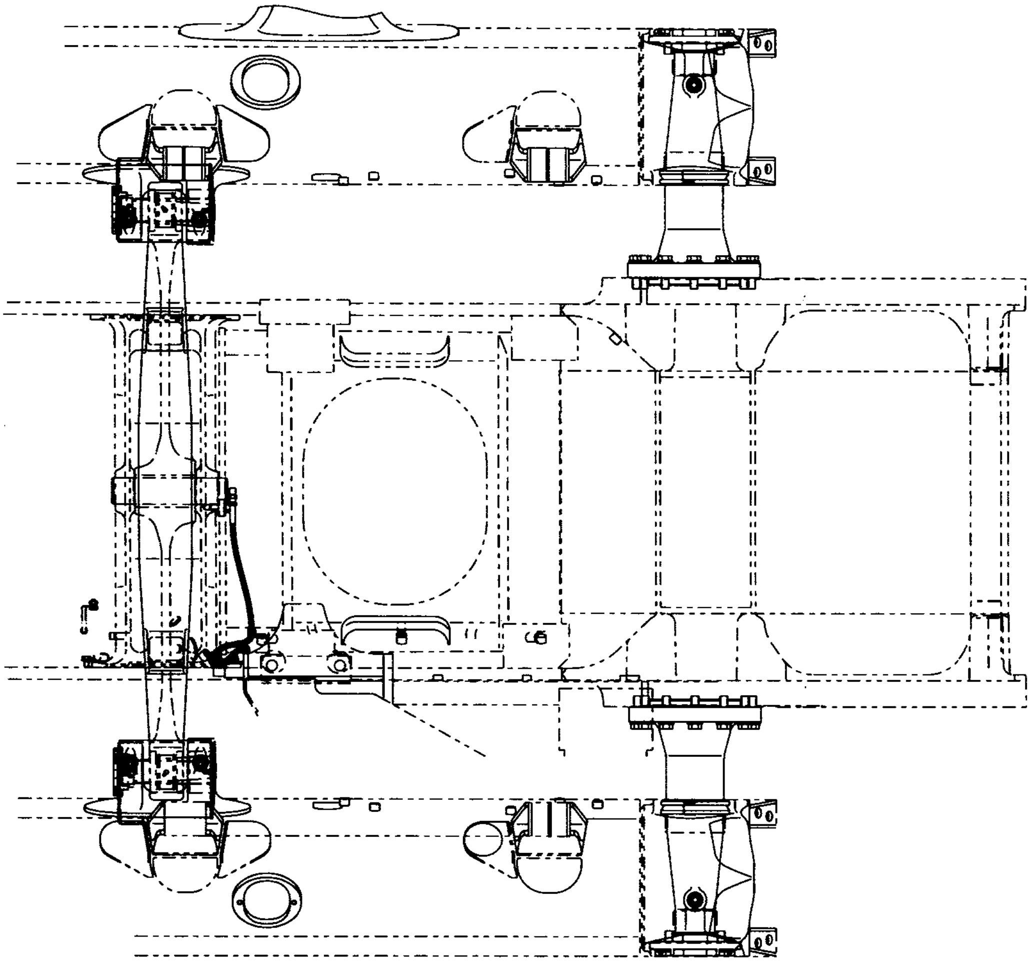




Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between pivot shaft and bushing (inside)	148	–0.145 –0.208	+0.125 +0.085	0.230 — 0.333	1.0	Replace bushing
2	Clearance between pivot shaft and bushing (outside)	105	–0.120 –0.174	+0.107 +0.072	0.192 — 0.281	1.0	
3	Clearance between center pin and bushing	70	–0.100 –0.146	+0.25 +0.19	0.290 — 0.396	0.5	
4	Clearance between side pin and bushing	60	–0.048 –0.078	–0.002 –0.033	0.015 — 0.076	0.5	
5	Clearance between side pin and spherical surface of bushing	66	–0.1 –0.3	+0.3 +0.1	0.2 — 0.6	1.0	
6	Press fitting force of pivot shaft bushing (inside)	0.9 — 22.6 KN { 0.1 — 2.3 ton }					—
7	Press fitting force of pivot shaft bushing (outside)	0.9 — 36.3 KN { 0.1 — 3.7 ton }					
8	Press fitting force of side pin bushing	68.6 — 235.4 KN { 7 — 24 ton }					

D65P-12 60891 and up
D65E-12 60948 and up
D65PX-12 60915 and up
D65EX-12 60942 and up



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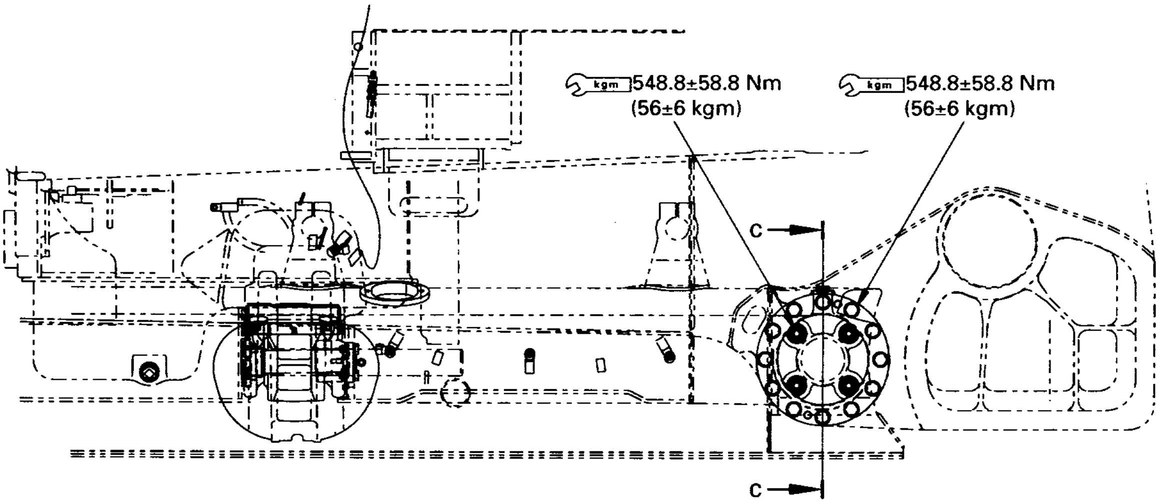
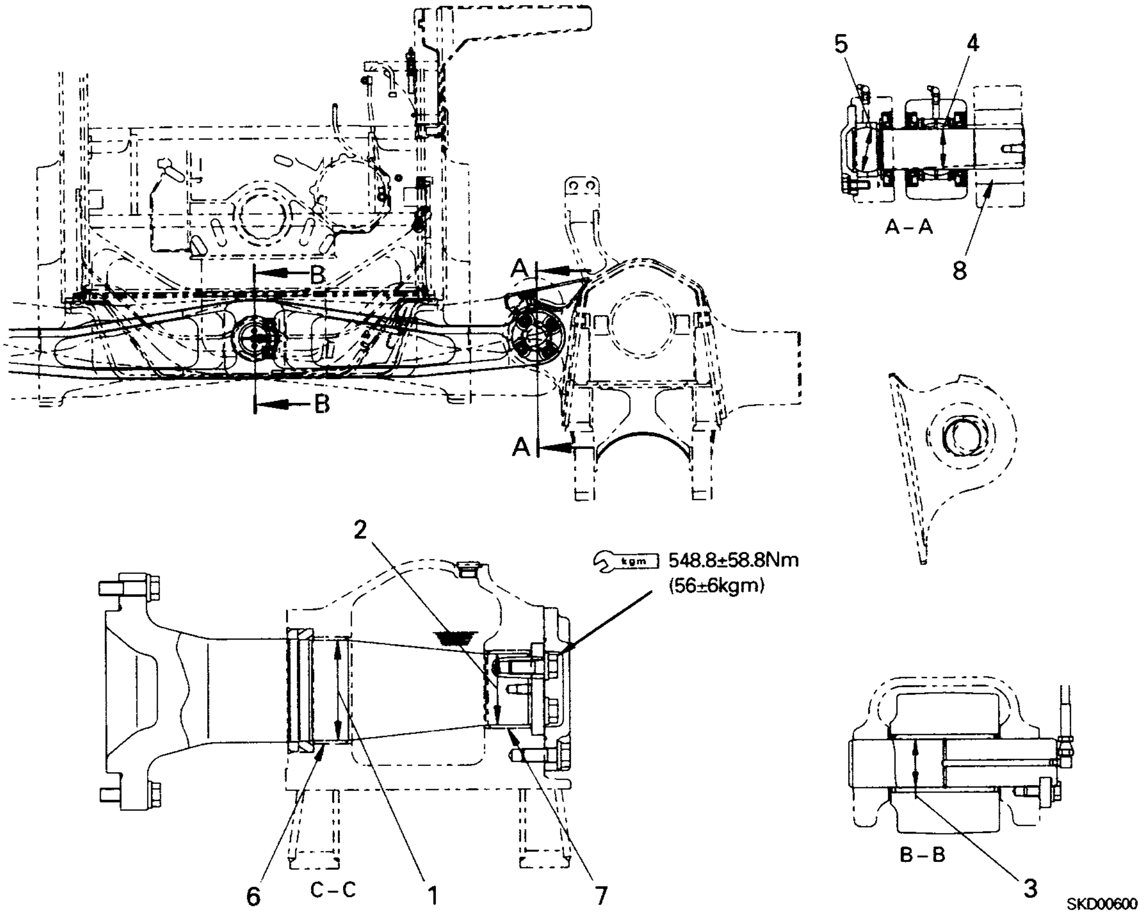


SKD00599



014012

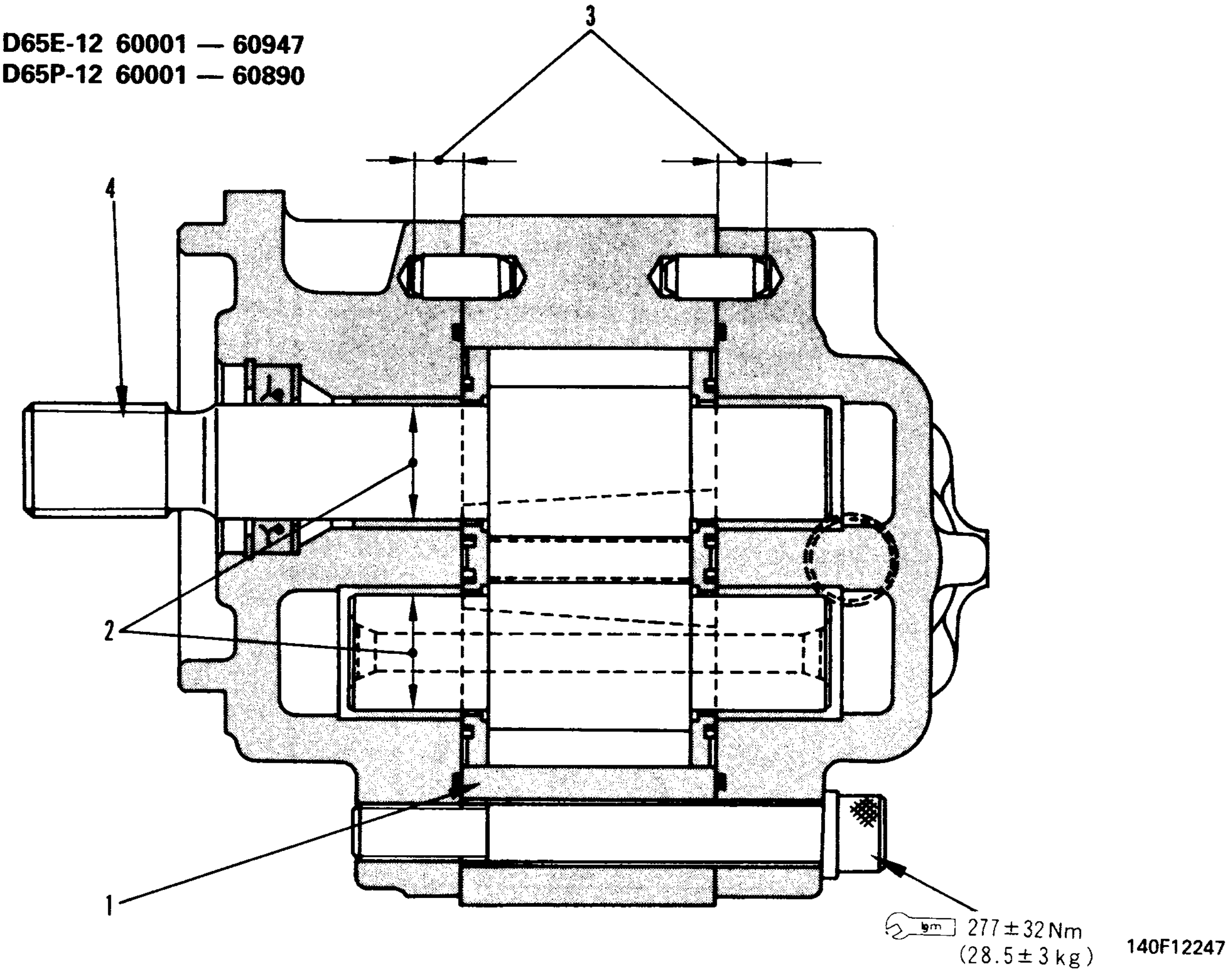
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between pivot shaft and bushing (inside)	148	–0.145 –0.208	+0.125 +0.085	0.230 — 0.333	1.0	Replace bushing
2	Clearance between pivot shaft and bushing (outside)	105	–0.120 –0.174	+0.107 +0.072	0.192 — 0.281	1.0	
3	Clearance between center pin and bushing	70	–0.100 –0.146	+0.25 +0.19	0.290 — 0.396	0.5	
4	Clearance between side pin and bushing	60	–0.048 –0.078	–0.002 –0.033	0.015 — 0.076	0.5	
5	Clearance between side pin and spherical surface of bushing	66	–0.1 –0.3	+0.3 +0.1	0.2 — 0.6	1.0	
6	Press fitting force of pivot shaft bushing (inside)	0.9 — 22.6 KN { 0.1 — 2.3 ton }					—
7	Press fitting force of pivot shaft bushing (outside)	0.9 — 36.3 KN { 0.1 — 3.7 ton }					
8	Press fitting force of side pin bushing	68.6 — 235.4 KN { 7 — 24 ton }					

HYDRAULIC PUMP

- **SAL(3)-100**

D65E-12 60001 — 60947
D65P-12 60001 — 60890



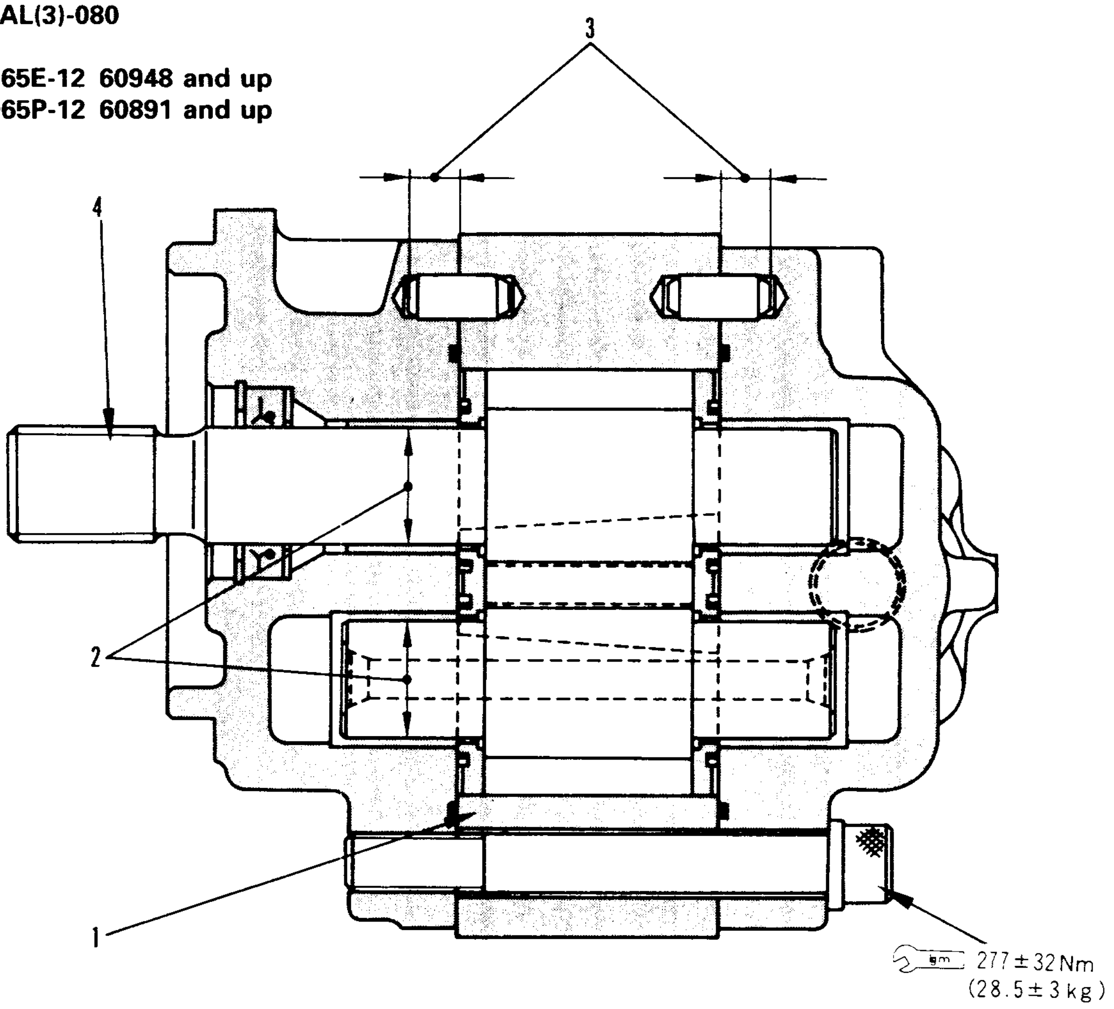
014012

Unit: mm

No.	Check item	Criteria				Remedy
1	Clearance between gear case and side plate	Standard clearance		Clearance limit		Replace
		0.13 — 0.18		0.22		
2	Clearance between inside diameter of plain bearing and outside diameter of gear shaft	0.060 — 0.149		0.20		
3	Depth for hitting in pin	Standard size	Tolerance	Repair limit		
		14	0 -0.5	—		
4	Spline shaft rotating torque	6.9 — 11.8 Nm (0.7 — 1.2 kgm)				—
—	Discharge amount (Oil: EO10-CD Oil temperature: 45 - 55°C)	Speed (rpm)	Discharge pressure	Standard discharge amount (ℓ/min)	Discharge amount limit (ℓ/min)	—
		2,500	20.6 MPa (210 kg/cm²)	231	214	

- **SAL(3)-080**

D65E-12 60948 and up
D65P-12 60891 and up



140F12247

014012

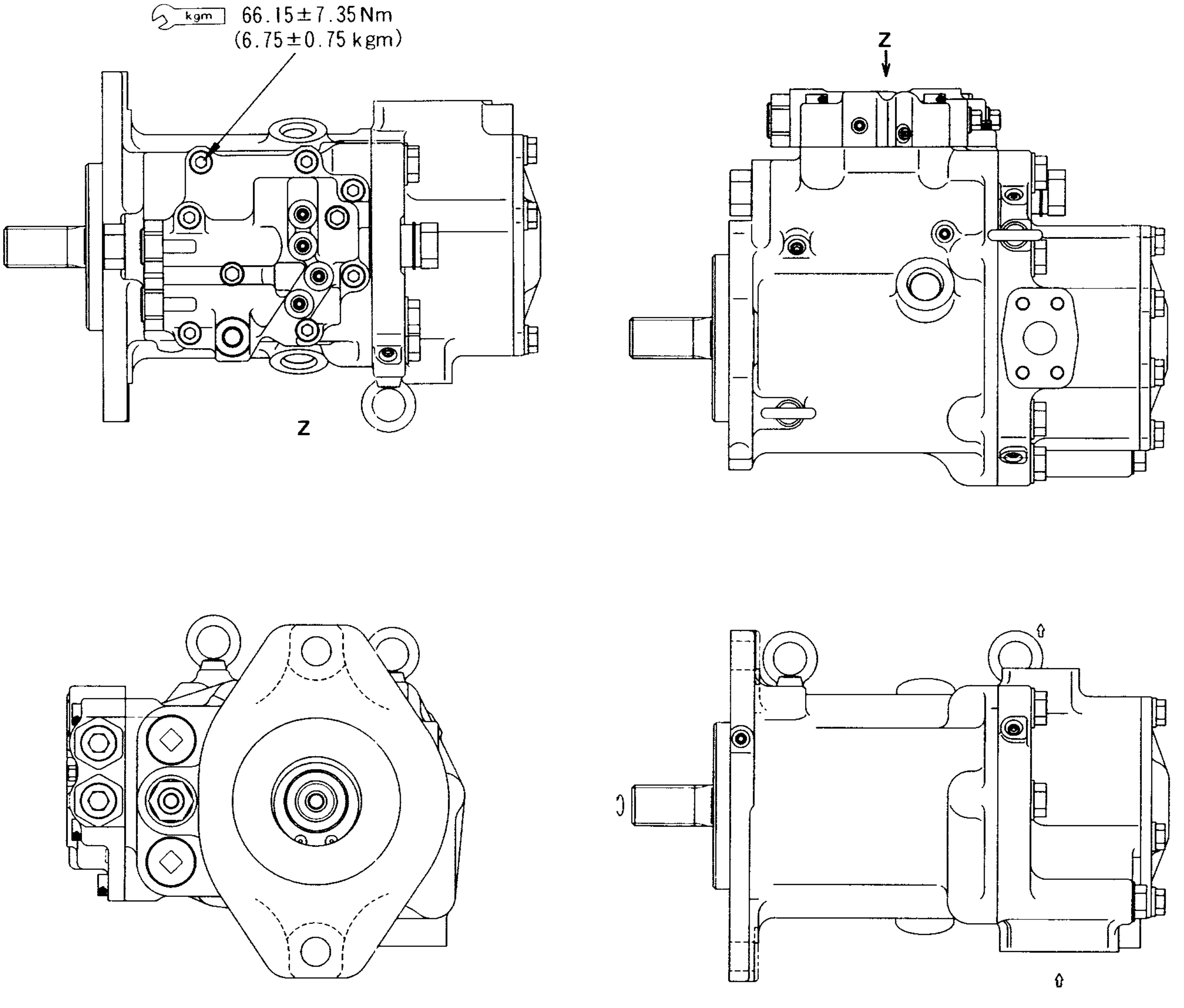
Unit: mm

No.	Check item	Criteria				Remedy
1	Clearance between gear case and side plate	Standard clearance		Clearance limit		Replace
		0.10 — 0.15		0.19		
2	Clearance between inside diameter of plain bearing and outside diameter of gear shaft	0.060 — 0.149		0.20		
3	Depth for hitting in pin	Standard size	Tolerance	Repair limit		
		14	0 -0.5	—		
4	Spline shaft rotating torque	6.9 — 11.8 Nm (0.7 — 1.2 kgm)				—
—	Discharge amount (Oil: EO10-CD Oil temperature: 45 – 55°C)	Speed (rpm)	Discharge pressure	Standard discharge amount (ℓ/min)	Discharge amount limit (ℓ/min)	—
		2,500	20.6 MPa (210 kg/cm^2)	184	170	

HYDRAULIC, HSS PUMP

- **HPV 95**

D65EX, PX-12



kgm 66.15±7.35 Nm (6.75±0.75 kgm)

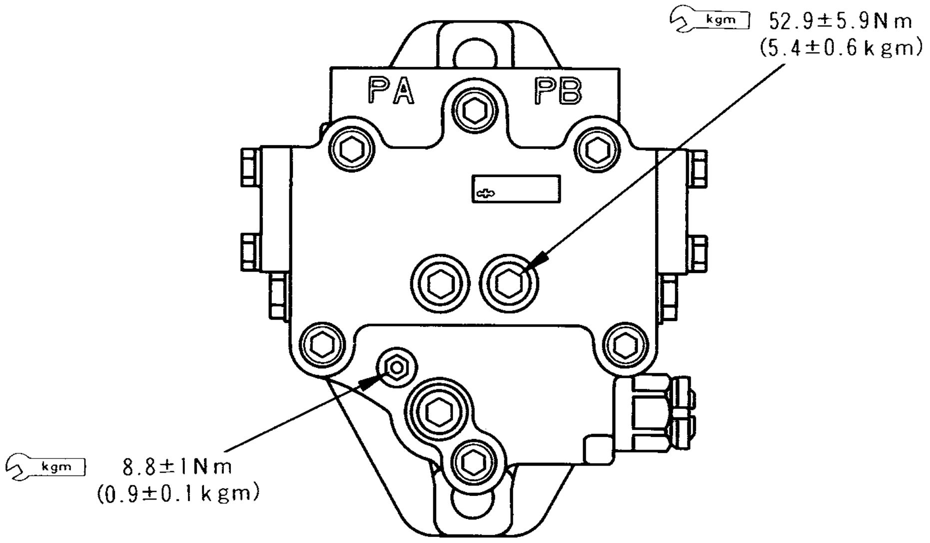
140F12248

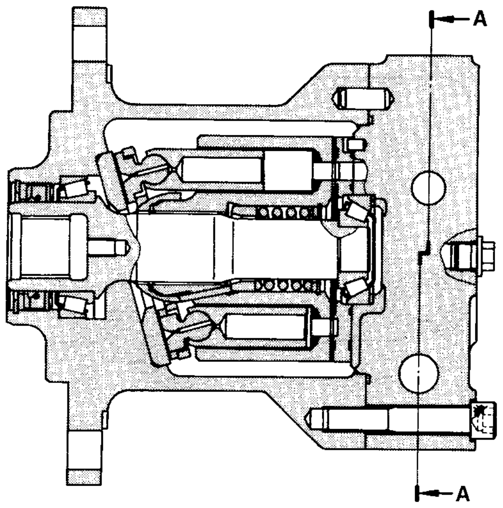
014012

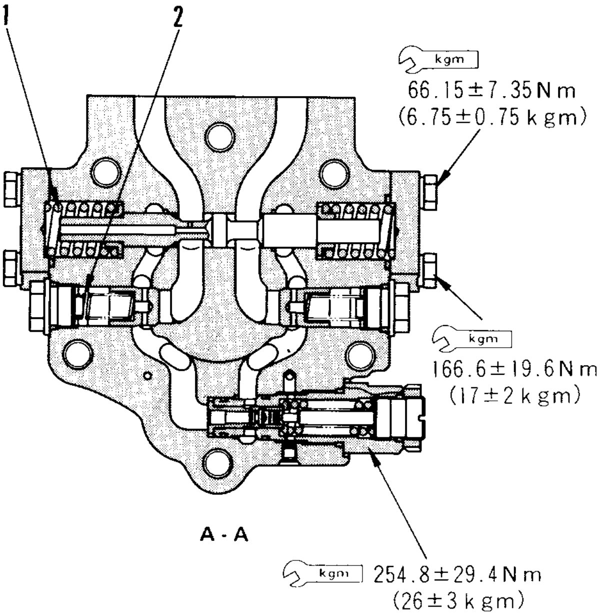
HSS MOTOR

- **HMF 95**

D65EX, PX-12







140F12249

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length × O.D.	Installed length	Installed load	Free length	Installed load	
1	Spool return spring	42.7 × 30.0	40.5	192.2 N (19.6 kg)	—	154.0 N (15.7 kg)	If there is any damage or deformation, replace spring
2	Check valve spring	43 × 13.8	32.9	1.28 N (0.13 kg)	—	0.98 N (0.10 kg)	

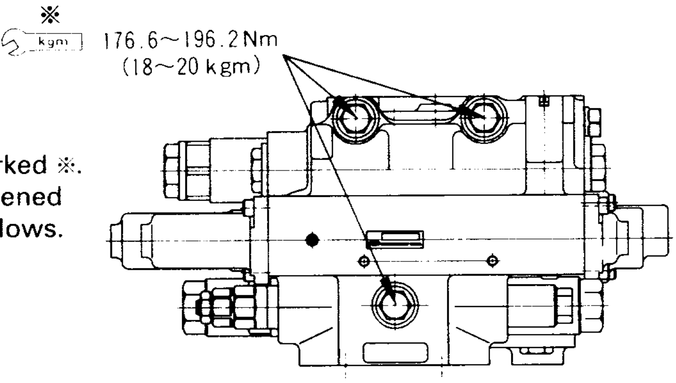
MAIN CONTROL VALVE

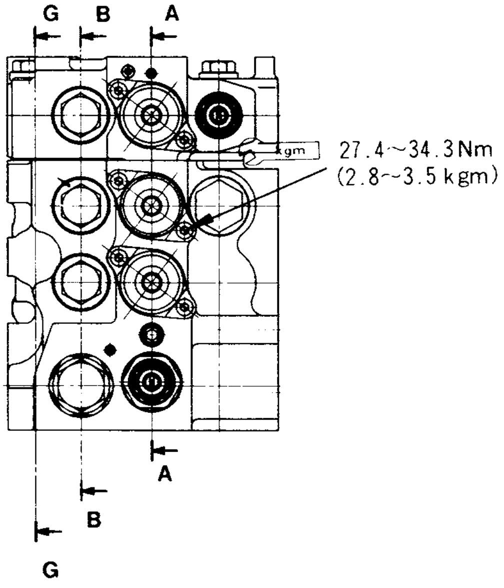
- **2 + 1-SPOOL VALVE (1/3)**

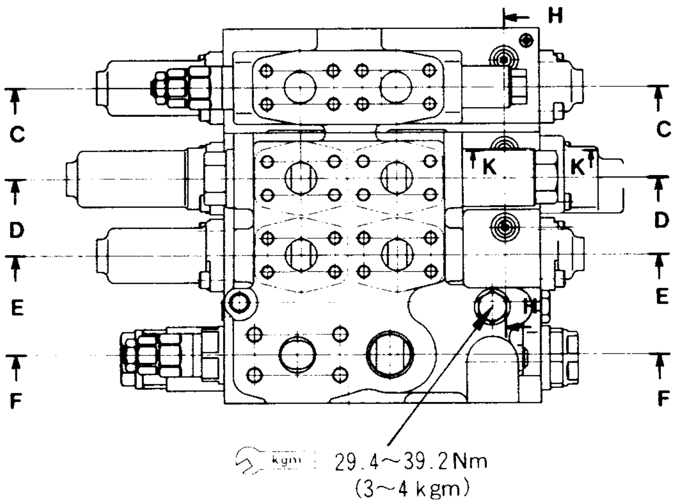
D65E-12 60001 — 60947
D65P-12 60001 — 60890

★ Precautions when tightening parts marked ※. To make sure that the 3 bolts are tightened uniformly, tighten in three steps as follows.

1st step	49 — 68.6 Nm (5 — 7 kgm)
2nd step	127.5 — 147.1 Nm (13 — 15 kgm)
3rd step	176.5 — 196.1 Nm (18 — 20 kgm)







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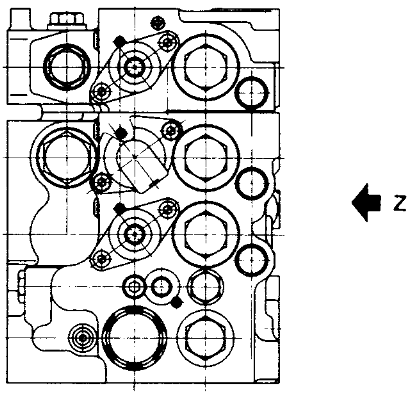
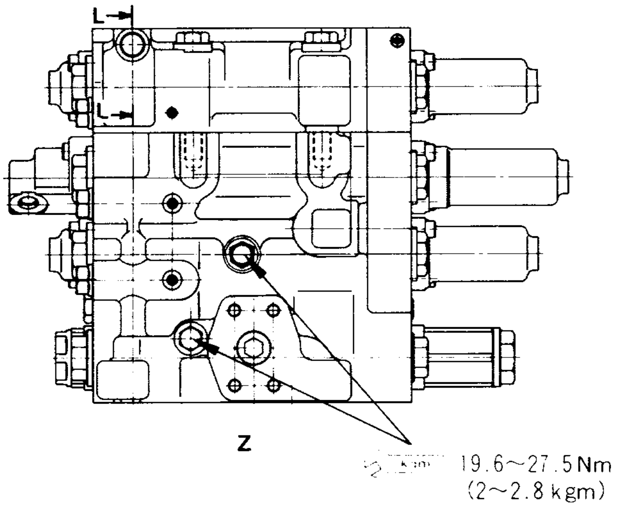
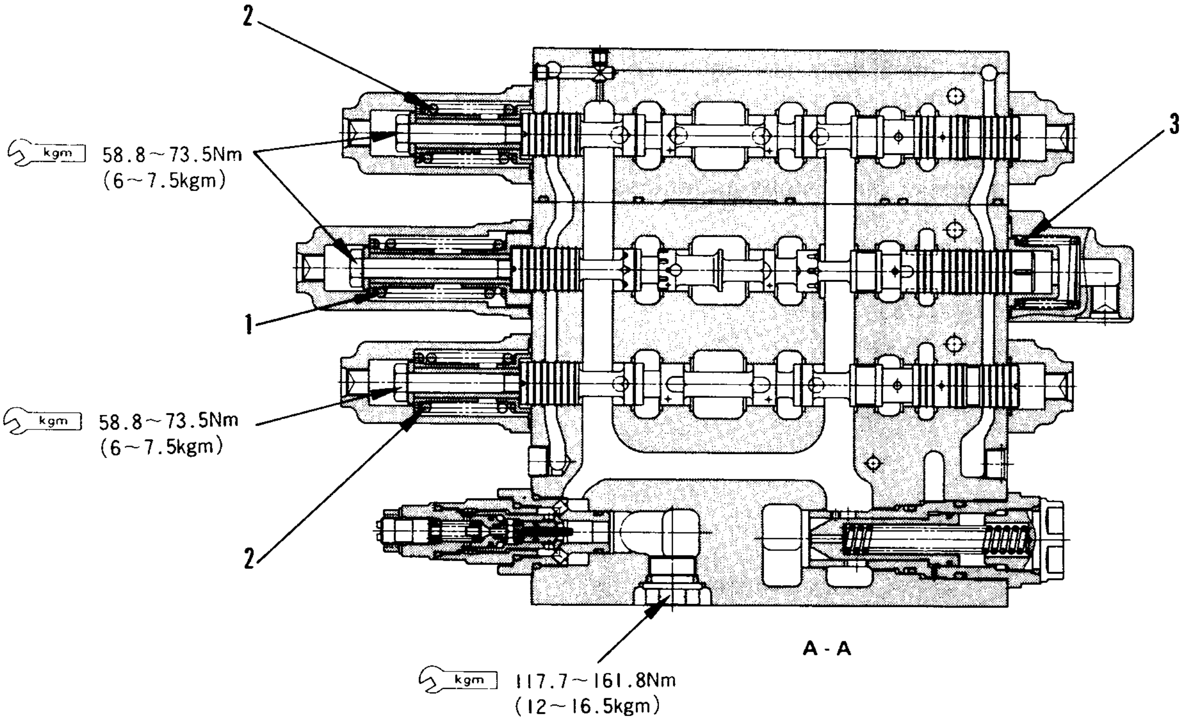
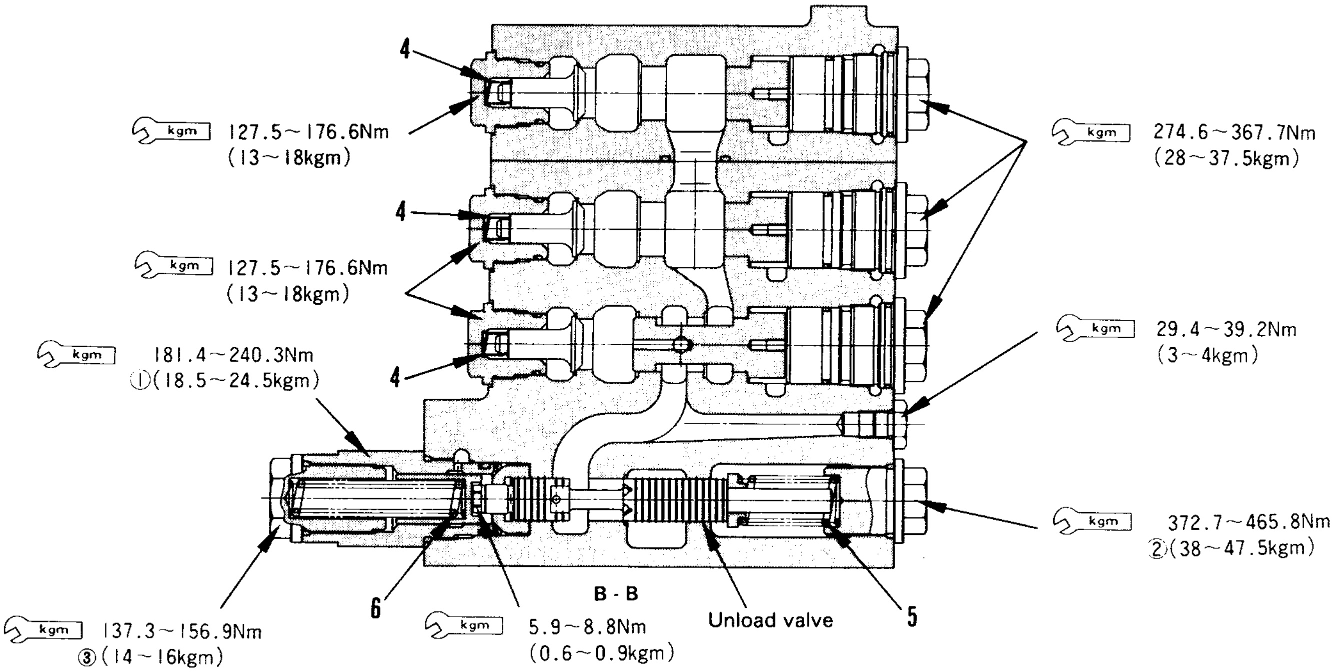




140F12250

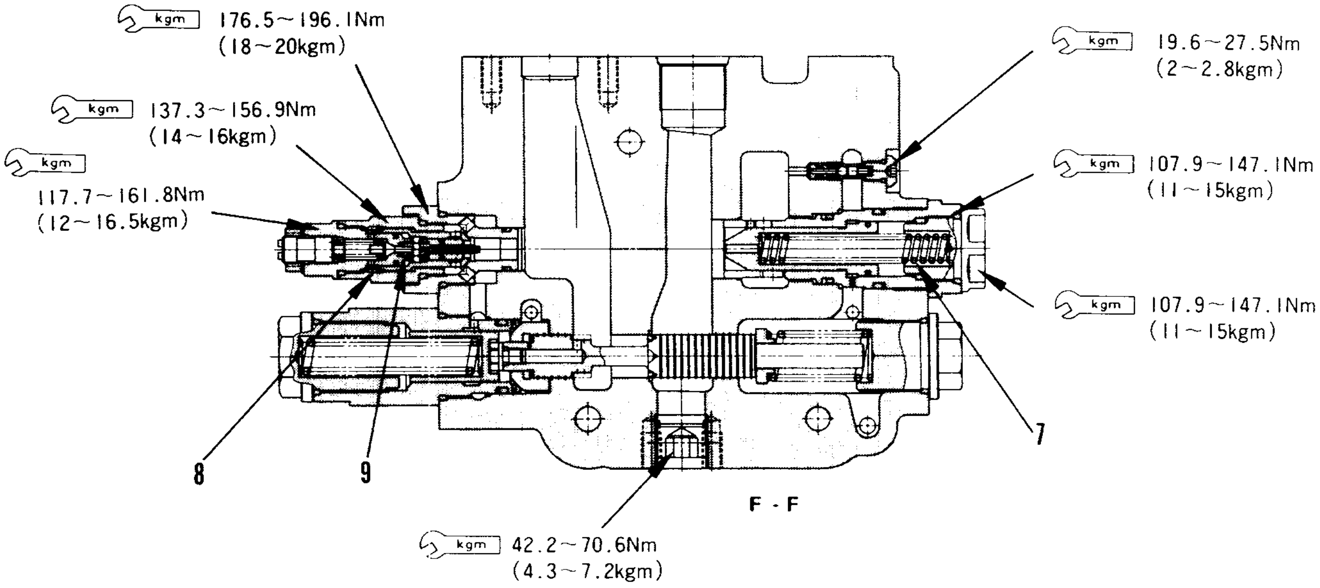
- **2 + 1-SPOOL VALVE (2/3)**





140F12251A

★ Precautions when assembling
When assembling the unload valve, tighten the plugs in the following order: ① → ② → ③

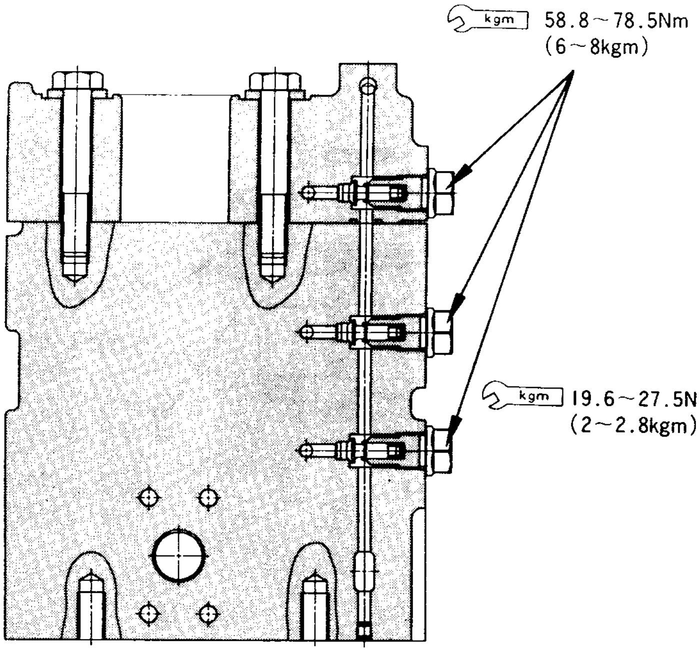


140F12252

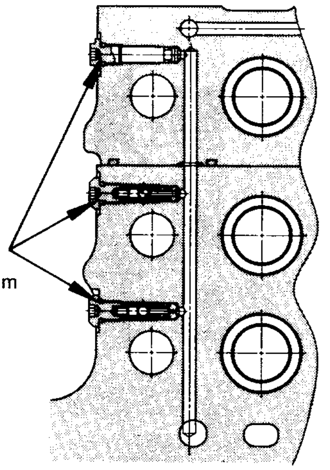
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length X O.D.	Installed length	Installed load	Free length	Installed load	
1	Spool return spring	73.4 X 3.1	68.5	223.6 N (22.8 kg)	—	178.9 N (18.2 kg)	If there is any damage or deformation, replace spring
2	Spool return spring (lift valve only)	51.7 X 31.3	50	140.2 N (14.3 kg)	—	112.2 N (11.4 kg)	
3	Spool return spring (for lift FLOAT)	65.3 X 36.5	33.5	335.4 N (34.2 kg)	—	268.3 N (27.4 kg)	
4	Load check valve spring	20.8 X 10.2	13.5	12.7 N (1.3 kg)	—	10.2 N (1.0 kg)	
5	Unload spring	87.2 X 26	53.1	442.3 N (45.1 kg)	—	353.8 N (36.1 kg)	
6	Cancel spring	118.4 X 19.5	92.5	443.3 N (45.2 kg)	—	354.6 N (36.2 kg)	
7	Back pressure valve spring	99.5 X 14.9	96	71.6 N (7.3 kg)	—	57.3 N (5.8 kg)	
8	Relief valve spring	16.3 X 21.3	9	2.16 N (0.22 kg)	—	1.01 N (0.10 kg)	
9	Relief valve spring	20 X 7	13.7	1.27 N (0.13 kg)	—	19.0 N (1.94 kg)	

- **2 + 1-SPOOL VALVE (3/3)**

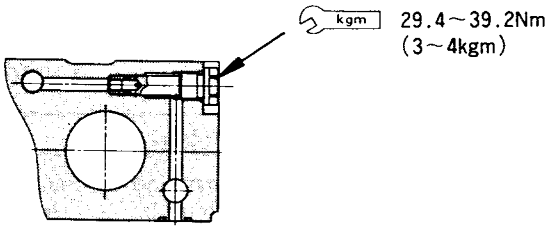


G - G

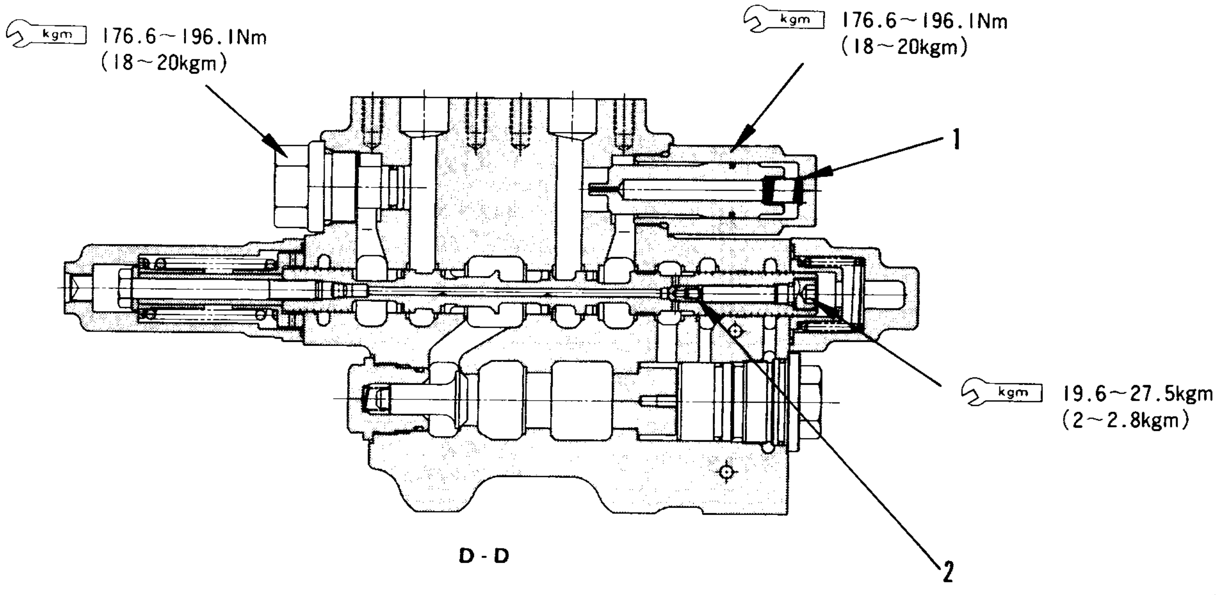


H - H

014012

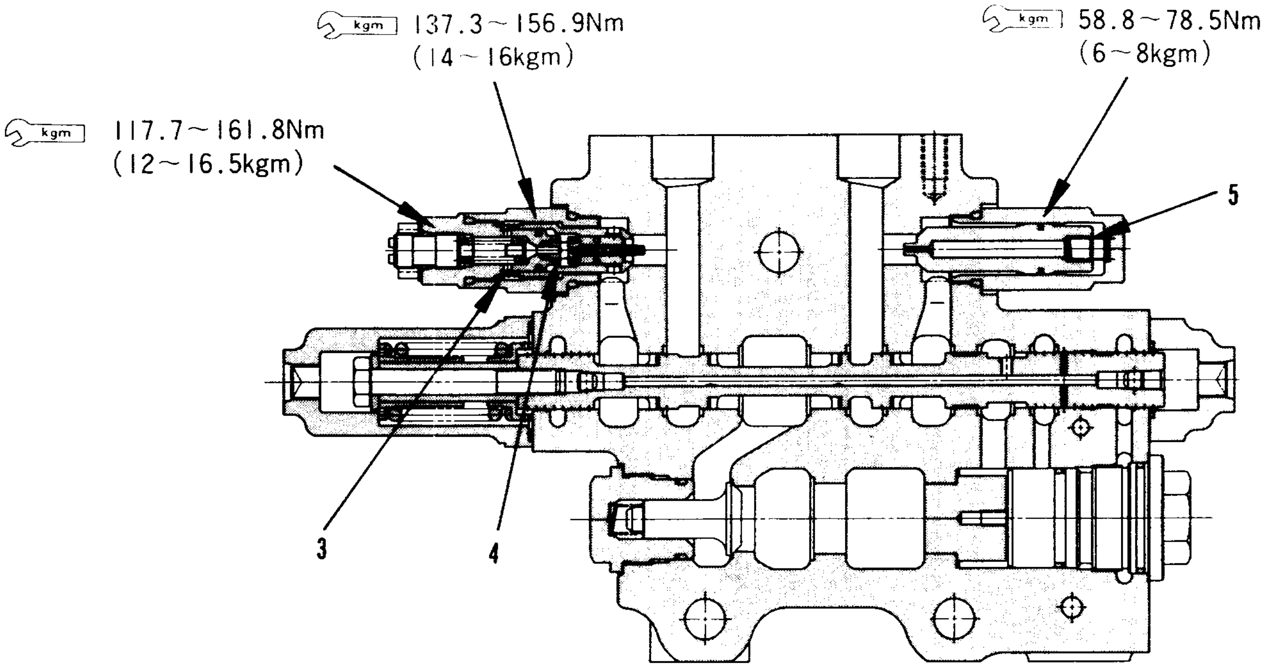


L - L



D - D

140F12253



C - C

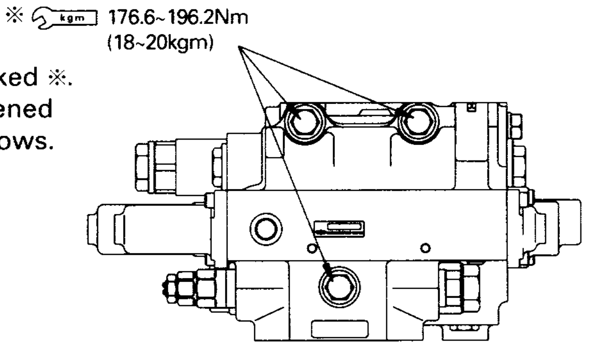
140F12254

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length X O.D.	Installed length	Installed load	Free length	Installed load	
1	Suction valve spring	27.9 X 13	18.8	6.3 N (0.64 kg)	—	5.0 N (0.51 kg)	If there is any damage or deformation, replace spring
2	Check valve spring inside spool	9.4 X 4.6	8.5	0.3 N (0.03 kg)	—	0.24 N (0.02 kg)	
3	Suction safety valve spring	16.3 X 21.3	9	2.16 N (0.22 kg)	—	1.73 N (0.18 kg)	
4	Suction safety valve spring	20 X 7	13.7	1.27 N (0.13 kg)	—	1.01 N (0.10 kg)	
5	Suction valve spring	29.5 X 8.95	16.5	23.7 N (2.42 kg)	—	19.0 N (1.94 kg)	

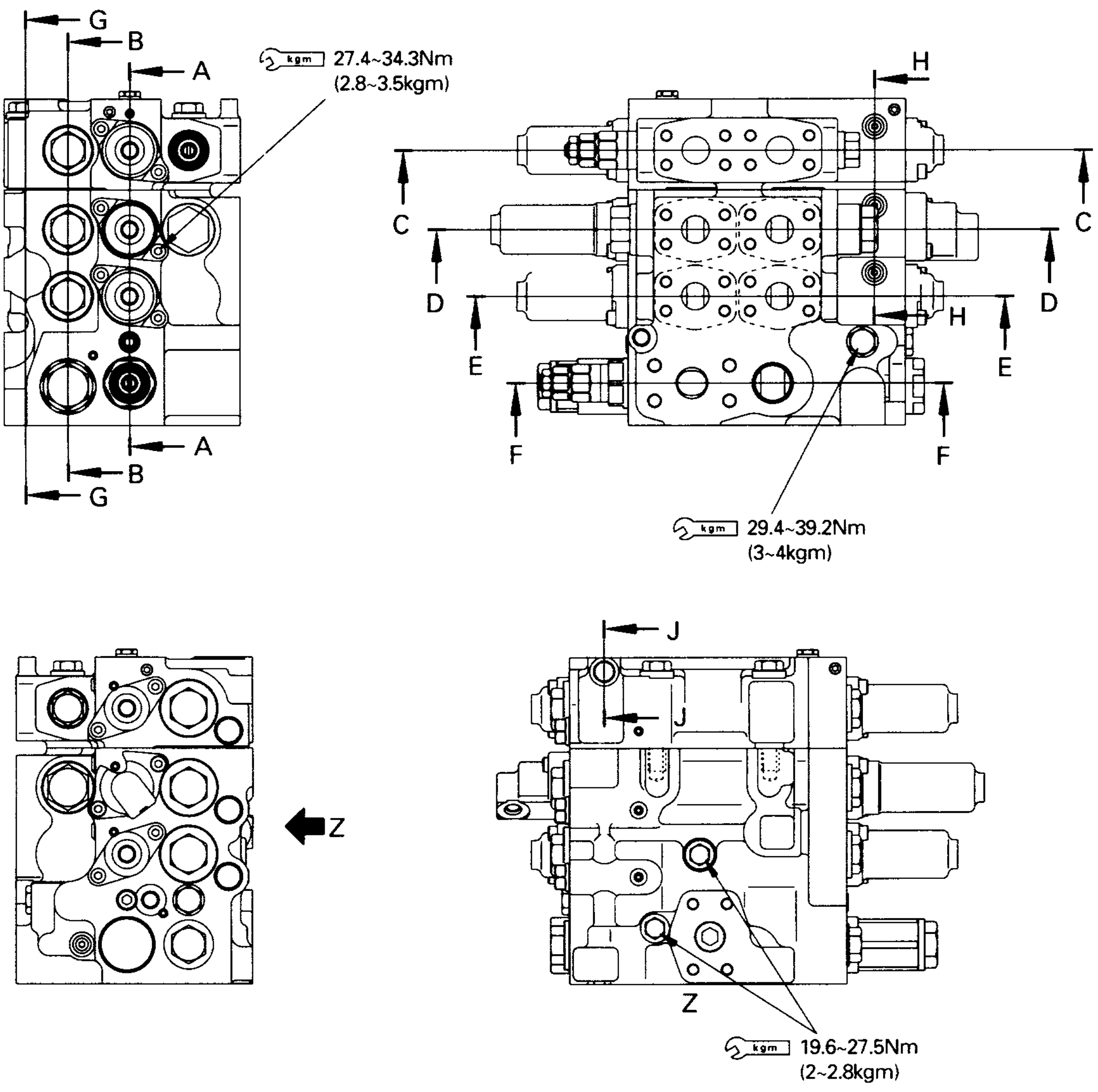
• 2 + 1-SPOOL VALVE (1/3)

D65E-12 60948 and up
D65P-12 60891 and up



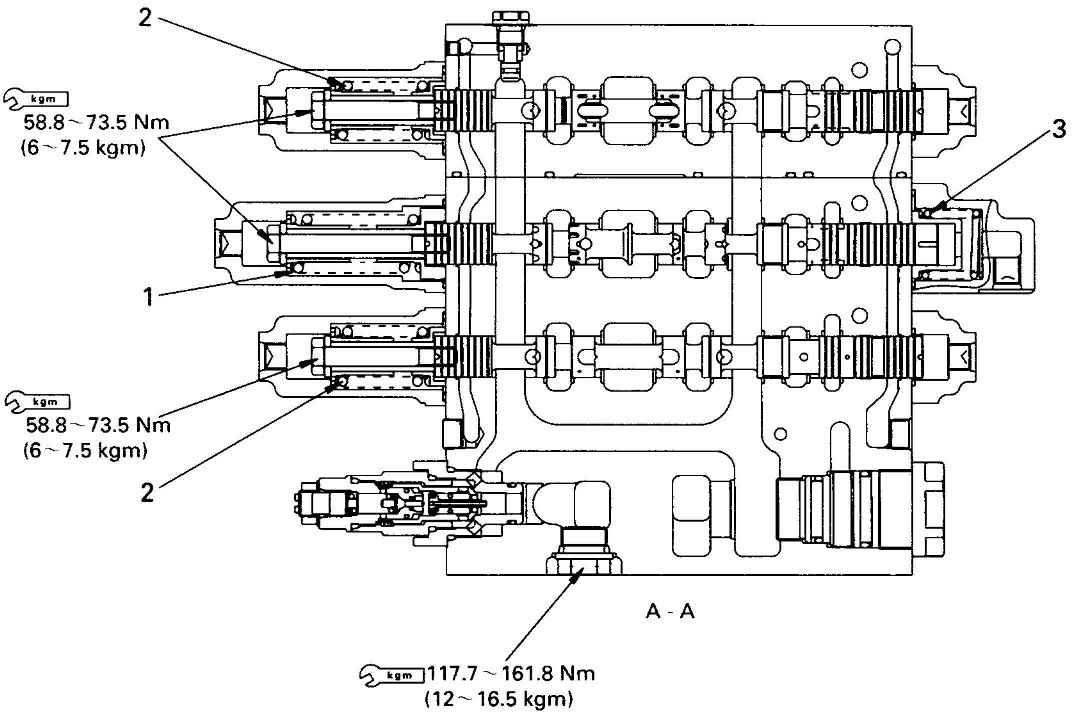
★ Precautions when tightening parts marked ※.
To make sure that the 3 bolts are tightened uniformly, tighten in three steps as follows.

1st step	49 — 68.6 Nm (5 — 7 kgm)
2nd step	127.5 — 147.1 Nm (13 — 15 kgm)
3rd step	176.5 — 196.1 Nm (18 — 20 kgm)

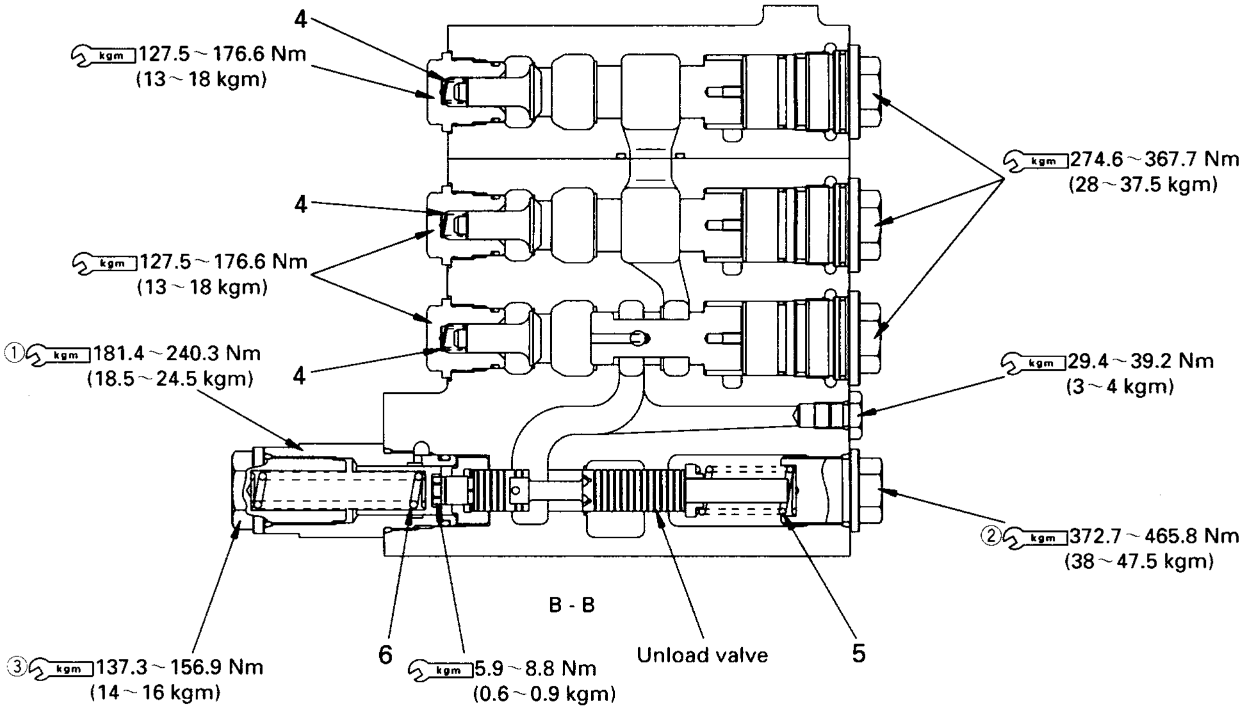


SKD00601

- **2 + 1-SPOOL VALVE (2/3)**

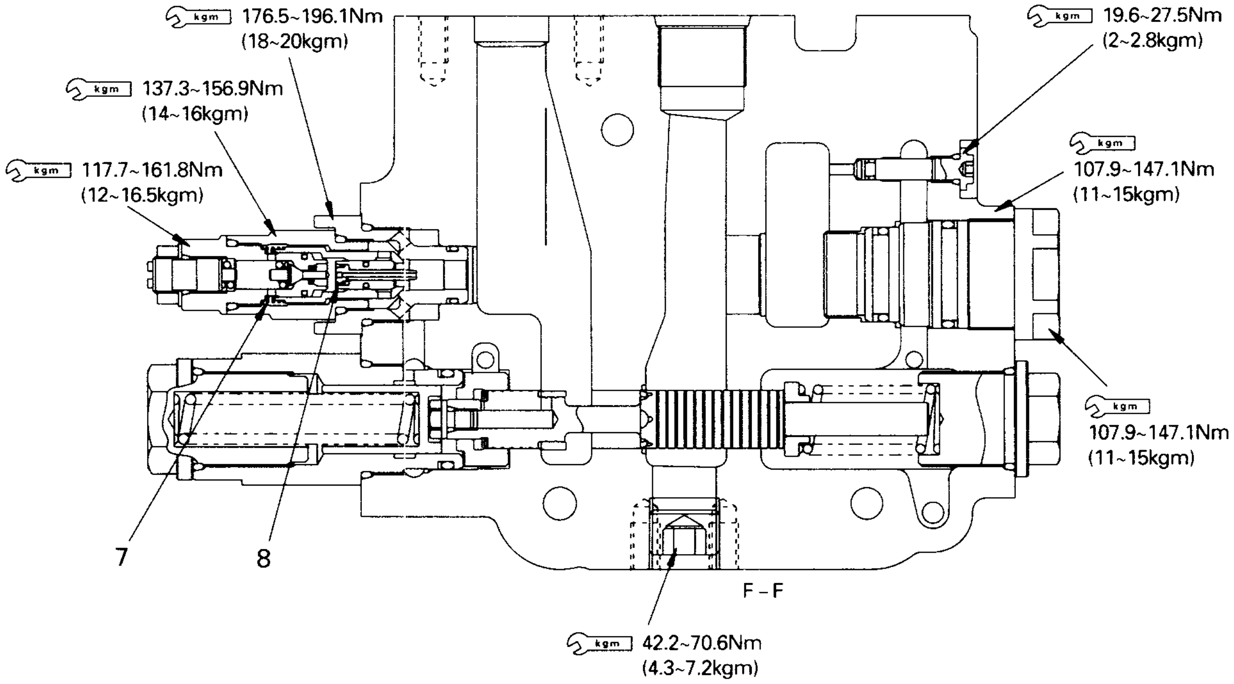


014012



SKD00602

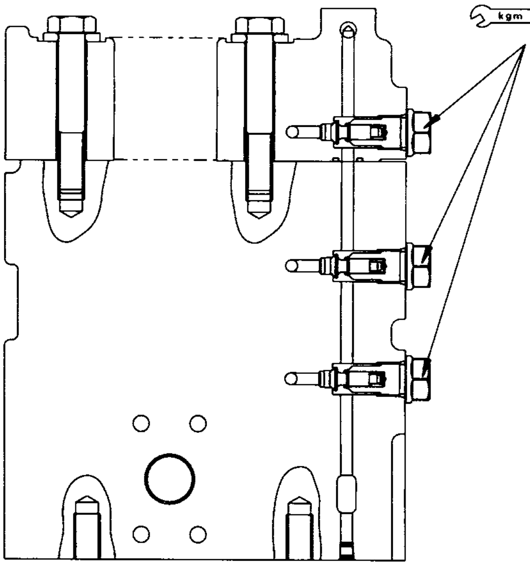
★ Precautions when assembling
When assembling the unload valve, tighten the plugs in the following order: ① → ② → ③



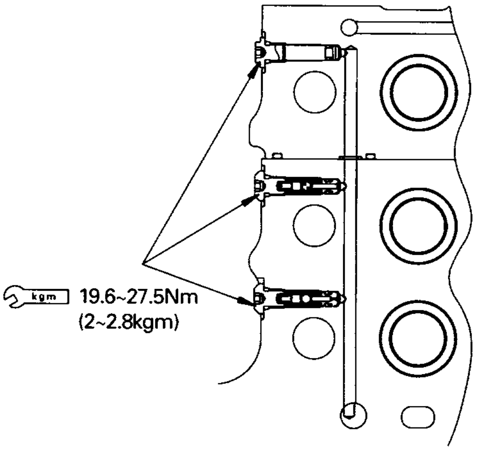
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length X O.D.	Installed length	Installed load	Free length	Installed load	
1	Spool return spring	73.4 X 3.1	68.5	223.6 N (22.8 kg)	—	178.9 N (18.2 kg)	If there is any damage or deformation, replace spring
2	Spool return spring (lift valve only)	51.7 X 31.3	50	140.2 N (14.3 kg)	—	112.2 N (11.4 kg)	
3	Spool return spring (for lift FLOAT)	65.3 X 36.5	33.5	335.4 N (34.2 kg)	—	268.3 N (27.4 kg)	
4	Load check valve spring	20.8 X 10.2	13.5	12.7 N (1.3 kg)	—	10.2 N (1.0 kg)	
5	Unload spring	87.2 X 26	53.1	442.3 N (45.1 kg)	—	353.8 N (36.1 kg)	
6	Cancel spring	118.4 X 19.5	92.5	443.3 N (45.2 kg)	—	354.6 N (36.2 kg)	
7	Relief valve spring	16.3 X 21.3	9	2.16 N (0.22 kg)	—	1.01 N (0.10 kg)	
8	Relief valve spring	20 X 7	13.7	1.27 N (0.13 kg)	—	19.0 N (1.94 kg)	

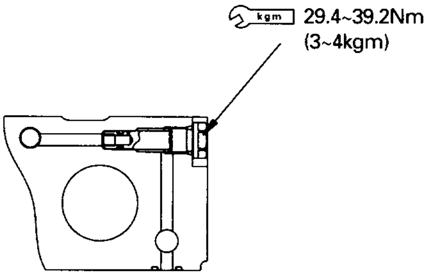
- **2 + 1-SPOOL VALVE (3/3)**



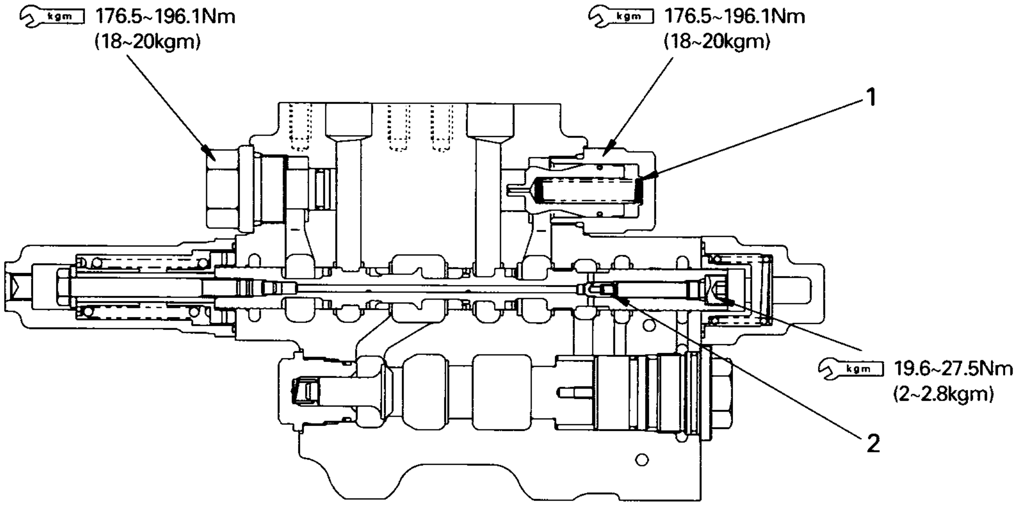
G – G



H – H



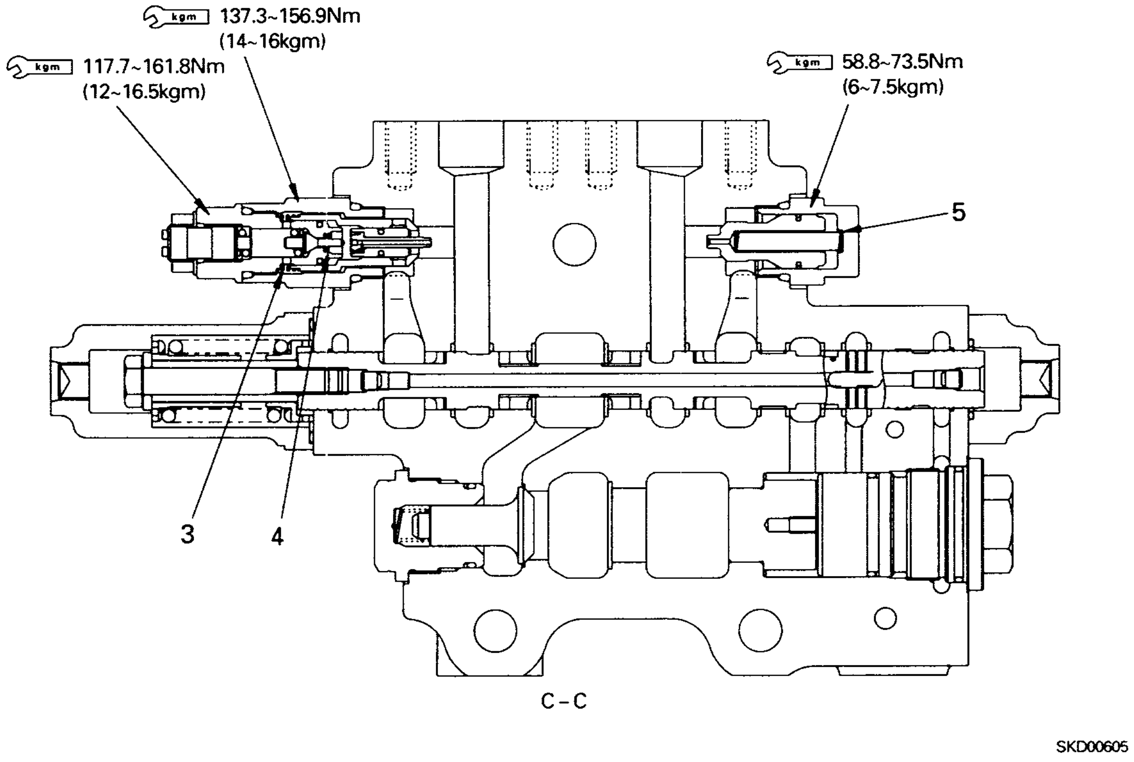
J – J



D – D

SKD00604

014012



Unit: mm

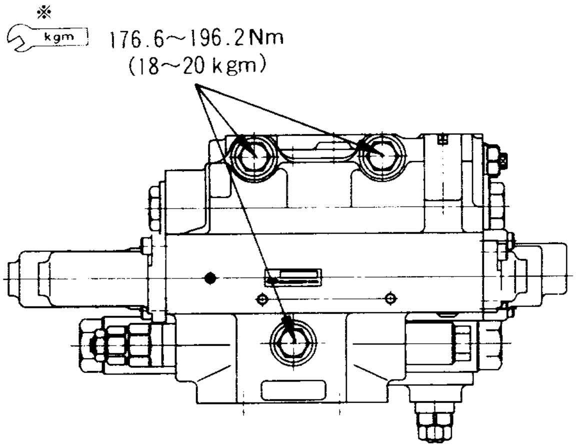
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length X O.D.	Installed length	Installed load	Free length	Installed load	
1	Suction valve spring	64.9 X 12.5	56	6.4 N (0.65 kg)	—	5.1 N (0.52 kg)	If there is any damage or deformation, replace spring
2	Check valve spring inside spool	9.4 X 4.6	8.5	0.3 N (0.03 kg)	—	0.24 N (0.02 kg)	
3	Suction safety valve spring	16.3 X 21.3	9	2.16 N (0.22 kg)	—	1.73 N (0.18 kg)	
4	Suction safety valve spring	20 X 7	13.7	1.27 N (0.13 kg)	—	1.01 N (0.10 kg)	
5	Suction valve spring	46.8 X 7.5	40.6	5.5 N (0.56 kg)	—	4.4 N (0.45 kg)	

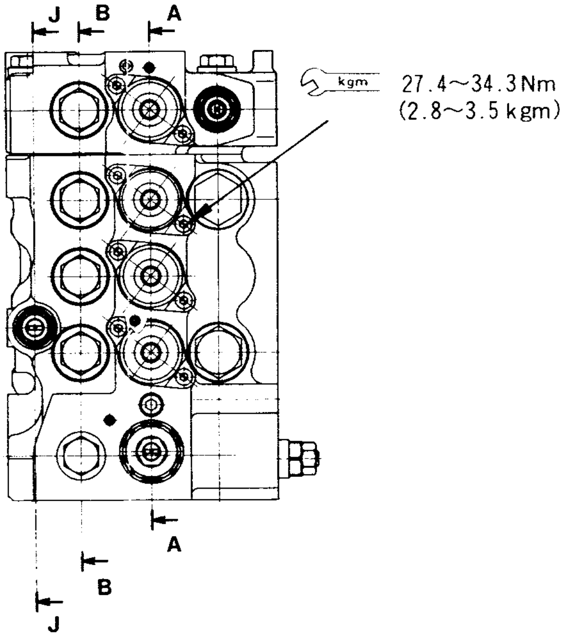
- **3 + 1-SPOOL VALVE (1/3)**

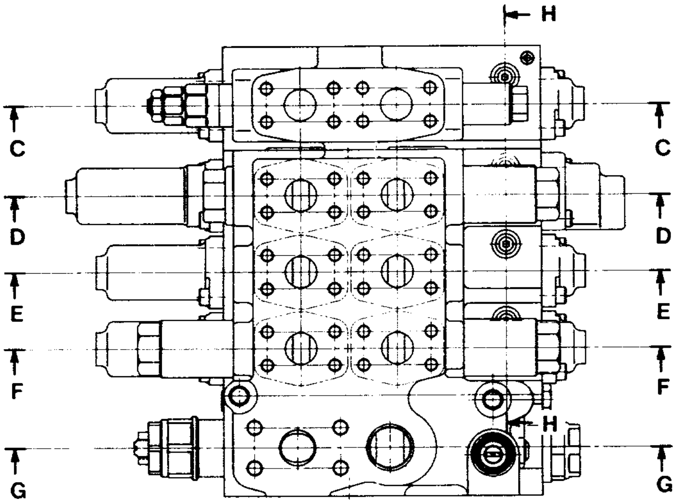
D65EX-12 60001 — 60941
D65PX-12 60001 — 60914

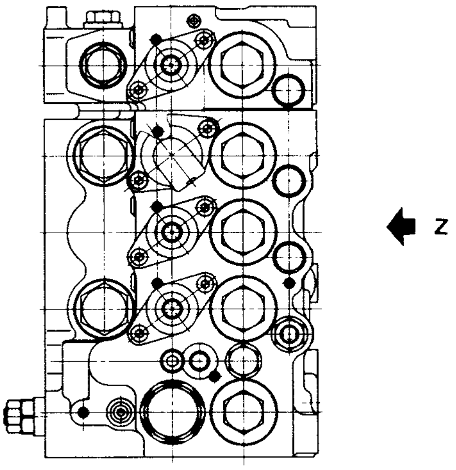
★ Precautions when tightening parts marked ※. To make sure that the 3 bolts are tightened uniformly, tighten in three steps as follows.

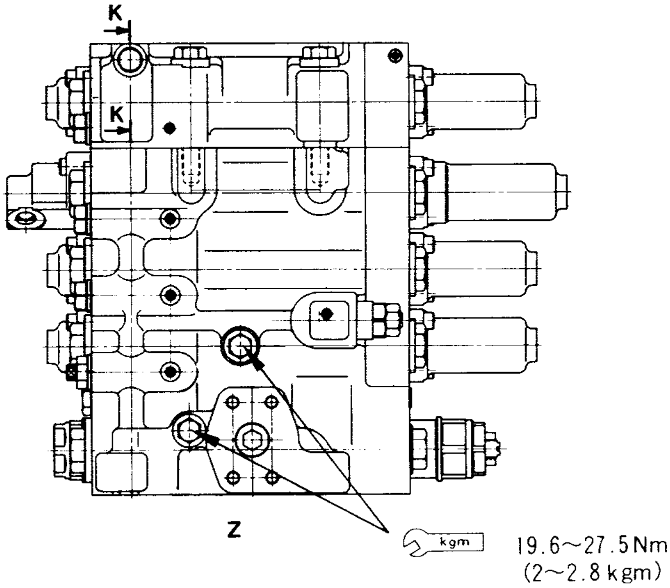
1st step	49 — 68.6 Nm (5 — 7 kgm)
2nd step	127.5 — 147.1 Nm (13 — 15 kgm)
3rd step	176.5 — 196.1 Nm (18 — 20 kgm)











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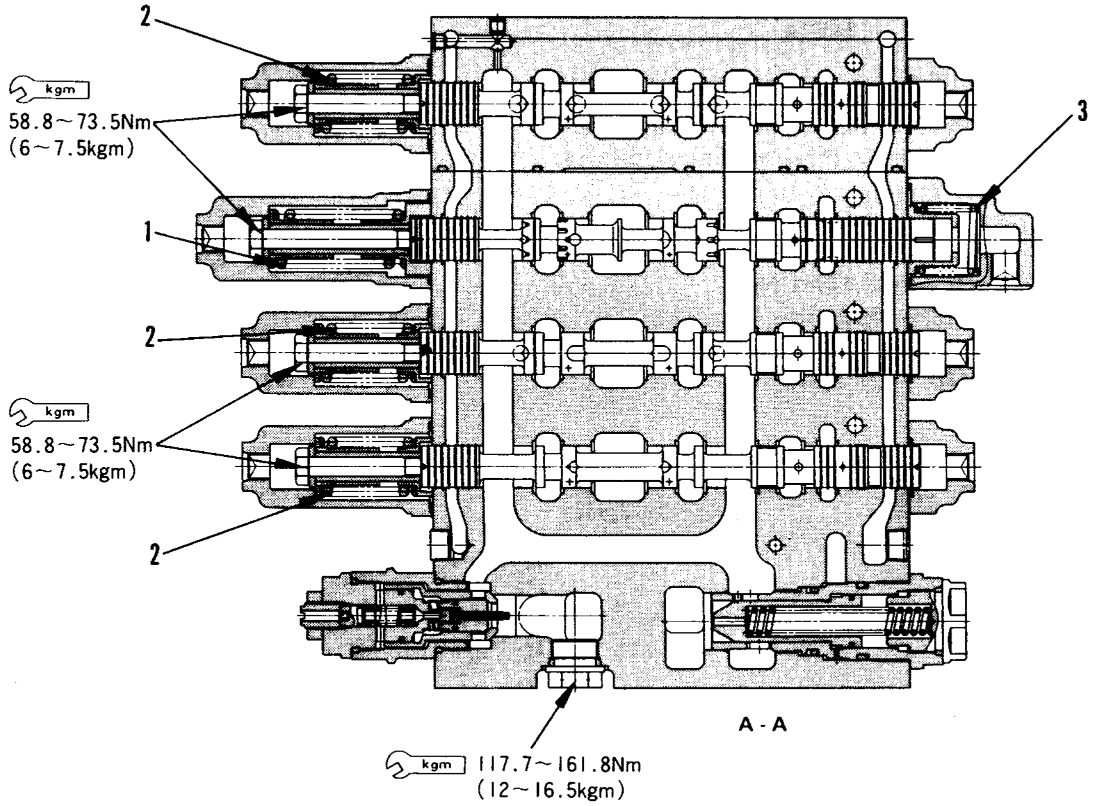
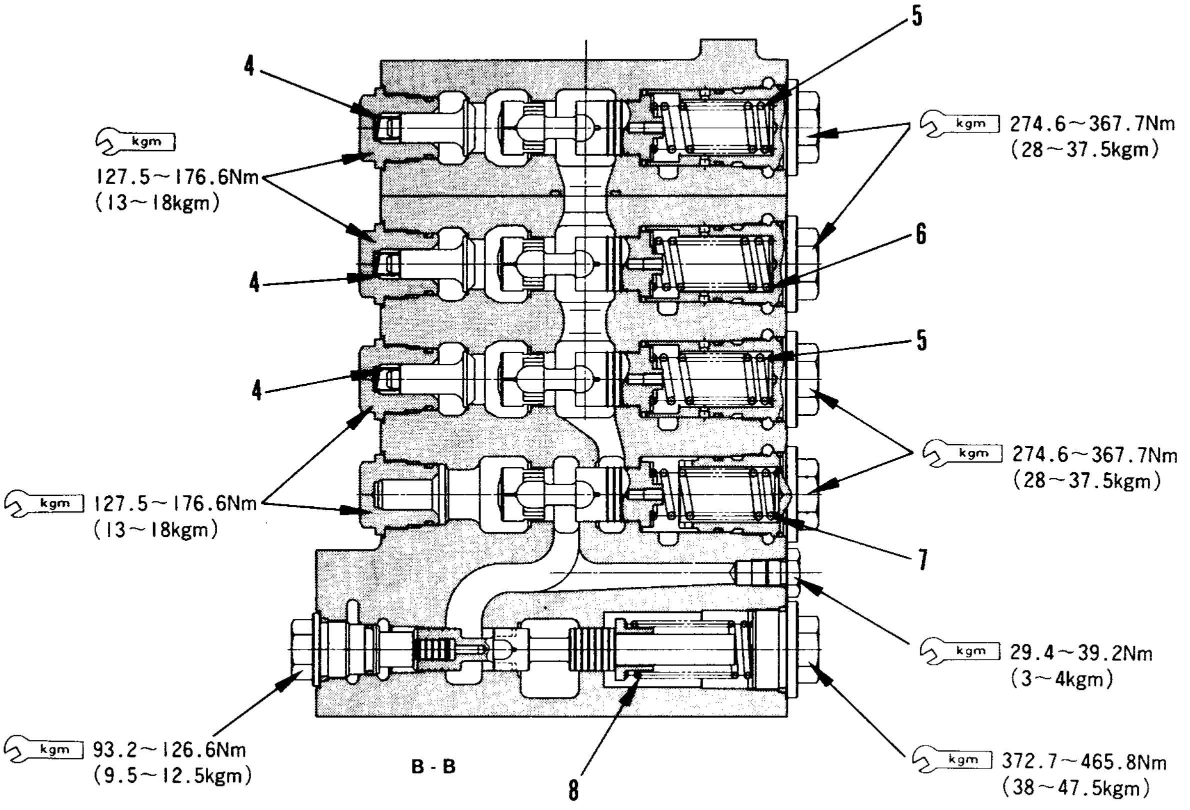
014012

- **3 + 1-SPOOL VALVE (2/3)**





014012

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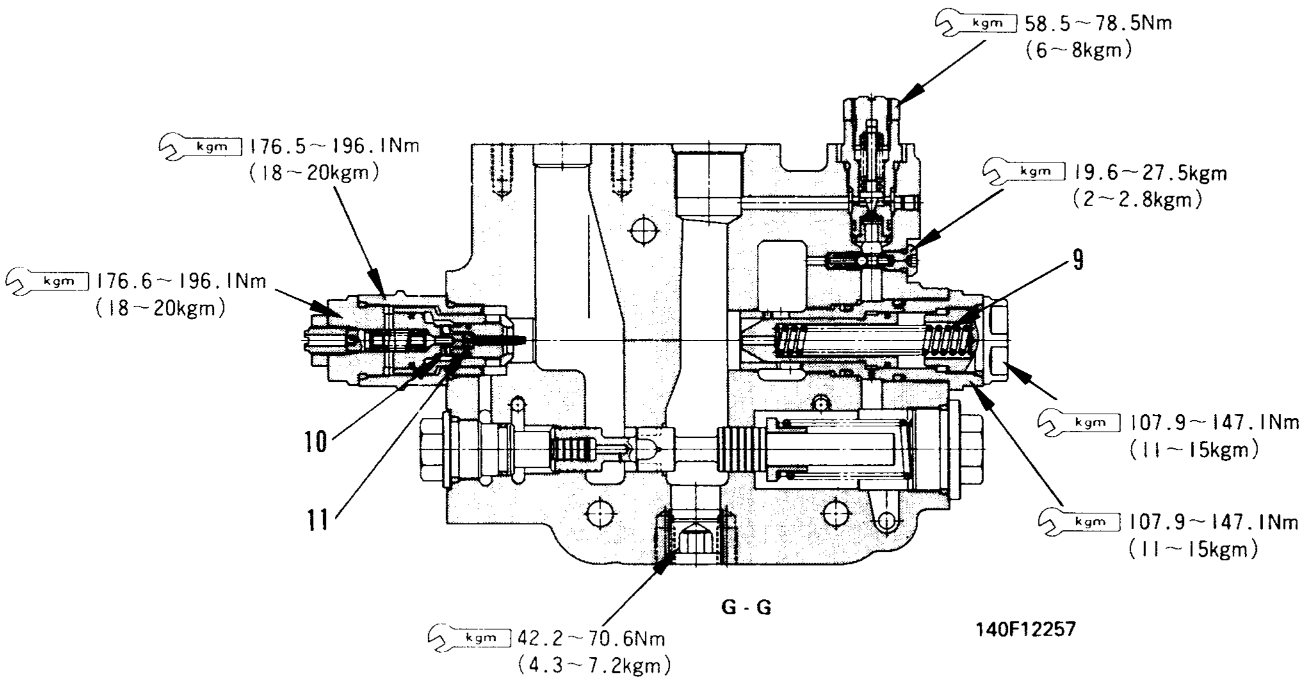
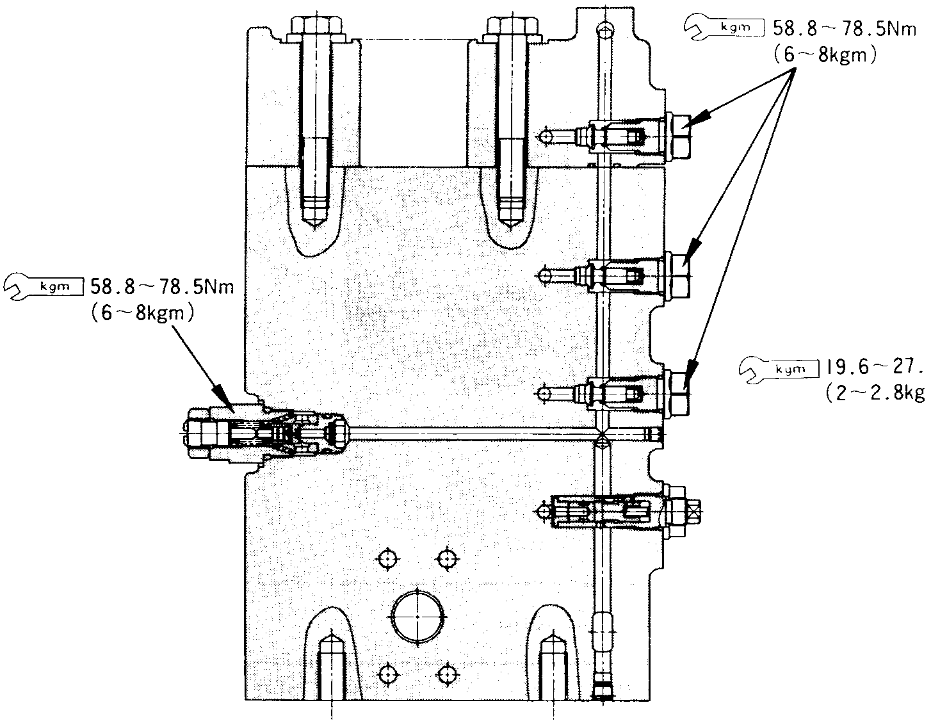


014012

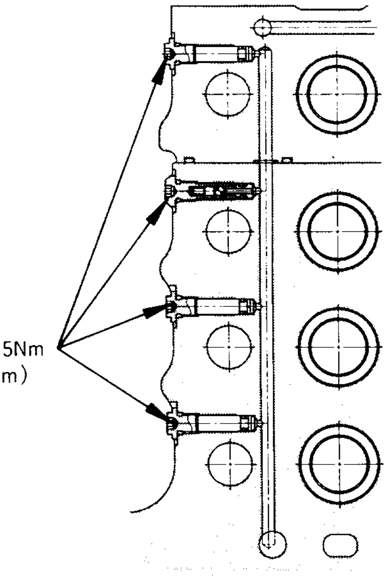
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length X O.D.	Installed length	Installed load	Free length	Installed load	
1	Spool return spring	73.4 X 31	68.5	223.6 N (22.8 kg)	—	178.9 N (18.2 kg)	If there is any damage or deformation, replace spring
2	Spool return spring (lift valve only)	51.7 X 31.3	50	140.2 N (14.3 kg)	—	112.2 N (11.4 kg)	
3	Spool return spring (for lift FLOAT)	65.3 X 36.5	33.5	335.4 N (34.2 kg)	—	268.3 N (27.4 kg)	
4	Load check valve spring	20.8 X 10.2	13.5	12.7 N (1.3 kg)	—	10.2 N (1.0 kg)	
5	Pressure compensation valve spring	70 X 26.5	62.5	179 N (20.1 kg)	—	143.2 N (16.1 kg)	
6	Pressure compensation valve spring (lift valve)	72.4 X 28	65.5	277.3 N (28.3 kg)	—	221.8 N (22.6 kg)	
7	Pressure compensation valve spring (steering valve)	70 X 26.5	65.5	116.6 N (11.9 kg)	—	93.3 N (9.52 kg)	
8	Unload spring	94.8 X 30	67	258.9 N (26.4 kg)	—	207.1 N (21.1 kg)	
9	Back pressure valve spring	99.5 X 14.9	96	71.6 N (7.3 kg)	—	57.3 N (5.8 kg)	
10	Suction safety valve spring	16 X 16	12	5.69 N (0.68 kg)	—	4.55 N (0.54 kg)	
11	Suction safety valve spring	20 X 7	14	0.89 N (0.091 kg)	—	0.71 N (0.073 kg)	

- **3 + 1-SPOOL VALVE (3/3)**

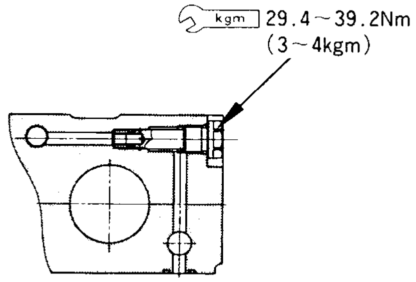


J - J

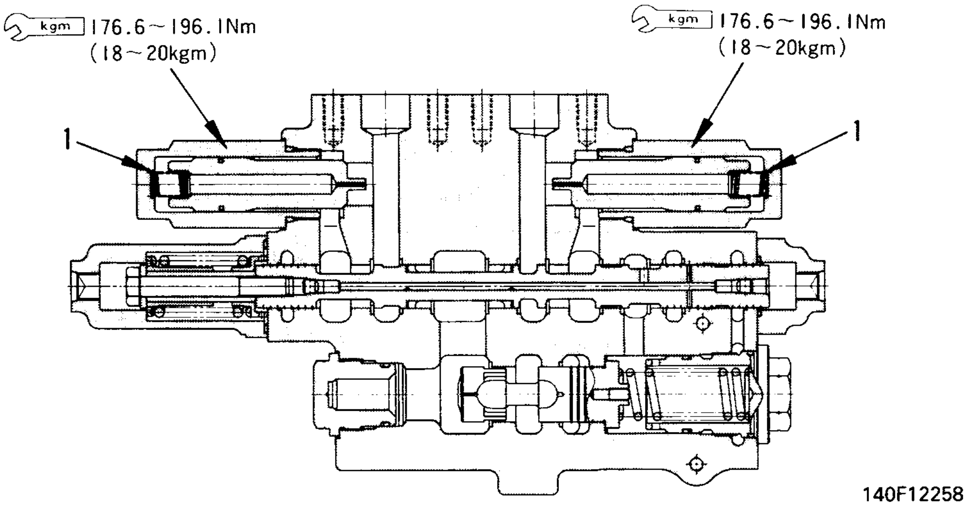


H - H

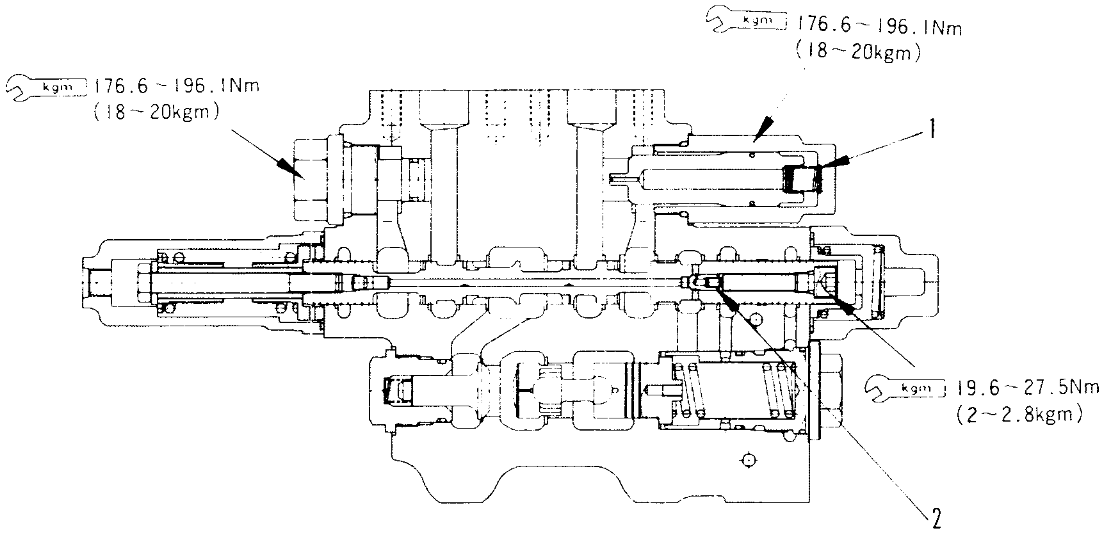
014012



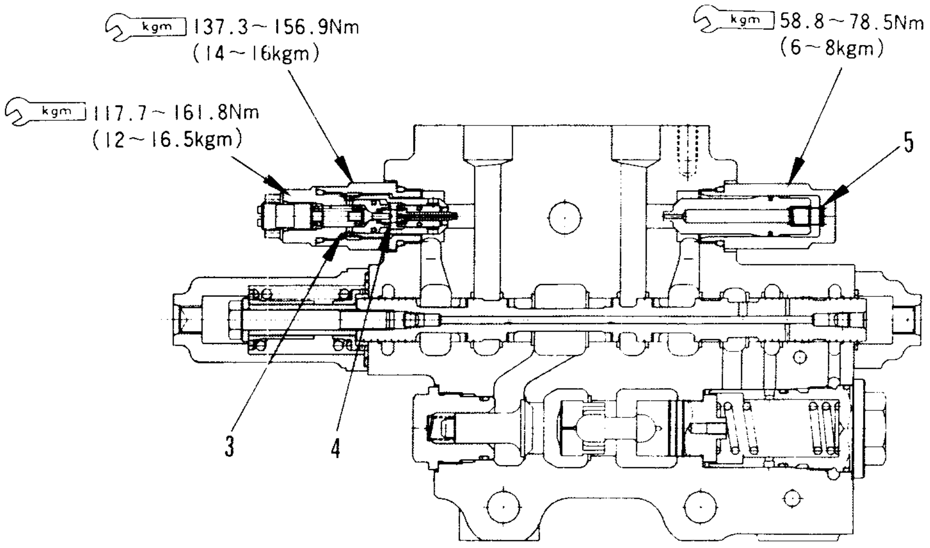
K - K



F - F



D - D



140F12259

C - C

Unit: mm

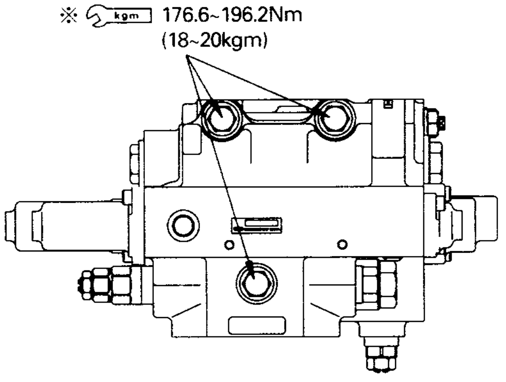
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length X O.D.	Installed length	Installed load	Free length	Installed load	
1	Suction valve spring	27.9 X 13	18.8	6.3 N (0.64 kg)	—	5.0 N (0.51 kg)	If there is any damage or deformation, replace spring
2	Check valve spring inside spool	9.4 X 4.6	8.5	0.3 N (0.03 kg)	—	0.24 N (0.02 kg)	
3	Suction safety valve spring	16.3 X 21.3	9	2.16 N (0.22 kg)	—	1.73 N (0.18 kg)	
4	Suction safety valve spring	20 X 7	13.7	1.27 N (0.13 kg)	—	1.01 N (0.10 kg)	
5	Suction valve spring	29.5 X 8.95	16.5	23.7 N (2.42 kg)	—	19.0 N (1.94 kg)	

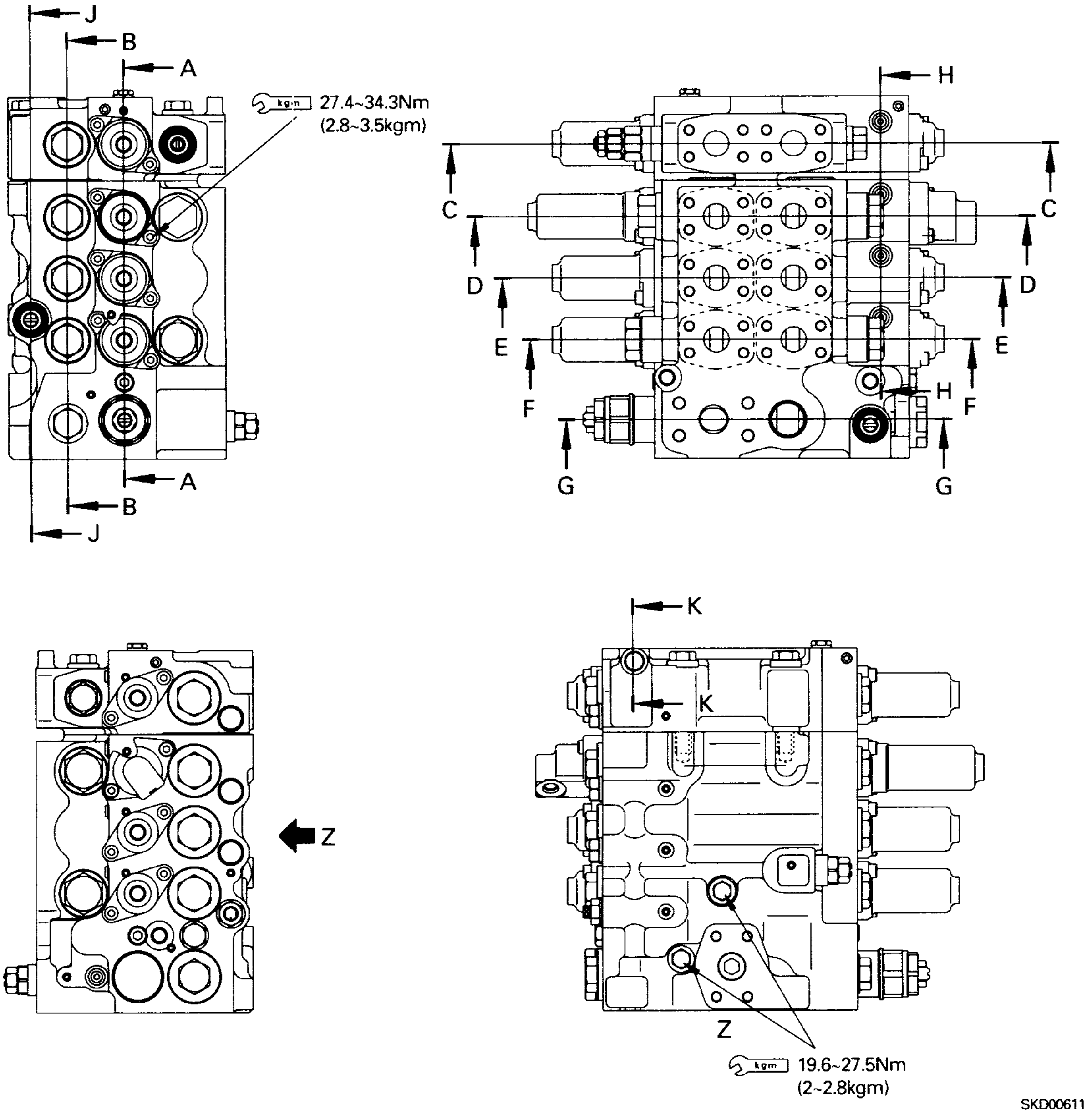
- **3 + 1-SPOOL VALVE (1/3)**

D65EX-12 60942 and up
D65PX-12 60915 and up

★ Precautions when tightening parts marked ※.
To make sure that the 3 bolts are tightened uniformly, tighten in three steps as follows.

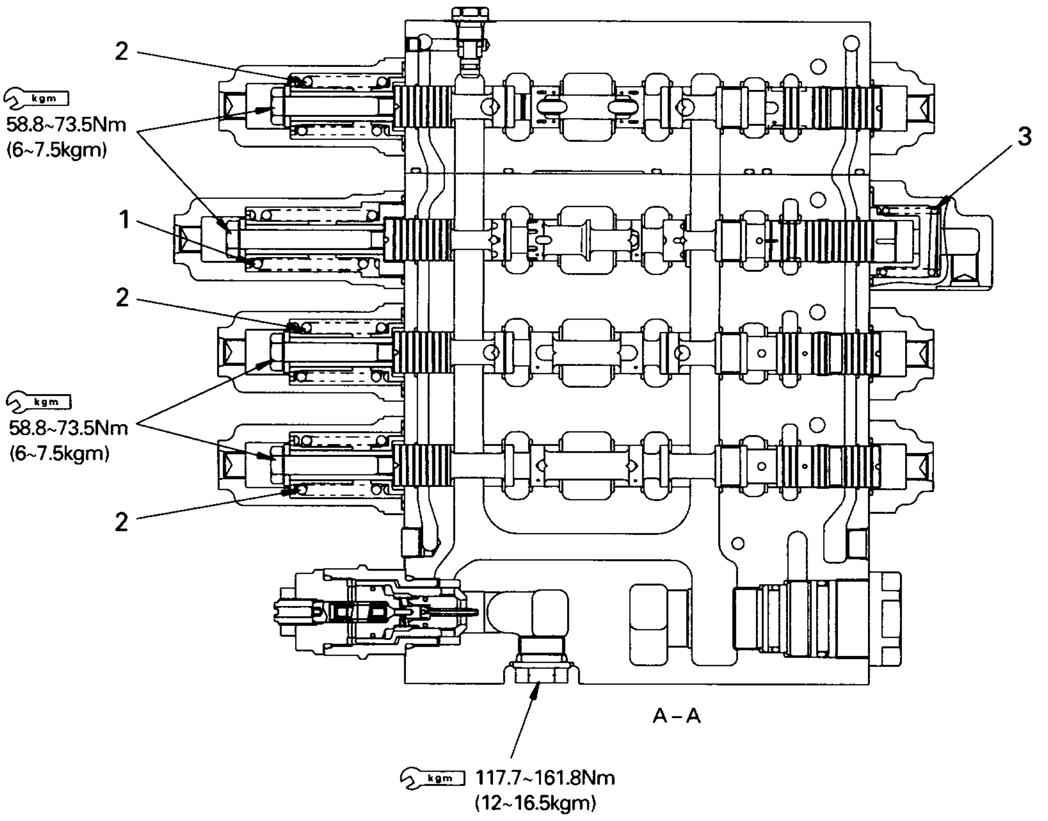
1st step	49 — 68.6 Nm (5 — 7 kgm)
2nd step	127.5 — 147.1 Nm (13 — 15 kgm)
3rd step	176.5 — 196.1 Nm (18 — 20 kgm)



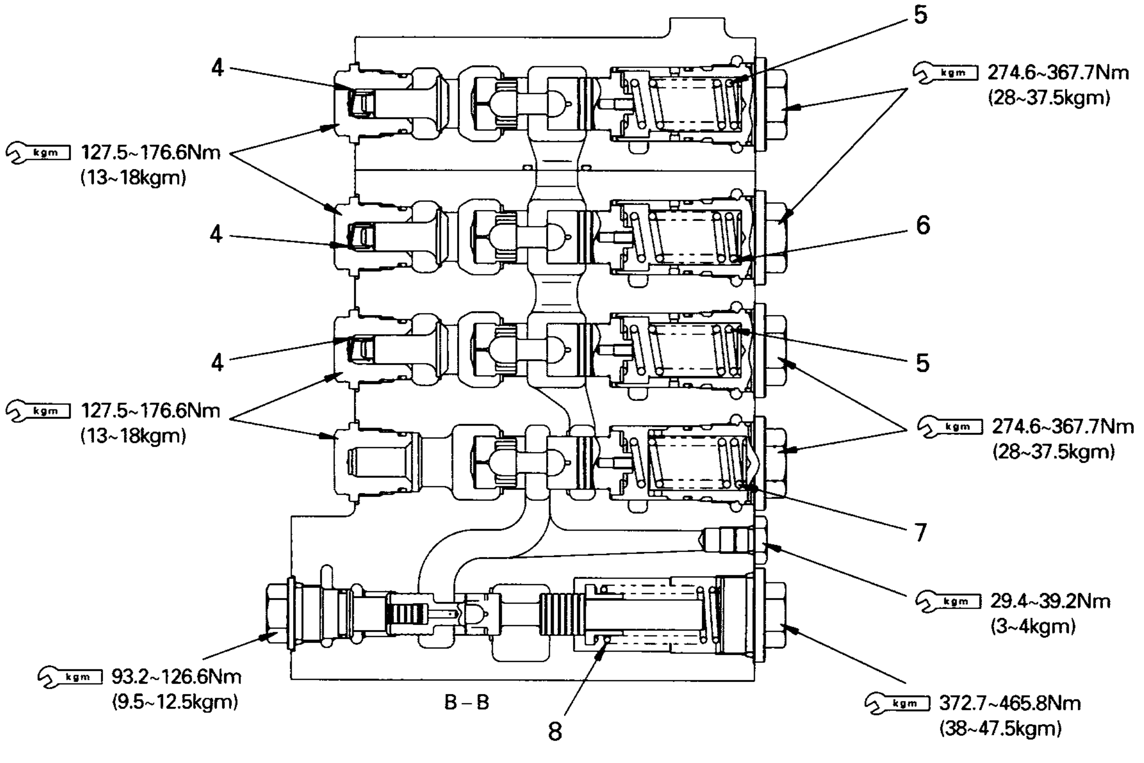


SKD00611

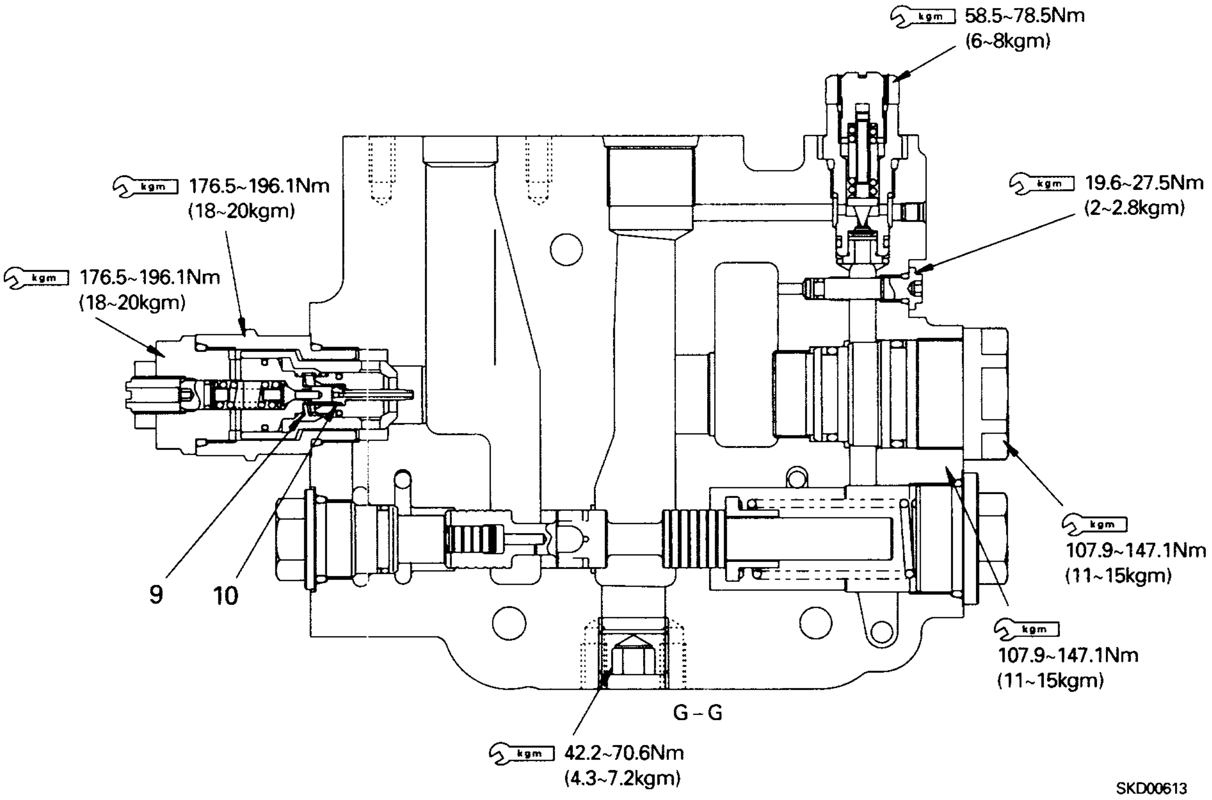
• 3 + 1-SPOOL VALVE (2/3)



014012



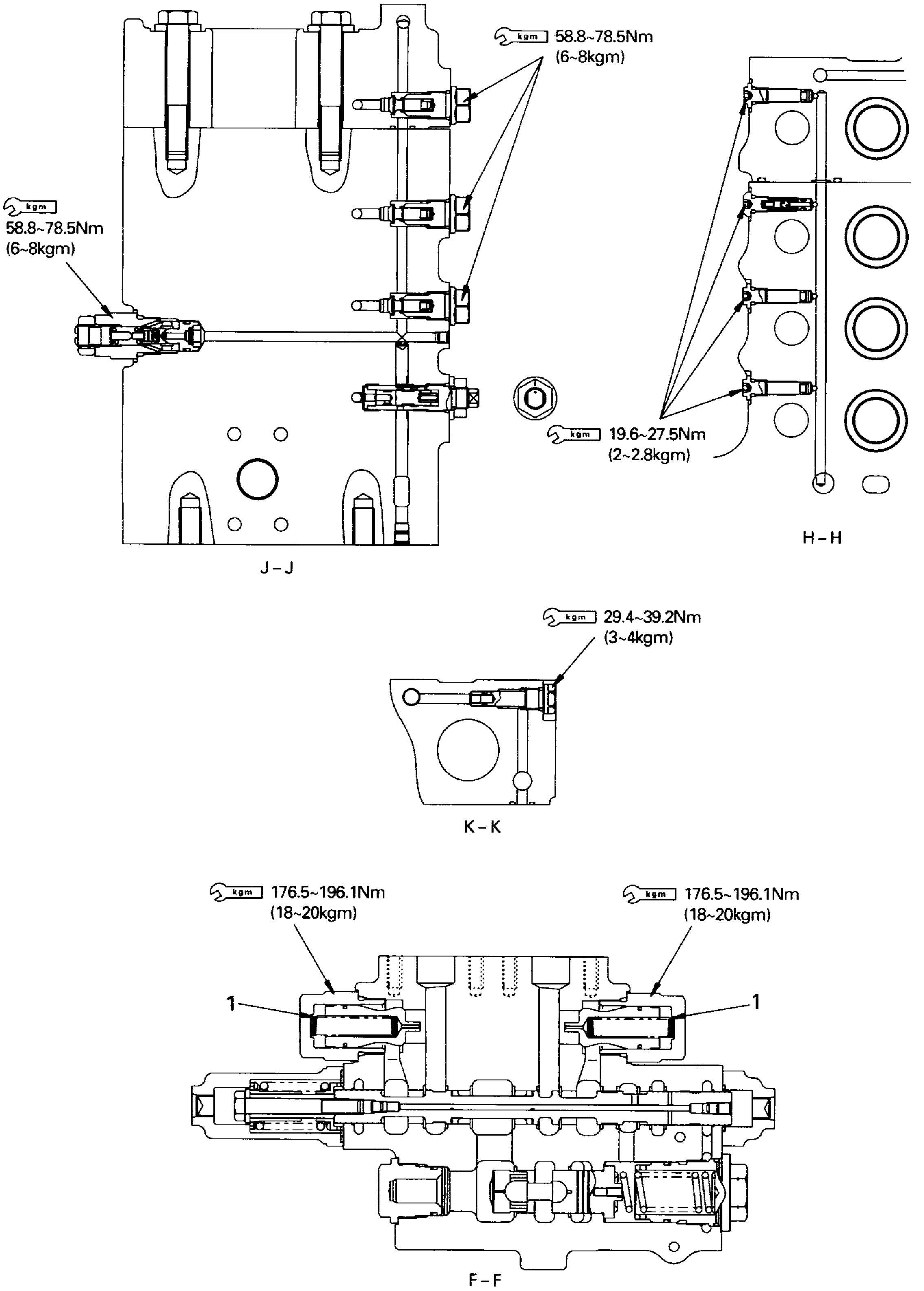
SKD00612



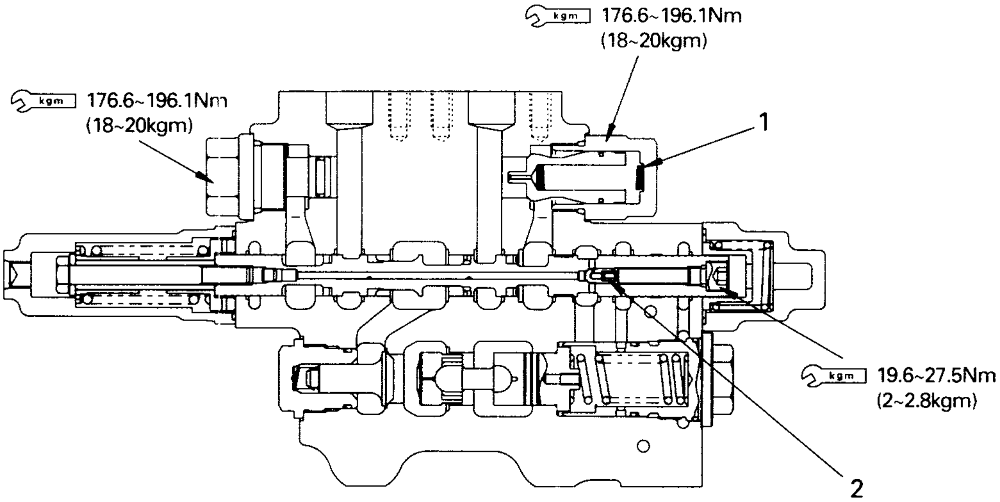
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length X O.D.	Installed length	Installed load	Free length	Installed load	
1	Spool return spring	73.4 X 31	68.5	223.6 N (22.8 kg)	—	178.9 N (18.2 kg)	If there is any damage or deformation, replace spring
2	Spool return spring (lift valve only)	51.7 X 31.3	50	140.2 N (14.3 kg)	—	112.2 N (11.4 kg)	
3	Spool return spring (for lift FLOAT)	65.3 X 36.5	33.5	335.4 N (34.2 kg)	—	268.3 N (27.4 kg)	
4	Load check valve spring	20.8 X 10.2	13.5	12.7 N (1.3 kg)	—	10.2 N (1.0 kg)	
5	Pressure compensation valve spring	70 X 26.5	62.5	179 N (20.1 kg)	—	143.2 N (16.1 kg)	
6	Pressure compensation valve spring (lift valve)	72.4 X 28	65.5	277.3 N (28.3 kg)	—	221.8 N (22.6 kg)	
7	Pressure compensation valve spring (steering valve)	70 X 26.5	65.5	116.6 N (11.9 kg)	—	93.3 N (9.52 kg)	
8	Unload spring	94.8 X 30	67	258.9 N (26.4 kg)	—	207.1 N (21.1 kg)	
9	Suction safety valve spring	16 X 16	12	5.69 N (0.68 kg)	—	4.55 N (0.54 kg)	
10	Suction safety valve spring	20 X 7	14	0.89 N (0.091 kg)	—	0.71 N (0.073 kg)	

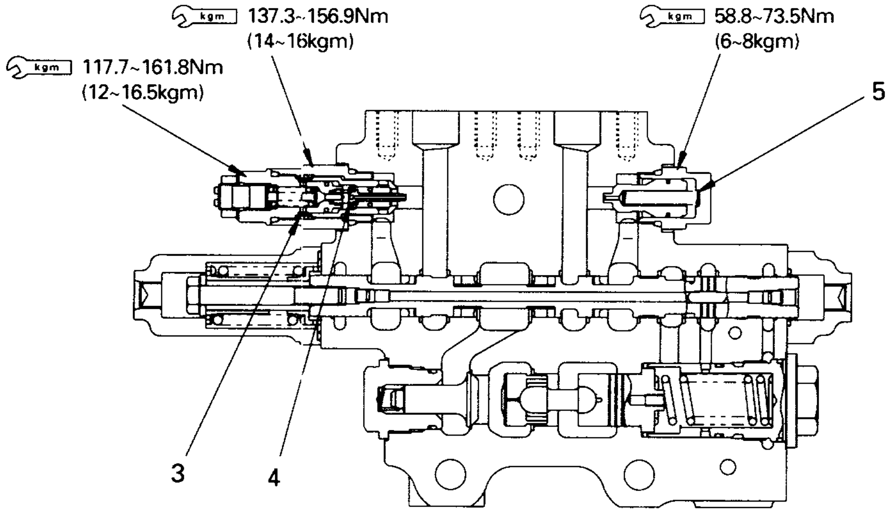
- **3 + 1-SPOOL VALVE (3/3)**



SKD00614



D-D



C-C

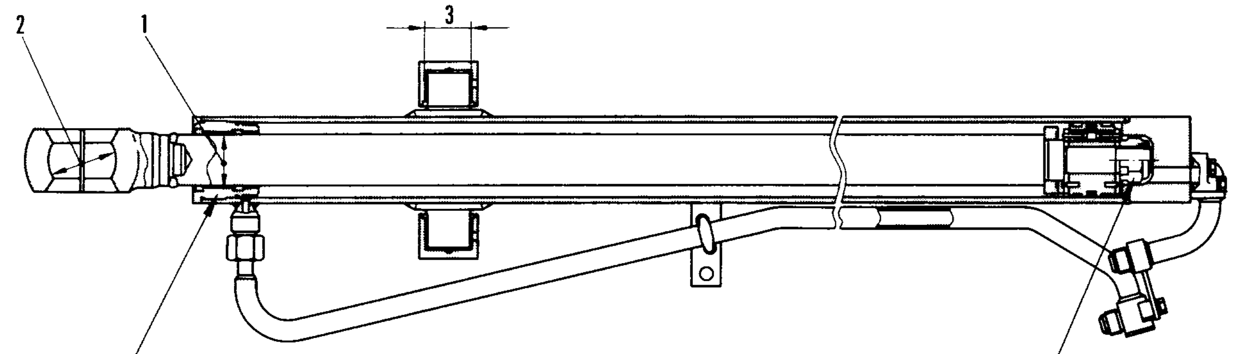
SKD00615

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length X O.D.	Installed length	Installed load	Free length	Installed load	
1	Suction valve spring	64.9 X 12.5	56	6.4 N (0.65 kg)	—	5.1 N (0.52 kg)	If there is any damage or deformation, replace spring
2	Check valve spring inside spool	9.4 X 4.6	8.5	0.3 N (0.03 kg)	—	0.24 N (0.02 kg)	
3	Suction safety valve spring	16.3 X 21.3	9	2.16 N (0.22 kg)	—	1.73 N (0.18 kg)	
4	Suction safety valve spring	20 X 7	13.7	1.27 N (0.13 kg)	—	1.01 N (0.10 kg)	
5	Suction valve spring	46.8 X 7.5	40.6	5.5 N (0.56 kg)	—	4.4 N (0.45 kg)	

WORK EQUIPMENT CYLINDER

- **BLADE LIFT (D65E, EX-12)**

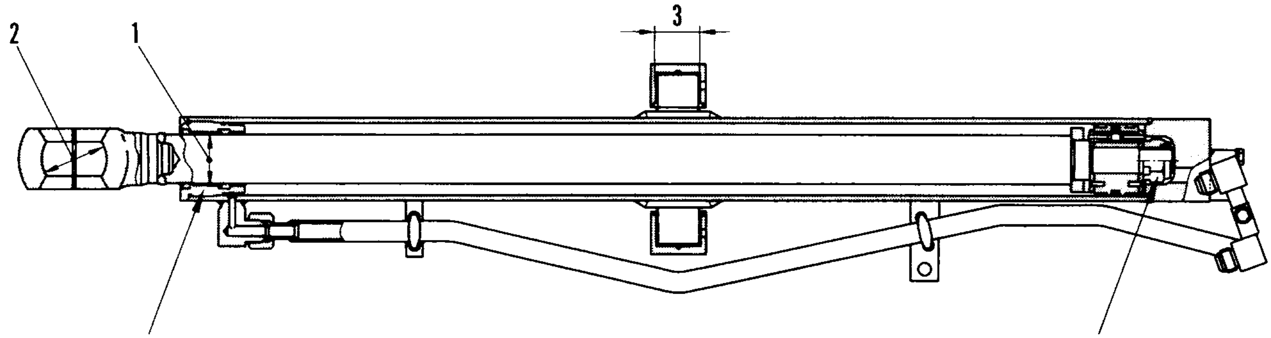


735 ± 73.6 Nm
(75 ± 7.5 kgm)

1,078.7 ± 107.9 Nm
(110 ± 11 kgm)
(Width across flats: 50 mm)

140F12260

- **BLADE LIFT (D65P, PX-12)**

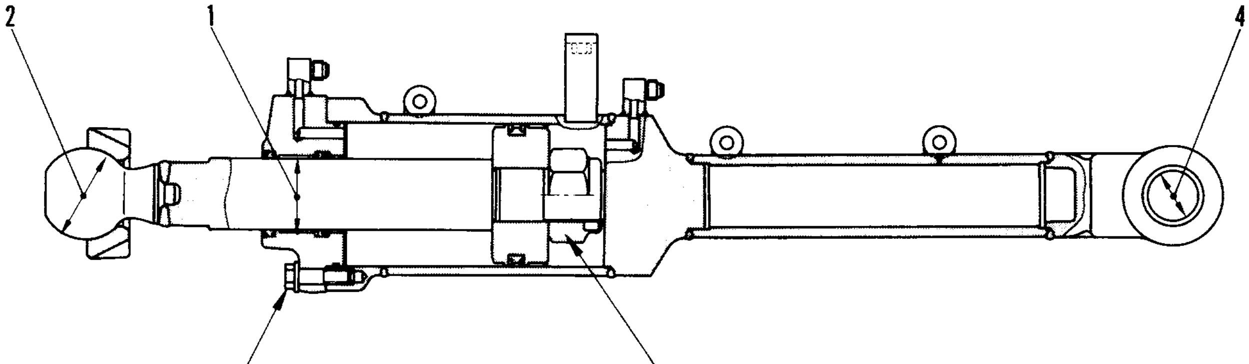


735 ± 73.6 Nm
(75 ± 7.5 kgm)

1,078.7 ± 107.9 Nm
(110 ± 11 kgm)
(Width across flats: 50 mm)

140F12261

- **BLADE TILT, PITCH**



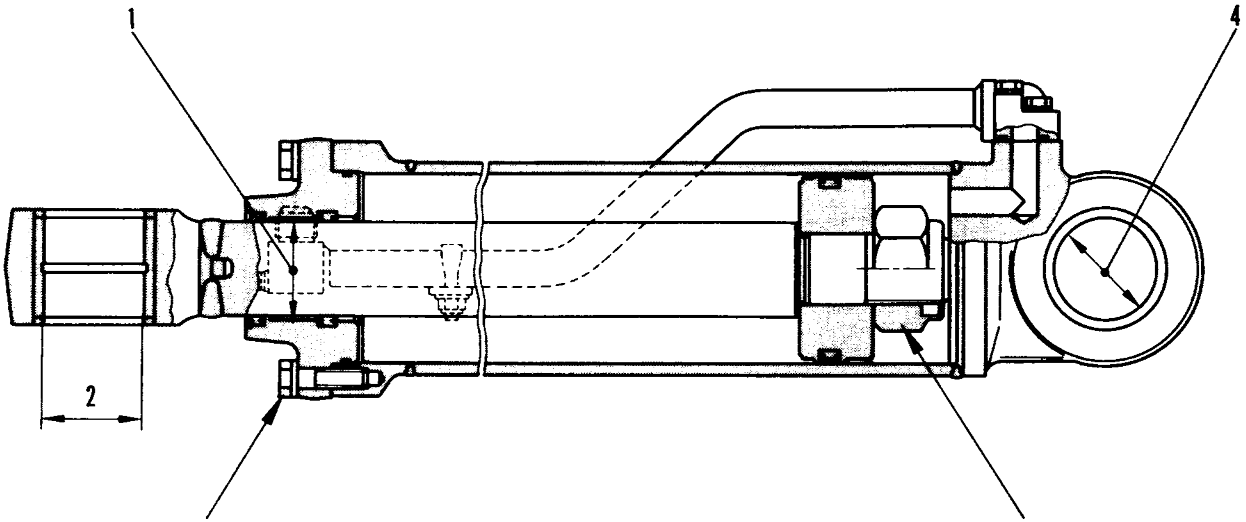
162.5 ± 14.8 Nm
(16.5 ± 1.5 kgm)
(Width across flats: 22 mm)

3,989.3 ± 398.9 Nm
(405 ± 40.5 kgm)
(Width across flats: 80 mm)

140F12262

014012

• RIPPER (D65E, EX-12)



162.5 ± 14.8 Nm
(16.5 ± 1.5 kgm)
(Width across flats: 22 mm)

3,989.3 ± 398.9 Nm
(405 ± 40.5 kgm)
(Width across flats: 80 mm)

140F12263

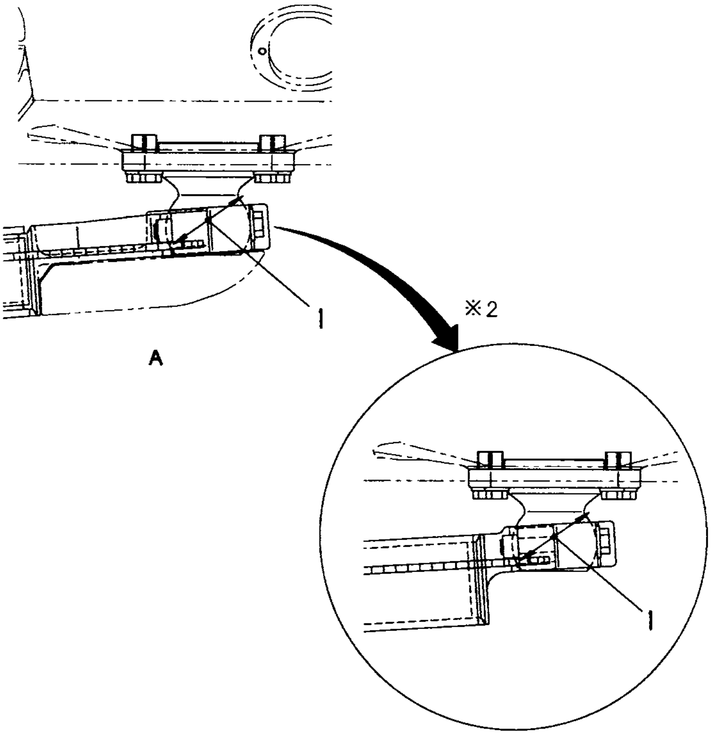
Unit: mm

No.	Check item		Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Lift	65	−0.030 −0.104	+0.262 +0.067	0.097 — 0.366	0.666	Replace bushing
		Tilt, pitch	70	−0.030 −0.104	+0.271 +0.075	0.105 — 0.375	0.675	
		Ripper	70	−0.030 −0.104	+0.271 +0.075	0.105 — 0.375	0.675	
2	Clearance between piston rod bushing and pin	Lift	85	−0.2 −0.3	+0.3 0	0.2 — 0.5	1.0	Adjust shim or replace
		Tilt, pitch	Shaft: 90 Hole: 91	−0.1 −0.3	+1.0 0	0.2 — 0.5	2.0	
		Ripper	75	−0.030 −0.076	+0.174 +0.100	0.130 — 0.250	1.0	Replace bushing
3	Clearance between cylinder support bushing and boss		55	−0.100 −0.174	+0.116 0	0.100 — 0.290	1.0	
4	Clearance between cylinder bottom support bearing and bushing	Tilt, pitch	50	−0.2 −0.4	+0.145 +0.080	0.280 — 0.545	1.0	
		Ripper	75	−0.030 −0.076	+0.174 +0.100	0.130 — 0.250	1.0	

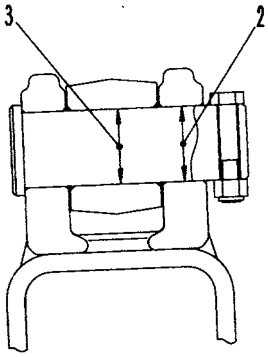
WORK EQUIPMENT

- **STRAIGHT TILTDOZER**
- **SEMI U-DOZER**

★ The diagram shows the straight tiltdozer.

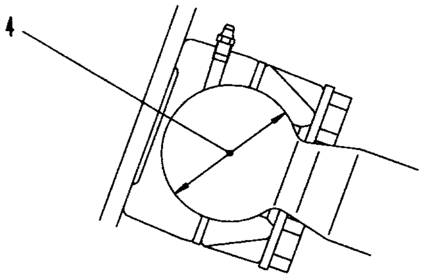


A

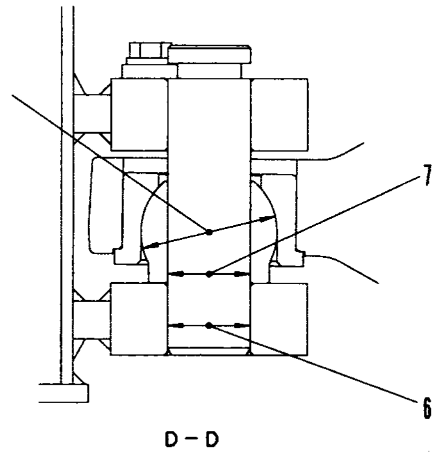


B − B

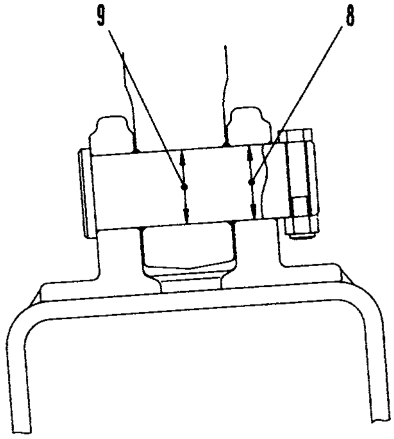
014012



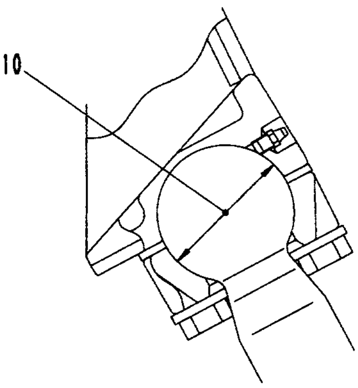
C − C



D − D



E − E

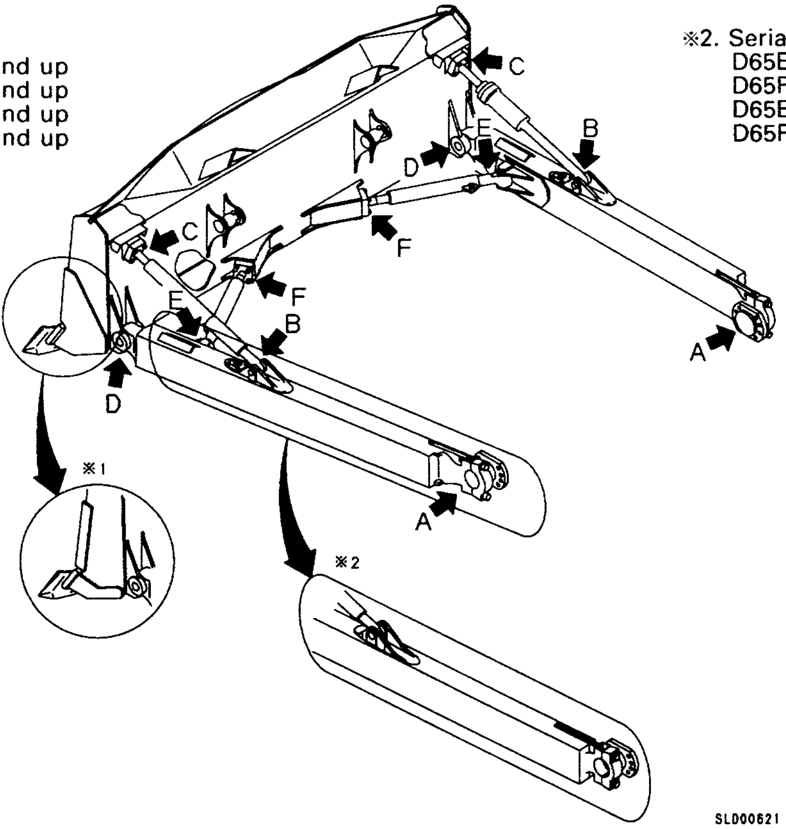


F − F

SKD01657

※1. Serial Numbers
D65E-12 60948 and up
D65P-12 60891 and up
D65EX-12 60942 and up
D65PX-12 60915 and up

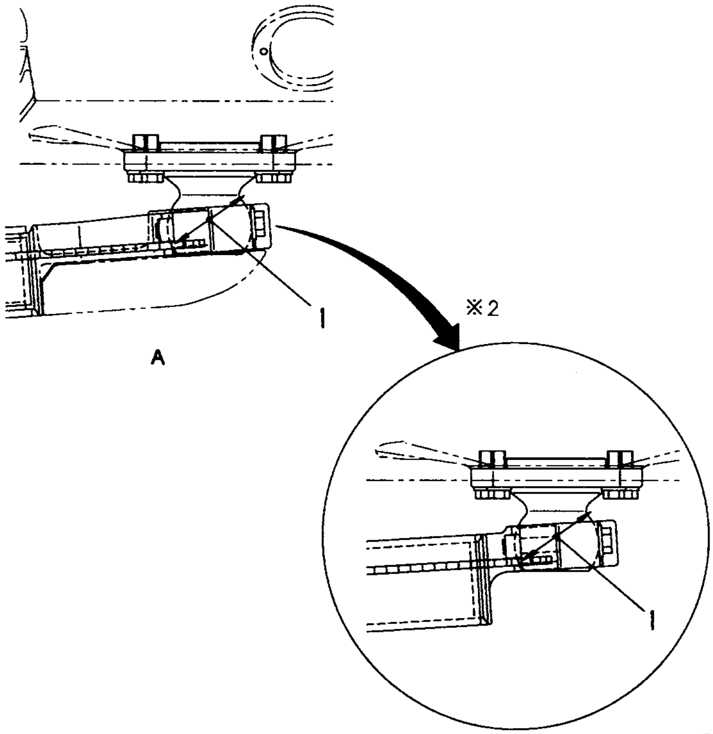
※2. Serial Numbers
D65E-12 61441 and up
D65P-12 61365 and up
D65EX-12 61446 and up
D65PX-12 61369 and up



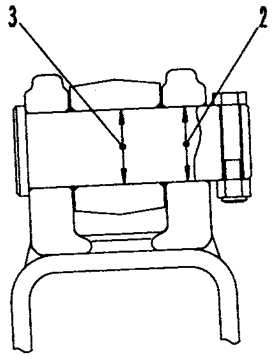
Unit: mm

No.	Check item		Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between trunnion and spherical surface of cap		140	-0.1 -0.5	+1.5 0	0.1 — 2.0	3	Replace
2	Clearance between brace mounting pin and bracket		50	-0.2 -0.4	+0.2 0	0.2 — 0.6	2	
3	Clearance between brace mounting pin and brace		50	-0.2 -0.4	+0.2 0	0.2 — 0.6	2	
4	Clearance between bracket and spherical surface of brace		90 (Shaft) 91 (Hole)	-0.1 -0.3	+1 0	0.2 — 0.5	2	Adjust shim or replace
5	Clearance between bearing and spherical surface of bushing	Straight tiltdozer	90	-0.1 -0.5	+0.5 0	0.1 — 1.0	2	Replace
		Semi U-dozer	100	-0.1 -0.5	+0.5 0	0.1 — 1.0	2	
6	Clearance between brace mounting pin and bracket		55	0 -0.3	+0.6 -0.2	0.2 — 0.9	2	
7	Clearance between frame mounting pin and bearing		55	0 -0.3	+0.5 +0.2	0.2 — 0.8	2	
8	Clearance between brace mounting pin and bracket		50	-0.2 -0.4	+0.2 0	0.2 — 0.6	2	
9	Clearance between brace mounting pin and brace		50	-0.2 -0.4	+0.2 0	0.2 — 0.6	2	
10	Clearance between bracket and spherical surface of brace		90 (Shaft) 91 (Hole)	-0.1 -0.3	+1 0	0.2 — 0.5	2	Adjust shim or replace

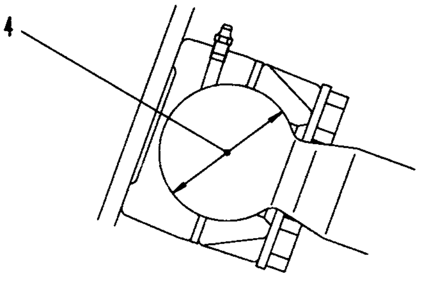
- **POWER PITCH DOZER**



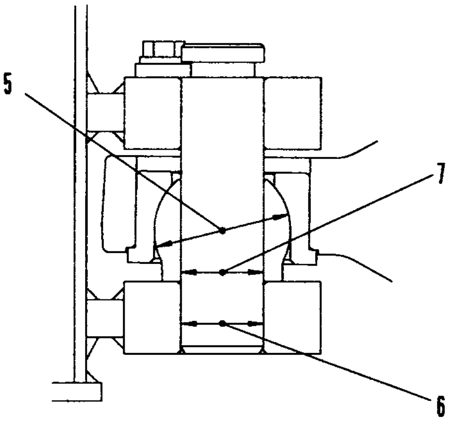
A



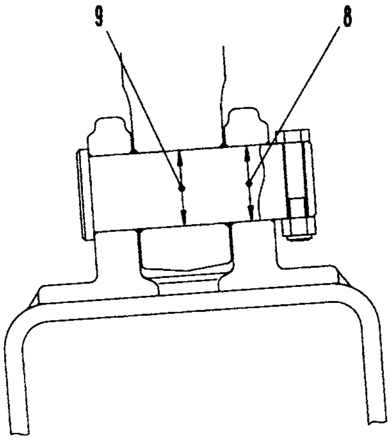
B – B



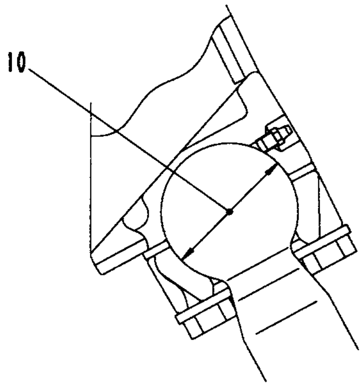
C – C



D – D



E – E



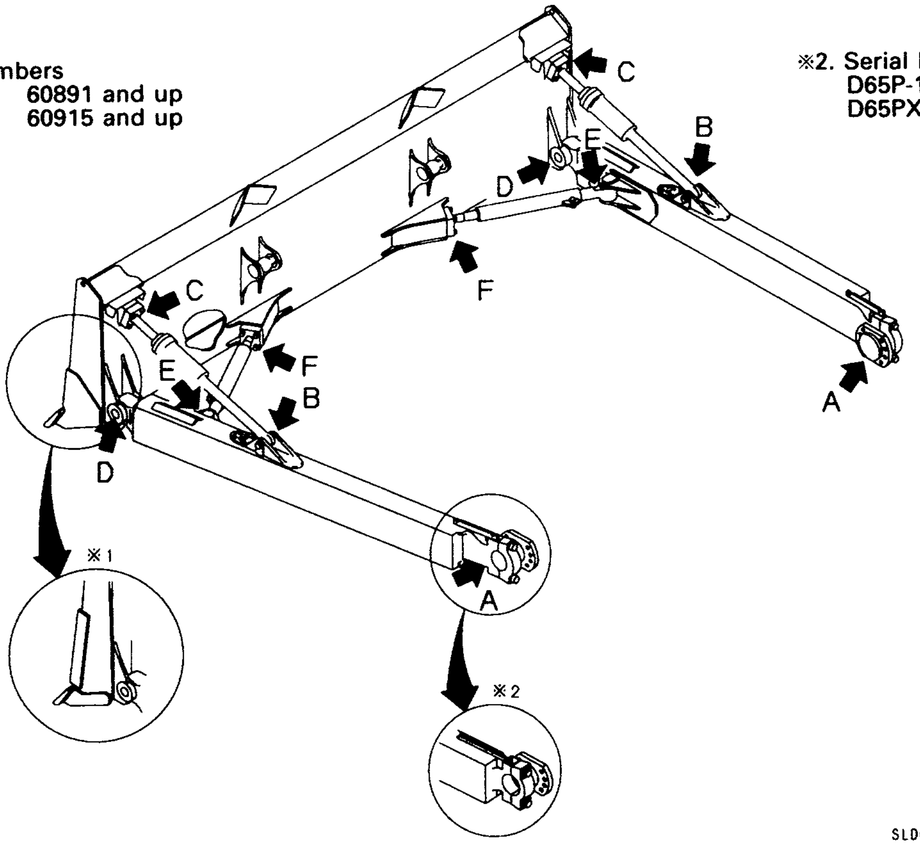
F – F

SKD01657

014012

※1. Serial Numbers
D65P-12 60891 and up
D65PX-12 60915 and up

※2. Serial Numbers
D65P-12 61365 and up
D65PX-12 61369 and up

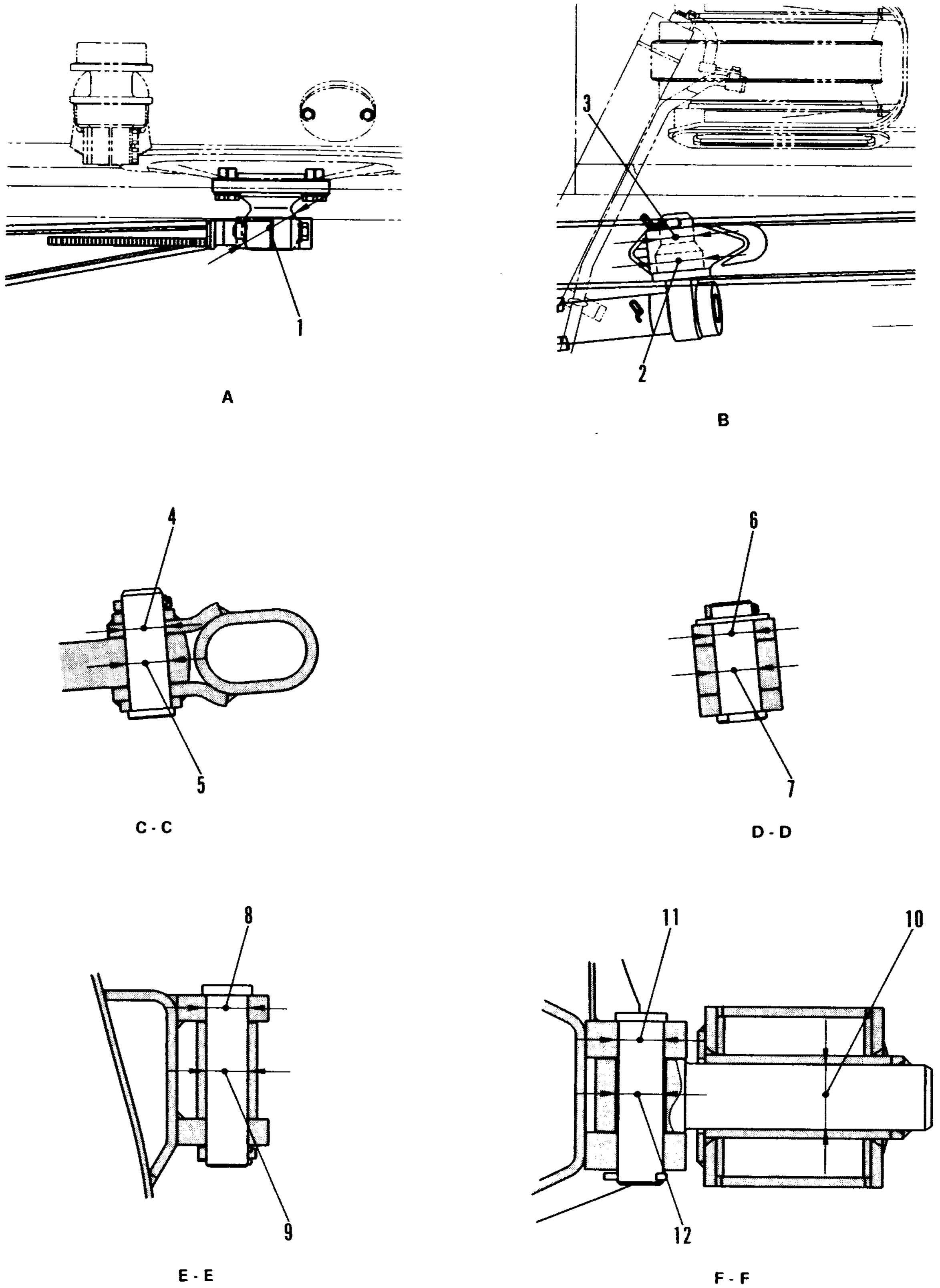


Unit: mm

No.	Check item		Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between trunnion and spherical surface of cap		140	-0.1 -0.5	+1.5 0	0.1 — 2.0	8	Replace
2	Clearance between brace mounting pin and bracket		50	-0.2 -0.4	+0.2 0	0.2 — 0.6	2	
3	Clearance between brace mounting pin and brace		50	-0.2 -0.4	+0.2 0	0.2 — 0.6	2	
4	Clearance between bracket and spherical surface of brace		90 (Shaft) 91 (Hole)	-0.1 -0.3	+1 0	0.2 — 0.5	2	Adjust shim or replace
5	Clearance between bearing and spherical surface of bushing	Straight tiltdozer	90	-0.1 -0.5	+0.5 0	0.1 — 1.0	2	Replace
		Semi U-dozer	100	-0.1 -0.5	+0.5 0	0.1 — 1.0	2	
6	Clearance between brace mounting pin and bracket		55	0 -0.3	+0.6 -0.2	0.2 — 0.9	2	
7	Clearance between frame mounting pin and bearing		55	0 -0.3	+0.5 +0.2	0.2 — 0.8	2	
8	Clearance between brace mounting pin and bracket		50	-0.2 -0.4	+0.2 0	0.2 — 0.6	2	
9	Clearance between brace mounting pin and brace		50	-0.2 -0.4	+0.2 0	0.2 — 0.6	2	
10	Clearance between bracket and spherical surface of brace		90 (Shaft) 91 (Hole)	-0.1 -0.3	+1 0	0.2 — 0.5	2	Adjust shim or replace

- **ANGLEDOZER**

D65E, EX-12



014012

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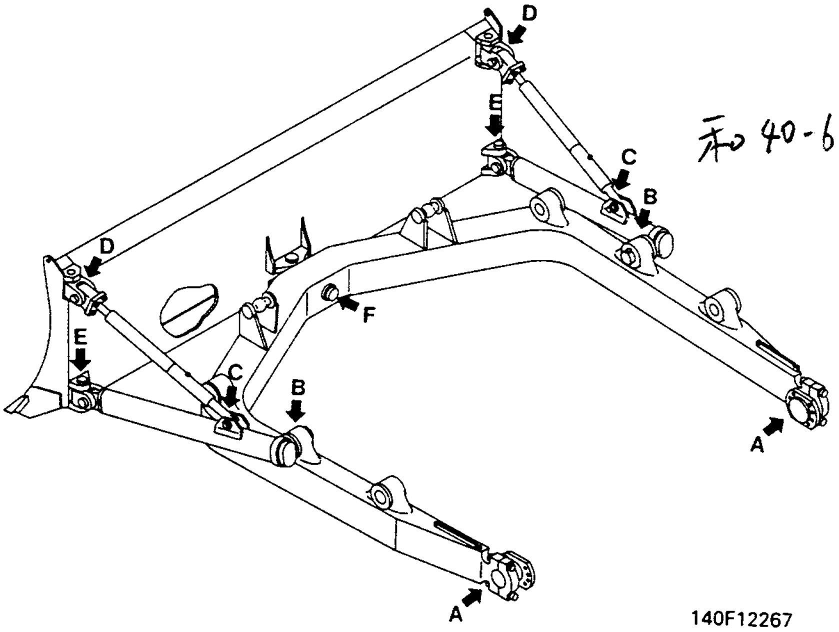


和40-69 P.1)

014012

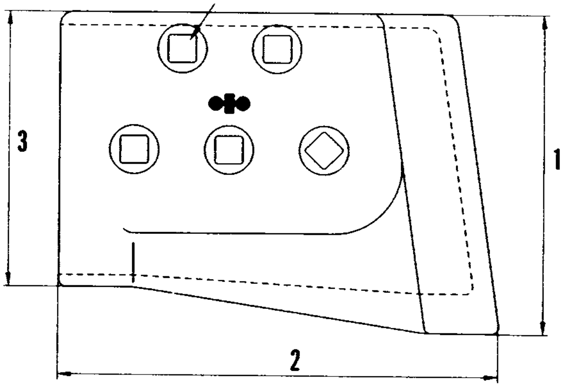
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between trunnion and spherical surface of cap	140	-0.1 -0.5	+1.5 0	0.1 — 2.0	8	Replace
2	Clearance between arm mounting pin and bracket (large)	100	-0.6 -1.0	+1.5 +1.0	1.6 — 2.5	3.5	
3	Clearance between arm mounting pin and bracket (small)	80	-0.6 -1.0	+1.5 +1.0	1.6 — 2.5	3.5	
4	Clearance between brace mounting pin and arm bracket	50	-0.3 -0.6	+0.7 0	0.3 — 1.3	2	
5	Clearance between brace mounting pin and brace	50	-0.3 -0.6	+0.2 0	0.3 — 0.8	2	
6	Clearance between brace mounting pin and joint	50	-0.3 -0.6	+0.2 0	0.3 — 0.8	2	
7	Clearance between brace mounting pin and bearing	50	-0.3 -0.6	+0.5 0	0.3 — 1.1	2	
8	Clearance between joint mounting pin and bracket	50	-0.1 -0.3	+0.3 0	0.1 — 0.6	2	
9	Clearance between joint mounting pin and joint	50	-0.1 -0.3	+0.2 0	0.1 — 0.5	2	
10	Clearance between center shaft and frame	79.5 (Shaft) 80 (Hole)	-0.2 -0.5	+0.5 -0.5	0.2 — 1.5	2	
11	Clearance between center shaft mounting pin and bracket	55	-0.1 -0.3	+0.3 0	0.1 — 0.6	2	
12	Clearance between center shaft mounting pin and center shaft	55 (Shaft) 60 (Hole)	-0.1 -0.3	+0.5 +0.1	5.2 — 5.8	7	

CUTTING EDGE, END BIT

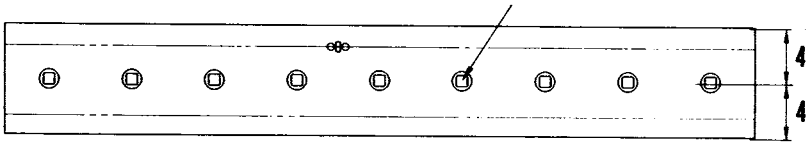
460.9 ± 68.6 Nm
(47 ± 7 kgm) (Straight tiltdozer (E, P), semi-U)

441.3 ± 49.0 Nm
(45 ± 5 kgm) (Angledozer)



460.9 ± 68.6 Nm
(47 ± 7 kgm) (Straight tiltdozer (E, P), semi-U)

441.3 ± 49.0 Nm
(45 ± 5 kgm) (Angledozer)



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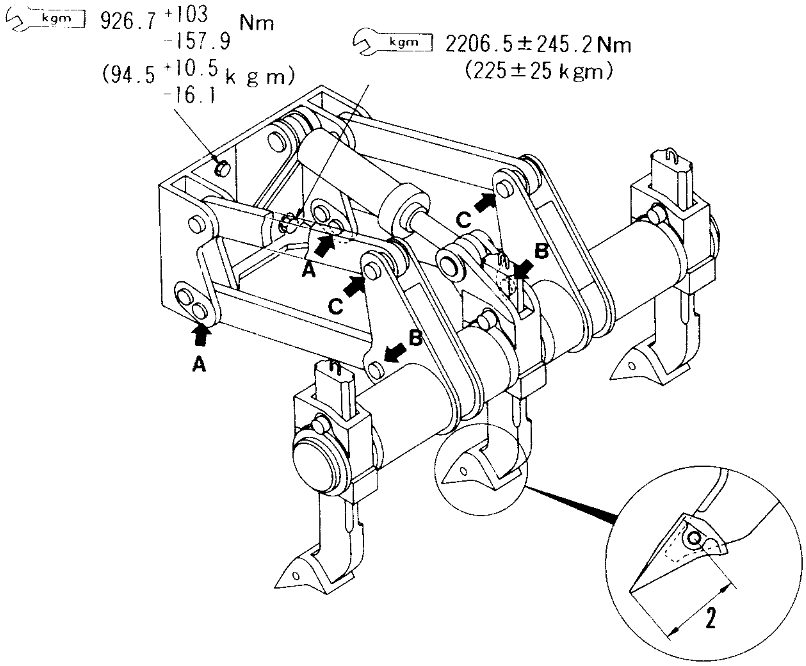
Unit: mm

No.	Check item		Criteria		Remedy
			Standard size	Repair limit	
1	Height of outside of end bit	Straight tiltdozer (E)	237	204	Replace
		Straight tiltdozer (P)	204	187	
		Semi-U	292	254	
		Angledozer	237	204	
2	Width of end bit	Straight tiltdozer (E)	325	300	
		Straight tiltdozer (P)	325	300	
		Semi-U	435	410	
		Angledozer	325	310	
3	Height of inside of end bit	Straight tiltdozer (E)	204	187	
		Straight tiltdozer (P)	204	187	
		Semi-U	254	237	
		Angledozer	204	187	
4	Height of cutting edge (from center of bolt mounting hole to edge)	Straight tiltdozer (E)	102	85	
		Straight tiltdozer (P)	102	85	
		Semi-U	102	85	
		Angledozer	102	85	

014012

RIPPER



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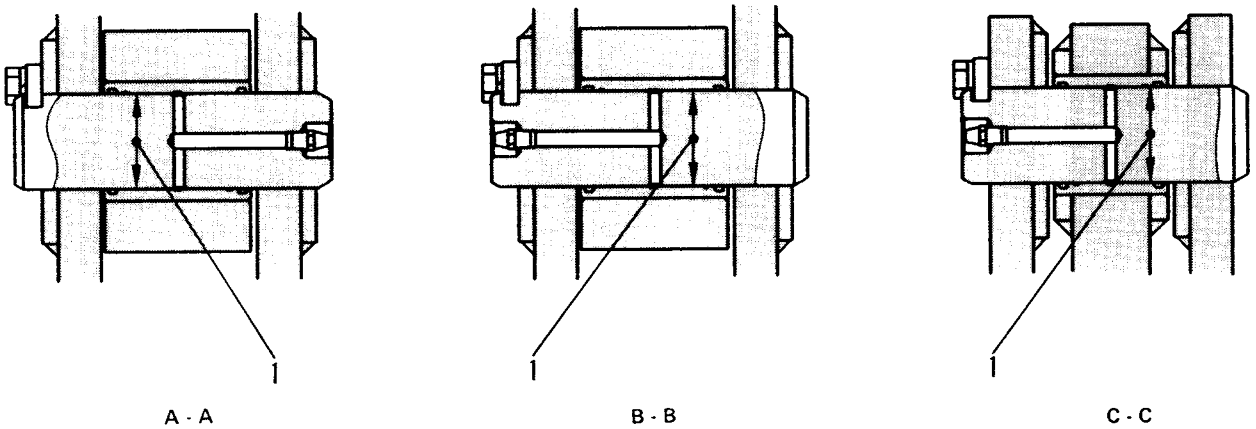


A - A B - B C - C

140F12270

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between bushing and mounting pin of link and beam	56	−0.030 −0.076	+0.3 +0.2	0.230 — 0.376	1.0	Replace bushing
2	Wear of point	Standard size		Repair limit			Replace
		222		152			

90 OTHERS

TRIMMING DOZER DDM060-4A

★ This section contains only information related to the trimming dozer.

SPECIFICATIONS

STRUCTURE AND FUNCTION

MAINTENANCE STANDARD

D65EX - PX-12 FOR KA SPEC.

D65EX-12 SERIAL NO. 63403 AND UP
D65PX-12 SERIAL NO. 63304 AND UP

★ This section contains only information different from the standard D65EX-12 (Serial No. 60942 and up) and D65PX-12 (Serial No. 60915 and up).

STRUCTURE AND FUNCTION

TESTING AND ADJUSTING

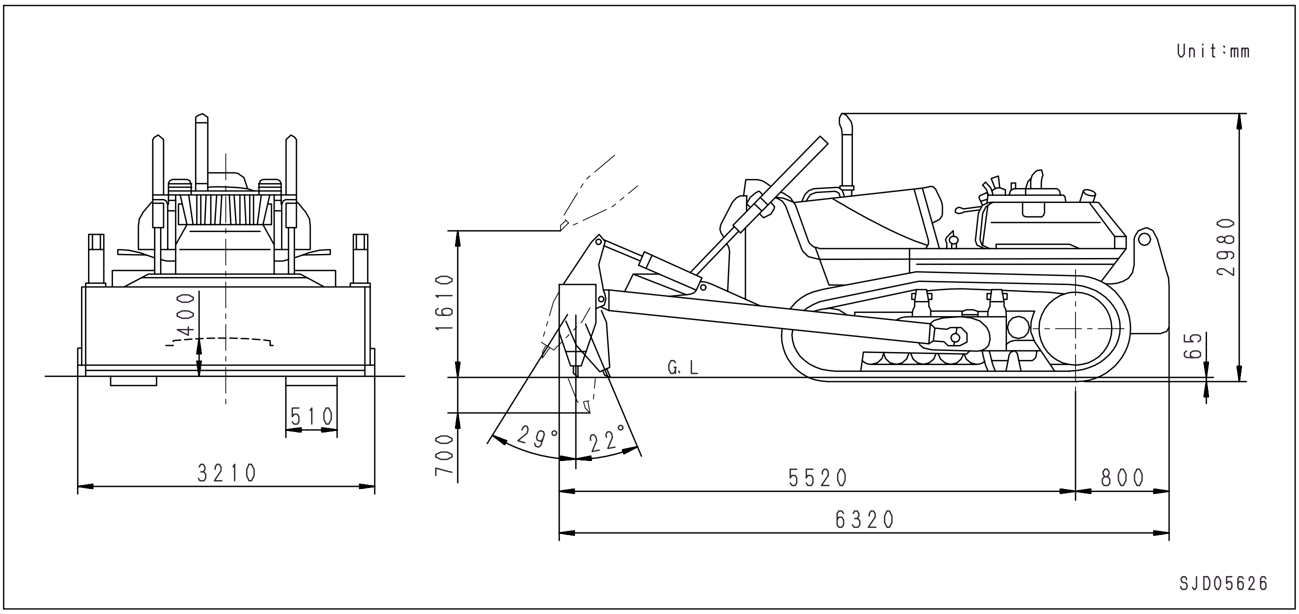
TROUBLESHOOTING

ELECTRIC CIRCUIT DIAGRAM

SPECIFICATIONS

SPECIFICATION DRAWING

- D65E, D65EX-12 Trimming dozer



SPECIFICATIONS

Serial No. 60001 – 65000

Machine model				D65EX-12
Serial Numbers				60001 and up
Weight		Operating weight • bare tracktor • with trimming dozer + cab	kg	 14,890 19,250
Performance		Min. turning radius	m	— (Counterrotation turn)
		Gradeability	deg	30
		Stability (front, rear, left, right)	deg	35
	Speed ranges	Forward 1st Forward 2nd Forward 3rd	km/h	3.9 6.8 10.6
		Reverse 1st Reverse 2nd Reverse 3rd	km/h	5.0 8.6 13.4
Dimensions	Ground pressure	Bare tractor With trimming dozer + cab	kPa {kg/cm²}	53.94 {0.55} 67.67 {0.69}
	Overall length	Bare tractor With trimming dozer	mm	4,365 6,475
	Overall width	Bar tractor With trimming dozer	mm	2,390 3,210
	Overall heights	To tip of exhaust pipe To top of operatior's compartment When cab is installed	mm	2,980 2,230 3,160

Machine model				D65EX-12
Serial Numbers				60001 and up
Dimensions		Track gauge	mm	1,880
		Length of track on ground		2,675
		Width of track shoe (standard)		510
		Min. ground clearance (To bottom of undercover)		400
Engine		Model		6D125-1
		Type		4-cycle, water cooled, inline vertical type, direct injection, with turbocharger
		No. of cylinder – bore x stroke	mm	6 – 125 x 150
		Piston displacement	ℓ {cc}	11.04 {11,040}
	Performance	Rated horsepower	kW/rpm {HP/rpm}	140/1,950 {187/1,950}
		Max. torque	Nm/rpm {kgm/rpm}	981/1,200 {100/1,200}
		High idling	rpm	2,100
		Low idling	rpm	825
		Min. fuel consumption ratio	g/kWh {g/HPh}	211 {155}
		Starting motor		24V, 7.5kW
		Alternator		24V, 35A
		Battery		12V, 140Ah x 2
		Radiator core type		D-6
Power train system		Torque converter		3-element, 1-stage, 1 phase
		Transmission		Planetary gear type, multiple disc clutch, hydraulically acturated, lubrication gear pump, force feed, forward 3 speed, reverse 3 speed, manual mechanical type

Machine model			D65EX-12
Serial Numbers			60001 and up
Power train system	Bebel gear shaft		Spiral bevel gear, force feed lubrication gear pump
	HSS steering	HSS steering system	Differential planetary gear type, hydraulic motor operated, hydraulically actuated
		Master brake	Wet type, multiple disc, spring boosted, foot operated, hydraulically actuated
	Final drive		1-stage spur gear, 1-stage planetary gear, splash type lubrication
Undercarriage	Suspension		Semi-rigid, floating beam
	Carrier roller		2 on each side
	Track roller		7 on each side
	Track shoe (510 mm)		Assembly type, single grouser, 39 on each side, pitch: 203.2 mm
Power train, lubrication pump			Gear type (SAL(2)-045+045)
PPC pump			Gear type (SBR(1)-010) Max. discharge pressure: 20.6 MPa {210 kg/cm^2} Theoretical discharge amount: 36.8 ℓ/min/3500 rpm
HSS motor			Piston type (HMF95DT), swash plate angle 16°, with brake valve Permissible peak pressure: 47 MPa {480 kg/cm^2} Rated flow (theoretical value): 183.2 ℓ/min/1908 rpm
Steering, work equipment hydraulic system	Hydraulic pump		Variable swash plate type (HPV95), CLSS load sensing typle Permissible peak pressure: 47 MPa {480 kg/cm^2}

Machine model					D65EX-12
Serial Numbers					60001 and up
Steering, work equipment hydraulic system	Main control valve		Type		3 + 1-spool type, hydraulically assisted (Trimming + lift + tilt + steering)
			• For trimming		
			• For blade lift		
			• For blade tilt		
			• For steering		
	Type				Reciprocal piston type
	Hydraulic cylinder	Dimensions of blade lift cylinder	Cylinder bore	mm	95
			Outside diameter of piston rod		65
			Piston stroke		1,165
			Max. distance between pins		1,685
			Min. distance between pins		520
		Dimensions of trimming cylinder	Cylinder bore	mm	120
			Outside diameter of piston rod		55
			Piston stroke		520
			Max. distance between pins		1,440
			Min. distance between pins		920
	Hydraulic tank				Box type (externally installed control valve)
Work equipment (trimming dozer)	Type				Hydraulic trimming dozer
	Blade support method				Hydraulic cylinder type
	Performance		Max. lifting height (from ground)	mm	1,610
			Max. lowering depth (from ground)	mm	700
			Max. tilt forward	deg.(°)	30
			Max. tilt back	deg.(°)	22
	Dimensions		Blade width	mm	3,210
			Blade height		1,000

Serial No. 65001 and up

Machine model				D65EX-12	D65E-12
Serial Numbers				65001 and up	65001 and up
Weight		Operating weight	kg		
		• bare tracktor		15,670	15,620
		• with trimming dozer + cab		20,120	19,950
Dimensions	Ground pressure	Bare tractor	kPa {kg/cm²}	55.90 {0.57}	55.90 {0.57}
		With trimming dozer + cab		72.60 {0.74}	71.60 {0.73}
	Overall length	Bare tractor	mm	4,365	4,365
		With trimming dozer		6,475	6,475
	Overall width	Bar tractor	mm	2,390	2,390
		With trimming dozer		3,210	3,210
	Overall heights	To tip of exhaust pipe	mm	2,990	2,990
		To top of operator's compartment		2,300	2,300
		When cab is installed		3,055	3,055

Serial No. 65001 and up

Machine model					D65EX-12	D65E-12
Serial Numbers					65001 and up	65001 and up
Steering, work equipment hydraulic system	Main control valve		Type		3 + 1-spool type, hydraulically assisted (Trimming + lift + tilt + steering)	3 spool type, hydraulically assisted (Trimming + lift + tilt)
			• For trimming			
			• For blade lift			
			• For blade tilt			
			• For steering			
	Type				Reciprocal piston type	Reciprocal piston type
	Hydraulic cylinder	Dimensions of blade lift cylinder	Cylinder bore	mm	95	95
			Outside diameter of piston rod		65	65
			Piston stroke		1,165	1,165
			Max. distance between pins		1,685	1,685
			Min. distance between pins		520	520
		Dimensions of trimming cylinder	Cylinder bore	mm	120	120
			Outside diameter of piston rod		55	55
			Piston stroke		520	520
			Max. distance between pins		1,440	1,440
			Min. distance between pins		920	920
	Hydraulic tank				Box type (externally installed control valve)	Box type (externally installed control valve)
Work equipment (trimming dozer)	Type				Hydraulic trimming dozer	Hydraulic trimming dozer
	Blade support method				Hydraulic cylinder type	Hydraulic cylinder type
	Performance		Max. lifting height (from ground)	mm	1,610	1,610
			Max. lowering depth (from ground)	mm	685	685
			Max. tilt forward	deg.(°)	29	29
			Max. tilt back	deg.(°)	22	22
	Dimen-sions		Blade width	mm	3,210	3,210
			Blade height		1,000	1,000

WEIGHT TABLE

Serial No. 60001 – 65000

Unit: kg

Machine model	D65EX-12
Serial No.	60001 and up
Engine, damper assembly	1,200
• Engine assembly	1,150
• Damper assembly	45
• Engine mount parts (wiring)	1.5
Radiator assembly (including oil cooler)	165
• Oil cooler assembly (for hydraulic oil)	6
Fuel tank assembly	120
Power train unit assembly	1,580
• Transmission assembly	485
• Torque converter, PTO assembly	290
• Transmission control valve assembly	17
• Main relief valve assembly	6
• HSS assembly	735
• Brake valve assembly	6
Final drive assembly (each side)	790
Sprocket assembly (each side)	8.3 x 9
Hull frame assembly	2,040
Track group assembly (each side)	1,545
• Track frame	640
• Idler assembly (each side)	200
• Track roller assembly (each side) (single)	54 x 5
• Track roller assembly (each side) (double)	61 x 2
• Carrier roller assembly (each side)	30 x 2

Unit: kg

Machine model	D65EX-12
Serial No.	60001 and up
Track shoe assembly (each side) (510 mm, wet type)	1,310
Pivot shaft (each side)	90
Equalizer bar	125
Hydraulic tank assembly	55
Main control valve	
• Trimming + lift + tilt + steering	95
Engine underguard	105
Transmission underguard	30
Operator's seat	35
Trimming dozer assembly	2,650
• Blade	1,090
• H-frame	1,240
• Trimming cylinder assembly	65 x 2
Blade lift cylinder assembly	95 x 2
Poer train pump assembly	20
Hydraulic • HSS pump assembly	65
HSS motor assembly	45
Cab assembly	570

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Serial No. 65001 and up

Unit: kg

Machine model	D65EX-12	D65E-12
Serial No.	65001 and up	65001 and up
Hydraulic tank assembly	55	55
Main control valve		
• Trimming + lift + tilt + steering	95	—
• Trimming + lift + tilt	—	90
Trimming dozer assembly	2,650	2,650
• Blade	1,170	1,170
• H-frame	1,310	1,310
• Trimming cylinder assembly	60 x 2	60 x 2
Blade lift cylinder assembly	95 x 2	—

TABLE OF FUEL, COOLANT AND LUBRICANTS

Serial No. 60001 – 65000

RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE −22 −4 14 32 50 68 86 104°F −30 −20 −10 0 10 20 30 40°C	CAPACITY (ℓ) Specified	CAPACITY (ℓ) Refill
Engine oil pan	Engine oil	SAE 30 SAE 10W SAE 10W-30 SAE 15W-40	44	38
Power train case		SAE 30	75	50
Final drive case (each)		SAE 10W	24	24
Damper case		SAE 30	1.7	1.7
Idler (each)			4.5	4.5
Pivot shaft case (each)			0.15	0.15
Hydraulic tank		SAE 10W SAE 10W-30 SAE 15W-40	95	55
Track roller (each)	Gear oil	GO 140	0.32	0.32
Carrier roller (each)			0.24	0.24
Fuel tank	Diesel fuel	ASTM D975 No. 2 *	340	—
Cooling system (including sub tank)	Coolant	Add antifreeze	58.2	—

* **ASTM D975 No. 1**

NOTE:

(1) When fuel sulphur content is less than 0.5 %, change oil in the oil pan every periodic maintenance hours described in this manual.
Change oil according to the following table if fuel sulphur content is above 0.5 %.

Fuel sulphur content	Change interval of oil in engine oil pan
0.5 to 1.0 %	1/2 of regular interval
Above 1.0 %	1/4 of regular interval

ASTM: American Society of Testing and Material
SAE: Society of Automotive Engineers
API: American Petroleum Institute

(2) When starting the engine in an atmospheric temperature of lower than 0°C, be sure to use engine oil of SAE10W, SAE10W-30 and SAE15W-40 even though an atmospheric temperature goes up to 10°C more or less in the day time.

(3) Use API classification CD as engine oil and if API classification CC, reduce the engine oil change interval to half.

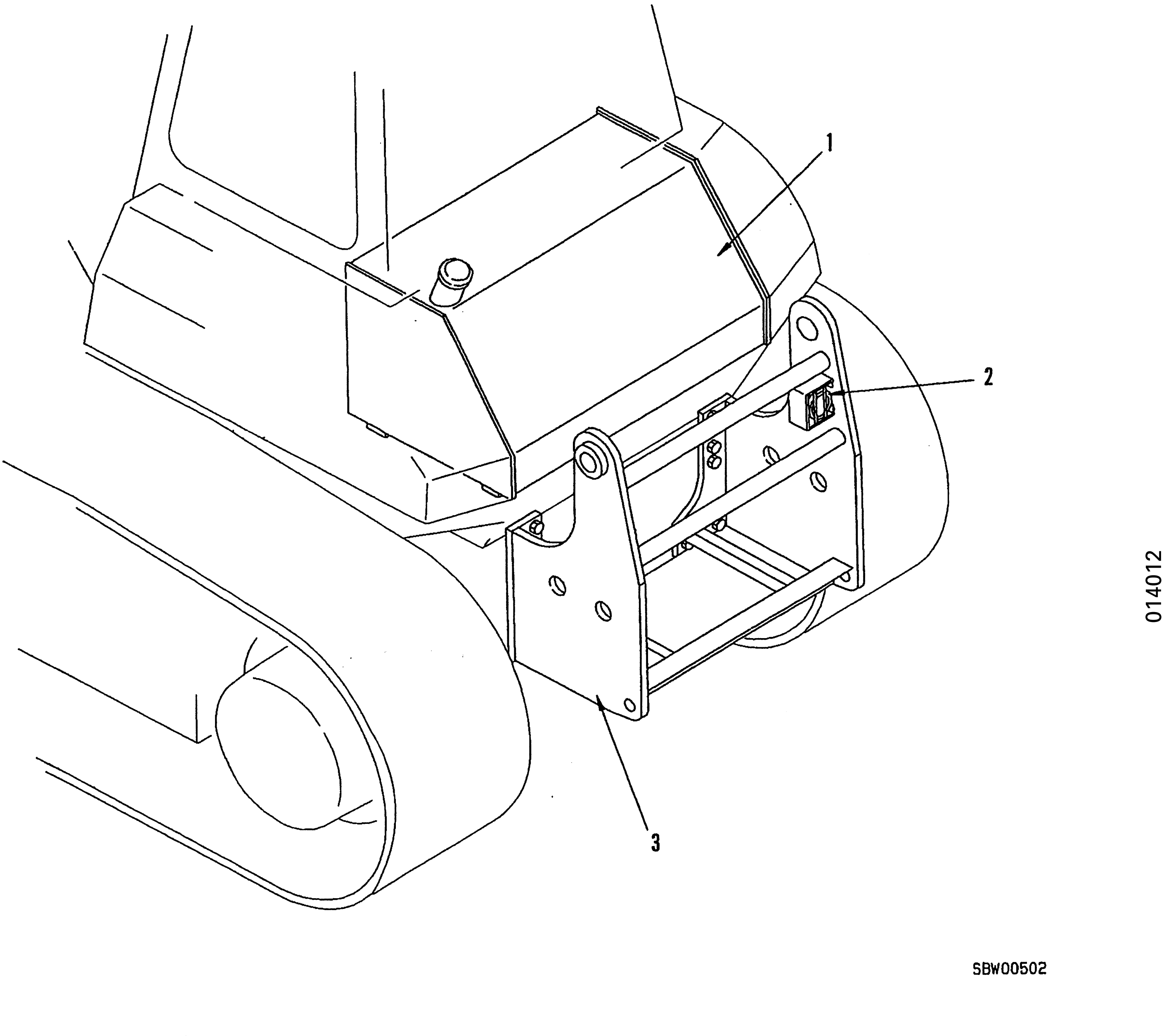
(4) There is no problem if single grade oil is mixed with multigrade oil (SAE10W-30, 15W-40), but be sure to add single grade oil that matches the temperature in the table on the left.

(5) We recommend Komatsu genuine oil which has been specifically formulated and approved for use in engine and hydraulic work equipment applications.

Specified capacity: Total amount of oil including oil for components and oil in piping.
Refill capacity: Amount of oil needed to refill system during normal inspection and maintenance.

STRUCTURE AND FUNCTION

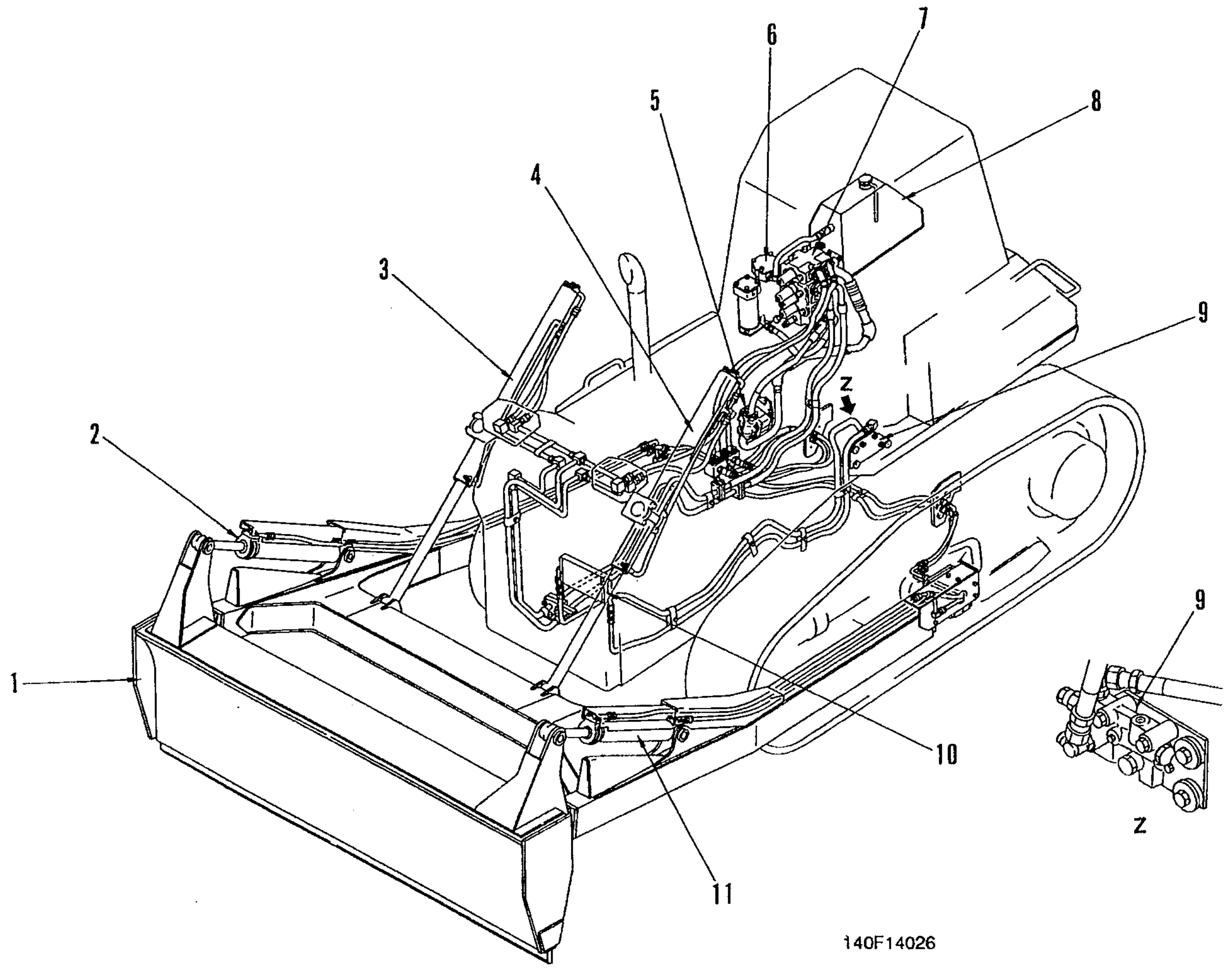
REAR GUARD



1. Fuel tank
2. Rear lamp (Red)
3. Rear guard

WORK EQUIPMENT HYDRAULIC PIPING DIAGRAM

TRIMMING DOZER



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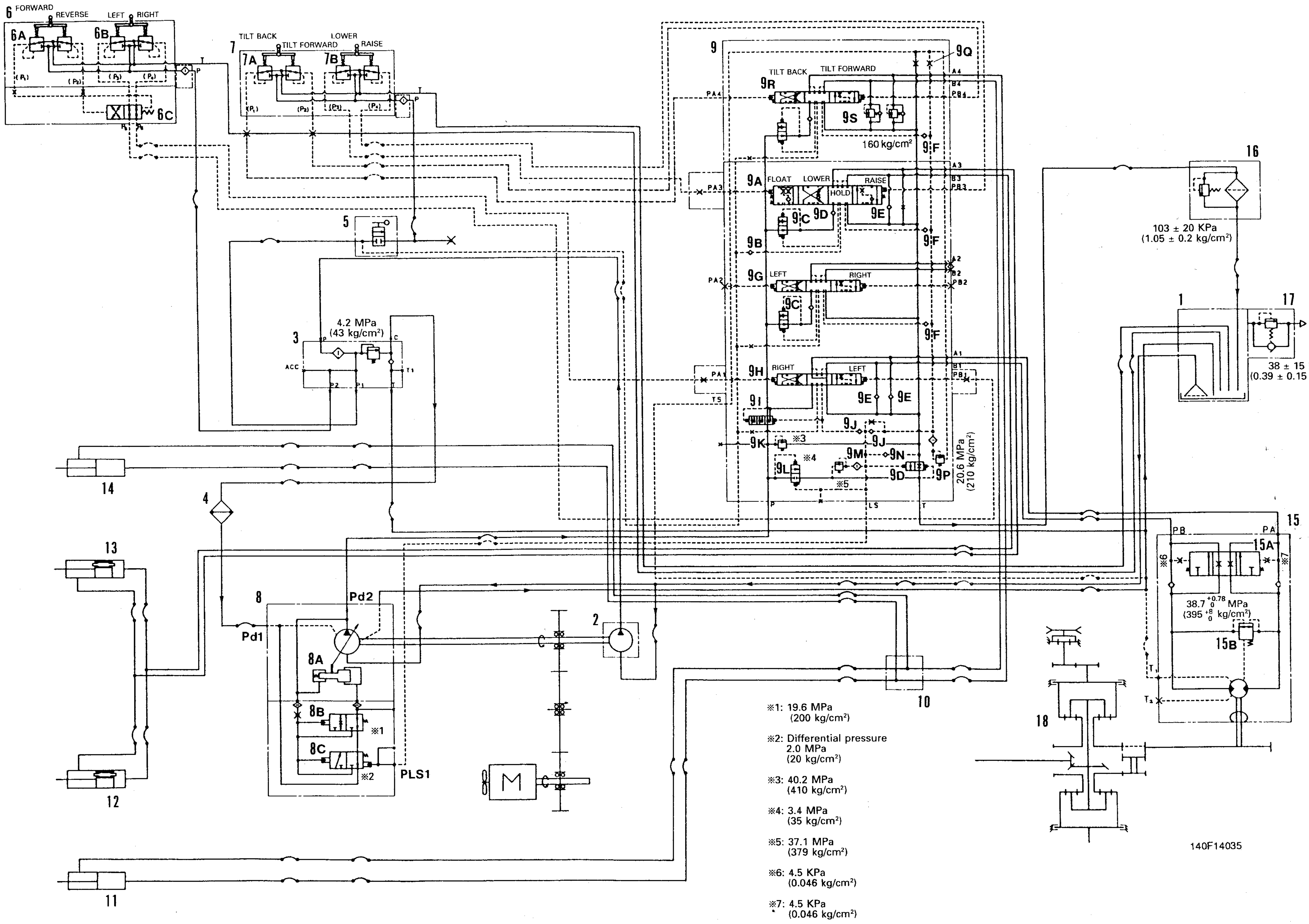
1. Blade
2. Right trimming cylinder
3. Right lift cylinder
4. Left lift cylinder
5. Hydraulic pump (SAL(1)100)
6. Oil filter
7. Main control valve
8. Hydraulic tank
9. PPC charge valve
10. Oil cooler
11. Left trimming cylinder

STEERING AND WORK EQUIPMENT HYDRAULIC CIRCUIT DIAGRAM

Serial No. 60001 – 65000

TRIMMING DOZER



※1: 19.6 MPa
(200 kg/cm²)

※2: Differential pressure
2.0 MPa
(20 kg/cm²)

※3: 40.2 MPa
(410 kg/cm²)

※4: 3.4 MPa
(35 kg/cm²)

※5: 37.1 MPa
(379 kg/cm²)

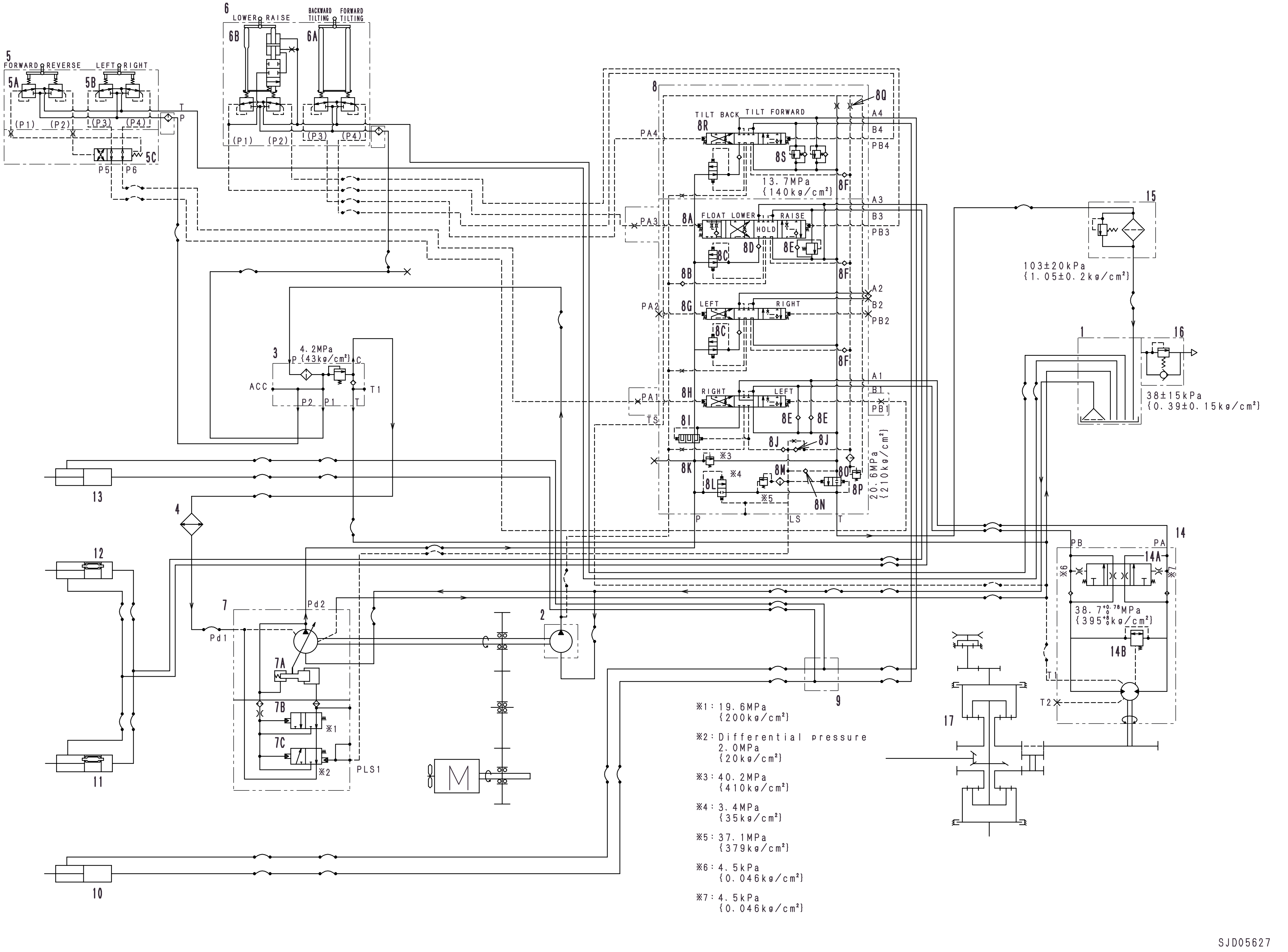
※6: 4.5 KPa
(0.046 kg/cm²)

※7: 4.5 KPa
(0.046 kg/cm²)

1. Hydraulic tank
2. PPC pump (SBR(1)-010)
3. PPC charge valve
4. Oil cooler
5. PPC lock valve
6. Steering control PPC valve
   6A. Direction (for HSS)
   6B. Steering
   6C. Steering circuit selector valve
7. Blade control PPC valve
   7A. Trimming
   7B. Blade lift
8. Hydraulic, HSS pump (HPV95)
   8A. Servo cylinder
   8B. Variable throttle valve
   8C. **LS** valve
9. Main control valve
   9A. Blade lift valve
   9B. Preset check valve
   9C. Pressure compensation valve
   9D. Load check valve
   9E. Suction valve
   9F. **LS** check valve (for main control valve)
   9G. Blade tilt valve
   9H. Steering valve
   9I. Steering priority valve
   9J. **LS** check valve (for steering valve)
   9K. Main relief valve
   9L. Unload valve
   9M. **LS** relief valve (for steering valve)
   9N. Back pressure check valve
   9O. Back pressure valve
   9P. **LS** relief valve (for main control valve)
   9Q. **LS** bypass valve
   9R. Trimming valve
   9S. Suction safety valve
10. Block
11. Left trimming cylinder
12. Left blade lift cylinder
13. Right blade lift cylinder
14. Right trimming cylinder
15. HSS motor (HMF95)
   15A. Counterbalance valve
   15B. Safety valve
16. Hydraulic filter
17. Hydraulic tank breaker relief valve
18. HSS unit

Serial No. 65001 and up

TRIMMING DOZER
FOR D65EX-12

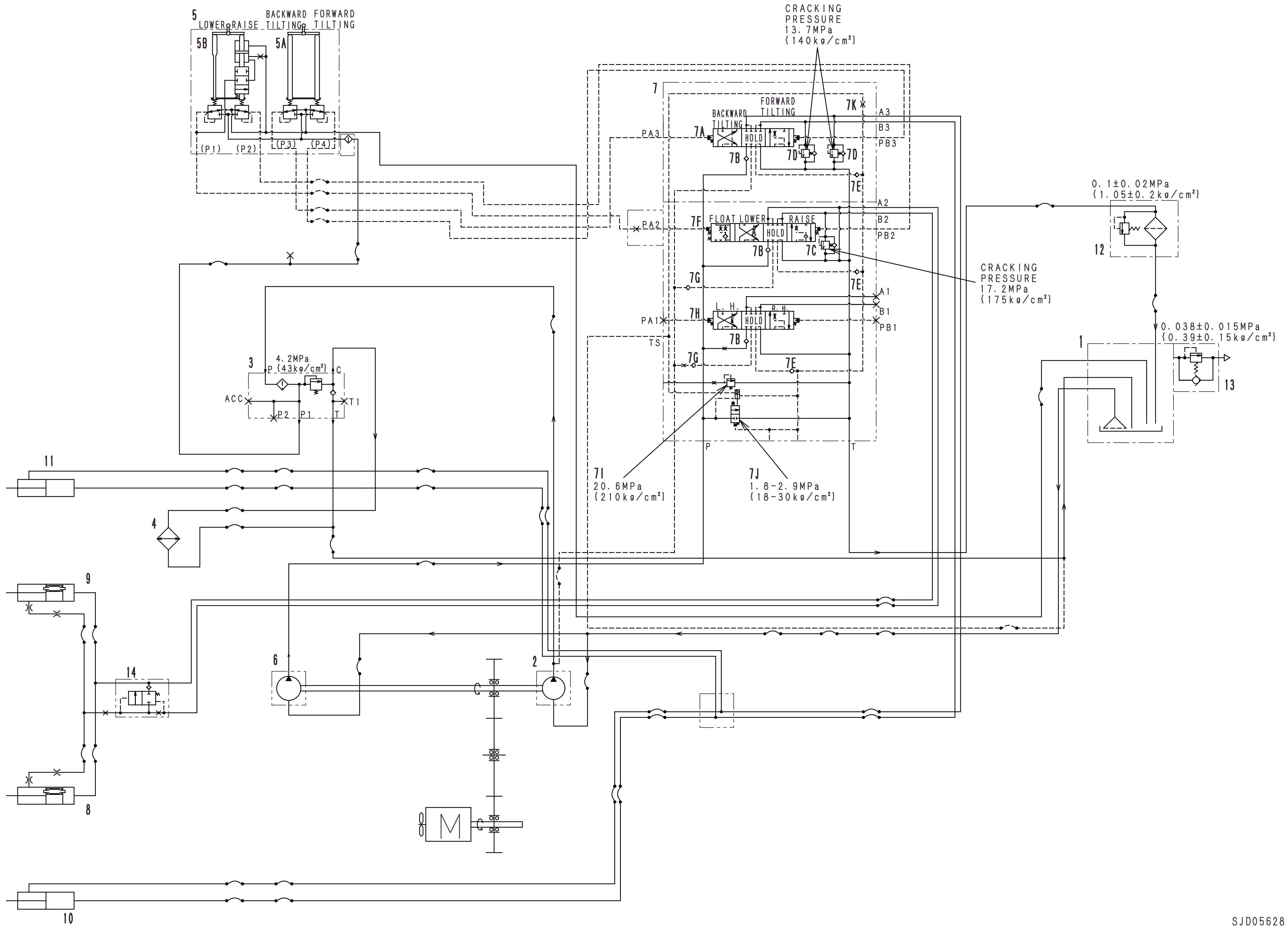


1. Hydraulic tank
2. PPC pump (SBR(1)-010)
3. PPC charge valve
4. Oil cooler
5. Steering control PPC valve
    - 5A. Direction (for HSS)
    - 5B. Steering
    - 5C. Steering circuit selector valve
6. Blade control PPC valve
    - 6A. Trimming
    - 6B. Blade lift
7. Hydraulic, HSS pump (HPV95)
    - 7A. Servo cylinder
    - 7B. Variable throttle valve
    - 7C. **LS** valve
8. Main control valve
    - 8A. Blade lift valve
    - 8B. Preset check valve
    - 8C. Pressure compensation valve
    - 8D. Load check valve
    - 8E. Suction safety valve
    - 8F. **LS** check valve (for main control valve)
    - 8G. Blade tilt valve
    - 8H. Steering valve
    - 8I. Steering priority valve
    - 8J. **LS** check valve (for steering valve)
    - 8K. Main relief valve
    - 8L. Unload valve
    - 8M. **LS** relief valve (for steering valve)
    - 8N. Back pressure check valve
    - 8O. Back pressure valve
    - 8P. **LS** relief valve (for main control valve)
    - 8Q. **LS** bypass valve
    - 8R. Trimming valve
    - 8S. Suction safety valve
9. Block
10. Left trimming cylinder
11. Left blade lift cylinder
12. Right blade lift cylinder
13. Right trimming cylinder
14. HSS motor (HMF95)
    - 14A. Counterbalance valve
    - 14B. Safety valve
15. Hydraulic filter
16. Hydraulic tank breaker relief valve
17. HSS unit

WORK EQUIPMENT HYDRAULIC CIRCUIT DIAGRAM

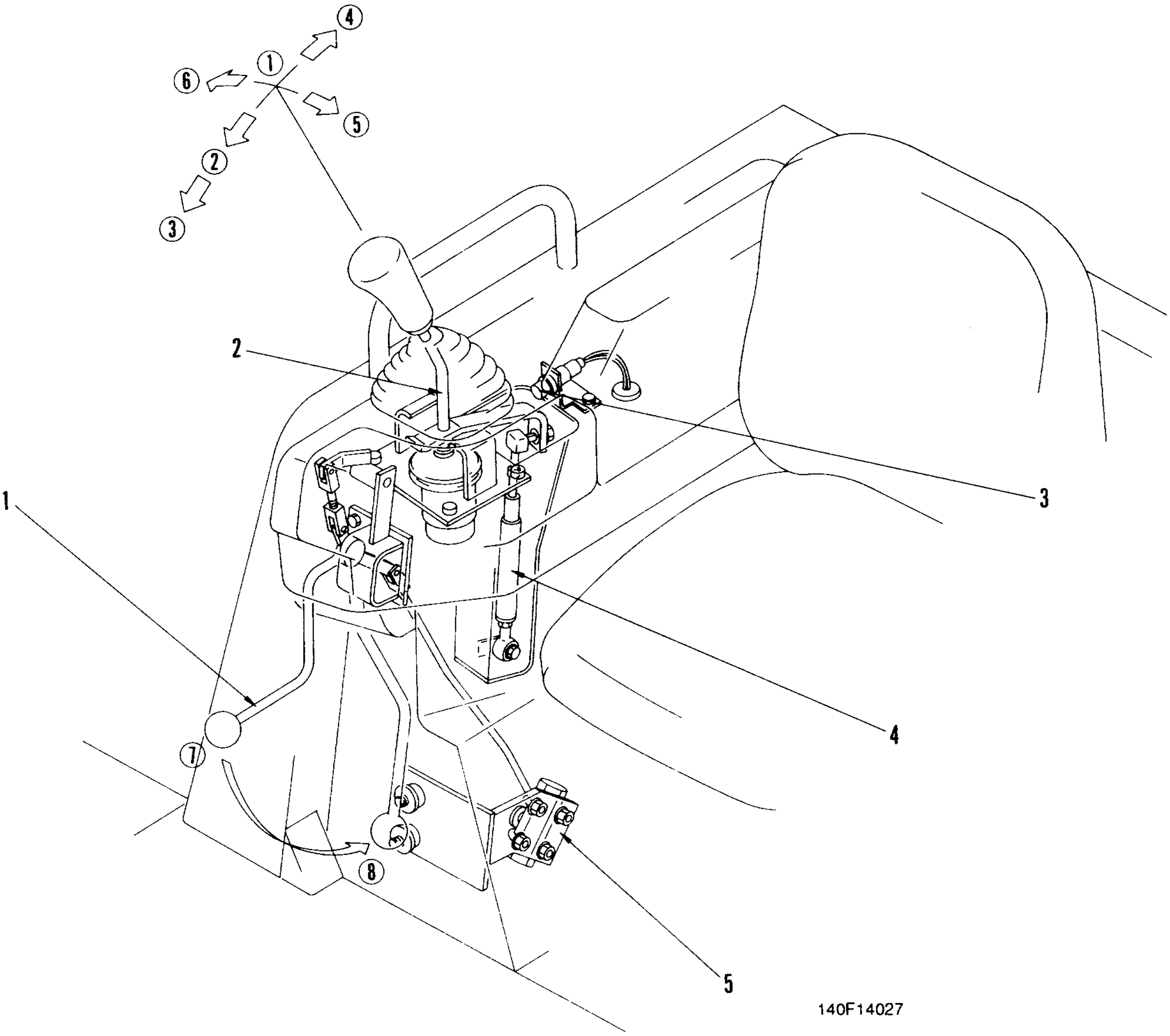
Serial No. 65001 and up

TRIMMING DOZER
FOR D65E-12



1. Hydraulic tank
2. PPC pump (SBR(1)-010)
3. PPC charge valve
4. Oil cooler
5. Blade control PPC valve
   - 5A. Trimming
   - 5B. Blade lift
6. Hydraulic pump (SAL(3)-080)
7. Main control valve
   - 7A. Trimming valve
   - 7B. Load check valve
   - 7C. Suction safety valve
   - 7D. Suction safety valve
   - 7E. **LS** check valve
   - 7F. Blade lift valve
   - 7G. Preset check valve
   - 7H. Blade tilt valve
   - 7I. Main relief valve
   - 7J. Variable unload valve
   - 7K. **LS** bypass valve
8. Left blade lift cylinder
9. Right blade lift cylinder
10. Left blade trimming cylinder
11. Right blade trimming cylinder
12. Hydraulic filter
13. Breather
14. Suction valve

WORK EQUIPMENT CONTROL



Lever positions

① Blade HOLD
② Blade LOWER
③ Blade FLOAT
④ Blade RAISE
⑤ Blade TILT BACK
⑥ Blade TILT FORWARD
⑦ FREE
⑧ LOCK

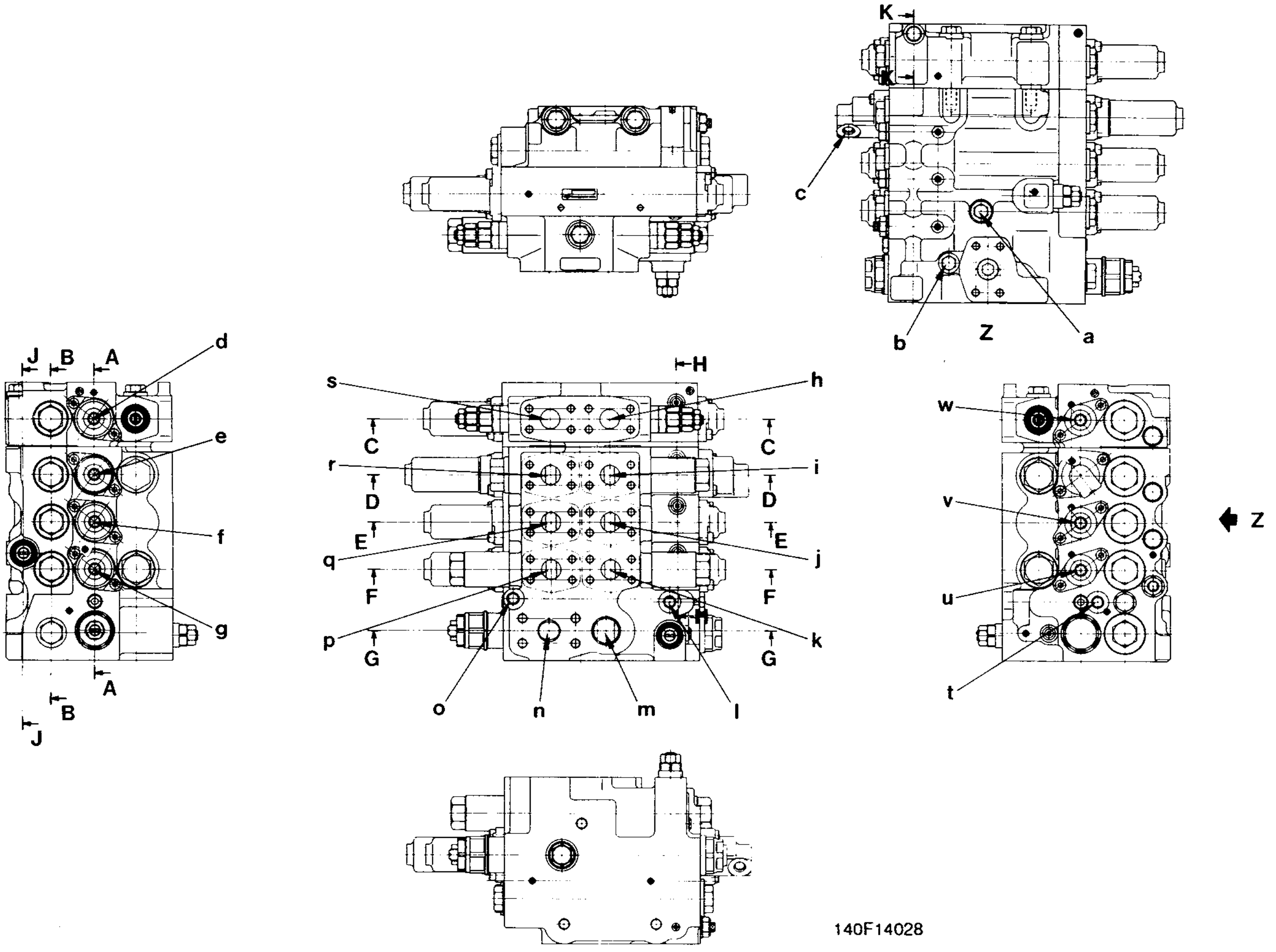
1. Safety lever
2. Blade control lever
3. Proximity switch
4. Detent (for holding lever)
5. PPC lock valve

Outline

- The work equipment control uses a PPC method in which each spool in the control valve is moved by the PPC valve.
- If safety lever (1) is placed at the LOCK position, blade control lever (2) cannot be moved to the LOWER position from the HOLD position. Proximity switch (3) is installed to prevent the engine from starting when the blade control lever is at the FLOAT position.
- Safety lever (1) is interconnected with PPC lock valve (5) and stops the oil in the PPC circuit when it is at the LOCK position.

MAIN CONTROL VALVE

(3 + 1 SPOOL VALVE: TRIMMING BLADE LIFT + TILT + STEERING)



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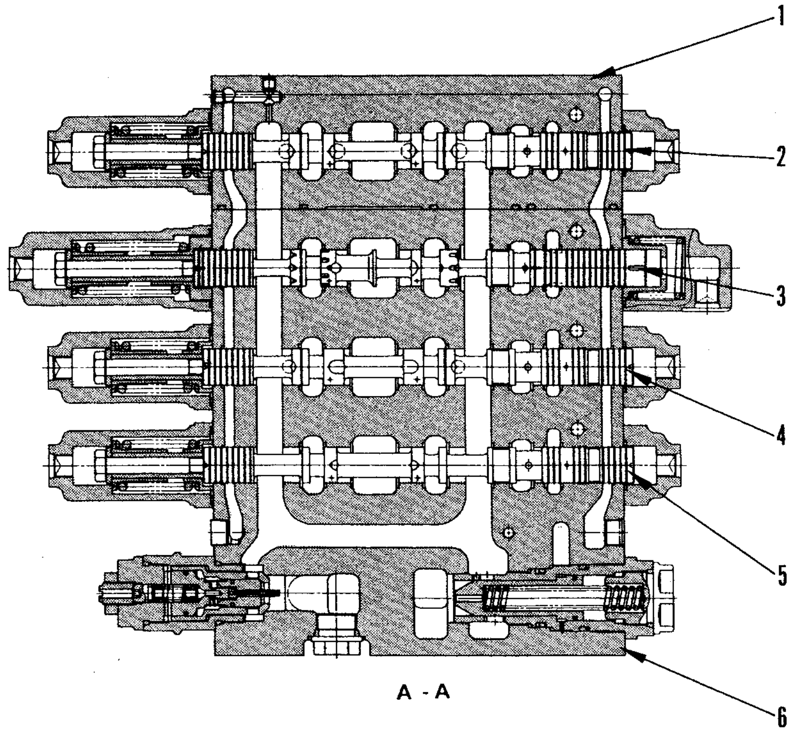
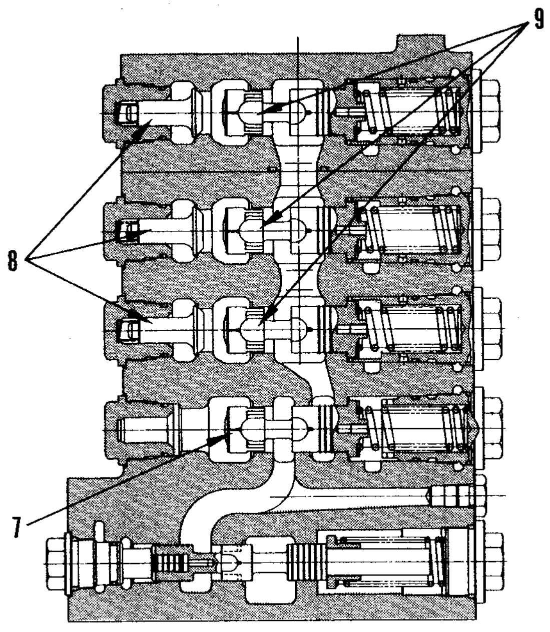
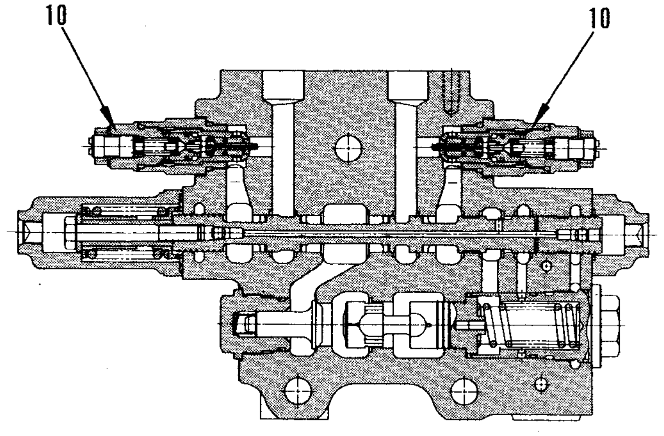
a. Port **PLSC** (**LS** pressure plug)
b. Port **PC** (pump pressure plug)
c. Port **PB3** (from PPC valve)
d. Port **PA4** (from PPC valve)
e. Port **PA3** (from PPC valve)
f. Port **PA2** (blind plug)
g. Port **PA1** (from PPC valve)
h. Port **B4** (to trimming cylinder bottom)
i. Port **B3** (to lift cylinder bottom)
j. Port **B2** (blind plug)
k. Port **B1** (to HSS motor)
l. Port **LS** (to pump **LS** valve)
m. Port **P** (from pump)
n. Port **T** (to tank)
o. Port **TS** (to tank)
p. Port **A1** (to HSS motor)
q. Port **A2** (blind plug)
r. Port **A3** (to lift cylinder head)
s. Port **A4** (to trimming cylinder head)
t. Port **Pi** (from PPC pump)
u. Port **PB1** (from PPC valve)
v. Port **PB2** (blind plug)
w. Port **PB4** (from PPC valve)



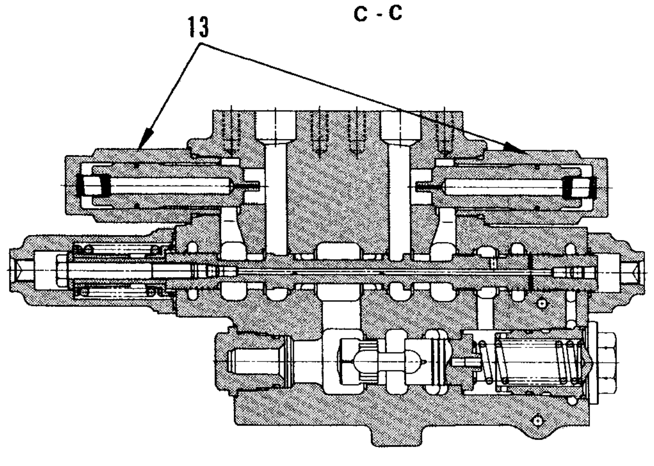
A - A



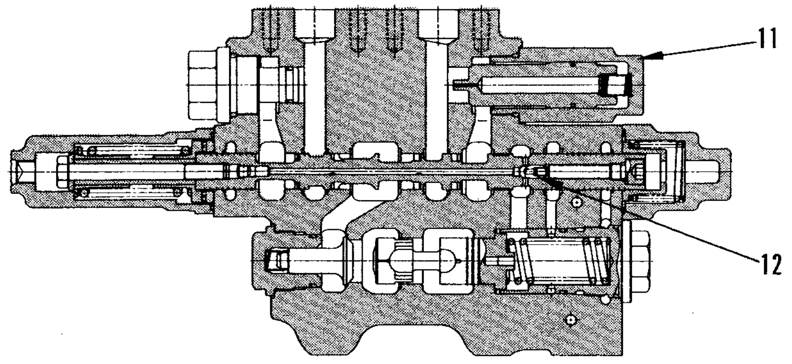
B - B



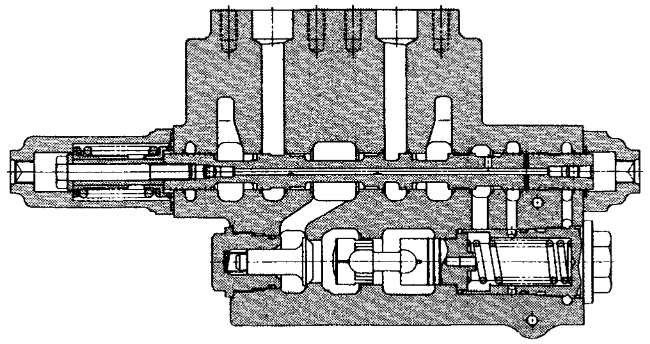
C - C



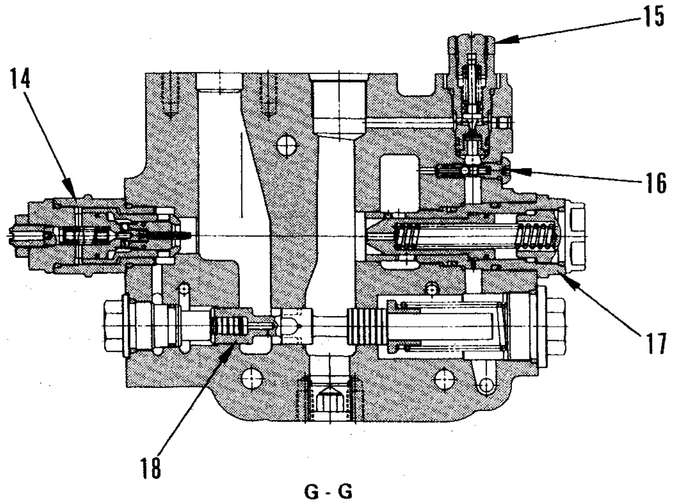
F - F



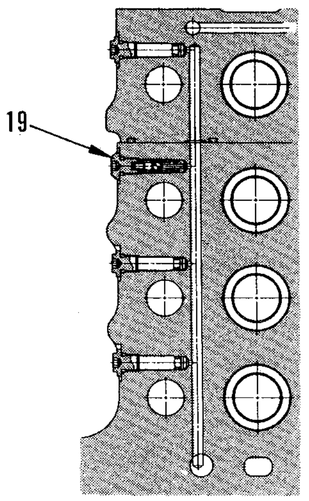
D - D



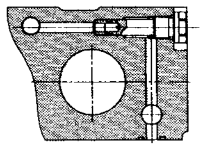
E - E



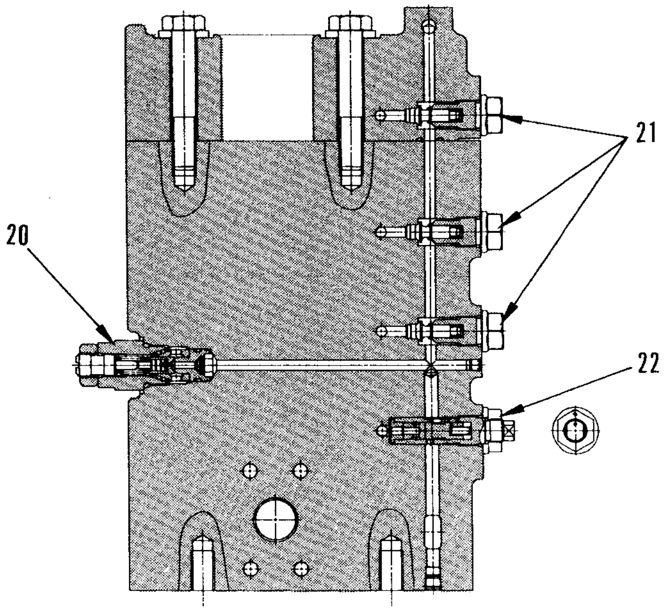
G - G



H - H



K - K



J - J

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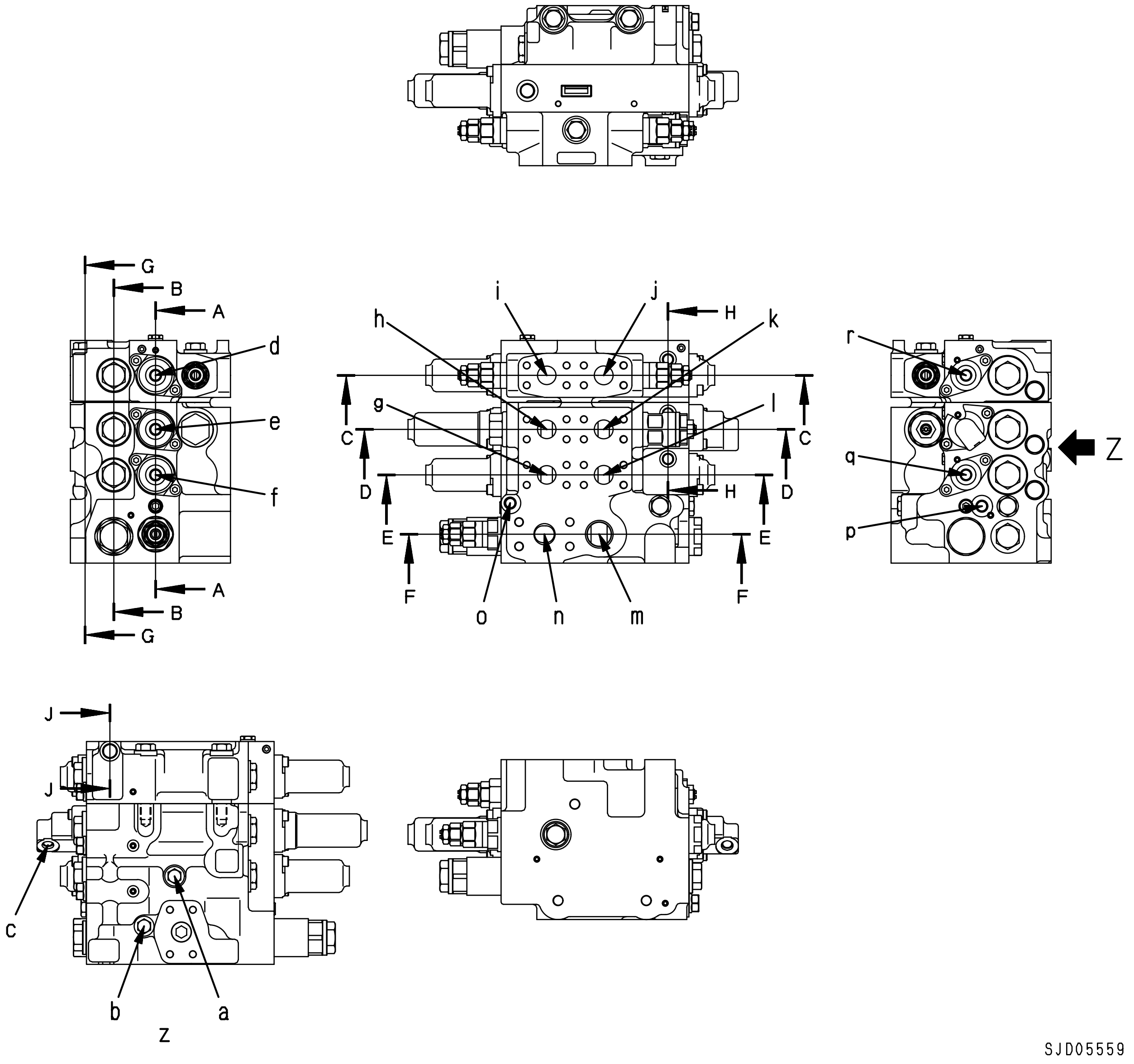
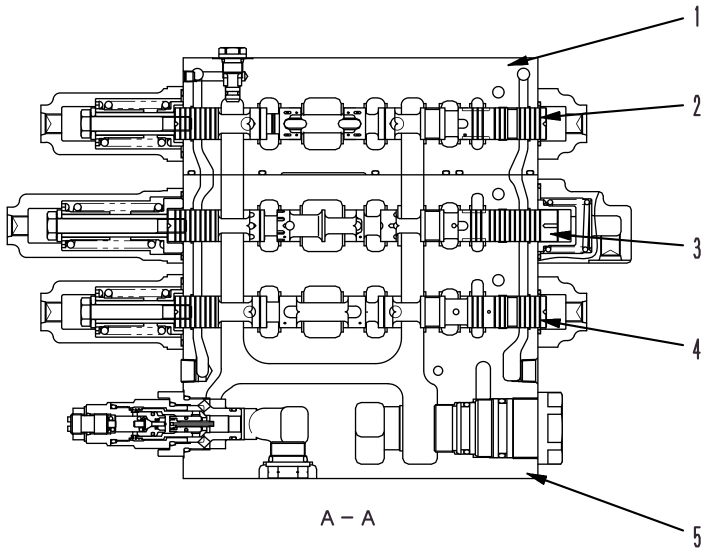
1. Valve block
2. Trimming spool
3. Lift spool
4. Tilt spool
5. Steering spool
6. Valve body
7. Steering priority valve
8. Load check valve
9. Pressure compensation valve
10. Suction safety valve
11. Suction valve
12. Check valve (built into spool)
13. Suction valve
14. Main relief valve
15. LS relief valve (for steering valve)
16. Back pressure check valve
17. Back pressure valve
18. Unload valve
19. Preset check valve
20. LS relief valve (for main control valve)
21. LS check valve (for main control valve)
22. LS check valve (for steering valve)

Serial No. 65001 and up

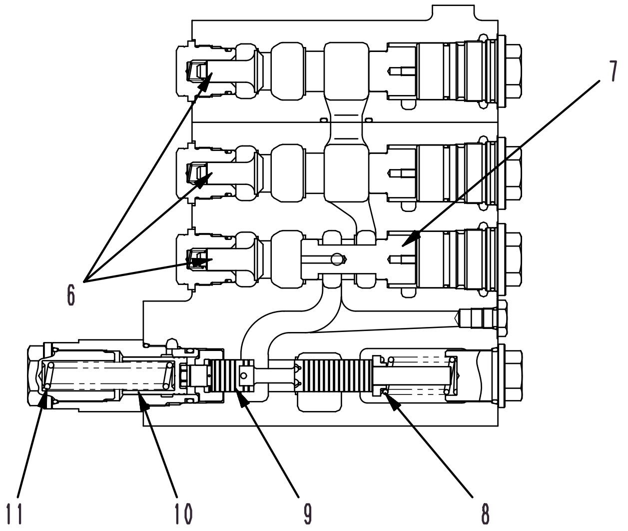
(3 SPOOL VALVE: TRIMMING BLADE LIFT + TILT) FOR D65E-12



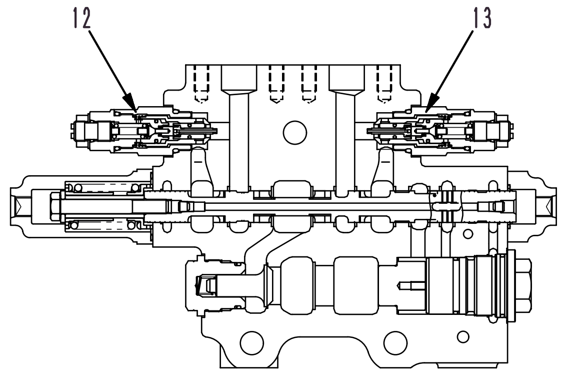
a. **PC** port (pump pressure detection plug)
b. **PLSC** port (**LS** pressure detection plug)
c. **PB2** port (from PPC valve)
d. **PA3** port (from PPC valve)
e. **PA2** port (from PPC valve)
f. **PA1** port (from PPC valve)
g. **A1** port (to tilt cylinder bottom)
h. **A2** port (to lift cylinder bottom)
i. **A3** port (to trimming cylinder bottom)
j. **B3** port (to trimming cylinder head)
k. **B2** port (to lift cylinder bottom)
l. **B1** port (to tilt cylinder head)
m. **T** port (to tank)
n. **P** port (from pump)
o. **S** port (to tank)
p. **Pi** port (from PPC pump)
q. **PB1** port (from PPC pump)
r. **PB3** port (from PPC pump)



A – A

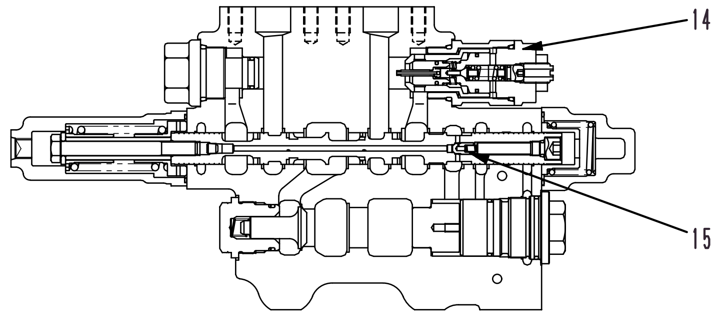


B – B

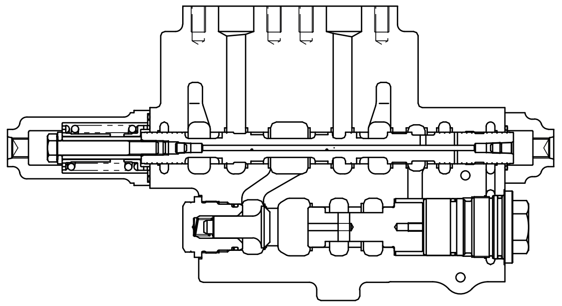


C – C

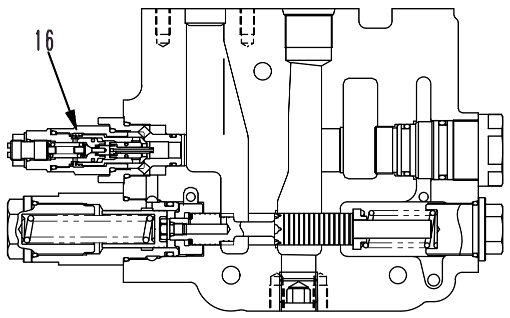
1. Valve block
2. Trimming spool
3. Lift spool
4. Tilt spool
5. Valve body
6. Load check valve
7. Orifice
8. Unload valve spring
9. Unload spool
10. Cancel piston
11. Cancel spring
12. Suction safety valve
13. Suction safety valve
14. Suction safety valve
15. Check valve (built into spool)
16. Main relief valve
17. **LS** check valve
18. Preset check valve
19. **LS** by-pass valve



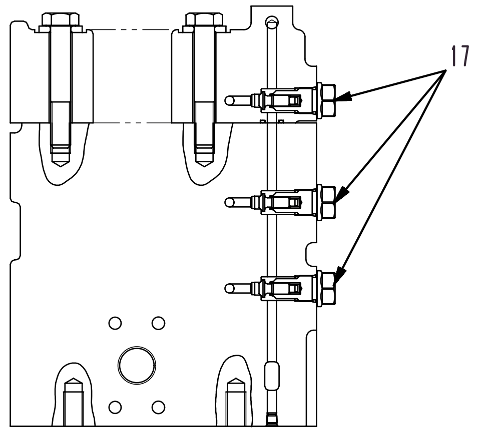
D – D



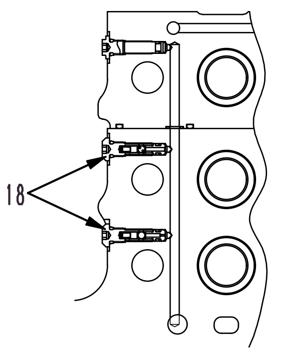
E – E



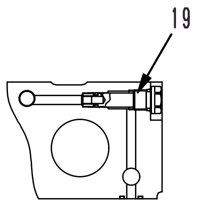
F – F



G – G



H – H



J – J

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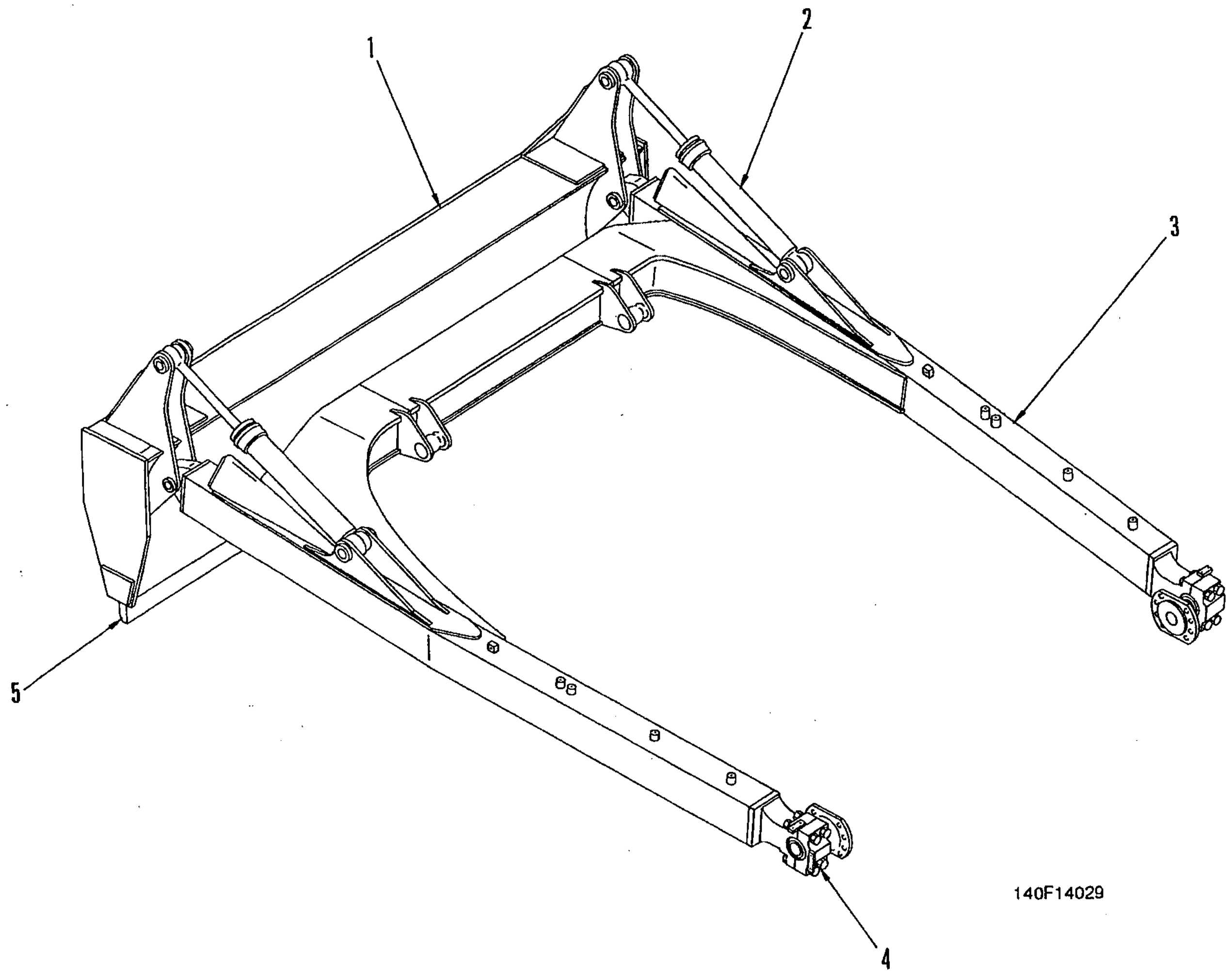
TRIMMING DOZER



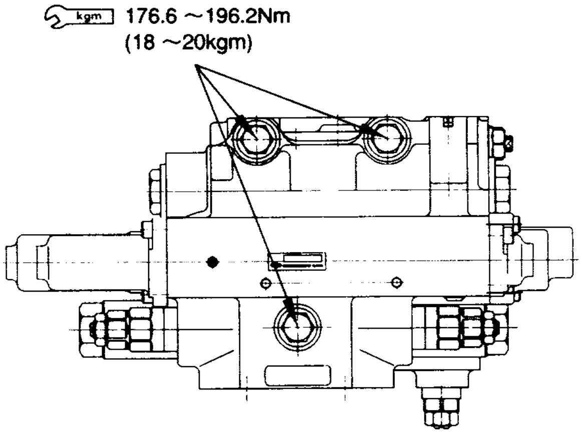
1. Blade
2. Trimming cylinder
3. H-frame
4. Trunnion
5. Cutting edge

Blade width	3,210 mm
Blade height	1,000 mm
Max. lifting height	1,610 mm
Max. lowering depth	700 mm
Max. tilt forward	29°
Max. tilt back	22°

MAINTENANCE STANDARD

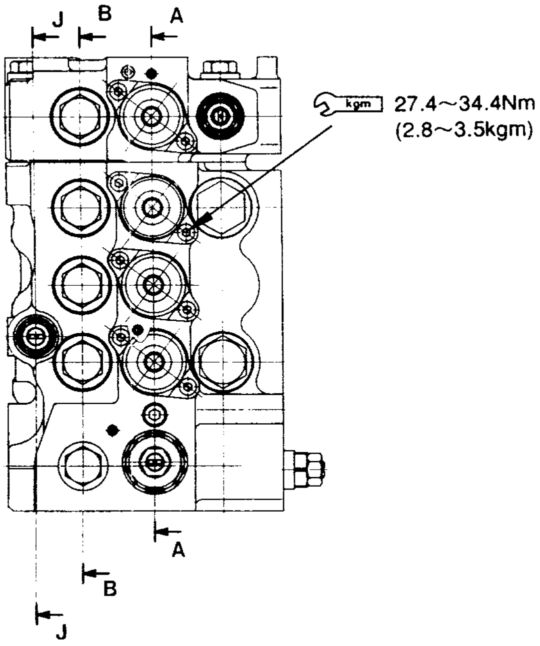
MAIN CONTROL VALVE

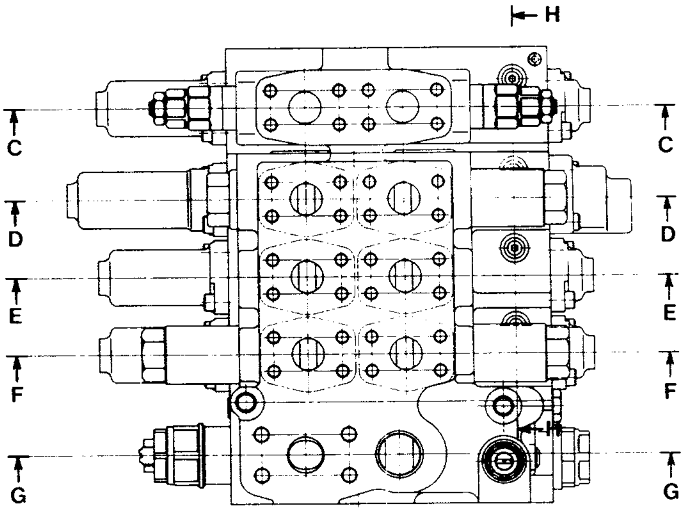
- **3 + 1 SPOOL VALVE (1/3)**



★ Precautions when tightening portions marked *.
To make sure that the three bolts are tightened uniformly, tighten in three stages as given below.

1st Step:	49 - 68.6 Nm (5 - 7 kg)
2nd Step:	127.5 - 147.1 Nm (13 - 15 kgm)
3rd Step:	176.5 - 196.1 Nm (18 - 20 kgm)





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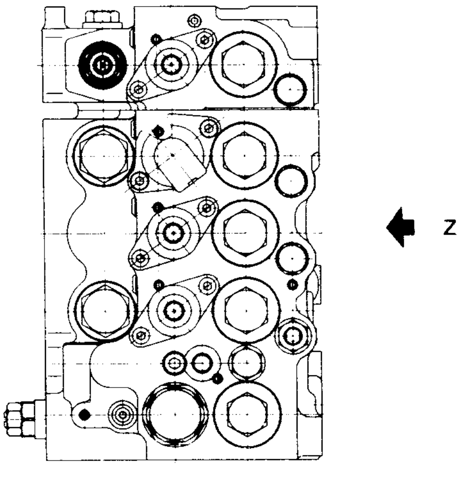

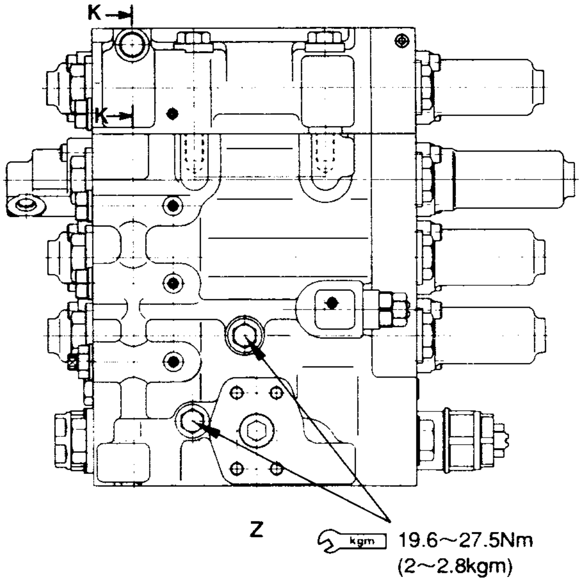

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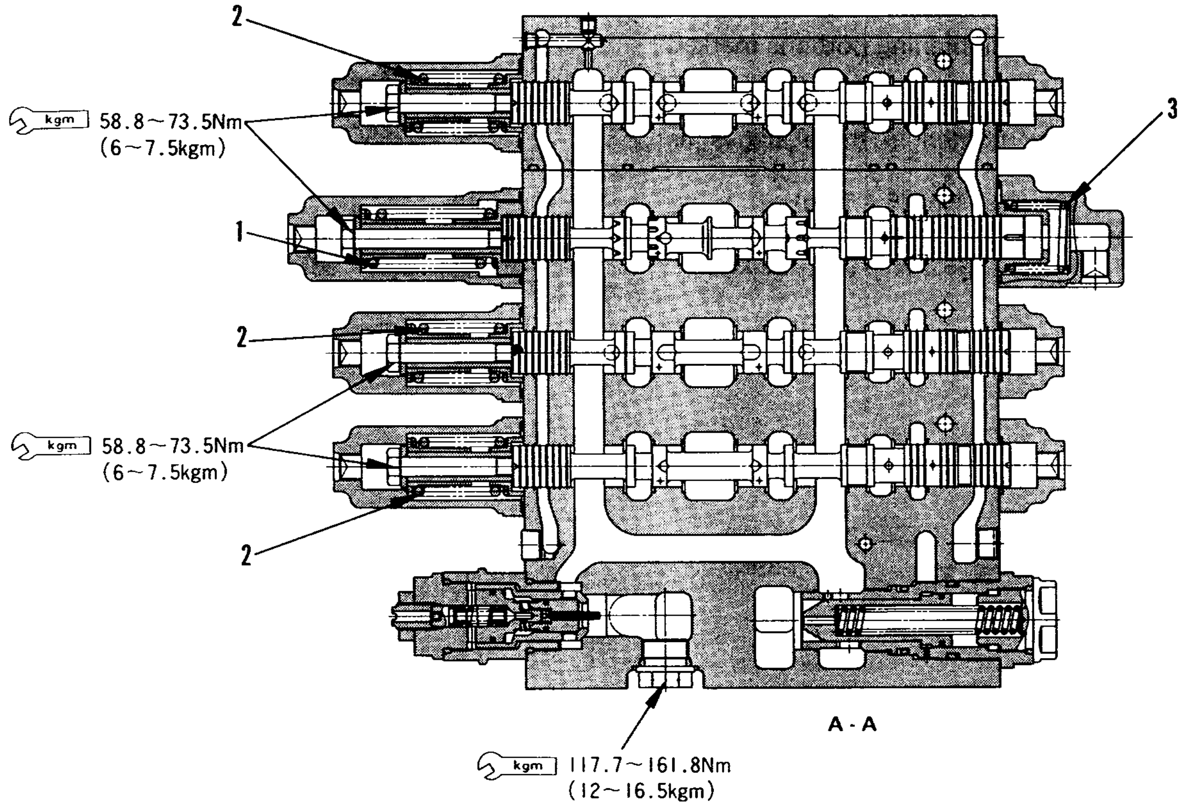
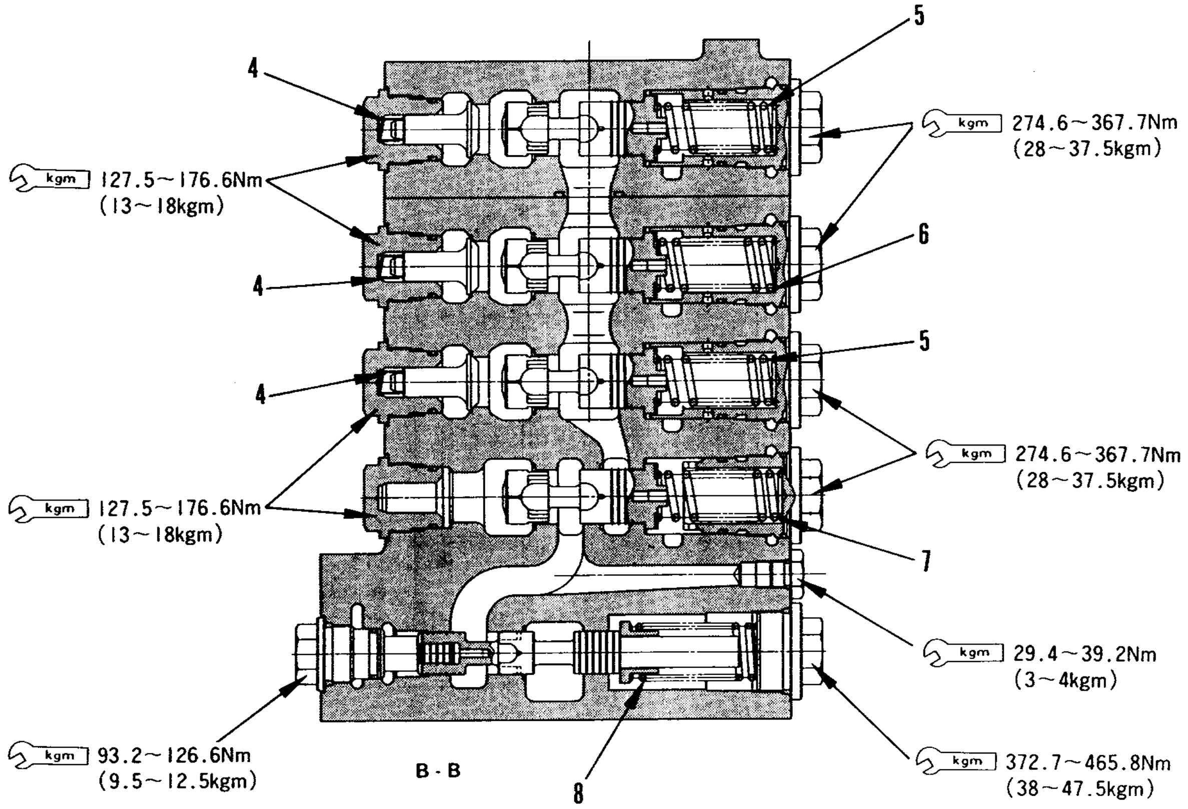
• 3 + 1 SPOOL VALVE (2/3)



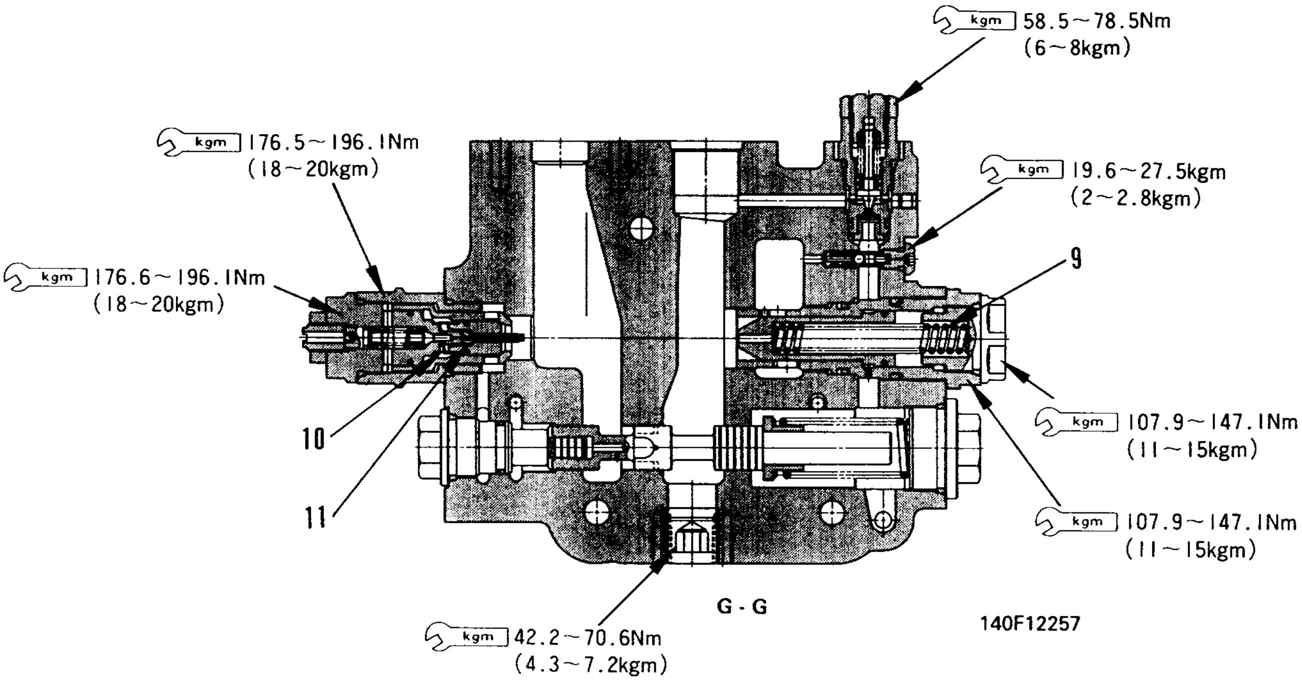
A - A

014012



B - B

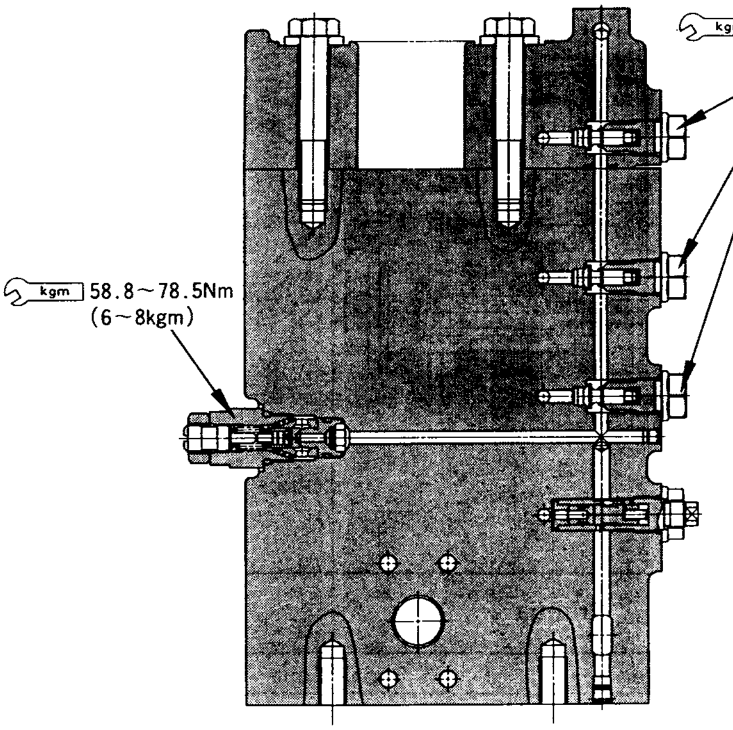
140F12256



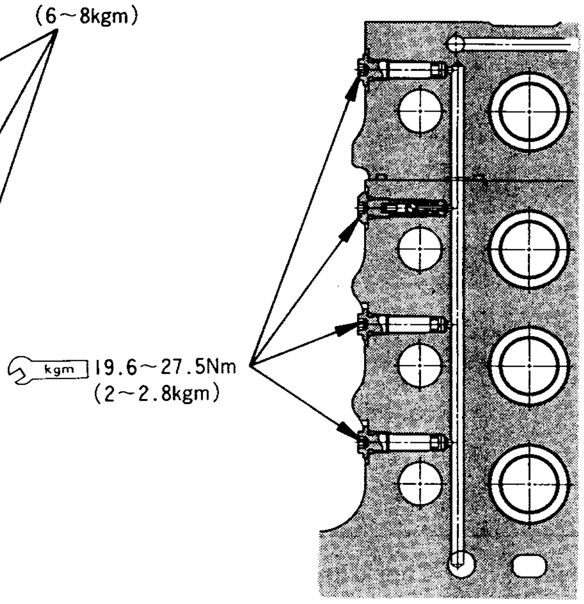
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x OD	Installation length	Installation load	Free length	Installation load	
1	Spool return spring	73.4 x 31	68.5	223.6 N (22.8 kg)	—	178.9 N (18.2 kg)	If there is any damage or deformation, replace spring
2	Spool return spring (lift valve only)	51.7 x 31.3	50	140.2 N (14.3 kg)	—	112.2 N (11.4 kg)	
3	Spool return spring (for lift FLOAT)	65.3 x 36.5	33.5	335.4 N (34.2 kg)	—	268.3 N (27.4 kg)	
4	Load check valve spring	20.8 x 10.2	13.5	12.7 N (1.3 kg)	—	10.2 N (1.0 kg)	
5	Pressure compensation valve spring	70 x 26.5	62.5	179 N (20.1 kg)	—	143.2 N (16.1 kg)	
6	Pressure compensation valve spring (lift valve)	72.4 x 28	65.5	277.3 N (28.3 kg)	—	221.8 N (22.6 kg)	
7	Pressure compensation valve spring (steering valve)	70 x 26.5	65.5	116.6 N (11.9 kg)	—	93.3 N (9.52 kg)	
8	Unload spring	94.8 x 30	67	258.9 N (26.4 kg)	—	207.1 N (21.1 kg)	
9	Back pressure valve spring	99.5 x 14.9	96	71.6 N (7.3 kg)	—	57.3 N (5.8 kg)	
10	Suction safety valve spring	16 x 16	12	5.69 N (0.68 kg)	—	4.55 N (0.54 kg)	
11	Suction safety valve spring	20 x 7	14	0.89 N (0.09 kg)	—	0.71 N (0.073 kg)	

• 3 + 1 SPOOL VALVE (3/3)

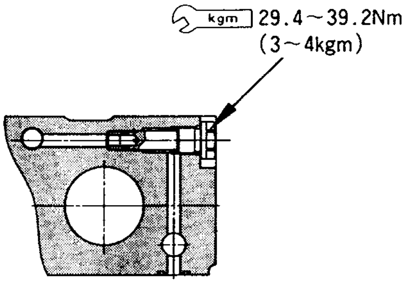


J - J

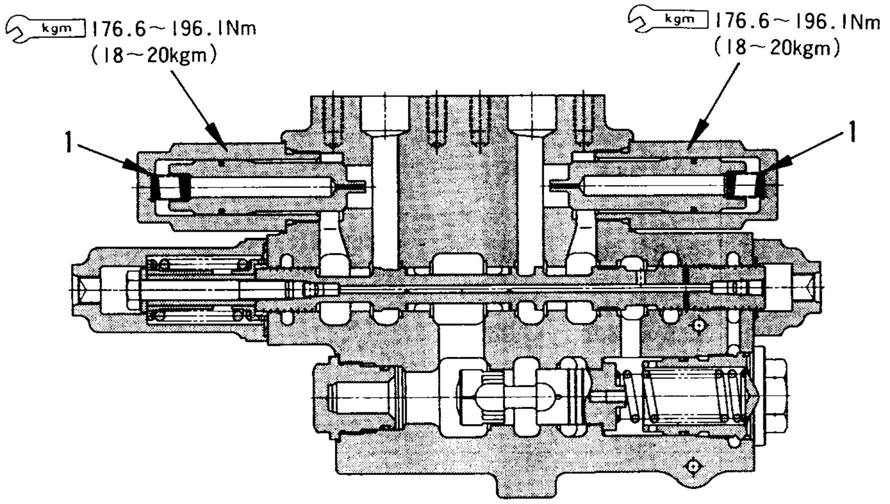


H - H

014012



K - K



F - F

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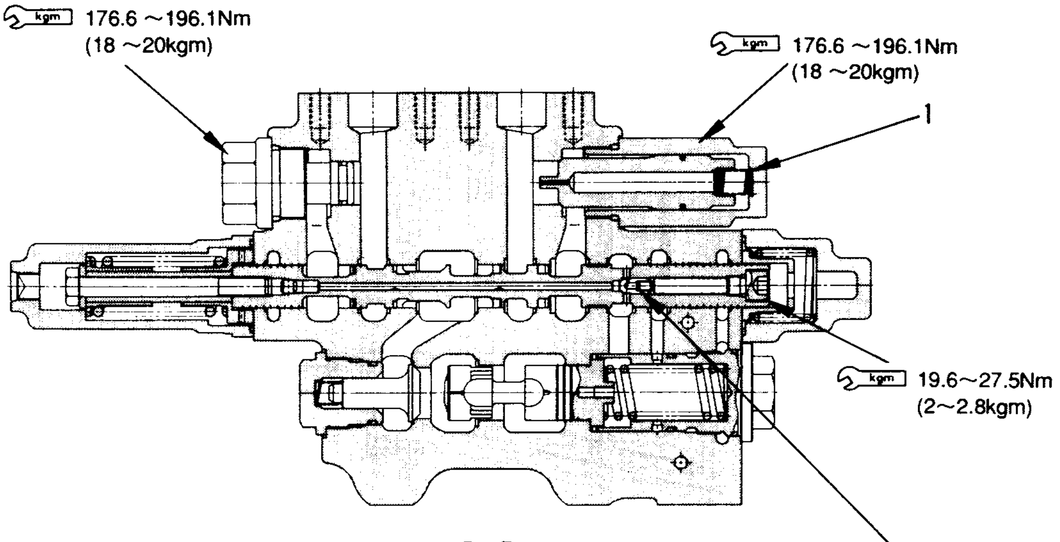
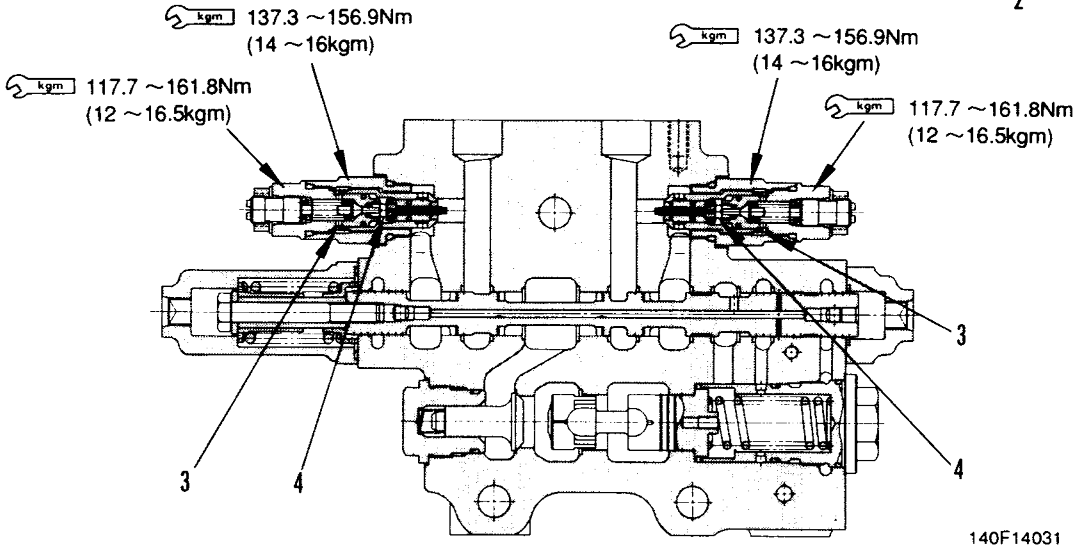


D - D



C - C

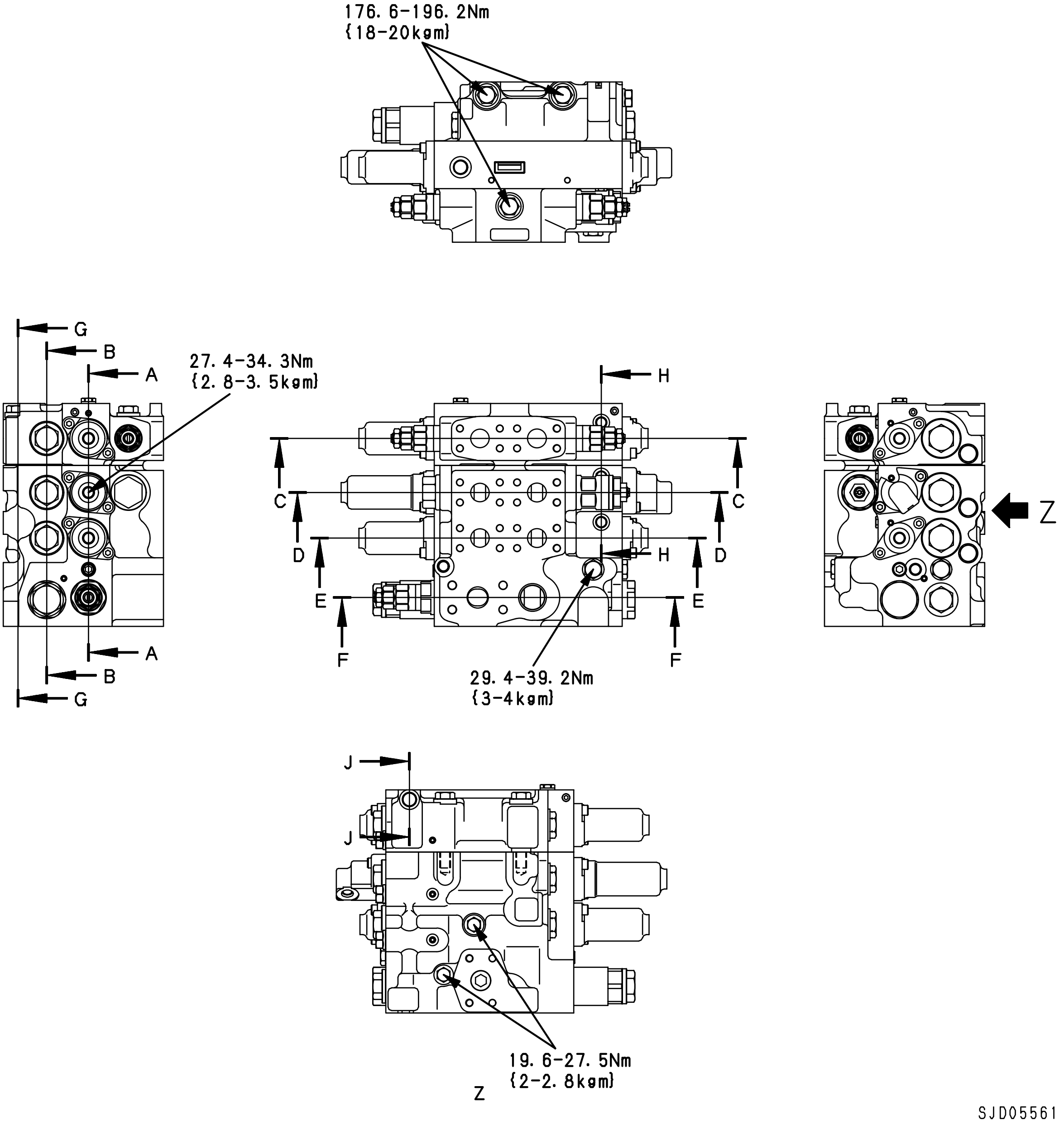
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x OD	Installation length	Installation load	Free length	Installation load	
1	Suction valve spring	27.9 x 31	18.8	6.3 N (0.64 kg)	—	5.0 N (0.51 kg)	If there is any damage or deformation, replace spring
2	Check valve spring inside spool	9.4 x 4.6	8.5	0.3 N (0.03 kg)	—	0.24 N (0.02 kg)	
3	Suction safety valve spring	16.3 x 21.3	9	2.16 N (0.22 kg)	—	1.73 N (0.18 kg)	
4	Suction safety valve spring	20 x 7	13.7	1.27 N (0.13 kg)	—	1.01 N (0.10 kg)	

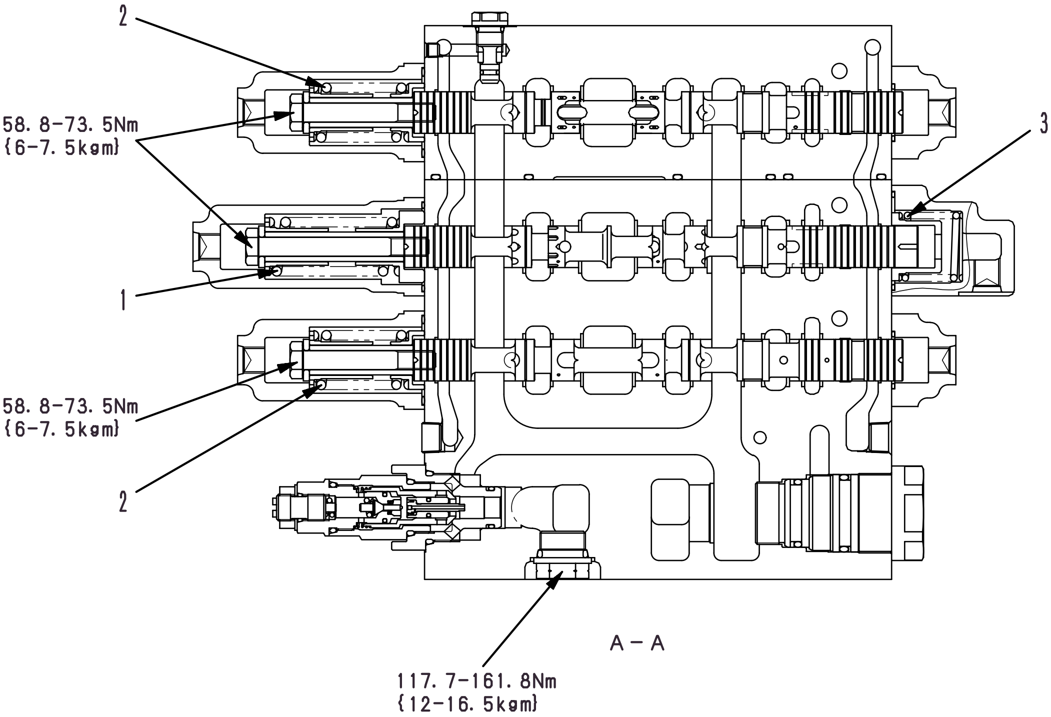
Serial No. 65001 and up

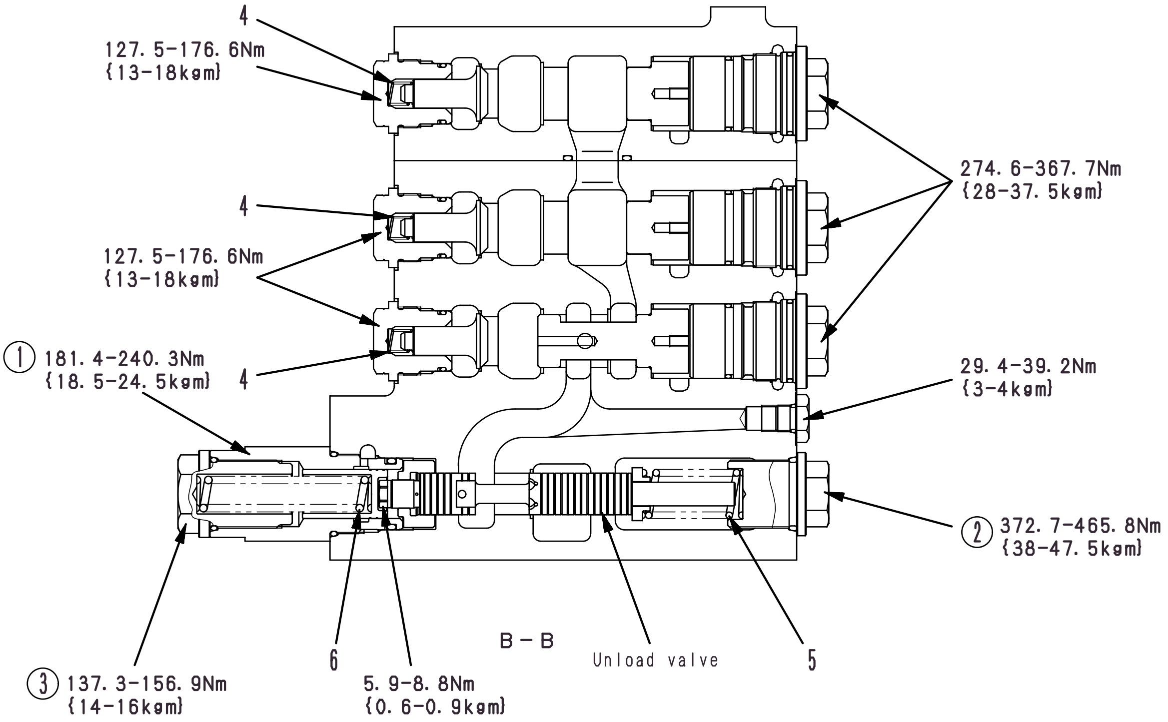
- **3 SPOOL VALVE, FOR D65E-12 (1/4)**

★ Precautions when tightening portions marked *.
To make sure that the three bolts are tightened uniformly, tighten in three stages as given below.
1st Step: 49 – 68.6 Nm (5 – 7 kg)
2nd Step: 127.5 – 147.1 Nm (13 – 15 kgm)
3rd Step: 176.5 – 196.1 Nm (18 – 20 kgm)



(2/4)

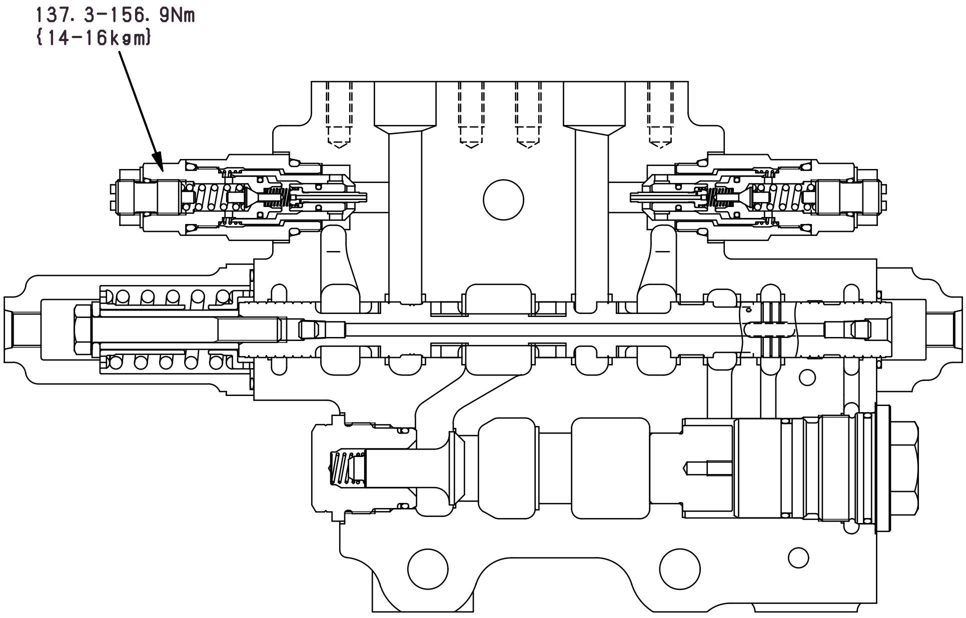




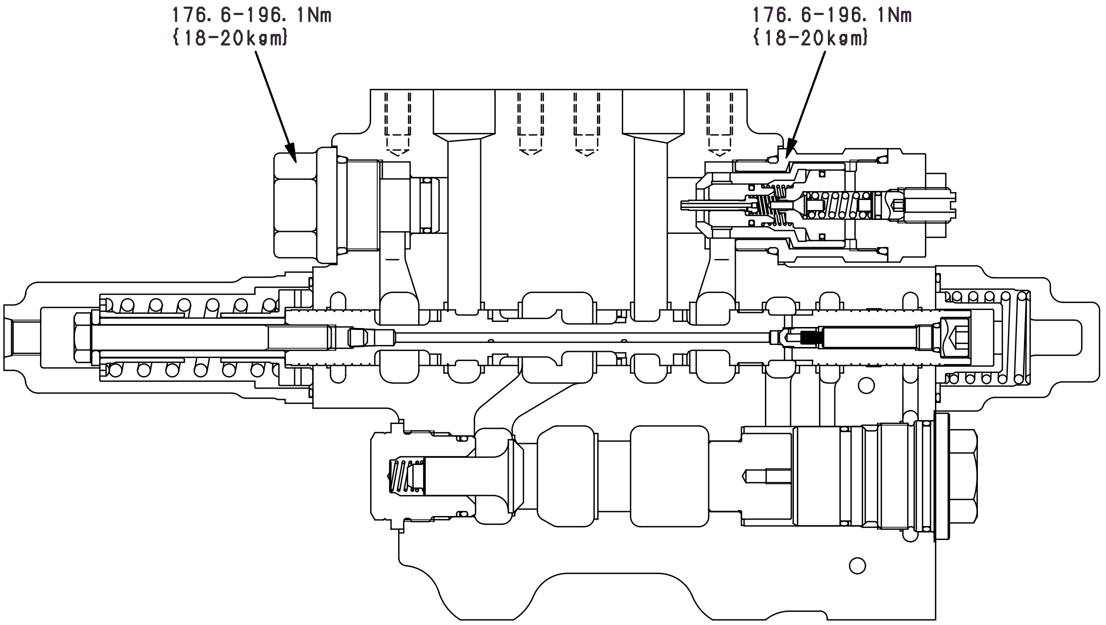
SJD05562

★ Precautions when assembling
When assembling the unload valve, thghten the plugs in the following order: [1] → [2] → [3]

(3/4)



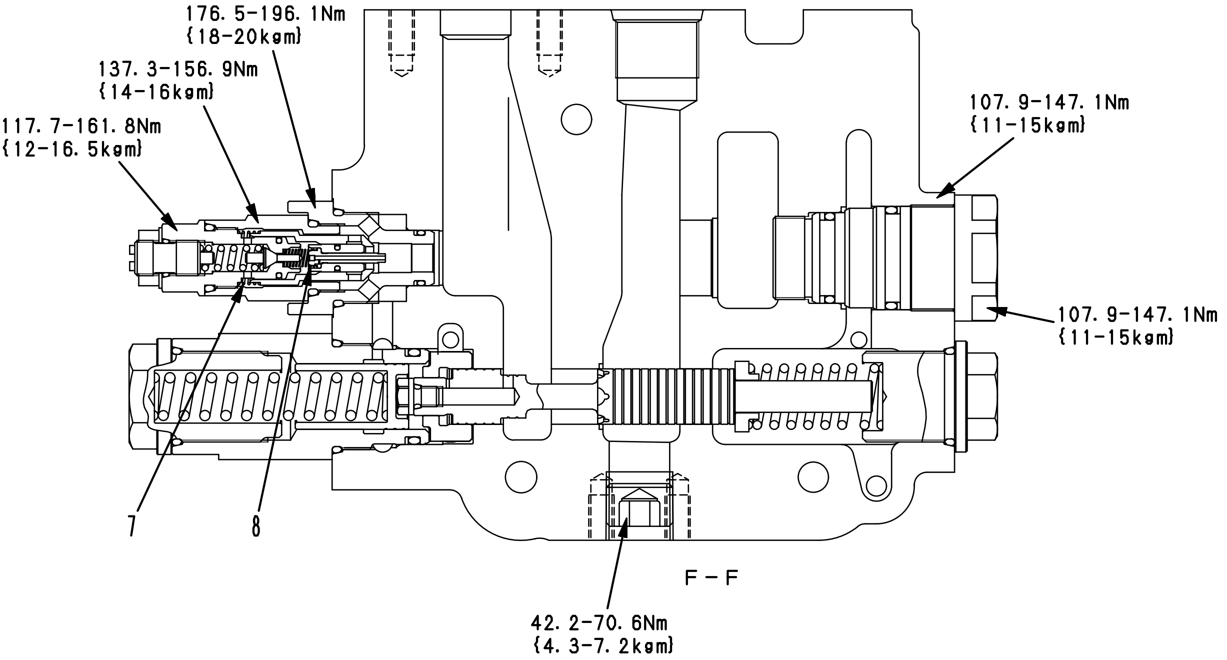
C – C



D – D

SJD05563

(4/4)

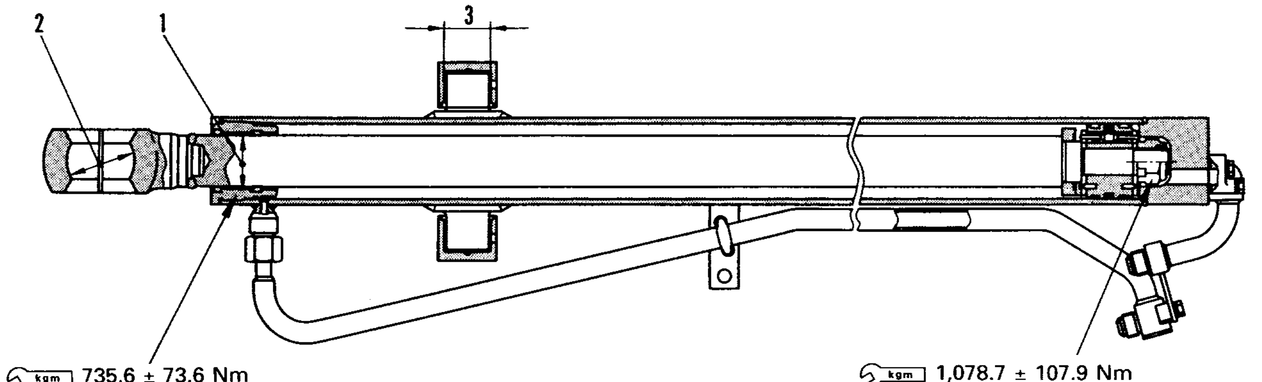


Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length × OD	Installation length	Installation load	Free length	Installation load	
1	Spool return spring	73.4 × 31	68.5	22.8 kg	—	18.2 kg	If there is any damage or deformation, replace spring
2	Spool return spring (lift valve only)	51.7 × 31.3	50	14.3 kg	—	11.4 kg	
3	Spool return spring (for lift FLOAT)	65.3 × 36.5	33.5	34.2 kg	—	27.4 kg	
4	Load check valve spring	20.8 × 10.2	13.5	1.3 kg	—	1.0 kg	
5	Unload spring	87.2 × 26	53.1	45.1 kg	—	36.1 kg	
6	Cancel spring	118.4 × 19.5	92.5	45.2 kg	—	36.2 kg	
7	Suction safety valve spring	16.3 × 21.3	9	0.22 kg	—	0.10 kg	
8	Suction safety valve spring	20 × 7	13.7	0.13 kg	—	1.94 kg	

WORK EQUIPMENT CYLINDER

• BLADE LIFT CYLINDER

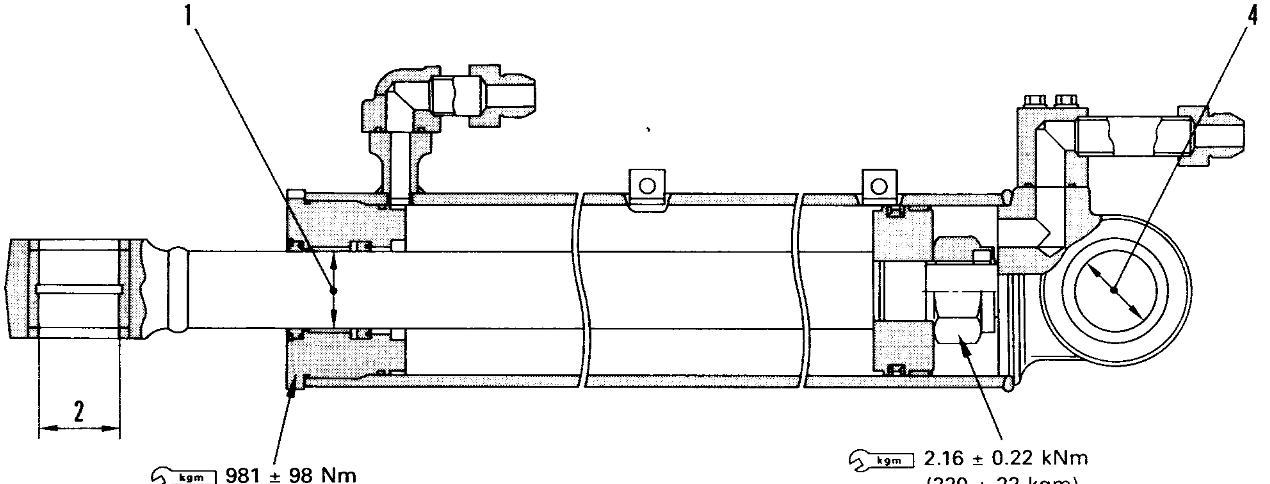


735.6 ± 73.6 Nm
(75 ± 7.5 kgm)

1,078.7 ± 107.9 Nm
(110 ± 11 kgm)
(Width across flats: 50 mm)

140F12260

• TRIMMING CYLINDER



981 ± 98 Nm
(100 ± 10 kgm)

2.16 ± 0.22 kNm
(220 ± 22 kgm)
(Width across flats: 60 mm)

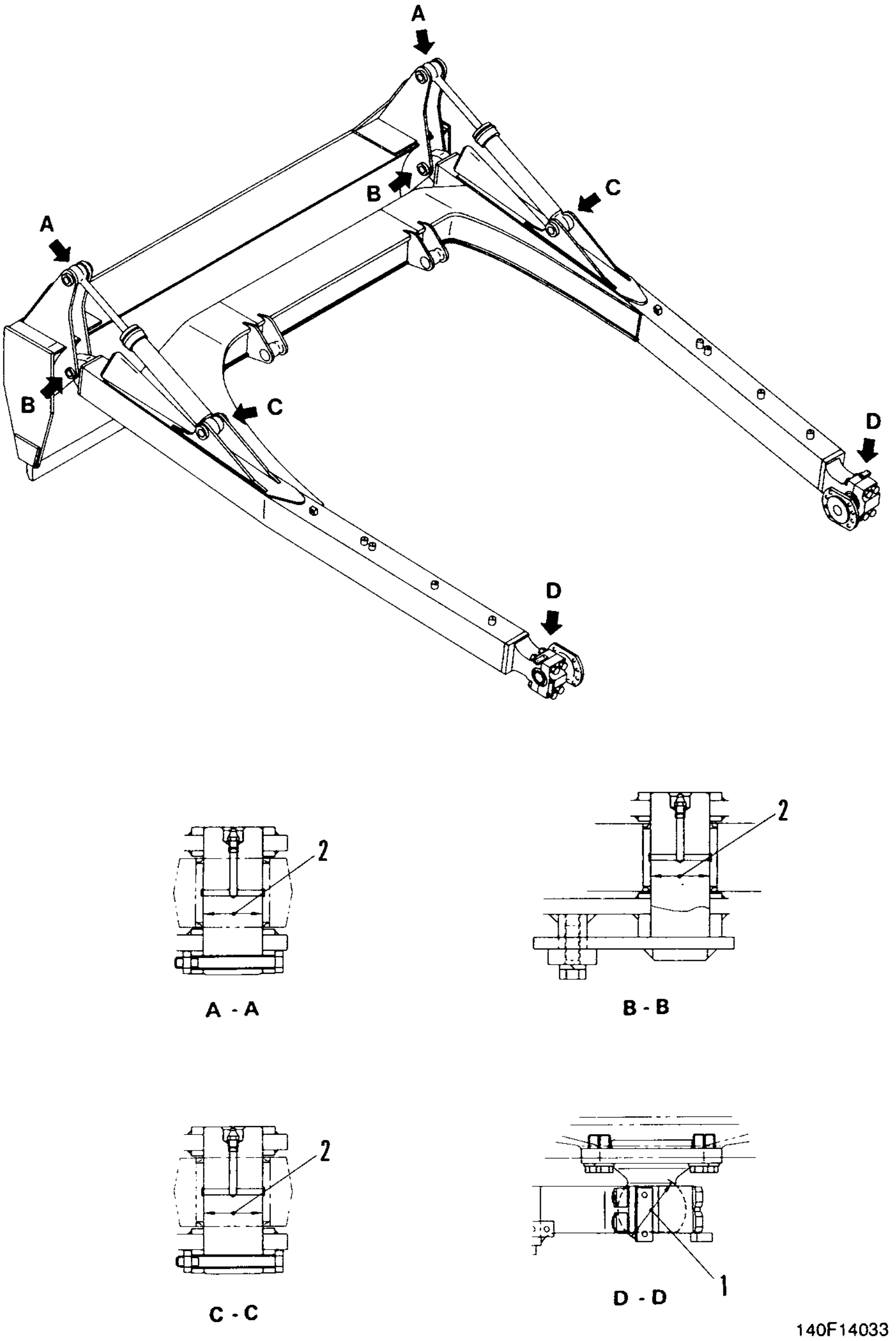
140F14032

014012

Unit: mm

No.	Check item		Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Lift	65	−0.030 −0.104	+0.262 +0.067	0.097 — 0.366	0.666	Replace bushing
		Trimming	55	−0.030 −0.104	+0.163 +0.006	0.036 — 0.267	0.567	
2	Clearance between piston rod bushing and pin	Lift	85	−0.2 −0.3	+0.3 0	0.2 — 0.6	1.0	Adjust shim or replace
		Trimming	60	−0.030 −0.076	+0.174 +0.100	0.130 — 0.250	1.0	
3	Clearance between cylinder support bushing and boss		55	−0.100 −0.174	+0.116 0	0.100 — 0.290	1.0	Replace bushing
4	Clearance between cylinder bottom support bearing and bushing		60	−0.030 −0.076	+0.174 +0.100	0.130 — 0.250	1.0	

TRIMMING DOZER



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Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between trunnion and spherical surface of cap	140	-0.1 -0.5	+0.15 0	0.1 — 0.65	1.0	Replace
2	Clearance between mounting pin and bushing	60	-0.030 -0.076	+0.174 +0.100	0.130 — 0.250	1.0	

D65EX,PX-12
(FOR KA SPEC.)

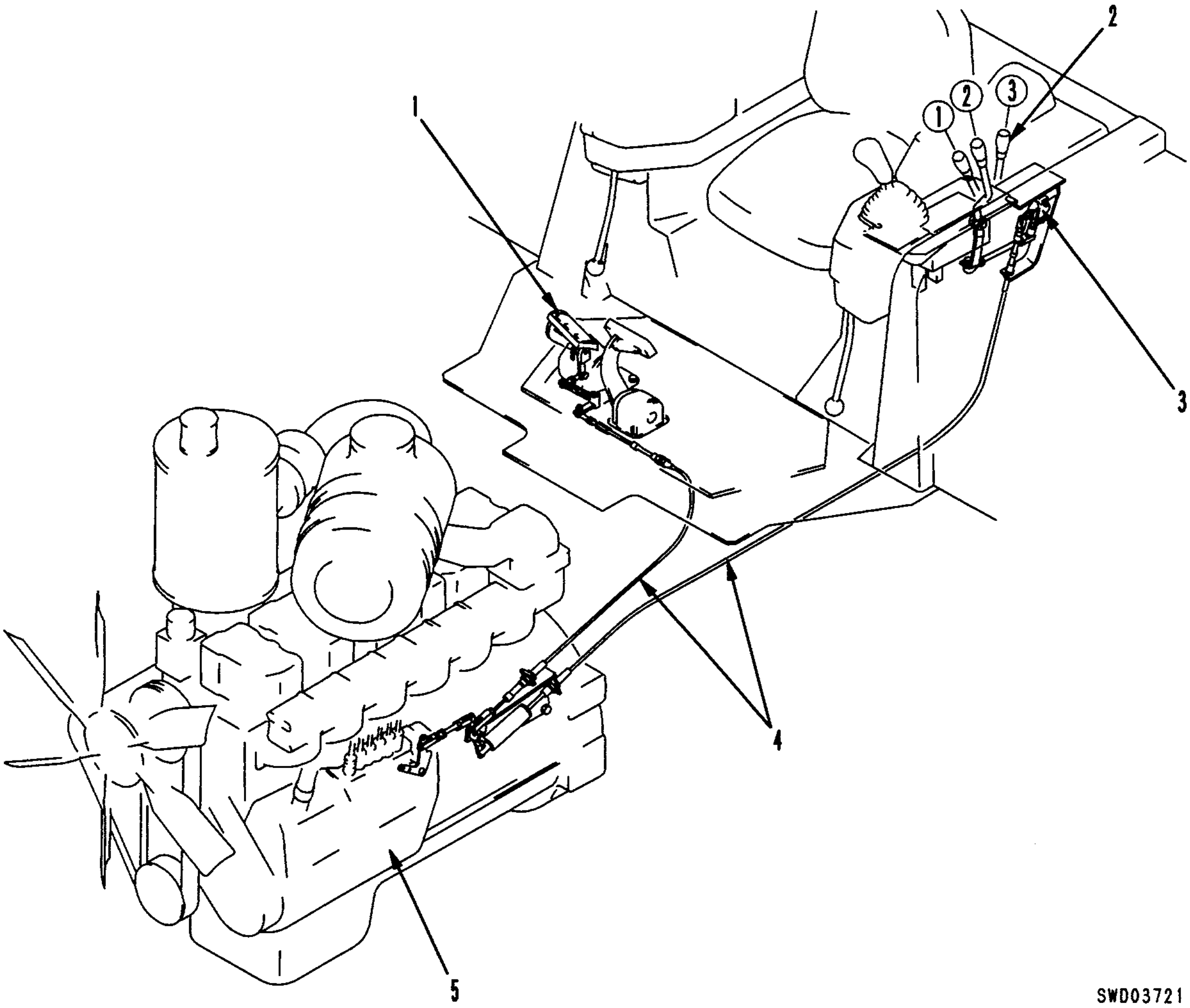
D65EX-12 Serial No. 63403 and up
D65PX-12 Serial No. 63304 and up

★ This section contains only information different from the standard D65EX-12 (Serial No. 60942 and up) and D65PX-12 (Serial No. 60915 and up).

STRUCTURE AND FUNCTION

ENGINE CONTROL

D65EX-12 63403 and up
D65PX-12 63304 and up



1. Decelerator pedal
2. Throttle lever
3. Clutch
4. Cable
5. Fuel injection pump

Lever positions

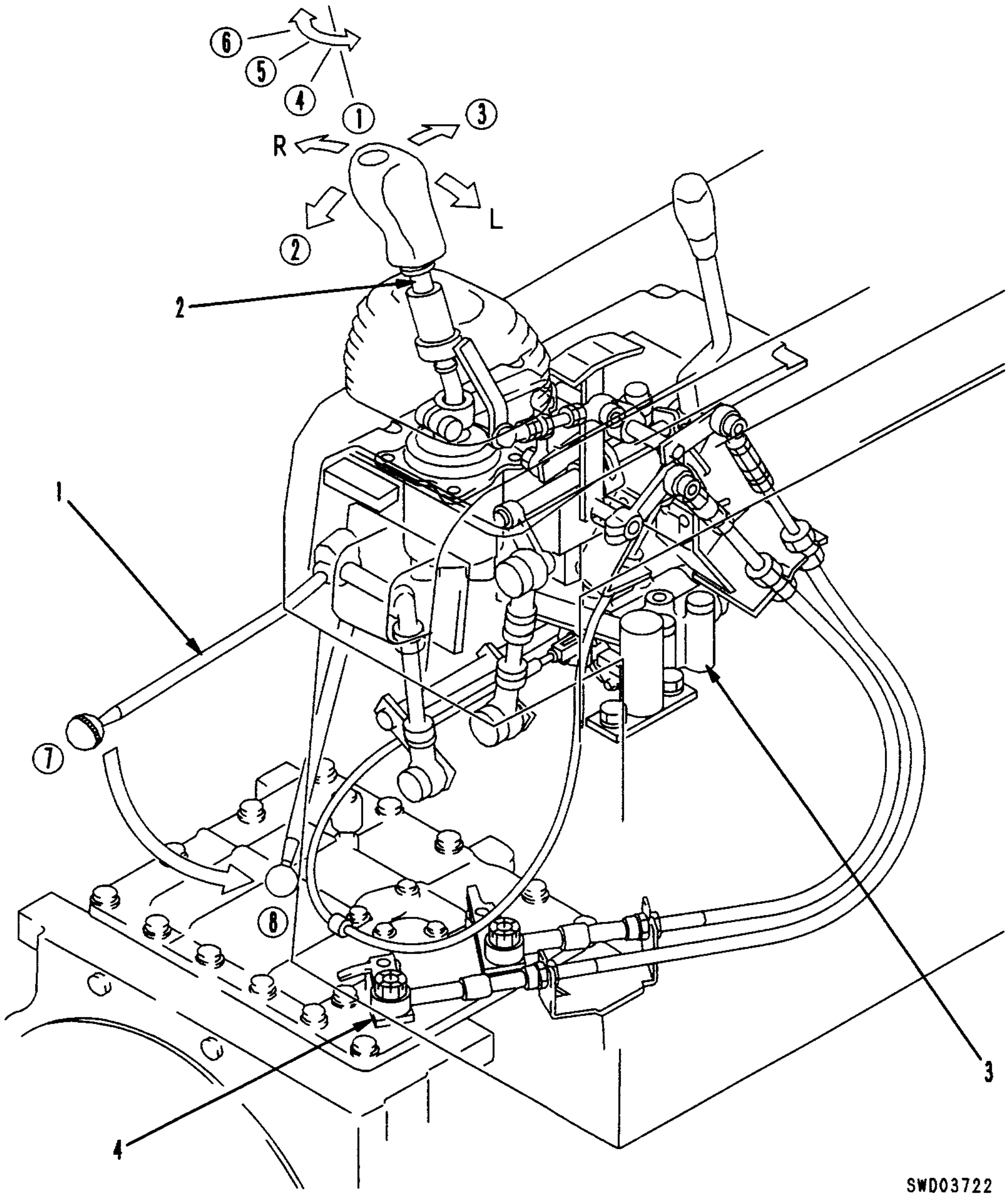
① STOP
② Low idling
③ High idling

OUTLINE

- The engine speed is controlled by throttle lever (2) or decelerator pedal (1)

TRANSMISSION CONTROL

D65EX-12 63403 and up
D65PX-12 63304 and up



Lever positions

① NEUTRAL
② FORWARD
③ REVERSE
④ 1st
⑤ 2nd
⑥ 3rd
⑧ FREE
⑧ LOCK

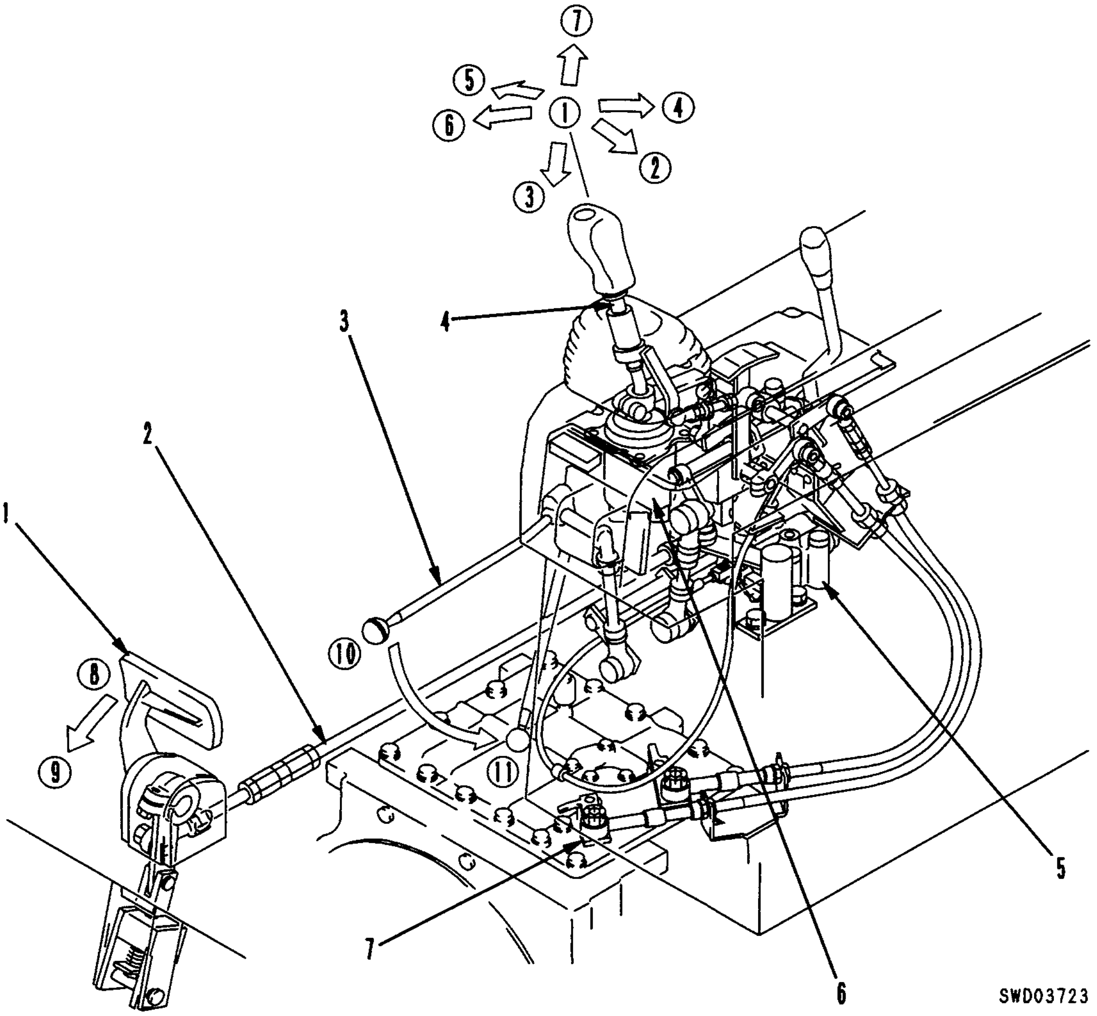
1. Safety lever
2. Joystick (directional change, gear shift)
3. Brake valve
4. Transmission control valve

OUTLINE

- The transmission controlled by joystick (2), which changes the direction ot travel, and selects the gear shift.

STEERING AND BRAKE CONTROL

D65EX-12 63403 and up
D65PX-12 63304 and up



Lever positions
① NEUTRAL
② Left counterrotation turn
③ Left FORWARD turn
④ Left REVERSE turn
⑤ Right counterrotation turn
⑥ Right FORWARD turn
⑦ Right REVERSE turn
⑧ Brake released
⑨ Brake applied
⑩ FREE
⑪ LOCK

1. Brake pedal
2. Rod
3. Safety lever
4. Joystick (steering)
5. Brake valve
6. Steering PPC valve
7. Transmission control valve

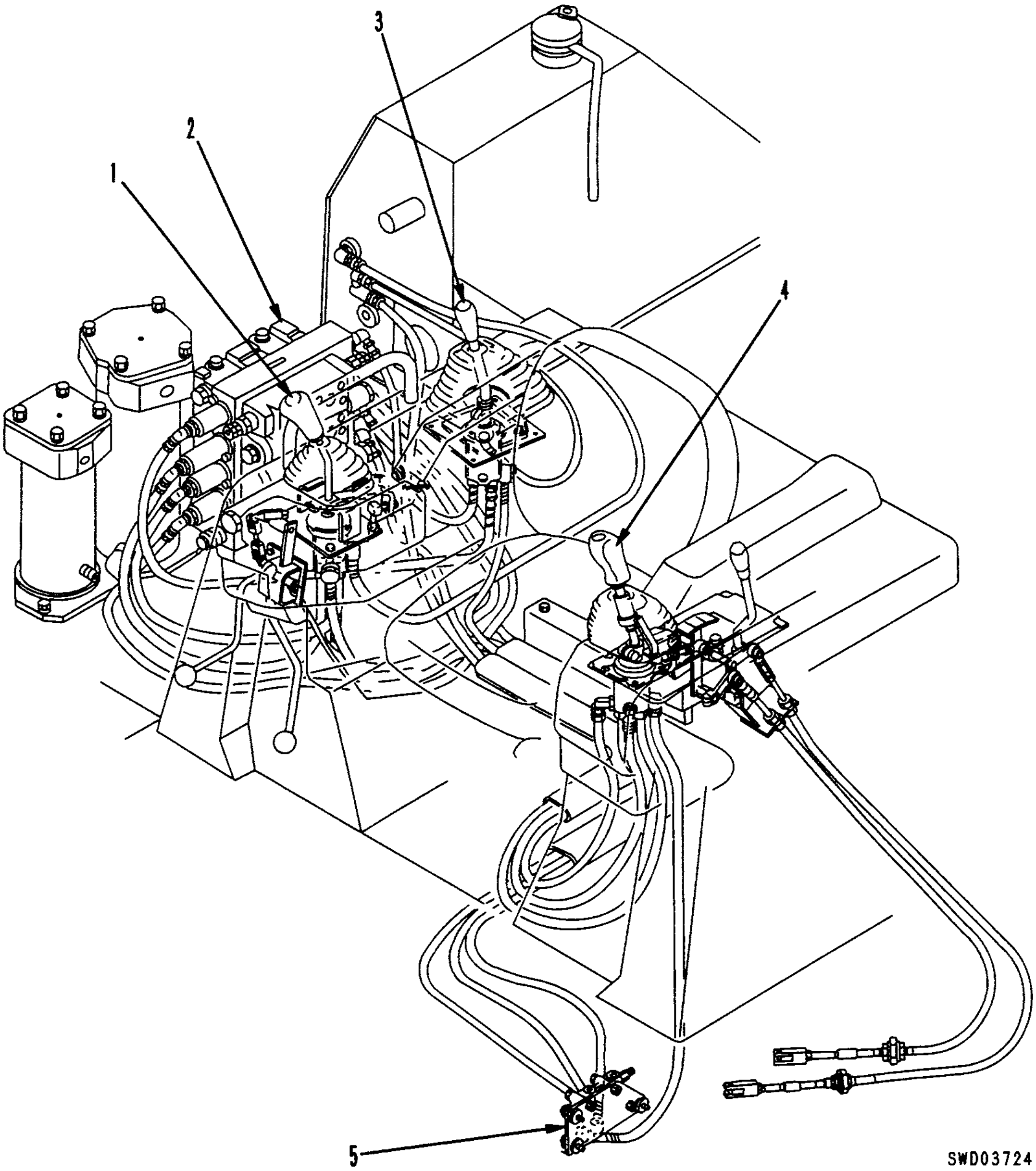
OUTLINE

- Steering and directional lever (4) moves the spool of the main control valve through PPC valve (6), and actuates the HSS motor to operate the steering.
- Brake pedal (1) actuates the spool of brake valve (5), and applies the left and right brakes at the same time.
- Safety lever (3) is interconnected with brake valve (5) and also acts as the parking brake.
- If joystick (4) is moved to the forward position and is then moved slightly to the left, the machine will turn gradually to the left. If the lever is moved fully to the left, the machine will turn sharply to the left.
- If joystick (4) is placed at the neutral position and is moved to the left, the machine will carry out a counter rotation turn to the left.

PPC CONTROL PIPING DIAGRAM

D65EX-12 63403 and up
D65PX-12 63304 and up

(Steering, blade, ripper control)



1. Blade control lever
2. Main control valve
3. Ripper control lever (D65EX-12 only)
4. Steering and directional lever
5. PPC charge valve

TESTING AND ADJUSTING

STANDARD VALUE TABLE FOR CHASSIS

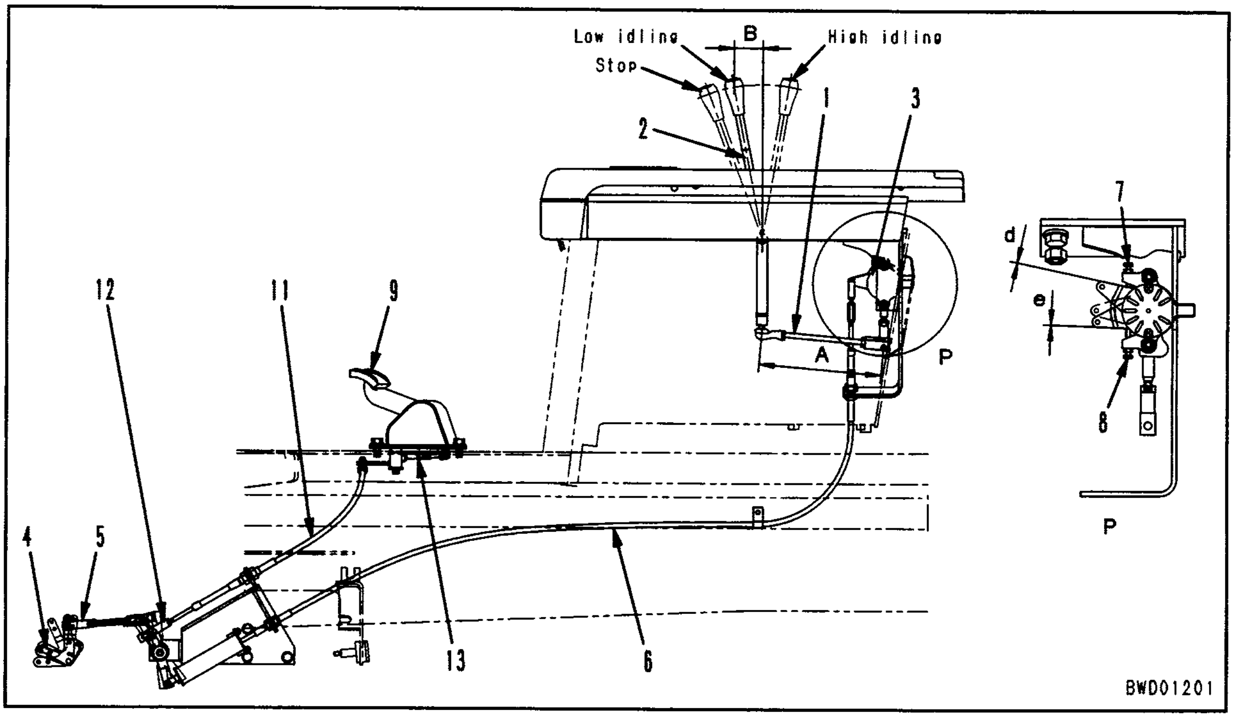
D65EX-12 63403 and up
D65PX-12 63304 and up

Classification	Check Item	Measuerment conditions		Unit	D65EX-12	
					Standard Value	Permissible Value
Engine stall	Torque converter stall speed	• Engine oil pressure: within operating range • Engine oil temperature: within operating range • Power train oil temperature: 70 - 80°C • Hydraulic oil temperature: 45 - 55°C • No. of speed range: F3		rpm	1,770 ± 100	1,650
Travel of control levers, pedals	Fuel control lever	Center of lever knob	Engine: Low idling → full throttle	mm	102 ± 20	102^{+40}_{-20}
			Engine: low idling → stop		48 ± 20	48^{+40}_{-20}
	Decelerator pedal	Center of pedal			57 ± 10	57 ± 10
	Gear shift lever	• Engine stopped • Center of lever knob	Between each speed range	degree	15 ± 3	15 ± 3
	Steering F-R lever	• Engine stopped • Center of lever knob	N → F	mm	52 ± 10	52 ± 10
			N → R		48 ± 10	48 ± 10
		• Engine low idling • Center of lever knob	Full stroke LEFT turn		90 ± 15	90 ± 15
			Full stroke RIGHT turn		90 ± 15	90 ± 15
			Until steering clutch is fully disengaged		—	—
	Brake pedal	• Engine low idling • Center of pedal	Full stroke		79 ± 12	79 ± 12
	Blade control lever	• Engine low idling • Center of lever knob • Hydraulic oil temperature: 45 - 55 °C	HOLD → RAISE		81 ± 12	81 ± 12
			HOLD → LOWER		58 ± 9	58 ± 9
			HOLD → LEFT TILT HOLD → RIGHT TILT		62 ± 10	62 ± 10
	Ripper control lever	• Engine low idling • Center of lever knob • Hydraulic oil temperature: 45 - 55 °C	HOLD → RAISE		77 ± 12	77 ± 12
			HOLD → LOWER		65 ± 10	65 ± 10
Operating force of control levers, pedals	Fuel control lever	• Center of lever knob	Engine: Low idling → full throttle	N (kg)	71.6 ± 29.4 (7.3 ± 3.0)	117.7 (12.0)
			Engine: full throttle → low idling		20.6 ± 9.8 (2.1 ± 1.0)	39.2 (4.0)
			Engine: Low idling → stop		68.7 ± 19.6 (7.0 ± 2.0)	117.7 (12.0)
	Decelerator pedal	• Engine speed: low iding (825 ± 25 rpm) • Center of pedal			98.1 ± 29.4 (10 ± 3)	147.1 (15)
	Gear shift lever	• Engine stopped • Center of lever knob	1st → 2nd		2.5 ± 0.6 (0.24 ± 0.06)	4.9 (0.5)
			2nd → 1st		2.7 ± 0.6 (0.28 ± 0.06)	4.9 (0.5)
			2nd → 3rd		3.9 ± 0.1 (0.40 ± 0.01)	5.9 (0.6)
			3rd → 2nd		1.6 ± 0.4 (0.16 ± 0.04)	2.9 (0.3)

D65PX-12							
Standard Value	Permissible Value	Standard Value	Permissible Value	Standard Value	Permissible Value	Standard Value	Permissible Value
1,770 ± 100	1,650						
102 ± 20	102^{+40}_{-20}						
48 ± 20	48^{+40}_{-20}						
57 ± 10	57 ± 10						
15 ± 3	15 ± 3						
52 ± 10	52 ± 10						
48 ± 10	48 ± 10						
90 ± 15	90 ± 15						
90 ± 15	90 ± 15						
—	—						
79 ± 12	79 ± 12						
81 ± 12	81 ± 12						
58 ± 9	58 ± 9						
62 ± 10	62 ± 10						
—	—						
—	—						
71.6 ± 29.4 (7.3 ± 3.0)	117.7 (12.0)						
20.6 ± 9.8 (2.1 ± 1.0)	39.2 (4.0)						
68.7 ± 19.6 (7.0 ± 2.0)	117.7 (12.0)						
98.1 ± 29.4 (10 ± 3)	147.1 (15)						
2.5 ± 0.6 (0.24 ± 0.06)	4.9 (0.5)						
2.7 ± 0.6 (0.28 ± 0.06)	4.9 (0.5)						
3.9 ± 0.1 (0.40 ± 0.01)	5.9 (0.6)						
1.6 ± 0.4 (0.16 ± 0.04)	2.9 (0.3)						

ADJUSTING FUEL CONTROL LINKAGE

D65EX-12 63403 and up
D65PX-12 63304 and up



1. Adjust mounting dimension A of rod (1) so that throttle lever (2) will be at IDLING position when lever assembly (3) is set to the low idling detent position.

    ★ Dimension A of rod (1): 263 mm

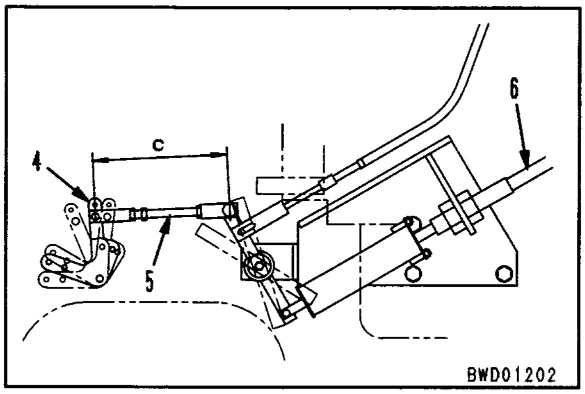
    ★ Dimension B of throttle lever (2): 84 mm

2. Set governor lever (4) of the fuel injection pump to the LOW IDLING position, align lever assembly (3) with the low idling detent position, then adjust rod (5) and connect cable (6).

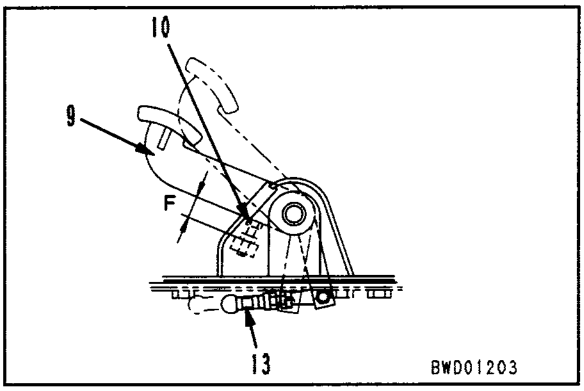
    ★ Dimension C of rod (5): 178 mm

3. Place governor lever (4) of the fuel injection pump at the HIGH IDLING position, set clearance d between the lever of the lever assembly (3) and stopper bolt (7) to 0, then turn stopper bolt (7) back two turns from this position and secure stopper bolt (7) in position.

4. Place governor lever (4) of the fuel injection pump at the STOP position, set clearance e between the lever of lever assembly (3) and stopper bolt (8) to 0, then secure stopper bolt (8) in position.



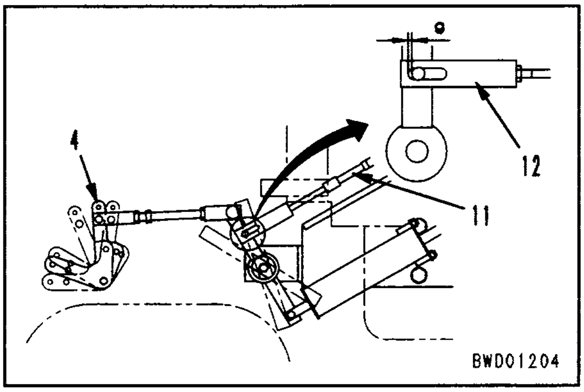
5. Adjust the height of stopper bolt (10) of decelerator pedal (9) to dimension F.
   ★ Stopper bolt height dimension F: 21 mm
6. Set governor lever (4) of the fuel injection pump to the LOW IDLING position, depress decelerator pedal (9) until it contacts stopper bolt (10), then connect cable (11), yoke (12), and rod (13).
   ★ Standard installed length of rod (13):
   88.1 mm



7. In the condition in Step 5, adjust with cable (11) and yoke (12) so that clearance g at the oblong hole of yoke (12) is 0.

   ★ When doing this, check that governor lever (4) of the fuel injection pump does not move from the low idling position.

8. Start the engine, move throttle lever (2) to the HIGH IDLING position, then depress decelerator pedal (9) until it contacts stopper bolt (10) and adjust the height of stopper bolt (10) so that engine speed is 900 rpm.

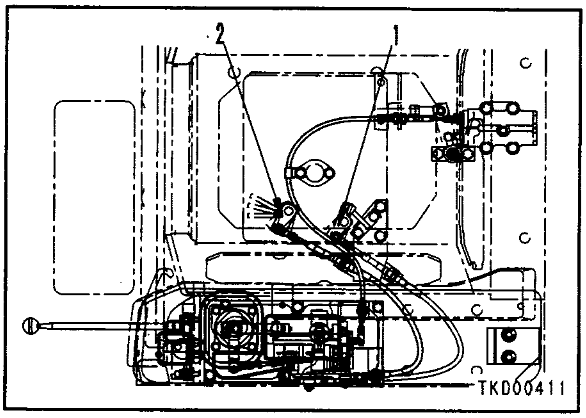


ADJUSTING LINKAGES OF FORWARD-REVERSE LEVER, GEAR SHIFT LEVER, AND PARKING BRAKE LEVER

D65EX-12 63403 and up
D65PX-12 63304 and up

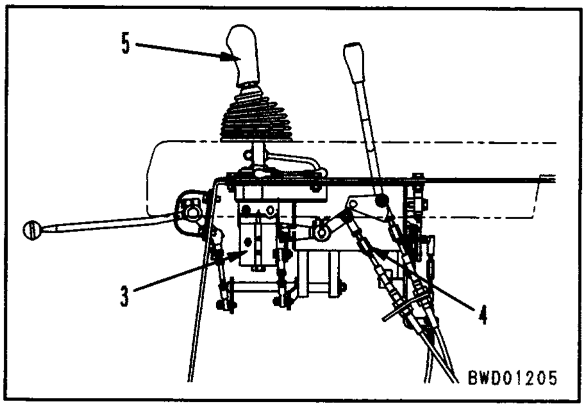
★ Tighten the locknut of the cable and rod securely, then bend the cotter pin securely.

★ Speed range selector lever (1) and directional selector lever (2) are installed to the transmission control valve, and the speed position and directional position are set by the detent inside the valve.



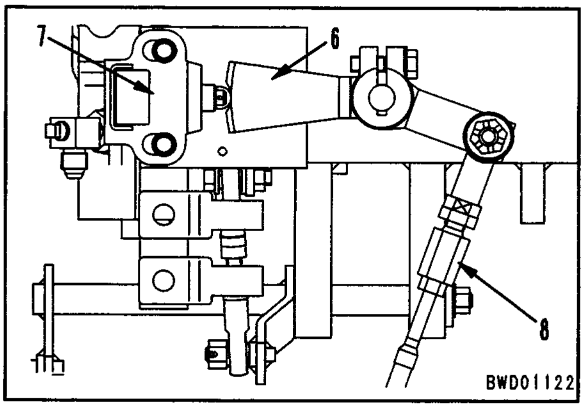
1. Adjusting directional linkage

1) Connect the directional lever linkages.
2) Set directional selector lever (2) at the N position, and turn turnbuckle (4) to adjust so that the lever of PPC valve (3) moves to the neutral position.
3) In the above condition, turn turnbuckle (4) one turn in the direction to shorten the distance.
   ★ The directional lever moves towards the front.
4) After adjusting, set directional lever (5) within the range of play of the N position and hold it fully at the R side to carry out a counterrotation turn. Check that the direction of the turn is the same as when travelling forward.

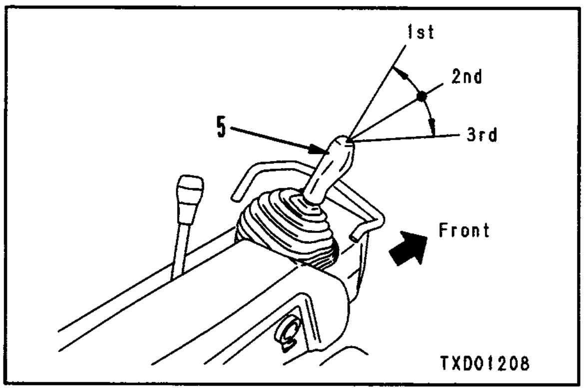


2. Adjusting gear shift lever linkage

1) Connect the all gear shift lever linkage and adjust turnbuckle (8) and limit switch (7) so that the cam of lever (6) will be aligned with the roller of the limit switch (7) when the gear shift lever is at the "2nd" position.



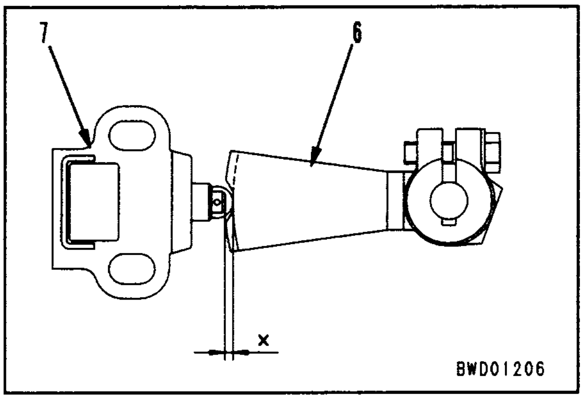
2) Under the condition of 1) above, install knob (5) with its mark "2" on the front side.



3. Adjusting limit switch

Adjust limit switch (7) so that it will move by X mm when lever (6) is set to its actuating position.

- Stroke X: 2.8 mm

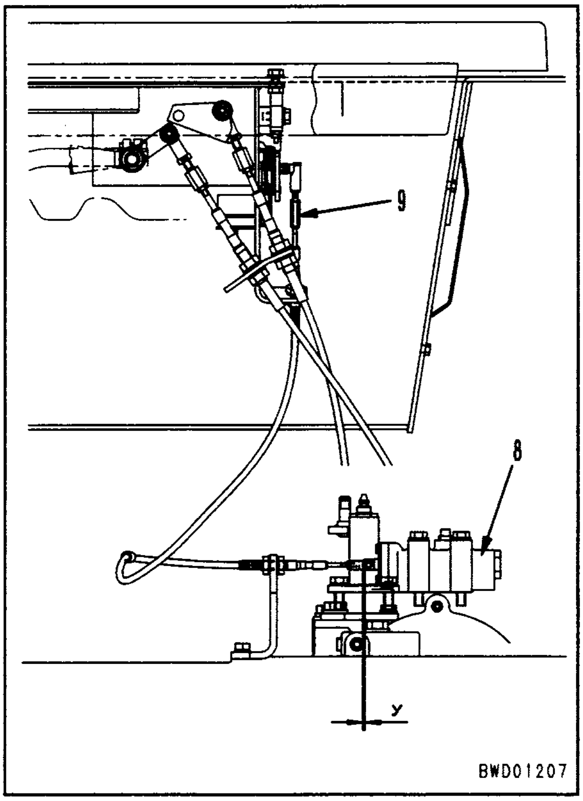


4. Adjust parking brake lever

Turn rod (9) so that the spool of brake valve (8) will move by y mm when parking brake lever is set to the "LOCK" position.

- Stroke y: 13 mm

★ After adjusting, check that steering and forward/reverse lever (5) can be set to the F or R position securely when: the parking brake lever is at the "FREE" position, and the former lever returns to the "N" position from the F or R position when the latter lever is set to the "LOCK" position.



TROUBLESHOOTING
CONNECTOR TYPES AND MOUNTING LOCATIONS

D65EX-12 63403 and up
D65PX-12 63304 and up

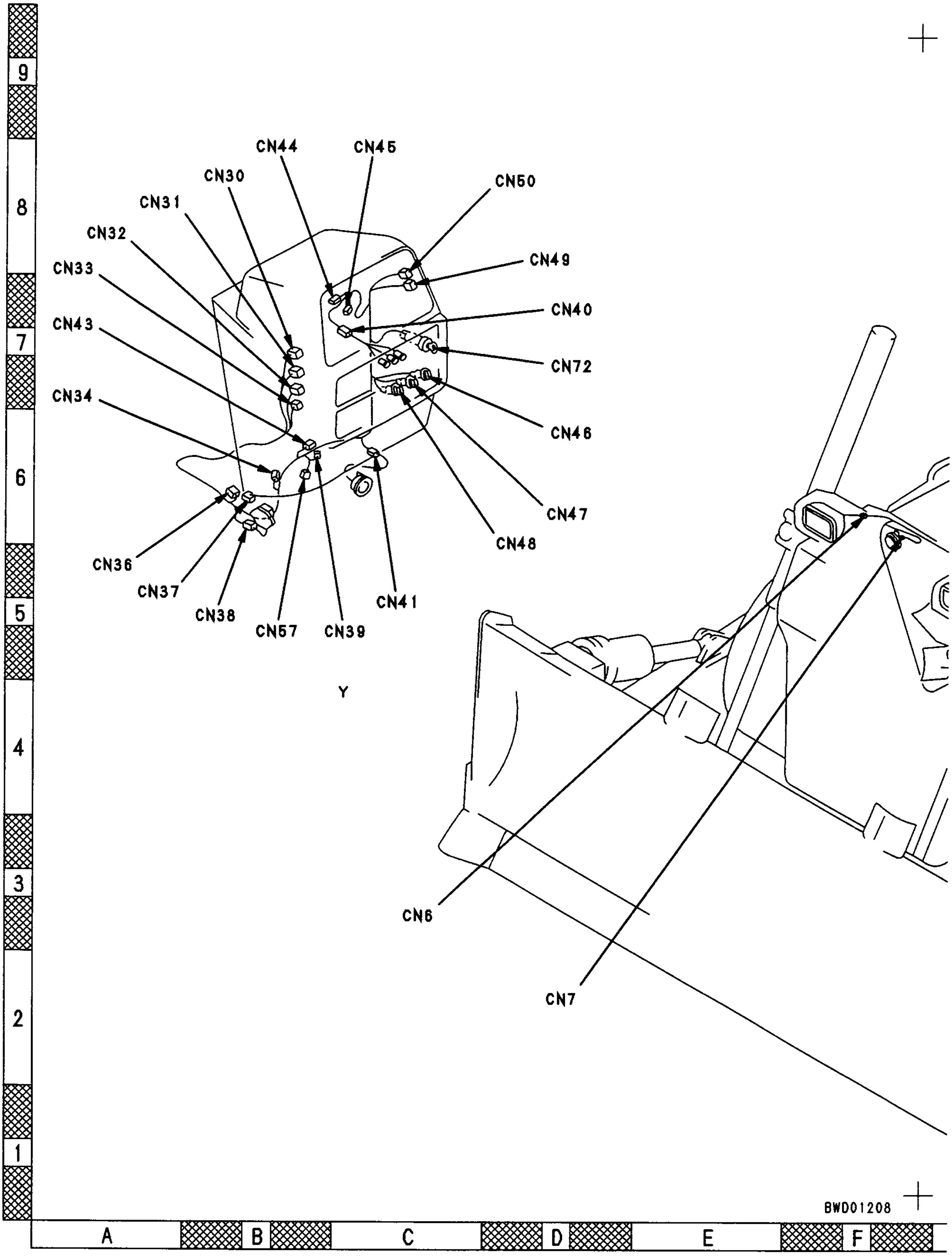
★ The ADDRESS column in this table shows the address in the connector position drawing (3-dimensional drawing).

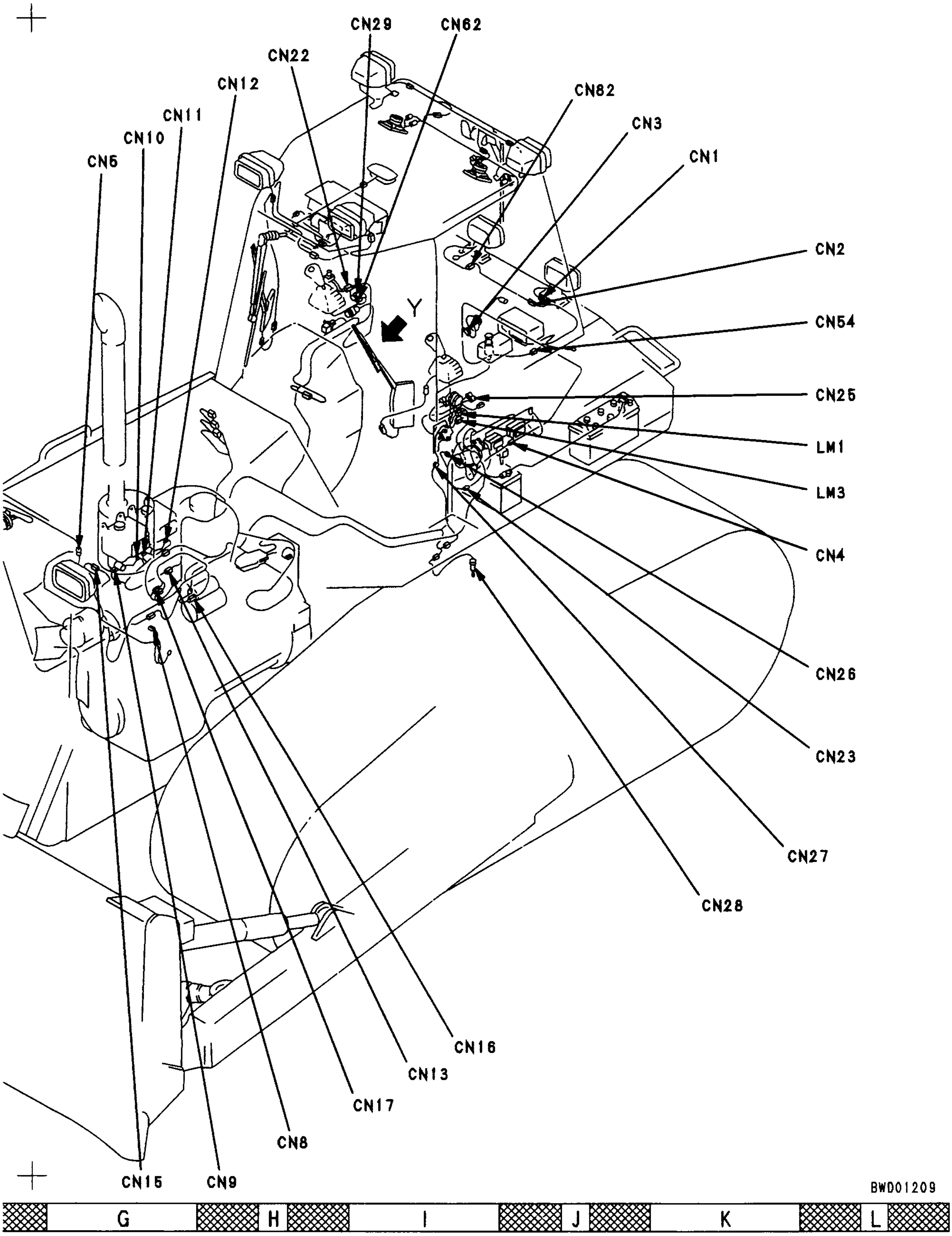
Connec-tor No.	Connec-tor type	No. of pins	Place of use	ADDRESS
CN1	M	1	Rear lamp	K-8
CN2	M	1	Rear lamp (additional)	L-8
CN3	X	2	Fuel lever sensor	K-9
CN4	X	4	Intermediate connector	L-5
CN5	M	1	Head lamp (left)	K-8
CN6	M	1	Head lamp (right)	C-3
CN7	KES	1	Horn	D-2
CN8	X	2	Intermediate connector	H-1
CN9	KES	2	Front washer tank (with cab)	H-1
CN10	KES	2	Front washer tank (with cab)	G-8
CN11	KES	2	Rear washer tank (with cab)	G-9
CN12	KES	2	Rear washer tank (with cab)	H-9
CN13	SWP	6	Intermediate connector (with cab)	I-1
CN14	X	1	Air conditioner magnet clutch (with cab)	—
CN15	X	2	Coolant temperature sensor	G-1
CN16	X	2	Starting motor	I-2
CN17	SWP	14	Intermediate connector	I-1
CN22	X	2	Horn switch	H-9
CN23	X	3	Neutral safety switch	L-4
CN24	X	1	Intermediate connector	—
CN25		1	Cab receptacle (to radio) with cab	L-7
CN26	KES	4	Cab washer switch (with cab)	L-4
CN27	X	3	Back up alarm limit switch	L-3
CN28	X	2	Power train oil temperature	K-3
CN29		1	Pitch operation switch	I-9
CN30	X	3	Intermediate connector	B-8
CN31	SWP	16	Intermediate connector	A-8
CN32	SWP	16	Intermediate connector	A-8
CN33	X	4	Intermediate connector	A-8
CN34	—	—	★Diode	A-7
CN36	KES	4	Magnet relay (with cab)	A-5
CN37	KES	4	Air conditioner relay (with cab)	A-5
CN38	KES	3	Bimetal timer	B-5
CN39	KES	3	Blower resistor with cab	C-5
CN40	SWP	6	Speed indicator lamp	D-7
CN41	M	2	Buzzer	C-5
CN43	KES	4	Thermostat, deal pressure switch (with cab)	A-7
CN44	KES	4	Blower switch (with cab)	B-8
CN45	KES	3	Air conditioner switch (with cab)	C-8
CN46	KES	4	Glow switch	D-6
CN47	KES	4	Lighting switch (Rear lamp	D-6
CN48	KES	4	Lighting switch (Head lamp)	D-6
CN49	AMP040	15	Monitor panel	D-8
CN50	AMP040	12	Monitor panel	D-8
CN52	X	1	Pitch operation solenoid valve	—
CN53	X	1	Pitch operation solenoid valve	—
CN54		1	Back up alarm	L-7
CN57	KES	2	Blower motor (with cab)	B-5
CN62		1	Pitch operation switch	I-9
CN72	SWP	6	Starting switch without cab	D-7
CN81	X	1	Pump motor	—
CN82	KES	1	Rear lamp (additional)	J-9
LM1	X	3	1st speed detection limit switch	L-6
LM3	X	3	2nd speed detection limit switch	L-6

★ This table includes connectors that are not shown in the drawings.

CONNECTOR POSITION DRAWING

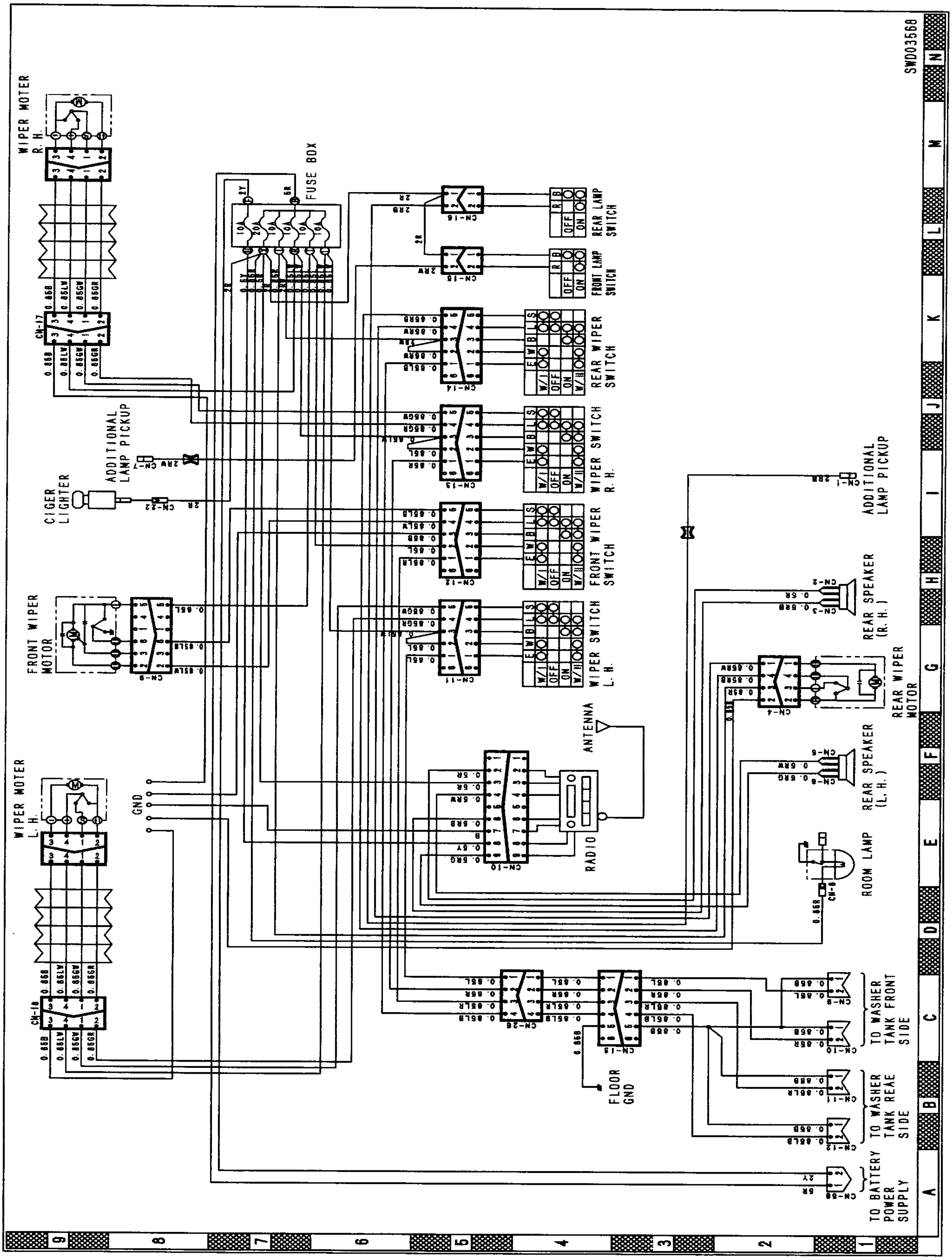
D65EX-12 63403 and up
D65PX-12 63304 and up



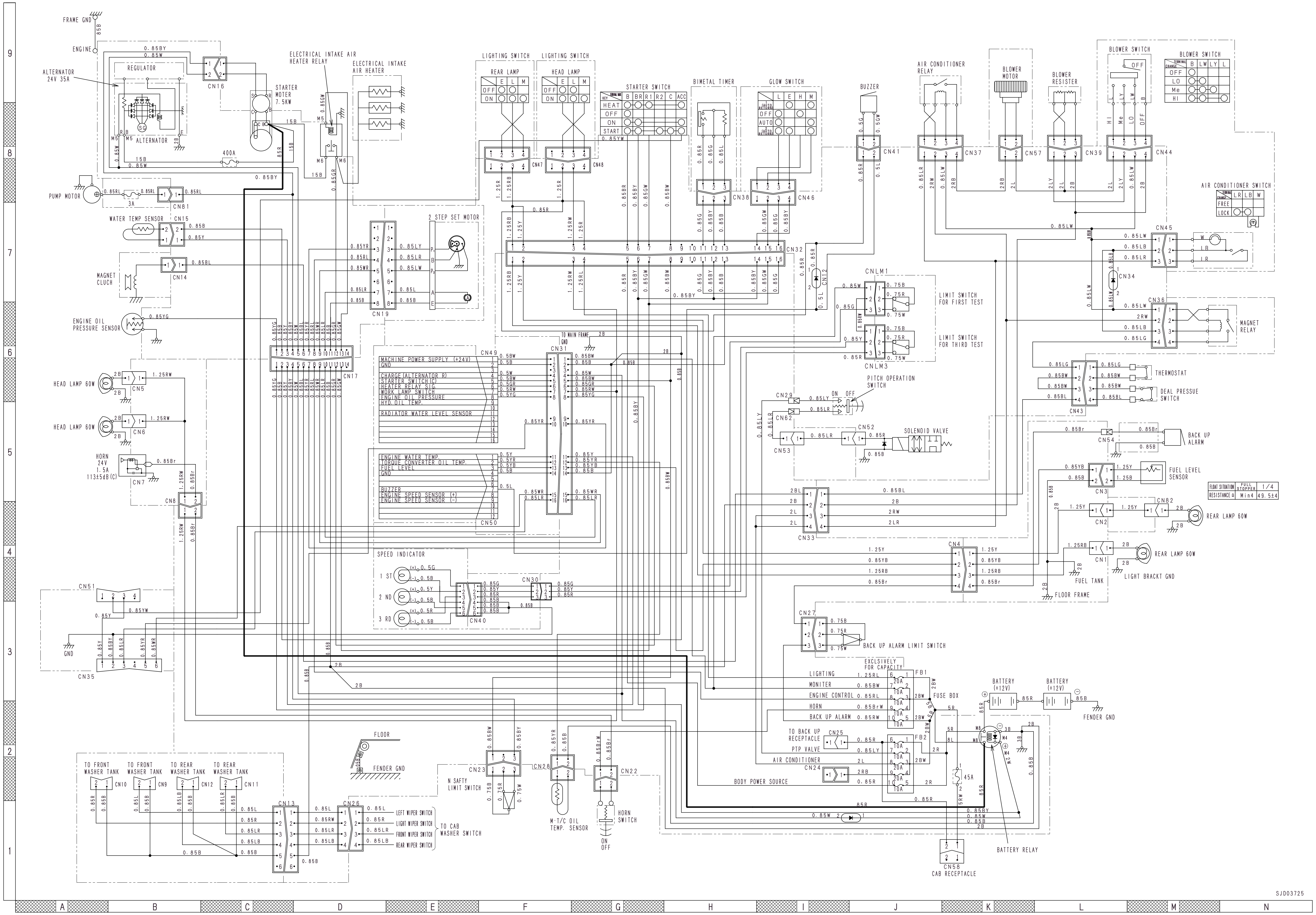

CN29
CN62
CN22
CN12
CN11
CN10
CN5
CN82
CN3
CN1
Y
CN2
CN54
CN25
LM1
LM3
CN4
CN26
CN23
CN27
CN28
CN16
CN13
CN17
CN8
CN15
CN9
BWD01209
G
H
I
J
K
L

ELECTRIC CIRCUIT DIAGRAM FOR CAB

D65EX-12 63403 and up
D65PX-12 63304 and up



ELECTRICAL CIRCUIT DIAGRAM
CAB Specification
D65EX-12 63403 and up
D65PX-12 63304 and up



ELECTRICAL CIRCUIT DIAGRAM

CANOPY specification

D65EX-12 63403 and up

D65PC-12 63304 and up