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1. STRUCTURE

This service 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 service 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 sections.

SECTION 1 GENERAL
This section explains the safety hints and gives the specification of the machine and major components.

SECTION 2 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.

SECTION 3 HYDRAULIC SYSTEM
This section explains the hydraulic circuit, single and combined operation.

SECTION 4 ELECTRICAL SYSTEM
This section explains the electrical circuit, monitoring system and each component. It serves not only to give an understanding electrical system, but also serves as reference material for trouble shooting.

SECTION 5 MECHATRONICS SYSTEM
This section explains the computer aided power optimization system and each component.

SECTION 6 TROUBLESHOOTING
This section explains the troubleshooting charts correlating **problems** to **causes**.

SECTION 7 MAINTENANCE STANDARD
This section gives the judgement standards when inspecting disassembled parts.

SECTION 8 DISASSEMBLY AND ASSEMBLY
This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

SECTION 9 COMPONENT MOUNTING TORQUE
This section shows bolt specifications and standard torque values needed when mounting components to the machine.

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your HYUNDAI distributor for the latest information.

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

Any additions, amendments or other changes will be sent to HYUNDAI 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 shows how to read the page number.
   Example 1
   2 - 3
   - 2: Item number(2. Structure and Function)
   - 3: 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.

   10 - 4
   10 - 4 - 1 ┐ Added pages
   10 - 4 - 2 ┘
   10 - 5

Revised edition mark(①②③…)

When a manual is revised, an edition mark is recorded on the bottom outside corner of the pages.

Revisions

Revised pages are shown at the **list of revised pages** on the between the contents page and section 1 page.

Symbols

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

Symbol	Item	Remarks
⚠	Safety	Special safety precautions are necessary when performing the work.
		Extra special safety precautions are necessary when performing the work because it is under internal pressure.
※	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.

3. 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

1. Method of using the Conversion Table to convert from millimeters to inches
   Convert 55mm into inches.

   (1) Locate the number 50in the vertical column at the left side, take this as ⓐ, then draw a horizontal line from ⓐ.

   (2) Locate the number 5in 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, 55mm = 2.165 inches.

2. Convert 550mm 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 55mm.

   (2) Carry out the same procedure as above to convert 55mm to 2.165 inches.

   (3) The original value(550mm) 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 550mm = 21.65 inches.

Millimeters to inches ⓑ 1mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
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

1mm = 0.03937in

	0	1	2	3	4	5	6	7	8	9
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

1kg = 2.2046lb

	0	1	2	3	4	5	6	7	8	9
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	59.5.	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

1 l = 0.2642 U.S.Gal

	0	1	2	3	4	5	6	7	8	9
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	6.6076	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	25.631	25.625	25.889	26.153

Liter to U.K. Gallon

1 l = 0.21997 U.K.Gal

	0	1	2	3	4	5	6	7	8	9
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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

	0	1	2	3	4	5	6	7	8	9
		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	396.6	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	10005.4
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

kgf/cm² to lbf/in²

$1kgf / cm^2 = 14.2233lbf / in^2$

	0	1	2	3	4	5	6	7	8	9
		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	2863	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	5603	2617	2631	2646	2660	2674	2688
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 verse 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.

°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	-6.7	20	68.0	12.8	55	131.0	32.2	90	194.0
-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	60	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	35	95.0	21.1	70	158.0	51.7	125	257.0
-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	172	347.0

SECTION 1 GENERAL

SECTION 1 GENERAL

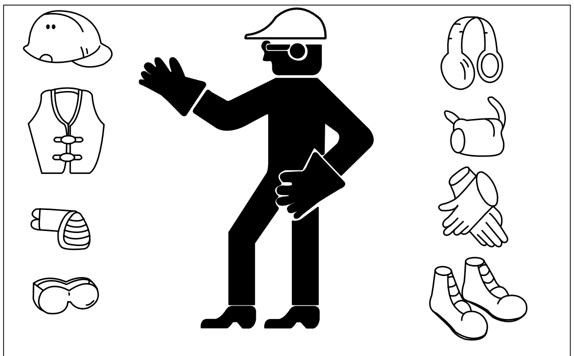
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

Unsafe work practices are dangerous. Understand service procedure before doing work; Do not attempt shortcuts.

WEAR PROTECTIVE CLOTHING

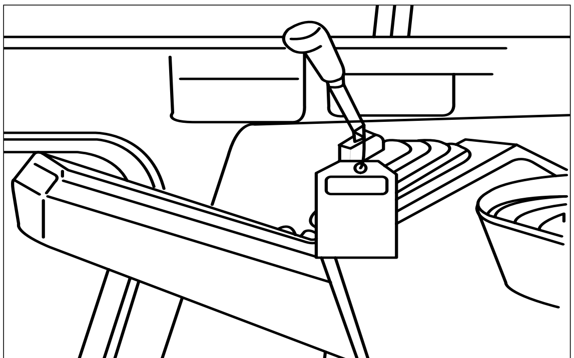
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

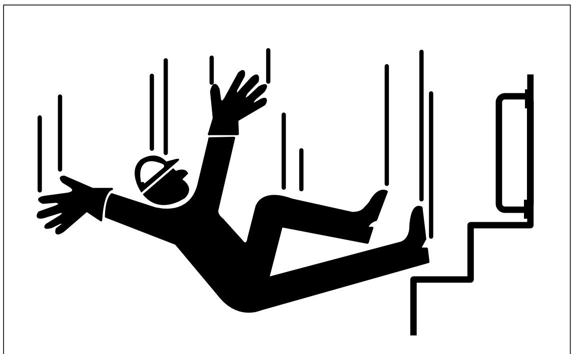
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a「**Do Not Operate**」tag on the right side control lever.



13031GE02

USE HANDHOLDS AND STEPS

Falling is one of the major causes of personal injury.
When you get on and off the machine, always maintain a three point contact with the steps and handrails and face the machine. Do not use any controls as handholds.
Never jump on or off the machine. Never mount or dismount a moving machine.
Be careful of slippery conditions on platforms, steps, and handrails when leaving the machine.



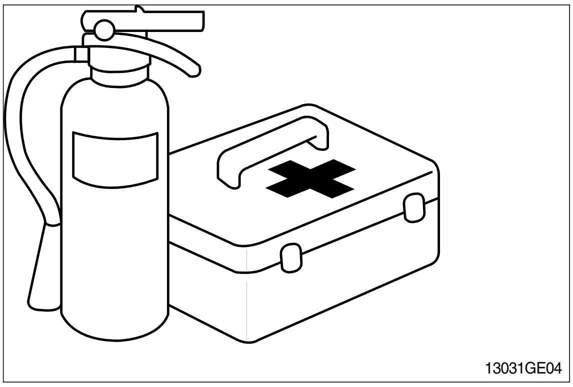
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

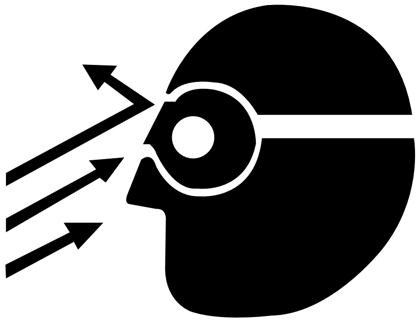
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



13031GE05

PROTECT AGAINST NOISE

Prolonged exposure to loud noise can cause impairment or loss of hearing.

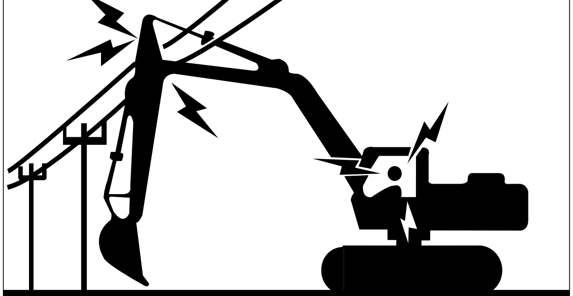
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

13031GE06

AVOID POWER LINES

Serious injury or death can result from contact with electric lines.

Never move any part of the machine or load closer to electric line than 3m(10ft) plus twice the line insulator length.

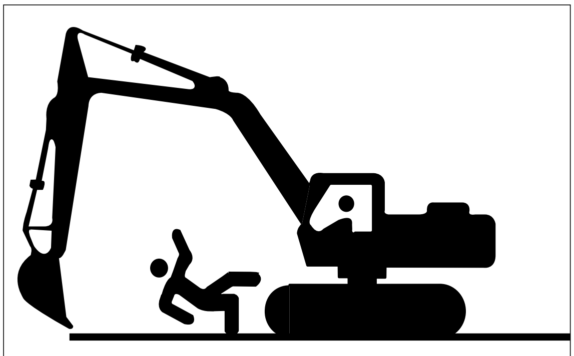


13031GE07

KEEP RIDERS OFF EXCAVATOR

Only allow the operator on the excavator. Keep riders off.

Riders on excavator are subject to injury such as being struck by foreign objects and being thrown off the excavator. Riders also obstruct the operator's view resulting in the excavator being operated in an unsafe manner.



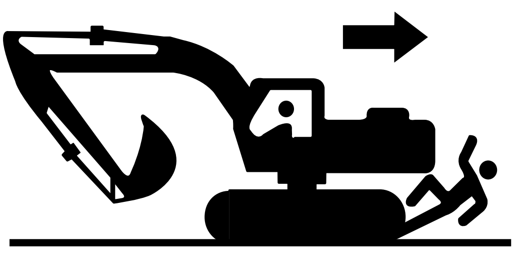
13031GE08

MOVE AND OPERATE MACHINE SAFELY

Bystanders can be run over. Know the location of bystanders before moving, swinging, or operating the machine.

Always keep the travel alarm in working condition. It warns people when the excavator starts to move.

Use a signal person when moving, swinging, or operating the machine in congested areas. Coordinate hand signals before starting the excavator.



13031GE09

OPERATE ONLY FORM OPERATOR'S SEAT

Avoid possible injury machine damage. Do not start engine by shorting across starter terminals.

NEVER start engine while standing on ground. Start engine only from operator's seat.

13031GE26

PARK MACHINE SAFELY

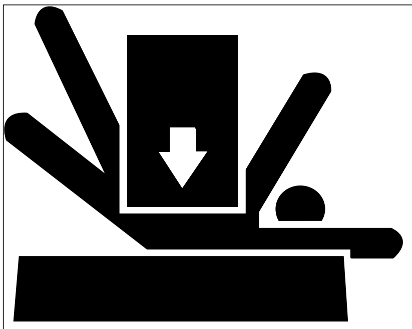
Before working on the machine:

- Park machine on a level surface.
- Lower bucket to the ground.
- Turn auto idle switch off.
- Run engine at 1/2 speed without load for 2 minutes.
- Turn key switch to OFF to stop engine.
  Remove key from switch.
- Move pilot control shutoff lever to locked position.
- Allow engine to cool.

SUPPORT MACHINE PROPERLY

Always lower the attachment or implement to the ground before you work on the machine. If you must work on a lifted machine or attachment, securely support the machine or attachment.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.

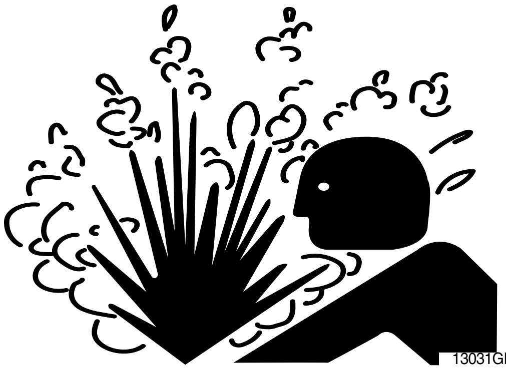


13031GE10

SERVICE COOLING SYSTEM SAFELY

Explosive release of fluids from pressurized cooling system can cause serious burns.

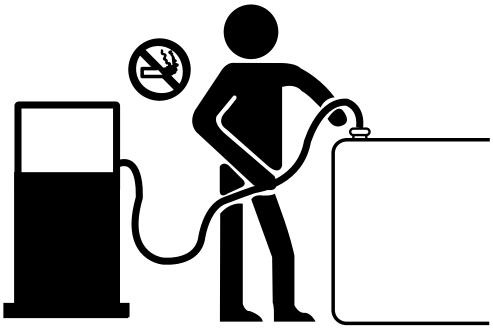
Shut off engine. Only remove filler cap when cool enough to touch with bare hands.



13031GE11

HANDLE FLUIDS SAFELY-AVOID FIRES

Handle fuel with care; It is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine.
Fill fuel tank outdoors.



13031GE12

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

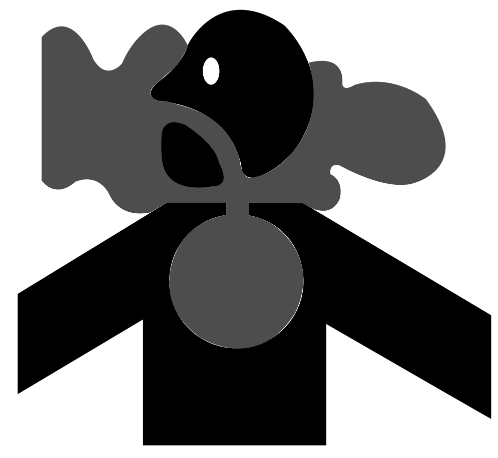
Do not store oily rags; They can ignite and burn spontaneously.

13031GE13

BEWARE OF EXHAUST FUMES

Prevent asphyxiation. Engine exhaust fumes can cause sickness or death.

If you must operate in a building, be positive there is adequate ventilation. Either use an exhaust pipe extension to remove the exhaust fumes or open doors and windows to bring enough outside air into the area.



13031GE14

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

Remove paint before welding or heating:

- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

ILLUMINATE WORK AREA SAFELY

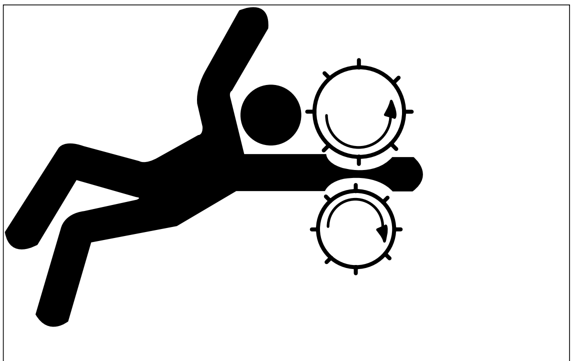
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

13031GE15

SERVICE MACHINE SAFELY

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.

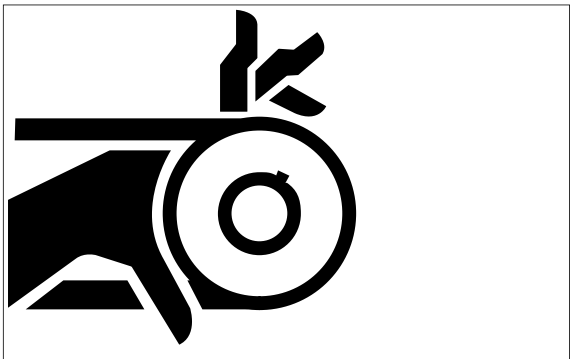


13031GE16

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

To prevent accidents, use care when working around rotating parts.



13031GE17

AVOID HIGH PRESSURE FLUIDS

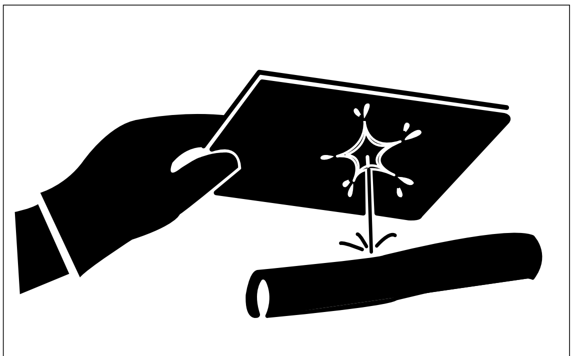
Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result.

13031GE18



13031GE19

AVOID HEATING NEAR PRESSURIZED FLUID LINES

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials.

Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area. Install fire resisting guards to protect hoses or other materials.

13031GE20

PREVENT BATTERY EXPLOSIONS

Keep sparks, lighted matches, and flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.

Do not charge a frozen battery; It may explode. Warm battery to 16˚C (60˚F).

13031GE21

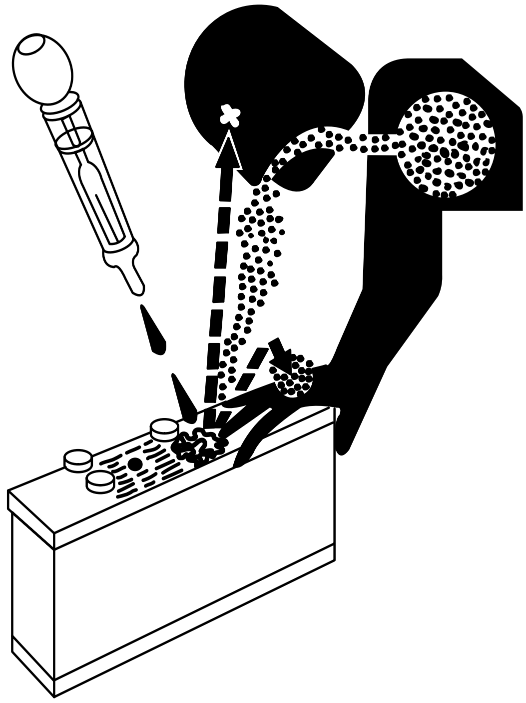
PREVENT ACID BURNS

Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:
1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 10-15 minutes.
   Get medical attention immediately.

If acid is swallowed:
1. Drink large amounts of water or milk.
2. Then drink milk of magnesia, beaten eggs, or vegetable oil.
3. Get medical attention immediately.



13031GE22

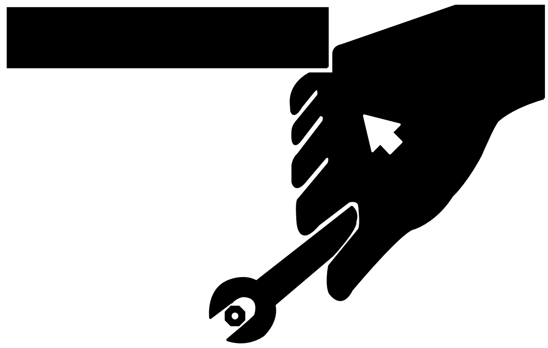
USE TOOLS PROPERLY

Use tools appropriate to the work. Makeshift tools, parts, and procedures can create safety hazards.

Use power tools only to loosen threaded tools and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only recommended replacement parts. (See Parts catalogue.)



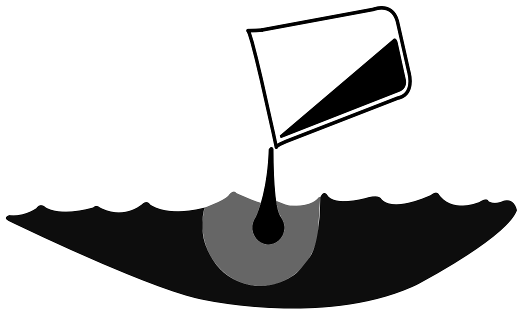
13031GE23

DISPOSE OF FLUIDS PROPERLY

Improperly disposing of fluids can harm the environment and ecology. Before draining any fluids, find out the proper way to dispose of waste from your local environmental agency.

Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

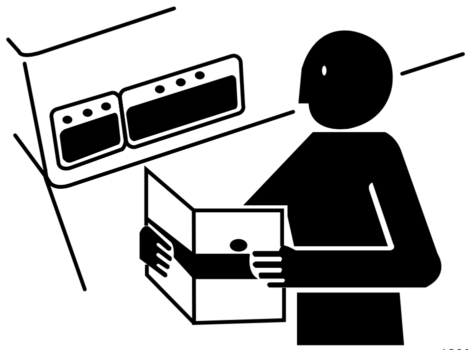
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.



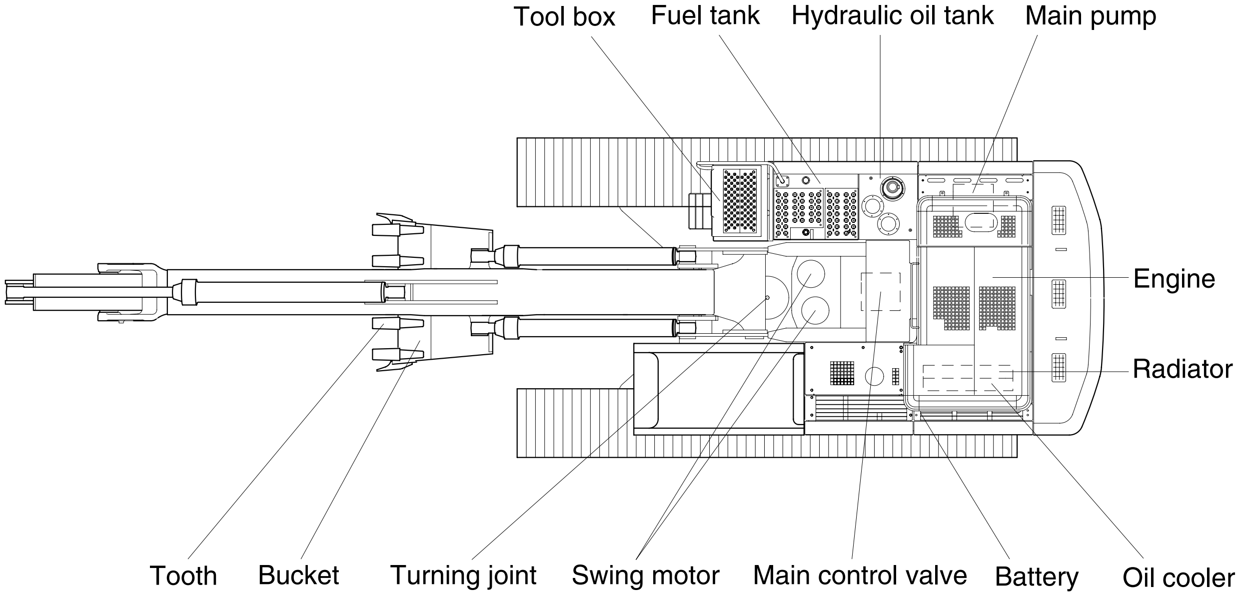
13031GE25

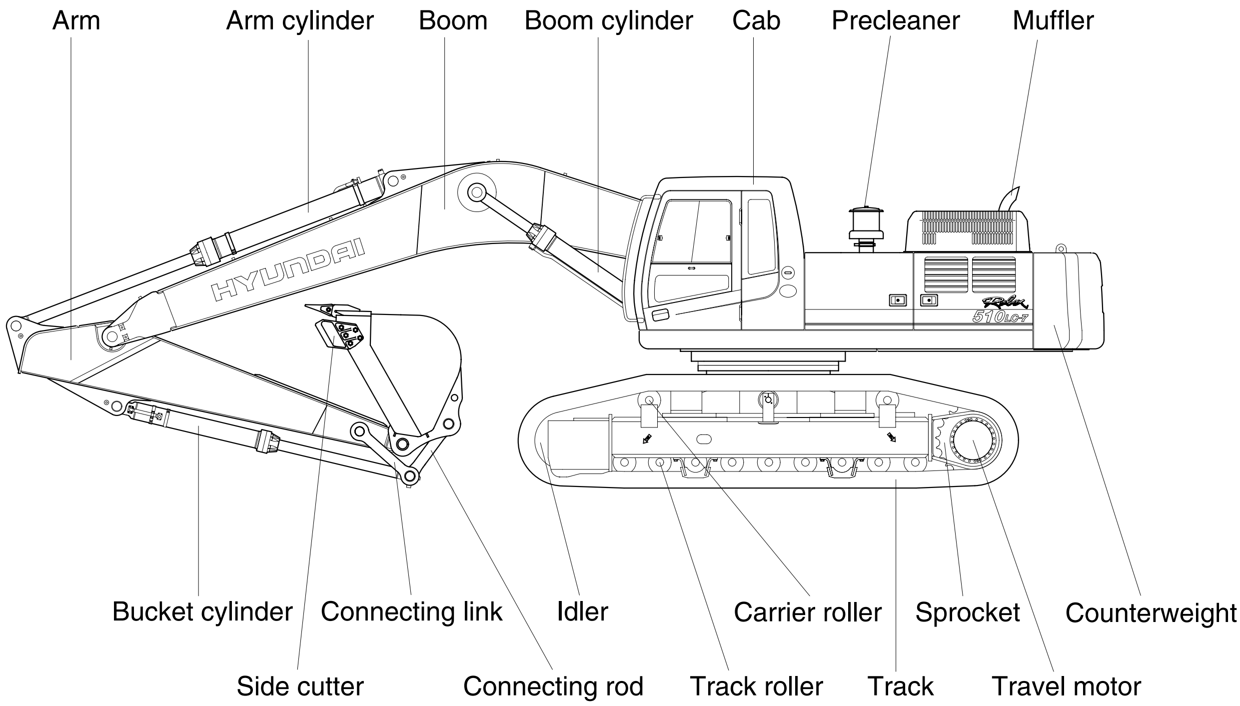
LIVE WITH SAFETY

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

GROUP 2 SPECIFICATIONS

1. MAJOR COMPONENT

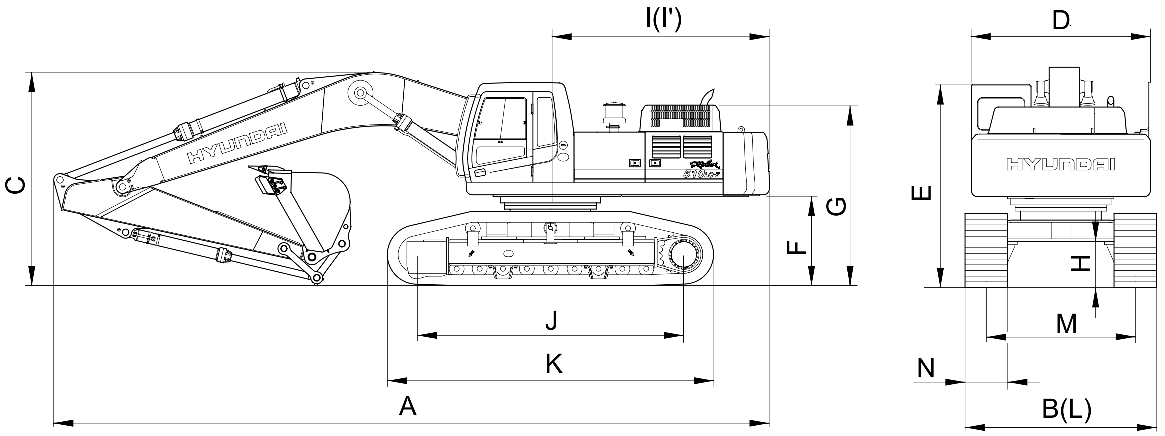




51072SP00

2. SPECIFICATIONS

· 6.55m(21' 6") BOOM and 2.70m(8' 10") ARM

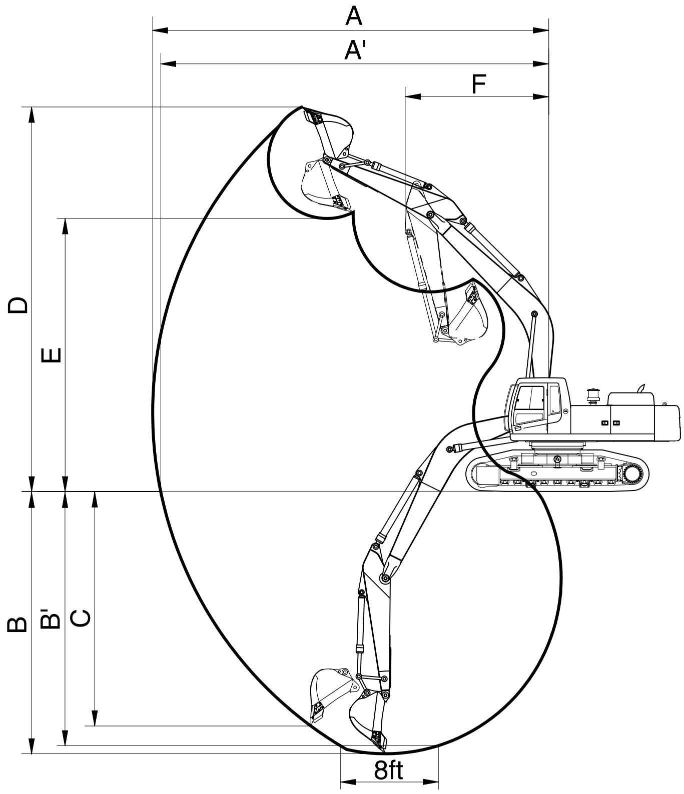


51072SP02

Description		Unit	Specification
Operating weight		kg(lb)	50000(110230)
Bucket capacity(SAE heaped), standard		$m^3(yd^3)$	3.03(3.96)
Overall length	A		11750(38' 7")
Overall width, with 600mm shoe	B		3480(11' 5")
Overall height	C		3950(13' 0")
Superstructure width	D		2980(9' 9")
Overall height of cab	E		3180(10' 5")
Ground clearance of counterweight	F		1295(4' 3")
Engine cover height	G		3015(9'11")
Minimum ground clearance	H	mm(ft-in)	555(1'10")
Rear-end distance	I		3665(12' 0")
Rear-end swing radius	I'		3720(12' 2")
Distance between tumblers	J		4470(14' 8")
Undercarriage length	K		5460(17'11")
Undercarriage width	L		3480(11' 5")
Track gauge	M		2880(9' 5")
Track shoe width, standard	N		600(24")
Travel speed(Low/high)		km/hr(mph)	3.3/5.2(2.0/3.2)
Swing speed		rpm	9.0
Gradeability		Degree(%)	35(70)
Ground pressure(600mm shoe)		$kgf/cm^2(psi)$	0.87(12.37)

3. WORKING RANGE

· **6.55m(21' 6") BOOM** (standard)

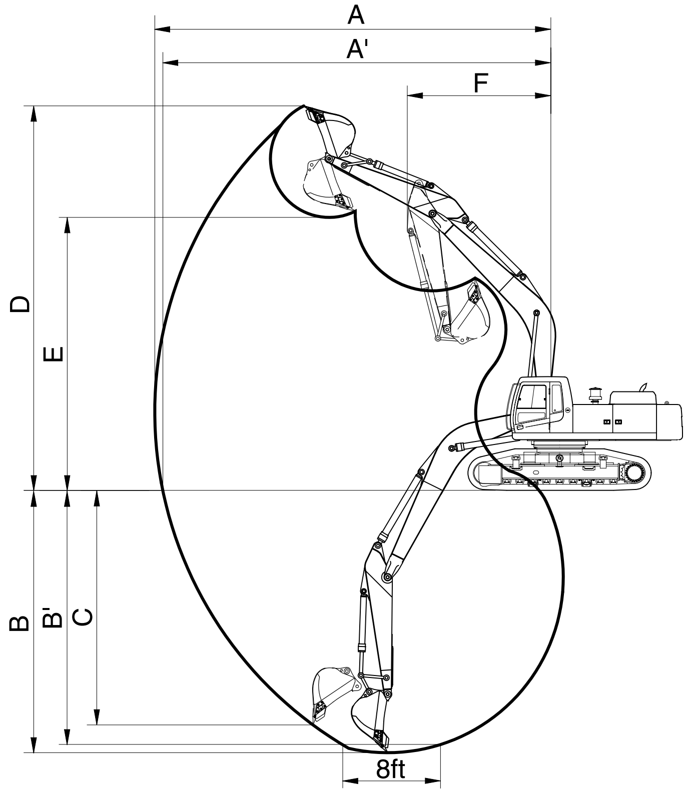


500072SP04

Description		2.40m(7' 10") Arm	※ 2.70m(8' 10") Arm
Max digging reach	A	10590mm (34' 9")	10920mm (35'10")
Max digging reach on ground	A'	10320mm (33'10")	10650mm (34'11")
Max digging depth	B	6130mm (20' 1")	6600mm (21' 8")
Max digging depth (8ft level)	B'	6150mm (20' 2")	6440mm (21' 2")
Max vertical wall digging depth	C	4590mm (15' 1")	5200mm (17' 1")
Max digging height	D	10060mm (33' 0")	10370mm (34' 0")
Max dumping height	E	6720mm (22' 1")	6990mm (22'11")
Min swing radius	F	4650mm (15' 3")	4530mm (14'10")
Bucket digging force	SAE	247.1[269.6] kN	248.1[270.7] kN
		25200[27490] kgf	25300[27600] kgf
		55560[60610] lbf	55780[60850] lbf
	ISO	286.4[312.4] kN	288.3[314.5] kN
		29200[31850] kgf	29400[32070] kgf
		64370[70220] lbf	64820[70710] lbf
Arm crowd force	SAE	278.5[303.8] kN	237.3[258.9] kN
		28400[30980] kgf	24200[26400] kgf
		62610[68300] lbf	53350[58200] lbf
	ISO	291.3[317.7] kN	248.1[270.7] kN
		29700[32400] kgf	25300[27600] kgf
		65480[71430] lbf	55780[60850] lbf

[ ] : Power boost ※Standard

· 7.06m(23' 2") BOOM (option)

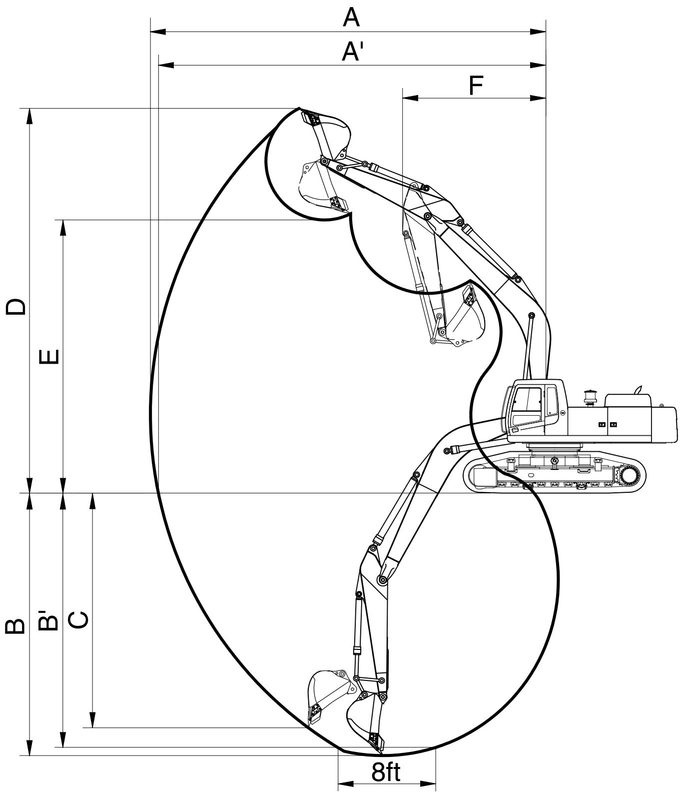


500072SP04

Description		2.40m(7'10") Arm	2.90m(9' 6") Arm	3.38m(11' 1") Arm	4.00m(13' 1") Arm	4.50m(14' 9") Arm
Max digging reach	A	11140mm (36' 7")	11530mm (37'10")	12080mm (39' 8")	12640mm (41' 6")	13130mm (43' 1")
Max digging reach on ground	A'	10890mm (35' 9")	11290mm (37' 0")	11840mm (38'10")	12420mm (40' 9")	12910mm (42' 4")
Max digging depth	B	6610mm (21' 8")	7110mm (23' 4")	7590mm (24'11")	8210mm (26'11")	8710mm (28' 7")
Max digging depth (8ft level)	B'	6430mm (21' 1")	6940mm (22' 9")	7440mm (24' 5")	8080mm (26' 6")	8590mm (28' 2")
Max vertical wall digging depth	C	4880mm (16' 0")	4780mm (15' 8")	5470mm (17'11")	5980mm (19' 7")	6480mm (21' 3")
Max digging height	D	10640mm (34'11")	10610mm (34'10")	11080mm (36' 4")	11290mm (37' 0")	11550mm (37'11")
Max dumping height	E	7290mm (23'11")	7350mm (24' 1")	7760mm (25' 6")	7980mm (26' 2")	8230mm (27' 0")
Min swing radius	F	5110mm (16' 9")	4910mm (16' 1")	4830mm (15'10")	4910mm (16' 1")	4960mm (16' 3")
Bucket digging force	SAE	247.1[269.6] kN	251.1[273.9] kN	253.0[276.0] kN	253.0[276.0] kN	253.0[276.0] kN
		25200[27490] kgf	25600[27930] kgf	25800[28150] kgf	25800[28150] kgf	25800[28150] kgf
		55560[60610] lbf	56440[61570] lbf	56880[62050] lbf	56880[62050] lbf	56880[62050] lbf
	ISO	286.4[312.4] kN	290.3[316.7] kN	292.2[318.8] kN	292.2[318.8] kN	292.2[318.8] kN
		29200[31850] kgf	29600[32290] kgf	29800[32510] kgf	29800[32510] kgf	29800[32510] kgf
		64370[70220] lbf	65260[71190] lbf	65700[71670] lbf	65700[71670] lbf	65700[71670] lbf
Arm crowd force	SAE	278.5[303.8] kN	225.6[246.1] kN	192.2[209.7] kN	171.6[187.2] kN	159.9[174.4] kN
		28400[30980] kgf	23000[25090] kgf	19600[21380] kgf	17500[19090] kgf	16300[17780] kgf
		62610[68300] lbf	50710[55320] lbf	43210[47140] lbf	38580[42090] lbf	35940[39210] lbf
	ISO	291.3[317.7] kN	235.4[256.8] kN	200.1[218.2] kN	177.5[193.6] kN	164.8[179.7] kN
		29700[32400] kgf	24000[26180] kgf	20400[22250] kgf	18100[19750] kgf	16800[18330] kgf
		65480[71430] lbf	52910[57720] lbf	44970[49060] lbf	39900[43530] lbf	37040[40410] lbf

[ ] : Power boost

· **9.00m(29' 6") BOOM** (option)



Description		5.85m(19' 2") Arm
Max digging reach	A	16280mm (53' 5")
Max digging reach on ground	A'	16100mm (52'10")
Max digging depth	B	11380mm (37' 4")
Max digging depth (8ft level)	B'	11280mm (37' 0")
Max vertical wall digging depth	C	10070mm (33' 0")
Max digging height	D	13930mm (45' 8")
Max dumping height	E	10530mm (34' 7")
Min swing radius	F	5940mm (19' 6")
Bucket digging force	SAE	251.1[273.9] kN
		25600[27930] kgf
		56440[61570] lbf
	ISO	296.2[323.1] kN
		30200[32950] kgf
		66580[72630] lbf
Arm crowd force	SAE	126.5[138.0] kN
		12900[14070] kgf
		28440[31030] lbf
	ISO	130.4[142.3] kN
		13300[14510] kgf
		29320[31990] lbf

[ ] : Power boost

4. WEIGHT

Item	R510LC-7	
	kg	lb
Upperstructure assembly	25470	56150
Main frame weld assembly	3940	8680
Engine assembly	940	2070
Main pump assembly	180	400
Main control valve assembly	420	930
Swing motor assembly	250	550
Hydraulic oil tank assembly	450	990
Fuel tank assembly	300	660
Counterweight	10700	23590
Cab assembly	310	680
Lower chassis assembly	13970	30800
Lower frame weld assembly	6100	13450
Swing bearing	600	1320
Travel motor assembly	425	940
Turning joint	50	110
Track recoil spring and idler	300	660
Idler	250	550
Carrier roller	40	90
Track roller	80	180
Track-chain assembly(600mm standard triple grouser shoe)	2790	6160
Front attachment assembly(6.55m boom, 2.70m arm, 3.03m^3 SAE heaped bucket)	10560	23280
6.55m boom assembly	3410	7520
2.70m arm assembly	1790	3950
3.03m^3 SAE heaped bucket	2490	5490
Boom cylinder assembly	910	2010
Arm cylinder assembly	540	1190
Bucket cylinder assembly	300	660
Bucket control rod assembly	130	290

5. LIFTING CAPACITIES

1) 6.55m(21' 6") boom, 2.70m(8' 10") arm equipped with 3.03m^3(SAE heaped) bucket, 600mm (24") triple grouser shoe and 10,700kg(23,590lb) counterweight.

- : Rating over-front
- : Rating over-side or 360 degree

Load point height		Load radius								At max. reach		
		3.0m(10.0ft)		4.5m(15.0ft)		6.0m(20.0ft)		7.5m(25.0ft)		Capacity		Reach
												m(ft)
7.5m	kg									*9320	8380	8.30
(25.0ft)	lb									*20550	18470	(27.2)
6.0m	kg					*12260	*12260	*10760	9780	*9130	6760	9.15
(20.0ft)	lb					*27030	*27030	*23720	21560	*20130	14900	(30.0)
4.5m	kg			*18300	*18300	*13740	*13740	*11380	9440	*9090	5900	9.65
(15.0ft)	lb			*40340	*40340	*30290	*30290	*25090	20810	*20040	13010	(31.7)
3.0m	kg					*15360	12940	*12150	9000	*9120	5490	9.86
(10.0ft)	lb					*33860	28530	*26790	19840	*20110	12100	(32.3)
1.5m	kg					*16470	12210	*12730	8590	*9160	5420	9.80
(5.0ft)	lb					*36310	26920	*28060	18940	*20190	11950	(32.2)
Ground	kg			*22630	18650	*16670	11800	*12800	8330	*9130	5700	9.47
Line	lb			*49890	41120	*36750	26010	*28220	18360	*20130	12570	(31.1)
-1.5m	kg	*25090	*25090	*20780	18720	*15800	11690	*12060	8250	*8870	6450	8.84
(-5.0ft)	lb	*55310	*55310	*45810	41270	*34830	25770	*26590	18190	*19550	14220	(29.0)
-3.0m	kg	*21470	*21470	*17630	*17630	*13610	11850			*8020	*8020	7.80
(-10.0ft)	lb	*47330	*47330	*38870	*38870	*30000	26120			*17680	*17680	(25.6)
-4.5m	kg			*12370	*12370							
(-15.0ft)	lb			*27270	*27270							

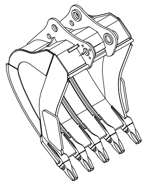
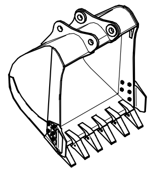
Note
1. Lifting capacity are based on SAE J1097 and ISO 10567.
2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The load point is a hook located on the back of the bucket.
4. *indicates load limited by hydraulic capacity.

2) 6.55m(21' 6") boom, 2.70m(8' 10") arm equipped with 2.79m³(SAE heaped) bucket, 600mm (24") triple grouser shoe and 10,700kg(23,590lb) counterweight.

Load point height		Load radius								At max. reach		
		3.0m(10.0ft)		4.5m(15.0ft)		6.0m(20.0ft)		7.5m(25.0ft)		Capacity		Reach
												m(ft)
7.5m	kg									*9400	8450	8.30
(25.0ft)	lb									*20720	18630	(27.2)
6.0m	kg					*12330	*12330	*10840	9840	*9210	6830	9.15
(20.0ft)	lb					*27180	*27180	*23900	21690	*20300	15060	(30.0)
4.5m	kg			*18380	*18380	*13820	*13820	*11460	9500	*9170	5980	9.65
(15.0ft)	lb			*40520	*40520	*30470	*30470	*25260	20940	*20220	13180	(31.7)
3.0m	kg					*15440	13010	*12230	9060	*9200	5560	9.86
(10.0ft)	lb					*34040	28680	*26960	19970	*20280	12260	(32.3)
1.5m	kg					*16560	12280	*12810	8660	*9240	5490	9.80
(5.0ft)	lb					*36510	27070	*28240	19090	*20370	12100	(32.2)
Ground	kg			*22720	18730	*16750	11870	*12880	8400	*9210	5770	9.47
Line	lb			*50090	41290	*36930	26170	*28400	18520	*20300	12720	(31.1)
-1.5m	kg	*25210	*25210	*20870	18800	*15880	11760	*12140	8320	*8960	6520	8.84
(-5.0ft)	lb	*55580	*55580	*46010	41450	*35010	25930	*26760	18340	*19750	14370	(29.0)
-3.0m	kg	*21580	*21580	*17720	*17720	*13690	11930			*8100	*8100	7.80
(-10.0ft)	lb	*47580	*47580	*39070	*39070	*30180	26300			*17860	*17860	(25.6)
-4.5m	kg			*12460	*12460							
(-15.0ft)	lb			*27470	*27470							

6. BUCKET SELECTION GUIDE

1) GENERAL BUCKET

	
2.79m³ SAE heaped bucket	※3.03m³ SAE heaped bucket

Capacity		Width		Weight	Recommendation					
					7.06m (23' 2") boom					6.55m(21'5") boom
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.4m arm (7' 10")	2.9m arm (9' 6")	3.38m arm (11' 1")	4.0m arm (13' 1")	4.5m arm (14' 9")	※2.4m arm (7' 10")
2.79m³ (3.65yd³)	2.47m³ (3.23yd³)	1830mm (69.3")	1865mm (75.2")	1960kg (4320lb)						
※3.03m³ (3.96yd³)	2.67m³ (3.49yd³)	1890mm (74.4")	2040mm (80.3")	2485kg (5480lb)						

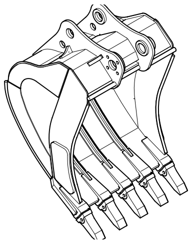
※ : Standard bucket

Applicable for materials with density of 2000kgf/m³ (3370lbf/yd³) or less

Applicable for materials with density of 1600kgf/m³ (2700lbf/yd³) or less

Applicable for materials with density of 1100kgf/m³ (1850lbf/yd³) or less

2) ROCK BUCKET



⊙ 2.2m^3 SAE
⊙ 2.43m^3 SAE
heaped bucket

Capacity		Width		Weight	Recommendation					
					7.06m (23' 2") boom					6.55m boom
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.4m arm (7' 10")	2.9m arm (9' 6")	3.38m arm (11' 1")	4.0m arm (13' 1")	4.5m arm (14' 9")	※2.4m arm (7' 10")
⊙2.20m^3 (2.88yd^3)	1.80m^3 (2.35yd^3)	1835mm (72.2")	-	2295kg (5060lb)						
⊙2.43m^3 (3.18yd^3)	2.10m^3 (2.75yd^3)	1885mm (74.2")	-	2335kg (5150lb)						

⊙ : Rock bucket

Applicable for materials with density of 2000kgf/m^3 (3370lbf/yd^3) or less

Applicable for materials with density of 1600kgf/m^3 (2700lbf/yd^3) or less

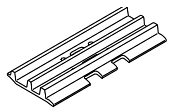
Applicable for materials with density of 1100kgf/m^3 (1850lbf/yd^3) or less

7. UNDERCARRIAGE

1) TRACKS

X-leg type center frame is integrally welded with reinforced box-section track frames. The design includes dry tracks, lubricated rollers, idlers, sprockets, hydraulic track adjusters with shock absorbing springs and assembled track-type tractor shoes with triple grousers.

2) TYPES OF SHOES

Model	Shapes		Triple grouser			
						
R510LC-7	Shoe width	mm(in)	※600(24)	700(28)	750(30)	800(32)
	Operating weight	kg(lb)	50000(110230)	50540(111420)	50810(112020)	51020(112610)
	Ground pressure	kgf/cm^2(psi)	0.87(12.37)	0.75(10.67)	0.71(10.10)	0.67(9.53)
	Overall width	mm(ft-in)	3480(11' 5")	3580(11' 9")	3640(11' 11")	3680(12' 1")

※ : Standard

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	2EA
Track rollers	9EA
Track shoes	53EA

4) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes

Confirm the category from the list of applications in **table 2**, then use **table 1** to select the shoe. Wide shoes(Categories B and C) have limitations on applications. Before using wide shoes, check the precautions, then investigate and study the operating conditions to confirm if these shoes are suitable.

Select the narrowest shoe possible to meet the required flotation and ground pressure. Application of wider shoes than recommendations will cause unexpected problem such as bending of shoes, crack of link, breakage of pin, loosening of shoe bolts and the other various problems.

※ **Table 1**

Track shoe	Specification	Category
600mm triple grouser	Standard	A
600mm double grouser	Option	A
700mm triple grouser, double grouser	Option	B
750mm triple grouser	Option	B
800mm triple grouser	Option	C

※ **Table 2**

Category	Applications	Precautions
A	Rocky ground, river beds, normal soil	· Travel at low speed on rough ground with large obstacles such as boulders or fallen trees
B	Normal soil, soft ground	· These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees · Travel at high speed only on flat ground · Travel slowly at low speed if it is impossible to avoid going over obstacles
C	Extremely soft gound (Swampy ground)	· Use the shoes only in the conditions that the machine sinks and it is impossible to use the shoes of category A or B · These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees · Travel at high speed only on flat ground · Travel slowly at low speed if it is impossible to avoid going over obstacles

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Cummins QSM 11
Type	4-cycle turbocharged diesel engine
Cooling method	Water cooling
Number of cylinders and arrangement	6 cylinders, in-line
Firing order	1-5-3-6-2-4
Combustion chamber type	Direct injection type
Cylinder bore × stroke	125 × 147.1mm(4.92" × 5.79")
Piston displacement	10800cc(505cu in)
Compression ratio	16.3 : 1
Rated gross horse power(SAE J1995)	358ps at 1900rpm(353Hp / 263kW at 1900rpm)
Maximum torque	182.5kgf · m(1320lbf · ft) at 1300rpm
Engine oil quantity	37.85 l (10U.S. gal)
Dry weight	942kg(2077lb)
High idling speed	1950 ± 50rpm
Low idling speed	800 ± 50rpm
Rated fuel consumption	144g/Hp · hr at 1900rpm
Starting motor	Delco remy 42MT (24V-7.2kW)
Alternator	Delco Remy 24V-70A
Battery	2 × 12V × 200Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 200cc/rev
Maximum pressure	330kgf/cm² (4690psi)[360kgf/cm² (5120psi)]
Rated oil flow	2 × 380 l /min (100.4U.S. gpm/83.6U.K. gpm)
Rated speed	1900rpm

[ ]: Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15cc/rev
Maximum pressure	35kgf/cm²(498psi)
Rated oil flow	28.5 ℓ/min(7.5U.S. gpm/6.3U.K. gpm)

4) MAIN CONTROL VALVE

Item	Specification
Type	9 spools
Operating method	Hydraulic pilot system
Main relief valve pressure	330kgf/cm²(4690psi) [360kgf/cm²(5120psi)]
Overload relief valve pressure	380kgf/cm²(5400psi)

[ ]: Power boost

5) SWING MOTOR

Item	Specification
Type	Fixed displacement axial piston motor
Capacity	148.5cc/rev
Relief pressure	285kgf/cm²(4050psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	63kgf・m(456lbf・ft)
Brake release pressure	23~50kgf/cm²(327~711psi)
Reduction gear type	2 - stage planetary
Swing speed	9.0rpm

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Relief pressure	345kgf/cm²(4910psi)
Capacity(max / min)	160/100cc/rev
Reduction gear type	3-stage planetary
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	17~50kgf/cm²(242~711psi)
Braking torque	103kgf・m(745lbf・ft)

7) REMOTE CONTROL VALVE

Item		Specification
Type		Pressure reducing type
Operating pressure	Minimum	6.5kgf/cm^2(92psi)
	Maximum	26kgf/cm^2(370psi)
Single operation stroke	Lever	61mm(2.4in)
	Pedal	123mm(4.84in)

8) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	ø 170× ø 115× 1570mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	ø 190× ø 130× 1820mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	ø 170× ø 115× 1370mm
	Cushion	Extend only

※ **Discoloration of cylinder rod can occur when the friction reduction additive of lubrication oil spreads on the rod surface.**

※ **Discoloration does not cause any harmful effect on the cylinder performance.**

9) SHOE

Item		Width	Ground pressure	Link quantity	Overall width
R510LC-7	Standard	600mm(24")	0.87kgf/cm^2(12.37psi)	53	3480mm(11' 5")
	Option	700mm(28")	0.75kgf/cm^2(10.67psi)	53	3580mm(11' 9")
		750mm(30")	0.71kgf/cm^2(10.10psi)	53	3640mm(11' 11")
		800mm(32")	0.67kgf/cm^2(9.53psi)	53	3680mm(12' 1")

10) BUCKET

Item		Capacity		Tooth quantity	Width	
		SAE heaped	CECE heaped		Without side cutter	With side cutter
R510LC-7	Standard	3.03m^3(3.96yd^3)	2.67m^3(3.49yd^3)	6	1890mm (74.4")	2040mm (80.3")
	Option	2.79m^3(3.65yd^3)	2.47m^3(3.23yd^3)	5	1830mm (69.3")	1865mm (75.2")
		⊙2.20m^3(2.88yd^3)	1.80m^3(2.35yd^3)	5	1835mm (72.2")	-
		⊙2.43m^3(3.18yd^3)	2.10m^3(2.75yd^3)	5	1885mm (74.2")	-

⊙ : Rock bucket(Esco type)

9. RECOMMENDED OILS

Use only oils listed below or equivalent.
Do not mix different brand oil.

Service point	Kind of fluid	Capacity l (U.S. gal)	Ambient temperature ℃ (℉) -20 (-4), -10 (14), 0 (32), 10 (50), 20 (68), 30 (86), 40 (104)
Engine oil pan	Engine oil	38(10)	SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Swing drive	Gear oil	5.0×2 (1.3×2)	SAE 85W-140
Final drive		5.0×2 (1.3×2)	
Hydraulic tank	Hydraulic oil	Tank; 250(66) System; 380(100)	ISO VG 32 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel	610(161)	ASTM D975 NO.1 ASTM D975 NO.2
Fitting (Grease nipple)	Grease	As required	NLGI NO.1 NLGI NO.2
Radiator (Reservoir tank)	Mixture of antifreeze and water 50 : 50	50(13.2)	Ethylene glycol base permanent type

SAE : Society of Automotive Engineers
API : American Petroleum Institute
ISO : International Organization for Standardization
NLGI : National Lubricating Grease Institute
ASTM : American Society of Testing and Material

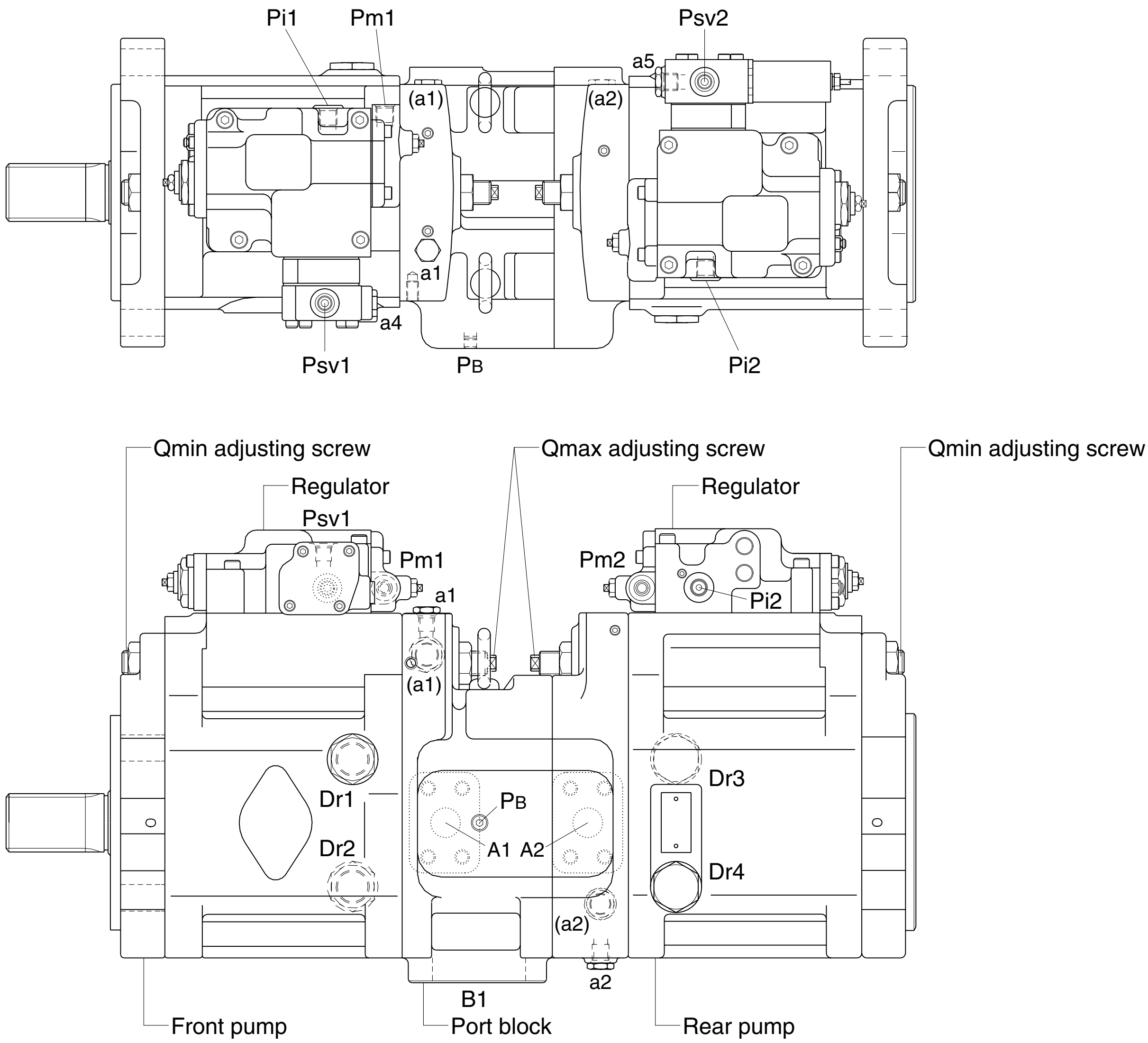
SECTION 2 STRUCTURE AND FUNCTION

SECTION 2 STRUCTURE AND FUNCTION

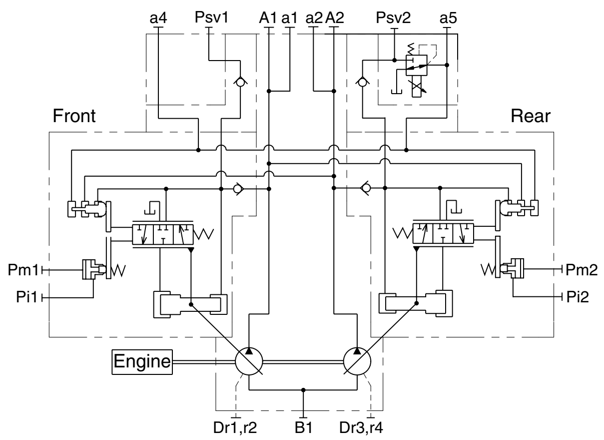
GROUP 1 PUMP DEVICE

1. STRUCTURE

The pump device consists of main pump, regulator.



470072MP01

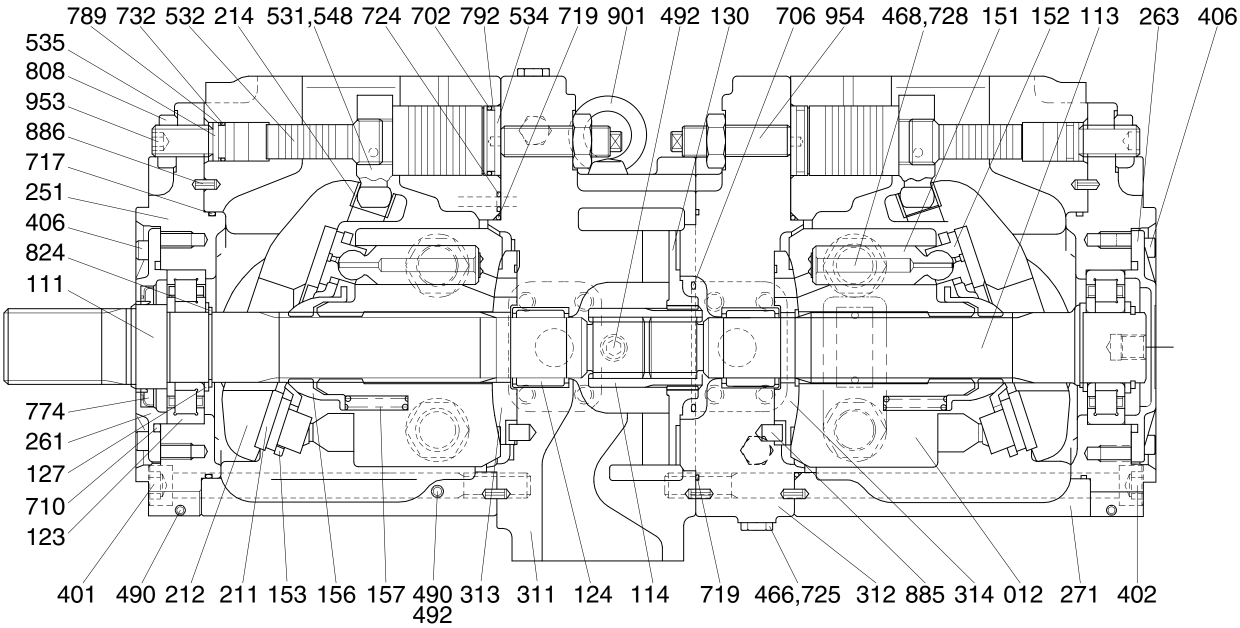


Hydraulic circuit

Port	Port name	Port size
A1,A2	Delivery port	SAE6000psi 1"
B1	Suction port	SAE2500psi 3"
Dr1~Dr4	Drain port	PF 3/4 - 23
Pi1,Pi2	Pilot port	PF 1/4 - 15
Pm1,Pm2	Qmax cut port	PF 1/4 - 15
Psv1, Psv2	Servo assist port	PF 1/4 - 15
a1, a2, a4, a5	Gauge port	PF 1/4 - 15
Pb	Gauge port	RC 1/8

1) MAIN PUMP(1/2)

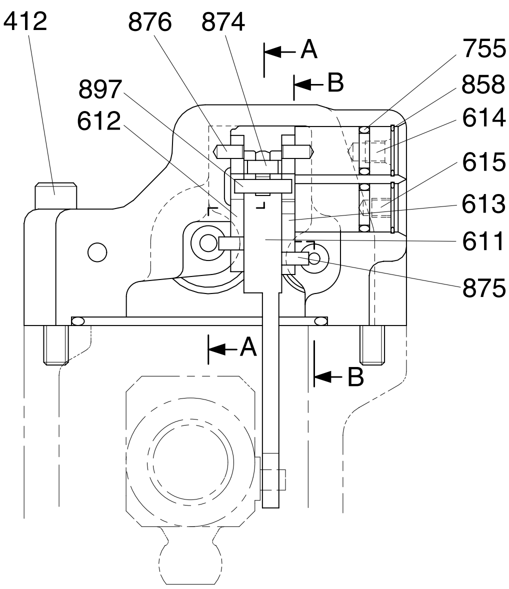
The main pump consists of two piston pumps(front & rear) and valve block.

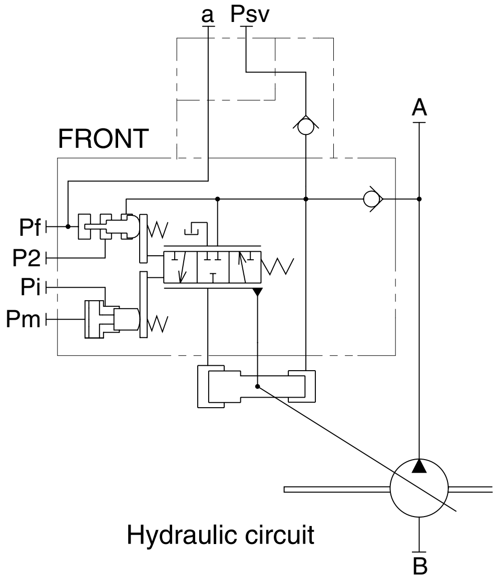


470072MP02

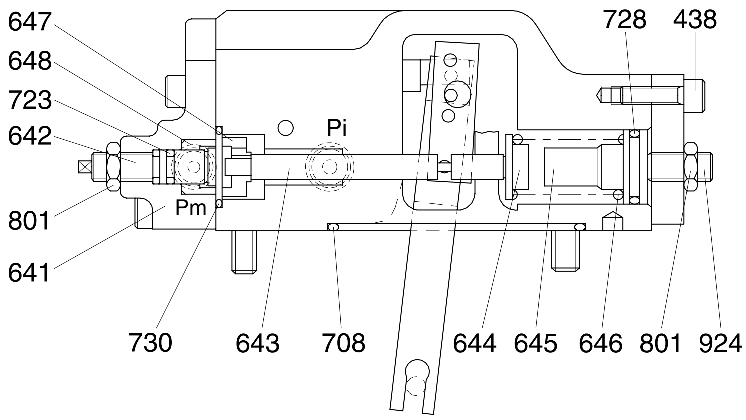
012	Cylinder block	271	Pump casing	710	O-ring
111	Drive shaft(F)	311	Valve cover(F)	717	O-ring
113	Driven shaft(R)	312	Valve cover(R)	719	O-ring
114	Coupling	313	Valve plate(R)	724	O-ring
123	Roller bearing	314	Valve plate(L)	725	O-ring
124	Needle bearing	401	Hexagon socket bolt	728	O-ring
127	Spacer	402	Hexagon socket bolt	732	O-ring
130	Booster	406	Hexagon socket bolt	774	Oil seal
151	Piston	466	VP Plug	789	Back up ring
152	Shoe	468	VP Plug	792	Back up ring
153	Plate	490	VP Plug	808	Hexagon head nut
156	Bushing	492	VP Plug	824	Snap ring
157	Cylinder spring	531	Tilting pin	885	Pin
211	Shoe plate	532	Servo piston	886	Spring pin
212	Swash plate	534	Stopper(L)	901	Eye bolt
214	Bushing	535	Stopper(S)	953	Set screw
251	Support plate	548	Feed back pin	954	Set screw
261	Seal cover(F)	702	O-ring		
263	Seal cover(R)	706	O-ring		

2) FRONT REGULATOR(1/2)

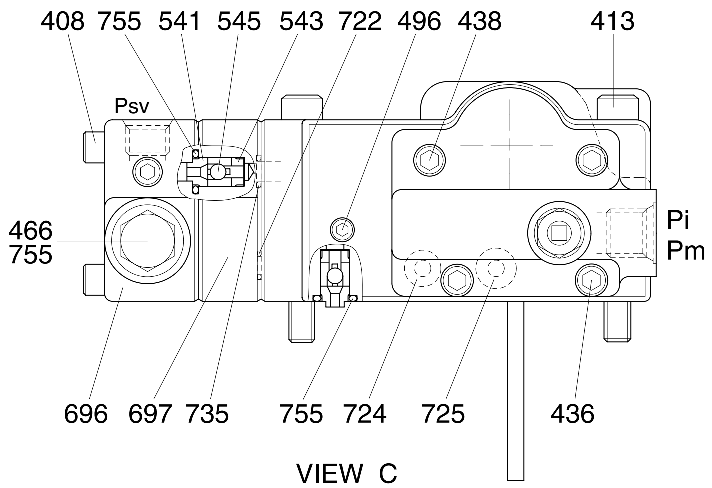




Hydraulic circuit



SECTION B-B

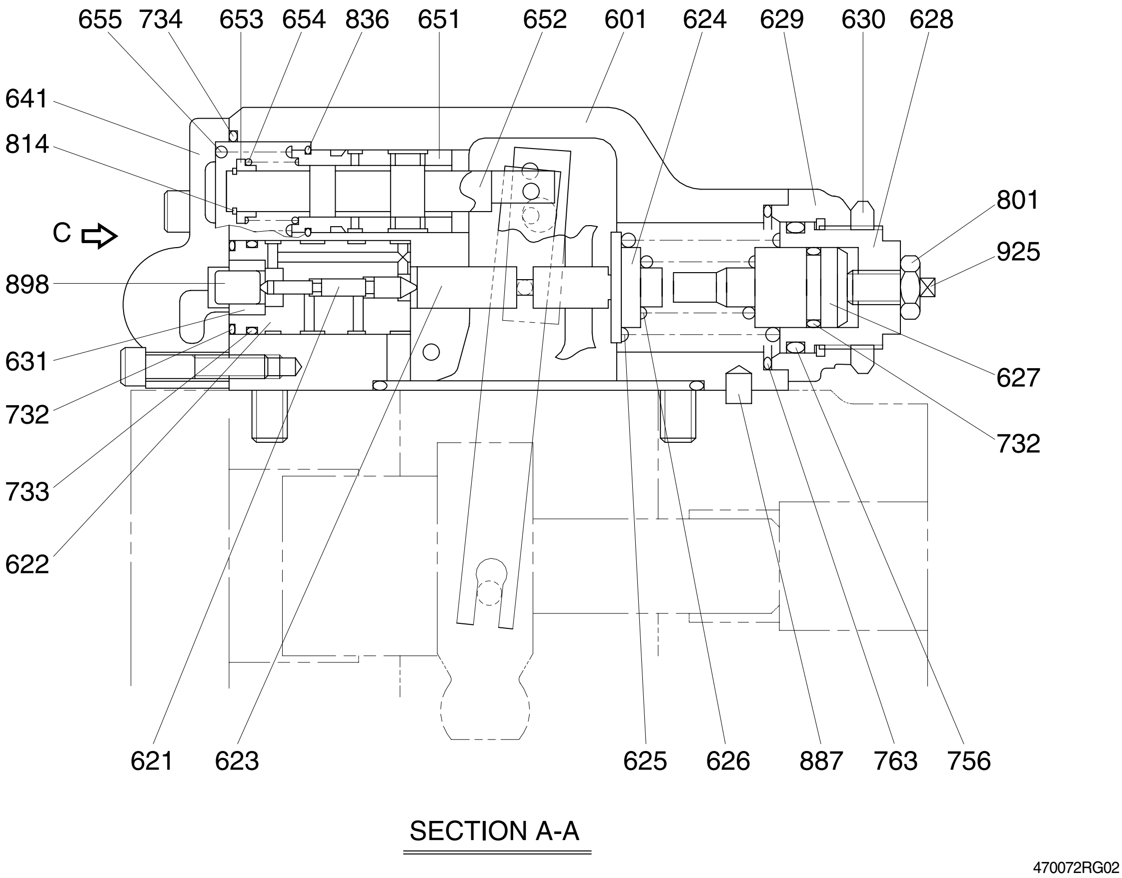


VIEW C

470072RG01

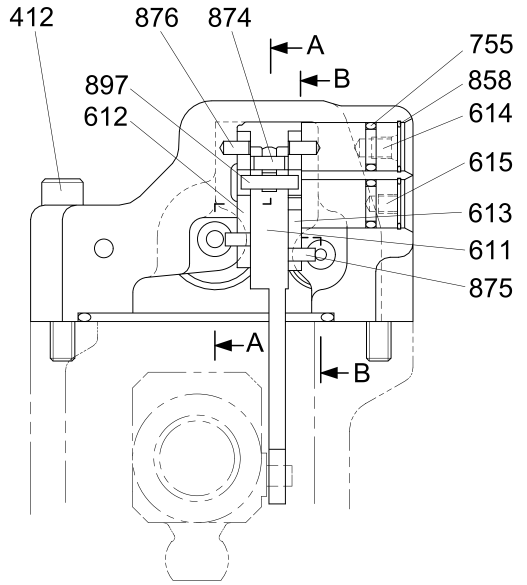
Port	Port name	Port size
Pi	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
P2	Companion delivery port	-
Pf	Powershift port	-
a	Gauge port	PF 1/4 - 15

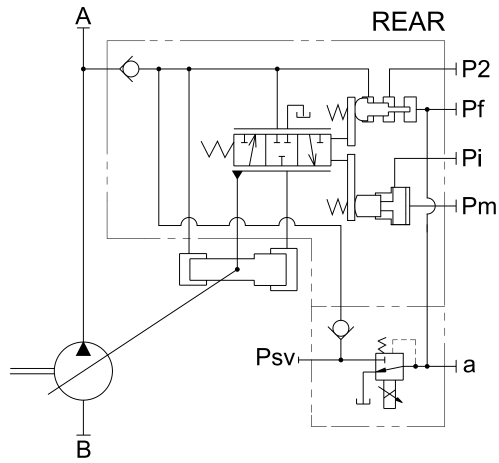
FRONT REGULATOR(2/2)



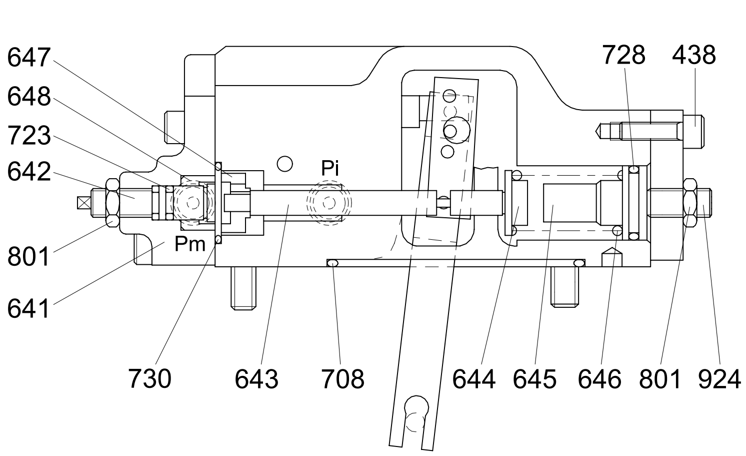
408	Hexagon socket screw	628	Adjust screw(C)	725	O-ring
412	Hexagon socket screw	629	Cover(C)	728	O-ring
413	Hexagon socket screw	630	Lock nut	730	O-ring
436	Hexagon socket screw	631	Sleeve, pf	732	O-ring
438	Hexagon socket screw	641	Pilot cover	733	O-ring
466	Plug	642	Adjust screw(QMC)	734	O-ring
496	Plug	643	Pilot piston	735	O-ring
541	Seat	644	Spring seat(Q)	755	O-ring
543	Stopper	645	Adjust stem(Q)	756	O-ring
545	Steel ball	646	Pilot spring	763	O-ring
601	Casing	647	Stopper	801	Nut
611	Feed back lever	648	Piston(QMC)	814	Snap ring
612	Lever(1)	651	Sleeve	836	Snap ring
613	Lever(2)	652	Spool(A)	858	Snap ring
614	Center plug	653	Spring seat	874	Spring pin
615	Adjust plug	654	Return spring	875	Pin
621	Compensator piston	655	Set spring	876	Pin
622	Piston case	696	Port cover	878	Pin
623	Compensator rod	697	Check valve plate	887	Pin
624	Spring seat(C)	708	O-ring	897	Pin
625	Outer spring	722	O-ring	898	Pin
626	Inner spring	723	O-ring	924	Set screw
627	Adjust stem(C)	724	O-ring	925	Adjust screw(QI)

3) REAR REGULATOR(1/2)

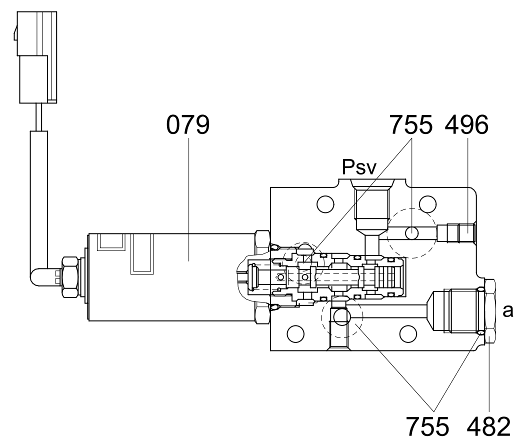




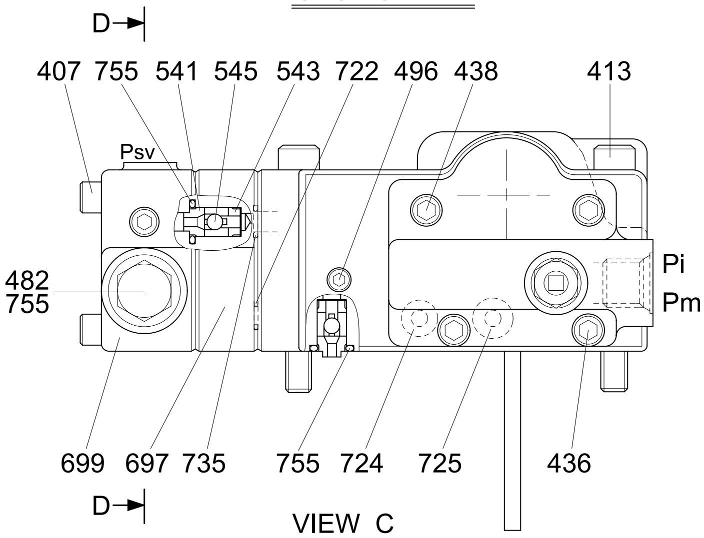
Hydraulic circuit



SECTION B-B



SECTION D-D

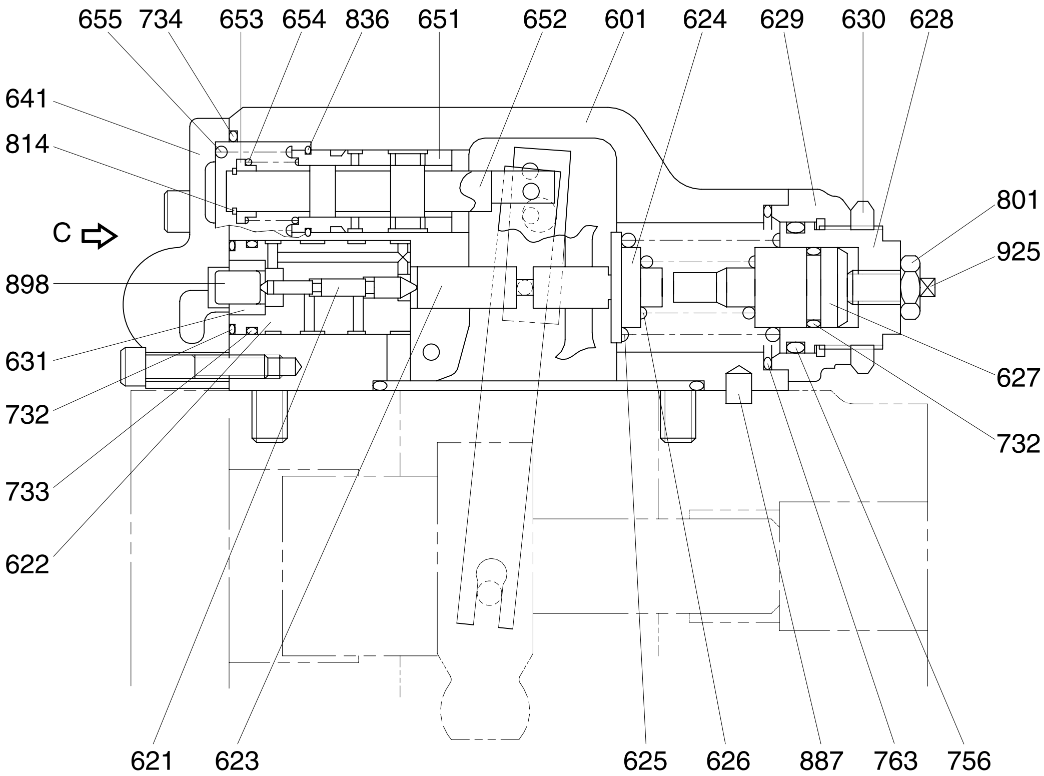


VIEW C

470072RG03

Port	Port name	Port size
Pi	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
P2	Companion delivery port	-
Pf	Powershift port	-
a	Gauge port	PF 1/4 - 15

REAR REGULATOR(2/2)

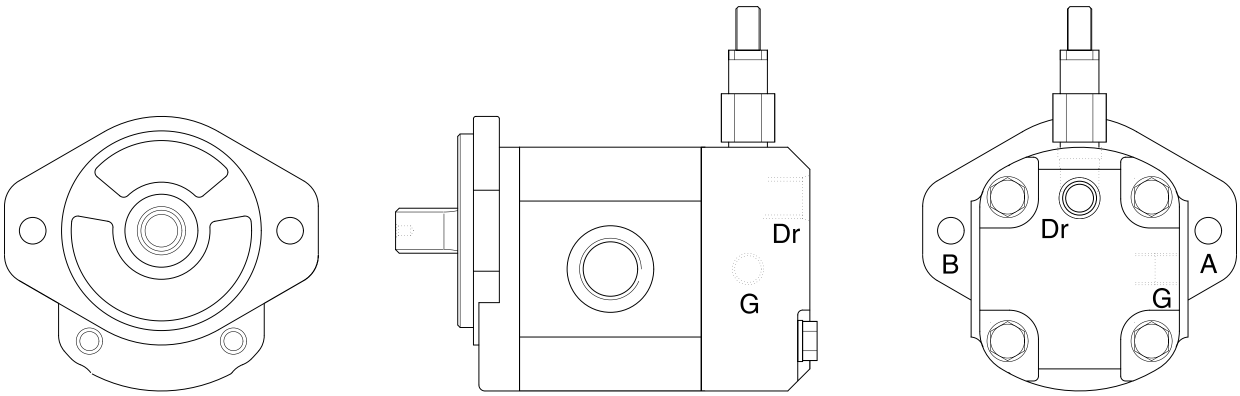


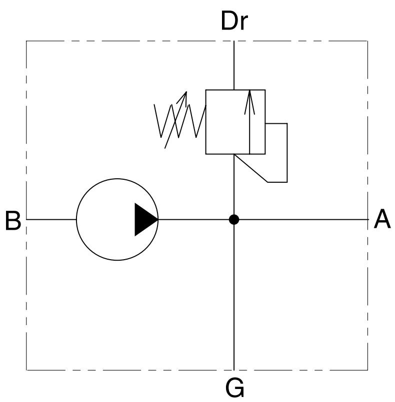
SECTION A-A

470072RG02

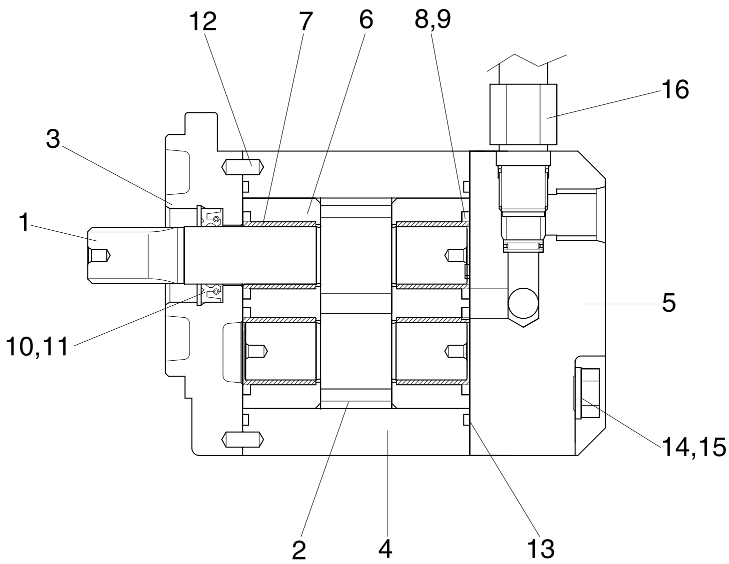
079	EPPR valve	627	Adjust stem(C)	724	O-ring
407	Hexagon socket screw	628	Adjust screw(C)	725	O-ring
412	Hexagon socket screw	629	Cover(C)	728	O-ring
413	Hexagon socket screw	630	Lock nut	730	O-ring
436	Hexagon socket screw	631	Sleeve, pf	732	O-ring
438	Hexagon socket screw	641	Pilot cover	733	O-ring
482	Plug	642	Adjust screw(QMC)	734	O-ring
496	Plug	643	Pilot piston	735	O-ring
541	Seat	644	Spring seat(Q)	755	O-ring
543	Stopper	645	Adjust stem(Q)	756	O-ring
545	Steel ball	646	Pilot spring	763	O-ring
601	Casing	647	Stopper	801	Nut
611	Feed back lever	648	Piston(QMC)	814	Snap ring
612	Lever(1)	651	Sleeve	836	Snap ring
613	Lever(2)	652	Spool(A)	858	Snap ring
614	Center plug	653	Spring seat	874	Spring pin
615	Adjust plug	654	Return spring	875	Pin
621	Compensator piston	655	Set spring	876	Pin
622	Piston case	697	Check valve plate	887	Pin
623	Compensator rod	699	Port cover	897	Pin
624	Spring seat(C)	708	O-ring	898	Pin
625	Outer spring	722	O-ring	924	Set screw
626	Inner spring	723	O-ring	925	Adjust screw(QI)

4) GEAR PUMP





Hydraulic circuit



470072GP01

Port	Port name	Port size
A	Delivery port	PF 1/2
B	Suction port	PF 1
G	Gauge port	PF 1/4
Dr	Drain port	PF 3/8

1 Gear shaft
2 Drive gear
3 Cover(F)
4 Gear housing
5 Cover(R)
6 Block
7 Bushing
8 Seal
9 Back up seal
10 Retainer seal
11 Snap ring
12 Dowel pin
13 O-ring
14 Hexagon bolt
15 Washer
16 Relief valve

2. FUNCTION

1) MAIN PUMP

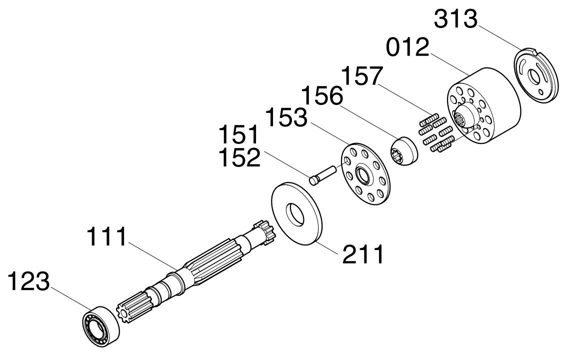
The pumps may classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery rates: and the valve cover group that changes over oil suction and discharge.

(1) Rotary group

The rotary group consists of drive shaft (F)(111), cylinder block(012), piston shoes(151,152), set plate(153), spherical bush(156), and cylinder spring(157).

The drive shaft is supported by bearing(123,124) at its both ends.

The shoe is caulked to the piston to from a spherical coupling. It has a pocket to relieve thrust force generated by loading pressure and the take hydraulic balance so that it slides lightly over the shoe plate(211). The sub group composed by a piston and a shoe is pressed against the shoe plate by the action of the cylinder spring via a retainer and a spherical bush. Similarly, the cylinder block is pressed against valve plate(313) by the action of the cylinder spring.



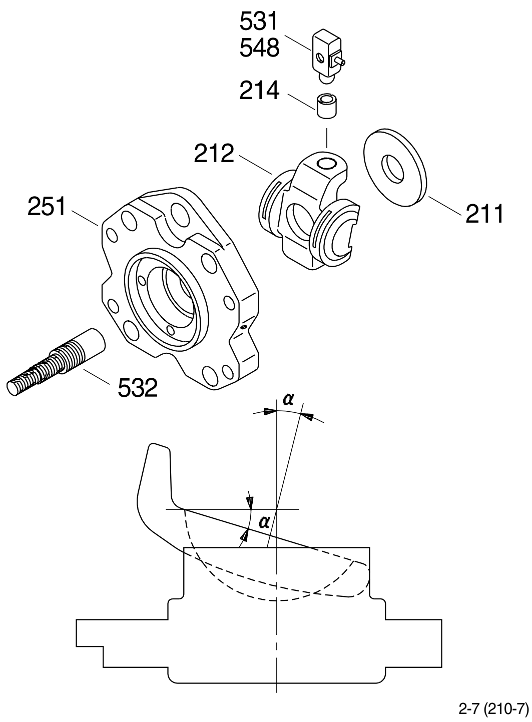
50072MP01

(2) Swash plate group

The swash plate group consists of swash plate(212), shoe plate(211), swash plate support(251), tilting bush(214), tilting pin(531) and servo piston(532).

The swash plate is a cylindrical part formed on the opposite side of the sliding surface of the shoe and is supported by the swash support.

If the servo piston moves to the right and left as hydraulic force controlled by the regulator is admitted to hydraulic chamber located on both sides of the servo piston, the swash plate slides over the swash plate support via the spherical part of the tilting pin to change the tilting angle(α)



2-7 (210-7)

(3) Valve cover group

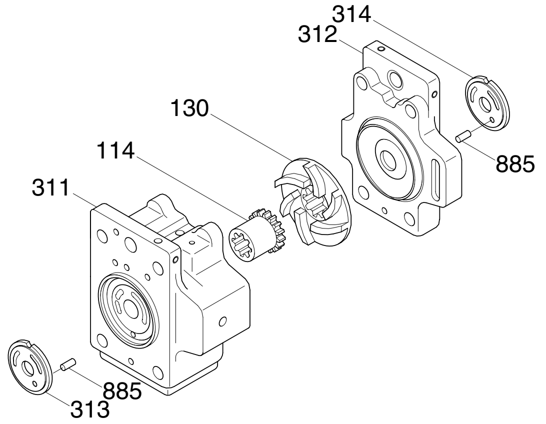
The valve cover group consists of valve cover(F, 311), valve cover(R, 312), valve plate(313, 314), spline coupling(114), booster(130) and valve plate pin(885).

The valve plate having two melon-shaped ports is fixed to the valve cover and feeds and collects oil to and from the cylinder cover.

The oil changed over by the valve plate is connected to an external pipeline by way of the valve cover.

Now, if the drive shaft is driven by a prime mover(electric motor, engine, etc), it rotates the cylinder block via a spline linkage at the same time. If the swash plate is tilted as in Fig(previous page) the pistons arranged in the cylinder block make a reciprocating motion with respect to the cylinder block, while they revolve with the cylinder block.

If you pay attention to a single piston, it performs a motion away from the valve plate(oil sucking process) within 180 degrees, and makes a motion towards the valve plate(or oil discharging process) in the rest of 180 degrees. When the swash plate has a tilting angle of zero, the piston makes no stroke and discharges no oil.



36072MP03

2) REGULATOR

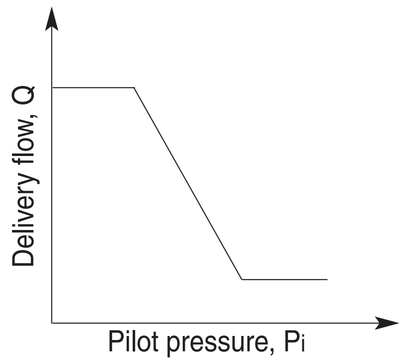
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

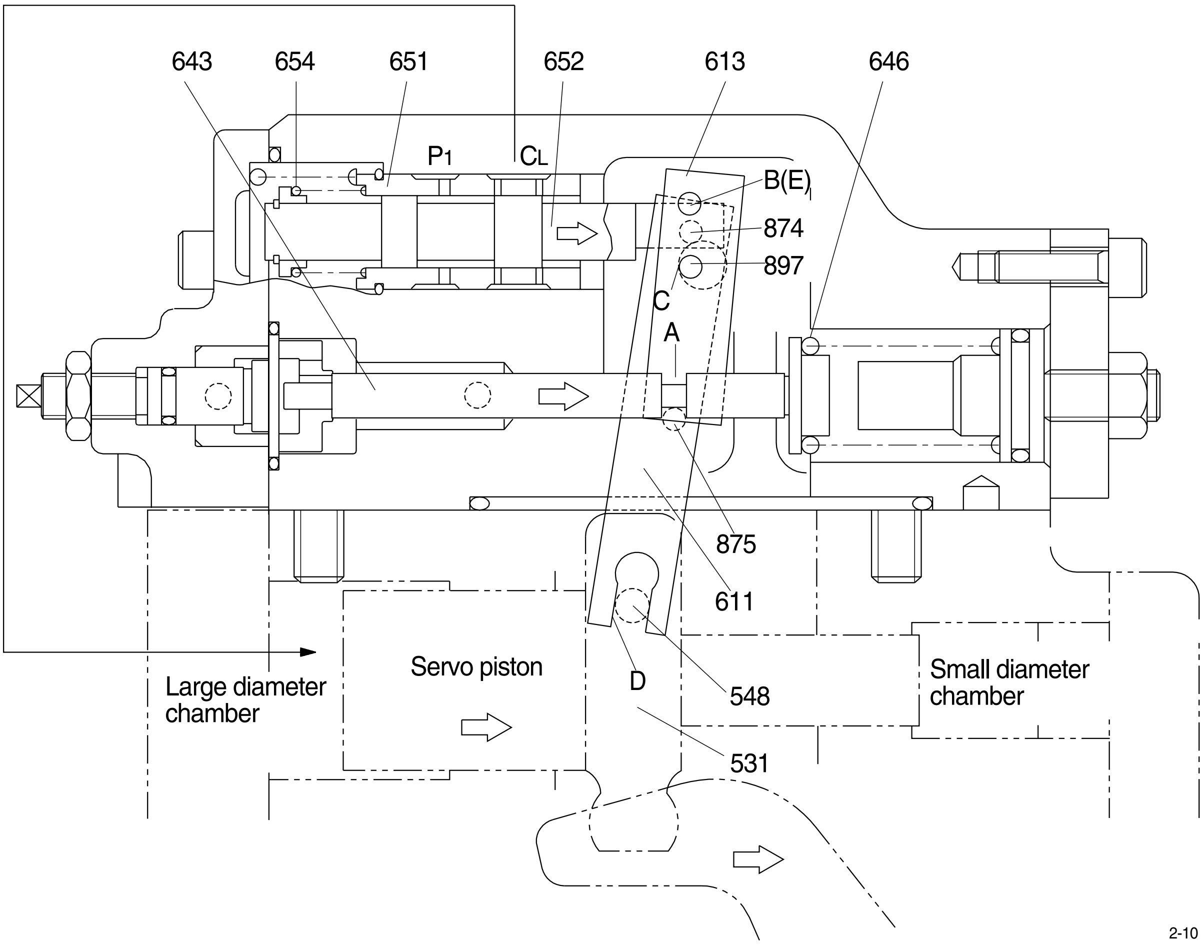
By changing the pilot pressure Pi, the pump tilting angle(delivery flow) is regulated arbitrarily, as shown in the figure.

This regulator is of the negative flow control in which the delivery flow Q decreases as the pilot pressure Pi rises.

With this mechanism, when the pilot pressure corresponding to the flow required for the work is commanded, the pump discharges the required flow only, and so it does not consume the power uselessly.



① Flow reducing function



As the pilot pressure Pi rises, the pilot piston(643) moves to the right to a position where the force of the pilot spring(646) balances with the hydraulic force.

The groove(A) in the pilot piston is fitted with the pin(875) that is fixed to lever 2(613). Therefore, when the pilot piston moves, lever 2 rotates around the fulcrum of point B [Fixed by the fulcrum plug(614) and pin(875)]. Since the large hole section(C) of lever 2 contains a protruding pin(897) fixed to the feedback lever(611), the pin(897) moves to the right as lever 2 rotates. Since the opposing-flat section(D) of the feedback lever is fitted with the pin(548) fixed by the tilting pin(531) that swings the swash plate, the feedback lever rotates around the fulcrum of point D, as the pin(897) moves.

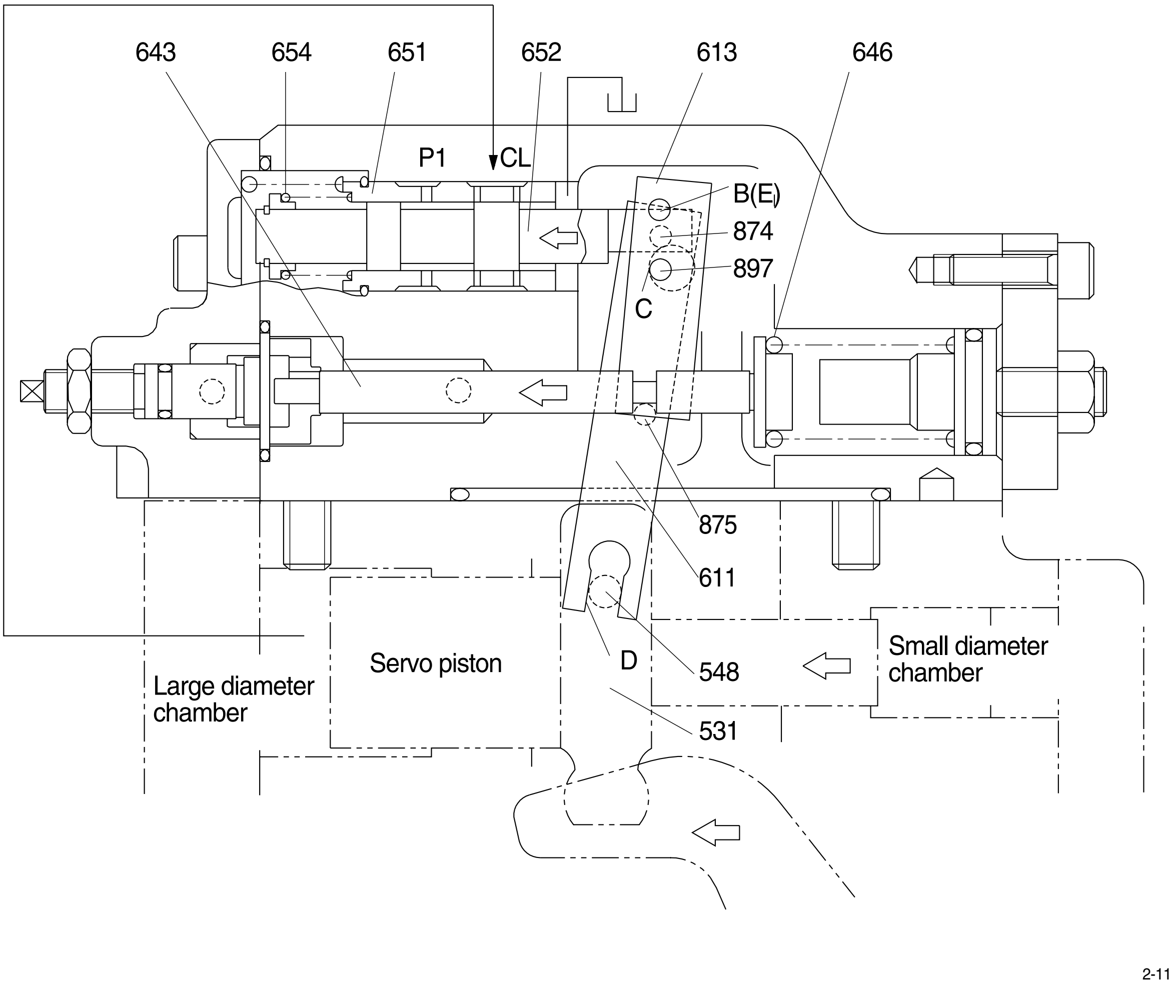
Since the feedback lever is connected with the spool(652) via the pin(874), the spool moves to the right.

The movement of the spool causes the delivery pressure P1 to connect to port CL through the spool and to be admitted to the large diameter section of the servo piston. The delivery pressure P1 that is constantly admitted to the small diameter section of the servo piston moves the servo piston to the right due to the area difference, resulting in decrease of the tilting angle.

When the servo piston moves to the right, point D also moves to the right. The spool is fitted with the return spring(654) and is tensioned to the left at all times, and so the pin(897) is pressed against the large hole section(C) of lever 2.

Therefore, as point D moves, the feedback lever rotates around the fulcrum of point C, and the spool is shifted to the left. This causes the opening between the sleeve(651) and spool(652) to close slowly, and the servo piston comes to a complete stop when it closes completely.

② Flow increasing function



As the pilot pressure Pi decreases, the pilot piston(643) moves to the left by the action of the pilot spring(646) and causes lever 2(613) to rotate around the fulcrum of point B. Since the pin(897) is pressed against the large hole section(C) of lever 2 by the action of the return spring(654) via the spool(652), pin(874), and feedback lever(611), the feedback lever rotates around the fulcrum of point D as lever 2 rotates, and shifts the spool to the left. Port CL opens a way to the tank port as the spool moves. This deprives the large diameter section of the servo piston of pressure, and shifts the servo piston to the left by the discharge pressure P1 in the small diameter section, resulting in an increase in the flow rate.

As the servo piston moves, point D also moves to the left, the feedback lever rotates around the fulcrum of point C, and the spool moves to the right till the opening between the spool and sleeve is closed.

③ Adjustment of flow control characteristic

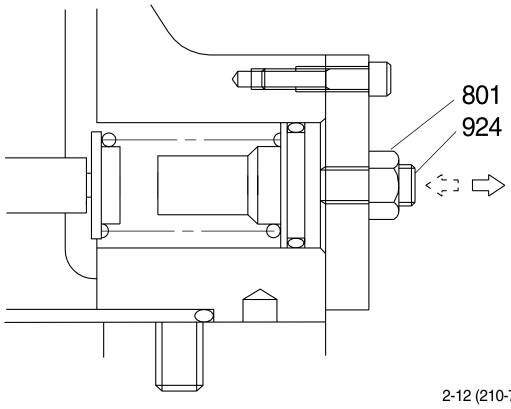
The flow control characteristic can be adjusted with the adjusting screw.

Adjust it by loosening the hexagon nut (801) and by tightening(or loosening) the hexagonal socket head screw(924).

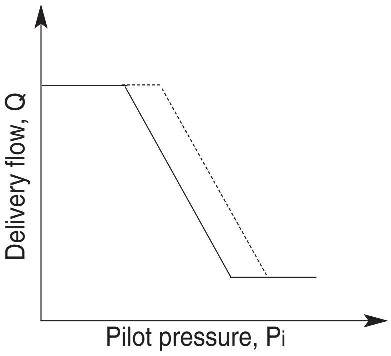
Tightening the screw shifts the control chart to the right as shown in the figure.

※ **Adjusting values are shown in table.**

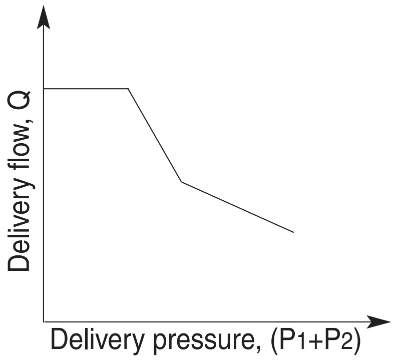
Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting screw(924)	Flow control starting pressure change amount	Flow change amount
(min^{-1})	(Turn)	(kgf/cm^2)	(l /min)
1900	+1/4	+1.63	+22.2



2-12 (210-7)



(2) Total horsepower control



The regulator decreases the pump tilting angle(delivery flow) automatically to limit the input torque within a certain value with a rise in the delivery pressure P1 of the self pump and the delivery pressure P2 of the companion pump.

(The input horsepower is constant when the speed is constant.)

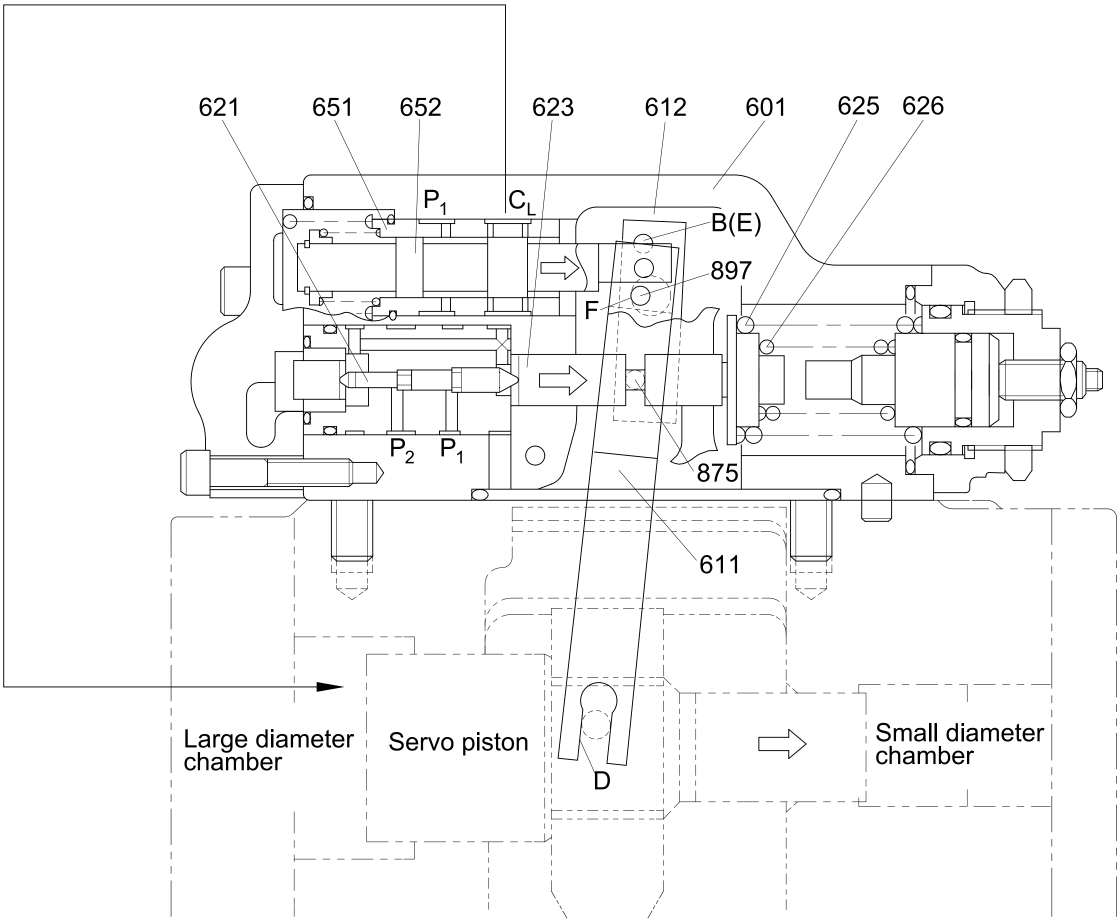
Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control is under way.

Since this regulator is of the simultaneous total horsepower type, it controls the tilting angles(displacement volumes) of the two pumps to the same value as represented by the following equation :

$$T_{in} = P1 \times q/2\pi + P2 \times q/2\pi$$
$$= (P1+P2) \times q/2\pi$$

The horsepower control function is the same as the flow control function and is summarized in the following.(For detailed behaviors of respective parts, refer to the section of flow control).

① Overload preventive function



45070RG09

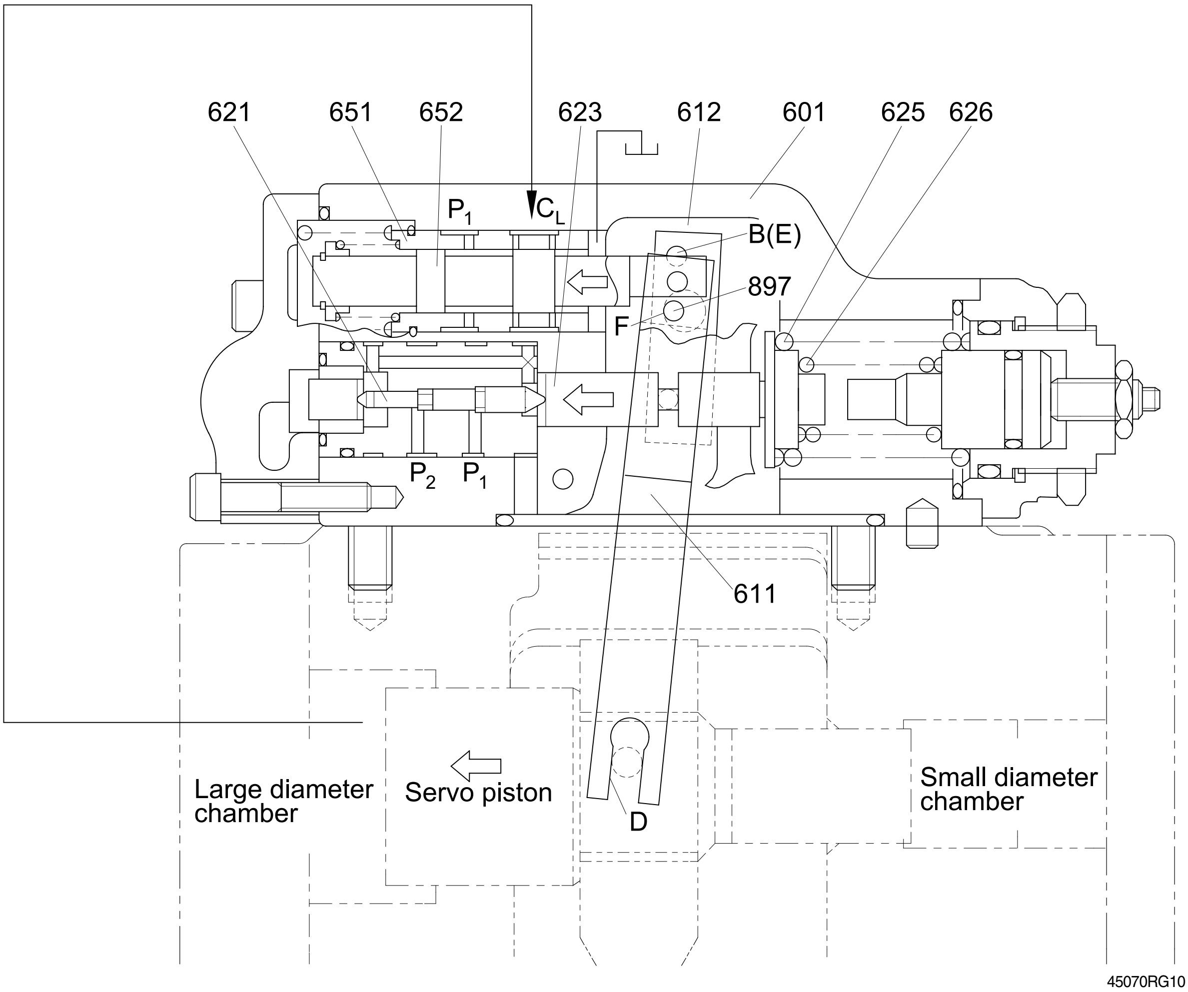
When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston(621). It presses the compensating rod(623) to the right till the force of the outer spring(625) and inner spring(626) balances with the hydraulic force. The movement of the compensating rod is transmitted to lever 1(612) via pin(875).

Lever 1 rotates around the pin(875) (E) fixed to the casing(601).

Since the large hole section(F) of lever 1 contains a protruding pin(897) fixed to the feedback lever(611), the feedback lever rotates around the fulcrum of point D as lever 1 rotates, and then the spool(652) is shifted to the right. As the spool moves, the delivery pressure P1 is admitted to the large diameter section of the servo piston via port CL, causes the servo piston move to the right, reduces the pump delivery, flow rate, and prevents the prime mover from being overloaded.

The movement of the servo piston is transmitted to the feedback lever via point D. Then the feedback lever rotates around the fulcrum of point F and the spool is shifted to the left. The spool moves till the opening between the spool(652) and sleeve(651) is closed.

② **Flow reset function**



As the self pump delivery pressure P1 or the companion pump delivery pressure P2 decreases, the compensating rod(623) is pushed back by the action of the springs(625 & 626) to rotate lever 1(612) around point E. Rotating of lever 1 causes the feedback lever(611) to rotate around the fulcrum of point D and then the spool(652) to move to the left. As a result, port CL opens a way to the tank port.

This causes the servo piston to move to the left and the pump's delivery rate to increase.

The movement of the servo piston is transmitted to the spool by the action of the feedback mechanism to move it till the opening between the spool and sleeve is closed.

③ **Low tilting angle(low flow) command preferential function**

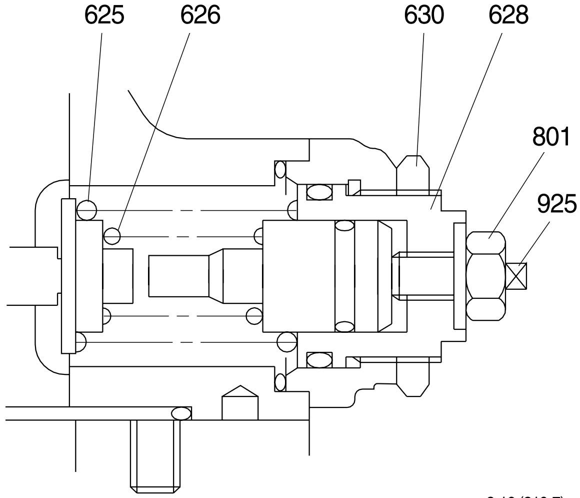
As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections(C & F) of levers 1 and 2. However, since sections C and F have the pins(ø 4) protruding from the large hole(ø 8), only the lever lessening the tilting angle contacts the pin(897) ; the hole(ø 8) in the lever of a larger tilting angle command is freed without contacting the pin(897). Such a mechanical selection method permits preference of the lower tilting angle command of the flow control and horsepower control.

④ **Adjustment of input horsepower**

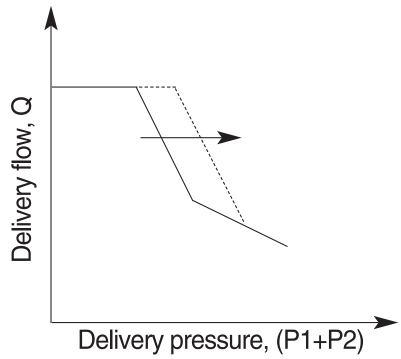
Since the regulator is of total cumulative horsepower type, adjust the adjusting screws of both the front and rear pumps, when changing the horsepower set values. The pressure change values by adjustment are based on two pumps pressurized at the same time, and the values will be doubled when only one pump is loaded.

a. **Adjustment of outer spring**

Adjust it by loosening the hexagon nut(630) and by tightening(or loosening) the adjusting screw C(628). Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C by N turns changes the setting of the inner spring(626), return the adjusting screw CI(925) by N×A turns at first.(A=1.54)



2-16 (210-7)



※ **Adjusting values are shown in table.**

Speed	Adjustment of outer spring		
	Tightening amount of adjusting screw(C) (628)	Compensating control starting pressure change amount	Input torque change amount
(min $^{-1}$)	(Turn)	(kgf/cm^2)	(kgf · m)
1900	+1/4	+17.85	+9.7

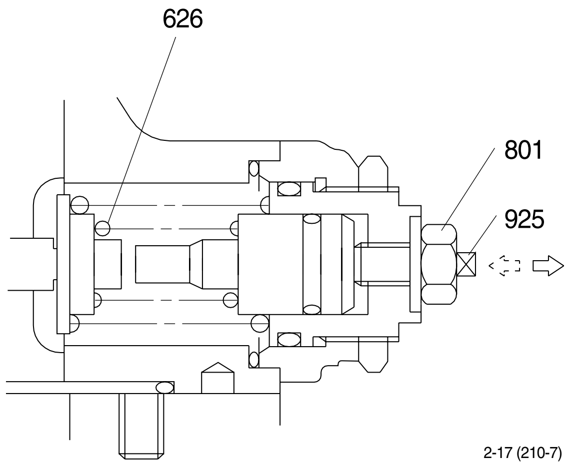
b. Adjustment of inner spring

Adjust it by loosening the hexagon nut (801) and by tightening(or loosening) the adjusting screw QI(925).

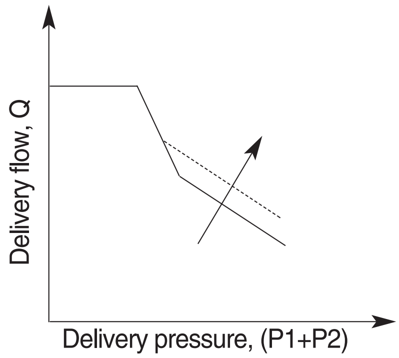
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

※ **Adjusting valves are shown in table.**

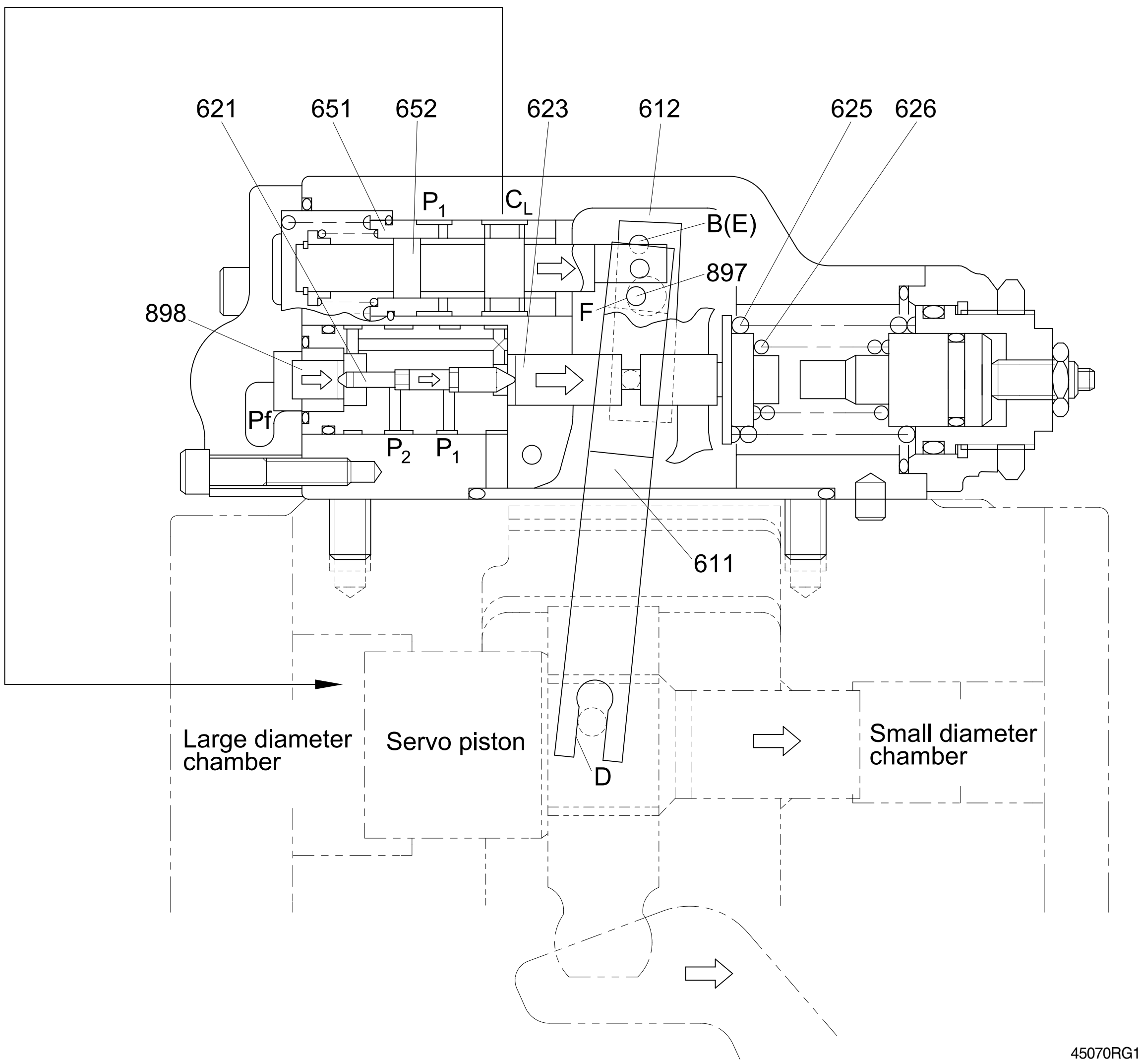
Speed	Adjustment of inner spring		
	Tightening amount of adjusting screw(QI) (925)	Flow change amount	Input torque change amount
(min^{-1})	(Turn)	(lpm)	(kgf · m)
1900	+1/4	+19.6	+10.4



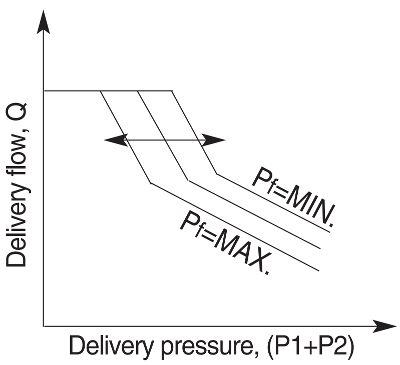
2-17 (210-7)



(3) Power shift control



45070RG11



The set horsepower valve is shifted by varying the command current level of the proportional pressure reducing valve attached to the pump.

Only one proportional pressure reducing valve is provided. However, the secondary pressure Pf (power shift pressure) is admitted to the horsepower control section of each pump regulator through the pump's internal path to shift it to the same set horsepower level.

This function permits arbitrary setting of the pump output power, thereby providing the optimum power level according to the operating condition.

The power shift pressure Pf controls the set horsepower of the pump to a desired level, as shown in the figure.

As the power shift pressure Pf rises, the compensating rod(623) moves to the right via the pin(898) and compensating piston(621).

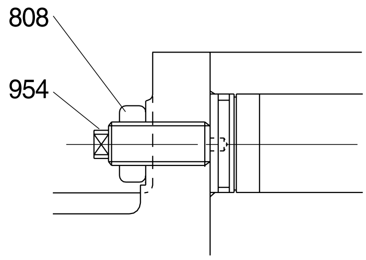
This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

(4) Adjustment of maximum and minimum flows

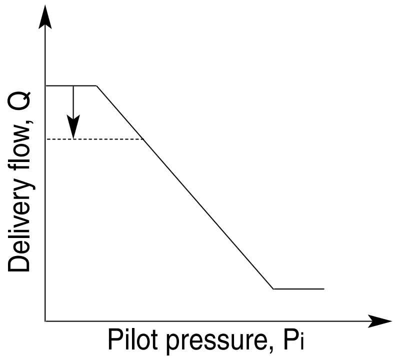
① Adjustment of maximum flow

Adjust it by loosening the hexagon nut(808) and by tightening(or loosening) the set screw(954).
The maximum flow only is adjusted without changing other control characteristics.

Speed (min^{-1})	Adjustment of max flow	
	Tightening amount of adjusting screw (954) (Turn)	Flow change amount (ℓ/min)
1900	+1/4	-7.3



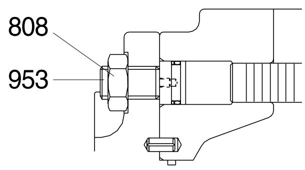
2-19(1)



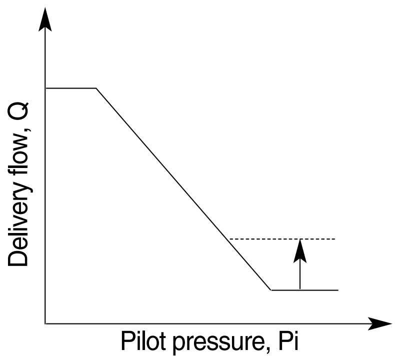
② Adjustment of minimum flow

Adjust it by loosening the hexagon nut(808) and by tightening(or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.
However, remember that, if tightened too much, the required horsepower during the maximum delivery pressure(or during relieving) may increase.

Speed (min^{-1})	Adjustment of min flow	
	Tightening amount of adjusting screw (953) (Turn)	Flow change amount (ℓ/min)
1900	+1/4	+7.3

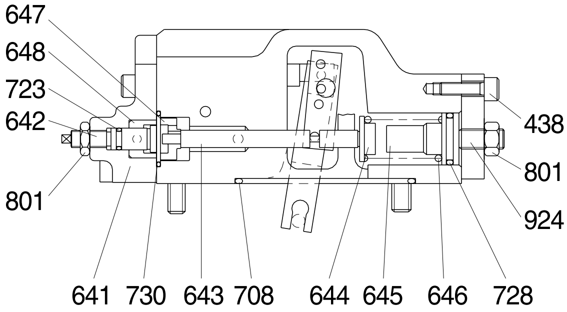


2-19(2)



(5) Qmax cut control

The regulator regulates the maximum delivery flow by inputting the pilot pressure Pm. Since this is a 2-position control method, the maximum delivery flow may be switched in two steps by turning on/off the pilot pressure Pm.(The maximum control flow cannot be controlled in intermediate level.)



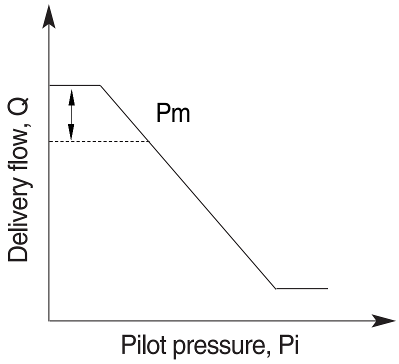
2-4

① **Functional explanation**

As shown in the figure, the pilot pressure Pm switches the maximum flow in two steps.

When the pilot pressure Pm is given, it is admitted to the lefthand side of the piston QMC(648). The piston QMC moves the stopper(647) and pilot piston(643) to the right, overcoming the force of the pilot spring(646), thereby reducing the delivery flow of the pump.

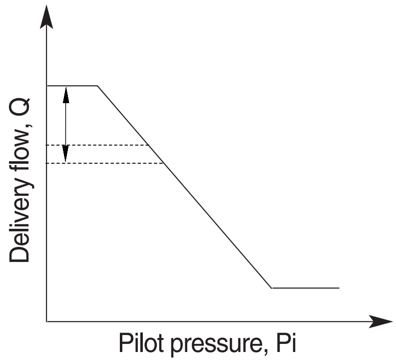
Since the adjusting screw QMC(642) is provided with a flange, the piston QMC stops upon contact with the flange, and the position of the pilot piston at this time determines the maximum flow of the pump.



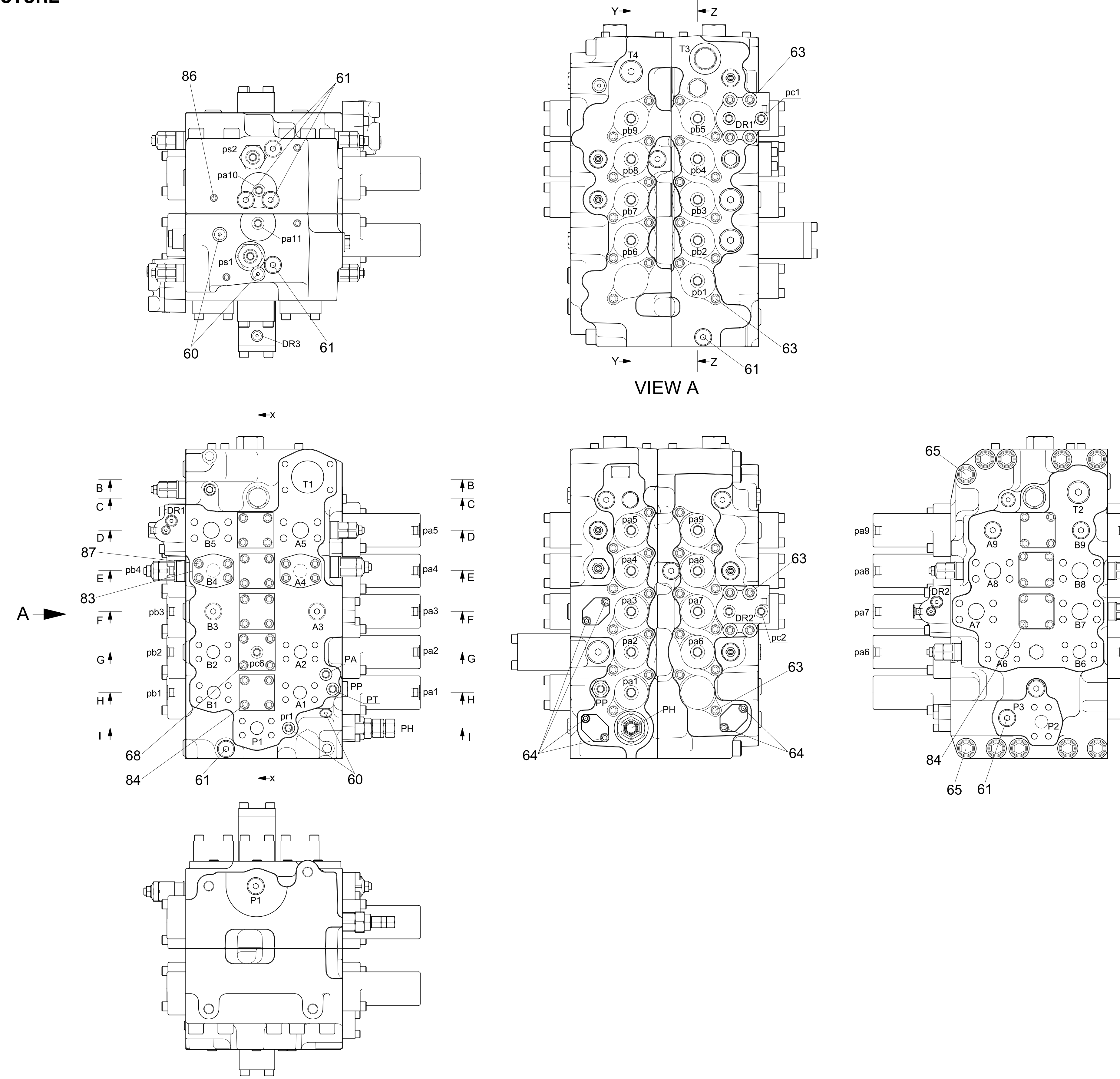
② **Adjustment of Qmax cut flow**

Adjust it by loosening the hexagon nut(801) and by tightening(or loosening) the adjusting screw QMC(642).

Tightening the screw decreases the Qmax cut flow as shown in the figure.



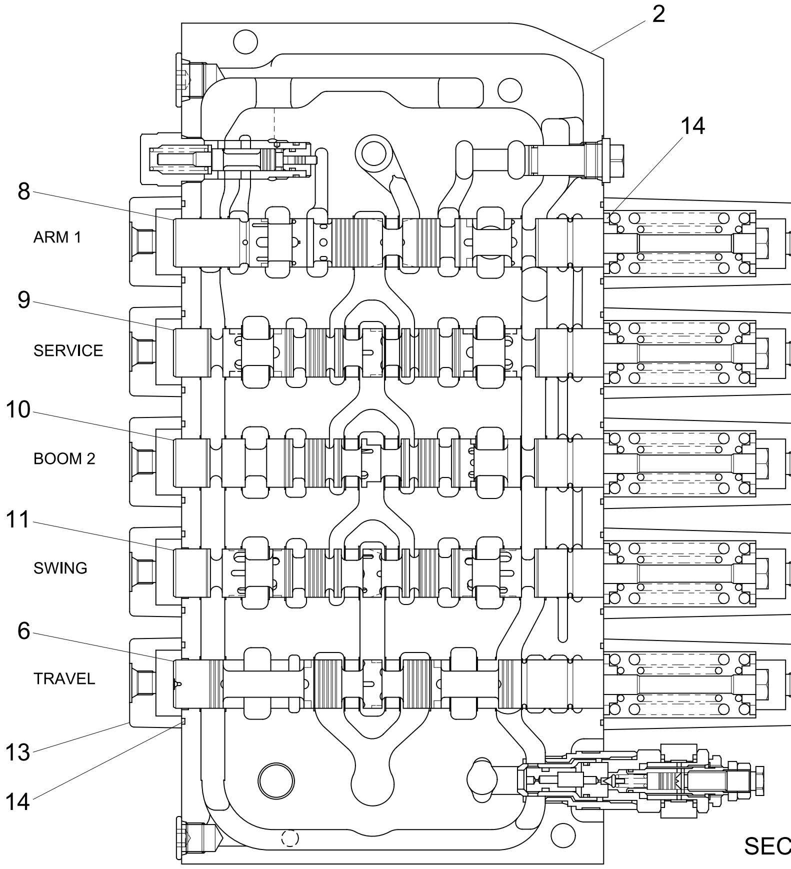
1. STRUCTURE



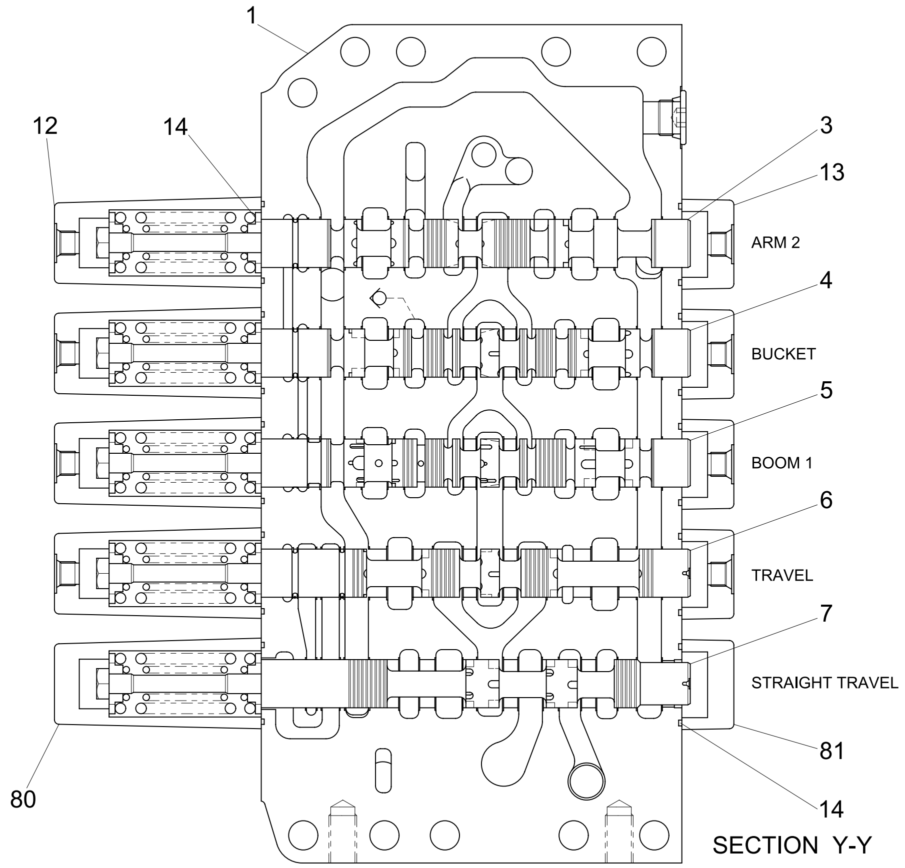
45071MC21

Mark	Port size	Thread depth (mm)
DR1, DR2, DR3, DR1', DR2', pr1, ps1, ps2, pc1, pc2, pc6, pa10, pa11, PA, PP, PH	PF 1/4	12
pa1~pa9, pb1~pb9	PF 3/8	14
A3, A9, B3, B9, P1, P3	PF 1/2	16
T3, T4	PF 3/4	17
T2	PF 1	21

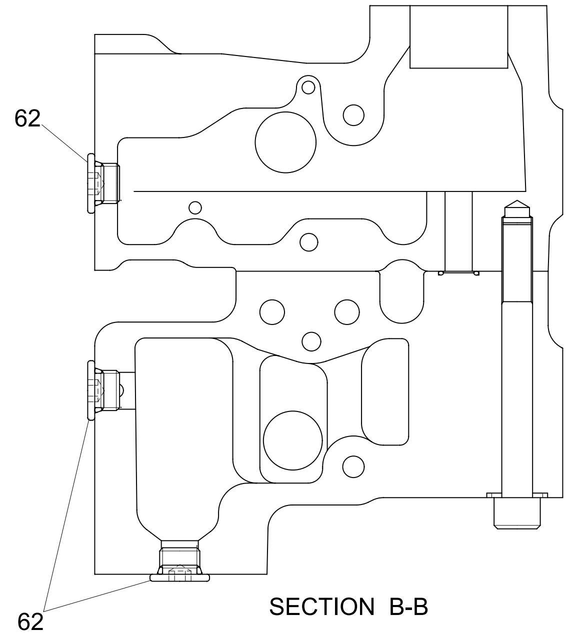
1 Valve housing
2 Valve housing
3 Spool assy(AM2)
4 Spool assy(BKT)
5 Spool assy(BM1)
6 Spool assy(TR)
7 Spool assy(S/TR)
8 Spool assy(AM1)
9 Spool assy(SER)
10 Spool assy(BM2)
11 Spool assy(SW)
12 Cap
13 Cap
14 O-ring
15 Poppet
16 Spring
17 Spacer
18 O-ring
19 Back up ring
20 Spool assy
21 Spring seat(A)
22 Spring
23 Plug
24 Spool assy
25 Spring
26 O-ring
27 Plug
28 Poppet
29 Spring
30 Poppet
31 Poppet
32 Poppet
33 Spring
34 Flange
35 O-ring
36 Poppet assy
37 Spring
38 Sleeve
39 Piston
40 O-ring
41 Back up ring
42 Body
43 Piston
44 Flange
45 O-ring
46 Poppet
47 Body assy
48 Relief valve kit
49 Relief valve kit
50 Relief valve assy
51 Plug assy
52 Poppet
53 Spring
54 Plug
55 O-ring
56 Flange
57 O-ring
59 Plug assy
60 Plug assy
61 Plug assy
62 Plug assy
63 Socket head bolt
64 Socket head bolt
65 Socket head bolt
68 Socket head bolt
69 Poppet
72 Relief valve kit
76 O-ring
77 O-ring
78 O-ring
79 O-ring
80 Cap
81 Cap
82 Steel ball
83 Flange
84 Socket head bolt
85 O-ring
86 Socket head bolt
87 Socket head bolt



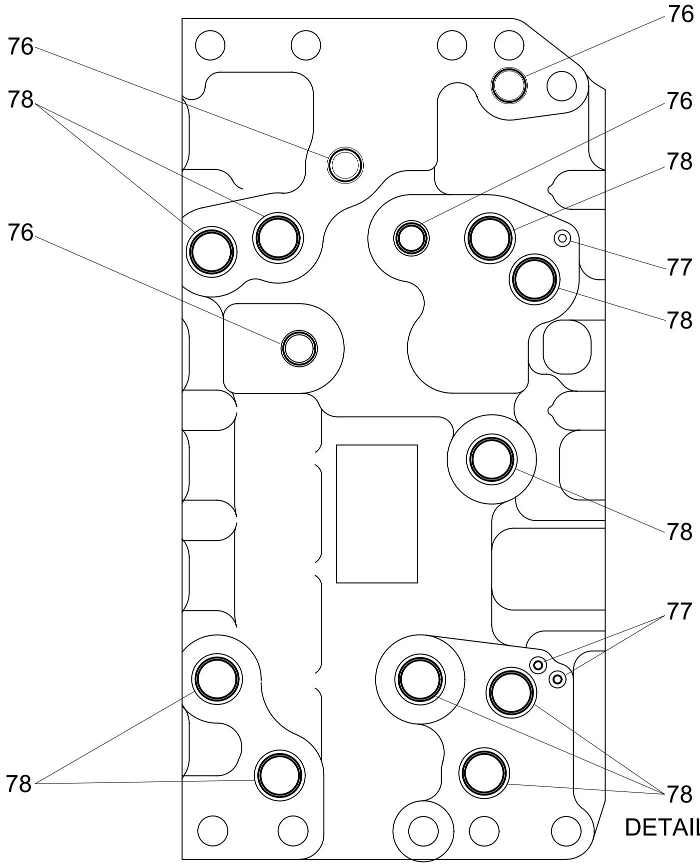
SECTION Z-Z



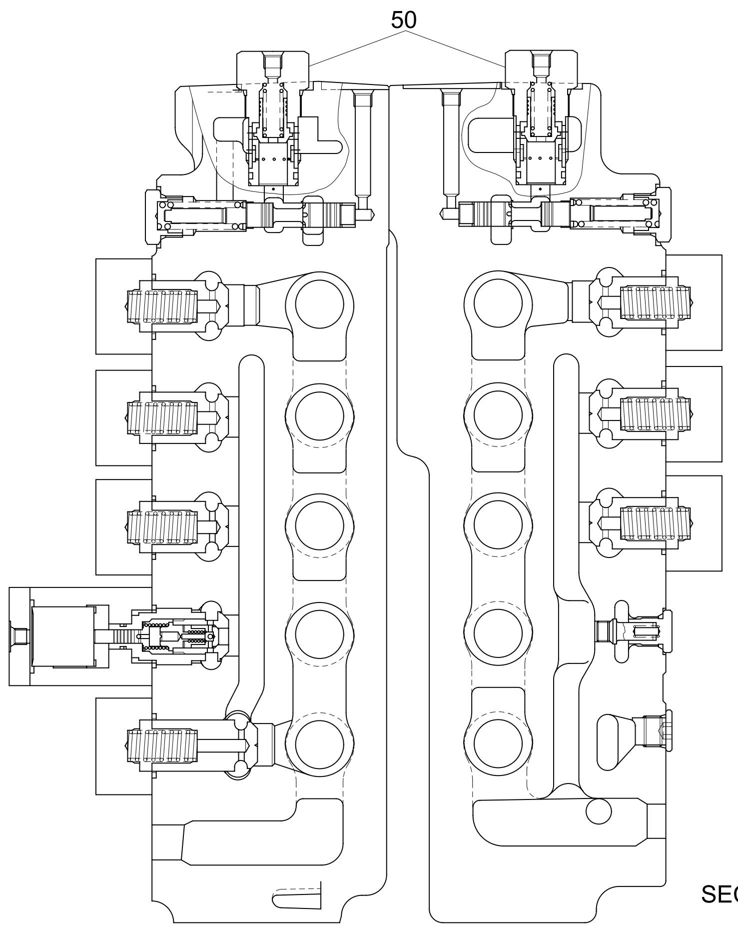
SECTION Y-Y



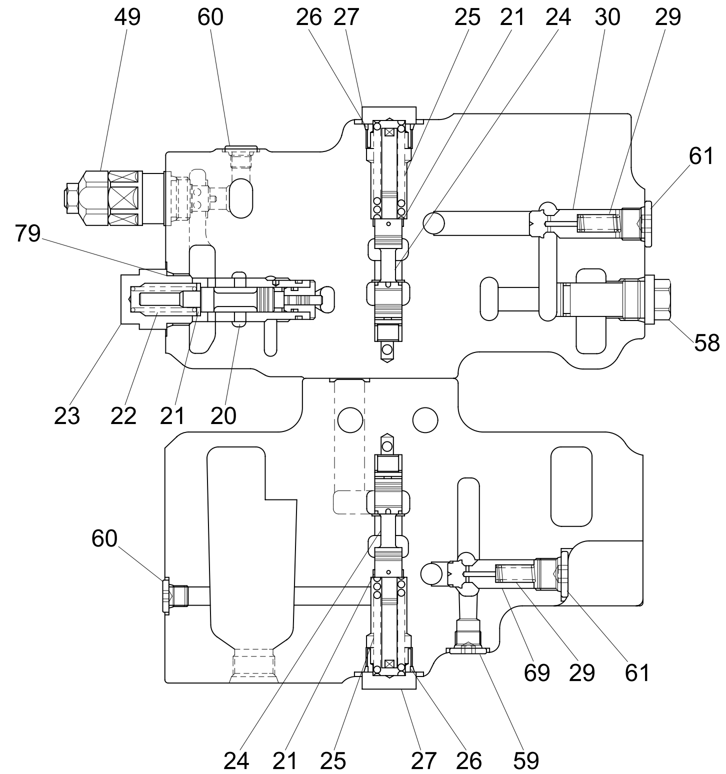
SECTION B-B



DETAIL OF COMBINED PLANE

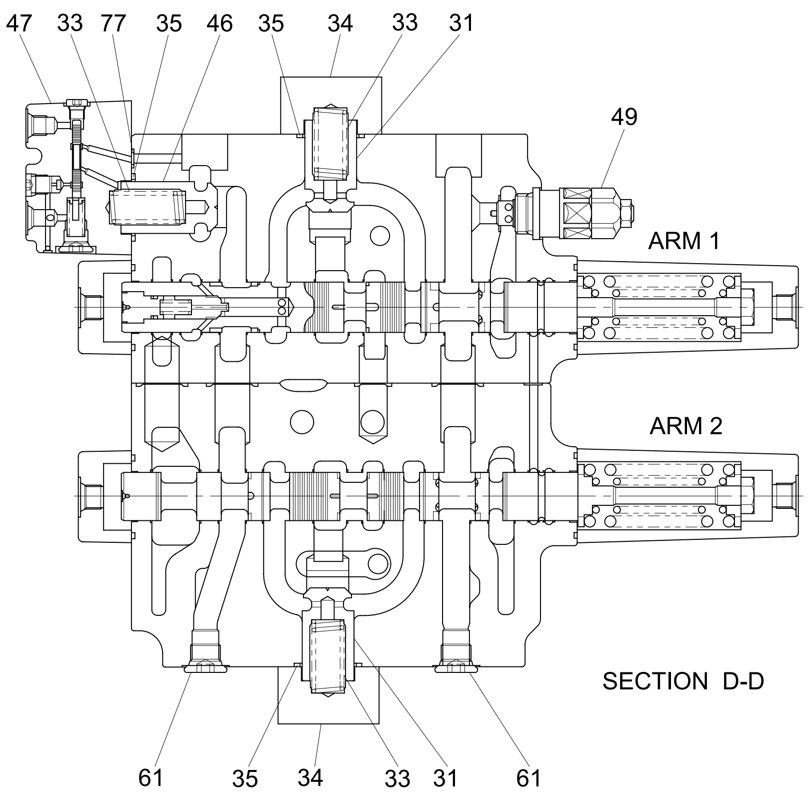


SECTION X-X

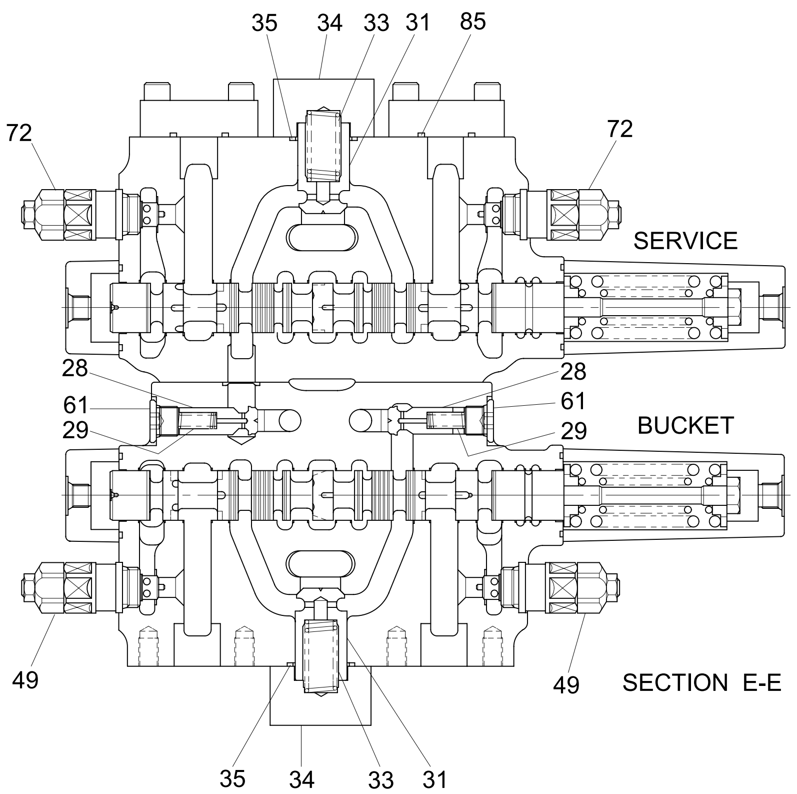


SECTION C-C

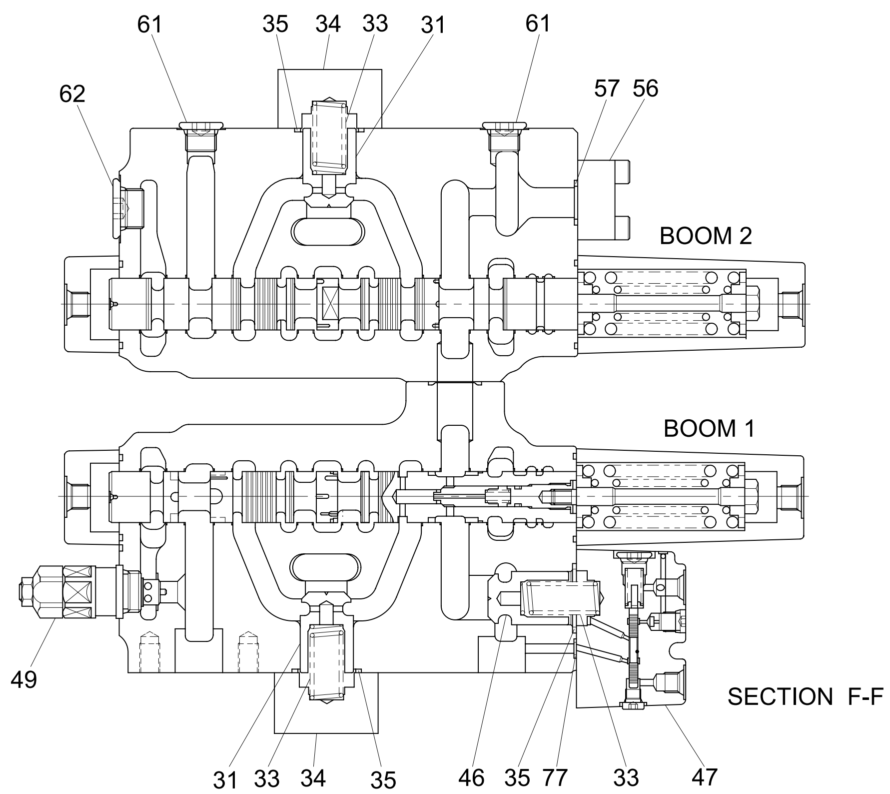
45071MC22



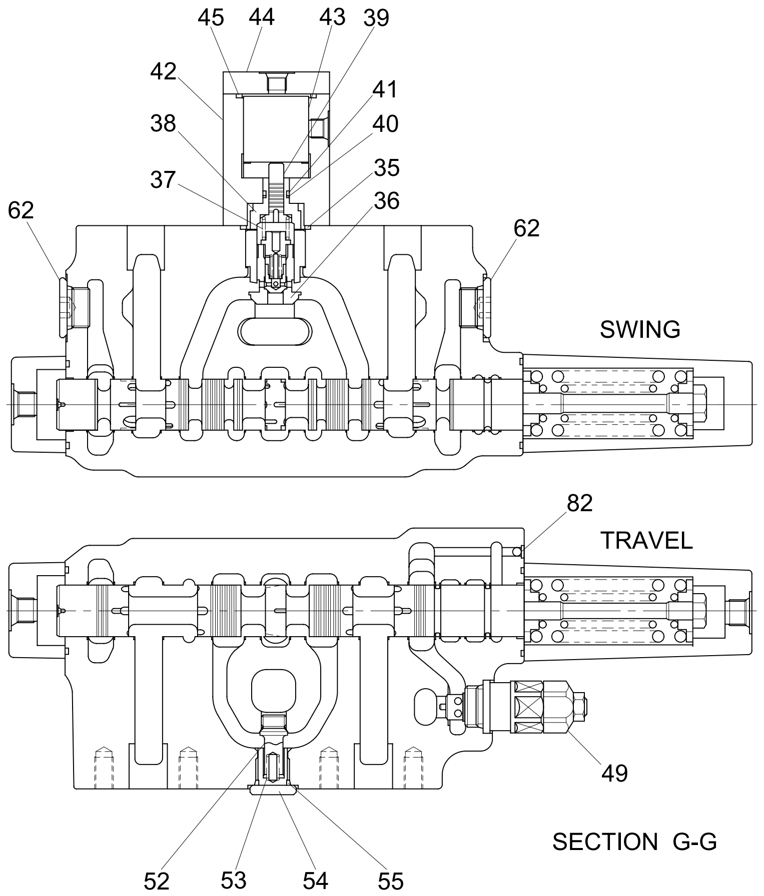
SECTION D-D



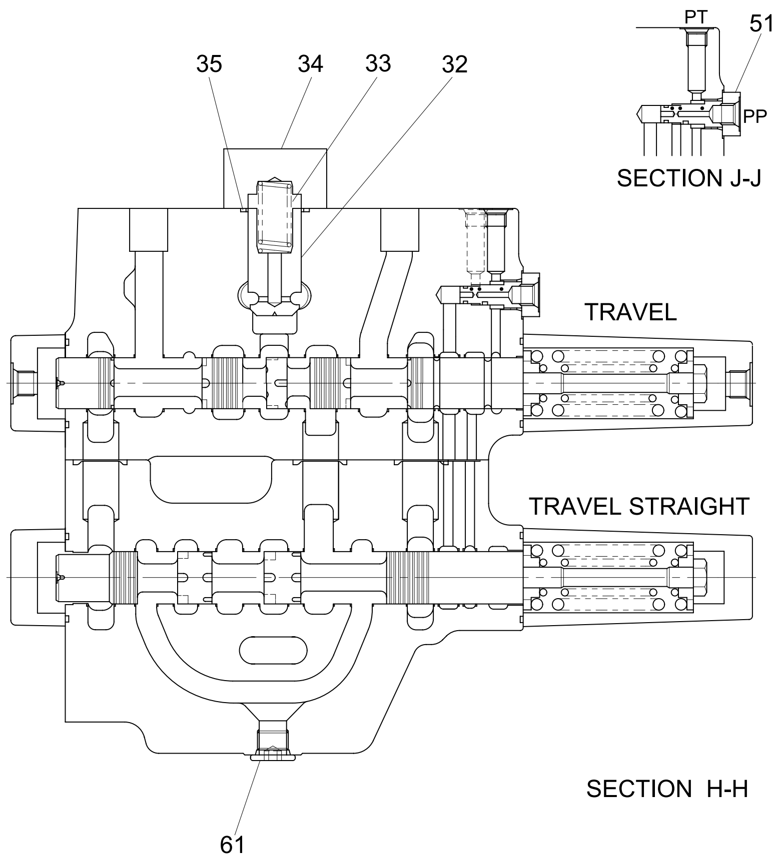
SECTION E-E



SECTION F-F

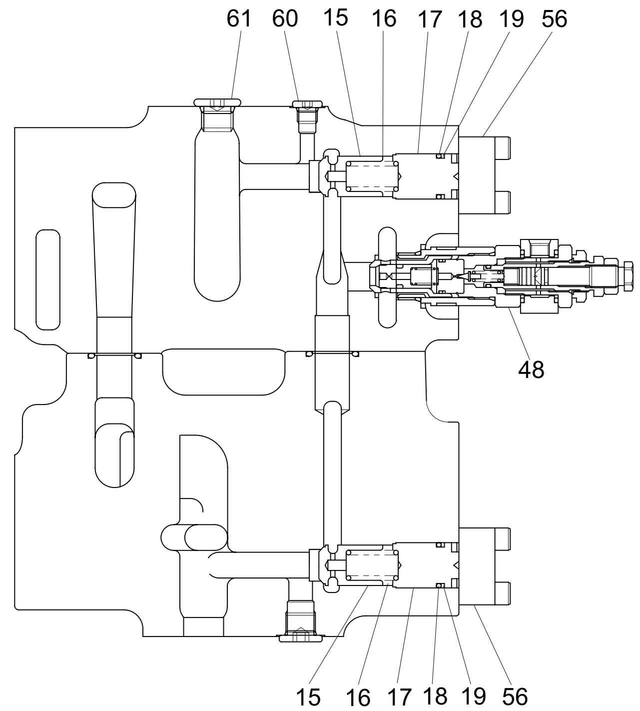


SECTION G-G



SECTION H-H

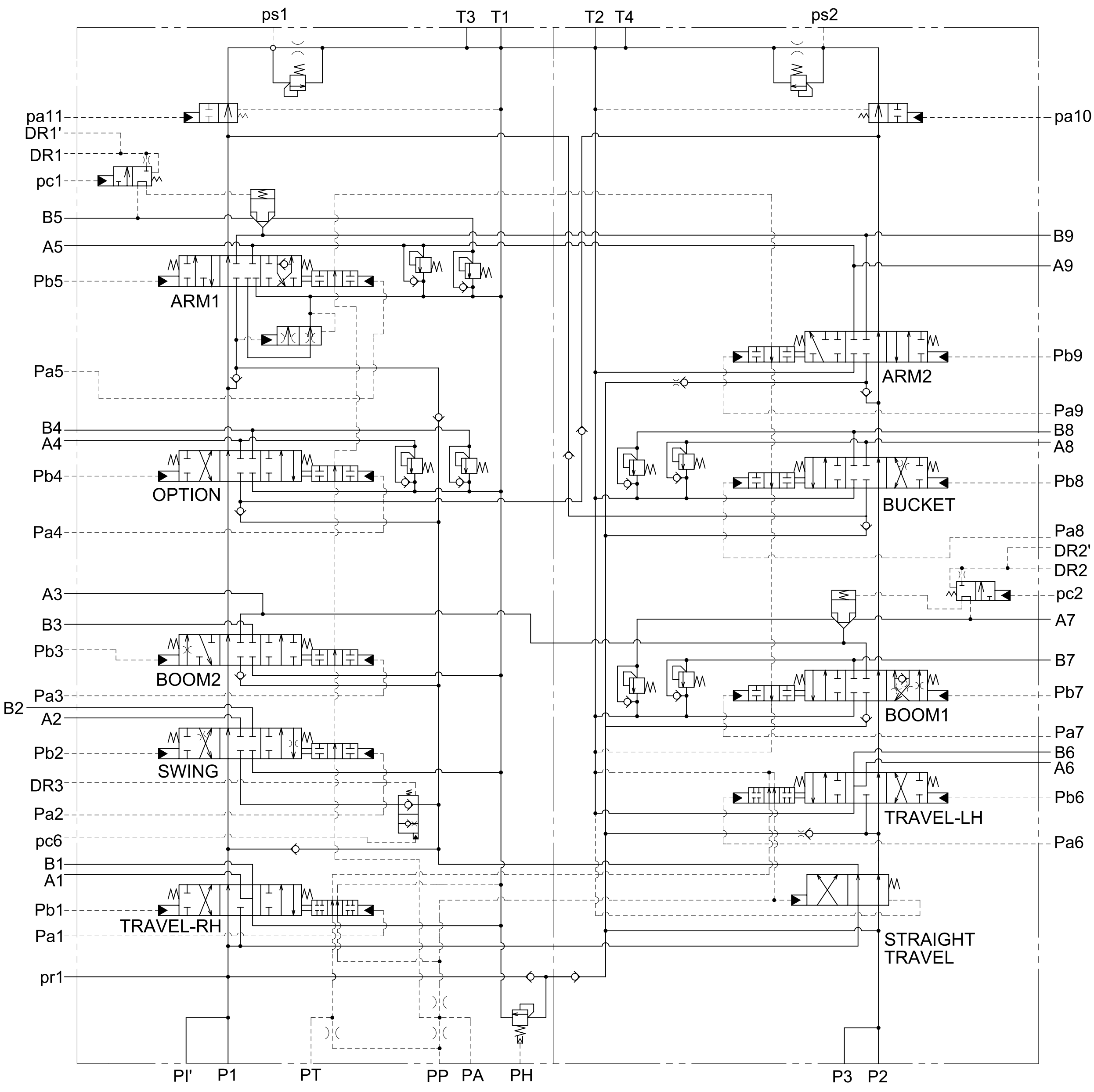
SECTION J-J



SECTION I-I

45071MC23

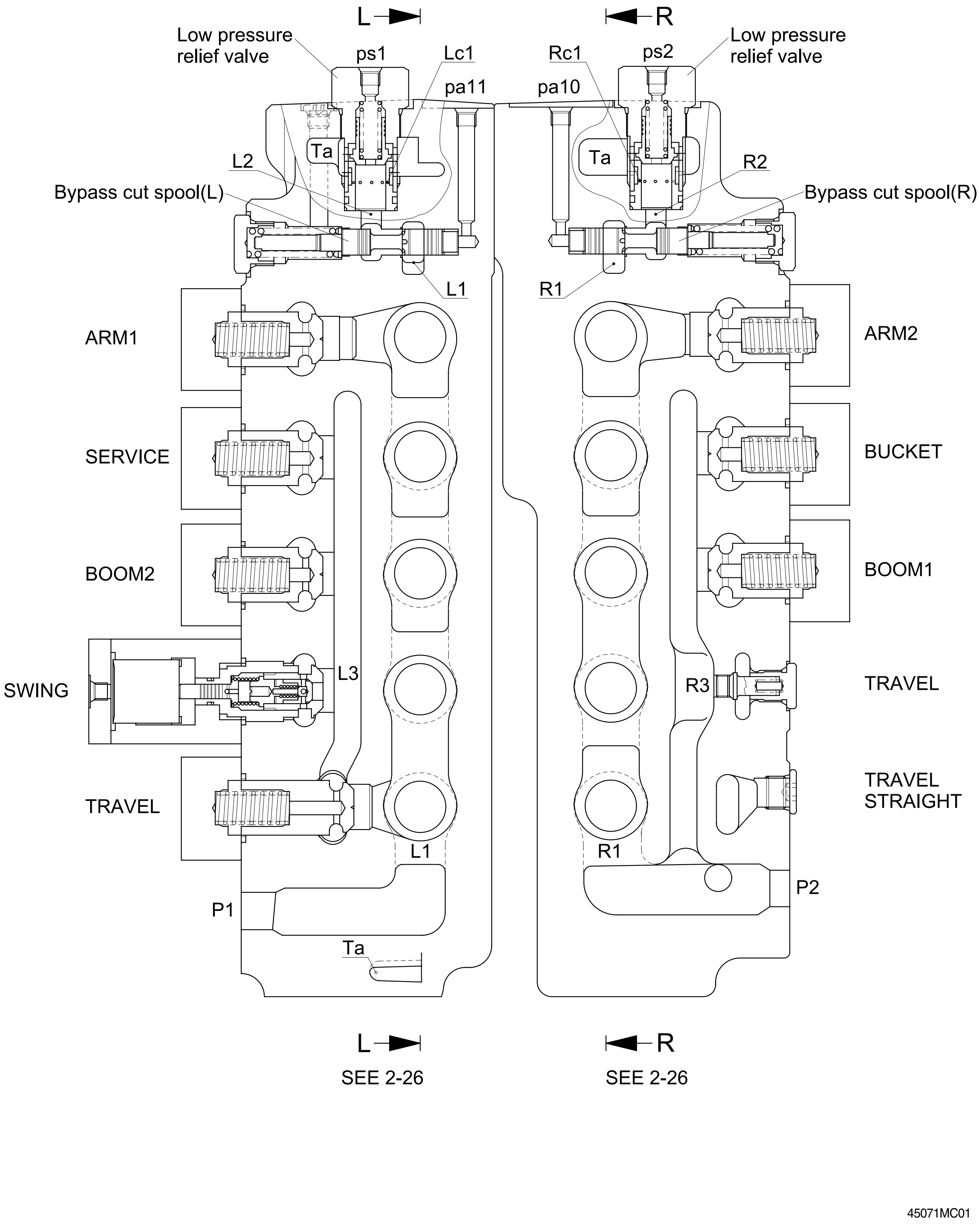
2. HYDRAULIC CIRCUIT



45071MC20

3. OPERATION

1) ALL SPOOL NEUTRAL



(1) Neutral passage

① Oil from pump P1 goes through neutral passage(L1) to the orifice(Lc1) of the low pressure relief valve and then oil returns to port T1 and T3 via tank passage(Ta).

② Oil from pump P2 goes through neutral passage(R1) to the orifice(Rc1) of the low pressure relief valve and then oil returns to port T1 and T3 via tank passage(Ta).

③ The pressure of upper chamber(L2), (R2) for the low pressure relief valve flow into pump through port ps1, ps2 and then controls the discharge of pump P1, P2.

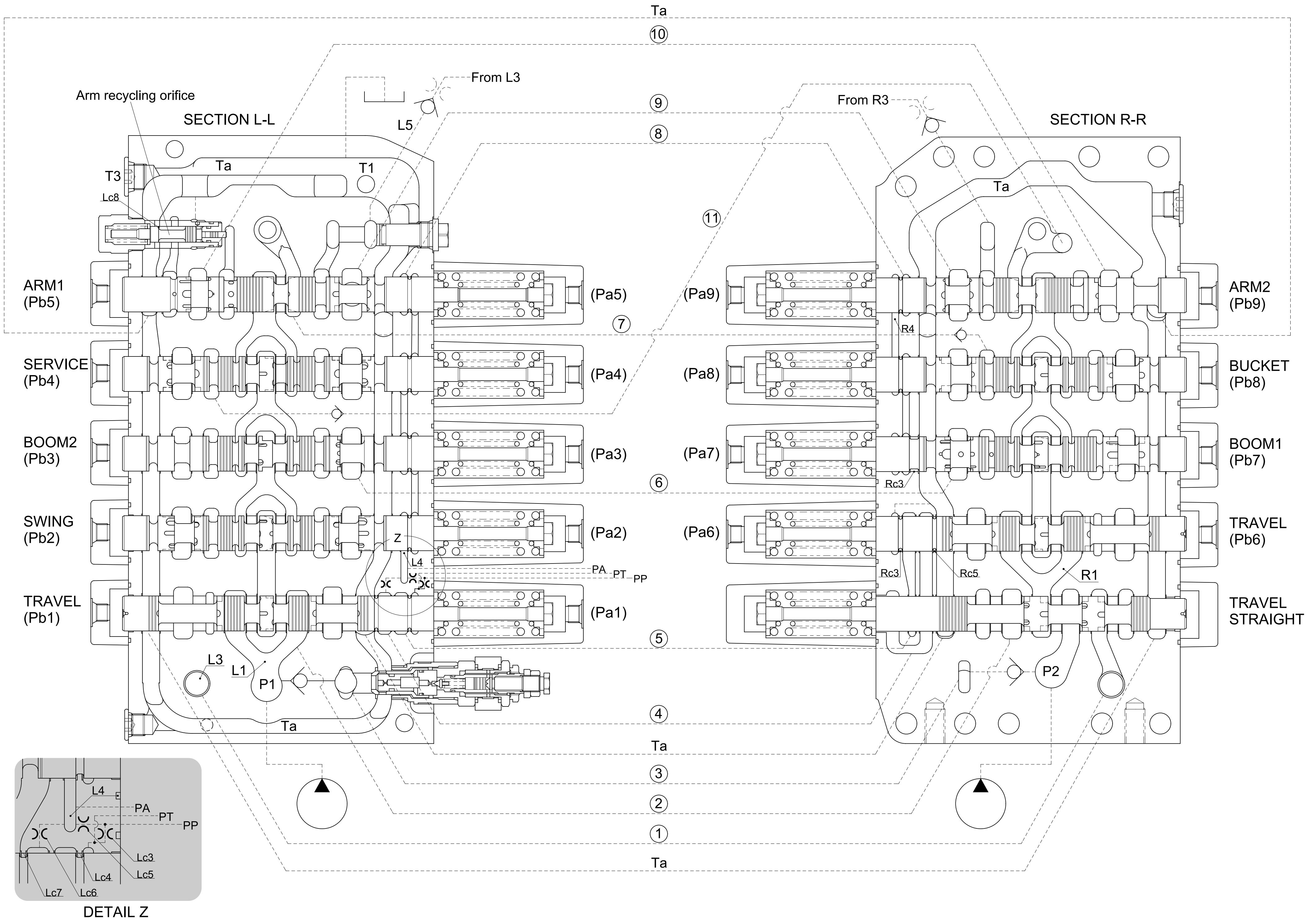
④ When a large amount of oil flows the neutral passage, the low pressure relief valves is operated. As a result, the shock pressure of port ps1, ps2 is prevented.

(2) Signal passage

① Oil from port PP flows into port PT via orifice(Lc3). At the same time, after passing through passage(⑤) via land (Lc4), oil returns to the tank passage(Ta) via land(Rc3).

② Meanwhile, some of oil from port PP flows into port PA via orifice (Lc5) and return to the tank passage(Ta) from boom 1 spool land(Rc4) via passage(L4, ⑧ , R4).

③ Oil via orifice(Lc6) flows into the tank passage(Ta) from land(Lc7) and return to the tank passage(Ta) via travel spool land(Rc5) through the passage ④.



45071MC02

2) SINGLE OPERATION

(1) Travel spool

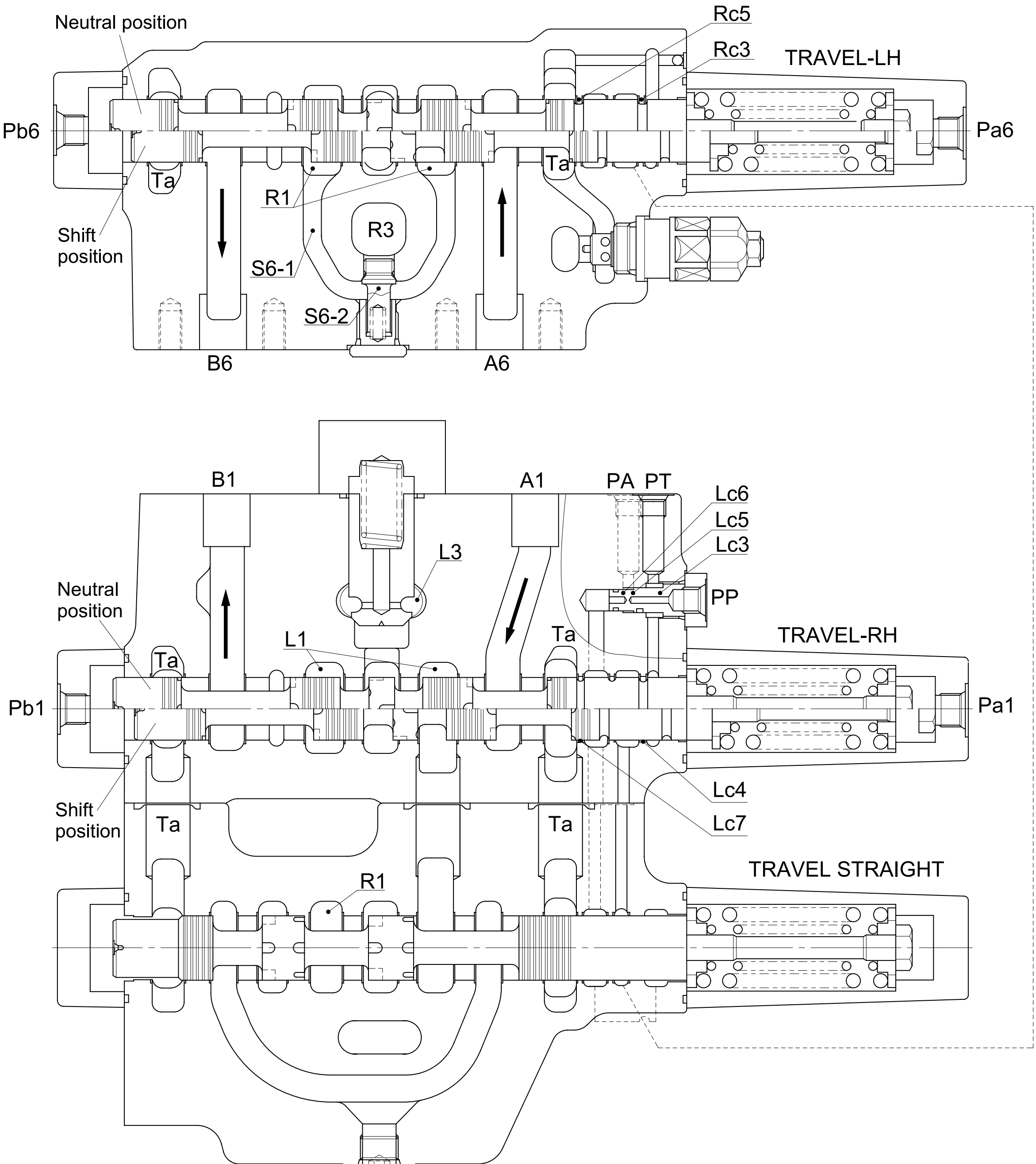
When the RH travel spool is pushed to right by the pilot pressure of port Pb1 the oil discharged from P1 port flows from the neutral passage(L1) to B1 port.

The oil from port A1 return to the tank via the tank passage(Ta).

When the LH travel spool is pushed to right by the pilot pressure of port Pb6 the oil discharged from P2 port flows from the neutral passage(R1) to B6 port through the passage S6-1.

At this time, the parallel passage(R3) and passage(S6-1) are to be maintained as same pressure as poppet(S6-2) is closed. The oil from A6 returns to the tank via the tank passage(Ta).

When the travel spool is pushed to the right by the pilot pressure, the land(Lc4, Rc3) is closed and the tank passage of the oil discharged from port PP is closed, and then the pressure of PT port is increased.

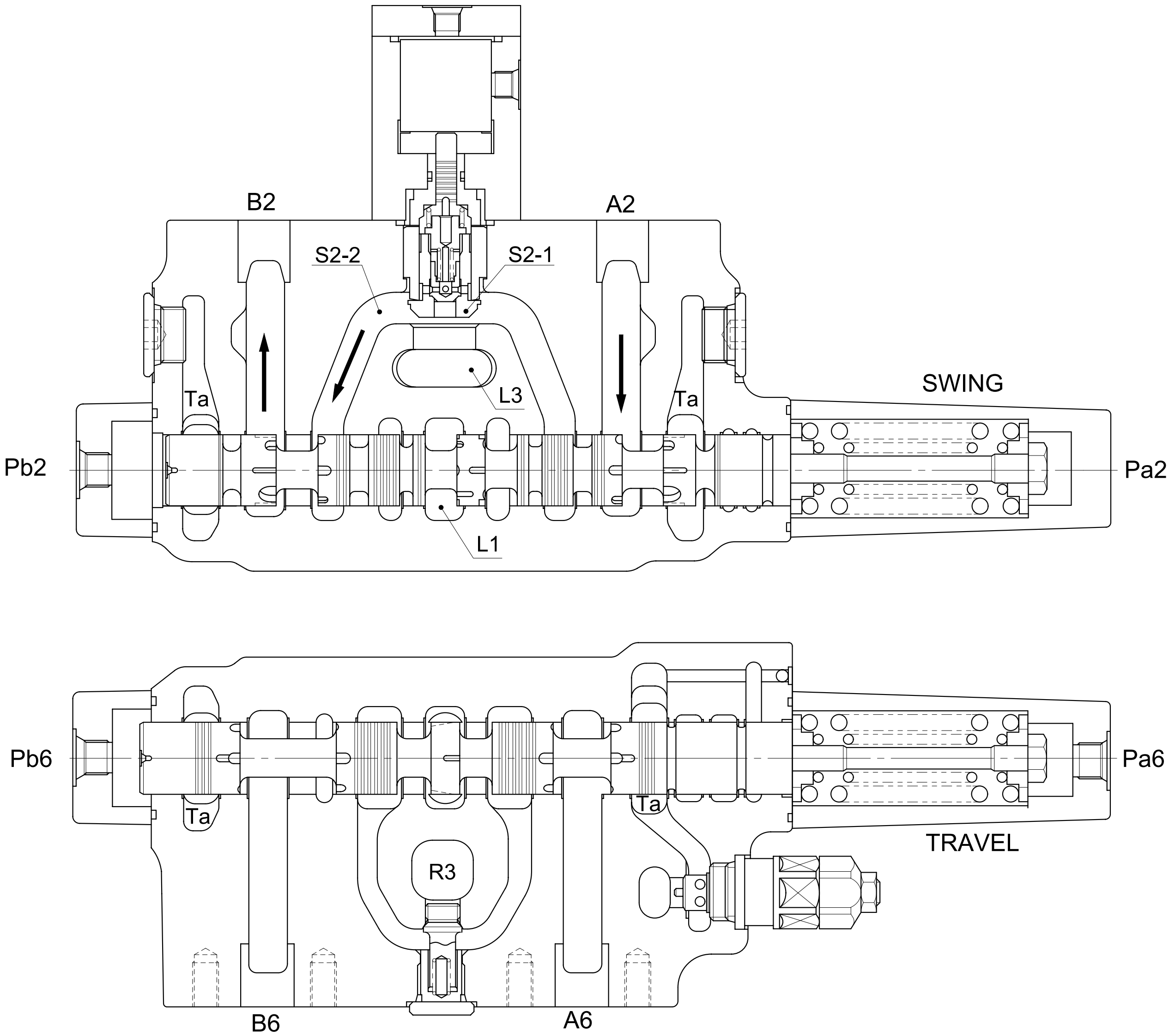


45071MC04

(2) Swing spool

When the swing spool is pushed to the right by the pilot pressure of port Pb2, the neutral passage(L1) is closed, the oil discharged from pump P1 pushes up the load check valve(S2-1), passage(S2-2) via parallel passage(L3) and then flows into port B2.

The oil from port A2 return to the tank via the tank passage(Ta).

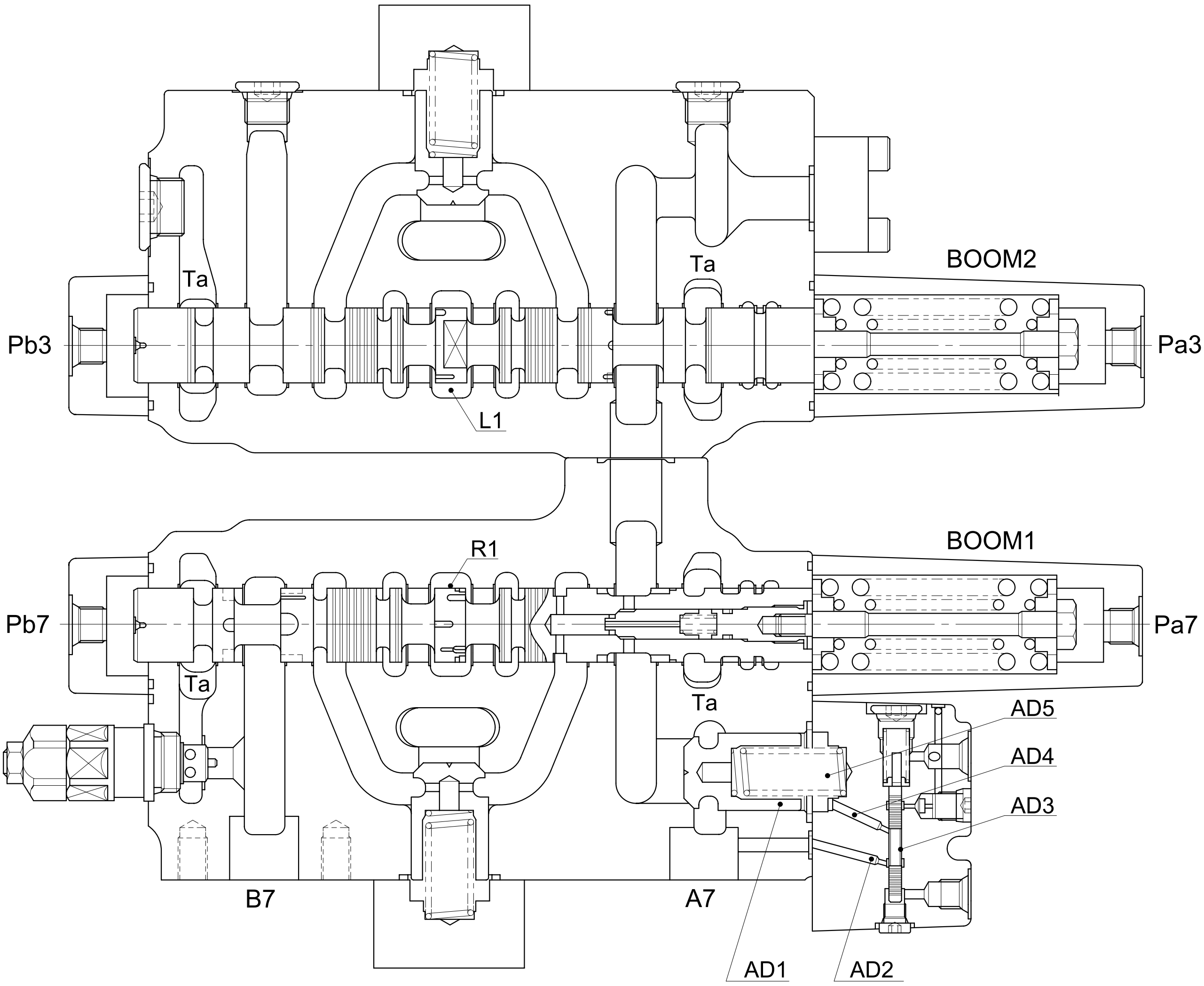


45071MC05

3) BOOM SPOOL

(1) Neutral

This valve is providing the anti-drift valve on the cylinder bottom side of boom 1 section. In neutral, the poppet(AD1) is seated by the pressure of spring chamber(AD5) because the oil from the port A7 is connection with spring chamber(AD5) via passage(AD2), spool(AD3) and passage(AD4).

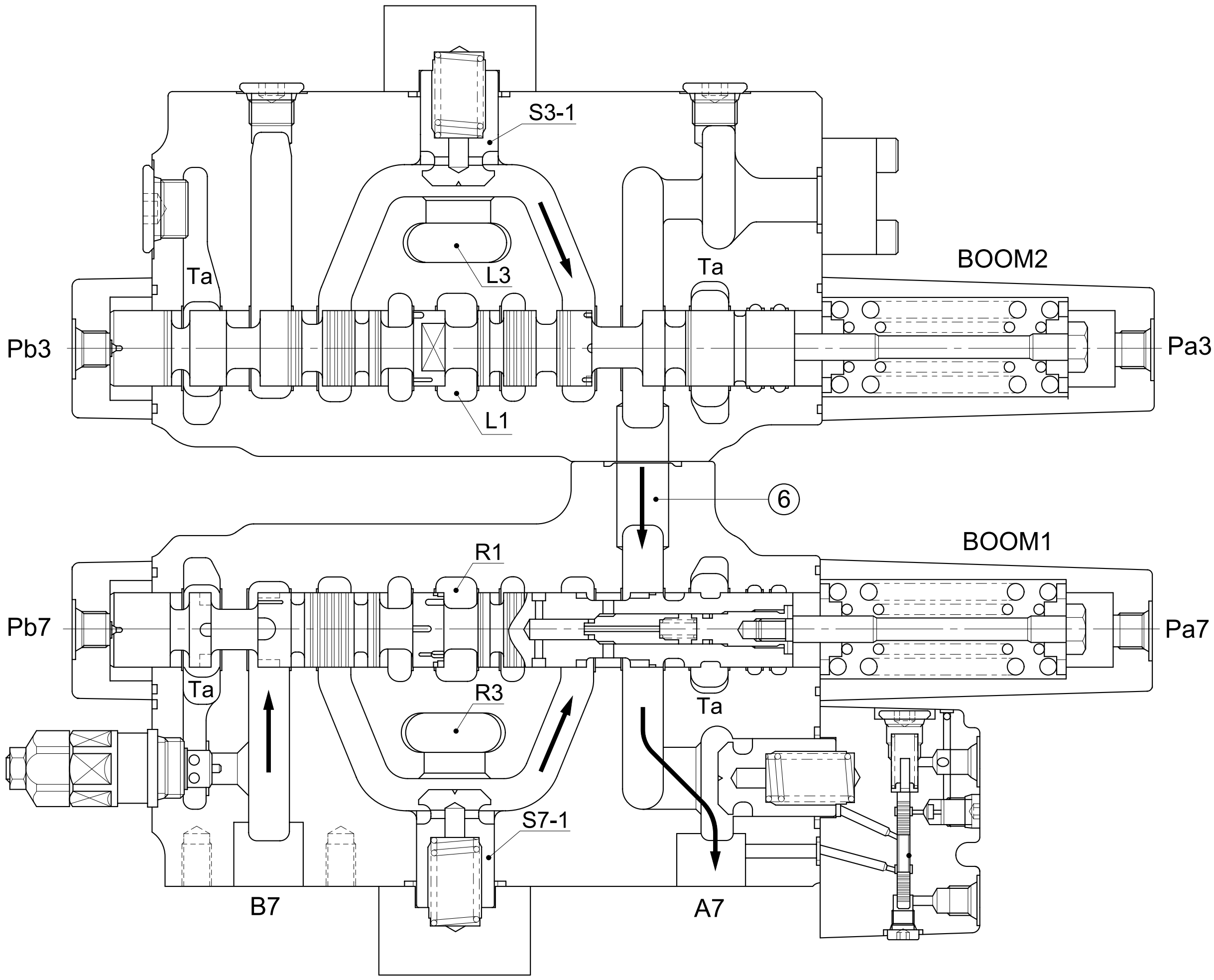


45071MC06

(2) Boom up (flow summation)

When the boom 1 spool is pushed to the left by the pilot pressure of port Pa7, the neutral passage(R1) is closed, the oil discharged from pump P2 flows into the port A7 via parallel passage(R3), the load check valve(S7-1). At the same time, the boom 2 spool is pushed to the left by the pilot pressure of port Pa3, the neutral passage(L1) is closed, the oil discharged from pump P1 flows into the port A7 via parallel passage(L3), the load check valve(S3-1) and then joins to the passage(⑥).

The return oil from port B7 flows into the tank via the tank passage(Ta).

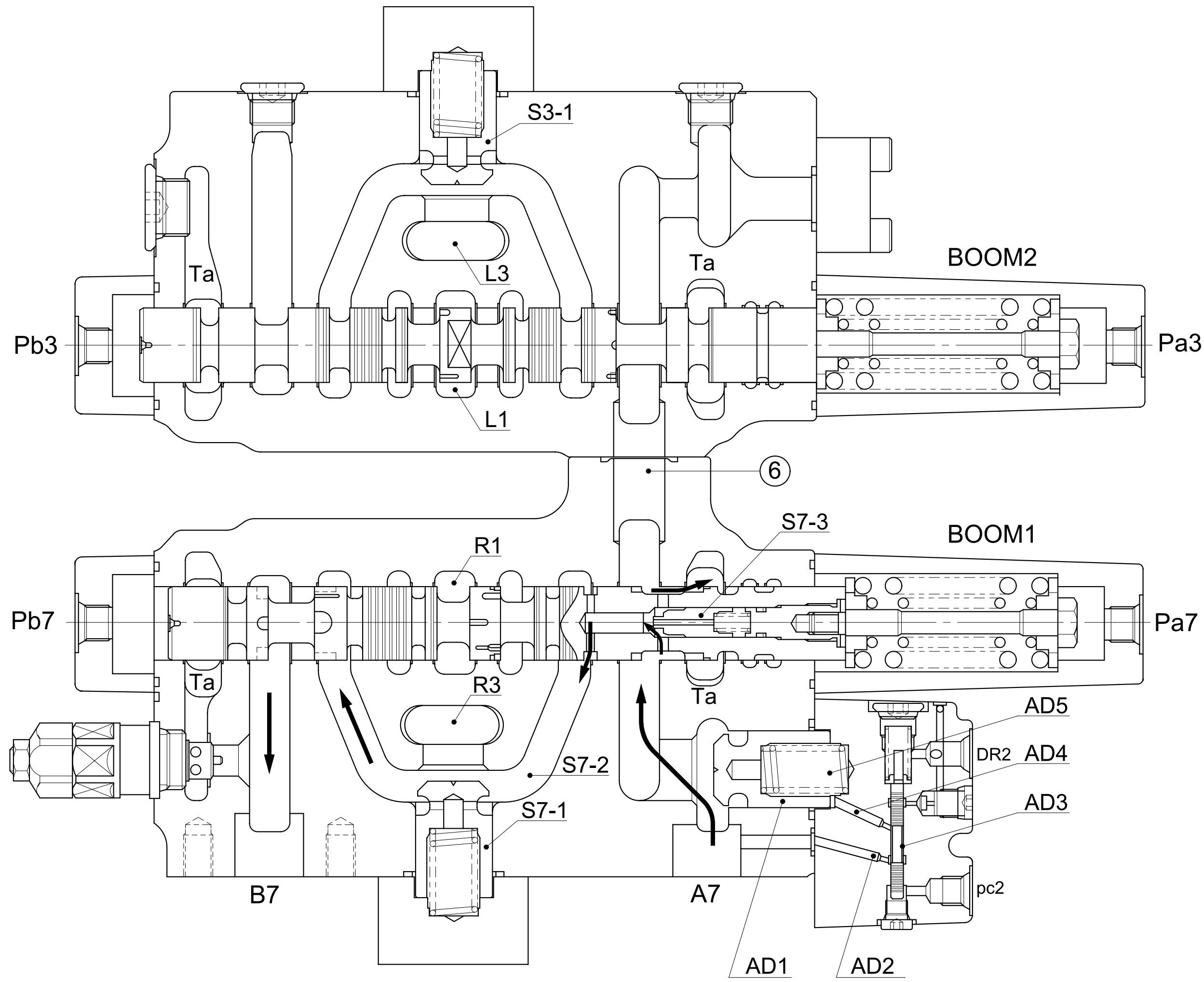


45071MC07

(3) Boom down(recycling)

When the boom 1 spool is pushed to the right by the pilot pressure of port Pb7, the neutral passage(R1) is closed, the oil discharged from pump P2 flows into the port B7 via parallel passage(R3) and the load check valve(S7-1). At the same time, as the port pc2 is pressurizing, the spool(AD3) of anti-drift valve is pushed up, the pressure of spring chamber(AD5) is released and the poppet(AD1) is opened and then the oil from port A7 flows into the tank passage(Ta). Some of returned oil makes the poppet(S7-3) inside boom 1 spool to open and is connected to the passage(S7-2) and flows together into the port B7.

This prevents the cavitation of cylinder rod side.



45071MC08

4) SERVICE SPOOL

When the service spool is pushed to the left by the pilot pressure of port Pb4, the neutral passage(L1) is closed, the oil discharged from pump P1 flows into the port B4 via parallel passage(L3), the load check valve(S4-1) and passage(S4-2).

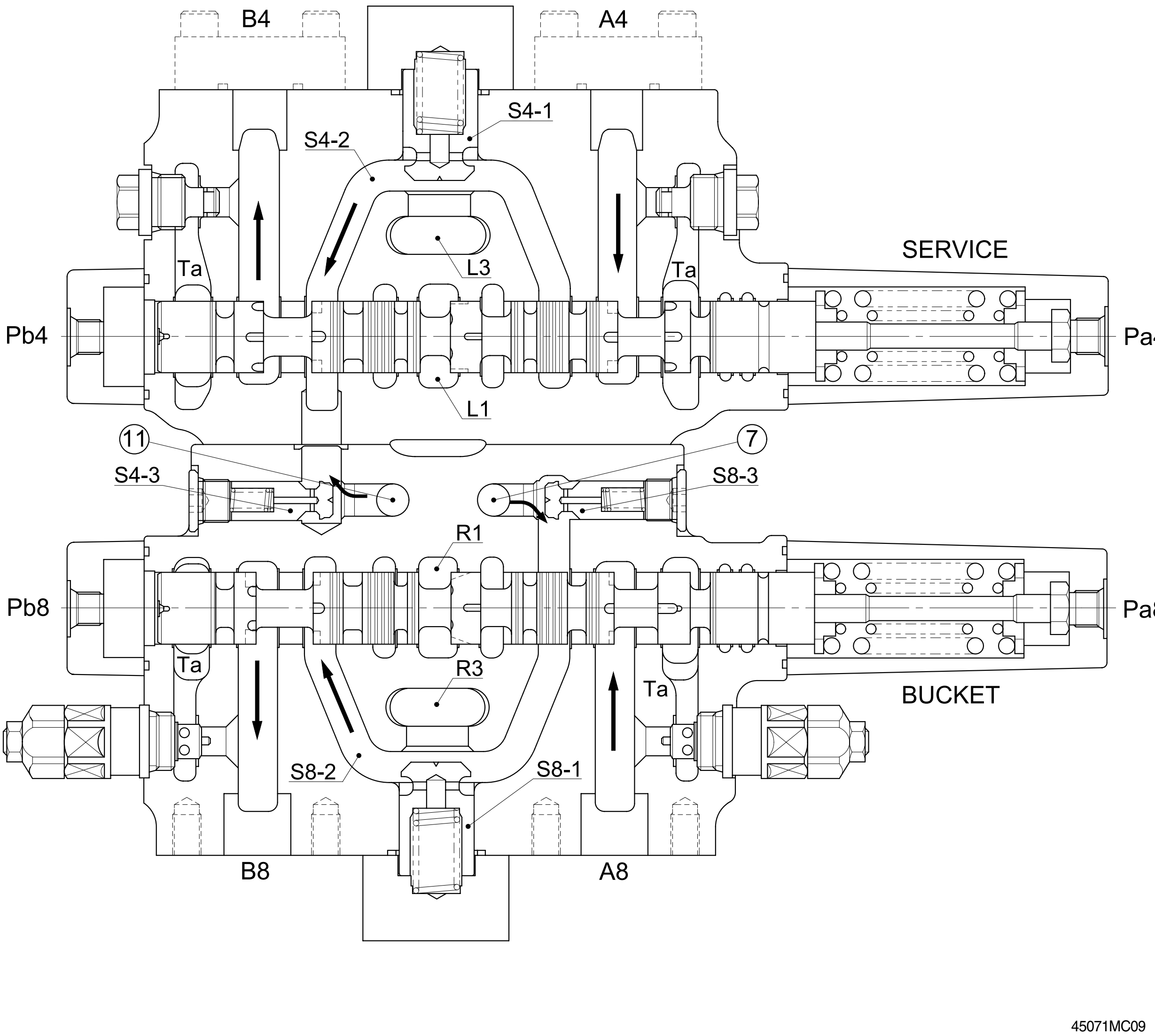
At the same time, as the port pa10(see 2-25 page) is pressurizing and the bypass cut spool(R) is pushed, the oil discharged from pump P2 flows together into the port B7 via passage(11), poppet(S4-3). The oil returned from port A4 flows into the tank via the tank passage(Ta).

5) BUCKET SPOOL

When the bucket spool is pushed to the left by the pilot pressure of port Pb8, the neutral passage(R1) is closed, the oil discharged from pump P2 flows into the port B8 via parallel passage(R3), the load check valve(S8-1) and passage(S8-2).

At the same time, as the port pa11 is pressurizing and the bypass cut spool(R) is pushed, the oil discharged from pump P1 flows together the passage(S8-2) via passage(7), poppet(S8-3).

The return oil from port A8 flows into the tank via the tank passage(Ta).



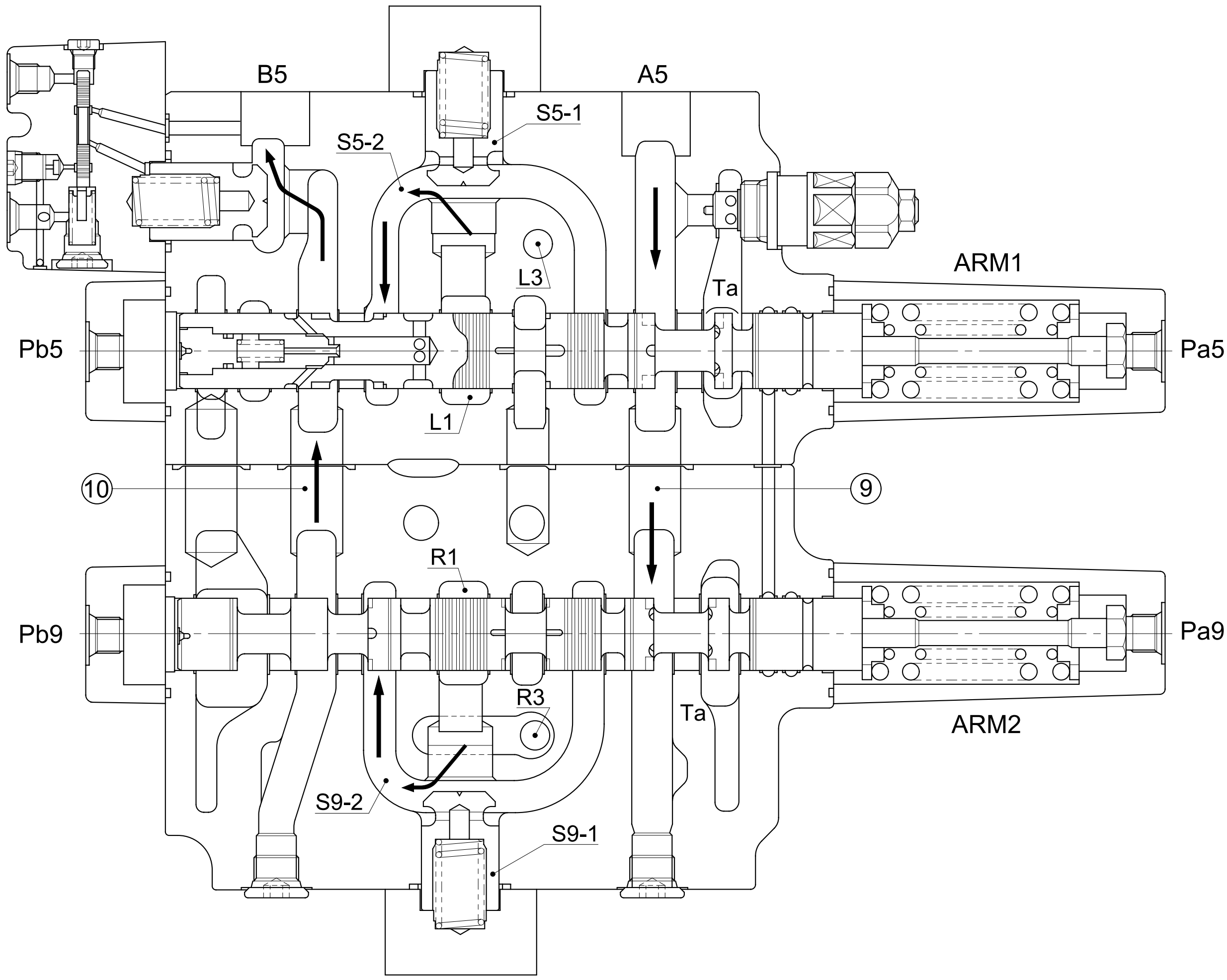
6) ARM SPOOL

(1) Arm out (flow summation)

When the arm 1 spool is pushed to the right by the pilot pressure of port Pb5, the oil discharged from pump P1 flows into the port B5 via neutral passage(L1), the load check valve(S5-1) and passage(S5-2).

When the arm 2 spool is pushed to the right by the pilot pressure of port Pb9, the oil discharged from pump P2 flows together the port B5 the passage(⑩) via the neutral passage(R1), the load check valve(S9-1) and passage(S9-2).

The return oil from port A5 flows into the tank via the tank passage(Ta).



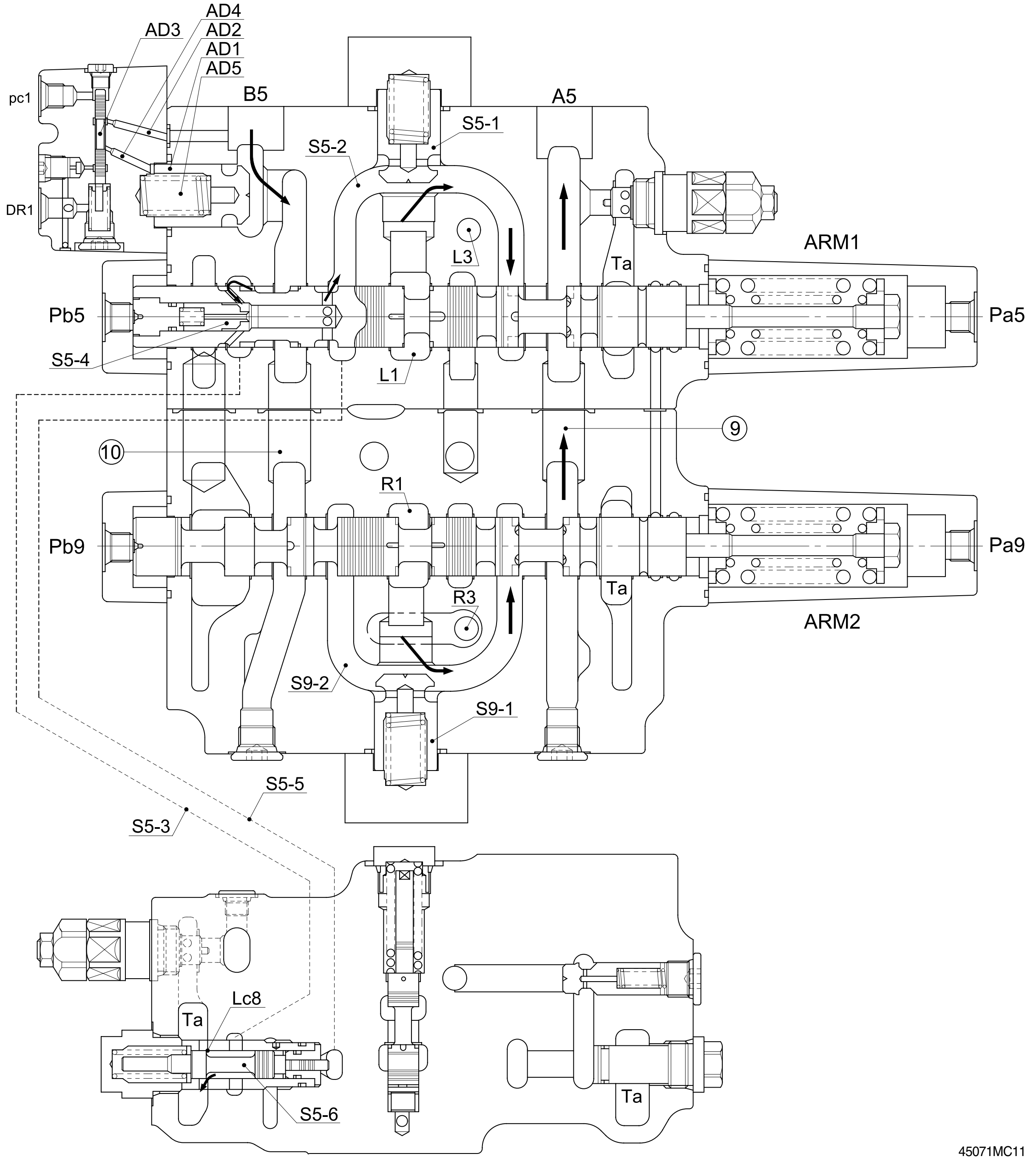
45071MC10

(2) Arm in (flow summation)

When the arm 1 spool is pushed to the left by the pilot pressure of port Pa5, the oil discharged from pump P1 flow into the port A5 via neutral passage(L1), the load check valve(S5-1) and passage(S5-2).

When the arm 2 spool is pushed to the left by the pilot pressure of port Pa9, the oil discharged from pump P2 flows together into the port A5 via neutral passage(R1), the load check valve(S9-1) and passage(S9-2).

At the same time, as the port pc1 is pressurizing and the spool(AD3) of anti-drift valve is pushed down, the pressure of spring chamber(AD5) is released and the poppet(AD1) is opened and then the oil returned from port B5 flows into the tank passage(Ta) through the passage(S5-4) inside arm 1 spool to open and is connected to the passage(S5-2) and flows together into the port A5, the cylinder speed is raised and also is prevents the cavitation of bottom side.

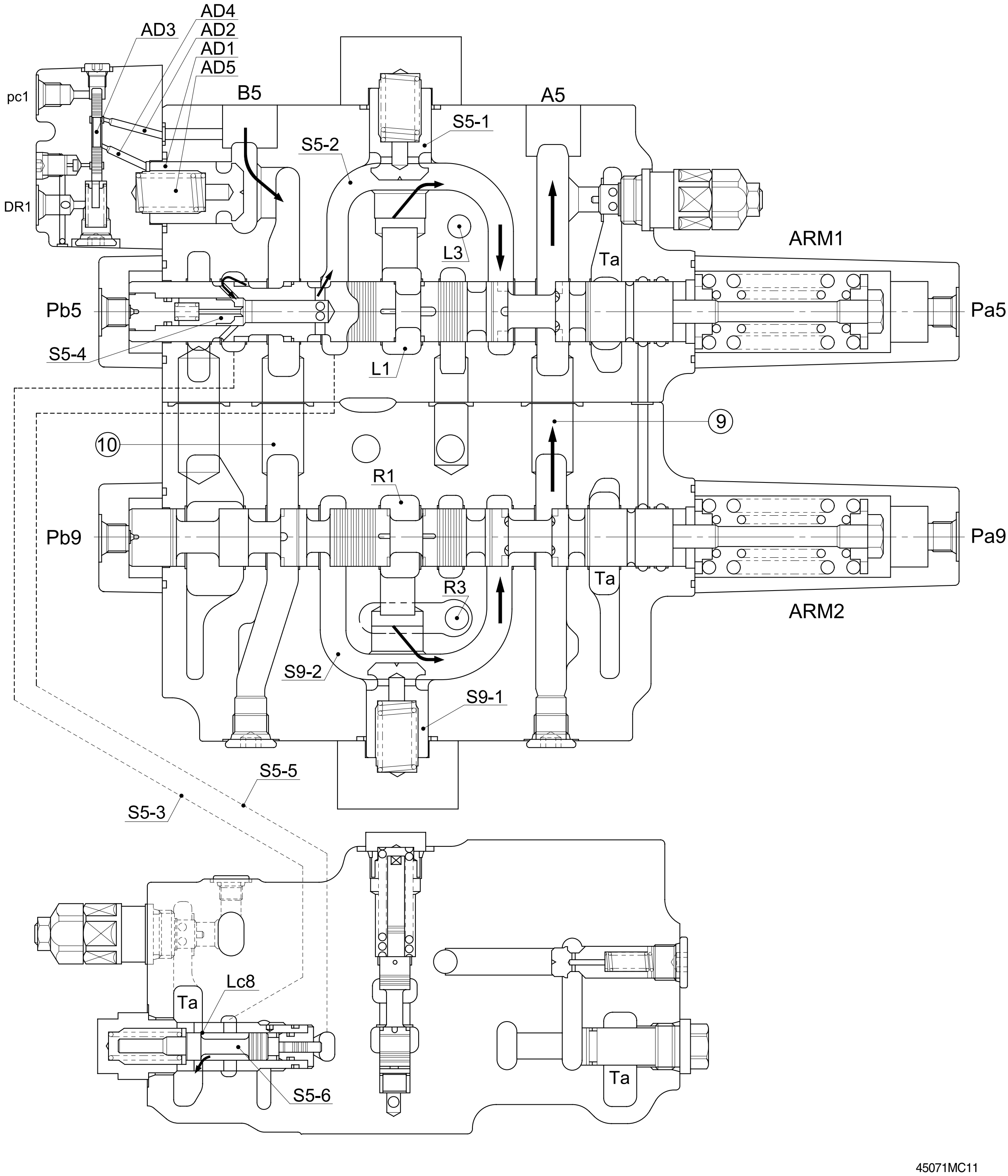


(3) Arm recycling (arm in)

When the arm is at in position, the spool(S5-6) stroke against the passage(S5-2) pressure guided from the passage(S5-5) is changed according to the opening angle of arm recycling orifice(Lc8).

When the pressure of the passage(S5-2) is high and this stroke is increased, the opening angle of orifice(Lc8) become large. On the contrary, when the pressure of passage(S5-2) is low, this stroke is decreased, the opening angle of orifice(Lc8) become small.

Therefore, the flow rate for arm recycling is changed by the pressure in bottom side of arm cylinder.



7) BYPASS CUT SPOOL

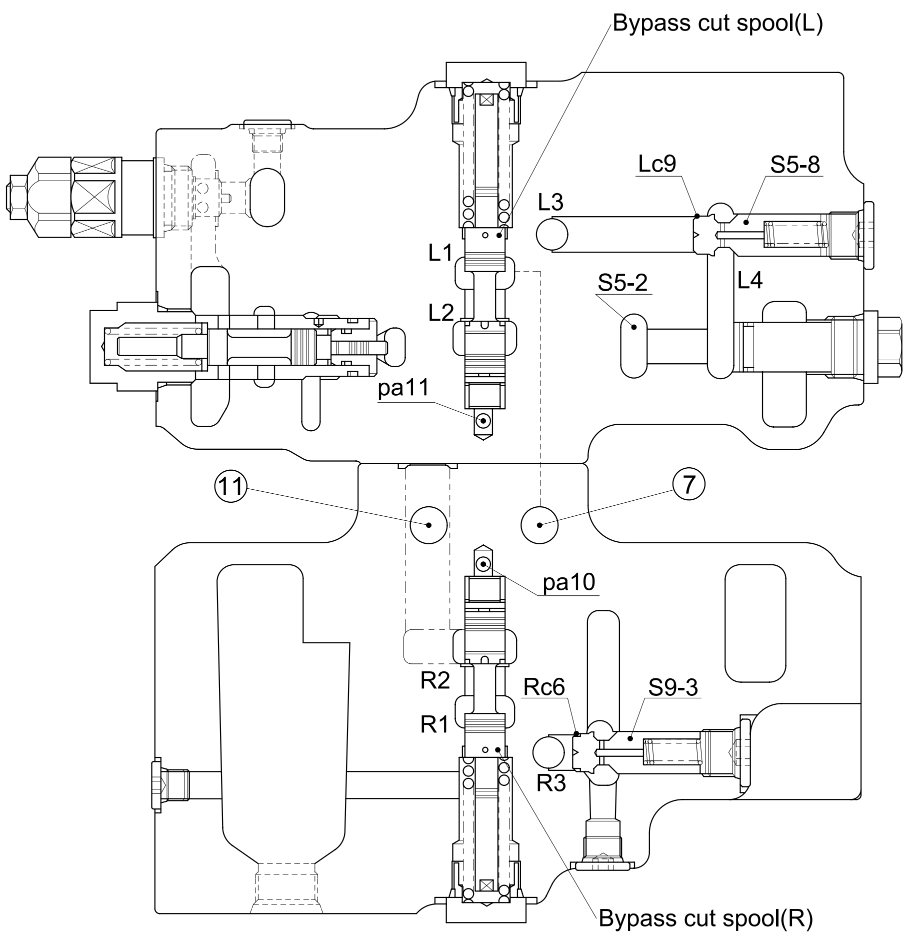
This valve is providing the bypass cut spool at the lowest stream of (upper stream of the low pressure relief valve) the neutral passage(L1, R1).

As the port pa10(pa11) is pressurizing and the bypass cut spool(L, R) is pushed, the neutral passage(L1, R1) is closed. The oil discharged from port P1 flows together into the passage(S8-2, see 2-32 page) of bucket section via passage(⑦), poppet(S8-3) and the oil discharged from P2 port flows together into the passage(S4-2) of service section via the passage(⑪) and poppet(S4-3, see 2-32 page).

8) PARALLEL ORIFICE FOR ARM

The arm 1 and arm 2 section of this valve has orifices in the parallel circuit for arm. These orifices controls the speed of arm at combined operation.

The parallel circuit of arm 2 section is connected to the passage(S9-2, see 2-35) through orifice(Rc6) in the edge of the poppet(S9-3) from the parallel passage(R3), the parallel circuit of arm 1 section is connected to the passage(S5-2, see 2-35) through orifice(Lc9) in the edge of the poppet(S5-8) from the parallel passage(L3).



45071MC12

9) RELIEF VALVE

(1) Main relief valve

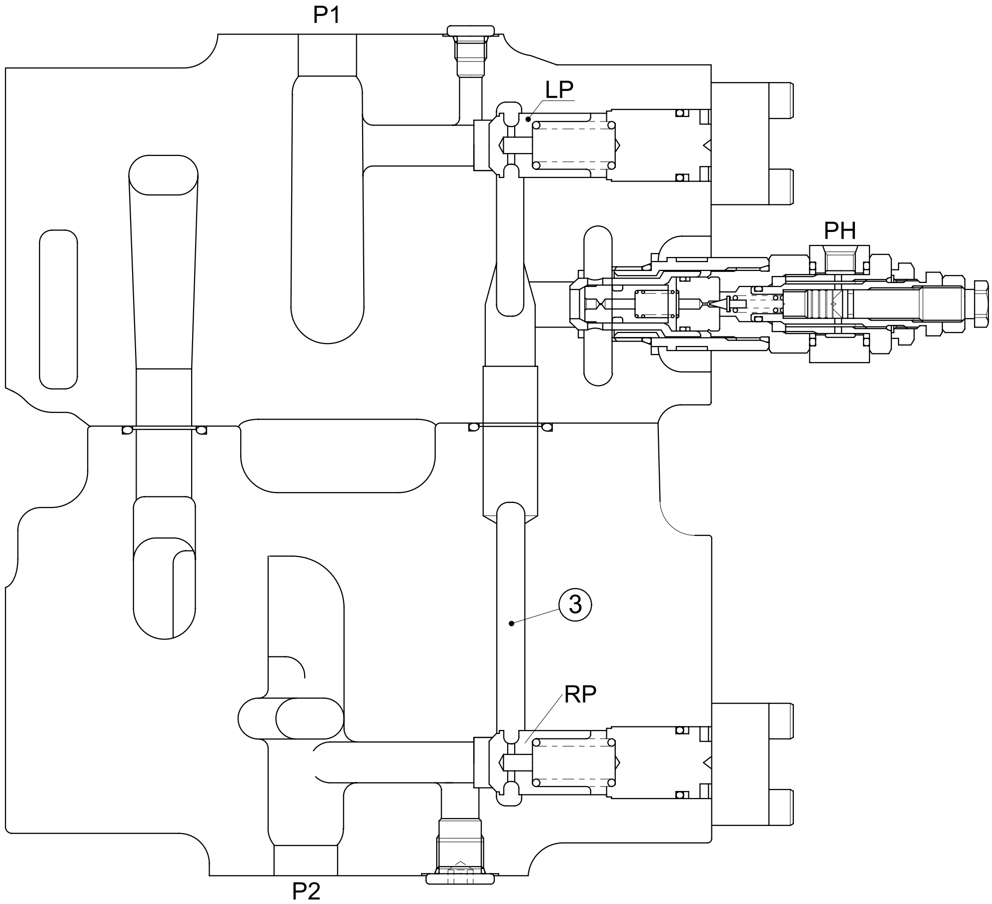
The oil discharged from P1 port via the poppet(LP) and the oil discharged from P2 port via the poppet(RP) flow into the main relief valve through the passage(3).

When the main relief valve is operating, the maximum pressure of pump P1, P2 is controlled.

(2) Overload relief valve

Overload relief valves are provided each cylinder ports of boom1, arm1 and bucket. These prevents the abnormal high pressure of actuators by external force.

Also, when the pressure of cylinder ports create back pressure, this valve opens allowing oil from tank to cylinder port; and then prevents cavitation.

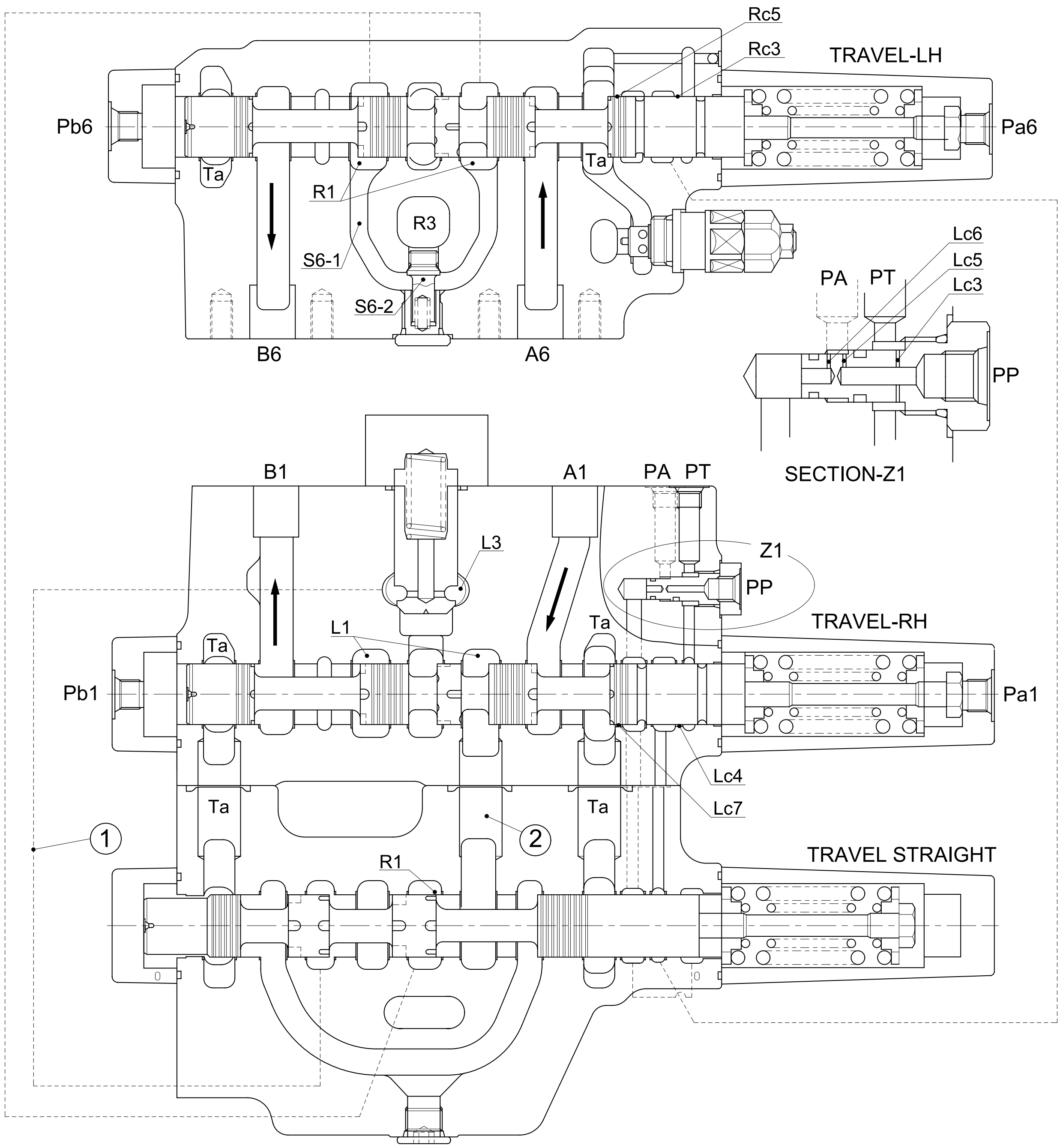


45071MC13

4. COMBINED OPERATION

1) TRAVEL COMBINED OPERATION

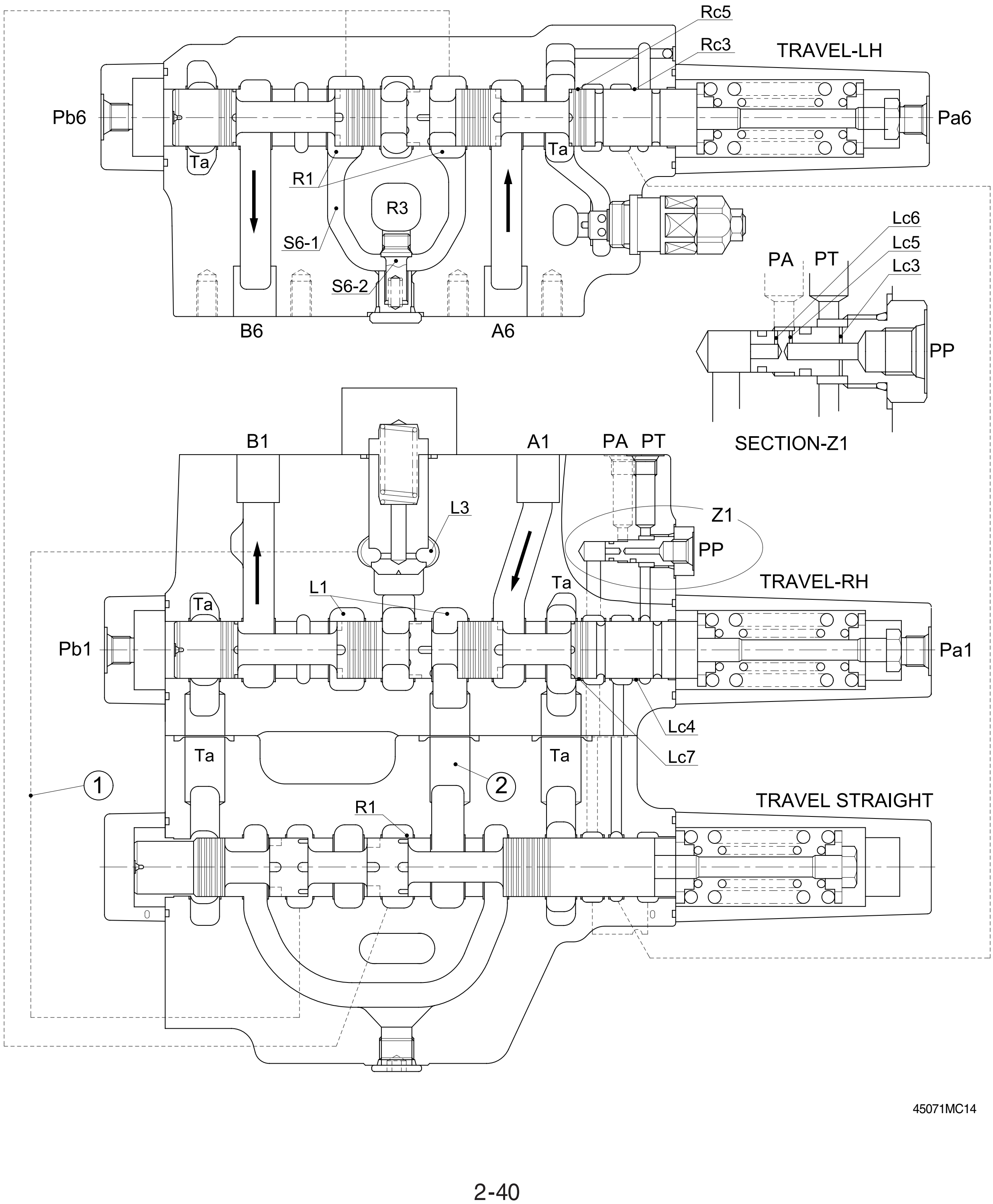
① While travel(forward, reverse and pivot turn) and front attachment(except travel section) functions are operated, the oil discharged from port PP is cut via land(Lc4, Lc7, Rc3, Rc5) and blocked from signal land except travel section to tank passage(Ta), the pressure of signal passage rises to the relief setting pressure of pilot pump and the straight travel spool is pushed to the left by raising of signal pressure and also, the pressure of port PT, PA port rises.



45071MC14

② When the straight travel spool is operated, the oil discharged from port P1 flows into RH travel section through the neutral passage(L1) and also flows into LH travel section via the neutral passage(R1) and passage(②). The oil discharged from port P2 flows into the parallel passage(L3) via passage(①).

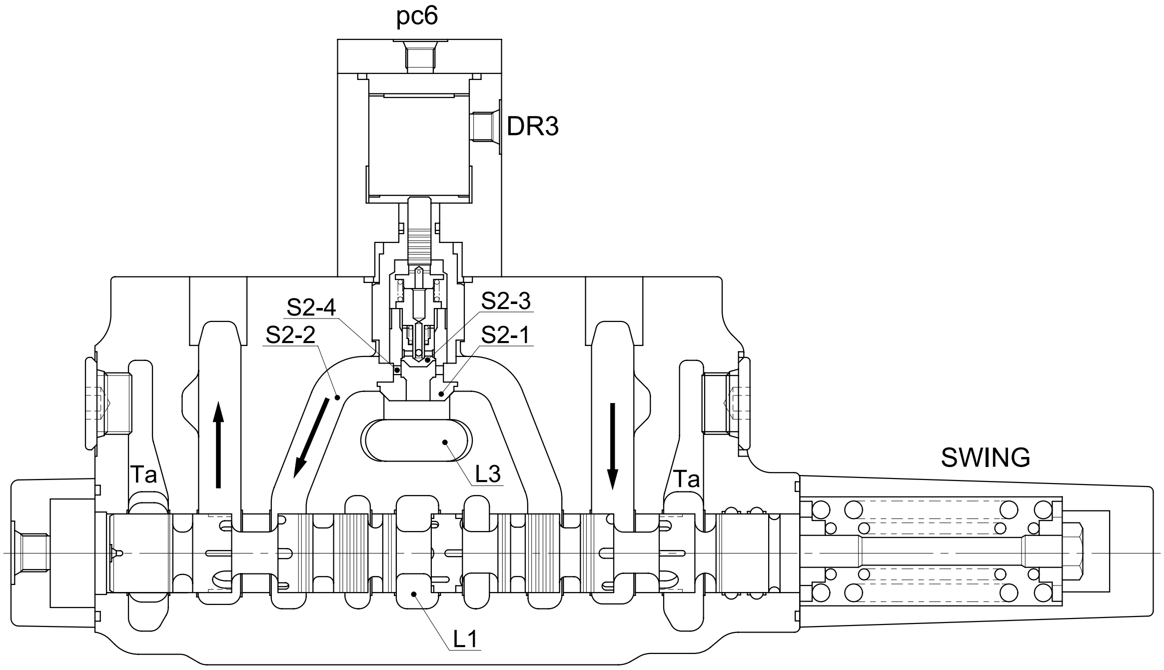
③ In case the load pressure of the section except travel is higher than that of the RH travel section, the partial oil of discharged from port P2 pushes open the poppet(S6-2) and flows together into the passage(S6-1) through the orifice at the edge of poppet. The travel(LH, RH) is operated by the discharged oil from port P1 and the other actuators are operated by the discharged oil from port P2. Thus, when travel and front attachment functions are operated simultaneously, keeps the straight travel.



2) SWING COMBINED OPERATION

When swing and boom up functions are operated, the poppet(S2-1) is seated by pressure of port pc6 and the poppet(S2-3) only opened and the supply pressure of the parallel passage(L3) is rises by orifice(S2-4).

As a result, boom and swing simultaneous operation is ensured even if lower load of swing section.



45071MC15

5. ANTI-DRIFT VALVE

The anti-drift valve is provided the boom bottom and arm rod side of cylinder port for prevention of self drifting by boom weight or bucket loads.

1) WHEN NEUTRAL

The oil from cylinder port flows into spring chamber(AD5) via passage(AD2), the around of spool(AD3) and passage(AD4).

Because of the difference of poppet area and spring force, the poppet(AD1) is seated certainly.

2) WHEN BOOM UP OR ARM OUT

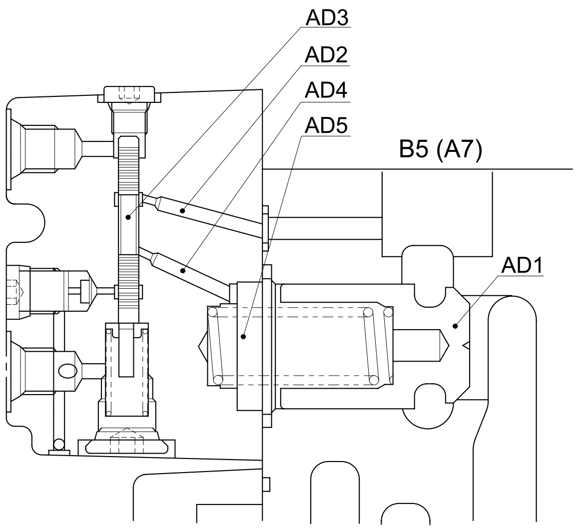
The oil from pump flows into cylinder by pushes open the poppet(AD1).

3) WHEN BOOM DOWN OR ARM IN

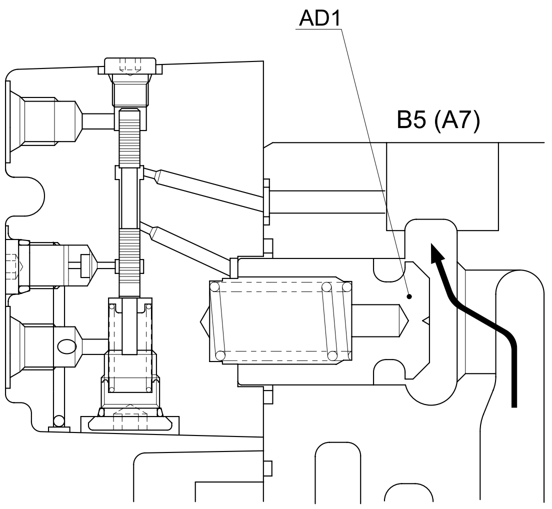
The spool(AD3) is pushed down by the pressure of pc1(pc2).

Then the oil of spring chamber(AD5) flows into the drain port DR1(DR2) and pushes open the poppet(AD1).

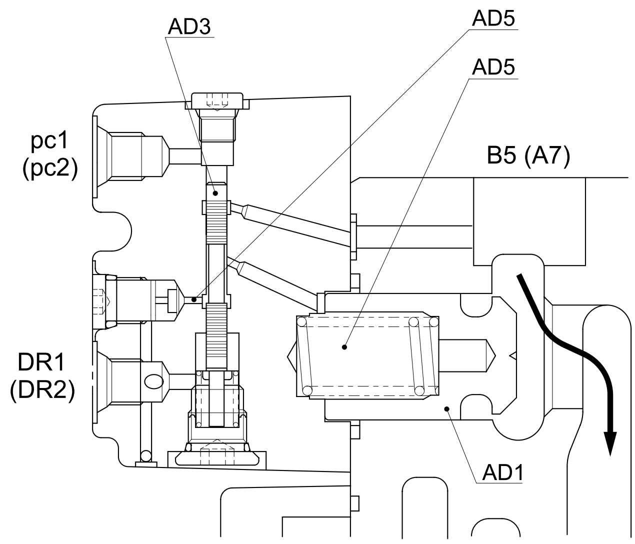
As a result, the oil from the cylinder port returns to tank passage(Ta).



NEUTRAL



ARM OUT
(BOOM UP)



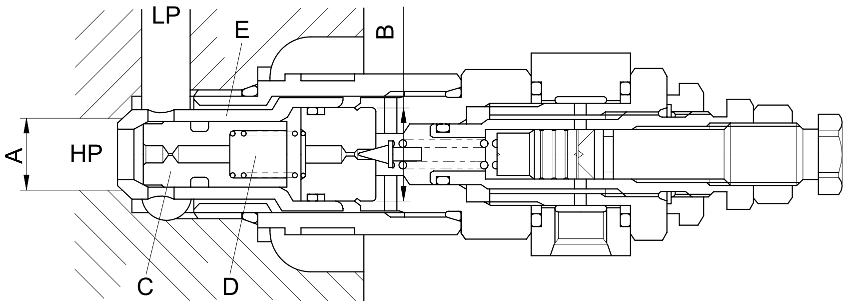
ARM IN
(BOOM DOWN)

45071MC16

6. RELIEF VALVE OPERATION

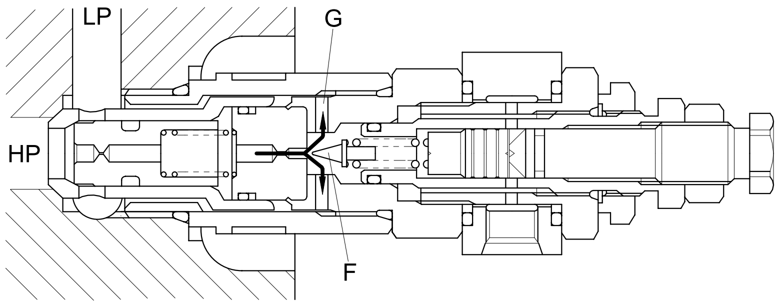
1) MAIN RELIEF VALVE

(1) This relief valve is built-in between the neutral passage(HP) and low pressure passage(LP), and the pressure oil fills up chamber(D) inside via orifice of main poppet(C).
Thus the sleeve(E) and the main poppet(C) are securely seated by difference area of A an B.



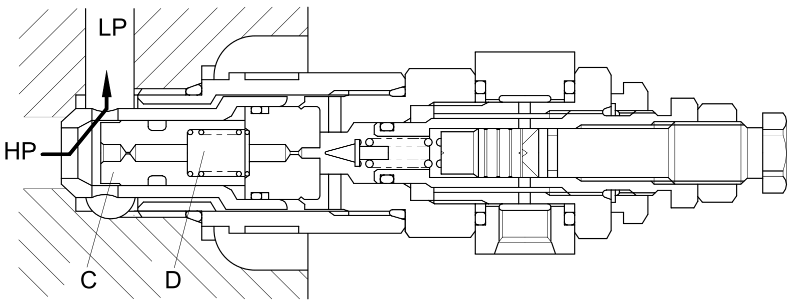
45071MC17

(2) When the pressure in neutral passage(HP) reaches the setting force of spring, pilot poppet(F) is opened.
The oil flows around poppet and into the low pressure passage(LP) via hole(G).



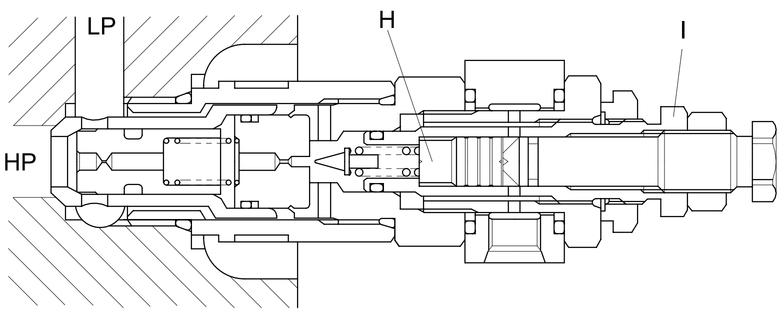
45071MC17-1

(3) When above flow is formed, the pilot poppet is opened; the pressure of chamber(D) drops, the main poppet(C) is opened and then the oil directly flows into the low pressure passage(LP).



45071MC17-2

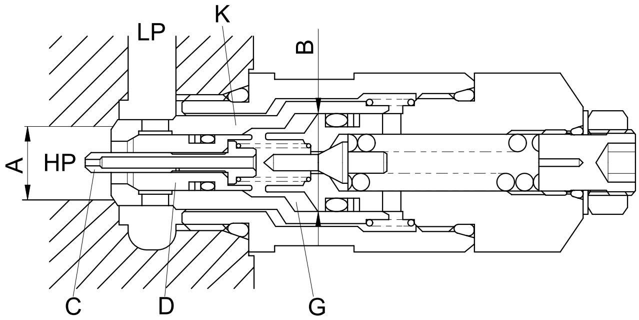
(4) High pressure setting pilot signal(Pi) : ON
The piston(H) moves to left by pilot pressure(Pi); set pressure of spring rises, making high pressure setting.



45071MC17-3

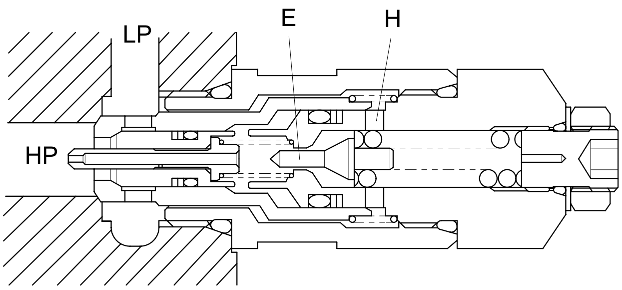
2) OVERLOAD RELIEF VALVE

(1) This relief valve is built-in the cylinder port(HP) and the low pressure(LP), and the pressure oil fills up camber(G) inside via hole of piston(C).
Thus the sleeve(K) and the main poppet(D) are securely seated by difference area of A and B.



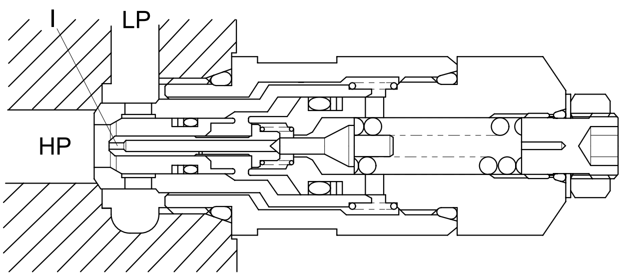
45071MC18

(2) When the pressure in cylinder port(HP) reaches the setting force of spring, the pilot poppet(E) is opened.
The oil flows around poppet and into the low pressure passage(LP) via hole(H).



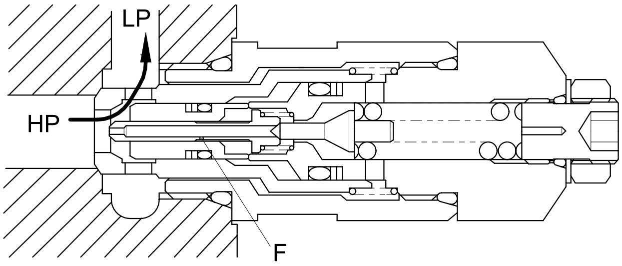
45071MC18-1

(3) When above flow is formed, the pilot poppet(E) is opened.
The pressure drops before and behind orifice(I); piston(C) moves to right and the piston(C) is seated at the tip of poppet(E).



45071MC18-2

(4) The oil flow from the high pressure passage(HP) to the poppet(D) behind is only around poppet and orifice(F); then the high pressure passage(HP) is higher than the poppet(D)behind pressure. Thus the poppet(D) is pushed open and the oil directly flows into low pressure passage(LP).

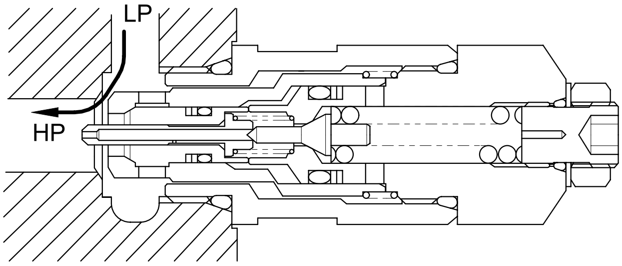


45071MC18-3

(5) Make up operation

This relief valve is built-in the cylinder port(HP) and the low pressure passage(LP), and the pressure oil fills up camber(G) inside via hole of piston(C).

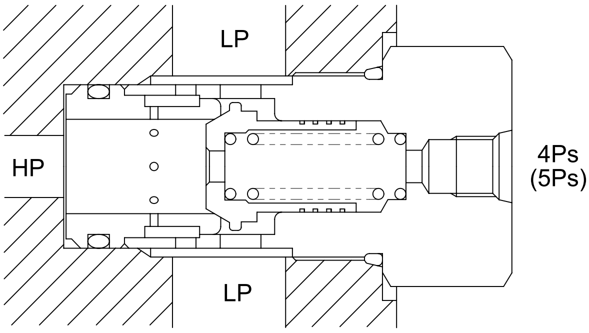
Thus the sleeve(K) and the main poppet(D) are securely seated by difference area of A and B.



45071MC18-4

3) LOW PRESSURE RELIEF VALVE

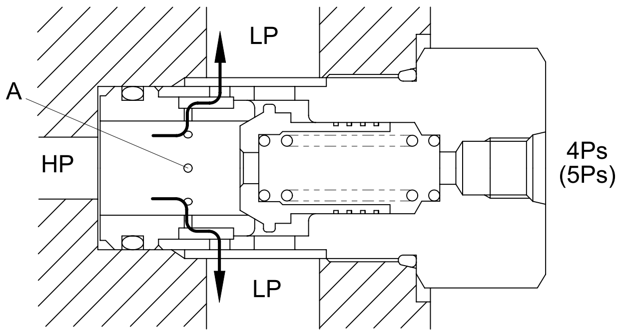
(1) When pump does not operational



45071MC19

(2) When spool neutral

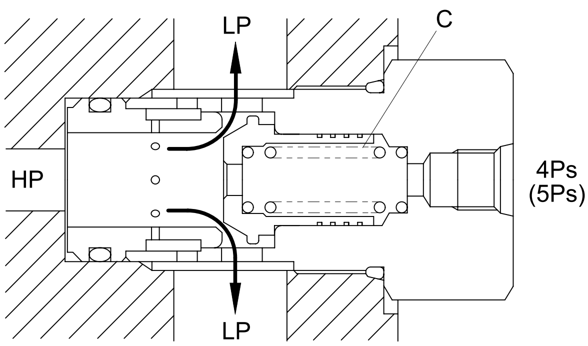
The neutral passage(HP) oil flows into the low pressure passage(LP) via signal orifice(S).
The signal port 4Ps(5Ps) pressure is raise by negative control orifice(A).



45071MC19-1

(3) Operation of low pressure relief

When the oil pressure neutral passage(HP) reaches the setting force of spring, the poppet is pushes open; the oil directly flows through passage(HP) to passage(LP) in order to prevent abnormal pressure.



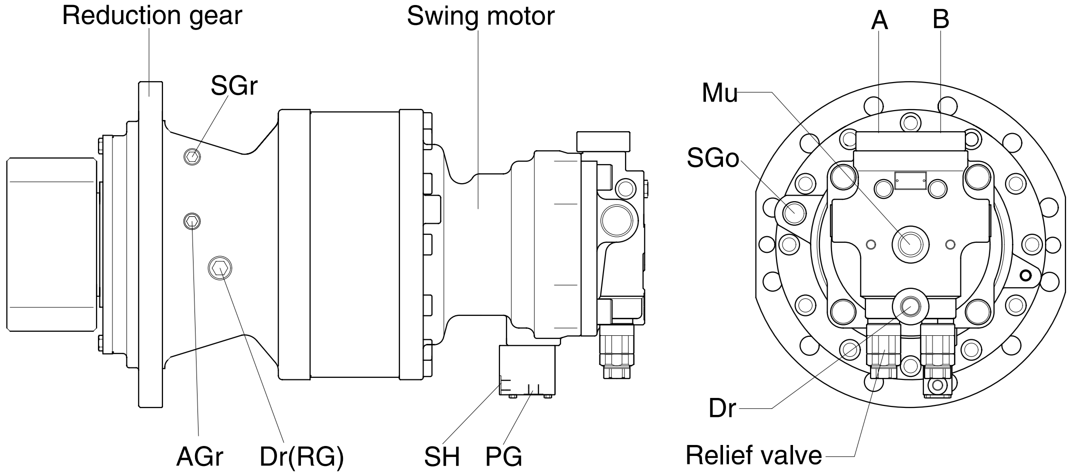
45071MC19-2

GROUP 3 SWING DEVICE (TYPE 1)

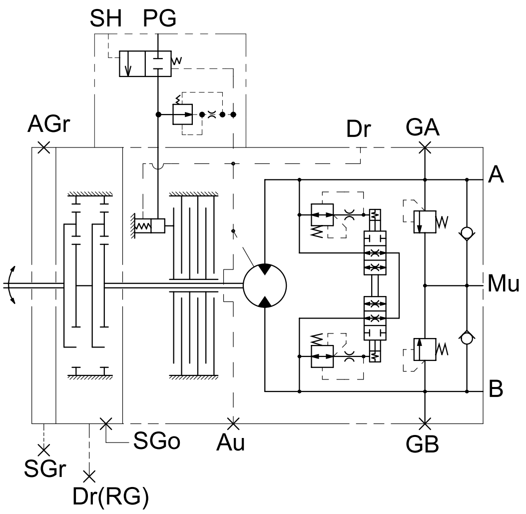
1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

Swing motor include mechanical parking valve, relief valve, make up valve and time delay valve.

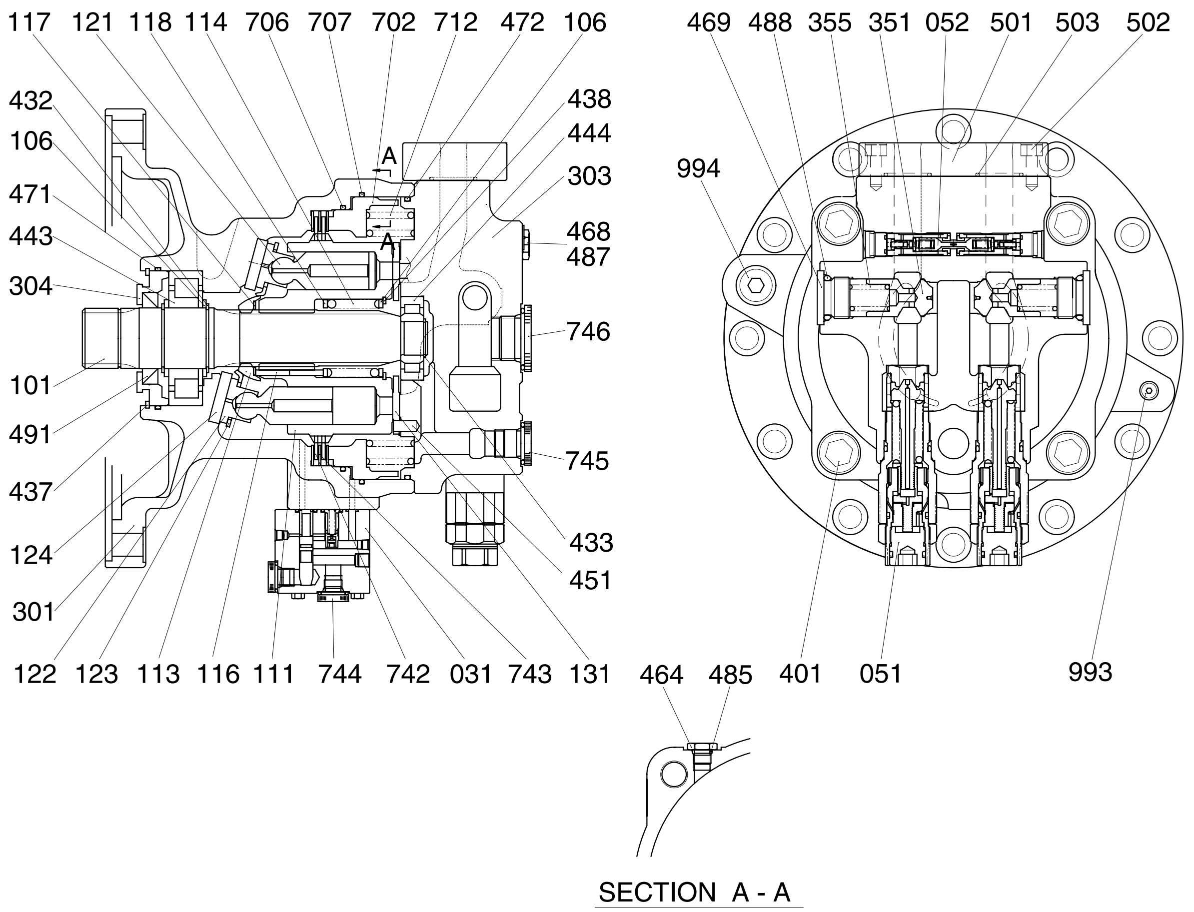


50072SM01



Port	Port name	Port size
A, B	Main port	PF 3/4
Dr	Drain port	PF 1/2
Mu	Make up port	PF 1
GA,GB	Gauge port	PF 1/4
Au	Air vent port	PF 1/4
SGo	Reduction gear oil fill port	PT 3/4
SGr	Reduction gear grease fill port	PT 1/4
AGr	Reduction gear air vent port	PT 1/4
Dr(RG)	Reduction gear drain port	PT 1/2
PG	Brake release port	PF 1/4
SH	Brake pilot port	PF 1/4

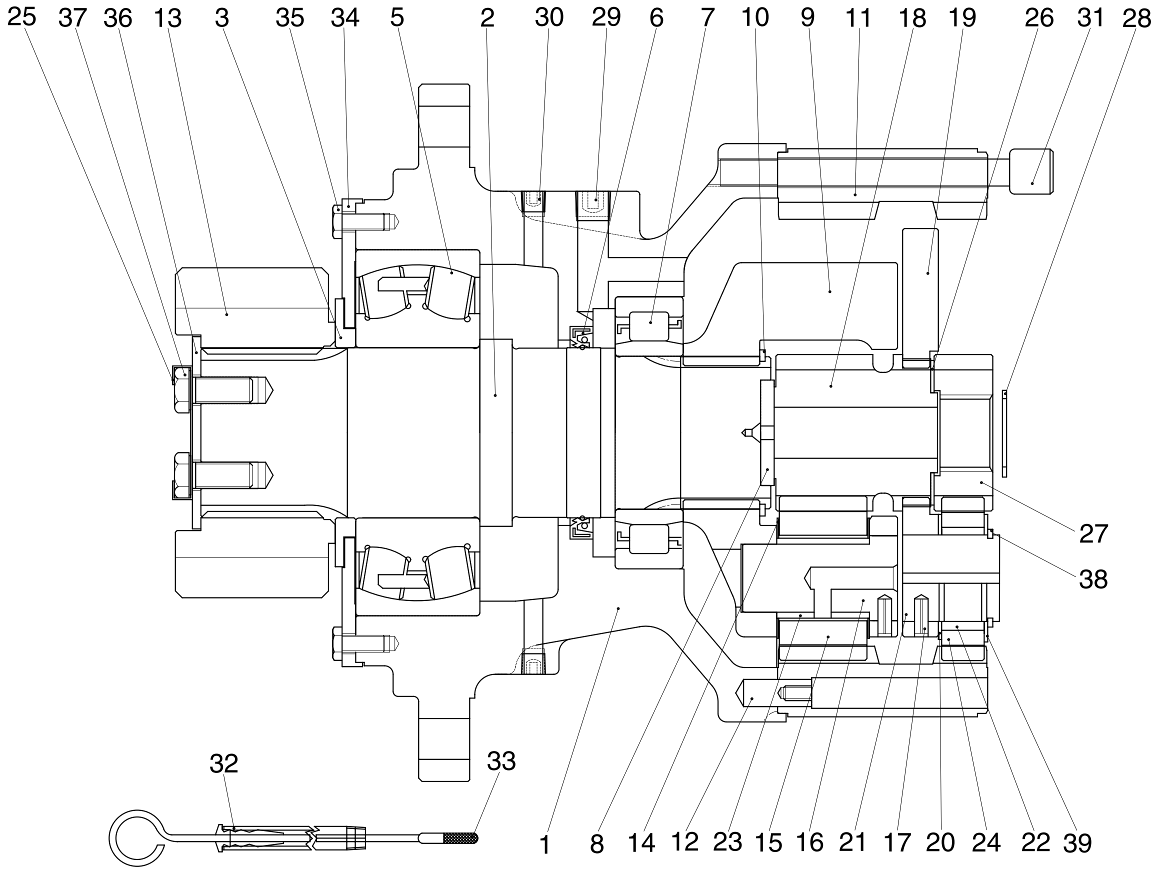
1) SWING MOTOR



50072SM02

031	Brake valve	303	Valve casing(K)	485	O-ring
051	Relief valve	304	Front cover	487	O-ring
052	Reactionless valve assy	351	Plunger(K)	488	O-ring
101	Drive shaft	355	Spring	491	Oil seal
106	Spacer	401	Socket bolt	501	Adapter
111	Cylinder block	432	Snap ring	502	Socket bolt
113	Spherical busing	433	Snap ring	503	O-ring
114	Cylinder spring	437	Snap ring	702	Brake piston
116	Push rod	438	Snap ring	706	O-ring
117	Spacer(F)	443	Roller bearing	707	O-ring
118	Spacer(R)	444	Roller bearing	712	Brake spring
121	Piston	451	Spring pin	742	Friction plate
122	Shoe plate	464	VP Plug	744	Dust plug
123	Retainer	468	VP Plug	745	Dust plug
124	Shoe	469	RO Plug	746	Dust plug
131	Valve plate	471	O-ring	993	PT Plug
301	Casing(F)	472	O-ring	994	PT Plug

2) REDUCTION GEAR



50072SM03

1	Casing	15	Planet gear 2	28	Stop ring
2	Drive shaft	16	Pin 2	29	Plug
3	Spacer	17	Spring pin	30	Plug
5	Roller bearing	18	Sun gear 2	31	Socket bolt
6	Oil seal	19	Carrier 1	32	Gage pipe
7	Roller bearing	20	Side plate 1	33	Gage bar
8	Thrust plate	21	Pin 1	34	Cover plate
9	Carrier 2	22	Needle cage	35	Hex bolt
10	Stop ring	23	Bushing 2	36	Lock plate
11	Ring gear	24	Planet gear 1	37	Hex bolt
12	Knock pin	25	Lock washer	38	Stop ring
13	Pinion gear	26	Side plate 3	39	Side plate 2
14	Thrust washer	27	Sun gear 1		

2. FUNCTION

1) ROTARY PART

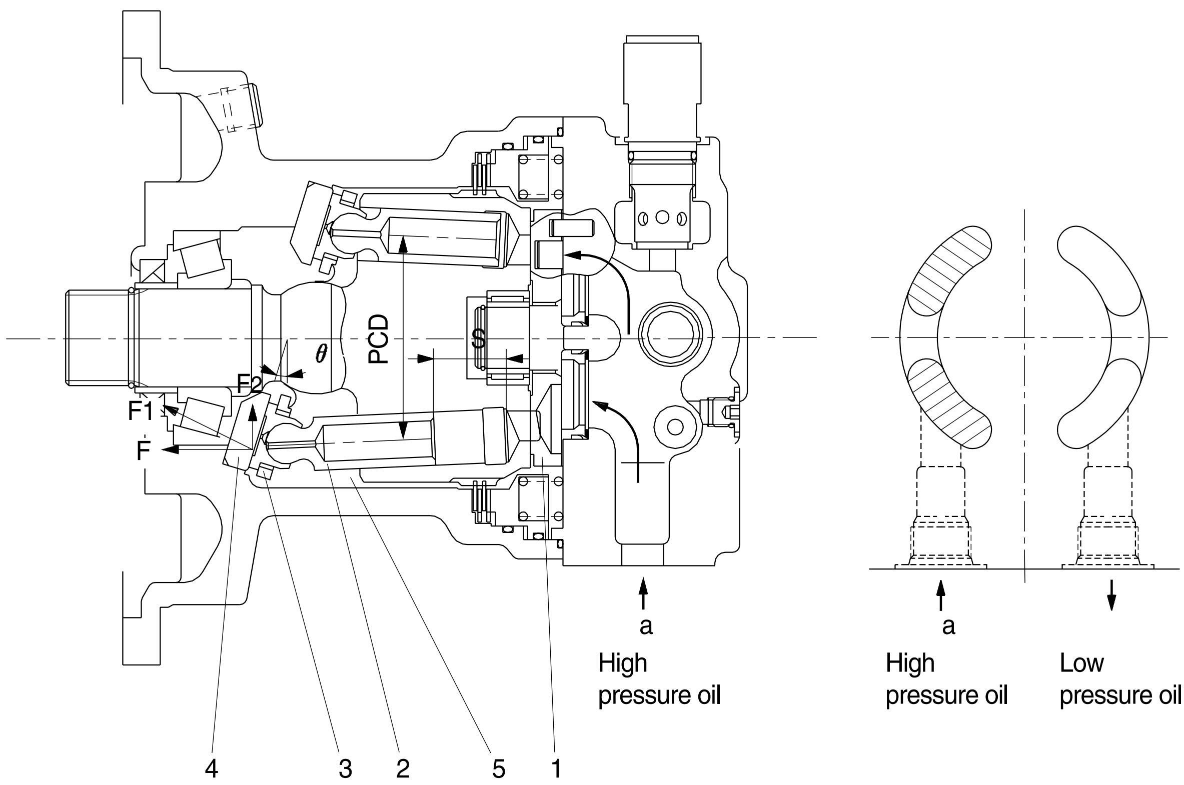
When high pressurized oil enters a cylinder through port(a), which is the inlet of balance plate(1), hydraulic pressure acting on the piston causes axial force F. The pressure force F works via the piston(2) upon the return plate(3) which acts upon the swash plate(4) via an hydrostatic bearing. Force F1 perpendicular to swash plate(4) and force F2 perpendicular to cylinder center.

Being transferred to the cylinder block(5) through piston, force F2 causes rotational moment at surroundings of cylinder.

Since cylinder block has 9 equidistantly arrayed pistons, rotational torque is transmitted to cylinder shaft in order by several pistons connected to the inlet port of high pressurized oil. When the direction of oil flow is reversed, rotational direction of cylinder is also reversed. Output torque is given by the equation.

$$T = \frac{p \times q}{2\pi}, \quad q = Z \cdot A \cdot PCD \cdot \tan\theta, \quad F1 = \frac{F}{\cos\theta}, \quad F_2 = F\tan\theta, \quad S = PCD \times \tan\theta$$

Where p : Effective difference of pressure(kgf/cm^2)
q : Displacement(cc/rev)
T : Output torque(kgf · cm)
Z : Piston number(9EA)
A : Piston area(cm^2)
θ : Tilting angle of swash plate(degree)
S : Piston stroke(cm)



2-52 (210-7)

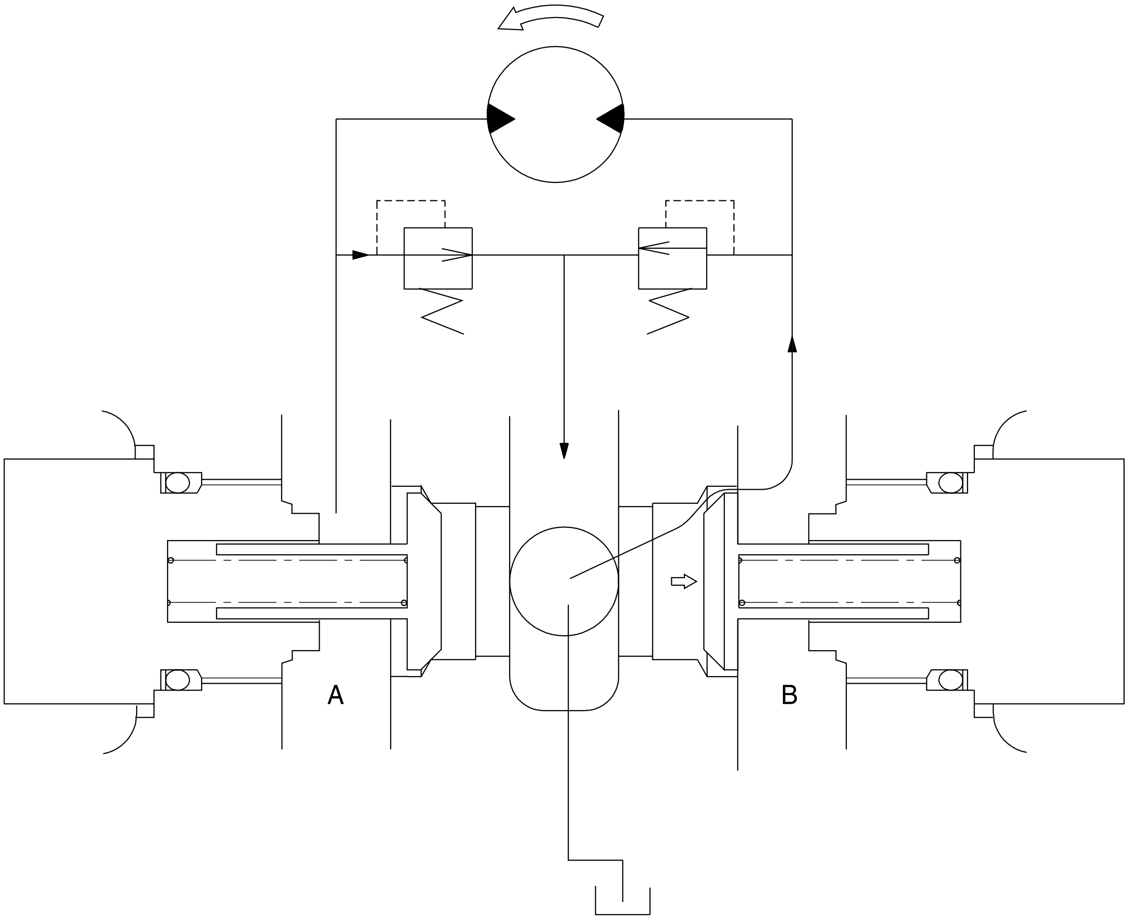
2) MAKE UP VALVE

In the system using this type of motor, there is no counter balance functioning valve and there happens the case of revolution exceeding hydraulic supply of motor. To prevent the cavitation caused by insufficient oil flow there is a make up valve to fill up the oil insufficiency.

A make up valve is provided immediately before the port leading to the hydraulic oil tank to secure feed pressure required when the hydraulic motor makes a pumping action. The boost pressure acts on the hydraulic motor's feed port via the make up valve.

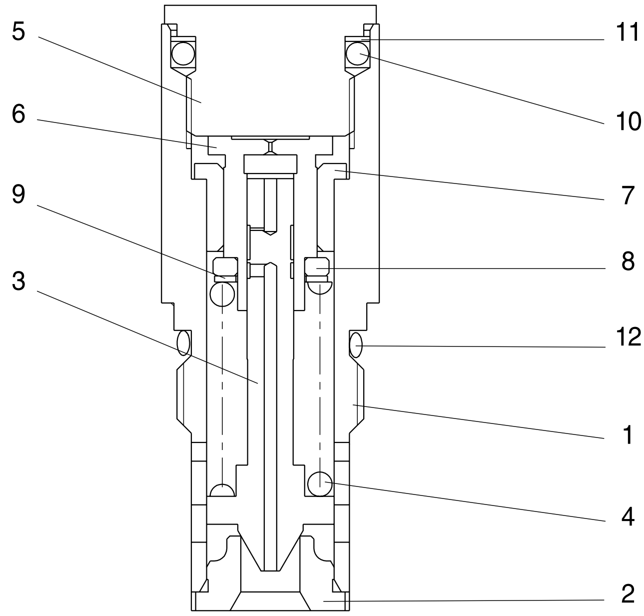
Pressurized oil into the port B, the motor rotate counterclockwise.

If the plunger of MCV moves neutral position, the oil in the motor is drain via left relief valve, the drain oil run into motor via right make up valve, which prevent the cavitation of motor.



R130SM03

3) RELIEF VALVE



1	Body
2	Seat
3	Plunger
4	Spring
5	Adjusting screw
6	Piston
7	Bushing
8	Spring seat
9	Shim
10	O-ring
11	Back up ring
12	O-ring

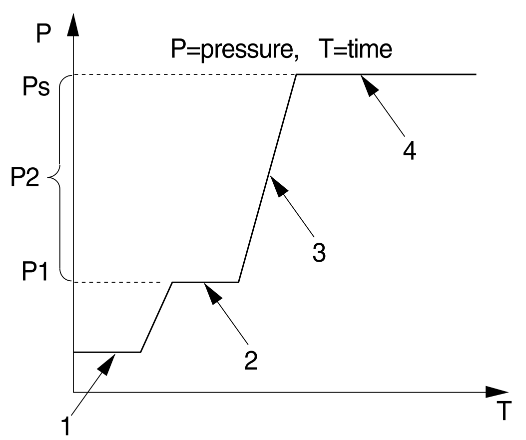
R130SM05

(1) Construction of relief valve

The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

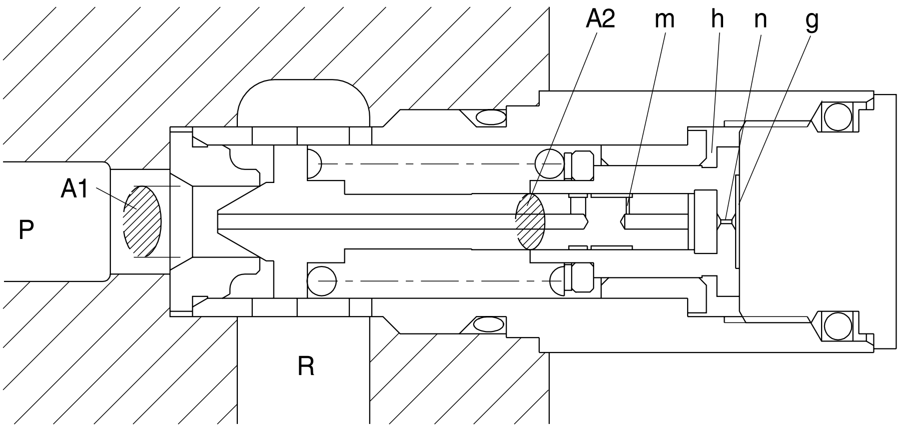
(2) Function of relief valve

Figure illustrates how the pressure acting on the relief valve is related to its rising process. Here is given the function, referring to the figure following page.



2-54(2) 210-7

① Ports (P,R) at tank pressure.

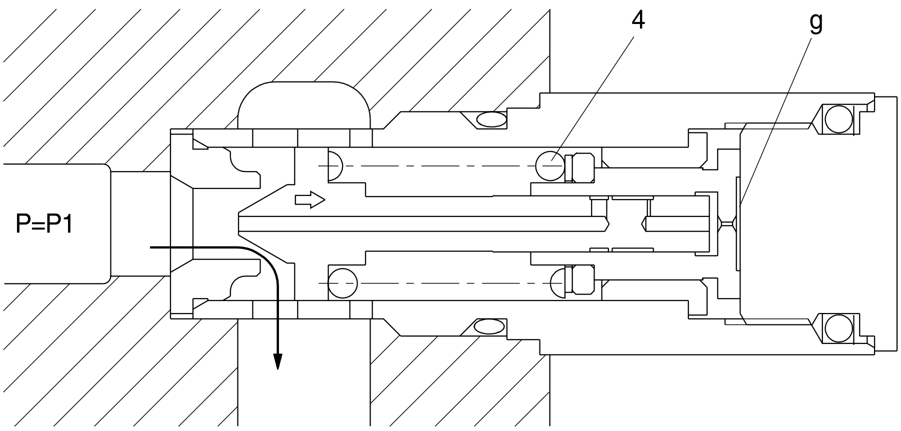


R130SM04

② When hydraulic oil pressure($P \times A_1$) reaches the preset force(F_{SP}) of spring(4), the plunger(3) moves to the right as shown.

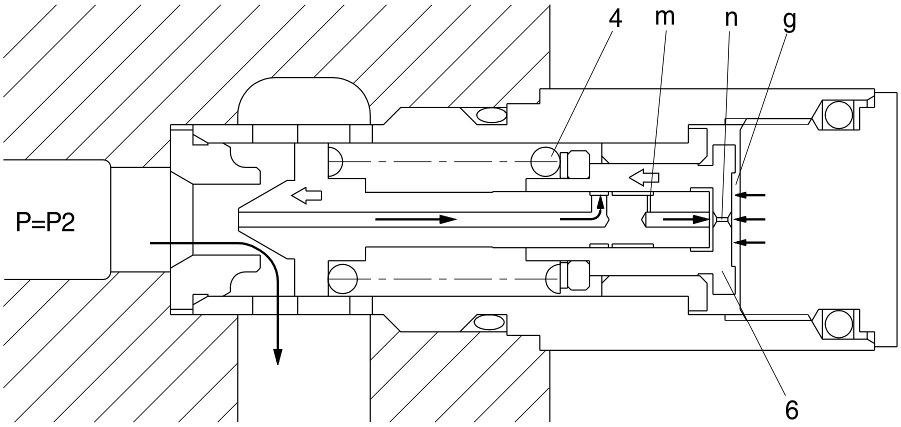
$P_1 \times A_1 = Fsp + Pg \times A_2$

$$P_1 = \frac{Fsp + Pg \times A_2}{A_1}$$



R130SM04

③ The oil flow chamber g via orifice m and n. When the pressure of chamber g reaches the preset force(F_{SP}) of spring(4), the piston(6) moves left and stop the piston(6) hits the bottom of bushing(7).

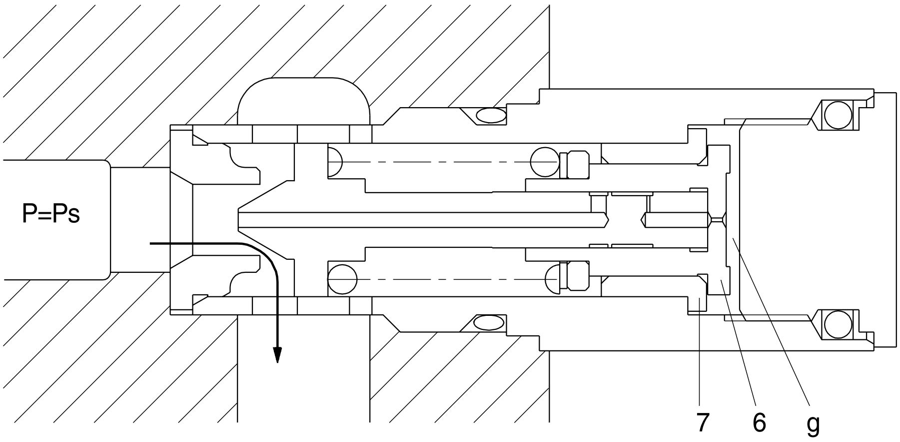


R130SM04

④ When piston(6) hits the bottom of bushing(7), it stops moving to the left any further. As the result, the pressure in chamber(g) equals(Ps).

$Ps \times A_1 = Fsp + Ps \times A_2$

$$Ps = \frac{Fsp}{A_1 - A_2}$$



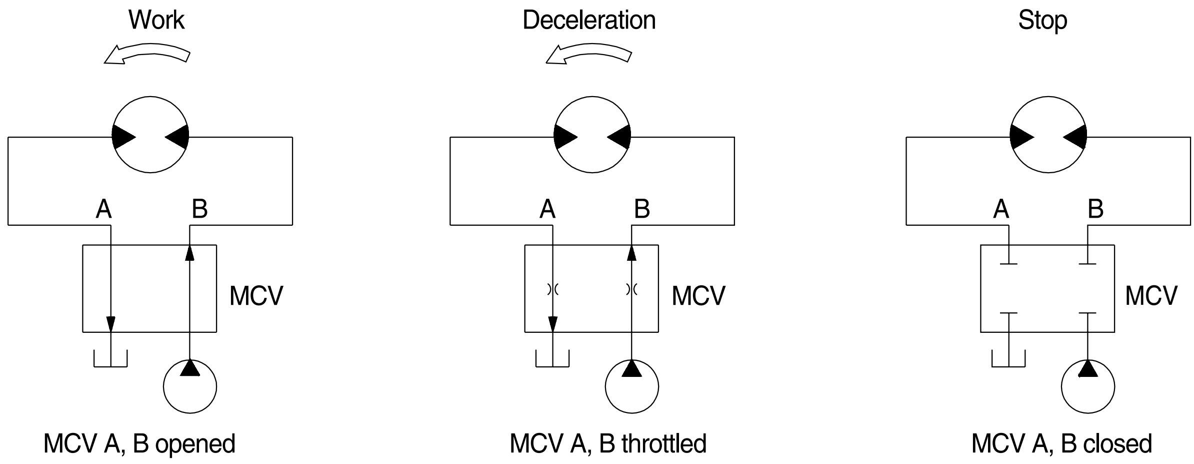
R130SM04

4) BRAKE SYSTEM

(1) Control valve swing brake system

This is the brake system to stop the swing motion of the excavator during operation.

In this system, the hydraulic circuit is throttled by the swing control valve, and the resistance created by this throttling works as a brake force to slow down the swing motion.



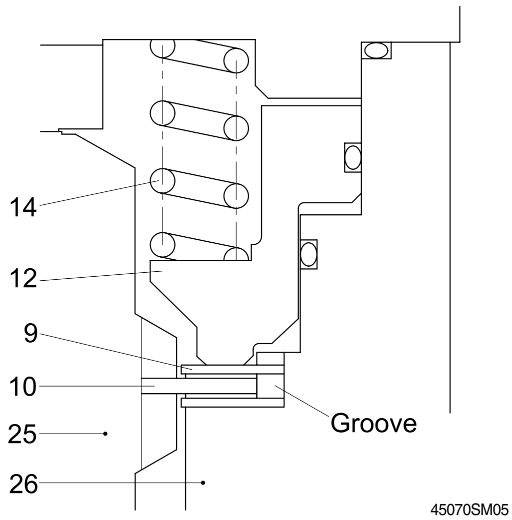
(2) Mechanical swing parking brake system

The mechanical swing parking brake system is installed to prevent the upper structure from swinging downhill because of its own weight when the excavator is parked on a slope since it completely eliminates the hydraulic drift of swing motion while the excavator is on a slop, work can be done more easily and safely.

① Brake assembly

Circumferential rotation of separate plate(9) is constrained by the groove located at housing(26). When housing is pressed down by brake spring(14) through lining plate(10), separate plate(9) and brake piston(12), friction force occurs there.

Cylinder(25) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.

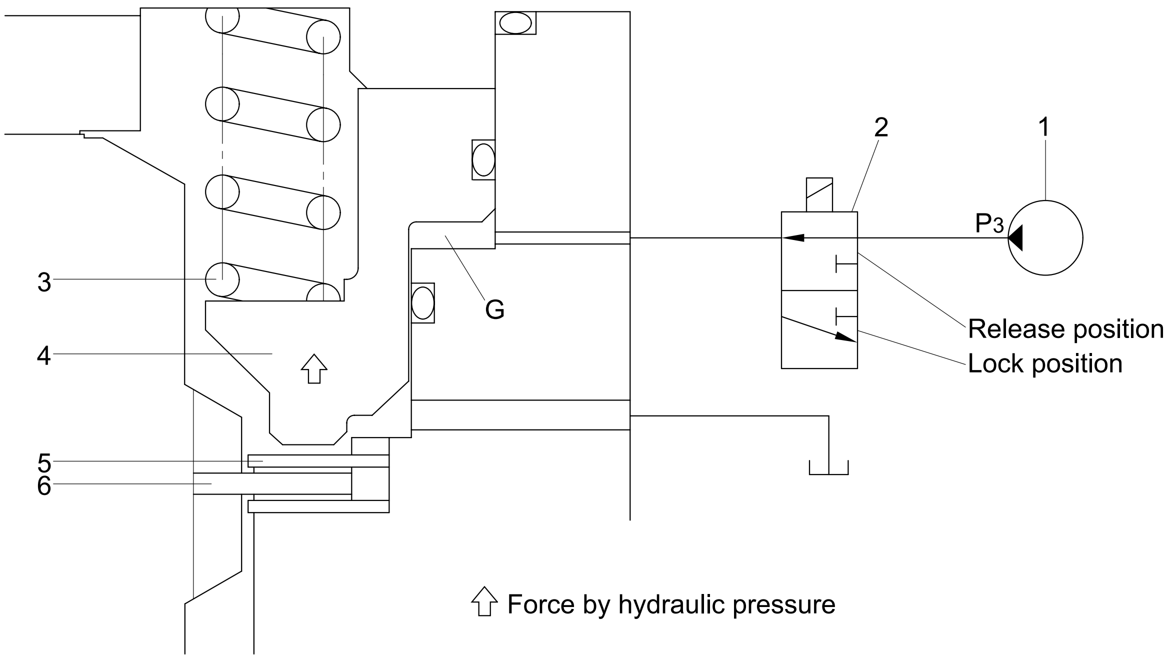


9	Separate plate	14	Spring
10	Lining plate	25	Cylinder
12	Brake piston	26	Housing

② **Operating principle**

a. When the swing control lever is operated, the swing lock solenoid valve is excited, so the pilot pump discharged oil(P3) goes to the chamber G.

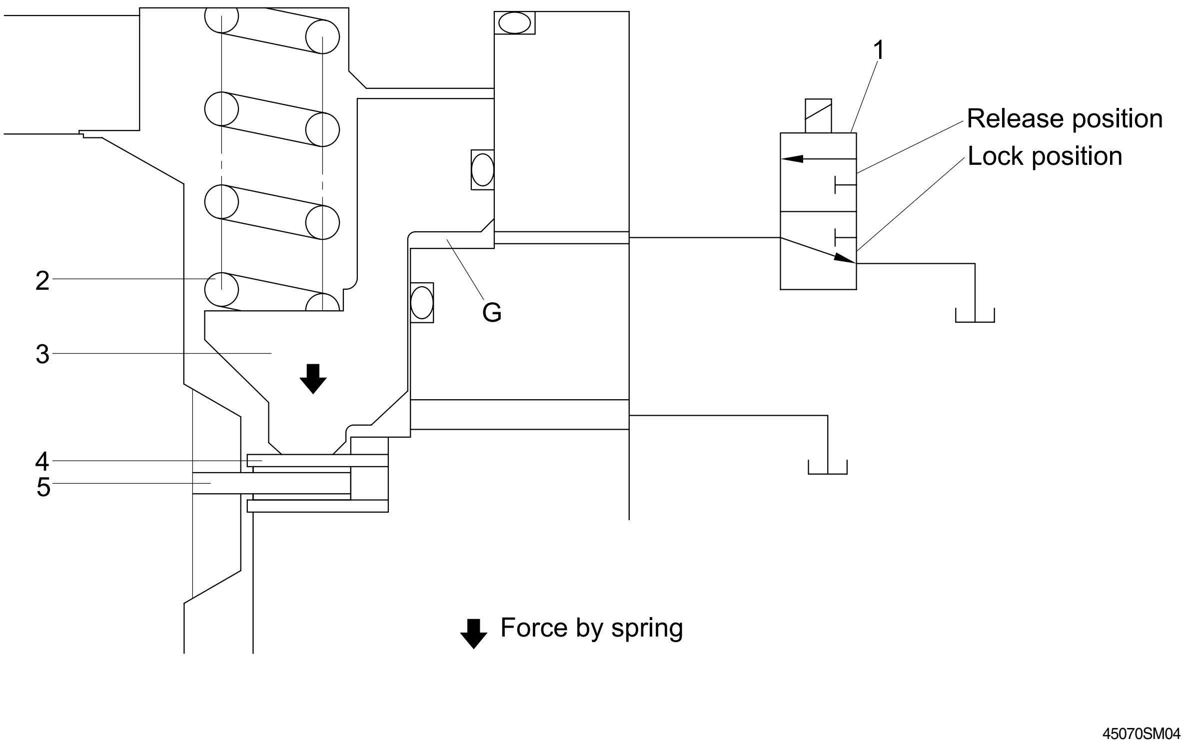
This pressure is applied to move the piston(6) to the upward against the force of the spring(9). Thus, it releases the brake force.



45070SM03

1 Pilot pump
2 Swing lock solenoid valve
3 Spring
4 Brake piston
5 Separate plate
6 Lining plate

b. When the swing control lever gets back to neutral position, the swing lock solenoid valve is deactivated, so the pilot pump discharged oil(P_3) is not applied to the chamber G.
Thus, the brake is actuated by spring force.



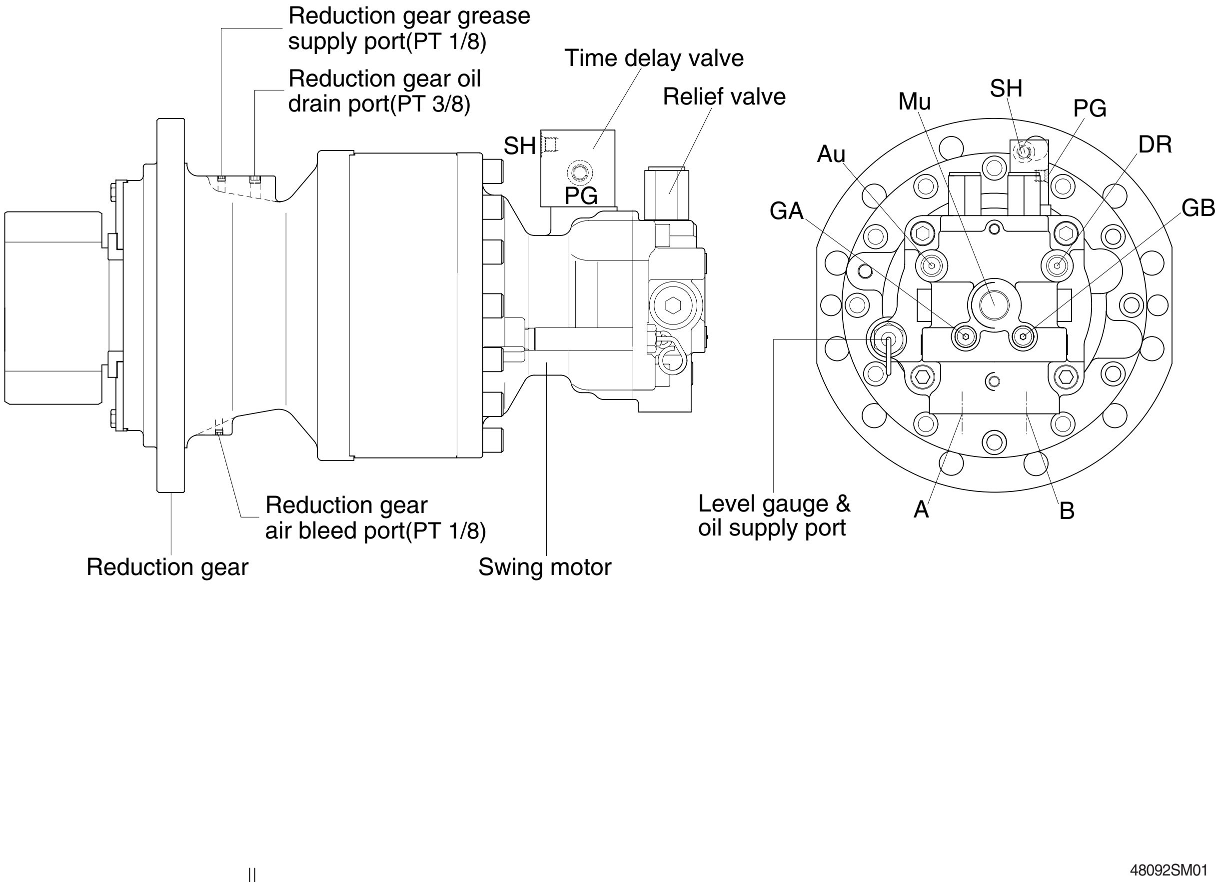
1 Swing lock solenoid valve
2 Spring
3 Brake piston
4 Separate plate
5 Lining plate

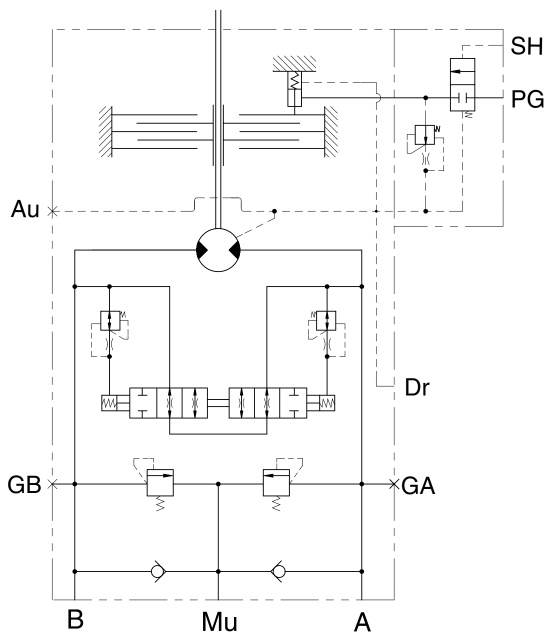
GROUP 3 SWING DEVICE (TYPE 2)

1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

Swing motor include mechanical parking valve, relief valve, make up valve and time delay valve.

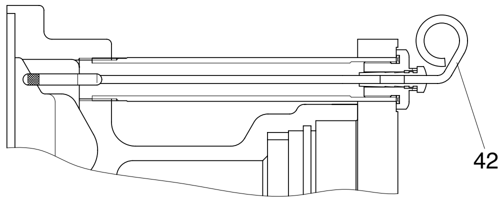




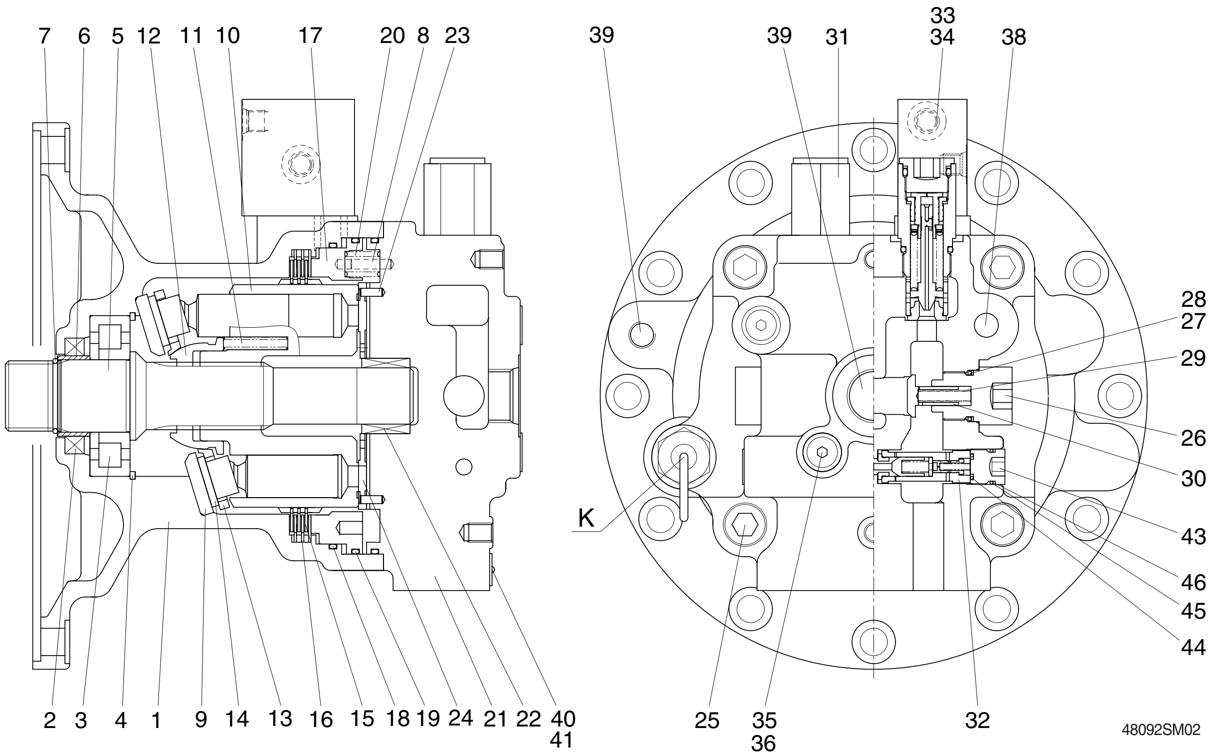
Hydraulic circuit

Port	Port name	Port size
A, B	Main port	ø 20
Dr	Drain port	PF 1/2
Mu	Make up port	PF 1
GA,GB	Gauge port	PF 1/4
Au	Air vent port	PF 1/4
PG	Brake release port	PF 1/4
SH	Brake pilot port	PF 1/4

1) SWING MOTOR

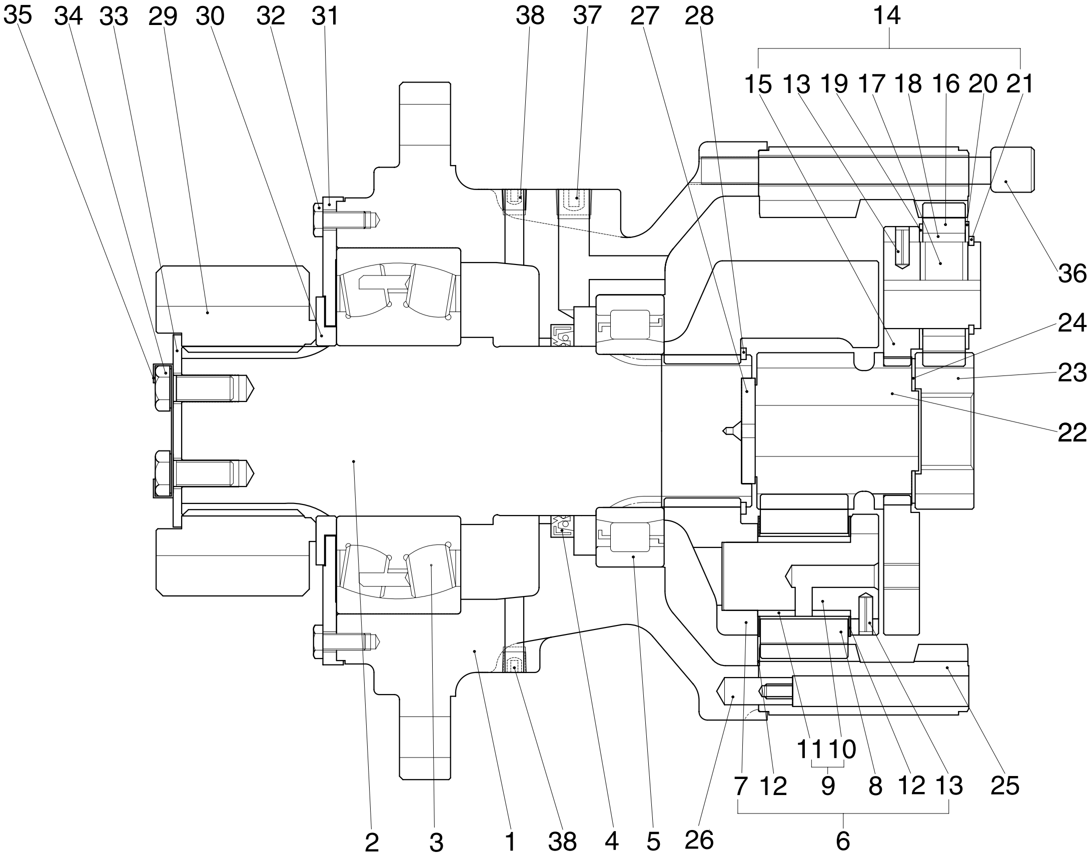


DETAIL K



1	Body	17	Brake piston	33	Time delay valve
2	Oil seal	18	O-ring	34	Wrench bolt
3	Roller bearing	19	O-ring	35	Plug
4	Snap ring	20	Spring	36	O-ring
5	Shaft	21	Rear cover	37	Plug
6	Bushing	22	Needle bearing	38	Plug
7	Stop ring	23	Pin	39	Plug
8	Pin	24	Valve plate	40	Name plate
9	Shoe plate	25	Wrench bolt	41	Rivet
10	Cylinder block	26	Plug	42	Level gauge
11	Spring	27	Back up ring	43	Plug
12	Ball guide	28	O-ring	44	O-ring
13	Set plate	29	Spring	45	O-ring
14	Piston assy	30	Check	46	Back up ring
15	Friction plate	31	Relief valve		
16	Plate	32	Anti-inversion valve		

2) REDUCTION GEAR



48092SM03

1	Casing	14	Carrier assy 1	27	Thrust plate 3
2	Drive shaft	15	Carrier 1	28	Stop ring
3	Roller bearing	16	Planet gear 1	29	Pinion gear
4	Oil seal	17	Pin 1	30	Spacer
5	Roller bearing	18	Needle cage	31	Cover plate
6	Carrier assy 2	19	Side plate 1	32	Hexagon bolt
7	Carrier 2	20	Side plate 2	33	Lock plate
8	Planet gear 2	21	Stop ring	34	Hexagon bolt
9	Pin assy 2	22	Sun gear 2	35	Lock washer
10	Pin 2	23	Sun gear 1	36	Socket bolt
11	Bush 2	24	Side plate 3	37	Plug
12	Thrust washer	25	Ring gear	38	Plug
13	Spring pin	26	Knock pin		

2. PRINCIPLE OF DRIVING

2.1 Generating the turning force

The high hydraulic supplied from a hydraulic pump flows into a cylinder (10) through valve casing of motor (21), and valve plate (24).

The high hydraulic is built as flowing on one side of Y-Y line connected by the upper and lower sides of piston (14).

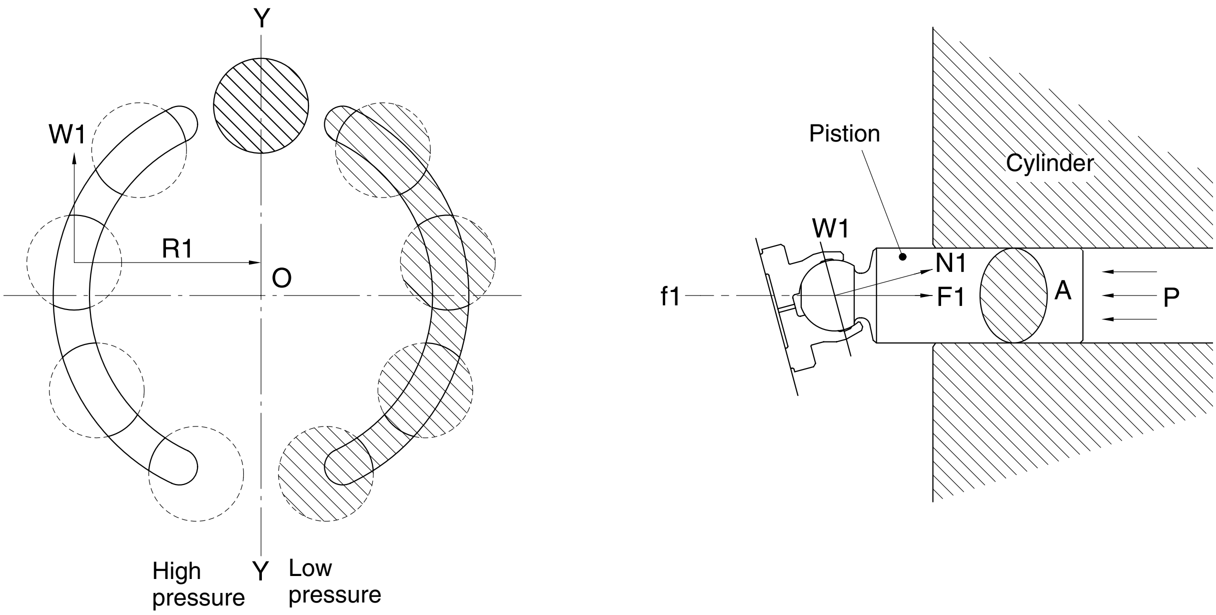
The high hydraulic can generate the force, F1=P×A (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

This force, F1, is divided as N1 thrust partial pressure and W1 radial partial pressure, in case of the plate of a tilt angle, α .

W1 generates torque, T=W1+R1, for Y-Y line connected by the upper and lower sides of the piston as following pictures.

The sum of torque (ΣW1×R1), generated from each piston (4~5 pieces) on the side of a high hydraulic, generates the turning force.

This torque transfers the turning force to a cylinder (10) through a piston; because a cylinder is combined with a turning axis and spline, a turning axis rotates and a turning force is sent.



21078TM05

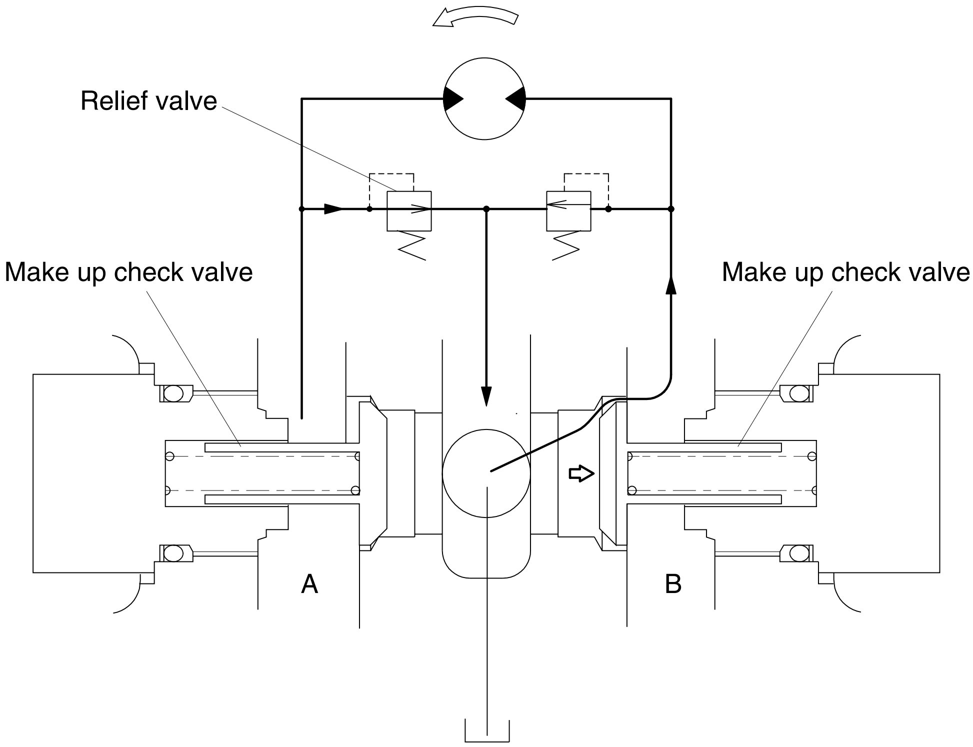
2) MAKE UP VALVE

In the system using this type of motor, there is no counter balance functioning valve and there happens the case of revolution exceeding hydraulic supply of motor. To prevent the cavitation caused by insufficient oil flow there is a make up valve to fill up the oil insufficiency.

A make up valve is provided immediately before the port leading to the hydraulic oil tank to secure feed pressure required when the hydraulic motor makes a pumping action. The boost pressure acts on the hydraulic motor's feed port via the make up valve.

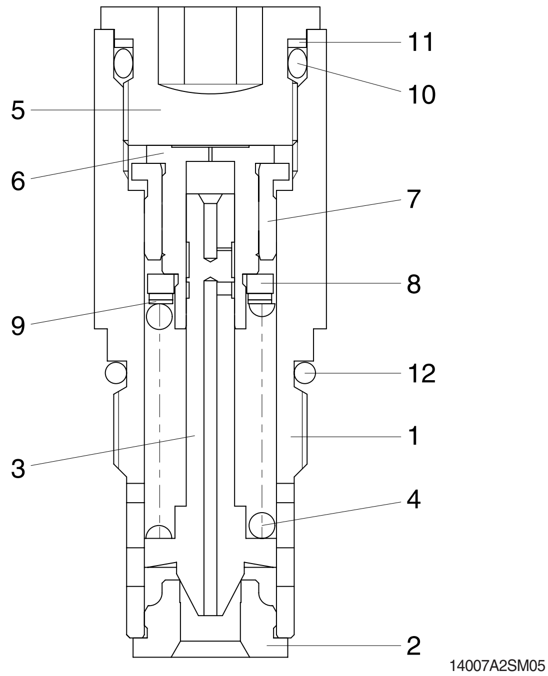
Pressurized oil into the port B, the motor rotate counterclockwise.

If the plunger of MCV moves neutral position, the oil in the motor is drain via left relief valve, the drain oil run into motor via right make up valve, which prevent the cavitation of motor.



21092SM04

3) RELIEF VALVE



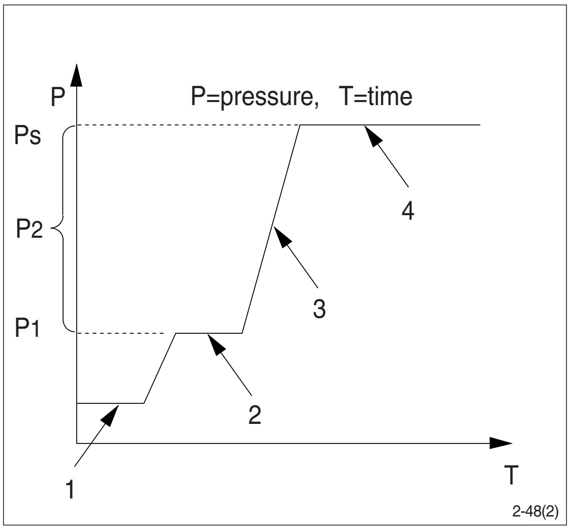
1	Body
2	Seat
3	Plunger
4	Spring
5	Adjusting screw
6	Piston
7	Bushing
8	Spring seat
9	Shim
10	O-ring
11	Back up ring
12	O-ring

(1) Construction of relief valve

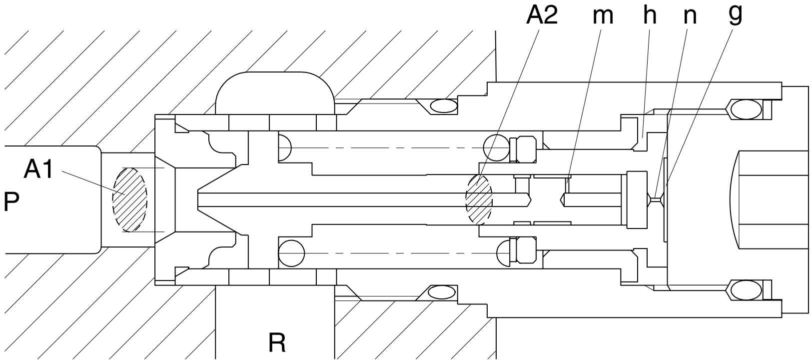
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(2) Function of relief valve

Figure illustrates how the pressure acting on the relief valve is related to its rising process. Here is given the function, referring to the figure following page.



① Ports (P,R) at tank pressure.

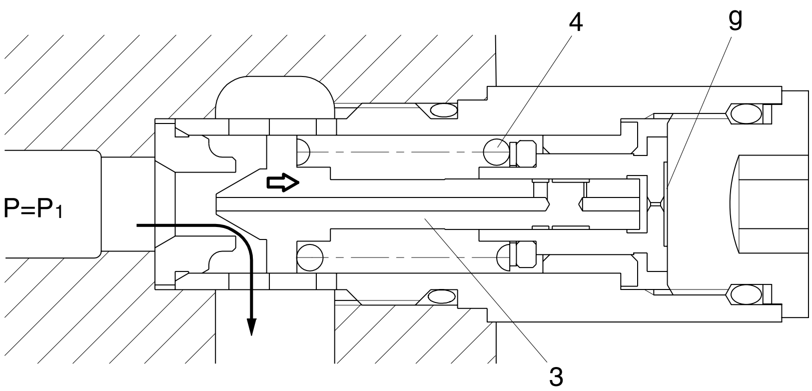


14007A2SM06

② When hydraulic oil pressure ($P \times A_1$) reaches the preset force (F_{SP}) of spring (4), the plunger (3) moves to the right as shown.

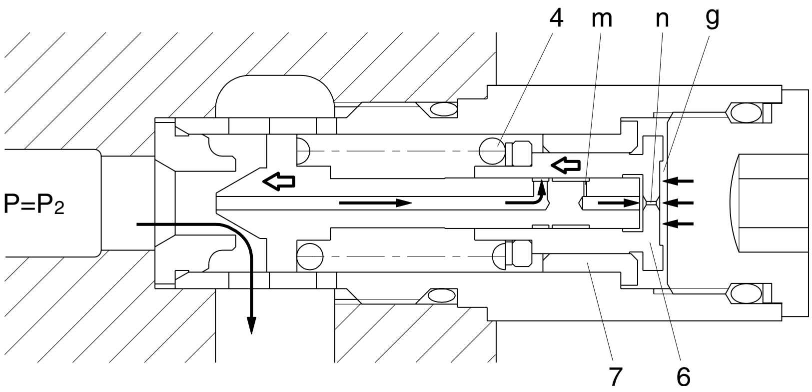
$P_1 \times A_1 = Fsp + Pg \times A_2$

$$P_1 = \frac{Fsp + Pg \times A_2}{A_1}$$



14007A2SM07

③ The oil flow chamber g via orifice m and n. When the pressure of chamber g reaches the preset force (F_{SP}) of spring (4), the piston (6) moves left and stop the piston (6) hits the bottom of bushing (7).

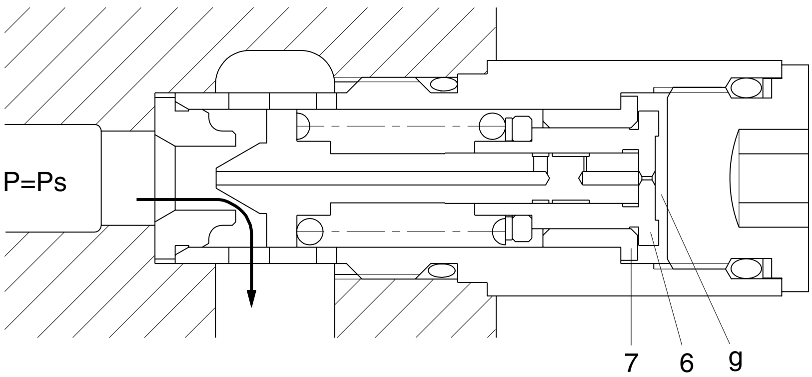


14007A2SM08

④ When piston (6) hits the bottom of bushing (7), it stops moving to the left any further. As the result, the pressure in chamber (g) equals (Ps).

$Ps \times A_1 = Fsp + Ps \times A_2$

$$Ps = \frac{Fsp}{A_1 - A_2}$$



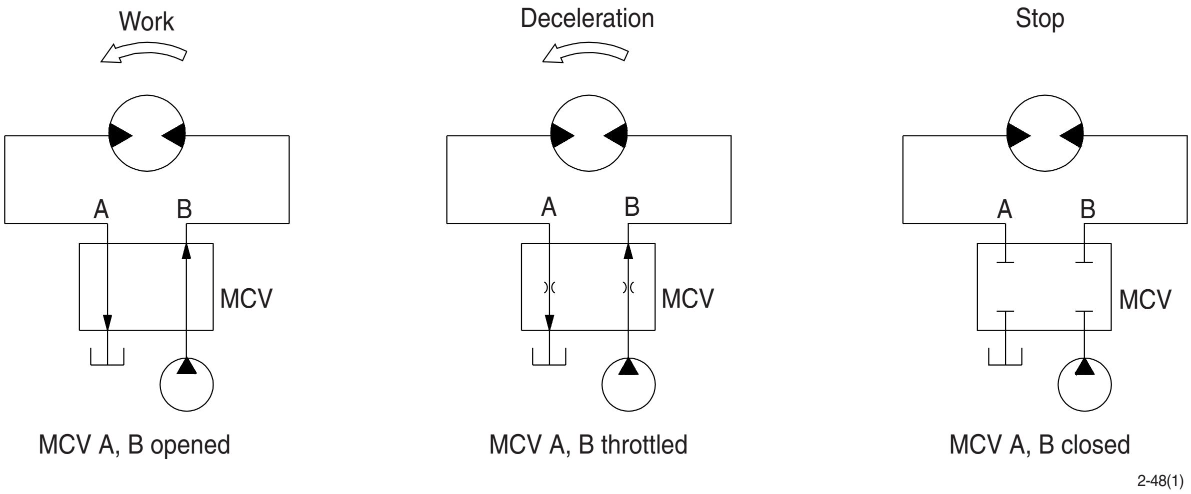
14007A2SM09

4) BRAKE SYSTEM

(1) Control valve swing brake system

This is the brake system to stop the swing motion of the excavator during operation.

In this system, the hydraulic circuit is throttled by the swing control valve, and the resistance created by this throttling works as a brake force to slow down the swing motion.



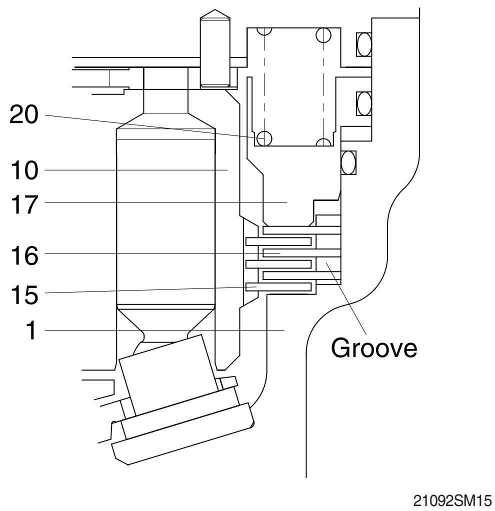
(2) Mechanical swing parking brake system

This is function as a parking brake only when all of the RCV lever (except travel pedal) are not operated.

① **Brake assembly**

Circumferential rotation of separate plate (16) is constrained by the groove located at housing (1). When housing is pressed down by brake spring (20) through friction plate (15), separate plate (16) and brake piston (17), friction force occurs there.

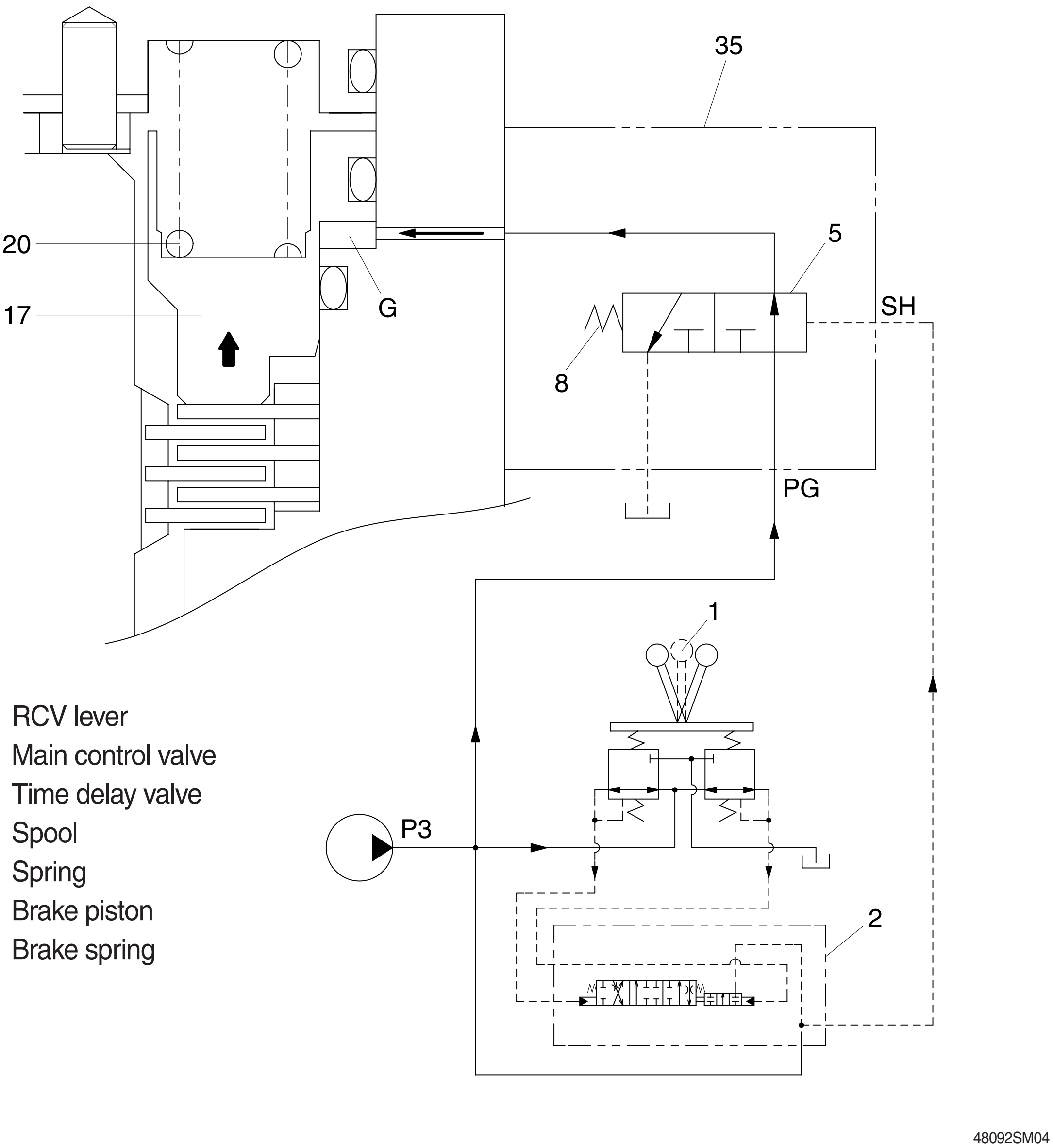
Cylinder block (10) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



1	Housing	16	Separate plate
10	Cylinder block	17	Brake piston
15	Friction plate	20	Spring

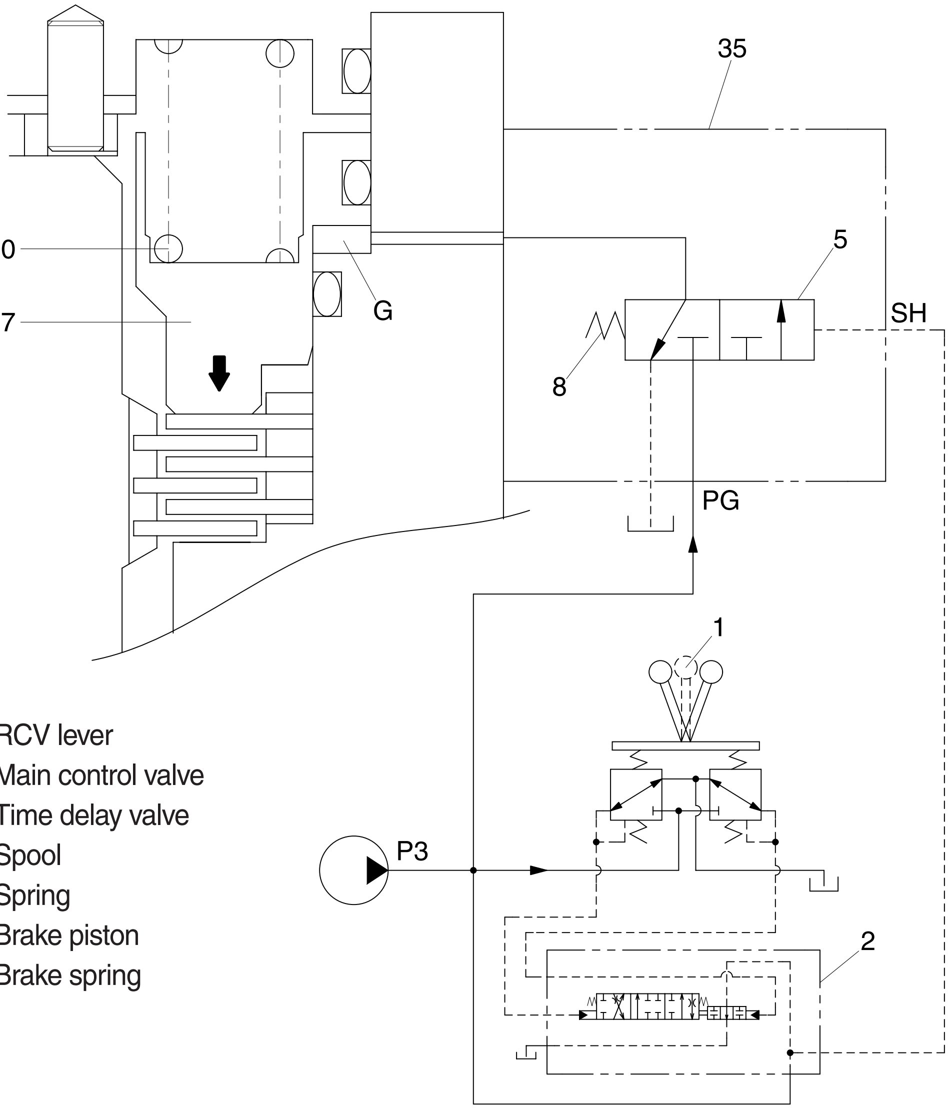
② Operating principle

a. When one of the RCV lever (1) is set to the operation position, the each spool is shifted to left or right and the pilot oil flow is blocked. Then the pilot oil go to SH of the time delay valve (3). This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.
This pressure is applied to move the piston (16) to the upward against the force of the spring (19). Thus, it releases the brake force.



1 RCV lever
2 Main control valve
3 Time delay valve
5 Spool
8 Spring
16 Brake piston
19 Brake spring

b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to right.
Then, the piston (16) is moved lower by spring force and the return oil from the chamber G flows back to tank port.
At this time, the brake works.



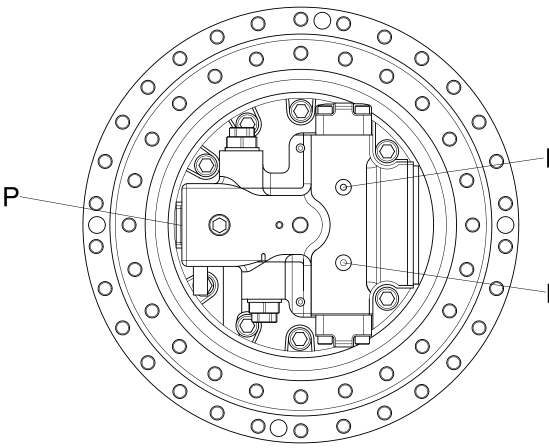
1 RCV lever
2 Main control valve
3 Time delay valve
5 Spool
8 Spring
16 Brake piston
19 Brake spring

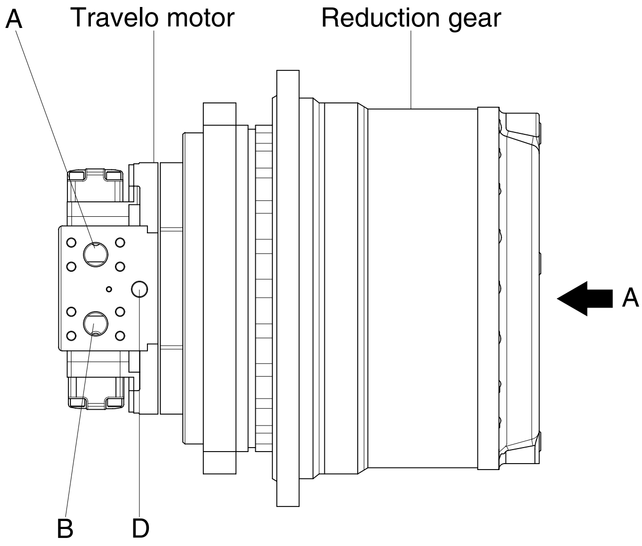
48092SM05

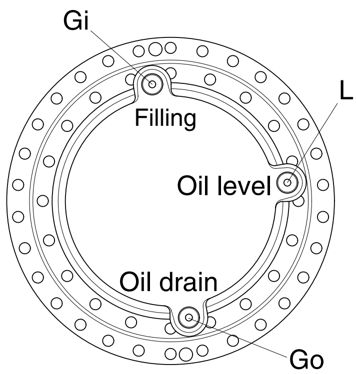
GROUP 4 TRAVEL DEVICE

1. CONSTRUCTION

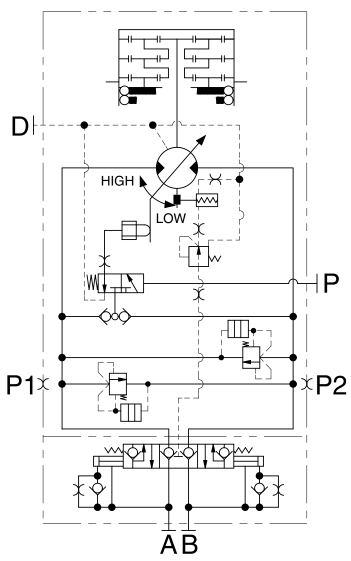
Travel device consists travel motor and gear box.
Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.







VIEW A



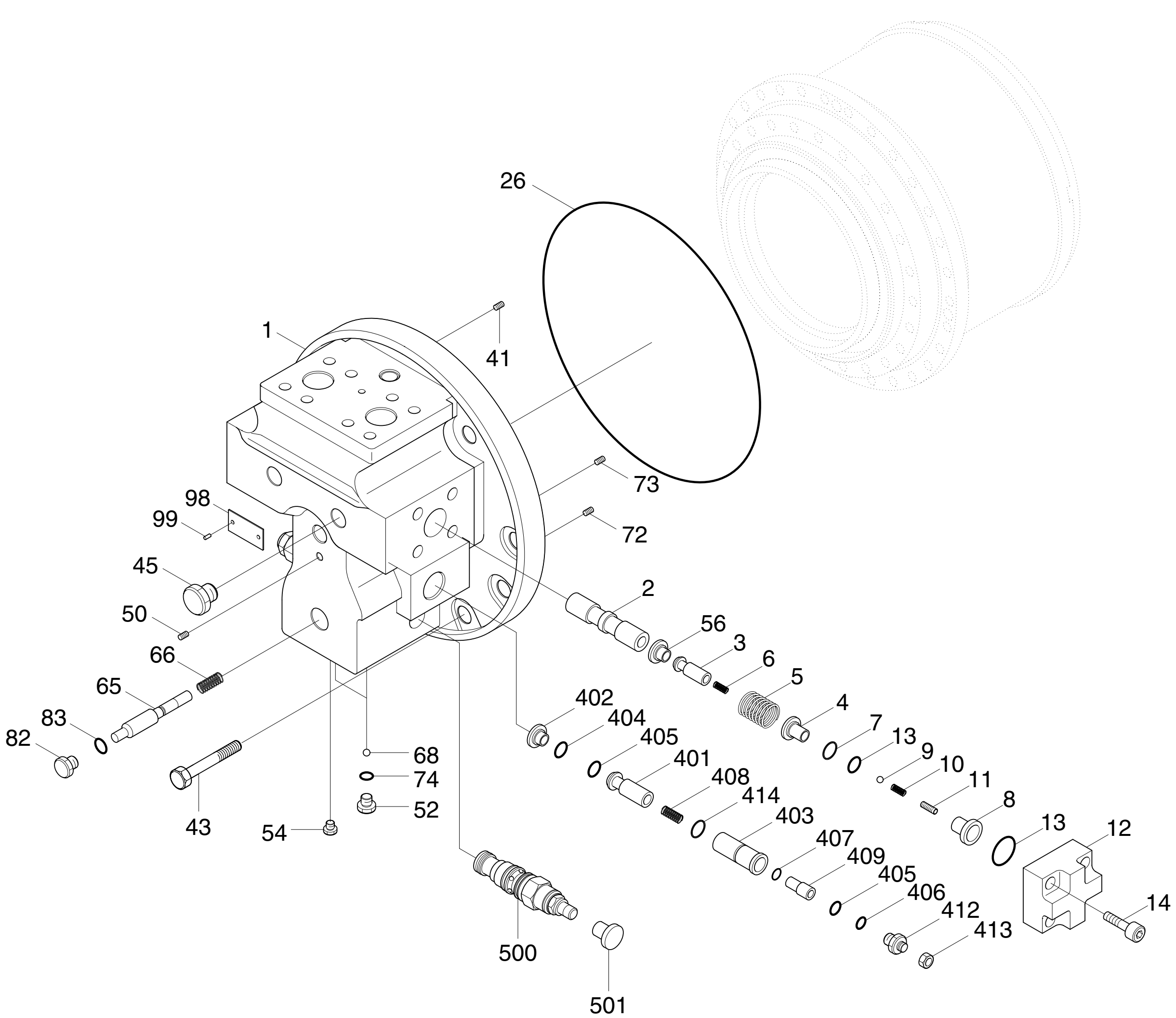
HYDRAULIC CIRCUIT

4809S2TM01

Port	Port name	Port size
A, B	Main port	SAE 5000 psi 1 1/4"
P1, P2	Pressure gauge port	PF 1/4
P	Pilot port	PF 1/4
D	Drain port	PF 1/2
L	Level gauge	PF 1/2
Gi	Gear oil filling port	PF 1/2
Go	Gear oil drain port	PF 1/2

2. STRUCTURE

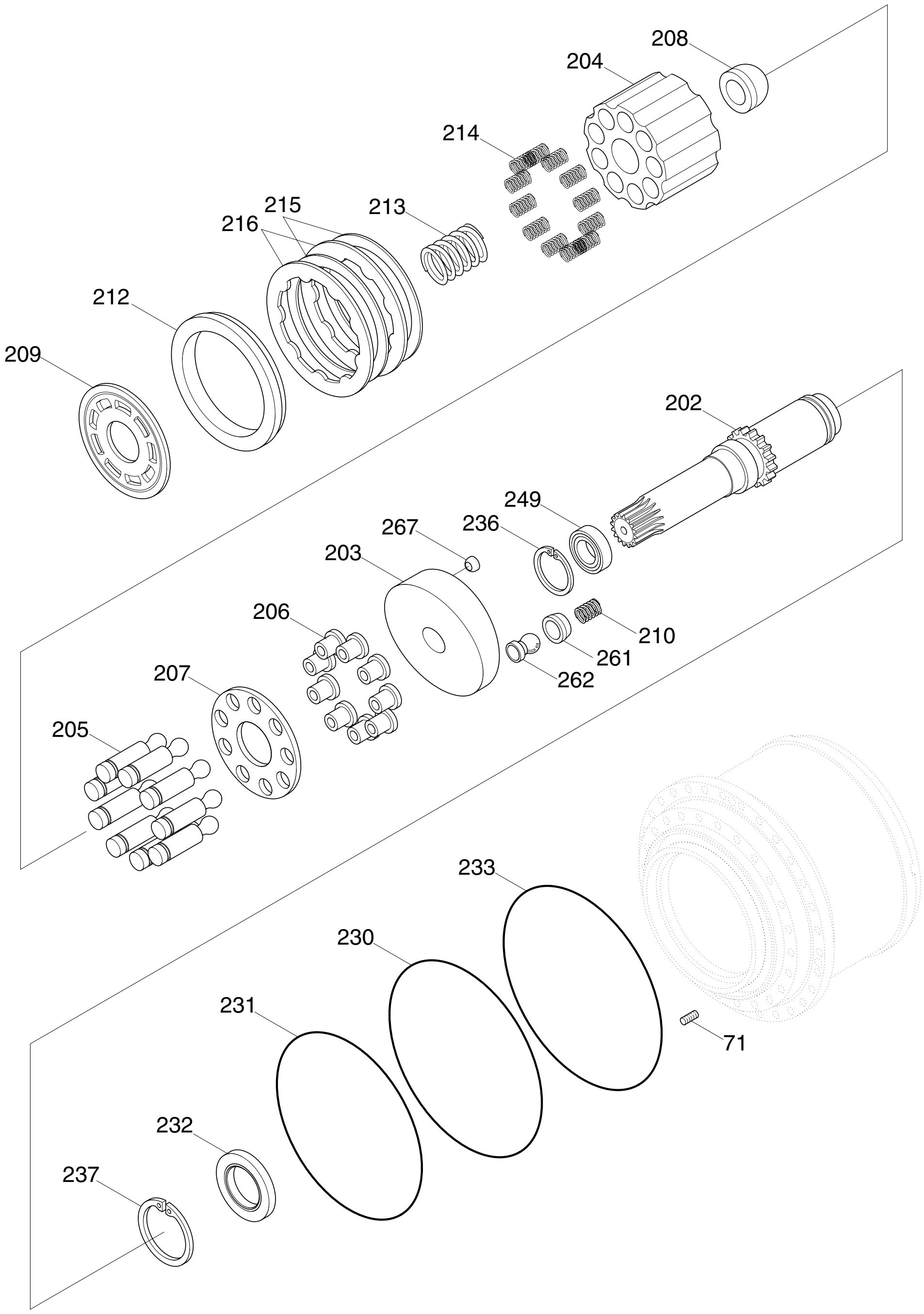
1) TRAVEL MOTOR (1/2)



4809S2TM02

1	Rear flange
2	Spool
3	Poppet
4	Plug
5	Check spring
6	Main spring
7	Washer
8	Seat
9	Steel ball
10	Spring
11	Screw
12	Cover
13	O-ring
14	Socket bolt
26	O-ring
41	Valve plate pin
43	Socket bolt
45	PT Plug
50	Needle bearing
52	RO Plug
54	Plug
56	Plug
65	Spool
66	Spring
68	Steel ball
72	Orifice
73	Orifice
74	O-ring
82	Plug
83	O-ring
98	Name plate
99	Rivet screw
401	Plunger
402	Seat
403	Body
404	Back up ring
405	O-ring
406	O-ring
407	Retainer
408	Spring
409	Piston
412	Adjust plug
413	Lock nut
414	Shim
500	Reducing valve
501	Cover

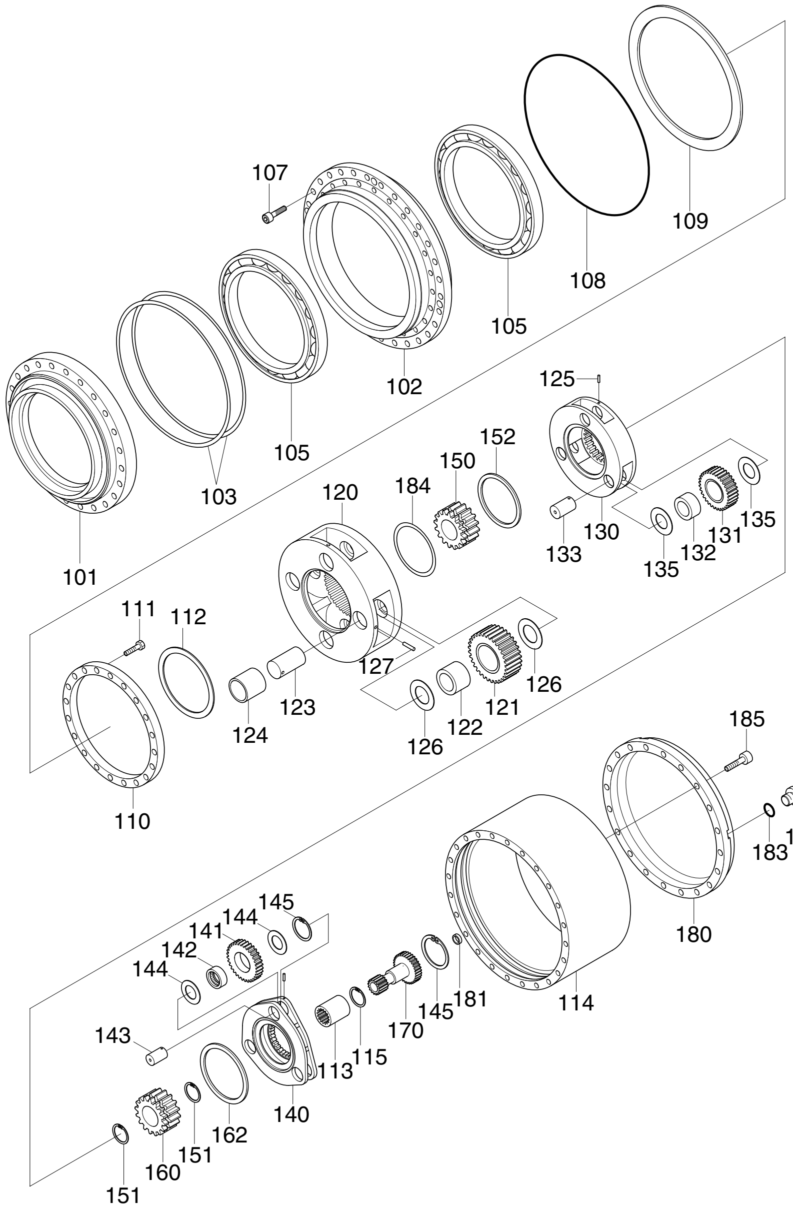
TRAVEL MOTOR (2/2)



480H2TM03

71	Orifice	209	Timing plate	231	O-ring
202	Drive shaft	210	Spring	232	Oil seal
203	Swash plate	212	Piston	233	O-ring
204	Cylinder block	213	Spring	236	Snap ring
205	Piston	214	Spring	237	Snap ring
206	Shoe	215	Friction plate	249	Roller bearing
207	Retainer plate	216	Mating plate	267	Pivot
208	Thrust ball	230	O-ring		

2) REDUCTION GEAR



101	Spindle	122	Needle bearing	144	Plate
102	Hub	123	Bushing	145	Snap ring
103	Seat	124	Shaft No. 3	150	Sun gear No.3
105	Angular bearing	125	Spring pin	151	Thrust ring
107	Socket bolt	126	Thrust washer	152	Clip
108	O-ring	127	Spring pin	160	Sun gear No.2
109	Piece	130	Carrier No. 2	162	Clip
110	Coupling	131	Planetary gear No.2	170	Drive gear
111	Socket bolt	132	Needle bearing	180	Cover
112	Thrust plate	133	Shaft No.2	181	Thrust washer
113	Coupling	135	Thrust washer	182	Plug
114	Ring gear	140	Carrier No.1	183	O-ring
115	Snap ring	141	Planetary gear No.1	184	Thrust ring
120	Carrier No. 3	142	Needle bearing	185	Socket bolt
121	Planetary gear No. 3	143	Ring		

3. FUNCTION OF HYDRAULIC MOTOR

1) TURNING FORCE GENERATION

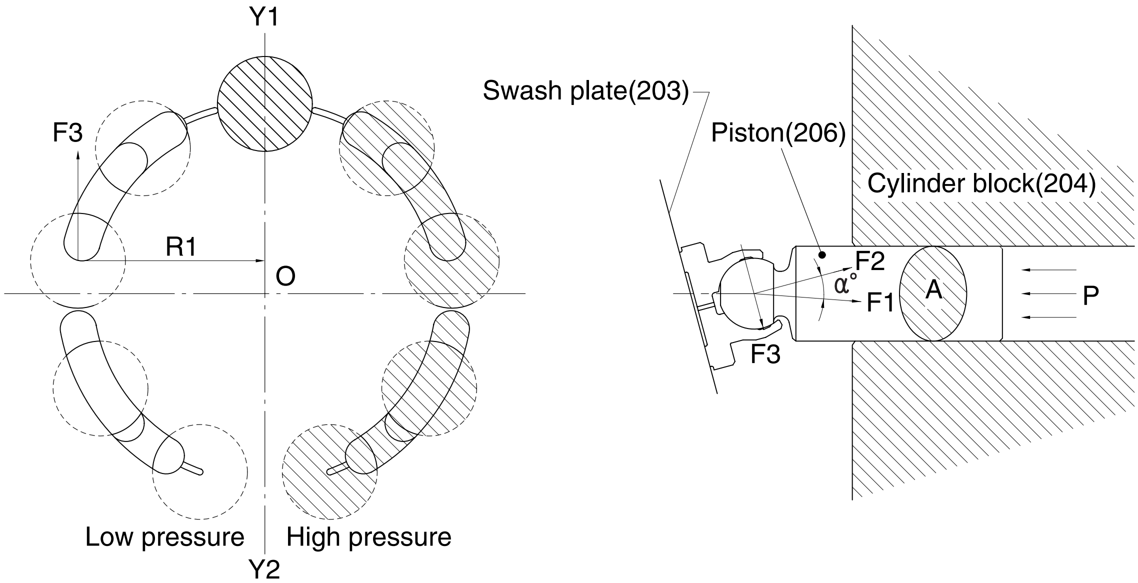
The pressure oil delivered from the hydraulic pump flows to rear flange of the motor, passes through the brake valve mechanism, and is introduced into cylinder block (204) via timing plate (209).

This oil constructively introduced only to one side of Y1-Y2 connecting the upper and lower dead points of stroke of piston (205). The pressurized oil fed to one side in cylinder block (204) pushes each piston (205) (four or five) and generates a force F(kgf) = P(kgf/cm^2) × A (cm^2).

This force acts on swash plate (203), and is resolves into components (F2 and F3) because swash plate (203) is fixed at an angle (α°) with the axis of drive shaft (202).

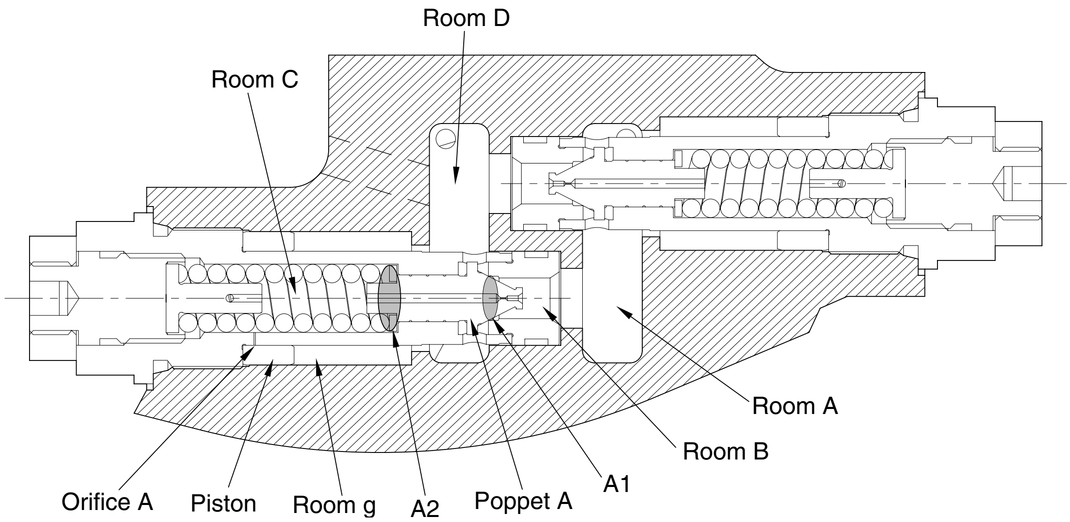
Radial component (F3) generates respective torques (T=F3 × RI) for (Y1)-(Y2). This residual of torque (T = S (F3 × RI)) rotates cylinder block (204) via piston (205). Cylinder block (204) is spline coupled with drive shaft (202).

So the drive shaft (202) rotates and the torque is transmitted.



4809S2TM03

2) FUNCTION OF RELIEF VALVE

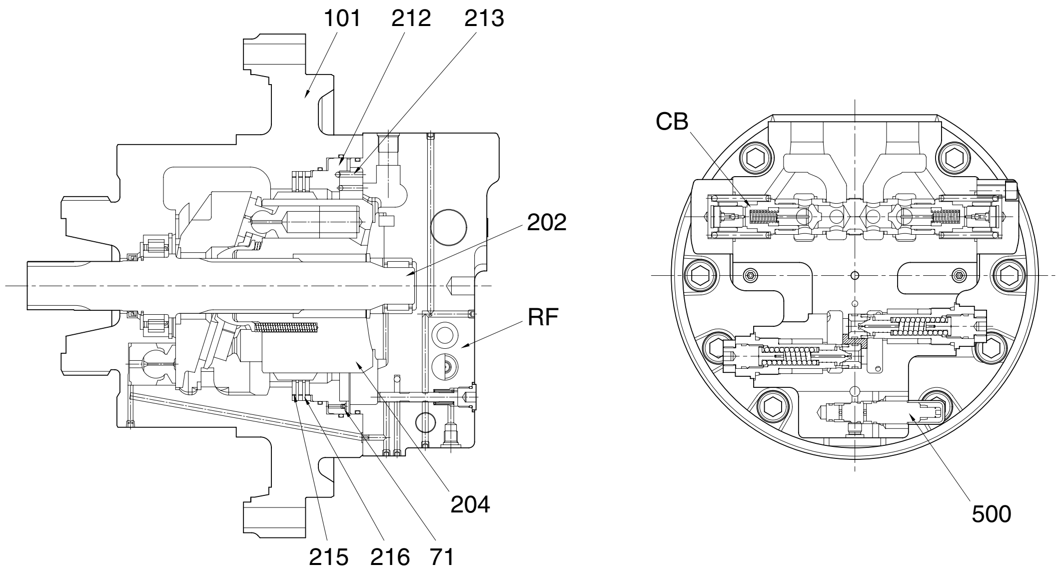


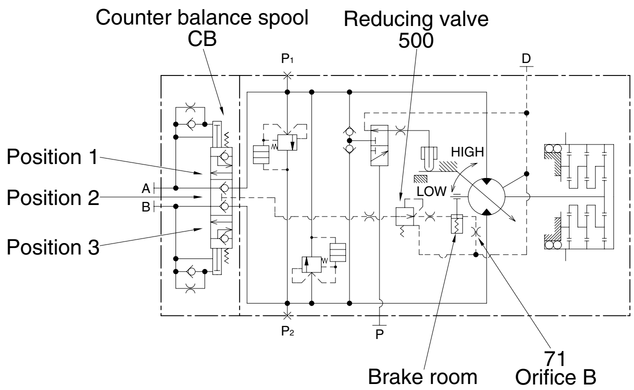
4809S2TM04

(1) The pressured oil that flowed in A room by the neutral position of counter balance spool is applied to the seat's room B at once. The poppet A is pushed on the left side by being that the room's pressured oil is forced as much as F1=A1 × P1 on section A1.
At the moment, the pressured oil goes through the orifice of poppet A.
This oil goes into the room C and goes into the room g through the orifice A then the piston is moved on the right side. The piston is reached to the stroke end, the oil has no way to go therefore.
A resultant force on force (F2=A2 × P2) pushing section A2 by the pressured oil and spring force is more than the force (F1=A1 × P1) working on section A1 of the poppet A.
During the piston is moved on the right side, the pressure of oil is kept uniformly.

(2) When the pressure of oil in the room B is higher then [F2 + spring force] the poppet opens and the pressured oil goes into the room D as a relief function.
In this way, by controlling the pressure in room A, B in two steps, the hydraulic motor is smoothly braked and to a stop.

3) FUNCTION BRAKE





4809S2TM05

The brake is released by applying to the brake piston the pressure led through the built in counterbalance spool subassembly. With no pressure working , the brake force is always ensured.
Brake force is generated from friction plate (215) which is combined with cylinder block (204) as spline, separate plate (216) which is embedded in spindle (101), spindle (101), parking piston (212).
Without pressure being applied to the brake piston, the brake piston is pushed by fourteen brake spring (213), and the friction plate and separation plate are held between the brake and spindle.
This holding force functions as the friction force. This friction force restrains the shaft (202) spline coupled with the cylinder block, and this function is the brake.

Normal travelling (at position 1 or 3)
During normal travelling, the pressured oil coming through the counter balance spool is applied to the brake room to release brake, after was decompressed at a reducing valve. At this time, the slight hydraulic oil is drained through the orifice B (71), but the pressure at brake room releases the braking by overcoming the spring force. Cause the pressure at brake room is always applied from the counter balance valve.

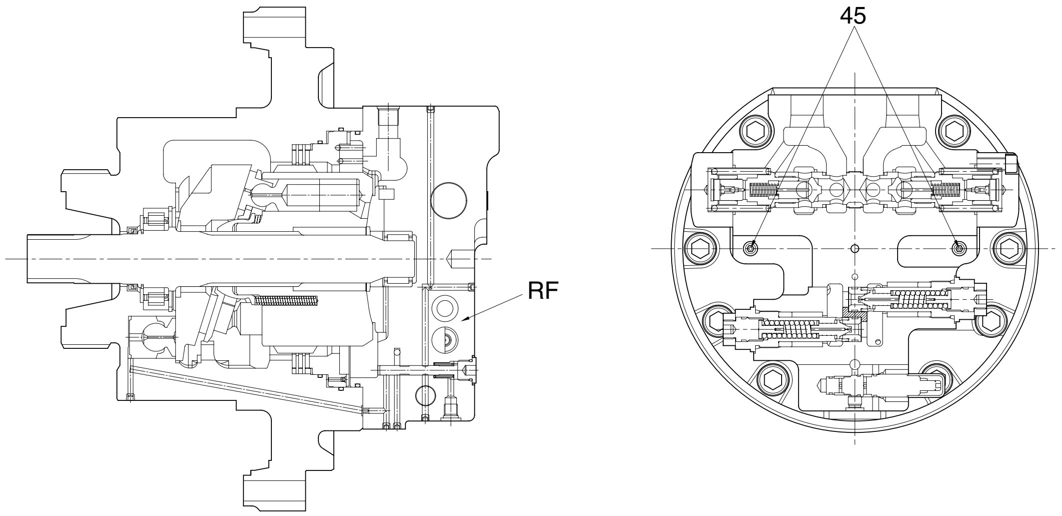
Neutral (at position 2)
The brake room's pressure is decreased by the blocked oil-passage, and the brake is generated by being that the brake spring force is much than the brake room's pressure. At this time, the hydraulic oil in the brake room is drained through the orifice B (71), then the spool returns to the neutral position. When the condition changes from travelling to stop, the brake runs in order of precedence after stopping motor, so it is preventing the damage of friction plate.

4) RELEASING METHOD OF BRAKE

In releasing the brake without applying the brake releasing pressure, follow the procedures shown below.

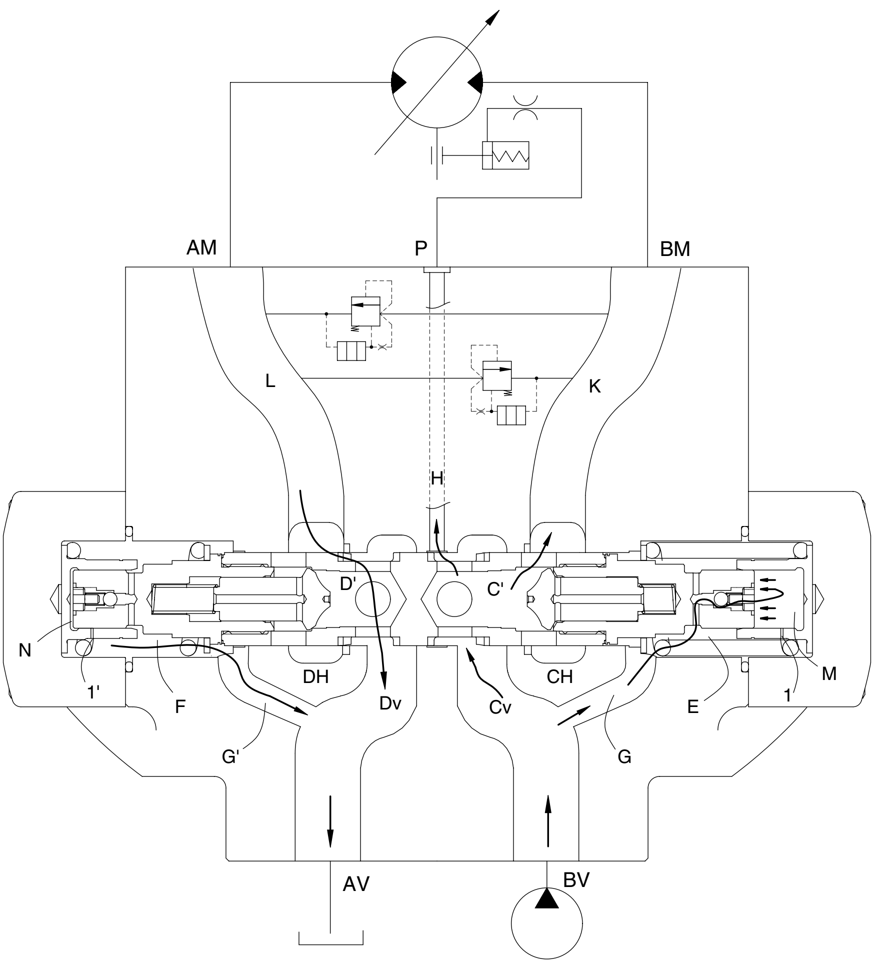
Details of work	Tools
Remove two plugs (45) from the rear flange (RF). (For their position, see the attached installation dimension.) Insert in there, tighten an M10 screw of 135 mm in length into a tapped hole of the brake piston. Then the condition having the brake released pressure is attained and the brake release pressure is attained and the brake is released.	Socket Wrench 6 mm 8 mm

※ **Even with the negative brake released, the hydraulic motor will not run.**
When it is difficult to generate the working pressure due to failure of the pump or so, and the whole machine is to be pulled for transportation without removing the hydraulic motor, connect pressure measurement ports Am, Bm with a short hose or something.
Then the machine can be pulled slowly.



4809S2TM08

5) FUNCTION OF COUNTER BALANCE VALVE



Suppose port Bv is connected to the hydraulic pump and port Av, to the tank.

The oil supplied from the hydraulic pump passes through Bv, Cv and C in sequence, pushes up the poppet of the check valve, passes through K to port Bm, and is supplied to the hydraulic motor to turn it.

Therefore, the pump discharge oil pressure incerases, and the pressure is led via passage G to spring room E and via the ball check valve to dumping room M. When the pressure in rooms E and M exceeds the value equivalent to the force of the spring which holds the spool at its neutral position, the spool begins to move left. Since the working oil in room N flows into room F via throuttle 1 or clearance 2 and that in room F is discharged via passage G through port Av to the tank, the spool moves left to have passage L-Dm-D-Dv composed. In addition, passage Cv-H-P is also composed, and the pump discharge pressure in port Bv is led to port P.

Because of the throttle or clearance provided for the working oil flow from room N, this changeover motion of the spool is comparatively slow. When the pump discharge pressure is higher, the spool movement is larger and above opening area of the spool is larger.

When the pump discharge pressure falls, pressures in rooms E and M fall and the spool will move right due to the spring on the room F side.

Since working oil in room M flows to room E via throttle 1 and that in room E, to port Bv via passage G, the spool moves right.

When the presssure at port Bv, falls down to eh tank pressure, the pressure in room E also falls to the tank pressure and becomes equal to that in room F, and so the spool returns to neutral position.

6) FUNCTION OF HIGH/LOW SPEED CHANGEOVER

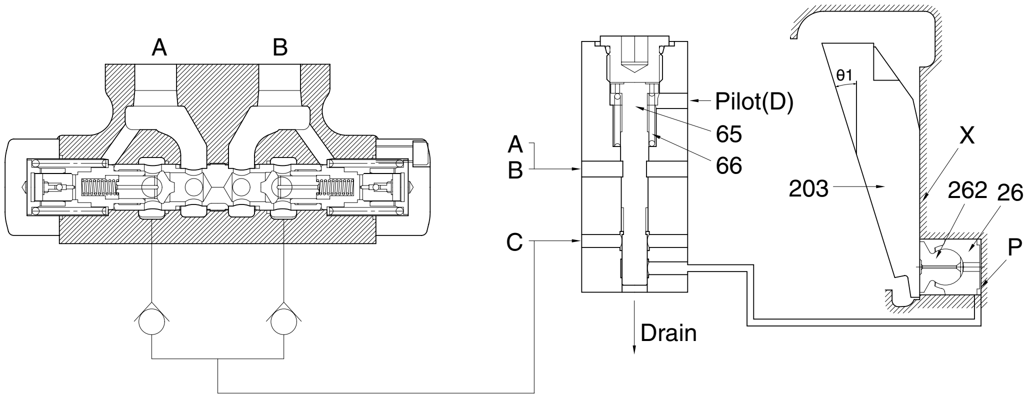
As a supporting mechanism for the swash plate (203) on which the shoe (262) slide, the pillar system is adopted to support the load with semi-cylindrical sliding bearings provided at both end of the mechanism. The capacity is changed by changing the tilting angle of this swash plate.

This is a mechanism that swash plate was pushed by tilting piston, and the tilting angle of the swash plate is decided in two positions ("large" and "small") by controlling has the flows to and from these piston rooms with the displacement changeover valve section.

(1) Low speed - at pilot pressure of less than 20 kgf/cm²

When no pilot pressure is supplied from (D) (at a pressure of 20 kgf/cm² or less), valve (65) is pressed toward the top by the force of spring (66) and (A) port or (B) port, the pressurized oil supply port (C) is shut off, and oil in chamber (P) is released into the motor case via valve (65).

Consequently, swash plate (203) is tilted at a maximum angle (Θ1) and the piston displacement of hydraulic motor becomes maximum, thus leading to low-speed rotation.



4809S2TM06

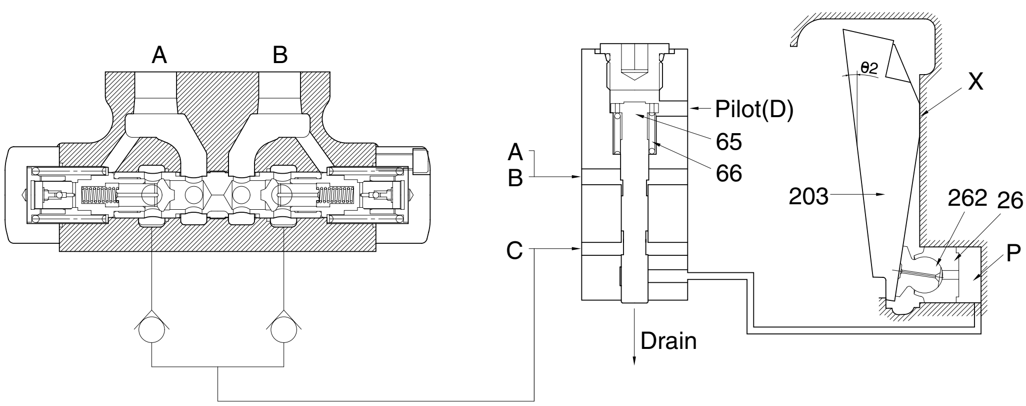
(2) High speed - at pilot pressure of 20 kgf/cm² or more.

When a pilot pressure is supplied from port (D) (at a pressure of 20 kgf/cm² or more), the pressure overcomes the force of spring (66) and (A) port or (B) port of 2 speed spool (65) is pressed toward the down.

The pressurized oil at supoly port (C) is then introduced into chamber (P) via 2 speed spool (65).

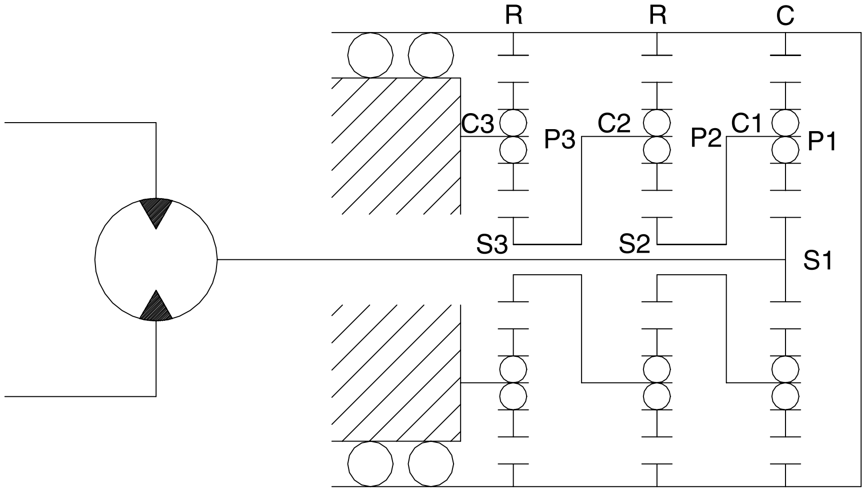
Piston (261) pushed up swash plate (203) until it touches side X of the spindle.

At this time, swash plate (203) is tilted at a minimum angle (Θ2) and the piston displacement of hydraulic motor becomes minimum, thus leading to high-speed rotation.



4809S2TM07

7) WORKING PRINCIPLE OF REDUCTION GEAR



4809S2TM09

The reduction gear is composed of a three-stage planetary gear mechanism shown in the following figure. Since the sun gear is designed to have a floating mechanism, errors of the gears and carrier pin hole pitches will not affect the gear's lives heavily.

The input rotation of the hydraulic motor is transmitted to the drive gear (D) and this drives the No. 1 planetary gears (P1). This No.1 planetary gears (P1) drives the cover gear (C) with the same force as the meshing tangential force with the drive gear (D), and also the No.1 carrier (C1) with the same force as the meshing reaction force.

In other words, the No.1 planetary gears (P1) revole rotating. This rotation of the No.1 carrier (C1) becomes the output of the 1st stage, and is transmitted directly to No.2 sun gear (S2). (No.1 carrier is spline-coupled with No.2 sun gear.)

Similarly the revolution of the No.2 planetary gears (P2) are transmitted via No.2 carrier (C2) to the No.3 sun gear (S3). Since the No.3 carrier (C3) supporting the No.3 planetary gears (P3) are fixed, the No.3 planetary gears (P3) do not revolve, but rotates to drive ring gear (R).

Therefore, the rotating case is driven by the overall driving torque of the cover and ring gear.

This reduction ratio is expressed as shown below :

$$I = \frac{(Z_D + Z_C)(Z_{S2} + Z_R)(Z_{S3} + Z_R)}{Z_D \times Z_{S2} \times Z_{S3}} - 1$$

Z_D : Teeth of the drive gear

Z_C : Teeth of the cover gear

Z_{S2} : Teeth of the No.2 sun gear

Z_{S3} : Teeth of the No.3 sun gear

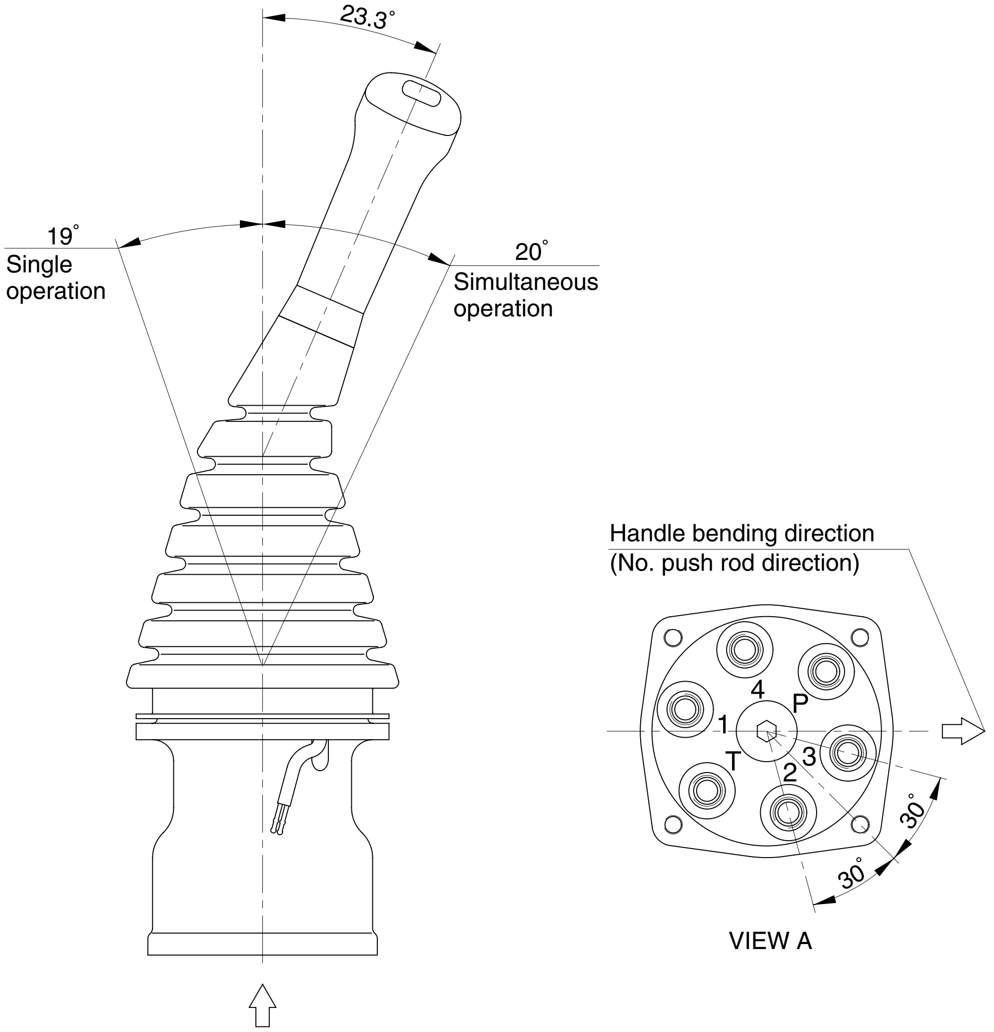
Z_R : Teeth of the ring gear

The direction of rotation is reverse to that of the input shaft.

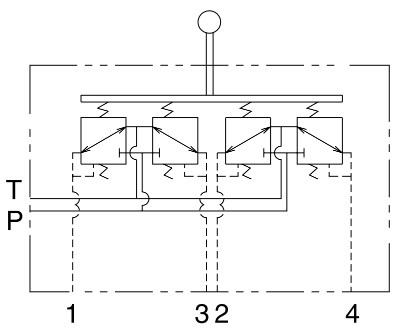
GROUP 5 RCV LEVER

1. STRUCTURE

The casing has the oil inlet port P(Primary pressure) and the oil outlet port T(Tank). In addition the secondary pressure is taken out through ports 1, 2, 3 and 4 provided at the bottom face.



25032RL01



Hydraulic circuit

Port	LH	RH	Port size
P	Pilot oil inlet port	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	Pilot oil return port	
1	Left swing port	Bucket out port	
2	Arm in port	Boom down port	
3	Right swing port	Bucket in port	
4	Arm out port	Boom up port	

CROSS SECTION

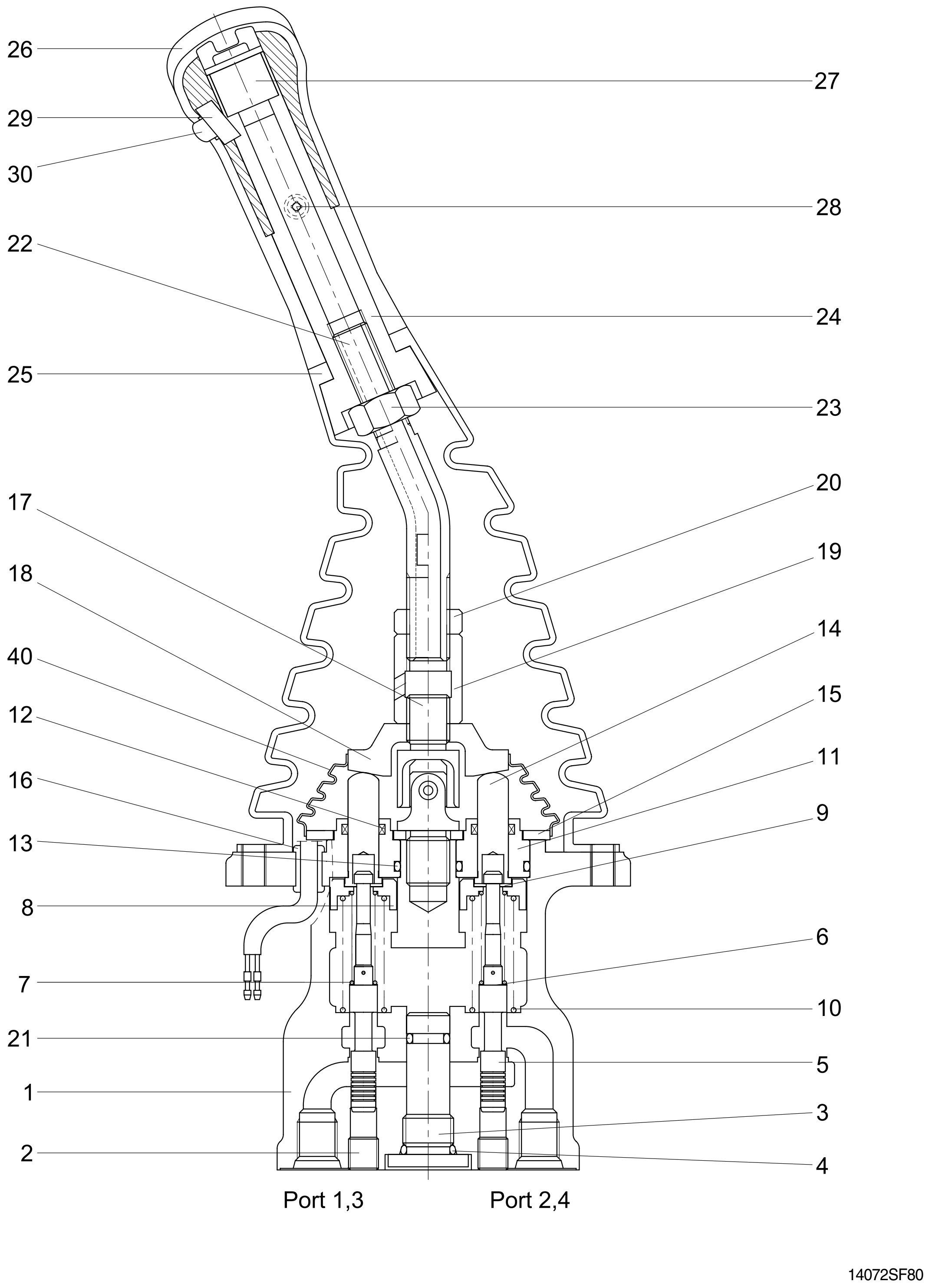
The construction of the pilot valve is shown in the attached cross section drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool(5), spring(7) for setting secondary pressure, return spring(10), stopper(9), spring seat(8) and shim(6). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 20.5kgf/cm^2(Depending on the type). The spool is pushed against the push rod(14) by the return spring.

When the push rod is pushed down by tilting the handle, the spring seat comes down simultaneously and changes setting of the secondary pressure spring.

1	Case	11	Plug	21	O-ring
2	Plug	12	Rod seal	22	Handle connector
3	Plug	13	O-ring	23	Nut
4	O-ring	14	Push rod	24	Insert
5	Spool	15	Plate	25	Boot
6	Shim	16	Bushing	26	Handle
7	Spring	17	Joint assembly	27	Switch assembly
8	Spring seat	18	Swash plate	28	Screw
9	Stopper	19	Adjusting nut	29	Switch assembly
10	Spring	20	Lock nut	30	Switch cover
				40	Boot

CROSS SECTION



2. FUNCTIONS

1) FUNDAMENTAL FUNCTIONS

The pilot valve is a valve that controls the spool stroke, direction, etc of a main control valve. This function is carried out by providing the spring at one end of the main control valve spool and applying the output pressure(Secondary pressure) of the pilot valve to the other end.

For this function to be carried out satisfactorily, the pilot valve is composed of the following elements.

(1) Inlet port(P) where oil is supplied from hydraulic pump.

(2) Output ports(1, 2, 3 & 4) to apply pressure supplied from inlet port to ends of control valve spools.

(3) Tank port(T) necessary to control the above output pressure.

(4) Spool to connect output port to inlet port or tank port.

(5) Mechanical means to control output pressure, including springs that work on the above spools.

2) FUNCTIONS OF MAJOR SECTIONS

The functions of the spool(5) are to receive the supply oil pressure from the hydraulic pump at its port P, and to change over oil paths to determine whether the pressure oil of port P is led to output ports 1, 2, 3 & 4 or the output port pressure oil to tank port T.

The spring(7) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod(14) is inserted and can slide in the plug(11).

For the purpose of changing the displacement of the push rod through the switch plate(19) and adjusting nut(20) are provided the handle(27) that can be tilted in any direction around the fulcrum of the universal joint(18) center.

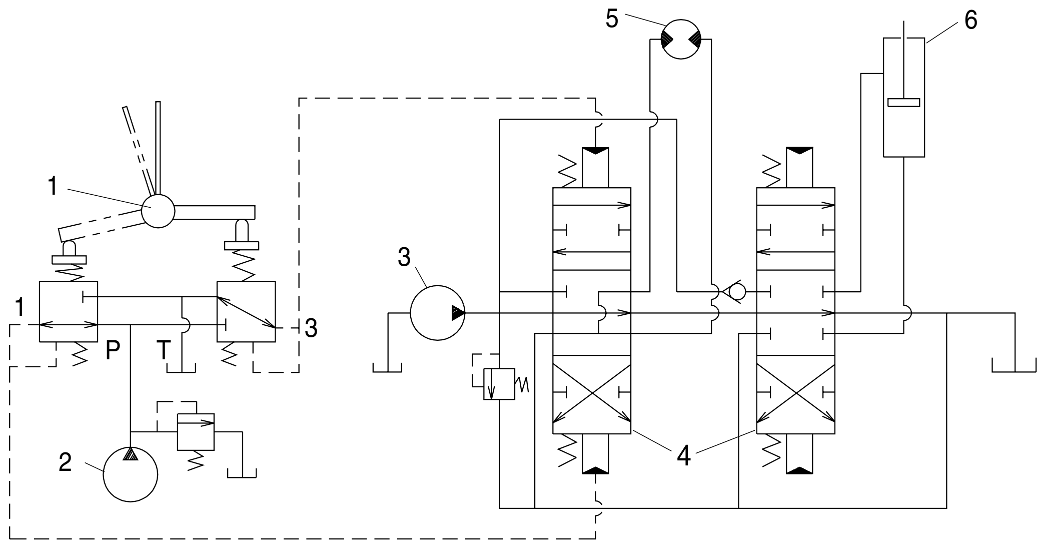
The spring(10) works on the case(1) and spring seat(8) and tries to return the push rod(14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

This also has the effect of a reaction spring to give appropriate control feeling to the operator.

3) OPERATION

The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

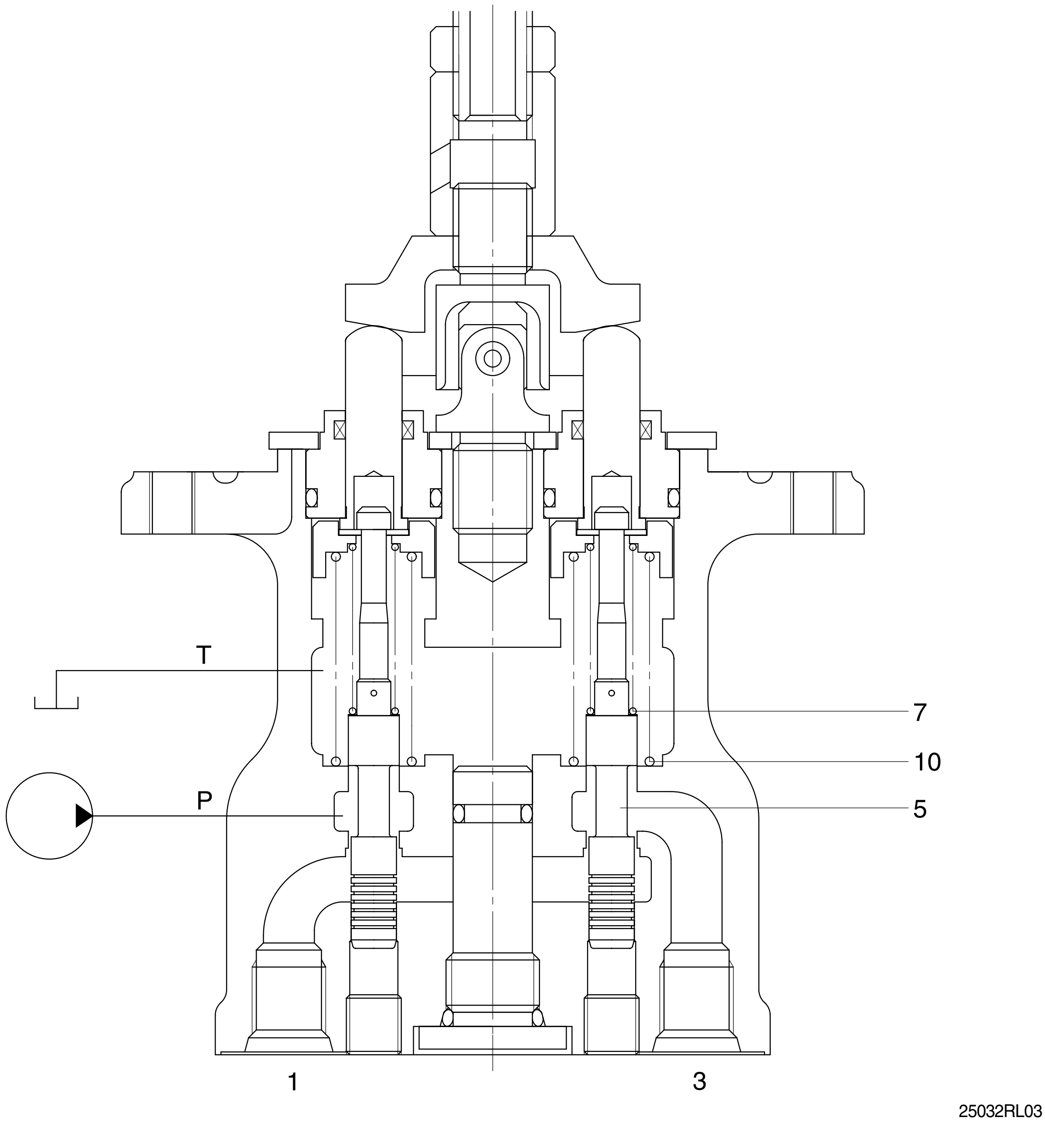
The diagram shown below is the typical application example of the pilot valve.



36072RL01

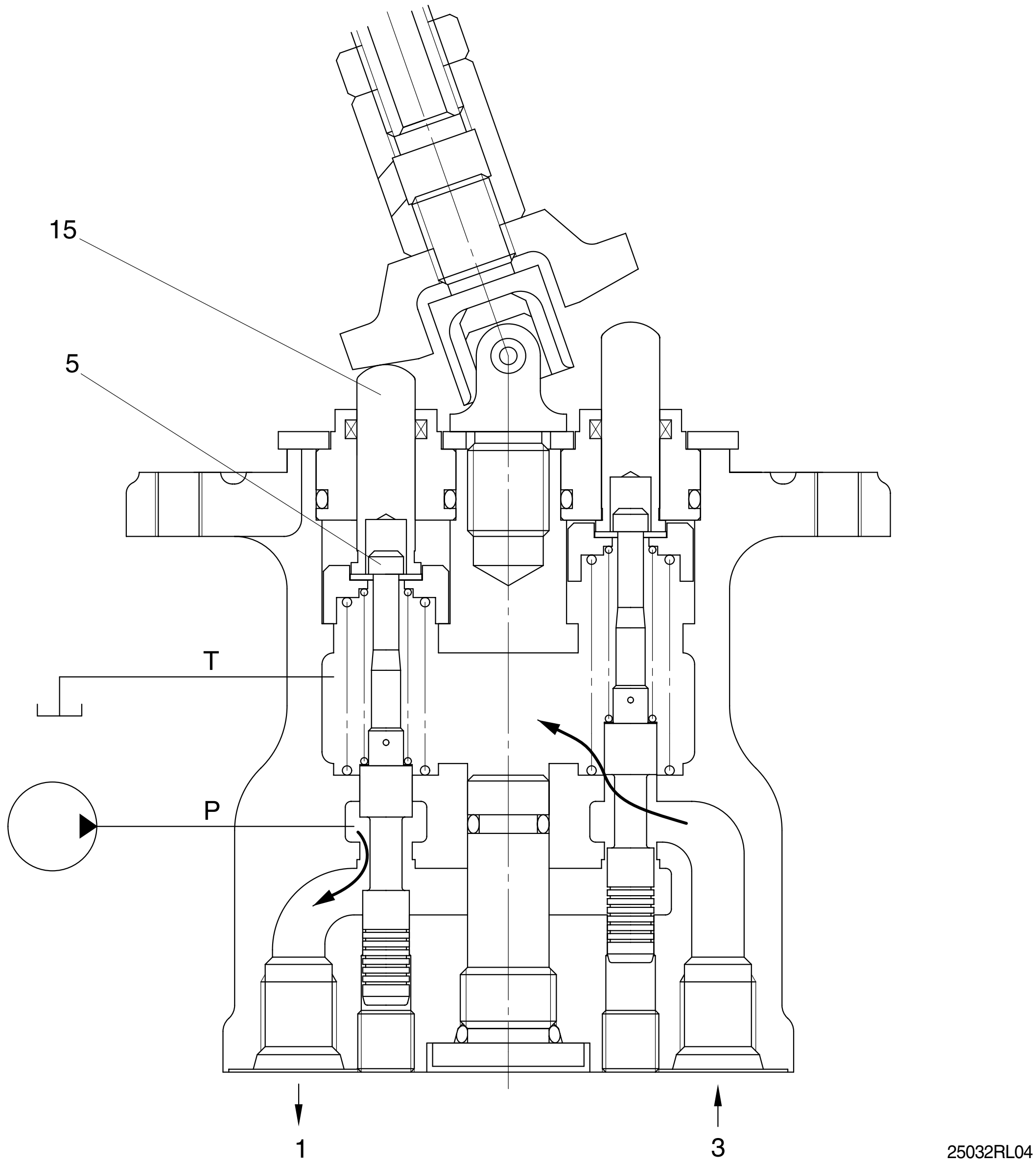
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where handle is in neutral position



The force of the spring(7) that determines the output pressure of the pilot valve is not applied to the spool(5). Therefore, the spool is pushed up by the spring(10) to the position of port(1, 3) in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where handle is tilted

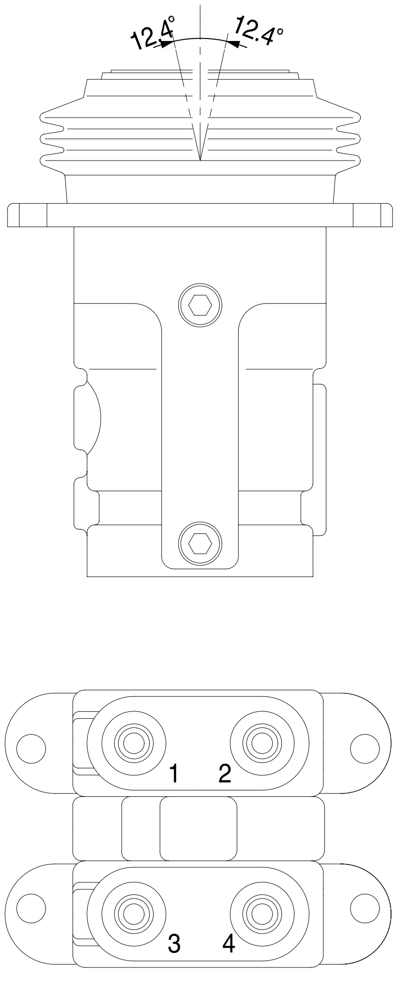


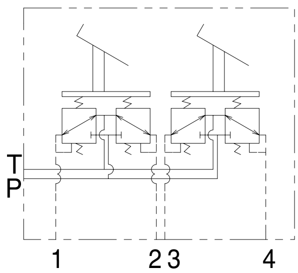
When the push rod(14) is stroked, the spool(5) moves downwards.
Then port P is connected with port(1) and the oil supplied from the pilot pump flows through port(1) to generate the pressure.
When the pressure at port(1) increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port(1) increases higher than the set pressure, port P is disconnected from port(1) and port T is connected with port(1). If it decreases lower than the set pressure, port P is connected with port(1) and port T is disconnected from port 1.
In this manner the secondary pressure is kept at the constant value.
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with the inside bottom of the push rod and the output pressure is left to be connected with port P.

GROUP 6 RCV PEDAL

1. STRUCTURE

The casing(Spacer) has the oil inlet port P(Primary pressure), and the oil outlet port T(Tank). In addition the secondary pressure is taken out through ports 1, 2, 3 and 4 provided at the bottom face.





Hydraulic circuit

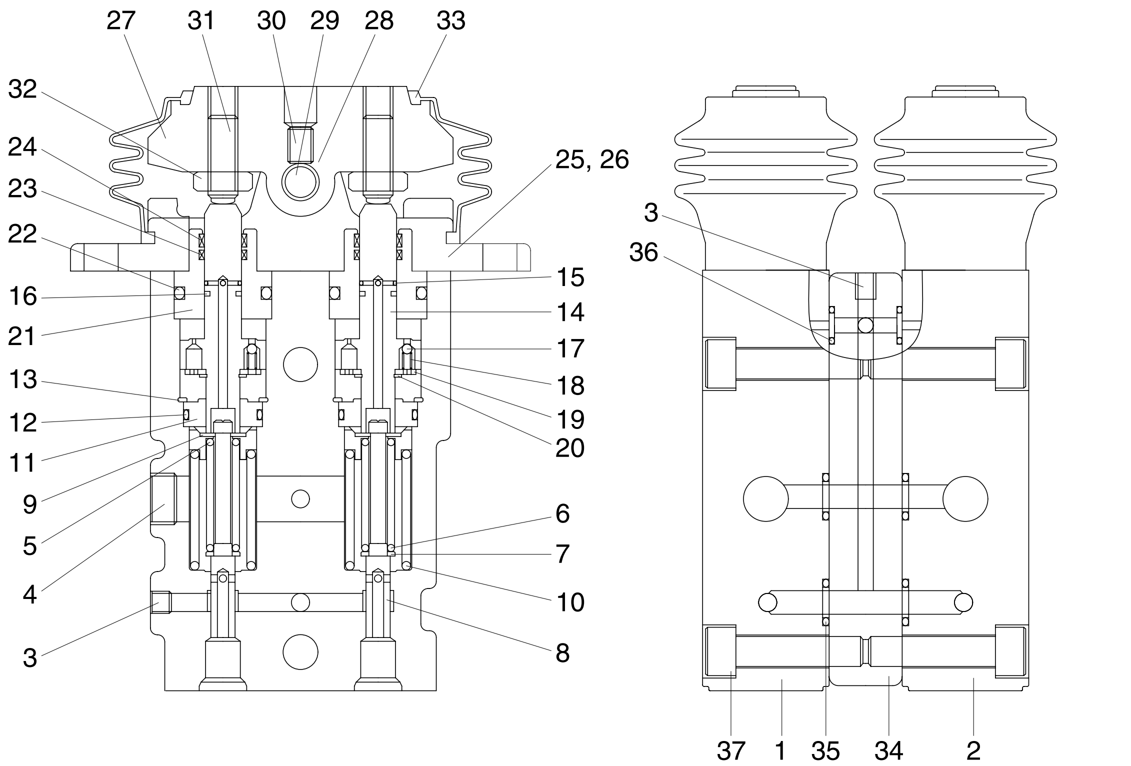
Port	Port	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	
1	Travel(LH, Forward)	
2	Travel(LH, Backward)	
3	Travel(RH, Forward)	
4	Travel(RH, Backward)	

CROSS SECTION

The construction of the RCV pedal is shown in the below drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool(8), spring(6) for setting secondary pressure, return spring(10), stopper(9), and spring seat(7). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 19 kgf/cm^2 (depending on the type). The spool is pushed against the push rod(14) by the return spring.

When the push rod is pushed down by tilting pedal, the spring seat comes down simultaneously and changes setting of the secondary pressure spring.



14072SF70

1	Body(1)	13	Snap ring	25	Cover
2	Body(2)	14	Push rod	26	Bolt
3	Plug	15	Spring pin	27	Cam
4	Plug	16	Seal	28	Bushing
5	Spring seat	17	Steel ball	29	Cam shaft
6	Spring	18	Spring	30	Set screw
7	Spring seat	19	Plate	31	Set screw
8	Spool	20	Snap ring	32	Nut
9	Stopper	21	Plug	33	Bellows
10	Spring	22	O-ring	34	Space
11	Rod guide	23	Rod seal	35	O-ring
12	O-ring	24	Dust seal	36	O-ring
				37	Bolt

2. FUNCTION

1) FUNDAMENTAL FUNCTIONS

The pilot valve is a valve controls the spool stroke, direction, etc of a main control valve. This function is carried out by providing the spring at one end of the main control valve spool and applying the output pressure(Secondary pressure) of the pilot valve to the other end.

For this function to be carried out satisfactorily, the pilot valve is composed of the following elements.

(1) Inlet port(P) where oil is supplied from hydraulic pump.

(2) Output port(1, 2, 3 & 4) to apply pressure supplied from inlet port to ends of control valve spools.

(3) Tank port(T) necessary to control the above output pressure.

(4) Spool to connect output port to inlet port tank port.

(5) Mechanical means to control output pressure, including springs that work on the above spools.

2) FUNCTIONS OF MAJOR SECTIONS

The functions of the spool(8) are to receive the supply oil pressure from the hydraulic pump at its port P, and to change over oil paths to determine whether the pressure oil of port P is led to output ports 1, 2, 3 & 4 or the output spool to determine the output pressure.

The spring(6) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod(14) is inserted and can slide in the plug(21).

For the purpose of changing th displacement of the push rod through the cam(27) and adjusting nut(32) are provided the pedal that can be tilted in any direction around the fulcrum of the cam(27) center.

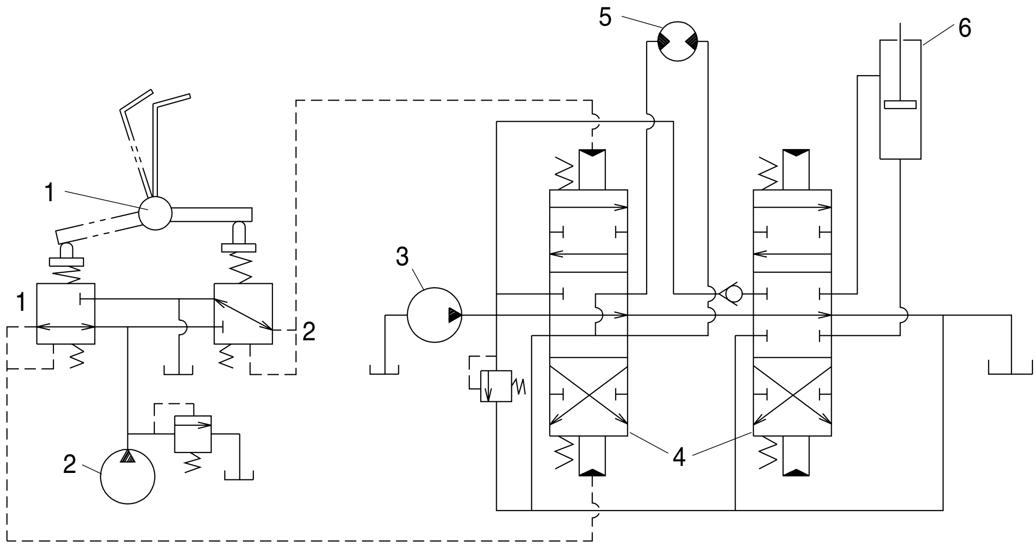
The spring(10) works on the casing(1) and spring seat(7) and tries to return the push rod(14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

This also has the effect of a reaction spring to give appropriate control feeling to the operator.

3) OPERATION

The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below ant the attached operation explanation drawing.

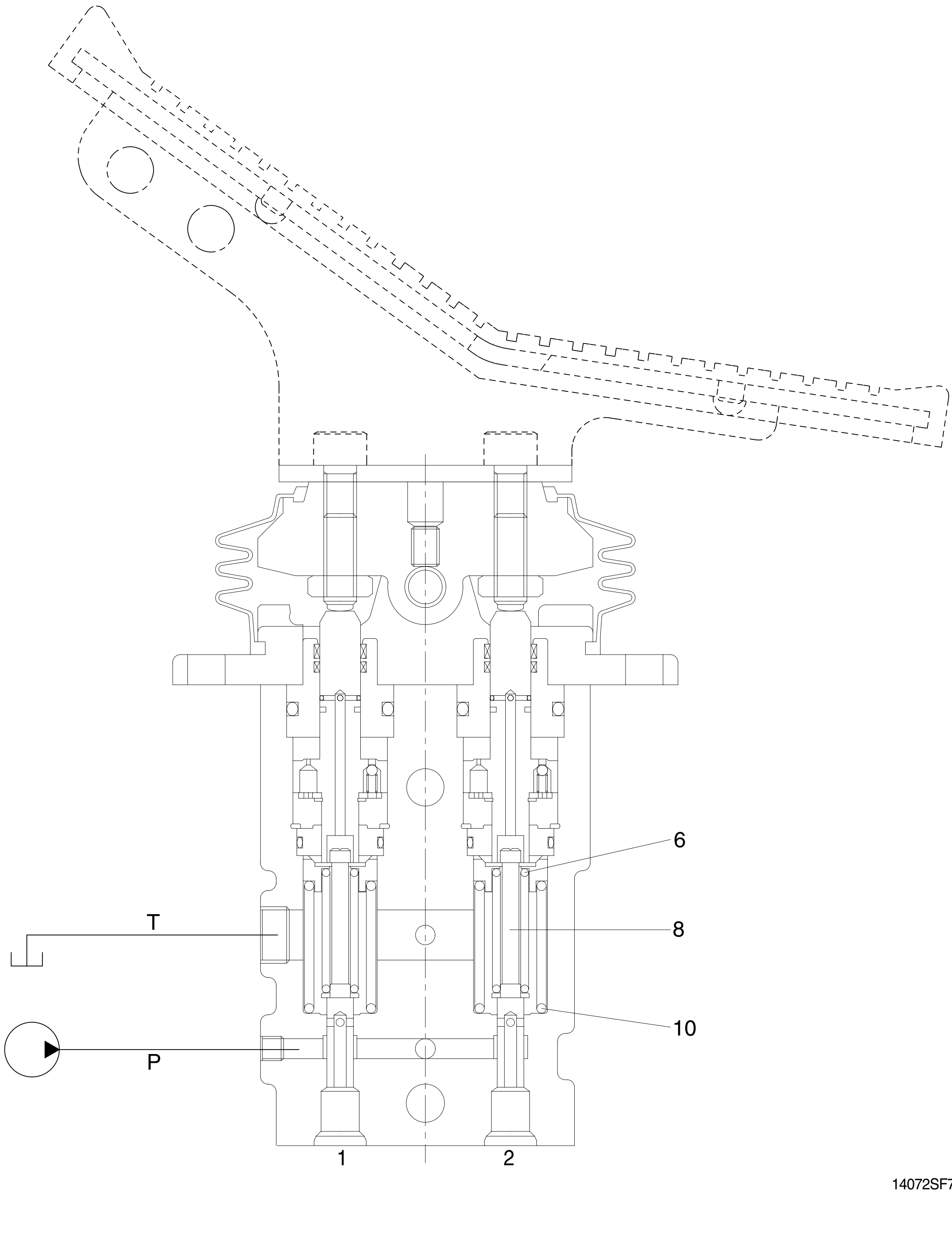
The diagram shown below is the typical application example of the pilot valve.



2-76 (140-7)

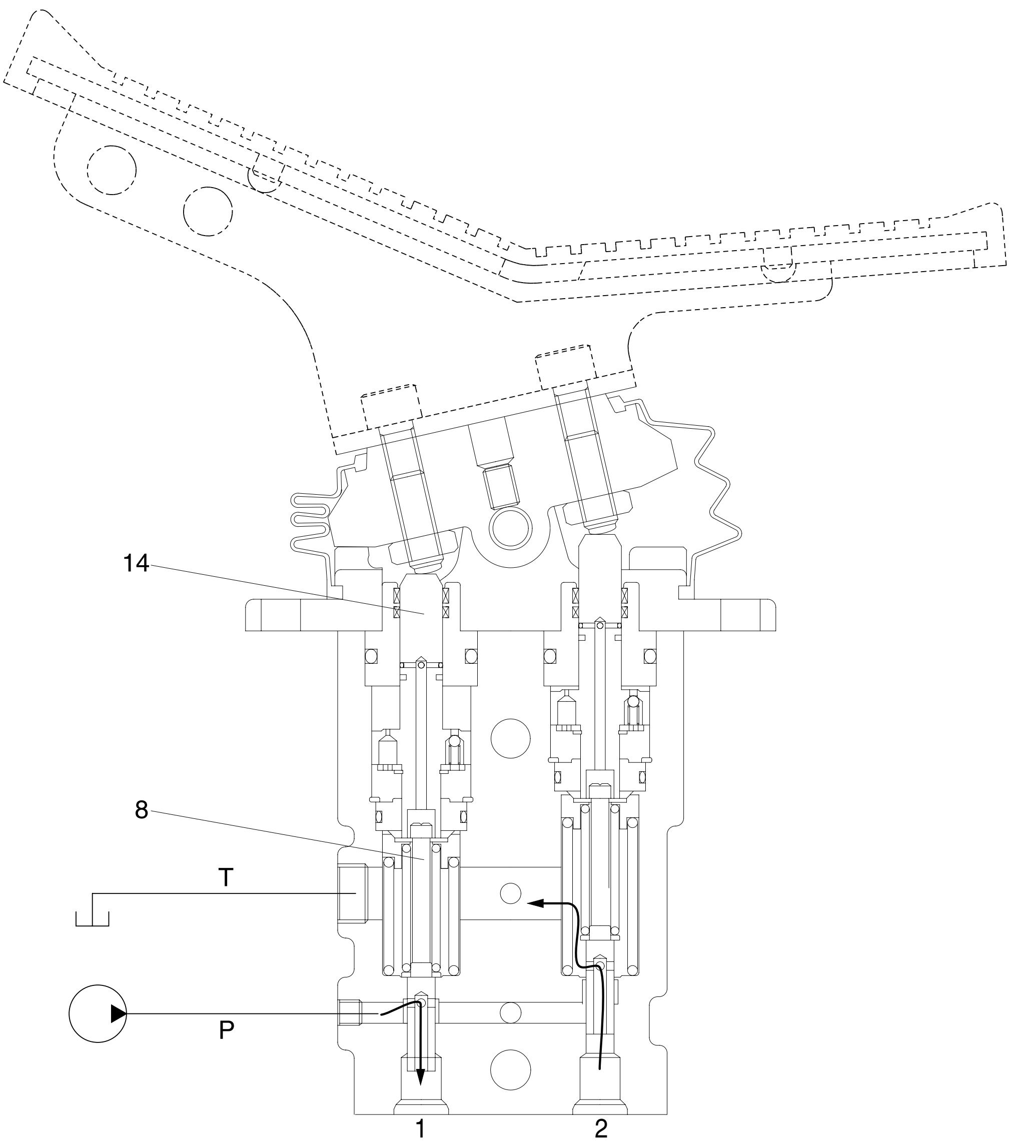
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where pedal is in neutral position



The force of the spring(6) that determines the output pressure of the pilot valve is not applied to the spool(8). Therefore, the spool is pushed up by the spring(10) to the position of port 2 in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where pedal is tilted

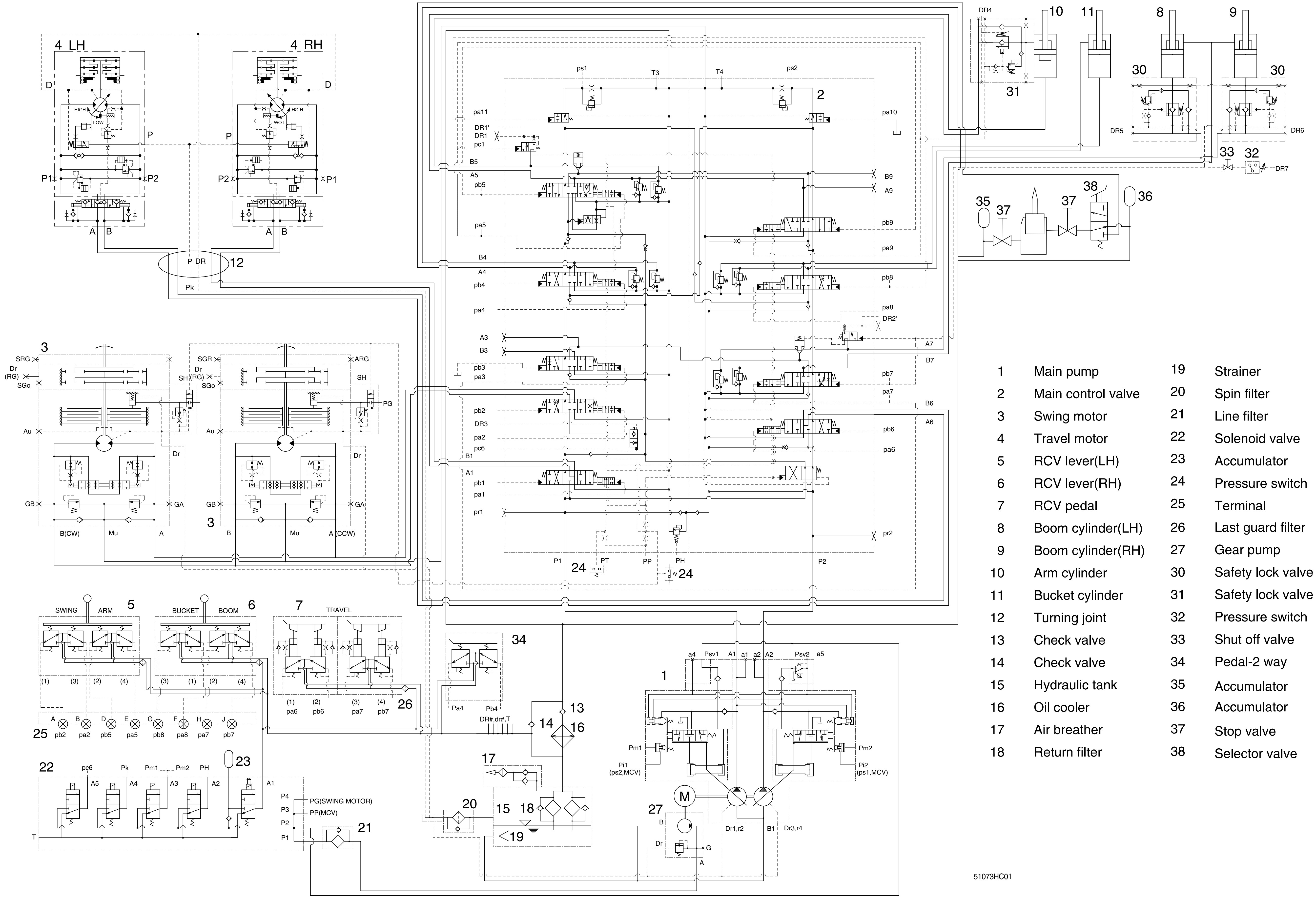


14072SF75

When the push rod(14) is stroked, the spool(8) moves downwards.
Then port P is connected with port 1, and the oil supplied from the pilot pump flows through port 1 to generate the pressure.
When the pressure at port 1 increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port 1 increases higher than the set pressure, port P is disconnected from port 1 and port T is connected with port 1. If it decreases lower than the set pressure, port P is connected with port 1 and port T is disconnected from port 1.
In this manner the secondary pressure is kept at the constant value.
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with inside bottom of the push rod and the output pressure is left to be connected with port P.

SECTION 3 HYDRAULIC SYSTEM

GROUP 1 HYDRAULIC CIRCUIT

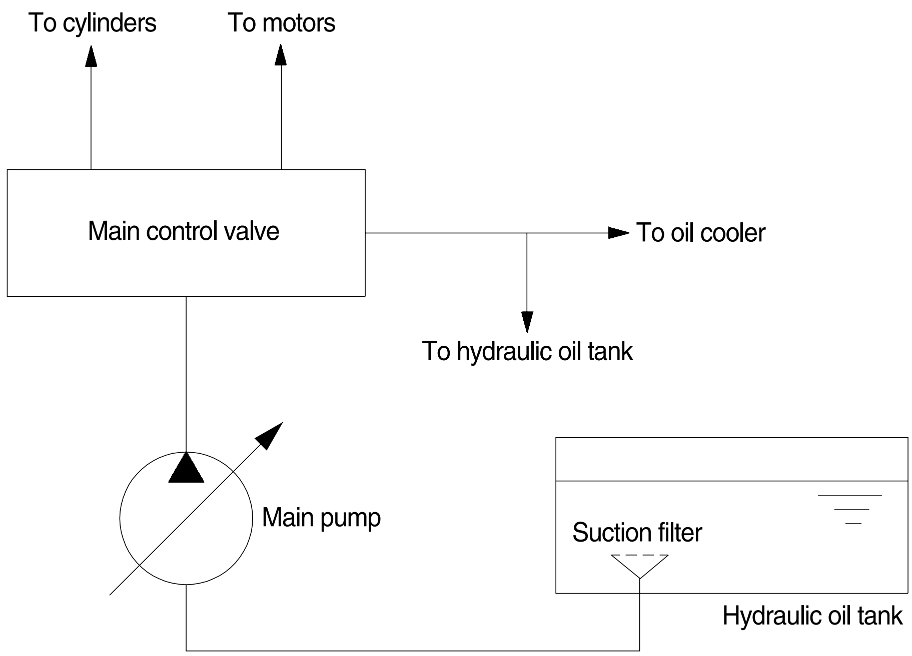


1	Main pump	19	Strainer
2	Main control valve	20	Spin filter
3	Swing motor	21	Line filter
4	Travel motor	22	Solenoid valve
5	RCV lever(LH)	23	Accumulator
6	RCV lever(RH)	24	Pressure switch
7	RCV pedal	25	Terminal
8	Boom cylinder(LH)	26	Last guard filter
9	Boom cylinder(RH)	27	Gear pump
10	Arm cylinder	30	Safety lock valve
11	Bucket cylinder	31	Safety lock valve
12	Turning joint	32	Pressure switch
13	Check valve	33	Shut off valve
14	Check valve	34	Pedal-2 way
15	Hydraulic tank	35	Accumulator
16	Oil cooler	36	Accumulator
17	Air breather	37	Stop valve
18	Return filter	38	Selector valve

GROUP 2 MAIN CIRCUIT

The main hydraulic circuit consists of suction circuit, delivery circuit, return circuit and drain circuit.
The hydraulic system consists of one main pump, one control valve, one swing motor, four cylinders and two travel motors.
The swash plate type variable displacement tandem axial piston pump is used as the main pump and is driven by the engine at ratio 1.0 of engine speed.

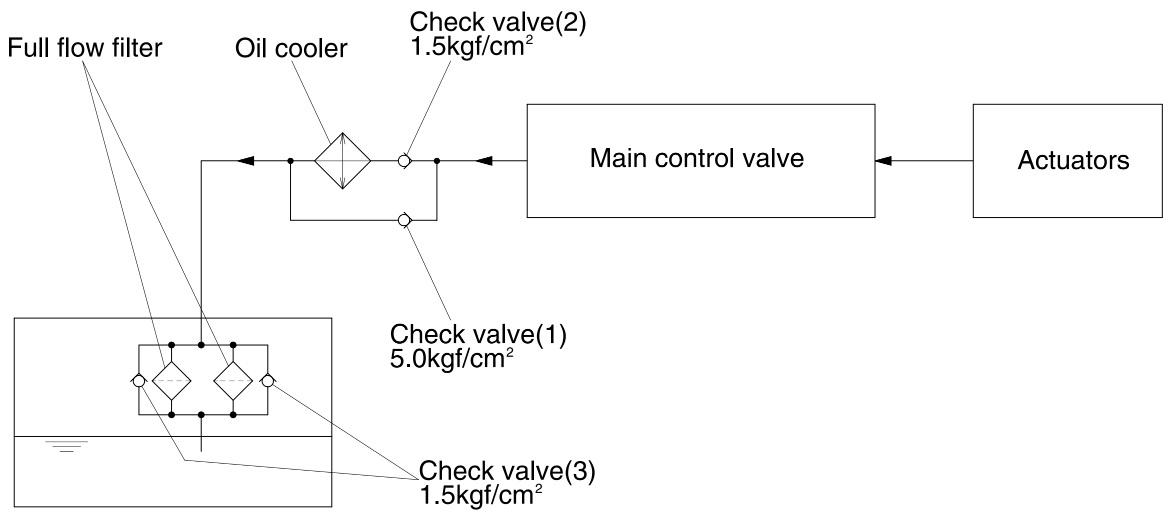
1. SUCTION AND DELIVERY CIRCUIT



3-02 (210-7)

The pumps receive oil from the hydraulic tank through a suction filter. The discharged oil from the pump flows into the control valve and goes out the tank ports.
The oil discharged from the main pump flows to the actuators through the control valve.
The control valve controls the hydraulic functions.
The return oil from the actuators flows to the hydraulic tank through the control valve and the oil cooler.

2. RETURN CIRCUIT



All oil from each actuator returns to the hydraulic tank through the control valve.

The bypass check valves are provided in the return circuit.

The setting pressure of bypass check valves are 1.5kgf/cm^2(21psi) and 5.0kgf/cm^2(71psi). Usually, oil returns to the hydraulic tank from the left side of control valve through oil cooler.

When oil temperature is low, viscosity becomes higher and flow resistance increases when passing through the oil cooler. The oil pressure exceeds 5.0kgf/cm^2(71psi), the oil returns directly to the hydraulic tank, resulting in the oil temperature being raised quickly at an appropriate level.

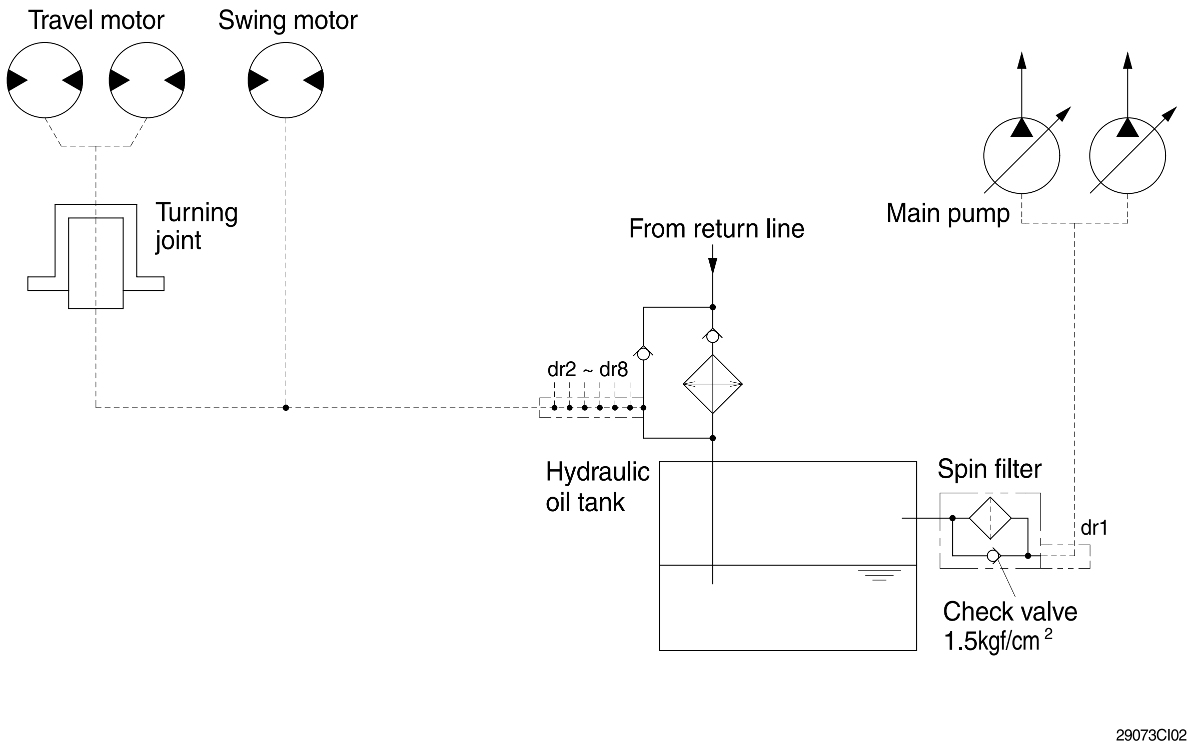
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve(1).

The full-flow filter and bypass relief valve are provided in the hydraulic tank.

The oil from right and left side of control valve is combined and filtered by the return filter. A bypass relief valve is provided in the full-flow filter.

When the filter element is clogged, the bypass relief valve opens at 1.5kgf/cm^2(21psi) differential pressure.

3. DRAIN CIRCUIT



Besides internal leaks from the motors and main pump, the oil for lubrication circulates. These oil have to be fed to the hydraulic tank passing through spin filter and full flow filter in the hydraulic tank.
When the drain oil pressure exceed 1.5kgf/cm^2(21psi), the oil returns to the hydraulic tank directly.

1) TRAVEL MOTOR DRAIN CIRCUIT

Oil leaking from the right and left travel motors comes out of the drain ports provided in the respective motor casing and join with each other. These oils pass through the turning joint and return to the hydraulic tank after being filtered by full flow filter in the hydranlic tank.

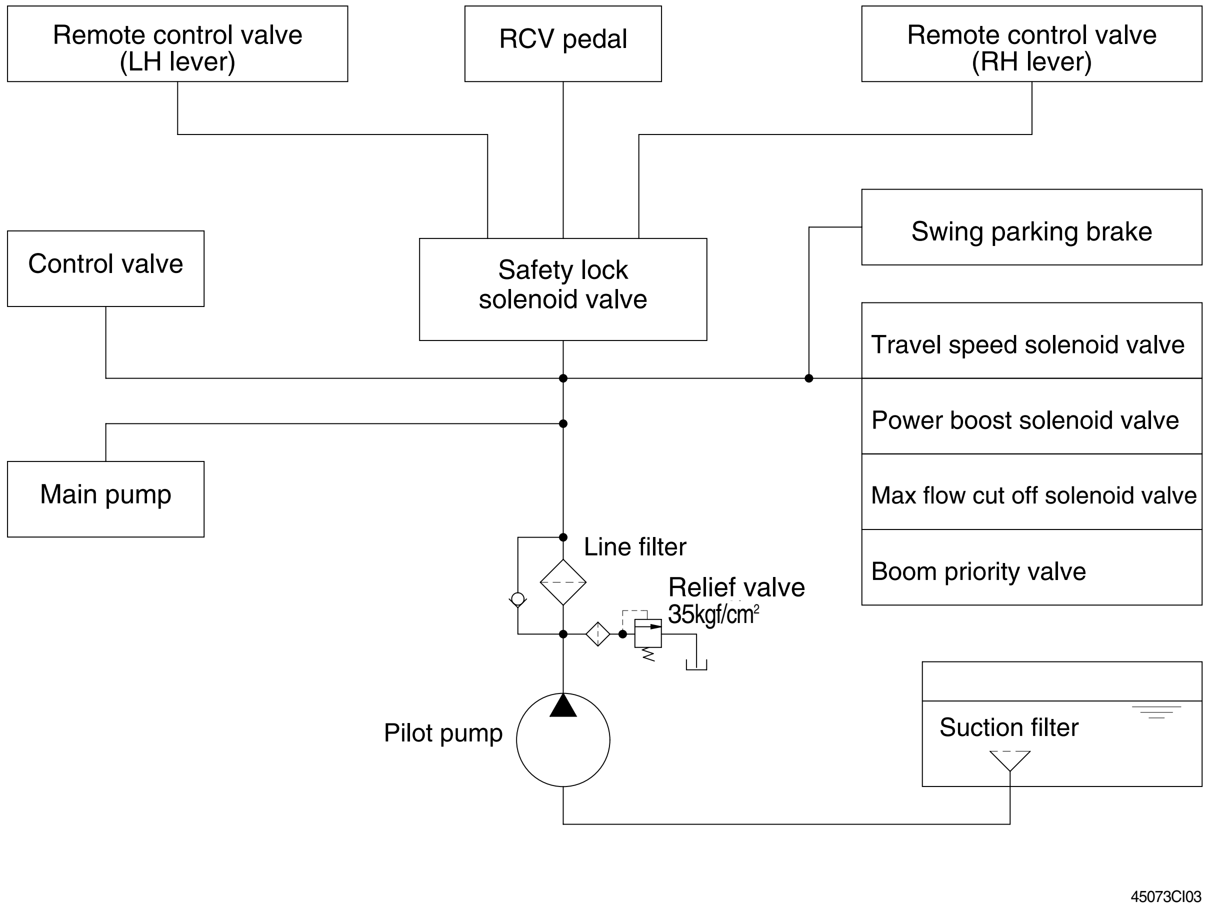
2) SWING MOTOR DRAIN CIRCUIT

Oil leaking from the swing motor come out and return to the hydraulic tank passing through a spin filter.

3) MAIN PUMP DRAIN CIRCUIT

Oil leaking from main pump come out and return to the hydraulic tank passing through spin filter.

GROUP 3 PILOT CIRCUIT

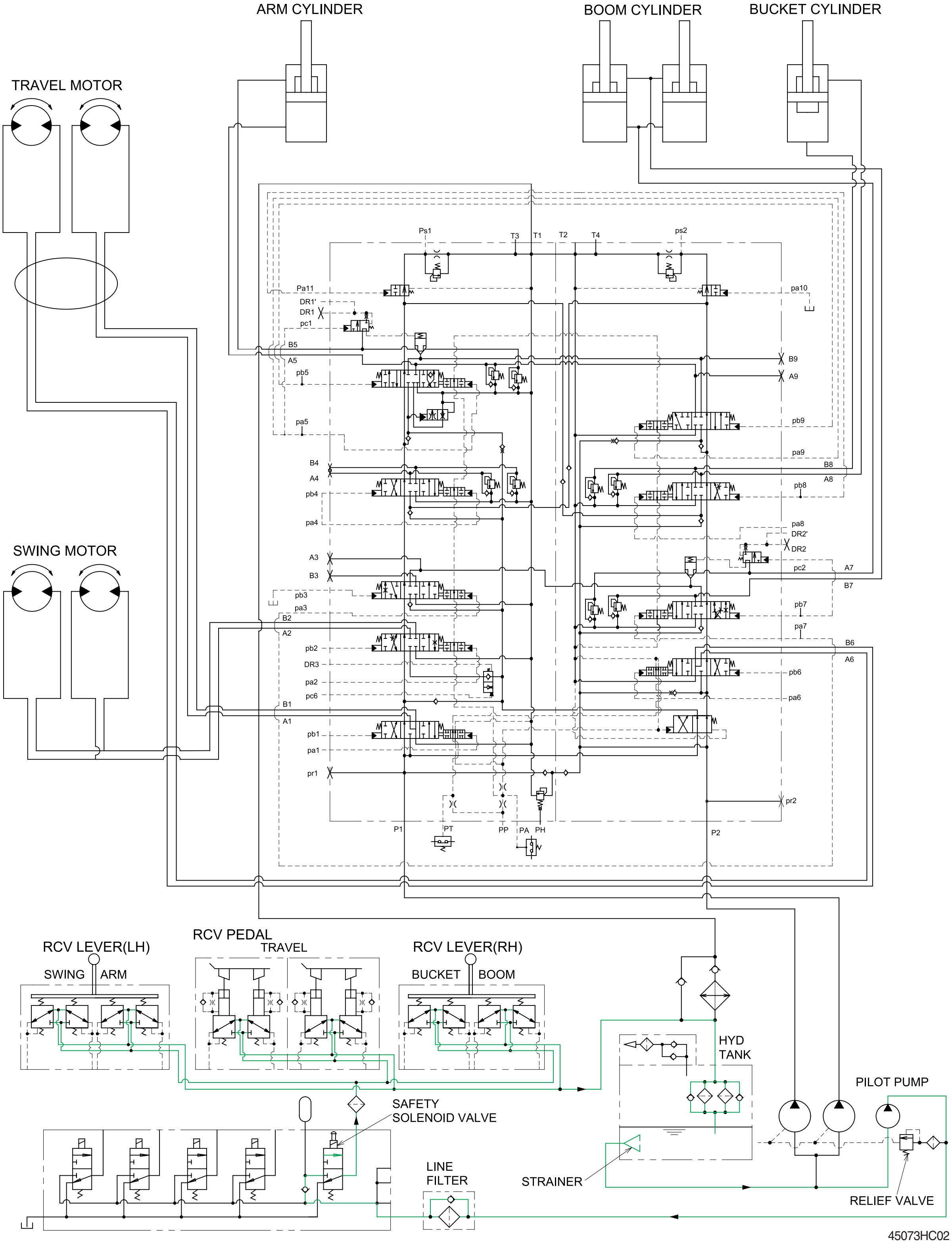


The pilot circuit consists of suction circuit, delivery circuit and return circuit.

The pilot pump is provided with relief valve, receives the oil from the hydraulic tank through the suction filter.

The discharged oil from the pilot pump flows to the remote control valve through line filter, EPPR valve, solenoid valve assemblies, swing parking brake, main control valve and safety lock solenoid valve.

1. SUCTION, DELIVERY AND RETURN CIRCUIT

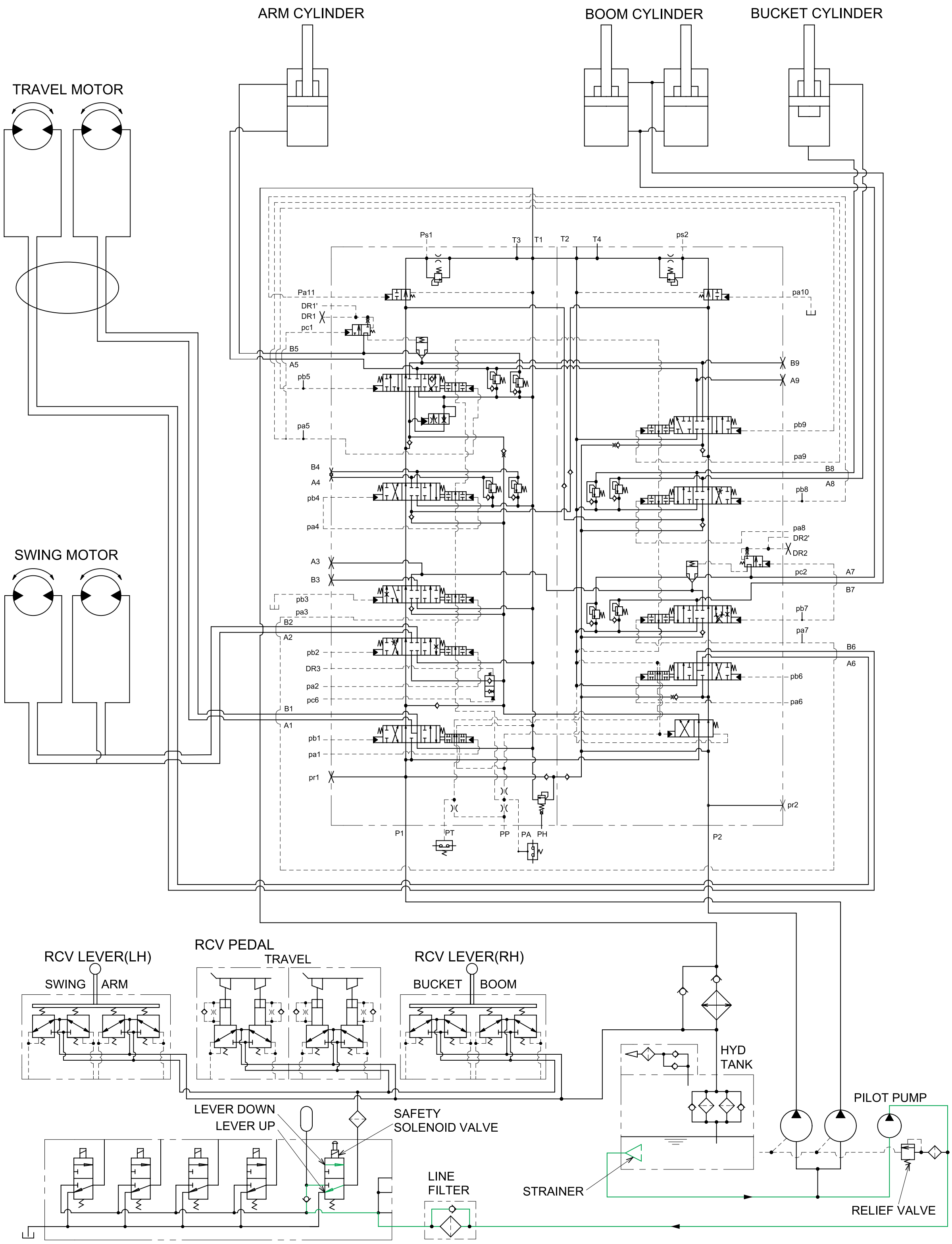


The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

The oil filtered by line filter flows remote control valve through safety solenoid valve.

The return oil from remote control valve returned to hydraulic tank.

2. SAFETY SOLENOID VALVE(SAFETY LEVER)

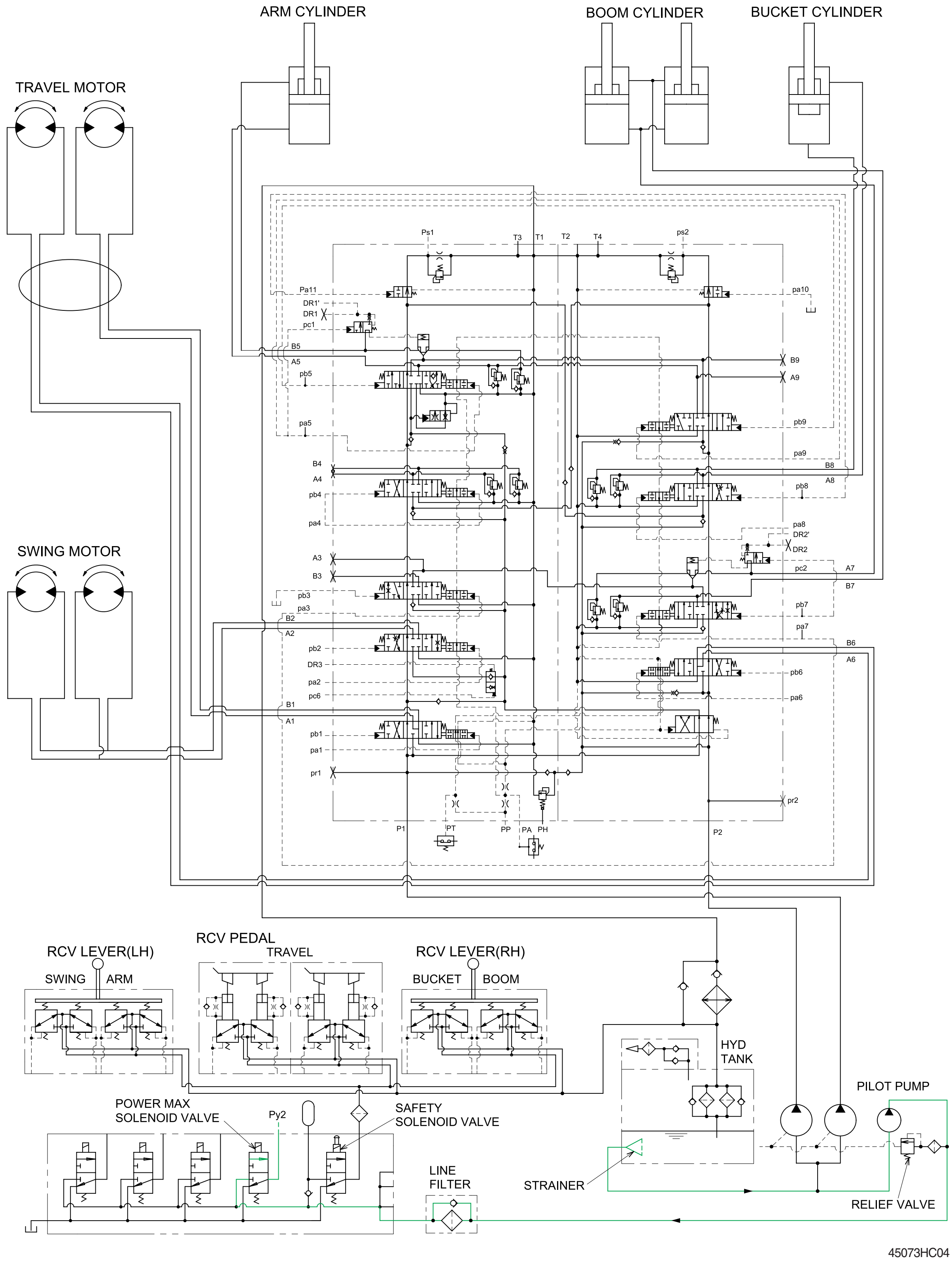


45073HC03

When the lever of the safety solenoid valve is moved downward, oil flows into the remote control valve through solenoid valve and line filter.

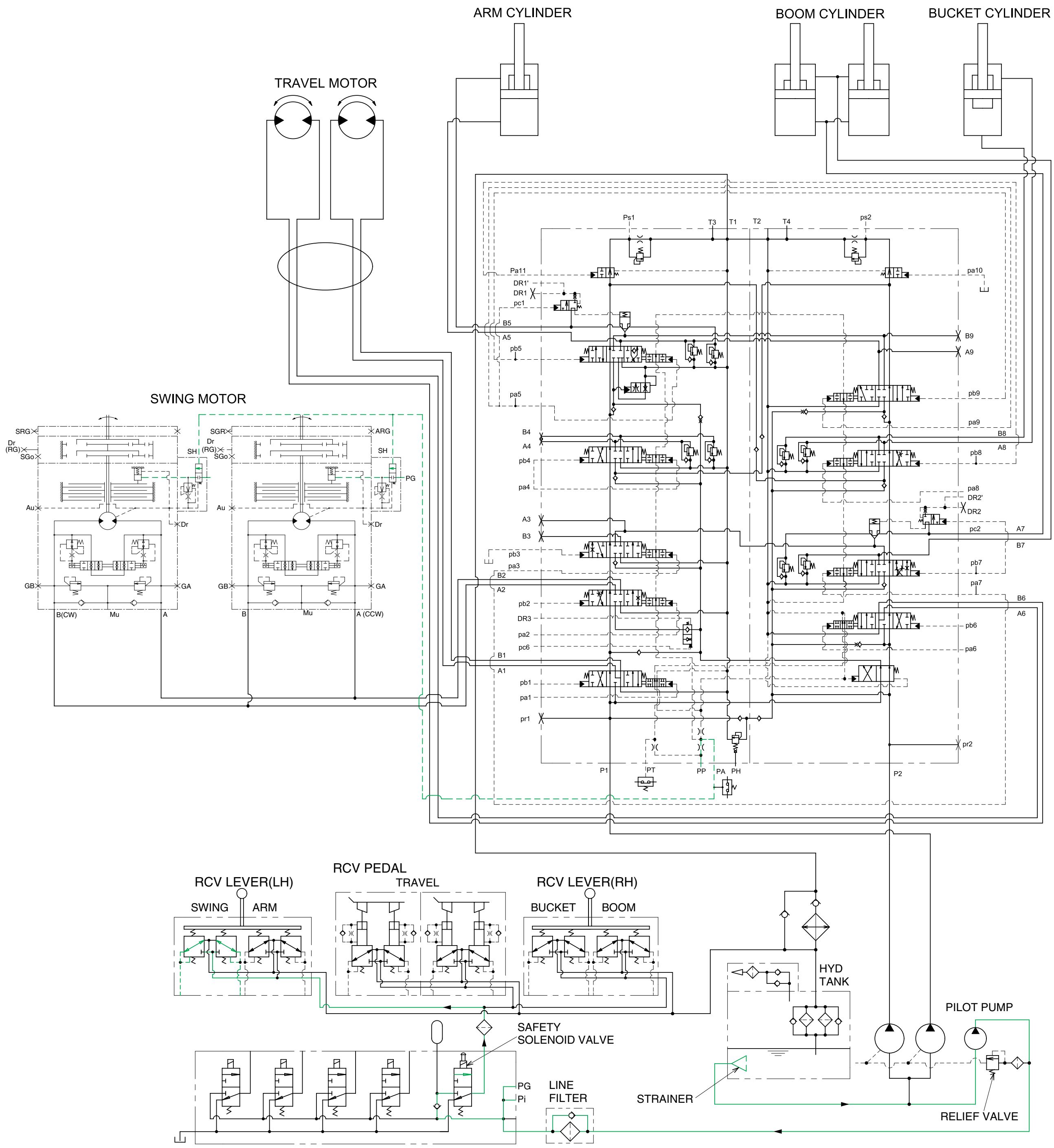
When the lever of the safety solenoid valve moved upward, oil does not flows into the remote control valve, because of blocked by the spool.

3. MAIN RELIEF PRESSURE CHANGE CIRCUIT



When the power max switch on the left control lever is pushed ON, the power max solenoid valve is actuated, the discharged oil from the pilot pump into Py2 port of the main relief valve of main control valve ; Then the setting pressure of the main control valve is raises from 330kgf/cm^2 to 360kgf/cm^2 for increasing the digging power. And even when press continuously, it is canceled after 8 seconds.

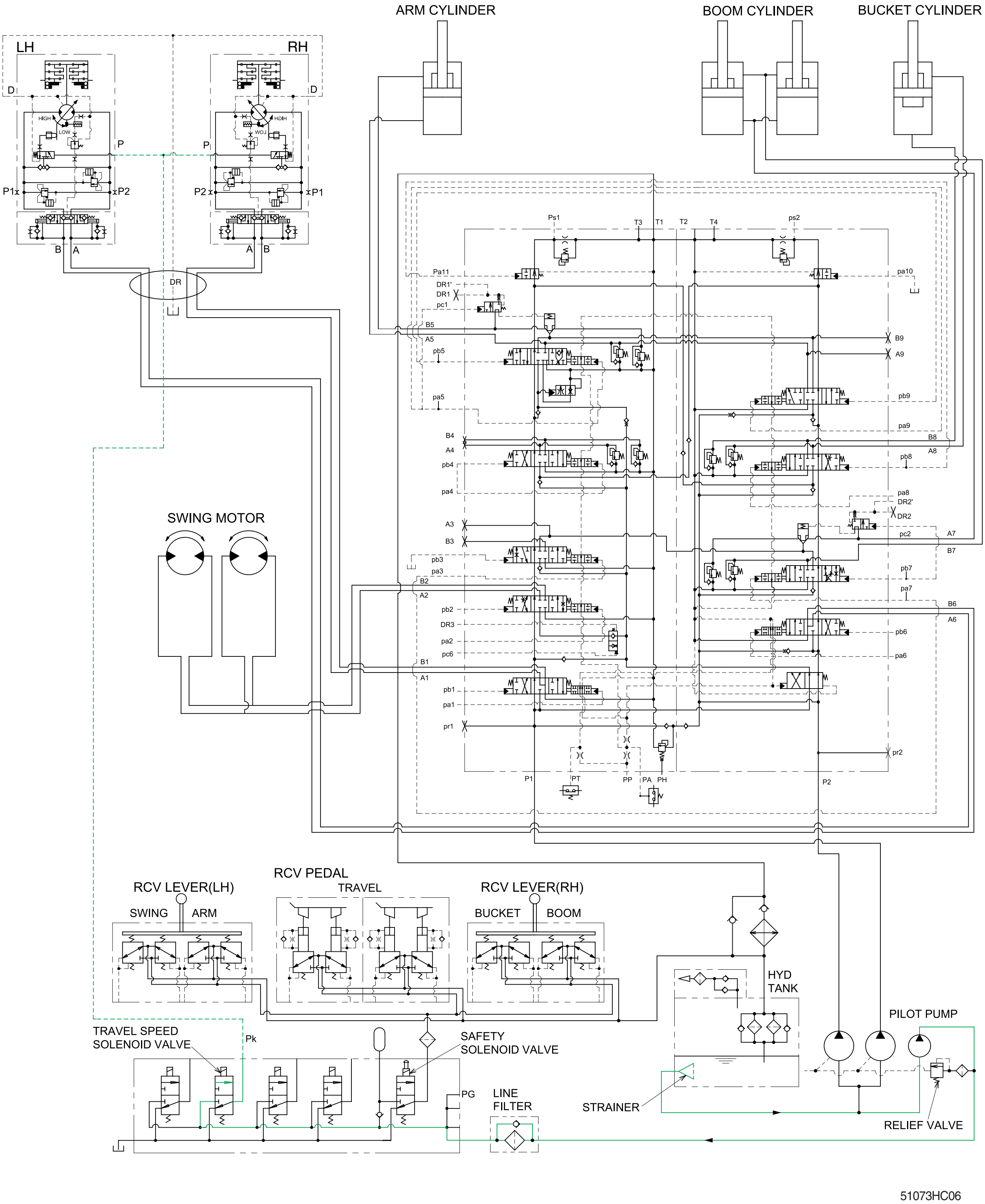
4. SWING PARKING BRAKE RELEASE



45073HC05

When one of the RCV lever (except travel lever) is tilted, the pilot oil flows into SH port through main control valve.
This pressure moves spool so, discharged oil from pilot valve flows to swing motor PG port.
This pressure is applied to swing motor disc, thus the brake is released.
When all of the RCV lever are set in the neutral position, oil in the swing motor disc cylinder is drained, thus the brake is applied.

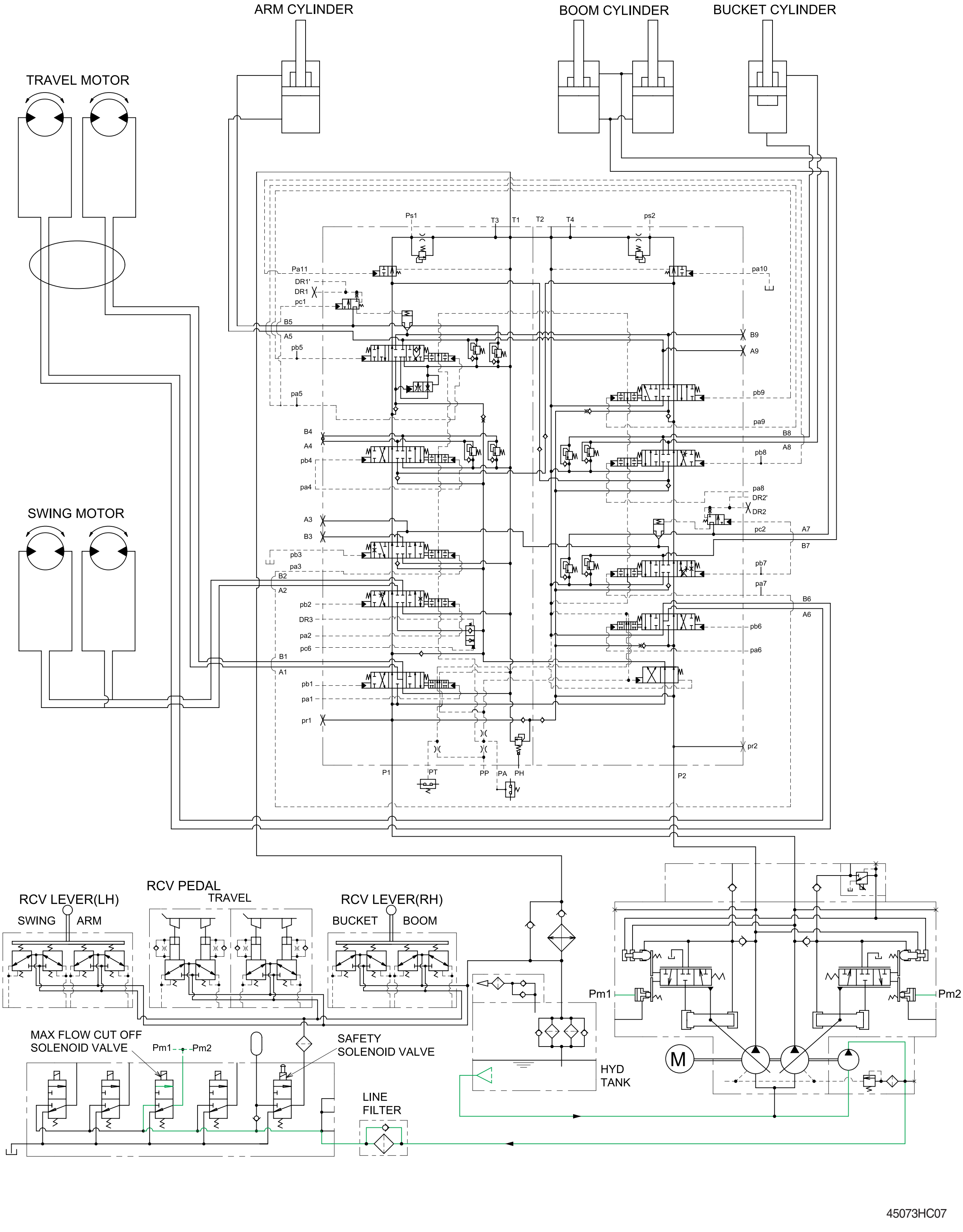
5. TRAVEL SPEED CONTROL PRESSURE



When the travel speed solenoid valve was placed in the Hi position, the pressure oil from pilot pump through line filter flows to port(Pk) of travel speed change over valve, and the control piston is pushed up, thus minimizing the displacement.

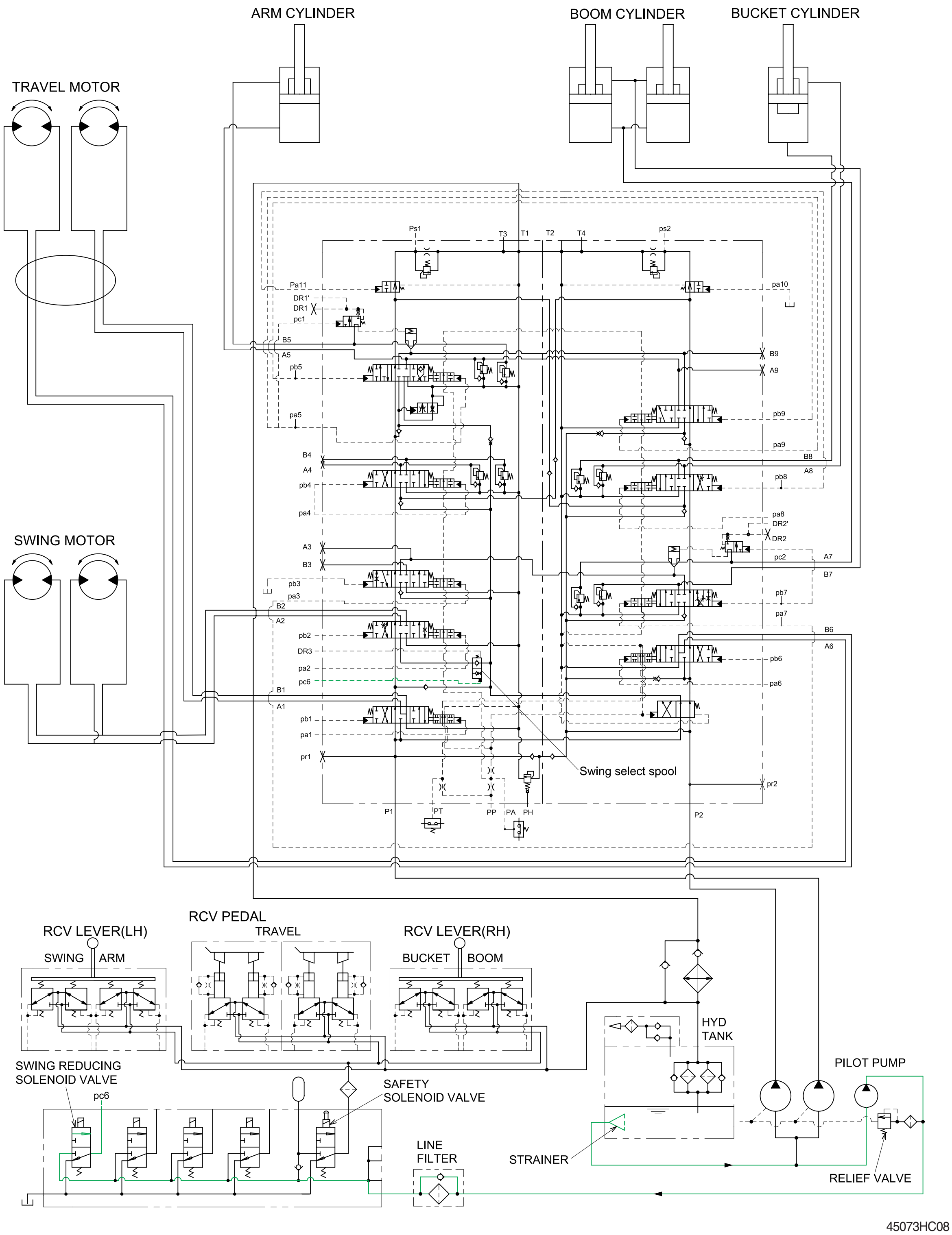
When the travel speed solenoid valve was placed in the Lo position, the oil of Pk port return to the tank and the control piston is returned, thus maximizing the displacement.

6. MAX FLOW CUT OFF SYSTEM



When the breaker operation mode is selected on the cluster, max flow cut off solenoid valve actuates automatically. Thus pilot pressure(Pm1,Pm2) is sent to the regulator and pump discharge volume is decreased.

7. BOOM PRIORITY SYSTEM



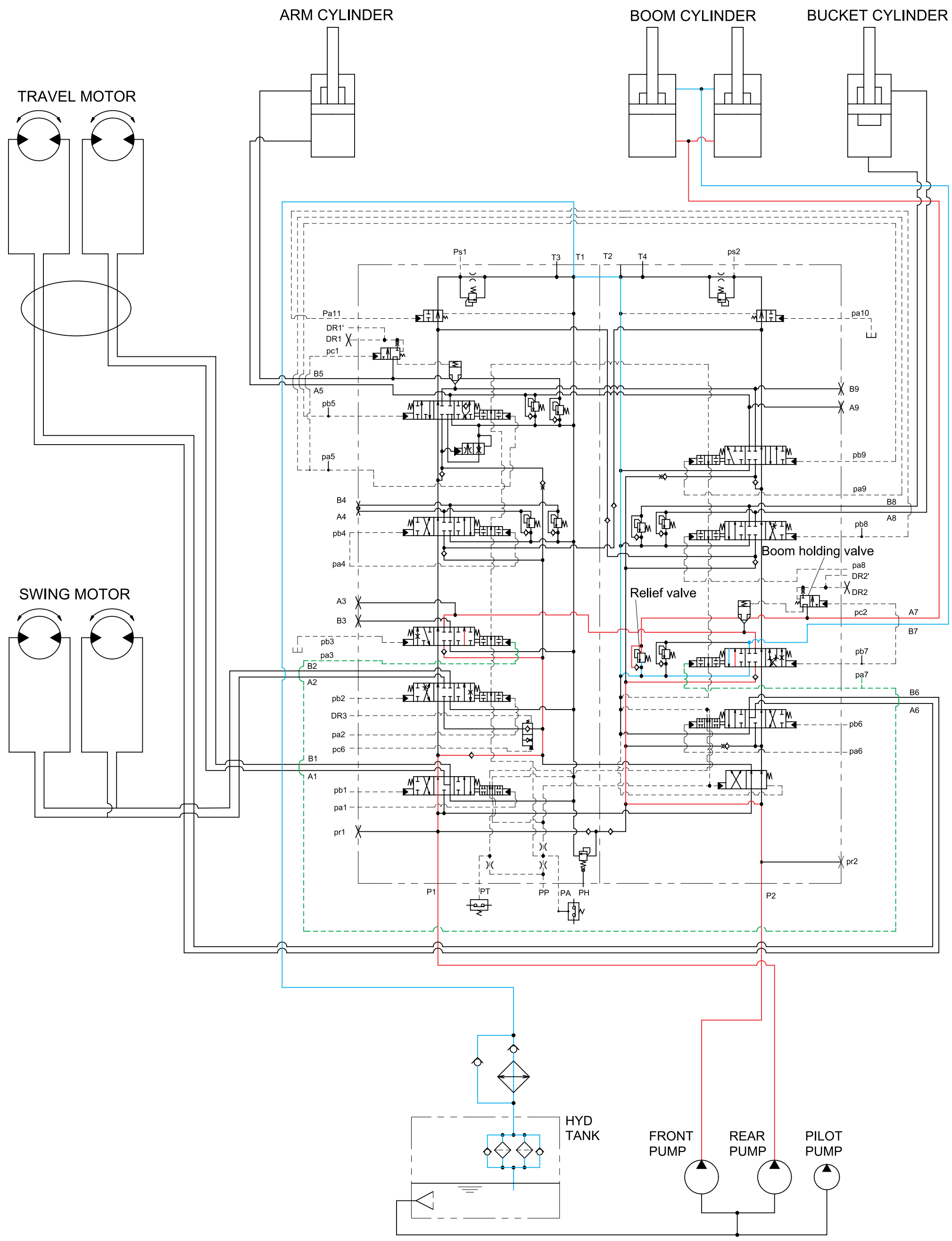
When carrying out the combined operation of swing and boom or arm, the boom or arm speed can be lowered than operating speed of swing. When the heary duty working mode in work mode is selected on the cluster, swing reducing solenoid valve actuates automatically.

The oil from pilot pump flows into the solenoid valve through the line filter.

6Pc pressure from solenoid valve change the swing select spool and decreases the oil flow rate to the swing section by orifice.

This is called the boom priority system.

1. BOOM UP OPERATION



45073HC09

When the RH control lever is pulled back, the boom spools in the main control valve are moved to the up position by the pilot oil pressure from the remote control valve.

The oil from the front and rear pump flows the main control valve and then goes to the large chamber of boom cylinders via logic valve.

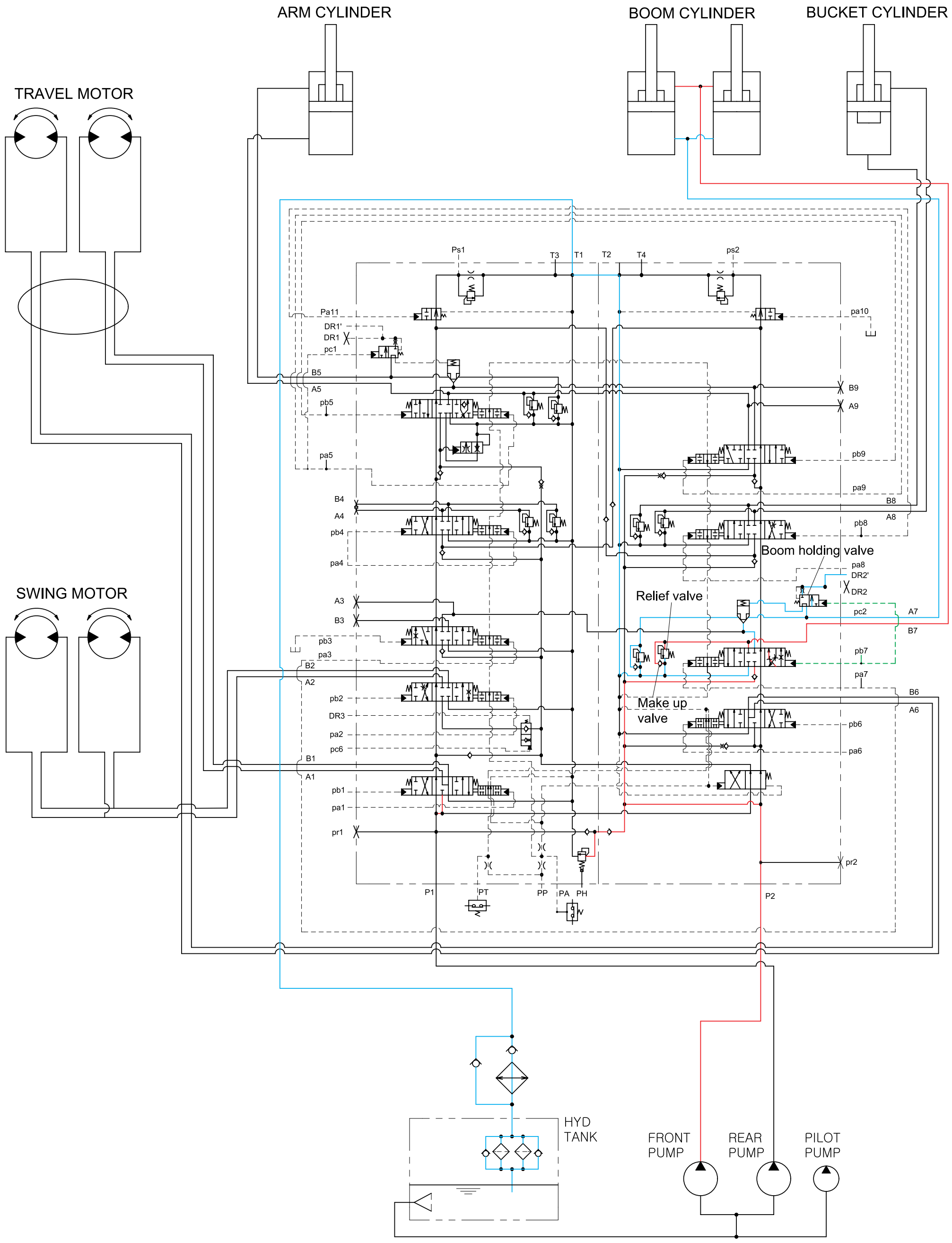
At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom spool in the main control valve. When this happens, the boom goes up.

The excessive pressure in the boom cylinder bottom end circuit is prevented by relief valve.

When the boom is up and the control lever is returned to neutral position, the circuit for the holding pressure at the bottom end of the boom cylinder is closed by the boom holding valve.

This prevents the hydraulic drift of boom cylinders.

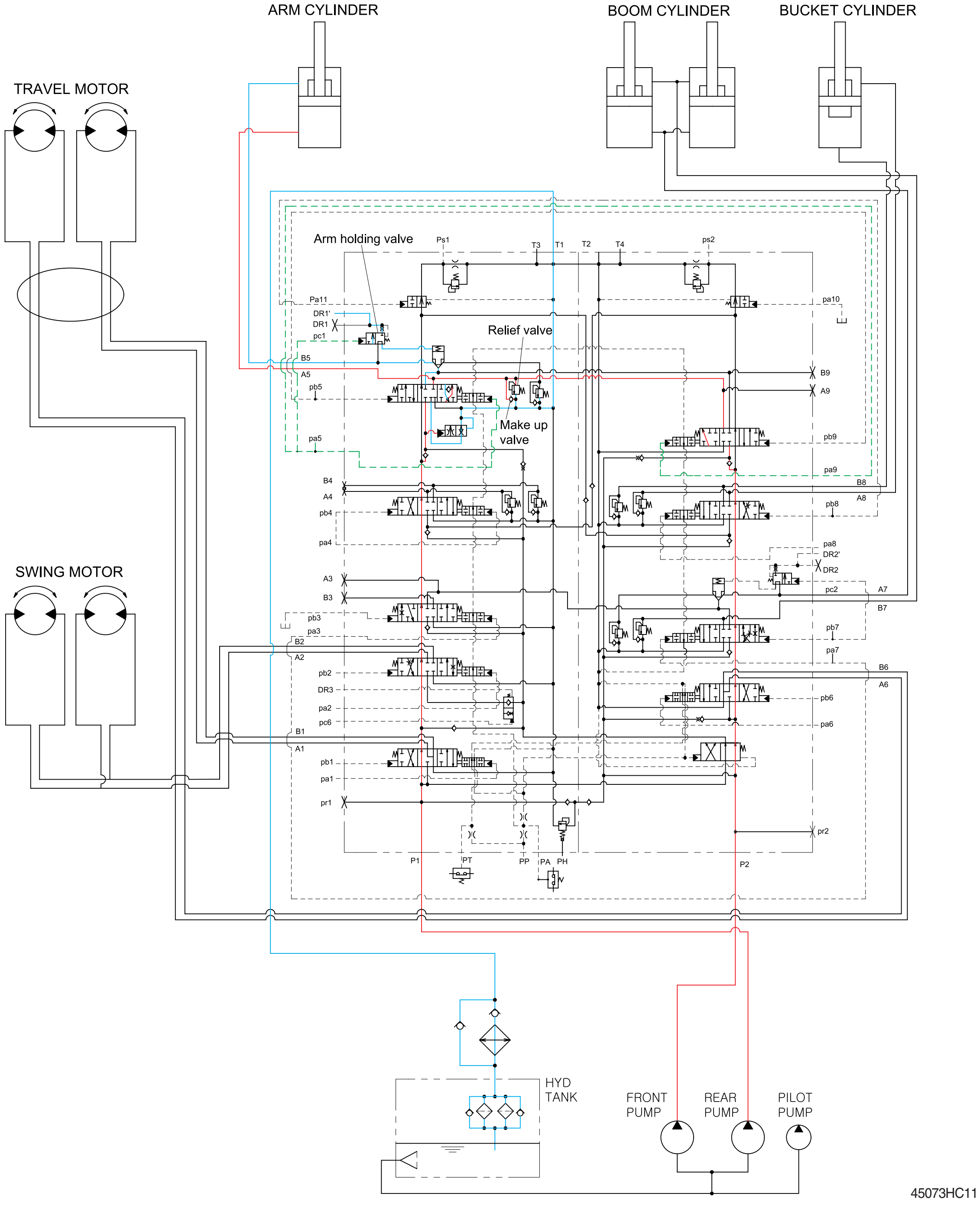
2. BOOM DOWN OPERATION



45073HC10

When the RH control lever is pushed forward, the boom spools in the main control valve are moved to the down position by the pilot oil pressure from the remote control valve.
The oil from the front pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom spool in the main control valve.
When the down speed of boom is faster, the oil returned from the large chamber of boom cylinder combines with the oil from the front pump, and flows into the small chamber of the boom cylinder.
This prevents cylinder cavitation by the negative pressure when the rear pump flow can not match the boom down speed. And the excessive pressure in the boom cylinder rod end circuit is prevented by the relief valve.

3. ARM ROLL IN OPERATION



When the LH control lever is pulled back, the arm spools in the main control valve are moved to the roll in position by the pilot oil pressure from the remote control valve.

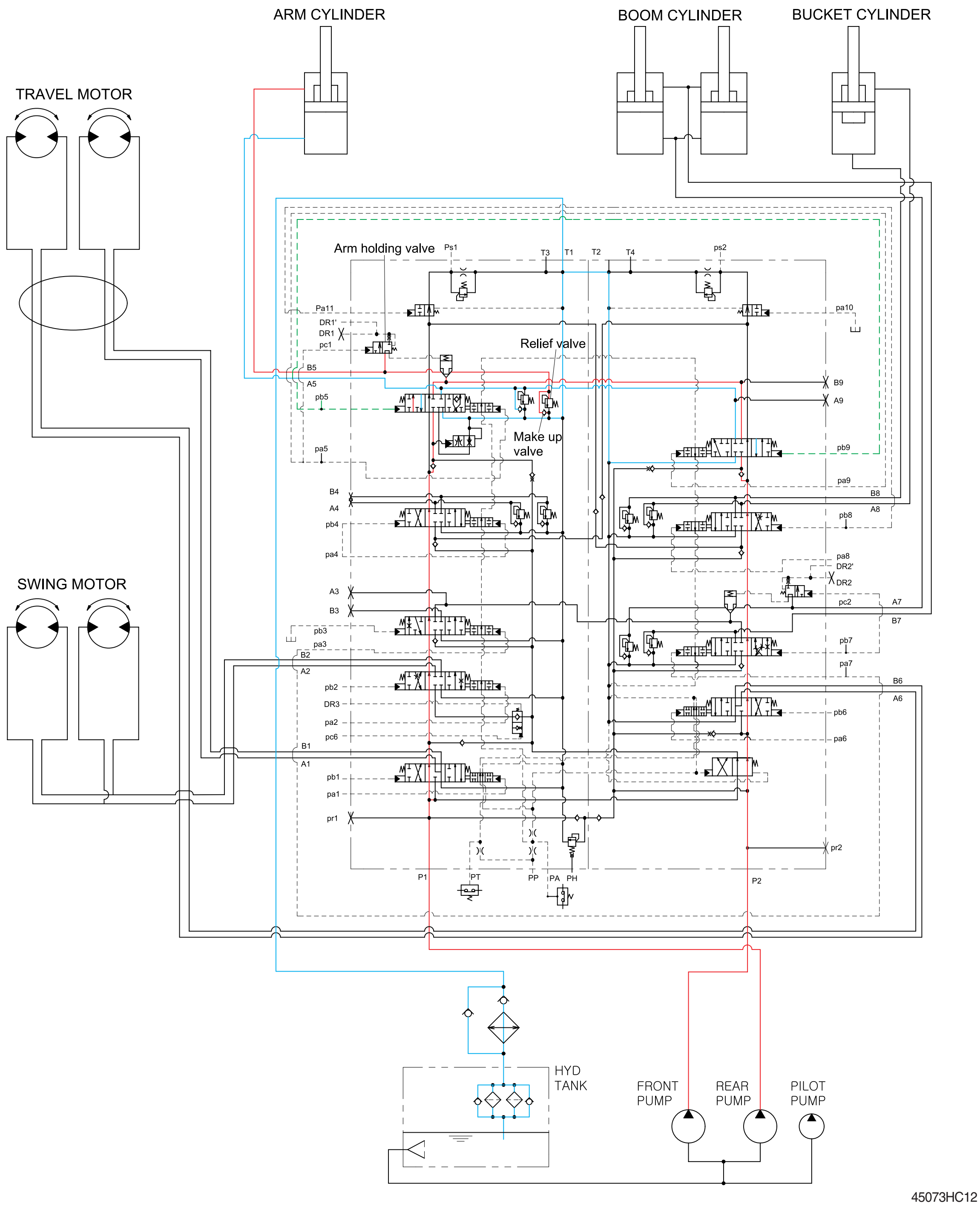
The oil from the front and rear pump flows into the main control valve and then goes to the large chamber of arm cylinder.

At the same time, the oil from the small chamber of arm cylinder returns to the hydraulic oil tank through the arm spool in the main control valve. When this happens, the arm roll in.

When the roll in speed of arm is faster, the oil returned from the small chamber of arm cylinder combines with the oil from both pump, and flows into the large chamber of the arm cylinder by a make up valve.

The excessive pressure in the arm cylinder bottom end circuit is prevented by relief valve.

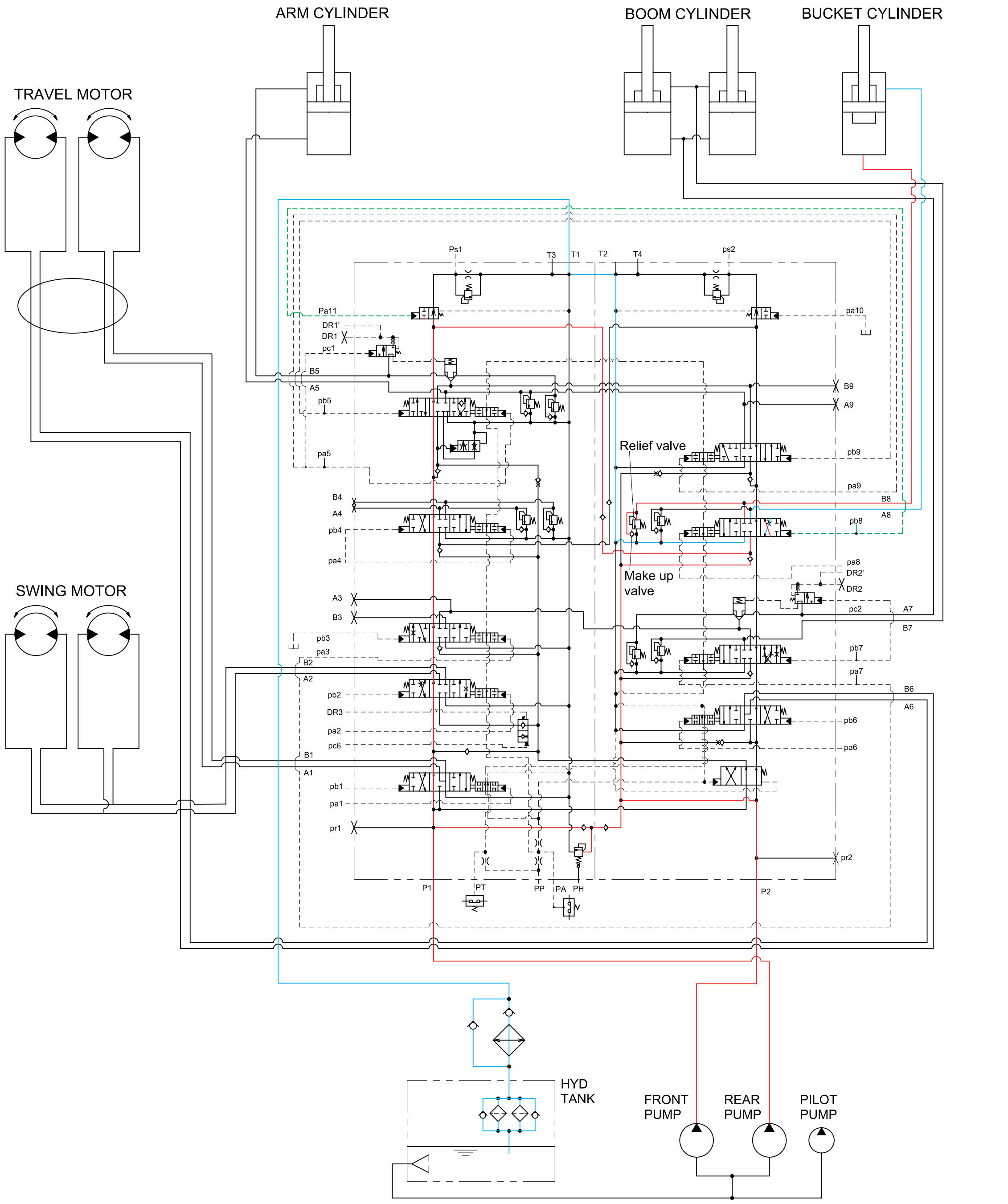
4. ARM ROLL OUT OPERATION



When the LH control lever is pushed forward, the arm spools in the main control valve are moved to the roll out position by the pilot oil pressure from the remote control valve. The oil from the front and rear pump flows into the main control valve and then goes to the small chamber of arm cylinder. At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm spool in the main control valve.

When this happens, the arm roll out. The excessive pressure in the arm cylinder rod end circuit is prevented by relief valve. When the arm is rolled out and the control lever is returned to neutral position, the circuit for the holding pressure at the rod end of the arm cylinder is closed by the arm holding valve. This prevents the hydraulic drift of arm cylinder.

5. BUCKET ROLL IN OPERATION

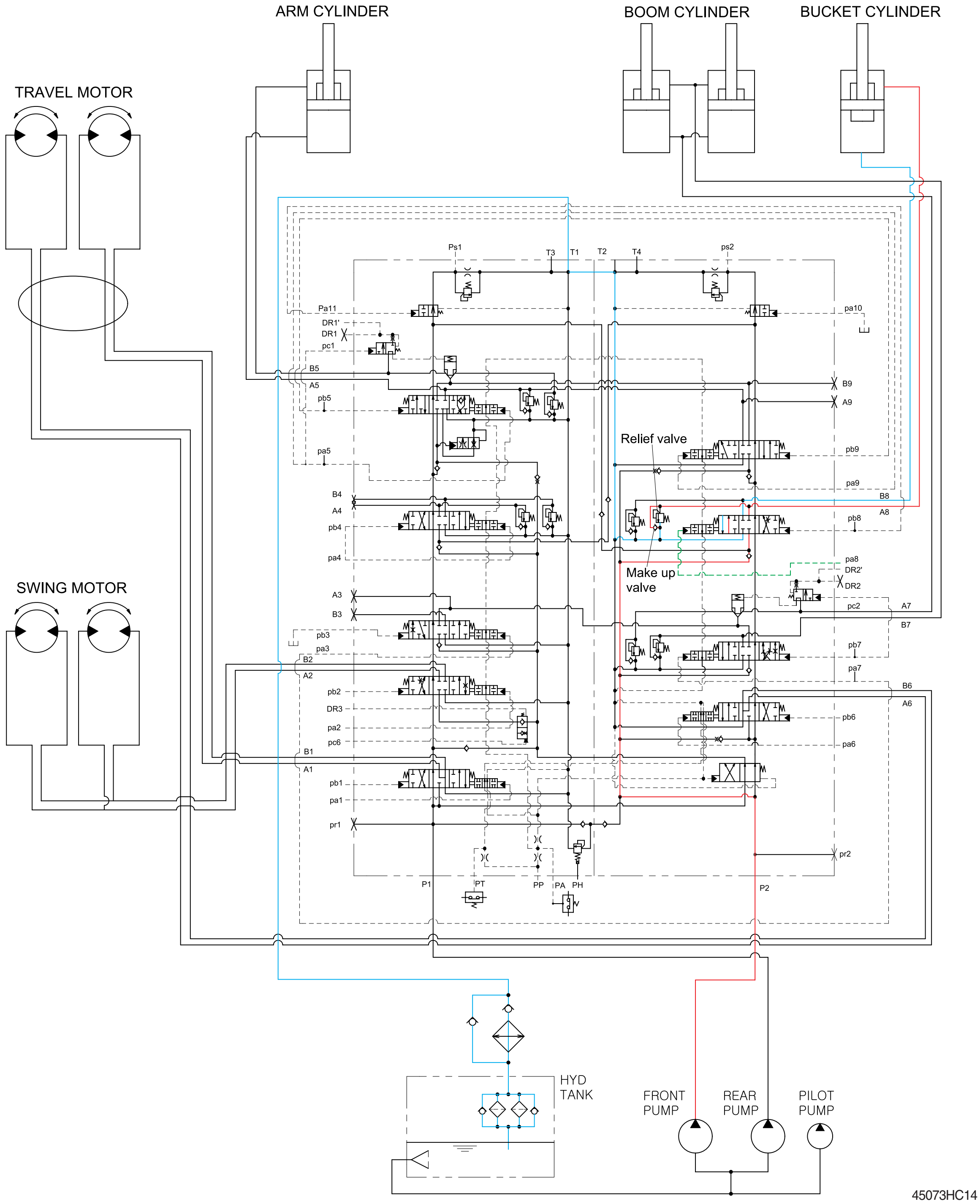


When the RH control lever is pulled left, the bucket spool in the main control valve is moved to the roll in position by the pilot oil pressure from the remote control valve.

The center bypass valve is blocked by pilot pressure(pa11) and then the oil from rear pump is joint to flow of the front pump via confluence passage.

The oil from the front and rear pump flows into the main control valve and then goes to the large chamber of bucket cylinder. At the same time, the oil from the small chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket roll in. The cavitation which will happen to the bottom of the bucket cylinder is prevented by the make up valve, on other hand. The excessive pressure is also prevented by an overload relief valve in the main control valve.

6. BUCKET ROLL OUT OPERATION

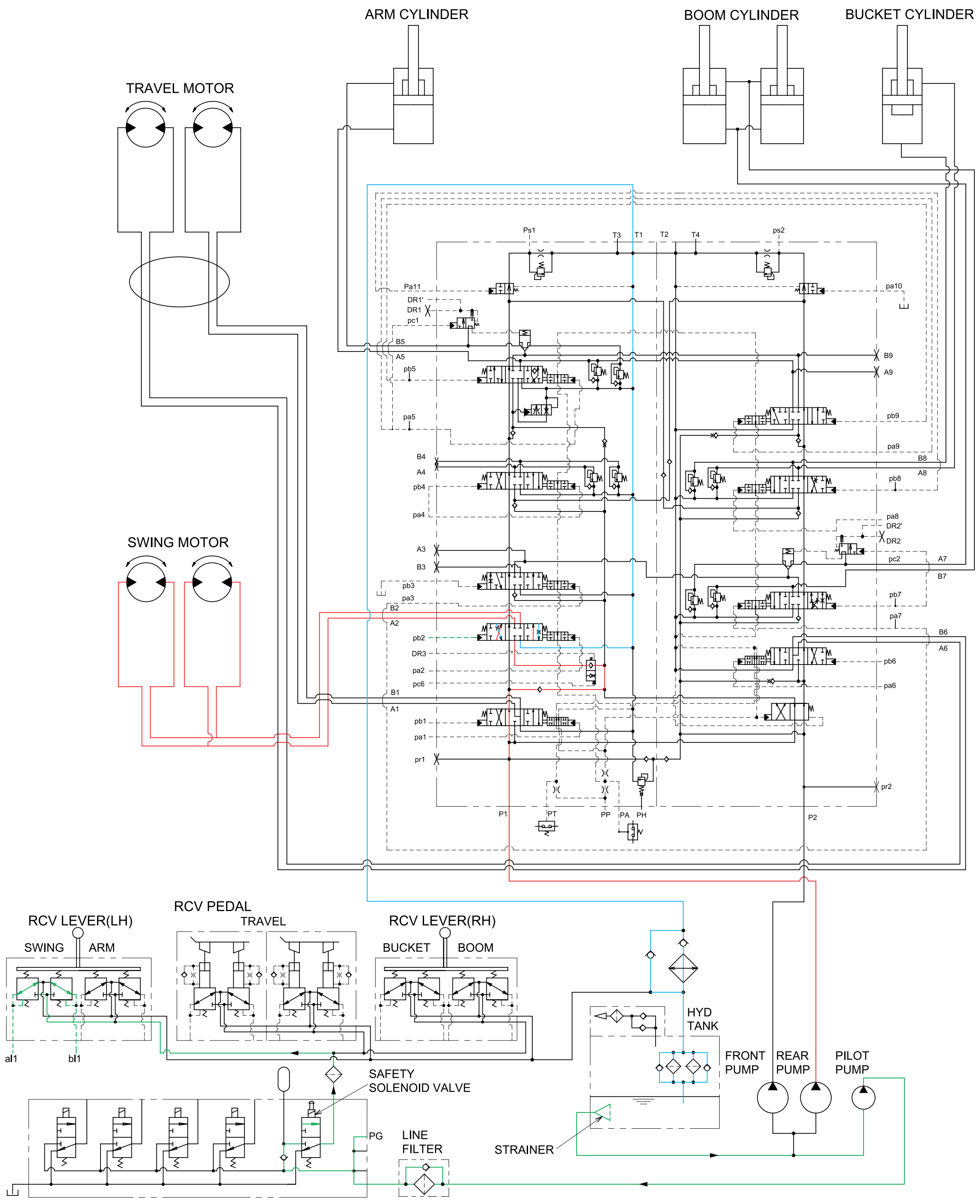


When the RH control lever is placed right, the bucket spool in the main control valve is moved to the roll out position by the pilot oil pressure from the remote control valve.

The oil from the front pump flows into the main control valve and then goes to the small chamber of bucket cylinder. At the same time the oil from the large chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens the bucket roll out.

The cavitation which will happen to the rod of the bucket cylinder is prevented by a make up valve, on other hand. The excessive pressure is also prevented by an overload relief valve in the main control valve.

7. SWING OPERATION



45073HC15

When the LH control lever is placed left or right, the swing spool in the main control valve is moved to the left or right swing position by the pilot oil pressure from the remote control valve.

The oil from the rear pump flows into the main control valve and then goes to the swing motor.

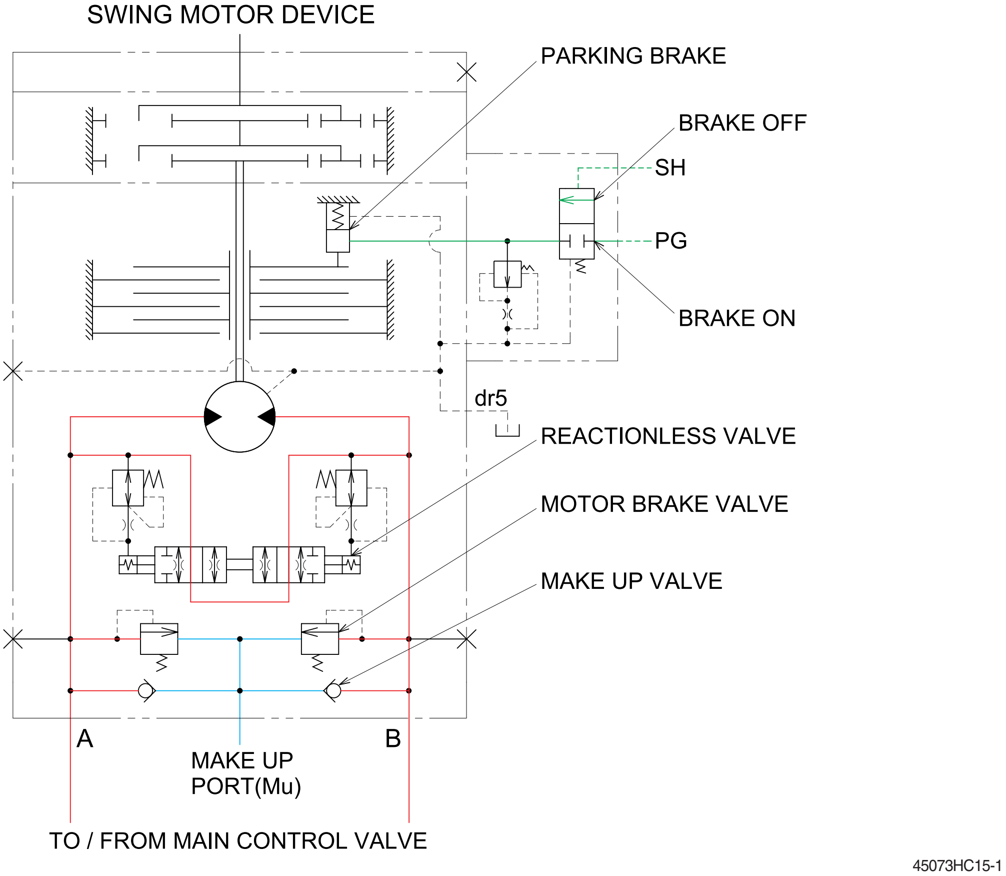
At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve.

When thin happens, the superstructure swings to the left or right.

The swing parking brake, make up valve and the motor brake valve are provide in the swing motors.

The cavitation which will happen to the swing motor is also prevented by the make up valve in the swing motor itself.

SWING CIRCUIT OPERATION



1) MOTOR BRAKE VALVE

Motor brake valve for the swing motor limits to cushion the starting and stopping pressure of swing operation.

2) MAKE UP VALVE

The make up valves prevent cavitation by supplying return oil to the vacuum side of the motor.

3) PARKING BRAKE

In case that the parking, of the machine at slope is required during operation, there is the danger of involuntary swing caused by the self weight of the machine. The brake is connected to prevent this involuntary swing.

PARKING BRAKE "OFF" OPERATION

The parking brake is released by the pilot pressure oil from the pilot pump.

When the left control lever placed in the swing position, the pilot oil flows into SH port through the MCV. This pressure transferred to the brake release valve and the brake release valve is change over. Then the pilot pressure lift the brake piston and release the parking brake.

PARKING BRAKE "ON" OPERATION

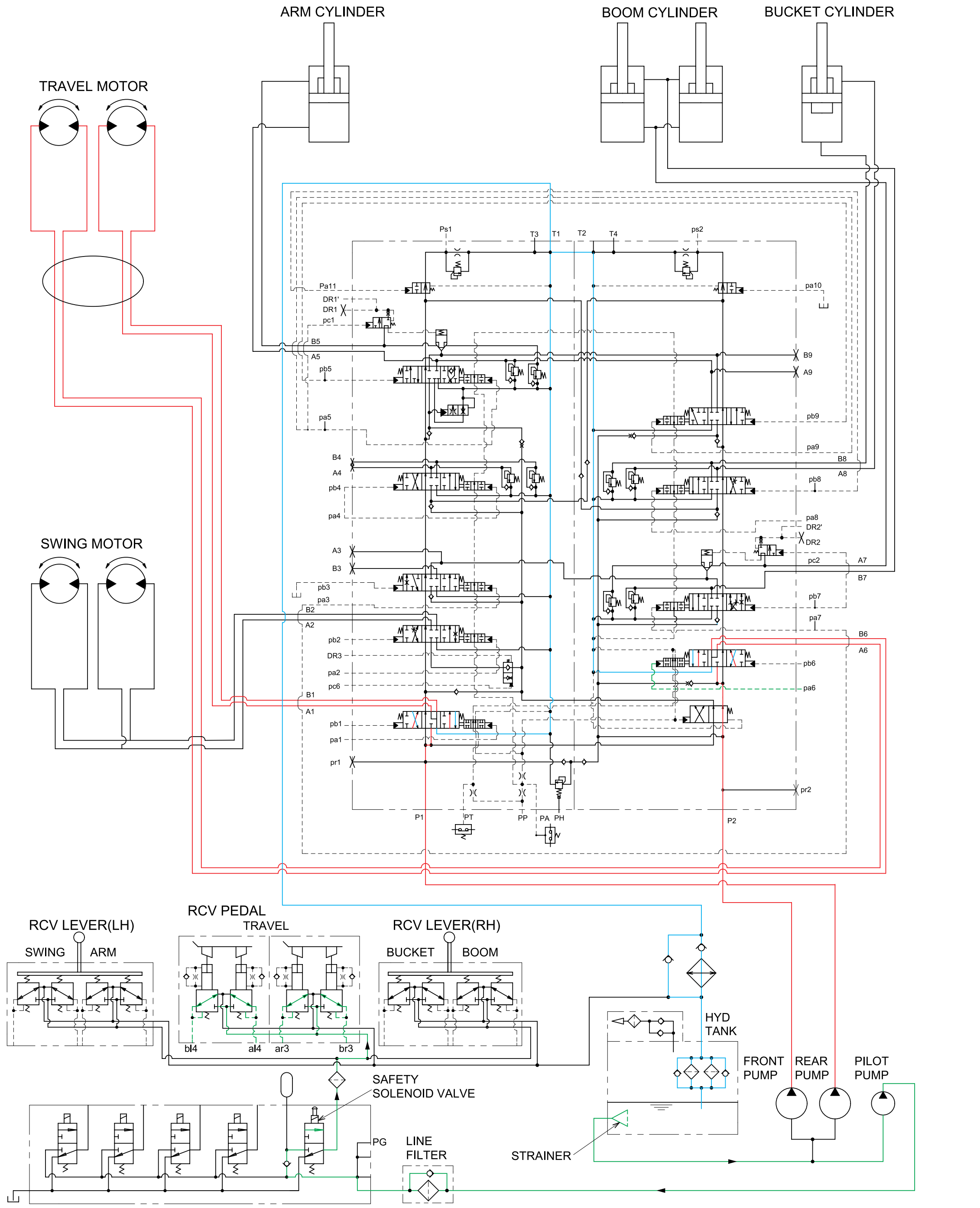
When the control lever placed in the neutral position, the pressure of the pilot oil passage down.

Then the brake release valve returned to the neutral position and the oil is returned from the brake piston to the tank. And the brake is set to 'ON".

4) REACTIONLESS VALVE

This bypass valve absorbs shocks produced as swing motion stops and reduced oscillation cause by swing motion.

8. TRAVEL FORWARD AND REVERSE OPERATION



45073HC16

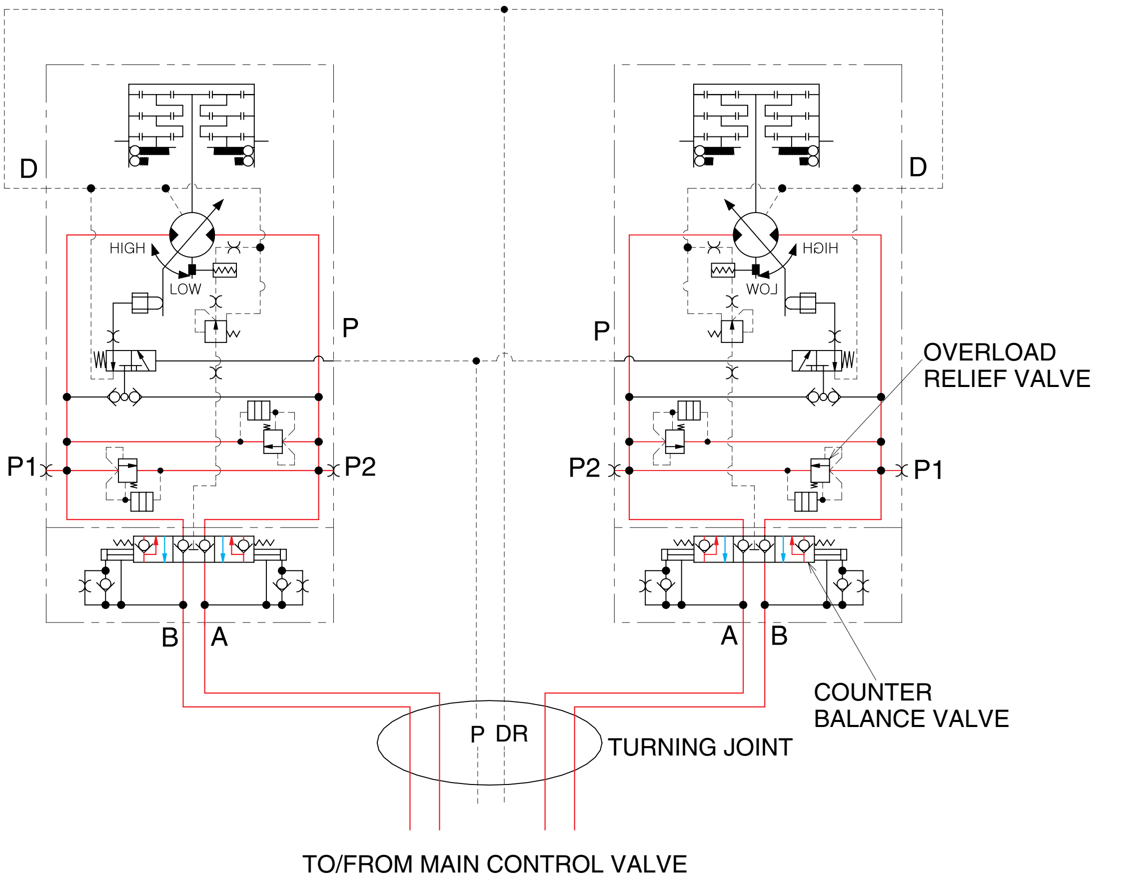
When the travel levers are placed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by the pilot oil pressure from the remote control valve.

The oil from the both pumps flow into the main control valve and then go to the both travel motors through the turning joint.

The return oil from both travel motors returns to the hydraulic oil tank through the turning joint and the travel(RH, LH) spools in the main control valve.

When this happens, the machine moves to the forward or reverse.

TRAVEL CIRCUIT OPERATION



Valves are provided on travel motors to offer the following functions.

1) COUNTER BALANCE VALVE

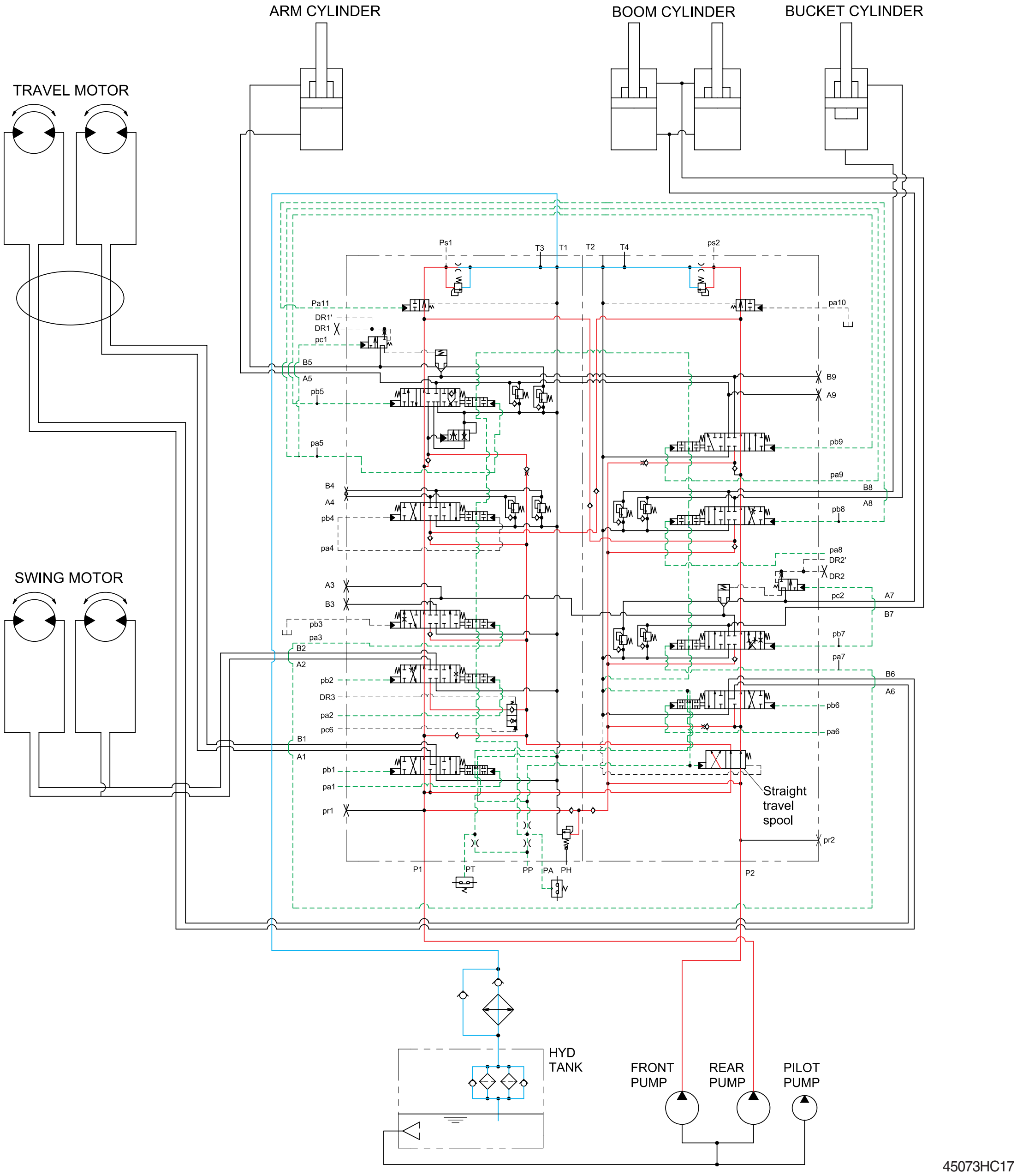
When stopping the motor of slope descending, this valve to prevent the motor over run.

2) OVERLOAD RELIEF VALVE

Relief valve limit the circuit pressure below 345kgf/cm^2 to prevent high pressure generated at a time of stopping the machine. Stopping the motor, this valve sucks the oil from lower pressure passage for preventing the negative pressure and the cavitation of the motor.

GROUP 5 COMBINED OPERATION

1. OUTLINE



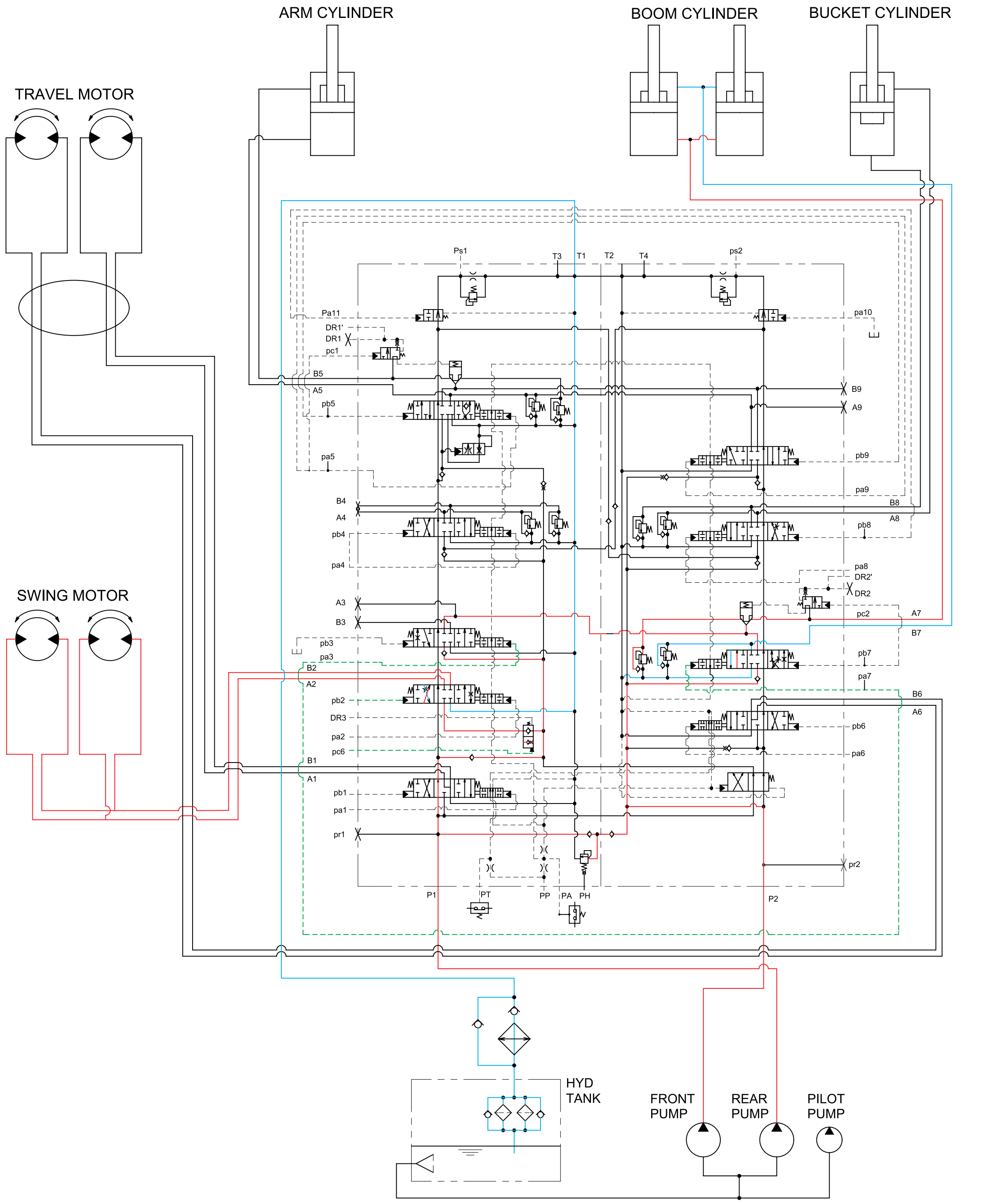
The oil from the front and rear pump flows through the neutral oil passage, bypass oil passage and confluence oil passage in the main control valve. Then the oil goes to each actuator and operates them. Check valves and orifices are located on these oil passage in the main control valve. These control the oil from the main pumps so as to correspond to the operation of each actuator and smooth the combined operation.

STRAIGHT TRAVEL SPOOL

This straight travel spool is provided in the main control valve.

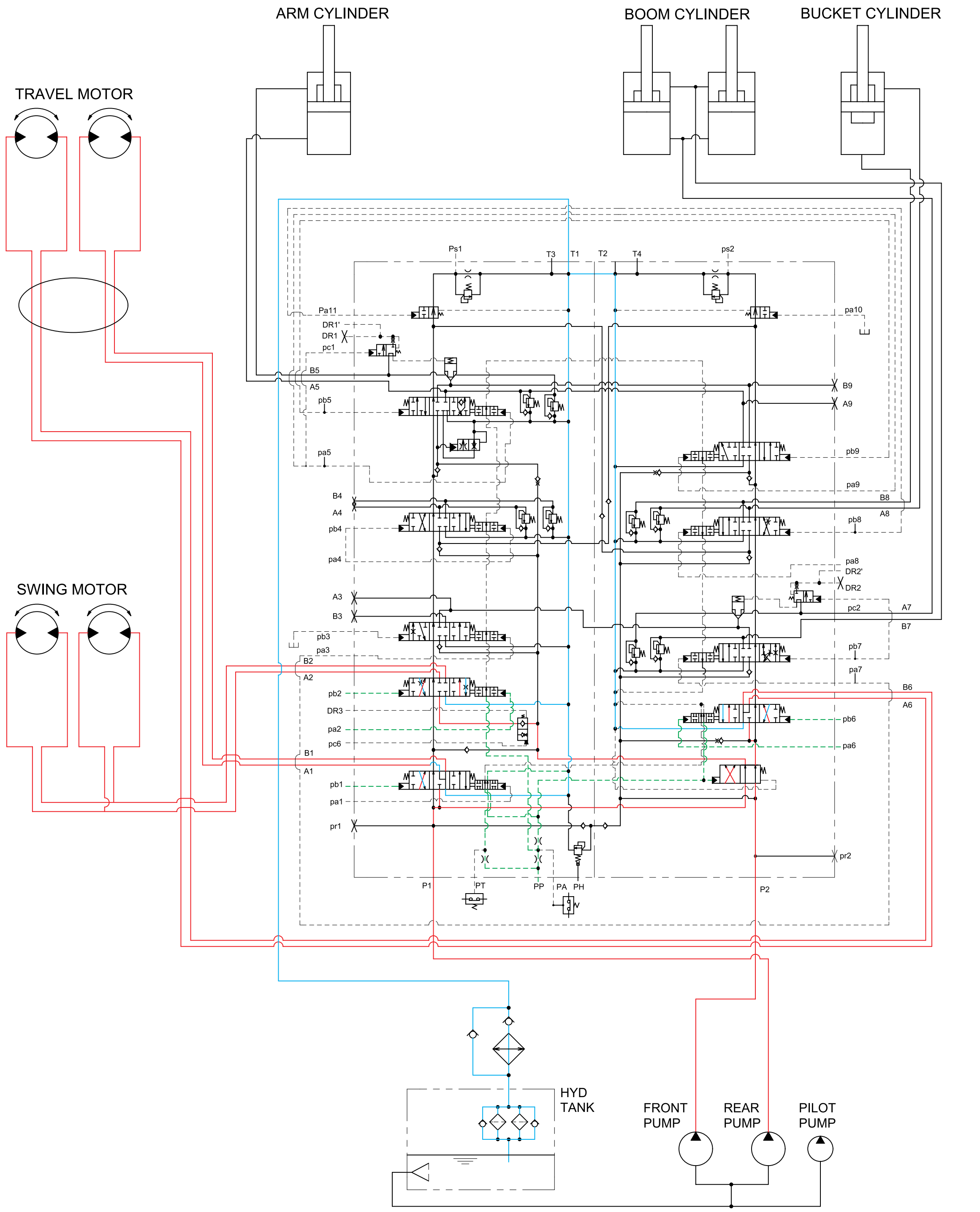
If any actuator is operated when traveling, the straight travel spool is pushed to the left by the pilot oil pressure(PP) from the pilot pump. Consequently, the left and right travel oil supply passage are connected, and equivalent amount of oil flows into the left and right travel motors. This keeps the straight travel.

2. COMBINED SWING AND BOOM UP OPERATION(HEAVY DUTY MODE)



When the swing and boom functions are operated, simultaneously the swing and boom spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve. The oil from the rear pump flows into the swing motor through the swing spool.
The oil from the front pump flows into the boom cylinders through the boom spool in the left control valve.
At the same time, the pressure in the boom circuits can be high while the swing pressure is low, therefore the oil from the front pump flows into the boom cylinders through boom spool via confluence oil passage by logic valve in case boom up operation.

3. COMBINED SWING AND TRAVEL OPERATION



45073HC22

When the swing and travel functions are operated, simultaneously the swing spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve. At the same time, the straight travel spool is pushed to the right by the pilot oil pressure(PP) from the pilot pump.

The oil from the rear pump flows into the swing motor through the swing spool. The oil from the front pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

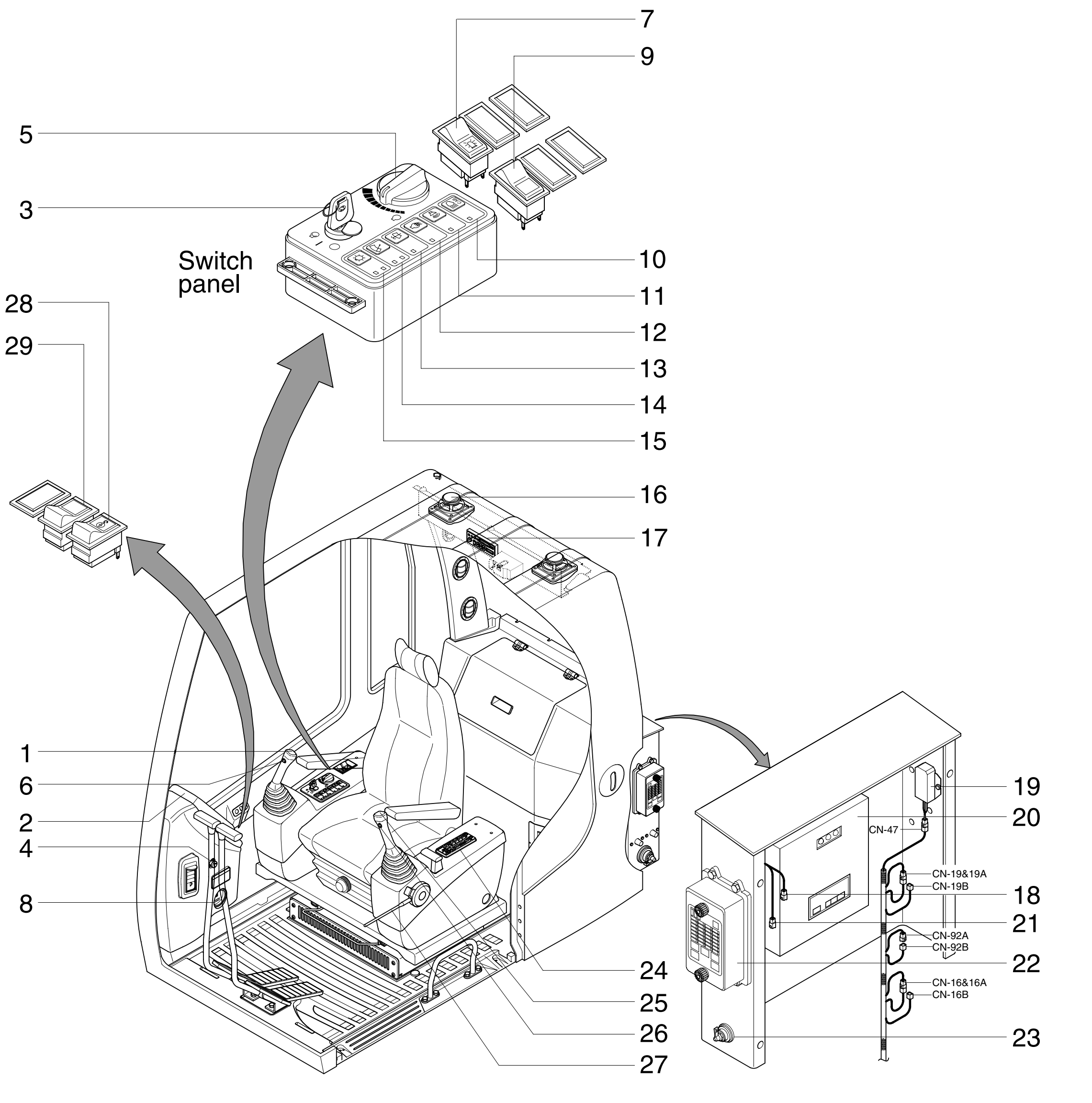
The superstructure swings and the machine travels straight.

SECTION 4 ELECTRICAL SYSTEM

SECTION 4 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION

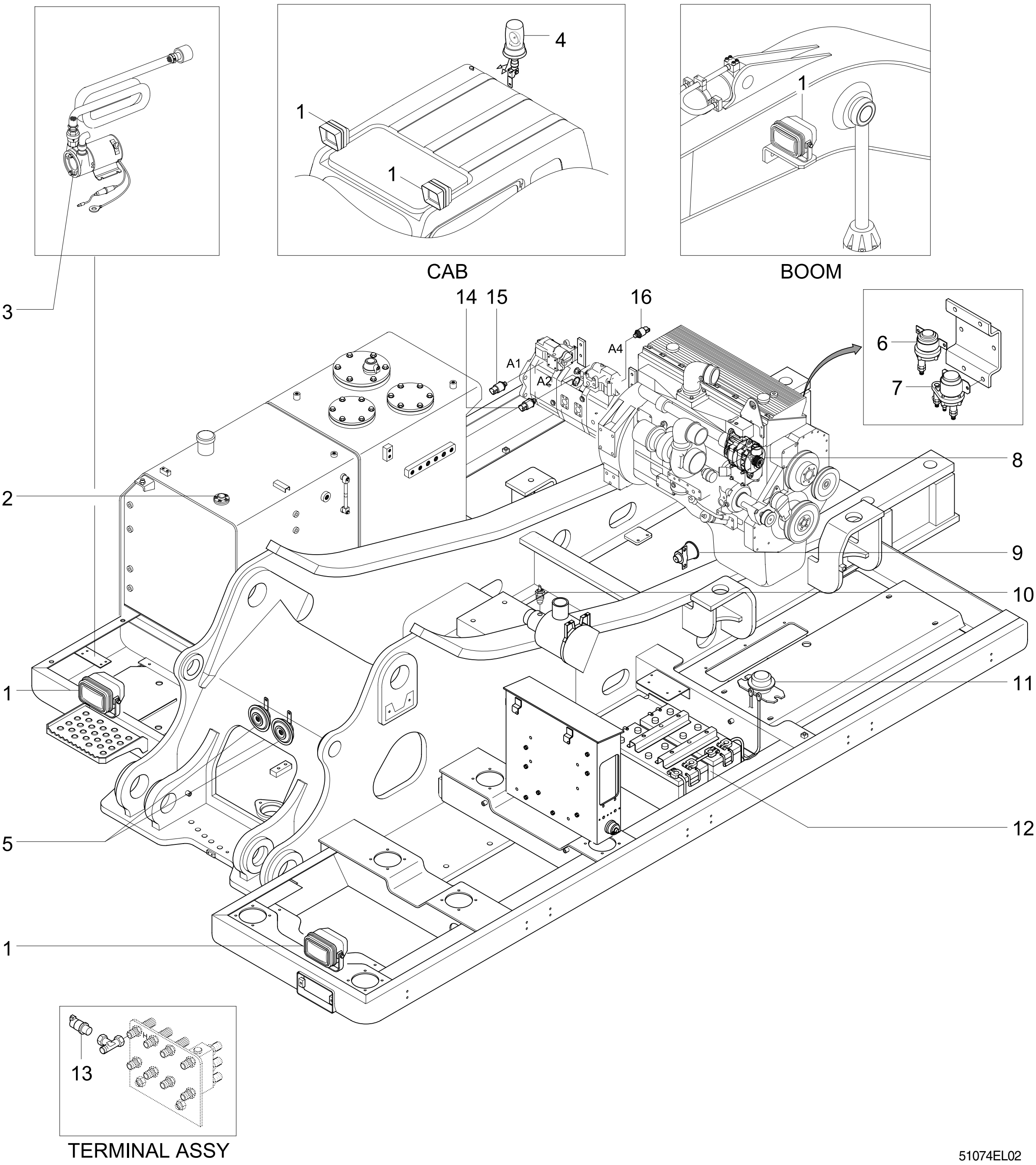
1. LOCATION 1



51074EL01

1	Horn switch	11	Travel alarm stop switch	21	J1939 serial connector
2	Cluster	12	Preheat switch	22	Fuse box
3	Starting switch	13	Washer switch	23	Master switch
4	Cigar lighter	14	Wiper switch	24	Aircon & heater switch panel
5	Accel dial	15	Main light switch	25	One touch decel switch
6	Breaker switch	16	Speaker	26	Power max switch
7	Beacon switch	17	Radio and USB palyer	27	Safety lever
8	Service meter	18	RS232 serial connector	28	Overload switch
9	Breaker selection switch	19	Prolix resistor	29	Quick coupling switch
10	Cab light switch	20	MCU		

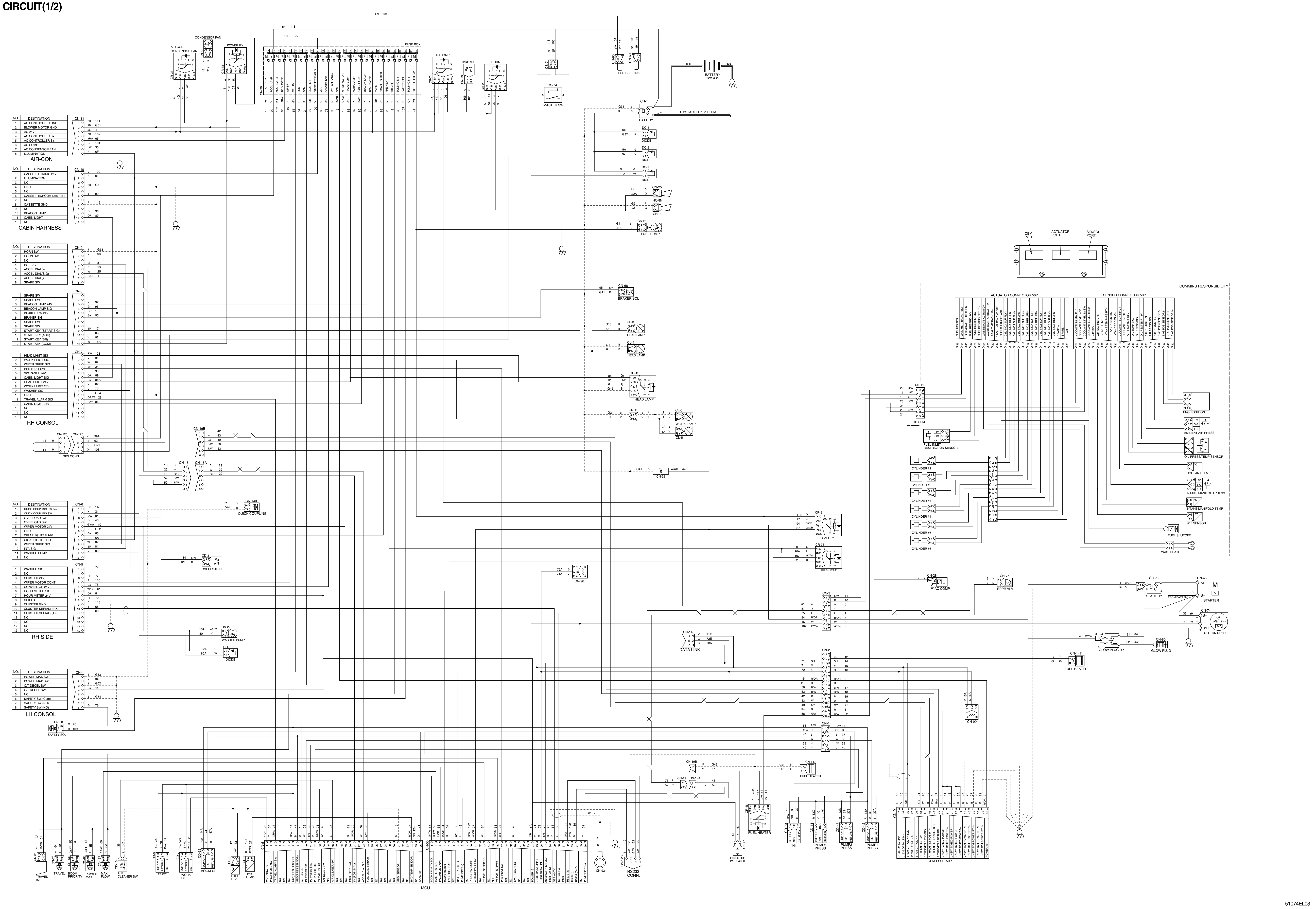
2. LOCATION 2



1	Lamp	7	Heater valve	13	Boom up pressure sensor
2	Fuel sender	8	Alternator	14	P1 pressure sensor
3	Fuel filler pump	9	Travel alarm buzzer	15	P2 pressure sensor
4	Beacon lamp	10	Air cleaner switch	16	EPPR pressure sensor
5	Horn	11	Battery relay		
6	Start relay	12	Battery		

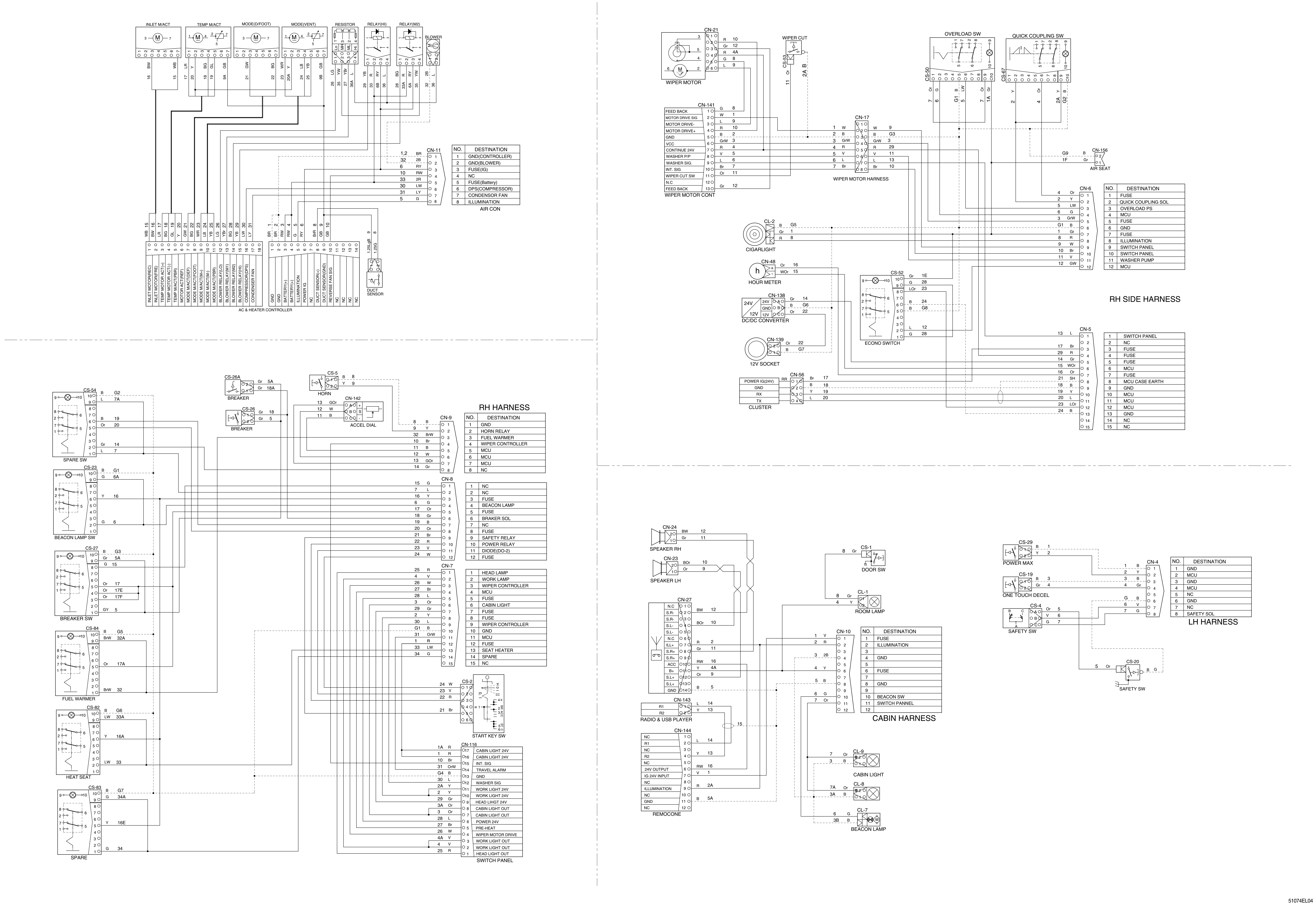
GROUP 2 ELECTRICAL CIRCUIT

· ELECTRICAL CIRCUIT(1/2)



51074EL03

· ELECTRICAL CIRCUIT(2/2)



1. POWER CIRCUIT

The negative terminal of battery is grounded to the machine chassis through master switch.

When the start switch is in the OFF position, the current flows from the positive battery terminal as shown below.

1) OPERATING FLOW

Battery → Battery relay → Fusible link 〔CN-60〕 → Master switch 〔CS-74〕

- → Fuse box 〔No.1〕
  - → I/conn 〔CN-8(12)〕 → Start switch 〔CS-2(1)〕
  - → Power relay 〔CR-35(30)]
- → Fuse box 〔No.2〕
  - → I/conn 〔CN-10(6)〕
    - → Room lamp 〔CL-1(2)〕 → Door switch 〔CS-1〕
    - → Cassette radio 〔CN-27(11)〕
  - → GPS connector 〔CN-125(1)〕
- → Fuse box 〔No.3〕 → I/conn 〔CN-11(4)〕 → AC & Heater controller 〔CN -116(3, 4)〕
- → Fuse box 〔No.4〕 → I/conn 〔CN-11(5)〕 → Relay(Hi, M2)
- → Fuse box 〔No.5〕 → I/conn 〔CN - 5(4)〕 → I/conn 〔CN -17(5)〕
  - → Wiper motor controller 〔CN-141(7)〕
  - → Wiper motor 〔CN-21(4)〕
- → Fuse box 〔No.6〕 → MCU 〔CN-50(7)〕

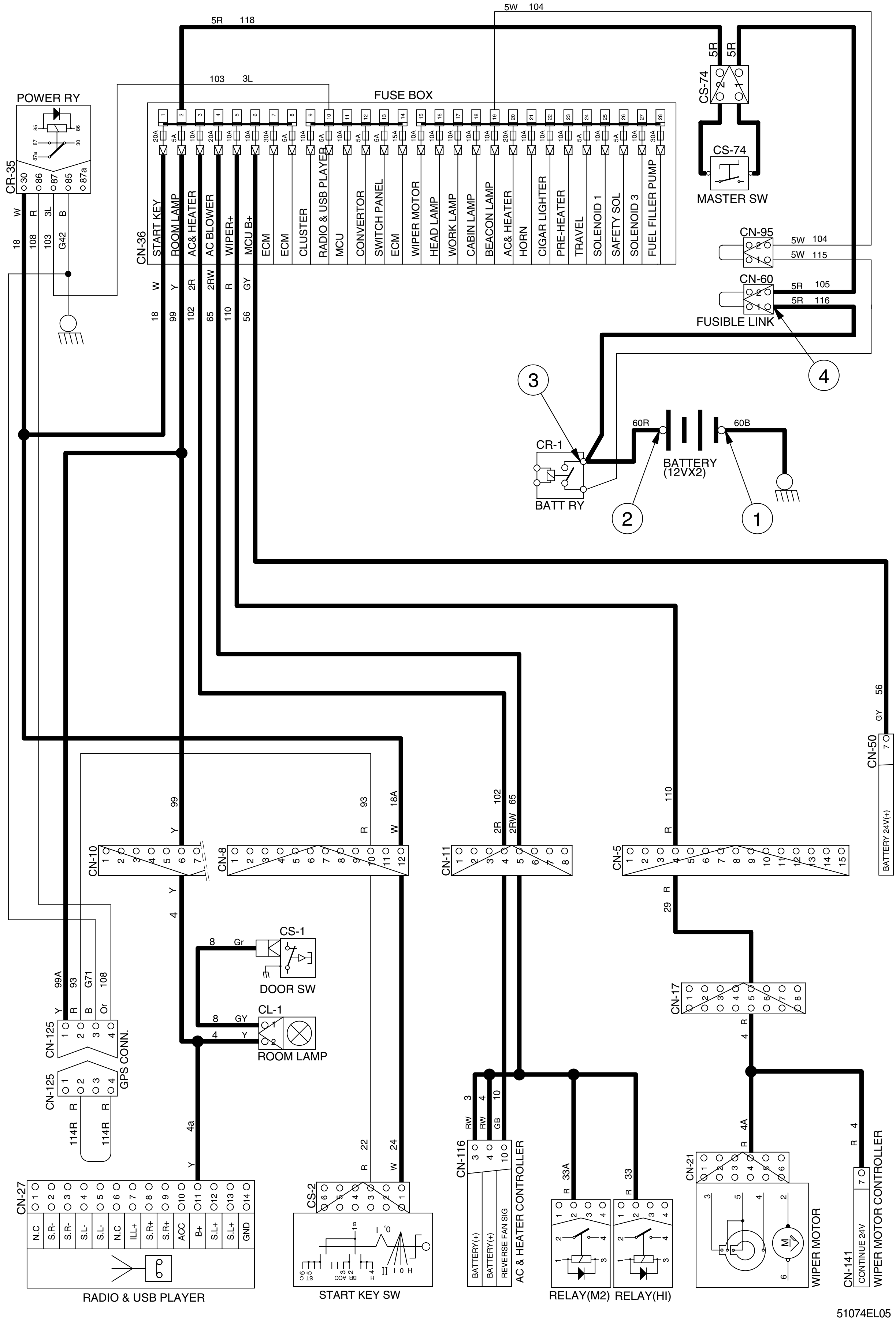
※ I/conn : Intermediate connector

2) CHECK POINT

Engine	Start switch	Check point	Voltage
OFF	OFF	① - GND (Battery 1EA)	10~12.5V
		② - GND (Battery 2EA)	20~25V
		③ - GND (Battery 2EA)	20~25V
		④ - GND (Fusible link)	20~25V

※ GND : Ground

POWER CIRCUIT



2. STARTING CIRCUIT

1) OPERATING FLOW

Battery(+) terminal → Battery relay〔CR-1〕→ Fusible link〔CN-60〕→ Master switch〔CS-74〕
→ Fuse box〔No.1〕→ I/conn〔CN-8(12)〕→ Start switch〔CS-2(1)〕

(1) When start key switch is in ON position

→ Start switch ON〔CS-2(2)〕→ I/conn〔CN-8(11)〕→ Battery relay〔CR-1〕
→ Battery relay operating (All power is supplied with the electric component)
→ Start switch ON〔CS-2(3)〕→ I/conn〔CN-8(10)〕→ GPS connector〔CN-125(2) → (4)〕
→ Power relay〔CR-35(86) → (87)〕→ Fuse box〔No.10〕

(2) When start key switch is in START position

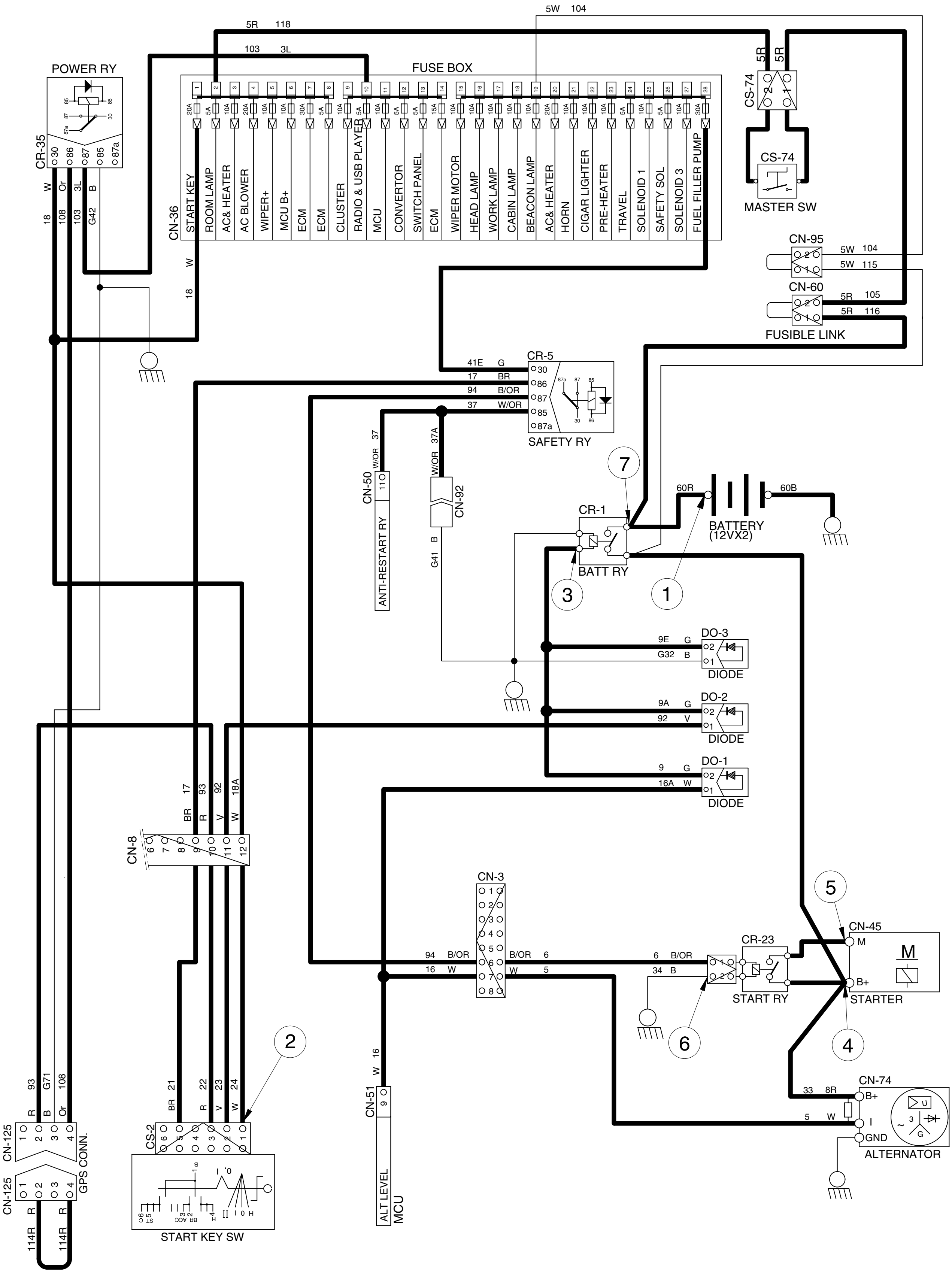
Start switch START〔CS-2(5)〕→ I/conn〔CN-8(9)〕→ Safety relay〔CR-5(86) → (87)〕
→ I/conn〔CN-3(6)〕→ Start relay〔CR-23(1)〕

2) CHECK POINT

Engine	Start switch	Check point	Voltage
OPERATING	START	① - GND(Battery) ② - GND(Start key) ③ - GND(Battery relay M4) ④ - GND(Starter B^+) ⑤ - GND(Starter M) ⑥ - GND(Start relay) ⑦ - GND(Battery relay M8)	20~25V

※ GND : Ground

STARTING CIRCUIT



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3. CHARGING CIRCUIT

When the starter is activated and the engine is started, the operator releases the key switch to the ON position.

Charging current generated by operating alternator flows into the battery through the battery relay (CR-1).

The current also flows from alternator to each electrical component and controller through the fuse box.

1) OPERATING FLOW

(1) Warning flow

Alternator "I" terminal → I/conn 〔CN-3(7)〕 → MCU alternator level 〔CN-51(9)〕 → Cluster charging warning lamp(Via serial interface)

(2) Charging flow

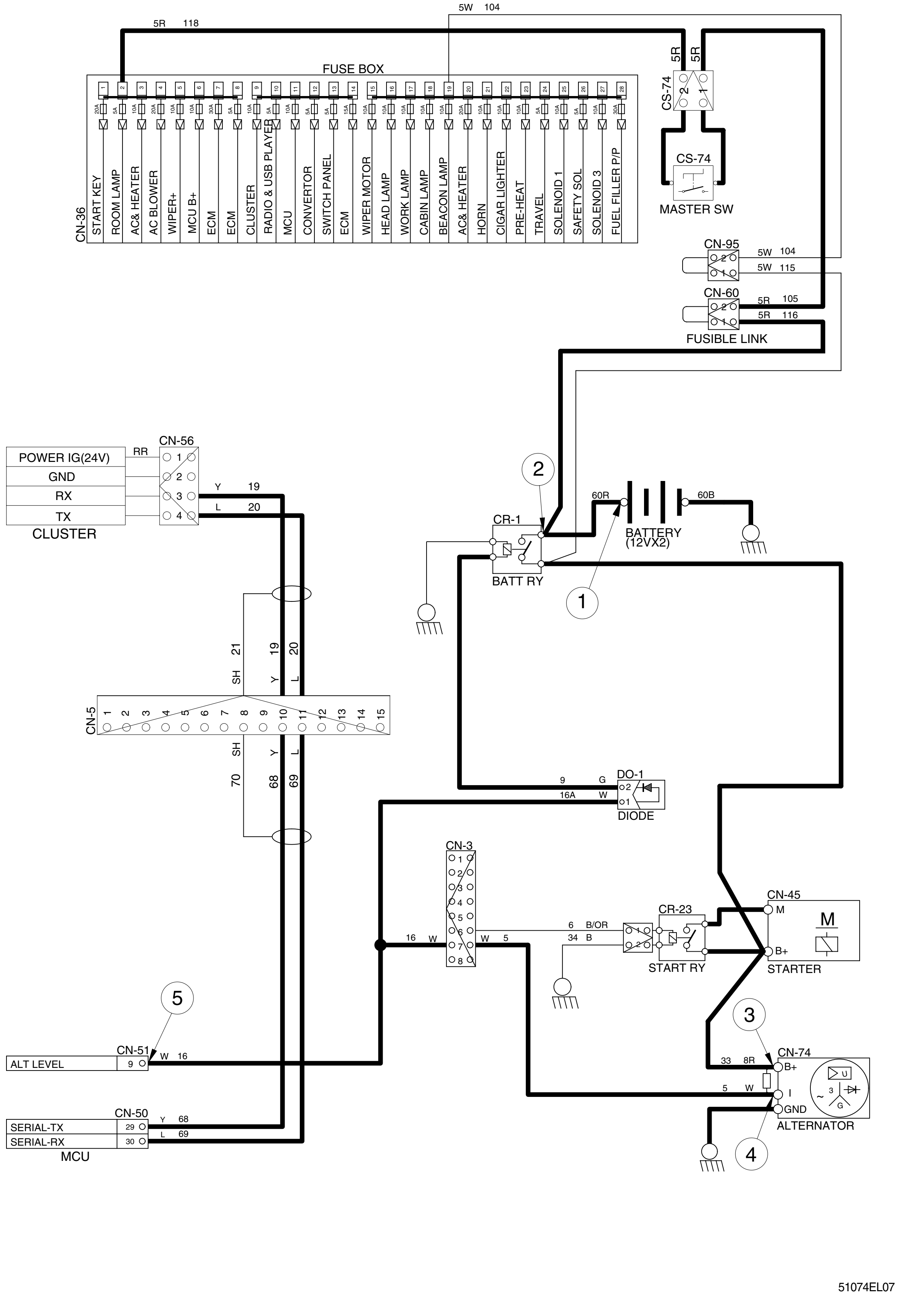
Alternator "B^+" terminal → Battery relay(M8) → Battery(+) terminal
→ Fusible link 〔CN-60〕 → Master switch 〔CS-74〕
→ Fuse box

2) CHECK POINT

Engine	Start switch	Check point	Voltage
Run	ON	① - GND(Battery voltage) ② - GND(Battery relay) ③ - GND(Alternator B^+ terminal) ④ - GND(Alternator I terminal) ⑤ - GND(MCU)	20~30V

※ GND : Ground

CHARGING CIRCUIT



4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.16) → I/conn 〔CN-7(7)〕 → Switch panel 〔CN-116(9)〕
Fuse box (No.17) → I/conn 〔CN-7(8)〕 → Switch panel 〔CN-116(10,11)〕

(1) Head light switch ON

Head light switch ON 〔CN-116(1)〕 → I/conn 〔CN-7(1)] → Head light & relay 〔CR-13(86) → (87)〕

- → Head light ON 〔CL-3(2), CL-4(2)〕
- → I/conn 〔CN-10(2)〕
  - → Radio and USB player illumination ON 〔CN-27(7)〕
  - → Remote controller illumination ON 〔CN-144(9)〕
- → I/conn 〔CN-11(8)〕 → AC & Heater controller illumination ON
- → I/conn 〔CN-6(8)〕 → Cigarlight 〔CL-2〕

(2) Work light switch ON

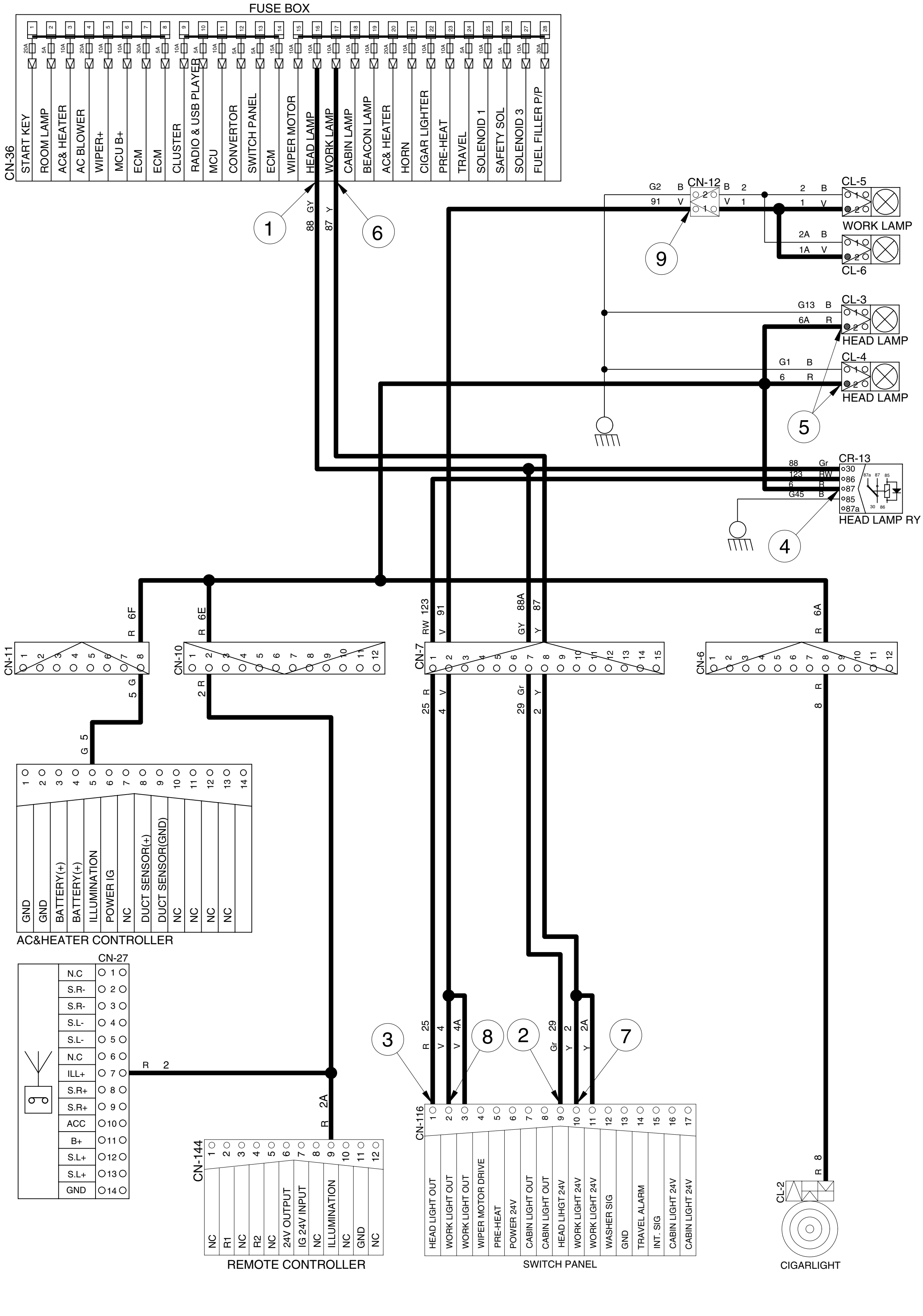
Work light switch ON 〔CN-116(2,3)〕 → I/conn 〔CN-7(2)〕 → I/conn 〔CN-12(1)〕
→ Work light ON 〔CL-5(2), CL-6(2)〕

2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND(Fuse box) ② - GND(Switch power input) ③ - GND(Switch power output) ④ - GND(Head light)	20~25V
STOP	ON	⑤ - GND(Fuse box) ⑥ - GND(Switch power input) ⑦- GND(Switch power output) ⑧ - GND(Work light)	20~25V

※ GND : Ground

HEAD AND WORK LIGHT CIRCUIT



5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.19) → I/conn 〔CN-8(3)〕 → Beacon lamp switch 〔CN-23(6)〕
Fuse box (No.18) → I/conn 〔CN-7(12)〕 → Switch panel 〔CN-116(16, 17)〕

(1) Beacon lamp switch ON

Beacon lamp switch ON 〔CS-23(2)〕 → Switch Indicator lamp ON 〔CS-23(9)〕
→ I/conn 〔CN-8(4)〕 → I/conn 〔CN-10(10)〕
→ Beacon lamp ON 〔CL-7〕

(2) Cab light switch ON

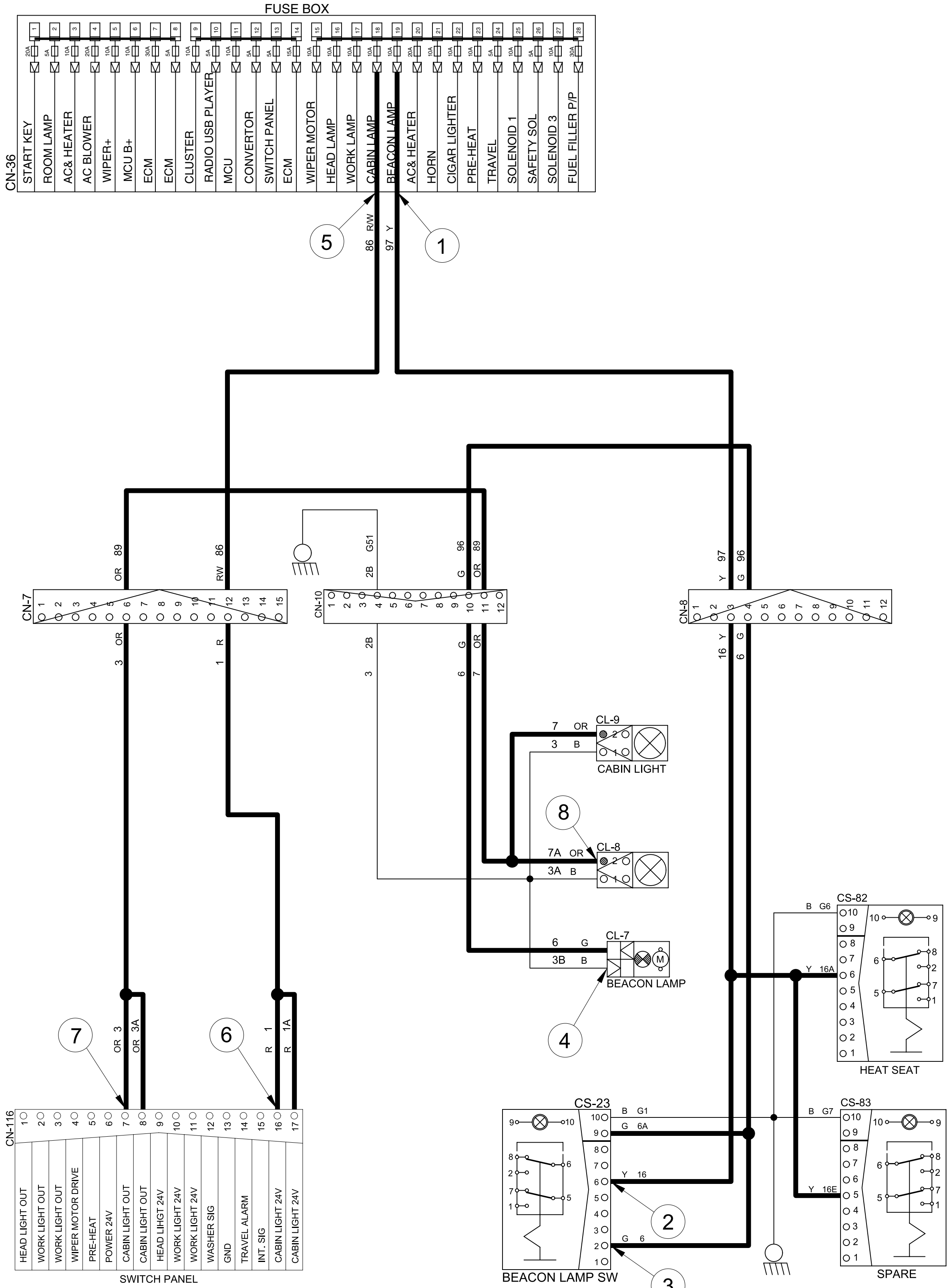
Cab light switch ON 〔CN-116(7, 8)〕 → I/conn 〔CN-7(6)〕 → I/conn 〔CN-10(11)〕
→ Cab light ON 〔CL-8(2), CL-9(2)〕

2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND(Fuse box) ② - GND(Switch power input) ③ - GND(Switch power output) ④ - GND(Beacon lamp)	20~25V
STOP	ON	⑤ - GND(Fuse box) ⑥ - GND(Switch power input) ⑦ - GND(Switch power output) ⑧ - GND(Cab light)	20~25V

※ GND : Ground

BEACON LAMP AND CAB LIGHT CIRCUIT



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6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.13) → I/conn 〔CN-7(5)〕 → Switch panel 〔CN-116(6)〕

Fuse box (No.5) → I/conn 〔CN-5(4)〕 → I/conn 〔CN-17(5)〕 → Wiper motor controller 〔CN-141(7)〕
→ Wiper motor 〔CN-21(4)〕

Fuse box (No.15) → I/conn 〔CN-6(5)〕 → I/conn 〔CN-17(4)〕 → Wiper motor controller 〔CN-141(6)〕
→ Washer pump 〔CN-22(2)〕

(2) Wiper switch ON : 1st step(Intermittent)

Wiper switch ON 〔CN-116(15)〕 → I/conn〔CN-9(4)〕 → I/conn〔CN-6(10)〕 → I/conn〔CN-17(8)〕
Wiper motor controller 〔CN-141(10) → (3)〕 → Wiper motor intermittently operating 〔CN-21(6)〕

(3) Wiper switch ON : 2nd step(Low speed)

Wiper switch ON 〔CN-116(4)〕 → I/conn 〔CN-7(3)〕 → I/conn 〔CN-6(9)〕 → I/conn〔CN-17(2)〕
→ Wiper motor controller 〔CN-141(2) → (4)〕 → Wiper motor operating 〔CN-21(2)〕

(4) Washer switch ON

Washer switch ON 〔CN-116(12)〕 → I/conn 〔CN-7(9)〕 → I/conn 〔CN-5(1)〕 → I/conn 〔CN-17(7)〕
→ Wiper motor controller 〔CN-141(9) → (8)〕 → I/conn 〔CN-17(6)〕 → I/conn 〔CN-6(11)〕
→ Washer pump 〔CN-22(1)〕 → Washer operating
Wiper switch ON 〔CN-116(4)〕 → I/conn 〔CN-7(3)〕 → I/conn 〔CN-6(9)〕 → I/conn〔CN-17(2)〕
→ Wiper motor controller 〔CN-141(2) → (4)〕 → Wiper motor operating 〔CN-21(2)〕

(5) Auto parking(When switch OFF)

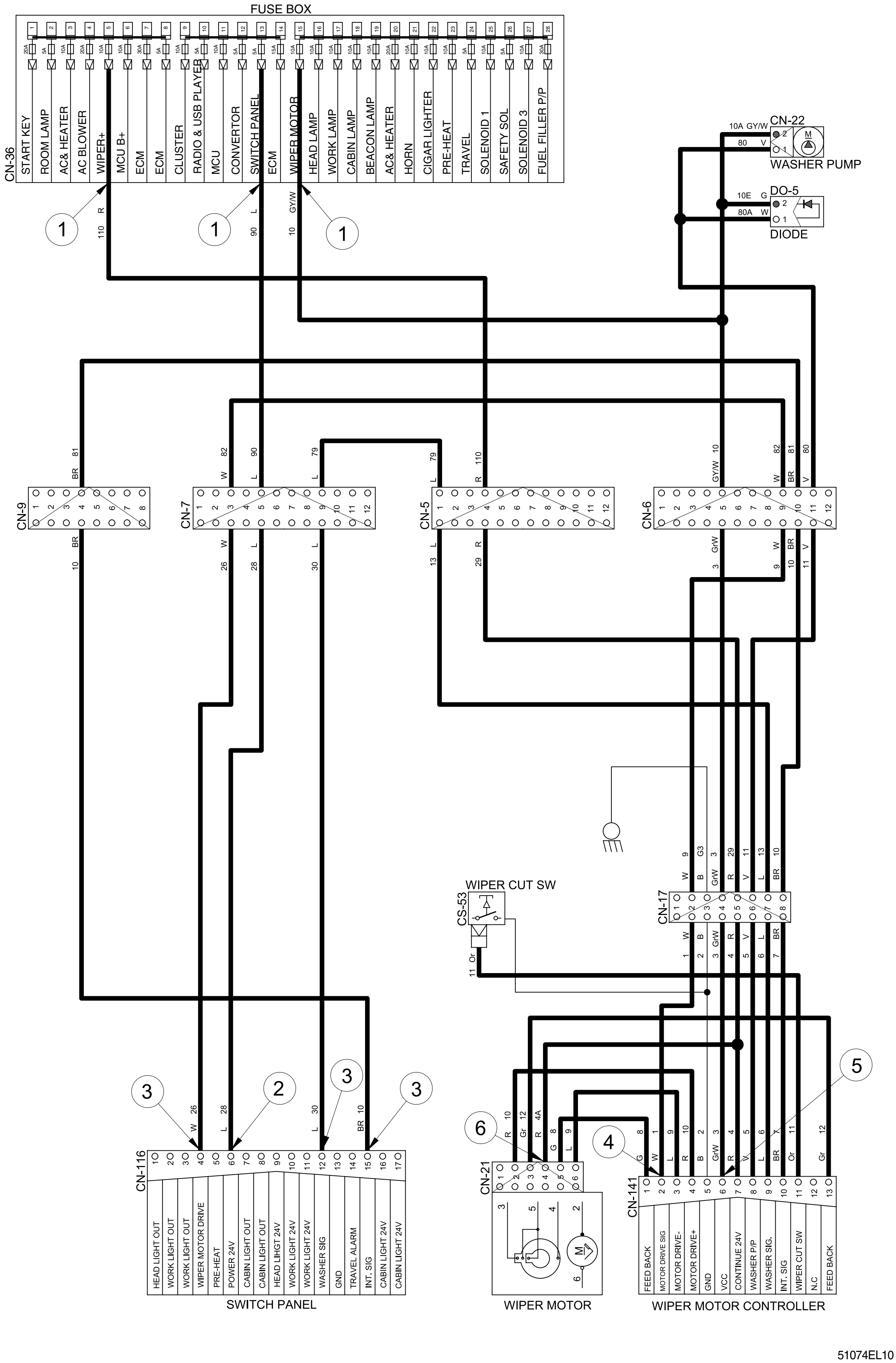
Switch OFF 〔CN-116(4)〕 → Wiper motor parking position by wiper motor controller

2) CHECK POINT

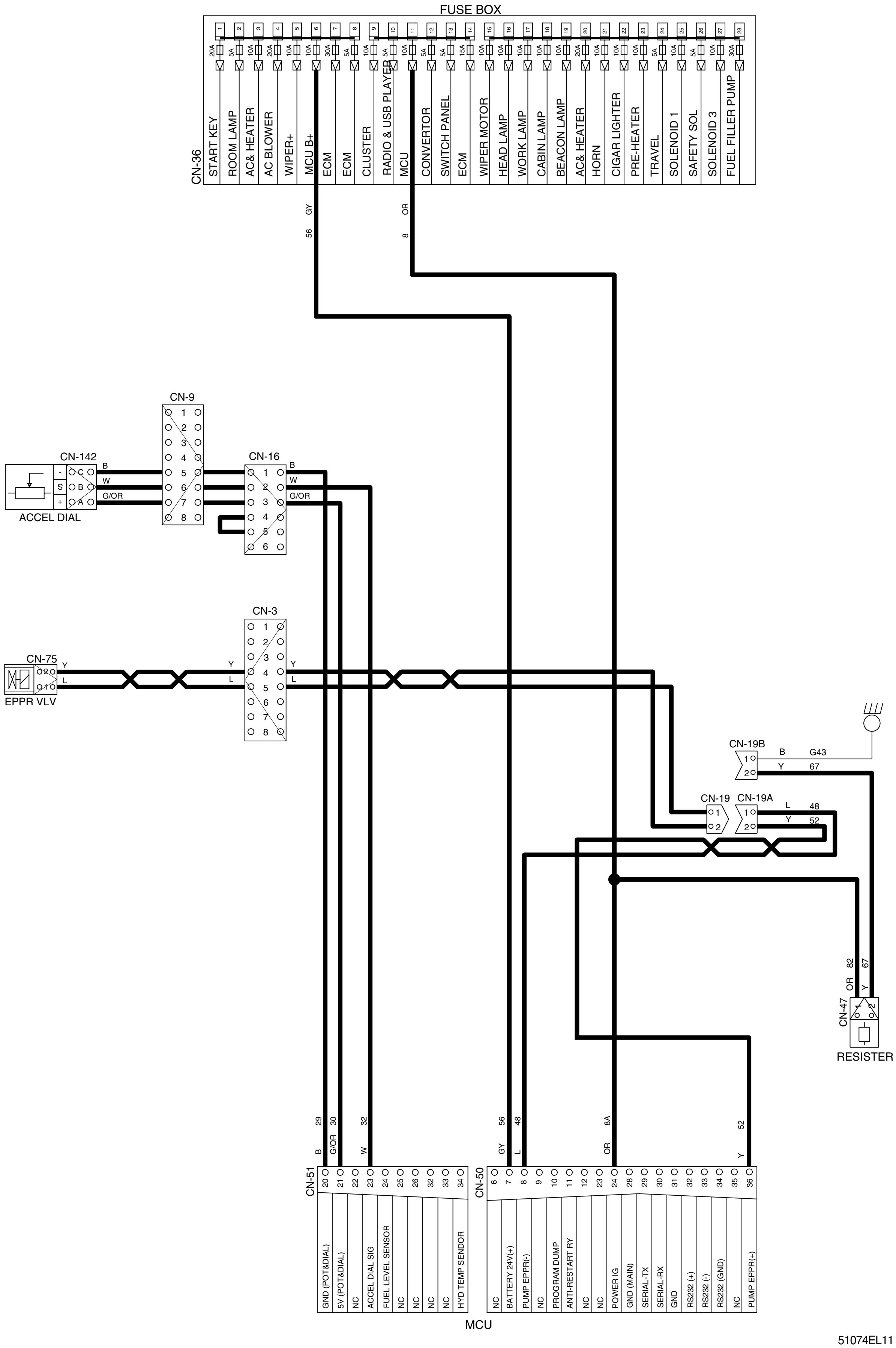
Engine	Start switch	Check point	Voltage
STOP	ON	① - GND(Fuse box) ② - GND(Switch power input)	24V
		③ - GND(Switch power output) ④ - GND(Wiper Power input)	0 ~ 5V
		⑤ - GND(Wiper power output) ⑥ - GND(Wiper motor)	24V

※ GND : Ground

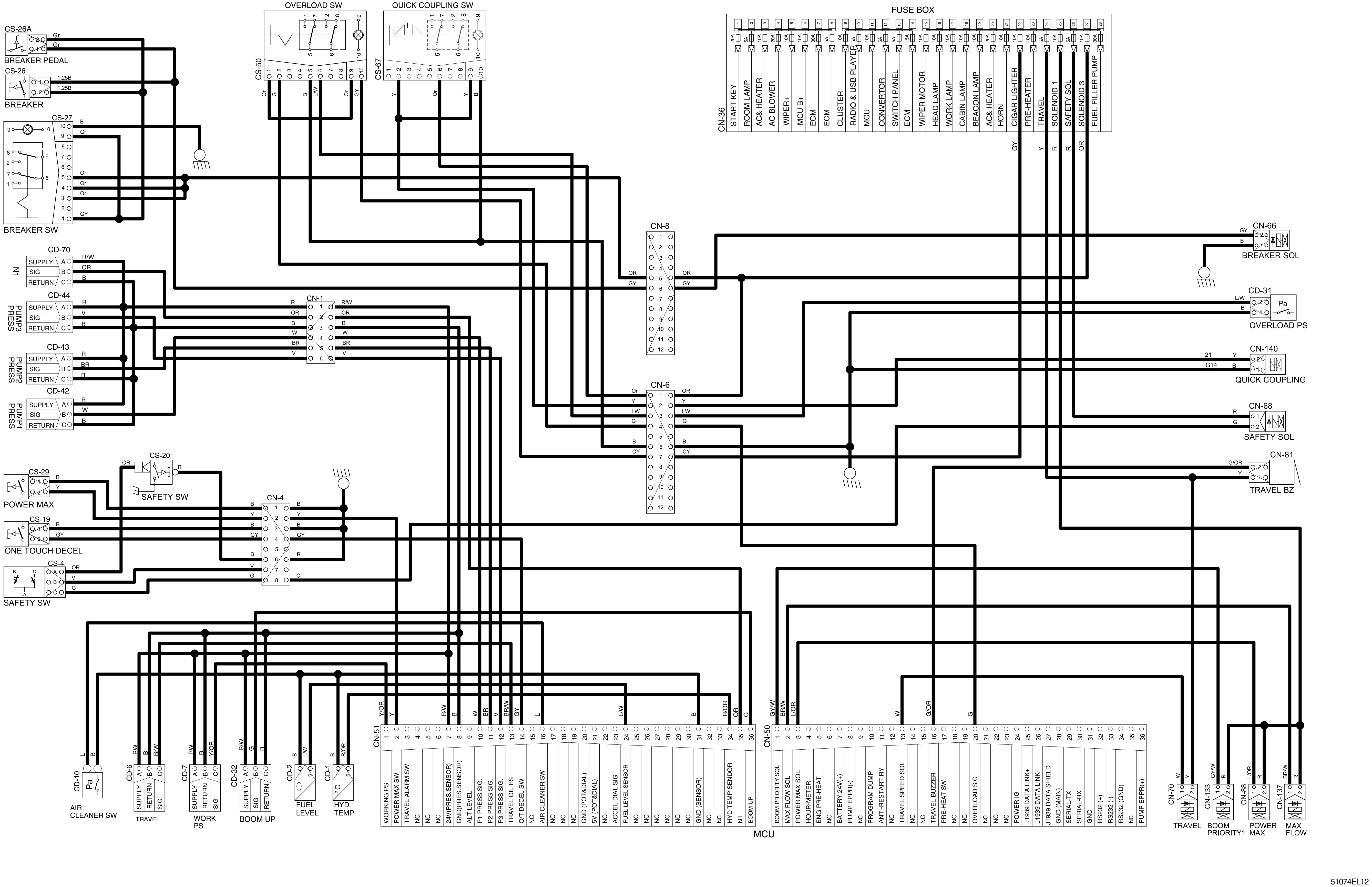
WIPER AND WASHER CIRCUIT



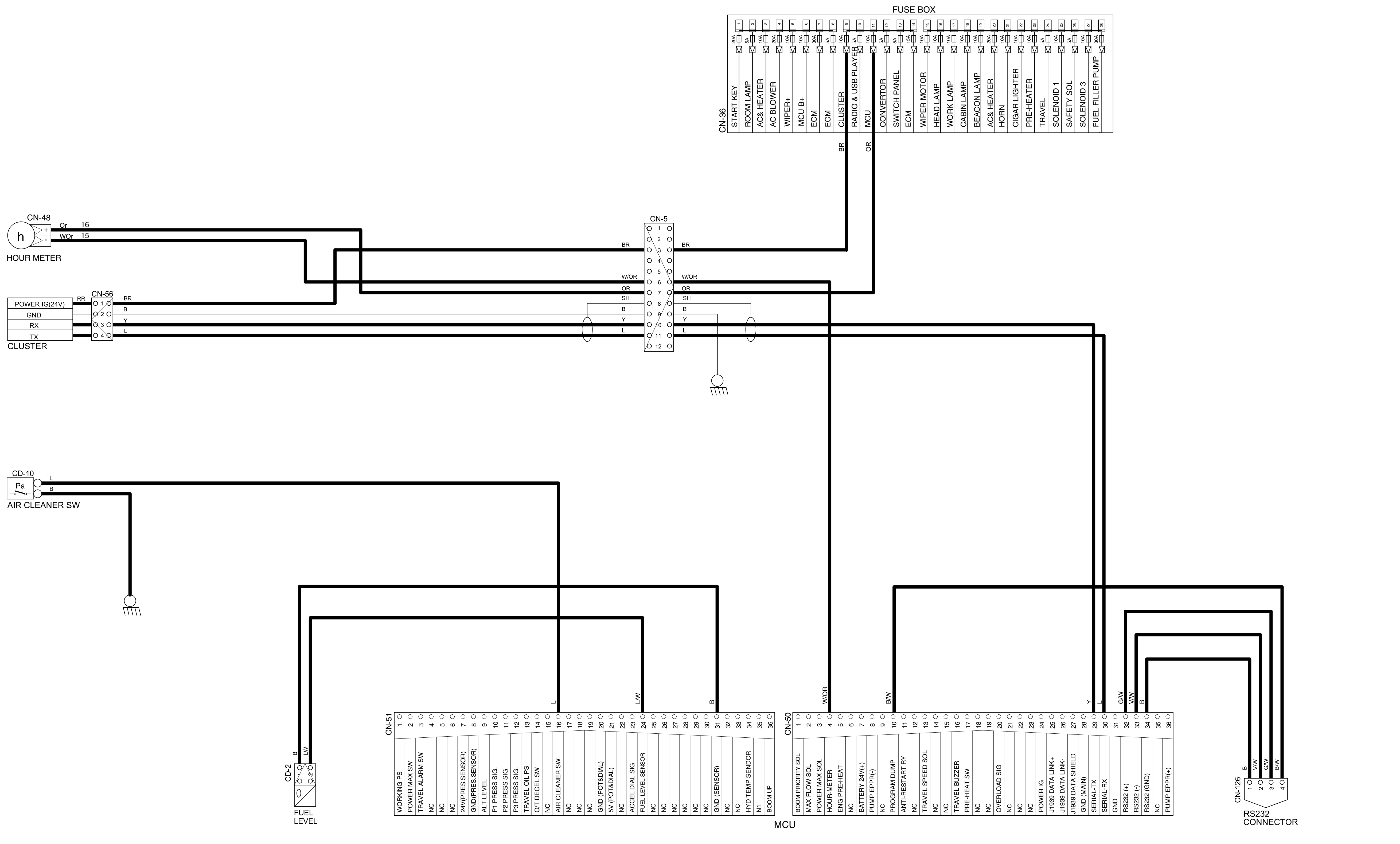
CONTROLLER CIRCUIT



ELECTRIC CIRCUIT FOR HYDRAULIC



MONITORING CIRCUIT



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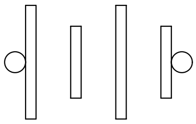
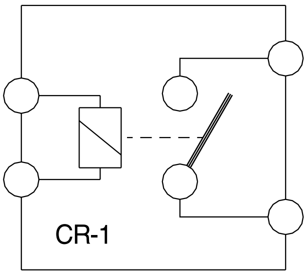
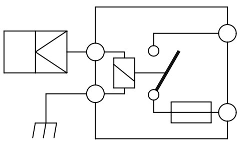
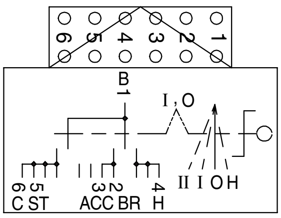
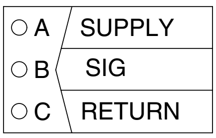
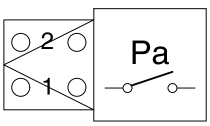
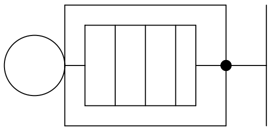
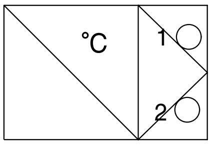
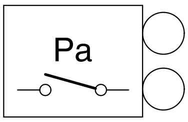
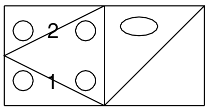
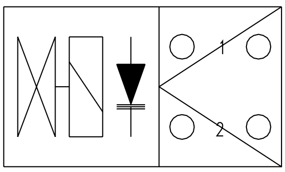
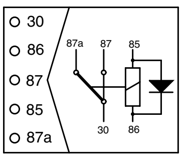
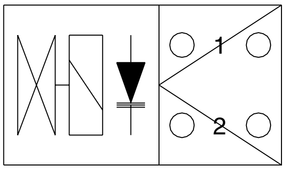
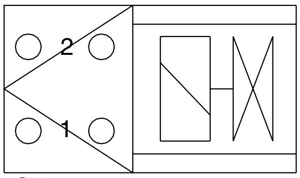
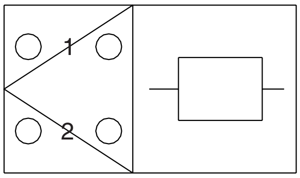
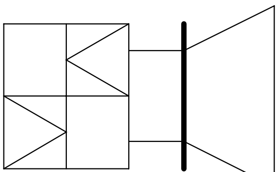
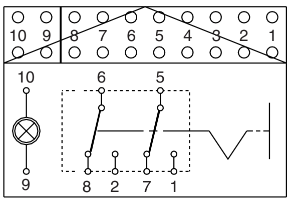
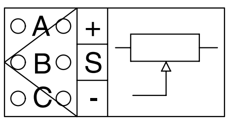
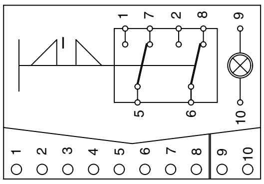
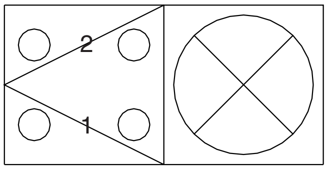
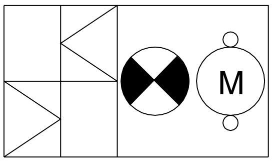
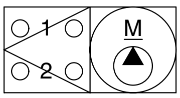
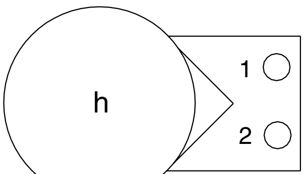
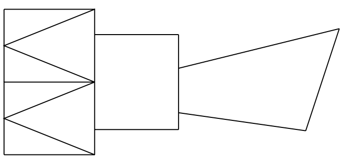
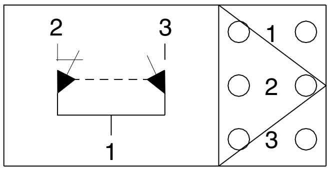
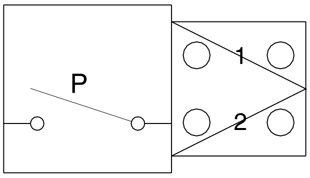
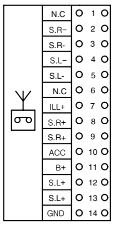
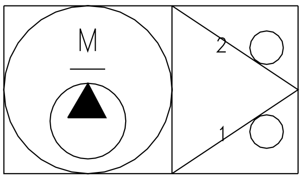
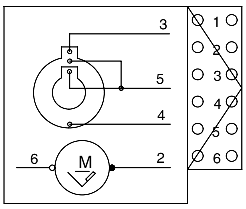
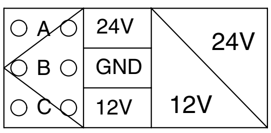
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

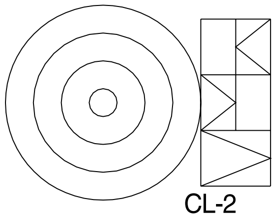
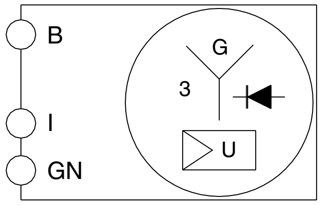
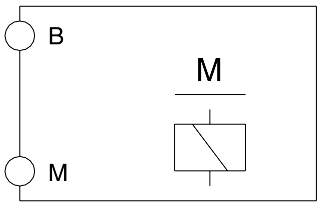
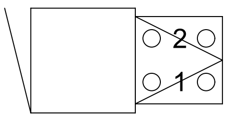
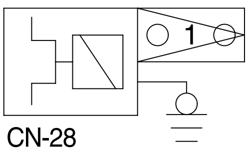
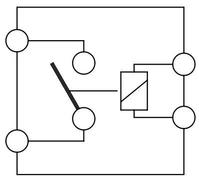
Part name	Symbol	Specifications	Check
Battery		12V × 160Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A(continuity) 1000A(30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50 Ω ※ Check contact Normal : ∞ Ω
Glow plug relay	 CR-24	24V 200A	※ Check contact Normal : 0.942 (For terminal 1-GND)
Start key	 CS-2	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	※ Check contact OFF : ∞ Ω (For each terminal) ON : 0 Ω (For terminal 1-3 and 1-2) START : 0 Ω (For terminal 1-5)
Pressure sensor (Travel, working, boom up, pump)	 CD-6 CD-7 CD-32 CD-42 CD-43 CD-44 CD-70	8~30V	※ Check contact Normal : 0.1 Ω
Pressure switch (For overload)	 CD-31	3~6kgf/cm^2 (N.O TYPE)	※ Check contact Normal : ∞ Ω

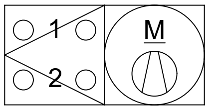
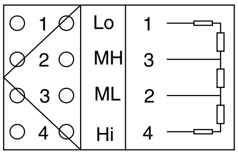
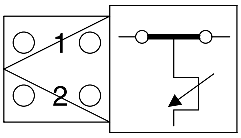
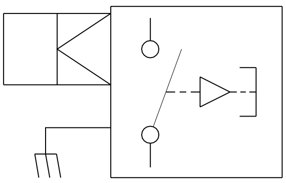
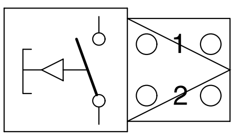
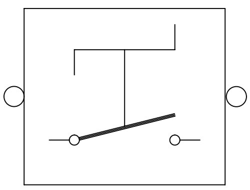
Part name	Symbol	Specifications	Check
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25 ~ 0.12 Ω
Temperature sensor (Hydraulic)	 CD-1	-	※ Check resistance 50˚C : 804 Ω 80˚C : 310 Ω 100˚C : 180 Ω
Air cleaner pressure switch	 CD-10	-	※ Check contact High level : ∞ Ω Low level : 0 Ω
Fuel sender	 CD-2	-	※ Check resistance Full : 50 Ω 6/12 : 350 Ω 11/12 : 100 Ω 5/12 : 400 Ω 10/12 : 150 Ω 4/12 : 450 Ω 9/12 : 200 Ω 3/12 : 500 Ω 8/12 : 250 Ω 2/12 : 550 Ω 7/12 : 300 Ω 1/12 : 600 Ω Empty warning : 700 Ω
Quick clamp solenoid	 CN-140	24V 6A	※Check contact Normal : 28.9MΩ (For terminal 1-2)
Relay	 CR-2 CR-5 CR-7 CR-13 CR-33 CR-35 CR-36 CR-46	24V 16A	※ Check resistance Normal : About 160 Ω (For terminal 85-86) 0 Ω (For terminal 30-87a) ∞ Ω (For terminal 30-87)

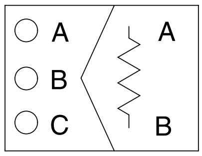
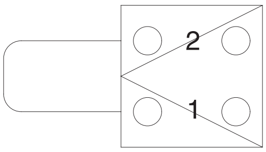
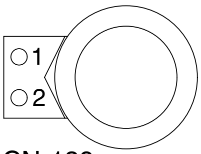
Part name	Symbol	Specifications	Check
Solenoid valve	 CN-66 CN-68 CN-70 CN-88 CN-133 CN-137	24V 1A	※ Check resistance Normal : 15~25Ω (For terminal 1-2)
EPPR valve	 CN-75	700mA	※ Check resistance Normal : 15~25Ω (For terminal 1-2)
Resistor	 CN-47	45Ω 20W±5%	※Check resistance Normal : 45Ω
Speaker	 CN-23(LH) CN-24(RH)	20W	※ Check disconnection Normal : A few Ω
Switch (Locking type)	 CS-23 CS-27 CS-50 CS-52 CS-54 CS-82 CS-83 CS-84	24V 8A	※ Check contact Normal ON : 0 Ω (For terminal 1-5, 2-6) ∞ Ω (For terminal 5-7, 6-8) OFF : ∞ Ω (For terminal 1-5, 2-6) 0 Ω (For terminal 5-7, 6-8)
Accel dial	 CN-142	-	※ Check resist Normal : About 5kΩ (For terminal A-C) Normal : Abowt 5V (For terminal A-C) : 2~4.5V (For terminal C-B)

Part name	Symbol	Specifications	Check
Switch	 CS-67	24V 8A	※ Check disconnection Normal : 1.0 Ω ON : 0 Ω (For terminal 1-5, 2-6) ∞ Ω (For terminal 5-7, 6-8) OFF : ∞ Ω (For terminal 1-5, 6-8) 0 Ω (For terminal 5-7, 6-8)
Head lamp, Work lamp, Room lamp, Cab lamp	 CL-1 CL-3 CL-4 CL-5 CL-6 CL-8 CL-9	24V 70W (H3 Type) 24V 10W (Room lamp)	※ Check disconnection Normal : A few Ω
Beacon lamp	 CL-7	21V 70A (H1 type)	※ Check disconnection Normal : A few Ω
Fuel filler pump	 CN-61	24V 10A 35 l /min	※ Check resistance Normal : 1.0 Ω
Hour meter	 CN-48	16~32V	※ Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground
Horn	 CN-20 CN-25	DC22~28V 2A	※ Check operation Supply power(24V) to each terminal and connect ground.

Part name	Symbol	Specifications	Check
Safety switch 1	 CS-4	24V 15A (N.C TYPE)	※Check contact Normal : 0 Ω (For terminal 1-2) ∞ Ω (For terminal 1-3) Operating : ∞ Ω (For terminal 1-2) 0 Ω (For terminal 1-3)
Receiver dryer	 CN-29	24V 2.5A	※Check contact Normal : ∞ Ω
Radio & USB player	 CN-27	24V 2A	※Check voltage 20~25V (For terminal 10-14, 11-14)
Washer pump	 CN-22	24V 3.8A	※Check contact Normal : 10.7 Ω (For terminal 1-2)
Wiper motor	 CN-21	24V 2A	※Check disconnection Normal : 7 Ω (For terminal 2-6)
DC/DC Converter	 CN-138	12V 3A	24V(A-B) 12V (B-C)

Part name	Symbol	Specifications	Check
Cigar lighter	 CL-2	24V 5A 1.4W	※ Check coil resistance Normal : About 1MΩ ※ Check contact Normal : ∞ Ω Operating time : 5~15sec
Alternator	 CN-74	24V 55A	※ Check contact Normal : 0 Ω (For terminal B+-I) Normal : 24~27.5V
Starter	 CN-45	Delco Remy 28MT 24V	※ Check contact Normal : 0.1 Ω
Travel alarm	 CN-81	24V 0.5A	※ Check contact Normal : 5.2 Ω
Aircon compressor	 CN-28	24V 79W	※ Check contact Normal : 13.4 Ω
Start relay	 CR-23	24V 300A	※ Check contact Normal : 0.94 Ω (For terminal 1-2)

Part name	Symbol	Specifications	Check
Blower motor		24V 9.5A	※Check resistance Normal : 2.5 Ω (For terminal 1-2)
Aircon resistor		-	※Check resistance Normal : 1.12 Ω (For terminal 4-2) 2.07 Ω (For terminal 2-3) 3.17 Ω (For terminal 3-1)
Duct sensor		1˚C OFF 4˚C ON	※Check resistance Normal : 0 Ω (For terminal 1-2), the atmosphere temp : Over 4˚C
Switch (Door, wiper cut, safety sw 2)	 CS-1 CS-20 CS-53	24V 2W	※Check resistance Normal : About 5M Ω
Switch (Power max, one touch decel, horn, breaker)	 CS-5 CS-19 CS-26 CS-29	24V 6A	※Check resistance Normal : ∞ Ω
Master switch	 CS-74	Continuous : 180AMPS Rush : 1000AMPS	※ Check disconnection Normal : About 0 Ω

Part name	Symbol	Specifications	Check
Resistor	 CN-98 CN-99	4W	※ Check resistance A-B : 120 Ω
Fusible link	 CN-60 CN95	60A	※ Check disconnection Normal : 0 Ω (Connect ring terminal and check resist between terminal 1 and 2)
Socket	 CN-139	12V 10A	-

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

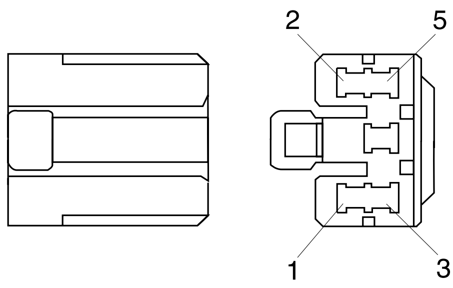
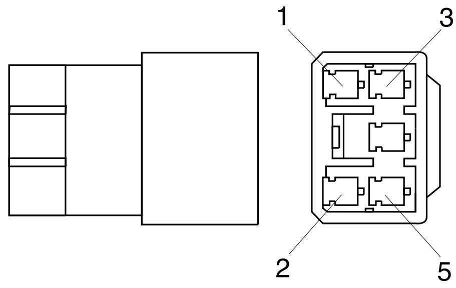
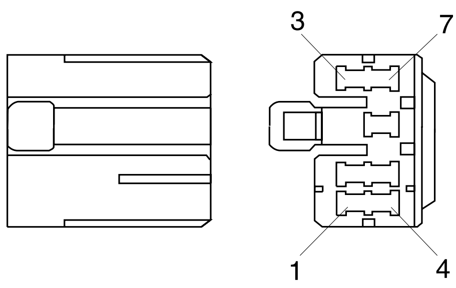
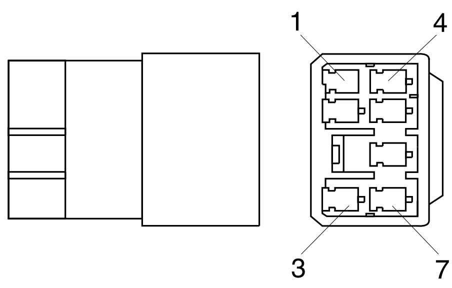
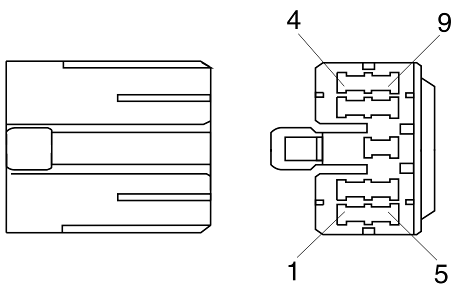
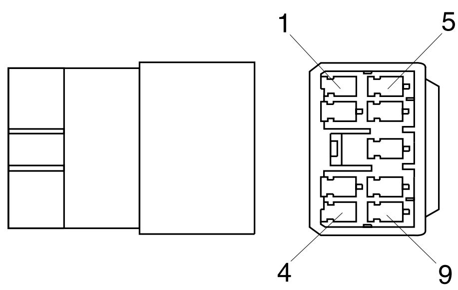
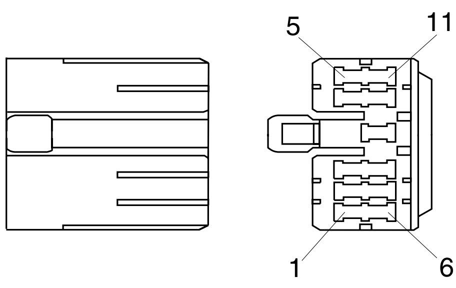
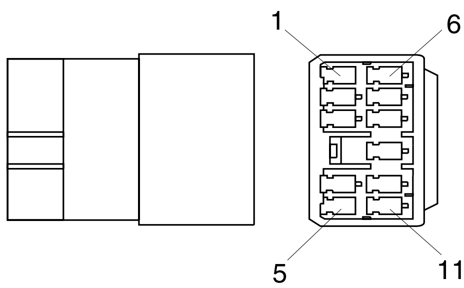
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	6	I/conn(Engine harness-Frame harness)	S816-006002	S816-106002
CN-2	AMP	15	I/conn(Engine harness-Frame harness)	2-85262-1	368301-1
CN-3	AMP	8	I/conn(Engine harness-Frame harness)	S816-008002	S816-108002
CN-4	AMP	8	I/conn(Frame harness-Console harness LH)	S816-008002	S816-108002
CN-5	AMP	15	I/conn(Frame harness-Side harness RH)	2-85262-1	368301-1
CN-6	AMP	12	I/conn(Frame harness-Side harness RH)	S816-012002	S816-112002
CN-7	AMP	15	I/conn(Frame harness-Console harness RH)	2-85262-1	368301-1
CN-8	AMP	12	I/conn(Frame harness-Console harness RH)	S816-012002	S816-112002
CN-9	AMP	8	I/conn(Frame harness-Console harness RH)	S816-008002	S816-108002
CN-10	DEUTSCH	12	I/conn(Frame harness-Cab harness)	DT06S-12S	DT04-12P
CN-11	DEUTSCH	8	I/conn(Frame harness-Aircon harness)	DT06-8S	-
CN-12	DEUTSCH	2	I/conn(Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P
CN-14	DEUTSCH	31	I/conn(Engine harness-Engine)	HD36-24-31SE	-
CN-16	AMP	6	Emergency engine speed control	S816-006002	S816-106002
CN-17	DEUTSCH	8	I/conn(Side harness RH-Wiper harness)	DT06-8S-EP06	DT04-8P
CN-19	AMP	2	Emergency MCU connector	S816-002002	-
CN-20	MOLEX	2	Horn	35825-0211	-
CN-21	AMP	6	Wiper motor	925276-0	-
CN-22	KET	2	Washer tank	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	MOLEX	2	Horn	35825-0211	-
CN-27	AMP	14	Radio & USB player	173852	-
CN-28	MWP	1	Aircon compressor	NMWP01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse box	21N8-20041	-
CN-45	RING-TERM	-	Starter	S820-108000	-
CN-47	FASTEN	2	Resistor	S810-002202	-
CN-47A	FASTEN	2	Resistor	-	S810-102202
CN-48	-	1	Hour meter	GP890469	-
CN-50	AMP	36	MCU	3441111-1	-
CN-51	AMP	36	MCU	3441111-1	-
CN-56	DEUTSCH	4	Cluster	-	DT04-4P-E004
CN-60	YAZAKI	2	Fusible link	21N4-01320	7122-4125-50
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	-

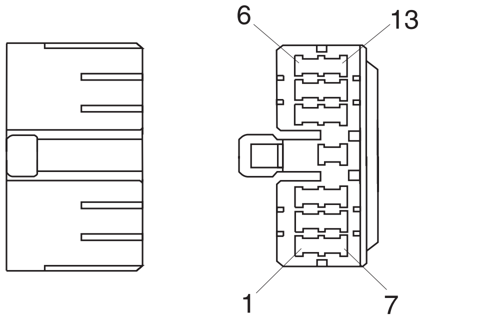
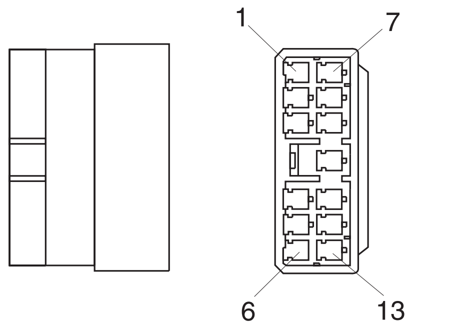
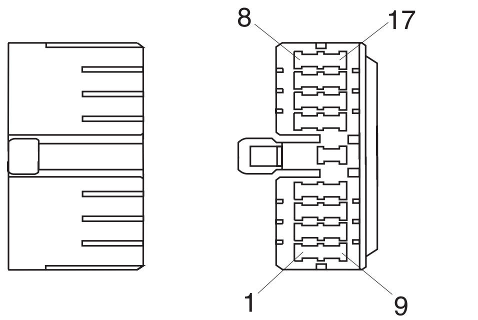
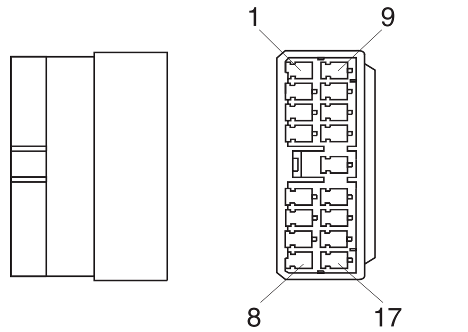
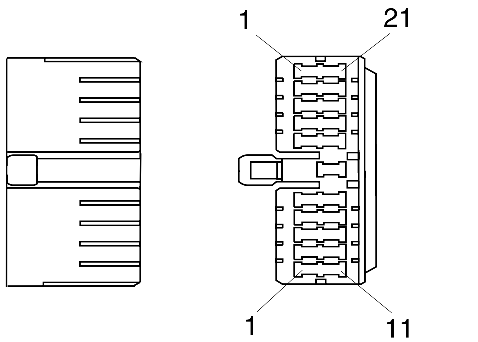
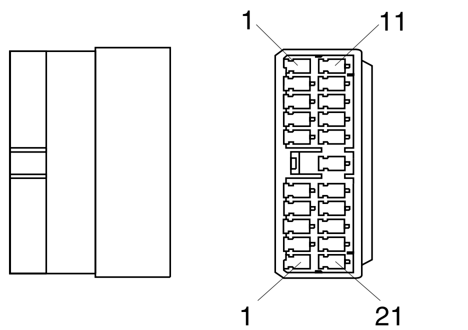
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	DT04-2P-E005
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-70	DEUTSCH	2	Travel solenoid	DT06-2S-EP06	-
CN-74	AMP	4	Alternator "I" term	12186568	-
CN-75	AMP	2	EPPR valve	S816-002002	-
CN-80	RING-TERM	-	Glow	S820-306000	-
CN-81	DEUTSCH	2	Travel buzzer	DT06-2S-EP06	-
CN-83	WWP	2	AC condensor fan	PB625-02027	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-91	DEUTSCH	50	ECM	DRC26-50S-01	-
CN-92	SWP	1	Emergency engine starting connector	S814-001100	S814-101100
CN-95	KET	2	Fusible link	21N4-01311	S813-130200
CN-98	DEUTSCH	3	Registor	DT06-3S-EP06	-
CN-116	PA	17	Switch panel	S811-017002	-
CN-125	AMP	4	GPS	S816-004002	S816-104002
CN-126	DEUTSCH	4	RS 232 connector	DT06-4S-EP06	DT04-4P-E005
CN-133	DEUTSCH	2	Max flow solenoid	DT06-2S-EP06	-
CN-137	DEUTSCH	2	Boom prioity solenoid	DT06-2S-EP06	-
CN-138	DEUTSCH	3	DC/DC converter	DT06-3S-P012	-
CN-139	DEUTSCH	2	12V socket	-	DT04-2P-E004
CN-140	DEUTSCH	2	Quick clamp	DT06-2S-EP06	DT04-2P-E005
CN-141	AMP	13	Wiper motor controller	172498-1	-
CN-142	DEUTSCH	3	Accel dial	DT06-3S-EP012	-
CN-143	AMP	12	Radio & USB player(With remocon)	S816-002002	-
CN-144	AMP	12	Remocon-radio & USB player	174045-2	-
CN-147	PACKARD	2	Fuel heater	1530-0027	1530-0002
CN-148	DEUTSCH	3	Data link	DT06-3S-EP06	DT04-3P-E004
· Relay					
CR-1	RING-TERM	-	Battery relay	-	S820-208002
CR-13	KET	5	Head lamp relay	MG 640927	-
CR-23	KET	2	Start relay	S814-002001	S814-102001
CR-24	RING-TERM	-	Preheater relay	S820-306000	-
CR-33	KET	5	AC condensor fan	MG 640927	-
CR-46	KET	5	Fuel heater relay	MG 640927	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014004	-
CS-2	SWP	6	Start key switch	S814-006000	-
CS-4	DEUTSCH	3	Safety switch 1	DT06-3S-P012	-
CS-5	DEUTSCH	1	Horn switch	-	DT04-2P-E004

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-19	DEUTSCH	2	One touch decel	DT06-2S	DT04-2P-E004
CS-20	AMP	1	Safety switch 2	S822-014002	-
CS-23	SWF	10	Beacon lamp switch	SWF 593757	-
CS-26	DEUTSCH	1	Breaker switch	DT06-2S-P012	-
CS-27	SWF	10	Breaker switch	SWF 593757	-
CS-29	DEUTSCH	2	Power max switch	DT06-2S-P012	-
CS-50	SWF	10	Overload switch	SWF 593757	-
CS-52	SWF	10	Econo switch	SWF 593757	-
CS-53	SHUR	1	Wiper cut switch	S822-014002	-
CS-54	SWF	10	Econo switch	SWF 593757	-
CS-67	SWF	10	Quick clamp switch	SWF 593757	-
CS-74	AMP	2	Master switch	S813-030201	-
CS-82	SWF		Seat heater switch	SWF 593757	
CS-83	SWF		Spear switch	SWF 593757	-
CS-84	SWF		Fuel warmer switch	SWF 593757	-
· Light					
CL-1	KET	2	Room lamp	MG 610392	-
CL-2	AMP	1	Cigar light	S822-014002	-
CL-3	AMP	2	Head lamp	S814-002000	-
CL-4	AMP	2	Head lamp	S814-002000	-
CL-5	DEUTSCH	2	Work lamp-LH	-	DT04-2P
CL-6	DEUTSCH	2	Work lamp-RH	-	DT04-2P
CL-7	SHUR	1	Beacon lamp	S822-014004	S822-114004
CL-8	DEUTSCH	2	Cab light-LH	DT04-2S	DT04-2P-E005
CL-9	DEUTSCH	2	Cab light-RH	DT04-2S	DT04-2P-E005
· Sensor, sendor					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel sender	DT06-2S-EP06	-
CD-6	DEUTSCH	3	Travel pressure switch	DT06-2S-EP06	-
CD-7	DEUTSCH	3	Working pressure switch	DT06-2S-EP06	-
CD-10	RING-TERM	-	Air cleaner switch	S820-104002	-
CD-31	DEUTSCH	2	Overload pressure switch	DT06-2S-EP06	DT04-2P-E005
CD-32	DEUTSCH	3	Boom up pressure switch	DT06-3S-EP06	-
CD-42	DEUTSCH	3	Pump pressure 1	DT06-3S-EP06	-
CD-43	DEUTSCH	3	Pump pressure 2	DT06-3S-EP06	-
CD-44	DEUTSCH	3	Pump pressure 3	DT06-3S-EP06	-
CD-70	DEUTSCH	3	N1 pressure switch	DT06-3S-EP06	-

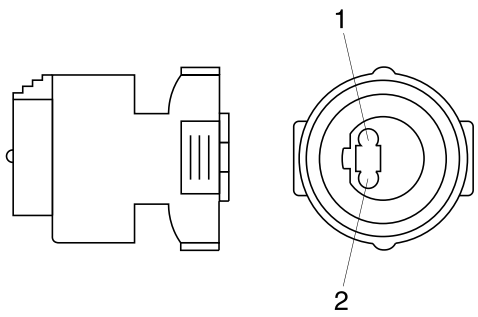
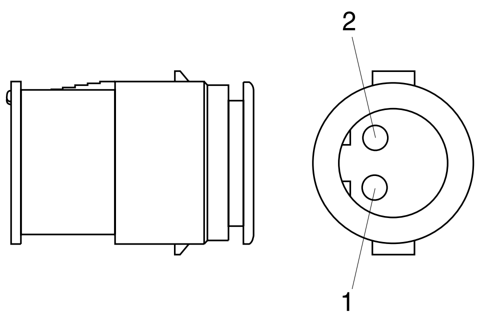
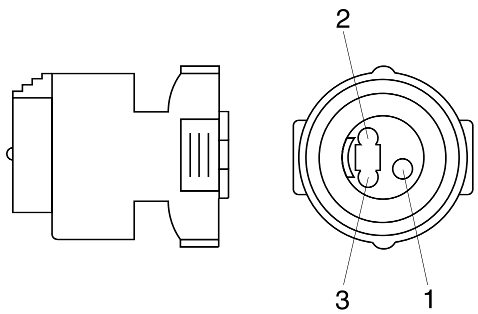
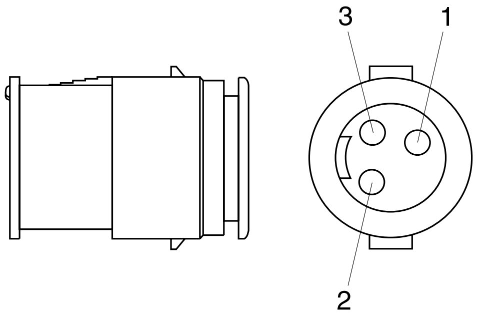
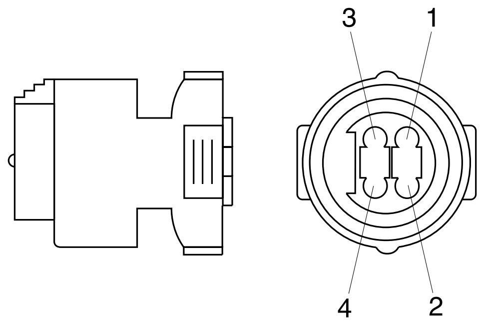
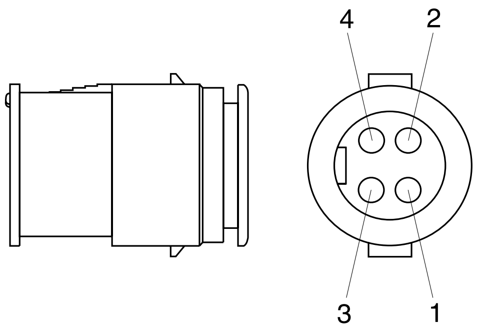
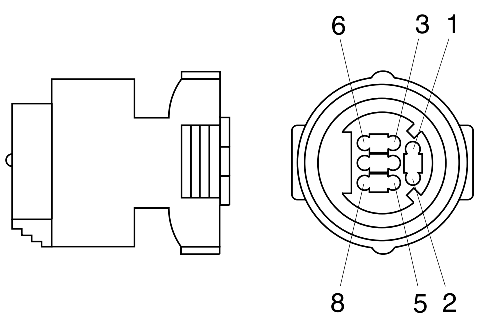
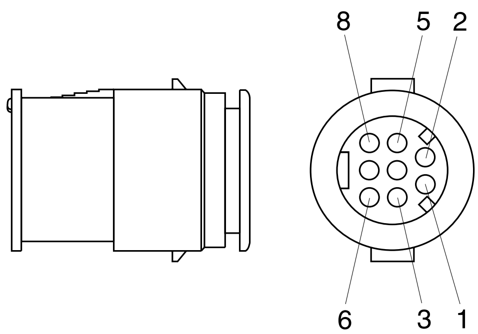
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

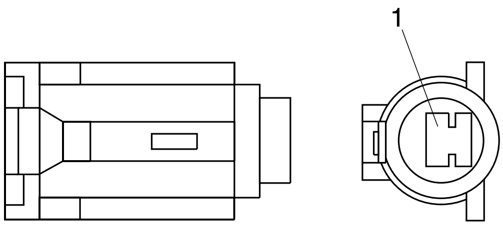
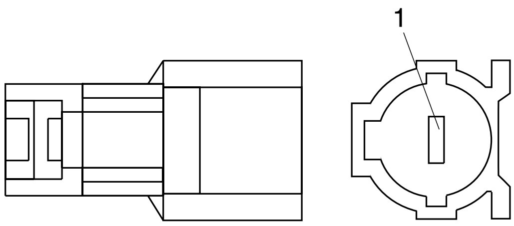
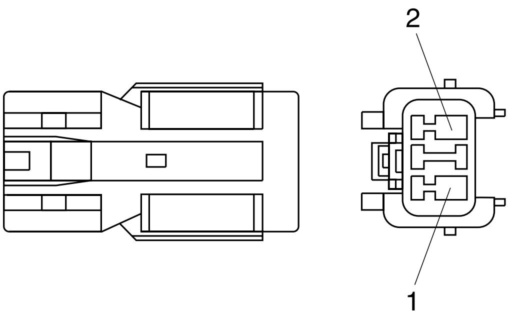
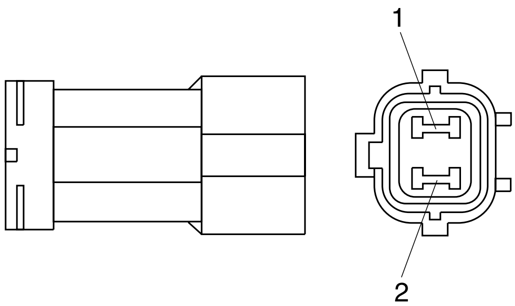
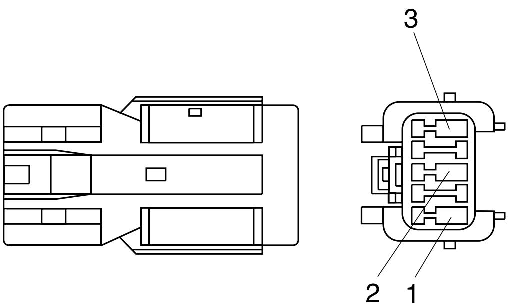
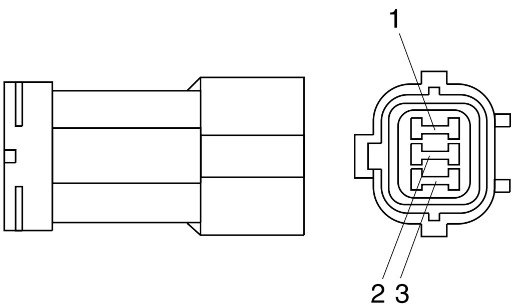
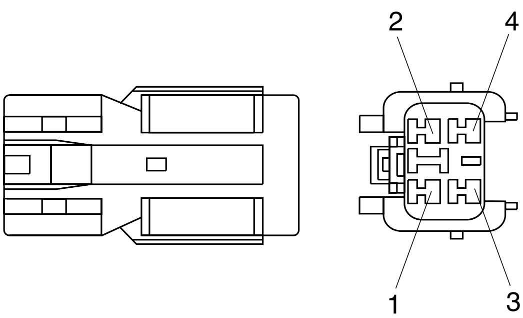
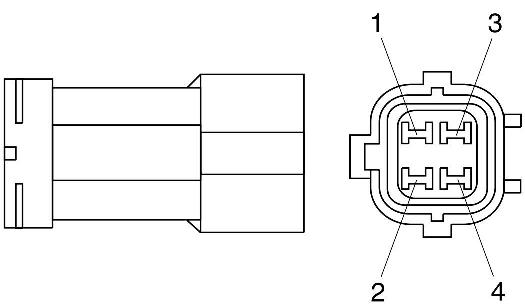
No. of pin	Receptacle connector(Female)	Plug connector(Male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

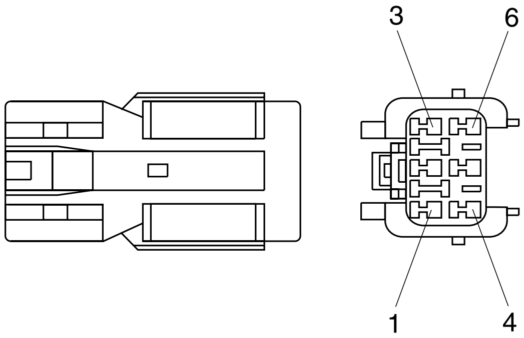
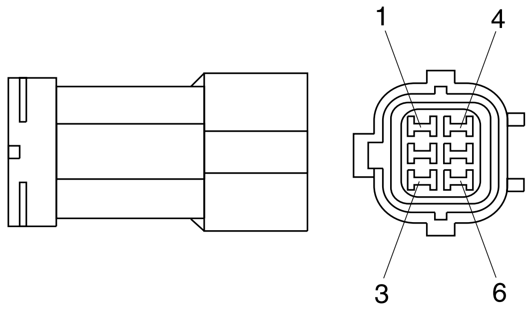
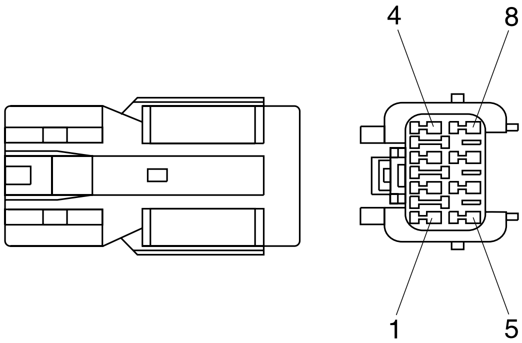
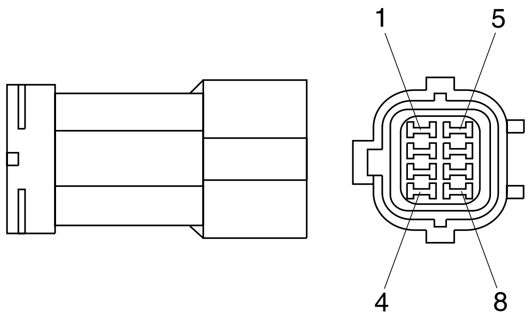
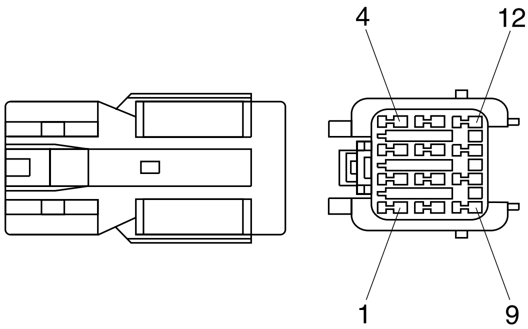
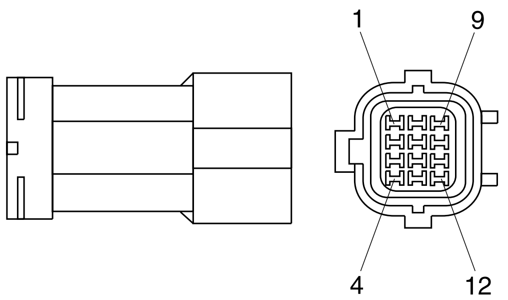
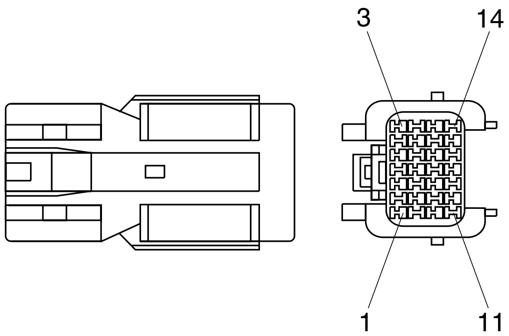
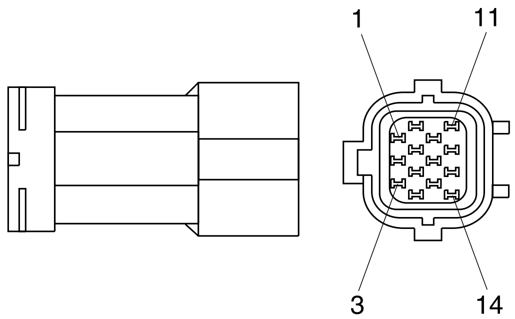
No. of pin	Receptacle connector(Female)	Plug connector(Male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) AMP J TYPE CONNECTOR

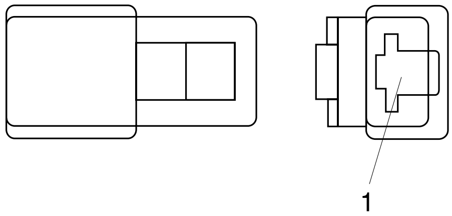
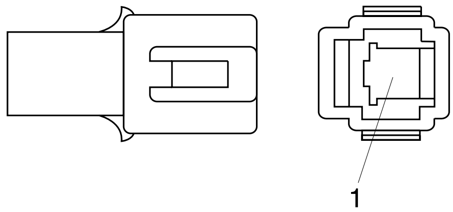
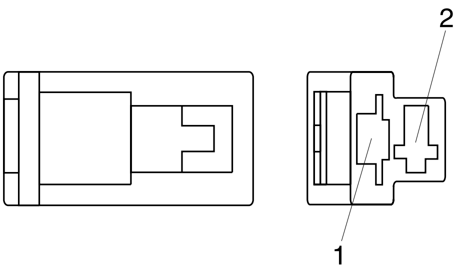
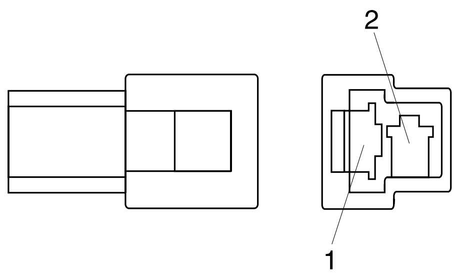
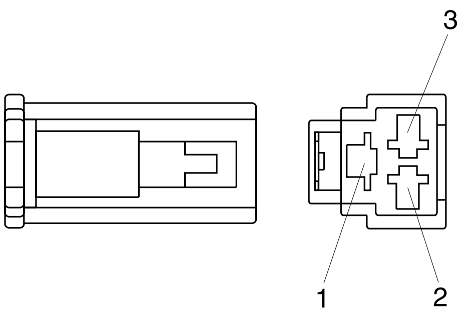
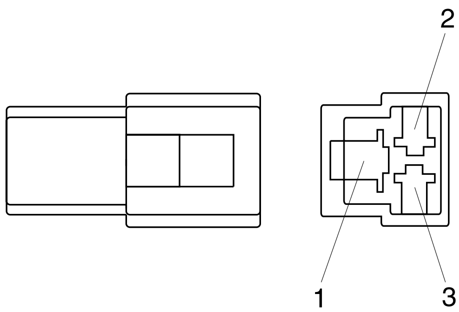
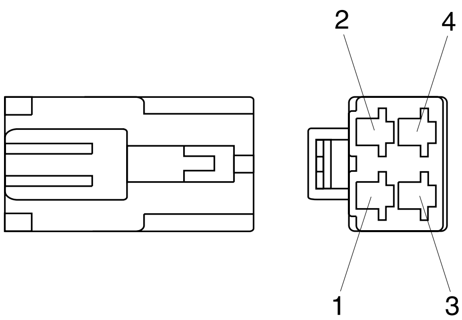
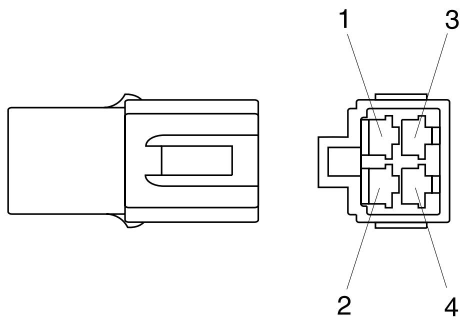
No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

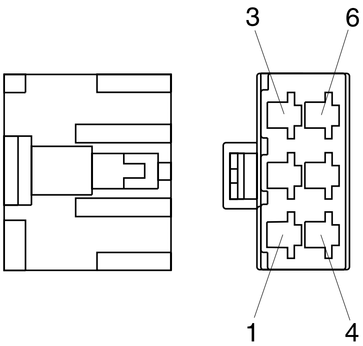
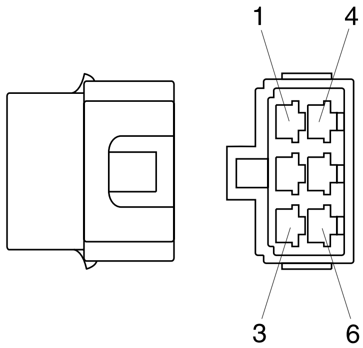
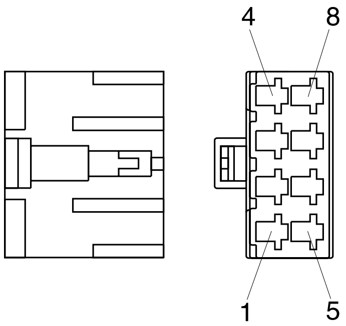
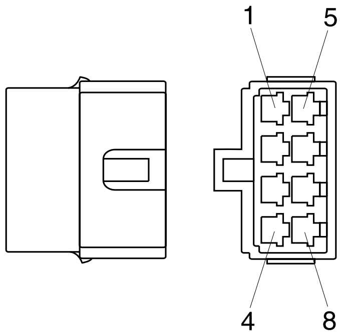
3) SWP TYPE CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
1	 S814-001000	 S814-101000
2	 S814-002000	 S814-102000
3	 S814-003000	 S814-103000
4	 S814-004000	 S814-104000

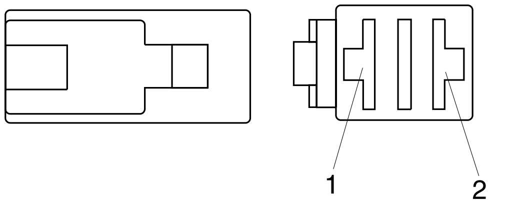
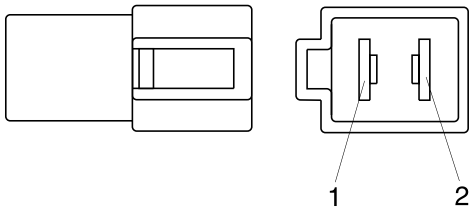
No. of pin	Receptacle connector(Female)	Plug connector(Male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

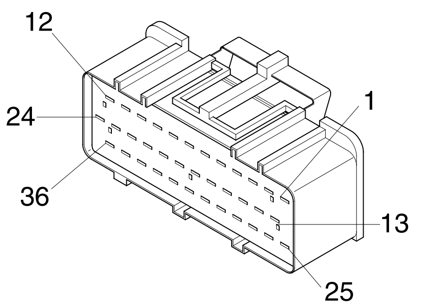
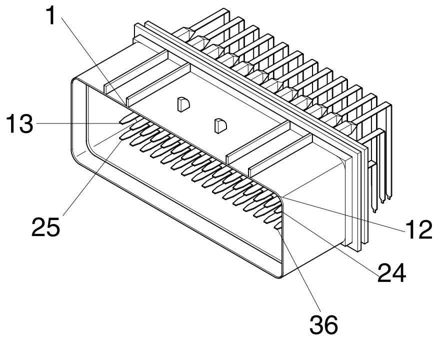
No. of pin	Receptacle connector(Female)	Plug connector(Male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

No. of pin	Receptacle connector(Female)	Plug connector(Male)
6	 S810-006202	 S810-106202
8	 S810-008202	 S810-108202

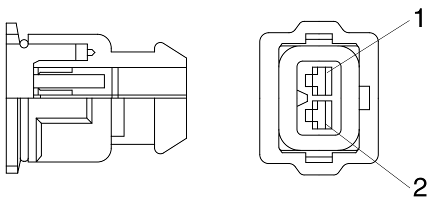
5) 375 FASTEN TYPE CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 S810-002402	 S810-102402

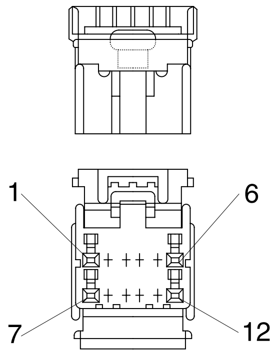
6) AMP ECONOSEAL CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
36	 344111-1	 344108-1

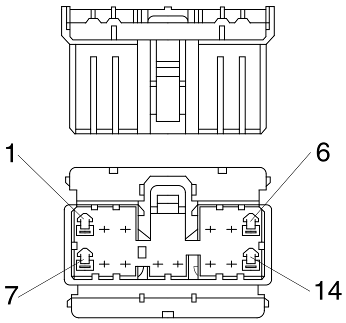
7) AMP TIMER CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 85202-1	

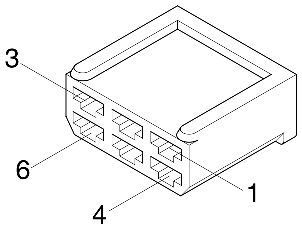
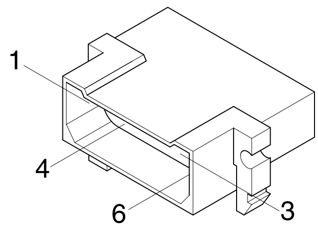
8) AMP 040 MULTILOCK CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
12	 174045-2	

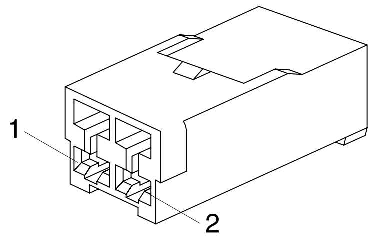
9) AMP 070 MULTILOCK CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
14	 173852	

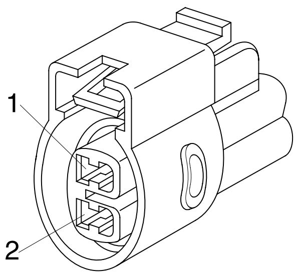
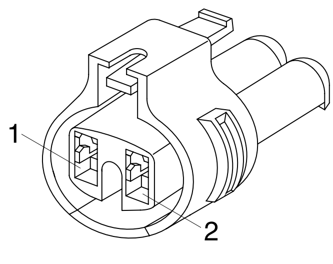
10) AMP FASTIN - FASTON CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
6	 925276-0	 480003-9

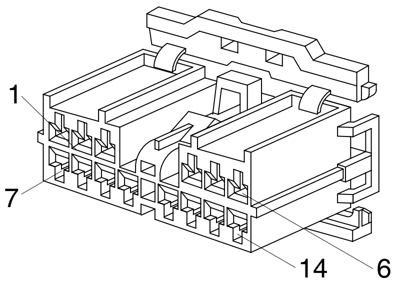
11) KET 090 CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 MG610070	

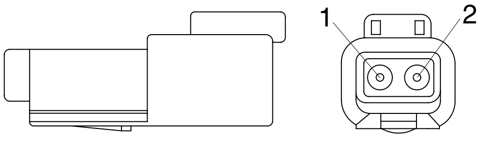
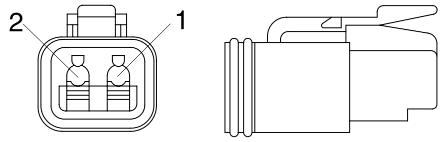
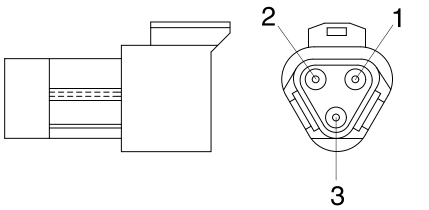
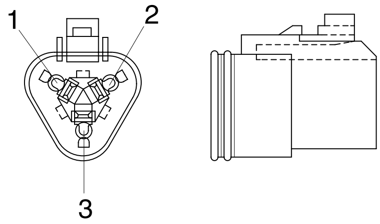
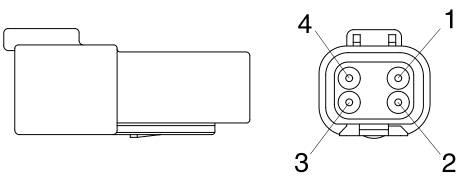
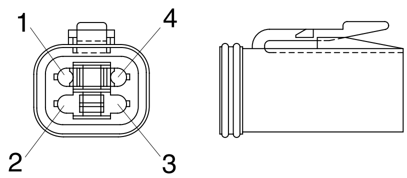
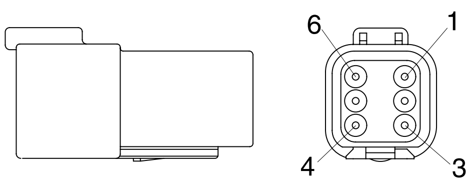
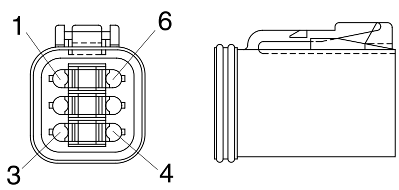
12) KET 090 WP CONNECTORS

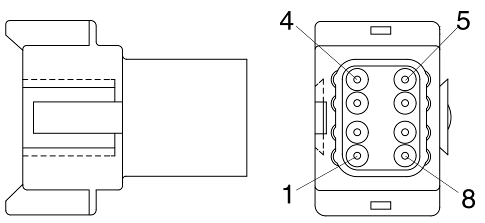
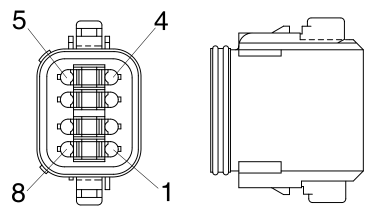
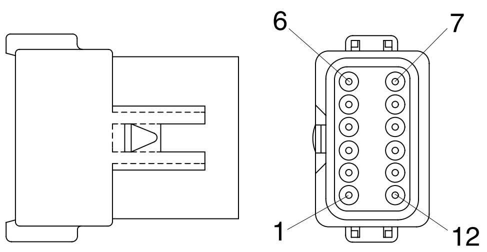
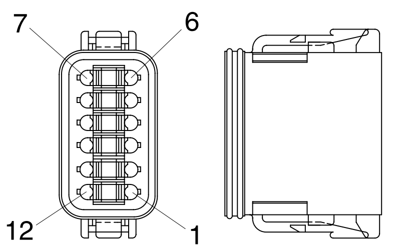
No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 MG640605	
2	 MG640795	

13) KET SDL CONNECTOR

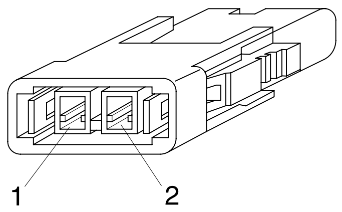
No. of pin	Receptacle connector(Female)	Plug connector(Male)
14	 MG610406	

14) DEUTSCH DT CONNECTORS

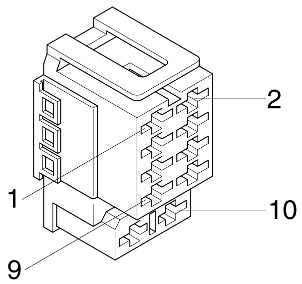
No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P
6	 DT06-6S	 DT04-6P

No. of pin	Receptacle connector(Female)	Plug connector(Male)
8	 DT06-8S	 DT04-8P
12	 DT06-12S	 DT04-12P

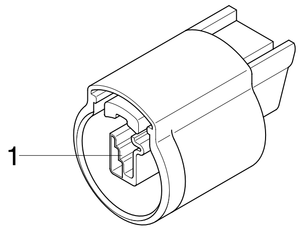
15) MOLEX 2CKTS CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 35215-0200	

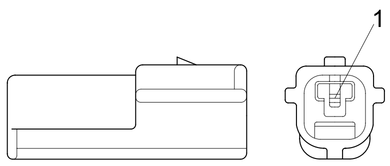
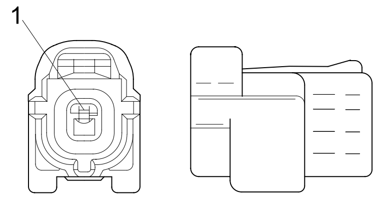
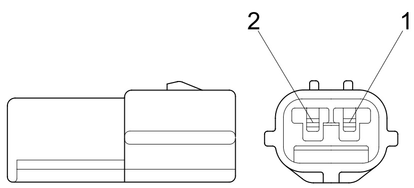
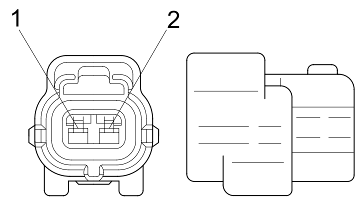
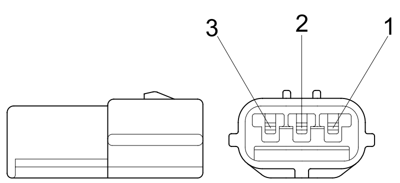
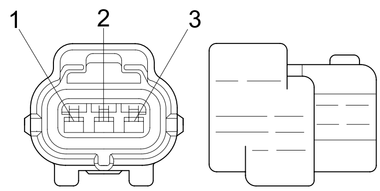
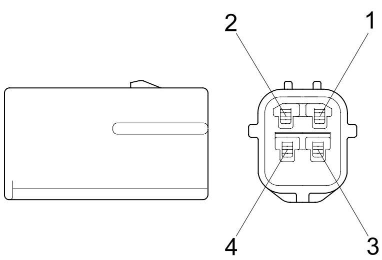
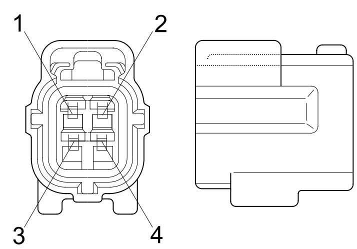
16) ITT SWF CONNECTOR

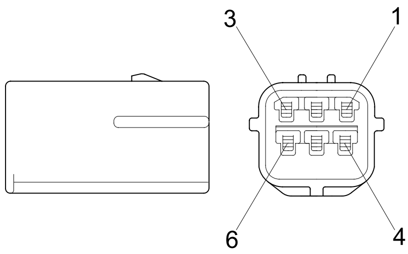
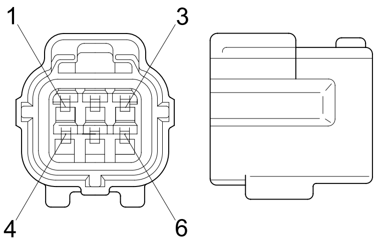
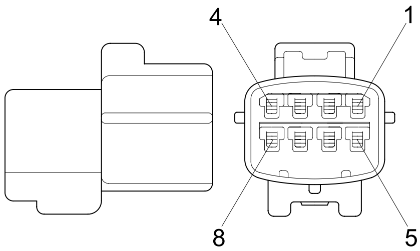
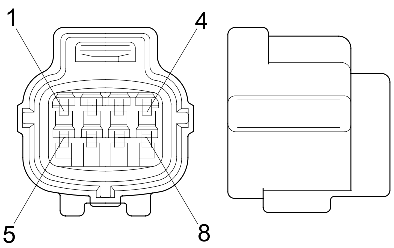
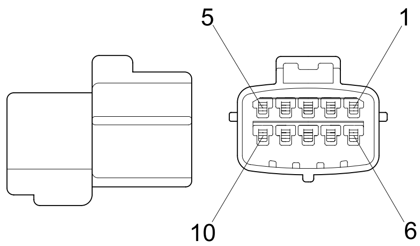
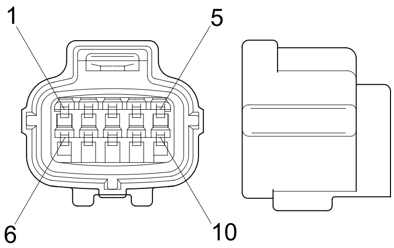
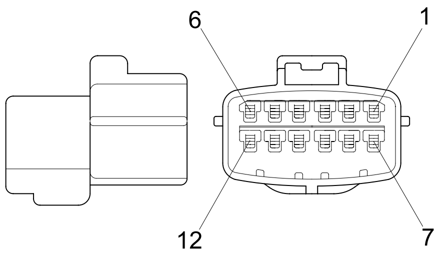
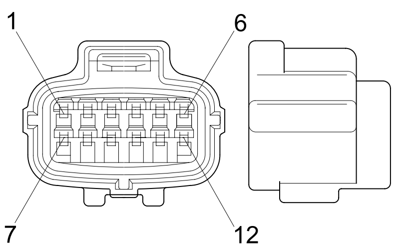
No. of pin	Receptacle connector(Female)	Plug connector(Male)
10	 SWF593757	

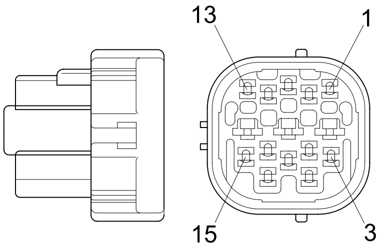
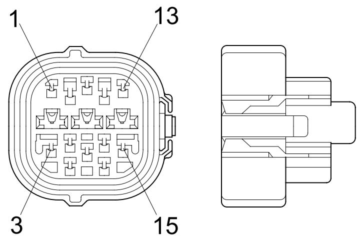
17) MWP NMWP CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
1	 NMWP01F-B	

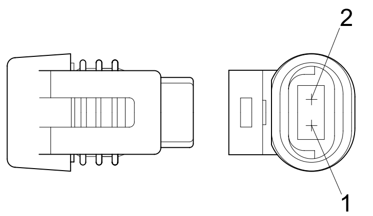
18) AMP ECONOSEAL J TYPE CONNECTORS

No. of pin	Receptacle connector(Female)	Plug connector(Male)
1	 S816-001002	 S816-101002
2	 S816-002002	 S816-102002
3	 S816-003002	 S816-103002
4	 S816-004002	 S816-104002

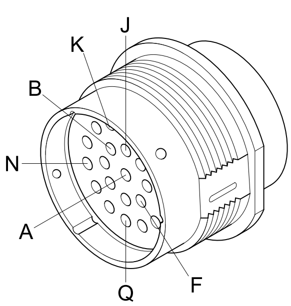
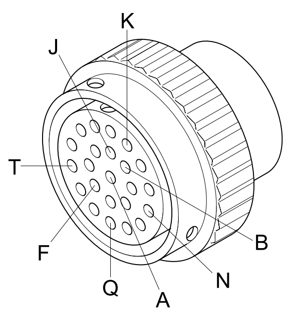
No. of pin	Receptacle connector(Female)	Plug connector(Male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

No. of pin	Receptacle connector(Female)	Plug connector(Male)
15	 368301-1	 2-85262-1

19) METRI-PACK TYPE CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 12040753	

20) DEUTSCH HD30 CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
23	 HD36-24-23SN	 HD34-24-23PN

SECTION 5 MECHATRONICS SYSTEM

SECTION 5 MECHATRONICS SYSTEM

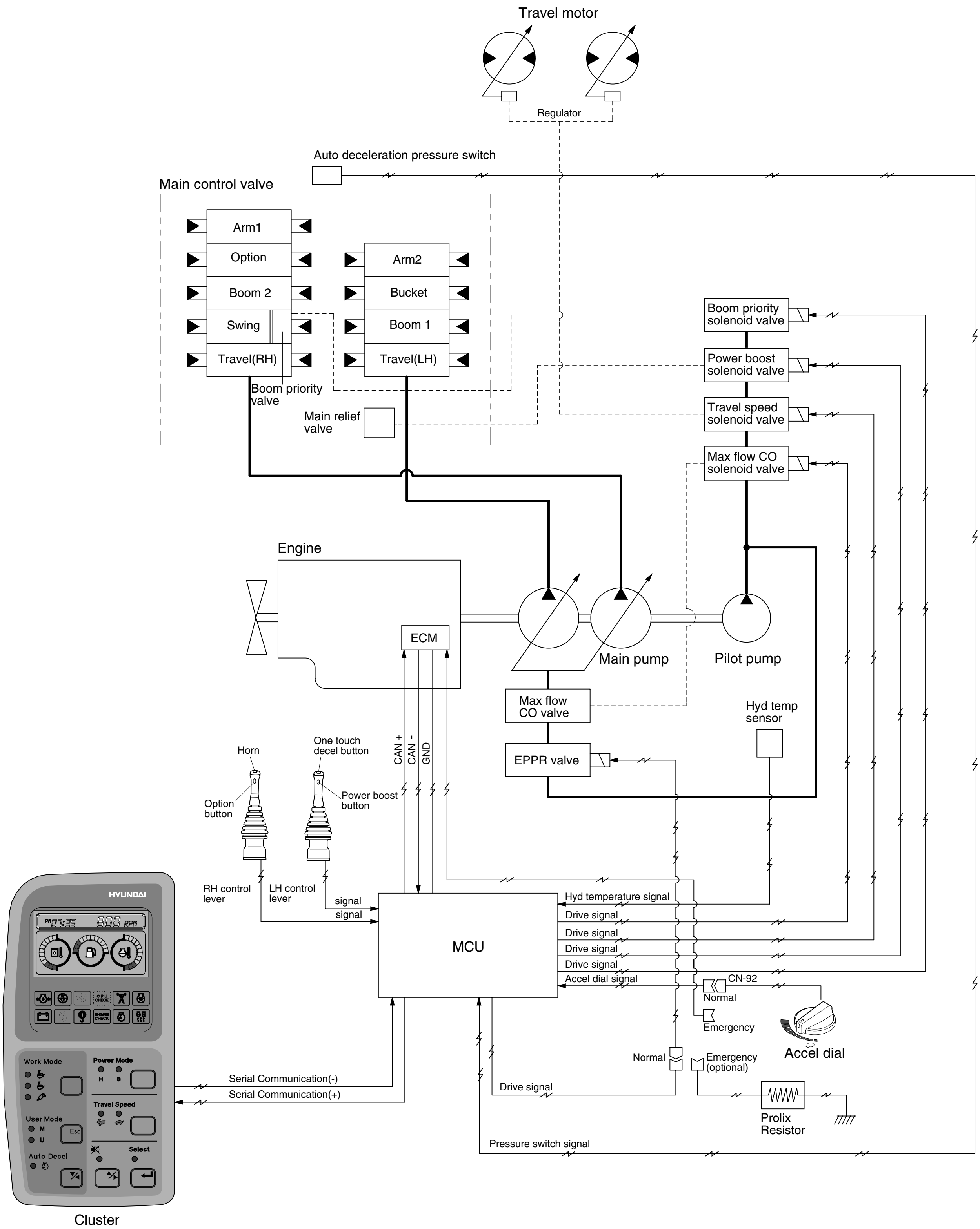
GROUP 1 OUTLINE

The NEW CAPO(Computer Aided Power Optimization) system controls engine and pump mutual power at an optimum and less fuel consuming state for the selected work by mode selection, auto-deceleration, power boost function, etc. It monitors machine conditions, for instance, engine speed, coolant temperature, hydraulic oil temperature, and hydraulic oil pressure, etc.

It consists for a MCU, a cluster, an electronic control module (ECM), an EPPR valve, and other components. The MCU and the cluster protect themselves from over-current and high voltage input, and diagnose malfunctions caused by short or open circuit in electric system, and display error codes on the cluster.

- NEW CAPO SYSTEM
  - Mode selection system
    - Engine speed control system
    - Pump flow control system
    - Work mode selection
    - User mode system(M, U)
  - Auto deceleration system
  - Power boost system
  - Travel speed control system
    - Travel speed control system
  - Automatic warming up system
  - Engine overheat prevention system
  - Max flow control system
  - Anti-restart system
  - Self-diagnostic system
    - Controller & cluster protection
    - Open-short diagnosis & error code display
    - ECM Fault code display
  - Machine monitoring system
    - Machine condition monitoring
    - Electric signal monitoring
  - One touch deceleration system
  - Boom priority system

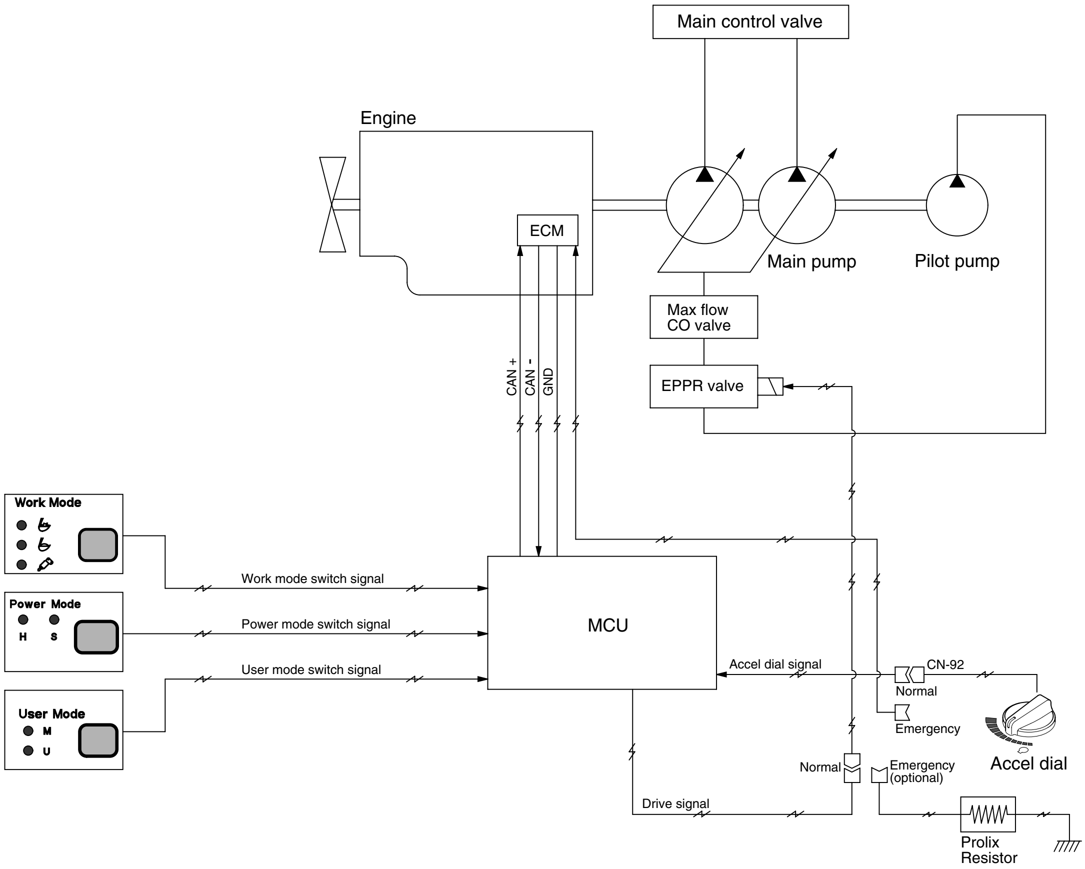
SYSTEM DIAGRAM



51075MS01

GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



51075MS02

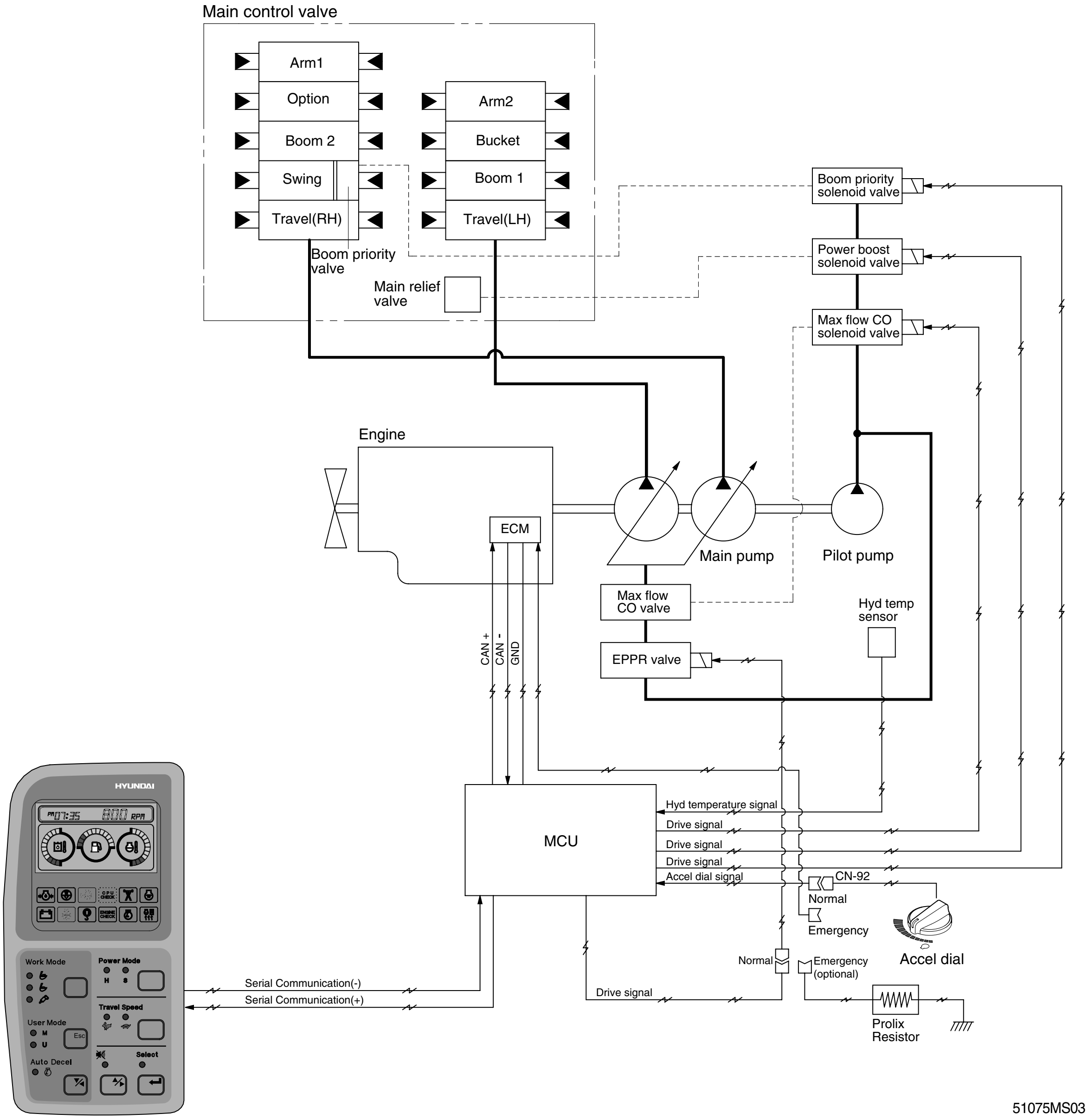
Mode selection system(Micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.

The combination of 2 power modes(H, S) and accel dial position(10 set) makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

Mode	Application	Power set (%)	Engine rpm		Power shift by EPPR valve	
			Unload	Load	Current (mA)	Pressure (kgf/cm^2)
M	High power	95	1750±50	1800	360±30	12
H	Standard power	85	1700±50	1750	360±30	12
S	Light power	70	1650±50	1700	360±30	12
AUTO DECEL	Engine deceleration	-	1000±100	-	700±30	38
One touch decel	Engine quick deceleration	-	800±100	-	700±30	38
KEY START	Key switch start position	-	800±100	-	700±30	38

2. WORK MODE SELECTION SYSTEM

3 work modes can be selected for the optional work speed of the machine operation.



1) HEAVY DUTY WORK MODE

The boom priority solenoid is activated to make the boom operation speed faster.

2) GENERAL WORK MODE

When key switch is turned ON, this mode is selected and swing operation speed is faster than heavy duty work mode.

3) BREAKER OPERATION MODE

It sets the pump flow to the optimal operation of breaker by activating the max flow cut-off solenoid.

Work mode	Boom priority solenoid	Max flow cut-off solenoid
Heavy duty	ON	OFF
General	OFF	OFF
Breaker	OFF	ON

3. USER MODE SELECTION SYSTEM

An operator can change the engine and pump power and memorize it for his preference.

Mode	Operation
U	High idle rpm, auto decel rpm EPPR pressure can be modulated and memorized separately

HOW TO MODULATE THE MEMORY SET

21074OP03G

1) Each memory mode has a initial set which are mid-range of max engine speed, auto decel rpm, and EPPR valve input current. When you select M or U, cluster LCD displays.

2) To change the engine high idle speed, press the USER mode switch and SELECT switch at the same time and then ACCEL blinks at 0.5 seconds interval.
   - By pressing ▲ or ▼ switch, ▮ will increase or decrease.

3) To change DECEL rpm, press the USER mode switch and SELECT switch once more and then DECEL blinks at 0.5 seconds interval.
   - By pressing ▲ or ▼ switch, ▮ will increase or decrease.

4) To change EPPR current, press the USER mode switch and SELECT switch one more and then EPPR blinks at 0.5 seconds interval.
   - By pressing ▲ or ▼ switch, ▮ will increase or decrease.

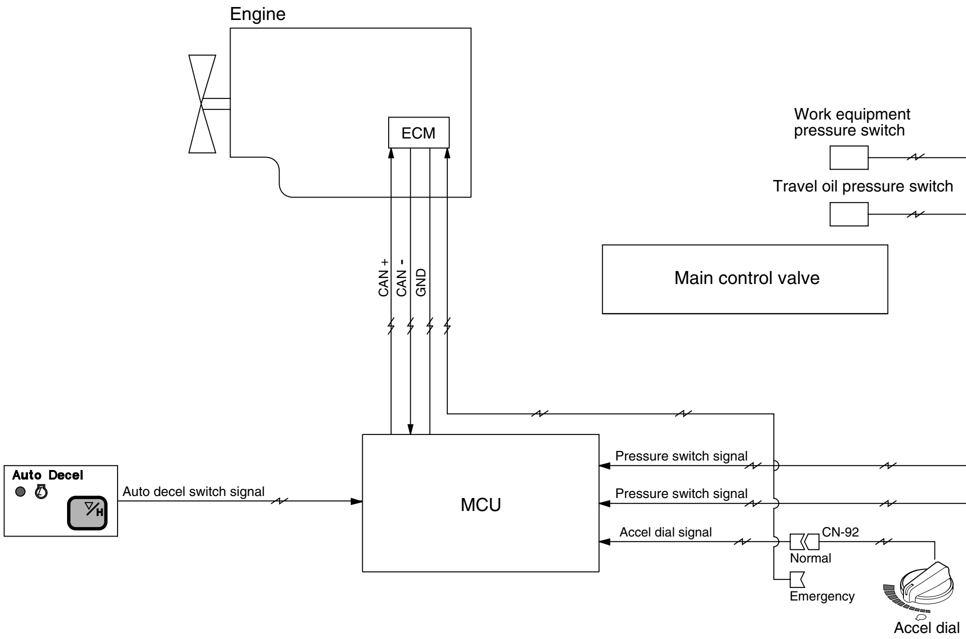
   · **LCD segment vs parameter setting**

Segment (▮)	ACCEL (rpm)	DECEL (rpm)	EPPR (mA)
1	1400	800	150
2	1450	850	200
3	1500	One touch decel low idle(900)	250
4	1550	950	300
5	1600	Decel rpm(1000)	350
6	1650	1050	400
7	1700	1100	450
8	1750	1150	500
9	1800	1200	550
10	1850	1250	600

5) To memorize the final setting, press the USER mode switch and SELECT switch one more time.

34075MS11

GROUP 3 AUTOMATIC DECELERATION SYSTEM

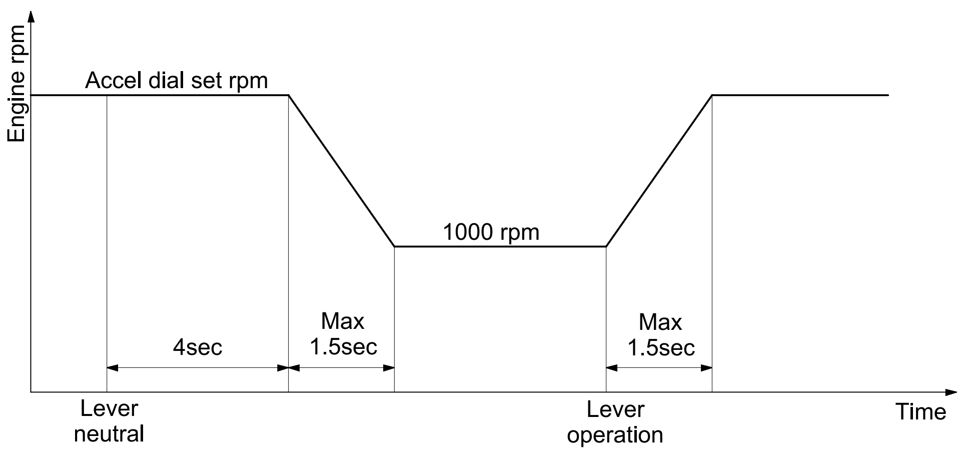


51075MS04

1. WHEN AUTO DECEL LAMP ON

If all the work equipment control levers including swing and travel levers are at neutral for at least 4 seconds, MCU transmits the throttle command to ECM to reduce the engine speed to 1000rpm. As the result of reducing the engine speed, fuel consumption and noise are effectively cut down during non-operation of the control levers.

When the Auto decel lamp is turned off by pressing the switch or any control lever is operated, the reduced engine speed rises upto the speed set before deceleration in a second.



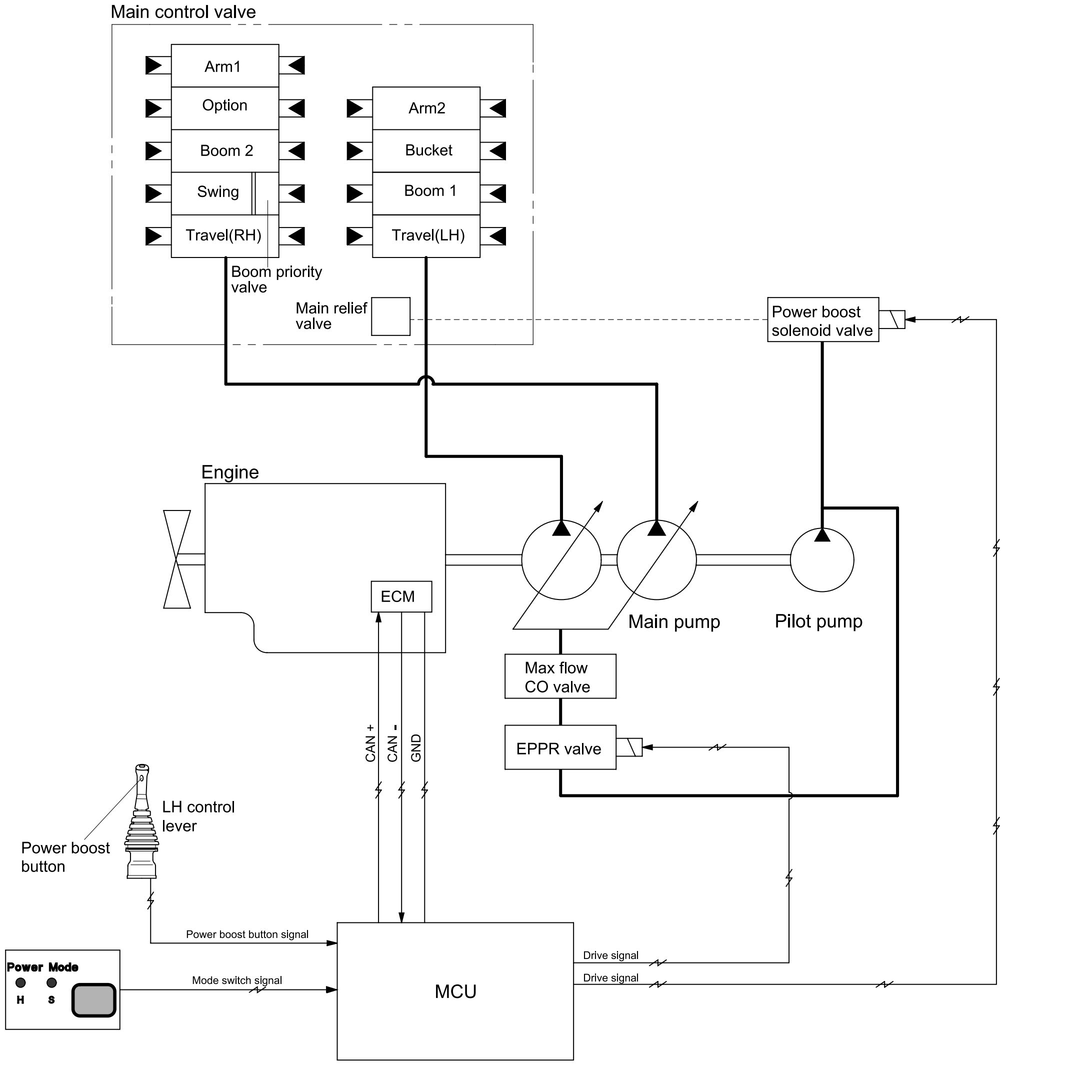
45075MS05

2. WHEN AUTO DECEL LAMP OFF

The engine speed can be set as desired using the engine speed switch, and even if the control levers are neutral, the engine speed is not reduced.

※ **Auto decel function can be activated when accel dial position is over 4.**

GROUP 4 POWER BOOST SYSTEM



51075MS04

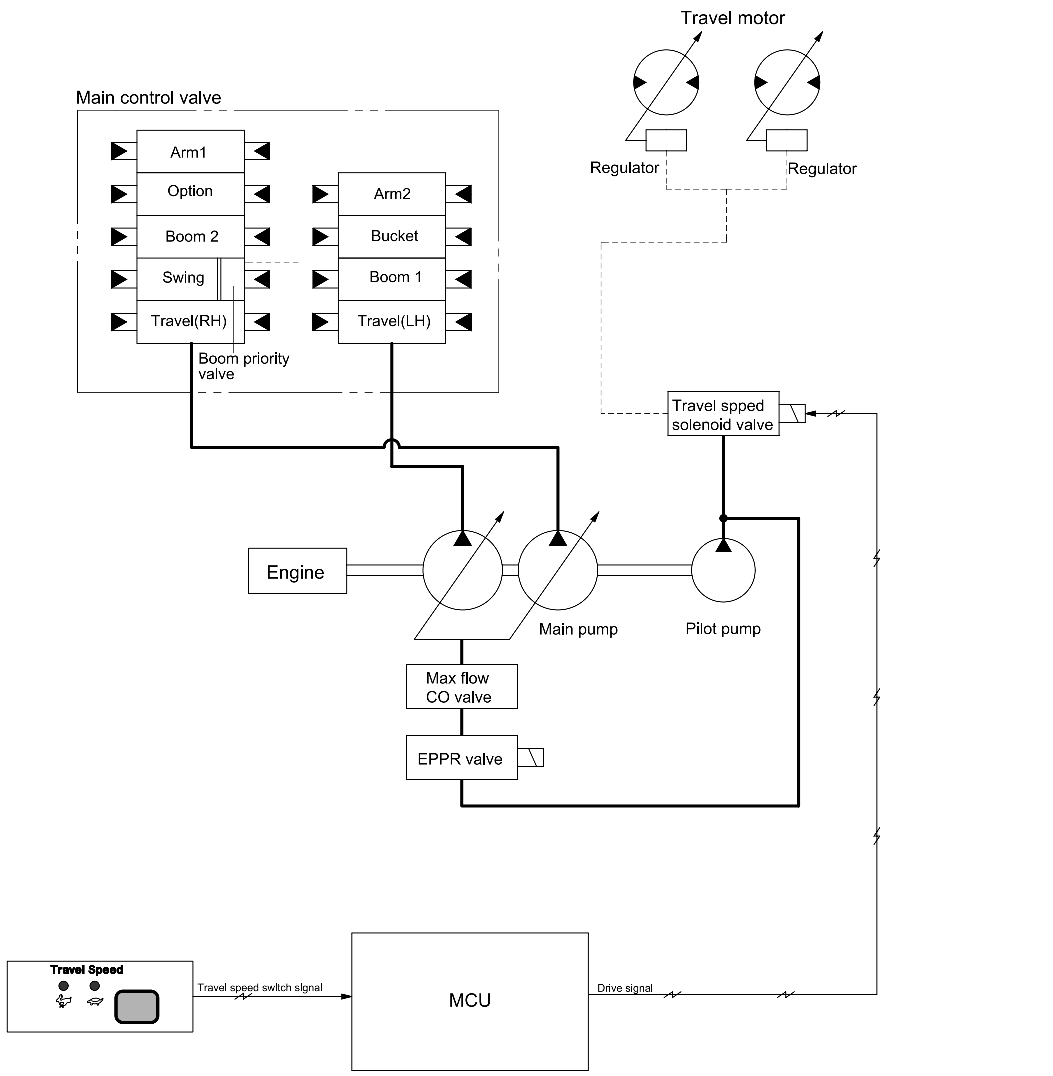
· When the power boost switch on the left control lever knob is pushed ON, the maximum digging power is increased by 10%.

· When the power set is at H or S and the power boost function is activated, the power boost solenoid valve pilot pressure raises the set pressure of the main relief valve to increase the digging power.

Description	Power boost switch	
	OFF	ON
Power set	H or S	H
Main relief valve set pressure	330kgf/cm^2	360kgf/cm^2
Time of operation	-	Even when pressed continuously, it is canceled after 8 sec.

※ Default - Power boolst solinoid valve : OFF

GROUP 5 TRAVEL SPEED CONTROL SYSTEM



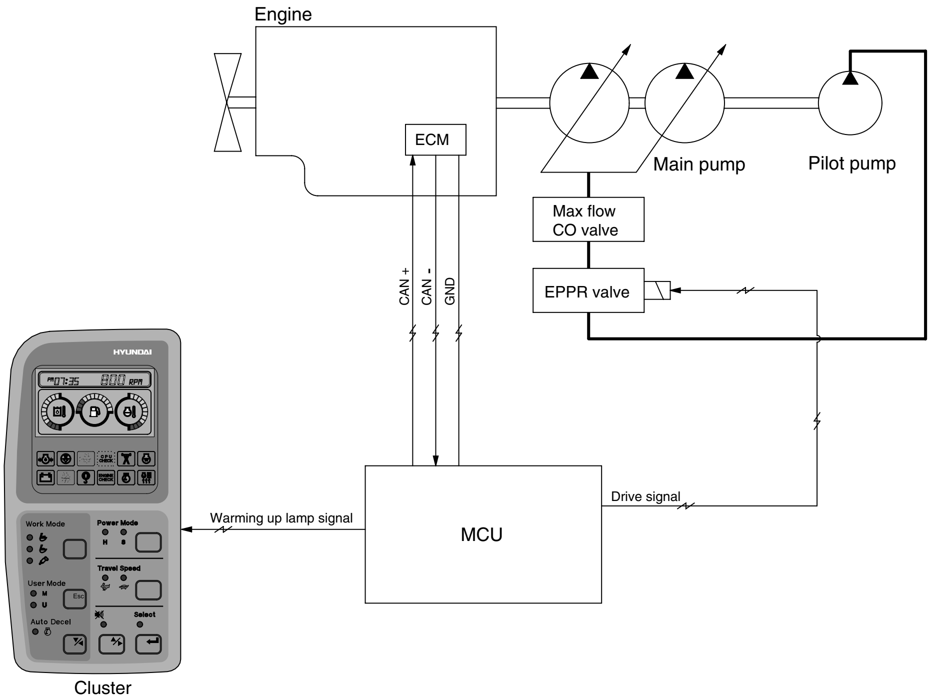
51075MS06

Travel speed can be switched manually by pressing the travel speed switch on the cluster.

Speed	Travel speed solenoid valve	Lamp on cluster	Operation
Lo	OFF	Turtle	Low speed, high driving torque in the travel motor
Hi	ON	Rabbit	High speed, low driving torque in the travel motor

※ Default : Turtle(Lo)

GROUP 6 AUTOMATIC WARMING UP FUNCTION



51075MS07

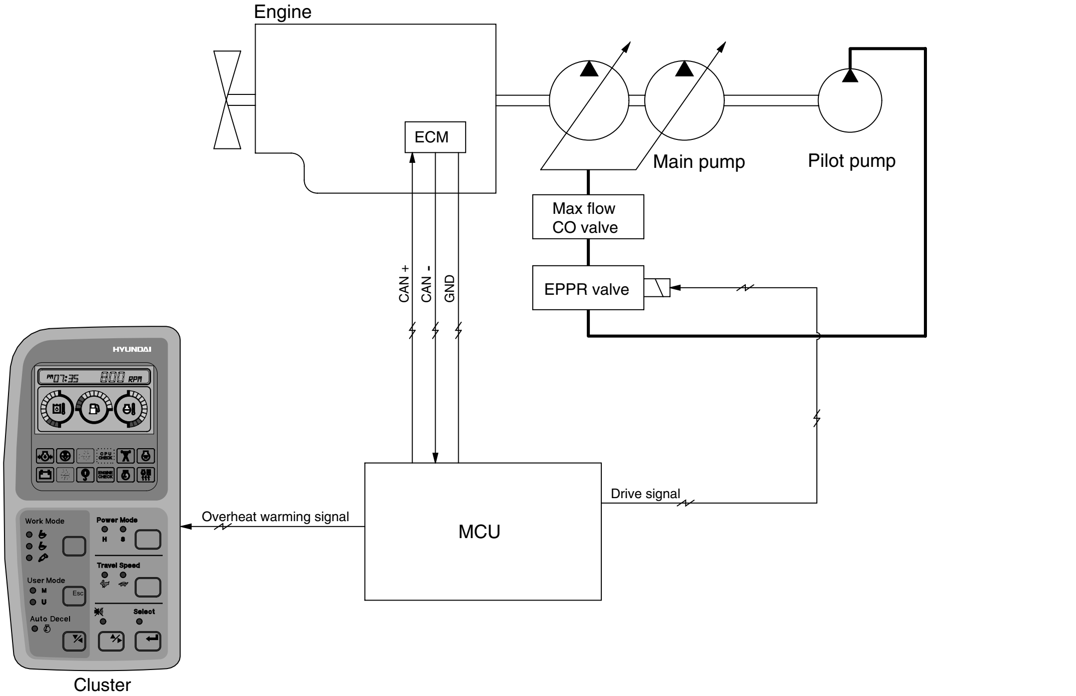
1. MCU receives engine coolant temperature from the ECM, and if the coolant temperature is less than 30℃, it increases the engine speed from key start rpm to 1000rpm. At this time the mode does not change.

2. In case of the coolant temperature increases up to 30℃, the engine speed is decreased to key start speed. And if an operator changes mode set during the warming up function, the MCU cancels the automatic warming up function.

3. LOGIC TABLE

Description	Condition	Function
Actuated	- Coolant temperature : Less than 30˚C (After engine run) - Accel dial position is under **3**	- Mode : Default(**S** mode) - Warming up time : 10 minutes(Max) - Warming up lamp : ON
Canceled	- Coolant temperature : Above 30˚C - Warming up time : Above 10 minutes - Changed mode set by operator - Increase engine speed by rotating accel dial clockwise ※ If any of the above conditions is applicable, the automatic warming up function is canceled	- Default mode - Default mode - Changed mode
Warming up lamp	- Coolant temperature : Above 30˚C	- Warming up lamp : OFF

GROUP 7 ENGINE OVERHEAT PREVENTION FUNCTION



51075MS08

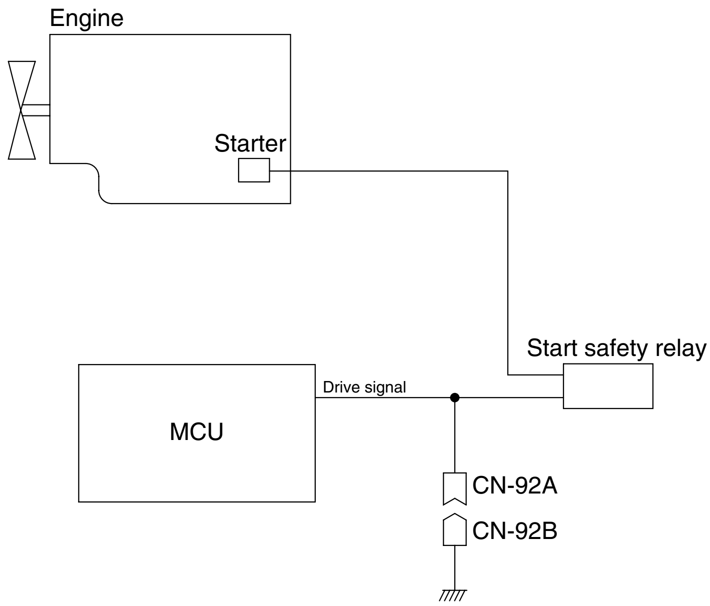
1. MCU receives engine coolant temperature from the ECM and when the engine coolant boils up to 110℃, it sends overheat warning signal to the cluster and decrease the engine speed same as accel dial **7** position.

2. If the coolant temperature drops less than 100℃, the MCU returns the mode to the mode set before. And if mode set is changed during the function, the MCU cancels the function.
   Even if the overheat prevention function is canceled by mode change, the overheat warning lamp turns OFF only when the coolant temperature is less than 100℃.

3. LOGIC TABLE

Description	Condition	Function
Actuated	- Coolant temperature : Above 110℃ - Accel dial set : Above **8**	- Engine rpm drop to accel dial 7 position - Overheat warning lamp & buzzer : ON
Canceled	- Coolant temperature : Less than 100℃ - Changed mode set by operator ※ If any of the above conditions is applicable, engine overheat prevention function is canceled	- Return to the mode and accel dial set before - Hold on the changed set
Overheat warning lamp	- Coolant temperature : Less than 100℃	- Overheat warning lamp : OFF

GROUP 8 ANTI-RESTART SYSTEM



51075MS10

1. ANTI-RESTART FUNCTION

After 10 seconds from the engine starts to run, MCU turns off the start safety relay to protect the starter from inadvertent restarting.

2. When a replacement or taking-off of the MCU is needed, connect CN-92a and CN-92b to ensure the engine start without the MCU.

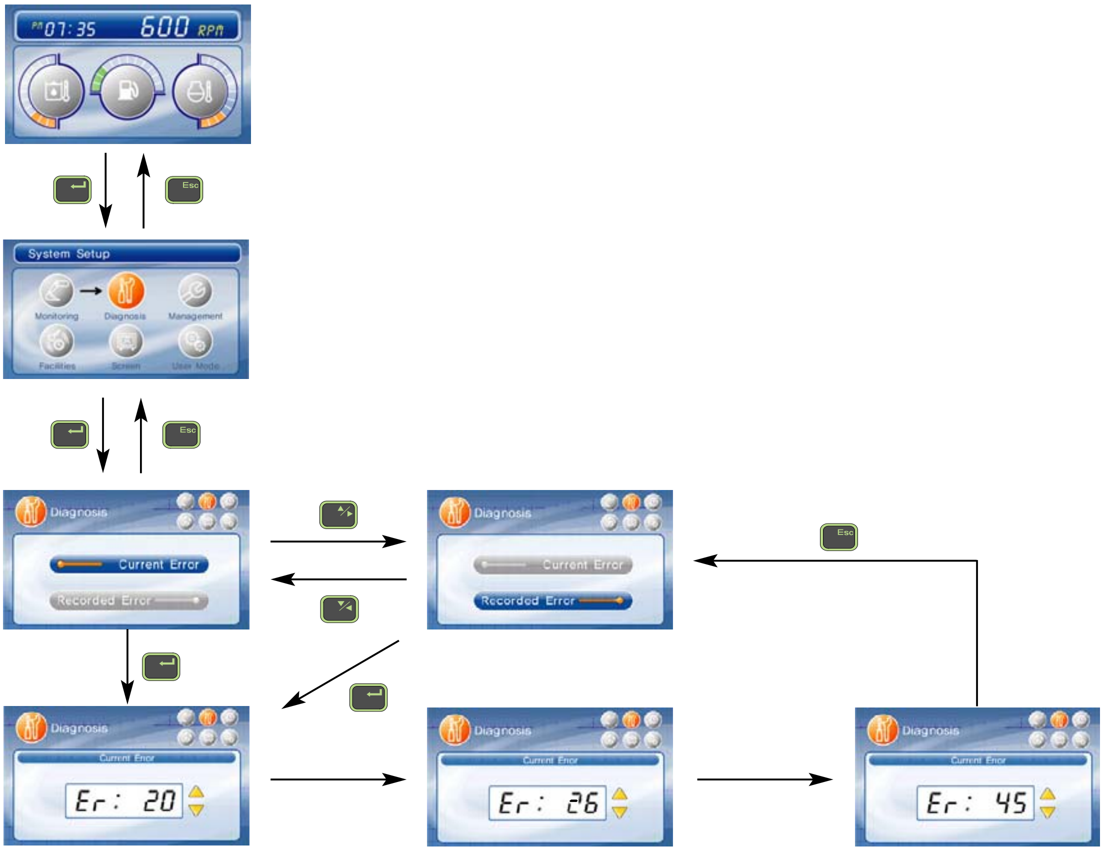
GROUP 9 SELF-DIAGNOSTIC SYSTEM

1. OUTLINE

When any abnormality occurs in the NEW CAPO system caused by electric parts malfunction and by open or short circuit, the MCU controller diagnoses the problem and sends the error codes to the cluster and also stores them in the memory.

The current or recorded error codes are displayed at the error display mode selected by touching **SELECT** switch 2 times while pressing **BUZZER STOP** switch.

2. CURRENT ERROR DISPLAY



3. ERROR CODES TABLE

Error code No.	Description
1	Short circuit in accel actuator system
2	Potentiometer circuit is shorted to Vcc(5V) or battery +
3	Short circuit in pump EPPR valve system
4	Short circuit in boom down EPPR valve system
5	Short circuit in travel speed solenoid system
6	Short circuit in power boost solenoid system
7	Short circuit in max flow solenoid system
10	Short circuit in hour-meter system
11	Accel dial circuit is shorted to Vcc(5V) or battery +
12	P1 pressure sensor circuit is shorted to power supply(24V) line
13	P2 pressure sensor circuit is shorted to power supply(24V) line
14	P3 pressure sensor circuit is shorted to power supply(24) line
15	Boom down pressure circuit is shorted to power supply(24V) line
16	Accel actuator circuit is open or shorted to ground
17	Potentiometer circuit is open or shorted to ground
18	Pump EPPR valve circuit is open or shorted to ground
19	Boom down EPPR valve circuit is open or shorted to ground
20	Travel speed solenoid circuit is open or shorted to ground
21	Power boost solenoid circuit is open or shorted to ground
22	Max flow solenoid circuit is open or shorted to ground
25	Hour-meter circuit is open or shorted to ground
26	Accel dial circuit is open or shorted to ground
27	P1 pressure sensor circuit is open or shorted to ground
28	P2 pressure sensor circuit is open or shorted to ground
29	P3 pressure sensor circuit is open or shorted to ground
30	Boom down pressure sensor circuit is open or shorted to ground
31	Engine preheater circuit is open or shorted to ground
32	Travel alarm buzzer circuit is open or shorted to ground
33	Alternator circuit is open or shorted to ground
34	Controller input voltage is below 18V
35	Controller input voltage is over 38V
36	Communication error with cluster
37	Engine speed sensor circuit is open or shorted to ground
38	Anti-restart relay circuit is open or shorted to ground
39	Accel actuator does not stop at a target position
40	There is more than 500rpm difference between target speed and actual speed

Error code No.	Description
41	Hydraulic oil temperature sensor circuit is shorted to ground
42	Fuel level sensor circuit is shorted to ground
43	Coolant temperature sensor circuit is shorted to ground
44	Boom up pressure sensor circuit is shorted to power supply(24V) line
45	Hydraulic oil temperature sensor circuit is open or shorted to battery +
46	Fuel level sensor circuit is open or shorted to battery +
47	Coolant temperature sensor circuit is open or shorted to battery +
48	Boom up pressure sensor circuit is open or shorted to ground
49	Engine preheater circuit is shorted to battery +
51	Boom priority solenoid circuit is open or shorted to ground
56	Travel alarm buzzer circuit is shorted to battery +
58	Boom priority solenoid circuit is shorted to battery +

4. ENGINE FAULT CODE INFORMATION (For QSM11)

Fault code No.	Reason	Effect(only when fault code is active)
111	Error internal to the ECM related to memory hardware failures or internal ECM voltage supply circuits.	Engine will not start.
115	No engine speed signal detected at both engine position sensor circuits.	Engine will die and will not start.
121	No engine speed signal detected from one of the engine position sensor circuits.	None on performance.
122	High voltage detected on the intake manifold pressure circuit.	Derate in power output of the engine.
123	Low voltage detected on the intake manifold pressure circuit.	Derate in power output of the engine.
131	High voltage detected at the throttle position signal circuit.	Severe derate(power and speed). Limp home power only.
132	Low voltage detected at the throttle position signal circuit.	Severe derate(power and speed). Limp home power only.
133	High voltage detected at the remote throttle position signal circuit.	None on performance if remote throttle is not used.
134	Low voltage detected at the remote throttle position signal circuit.	None on performance if remote throttle is not used.
135	High voltage detected at the oil pressure circuit.	No engine protection for oil pressure.
141	Low voltage detected at the oil pressure circuit.	No engine protection for oil pressure.
143	Oil pressure signal indicates oil pressure below the low oil pressure engine protection limit.	Progressive power and speed derate with increasing time after alert. If engine protection shutdown feature is enable, engine will shut down 30 seconds after red lamp starts flashing.
144	High voltage detected at the coolant temperature circuit.	Possible white smoke. Fan will stay on if controlled by the electronic control module (ECM). No engine protection for coolant temperature.
145	Low voltage detected at the coolant temperature circuit.	Possible white smoke. Fan will stay on if controlled by electronic control module (ECM). No engine protection for coolant temperature.
147	A frequency of less then 100Hz was detected at the frequency throttle signal pin of the actuator harness connector at the ECM.	Calibration dependent power and speed derate.
148	A frequency of more than 100Hz was detected at the frequency throttle signal pin of the actuator harness connector at the ECM.	Calibration dependent power and speed derate.
151	Coolant temperature signal indicates coolant temperature above 104˚ C(220˚F).	Progressive power derate with increasing time after alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red lamp starts flashing.
153	High voltage detected at the intake manifold temperature circuit.	Possible white smoke. Fan will stay on if controlled by electronic control module (ECM). No engine protection for coolant temperature.
154	Low voltage detected at the intake manifold temperature circuit.	Possible white smoke. Fan will stay on if controlled by electronic control module (ECM). No engine protection for coolant temperature.
155	Intake manifold temperature signal indicates temperature above 87.8˚ C(190˚F).	Progressive power derate with increasing time after alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red lamp starts flashing.
187	Low voltage detected on the ECM voltage supply line to some sensors(VSEN2 supply).	Engine will run derated. No engine protection for oil pressure and coolant level.

Fault code No.	Reason	Effect(only when fault code is active)
211	Additional machine diagnostic codes have been logged. Check other ECM's for diagnostic codes.	None on engine performance.
212	High voltage detected at the oil temperature circuit.	No engine protection for oil temperature.
213	Low voltage detected at the oil temperature circuit.	No engine protection for oil temperature.
214	Oil temperature signal indicates oil temperate above 123.9˚ C(225˚ F).	Progressive power derate with increasing time after alert. If engine protection shutdown feature is enabled, engine will shut down 30sec after the red lamp starts flashing.
219	Low oil level was detected in the Centinel™ makeup oil tank.	None on performance. Centinel™ deactivated.
221	High voltage detected at the ambient air pressure circuit.	Derate in power output of the engine.
222	Low voltage detected at the ambient air pressure circuit.	Derate in power output of the engine.
223	Incorrect voltage detected at the Centinal™ actuator circuit by the ECM.	None on performance. Centinel™ deactivated.
227	High voltage detected on the ECM voltage supply line to some sensors(VSEN2 supply).	Engine will run derated. No engine protection for oil pressure and coolant level.
234	Engine speed signal indicates engine speed is greater than 2730 rpm.	Fuel shutoff valve closes until engine speed falls to 2184 rpm.
235	Coolant level signal indicates coolant level is below the normal range.	Progressive power derate with increasing time after alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red lamp starts flashing.
237	Duty cycle of the throttle input signal to the primary or secondary engine for multiple unit synchronization is less than 3 percent or more than 97 percent.	All engines(primary and secondary) are shut down with increasing time after alert if hard-coupled. Only secondary engines are shut down with increasing time after alert if soft-coupled.
241	The ECM lost the vehicle speed signal.	Engine speed limited to maximum engine speed without vehicle speed sensor parameter value Cruise Control. Gear-Down Protection and Road Speed Governor will not work (automotive only).
242	Invalid or inappropriate vehicle speed signal detected. Signal indicates an intermittent connection or VSS tampering.	Engine speed limited to maximum engine speed without vehicle speed sensor parameter value Cruise Control. Gear-Down Protection and Road Speed Governor will not work (automotive only).
245	Less than 6 VDC detected at fan clutch circuit when on. Indicates an excessive current draw from the ECM or faulty ECM output circuit.	The fan may stay on at all times.
254	Less than 6 VDC detected at FSO circuit when on. Indicates an excessive current draw from the ECM or a faulty ECM output circuit.	The ECM turns off the FSO supply voltage. The engine will shut down.
255	Externally supplied voltage detected going to the fuel shutoff solenoid supply circuit.	None on performance. Fuel shutoff valve stays open.
285	The ECM expected information from a multiplexed device but did not receive it soon enough or did not receive it at all.	At least one multiplexed device will not operate properly.
286	The ECM expected info from a multiplexed device but only received a portion of the necessary information.	At least on multiplexed device will not operate properly.
287	The machine vehicle electronic control unit (VECU) detected a fault with its throttle pedal.	The engine will only idle.

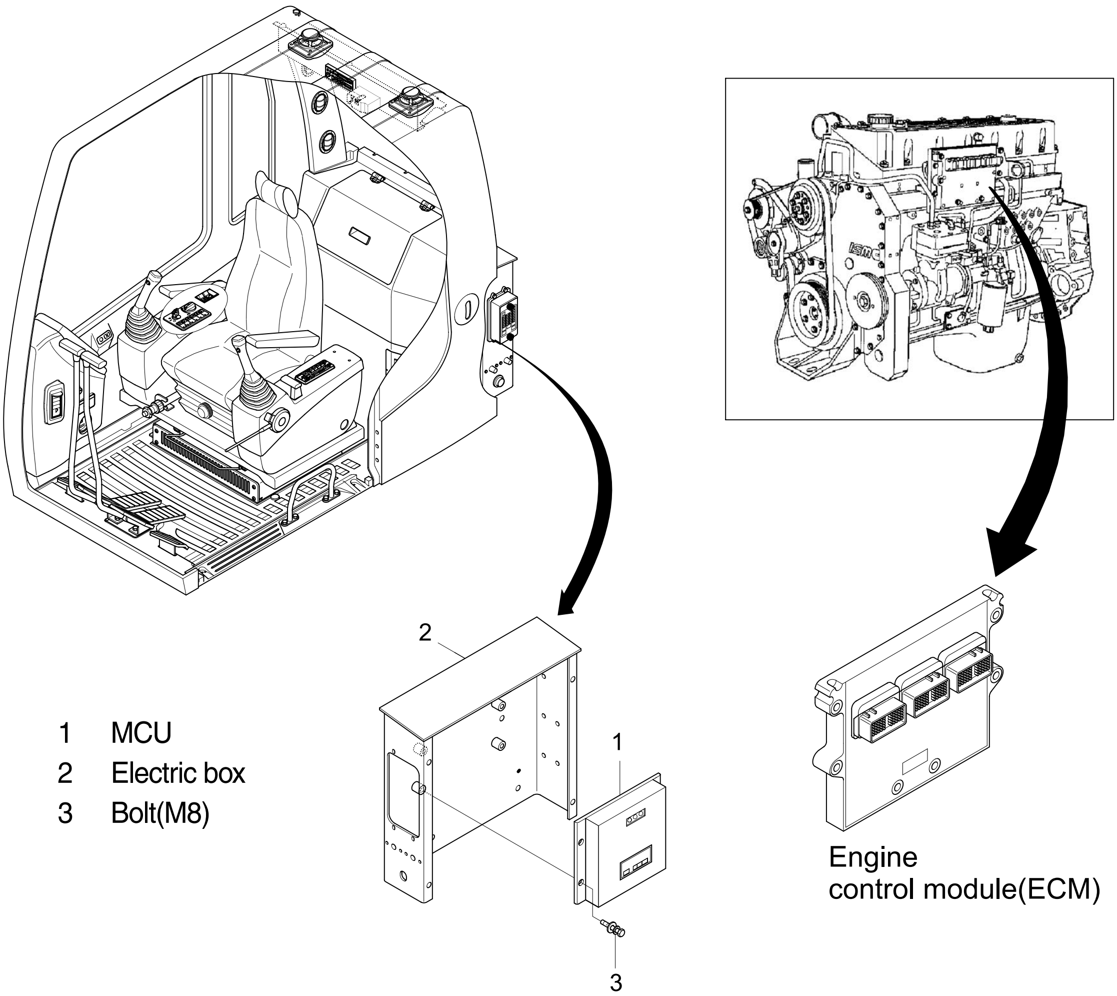
Fault code No.	Reason	Effect(only when fault code is active)
288	The machine vehicle electronic control unit (VECU) detected a fault with its remote throttle.	The engine will not respond to the remote throttle.
293	High voltage detected at the machine temperature sensor signal pin of the 31-pin machine connector.	No engine protection for machine temperature.
294	Low voltage detected at the machine temperature sensor signal pin of the 31-pin machine connector.	No engine protection for machine temperature.
295	An error in the ambient air pressure sensor signal was detected by the ECM.	Engine is derated to no air setting.
297	High voltage detected at the machine pressure sensor signal pin of the 31-pin machine connector.	No engine protection for machine pressure.
298	Low voltage detected at the machine pressure sensor signal pin of the 31-pin machine connector.	No engine protection for machine pressure.
299	Engine shutdown by device other than key switch before proper engine cool down resulting in filtered load factor above maximum shutdown threshold.	No action taken by the ECM.
311	Current detected at No.1 injector when voltage is turned off.	Current to injector is shut off.
312	Current detected at No.5 injector when voltage is turned off.	Current to injector is shut off.
313	Current detected at No.3 injector when the voltage is turned off	Current to injector is shut off.
314	Current detected at No 6 injector when the voltage is turned off.	Current to injector is shut off.
315	Current detected at No.2 injector when the voltage is turned off.	Current to injector is shut off.
319	Real time clock lost power.	None on performance. Data in the ECM will not have accurate time and date information.
321	Current detected at No.4 injector when the voltage is turned on.	Current to injector is shut off.
322	No current detected at No.1 injector when the voltage is turned on.	Current to injector is shut off.
323	No current detected at No.5 injector when the voltage is turned on.	Current to injector is shut off.
324	No current detected at No.3 injector when the voltage is turned on.	Current to injector is shut off.
325	No current detected at No.6 injector when the voltage is turned on.	Current to injector is shut off.
331	No current detected at No.2 injector when the voltage is turned on.	Current to injector is shut off.
332	No current detected at No.4 injector when the voltage is turned on.	Current to injector is shut off.
341	Severe loss of data from the ECM.	Possible no noticeable performance effects OR engine dying OR hard starting. Fault information, trip information and maintenance monitor data may be inaccurate.
343	Internal ECM error.	Possible none on performance or severe derate.
349	A frequency greater than calibrated threshold was detected at the tail shaft governor signal pin of the 31-pin machine connector.	Calibration dependent power and speed derate.
352	Low voltage detected on the ECM voltage supply line to some sensors (VSEN 1 supply).	Engine is derated to no air setting.

Fault code No.	Reason	Effect(only when fault code is active)
386	High voltage detected on the ECM voltage supply line to some sensors (VSEN 1 supply).	Engine is derated to no air setting.
387	High voltage detected on the ECM voltage supply line to the throttle(VTP supply).	Engine will only idle.
415	Oil pressure signal indicates oil pressure below the very low oil pressure engine protection limit.	Progressive power derate with increasing time from alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red lamp starts flashing.
418	Water has been detected in the fuel filter.	Possible white smoke, loss of power, or hard starting.
419	An error in the intake manifold pressure sensor signal was detected by the ECM.	Engine is derated to no air setting.
422	Voltage detected simultaneously on both the coolant level high and low signal circuits OR no voltage detected on both circuits.	No engine protection for coolant level.
426	Communication between the ECM and the J1939 data link has been lost.	None on performance. J1939 devices may not operate.
428	High voltage detected at water-in-fuel sensor.	None on performance.
429	Low voltage detected at water-in-fuel sensor.	None on performance.
431	Voltage detected simultaneously on both the idle validation off-idle and on-idle circuits.	None on performance.
432	Voltage detected at idle validation on-idle circuit when voltage at throttle position circuit indicates the pedal is not at idle OR voltage detected at idle validation off-idle circuit when voltage at throttle position circuit indicates the pedal is at idle.	Engine will only idle.
433	Voltage signal at intake manifold pressure circuit indicates high intake manifold pressure but other engine characteristics indicate intake manifold pressure must be low.	Derate to no air setting.
434	Supply voltage to the ECM fell below 6.2 VDC for a fraction of a second OR the ECM was not allowed to power down correctly (retain battery voltage for 30 seconds after key off).	Possible no noticeable performance effects OR possibility of engine dying OR hard starting. Fault information, trip information and maintenance monitor data may be inaccurate.
435	An error in the oil pressure sensor signal was detected by the ECM.	None on performance. No engine protection for oil pressure.
441	Battery voltage below normal operating level.	Possible no noticeable performance effects OR possibility of rough idle.
442	Battery voltage below normal operating level.	None on performance.
443	Low voltage detected on the ECM voltage supply line to the throttle(s) (VTP supply).	Engine will only idle.
489	Auxiliary speed frequency on input pin indicated that the frequency is below a calibration dependent threshold.	Engine will only idle.
527	Less than 17.0 VDC detected at the dual output A signal pin of the 31-pin machine connector.	No action taken by the ECM.
528	Less than 17.0 VDC detected at the dual output B signal pin of the 31-pin machine connector.	No action taken by the ECM.
529	Less than 17.0 VDC detected at the dual output B signal pin at the ECM.	No action taken by the ECM.
551	No voltage detected simultaneously on both the idle validation off-idle and on-idle circuits.	Engine will only idle.
581	High voltage detected at the fuel inlet restriction sensor signal pin.	Fuel inlet restriction monitor deactivated.

Fault code No.	Reason	Effect(only when fault code is active)
582	Low voltage detected at the fuel inlet restriction sensor signal pin	Fuel inlet restriction monitor deactivated.
583	Restriction has been detected at the fuel pump inlet.	Fuel inlet restriction monitor warning is set.
596	High battery voltage detected by the battery voltage monitor feature.	Yellow lamp will be lit until high battery voltage condition is corrected.
597	ICON™ has restarted the engine three times within three hours due to low battery voltage (automotive only) OR low battery voltage detected by the battery voltage monitor feature.	Yellow lamp will be lit until low battery voltage condition is corrected. The ECM may increase idle speed and deactivate idle decrement switch if idle speedup is enabled. The engine will run continuously if ICON™ is active (automotive only).
598	Very low battery voltage detected by the battery voltage monitor feature.	Red lamp lit until very low battery voltage condition is corrected.
611	Engine shutdown by operator before proper engine cool down resulting in filtered load factor above maximum shutdown threshold.	No action taken by the ECM.
951	A power imbalance between cylinders was detected by the ECM.	Engine may have rough idle or misfire.

GROUP 10 ENGINE CONTROL SYSTEM

1. MCU (Machine control unit) AND ECM (Electronic control module)



1 MCU
2 Electric box
3 Bolt(M8)

45075MS06

2. MCU ASSEMBLY

1) To match the pump absorption torque with the engine torque, MCU varies EPPR valve output pressure, which control pump discharge amount whenever feedbacked engine speed drops under the reference rpm of each mode set.

2) Three LED lamps on the MCU display as below.

LED lamp	Trouble	Service
G is turned ON	Normal	-
G and R are turned ON	Trouble on MCU	· Change the MCU
G and Y are turned ON	Trouble on serial communication line	· Check if serial communication lines between controller and cluster are disconnected
Three LED are turned OFF	Trouble on MCU power	· Check if the input power wire (24 V, GND) of controller is disconnected · Check the fuse

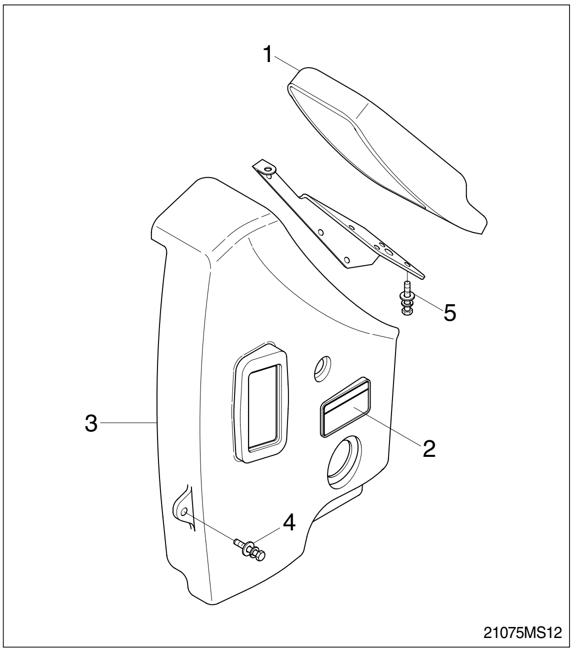
G : green, R : red, Y : yellow

3. EXCHANGE METHOD OF THE ROM

1) Disassemble the ash tray(2).

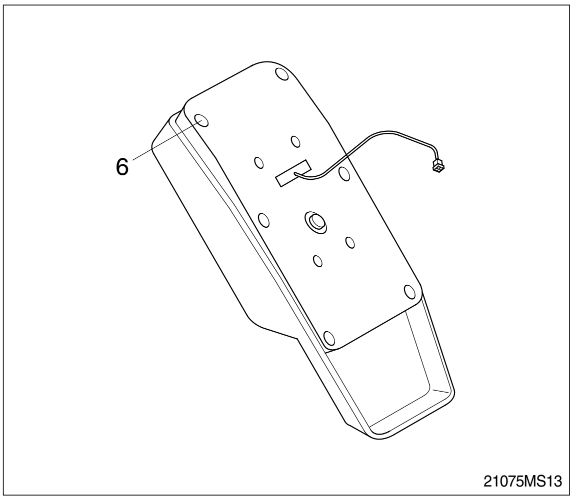
2) Disassemble the wiper motor cover(3).

3) Disassemble the cluster(1).

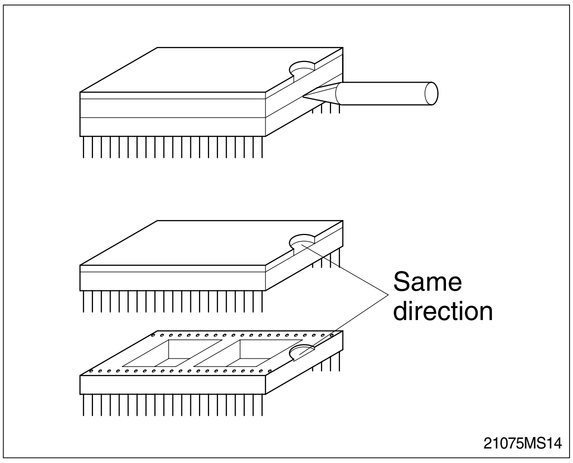


4) Loosen the screws(6EA) located back of the cluster.

5) Then you can open the upper case of the cluster easily.



6) Install the new ROM.(Be careful of direction and assmelbe the cluster in the reverse order to removal).



GROUP 11 EPPR VALVE

1. COMPOSITION OF EPPR VALVE

EPPR(Electro Proportional Pressure Reducing) valve consists of electro magnet and spool valve installed at main hydraulic pump.

1) ELECTRO MAGNET VALVE

Receive electric current from MCU and move the spool proportionally according to the specific amount of electric current value.

2) SPOOL VALVE

Is the two way direction control valve for pilot pressure to reduce hydraulic pump flow.
When the electro magnet valve is activated, pilot pressure enters into flow regulator of hydraulic pump. So, pump flow decreases to prevent engine stall.

3) PRESSURE AND ELECTRIC CURRENT VALUE FOR EACH MODE

Mode		Pressure		Electric current (mA)	Engine rpm (At accel dial 10)
		kgf/cm^2	psi		
Standard (Ver : 1.x)	M	12 ± 3	171 ± 40	360 ± 30	1750 ± 50
	H	12 ± 3	171 ± 40	360 ± 30	1700 ± 50
	S	12 ± 3	171 ± 40	360 ± 30	1650 ± 50

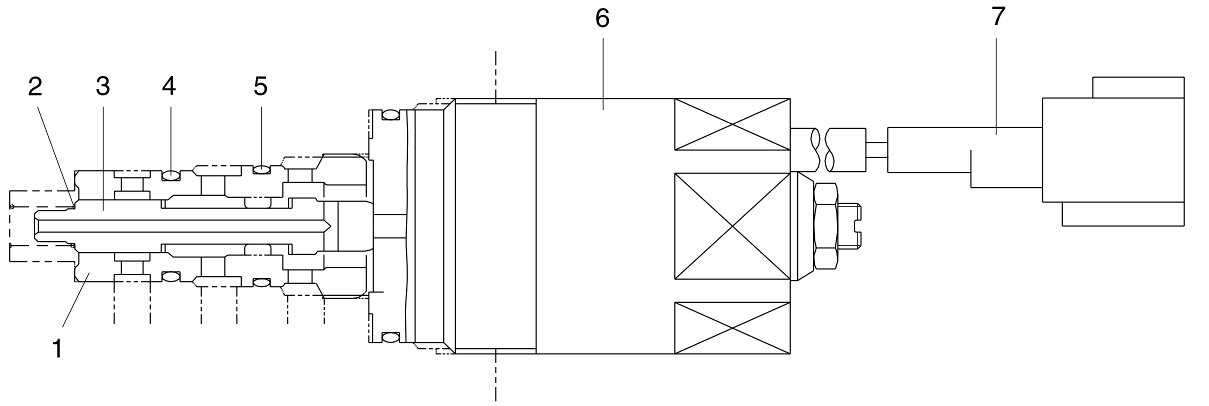
2. HOW TO SWITCH THE VERSION(3.1↔ 4.1) ON THE CLUSTER

You can switch the EPPR valve pressure set by selecting the version(3.1↔4.1).

- Dual mode
  · Changing the MCU mode

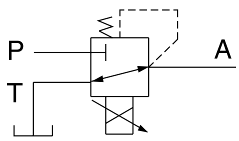
2. OPERATING PRINCIPLE

1) STRUCTURE



5-22(1) 210-7

1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

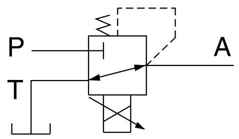


5-22A (210-7)

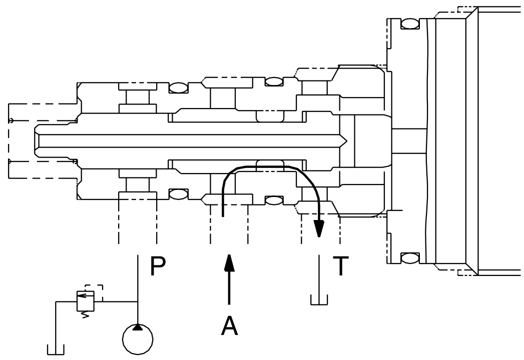
P Pilot oil supply line(Pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at hydraulic pump

2) AT H MODE

Pressure line is blocked and A oil returns to tank.

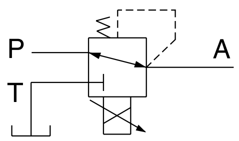


5-22B (210-7)

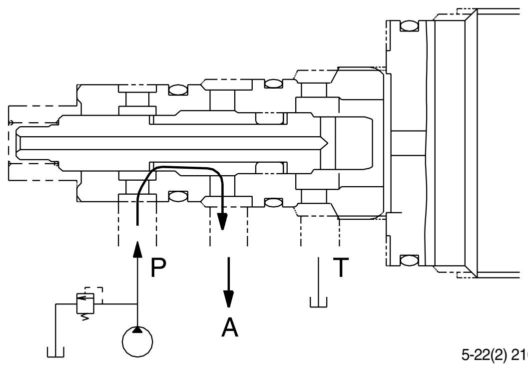


3) AT S MODE

Secondary pressure enters into A.



5-22C (210-7)



5-22(2) 210-7

3. EPPR VALVE CHECK PROCEDURE

1) CHECK ELECTRIC VALUE AT EPPR VALVE

(1) Start engine.

(2) Set S-mode and cancel auto decel mode.

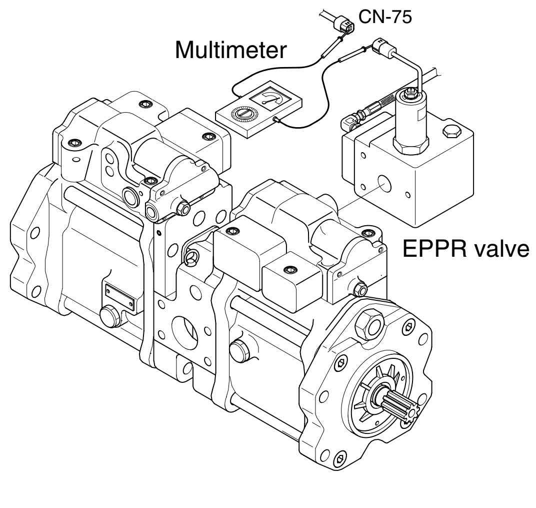
(3) Position the accel dial at 10.

(4) If tachometer show approx 1650±50rpm, disconnect one wire harness from EPPR valve.

(5) Install multimeter as figure.

(6) Check electric current at bucket circuit relief position.

Spec : 200~450mA



2507A5MS08

2) CHECK PRESSURE AT EPPR VALVE

(1) Remove plug and connect pressure gauge as figure.
 · Gauge capacity : 0 to 40-50kgf/cm^2
 (0 to 580-725psi)

(2) Start engine.

(3) Set S-mode and cancel auto decel mode.

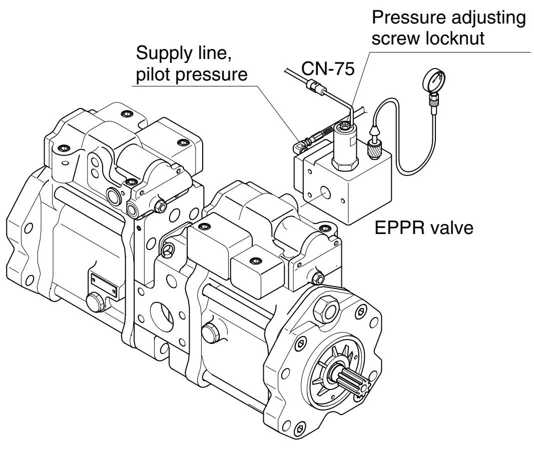
(4) Position the accel dial at 10.

(5) If tachometer show approx 1650±50rpm, check pressure at relief position of bucket circuit by operating bucket control lever.

(6) If pressure is not correct, adjust it.

(7) After adjust, test the machine.

Spec : 2~25kgf/cm^2(30~350psi)



2507A5MS09

GROUP 11 EPPR VALVE

1. COMPOSITION OF EPPR VALVE

EPPR(Electro Proportional Pressure Reducing) valve consists of electro magnet and spool valve installed at main hydraulic pump.

1) ELECTRO MAGNET VALVE

Receive electric current from MCU and move the spool proportionally according to the specific amount of electric current value.

2) SPOOL VALVE

Is the two way direction control valve for pilot pressure to reduce hydraulic pump flow.
When the electro magnet valve is activated, pilot pressure enters into flow regulator of hydraulic pump.
So, pump flow decreases to prevent engine stall.

3) PRESSURE AND ELECTRIC CURRENT VALUE FOR EACH MODE

Mode		Pressure		Electric current (mA)	Engine rpm (At accel dial 10)
		kgf/cm²	psi		
Standard (Ver : 1.x)	M	12 ± 3	171 ± 40	360 ± 30	1750 ± 50
	H	12 ± 3	171 ± 40	360 ± 30	1700 ± 50
	S	12 ± 3	171 ± 40	360 ± 30	1650 ± 50

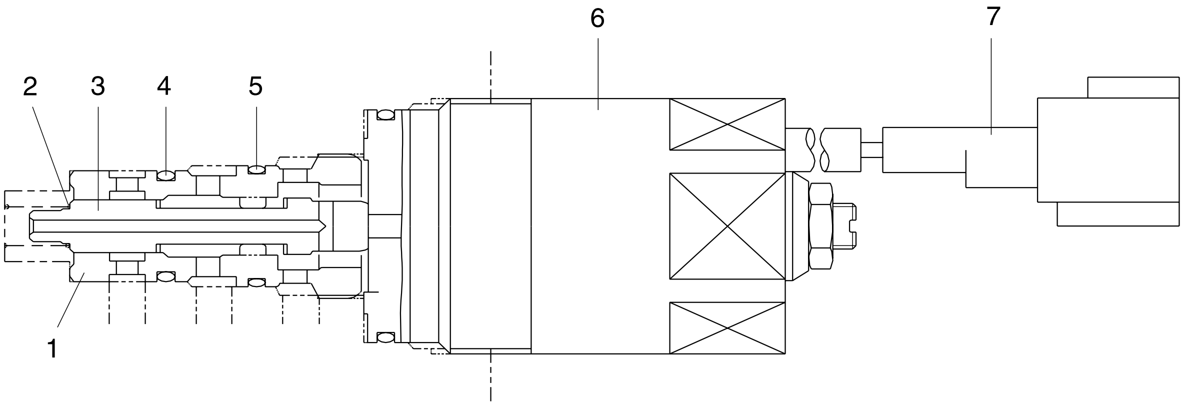
2. HOW TO SWITCH THE VERSION(3.1↔4.1) ON THE CLUSTER

You can switch the EPPR valve pressure set by selecting the version(3.1↔4.1).

- Dual mode
  · Changing the MCU mode

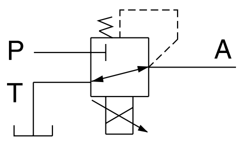
2. OPERATING PRINCIPLE

1) STRUCTURE



5-22(1) 210-7

1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

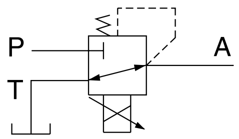


5-22A (210-7)

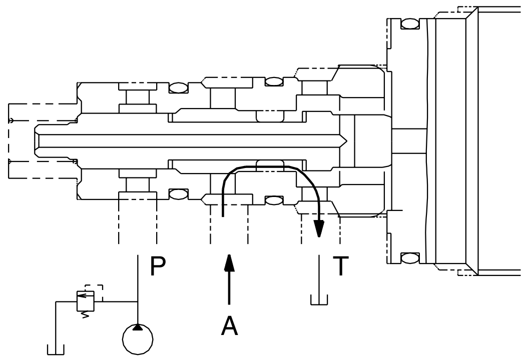
P Pilot oil supply line(Pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at hydraulic pump

2) AT H MODE

Pressure line is blocked and A oil returns to tank.

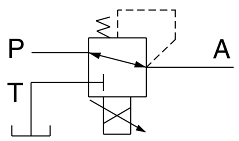


5-22B (210-7)

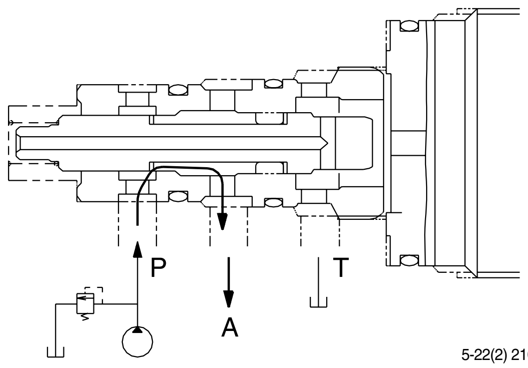


3) AT S MODE

Secondary pressure enters into A.



5-22C (210-7)



5-22(2) 210-7

3. EPPR VALVE CHECK PROCEDURE

1) CHECK ELECTRIC VALUE AT EPPR VALVE

(1) Start engine.

(2) Set S-mode and cancel auto decel mode.

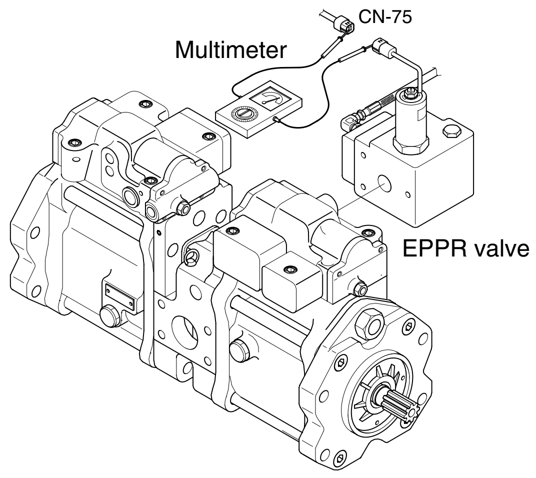
(3) Position the accel dial at 10.

(4) If tachometer show approx 1650±50rpm, disconnect one wire harness from EPPR valve.

(5) Install multimeter as figure.

(6) Check electric current at bucket circuit relief position.

Spec : 200~450mA



2507A5MS08

2) CHECK PRESSURE AT EPPR VALVE

(1) Remove plug and connect pressure gauge as figure.
· Gauge capacity : 0 to 40-50kgf/cm^2
(0 to 580-725psi)

(2) Start engine.

(3) Set S-mode and cancel auto decel mode.

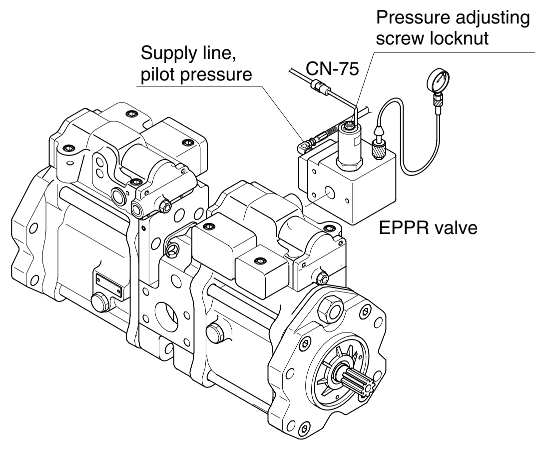
(4) Position the accel dial at 10.

(5) If tachometer show approx 1650±50rpm, check pressure at relief position of bucket circuit by operating bucket control lever.

(6) If pressure is not correct, adjust it.

(7) After adjust, test the machine.

Spec : 2~25kgf/cm^2(30~350psi)



2507A5MS09

GROUP 12 MONITORING SYSTEM

1. OUTLINE

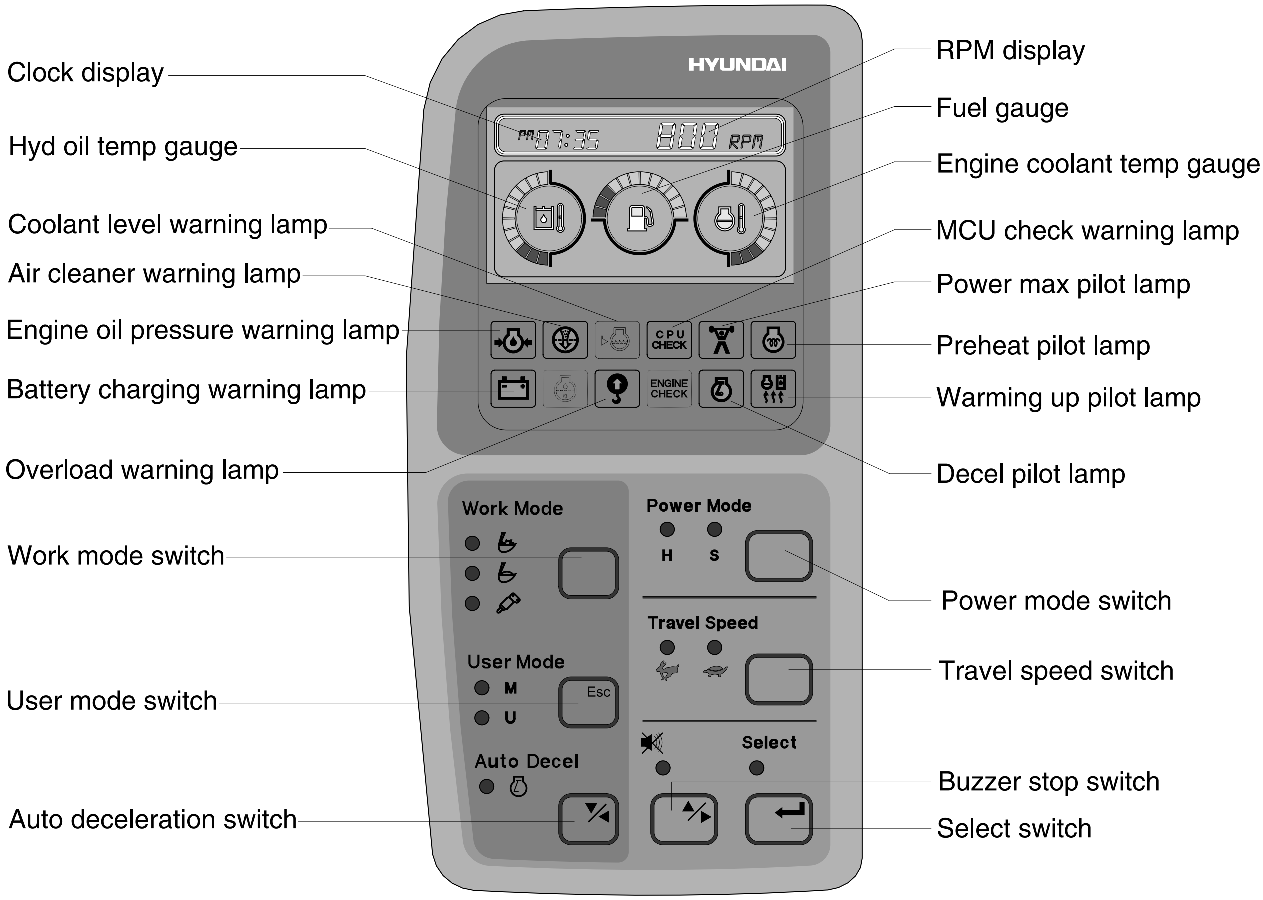
Monitoring system consists of the monitor part and switch part.

The monitor part gives warnings when any abnormality occurs in the machine and informs the condition of the machine.

Various select switches are built into the monitor panel, which act as the control portion of the machine control system.

2. CLUSTER

1) MONITOR PANEL



30075MS01

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor initial 5 seconds

a. All lamps light up.
b. Buzzer sound.

② Check monitor after 5 seconds : Indicate cluster version and machine condition

a. Cluster program version : 「1.00」 ◄— Indicates program version 「1.00」 for 5 seconds.
b. Tachometer : 0rpm
c. Fuel gauge : All light up below appropriate level
d. Hydraulic temperature : All light up below appropriate level
e. Engine coolant temperature gauge : All light up below appropriate level
f. Warning lamp
※ During start key **ON** the engine oil pressure lamp and battery charging lamp go on, but it is not abnormal.
※ When engine coolant temperature below 30°C, the warming up lamp lights up.

③ Indicating lamp state

a. Work mode selection : General work
b. Power mode selection : S mode
c. User mode selection : No LED ON
d. Auto decel LED : ON
e. Travel speed pilot lamp : Low(Turttle)

(2) Start of engine

① Check machine condition

a. Tachometer indicates at present rpm
b. Gauge and warning lamp : Indicate at present condition.
※ When normal condition : All warning lamp OFF
c. Work mode selection : General work
d. Power mode selection : S mode
e. User mode selection : No LED ON
f. Auto decel LED : ON
g. Travel speed pilot lamp : Low(Turttle)

② When warming up operation

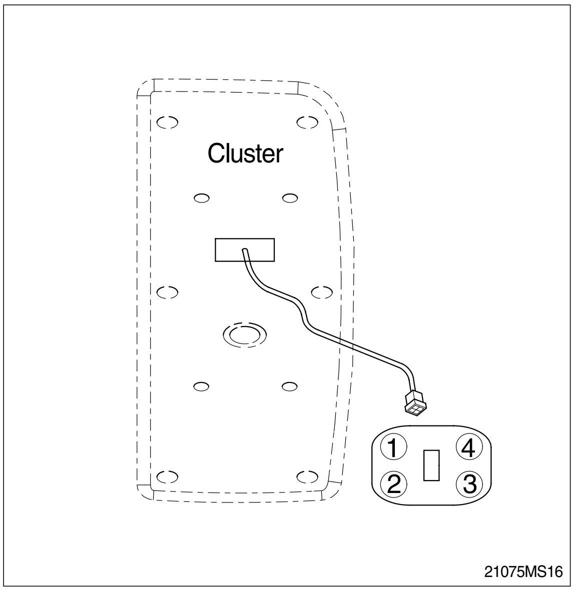
a. Warming up lamp : ON
b. 10 seconds after engine started, engine speed increases to 1000rpm(Auto decel LED : ON)
※ Others same as above ①.

③ When abnormal condition

a. The lamp lights up and the buzzer sounds.
b. If **BUZZER STOP** switch is pressed, buzzer sound is canceled but the lamp light up until normal condition.

3. CLUSTER CONNECTOR

No.	Signal	Input / Output
1	Power IG(24V)	Input(20~32V)
2	GND	Input(0V)
3	Serial-(RX)	Input(Vpp=12V)
4	Serial+(TX)	Output(Vpp=4V)



4. CLUSTER FUNCTION

1) LCD main operation display

Default screen

1607A3CD02A

Option screen

1607A3CD02B

1 Time display
2 RPM display
3 Hydraulic oil temperature gauge
4 Fuel level gauge
5 Engine coolant temperature gauge

(1) Time display

1607A3CD02C

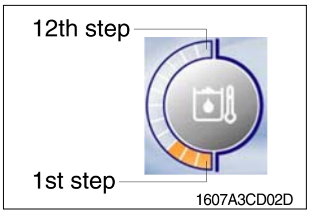
① This displays the current time.
※ **Refer to the page 5-45 to set time for details.**

(2) RPM display

1607A3CD02C

① This displays the engine rpm.

(3) Hydraulic oil temperature gauge



1607A3CD02D

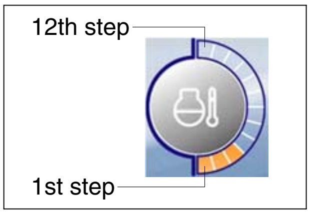
① This gauge indicates the temperature of hydraulic oil in 12 step gauge.
· 1st step : Below 30°C(86°F)
· 2nd~10th step : 30-105 °C(86-221°F)
· 11th~12th step : Above 105°C(221°F)
② The gauge between 2nd and 10th steps illuminates when operating.
③ Keep idling engine at low speed until the gauge between 2nd and 10th steps illuminates, before operation of machine.
④ When the gauge of 11th and 12th steps illuminates, reduce the load on the system. If the gauge stays in the 11th~12th steps, stop the machine and check the cause of the problem.

(4) Fuel level gauge

1607A3CD02E

① This gauge indicates the amount of fuel in the fuel tank.
② Fill the fuel when the 1st step or fuel icon blinks in red.
※ **If the gauge illuminates the 1st step or fuel icon blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.**

(5) Engine coolant temperature gauge



1607A3CD02F

① This gauge indicates the temperature of coolant in 12 step gauge.
· 1st step : Below 30°C(86°F)
· 2nd~10th step : 30-105 °C(86-221°F)
· 11th~12th step : Above 105°C(221°F)
② The gauge between 2nd and 10th steps illuminates when operating.
③ Keep idling engine at low speed until the gauge between 2nd and 10th steps illuminates, before operation of machine.
④ When the gauge of 11th and 12th steps illuminates, turn OFF the engine, check the radiator and engine.

3) Warning of main operation screen

(1) Warning display

① Engine coolant temperature

- This lamp blinks and the buzzer sounds when the temperature of coolant is over the normal temperature 105°C (221°F) .
- Check the cooling system when the lamp blinks.

② Fuel level

- This lamp blinks and the buzzer sounds when the level of fuel is below 68 l (18 U.S. gal).
- Fill the fuel immediately when the lamp blinks.

③ Hydraulic oil temperature

- This warning lamp operates and the buzzer sounds when the temperature of hydraulic oil is over 105 °C (221 °F) .
- Check the hydraulic oil level when the lamp blinks.
- Check for debris between oil cooler and radiator.

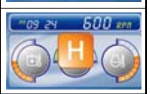
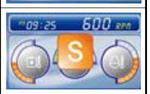
④ All gauge

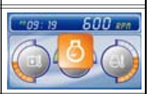
- This lamp blinks and the buzzer sounds when the all gauge is abnormal.
- Check the each system when the lamp blinks.

⑤ Communication error

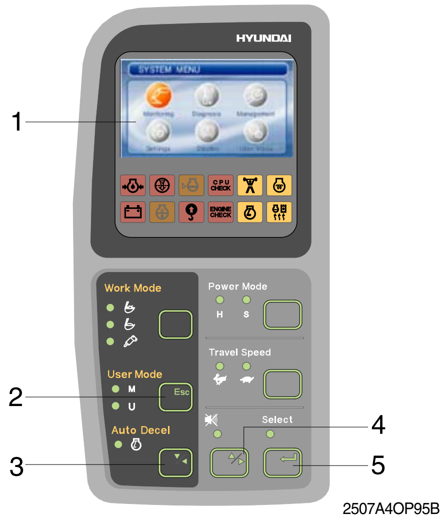
- Communication problem between MCU controller and cluster makes the lamp blinks and the buzzer sounds.
- Check if any fuse for MCU burnt off.
  If not check the communication line between them.

(2) Pop-up icon display

No	Switch	Selected mode	Display
1	Work mode switch	General work mode	
		Heavy duty work mode	
		Breaker operation mode	
2	Power mode switch	High power work mode	
		Standard power work mode	

No	Switch	Selected mode	Display
3	Auto deceleration switch	Light ON	
		Light OFF	
4	Travel speed control switch	Low speed	
		High speed	

4) LCD



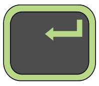
2507A4OP95B

1  : LCD

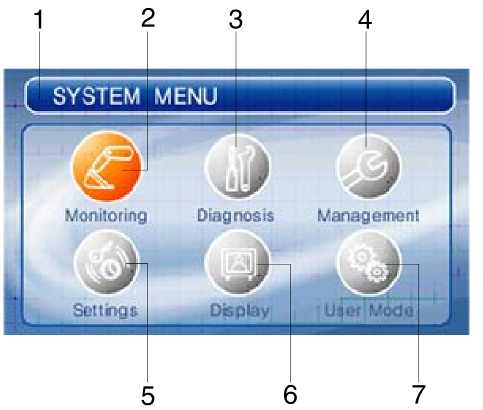
2  : Escape,
Return to the previous menu

3  : Down/Left Direction

4  : Up/Right Direction

5  : Select(Enter)
Activate the currently chosen item

(1) Main menu



2507A4OP94

1  : Menu information

2  : Monitoring
- Equipment, Switch, Output

3  : Diagnosis
- Current error, Recorded error

4  : Maintenance

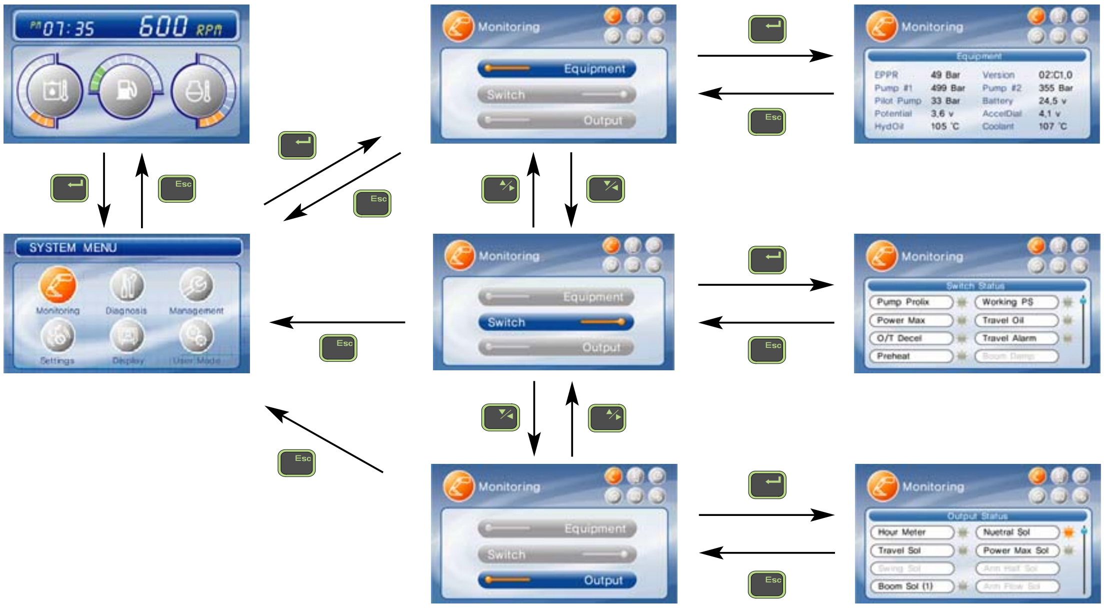
5  : Settings
- Time set, Dual mode
- System lock(Reserved)

6  : Display
- Operation skin, Brightness, Language

7  : User mode

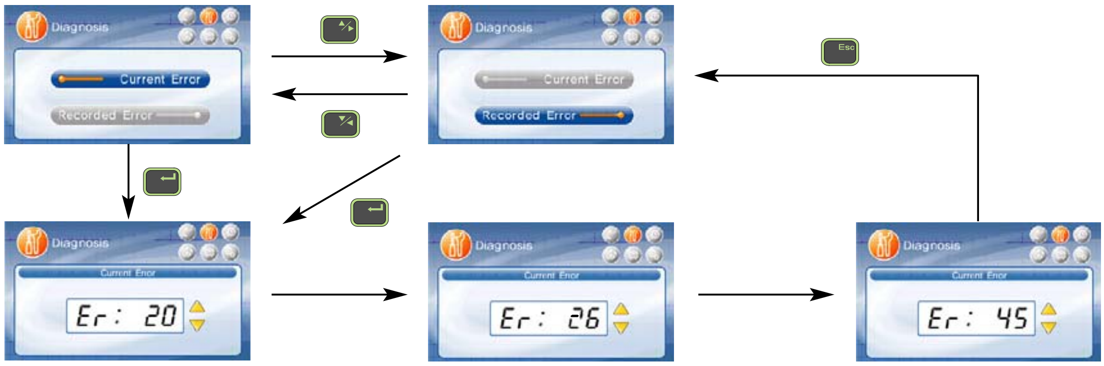
(2) Display map

① Monitoring

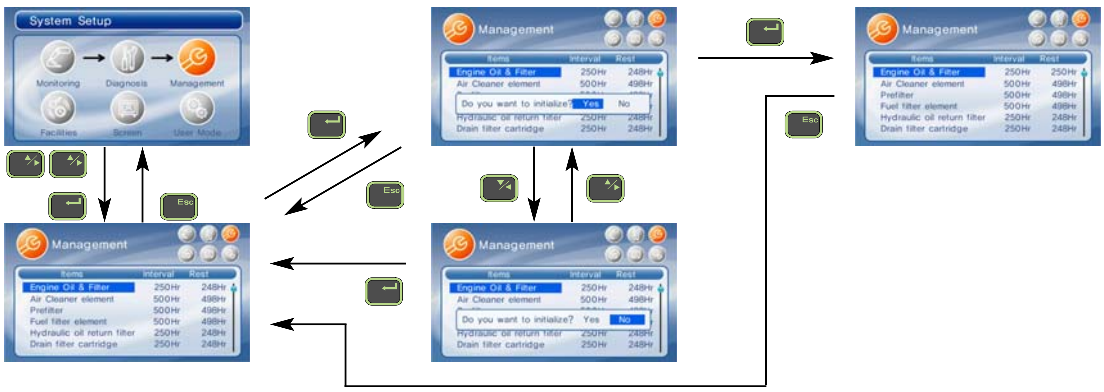


② Diagnosis

- If there are more than 2 error codes, each one can be displayed by pressing or switch respectively.



③ Maintenance



④ Setting

a. Time set

b. System lock - Reserved

c. Dual mode

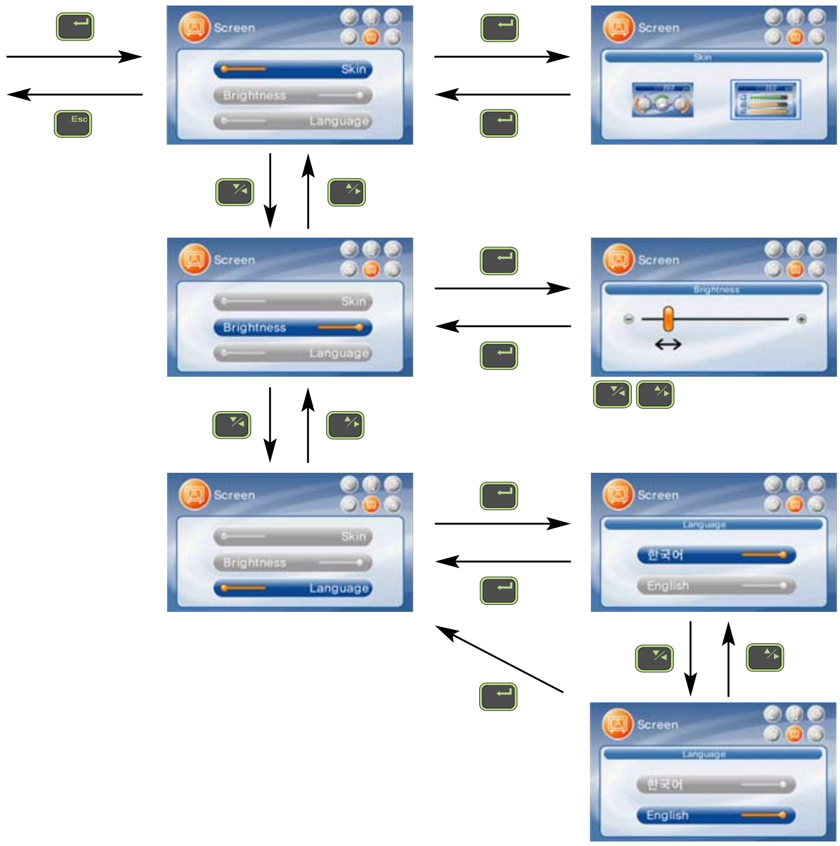
- Changing the MCU mode

⑤ Display

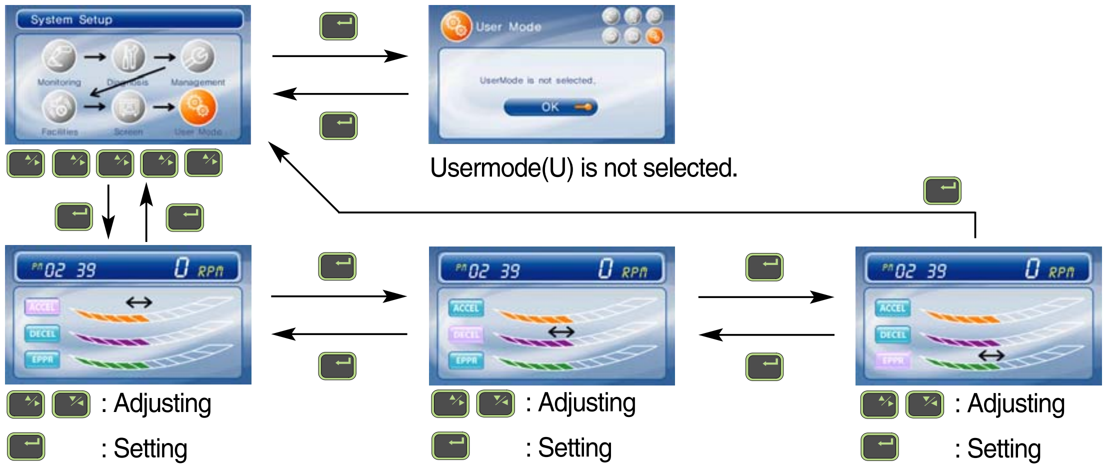
a. Operation skin

b. Brightness

c. Language

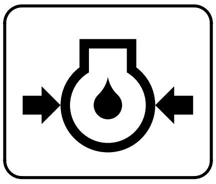


⑥ User mode


System Setup
Monitoring
Management
Facilities
Screen
User Mode
UserMode is not selected.
OK
Usermode(U) is not selected.
ACCEL
DECEL
EPPR
: Adjusting
: Setting
: Adjusting
: Setting
: Adjusting
: Setting

5) Warning and pilot lamp

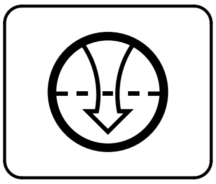
(1) Engine oil pressure warning lamp



21073CD07

① This lamp blinks and the buzzer sounds after starting the engine because of the low oil pressure.
② If the lamp blinks during engine operation, shut OFF engine immediately. Check oil level.

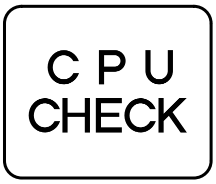
(2) Air cleaner warning lamp



21073CD08

① This lamp blinks and the buzzer sounds when the filter of air cleaner is clogged.
② Check the filter and clean or replace it.

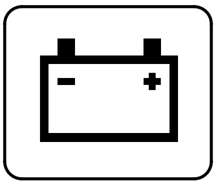
(3) MCU check warning lamp



21073CD10

① If any fault code is received from MCU, this lamp blinks and the buzzer sounds.
② Check the communication line between MCU and cluster.

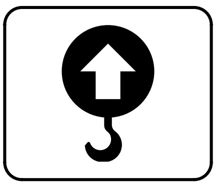
(4) Battery charging warning lamp



21073CD13

① This lamp blinks and the buzzer sounds when the starting switch is ON, it is turned OFF after starting the engine.
② Check the battery charging circuit when this lamp blinks during engine operation.

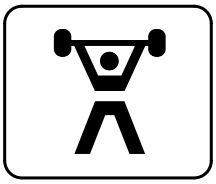
(5) Overload warning lamp (Option)



21073CD15

① When the machine is overload, the overload warning lamp blinks during the overload switch is ON.

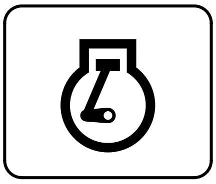
(6) Power max pilot lamp



21073CD11

① The lamp will be ON when pushing power max switch on the LH RCV lever.

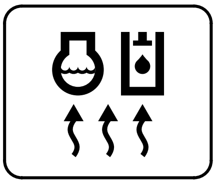
(7) Decel pilot lamp



21073CD17

① Operating auto decel or one touch decel makes the lamp ON.
② The lamp will be ON when pushing one touch decel switch on the LH RCV lever.

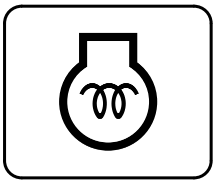
(8) Warming up pilot lamp



21073CD18

① This lamp is turned ON when the coolant temperature is below 30°C (86 °F).
② The automatic warming up is cancelled when the engine coolant temperature is above 30 °C, or when 10 minutes have passed since starting.

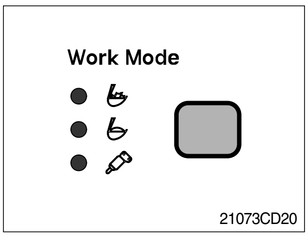
(9) Preheat pilot lamp



21073CD12

① Turning the start key switch ON position starts preheating in cold weather.
② Start the engine as this lamp is OFF.

(10) Work mode switch

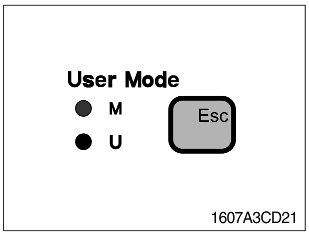


21073CD20

① This switch is to select the machine operation mode, which shifts from general operation mode to heavy operation mode and breaker mode in a raw by pressing the switch.
- : Heavy duty work mode
- : General work mode
- : Breaker operation mode

※ **Refer to the page 5-4 for details.**

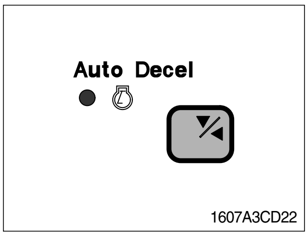
(11) User mode switch



① This switch is to select the maximum power or user mode.
- M : Maximum power
- U : Memorizing operators preferable power setting.

※ **Refer to the page 5-5 for details.**

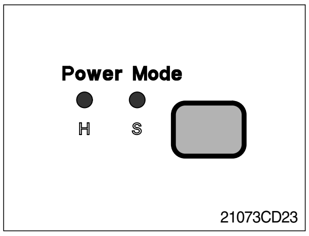
(12) Auto deceleration switch



① This switch is used to actuate or cancel the auto deceleration function.

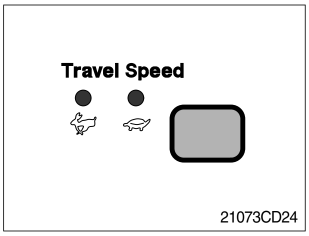
② When the switch actuated and all control levers and pedals are at neutral position, engine speed will be lowered automatically to save fuel consumption.
- Light ON : Auto deceleration function is selected.
- Light OFF : a. Auto deceleration function is cancelled so that the engine speed increased to previous setting value.
  b. One touch decel function is available.

(13) Power mode switch



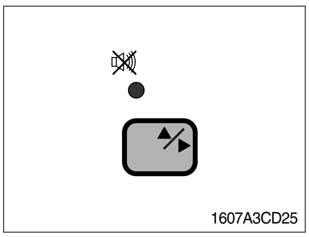
① The lamp of selected mode is turned ON by pressing the switch( ).
- H : High power work.
- S : Standard power work.

(14) Travel speed control switch



① This switch is to control the travel speed which is changed to high speed(Rabbit mark) by pressing the switch and low speed(Turtle mark) by pressing it again.

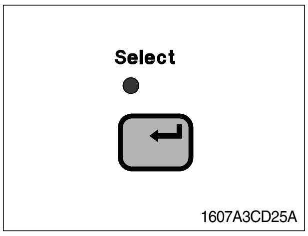
(15) Buzzer stop switch



① When the starting switch is turned ON first, normally the alarm buzzer sounds for 2 seconds during lamp check operation.

② The red lamp lights ON and the buzzer sounds when the machine has a problem.
In this case, press this switch and buzzer stops, but the red lamp lights until the problem is cleared.

(16) Select switch



① This switch is used to enter main menu and sub menu of LCD.

※ **Refer to the page 5-30 for details.**

SECTION 6 TROUBLESHOOTING

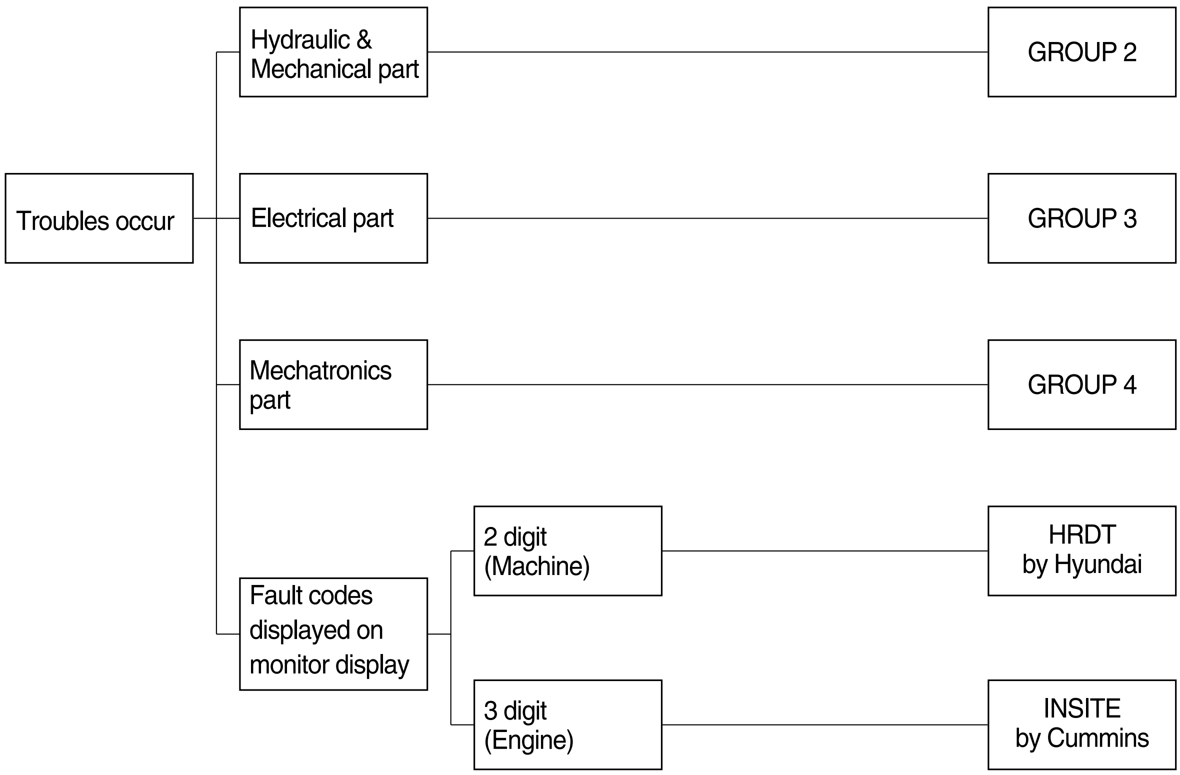
SECTION 6 TROUBLESHOOTING

GROUP 1 BEFORE TROUBLESHOOTING

1. INTRODUCTION

When a trouble is occurred in the machine, this section will help an operator to maintain the machine with easy.

The trouble of machine is parted Hydraulic & Mechanical system, Electrical system and Mechatronics system. At each system part, an operator can check the machine according to the troubleshooting process diagram.



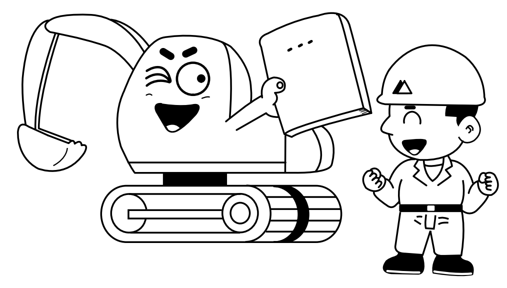
※ If fault codes (2 or 3 digits) are displayed on the monitor, please contact Hyundai or Cummins.

2. DIAGNOSING PROCEDURE

To carry out troubleshooting efficiently, the following steps must be observed.

STEP 1. Study the machine system

Study and know how the machine is operating, how the system is composing, what kinds of function are installed in the machine and what are specifications of the system components by the machine service manual.
Especially, deepen the knowledge for the related parts of the trouble.

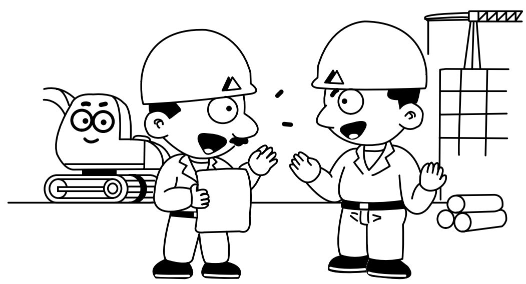


13031SH02

STEP 2. Ask the operator

Before inspecting, get the full story of malfunctions from a witness --- the operator.

1) How the machine is used and when it is serviced?
2) When the trouble was noticed and what work the machine was doing at that time?
3) What is the phenomenon of the trouble? Was the trouble getting worse, or did it come out suddenly for the first time?
4) Did the machine have any troubles previously? If so, which parts were repaired before.

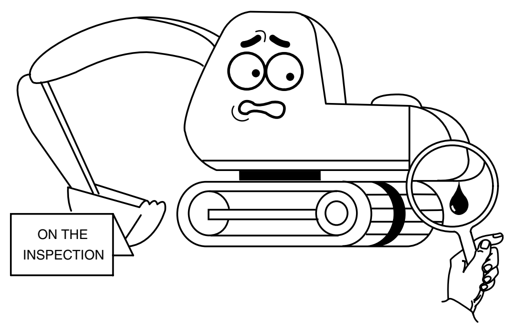


13031SH03

STEP 3. Inspect the machine

Before starting troubleshooting, check the machine for the daily maintenance points as shown in the operator's manual.

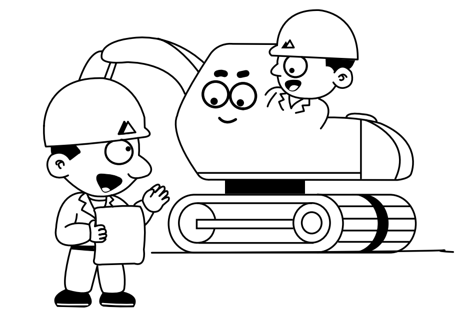
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



6-2(3) 210-7

STEP 4. Inspect the trouble actually on the machine

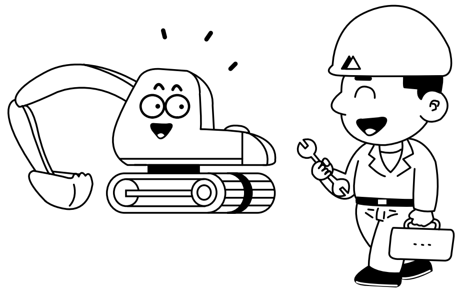
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



6-3(1) 210-7

STEP 5. Perform troubleshooting

According to where the trouble parts are located, hydraulic & mechanical system part or electrical system part or mechatronics system part, perform troubleshooting the machine refer to the each system part's troubleshooting process diagram.

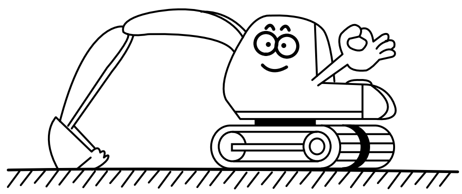


13031SH05

STEP 6. Trace a cause

Before reaching a conclusion, check the most suspectible causes again. Try to trace what the real cause of the trouble is.

Make a plan of the appropriate repairing procedure to avoid consequential malfunctions.



6-3(3) 210-7

GROUP 2 HYDRAULIC AND MECHANICAL SYSTEM

1. INTRODUCTION

1) MACHINE IN GENERAL

(1) If even a minor fault is left intact and operation is continued, a fatal failure may be caused, entailing a large sum of expenses and long hours of restoration.
Therefore when even a small trouble occurs, do not rely on your intuition and experience, but look for the cause based on the troubleshooting principle and perform maintenance and adjustment to prevent major failure from occurring. Keep in mind that a fault results from a combination of different causes.

(2) The following lists up commonly occurring faults and possible causes with this machine. For the troubleshooting of the engine, refer to the coming troubleshooting and repair.

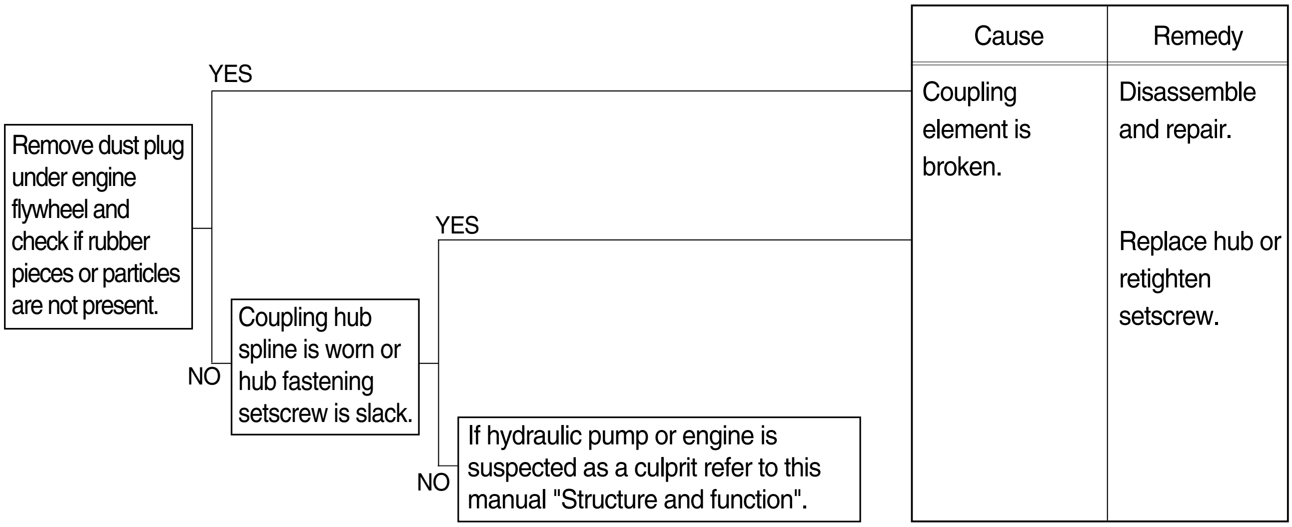
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

(4) Ask user or operator the following.
① Was there any strange thing about machine before failure occurred?
② Under what conditions did the failure occur?
③ Have any repairs been carried out before the failure?

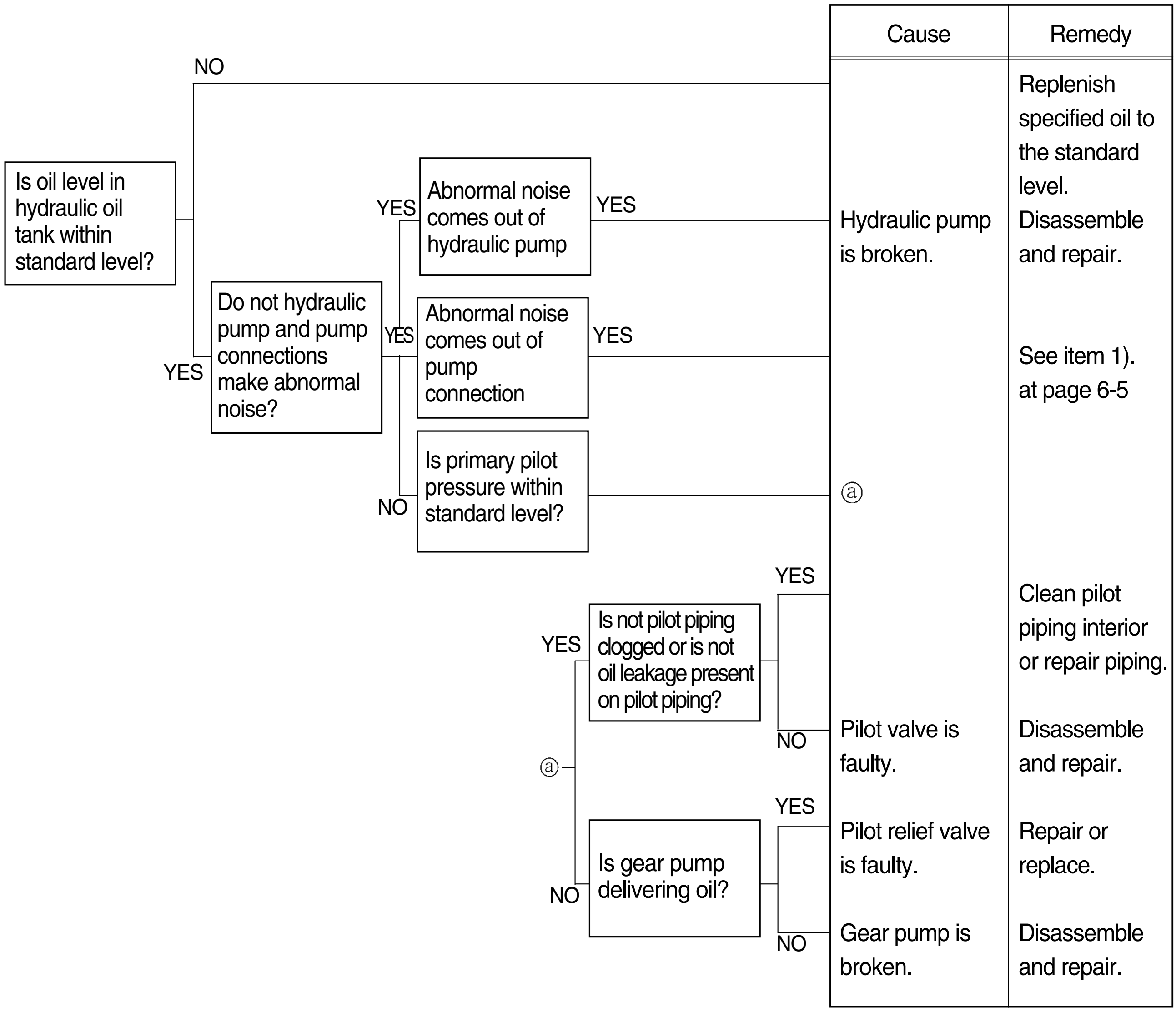
(5) Check before troubleshooting.
① Check oil and fuel level.
② Check for any external leakage of oil from components.
③ Check for loose or damage of wiring and connections.

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION



2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

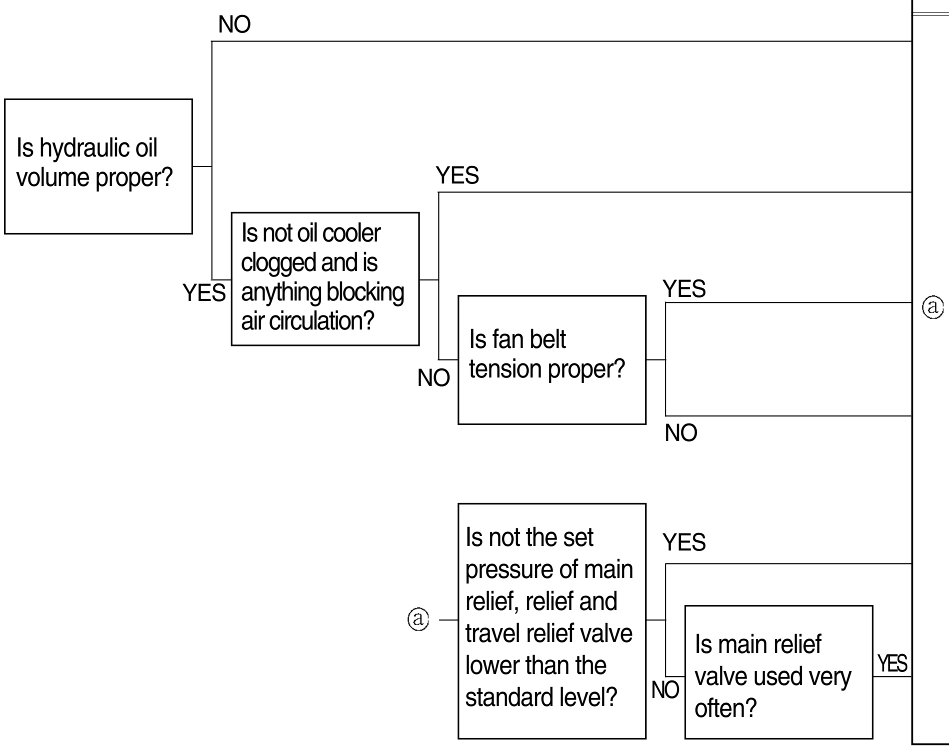


3. HYDRAULIC SYSTEM

1) HYDRAULIC OIL IS CLOUDY

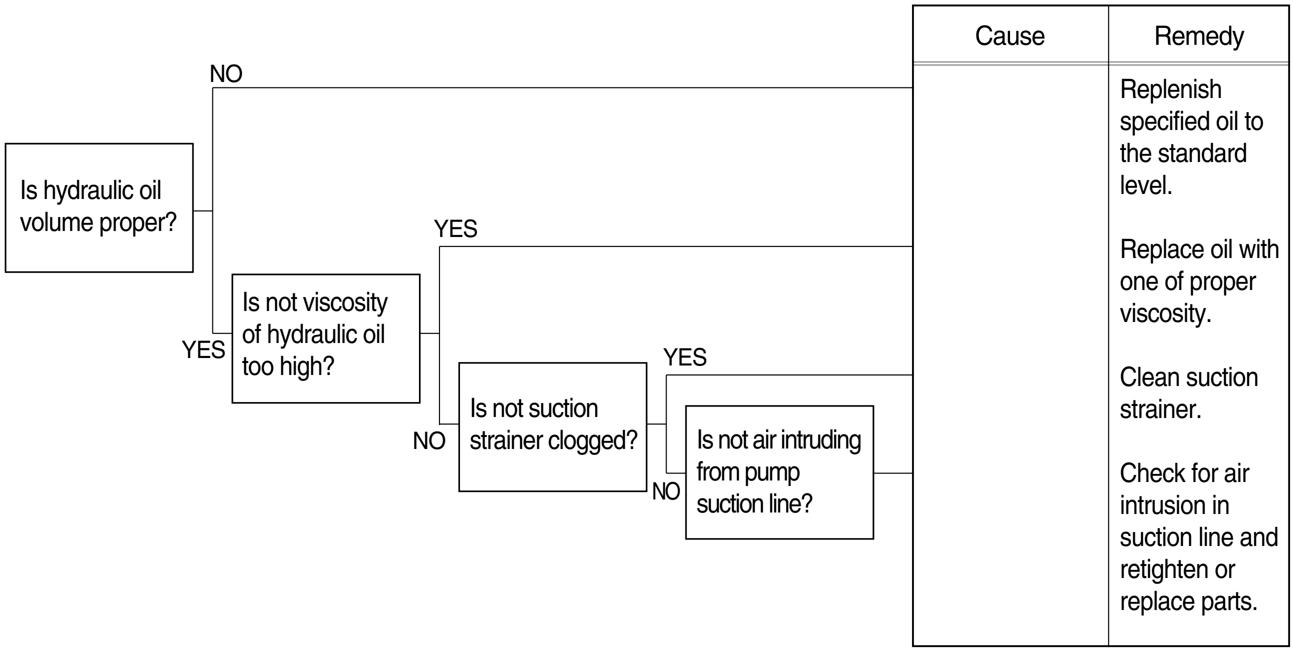
Cause	Remedy
Water is mixed.	Put hydraulic oil still, separate water and dispose it or replace hydraulic oil.
Air is intruded.	Check suction line and return line and eliminate the air intruding source.

2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY

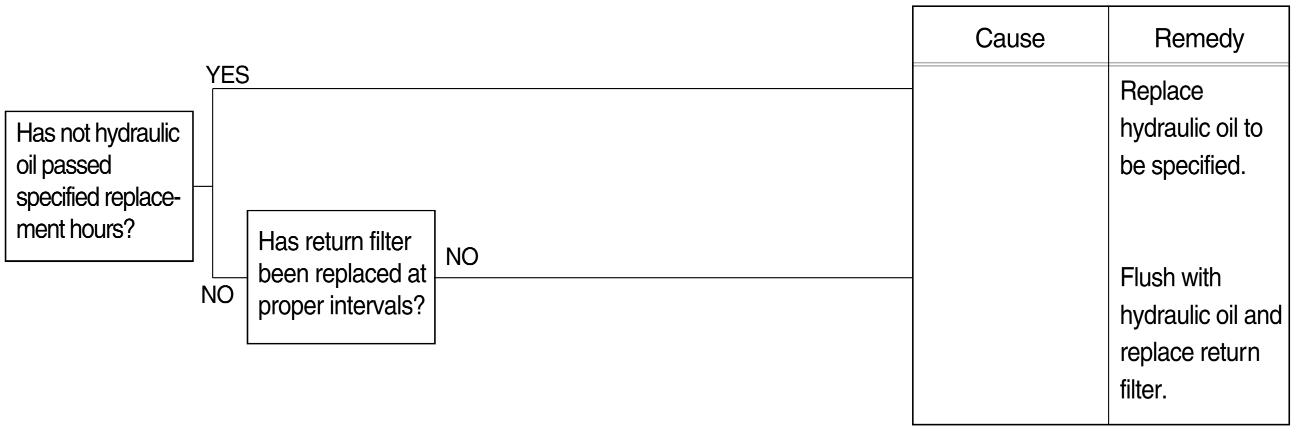


Cause	Remedy
	Replenish specified oil to the standard level.
	Clean oil cooler. Secure air circulation route.
	Adjust belt tension or replace belt.
	Readjust set pressure.
	Reduce load.

3) CAVITATION OCCURS WITH PUMP

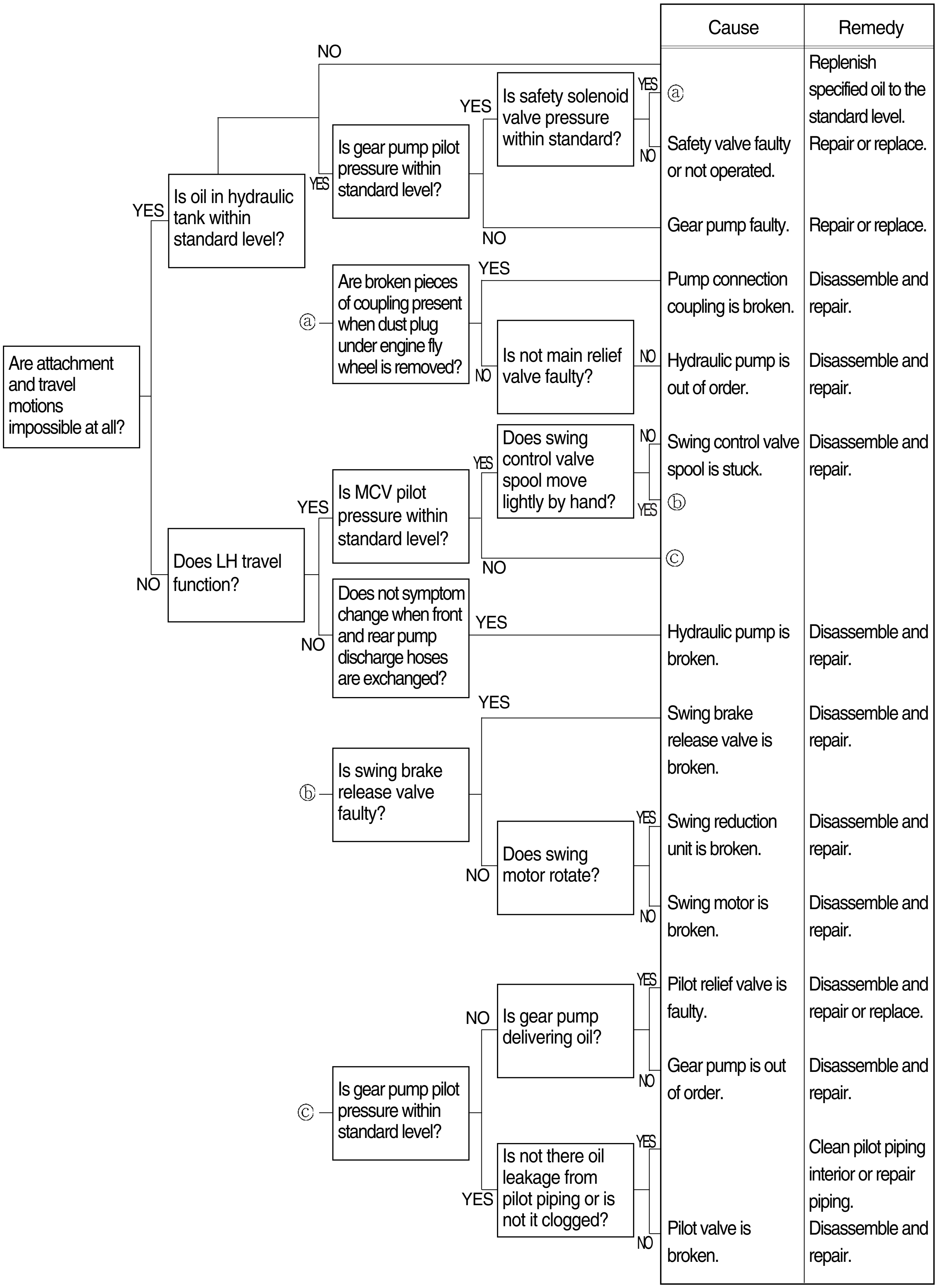


4) HYDRAULIC OIL IS CONTAMINATED

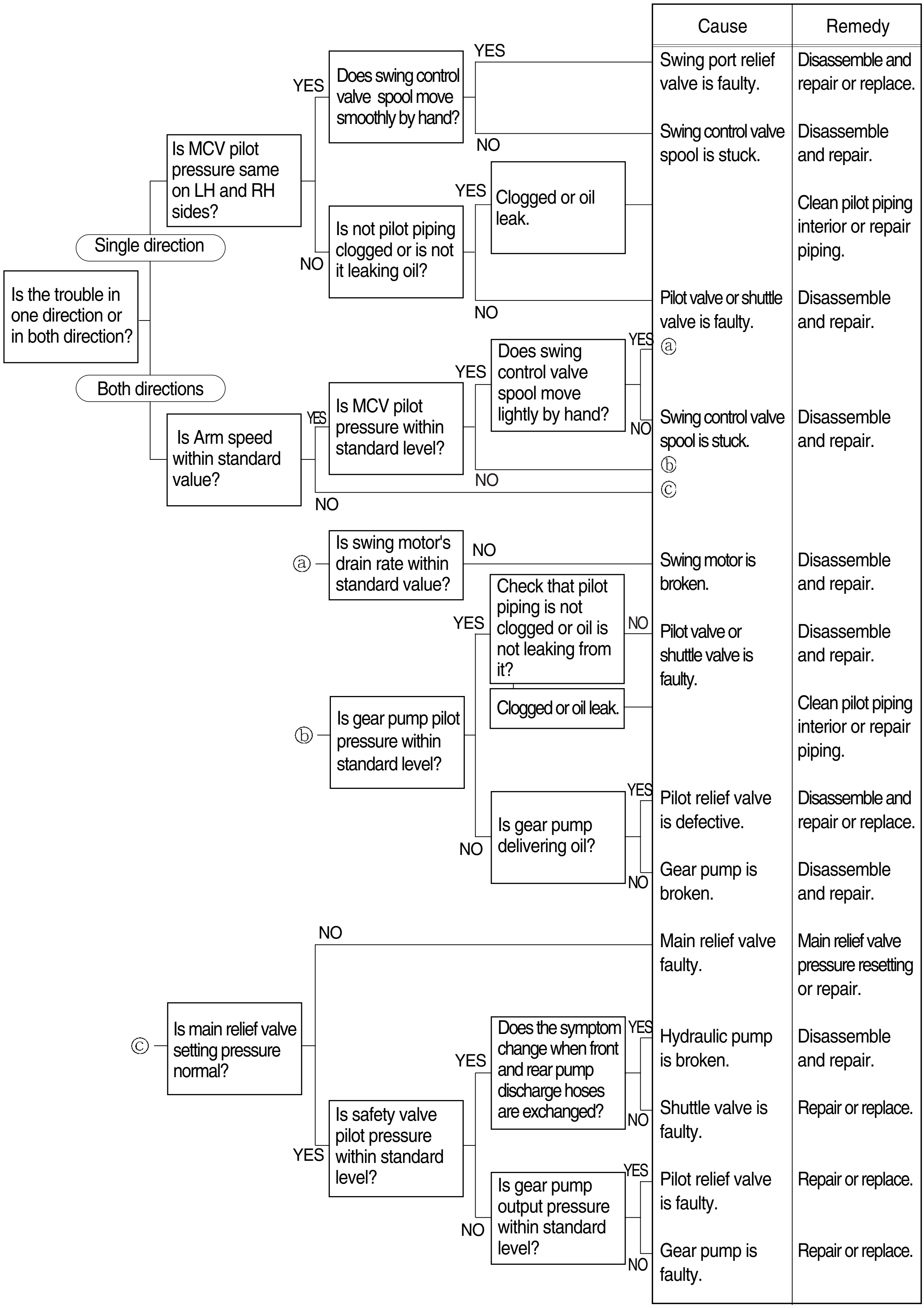


4. SWING SYSTEM

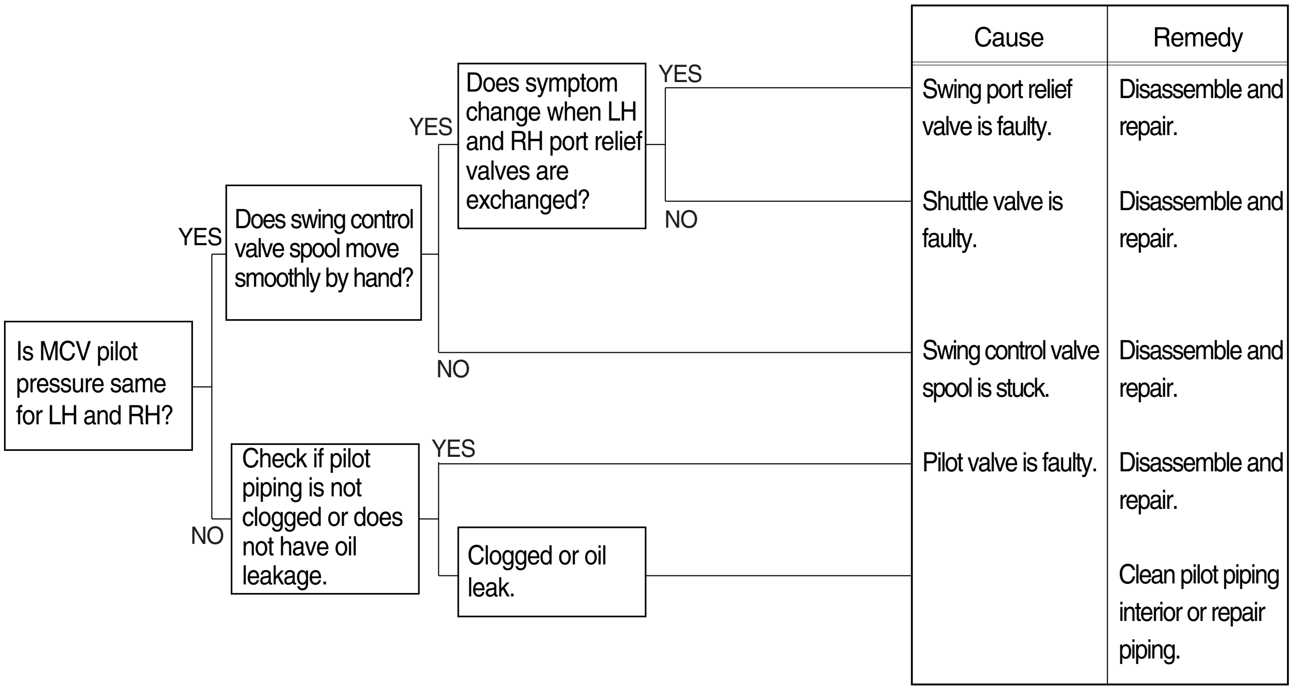
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



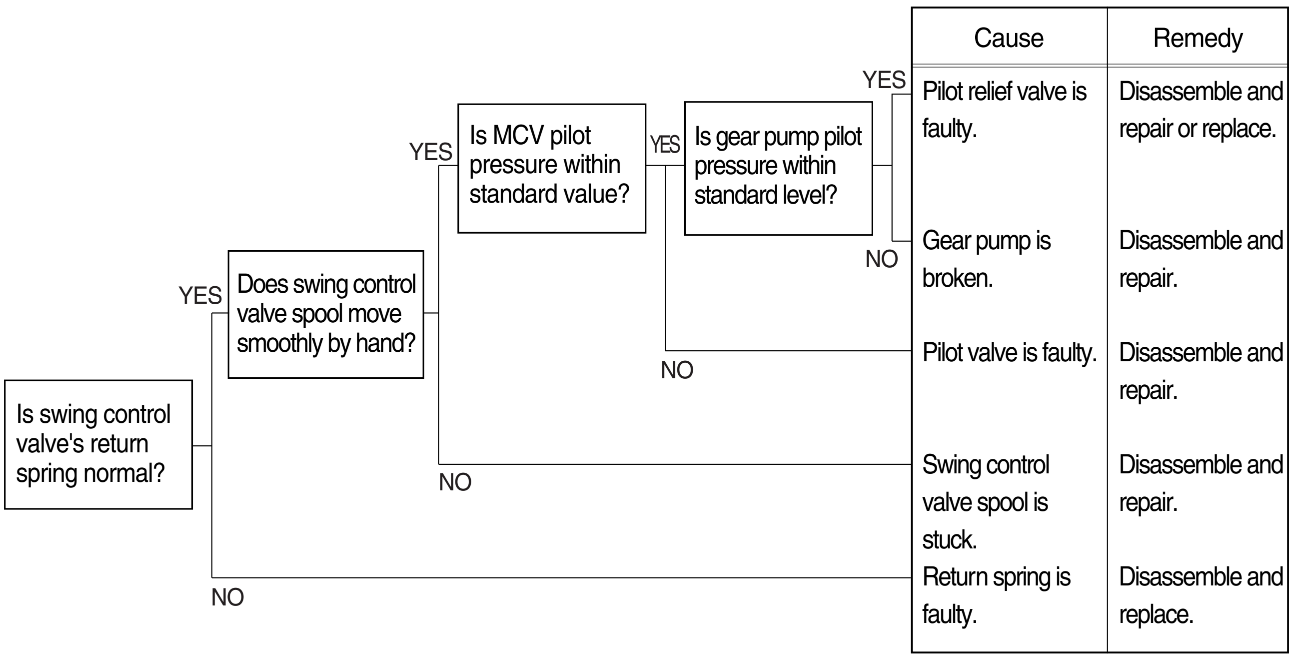
2) SWING SPEED IS LOW



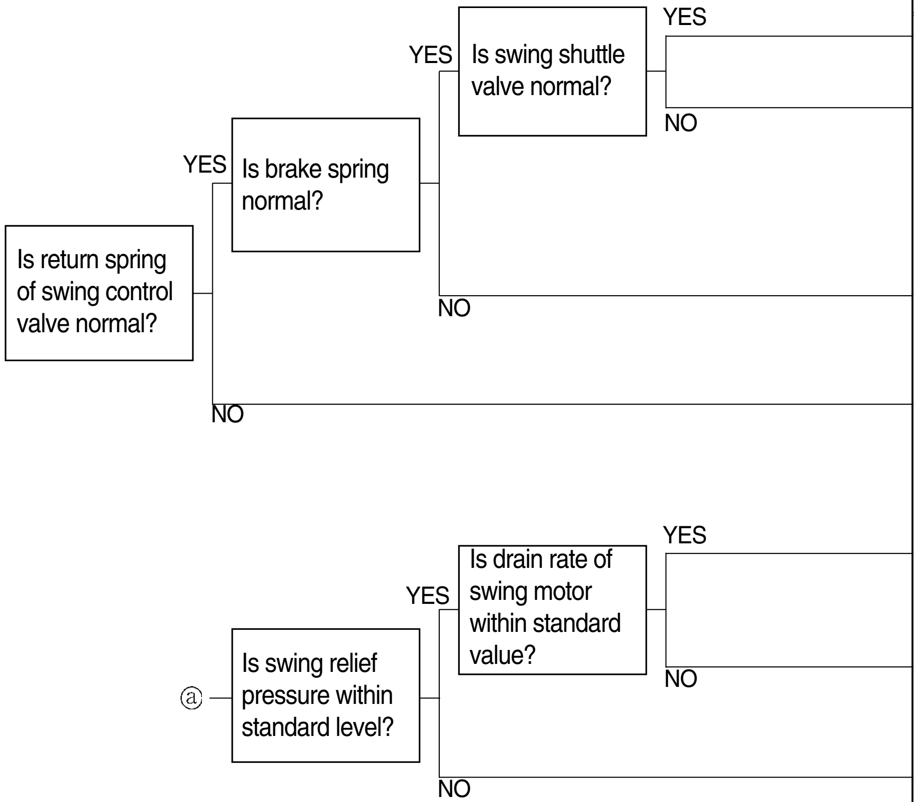
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP



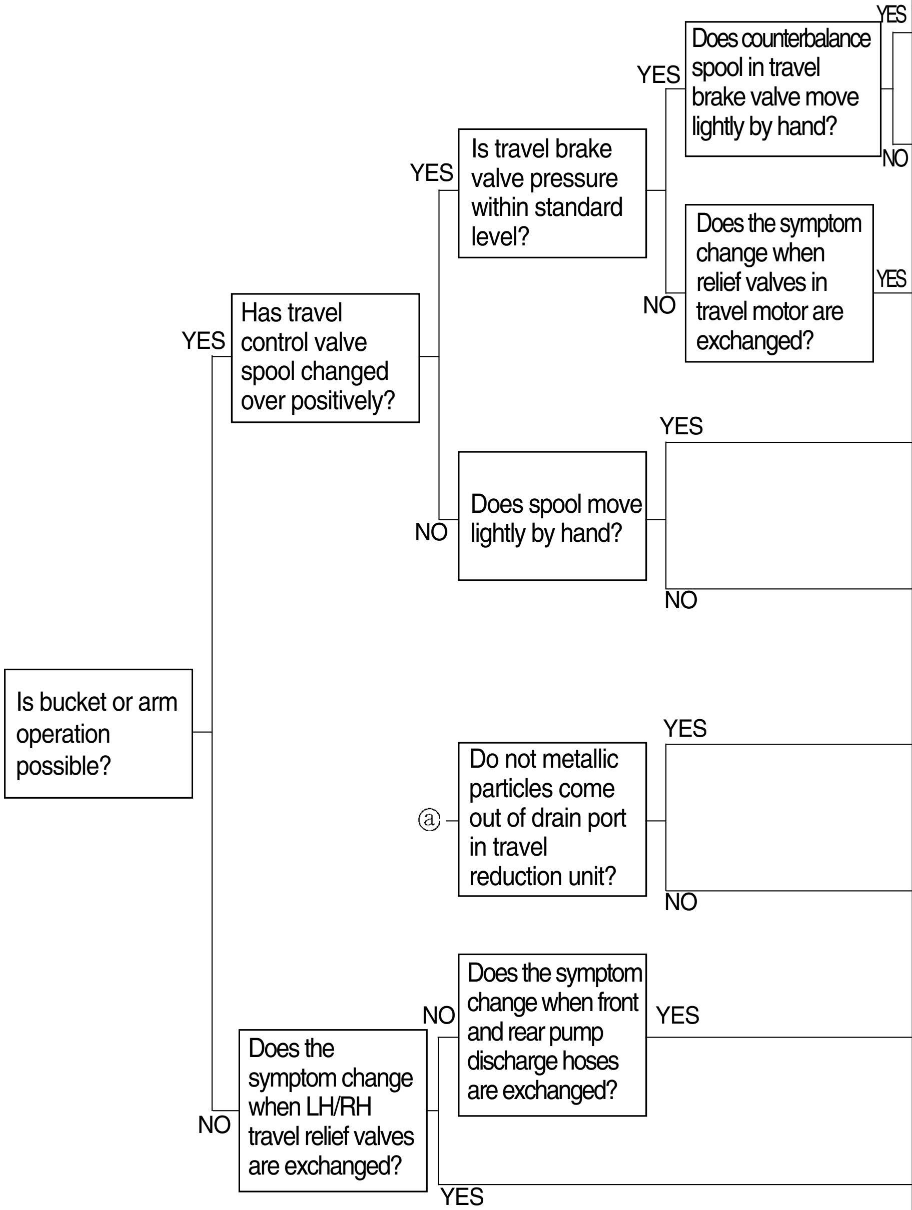
5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE



Cause	Remedy
ⓐ	
Shuttle valve is faulty.	Disassemble and replace.
Brake spring is faulty.	Disassemble and replace.
Return spring of swing control valve is faulty.	Disassemble and replace.
Swing relief valve is faulty.	Disassemble and repair or replace.
Swing motor is broken.	Disassemble and repair.
	Adjust swing relief valve pressure or replace swing relief valve.

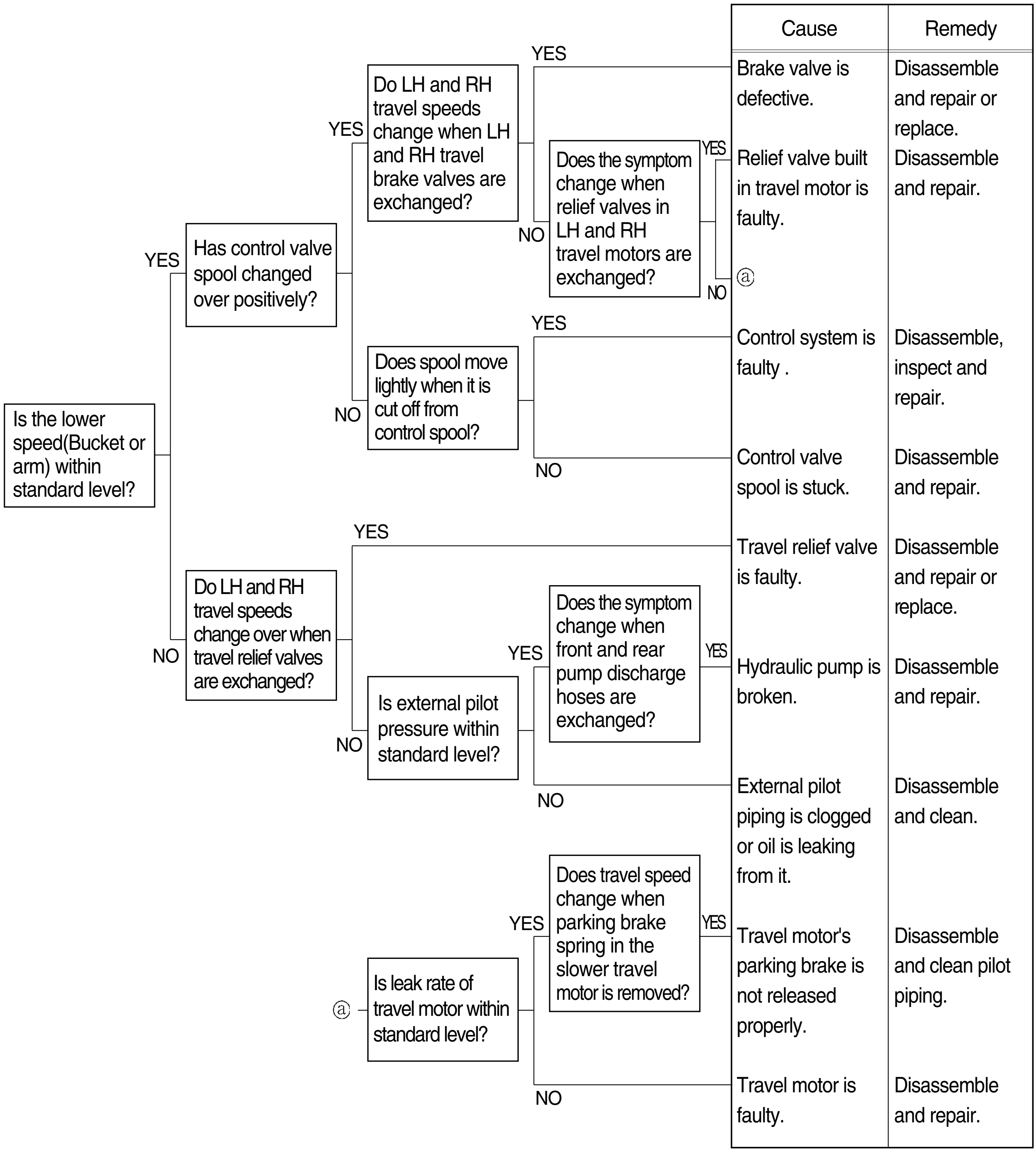
5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



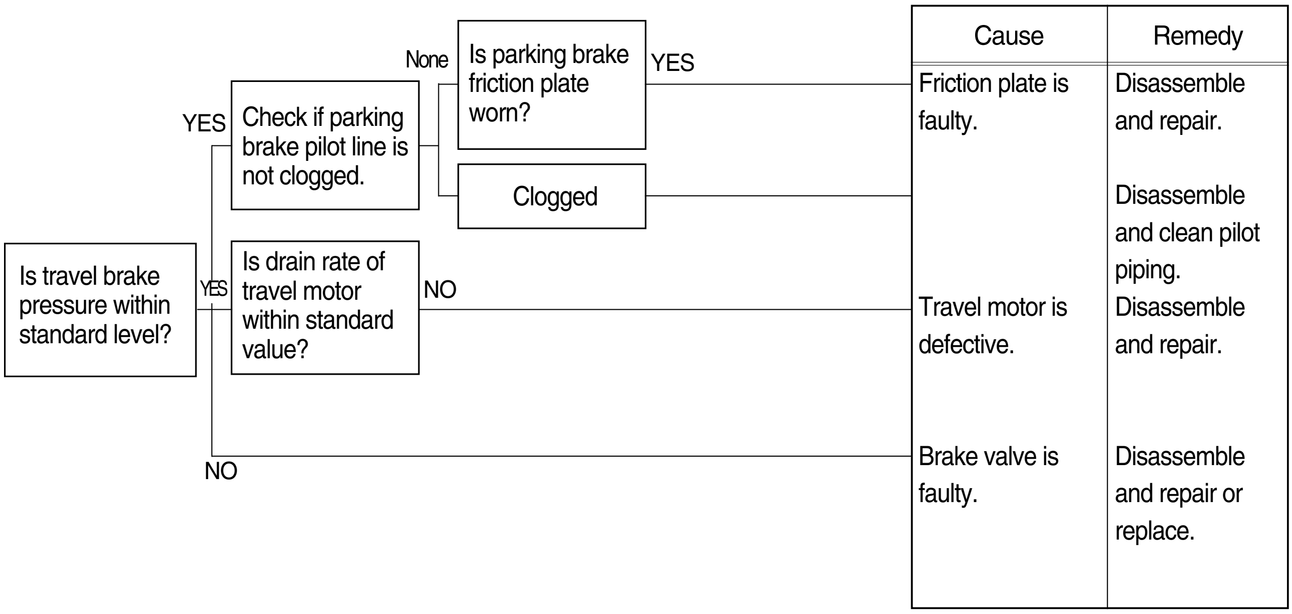
Cause	Remedy
ⓐ	
Counter spool in travel brake valve is stuck.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
Control system is defective.	Disassemble inspect and repair.
Travel control valve spool is stuck.	Disassemble and repair.
Travel reduction unit is faulty.	Disassemble and repair.
Travel motor is out of order.	Disassemble and repair.
Hydraulic pump is broken.	Disassemble and repair.
Travel relief valves are faulty.	Disassemble and repair or replace.

2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES

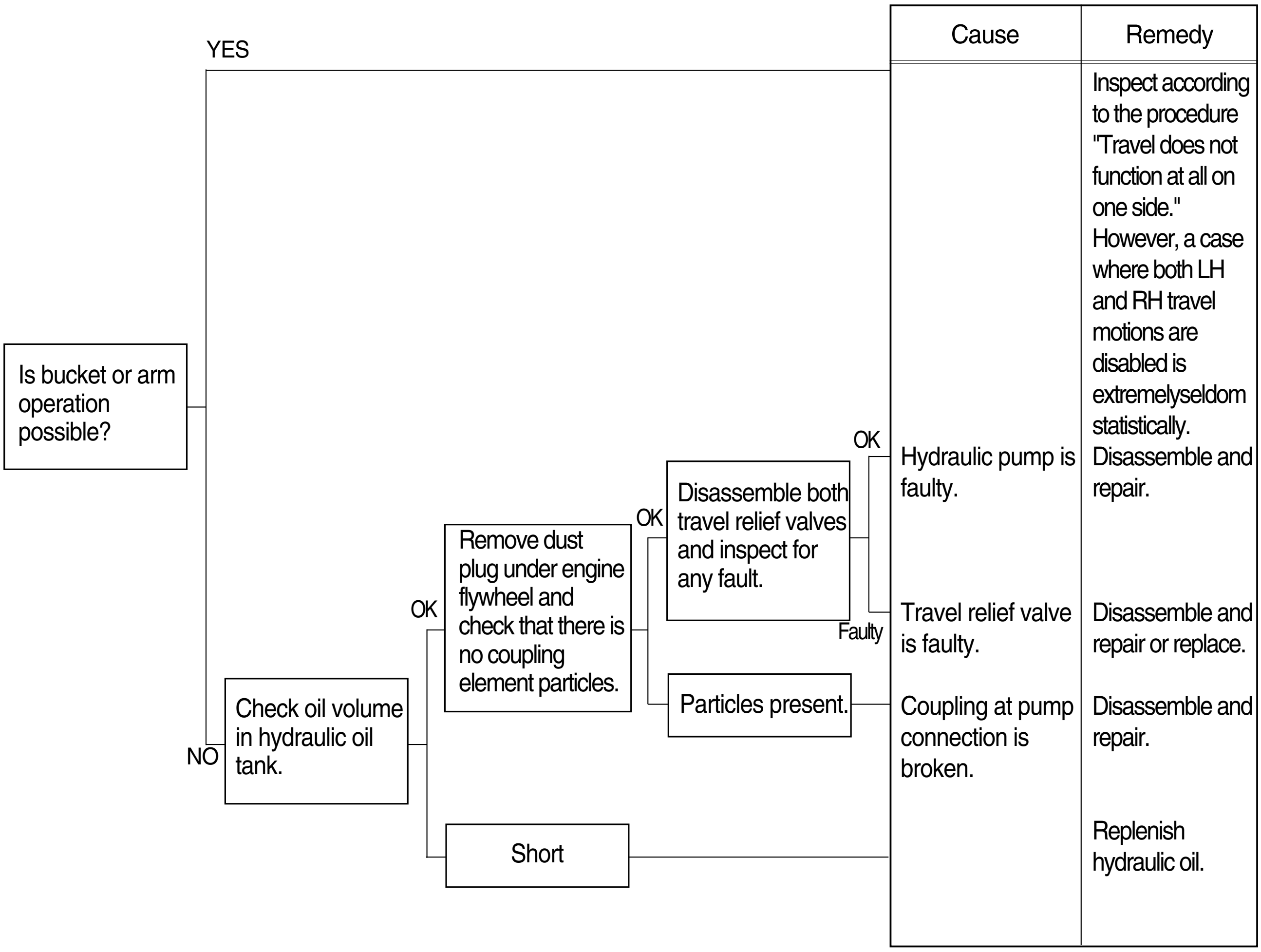


3) MACHINE DOES NOT STOP ON A SLOPE

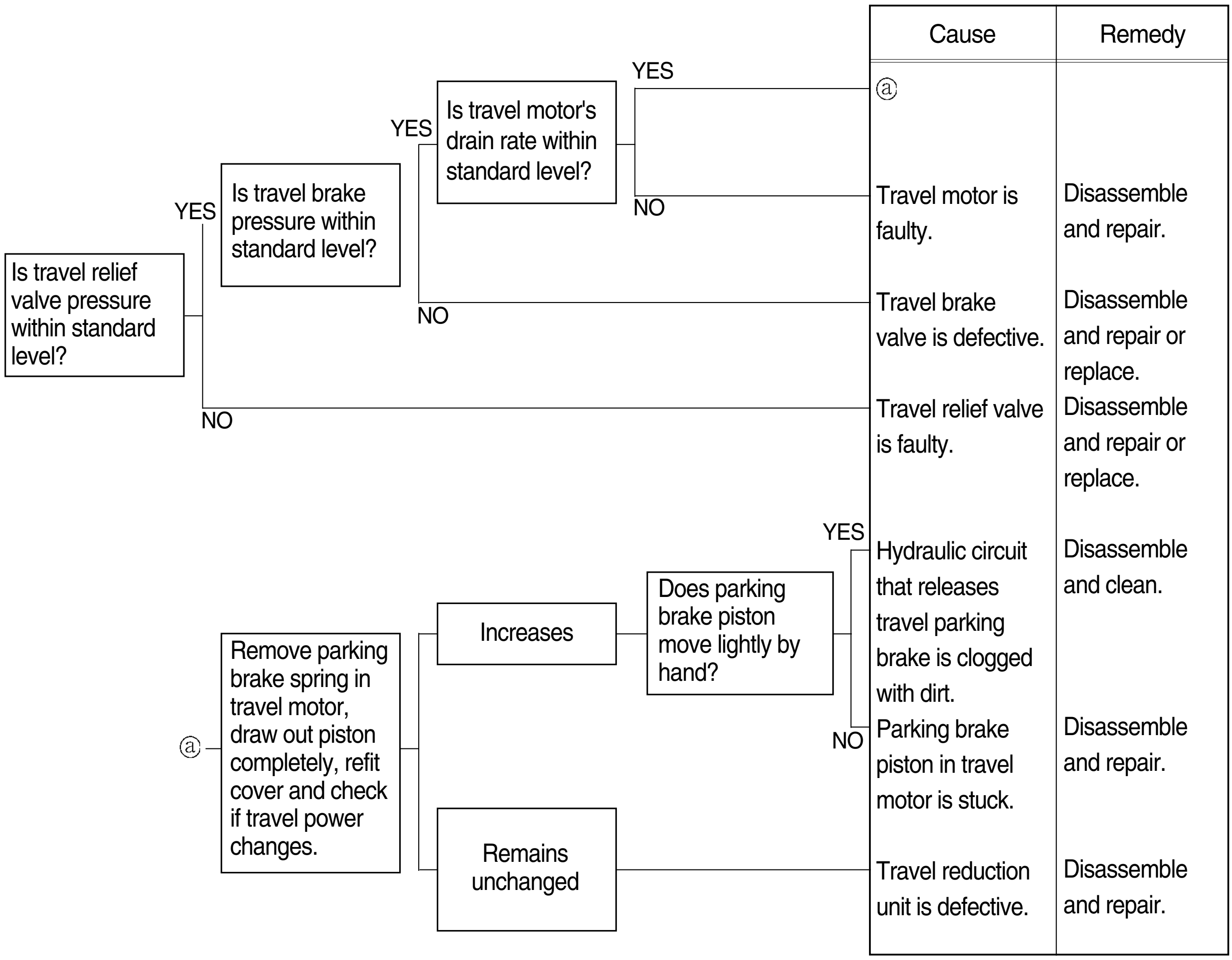
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

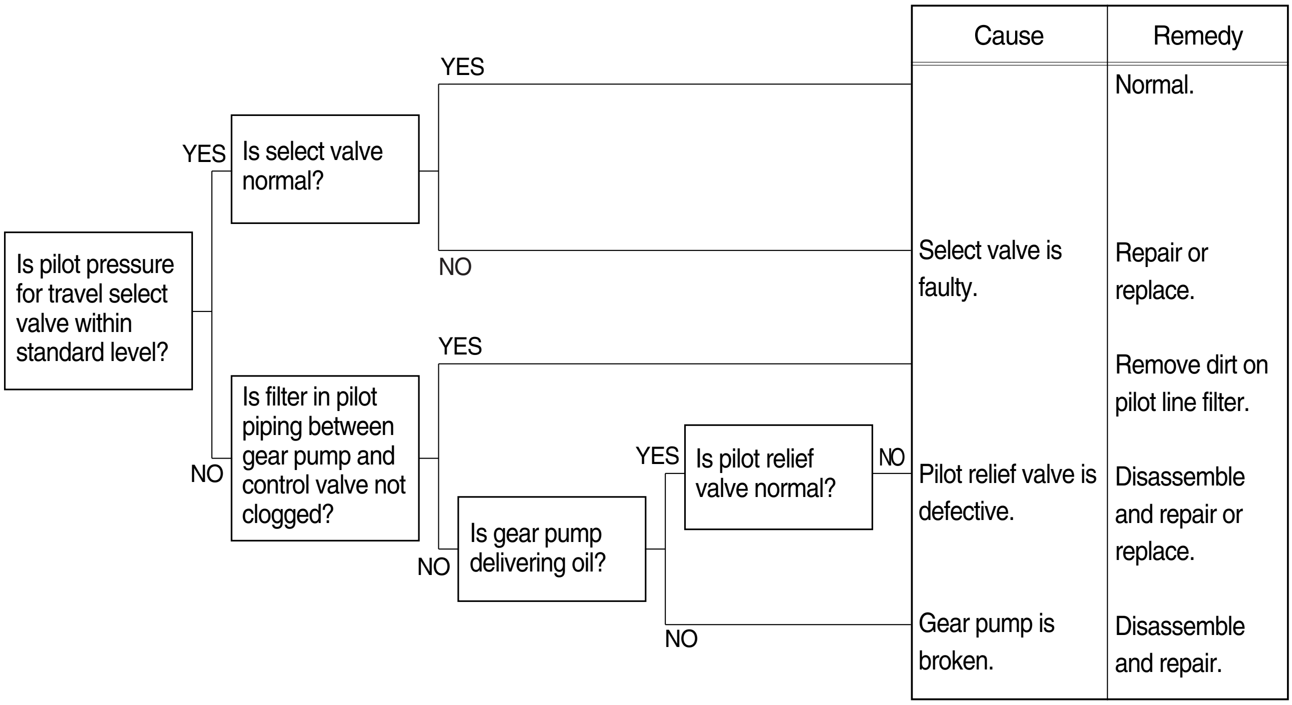


5) TRAVEL ACTION IS POWERLESS(Travel only)



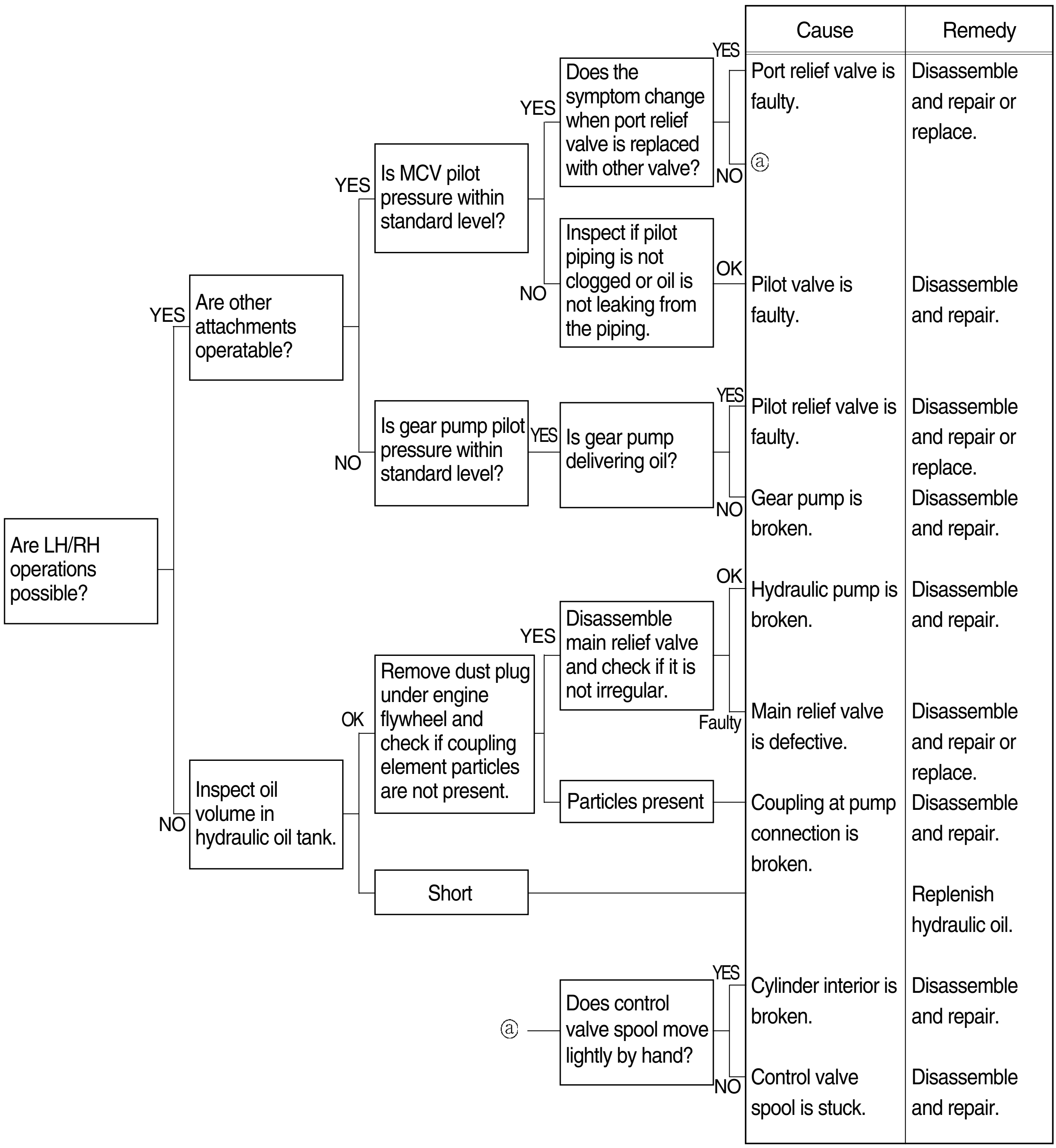
6) MACHINE RUNS RECKLESSLY ON A SLOPE

7) MACHINE MAKES A CURVED TRAVEL OR DOES NOT TRAVEL AT ALL WHEN TRAVEL AND ATTACHMENT OPERATIONS ARE EXECUTED AT THE SAME TIME

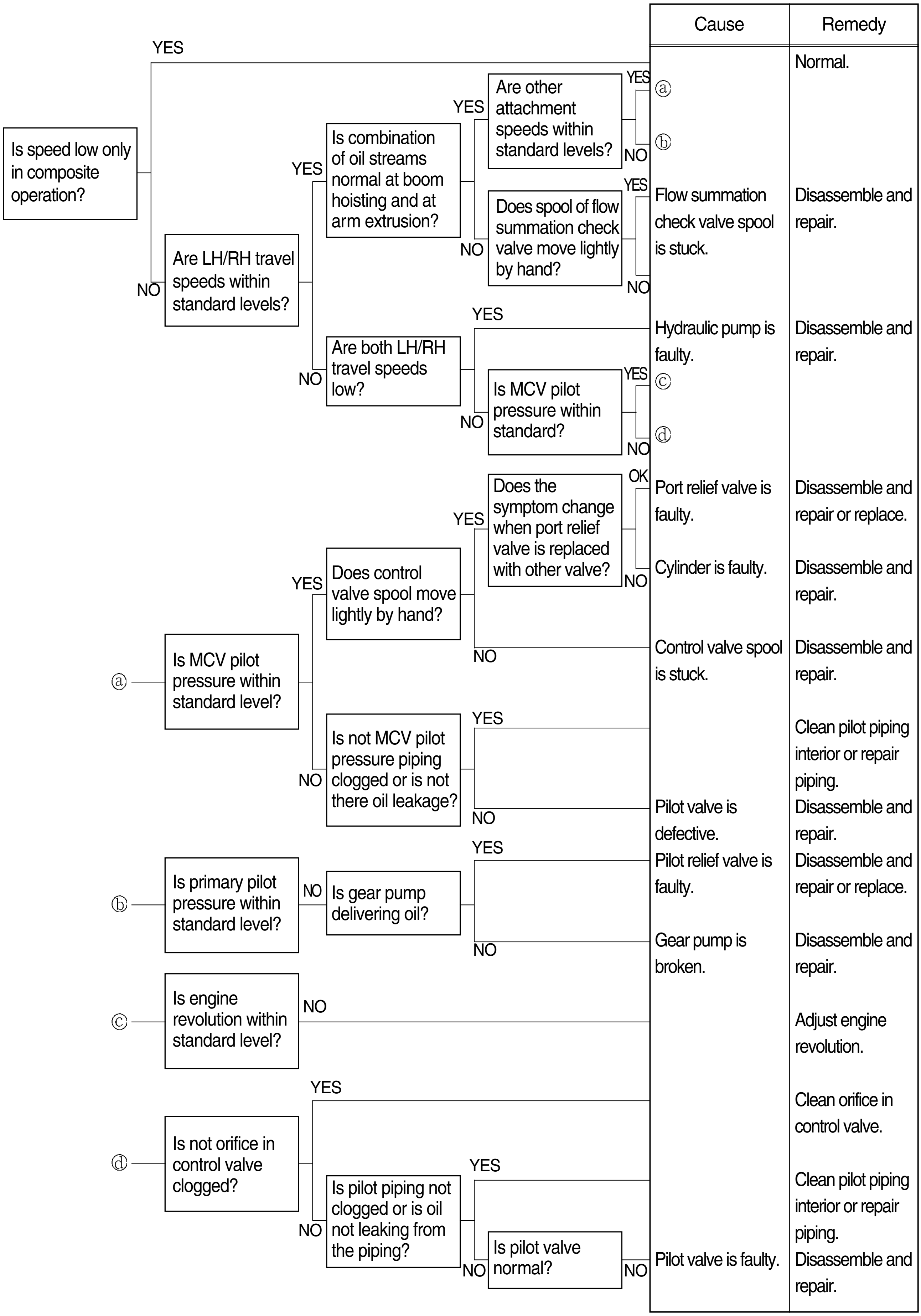


6. ATTACHMENT SYSTEM

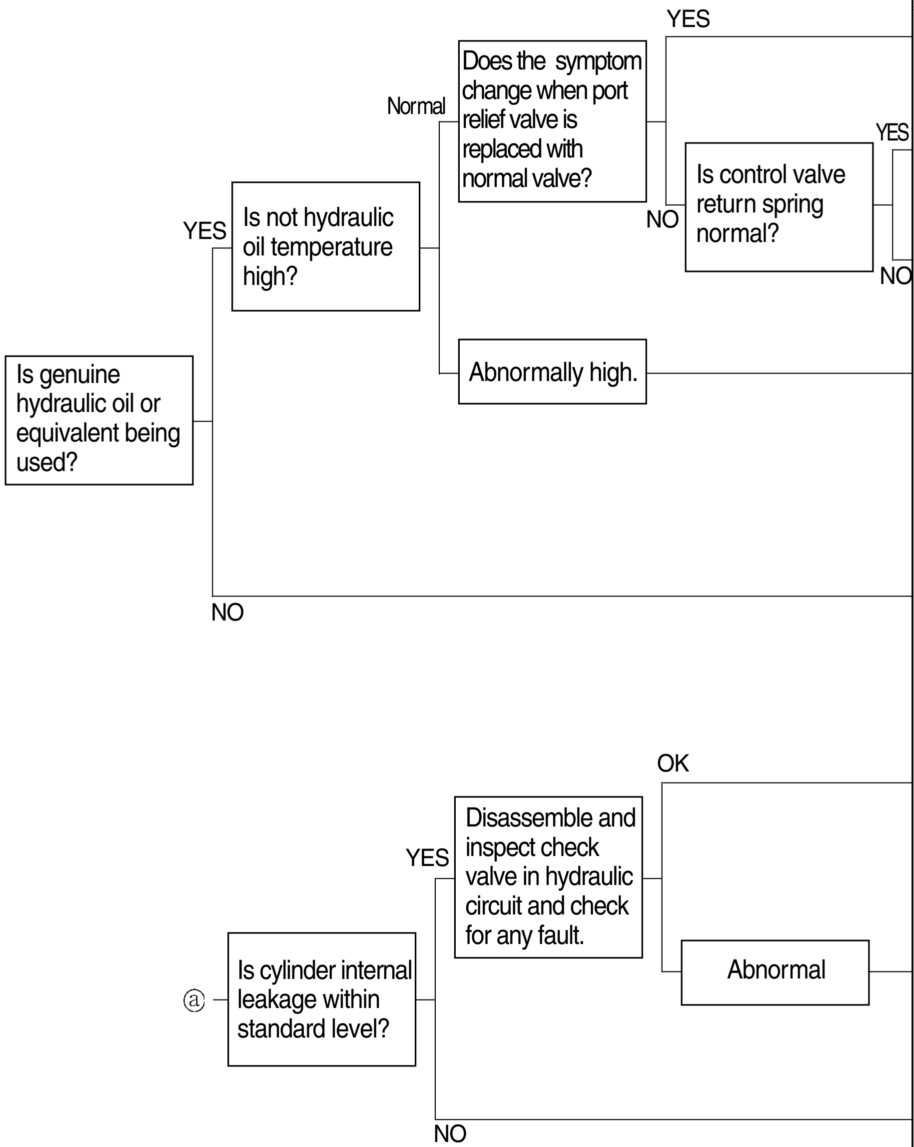
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

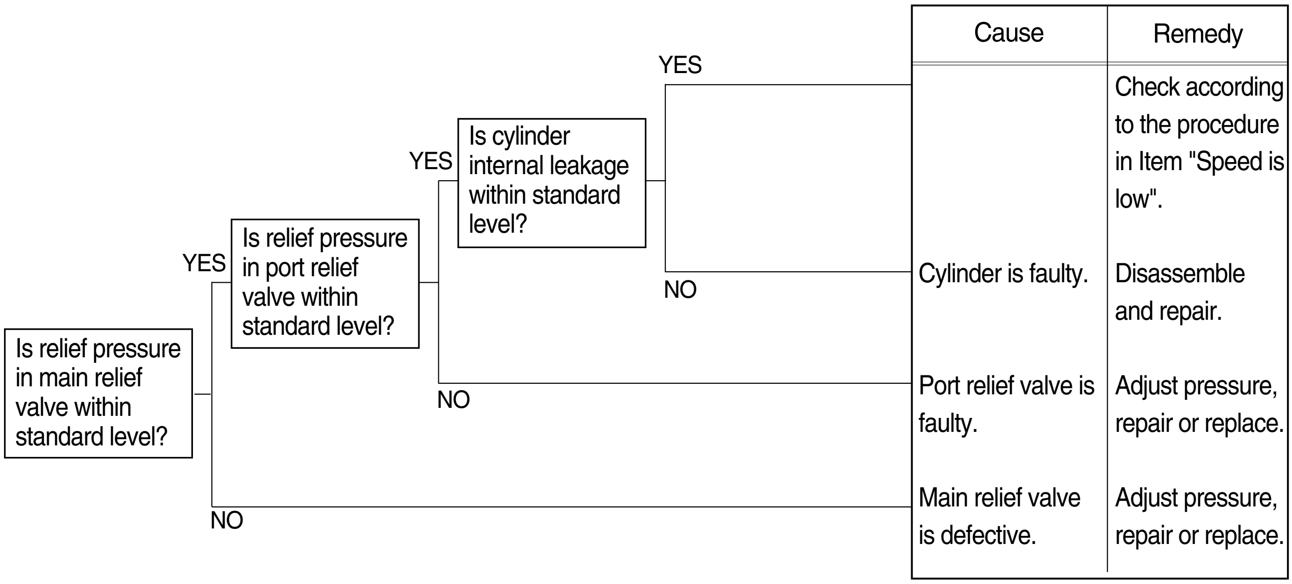


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT

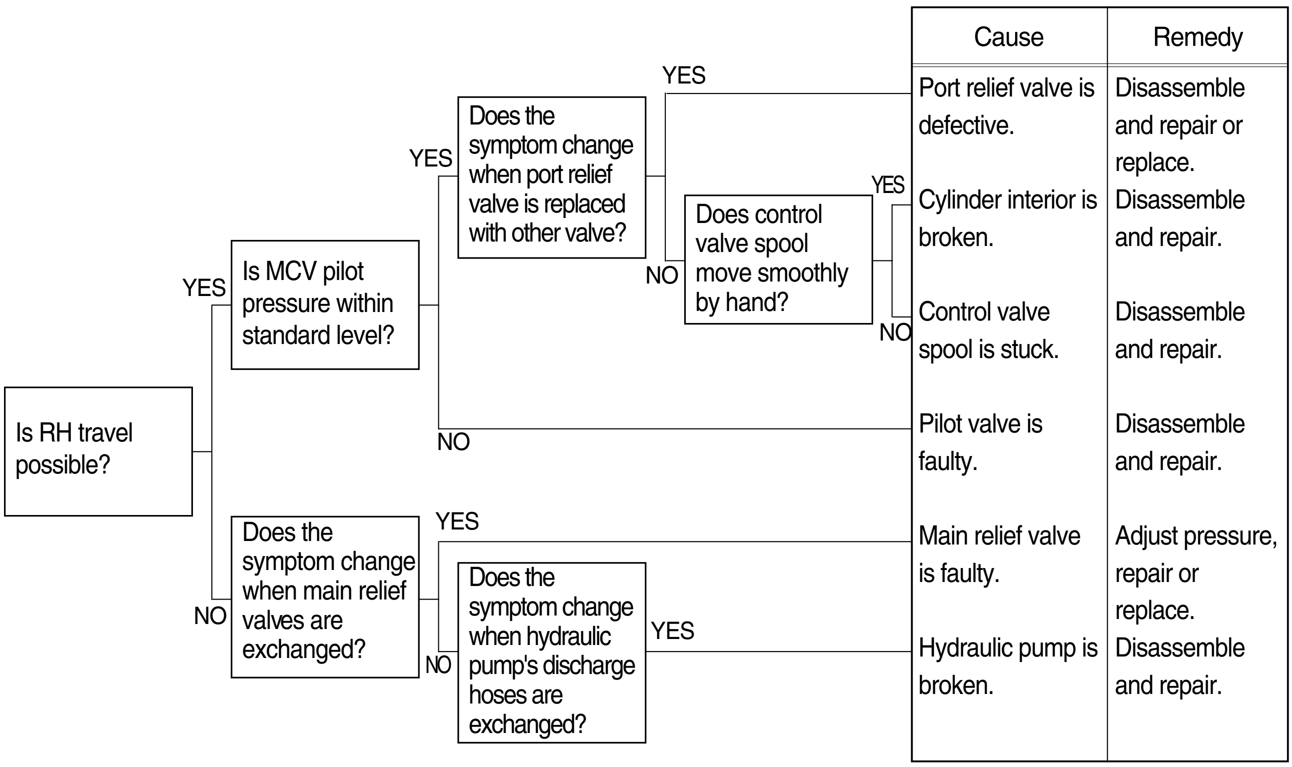


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between control valve casing and spool is poor.	Disassemble and repair.
Contact surface between poppet and seat is poor.	Disassemble and repair.
Cylinder is faulty.	Disassemble

4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



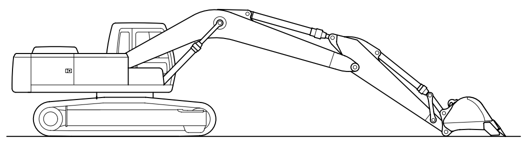
6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

Is boom foot pin greased sufficiently?

	Cause	Remedy
YES		Frictional noise occurs between the sliding faces of boom cylinder's oil seal and boom proper. ※ Frictional noise will disappear if they are kept used.
NO	Boom foot pin has run out of grease.	Supply grease to it. ※ If seizure is in an initial stage, supply sufficient grease. If seizure is in a grown state, correct it by paper lapping or with an oil stone.

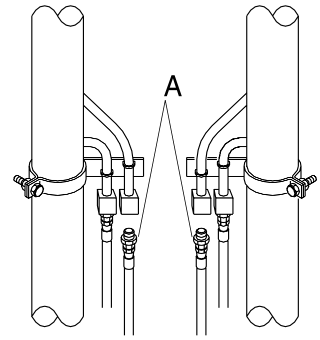
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

1. Lower the bucket teeth to the ground with bucket cylinder fully retracted and arm cylinder rod retracted almost in full.



29076TS01

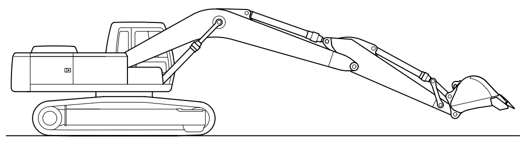
2. Disconnect hoses(A) from rod side of boom cylinder and drain oil from cylinders and hose.(Put cups on piping and hose ends)



6-20(2) 210-7

3. Raise bucket OFF the ground by retracting the arm cylinder rod.

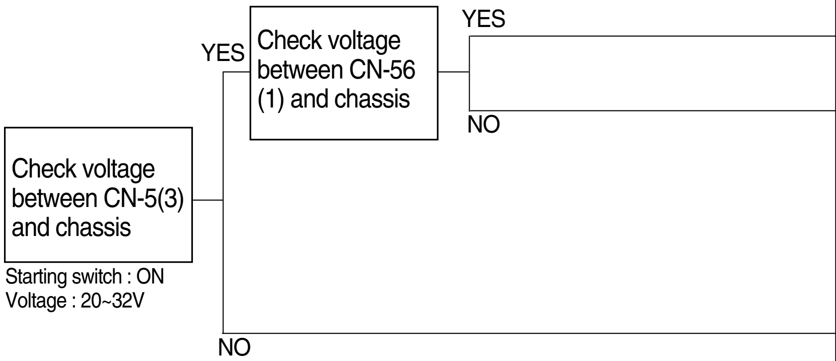
   If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.
   If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



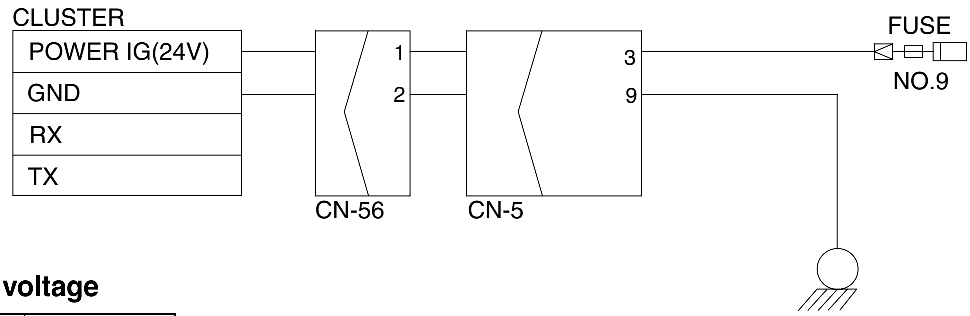
29076TS01

1. WHEN STARTING SWITCH IS TURNED ON, MONITOR PANEL DISPLAY DOES NOT APPEAR

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.9.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective clucter	Replace
Disconnection in wiring harness or poor contact between CN-5(3)-CN-56(1)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CN-5(3)- and fuse No.9	Repair or replace (After clean)



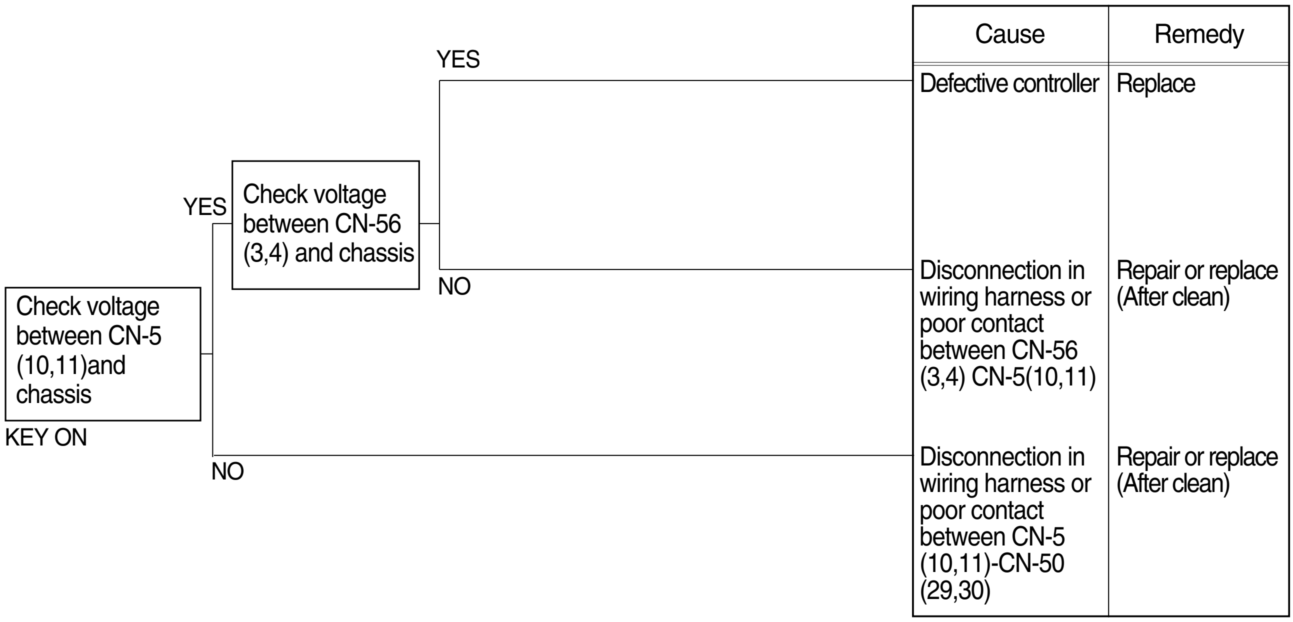
Check voltage

YES	20 ~ 32V
NO	0V

51076ES01

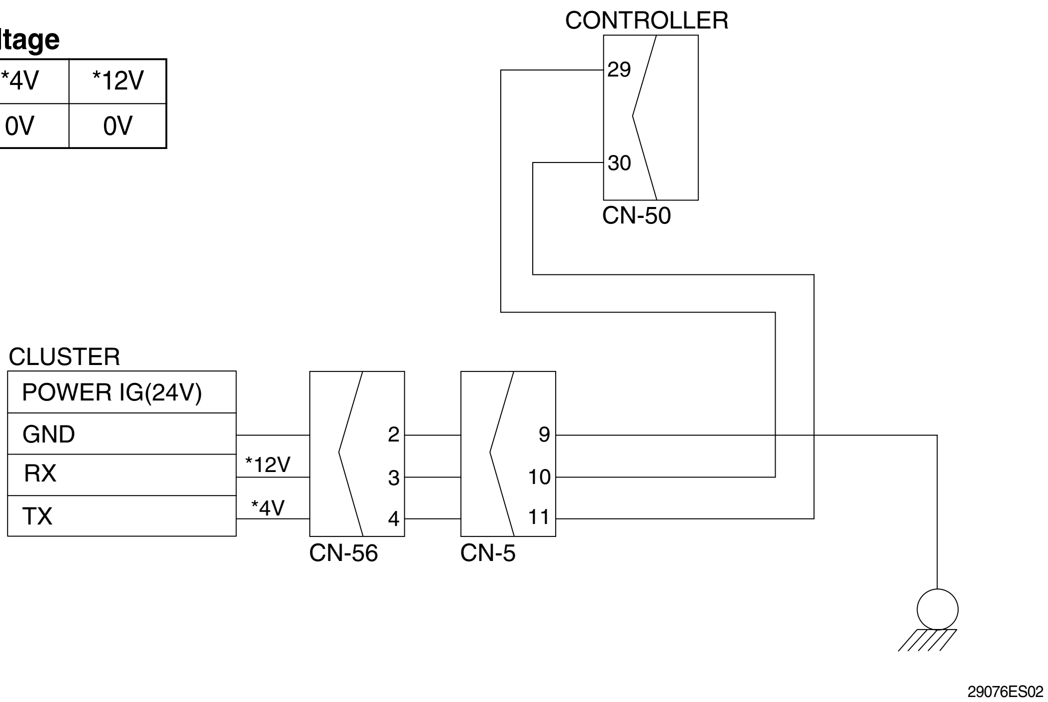
2. COMMUNICATION ERROR "Co : Er" FLASHES ON THE CLUSTER

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



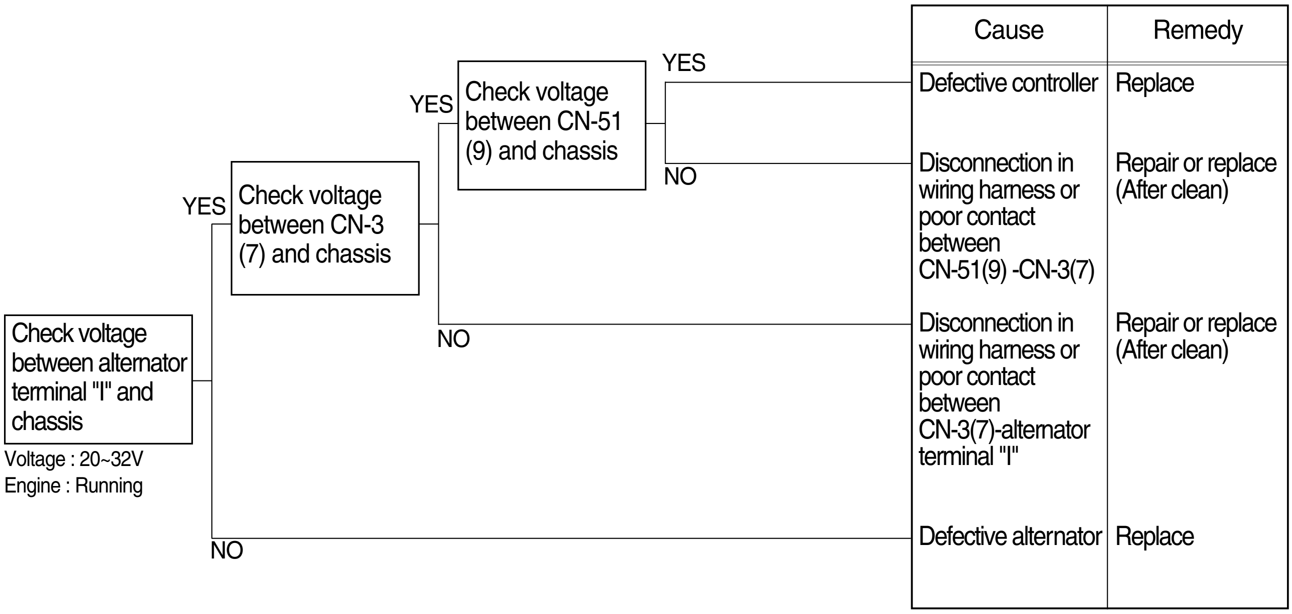
Check voltage

YES	*4V	*12V
NO	0V	0V



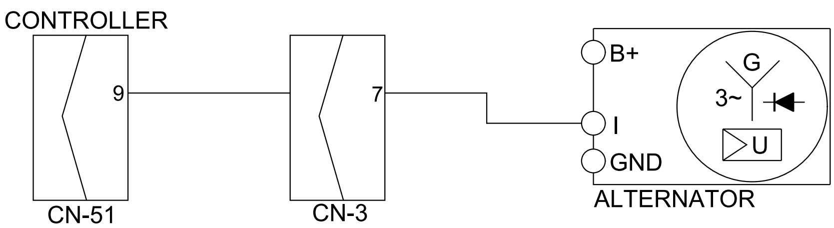
3. BATTERY CHARGING WARNING LAMP LIGHTS UP(Starting switch : ON)

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Check voltage

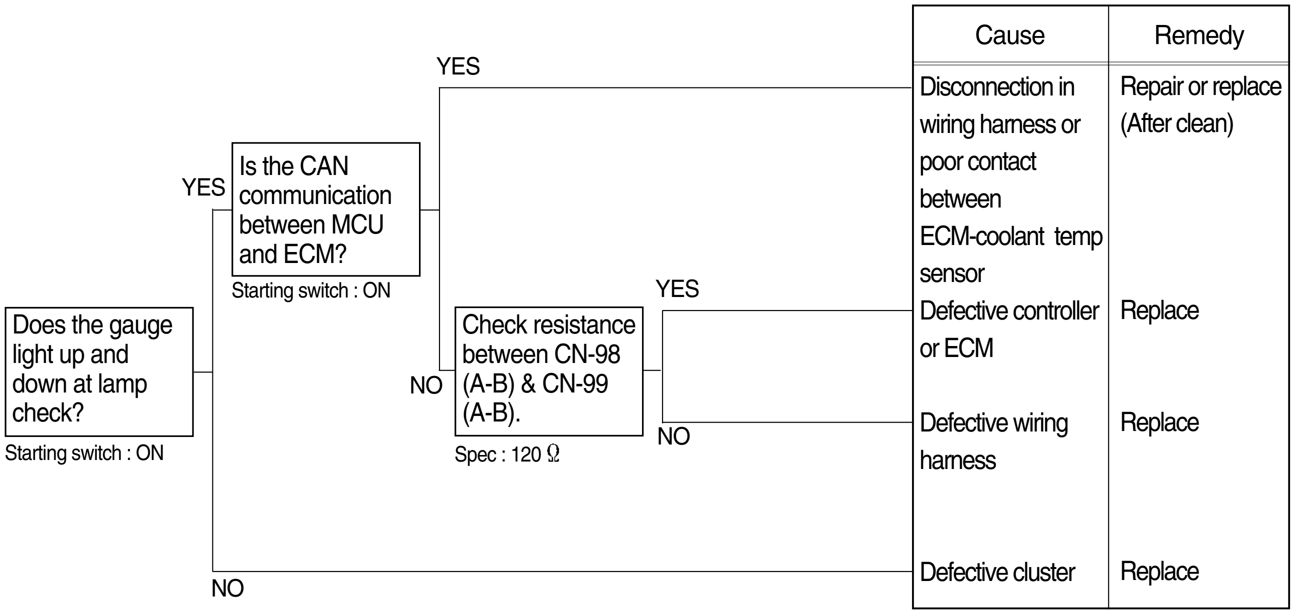
YES	20 ~ 32V
NO	0V

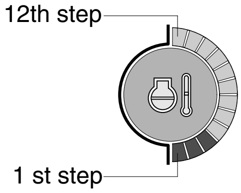


51076ES02

4. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP(Engine is started)

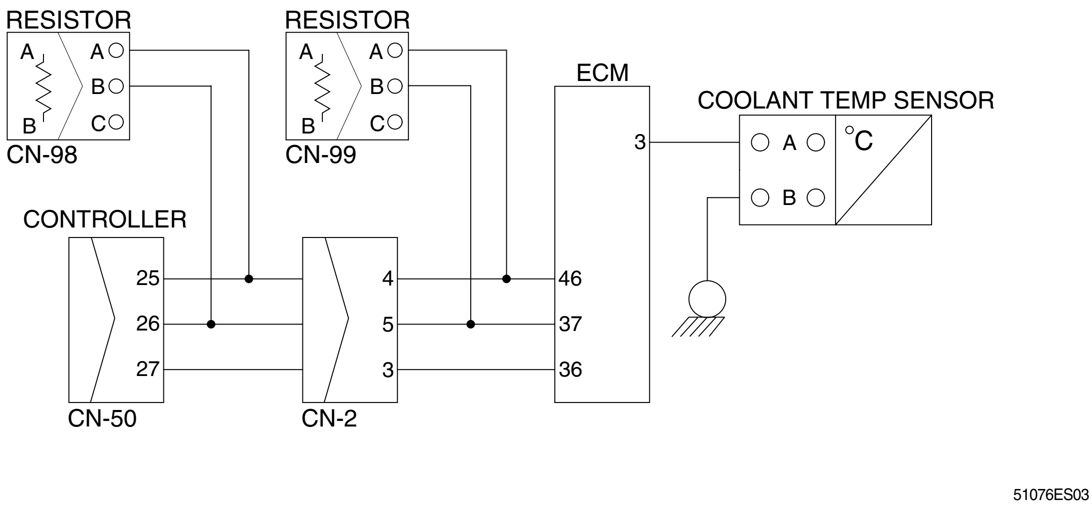
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





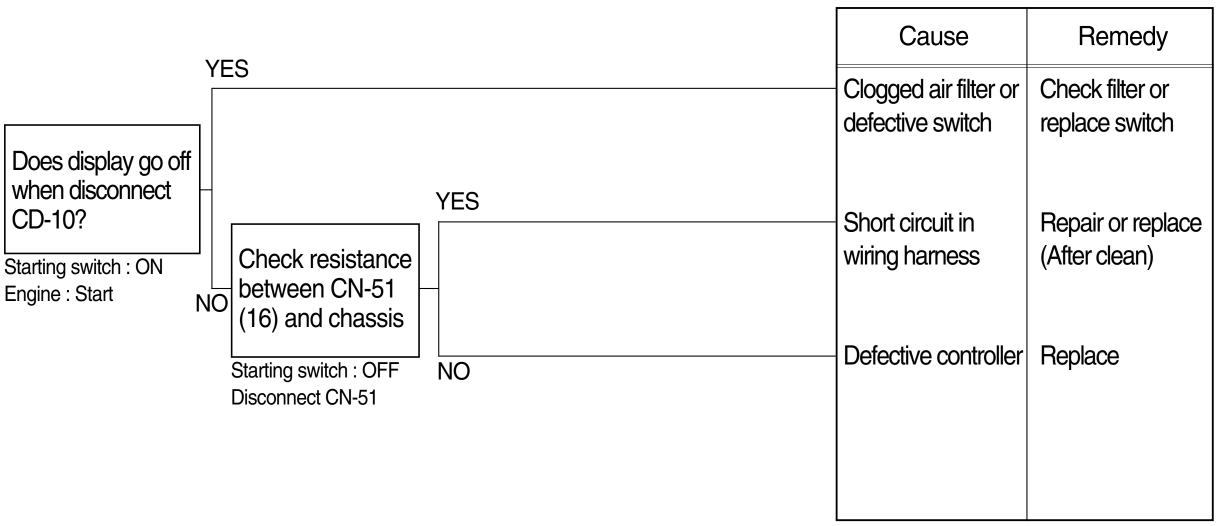
Check Table

Item \ Temperature	White range (~29℃)	Green range (30~105℃)	Red range (105℃ ~)



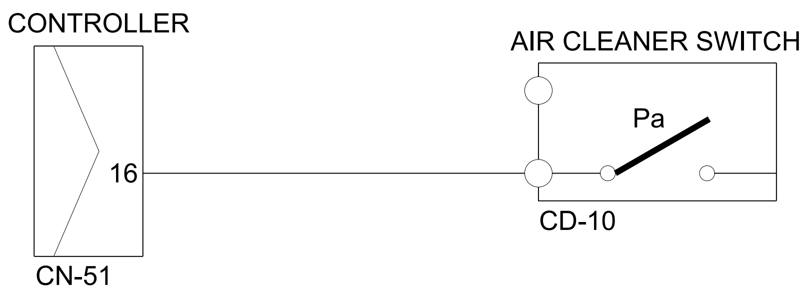
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP(Engine is started)

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Check resistance

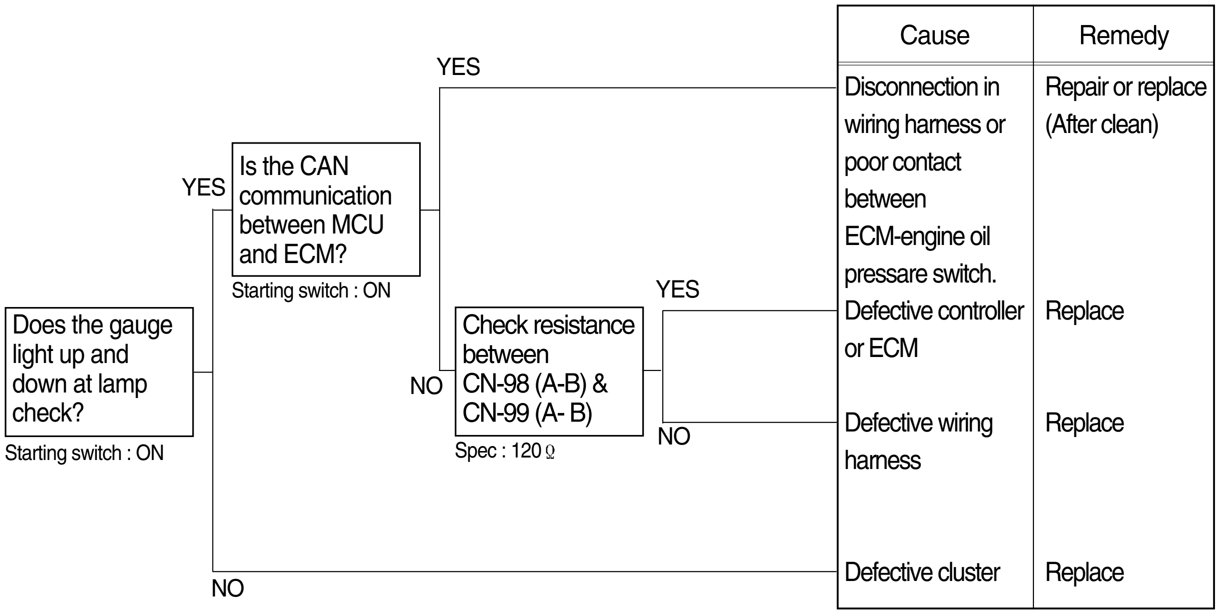
YES	MAX 1Ω
NO	MIN 1MΩ



36076TS05

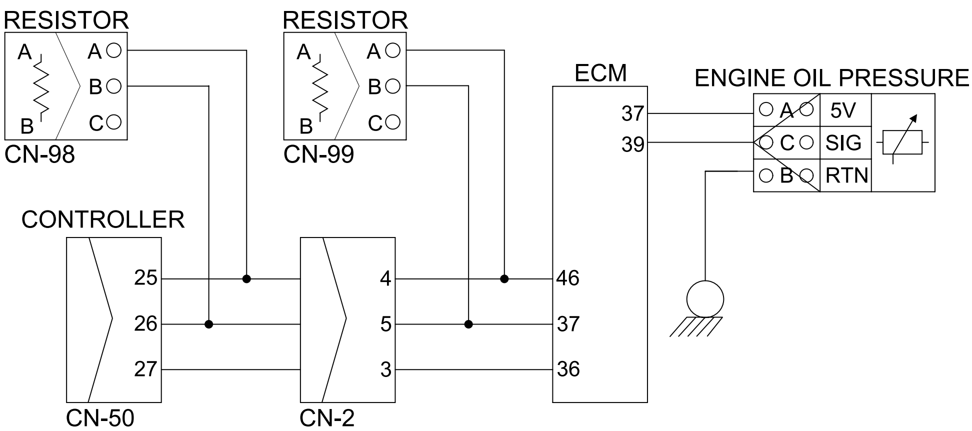
6. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP(Engine is started)

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Check resistance

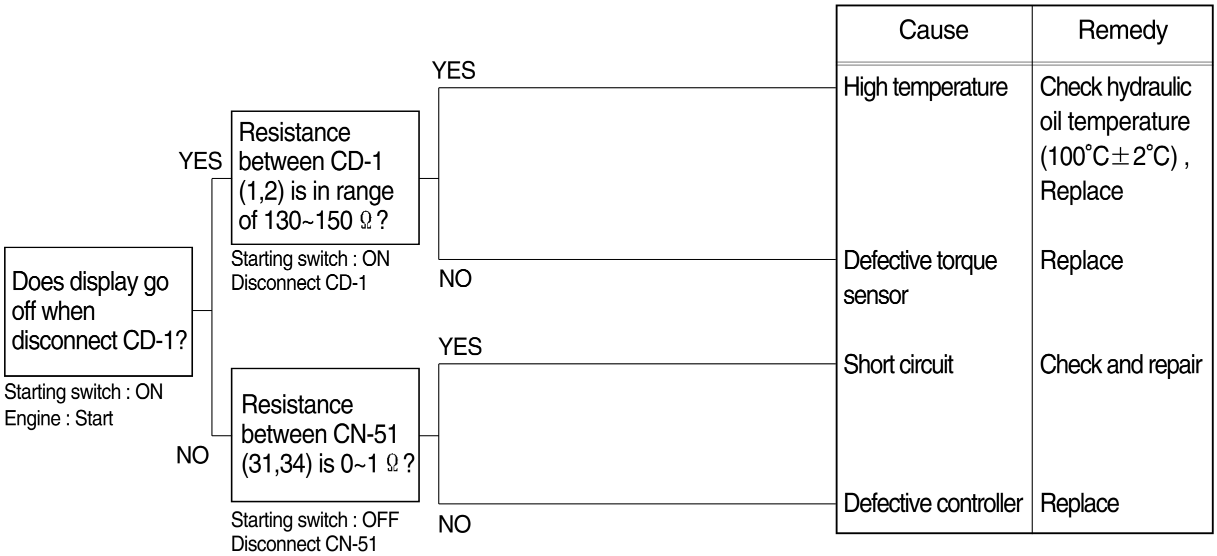
YES	MAX 1Ω
NO	MIN 1MΩ

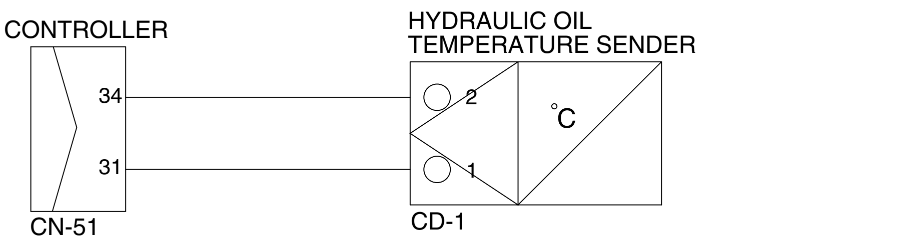


51076ES04

7. WHEN HYDRAULIC OIL TEMPERATURE WARNING LAMP LIGHTS UP(Engine is started)

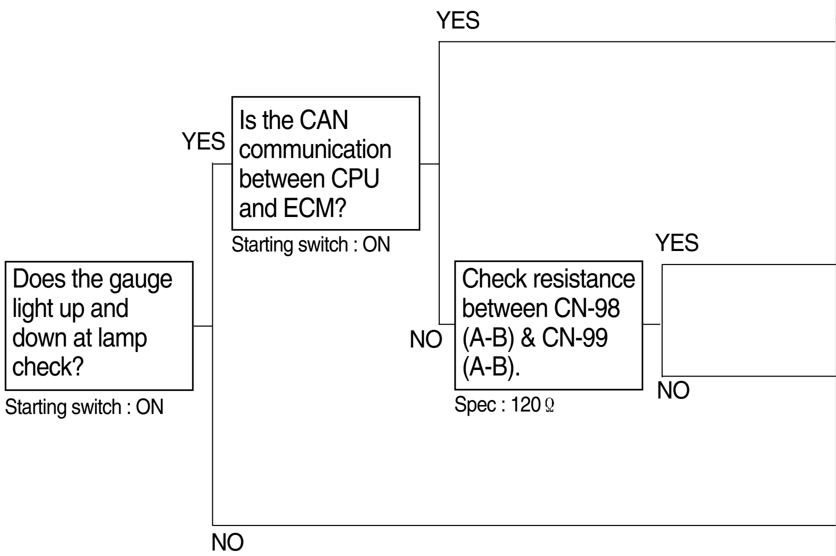
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.



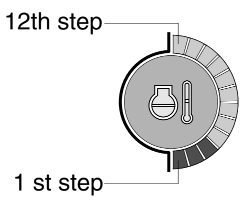


8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

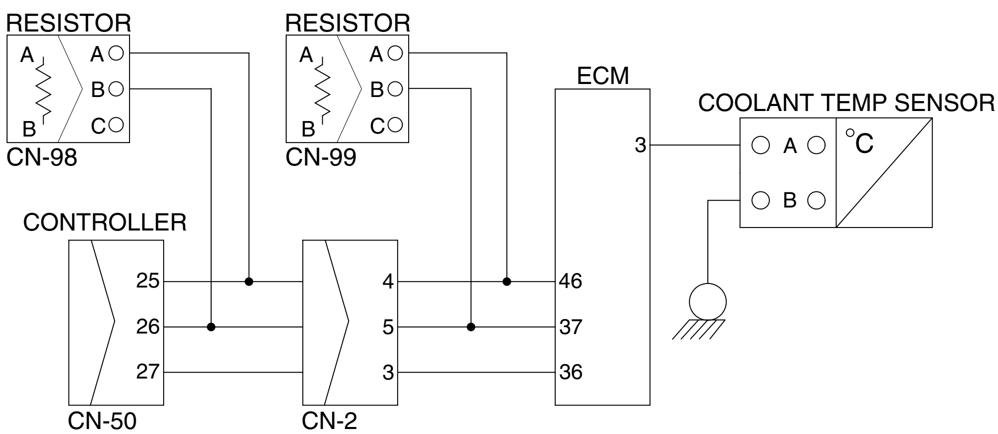


Cause	Remedy
Disconnection in wiring harness or poor contact between ECM-coolant temp sensor	Repair or replace (After clean)
Defective controller or ECM	Replace
Defective wiring harness	Replace
Defective cluster	Replace



Check Table

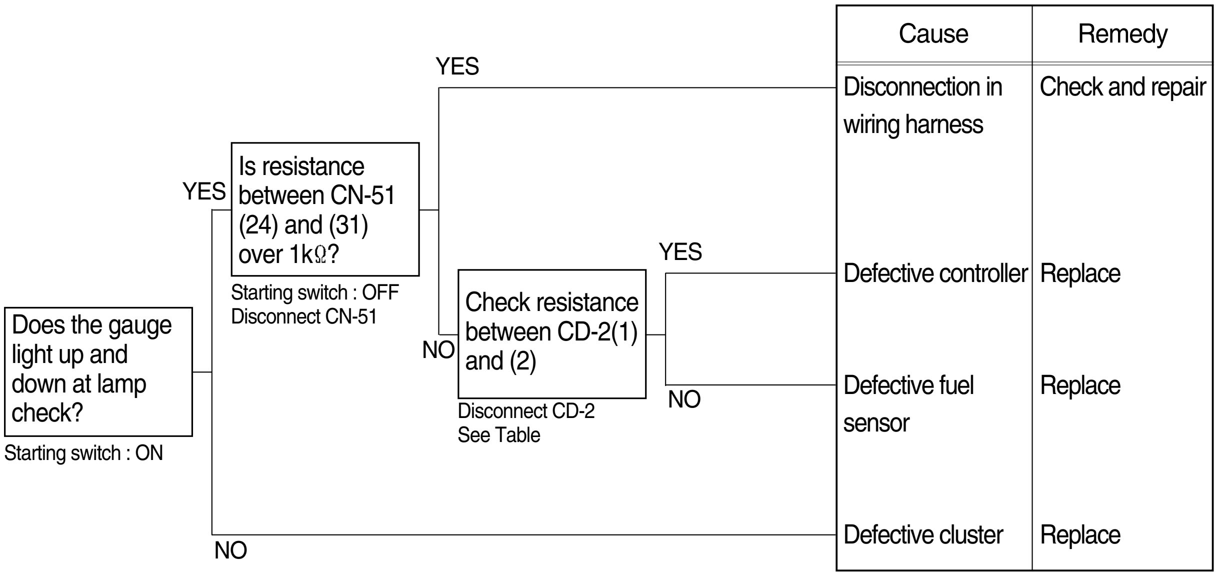
Temperature / Item	White range (~29˚C)	Green range (30~105˚C)	Red range (105˚C ~)

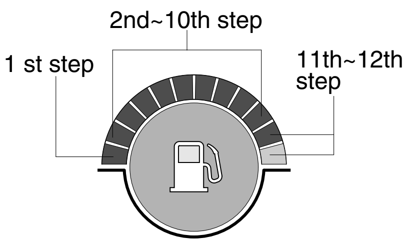


51076ES03

9. WHEN FUEL GAUGE DOES NOT OPERATE(Check warning lamp ON/OFF)

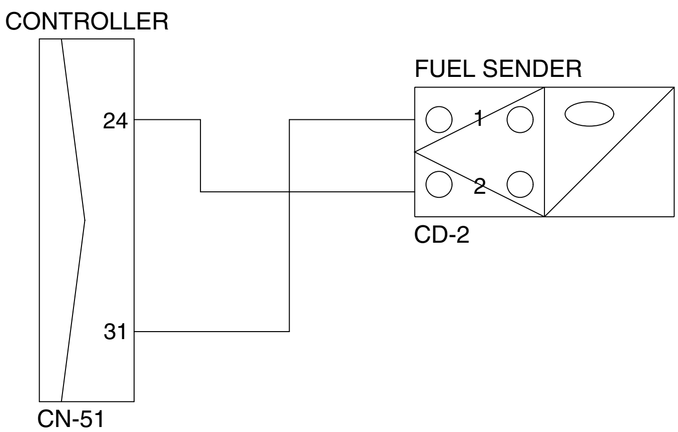
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

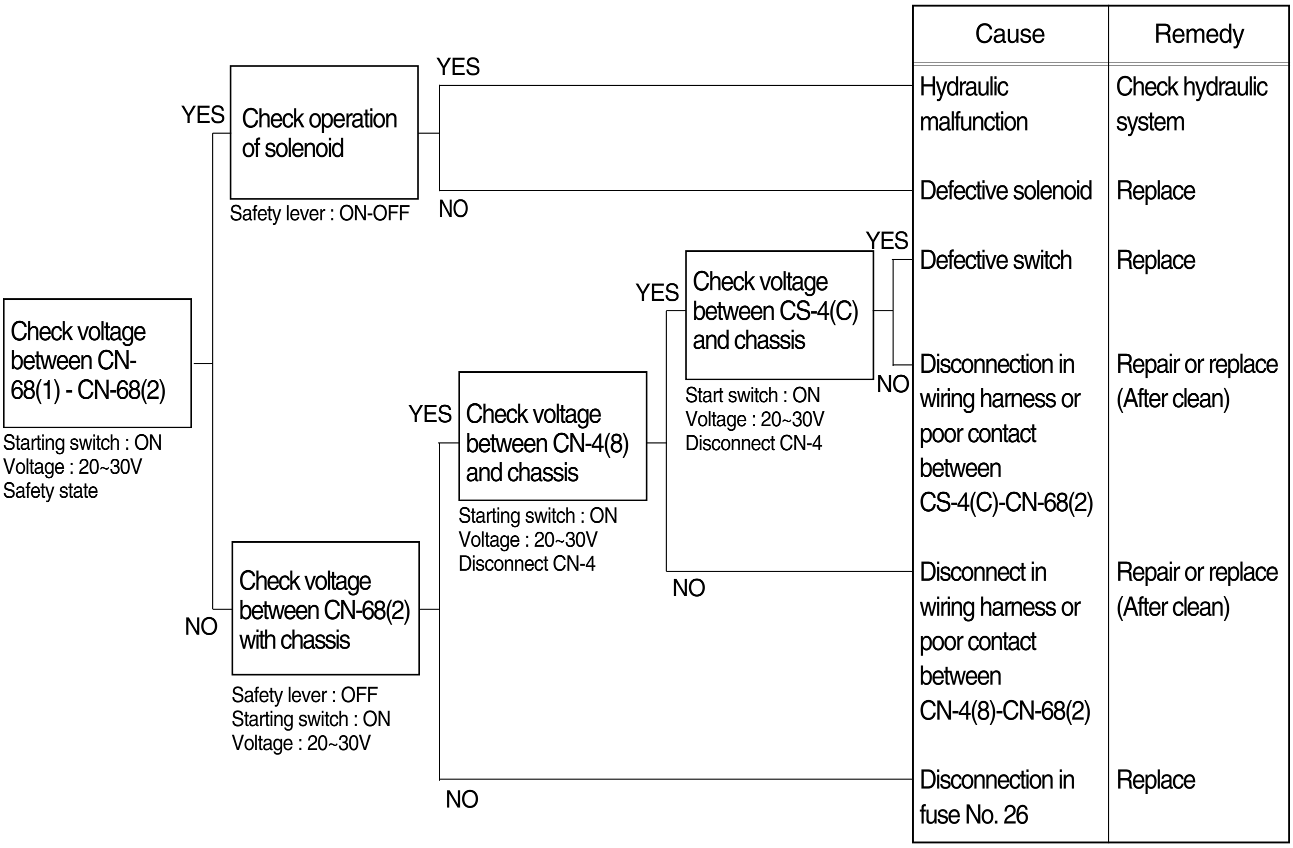
Item \ Level	White range	Green range	Red range
Unit Resistance(Ω)	700~601	600~101	~100
Tolerance(%)	±5	±5	±5

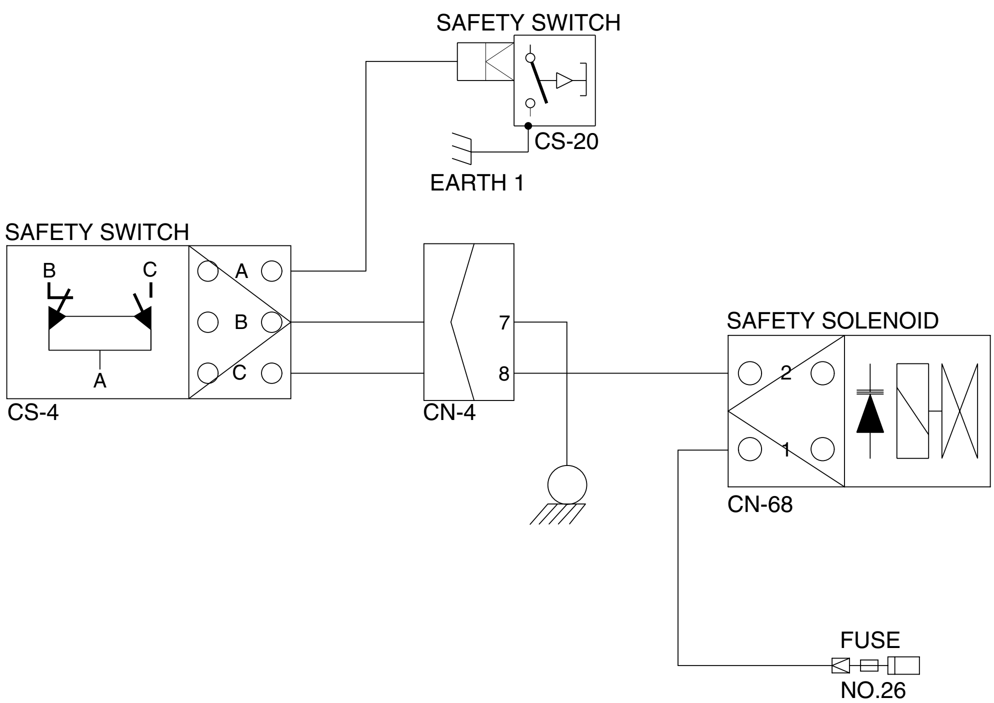


29076ES06

10. WHEN SAFETY SOLENOID DOES NOT OPERATE

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.26.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

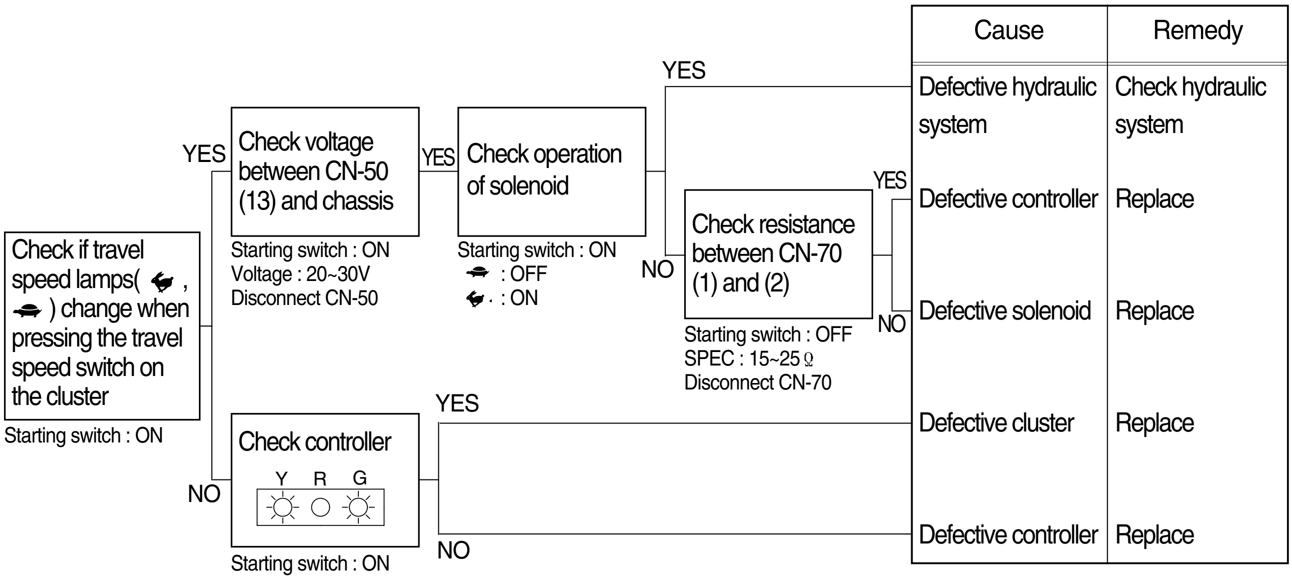


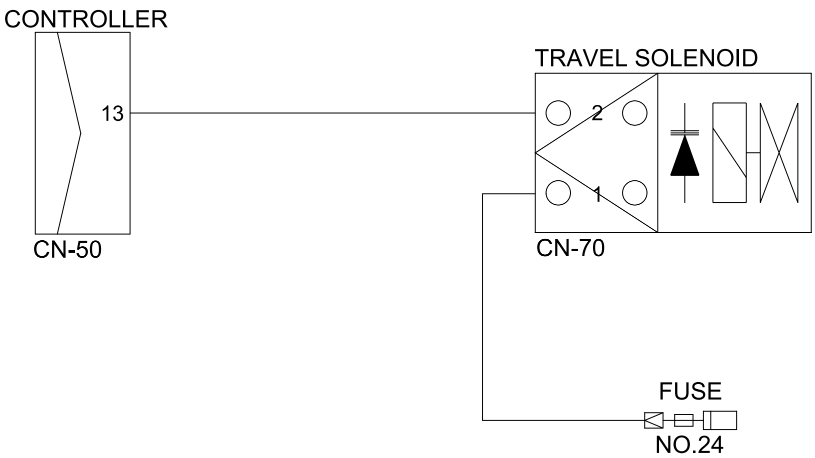


51076ES05

11. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.24 .
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

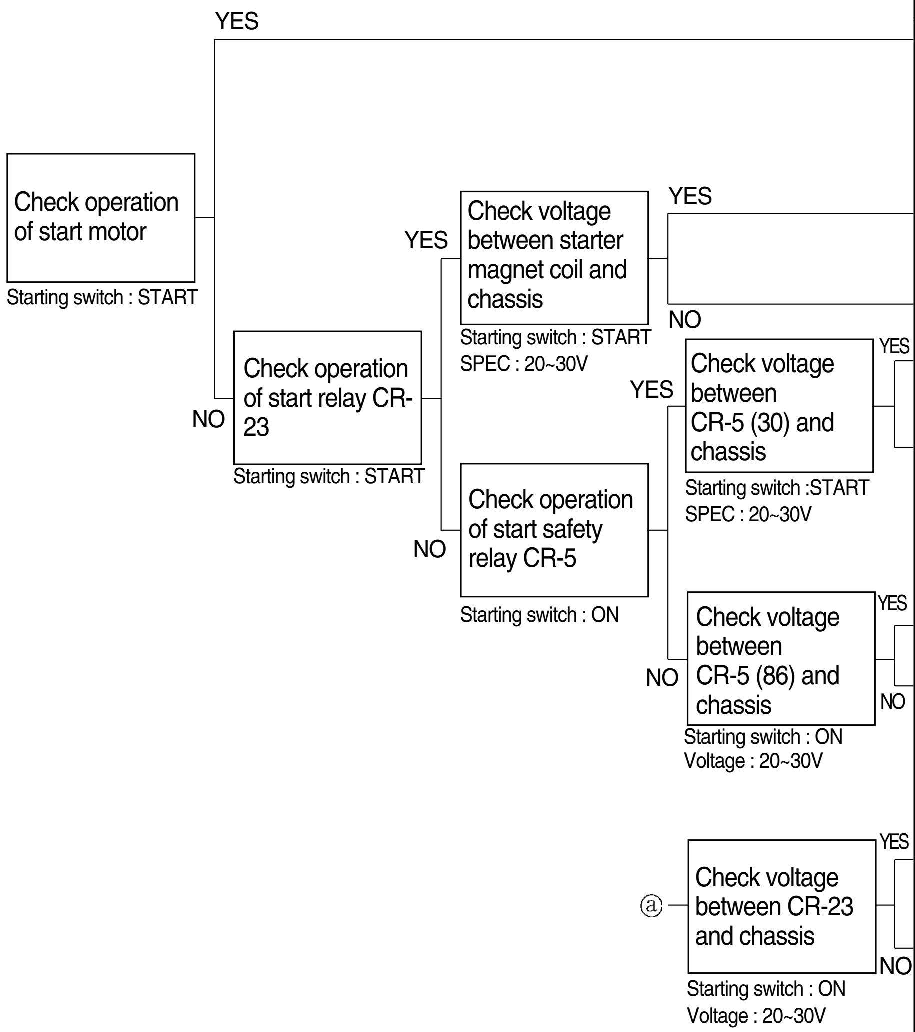




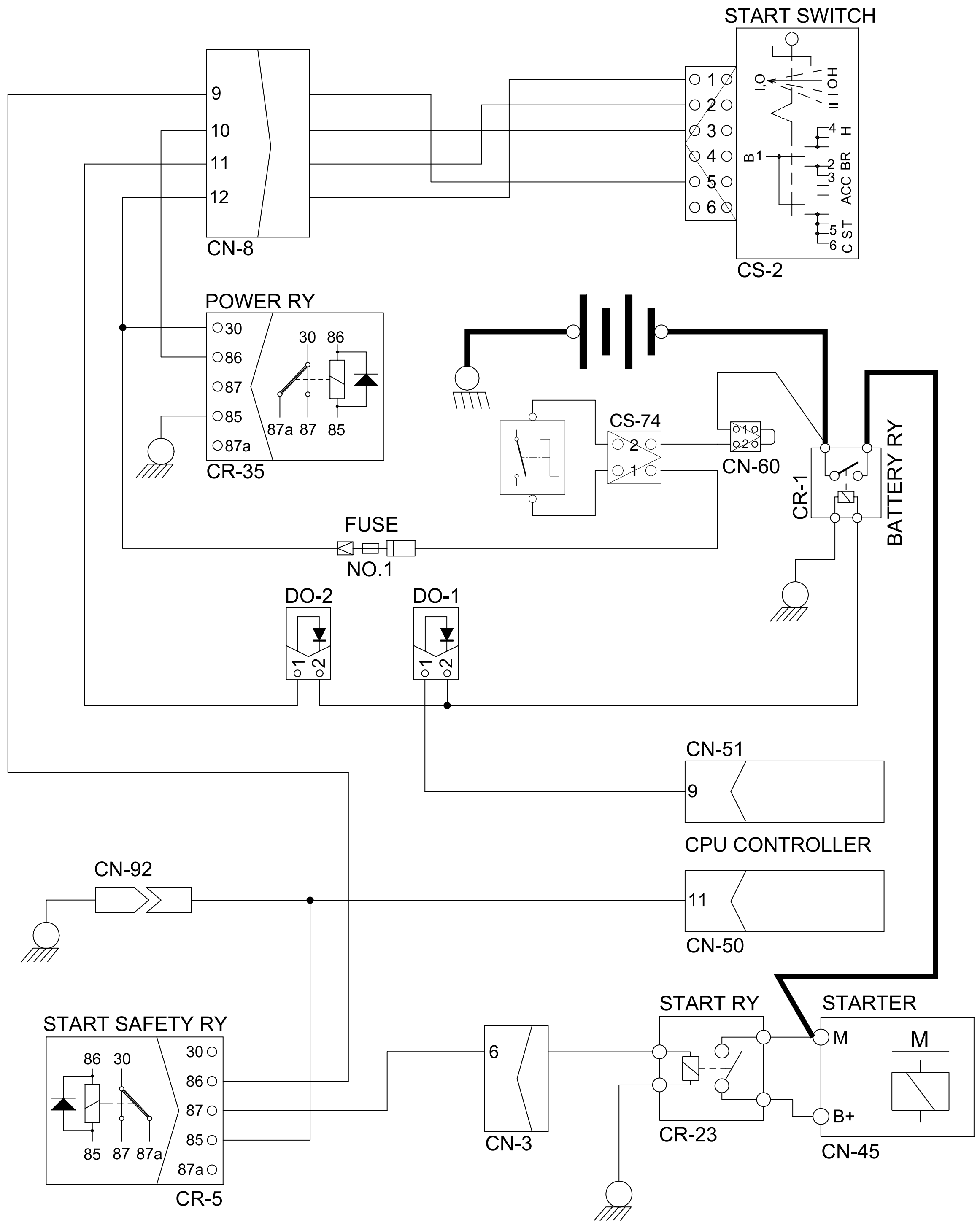
45076ES03

12. WHEN ENGINE DOES NOT START

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



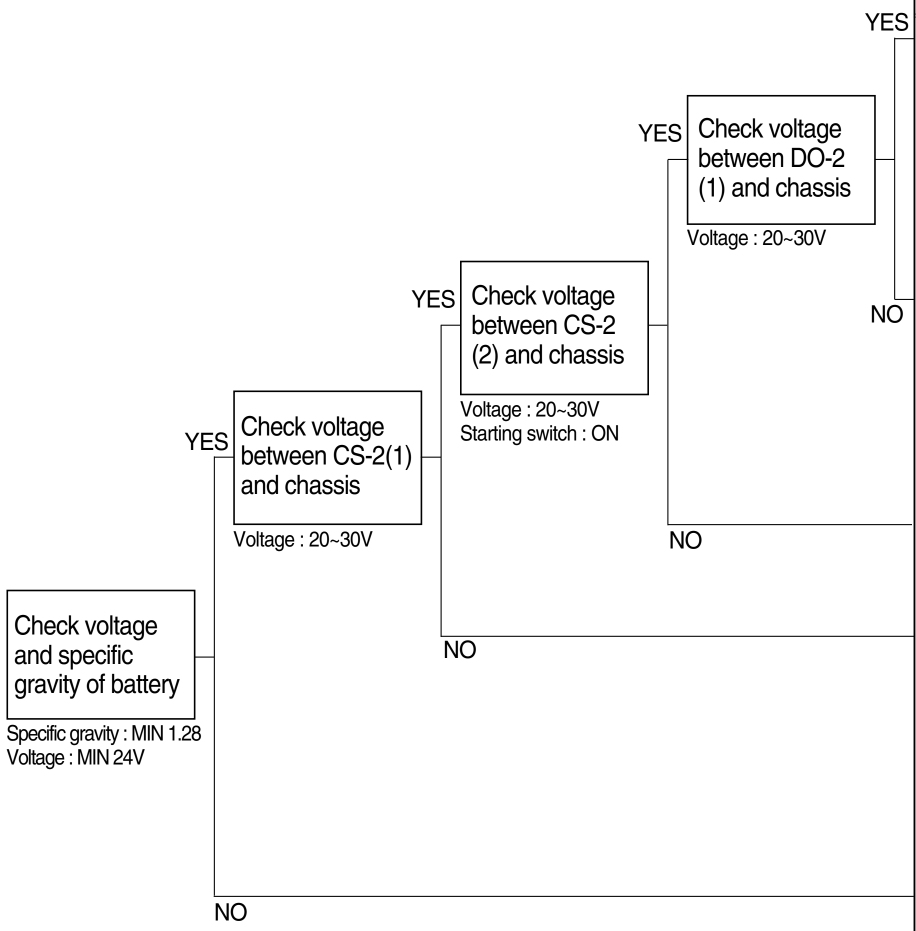
Cause	Remedy
Defective battery	Check engine system charge or replace(After checking specific gravity of battery)
Defective magnet of start motor	Replace
Defective start relay	Replace
ⓐ	
Defective start safety relay	Repair or replace (After clean)
Defective relay	Replace
Disconnection in wiring harness or poor contact between CR-5(86) and CS-2(5)	Repair or replace (After clean)
Defective start relay	Replace
Disconnection in wiring harness or poor contact between CR-5(87)-CR-23	Repair or replace (After clean)



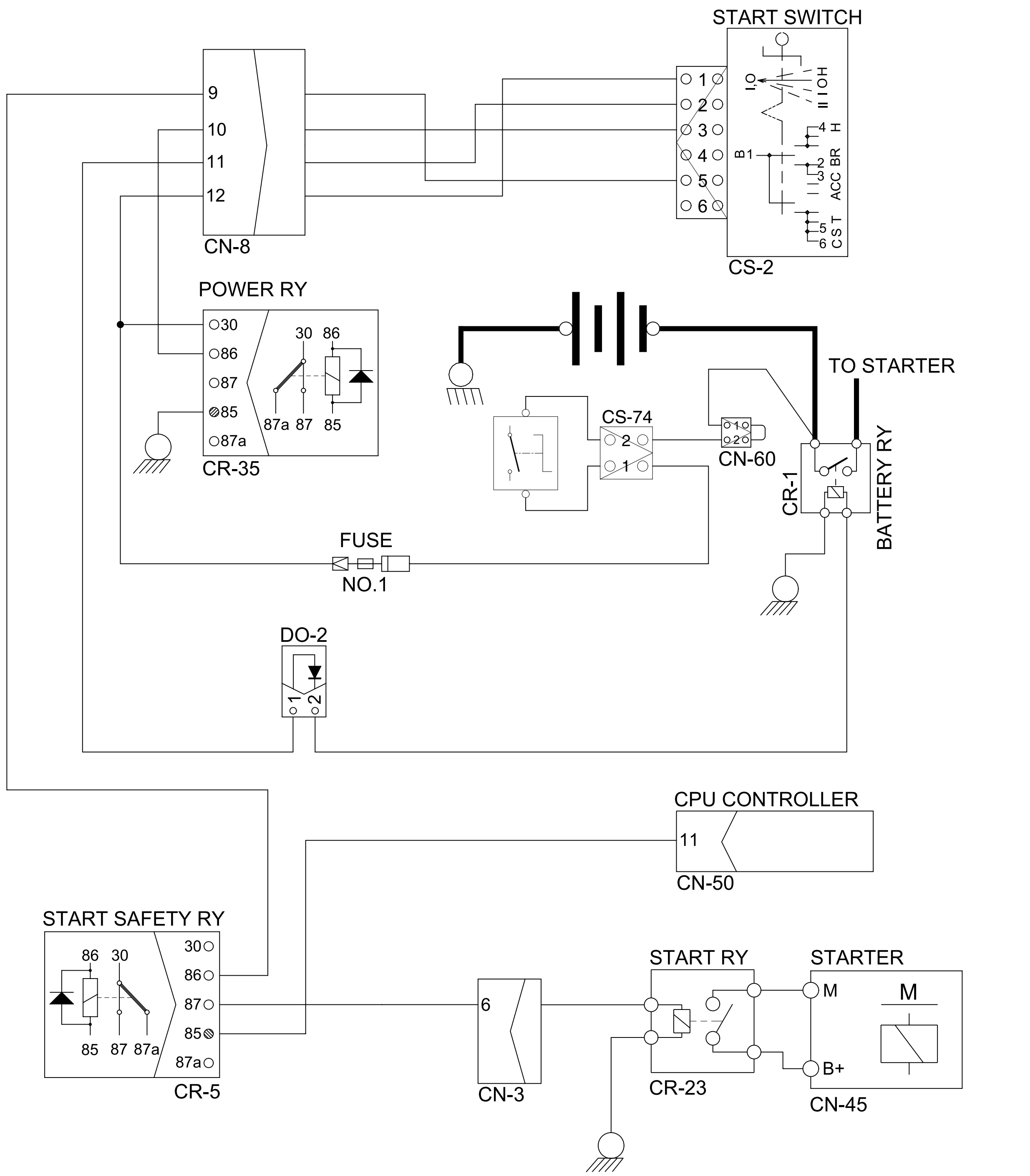
50076ES07

13. WHEN STARTING SWITCH ON DOES NOT OPERATE

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and master switch ON.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



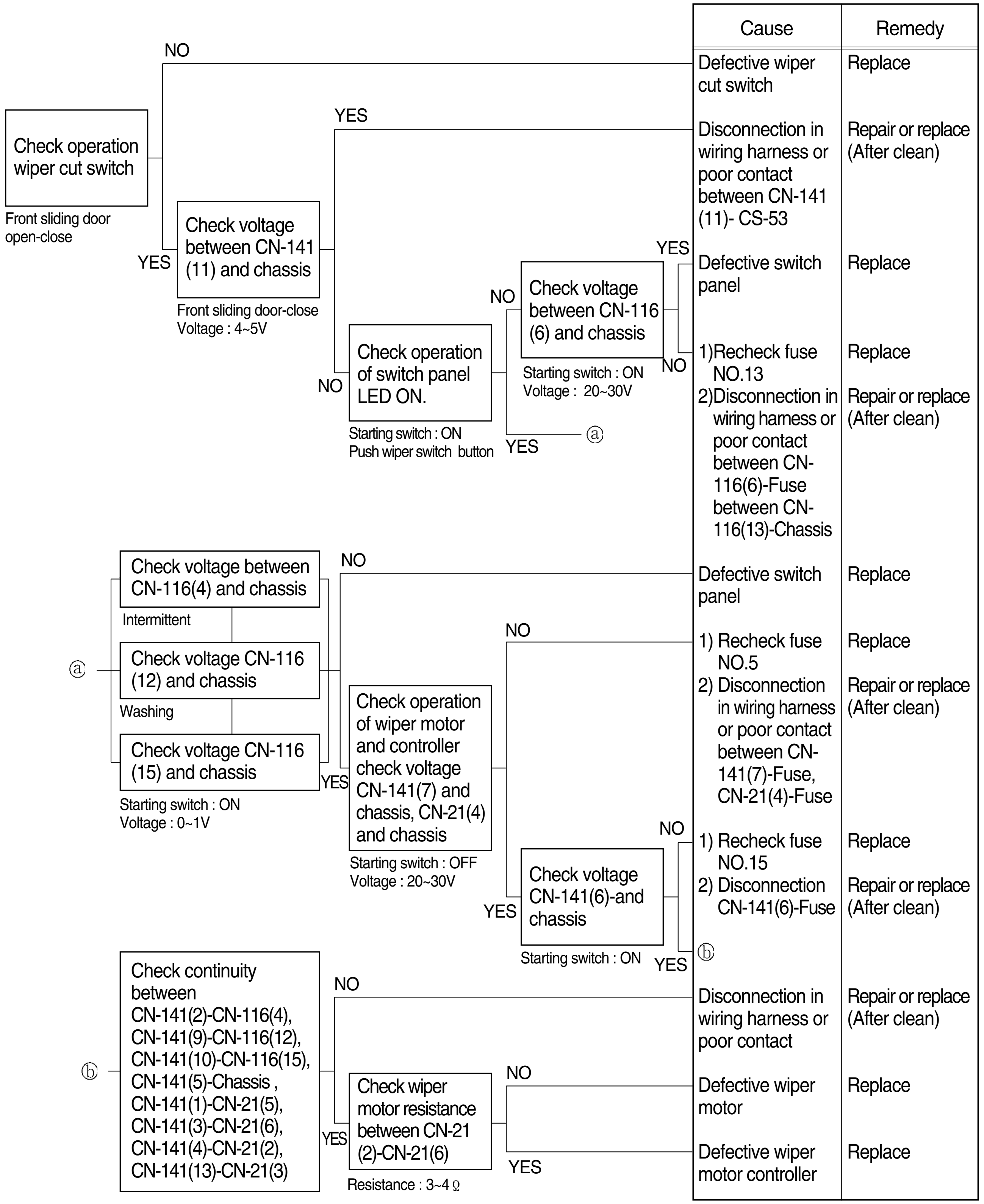
Cause	Remedy
Disconnection in wiring harness or poor contact between DO-2(1)-CR-1 or defective battery relay	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CS-2(2)-CN-8(11)- DO-2(1)	Replace
Defective starting switch	Replace
Disconnection in wiring harness or poor contact between CS-2(1)-CN-8(12)-CN-60-CR-1-Battery	Replace
Battery capacity too low	Charge or replace (After clean)

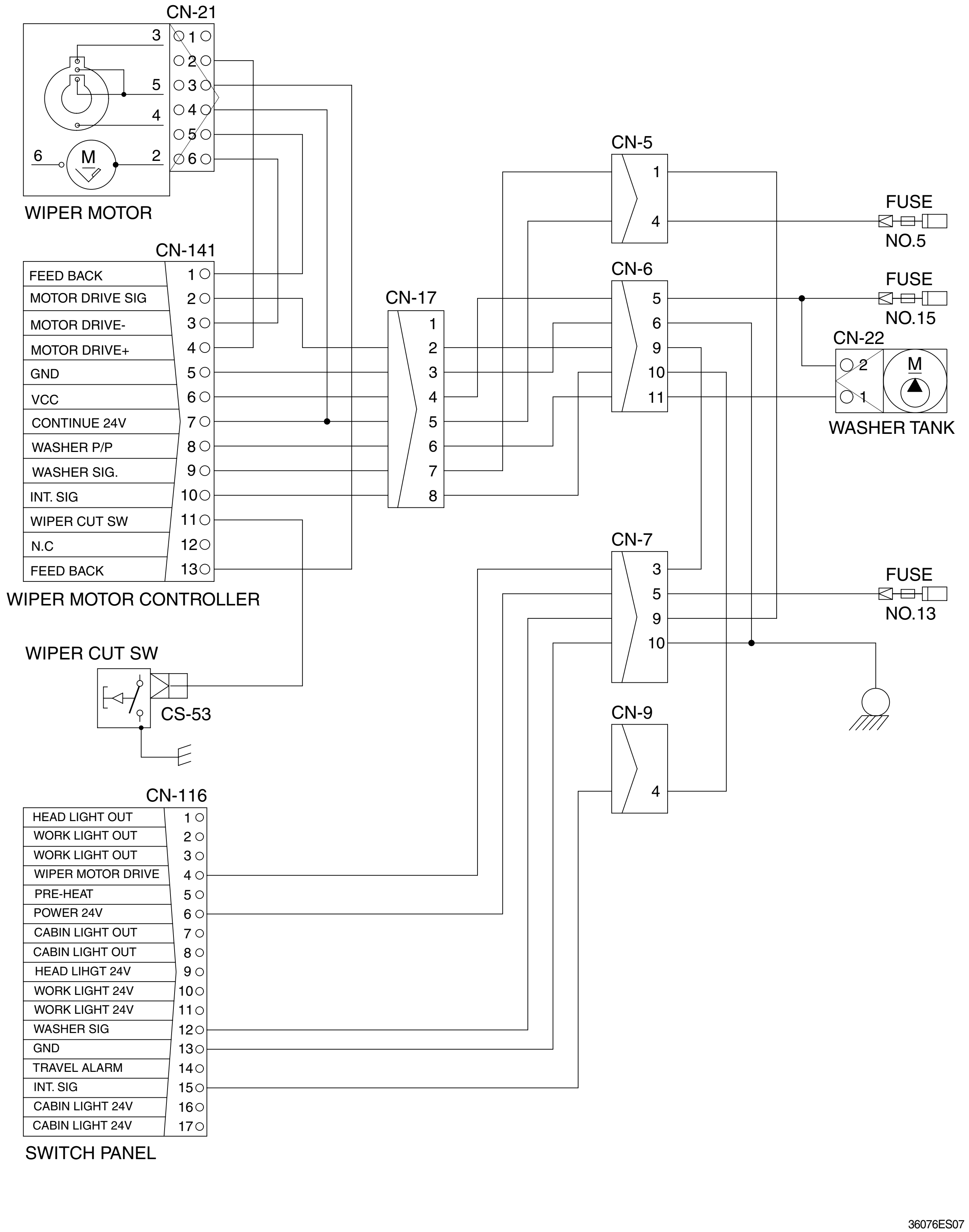


50076ES08

14. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

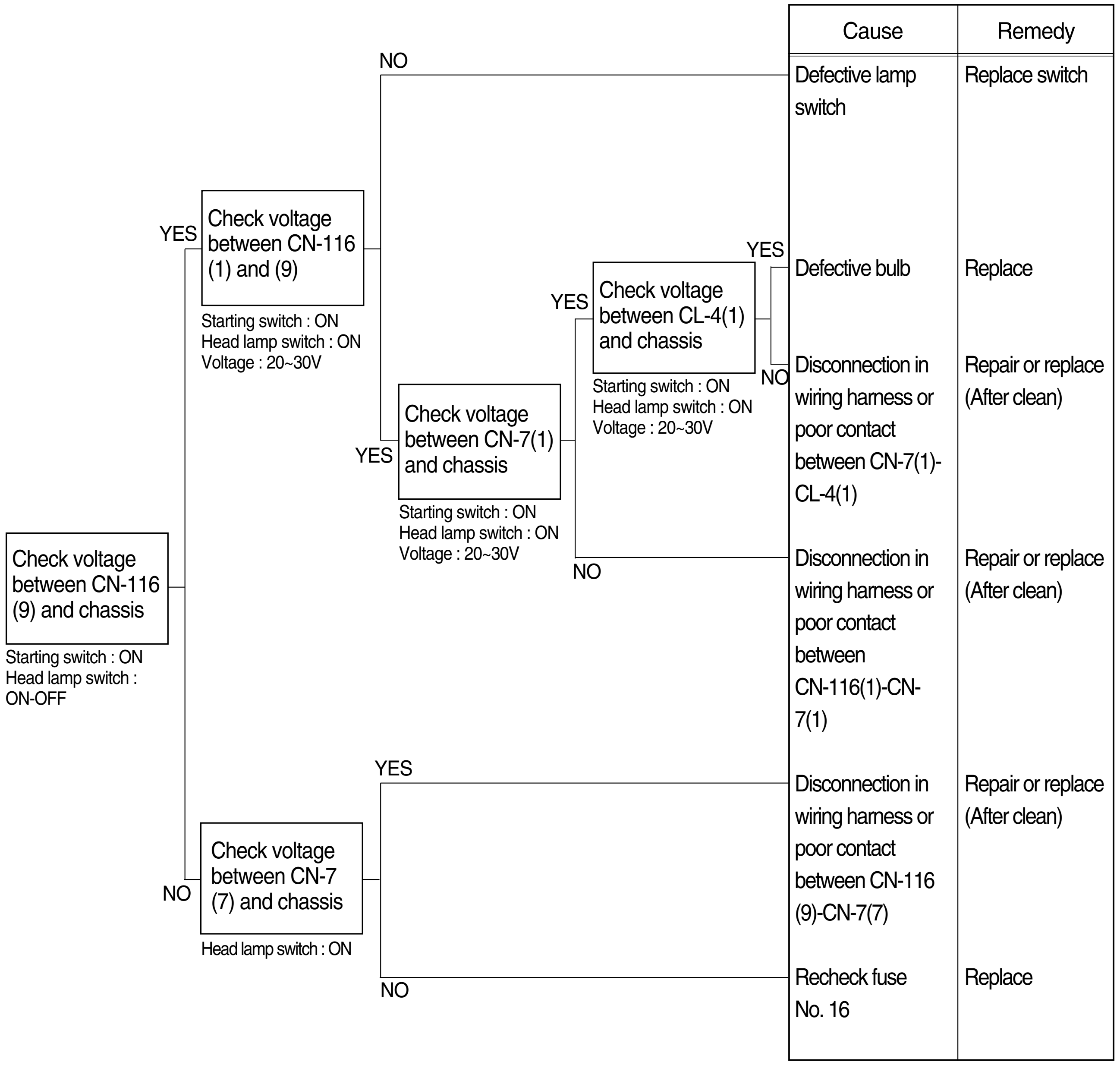
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.5,13 and 15 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

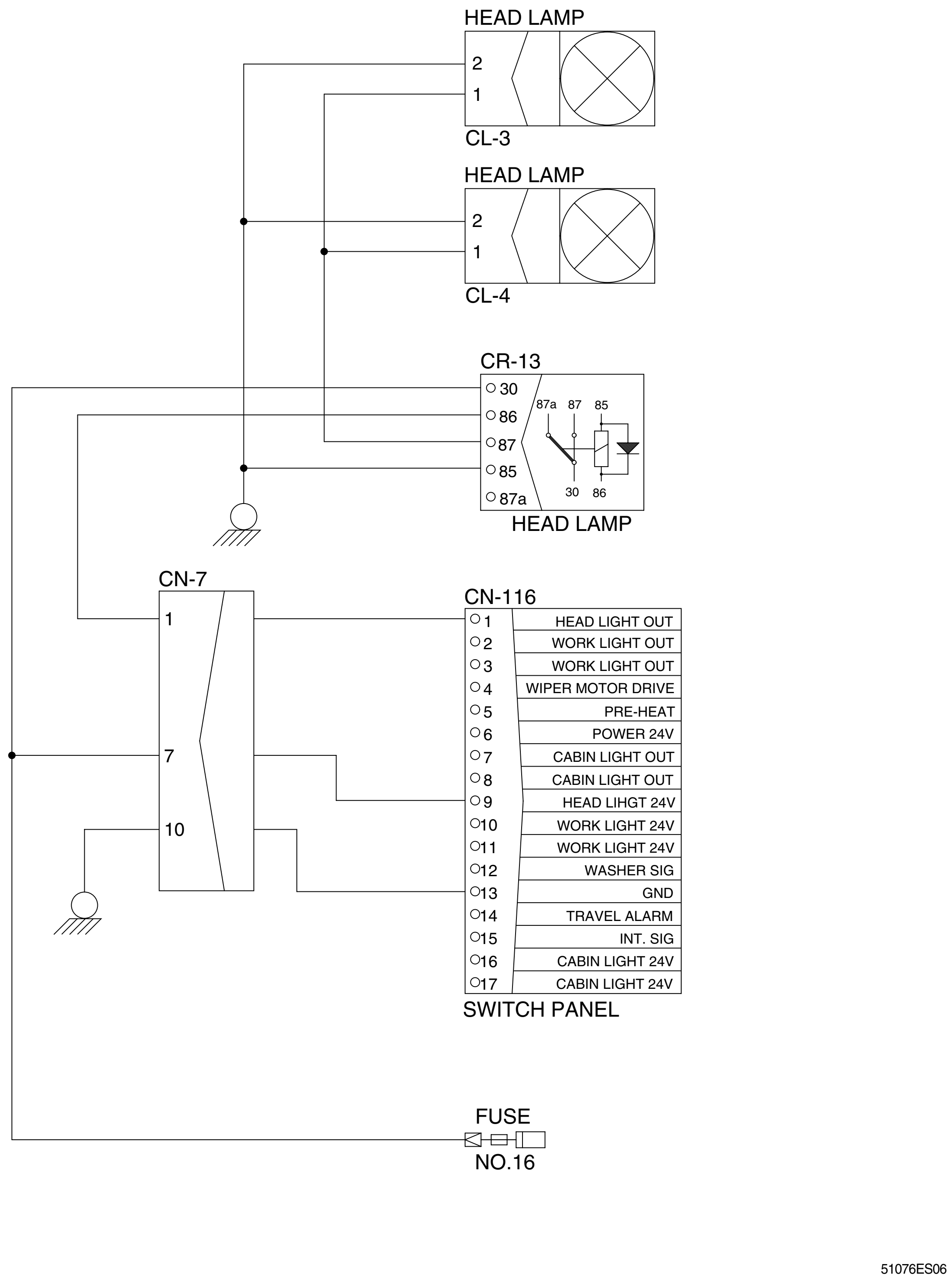




15. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

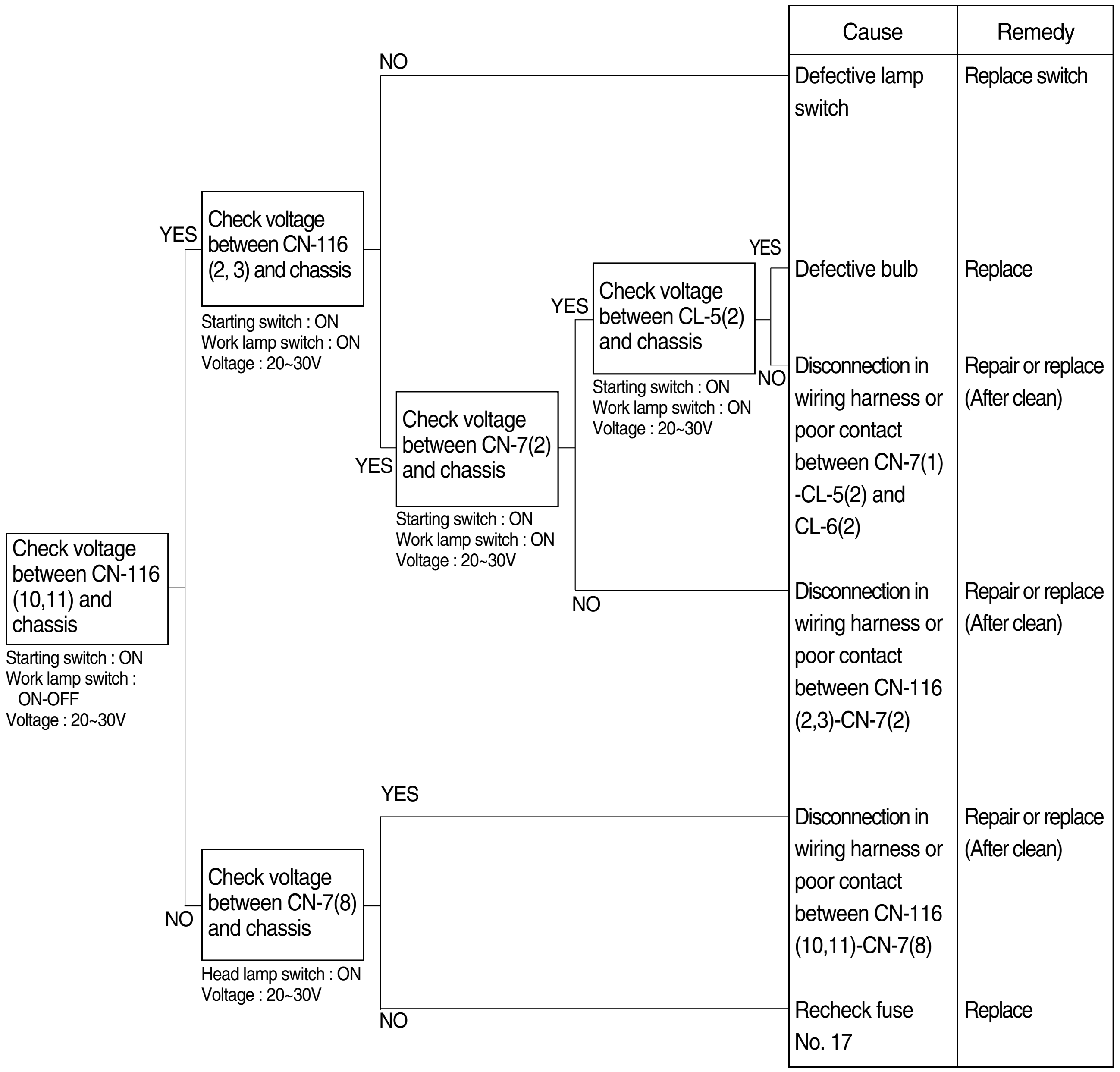
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.16.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

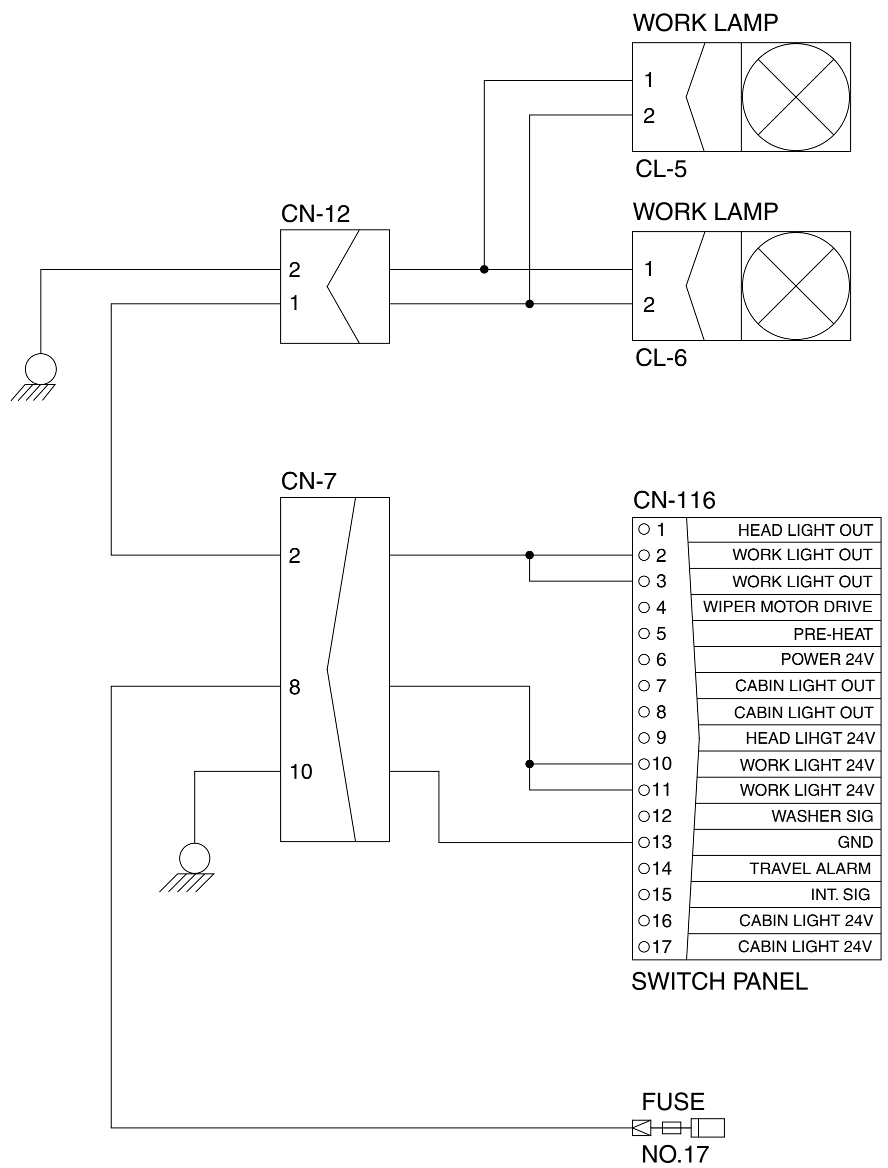




16. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.17.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





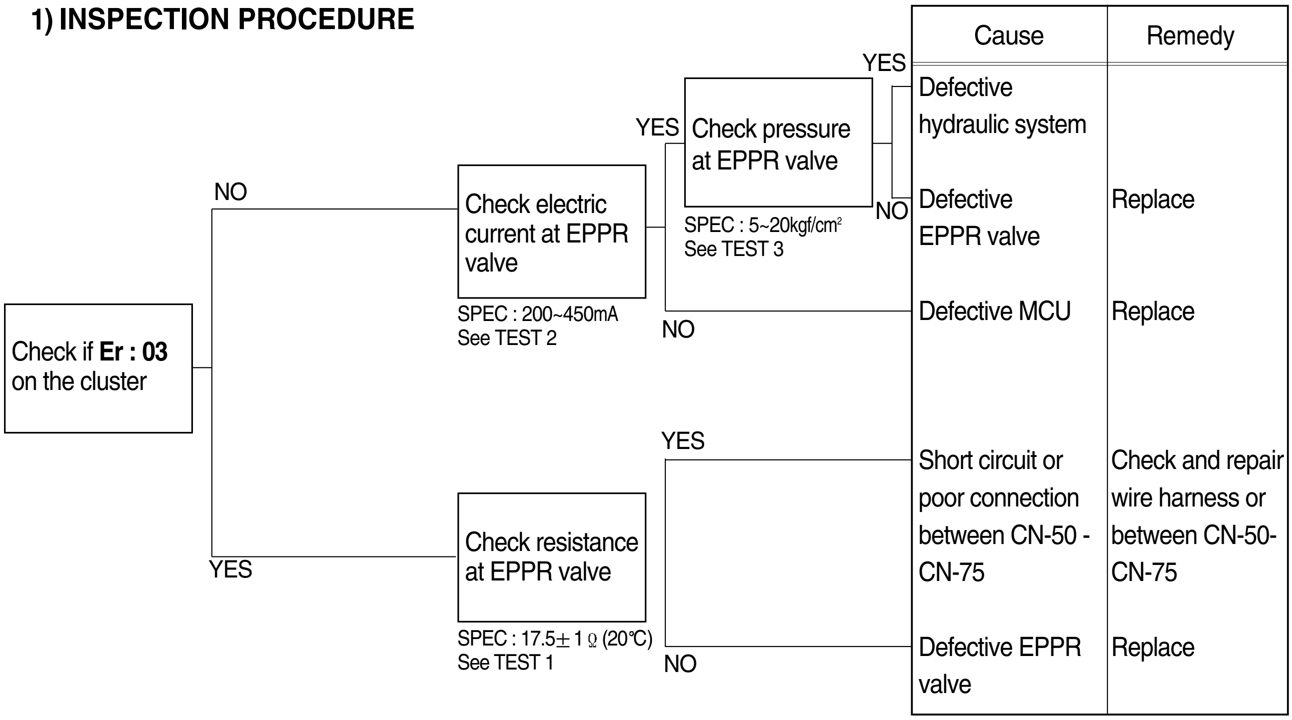
36076ES09

GROUP 4 MECHATRONICS SYSTEM

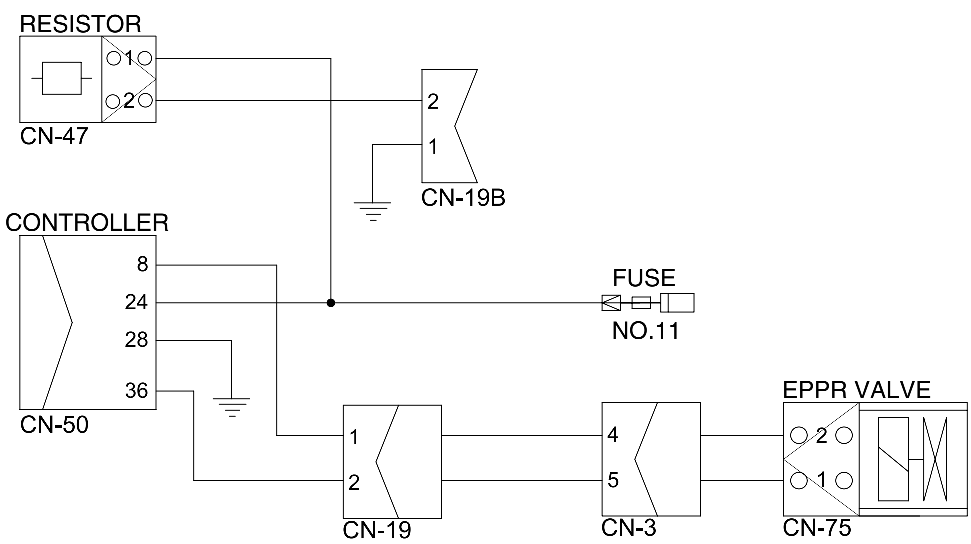
1. ALL ACTUATORS SPEED ARE SLOW

※ Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.
※ Spec : M-mode 1750±50rpm H-mode 1700±50rpm S-mode 1650±50rpm
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



50076MS01

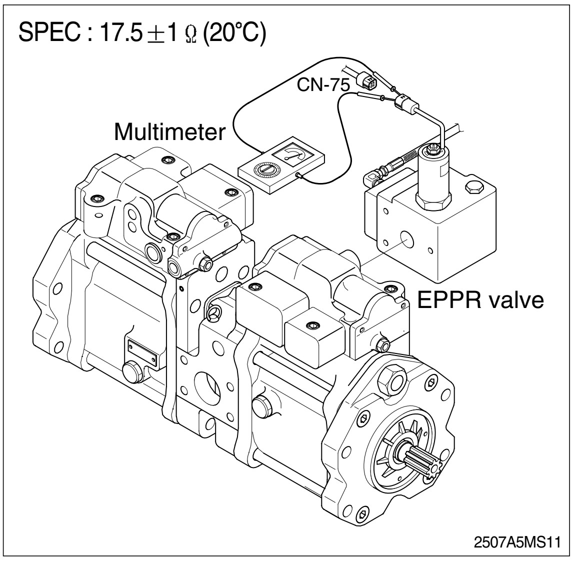
2) TEST PROCEDURE

(1) **Test 1 :** Check resistance at connector CN-75.

① Starting key OFF.

② Disconnect connector CN-75 from EPPR valve at main hydraulic pump.

③ Check resistance between 2 lines as figure.



(2) **Test 2 :** Check electric current at EPPR valve.

① Install multimeter as figure.

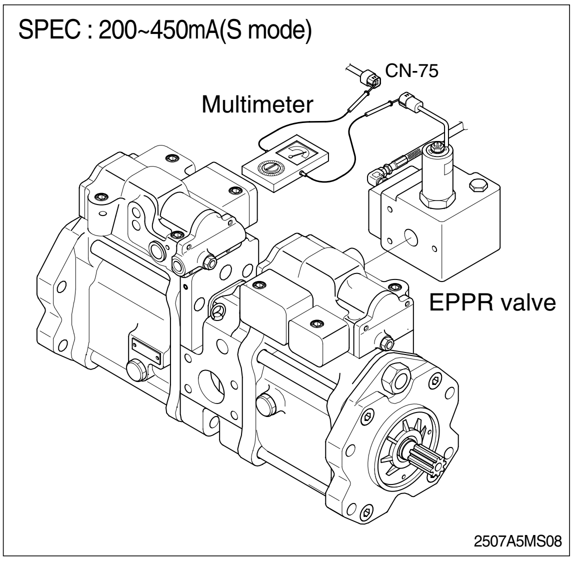
② Start engine.

③ Set the accel dial at "10"(MAX)

④ Set H-mode and cancel auto decel

⑤ mode.

If tachometer show approx 1700±50rpm, check electric current.



(3) **Test 3 :** Check pressure at EPPR valve.

① Remove plug and connect pressure gauge as figure.

· Gauge capacity : 0 to 40~50kgf/cm²
(0 to 570~710psi)

② Start engine.

③ Set the accel dial at "10"(Max).

④ Set H-mode and cancel auto decel

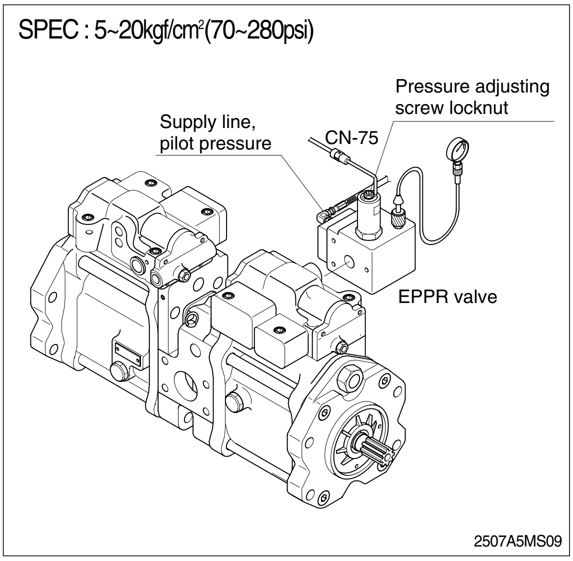
⑤ mode.

If tachometer show approx 1700±50rpm,

⑥ check pressure.

⑦ If pressure is not correct, adjust it.

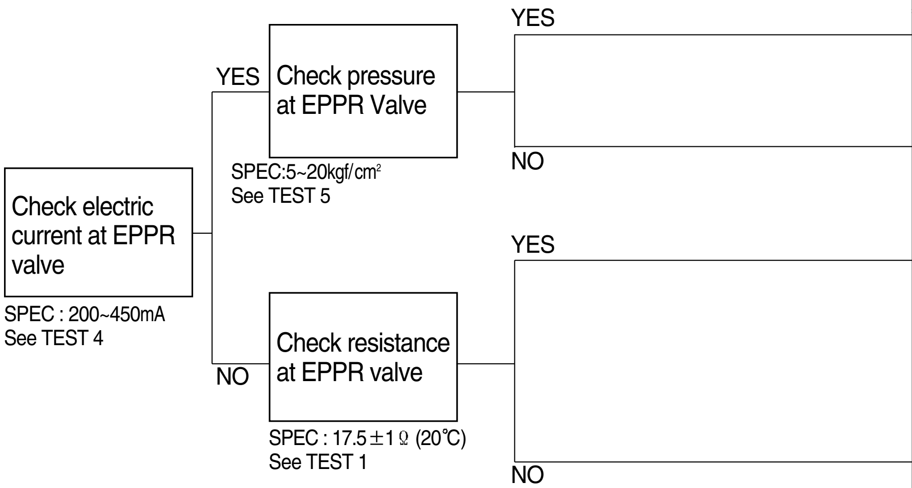
After adjust, test the machine.



2. ENGINE STALL

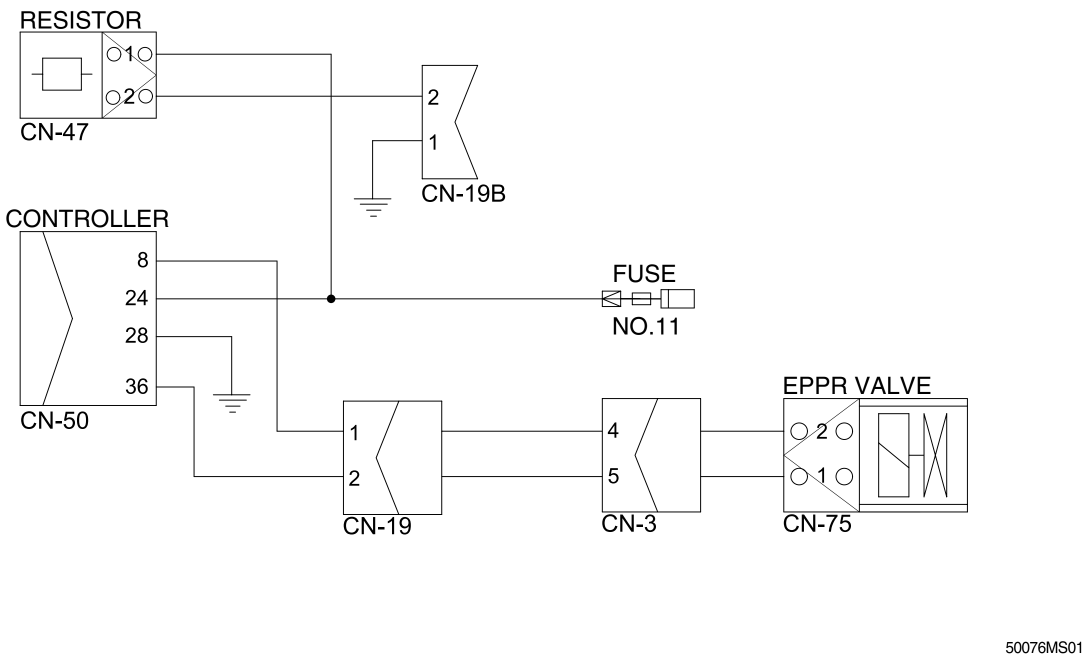
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Not enough engine power	Contact cummins engine dealer
Defective EPPR valve	Replace
Short circuit or poor connection between CN-50 - CN-3 or CN-50 - CN-75	Check and repair wire harness
Defective EPPR valve	Replace

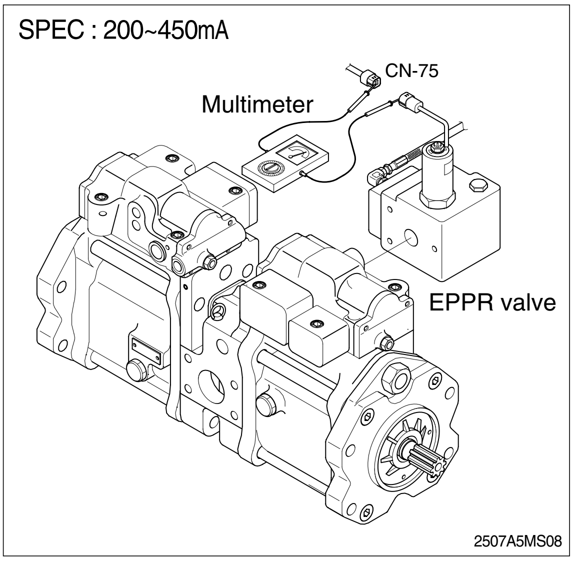
Wiring diagram



2) TEST PROCEDURE

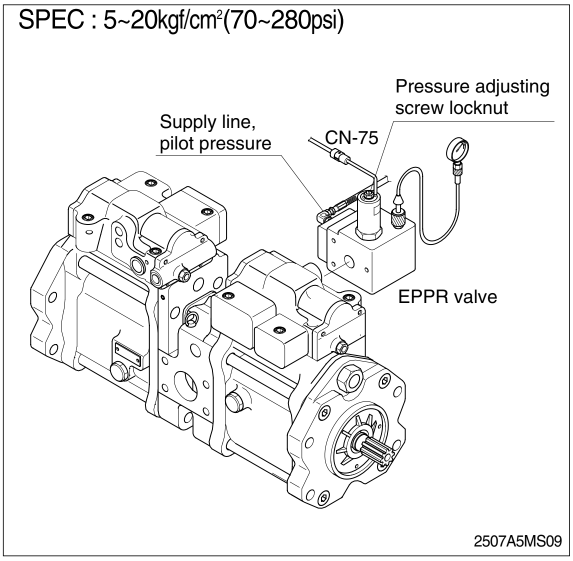
(1) **Test 4 :** Check electric current at EPPR valve at H-mode

① Install multimeter as figure.
② Start engine.
③ Set the accel dial at "10"(max)
④ Set H-mode with 1700±50rpm.
⑤ Check electric current.



(2) **Test 5 :** Check pressure at EPPR valve at H-mode

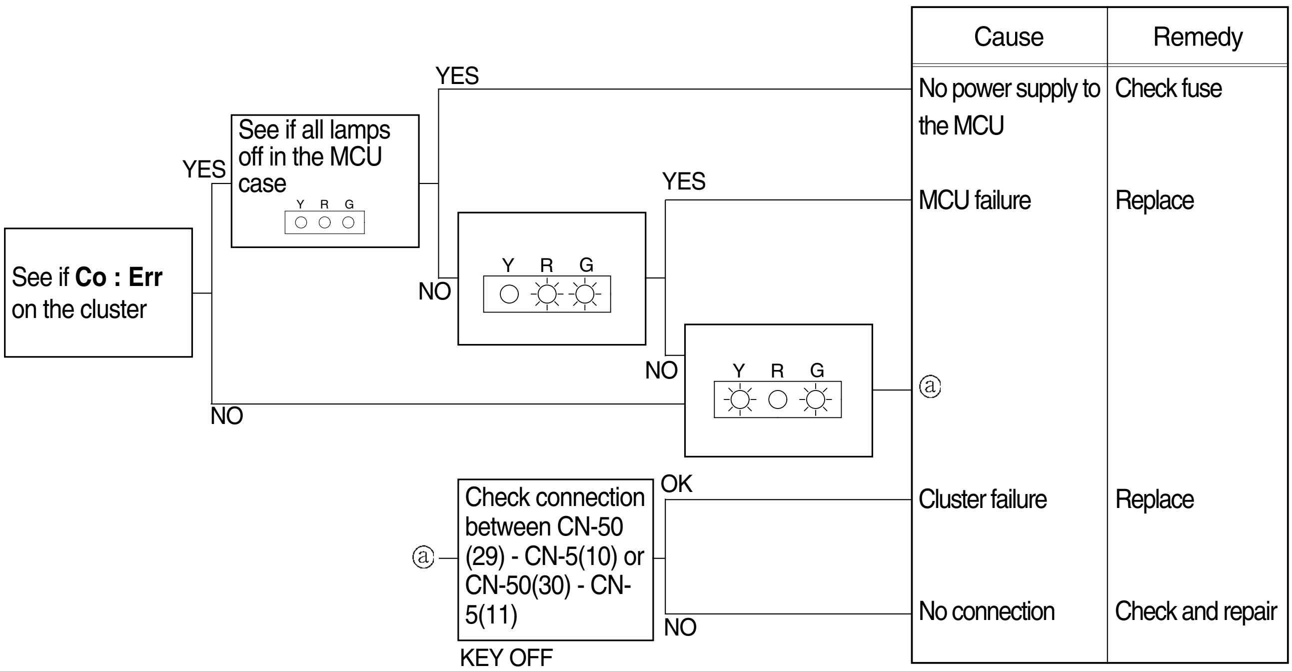
① Connect pressure gauge at EPPR valve.
② Start engine.
③ Set the accel dial at "10"(max)
④ Set H-mode with 1700±50rpm.
⑤ Operate bucket lever completely push or pull.
⑥ Hold arm lever at the end of stroke.
⑦ Check pressure at relief position.



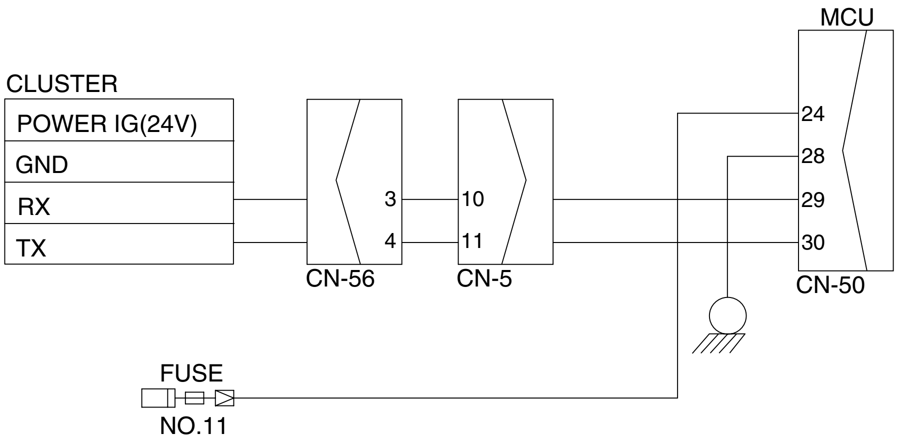
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram

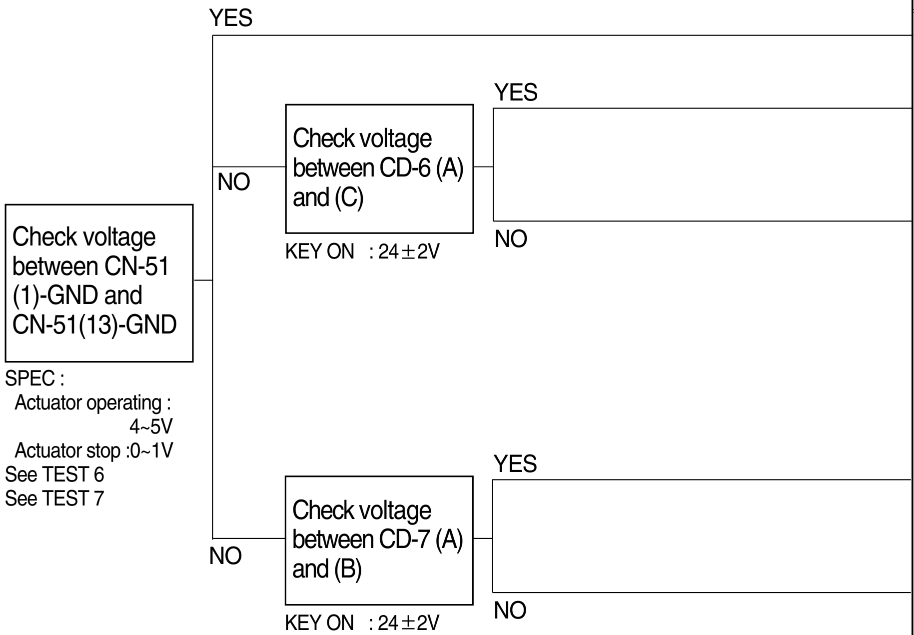


51076MS01

4. AUTO DECEL SYSTEM DOES NOT WORK

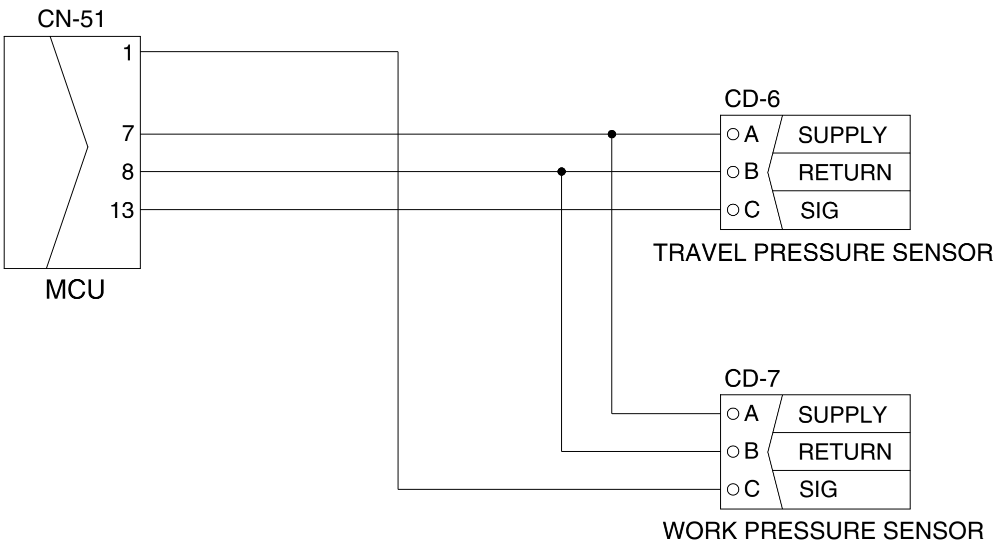
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Defective travel pressure switch	Replace
Short circuit or poor connection between CN-51(7)-CD-6(A) and/or CN-51(8)-CD-6(B)	Replace or repair
Defective work pressure sensor	Replace
Short circuit or poor connection between CN-51(7)-CD-7(A) and/or CN-51(8)-CD-7(B)	Replace or repair

Wiring diagram



51076MS02

2) TEST PROCEDURE

(1) **Test 6 :** Check voltage at CN-51(1) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.

② Starting key ON.

③ Insert prepared pin to rear side of connectors : One pin to (1) of CN-51.

④ Check voltage as figure.

(2) **Test 7** : Check voltage at CN-51(13) and ground.

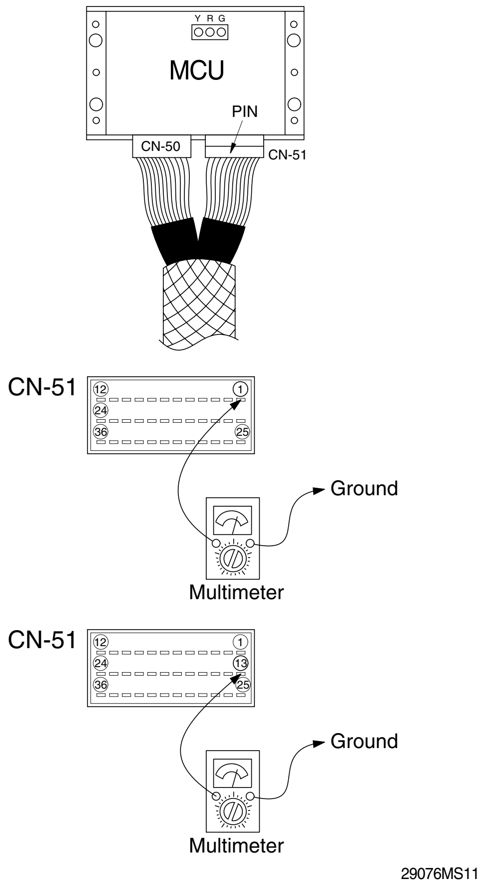
① Prepare 1 piece of thin sharp pin, steel or copper

② Starting key ON.

③ Insert prepared pin to rear side of connectors : One pin to (13) of CN-51

④ Check voltage as figure.

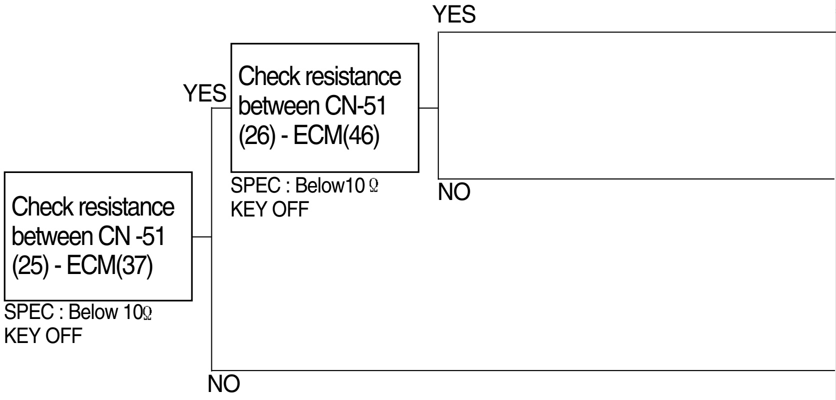
SPEC : Actuator stop : 4~5V
Actuator operating : 0~1V



5. MALFUNCTION OF WARMING UP

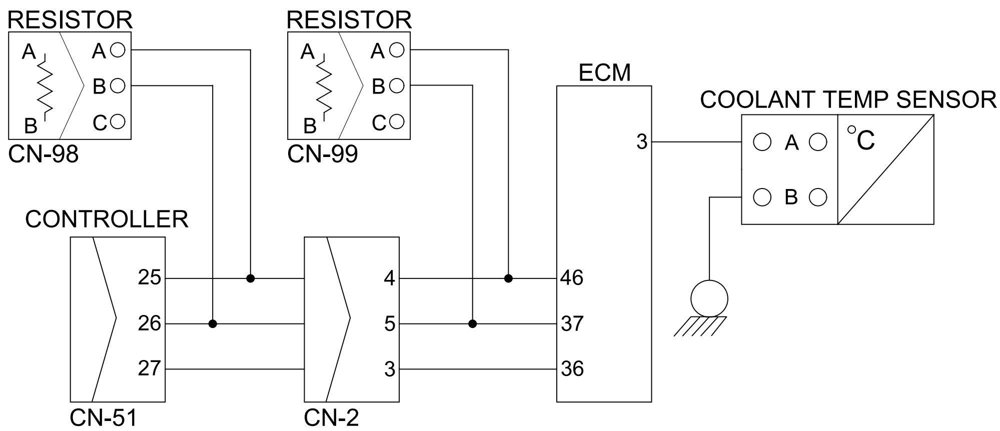
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU or Sensor	Repair or Replace
Poor connection between CN-51 (26) - ECM(46)	Repair
Poor connection between CN-51(25) - ECM(37)	Repair

Wiring diagram

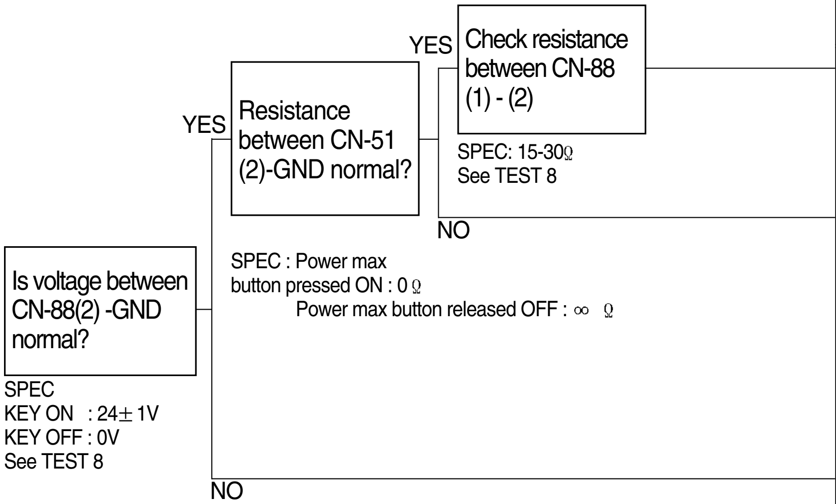


45076ES04

6. MALFUNCTION OF POWER MAX

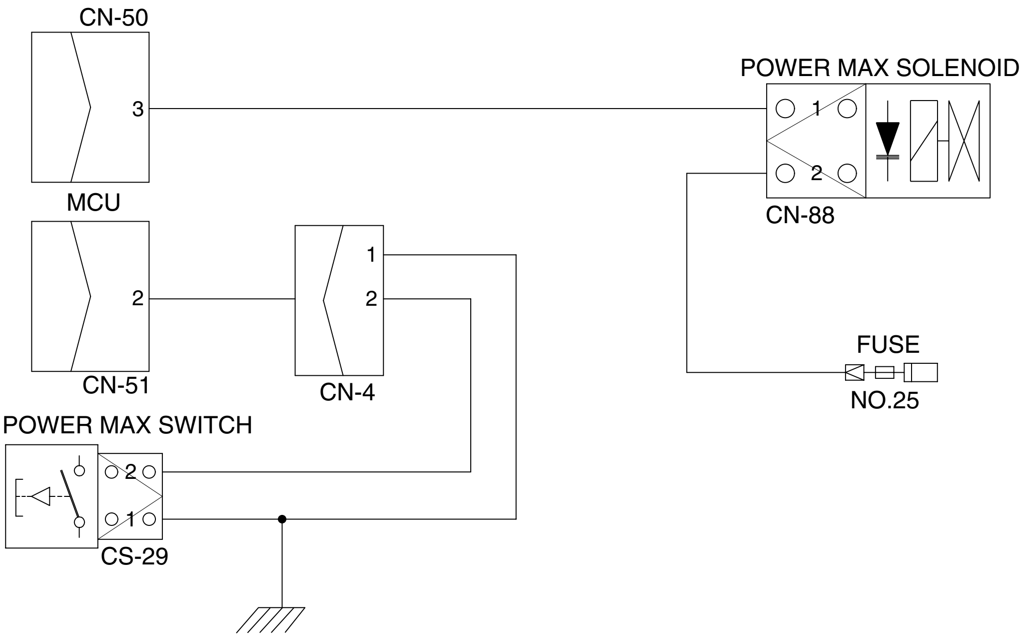
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective power max. solenoid valve	Repair or replace
Short circuit or poor connection between CN-51(2) - CS-29 and CN-50 (3) -CN-88(1)	Repair or replace
Short circuit or poor connection between CN-88(2)- battery relay(+)	Repair or replace

Wiring diagram



51076MS03

2) TEST PROCEDURE

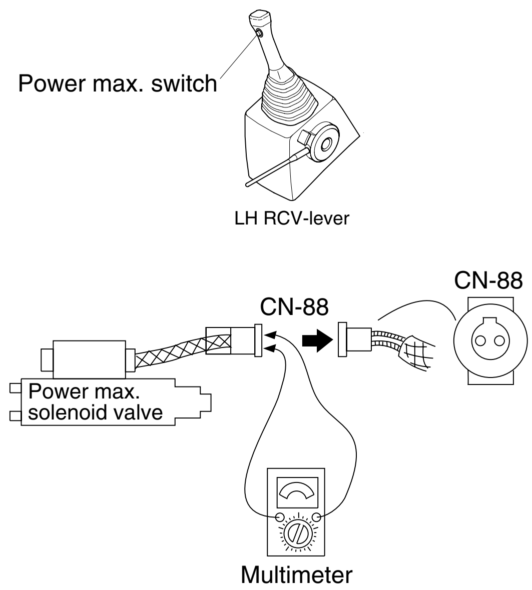
(1) **Test 8:** Check voltage between connector CN-88 - GND.

① Start key ON.

② Disconnect connector CN-88 from power max solenoid valve.

③ Check voltage as figure.

SPEC : Key ON : 24±1V
Key OFF : 0V
Resistance : 15~30 Ω



29076MS14

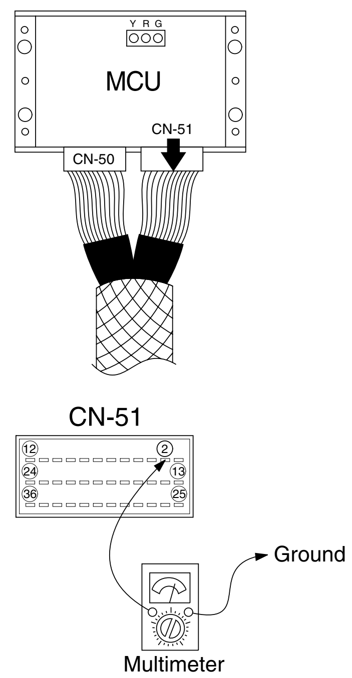
(2) **Test 9:** Check resistance between connector CN-51(2)-GND.

① Starting key OFF.

② Remove MCU and disconnect connector CN-51 from MCU.

③ Check resistance as figure.

SPEC : Power max button pressed ON : 0 Ω
Power max button released OFF : ∞ Ω

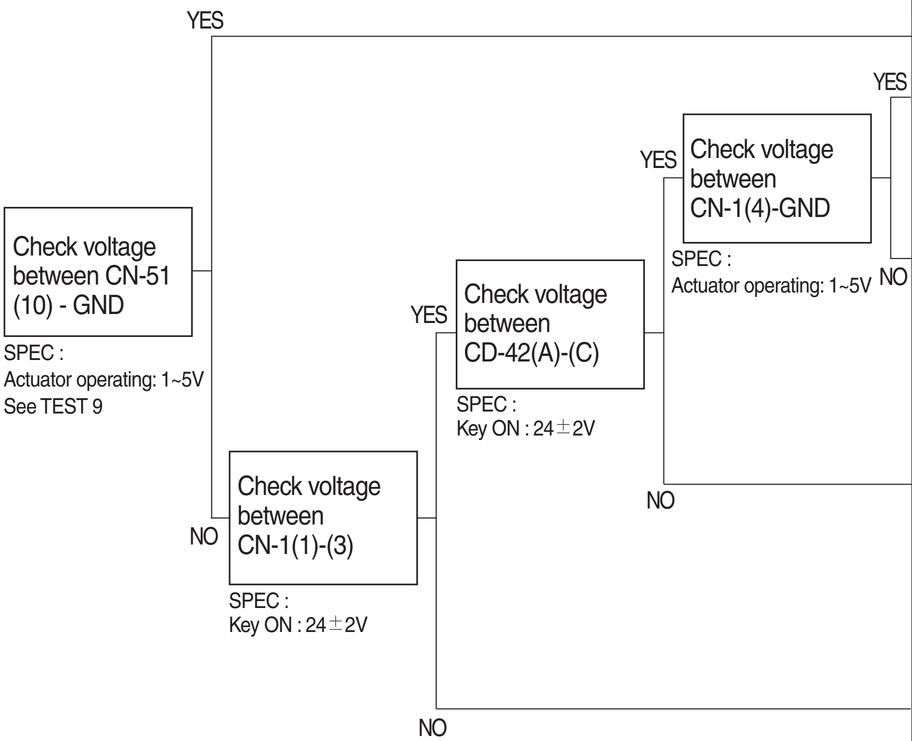


29076MS15

7. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

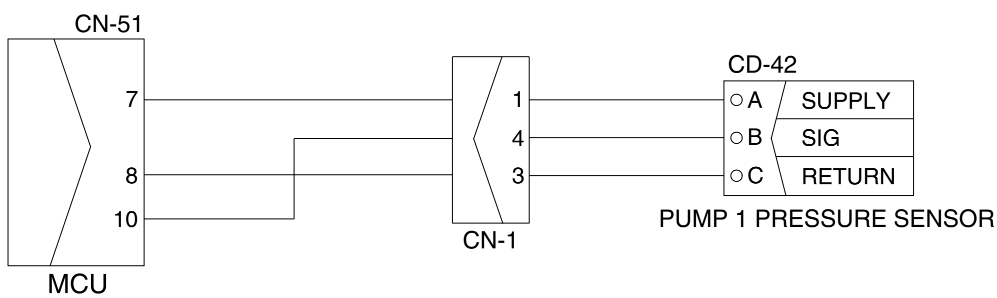
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-51-(10)-CN-1(4)	Replace or repair
Detective P1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(4)-CD-42(B)	Replace or repair
Short circuit or poor connection between CD-42(A)-CN-1(1) or CD-42(C)-CN-1(3)	Replace or repair
Short circuit or poor connection between CN-1(1)-CN-51(7) or CN-1 (3) - CN-51(8)	Replace or repair

Wiring diagram



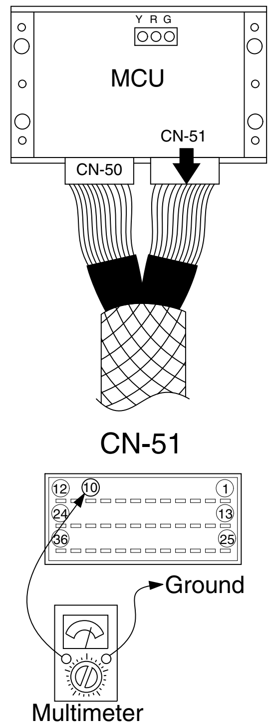
51076MS04

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-51 (10) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (10) of CN-51.
③ Starting key ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

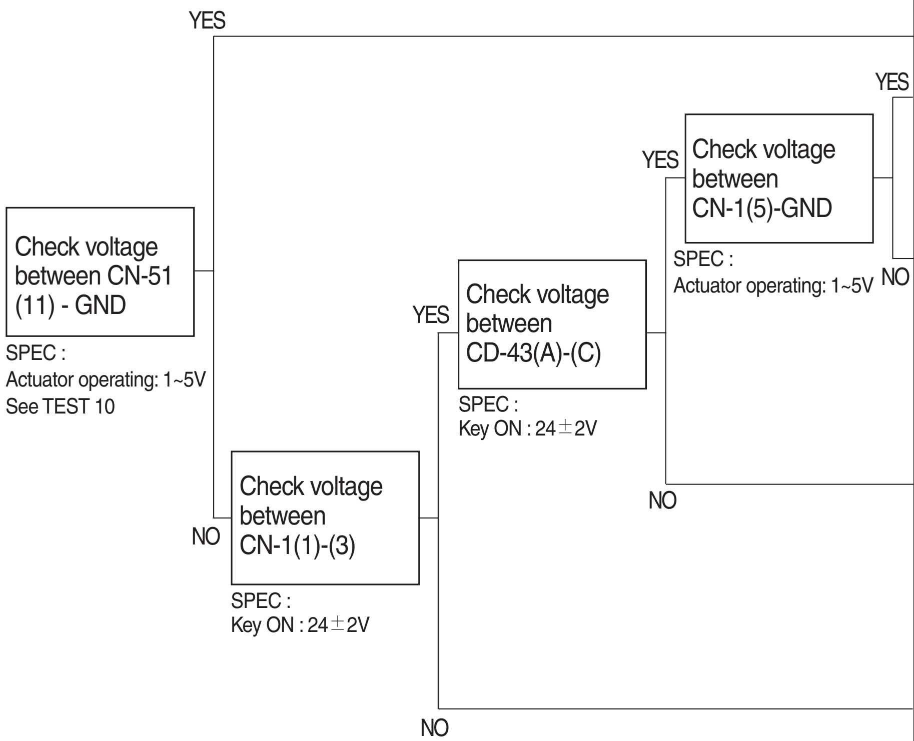


51076MS05

8. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

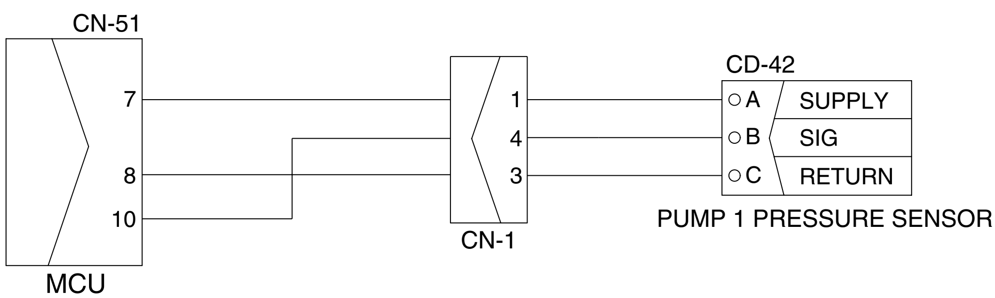
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-51-(11)-CN-1(5)	Replace or repair
Detective P2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(5)-CD-43(B)	Replace or repair
Short circuit or poor connection between CD-43(A)-CN-1(1) or CD-43(C)-CN-1(3)	Replace or repair
Short circuit or poor connection between CN-1(1)-CN-51(7) or CN-1 (3) - CN-51(8)	Replace or repair

Wiring diagram



51076MS06

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-51 (11) and ground.

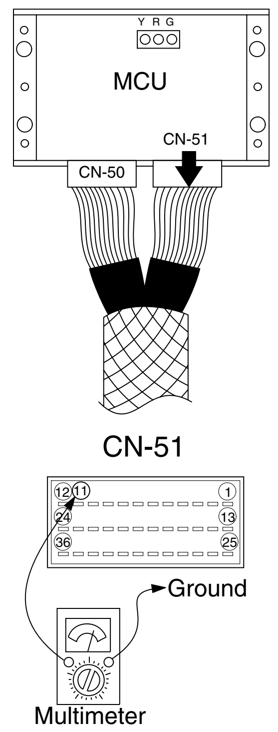
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (11) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

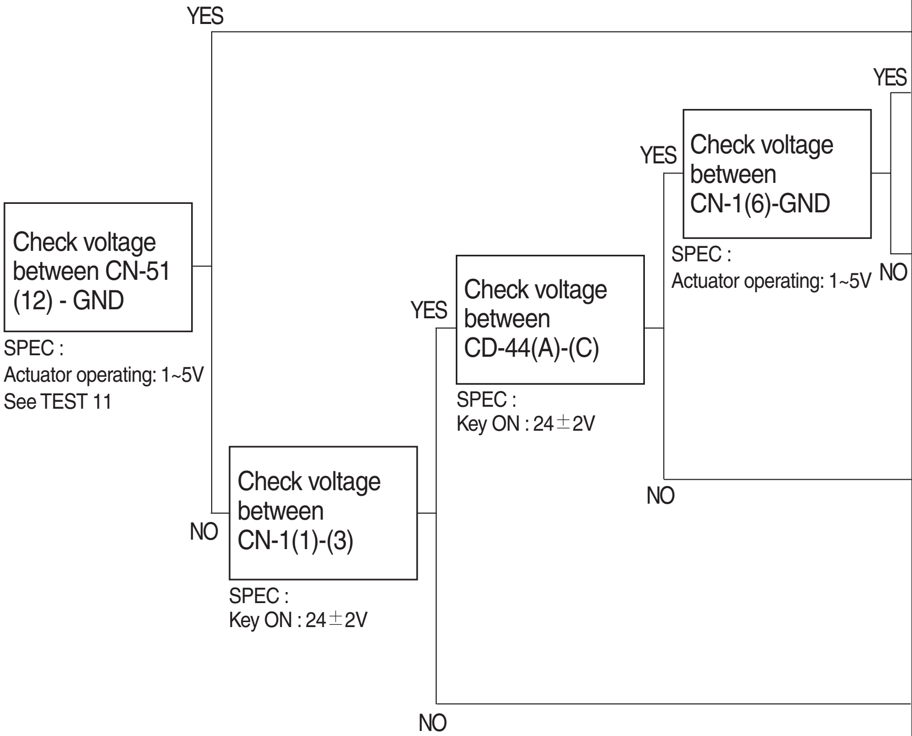
SPEC : Actuator operating : 1~5 V



9. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

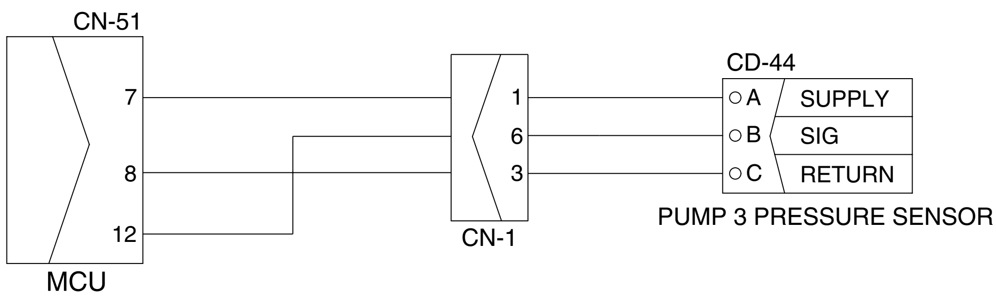
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-51-(12)-CN-1(6)	Replace or repair
Detective P3 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(6)-CD-44(B)	Replace or repair
Short circuit or poor connection between CD-44(A)-CN-1(1) or CD-44(C)-CN-1(3)	Replace or repair
Short circuit or poor connection between CN-1(1)-CN-51(7) or CN-1 (3) - CN-51(8)	Replace or repair

Wiring diagram



51076MS08

2) TEST PROCEDURE

(1) Test 11 : Check voltage at CN-51 (12) and ground.

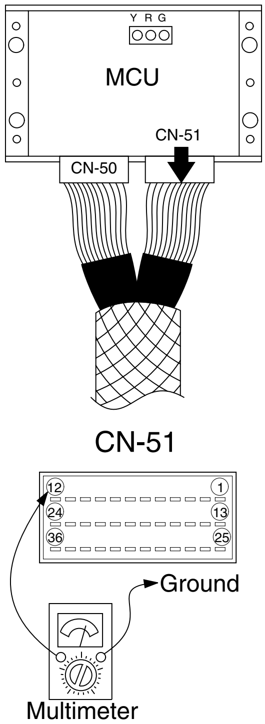
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (12) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

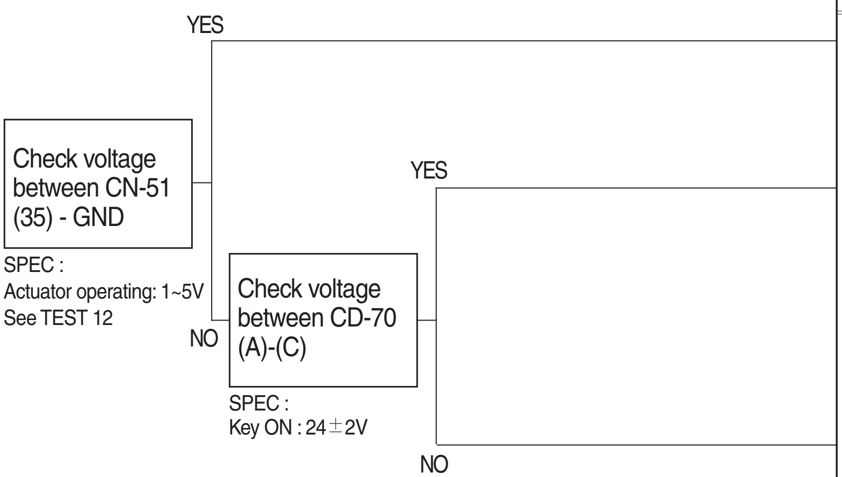


51076MS09

10. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

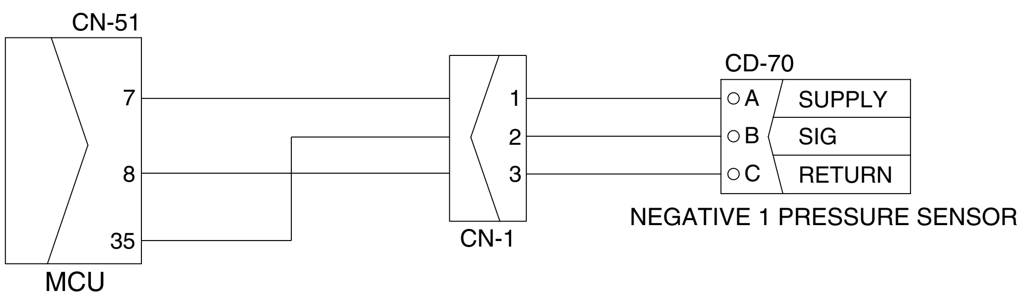
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective N1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (37)-CD-70 (B)	Replace or repair
Short circuit or poor connection between CD-70 (A)-CN-51(4) or CD-70(C)- CN-51 (5)	Replace or repair

Wiring diagram



51076MS12

2) TEST PROCEDURE

(1) Test 12 : Check voltage at CN-51 (35) and ground.

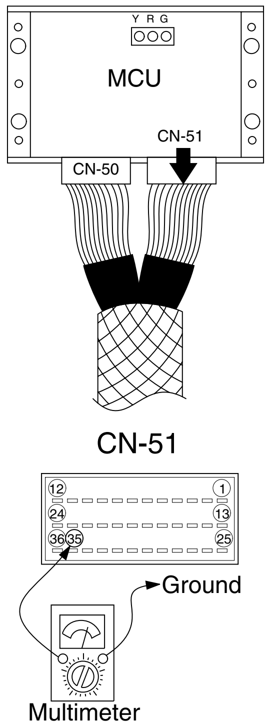
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (35) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

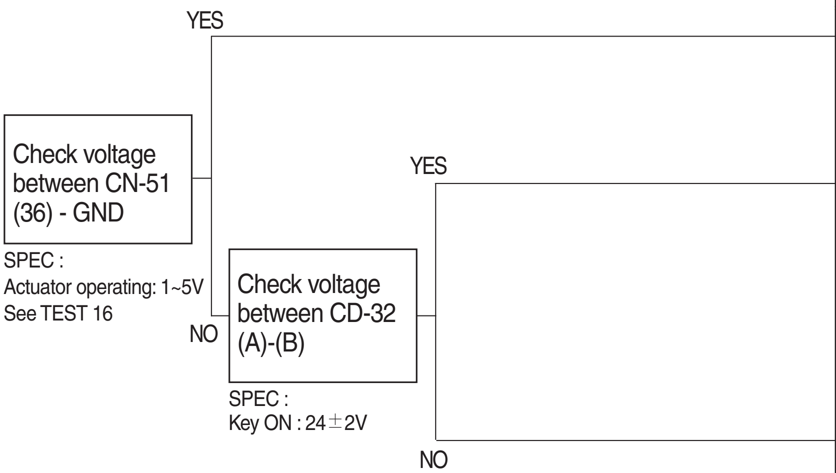


51076MS13

11. MALFUNCTION OF BOOM UP PRESSURE SENSOR

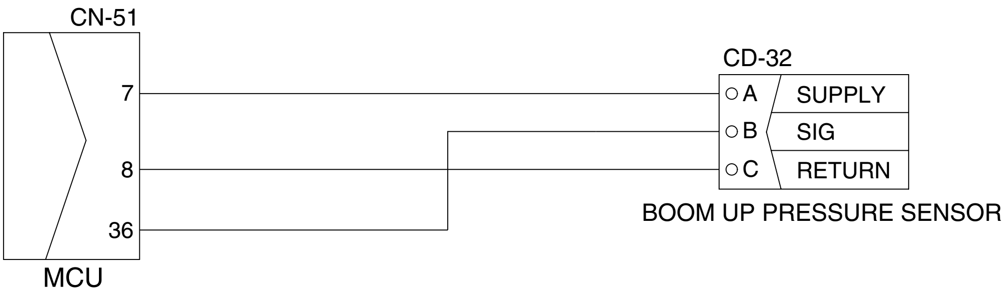
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-51 (36)-CD-32 (B)	Replace or repair
Short circuit or poor connection between CD-32 (A)-CN-51(7) or CD-32(C)- CN-51 (8)	Replace or repair

Wiring diagram



51076MS10

2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-51 (36) and ground.

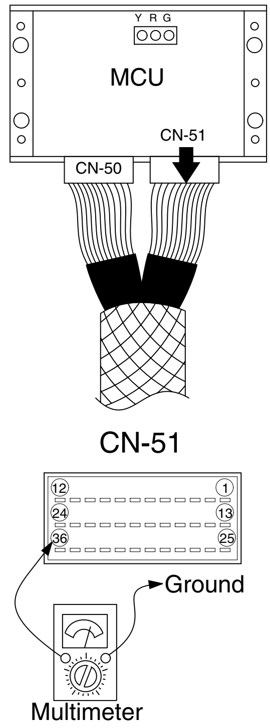
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (36) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



51076MS11

SECTION 7 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check:

1) **OPERATIONAL PERFORMANCE OF A NEW MACHINE**

Whenever a new machine is delivered in parts and reassembled at a customer's site, it must be tested to confirm that the operational performance of the machine meets **Hyundai spec**.

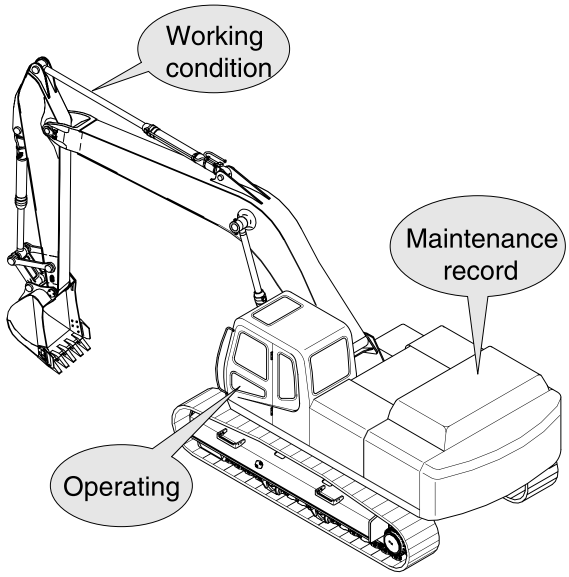
2) **OPERATIONAL PERFORMANCE OF A WORKING MACHINE**

With the passage of time, the machine's operational performance deteriorates, so that the machine needs to be serviced periodically to restore it to its original performance level.

Before servicing the machine, conduct performance tests to check the extent of deterioration, and to decide what kind of service needs to be done(by referring to the "Service Limits" in this manual).

3) **OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE**

After the machine is repaired or serviced, it must be tested to confirm that its operational performance was restored by the repair and/or service work done.

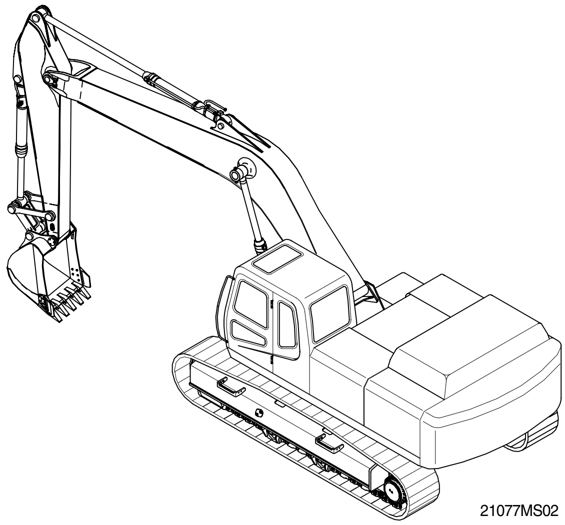


21077MS01

2. TERMINOLOGY

1) STANDARD

Specifications applied to the brand-new machine, components and parts.

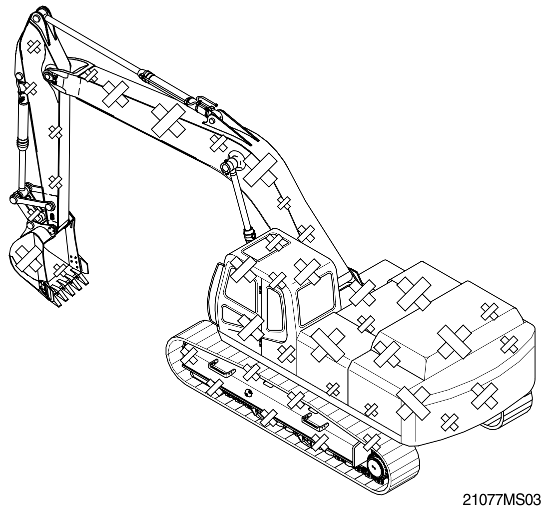


21077MS02

2) SERVICE LIMIT

The lowest acceptable performance level. When the performance level of the machine falls below this level, the machine must be removed from work and repaired.

Necessary parts and components must be replaced.



21077MS03

3. OPERATION FOR PERFORMANCE TESTS

1) Observe the following rules in order to carry out performance tests accurately and safely.

(1) The machine

Repair any defects and damage found, such as oil or water leaks, loose bolts, cracks and so on, before starting to test.

(2) Test area

① Select a hard, flat surface.

② Secure enough space to allow the machine to run straight more than 20m, and to make a full swing with the front attachment extended.

③ If required, rope off the test area and provide signboards to keep unauthorized personnel away.

(3) Precautions

① Before starting to test, agree upon the signals to be employed for communication among coworkers. Once the test is started, be sure to communicate with each other using these signals, and to follow them without fail.

② Operate the machine carefully and always give first priority to safety.

③ While testing, always take care to avoid accidents due to landslides or contact with high voltage power lines. Always confirm that there is sufficient space for full swings.

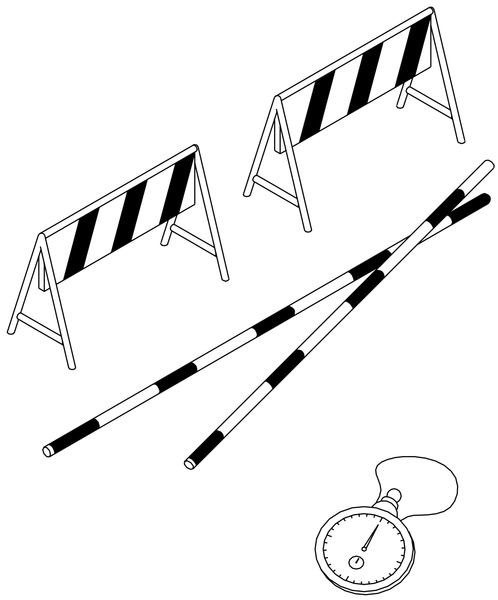
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(4) Make precise measurements

① Accurately calibrate test instruments in advance to obtain correct data.

② Carry out tests under the exact test conditions prescribed for each test item.

③ Repeat the same test and confirm that the test data obtained can be procured repeatedly. Use mean values of measurements if necessary.



7-3 (210-7)

2) ENGINE SPEED

(1) Measure the engine speed at each power mode

※ The engine speed at each power mode must meet standard RPM; if not, all other operational performance data will be unreliable. It is essential to perform this test first.

(2) Preparation

① Warm up the machine, until the engine coolant temperature reaches 50℃ or more, and the hydraulic oil is 50±5℃.

② Set the accel dial at 10(Max) position.

③ Push the M-mode switch and confirm that the fuel injection pump governor lever comes into contact with the high-idle stopper.

④ Measure the engine RPM.

(3) Measurement

① Start the engine. The engine will run at start idle speed. Measure engine speed with a tachometer.

② Measure and record the engine speed at each mode(M, H, S).

③ Select the M-mode.

④ Lightly operate the bucket control lever a few times, then return the control lever to neutral; The engine will automatically enter the auto-idle speed after 4 seconds.

⑤ Measure and record the auto deceleration speed.

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
R510LC-7	Start idle	800±100	
	M mode	1750±50	
	H mode	1700±50	
	S mode	1650±50	
	Auto decel	1000±100	
	One touch decal	800±100	

Condition : Set the accel dial at 10(Max) position.

3) TRAVEL SPEED

(1) Measure the time required for the excavator to travel a 20m test track.

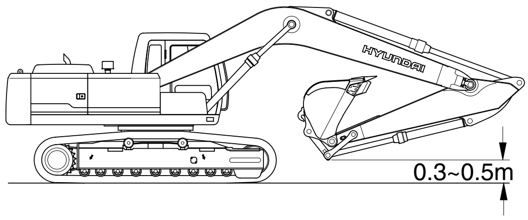
(2) Preparation

① Adjust the tension of both tracks to be equal.

② Prepare a flat and solid test track 20m in length, with extra length of 3 to 5m on both ends for machine acceleration and deceleration.

③ Hold the bucket 0.3 to 0.5m above the ground with the arm and bucket rolled in.

④ Keep the hydraulic oil temperature at 50±5°C.



290LC7MS01

(3) Measurement

① Measure both the low and high speeds of the machine.

② Before starting either the low or high speed tests, adjust the travel mode switch to the speed to be tested, then select the following switch positions.

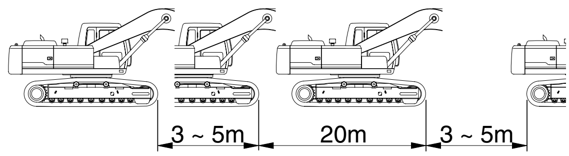
· Mode selector : H mode

③ Start traveling the machine in the acceleration zone with the travel levers at full stroke.

④ Measure the time required to travel 20m.

⑤ After measuring the forward travel speed, turn the upperstructure 180° and measure the reverse travel speed.

⑥ Repeat steps ④ and ⑤ three times in each direction and calculate the average values.



290LC7MS02

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20m

Model	Travel speed	Standard	Maximum allowable	Remarks
R510LC-7	1 Speed	22.5±2.0	28	
	2 Speed	13.6±1.0	17	

4) TRACK REVOLUTION SPEED

(1) Measure the track revolution cycle time with the track raised off ground.

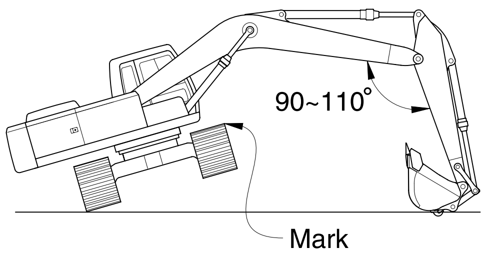
(2) Preparation

① Adjust the tension of both side tracks to be equal.

② On the track to be measured, mark one shoe with chalk.

③ Swing the upperstructure 90° and lower the bucket to raise the track off ground. Keep the boom-arm angle between 90 to 110° as shown. Place blocks under machine frame.

④ Keep the hydraulic oil temperature at 50±5°C.



21077MS06

(3) Measurement

① Select the following switch positions.

· Travel mode switch : 1 or 2 speed
· Mode selector : H mode
· Auto decel switch : OFF

② Operate the travel control lever of the raised track in full forward and reverse.

③ Rotate 1 turn, then measure time taken for next 3 revolutions.

④ Raise the other side of machine and repeat the procedure.

⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

The revolution cycle time of each track should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Travel speed	Standard	Maximum allowable
R510LC-7	1 Speed	28±2.0	48
	2 Speed	23.3±2.0	29.2

5) TRAVEL DEVIATION

(1) Measure the deviation by the tracks from a 20m straight line.

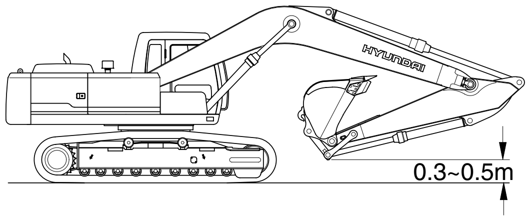
(2) Preparation

① Adjust the tension of both tracks to be equal.

② Provide a flat, solid test yard 20m in length, with extra length of 3 to 5m on both ends for machine acceleration and deceleration.

③ Hold the bucket 0.3 to 0.5m above the ground with the arm and bucket rolled in.

④ Keep the hydraulic oil temperature at 50±5°C.



290LC7MS01

(3) Measurement

① Measure the amount of mistracking at high and low travel speeds.

② Before beginning each test, select the following switch positions.

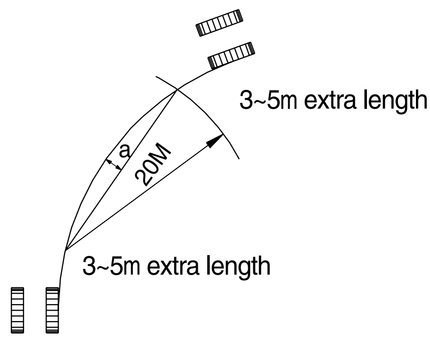
· Mode selector : H mode

③ Start traveling the machine in the acceleration zone with the travel levers at full stroke.

④ Measure the distance between a straight 20m line and the track made by the machine.(Dimension a)

⑤ After measuring the tracking in forward travel, turn the upperstructure 180° and measure that in reverse travel.

⑥ Repeat steps ④ and ⑤ three times and calculate the average values.



7-7(2) 210-7

(4) Evaluation

Mistrack should be within the following specifications.

Unit : mm / 20m

Model	Standard	Maximum allowable	Remarks
R510LC-7	200 below	250	

6) SWING SPEED

(1) Measure the time required to swing three complete turns.

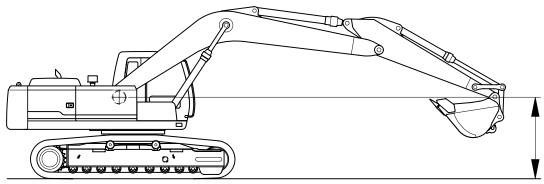
(2) Preparation

① Check the lubrication of the swing gear and swing bearing.

② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.

④ Keep the hydraulic oil temperature at 50±5°C.



290LC7MS03

(3) Measurement

① Select the following switch positions.

· Mode selector : Each mode

② Operate swing control lever fully.

③ Swing 1 turn and measure time taken to swing next 3 revolutions.

④ Repeat steps ② and ③ three time and calculate the average values.

(4) Evaluation

The time required for 3 swings should meet the following specifications.

Unit : Seconds / 3 revolutions

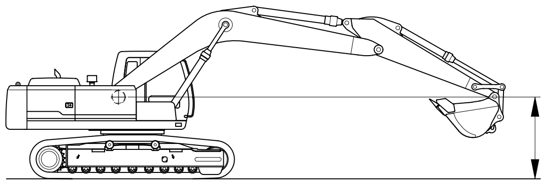
Model	Power selector switch	Standard	Maximum allowable
R510LC-7	H mode	18.9±1.5	23.7

7) SWING FUNCTION DRIFT CHECK

(1) Measure the swing drift on the bearing outer circumference when stopping after a 360° full speed swing.

(2) Preparation

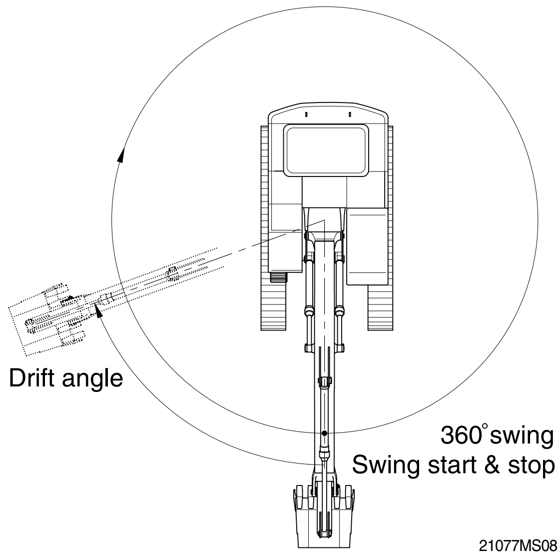
① Check the lubrication of the swing gear and swing bearing.
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.
④ Make two chalk marks: one on the swing bearing and one directly below it on the track frame.
⑤ Swing the upperstructure 360°.
⑥ Keep the hydraulic oil temperature at 50±5°C.



290LC7MS03

(3) Measurement

① Conduct this test in the H mode.
② Select the following switch positions.
・ Mode selector : H mode
③ Operate the swing control lever fully and return it to the neutral position when the mark on the upperstructure aligns with that on track frame after swinging 360°.
④ Measure the distance between the two marks.
⑤ Align the marks again, swing 360°, then test the opposite direction.
⑥ Repeat steps ④ and ⑤ three times each and calculate the average values.



21077MS08

(4) Evaluation

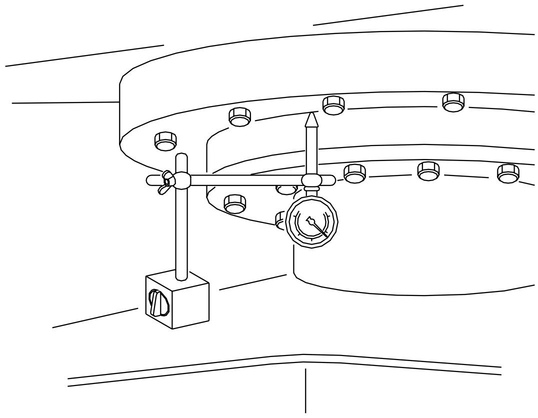
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Mode select switch	Standard	Maximum allowable	Remarks
R510LC-7	H mode	90 below	112.5	

8) SWING BEARING PLAY

(1) Measure the swing bearing play using a dial gauge to check the wear of bearing races and balls.



7-10(1) 210-7

(2) Preparation

① Check swing bearing mounting cap screws for loosening.

② Check the lubrication of the swing bearing. Confirm that bearing rotation is smooth and without noise.

③ Install a dial gauge on the track frame as shown, using a magnetic base.

④ Position the upperstructure so that the boom aligns with the tracks facing towards the front idlers.

⑤ Position the dial gauge so that its needle point comes into contact with the bottom face of the bearing outer race.

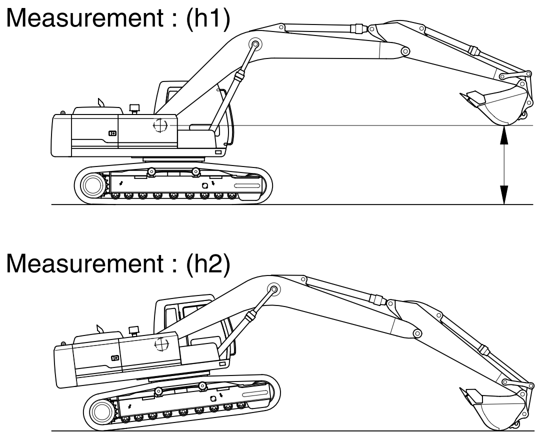
⑥ Bucket should be empty.

(3) Measurement

① With the arm rolled out and bucket rolled in, hold the bottom face of the bucket to the same height of the boom foot pin.
Record the dial gauge reading(h1).

② Lower the bucket to the ground and use it to raise the front idler 50cm.
Record the dial gauge reading(h2).

③ Calculate bearing play(H) from this data(h1 and h2) as follows.
H=h2-h1



290LC7MS04

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
R510LC-7	0.5 ~ 1.5	3.0	

9) HYDRAULIC CYLINDER CYCLE TIME

(1) Measure the cycle time of the boom, standard arm, and standard bucket cylinders.

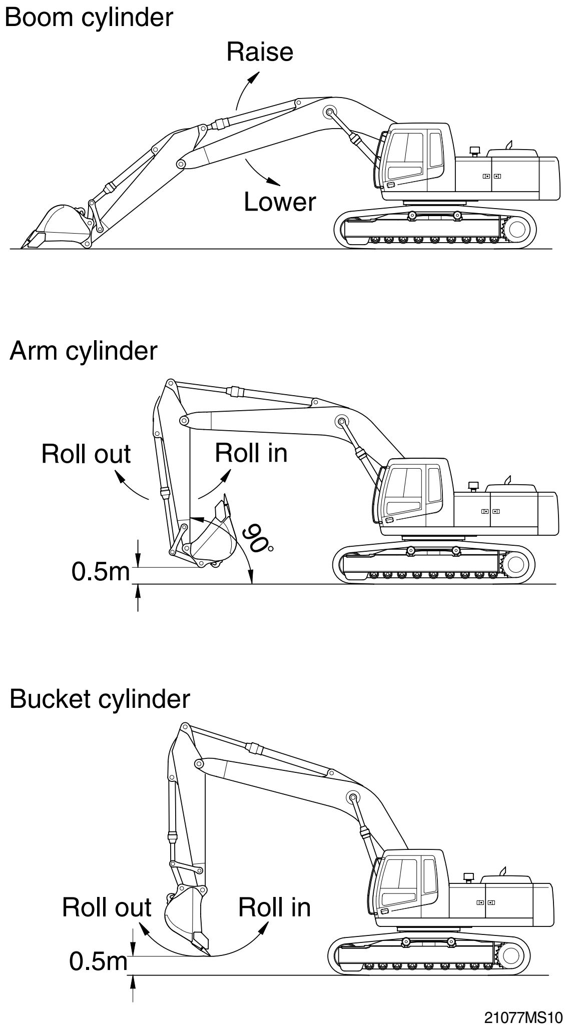
(2) Preparation

① To measure the cycle time of the boom cylinders:
With the arm rolled out and the empty bucket rolled out, lower the bucket to the ground, as shown.

② To measure the cycle time of the arm cylinder.
With the empty bucket rolled in, position the arm so that it is vertical to the ground. Lower the boom until the bucket is 0.5m above the ground.

③ To measure the cycle time of the bucket cylinder.
The empty bucket should be positioned at midstroke between roll-in and roll-out, so that the sideplate edges are vertical to the ground.

④ Keep the hydraulic oil temperature at 50±5℃.



(3) Measurement

① Select the following switch positions.

· Mode selector : H mode

② To measure cylinder cycle times.

- Boom cylinders.
  Measure the time it takes to raise the boom, and the time it takes to lower the boom. To do so, position the boom at one stroke end then move the control lever to the other stroke end as quickly as possible.
- Arm cylinder.
  Measure the time it takes to roll in the arm, and the time it takes to roll out the arm. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.

- Bucket cylinders
  Measure the time it takes to roll in the bucket, and the time it takes to roll out the bucket. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.
- Repeat each measurement 3 times and calculate the average values.

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds

Model	Function	Standard	Maximum allowable	Remarks
R510LC-7	Boom raise	4.3±0.3	5.2	
	Boom lower	3.8±0.4	4.5	
	Arm in	4.1±0.4	5.1	
	Arm out	3.5±0.3	4.3	
	Bucket load	3.0±0.4	3.6	
	Bucket dump	3.0±0.3	3.7	

10) DIG FUNCTION DRIFT CHECK

(1) Measure dig function drift, which can be caused by oil leakage in the control valve and boom, standard arm, and standard bucket cylinders, with the loaded bucket.
When testing the dig function drift just after cylinder replacement, slowly operate each cylinder to its stroke end to purge air.

(2) Preparation

① Load bucket fully. Instead of loading the bucket, weight(W) of the following specification can be used.

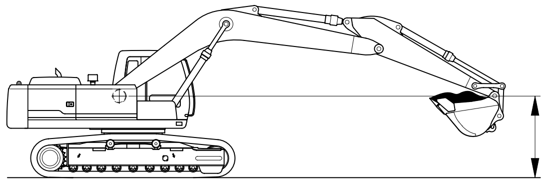
· W=$M^3 \times 1.5$
Where :
M^3 = Bucket heaped capacity(m^3)
1.5 = Soil specific gravity

② Position the arm cylinder with the rod 20 to 30mm extended from the fully retracted position.

③ Position the bucket cylinder with the rod 20 to 30mm retracted from the fully extended position.

④ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin.

⑤ Keep the hydraulic oil temperature at 50±5°C.


290LC7MS05

(3) Measurement

① Stop the engine.

② Five minutes after the engine has been stopped, measure the changes in the positions of the boom, arm and bucket cylinders.

③ Repeat step ② three times and calculate the average values.

(4) The measured drift should be within the following specifications.

Unit : mm / 5min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
R510LC-7	Boom cylinder	10 below	20	
	Arm cylinder	10 below	20	
	Bucket cylinder	40 below	50	

11) CONTROL LEVER OPERATING FORCE

(1) Use a spring scale to measure the maximum resistance of each control lever at the middle of the grip.

(2) Preparation

① Keep the hydraulic oil temperature at 50±5°C.

(3) Measurement

① Start the engine.

② Select the following switch positions.

· Mode selector : H mode

③ Operate each boom, arm, bucket and swing lever at full stroke and measure the maximum operating force for each.

④ Lower the bucket to the ground to raise one track off the ground. Operate the travel lever at full stroke and measure the maximum operating force required. When finished, lower the track and then jack-up the other track.

⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

The measured operating force should be within the following specifications.

Unit : kgf

Model	Kind of lever	Standard	Maximum allowable	Remarks
R510LC-7	Boom lever	1.6 or below	2.0	
	Arm lever	1.6 or below	2.0	
	Bucket lever	1.6 or below	2.0	
	Swing lever	1.6 or below	2.0	
	Travel lever	2.1 or below	3.15	

12) CONTROL LEVER STROKE

(1) Measure each lever stroke at the lever top using a ruler.

※ When the lever has play, take a half of this value and add it to the measured stroke.

(2) Preparation

Keep the hydraulic oil temperature at 50±5℃.

(3) Measurement

① Stop the engine.

② Measure each lever stroke at the lever top from neutral to the stroke end using a ruler.

③ Repeat step ② three times and calculate the average values.

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Kind of lever	Standard	Maximum allowable	Remarks
R510LC-7	Boom lever	87±10	109	
	Arm lever	87±10	109	
	Bucket lever	87±10	109	
	Swing lever	87±10	109	
	Travel lever	142±10	178	

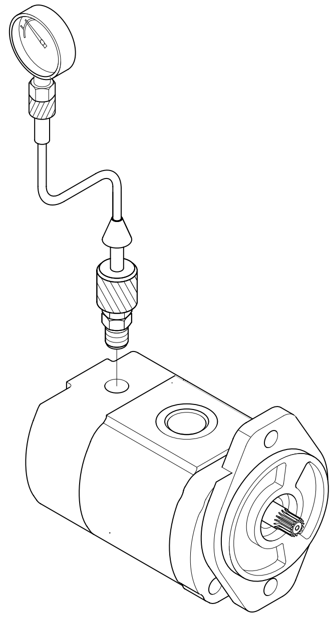
13) PILOT PRIMARY PRESSURE

(1) Preparation

① Stop the engine.
② Remove the top cover of the hydraulic tank oil supply port with a wrench.
③ Loosen and remove plug on the pilot pump delivery port and connect pressure gauge.
④ Start the engine and check for oil leakage from the port.
⑤ Keep the hydraulic oil temperature at 50±5°C.

(2) Measurement

① Select the following switch positions.
· Engine speed : Decel rpm(1000)



50077MS01

(3) Evaluation

The average measured pressure should meet the following specifications:

Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
R510LC-7	Decel rpm(1000)	35±5	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE

(1) Preparation

① Stop the engine.

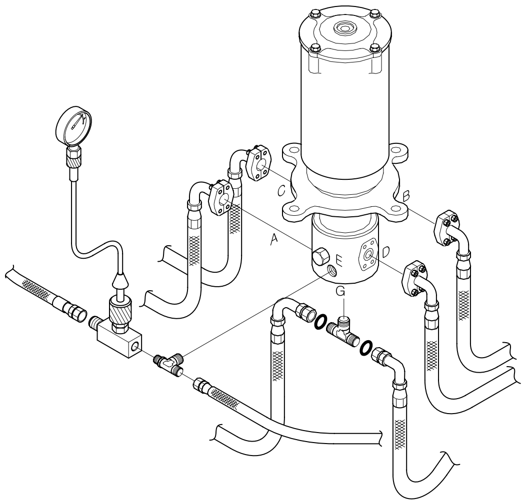
② Remove the top cover of the hydraulic tank oil supply port with a wrench.

③ Push the pressure release button to bleed air.

④ To measure the speed selecting pressure: Install a connector and pressure gauge assembly to turning joint P port as shown.

⑤ Start the engine and check for on leakage from the adapter.

⑥ Keep the hydraulic oil temperature at 50±5°C.



45077MS02

(2) Measurement

① Select the following switch positions.
Travel mode switch : 1 speed
2 speed

· Mode selector : M mode

② Measure the travel speed selecting pressure in the Hi or Lo mode.

③ Lower the bucket to the ground to raise the track off the ground. Operate the travel lever at full stroke and measure the fast speed pressure.

④ Repeat steps ② and ③ three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

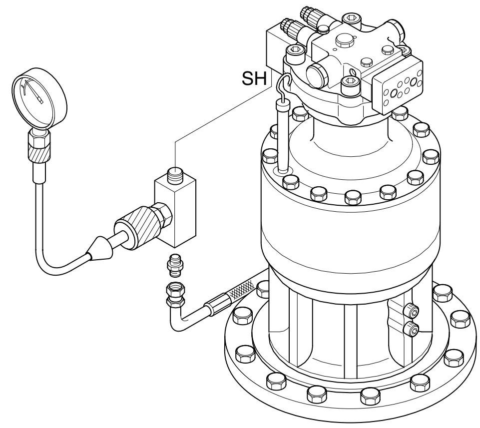
Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
R510LC-7	1 Speed	0	-	
	2 Speed	33±5	-	

15) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation

① Stop the engine.
② Remove the top cover of the hydraulic tank oil supply port with a wrench.
③ The pressure release L wrench to bleed air.
④ Install a connector and pressure gauge assembly to swing motor SH port, as shown.
⑤ Start the engine and check for oil leakage from the adapter.
⑥ Keep the hydraulic oil temperature at 50±5°C.



50077MS03

(2) Measurement

① Select the following switch positions.
· Mode selector : M mode
② Operate the swing function or arm roll in function and measure the swing brake control pressure with the brake disengaged. Release the control lever to return to neutral and measure the control pressure when the brake is applied.
Repeat step ② three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

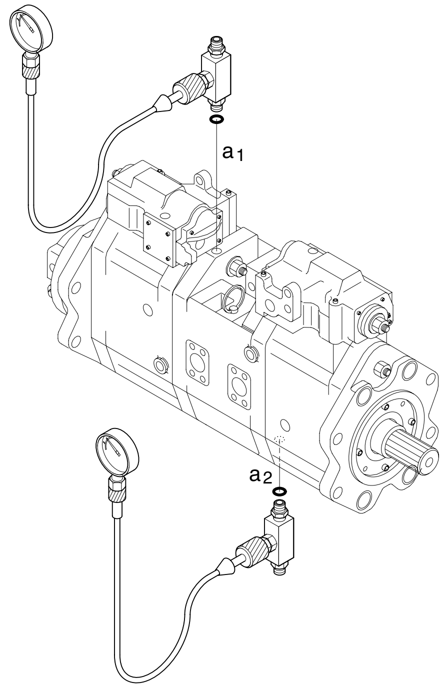
Unit : kgf / cm²

Model	Description	Standard	Allowable limits	Remarks
R510LC-7	Brake disengaged	33	22~50	
	Brake applied	0	-	

16) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

① Stop the engine.
② Remove the top cover of the hydraulic tank oil supply port with a wrench.
③ Push the pressure release button to bleed air.
④ To measure the main pump pressure. Install a connector and pressure gauge assembly main pump gauge port as shown.
⑤ Start the engine and check for oil leakage from the port.
⑥ Keep the hydraulic oil temperature at 50±5°C.



36077MS03

(2) Measurement

① Select the following switch positions.
· Mode selector : M mode
② Measure the main pump delivery pressure in the M mode(High idle).

(3) Evaluation

The average measured pressure should meet the following specifications.

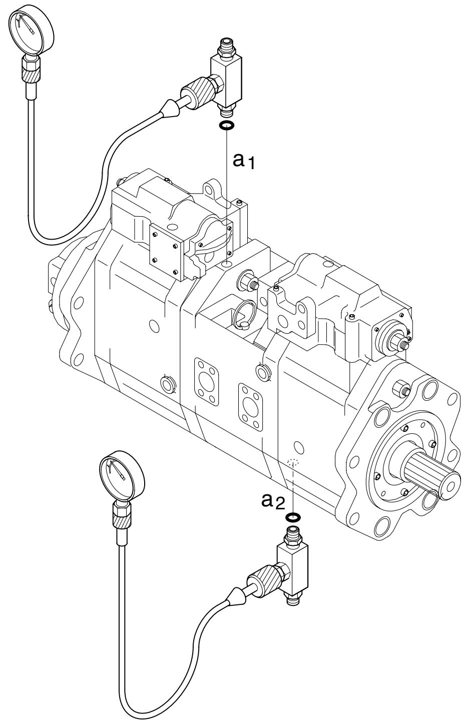
Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
R510LC-7	High ilde	45±5	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

① Stop the engine.
② Remove the top cover of the hydraulic tank oil supply port with a wrench.
③ Push the pressure release button to bleed air.
④ To measure the system relief pressure. Install a connector and pressure gauge assembly main pump gauge port, as shown.
⑤ Start the engine and check for oil leakage from the port.
⑥ Keep the hydraulic oil temperature at 50±5°C.



36077MS03

(2) Measurement

① Select the following switch positions.
· Mode selector : M mode
② Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.
③ In the swing function, place bucket against an immovable object and measure the relief pressure.
④ In the travel function, lock undercarriage with an immovable object and measure the relief pressure.

(3) Evaluation

The average measured pressure should be within the following specifications.

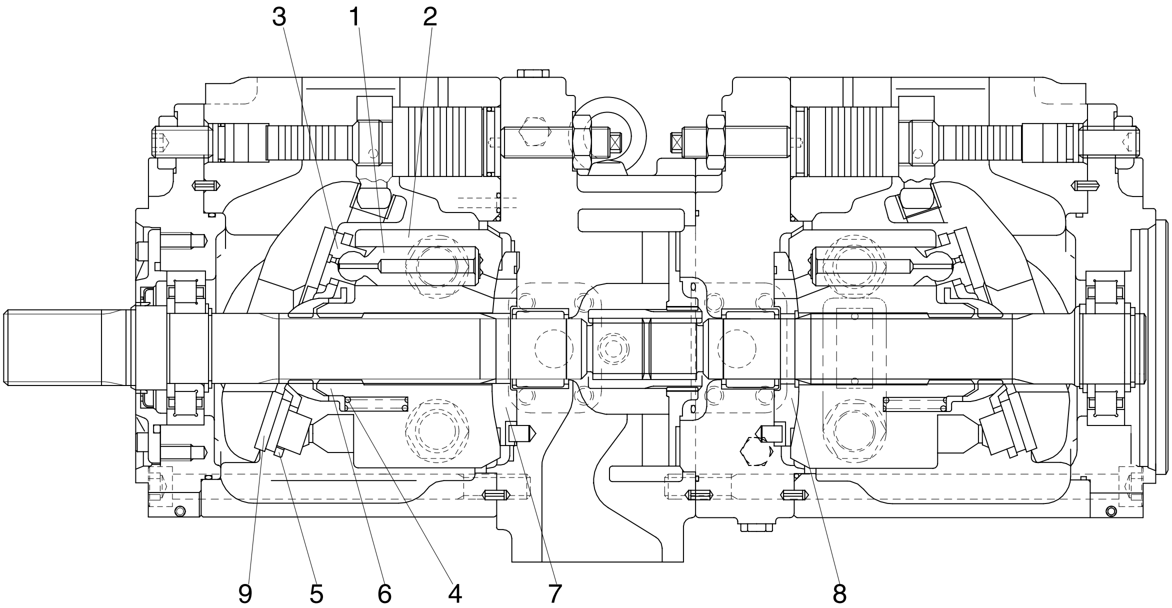
Unit : kgf / cm²

Model	Function to be tested	Standard	Maximum allowable
R510LC-7	Boom, Arm, Bucket	330(360)±10	390±10
	Travel	345±10	-
	Swing	285±10	-

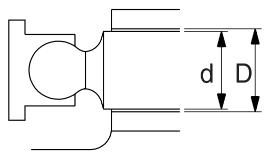
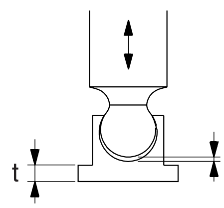
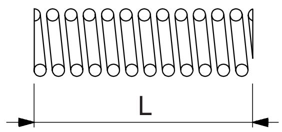
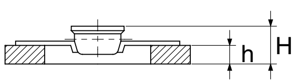
(   ) : Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



50077MP01

Part name & inspection item		Standard dimension	Recommended replacement value	Counter easures
Clearance between piston(1) & cylinder bore(2) (D-d)		0.038	0.078	Replace piston or cylinder.
Play between piston(1) & shoe caulking section(3) (δ)		0-0.1	0.35	Replace assembly of piston & shoe.
Thickness of shoe (t)		5.4	5.0	
Free height of cylinder spring(4) (L)		40.9	40.1	Replace cylinder spring.
Combined height of set plate(5) & spherical bushing(6) (H-h)		13.5	12.5	Replace retainer or set plate.
Surface roughness for valve plate(Sliding face) (7,8), swash plate (shoe plate area)(9), & cylinder(2)(Sliding face)	Surface roughness necessary to be corrected	3z		Lapping
	Standard surface roughness (Corrected value)	0.4z or lower		

2. MAIN CONTROL VALVE

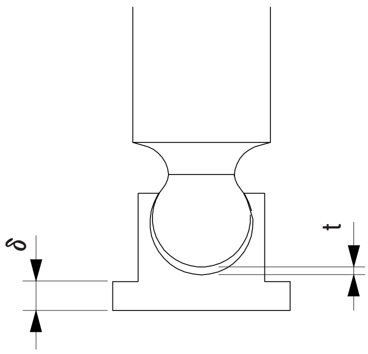
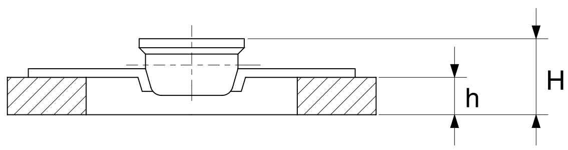
Part name	Inspection item	Criteria & measure
Casing	· Existence of scratch, rusting or corrosion.	· In case of damage in following section, replace part. - Sliding sections of casing fore and spool, especially land sections applied with holded pressure. - Seal pocket section where spool is inserted. - Sealing section of port where O-ring contacts. - Sealing section of each relief valve for main, travel and port. - Other damages that may damage normal functions.
Spool	· Existence of scratch, gnawing, rusting or corrosion. · O-ring seal sections at both ends. · Insert spool into casing hole, rotate and reciprocate it.	· Replacement when its outside sliding section has scratch (especially on seals-contacting section). · Replacement when its sliding section has scratch. · Correction or replacement when O-ring is damaged or when spool does not move smoothly.
Poppet	· Damage of poppet or spring. · Insert poppet into casing and function it.	· Correction or replacement when sealing is incomplete. · Normal when it can function lightly without being caught.
Around spring	· Rusting, corrosion, deformation or breaking of spring, spring seat, plug or cover.	· Replacement for significant damage.
Around seal for spool	· External oil leakage. · Rusting, corrosion or deformation of seal plate.	· Correction or replacement. · Correction or replacement.
Main relief valve, port relief valve & negative control relief valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · Abnormal spring. · O-rings, back up rings and seals.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement. · 100% replacement in general.

3. SWING DEVICE (TYPE 1)

Part name	Inspection item	Remedy
Balance plate	· Worn less than 0.03mm · Worn more than 0.03mm · Sliding surface has a seizure(even though small).	· Lapping · Replace · Replace
Shoe of piston assembly	· Sliding surface has a damage. · Sliding surface depression( ) dimension less than 0.45mm or has a large damage.	· Lapping · Replace parts or motor
Piston of piston assembly	· Sliding surface has a seizure(even though small).	· Replace motor
Piston hole of cylinder assembly	· Sliding surface has a seizure. · Sliding surface has a damage.	· Replace motor · Replace motor
Taper roller bearing Needle bearing Roller bearing	· In case 3000hour operation. · Rolling surface has a damage.	· Replace · Replace

3. SWING DEVICE (TYPE 2)

1) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.028	0.058	Replace piston or cylinder block
Play between piston and shoe caulking section (δ)	0	0.3	Replace assembly of piston and shoe
Thickness of shoe (t)	5.5	5.3	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H-h)	6.5	6.0	Replace set of retainer plate and sperical bushing
Thickness of friction plate	4.0	3.6	Replace
			

2) SLIDING PARTS

Part name	Standard roughness	Allowable roughness	Remark
Shoe	0.8-Z (Ra=0.2) (LAPPING)	3-Z (Ra=0.8)	
Shoe plate	0.4-Z (Ra=0.1) (LAPPING)	3-Z (Ra=0.8)	
Cylinder	1.6-Z (Ra=0.4) (LAPPING)	12.5-Z (Ra=3.2)	
Valve plate	0.8-Z (Ra=0.2) (LAPPING)	6.3-Z (Ra=1.6)	

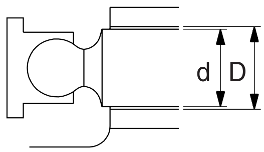
4. TRAVEL MOTOR

Replace parts in accordance with the following standards. However, if a part is damaged significantly in terms of its appearance, replace it irrespective of the standards.

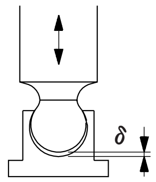
1) HYDRAULIC MOTOR

Part name & inspection item	Standard dimension	Recommended value for replacement	Remedy
Clearance between piston & cylinder bore (D-d)	0.052 mm	0.077 mm	Replacement
Clearance caulked part between piston and shoe (δ)	0.1 mm	0.3 mm	Replacement
Thickness of shoe	7.5 mm	7.3 mm	Replacement
Assembled height of spherical bush and set plate (H-h)	26.5 mm	26.0 mm	Replacement as a set
Free length of cylinder spring	68.0 mm	67.4 mm	Replacement
Shaft over pin dia. Output spline Cylinder spline	51.402 (ø 4.5) 58.878 (ø 4.5)	52.002 mm 59.478 mm	Replacement if either one reaches replacement value.
Spline over dia. Spline in cylinder Spline in spherical bushing	42.302 (ø 6)	42.902 mm	Replacement
Thickness of separation plate Thickness of friction plate	2.43 mm 3.9 mm	2.23 mm 3.7 mm	Replacement
Free length of brake spring	39.77 mm	38.77 mm	Replacement
Displacement over teeth Over pin dia. of friction plate internal teeth	68.77 (8teeth) 173.67 (ø 5)	68.47 mm 174.27 mm	Replacement Replacement
Roughness of sliding surfaces Swash plate/shoe Cylinder block/valve plate	0.4 - z 0.4 - z	3 - z 3 - z	Each independent lapping Mutual lapping
Roller bearing Needle bearing	-	-	Replacement if flaking is found on rolling surface.
O-ring Oil seal	-	-	Replacement at every disassembly, in principle.

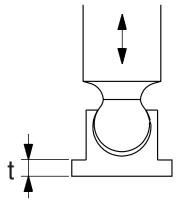
Part name & inspection item	Standard dimension	Recommended value for replacement	Remedy
Bolt	-	-	Replacement if elongation is found.



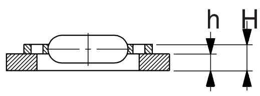
clearance between piston
and cylinder bore : D-d



Play at caulking between piston and shoe : δ



Thickness of shoe : t



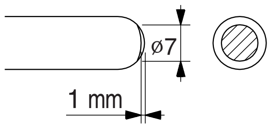
Assembled height of set plate
and spherical bushing : H-h

2) REDUCTION GEAR

Part name & inspection item	Standard dimension	Recommended value for replacement	Remedy
Pitting or crack of gear	-	Pitting area rate : 10%	Replacement pitting or crack is found
Motor driving gear external spline	Overpin 51.402(ø4.5)	52.002 mm	(Z=14)
Drive gear internal spline	Overpin 51.491 (ø4.5)	52.091 mm	Replacement (Z=17)
No. 1 planetary gear	Displacement 48.352 (4EA)	48.052 mm	Replacement (Z=26)
No. 1 carrier internal spline	Overpin 108.01 (ø13)	108.61 mm	Replacement (Z=21)
No. 2 sun gear	Displacement 65.555 (4EA)	65.255 mm	Replacement (Z=21)
No. 2 planetary gear	Displacement 64.724 (5EA)	64.424 mm	Replacement (Z=23)
No. 2 carrier internal spline	Overpin 119.97 (ø13)	120.57 mm	Replacement (Z=23)
Ring gear	Overpin 399.97 (ø10.3)	400.57 mm	Replacement (Z=69)
No. 3 sun gear	Displacement 65.881 (4EA)	65.581 mm	Replacement (Z=23)
No. 3 planetary gear	Displacement 47.474 (3EA)	47.174 mm	Replacement (Z=22)
No. 3 carrier internal spline	Overpin 161.24 (ø7.5)	161.84 mm	Replacement (Z=45)
Cover internal gear	Overpin 345.0 (ø7.7)	345.60 mm	Replacement (Z=79)
Crack and flaking of bearing inner/outer races and rollers	-	-	Replacement if crack or flaking is found.
Crack and flaking of 1st/2nd/3rd planetary gears and pins	-	-	Replacement if crack or flaking is found.
Radial clearance of needle bearing	0.01-0.04 mm	0.07 mm	Replacement as a set.
Crack of spline contact part	-	-	Replacement if crack or flaking is found.

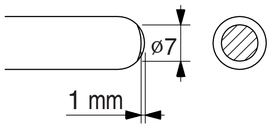
Part name & inspection item	Standard dimension	Recommended value for replacement	Remedy
Backlash of spline contact part	0.1-0.3 mm	0.5 mm	Replacement as a recommended value for replacement.
Thrust ring 90	Thickness 8 mm	7.6 mm	Replacement if severe wear or seizure is found on sliding surface.
Floating seal	-	-	Replacement of scratch or rust is found in sliding surface. Replacement if O-ring is deformed of damaged.
Gear oil	-	-	1st time : 500hr 2nd time and later : Every 2000hr After disassembling, fill with new oil without fail. (The above times are measured with engine hour meter.)

5. RCV LEVER

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage becomes more than 1000cc/m at neutral handle position, or more than 2000cc/m during operation.	Conditions : Primary pressure : 30 kgf/cm^2 Oil viscosity : 23cSt
Spool	This is to be replaced when the sliding surface has worn more than 10μm, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

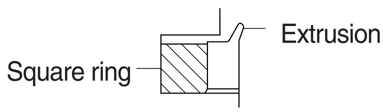
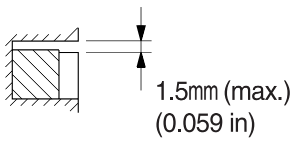
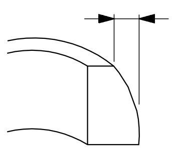
Notes
1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.
2. When loosening the hexagon socket head cap screw(125), replace the seal washers(121) without fail.

6. RCV PEDAL

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage effect to the system. For example, the primary pressure drop.	Conditions : Primary pressure : 30 kgf/cm^2 Oil viscosity : 23cSt
Spool	This is to be replaced when the sliding surface has worn more than 10μm, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

7. TURNING JOINT

Part name		Maintenance standards	Remedy
Body, Stem	Sliding surface with sealing sections.	Plating worn or peeled due to seizure or contamination.	Replace
	Sliding surface between body and stem other than sealing section.	·Worn abnormality or damaged more than 0.1 mm (0.0039 in) in depth due to seizure contamination.	Replace
		·Damaged more than 0.1 mm (0.0039 in) in depth.	Smooth with oilstone.
	Sliding surface with thrust plate.	·Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		·Worn less than 0.5 mm (0.02 in).	Smooth
		·Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Smooth
Cover	Sliding surface with thrust plate.	·Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		·Worn less than 0.5 mm (0.02 in).	Smooth
		·Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Replace
Seal set	-	·Extruded excessively from seal groove square ring. 	Replace
	-	·Slipper ring 1.5 mm (0.059 in) narrower than seal groove, or narrower than back ring. 	Replace
	-	·Worn more than 0.5 mm (0.02 in)~1.5 mm (MAX.) (0.059 in) 	Replace

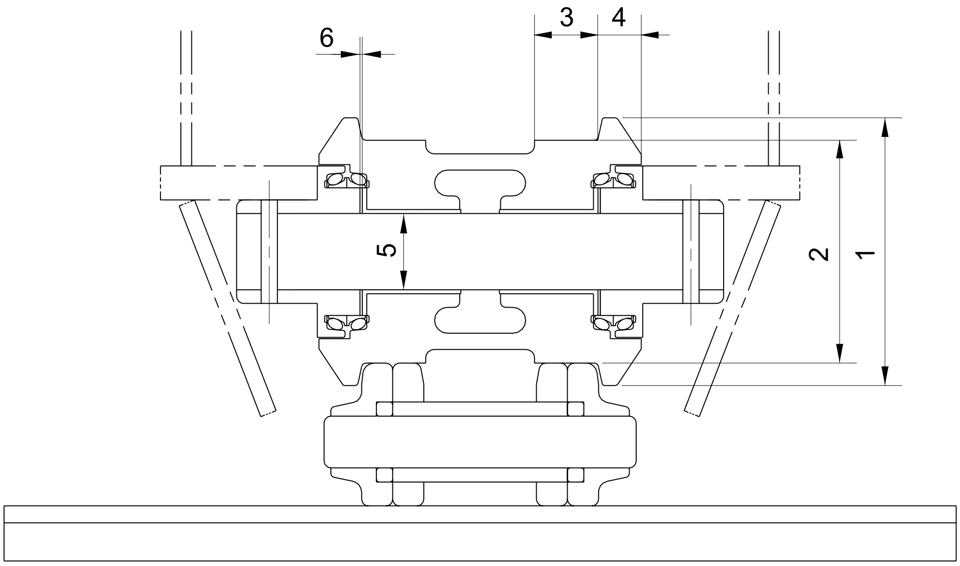
8. CYLINDER

Part name	Inspecting section	Inspection item	Remedy
Piston rod	· Neck of rod pin	· Presence of crack	· Replace
	· Weld on rod hub	· Presence of crack	· Replace
	· Stepped part to which piston is attached.	· Presence of crack	· Replace
	· Threads	· Presence of crack	· Recondition or replace
	· Plated surface	· Plating is not worn off to base metal. · Rust is not present on plating. · Scratches are not present.	· Replace or replate · Replace or replate · Recondition, replate or replace
	· Rod	· Wear of O.D.	· Recondition, replate or replace
	· Bushing at mounting part	· Wear of I.D.	· Replace
Cylinder tube	· Weld on bottom	· Presence of crack	· Replace
	· Weld on head	· Presence of crack	· Replace
	· Weld on hub	· Presence of crack	· Replace
	· Tube interior	· Presence of faults	· Replace if oil leak is seen
	· Bushing at mounting part	· Wear on inner surface	· Replace
Gland	· Bushing	· Flaw on inner surface	· Replace if flaw is deeper than coating

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK

1) TRACK ROLLER

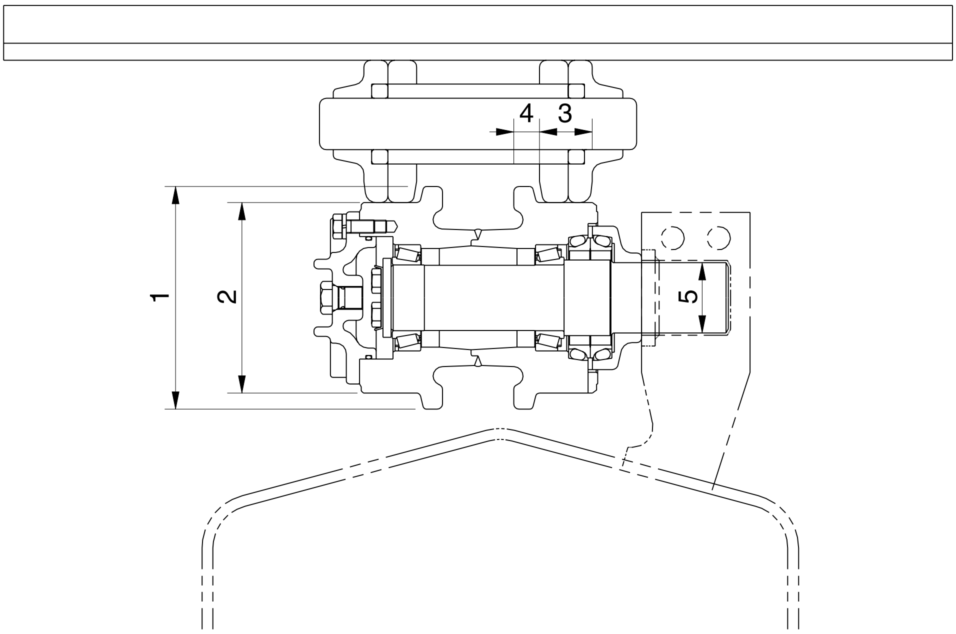


32077MS01

Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		ø250		-		
2	Outside diameter of tread	ø200		ø188		
3	Width of tread	54.6		60.6		
4	Width of flange	34.4		-		
5	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Bushing			
		ø85 $^{-0.25}_{-0.35}$	ø85 $^{+0.176}_{+0.029}$	0.279 to 0.526	2.0	
6	Side clearance of roller (Both side)	Standard clearance		Clearance limit		Replace
		0.12~1.3		2.0		

2) CARRIER ROLLER

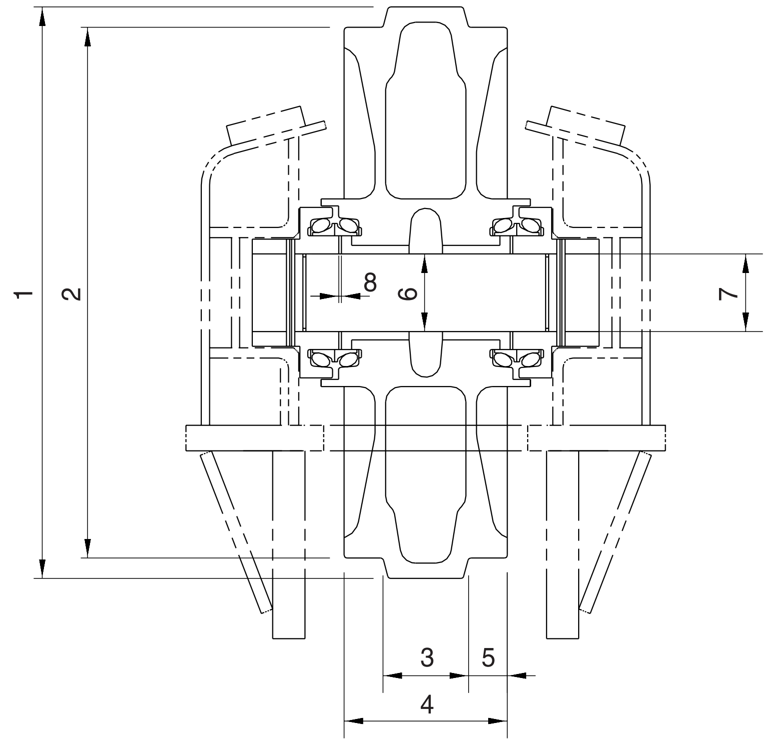


21073MS02

Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		ø 220		-		
2	Outside diameter of tread	ø 191		ø 181		
3	Width of tread	51		56		
4	Width of flange	20		-		
5	Clearance between shaft and support	Standard size & tolerance		Standard clearance	Clearance limit	Replace
		Shaft	Hole			
		ø 57.15 $^{0}_{-0.1}$	ø 57.15 $^{+0.3}_{+0.1}$	0.1 to 0.4	1.2	

3) IDLER

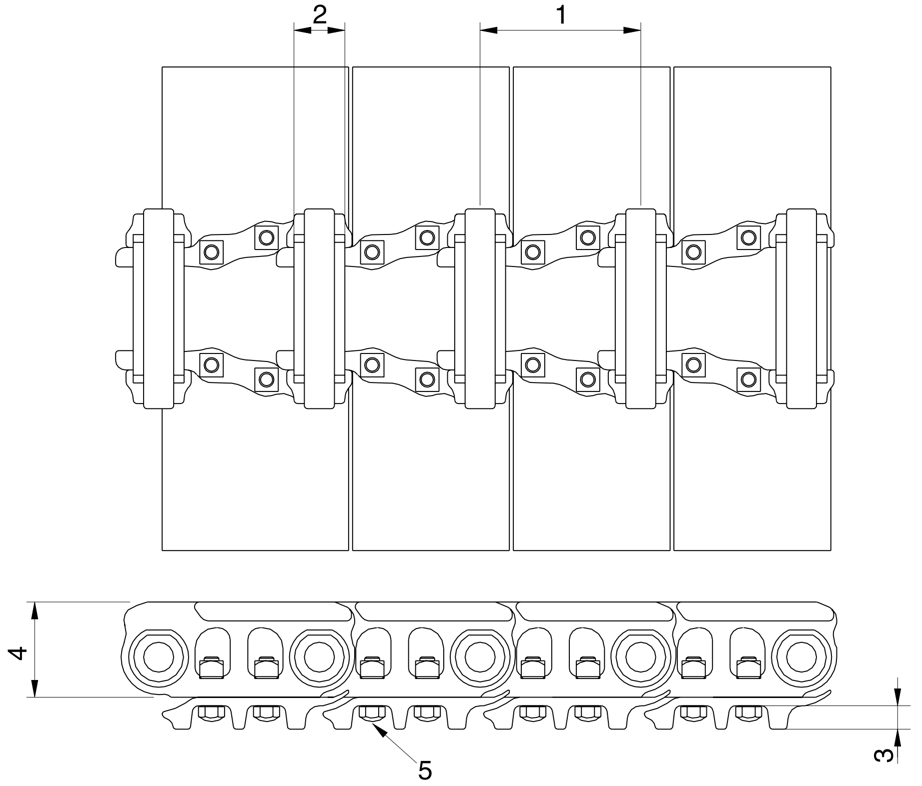


21073MS03

Unit : mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of protrusion</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="6">Rebuild or replace</td></tr>
<tr><td colspan="2">ø682</td><td colspan="2">-</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">ø630</td><td colspan="2">ø616</td></tr>
<tr><td>3</td><td>Width of protrusion</td><td colspan="2">102</td><td colspan="2">-</td></tr>
<tr><td>4</td><td>Total width</td><td colspan="2">203</td><td colspan="2">-</td></tr>
<tr><td>5</td><td>Width of tread</td><td colspan="2">50.5</td><td colspan="2">57.5</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Clearance between shaft and bushing</td><td colspan="2">Standard size & 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>$ø85^{\,0}_{-0.035}$</td><td>$ø85.35^{+0.05}_{\,0}$</td><td>0.35 to 0.435</td><td>2.0</td></tr>
<tr><td>7</td><td>Clearance between shaft and support</td><td>$ø85^{\,0}_{-0.035}$</td><td>$ø85^{+0.090}_{+0.036}$</td><td>0.036 to 0.125</td><td>1.2</td><td>Replace</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Side clearance of idler (Both side)</td><td colspan="2">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="2">0.25 to 0.12</td><td colspan="2">2.0</td></tr>
</table>

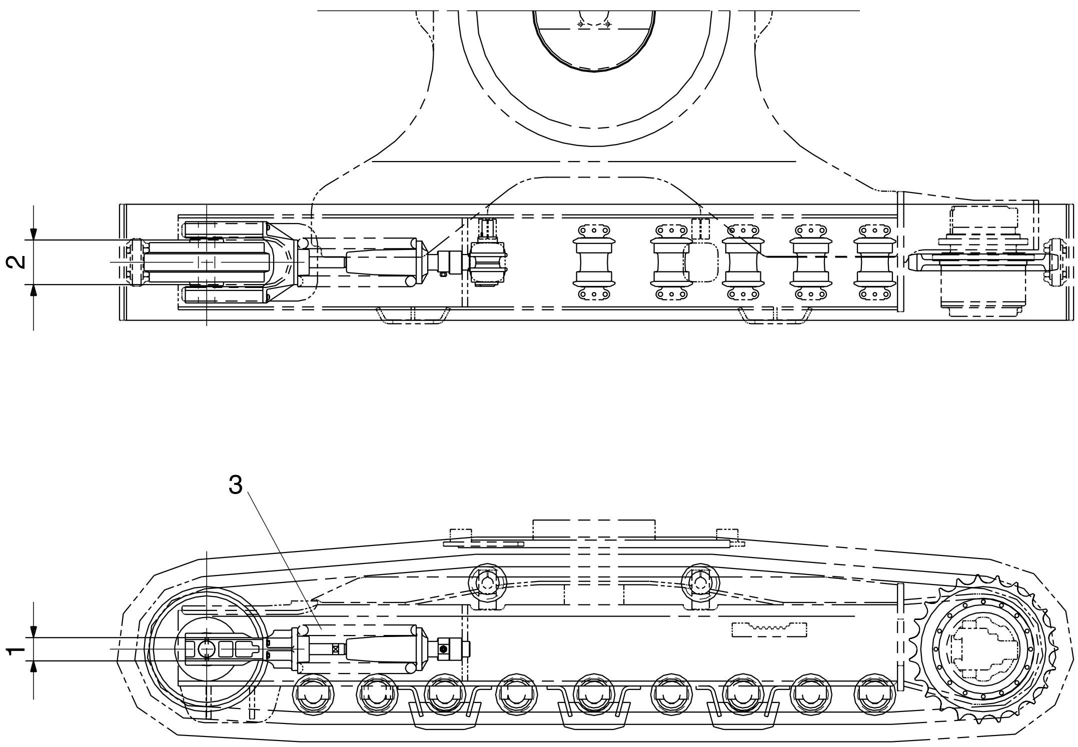
4) TRACK



Unit : mm

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		215.9	220.9	
2	Outside diameter of bushing	ø 71	ø 60.4	Rebuild or replace
3	Height of grouser	36	21	
4	Height of link	129	115	
5	Tightening torque	Initial tightening torque : 105±5kgf · m		Retighten

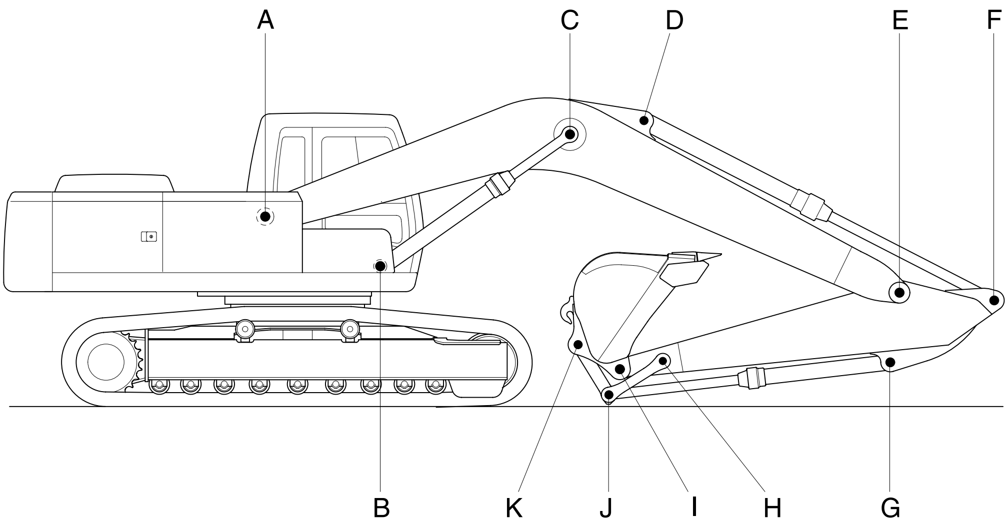
5) TRACK FRAME AND RECOIL SPRING



Unit : mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Vertical width of idler guide</td><td></td><td>Standard size</td><td colspan="2">Tolerance</td><td>Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td>Track frame</td><td>123</td><td colspan="2">+2
0</td><td>127</td></tr>
<tr><td>Idler support</td><td>120</td><td colspan="2">0
-1.5</td><td>116</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width of idler guide</td><td>Track frame</td><td>292</td><td colspan="2">+2
0</td><td>296</td></tr>
<tr><td>Idler support</td><td>290</td><td colspan="2">-</td><td>287</td></tr>
<tr><td rowspan="3">3</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</td><td>Installation length</td><td>Installation load</td><td>Free length</td><td>Installation load</td></tr>
<tr><td>ø 276 × 865</td><td>707</td><td>288401kg</td><td>-</td><td>23072kg</td></tr>
</table>

2. WORK EQUIPMENT



21077MS20

Unit : mm

Mark	Measuring point (Pin and Bushing)	Normal value	Pin		Bushing		Remedy & Remark
			Recomm. service limit	Limit of use	Recomm. service limit	Limit of use	
A	Boom Rear	120	119	118.5	120.5	121	Replace
B	Boom Cylinder Head	120	119	118.5	120.5	121	
C	Boom Cylinder Rod	120	119	118.5	120.5	121	
D	Arm Cylinder Head	120	119	118.5	120.5	121	
E	Boom Front	120	119	118.5	120.5	121	
F	Arm Cylinder Rod	120	119	118.5	120.5	121	
G	Bucket Cylinder Head	110	109	108.5	110.5	111	
H	Arm Link	100	99	98.5	100.5	101	
I	Bucket and Arm Link	120	119	118.5	120.5	121	
J	Bucket Cylinder Rod	110	109	108.5	110.5	111	
K	Bucket Link	120	119	118.5	120.5	121	

SECTION 8 DISASSEMBLY AND ASSEMBLY

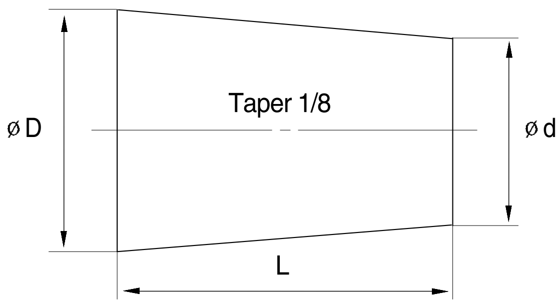
SECTION 8 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

1) Lower the work equipment completely to the ground.
   If the coolant contains antifreeze, dispose of it correctly.
2) After disconnecting hoses or tubes, cover them or fit blind plugs to prevent dirt or dust from entering.
3) When draining oil, prepare a container of adequate size to catch the oil.
4) Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.
5) To prevent any excessive force from being applied to the wiring, always hold the connectors when disconnecting the connectors.
6) Fit wires and hoses with tags to show their installation position to prevent any mistake when installing.
7) Check the number and thickness of the shims, and keep in a safe place.
8) When raising components, be sure to use lifting equipment of ample strength.
9) When using forcing screws to remove any components, tighten the forcing screws alternately.
10) Before removing any unit, clean the surrounding area and fit a cover to prevent any dust or dirt from entering after removal.
11) When removing hydraulic equipment, first release the remaining pressure inside the hydraulic tank and the hydraulic piping.
12) If the part is not under hydraulic pressure, the following corks can be used.

Nominal number	Dimensions		
	D	d	L
06	6	5	8
08	8	6.5	11
10	10	8.5	12
12	12	10	15
14	14	11.5	18
16	16	13.5	20
18	18	15	22
20	20	17	25
22	22	18.5	28
24	24	20	30
27	27	22.5	34



2. INSTALL WORK

1) Tighten all bolts and nuts(Sleeve nuts) to the specified torque.

2) Install the hoses without twisting or interference.

3) Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.

4) Bend the cotter pin or lock plate securely.

5) When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2-3 drops of adhesive.

6) 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.

7) Clean all parts, and correct any damage, dents, burrs, or rust.

8) Coat rotating parts and sliding parts with engine oil.

9) When press fitting parts, coat the surface with antifriction compound(LM-P).

10) After installing snap rings, check that the snap ring is fitted securely in the ring groove(Check that the snap ring moves in the direction of rotation).

11) When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.

12) When using eyebolts, check that there is no deformation or deterioration, and screw them in fully.

13) When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.

14) When operating the hydraulic cylinders for the first time after repairing and reassembling the hydraulic cylinders, pumps, or other hydraulic equipment or piping, always bleed the air from the hydraulic cylinders as follows:

(1) Start the engine and run at low idling.

(2) Operate the control lever and actuate the hydraulic cylinder 4-5 times, stopping 100mm before the end of the stroke.

(3) Next, operate the piston rod to the end of its stroke to relieve the circuit. (The air bleed valve is actuated to bleed the air.)

(4) After completing this operation, raise the engine speed to the normal operating condition.

※ If the hydraulic cylinder has been replaced, carry out this procedure before assembling the rod to the work equipment.

※ Carry out the same operation on machines that have been in storage for a long time after completion of repairs.

3. COMPLETING WORK

1) 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.

2) 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.

3) 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.

4) Add the specified amount of grease(Molybdenum disulphied grease) to the work equipment related parts.

GROUP 2 TIGHTENING TORQUE

1. MAJOR COMPONENTS

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt, nut(engine-bracket)	M16 × 2.0	29.7 ± 5.0	215 ± 36.2
2		Engine mounting bolt, nut(bracket-frame)	M22 × 2.5	69.8 ± 6.0	505 ± 43.3
3		Radiator mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
4		Coupling mounting socket bolt	M20 × 2.5	46.5 ± 2.5	336 ± 18.1
5		Main pump housing mounting bolt	M10 × 1.5	4.8 ± 0.3	35 ± 2.2
6	Hydraulic system	Main pump mounting bolt	M20 × 2.5	44 ± 6.6	318 ± 47.7
7		Main control valve mounting nut	M20 × 2.5	42 ± 4.5	304 ± 30.5
8		Fuel tank mounting bolt	M20 × 2.5	45 ± 5.1	325 ± 36.8
9		Hydraulic oil tank mounting bolt	M20 × 2.5	45 ± 5.1	325 ± 36.8
10		Turning joint mounting bolt, nut	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
11	Power train system	Swing motor mounting bolt	M20 × 2.5	58.4 ± 6.4	422 ± 46.2
12		Swing bearing upper part mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
13		Swing bearing lower part mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
14		Travel motor mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
15		Sprocket mounting bolt	M22 × 2.5	77.4 ± 7.5	560 ± 54.2
16	Under carriage	Carrier roller mounting bolt, nut	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
17		Track roller mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
18		Track tension cylinder mounting bolt	M22 × 1.5	87.2 ± 12.5	602 ± 90
18		Track shoe mounting bolt, nut	M24 × 1.5	140 ± 14	1012 ± 101
19		Track guard mounting bolt	M22 × 2.5	81.9 ± 16.1	592 ± 116
20	Others	Counterweight mounting bolt	M42 × 3.0	390 ± 40	2821 ± 289
21		Center frame support & lower track mounting	M33 × 3.5	220 ± 20	1591 ± 145
22		bolt	M12 × 1.75	12.2 ± 1.3	88.2 ± 9.4
23		Cab mounting bolt	M 8 × 1.25	2.5 ± 0.5	18.1 ± 3.6

※ For tightening torque of engine and hydraulic components, see engine maintenance guide and service manual.

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT - Coarse thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 6 × 1.0	0.85 ~ 1.25	6.15 ~ 9.04	1.14 ~ 1.74	8.2 ~ 12.6
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.7	2.7 ~ 4.1	19.5 ~ 29.7
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60.0
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 81.0	9.8 ~ 15.8	70.9 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 163
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.0	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 344
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	349 ~ 458	65.8 ~ 98.0	476 ~ 709
M24 × 3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30 × 3.0	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1656
M36 × 4.0	174 ~ 236	1261 ~ 1704	250 ~ 310	1808 ~ 2242

(2) Fine thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8 × 1.0	2.2 ~ 3.4	15.9 ~ 24.6	3.0 ~ 4.4	21.7 ~ 31.8
M10 × 1.2	4.5 ~ 6.7	32.5 ~ 48.5	5.9 ~ 8.9	42.7 ~ 64.4
M12 × 1.25	7.8 ~ 11.6	56.4 ~ 83.9	10.6 ~ 16.0	76.7 ~ 116
M14 × 1.5	13.3 ~ 18.1	96.2 ~ 131	17.9 ~ 24.1	130 ~ 174
M16 × 1.5	19.9 ~ 26.9	144 ~ 195	26.6 ~ 36.0	192 ~ 260
M18 × 1.5	28.6 ~ 43.6	207 ~ 315	38.4 ~ 52.0	278 ~ 376
M20 × 1.5	40.0 ~ 54.0	289 ~ 391	53.4 ~ 72.2	386 ~ 522
M22 × 1.5	52.7 ~ 71.3	381 ~ 516	70.7 ~ 95.7	511 ~ 692
M24 × 2.0	67.9 ~ 91.9	491 ~ 665	90.9 ~ 123	658 ~ 890
M30 × 2.0	137 ~ 185	990 ~ 1339	182 ~ 248	1314 ~ 1796
M36 × 3.0	192 ~ 260	1390 ~ 1880	262 ~ 354	1894 ~ 2562

2) PIPE AND HOSE

Thread size	Width across flat(mm)	kgf · m	lbf · ft
1/4"	19	3	21.7
3/8"	22	4	28.9
1/2"	27	5	36.2
3/4"	36	12	86.8
1"	41	14	101

3) FITTING

Thread size	Width across flat(mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	6	43.4
3/4"	36	13	94.0
1"	41	15	109

GROUP 3 PUMP DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

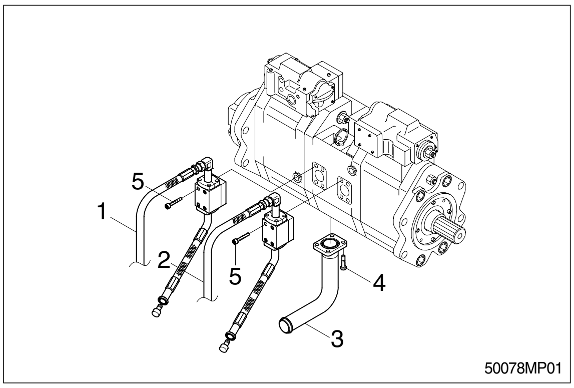
(2) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

(3) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.

· Hydraulic tank quantity : 250 l

(4) Remove socket bolts(5) and disconnect hose (1,2).



(5) Disconnect pilot line hoses(4, 5, 6, 7, 8, 9, 10, 11).

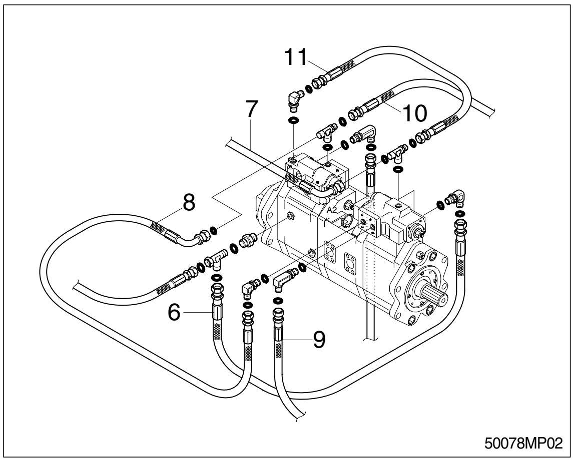
(6) Remove bolts(4) and disconnect pump suction tube (3).

※ When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(7) Sling the pump assembly and remove the pump mounting bolts.

· Weight : 180kg(400lb)

※ Pull out the pump assembly from housing. When removing the pump assembly, check that all the hoses have been disconnected.



2) INSTALL

(1) Carry out installation in the reverse order to removal

(2) Remove the suction strainer and clean it.

(3) Replace the return filter with a new one.

(4) Remove breather and clean it.

(5) After adding oil to the hydraulic tank to the specified level.

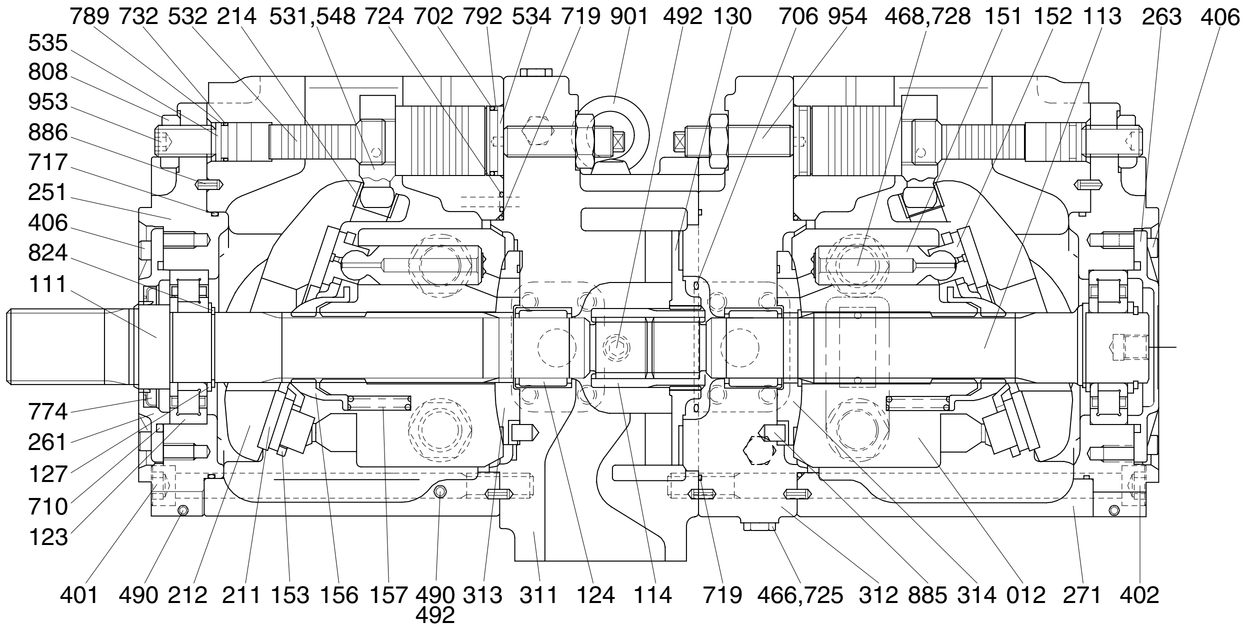
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug(2EA)
② Tighten plug lightly
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(7) Start the engine, run at low idling(3~5 minutes) to circulate the oil through the system.

(8) Confirmed the hydraulic oil level and check the hydraulic oil leaks or not.

2. MAIN PUMP(1/2)

1) STRUCTURE



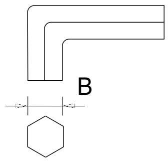
470072MP02

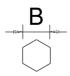
012 Cylinder block
111 Drive shaft(F)
113 Driven shaft(R)
114 Coupling
123 Roller bearing
124 Needle bearing
127 Spacer
130 Booster
151 Piston
152 Shoe
153 Plate
156 Bushing
157 Cylinder spring
211 Shoe plate
212 Swash plate
214 Bushing
251 Support plate
261 Seal cover(F)
263 Seal cover(R)
271 Pump casing
311 Valve cover(F)
312 Valve cover(R)
313 Valve plate(R)
314 Valve plate(L)
401 Hexagon socket bolt
402 Hexagon socket bolt
406 Hexagon socket bolt
466 VP Plug
468 VP Plug
490 VP Plug
492 VP Plug
531 Tilting pin
532 Servo piston
534 Stopper(L)
535 Stopper(S)
548 Feed back pin
702 O-ring
706 O-ring
710 O-ring
717 O-ring
719 O-ring
724 O-ring
725 O-ring
728 O-ring
732 O-ring
774 Oil seal
789 Back up ring
792 Back up ring
808 Hexagon head nut
824 Snap ring
885 Pin
886 Spring pin
901 Eye bolt
953 Set screw
954 Set screw

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

Tool name & size		Part name			
Allen wrench 	B	Hexagon socket head bolt	PT plug (PT thread)	PO plug (PF thread)	Hexagon socket head setscrew
	4	M 5	BP-1/16	-	M 8
	5	M 6	BP1/ 8	-	M10
	6	M 8	BP-1/ 4	PO-1/4	M12, M14
	8	M10	BP-3/ 8	PO-3/8	M16, M18
	17	M20, M22	BP-1	PO-1, 1 1/4, 1 1/2	-

Tool name & size		Part name		
Double ring spanner, socket wrench, double(Single) open end spanner 	-	Hexagon head bolt	Hexagon head bolt	VP plug (PF thread)
	19	M12	M12	VP-1/4
	24	M16	M16	-
	27	M18	M18	VP-1/2
	30	M20	M20	-
	36	-	-	VP-3/4

Tool name & size	Part name
Adjustable angle wrench	Medium size, 1 set
Screw driver	Minus type screw driver, Medium size, 2 sets
Hammer	Plastic hammer, 1 set
Pliers	For snap ring, TSR-160
Steel bar	Steel bar of key material approx. $10 \times 8 \times 200$
Torque wrench	Capable of tightening with the specified torques

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (Material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	115.7	0.47	12
	M16	24.0	173.6	0.55	14
	M18	34.0	245.9	0.55	14
	M20	44.0	318.3	0.67	17
	M22	64.0	462.9	0.67	17
PT plug(Material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT 1/16	0.7	5.1	0.16	4
	PT 1/ 8	1.05	7.59	0.20	5
	PT 1/ 4	1.75	12.66	0.24	6
	PT 3/ 8	3.5	25.3	0.31	8
	PT 1/ 2	5.0	36.2	0.39	10
PF plug(Material : S45C)	PF 1/ 4	3.0	21.7	0.24	6
	PF 1/ 2	10.0	72.3	0.39	10
	PF 3/ 4	15.0	108.5	0.55	14
	PF 1	19.0	137.4	0.67	17
	PF 1 1/4	27.0	195.3	0.67	17
	PF 1 1/2	28.0	202.5	0.67	17

3) DISASSEMBLY

(1) Select place suitable to disassembling.

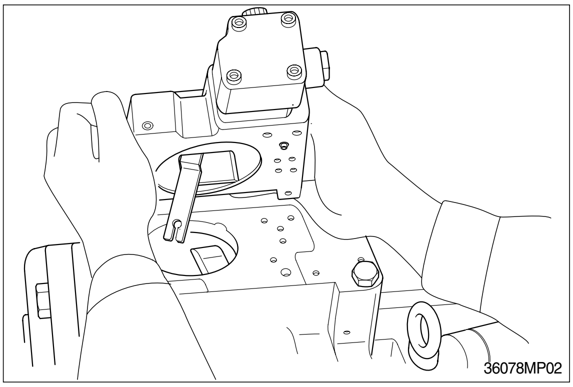
※ Select clean place.

※ Spread rubber sheet, cloth or so on on overhaul workbench top to prevent parts from being damaged.

(2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.

(3) Remove drain port plug(468) and let oil out of pump casing(Front and rear pump).

(4) Remove hexagon socket head bolts(412, 413) and remove regulator.



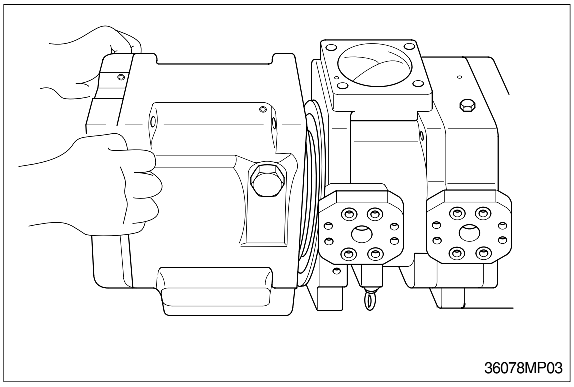
(5) Loosen hexagon socket head bolts(401) which tighten swash plate support(251), pump casing(271) and valve cover(F, 311).

※ If gear pump and so on are fitted to rear face of pump, remove them before starting this work.

(6) Loosen hexagon socket head bolts(402) which tighten swash plate support(251), pump casing(271) and valve cover(R, 312).

(7) Place pump horizontally on workbench with its regulator-fitting surface down, and separate pump casing(271) from valve cover(F, 311).

※ Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.

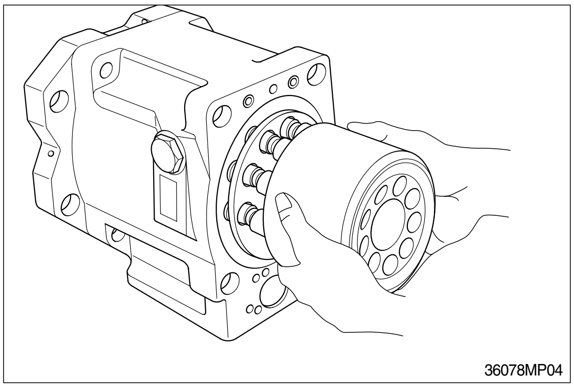


36078MP03

(8) Separate valve cover(F, 311) from valve cover(R, 312) and pull out booster(130), spline coupling(114).

(9) Separate valve cover(R, 312) from pump casing and then pull out the cylinder block(012) of pump casing(271) straightly over drive shaft(R, 113). Pull out also pistons(151), set plate(153), spherical bush(156) and cylinder springs (157) simultaneously.

※ Take care not to damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.

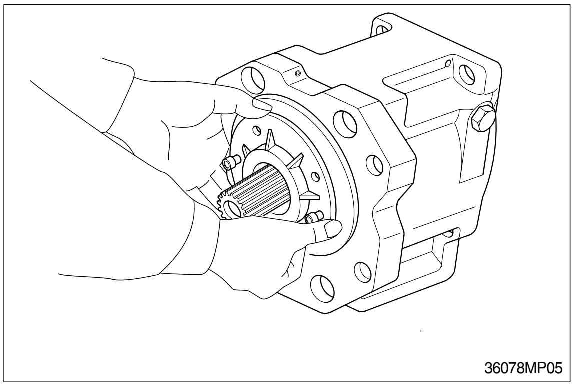


36078MP04

(10) Remove hexagon socket head bolts(406) and then seal cover(F, 261).

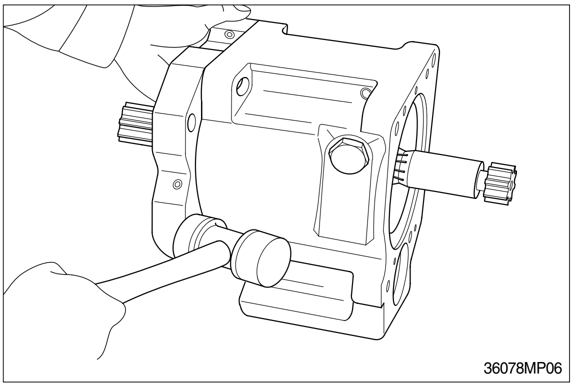
※ Fit bolt into pulling-out tapped hole of seal cover(F), and cover can be removed easily.

※ Since oil seal is fitted on seal cover(F), take care not to damage it when removing cover.

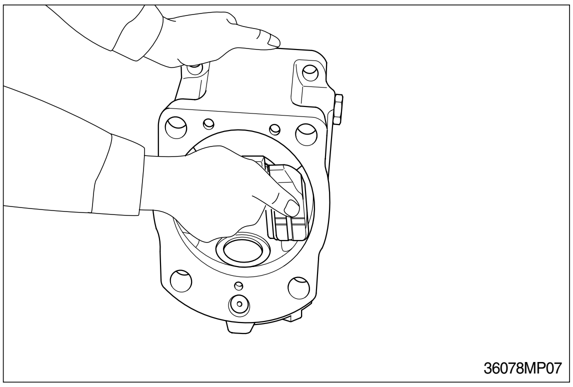


36078MP05

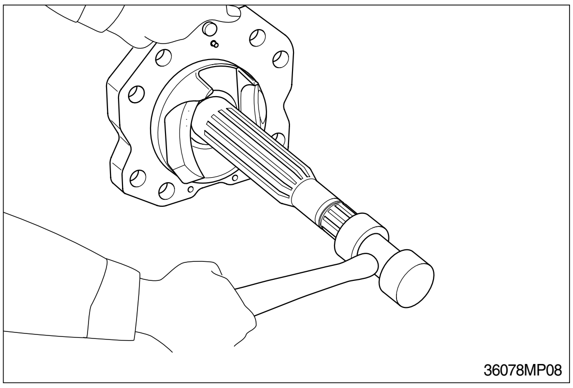
(11) Tapping lightly fitting flange section of swash plate support(251) on its pump casing side, separate swash plate support from pump casing.



(12) Remove shoe plate(211) and swash plate(212) from pump casing(271).

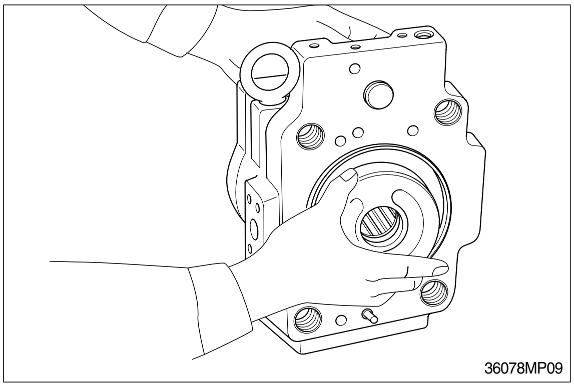


(13) Tapping lightly shaft ends of drive shafts(111, 113) with plastic hammer, take out drive shafts from swash plate supports.



(14) Remove valve plates(313, 314) from valve cover(311, 312).

※ These may be removed in work 7, 9.



(15) If necessary, remove stopper (L, 534), stopper(S, 535), servo piston(532) and tilting pin(531) from pump casing(271), and needle bearing(124) from valve cover(311, 312).

※ In removing tilting pin, use a protector to prevent pin head from being damaged.

※ Since loctite is applied to fitting areas of tilting pin and servo piston, take care not to damage servo piston.

※ Do not remove needle bearing as far as possible, except when it is considered to be out of its life span.

※ Do not loosen hexagon nuts of valve cover and swash plate support.
If loosened, flow setting will be changed.

(16) This is the end of disassembling procedures.

4) ASSEMBLY

(1) For reassembling reverse the disassembling procedures, paying attention to the following items.

① Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.

② Clean each part fully with cleaning oil and dry it with compressed air.

③ Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.

④ In principle, replace seal parts, such as O-rings, oil seals, etc.

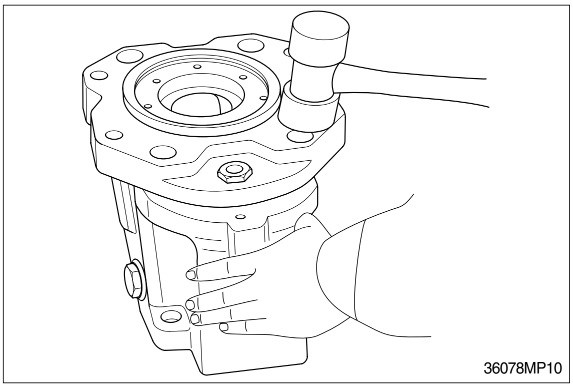
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-11, 12.

⑥ For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

(2) Fit swash plate support(251) to pump casing(271), tapping the former lightly with a hammer.

※ After servo piston, tilting pin, stopper(L) and stopper(S) are removed, fit them soon to pump casing in advance for reassembling.

※ In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply loctite(Medium strength) to their threaded sections.

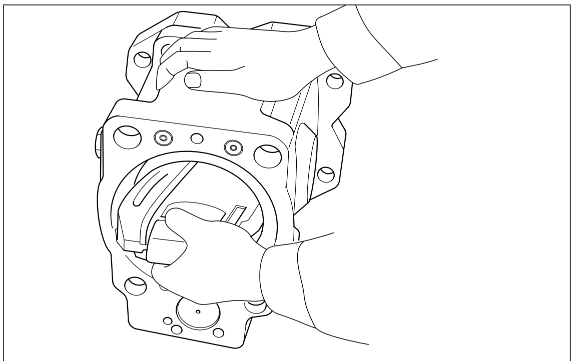


36078MP10

(3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin(531) and fit swash plate (212) to swash plate support(251) correctly.

※ Confirm with fingers of both hands that swash plate can be removed smoothly.

※ Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily.



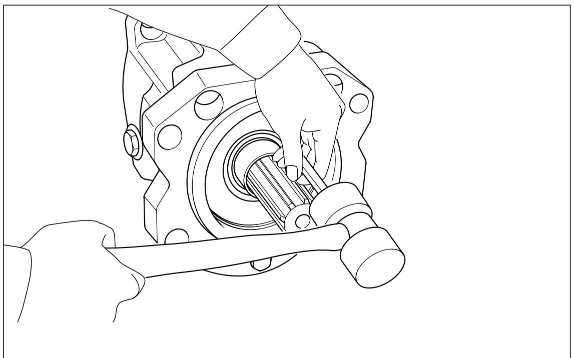
36078MP11

(4) To swash plate support(251), fit drive shaft(111) set with bearing(123), bearing spacer(127) and snap ring(824).

※ Do not tap drive shaft with hammer or so on.

※ Assemble them into support, tapping outer race of bearing lightly with plastic hammer.

Fit them fully, using steel bar or so on.



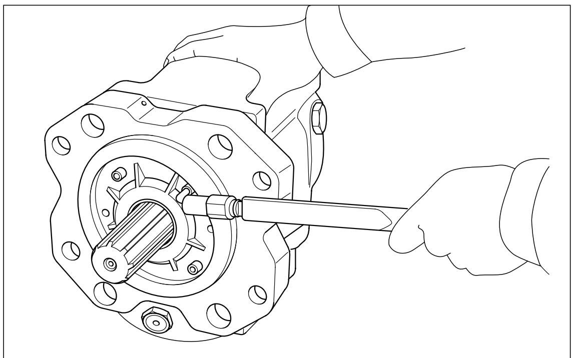
36078MP12

(5) Assemble seal cover(F, 261) to pump casing(271) and fix it with hexagon socket head bolts(406).

※ Apply grease lightly to oil seal in seal cover(F).

※ Assemble oil seal, taking full care not to damage it.

※ For tandem type pump, fit rear cover(263) and seal cover(262) similarly.

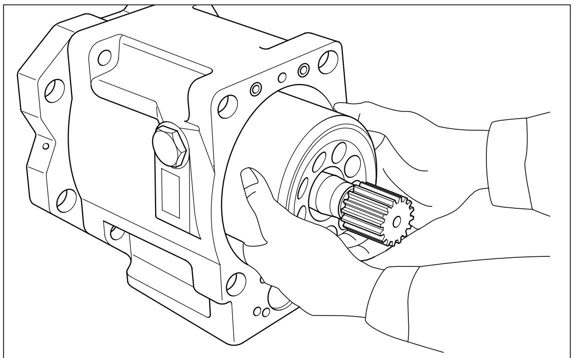


36078MP13

(6) Assemble piston cylinder subassembly 〔cylinder block(012), piston subassembly (151, 152), set plate(153), spherical bushing(156) and cylinder spring (157)〕.

Fit spline phases of retainer and cylinder.

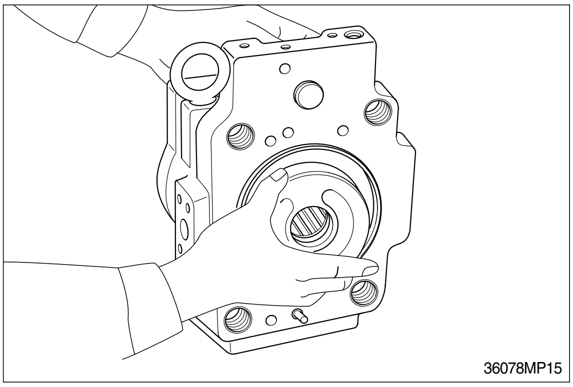
Then, insert piston cylinder subassembly into pump casing(271).



36078MP14

(7) Fit valve plate(313) to valve cover(F, 311), and fit valve plate(314) to valve cover(R, 312), entering pin into pin hole.

※ Take care not to mistake suction / delivery directions of valve plate.

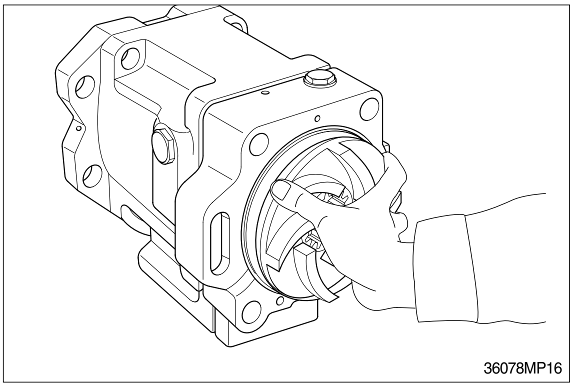


36078MP15

(8) Fit valve block(R, 312) to pump casing (271) and fit spline coupling(114) and booster(130) to shaft(R, 113).

※ Take care not to mistake direction of valve cover.
Fit valve cover with regulator up and with delivery flange left, viewed from front side.

※ Take care not to mistake direction of booster(130).
(Refer to the sectional drawing)

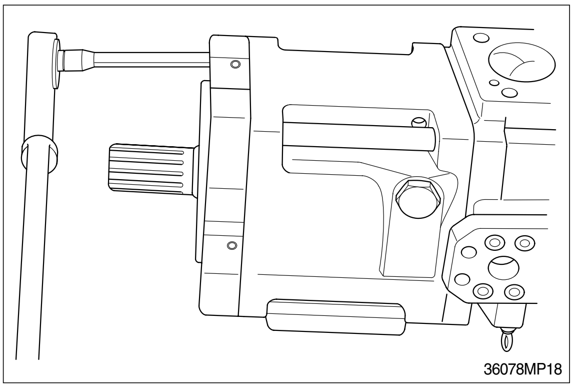


36078MP16

(9) Fit valve cover(F, 311) to valve cover(R) and tighten hexagon socket head bolts(402).

(10) Fit pump casing(271) with shaft(F, 111) to valve cover(F, 311) and tighten hexagon socket head bolts(401).

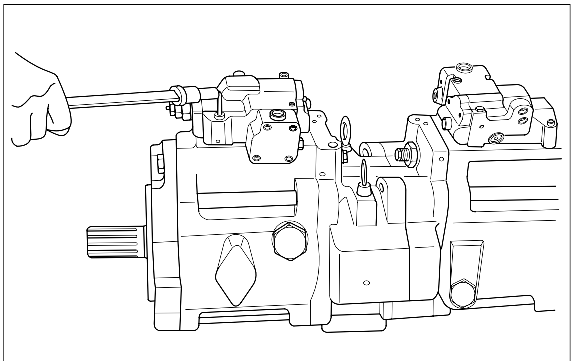
※ Mate spline phases of shaft(F) and spline coupling, with shaft(F) been rotating.



36078MP18

(11) Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts(412,413).

※ Take care not to mistake regulator of front pump for that of rear pump.

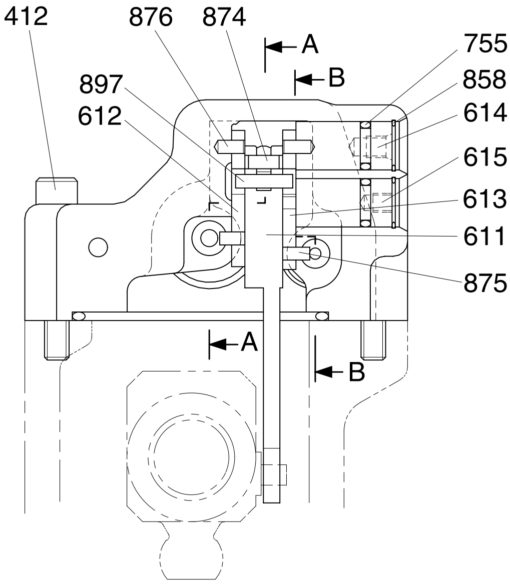


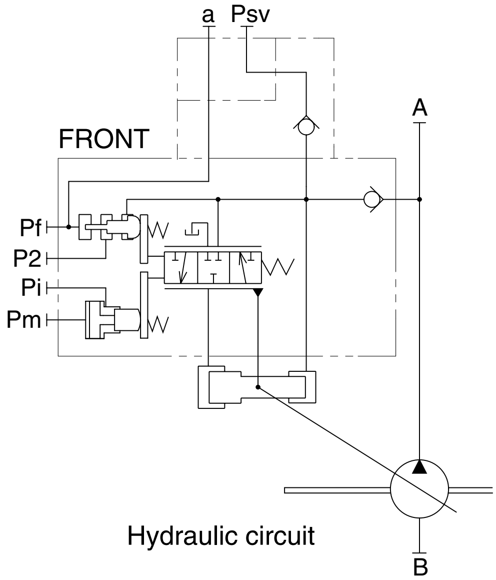
36078MP17

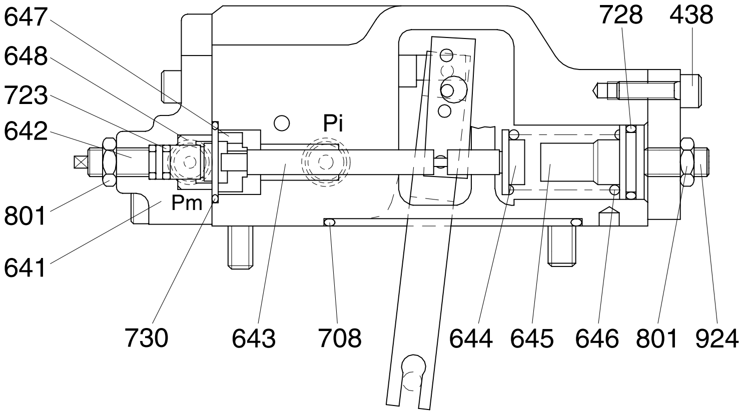
(12) Fit drain port plug(468).

This is the end of reassembling procedures.

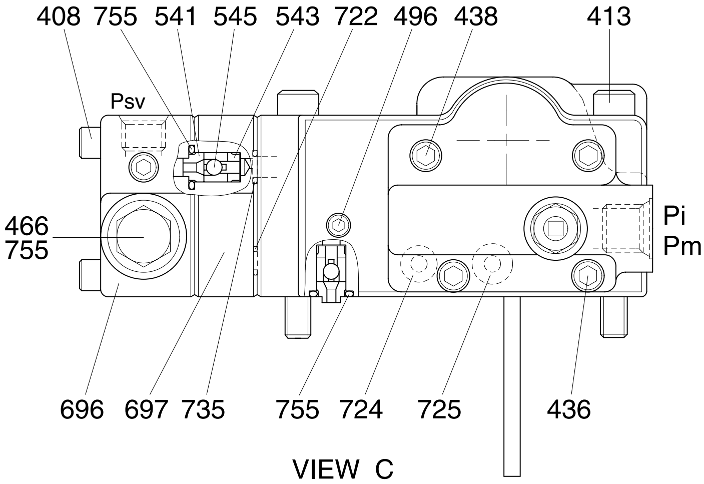
5) REGULATOR(1/2)







SECTION B-B

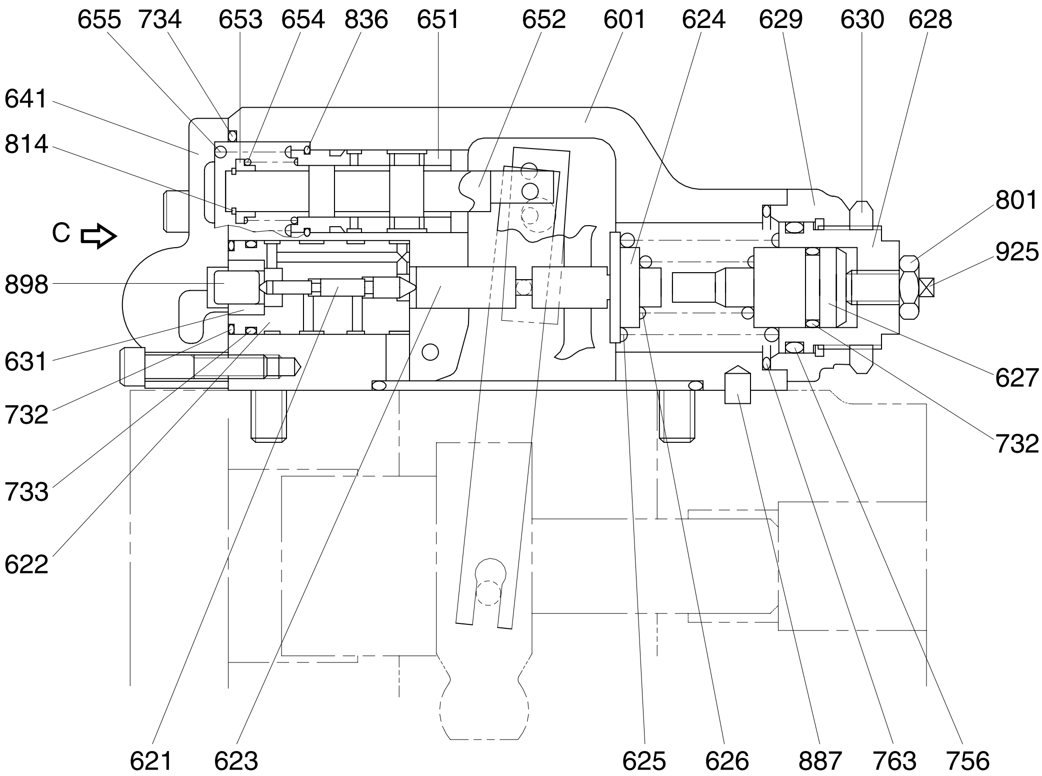


VIEW C

470072RG01

Port	Port name	Port size
Pi	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
P2	Companion delivery port	-
Pf	Powershift port	-
a	Gauge port	PF 1/4 - 15

REGULATOR(2/2)



SECTION A-A

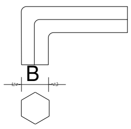
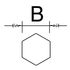
470072RG02

408	Hexagon socket screw	628	Adjust screw(C)	725	O-ring
412	Hexagon socket screw	629	Cover(C)	728	O-ring
413	Hexagon socket screw	630	Lock nut	730	O-ring
436	Hexagon socket screw	631	Sleeve, pf	732	O-ring
438	Hexagon socket screw	641	Pilot cover	733	O-ring
466	Plug	642	Adjust screw(QMC)	734	O-ring
496	Plug	643	Pilot piston	735	O-ring
541	Seat	644	Spring seat(Q)	755	O-ring
543	Stopper	645	Adjust stem(Q)	756	O-ring
545	Steel ball	646	Pilot spring	763	O-ring
601	Casing	647	Stopper	801	Nut
611	Feed back lever	648	Piston(QMC)	814	Snap ring
612	Lever(1)	651	Sleeve	836	Snap ring
613	Lever(2)	652	Spool(A)	858	Snap ring
614	Center plug	653	Spring seat	874	Spring pin
615	Adjust plug	654	Return spring	875	Pin
621	Compensator piston	655	Set spring	876	Pin
622	Piston case	696	Port cover	878	Pin
623	Compensator rod	697	Check valve plate	887	Pin
624	Spring seat(C)	708	O-ring	897	Pin
625	Outer spring	722	O-ring	898	Pin
626	Inner spring	723	O-ring	924	Set screw
627	Adjust stem(C)	724	O-ring	925	Adjust screw(QI)

6) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><th colspan="2">Tool name & size</th><th colspan="12">Part name</th></tr>
<tr><td>Name</td><td>B</td><td colspan="3">Hexagon socket head bolt</td><td colspan="3">PT plug (PT thread)</td><td colspan="3">PO plug (PF thread)</td><td colspan="3">Hexagon socket head setscrew</td></tr>
<tr><td rowspan="3">Allen wrench </td><td>4</td><td colspan="3">M 5</td><td colspan="3">BP-1/16</td><td colspan="3">-</td><td colspan="3">M 8</td></tr>
<tr><td>5</td><td colspan="3">M 6</td><td colspan="3">BP-1/8</td><td colspan="3">-</td><td colspan="3">M10</td></tr>
<tr><td>6</td><td colspan="3">M 8</td><td colspan="3">BP-1/4</td><td colspan="3">PO-1/4</td><td colspan="3">M12, M14</td></tr>
<tr><td rowspan="2">Double ring spanner,
socket wrench, double(Single)
open end spanner </td><td>-</td><td colspan="4">Hexagon head bolt</td><td colspan="4">Hexagon nut</td><td colspan="4">VP plug (PF thread)</td></tr>
<tr><td>6</td><td colspan="4">M 8</td><td colspan="4">M 8</td><td colspan="4">-</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="12">Small size, Max 36mm</td></tr>
<tr><td colspan="2">Screw driver</td><td colspan="12">Minus type screw driver, Medium size, 2 sets</td></tr>
<tr><td colspan="2">Hammer</td><td colspan="12">Plastic hammer, 1 set</td></tr>
<tr><td colspan="2">Pliers</td><td colspan="12">For snap ring, TSR-160</td></tr>
<tr><td colspan="2">Steel bar</td><td colspan="12">4 × 100mm</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="12">Capable of tightening with the specified torques</td></tr>
<tr><td colspan="2">Pincers</td><td colspan="12">-</td></tr>
<tr><td colspan="2">Bolt</td><td colspan="12">M4, Length : 50mm</td></tr>
</table>

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt Material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT Plut(Materal : S45C) ※Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plut(Materal : S35C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

Since the regulator consists of small precision finished parts, disassembly and assembly are rather complicated.

For this reason, replacement of a regulator assembly is recommended, unless there is a special reason, but in case disassembly is necessary for an unavoidable reason, read through this manual to the end before starting disassembly.

(1) Choose a place for disassembly.

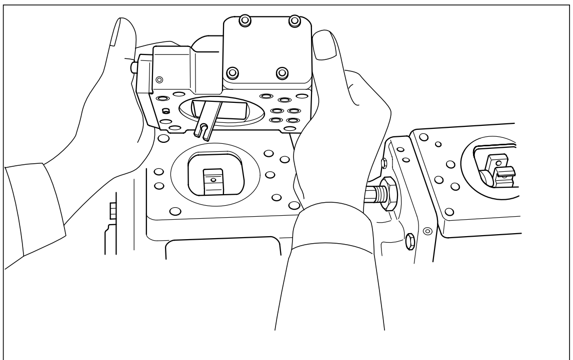
※ Choose a clean place.

※ Spread rubber sheet, cloth, or so on on top of work-bench to prevent parts from being damaged.

(2) Remove dust, rust, etc. from surfaces of regulator with clean oil.

(3) Remove hexagon socket head screw (412, 413) and remove regulator main body from pump main body.

※ Take care not to lose O-ring.



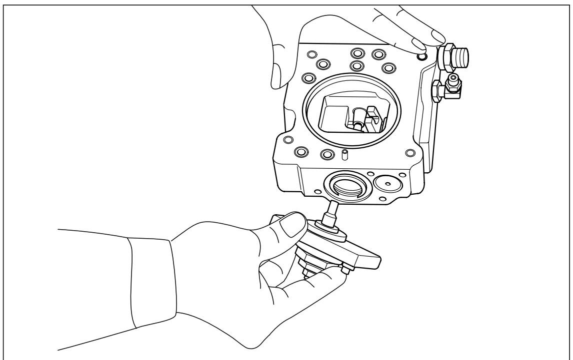
REG01 (210-7)

(4) Remove hexagon socket head screw (438) and remove cover(C,629)

※ Cover(C) is fitted with adjusting screw (C,QI) (628, 925), adjusting ring(C, 627), lock nut(630), hexagon nut(801) and adjusting screw(924).

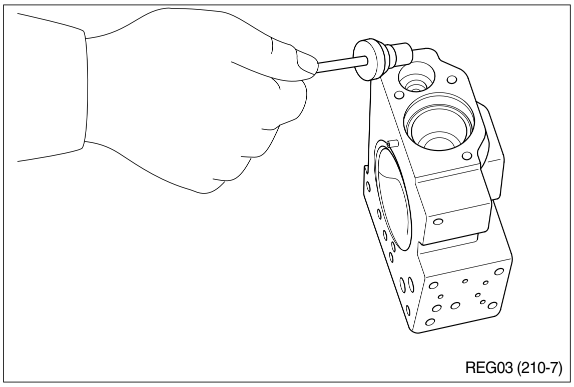
Do not loosen these screws and nuts.

If they are loosened, adjusted pressure-flow setting will vary.

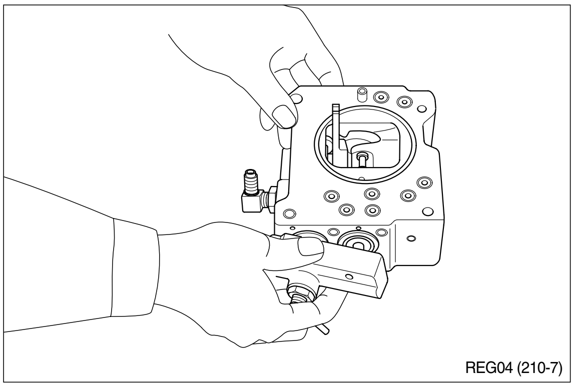


REG02 (210-7)

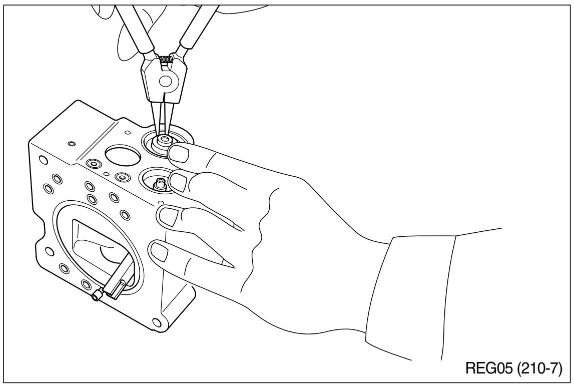
(5) After removing cover(C, 629) subassembly, take out outer spring(625), inner spring (626) and spring seat(C, 624) from compensating section.
Then draw out adjusting ring(Q, 645), pilot spring(646) and spring seat(644) from pilot section.
※ Adjusting ring(Q,645) can easily be drawn out with M4 bolt.


REG03 (210-7)

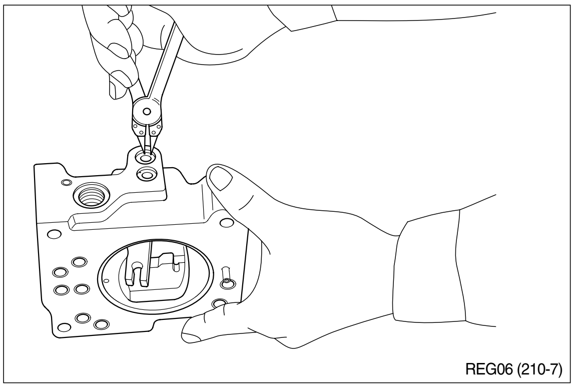
(6) Remove hexagon socket head screws (436, 438) and remove pilot cover(641).
After removing pilot cover, take out set spring(655) from pilot section.

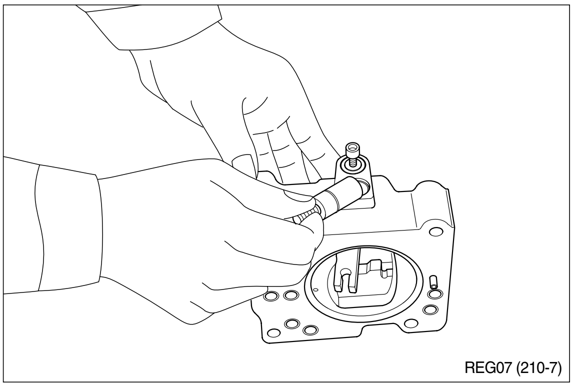

REG04 (210-7)

(7) Remove snap ring(814) and take out spring seat(653), return spring(654) and sleeve(651).
※ Sleeve(651) is fitted with snap ring(836).
※ When removing snap ring(814), return spring(654) may pop out.
Take care not to lose it.

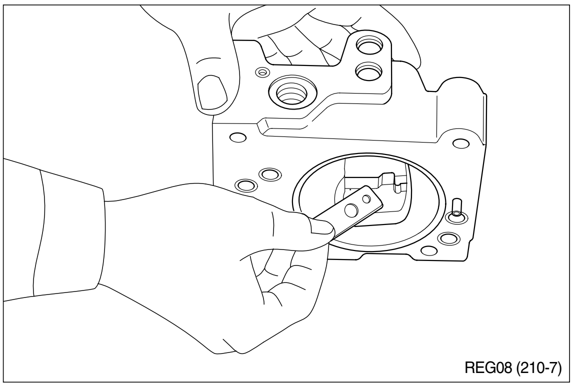

REG05 (210-7)

(8) Remove locking ring(858) and take out fulcrum plug(614) and adjusting plug (615).
※ Fulcrum plug(614) and adjusting plug (615) can easily be taken out with M6 bolt.

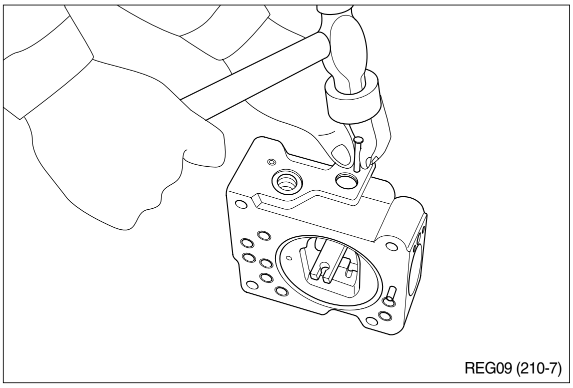

REG06 (210-7)

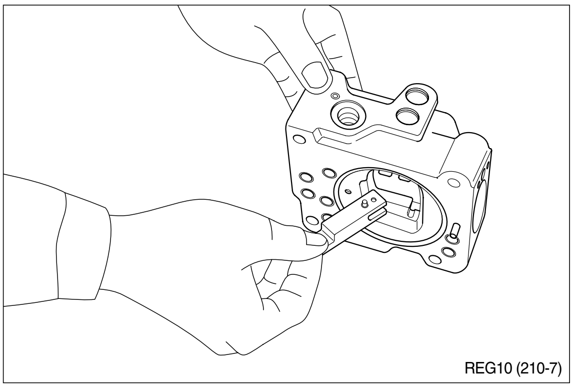

REG07 (210-7)

(9) Remove lever(2, 613). Do not draw out pin(875).
※ Work will be promoted by using pincers or so on.


REG08 (210-7)

(10) Draw out pin(874) and remove feedback lever(611).
Push out pin(874, 4mm in dia.) from above with slender steel bar so that it may not interfere with lever(1, 612).


REG09 (210-7)


REG10 (210-7)

(11) Remove lever(1, 612). Do not draw out pin(875).

(12) Draw out pilot piston(643) and spool(652).

(13) Draw out piston case(622), compensating piston(621) and compensating rod(623).

※ Piston case(622) can be taken out by pushing compensating rod(623) at opposite side of piston case.

This completes disassembly.

4) ASSEMBLY

(1) For assembly, reverse disassembly procedures, but pay attention to the following items.

① Always repair parts that were scored at disassembly.

② Get replacement parts ready beforehand.
Mixing of foreign matter will cause malfunction.
Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.

③ Always tighten bolts, plugs, etc. to their specified torques.

④ Do not fail to coat sliding surfaces with clean hydraulic oil before assembly.

⑤ Replace seals such as O-ring with new ones as a rule.

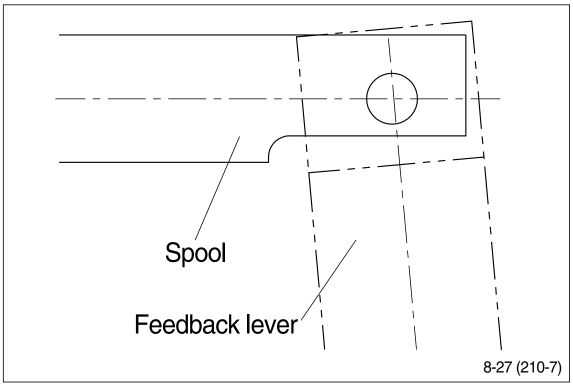
(2) Put compensating rod(623) into compensating hole of casing(601).

(3) Put pin force-fitted in lever(1, 612) into groove of compensating rod and fit lever (1) to pin force-fitted in casing.

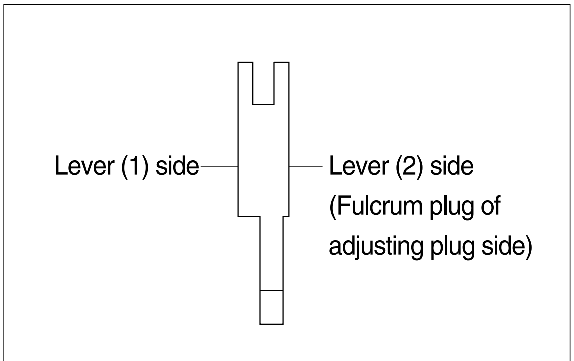
(4) Fit spool(652) and sleeve(651) into hole in spool of casing.

※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.



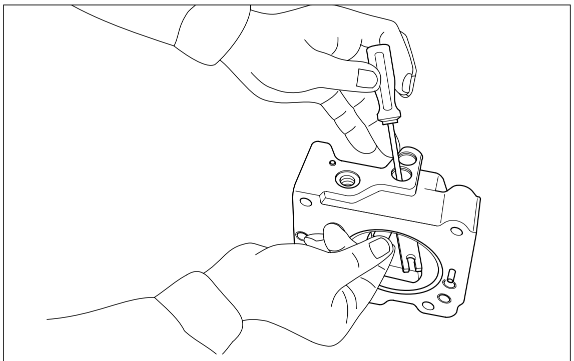
(5) Fit feedback lever(611), matching its pin hole with pin hole in spool.
Then insert pin(874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



8-28 (210-7)

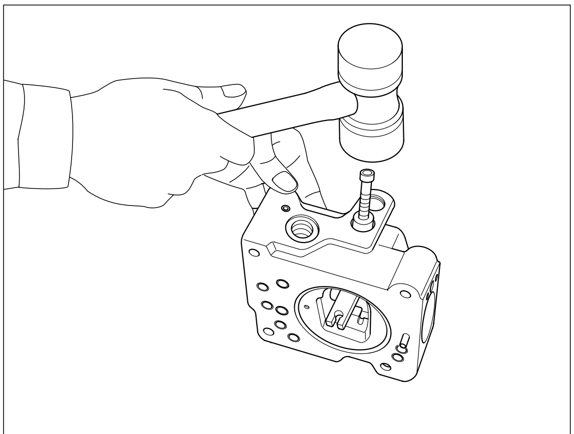
(6) Put pilot piston(643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

(7) Put pin force-fitted in lever(2, 613) into groove of pilot piston.
Then fix lever(2).

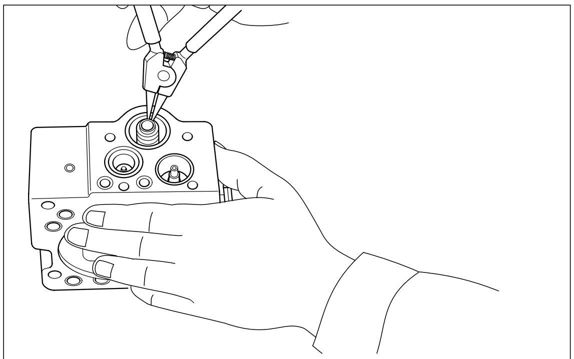

REG11 (210-7)

(8) Fit fulcrum plug(614) so that pin force-fitted in fulcrum plug(614) can be put into pin hole of lever(2).
Then fix locking ring(858).

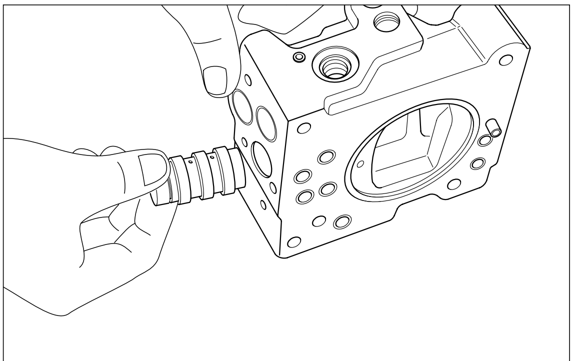
(9) Insert adjusting plug(615) and fit locking ring.
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.


REG12 (210-7)

(10) Fit return spring(654) and spring seat (653) into spool hole and attach snap ring (814).

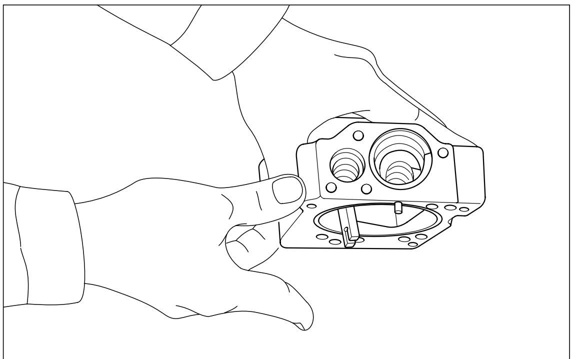

REG13 (210-7)

(11) Fit set spring(655) to spool hole and put compensating piston(621) and piston case(622) into compensating hole.
Fit pilot cover(641) and tighten it with hexagonal socket head screws(436, 438).



REG14 (210-7)

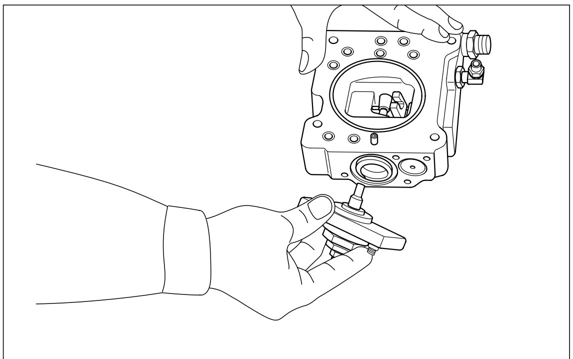
(12) Put spring seat(644), pilot spring(646) and adjusting ring(Q, 645) into pilot hole.
Then fix spring seat(624), inner spring (626) and outer spring(625) into compensating hole.
※ When fitting spring seat, take care not to mistake direction of spring seat.



REG15 (210-7)

(13) Install cover(C, 629) fitted with adjusting screws(628, 925), adjusting ring(C, 627), lock nut(630), hexagon nut(801) and adjusting screw(924).
Then tighten them with hexagonal socket head screws(438).

This completes assembly.



REG16 (210-7)

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

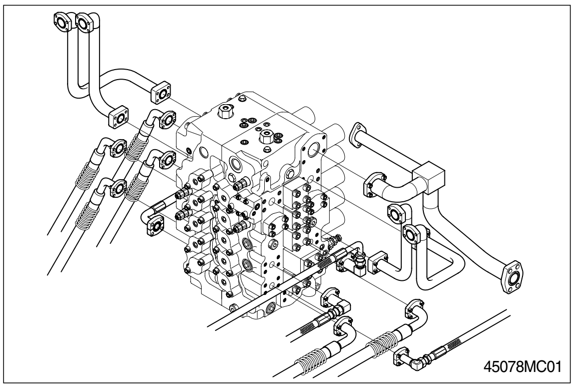
⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Remove bolts and disconnect pipe.

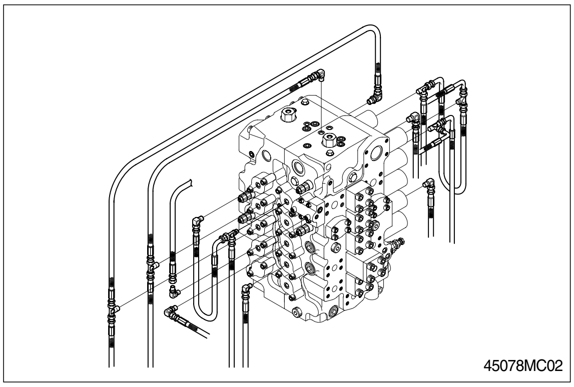
(5) Disconnect pilot line hoses.

(6) Disconnect pilot piping.



(7) Sling the control valve assembly and remove the control valve mounting bolt.
· Weight : 420kg(930lb)

(8) Remove the control valve assembly.
When removing the control valve assembly, check that all the piping have been disconnected.

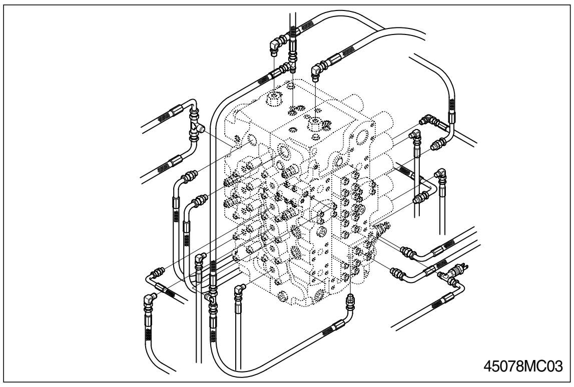


2) INSTALL

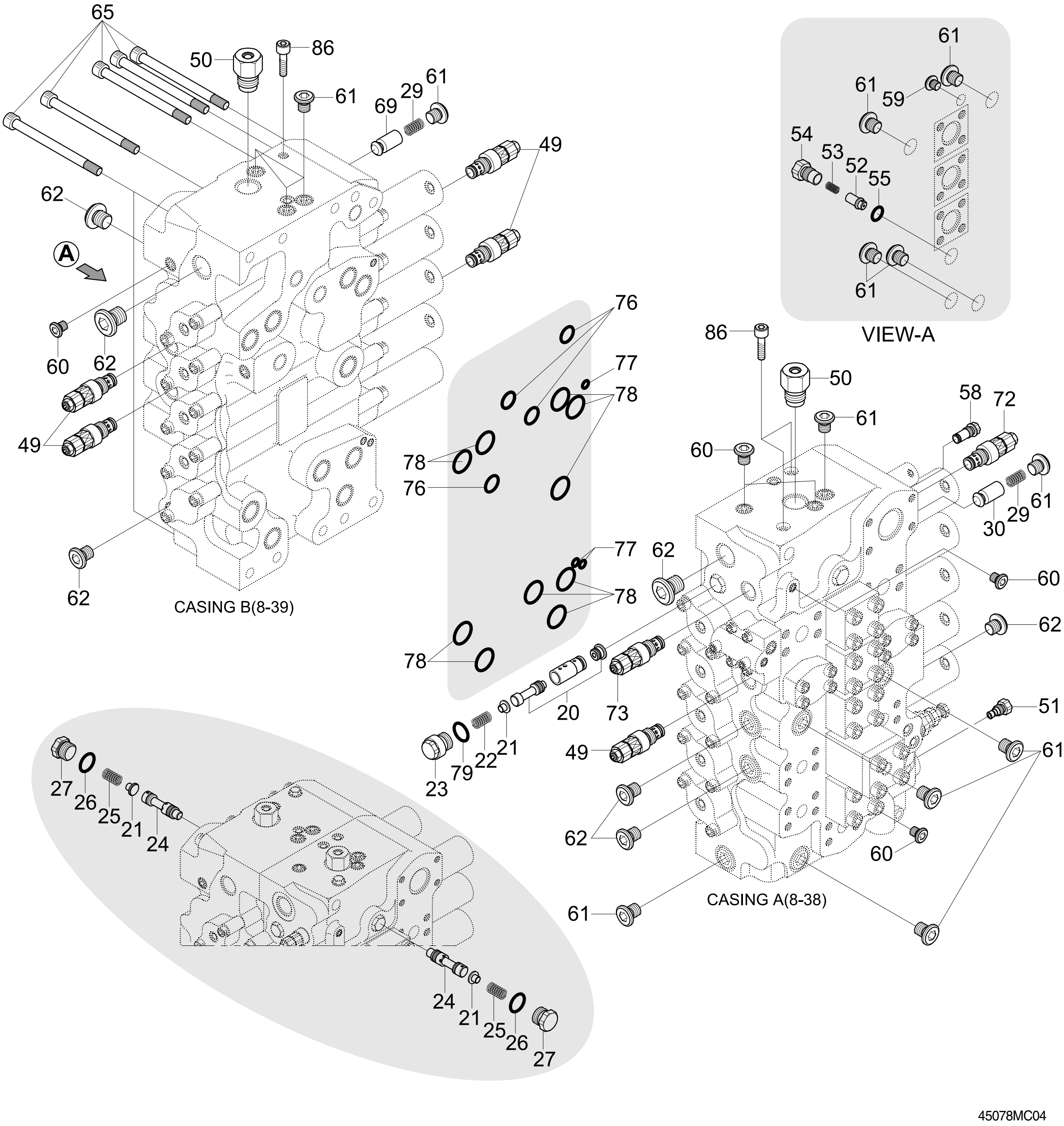
(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from below items.
① Cylinder(Boom, arm, bucket)
② Swing motor
③ Travel motor
※ See each item removal and install.

(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.

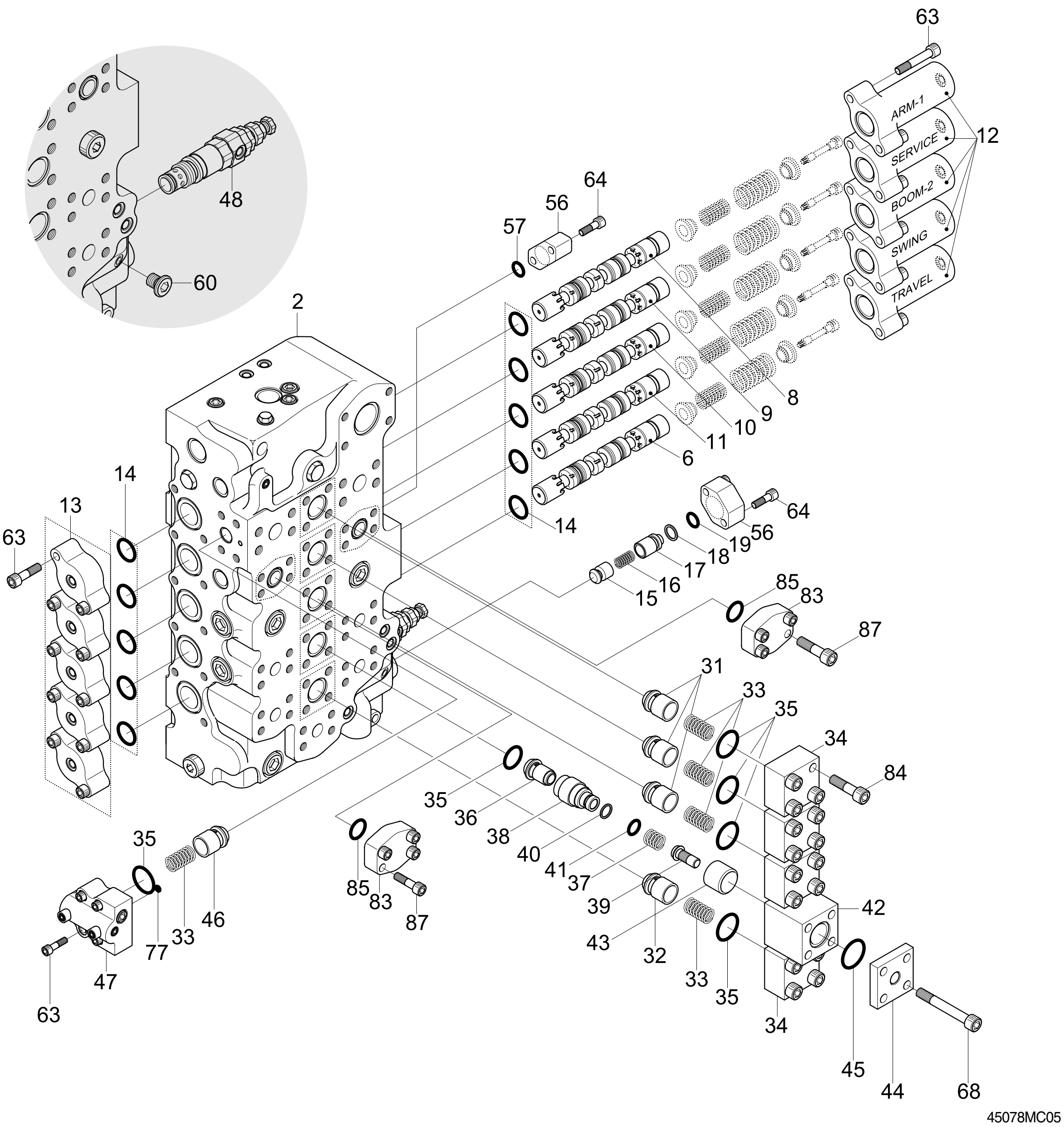


2. STRUCTURE(1/3)



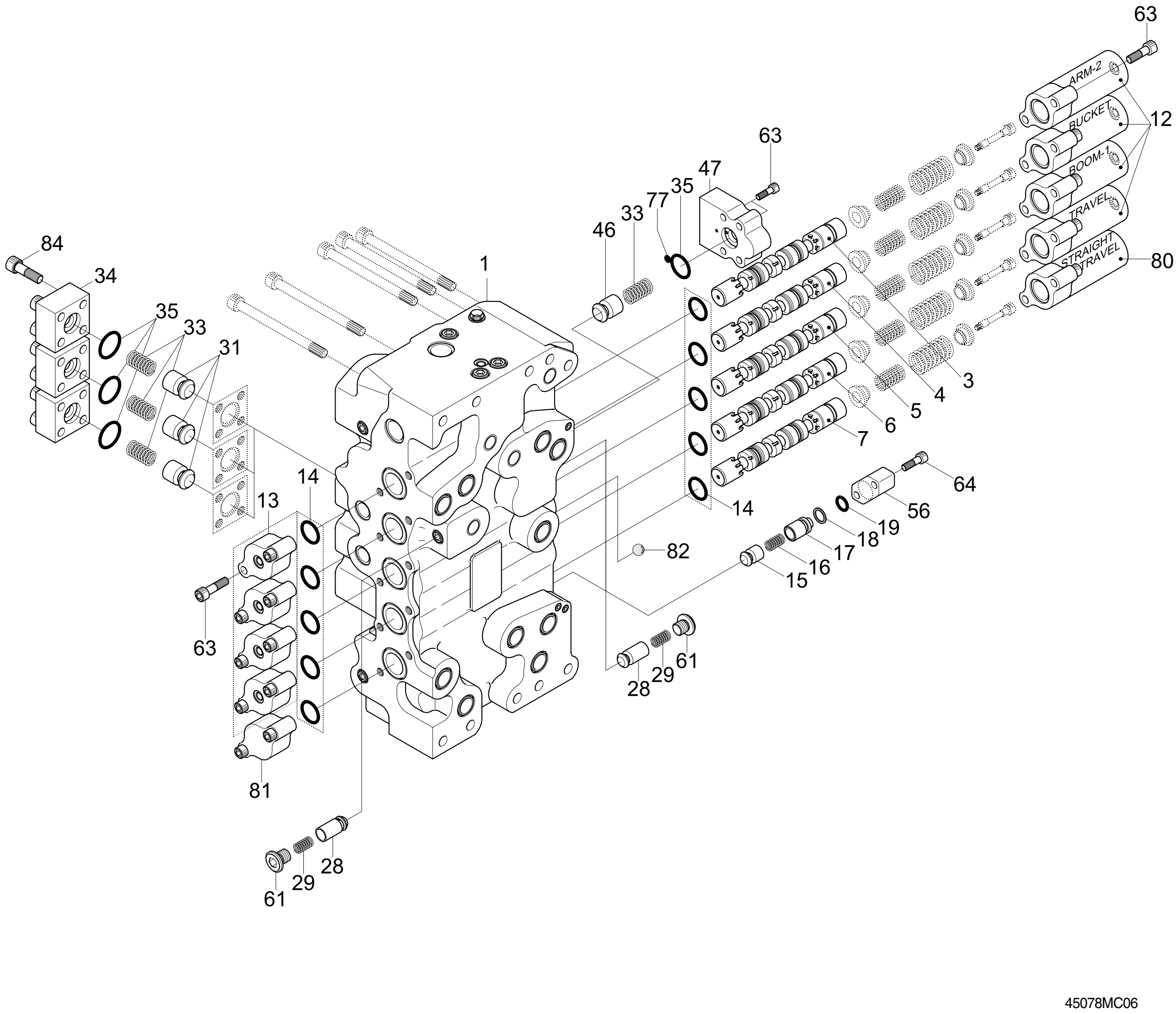
20	Spool assy	50	Relief valve assy	62	Plug assy
21	Spring seat	51	Plug assy	65	Bolt
22	Spring	52	Poppet	69	Poppet
23	Plug	53	Spring	72	Relief valve kit
24	Spool assy	54	Plug	73	Relief valve kit
25	Spring	55	O-ring	76	O-ring
26	O-ring	58	Plug assy	77	O-ring
27	Plug	59	Plug assy	78	O-ring
29	Spring	60	Plug assy	79	O-ring
30	Poppet	61	Plug assy	86	Socket head bolt
49	Relief valve kit				

STRUCTURE(2/3)



2	Housing	32	Poppet	46	Poppet
6	Spool assy	33	Spring	47	Body assy
8	Spool assy	34	Flange	48	Relief valve assy
9	Spool assy	35	O-ring	56	Flange
10	Spool assy	36	Poppet assy	57	O-ring
11	Spool assy	37	Spring	60	Plug assy
12	Cap	38	Sleeve	63	Bolt
13	Cap	39	Piston	64	Bolt
14	O-ring	40	O-ring	68	Bolt
15	Poppet	41	Back up ring	77	O-ring
16	Spring	42	Body	83	Flange
17	Spacer	43	Piston	84	Bolt
18	O-ring	44	Flange	85	O-ring
19	Back up ring	45	O-ring	87	Bolt
31	Poppet				

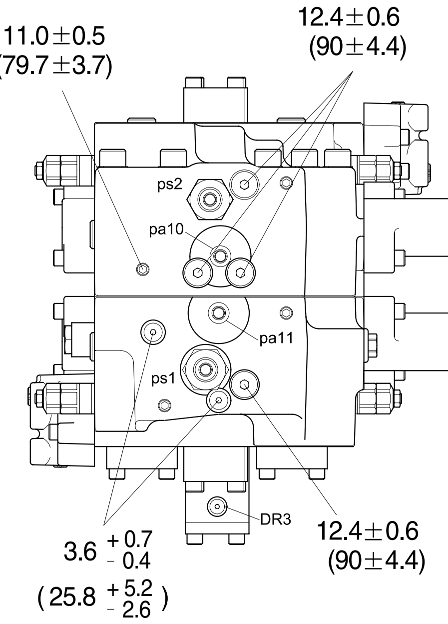
STRUCTURE(3/3)

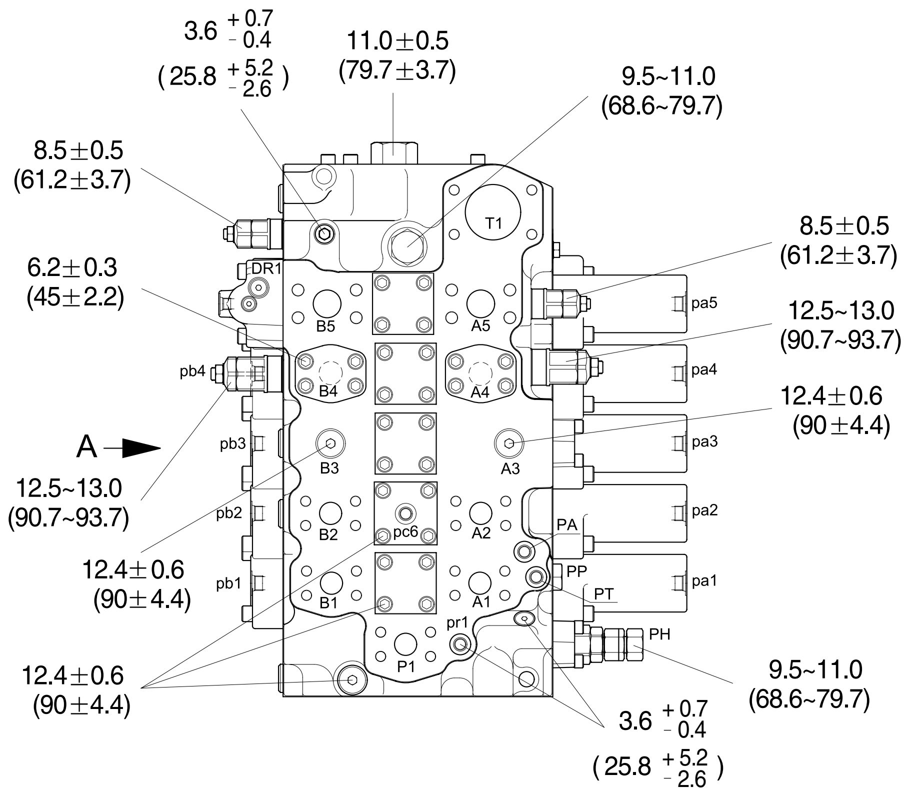


1	Housing	17	Spacer	47	Body assy
3	Spool assy	18	O-ring	56	Flange
4	Spool assy	19	Back up ring	61	Plug assy
5	Spool assy	28	Poppet	63	Bolt
6	Spool assy	29	Spring	64	Bolt
7	Spool assy	31	Poppet	77	O-ring
12	Cap	33	Spring	80	Cap
13	Cap	34	Flange	81	Cap
14	O-ring	35	O-ring	82	Steel ball
15	Poppet	46	Poppet	84	Bolt
16	Spring				

3. TIGHTENING TORQUE(1/2)

※ **Unit : kgf · m (lbf · ft)**

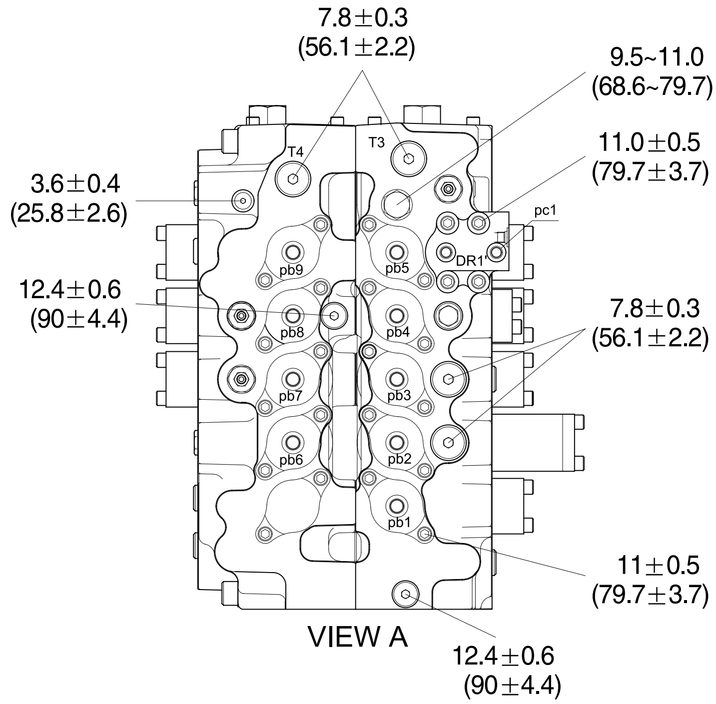


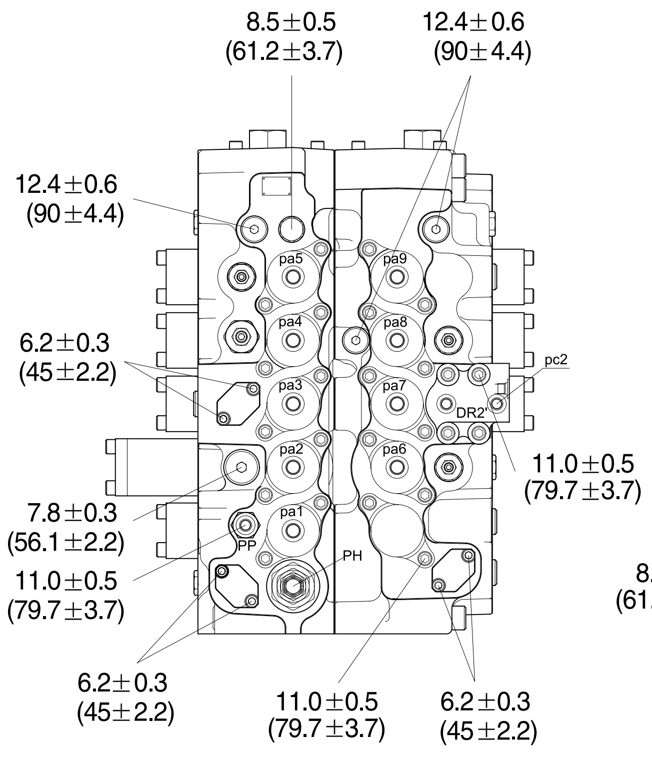


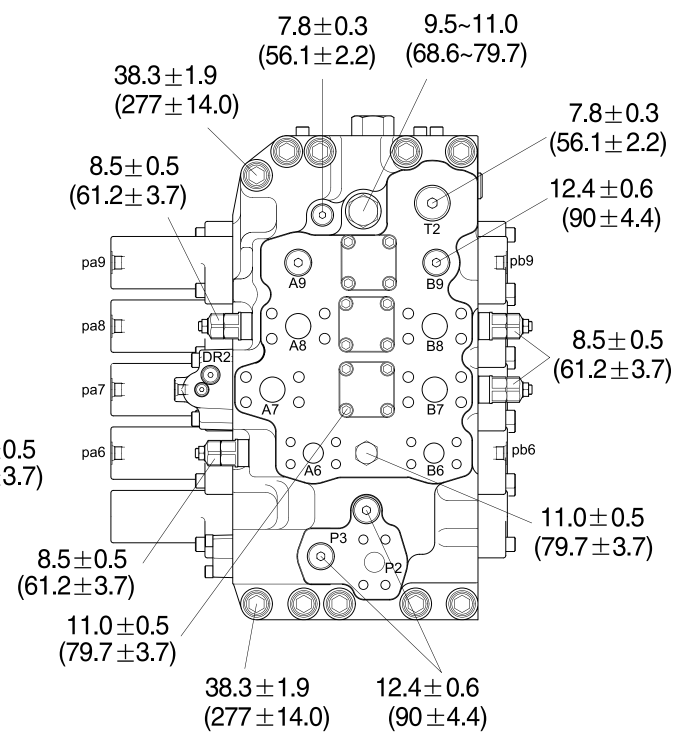
45078MC00

TIGHTENING TORQUE(2/2)

※ **Unit : kgf · m (lbf · ft)**







45078MC30

4. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) All hydraulic components are manufactured to a high precision. Consequently, before disassembling and assembling them, it is essential to select an especially clean place.

(2) In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.

(3) When a control valve is to be remove from the machine, apply caps and masking seals to all ports. Before disassembling the valve, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working. Spread paper or a rubber mat on the bench, and disassemble the valve on it.

(4) Support the body section carefully when carrying or transferring the control valve. Do not lift by the exposed spool, end cover section etc.

(5) After disassembling and assembling of the component it is desired to carry out various tests(For the relief characteristics, leakage, flow resistance, etc.), but hydraulic test equipment is necessary for these tests. Therefore, even when its disassembling can be carried out technically, do not disassemble such components that cannot be tested, adjusted, and so on. Additionally one should always prepare clean cleaning oil, hydraulic oil, grease, etc. beforehand.

2) DISASSEMBLY

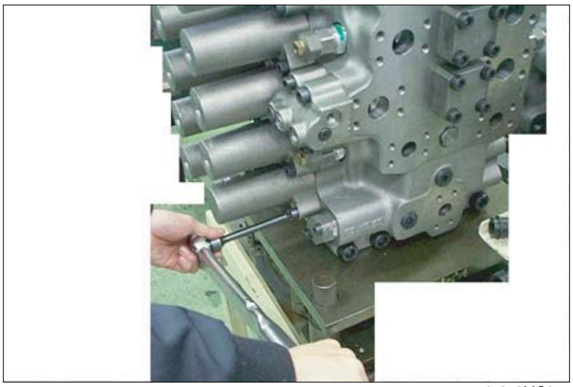
The figure in ( ) shown after the part name in explanation sentence shows its number in the construction figures.

(1) Place control valve on working bench.

※ Disassemble the valve in a clean and dry environment and pay careful attention not to damage the sealing flange faces.

(2) Main spool

① Loosen socket head bolts(63) and remove the lock cap(12, 80).
Pull out O-ring(14) from valve housing.



45078MC07

② Remove all spool(3~11) of subassembly itself from valve housing.

※ Be careful not to be damaged while pulling out spools. Identify them with a tag to prevent from being mistaken at disassembly.

45078MC08

③ Spools sub assy(3, 4, 6, 7, 9, 10, 11).

45078MC10

④ Spool sub assy(5).


45078MC11

⑤ Spool sub assy(8).

※ When disassemble the spool assembly, fix the spool with vise. On this occasion attach wood between vise blades to prevent the spool from damaging.

※ Heat the outer race of spool with industrial drier and then loosen easily .
(Temperature : 200~250℃)

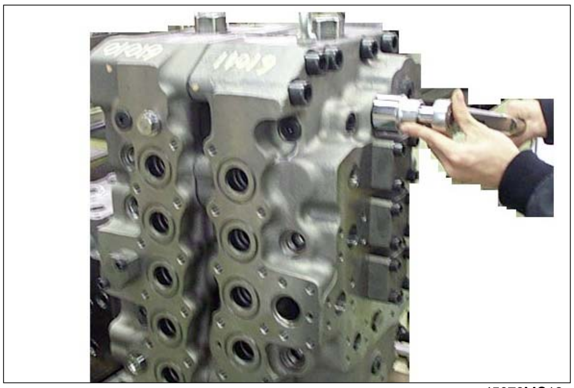

45078MC12

⑥ Loosen the socket head bolt(63) and remove the short cap(13, 81).
Pull out O-ring(14) from valve housing.


45078MC09

(3) Center bypass cut spool assy(24)

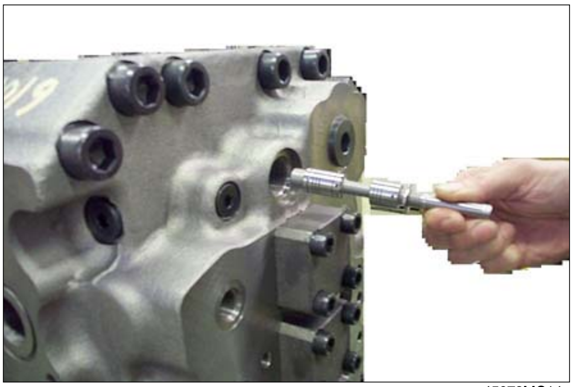
① Loosen the plug(27) and remove spring(25), spring seat(21) and the spool(24).


45078MC13

② Pull out O-ring(20).

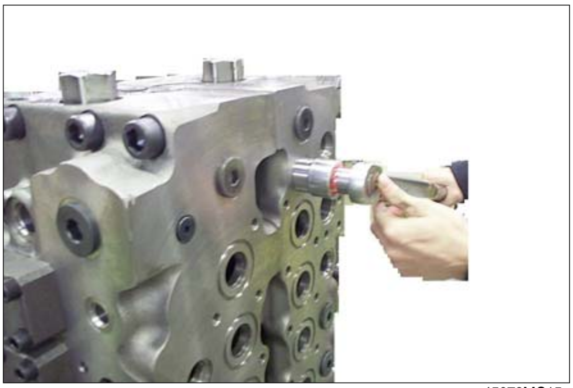
※ When disassemble the spool assembly, fix the spool with vise. On this occasion attach wood between vise blades to prevent the spool from damaging.

※ Heat the outer race of spool with industrial drier and then loosen easily . (Temperature : 200~250°C)

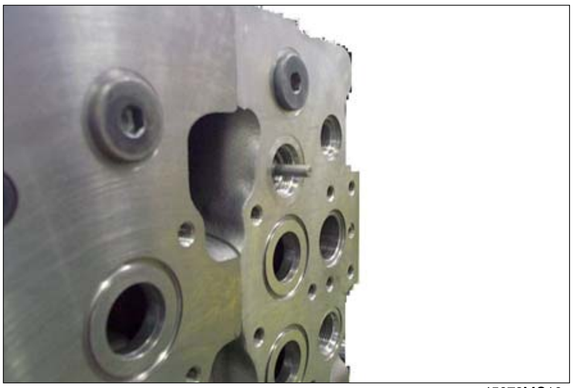

45078MC14

(4) Arm1 regeneration spool assy(20)

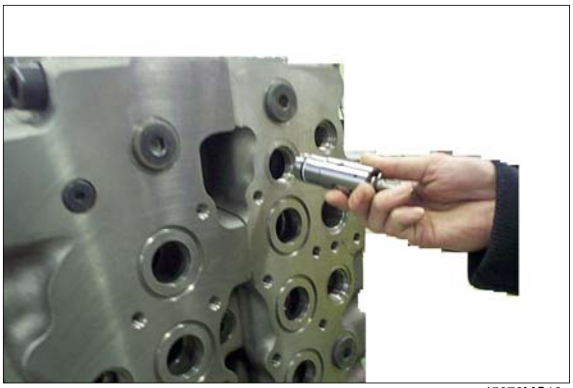
① Loosen the plug(23) and pull out O-ring(79).


45078MC15

② Disassemble spring(22), spring seat(21) and spool(20).


45078MC16

③ Pull out sleeve of hole inside at same time, disassemble sleeve and piston.


45078MC18

(5) Inspection after disassembly

Clean all disassembled parts with clean mineral oil fully, and dry them with compressed air. Then, place them on clean papers or cloths for inspection.

① Control valve

a. Check whole surfaces of all parts for burrs, scratches, notches and other defects.
b. Confirm that seal groove faces of casing and block are smooth and free of dust, dent, rust etc.
c. Correct dents and damages and check seat faces within the casing, if any, by lapping.
※ Pay careful attention not to leave any lapping agent within the casing.
d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and paths are free from foreign matter.
e. If any spring is broken or deformed, replace it with new one.
f. When a relief valve does not function properly, repair it, following the prescribed disassembly and assembly procedures.
g. Replace all seals and O-rings with new ones.

② Relief valve

a. Confirm that all seat faces at ends of all poppets and seats are free of defects and show uniform and consistent contact faces.
b. Confirm manually that main poppet and seat can slide lightly and smoothly.
c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so on.
d. Confirm that springs are free from breakage, deformation, and wear.
e. Confirm that orifices of main poppet and seat section are not clogged with foreign matter.
f. Replace all O-rings with new ones.
g. When any light damage is found in above inspections, correct it by lapping.
h. When any abnormal part is found, replace it with a completely new relief valve assembly.

3) ASSEMBLY

(1) General comments

① In this assembly section, explanation only is shown.
For further understanding, please refer to the figures and photographs shown in the previous disassembly section.

② Figure in ( ) shown after the part name in the explanation refers to the reference identity number shown on the construction figure shown in the spares section.

③ **Cautions in assembling seal**

a. Pay close attention to keeping all seals free from handling damage and inspect carefully for damage before using them.

b. Apply clean grease or hydraulic oil to the seal so as to ensure it is fully lubricated before assembly.

c. Do not stretch seals so much as to deform them permanently.

d. In fitting O-rings, pay close attention not to roll them into their final position in addition, a twisted O-ring cannot easily untwist itself naturally and could thereby cause inadequate sealing and thereby both internal and external oil leakage.

e. Tighten fitting bolts for all sections with a torque wrench adjusted to the respective tightening torque as shown on the corss section drawings of the spares section.

(2) Main spool

① Apply loctite to thread of spools(3, 4, 6, 7, 9, 10, 11) and assemble spring seat, spring and spool end. Assemble spool end to spool after fixing spool with a vise attached wood.
※ Be careful not to applying loctite too much.
· Tightening torque : 2.4 ~ 2.6 kgf · m(17.4 ~ 18.8lbf · ft)
Fit O-ring into housing and assemble spools(3, 4, 6, 7, 9, 10, 11) into housing.
Assemble lock cap on housing and tighten hex socket bolt.
· Tightening torque : 11±0.5 kgf · m(79.7±3.7lbf · ft)

② Insert poppet, spring into spool(5) and then apply loctite to thread of spool.
Fit O-ring and backup ring on the plug and then tighten plug.
Assemble spring seat, spring, and spool end and then assemble spool end sub assy to spool after fixing spool with a vise attached wood.
· Tightening torque : 2.4 ~ 2.6 kgf · m(17.4 ~ 18.8lbf · ft)
Fit O-ring into housing and assemble spool(5) into housing.
Assemble lock cap on housing and tighten hex socket bolt.
· Tightening torque : 11±0.5 kgf · m(79.7±3.7lbf · ft)

③ Insert poppet, spring into spool(8) and then apply loctite to thread for spool.
Fit O-ring and backup ring on the plug and then tighten plug.
Assemble spring seat, spring, and spool end and then assemble spool end sub assy to spool after fixing spool with a vise attached wood.
· Tightening torque : 2.4 ~ 2.6 kgf · m(17.4 ~ 18.8lbf · ft)
Fit O-ring into housing and assemble spool(8) into housing.
Assemble lock cap on housing and tighten hex socket bolt.
· Tightening torque : 11±0.5 kgf · m(79.7±3.7lbf · ft)

④ Assemble short cap on housing and tighten hex socket bolt.
· Tightening torque : 11±0.5 kgf · m(79.7±3.7lbf · ft)

(3) Center bypass cut spool assy(24)

① Apply loctite to thread of spool, assemble spool end to spool.
※ Be careful not to appling loctite too much.
② Assemble spool assy, spring seat, spring and tighten plug with O-ring.
· Tightening torque : 9.5 ~ 11.0 kgf · m(68.6 ~ 79.7lbf · ft)

(4) Arm1 regeneration spool assy(20)

① Assemble backup rings and O-rings to sleeve respectively.
② Assemble piston to sleeve which seal is assemble, and insert spool into sleeve.
③ Assemble spool assy, spring seat, spring and tighten plug with O-ring.
· Tightening torque : 9.5 ~ 11.0 kgf · m(68.6 ~ 79.7lbf · ft)

GROUP 5 SWING DEVICE (TYPE 1)

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious in injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

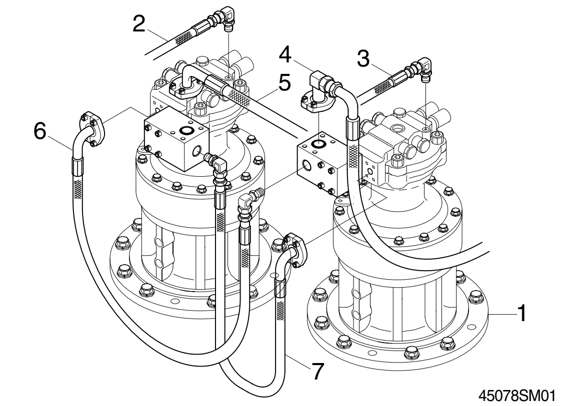
13031GE18

(3) Disconnect pipe assy(4, 5, 6, 7).

(4) Disconnect pilot line hoses(2, 3, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17).

(5) Sling the swing motor assembly(1)and remove the swing motor mounting bolts(18).

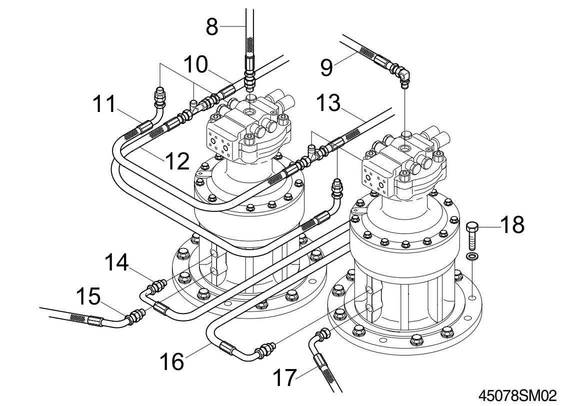
- Motor device weight : 63kg(139lb)
- Tightening torque : 58.4kgf · m (422.4lbf · ft)



45078SM01

(6) Remove the swing motor assembly.

※ When removing the swing motor assembly, check that all the piping have been disconnected.



45078SM02

2) INSTALL

(1) Carry out installation in the reverse order to removal.

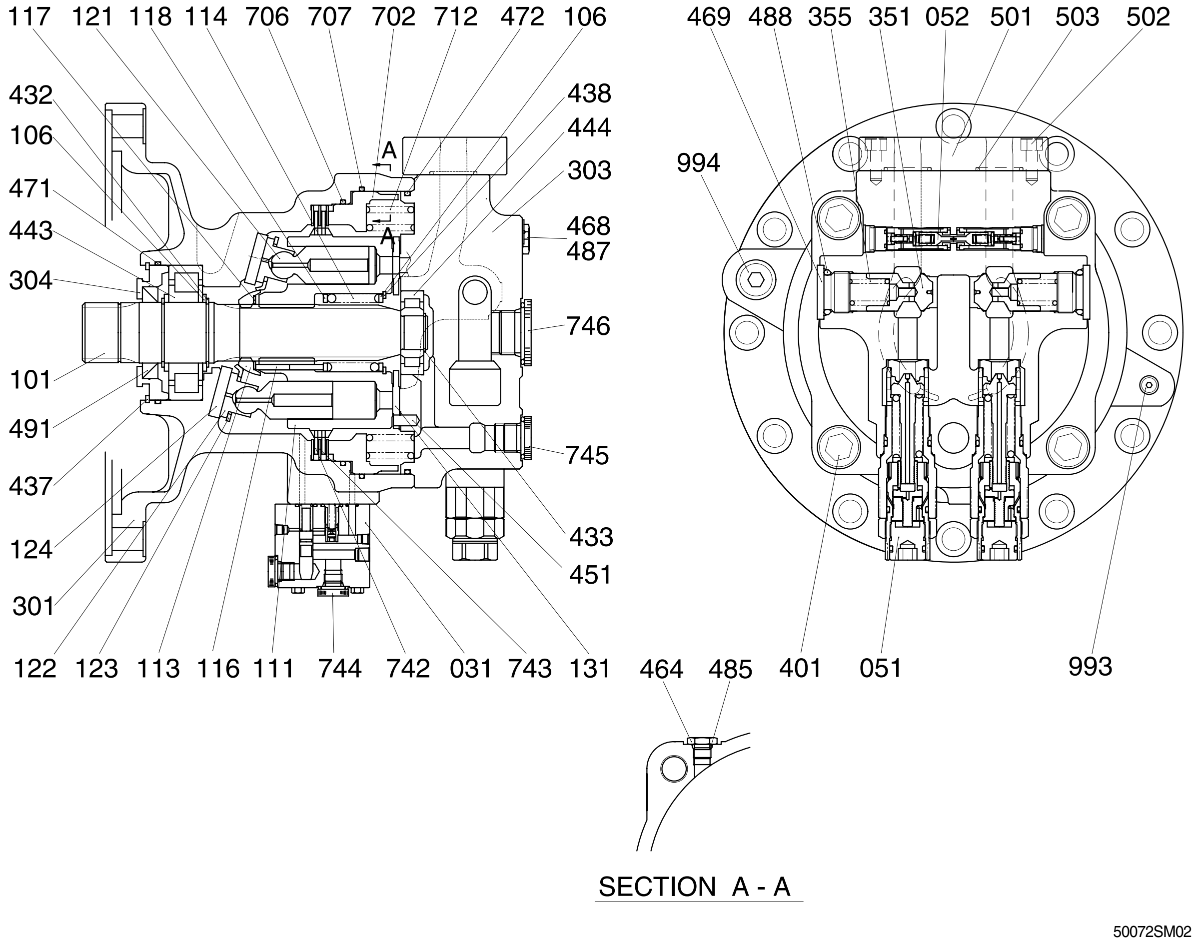
(2) Bleed the air from the swing motor.

① Remove the air vent plug.
② Pour in hydraulic oil until it over flows from the port.
③ Tighten plug lightly.
④ Start the engine, run at low idling, and check oil come out from plug.
⑤ Tighten plug fully.

(3) Confirmed the hydraulic oil level and check the hydraulic oil leak or not.

2. SWING MOTOR

1) STRUCTURE

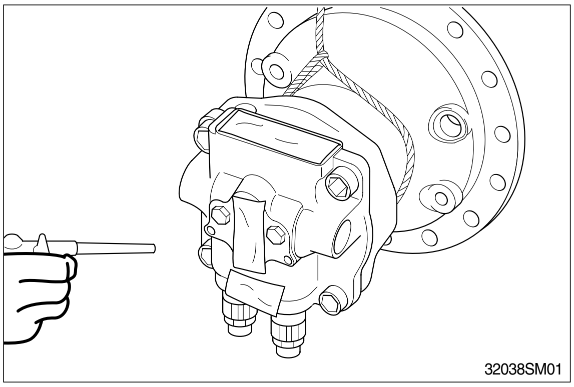


031	Brake valve	303	Valve casing(K)	485	O-ring
051	Relief valve	304	Front cover	487	O-ring
052	Reactionless valve assy	351	Plunger(K)	488	O-ring
101	Drive shaft	355	Spring	491	Oil seal
106	Spacer	401	Socket bolt	501	Adapter
111	Cylinder block	432	Snap ring	502	Socket bolt
113	Spherical busing	433	Snap ring	503	O-ring
114	Cylinder spring	437	Snap ring	702	Brake piston
116	Push rod	438	Snap ring	706	O-ring
117	Spacer(F)	443	Roller bearing	707	O-ring
118	Spacer(R)	444	Roller bearing	712	Brake spring
121	Piston	451	Spring pin	742	Friction plate
122	Shoe plate	464	VP Plug	744	Dust plug
123	Retainer	468	VP Plug	745	Dust plug
124	Shoe	469	RO Plug	746	Dust plug
131	Valve plate	471	O-ring	993	PT Plug
301	Casing(F)	472	O-ring	994	PT Plug

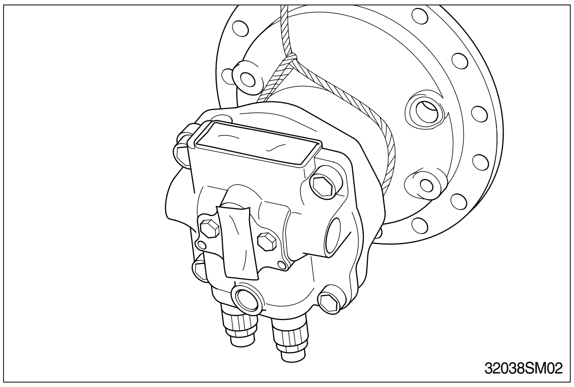
2) DISASSEMBLY

(1) Lift the motor out. Clean the motor in kerosene and dry with compressed air.

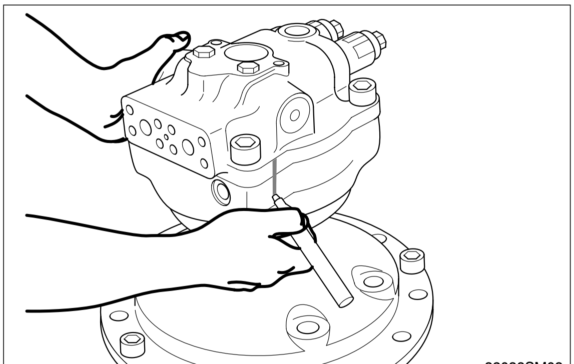
※ To avoid dust inside the motor, mask all the ports of the motor with tapes.


32038SM01

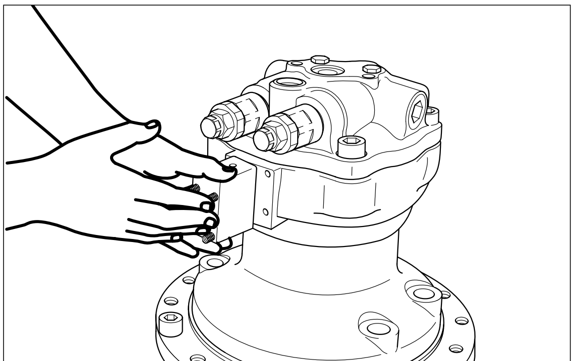
(2) Loosen the drain plug to discharge oil in the casing(301).


32038SM02

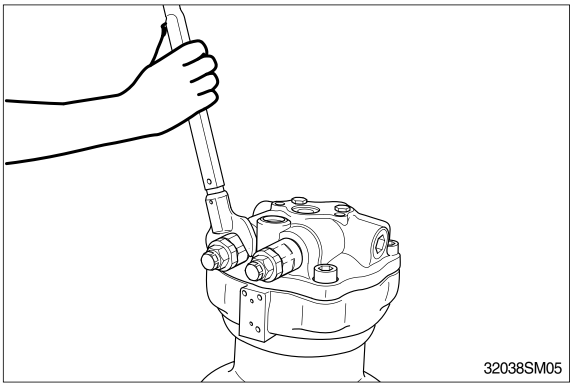
(3) Fix the drive shaft(101) on the workbench with the end of output shaft down. Put matching marks on casing (301) and valve casing(303) for easy reassembly.


32038SM03

(4) Remove the valve(052).


32038SM04

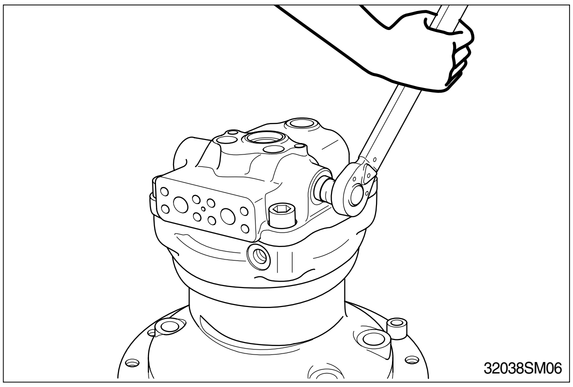
(5) Remove the relief valve(051) from valve casing(303).



32038SM05

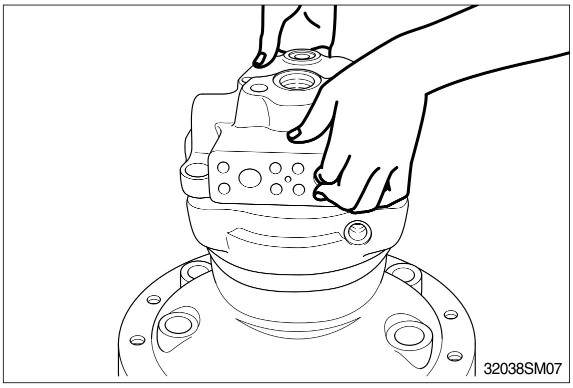
(6) Remove plug(469) from valve casing (303) and spring(355), plunger(351).

※ Be careful not to damage the plunger seat assembly.



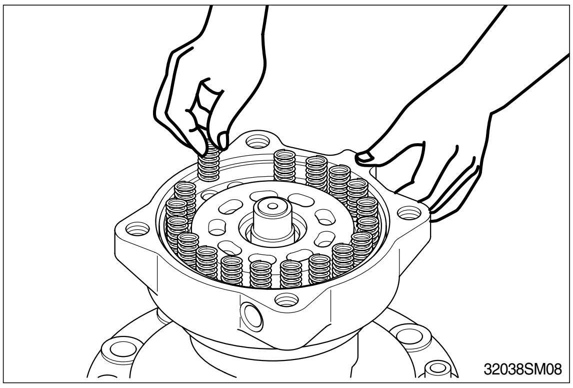
32038SM06

(7) Remove valve casing(303) from casing (301). Then, remove the valve plate(131) from valve casing(303) with care.



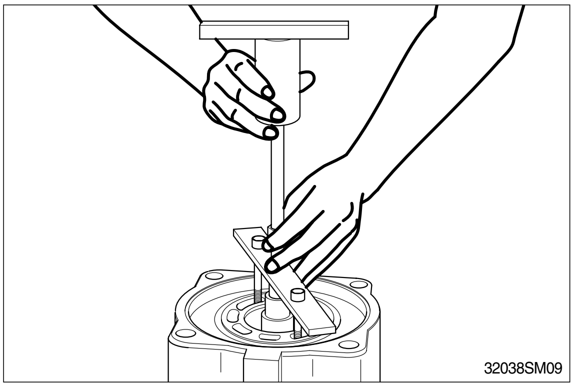
32038SM07

(8) Remove the brake spring(712) from brake piston(702).



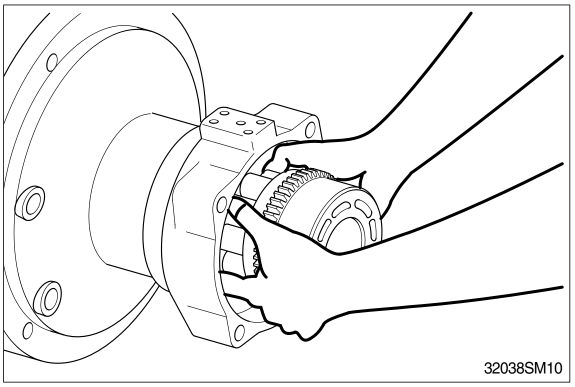
32038SM08

(9) Remove brake piston(702) from casing (301).

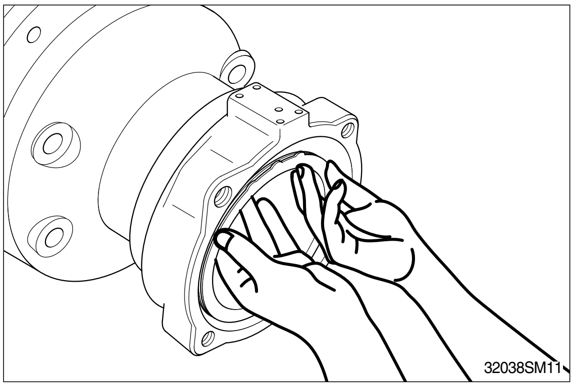


(10) Remove the cylinder(111) from the output shaft (101) with the motor positioned horizontally. Remove piston(121), retainer(123), spherical bushing(113), spacer (117) and shoe plate(124).

※ If shoe plate would not removed easily, try again after procedure(14).

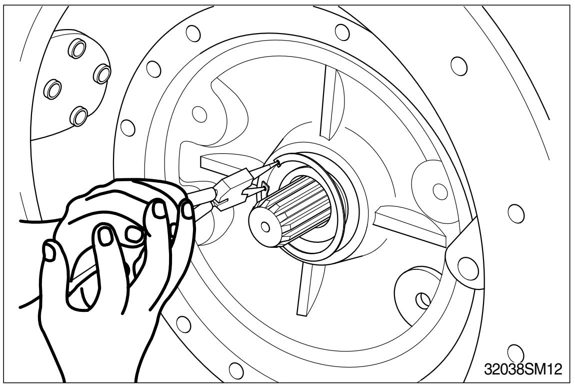


(11) Remove friction plate(742) and separate plate(743) from casing(301).

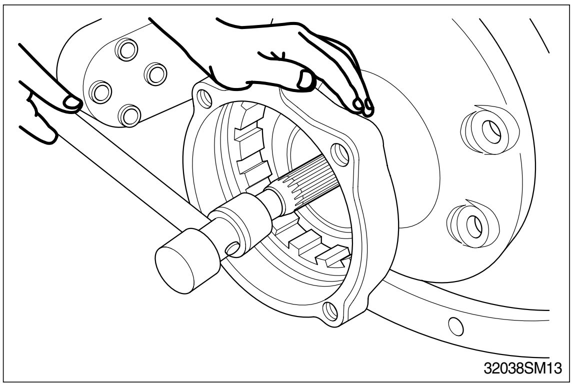


(12) Remove snap ring(437) with plier and remove the front cover(304) from casing(301).

※ Front cover could be removed with sliding shaft if necessary.

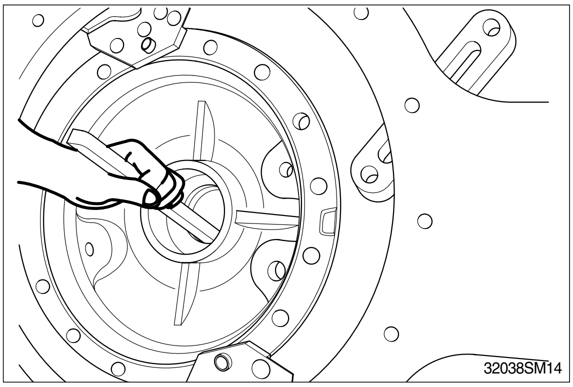


(13) Remove drive shaft(101) from casing (301).



32038SM13

(14) Remove the shoe plate(124) from casing (301).

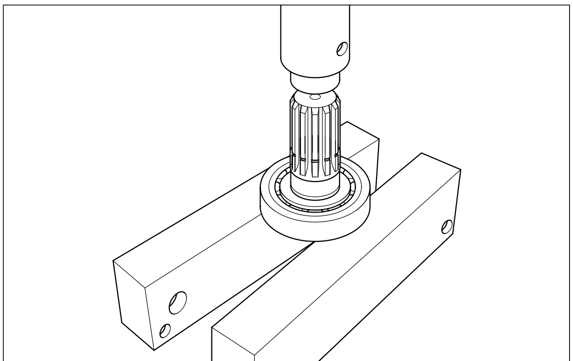


32038SM14

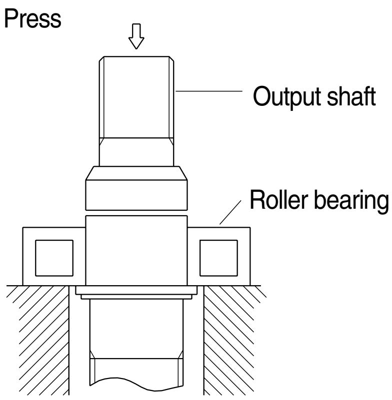
(15) Proceed with following job only when necessary.

① Remove the snap ring(432), spacer(106) from drive shaft(101) and remove the cone of roller bearing(443) by press.

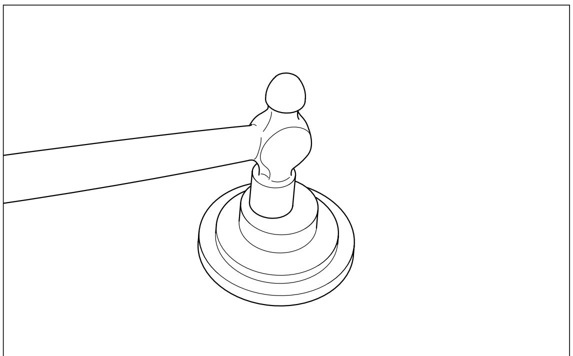
※ Do not reuse bearings.



32038SM15

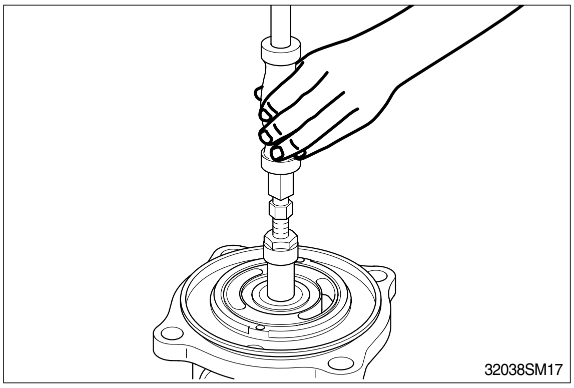


② Remove oil seal(491) from front cover (304).

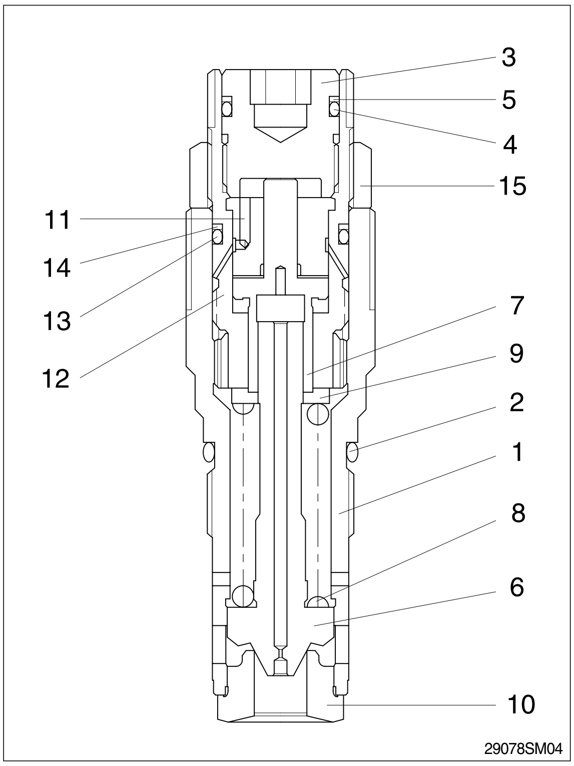


32038SM16

③ Remove the roller bearing(444) from the valve casing(303) by using slide hammer bearing puller.



④ When disassembling the relief valve, release the plug(3).
Remove the piston(7), spring seat(9), spring(8) and plunger(6) with the body(1) downwards.
※ Do not release the lock nut(15).

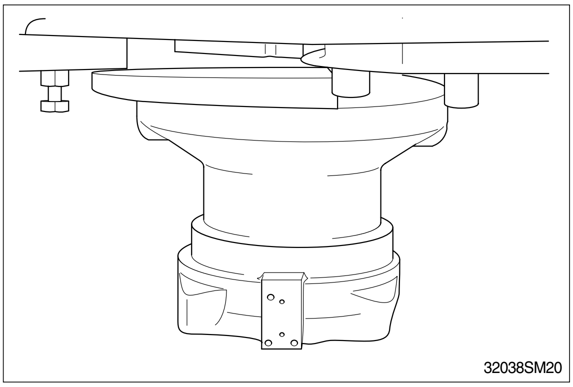


This completes disassembly.

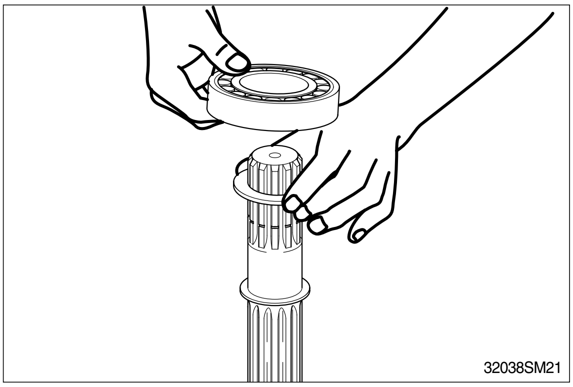
3) ASSEMBLY

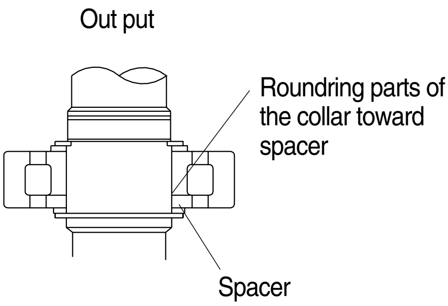
Do the reassembly in the reverse procedure of the disassembly.

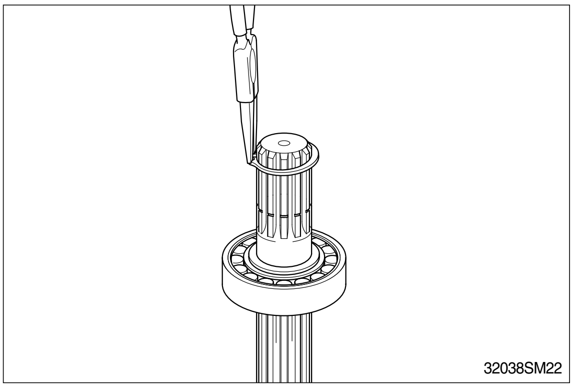
(1) Place the casing(301) on the workbench with the valve casing(303) downward.



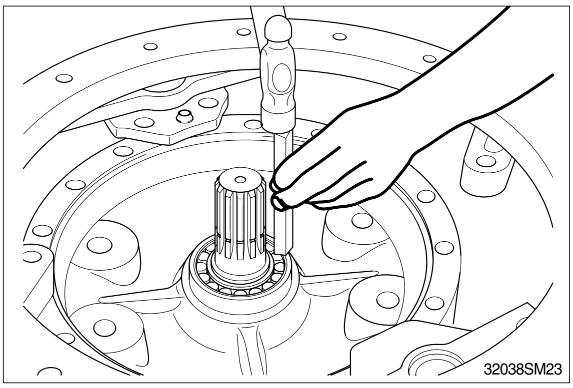
(2) When reassembling the roller bearing, install the snap ring(432), and spacer(106) to the drive shaft(101). Insert the collar and cone of the roller bearing(443). Install the spacer(106) and snap ring(432). Install snap ring(433) to the output shaft (101) by heating the cone of the roller bearing(444).



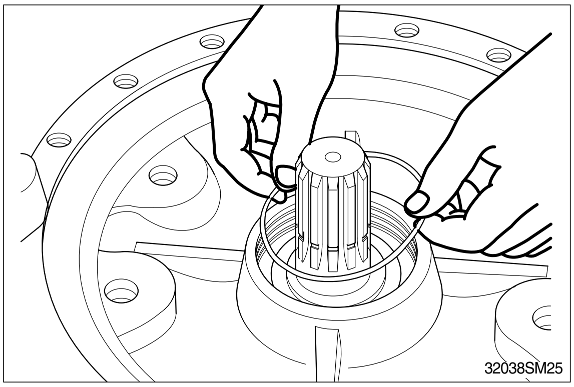




(3) Insert the drive shaft(101) into the casing (301) with the end of output shaft upward and tap the outer race of roller bearing with the hammer.

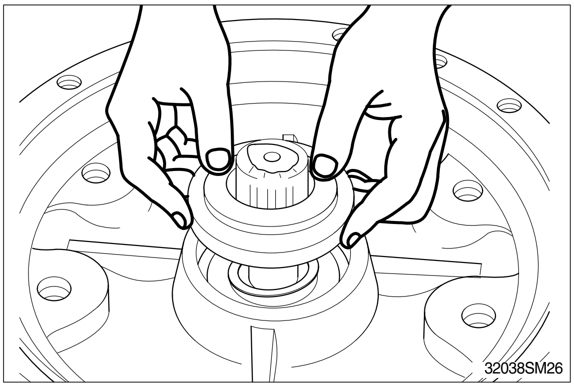


(4) Tack O-ring(471) to the casing(301).

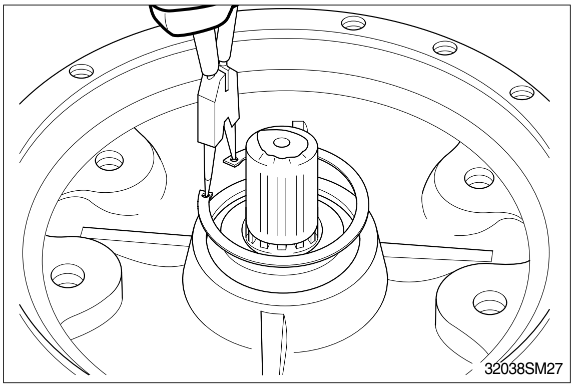


(5) Reassemble the front cover(304) to the casing(301).

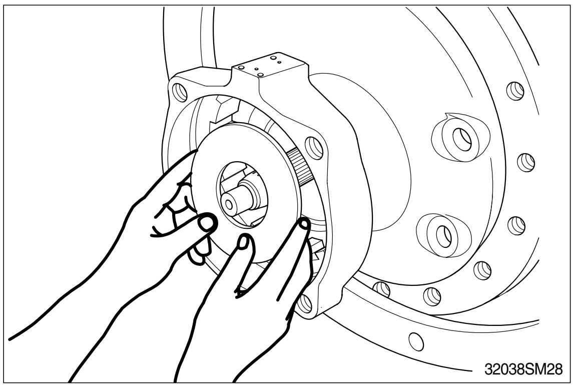
※ Apply grease to the rib of oil seal to avoid damage to the rib.



(6) Install the snap ring(437) to the casing (301).

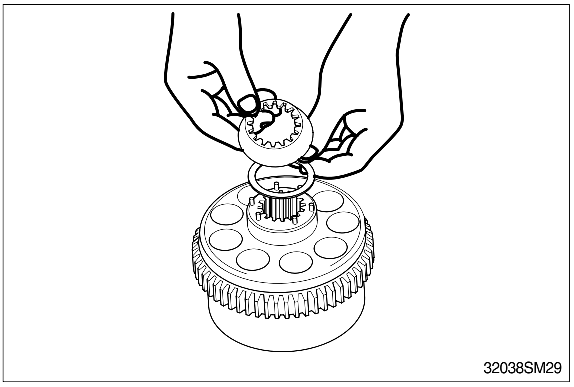


(7) Insert the shoe plate(124) with the casing (301) position horizontally.



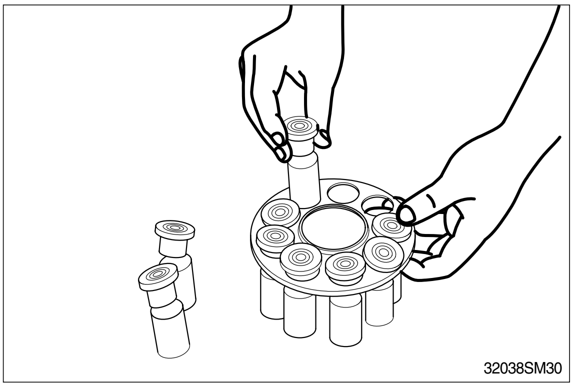
(8) Insert the push rod(116) into the cylinder (111). Place the spherical bushing(113) assembled with spacer(117) onto the cylinder.

※ Insert two push rods in each hole.



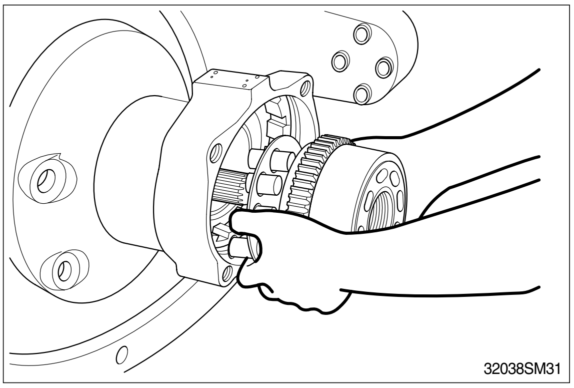
32038SM29

(9) Install the piston sub-assembly(121, 122) to the retainer(123).



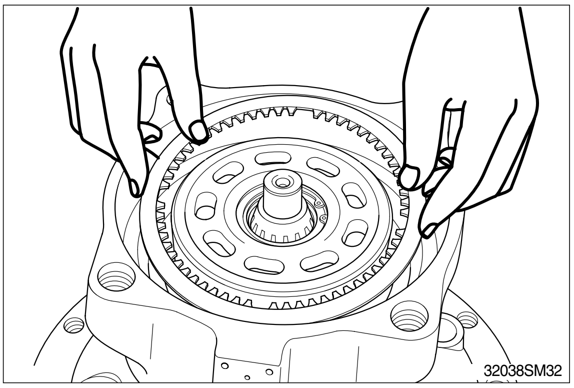
32038SM30

(10) Reassemble the piston assembly(121, 122) to the cylinder(111).



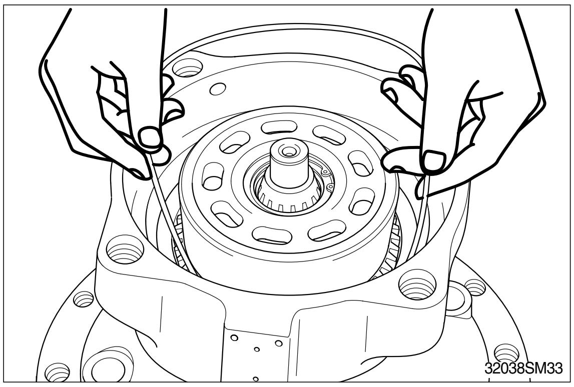
32038SM31

(11) Place the casing(301) under the front cover(304) and reassemble 3 sheets of separate plate(743) and then 2 sheets of friction plate(742) to the casing(301).

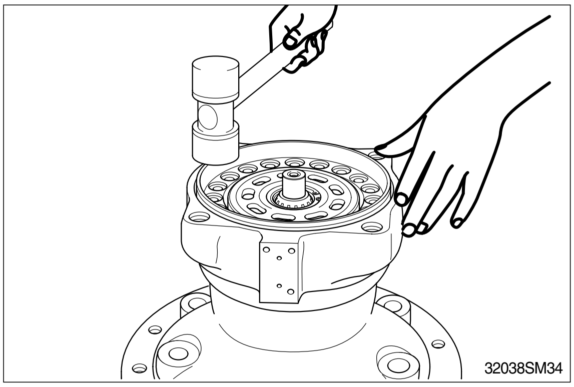


32038SM32

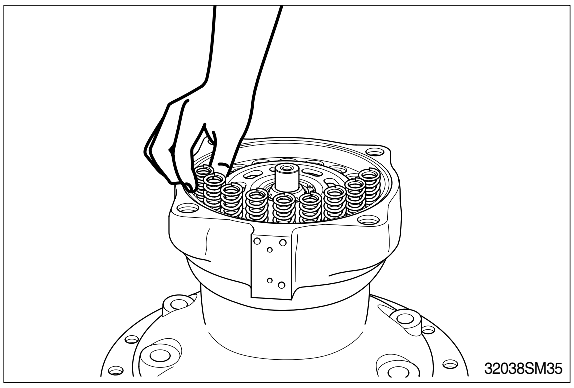
(12) Insert O-ring(706, 707) inside the casing (301).



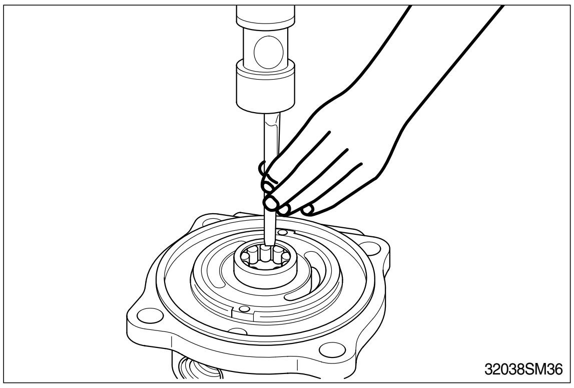
(13) Reassemble brake piston(702) to the casing(301).



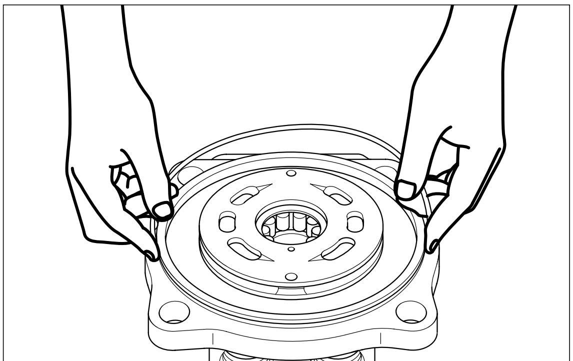
(14) Reassemble brake spring(712) to the brake piston(702).



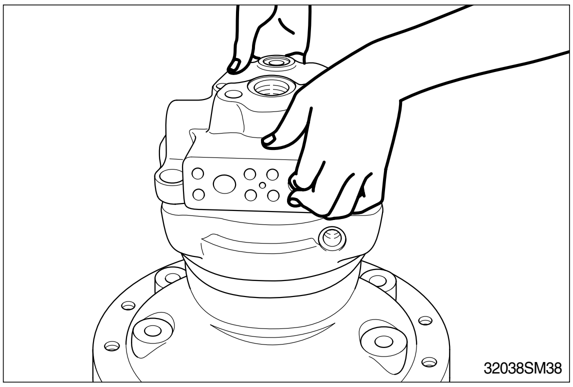
(15) When assembling the roller bearing(444), insert the roller bearing(444) into valve casing(303) by hammering.



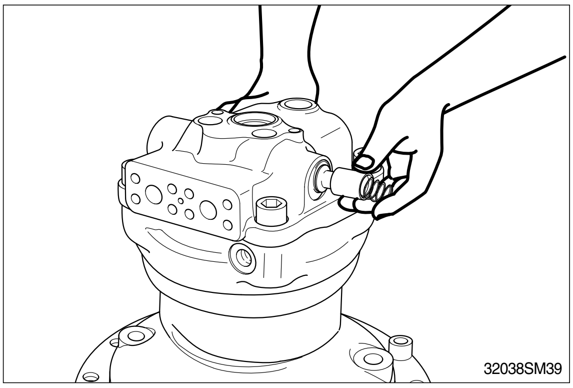
(16) Reassemble valve plate(131) to the valve casing(303) and reassemble O-ring(472).


32038SM37

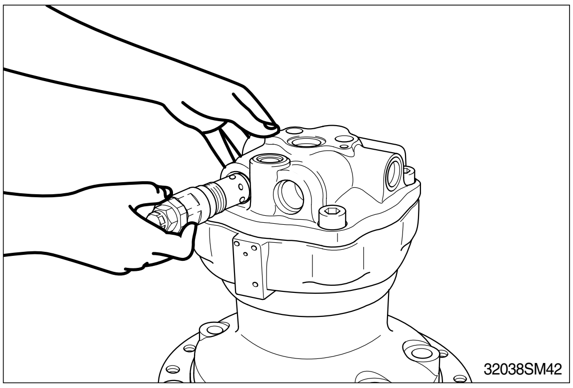
(17) Connect the valve casing(303) with the casing(301) and tighten the hexagon socket bolt(401).


32038SM38

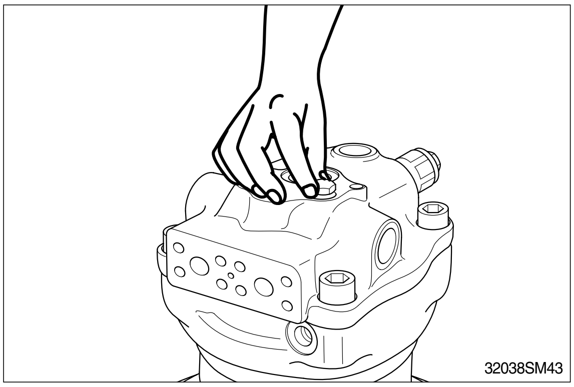
(18) Insert plunger(351) and spring(355) in the valve casing and install O-ring(488). Tighten plug(469) to the valve casing.


32038SM39

(19) Insert O-rings(051-1) to the relief valve (051) and reassemble them to valve casing(303).


32038SM42

(20) Tighten the plug(468) to valve casing(303) with O-ring(487) and tighten the plug(464) to casing(301) with O-ring(485).



32038SM43

(21) Connect the valve casing(303) with the casing(301).

This completes assembly.

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

(1) Remove the swing motor assembly.
For details, see **removal of swing motor assembly**.

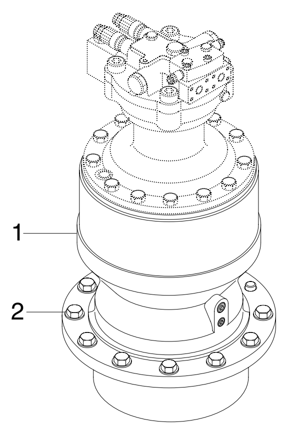
(2) Sling reduction gear assembly(1) and remove mounting bolts(2).

(3) Remove the reduction gear assembly.
· Reduction gear device weight : 180kg (396lb)

13031GE18

2) INSTALL

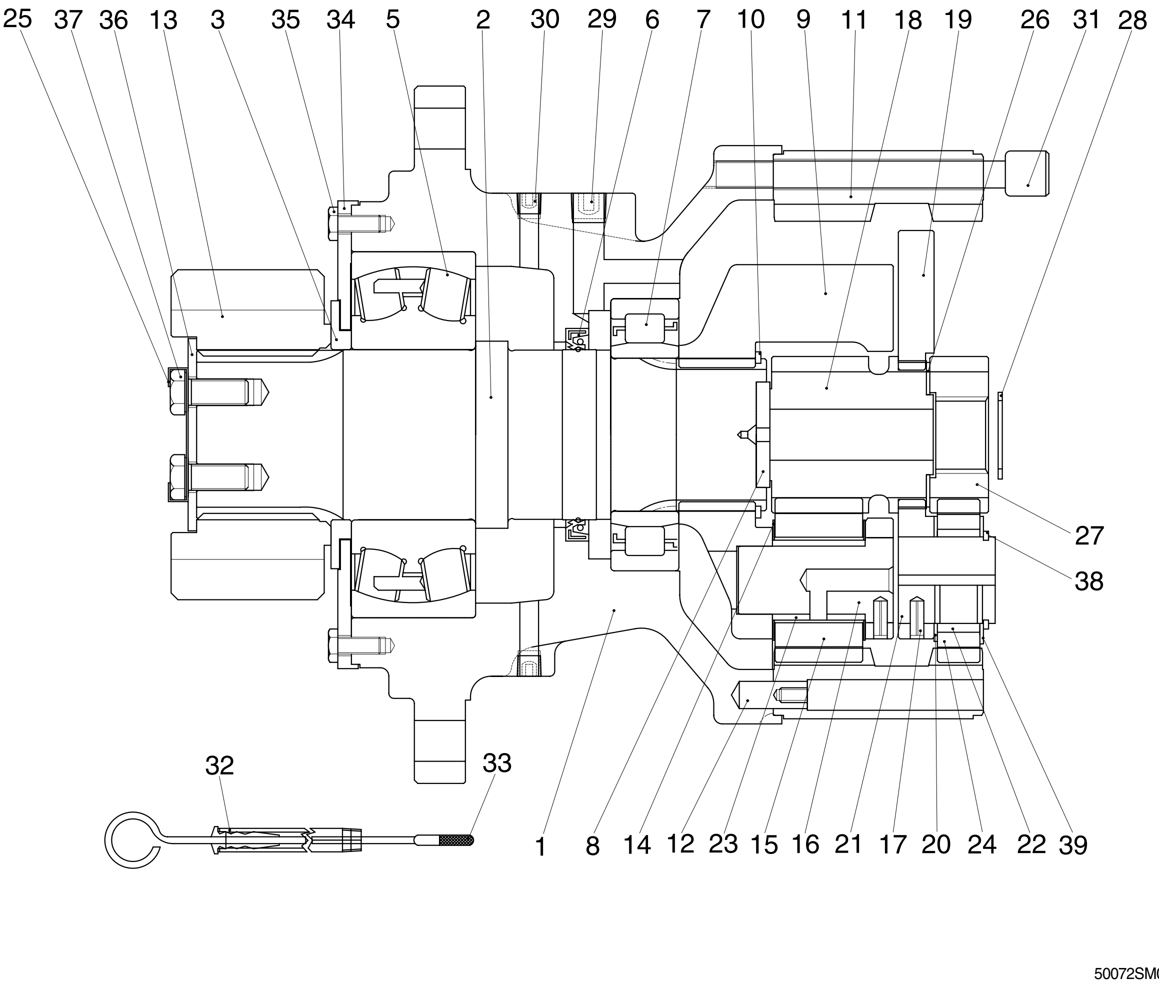
(1) Carry out installation in the reverse order to removal.
· Tightening torque : 49.2~66.6kgf · m (356~481lbf · ft)



21078DA05

4. REDUCTION GEAR

1) STRUCTURE



1	Casing	15	Planet gear 2	28	Stop ring
2	Drive shaft	16	Pin 2	29	Plug
3	Spacer	17	Spring pin	30	Plug
5	Roller bearing	18	Sun gear 2	31	Socket bolt
6	Oil seal	19	Carrier 1	32	Gage pipe 39
7	Roller bearing	20	Side plate 1	33	Gage bar side plate2
8	Thrust plate	21	Pin 1	34	Cover plate
9	Carrier 2	22	Needle cage	35	Hex bolt
10	Stop ring	23	Bushing	36	Lock plate
11	Ring gear	24	Planet gear 1	37	Hex bolt
12	Knock pin	25	Lock washer	38	Stop ring
13	Pinion gear	26	Side plate 3	39	Side plate 2
14	Thrust washer	27	Sun gear 1	40	Air breather assy

2) DISASSEMBLY

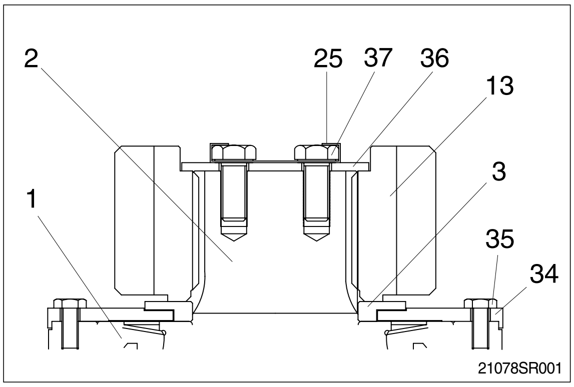
(1) Spread off the 4 corners of lock washer (25) with a tool.

※ Do not reuse lock washer(25).

Loosen the hexagon bolts(37) and then remove lock washer(25) and lock plate (36) from the pinion gear(13).

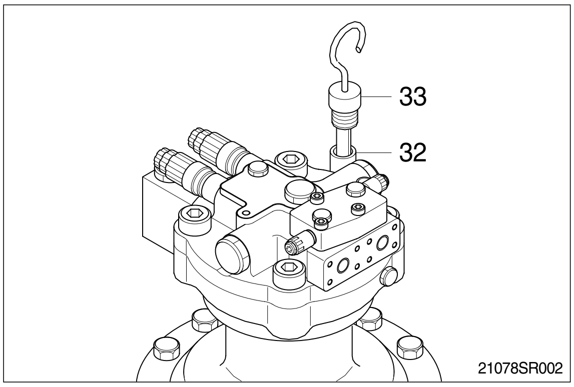
Remove pinion gear(13) and spacer(3) from the drive shaft(2).

Remove cover plate(34) from the casing (1) by loosening the hexagon socket bolts (35).

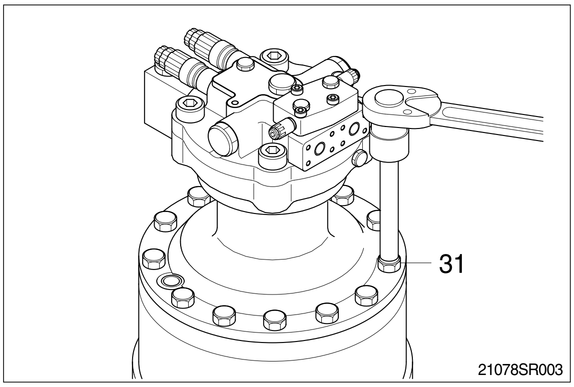


(2) Remove gauge bar(33) and gauge pipe (32) from the swing motor casing.

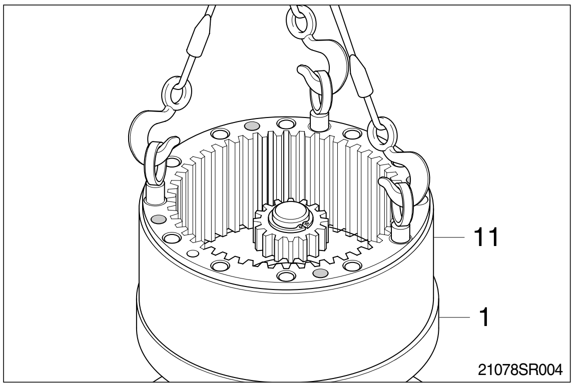
※ Pour the gear oil out of reduction gear into the clean bowl to check out the friction decrease.



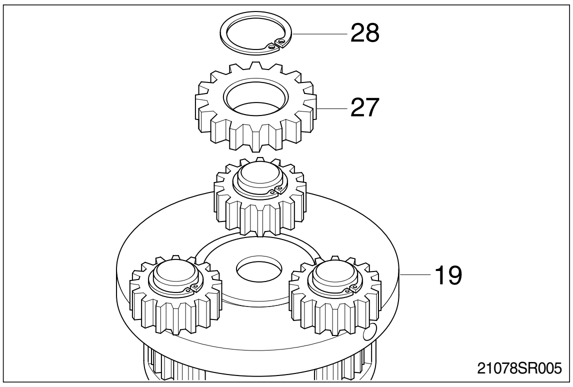
(3) Loosen the socket bolts(31) to separate swing motor from reduction gear.



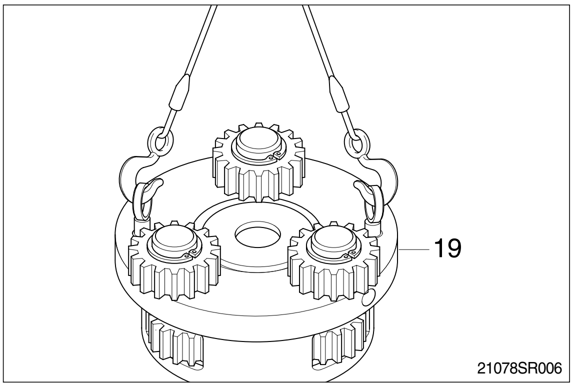
(4) Tighten 3 M16 eye bolts to the ring gear (11) and then lift the ring gear(11) out of the casing(1).



(5) Remove stop ring(28) and then sun gear1 (27).



(6) Tighten two M10 eye bolts to carrier1(19) and lift up and remove carrier1(19) as subassembly.



(7) Disassembling carrier1(19) assembly.

① Remove stop ring(38).

② Remove side plate2(39), planet gear1 (24), needle cage(22), side plate1(20) and side plate3(26) from the carrier.

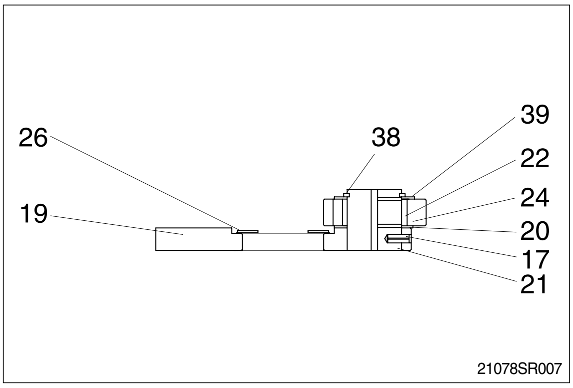
③ Using M8 solid drill, crush spring pin(17) so that the pin1(21) can be removed by hammering.

④ Remove side plate3(26) from carrier1(19).

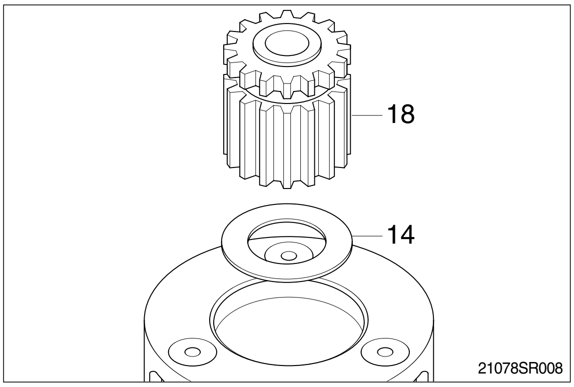
※ Do not reuse spring pin(17).

※ Do not remove pin1(21), carrier1(19) and spring pin(17) but in case of replacement.

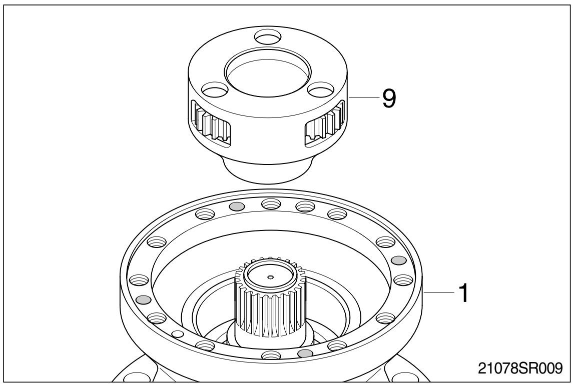
※ Put matching marks on the planet gear1 (24) and the pin1(21) for easy reassembly.



(8) Remove sun gear2(18) and thrust gear (14).



(9) Remove carrier2(9) assembly from casing (1).



(10) Disassembling carrier2(9) assembly

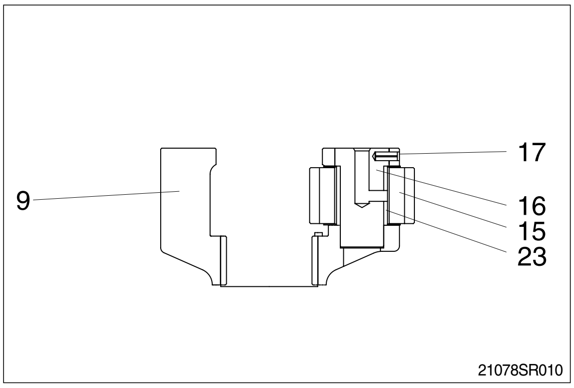
① Using M8 solid drill, crush spring pin(17) so that the pin2(16) can be removed.

※ Do not reuse spring pin(17).

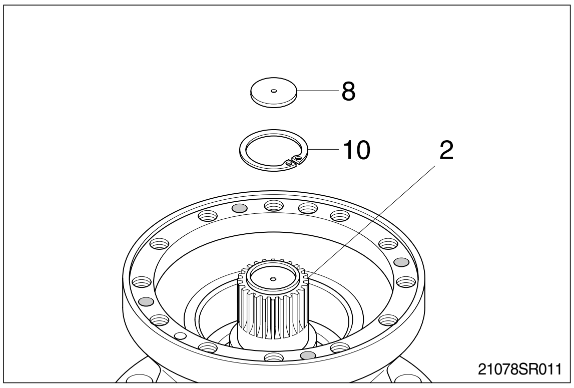
② Remove pin2(16), planet gear2(15) and bush2(23) from the carrier2(9).

※ Put matching marks on the planet gear2 (15) and the pin2(16) for easy reassembly.

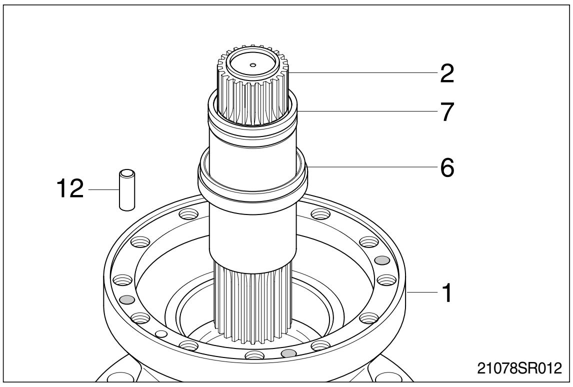
※ Do not disassemble pin2(16), carrier2(9) and spring pin(17) but in case of replacement.



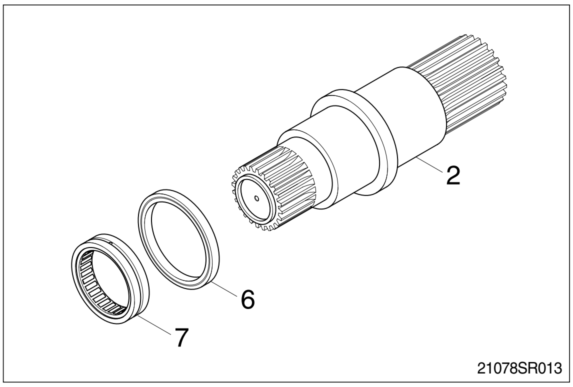
(11) Remove thrust plate3(8) and stop ring (10) from the drive shaft(2).



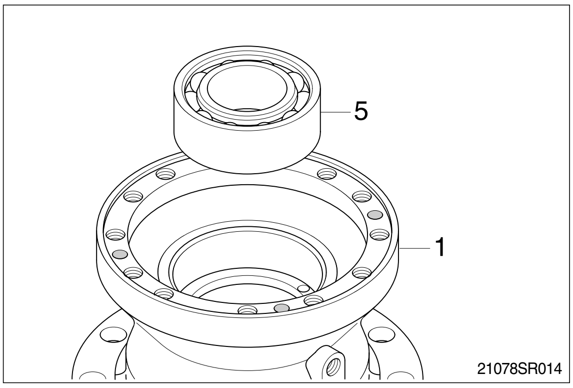
(12) Remove drive shaft(2) with roller bearing(7) and oil seal(6) assembled.
Remove knock pin(12) from the casing(1).



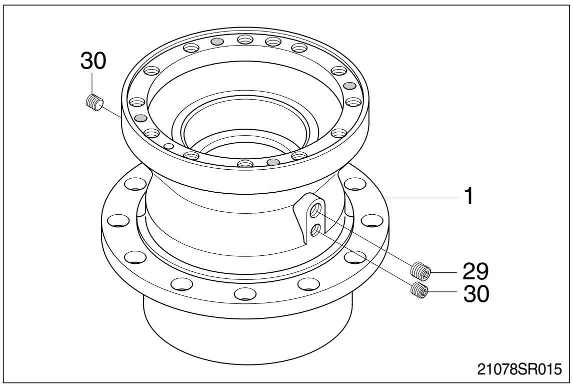
(13) Remove roller bearing(7) and oil seal(6) from the drive shaft(2).
※ Do not reuse oil seal(6) once removed.



(14) Using the bearing disassembly tool, remove roller bearing(5).

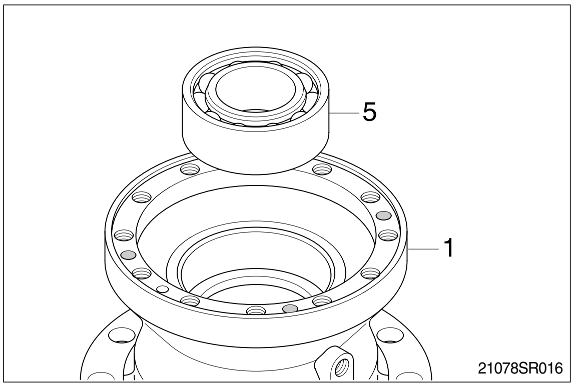


(15) Remove plugs(29, 30) from the casing(1).



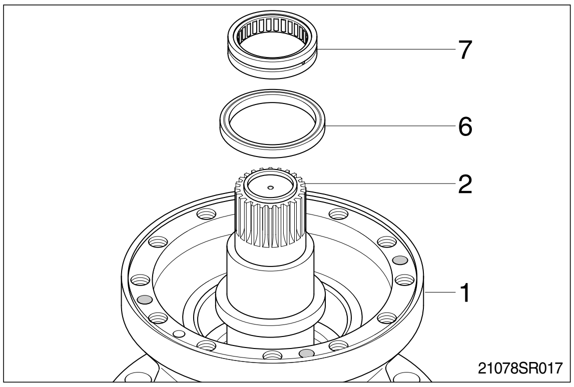
3) ASSEMBLY

(1) Assemble roller bearing(5) inside the casing(1).



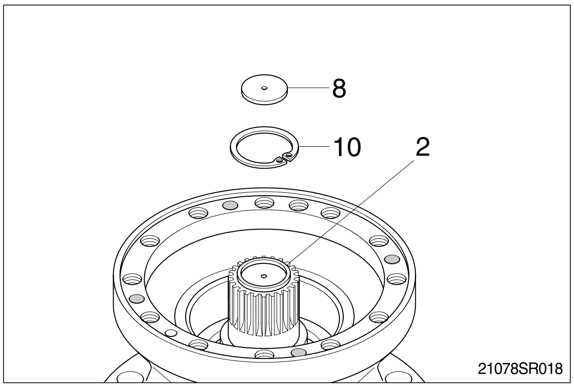
21078SR016

(2) Assemble the drive shaft(2) into the casing(1) and then install oil seal(6) and roller bearing(7).



21078SR017

(3) Install stop ring(10) and thrust plate 3(8) on top of drive shaft(2).



21078SR018

(4) Assembling carrier2(9) assembly.

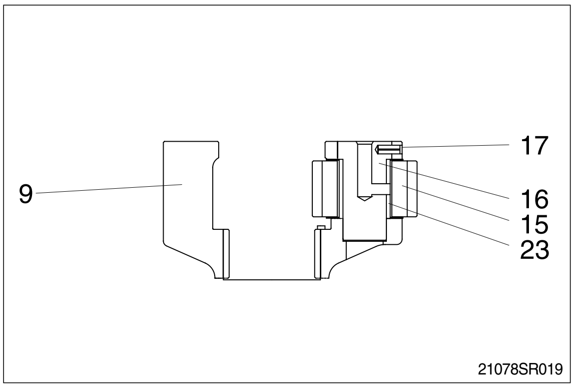
① Install thrust washer(14) inside the carrier2 (9).

② Install bush2(23) inside the planet gear2 (15) and then assemble them to the carrier2(9).

③ Assemble the pin2(16) to the carrier2(9) and then press the spring pin(17) by hammering.

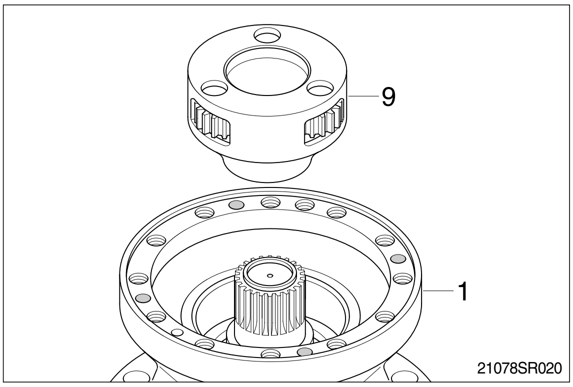
④ Punch 2 points of the spring pin(17) lip.

※ Take care not to mistake the matching marks of each part.



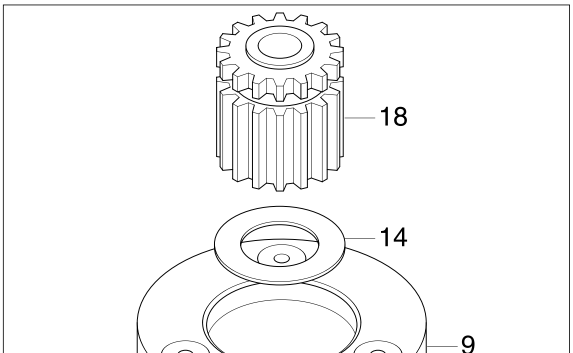
21078SR019

(5) Assemble carrier2(9) assembly correctly to the drive shaft(2).



21078SR020

(6) Assemble sun gear2(18) and thrust washer(14) to the center of the carrier2(9) assembly.



21078SR021

(7) Assembling carrier1(19) assembly.

① Assemble the pin1(21) to the carrier1(19) and then press the spring pin(17) by hammering.

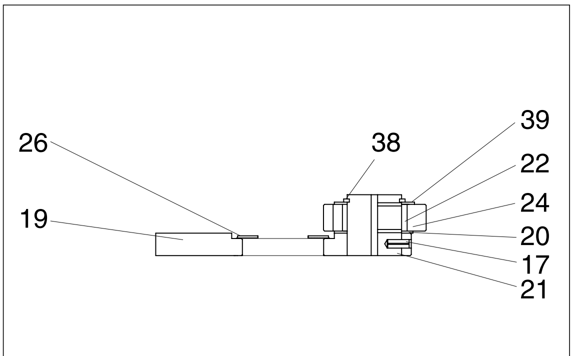
② Punch 2 points of the spring pin's(17) lip.

③ Install side plate3(26) onto the center of carrier1(19).

④ Install needle cage(22) into the planet gear1(24).

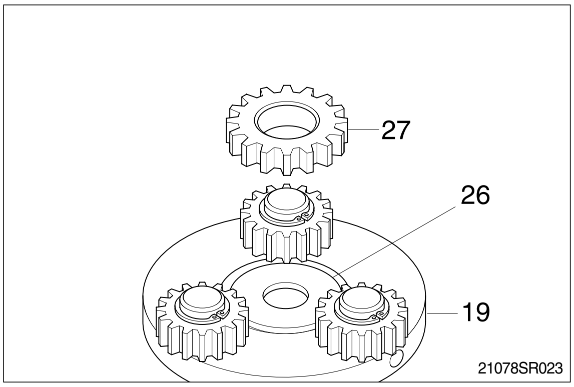
⑤ Assemble side plate(20), planet gear1 (24), side plate2(39) and then stop ring (38) to the pin1(21).

※ Take care not to mistake the matching marks of each part.

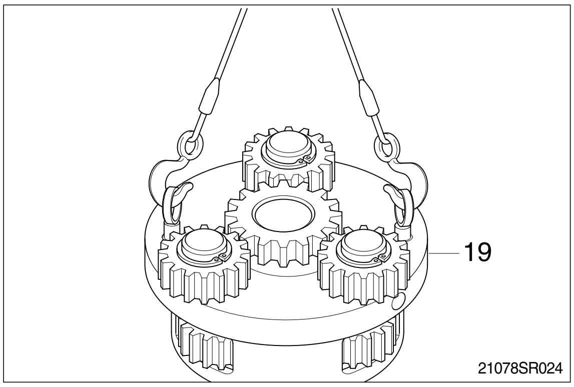


21078SR022

(8) Install sun gear1(27) onto the side plate3 (26).



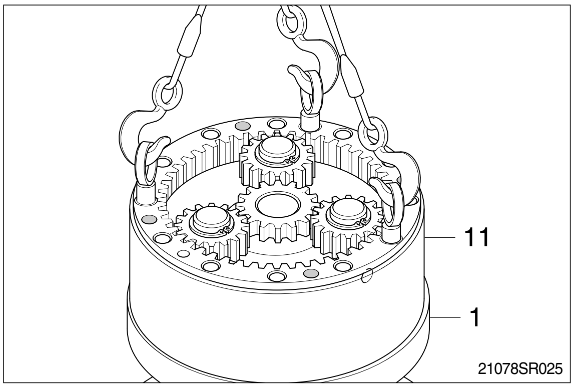
(9) Assemble carrier1(19) assembly onto the carrier2(9) assembly.



(10) Apply loctite to the tapped holes of casing (1).

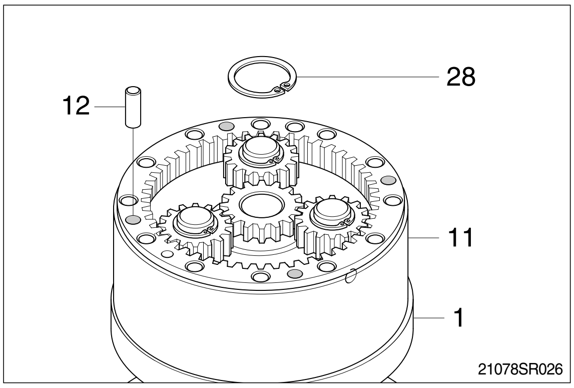
(11) Tighten 3 M16 eye bolts to the ring gear(11) and lift up and then assemble it onto the casing(1).

※ Don't fail to coincide the knock pin(12) holes.



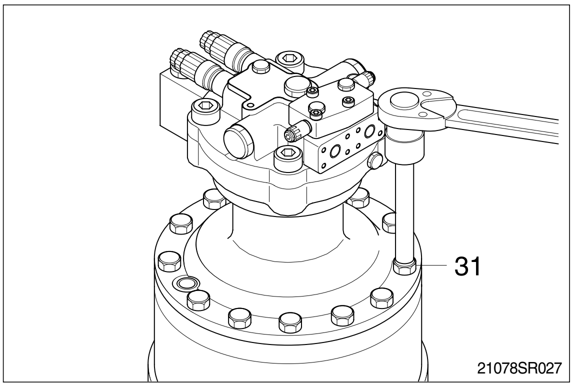
(12) Hammer 4 knock pins(12) around the ring gear(11).

(13) Assemble stop ring(28) to the drive shaft of the swing motor.



(14) Apply loctite to the tapped holes of the ring gear(11) and then mount swing motor onto the ring gear(11).

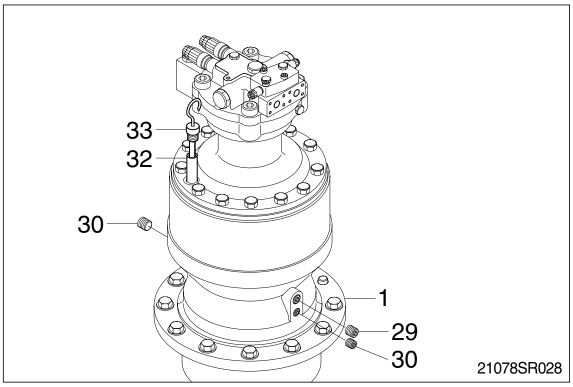
※ Don't fail to coincide the gauge bar(33) hole.



(15) Tighten socket bolts(31) around the swing motor assembly.

· Tightening torque : 25±2.5kgf · m (181±18lbf · ft)

(16) Assemble plugs(29, 30), gauge bar(33) and gauge pipe(32).



(17) Turn the swing motor assembly upside down and assemble cover plate(34) by tightening the hexagon socket bolts(35).

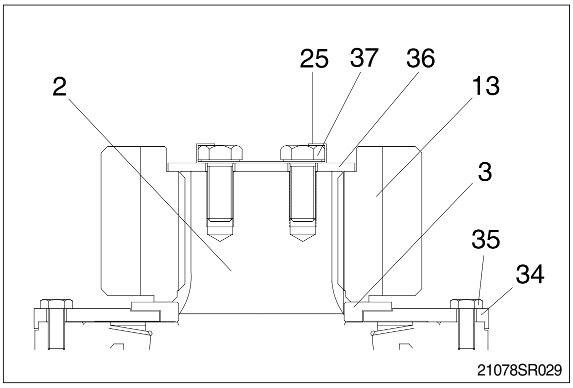
Install spacer(3) and pinion gear(13) to the drive shaft(2).

Assemble lock plate(36) on the pinion gear(13).

Assemble 2 lock washers(25) on the lock plate(36) with their 2 hole coincided individually to the tapped holes of drive shaft(2).

Tighten hexagon socket bolts(37) to the drive shaft(2) and then fold all the lock washer(25) corners over the hexagon bolts(37).

· Tightening torque : 25±2.5kgf · m (181±18lbf · ft)



(18) Inject oil into the reduction gear.

GROUP 5 SWING DEVICE (TYPE 2)

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.


13031GE18

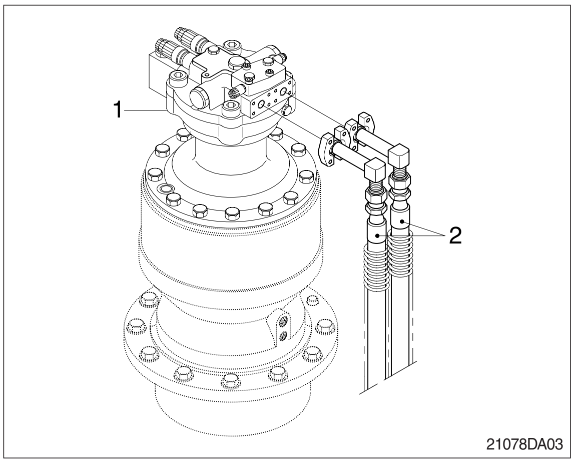
(4) Disconnect hose assembly (2).

(5) Disconnect pilot line hoses (3, 4, 5, 6, 7).

(6) Sling the swing motor assembly (1) and remove the swing motor mounting bolts (8).
·Motor device weight : 61 kgf·m (135 lbf·ft)

(7) Remove the swing motor assembly.

※ When removing the swing motor assembly, check that all the piping have been disconnected.



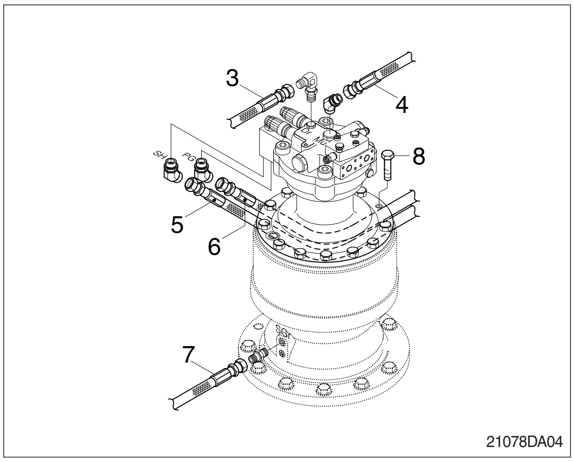
21078DA03

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the swing motor.
① Remove the air vent plug.
② Pour in hydraulic oil until it overflows from the port.
③ Tighten plug lightly.
④ Start the engine, run at low idling and check oil come out from plug.
⑤ Tighten plug fully.

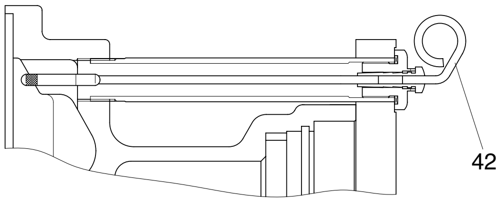
(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.



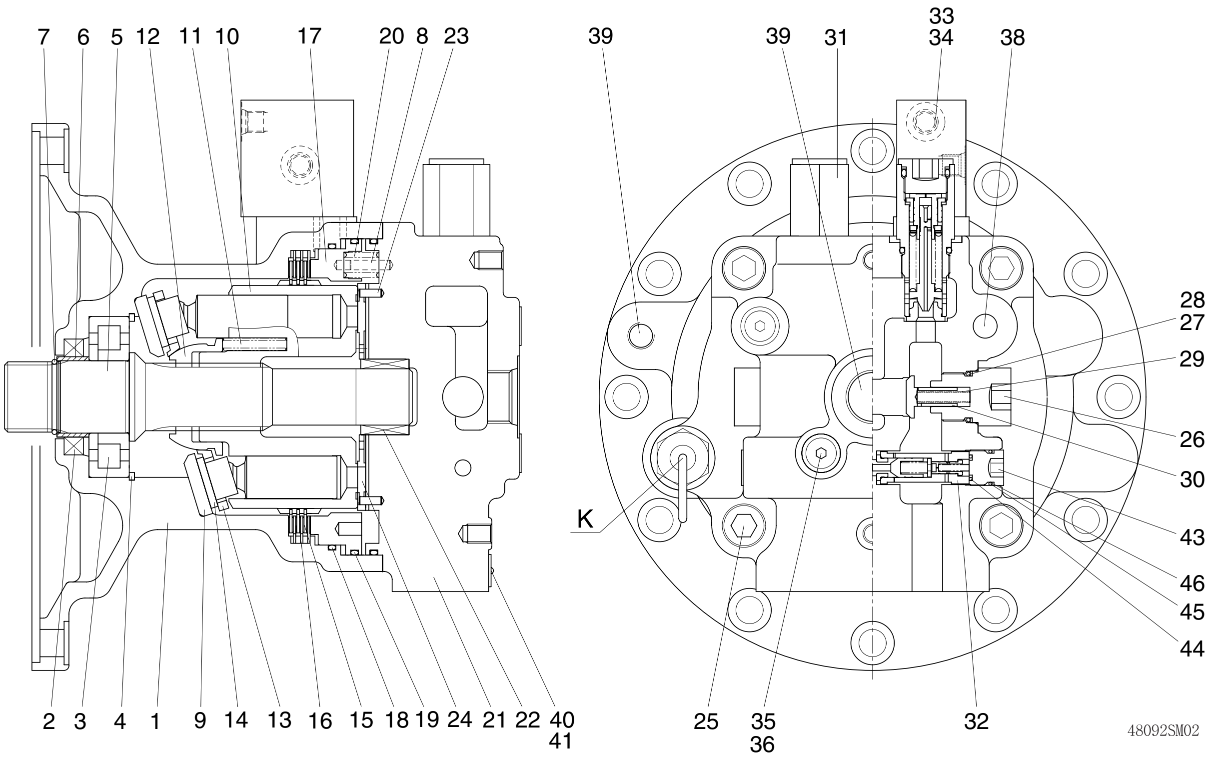
21078DA04

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



DETAIL K

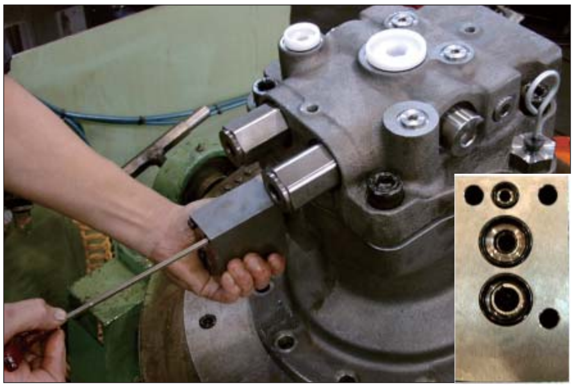


1 Body
2 Oil seal
3 Roller bearing
4 Snap ring
5 Shaft
6 Bushing
7 Stop ring
8 Pin
9 Shoe plate
10 Cylinder block
11 Spring
12 Ball guide
13 Set plate
14 Piston assy
15 Friction plate
16 Plate
17 Brake piston
18 O-ring
19 O-ring
20 Spring
21 Rear cover
22 Needle bearing
23 Pin
24 Valve plate
25 Wrench bolt
26 Plug
27 Back up ring
28 O-ring
29 Spring
30 Check
31 Relief valve
32 Anti-inversion valve
33 Time delay valve
34 Wrench bolt
35 Plug
36 O-ring
37 Plug
38 Plug
39 Plug
40 Name plate
41 Rivet
42 Level gauge
43 Plug
44 O-ring
45 O-ring
46 Back up ring

2) DISASSEMBLING

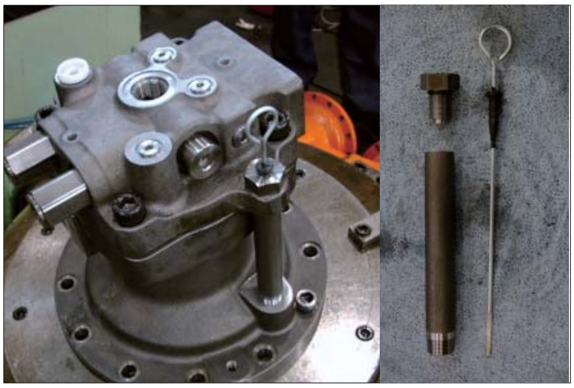
(1) Disassembly the sub of a TURNING AXIS

① Unloosing wrench bolt and disassemble time delay valve assy (35) from rear cover (21).



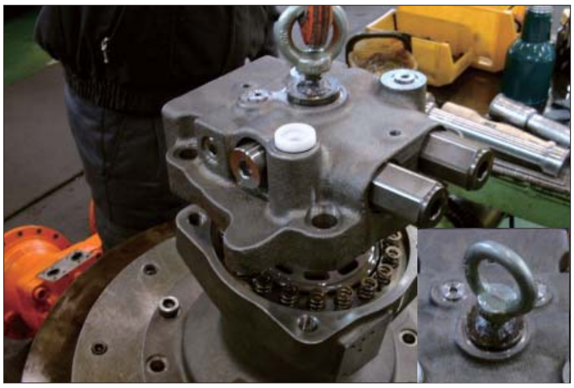
14078SM201/201A

② Disassemble level gauge (42) from body (1).



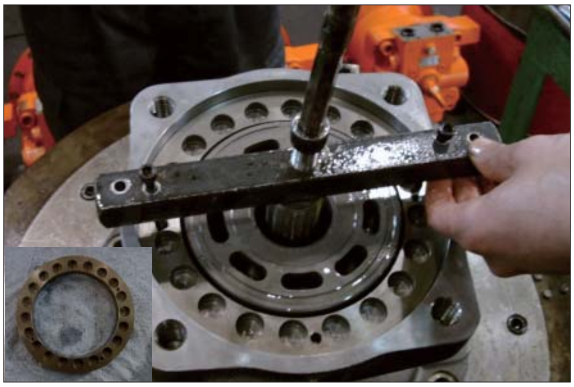
14078SM202/202A

③ Hang rear cover (21) on hoist, unloose wrench bolt (25) and disassemble from body (1).



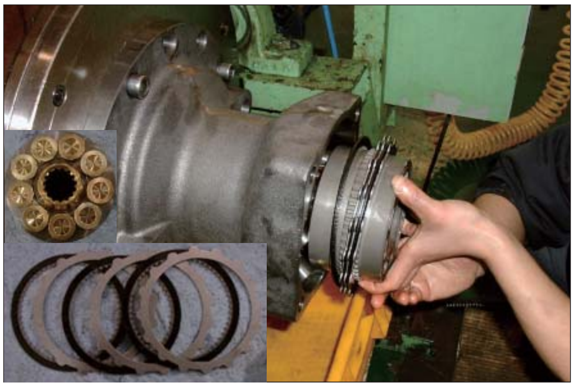
14078SM203/203A

④ Using a jig, disassemble break piston (17) from body (1).



14078SM204/204A

⑤ Disassemble respectively cylinder block assy, fricktion plate (15), plate (16) from body (1).



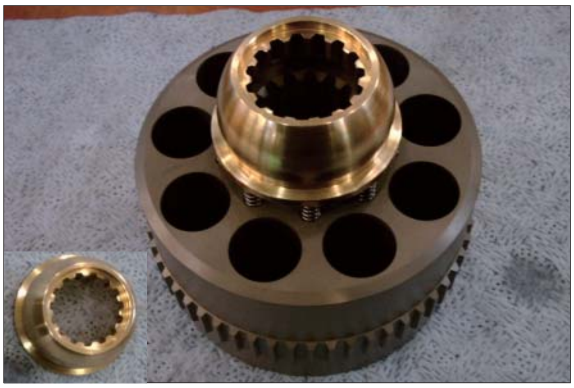
14078SM205/205A/B

(2) Disassemble cylinder block assy sub

① Disassemble pistion assy (14), set plate (13) from cylinder block assy.

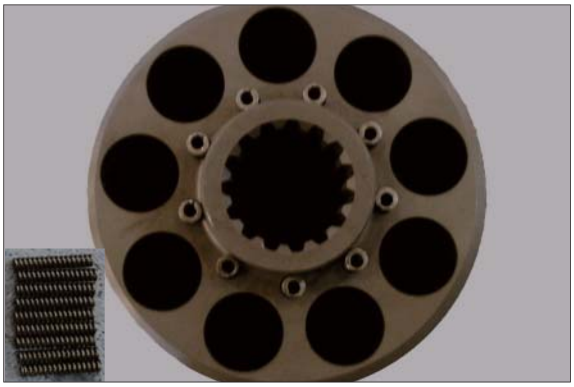
14078SM206/205B

② Disassemble ball guide (12) from cylinder block (10).



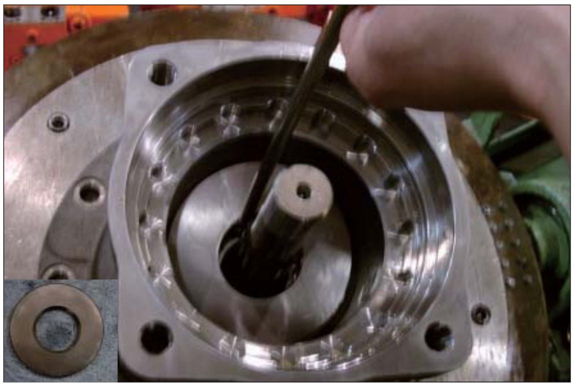
14078SM207/207A

③ Disassemble spring (11) from cylinder block (10).



14078SM208/208A

④ Disassemble shoe plate (9) from body (1).

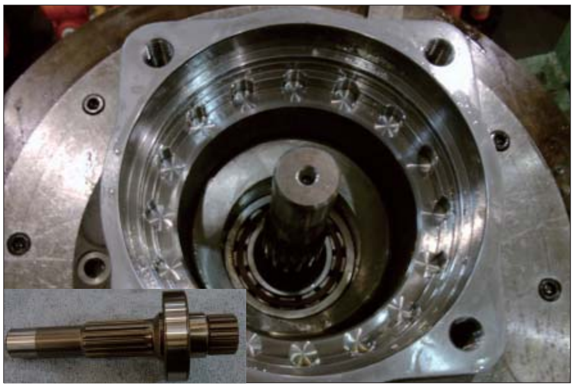


14078SM209/209A

⑤ Using a plier jig, disassemble snap ring (4) from shaft (5).

14078SM210/210A

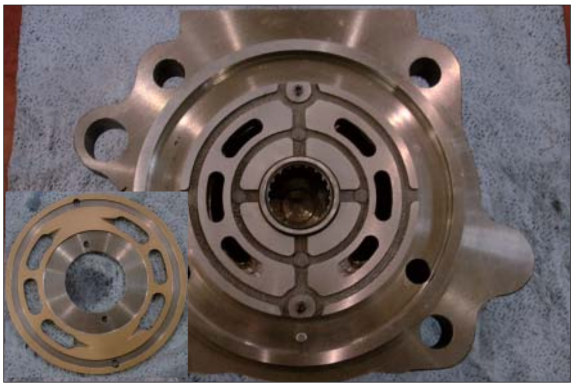
⑥ Disassemble shaft assy from body (1).



14078SM211/211A

(3) Disassemble rear cover assy sub

① Disassemble pin (8, 23), valve plate (24) from rear cover (21).

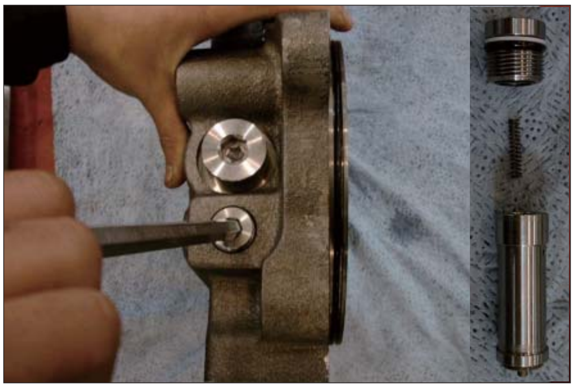


14078SM212/212A

② Using a torque wrench, disassemble relief valve assy (31) 2 set from rear cover (21).

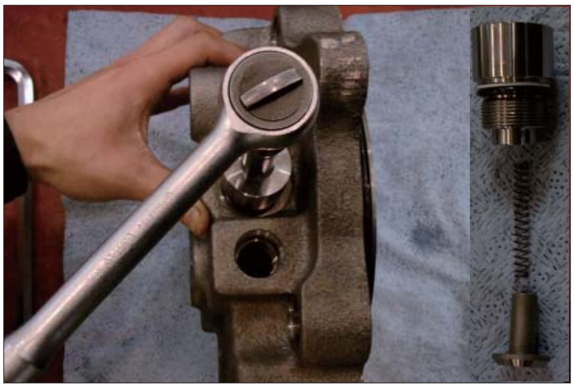
14078SM213/213A

③ After disassembling plug with a L-wrench from rear cover (21), disassemble respectively back up ring, O-ring, O-ring, spring, anti-inversion valve assy (32)



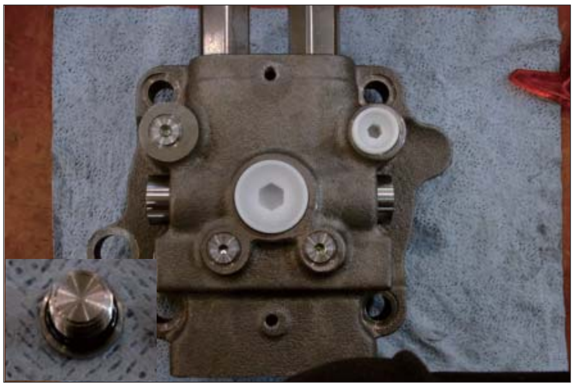
14078SM214/214A

④ Disassemble make up check valve assy with a torque wrench from rear cover (21).



14078SM215/215A

⑤ Disassemble respectively plug (35, 38, 39), with a L-wrench from rear cover (21).

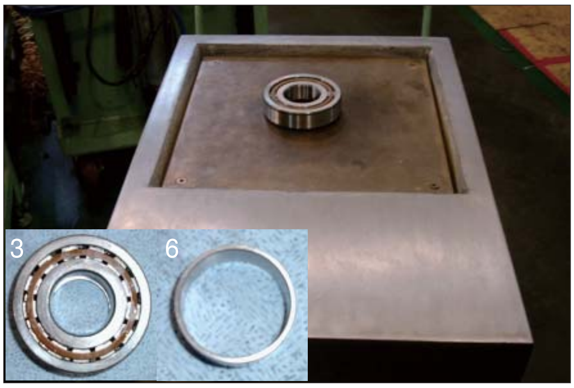


14078SM216/216A

3) ASSEMBLING

(1) Assemble the sub of a turning axls

① Put roller bearing (3), bushing (6) on pre-heater and provide heat to inner wheel (compressing temp : 290˚C for 2minutes)
- · Roller bearing ×1EA
- · Bushing× 1EA

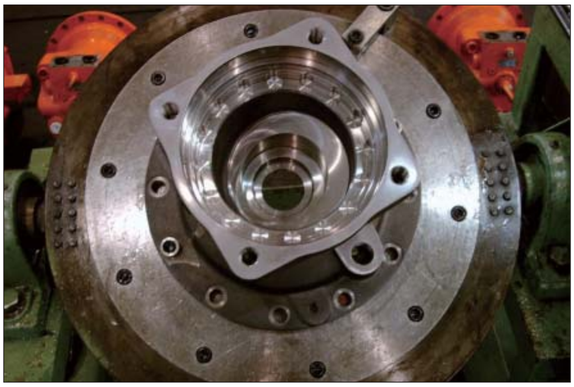


14078SM217/217A/B

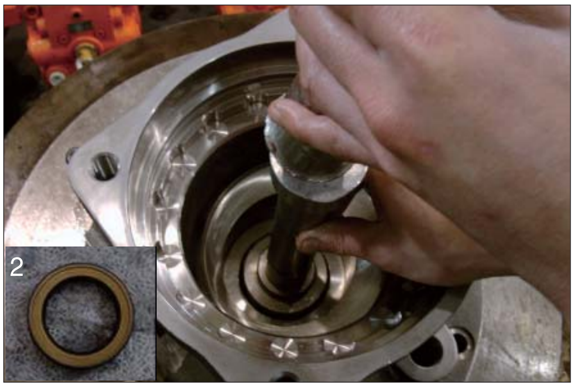
② After assembling and compressing preheated roller bearing (3), bushing (6) into shaft (5).
- · Stop ring ×1EA
- · Shaft× 1EA

14078SM218/218A/B

③ Put body (1) on a assembling jig, fix it with bolts to prohibit moving.

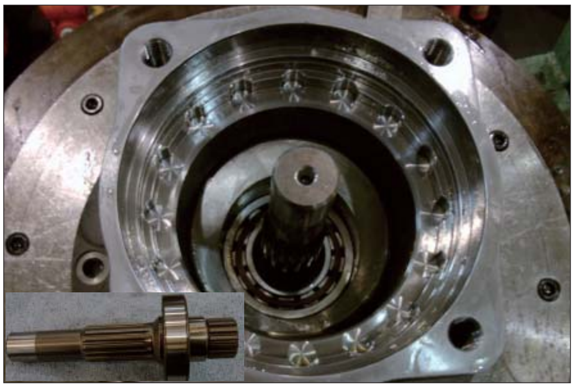

14078SM219

④ Using a compressing tool and steel stick, assemble oil seal (2) into body (1).
  · Oil seal ×1EA



14078SM220/220A

⑤ Insert above shaft sub into body (1) and assemble it with a steel stick.

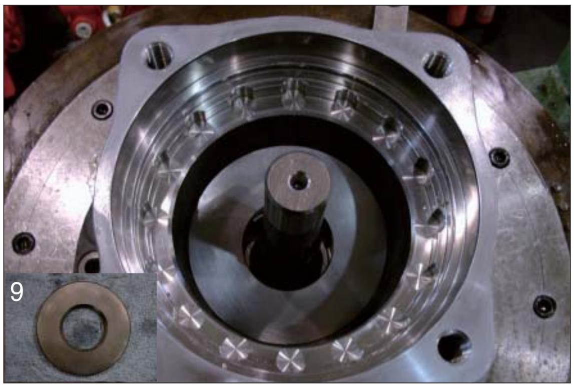


14078SM211/211A

⑥ Fix snap ring (4) to shaft with a plier jig.
  · Snap ring ×1EA

14078SM210/210A

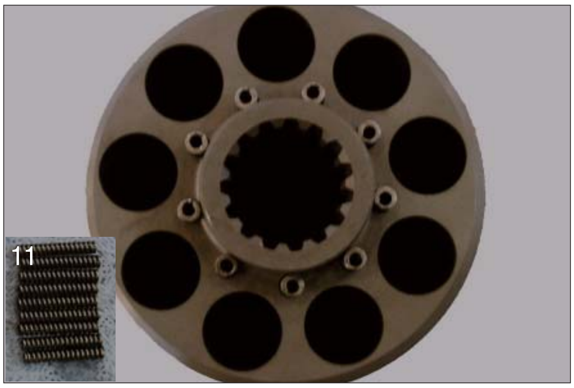
⑦ Spread grease on shoe plate (9) and assemble on the body.
  · Shoe plate ×1EA



14078SM222/209A

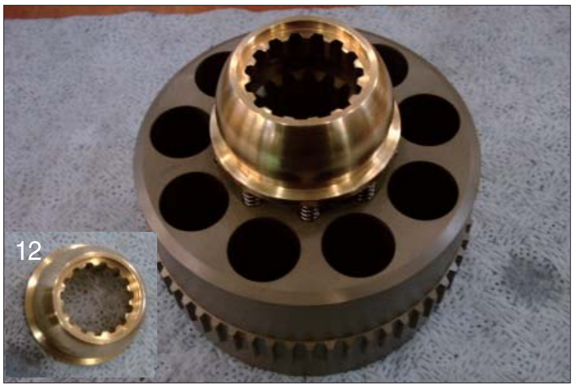
(2) Assemble the sub of cylinder block assy

① Assemble spring (11) 9 set into cylinder block (10).
  · Spring ×9EA



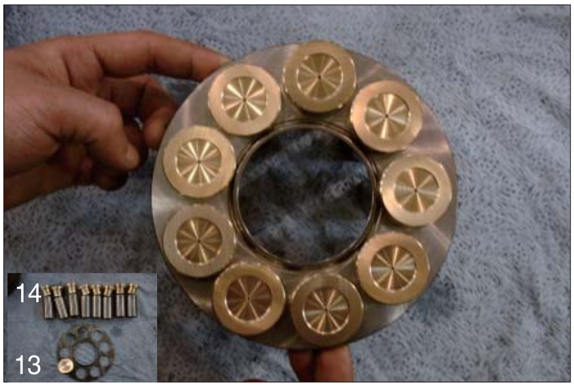
14078SM208/208A

② Assemble ball guide (12) into cylinder.
  · Ball guide ×1EA



14078SM207/207A

③ Assemble piston assy (14) 9 set into set plate (13).
  · Piston assy ×9EA
  · SET plate ×1EA

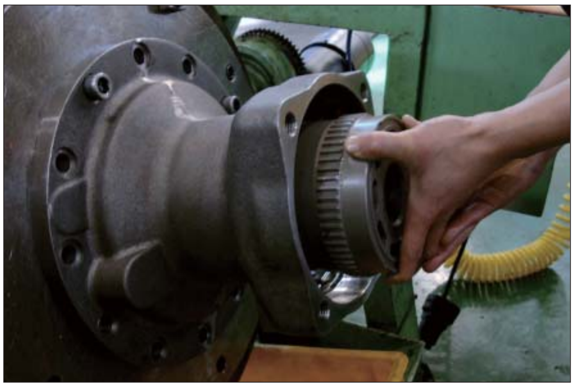


14078SM223/223A

④ Assemble above item ② and ③.

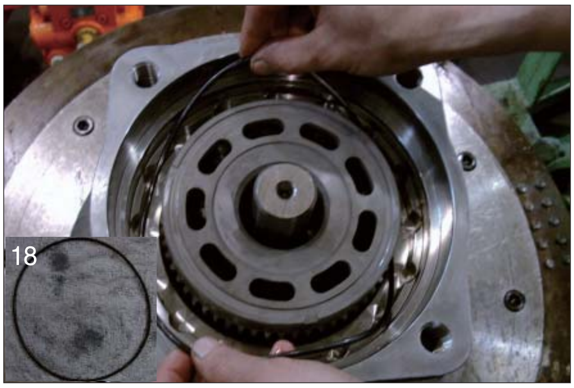
14078SM224

⑤ Assemble cylinder block assy into body (1).



14078SM225

⑥ Assemble O-ring (18) into body (1).
· O-ring ×1EA



14078SM226/226A

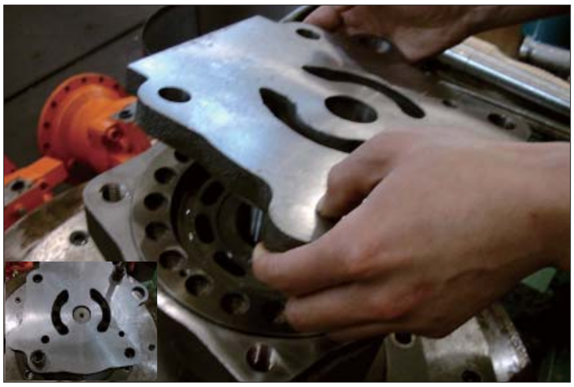
⑦ Assemble 3 set of plate (16), friction plate (15) respectively into body.
· Plate ×3EA
· Friction plate ×3EA

14078SM227/205A

⑧ Assemble O-ring (19) into break piston (17).
· O-ring ×2EA

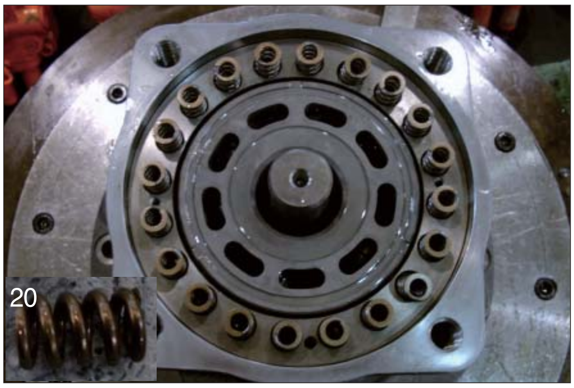
14078SM228/226A

⑨ Insert break piston assy into body (1) and compress it with a jig and hammer.



14078SM229/229A

⑩ Assemble spring (20) (20EA) into break piston (17).
· Spring ×20EA



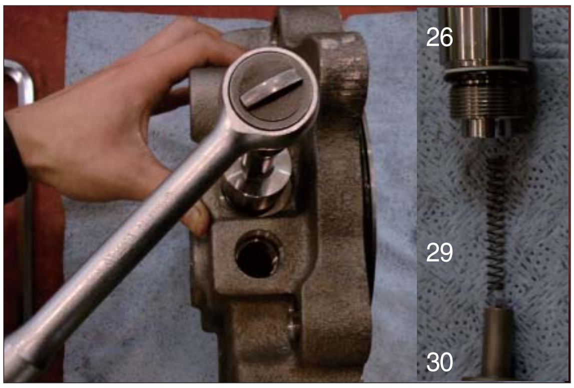
14078SM230/230A

(3) Assemble the sub of rear cover assy sub

① Assemble the sub of make up check valve assy.
Assemble O-ring (28), back up ring (27) into plug (26) with a O-ring assembling jig.
· Plug×1EA
· Back up ring×1EA
· O-ring×1EA

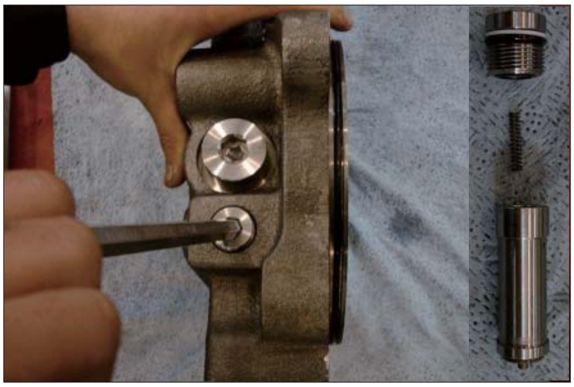
14078SM231/231A/B

② Assemble respectively make up check valve assy spring (29), check (30), plug (26) into rear cover (21) after then screw it torque wrench.
· Make up check sub ×2set
· Spring ×2EA
· Check ×3EA

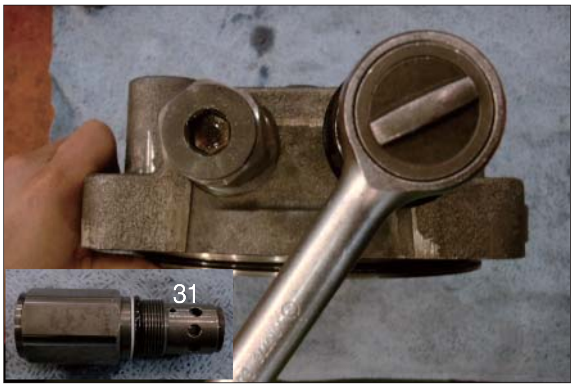


14078SM215/215A

③ Assemble respectively plug (43), back up ring, O-ring, O-ring, spring, anti-rotating valve assy (32) into rear cover (21).
(Bilateral symmetry assembling)
· Anti-Inversion v/v assy × 2set
· O-ring (P12) × 2EA
· O-ring (P18) × 2EA
· Back up ring (P18) × 2EA

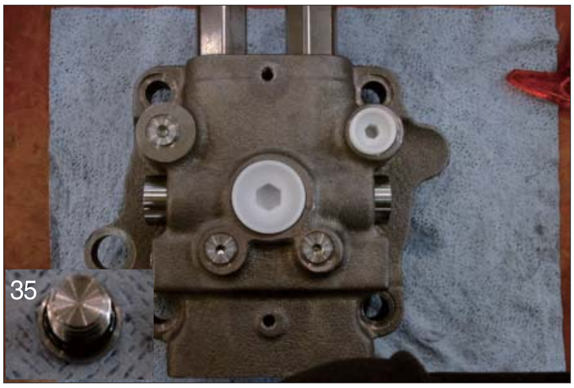

14078SM214/214A

④ Assemble relief valve assy (31) 2set into rear cover (21) with a torque wrench.
(Bilateral symmetry assembling)



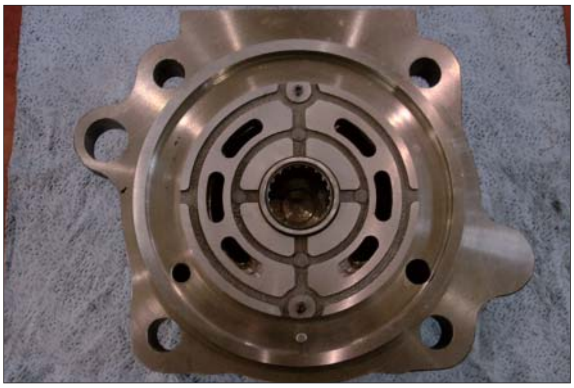
14078SM213/213A

⑤ Assemble plug (35), plug (37, 38) into rear cover (21) with a L-wrench.
* Plug × 3EA (PF1/4)

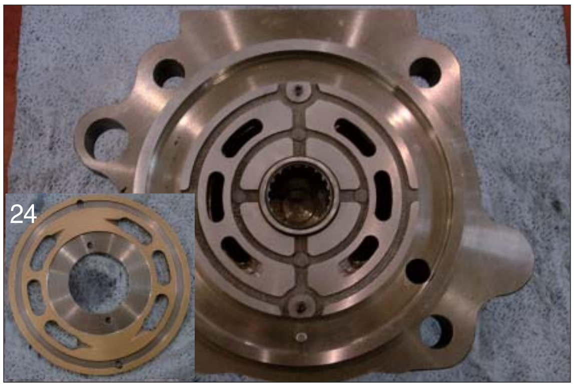


14078SM216/216A

⑥ After assembling needle bearing (22) into rear cover (21), with a hammer assemble pin (8, 23).
* Pin × 1EA
* Pin × 2EA

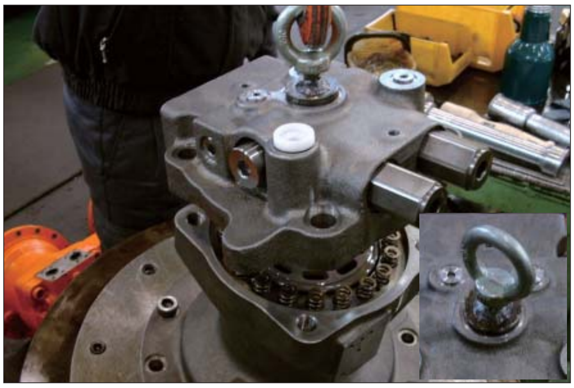

14078SM212

⑦ Spreading grease on valve plate (24), assemble into rear cover (21).
· Valve plate × 1EA



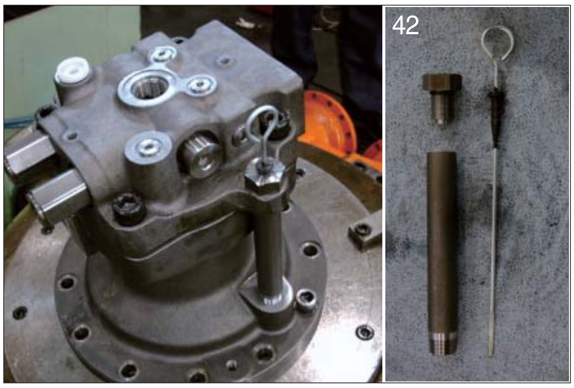
14078SM212/212A

⑧ Lift up rear cover assy on body (1) by a crane and assemble it with a wrench bolt (25).



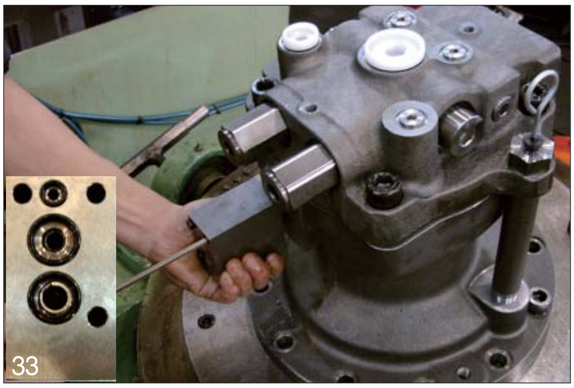
14078SM203/203A

⑨ Assemble level gauge (42) into body (1).



14078SM202/202A

⑩ Assemble time delay valve assy (33) into rear cover (21) with a wrench bolt (34).



14078SM01/201A

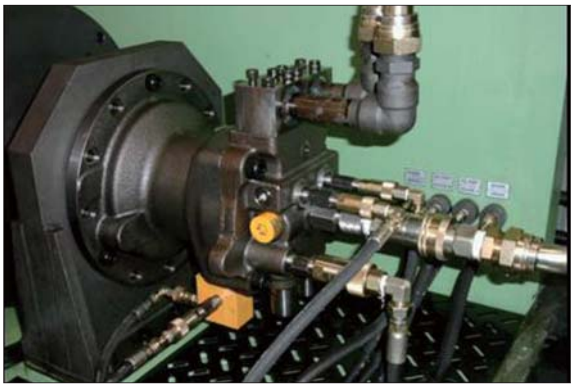
(4) Air pressing test
Be sure of leakage, after press air into assembled motor


14078SM232

(5) Leakage check
After cleaning motor by color check No.1, paint No.3 and be sure of leakage.


14078SM233/233A

(6) Mount test bench
Mounting motor test bench, test the availability of each part.


220078SM14

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

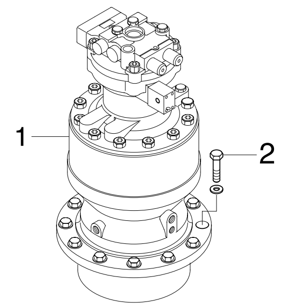

13031GE18

(1) Remove the swing motor assembly.
For details, see removal of swing motor assembly.

(2) Sling reduction gear assembly (1) and remove mounting bolts (2).

(3) Remove the reduction gear assembly.
· Reduction gear device weight : 180 kgf · m
(396 lbf · ft)

2) INSTALL

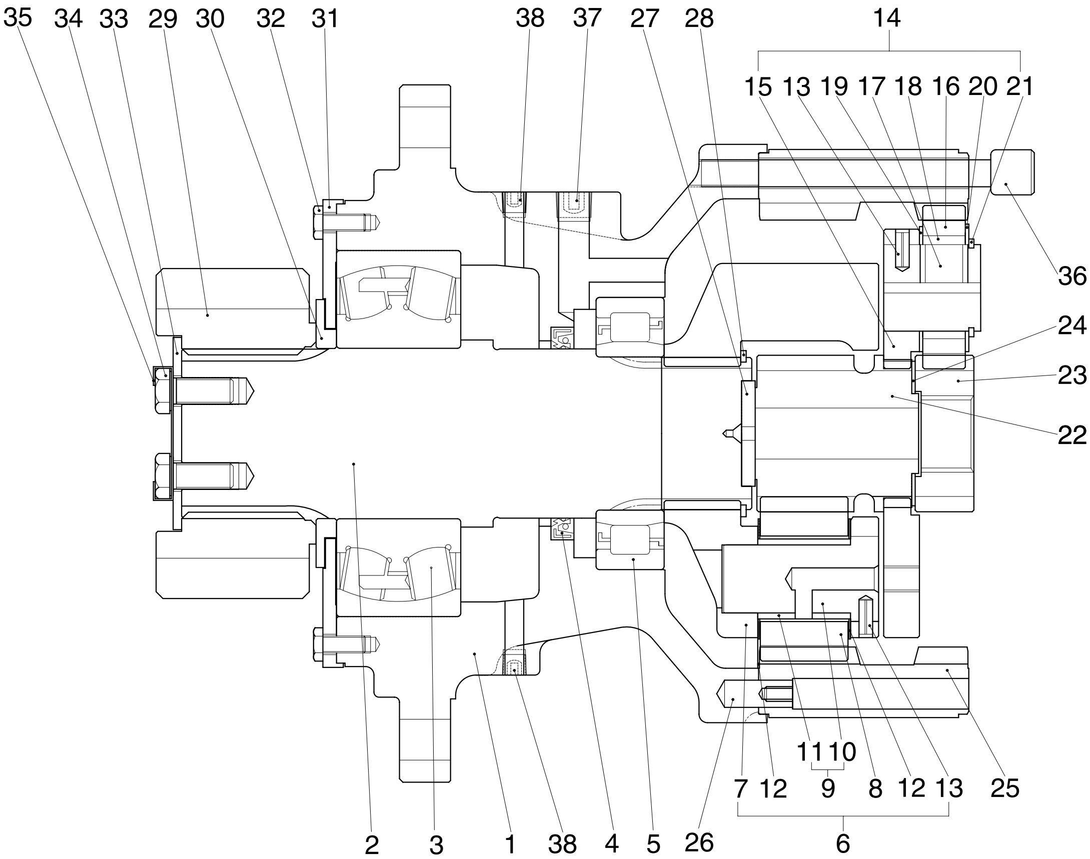


21098SM11

(1) Carry out installation in the reverse order to removal.
· Tightening torque : 58.4±6.4 kgf · m
(422±46.3 lbf · ft)

4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



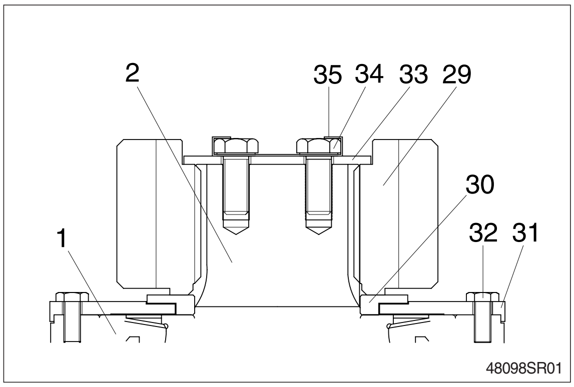
48092SM03

1	Casing	14	Carrier assy 1	27	Thrust plate 3
2	Drive shaft	15	Carrier 1	28	Stop ring
3	Roller bearing	16	Planet gear 1	29	Pinion gear
4	Oil seal	17	Pin 1	30	Spacer
5	Roller bearing	18	Needle cage	31	Cover plate
6	Carrier assy 2	19	Side plate 1	32	Hexagon bolt
7	Carrier 2	20	Side plate 2	33	Lock plate
8	Planet gear 2	21	Stop ring	34	Hexagon bolt
9	Pin assy 2	22	Sun gear 2	35	Lock washer
10	Pin 2	23	Sun gear 1	36	Socket bolt
11	Bush 2	24	Side plate 3	37	Plug
12	Thrust washer	25	Ring gear	38	Plug
13	Spring pin	26	Knock pin		

2) DISASSEMBLY

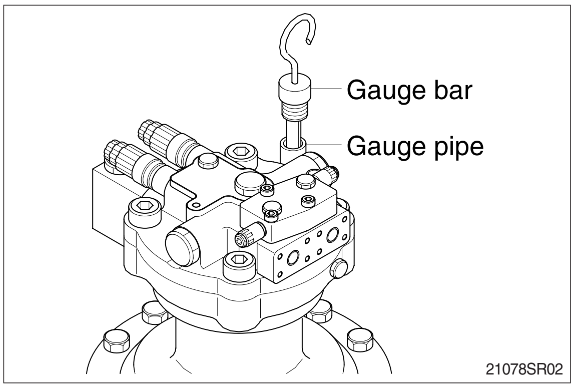
(1) Spread off the 4 corners of lock washer (35) with a tool.

※ Do not reuse lock washer (35).
Loosen the bolts (34) and then remove lock washer (35) and lock plate (33) from the pinion gear (29).
Remove pinion gear (29) and spacer (30) from the drive shaft (2).
Remove cover plate (31) from the casing (1) by loosening the hexagon bolts (32).

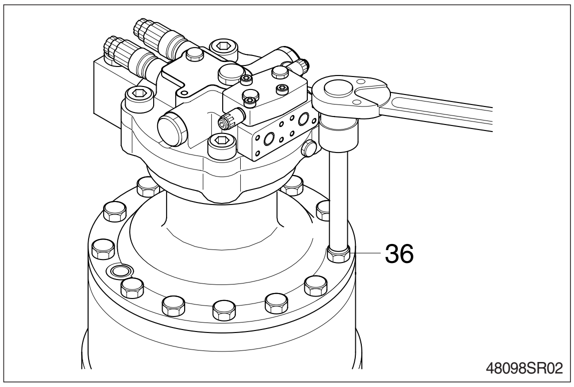


(2) Remove gauge bar and gauge pipe from the swing motor casing.

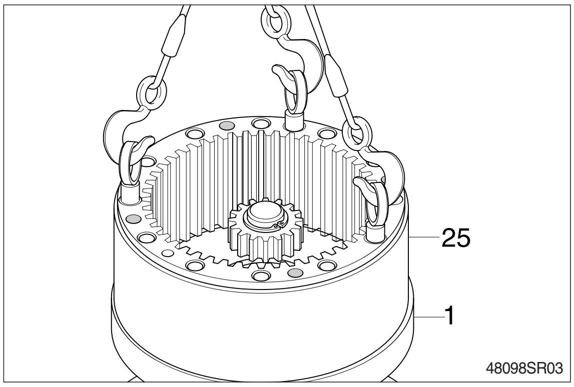
※ Pour the gear oil out of reduction gear into the clean bowl to check out the friction decrease.



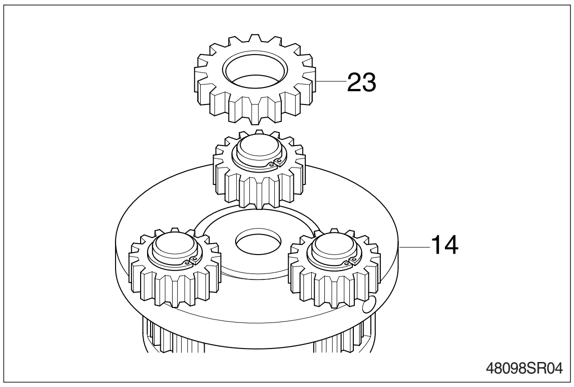
(3) Loosen the socket bolts (36) to separate swing motor from reduction gear.



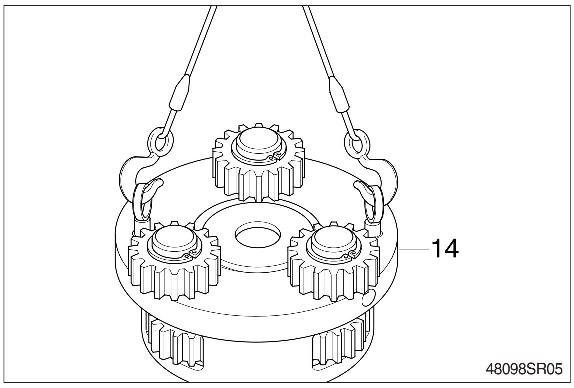
(4) Tighten 3 M16 eye bolts to the ring gear (25) and then lift the ring gear (25) out of the casing (1).



(5) Remove sun gear1 (23).



(6) Tighten two M10 eye bolts to carrier1 (14) and lift up and remove carrier1 (14) as subassembly.



(7) Disassembling carrier1 (14) assembly.

① Remove stop ring (21).

② Remove side plate2 (20), planet gear1 (16), needle cage (18), side plate1 (19) and side plate3 (24) from the carrier.

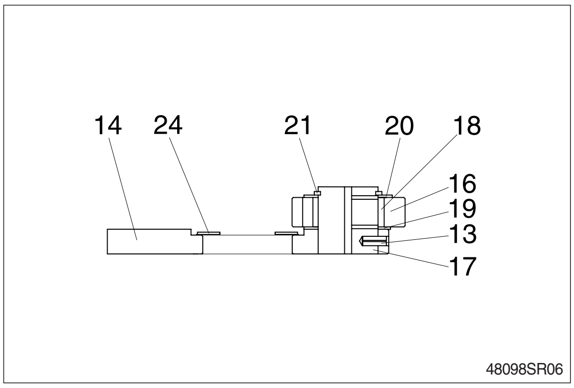
③ Using M8 solid drill, crush spring pin (13) so that the pin1 (17) can be removed by hammering.

④ Remove side plate3 (24) from carrier1 (14).

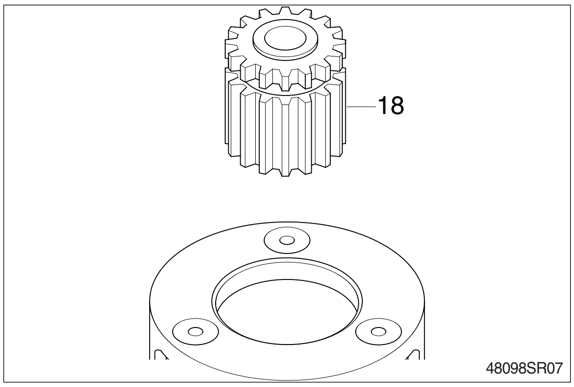
※ Do not reuse spring pin (13).

※ Do not remove pin1 (17), carrier1 (14) and spring pin (13) but in case of replacement.

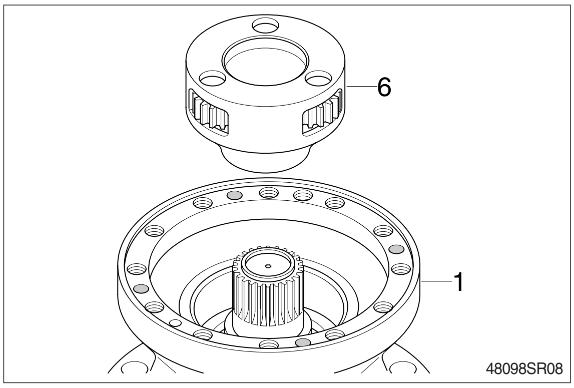
※ Put matching marks on the planet gear1 (16) and the pin1 (38) for easy reassembly.



(8) Remove sun gear2 (22).



(9) Remove carrier2 (6) assembly from casing (1).



(10) Disassembling carrier 2 (6) assembly

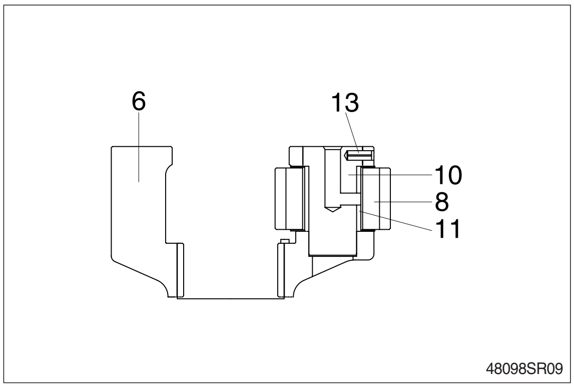
① Using M8 solid drill, crush spring pin (13) so that the pin & bushing (10) can be removed.

※ Do not reuse spring pin (13).

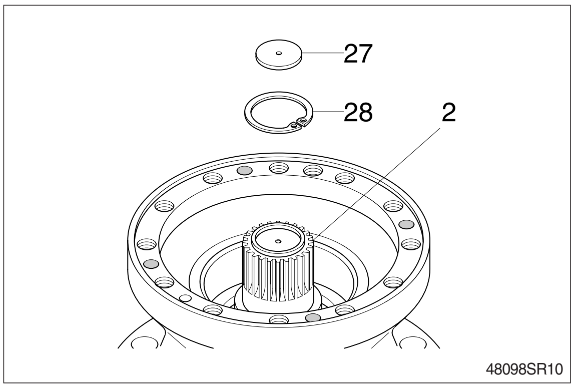
② Remove pin & bushing (10), planet gear 2 (8) and bushing 2 (11) from the carrier 2 (9).

※ Put matching marks on the planet gear 2 (8) and the pin & bushing (10) for easy reassembly.

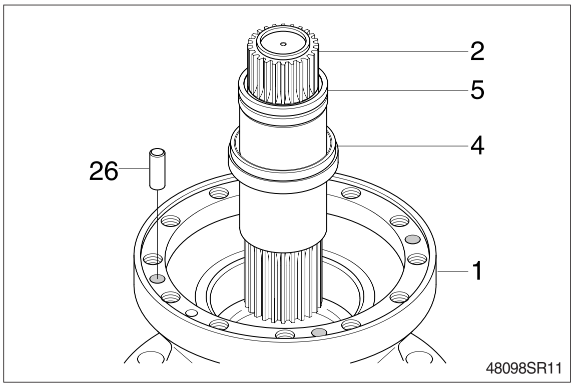
※ Do not disassemble pin & bushing (10), carrier 2 (6) and spring pin (13) but in case of replacement.



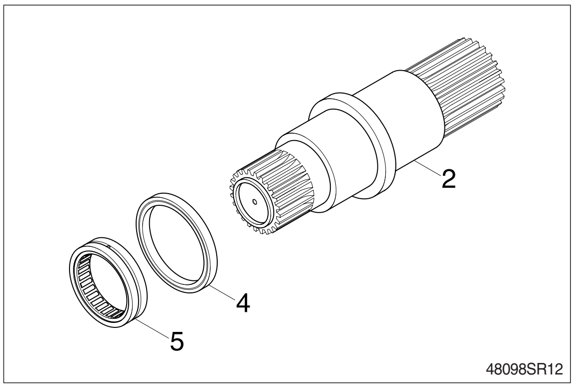
(11) Remove thrust plate (27) and stop ring (28) from the drive shaft (2).



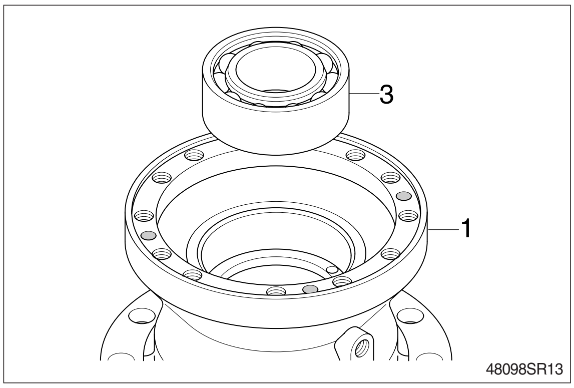
(12) Remove drive shaft (2) with roller bearing (5) and oil seal (4) assembled.
Remove knock pin (26) from the casing (1).



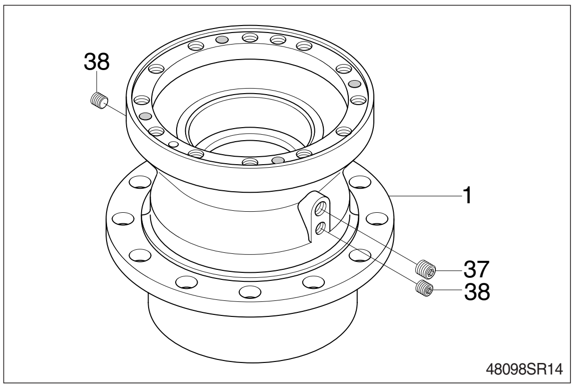
(13) Remove roller bearing (5) and oil seal (4) from the drive shaft (2).
※ Do not reuse oil seal (4) once removed.



(14) Using the bearing disassembly tool, remove roller bearing (3).

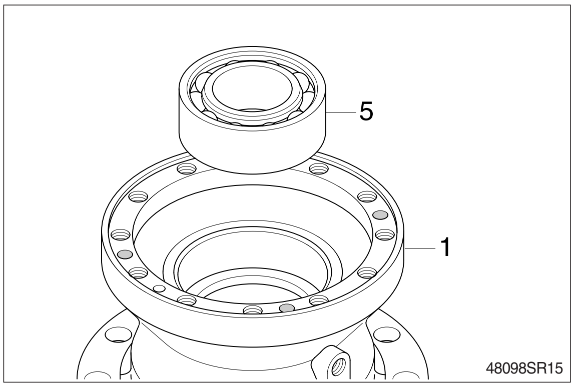


(15) Remove plugs (37, 38) from the casing (1).

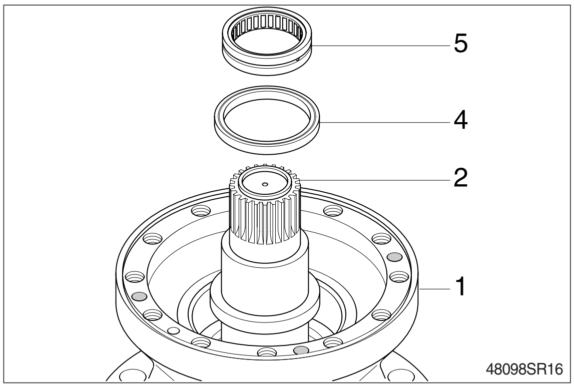


3) ASSEMBLY

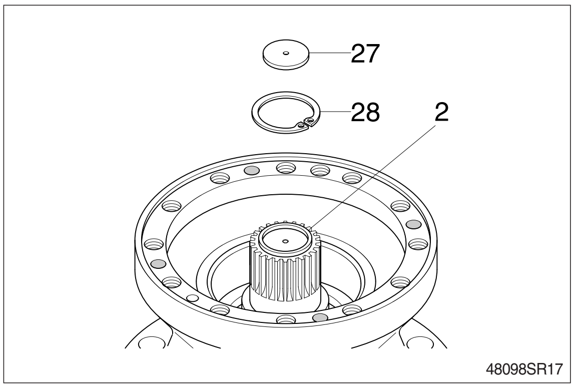
(1) Assemble roller bearing (3) inside the casing (1).



(2) Assemble the drive shaft (2) into the casing (1) and then install oil seal (4) and roller bearing (5).



(3) Install stop ring (28) and thrust plate (27) on top of drive shaft (2).



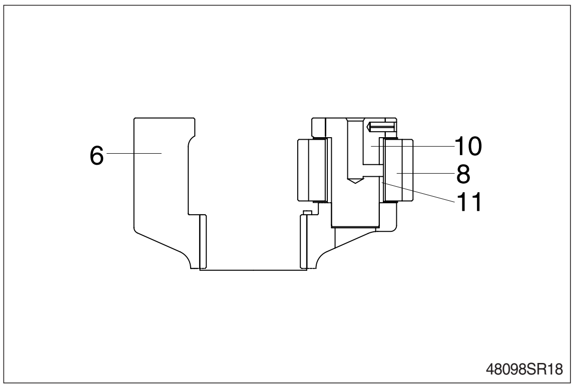
(4) Assembling carrier2 (6) assembly.

① Install bushing 2 (11) inside the planet gear 2 (8) and then assemble them to the carrier 2 (6).

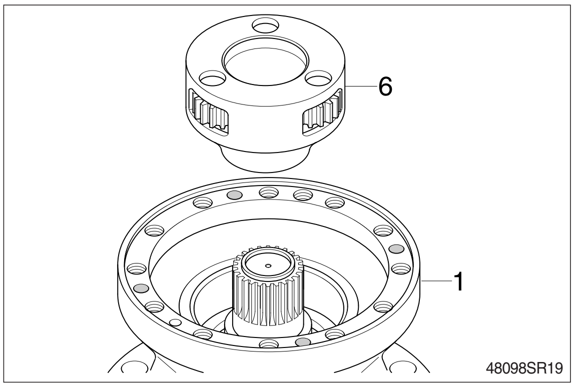
② Assemble the pin & bushing (10) to the carrier 2 (6) and then press the spring pin (13) by hammering.

③ Punch 2 points of the spring pin (13) lip.

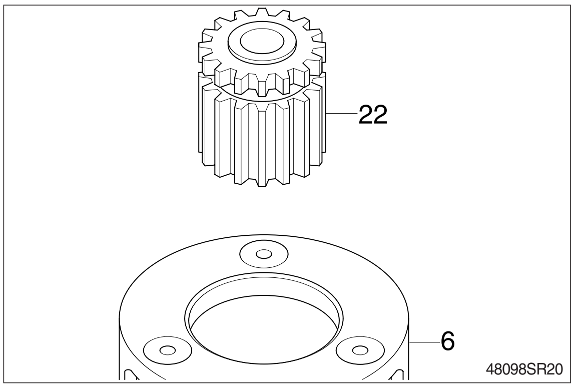
※ Take care not to mistake the matching marks of each part.



(5) Assemble carrier 2 (6) assembly correctly to the drive shaft (2).



(6) Assemble sun gear2 (22) to the center of the carrier2 (6) assembly.



(7) Assembling carrier1 (14) assembly.

① Assemble the pin1 (38) to the carrier1 (14) and then press the spring pin (13) by hammering.

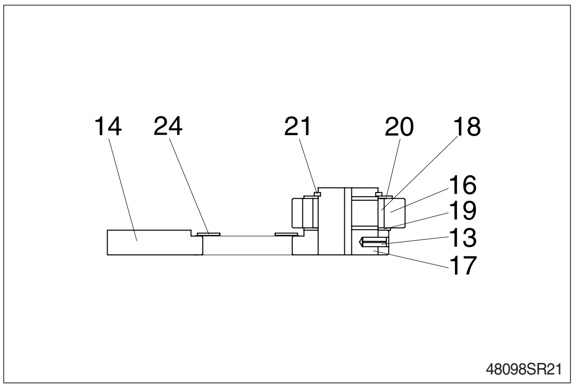
② Punch 2 points of the spring pin's (13) lip.

③ Install side plate3 (24) onto the center of carrier1 (14).

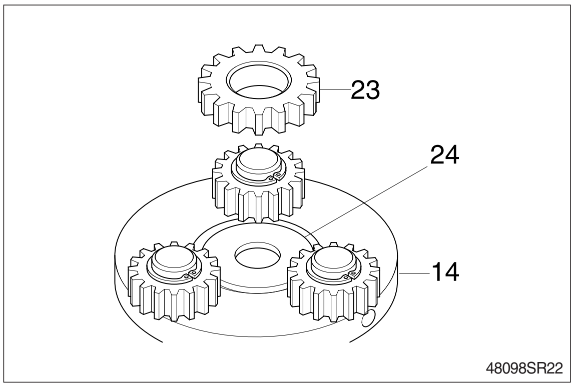
④ Install needle cage (18) into the planet gear1 (16).

⑤ Assemble side plate (19), planet gear1 (16), side plate2 (20) and then stop ring (21) to the pin1 (17).

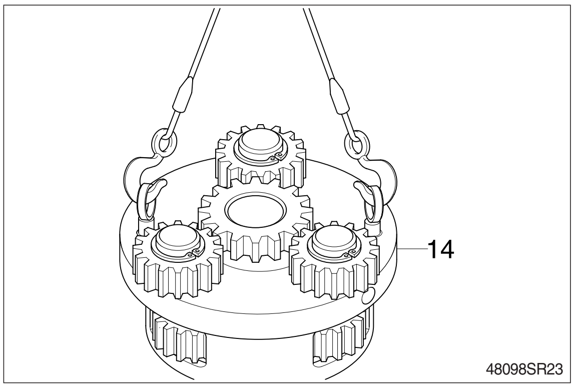
※ Take care not to mistake the matching marks of each part.



(8) Install sun gear1 (23) onto the side plate3 (24).



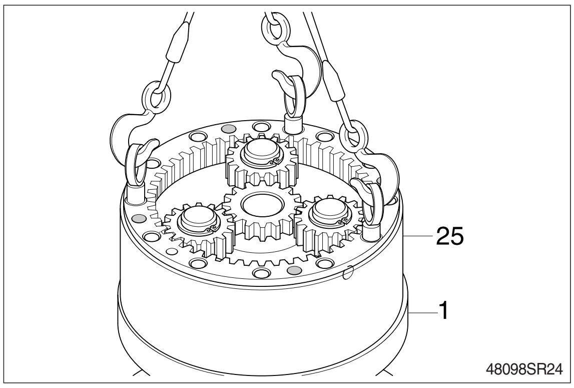
(9) Assemble carrier 1 (14) assembly onto the carrier2 assembly.



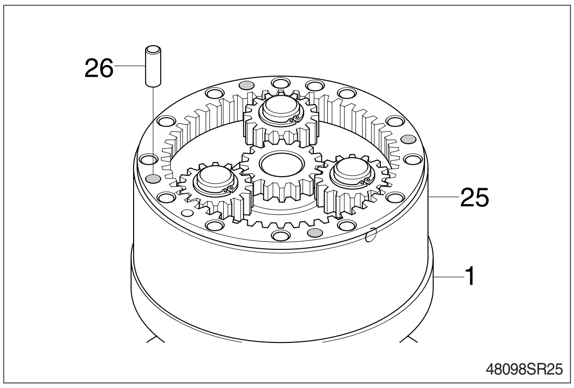
(10) Apply loctite to the tapped holes of casing (1).

(11) Tighten 3 M16 eye bolts to the ring gear (25) and lift up and then assemble it onto the casing (1).

※ Don't fail to coincide the knock pin (26) holes.



(12) Hammer 4 knock pins (26) around the ring gear (25).

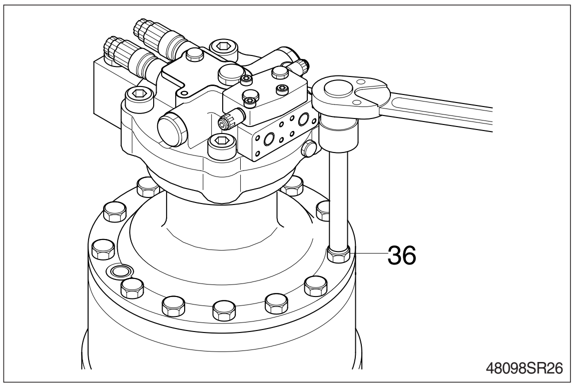


(13) Apply loctite to the tapped holes of the ring gear (25) and then mount swing motor onto the ring gear (25).

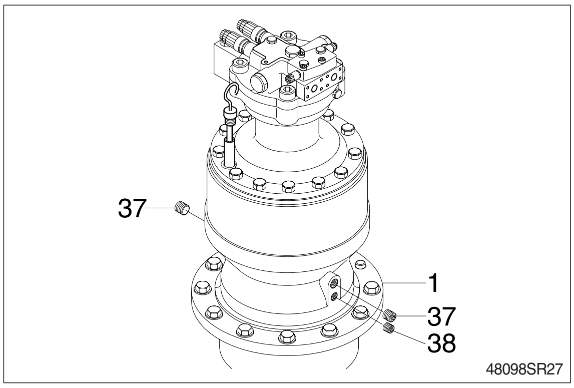
※ Don't fail to coincide the gauge bar (42) hole.

(14) Tighten socket bolts (36) around the swing motor assembly.

· Tightening torque : 24 kgf · m (173 lbf · ft)

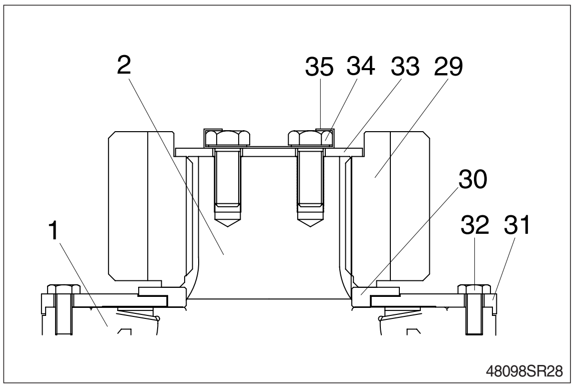


(15) Assemble plugs (37, 38).



(16) Turn the swing motor assembly upside down and assemble cover plate (31) by tightening the hexagon bolts (32).
Install spacer (30) and pinion gear (29) to the drive shaft (2).
Assemble lock plate (33) on the pinion gear (29).
Assemble 2 lock washers (35) on the lock plate (33) with their 2 hole coincided individually to the tapped holes of drive shaft (2).
Tighten hexagon bolts (34) to the drive shaft (2) and then fold all the lock washer (35) corners over the hexagon bolts (34).

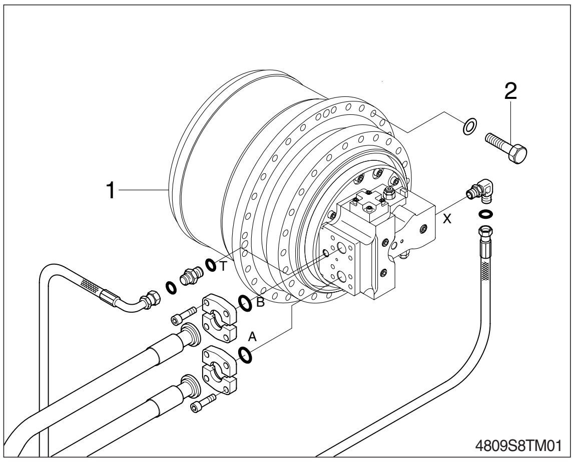
· Tightening torque : 24 kgf · m (173 lbf · ft)



(17) Inject oil into the reduction gear.

GROUP 6 TRAVEL DEVICE

1. REMOVAL AND INSTALL



1) REMOVAL

(1) Swing the work equipment 90° and lower it completely to the ground.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Remove the track shoe assembly.
For details, see removal of track shoe assembly.

(5) Remove the cover.

(6) Remove the hoses.
※ Fit blind plugs to the disconnected hoses.

(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly (1).

(9) Remove the mounting bolts (2), then remove the travel device assembly.
· Weight : 440 kg (970 lb)

2) INSTALL

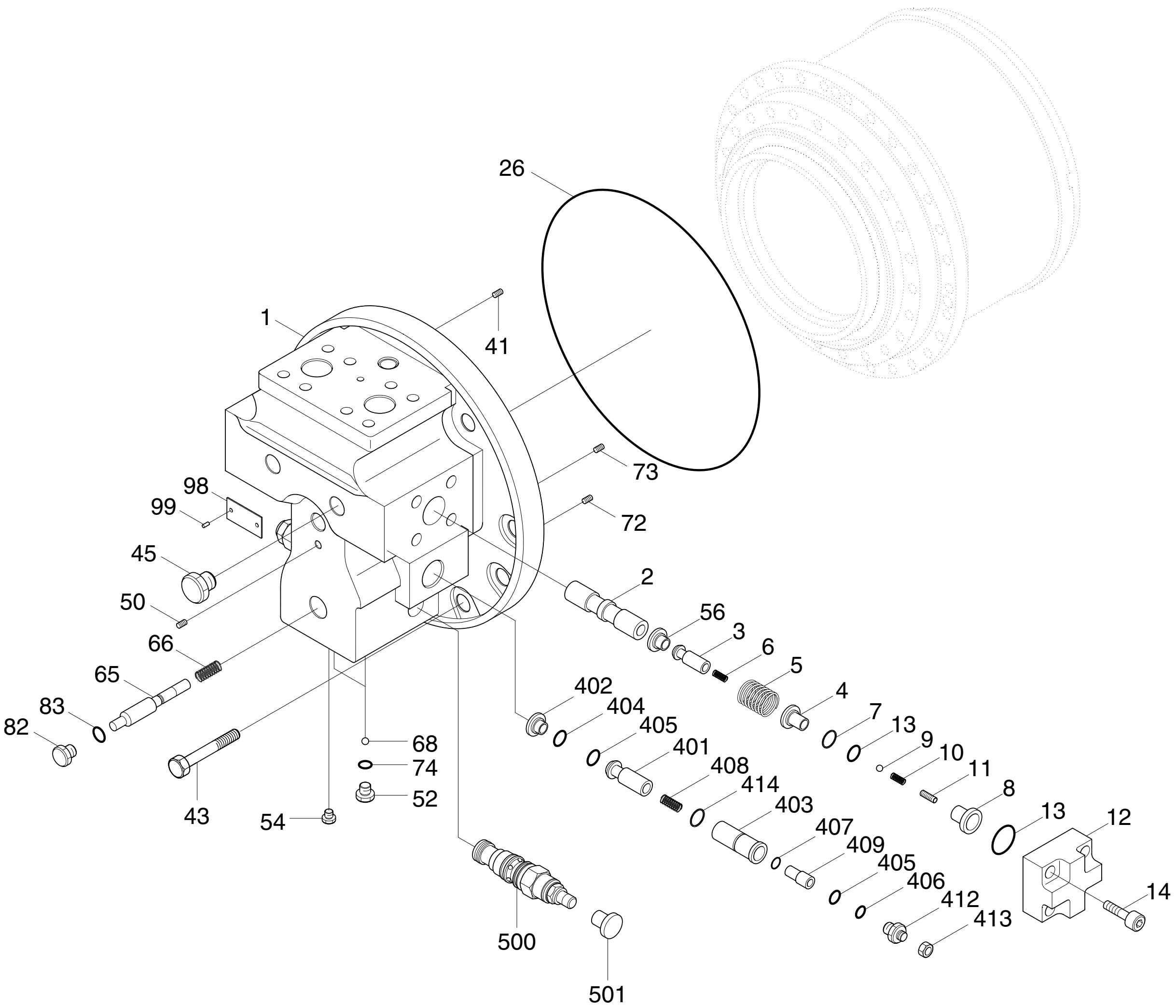
(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the travel motor.
① Remove the air vent plug.
② Pour in hydraulic oil until it overflows from the port.
③ Tighten plug lightly.
④ Start the engine, run at low idling, and check oil come out from plug.
⑤ Tighten plug fully.

(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

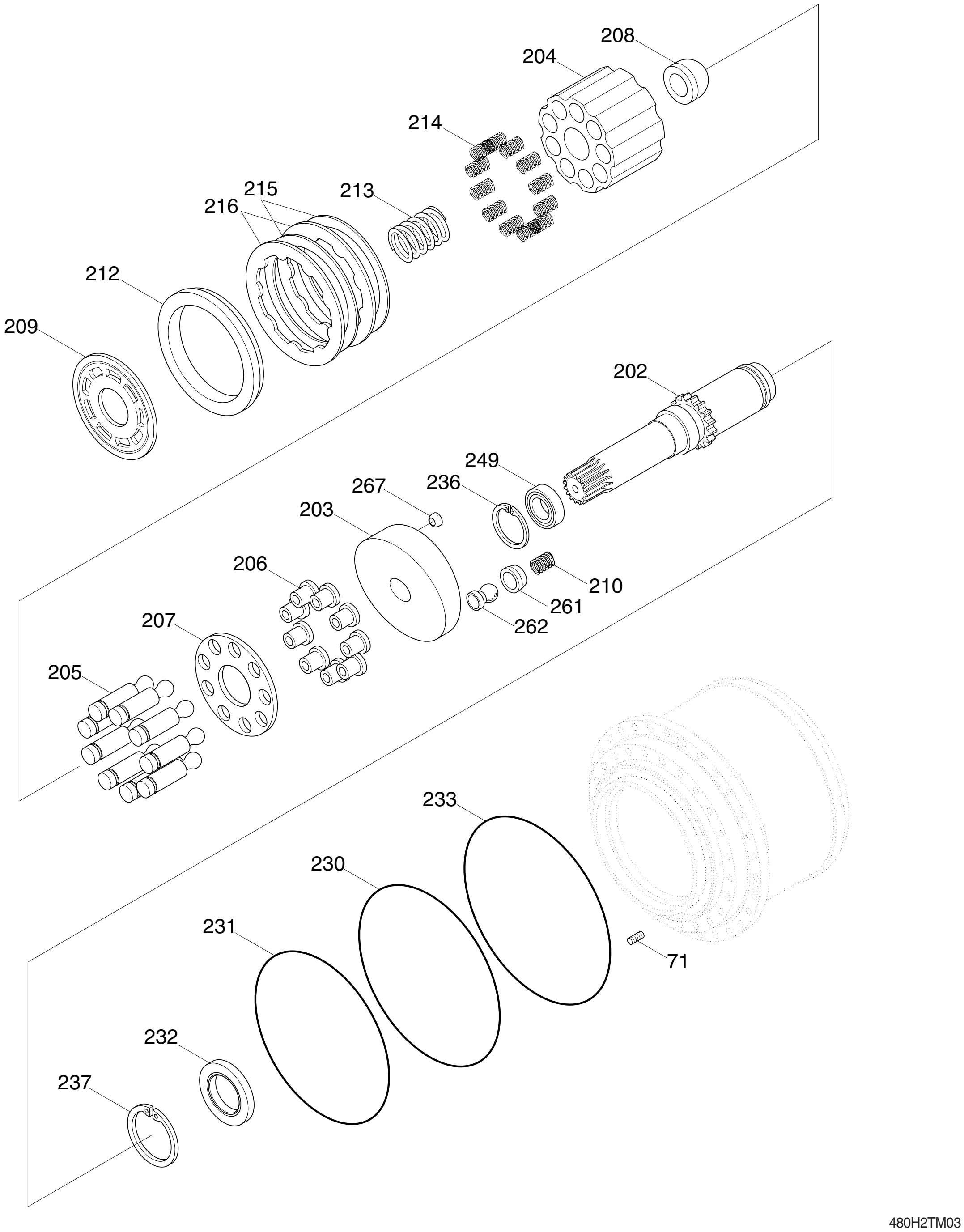
2. TRAVEL MOTOR

1) STRUCTURE (1/2)



1	Rear flange	43	Socket bolt	401	Plunger
2	Spool	45	PT Plug	402	Seat
3	Poppet	50	Needle bearing	403	Body
4	Plug	52	RO Plug	404	Back up ring
5	Check spring	54	Plug	405	O-ring
6	Main spring	56	Plug	406	O-ring
7	Washer	65	Spool	407	Retainer
8	Seat	66	Spring	408	Spring
9	Steel ball	68	Steel ball	409	Piston
10	Spring	72	Orifice	412	Adjust plug
11	Screw	73	Orifice	413	Lock nut
12	Cover	74	O-ring	414	Shim
13	O-ring	82	Plug	500	Reducing valve
14	Socket bolt	83	O-ring	501	Cover
26	O-ring	98	Name plate		
41	Valve plate pin	99	Rivet screw		

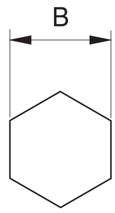
STRUCTURE (2/2)



71	Orifice	209	Timing plate	231	O-ring
202	Drive shaft	210	Spring	232	Oil seal
203	Swash plate	212	Piston	233	O-ring
204	Cylinder block	213	Spring	236	Snap ring
205	Piston	214	Spring	237	Snap ring
206	Shoe	215	Friction plate	249	Roller bearing
207	Retainer plate	216	Mating plate	267	Pivot
208	Thrust ball	230	O-ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

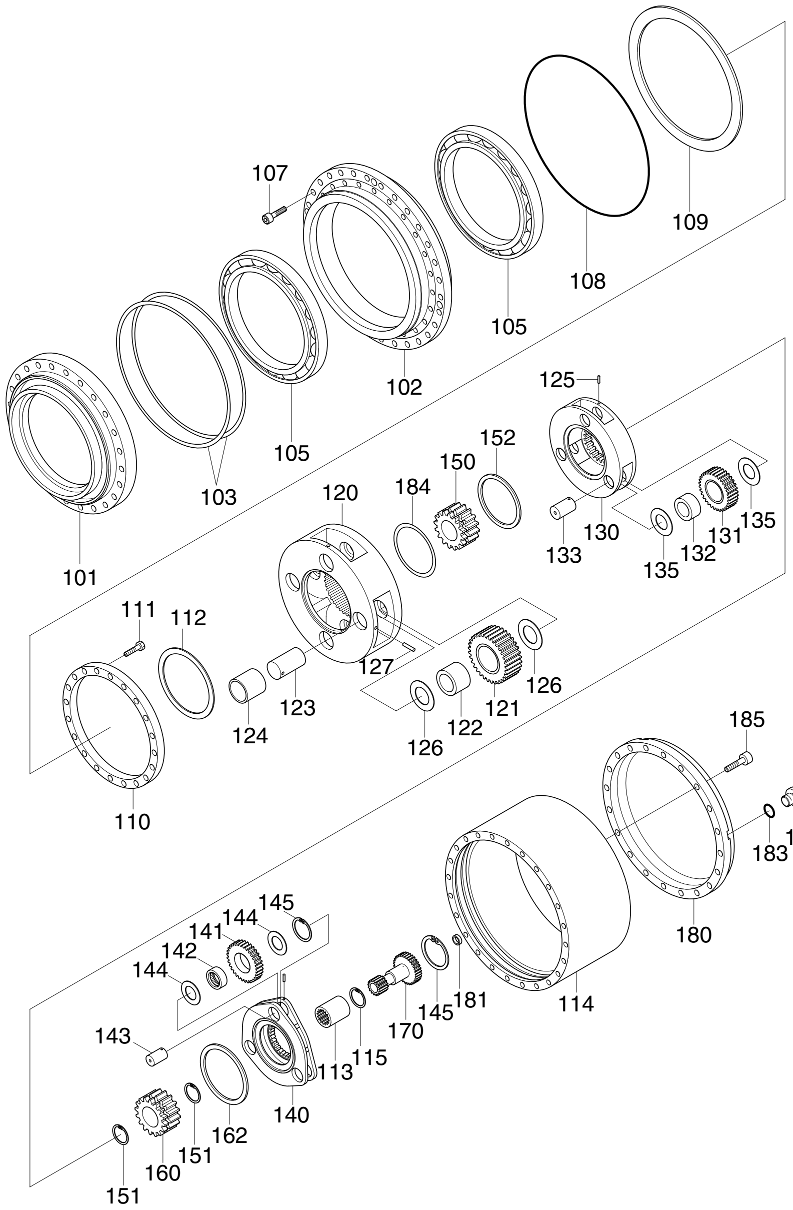
Tool name	Remark	
Allen wrench	2	
	4	
	6	
	10	
	17	
Socket for socket wrench, spanner	19	
	22.4	
	41	
Torque wrench	Capable of tightening with the specified torques.	
Plier (For hole, TPR-90)	For snap ring (236)	
Plier (For shaft)	For snap ring (237)	
(-) Driver	-	
Plastic hammer	Wooden hammer allowed. Nominal 1 or so	
Steel rod approx	$7 \times 7 \times 200$mm, Bearing (50, 249)	
Monkey wrench	-	
Oil seal inserting jig	-	
Bearing plier	-	
Seal tape	-	

(2) Tightening torque

Part name	Item	Size	Torque		Wrench size	
			kgf · m	lbf · ft	in	mm
Socket bolt	14	M12×45	10	72.3	0.39	10
Socket bolt	43	M20×45	44	318	0.67	17
Plug	54	NPTF 1/16	1.0	72.3	0.16	4
Plug	45	PT 1/2	2.2	15.9	0.24	6
VP Plug	56	PF 1/4	3.7	26.8	0.75	19
Plug	52	PF 1/4	3.7	26.8	0.24	6
Plug	82	PF 1/2	11	79.6	0.39	10
Orifice	71	M4×0.7	0.36	2.6	0.08	2

3. TRAVEL REDUCTION GEAR

1) STRUCTURE

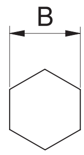


480H2TM04

101	Spindle	122	Needle bearing	144	Plate
102	Hub	123	Bushing	145	Snap ring
103	Seat	124	Shaft No. 3	150	Sun gear No.3
105	Angular bearing	125	Spring pin	151	Thrust ring
107	Socket bolt	126	Thrust washer	152	Clip
108	O-ring	127	Spring pin	160	Sun gear No.2
109	Piece	130	Carrier No. 2	162	Clip
110	Coupling	131	Planetary gear No.2	170	Drive gear
111	Socket bolt	132	Needle bearing	180	Cover
112	Thrust plate	133	Shaft No.2	181	Thrust washer
113	Coupling	135	Thrust washer	182	Plug
114	Ring gear	140	Carrier No.1	183	O-ring
115	Snap ring	141	Planetary gear No.1	184	Thrust ring
120	Carrier No. 3	142	Needle bearing	185	Socket bolt
121	Planetary gear No. 3	143	Ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	10	
	17	
Torque wrench	Capable of tightening with the specified torques.	
Plier (for shaft)	Snap ring (145)	
Plier (for hole)	Snap ring (115)	
(-) Driver	For removing floating seal	
Plastic hammer	Wooden hammer allowed	
Eye bolt	M8, M16, M20, For lifting-up	
Press (1 ton)	Angular bearing (105)	
Tap M16	For removing screw lock in tapped holes	
Oil stone	For finishing mating faces	
Punch	For preventing spring pin from coming out	
Loctite	Socket bolt (107)	

(2) Tightening torque

Part name	Item	Size	Torque		Wrench size	
			kgf · m	lbf · ft	inch	mm
Socket bolt	107	M20 × 90	50.3	364	17	0.67
	111	M16 × 35	25.7	186	14	0.55
Plug	182	PF 1/2	10	72.3	10	0.39
Set screw	185	M12 × 35	10.4	75.2	10	0.39

4. DISASSEMBLING

1) GENERAL PRECAUTIONS

(1) Pay attention to not damaging contact surfaces for O-rings, oil seals, etc. and contact/sliding surfaces for gears, pins, bearings, etc.

(2) This motor can be disassembled even in a state on the reduction gear.
However, in that case, pay full attention to preventing mud, dust, etc. from entering in it.

(3) The numerical in parentheses following each part name indicates its part number shown in the attached **assembly drawings.**

(4) The piping side of the motor is referred to as the rear side, and the output side as the front side.

2) DISASSEMBLY OF REDUCTION GEAR

(1) Select a disassembling place.
※ Select a clean place.
※ Spread rubber sheet or cloth on work bench to prevent parts from being damaged.

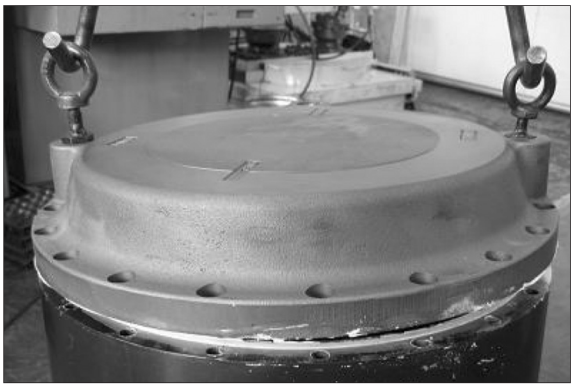
(2) Remove dust, mud, etc. from reduction gear surfaces with washing oil or so.

(3) Place reduction gear with its gear oil drain port or level gauge at the lowest position, and drain reduction gear oil.
※ Receive gear oil with clean vessel and check it for abnormalities.
Renew gear oil.

(4) Place reduction gear with its side cover (180) upward, than remove socket bolt (185).
※ Don't reuse thrust washer (181) in cover.

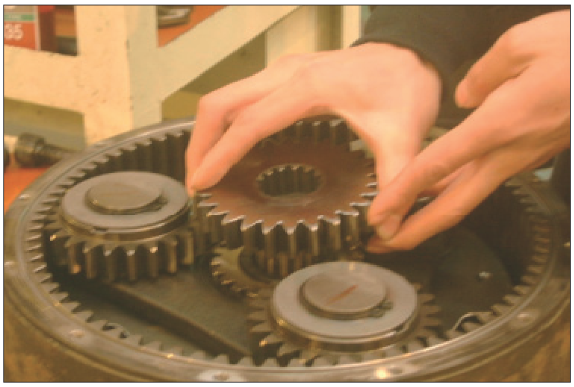
480H8TM01

(5) Remove cover (180) from ring gear (114).
※ Mount two eyebolt (PF 1/2), then lift it using crame.



480H8TM02

(6) Remove drive gear (170).



370078TM02

(7) Remove carrier 1 (140), together with planetary gears 1 (141), sun gear 2 (160), etc. fitted.

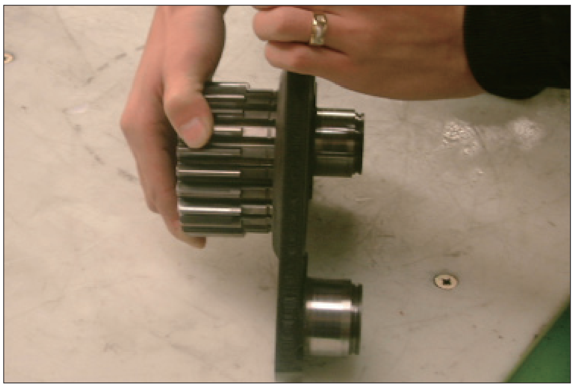
370078TM03

(8) Remove snap ring (145), and then remove side plate (144), planetary gear 1 (141), needle cage (142).

※ If flaking is observed on the inner ring surface replace inner ring. In this case, replace planetary gear 1 and needle cage simultaneously.

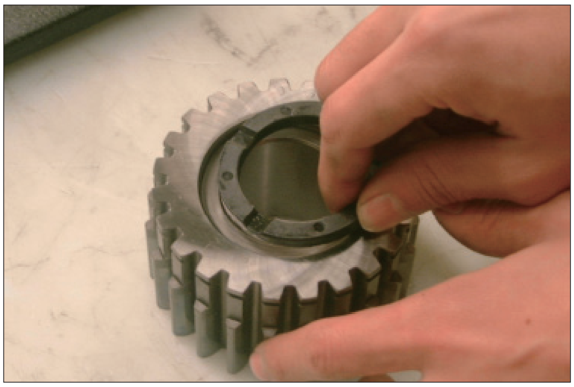
370078TM04

(9) Remove clip (162), and then remove carrier 1 (140) from sun gear 2 (160).



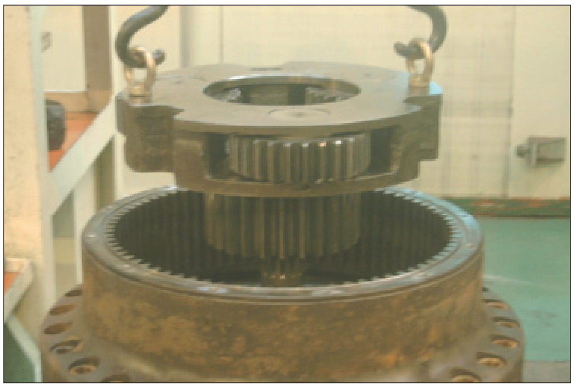
370078TM05

(10) Remove thrust ring (151).


370078TM06

(11) Remove carrier 2 (130).

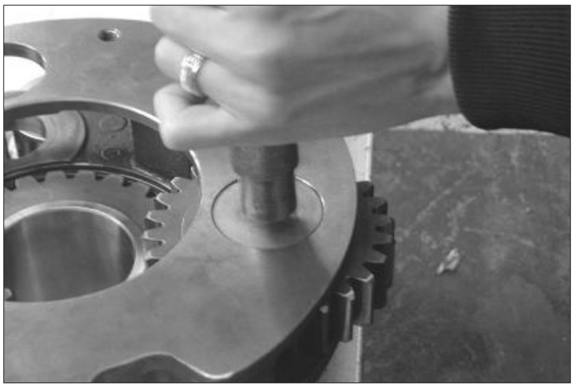
※ Mount two eyebolt M16, then lift it using crane.


370078TM07

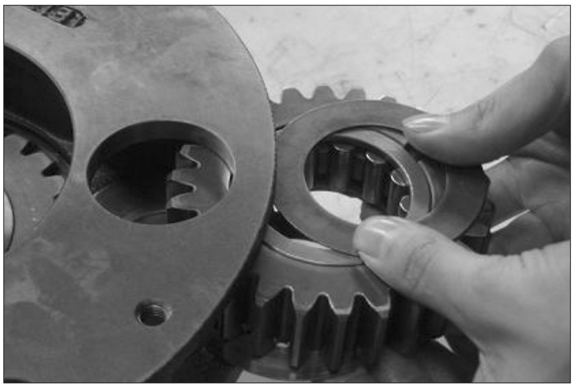
(12) Remove spring pin (125), and shaft bearing 2 (133), from carrier 2 (130).

※ Carry out the following check in advance. If any abnormality should be found, carry out disassembling.

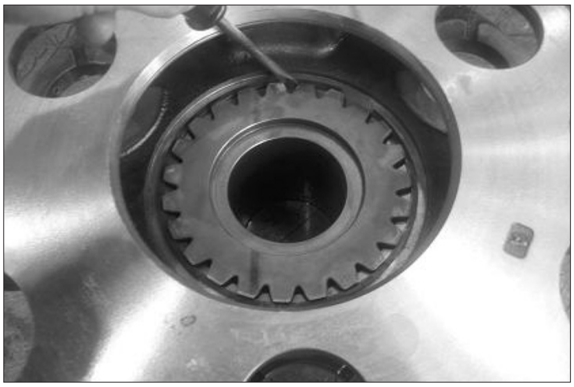
· Is there any crevice, crack or pitting on tooth surface of planetary gear?
· When turning planetary gear lightly, is there any abnormal noise or eccentric clearance.


480H8TM12

(13) Remove planetary gear 2 (131), and needle bearing (132) from carrier 2 (130).


480H8TM13

(14) Remove thrust ring (151) from sun gear (150), than remove clip (152) and remove carrier 2 (130) from sun gear 3 (150).



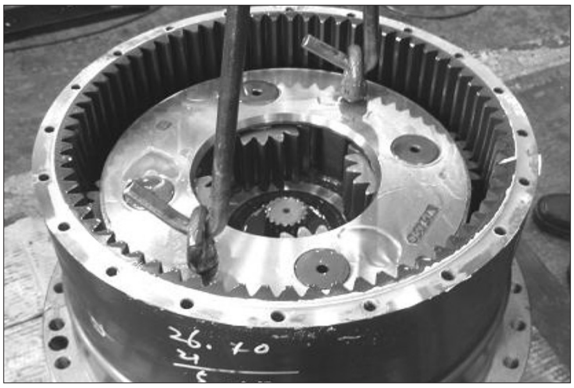
480H8TM14

(15) Remove coupling (113) from drive shaft (202).

480H8TM15

(16) Remove carrier 3 (120), with planetary gear 3 (121) that they are fitted. Then remove thrust plate (112).

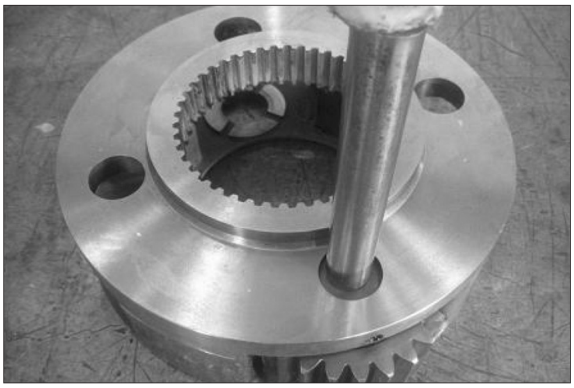
※ Mount two eyebolt M16, then lift it using crane.



480H8TM16

(17) Remove spring pin (127) then remove shaft bearing 3 (124) from carrier 3.

※ Remove shaft bearing 3 from carrier 3 rear.

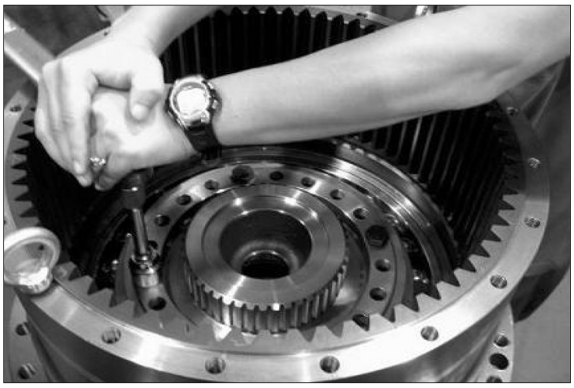


480H8TM17

(18) Remove planetary gear 4 (121), needle bearing (122), floating bush (123), thrust washer (126) from carrier 3.

480H8TM18

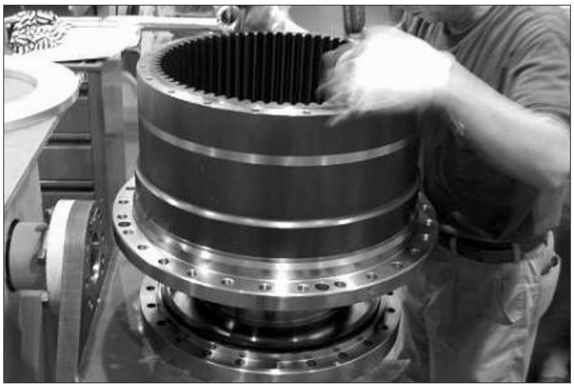
(19) Remove coupling (110), then distance piece.



480H8TM19

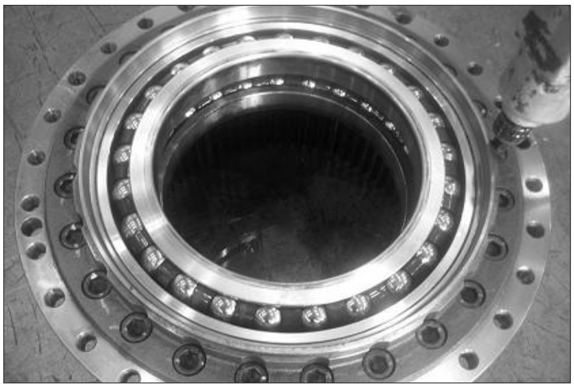
(20) Remove subassembly with hub (102) and ring gear (114), then remove floating seal (103).

※ Mount two eyebolt (M12), then lift it using crane.



480H8TM20

(21) Remove socket bolt (107) then remove hub (102) and ring gear (114).



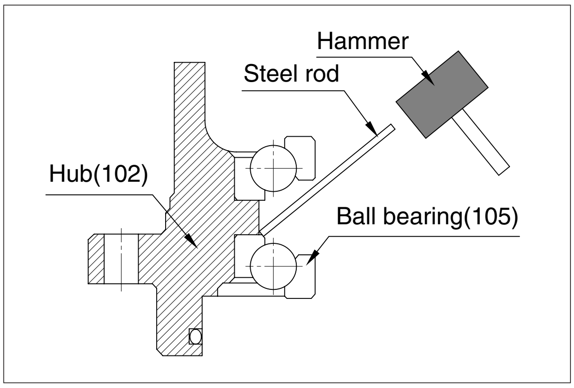
480H8TM21

(22) Remove angular bear (105, 2EA) from hub (102).

※ In case of removing bearing, exchange new angular bearing.

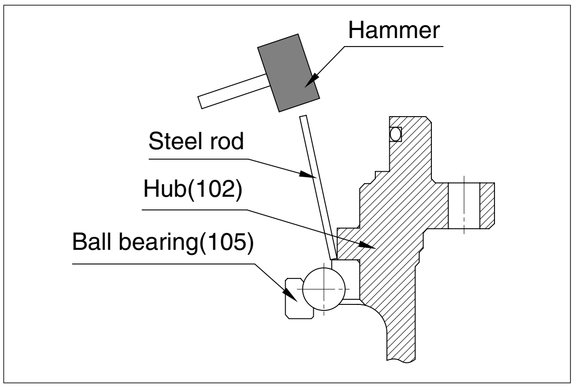
480H8TM22

(23) As show right fiqure, remove angular bearing (105, 1EA) from hub (102).



480H8TM23

(24) As show right fiqure, remove remained angular bearing (105) from hub (102).



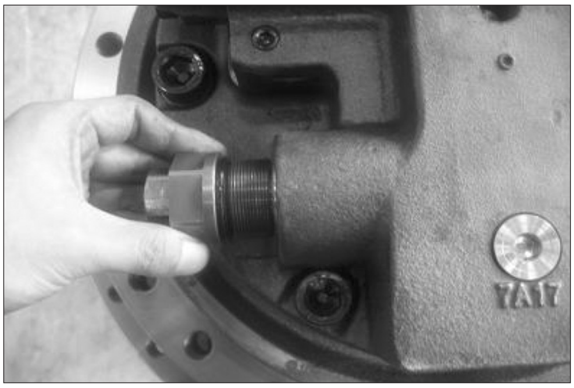
480H8TM24

3) DISASSEMBLY OF MOTOR

(1) Loosen reducing valve assy.

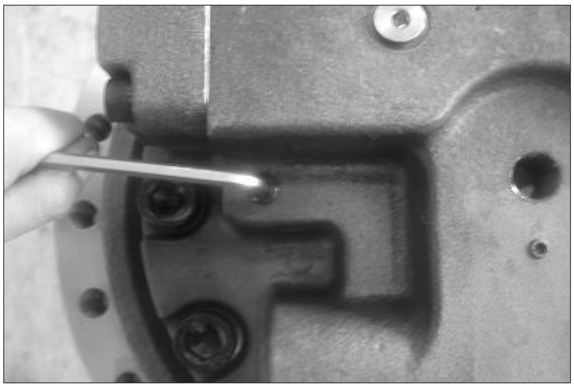
480H8TM25

(2) Loosen relief valve (RV1), (2ST).



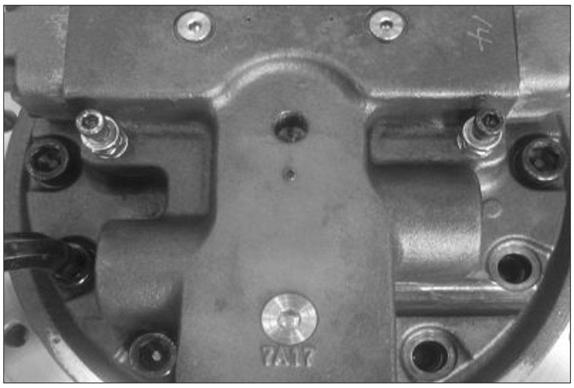
480H8TM26

(3) Remove plug (45, 2EA) then tight two M10×135L bolts with brake piston (212) through holes on rear flange.



480H8TM27

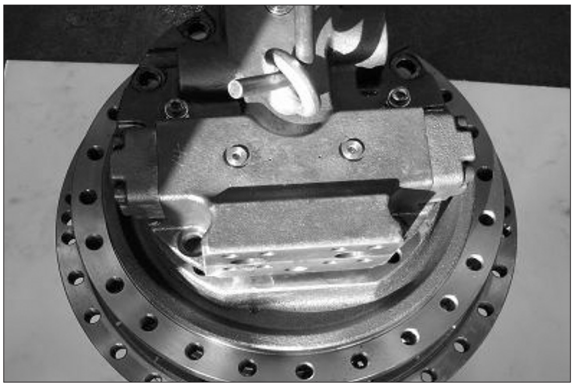
(4) Remove socket bolt (43, 8EA).



480H8TM28

(5) Remove it as lifting rear flange sub.

※ Please tight M20 eye bolt (1EA), lift rear flange sub using crane as a convenience.


480H8TM29

(6) Remove socket bolt (M10×135) then remove parking piston (212) and spring (213).


480H8TM30

(7) Remove spring (213) then remove timing plate (209).

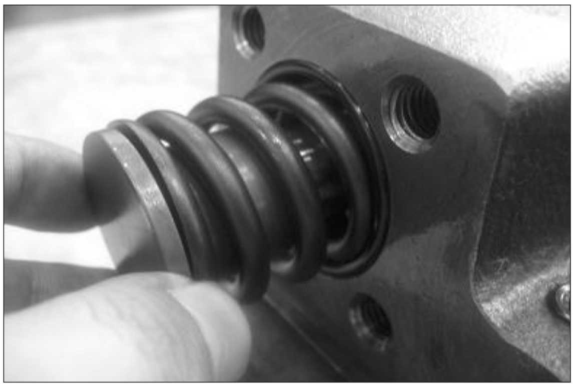

480H8TM31

(8) Remove plug (56), then remove spring (66) and spool (65).


480H8TM32

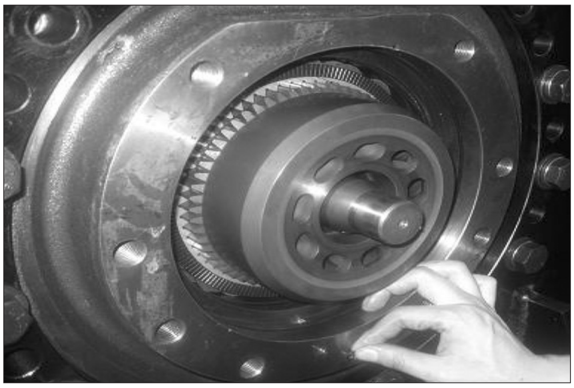
(9) Remove socket bolt (14) and cover (12) then remove counter balance spool assy.

※ If any abnormality should be found, exchange new counter balance spool assy.



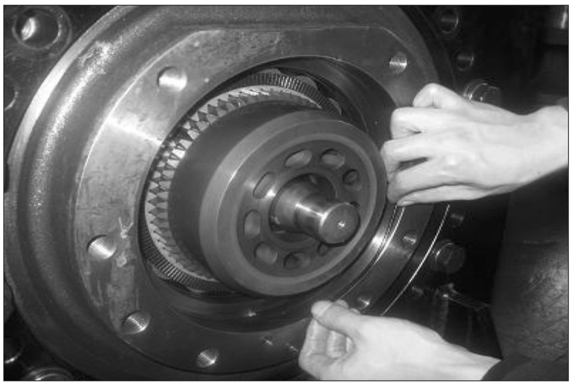
480H8TM33

(10) Remove O-ring (233) (2EA).



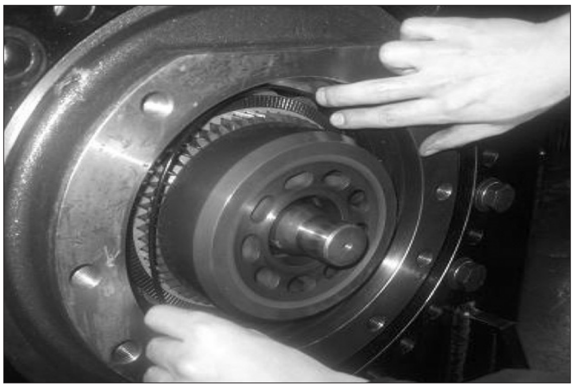
480H8TM34

(11) Remove O-ring (230).



480H8TM35

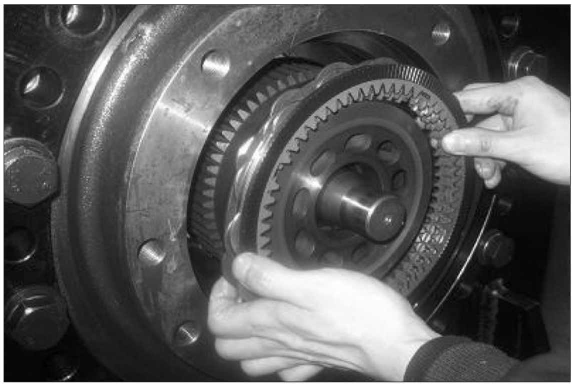
(12) Remove O-ring (231).



480H8TM36

(13) Remove friction plate (215, 4EA) and mating plate (216, 3EA).

※ In this case, motor should be located in horizontally.



480H8TM37

(14) Remove cylinder block kit.

※ In this case, motor should be located in horizontally.

480H8TM38

(15) Remove retainer (207) assembled piston assy from cylinder block (204).

480H8TM39

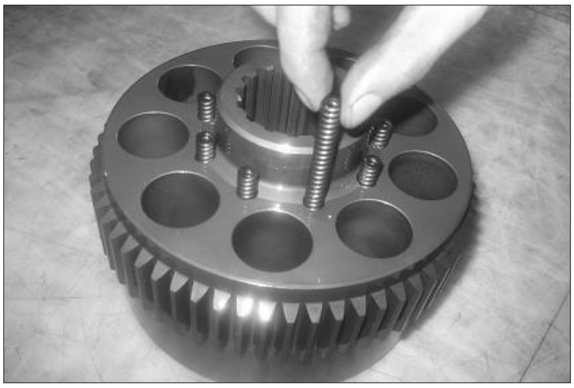
(16) Remove piston assy from retainer (207).

480H8TM40

(17) Remove trust ball (208).

480H8TM41

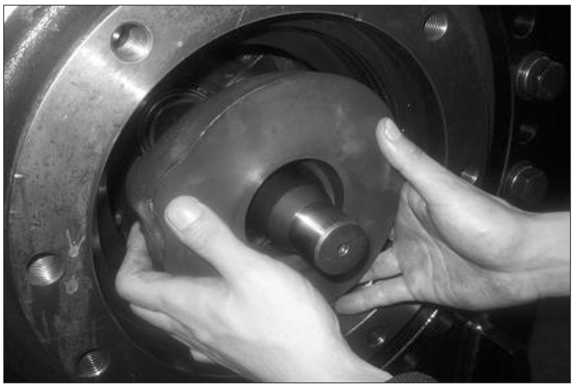
(18) Remove cylinder block spring (214, 9EA).



480H8TM42

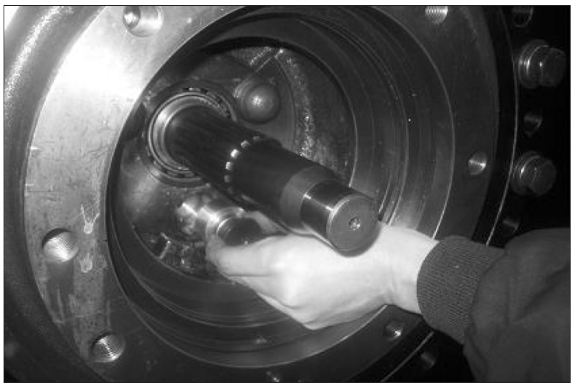
(19) Remove swash plate (203).

※ In this case, motor should be located in horizontally.



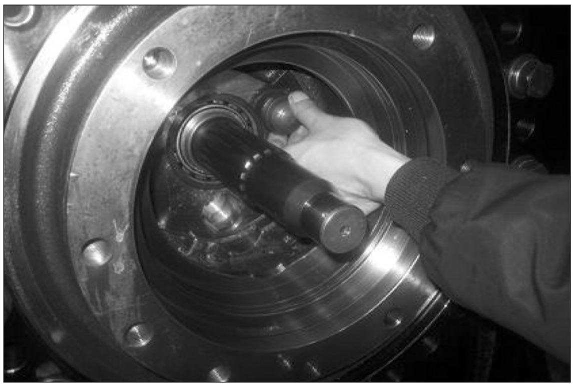
480H8TM43

(20) Remove piston assy (2 speed).



480H8TM44

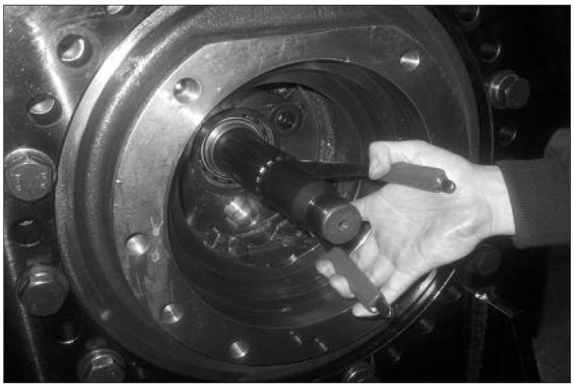
(21) Remove pivot (267, 2EA).



480H8TM45

(22) Remove snap ring (236), and then hit front side end face of shaft (202) lightly with plastic hammer or so to remove from spindle (101).

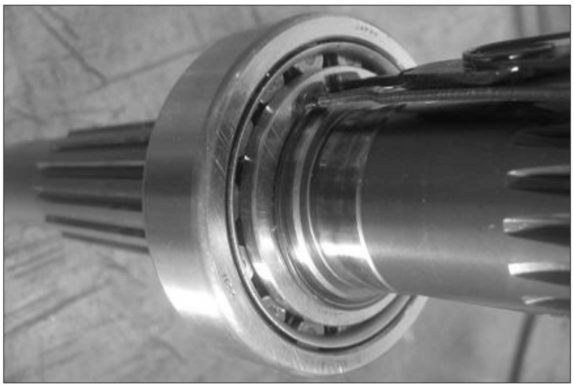
※ As remove snap ring (236), use snap ring plier.



480H8TM46

(23) Remove snap ring (237), then remove roller bearing (249).

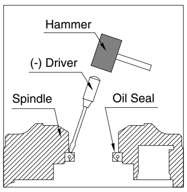
※ Use snap ring plier.



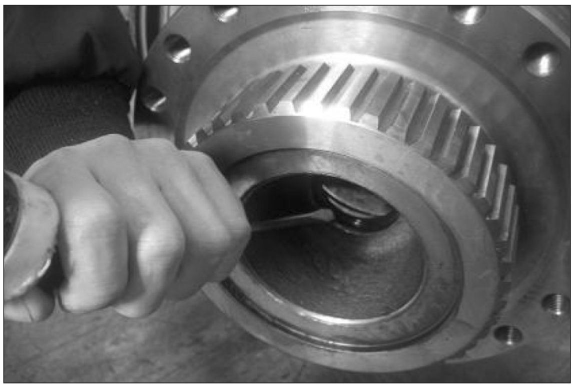
480H8TM47

(24) Remove oil seal (232) from spindle (101).

※ Do not reuse the disassembling oil seal (232). As reassembly, use new oil seal.



Remove the oil seal (232) by hammering from the spindle (101) at the circumference of the oil seal (232) using (-) driver.



480H8TM48

That is all of disassembling work. The pins (41) force-fitted to the valve casing cannot be removed.

5. ASSEMBLING

1) GENERAL CAUTIONS

(1) Clean each part fully with washing oil and dry it by blasting compressed air. It is better not to use waste cloths as much as possible.
However, if they are to be used, use clean ones, and pay attention to not leaving lint and so on.
Don't clean the friction plate with washing oil without fail.

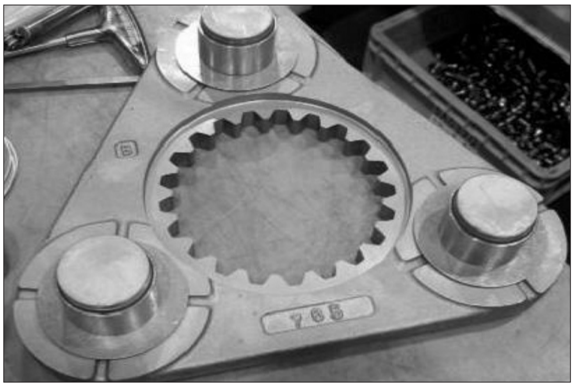
(2) Use the torque wrench in tightening fitting screws and plugs to their respective torque shown in page 8-72, 8-74.

(3) When hammering is required, use the plastic hammer and try to hit parts lightly.

(4) Similarly to the disassembling procedures, the numeral in parentheses following each part name indicates its item number shown in the attached assembly drawings.

2) ASSEMBLY OF REDUCTION GEAR

(1) Assemble side plate E (144) and inner race (143) to carrier 1 (140).

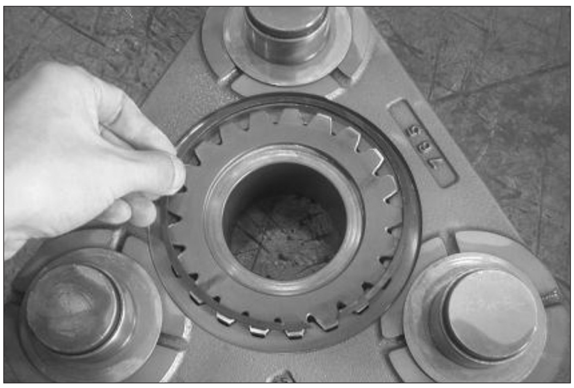


480H8TM50

(2) Assemble needle bearing (142).

480H8TM51

(3) Assemble sun gear 2 to carrier 1 and fit clip (162).



480H8TM52

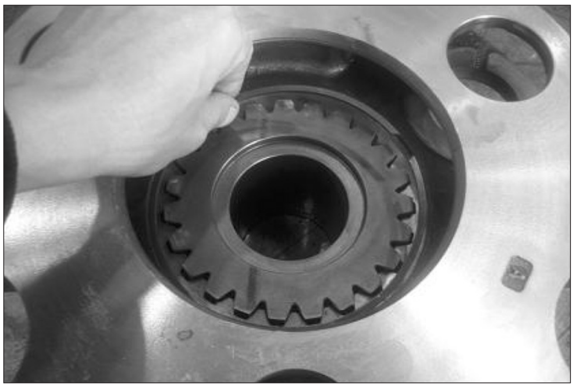
(4) Assemble planetary gear 1 (141) and side plate (144).

480H8TM53

(5) Assemble snap ring (145) using snap ring plier.

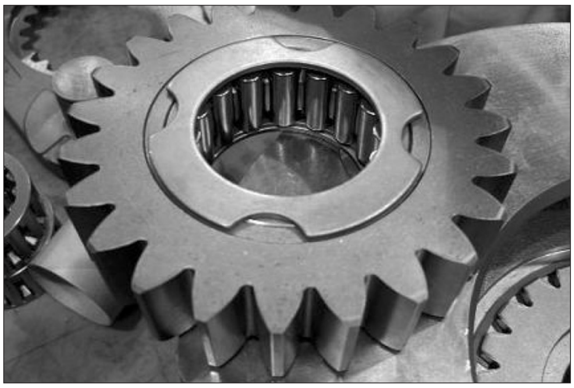
480H8TM54

(6) Assemble sun gear 3 (150) to carrier 2 and fit clip (152).



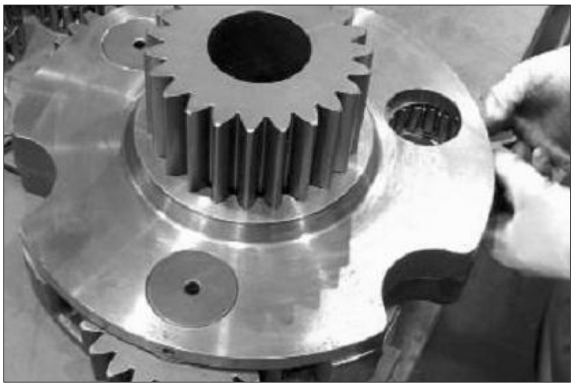
480H8TM55

(7) Assemble thrust washer (135) and needle bearing (132), thrust washer (136) to planetary gear 2 (131).



480H8TM56

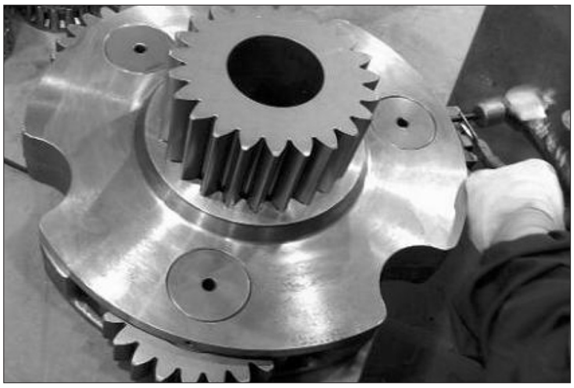
(8) Assemble sub assy assembled in the above process and shaft bearing 2 (133).



480H8TM57

(9) Insert spring pin (125) into pin holes of carrier 2 (130).

※ Mate pin of carrier 2 (130) with center of shaft bearing.

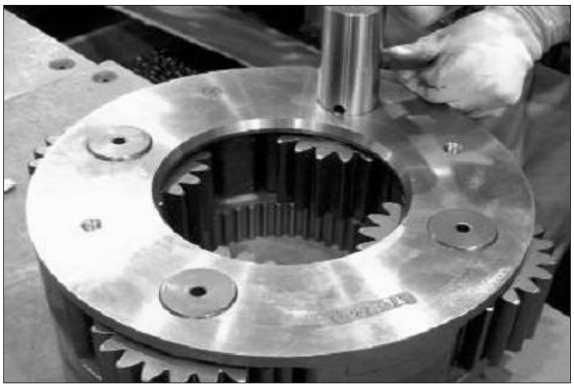


480H8TM58

(10) Assemble needle bearing (122) and floating bush (123) into inside of planetary gear 3 (121) and insert them into carrier 3 (120) holding them between thrust washer (126).

480H8TM59

(11) Insert shaft bearing 3 (124).



480H8TM60

(12) Insert spring pin (127) into pin holes of carrier 3 (120).

※ Mate pin of carrier 3 (120) with center of shaft bearing.

480H8TM61

(13) Assemble angular bearing (105) to hub (102).

480H8TM62

(14) Assemble angular bearing (105) in other side of hub (102).

480H8TM63

(15) Assemble hub (102) into ring gear (114) then tighten socket bolt (107) to specified torque to fix hub.

※ Tightening torque
Socket bolt (107) : 50.3 kgf · m
(364 lbf · ft)

480H8TM64

(16) Assemble hub (102) and ring gear (114) assy to spindle (101).

480H8TM65

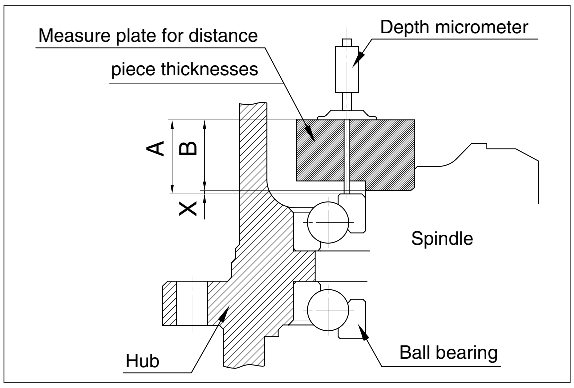
(17) Steps 1 through 4 of the original assembling procedure must be carried out as directed.

① Mount a measure plate on the spindle without inserting a distance piece.
② Tighten socket bolt (111) lightly.
③ As shown in the diagram at right, measure dimension "A" using depth micrometer.
④ As shown in the diagram at right, measure dimension "C" of coupling (B) (110) to be mounted.
⑤ Using the clearance measurements calculate the appropriate distance piece (109) thickness as follows.

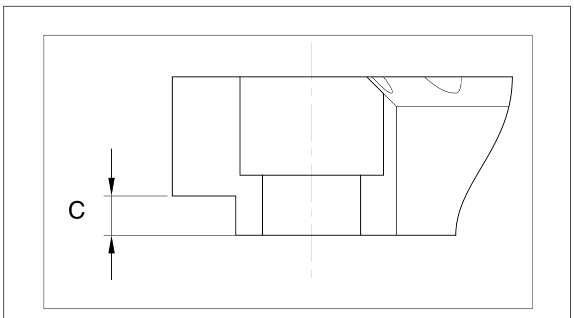
a. Measure the clearance between the edge of the spindle (101) and that of the ball bearing (105).
Take this clearance as "X"
"X" = "A" - "B"
b. Next, determine the distance piece (109) of the appropriate thickness.
Take this thickness as "T"
"T" = ("C" - "X")±0.1

⑥ Using the results the of step (1) through (5) above, select the appropriate thickness from 9 types.

480H8TM66



480H8TM67

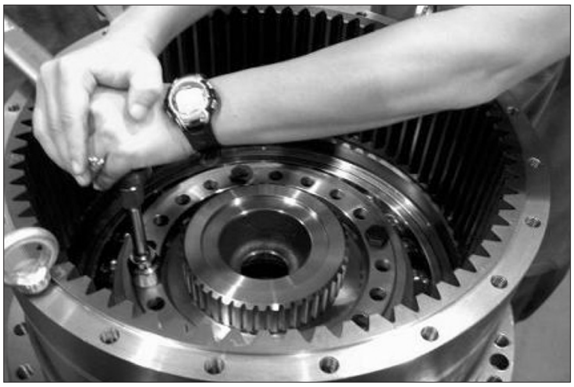


Coupling B(110)

480H8TM68

(18) Tighten to specified torque socket bolt (111) to coupling B (110).

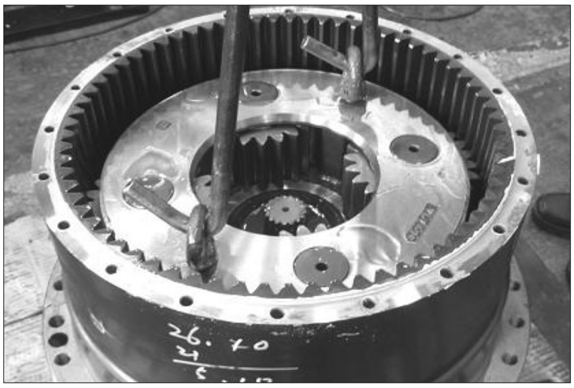
※ Tightening torque
socket bolt (111) : 25.7 kgf · m
(186 lbf · ft)



480H8TM69

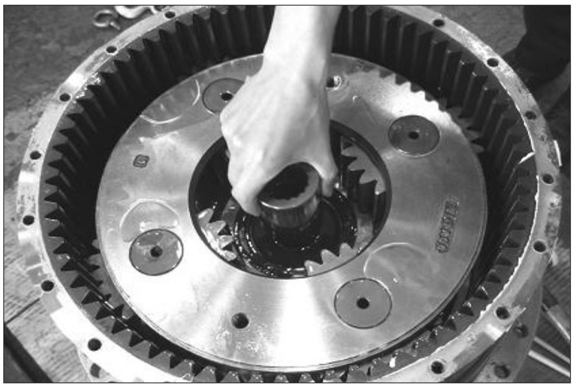
(19) Mount thrust plate R (112) to spindle (101), and then assemble carrier 3 sub-assembly to ring gear (114).

※ Mount two eyebolt (M16), then assemble it using crane.



480H8TM70

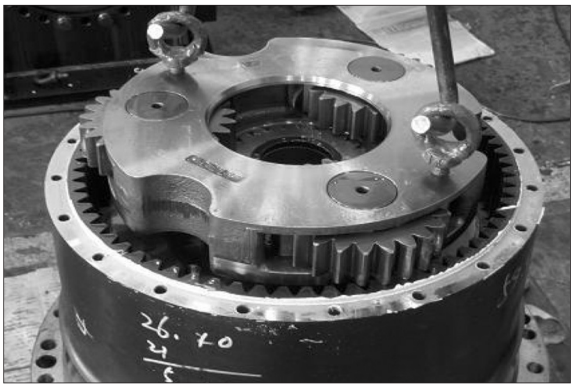
(20) Assemble coupling (113) to drive shaft (202).



480H8TM71

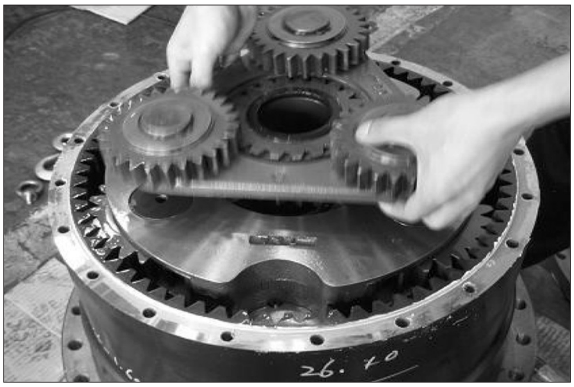
(21) Assemble carrier 2 sub-assembly to ring gear (114).

※ Mount two eyebolt (M16), then assemble it using crane.



480H8TM72

(22) Assemble carrier 1 sub assembly to ring gear (114).
Assemble thrust ring 90 (151).



480H8TM73

(23) Assemble drive gear (170).

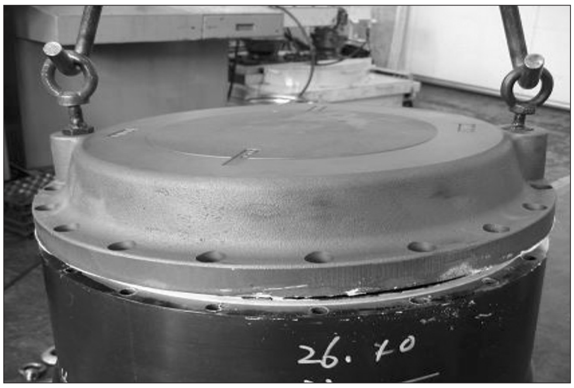
480H8TM74

(24) Assemble thrust washer M (181) to cover (180) using plastic hammer.

480H8TM75

(25) Apply sealant to the ring gear (114) after installing with the cover.

※ Mount two eyebolt (PF 1/2), then assemble it using crane.



480H8TM76

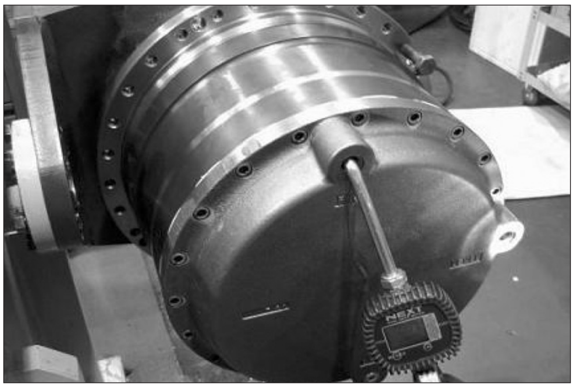
(26) Assemble socket bolt (185) to cover (180).

※ Tightening torque
Socket bolt (185) : 10.4 kgf · m
(75.2 lbf · ft)

480H8TM77

(27) Injection reduction gear oil.

※ Injected reduction gear oil :
Approximately 10.0 l



480H8TM78

(28) Tighten plug (182) to reduction gear oil inlets.

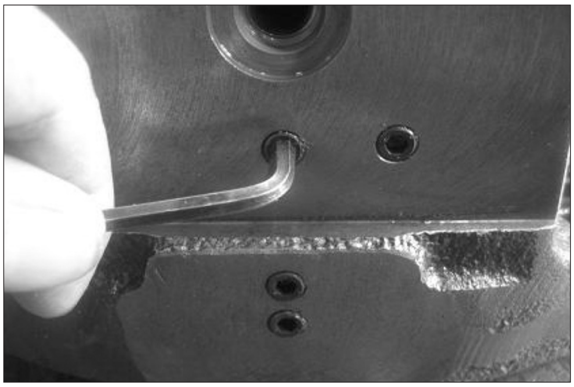
※ Tightening torque
Plug (182) : 10 kgf · m
(72.3 lbf · ft)

480H8TM79

2) ASSEMBLY OF MOTOR

(1) Tighten plugs (54, 7EA) into rear flange (1) with specified torque.

※ Tightening torque
Plug (54) : 1 kgf · m (7.2 lbf · tf)



480H8TM80

(2) Tighten plugs (56, 2EA) into rear flange (1) with specified torque.

※ Tightening torque
Plug (56) : 3.7 kgf · m (26.7 lbf · tf)

480H8TM81

(3) Assemble two speed spring (66), two speed spool (65) in the order named.

480H8TM82

(4) Tighten plug (82) into rear flange (1) with specified torque.

※ Tightening torque
Plug (82) : 11 kgf · m (80 lbf · ft)

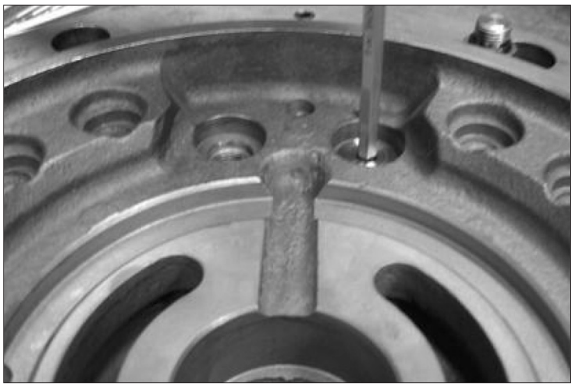
480H8TM83

(5) Assemble steel ball (68).

480H8TM84

(6) Tighten plugs (52) into rear flange (1) with specified torque.

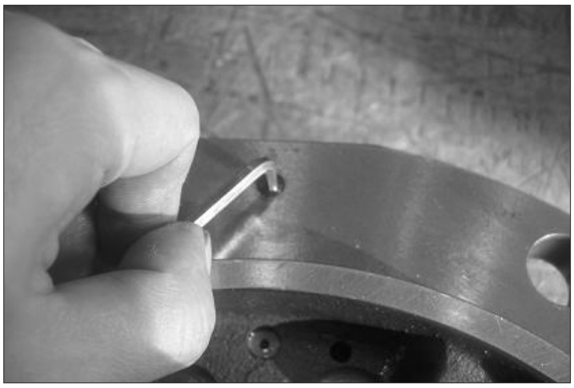
※ Tightening torque
Plug (52) : 3.7 kgf · m (27 lbf · ft)



480H8TM85

(7) Tighten orifice (71) into rear flange (1) with specified torque.

※ Tightening torque
Orifice (71) : 0.36 kgf · m (2.6 lbf · ft)



480H8TM86

(8) Assemble counterbalance spool (2).

480H8TM87

(9) Assemble washer (7) into rear flange (1).

480H8TM88

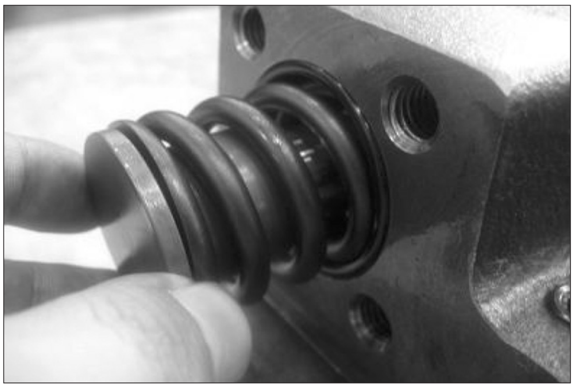
(10) Assemble O-ring (13) (P44).

480H8TM89

(11) Assemble main spring (6).

480H8TM90

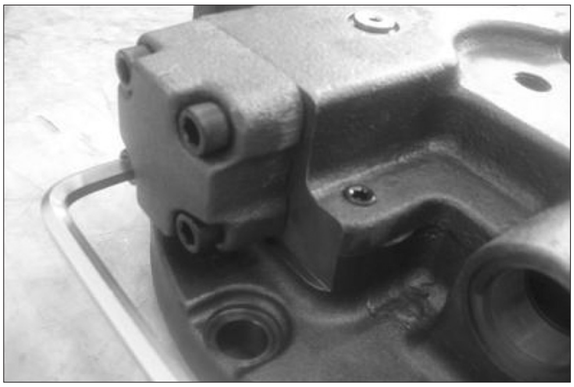
(12) Assemble counter balance spool (2), washer (7), main spring (6), seat (8) in the order named.



480H8TM91

(13) Fix cover (12) by tightening socket bolt (14).

※ Tightening torque
Socket bolt (14) : 10 kgf · m (72.3 lbf · ft)



480H8TM92

(14) Interference-fit pin (41).

480H8TM93

(15) Interference-fit needle bearing (50).

※ It isn't necessary when needle bearing was disassembled from the rear flange.

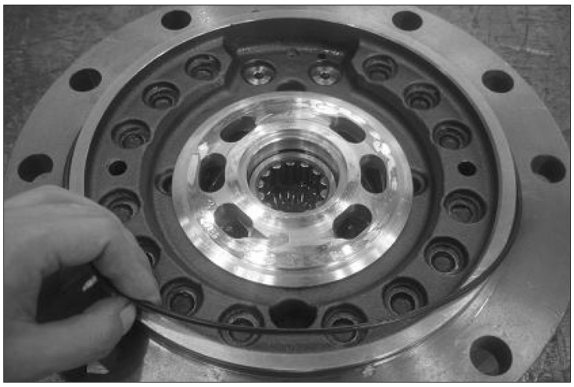
480H8TM94

(16) Assemble timing plate (209) to gear flange (1) sub-assembly.

※ Apply grease on timing plate rear flange surface and pay attention to not dropping timing plate.

480H8TM95

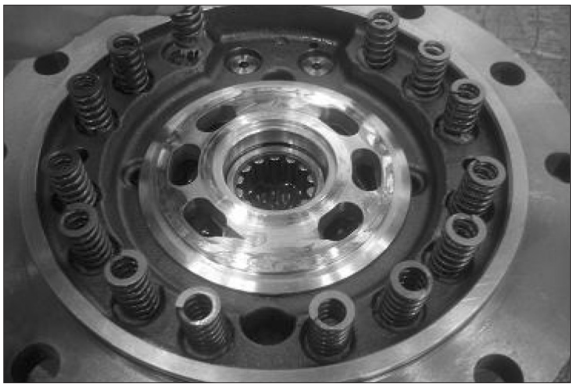
(17) Assemble O-ring (26) (WG51) to rear flange (1) sub-assembly.



480H8TM96

(18) Assemble brake spring (213) (14EA) to rear flange (1) sub-assembly.

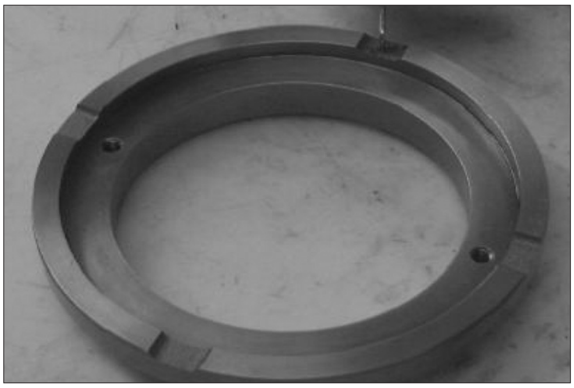
※ Apply grease on spring and pay attention to not dropping spring.



480H8TM97

(19) Assembly orifice (71) to piston (parking) (212).

※ Tightening torque : 0.36 kgf · m (0.3 lbf · ft)



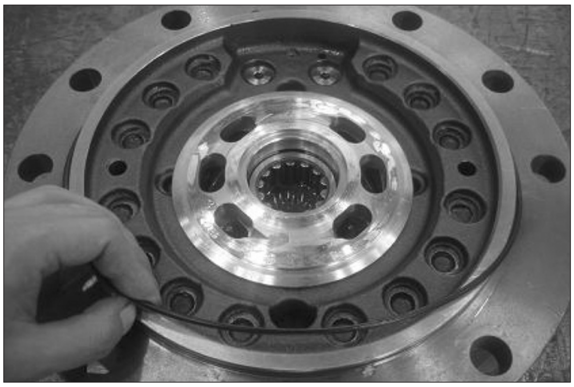
480H8TM98

(20) Screw two M10×135 bolts on the holes for compelling brake release.
Sub-assembly (rear flange & piston (parking)).

※ After finishing assembly, two M10×135 (2EA) bolts will be removed.

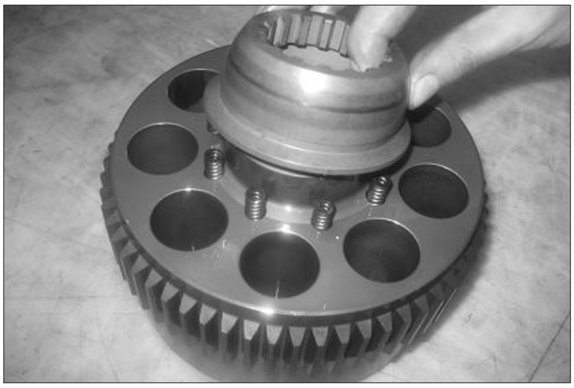
480H8TM99

(21) Assemble cylinder spring (214, 9EA) to cylinder block (204).



480H8TM100

(22) Assemble thrust ball (208) to cylinder block (204).



480H8TM101

(23) Put piston (261), shoe (262) sub-assembly (9EA) to retainer plate (207).

480H8TM102

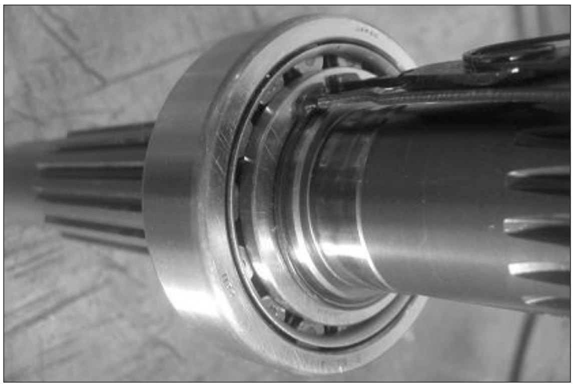
(24) Assemble retainer plate assembly to cylinder block (204).

480H8TM103

(25) Put roller bearing (249) on drive shaft (202), and assemble snap ring (236) by using the plier.

※ Pay attention to not damaging oil seal sliding area of driving shaft.

※ Pay attention to not fitting snap ring the other way around.

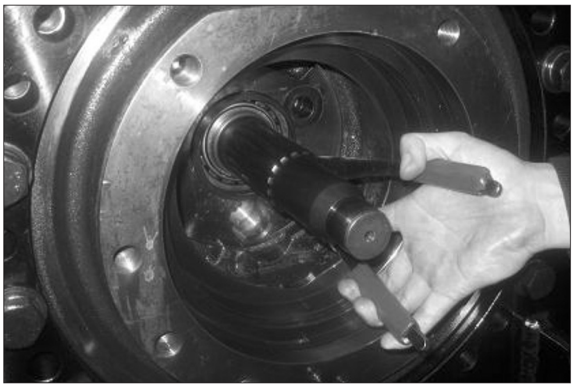


480H8TM104

(26) Interference-fit oil seal (232) into spindle (101) by special tool.

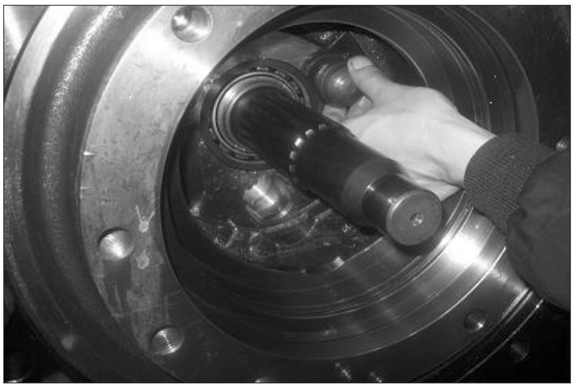
480H8TM105

(27) Assemble drive shaft (202) to spindle (101), and assemble snap ring (236) by using the plier.



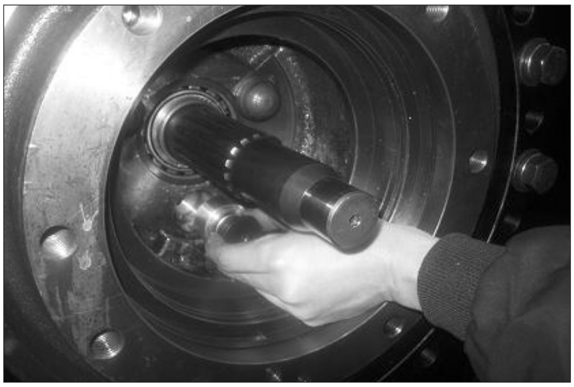
480H8TM106

(28) Assemble pivot (267).



480H8TM107

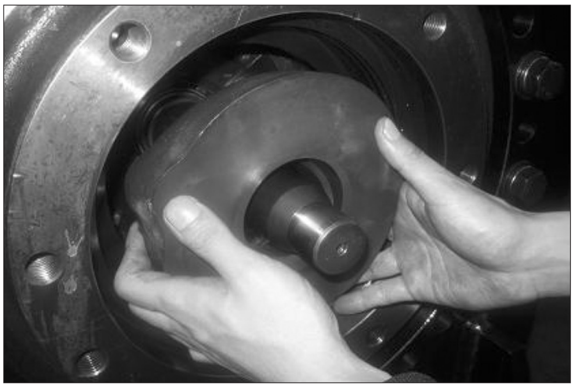
(29) Assemble two speed piston (261), shoe (262) assy.



480H8TM108

(30) Apply grease on sliding area of swash plate (203) rear surface and then assemble swash plate (203) to spindle (101).

※ Confirm with finger tips of both hands whether swash plate moves smoothly.



480H8TM109

(31) Assemble cylinder block sub-assembly (CB1) to spindle (101).

※ Apply working fluid to the swash plate (203) thinly.

480H8TM110

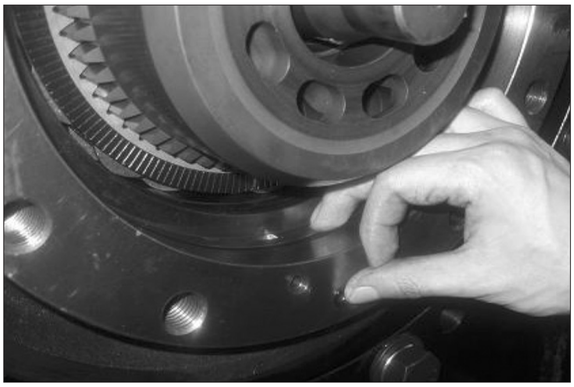
(32) Assemble mating plate (216, 3EA) and friction plate (215, 4EA) into cylinder block (204).

※ Ortehr :
Friction plate → Mating plate → Friction plate → Mating plate → Friction plate → Mating plate → Friction plate

480H8TM111

(33) Assemble O-ring (233) (P8) into spindle (101).

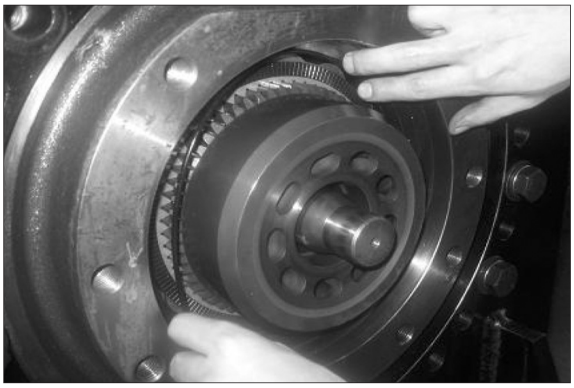
※ Do not reuse the disassembling O-ring (233).



480H8TM112

(34) Assemble O-ring (231) (WG48) into spindle (101).

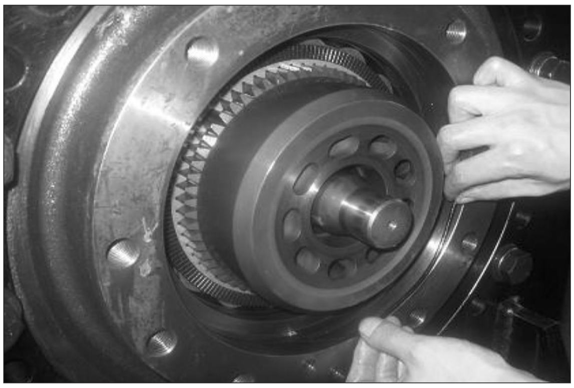
※ Do not reuse the disassembling O-ring (231).



480H8TM113

(35) Assemble O-ring (230) (WG52) into spindle (101).

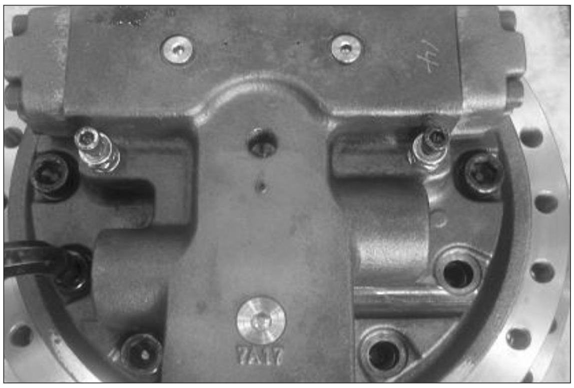
※ Do not reuse the disassembling O-ring (230).



480H8TM114

(36) Tighten socket bolt (43) (8EA) to rear flange (1).

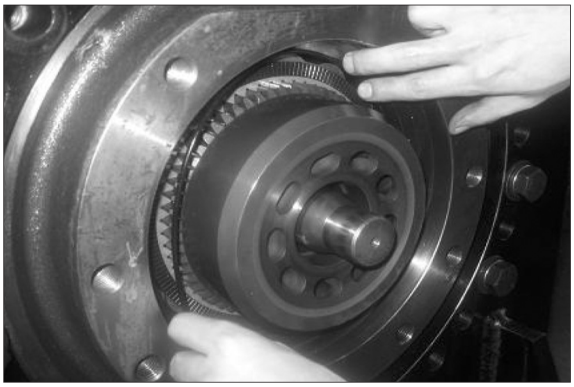
※ Apply grease on roller of needle bearing (50) in rear flange (1).
Tightening torque :
Socket bolt (43) : 44 kgf · m (318 lbf · ft)



480H8TM115

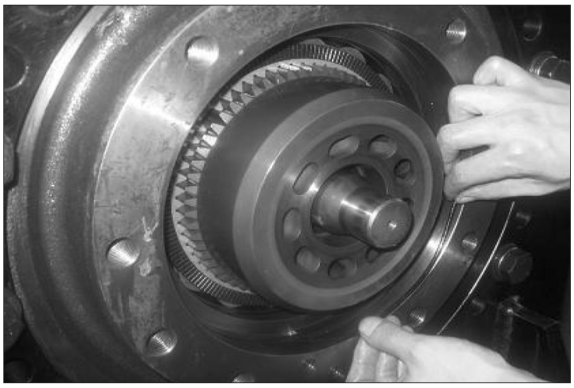
(37) Disassemble socket bolt (M10×135) on the holes for compelling brake release. And then assemble plug (45, 2EA).

※ Tightening torque :
Plug (45) : 2.2 kgf · m (15.9 lbf · ft)


480H8TM116

(38) Tighten to specified torque relief valve (RV1) (2 set) to rear flange sub-assembly.

※ Tightening torque :
Relief valve (RV1) : 25 kgf · m (181 lbf · ft)

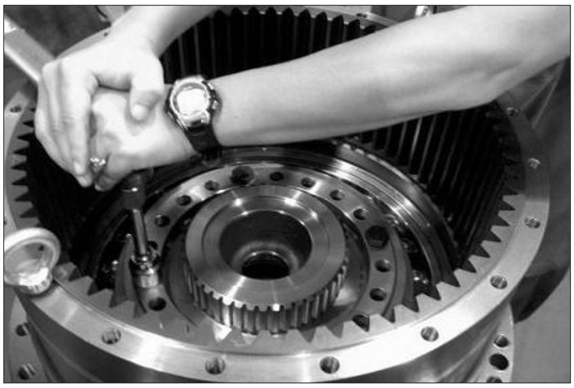

480H8TM117

(39) Tighten to specified torque reducing valve (500) (1 set) to rear flange sub-assembly.

※ Tightening torque
Reducing valve (500) :
4.5 kgf · m (32.5 lbf · ft)


480H8TM25

(40) Assemble reducing valve cover (501) to rear flange sub-assembly.


480H8TM19

GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ Escaping fluid under pressure can penetrate the skin causing serious injury.

13031GE18

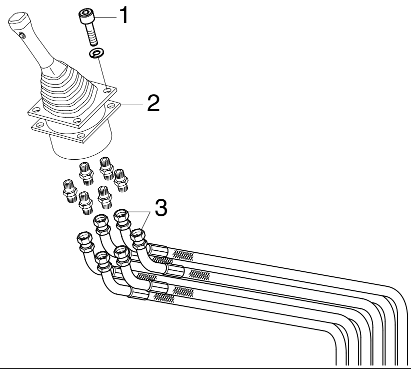
(4) Loosen the socket bolt(1).

(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses(3).

(7) Remove the pilot valve assembly(2).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.



21078DA06

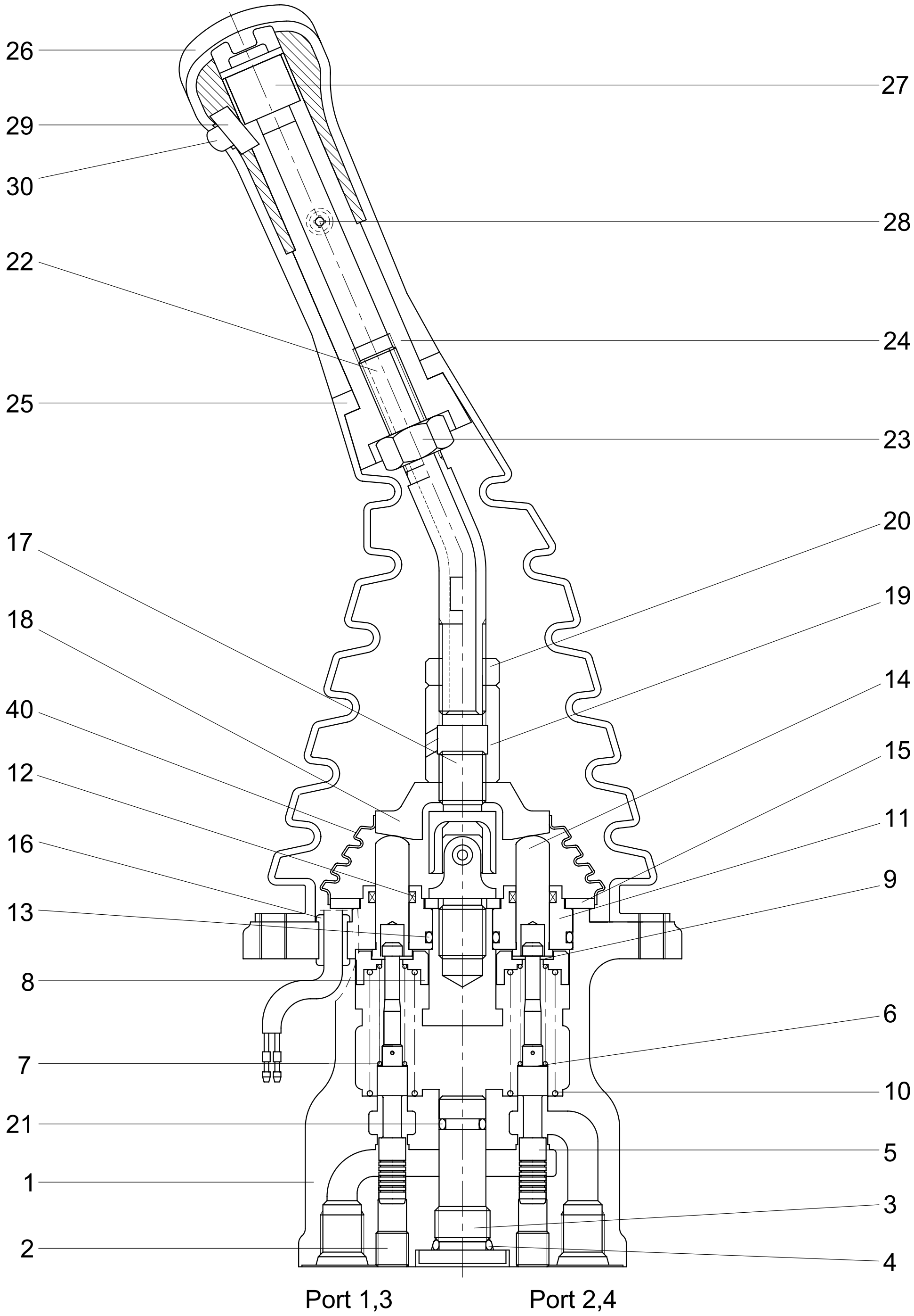
2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

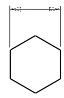


14072SF80

1 Case
2 Plug
3 Plug
4 O-ring
5 Spool
6 Shim
7 Spring
8 Spring seat
9 Stopper
10 Spring
11 Plug
12 Rod seal
13 O-ring
14 Push rod
15 Plate
16 Bushing
17 Joint assembly
18 Swash plate
19 Adjusting nut
20 Lock nut
21 O-ring
22 Handle connector
23 Nut
24 Insert
25 Boot
26 Handle
27 Switch assembly
28 Screw
29 Switch assembly
30 Switch cover
40 Boot

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	
Spanner	22	
	27	
(+) Driver	Length 150	
(-) Driver	Width 4~5	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Plug	2	PT 1/8	3.0	21.7
Joint	18	M14	3.5	25.3
Swash plate	19	M14	5.0±0.35	36.2±2.5
Adjusting nut	20	M14	5.0±0.35	36.2±2.5
Lock nut	21	M14	5.0±0.35	36.2±2.5
Screw	29	M 3	0.05	0.36

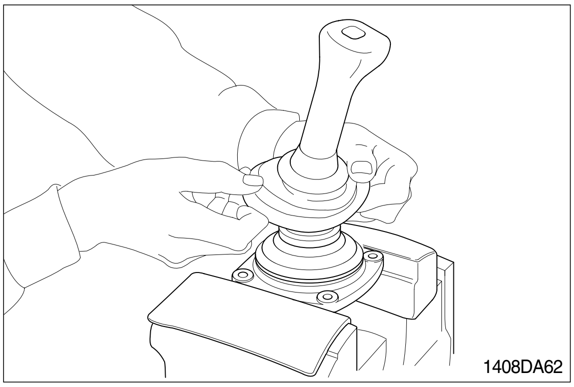
3) DISASSEMBLY

(1) Clean pilot valve with kerosene.

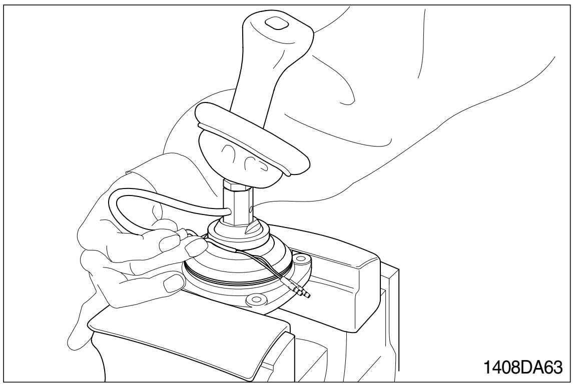
※ Put blind plugs into all ports

(2) Fix pilot valve in a vise with copper(or lead) sheets.

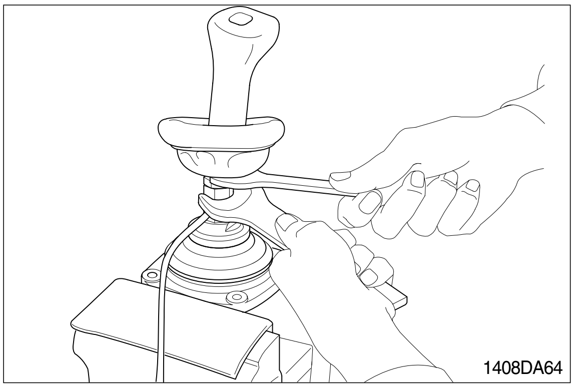
(3) Remove end of boot(25) from case(1) and take it out upwards.



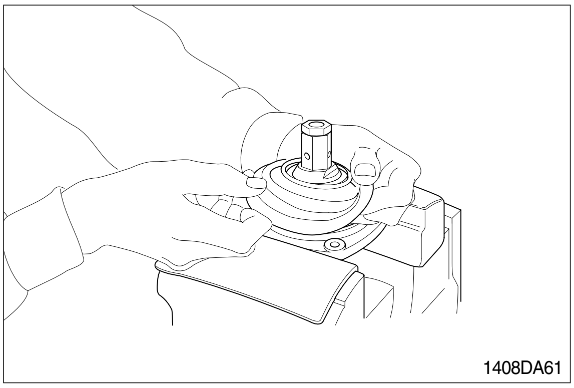
※ For valve with switch, remove cord also through hole of casing.



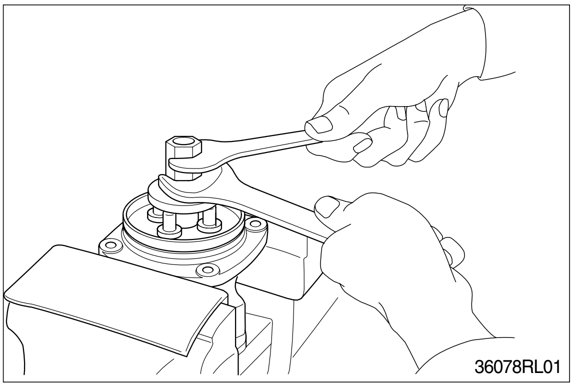
(4) Loosen lock nut(20) and adjusting nut(19) with spanners on them respectively, and take out handle section as one body.



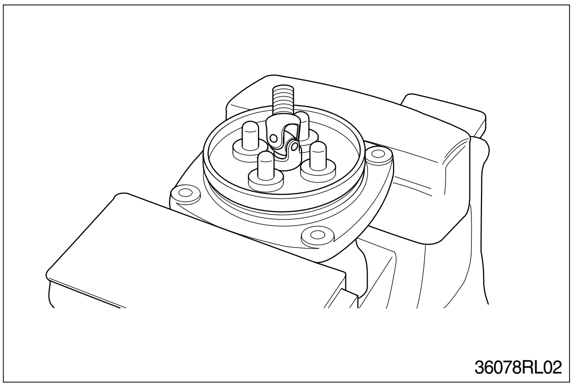
(5) Remove the boot(40)



(6) Loosen adjusting nut(19) and plate(18) with spanners on them respectively, and remove them.



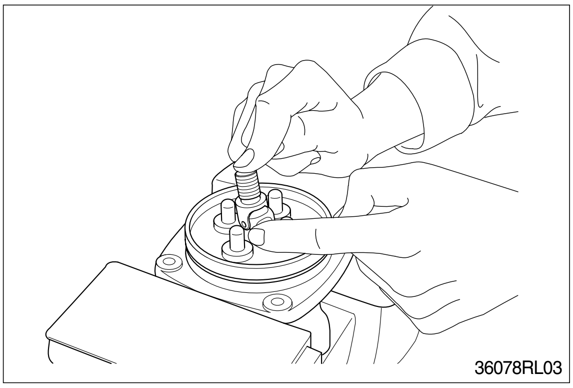
36078RL01



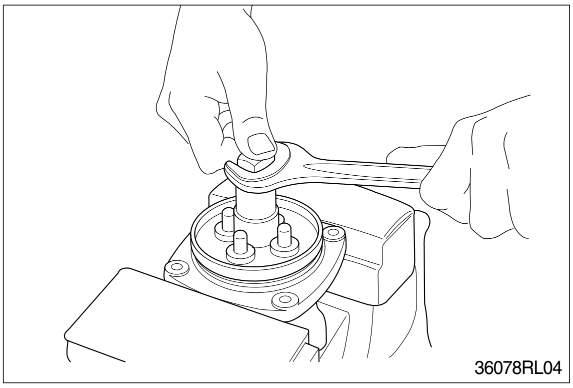
36078RL02

(7) Turn joint anticlockwise to loosen it, utilizing jig(Special tool).

※ When return spring(10) is strong in force, plate(15), plug(11) and push rod(14) will come up on loosening joint.
Pay attention to this.

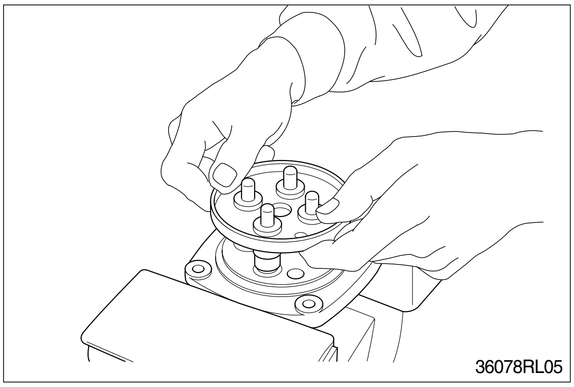


36078RL03



36078RL04

(8) Remove plate(15).

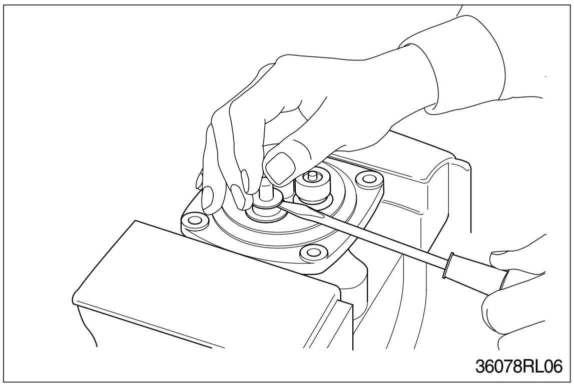


36078RL05

(9) When return spring(10) is weak in force, plug(11) stays in casing because of sliding resistance of O-ring.

※ Take it out with minus screwdriver.
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

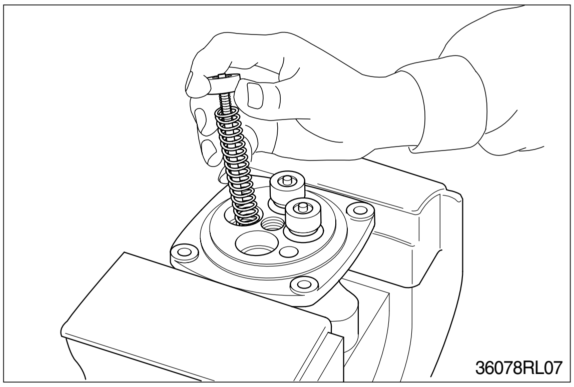
※ During taking out, plug may jump up due to return spring(10) force.
Pay attention to this.



36078RL06

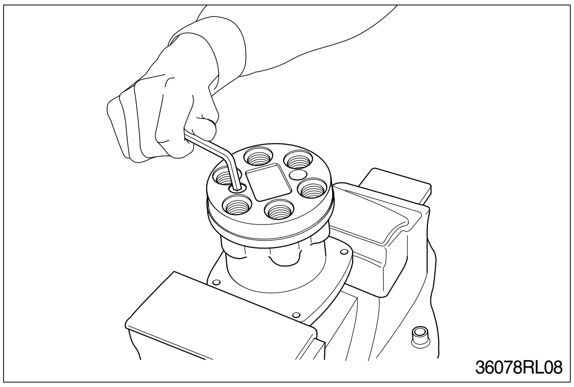
(10) Remove reducing valve subassembly and return spring(10) out of casing.

※ Record relative position of reducing valve subassembly and return springs.



36078RL07

(11) Loosen hexagon socket head plug(2) with hexagon socket screw key.



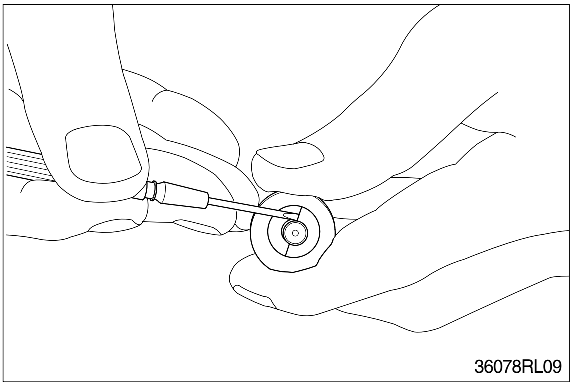
36078RL08

(12) For disassembling reducing valve section, stand it vertically with spool(5) bottom placed on flat workbench. Push down spring seat(8) and remove two pieces of semicircular stopper(9) with tip of small minus screwdriver.

※ Pay attention not to damage spool surface.

※ Record original position of spring seat(8, 31).

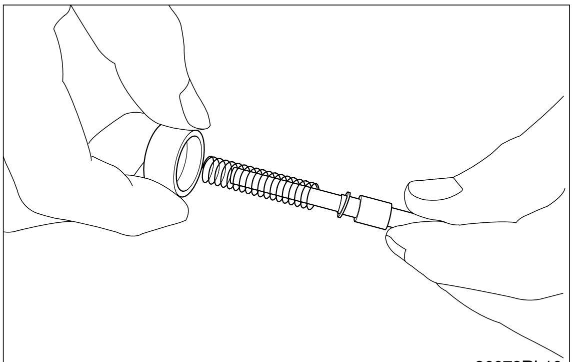
※ Do not push down spring seat more than 6mm.



36078RL09

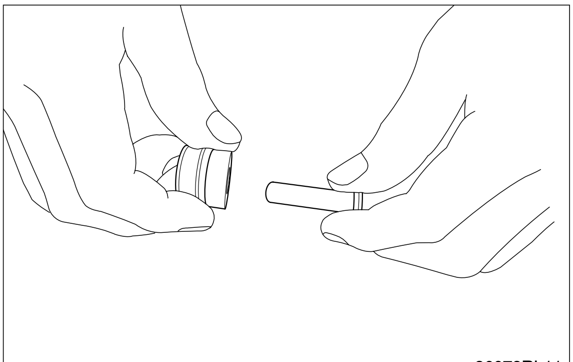
(13) Separate spool(5), spring seat(8), spring(7) and shim(6) individually.

※ Until being assembled, they should be handled as one subassembly group.



36078RL10

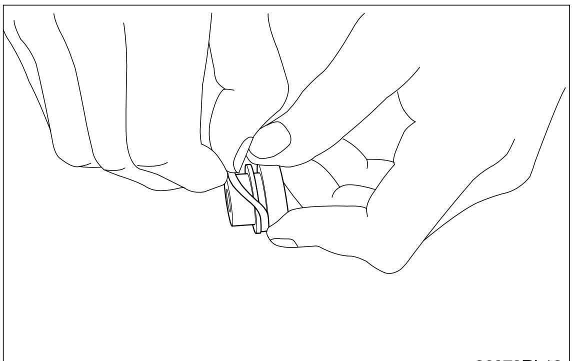
(14) Take push rod(14) out of plug(11).



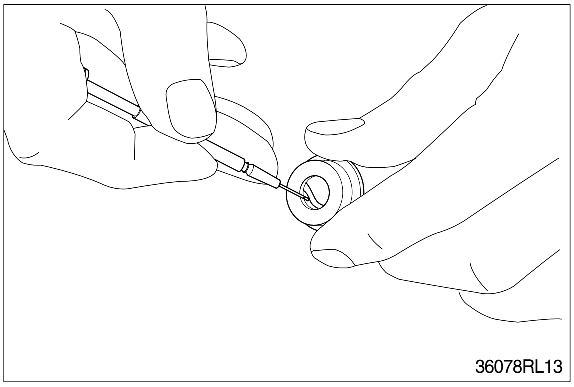
36078RL11

(15) Remove O-ring(13) and seal(12) from plug(11).

Use small minus screwdriver or so on to remove this seal.

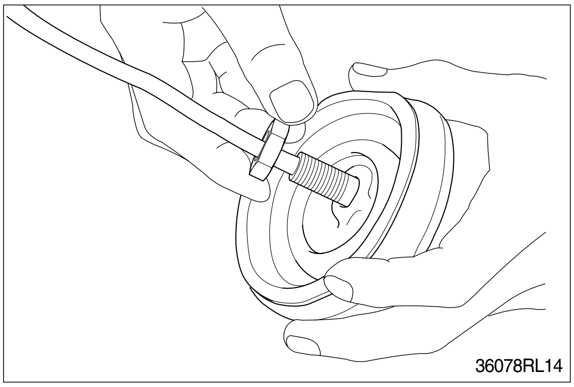


36078RL12

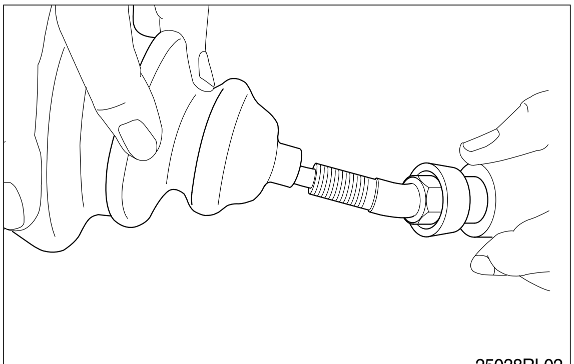


36078RL13

(16) Remove lock nut(20) and then boot(25).



36078RL14



25038RL02

(17) Cleaning of parts

① Put all parts in rough cleaning vessel filled with kerosene and clean them (Rough cleaning).

※ If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.

※ If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.
Therefore, control cleanliness of kerosene fully.

② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides(Finish cleaning).

※ Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

(18) Rust prevention of parts.

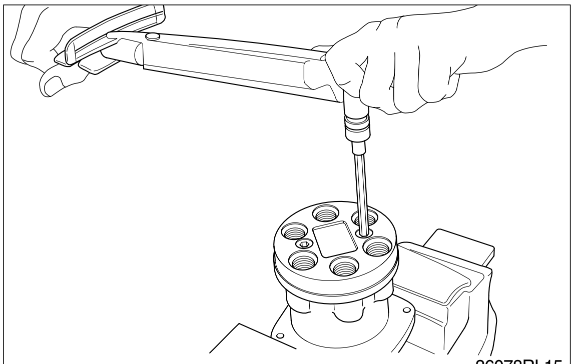
Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

4) ASSEMBLY

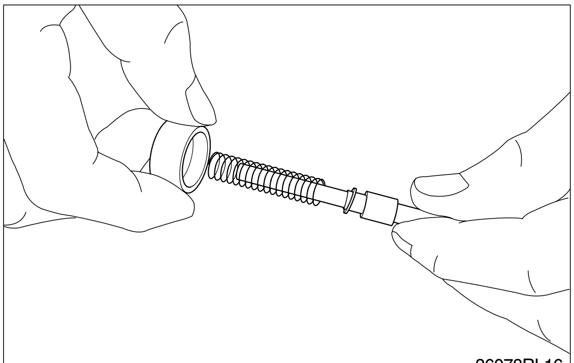
(1) Tighten hexagon socket head plug(2) to the specified torque.

※ Tighten two bolts alternately and slowly.



36078RL15

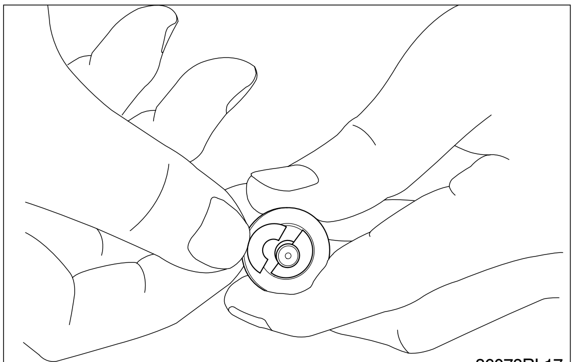
(2) Put shim(6), springs(7) and spring seat(8) onto spool(5) in this order.



36078RL16

(3) Stand spool vertically with its bottom placed on flat workbench, and with spring seat pushed down, put two pieces of semicircular stopper(9) on spring seat without piling them on.

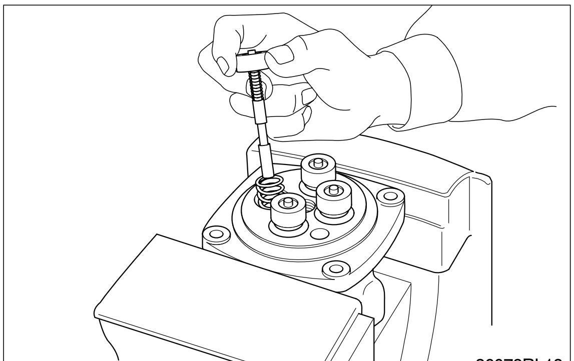
※ Assemble stopper(9) so that its sharp edge side will be caught by head of spool. Do not push down spring seat more than 6mm.



36078RL17

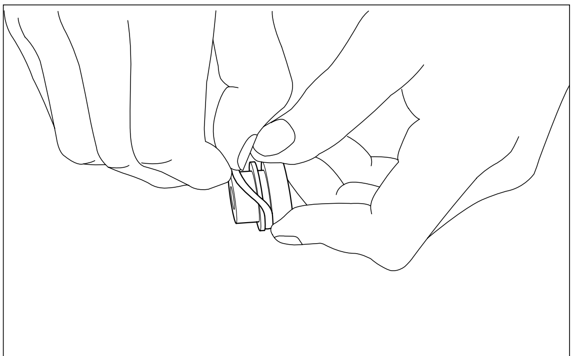
(4) Assemble spring(10) into casing(1). Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.



36078RL18

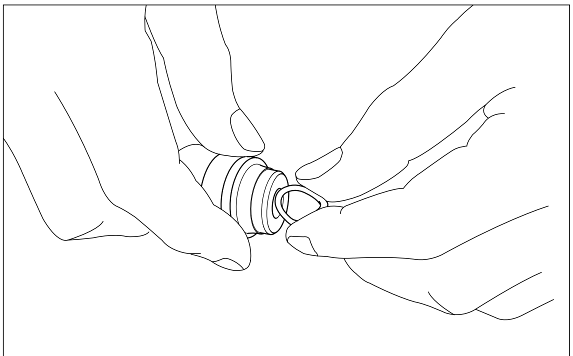
(5) Assemble O-ring(13) onto plug(11).



36078RL19

(6) Assemble seal(12) to plug(11).

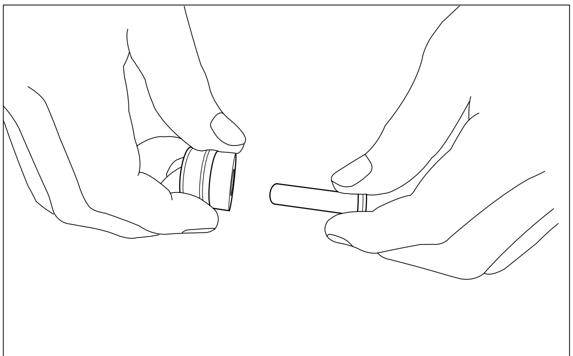
※ Assemble seal in such lip direction as shown below.



36078RL20

(7) Assemble push rod(14) to plug(11).

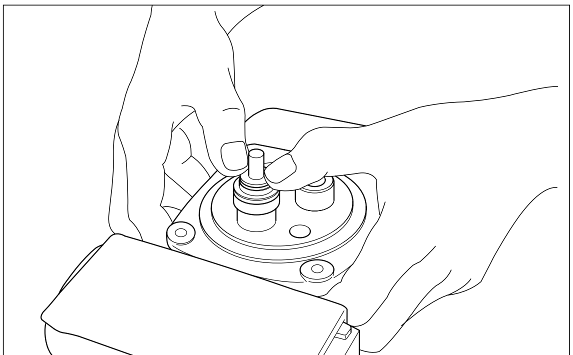
※ Apply working oil on push-rod surface.



36078RL21

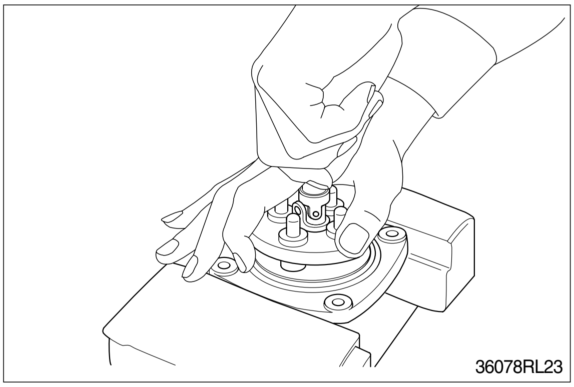
(8) Assemble plug subassembly to casing.

※ When return spring is weak in force, subassembly stops due to resistance of O-ring.



36078RL22

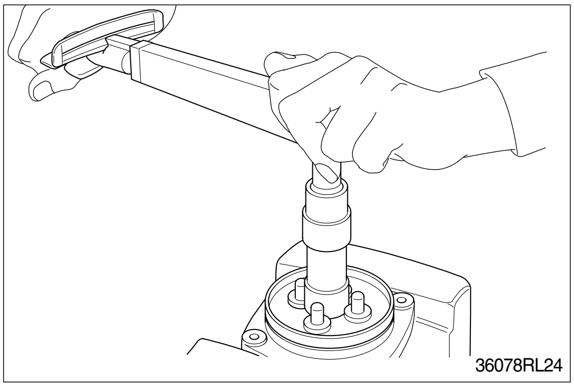
(9) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate(15), and tighten joint(17) temporarily.



36078RL23

(10) Fit plate(15).

(11) Tighten joint(17) with the specified torque to casing, utilizing jig.

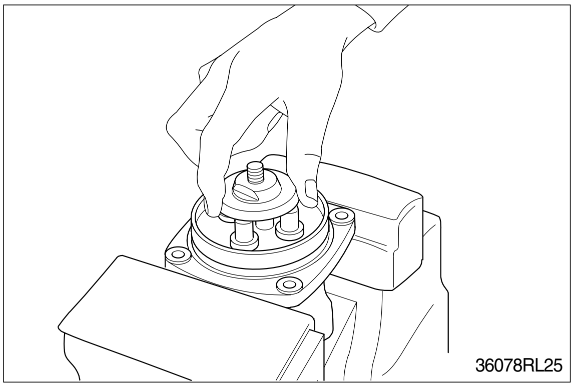


36078RL24

(12) Assemble swash plate(18) to joint(17).

※ Screw it to position that it contacts with 4 push rods evenly.

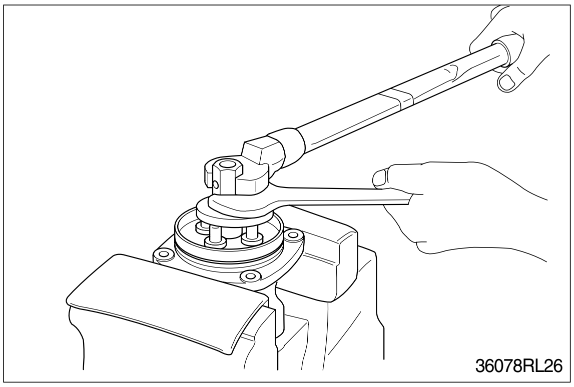
※ Do not screw it over.



36078RL25

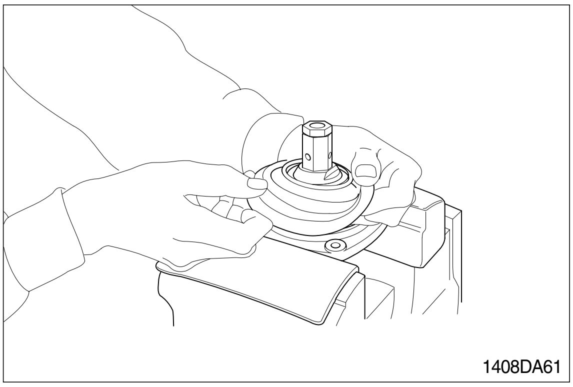
(13) Assemble adjusting nut(19), apply spanner to width across flat of plate(18) to fix it, and tighten adjusting nut to the specified torque.

※ During tightening, do not change position of disk.

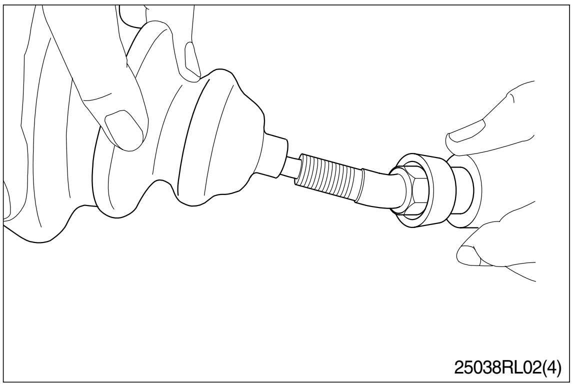


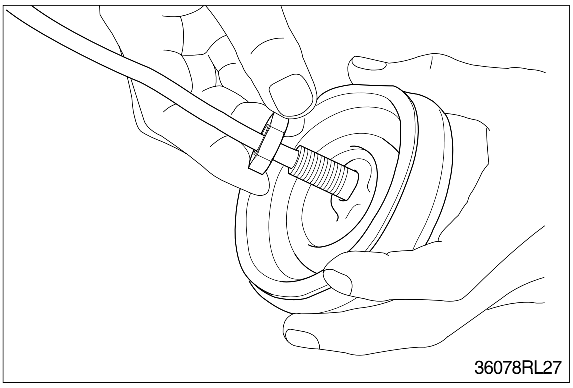
36078RL26

(14) Fit boot(40) to plate.

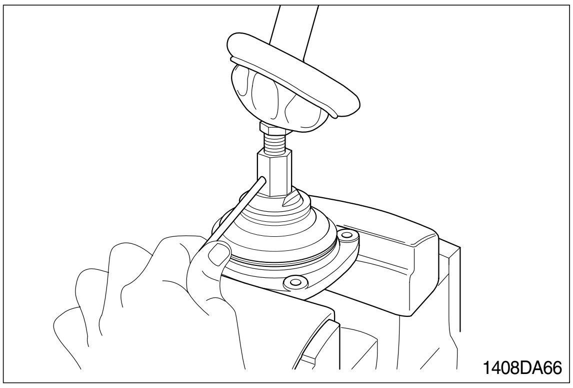


(15) Fit boot(25) and lock nut(20), and handle subassembly is assembled completely.



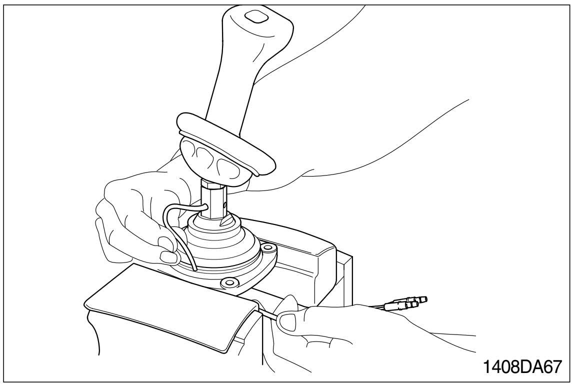


(16) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.



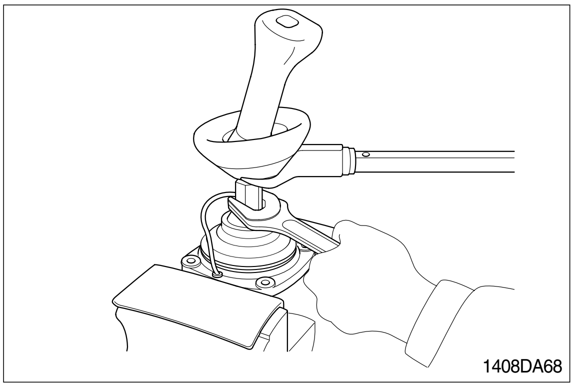
(17) Assemble bushing(16) to plate and pass cord and tube through it.

※ Provide margin necessary to operation.



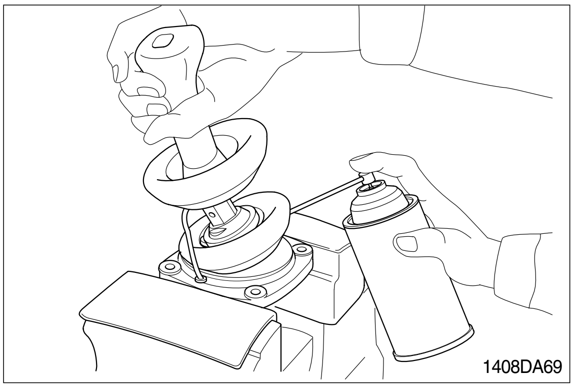
1408DA67

(18) Determine handle direction, tighten lock nut(20) to specified torque to fix handle.



1408DA68

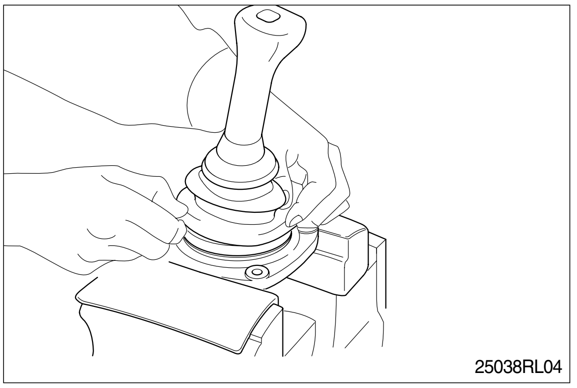
(19) Apply grease to rotating section of joint and contacting faces of disk and push rod.



1408DA69

(20) Assemble lower end of bellows to casing.

(21) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



25038RL04

GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

13031GE18

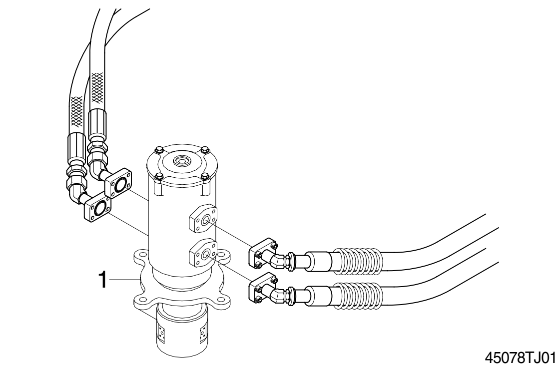
(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.



45078TJ01

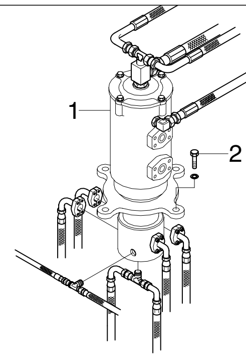
(4) Disconnect all hoses .

(5) Sling the turning joint assembly(1) and remove the mounting bolt(2).
- · Weight : 50kg(110lb)
- · Tightening torque : 29.7 ± 45kgf · m (215 ± 32.5lbf · ft)

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

2) INSTALL



45078TJ02

(1) Carry out installation in the reverse order to removal.

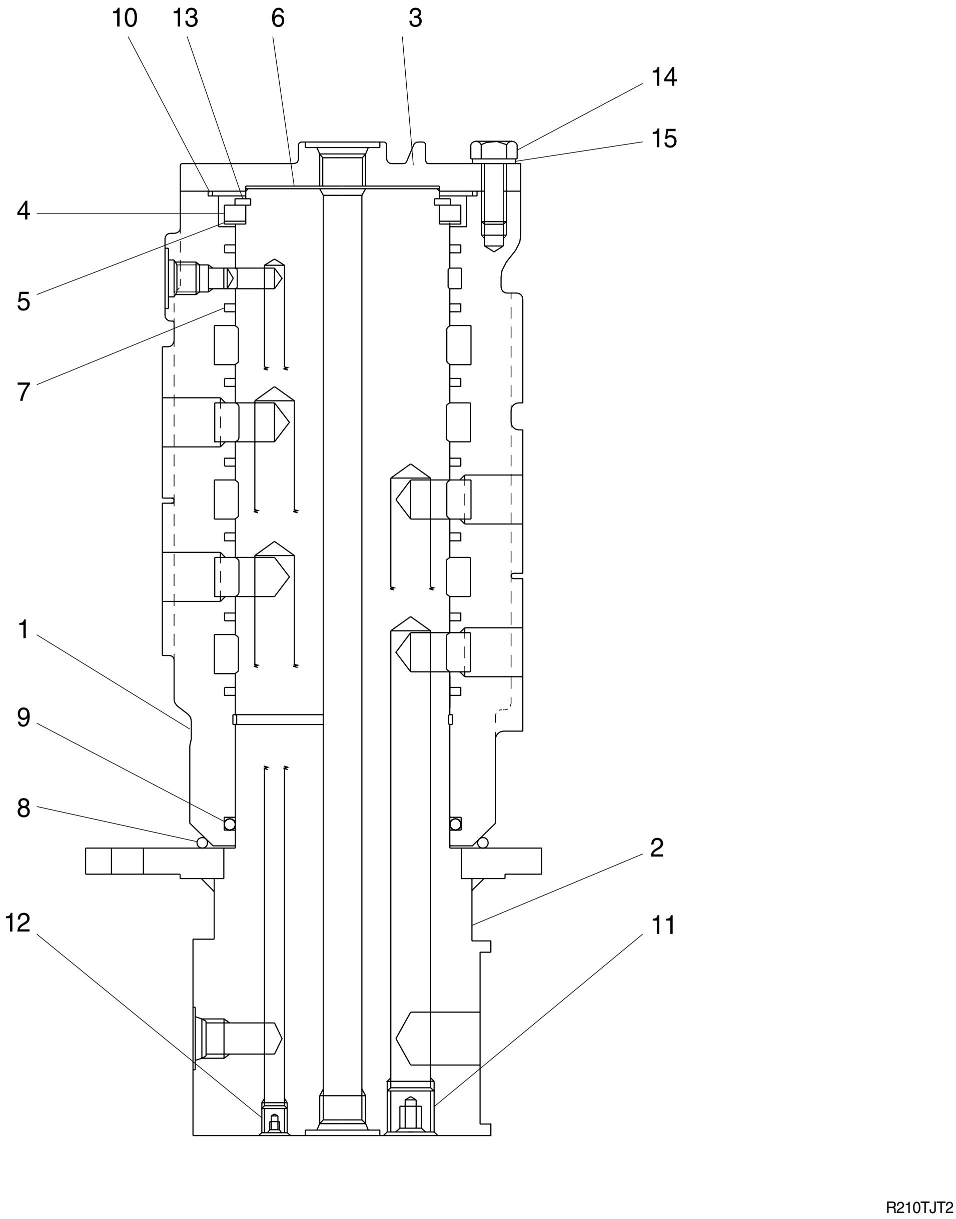
※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

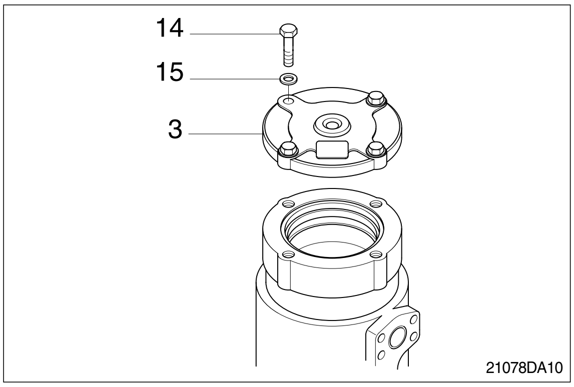


1	Hub	6	Shim	11	Plug
2	Shaft assembly	7	Slipper seal	12	Plug
3	Cover	8	O-ring	13	Retaining ring
4	Spacer	9	O-ring	14	Hexagon bolt
5	Shim	10	O-ring	15	Spring washer

2) DISASSEMBLY

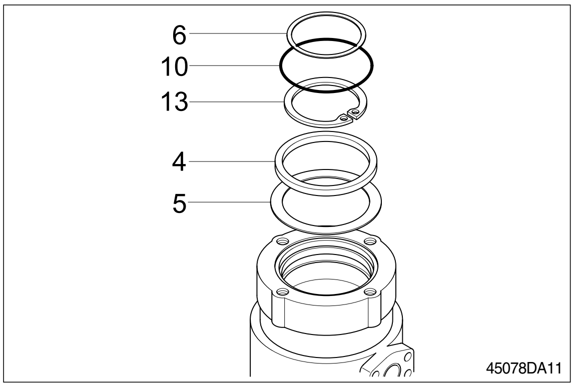
※ Before the disassembly, clean the turning joint.

(1) Remove bolts(14), washer(15) and cover(3).



(2) Remove shim(6) and O-ring(10).

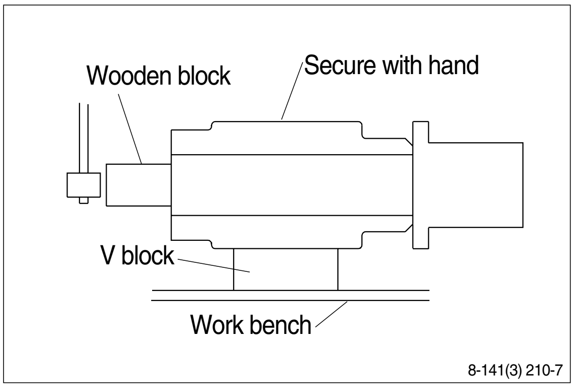
(3) Remove retainer ring(13), spacer(4) and shim(5).



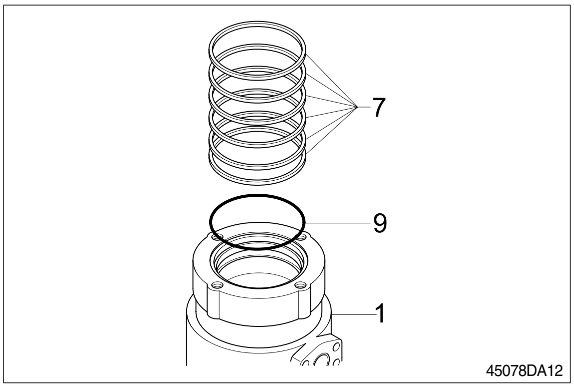
(4) Place body(1) on a V-block and by using a wood buffer at the shaft end, hit out shaft(2) to about 1/2 from the body with a hammer.

※ Take care not to damage the shaft(2) when remove body(1) or rest it sideway.

※ Put a fitting mark on body(1) and shaft(2).



(5) Remove six slipper seals(7) and O-ring(9), from body(1).



3) ASSEMBLY

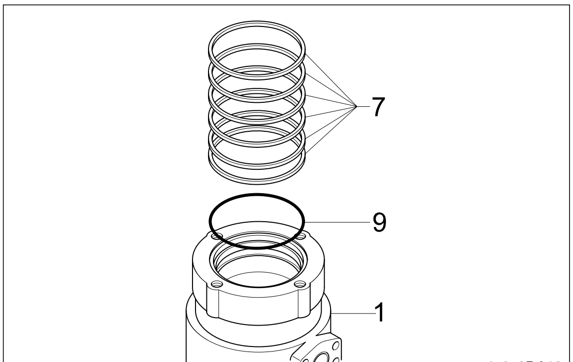
※ Clean all parts.

※ As a general rule, replace oil seals and O-ring.

※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

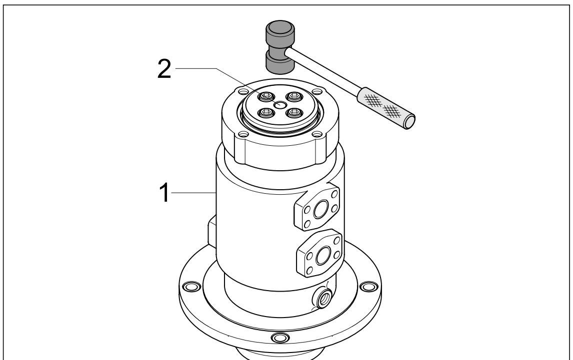
(1) Fix seven slipper seal(7) and O-ring(9), to body(1).

(2) Fit O-ring(8) to shaft(2).



45078DA12

(3) Set shaft(2) on block, tap body(1) with a plastic hammer to install.

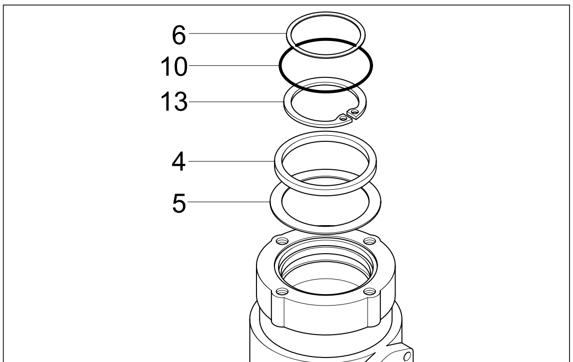


45078DA13

(4) Fit shim(5), spacer(4) and retainer ring (13) to shaft(2).

(5) Fit O-ring(10) to body(1).

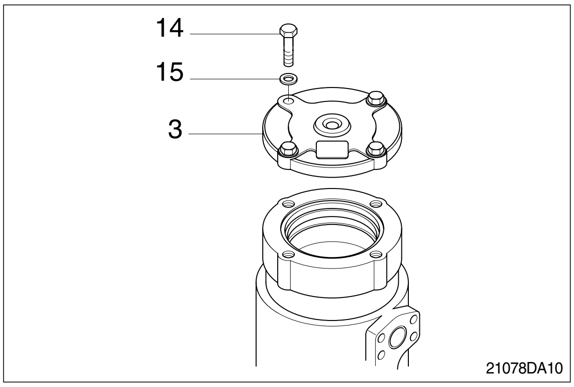
(6) Fit shim(6) to shaft(2).



45078DA11

(7) Install cover(3) to body(1) and tighten bolts(14).

· Torque : 10~12.5kgf · m(72.3~90.4lbf · ft)



GROUP 9 BOOM, ARM AND BUCKET CYLINDER

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

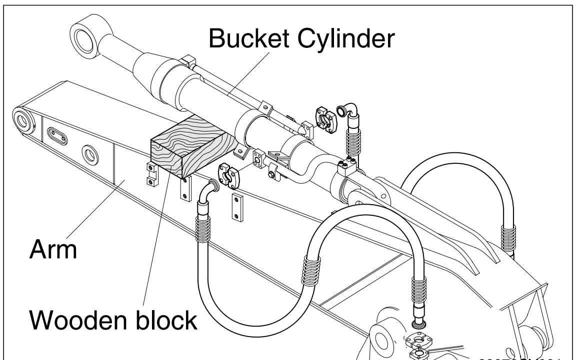
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank.

※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.


13031GE18

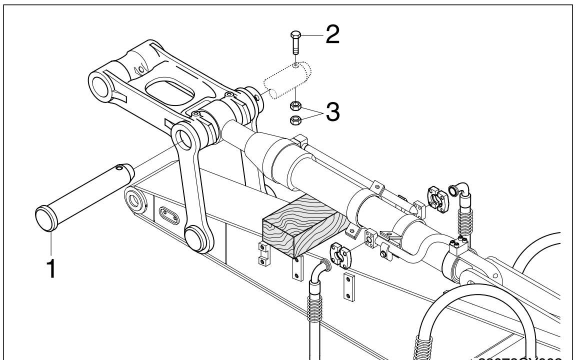
① Set block between bucket cylinder and arm.



29078CY001

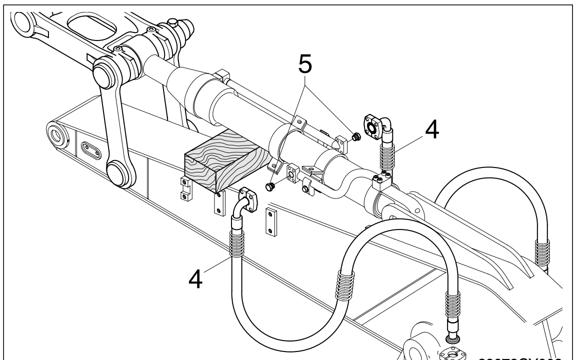
② Remove bolt(2), nut(3) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



29078CY002

③ Disconnect bucket cylinder hoses(4) and put plugs(5) on cylinder pipe.

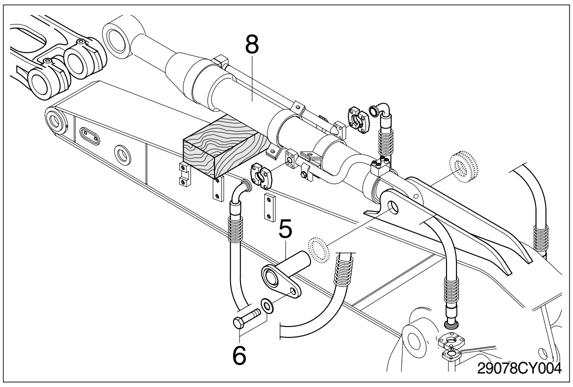


29078CY003

④ Sling bucket cylinder assembly(8) and remove bolt(6) then pull out pin (5).

⑤ Remove bucket cylinder assembly(8).

· Weight : 300kg(660lb)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ Bleed the air from the bucket cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2) ARM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

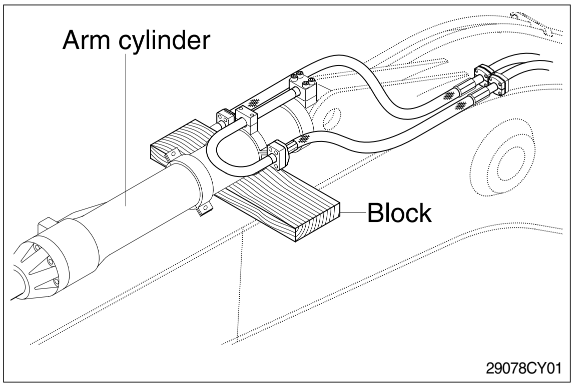
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

▲ Loosen the breather slowly to release the pressure inside the hydraulic tank.

※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between arm cylinder and boom.

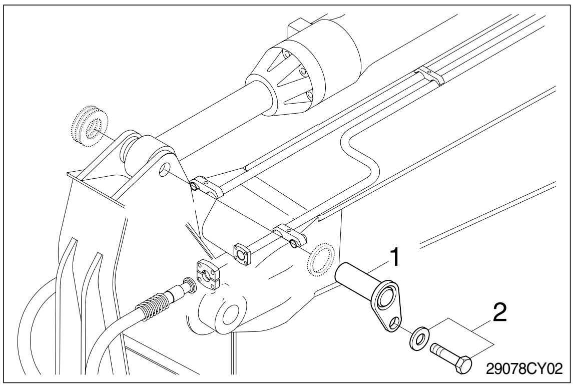

13031GE18



29078CY01

② Remove bolt(2) and pull out pin(1).

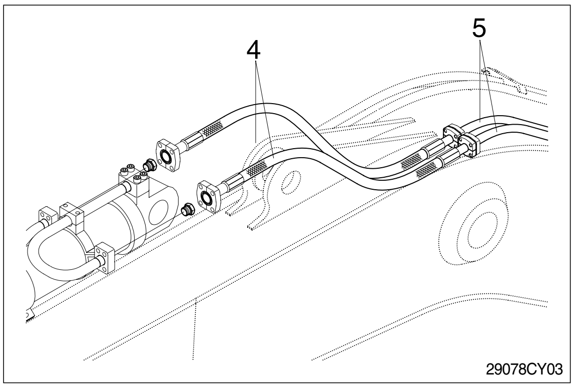
※ Tie the rod with wire to prevent it from coming out.



29078CY02

③ Disconnect arm cylinder hoses(4) and put plugs on cylinder pipe.

④ Disconnect greasing pipings(5).

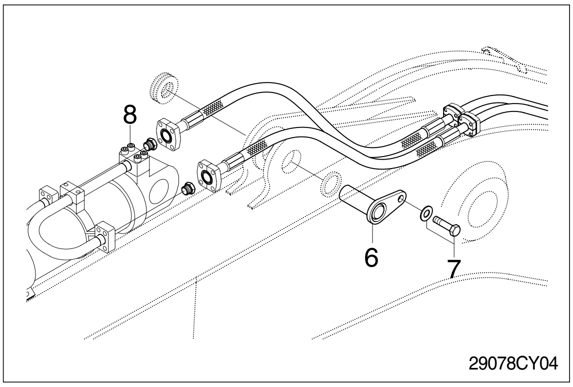


29078CY03

⑤ Sling arm assembly(8) and remove bolt (7) then pull out pin(6).

⑥ Remove arm cylinder assembly(8).

  · Weight : 540kg(1190lb)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ Bleed the air from the arm cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

3) BOOM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

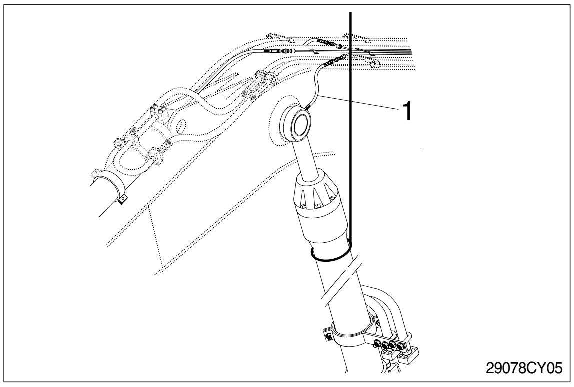
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank.

※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

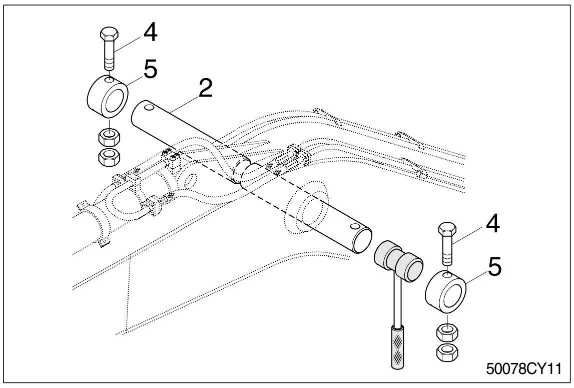
① Disconnect greasing hoses(1).

② Sling boom cylinder assembly.

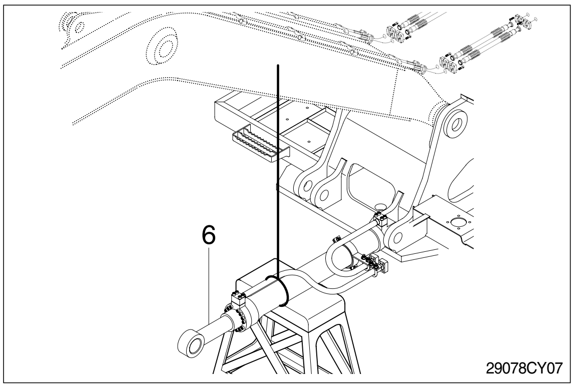


③ Remove bolt(4), pin stopper(5) and pull out pin(2).

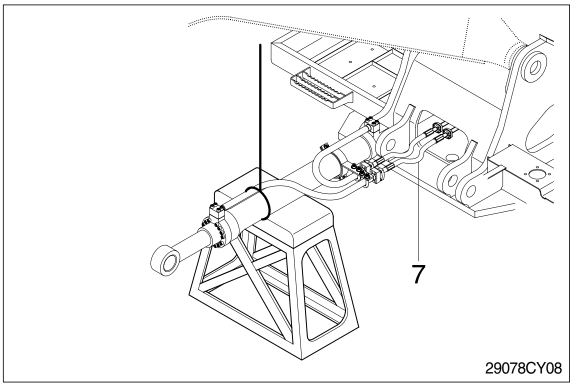
※ Tie the rod with wire to prevent it from coming out.



④ Lower the boom cylinder assembly(6) on a stand.



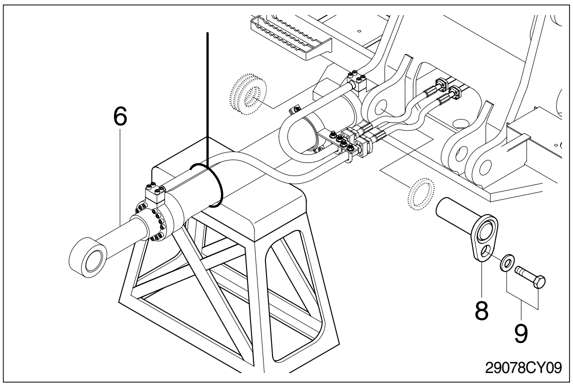
⑤ Disconnect boom cylinder hoses(7) and put plugs on cylinder pipe.



⑥ Remove bolt(9) and pull out pin(8).

⑦ Remove boom cylinder assembly(6).

· Weight : 910kg(2010lb)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

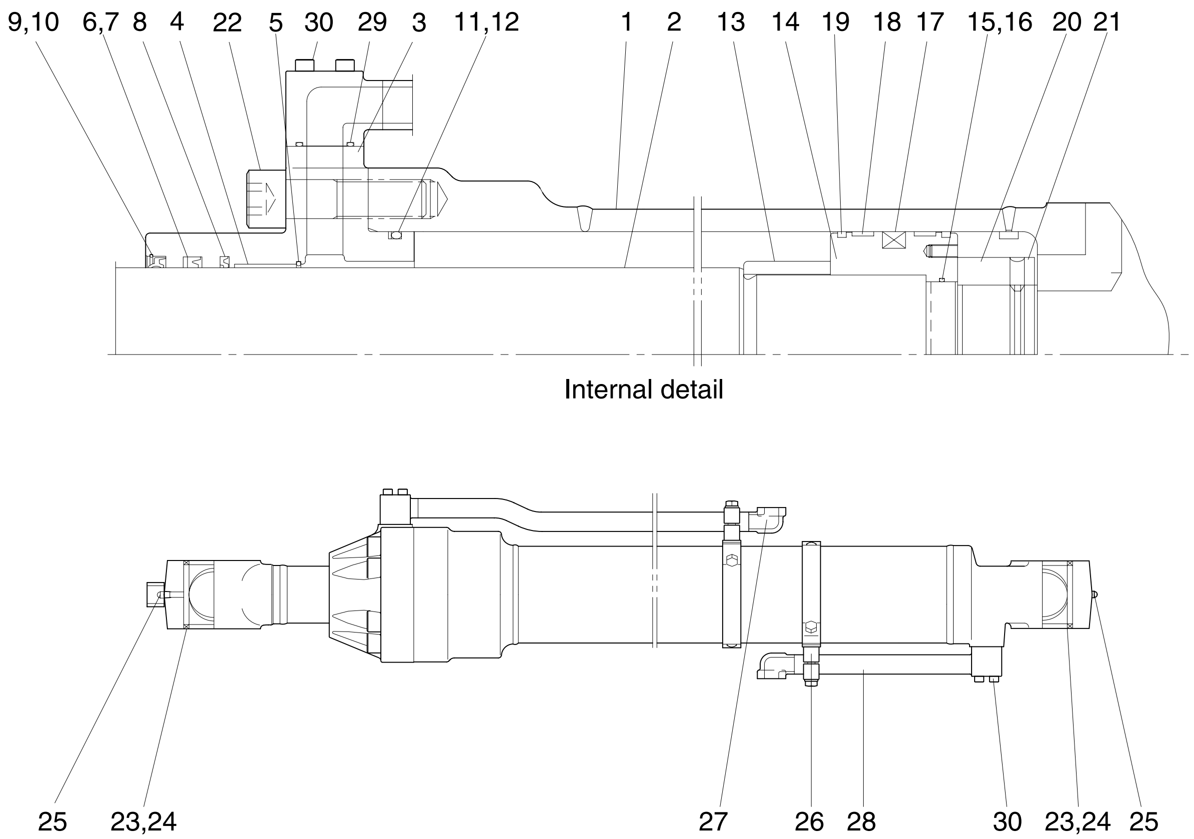
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

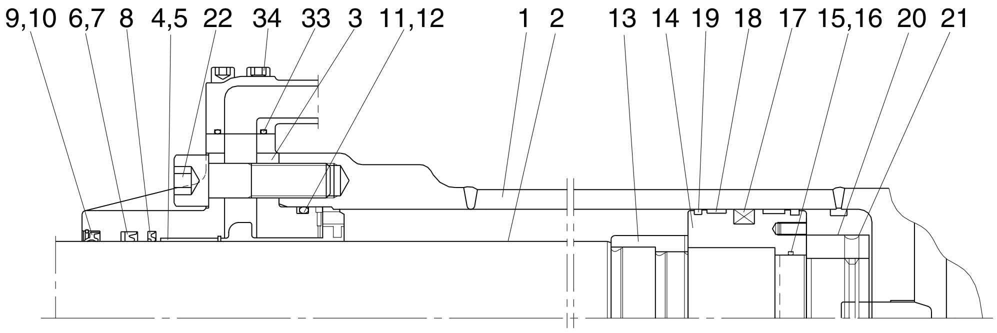
(1) Bucket cylinder



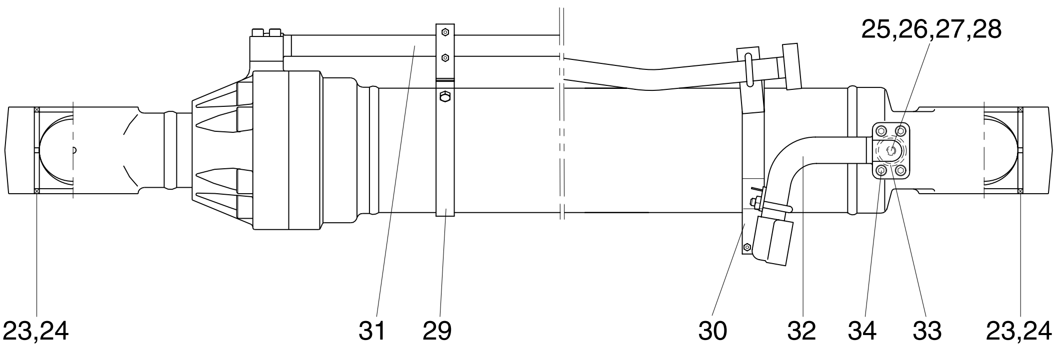
50078BK02

1	Tube assembly	11	O-ring	21	Hexagon socket set screw
2	Rod assembly	12	Back up ring	22	Hexagon socket head bolt
3	Gland	13	Cushion ring	23	Pin bushing
4	DD2 bushing	14	Piston	24	Dust seal
5	Snap ring	15	O-ring	25	Grease nipple
6	Rod seal	16	Back up ring	26	Band assembly
7	Back up ring	17	Piston seal	27	Pipe assembly
8	Buffer ring	18	Wear ring	28	Pipe assembly
9	Dust wiper	19	Dust ring	29	O-ring
10	Snap ring	20	Lock nut	30	Hexagon socket head bolt

(2) Arm cylinder

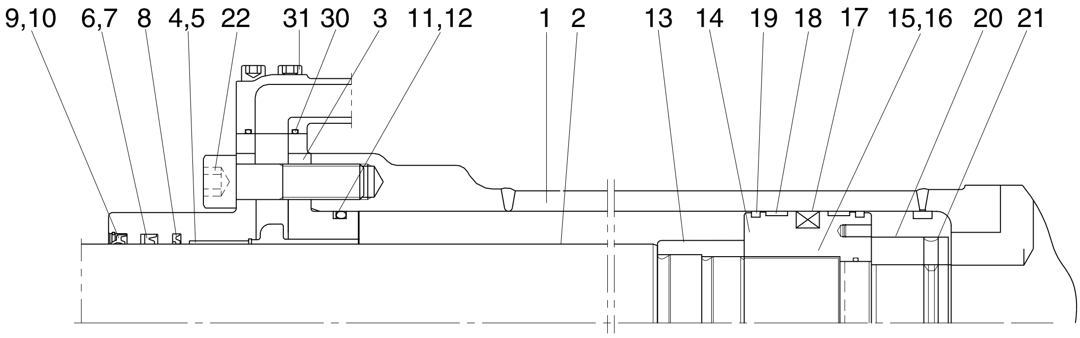


Internal detail

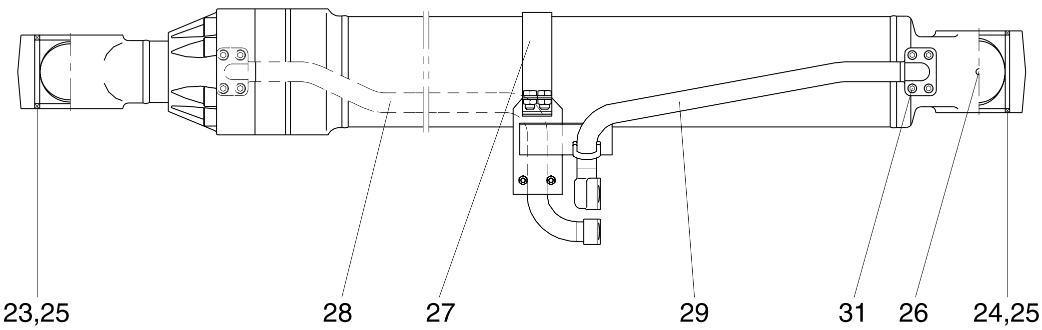


1	Tube assembly	12	Back up ring	23	Pin bushing
2	Rod assembly	13	Cushion ring	24	Dust seal
3	Gland	14	Piston	25	Check valve
4	DD2 bushing	15	O-ring	26	Coil spring
5	Snap ring	16	Back up ring	27	O-ring
6	Rod seal	17	Piston seal	28	Plug
7	Back up ring	18	Wear ring	29	Band assembly
8	Buffer ring	19	Dust ring	30	Band assembly
9	Dust wiper	20	Lock nut	31	Pipe assembly
10	Snap ring	21	Hexagon socket set screw	32	Pipe assembly
11	O-ring	22	Hexagon socket head bolt	33	O-ring
				34	Hexagon socket head bolt

(3) Boom cylinder



Internal detail

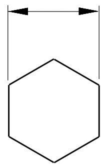


50078BO01

1 Tube assembly
2 Rod assembly
3 Gland
4 DD2 bushing
5 Snap ring
6 Rod seal
7 Back up ring
8 Buffer ring
9 Dust wiper
10 Snap ring
11 O-ring
12 Back up ring
13 Cushion ring
14 Piston
15 O-ring
16 Back up ring
17 Piston seal
18 Wear ring
19 Dust ring
20 Lock nut
21 Hexagon socket set screw
22 Hexagon socket head bolt
23 Pin bushing
24 Pin bushing
25 Dust seal
26 Grease nipple
27 Band assembly
28 Pipe assembly
29 Pipe assembly
30 O-ring
31 Hexagon socket head bolt

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	10	
	14	
	18	
	24	
	30	
(-) Driver	Small and large sizes	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Socket head bolt	Bucket cylinder	22	M22	63.0±6.0	456±43
	Boom cylinder	22	M22	63.0±6.0	456±43
	Arm cylinder	22	M24	79.0±8.0	571±58
Socket head bolt	Bucket cylinder	21	M10	5.4±0.5	39.1±3.6
		30	M12	9.4±1.0	68.0±7.2
	Boom cylinder	21	M10	5.4±0.5	39.1±3.6
		31	M12	9.4±1.0	68.0±7.2
	Arm cylinder	21	M10	5.4±0.5	39.1±3.6
		34	M12	9.4±1.0	68.0±7.2

3) DISASSEMBLY

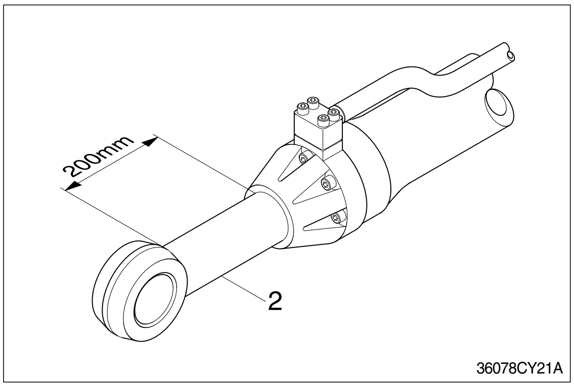
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder.

① Hold the clevis section of the tube in a vise.

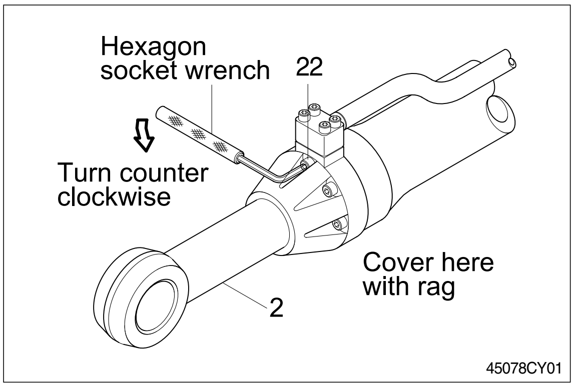
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside

② Pull out rod assembly(2) about 200㎜ (7.1in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



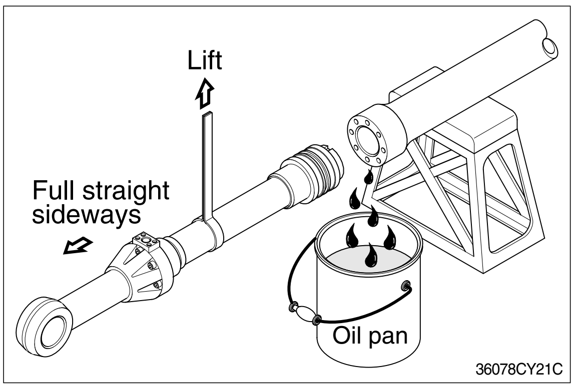
③ Loosen and remove socket bolts(22) of the gland in sequence.

※ Cover the extracted rod assembly(2) with rag to prevent it from being accidentally damaged during operation.



④ Draw out cylinder head and rod assembly together from tube assembly(1).

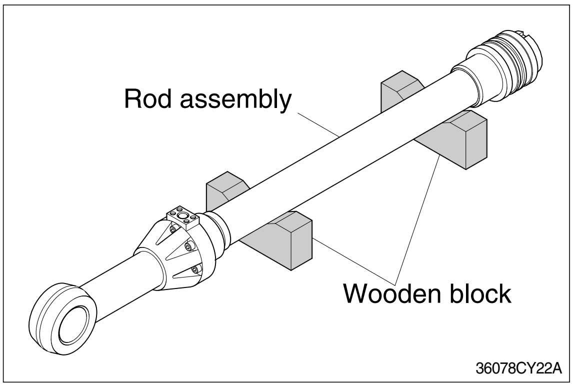
※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly(2) with a crane or some means and draw it out. However, when rod assembly(2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



Note that the plated surface of rod assembly(2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly on a wooden V-block that is set level.

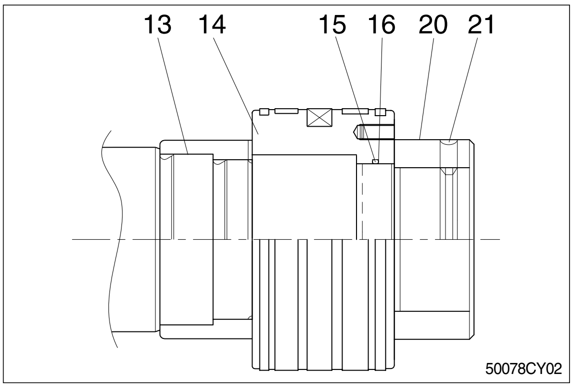
※ Cover a V-block with soft rag.



(2) Remove piston and cylinder head

① Remove screw(21) and lock nut(20).

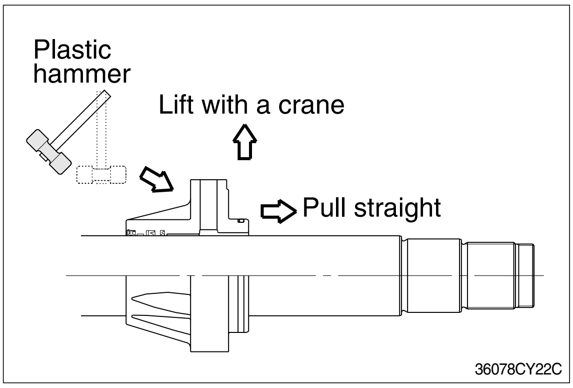
② Remove piston assembly(14), back up ring(16), and O-ring(15).



③ Remove the cylinder head assembly from rod assembly(2).

※ If it is too heavy to move, move it by striking the flanged part of cylinder head with a plastic hammer.

※ Pull it straight with cylinder head assembly lifted with a crane.
Exercise care so as not to damage the lip of rod bushing(4) and packing (6, 7, 8, 9, 10) by the threads of rod assembly(2).

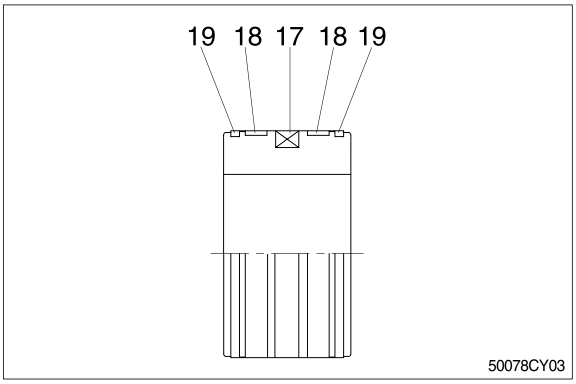


(3) Disassemble the piston assembly

① Remove wear ring(18).

② Remove dust ring(19) and piston seal (17).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

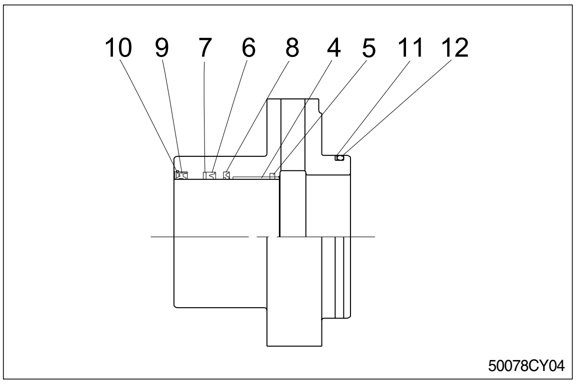
① Remove back up ring(12) and O-ring (11).

② Remove snap ring(10), dust wiper(9).

③ Remove back up ring(7), rod seal(6) and buffer ring(8).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

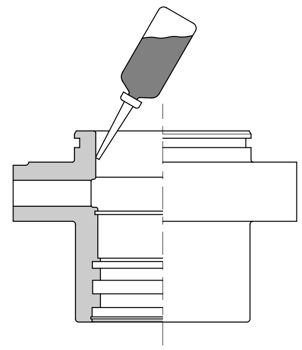


3) ASSEMBLY

(1) Assemble cylinder head assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

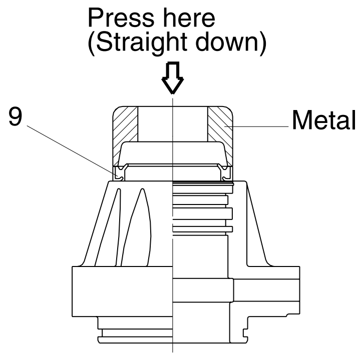
① Coat the inner face of gland(3) with hydraulic oil.



21078DA37

② Coat dust wiper(9) with grease and fit dust wiper(9) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.

③ Fit snap ring(10) to the stop face.

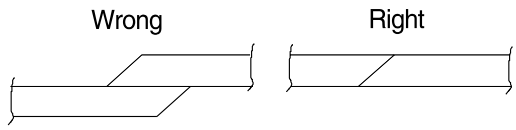


36078CY24A

④ Fit back up ring(7), rod seal(6) and buffer ring(8) to corresponding grooves, in that order.

※ Coat each packing with hydraulic oil before fitting it.

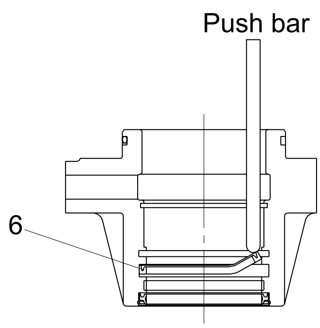
※ Insert the backup ring until one side of it is inserted into groove.



8-157(3) 210-7

※ Rod seal(6) has its own fitting direction. Therefore, confirm it before fitting them.

※ Fitting rod seal(6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.

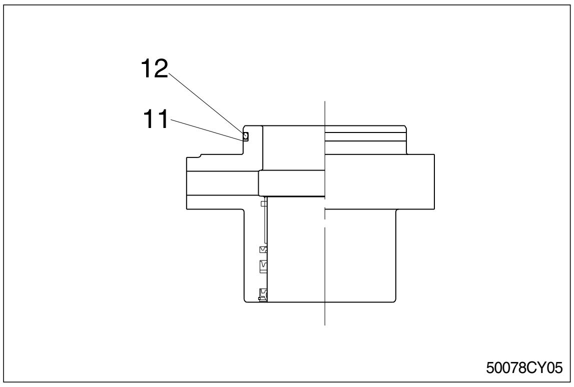


45078CY24

⑤ Fit back up ring(12) to gland(3).

※ Put the backup ring in the warm water of 30~50°C.

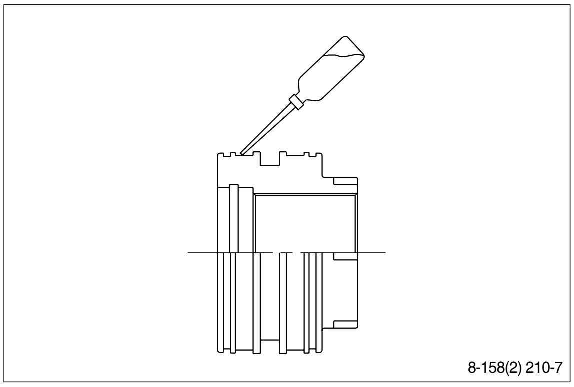
⑥ Fit O-ring(11) to gland(3).



(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

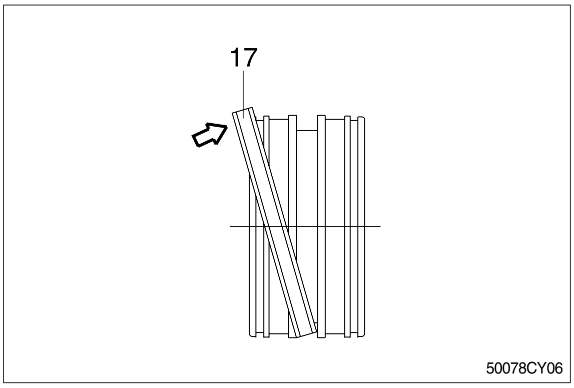
① Coat the outer face of piston(17) with hydraulic oil.



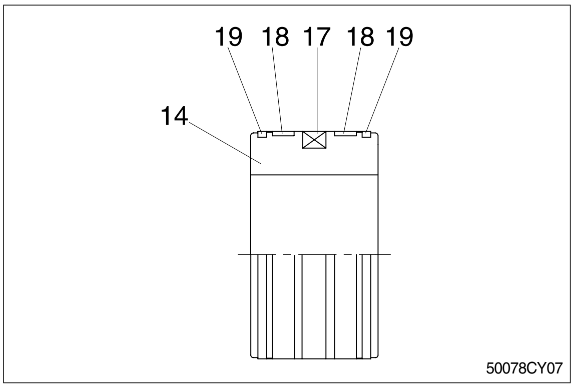
② Fit piston seal(17) to piston.

※ Put the piston seal in the warm water of 60~100°C for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.



③ Fit wear ring(18) and dust ring(19) to piston(14).

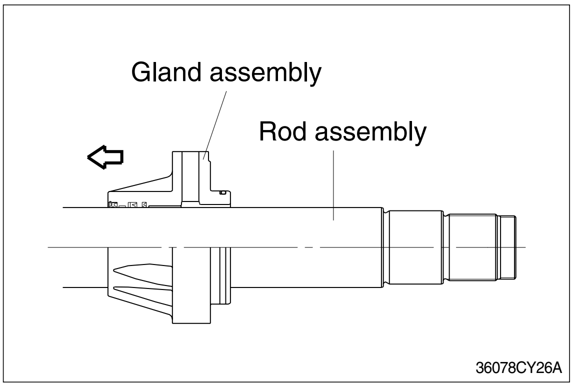


(3) Install piston and cylinder head

① Fix the rod assembly to the work bench.

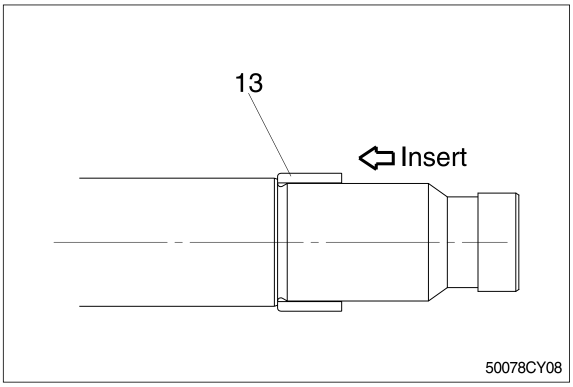
② Apply hydraulic oil to the outer surface of rod assembly(2), the inner surface of piston and cylinder head.

③ Insert cylinder head assembly to rod assembly.

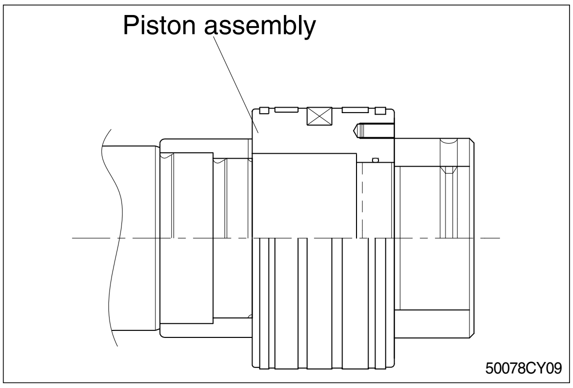


④ Insert cushion ring(13) to rod assembly.

※ Note that cushion ring(13) has a direction in which it should be fitted.



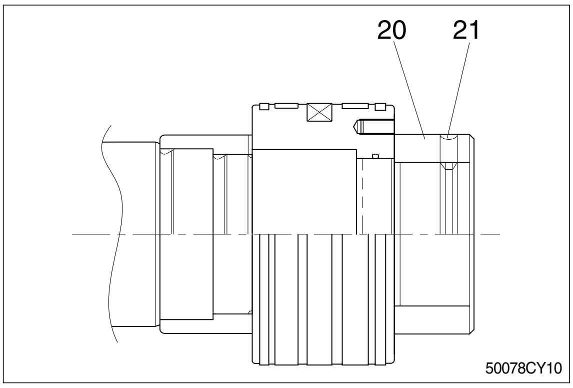
⑤ Fit piston assembly to rod assembly.



⑥ Fit lock nut(20) and tighten the screw (21).

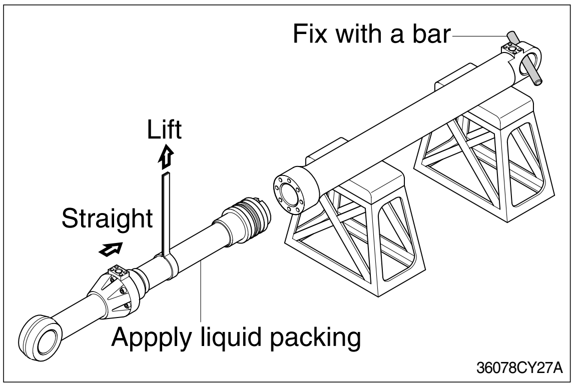
· Tightening torque :

Item		kgf · m	lbf · ft
Bucket	21	5.4±0.5	39.1±3.6
Boom	21	5.4±0.5	39.1±3.6
Arm	21	5.4±0.5	39.1±3.6



(3) Overall assemble

① Place a V-block on a rigid work bench. Mount the tube assembly(1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

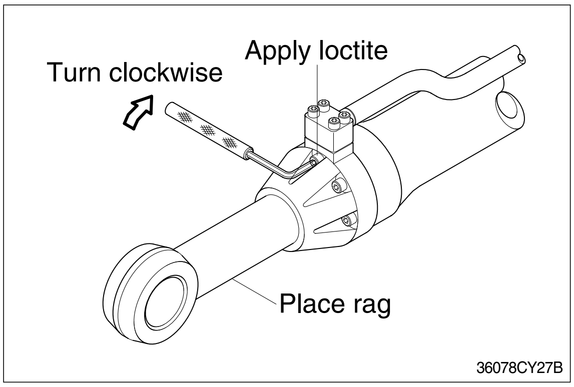


② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

※ Be careful not to damage piston seal by thread of tube assembly.

③ Match the bolt holes in the cylinder head flange to the tapped holes in the tube assembly and tighten socket bolts to a specified torque.

※ Refer to the table of tightening torque.



GROUP 10 UNDERCARRIAGE

1. TRACK LINK

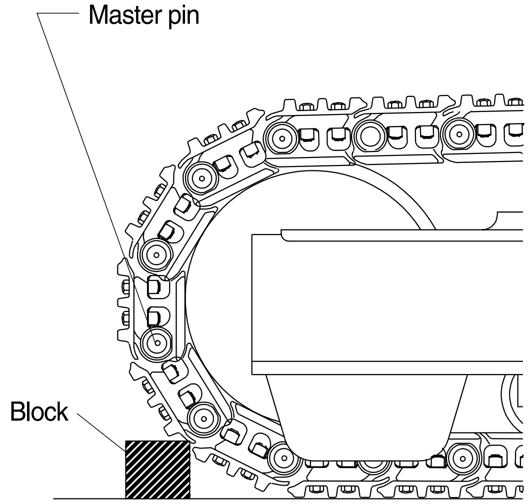
1) REMOVAL

(1) Move track link until master pin is over front idler in the position put wooden block as shown.

(2) Loosen tension of the track link.

※ If track tension is not relieved when the grease valve is loosened, move the machine backwards and forwards.

(3) Push out master pin by using a suitable tool.

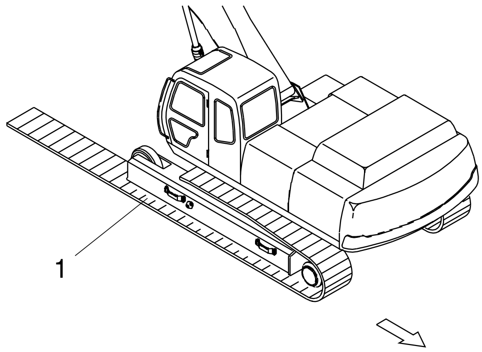


8-161(1) 210-7

(4) Move the machine slowly in reverse, and lay out track link assembly (1).

※ Jack up the machine and put wooden block under the machine.

※ Don't get close to the sprocket side as the track shoe plate may fall down on your feet.

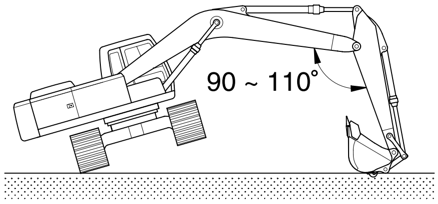


8-161(1) 210-7

2) INSTALL

(1) Carry out installation in the reverse order to removal.

※ Adjust the tension of the track link.



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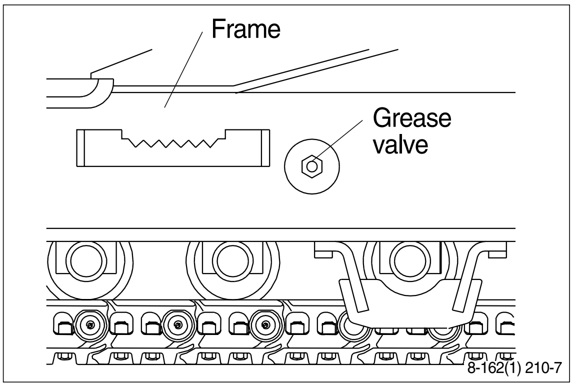
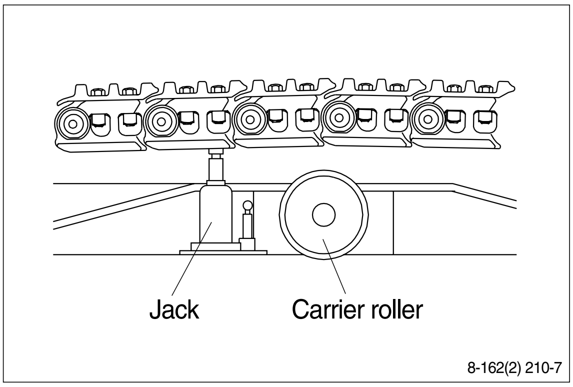
2. CARRIER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.



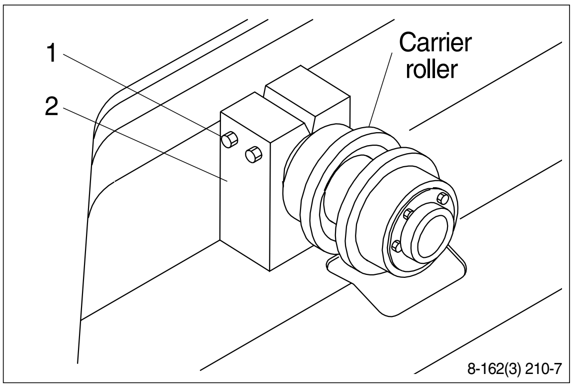
(2) Jack up the track link height enough to permit carrier roller removal.



(3) Loosen the lock nut (1).

(4) Open bracket(2) with a screwdriver, push out from inside, and remove carrier roller assembly.

· Weight : 80kg(180lb)



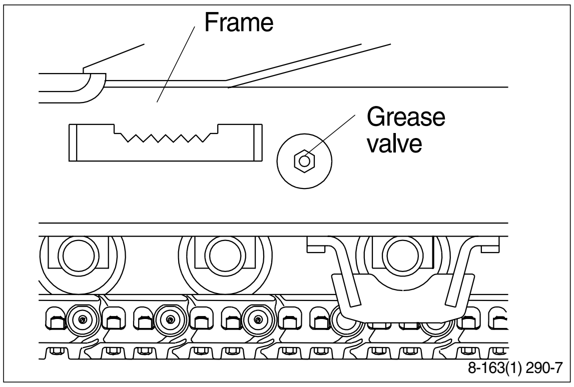
2) INSTALL

(1) Carry out installation in the reverse order to removal.

3. TRACK ROLLER

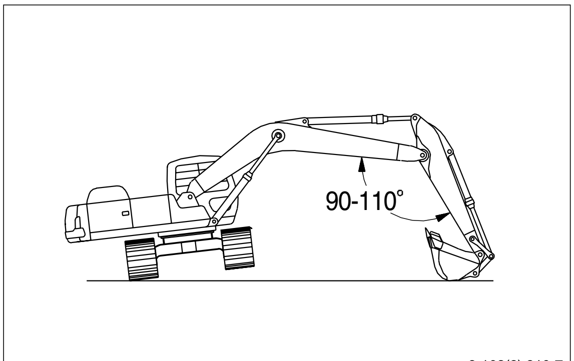
1) REMOVAL

(1) Loosen tension of the track link.



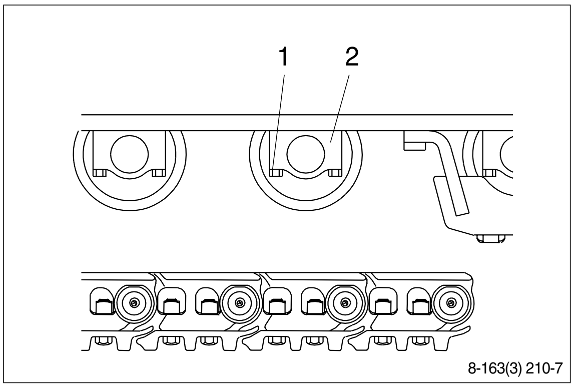
8-163(1) 290-7

(2) Using the work equipment, push up track frame on side which is to be removed.
※ After jack up the machine, set a block under the unit.



8-163(2) 210-7

(3) Remove the mounting bolt(1) and draw out the track roller(2).
· Weight : 80kg(180lb)



8-163(3) 210-7

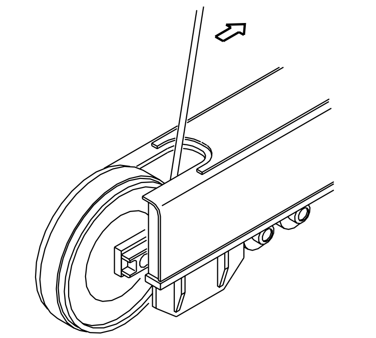
2) INSTALL

(1) Carry out installation in the reverse order to removal.

4. IDLER AND RECOIL SPRING

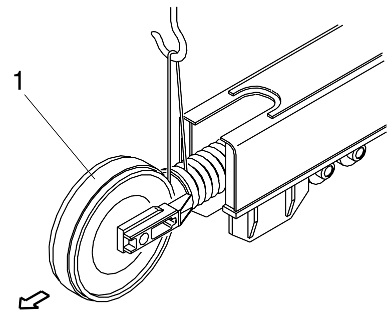
1) REMOVAL

(1) Remove the track link.
For detail, see **removal of track link**.



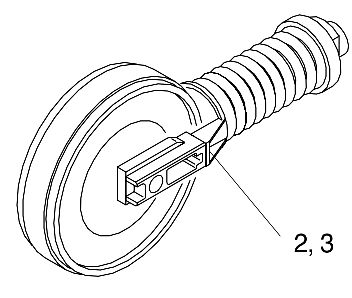
8-164(1) 210-7

(2) Sling the recoil spring(1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 550kg(1210lb)



8-164(2) 210-7

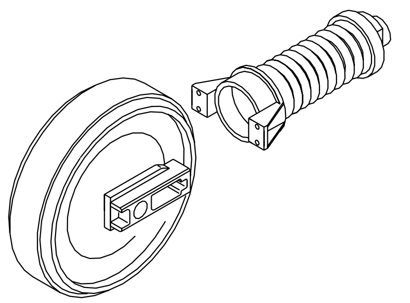
(3) Remove the bolts(2), washers(3) and separate ilder from recoil spring.



8-164(3) 210-7

2) INSTALL

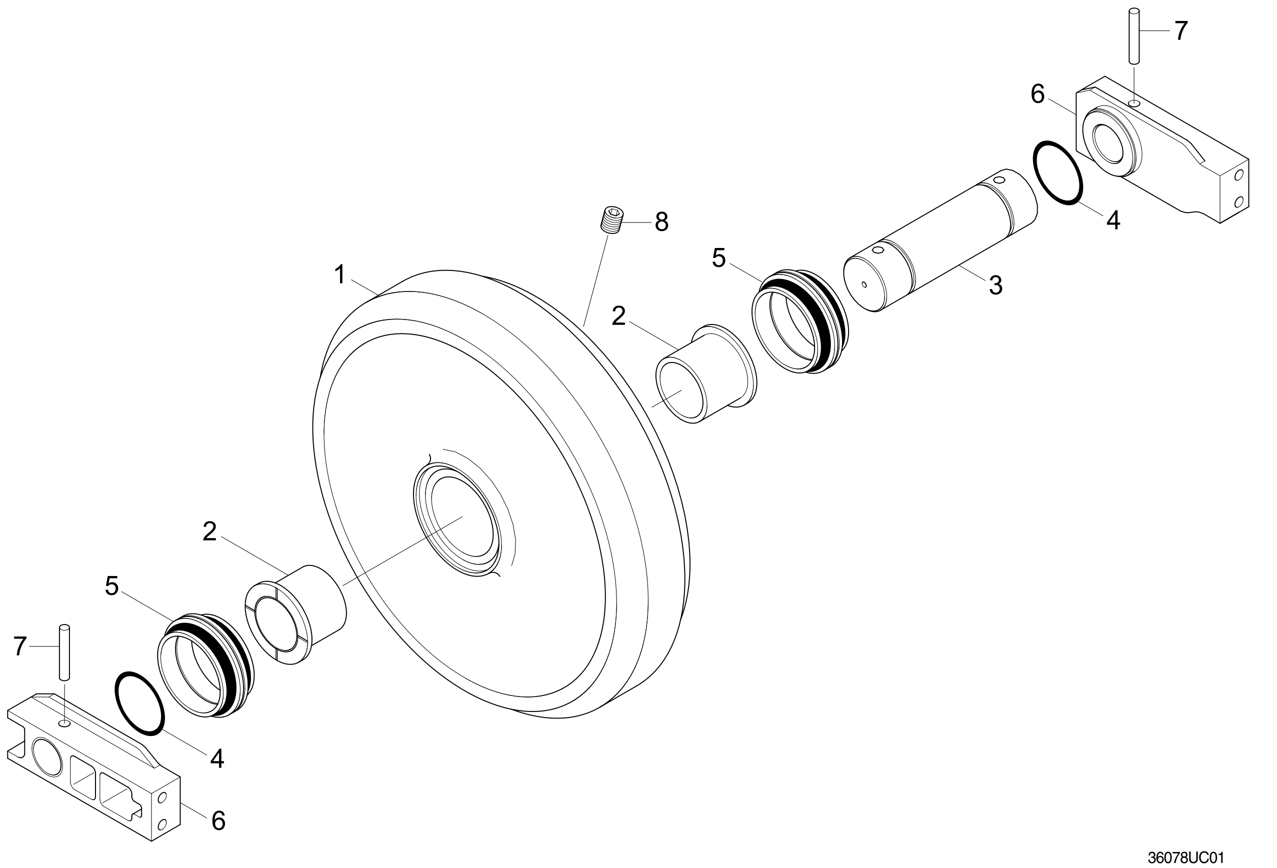
(1) Carry out installation in the reverse order to removal.
※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



8-164(4) 210-7

3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure

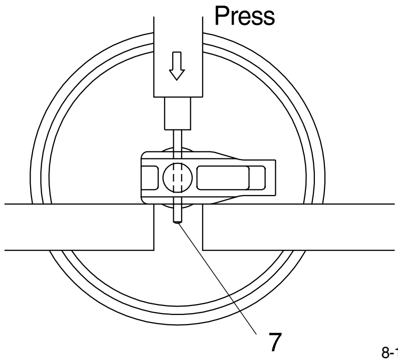


1	Shell	4	O-ring	7	Spring pin
2	Bushing	5	Seal assembly	8	Plug
3	Shaft	6	Bracket		

(2) Disassembly

① Remove plug and drain oil.

② Draw out the spring pin(7), using a press.

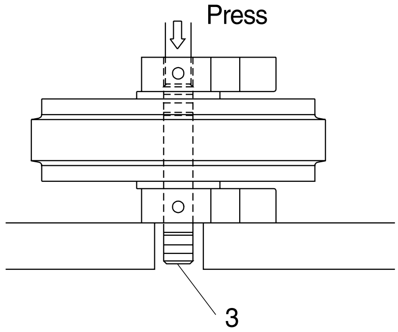


8-166(1) 210-7

③ Pull out the shaft(2) with a press.

④ Remove seal(5) from shell(1) and bracket(6).

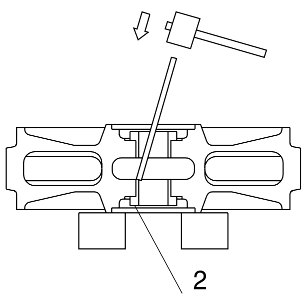
⑤ Remove O-ring(4) from shaft.



8-166(2) 210-7

⑥ Remove the bushing(2) from idler, using a special tool.

※ Only remove bushing if replacement is necessity.



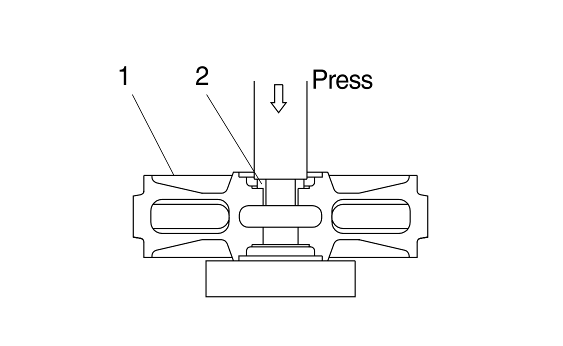
8-166(3) 210-7

(3) Assembly

※ Before assembly, clean the parts.

※ Coat the sliding surfaces of all parts with oil.

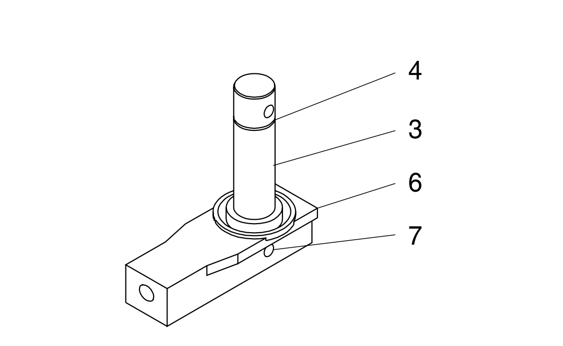
① Cool up bushing(2) fully by some dry ice and press it into shell(1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



8-167(1) 210-7

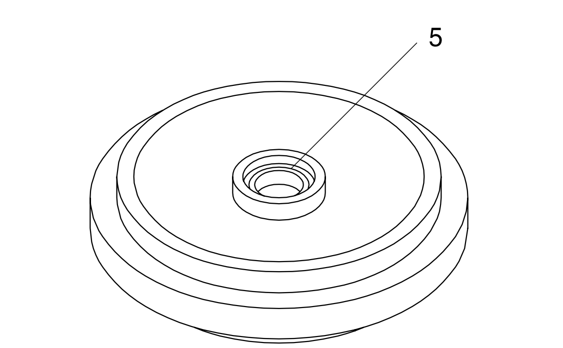
② Coat O-ring(4) with grease thinly, and install it to shaft(3).

③ Insert shaft(3) into bracket(6) and drive in the spring pin(7).



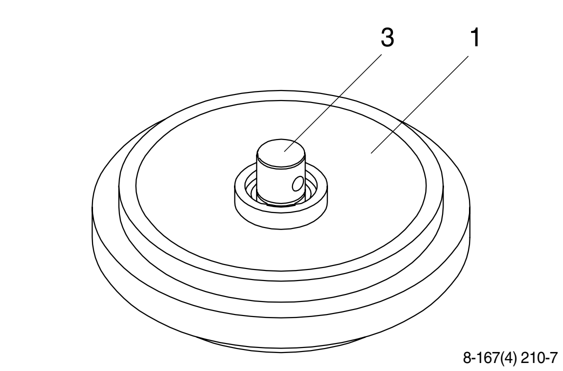
8-167(2) 210-7

④ Install seal(5) to shell(1) and bracket(6).



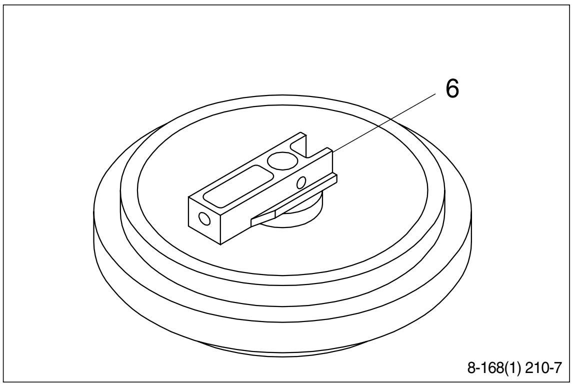
8-167(3) 210-7

⑤ Install shaft(3) to shell(1).



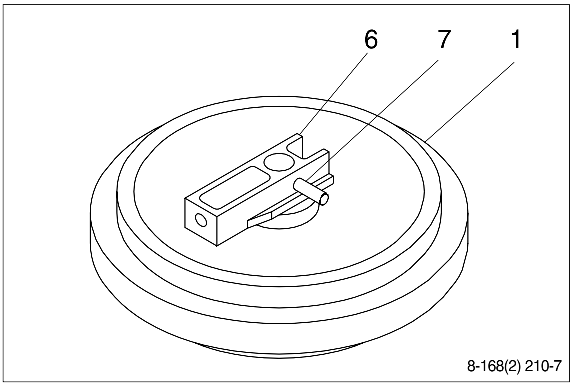
8-167(4) 210-7

⑥ Install bracket(6) attached with seal(5).



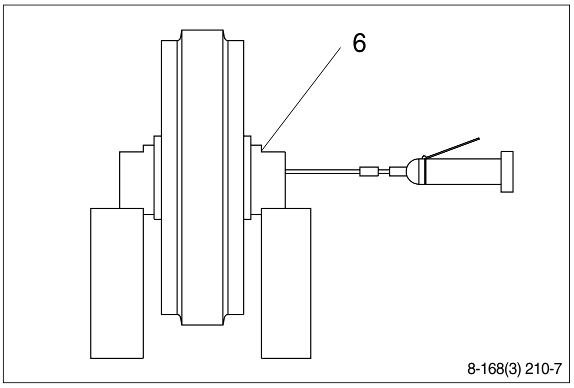
8-168(1) 210-7

⑦ Knock in the spring pin(7) with a hammer.



8-168(2) 210-7

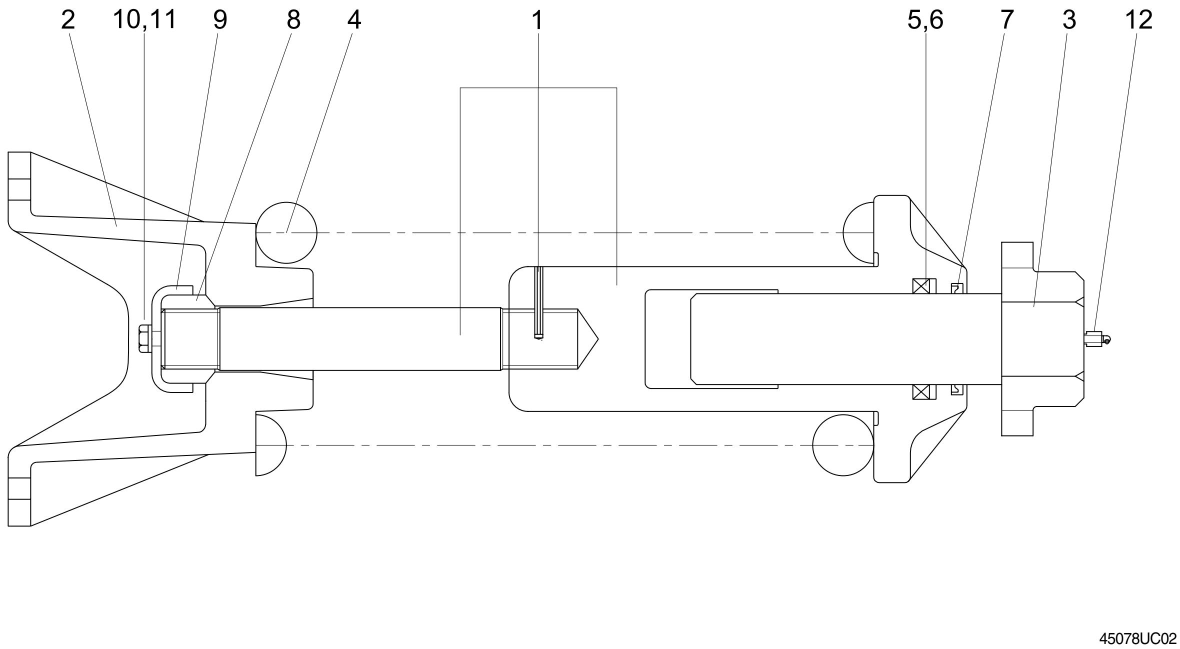
⑧ Lay bracket(6) on its side.
Supply engine oil to the specified level, and tighten plug.



8-168(3) 210-7

4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



1	Body	5	Rod seal	9	Lock plate
2	Bracket	6	Back up ring	10	Hex bolt
3	Rod assembly	7	Dust seal	11	Spring washer
4	Spring	8	Lock nut	12	Grease valve

(2) Disassembly

① Apply pressure on spring(4) with a press.

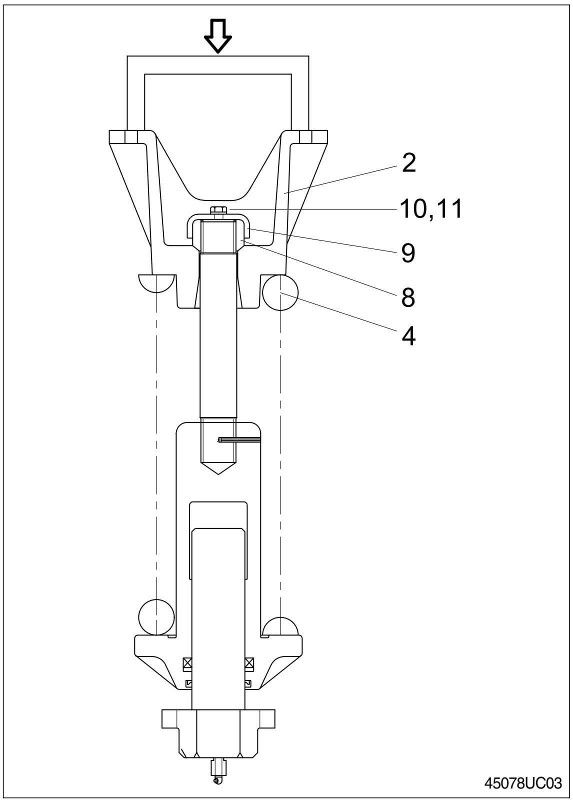
※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

· Spring set load : 24375㎏(53737lb)

② Remove bolt(10), spring washer(11) and lock plate(9).

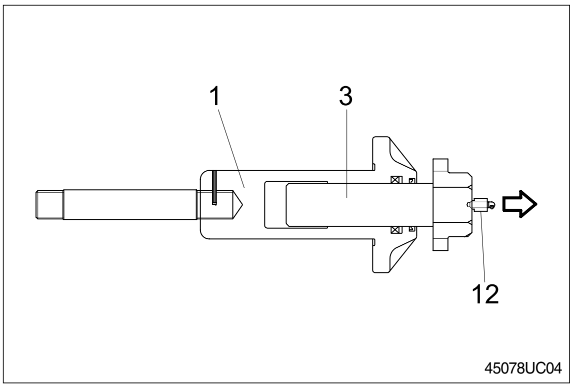
③ Remove lock nut(8).
Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

④ Lighten the press load slowly and remove bracket(2) and spring(4).

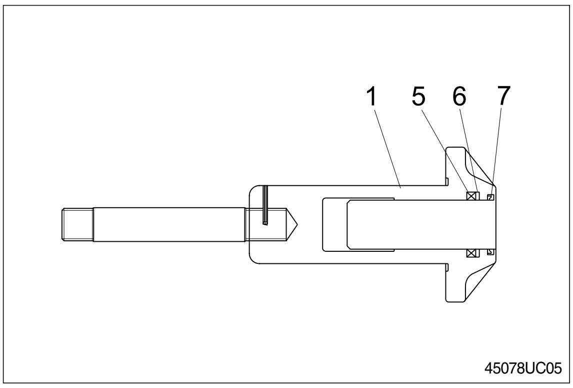


⑤ Remove rod(3) from body(1).

⑥ Remove grease valve(12) from rod(3).



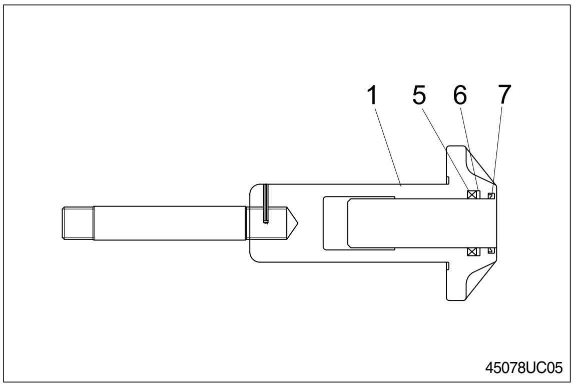
⑦ Remove rod seal(5), back up ring(6) and dust seal(11).



(3) Assembly

① Install dust seal(7), back up ring(6) and rod seal(5) to body(1).

※ When installing dust seal(7) and rod seal(5), take full care so as not to damage the lip.

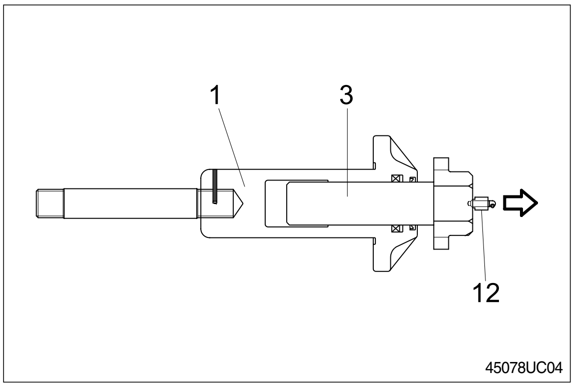


② Pour grease into body(1), then push in rod(3) by hand.
After take grease out of grease valve mounting hole, let air out.

※ If air letting is not sufficient, it may be difficult to adjust the tension of crawler.

③ Fit grease valve(12) to rod(3).

· Tightening torque : 13.0±1.0kgf · m
(94±7.2lbf · ft)

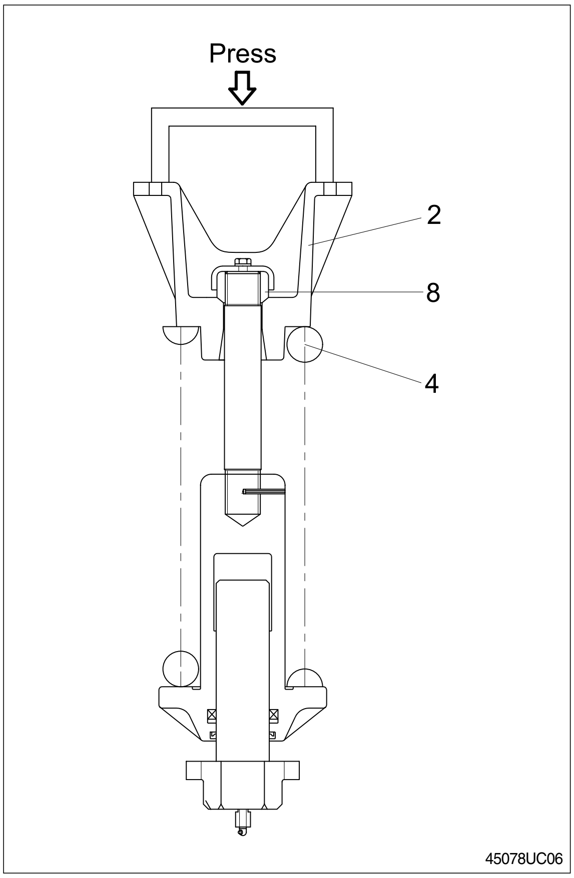


④ Install spring(4) and bracket(2) to body (1).

⑤ Apply pressure to spring(4) with a press and tighten lock nut(8).

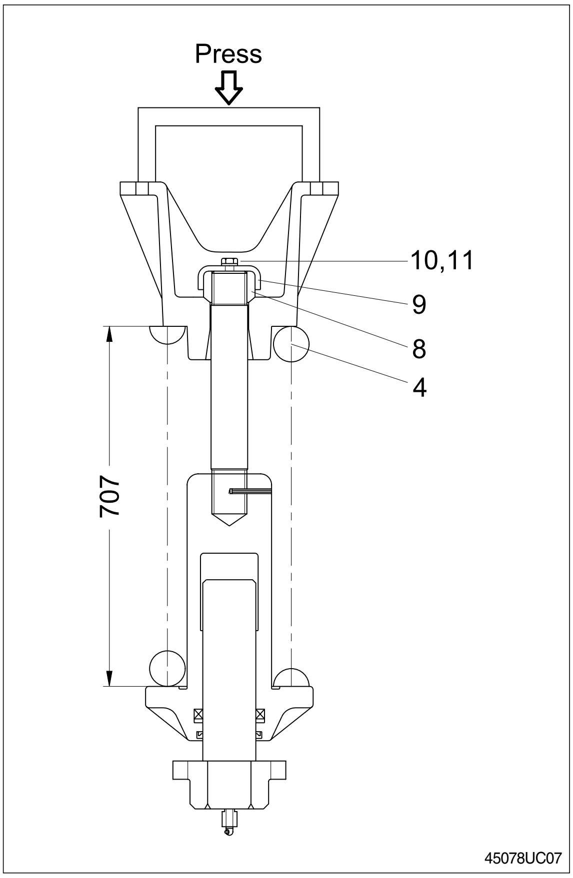
※ Apply sealant before assembling.

※ During the operation, pay attention specially to prevent the press from slipping out.



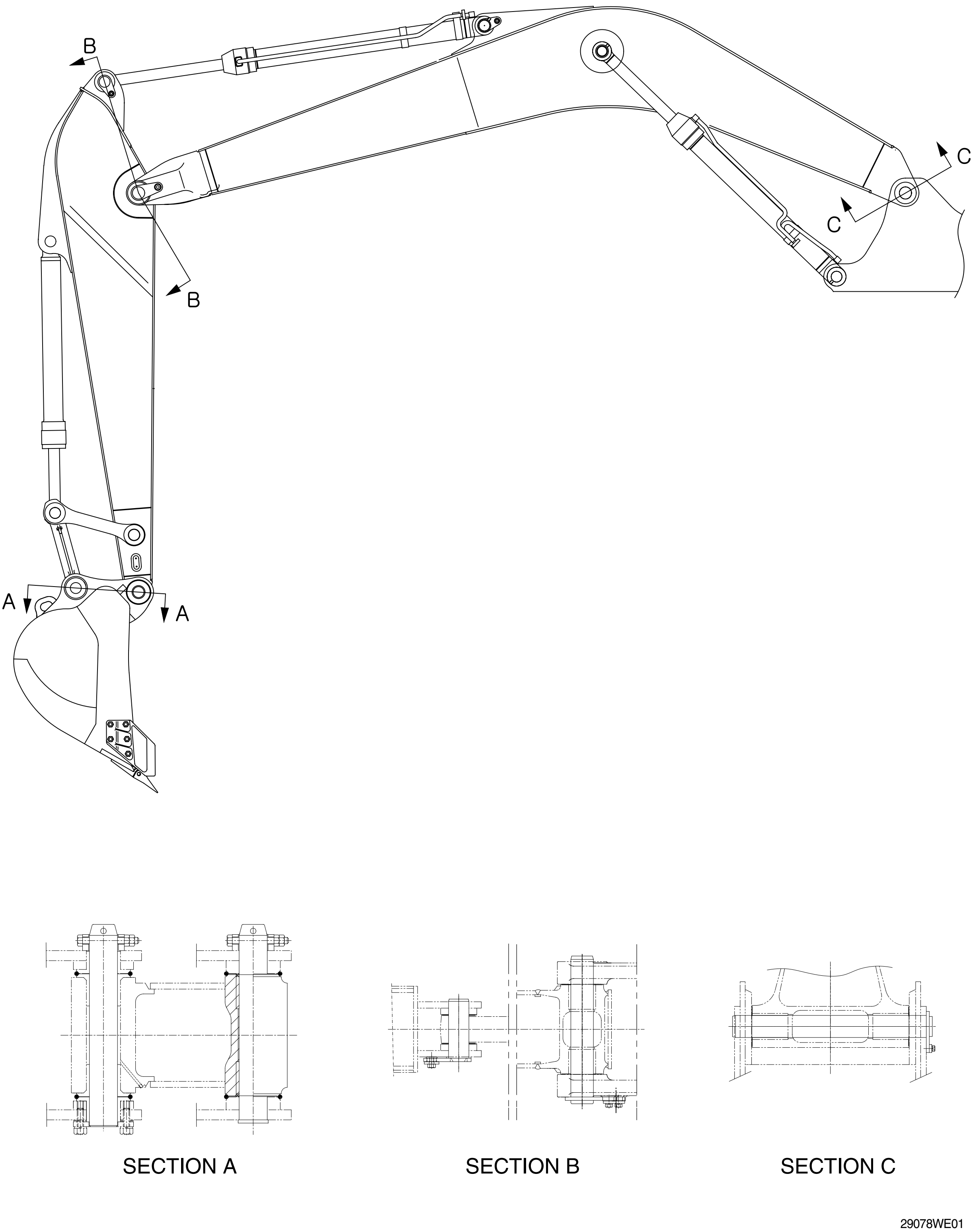
⑥ Lighten the press load and confirm the set length of spring(4).

⑦ After the setting of spring(4), install lock plate(9), spring washer(11) and bolt(10).



GROUP 11 WORK EQUIPMENT

1. STRUCTURE

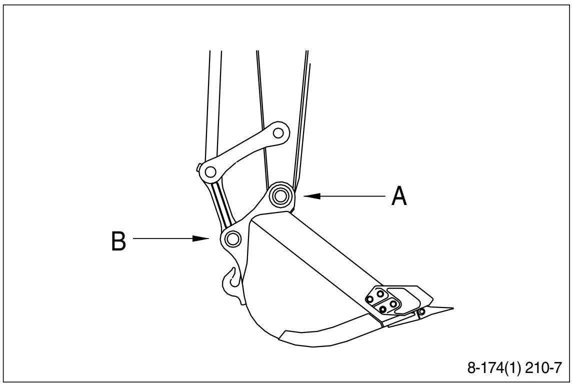


2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

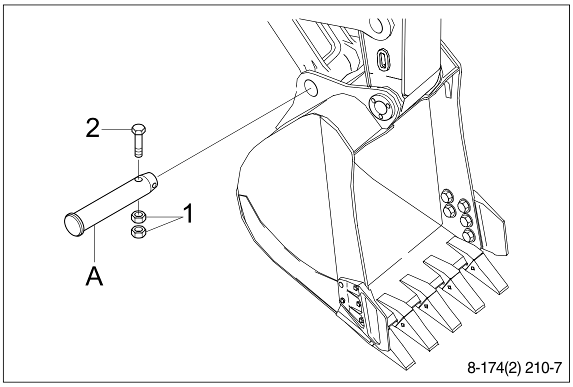
(1) Removal

① Lower the work equipment completely to ground with back of bucket facing down.



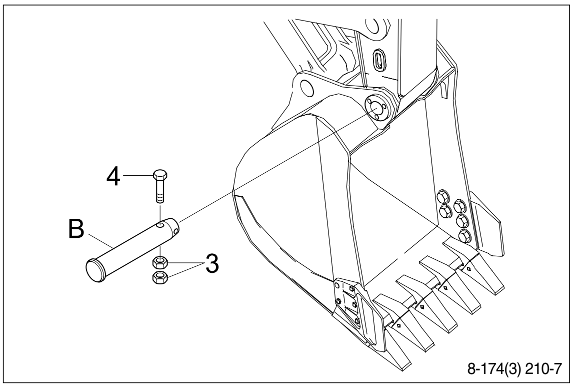
8-174(1) 210-7

② Remove nut(1), bolt(2) and draw out the pin(A).



8-174(2) 210-7

③ Remove nut(3), bolt(4) and draw out the pin(B).



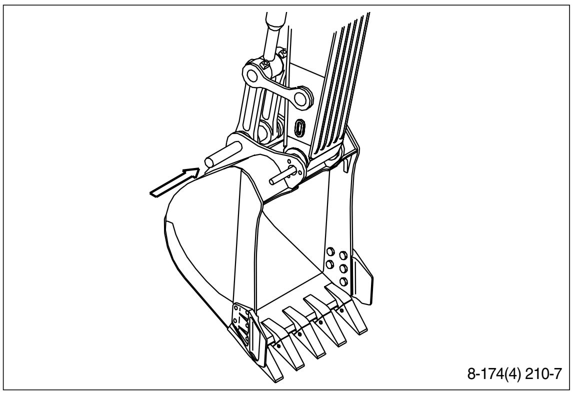
8-174(3) 210-7

(2) Install

① Carry out installation in the reverse order to removal.

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ Adjust the bucket clearance.
For detail, see **operation manual.**



8-174(4) 210-7

2) ARM ASSEMBLY

(1) Removal

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ Escaping fluid under pressure can penetrated the skin causing serious injury.

① Remove bucket assembly.
For details, see **removal of bucket assembly.**

② Disconnect bucket cylinder hose(1).

⚠ Fit blind plugs in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.

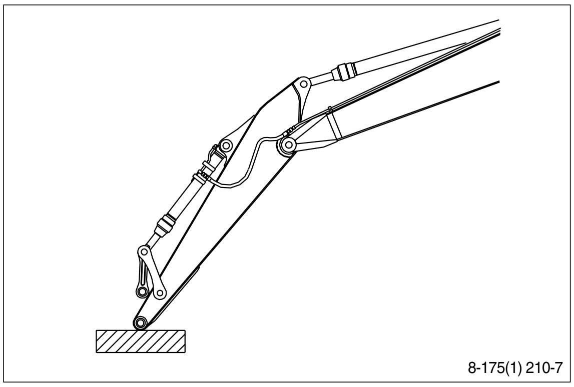
③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

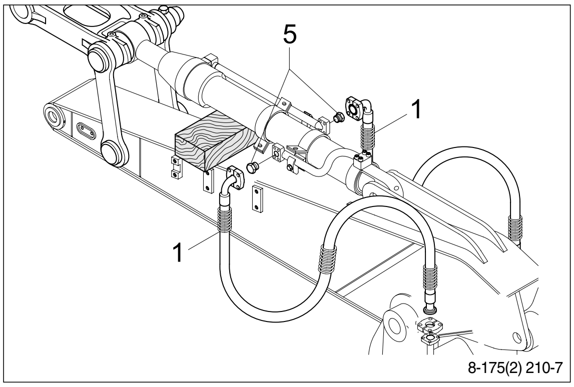
※ Tie the rod with wire to prevent it from coming out.

④ For details, see **removal of arm cylinder assembly.**
Place a wooden block under the cylinder and bring the cylinder down to it.

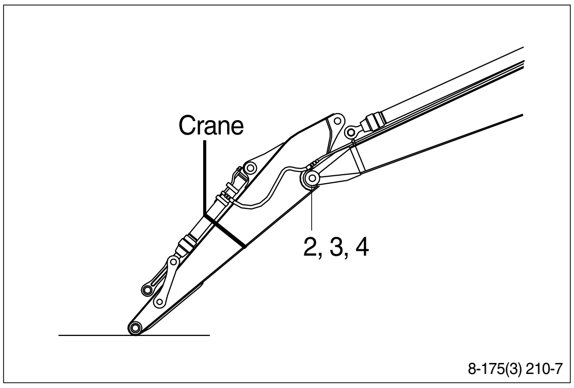
⑤ Remove bolt(2), plate(3) and pull out the pin(4) then remove the arm assembly.
· Weight : 1450㎏(3200lb)

※ When lifting the arm assembly, always lift the center of gravity.


8-175(1) 210-7



8-175(2) 210-7



8-175(3) 210-7

(2) Install

① Carry out installation in the reverse order to removal.

⚠ When lifting the arm assembly, always lift the center of gravity.

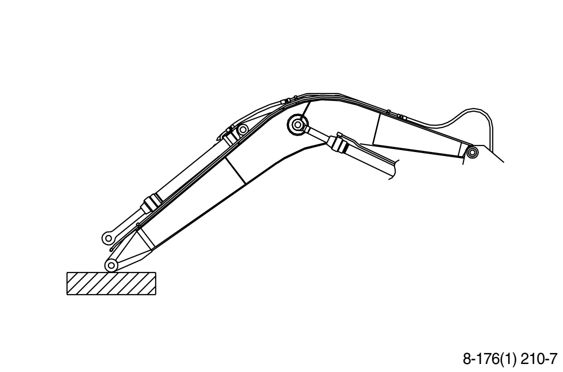
※ Bleed the air from the cylinder.

3) BOOM ASSEMBLY

(1) Removal

① Remove arm and bucket assembly.
For details, see **removal of arm and bucket assembly.**

② Remove boom cylinder assembly from boom.
For details, see **removal of boom cylinder assembly.**



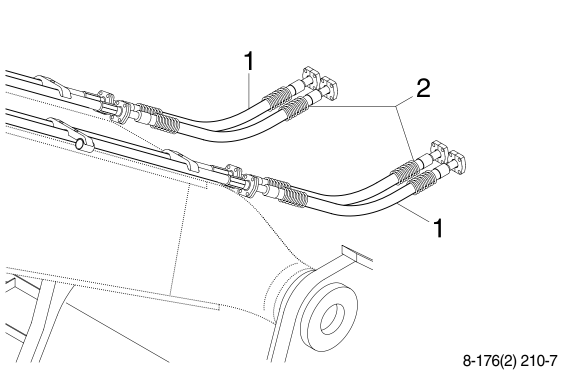
8-176(1) 210-7

③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose(2) and arm cylinder hose(1).

※ When the hose are disconnected, oil may spurt out.

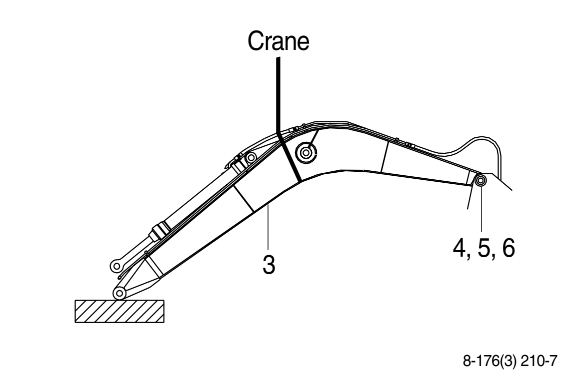
⑤ Sling boom assembly(3).



8-176(2) 210-7

⑥ Remove bolt(4), plate(5) and pull out the pin(6) then remove boom assembly.
· Weight : 3300kg(7360lb)

※ When lifting the boom assembly always lift the center of gravity.



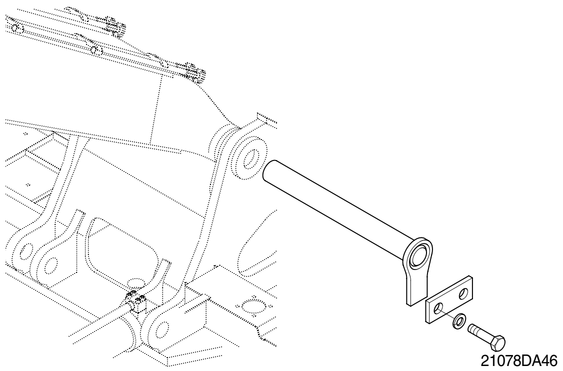
8-176(3) 210-7

(2) Install

① Carry out installation in the reverse order to removal.

⚠ When lifting the boom assembly, always lift the center of gravity.

※ Bleed the air from the cylinder.



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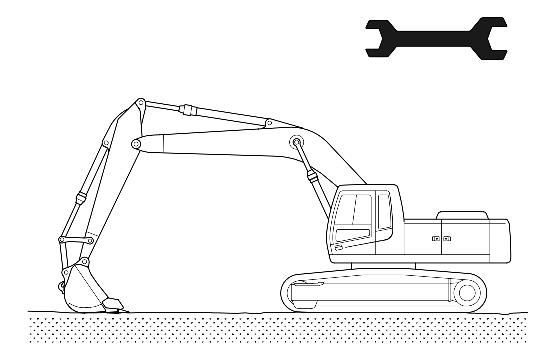
SECTION 9 COMPONENT MOUNTING TORQUE

SECTION 9 COMPONENT MOUNTING TORQUE

GROUP 1 INTRODUCTION GUIDE

1. This section shows bolt specifications and standard torque values needed when mounting components to the machine.
2. Use genuine Hyundai spare parts.
   We expressly point out that Hyundai will not accept any responsibility for defects resulted from non-genuine parts.
   In such cases Hyundai cannot assume liability for any damage.

※ **Only metric fasteners can be used and incorrect fasteners may result in machine damage or malfunction.**
※ **Before installation, clean all the compone-nts with a non-corrosive cleaner. Bolts and threads must not be worn or damaged.**



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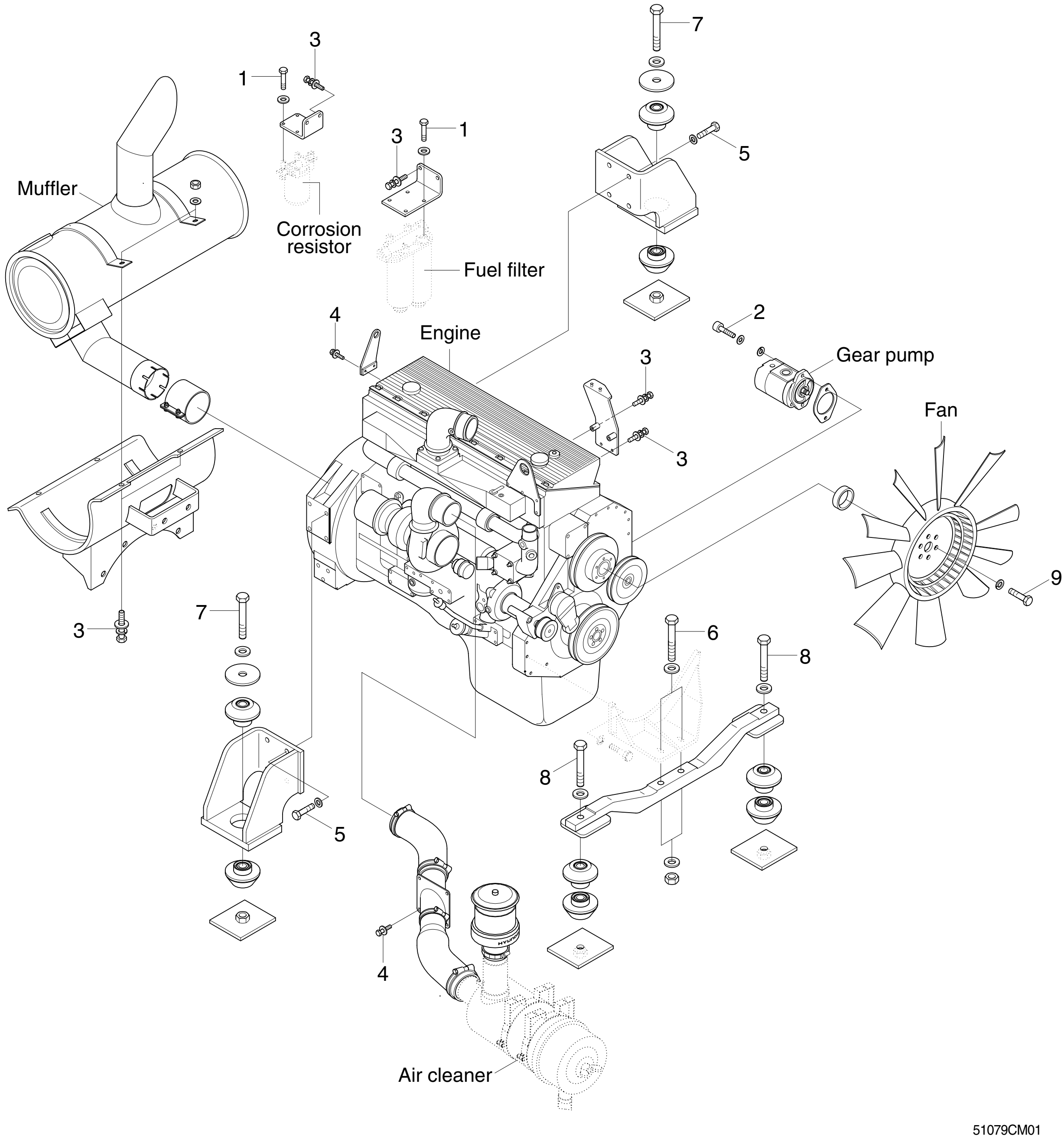
GROUP 2 ENGINE SYSTEM

ENGINE AND ACCESSORIES MOUNTING

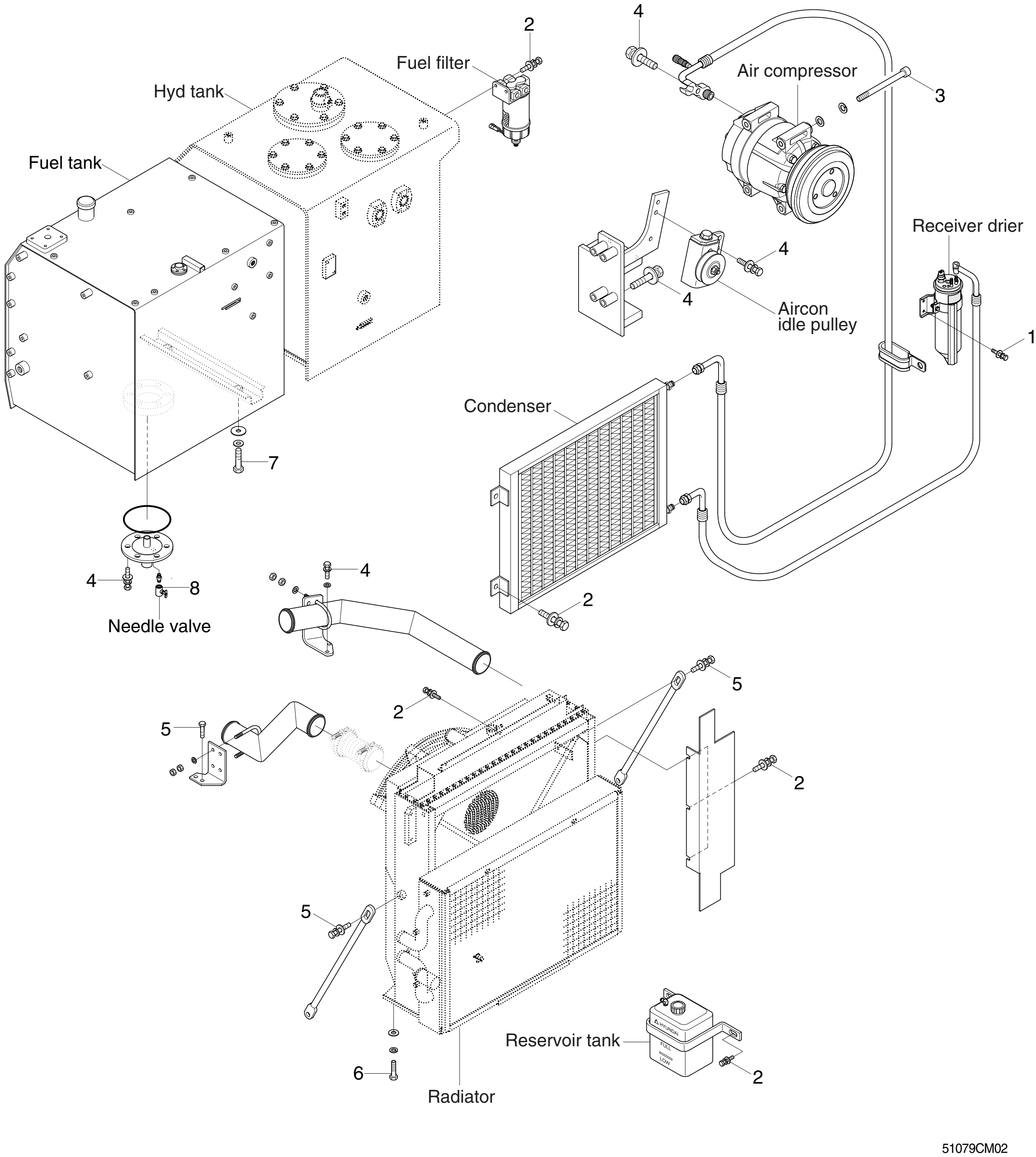


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.44±0.3	10.4±2.2
2	M 8×1.25	4.05±0.8	29.3±5.8
3	M10×1.5	6.9±1.4	49.9±10.1
4	M12×1.75	12.8±3.0	92.6±21.7
5	M16×2.0	29.7±5.0	215±36.2

Item	Size	kgf · m	lbf · ft
6	M20×2.5	57.9±8.7	419±62.9
7	M22×2.5	69.8±6.0	505±43.3
8	M22×2.5	81.9±16.1	592±116
9	3/8-16 UNC	6.1±1.0	44.1±7.2
-	-	-	-

COOLING SYSTEM AND FUEL TANK MOUNTING



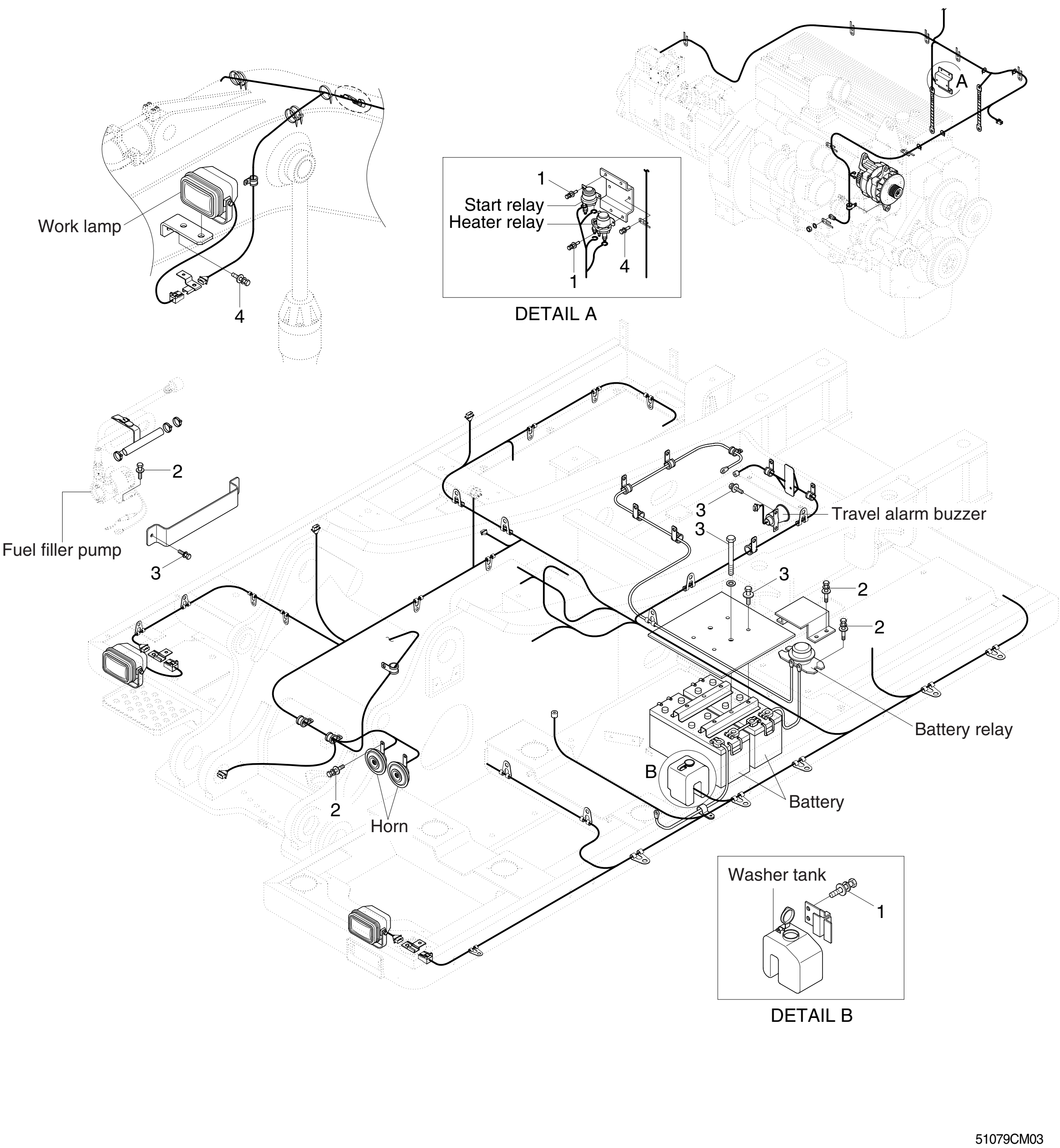
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M 8×1.25	4.05±0.8	29.3±5.8
4	M10×1.5	6.9±1.4	49.9±10.1

Item	Size	kgf · m	lbf · ft
5	M12×1.75	12.8±3.0	92.6±21.7
6	M16×2.0	29.7±4.5	215±32.5
7	M20×2.5	45±5.1	325±36.9
8	-	2.3±0.6	16.6±4.3

GROUP 3 ELECTRIC SYSTEM

ELECTRIC COMPONENTS MOUNTING 1

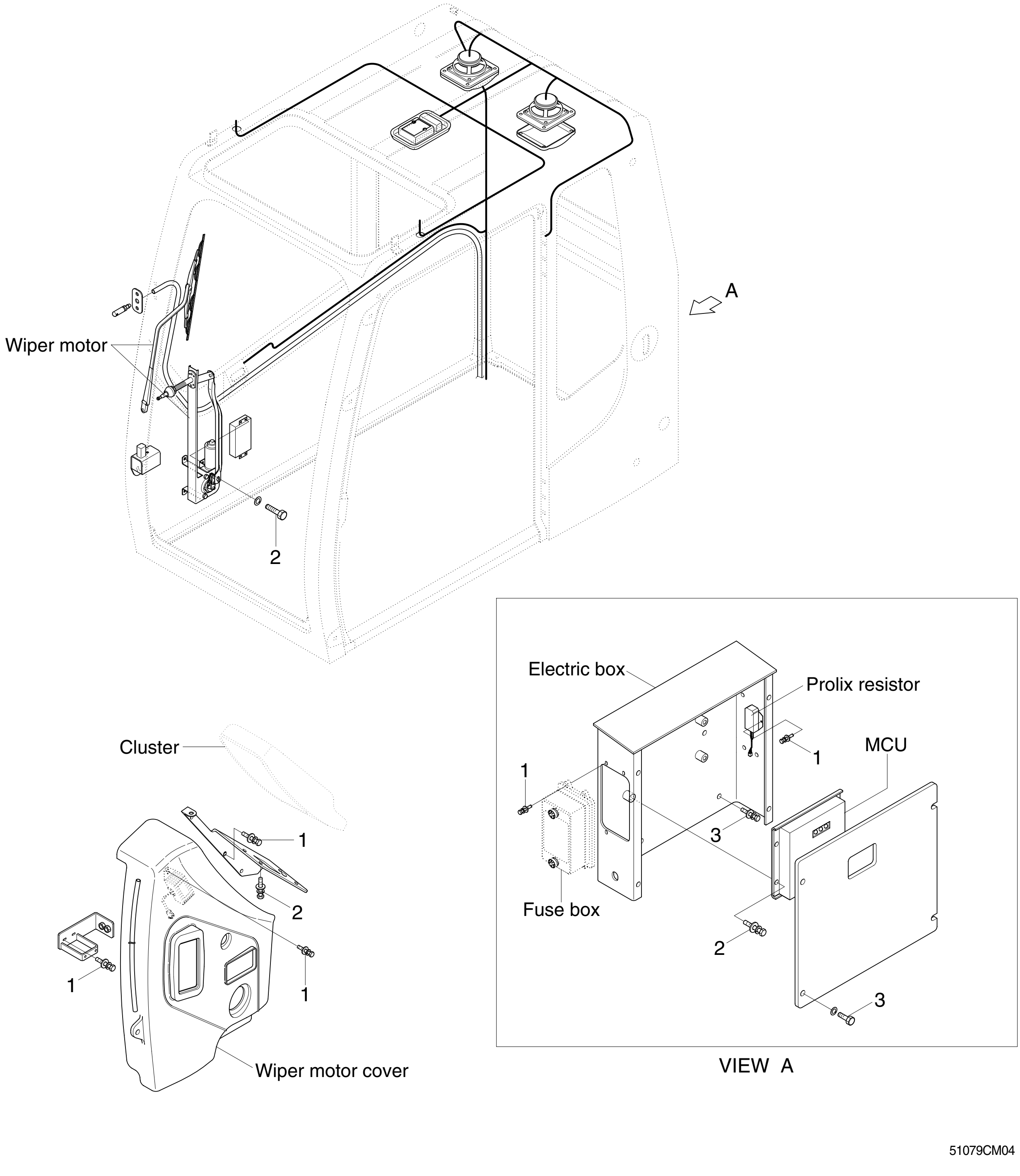


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6

Item	Size	kgf · m	lbf · ft
3	M10×1.5	6.9±1.4	49.9±10.1
4	M12×1.75	12.8±3.0	92.6±21.7

ELECTRIC COMPONENTS MOUNTING 2



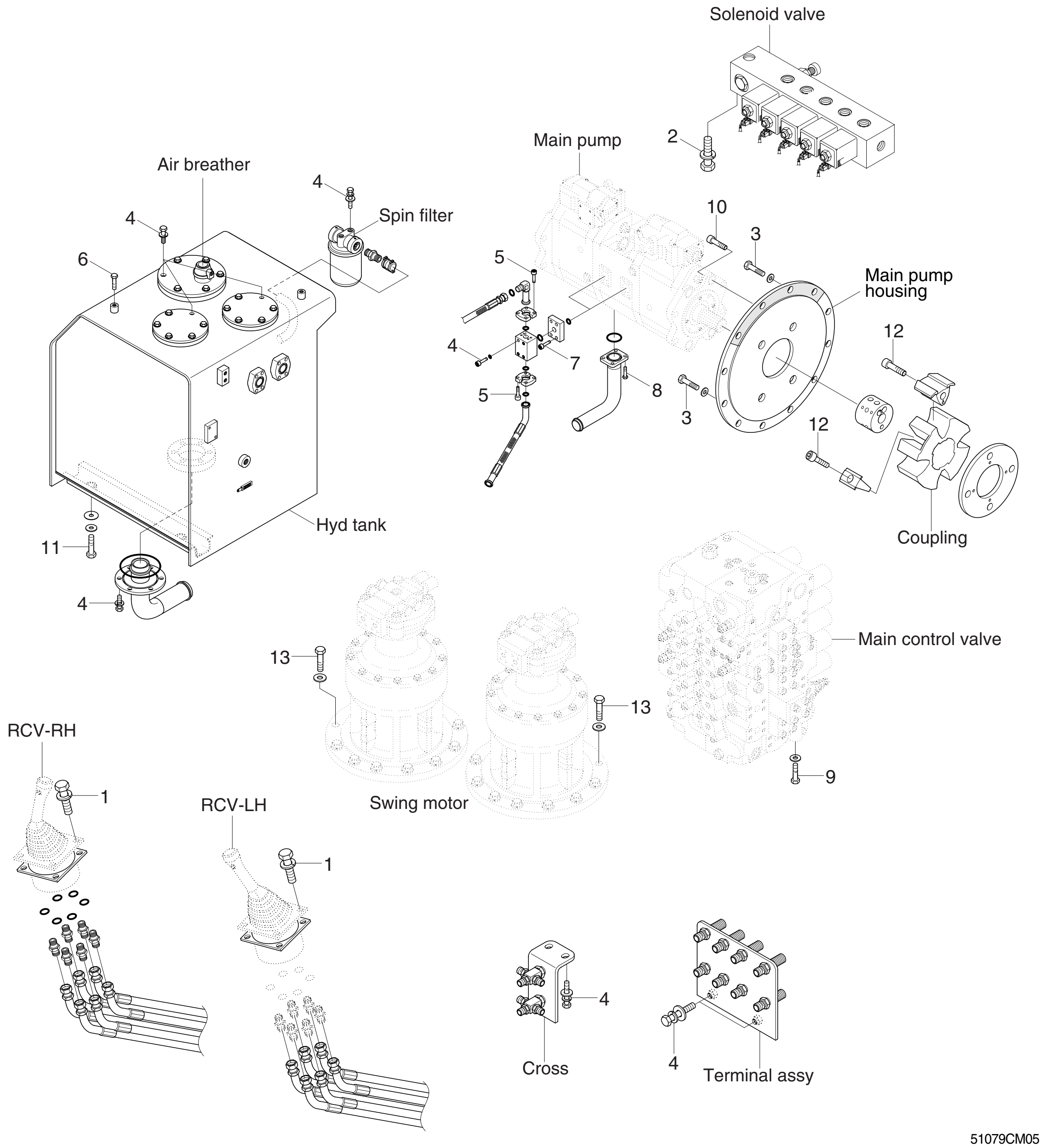
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6

Item	Size	kgf · m	lbf · ft
3	M10×1.5	6.9±1.4	49.9±10.1
-	-	-	-

GROUP 4 HYDRAULIC SYSTEM

HYDRAULIC COMPONENTS MOUNTING 1

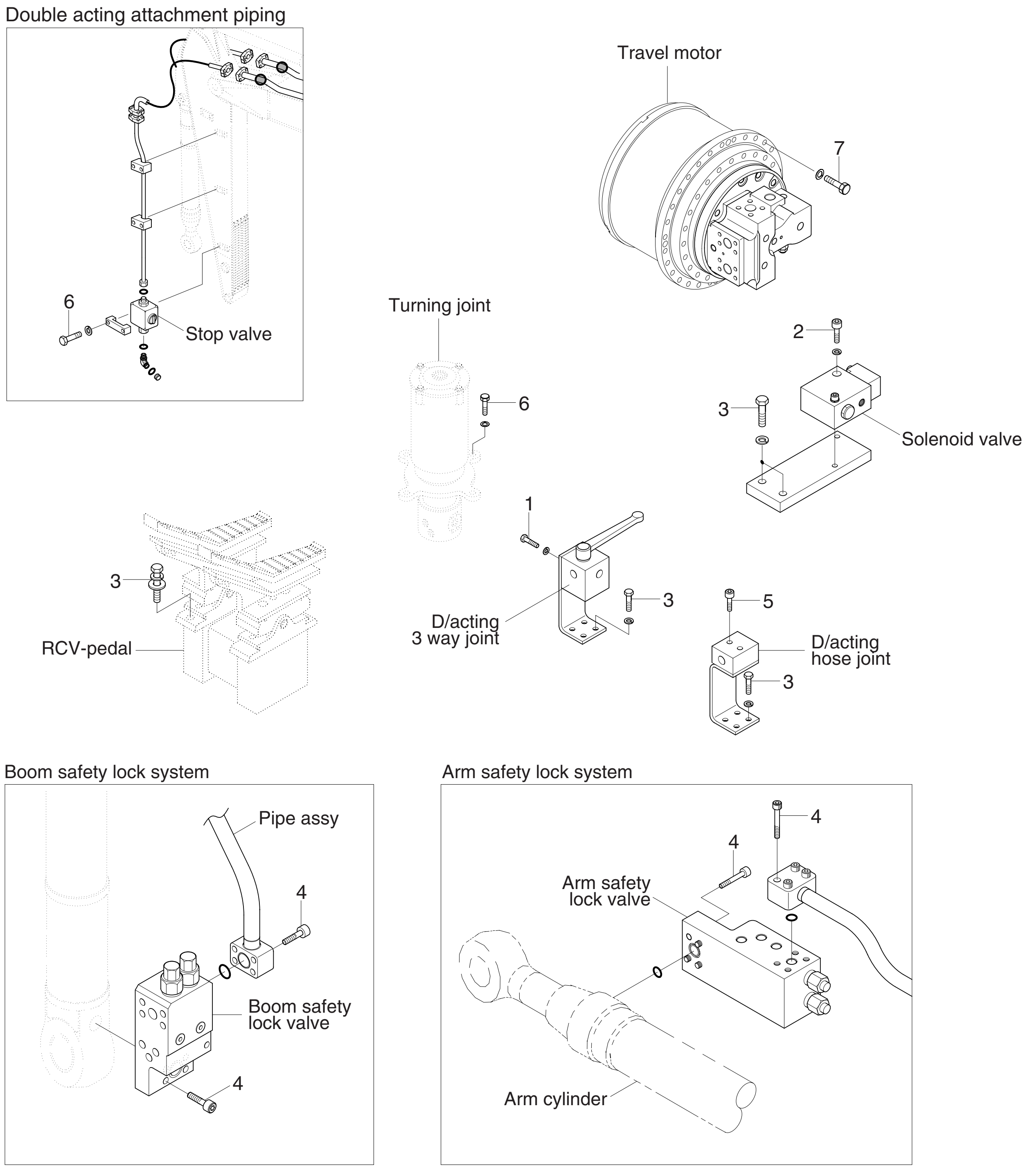


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M10×1.5	4.8±0.3	34.7±2.2
4	M10×1.5	6.9±1.4	49.9±10.1
5	M10×1.5	8.27±1.7	59.8±12.3
6	M12×1.75	12.8±3.0	92.6±21.7
7	M12×1.75	14.7±2.2	106±15.9

Item	Size	kgf · m	lbf · ft
8	M16×2.0	35.6±7.1	257±51.3
9	M20×2.5	42±4.5	304±30.5
10	M20×2.5	44±6.6	318±47.7
11	M20×2.5	45±5.1	325±36.8
12	M20×2.5	46.5±2.5	336±18.1
13	M20×2.5	58.4±6.4	422±46.3
-	-	-	-

HYDRAULIC COMPONENTS MOUNTING 2



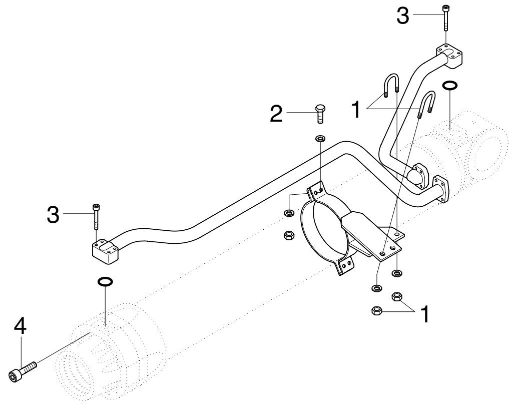
51079CM06

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	3.43±0.7	24.8±5.1
2	M 8×1.25	4.05±0.8	29.3±5.8
3	M10×1.5	6.9±1.4	49.9±10.1
4	M12×1.75	12.8±3.0	92.6±21.7

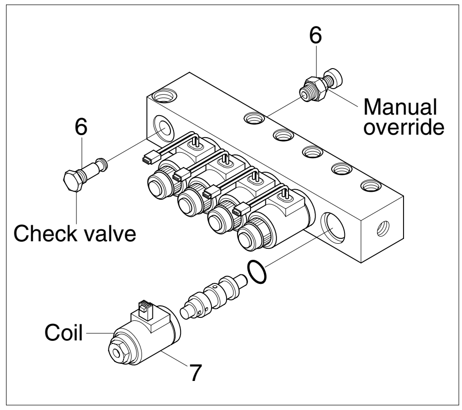
Item	Size	kgf · m	lbf · ft
5	M12×1.75	14.7±2.2	106±15.9
6	M16×2.0	29.7±4.5	215±32.5
7	M20×2.5	57.9±8.7	419±62.9
-	-	-	-

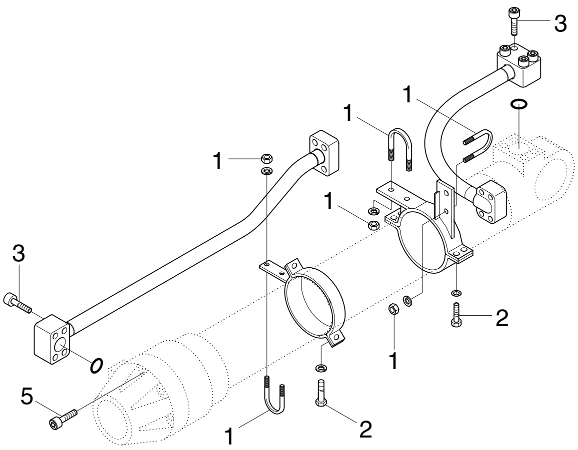
HYDRAULIC COMPONENTS MOUNTING 3



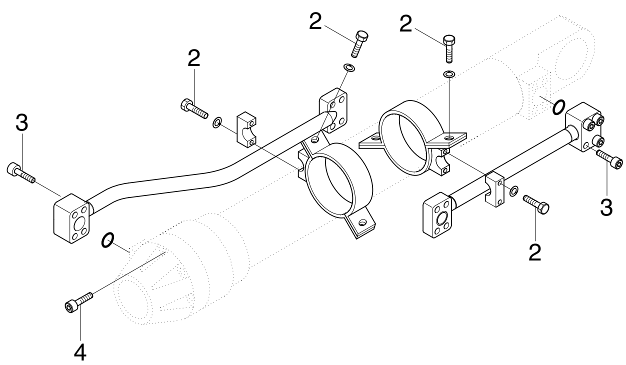
BOOM CYLINDER

Solenoid valve





ARM CYLINDER



BUCKET CYLINDER

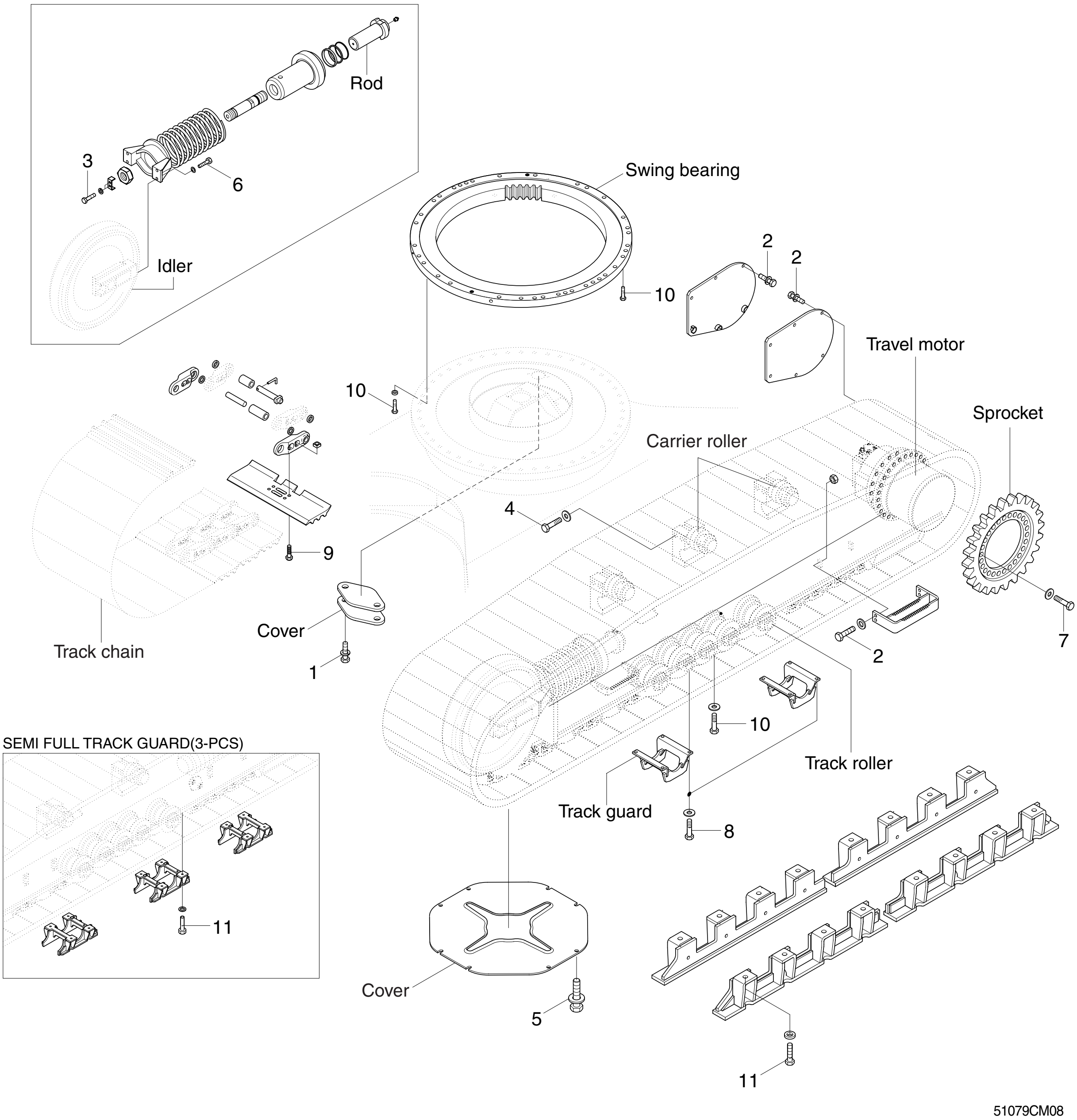
51079CM07

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	3.2±0.3	23.1±2.2
2	M12×1.75	5.5±0.6	39.8±4.3
3	M12×1.75	9.4±1.0	68.0±7.2
4	M22×2.5	63±6.0	456±43.3

Item	Size	kgf · m	lbf · ft
5	M24×3.0	79±8.0	571±57.9
6	M22×2.5	4.1	29.7
7	M27×3.0	5.1	36.9
-	-	-	-

GROUP 5 UNDERCARRIAGE



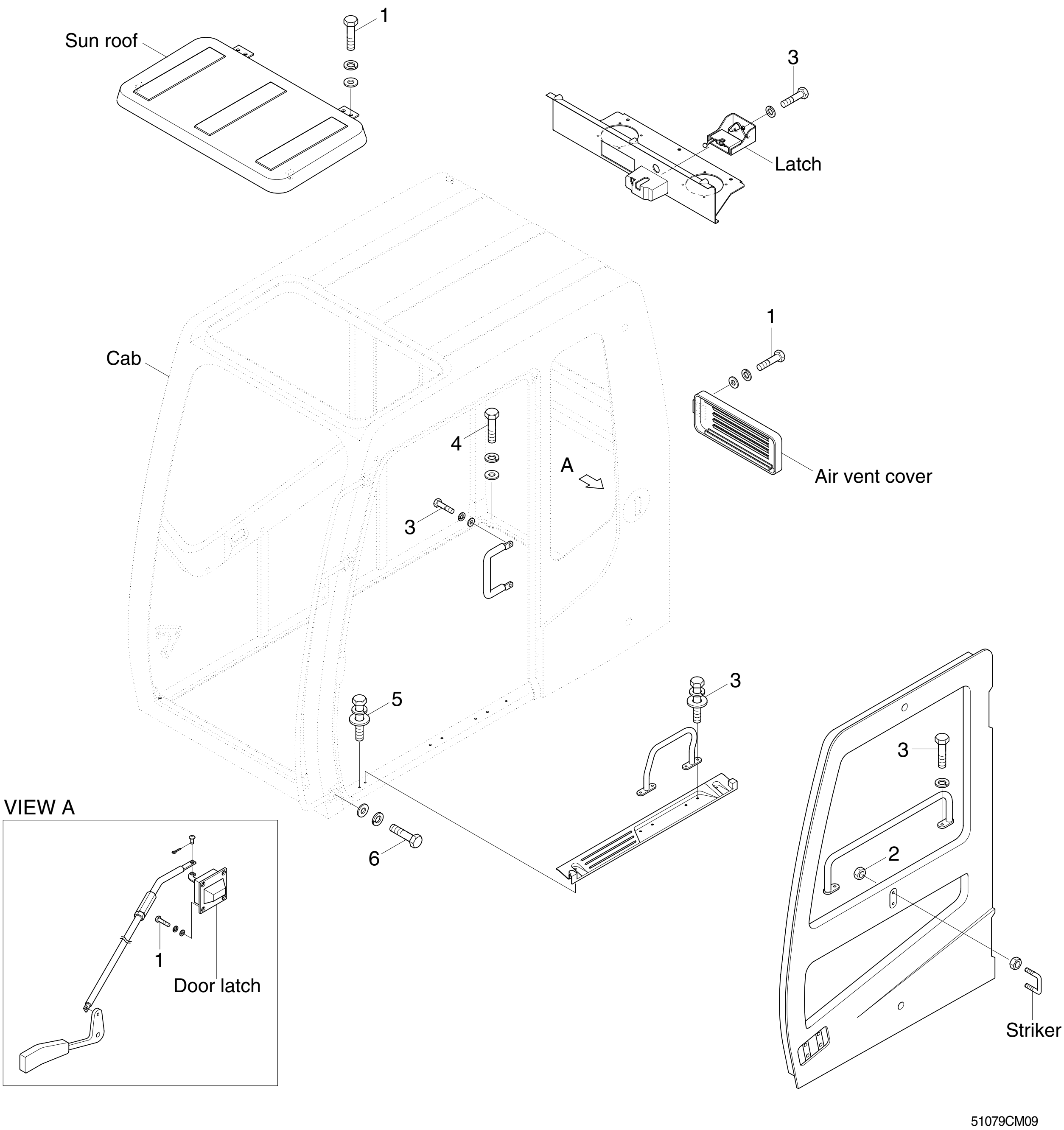
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	6.9±1.4	49.9±10.1
2	M12×1.75	12.8±3.0	92.6±21.7
3	M14×1.5	21±3.1	152±22.4
4	M16×2.0	29.7±3.0	215±21.7
5	M16×2.0	29.7±4.5	215±32.5

Item	Size	kgf · m	lbf · ft
6	M22×1.5	87.2±12.5	631±90.4
7	M22×2.5	77.4±7.5	560±54.2
8	M22×2.5	81.9±16.1	592±116
9	M24×1.5	140±14	1012±101
10	M24×3.0	100±10	723±72.3

GROUP 6 STRUCTURE

CAB AND ACCESSORIES MOUNTING

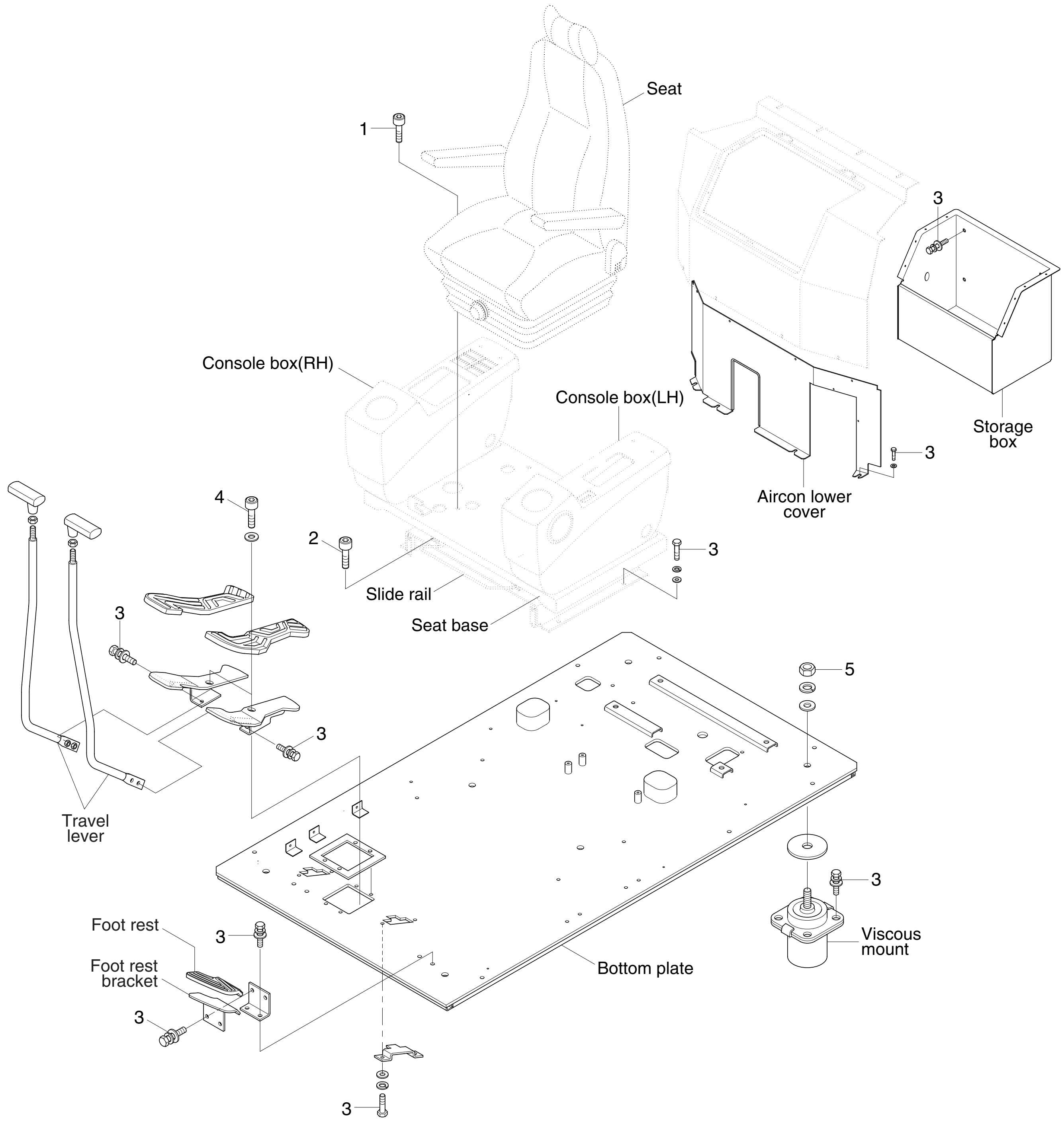


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	4.7±0.9	34.0±6.5
3	M10×1.5	6.9±1.4	49.9±10.1

Item	Size	kgf · m	lbf · ft
4	M12×1.75	12.2±1.3	89.2±9.4
5	M12×1.75	12.8±3.0	92.6±21.7
6	M16×2.0	29.7±4.5	215±32.5

CAB INTERIOR MOUNTING

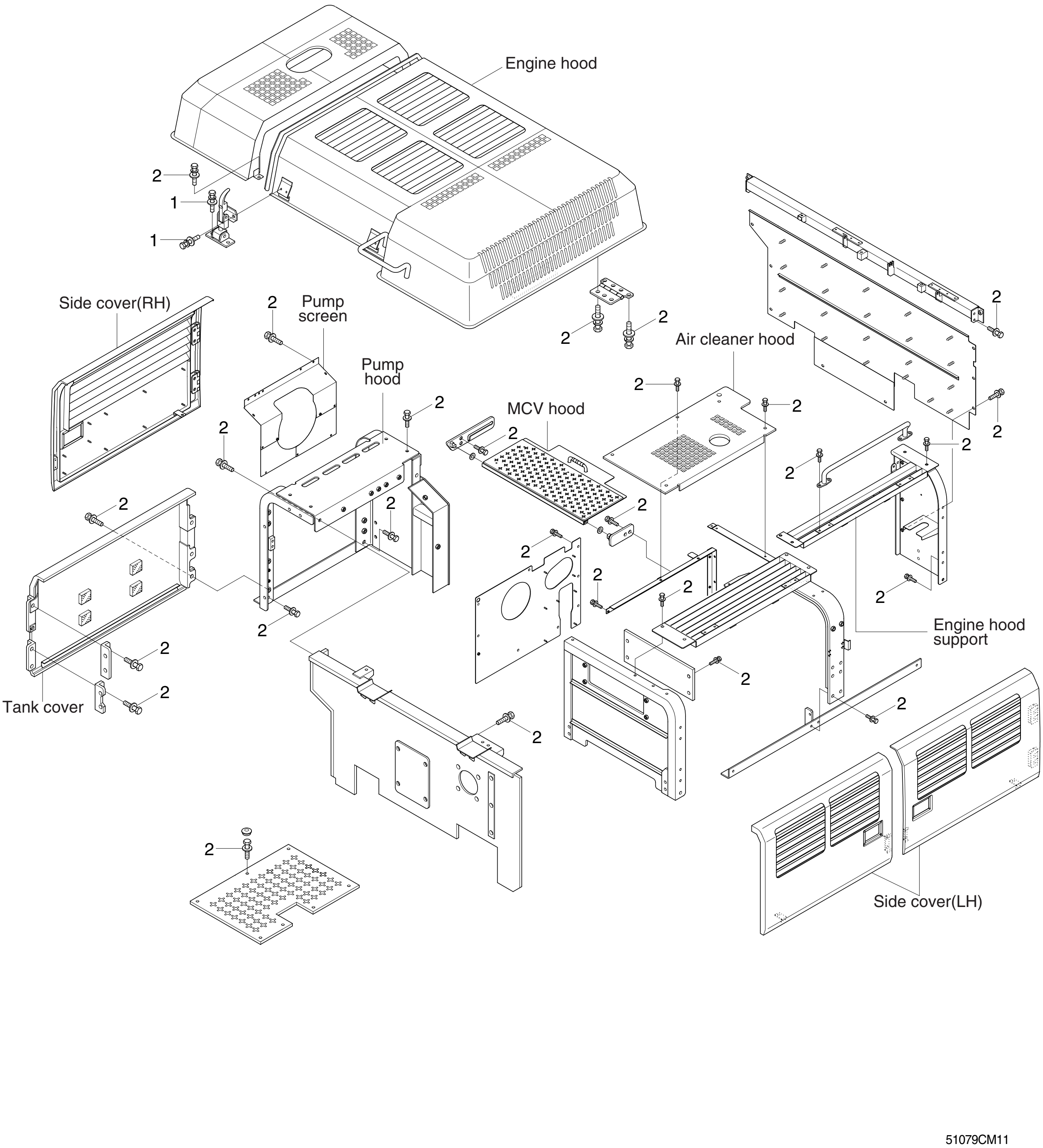


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M 8×1.25	4.05±0.8	29.3±5.8
3	M10×1.5	6.9±1.4	49.9±10.1

Item	Size	kgf · m	lbf · ft
4	M10×1.5	8.27±1.7	59.8±12.3
5	M16×2.0	29.7±4.5	215±32.5
-	-	-	-

COWLING MOUNTING

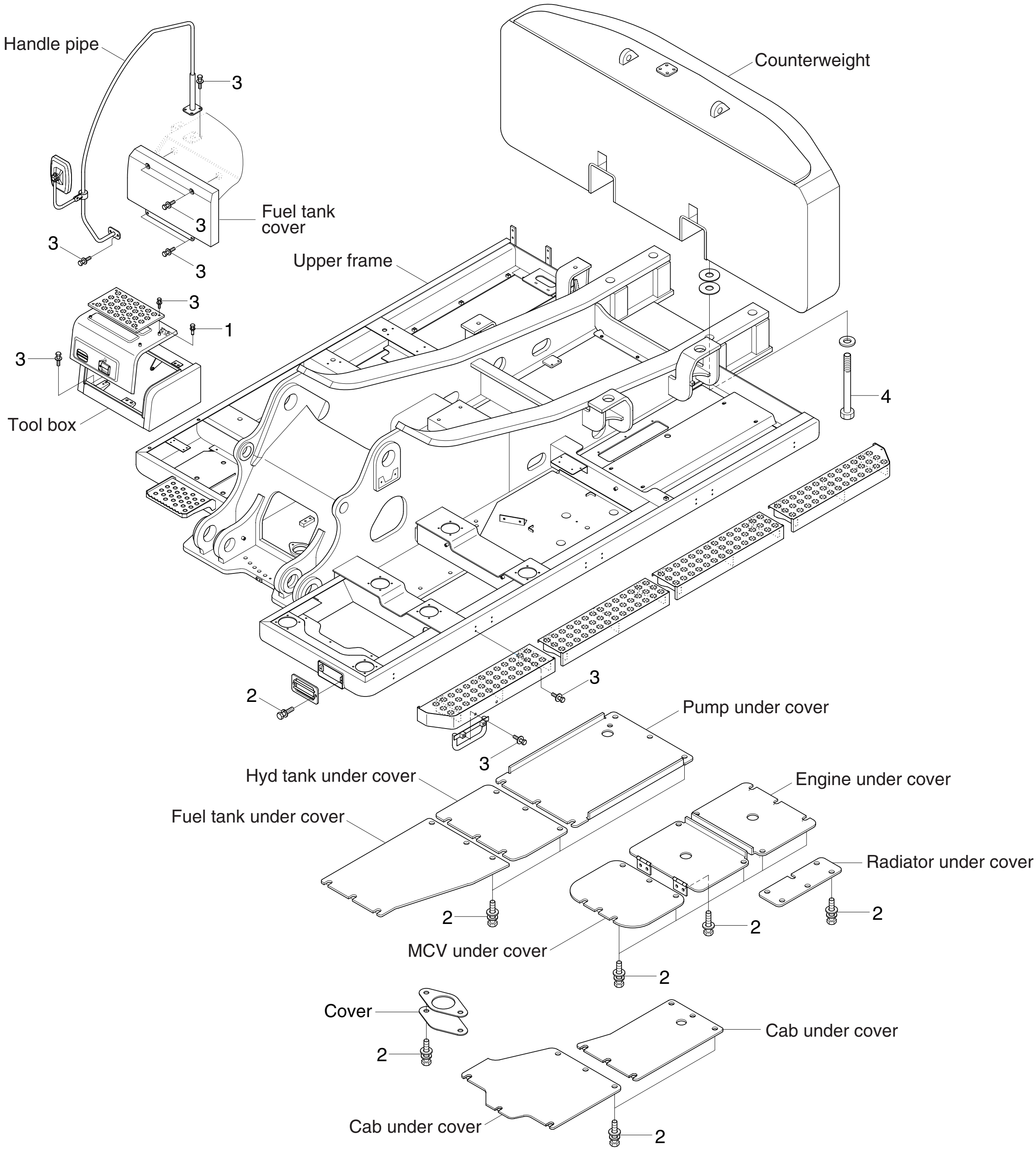


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6

Item	Size	kgf · m	lbf · ft
2	M12×1.75	12.8±3.0	92.6±21.7

COUNTERWEIGHT AND COVERS MOUNTING

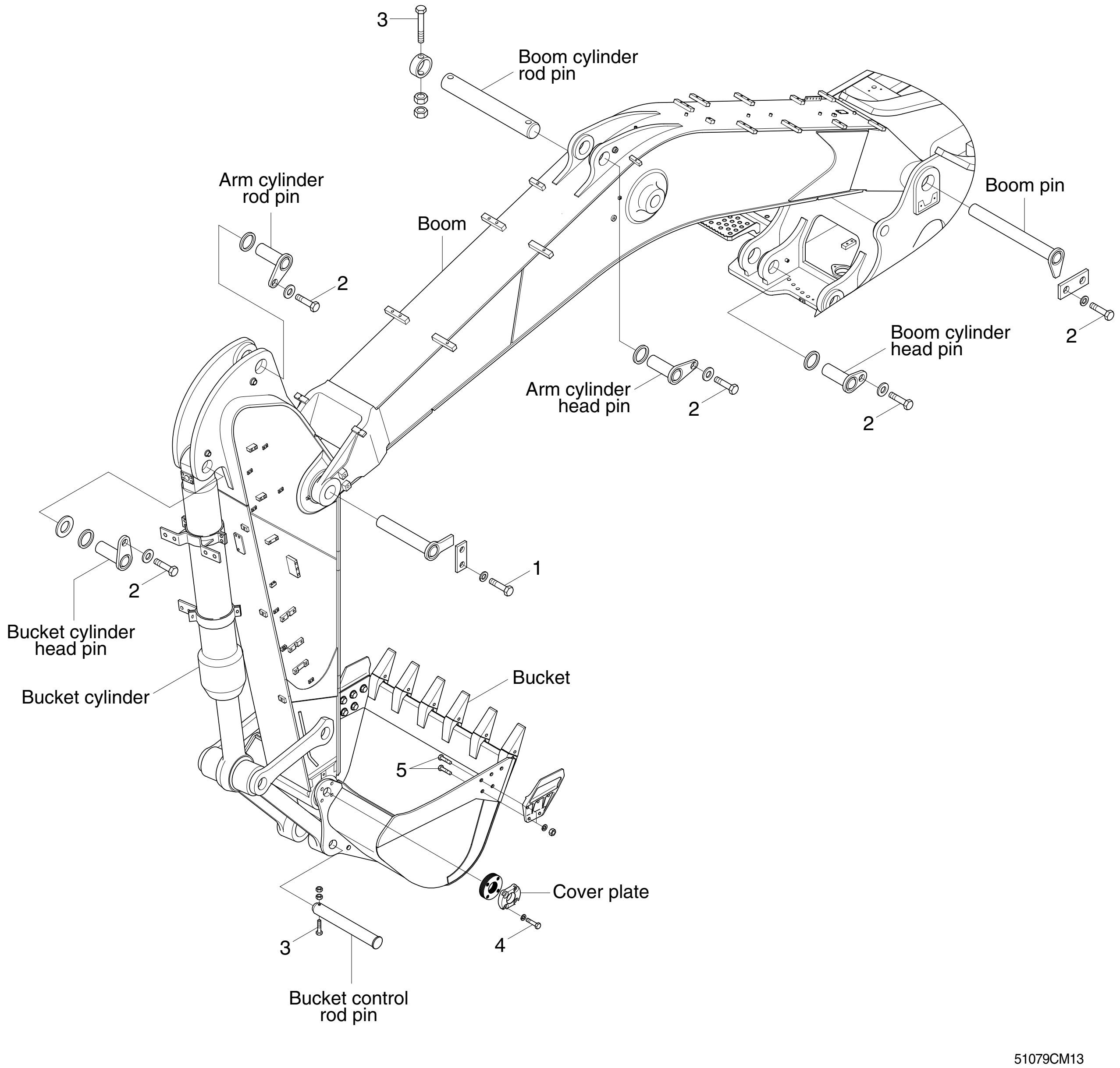


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	6.9±1.4	49.9±10.1

Item	Size	kgf · m	lbf · ft
3	M12×1.75	12.8±3.0	92.6±21.7
4	M42×4.5	390±40	2821±289

GROUP 7 WORK EQUIPMENT



· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M16×2.0	29.7±4.5	215±32.5
2	M20×2.5	57.9±8.7	419±62.9
3	M24×3.0	100±15	723±108

Item	Size	kgf · m	lbf · ft
4	M27×3.0	140±15	1013±108
5	M30×3.5	199±30	1439±217
-	-	-	-