SHOP MANUAL

KOMATSU

PC650-5
PC710-5

MACHINE MODEL	SERIAL NUMBER
PC650-5	**20001 and up**
PC650SE-5	**20001 and up**
PC650LC-5	**20001 and up**
PC710-5	**10001 and up**
PC710SE-5	**10001 and up**

- This shop manual may contain attachments and optional equipment that are not available in your area. Please consult your local Komatsu distributor for those items you may require. Materials and specifications are subject to change without notice.
- PC650-5 and PC710-5 mount the SA6D140-1 engine.
  For details of the engine, see the 140 Series Engine Shop Manual.

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SAFETY
SAFETY NOTICE

IMPORTANT SAFETY NOTICE

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

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

GENERAL PRECAUTIONS

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

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

PREPARATIONS FOR WORK

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

PRECAUTIONS DURING WORK

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

FOREWORD

GENERAL

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

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

STRUCTURE AND FUNCTION

This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

TESTING AND ADJUSTING

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

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.

MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

NOTICE

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

HOW TO READ THE SHOP MANUAL

VOLUMES

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

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

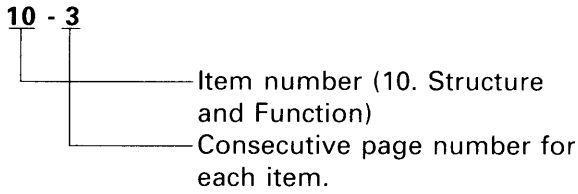
These various volumes are designed to avoid duplicating the same information. Therefore, to deal with all repairs for any model , it is necessary that chassis, engine, electrical and attachment volumes be available.

DISTRIBUTION AND UPDATING

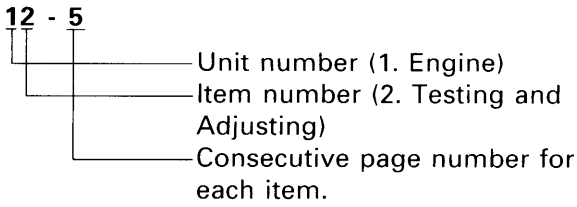
Any additions, amendments or other changes will be sent to KOMATSU distributors. Get the most up-to-date information before you start any work.

FILING METHOD

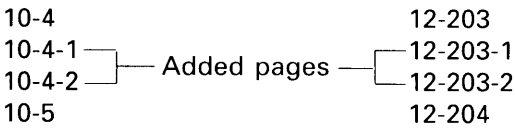
1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number.
   Example 1 (Chassis volume):



   Example 2 (Engine volume):



3. Additional pages: Additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.
   Example:



REVISED EDITION MARK

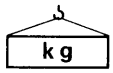
When a manual is revised, an edition mark (①②③....) is recorded on the bottom of the pages.

REVISIONS

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

SYMBOLS

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

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

HOISTING INSTRUCTIONS

HOISTING

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

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

WIRE ROPES

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

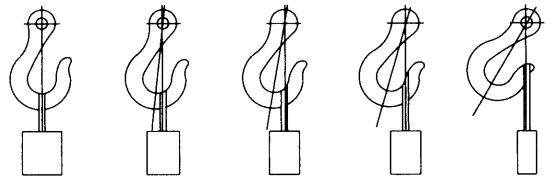
Wire ropes
(Standard "Z" or "S" twist ropes without galvanizing)

Rope diameter	Allowable load	
mm	KN	tons
10	9.8	1.0
11.2	13.7	1.4
12.5	15.7	1.6
14	21.6	2.2
16	27.5	2.8
18	35.3	3.6
20	43.1	4.4
22.4	54.9	5.6
30	98.1	10.0
40	176.5	18.0
50	274.6	28.0
60	392.2	40.0

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

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

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



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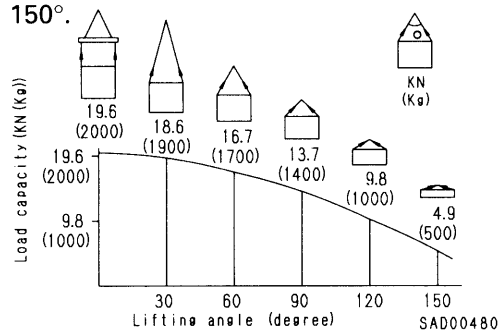
3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound onto the load.
   ⚠ Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident.

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



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COATING MATERIALS

The recommended coating materials prescribed in Komatsu Shop Manuals are listed below.

Category	Komatsu code	Part No.	Q'ty	Container	Main applications, features
Adhesive	LT-1A	790-129-9030	150 g	Tube	• Used to prevent rubber gaskets, rubber cushions, and cork plugs from coming out
	LT-1B	790-129-9050	20 g (x2)	Plastic container	• Used in places requiring an immediately effective, strong adhesive. Used for plastics (except polyethylene, polypropylene, tetrafluoroethylene, and vinyl chloride), rubber, metal, and non-metal.
	LT-2	09940-00030	50 g	Plastic container	• Features: Resistance to heat, chemicals • Used for anti-loosening and sealant purposes for bolts and plugs.
	LT-3	790-129-9060 (Set of adhesive and hardenging agent)	Adhesive :1 Kg Hardening agent: :500 g	Can	• Used as adhesive or sealant for metal, glass, plastic
	LT-4	790-129-9040	250 g	Plastic container	• Used as sealant for machined holes
	(Loctite 648-50)	79A-129-9110	50 cc	—	• Features: Resistance to heat, chemicals • Used at joint portions subject to high temperature
Gasket sealant	LG-1	790-129-9010	200 g	Tube	• Used as adhesive or sealant for gaskets and packings of power train case, etc.
	LG-3	790-129-9070	1 Kg	Can	• Features: Resistance to heat • Used as sealant for flange surfaces and bolts at high temperature locations, used to prevent seizure • Used as sealant for heat resistant gasket for high temperature locations such as engine precombustion chamber, exhaust pipe
	LG-4	790-129-9020	200 g	Tube	• Features: Resistance to water, oil • Used as sealant for flange surface, thread • Also possible to use as sealant for flanges with large clearance • Used as sealant for mating surfaces of final drive case, transmission case
	LG-5	790-129-9080	1 Kg	Plastic container	• Used as sealant for various threads, pipe joints, flanges • Used as sealant for tapered plugs, elbows, nipples of hydraulic piping
	LG-6	09940-00011	250 g	Tube	• Features: Silicon based, resistance to heat, cold • Used as sealant for flange surface, thread • Used as sealant for oil pan, final drive case, etc.
	LG-7	09920-00150	150 g	Tube	• Features: Silicon based, quick hardening type • Used as sealant for flywheel housing, intake manifold, oil pan, thermostat housing, etc.
Rust prevention lubricant	LM-G	09940-00051	60 g	Can	• Used as lubricant for sliding parts (to prevent squeaking)
Molybdenum disulphide lubricant	LM-P	09940-00040	200 g	Tube	• Used to prevent seizure or scuffing of the thread when press fitting or shrink fitting • Used as lubricant for linkage, bearings, etc.
Lithium grease	G2-LI	SYG-350LI SYG-400LI SYG-400LI-A SYG-160LI SYGA-160CNLI	Various	Various	• General purpose type
Calcium grease	G2-CA	SSG2-400CA SYG2-350CA SYG2-400CA-A SYG2-160CA SYGA-16CNCA	Various	Various	• Used for normal temperature, light load bearing at places in contact with water or steam
Molybdenum disulphide grease	—	SYG2-400M	400 g (10 per case)	Bellows type	• Used for places with heavy load

STANDARD TIGHTENING TORQUE

STANDARD TIGHTENING TORQUES OF BOLTS AND NUTS

The following charts give the standard tightening torques of bolts and nuts. Exceptions are given in section of **DISASSEMBLY AND ASSEMBLY**.

1 Kgm = 9.806 Nm

Thread diameter of bolt	Width across flats	 SAD00481	 SAD00482
mm	mm	Nm	kgm
6	10	13.2±1.4	1.35±0.15
8	13	31.4±2.9	3.2±0.3
10	17	65.7±6.8	6.7±0.7
12	19	112±9.8	11.5±1.0
14	22	177±19	18.0±2.0
16	24	279±29	28.5±3
18	27	383±39	39±4
20	30	549±58	56±6
22	32	745±78	76±8
24	36	927±98	94.5±10
27	41	1320±140	135±15
30	46	1720±190	175±20
33	50	2210±240	225±25
36	55	2750±290	280±30
39	60	3280±340	335±35

★ This torque table does not apply to the bolts with which nylon packings or other nonferrous metal washers are to be used, or which require tightening to otherwise specified torque.

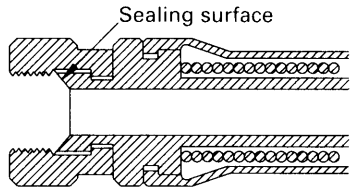
TIGHTENING TORQUE OF SPLIT FLANGE BOLTS

Use these torques for split flange bolts.

Thread diameter of bolt	Width across flats	Tightening torque	
mm	mm	Nm	kgm
10	14	65.7±6.8	6.7±0.7
12	17	112±9.8	11.5±1
16	22	279±29	28.5±3

TIGHTENING TORQUE FOR FLARED NUTS

Use these torques for flared part of nut.



SAD00483

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

ELECTRIC WIRE CODE

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

CLASSIFICATION BY THICKNESS

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

CLASSIFICATION BY COLOR AND CODE

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

CONVERSION TABLE

METHOD OF USING THE CONVERSION TABLE

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

EXAMPLE

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

1. Convert 55 mm into inches.
   (1) Locate the number 50 in the vertical column at the left side, take this as Ⓐ, then draw a horizontal line from Ⓐ.
   (2) Locate the number 5 in the row across the top, take this as Ⓑ, then draw a perpendicular line down from Ⓑ.
   (3) Take the point where the two lines cross as Ⓒ. This point Ⓒ gives the value when converting from millimeters to inches. Therefore, 55 mm = 2.165 inches.

2. Convert 550 mm into inches.
   (1) The number 550 does not appear in the table, so divide by 10 (move the decimal point one place to the left) to convert it to 55 mm.
   (2) Carry out the same procedure as above to convert 55 mm to 2.165 inches.
   (3) The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (move the decimal point one place to the right) to return to the original value. This gives 550 mm = 21.65 inches.

Millimeters to inches

1 mm = 0.03937 in

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

Millimeters to Inches

1 mm = 0.03937 in

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

Kilogram to Pound

1 kg = 2.2046 lb

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

Liter to U.S. Gallon

1ℓ = 0.2642 U.S. Gal

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

Liter to U.K. Gallon

1ℓ = 0.21997 U.K. Gal

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

kgm to ft. lb

1 kgm = 7.233 ft. lb

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

kg/cm² to lb/in²

1kg/cm² = 14.2233 lb/in²

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

Temperature

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

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

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

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

1°C = 33.8°F

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

01 GENERAL

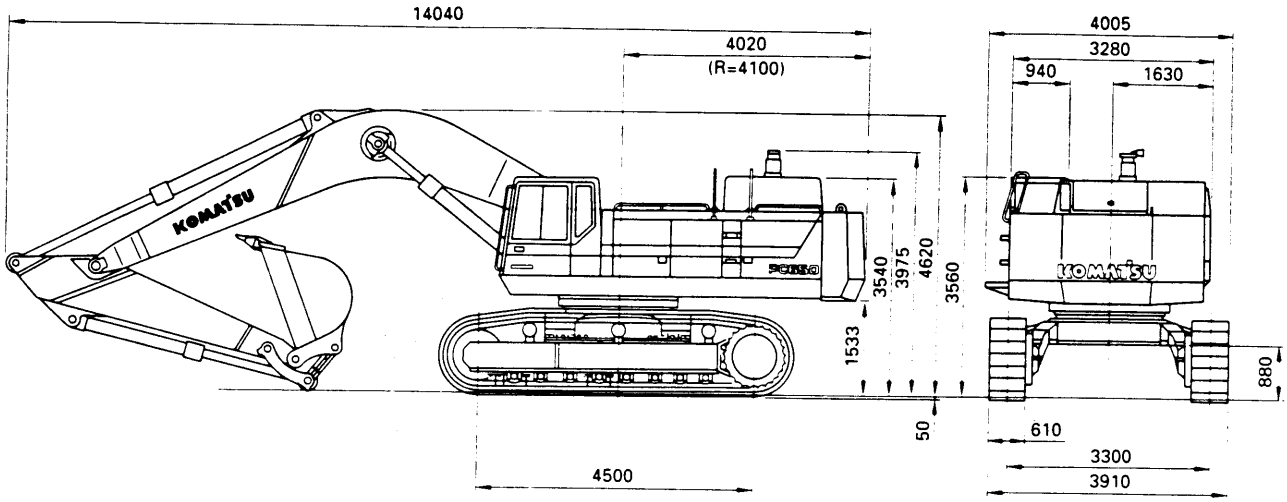
020905

ASSEMBLY DRAWING

BACK HOE

PC650-5

Unit: mm



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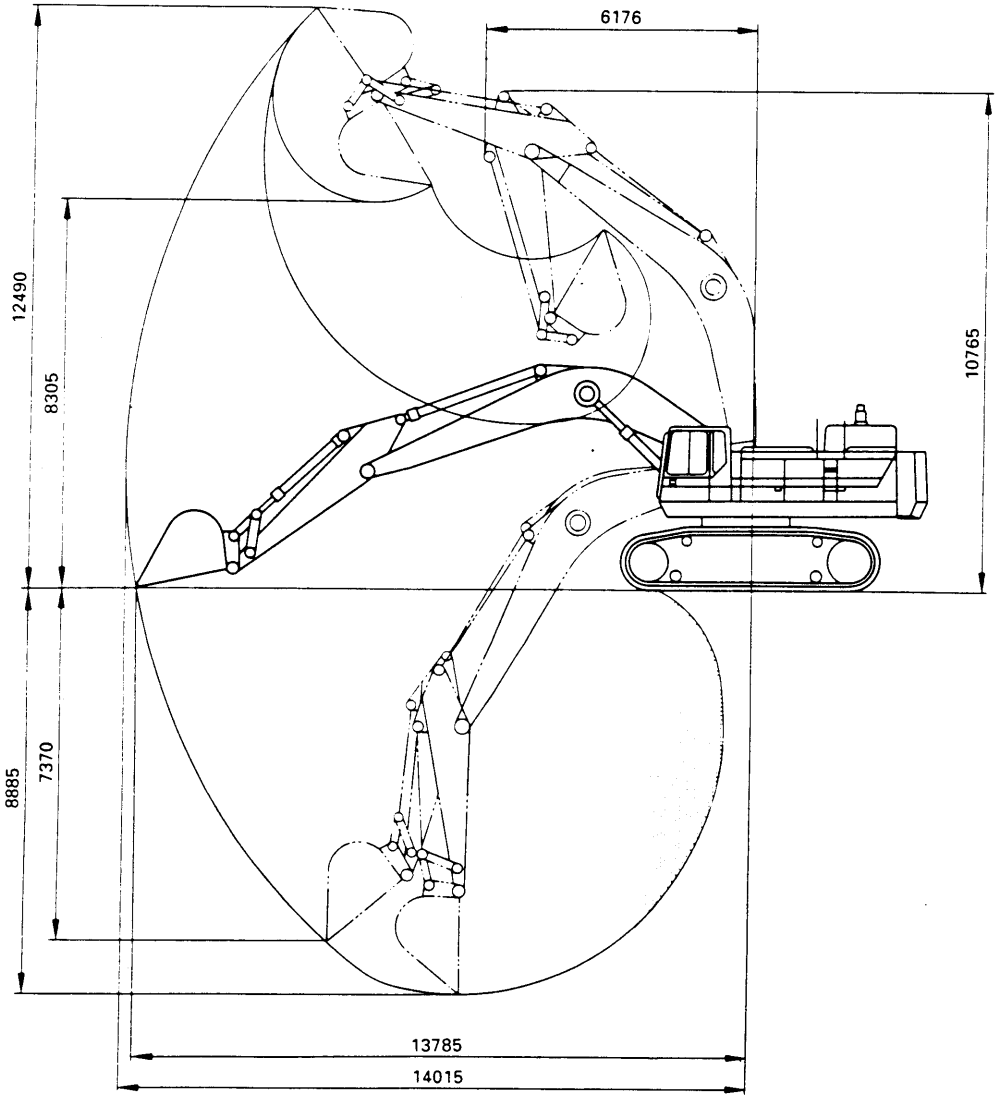
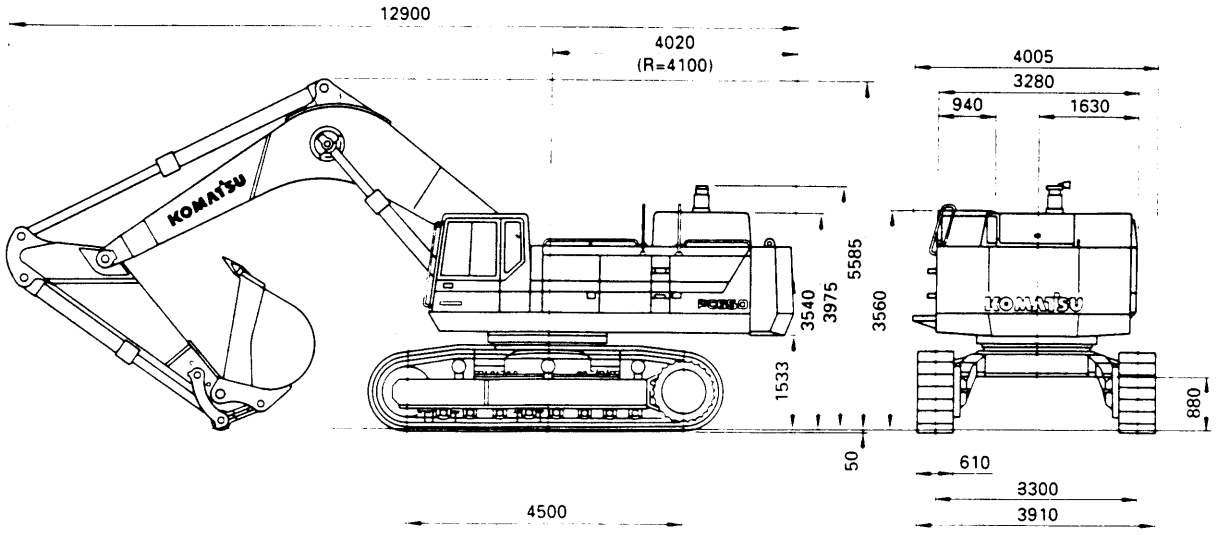


209F05003

020905

PC650SE-5

Unit: mm



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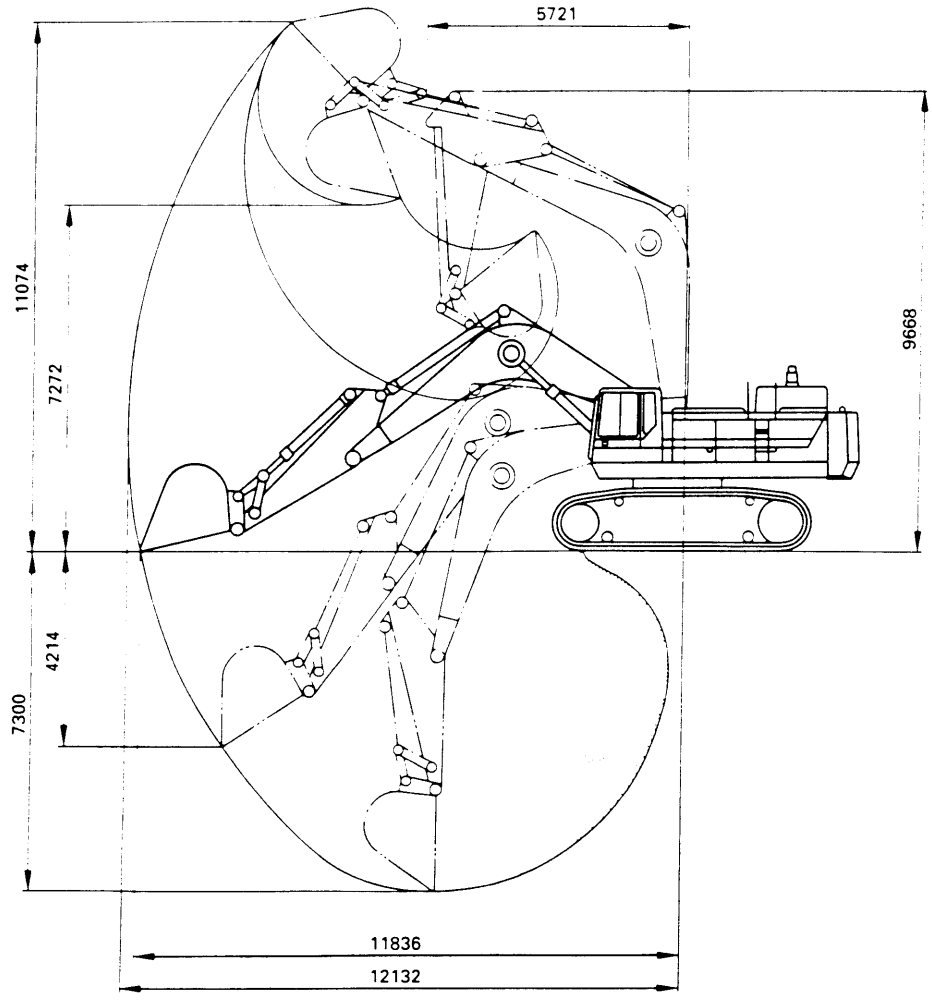

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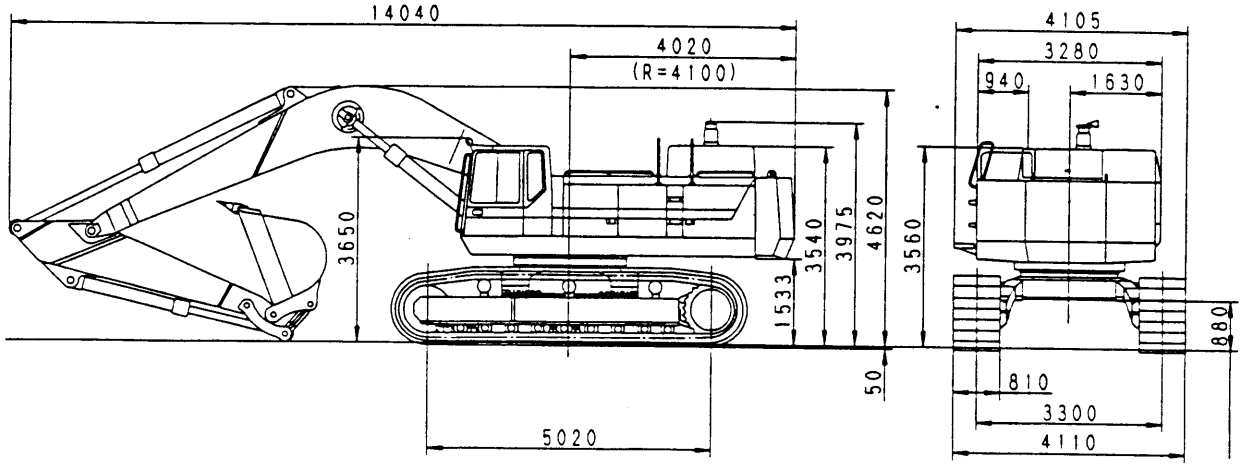
PC650LC-5

Unit: mm



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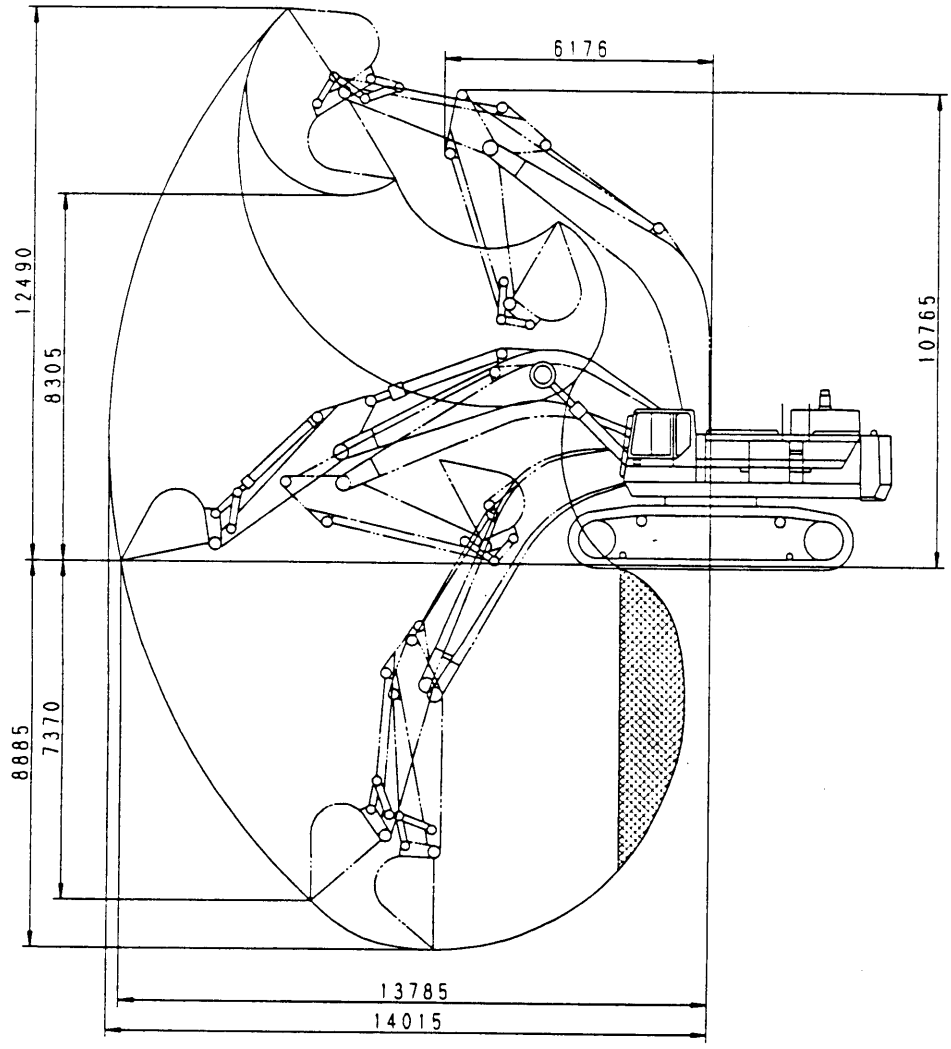

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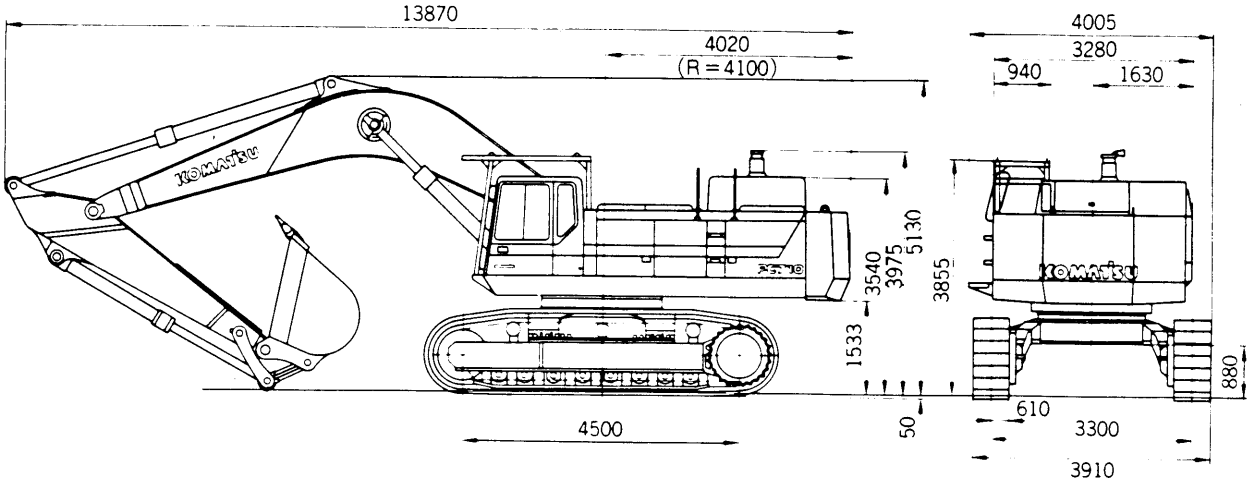
020905

Unit: mm



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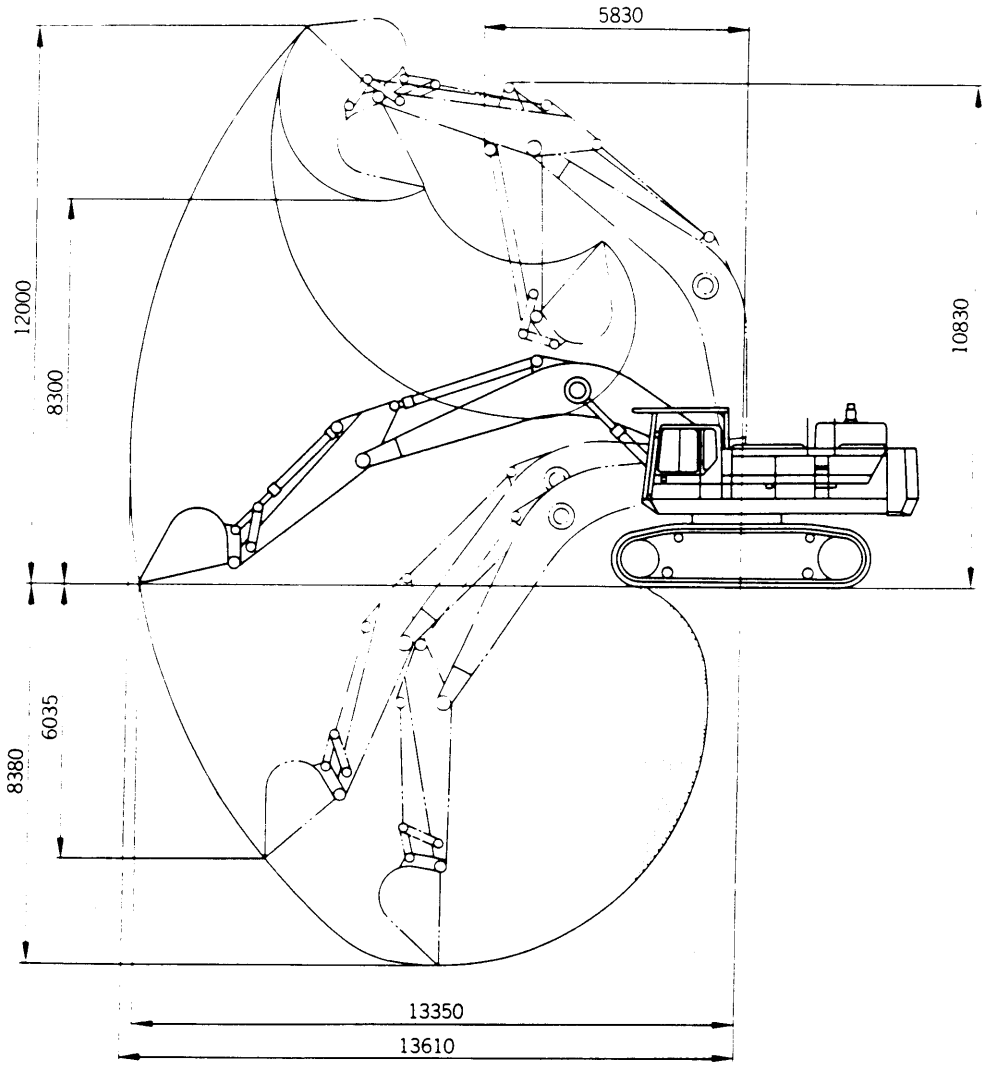

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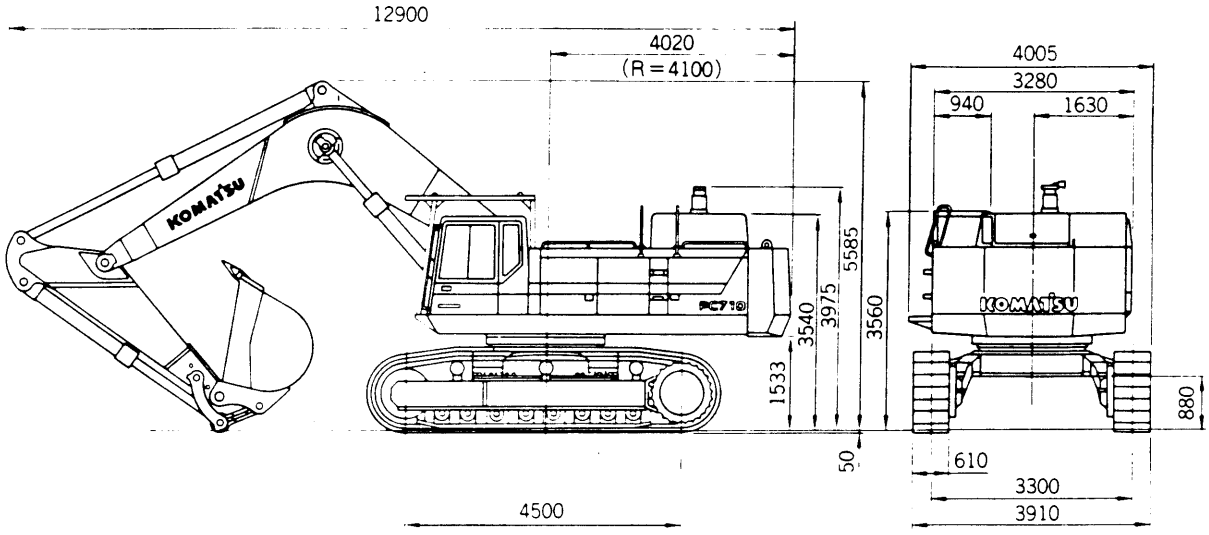
020905

PC710SE-5

Unit: mm



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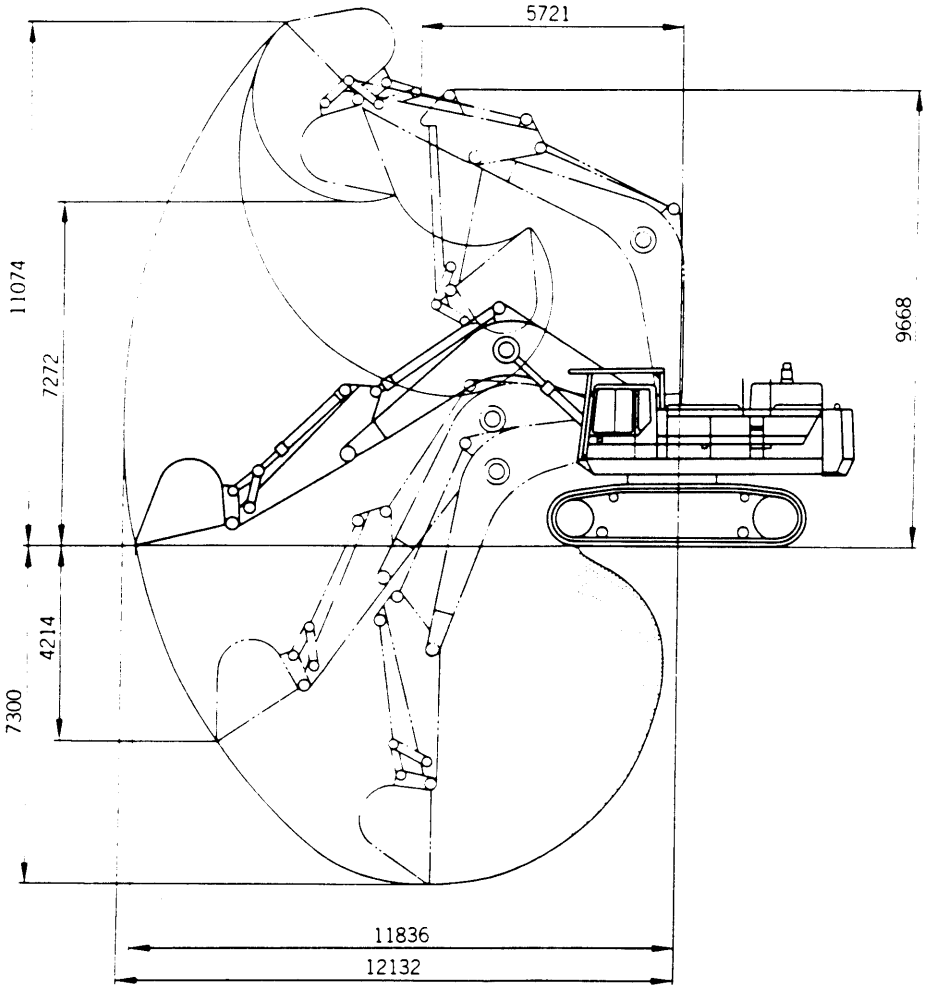

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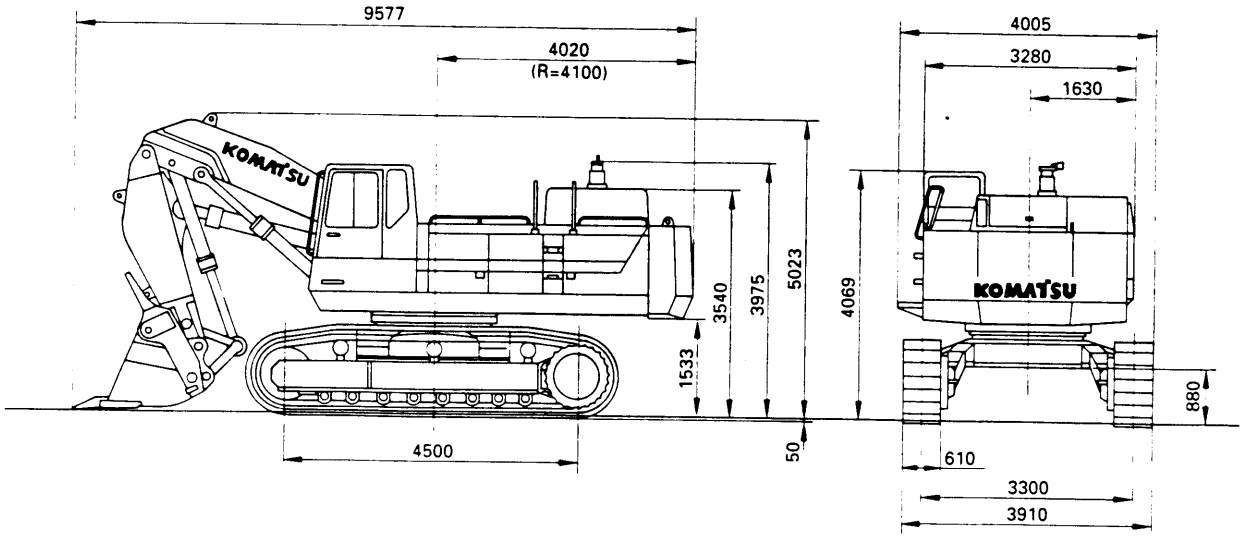
LOADING SHOVEL

Unit: mm



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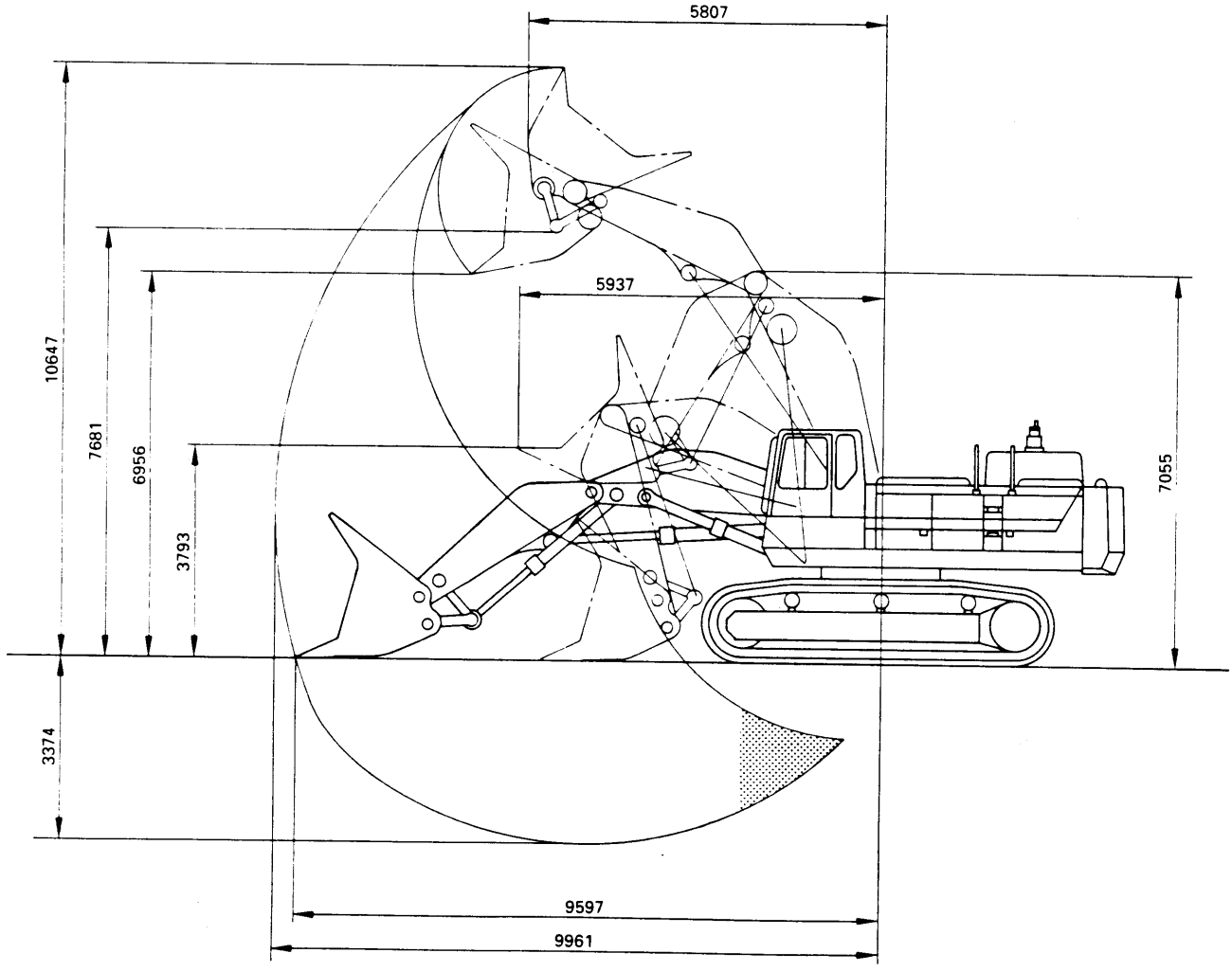

F20905011

020905

SPECIFICATIONS

BACK HOE

		Machine Model		PC650-5	PC650SE-5	PC650LC-5
		Serial No.		20001 and up	20001 and up	20001 and up
		Operating weight	(kg)	67,050	67,980	69,940
		Bucket capacity	(m^3)	2.5	3.5	2.1
Performance	Working range	Maximum digging depth	(mm)	8,885	7,300	8,885
		Maximum vertical wall depth	(mm)	7,370	4,215	7,370
		Maximum digging reach	(mm)	14,015	12,130	14,015
		Maximum digging reach at ground level	(mm)	13,785	11,835	13,785
		Maximum digging height	(mm)	12,490	11,075	12,490
		Maximum dumping height	(mm)	8,305	7,270	8,305
		Maximum digging force	(kN(kg))	253(25,800)	338(34,500)	253(25,800)
		Swing speed	(rpm)	5.7	5.7	5.7
		Maximum swing slope angle	(deg)	14.0	14.0	14.0
		Travel speed	(km/h)	Lo: 2.7, Hi: 4.1	Lo: 2.7, Hi: 4.1	Lo: 2.7, Hi: 4.1
		Gradeability	(deg)	35	35	35
		Ground pressure [standard shoe width: mm]	(MPa(kg/cm^2))	0.107(1.09) [610]	0.108(1.107) [610]	0.076(0.780) [810]
Dimensions		Overall length	(mm)	14,040	12,900	14,040
		Overall width	(mm)	4,005	4,005	4,110
		Overall width of crawler	(mm)	3,910	3,910	4,110
		Overall height	(mm)	4,620	5,585	4,620
		Height of machine	(mm)	3,975	3,975	3,975
		Ground clearance of counterweight	(mm)	1,533	1,533	1,533
		Minimum ground clearance	(mm)	880	880	880
		Minimum swing radius at counterweight	(mm)	4,100	4,100	4,100
		Minimum swing radius of work equipment	(mm)	6,176	5,721	6,176
		Arm height at minimum swing radius	(mm)	10,765	9,668	10,765
		Length of track on ground	(mm)	4,500	4,500	5,020
		Track gauge	(mm)	3,300	3,300	3,300
		Machine cab height	(mm)	3,540	3,540	3,540

020905

Machine model			PC650-5	PC650SE-5	PC650LC-5
Serial No.			20001 and up	20001 and up	20001 and up
Engine	Model		SA6D140-1		
	Type		4-cycle, water cooled in-line vertical, direct injection type with turbocharger and aftercooler		
	No. of cylinders - bore x stroke	(mm)	6 - 140 x 165		
	Total displacement	(cc)	15,240		
	Flywheel horsepower	(kW(HP)/rpm)	306(410)/1,800		
	Maximum torque	(Nm(kgm)/rpm)	1,804(184)/1,400		
	High idling speed	(rpm)	1,980		
	Low idling speed	(rpm)	700		
	Minimum fuel consumption ratio	(g/kW.h(g/HP.h))	201(148)		
	Starting motor		24 V, 7.5 kW		
	Alternator		24 V, 50 A		
	Battery		12 V, 170 Ah x 2		
Undercarriage	Carrier roller	(each side)	3		3
	Track roller	(each side)	8		9
	Track shoe	(each side)	Assembled double grouser shoe, 47 on each side		Assembled double grouser shoe, 47 on each side
Hydraulic system	Hydraulic pump: Type, No.		Variable displacement tandem piston pump x 2 Variable displacement single piston pump x 1 Fixed displacement tandem gear pump x 1		
	Hydraulic pump: Discharge flow	(ℓ/min)	419 x 2 + 314 + 157		
	Hydraulic pump: Set pressure	(MPa(kg/cm²))	Piston type: 31.4(320) Gear type: 2.9(30)		
	Control valve: Type, No.		1-spool type x 1 4-spool type x 1 5-spool type x 1		
	Control valve: Operating method		Hydraulic assist		
	Hydraulic motor: Travel motor		Piston type (with brake valve) x 2		
	Hydraulic motor: Swing motor		Piston type (with safety valve) x 2		
	Hydraulic cylinder		Double acting piston type		
	Hydraulic tank		Box type with breather		
	Hydraulic line filter		Outlet port of pump		
	Hydraulic return filter		Tank return side		
	Hydraulic cooler		Air cooled		

020905

		Machine Model		PC710-5	PC710SE-5	
		Serial No.		10001 and up	10001 and up	
	Operating weight		kg	70,540	70,540	
	Bucket capacity		m^3	2.6	3.5	
Performance	Working range	Maximum digging depth	mm	8,380	7,300	
		Maximum vertical wall depth	mm	6,035	4,215	
		Maximum digging reach	mm	13,610	12,130	
		Maximum digging reach at ground level	mm	13,350	11,835	
		Maximum digging height	mm	12,000	11,075	
		Maximum dumping height	mm	8,300	7,270	
	Maximum digging force		kN{kg}	273{27,800}	338{34,500}	
	Swing speed		rpm	5.7	5.7	
	Maximum swing slope angle		deg	14.0	14.0	
	Travel speed		km/h	Lo: 2.7, Hi: 4.1	Lo: 2.7, Hi: 4.1	
	Gradeability		deg	35	35	
	Ground pressure [standard shoe width: mm]		MPa{kg/cm²}	0.113{1,147} [610]	0.113{1,147} [610]	
Dimensions	Overall length		mm	13,870	12,900	
	Overall width		mm	4,005	4,005	
	Overall width of crawler		mm	3,910	3,910	
	Overall height		mm	5,130	5,585	
	Height of machine		mm	3,540	3,540	
	Ground clearance of counterweight		mm	1,533	1,533	
	Minimum ground clearance		mm	880	880	
	Minimum swing radius at counterweight		mm	4,100	4,100	
	Minimum swing radius of work equipment		mm	5,830	5,721	
	Arm height at minimum swing radius		mm	10,830	9,668	
	Length of track on ground		mm	4,500	4,500	
	Track gauge		mm	3,300	3,300	
	Machine cab height		mm	3,540	3,540	

020905

Machine Model			PC710-5	PC710SE-5	
Serial No.			10001 and up	10001 and up	
Engine	Model		SA6D140-1		
	Type		4-cycle, water cooled in-line vertical, direct injection type with turbocharger and aftercooler		
	No. of cylinders - bore x stroke	mm	6 - 140 x 165		
	Total displacement	cc	15,240		
	Flywheel horsepower	kW{HP}/rpm	306{410}/1,800		
	Maximum torque	Nm{kgm}/rpm	1,804{184}/1,400		
	High idling speed	rpm	1,980		
	Low idling speed	rpm	700		
	Minimum fuel consumption ratio	g/kW.h {g/HP.h}	201 {148}		
	Starting motor		24 V, 7.5 kW		
	Alternator		24 V, 50 A		
	Battery		12 V, 170 Ah x 2		
Undercarriage	Carrier roller (each side)		3		
	Track roller (each side)		8		
	Track shoe (each side)		Assembled double grouser shoe, 47 on each side		
Hydraulic system	Hydraulic pump: Type, No.		Variable displacement tandem piston pump x 2 Variable displacement single piston pump x 1 Fixed displacement tandem gear pump x 1		
	Hydraulic pump: Discharge flow	ℓ/min	419 x 2 + 314 + 157		
	Hydraulic pump: Set pressure	MPa {kg/cm^2}	Piston type: 31.4{320} Gear type: 2.9{30}		
	Control valve: Type, No.		1-spool type x 1 4-spool type x 1 5-spool type x 1		
	Control valve: Operating method		Hydraulic assist		
	Hydraulic motor: Travel motor		Piston type(with brake valve) x 2		
	Hydraulic motor: Swing motor		Piston type(with safety valve) x 1		
	Hydraulic cylinder		Double acting piston type		
	Hydraulic tank		Box type with breather		
	Hydraulic line filter		Outlet port of pump		
	Hydraulic return filter		Tank return side		
	Hydraulic cooler		Air cooled		

020905

LOADING SHOVEL

Machine Model				PC650-5		
Serial No.				20001 and up		
Operating weight			(kg)	69,300		
Bucket capacity			(m^3)	3.8		
Performance	Working range	Maximum digging depth	(mm)	3,374		
		Maximum vertical wall depth	(mm)	–		
		Maximum digging reach	(mm)	9,961		
		Maximum digging reach at ground level	(mm)	9,597		
		Maximum digging height	(mm)	10,647		
		Maximum dumping height	(mm)	6,956		
	Maximum digging force		(kN(kg))	431(44,000)		
	Swing speed		(rpm)	5.7		
	Maximum swing slope angle		(deg)	14.0		
	Travel speed		(km/h)	Lo: 2.7, Hi: 4.1		
	Gradeability		(deg)	35		
	Ground pressure (standard shoe width: 610 mm)		(MPa(kg/cm²))	0.11(1.13)		
Dimensions	Overall length		(mm)	9,577		
	Overall width		(mm)	4,005		
	Overall width of crawler		(mm)	3,910		
	Overall height		(mm)	5,023		
	Height of machine		(mm)	4,069		
	Ground clearance of counterweight		(mm)	1,533		
	Minimum ground clearance		(mm)	880		
	Minimum swing radius at counterweight		(mm)	4,100		
	Minimum swing radius of work equipment		(mm)	5,937		
	Arm height at minimum swing radius		(mm)	7,055		
	Length of track on ground		(mm)	4,500		
	Track gauge		(mm)	3,300		
	Machine cab height		(mm)	3,540		

020905

Machine model			PC650-5		
Serial No.			20001 and up		
Engine	Model		SA6D140-1		
	Type		4-cycle, water cooled in-line vertical, direct injection type with turbocharger and aftercooler		
	No. of cylinders – bore x stroke	(mm)	6 – 140 x 165		
	Total displacement	(cc)	15,240		
	Flywheel horsepower	(kW(HP)/rpm)	306(410)/1,800		
	Maximum torque	Nm(kgm)/rpm	1,804(184)/1,400		
	High idling speed	(rpm)	1,980		
	Low idling speed	(rpm)	700		
	Minimum fuel consumption ratio	(g/kW.h(g/HP.h))	201(148)		
	Starting motor		24 V, 7.5 kW		
	Alternator		24 V, 50 A		
	Battery		12 V, 170 Ah x 2		
Undercarriage	Carrier roller	(each side)	3		
	Track roller	(each side)	8		
	Track shoe	(each side)	Assembled double grouser shoe, 47 on each side		
Hydraulic system	Hydraulic pump	Type, No.	Variable displacement tandem piston pump x 2 Variable displacement single piston pump x 1 Fixed displacement tandem gear pump x 1		
		Discharge flow	(ℓ /min)	419 x 2 + 314 + 157	
		Set pressure	(MPa(kg/cm²))	Piston type: 31.4(320) Gear type: 2.9(30)	
	Control valve	Type, No.	1-spool type x 1 4-spool type x 1 5-spool type x 1		
		Operating method		Hydraulic assist	
	Hydraulic motor	Travel motor		Piston type (with brake valve) x 2	
		Swing motor		Piston type (with safety valve) x 2	
	Hydraulic cylinder			Double acting piston type	
	Hydraulic tank			Box type with breather	
	Hydraulic line filter			Outlet port of pump	
	Hydraulic return filter			Tank return side	
	Hydraulic cooler			Air cooled	

020905

WEIGHT TABLE

BACK HOE

Unit: kg

Machine model	PC650-5	PC650SE-5	PC650LC-5
Serial No.	20001 and up	20001 and up	20001 and up
Engine assembly	2,487	2,487	2,487
• Engine	1,475	1,475	1,475
• PTO (including lubricating piping)	543	543	543
• No. 1 pump	164	164	164
• No. 2 pump	147	147	147
• Swing pump	137	137	137
• Charging and PTO lubricating pump	17.7	17.7	17.7
Radiator assembly	646	646	646
Oil cooler assembly	154	154	154
Hydraulic tank (excluding oil)	431	431	431
Revolving frame (including left and right decks)	14,200	14,200	16,150
Operator's cab	280	280	280
Swing machinery	865	865	865
Swing motor	122	122	122
Travel motor	220 x 2	220 x 2	220 x 2
Swing control valve	355	355	355
L.H. 5-spool control valve	245	245	245
R.H. 4-spool control valve	240	240	240
Center swivel joint	69	69	69
Counterweight (excluding mounting bolts)	8,650	8,650	10,600
Track frame assembly	18,435	18,435	19,163
• Center frame	4,763	4,763	4,763
• Track frame	2,487 x 2	2,487 x 2	2,715 x 2
• Carrier roller	71.5 x 6	71.5 x 6	71.5 x 6
• Track roller	136 x 16	136 x 16	136 x 18
• Idler cushion assembly	782 x 2	782 x 2	782 x 2
• Idler	450 x 2	450 x 2	450 x 2
• Final drive	1,147 x 2	1,147 x 2	1,147 x 2
• Swing circle	1,335	1,335	1,335

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Unit: kg

Machine model	PC650-5	PC650SE-5		PC650LC-5
Serial No.	20001 and up	20001 - 20163	20164 and up	20001 and up
Track shoe assembly				
610 mm double grouser shoe	7,560	7,560	7,560	—
710 mm double grouser shoe	—	—	8,240	—
810 mm double grouser shoe	8,880	—	—	9,630
1,010 mm double grouser shoe	9,360	—	—	10,160
1,110 mm double grouser shoe	—	—	—	11,740
Boom assembly (excluding piping)	6,380	6,160	6,310	6,380
Arm assembly (excluding piping)	2,280	2,510	2,760	2,280
Bucket assembly (excluding piping)	2,320	2,980	3,000	2,320
Boom cylinder assembly	790 x 2	790 x 2	790 x 2	790 x 2
Arm cylinder assembly	861	861	861	861
Bucket cylinder assembly	586	704	704	586
Boom foot pin	45.2 x 2	45.2 x 2	45.2 x 2	45.2 x 2
Boom cylinder bottom pin	33.8 x 2	33.8 x 2	33.8 x 2	33.8 x 2
Boom cylinder head pin	25.7 x 2	25.7 x 2	25.5 x 2	25.7 x 2
Boom, arm connecting pin	91.5	91.5	105	91.5
Arm cylinder bottom pin	44	44	45	44
Arm cylinder head pin	31	31	31	31
Link, arm connecting pin	50	50	56.1	50
Link, bucket connecting pin	56.3	56.3	62.2	56.3
Bucket cylinder head pin	50	50	56.1	50
Boom cylinder bottom pin	34.5	34.5	44.9	34.5
Arm, bucket connecting pin	63.7	63.7	91.4	63.7
Link assembly	378	378	416	378

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Unit: kg

Machine Model	PC710-5	PC710SE-5	
Serial No.	10001 and up	10001 and up	
Engine assembly	2,487	2,487	
• Engine	1,475	1,475	
• PTO (including lubricating piping)	543	543	
• No. 1 pump	164	164	
• No. 2 pump	147	147	
• Swing pump	137	137	
• Charging and PTO lubricating pump	17.7	17.7	
Radiator assembly	646	646	
Oil cooler assembly	154	154	
Hydraulic tank (excluding oil)	431	431	
Revolving frame (including left and right decks)	16,150	16,150	
Operator's cab	280	280	
Swing machinery	865	865	
Swing motor	122	122	
Travel motor	220 x 2	220 x 2	
Swing control valve	355	355	
L.H. 5-spool control valve	245	245	
R.H. 4-spool control valve	240	240	
Center swivel joint	69	69	
Counterweight (including mounting bolts)	10,600	10,600	
Track frame assembly	18,435	18,435	
• Center frame	4,763	4,763	
• Track frame	2,487 x 2	2,487 x 2	
• Carrier roller	71.5 x 6	71.5 x 6	
• Track roller	136 x 16	136 x 16	
• Idler cushion assembly	782 x 2	782 x 2	
• Idler	450 x 2	450 x 2	
• Final drive	1,147 x 2	1,147 x 2	
• Swing circle	1,335	1,335	

020905

Unit: kg

Machine Model	PC710-5	PC710SE-5		
Serial No.	10001 and up	10001 - 10109 10111 - 10118	10110 10119 and up	
Track shoe assembly				
610 mm double grouser shoe	7,560	7,560	7,560	
710 mm double grouser shoe	8,240	8,240	8,240	
810 mm double grouser shoe				
1,010 mm double grouser shoe				
1,110 mm double grouser shoe				
Boom assembly (excluding piping)	6,600	6,160	6,310	
Arm assembly (excluding piping)	2,580	2,510	2,760	
Bucket assembly (excluding piping)	2,550	2,980	3,000	
Boom cylinder assembly	790 x 2	790 x 2	790 x 2	
Arm cylinder assembly	861	861	861	
Bucket cylinder assembly	586	704	704	
Boom foot pin	45.2 x 2	45.2 x 2	45.2 x 2	
Boom cylinder bottom pin	33.8 x 2	33.8 x 2	33.8 x 2	
Boom cylinder head pin	25.5 x 2	25.7 x 2	25.5 x 2	
Boom, arm connecting pin	105	91.5	105	
Arm cylinder bottom pin	45	44	45	
Arm cylinder head pin	30	31	31	
Link, arm connecting pin	56.1	50	56.1	
Link, bucket connecting pin	62.2	56.3	62.2	
Bucket cylinder head pin	56.1	50	56.1	
Boom cylinder bottom pin	36.8	34.5	44.9	
Arm, bucket connecting pin	91.4	63.7	91.4	
Link assembly	432	378	416	

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LOADING SHOVEL

Unit: kg

Machine model	PC650-5		
Serial No.	20001 and up		
Engine assembly	2,487		
• Engine	1,475		
• PTO (including lubricating piping)	543		
• No. 1 pump	164		
• No. 2 pump	147		
• Swing pump	137		
• Charging and PTO lubricating pump	17.7		
Radiator assembly	646		
Oil cooler assembly	154		
Hydraulic tank (excluding oil)	431		
Revolving frame (including left and right decks)	14,200		
Operator's cab	280		
Swing machinery	865		
Swing motor	122		
Travel motor	220 x 2		
Swing control valve	355		
L.H. 5-spool control valve	245		
R.H. 4-spool control valve	240		
Center swivel joint	69		
Counterweight (excluding mounting bolts)	8,650		
Track frame assembly	18,435		
• Center frame	4,763		
• Track frame	2,487 x 2		
• Carrier roller	71.5 x 6		
• Track roller	136 x 16		
• Idler cushion assembly	782 x 2		
• Idler	450 x 2		
• Final drive	1,147 x 2		
• Swing circle	1,335		

020905

Unit: kg

Machine model	PC650-5		
Serial No.	20001 and up		
Track shoe assembly			
610 mm double grouser shoe	7,560		
810 mm double grouser shoe	8,880		
1,110 mm double grouser shoe	9,630		
Boom assembly (excluding piping)	4,007		
Arm assembly (excluding piping)	2,725		
Bucket assembly (excluding piping)	5,524		
Boom cylinder assembly	568 x 2		
Arm cylinder assembly	862		
Bucket cylinder assembly	526 x 2		
Bottom dump cylinder assembly	134 x 2		
Boom foot pin	43.5 x 2		
Boom cylinder bottom pin	32 x 2		
Boom cylinder head pin	25.2 x 2		
Boom, arm connecting pin	45 x 2		
Arm cylinder bottom pin	55.4		
Arm cylinder head pin	55.4		
Link, arm connecting pin	35.3 x 2		
Link, bucket connecting pin	36.7 x 2		
Bucket cylinder head pin	36.8 x 2		
Boom cylinder bottom pin	35.3 x 2		
Arm, bucket connecting pin	51.8 x 2		
Link assembly	440		

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LIST OF LUBRICANT AND WATER

RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE -22 -4 14 32 50 68 86 104 122°F -30 -20 -10 0 10 20 30 40 50°C	CAPACITY (ℓ)	
			Specified	Refill
Engine oil pan	Engine oil	SAE 30 SAE 10W SAE 10W-30 SAE 15W-40	48	43
PTO case	Engine oil	SAE 30 SAE 10W	10	10
Idler (each)	Gear oil	GO140B	0.63	—
Track roller (each)	Gear oil	GO140B	0.48	—
Carrier roller (each)	Gear oil	GO140B	0.73	—
Swing machinery case	Engine oil	SAE 30	37	37
Final drive case (each)	Engine oil	SAE 30	17	17
Hydraulic system	Engine oil	SEA 10W SAE 10W-30 SAE 15W-40	860	480
Fuel tank	Diesel fuel	ASTM D975 No. 2 ※	740	—
Cooling system	Water	Add antifreeze	139	—

※ ASTM D975 No. 1

020905

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

NOTE:

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

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

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

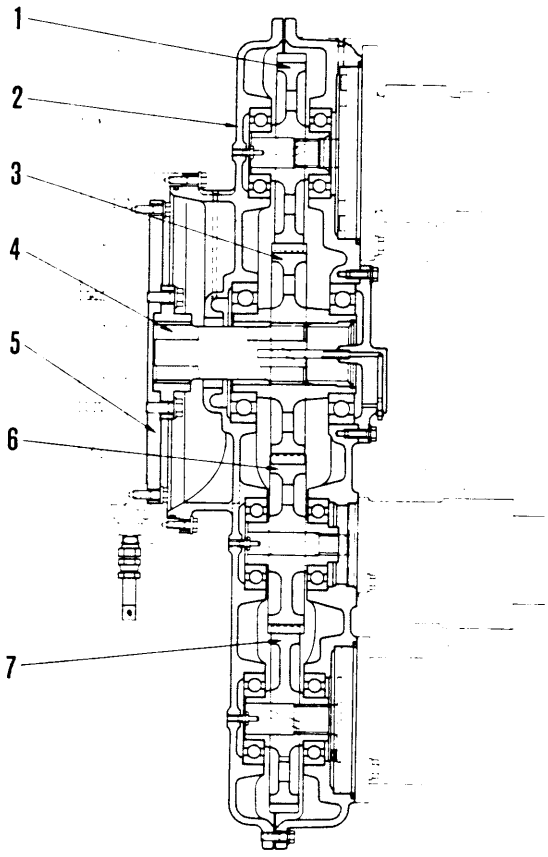
Specified capacity: Total amount of oil including oil for components and oil in piping.
Refill capacity: Amount of oil needed to refill system during normal inspection and maintenance.

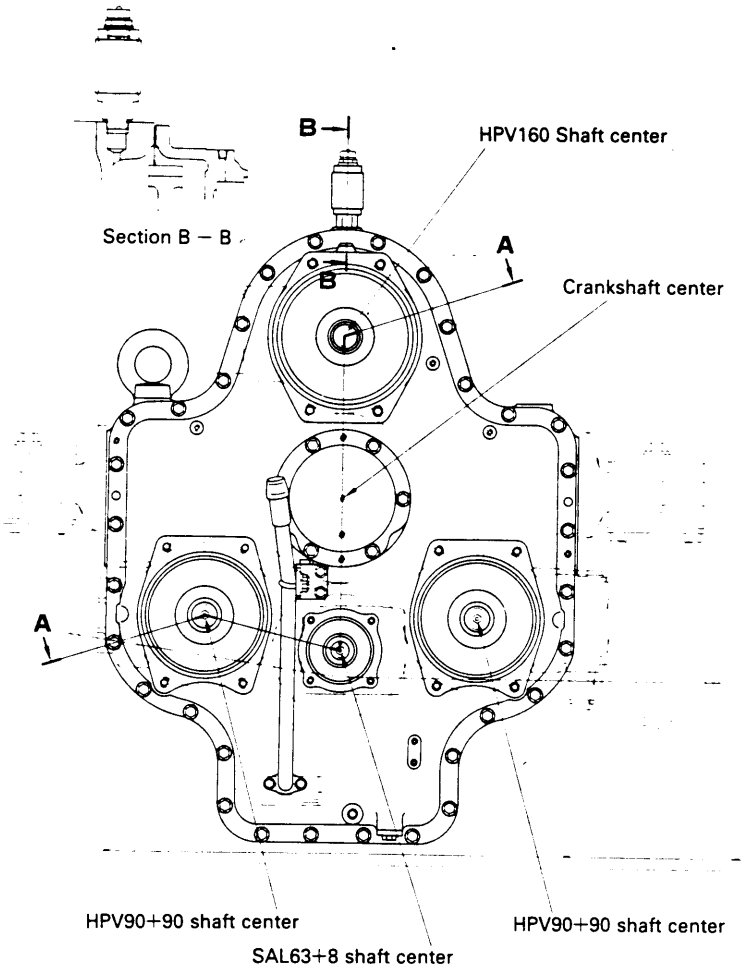
(3) Use API classification CD engine oil and if API classification CC, reduce the engine oil change interval to half.
(4) There is no problem if single grade oil is mixed with multigrade oil (SAE10W-30, 15W-40), but be sure to add single oil that matches the temperature in the table on the left.
(5) We recommend Komatsu genuine oil which has been specifically formulated and approved for use in engine and hydraulic work equipment applications.

10 STRUCTURE AND FUNCTION

020905

PTO (Power Take-Off)





020905

1. Driven gear (No. of teeth: 46)
2. PTO case
3. Drive gear (No. of teeth: 51)
4. Input shaft
5. Connecting plate
6. Driven gear (No. of teeth: 41)
7. Driven gear (No. of teeth: 43)

SPECIFICATIONS

Volume of lubrication oil: 11ℓ (SAE30).

Reduction ratio:

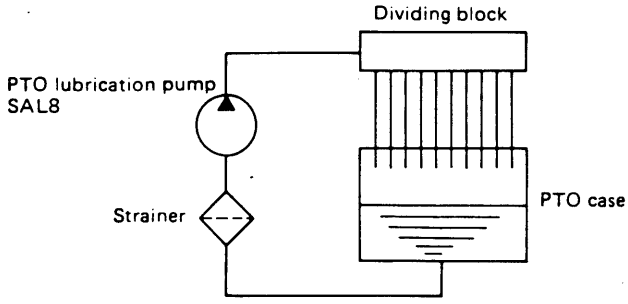
HPV90 + 90 pump shaft = $\frac{43}{51}$ = 0.843

HPV160 pump shaft = $\frac{46}{51}$ = 0.902

SAL63 + 8 pump shaft = $\frac{41}{51}$ = 0.804

PTO LUBRICATION SYSTEM

Hydraulic circuit diagram



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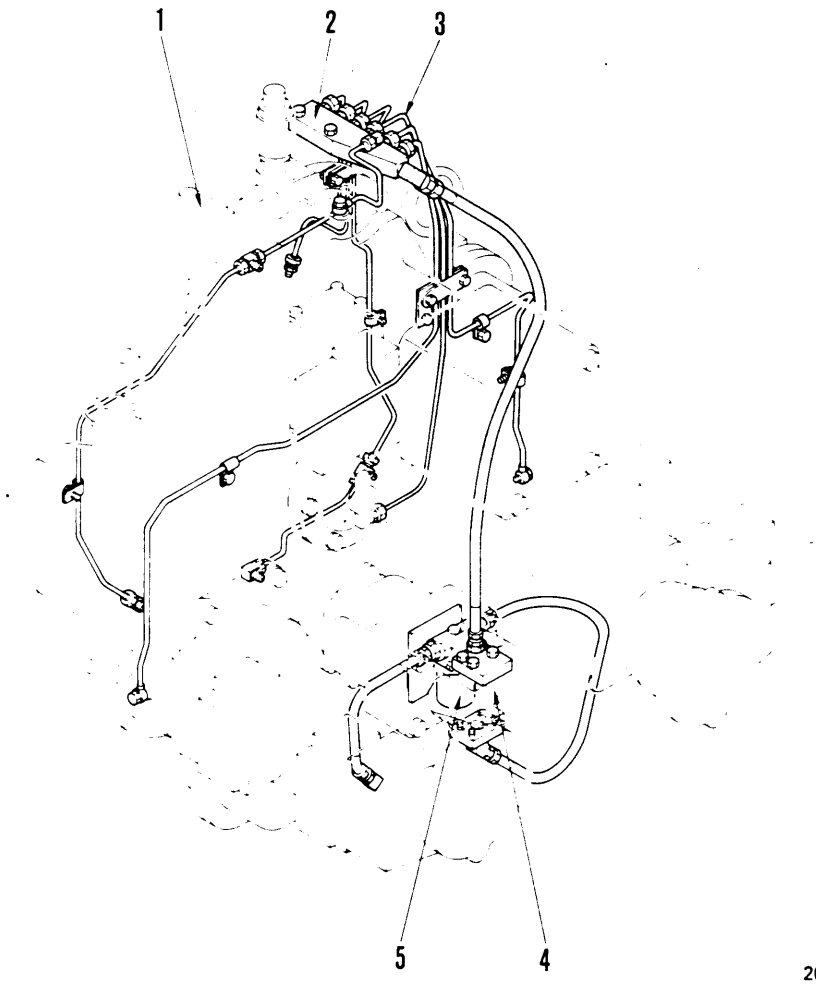
Hydraulic piping

020905



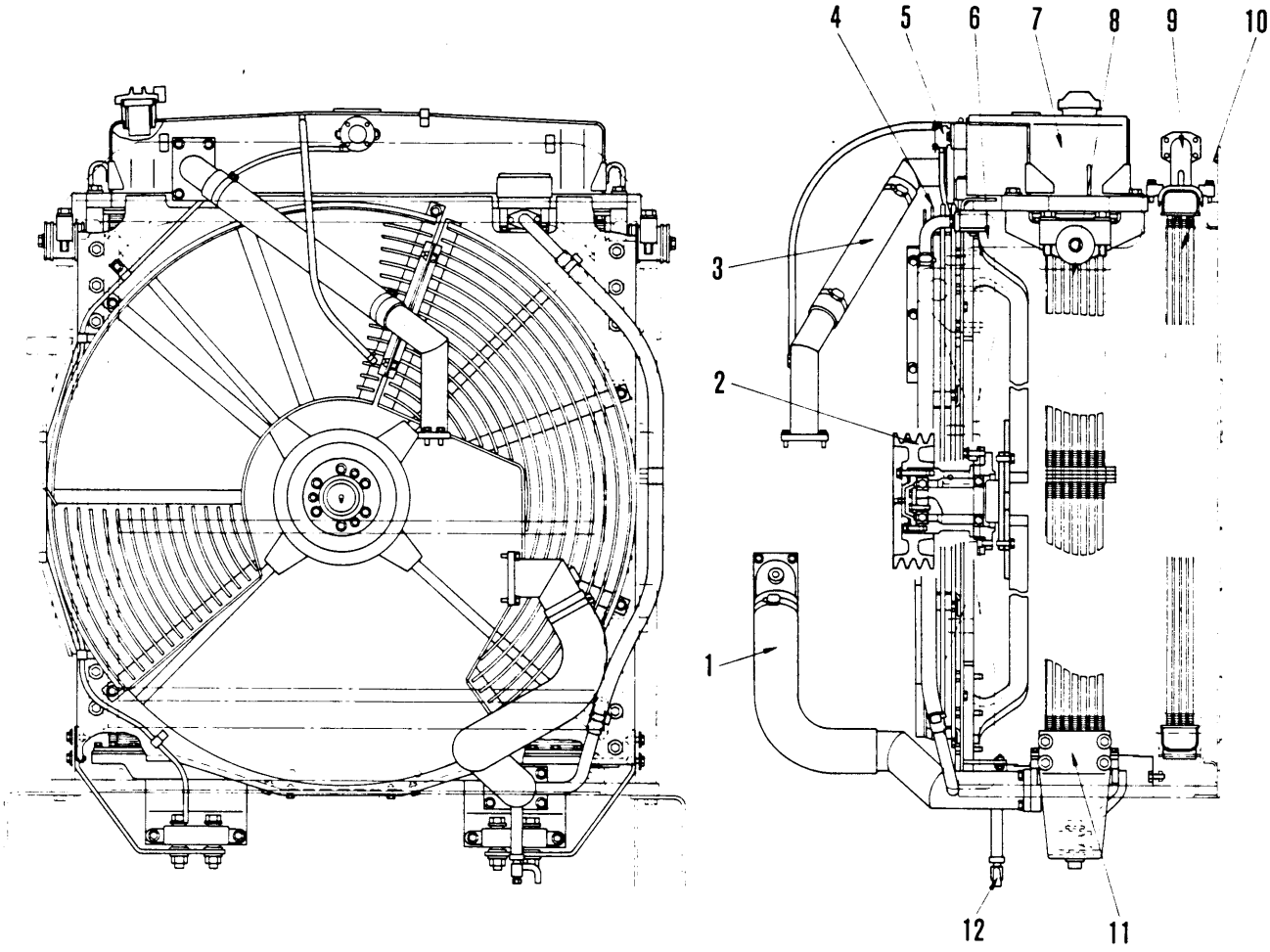
209F05011

1. PTO case
2. Dividing block
3. Lubrication piping
4. Charging and PTO lubrication pump (SAL63 + 8)
5. Oil filter

OUTLINE

In the PTO, the SAL8 of charging and PTO lubrication pump (4) is used to send the lubricating oil inside the PTO case through oil filter (5) to the top dividing block (2). From here, it is divided and sent to each part of the PTO and lubricates and cools all the gears.

RADIATOR AND OIL COOLER



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020905

1. Radiator outlet tube
2. Fan pulley
3. Radiator inlet hose
4. Fan guard
5. Pressure valve
6. Fan
7. Radiator upper tank
8. Radiator core
9. Oil cooler inlet tube
10. Oil cooler core
11. Radiator lower tank
12. Radiator drain valve

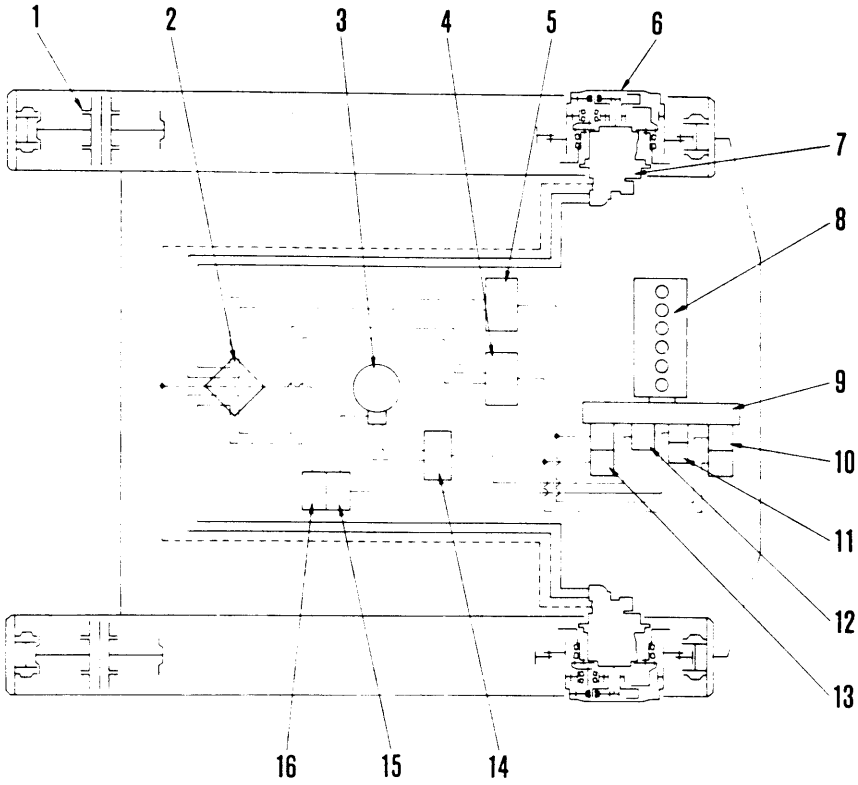
SPECIFICATIONS

1. Fan
   Outside diameter: 1,350 mm
   No. of blade: 8
   Fan speed: Standard 890 mm
   (At engine rated rpm: 1,800 rpm)

2. Radiator
   Core type: D7
   Fin pitch: 4 mm
   Pressure valve set pressure: 0.75 ± 0.1 kg/cm²
   Vacuum valve set pressure: 0 – 0.07 kg/cm²

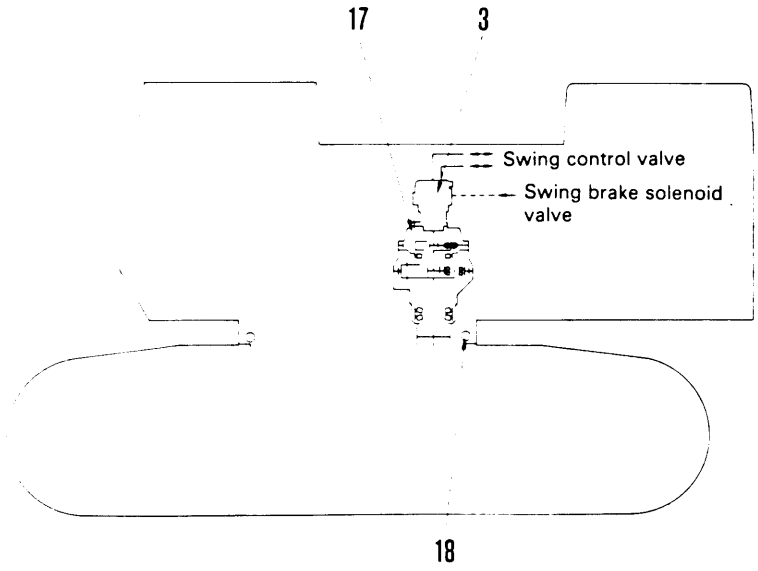
3. Oil cooler
   Core type: J4
   Fin pitch: 3 mm

POWER TRAIN



1. Idler
2. Center swivel joint
3. Swing motor
4. L.H. 5-spool control valve
5. R.H. 4-spool control valve
6. Final drive and sprocket
7. Travel motor
8. Engine
9. PTO
10. No. 1 pump
11. Charging pump and PTO lubricating pump
12. Swing pump
13. No. 2 pump
14. Swing control valve
15. Swing brake solenoid valve
16. Travel speed solenoid valve
17. Swing machinery
18. Swing circle

020905



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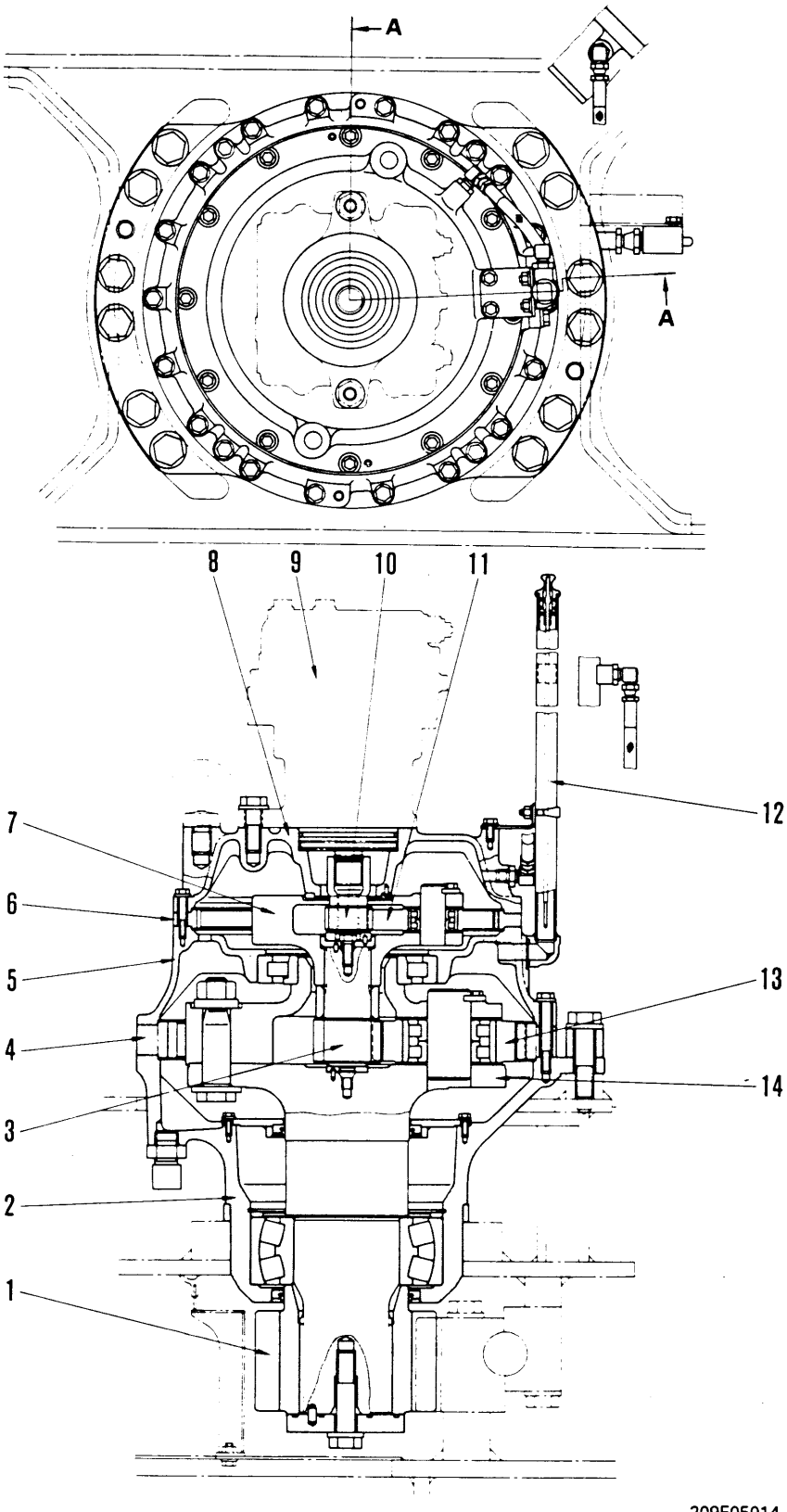
SWING MACHINERY



Section A – A

209F05014

1. Swing pinion
2. Housing
3. No. 2 sun gear (13 teeth)
4. No. 2 ring gear (80 teeth)
5. Case
6. No. 1 ring gear (160 teeth)
7. No. 1 planetary carrier
8. Cover
9. Swing motor
10. No. 1 sun gear (23 teeth)
11. No. 1 planetary gear (36 teeth)
12. Oil level gauge
13. No. 2 planetary gear (33 teeth)
14. No. 2 planetary carrier

SPECIFICATIONS

Reduction ratio:

$$\frac{23 + 160}{23} \times \frac{13 + 80}{13} \times \frac{86}{13} = 376.55$$

Continuous rotating speed: 5.3 rpm

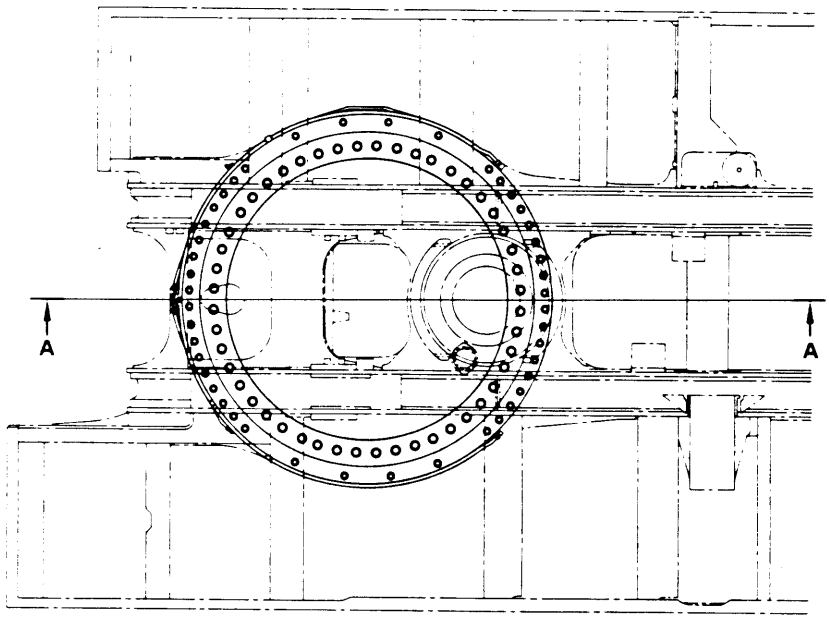
Volume of lubrication oil:

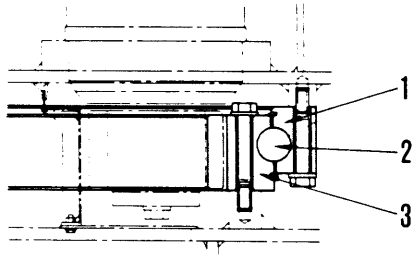
Upper 37 ℓ (Engine oil SAE30)

Lower 6 ℓ (Grease G2-LI)

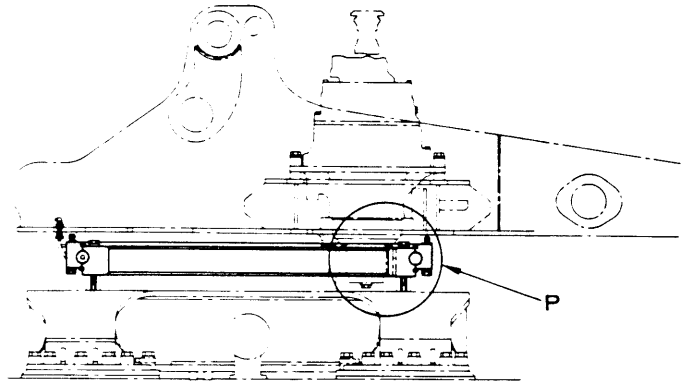
020905

SWING CIRCLE





Detail P



Section A – A

209F3039

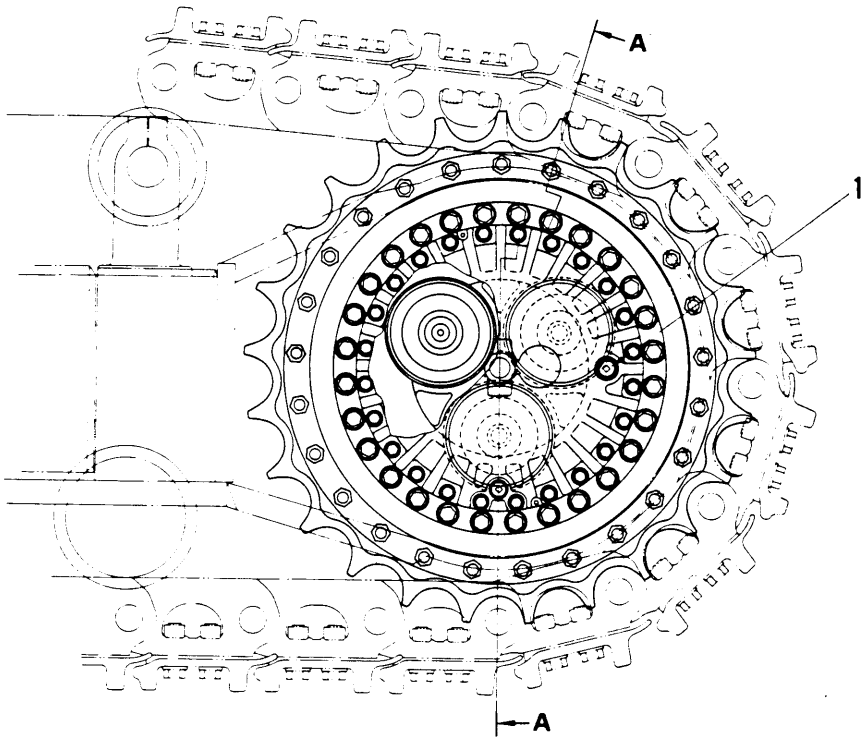
020905

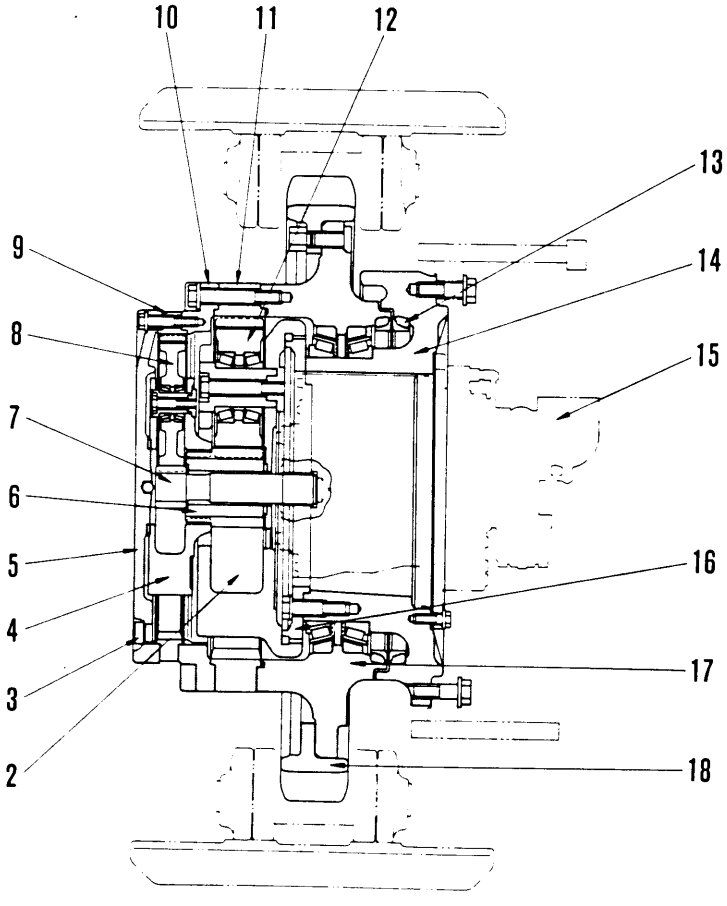
1. Swing circle outer race
2. Ball bearing
3. Swing circle inner race

SPECIFICATION

Grease volume: 95 ℓ (G2-LI)

FINAL DRIVE





Section A – A

209F05015

1. Level plug
2. No. 1 planetary carrier
3. Drain plug
4. No. 2 planetary carrier
5. Cover
6. No. 1 sun gear (15 teeth)
7. No. 2 sun gear (12 teeth)
8. No. 2 planetary gear (43 teeth)
9. No. 2 ring gear (99 teeth)
10. Spacer
11. No. 1 ring gear (77 teeth)
12. No. 1 planetary gear (29 teeth)
13. Floating seal
14. Housing
15. Travel motor
16. Retainer
17. Hub
18. Sprocket

SPECIFICATION

Reduction ratio:

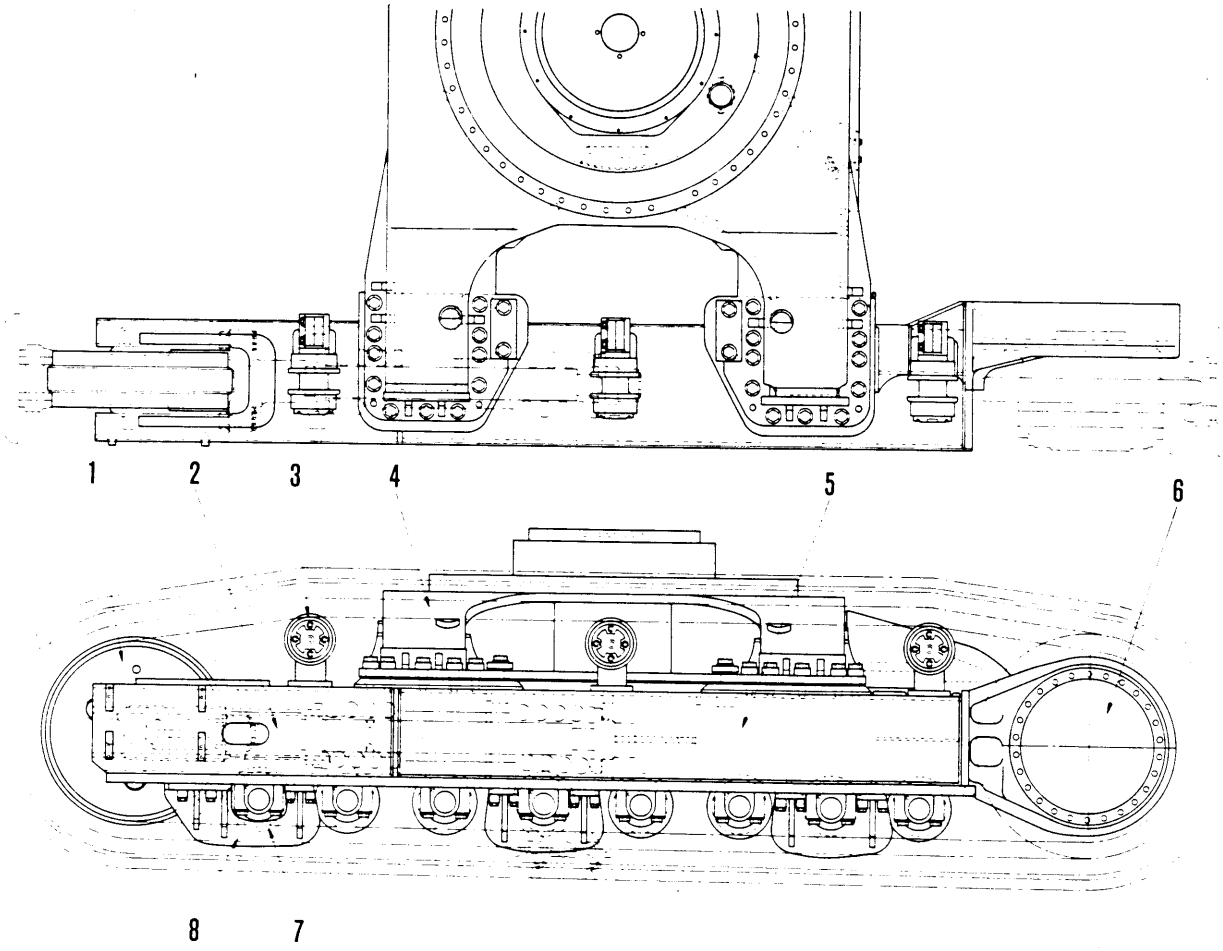
$$-\left(\frac{99+12}{12}\right) \times \left(\frac{77+15}{15}\right) + 1 = -55.733$$

Volume of lubricating oil: 35 ℓ (SAE30)

020905

TRACK FRAME

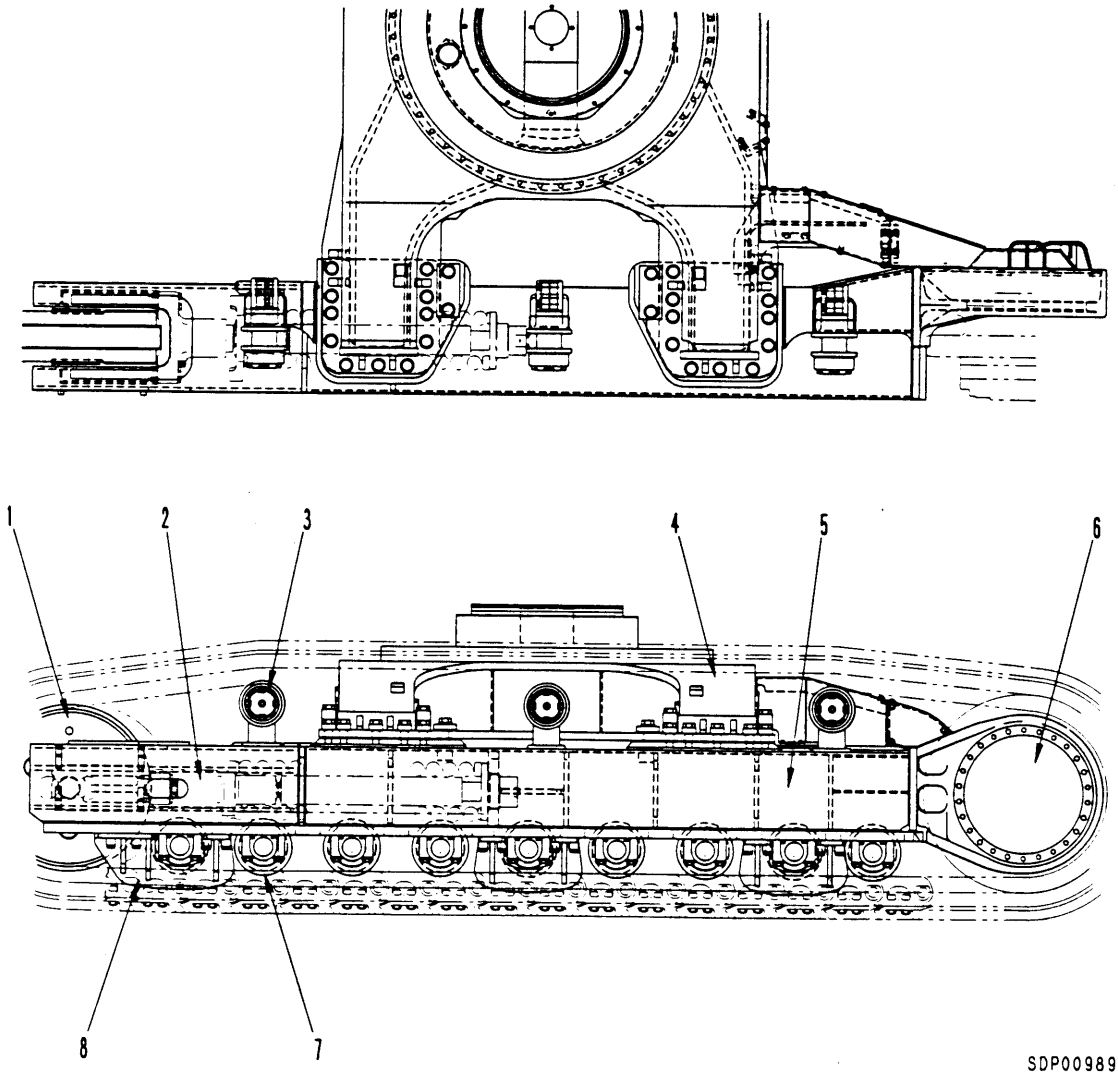
PC650-5
PC650SE-5



209F05016

020905

1. Idler
2. Idler cushion
3. Carrier roller
4. Center frame
5. Track frame
6. Travel motor
7. Track roller
8. Guard



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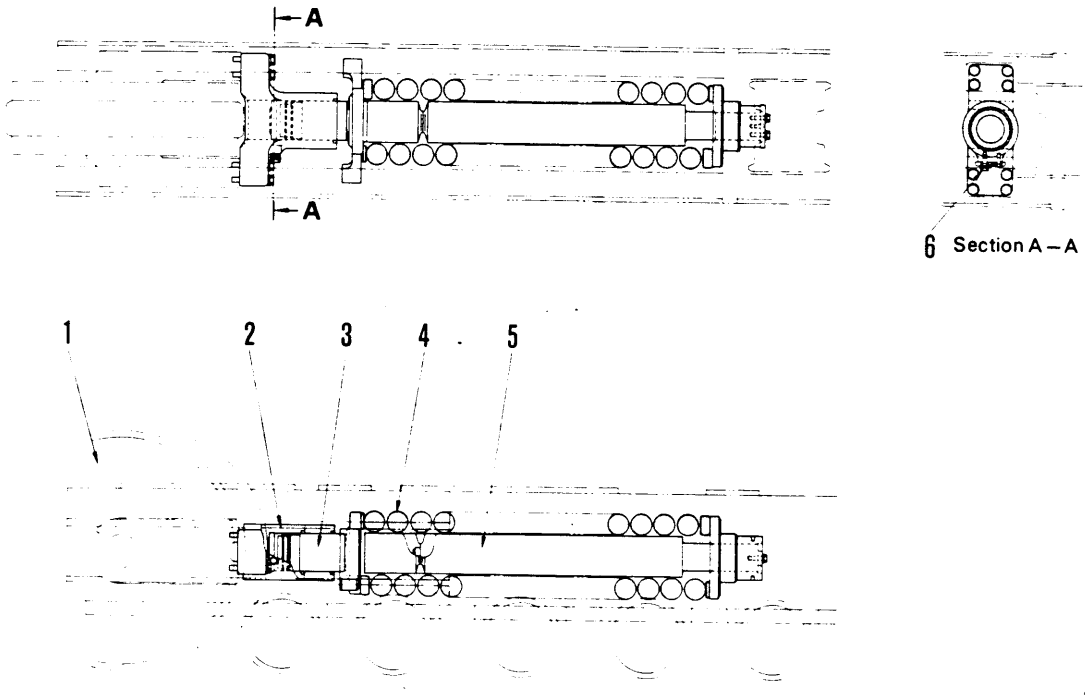
1. Idler
2. Idler cushion
3 Carier roller
4. Center frame
5. Track frame
6. Travel motor
7. Track roller
8. Guard

IDLER CUSHION

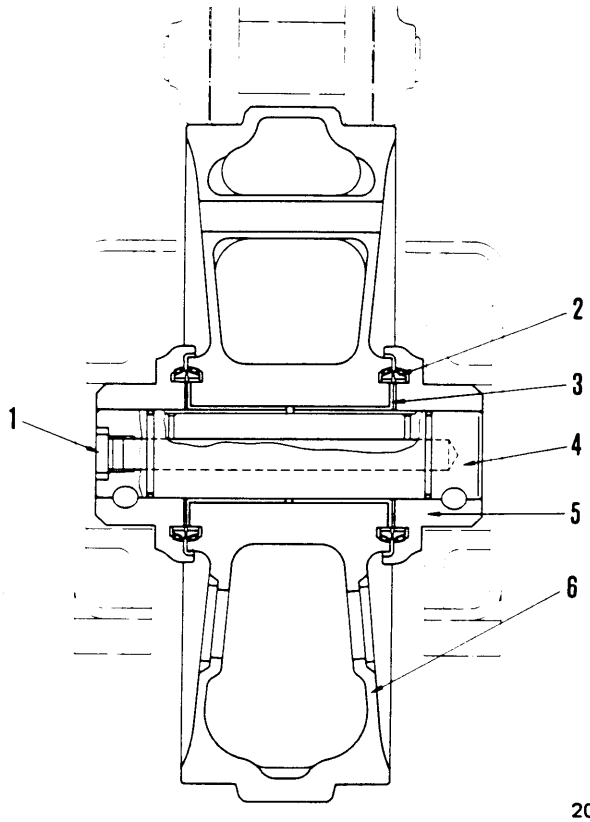


209F05017

1. Idler
2. Cylinder
3. Piston
4. Recoil spring
5. Rod
6. Lubricator

020905

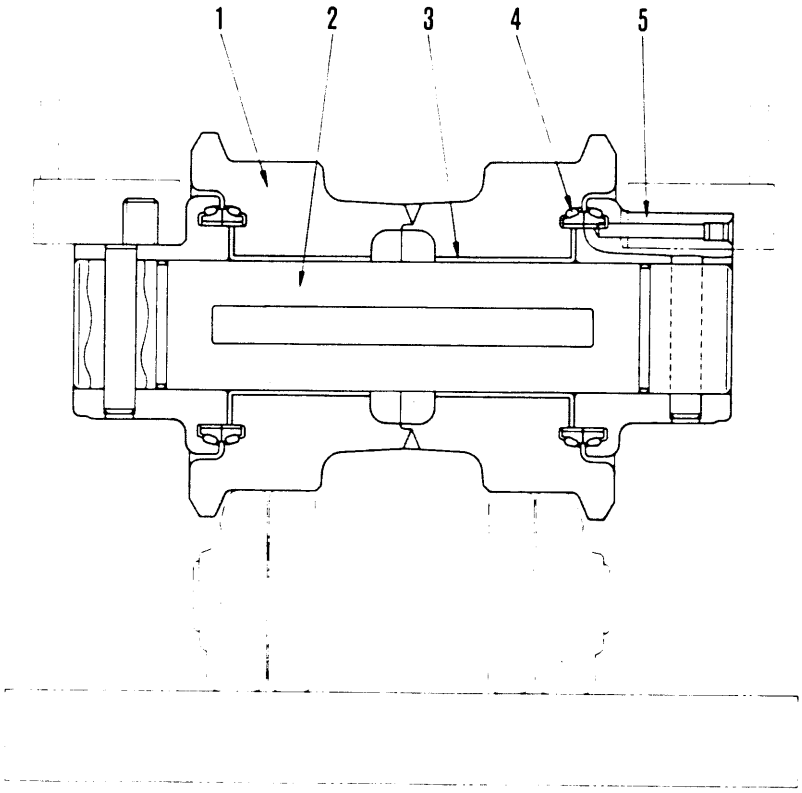
IDLER



209F3044

1. Lubricating plug
2. Floating seal
3. Bushing
4. Idler shaft
5. Bearing support
6. Idler

TRACK ROLLER



1. Roller
2. Shaft
3. Bushing
4. Floating seal
5. Support

209F05018

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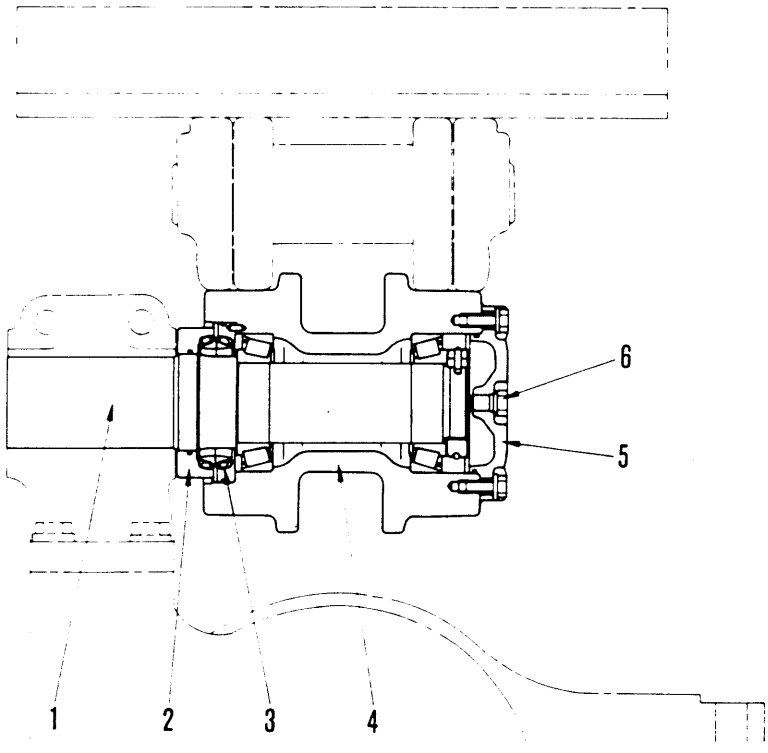
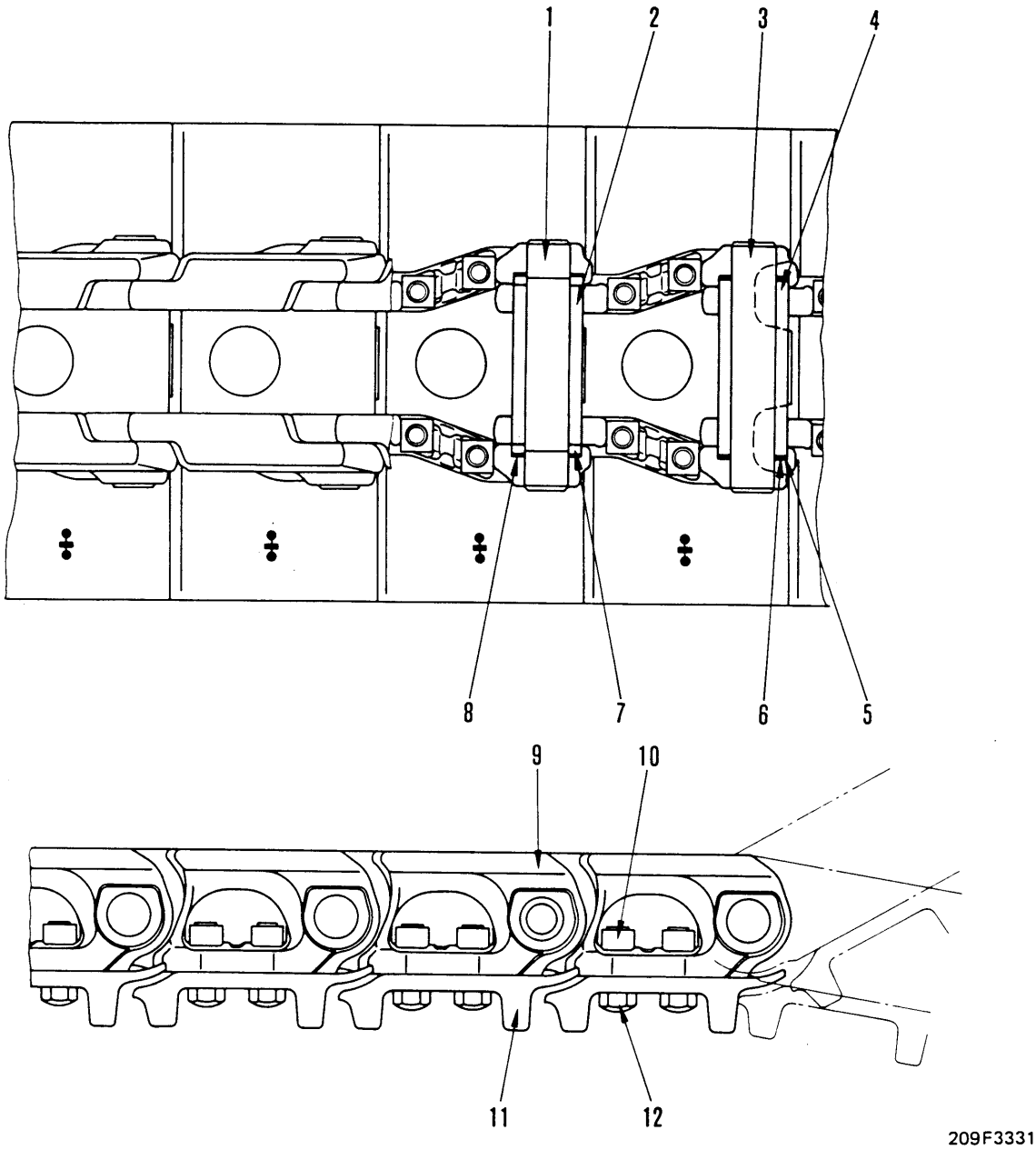
CARRIER ROLLER



1. Shaft
2. Collar
3. Floating seal
4. Roller
5. Cover
6. Lubricating plug

209F05019

TRACK SHOE

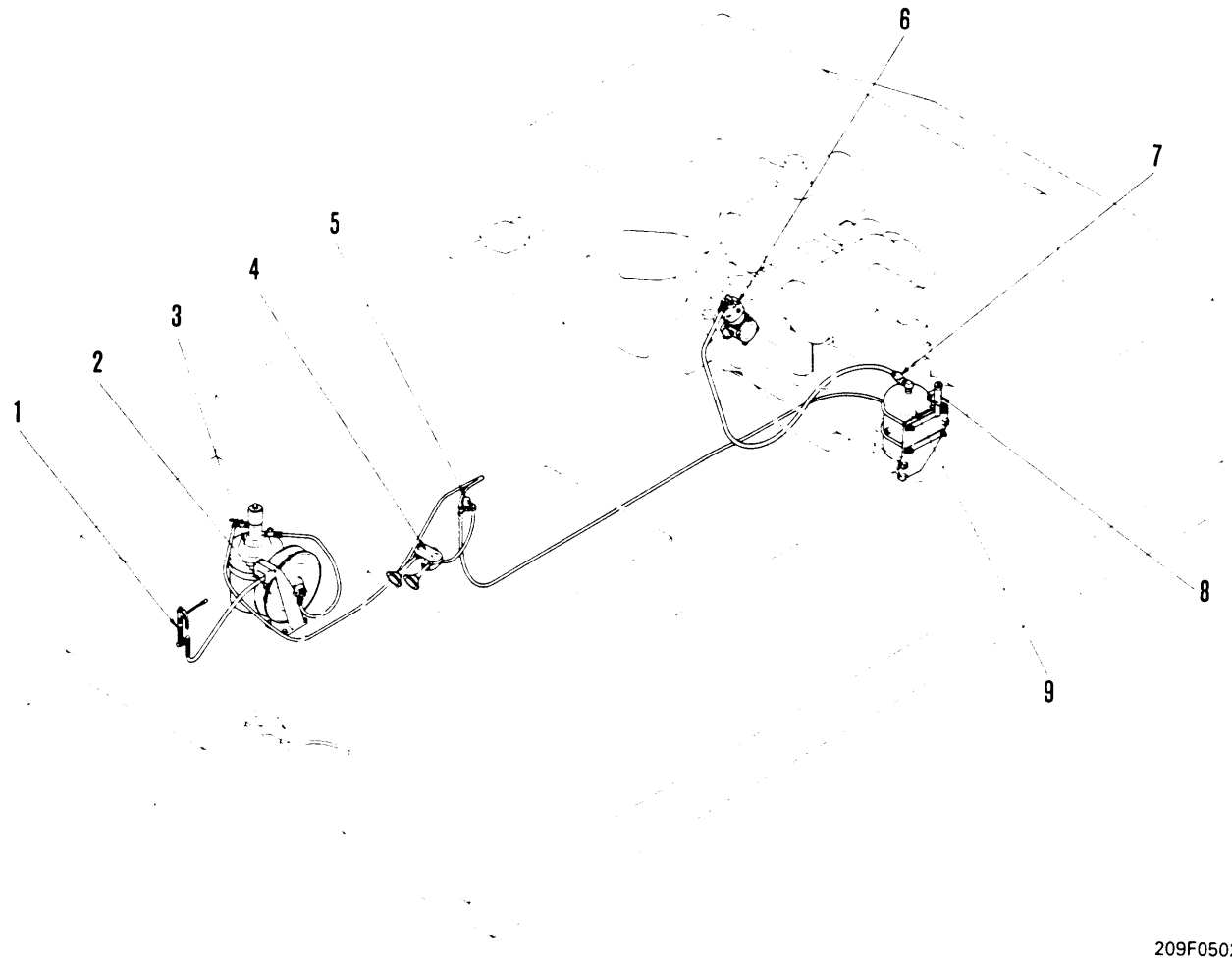


209F3331

020905

1. Regular pin
2. Regular bushing
3. Master pin
4. Master bushing
5. Master seal (washer)
6. Master dust seal (spacer)
7. Regular dust seal (spacer)
8. Regular dust seal (washer)
9. Link
10. Shoe nut
11. Shoe
12. Shoe bolt

AIR PIPING

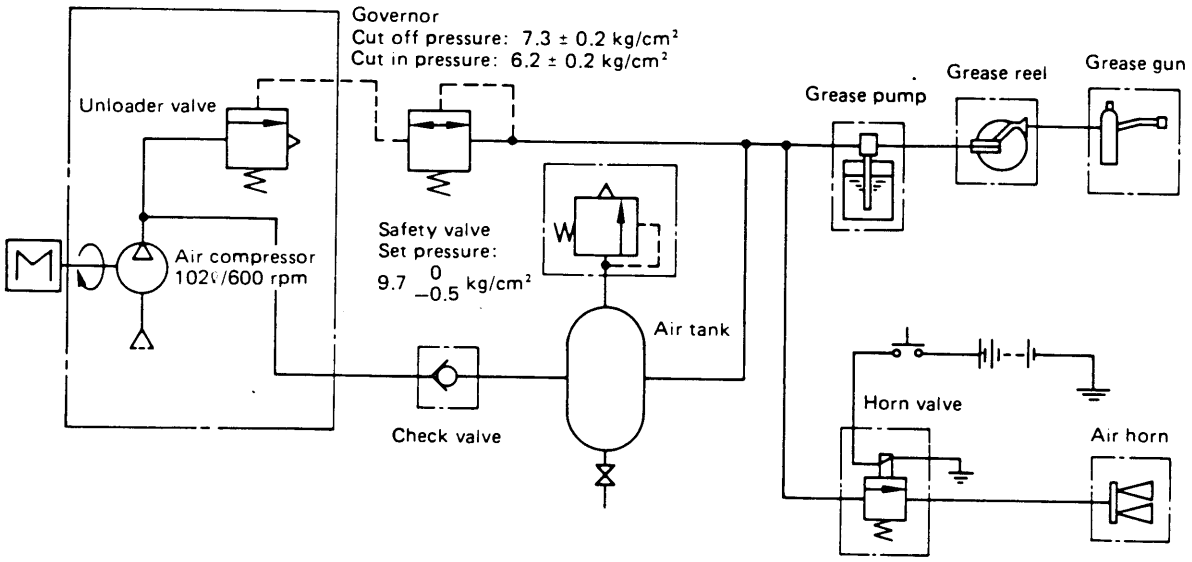


020905

209F05020

1. Grease gun
2. Grease reel
3. Grease pump
4. Air horn
5. Horn valve
6. Air compressor
7. Air governor
8. Safety valve
9. Air tank

AIR CIRCUIT DIAGRAM



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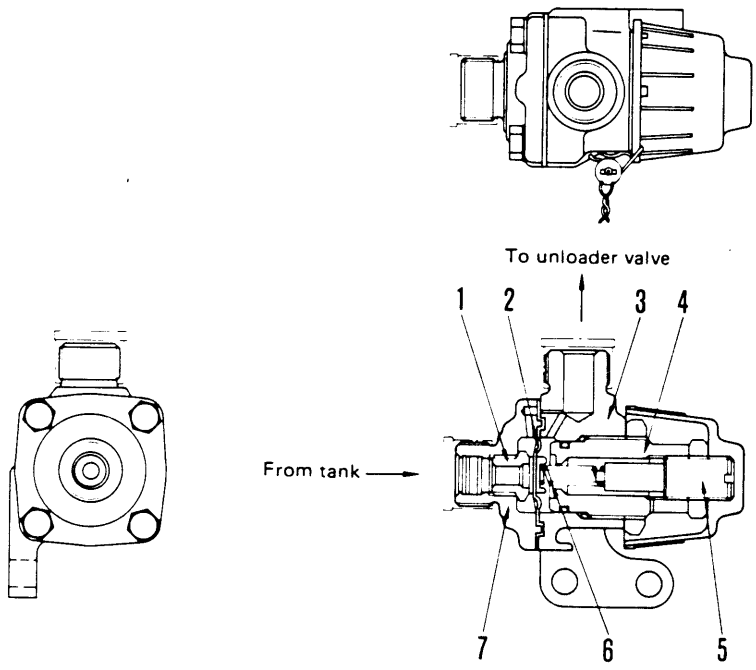
AIR COMPRESSOR

★ See ENGINE SHOP MANUAL.

AIR GOVERNOR



1. Valve seat
2. Diaphragm
3. Body
4. Sleeve
5. Adjustment screw
6. Spring
7. Cover

209F3049

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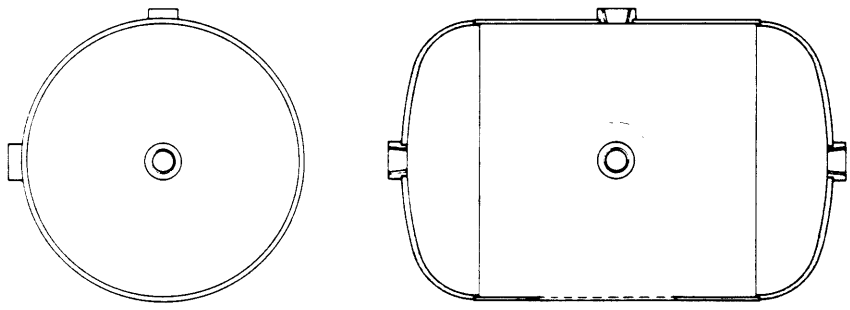
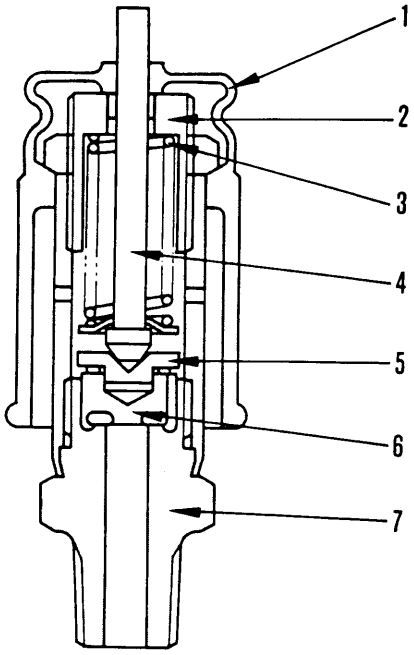
AIR TANK



SPECIFICATION
Capacity: 15 ℓ

209F3050

SAFETY VALVE



209F3051

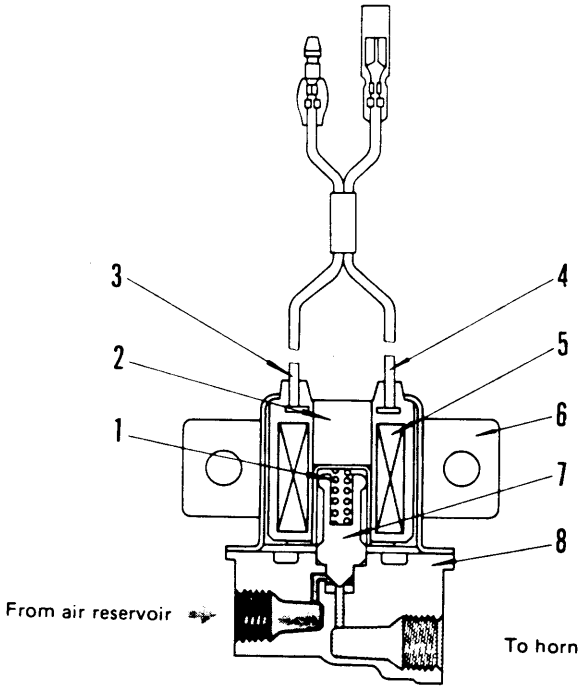
1. Cover
2. Sleeve
3. Spring
4. Pin
5. Cap
6. Valve
7. Nipple

SPECIFICATION

Set pressure: 9.7 $^{0}_{-0.5}$ kg/cm²

020905

HORN VALVE

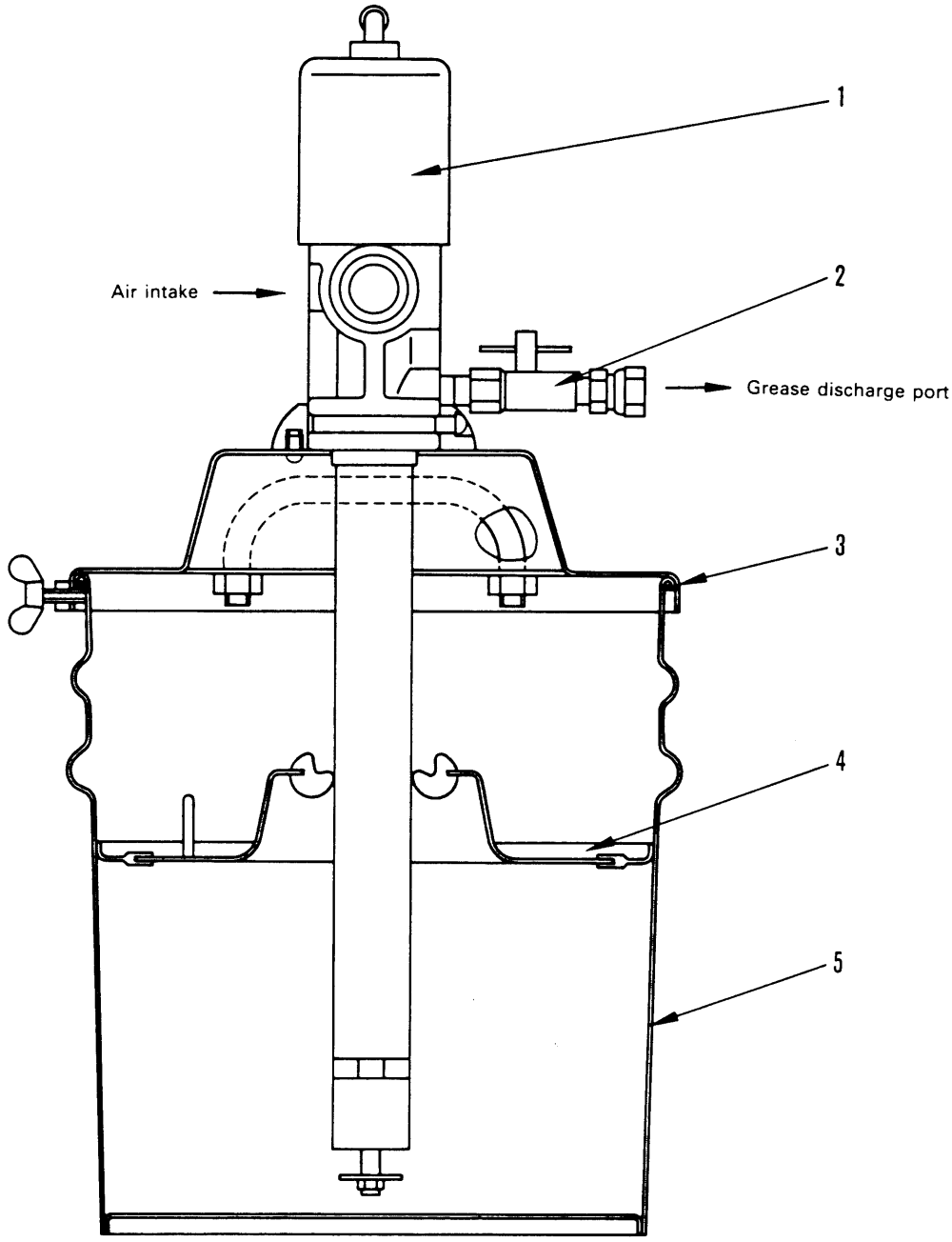


20DF115

1. Spring
2. Magnet
3. Wire
4. Wire
5. Coil
6. Cover
7. Piston
8. Body

GREASE PUMP

020905



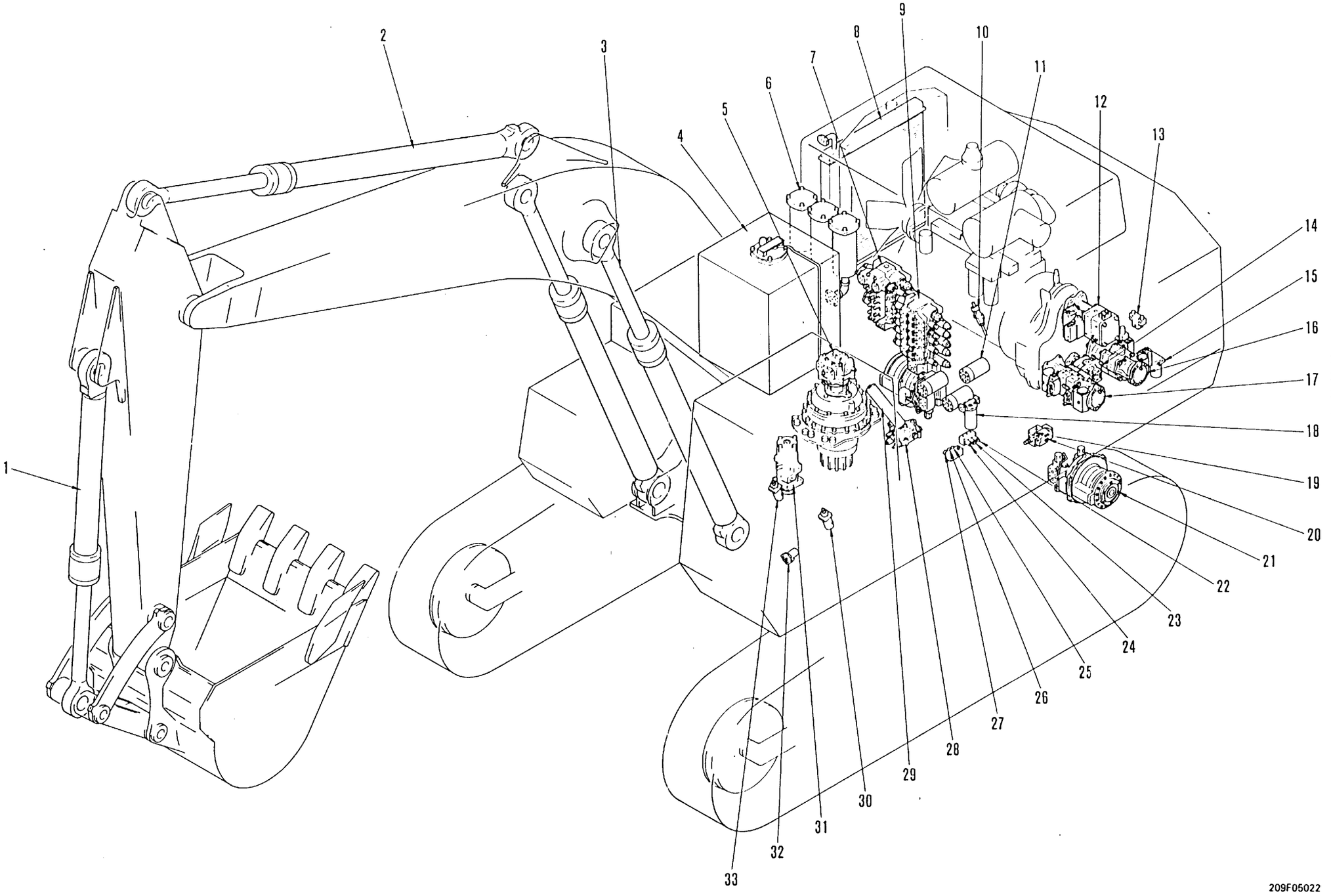
209F05021

1. Silencer
2. Valve
3. Cover
4. Follower plate
5. Grease tank

HYDRAULIC UNIT LOCATION

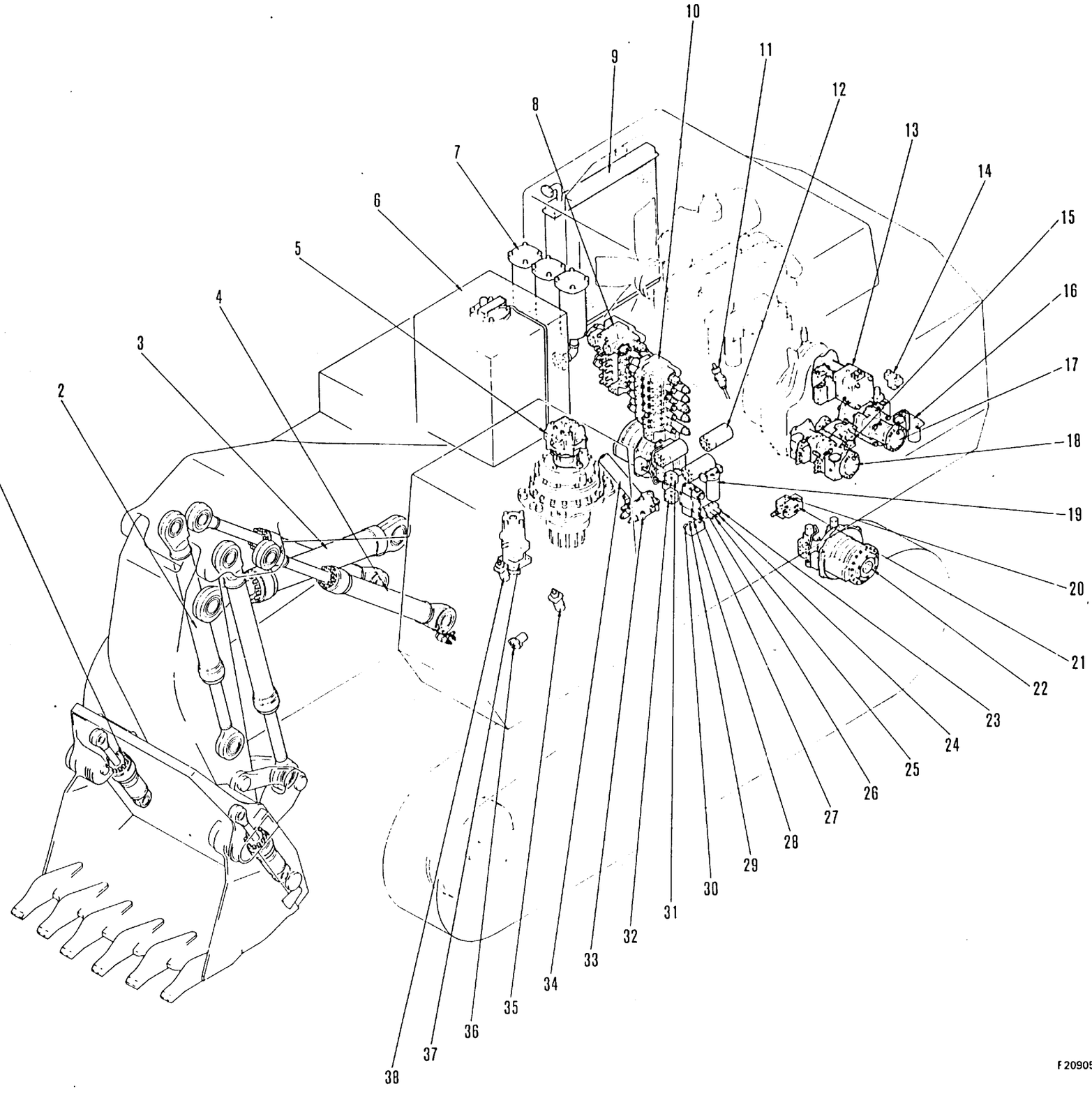
BACK HOE

020905



1. Bucket cylinder
2. Arm cylinder
3. Boom cylinder
4. Hydraulic tank
5. Swing motor
6. Return oil filter
7. R.H. 4-spool control valve
8. Oil cooler
9. L.H. 5-spool control valve
10. Auto-deceleration cylinder
11. Line oil filter
12. Swing pump
13. Auto-deceleration solenoid valve
14. Charging and PTO lubricating pump
15. Pilot oil filter
16. No. 1 pump
17. No. 2 pump
18. Drain oil filter
19. Control relief valve
20. Safety lock valve
21. Travel motor
22. Heavy lift solenoid valve
23. Machine push up solenoid valve
24. Straight-travel solenoid valve
25. Free swing solenoid valve
26. Swing brake solenoid valve
27. Travel speed solenoid valve
28. Swing control valve
29. Accumulator
30. L.H. PPC valve
31. Center swivel joint
32. Travel PPC valve
33. R.H. PPC valve

209F05022



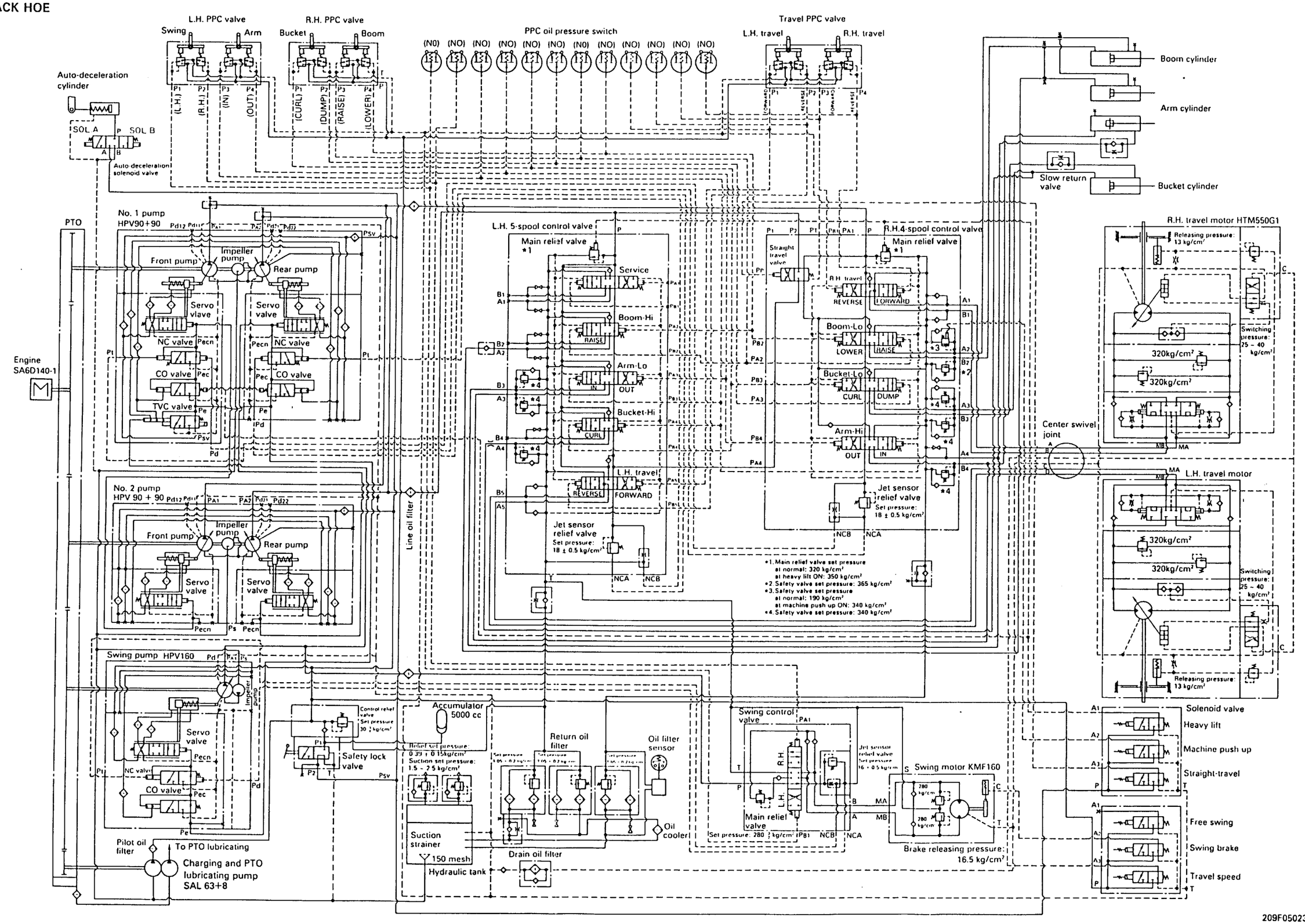
F20905012

1. Bottom dump cylinder
2. Bucket cylinder
3. Arm cylinder
4. Boom cylinder
5. Swing motor
6. Hydraulic tank
7. Return oil filter
8. R.H. 4-spool control valve
9. Oil cooler
10. L.H. 5-spool control valve
11. Auto-deceleration cylinder
12. Line oil filter
13. Swing pump
14. Auto-deceleration solenoid valve
15. Charging and PTO lubricating pump
16. Pilot oil filter
17. No. 1 pump
18. No. 2 pump
19. Drain oil filter
20. Control relief valve
21. Safety lock valve
22. Travel motor
23. Bottom dump close solenoid valve
24. Machine push up solenoid valve
25. Straight-travel solenoid valve
26. Boom EPC valve
27. Bucket EPC valve
28. Bottom dump open solenoid valve
29. Swing brake solenoid valve
30. Travel speed solenoid valve
31. Boom shuttle valve
32. Bucket shuttle valve
33. Swing control valve
34. Accumulator
35. L.H. PPC valve
36. Travel PPC valve
37. Center swivel joint
38. R.H. PPC valve

020905

HYDRAULIC CIRCUIT DIAGRAM

BACK HOE



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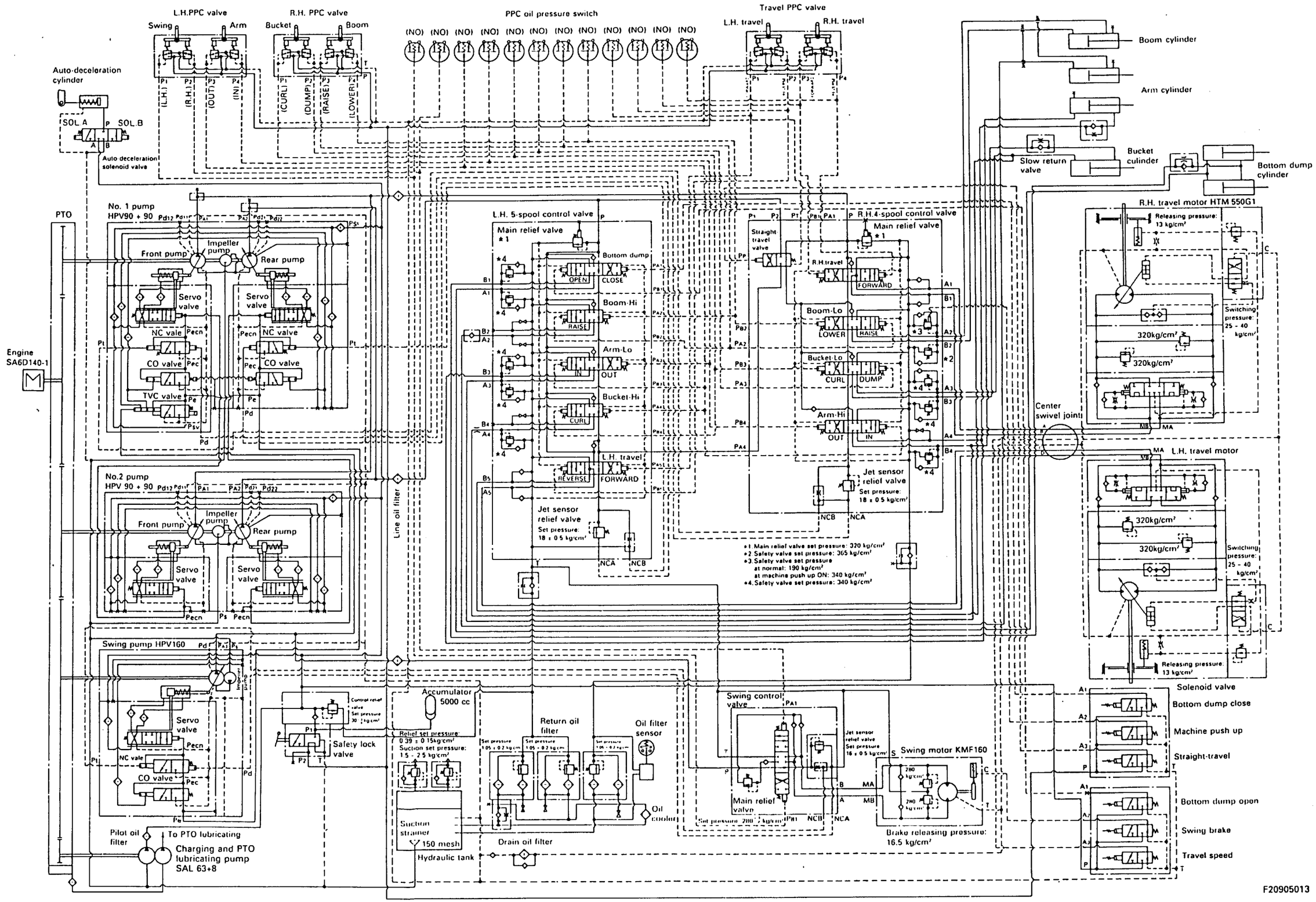
LOADING SHOVEL



F20905013

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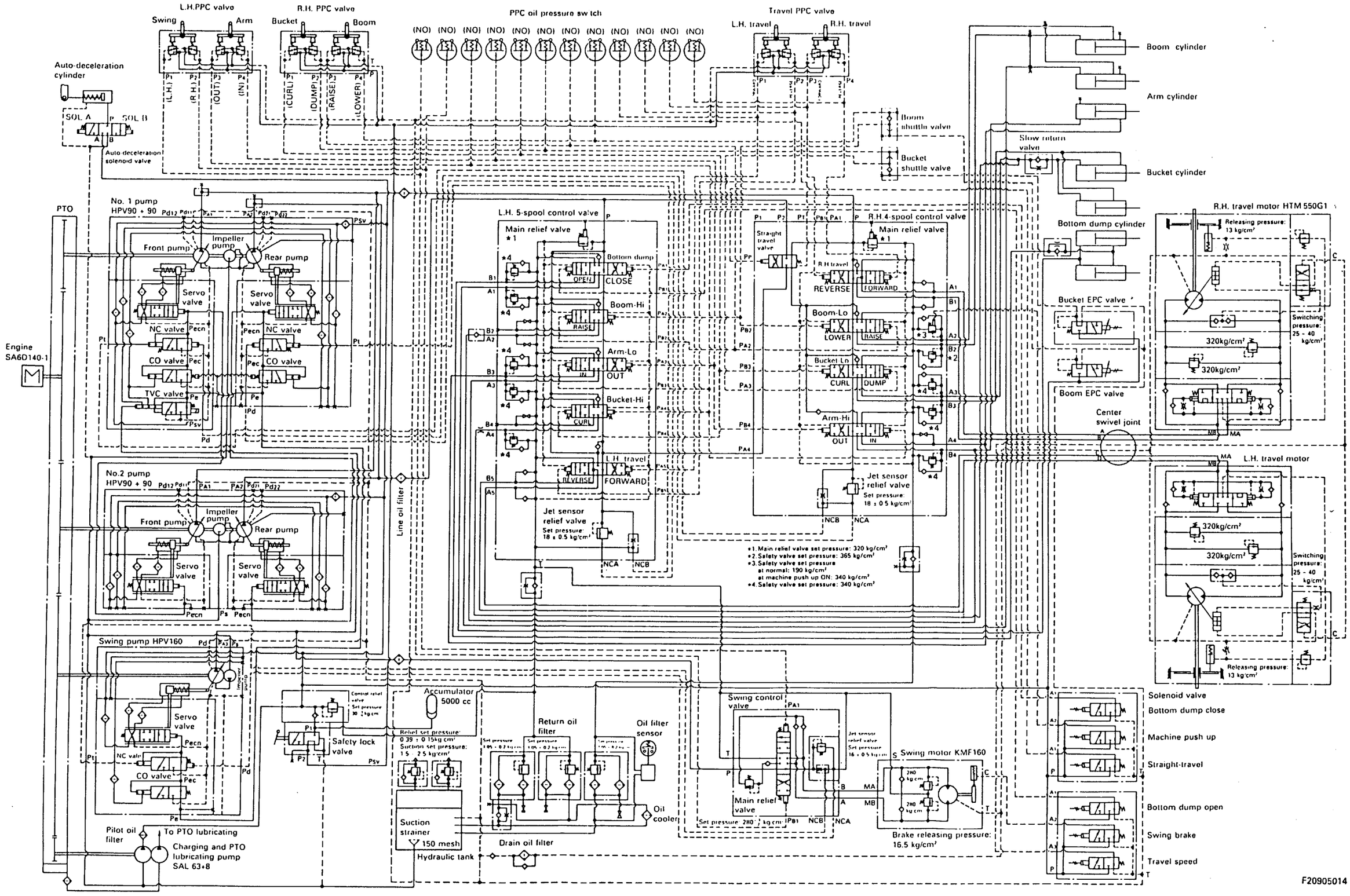
LOADING SHOVEL

★ FOR MACHINE EQUIPPED WITH WORK EQUIPMENT CONTROL SYSTEM



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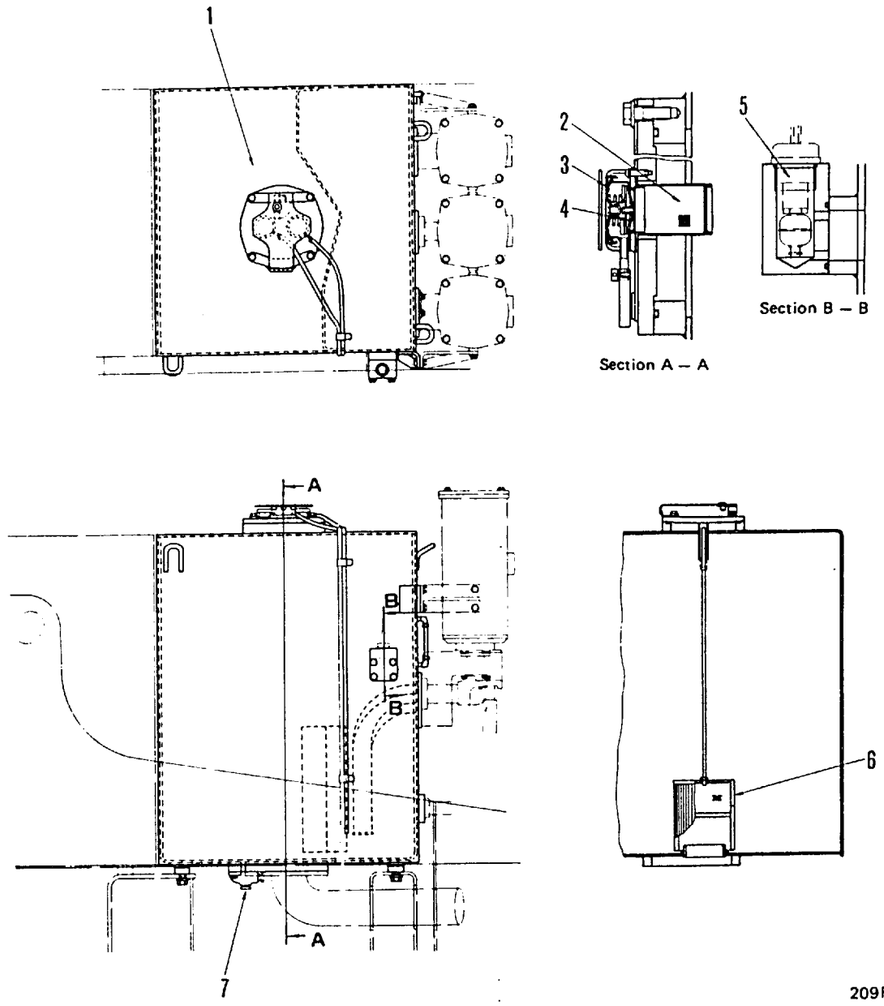
HYDRAULIC TANK



209F3055

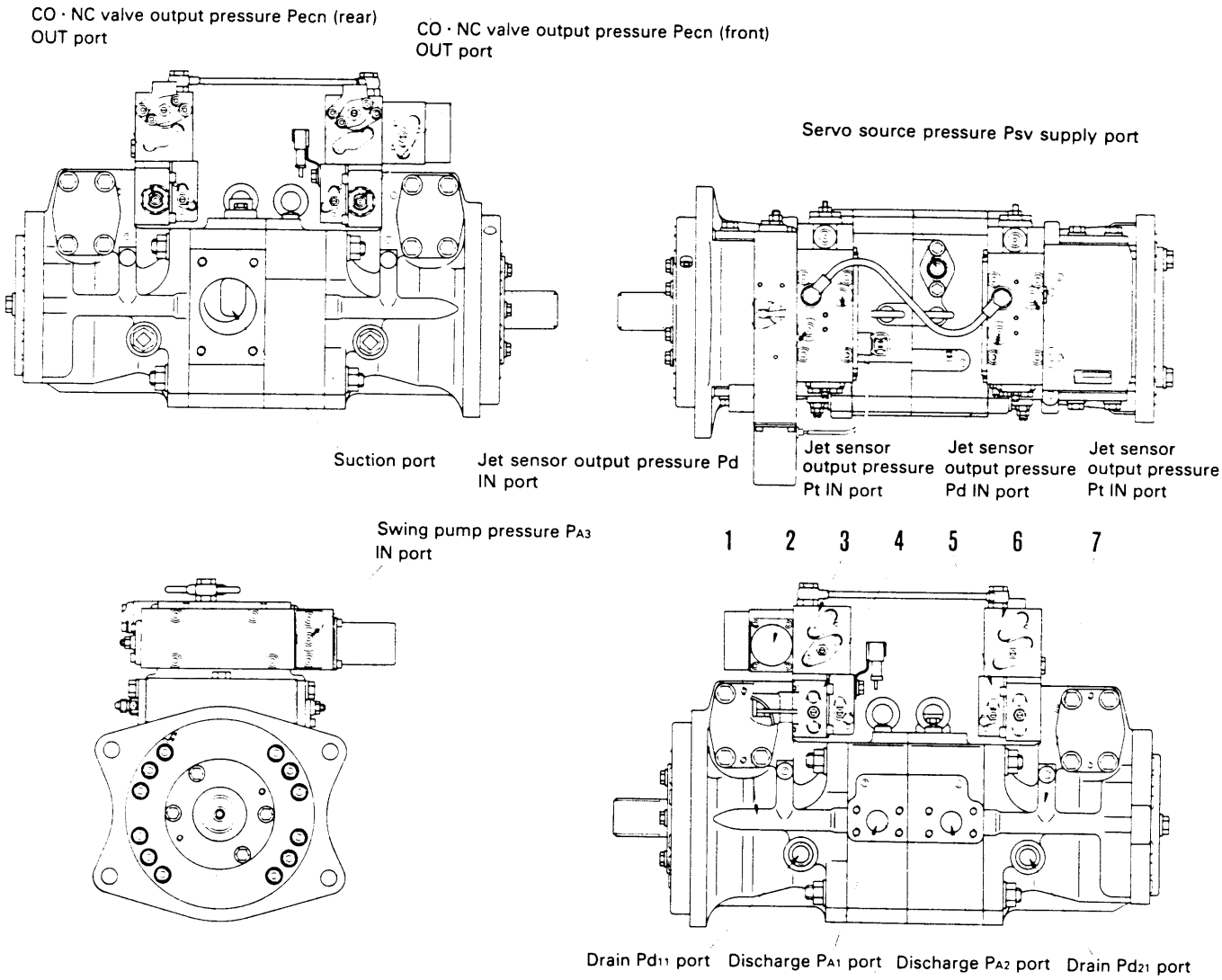
1. Hydraulic tank
2. Strainer
3. Filler cap
4. Pressure valve
5. Oil level sensor
6. Suction strainer
7. Drain valve

SPECIFICATION

- Relief set pressure: 0.39 ± 0.15 kg/cm²
- Suction set pressure: 0 – 0.046 kg/cm²

020905

No. 1 PUMP

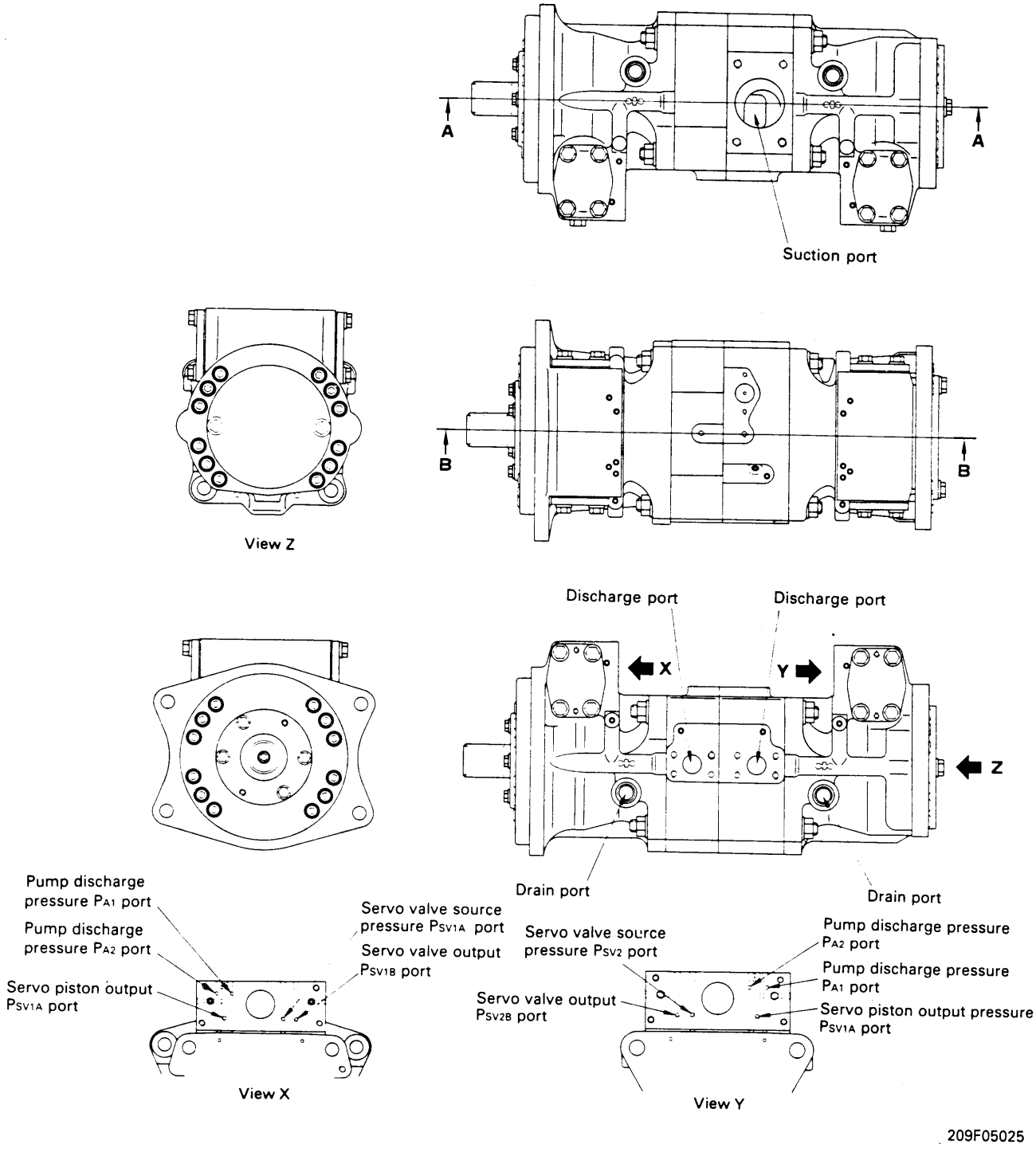


209F05024

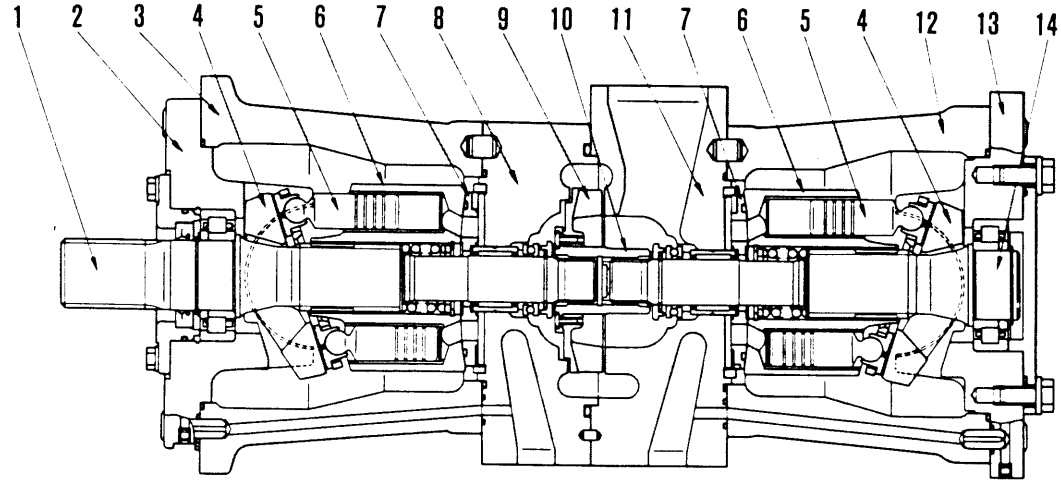
020905

1. Front pump
2. TVC valve
3. Front CO•NC valve
4. Front servo valve
5. Rear servo valve
6. Rear CO•NC valve
7. Rear pump

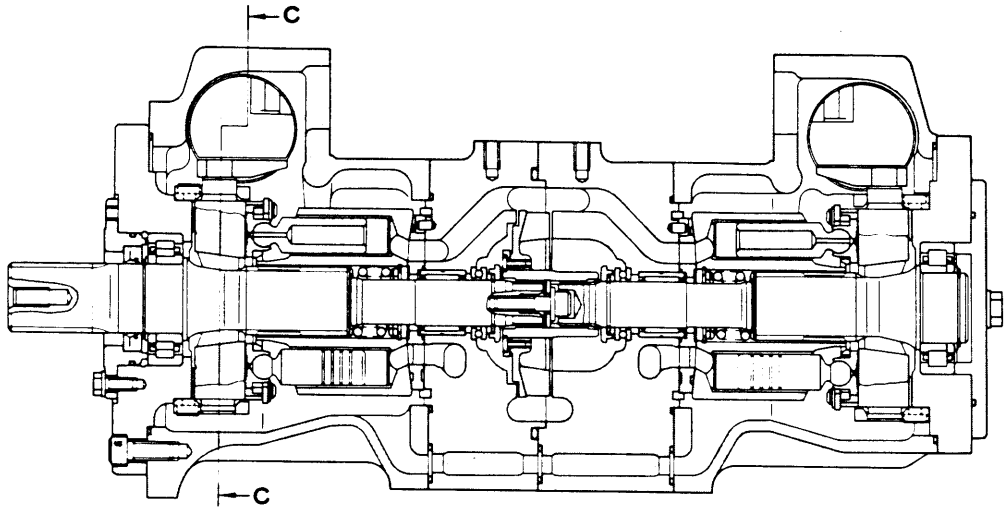
1. MAIN PISTON PUMP (HPV90 + 90)



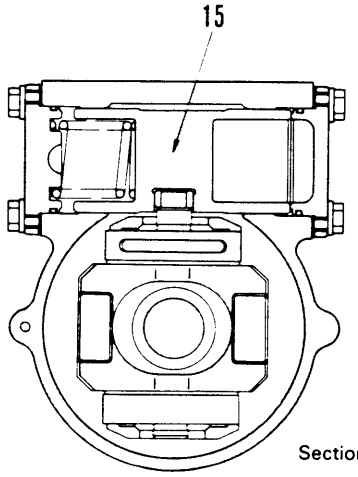
020905



Section A – A



Section B – B



Section C – C

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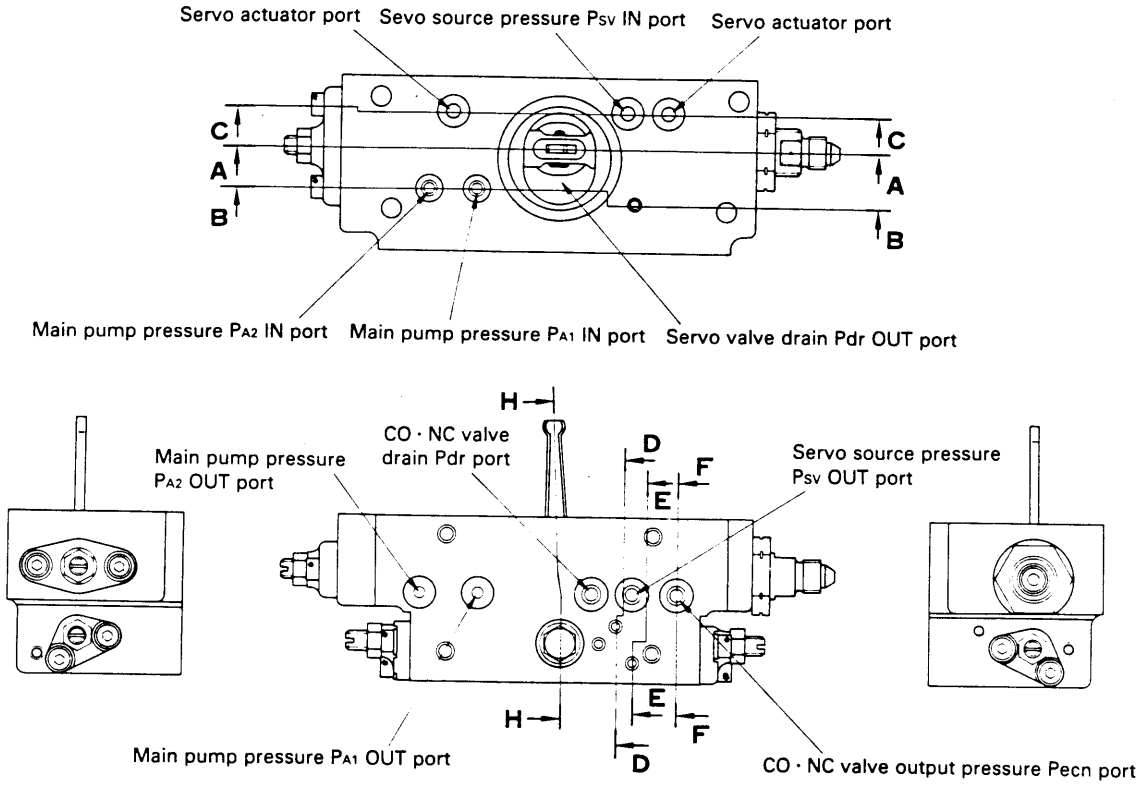
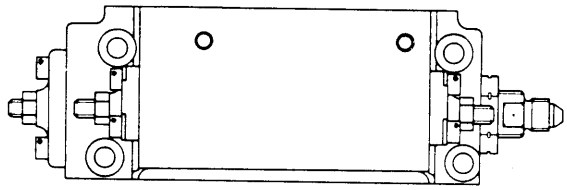
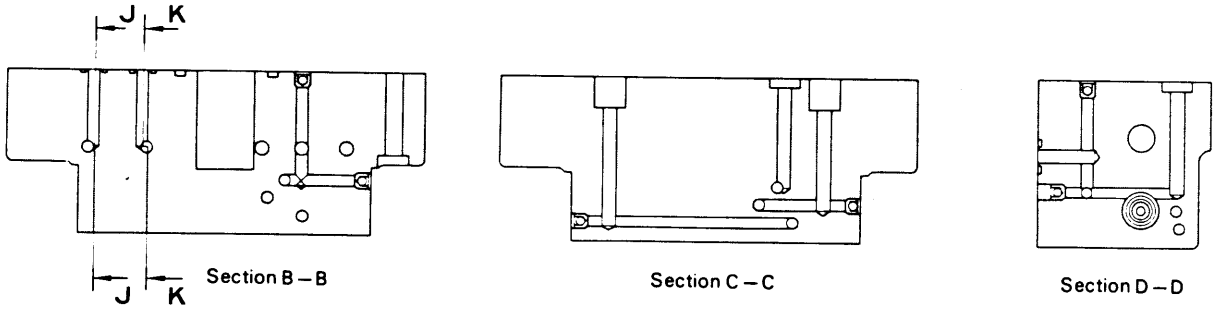
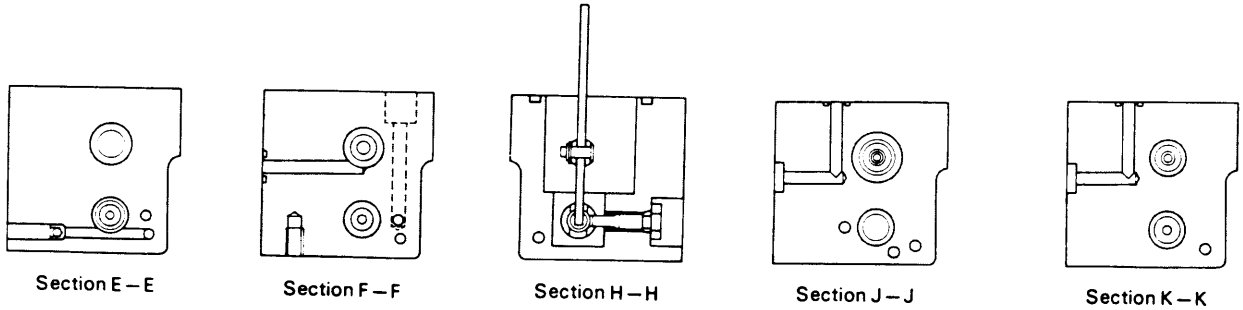
1. Front shaft
2. Front cradle
3. Front case
4. Rocker cam
5. Piston
6. Cylinder
7. Valve plate
8. Front end cap
9. Impeller
10. Coupling
11. Rear end cap
12. Rear case
13. Rear cradle
14. Rear shaft
15. Servo piston

2. SERVO VALVE









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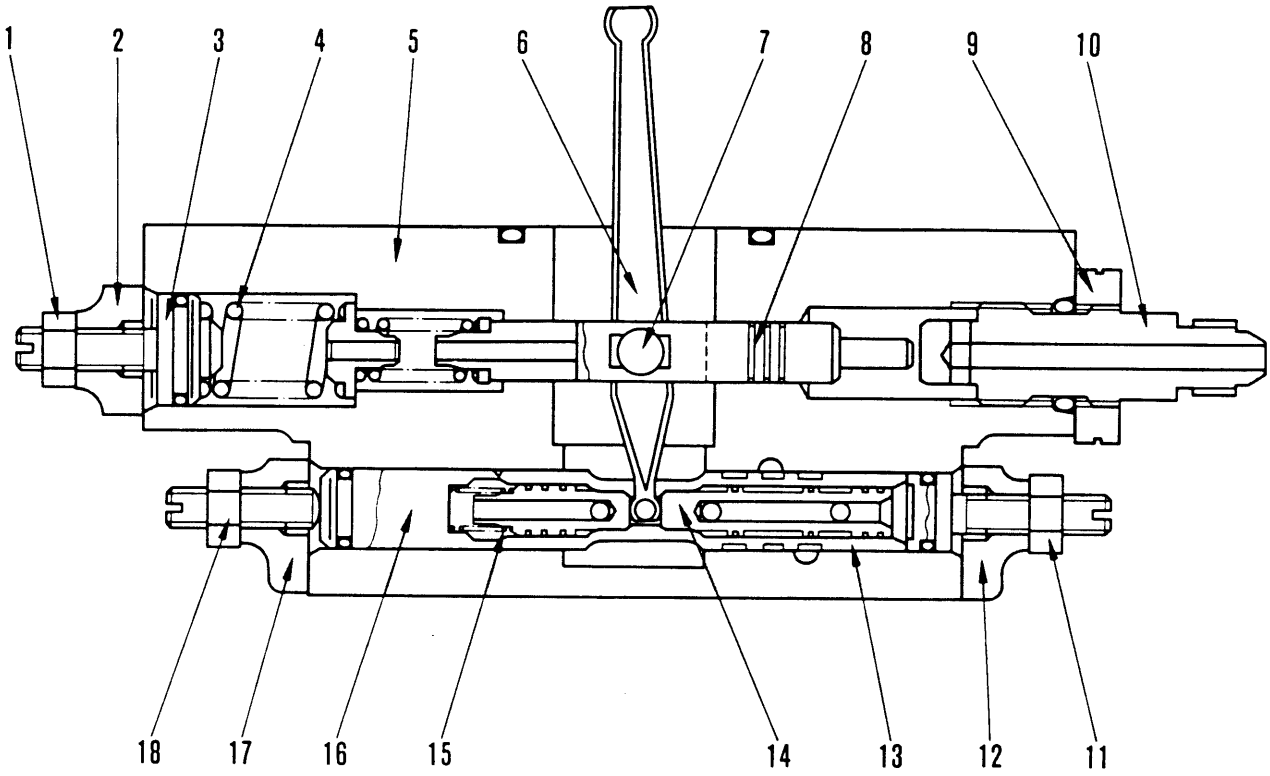

Section A – A

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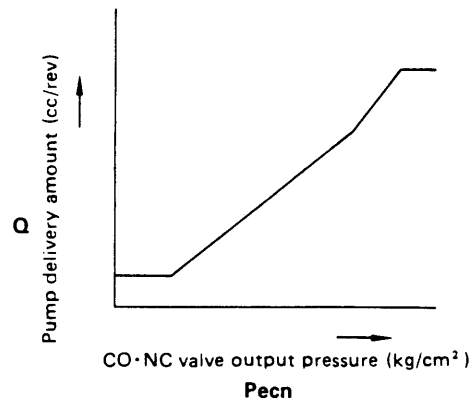
020905

1. Lock nut
2. Cover
3. Plug
4. Spring
5. Body
6. Arm
7. Pin
8. Control piston
9. Lock nut
10. Plug
11. Lock nut
12. Cover
13. Sleeve
14. Guide spool
15. Spring
16. Plug
17. Cover
18. Lock nut

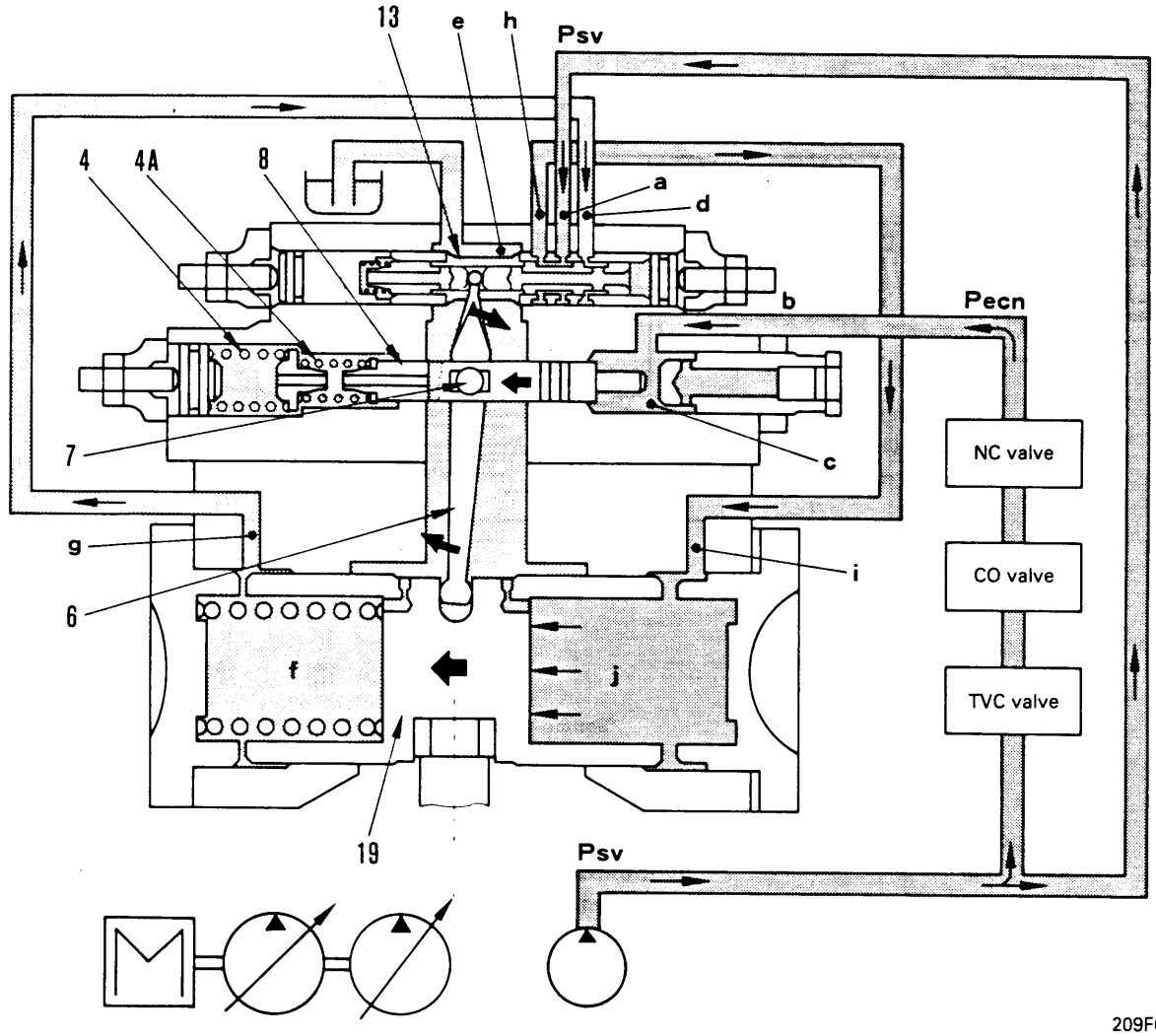
FUNCTION

- Delivery amounts of two main piston pumps are controlled separately by the respective servo valve.
- The stroke of the actuator (servo piston) which changes the delivery of the variable displacement pump, is controlled by the pump servo valve.
  The relationship between the delivery amounts Q_1 (or Q_2) of the pump and the input signal pressure **Pecn** to the servo valve is as shown in the graph on the right. The stroke of the actuator (servo piston) is proportional to the oil pressure from TVC valve, in other words, delivery amounts Q_1 (or Q_2) vary in direct proportion to **Pecn**.



OPERATION

1) Operation for increasing pump discharges (rocker cam angle changes to the large)



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020905

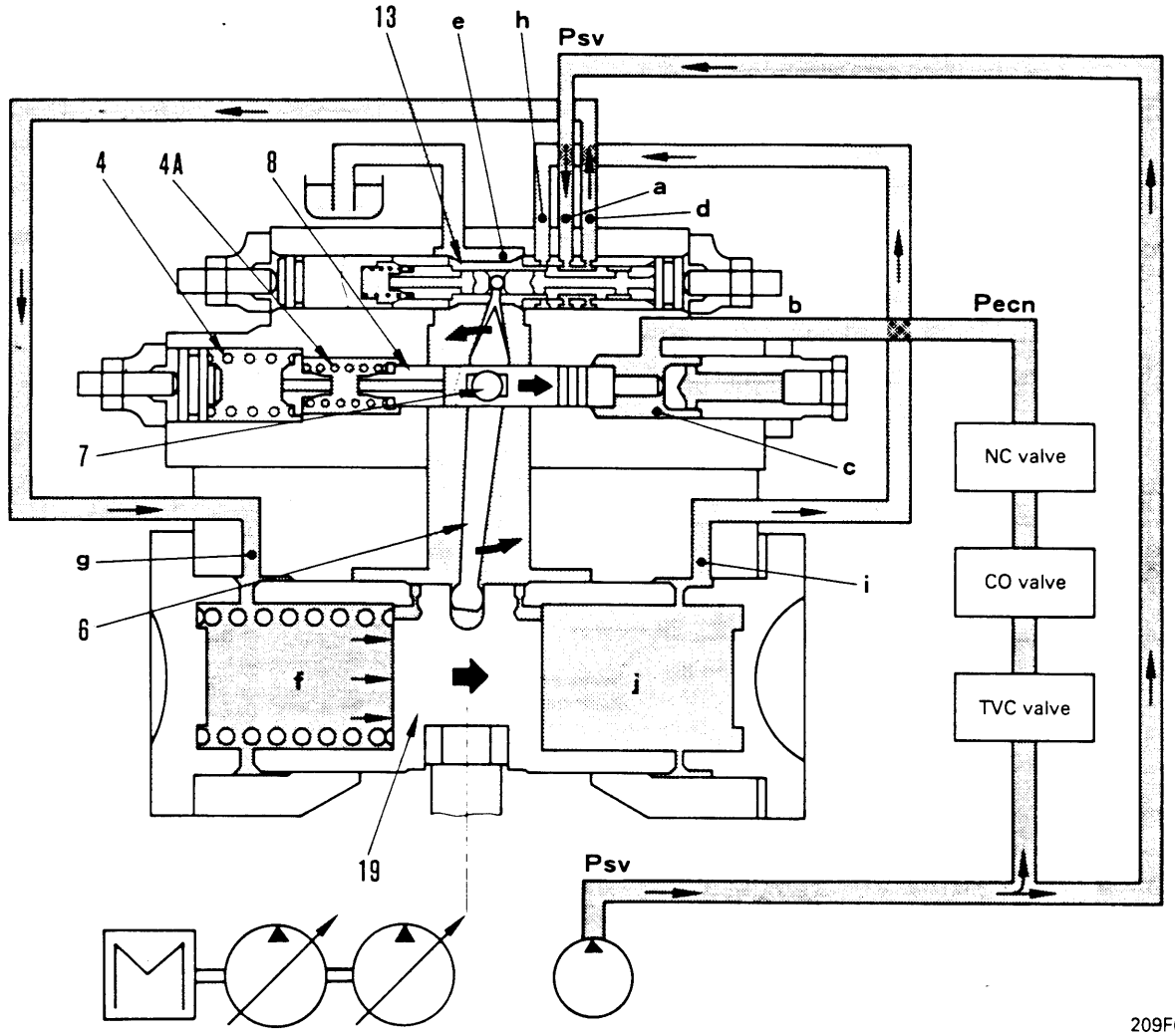
- Charging pump pressure **Psv** is sent to port **a**. Signal pressure **Pecn** from the NC valve is sent from port **b** to chamber **c**.

- As signal pressure **Pecn** rises, the pressure in chamber **c** pushes control piston (8) to the left in the direction of the arrow. The piston stops in a position where it is balanced with the force of springs (4) and (4A).
  At the same time, arm (6) uses serve piston (19) as a fulcrum, moves to the left in the same way as control piston (8), and while fluctuating, moves guide spool (13) to the left.

- The movement of guide spool (13) closes port **a** and port **d**, and connects port **d** with drain chamber **e**. As a result, servo piston chamber **f** is also connected to chamber **e** through port **g** and port **d**.
  At the same time, port **a** and port **h** are connected, and the flow passes through port **i** to servo piston chamber **j** to push servo piston (19) to the left in the direction of the arrow. The rocker cam angle of the main piston pump becomes larger, and the pump discharge volume increases.

- Because of the movement of servo piston (19), arm (6) rotates clockwise around pin (7), moves guide spool (13) to the right, and closes port **a**, port **d**, and port **h**, so the discharge volume increases only by an amount corresponding to signal pressure **Pecn**.

2) **Operation for decreasing pump discharges (rocker cam angle changes to the small)**



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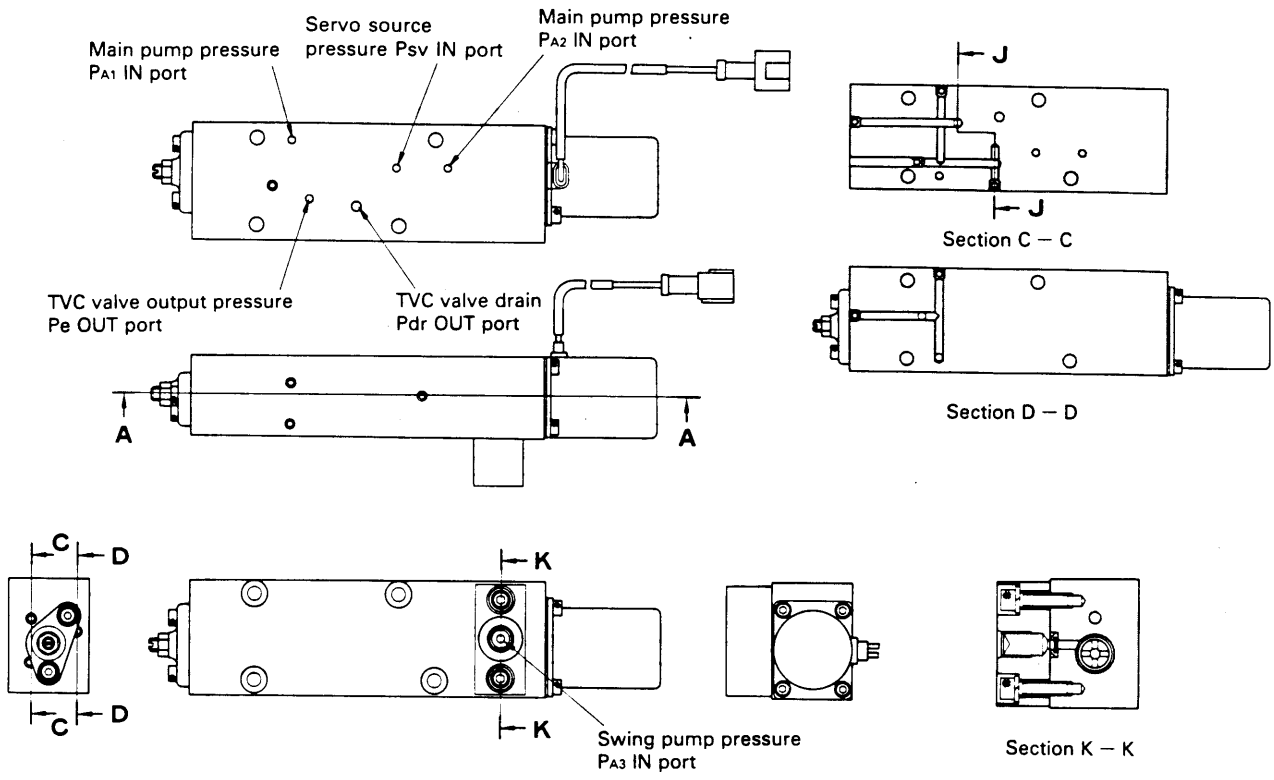
- When signal pressure **Pecn** drops, control piston (8) moves to the right in the direction of the arrow to a point where the hydraulic pressure of chamber **c** is in balance with the force of springs (4) and (4A).
  At the same time, arm (6) uses servo piston (19) as a fulcrum, moves to the right in the same way as control piston (8), and while fluctuating, moves guide spool (13) to the right.

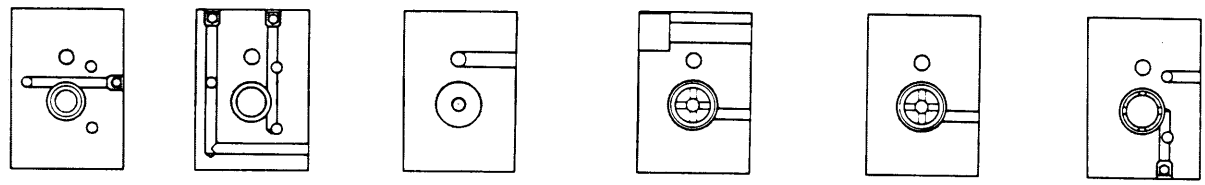
- The movement of guide spool (13) closes port **a** and port **h**, and connects port **h** with drain chamber **e**. As a result, servo piston chamber **j** is also connected to chamber **e** through port **i** and port **h**.

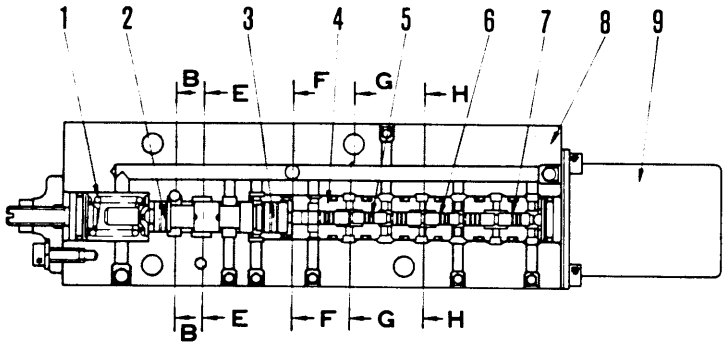
  At the same time, port **a** and port **d** are connected, and the flow passes through port **g** to servo piston chamber **f** to push servo piston (19) to the right in the direction of the arrow. The rocker cam angle of the main piston pump becomes smaller, and the pump discharge volume decreases.

- Because of the movement of servo piston (19), arm (6) rotates counterclockwise around pin (7), moves guide spool (13) to the left, and closes port **a**, port **d**, and port **h**, so the discharge volume decreases only by an amount corresponding to signal pressure **Pecn**.

3. TVC VALVE







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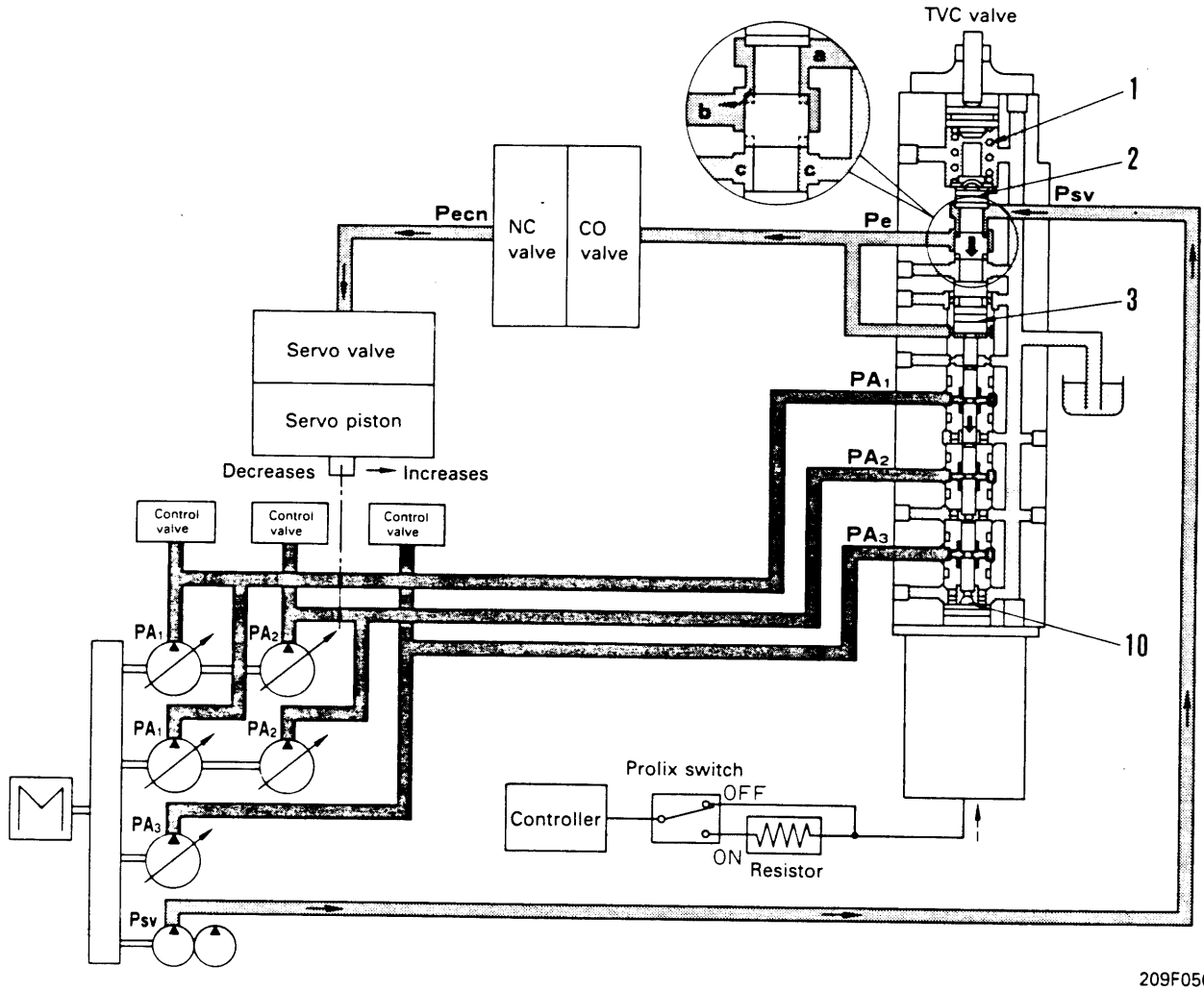
020905

1. Spring
2. Spool
3. Piston
4. Sleeve
5. Piston
6. Piston
7. Piston
8. Body
9. Solenoid

FUNCTION AND OPERATION

1) When command current from controller in H mode is small

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS**



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FUNCTION

- When the OLSS mode is set to H mode, the discharge flow from the pump is controlled to the optimum by the command current from the controller to match the change in the engine speed.

- In S mode or L mode, and when the prolix switch is ON, the pump discharge flow is controlled to match the pump discharge pressure (load) by hydraulic sensing in accordance with a constant pump absorption torque.

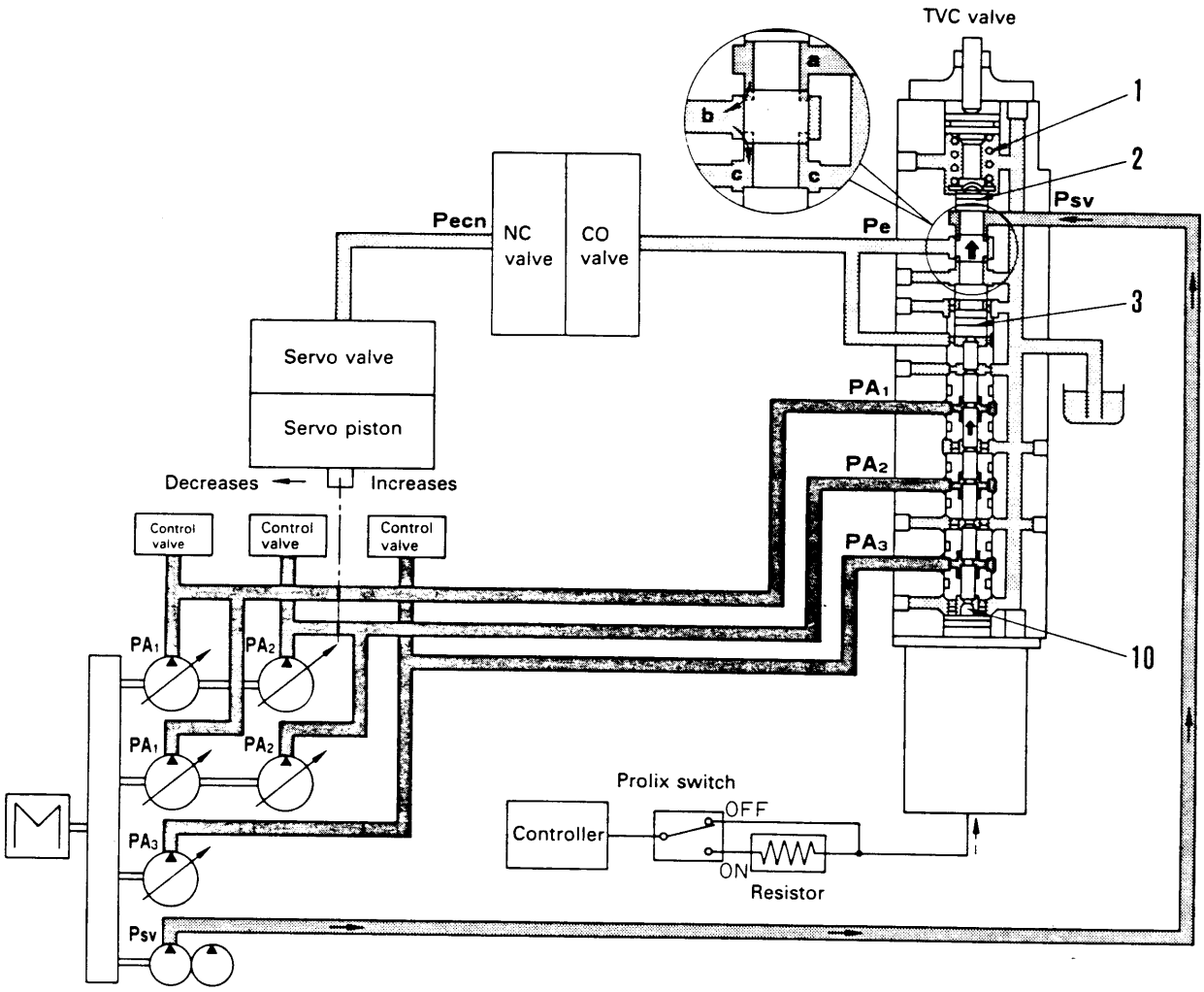
★ For details, see MACHINE CONTROL SYSTEM.

OPERATION

- Because of the command current sent from the controller, solenoid push pin (10) moves, and piston (2) also moves. When this happens, it stops at a point where the sum of the force of spring (1) and the force of push pin (10) and the force of TVC output pressure **Pe** acting on piston (3) is in balance. At this point, the command current is small, so piston (2) is balanced at the bottom.
  As a result, ports **a** and **b** are both almost completely open, and almost all the pressure oil from the charging pump output as TVC output pressure **Pe**.
  For this reason, the pump discharge volume becomes the maximum.

2) When command current from controller in H mode is large

★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS



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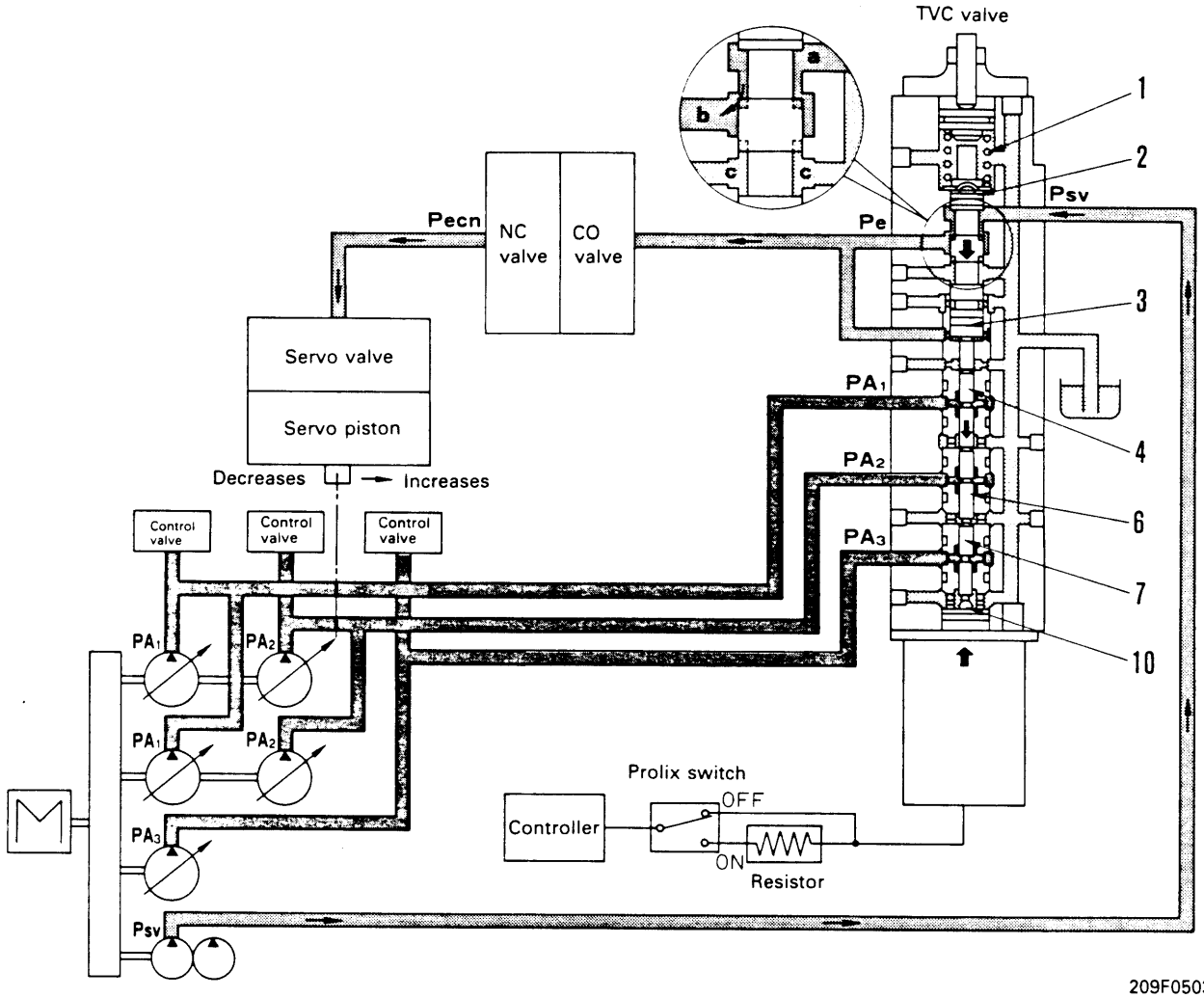
- Because of the command current sent from the controller, solenoid push pin (10) moves, and piston (2) also moves. When this happens, it stops at a point where it is balanced with the force of spring (1). At this point, the command current is large, so piston (2) is balanced at the top.

  As a result, the flow of the oil sent from the charging pump is throttled at port **a** and port **b**, and at the same time, the area of the opening at a port **b** and port **c** (drain port) becomes larger. For this reason, the TVC valve output pressure **Pe** drops and the pump discharge volume is reduced.

3) In S mode (When in L mode or prolix switch is ON) and load on pump is small



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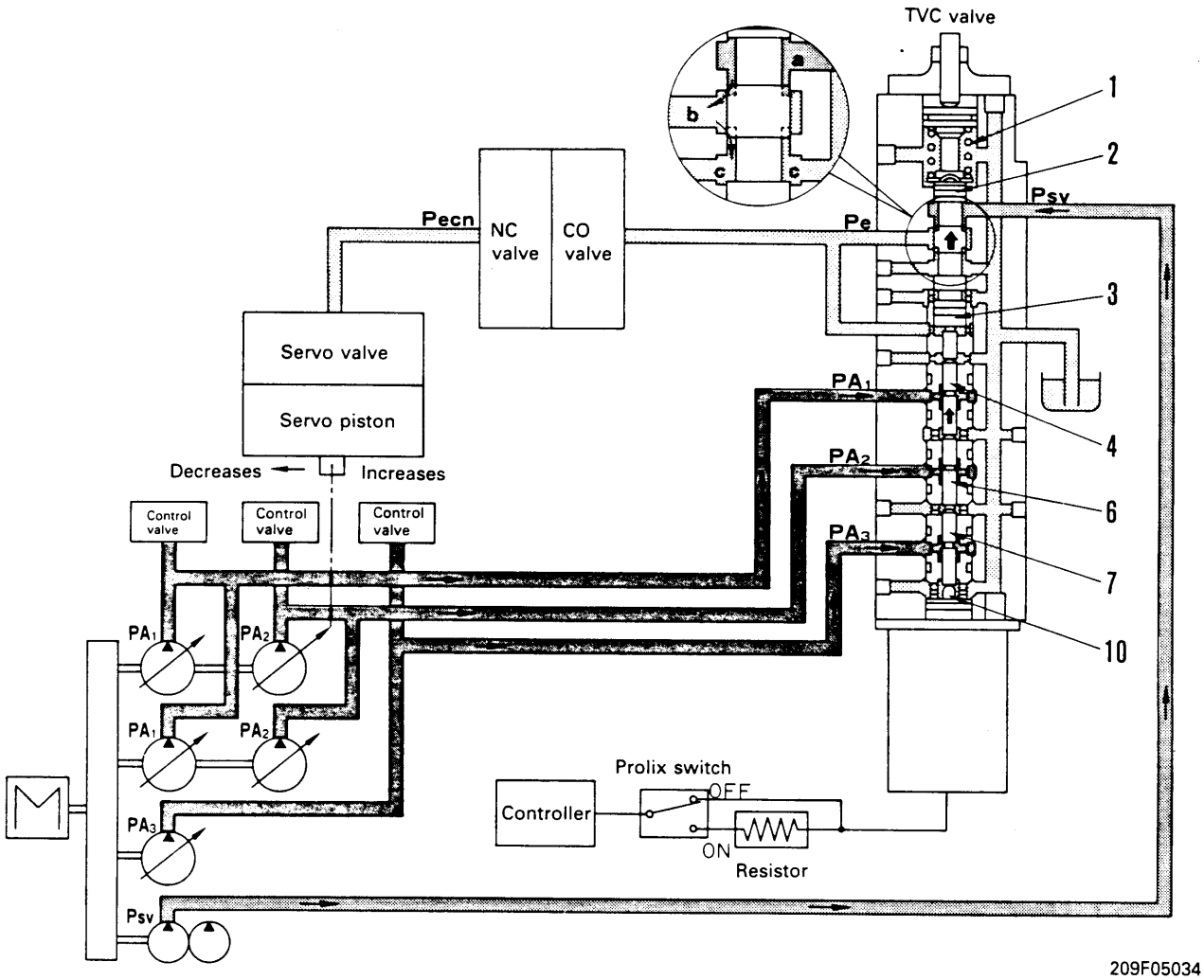
- If the setting is changed to S mode (L mode or prolix switch ON), solenoid push pin (10) is pushed up; this makes the set pressure of spring (1) larger, and this condition is maintained.
- As a result, the absorption torque of the pump becomes constant, and TVC output pressure **Pe** (= pump discharge flow) is controlled by the pump discharge pressure.
- Main pump discharge pressures **PA1**, **PA2** and **PA3** are low, so spool (2) is pushed down by spring (1). As a result, charging pump discharge pressure **Psv** and TVC valve output pressure **Pe** are equal.
  At this point, the TVC valve output pressure **Pe** becomes the maximum, and the main pump discharge volume is also the maximum.

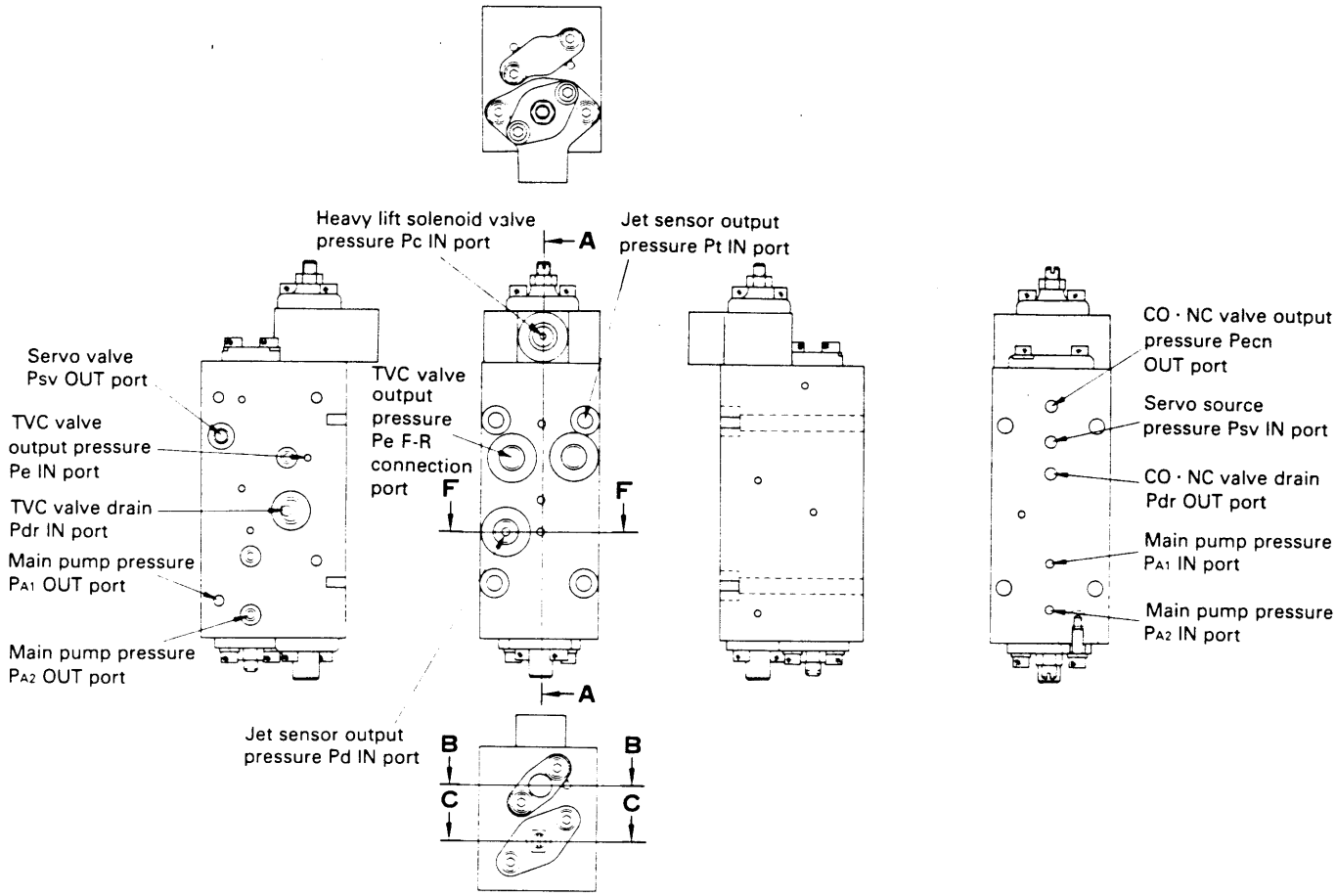
4) In S mode (When in L mode or prolix switch is ON) and load on pump is large



020905

- When main pump discharge pressure **PA1** (or **PA2** or **PA3**) increases, spool (2) is moved up by piston (4) (or piston (6) or piston (7)). As a result, the flow of the oil at port **a** and port **b** is throttled by the notch in the spool, and at the same time, the area of the opening at port **b** and port **c** (drain port) becomes larger. For this reason, the output pressure **Pe** of the TVC valve drops and the main pump discharge volume is reduced.

4. CO•NC VALVE



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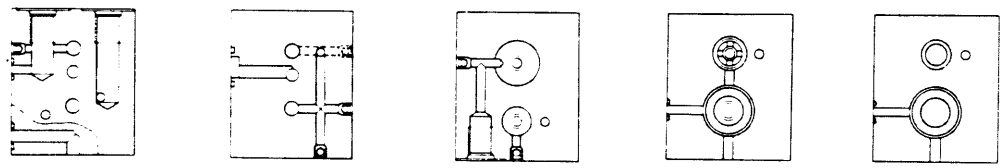

Section D – D | Section E – E | Section F – F | Section G – G | Section H – H

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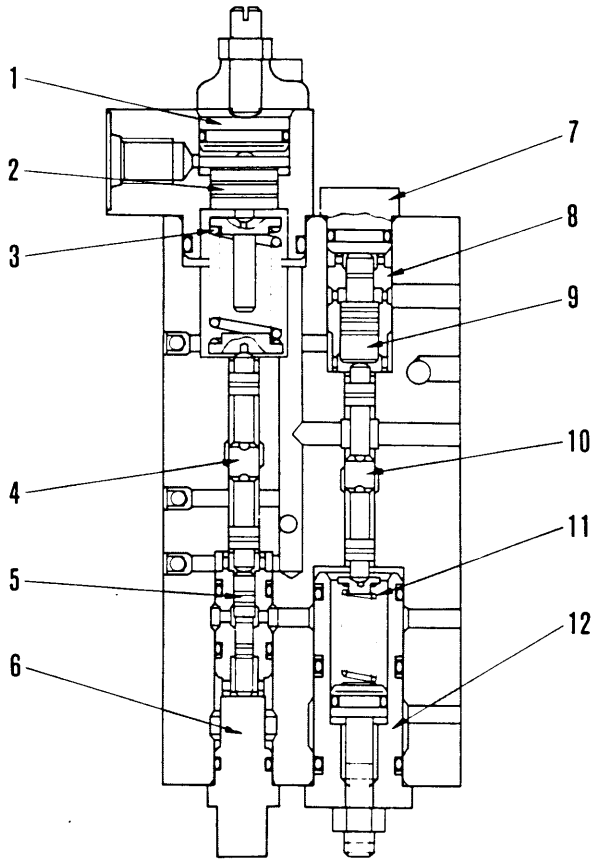

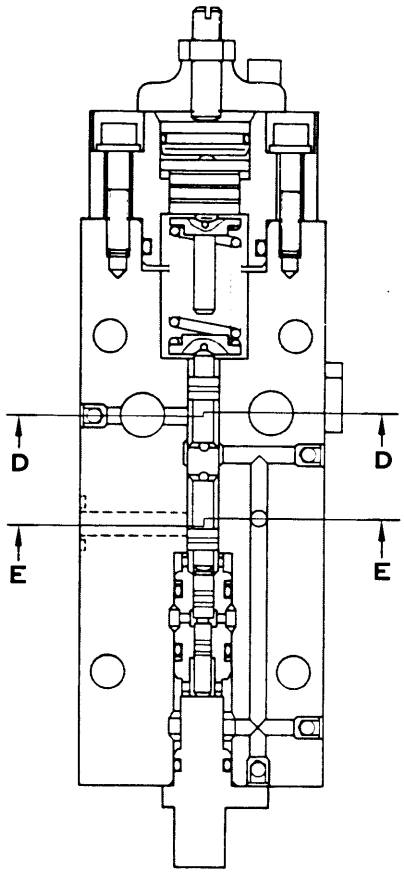

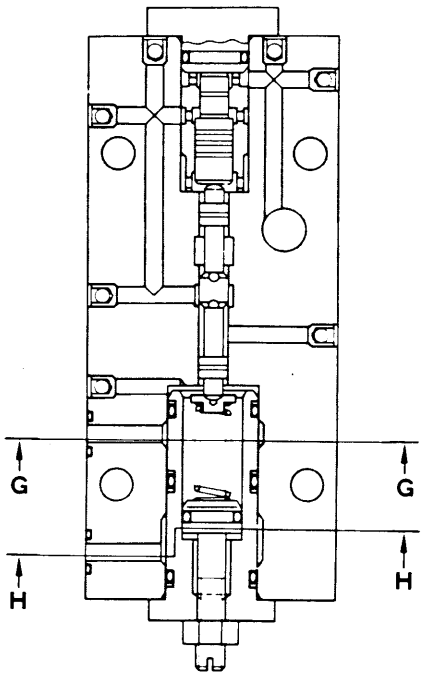

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020905

CO VALVE

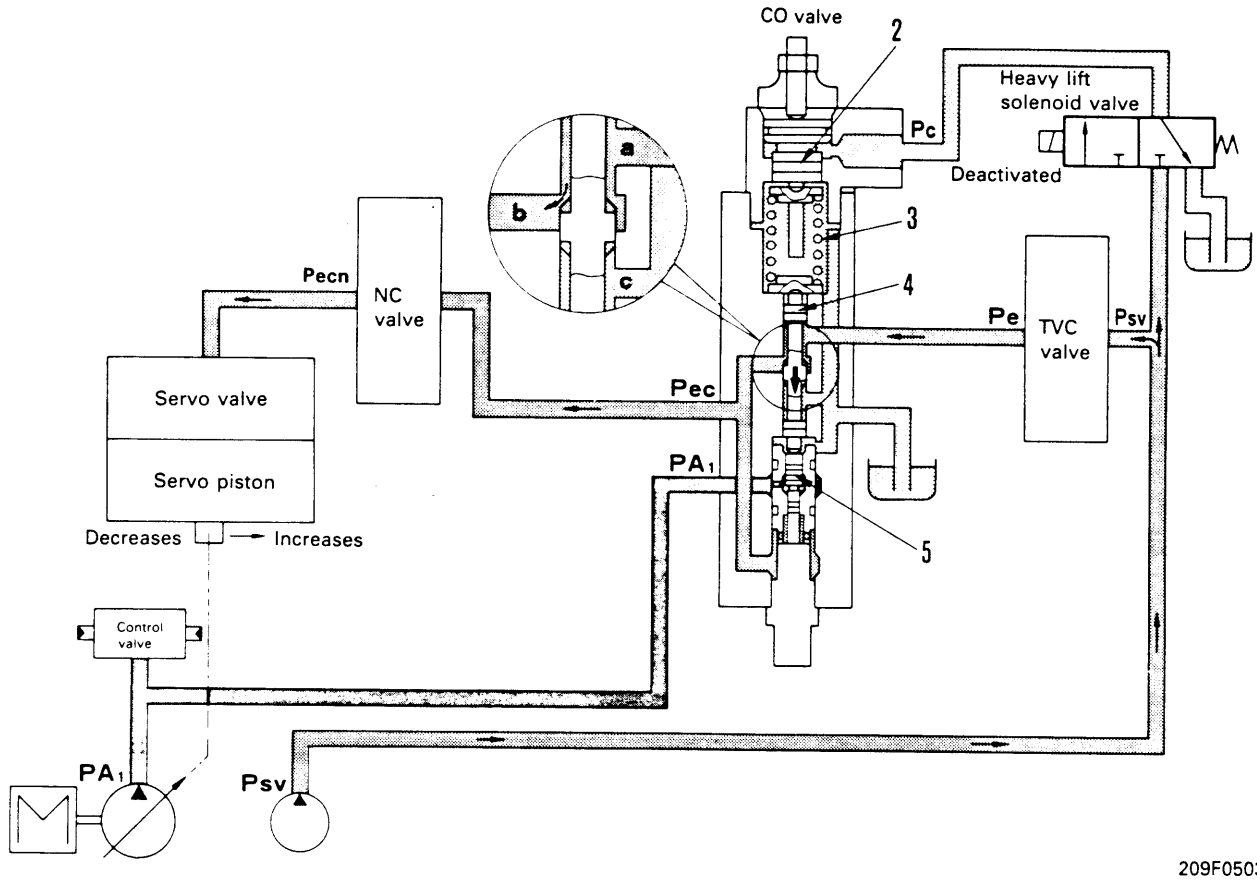
1. Plug
2. Piston
3. Spring
4. Spool
5. Piston
6. Plug

NC VALVE

7. Plug
8. Sleeve
9. Piston
10. Spool
11. Spring
12. Plug

FUNCTION AND OPERATION OF CO VALVE

1) When main pump discharge pressure is below relief pressure



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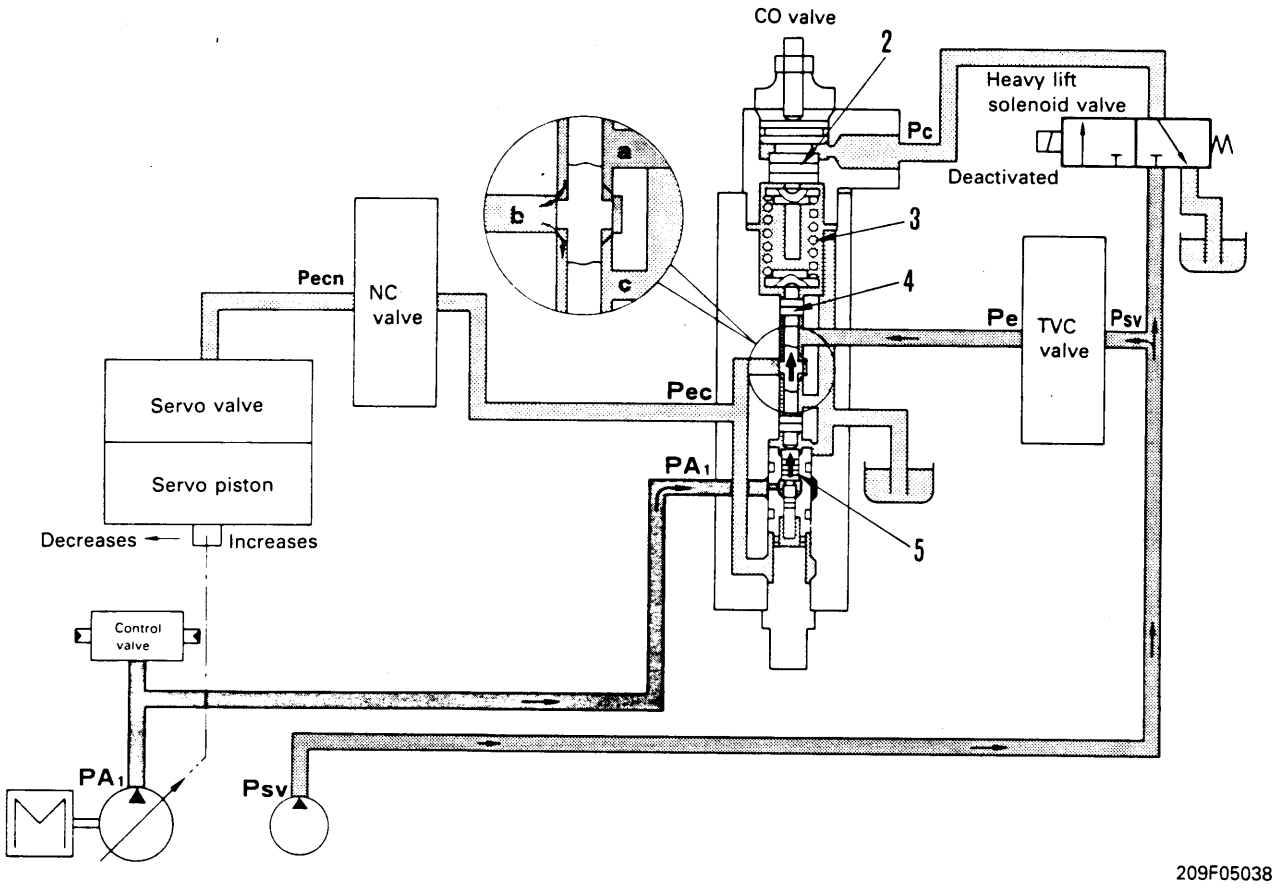
FUNCTION

- If the load increases during operation, and the main pump discharge pressure rises and comes close to the relief pressure, the CO valve carries out the cut-off function to reduce the pump discharge volume and decrease the relief loss.
- At the same time, the pilot pressure of the heavy lift solenoid valve also has the function of canceling the cut-off.
- The CO valve is controlled by balancing the spring with the sum of the main pump discharge pressure **PA** and CO valve output pressure **Pec**.

OPERATION

- Spool (4) is pushed down by spring (3).
  As a result, port **a** and port **b** are fully open, and TVC valve output pressure **Pe** is equal to CO valve output pressure **Pec**.
  For this reason, CO valve output pressure **Pec** becomes the maximum, and the main pump discharge volume also becomes the maximum.

2) When main discharge pressure is close to relief pressure



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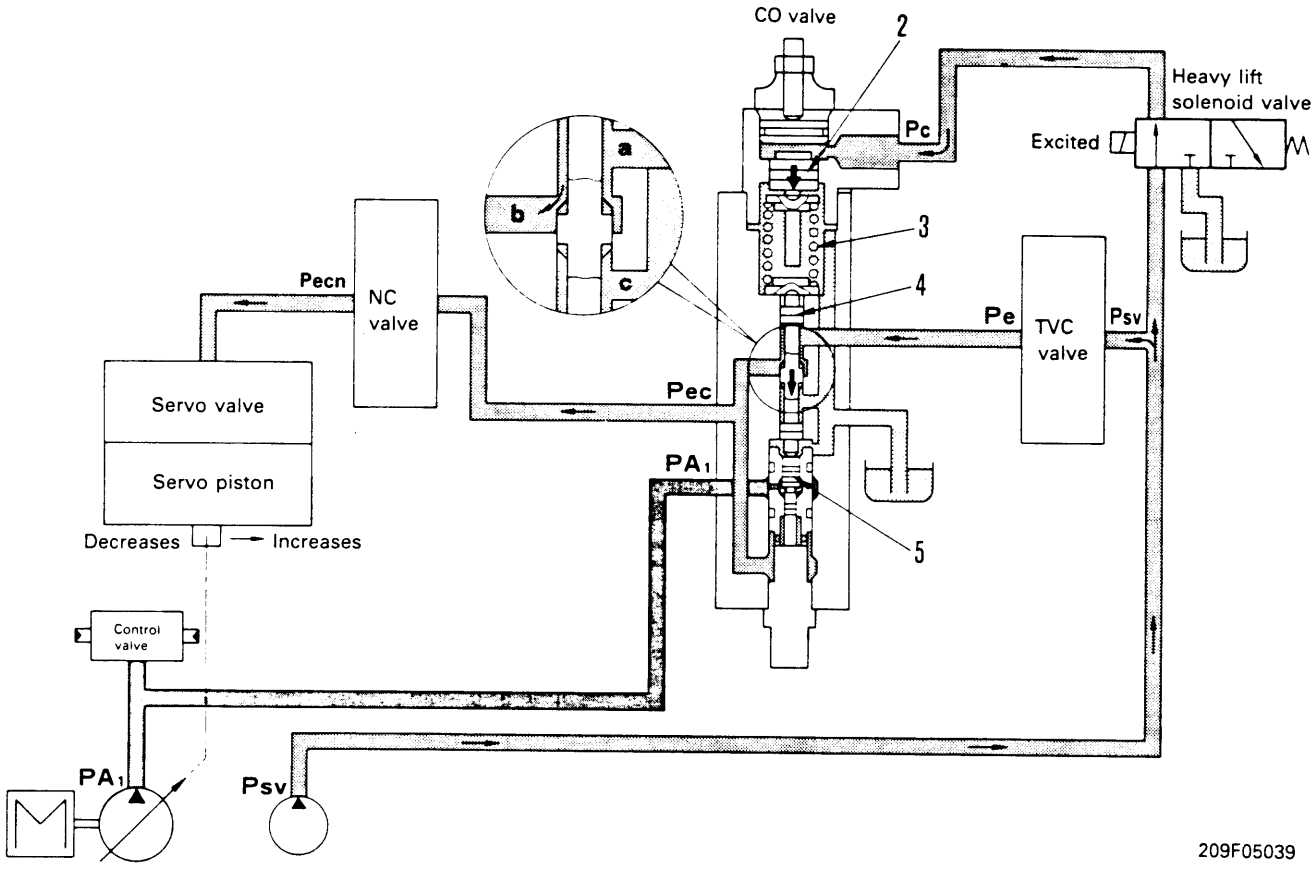
- As the load increases and main pump discharge pressure **PA** comes close to the relief pressure, main pump discharge pressure **PA** pushes piston (5). At the same time, CO valve output pressure **Pec** pushes piston (5), and spool (4) moves up.
  As a result, the flow from port **a** to port **b** is throttled by the notch in the spool, and the area of the opening of port **b** and port **c** (drain port) becomes larger.
  For this reason, CO valve output pressure **Pec** drops and the pump discharge flow becomes the minimum.

3) When cut-off function is canceled by heavy lift solenoid valve

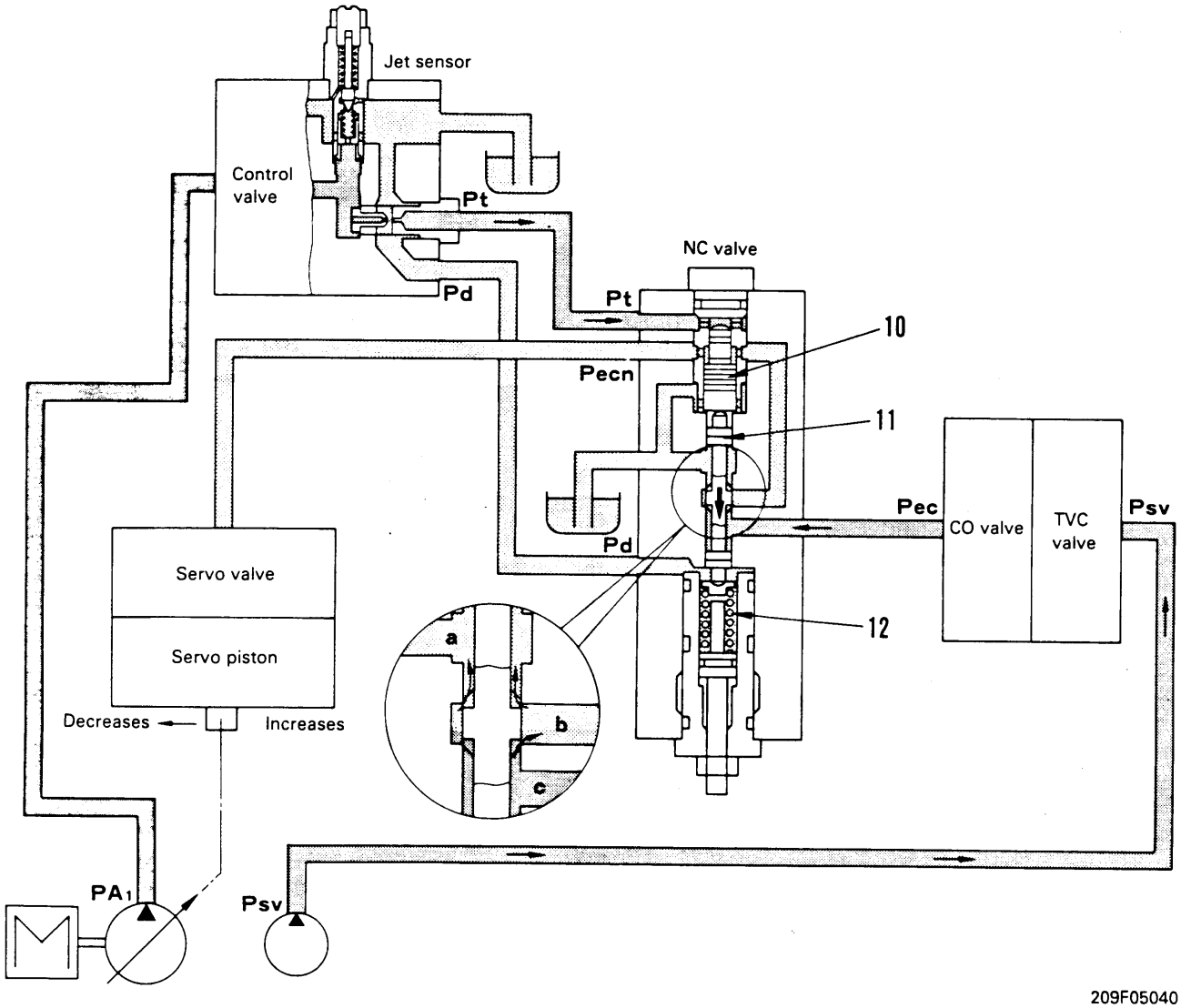


020905

- When the heavy lift solenoid valve is switched, its pilot pressure goes to port **Pc**, and piston (2) is pushed down. As a result, the set pressure of spring (3) becomes larger, so even when main pump discharge pressure **PA** rises and reaches the relief pressure, spool (4) is not actuated, and CO valve output pressure **Pec** remains at the maximum.

FUNCTION AND OPERATION OF NC VALVE

1) Control valve at neutral



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020905

FUNCTION

- The NC valve controls the main pump discharge volume according to the amount of operation of the control valve spool, and carries out the function of controlling the oil flow to reduce the neutral loss and fine control loss.

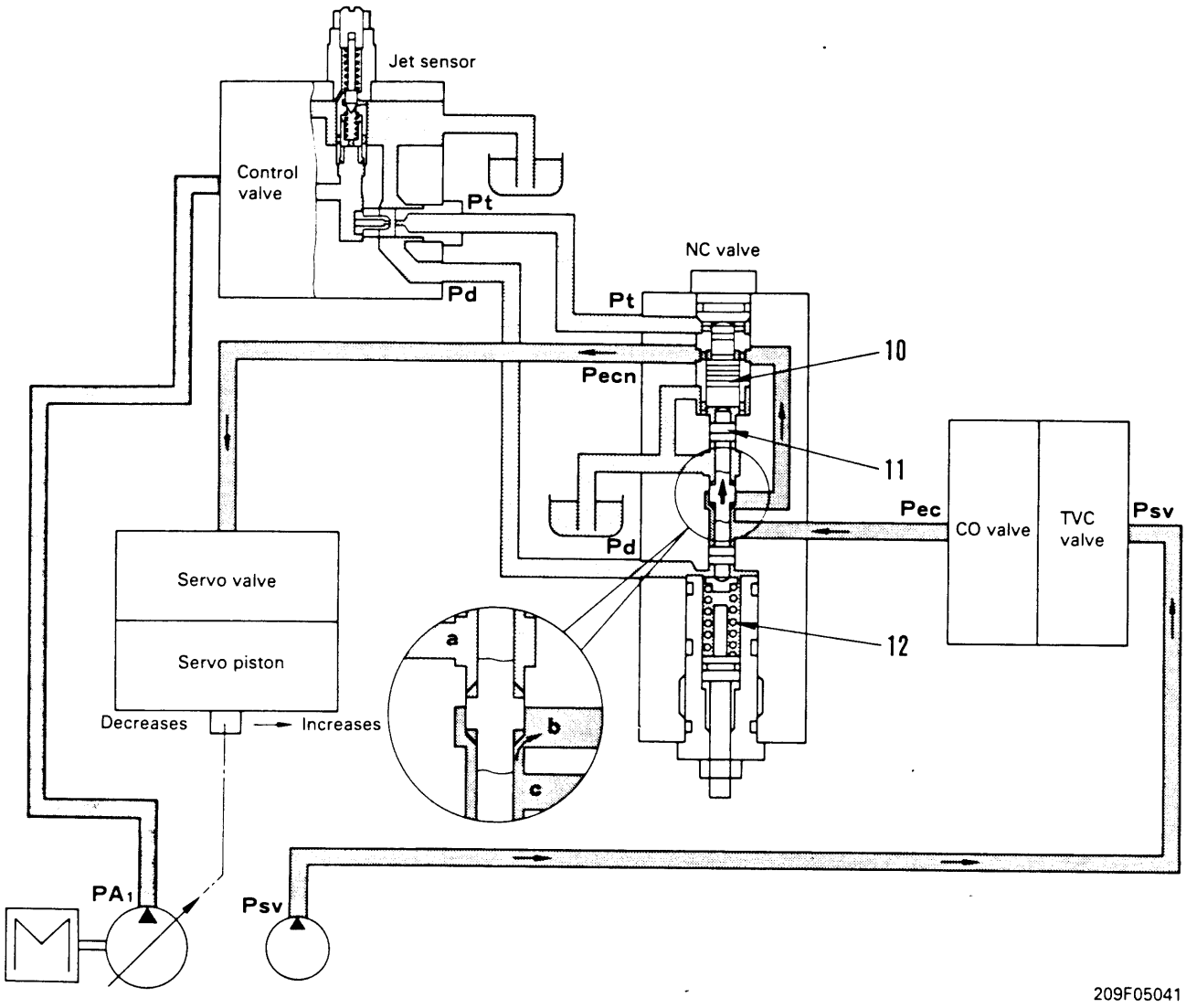
- The NC valve is controlled by balancing the sum of jet sensor output pressure **Pt** and NC valve output pressure **Pecn** with the sum of the force of NC valve spring (12) and jet sensor output pressure **Pd**.

- The jet sensor detects the flow of return oil passing through the control valve and returning to the tank, and takes it as NC valve **Pt** and **Pd**.

OPERATION

- The differential pressure (**Pt** – **Pd**) of the jet sensor reaches the maximum and jet sensor output pressure **Pt** acting on piston (10) becomes greater than the sum of the force of spring (12) and jet sensor output pressure **Pd** acting on the lower end of spool (11).
  As a result, spool (11) is pushed downward, causing a restriction of the oil flow between port **c** and port **b** and in turn opening port **b** and port **a** (drain port).
  Output pressure **Pecn** of the NC valve is then reduced to the minimum and the main pump discharge is also reduced to the minimum with the swash plate angle minimized through the operation of the servo valve.

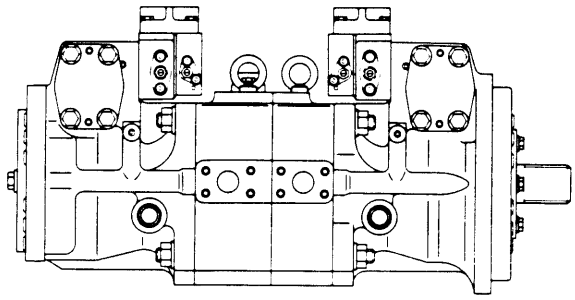
2) **When the control valve is operated**

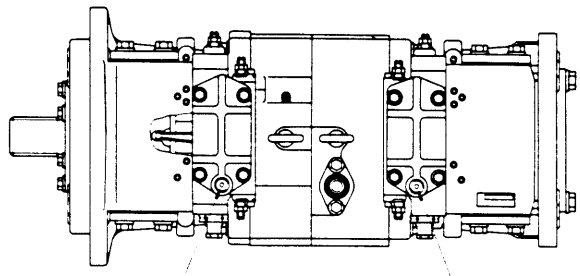


020905

- With the jet sensor differential pressure (**Pt** – **Pd**) reduced according to the operation of the control valve, spool (11) is pushed upward, fully opening port **c** and port **b**.
  Thus, the NC valve output pressure **Pecn** increases. Together with the increase in the main pump swash plate angle through the servo valve operation, the main pump discharge is also increased. That is to say, the pump discharge increases as the stroke of the lever increases.

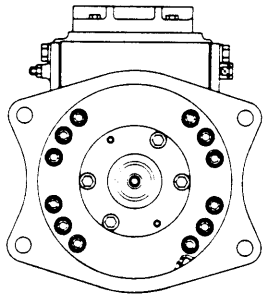
No. 2 PUMP





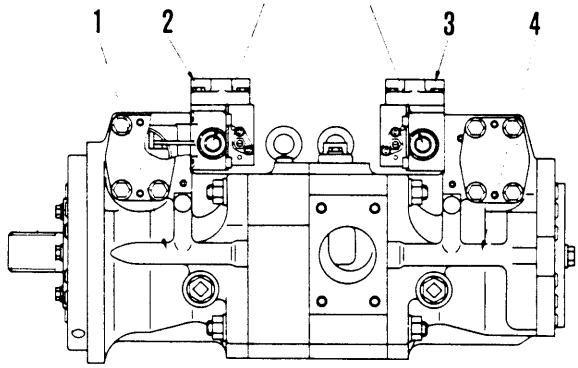
CO · NC valve output pressure Pecn (front)

CO · NC valve output pressure Pecn (rear)



CO · NC valve output pressure Pecn (front) pick-up port

CO • NC valve output pressure Pecn (rear) pick-up port



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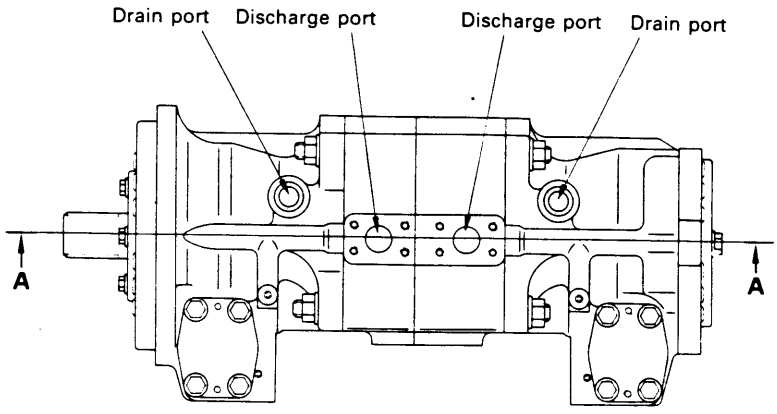
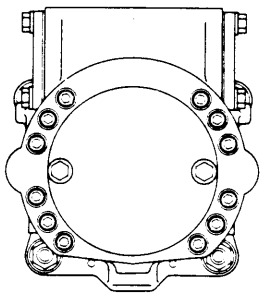
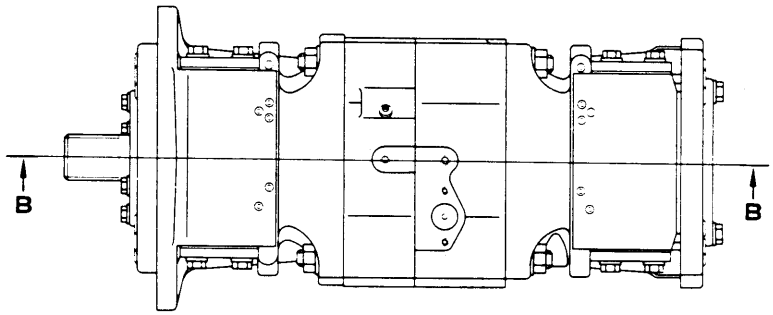
020905

1. Front pump
2. Front servo valve
3. Rear servo valve
4. Rear pump

1. MAIN PISTON PUMP (HPV90 + 90)







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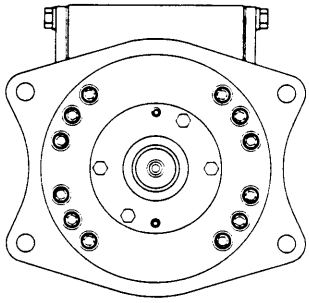

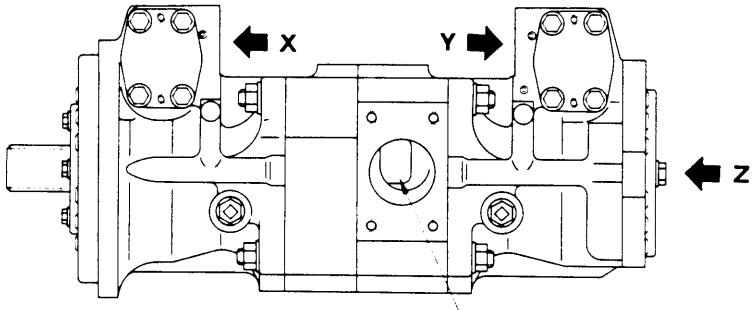

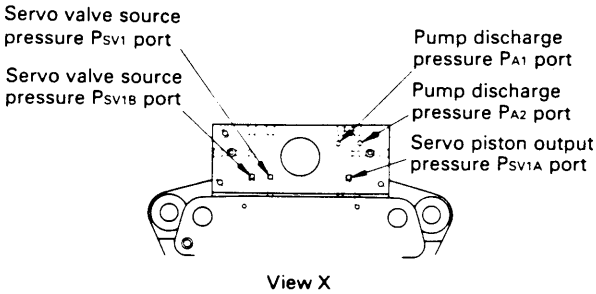

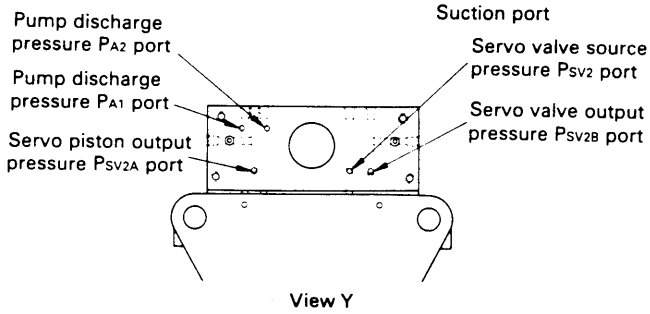

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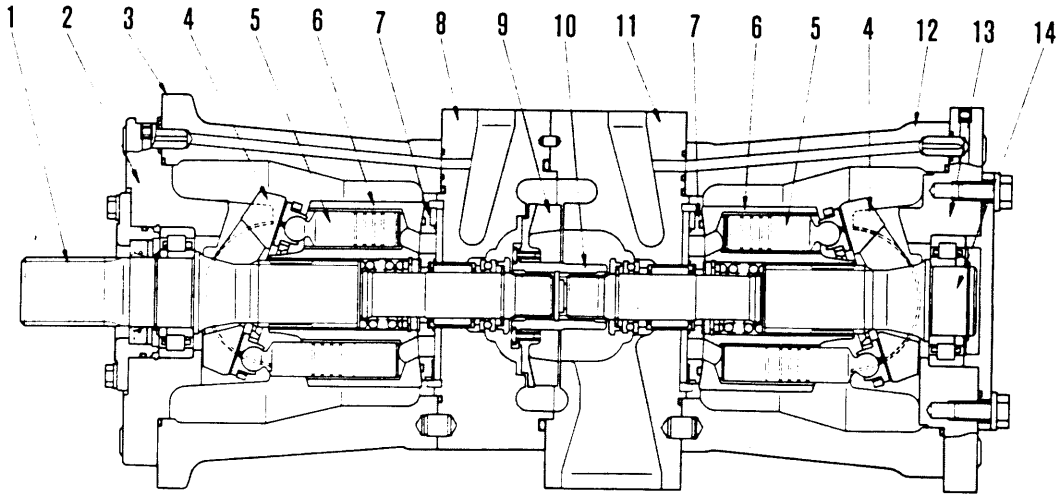
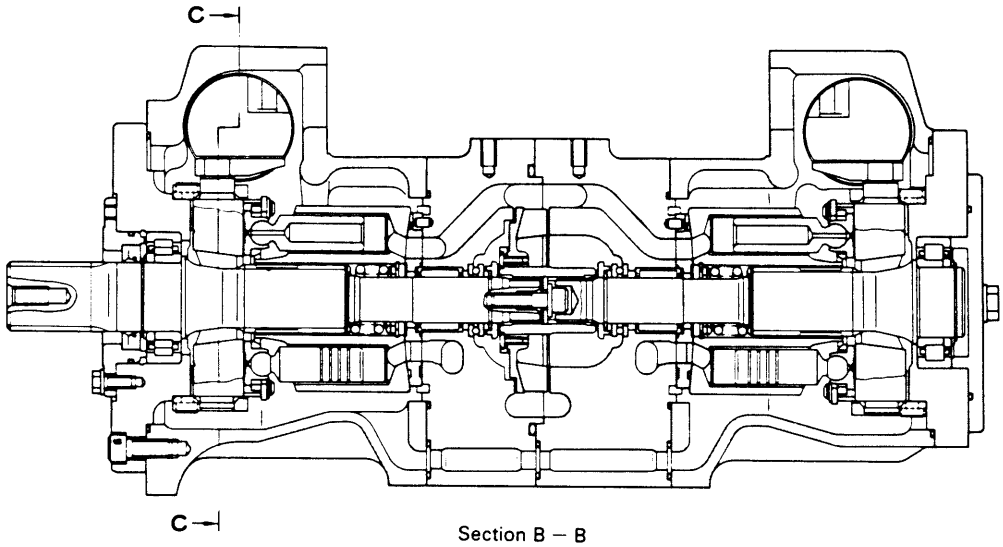
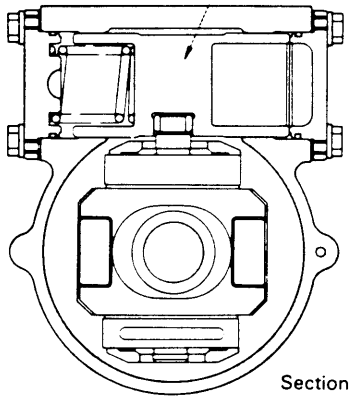


Section A – A



Section B – B

15



Section C – C

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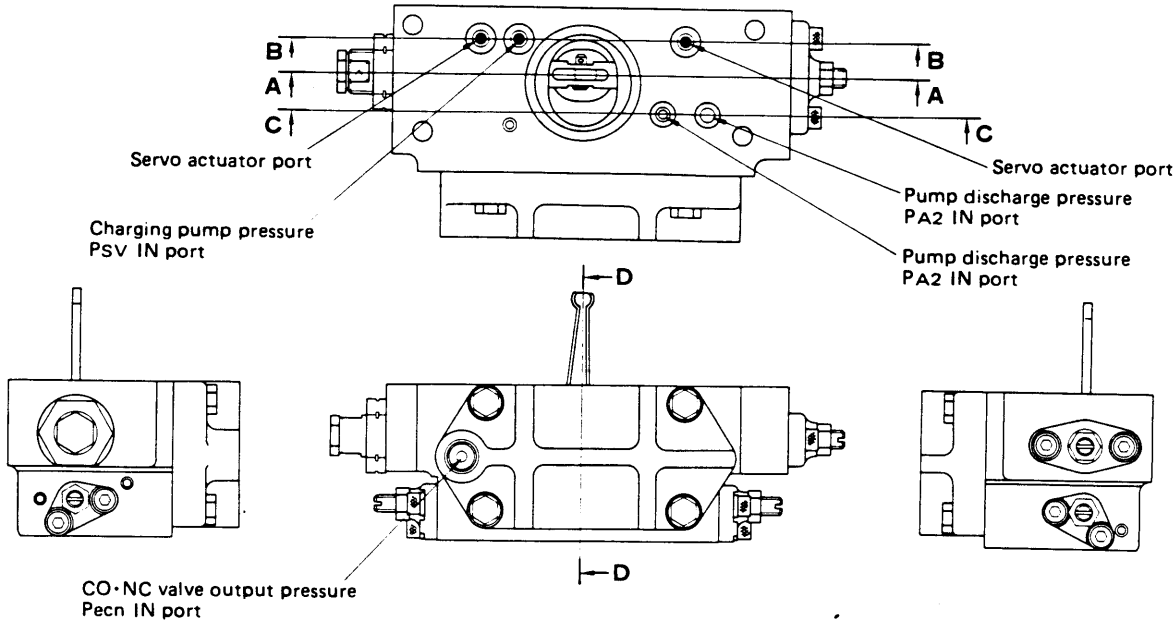
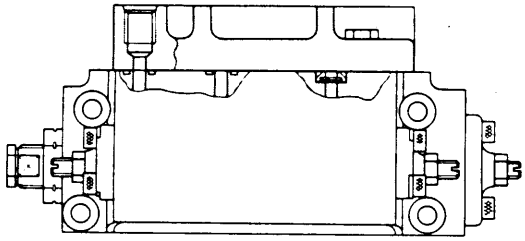
020905

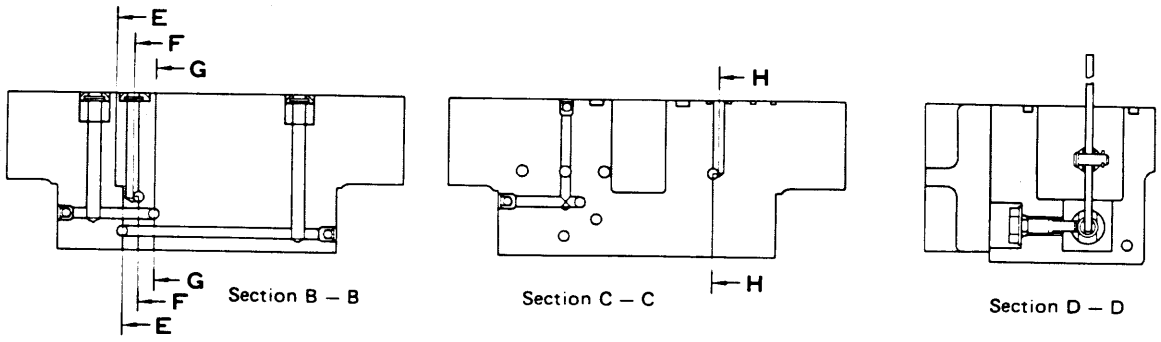
1. Front shaft
2. Front cradle
3. Front case
4. Rocker cam
5. Piston
6. Cylinder
7. Valve plate
8. Front end cap
9. Impeller
10. Coupling
11. Rear end cap
12. Rear case
13. Rear cradle
14. Rear shaft
15. Servo piston

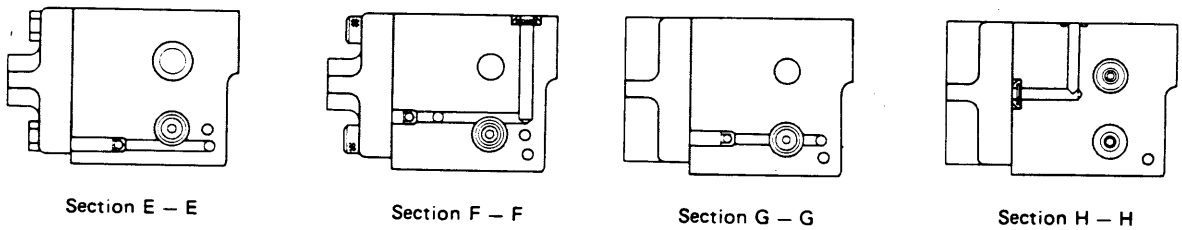
2. SERVO VALVE

★ For details of the operation, see No. 1 PUMP.









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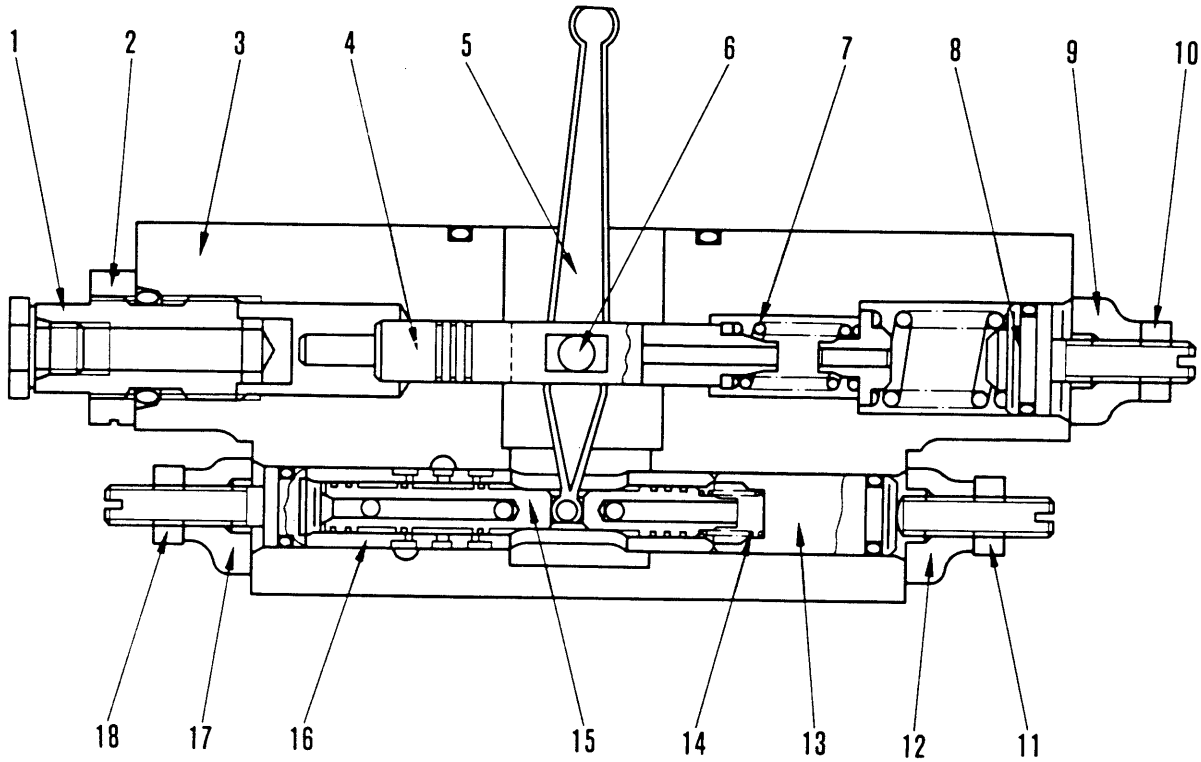
020905

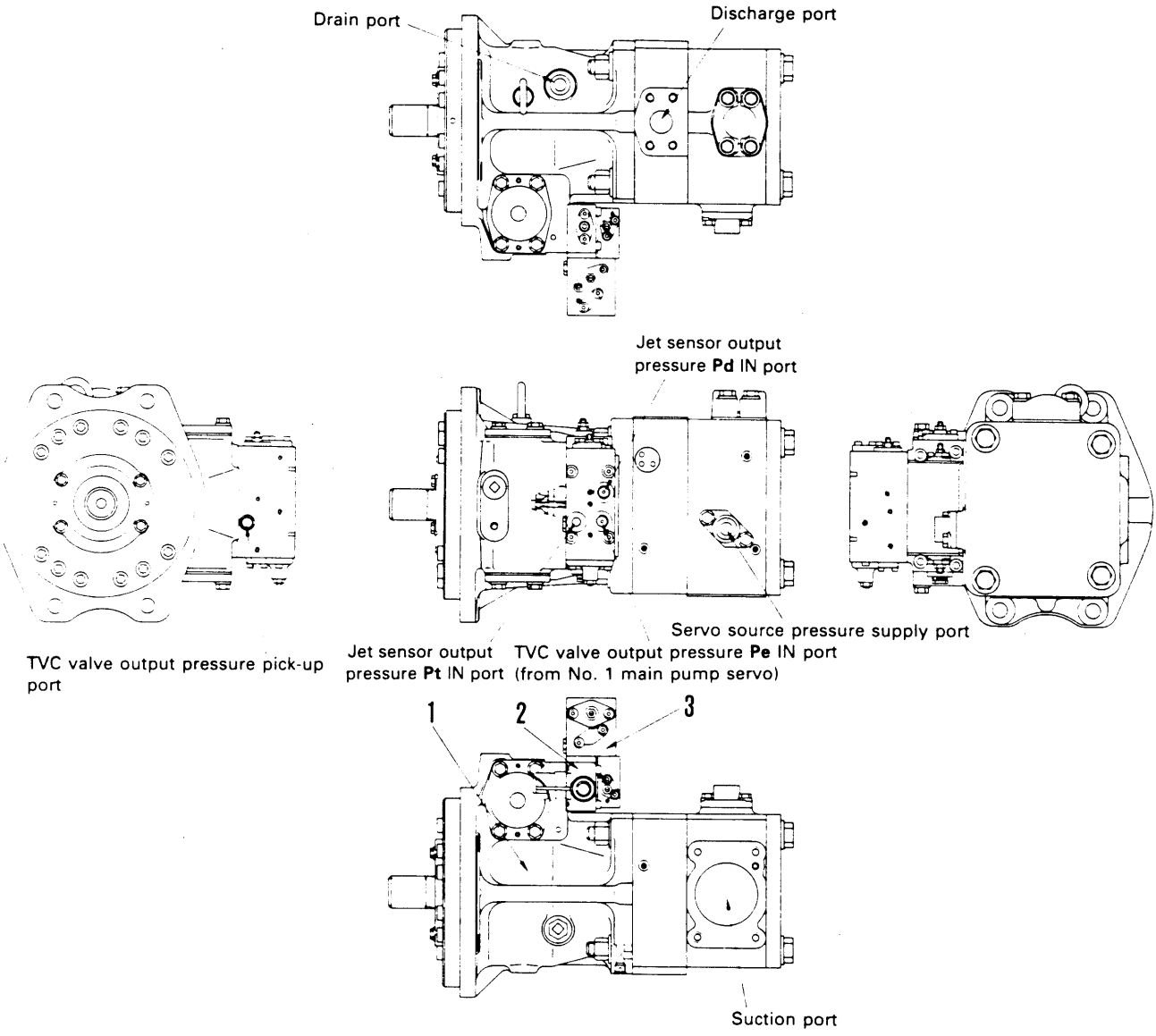


Section A – A

209F3067

020905

1. Plug
2. Lock nut
3. Body
4. Control piston
5. Arm
6. Pin
7. Spring
8. Plug
9. Cover
10. Lock nut
11. Lock nut
12. Cover
13. Plug
14. Spring
15. Guide spool
16. Sleeve
17. Cover
18. Lock nut



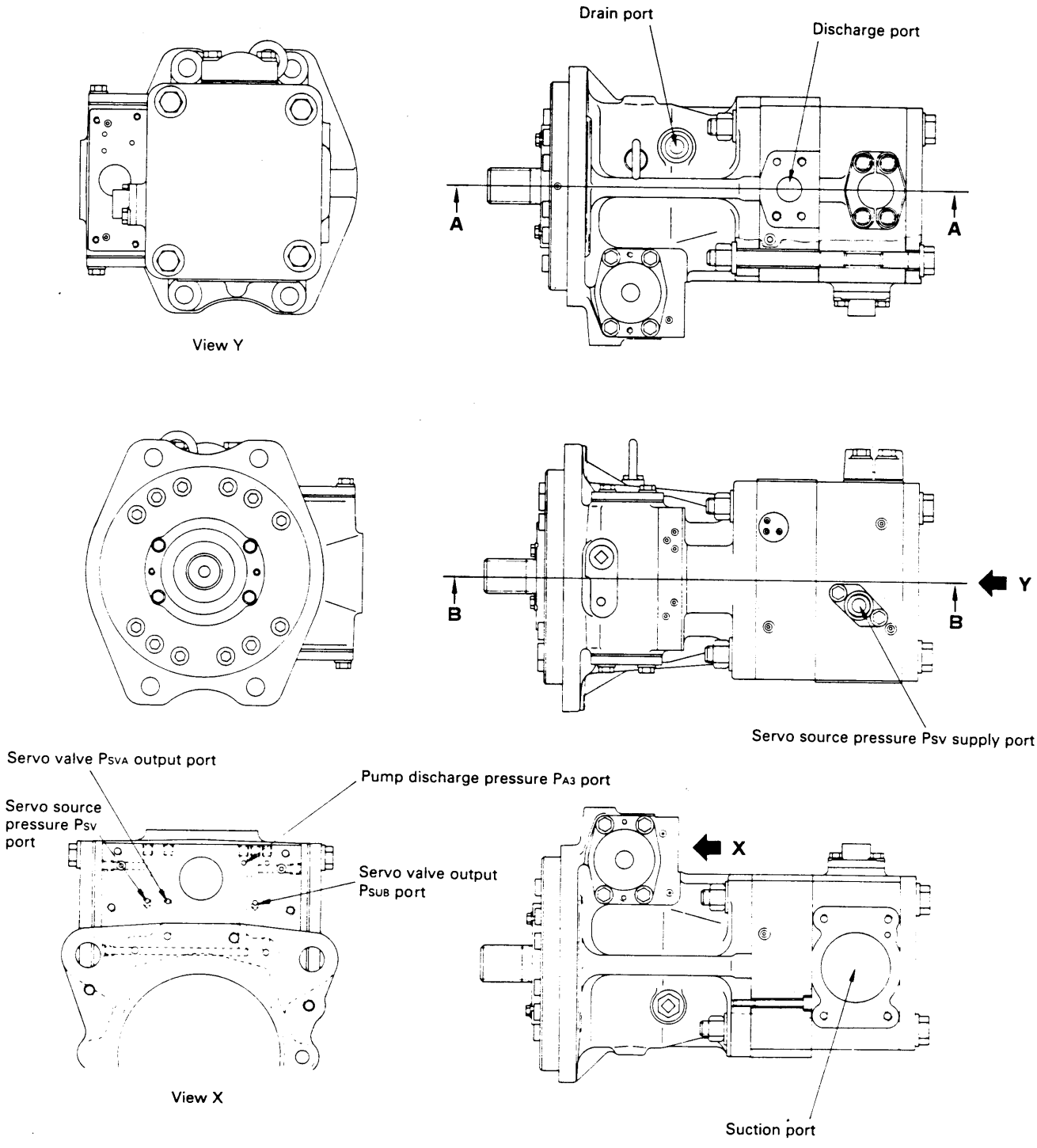
209F05046

020905

1. Main pump
2. CO•NC valve
3. Servo valve

★ For details of the structure and operation of the servo valve, see NO. 1 PUMP.

1. MAIN PISTON PUMP (HPV160)



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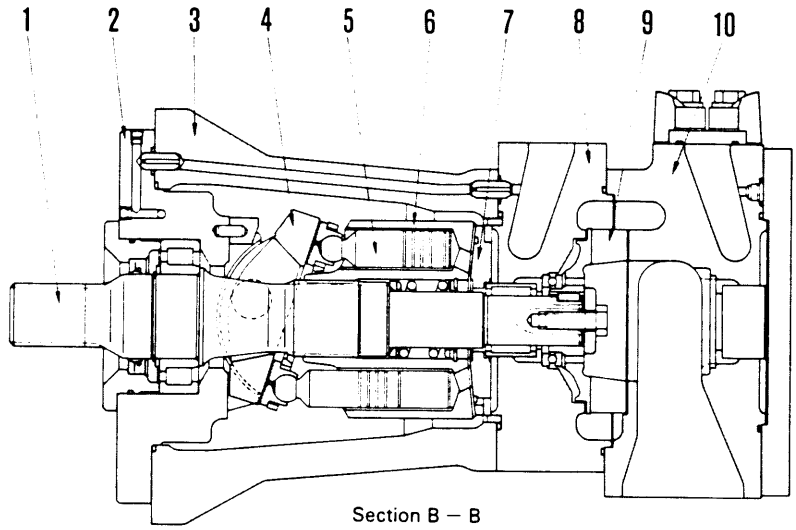
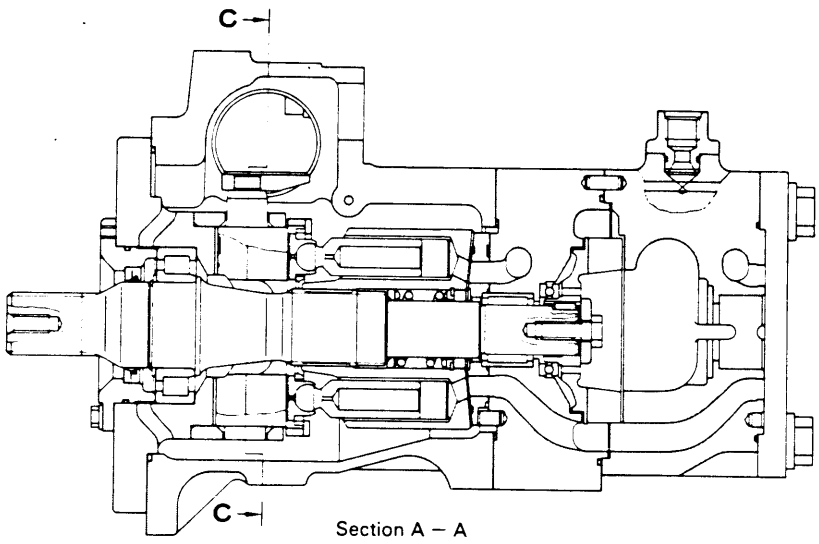
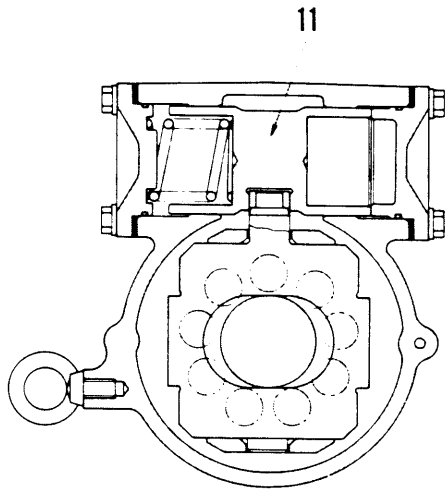


Section B – B



Section A – A



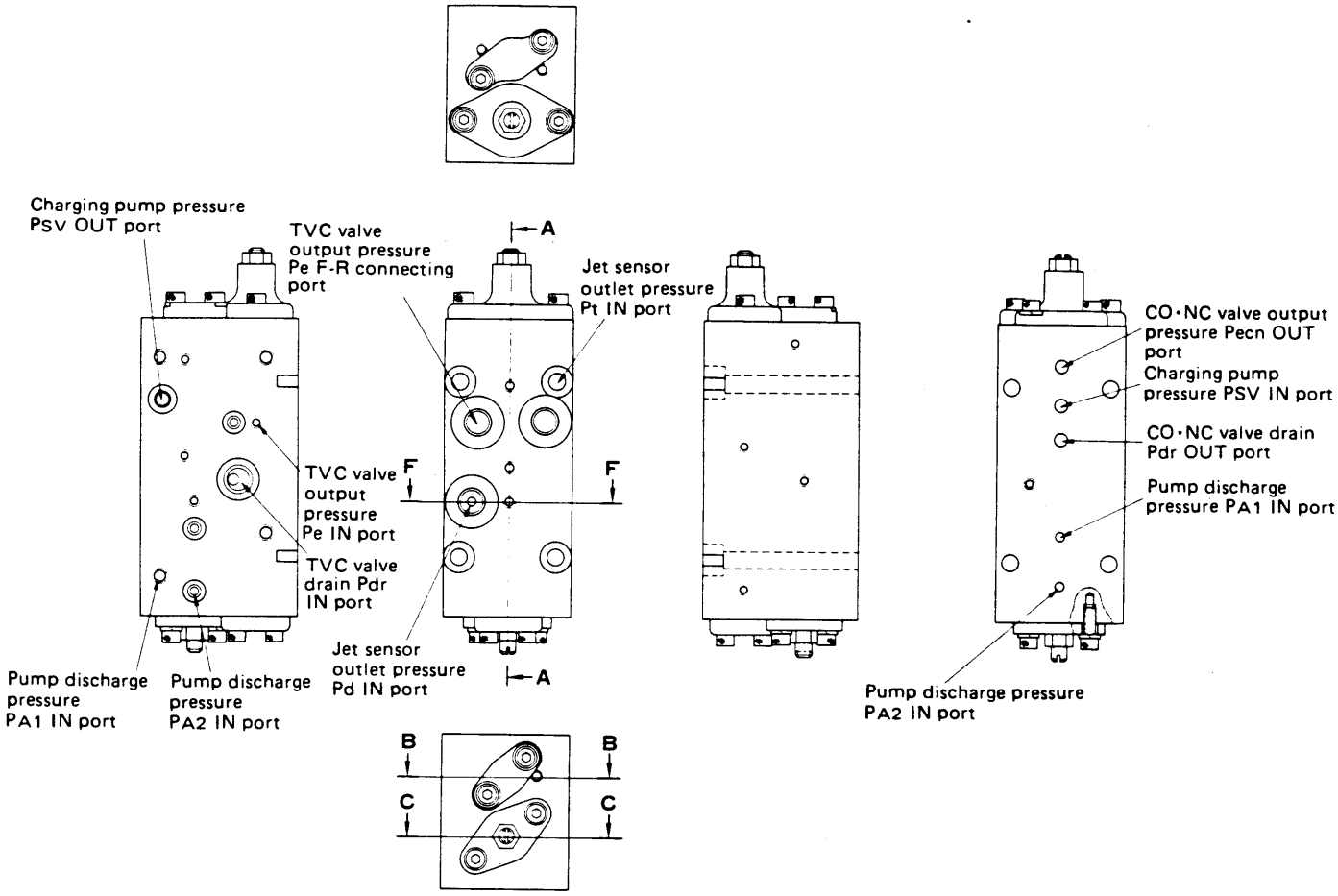
Section C – C

209F05048

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

2. CO•NC VALVE

★ For details of the operation of the CO•NC valve, see NO. 1 PUMP.



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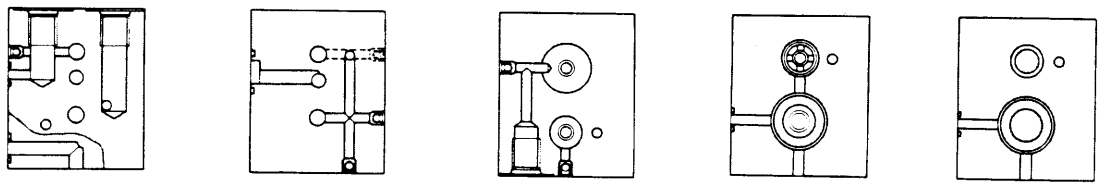
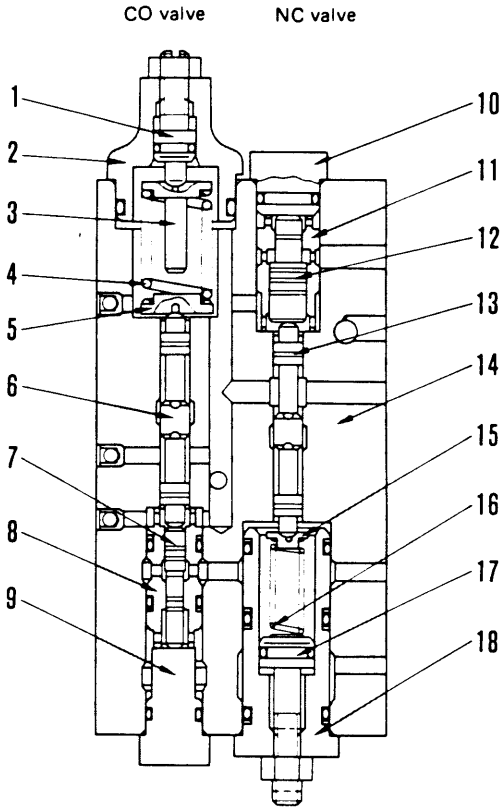
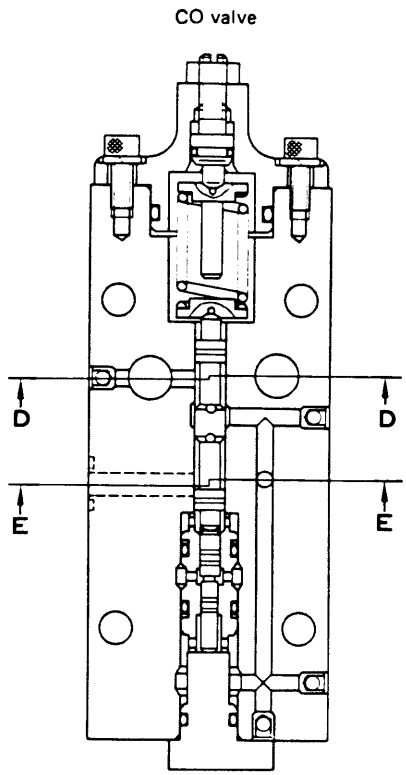


Section D – D | Section E – E | Section F – F | Section G – G | Section H – H

209F3069

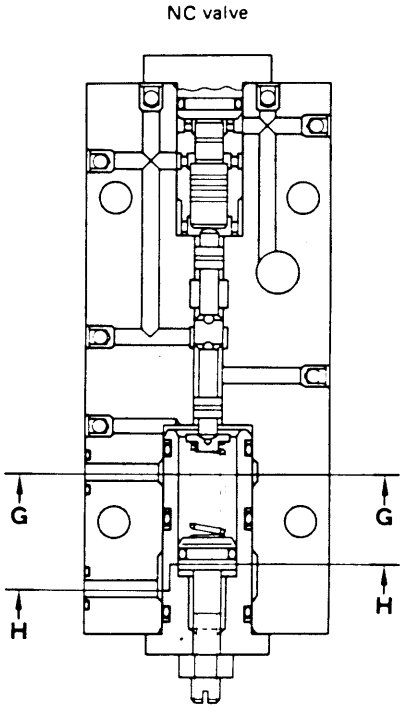


Section A – A



Section B – B

020905



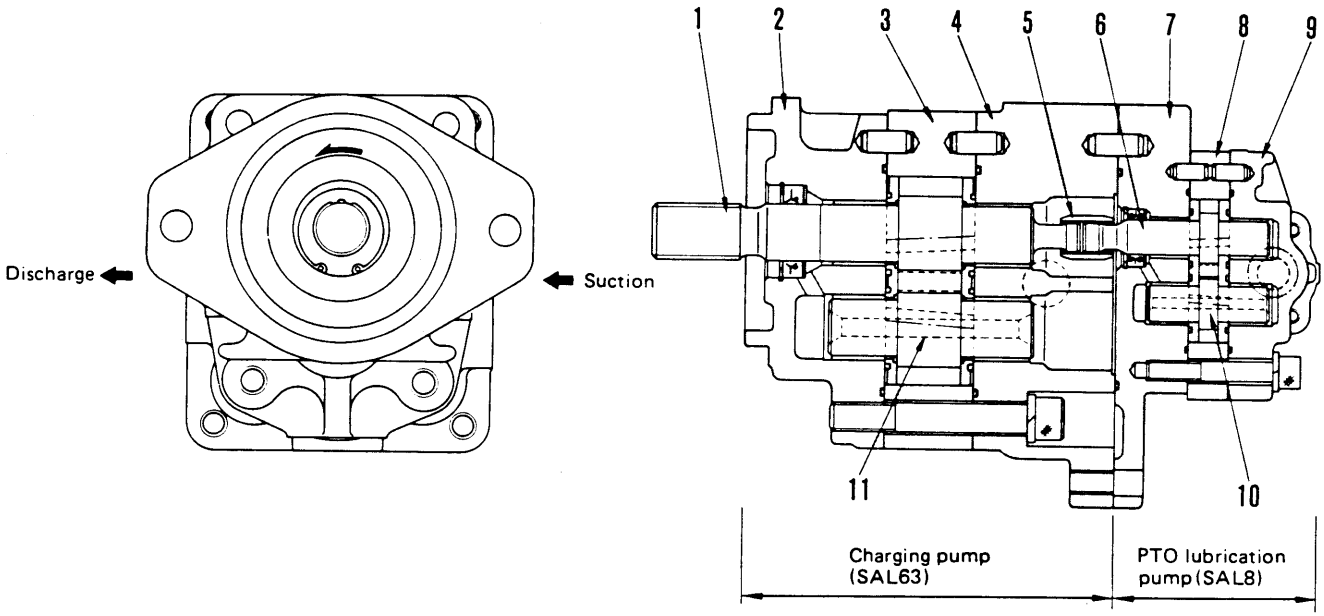
Section C – C

CO VALVE	NC VALVE
1. Plug	10. Plug
2. Cover	11. Sleeve
3. Seat	12. Piston
4. Spring	13. Spool
5. Seat	14. Body
6. Spool	15. Seat
7. Piston	16. Spring
8. Sleeve	17. Plug
9. Plug	18. Cover

209F3070

CHARGING AND PTO LUBRICATING PUMP

SAL63 + 8



209F3073

020905

1. Drive gear
2. Bracket
3. Gear case
4. Cover
5. Coupling
6. Drive gear
7. Bracket
8. Gear case
9. Cover
10. Driven gear
11. Driven gear

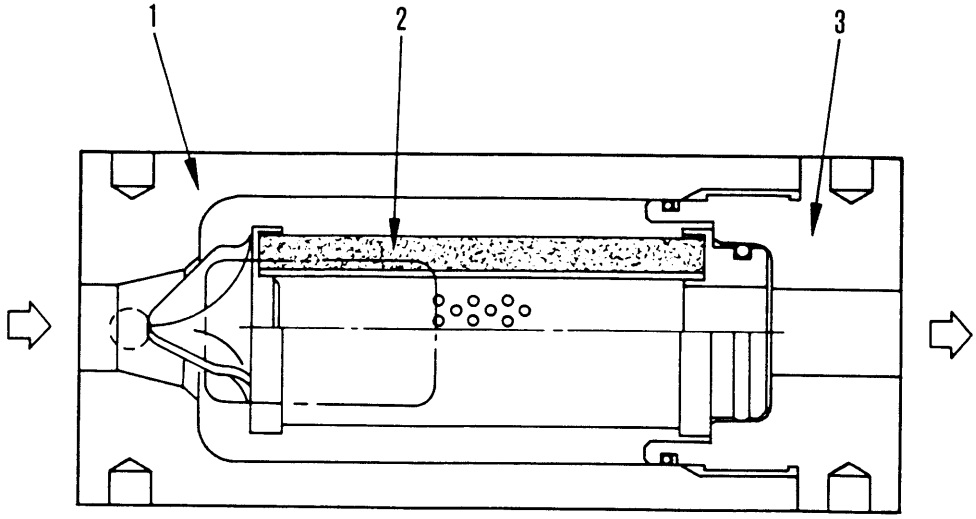
OUTLINE

In this tandem gear pump, the SAL63 is for the PPC and OLSS charging, and the SAL8 is for PTO lubrication.

SPECIFICATIONS

Theoretical delivery:	SAL63	63.1 cc/rev.
	SAL8	8.5 cc/rev.
Max. delivery pressure:	210 kg/cm²	

LINE OIL FILTER



1. Body
2. Element
3. Cover

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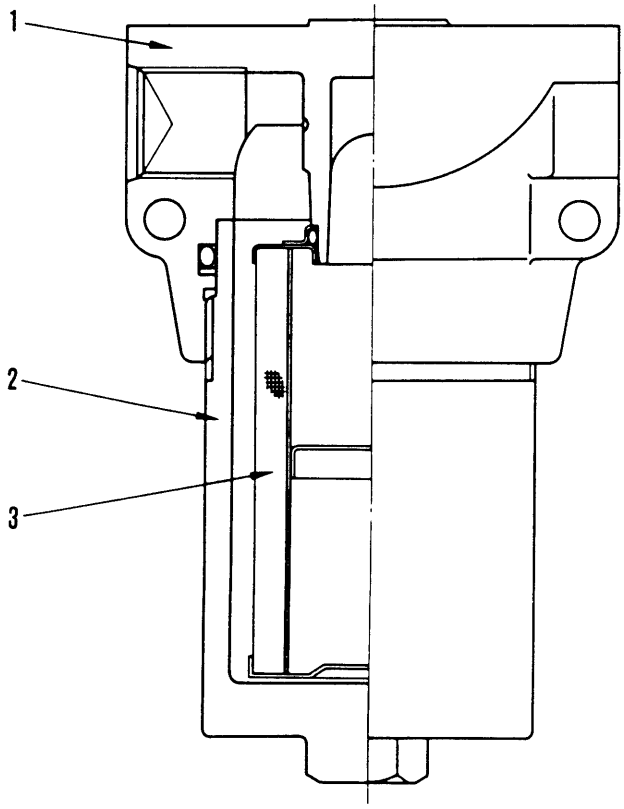
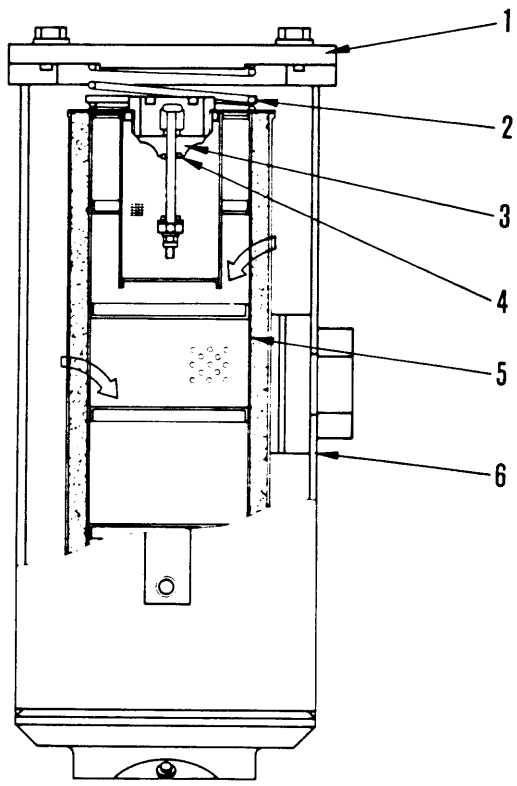
PILOT OIL FILTER



1. Bracket
2. Cartridge
3. Element

209F3074

RETURN OIL FILTER



1. Cover
2. Spring
3. Bypass valve
4. Bypass valve spring
5. Element
6. Housing

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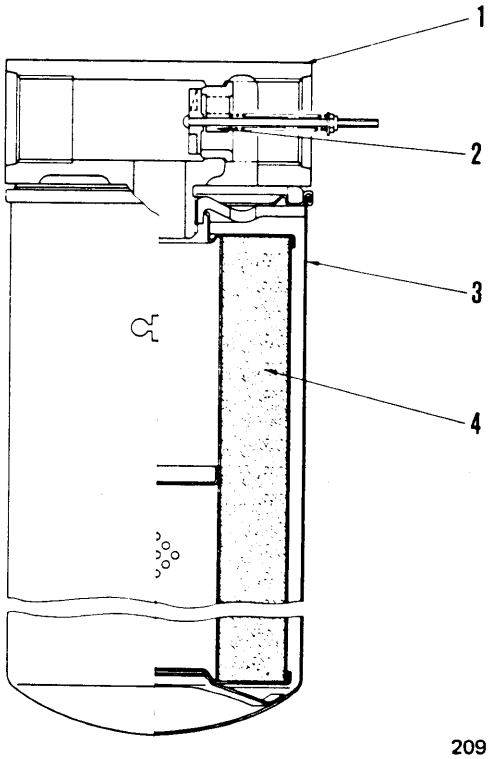
DRAIN OIL FILTER



1. Bracket
2. Safety valve
3. Cartridge
4. Element

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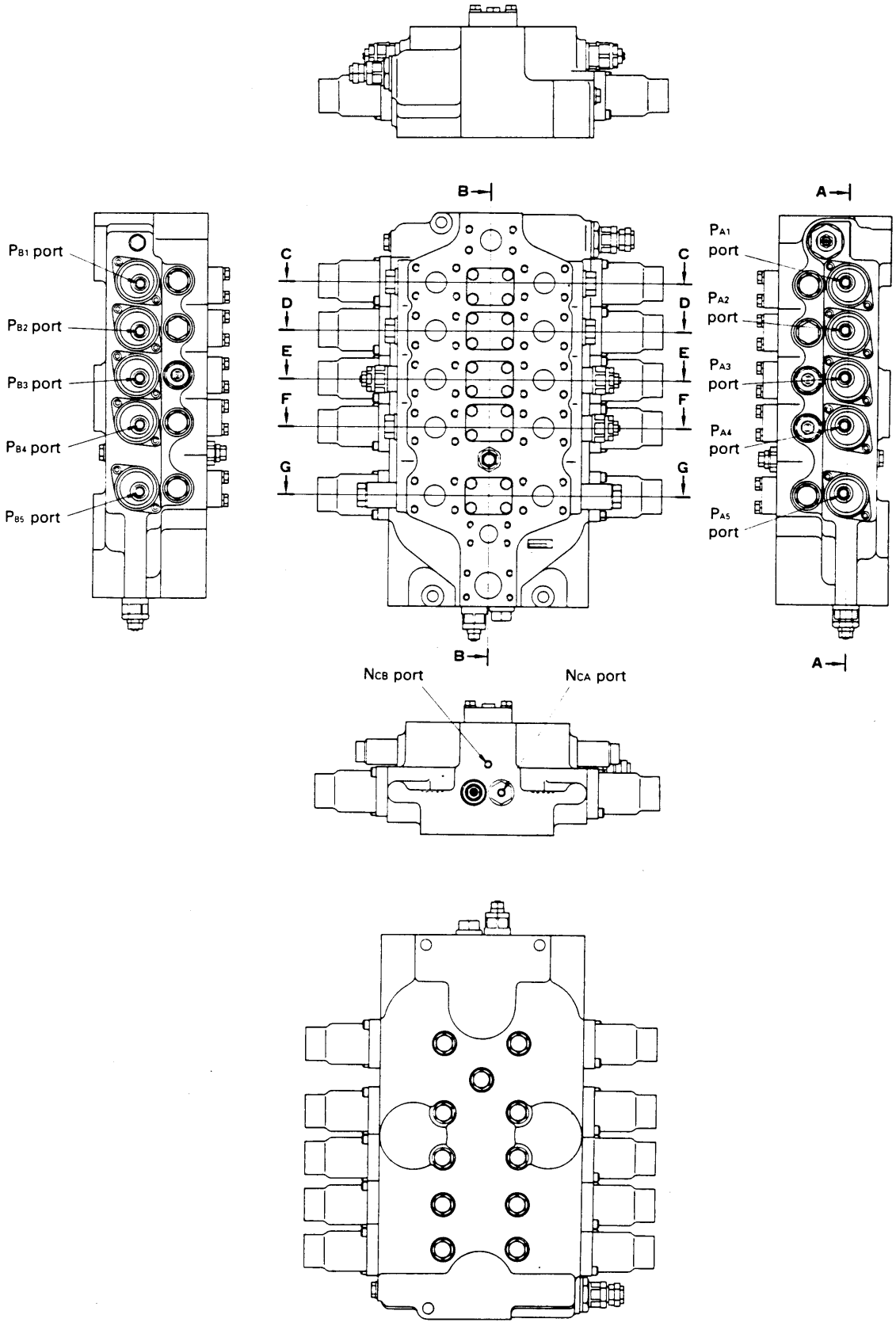
L.H. 5-SPOOL CONTROL VALVE

BACK HOE



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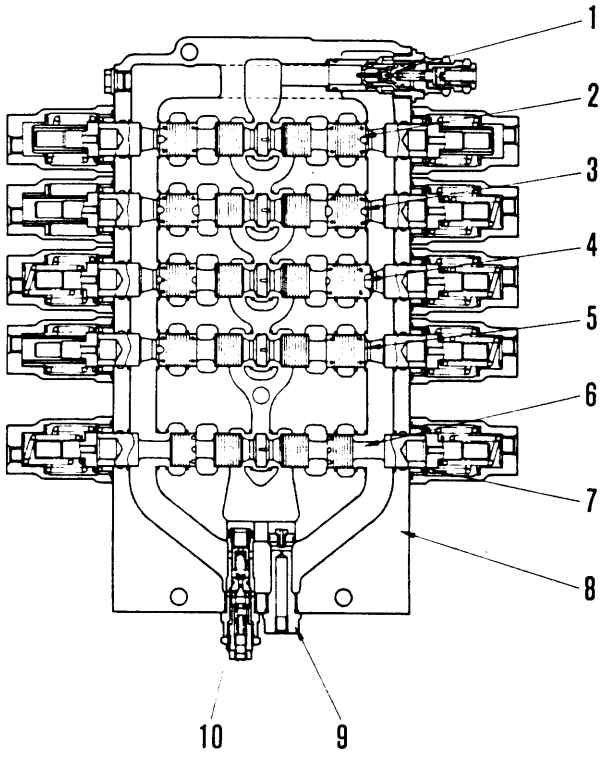

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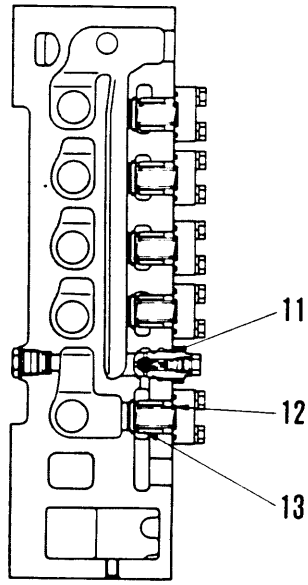
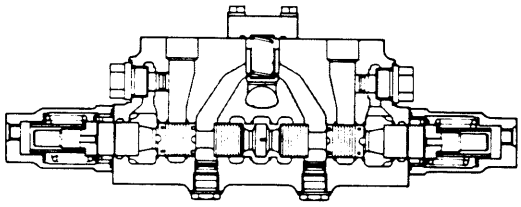


Section B – B

020905



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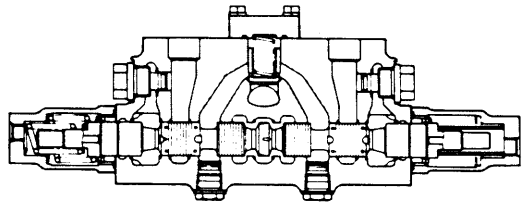

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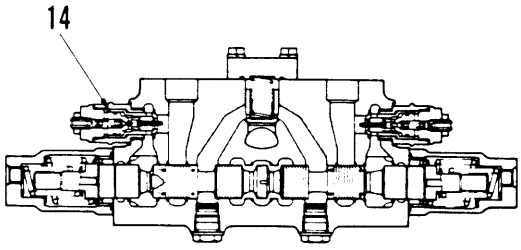
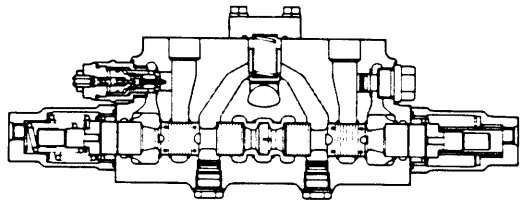
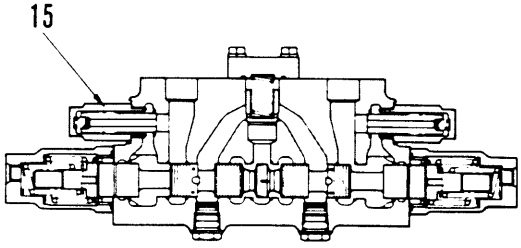


Section E – E



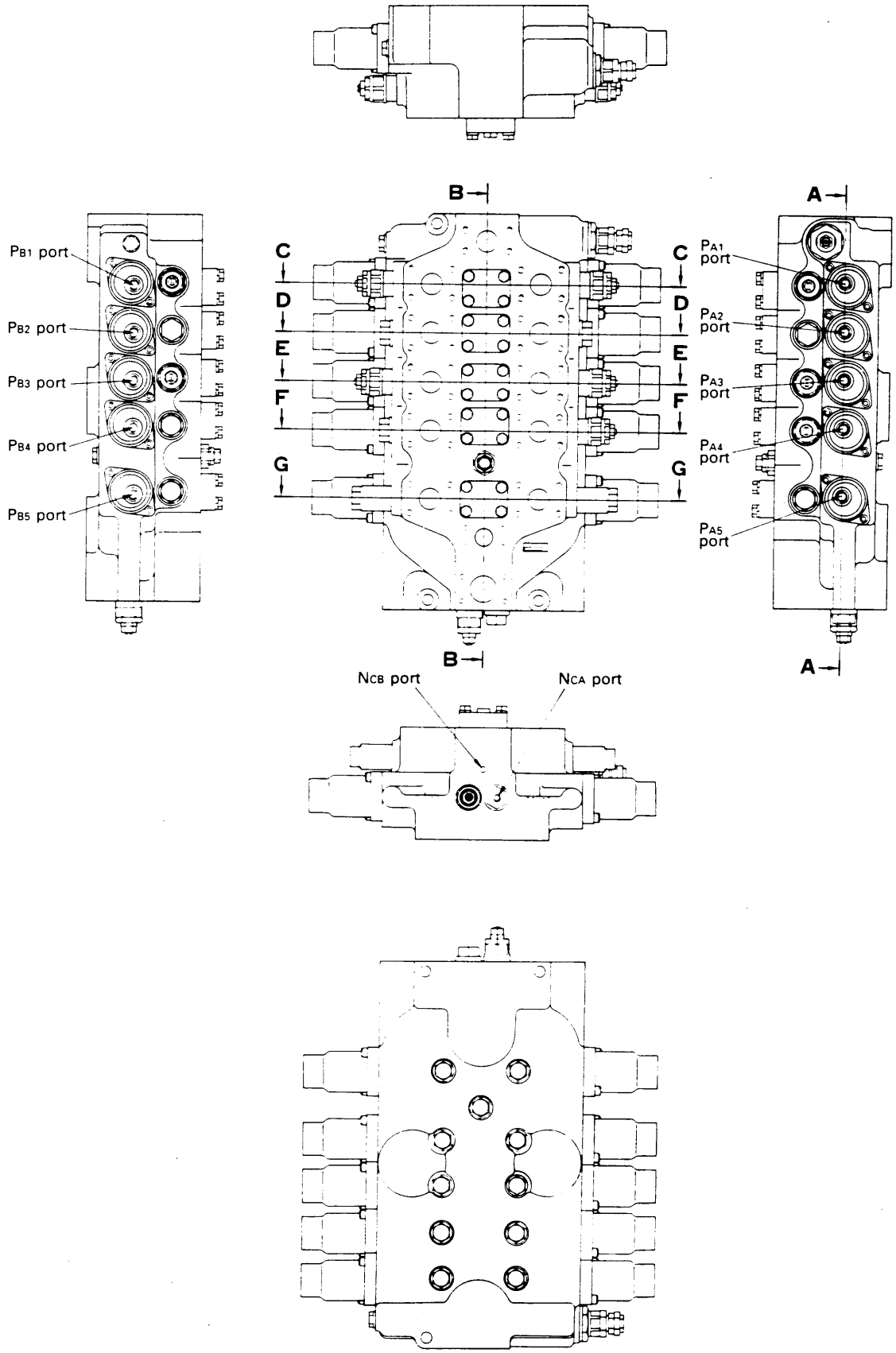
Section F – F



Section G – G

F20905015

1. Main relief valve
2. Spool (Service)
3. Spool (Boom-Hi)
4. Spool (Arm-Lo)
5. Spool (Bucket-Hi)
6. Spool (L.H. travel)
7. Spool return spring
8. Body
9. Jet sensor orifice
10. Jet sensor relief valve
11. Throttle valve
12. Check valve spring
13. Check valve
14. Safety-suction valve
15. Suction valve



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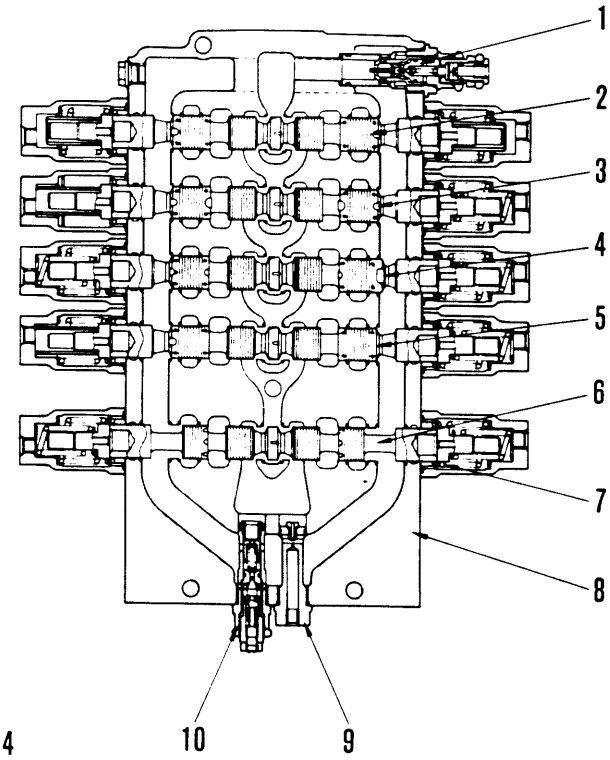
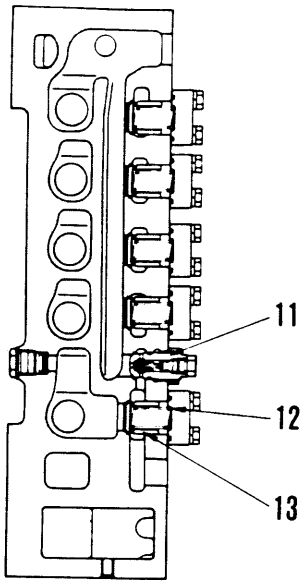
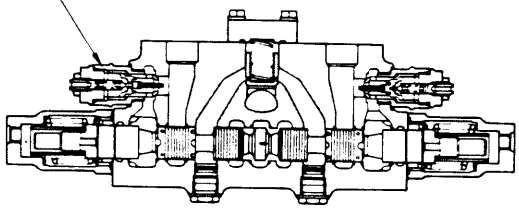


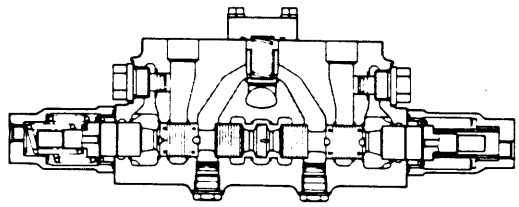
Section A – A



Section B – B



Section C – C



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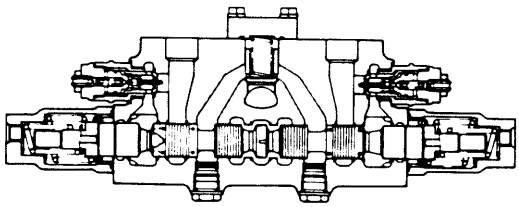

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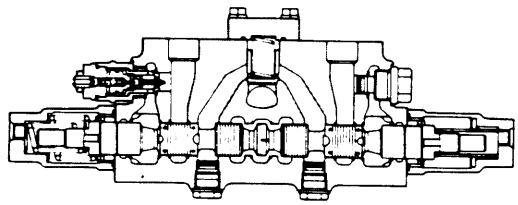

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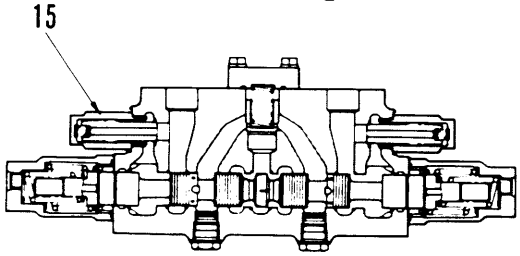


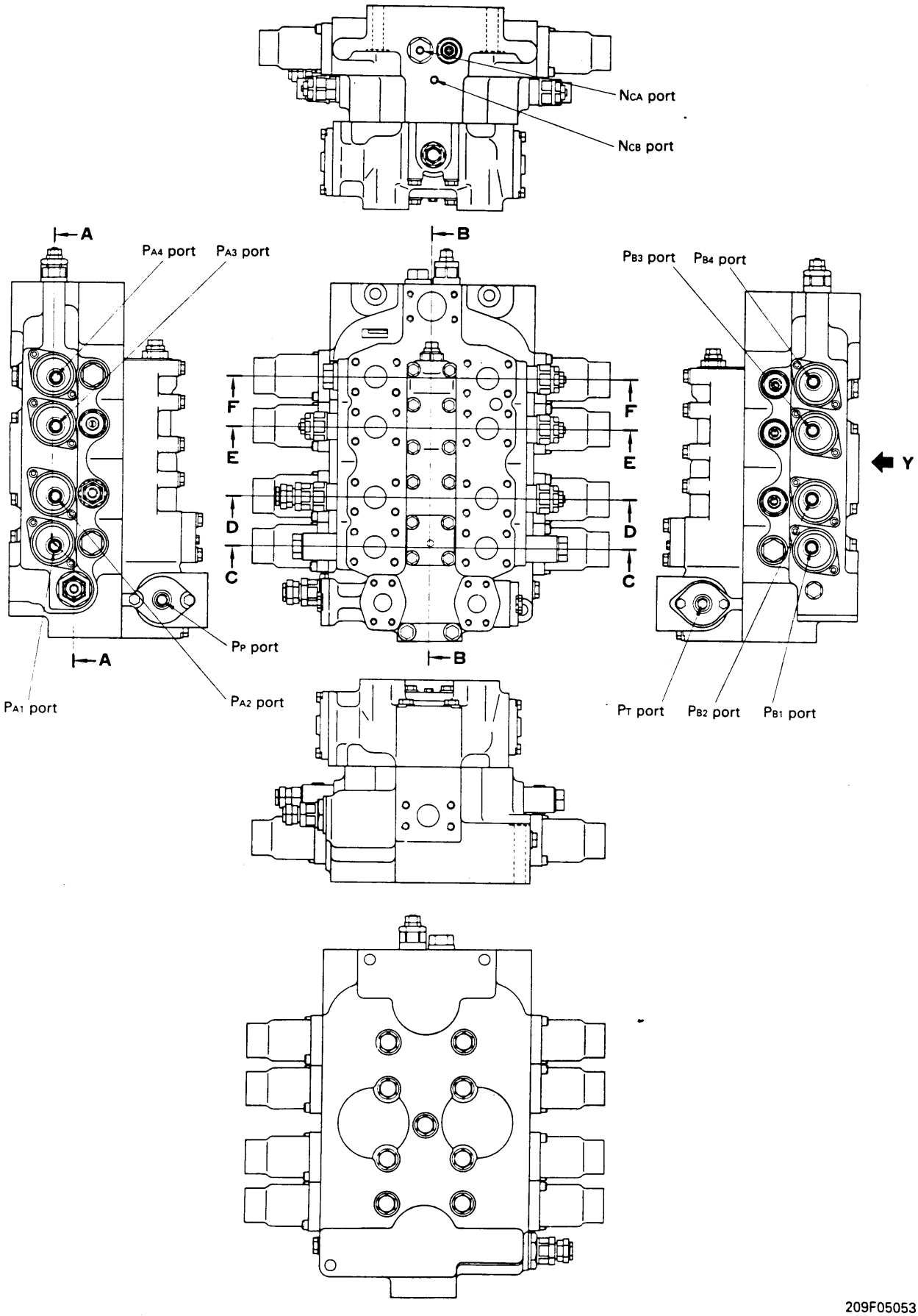
Section G – G

020905

F20905017

1. Main relief valve
2. Spool (Bottom dump)
3. Spool (Boom-Hi)
4. Spool (Arm-Lo)
5. Spool (Bucket-Hi)
6. Spool (L.H. travel)
7. Spool return spring
8. Body
9. Jet sensor orifice
10. Jet sensor relief valve
11. Throttle valve
12. Check valve spring
13. Check valve
14. Safety-suction valve
15. Suction valve

R.H. 4-SPOOL CONTROL VALVE



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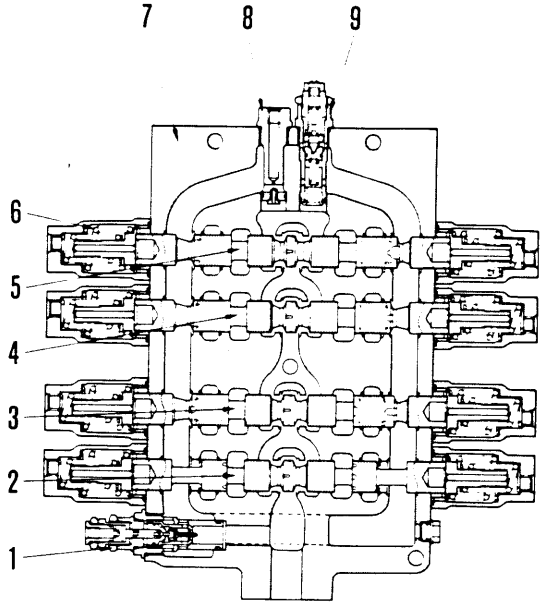
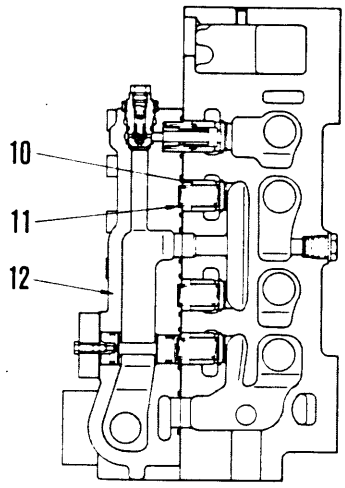


Section A – A



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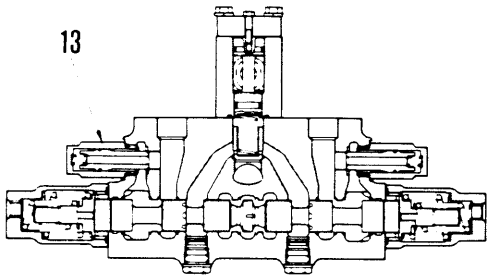

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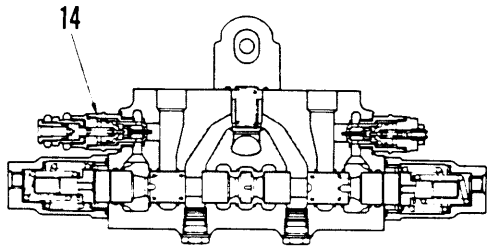
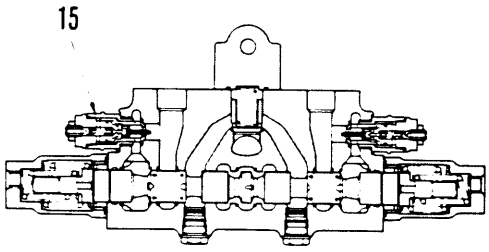


Section D – D



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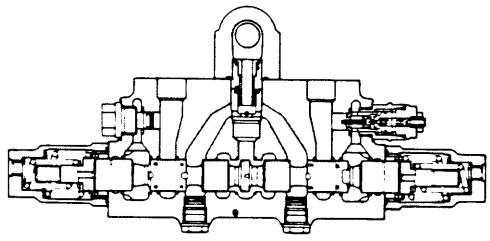

Section F – F

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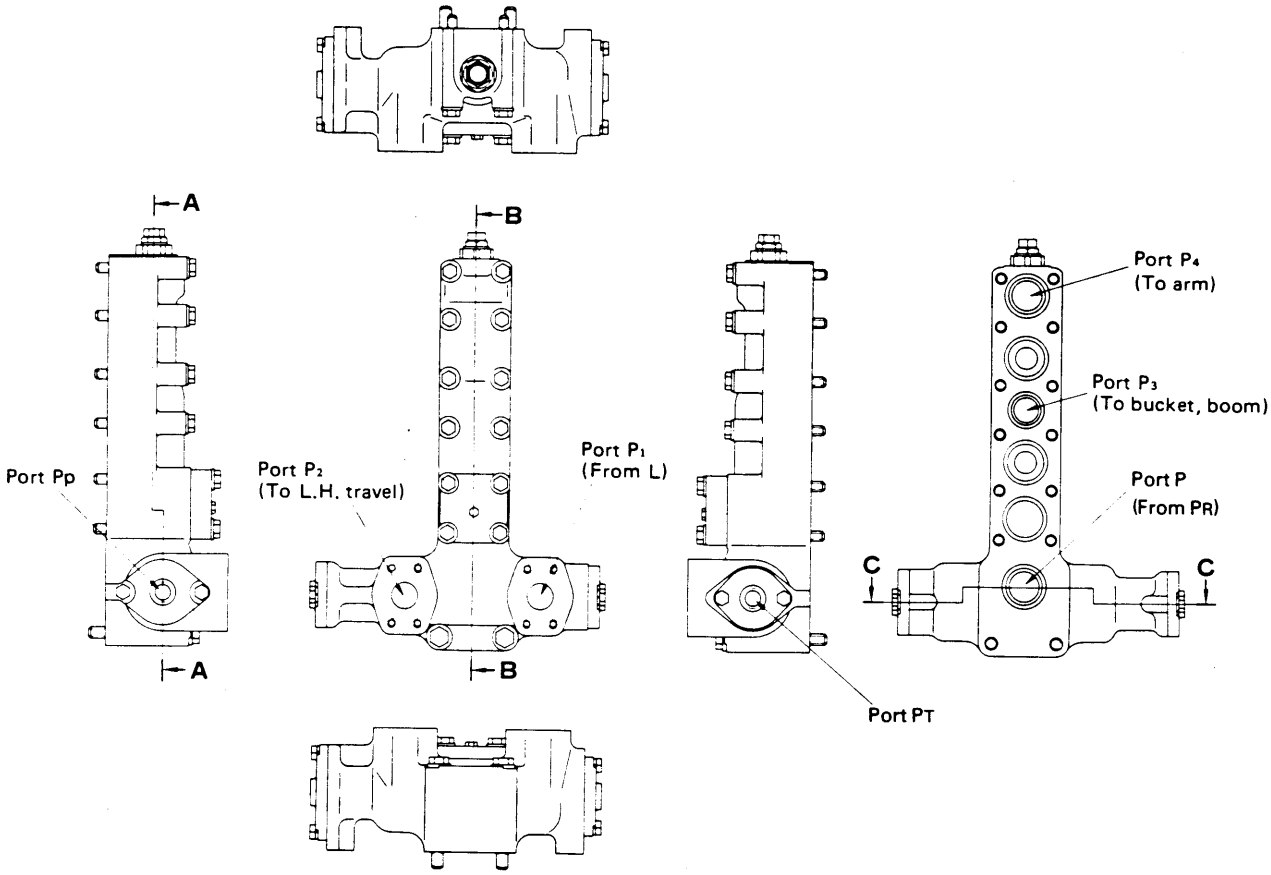
1. Main relief valve
2. Spool (R.H. travel)
3. Spool (Boom-Lo)
4. Spool (Bucket-Lo)
5. Spool (Arm-Hi)
6. Spool return spring
7. Body
8. Jet sensor orifice
9. Jet sensor relief valve
10. Check valve
11. Check valve spring
12. Straight-travel valve
13. Suction valve
14. Safety-suction valve
15. Safety-suction valve

STRAIGHT-TRAVEL VALVE



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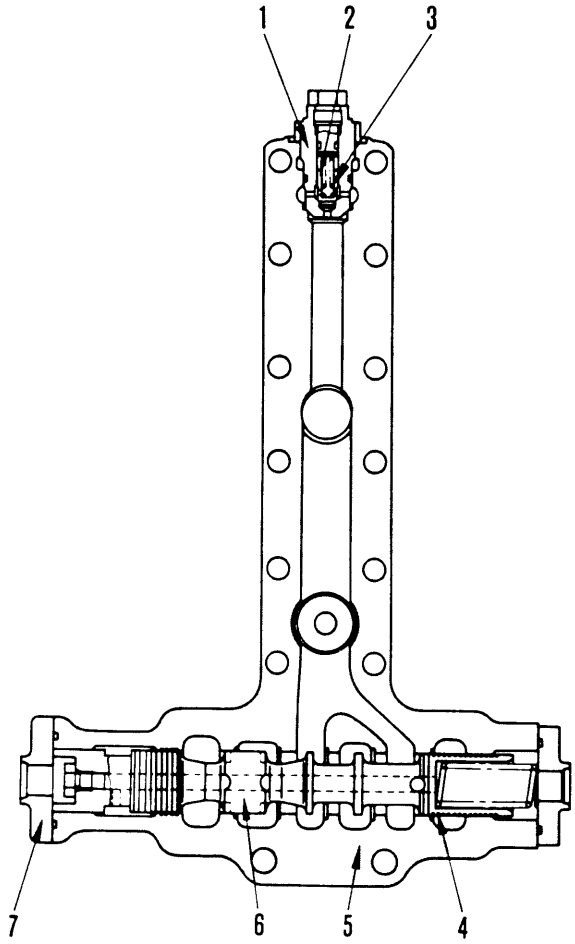
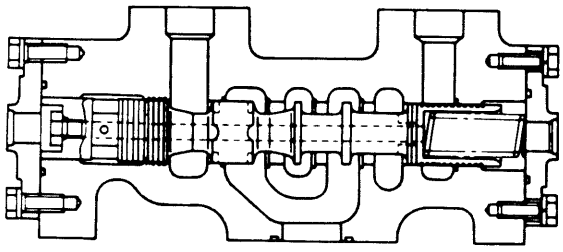
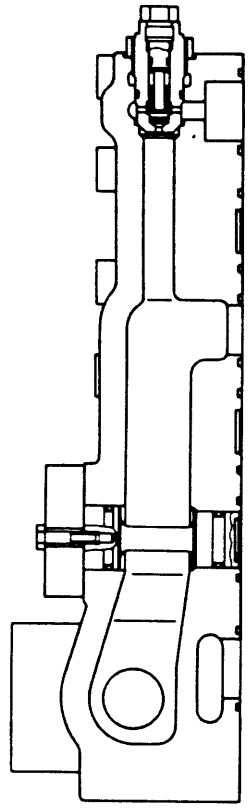


Section A – A



Section C – C



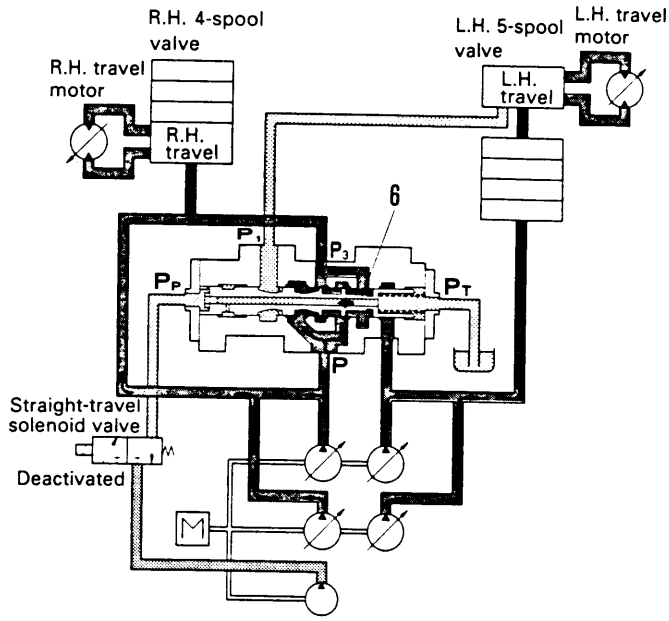
Section B – B

209F05055

1. Orifice
2. Check valve
3. Spring
4. Spool return spring
5. Body
6. Spool
7. Cover

FUNCTION

- If the boom, arm, or bucket are operated at the same time as the travel, the pressure oil flowing to the L.H. and R.H. travel circuits is divided and sent to the boom, arm, or bucket circuit. The travel circuit on the side where the oil flow is divided will have a smaller flow of oil to the motor than the travel circuit on the side which is not divided, so the flow in the motor circuit will drop and the machine will deviate to one side.
- To prevent this, the straight-travel valve is switched to interconnect the L.H. and R.H. travel circuits, thereby ensuring and equal supply of oil to both the L.H. and R.H. travel motors. This keeps both the L.H. and R.H. motors rotating at the same speed, and prevents any travel deviation.



209F05056

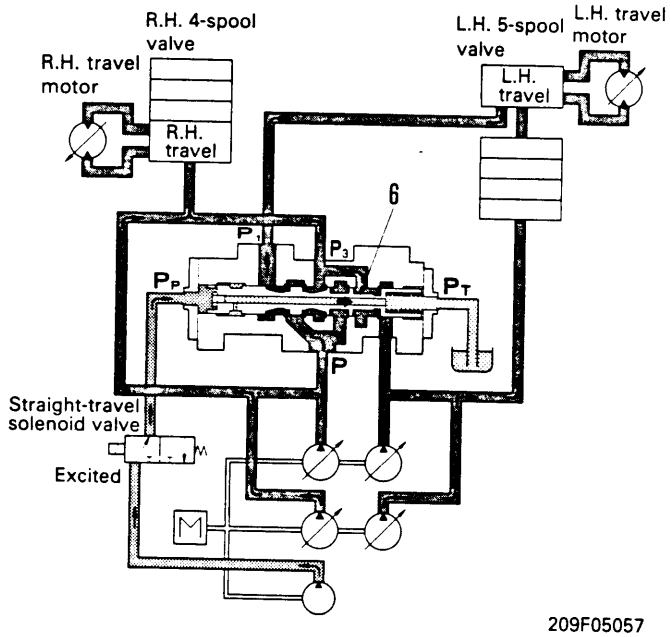
OPERATION

When operating only travel circuit (straight-travel solenoid valve deactivated)

- The straight-travel solenoid valve is deactivated, so the pilot pressure does not flow, and spool (6) remains pushed to the left.
- Because of this, port **P1** (L.H. travel circuit) and port **P3** (R.H. travel circuit) are not interconnected, but are kept as independent circuit.

Travel and work equipment circuits operated at the same time (straight-travel solenoid valve excited)

- The straight-travel solenoid valve is excited, so pilot pressure flows and spool (6) is pushed to the right.
- When this happens, port **P1** and port **P3** are interconnected to ensure an equal flow of oil to the L.H. and R.H. travel motors. The L.H. and R.H. travel motors rotate at the same speed, so there is no travel deviation.



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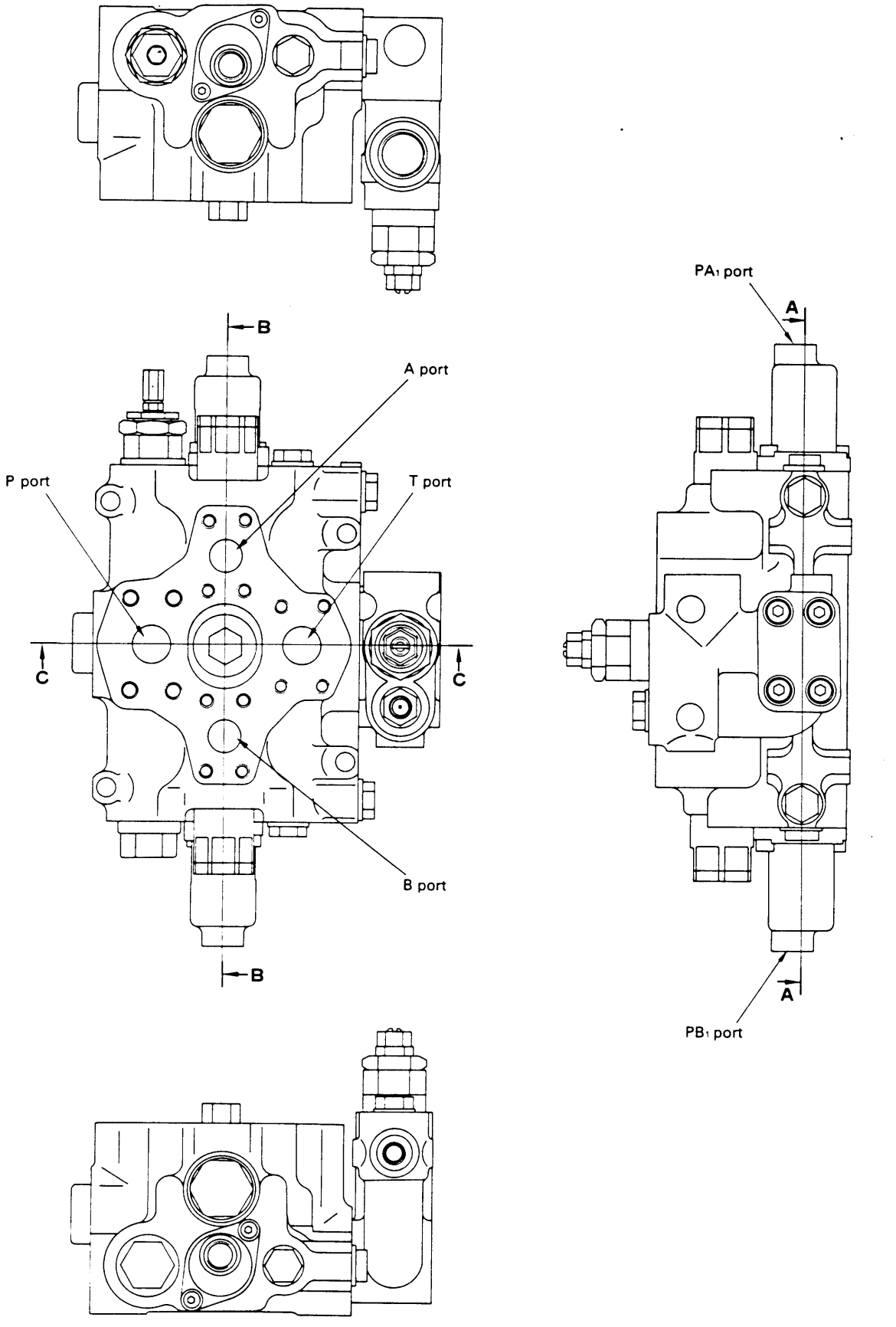
SWING CONTROL VALVE



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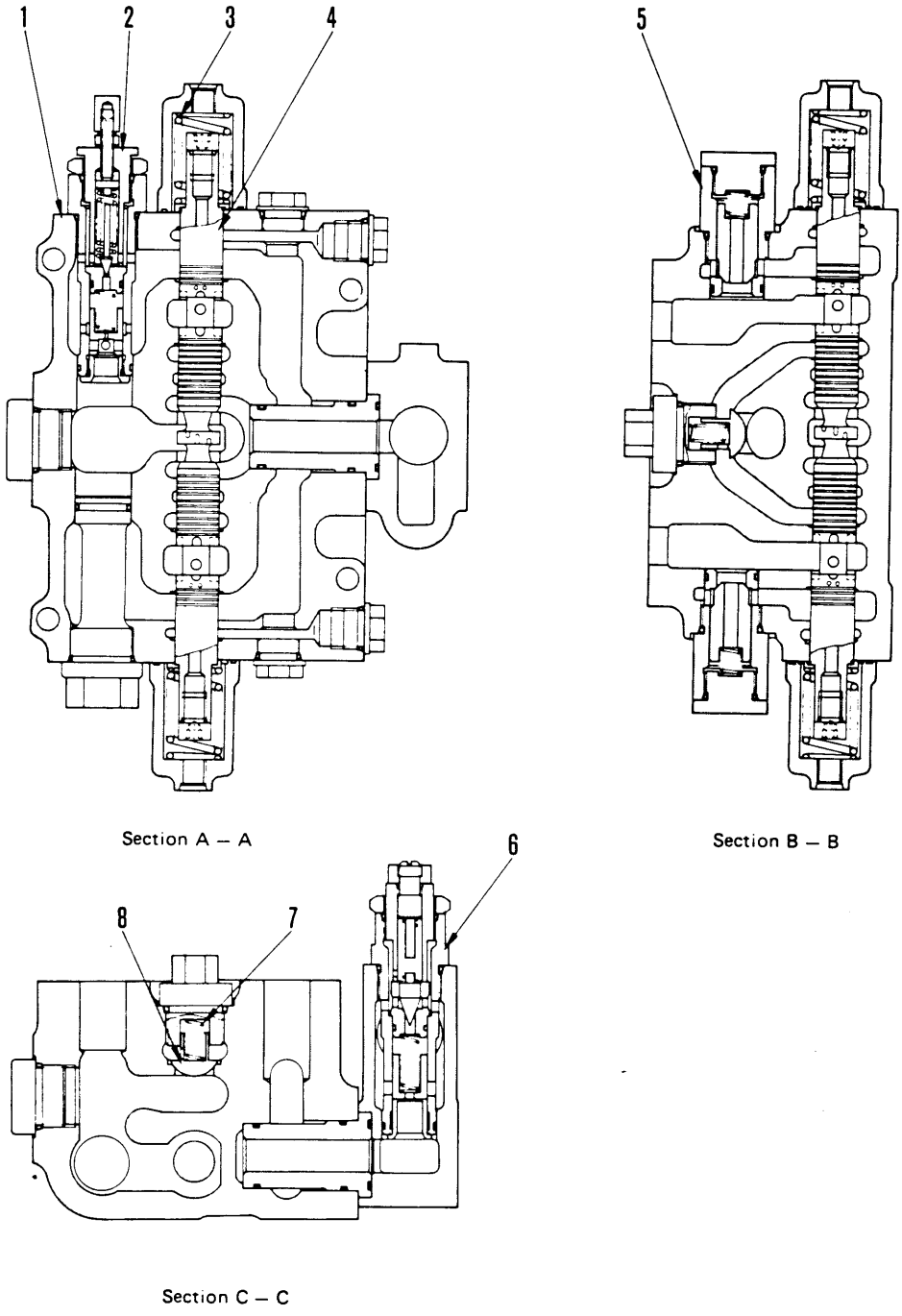
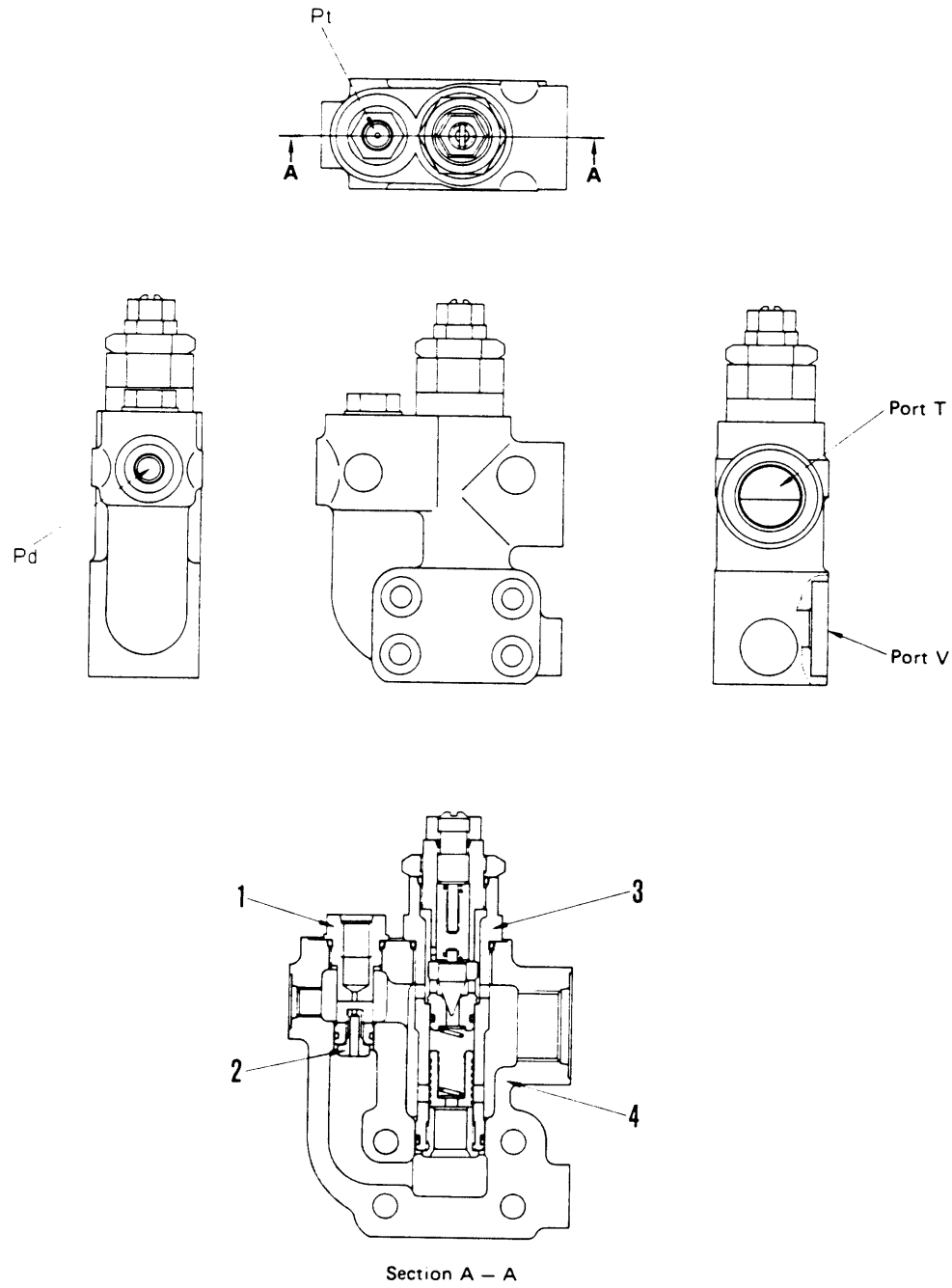


020905

1. Body
2. Main relief valve
3. Spool return spring
4. Spool
5. Suction valve
6. Jet sensor
7. Check valve spring
8. Check valve

JET SENSOR



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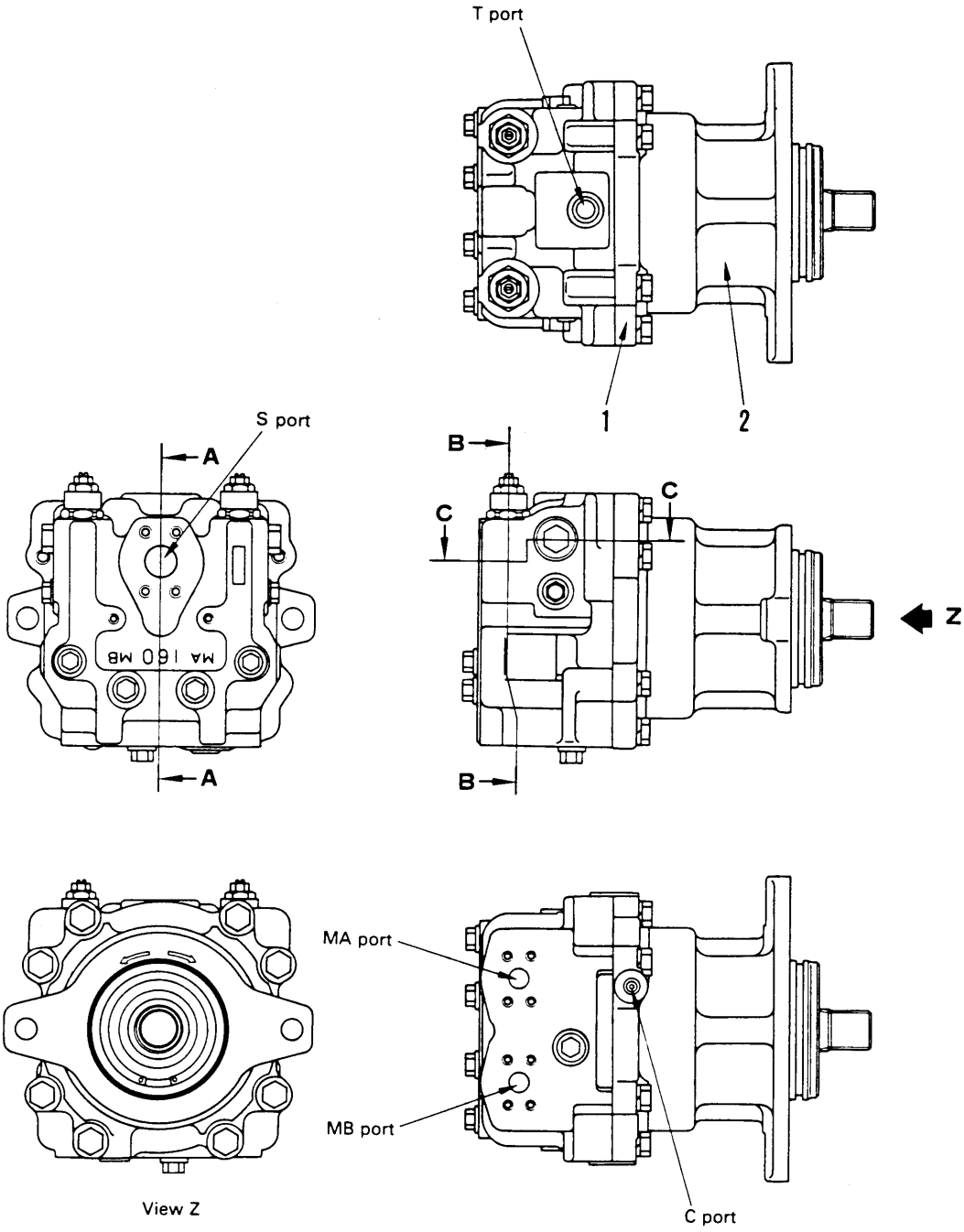
1. Sensor
2. Orifice
3. Relief valve
4. Body

SWING MOTOR



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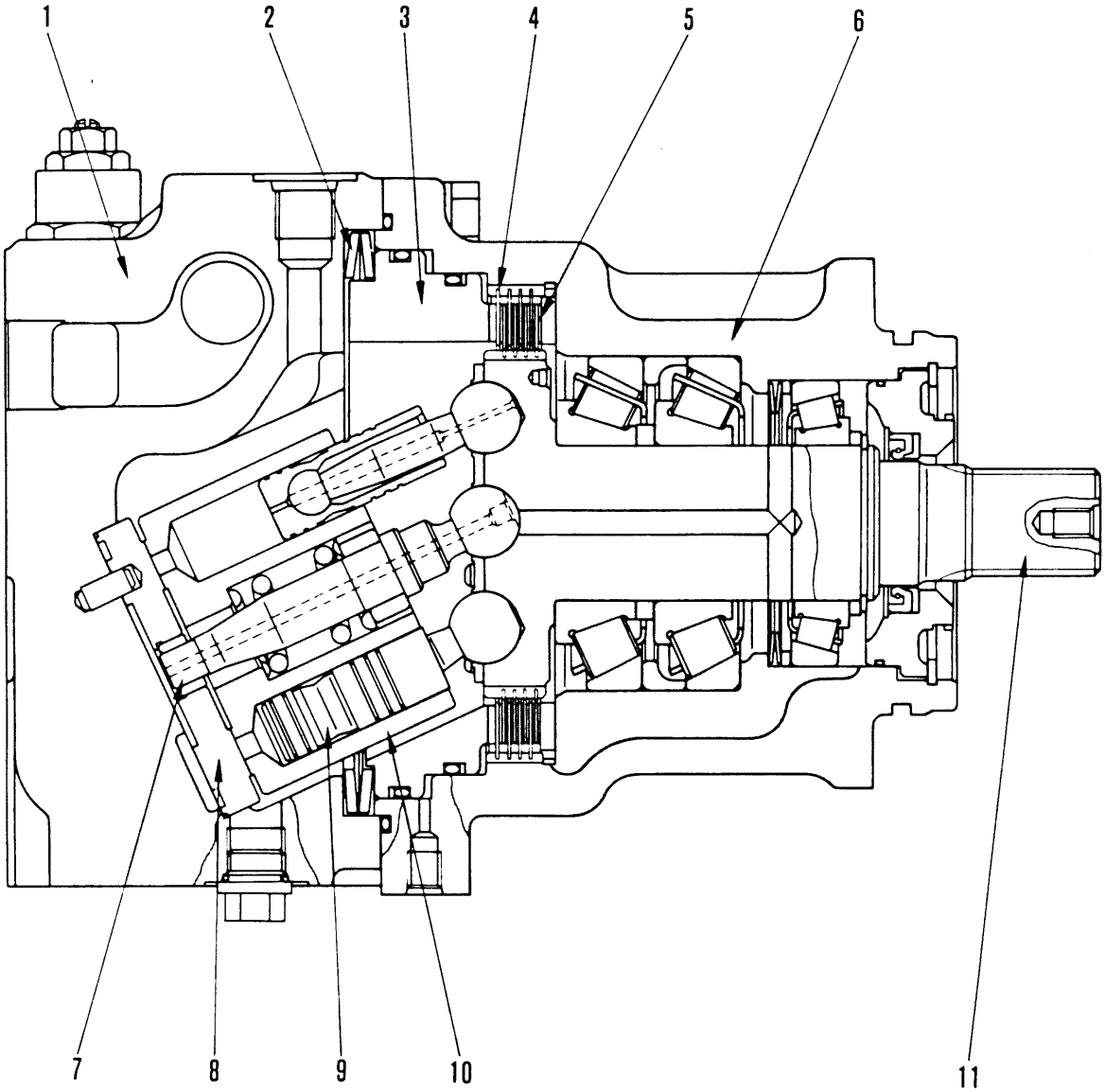
SPECIFICATIONS

Type:	KMF160AB-2
Theoretical delivery:	160.7 cc/rev
Safety valve set pressure:	280 kg/cm²
Rated speed:	2,106 rpm
Brake releasing pressure:	16 ± 2 kg/cm²

1. SWING MOTOR

020905



Section A – A

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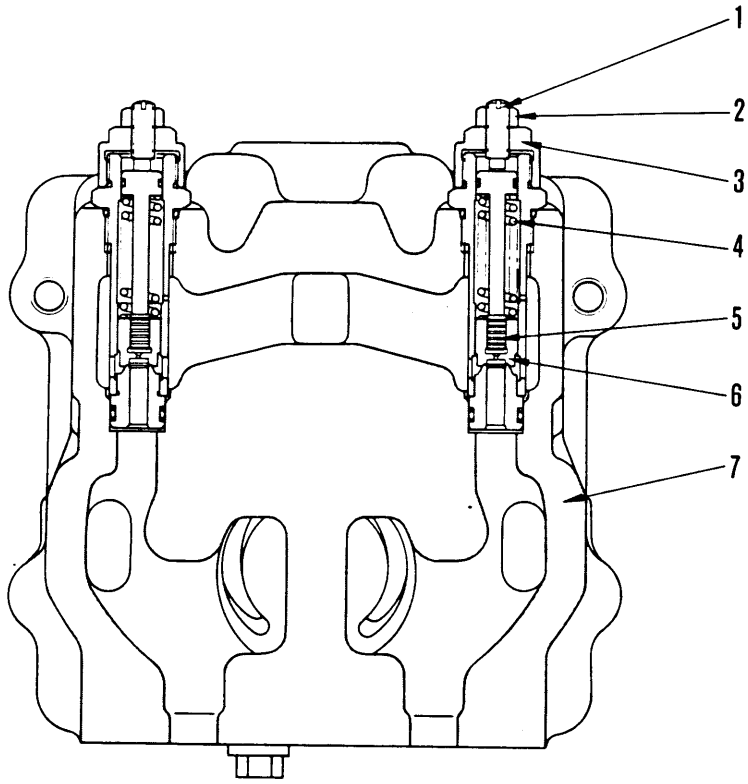
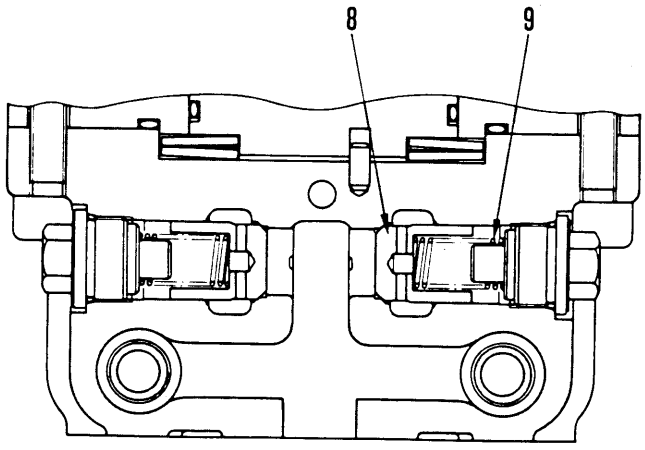
1. Housing
2. Brake spring
3. Brake piston
4. Plate
5. Disc
6. Brake case
7. Center shaft
8. Valve plate
9. Piston
10. Cylinder block
11. Output shaft

2. SAFETY VALVE



Section B – B



Section C – C

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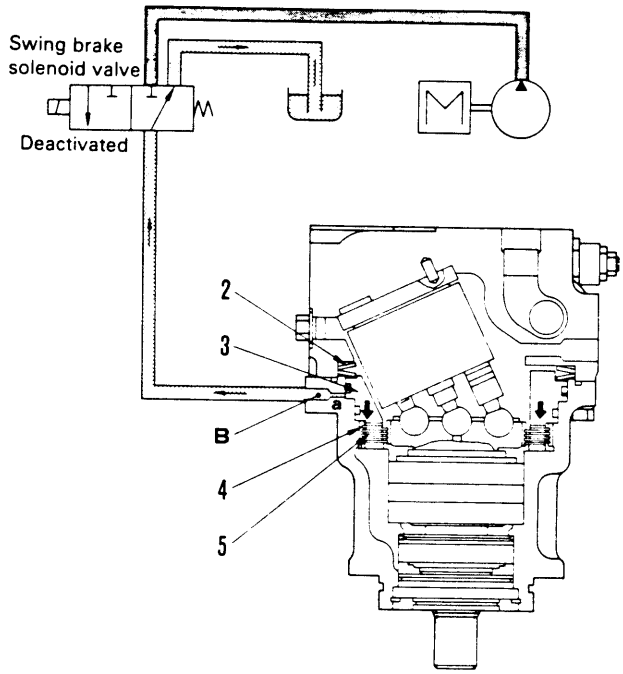
1. Adjustment screw
2. Lock nut
3. Sleeve
4. Safety valve spring
5. Pilot piston
6. Safety valve
7. Housing
8. Check valve
9. Check valve spring

SWING MECHANICAL BRAKE

OPERATION

1) **When swing brake solenoid valve is deactivated**
When the swing brake solenoid valve is deactivated, the pressurized oil from the charging pump is shut off and port **B** is connected to the tank circuit.
Because of this, brake piston (3) is pushed down in the direction of the arrow by brake spring (2), so disc (5) and plate (4) are pushed together and the brake is applied.



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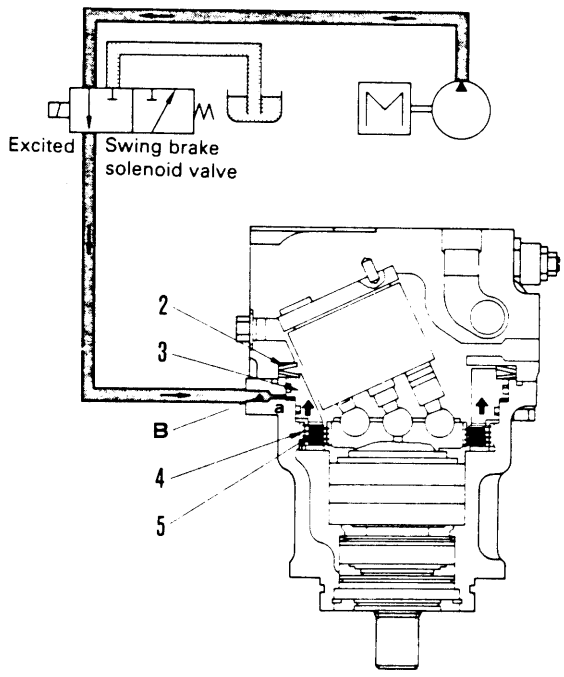
2) **When swing brake solenoid valve is excited**
When the swing brake solenoid valve is excited, the valve is switched, and the pressurized oil from the charging pump enters port **B** and flows to brake chamber **a**.
The pressurized oil entering chamber **a** overcomes the force of brake spring (2), and brake piston (3) is pushed up in the direction of the arrow. Because of this, disc (5) and plate (4) separate, and the brake is released.



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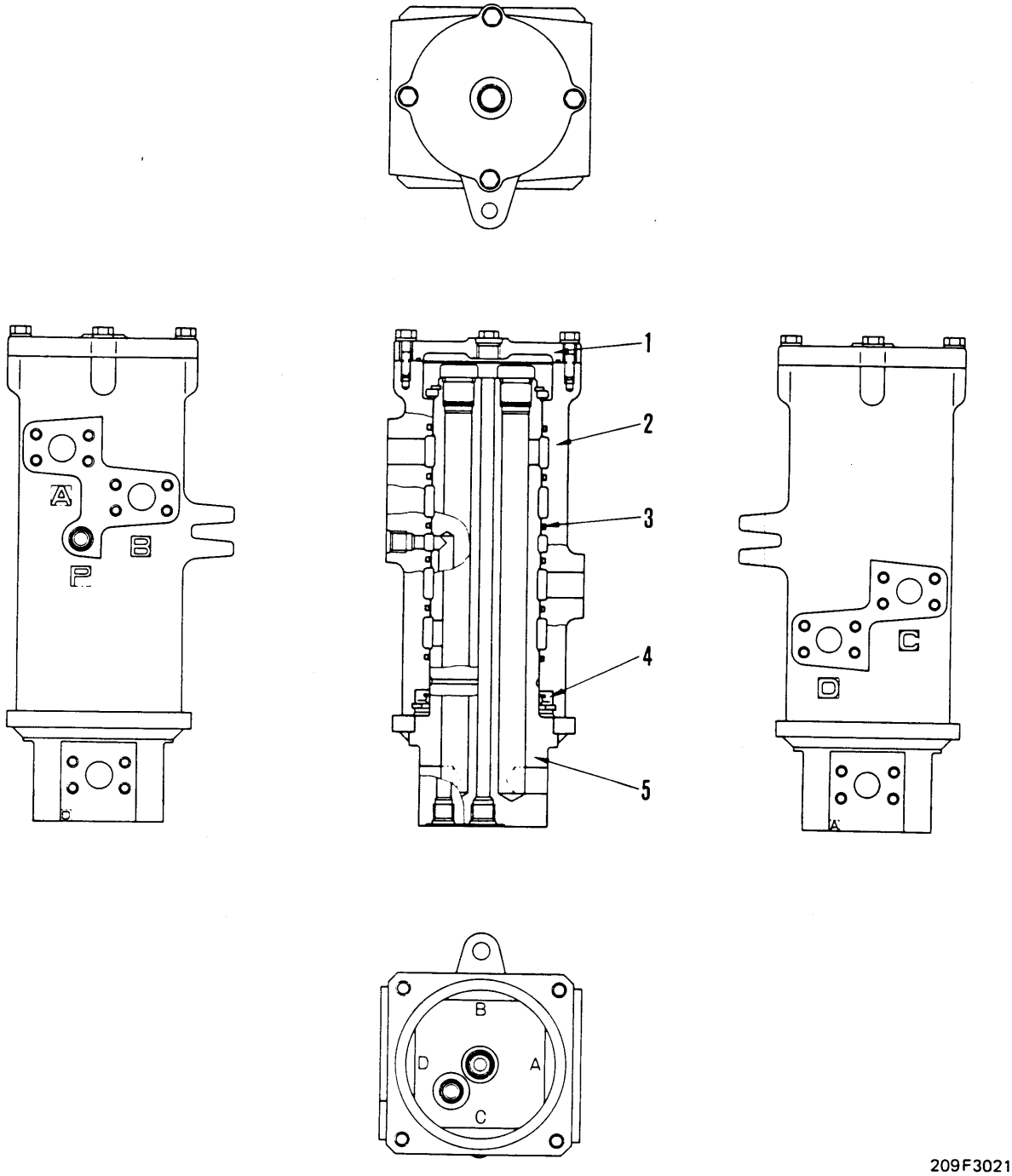
CENTER SWIVEL JOINT



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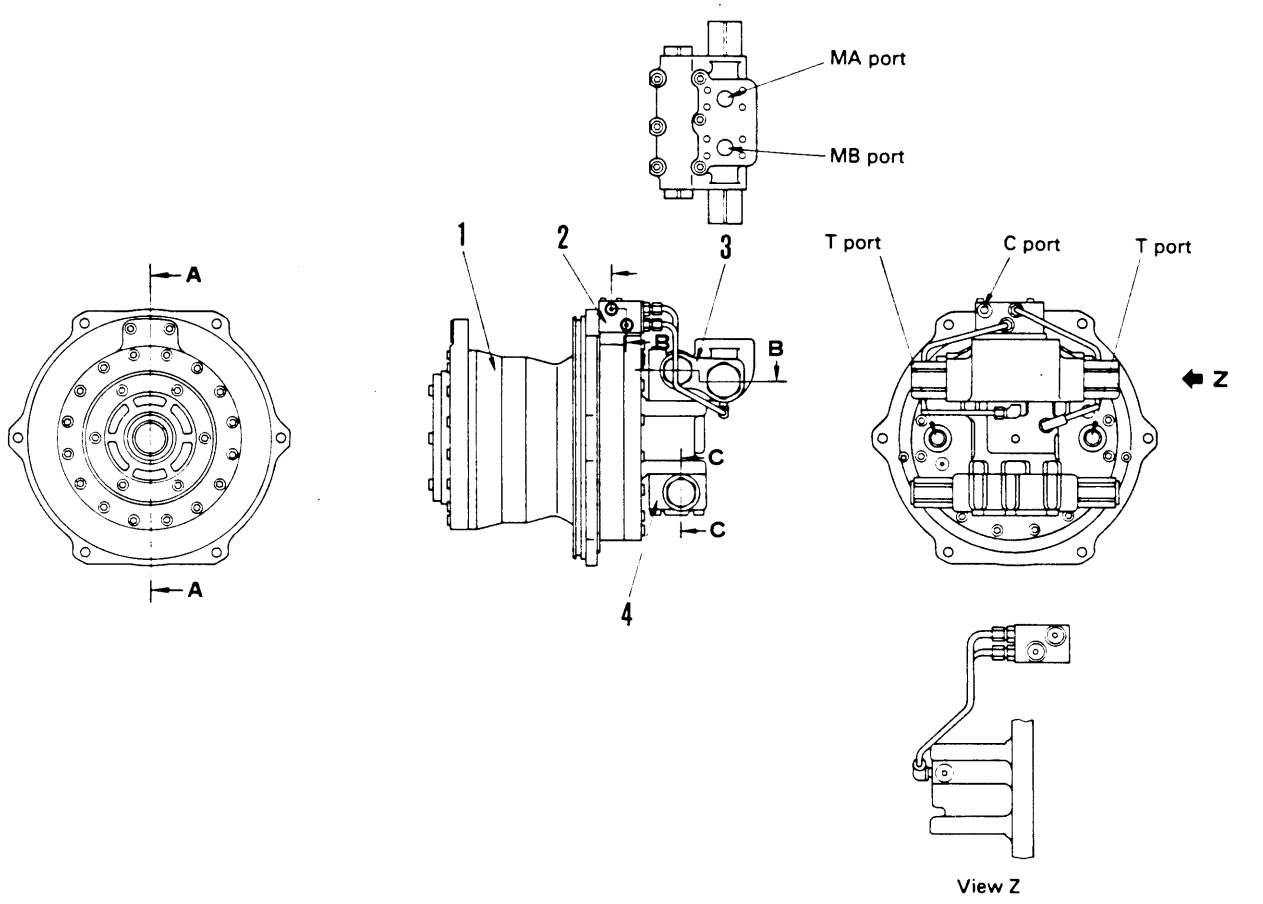
1. Cover
2. Body
3. Slipper
4. Oil seal
5. Shaft

TRAVEL MOTOR



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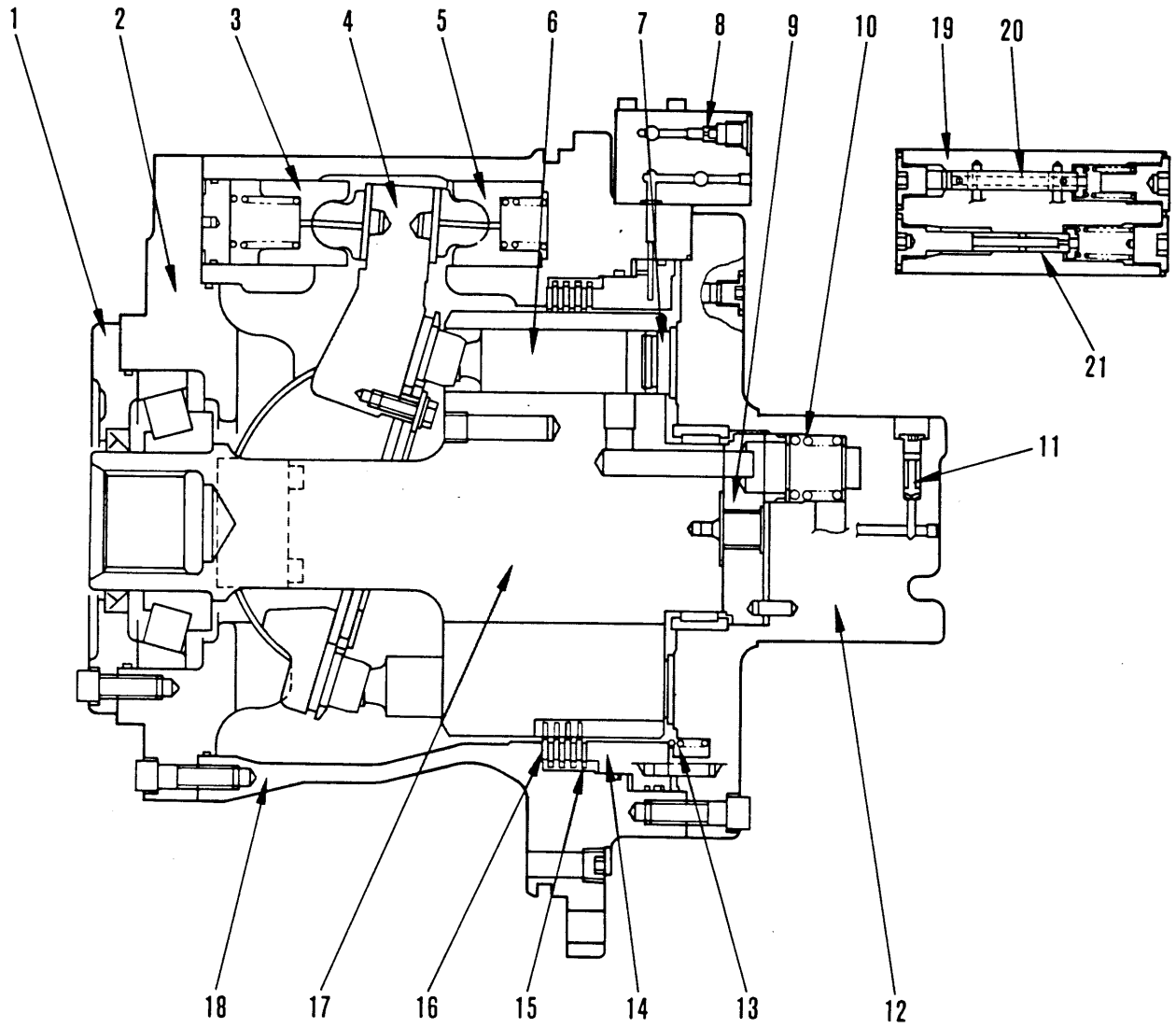
1. Motor
2. Selector valve and reducing valve
3. Counterbalance valve
4. Safety valve

SPECIFICATIONS

Type:	HTM550G1
Theoretical delivery	
Max. (at Low speed):	552 cc/rev
Min. (at High speed):	361 cc/rev
Rotating speed	
Max. (at Low speed):	751 rpm (406 ℓ /min)
Min. (at High speed):	1,150 rpm (406 ℓ /min)
Parking brake releasing pressure:	10 kg/cm²
Pilot spool switching pressure:	15 kg/cm²

1. MOTOR, SPEED SELECTOR VALVE AND PARKING BRAKE



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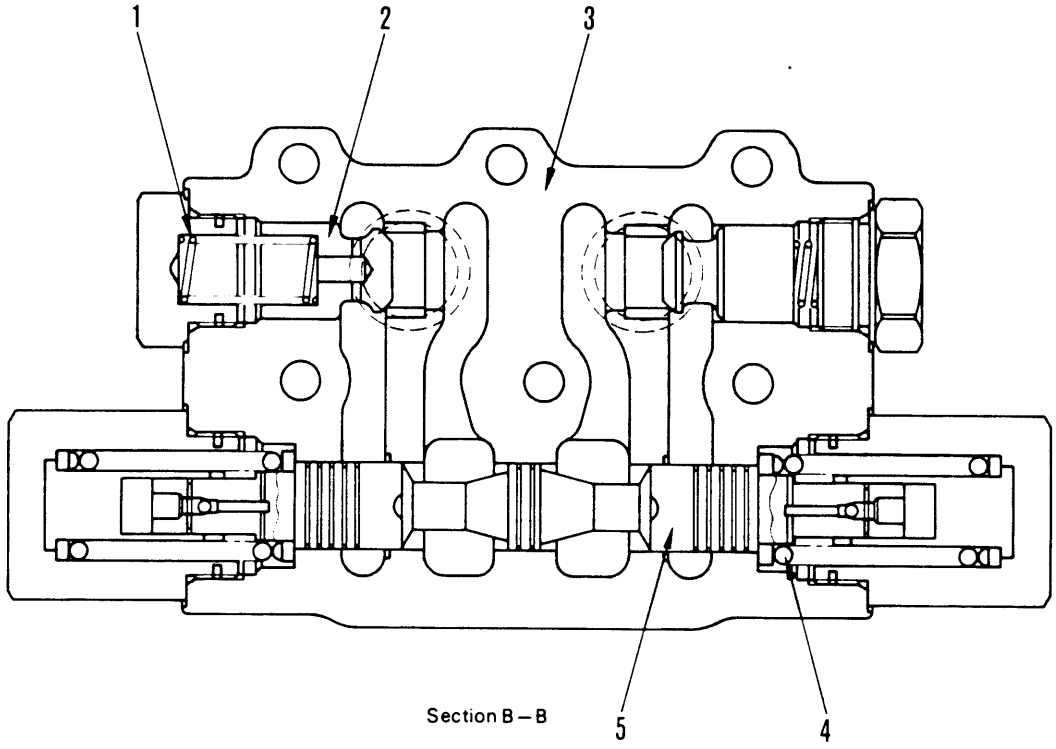
020905

1. Retainer
2. Flange
3. Piston (high speed)
4. Cam
5. Piston (low speed)
6. Piston
7. Shoe
8. Orifice
9. Valve plate
10. Spring
11. Check valve
12. Cover
13. Brake spring
14. Brake piston
15. Disc
16. Plate
17. Cylinder
18. Housing
19. Valve body
20. Selector valve
21. Reducing valve

2. BRAKE VALVE



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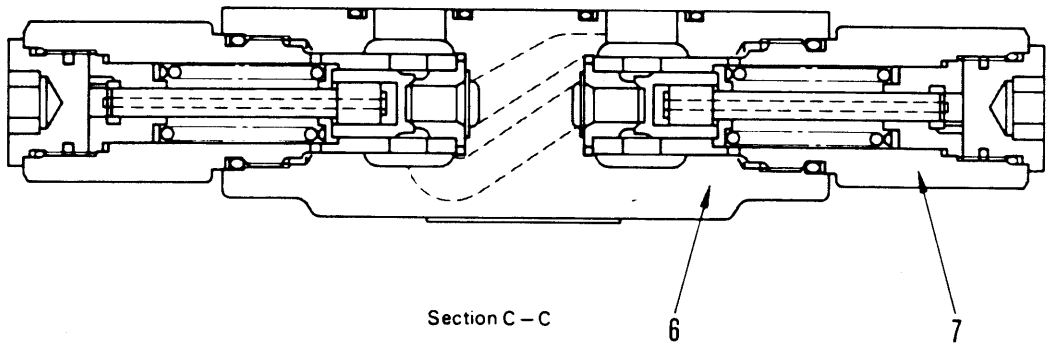


209F3329

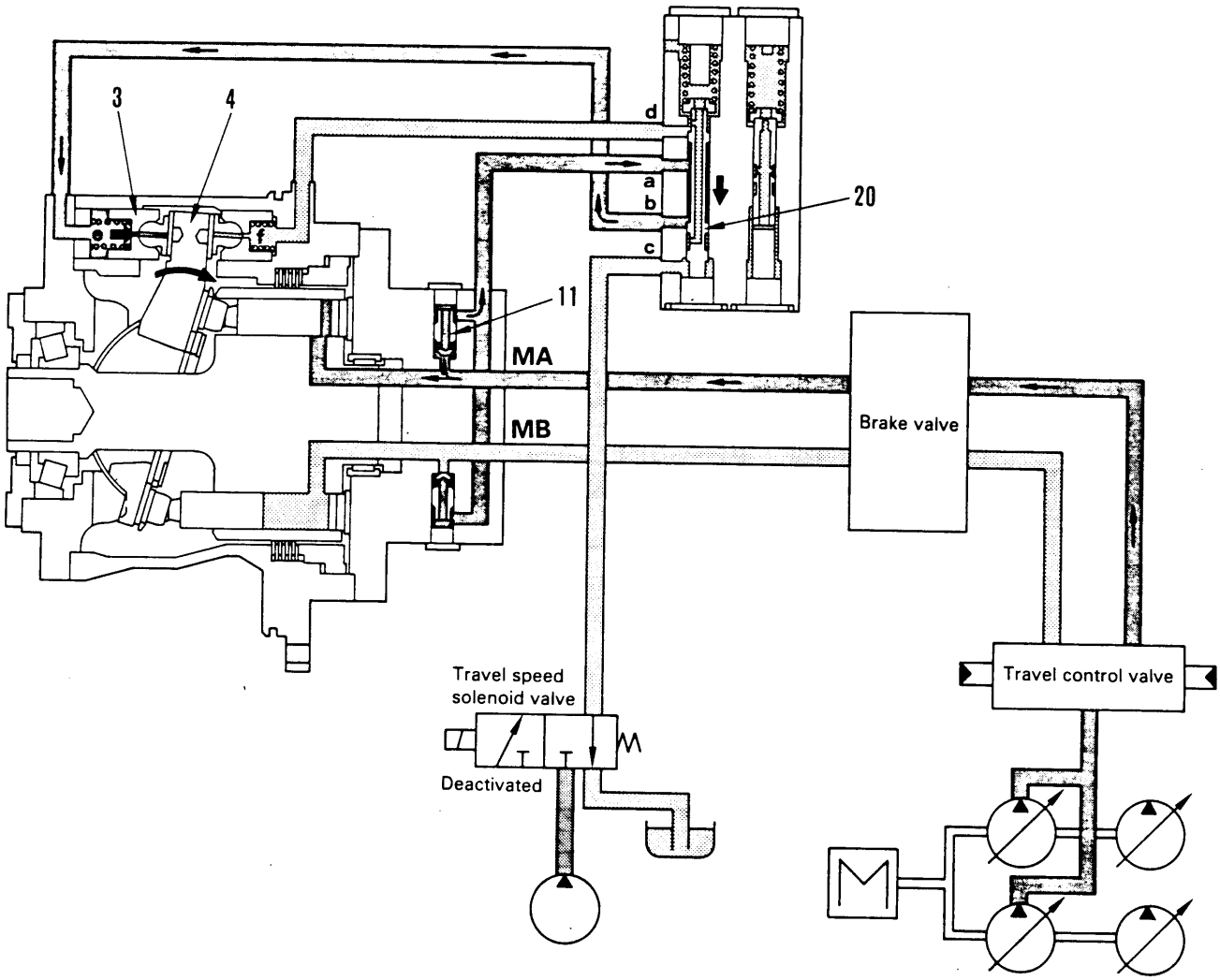
1. Check valve spring
2. Check valve
3. Body
4. Spool return spring
5. Spool
6. Body
7. Safety valve

SPECIFICATIONS

Safety valve set pressure: 320 kg/cm²
Spool switching pressure: 16 kg/cm²

OPERATION OF MOTOR

1) At low speed (travel speed solenoid valve deactivated, motor swash plate angle at maximum)



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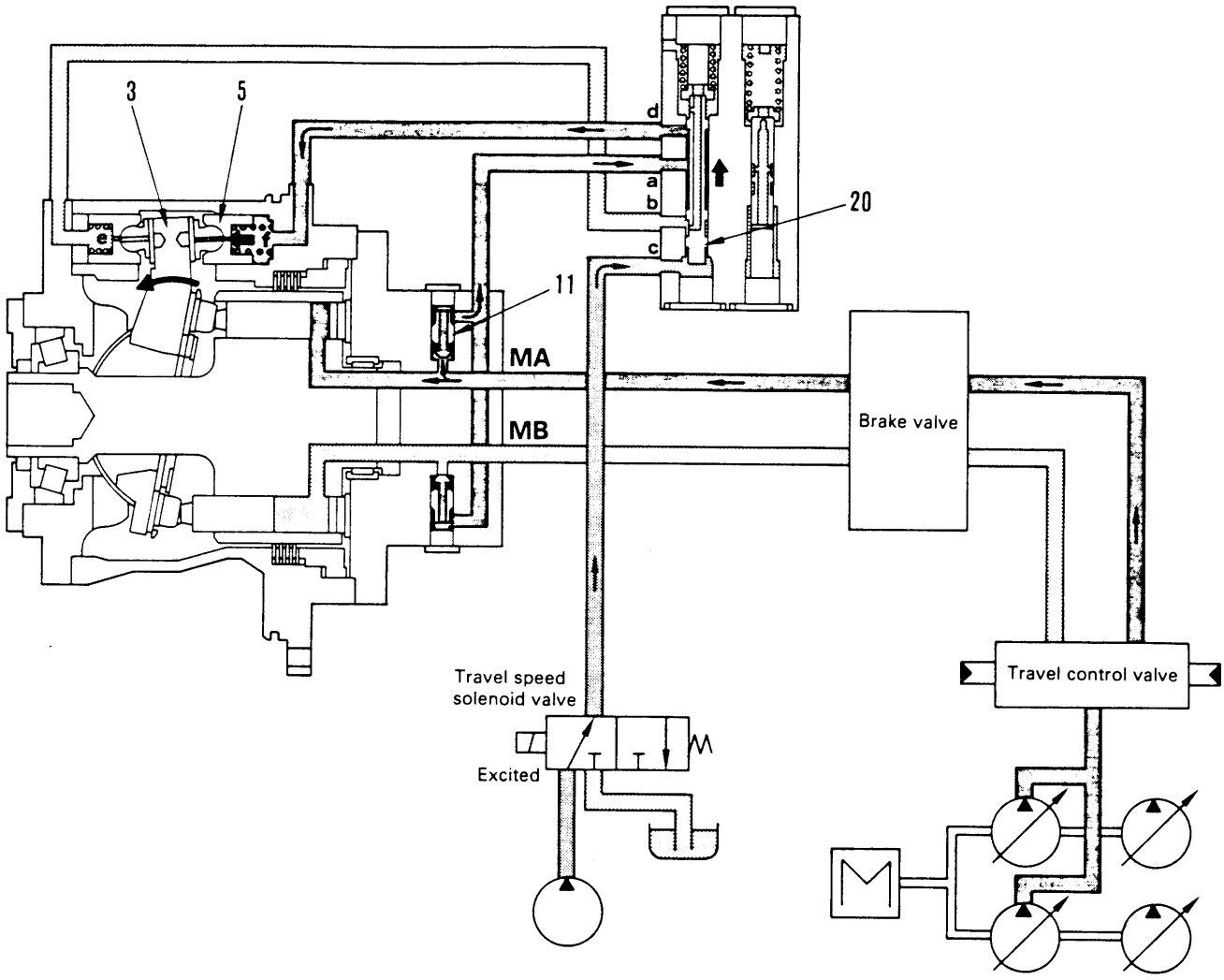
- When the travel speed solenoid valve is deactivated, the pressure oil from the charging pump does not flow to pilot port **c** of selector valve (20), so selector valve (20) is kept pushed down in the direction of the arrow by the spring.
- Because of this, the pressure oil sent from the main pump by check valve (11) passes from passage **a** of selector valve (20) through passage **b**, enters chamber **e** of piston (3), and pushes piston (3) to the right in the direction of the arrow.
- When piston (3) is pushed, cam (4), which is connected to the piston, moves. The swash plate of the motor is set to the maximum angle (maximum displacement), and the travel speed is set to low speed.

2) **At high speed (travel speed solenoid valve excited, motor swash plate angle at minimum)**



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- When the travel speed solenoid valve is excited, the pressure oil from the charging pump flows to pilot port **c** of selector valve (20), and selector valve (20) is pushed up in the direction of the arrow.
- Because of this, the pressure oil sent from the main pump by check valve (11) passes from passage **a** of selector valve (20) through passage **d**, enters chamber **f** of piston (5), and pushes piston (5) to the left in the direction of the arrow.
- When piston (5) is pushed, cam (4), which is connected to the piston, moves. The swash plate of the motor is set to the minimum angle (minimum displacement), and the travel speed is set to high speed.

OPERATION OF BRAKE VALVE

- The brake valve consists of a counterbalance valve (5), check valve (1) and safety valve (7) in a circuit as shown in the diagram on the right (Fig. 1)
- The function and operation of each component is as given below.

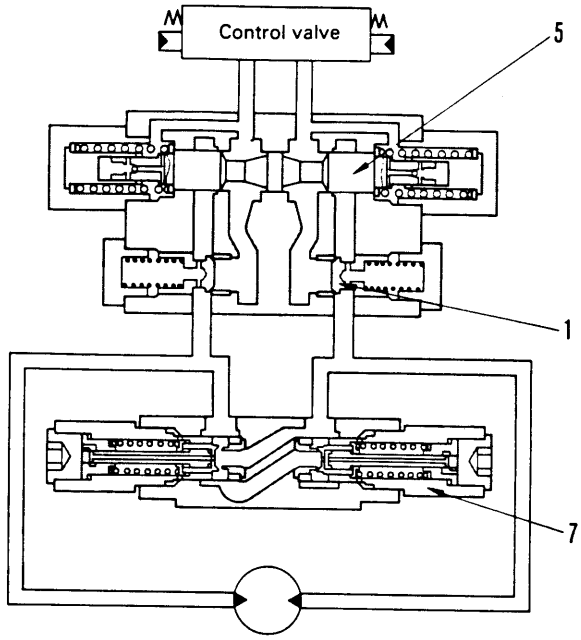

Fig.1 209F05067

1) Counterbalance valve, check valve

Function

- When traveling down a slope, the weight of the machine makes it try to travel faster than the speed of the motor.
  As a result, if the machine travels with the engine at low speed, the motor will rotate without load and will run away, which is extremely dangerous. To prevent this, these valves act to make the machine travel according to the engine speed (pump discharge volume).

Operation when pressure is supplied

- When the travel lever is operated, the pressurized oil from the control valve is supplied to port **PA**. It pushes open check valve **C1** and flows from motor inlet port **MA** to motor outlet port **MB**. However, the motor outlet port is closed by check valve **C2** and spool (1), so the pressure at the supply side rises. (Fig. 2)
- The pressurized oil at the supply side flows from orifice **D1** in spool (1) to chamber **E1**, and when the pressure in chamber **E1** goes above the spool switching pressure, spool (1) is pushed to the right in the direction of the arrow.
  As a result, port **MB** and port **PB** are connected, the outlet port side of the motor is opened, and the motor starts to rotate. (Fig. 3)

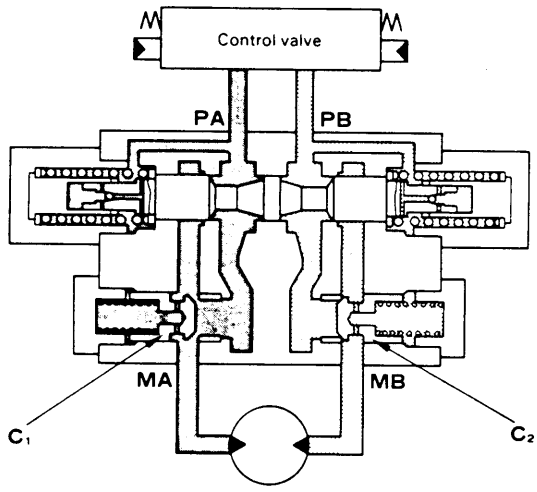

Fig.2 F20903264

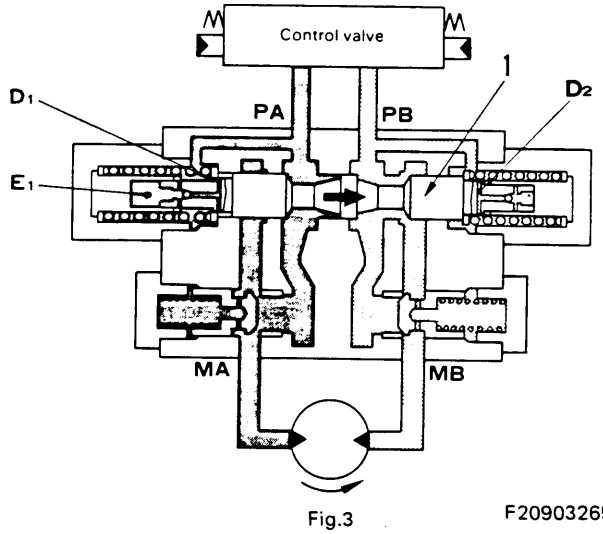

Fig.3 F20903265

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Operation of brake when traveling downhill

- If the machine tries to run away when traveling downhill, the motor will turn under no load, so the pressure at the motor inlet port will drop, and the pressure in chamber **E**1 through orifice **D**1 will also drop.
  When the pressure in chamber **E**1 drops below the spool switching pressure, spool (1) is returned to the left in the direction of the arrow by spring and outlet port **MB** is throttled.
  As a result, the pressure at the outlet port side rises, resistance is generated to the rotation of the motor, and this prevents running away.
  In other words, the spool is moved to a position where the pressure at outlet port **MB** balances the pressure at the inlet port and the force generated by the weight of the machine. It throttles the outlet port circuit and controls the speed according to the discharge volume of the pump. (Fig. 4)

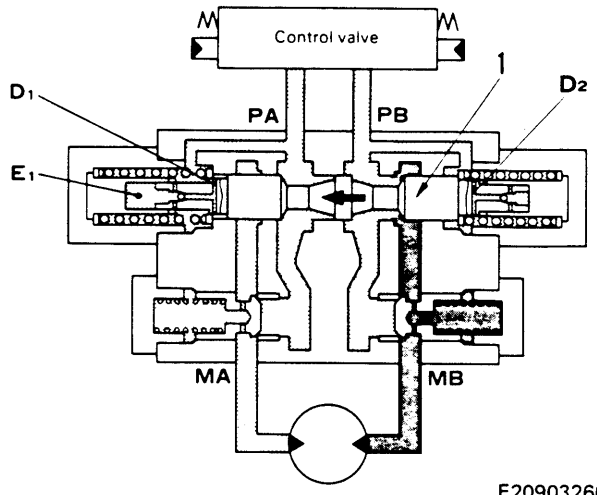

Fig.4 F20903266

2) Safety valve

Function

- When travel is stopped (or when traveling downhill), the circuit at the inlet and outlet ports of the motor are closed by the counterbalance valve, but the motor is rotated by inertia, so the pressure at the outlet port of the motor will become abnormally high and damage the motor or piping. The safety valve acts to release this abnormal pressure and sent it to the inlet port side of the motor to prevent damage to the equipment.

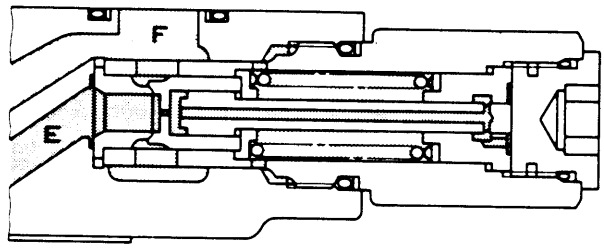

Fig.5 F20903268

Operation

- When stopping travel (or when traveling downhill), chamber **E** in the outlet port circuit is closed by the check valve of the counterbalance valve, but the pressure at the outlet port rises because of inertia. (Fig. 5)

- If the pressure goes above the set pressure, the force produced by the difference in area between **D**1 and **D**2 [$\pi/4(D_1^2 - D_2^2)$ x pressure] overcomes the force of the spring and moves the poppet to the right, so the oil flows to chamber **F** in the circuit on the opposite side. (Fig. 6)

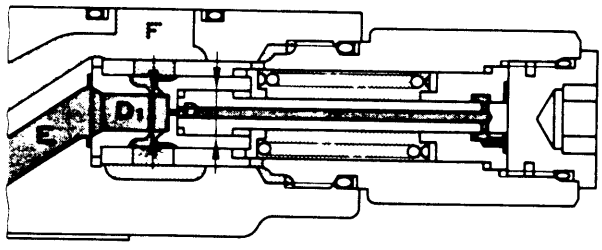

Fig.6 F20903269

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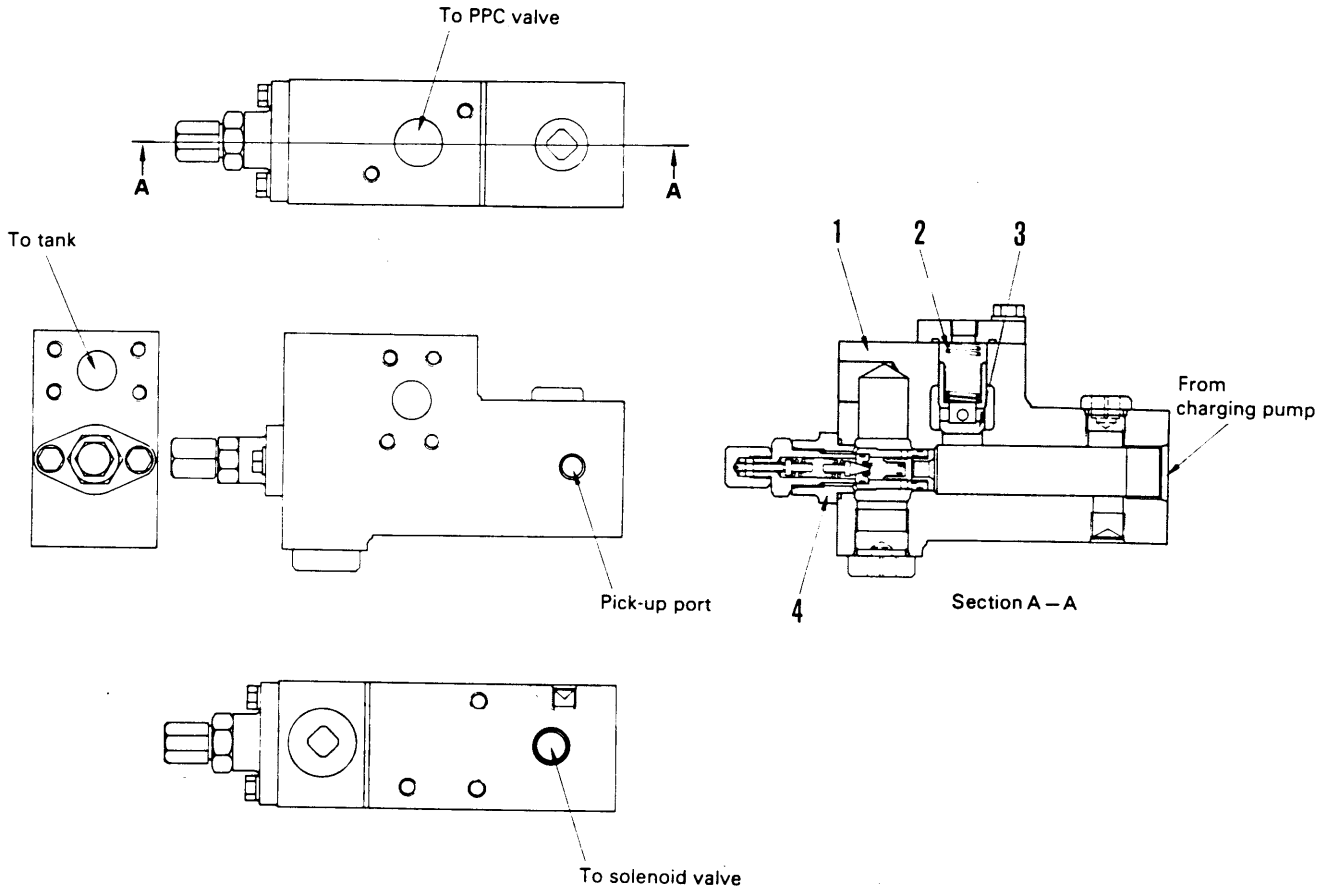
CONTROL RELIEF VALVE



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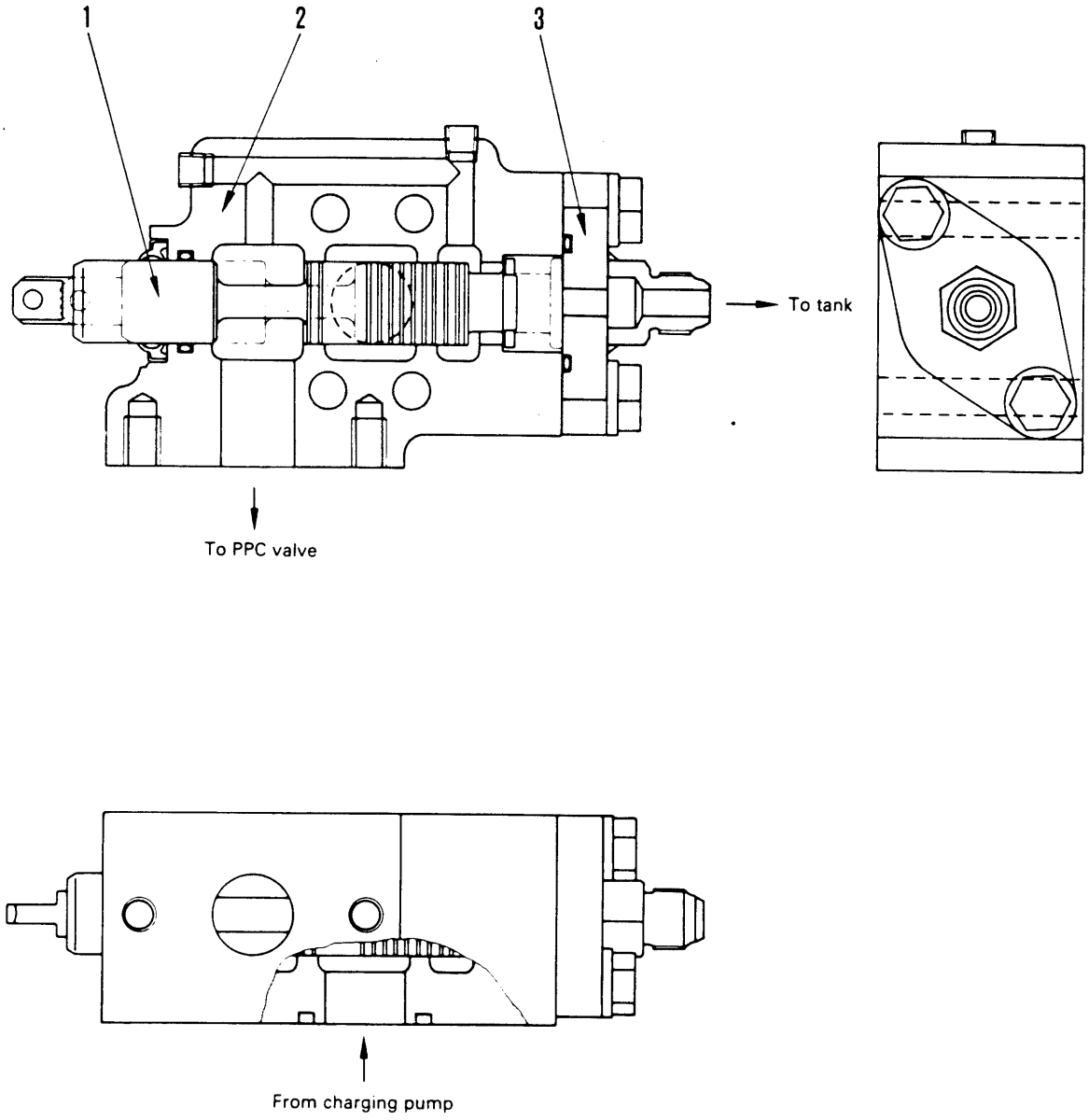
1. Valve body
2. Check valve spring
3. Check valve
4. Relief valve

SPECIFICATION

Set pressure: $30\ ^{+3}_{0}$ kg/cm² (at 135 ℓ /min)

SAFETY LOCK VALVE



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1. Spool
2. Valve body
3. Cover

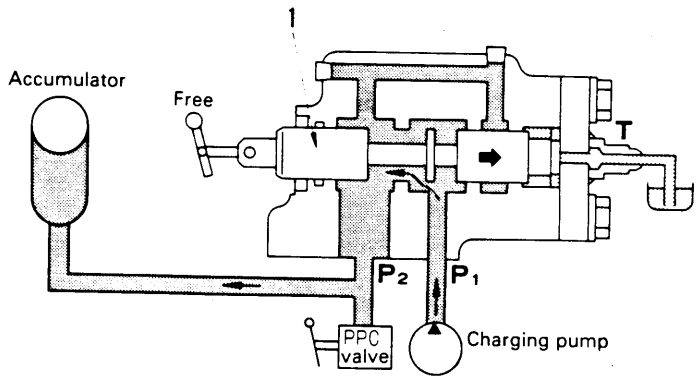
FUNCTION

- Safety lock valve is in the circuit between the charging pump (Pilot relief valve) and the PPC valve.
  It acts to open and close the flow of pressurized oil to the PPC valve.
- The operation of the control levers can be locked by closing the circuit

OPERATION

When safety lock lever is at FREE

When the safety lock lever is set to the FREE position, the cable moves spool (1) to the right. Port **P1** and port **P2** are opened, and the pressurized oil from the charging pump flows to the PPC valve.
As a result, when the control levers are operated, the PPC valves are actuated.



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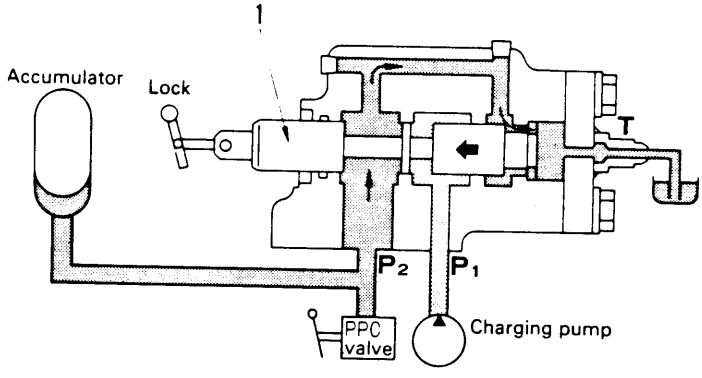
When safety lock lever is at LOCK

When the safety lock lever is set to the LOCK position, the cable moves spool (1) to the left, port **P1** and port **P2** are closed, port **P2** and port **T** are opened, and the pressurized oil from the charging pump does not flow to the PPC valve. As a result, when the control levers are operated, the PPC valves are not actuated.



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ACCUMULATOR

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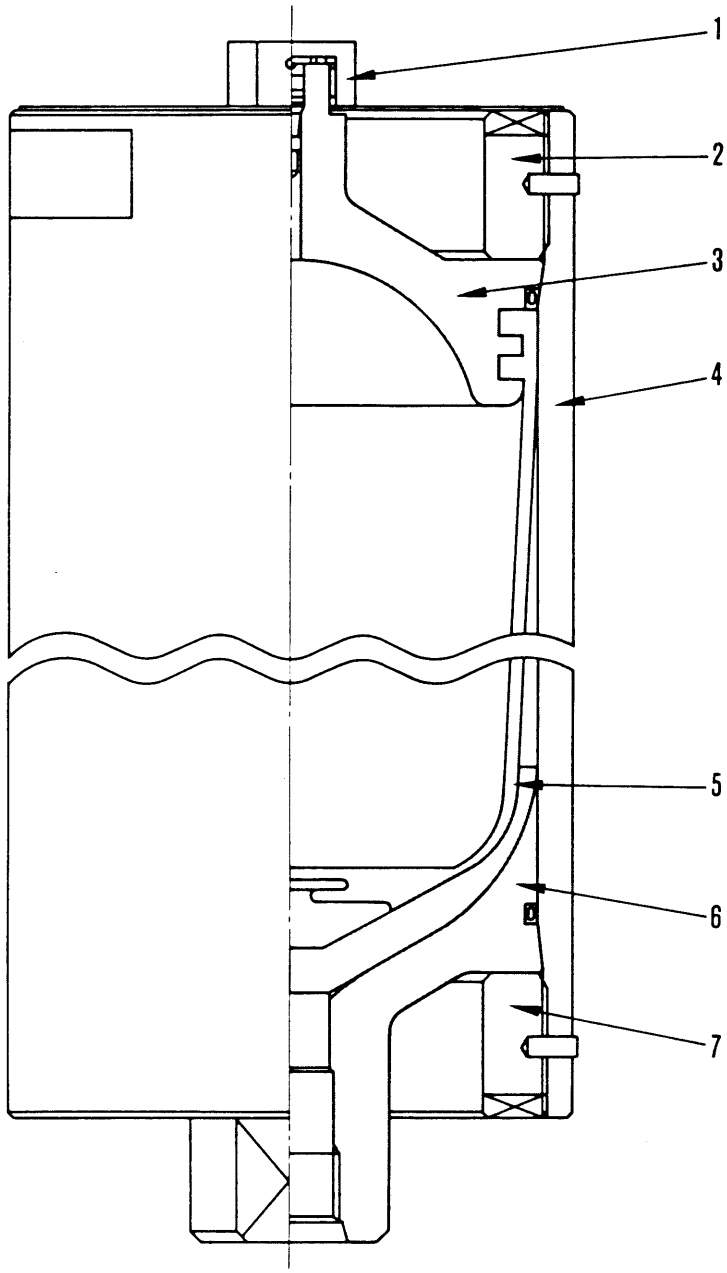


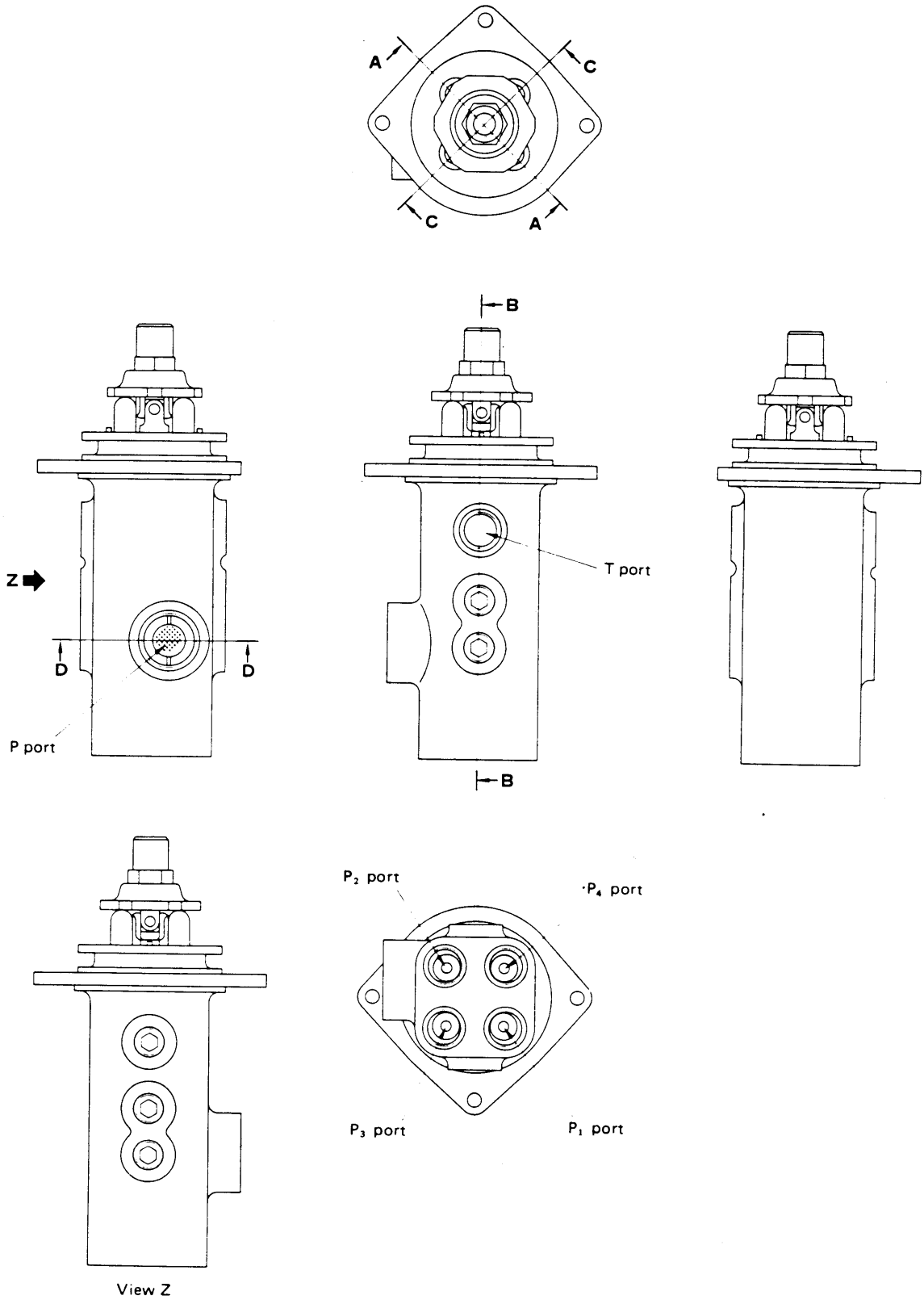
209F05072

1. Cap
2. Nut
3. Cap
4. Body
5. Bladder
6. Port
7. Nut

SPECIFICATIONS
Gas capacity: 300 cc
Gas pressure: 12 kg/cm²

PPC VALVE

FOR WORK EQUIPMENT AND SWING



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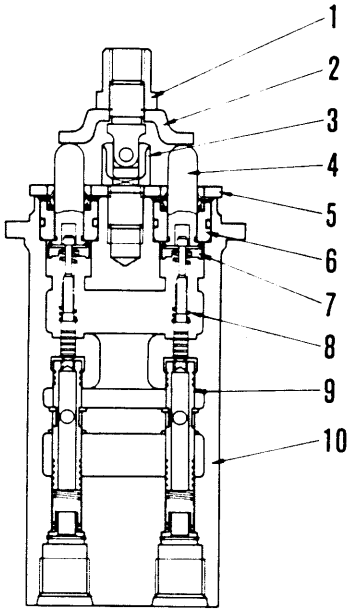
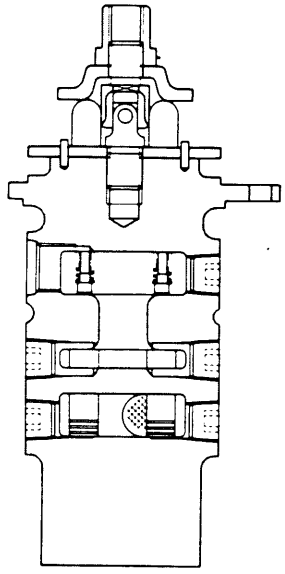
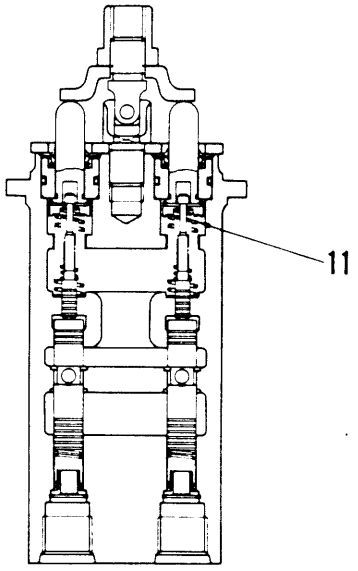


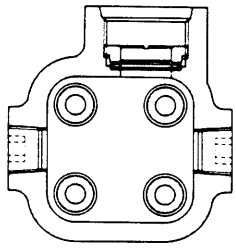
Section A – A



Section B – B



Section C – C



Section D – D

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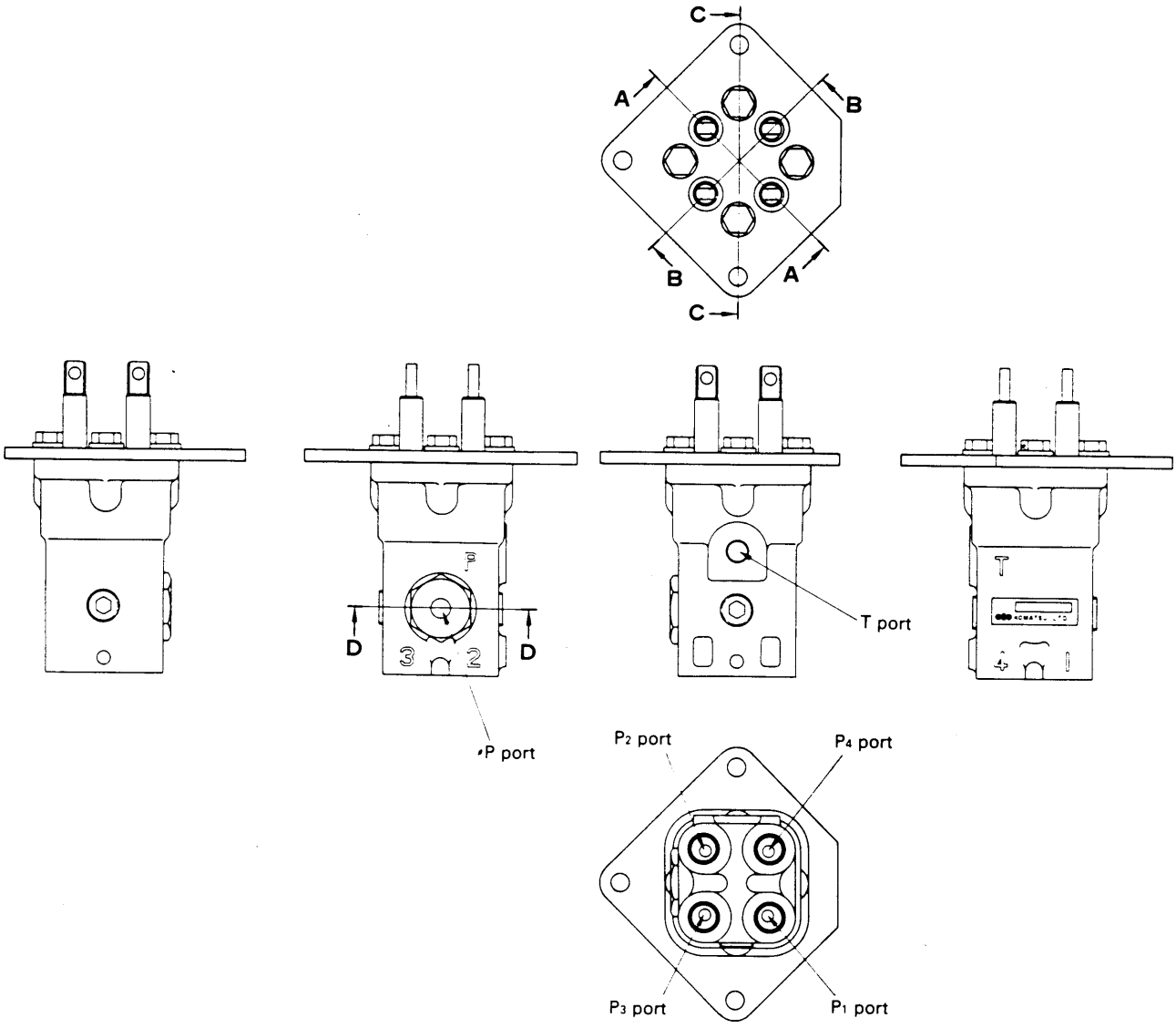
1. Nut
2. Disc
3. Joint
4. Piston
5. Plate
6. Collar
7. Retainer
8. Metering spring
9. Valve
10. Body
11. Centering spring

FOR TRAVEL



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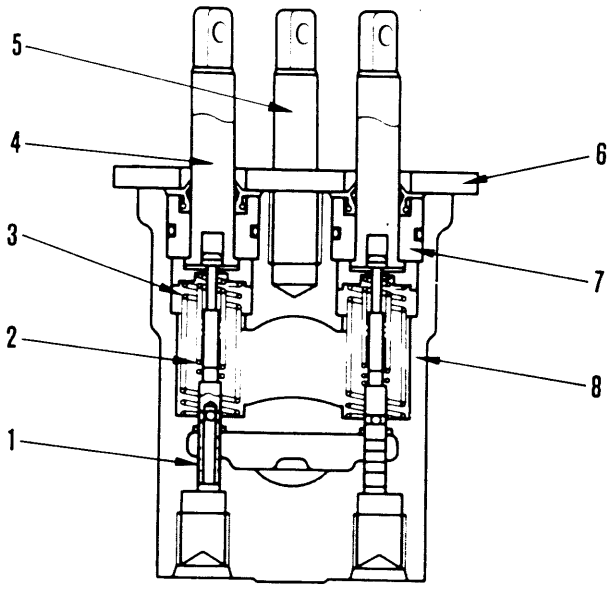
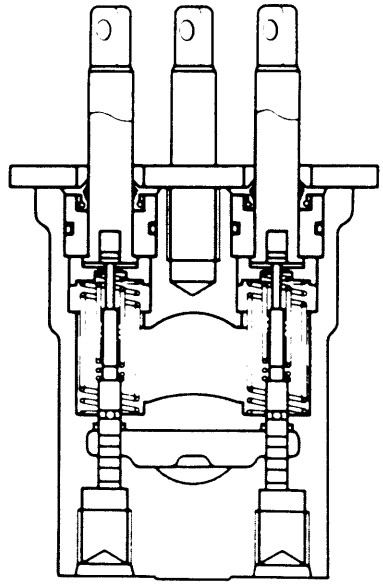
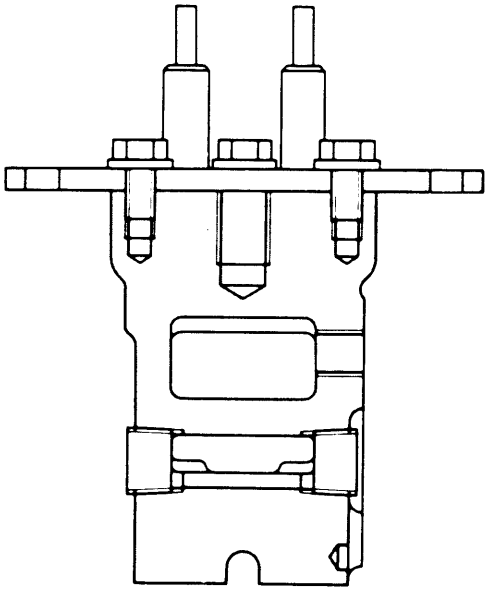


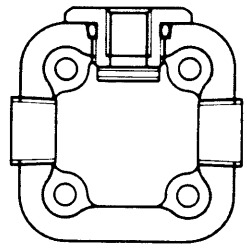
Section A – A



Section B – B



Section C – C



Section D – D

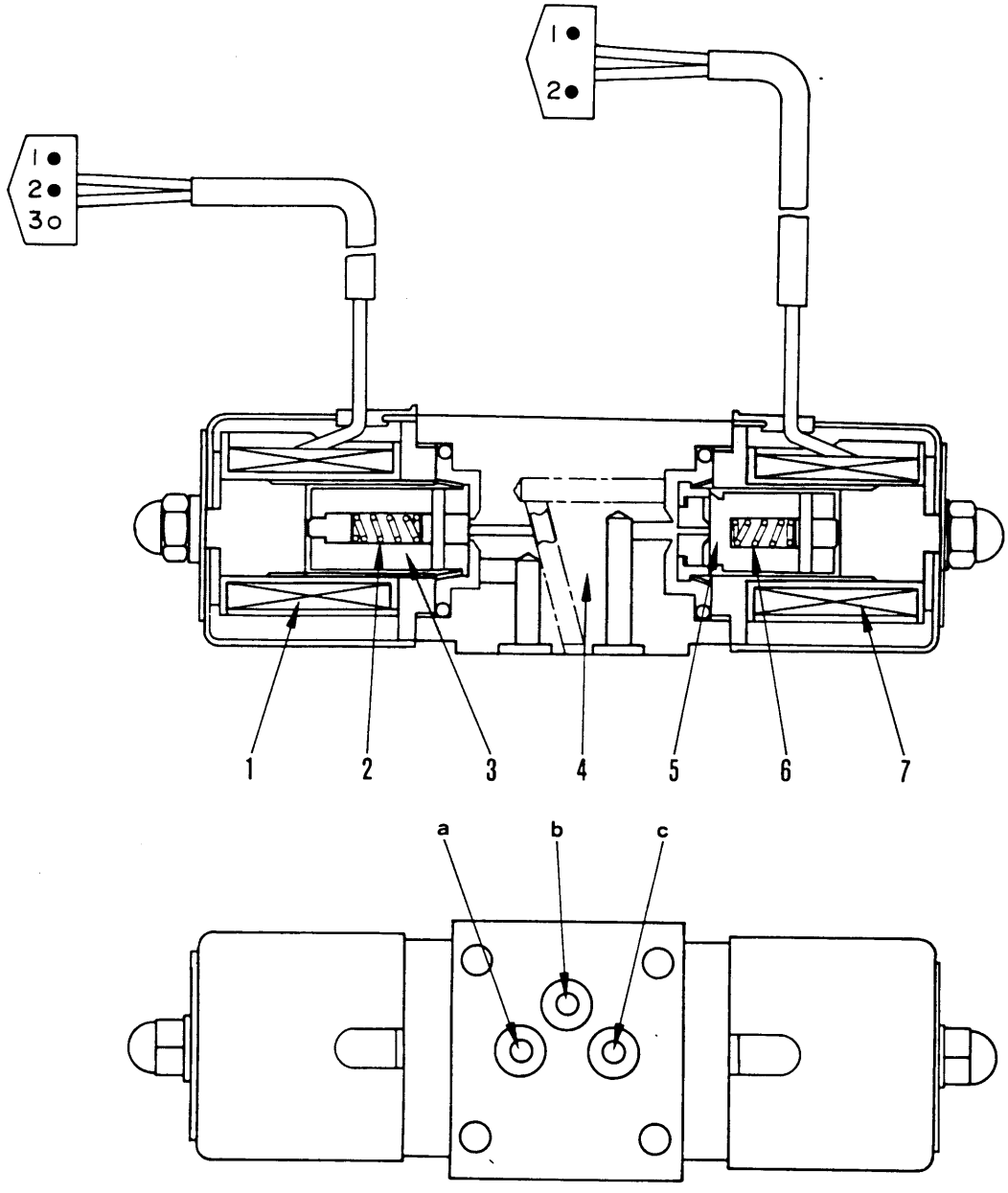
209F05073

1. Spool
2. Metering spring
3. Centering spring
4. Piston
5. Bolt
6. Plate
7. Collar
8. Body

SOLENOID VALVE ASSEMBLY

FOR AUTO-DECELERATION

★ **FOR MACHINE EQUIPPED WITH AUTO-DECELERATION**



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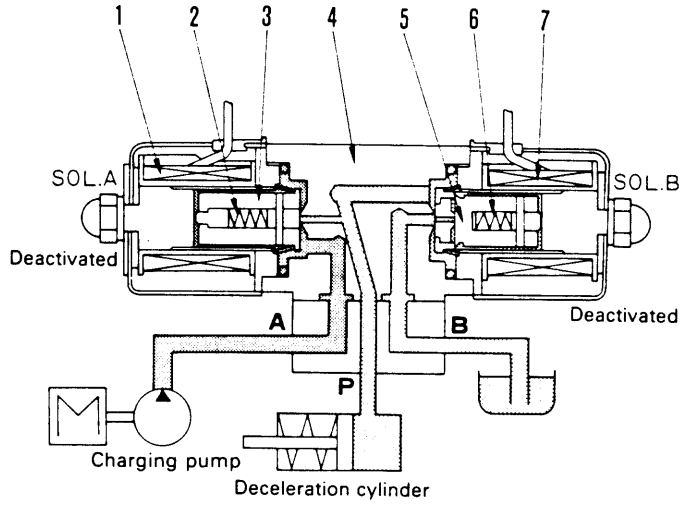
a. **A** port (To tank)
b. **P** port (To deceleration cylinder)
c. **B** port (From charging pump)

1. Solenoid A
2. Return spring
3. Plunger
4. Valve body
5. Plunger
6. Return spring
7. Solenoid B

OPERATION

1) Solenoids A, B both deactivated.

- If solenoids A, B are both deactivated, plungers (3) and (5) are pushed into the body by return springs (2) and (6).
- This closes ports **P**, **A**, and **B**, and each is kept independent.



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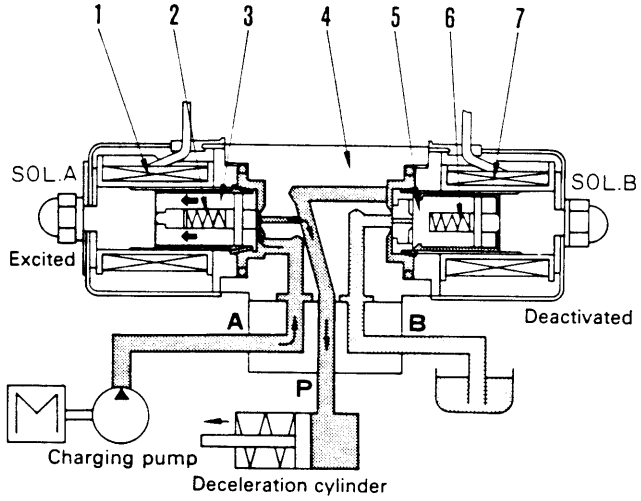
2) Solenoid A excited, solenoid B deactivated

- When solenoid A is excited, plunger (3) is pulled to the left.
  When this happens, port **A** and port **P** are interconnected, and the pressure oil from the charging pump passes through the inside of the solenoid, flows to the deceleration cylinder, and extends the cylinder.
- At the same time, solenoid B is deactivated, so port **B** is closed.



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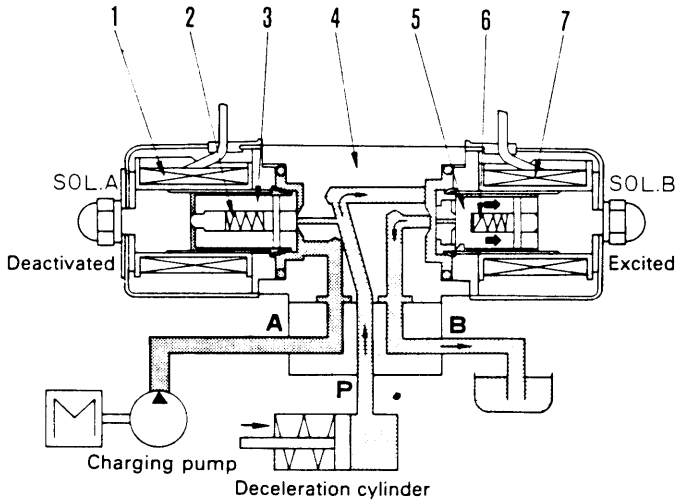
3) Solenoid A deactivated, solenoid B excited

- Solenoid A is deactivated, so port **A** is closed.
- At the same time, when solenoid B is excited, plunger (5) is pulled to the right.
  When this happens, port **P** and port **B** are interconnected, and pressure oil from the deceleration cylinder passes through the inside of the solenoid and drains to the tank, so the cylinder is retracted by the spring.

★ Solenoids A and B are not excited at the same time.



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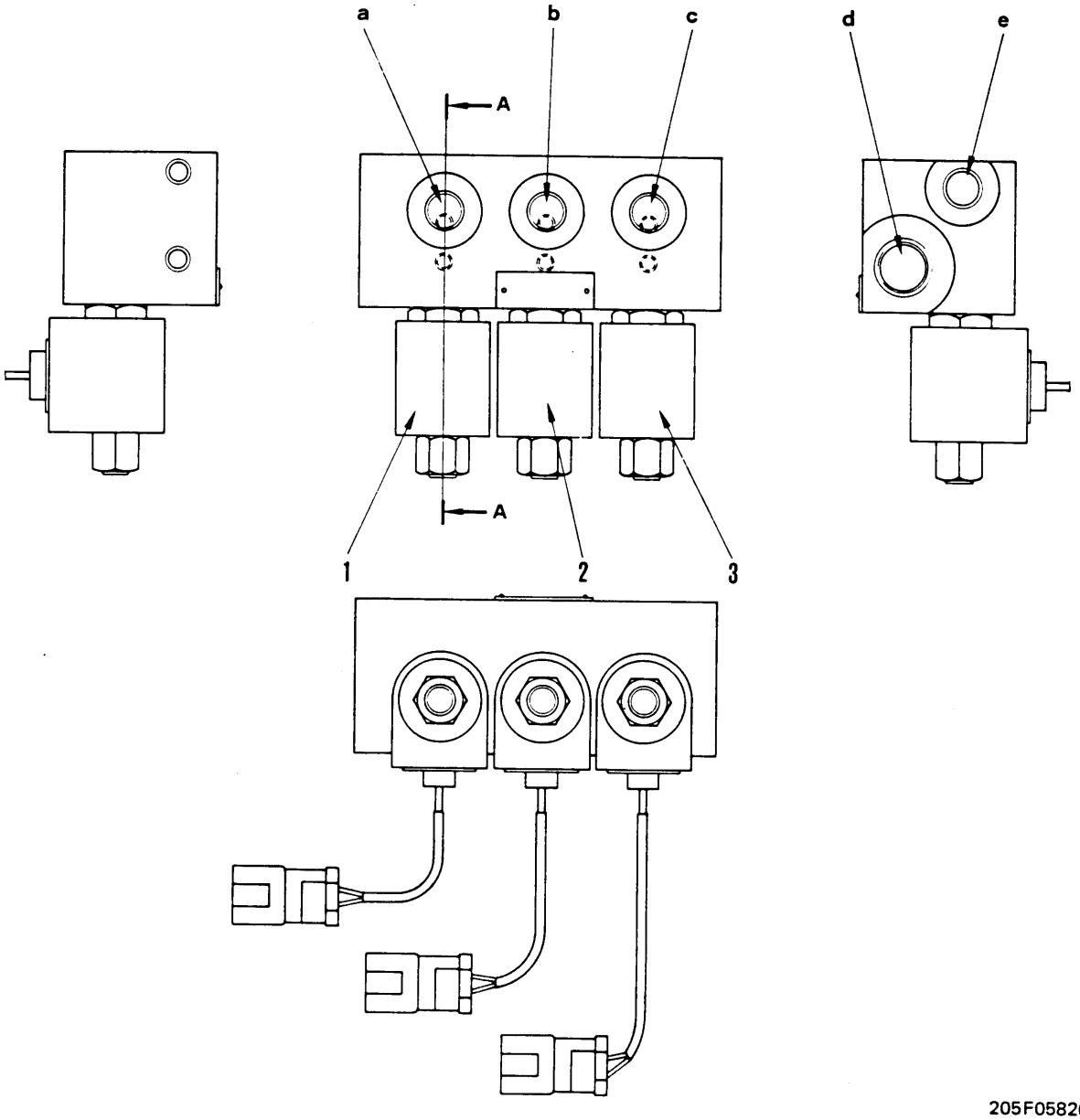
BACK HOE
FOR TRAVEL SPEED, SWING BRAKE, FREE SWING (front of machine)
FOR STRAIGHT-TRAVEL, MACHINE PUSH UP, HEAVY LIFT (rear of machine)



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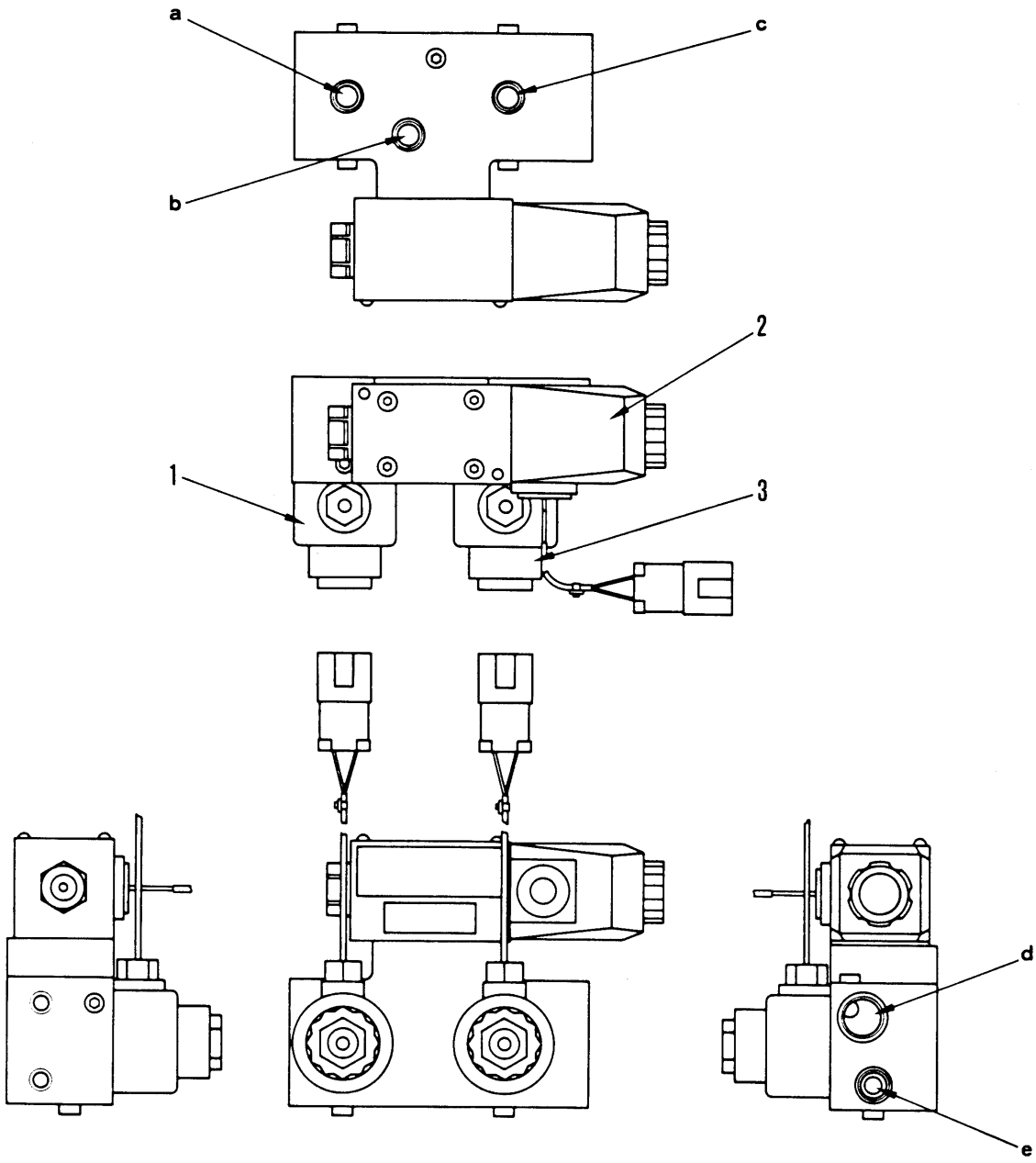
020905

a. Blind (front of machine)
   To straight-travel valve (rear of machine)
b. To swing motor (front of machine)
   To boom-Lo safety valve (rear of machine)
c. To L.H. and R.H. travel motor (front of machine)
   To L.H. and R.H. main relief valve, CO valve (rear of machine)
d. **P** port (From charging pump)
e. **T** port (To tank)

1. Free swing solenoid valve (front of machine)
   Straight-travel solenoid valve (rear of machine)
2. Swing brake solenoid valve (front of machine)
   Machine push up solenoid valve (rear of machine)
3. Travel speed solenoid valve (front of machine)
   Heavy lift solenoid valve (rear of machine)

LOADING SHOVEL
FOR TRAVEL SPEED, SWING BRAKE, BOTTOM DUMP OPEN (front of machine)
FOR STRAIGHT-TRAVEL, MACHINE PUSH UP, BOTTOM DUMP CLOSE (rear of machine)



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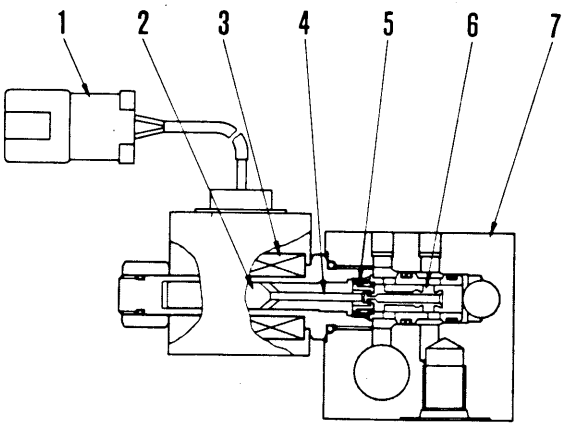
a. Blind (front of machine)
   To straight-travel valve (rear of machine)
b. To swing motor (front of machine)
   To boom-Lo safety valve (rear of machine)
c. To bottom dump control valve (front of machine)
   To bottom dump control valve (rear of machine)
d. **P** port (From charging pump)
e. **T** port (To tank)

1. Free swing solenoid valve (front of machine)
   Straight-travel solenoid valve (rear of machine)
2. Swing brake solenoid valve (front of machine)
   Machine push up solenoid valve (rear of machine)
3. Bottom dump open solenoid valve (front of machine)
   Bottom dump close solenoid valve (rear of machine)



Section A – A

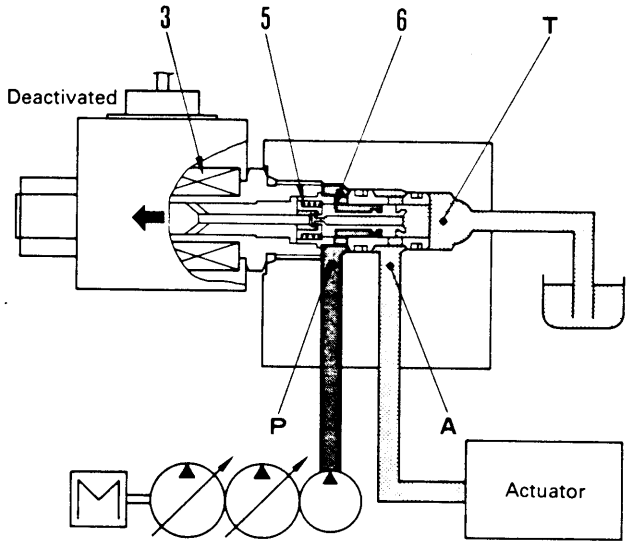
205F05827

1. Connector
2. Plunger
3. Coil
4. Push pin
5. Spring
6. Spool
7. Body

OPERATION

Solenoid deactivated

- The signal current does not flow, so coil is deactivated.
- As a result, port **P** is closed, and the pressure oil from the charging pump does not flow to the actuator.
  At the same time, the oil from the actuator flows from port **A** to port **T**, and drains to the tank.



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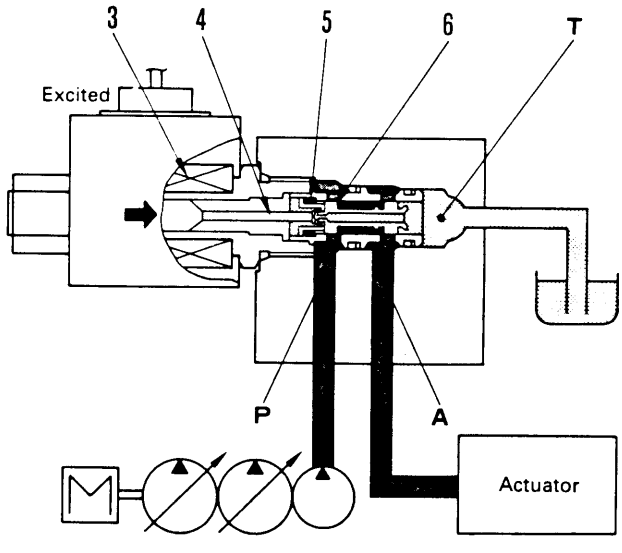
Solenoid excited

- When the signal current flows to coil, coil is excited.
- Because of this, pressure oil from the charging pump flows from port **P** to port **A**, and then flows to the actuator.
  At the same time, port **T** is closed, so the oil does not flow to the tank.



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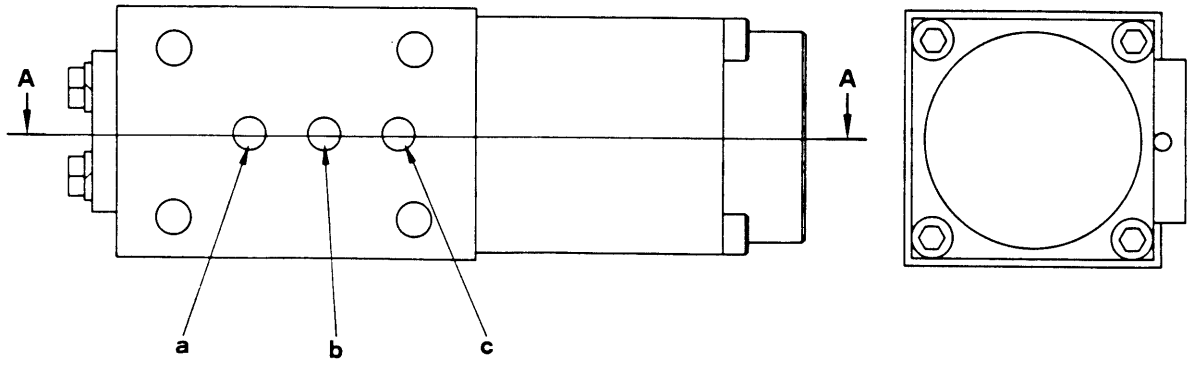
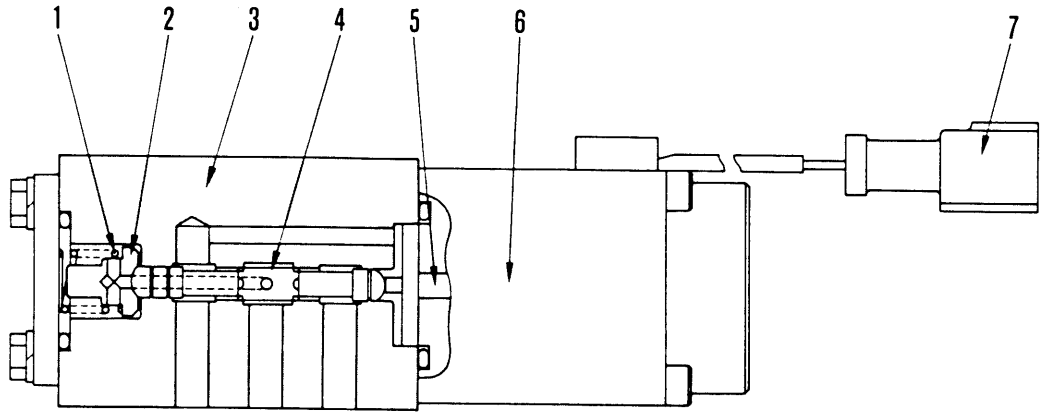
EPC VALVE

LOADING SHOVEL

★ FOR MACHINE EQUIPPED WITH WORK EQUIPMENT CONTROL SYSTEM





Section A – A

F20905018

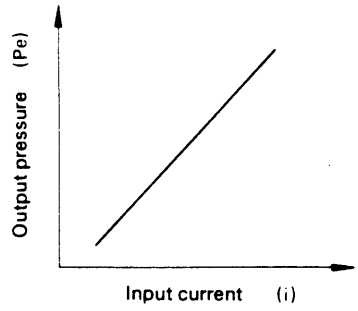
020905

a. **T** port (To tank)
b. **P_i** port (From charging pump)
c. **P_c** port (To control valve)

1. Return spring
2. Retainer
3. Body
4. Spool
5. Push pin
6. Solenoid
7. Connector

FUNCTION

- The EPC valve consists of a hydraulic valve and a proportional control solenoid.
- The relationship between input current (i) from the controller and EPC valve output pressure (Pe) is as shown in the graph below.

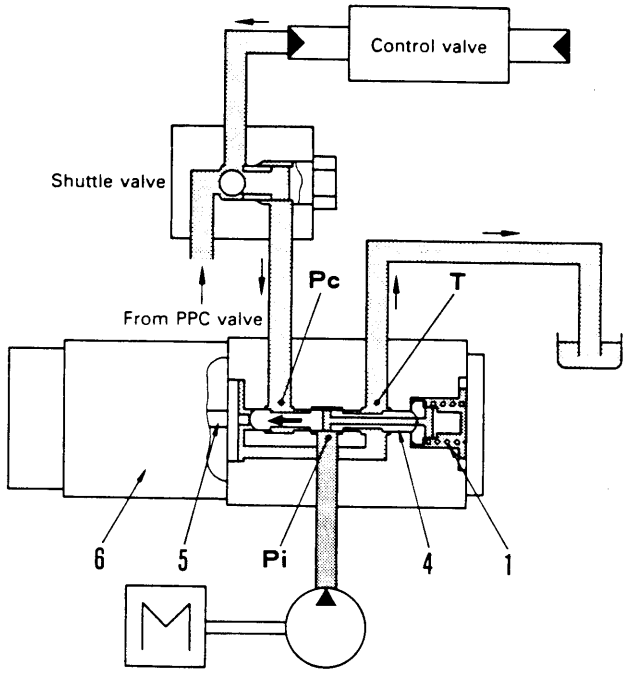


F21TY009

OPERATION

When solenoid is deactivated

- The signal current does not flow, so solenoid (6) is deactivated.
- Because of this, spool (4) is pushed fully to the left in the direction of the arrow by spring (1).
- As a result, port **Pi** is closed, and the pressure oil from the charging pump does not flow to the control valve.
  At the same time, the oil from the control valve flows from port **Pc** to port **T**, and is drained to the tank.



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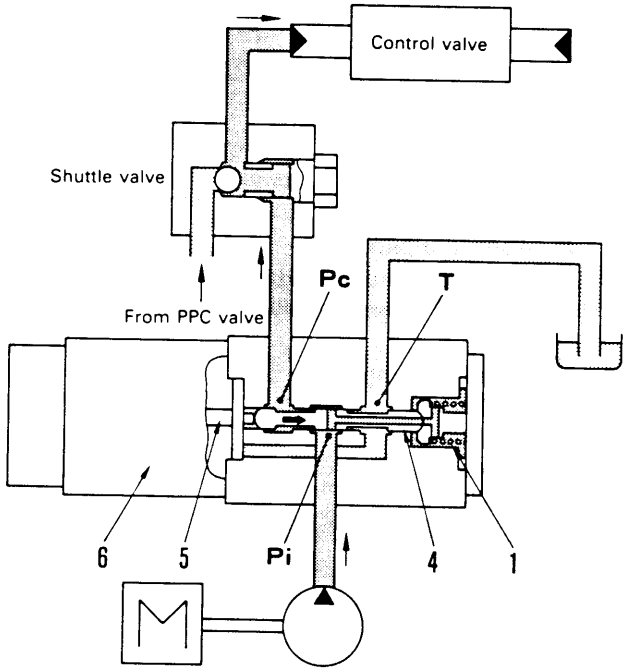
020905

When solenoid is excited

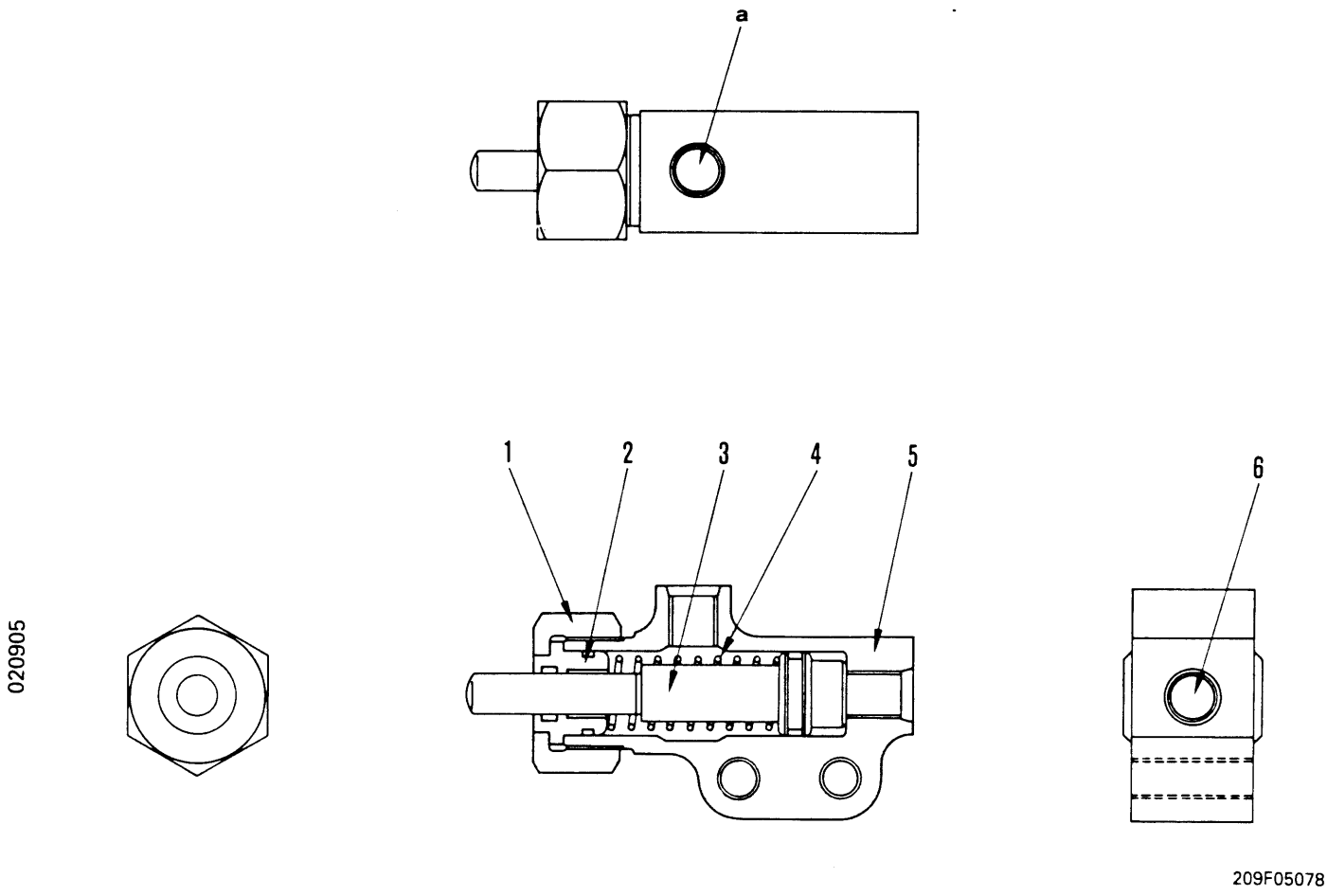
- When the signal current flows to solenoid (6), solenoid (6) is excited, and push pin (5) moves to the right in the direction of the arrow in accordance with the size of the signal current.
- Because of this, spool (4) is pushed to the right in the direction of the arrow.
- As a result, the pressure oil from the charging pump flows from port **Pi** to port **Pc**, passes through the shuttle valve, and flows to the control valve to push the spool.
  At the same time, port **T** closes, and the oil does not flow to the tank.



F20905020A

AUTO-DECELERATION CYLINDER

★ **FOR MACHINE EQUIPPED WITH AUTO-DECELERATION**



020905

209F05078

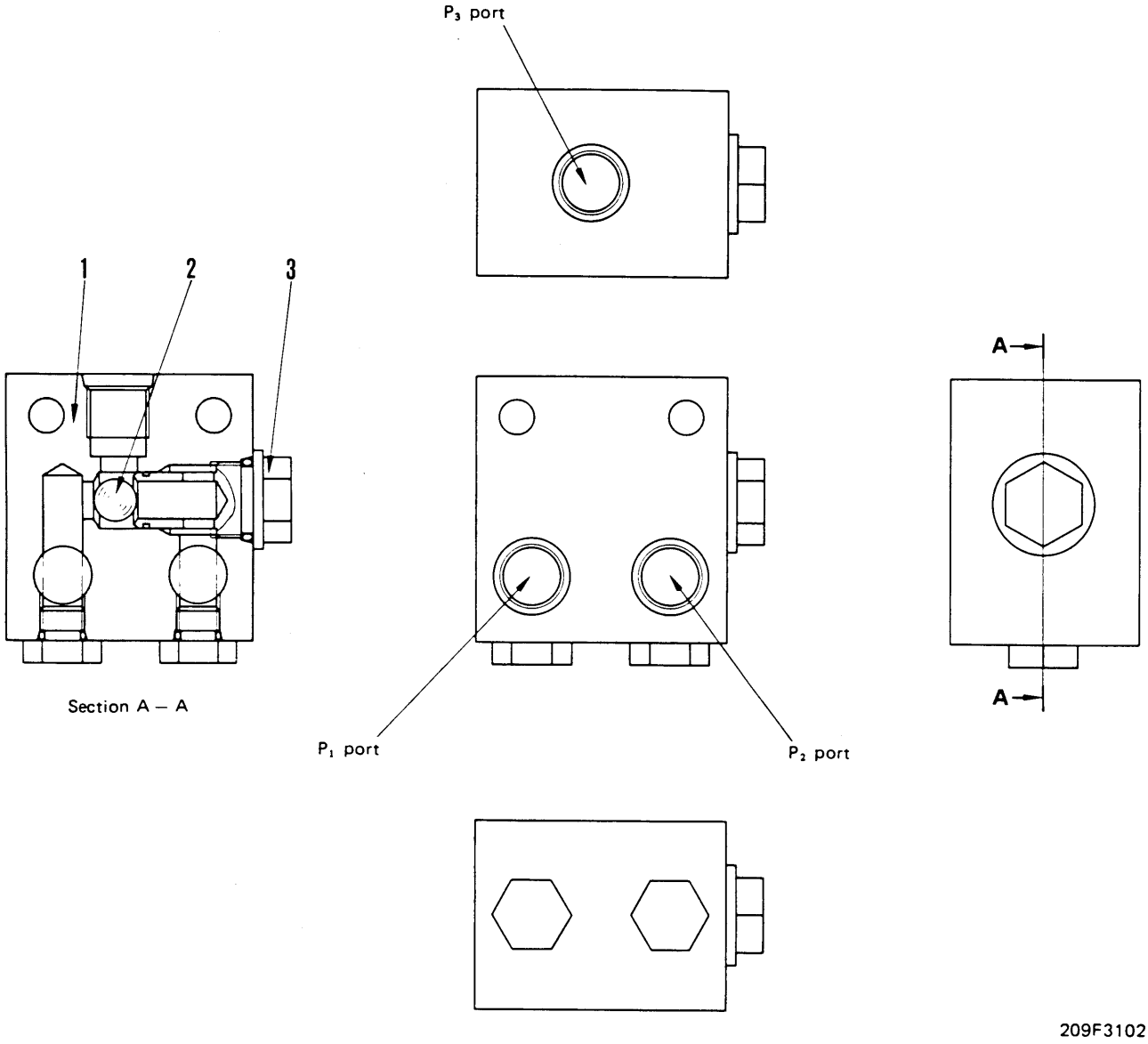
a. To tank
b. From auto-deceleration solenoid valve

1. Head nut
2. Head
3. Piston
4. Return spring
5. Cylinder

PPC SHUTTLE VALVE

LOADING SHOVEL

★ **FOR MACHINE EQUIPPED WITH WORK EQUIPMENT CONTROL SYSTEM**

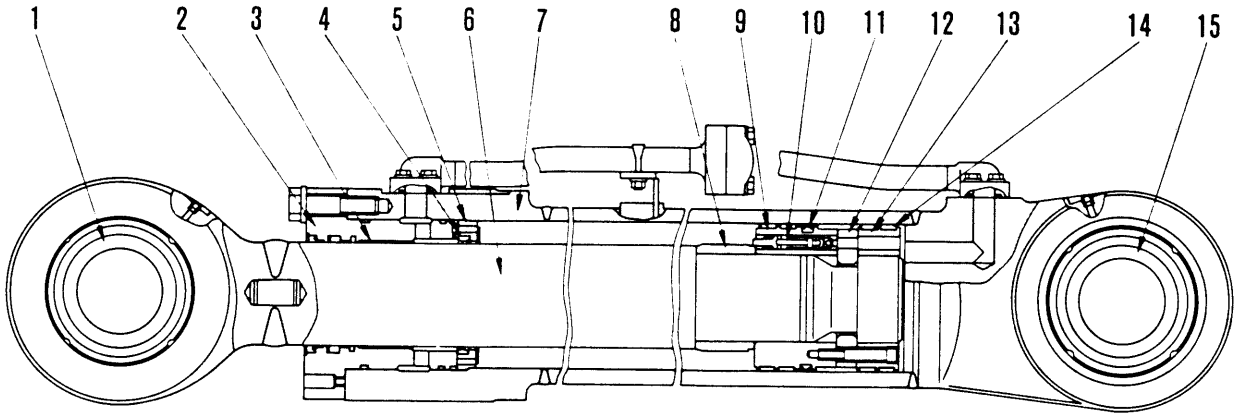


1. Block
2. Ball
3. Plug

HYDRAULIC CYLINDER

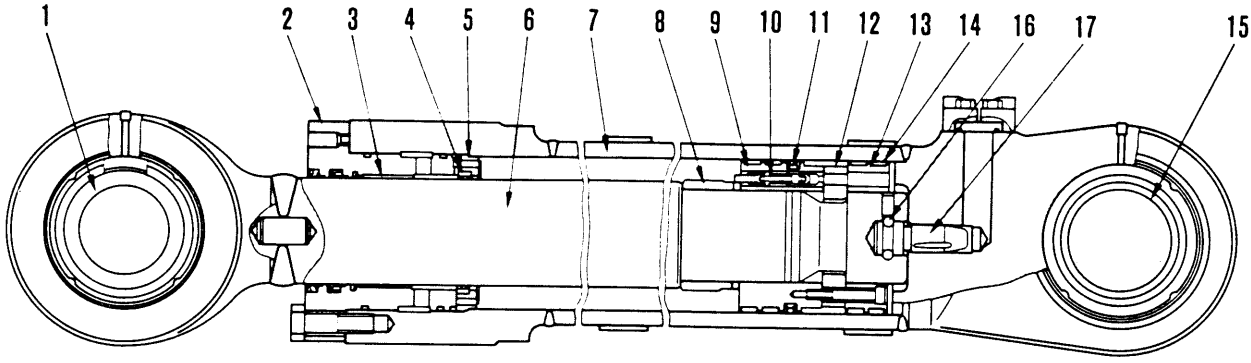
BACK HOE

1. BOOM CYLINDER



209F05079

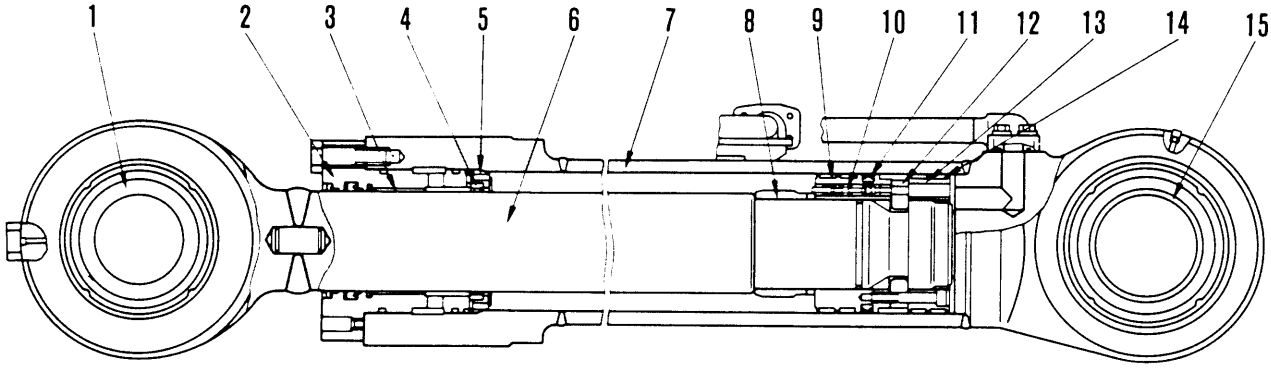
2. ARM CYLINDER



209F3109

020905

3. BUCKET CYLINDER



209F05080

1. Head side bushing
2. Cylinder head
3. Bushing
4. Ring
5. Collar
6. Piston rod
7. Cylinder
8. Head side cushion plunger
9. Piston
10. Piston valve
11. Piston ring
12. Spacer
13. Piston
14. Wear ring
15. Bottom side bushing
16. Ball
17. Bottom side cushion plunger

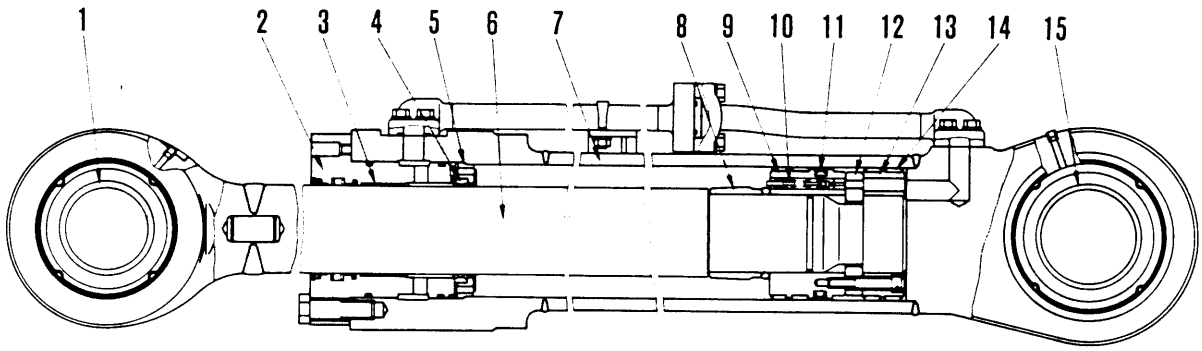
SPECIFICATIONS

Item \ Cylinder	Boom	Arm	Bucket	
			PC650-5	PC650SE-5
Cylinder inside diameter	200	200	180	200
Piston rod outside diameter	140	140	130	140
Stroke	1,892	2,250	1,540	1,485
Maximum stroke	4,767	5,470	3,980	3,955
Minimum stroke	2,875	3,220	2,440	2,470

020905

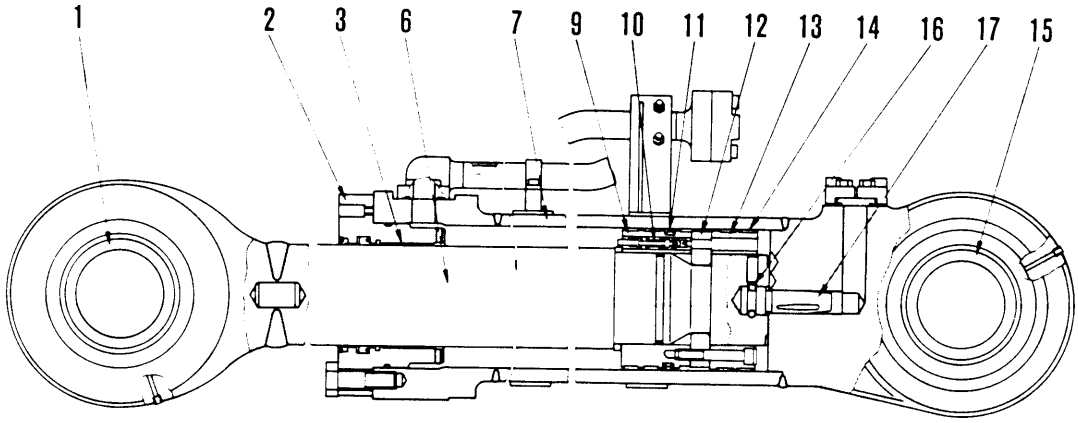
LOADING SHOVEL

1. BOOM CYLINDER



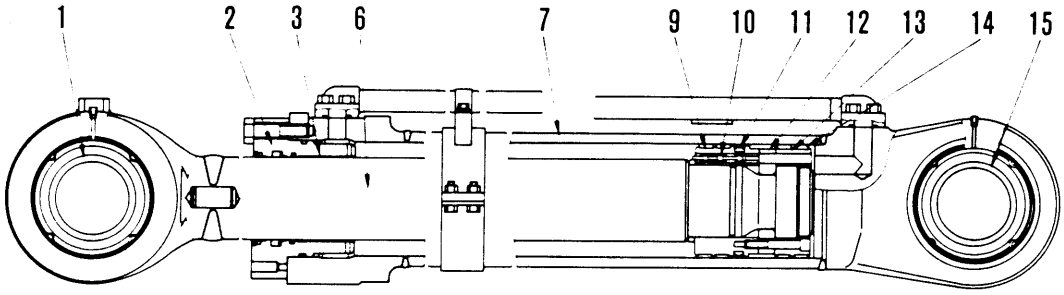
F20905021

2. ARM CYLINDER



F20905022

3. BUCKET CYLINDER



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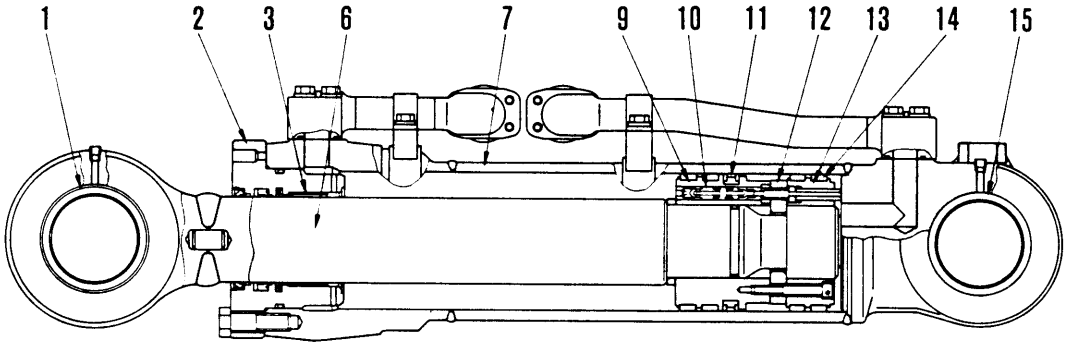
020905

4. BOTTOM DUMP CYLINDER



F20905024

1. Head side bushing
2. Cylinder head
3. Bushing
4. Ring
5. Collar
6. Piston rod
7. Cylinder
8. Head side cushion plunger
9. Piston
10. Piston valve
11. Piston ring
12. Spacer
13. Piston
14. Wear ring
15. Bottom side bushing
16. Ball
17. Bottom side cushion plunger

020905

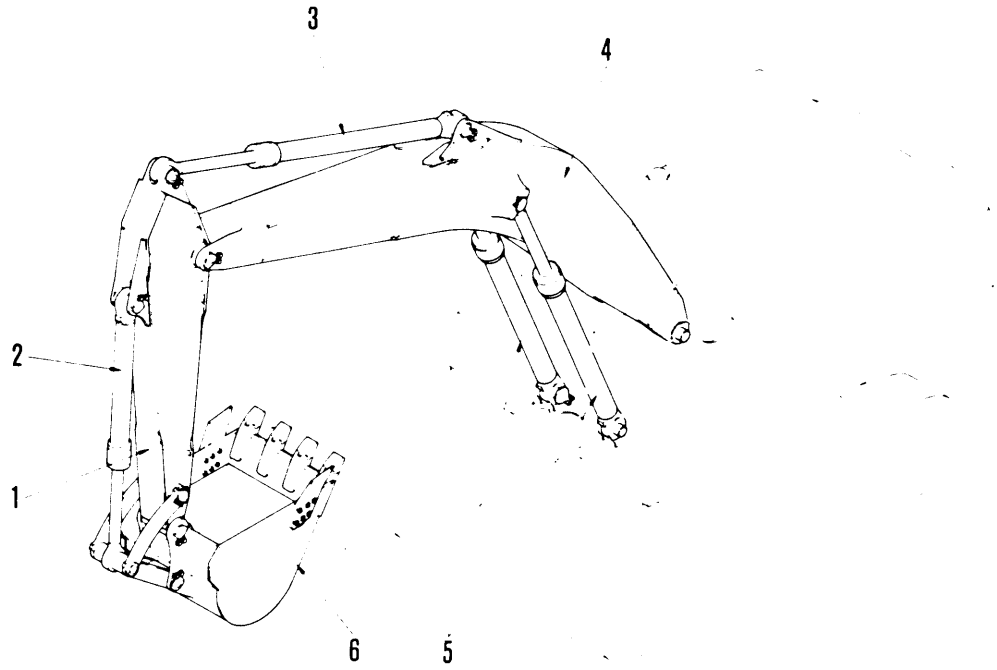
SPECIFICATIONS

Item \ Cylinder	Boom	Arm	Bucket	Bottom dump
Cylinder inside diameter	180	225	180	140
Piston rod outside diameter	120	160	130	90
Stroke	1,498	1,530	1,300	335
Maximum stroke	4,240	4,130	3,750	1,235
Minimum stroke	2,750	2,600	2,450	900

WORK EQUIPMENT

BACK HOE

PC650-5



1. Arm
2. Bucket cylinder
3. Arm cylinder
4. Boom
5. Boom cylinder
6. Bucket

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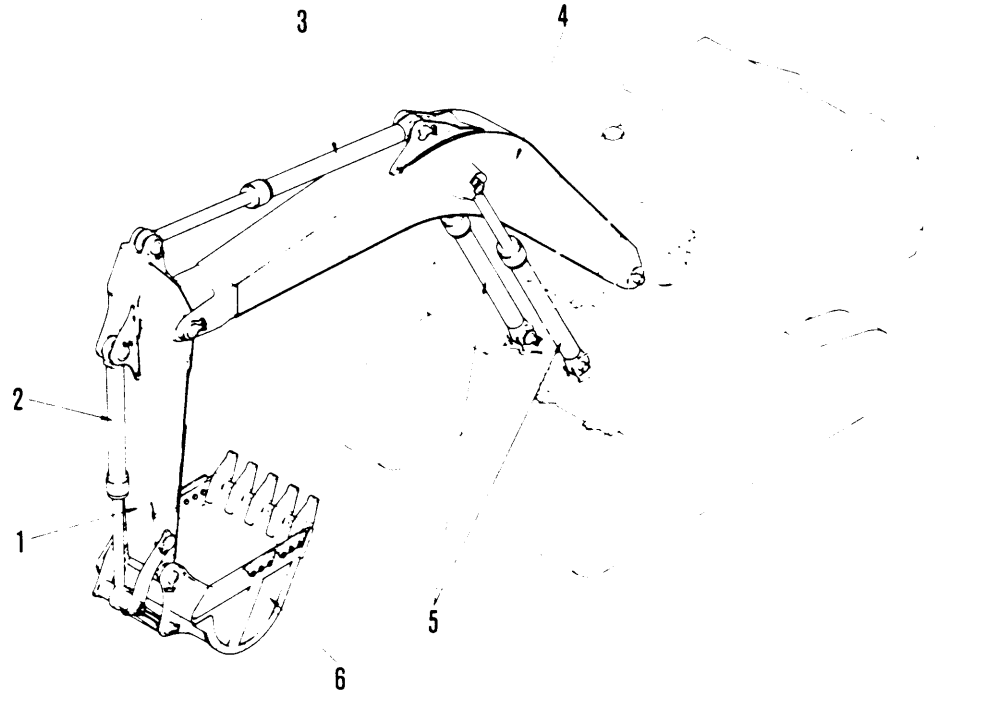
020905

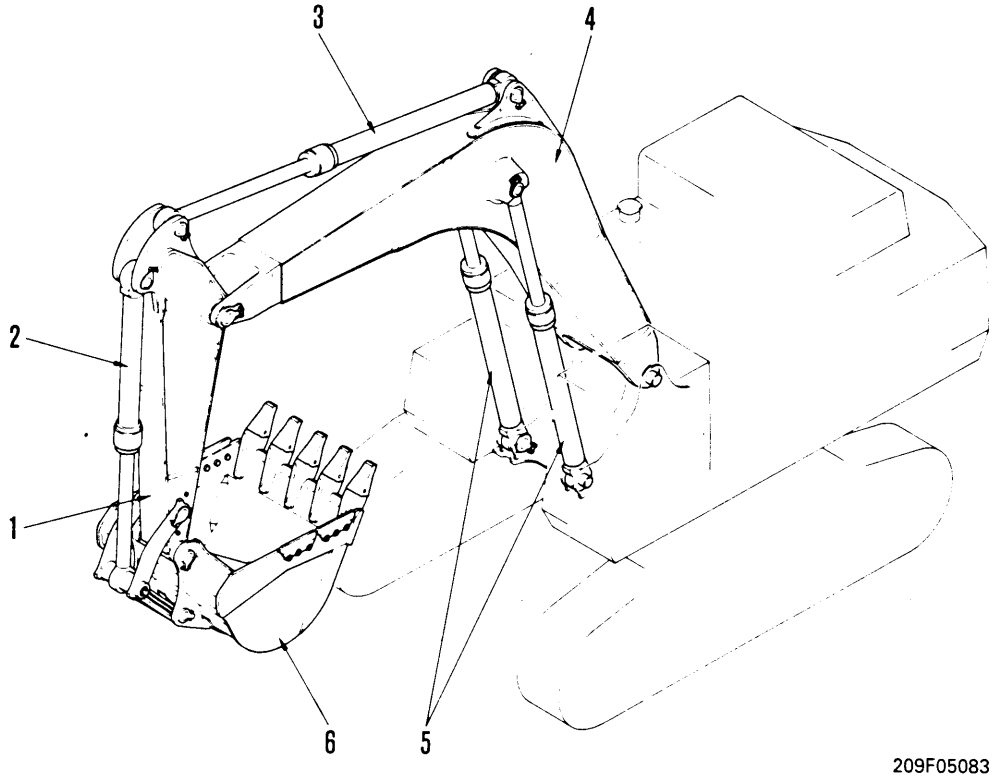
PC710-5



1. Arm
2. Bucket cylinder
3. Arm cylinder
4. Boom
5. Boom cylinder
6. Bucket

209F05082

PC650SE-5
PC710SE-5

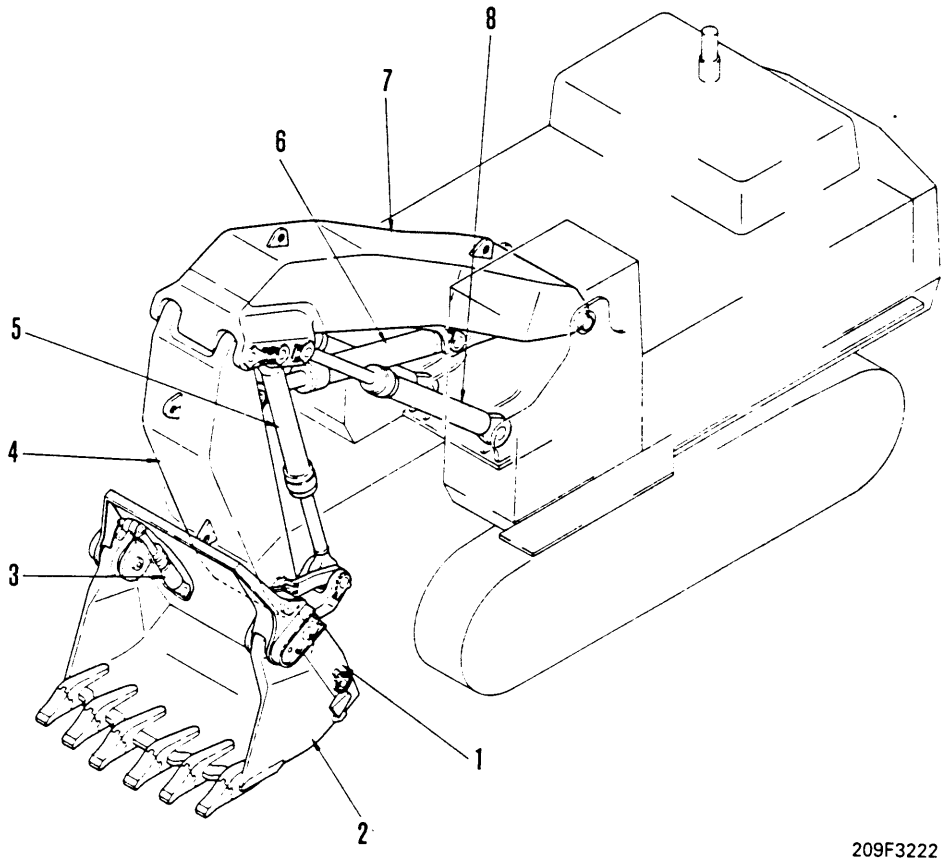


209F05083

1. Arm
2. Bucket cylinder
3. Arm cylinder
4. Boom
5. Boom cylinder
6. Bucket

020905

LOADING SHOVEL



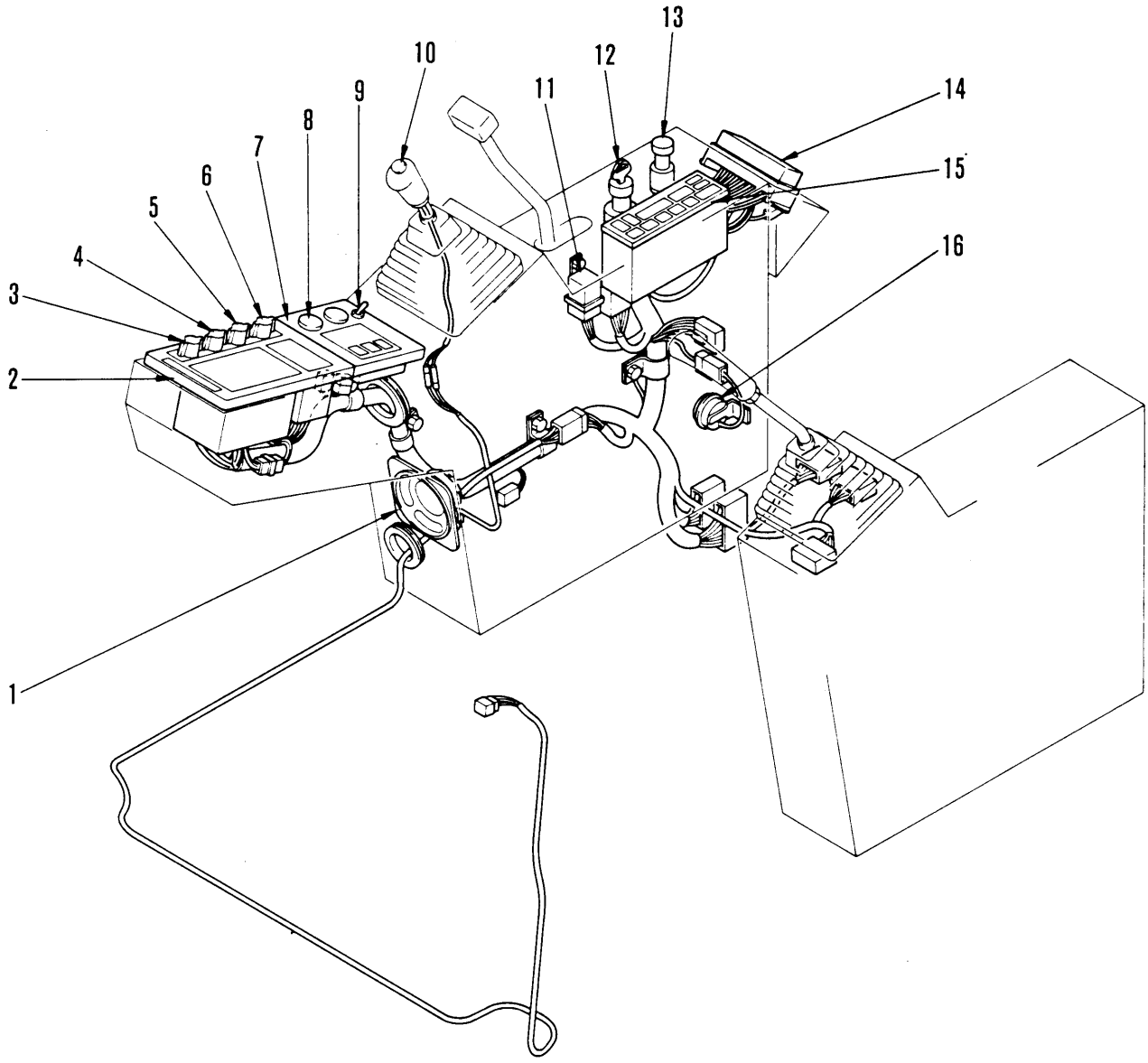
209F3222

1. Rear bucket
2. Front bucket
3. Bottom dump cylinder
4. Arm
5. Bucket cylinder
6. Arm cylinder
7. Boom
8. Boom cylinder

020905

ELECTRICAL WIRING DIAGRAM

BACK HOE



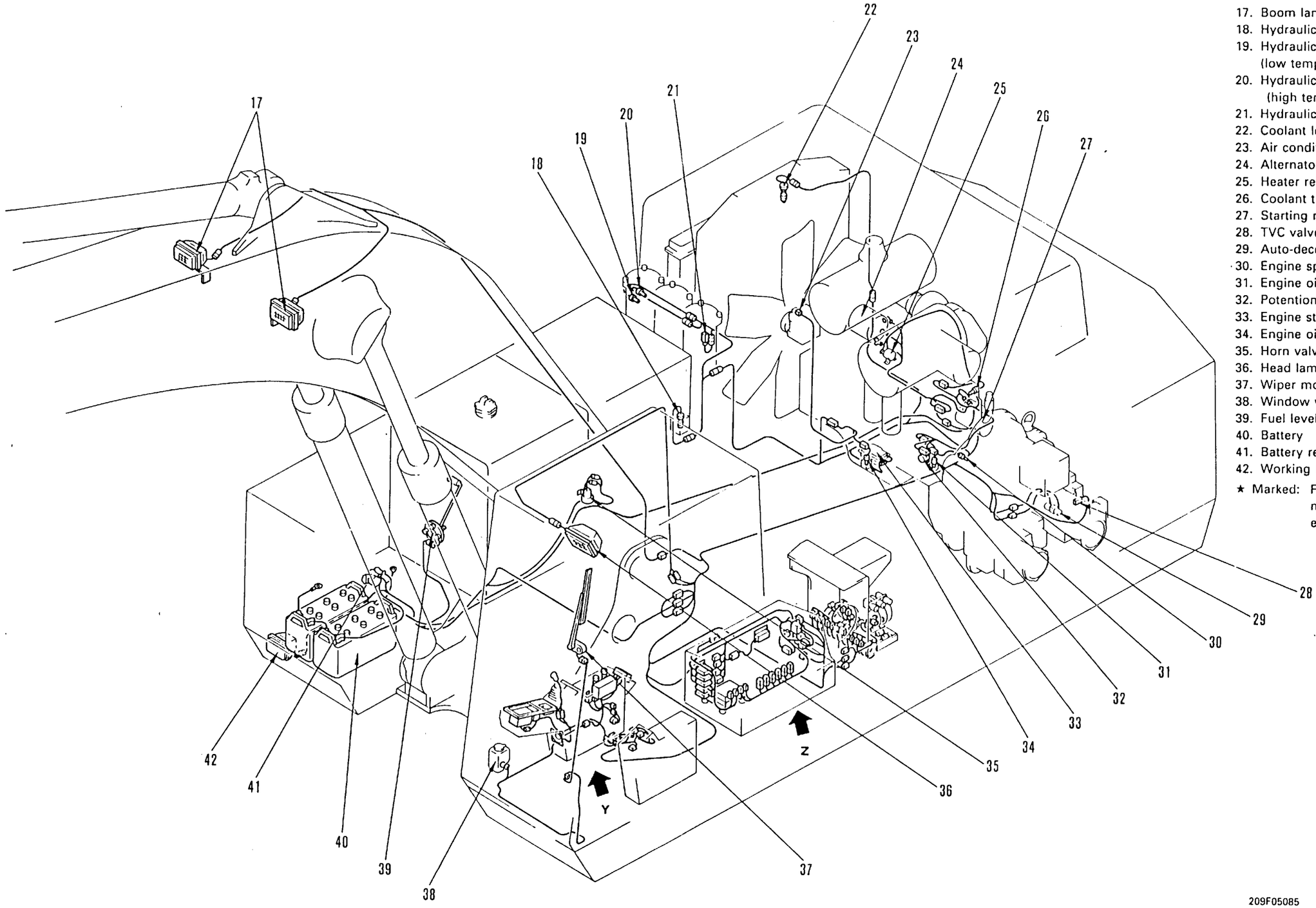
View Y

209F05084

020905

1. Speaker
2. Monitor panel (upper)
3. Mode selection switch
4. Lamp switch
5. Wiper switch
6. Travel speed switch
7. Monitor panel (lower)
8. Swing lock lamp
9. Swing lock switch
10. Horn switch
11. Lighting relay
12. Starting switch
13. Cigarette lighter
14. Fuse box
15. Radio
16. Buzzer

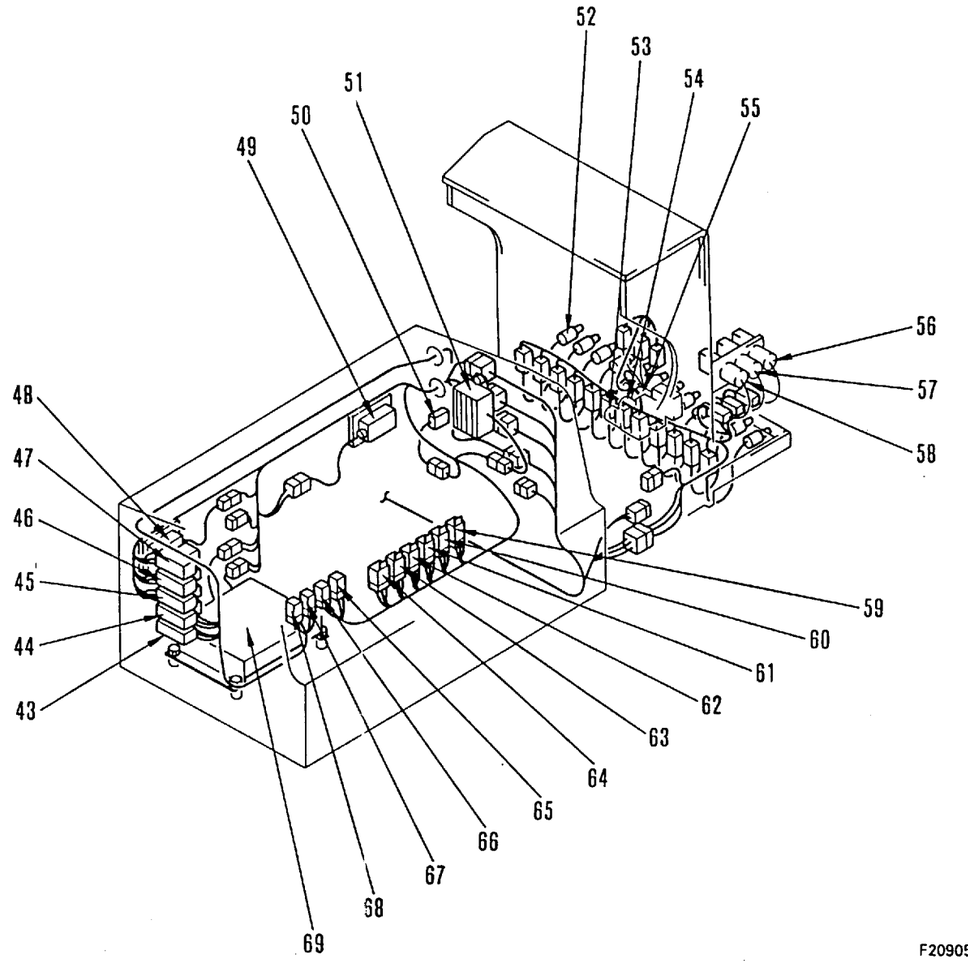
020905



17. Boom lamp
18. Hydraulic oil level sensor
19. Hydraulic oil temperature sensor (low temperature)
20. Hydraulic oil temperature sensor (high temperature)
21. Hydraulic oil filter sensor
22. Coolant level sensor
23. Air conditioner compressor
24. Alternator
25. Heater relay
26. Coolant temperature sensor
27. Starting motor
28. TVC valve
29. Auto-deceleration solenoid valve ★
30. Engine speed sensor ★
31. Engine oil pressure sensor
32. Potentiometer ★
33. Engine stop motor
34. Engine oil level sensor
35. Horn valve
36. Head lamp
37. Wiper motor
38. Window washer
39. Fuel level sensor
40. Battery
41. Battery relay
42. Working lamp

★ Marked: For machine equipped with 3-stage mode selector OLSS and auto-deceleration

209F05085



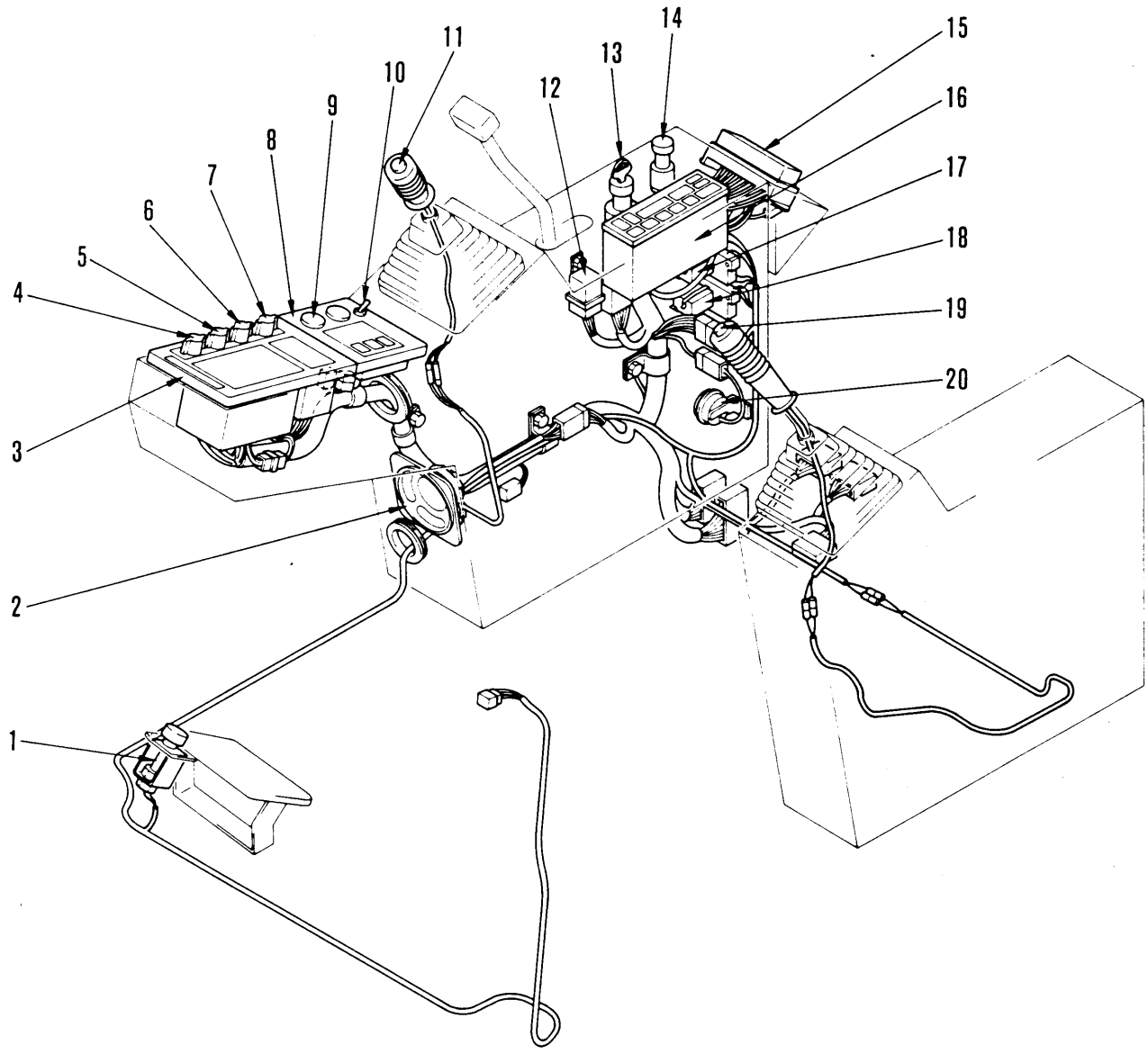
F20905025

43. Arm IN•bucket CURL relay
44. Boom relay
45. Straight-travel cancel relay
46. Swing holding brake•auto-deceleration relay
47. Straight-travel•auto-deceleration relay
48. Hydraulic filter clogging timer
49. Swing holding brake timer
50. Prolix switch ★
51. Prolix resistor ★
52. PPC oil pressure switch
53. Travel speed solenoid valve
54. Swing brake solenoid valve
55. Free swing solenoid valve
56. Heavy lift solenoid valve
57. Machine push up solenoid valve
58. Straight-travel solenoid valve
59. Swing lock relay
60. Free swing relay
61. Horn relay
62. Stop motor relay
63. Working lamp relay
64. Head lamp relay
65. Auto-deceleration relay
66. Swing lock relay
67. Machine push up relay
68. Heavy lift relay
69. Auto-deceleration • OLSS controller ★

★ Marked: For machine equipped with 3-stage mode selector OLSS and auto-deceleration

020905

LOADING SHOVEL

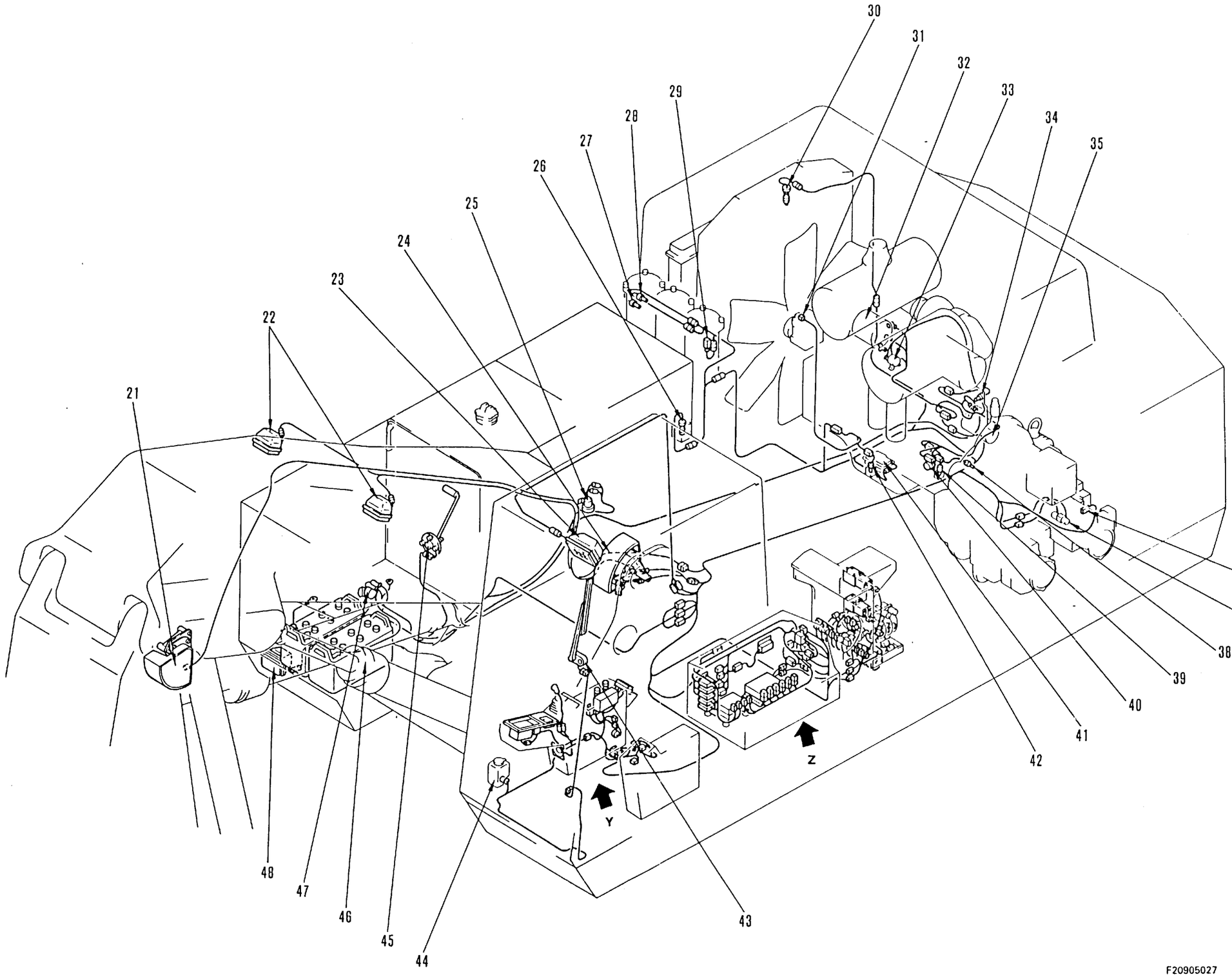


View Y

F20905026

020905

1. Horn switch
2. Speaker
3. Monitor panel (upper)
4. Mode selection switch
5. Lamp switch
6. Wiper switch
7. Travel speed switch
8. Monitor panel (lower)
9. Swing lock lamp
10. Swing lock switch
11. Bottom dump open switch
12. Lighting relay
13. Starting switch
14. Cigarette lighter
15. Fuse box
16. Radio
17. Bottom dump open relay
18. Bottom dump close relay
19. Bottom dump close switch
20. Buzzer



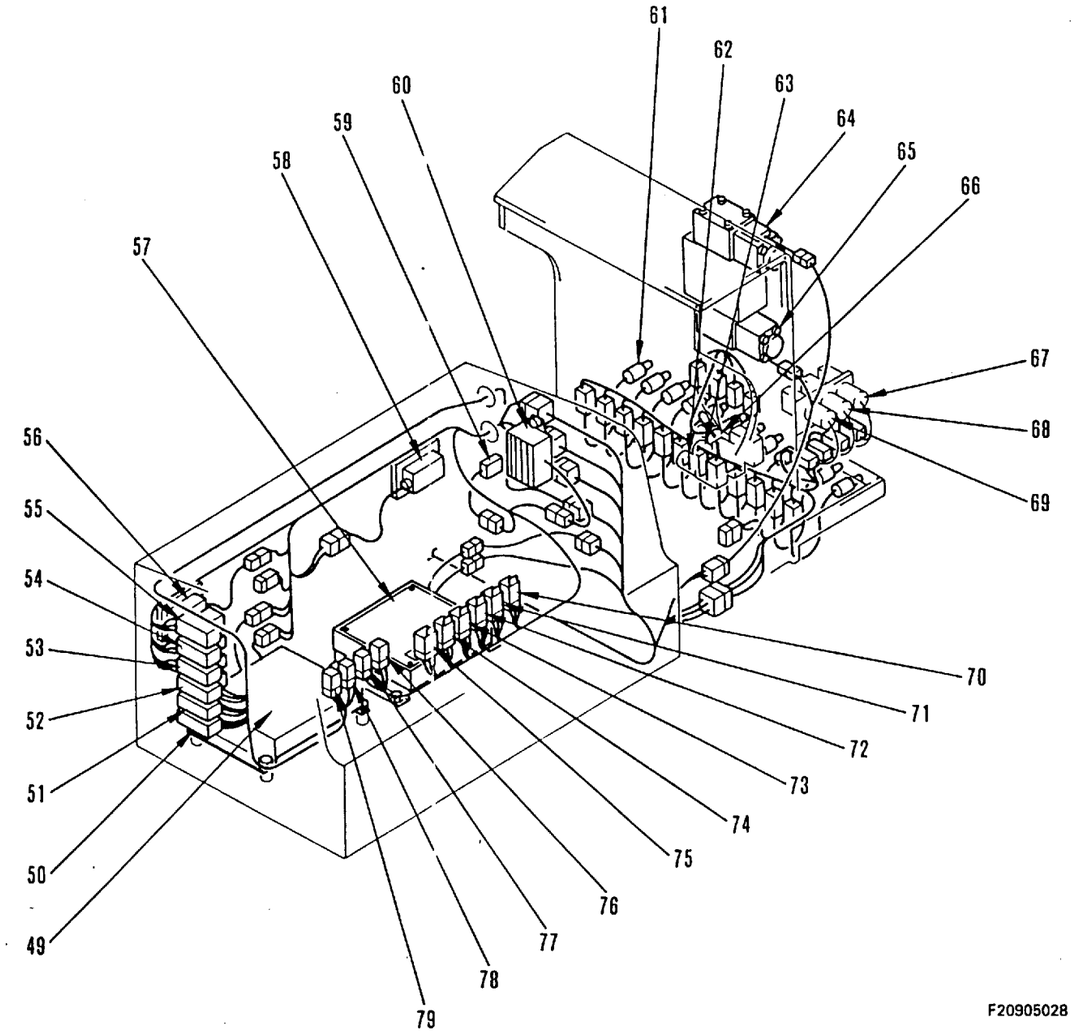
020905

21. Arm potensiometer ※
22. Boom lamp
23. Head lamp
24. Boom potensiometer ※
25. Horn valve
26. Hydraulic oil level sensor
27. Hydraulic oil temperature sensor (low temperature)
28. Hydraulic oil temperature sensor (high temperature)
29. Hydraulic oil filter sensor
30. Coolant level sensor
31. Air conditioner compressor
32. Alternator
33. Heater relay
34. Coolant temperature sensor
35. Starting motor
36. TVC valve
37. Auto-deceleration solenoid valve ★
38. Engine speed sensor ★
39. Engine oil pressure sensor
40. Potentiometer ★
41. Engine stop motor
42. Engine oil level sensor
43. Wiper motor
44. Window washer
45. Fuel level sensor
46. Battery
47. Battery relay
48. Working lamp

★ marked: For machine equipped with 3-stage mode selector OLSS and auto-deceleration

※ marked: For machine equipped with work equipment control system

F20905027



F20905028

020905

49. Auto-deceleration · OLSS controller ★
50. Arm IN · bucket relay
51. Arm OUT relay
52. Boom relay
53. Straight-travel relay
54. Swing holding brake · auto-deceleration relay
55. Straight-travel · auto-deceleration relay
56. Hydraulic filter clogging timer
57. Work equipment controller ※
58. Swing holding brake timer
59. Prolix switch ★
60. Prolix resistor ★
61. PPC oil pressure switch
62. Travel speed solenoid valve
63. Swing brake solenoid valve
64. Boom EPC valve
65. Bucket EPC valve
66. Bottom dump open solenoid valve
67. Bottom dump close solenoid valve
68. Machine push up solenoid valve
69. Straight-travel solenoid valve
70. Swing lock relay
71. Free swing relay
72. Horn relay
73. Stop motor relay
74. Working lamp relay
75. Head lamp relay
76. Auto-deceleration relay
77. Swing lock relay
78. Machine push up relay
79. Heavy lift relay

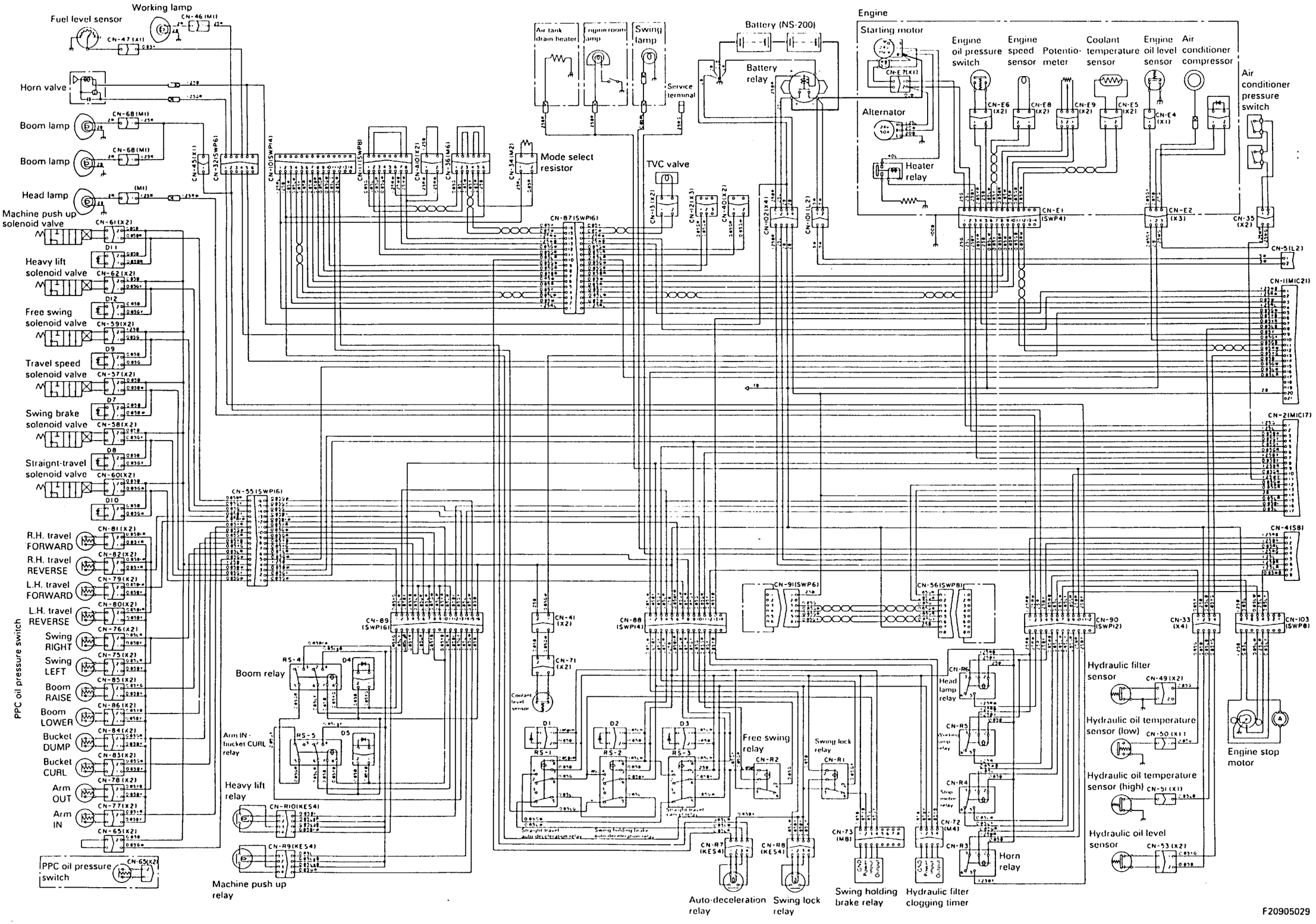
★ marked: For machine equipped with 3-stage mode selector OLSS and auto-deceleration

※ marked: For machine equipped with work equipment control system

ELECTRICAL CIRCUIT DIAGRAM

BACK HOE

★ FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS



020905

Starting switch connecting table

	B	BR	R1	R2	C	ACC
OFF	○					
HEAT	○	○	○			○
ON	○	○				○
START	○			○	○	

Fuse box connecting table

No.	Connecting circuit
1	Engine stop motor
2	Radio (back up), room lamp, starting switch
3	Lamp
4	Swing lamp, fog lamp
5	Monitor panel, controller, panel switch
6	Air conditioner
7	Oil pressure switch, solenoid valve, filter clogging timer
8	Horn, air tank drain heater, engine room lamp
9	Wiper
10	Cigarette lighter, radio

Mode selection switch

Terminal	1	2	3	4	
	H	M	L	E	
S				○	
L			○	○	3A

Travel speed switch

Terminal	1	2	3	4	
	H	M	L	E	
Lo				○	
HI			○	○	3A

Lamp switch

Terminal	1	2	3	4	
	H	M	L	E	
OFF				○	
I			○	○	3A
II		○	○	○	10A

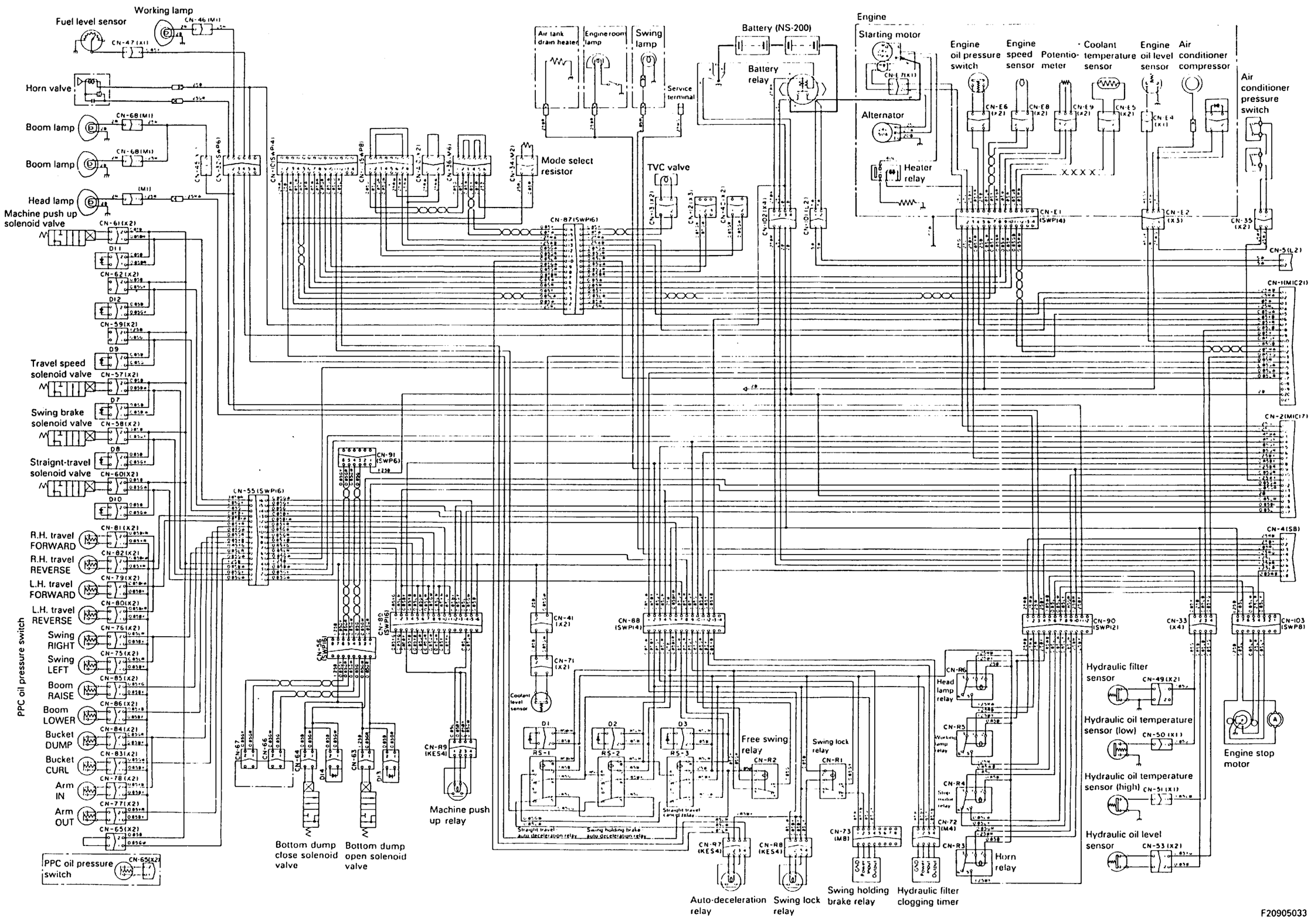
Wiper switch

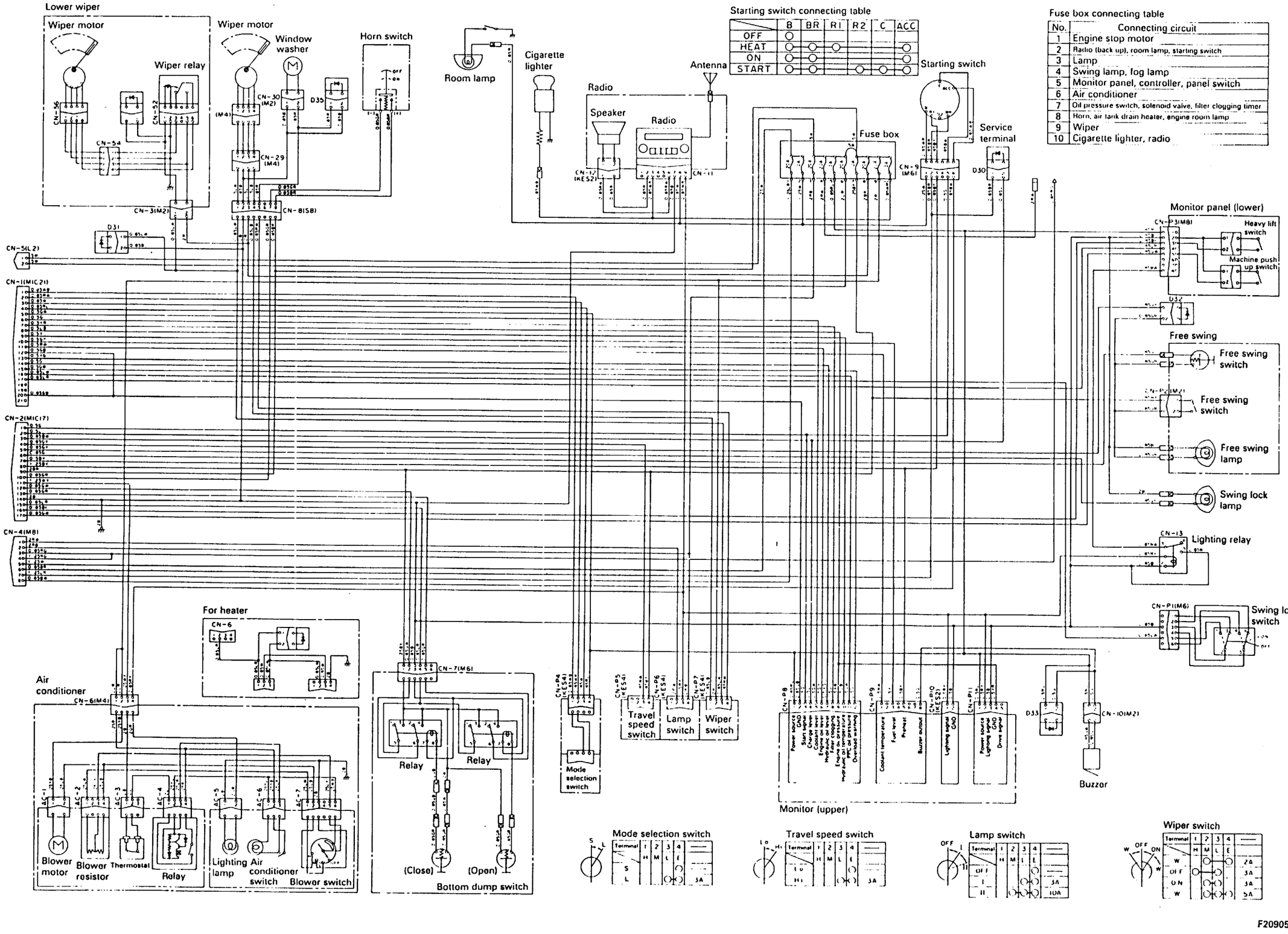
Terminal	1	2	3	4	
	H	M	L	E	
W	○			○	2A
OFF	○				3A
ON		○	○		3A
W		○	○	○	5A

F20905030

LOADING SHOVEL

★ FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS

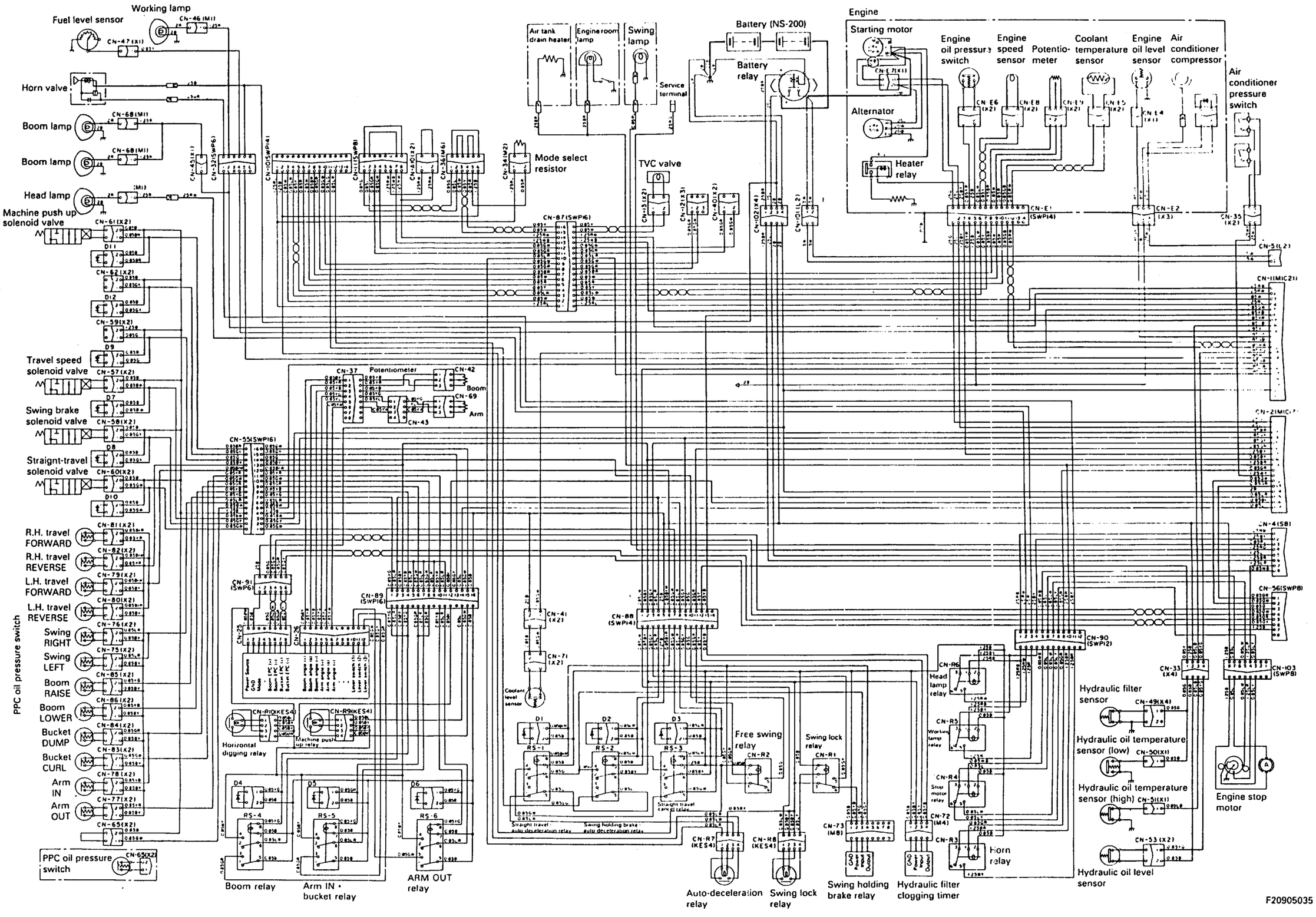



Lower wiper
Wiper motor
Wiper relay
Wiper motor
Window washer
Horn switch
Room lamp
Cigarette lighter
Radio
Speaker
Radio
Antenna
Starting switch connecting table
B BR R1 R2 C ACC
OFF
HEAT
ON
START
Starting switch
Fuse box
Service terminal
Fuse box connecting table
No. Connecting circuit
1 Engine stop motor
2 Radio (back up), room lamp, starting switch
3 Lamp
4 Swing lamp, fog lamp
5 Monitor panel, controller, panel switch
6 Air conditioner
7 Oil pressure switch, solenoid valve, filter clogging timer
8 Horn, air tank drain heater, engine room lamp
9 Wiper
10 Cigarette lighter, radio
Monitor panel (lower)
Heavy lift switch
Machine push up switch
Free swing
Free swing switch
Free swing switch
Free swing lamp
Swing lock lamp
Lighting relay
Swing lock switch
For heater
Air conditioner
Blower motor
Blower resistor
Thermostat
Relay
Lighting lamp
Air conditioner switch
Blower switch
Relay
Relay
(Close)
(Open)
Bottom dump switch
Mode selection switch
Travel speed switch
Lamp switch
Wiper switch
Buzzer
Monitor (upper)
F20905034

020905

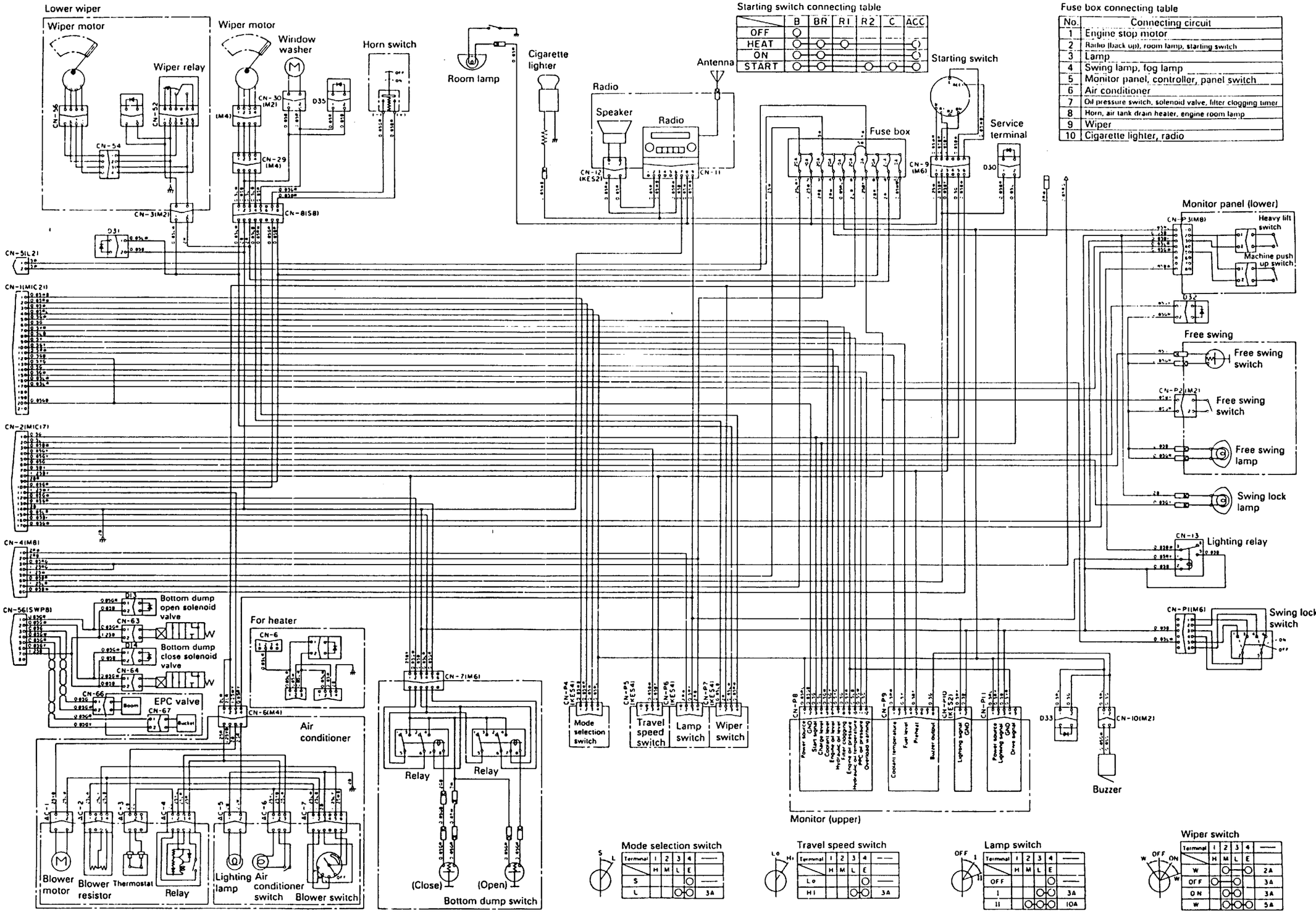
LOADING SHOVEL

★ FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS AND WORK EQUIPMENT CONTROL SYSTEM



F20905035

020905



Starting switch connecting table

	B	BR	R1	R2	C	ACC
OFF	○					○
HEAT	○	○	○			○
ON	○	○				○
START	○	○		○	○	○

Fuse box connecting table

No.	Connecting circuit
1	Engine stop motor
2	Radio (back up), room lamp, starting switch
3	Lamp
4	Swing lamp, fog lamp
5	Monitor panel, controller, panel switch
6	Air conditioner
7	Oil pressure switch, solenoid valve, filter clogging timer
8	Horn, air tank drain heater, engine room lamp
9	Wiper
10	Cigarette lighter, radio

Mode selection switch

Terminal	H	M	L	E	
S				○	—
L			○	○	3A

Travel speed switch

Terminal	H	M	L	E	
Lo				○	—
Hi			○	○	3A

Lamp switch

Terminal	H	M	L	E	
OFF				○	—
I			○	○	3A
II			○	○	10A

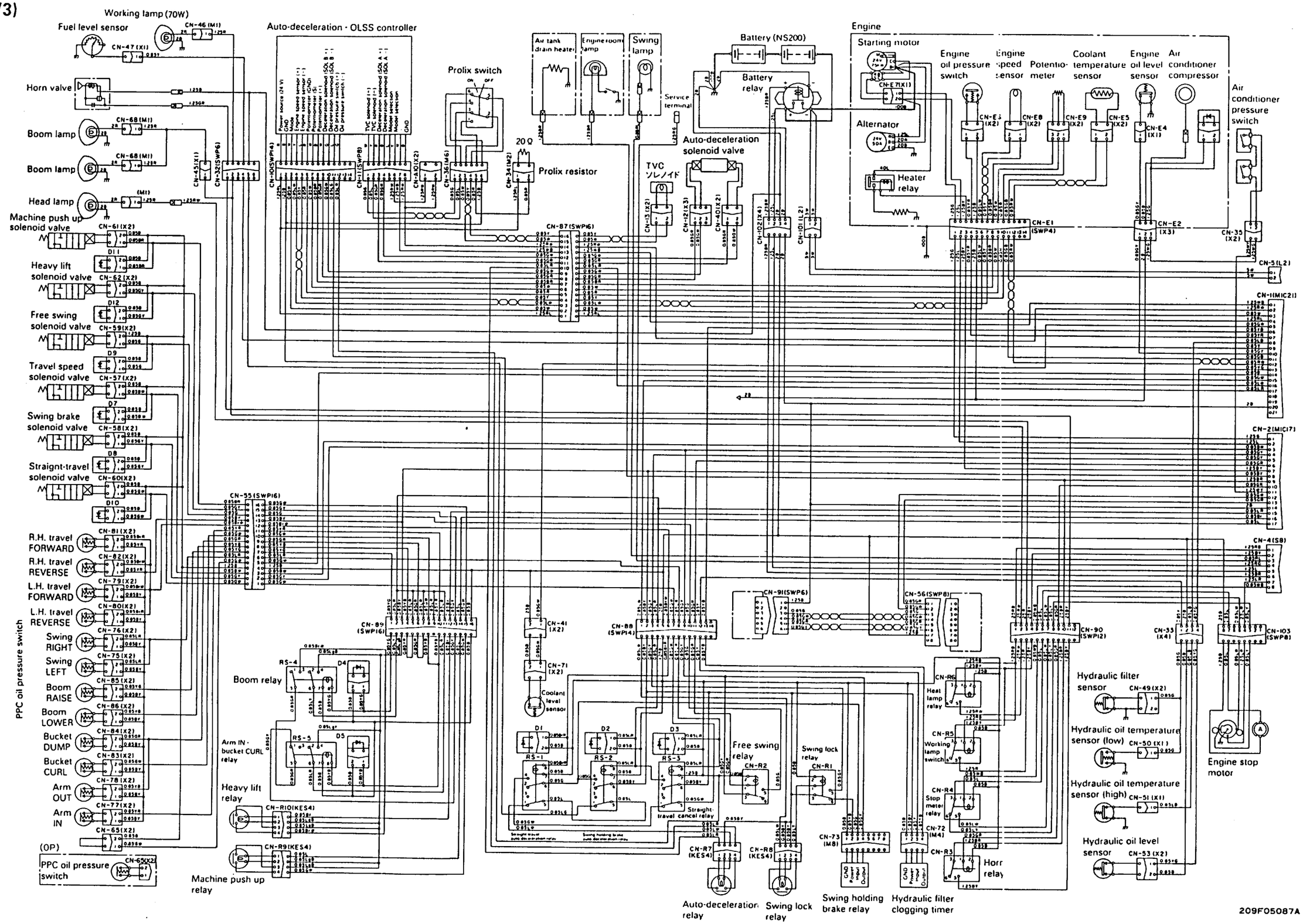
Wiper switch

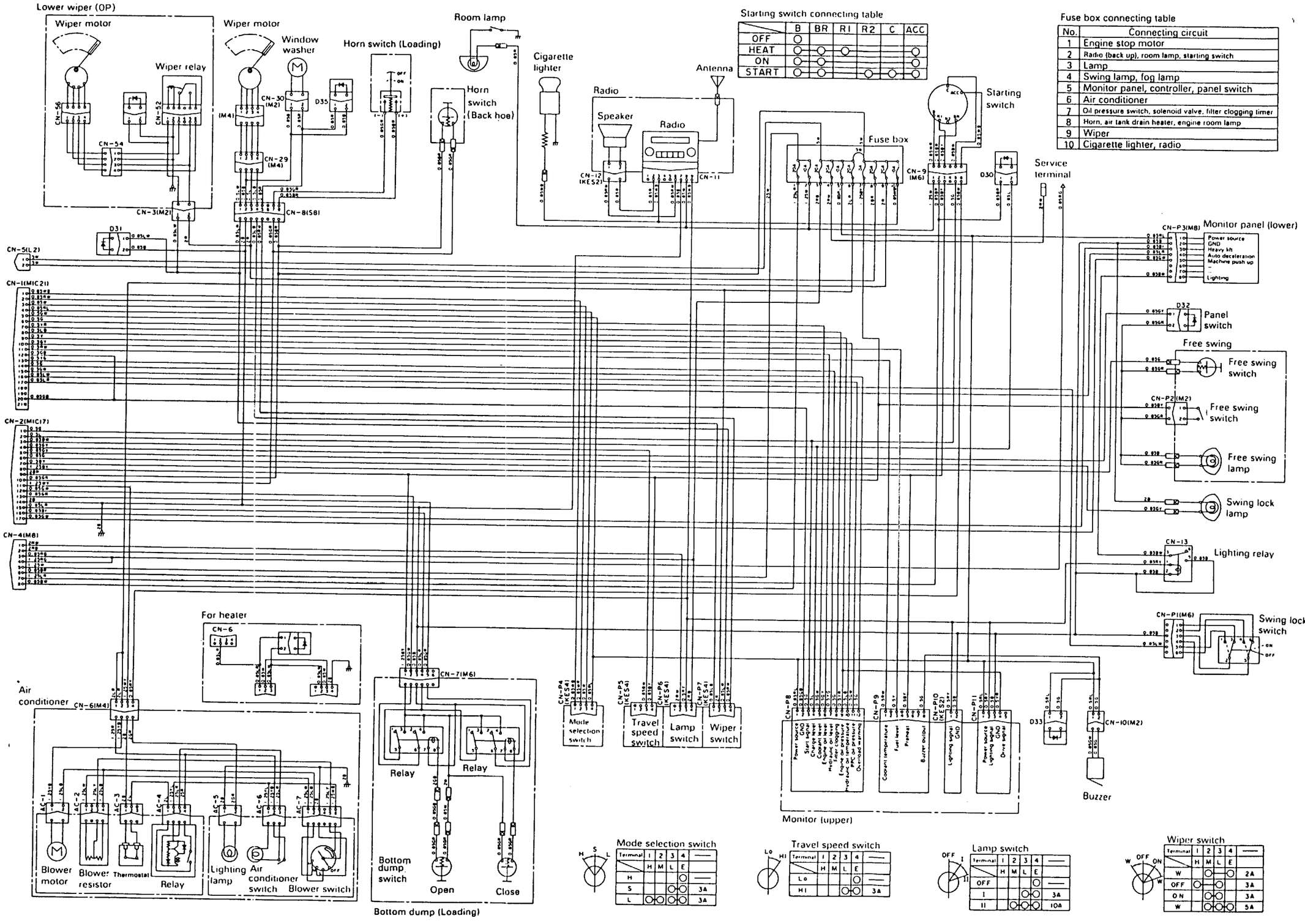
Terminal	I	2	3	4	
	H	M	L	E	
W				○	2A
OFF	○			○	3A
ON	○	○		○	3A
W	○	○	○	○	5A

F20905036

PC650-5: 20001 – 20096, 20099 – 20103, 20106 – 20108
PC710-5: 10001 – 10085

(1/3)




Lower wiper (OP)
Wiper motor
Wiper relay
CN-56
CN-52
CN-54
CN-3(M2)
Wiper motor
Window washer
Horn switch (Loading)
CN-30 (M2)
(M4)
D35
CN-29 (M4)
CN-8(S8)
Room lamp
Horn switch (Back hoe)
Cigarette lighter
Radio
Speaker
Radio
CN-12 (KES2)
CN-11
Antenna
Starting switch connecting table
B BR RI R2 C ACC
OFF
HEAT
ON
START
Fuse box connecting table
No. Connecting circuit
1 Engine stop motor
2 Radio (back up), room lamp, starting switch
3 Lamp
4 Swing lamp, fog lamp
5 Monitor panel, controller, panel switch
6 Air conditioner
7 Oil pressure switch, solenoid valve, filter clogging timer
8 Horn, air tank drain heater, engine room lamp
9 Wiper
10 Cigarette lighter, radio
Fuse box
CN-9 (M6)
Starting switch
D30
Service terminal
D31
CN-5(L2)
CN-1(MIC21)
CN-2(MIC17)
CN-4(M8)
CN-P3(M8)
Monitor panel (lower)
Power source
GND
Heavy lift
Auto deceleration
Machine push up
Lighting
D32
Panel switch
Free swing
Free swing switch
CN-P2(M2)
Free swing switch
Free swing lamp
Swing lock lamp
CN-13
Lighting relay
CN-P1(M6)
Swing lock switch
ON
OFF
For heater
CN-6
Air conditioner
CN-6(M4)
AC-1
AC-2
AC-3
AC-4
AC-5
AC-6
AC-7
Blower motor
Blower resistor
Thermostat
Relay
Lighting lamp
Air conditioner switch
Blower switch
CN-7(M6)
Relay
Relay
Bottom dump switch
Open
Close
Bottom dump (Loading)
CN-P4 (KES4)
Mode selection switch
CN-P5 (KES4)
Travel speed switch
CN-P6 (KES4)
Lamp switch
CN-P7 (KES4)
Wiper switch
CN-P8
CN-P9
CN-P10 (KES2)
CN-P11
Monitor (upper)
D33
CN-10(M2)
Buzzer
Mode selection switch
Terminal I 2 3 4
H M L E
H
S 3A
L 3A
Travel speed switch
Terminal I 2 3 4
H M L E
Lo
HI 3A
Lamp switch
Terminal I 2 3 4
H M L E
OFF
I 3A
II 10A
Wiper switch
Terminal I 2 3 4
H M L E
W 2A
OFF 3A
ON 3A
W 5A
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Starting switch connecting table

	B	BR	R1	R2	C	ACC
OFF	○					
HEAT	○	○	○			○
ON	○	○				○
START	○	○		○	○	○

Fuse box connecting table

No.	Connecting circuit
1	Engine stop motor
2	Radio (back up), room lamp, starting switch
3	Lamp
4	Swing lamp, fog lamp
5	Monitor panel, controller, panel switch
6	Air conditioner
7	Oil pressure switch, solenoid valve, filter clogging timer
8	Horn, air tank drain heater, engine room lamp
9	Wiper
10	Cigarette lighter, radio

Mode selection switch

Terminal	1	2	3	4	
	H	M	L	E	
H				○	
S			○	○	3A
L	○	○	○	○	3A

Travel speed switch

Terminal	1	2	3	4	
	H	M	L	E	
Lo				○	
Hi			○	○	3A

Lamp switch

Terminal	1	2	3	4	
	H	M	L	E	
OFF				○	
I			○	○	3A
II	○	○	○	○	10A

Wiper switch

Terminal	1	2	3	4	
	H	M	L	E	
W				○	2A
OFF					3A
ON			○	○	3A
W	○	○	○	○	5A

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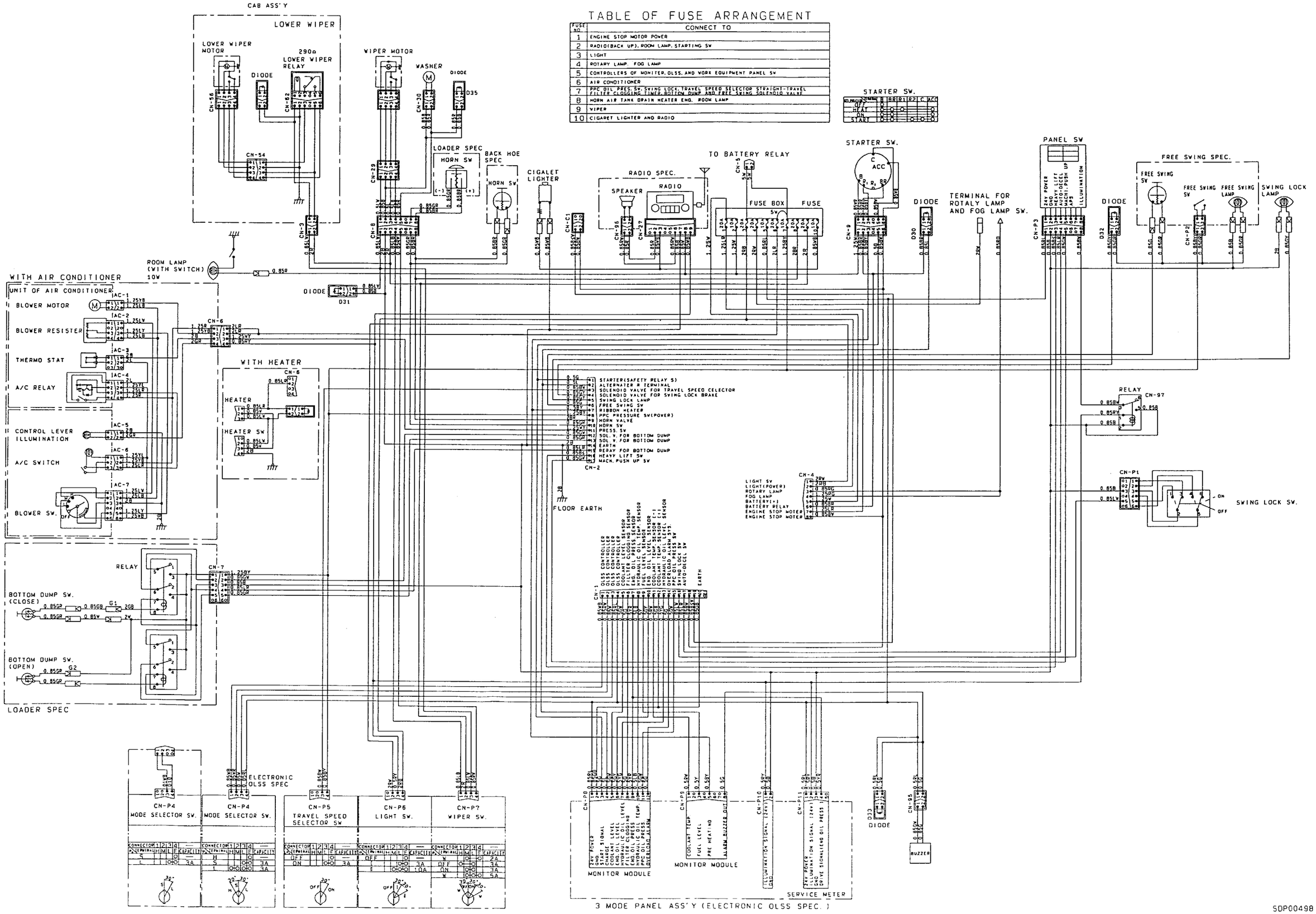
TABLE OF FUSE ARRANGEMENT

FUSE NO.	CONNECT TO
1	ENGINE STOP MOTOR POWER
2	RADIO(BACK UP), ROOM LAMP, STARTING SW
3	LIGHT
4	ROTARY LAMP, FOG LAMP
5	CONTROLLERS OF MONITER, OLSS, AND WORK EQUIPMENT PANEL SW
6	AIR CONDITIONER
7	PPC OIL PRES. SW, SWING LOCK, TRAVEL SPEED SELECTOR STRAIGHT-TRAVEL FILTER CLOGGING TIMER, BOTTOM DUMP AND FREE SWING SOLENOID VALVE
8	HORN, AIR TANK DRAIN HEATER ENG. #ROOM LAMP
9	WIPER
10	CIGARET LIGHTER AND RADIO



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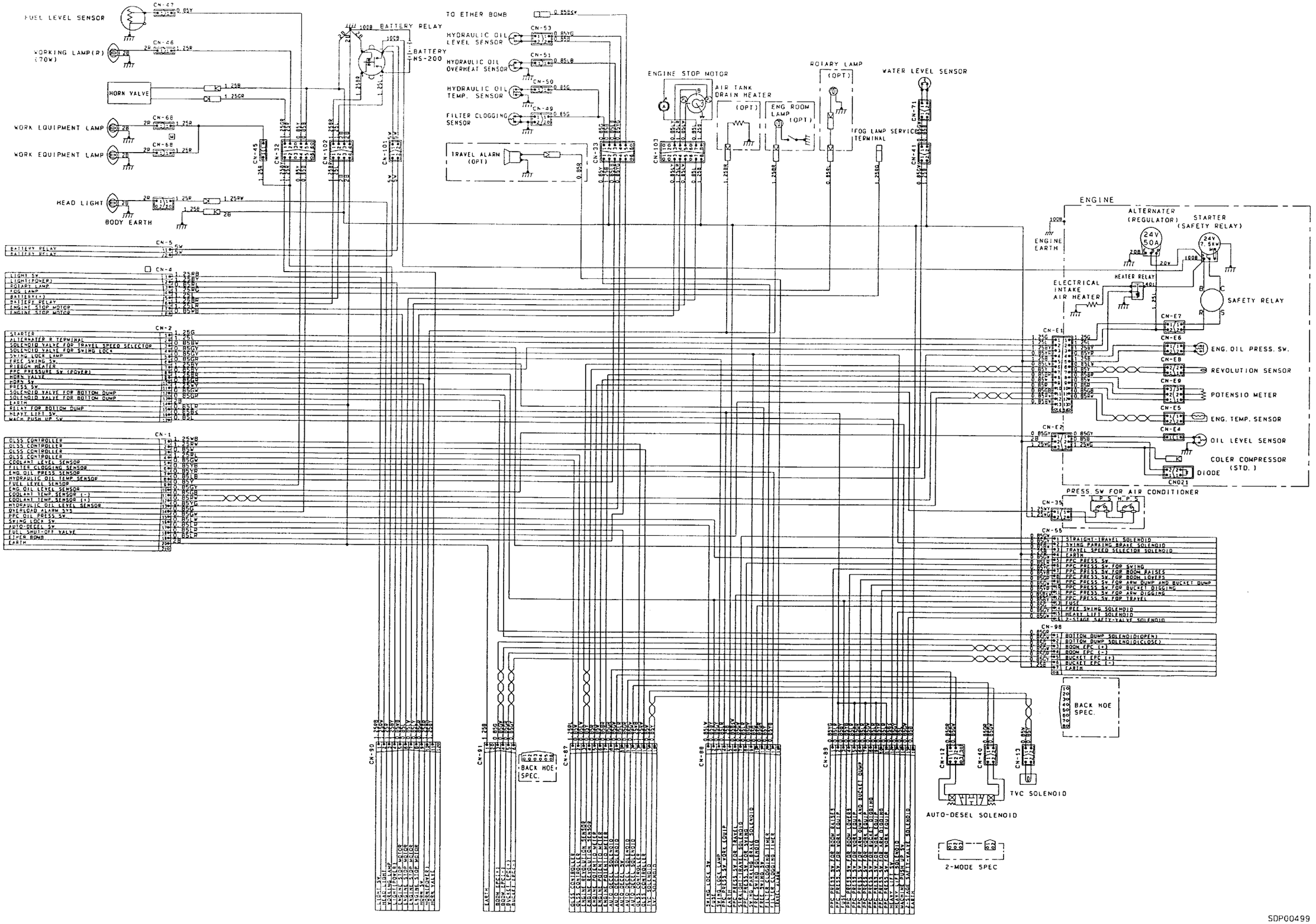
(2/3)



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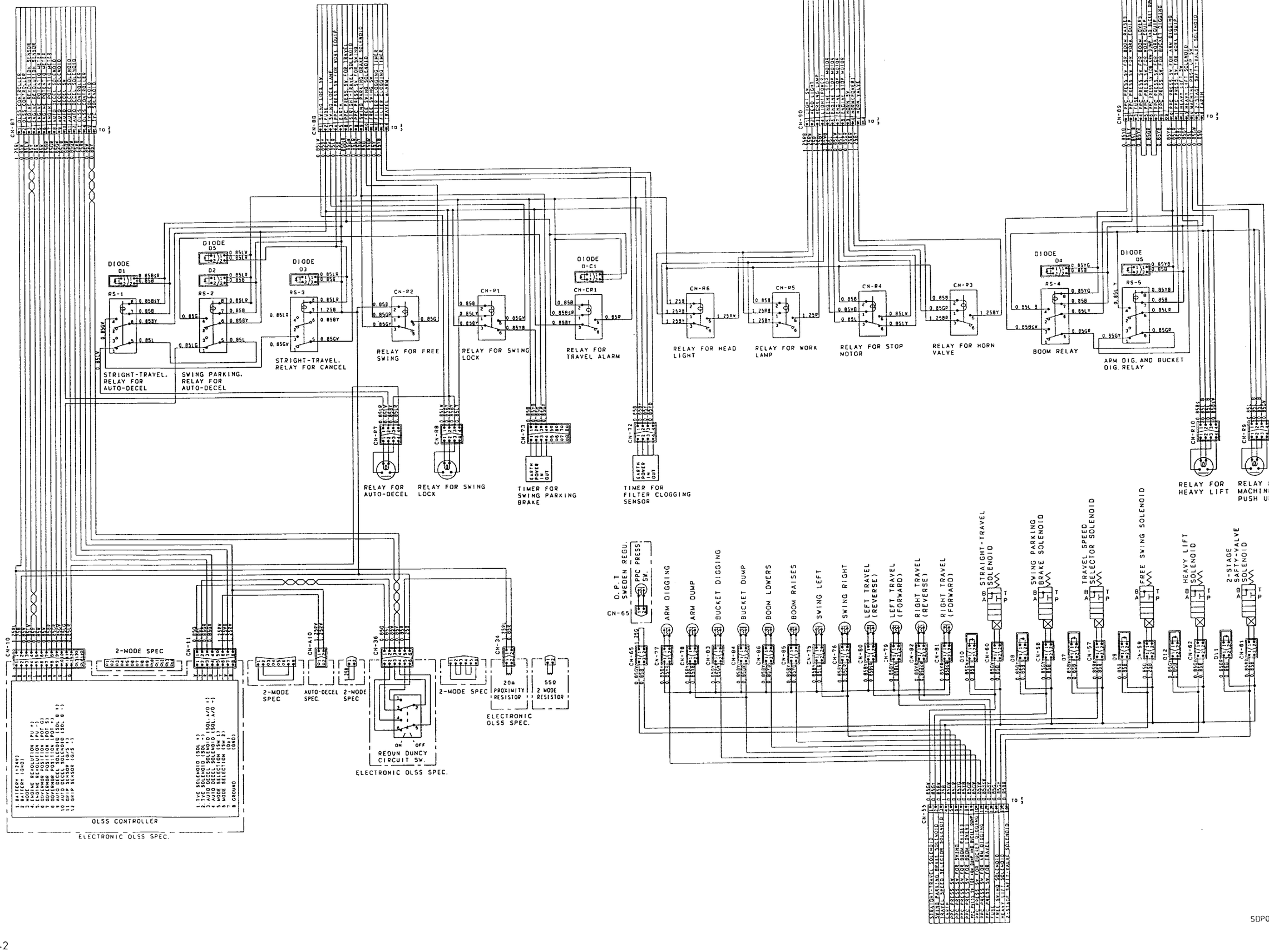
CN-87
CN-88
CN-90
CN-89
TO 2/3
DIODE D1
DIODE D2
DIODE D3
DIODE D5
DIODE D-C1
DIODE D4
DIODE D5
RS-1
RS-2
RS-3
RS-4
RS-5
STRIGHT-TRAVEL. RELAY FOR AUTO-DECEL
SWING PARKING. RELAY FOR AUTO-DECEL
STRIGHT-TRAVEL. RELAY FOR CANCEL
CN-R2
RELAY FOR FREE SWING
CN-R1
RELAY FOR SWING LOCK
CN-CR1
RELAY FOR TRAVEL ALARM
CN-R6
RELAY FOR HEAD LIGHT
CN-R5
RELAY FOR WORK LAMP
CN-R4
RELAY FOR STOP MOTOR
CN-R3
RELAY FOR HORN VALVE
BOOM RELAY
ARM DIG. AND BUCKET DIG. RELAY
CN-R7
RELAY FOR AUTO-DECEL
CN-R8
RELAY FOR SWING LOCK
CN-73
TIMER FOR SWING PARKING BRAKE
CN-72
TIMER FOR FILTER CLOGGING SENSOR
CN-R10
RELAY FOR HEAVY LIFT
CN-R9
RELAY FOR MACHINE PUSH UP
CN-10
CN-11
CN-A10
CN-36
CN-34
2-MODE SPEC
2-MODE SPEC
AUTO-DECEL SPEC.
2-MODE SPEC
2-MODE SPEC
20Ω PROXIMITY RESISTOR
55Ω 2 MODE RESISTOR
ELECTRONIC OLSS SPEC.
ON OFF
REDUN DUNCY CIRCUIT SW.
ELECTRONIC OLSS SPEC.
OLSS CONTROLLER
ELECTRONIC OLSS SPEC.
O.P.T SWEDEN REGU.
PPC PRESS. SW.
CN-65
ARM DIGGING
ARM DUMP
BUCKET DIGGING
BUCKET DUMP
BOOM LOWERS
BOOM RAISES
SWING LEFT
SWING RIGHT
LEFT TRAVEL (REVERSE)
LEFT TRAVEL (FORWARD)
RIGHT TRAVEL (REVERSE)
RIGHT TRAVEL (FORWARD)
STRAIGHT-TRAVEL SOLENOID
SWING PARKING BRAKE SOLENOID
TRAVEL SPEED SELECTOR SOLENOID
FREE SWING SOLENOID
HEAVY LIFT SOLENOID
2-STAGE SAFTY-VALVE SOLENOID
CN-55
TO 1/3
020905
SDP00500

TABLE OF FUSE ARRANGEMENT

FUSE NO.	CONNECT TO
1	ENGINE STOP MOTOR POWER (ONLY KOMATSU ENGINE SPEC)
2	RADIO(BACK UP), ROOM LAMP, STARTING SW
3	LIGHT
4	ROTARY LAMP, FOG LAMP
5	CONTROLLERS OF MONITER, OLSS, AND WORK EQUIPMENT PANEL SW
6	AIR CONDITIONER
7	PPC OIL PRESS SW, SWING LOCK, TRAVEL SPEED SELECTOR, STRAIGHT-TRAVEL, FILTER CLOGGING TIMER, BOTTOM DUMP, FREE SWING SOLENOID VALVE AND TRAVEL ALARM
8	HORN, AIR TANK DRAIN HEATER, ENG ROOM LAMP
9	WIPER
10	CIGARET LIGHTER AND RADIO

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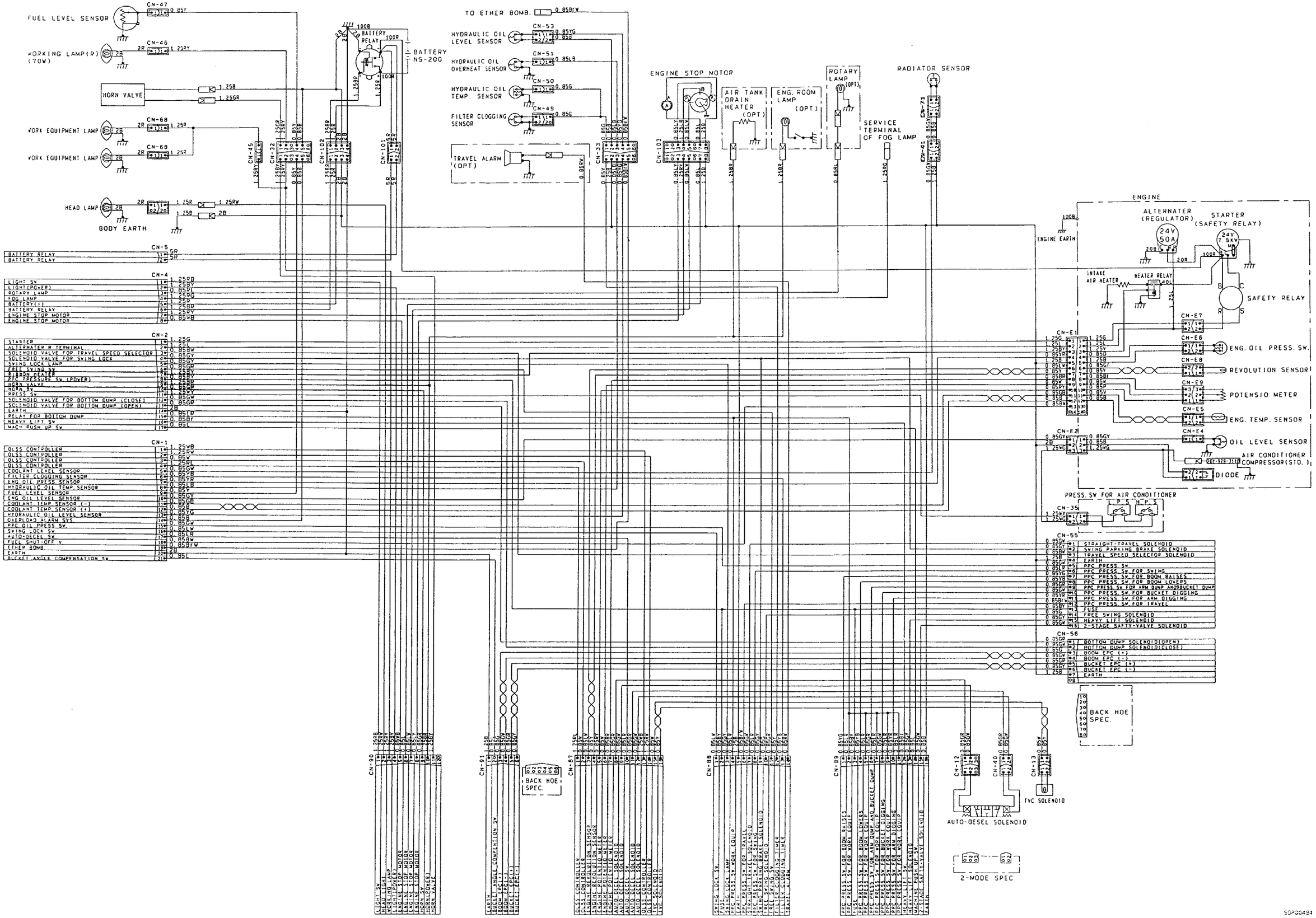
FUEL LEVEL SENSOR
CN-47
WORKING LAMP(R) (70W)
CN-46
HORN VALVE
WORK EQUIPMENT LAMP
CN-68
HEAD LAMP
BODY EARTH
BATTERY RELAY
BATTERY NS-200
TO ETHER BOMB.
HYDRAULIC OIL LEVEL SENSOR
CN-53
HYDRAULIC OIL OVERHEAT SENSOR
CN-51
HYDRAULIC OIL TEMP. SENSOR
CN-50
FILTER CLOGGING SENSOR
CN-49
TRAVEL ALARM (OPT)
ENGINE STOP MOTOR
AIR TANK DRAIN HEATER (OPT)
ENG. ROOM LAMP (OPT)
ROTARY LAMP (OPT)
SERVICE TERMINAL OF FOG LAMP
RADIATOR SENSOR
CN-78
CN-5
BATTERY RELAY
CN-4
LIGHT SW
LIGHT(POWER)
ROTARY LAMP
FOG LAMP
BATTERY(+)
BATTERY RELAY
ENGINE STOP MOTOR
CN-2
STARTER
ALTERNATER R TERMINAL
SOLENOID VALVE FOR TRAVEL SPEED SELECTOR
SOLENOID VALVE FOR SWING LOCK
SWING LOCK LAMP
FREE SWING SW
RIBBON HEATER
PPC PRESSURE SW (POWER)
HORN VALVE
HORN SW
PRESS SW
SOLENOID VALVE FOR BOTTOM DUMP (CLOSE)
SOLENOID VALVE FOR BOTTOM DUMP (OPEN)
EARTH
RELAY FOR BOTTOM DUMP
HEAVY LIFT SW
MACH. PUSH UP SW.
CN-1
QLSS CONTROLLER
COOLANT LEVEL SENSOR
FILTER CLOGGING SENSOR
ENG OIL PRESS SENSOR
HYDRAULIC OIL TEMP. SENSOR
FUEL LEVEL SENSOR
ENG OIL LEVEL SENSOR
COOLANT TEMP SENSOR (-)
COOLANT TEMP SENSOR (+)
HYDRAULIC OIL LEVEL SENSOR
OVERLOAD ALARM SYS.
PPC OIL PRESS SW.
SWING LOCK SW.
AUTO-DECEL SW.
FUEL SHUT-OFF V.
ETHER BOMB
EARTH
BUCKET ANGLE COMPENSATION SW.
ENGINE
ALTERNATER (REGULATOR)
STARTER (SAFETY RELAY)
24V 50A
24V 7.5KW
ENGINE EARTH
INTAKE AIR HEATER
HEATER RELAY
SAFETY RELAY
CN-E7
CN-E6
ENG. OIL PRESS. SW.
CN-E8
REVOLUTION SENSOR
CN-E9
POTENSIO METER
CN-E5
ENG. TEMP. SENSOR
CN-E4
OIL LEVEL SENSOR
CN-E1
CN-E2
AIR CONDITIONER COMPRESSOR(STD.)
DIODE
PRESS SW FOR AIR CONDITIONER
CN-35
CN-55
STRAIGHT-TRAVEL SOLENOID
SWING PARKING BRAKE SOLENOID
TRAVEL SPEED SELECTOR SOLENOID
EARTH
PPC PRESS SW
PPC PRESS SW FOR SWING
PPC PRESS SW FOR BOOM RAISES
PPC PRESS SW FOR BOOM LOWERS
PPC PRESS SW FOR ARM DUMP AND BUCKET DUMP
PPC PRESS SW FOR BUCKET DIGGING
PPC PRESS SW FOR ARM DIGGING
PPC PRESS SW FOR TRAVEL
FUSE
FREE SWING SOLENOID
HEAVY LIFT SOLENOID
2-STAGE SAFTY-VALVE SOLENOID
CN-56
BOTTOM DUMP SOLENOID(OPEN)
BOTTOM DUMP SOLENOID(CLOSE)
BOOM EPC (+)
BOOM EPC (-)
BUCKET EPC (+)
BUCKET EPC (-)
EARTH
BACK HOE SPEC.
CN-90
CN-91
CN-87
CN-88
CN-89
CN-12
CN-40
CN-13
TVC SOLENOID
AUTO-DESEL SOLENOID
2-MODE SPEC
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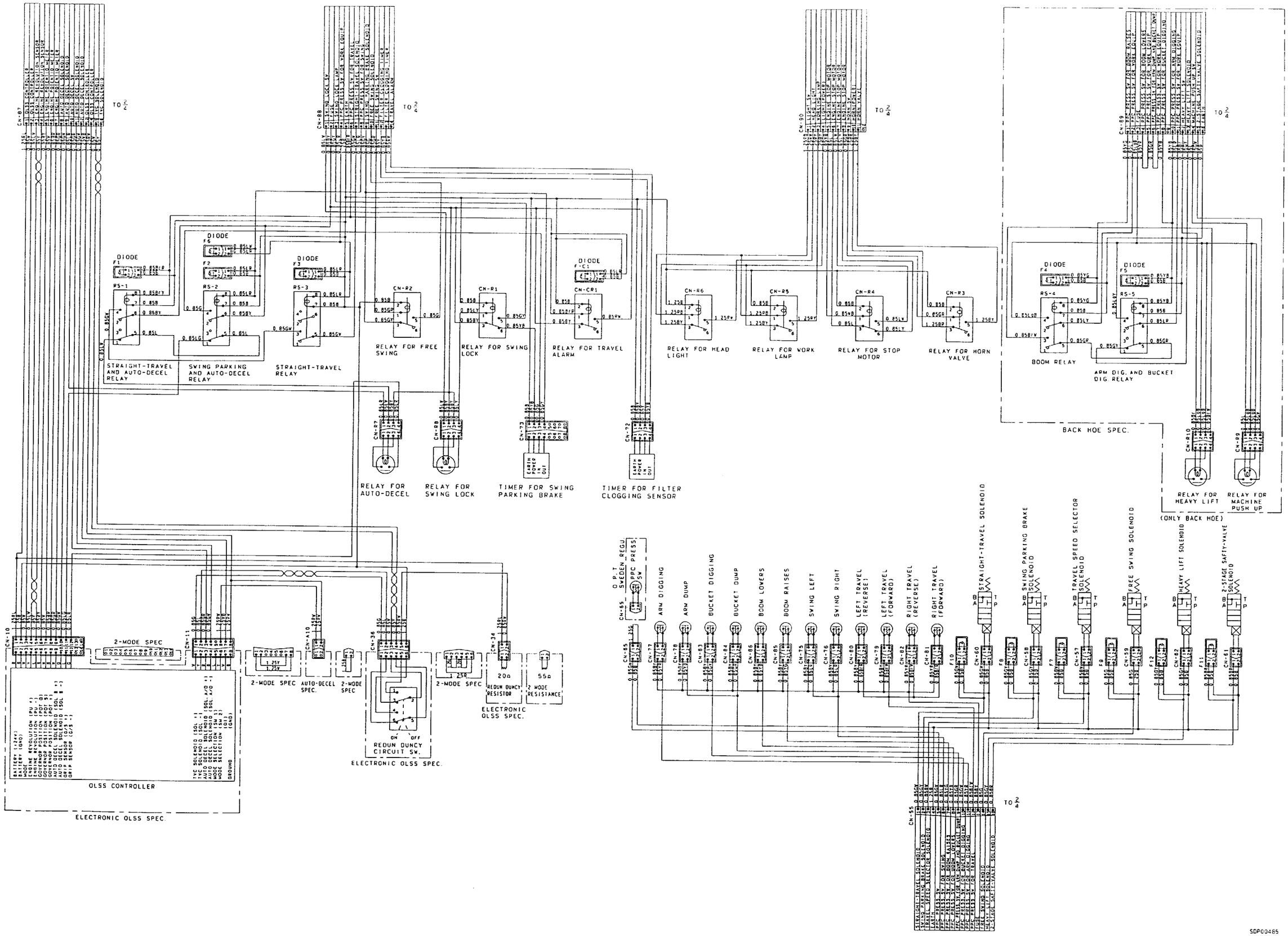
CN-87
CN-88
CN-90
CN-89
TO 2/4
DIODE F1
DIODE F2
DIODE F3
DIODE F6
DIODE F-C1
DIODE F4
DIODE F5
RS-1
RS-2
RS-3
RS-4
RS-5
CN-R1
CN-R2
CN-R3
CN-R4
CN-R5
CN-R6
CN-CR1
STRAIGHT-TRAVEL AND AUTO-DECEL RELAY
SWING PARKING AND AUTO-DECEL RELAY
STRAIGHT-TRAVEL RELAY
RELAY FOR FREE SWING
RELAY FOR SWING LOCK
RELAY FOR TRAVEL ALARM
RELAY FOR HEAD LIGHT
RELAY FOR WORK LAMP
RELAY FOR STOP MOTOR
RELAY FOR HORN VALVE
BOOM RELAY
ARM DIG. AND BUCKET DIG. RELAY
BACK HOE SPEC.
CN-87
CN-88
CN-73
CN-72
RELAY FOR AUTO-DECEL
RELAY FOR SWING LOCK
TIMER FOR SWING PARKING BRAKE
TIMER FOR FILTER CLOGGING SENSOR
CN-R10
CN-R9
RELAY FOR HEAVY LIFT
RELAY FOR MACHINE PUSH UP
(ONLY BACK HOE)
CN-10
CN-11
CN-A10
CN-36
CN-34
2-MODE SPEC
2-MODE SPEC
AUTO-DECEL SPEC.
2-MODE SPEC
2-MODE SPEC
20Ω
REDUN DUNCY RESISTOR
55Ω
2 MODE RESISTANCE
ON
OFF
REDUN DUNCY CIRCUIT SW.
ELECTRONIC OLSS SPEC.
ELECTRONIC OLSS SPEC.
OLSS CONTROLLER
ELECTRONIC OLSS SPEC.
O P T
SWEDEN REGU
PPC PRESS SW
CN-65
CN-55
ARM DIGGING
ARM DUMP
BUCKET DIGGING
BUCKET DUMP
BOOM LOWERS
BOOM RAISES
SWING LEFT
SWING RIGHT
LEFT TRAVEL (REVERSE)
LEFT TRAVEL (FORWARD)
RIGHT TRAVEL (REVERSE)
RIGHT TRAVEL (FORWARD)
STRAIGHT-TRAVEL SOLENOID
SWING PARKING BRAKE SOLENOID
TRAVEL SPEED SELECTOR SOLENOID
FREE SWING SOLENOID
HEAVY LIFT SOLENOID
2-STAGE SAFTY-VALVE SOLENOID
TO 2/4
SDP00485

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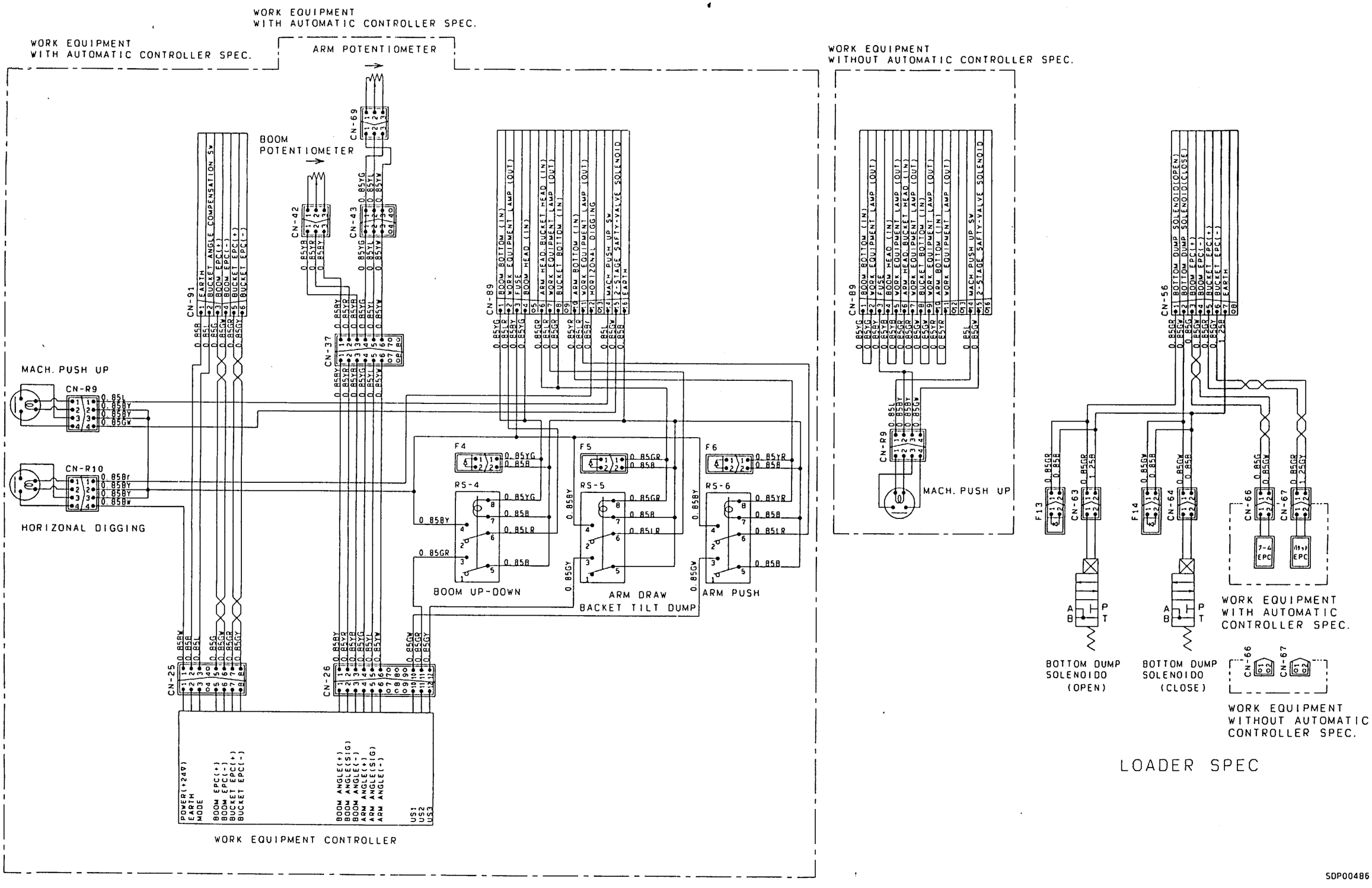
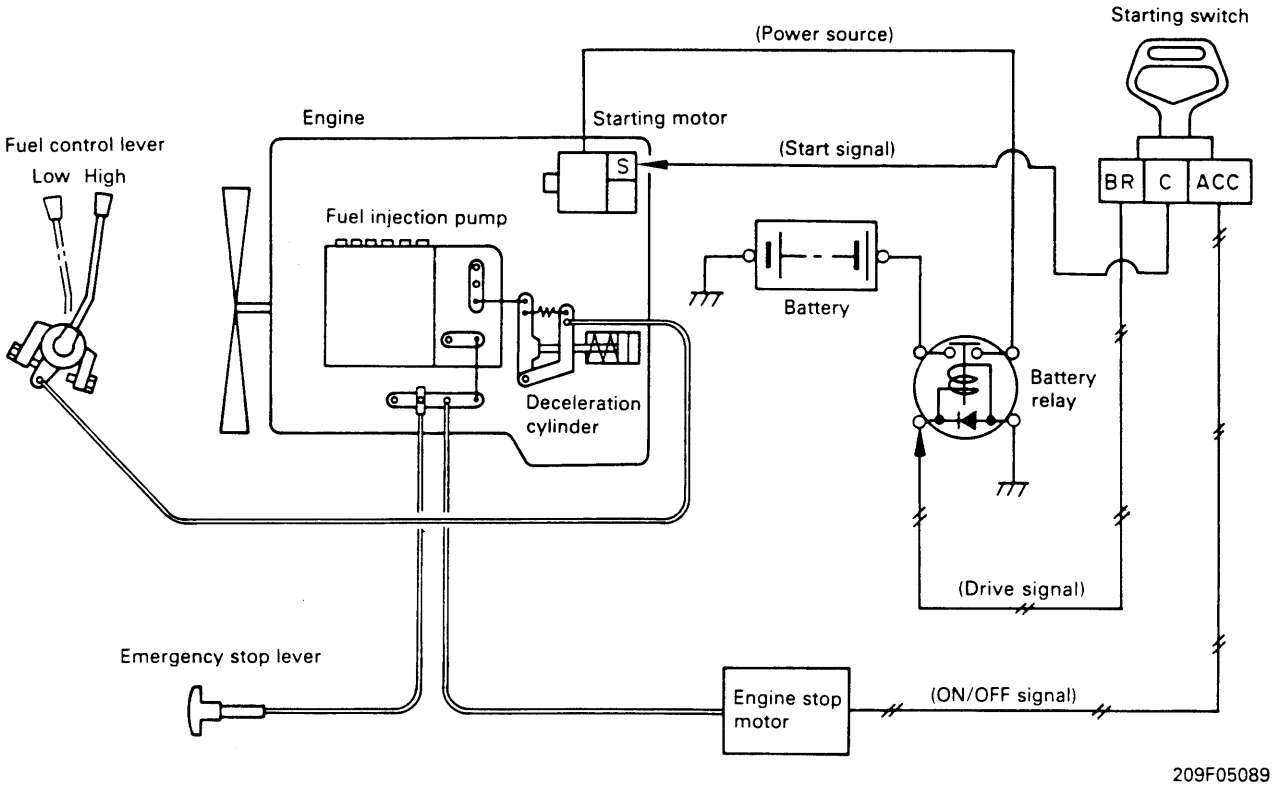

WORK EQUIPMENT
WITH AUTOMATIC CONTROLLER SPEC.
ARM POTENTIOMETER
BOOM
POTENTIOMETER
MACH. PUSH UP
HORIZONAL DIGGING
BOOM UP-DOWN
ARM DRAW
BACKET TILT DUMP
ARM PUSH
WORK EQUIPMENT CONTROLLER
WORK EQUIPMENT
WITHOUT AUTOMATIC CONTROLLER SPEC.
BOTTOM DUMP
SOLENOIDO
(OPEN)
BOTTOM DUMP
SOLENOIDO
(CLOSE)
WORK EQUIPMENT
WITH AUTOMATIC
CONTROLLER SPEC.
WORK EQUIPMENT
WITHOUT AUTOMATIC
CONTROLLER SPEC.
LOADER SPEC
020905
SDP00486

ENGINE CONTROL



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OUTLINE

- The engine is stopped and started with the starting switch.
- The engine speed is controlled by the lever.
- A mechanical type emergency stop lever is provided on the outside of the chassis in case there should be any trouble in the electrical circuit.

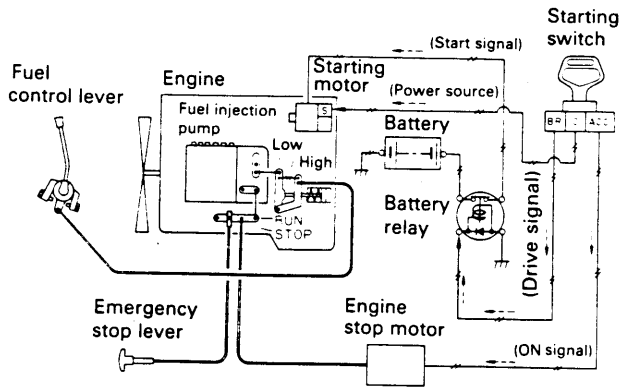
★ For details of the auto-deceleration function, see MACHINE CONTROL SYSTEM.

OPERATION

1) Starting engine

When the starting switch is turned to the START position, the starting signal flows to the starting motor, and the starting motor rotates to start the engine.

When this happens, the engine stop motor is actuated by the signal from the starting switch, and the cable is kept extended.



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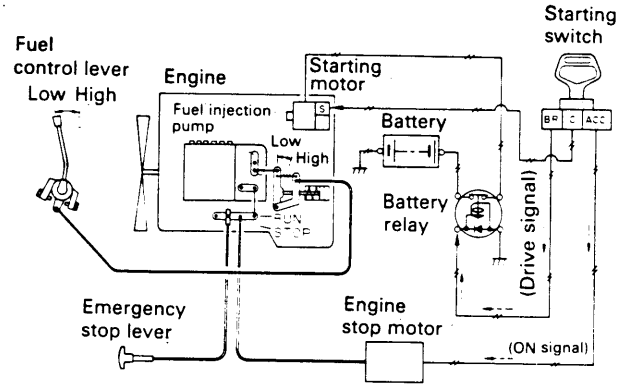
2) Controlling engine speed

The engine speed is controlled with the fuel control lever.



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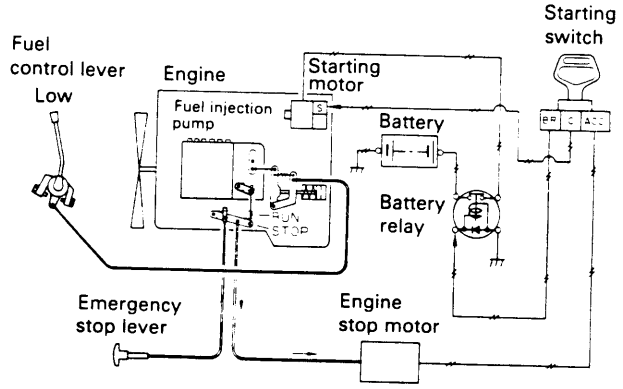
3) Stopping engine

When the starting switch is turned to the STOP position, the stop signal flows to the engine stop motor.

This actuates the motor to retract the cable and moves the fuel injection pump stop lever to the STOP position to stop the engine.



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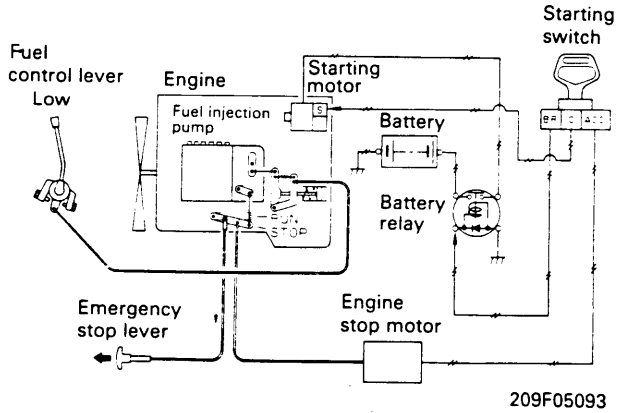
★ Emergency stop

If there should be any trouble in the electrical system and the engine stop motor is not actuated, pull the emergency stop lever on the right side outside the revolving frame to stop the engine.



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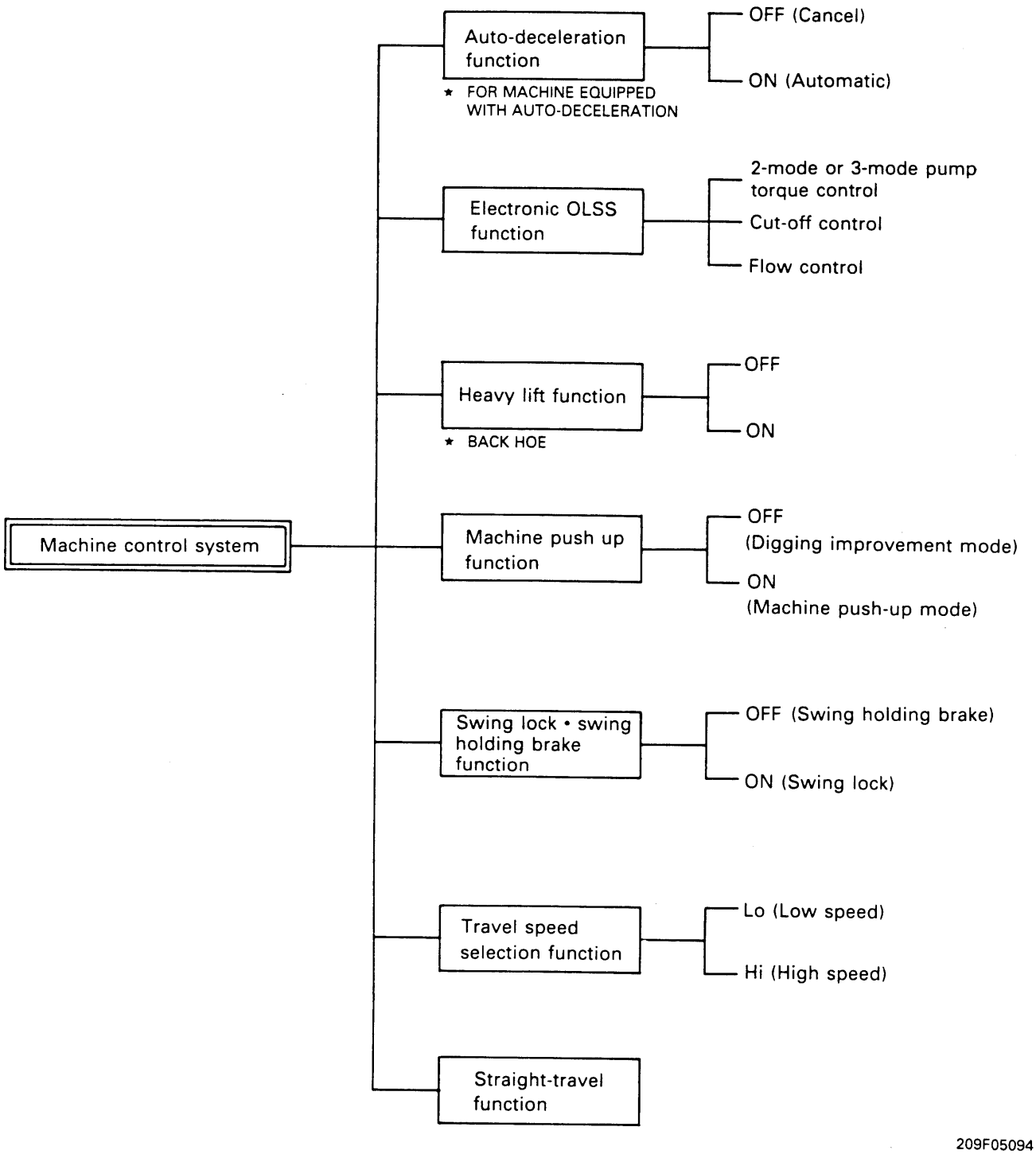
MACHINE CONTROL SYSTEM

CONTROL FUNCTION



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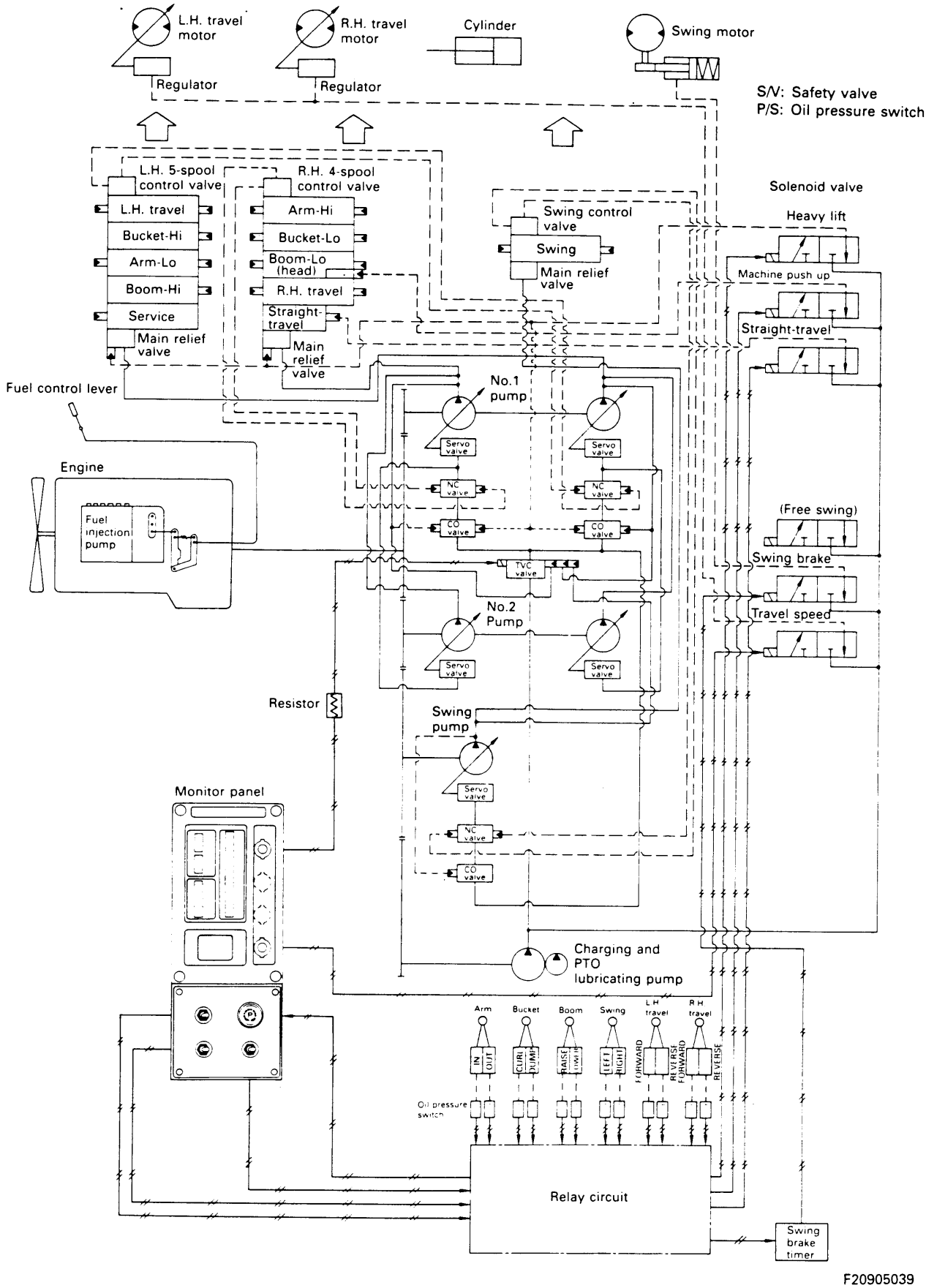
TOTAL SYSTEM DIAGRAM

BACK HOE

★ **FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS**



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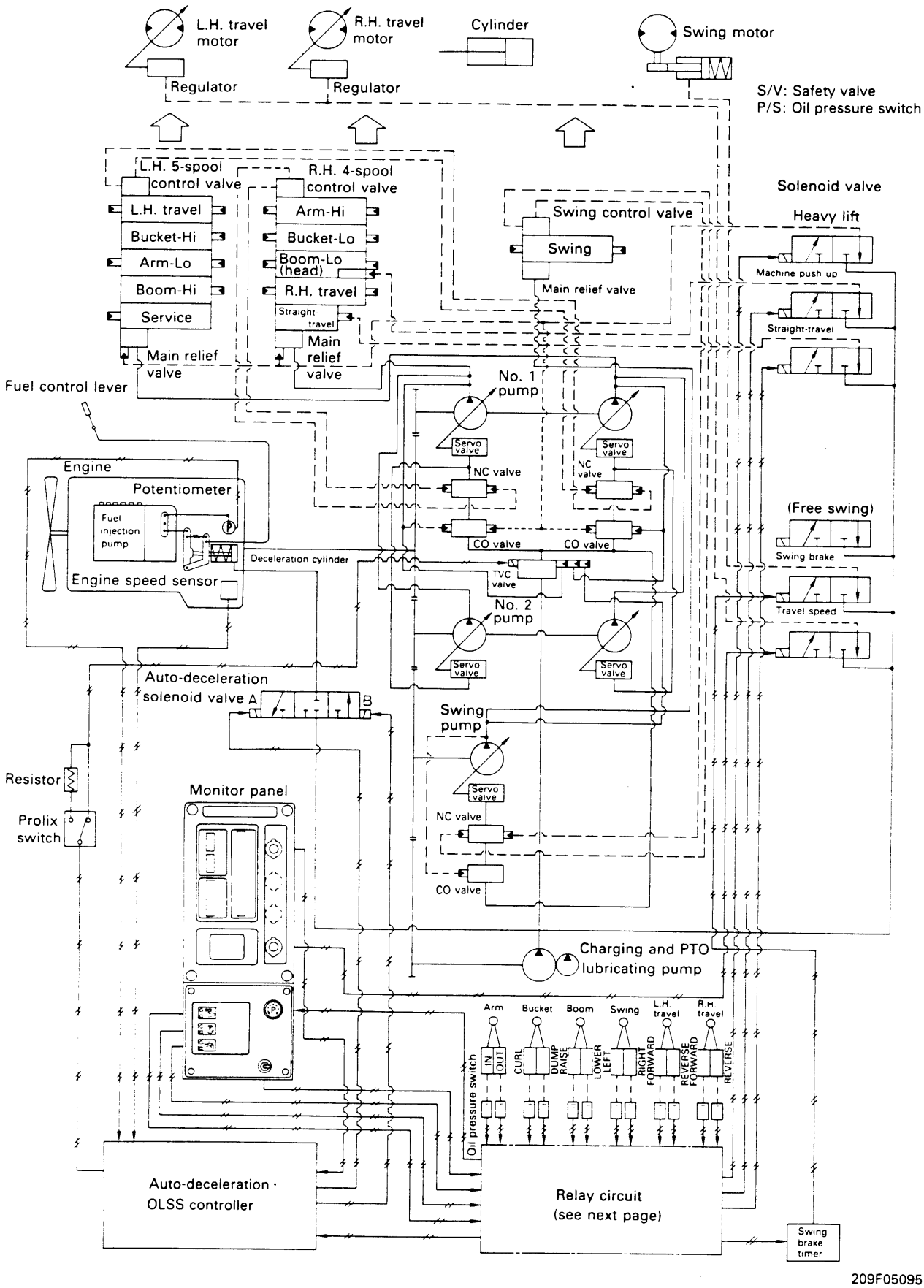
BACK HOE

★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION



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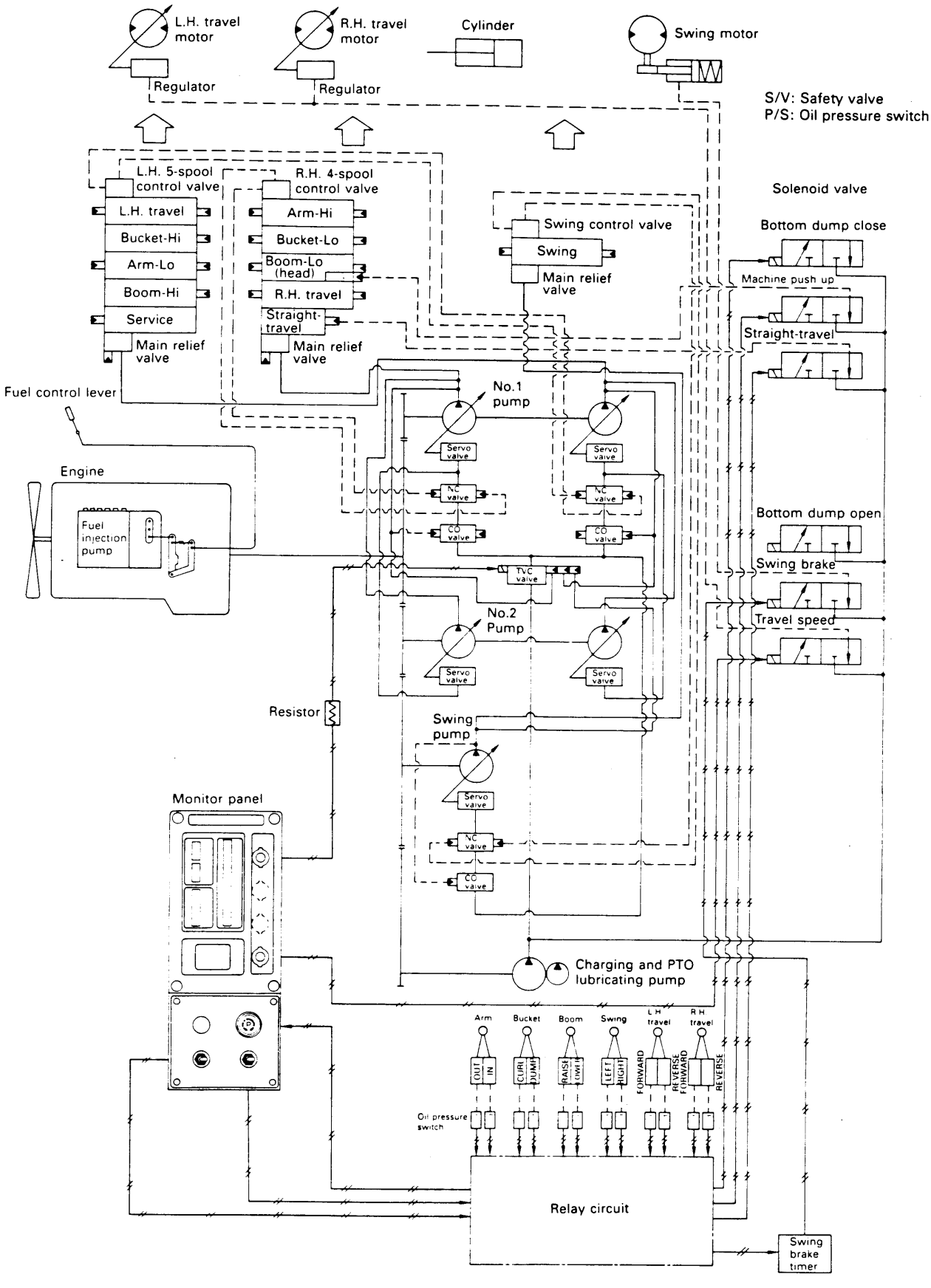
LOADING SHOVEL

★ **FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS**



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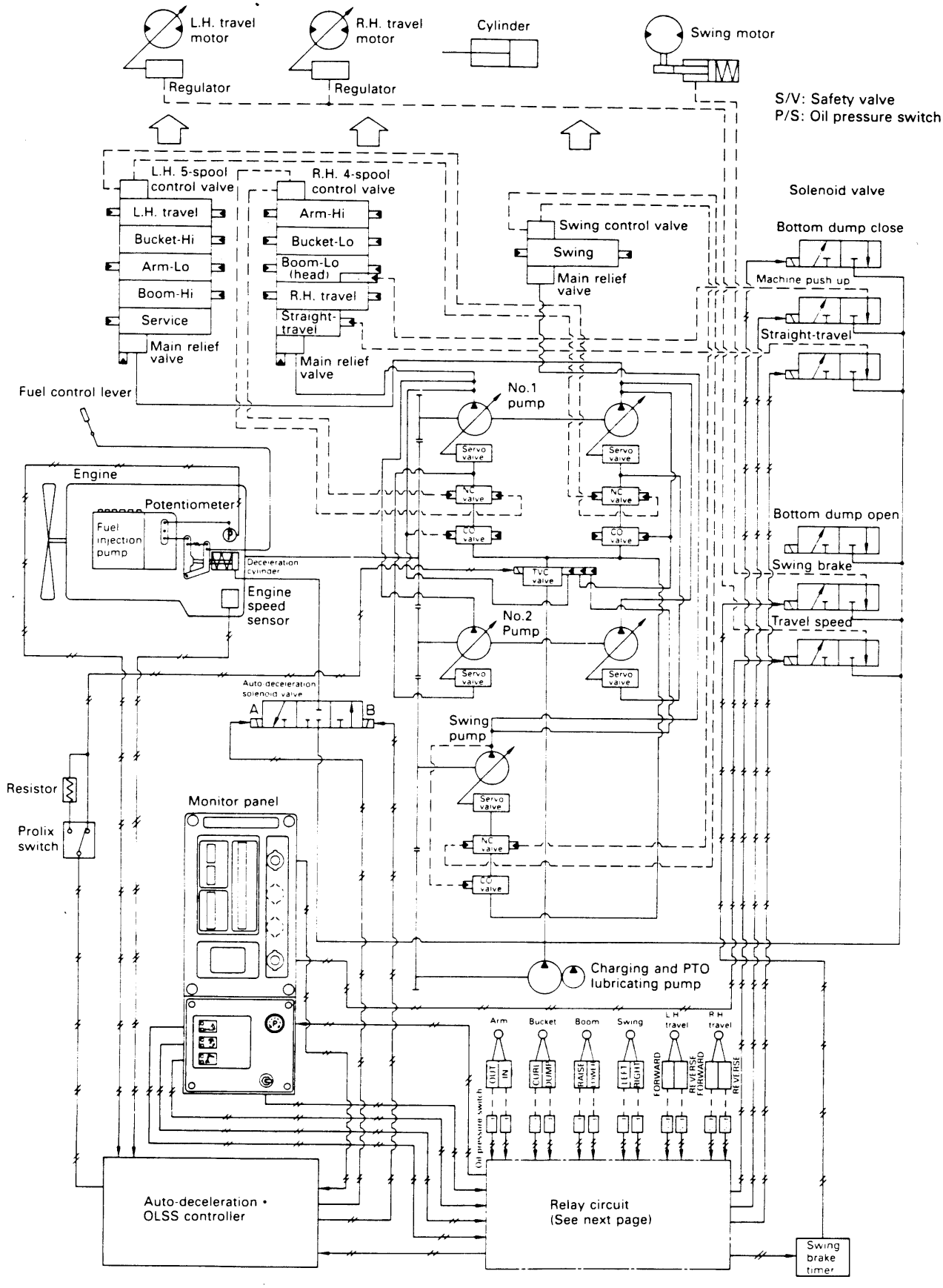
LOADING SHOVEL

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**



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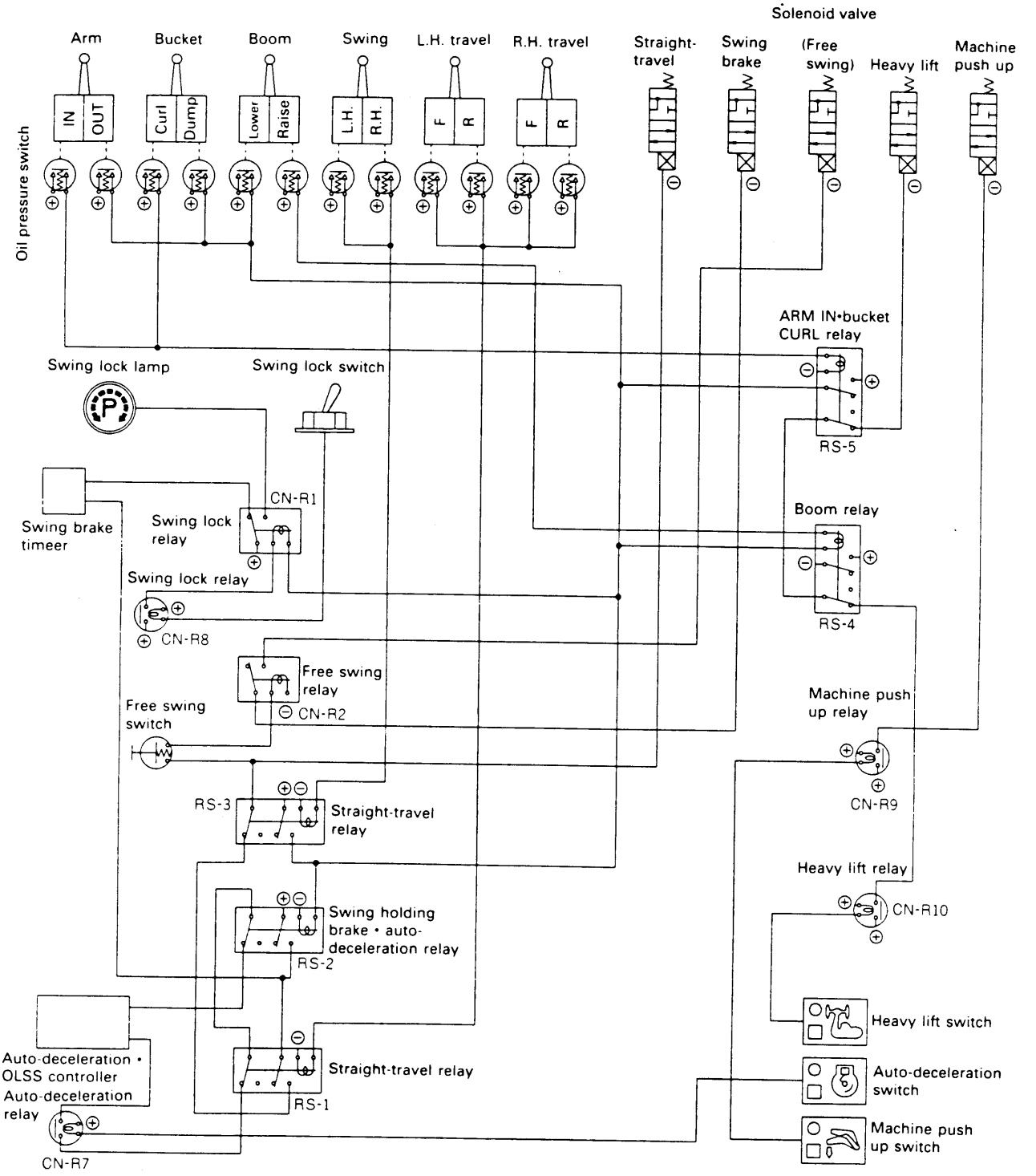
RELAY CIRCUIT DIAGRAM
BACK HOE

The machine control system uses 11 relays, and the structure of the circuits is as shown below.
(The travel speed solenoid system does not pass through the relay circuit: the switch and solenoid are connected directly.)

PC650-5: 20001 – 20096, 20099 – 20103, 20106 – 20108
PC710-5: 10001 – 10085



(+): Power source (+24V)
(–): Ground

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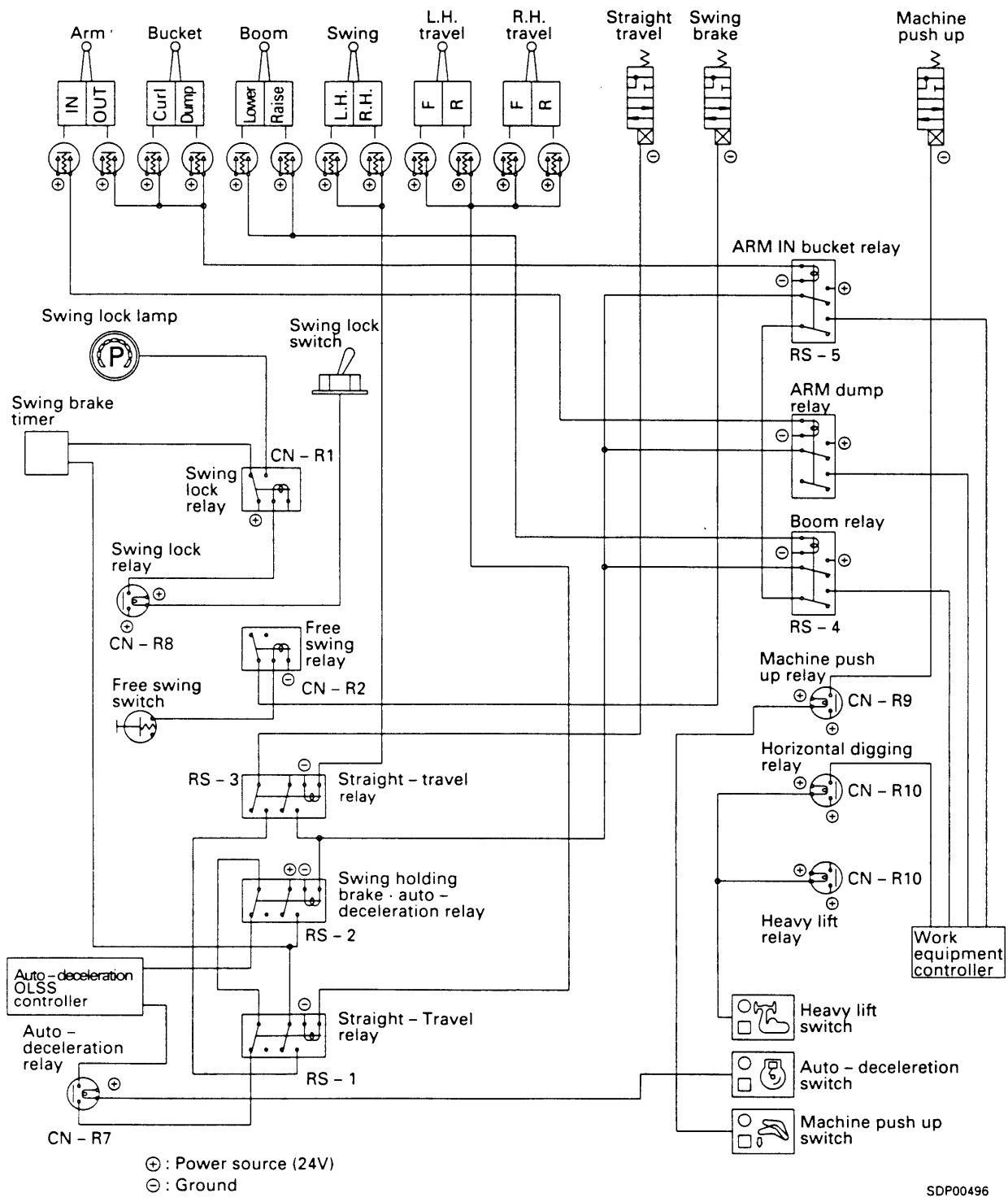
LOADING SHOVEL

The machine control system uses 12 relays, and the structure of the circuits is as shown below.
(The travel speed solenoid system does not pass through the relay circuit: the switch and solenoid are connected directly.)

PC650-5: 20001 – 20096, 20099 – 20103, 20106 – 20108
PC710-5: 10001 – 10085



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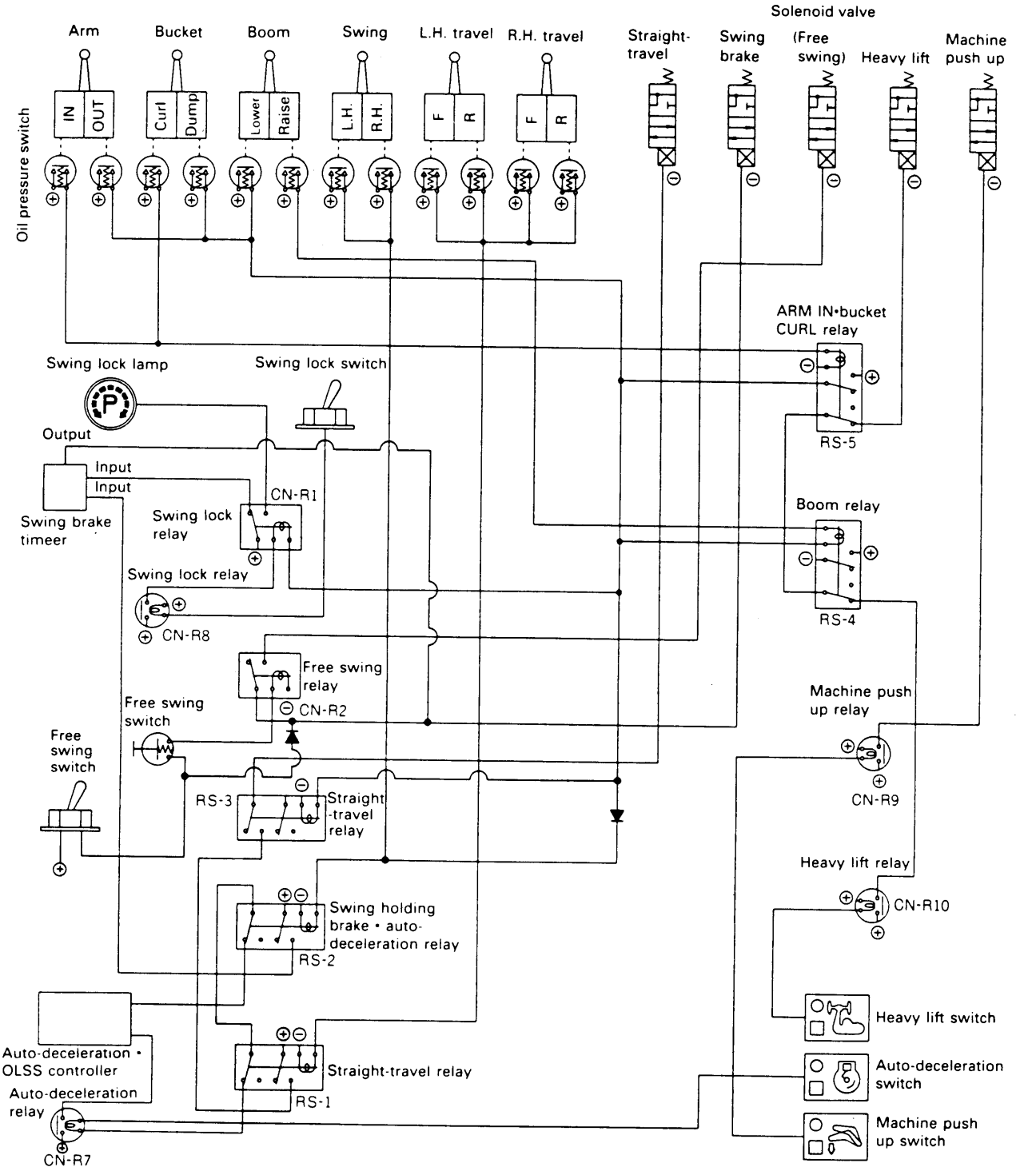
BACK HOE

The machine control system uses 11 relays, and the structure of the circuits is as shown below.
(The travel speed solenoid system does not pass through the relay circuit: the switch and solenoid are connected directly.)

PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up



(+): Power source (+24V)
(–): Ground

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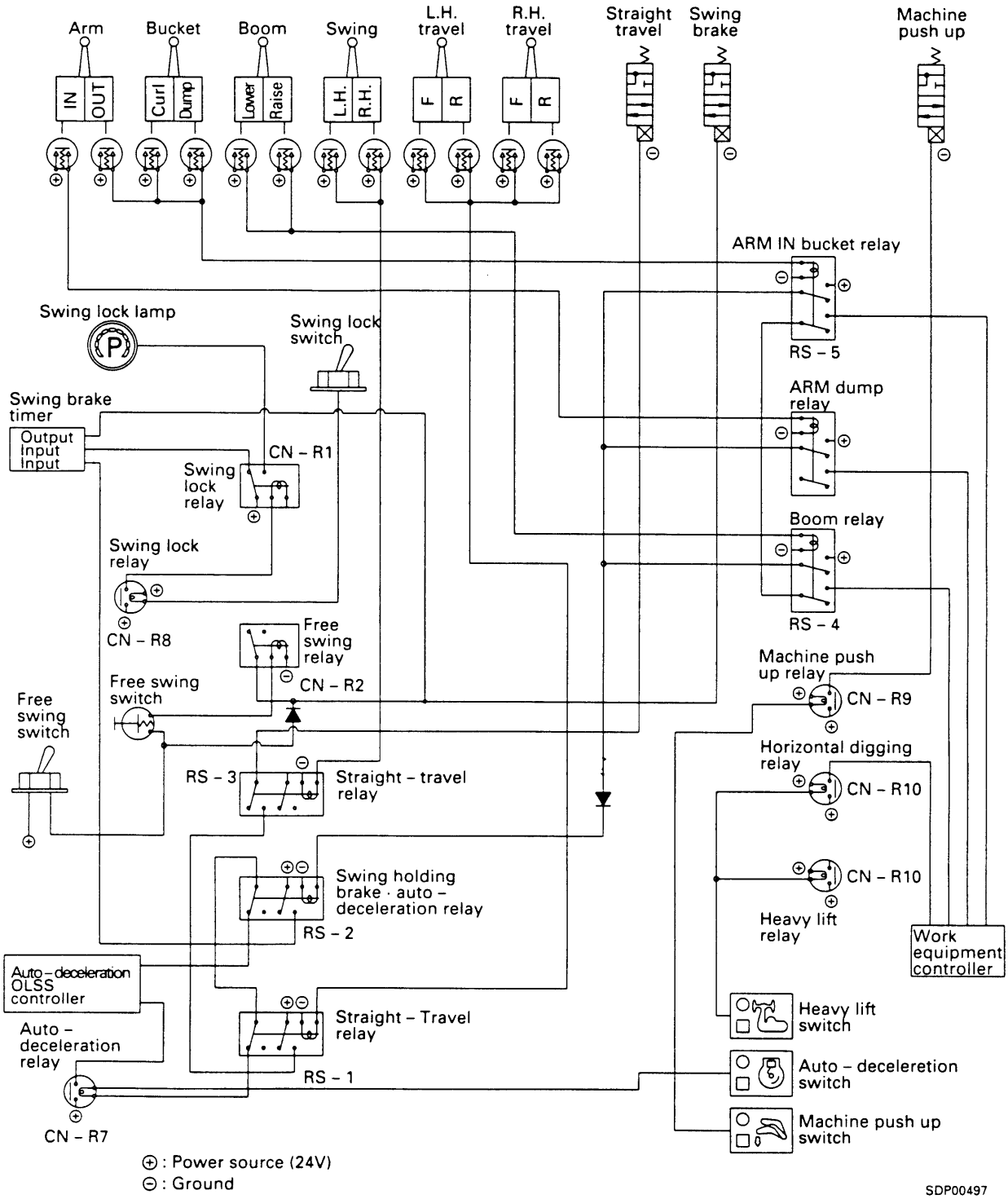
020905

LOADING SHOVEL

The machine control system uses 12 relays, and the structure of the circuits is as shown below.
(The travel speed solenoid system does not pass through the relay circuit: the switch and solenoid are connected directly.)

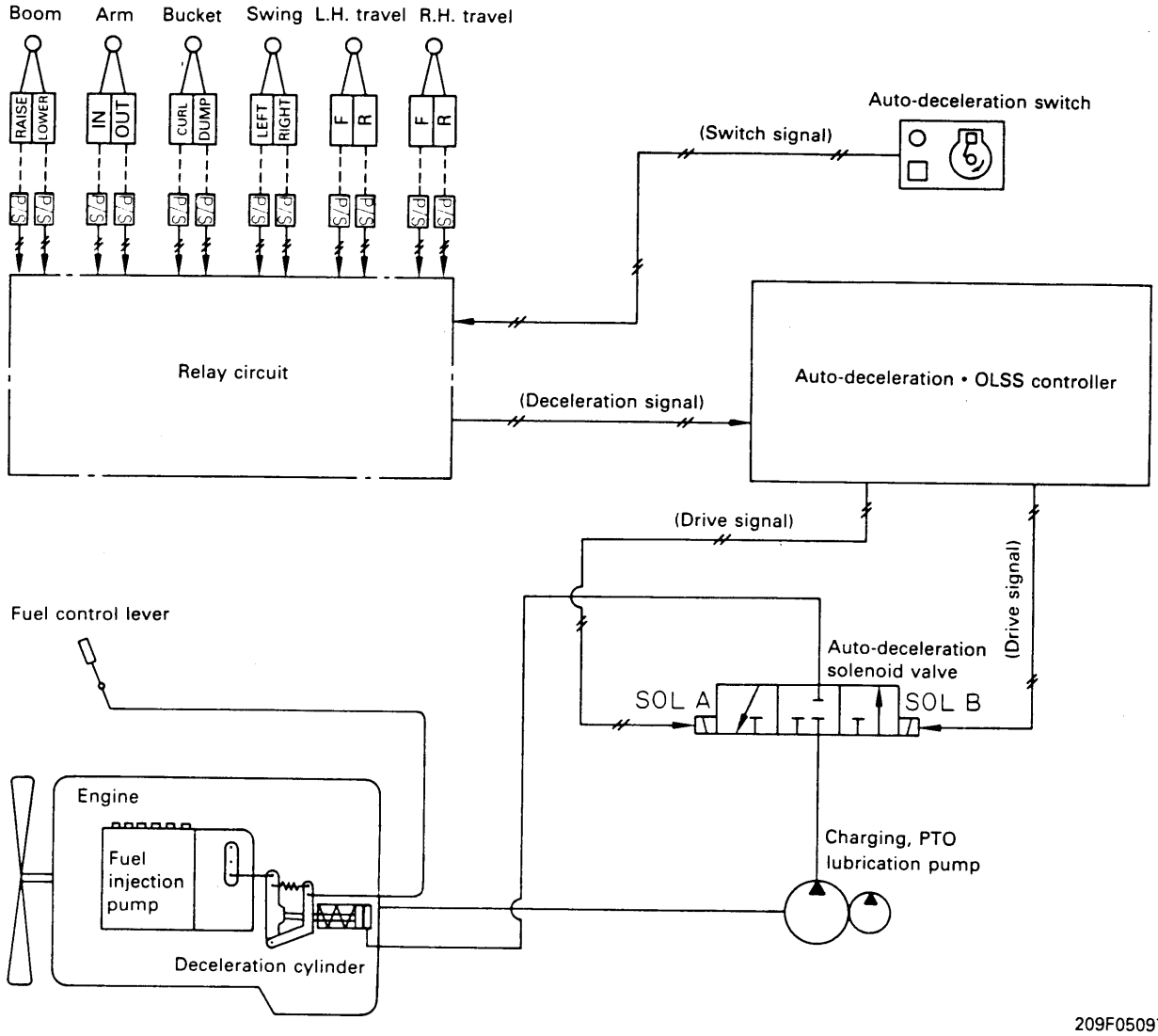
PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up



020905

1. AUTO-DECELERATION FUNCTION

★ **FOR MACHINE EQUIPPED WITH AUTO-DECELERATION**



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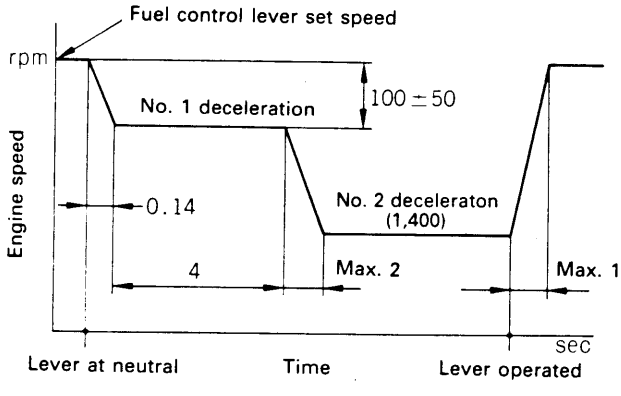
OUTLINE

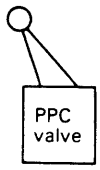
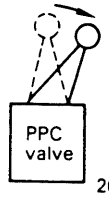
- When all the control levers are at neutral, such as when waiting for work, the engine speed is automatically lowered to a mid-range speed (deceleration speed) to save fuel and to reduce noise.
- When work is started again, the engine speed immediately rises to the set speed.



209F05098

OPERATION

- When fuel control lever is at high idling and auto-deceleration switch is ON

Control lever		Operated	Neutral	Operated
		 209F05099	 209F05100	 209F05101
Auto-deceleration solenoid valve	Solenoid A	24V / 0V		
	Solenoid B	24V / 0V	0.14 sec. 4.0 sec.	
Deceleration category		Not actuated	No. 1 deceleration	No. 2 deceleration / Reset
Engine speed		High idling	2,000 – 2,050 rpm	1,350 – 1,450 rpm / High idling

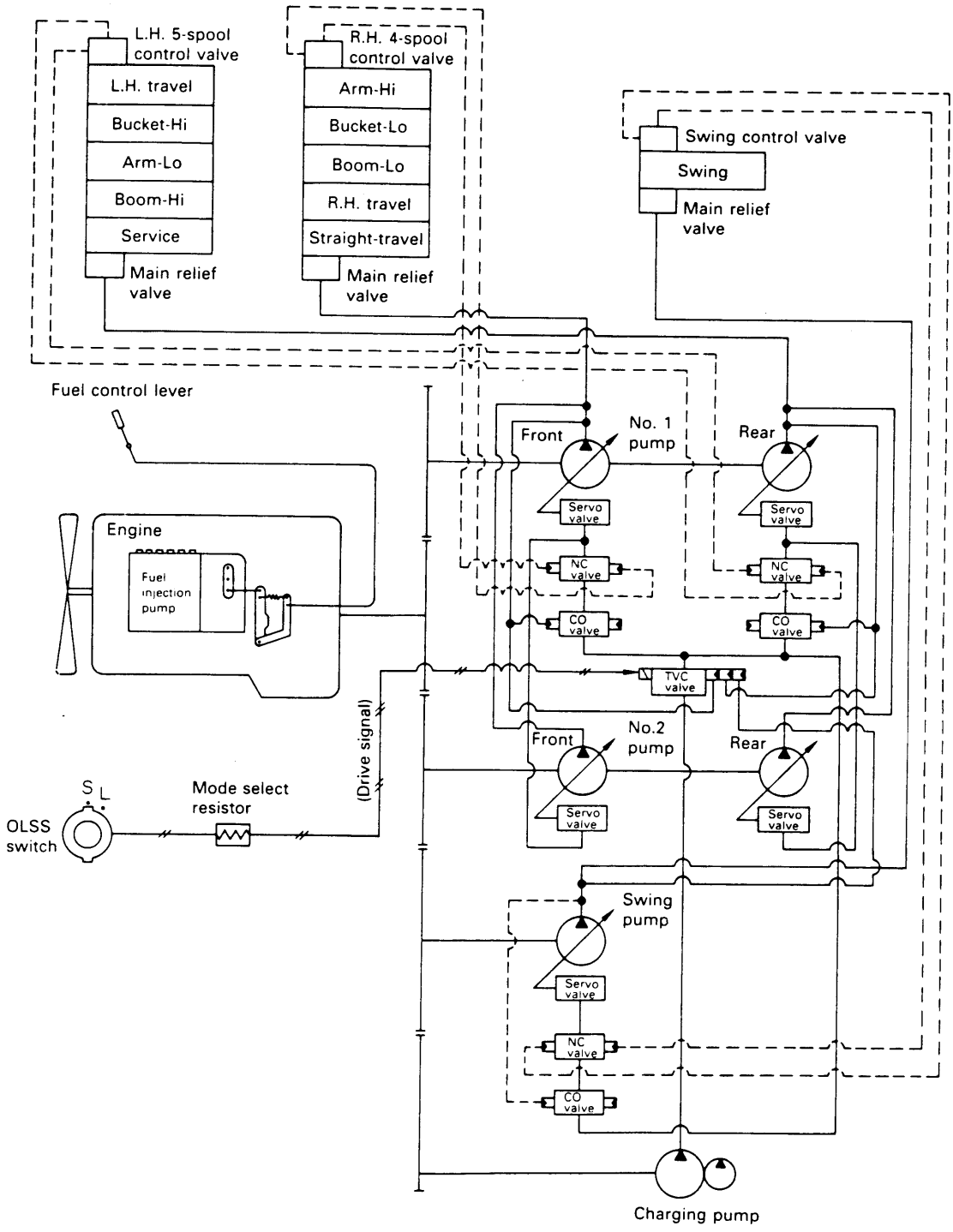
020905

★ Auto-deceleration solenoid valve
For details of the structure and operation, see SOLENOID VALVE ASSEMBLY.

★ Auto-deceleration cylinder
For details of the structure and operation, see AUTO-DECELERATION CYLINDER.

2. ELECTRONIC OLSS FUNCTION

★ **FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS**



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OUTLINE

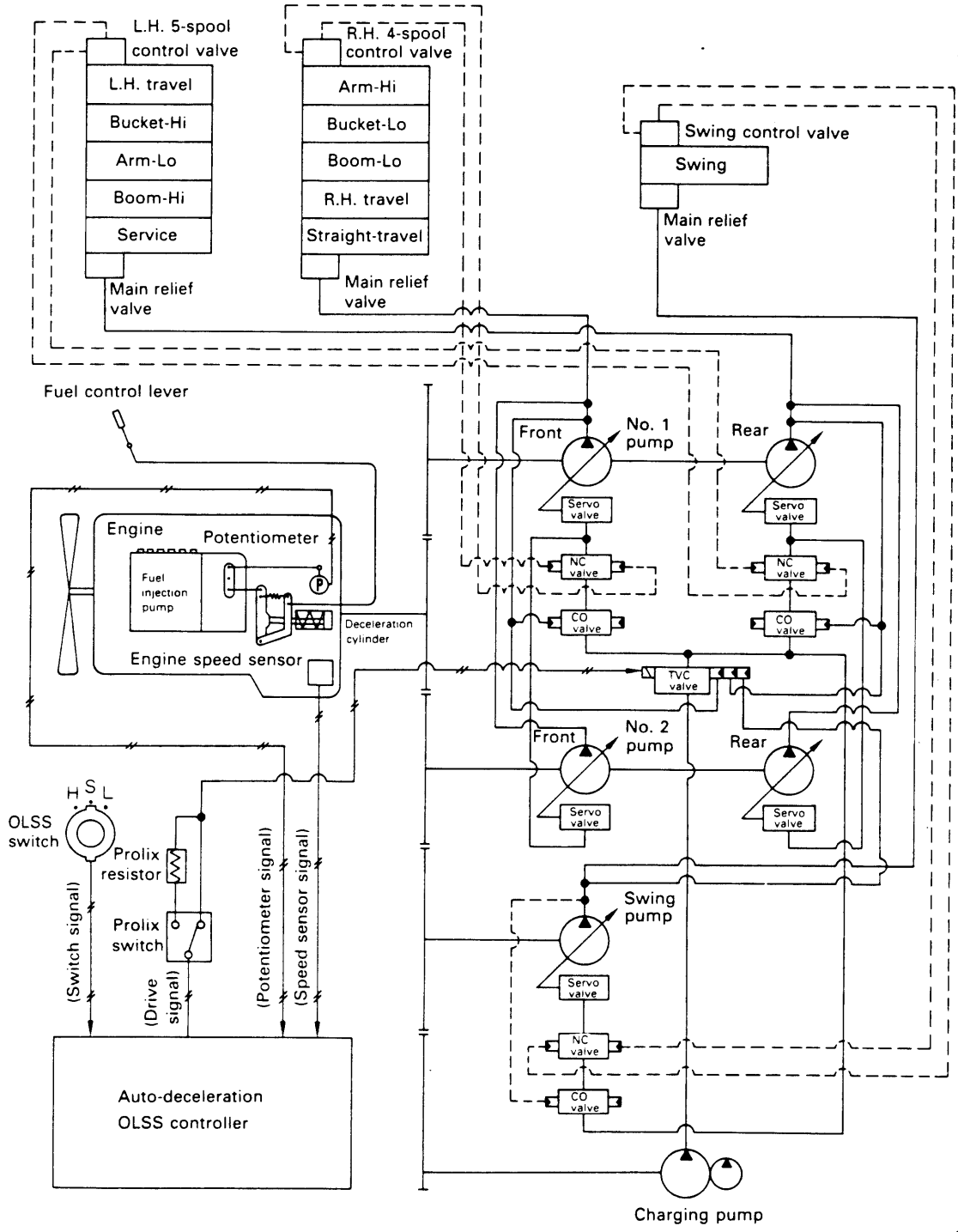
The electronic OLSS (Electronic type Open center Load Sensing System) controls the angle (discharge volume) of the swash plate type variable displacement pump, to reduce the various type of hydraulic loss that occur during operation, and to improve the ease of fine control. This system also maintains the optimum matching between the engine and the pump to reduce fuel consumption.

It is possible to set the pump absorption torque to two or three stages,

- 2-stage: S mode, L mode,
- 3-stage: H mode, S mode, L mode.

By selecting the L mode during light operations, it is possible to further reduce the fuel consumption.

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS**



020905

OPERATION

1) Mode selection pump torque control function

- H mode: Engine speed sensing control
  - ★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS

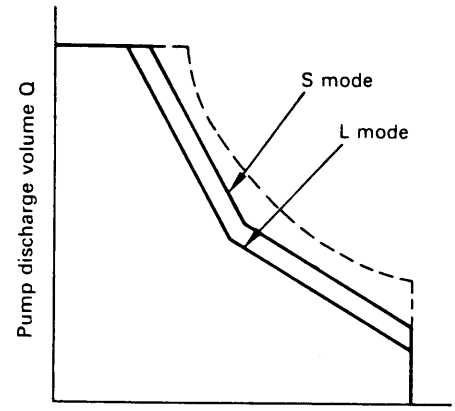
  The engine speed set by the governor (potentiometer) and the actual engine speed (engine speed sensor) are detected, and based on these, the controller carries out controls so that the pump absorption torque always matches at the engine rated output point. In other words, even if there is a change in the load during operations, the pump absorption torque is changed so that the work can always be carried out at the engine rated output point.
- S mode: Hydraulic sensing control
  The pump absorption torque is set to a lower constant than with the H mode, and hydraulic sensing control is carried out according to that absorption torque.
- ★ Hydraulic sensing (pressure compensation)
  The discharge amount is controlled to match the discharge pressure according to the constant pump absorption torque that has been set.
- L mode: Hydraulic sensing
  The pump absorption torque is set to an even lower constant than with the S mode, and hydraulic sensing control is carried out according to that absorption torque.
- When prolix switch is ON
  - ★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS

  If any abnormality should occur in the controller, the prolix switch can be turned ON to set the pump absorption torque to a lower constant than in H mode, and hydraulic sensing is carried out according to that absorption torque.

2) Flow control function

- The discharge flow is adjusted according to the travel of the control lever (flow needed by control valve) to improve the ease of operation and to reduce the fuel consumption.
- When the levers are at neutral, the pump discharge volume is set to the minimum to reduce any waste flow of oil. When the lever is operated, the discharge amount is set according to the travel of the lever, and this reduces any waste flow during fine control operations, and also improves the response of the work equipment when the lever is operated to the full position.

★ FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS



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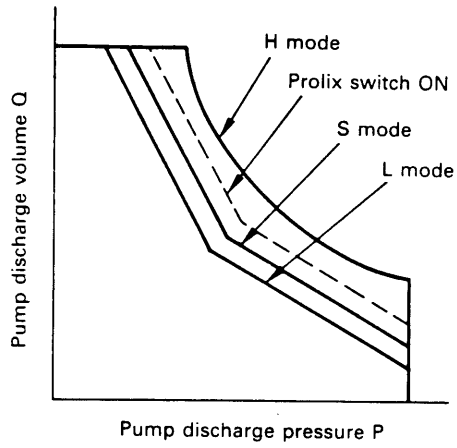
★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS



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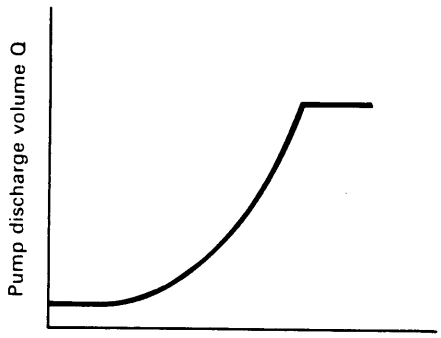

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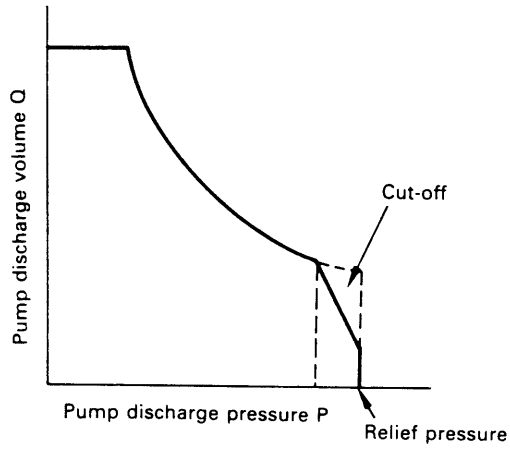
3) Cut-off function

- If the load becomes large during operation, and the pump discharge pressure comes close to the relief pressure, the pump discharge volume is reduced to reduce the relief loss.
- It is also provided with a cancel function to cancel the cut-off function when the main relief pressure has been raised by using the heavy lift function.



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★ TVC valve
For details of the structure and operation, see NO. 1 PUMP.

★ CO•NC valve
For details of the structure and operation, see NO. 1 PUMP.

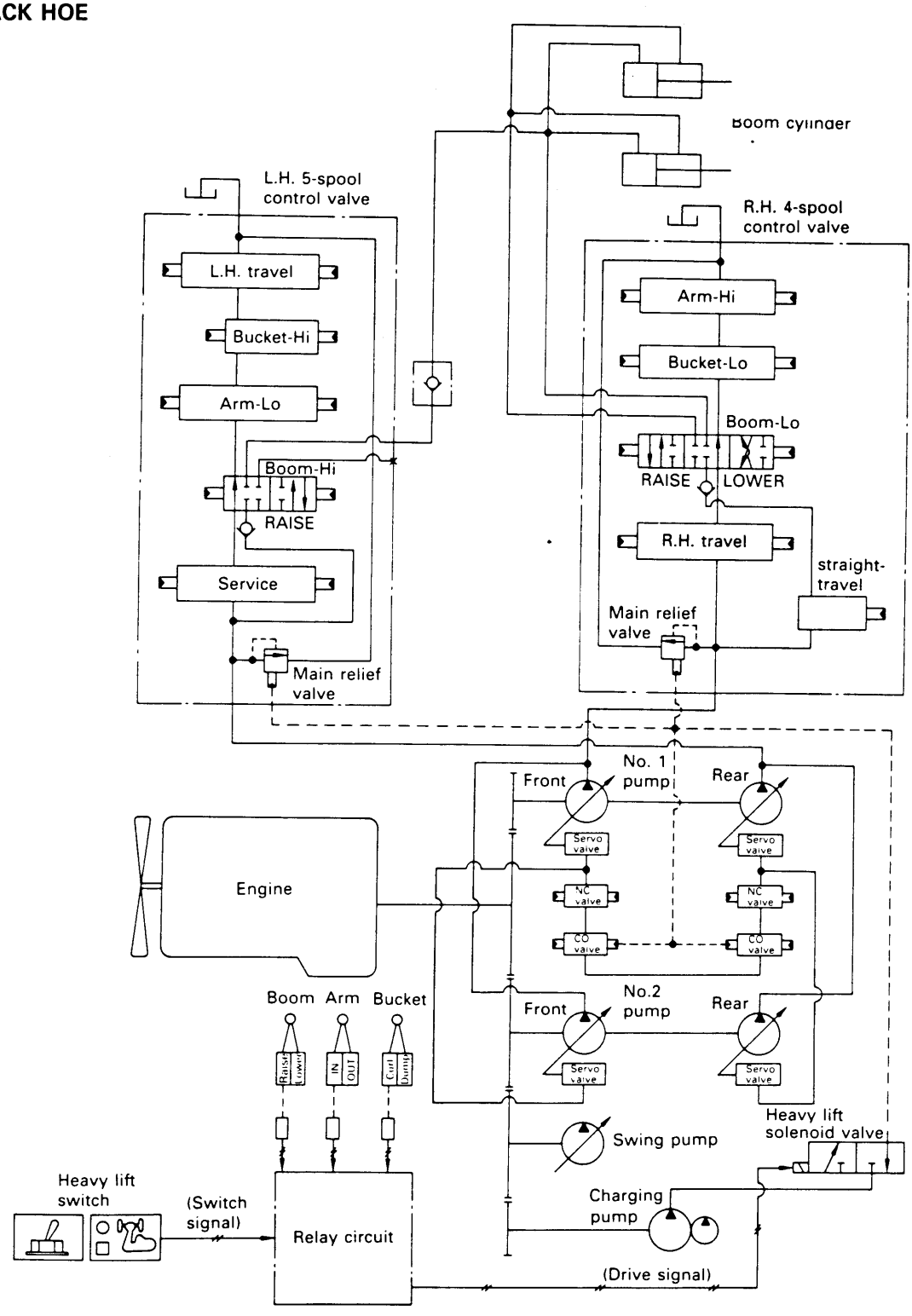
★ Jet sensor
For details of the structure and operation, see SWING CONTROL VALVE.

★ Servo valve
For details of the structure and operation, see NO. 1 PUMP.

020905

3. HEAVY LIFT FUNCTION

BACK HOE



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020905

OUTLINE

- This function increases the lifting force of the boom by approx. 10%.
- It is actuated only when the boom RAISE is operated independently.
  If the arm IN or bucket CURL is operated at the same time, it is automatically canceled.

OPERATION

Heavy lift switch	Lever operation		Heavy lift solenoid valve	Main relief valve set pressure (kg/cm²)	CO valve	Boom lifting force	Remarks
	Boom RAISE	Arm IN or Bucket CURL					
OFF	Operated	–	Deactivated	320	Actuated	Normal	
ON	Operated	Neutral	Excited	350	Canceled	10% up	
		Operated	If the arm IN or bucket CURL is operated during boom RAISE operations, this function is automatically canceled. This produces the same condition as when the switch is turned OFF.			Normal	

★ Heavy lift solenoid valve
For details of the structure and operation, see SOLENOID VALVE ASSEMBLY.

★ CO valve
For details of the structure and operation, see NO. 1 PUMP.

★ Main relief valve
For details of the structure and operation, see L.H. 5-SPOOL CONTROL VALVE.

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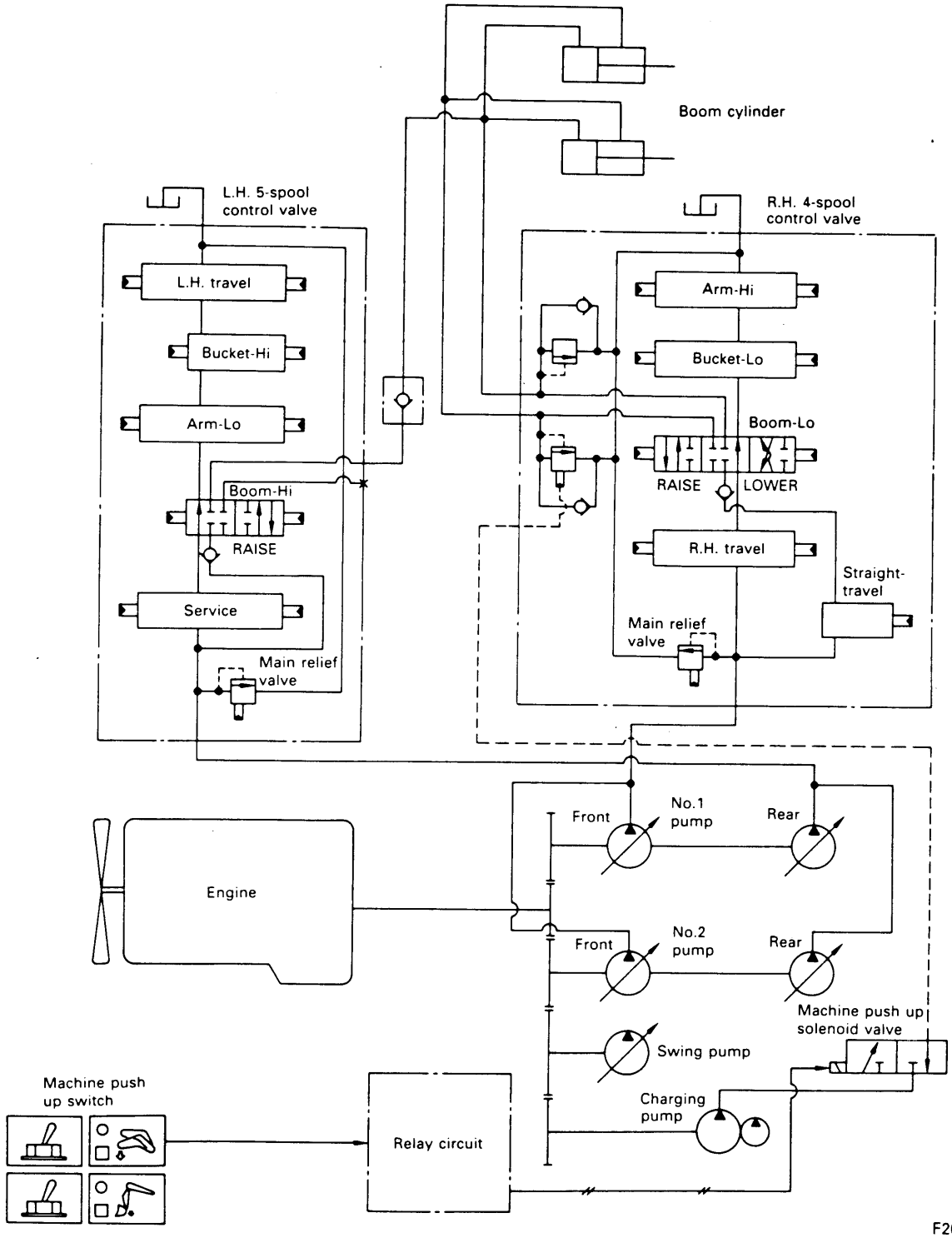
4. MACHINE PUSH UP FUNCTION



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OUTLINE

- This function switches the pushing force of the boom to increase the pushing force and the digging efficiency by reducing the digging resistance of the boom. This helps to increase the ease of operation in cutting roots, digging square holes, twist swing, and escaping from soft ground.

OPERATION

- This function is carried out by switching the set pressure of the safety valve at the boom cylinder head end of the R.H. 4-spool control valve boom-Lo to two levels: low pressure (190 kg/cm²) and high pressure (340 kg/cm²).
- For details of the operation, see the following table.

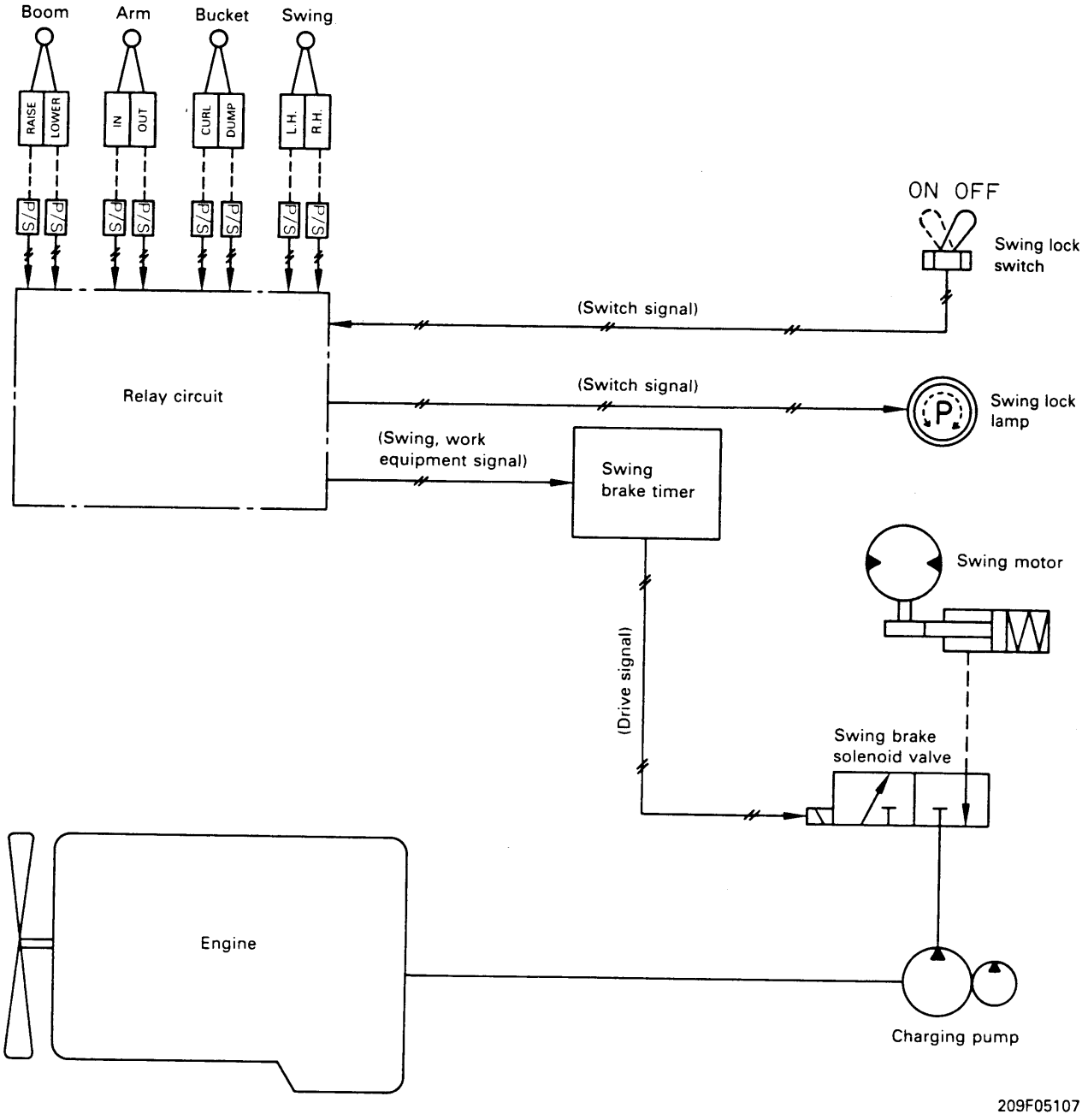
Mode	Machine push up switch	Machine push up solenoid valve	Safety valve set pressure (kg/cm²)	Effect
Digging improvement mode	OFF	Deactivated	190	By reducing the push force of the boom, the boom is automatically able to escape in the RAISE direction. This means that the boom needs to be operated in the RAISE direction less frequently, thereby enabling digging to be carried out smoothly.
Machine push up mode	ON	Excited	340	By increasing the thrust force for boom LOWER, the ease of operation is increased for cutting roots, digging square holes, twist swing, or escaping from soft ground.

020905

★ Machine push up solenoid
For details of the structure and operation, see SOLENOID VALVE ASSEMBLY.

★ Boom safety valve
For details of the structure and operation, see R.H. 4-SPOOL CONTROL VALVE.

5. SWING LOCK, SWING HOLDING BRAKE FUNCTION



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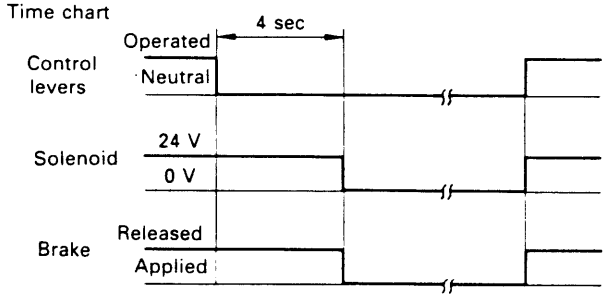
OUTLINE

- A swing lock (manual type) and swing mechanical brake (automatic type) are employed to allow the swing to be locked at the desired position and to prevent hydraulic drift after the swing is stopped.

OPERATION

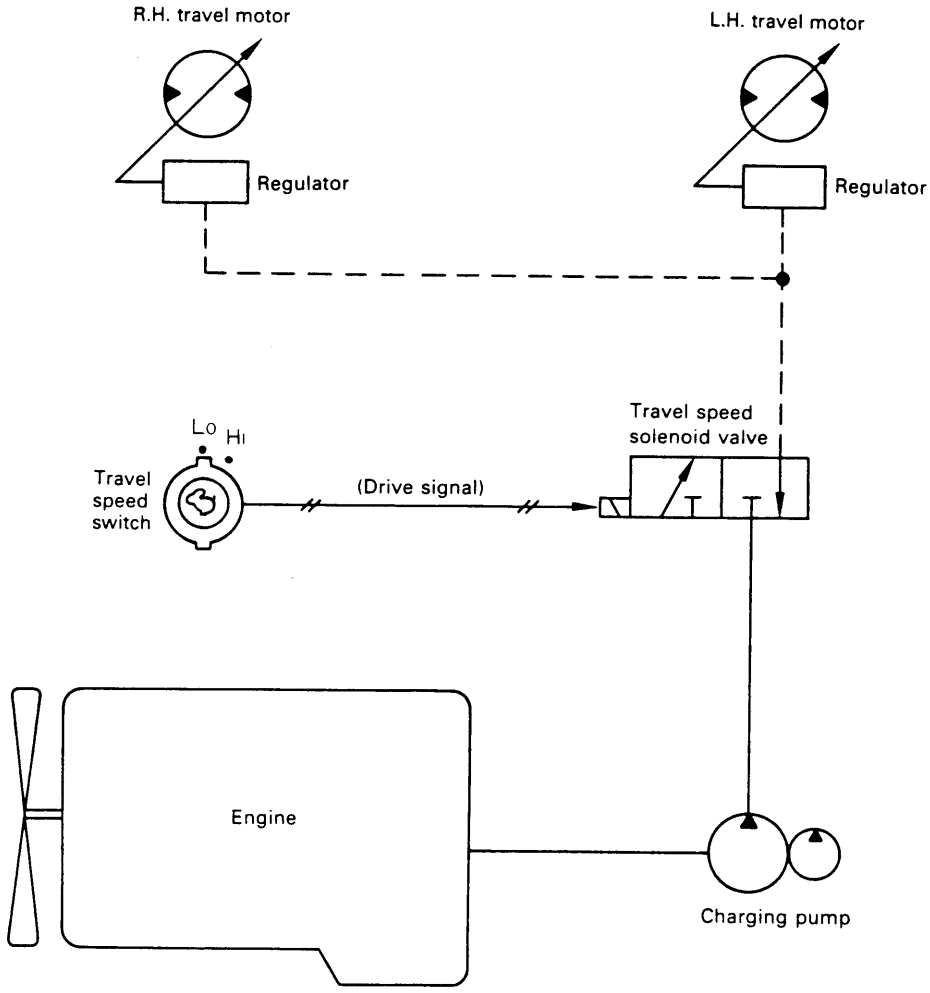
Mode	Swing lock switch	Swing lock lamp	Swing brake solenoid valve	Operation
Swing holding brake	OFF	OFF	See diagram on right	When the swing and work equipment levers are all placed at neutral, the swing brake is actuated after a delay of approx. 4 sec. If any of the swing or other work equipment control levers are operated, the swing brake is released and the upper structure can swing freely. Time chart  209F05108
Swing lock	ON	ON	Deactivated	The swing is locked by the swing brake, so even if the swing lever is operated, the swing brake is not released and the upper structure cannot swing.

020905

★ Swing brake solenoid valve
For details of the structure and operation, see SOLENOID VALVE ASSEMBLY.

★ Swing motor
For details of the structure and operation, see SWING MOTOR.

6. TRAVEL SPEED SELECTION FUNCTION



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OUTLINE

★ By switching between low speed (2.7 km/h) and high speed (4.1 km/h), it is possible to obtain a travel speed to match the jobsite conditions.

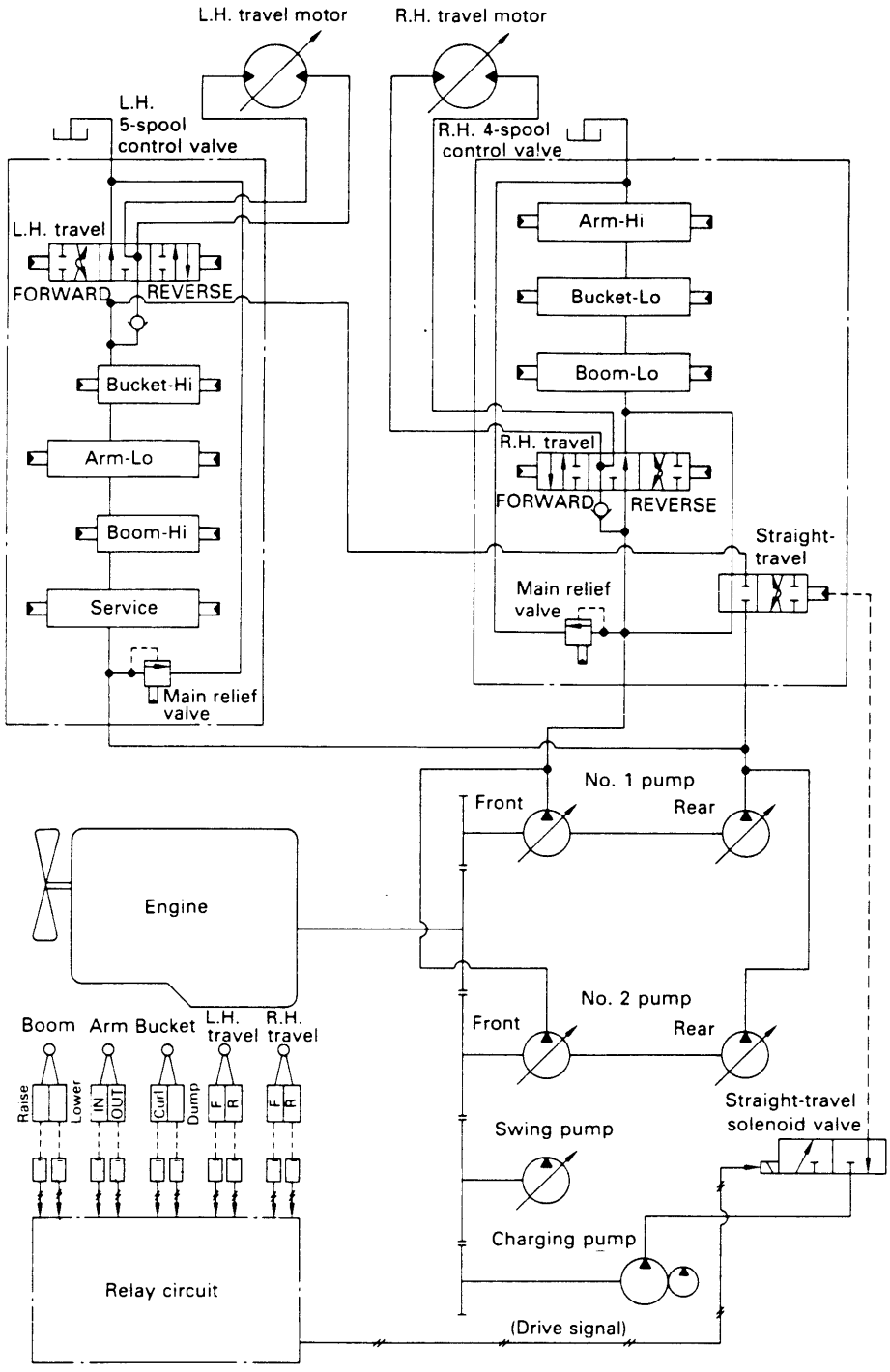
OPERATION

Travel speed switch	Travel speed solenoid valve	Travel motor swash plate angle	Travel speed	Remarks
Lo	Deactivated	Max.	Low speed (2.7 km/h)	Suitable for moving short distances and when drawbar pull is needed
Hi	Excited	Min.	High speed (4.1 km/h)	Suitable for moving long distances

★ Travel speed solenoid valve
For details of the structure and operation, see SOLENOID VALVE ASSEMBLY.

★ Travel motor
For details of the structure and operation, see TRAVEL MOTOR.

7. STRAIGHT-TRAVEL FUNCTION



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OUTLINE

- If the boom, arm, or bucket are operated at the same time as the travel, the pressure oil flowing to the L.H. and R.H. travel circuits is divided and sent to the boom, arm, or bucket circuit. The travel circuit on the side where the oil flow is divided will have a smaller flow of oil to the motor than the travel circuit on the side which is not divided, so the flow in the motor circuit will drop and the machine will deviate to one side.
- To prevent this, the straight-travel valve is switched to interconnect the L.H. and R.H. travel circuits, thereby ensuring and equal supply of oil to both the L.H. and R.H. travel motors. This keeps both the L.H. and R.H. motors rotating at the same speed, and prevents any travel deviation.

OPERATION

L.H., R.H. travel levers	Work equipment levers	Straight-travel solenoid valve	Straight-travel valve	Remarks
Operation	Neutral	Deactivated	Not actuated	L.H. and R.H. travel motor circuits are independent
	Operated	Excited	Actuated	L.H. and R.H. travel motor circuits are actuated

★ Straight-travel solenoid valve
For details of the structure and operation, see SOLENOID VALVE ASSEMBLY.

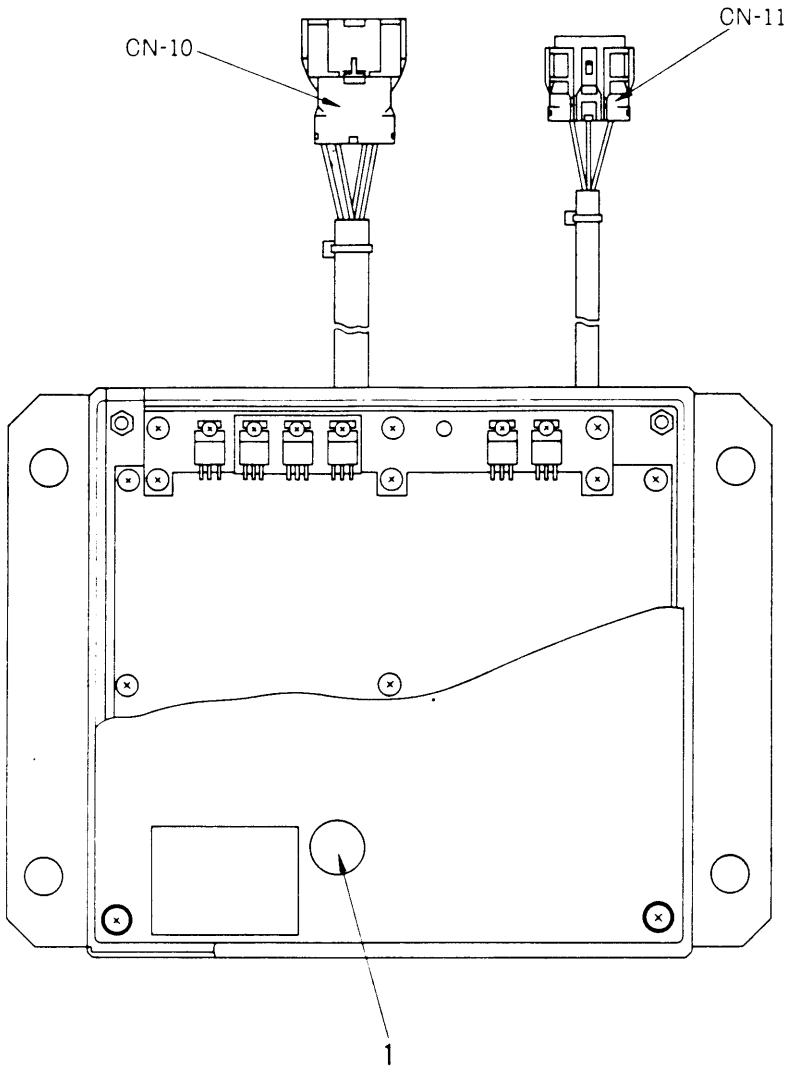
★ Straight-travel valve
For details of the structure and operation, see R.H. 4-SPOOL CONTROL VALVE.

020905

8. COMPONENTS OF SYSTEM

1) AUTO-DECELERATION • OLSS CONTROLLER

★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION



209F05111

1. Self-diagnostic display

Input/output signals

CN-10

No.	Signal	Input/output
1	Power source (24V)	–
2	GND	–
3	Mode	Input
4	Engine speed sensor (+)	Input
5	Engine speed sensor (–)	–
6	Potentiometer (GND)	–
7	Potentiometer (S)	Input
8	Potentiometer (+)	–
9	Deceleration solenoid (SOL. B +)	Output
10	Deceleration solenoid (SOL. B –)	–
11	Oil pressure switch (+)	Output
12	Oil pressure switch (–)	–
13	–	–
14	–	–

CN-11

No.	Signal	Input/output
1	TVC solenoid (+)	Output
2	TVC solenoid (–)	–
3	Deceleration solenoid (SOL. A +)	Output
4	Deceleration solenoid (SOL. A –)	–
5	Model selection (1)	Input
6	Model selection (2)	Input
7	–	–
8	GND	–

020905

FUNCTION

Auto-deceleration portion

- This receives the signal from the control levers, and when they are in the deceleration condition, it carries out the timer function. Based on this, it drives the auto-deceleration solenoid valve.

Electronic OLSS portion

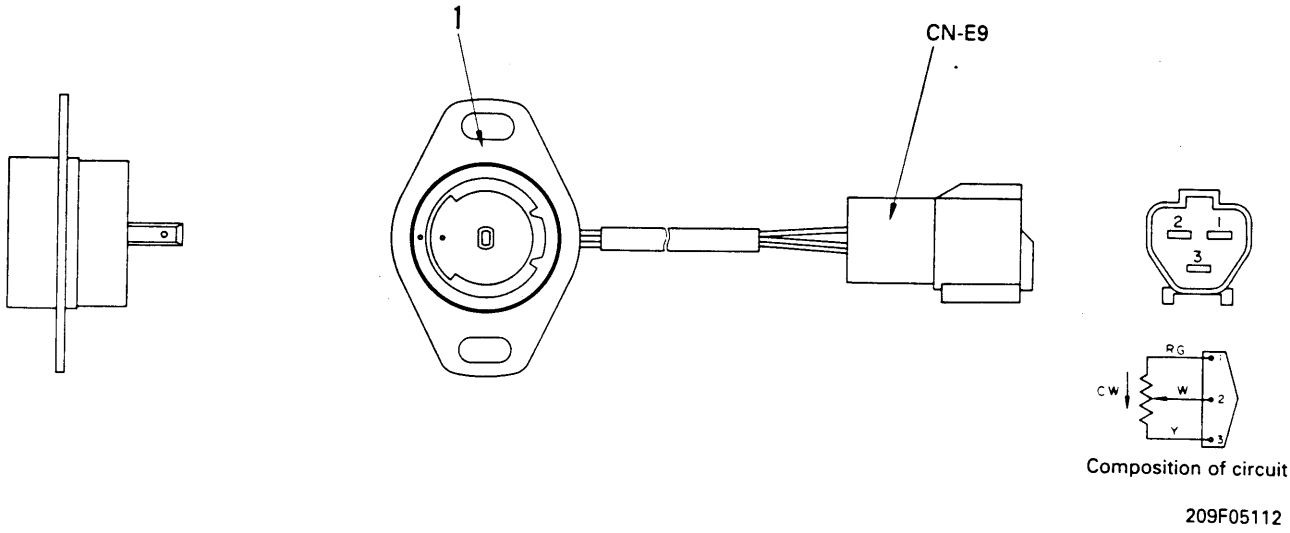
- In the H mode, it receives the signal from the potentiometer and engine speed sensor, and carries out the engine speed sensing function. Based on this, it drives the TVC valve.
- In the S and L modes, it drives the TVC valve with a constant current to match the pump absorption torque that has been set.

Self-diagnostic portion

- The controller itself observes the input signal, output signal, and self function, and always displays the normal actuation or the location of the problem with the red and green LEDs on the self-diagnostic display. (For details, see TROUBLE-SHOOTING)

2) POTENTIOMETER

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS**



1. Potentiometer (variable resistance)

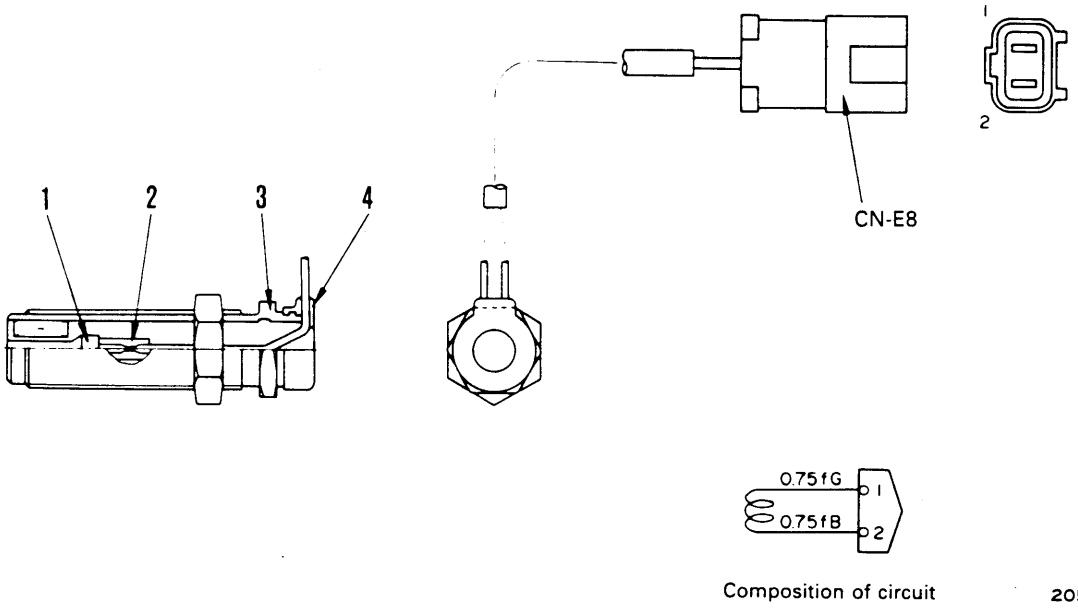
FUNCTION

- This is interconnected with the injection pump governor lever of the engine, and detects the set speed of the engine.

020905

3) ENGINE SPEED SENSOR

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS**



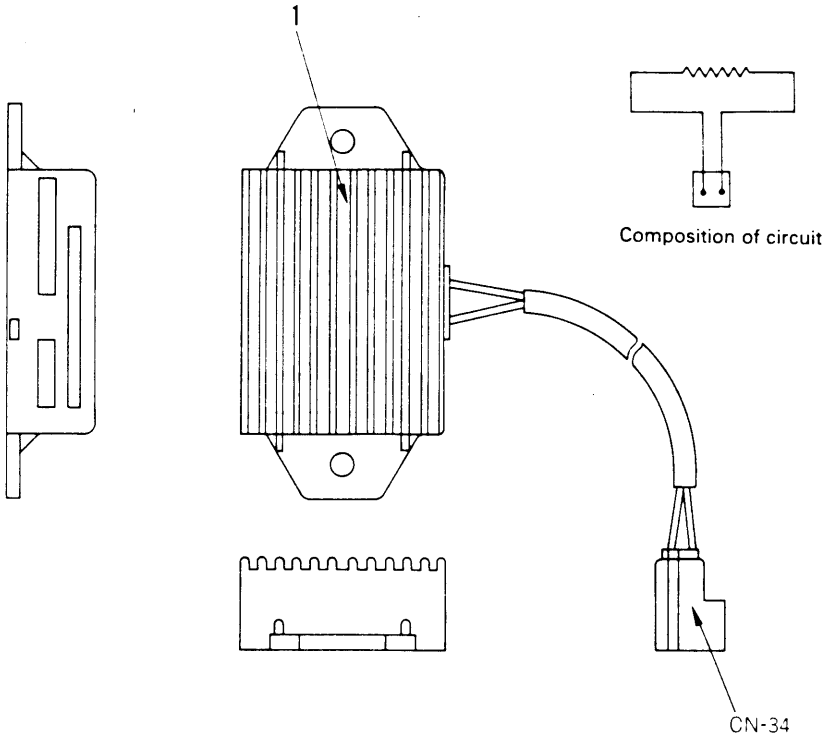
1. Magnet
2. Terminal
3. Case
4. Boot

FUNCTION

- This is installed to the engine flywheel, and detects the actual speed of the engine.

4) PROLIX RESISTOR

★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS



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1. Resistor

SPECIFICATION

Resistance value: 20 Ω

FUNCTION

- This is installed in the prolix circuit of the electronic OLSS, and when the prolix switch is turned ON, it generates a constant current to the TVC solenoid.

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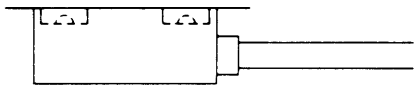
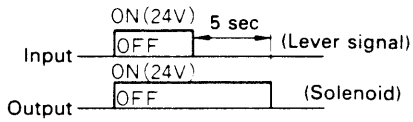
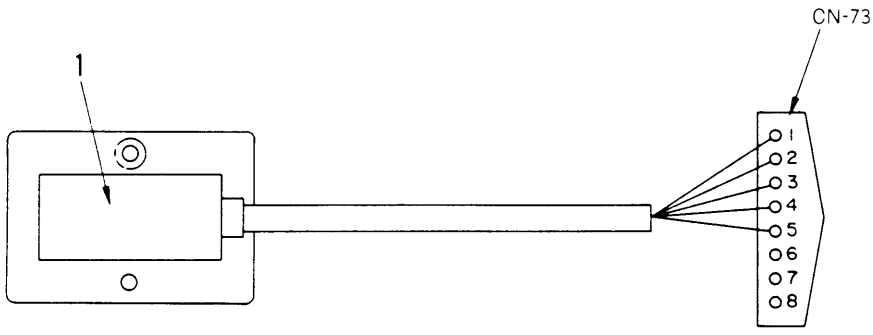
5) SWING BRAKE TIMER



Input/output signal time chart





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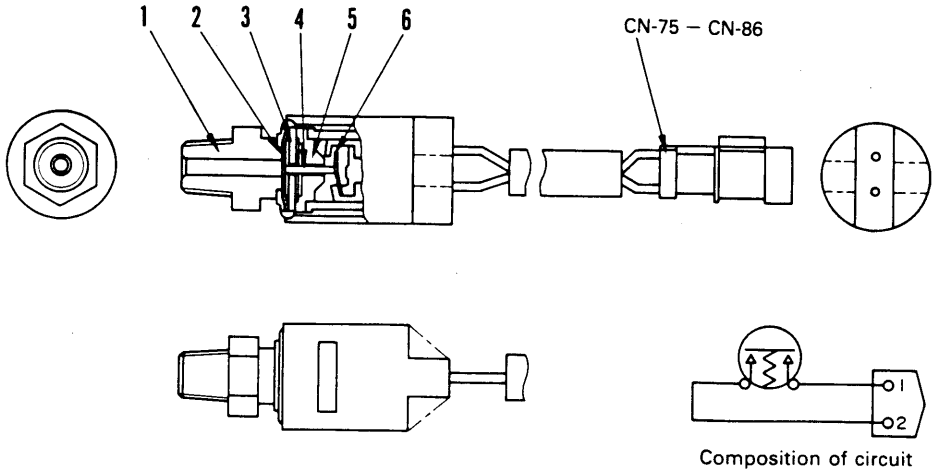
1. Timer

FUNCTION

- This receives the signal from the work equipment and swing control levers, carries out the timer function, and drives the swing brake solenoid valve.

6) PPC OIL PRESSURE SWITCH



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1. Plug
2. Diaphragm
3. Backup ring
4. Pin
5. Guide pin
6. Movable contact

SPECIFICATIONS

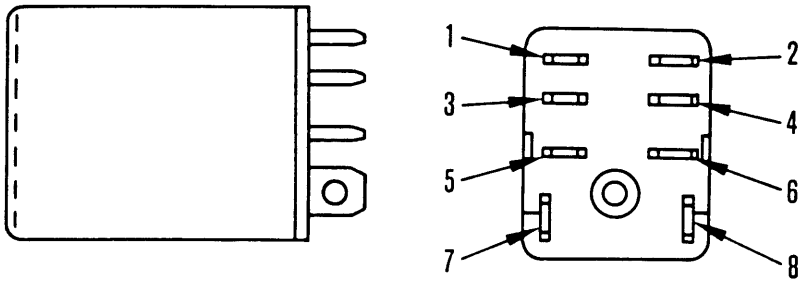
Actuation pressure:
5.0 + 1.0 kg/cm²
Reset pressure: 3.0 + 0.5 kg/cm²

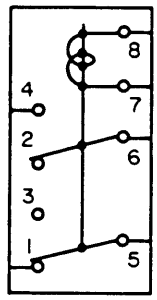
FUNCTION

- There are 12 switches installed in the pilot circuit between the PPC valve and the control valve, and these detect if each lever is being operated or is at neutral.

020905

7) STRAIGHT-TRAVEL • AUTO-DECELERATION RELAY (RS-1)
SWING HOLDING BRAKE • AUTO-DECELERATION RELAY (RS-2)
STRAIGHT-TRAVEL CANCEL RELAY (RS-3)
BOOM RELAY (RS-4)
ARM IN • BUCKET CURL RELAY (RS-5) [BACK HOE]
ARM IN • BUCKET RELAY (RS-5) [LOADING SHOVEL]
ARM OUT RELAY (RS-6) [LOADING SHOVEL]





Composition of circuit

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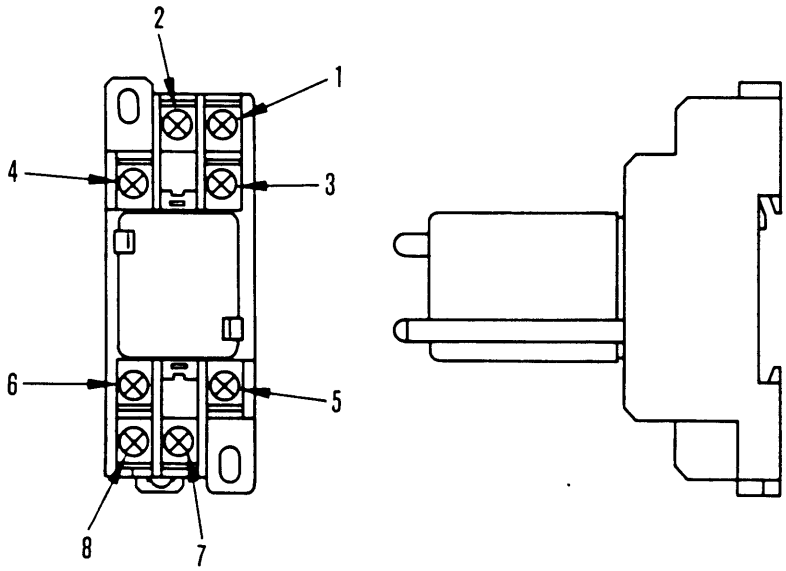
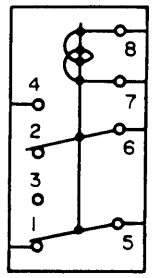
8) BOTTOM DUMP OPEN RELAY (RS-7) [LOADING SHOVEL]
BOTTOM DUMP CLOSE RELAY (RS-8) [LOADING SHOVEL]

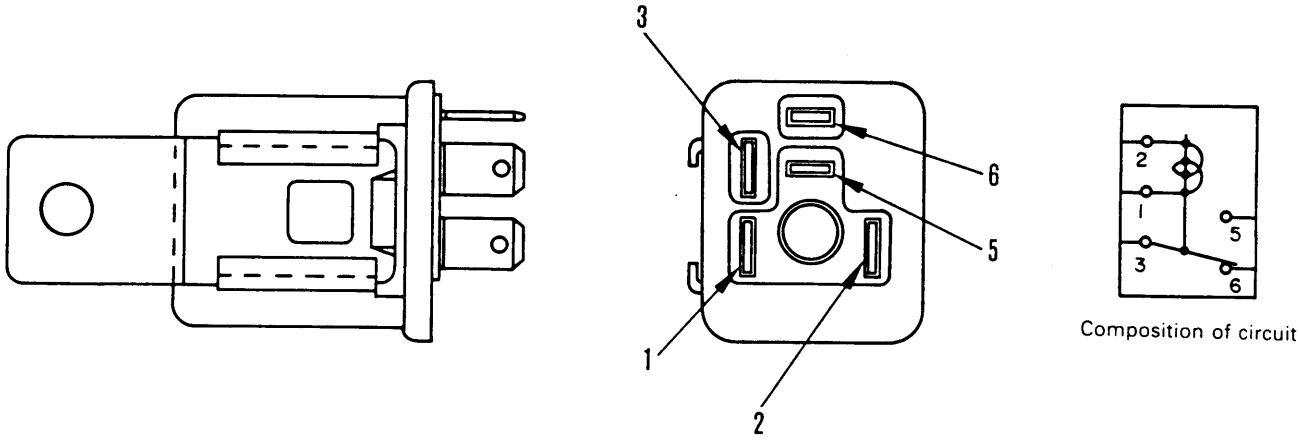




Composition of circuit

F20905049

9) SWING LOCK RELAY (CN-R1)
FREE SWING RELAY (CN-R2)
HORN RELAY (CN-R3)
STOP MOTOR RELAY (CN-R4)
WORKING LAMP RELAY (CN-R5)
HEAD LAMP RELAY (CN-R6)

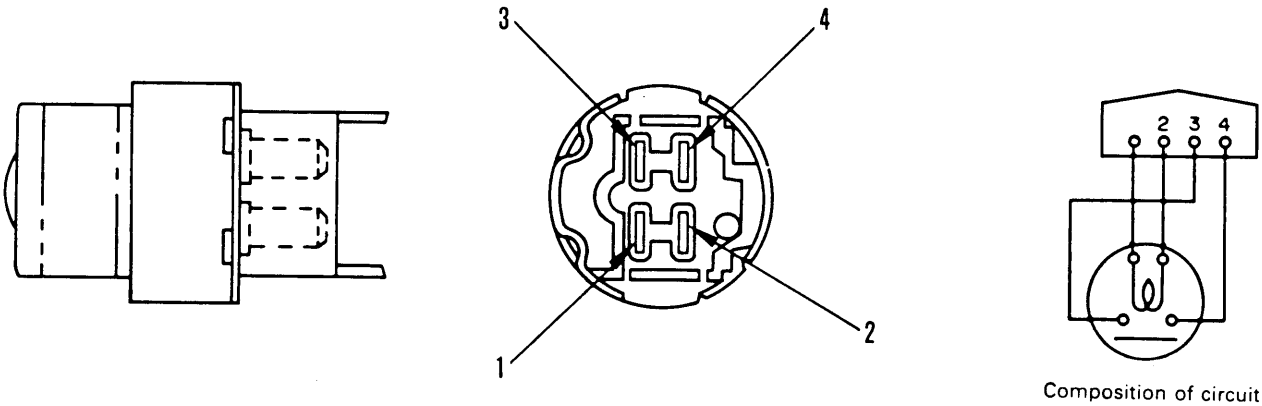


Composition of circuit

F20905050

020905

10) AUTO-DECELERATION RELAY (CN-R7)
SWING LOCK RELAY (CN-R8)
MACHINE PUSH UP RELAY (CN-R9)
HEAVY LIFT RELAY (CN-R10) [BACK HOE]
HORIZONTAL DIGGING RELAY (CN-R10) [LOADING SHOVEL]



Composition of circuit

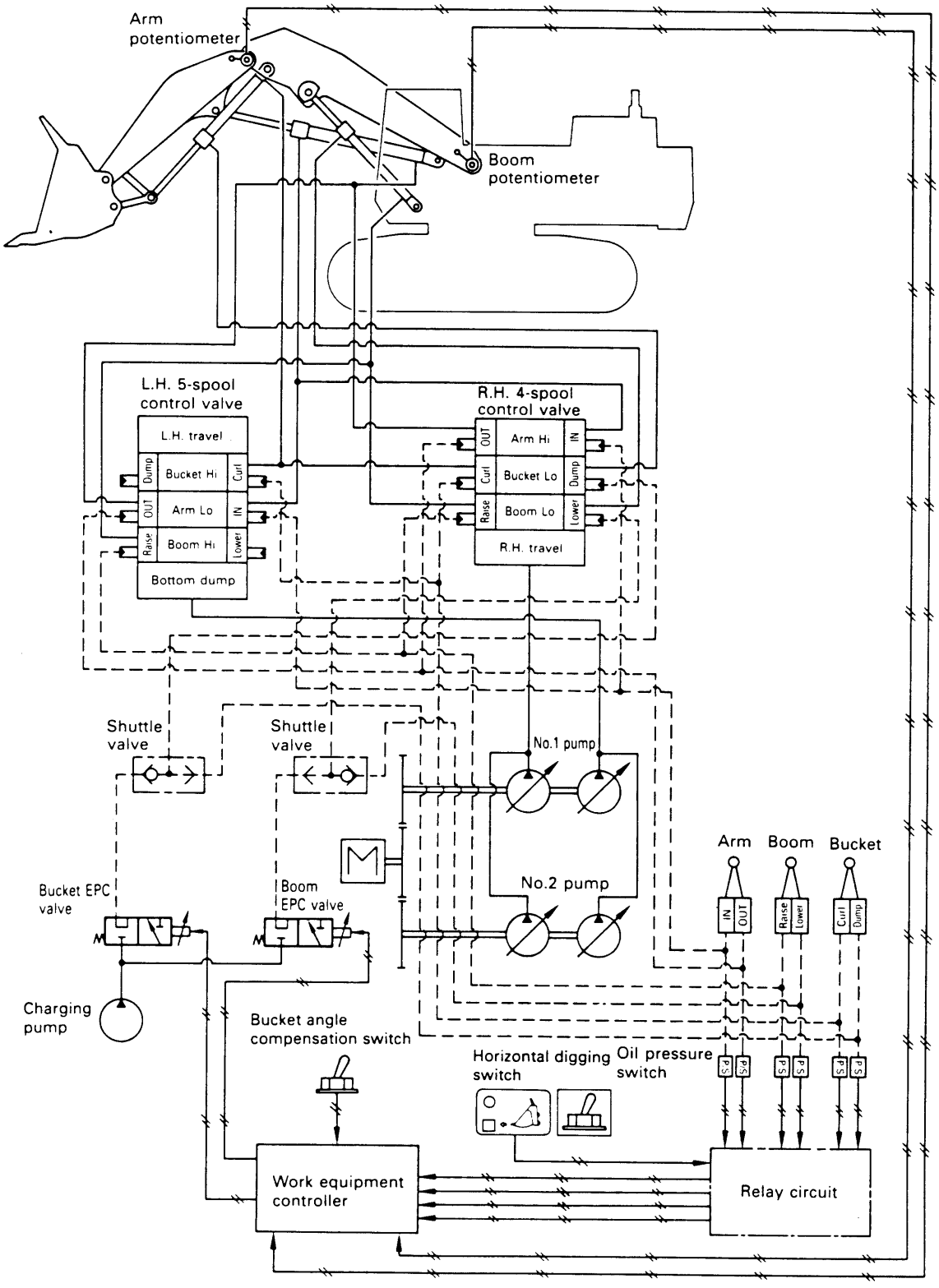
F20905051

WORK EQUIPMENT CONTROL SYSTEM

LOADING SHOVEL

★ FOR MACHINE EQUIPPED WITH WORK EQUIPMENT CONTROL SYSTEM

SYSTEM DIAGRAM



F20905052

020905

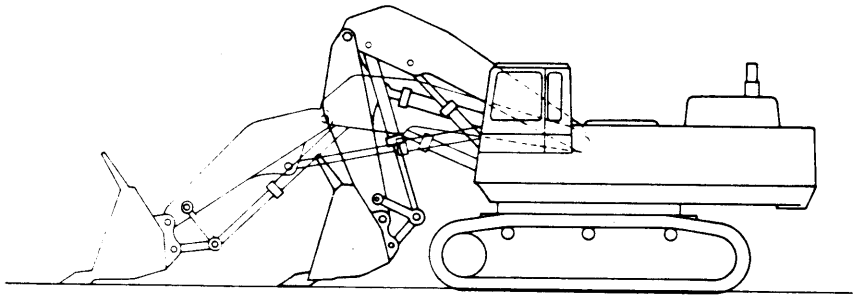
RELAY CIRCUIT

★ See MACHINE CONTROL SYSTEM.

1. HORIZONTAL DIGGING COMPENSATION FUNCTION

OUTLINE

- During ARM OUT operations, the BOOM LOWER control is carried out so that the height of the arm top pin moves horizontally and parallel to the machine. The link is used to keep the bucket angle the same.

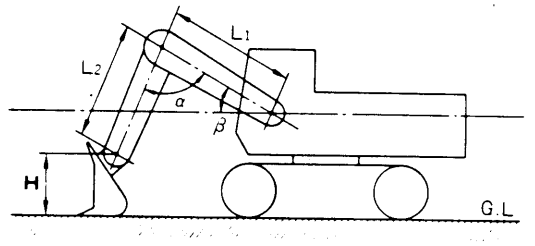


209F3210

020905

OPERATION

- The boom and arm potentiometers input the angles of the work equipment to the controller.
  In this way, the controller can always calculate height H of the arm top pin.
- When the lever is operated to ARM OUT, the amount to lower the boom in order to maintain height H must be calculated. To carry out this movement, the controller sends electric current to the boom EPC valve solenoid to lower the boom.
  In this way, the boom EPC valve is actuated and pressurized oil from the charging pump passes through the shuttle valve and actuates the boom-Lo control valve to lower the boom.



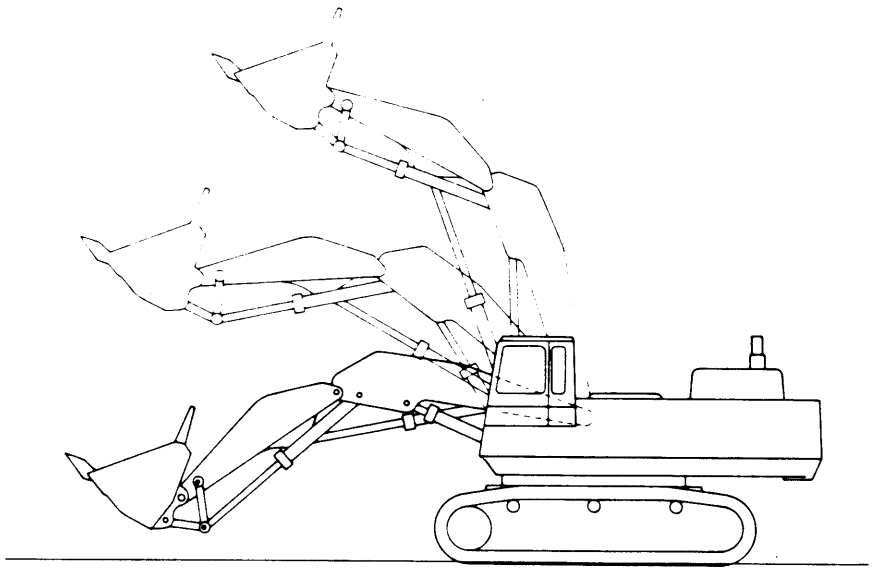
209F3213

2. BUCKET ANGLE COMPENSATION FUNCTION

OUTLINE

- During BOOM RAISE operations, when the height of the arm top pin goes above approx. 4.8 m, the BOOM RAISE speed and BUCKET DUMP speed are made proportional. This controls the BUCKET DUMP operation so that the load inside the bucket does not spill back towards the operator's cab.

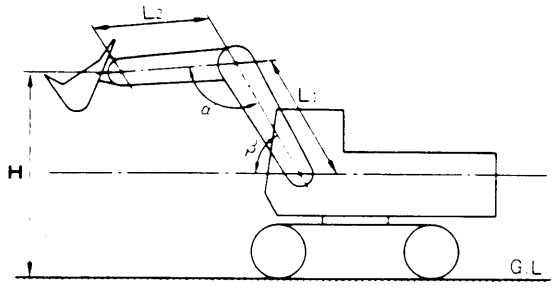
020905



209F3211

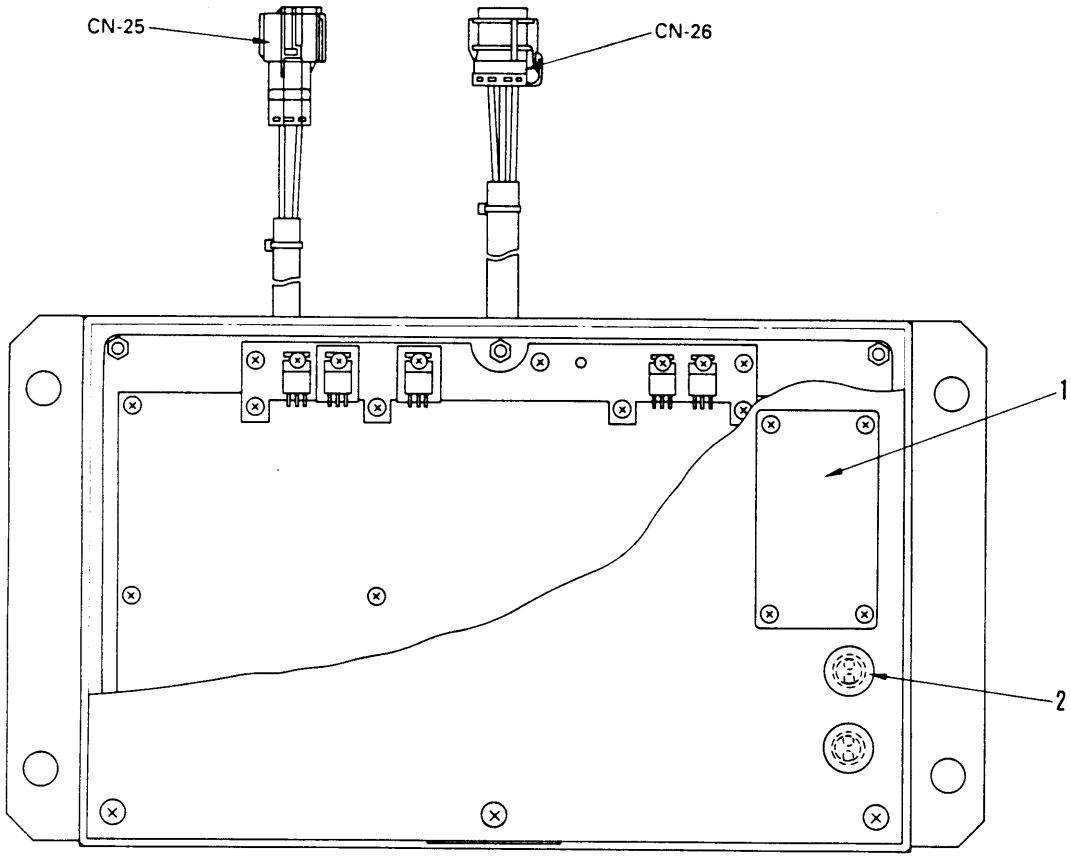
OPERATION

- The boom and arm potentiometers input the angles of the work equipment to the controller.
  In this way, the controller can always calculate height H of the arm top of pin.
- When the lever is operated to BOOM RAISE, and height H is above 4.8 m, the controller sends electric current to the bucket EPC valve solenoid to move the bucket to the DUMP direction to match the BOOM RAISE speed.
  In this way, the bucket EPC valve is actuated and pressurized oil from the charging pump passes through the shuttle valve and actuates the bucket-Lo control valve to move the bucket to the DUMP direction.



209F3215

3. COMPONENTS OF SYSTEM
1) WORK EQUIPMENT CONTROLLER



F20905053

020905

1. Adjustment trimmer window
2. Self-diagnostic display window

FUNCTION

- This receives the work equipment angle signal from the boom and arm potentiometers, calculates the height of the arm top pin, and outputs the drive signal to the boom and bucket EPC valves when pushing the arm and when raising the boom.

Self-diagnostic portion

- The controller itself monitors the input signal, output signal, and its own functions. It uses four red and green LEDs on the self-diagnostic display to show to the outside that the equipment is working normally, or to indicate the location of any failure.
  (For details, see TROUBLESHOOTING.)

Input/output signals

CN-25

No.	Signal	Input/output
1	Power source (24V)	–
2	GND	–
3	Horizontal digging switch	Input
4	–	–
5	Boom EPC solenoid (+)	Output
6	Boom EPC solenoid (–)	Output
7	Bucket EPC solenoid (+)	Output
8	Bucket EPC solenoid (–)	Output

CN-26

No.	Signal	Input/output
1	Boom potentiometer (+)	–
2	Boom potentiometer (S)	Input
3	Boom potentiometer (–)	–
4	Arm potentiometer (+)	–
5	Arm potentiometer (S)	Input
6	Arm potentiometer (–)	–
7	–	–
8	–	–
9	–	–
10	Arm OUT oil pressure switch	Input
11	Boom oil pressure switch	Input
12	Arm IN • bucket oil pressure switch	Input

2) **BOOM POTENTIOMETER**
ARM POTENTIOMETER
★ See MACHINE CONTROL SYSTEM.

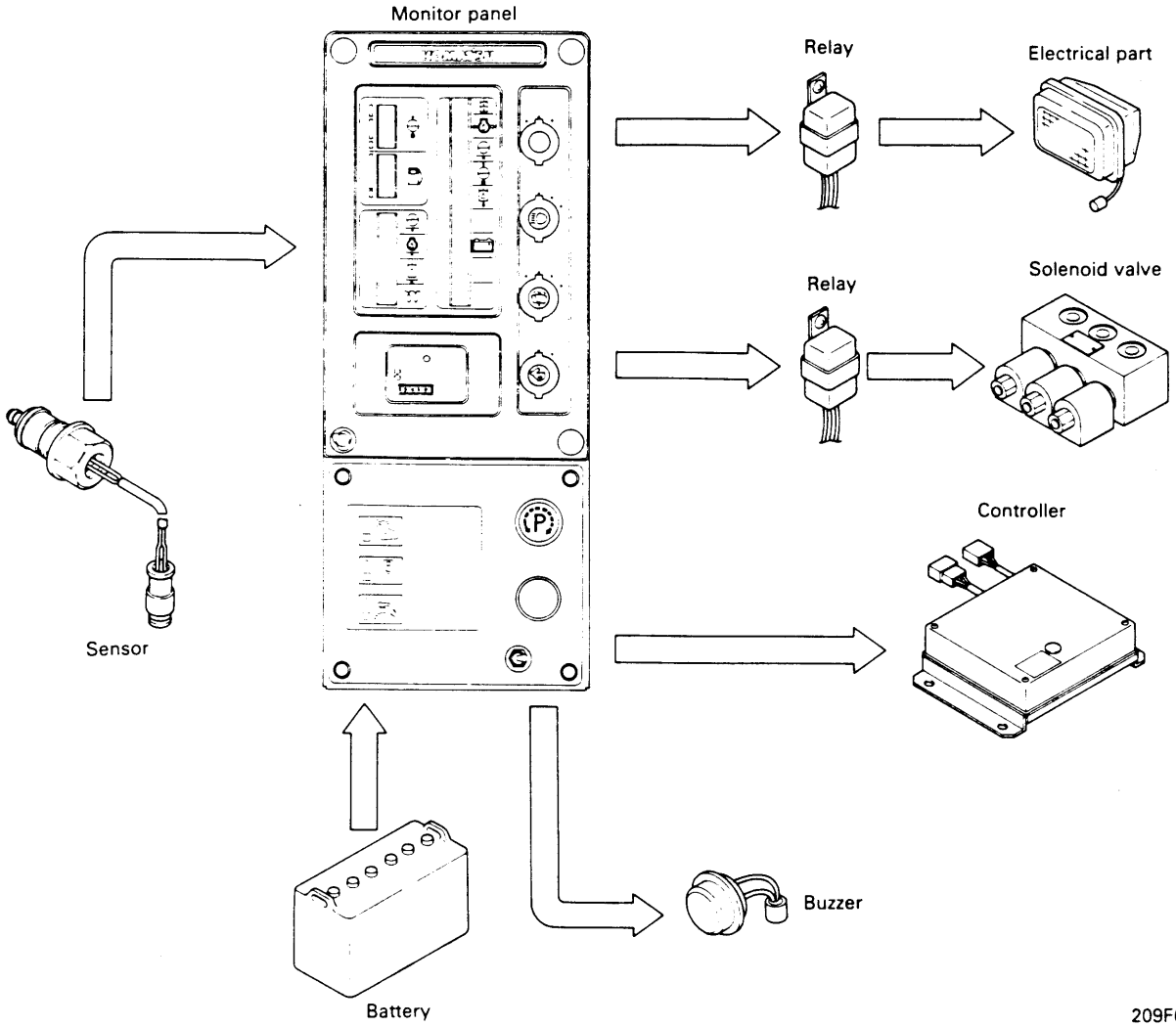
3) **BOOM EPC VALVE**
BUCKET EPC VALVE
★ See EPC VALVE.

4) **OIL PRESSURE SWITCH**
★ See MACHINE CONTROL SYSTEM.

5) **RELAYS**
★ See MACHINE CONTROL SYSTEM.

020905

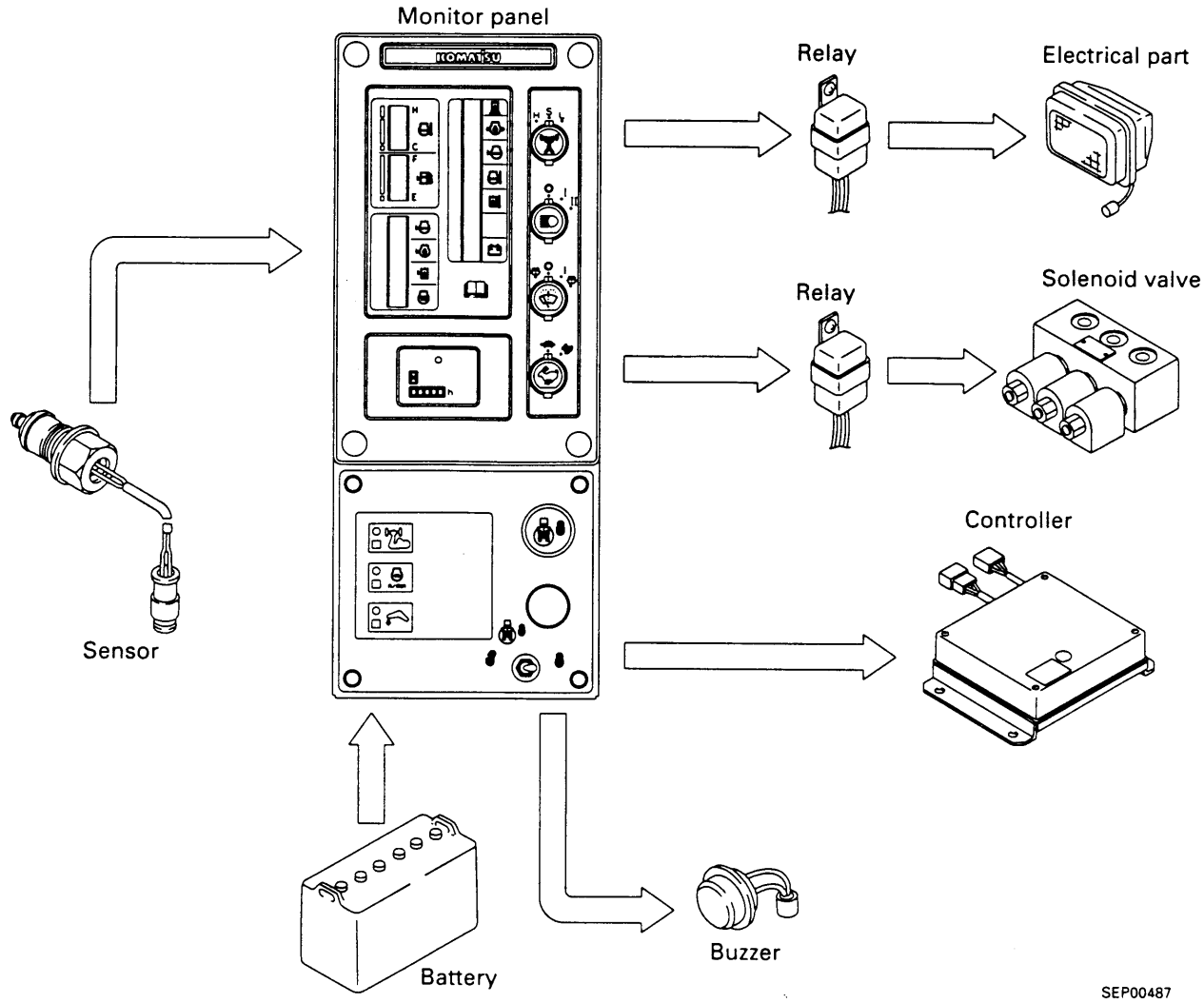
MACHINE MONITORING SYSTEM



020905

- The machine monitoring system observes the condition of the machine through the sensors installed to various parts of the machine, and processes this information quickly. The system informs the operator of the condition of the machine by displaying the condition on the panel. The content of the panel displays can be broadly divided into the following.
  1. Monitor portion that gives warnings when any abnormality occurs in the machine.
  2. The gauge portion (coolant temperature, fuel level) that always informs the condition of the machine.
- Various modes selector switches are built into the monitor panel, and it acts as the control portion of the machine control system.

REGULATION OF EC INCLUSION



020905

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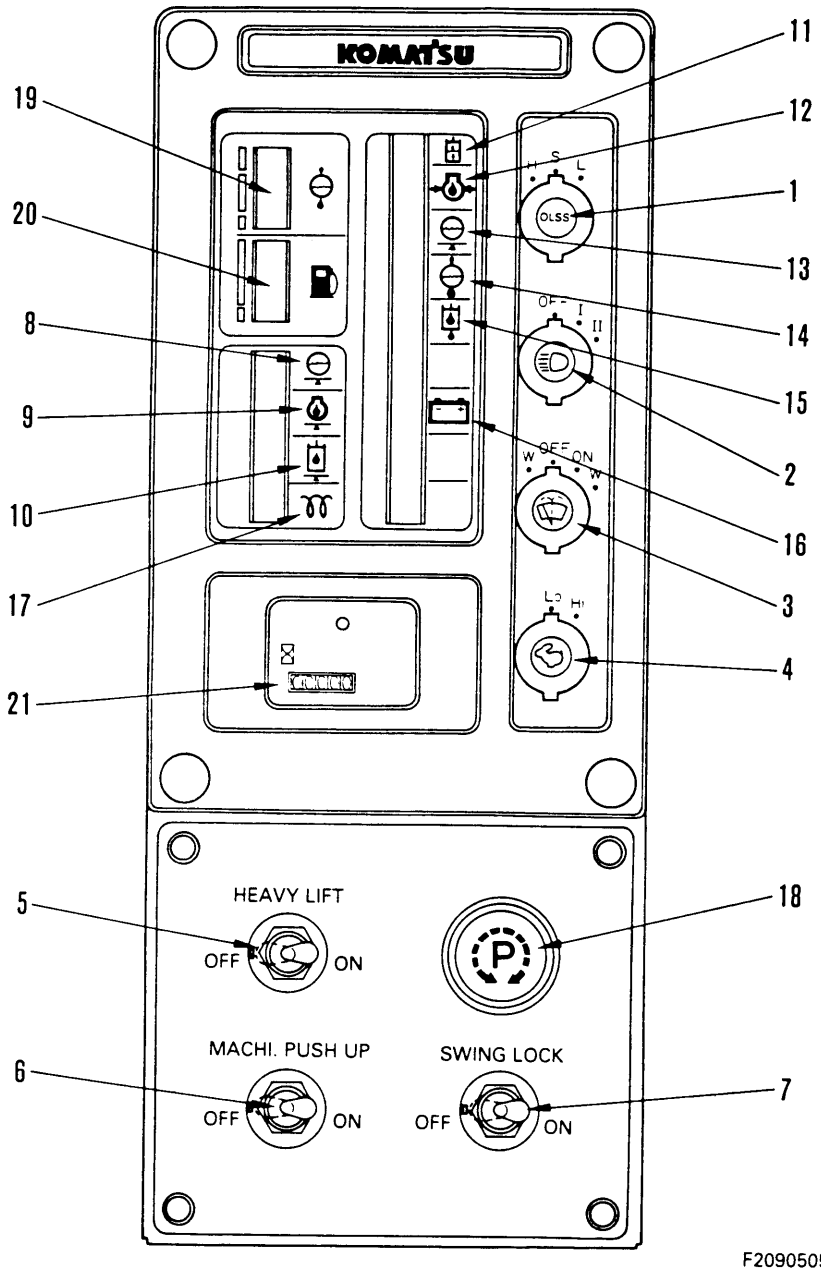
SWITCHES AND MONITOR

BACK HOE

★ FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS



F20905054

SWITCHES

1. Mode selector switch
2. Lamp switch
3. Wiper switch
4. Travel speed switch
5. Heavy lift switch
6. Machine push up switch
7. Swing lock switch

MONITOR

[CHECKS BEFORE STARTING items]

8. Coolant level
9. Engine oil level
10. Hydraulic oil level

[CAUTION items]

11. Hydraulic filter
12. Engine oil pressure
13. Coolant level
14. Coolant temperature
15. Hydraulic oil temperature
16. Charge

[PILOT items]

17. Preheating
18. Swing lock

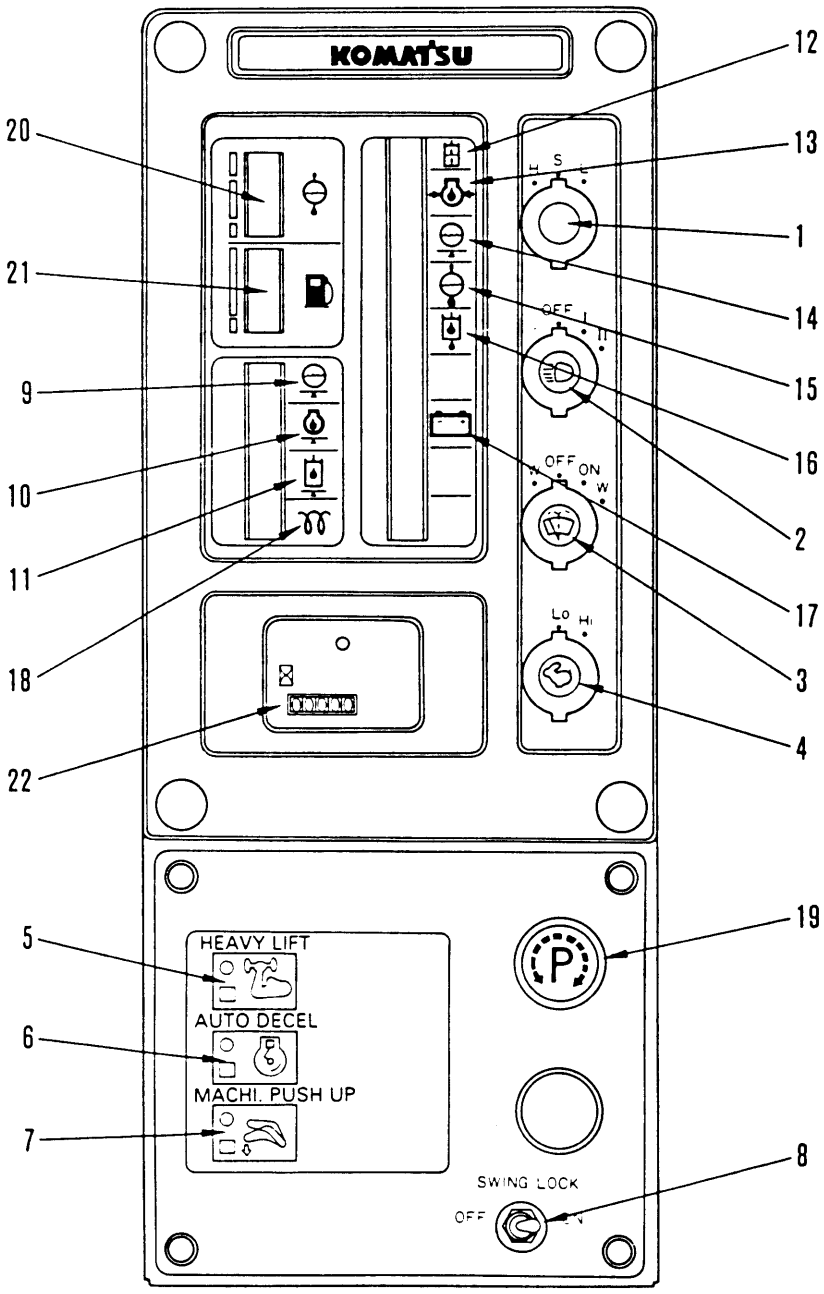
[GAUGE items]

19. Coolant temperature
20. Fuel level
21. Service meter

020905

BACK HOE

★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION



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SWITCHES

1. Mode selector switch
2. Lamp switch
3. Wiper switch
4. Travel speed switch
5. Heavy lift switch
6. Auto-deceleration switch
7. Machine push up switch
8. Swing lock switch

MONITOR

[CHECKS BEFORE STARTING items]

9. Coolant level
10. Engine oil level
11. Hydraulic oil level

[CAUTION items]

12. Hydraulic filter
13. Engine oil pressure
14. Coolant level
15. Coolant temperature
16. Hydraulic oil temperature
17. Preheating

[PILOT items]

18. Preheating
19. Coolant temperature

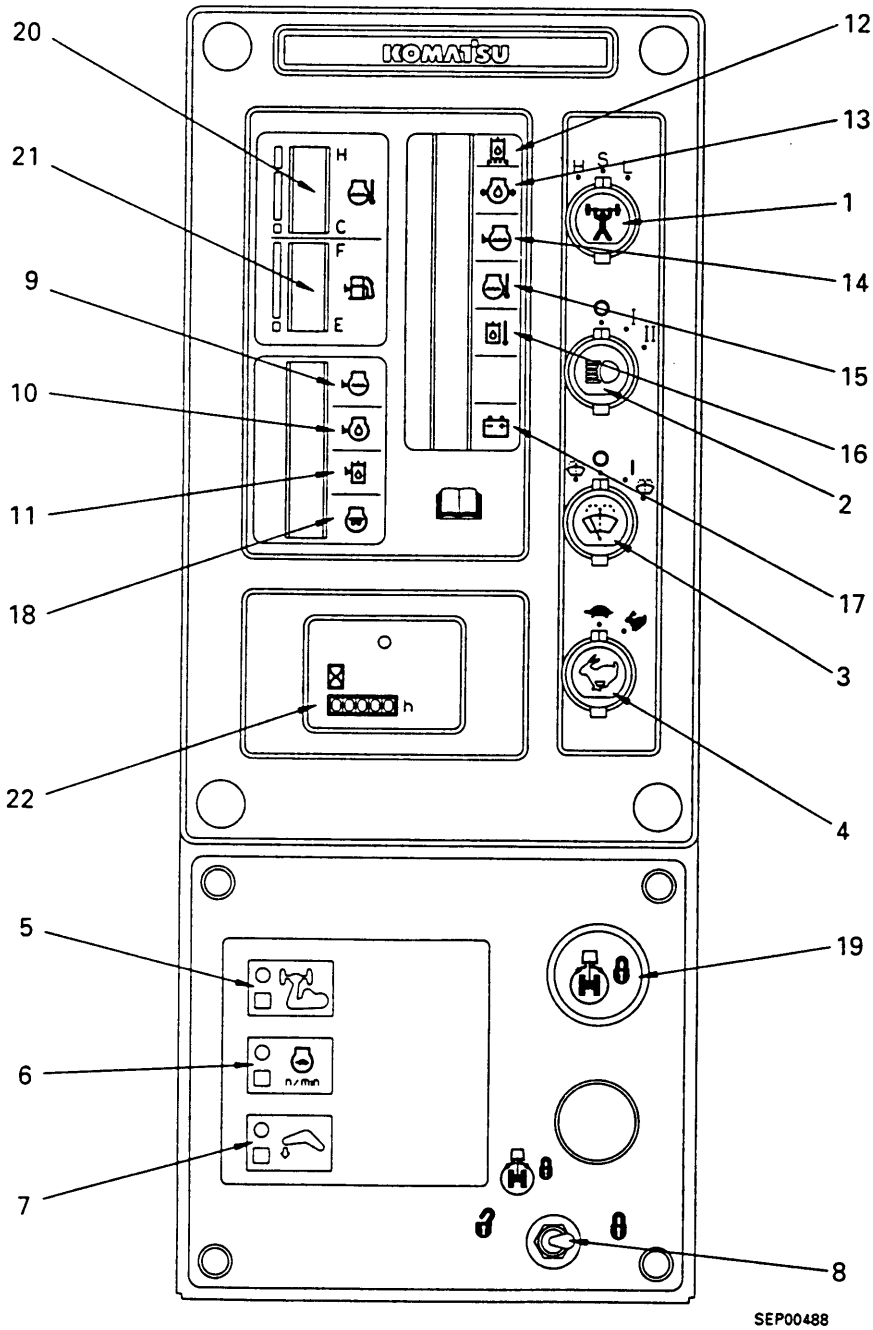
[GAUGE items]

20. Coolant temperature
21. Fuel level
22. Service meter

BACK HOE

★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION

REGULATION OF EC INCLUSION



SWITCHES

1. Mode selector switch
2. Lamp switch
3. Wiper switch
4. Travel speed switch
5. Heavy lift switch
6. Auto-deceleration switch
7. Machine push up switch
8. Swing lock switch

MONITOR

[CHECKS BEFORE STARTING items]

9. Coolant level
10. Engine oil level
11. Hydraulic oil level

[CAUTION items]

12. Hydraulic filter
13. Engine oil pressure
14. Coolant level
15. Coolant temperature
16. Hydraulic oil temperature
17. Preheating

[PILOT items]

18. Preheating
19. Coolant temperature

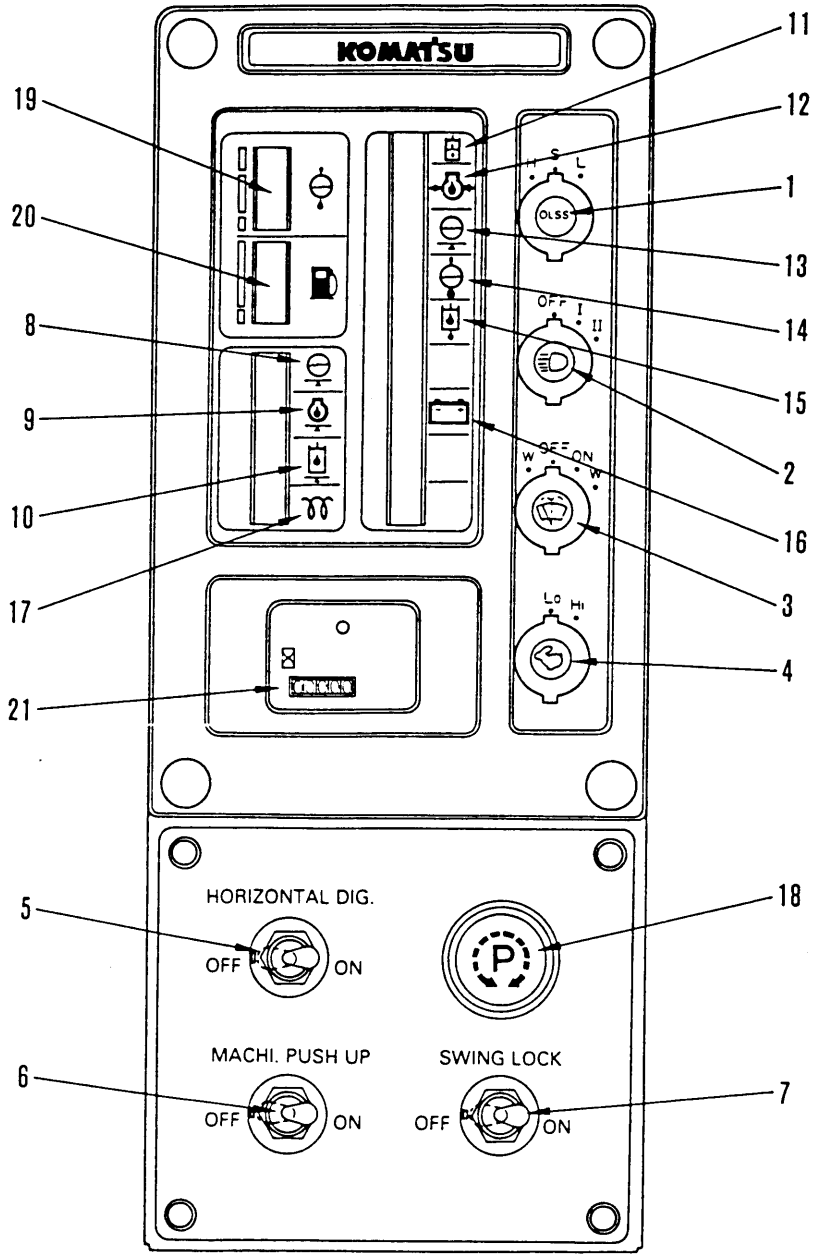
[GAUGE items]

20. Coolant temperature
21. Fuel level
22. Service meter

020905

LOADING SHOVEL

★ FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS



F20905055

SWITCHES

1. Mode selector switch
2. Lamp switch
3. Wiper switch
4. Travel speed switch
5. Horizontal digging switch
6. Machine push up switch
7. Swing lock switch

MONITOR

[CHECKS BEFORE STARTING items]

8. Coolant level
9. Engine oil level
10. Hydraulic oil level

[CAUTION items]

11. Hydraulic filter
12. Engine oil pressure
13. Coolant level
14. Coolant temperature
15. Hydraulic oil temperature
16. Charge

[PILOT items]

17. Preheating
18. Swing lock

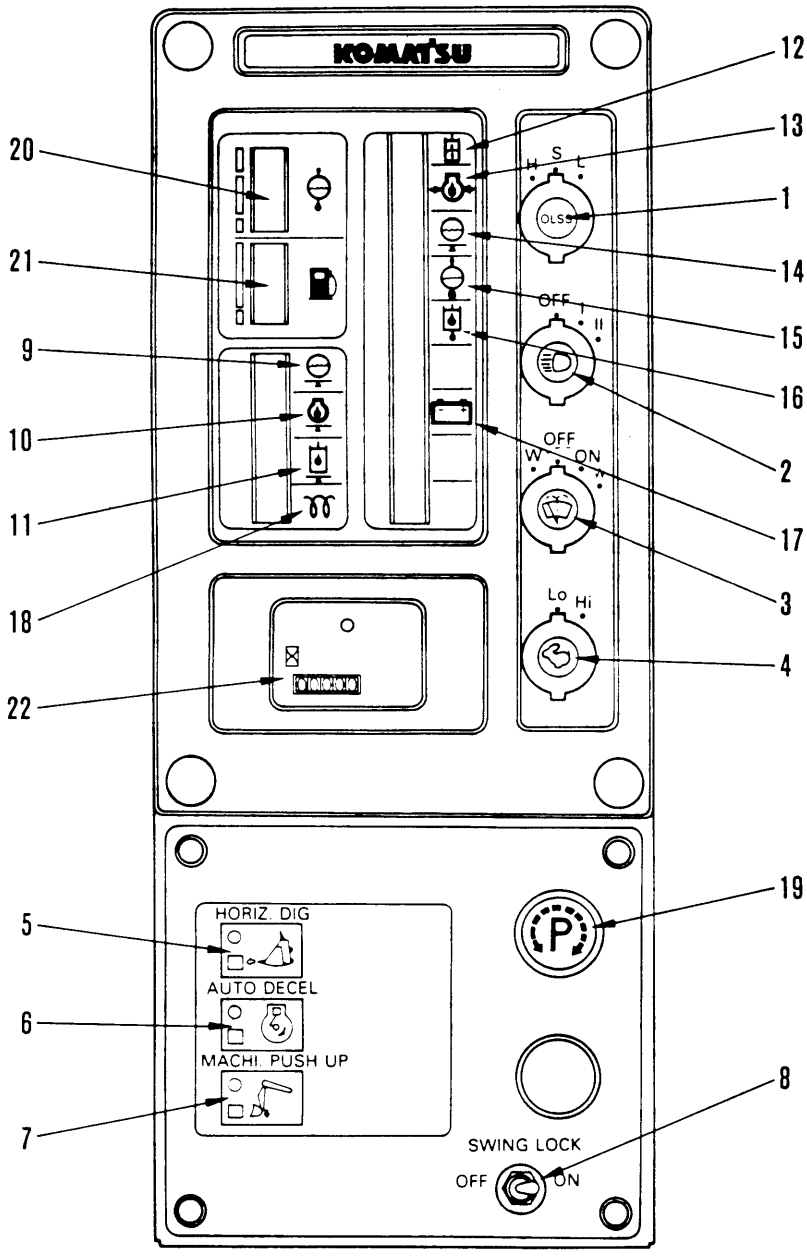
[GAUGE items]

19. Coolant temperature
20. Fuel level
21. Service meter

020905

LOADING SHOVEL

★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION



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020905

SWITCHES

1. Mode selector switch
2. Lamp switch
3. Wiper switch
4. Travel speed switch
5. Horizontal digging switch
6. Auto-deceleration switch
7. Machine push up switch
8. Swing lock switch

MONITOR

[CHECKS BEFORE STARTING items]

9. Coolant level
10. Engine oil level
11. Hydraulic oil level

[CAUTION items]

12. Hydraulic filter
13. Engine oil pressure
14. Coolant level
15. Coolant temperature
16. Hydraulic oil temperature
17. Charge

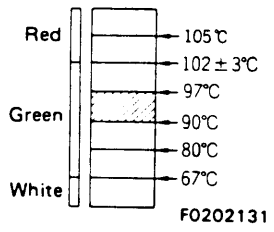
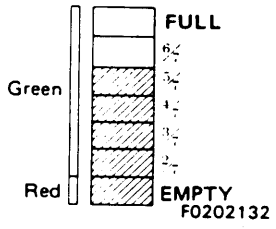
[PILOT items]

18. Preheating
19. Swing lock

[GAUGE items]

20. Coolant temperature
21. Fuel level
22. Service meter

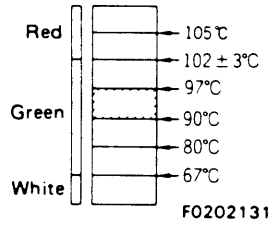
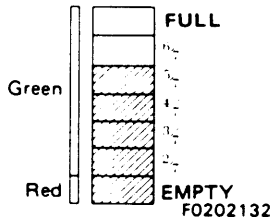
INDICATION ON MONITOR PANEL

Classification of indication	Symbol	Item	Condition for displaying abnormalities	Description
CHECKS-BEFORE STARTING		Coolant level	Below low level	Indicates when placing the starting switch to ON before starting the engine. If it is normal, the lamp goes off. If it is an abnormality the lamp flashes.
		Engine oil level	Below low level	
		Hydraulic oil level	Below low level	
CAUTION MONITOR GROUP		Hydraulic oil filter	Above specified pressure	Indicates while the engine is running and the starting switch is set to ON. If it is normal, the lamp goes off. If it is an abnormality, the lamp flashes and the buzzer sounds. In case of an abnormality in charge level, the buzzer does not sound but the lamp flashes.
		Engine oil pressure	Below specified pressure	
		Coolant level	Below low level	
		Coolant temperature	Above specified temperature (above 105°C)	
		Hydraulic oil temperature	Above specified temperature	
		Charge level	When charging system fails	
PILOT		Engine preheat	When preheating	When the starting switch is turned to HEAT position, this pilot lights for 36 seconds, then flashes (for 16 seconds) to indicate the preheating is finished.
	(P)	Swing lock	When swing lock switch ON	
GAUGE GROUP		Coolant temperature		Appropriate place (one place only) lights up.
		Fuel level		All light up below appropriate level
		Service meter	0 – 99,999 hours	Operates while the engine oil pressure is normal
		Service meter indicator		The lamp flashes while the service meter is working.

020905

INDICATION ON MONITOR PANEL

REGULATION OF EC INCLUSION

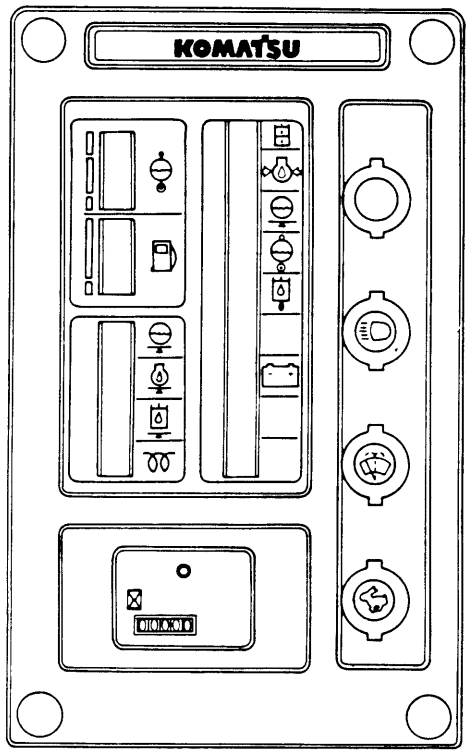
Classification of indication	Symbol	Item	Condition for displaying abnormalities	Description
CHECKS-BEFORE STARTING		Coolant level	Below low level	Indicates when placing the starting switch to ON before starting the engine. If it is normal, the lamp goes off. If it is an abnormality the lamp flashes.
		Engine oil level	Below low level	
		Hydraulic oil level	Below low level	
CAUTION MONITOR GROUP		Hydraulic oil filter	Above specified pressure	Indicates while the engine is running and the starting switch is set to ON. If it is normal, the lamp goes off. If it is an abnormality, the lamp flashes and the buzzer sounds. In case of an abnormality in charge level, the buzzer does not sound but the lamp flashes.
		Engine oil pressure	Below specified pressure	
		Coolant level	Below low level	
		Coolant temperature	Above specified temperature (above 105°C)	
		Hydraulic oil temperature	Above specified temperature	
		Charge level	When charging system fails	
PILOT		Engine preheat	When preheating	When the starting switch is turned to HEAT position, this pilot lights for 36 seconds, then flashes (for 16 seconds) to indicate the preheating is finished.
		Swing lock	When swing lock switch ON	
GAUGE GROUP		Coolant temperature	 F0202131	Appropriate place (one place only) lights up.
		Fuel level	 F0202132	All light up below appropriate level
		Service meter	0 – 99,999 hours	Operates while the engine oil pressure is normal
		Service meter indicator		The lamp flashes while the service meter is working.

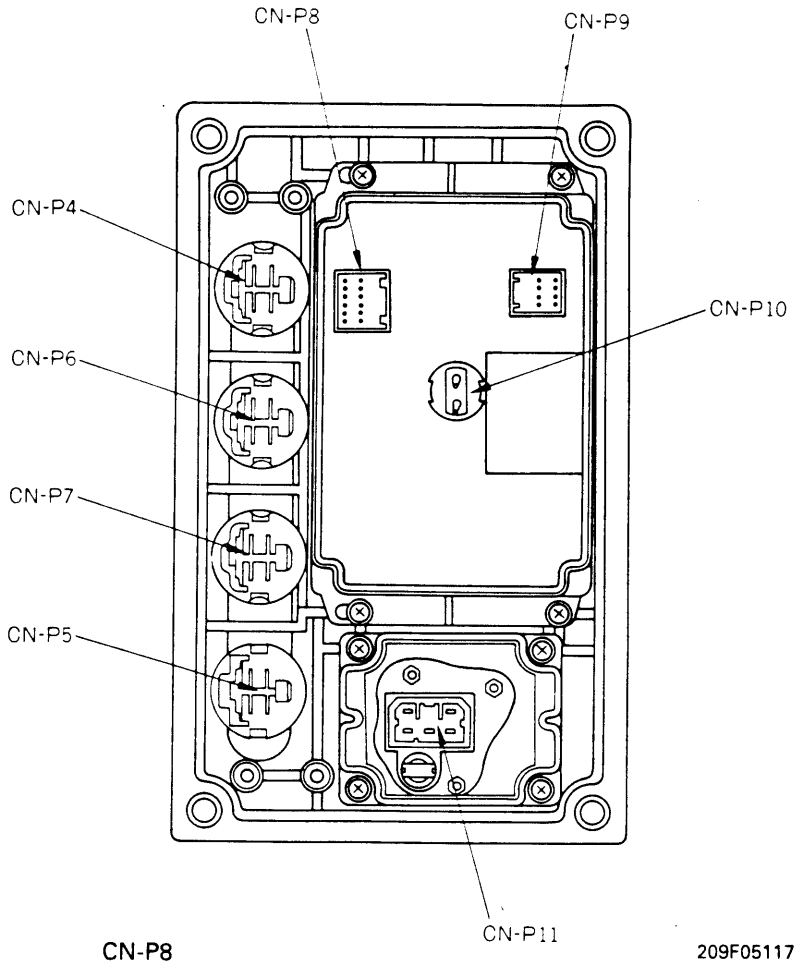
020905

SEP00489

1. MONITOR PANEL

1) UPPER PANEL





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020905

Input/output signals

CN-P4

No.	Signal	Input/output
1	Controller (GND)	Output
2	Controller	Output
3	Controller	Output
4	Power source (24V)	–

CN-P5

No.	Signal	Input/output
1	–	–
2	–	–
3	Travel speed solenoid	Output
4	Power source (24V)	–

CN-P6

No.	Signal	Input/output
1	–	–
2	Head lamp, working lamp relay	Output
3	Monitor panel, air conditioner panel	Output
4	Power source (24V)	–

CN-P7

No.	Signal	Input/output
1	Wiper motor	Output
2	Power sour (24V)	–
3	Lower wiper relay	Output
4	Washer	Output

CN-P8

No.	Signal	Input/output
1	Power source (24V)	–
2	GND	–
3	Starting signal	Input
4	Charge	Input
5	Coolant level	Input
6	Engine oil level	Input
7	Hydraulic oil level	Input
8	Hydraulic filter	Input
9	Engine oil pressure	Input
10	Hydraulic oil temperature	Input
11	PPC oil pressure	Input
12	Overload warning	Input

CN-P9

No.	Signal	Input/output
1	Coolant temperature	Input
2	Fuel level	Input
3	Preheating	Input
4	Buzzer	Output

CN-P10

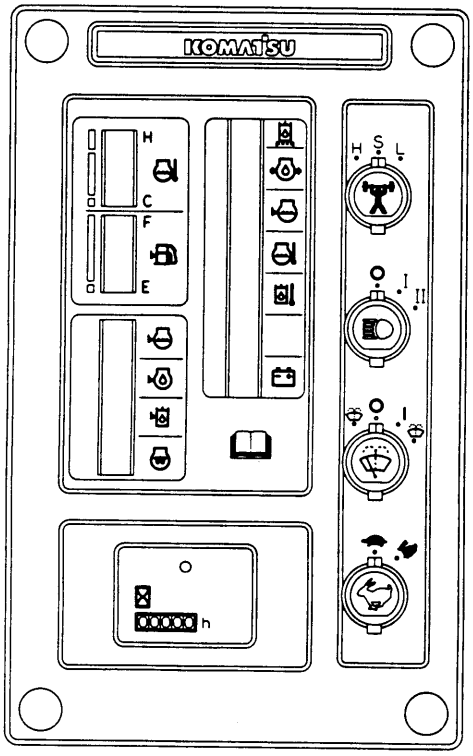
No.	Signal	Input/output
1	Lighting signal (24V)	Input
2	GND	–

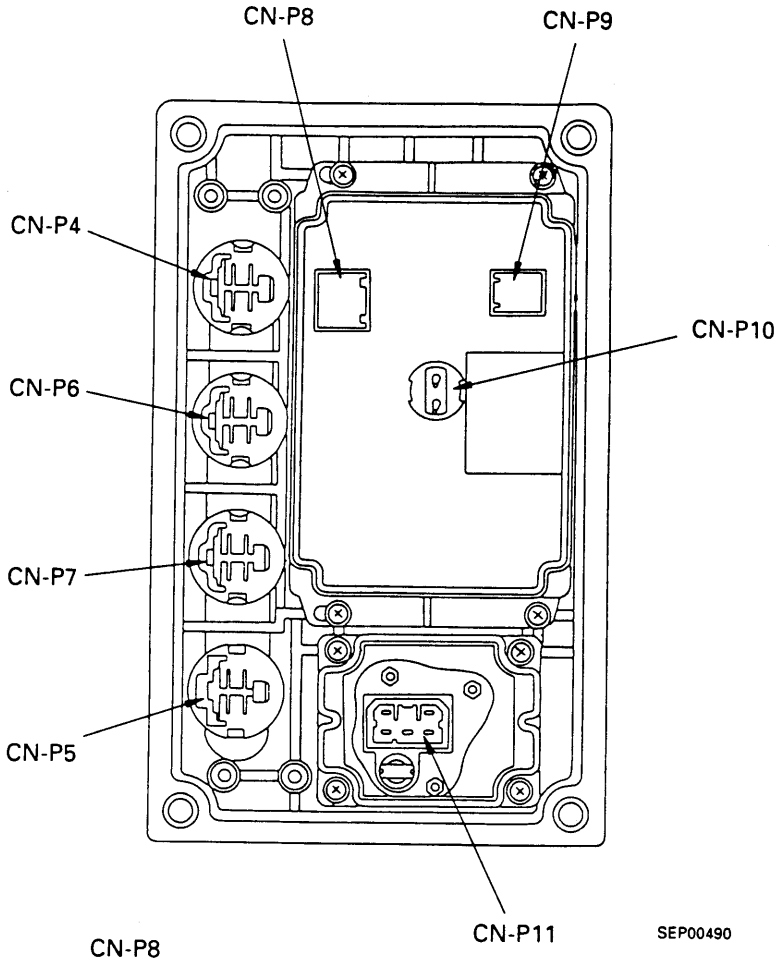
CN-P11

No.	Signal	Input/output
1	Power source (24V)	–
2	Lighting signal (24V)	Input
3	GND	–
4	Drive signal (Engine oil press.)	Input

1) UPPER PANEL

REGULATION OF EC INCLUSION





SEP00490

020905

Input/output signals

CN-P4

No.	Signal	Input/output
1	Controller (GND)	Output
2	Controller	Output
3	Controller	Output
4	Power source (24V)	–

CN-P5

No.	Signal	Input/output
1	–	–
2	–	–
3	Travel speed solenoid	Output
4	Power source (24V)	–

CN-P6

No.	Signal	Input/output
1	–	–
2	Head lamp, working lamp relay	Output
3	Monitor panel, air conditioner panel	Output
4	Power source (24V)	–

CN-P7

No.	Signal	Input/output
1	Wiper motor	Output
2	Power sour (24V)	–
3	Lower wiper relay	Output
4	Washer	Output

CN-P8

No.	Signal	Input/output
1	Power source (24V)	–
2	GND	–
3	Starting signal	Input
4	Charge	Input
5	Coolant level	Input
6	Engine oil level	Input
7	Hydraulic oil level	Input
8	Hydraulic filter	Input
9	Engine oil pressure	Input
10	Hydraulic oil temperature	Input
11	PPC oil pressure	Input
12	Overload warning	Input

CN-P9

No.	Signal	Input/output
1	Coolant temperature	Input
2	Fuel level	Input
3	Preheating	Input
4	Buzzer	Output

CN-P10

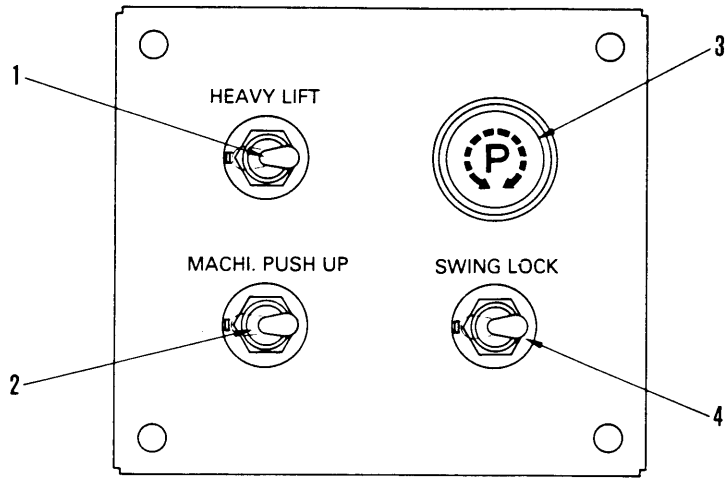
No.	Signal	Input/output
1	Lighting signal (24V)	Input
2	GND	–

CN-P11

No.	Signal	Input/output
1	Power source (24V)	–
2	Lighting signal (24V)	Input
3	GND	–
4	Drive signal (Engine oil press.)	Input

2) LOWER PANEL

★ FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS BACK HOE



1. Heavy lift switch
2. Machine push up switch
3. Swing lock lamp
4. Swing lock switch

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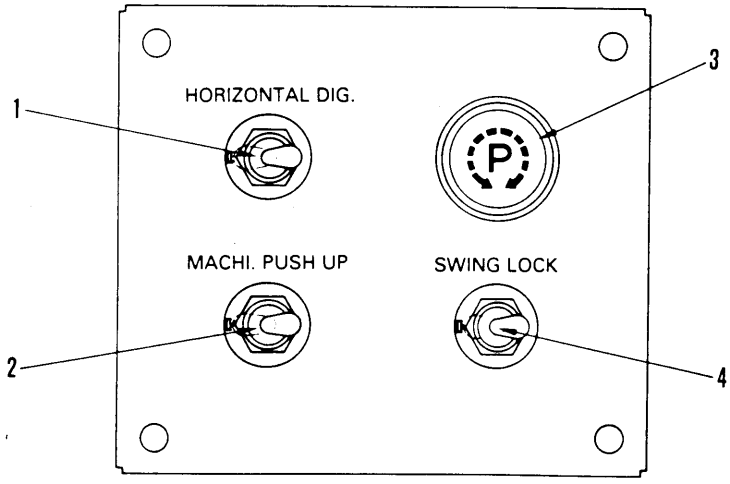
020905

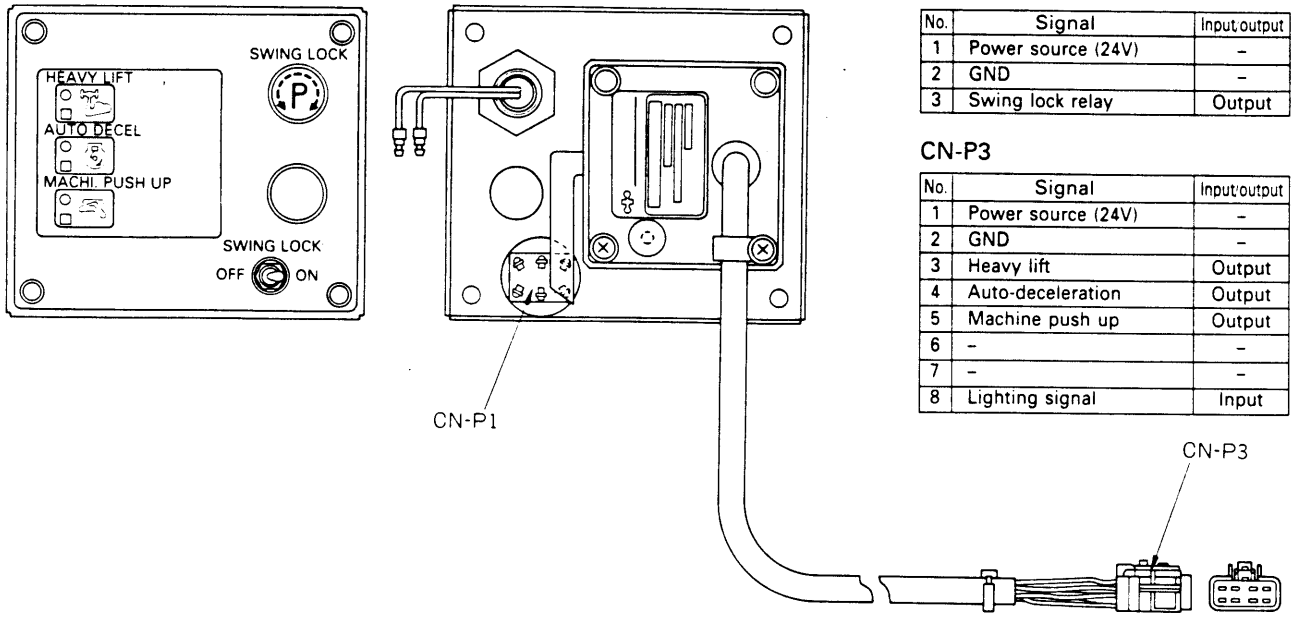
LOADING SHOVEL



1. Horizontal digging switch
2. Machine push up switch
3. Swing lock lamp
4. Swing lock switch

F20905058

★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION BACK HOE



209F05118

Input/output signal

CN-P1

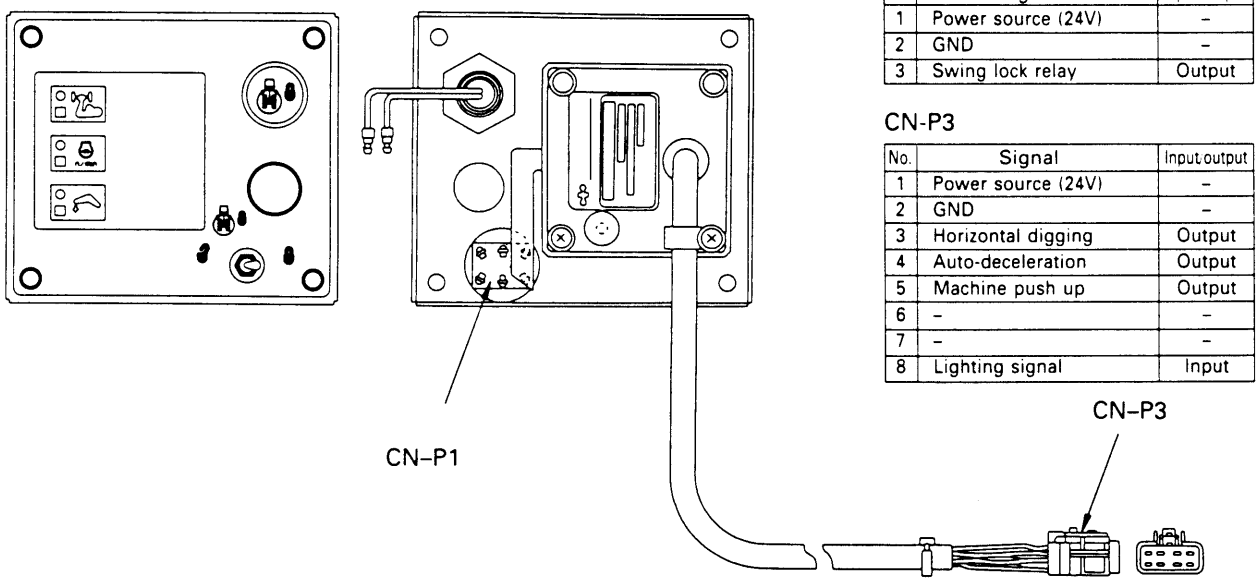
No.	Signal	Input/output
1	Power source (24V)	–
2	GND	–
3	Swing lock relay	Output

CN-P3

No.	Signal	Input/output
1	Power source (24V)	–
2	GND	–
3	Heavy lift	Output
4	Auto-deceleration	Output
5	Machine push up	Output
6	–	–
7	–	–
8	Lighting signal	Input

020905

REGULATION OF EC INCLUSION



SEP00491

Input/output signal

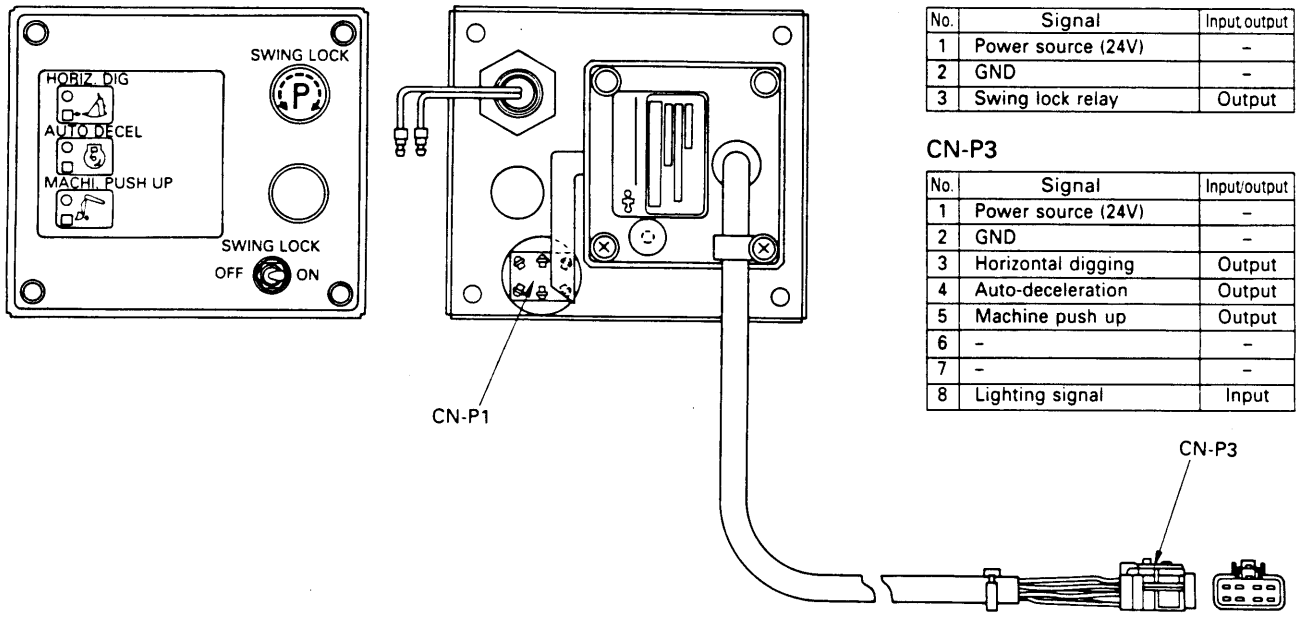
CN-P1

No.	Signal	Input/output
1	Power source (24V)	–
2	GND	–
3	Swing lock relay	Output

CN-P3

No.	Signal	Input/output
1	Power source (24V)	–
2	GND	–
3	Horizontal digging	Output
4	Auto-deceleration	Output
5	Machine push up	Output
6	–	–
7	–	–
8	Lighting signal	Input

LOADING SHOVEL



F20905059

Input/output signal

CN-P1

No.	Signal	Input output
1	Power source (24V)	-
2	GND	-
3	Swing lock relay	Output

CN-P3

No.	Signal	Input/output
1	Power source (24V)	-
2	GND	-
3	Horizontal digging	Output
4	Auto-deceleration	Output
5	Machine push up	Output
6	-	-
7	-	-
8	Lighting signal	Input

020905

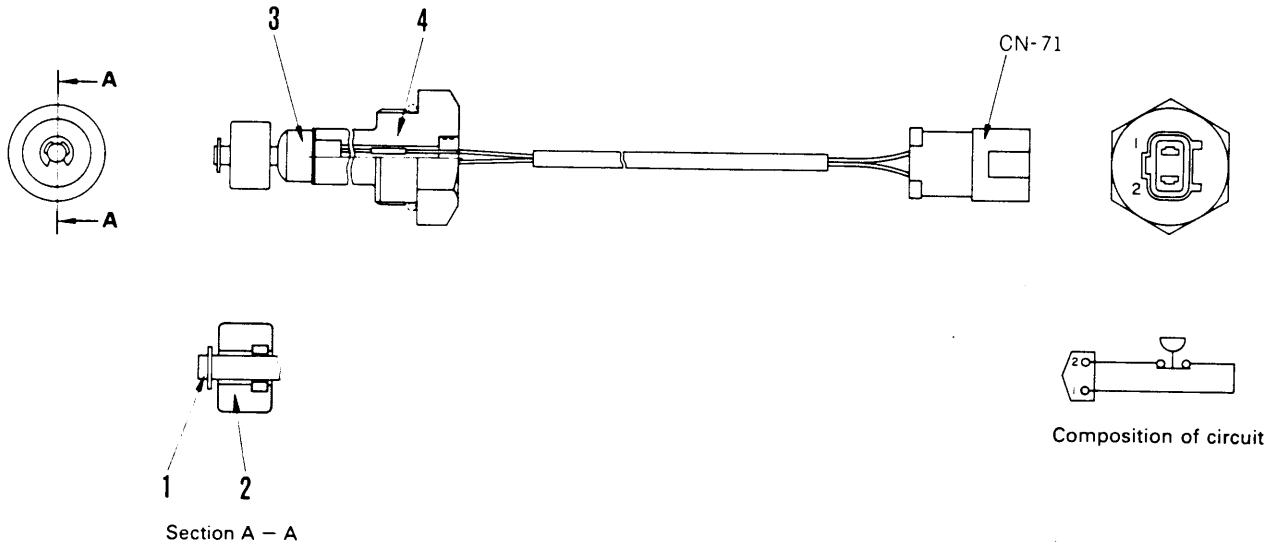
2. SENSORS

- The signals from the sensors are input directly to the panel.
  (The signal from the hydraulic filter sensor system is input through the timer.)
- For the contact type sensors, one side is always connected to the chassis ground. When the contact is closed and the signal wire is connected to the chassis, the panel judges that this is the normal signal.

Display category	Type of sensor	Sensor method	When normal	When abnormal
CHECKS BEFORE STARTING	Coolant level	Contact	ON	OFF
	Engine oil level	Contact	ON	OFF
	Hydraulic oil level	Contact	ON	OFF
CAUTION	Hydraulic filter	Contact	ON	OFF
	Hydraulic oil temperature (low temperature)	Contact	ON	OFF
	Engine oil pressure	Contact	ON	OFF
	Hydraulic oil temperature (high temperature)	Contact	ON	OFF
GAUGE	Coolant temperature	Resistance	–	–
	Fuel level	Resistance	–	–

020905

1) COOLANT LEVEL SENSOR



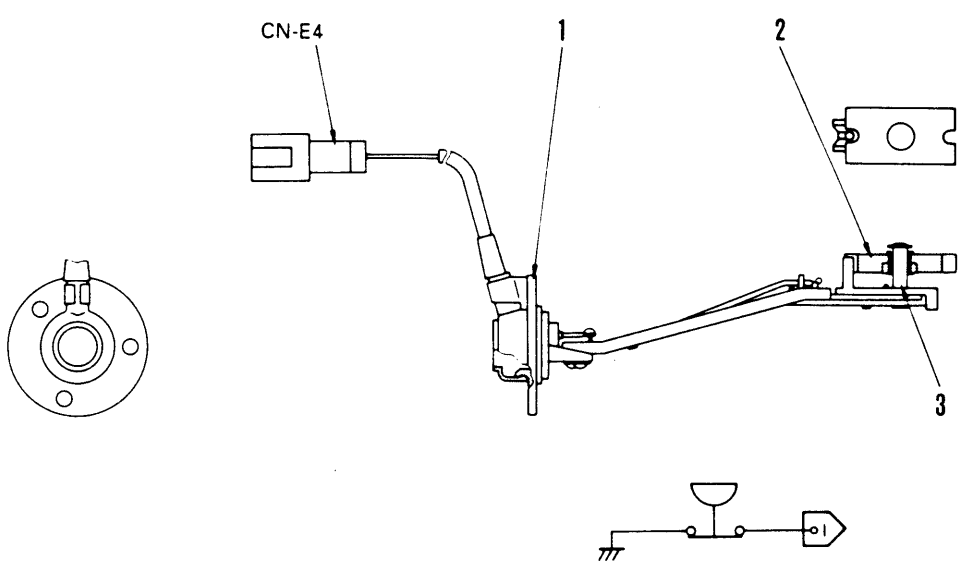
Section A – A

Composition of circuit

209F05119

1. Shaft
2. Float
3. Switch
4. Plug

2) ENGINE OIL LEVEL SENSOR



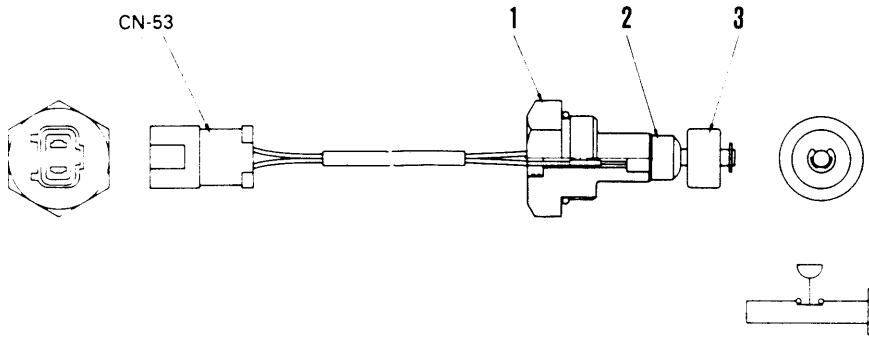
1. Bracket
2. Float
3. Switch

Composition of circuit

205F05167A

020905

3) HYDRAULIC OIL LEVEL SENSOR

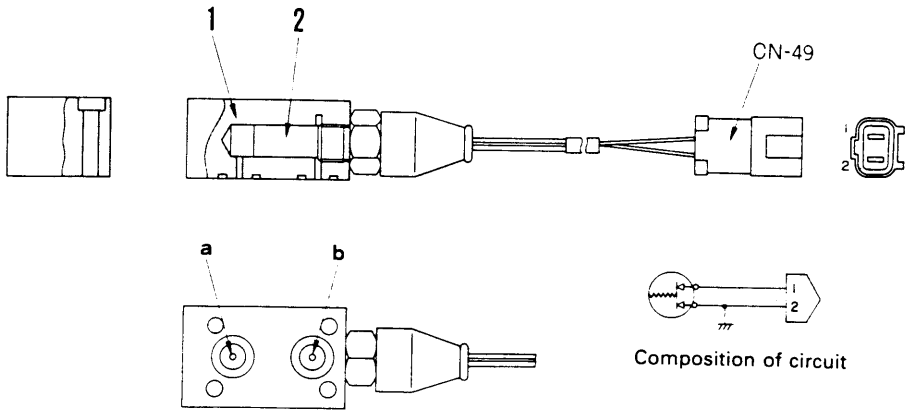


1. Plug
2. Switch
3. Float

Composition of circuit

205F05168

4) HYDRAULIC FILTER SENSOR



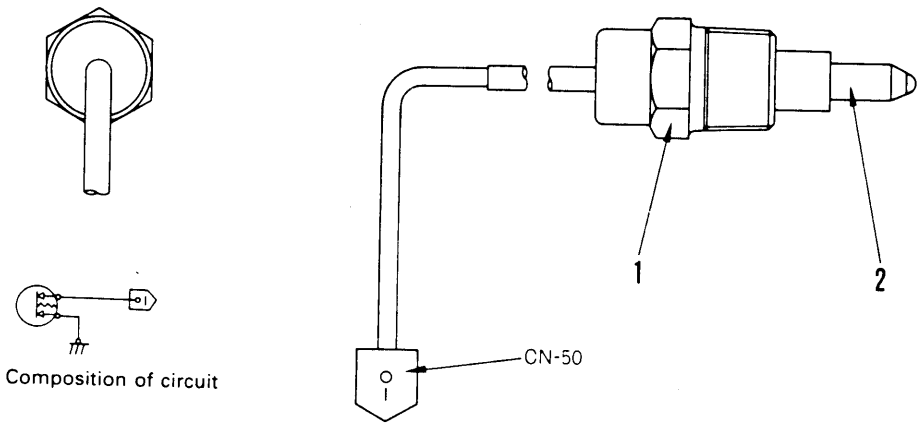
a. High pressure inlet port
b. Low pressure outlet port

1. Block
2. Sensor

SPECIFICATIONS
OFF pressure: 1.0 ± 0.2 kg/cm²

209F05120

- **HYDRAULIC OIL TEMPERATURE SENSOR (LOW TEMPERATURE)**

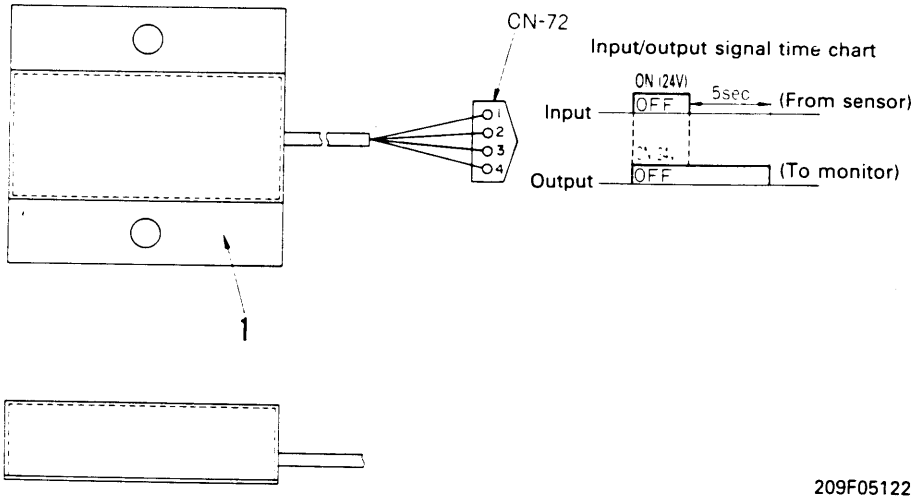


1. Plug
2. Sensor

SPECIFICATIONS
ON temperature: 13°C
OFF temperature: 20 ± 5°C

209F05121

- **HYDRAULIC FILTER CLOGGING TIMER**



1. Timer

FUNCTION
- When the OFF signal is received from the hydraulic filter sensor, the timer function is carried out, and then the signal to the monitor is switched OFF.

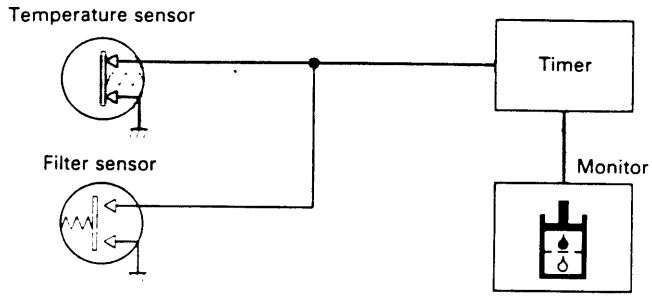
209F05122

020905

ELECTRIC CIRCUIT FOR HYDRAULIC FILTER MONITOR SYSTEM

FUNCTION

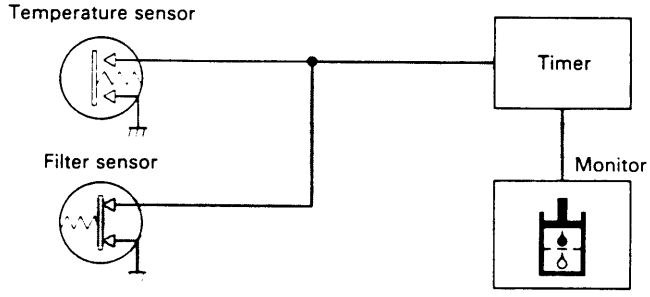
- Immediately after starting the engine, the oil temperature is low and the oil viscosity is high. As a result, resistance is generated in the filter, so the hydraulic filter sensor is switched OFF.
  To cancel this electrically, a hydraulic oil temperature (low temperature) sensor is installed, and at low temperatures, this hydraulic oil temperature sensor is switched ON.
- There may also be cases when the filter sensor is switched OFF because of momentary changes in the oil pressure.
  To cancel this electrically, a timer is installed which gives a 5-second delay in the display.



209F05123

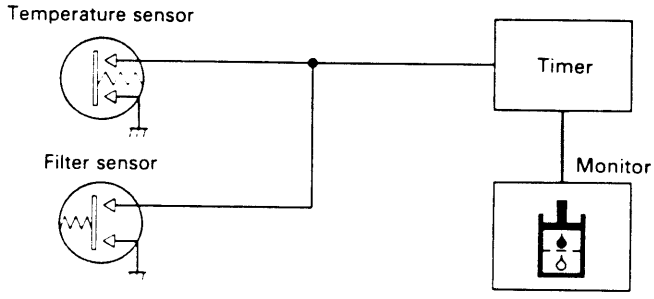
OPERATION

1) **When starting engine**
   Immediately after starting the engine, the oil temperature is low and the oil viscosity is high. As a result, resistance is generated in the filter, so the hydraulic filter sensor is switched OFF.
   However, the temperature sensor, which is connected in parallel to the filter sensor, is ON, so the signal to the timer is switched ON, and the monitor does not give any display (Fig. 1).



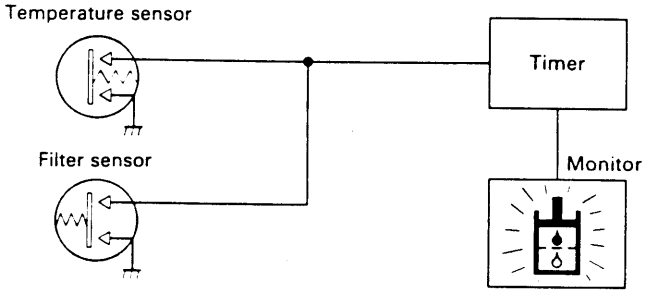
209F05124

2) **When engine running and oil temperature rise**
   When the oil temperature rises and the viscosity of the oil becomes lower, the flow of hydraulic oil becomes smooth and the filter sensor is turned ON.
   At the same time, when the oil temperature rises, the temperature sensor is switched OFF (Fig. 2).
3) **When filter is clogged**
   - When the filter becomes clogged, the filter sensor sends an OFF signal to the timer (Fig. 3).



209F05125

   - When the timer receives the OFF signal from the filter sensor, it starts the timer in order to judge if the signal is a momentary phenomenon. If the filter sensor is not turned back on within 5 seconds, it sends an OFF signal to the monitor.
   - When the monitor receives the OFF signal from the timer, it lights up the hydraulic filter monitor lamp (Fig. 4).



209F05126

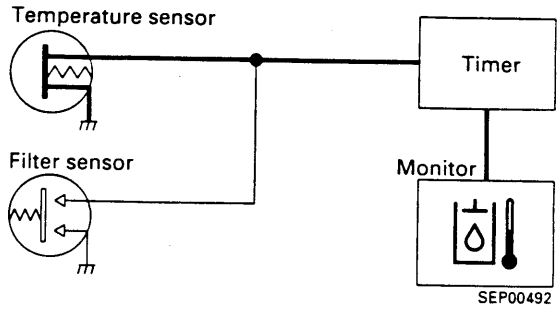
020905

ELECTRIC CIRCUIT FOR HYDRAULIC FILTER MONITOR SYSTEM

REGULATION OF EC INCLUSION

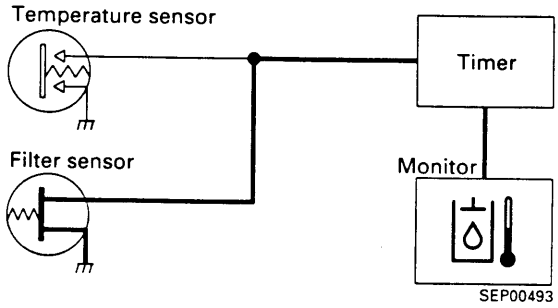
FUNCTION

- Immediately after starting the engine, the oil temperature is low and the oil viscosity is high. As a result, resistance is generated in the filter, so the hydraulic filter sensor is switched OFF.
  To cancel this electrically, a hydraulic oil temperature (low temperature) sensor is installed, and at low temperatures, this hydraulic oil temperature sensor is switched ON.
- There may also be cases when the filter sensor is switched OFF because of momentary changes in the oil pressure.
  To cancel this electrically, a timer is installed which gives a 5-second delay in the display.

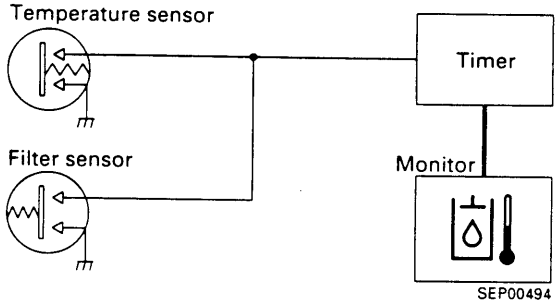


OPERATION

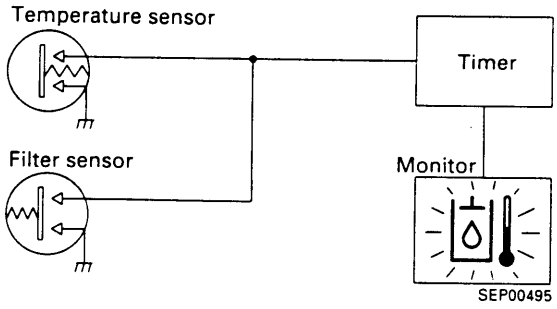
1) **When starting engine**
   Immediately after starting the engine, the oil temperature is low and the oil viscosity is high. As a result, resistance is generated in the filter, so the hydraulic filter sensor is switched OFF.
   However, the temperature sensor, which is connected in parallel to the filter sensor, is ON, so the signal to the timer is switched ON, and the monitor does not give any display (Fig. 1).



2) **When engine running and oil temperature rise**
   When the oil temperature rises and the viscosity of the oil becomes lower, the flow of hydraulic oil becomes smooth and the filter sensor is turned ON.
   At the same time, when the oil temperature rises, the temperature sensor is switched OFF (Fig. 2).

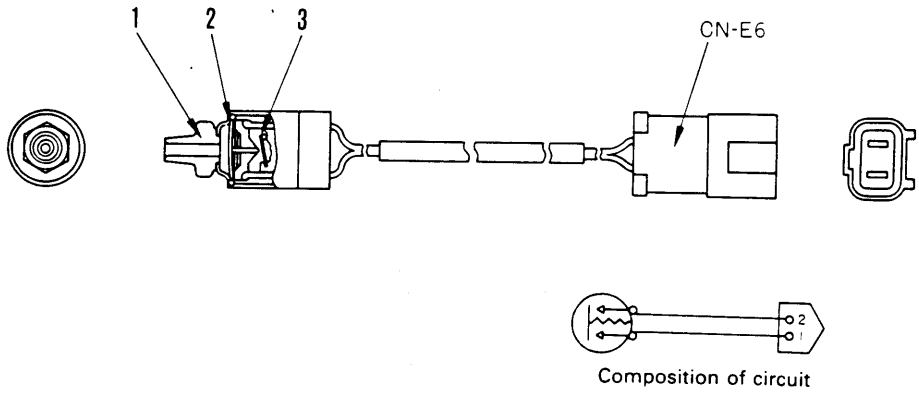


3) **When filter is clogged**
   - When the filter becomes clogged, the filter sensor sends an OFF signal to the timer (Fig. 3).
   - When the timer receives the OFF signal from the filter sensor, it starts the timer in order to judge if the signal is a momentary phenomenon. If the filter sensor is not turned back on within 5 seconds, it sends an OFF signal to the monitor.
   - When the monitor receives the OFF signal from the timer, it lights up the hydraulic filter monitor lamp (Fig. 4).



020905

5) ENGINE OIL PRESSURE SENSOR



Composition of circuit

1. Plug
2. Diaphragm
3. Switch

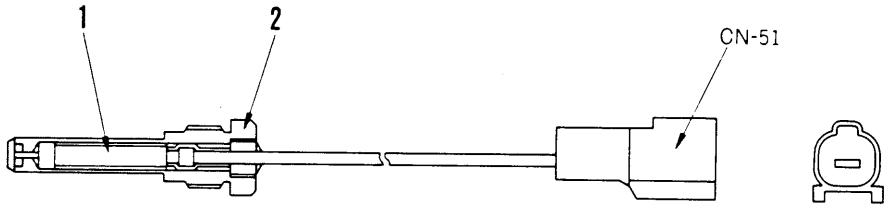
SPECIFICATIONS

ON pressure: 1.3 ± 0.3 kg/cm²

OFF pressure: $0.5\ ^{+0.3}_{-0.2}$ kg/cm²

209F05127

6) HYDRAULIC OIL TEMPERATURE SENSOR (HIGH TEMPERATURE)



1. Sensor
2. Plug

SPECIFICATIONS

ON temperature: 98 ± 3°C

OFF temperature: 102 ± 3°C

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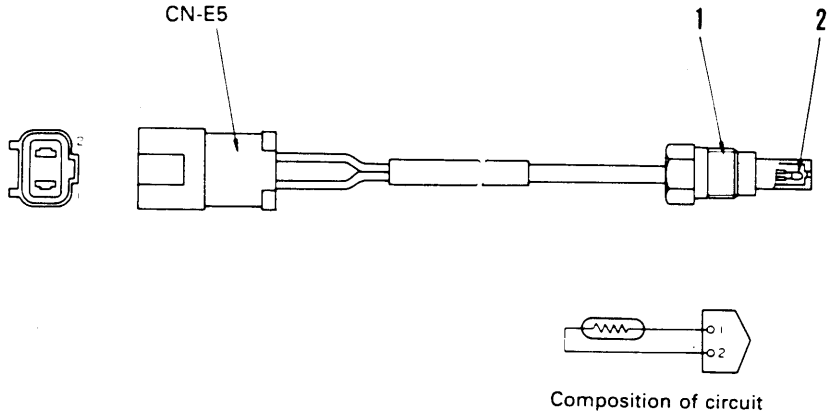
209F05128

7) COOLANT TEMPERATURE SENSOR

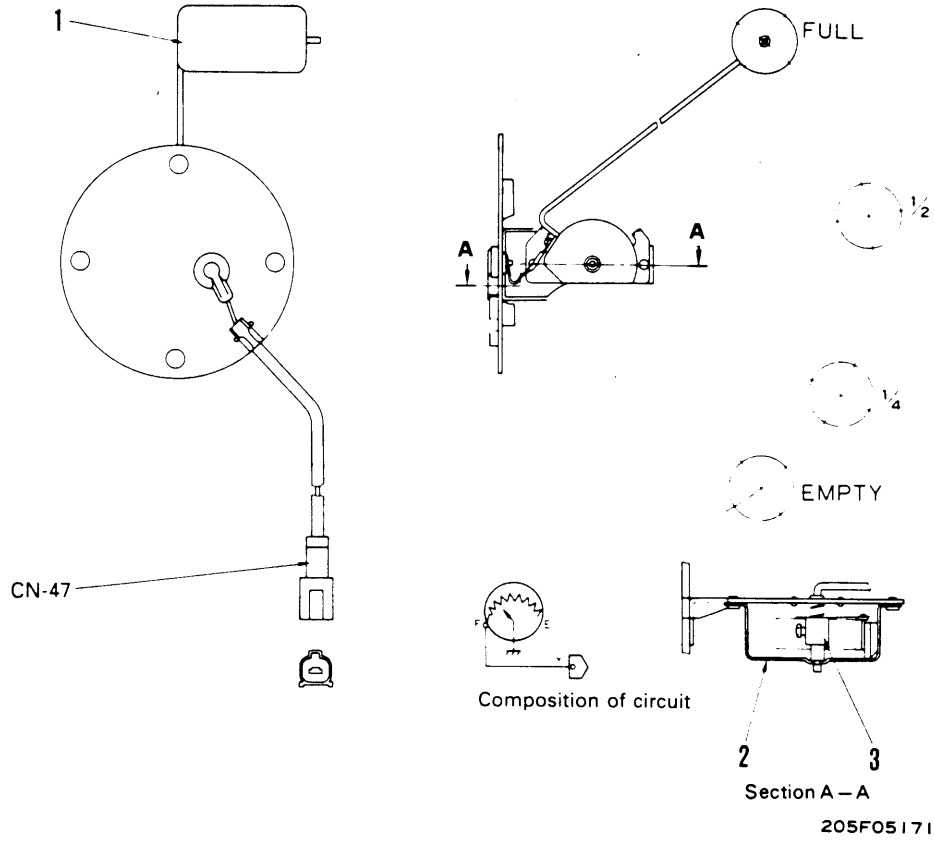


Composition of circuit

1. Plug
2. Sensor

205F05170A

8) FUEL LEVEL SENSOR



1. Float
2. Cover
3. Variable resistance

020905

20 TESTING AND ADJUSTING

020905

⚠ Before performing inspection, adjustment or faultfinding, park the machine on level ground and check the safety pin and chock.

⚠ When preforming joint work, make apporpriate signals and allow only authorized personnel near the machine.

⚠ When checking the water level, allow the engine to cool down before removing the radiator cap to prevent the risk of being scalded by hot water which may spurt out if the engine is hot.

⚠ Take great care to avoid getting caught in rotating parts such as the fan, ect.

TABLE OF JUDGEMENT STANDARD VALUE

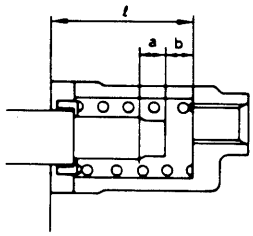
- **FOR ENGINE**

Machine model			PC650-5 PC650SE-5	
Engine			SA6D140-1	
Item	Measurement condition	Unit	Standard value	Permissible value
Engine speed	High idling	rpm	1,980 ± 50	1,980 ± 50
	Low idling	rpm	700 ± 50	700 ± 50
	Rated speed	rpm	1,800	–
Intake air pressure	At rated output	mmHg	Min. 1,100	880
Exhaust gas pressure	All speed range (intake air temp: 20°C)	°C	Max. 700	Max. 700
Exhaust gas color	At sudden acceleration	Bosch index	Max. 6.0	7.2
	At high idling	Bosch index	Max. 2.0	3.0
Valve clearance (normal temperature)	Intake valve	mm	0.43	–
	Exhaust valve	mm	0.80	–
Compression pressure (SAE 30 oil)	Oil temperature: 40 – 60°C	kg/cm²	32	22
	(Engine speed)	(rpm)	(160 – 200)	(160 – 200)
Blow-by pressure (SAE 30 oil)	(Coolant temperature: Operating range) At rated output	mmH_2O	Max. 200	400
Oil pressure (SAE 30 oil)	(Coolant temperature: Operating range)			
	At high idling	kg/cm²	2.5 – 5.0	1.8
	At low idling (SAE 30)	kg/cm²	1.2	0.7
	At low idling (SAE10W)	kg/cm²	1.0	0.7
Oil temperature	All speed range (inside oil pan)	°C	80 – 110	120
Fuel injection timing	B. T. D. C.	deg.	28 ± 1	28 ± 1
Alternator belt tension	Deflection when pressed with finger force of approx. 6 kg	mm	10	8 – 12
Fan belt tension	Protrusion of adjustment bolt	mm	55 ± 4	–

020905

- **FOR CHASSIS (FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS)**

★ The standard values and permissible values shown in this table are all values when mode selector switch is at S mode.

Machine model					PC650-5 PC650SE-5					
Classification	Item	Measurement condition		Unit	Standard value			Permissible value		
Engine speed	At front pumps relief (No. 1F + No. 2F)	• Hydraulic oil temperature: 45 – 55°C • Engine coolant temperature: Within operating range • Engine oil pressure: Within operating range		rpm	Min. 1,880			1,830		
	At front and rear pumps relief (No. 1F, R + No. 2F, R)				Min. 1,880			1,830		
	At swing pump relief				Min. 1,930			1,880		
	At heavy lift relief	• Set heavy lift switch ON • At only BOOM RAISE relief			Min. 1,700			1,650		
	At auto-deceleration acts	• Fuel control lever at high idling • All control levers at neutral			–			–		
Spool travel	Boom-Lo control valve	 202F2302		mm	ℓ	a	b	ℓ	a	b
	Boom-Hi control valve									
	Arm-Lo control valve									
	Arm-Hi control valve									
	Bucket-Lo control valve									
	Bucket-Hi control valve				69	11	11	69	11	11
	L. H. travel control valve									
	R. H. travel control valve									
	Service valve (Bottom dump control valve)									
	Swing control valve				29.5	11	11	29.5	11	11
Control lever travel	Boom control lever	• At center of lever knob • Measure at end of stroke • Engine stopped	Neutral → Raise, Lower	mm	64 ± 10			64 ± 10		
	Arm control lever		Neutral → In, Out		64 ± 10			64 ± 10		
	Bucket control lever		Neutral → Curl, Dump		64 ± 10			64 ± 10		
	Swing control lever		Neutral → L.H., R.H.		64 ± 10			64 ± 10		
	Travel control lever		Neutral → Forward, Reverse		115 ± 15			115 ± 15		
	Safety lock lever		Lock ↔ Free		300 ± 30			300 ± 30		
	Fuel control lever		Low idling ↔ High idling		150 ± 20			150 ± 20		
	Play of control lever		Work equipment		0 – 7			0 – 7		
			Travel		0 – 20			0 – 20		

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Machine model					PC650-5 PC650SE-5	
Classification	Item	Measurement condition		Unit	Standard value	Permissible value
Operating force	Boom control lever	• Engine at high idling • Hydraulic oil temperature: 45 – 55°C • For control lever, fit push-pull scale to center of knob to measure. • For control pedal, fit push-pull scale to tip of pedal to measure. • Measure max. value to end of travel.		kg	2.4 ± 0.6	2.4 ± 0.6
	Arm control lever				2.4 ± 0.6	2.4 ± 0.6
	Bucket control lever				2.1 ± 0.6	2.1 ± 0.6
	Swing control lever				2.1 ± 0.6	2.1 ± 0.6
	Travel control lever				2.5 ± 0.6	2.5 ± 0.6
	Fuel control lever				5.5 – 7	5.5 – 7
Hydraulic pressure	Boom		Raise: At heavy lift switch OFF	Kg/cm²	320 ± 10	320^{+10}_{-20}
			Raise: At heavy lift switch ON		350^{+5}_{-10}	350^{+5}_{-20}
			Lower: At machine push up switch OFF		215 ± 15	215^{+15}_{-20}
			Lower: At machine push up switch ON		320 ± 10	320^{+10}_{-20}
	Arm	• Hydraulic oil temperature: 45 – 55°C • Engine at high idling • Relieve only circuit to be measured			320 ± 10	320^{+10}_{-20}
	Bucket				320 ± 10	320^{+10}_{-20}
	Travel				320 ± 10	320^{+10}_{-20}
	Swing				280^{+20}_{0}	280^{+20}_{-10}
	Control				30^{+5}_{0}	30^{+5}_{0}
	TVC valve output pressure	• Hydraulic oil temperature: 45 – 55°C • Engine at high idling	Lever at neutral		23 ± 2	Min. 18
			Boom raise relief		14.5 ± 2	14 ± 2
			Swing pump relief		Min. 18	Min. 18
			At heavy lift switch ON, boom raise relief		12.5 ± 2	12 ± 2
	NC valve output pressure	• Hydraulic oil temperature: 45 – 55°C • Engine at high idling	Lever at neutral		Max. 4	Max. 5.5
			Lever at stroke end Raise track on one side than rotate sprocket ★		Min. 18	Min. 18

★ Measure at the NC valve, but neither the NC valve nor the CO valve are actuated, so the measurement is the pressure of the TVC valve.

★ When measuring at BOOM RAISE relief, do not operate to the end of the stroke. Relieve the circuit before the end of the stroke. (At the end of the RAISE stroke, the piston valve opens.)

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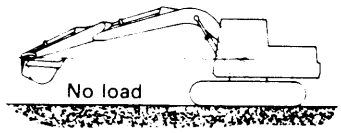
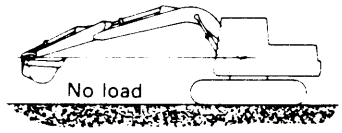
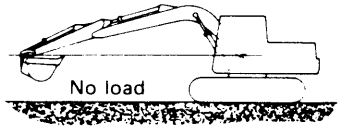
Machine model					PC650-5 PC650SE-5	
Classification	Item		Measurement condition	Unit	Standard value	Permissible value
Hydraulic pressure	Difference pressure of jet sensor	Lever at neutral	• Hydraulic oil temperature: 45 – 55°C • Engine at high idling • Control lever at neutral	kg/cm²	18 ± 2.0	Min. 15
		Lever at end of travel	• Hydraulic oil temperature: 45 – 55°C • Engine at high idling • Control lever at end of travel (Pump discharge pressure as desired)		Max. 2.0	Max. 2.0
	Lowered hydraulic pressure		• Hydraulic oil temperature: 45 – 55°C • Difference oil relief pressure between at engine full speed and at engine low speed (two pump relief)		Max. 20	30
Swing	Swing brake angle		Measuring posture Max. reach  202F2323 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Stop after swinging one turn and measure distance that swing circle moves • ( ): Distance of movement on outside circumference of swing circle	deg. (mm)	Max. 45 (Max. 775)	Max. 60 (Max. 1,040)
	Time taken to start swing		Measuring posture Max. reach  202F2323 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Time taken from starting position to swing 90° and 180°	90° 180°	sec.	4.4 – 5.3 7.0 – 8.6	Max. 5.6 Max. 9.0
	Time taken to swing		Measuring posture Max. reach  202F2323 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Swing one turn, and measure time taken to swing next 5 turns		sec.	50.0 – 56.0	Max. 58

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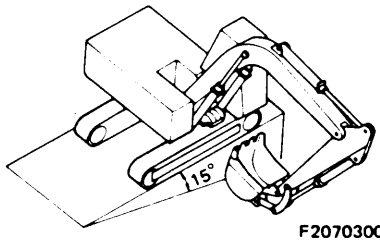
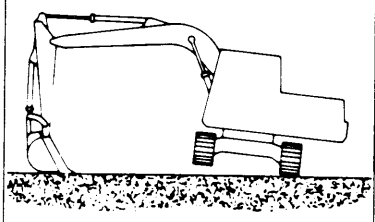
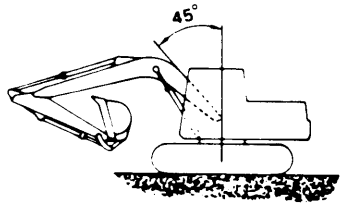
Machine model					PC650-5 PC650SE-5			
Classification	Item	Measurement condition		Unit	Standard value		Permissible value	
Swing	Hydraulic drift of swing	 F20703006 • Engine stopped • Hydraulic oil temperature: 45 – 55°C • Set machine on 15° slope, and set upper structure at 90° to the side. • Make match marks on swing circle outer race and trank frame. • Measure distance that match marks move apart after 5 minutes.		mm	0		0	
	Leakage of swing motor	• Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Swing lock switch ON • Relieve swing circuit		ℓ /min	Max. 5		Max. 10	
Travel	Travel speed (1)	Measuring posture  205F2427 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Raise track on one side at a time, rotate one turn, then measure time taken for next 5 turns.	Lo	sec.	STD 73.5 – 81.5	LC 81.0 – 90.0	STD 73.5 – 81.5	LC 81.0 – 90.0
			Hi		49.0 – 58.0	55.0 – 65.0	49.0 – 58.0	55.0 – 65.0
	Travel speed (2)	Measuring posture  205F2409 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Run up for at least 10 m, and measure time taken to travel next 20 m on flat ground.	Lo	sec.	24.0 – 30.0	26.5 – 33.0	24.0 – 30.0	26.5 – 33.0
			Hi		16.0 – 19.0	18.0 – 21.0	16.0 – 19.0	18.0 – 21.0

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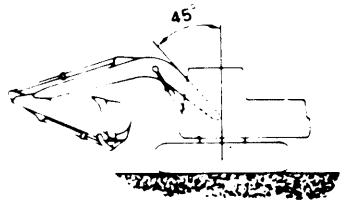
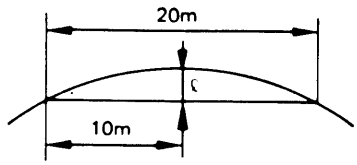
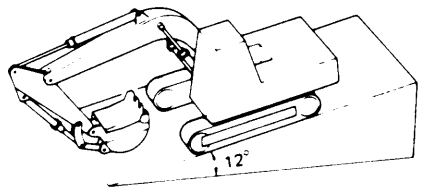
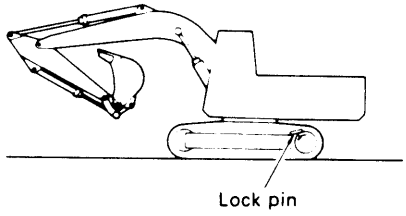
Machine model				PC650-5 PC650SE-5	
Classification	Item	Measurement condition	Unit	Standard value	Permissible value
Travel	Travel deviation	Measuring posture  205F2409 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Run up for at least 10 m, and measure deviation when traveling next 20 m on flat ground. ★ Use a hard horizontal surface  205F2402 ★ Measure dimension ℓ	mm	Max. 200	Max. 220
	Hydraulic drift of travel	Measuring posture  F20703007 • Engine stopped • Hydraulic oil temperature: 45 – 55°C • Stop machine on 12° slope with sprocket facing straight up the slope. • Measure the distance the machine moves in 5 minutes.	mm	0	0
	Leakage of travel motor	 F20703008 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Lock shoes and relieve travel circuit.	ℓ/min	Max. 10	Max. 20

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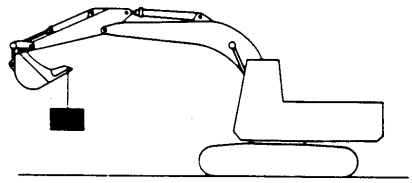
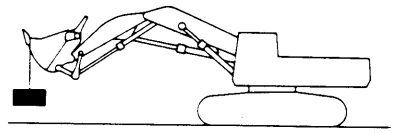
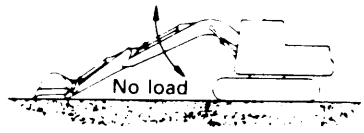
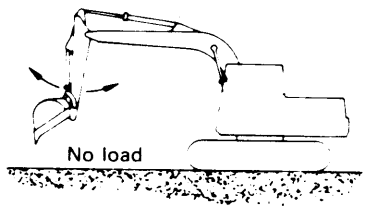
Machine model					PC650-5 PC650SE-5			
Classification	Item		Measurement condition	Unit	Standard value		Permissible value	
					BACK HOE	LOADING SHOVEL	BACK HOE	LOADING SHOVEL
Work equipment	Hydraulic drift	Total work equipment (hydraulic drift at tip of bucket teeth)	Measuring posture BACK HOE  200F1001 LOADING SHOVEL  200F1002 • Place in above posture and measure extension or retraction of cylinder and downward movement at tip of bucket teeth. • Bucket: Rated load BACK HOE: 4,500 kg (PC650) 6,300 kg (PC650SE) LOADING SHOVEL: 6,840 kg • Horizontal, flat fround • Levers at neutral • Engine stopped • Hydraulic oil temperature: 45 – 55°C • Start measuring immediately after setting. • Measure hydraulic drift for each 5 minutes, and judge from results for 15 minutes. • ( ): Bucket no load	mm	Max. 1,200 (Max. 650)	Max. 1,300	Max. 1,800 (max. 1,000)	Max. 1,500
		Boom cylinder (amount of retraction of cylinder)			60 (35)	Max. 150	Max. 90 (Max. 50)	
		Arm cylinder (amount of extension of cylinder)			165 (70)	Max. 30	Max. 250 (Max. 105)	
		Bucket cylinder (amount of retraction of cylinder)			50 (15)	Max. 8	Max. 75 (Max. 25)	
	Work equipment speed	Boom Bucket teeth in contact with ground ▲ ▼ Cylinder fully extended	Measuring posture  No load 205F2421 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C	RAISE	5.8 ± 0.6	6.0 ± 0.6	–	–
				LOWER	4.2 ± 0.4	3.6 ± 0.4	–	–
		Arm Cylinder fully retracted ▲ ▼ Fully extened	Measuring posture  No load 205F2422 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C	IN	5.2 ± 0.5	4.5 ± 0.5	–	–
				OUT	3.7 ± 0.4	2.7 ± 0.3	–	–
				sec.				

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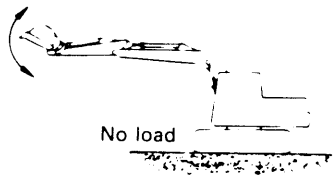
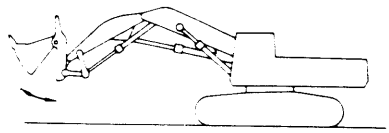
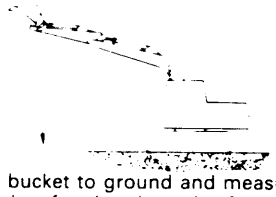
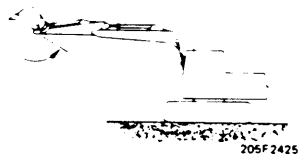
Machine model					PC650-5 PC650SE-5			
Classification	Item		Measurement condition	Unit	Standard value		Permissible value	
					BACK HOE	LOADING SHOVEL	BACK HOE	LOADING SHOVEL
Work equipment	Work equipment speed	Bucket Cylinder fully retracted ▲ ▼ Fully extended	Measuring posture  No load 205F2423 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C	CURL	3.4 ± 0.4	4.6 ± 0.5	–	–
				DUMP	3.4 ± 0.4	4.0 ± 0.4	–	–
		Bottom dump Cylinder fully retracted ▲ ▼ Fully extended	Measuring posture  200F1005 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C	OPEN	–	1.8 ± 0.2	–	–
				CLOSE	–	1.8 ± 0.2	–	–
	Time lag	Boom	Measuring posture  205F2424 • Lower bucket to ground and measure time taken for chassis to rise from ground • Engine at low idling • Hydraulic oil temperature: 45 – 55°C	sec.	Max. 3	Max. 3	Max. 3	Max. 3
		Arm	Measuring posture  205F2422 • Amount of time when arm stops for a moment • Engine at low idling • Hydraulic oil temperature: 45 – 55°C		Max. 3	Max. 3	Max. 3	Max. 3
		Bucket	Measuring posture  205F2425 • Amount of time when bucket stops for a moment • Engine at low idling • Hydraulic oil temperature: 45 – 55°C		Max. 3	Max. 3	Max. 3	Max. 3

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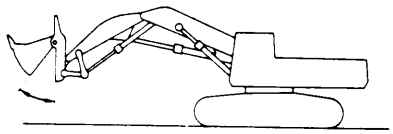
Machine model					PC650-5 PC650SE-5			
Classi-fication	Item		Measurement condition	Unit	Standard value		Permissible value	
					BACK HOE	LOADING SHOVEL	BACK HOE	LOADING SHOVEL
Work equipment	Time lag	Bottom dump	Measuring posture  200F1005 • Engine at Low idling • Hydraulic oil temperature: 45 – 55°C • Time taken for bottom dump to move again when operated from max. bottom open position and stopped temporarily.	sec.	–	Max. 3	–	Max. 3
	Internal leakage	Cylinder	• Hydraulic oil temperature: 45 – 55°C • Engine at high idling • Relieve circuit to be measured	cc/min	Max. 5		Max. 20	
		Center swivel joint			Max. 10		Max. 100	

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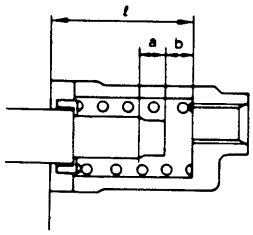
- **FOR CHASSIS (FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION)**

★ The standard values and permissible values shown in this table are all values when mode selector switch is at H mode.

Machine model					PC650-5 PC650SE-5					
Classification	Item	Measurement condition		Unit	Standard value			Permissible value		
Engine speed	At front pumps relief (No. 1F + No. 2F)	• Hydraulic oil temperature: 45 – 55°C • Engine coolant temperature: Within operating range • Engine oil pressure: Within operating range		rpm	Min. 1,880			1,830		
	At front and rear pumps relief (No. 1F, R + No. 2F, R)				Min. 1,880			1,830		
	At swing pump relief				Min. 1,930			1,880		
	At heavy lift relief	• Set heavy lift switch ON • At only BOOM RAISE relief			Min. 1,700			1,650		
	At auto-deceleration acts	• Fuel control lever at high idling • All control levers at neutral			1,200 ± 100			1,200 ± 100		
Spool travel	Boom-Lo control valve	 202F2302		mm	ℓ	a	b	ℓ	a	b
	Boom-Hi control valve				69	11	11	69	11	11
	Arm-Lo control valve									
	Arm-Hi control valve									
	Bucket-Lo control valve									
	Bucket-Hi control valve									
	L. H. travel control valve									
	R. H. travel control valve									
	Service valve (Bottom dump control valve)									
	Swing control valve				29.5	11	11	29.5	11	11
Control lever travel	Boom control lever	• At center of lever knob • Measure at end of stroke • Engine stopped	Neutral → Raise, Lower	mm	64 ± 10			64 ± 10		
	Arm control lever		Neutral → In, Out		64 ± 10			64 ± 10		
	Bucket control lever		Neutral → Curl, Dump		64 ± 10			64 ± 10		
	Swing control lever		Neutral → L.H., R.H.		64 ± 10			64 ± 10		
	Travel control lever		Neutral → Forward, Reverse		115 ± 15			115 ± 15		
	Safety lock lever		Lock ← → Free		300 ± 30			300 ± 30		
	Fuel control lever		Low idling ← → High idling		150 ± 20			150 ± 20		
	Play of control lever		Work equipment		0 – 7			0 – 7		
			Travel		0 – 20			0 – 20		

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Machine model					PC650-5 PC650SE-5	
Classification	Item	Measurement condition		Unit	Standard value	Permissible value
Operating force	Boom control lever	• Engine at high idling • Hydraulic oil temperature: 45 – 55°C • For control lever, fit push-pull scale to center of knob to measure. • For control pedal, fit push-pull scale to tip of pedal to measure. • Measure max. value to end of travel.		kg	2.4 ± 0.6	2.4 ± 0.6
	Arm control lever				2.4 ± 0.6	2.4 ± 0.6
	Bucket control lever				2.1 ± 0.6	2.1 ± 0.6
	Swing control lever				2.1 ± 0.6	2.1 ± 0.6
	Travel control lever				2.5 ± 0.6	2.5 ± 0.6
	Fuel control lever				5.5 – 7	5.5 – 7
Hydraulic pressure	Boom	Raise	At heavy lift switch OFF	Kg/cm²	320 ± 10	320^{+10}_{-20}
			At heavy lift switch ON		350^{+5}_{-10}	350^{+5}_{-20}
		Lower	At machine push up switch OFF		215 ± 15	215^{+15}_{-20}
			At machine push up switch ON		320 ± 10	320^{+10}_{-20}
	Arm	• Hydraulic oil temperature: 45 – 55°C • Engine at high idling • Relieve only circuit to be measured			320 ± 10	320^{+10}_{-20}
	Bucket				320 ± 10	320^{+10}_{-20}
	Travel				320 ± 10	320^{+10}_{-20}
	Swing				280^{+20}_{0}	280^{+20}_{-10}
	Control				30^{+5}_{0}	30^{+5}_{0}
	TVC valve output pressure	• Hydraulic oil temperature: 45 – 55°C • Engine at high idling	Lever at neutral		23 ± 2	Min. 18
			Boom raise relief		14.5 ± 2	14 ± 2
			Swing pump relief		Min. 18	Min. 18
			At heavy lift switch ON, boom raise relief		12.5 ± 2	12 ± 2
	NC valve output pressure	• Hydraulic oil temperature: 45 – 55°C • Engine at high idling	Lever at neutral		Max. 4	Max. 5.5
			Lever at stroke end Raise track on one side than rotate sprocket ★		Min. 18	Min. 18

★ Measure at the NC valve, but neither the NC valve nor the CO valve are actuated, so the measurement is the pressure of the TVC valve.

★ When measuring at BOOM RAISE relief, do not operate to the end of the stroke. Relieve the circuit before the end of the stroke. (At the end of the RAISE stroke, the piston valve opens.)

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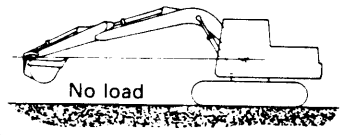
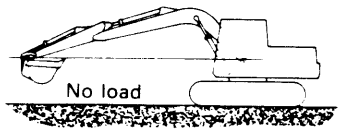
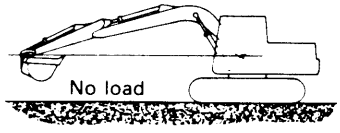
Machine model					PC650-5 PC650SE-5	
Classification	Item		Measurement condition	Unit	Standard value	Permissible value
Hydraulic pressure	Difference pressure of jet sensor	Lever at neutral	• Hydraulic oil temperature: 45 – 55°C • Engine at high idling • Control lever at neutral	kg/cm²	18 ± 2.0	Min. 15
		Lever at end of travel	• Hydraulic oil temperature: 45 – 55°C • Engine at high idling • Control lever at end of travel (Pump discharge pressure as desired)		Max. 2.0	Max. 2.0
	Lowered hydraulic pressure		• Hydraulic oil temperature: 45 – 55°C • Difference oil relief pressure between at engine full speed and at engine low speed (two pump relief)		Max. 20	30
Swing	Swing brake angle		Measuring posture Max. reach  202F2323 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Stop after swinging one turn and measure distance that swing circle moves • ( ): Distance of movement on outside circumference of swing circle	deg. (mm)	Max. 45 (Max. 775)	Max. 60 (Max. 1,040)
	Time taken to start swing		Measuring posture Max. reach  202F2323 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Time taken from starting position to swing 90° and 180°	90° sec. 180°	4.4 – 5.3 7.0 – 8.6	Max. 5.6 Max. 9.0
	Time taken to swing		Measuring posture Max. reach  202F2323 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Swing one turn, and measure time taken to swing next 5 turns	sec.	50.0 – 56.0	Max. 58

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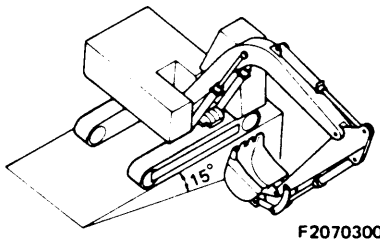
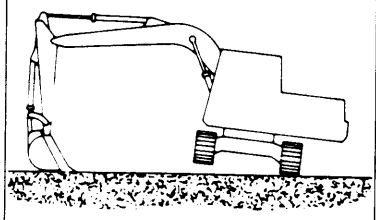
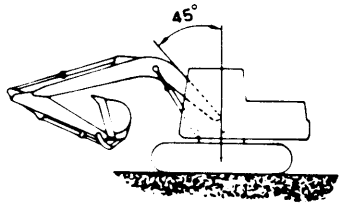
Machine model					PC650-5 PC650SE-5			
Classification	Item	Measurement condition		Unit	Standard value		Permissible value	
Swing	Hydraulic drift of swing	 F20703006 • Engine stopped • Hydraulic oil temperature: 45 – 55°C • Set machine on 15° slope, and set upper structure at 90° to the side. • Make match marks on swing circle outer race and trank frame. • Measure distance that match marks move apart after 5 minutes.		mm	0		0	
	Leakage of swing motor	• Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Swing lock switch ON • Relieve swing circuit		ℓ /min	Max. 5		Max. 10	
Travel	Travel speed (1)	Measuring posture  205F2427 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Raise track on one side at a time, rotate one turn, then measure time taken for next 5 turns.	Lo	sec.	STD 73.5 – 81.5	LC 81.0 – 90.0	STD 73.5 – 81.5	LC 81.0 – 90.0
			Hi		49.0 – 58.0	55.0 – 65.0	49.0 – 58.0	55.0 – 65.0
	Travel speed (2)	Measuring posture  205F2409 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Run up for at least 10 m, and measure time taken to travel next 20 m on flat ground.	Lo	sec.	24.0 – 30.0	26.5 – 33.0	24.0 – 30.0	26.5 – 33.0
			Hi		16.0 – 19.0	18.0 – 21.0	16.0 – 19.0	18.0 – 21.0

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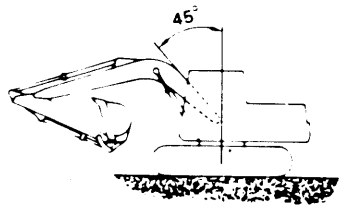
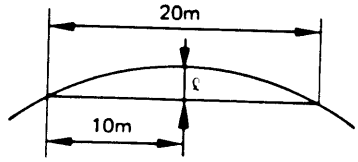
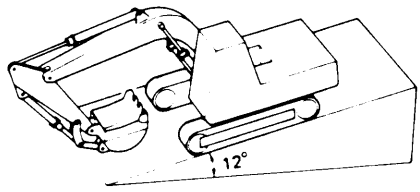
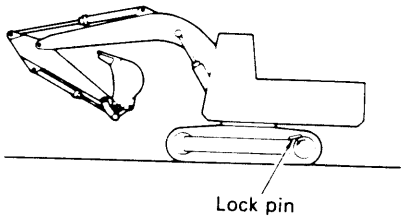
Machine model				PC650-5 PC650SE-5	
Classification	Item	Measurement condition	Unit	Standard value	Permissible value
Travel	Travel deviation	Measuring posture  205F2409 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Run up for at least 10 m, and measure deviation when traveling next 20 m on flat ground. ★ Use a hard horizontal surface  205F2402 ★ Measure dimension ℓ	mm	Max. 200	Max. 220
	Hydraulic drift of travel	Measuring posture  F20703007 • Engine stopped • Hydraulic oil temperature: 45 – 55°C • Stop machine on 12° slope with sprocket facing straight up the slope. • Measure the distance the machine moves in 5 minutes.	mm	0	0
	Leakage of travel motor	 F20703008 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C • Lock shoes and relieve travel circuit.	ℓ/min	Max. 10	Max. 20

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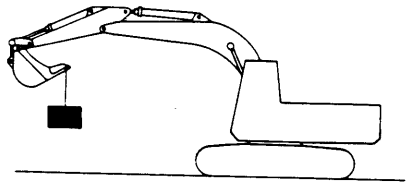
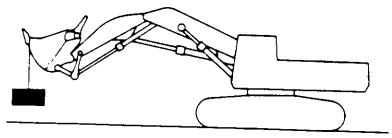
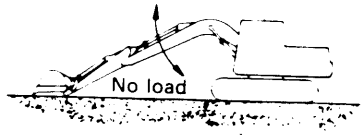
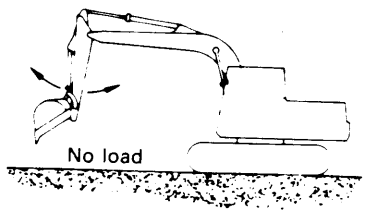
Machine model					PC650-5 PC650SE-5			
Classification	Item	Measurement condition		Unit	Standard value		Permissible value	
					BACK HOE	LOADING SHOVEL	BACK HOE	LOADING SHOVEL
Work equipment	Hydraulic drift — Total work equipment (hydraulic drift at tip of bucket teeth)	Measuring posture BACK HOE  200F1001 LOADING SHOVEL  200F1002 • Place in above posture and measure extension or retraction of cylinder and downward movement at tip of bucket teeth. • Bucket: Rated load BACK HOE: 4,500 kg (PC650) 6,300 kg (PC650SE) LOADING SHOVEL: 6,840 kg • Horizontal, flat fround • Levers at neutral • Engine stopped • Hydraulic oil temperature: 45 – 55°C • Start measuring immediately after setting. • Measure hydraulic drift for each 5 minutes, and judge from results for 15 minutes. • ( ): Bucket no load		mm	Max. 1,200 (Max. 650)	Max. 1,300	Max. 1,800 (max. 1,000)	Max. 1,500
	Hydraulic drift — Boom cylinder (amount of retraction of cylinder)				60 (35)	Max. 150	Max. 90 (Max. 50)	
	Hydraulic drift — Arm cylinder (amount of extension of cylinder)				165 (70)	Max. 30	Max. 250 (Max. 105)	
	Hydraulic drift — Bucket cylinder (amount of retraction of cylinder)				50 (15)	Max. 8	Max. 75 (Max. 25)	
	Work equipment speed — Boom Bucket teeth in contact with ground ▲ ▼ Cylinder fully extended	Measuring posture  No load 205F2421 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C	RAISE	sec.	5.5 ± 0.6	5.9 ± 0.6	–	–
			LOWER		4.2 ± 0.4	3.5 ± 0.4	–	–
	Work equipment speed — Arm Cylinder fully retracted ▲ ▼ Fully extened	Measuring posture  No load 205F2422 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C	IN		5.2 ± 0.5	4.2 ± 0.4	–	–
			OUT		3.5 ± 0.4	2.7 ± 0.3	–	–

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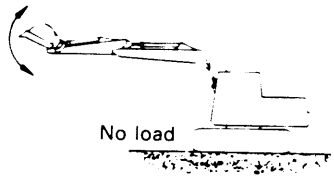
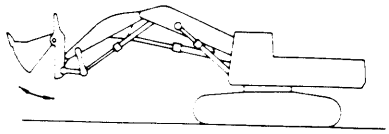
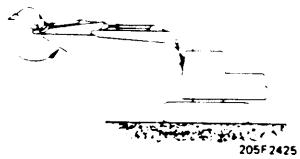
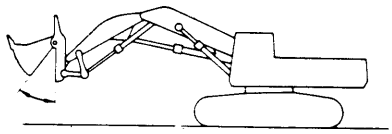
Machine model						PC650-5 PC650SE-5			
Classification	Item		Measurement condition		Unit	Standard value		Permissible value	
						BACK HOE	LOADING SHOVEL	BACK HOE	LOADING SHOVEL
Work equipment	Work equipment speed	Bucket Cylinder fully retracted ▲ ▼ Fully extended	Measuring posture  No load 205F2423 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C	CURL	sec.	3.4 ± 0.4 3.8 ± 0.4 (SE)	4.3 ± 0.4	–	–
				DUMP		3.2 ± 0.4 3.6 ± 0.4 (SE)	4.0 ± 0.4	–	–
		Bottom dump Cylinder fully retracted ▲ ▼ Fully extended	Measuring posture  200F1005 • Engine at high idling • Hydraulic oil temperature: 45 – 55°C	OPEN		–	1.6 ± 0.3	–	–
				CLOSE		–	1.8 ± 0.3	–	–
	Time lag	Boom	Measuring posture  205F2424 • Lower bucket to ground and measure time taken for chassis to rise from ground • Engine at low idling • Hydraulic oil temperature: 45 – 55°C			Max. 3	Max. 3	Max. 3	Max. 3
		Arm	Measuring posture  205F2422 • Amount of time when arm stops for a moment • Engine at low idling • Hydraulic oil temperature: 45 – 55°C			Max. 3	Max. 3	Max. 3	Max. 3
		Bucket	Measuring posture  205F2425 • Amount of time when bucket stops for a moment • Engine at low idling • Hydraulic oil temperature: 45 – 55°C			Max. 3	Max. 3	Max. 3	Max. 3

Machine model					PC650-5 PC650SE-5			
Classification	Item		Measurement condition	Unit	Standard value		Permissible value	
					BACK HOE	LOADING SHOVEL	BACK HOE	LOADING SHOVEL
Work equipment	Time lag	Bottom dump	Measuring posture  200F1005 • Engine at Low idling • Hydraulic oil temperature: 45 – 55°C • Time taken for bottom dump to move again when operated from max. bottom open position and stopped temporarily.	sec.	–	Max. 3	–	Max. 3
	Internal leakage	Cylinder	• Hydraulic oil temperature: 45 – 55°C • Engine at high idling • Relieve circuit to be measured	cc/min	Max. 5		Max. 20	
		Center swivel joint			Max. 10		Max. 100	

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STANDARD VALUE TABLE FOR ELECTRICAL SYSTEM

★ FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS

Classifications	Component	Connector No.	Inspection method	Judgement table	Measurement conditions
Machine control system	Mode selector switch	CNP4 (male)	Continuity	If the condition is as shown in the table, it is normal. S mode: Between (1) – (2): No continuity L mode: Between (1) – (2): Continuity	1) Turn starting switch OFF. 2) Disconnect CNP4.
	Heavy lift switch **BACK HOE**	CNP3H	Measure voltage	If the condition is as shown in the table, it is normal. Switch ON: Between (2) – chassis: Max. 1 V Switch OFF: Between (2) – chassis: 20 – 30 V	1) Turn starting switch ON. 2) Insert T-adapter in CNP3H.
	Machine push up switch	CNP3M	Measure voltage	If the condition is as shown in the table, it is normal. Switch ON: Between (2) – chassis: Max. 1 V Switch OFF: Between (2) – chassis: 20 – 30 V	1) Turn starting switch ON. 2) Insert T-adapter in CNP3M.

★ FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS
★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION

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Classifications	Component	Connector No.	Inspection method	Judgement table	Measurement conditions
Machine control system	TVC solenoid valve	CN13 (male)	Measure resistance	If the condition is as shown in the table, it is normal. Between (1) – (2): 10 – 25 Ω Between (1), (2) – chassis: No continuity	1) Turn starting switch OFF. 2) Disconnect CN13.
	Heavy lift solenoid valve **BACK HOE**	CN62 (male)	Measure resistance	If the condition is as shown in the table, it is normal. Between (1) – (2): 20 – 40 Ω Between (1), (2) – chassis: No continuity	1) Turn starting switch OFF. 2) Disconnect CN62.
	Machine push up solenoid valve	CN61 (male)	Measure resistance	If the condition is as shown in the table, it is normal. Between (1) – (2): 20 – 40 Ω Between (1), (2) – chassis: No continuity	1) Turn starting switch OFF. 2) Disconnect CN61.
	Swing lock switch	CNP1 (male)	Continuity	If the condition is as shown in the table, it is normal. Switch ON: Between (3) – (5): No continuity Switch OFF: Between (3) – (5): Continuity Between (1), (2), (3), (4), (5), (6) – chassis: No continuity	1) Turn starting switch OFF. 2) Disconnect CNP1.
	Swing brake solenoid valve	CN58 (male)	Measure resistance	If the condition is as shown in the table, it is normal. Between (1) – (2): 20 – 40 Ω Between (1), (2) – chassis: No continuity	1) Turn starting switch OFF. 2) Disconnect CN58.

Classifications	Component	Connector No.	Inspection method	Judgement table	Measurement conditions
Machine control system	Swing holding brake timer	CN73	Continuity	If the condition is as shown in the table, it is normal. Between (female) (1) – chassis: Continuity	1) Turn starting switch OFF. 2) Disconnect CN73.
			Measure voltage	If the condition is as shown in the table, it is normal. Between (2) – (1): 20 – 30 V	1) Turn starting switch ON. 2) Insert T-adapter to CN73.
				If the condition is as shown in the table, it is normal. Swing lever: Between (3) – (1): Neutral: 0 V; Operated: 20 – 30 V Swing lever: Between (4) – (1): Neutral: ★ 0 V; Operated: 20 – 30 V ★ It becomes 0 V approx. 5 sec. after the swing lever is placed at Neutral. (It is also possible to connect a short connector instead of placing the swing lever at Neutral.)	1) Start engine 2) Insert T-adapter to CN73.
	Travel speed switch	CNP5 (male)	Continuity	If the condition is as shown in the table, it is normal. Between (3) – (4): Lo (low speed): No continuity; Hi (high speed): Continuity	1) Turn starting switch OFF. 2) Disconnect CNP5.
	Travel speed solenoid valve	CN57 (male)	Measure resistance	If the condition is as shown in the table, it is normal. Between (1) – (2): 20 – 40 Ω Between (1), (2) – chassis: No continuity	1) Turn starting switch OFF. 2) Disconnect CN57.
	Straight-travel solenoid valve	CN60 (male)	Measure resistance	If the condition is as shown in the table, it is normal. Between (1) – (2): 20 – 40 Ω Between (1), (2) – chassis: No continuity	1) Turn starting switch OFF. 2) Disconnect CN60.
	PPC oil pressure switch: Boom RAISE	CN85	As shown on right	1) When using short connector If the condition is as shown in the table, the switch is defective. Connect short connector: Auto-deceleration is actuated normally Disconnect each connector: Auto-deceleration is not actuated	1) Start engine. 2) Turn auto-deceleration switch ON. Put fuel lever to FULL position. 3) All levers at Neutral.
	Boom LOWER	CN86			
	Arm IN	CN77			
	Arm OUT	CN78			
	Bucket CURL	CN83			
	Bucket DUMP	CN84			
	Swing LEFT	CN75			
	Swing RIGHT	CN76			
	L.H. travel FORWARD	CN79			
	L.H. travel REVERSE	CN80			
	R.H. travel FORWARD	CN81			
	R.H. travel REVERSE	CN82		1) Insert T-adapter to CN73. If the condition is as shown in the table, it is normal. Between (1) – (2): Lever at neutral: No continuity; Lever operated: Continuity	1) Start engine. 2) Disconnect each connector.

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★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION

Classifications	Component	Connector No.	Inspection method	Judgement table	Measurement conditions
Machine control system > Auto-deceleration • OLSS controller	Power source	CN10	Measure voltage	Between (1) and chassis: 20 – 30 V	1) Turn starting switch ON. 2) Insert T-adapter in CN10.
	Ground connection	CN10 (female)	Continuity	Between (2) – chassis: Continuity	1) Turn starting switch OFF. 2) Disconnect CN10.
	Mode selector switch	CN10 (female) CN11 (male)	Continuity	H mode: Between CN10 (7) – (8) / Between CN10 (3) – (1): No continuity S mode: Between CN11 (7) – (8): No continuity; Between CN10 (3) – (1): Continuity L mode: Between CN11 (7) – (8) / Between CN10 (3) – (1): No continuity	1) Turn starting switch OFF. 2) Disconnect CN10 and CN11.
	Potentiometer	CN10 (female)	Measure resistance	Between (6) – (8): 4 – 6 kΩ	1) Turn starting switch OFF. 2) Disconnect CN10.
	Auto-deceleration signal	CN10 (female)	Continuity	Deceleration switch / Control lever / Between (11) – (12) ON / Neutral: Continuity ON / Operated: No continuity OFF / Neutral: No continuity OFF / Operated: No continuity	1) Start engine. 2) Disconnect CN10.
	TVC solenoid	CN11 (male)	Measure resistance	Prolix switch OFF / Between (11) – (12): 10 – 25 Ω Prolix switch ON / Between (11) – (12): No continuity	1) Turn starting switch OFF. 2) Disconnect CN11.
	Auto-deceleration solenoid A	CN11 (male)	Measure resistance	Between (3) – (4): 50 – 80 Ω	1) Turn starting switch OFF. 2) Disconnect CN11.
	Auto-deceleration solenoid B	CN10 (female)	Measure resistance	Between (9) – (10): 50 – 80 Ω	1) Turn starting switch OFF. 2) Disconnect CN11.
	Auto-deceleration switch	CNP3	Measure voltage	If the condition is as shown in the table, it is normal. Switch ON / Between (4) – chassis: Max. 1 V Switch OFF / Between (4) – chassis: 20 – 30 V	1) Turn starting switch ON. 2) Insert T-adapter to CNP3.

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Classifications	Component	Connector No.	Inspection method	Judgement table	Measurement conditions
Machine control system	Auto-deceleration solenoid valve	CN12 (male) CN40 (male)	Measure resistance	If the condition is as shown in the table, it is normal. CN12 (male): Solenoid A Between (1) – (2): 50 – 80 Ω Between (1), (2) – chassis: No continuity CN40 (male): Solenoid B Between (1) – (2): 50 – 80 Ω Between (1), (2) – chassis: No continuity	1) Turn starting switch OFF. 2) Disconnect CN12, CN40.
	Mode selector switch	CNP4 (male)	Continuity	If the condition is as shown in the table, it is normal. H mode: Between (1) – (2), Between (3) – (4): No continuity S mode: Between (1) – (2): No continuity; Between (3) – (4): Continuity L mode: Between (1) – (2), Between (3) – (4): Continuity	1) Turn starting switch OFF. 2) Disconnect CNP4.
	Engine speed sensor	CNE8 (male)	Measure resistance	If the condition is as shown in the table, it is normal. Between (1) – (2): 300 – 1,000 Ω Between (1), (2) – chassis: No continuity	1) Turn starting switch OFF. 2) Disconnect CNE8.
	Potentiometer	CNE9 (male)	Measure resistance	If the condition is as shown in the table, it is normal. Between (1) – (3): 4 – 6 kΩ	1) Turn starting switch OFF. 2) Disconnect CNE9.
	Prolix switch	CN36 (male)	Continuity	If the condition is as shown in the table, it is normal. Between (1) – (3): OFF: Continuity; ON: No continuity Between (2) – (4): OFF: Continuity; ON: No continuity Between (3) – (5): OFF: No continuity; ON: Continuity Between (4) – (6): OFF: No continuity; ON: Continuity Between (1), (2), (3), (4), (5), (6) – chassis: No continuity	1) Turn starting switch OFF. 2) Disconnect CNE36.
	Prolix resistor	CN34 (male)	Measure resistance	If the condition is as shown in the table, it is normal. Between (1) – (2): 10 – 30 Ω	1) Turn starting switch OFF. 2) Disconnect CN34.
	Heavy lift switch **BACK HOE**	CNP3	Measure voltage	If the condition is as shown in the table, it is normal. Switch ON: Between (3) – chassis: Max. 1 V Switch OFF: Between (3) – chassis: 20 – 30 V	1) Turn starting switch ON. 2) Insert T-adapter in CNP3.
	Machine push up switch	CNP3	Measure voltage	If the condition is as shown in the table, it is normal. Switch ON: Between (5) – chassis: Max. 1 V Switch OFF: Between (5) – chassis: 20 – 30 V	1) Turn starting switch ON. 2) Insert T-adapter in CNP3.

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★ **FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS**

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

Classifications	Component	Connector No.	Inspection method	Judgement table	Measurement conditions
Machine monitor system	PPC oil pressure switch	CHECK, PILOT portion		If the condition is as shown in table 1 – 4, the monitor panel is normal.	1) Turn starting switch ON. 2) Insert T-adapter.

Table 1 (CHECK, PILOT portion)

Monitor item \ Signal		Monitor auxiliary signal input: Engine oil pressure signal★1 CNP8 (9)	Start signal★2 CNP8 (3)	Alternator signal★3 CNP8 (4)	Monitor item sensor signal input★4
Coolant level CNP8 (5)	Flashing	At engine oil pressure signal H and start signal L		L	H
	OFF				L
Engine oil level CNP8 (6)	Flashing	At engine oil pressure signal H and start signal L		L	H
	OFF				L
Hydraulic oil level CNP8 (7)	Flashing	At engine oil pressure signal H and start signal L		L	H
	OFF				L
Preheating CNP9 (5)	ON	At engine oil pressure signal H and start signal L		–	H
	OFF				L

The H and L in the table above are following voltage

★1 Engine oil pressure signal
H: 3.5 – 30 V
L: Approx. 0 V

★2 Start signal
H: 3 – 30 V
L: Approx. 0 V

★3 Alternator signal
H: 27.5 – 30 V
L: Max. 5 V

★4 Sensor signal
H: 3.5 – 30 V
L: Approx. 0 V

CAUTION portion

Table 2. (CAUTION portion)

Monitor item \ Signal		Monitor auxiliary signal input: Engine oil pressure signal★1 CNP8 (9)	Satrt signal★2 CNP8 (3)	Alternator signal★3 CNP8 (4)	Monitor item sensor signal input★4
Engine oil pressure CNP8 (9)	Flashing	H	–	H	–
	OFF	L			
Coolant level CNP8 (5)	Flashing	At engine oil pressure signal L and start signal H		H	H
	OFF				L
Coolant temperature CNP9 (1)	Flashing	At engine oil pressure signal L and start signal H		H	–
	OFF				
Charge level CNP8 (4)	Flashing	At engine oil pressure signal L and start signal H		L	–
	OFF			H	

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Classifications	Component	Connector No.	Inspection method	Judgement table	Measurement conditions
Machine monitor system	Monitor panel	GAUGE portion		Table 3 (GAUGE portion)	1) Measure resistance with starting switch OFF. 2) Check display with starting switch ON.

	Gauge display position	Display level resistance (kΩ) (Monitor panel input resistance)
	Starting switch ON	Starting switch OFF
Coolant level gauge Measure resistance between CNP9 (female) (1) and CNP8 (female) (2)	Top ↑ / Display position / ↓ Bottom	Min. – Max.
	ALL OFF	0 – 0.34
	7	0.28 – 2.62
	6	2.48 – 3.67
	5	3.46 – 4.19
	4	3.95 – 5.07
	3	4.78 – 6.75
	2	6.36 – 10.05
	1	9.47 – disconnection
Fuel level gauge Measure resistance between CNP9 (female) (3) and CNP8 (female) (2)	Top ↑ / Display position / ↓ Bottom	
	7	0 – 14.4
	6	11.0 – 27.2
	5	24.6 – 37.8
	4	34.2 – 42.8
	3	38.7 – 51.9
	2	47.0 – 84.0
	1	72.6 – 726
	ALL OFF	594 – disconnection

	Component	Connector No.	Inspection method	Judgement table	Measurement conditions
		Buzzer signal, lighting signal		Table 4 (Buzzer signal, lighting signal)	1) Start engine 2) Insert T-adapter

A	Voltage between CNP10 (1) and chassis Voltage between CNP11 (2) and chassis (lighting input)	Lamp switch ON 20 – 30 V
		Lamp switch OFF 0 V
B	Voltage between CNP11 (1) and chassis (+24V input)	Starting switch ON 20 – 30 V
		Starting switch OFF 0 V
C	CNP9 (3) (buzzer output) [Disconnect CN71 (coolant lever sensor) ⟷ Connect short connector to CN71]	When connector is disconnected, buzzer sounds or repeats as follows: Above 20 V: For 0.8 sec Below 1 V: For 0.8 sec
		When short connector is connected, buzzer stops or voltage is below 20 V

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Classifications	Component	Connector No.	Inspection method	Judgement table	Measurement conditions
Machine monitor system	Monitor panel: Power source	CNP8	Measure voltage	If the condition is as shown in the table, it is normal. Starting switch OFF: Between (1) – (2): 0 V Starting switch ON: Between (1) – (2): 20 – 30 V	1) Turn starting switch ON. 2) Insert T-adapter in CNP8.
	Monitor panel: Ground connection	CNP8 (female)	Continuity	If the condition is as shown in the table, it is normal. Between (2) – chassis: Continuity	1) Turn starting switch OFF. 2) Disconnect CNP8.
	Monitor panel: Buzzer output	CNP8 CNP9	Measure voltage	If the condition is as shown in the table, it is normal. Buzzer stopped: Between CNP9 (8) – CNP8 (2): 20 – 30 V Buzzer actuated: Between CNP9 (8) – CNP8 (2): Max. 1 V	1) Turn starting switch ON. 2) Insert T-adapter in CNP8, CNP9.
	Monitor panel: Lighting input	CNP10 CNP11	Measure voltage	If the condition is as shown in the table, it is normal. Lamp switch OFF: Between CNP10 (1) – (2): 0 V Lamp switch ON: Between CNP11 (2) – (3): 20 – 30 V	1) Turn starting switch ON. 2) Insert T-adapter in CNP10, CNP11.
	Monitor panel: Service meter	CNP11	Measure voltage	If the condition is as shown in the table, it is normal. Starting switch ON: Between (1) – (3): 20 – 30 V Starting switch OFF: Between (1) – (3): Max. 1 V	1) Turn starting switch ON. 2) Insert T-adapter in CNP11.
	Coolant level sensor	CN71 (female)	Short connector	1) When using short connector If the condition is as shown in the table, the sensor is defective. Connect short connector: Monitor lamp goes off Disconnect CN71: Monitor lamp lights up	1) Turn starting switch ON.
	Coolant level sensor	CN71 (male)	Continuity	2) When checking continuity If the condition is as shown in the table, the sensor is normal. Coolant level Normal: Between (1) – (2): Continuity Coolant level Abnormal: Between (1) – (2): No continuity	1) Turn starting switch OFF. 2) Disconnect CN71.
	Engine oil level sensor	CNE4 (female)	Short connector	1) When using short connector If the condition is as shown in the table, the sensor is defective. Connect short connector: Monitor lamp goes off Disconnect CNE4: Monitor lamp lights up	1) Turn starting switch ON.
	Engine oil level sensor	CNE4 (male)	Continuity	2) When checking continuity If the condition is as shown in the table, the sensor is normal. Oil level Normal: Between (1) – chassis: Continuity Oil level Abnormal: Between (1) – chassis: No continuity	1) Turn starting switch OFF. 2) Disconnect CNE4.

Classifications	Component	Connector No.	Inspection method	Judgement table	Measurement conditions
Machine monitor system	Hydraulic oil level sensor	CN 53 (female)	Short connector	1) When using short connector If the condition is as shown in the table, the sensor is defective. Connect short connector → Monitor lamp goes off Disconnect CN53 → Monitor lamp lights up	1) Turn starting switch ON.
		CN53 (male)	Continuity	2) When checking continuity If the condition is as shown in the table, the sensor is normal. Oil level Normal / Between (1) – (2) → Continuity Oil level Abnormal / Between (1) – (2) → No continuity	1) Turn starting switch OFF. 2) Disconnect CN53.
	Hydraulic oil filter sensor	CN49 (female)	Ground (1) pin	1) When grounding pin (1) If the condition is as shown in the table, the sensor is defective. Ground pin (1) → Monitor lamp goes off Disconnect CN49 → Monitor lamp lights up	1) Start engine. 2) Hydraulic oil temperature: Min. 50°C.
		CN49 (male)	Continuity	2) When checking continuity If the condition is as shown in the table, the sensor is normal. Filter clogged No / Between (1) – chassis → Continuity Filter clogged Yes / Between (1) – chassis → No continuity	1) Start engine 2) Hydraulic oil temperature: Min. 50°C 3) Ground pin (2).
	Engine oil pressure sensor	CNE6 (female)	Short connector	1) When using short connector If the condition is as shown in the table, the sensor is defective. Connect short connector → Monitor lamp goes off Disconnect CNE6 → Monitor lamp lights up	1) Start engine.
		CNE6 (male)	Continuity	2) When checking continuity If the condition is as shown in the table, the sensor is normal. Oil pressure 1kg/cm² and above / Between (1) – (2) → Continuity Oil pressure Below 0.3kg/cm² / Between (1) – (2) → No continuity	1) Start engine. 2) Disconnect CNE6.
	Hydraulic oil temperature sensor	CN51 (female)	Ground (1) pin	1) When grounding pin (1) If the condition is as shown in the table, the sensor is defective. Ground pin (1) → Monitor lamp goes off Disconnect CN51 → Monitor lamp lights up	1) Start engine.
		CN51 (male)	Continuity	2) When checking continuity If the condition is as shown in the table, the sensor is normal. Oil temperature below 120°C / Between (1) – chassis → Continuity Oil temperature above 120°C / Between (1) – chassis → No continuity	1) Start engine. 2) Disconnect CN51.

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Classifications	Component	Connector No.	Inspection method	Judgement table	Measurement conditions
Machine Monitor system	Coolant temperature sensor	CNE5 (male)	Measure resistance	If the condition is as shown in the table, the sensor is normal. Normal temperature (25°C) — Between (1) – (2) — Approx. 37 – 50 kΩ 100°C — Between (1) – (2) — Approx. 3.5 – 4.0 kΩ	1) Turn starting switch OFF. 2) Disconnect CNE5.
	Fuel level sensor	CN47 (male)	Measure resistance	If the condition is as shown in the table, it is normal. Full — Between (1) – chassis — Less than approx. 12 Ω Empty — Between (1) – chassis — Approx. 85 – 110 Ω	1) Turn starting switch OFF. 2) Disconnect CN47.

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TOOLS FOR TESTING, ADJUSTING AND TROUBLESHOOTING

Check, measurement items	Symbol		Part No.	Part Name	Remarks
Engine speed	A		799-203-8000	Multi-tachometer	Digitial display L: 60 – 2,000 rpm H: 60 – 19,999 rpm
Intake air pressure	B		799-401-2310	Gauge	1,500 mmHg
Water, oil, exhaust gas temperature	C	1	799-101-1500	Digital temperature gauge	–50 – 1,200°C
		2	799-201-1110	Wiring harness	For measuring exhaust gas temperature
Exhaust gas color	D	1	799-201-9000	Handy smoke checker	Discoloration 0 – 70% (with standard color) (Discolorration x 1/10 = Bosch index)
		2	Commercially available	Smoke meter	
Valve clearance	E		Commercially available	Feeler gauge	–
Compression pressure	F	1	795-502-1590	Compression gauge	0 – 70 kg/cm² Kit part number 795-502-1205
		2	795-502-1500	Adapter	
Blow-by pressure	G		799-201-1504	Blow-by checker	0 – 500 mmH_2O
Hydraulic pressure	H	1	799-101-5001	Hydraulic tester	Pressure gauge 25, 60, 400, 600 kg/cm²
			799-261-1201	Digital hydraulic tester	Pressure gauge 700 kg/cm²
		2	799-401-2320	Hydraulic gauge	Pressure gauge 10 kg/cm²
		3	790-261-1310	Adapter	Both male and female 14 x 1.5 (female PT 1/8)
			790-261-1320		Both male and female 18 x 1.5 (female PT 1/8)
			790-261-1330		Both male and female 22 x 1.5 (female PT 1/8)
Operating force	I		79A-264-0020	Push-pull scale	
Stroke, hydraulic drift	J		Commercially available	Scale	
Work equipment speed	K		Commercially available	Stopwatch	
Troubleshooting of voltage and resistance values	L		79A-264-0210	Tester	
Troubleshooting of harness and sensor	M		799-601-2700	T-adapter kit	
			799-601-7100		
			799-601-7200		

020905

MEASURING ENGINE SPEED

⚠ Be careful not to touch any high temperature parts when installing or removing the measuring equipment.

★ Measure the engine speed under the following conditions.
- Coolant temperature: Within operating range
- Hydraulic oil temperature: 45 – 55°C

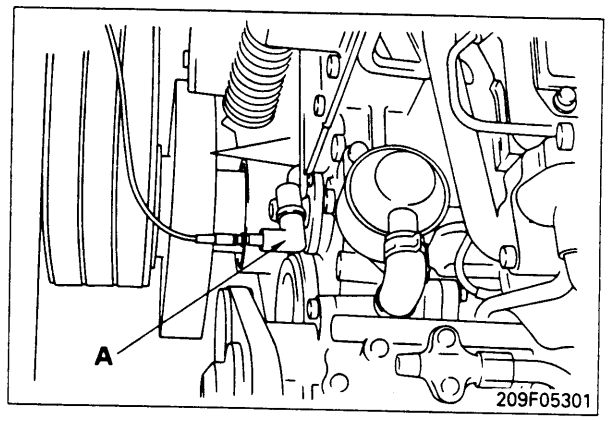
1. Remove the cap from the engine speed pickup, then install the adapter of tachometer **A**.
2. Connect tachometer **A** and the adapter with a cable.
3. **Measuring**

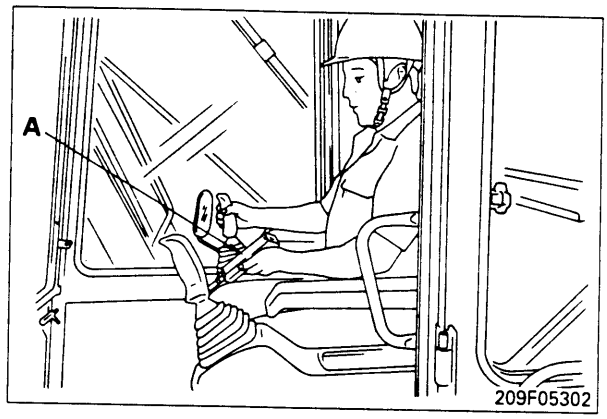
   ⚠ Be careful not to touch any rotating parts or high temperature parts when measuring the engine speed.

   1) Measuring low idling and high idling speed:
   Measure the engine speed when the fuel control lever is set to the low idling and high idling positions.

   2) Measuring engine speed at pump relief:
   Run the engine at high idling and measure the engine speed when each pump is relieved.

      ★ For details of the pumps that are relieved, see STANDARD VALUES TABLE.





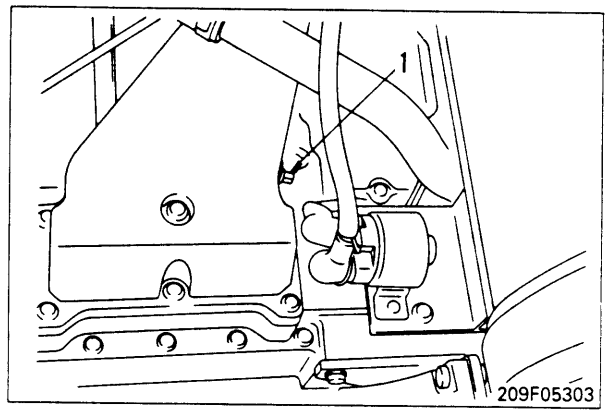
020905

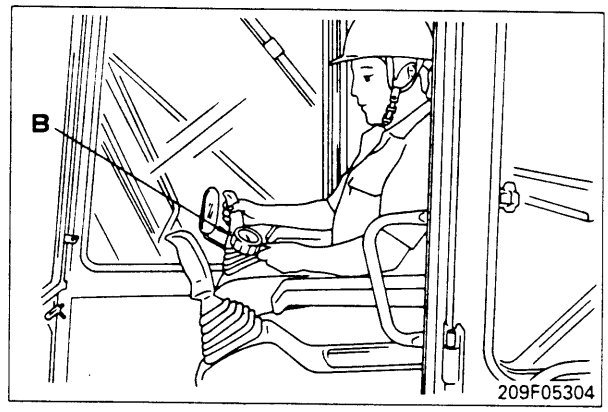
MEASURING INTAKE AIR PRESSURE (BOOST PRESSURE)

⚠ Be careful not to touch any high temperature parts when installing or removing the measuring equipment.

★ Measure the intake air pressure under the following conditions.
- Coolant temperature: Within operating range
- Hydraulic oil temperature: 45 – 55°C

1. Remove plug (1) (PT 1/8) for measuring the intake air pressure, then connect the nipple and hose inside the pressure gauge kit.
2. Connect gauge **B** (1500 mmHg) to the hose.
3. Run the engine at above midrange speed, and use the self-seal portion of the gauge to drain the oil inside the hose.
   - ★ Insert the gauge about half way, and repeatedly open the self-seal portion to drain the oil.
   - ★ If there is oil inside the hose, the gauge will not work, so always drain the oil.
4. Run the engine at high idling, raise the boom, relieve the circuit, and measure the pressure.





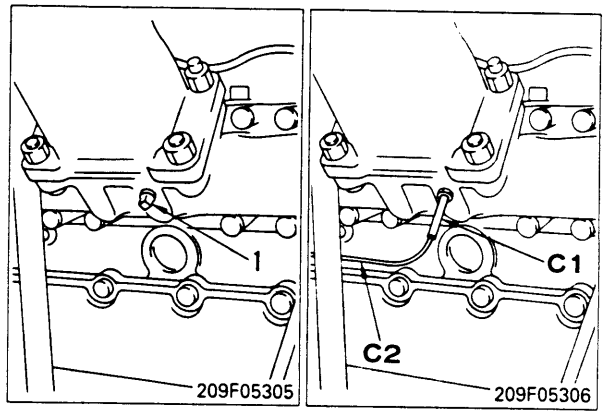
020905

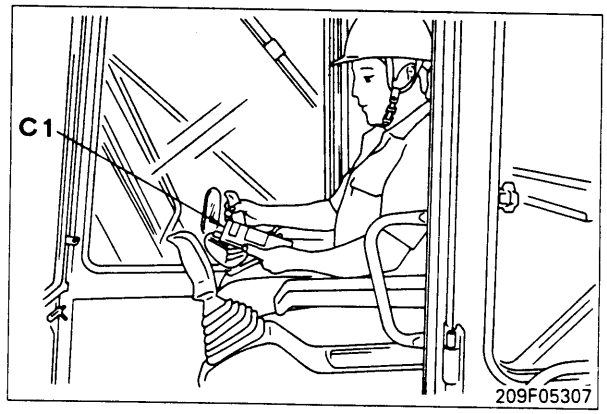
MEASURING EXHAUST GAS TEMPERATURE

★ Wait for the temperature of the exhaust manifold to go down before installing or removing the temperature sensor.

★ Measure the exhaust gas temperature under the following conditions.
- Coolant temperature: Within operating range
- Hydraulic oil temperature: 45 – 55°C

1. Remove plug (1) for measuring the temperature, then install exhaust gas temperature sensor **C1**.
   ★ Fix the wiring harness of the sensor with a clamp to prevent it from touching any high temperature part.
2. Connect wiring harness **C2** to the temperature sensor and temperature gauge **C1**.
3. **Measuring**
   1) When measuring the maximum temperature for troubleshooting:
      Measure the maximum temperature during operations.
   2) When measuring the change in temperature over time for Pm clinic:
      Run the engine at high idling, raise the boom, relieve the circuit, and measure the temperature when it becomes stable.





020905

MEASURING EXHAUST GAS COLOR

- When carrying out this measurement in the field or where is no air or power supply, use handy smoke checker **D1**; when recording official data, use smoke meter **D2**.

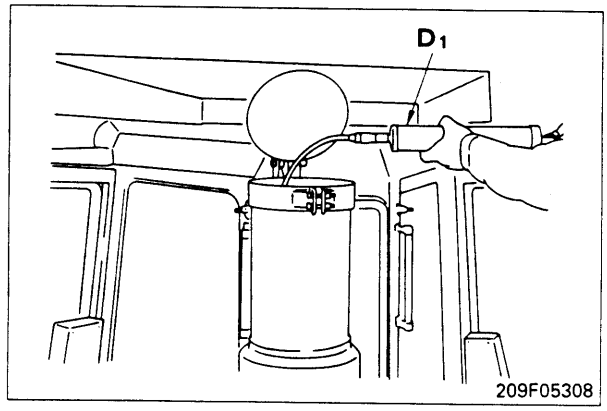
★ Raise the coolant temperature to the operating range before measuring.

⚠ Be careful not to touch any high temperature parts when installing or removing the measuring equipment.

020905

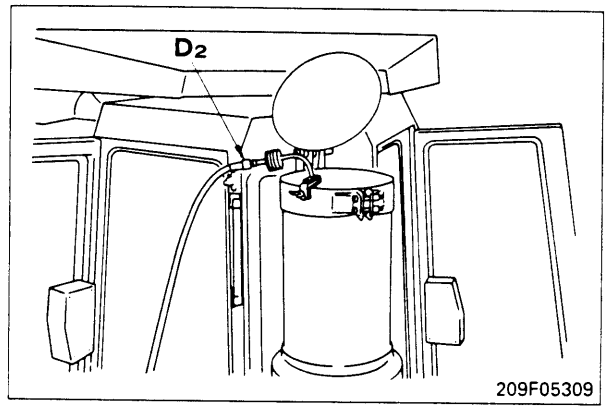
1. Measuring with handy smoke checker D1.

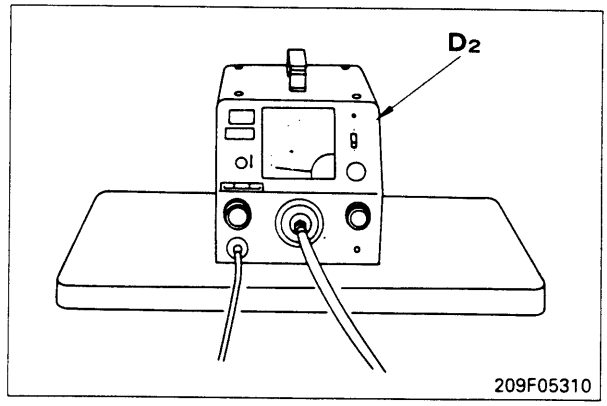
1) Fit filter paper in tool **D1**.
2) Insert the exhaust gas intake port into the exhaust pipe, accelerate the engine suddenly, and operate the handle of tool **D1** at the same time to catch the exhaust gas on the filter paper.
3) Remove the filter paper and compare it with the scale provided with the equipment to judge the exhaust gas color.



2. Measuring with smoke meter D2.

1) Insert probe ① in the outlet of exhaust pipe (1) and secure it to the exhaust pipe with a clip.
2) Connect the probe hose, accelerator switch plug and air hose to tool **D2**.
   ★ The pressure of the air supply should be under 15 kg/cm².
3) Connect the power cord to the AC100V socket.
   ★ Check that the power switch of tool **D2** is OFF before connecting the cord.
4) Loosen the cap nut of the suction pump and insert the filter paper.
   ★ Fit the filter paper securely so that the exhaust gas does not leak.
5) Turn the power switch of tool **D2** ON.
6) Accelerate the engine suddenly. At the same time, depress the accelerator pedal, and catch the exhaust gas color on the filter paper.
7) Lay filter paper used to catch the exhaust gas color on top of unused filter papers (10 sheets or more) inside the filter paper holder, and read the indicated value.





ADJUSTING VALVE CLEARANCE

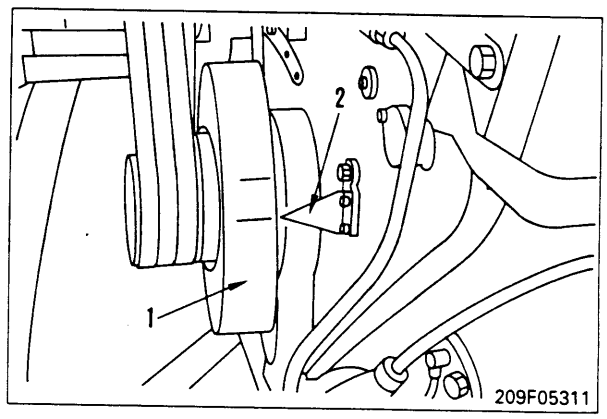
1. Remove the cylinder head cover.
2. Rotate the crankshaft in the normal direction to align pointer (2) with the 1.6 TOP mark on crankshaft pulley (1). When rotating, check the movement of the intake valves of No. 1 cylinder.
3. When No. 1 cylinder is at compression top dead center, adjust the valves marked ●. Next, rotate the crankshaft 360° in the normal direction and adjust the valve clearance of the remaining valves marked ○.
   ★ Valve arrangement

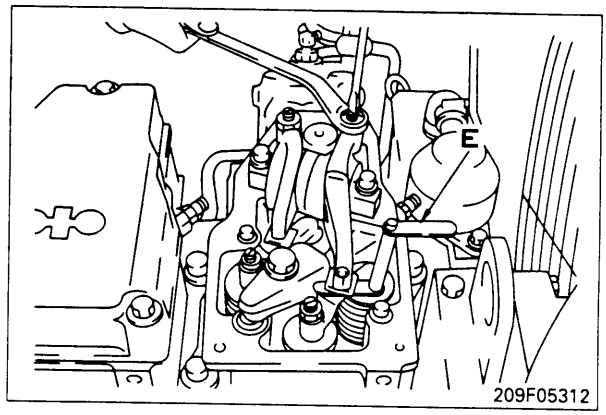
Cylinder No.	1		2		3		4		5		6	
Intake valve	●		●		○		●		○		○	
Exhaust valve		●		○		●		○		●		○

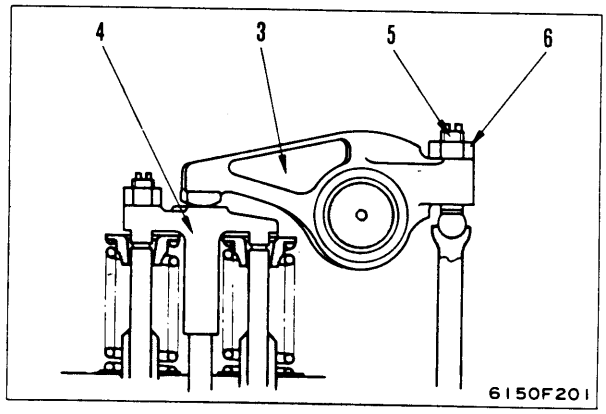
4. To adjust, insert feeler gauge **E** between rocker arm (3) and crosshead (4), and turn adjustment screw (5) until the clearance is a sliding fit. Then tighten locknut (6) to hold the adjustment screw in position.
   kgm Locknut: 6.0 ± 0.6 kgm

★ After adjusting No. 1 cylinder at compression top dead center, it is also possible to turn the crankshaft 120° each time and adjust the valve clearance of each cylinder according to the firing order.
   • Firing order: 1 – 5 – 3 – 6 – 2 – 4

★ After tightening the locknut, check the clearance again.







020905

MEASURING COMPRESSION PRESSURE

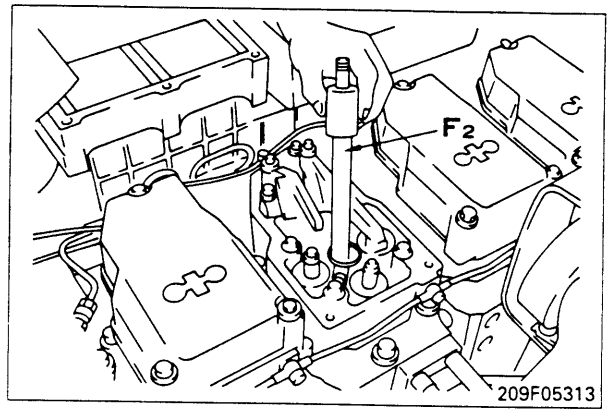
⚠ When measuring the compression pressure, be careful not to touch the exhaust manifold or muffler, or to get your clothes caught in the fan, fan belt, or other rotating parts.

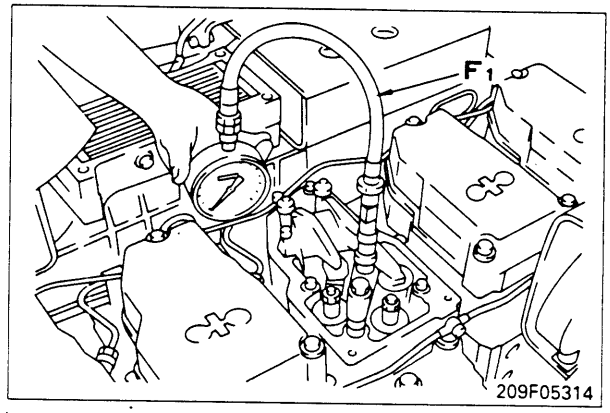
1. Adjust valve clearance.
   ★ For details, see ADJUSTING VALVE CLEARANCE.
2. Warm up the engine so that the oil temperature is 40 – 60°C.
3. Remove the nozzle holder assembly from the cylinder to be measured.
4. Install adapter **F2** in the nozzle holder mount, and connect compression gauge **F1**.
5. Set multi-tachometer **A** in position.
6. Disconnect the cable from the engine stop motor, place the stop lever of injection pump at the STOP position, then crank the engine with the starting motor and measure compression pressure.

★ Measure the compression pressure at the point where the pressure gauge indicator remains steady.

★ When measuring the compression pressure, measure the engine speed to confirm that it is within the specified range.

★ After measuring the compression pressure, install the nozzle holder assembly.



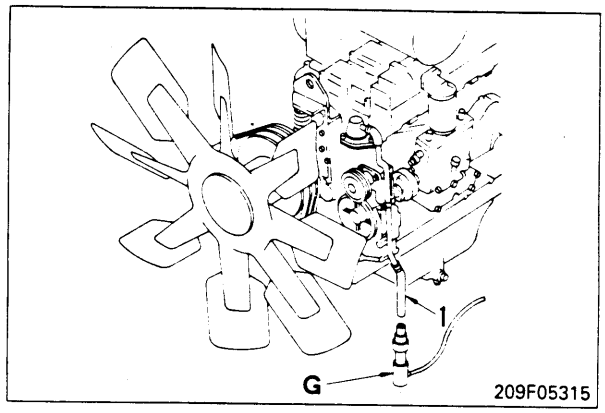


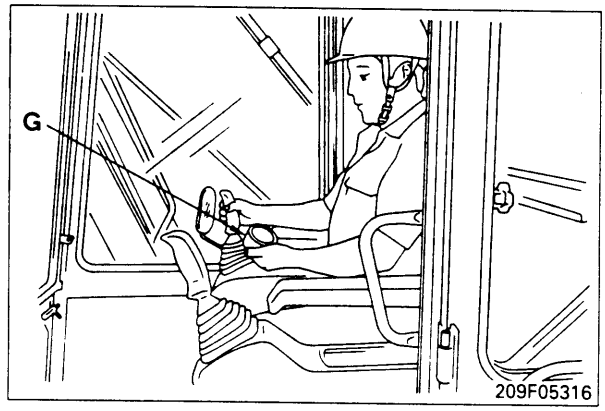
020905

MEASURING BLOW-BY PRESSURE

★ Measure the blow-by pressure under the following conditions.
- Coolant temperature: Within operating range.
- Hydraulic oil temperature: 50 – 80°C

1. Install the nozzle of blow-by checker **G** to blow-by hose (1).
2. Connect the nozzle and gauge with the hose.
3. Run the engine at high idling, raise the boom and measure the blow-by pressure when the circuit is relieved.





020905

TESTING AND ADJUSTING FUEL INJECTION TIMING

There are the following methods for testing and adjusting the fuel injection timing of the injection pump.

- The match mark aligning method, used when assembling the injection pump to the original engine without repairing it.
- The delivery valve method, used when assembling the injection pump that has been repaired or replaced.

★ Set the No. 1 cylinder to the compression top dead center before testing and adjusting.
For details, see ADJUSTING VALVE CLEARANCE.

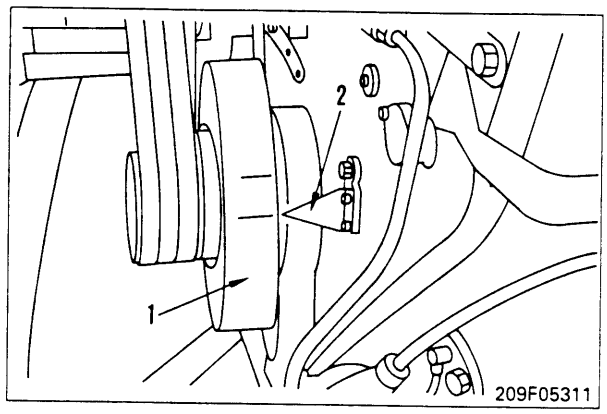
Testing and adjusting by aligning match marks method

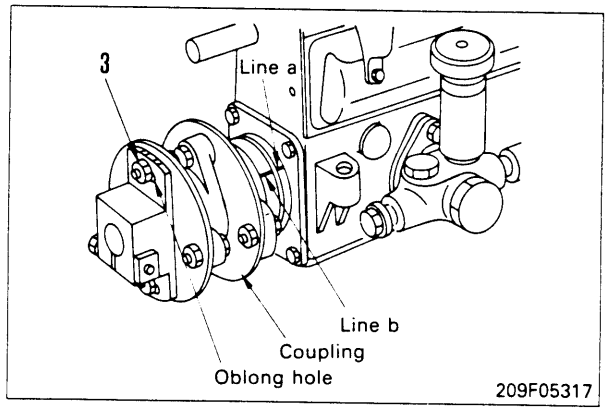
1. Testing

1) Turn the crankshaft back 30 – 40° in the reverse direction from No. 1 cylinder TOP.
2) Turn slowly in the normal direction, and align the **I.J.** line on crankshaft pulley (1) with pointer (2).
3) Check that line **a** on the injection pump and line **b** on the coupling are aligned.

2. Adjusting

★ If the lines are not aligned, loosen nut (3), and move the coupling to align the marks, then tighten the nut again.
kgm Nut: 6.2 ± 0.2 kgm

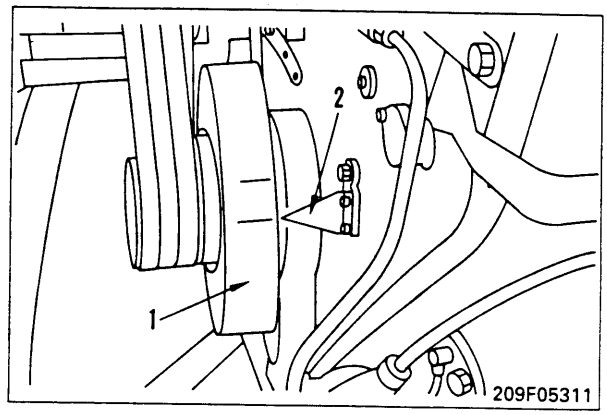


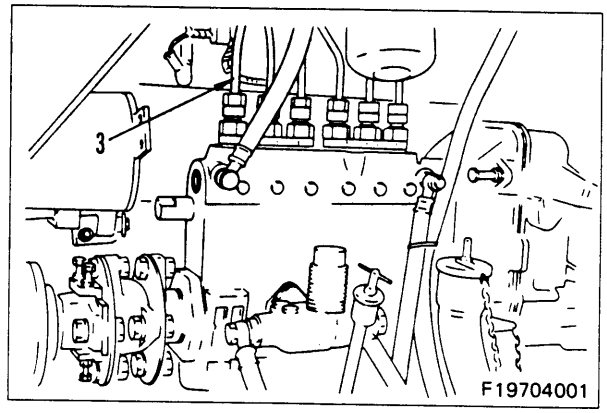


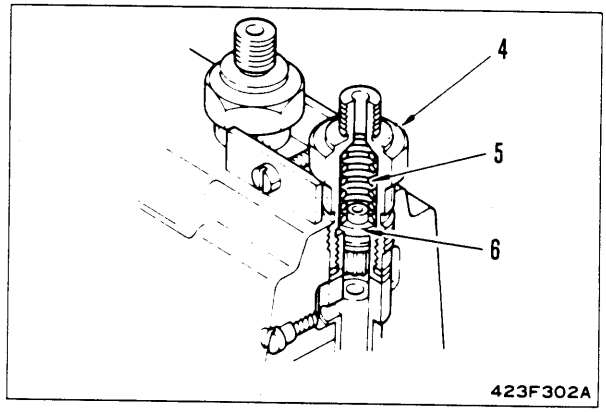
020905

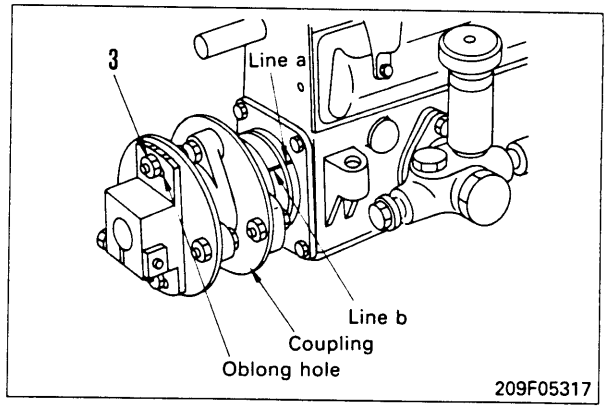
Testing and adjusting by delivery valve method

1. Rotate the crankshaft back 40 – 50° in the reverse direction from No. 1 cylinder compression top dead center.
2. Rotate the crankshaft in the normal direction and align the **I.J.** line on crankshaft pulley (1) with pointer (2).
3. Disconnect fuel injection tube (3) from No. 1 cylinder.
4. Remove delivery valve holder (4), take out spring (5) and delivery valve (6), then install only delivery valve holder (4) again.
5. Place the fuel control lever at the high idling position.
6. Loosen nut (7) at the coupling oblong hole, then operate the priming pump, and move the coupling. Stop at the position where fuel stops flowing from the delivery valve holder.
7. Tighten nut (7) of the oblong hole in the coupling.
   kgm Nut: 6.2 ± 0.2 kgm
   ★ If line **a** and **b** are not aligned, make a new line **a** to match line **b**.
8. Remove delivery valve holder (4), assemble delivery valve (6) and spring (5), then install delivery valve holder (4) again.
   kgm Delivery valve holder: 11.5 ± 0.5 kgm
9. Connect fuel injection tube (1).
   kgm Sleeve nut: 2.2 ± 0.2 kgm







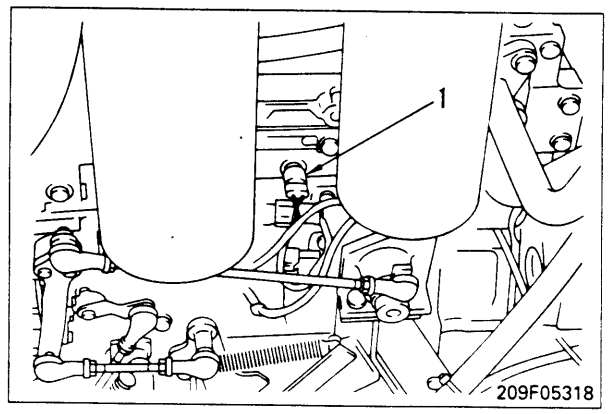


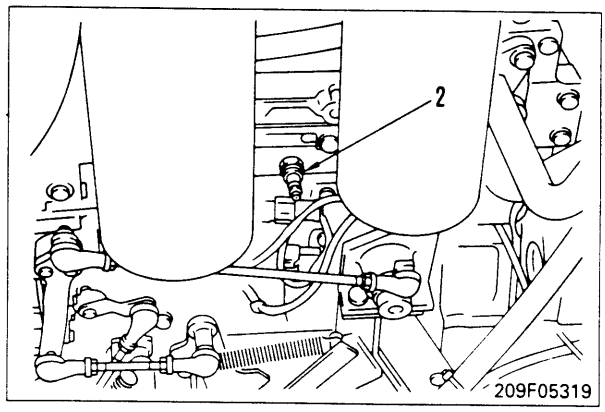
020905

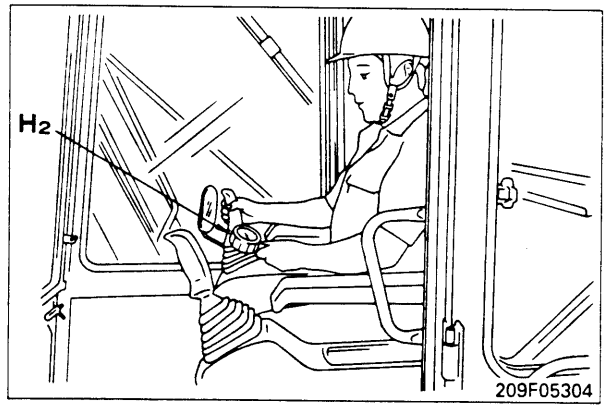
MEASURING ENGINE OIL PRESSURE

★ Measure the engine oil pressure under the following conditions.
- Coolant temperature: Within operating range

1. Remove engine oil pressure sensor (1), and install nipple (2).
2. Connect oil pressure gauge H_2 (10 kg/cm^2) with the hose of oil pressure gauge H_1.
3. Start the engine, and measure the oil pressure at low idling and high idling.





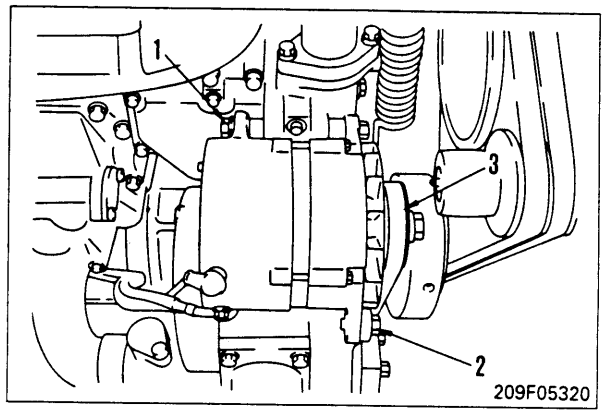


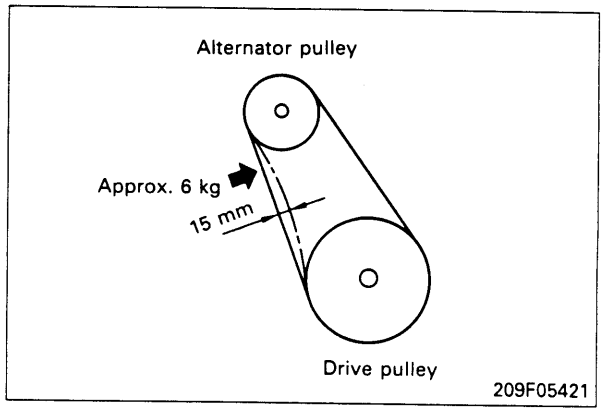
020905

TESTING AND ADJUSTING ALTERNATOR BELT TENSION

★ If the deflection is not within the standard value when the belt is pushed at a point midway between the alternator pulley and drive pulley, or when carrying out maintenance after replacing the belt, adjust as follows.

1. Loosen mounting bolt (1) of the alternator assembly and belt tension adjustment bolt (2).
2. Using a pipe, move the alternator assembly, and when the tension of belt (3) is correct, tighten adjustment bolt(3), then tighten the alternator mounting bolt (1).
3. After adjusting the belt tension, check as given above that the tension of the belt is within the standard value.

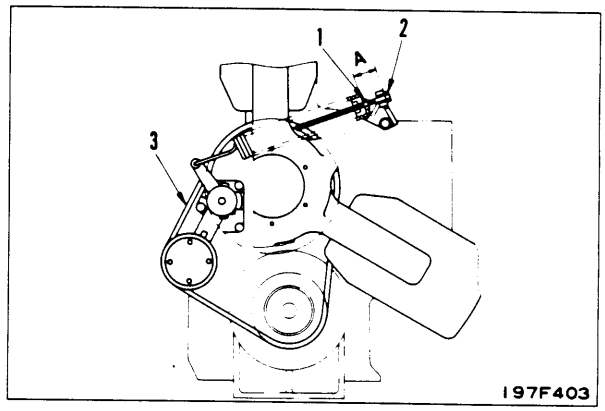




TESTING AND ADJUSTING FAN BELT TENSION

★ The fan belt uses a device that maintains a constant tension regardless of any elongation of the V-belt, so there is no need to carry out any adjustment until the belt is cut. However, if dimension **A** is not within a range of 55 ± 4 mm, or when carrying out maintenance after replacing the belt, adjust as follows.

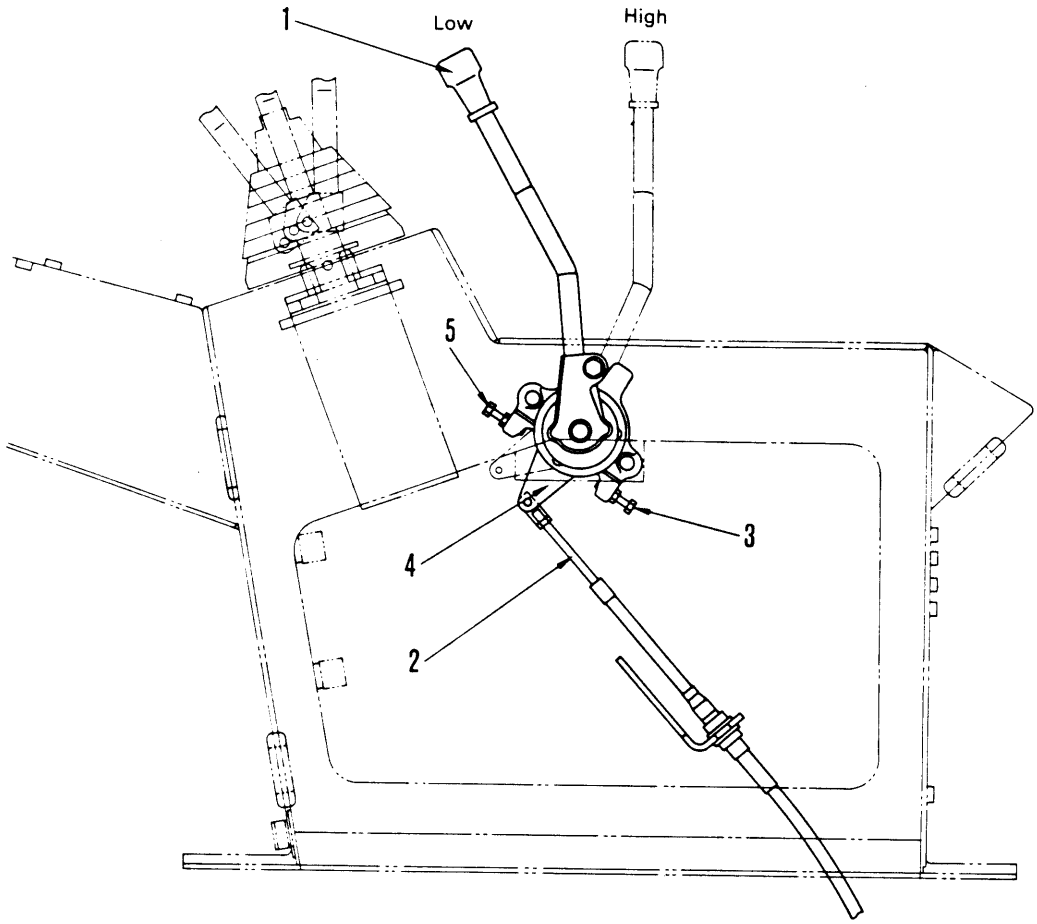
1. Loosen mounting bolt (1) and turn adjustment bolt (2) to adjust the tension of belt (3).
2. After adjusting the belt tension, use scale ① to check that dimension **A** is within a range of 55 ± 4 mm.



020905

ADJUSTING FUEL CONTROL LINKAGE

1. Adjusting fuel control lever



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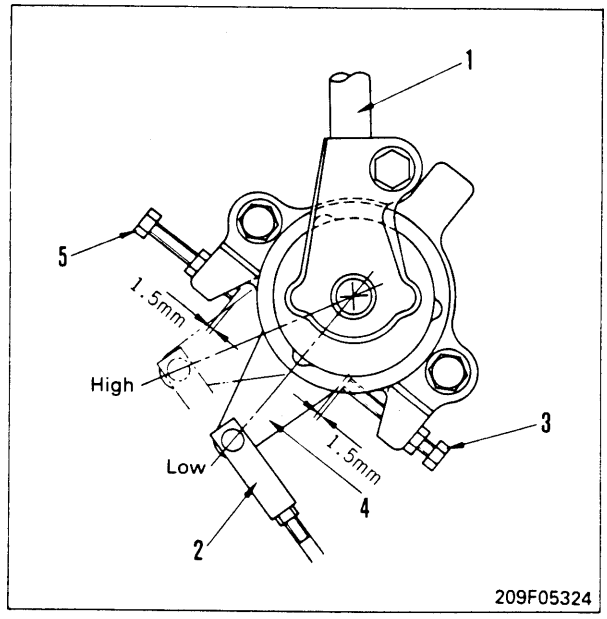
1) Operate fuel control lever (1), set the engine governor lever to the low idling position, then connect cable (2).
2) Next, adjust stopper bolt (3) so that the clearance between stopper bolt (3) and lever (4) is 1.5 mm.
3) Operate fuel control lever (1), set the engine governor lever to the high idling position, then adjust stopper bolt (5) so that the clearance between stopper bolt (5) and lever (4) is 1.5 mm.
   ★ If the stopper bolt is turned back 1.5 turns, this will give a clearance of approx. 1.5 mm.



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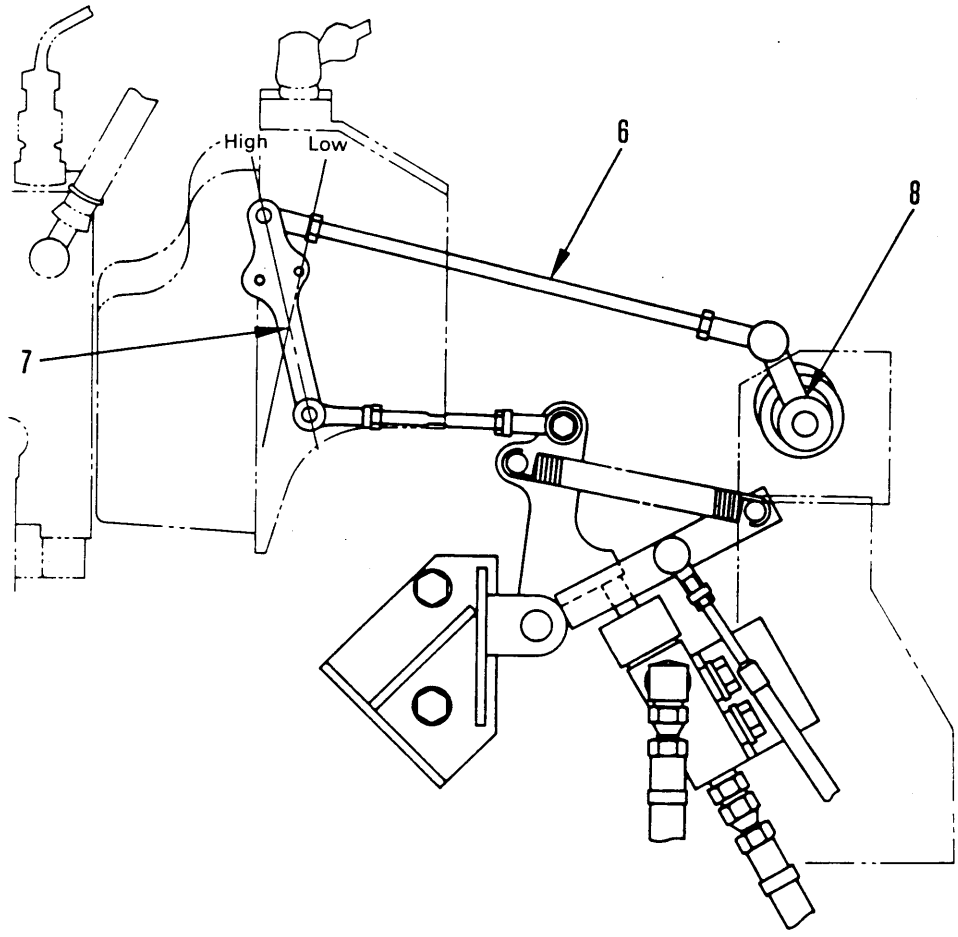
2. **Connecting potentiometer**

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**



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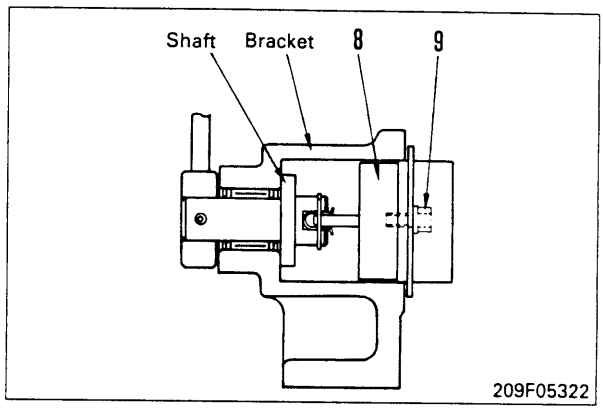
★ After replacing the potentiometer, or if the speed of the work equipment is slow or there is deviation in travel, adjust as follows.

1) Install rod (6), place governor lever (7) of the fuel injection pump at the high idling position, then insert potentiometer (8).
   ★ Push in the potentiometer so that the neutral point does not move out of position.
2) Fix the potentiometer in position, then tighten mounting bolts (9) in turn.



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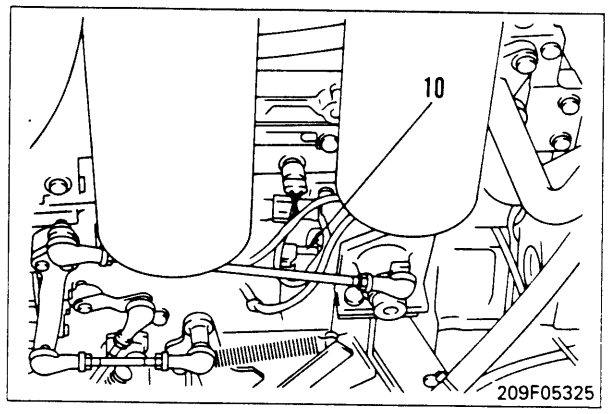
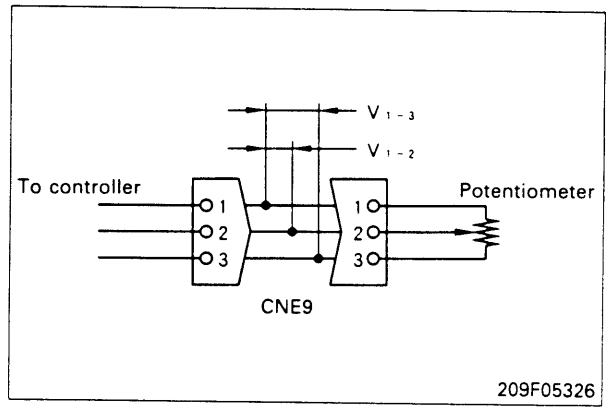
3. **Testing potentiometer**

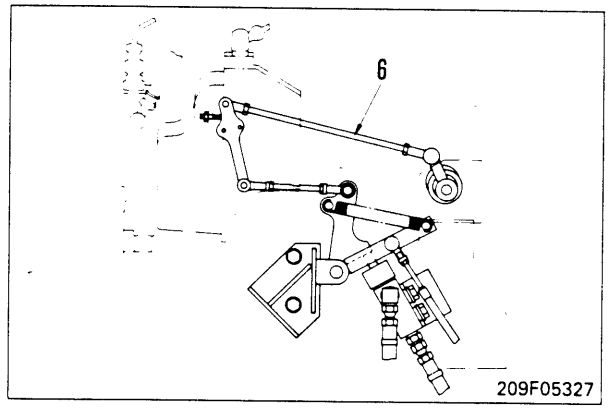
★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

★ After installing the potentiometer in Step 2, test and adjust the potentiometer as follows.

1) Disconnect connector CNE9 (10) of the potentiometer, and connect T-adapter **M**.
2) Start the engine, then pull the fuel control lever in the high idling direction until it contacts the stopper bolt.
3) Using a tester, measure voltage V_{1-3} between pins (1) and (3) of connector CNE9.
   - ★ V_{1-3} = 4.9 – 5.1 V
   - ★ If V_{1-3} is not within a range 4.9 – 5.1 V, check the battery, alternator, controller, and chassis wiring.
4) Measure voltage V_{1-2} between pins (1) and (2) of connector CNE9.
   - ★ $V_{1-2} = (V_{1-3}/2)$ = 2.50 ± 0.06 V
   - ★ If the voltage is not the standard value, adjust the length of rod (6) to bring the voltage within the standard value.







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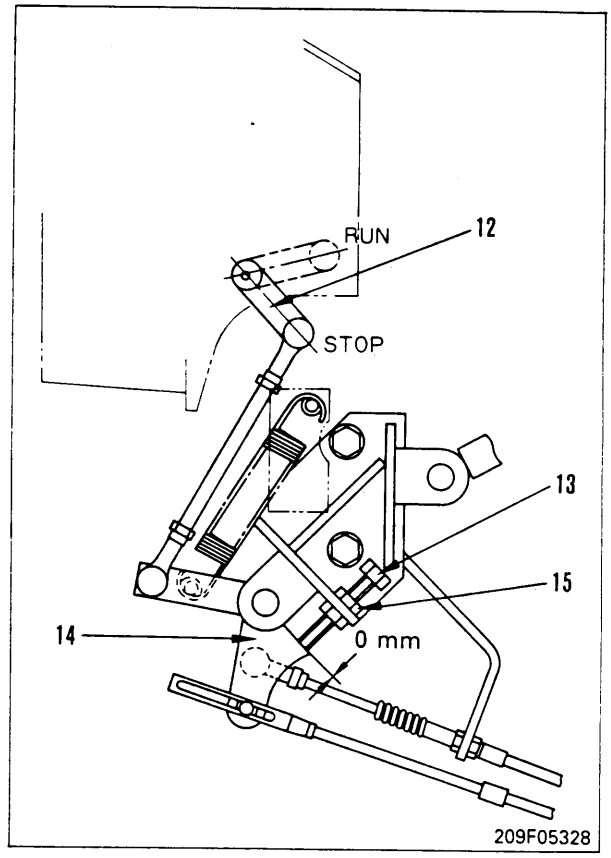
4. Adjusting engine stop lever

1) Turn the starting switch OFF.
2) Set injection pump stop lever (12) to the STOP position.
3) Set the clearance between stopper bolt (13) and stop lever (14) to 0 mm.
4) Separate stop lever (14) from stopper bolt (13), tighten stopper bolt (13) one turn, then tighten locknut (15).



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5. Adjusting auto-deceleration linkage

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

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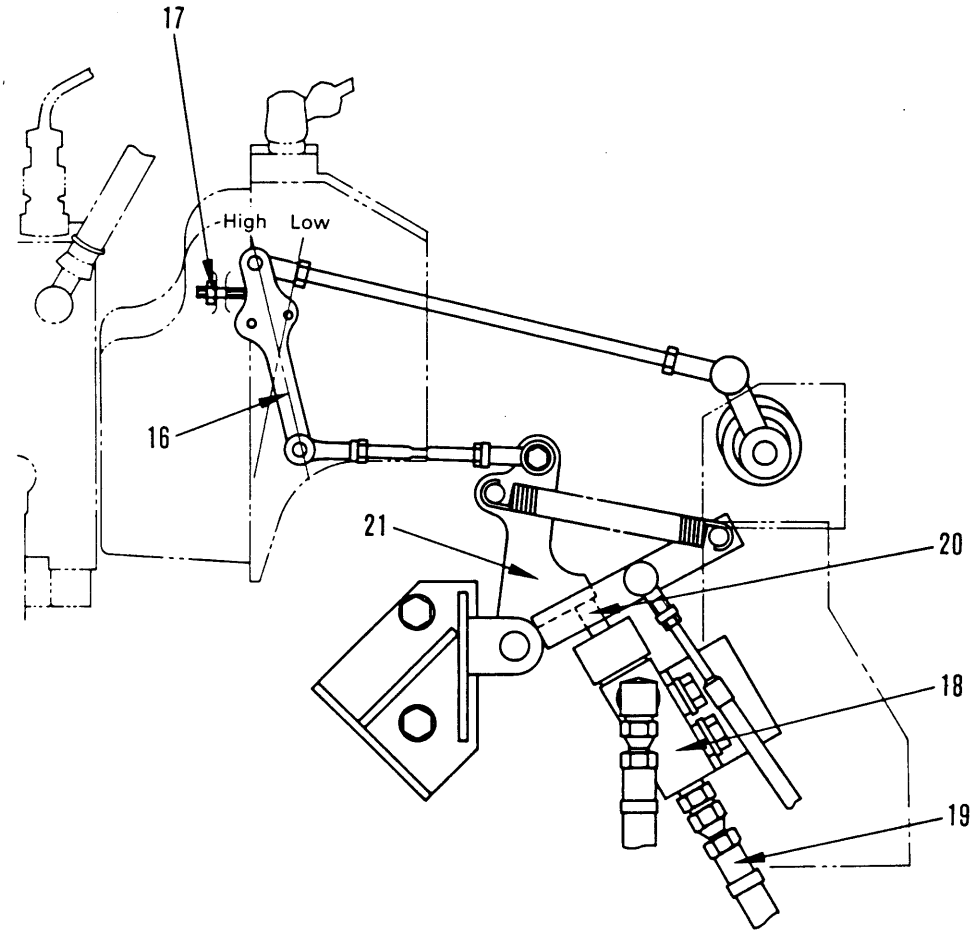

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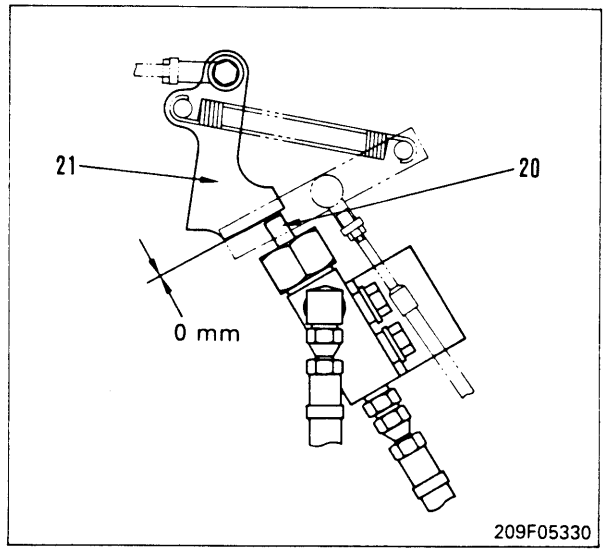
1) With the engine stopped, set the fuel control lever to the high idling position.
   Check that governor lever (16) is in contact with stopper bolt (17).
2) Loosen bottom hose (19) of deceleration cylinder (18), and release the internal pressure of the cylinder.
3) Loosen the mounting bolt of the deceleration cylinder, and adjust so that clearance between lever (21) and the tip of plunger (20) of deceleration cylinder (18) is 0 mm.
   ★ Target: 0 – 0.5 mm
4) Be careful not to let the center of the plate of lever (21) and the center of deceleration cylinder move out of position, and tighten the mounting bolt.



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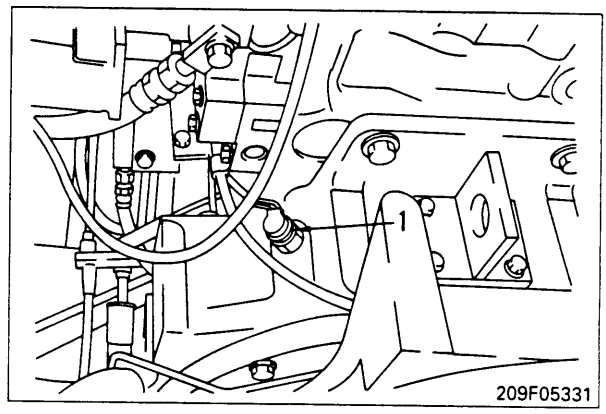
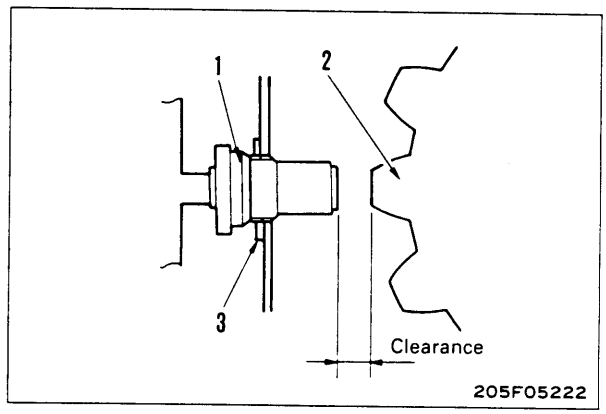
ADJUSTING ENGINE SPEED SENSOR

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

1. Screw in so that the tip of sensor (1) contacts gear (2).
2. When sensor (1) contacts gear (2), turn it back one turn.
3. Tighten locknut (3).
   - ★ When connecting the wiring, be careful to prevent any excessive force from bearing on the wiring on the sensor.
   - ★ Be careful not to scratch the top of the sensor or to get any metal powder stuck to it.





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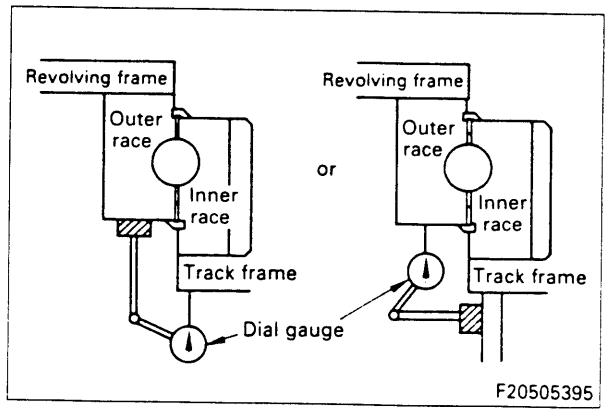
CHECKING SWING CIRCLE BEARING CLEARANCE

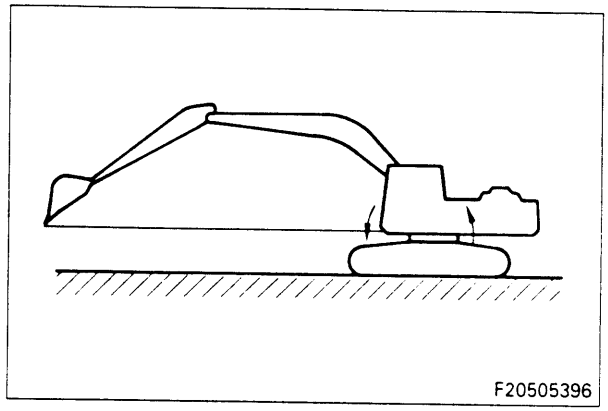
★ When measuring the clearance of the swing circle bearing when it is still mounted on the machine, do as follows.

1. Fix a dial gauge equipped with a magnet to the outer race (or inner race) of the swing circle, and put the probe in contact with the end face of the inner race (or outer race).
   Set the dial gauge at the front or rear.



2. Set the work equipment to the maximum reach with the tip of the bucket at the height of the bottom surface of the frame.
   In this condition, the front of the upper structure will go down, and the rear will go up.

3. Set the dial gauge to the 0 point.



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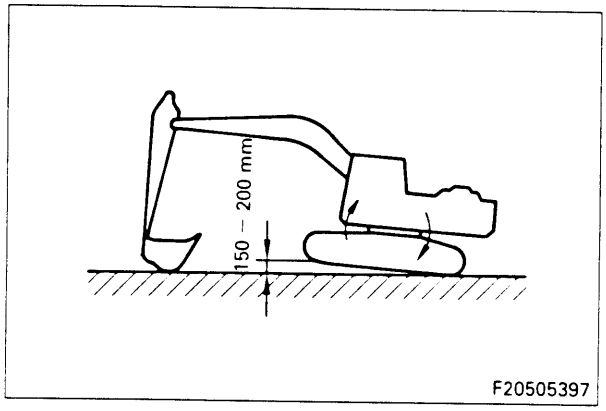
4. Set the arm at 90° perpendicular to the ground surface, then lower the boom until the front of the track comes off the ground.
   The front of the upper structure will go up, and the rear will go down.

5. With the machine in this condition, read the value on the dial gauge.
   This reading of the dial gauge is the clearance of the swing circle bearing.
   ⚠ When carrying out the measurement, do not put your hands or feet under the undercarriage.

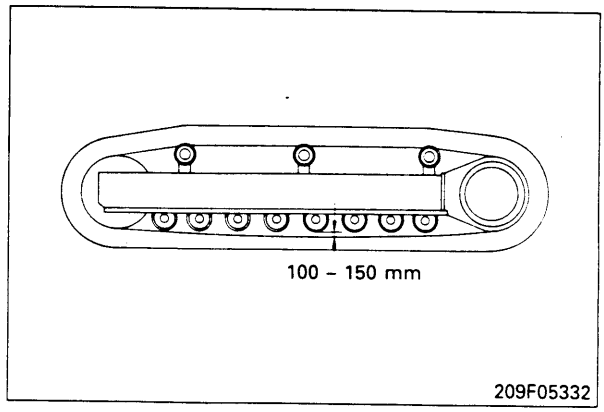


6. Return the machine to the condition in Step 2, and check that the dial gauge has returned to the 0 point.
   If the dial gauge has not returned to the 0 point, repeat Steps 2 – 5.

TESTING AND ADJUSTING TRACK SHOE TENSION

Testing

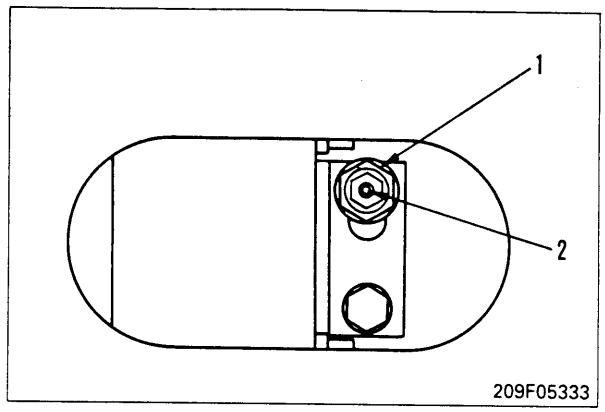
1. Raise the chassis with the boom and arm, then measure the clearance between the roller tread surface of the track link and the tread surface of the 4th track roller from the sprocket.



Adjusting

★ If the track shoe tension is not within the standard value, adjust as follows.

1. When tension is too tight
   Loosen plug (1) slowly and discharge grease.
   ⚠ The grease is under extremely high pressure, and there is danger that the plug may fly out, so never loosen plug (1) more than one turn.
   ★ If the grease does not come out easily, move the machine slowly backwards and forwards.
2. If tension is too loose
   Pump in grease through grease fitting (2).
   ★ If the grease cannot be pumped in easily, move the machine slowly backwards and forwards.



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TESTING AND ADJUSTING WORK EQUIPMENT, SWING, TRAVEL CIRCUIT PRESSURE

Measuring

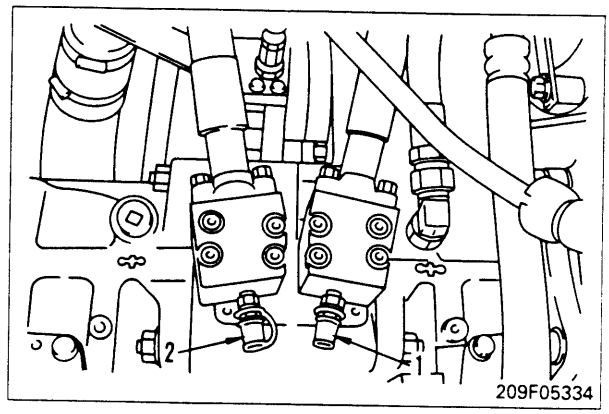
1. Measuring at normal pressure

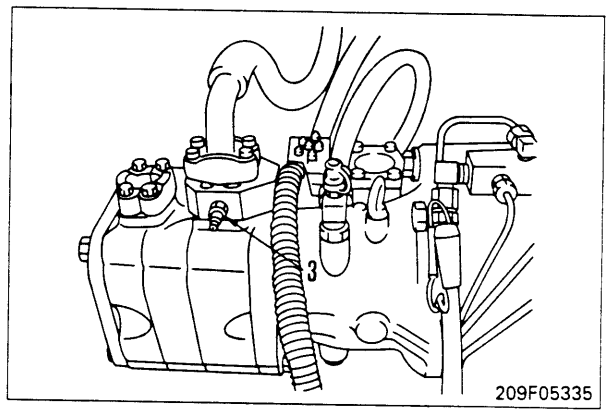
★ Oil temperature when measuring: 45 – 55°C

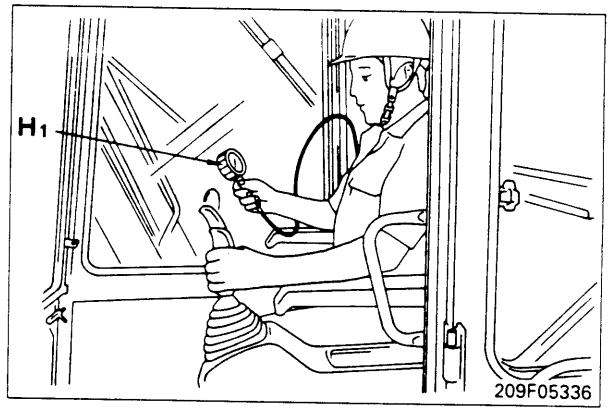
⚠ Lower the work equipment to the ground and stop the engine. Operate the control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. After doing this, set the safety lock lever to the LOCK position.

1) Install oil pressure gauge **H_1** (600 kg/cm²) to quick couplers (1), (2), or (3) of the circuit to be measured.
   - (1): For front pump (R.H. 4-spool control valve)
   - (2): For rear pump (L.H. 5-spool control valve)
   - (3): For swing pump (swing control valve)

2) Start the engine, set to H mode, then measure the main relief pressure with the engine running at high idling.
   - Condition of actuator being measured
     i) For the work equipment, fully retract each cylinder.
     ii) For the swing, set the swing lock switch to the ON position.
     iii) For the travel, fit block ① under the track shoe grouser, or fit block ② between the sprocket and frame to lock the track, then measure each side separately.



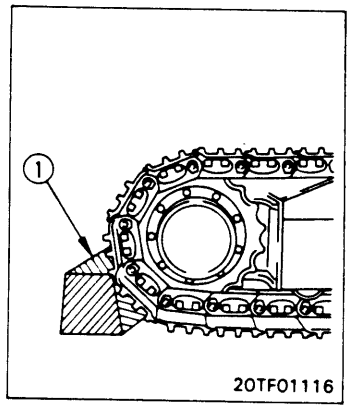


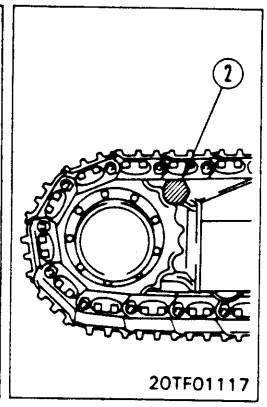


2. Measuring when pressure has risen

1) When main relief valve pressure has risen
   i) Set the heavy lift switch to ON.
   ii) Set the boom against a rock wall, operate the boom lever to the RAISE position to relieve the circuit, then measure the oil pressure.

★ When measuring with the circuit relieved at the end of the boom RAISE stroke, block (use a blind plug) the port at the head end of the cylinder.





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2) When pressure of safety valve for boom LOWER has risen
   i) Set the machine push up switch to ON.
   ii) Relieve the boom LOWER circuit and measure the pressure.
      ★ The set pressure when the pressure has risen is higher than the set pressure for the main relief, so if the main relief pressure is measured and found to be 320 kg/cm², the pressure is normal.
      ★ If the pressure has not risen, the pressure is 190 kg/cm² (cracking pressure), so this pressure is measured.

Adjusting

1. Main relief valve of L.H. and R.H. control valves

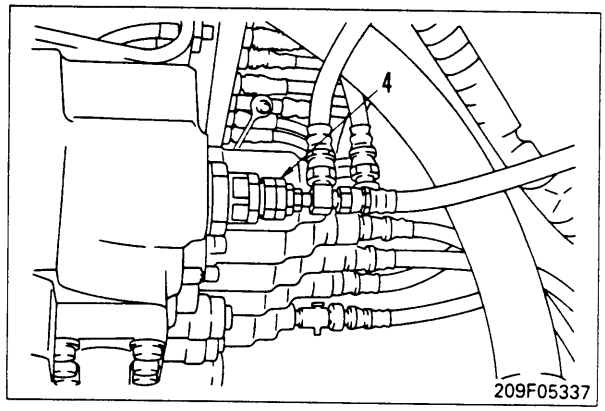
- (4): Main relief valve of L.H. 5-spool control valve
- (5): Main relief valve of R.H. 4-spool control valve

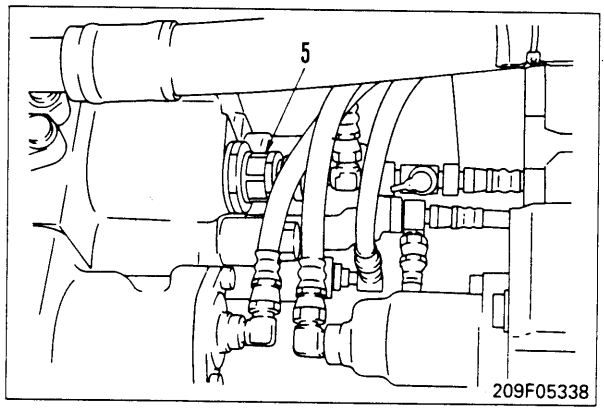
1) Adjusting high set pressure side
   i) Loosen locknut (6), and turn holder (7) to adjust.
      ★ Turn the holder to adjust as follows.
         • To INCREASE pressure, turn CLOCKWISE
         • To DECREASE pressure, turn COUNTERCLOCKWISE.
      ★ Change in pressure for one turn of holder: 222 kg/cm²
      kgm Locknut: 11.0 ± 1.5 kgm
      ★ When adjusting the high set pressure, the low set pressure also changes, so always adjust the low set pressure following this.

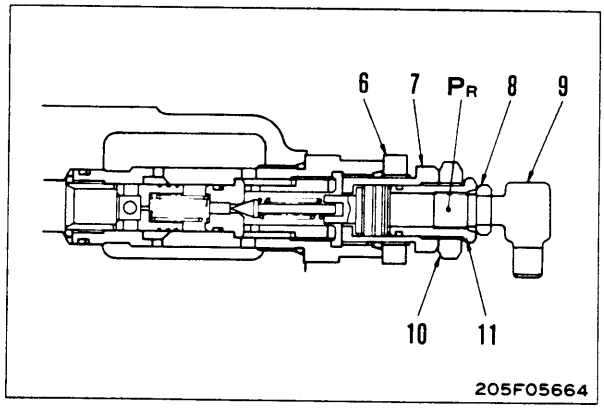
2) Adjusting low set pressure side
   i) Loosen locknut (8).
      ★ Check that elbow (9) moves.
   ii) Loosen locknut (10), and turn holder (11) to adjust.
      ★ Turn the holder to adjust as follows.
         • To INCREASE pressure, turn CLOCKWISE.
         • To DECREASE pressure, turn COUNTERCLOCKWISE.
      ★ Change in pressure for one turn of holder: 222 kg/cm²
      kgm Locknut: 8.75 ± 0.75 kgm

★ Normally, the pressure at port P_R is less than 13 kg/cm², and at high set pressure, it is approx. 30 kg/cm².

★ After completion of adjustment, repeat Step 1 to check the set pressure again.







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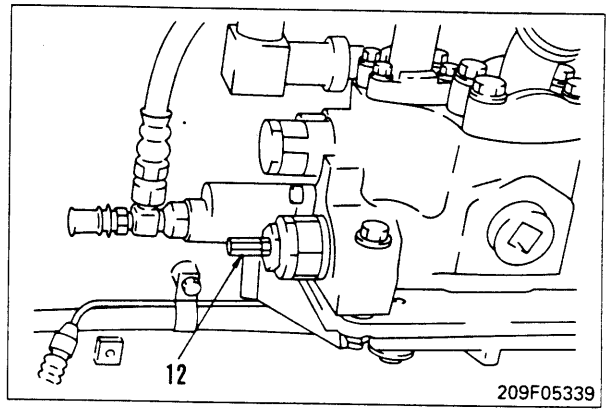
2. **Main relief valve of swing control valve**
   - (12): Main relief valve of swing control valve
   1) Remove cap (13).
   2) Loosen locknut (14), and turn adjustment screw (15) to adjust.
      ★ Turn the adjustment screw to adjust as follows.
         - To INCREASE pressure, turn CLOCKWISE.
         - To DECREASE pressure, turn COUNTER-CLOCKWISE.
      ★ Change in pressure for one turn of adjustment screw: 35.7 kg/cm²
      Locknut: 3.2 ± 0.3 kgm
      ★ After completion of adjustment, repeat Step 1 to check the set pressure again.



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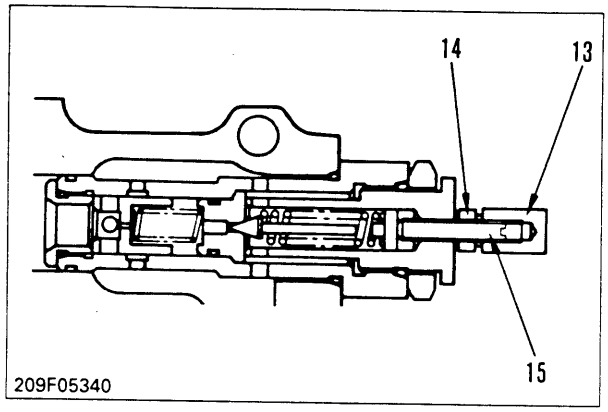

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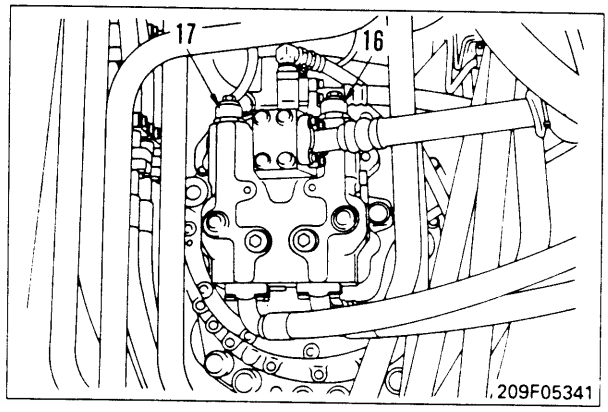
3. **Swing motor safety valve**
   - (16): Safety valve for left swing
   - (17): Safety valve for right swing
   1) Loosen locknut (18), and turn adjustment screw (19) to adjust.
      ★ Turn the adjustment screw to adjust as follows.
         - To INCREASE pressure, turn CLOCKWISE.
         - To DECREASE pressure, turn COUNTER-CLOCKWISE.
      ★ Change in pressure for one turn of adjustment screw: 48.6 kg/cm²
      Locknut: 4 ± 1 kgm
      ★ After completion of adjustment, repeat Step 1 to check the set pressure again.
      ★ Adjust the safety valve set pressure for the swing motor only. Do not adjust any other safety valve set pressure.



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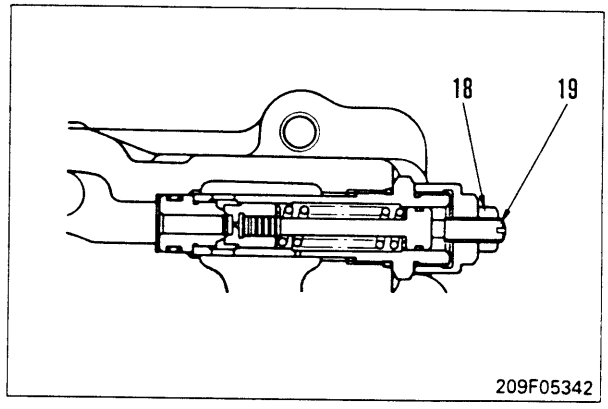

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TESTING AND ADJUSTING CONTROL CIRCUIT PRESSURE

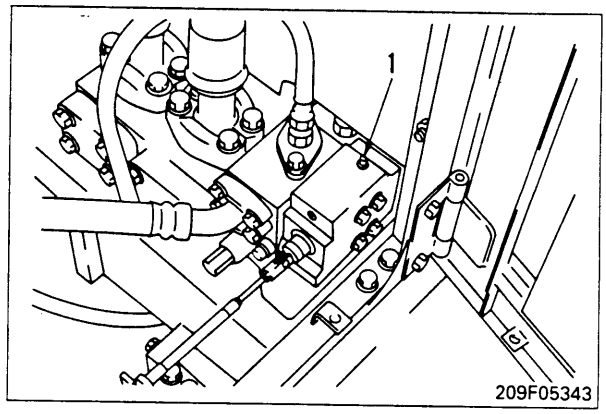
Measuring

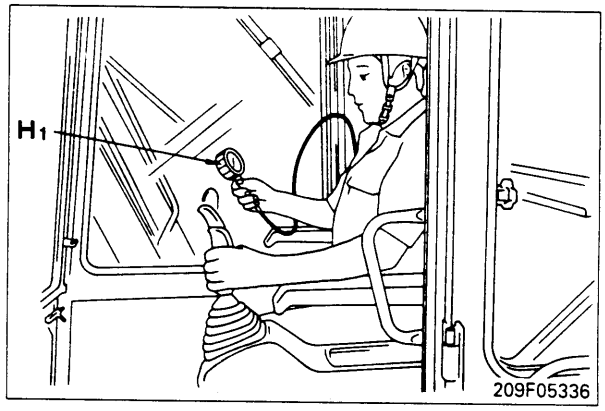
★ Oil temperature when measuring: 45 – 55°C

1. Remove pressure pickup plug (1) (10 mm, P=1.25), and install oil pressure gauge H_1 (60 kg/cm²).
2. Start the engine and measure with the engine running at high idling.
   ★ When testing for any leakage of oil from the components in the control circuit, use the parts given in the table below to shut off the following portion of the circuit when measuring the relief pressure.

No.	Portion of hydraulic circuit shut off	Component that can be tested
1	Piston pump inlet port	Piston pump
2.	Solenoid valve inlet port	Solenoid valve
3.	Travel PPC valve inlet port	Travel PPC valve
4.	L.H. PPC valve inlet port	L.H. PPC valve
5.	R.H. PPC valve inlet port	R.H. PPC valve

   ★ The components from No. 2 down can be checked if the equipment above them in the list is normal.
   ★ Use the following parts to shut off the circuit.
   - For elbow
     Sleeve nut: 07221-20315
     Plug: 07222-00315
   - For hose
     Plug: 07376-50315





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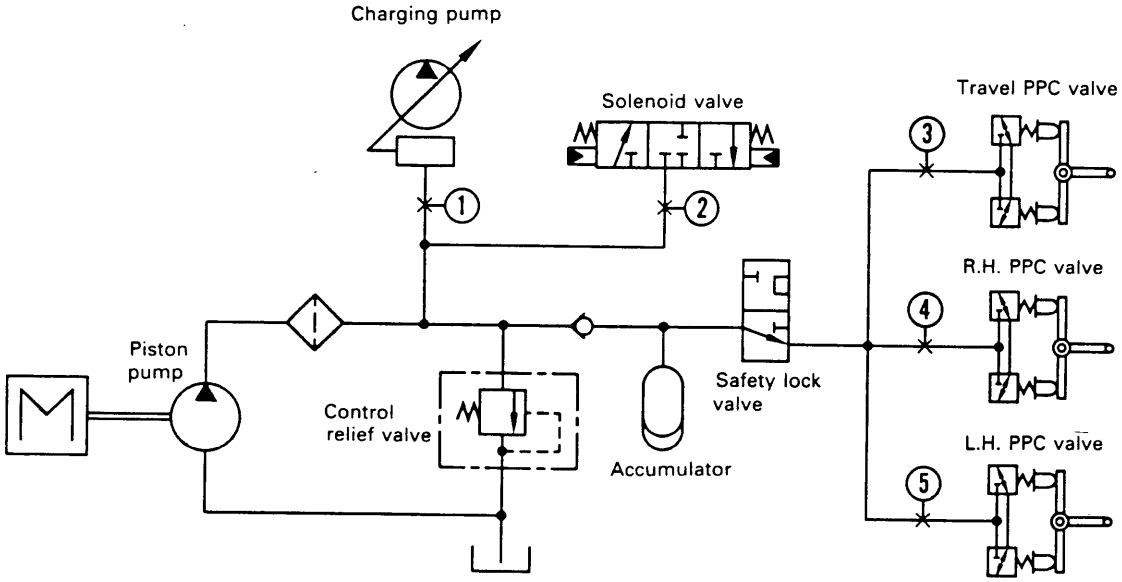

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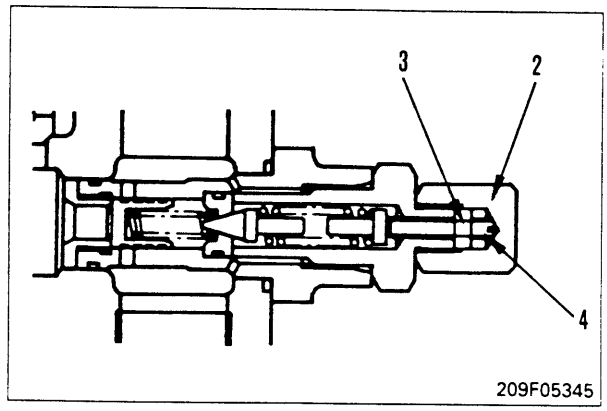
Adjusting

1. Remove cap (2).
2. Loosen locknut (3), then turn adjustment screw (4) to adjust.
   - ★ Turn the adjustment screw to adjust as follows.
     - To INCREASE pressure, turn CLOCKWISE.
     - To DECREASE pressure, turn COUNTER-CLOCKWISE.
   - ★ Change in pressure for one turn of adjustment screw:
   - kgm Locknut:
   - ★ After completion of adjustment, repeat Step 1 to check the set pressure again.



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TESTING AND ADJUSTING PISTON PUMP CONTROL PRESSURE

1. TVC valve output pressure

Measuring

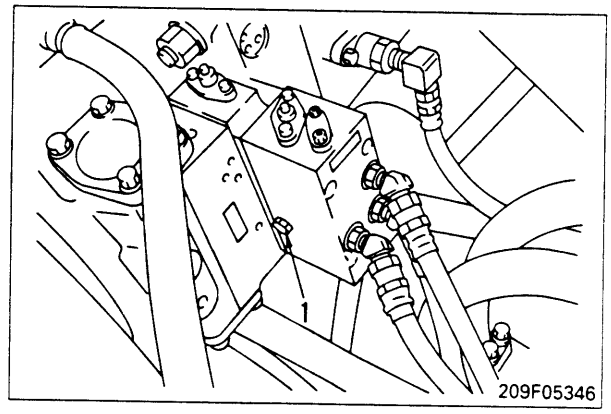
★ Oil temperature when measuring: 45 – 55°C

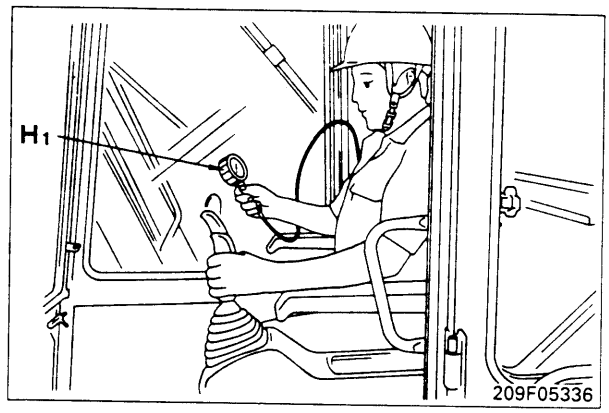
★ First, measure the charging pump relief pressure to confirm that it is normal.

★ The TVC valve output pressure varies with the average pressure of the pump discharge pressures ($\frac{P_1 + P_2}{2}$ = average pressure), so before measuring, always adjust the main relief pressure to the standard value.

1) Remove pressure pickup plug (1) (10 mm, P=1.25) of the swing pump NC valve, and install oil pressure gauge **H_1** (60 kg/cm²).

2) Start the engine, set to H mode, then measure the hydraulic pressure at the following two points with the engine running at high idling.
   i) Output pressure at 2-pump relief (No. 1 pump + No. 2 pump)
   ii) Output pressure at 2-pump + swing pump relief





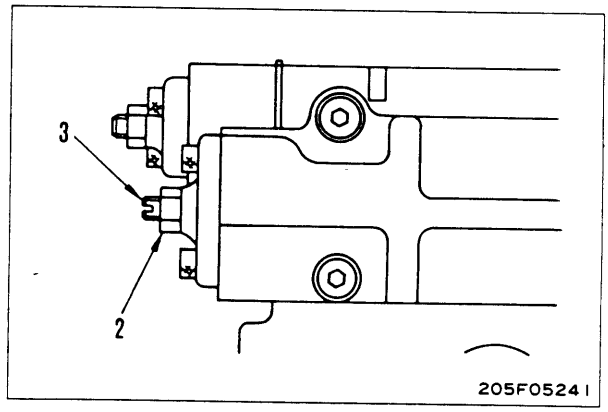
Adjusting

★ If the result of the measurement shows that the hydraulic pressure is not within the standard value, adjust as follows.

1) Loosen locknut (2).

2) Turn adjustment screw (3) to adjust.
   ★ Turn the adjustment screw to adjust as follows.
   • To INCREASE pressure, turn CLOCKWISE.
   • To DECREASE pressure, turn COUNTER-CLOCKWISE.
   ★ Change in pressure for one turn of adjustment screw: Approx. 3.5 kg/cm²
   kgm Locknut:
   ★ After completion of adjustment, repeat Step 1 to check the set pressure again.

★ If the adjustment screw is stiff, and it is turned forcibly, there is danger that the tip may be damaged. If the screw is stiff, remove the TVC valve assembly, then remove the cover assembly, and add a lubricant to the screw before trying to remove it.



2. Output pressure of CO valve and NC valve

The output pressure of the NC valve flows to the servo valve and controls the discharge flow of the piston pump.

The oil flows from the TVC valve ⟶ CO valve ⟶ NC valve ⟶ servo valve, and the output pressure changes as follows in response to the operation of the control lever or work equipment.

★ When control lever is at neutral

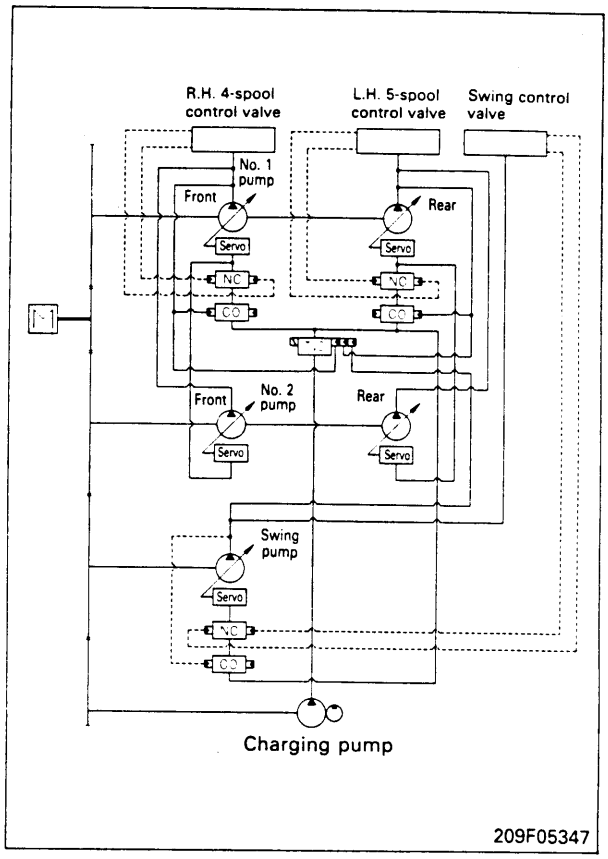
Because of the differential pressure of the jet sensor, the NC valve is actuated and the output pressure is reduced to 5.5 kg/cm² or below. (The pump discharge flow is the minimum.)

★ At hydraulic cylinder relief

The CO valve is actuated, and reduces the pressure going to the NC valve to 5.5 kg/cm² or below. The NC valve sends this pressure as it is to the servo valve. (The pump discharge flow at this point is also the minimum.)

★ When work equipment, swing, travel are actuated

The output pressure of the TVC valve is not affected by the CO valve and NC valve; it sends oil to the servo as it is. (The pump discharge flow varies between the maximum and the point where the CO valve is actuated.)



Measuring

★ Oil temperature when measuring: 45 – 55°C

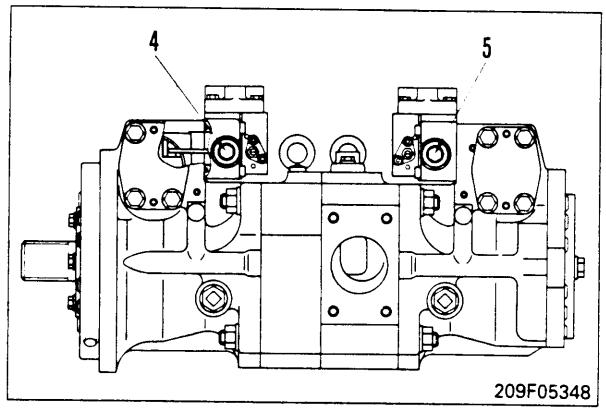
• Remove pressure pickup plug (4), (5), or (6) (10 mm, P=1.25), then install oil pressure gauge H_1 (60 kg/cm²).
  - (4): For front pump (at No. 2 pump)
  - (5): For rear pump (at No. 2 pump)
  - (6): For swing pump
  - ★ It is at the body side of the servo valve.

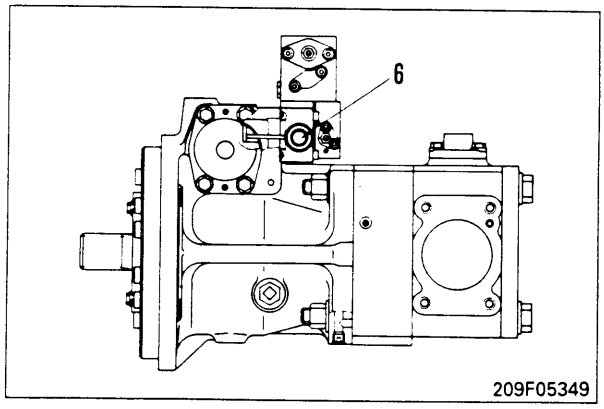
1) Output pressure when NC valve is actuated

Start the engine, set to H mode, and measure the hydraulic pressure with the engine running at high idling and all the control levers at neutral.

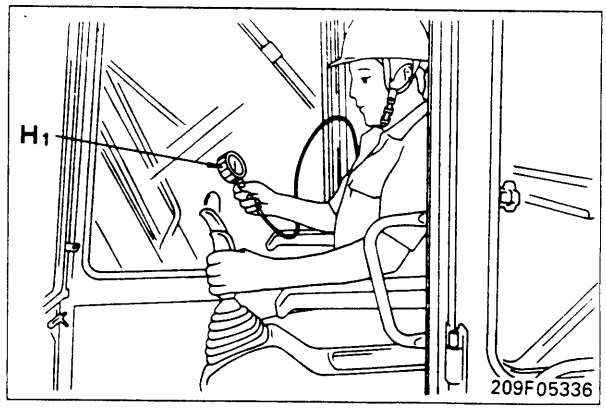
★ Set the auto-deceleration switch OFF.

★ If the output pressure is more than 5.5 kg/cm², measure the differential pressure of the jet sensor.





2) Output pressure when CO valve is actuated
Measure at the same time as measuring the output pressure of the TVC valve.
   i) No. 1 pump, No. 2 pump
   Run the engine at high idling, set to H mode, and measure the hydraulic pressure when any one of the boom (except LOWER), arm, or bucket circuits is relieved.
   ★ Always set the heavy lift switch OFF when raising the boom.
   ii) Swing pump
   Run the engine at high idling, set to H mode, and measure the hydraulic pressure when the swing circuit is relieved.
   ★ Turn the swing lock switch ON.



3) Output pressure when CO valve and NC valve are not actuated
Measure the hydraulic pressure of the No. 1 pump and No. 2 pump when the track is rotating freely, and measure the hydraulic pressure of the swing pump when swinging the upper structure.
⚠ The measurements are carried out when the upper structure is swinging or when the tracks are rotating freely, so be careful to check that the surrounding area is safe.
★ Measure the output pressure of the TVC valve at the same time, and if the difference is large (more than 1 kg/cm^2), there is probably defective actuation of the CO valve or NC valve.

Adjusting

1) CO valve

★ If the set pressure of the CO valve is high, the discharge flow at relief is not reduced. Because of this, the relief pressure becomes higher, so always adjust to the standard pressure.

i) Loosen locknut (7), then turn adjustment screw (8) to adjust.

★ Turn the adjustment screw to adjust as follows.

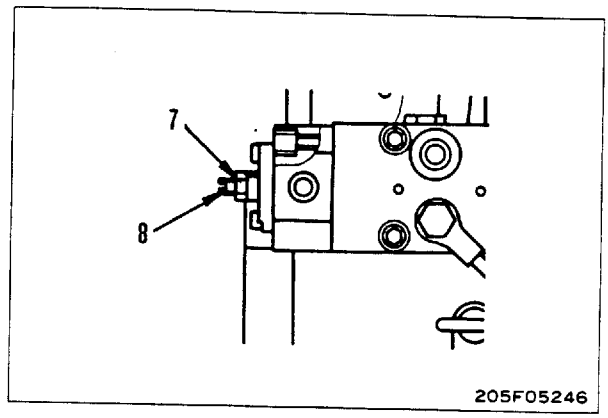
- To INCREASE pressure, turn CLOCKWISE.
- To DECREASE pressure, turn COUNTER-CLOCKWISE.

★ Change in pressure for one turn of adjustment screw: 41.25 kg/cm²

★ If the pressure does not go down even when the adjustment screw is turned, there is probably some defect inside the CO valve.

kgm Locknut: 0.8 ± 0.2 kgm

ii) After completion of adjustment, repeat Step 1 to check the set pressure again.



2) NC valve

★ The NC valve is actuated by the differential pressure of the jet sensor, so when adjusting, always check first that the differential pressure of the jet sensor is normal.

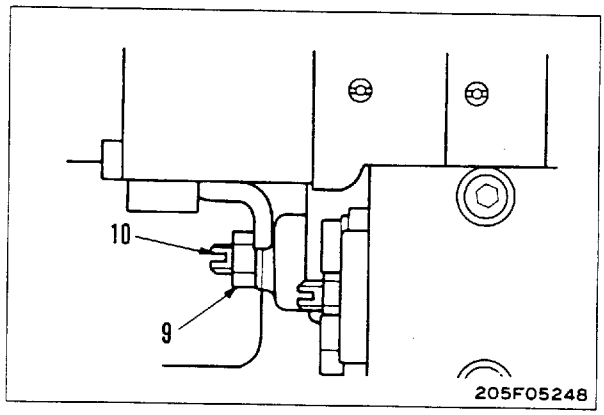
i) Loosen locknut (9), then turn adjustment screw (10) to adjust.

★ Turn the adjustment screw to adjust as follows.

- To INCREASE pressure, turn CLOCKWISE.
- To DECREASE pressure, turn COUNTER-CLOCKWISE.

★ Change in pressure for one turn of adjustment screw: 4.3 kg/cm².

kgm Locknut: 0.8 ± 0.2 kgm



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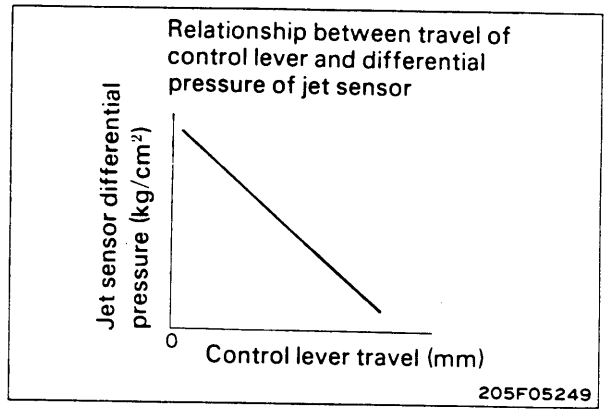
3. **Differential pressure of jet sensor**

High pressure and low pressure (high – low = differential pressure) is created at the outlet port of the control valve, and this differential pressure controls the NC valve.

The differential pressure is at its maximum when the work equipment control levers are at neutral, and is at its minimum when the work equipment control levers are operated to the end of their stroke.

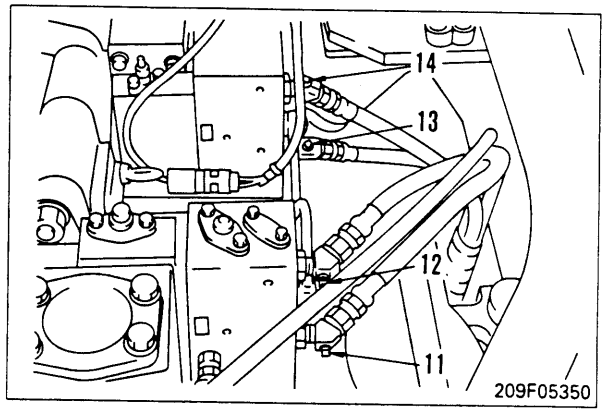


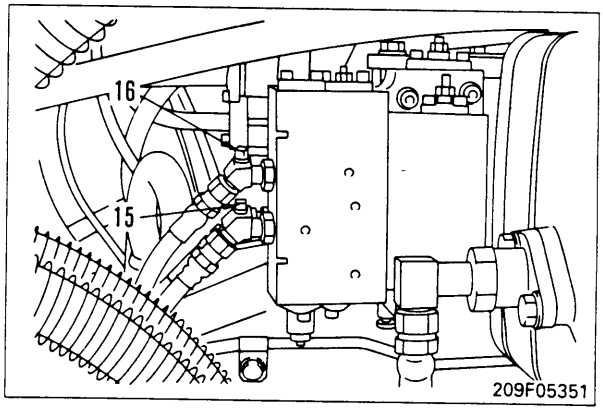
Measuring

⚠ Release the pressure inside the hydraulic tank.

★ Oil temperature when measuring: 45 – 55°C

1) Remove pressure pickup plugs (11) and (12), (13) and (14), or (15) and (16).
   - (11): High pressure side of R.H. 4-spool control valve (No. 1 front pump)
   - (12): Low pressure side of R.H. 4-spool control valve (No. 1 front pump)
   - (13): High pressure side of L.H. 5-spool control valve (No. 1 rear pump)
   - (14): Low pressure side of L.H. 5-spool control valve (No. 1 rear pump)
   - (15): High pressure side of swing control valve (swing pump)
   - (16): Low pressure side of swing control valve (swing pump)
2) Install oil pressure gauge **H1** (high pressure side: 60 kg/cm², low pressure side: 25 kg/cm²).
3) Measuring with control levers at neutral (max. differential pressure)
   Run the engine at high idling and set to H mode, then measure the differential pressure with the control levers at neutral.
   ★ High pressure (Pt) – low pressure (Pd) = differential pressure
   ★ The differential pressure is the maximum.
4) Measuring with control levers actuated (min. differential pressure)
   i) No. 1 pump, No. 2 pump
      Using the work equipment, raise the track frame on one side, and measure the differential pressure when the track is rotating freely (with the control lever operated to the end of its travel).
   ii) Swing pump
      Measure the differential pressure when swinging (with the control lever operated to the end of its travel).
   ★ The differential pressure is the minimum.





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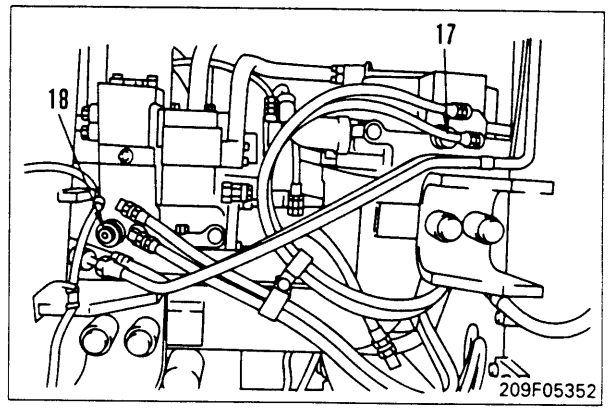
Measuring

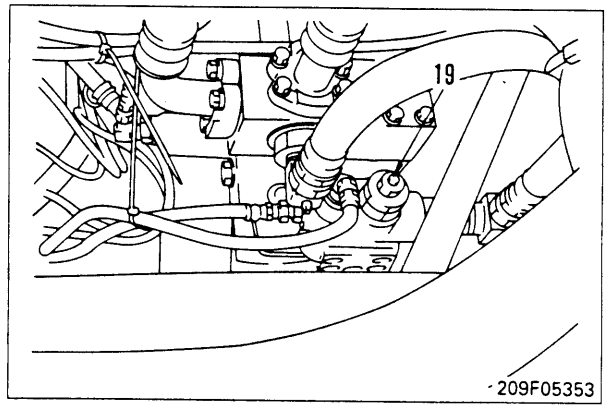
★ If the results of the measurement show that the differential pressure is not within the standard value, adjust as follows.

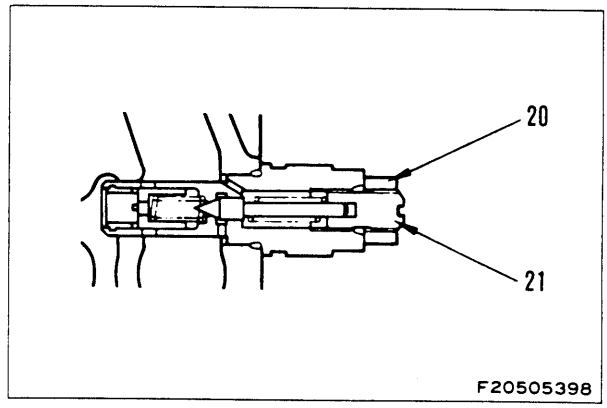
• (17): For L.H. 5-spool control valve
(18): For R.H. 4-spool control valve
(19): For swing control valve

1) Loosen locknut (20), then turn adjustment screw (21) to adjust.
   ★ Turn the adjustment screw to adjust the pressure (high pressure side) as follows.
      • To INCREASE Pressure, turn CLOCKWISE.
      • To DECREASE Pressure, turn COUNTER-CLOCKWISE.
   ★ Change in pressure for one turn of adjustment screw: 1.4 kg/cm²
   kgm Locknut: 7.0 ± 1.0 kgm

★ After completion of adjustment, repeat Step 1 to check the set pressure again.







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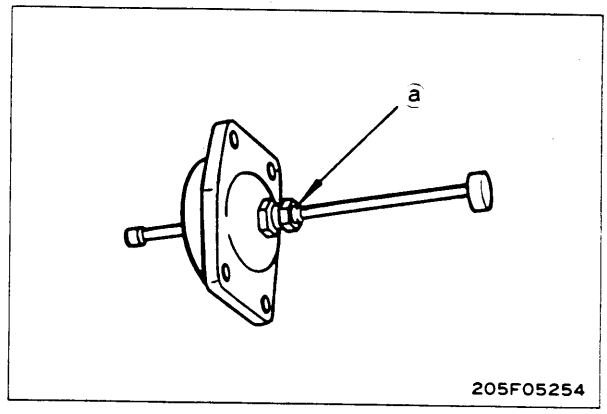
MEASURING STROKE OF SERVO PISTON

★ If the output pressure of the NC valve is normal, and it is considered that the pump performance is defective, inspect as follows to determine if the servo valve is defective or not.

1. Prepare the tool

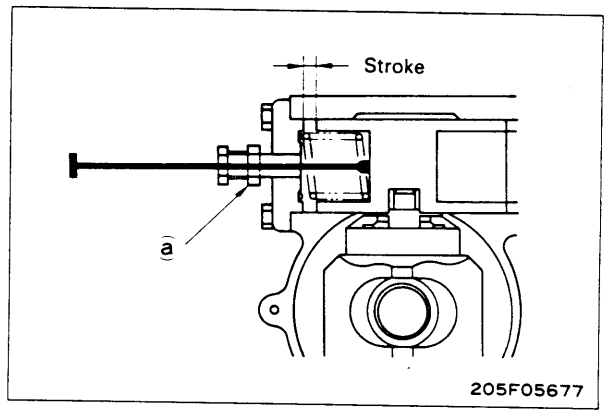
Make up gauge ⓐ from the following parts.

1) Servo piston cap (side which has spring)
2) Dump truck brake wear measurement gauge (566-98-41120)
3) Tap PT 1/4 threads in the center of the cap, and install the gauge.



2. Measuring

1) Remove the cap (with the spring) from the side to be measured.
   ★ The cap is pushed by the spring, so use bolt (01016-31070) and a nut.
2) Fit the shims that were removed, and install gauge ⓐ.
   ★ Do not let the shims catch on the threaded portion of the bolt.
3) Stop the engine, push the rod in fully, then measure the dimension of the rod.
4) Raise the track shoe on the side where the gauge is installed, and measure the dimension of the rod when the engine is run at high idling and the track is rotated freely.
   ★ Standard stroke
   No.1, No. 2 pump (HPV90 + 90): Approx. 7.8 mm
   Swing pump (HPV160): Approx. 11.2 mm
   ★ When the track shoe is rotated freely, push the rod by hand, and check at the same time that the rod moves smoothly in accordance with the travel of the control lever.



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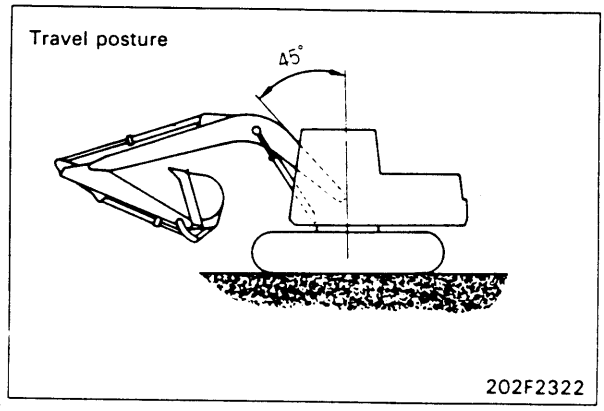
TESTING AND ADJUSTING TRAVEL DEVIATION

★ Drive the machine on flat ground.

1. **Measuring when traveling**
   1) Set the machine in the travel posture.
      ★ For the travel posture, extend the bucket and arm cylinder rods fully, and hold the boom angle at 45°.
   2) Travel for 10 m, then measure the deviation when traveling for the next 20 m.
      ★ Set to H mode and measure with the engine at high idling.
      ★ Measure when driving the machine on a flat firm ground surface or on concrete (a surface with little travel resistance).



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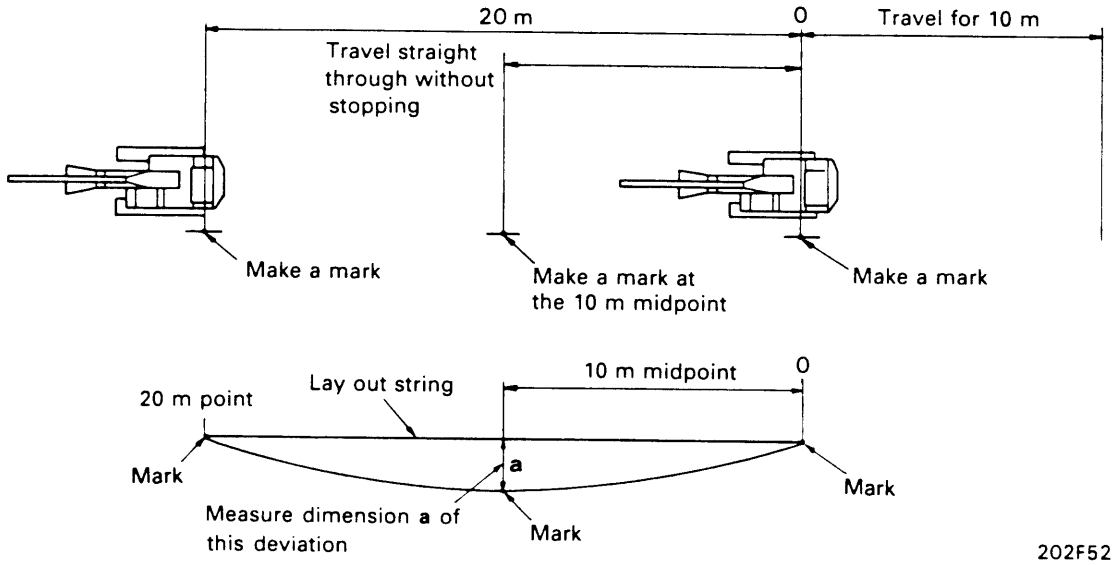


2. Adjusting

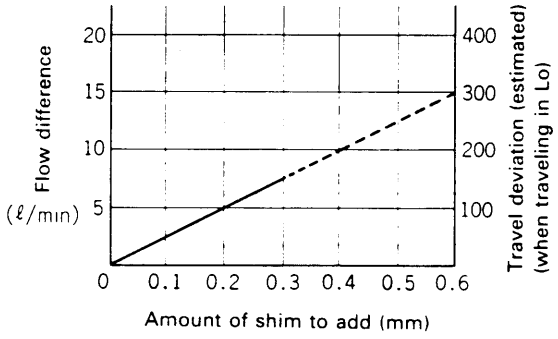
If the results of the measurement are not within the standard value, adjust as follows.

★ Adjustment procedure

Deviates to right	Deviates to left
Adjust or add shim to front pump at ⓐ	Adjust or add shim to rear pump at ⓑ

- If the travel deviation does not come within the standard value even when adjusted, go to Troubleshooting item "Travel deviation is excessive".

1) Loosen 4 bolts (1).
   ★ Split shims are used, so it is not necessary to remove the bolts.
2) Add the appropriate thickness of shim (2), then tighten bolts (1).
   ★ The additional shim thickness is a maximum of 0.3 mm for one pump.
   kgm Mounting bolt: 6.75 ± 0.75 kgm
   ★ Amount of deviation and amount of shim to add (for one pump)
   to add (for one pump)



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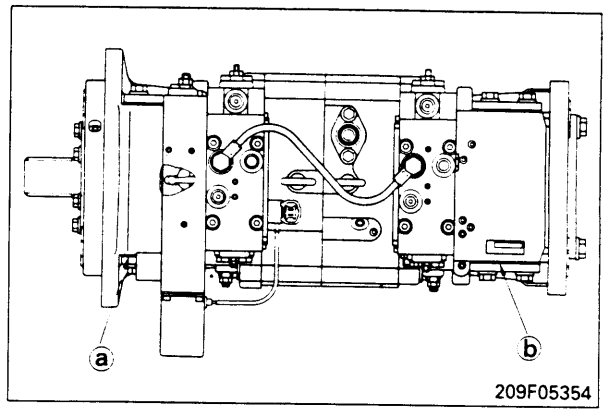
No. 1 pump



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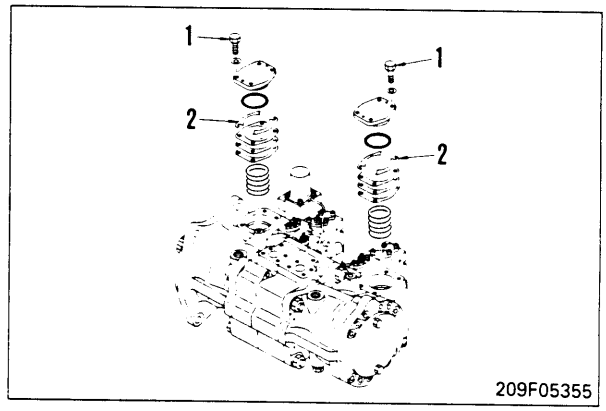

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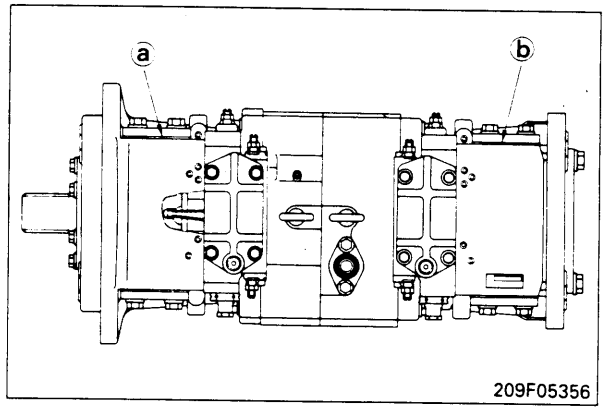
No. 2 pump



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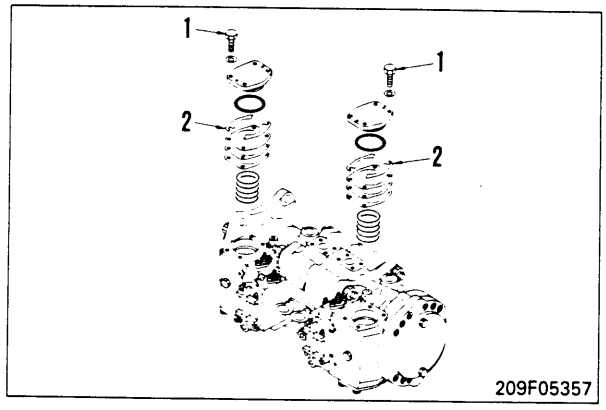

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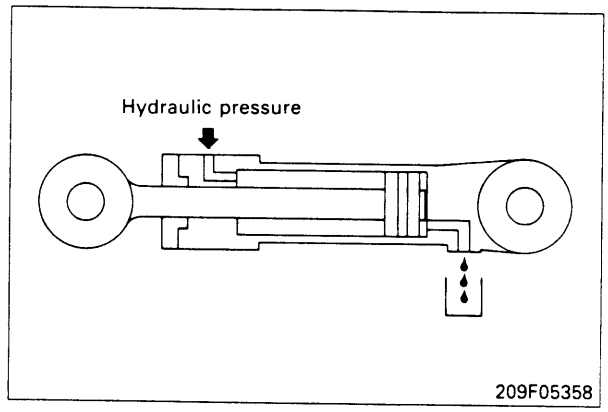
MEASURING OIL LEAKAGE

★ Oil temperature when measuring: 45 – 55°C

1. **Hydraulic cylinder**
   1) Fully retract the rod of the hydraulic cylinder to be measured, then stop the engine.
      ★ For the boom cylinder, disconnect the mounting pin at the rod end.
      Operate the control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. After doing this, set the safety lock lever to the LOCK position.
   2) Disconnect the piping at the bottom end, and block the piping at the chassis end with a blind plate.
      ⚠ Be careful not to disconnect the piping at the head end.
   3) Run the engine at high idling, and apply the relief pressure to the head of the cylinder (cylinder retracted side).
   4) Wait for 30 seconds, then measure the amount of leakage for the next minute.



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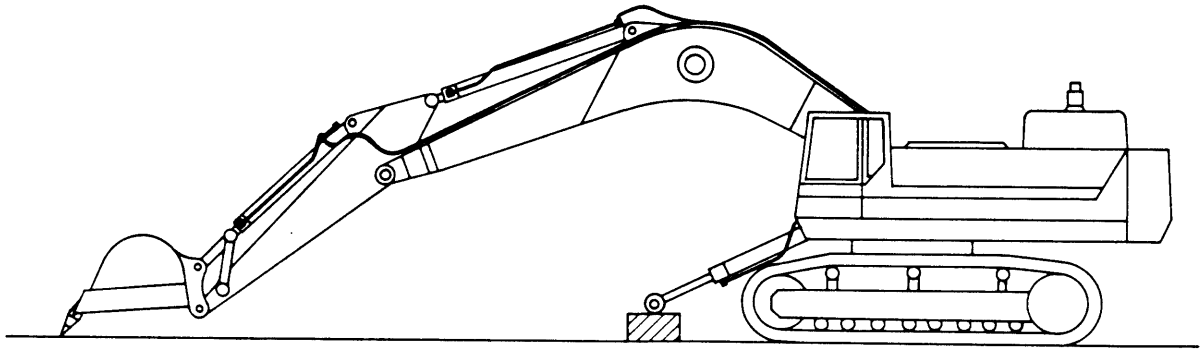
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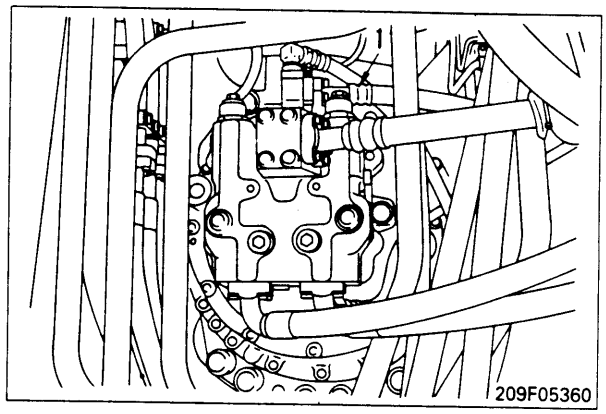
2. Swing motor

1) Disconnect drain hose (1) of the swing motor, then install a blind plug at the tank end.
2) Set the swing lock switch ON.
3) Run the engine at high idling, and relieve the swing circuit.
4) Wait for 30 seconds, then measure the leakage for the next minute.

★ After measuring once, swing the upper structure 180° and measure again.



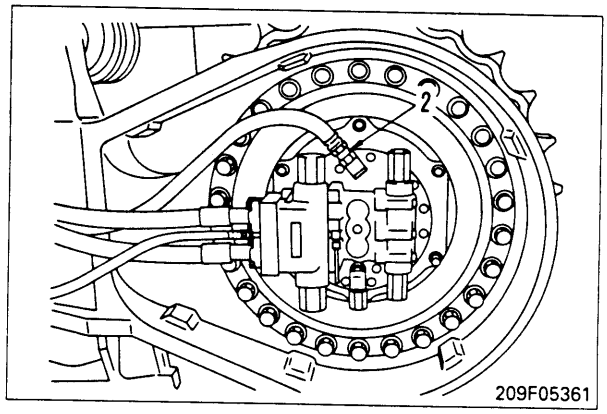
3. Travel motor

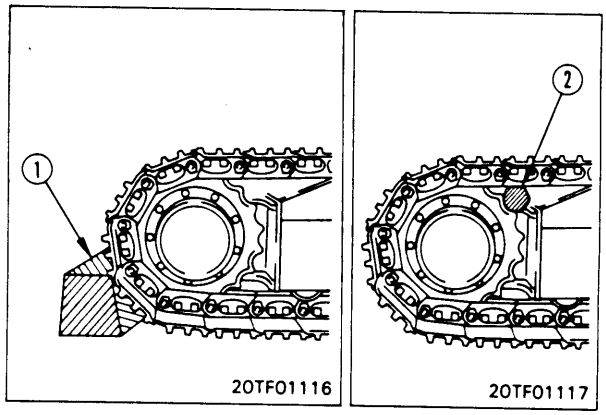
1) Disconnect drain hose (2) of the travel motor, then install a blind plug at the hose end.
2) Fit block ① under the track shoe grouser, or fit block ② between the sprocket and frame to lock the track.
3) Run the engine at high idling, and relieve the travel circuit.

⚠ There is danger that mistaken operation of the lever may lead to an accident, so use signals and carry out the operation carefully.

4) Wait for 30 seconds, then measure the leakage for the next minute.

★ When measuring, move the motor a little each time (change the position of the valve plate and cylinder, and piston and cylinder), and carry out the measurement several times.





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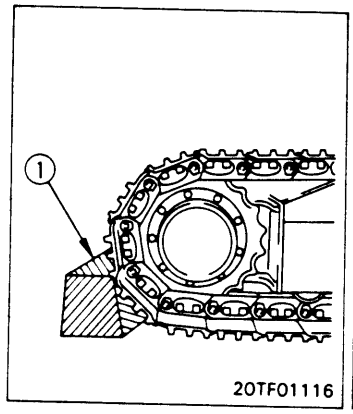
4. Center swivel joint

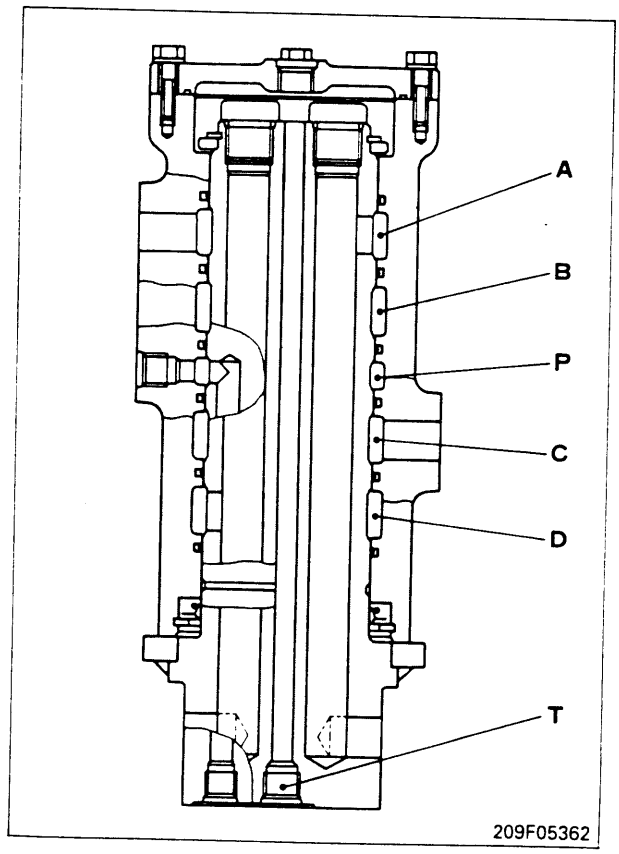
- If there is any abnormality in the travel (travel deviation, lack of travel speed), and there is no abnormality in the hydraulic pump or control valve, check the center swivel joint.

Table 1

•Swivel joint port to check	Direction of rotation of travel motor	Swivel joint port to measure
A	R.H. FORWARD	B • T
B	R.H. REVERSE	A • P
C	L.H. REVERSE	P • D
D	L.H. FORWARD	C • T
P	Travel speed selection	B • C

1) To lock the rotation of the travel motor for the port to be measured, fit block ① under the track shoe grouser, or fit block ② between the sprocket and frame, then stop the engine.
   ⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.
2) Disconnect the hoses at the top of the swivel from the ports to be measured both sides the port to be checked, then fit blind plugs in the hoses.
   ★ For details of the combination of the port to be checked and the port to be measured, see Table 1.
   ★ Use the following parts as blind plugs.
   - Main hose: Flange (07379-01044)
     Split flange (07371-31049)
     Drain hose: Plug (07376-50315)
     (07376-50628)
3) Run the engine at high idling, and catch the amount of oil that leaks from the measurement port in a measuring cylinder as follows.
   i) Ports A, B, C, D
   Relieve the travel motor of the ports to be checked slowly in the direction of rotation.
   ★ Rotating direction of checking port, see Table 1.
   ii) Port P
   Set the travel speed switch to the Hi position.
4) Wait for one minute, then measure the leakage for the next minute.





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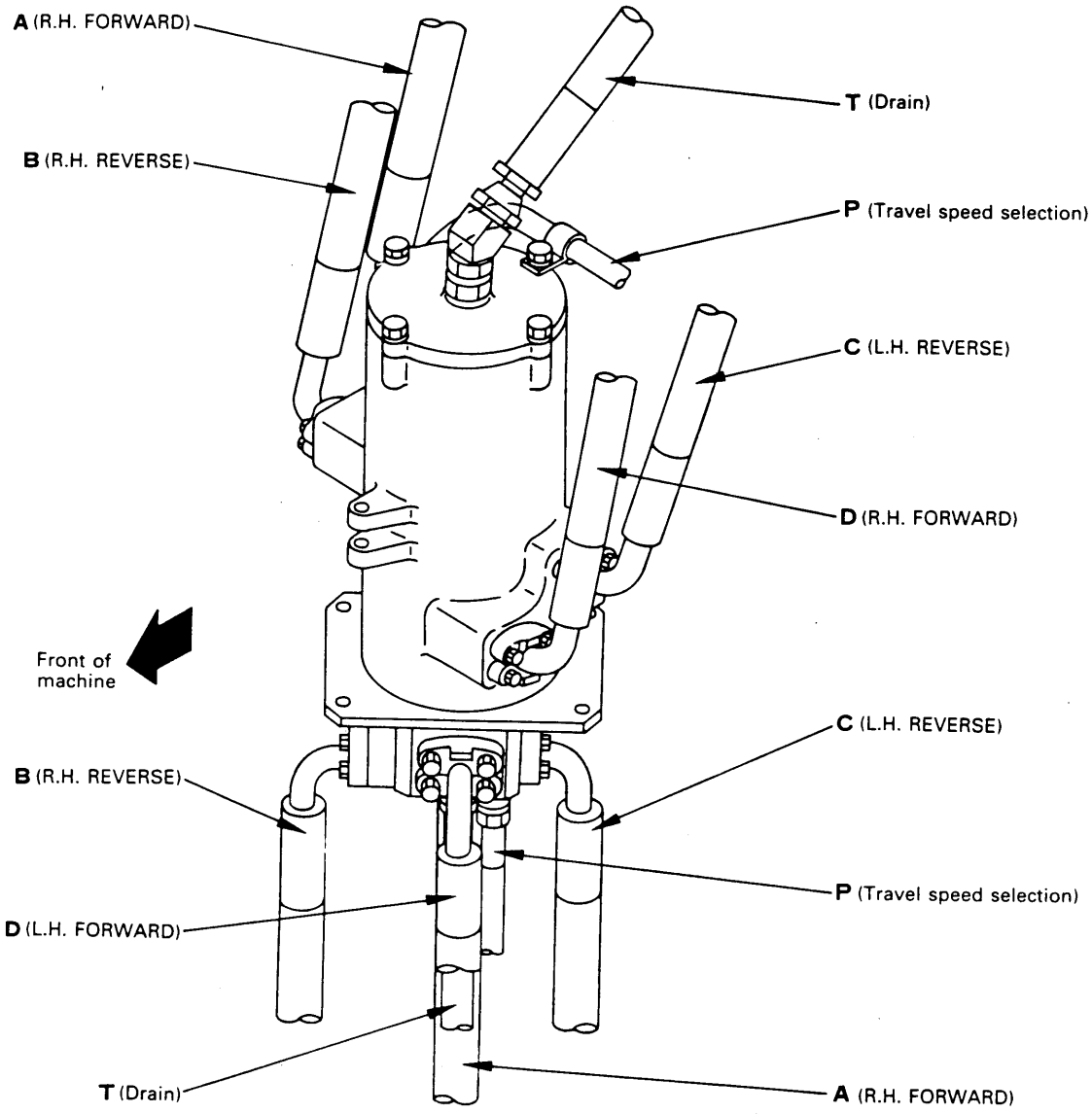

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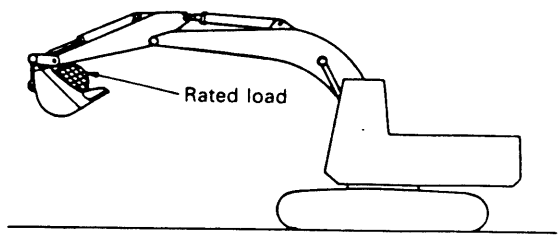
CHECKING LOCATIONS CAUSING HYDRAULIC DRIFT OF WORK EQUIPMENT

★ If hydraulic drift occurs in the work equipment (cylinder), check as follows to see if the cause is the cylinder packing or in the control valve.

1. Inspection of boom, bucket cylinder

1) Set in the posture for measuring hydraulic drift, then stop the engine.
2) Operate the control lever to RAISE (for the boom) or CURL (for the bucket).
   - If the downward movement becomes fast, the packing is defective.
   - If there is no change, the control valve is defective.

Boom, bucket measuring posture



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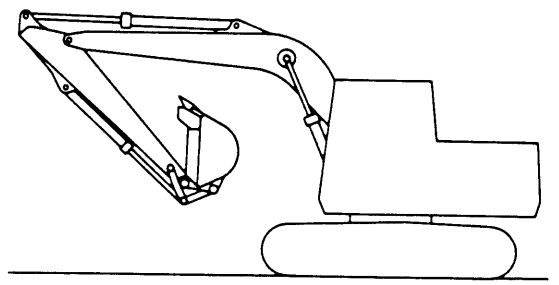
2. Inspection of arm cylinder

1) Pull in the arm cylinder to a position 100 mm from the fully pulled-in position, then stop the engine.
2) Operate the control lever to IN.
   - If the downward movement becomes fast, the packing is defective.
   - If there is no change, the control valve is defective.
   - ★ If the pressure in the accumulator has been removed, run the engine for approx. 10 seconds to charge the accumulator before carrying out the operation.

Arm measuring posture



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[Reference]

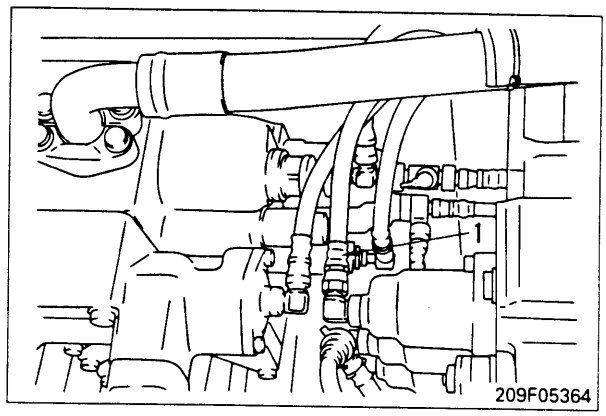
If the cause of the hydraulic drift is in the packing, the speed of downward movement in the above operation will become faster for the following reasons.

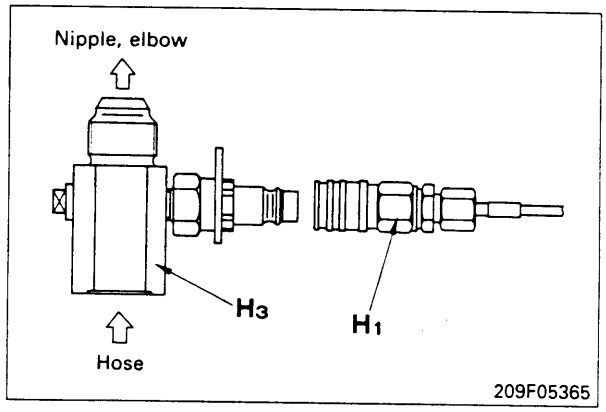
1) With the work equipment in the posture given above, (holding pressure applied to the bottom end), the oil will leak from the bottom end to the head end. However, the volume at the head end is smaller than at the bottom end (by an amount equal to the area of the rod), so if the oil flows in from the bottom end, the internal pressure at the head end will rise.
2) If the internal pressure at the head end rises, a balance will be made in proportion to this at a certain pressure (this differs according to the amount of leakage).
3) When the pressure becomes balanced, the speed of downward movement becomes slower. In this condition, if the lever is operated as shown above, the circuit at the head end is connected to the drain circuit (the bottom end is closed by a check valve), and the oil at the head end flows to the drain circuit to increase the speed of downward movement.

MEASURING PPC VALVE OUTPUT PRESSURE

★ Oil temperature when measuring: 45 – 55°C

1. Disconnect hose (1) (see diagram below) of the circuit to be measured.
2. Install adapter **H3** between the hose and elbow.
3. Install oil pressure gauge **H1** (60 kg/cm²) to adapter **H3**.
4. Run the engine at high idling, operate the control lever of the circuit to be measured, and measure the pressure.





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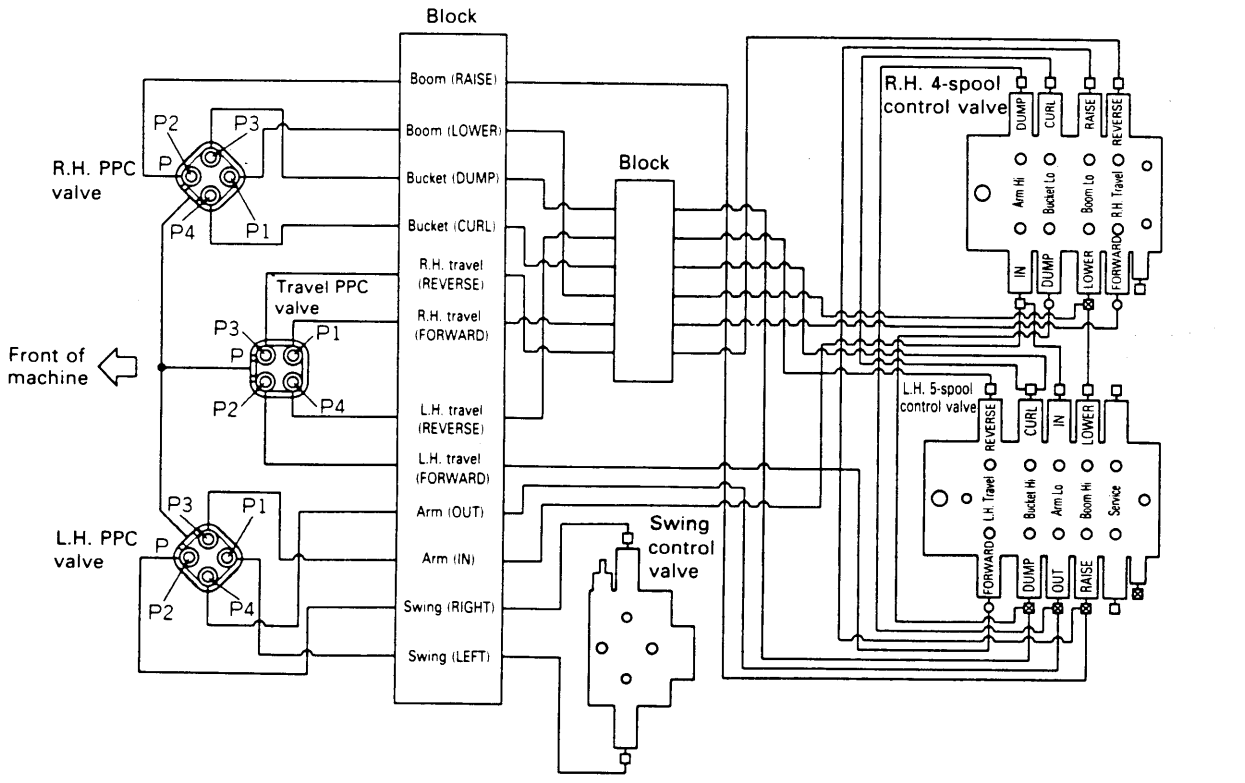
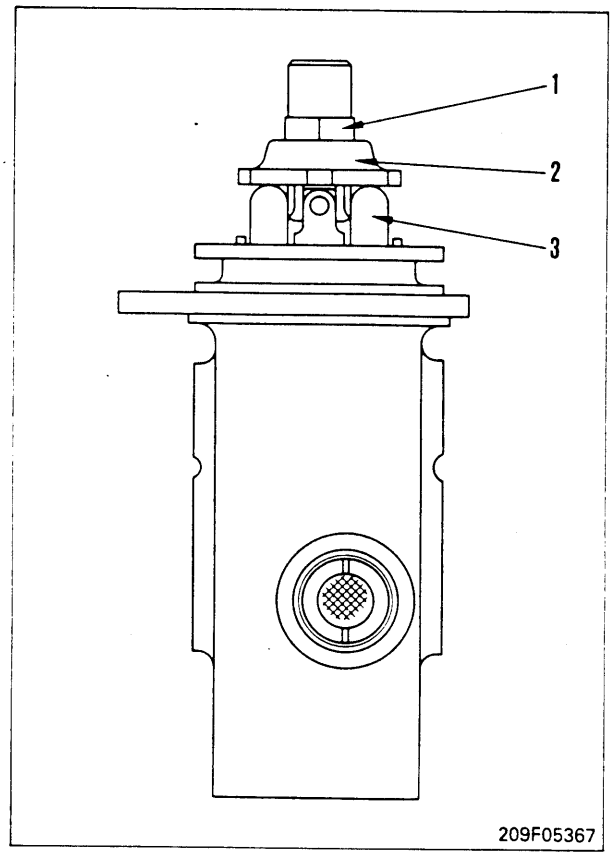


ADJUSTING WORK EQUIPMENT, SWING PPC VALVE

★ If there is excessive play in the work equipment or swing lever, adjust as follows.

⚠ Lower the work equipment to the ground and stop the engine. Operate the control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Set the safety lock lever to the LOCK position.

1. Remove the PPC valve.
2. Loosen locknut (1), and screw in disc (2) until it contacts the head of 4 pistons (3).
   ★ When adjusting, do not operate the pistons.
3. Hold disc (2) in position and tighten locknut (1) to the specified tightening torque.
   kgm Locknut: 3.5 ± 0.5 kgm
   ★ With this adjustment, the clearance between disc (2) and piston (3) is made 0.



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MEASURING SOLENOID VALVE OUTLET PRESSURE

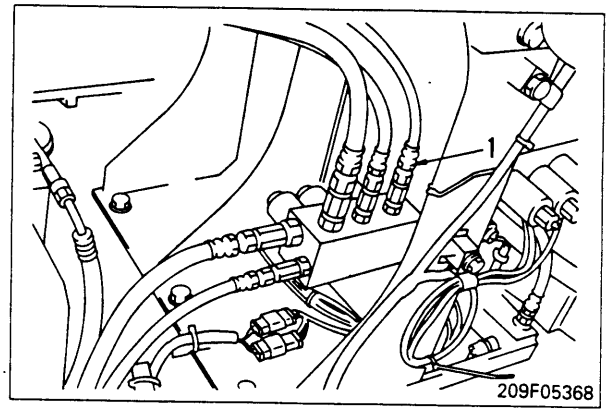
- Measure each solenoid valve at the following locations.

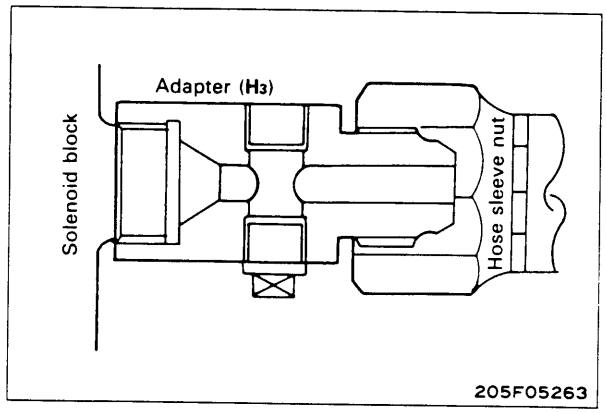
No.	Solenoid valve	Measurement location
1	Swing brake	Solenoid valve outlet port
2	Travel speed	
3	Straight-travel	
4	Heavy lift	
5	Machine push up	

1. Disconnect hose (1), then install adapter **H3** between the measurement position and the hose.
   ★ Adapter

Size	Part No.
02	790-261-1310
03	790-261-1320
04	790-261-1330

2. Install hydraulic pressure gauge **H1** (60 kg/cm²) to the adapter.
3. Run the engine at high idling and measure the pressure under the following conditions.
   1) Swing brake solenoid valve
      Set the swing lock switch OFF, and operate the swing.
   2) Travel speed solenoid valve
      Turn the travel speed switch to Hi.
   3) Straight-travel solenoid valve
      Operate the travel and work equipment at the same time.
      ★ The swing circuit is independent, so the solenoid is not actuated.
   4) Heavy lift solenoid valve
      Set the heavy lift switch ON, and operate the boom lever independently to boom RAISE.
   5) Machine push up solenoid valve
      Set the machine push up switch ON.





020905

BLEEDING AIR

Order for operations and procedure for bleeding air

Air bleeding item / Nature of work	Air bleeding procedure					
	1	2	3	4	5	6
	Bleed air from pump	Start engine	Bleed air from cylinder	Bleed air from swing motor	Bleed air from travel motor	Start operations
• Replace hydraulic oil • Clean strainer	○ →	○ →	○ →	○ (Note 1) →	○ (Note 1) →	○
• Replace return filter element		○ →	→	→	→	○
• Replace, repair pump • Replace, clean line filter element • Remove suction piping	○ →	○ →	○ →	→	→	○
• Replace, repair control valve		○ →	○ →	○ →	○ →	○
• Replace cylinder • Remove cylinder piping		○ →	○ →	→	→	○
• Replace swing motor • Remove swing motor piping		○ →	→	○ →	→	○
• Replace travel motor, swivel • Remove travel motor, swivel piping		○ →	→	→	○ →	○

Note 1: Bleed the air from the swing and travel motors only when the oil inside the motor case has been drained.

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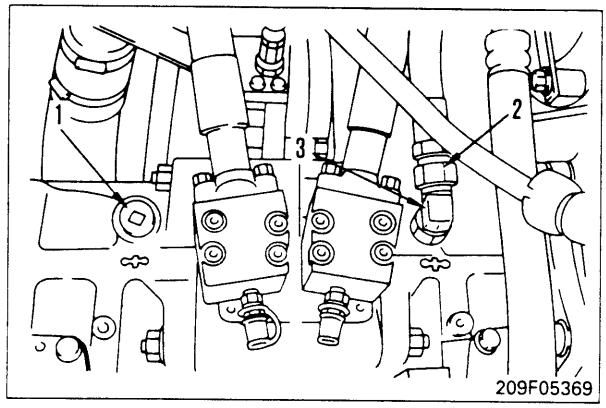
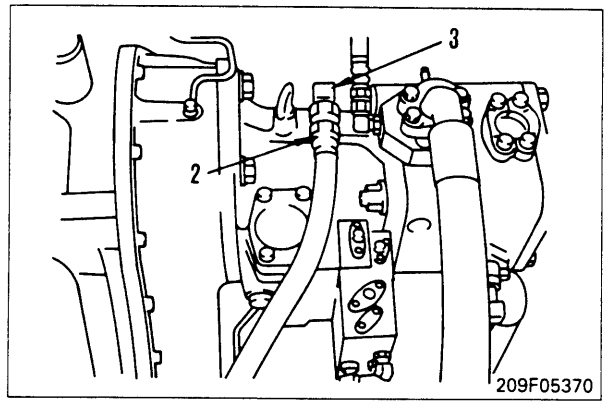
1. Bleeding air from pump

1) Remove air bleed plug (1).
   ★ If the hose is connected, remove hose (2), then remove elbow (3).
2) Pour in hydraulic oil until it overflows from the port.
3) Tighten plug (1) lightly.
   ★ If the hose is connected, tighten elbow (3) fully, then tighten hose (2) lightly.
4) Start the engine, run at low idling, and check that clear oil (not milky white) comes out from plug (1) and the hose (2) mount.
5) Tighten plug (1) and hose (2) fully.





2. **Bleeding air from hydraulic cylinders**
   1) Start the engine and run at idling for approx. 5 minutes.
   2) Run the engine at low idling, then raise and lower the boom 4 – 5 times in succession.
      ★ Operate the piston rod to approx. 100 mm before the end of its stroke. Do not relieve the circuit under any circumstances.
   3) Next, extend the piston rod to the end of its stroke to relieve the circuit.
      ★ Do not operate the piston rod to the end of its stroke when retracting the piston rod.
      ★ The piston valve is actuated to release the air.
   4) Repeat Steps 2) and 3) to bleed the air from the arm and bucket cylinders.

   ★ When the hydraulic cylinders have been replaced, it is better to carry out this operation before connecting them to the work equipment. (Particularly with the LOWER circuit of the boom cylinder, if the cylinder is connected to the boom it is impossible to operate the cylinder to the end of its stroke.)

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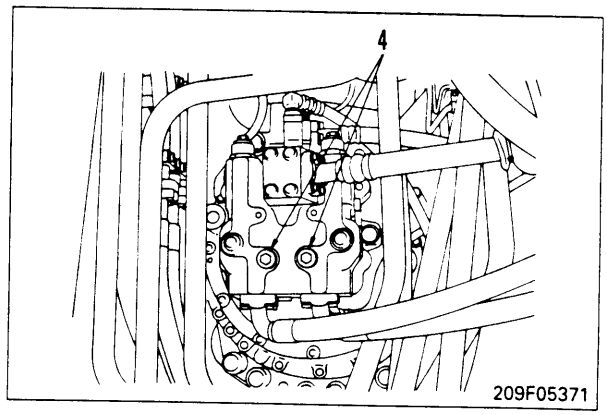
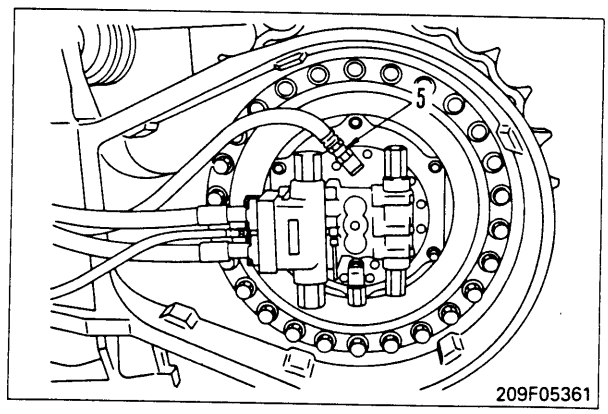
3. **Bleeding air from swing motor**
   1) Remove air bleed plug (4).
   2) Pour in hydraulic oil until it overflows from the port.
   3) Tighten plug (4) lightly.
   4) Start the engine, run at low idling, and check that clear oil (not milky white) comes out from the mount of plug (1).
   5) Tighten plug (4) fully.



4. **Bleeding air from travel motor**
   1) Loosen drain hose (5).
   2) Start the engine, run at low idling, and check that clear oil (not milky white) comes out from plug (5) and the hose mount.
   3) Tighten hose (5) fully.



RELEASING REMAINING PRESSURE IN HYDRAULIC CIRCUIT

★ If the piping between the hydraulic cylinder and the control valve is disconnected, remove the remaining pressure from the circuit as follows. The travel circuit is an open circuit, so there is no remaining pressure. It is enough to remove the oil filler cap.

1. Loosen the oil filler cap slowly to release the pressure inside the tank.
2. Operate the control levers.
   ★ When the levers are operated 2 – 3 times, the pressure stored in the accumulator is removed.
3. Start engine, run at low idling for approx. 5 minutes, then stop the engine and operate the control levers.
   ★ Repeat the above operation 2 – 3 times to release all the remaining pressure.

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TROUBLESHOOTING

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POINTS TO REMEMBER WHEN TROUBLESHOOTING

⚠ Stop the machine in a level place, and check that the safety pin, blocks, and parking brake are securely fitted.

⚠ When carrying out the operation with two or more workers, keep strictly to the agreed signals, and do not allow any unauthorized person to come near.

⚠ If the radiator cap is removed when the engine is hot, hot water may spu ' out and cause burns, so wait for the engine to cool down before starting troubleshooting.

⚠ Be extremely careful not to touch any hot parts or to get caught in any rotating parts.

⚠ When disconnecting wiring, always disconnect the negative (–) terminal of the battery first.

⚠ When removing the plug or cap from a location which is under pressure from oil, water, or air, always release the internal pressure first. When installing measuring equipment, be sure to connect it properly.

The aim of troubleshooting is to pinpoint the basic cause of the failure, to carry out repairs swiftly, and to prevent reoccurrence of the failure.
When carrying out troubleshooting, and important point is of course to understand the structure and function. However, a short cut to effective troubleshooting is to ask the operator various questions to form some idea of possible causes of the failure that would produce the reported symptoms.

1. When carrying out troubleshooting, do not hurry to disassemble the components.
   If components are disassembled immediately any failure occurs:
   - Parts that have no connection with the failure or other unnecessary parts will be disassembled.
   - It will become impossible to find the cause of the failure.

   It will also cause a waste of manhours, parts, or oil or grease, and at the same time, will also lose the confidence of the user or operator.
   For this reason, when carrying out troubleshooting, it is necessary to carry out thorough prior investigation and to carry out troubleshooting in accordance with the fixed procedure.
2. Points to ask user or operator
   1) Have any other problems occurred apart from the problem that has been reported?
   2) Was there anything strange about the machine before the failure occurred?
   3) Did the failure occur suddenly, or were there problems with the machine condition before this?
   4) Under what conditions did the failure occur?
   5) Had any repairs been carried out before the failure?
      When were these repairs carried out?
   6) Has the same kind of failure occurred before?
3. Check before troubleshooting
   1) Check the oil level
   2) Check for any external leakage of oil from the piping or hydraulic equipment.
   3) Check the travel of the control levers.
   4) Check the stroke of the control valve spool.
   5) Other maintenance items can be checked externally, so check any item that is considered to be necessary.
4. Confirming failure
   - Confirm the extent of the failure yourself, and judge whether to handle it as a real failure or as a problem with the method of operation, etc.
     ★ When operating the machine to reenact the troubleshooting symptoms, do not carry out any investigation or measurement that may make the problem worse.
5. Troubleshooting
   - Use the results of the investigation and inspection in Items 2 – 4 to narrow down the causes of failure, then use the troubleshooting flowchart to locate the position of the failure exactly.
     ★ The basic procedure for troubleshooting is as follows.
       1) Start from the simple points.
       2) Start from the most likely points.
       3) Investigate other related parts or information.
6. Measures to remove root cause of failure
   - Even if the failure is repaired, if the root cause of the failu -e is not repaired, the same failure will occur again.
     To prevent this, always investigate why the problem occurred. Then, remove the root cause.

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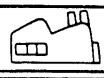
SEQUENCE OF EVENTS IN TROUBLESHOOTING

Office, shop



TEW00180

Jobsite

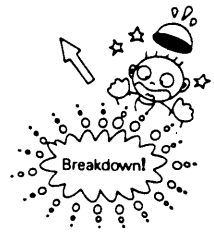
TEW00181

Step 1

Examination, confirmation of symptoms

1) When a request for repairs is received, first ask the following points.
   - Name of customer
   - Type, serial number of machine
   - Details of jobsite, etc.
2) Ask questions to gain an outline of the problem.
   - Condition of failure
   - Work being carried out at the time of the failure
   - Operating environment
   - Past history, details of maintenance, etc.

TEW00182

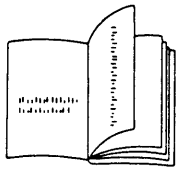


TEW00183

Step 2

Determining probable location of cause

1) Look at the troubleshooting section of the shop manual to find locations of possible causes.



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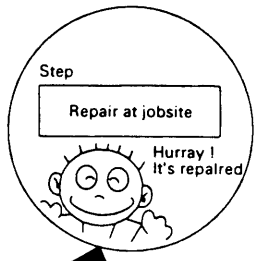
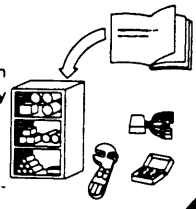


TEW00185

Step 3

Preparation of troubleshooting tools

1) Look at the table of troubleshooting tools in the shop manual and prepare the necessary tools.
   - T-adapter
   - Hydraulic pressure gauge kit, etc.
2) Look in the parts book and prepare the necessary replacement parts.

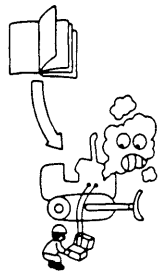


TEW00186

Step 7

- Pinpoint locations of failure (carry out troubleshooting)
- Decide action to take

1) Before starting troubleshooting, locate and repair simple failures.
   - Check before starting items
   - Other check items
2) See the Troubleshooting Section of the shop manual, select a troubleshooting flowchart that matches the symptoms, and carry out troubleshooting.



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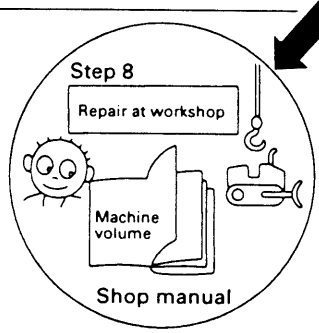


TEW00188

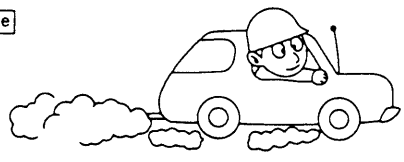
Step 6

Re-enacting failure

- Drive and operate the machine to confirm the condition and judge if there is really a failure.

Step 4

Go to jobsite

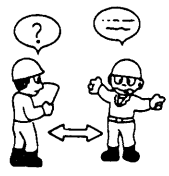


TEW00189

Step 5

Ask operator questions to confirm details of failure.

- Was there anything strange about the machine before the failure occurred?
- Did the failure occur suddenly?
- Had any repairs been carried out before the failure?



TEW00190

020905

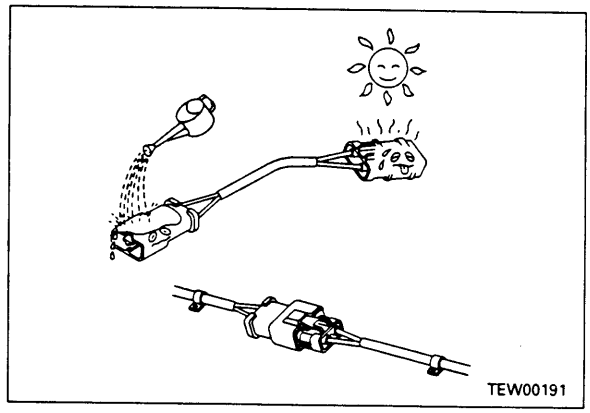
POINTS TO REMEMBER WHEN CARRYING OUT MAINTENANCE

To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct operation, maintenance and inspection, troubleshooting, and repairs must be carried out. This section deals particularly with correct repair procedures for mechatronics and is aimed at improving the quality of repairs. For this purpose, it gives sections on "Handling electric equipment" and "Handling hydraulic equipment" (particularly gear oil and hydraulic oil).

1. POINTS TO REMEMBER WHEN HANDLING ELECTRIC EQUIPMENT

1) Handling wiring harnesses and connectors

Wiring harnesses consist of wiring connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protectors or tubes used for protecting the wiring.
Compared with other electrical components fitted in boxes or cases, wiring harnesses are more likely to be affected by the direct effects of rain, water, heat, or vibration. Furthermore, during inspection and repair operations, they are frequently removed and installed again, so they are likely to suffer deformation or damage. For this reason, it is necessary to be extremely careful when handling wiring harnesses.


TEW00191

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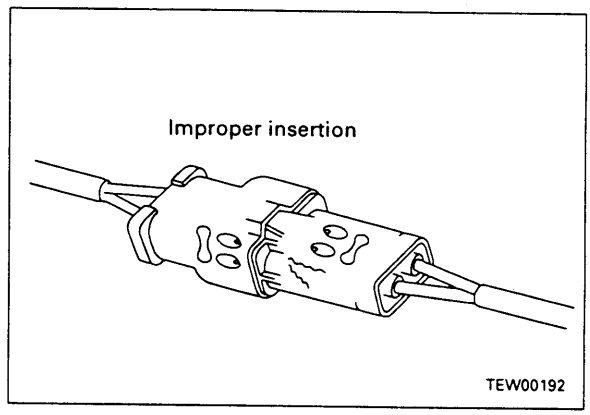
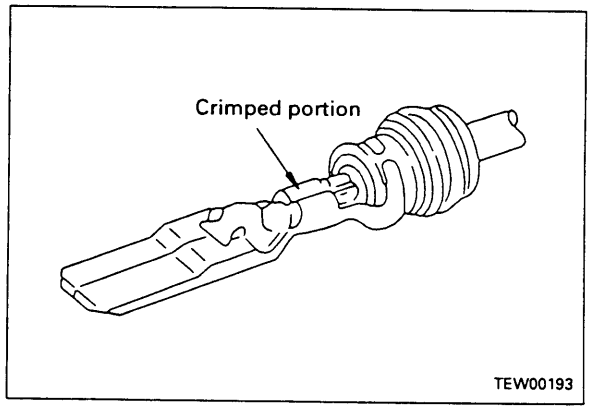
Main failures occurring in wiring harness

① Defective contact of connectors (defective contact between male and female)
Problems with defective contact are likely to occur because the male connector is not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned, or because there is corrosion or oxidization of the contact surfaces.



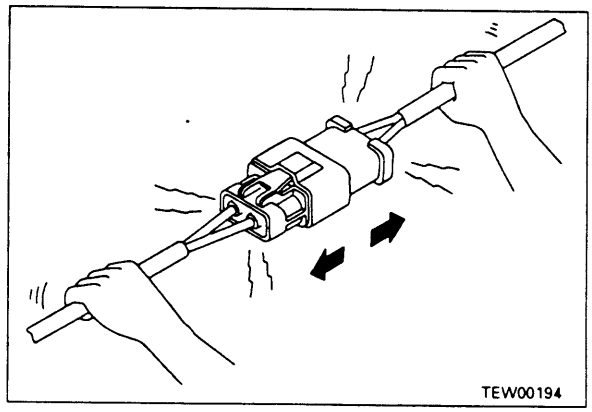
TEW00192

② Defective crimping or soldering of connectors
The pins of the male and female connectors are in contact at the crimped terminal or soldered portion, but if there is excessive force brought to bear on the wiring, the plating at the joint will peel and cause improper connection or breakage.

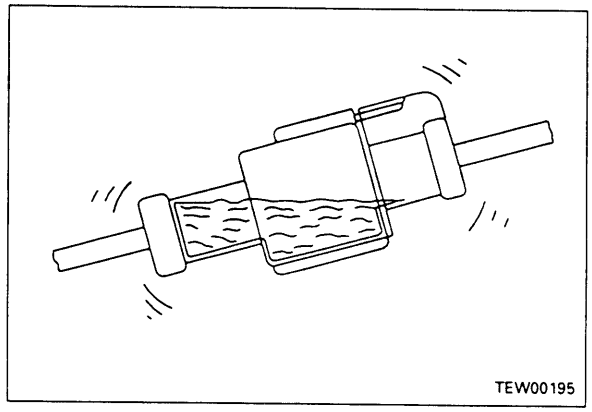


TEW00193

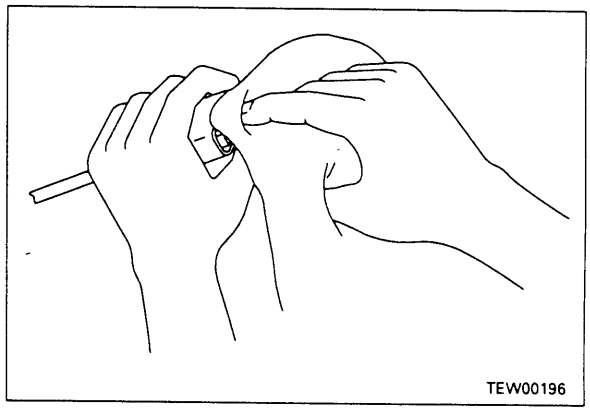
③ Disconnections in wiring
If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the crimping of the connector may separate, or the soldering may be damaged, or the wiring may be broken.


TEW00194

④ High-pressure water entering connector
The connector is designed to make it difficult for water to enter (drip-proof structure), but if high-pressure water is sprayed directly on the connector, water may enter the connector, depending on the direction of the water jet.
As already said, the connector is designed to prevent water from entering, but at the same time, if water does enter, it is difficult for it to be drained. Therefore, if water should get into the connector, the pins will be short-circuited by the water, so if any water gets in, immediately dry the connector or take other appropriate action before passing electricity through it.


TEW00195

⑤ Oil or dirt stuck to connector
If oil or grease are stuck to the connector and an oil film is formed on the mating surface between the male and female pins, the oil will not let the electricity pass, so there will be defective contact.
If there is oil or grease stuck to the connector, wipe it off with a dry cloth or blow it dry with compressed air and spray it with a contact restorer.
★ When wiping the mating portion of the connector, be careful not to use excessive force or deform the pins.
★ If there is oil or water in the compressed air, the contacts will become even dirtier, so remove the oil and water from the compressed air completely before cleaning with compressed air.


TEW00196

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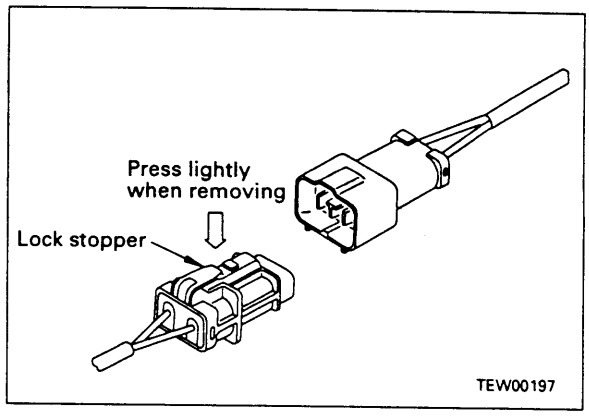
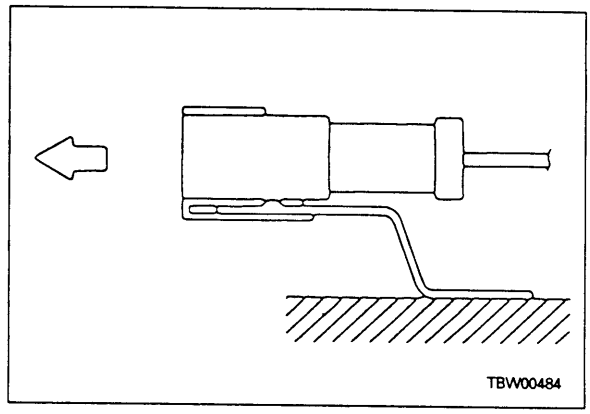
2) Removing, installing, and drying connectors and wiring harnesses

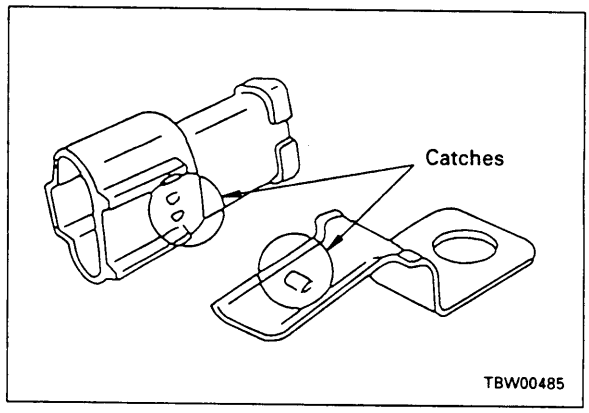
- **Disconnecting connectors**

① Hold the connectors when disconnecting.
When disconnecting the connectors, hold the connectors and not the wires. For connectors held by a screw, loosen the screw fully, then hold the male and female connectors in each hand and pull apart. For connectors which have a lock stopper, press down the stopper with your thumb and pull the connectors apart.
★ Never pull with one hand.

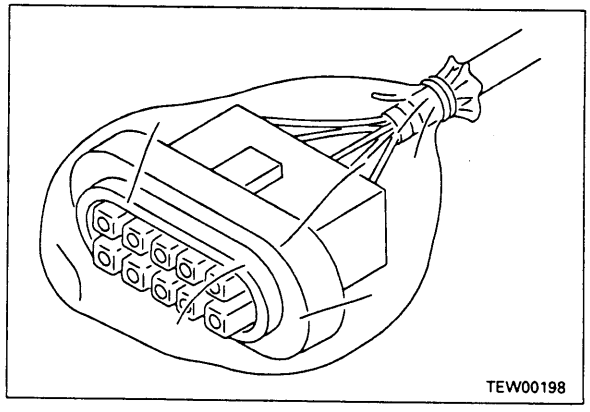


② When removing from clips
When removing a connector from a clip, pull the connector in a parallel direction to the clip.
★ If the connector is twisted up and down or to the left or right, the housing may break.





③ Action to take after removing connectors
After removing any connector, cover it with a vinyl bag to prevent any dust, dirt, oil, or water from getting in the connector portion.
★ If the machine is left disassembled for a long time, it is particularly easy for improper contact to occur, so always cover the connector.



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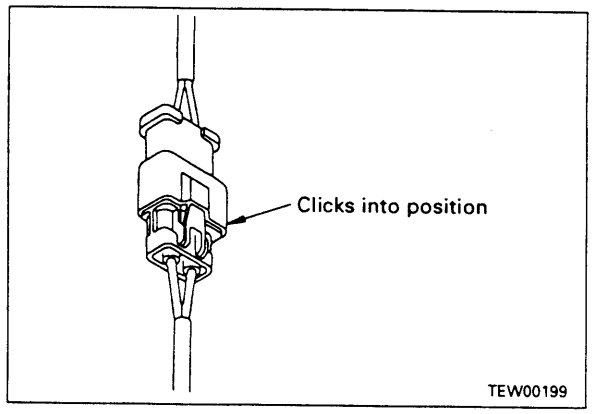
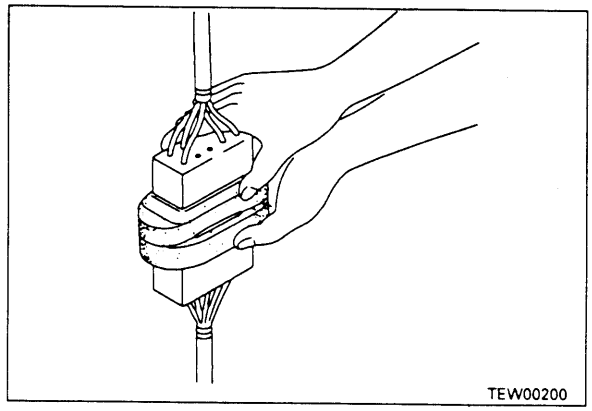
- **Connecting connectors**
  ① Check the connector visually.
  1) Check that there is no oil, dirt, or water stuck to the connector pins (mating portion).
  2) Check that there is no deformation, defective contact, corrosion, or damage to the connector pins.
  3) Check that there is no damage or breakage to the outside of the connector.
  ★ If there is any oil, water, or dirt stuck to the connector, wipe it off with a dry cloth. If any water has got inside the connector, warm the inside of the wiring with a dryer, but be careful not to make it too hot as this will cause short circuits.
  ★ If there is any damage or breakage, replace the connector.

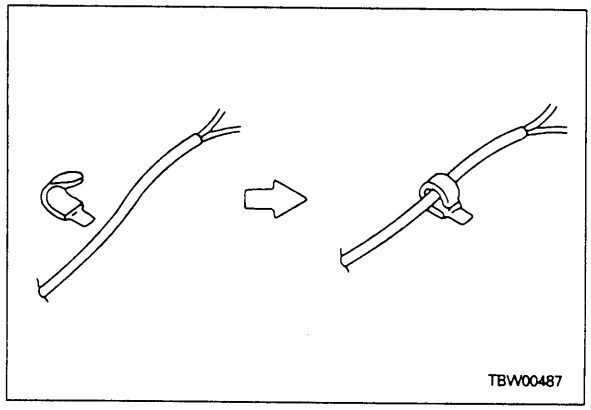
  ② Fix the connector securely.
  Align the position of the connector correctly, then insert it securely.
  For connectors with lock stopper, push in the connector until the stopper clicks into position.

  ③ Correct any protrusion of the boot and any misalignment of the wiring harness
  For connectors fitted with boots, correct any protrusion of the boot. In addition, if the wiring harness is misaligned, or the clamp is out of position, adjust it to its correct position.
  ★ If the connector cannot be corrected easily, remove the clamp and adjust the position.

  ④ If the connector clamp has been removed, be sure to return it to its original position. Check also that there are no loose clamps.





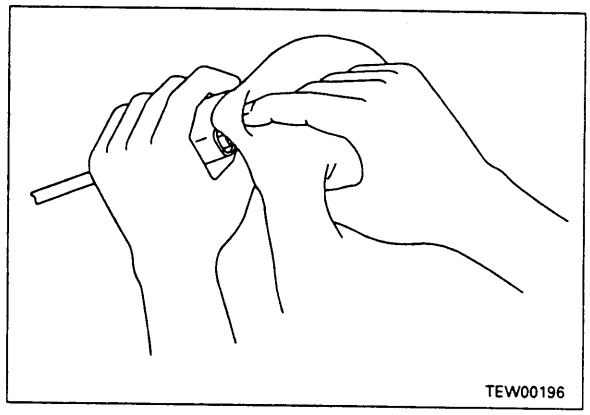


020905

- **Drying wiring harness**
  If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high-pressure water or steam directly on the wiring harness.

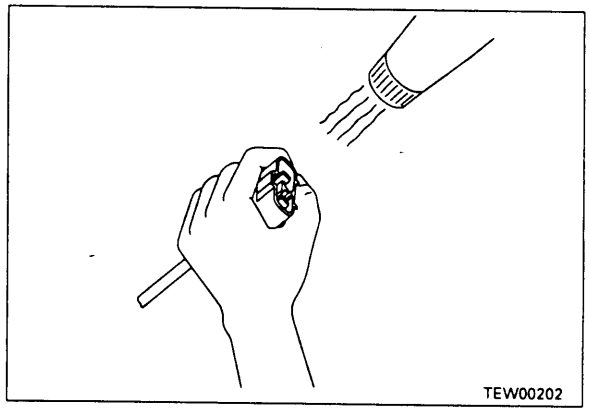
  If water gets directly on the connector, do as follows.

  ① Disconnect the connector and wipe off the water with a dry cloth.
  ★ If the connector is blown dry with compressed air, there is the risk that oil in the air may cause defective contact, so remove all oil and water from the compressed air before blowing with air.

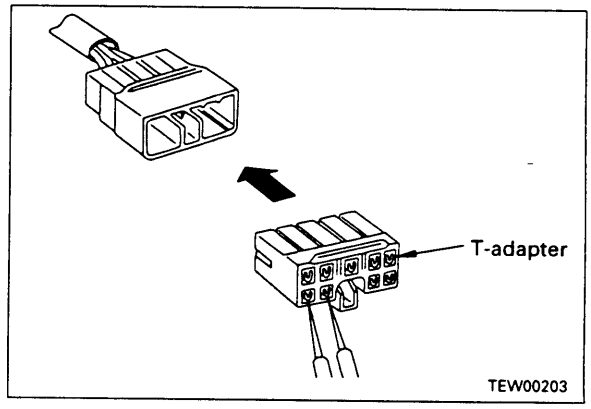

TEW00196

020905

② Dry the inside of the connector with a dryer. If water gets inside the connector, use a dryer to dry the connector.
★ Hot air from the dryer can be used, but regulate the time that the hot air is used in order not to make the connector or related parts too hot, as this will cause deformation or damage to the connector.


TEW00202

③ Carry out a continuity test on the connector. After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.
★ After completely drying the connector, blow it with contact restorer and reassemble.

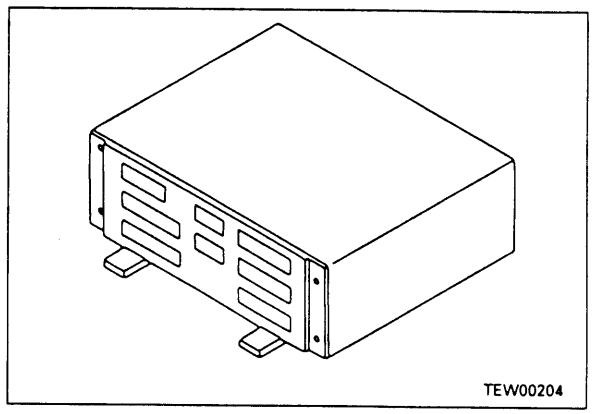


TEW00203

3) Handling control box

① The control box contains a microcomputer and electronic control circuits. These control all of the electronic circuits on the machine, so be extremely careful when handling the control box.

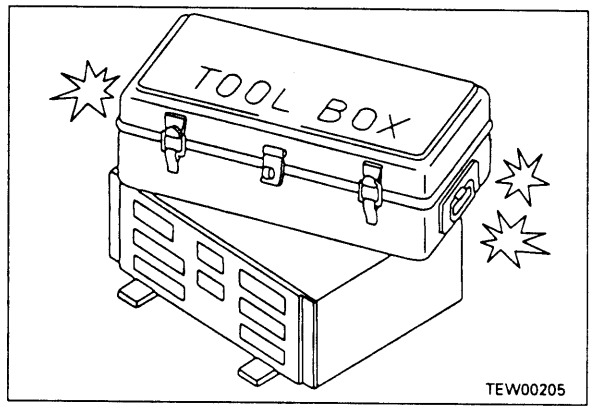
② Do not open the cover of the control box unless necessary.



③ Do not place objects on top of the control box.

④ Cover the control connectors with tape or a vinyl bag.
Never touch the connector contacts with your hand.

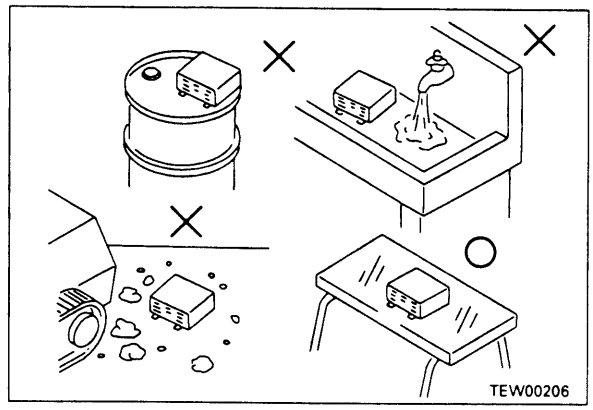
⑤ During rainy weather, do not leave the control box in a place where it is exposed to rain.



020905

⑥ Do not place the control box on oil, water, or soil, or in any hot place, even for a short time.
(Place it on a suitable dry stand).

⑦ Precautions when carrying out arc welding
When carrying out arc welding on the body, disconnect all wiring harness connectors connected to the control box. Fit an arc welding ground close to the welding point.



2. Points to remember when troubleshooting electric circuits

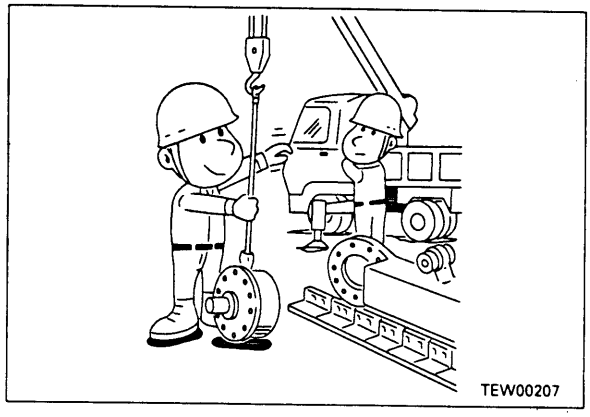
1) Always turn the power OFF before disconnecting or connect connectors.
2) Before carrying out troubleshooting, check that all the related connectors are properly inserted.
   ★ Disconnect and connect the related connectors several times to check.
3) Always connect any disconnected connectors before going on to the next step.
   ★ If the power is turned ON with the connectors still disconnected, unnecessary abnormality displays will be generated.
4) When carrying out troubleshooting of circuits (measuring the voltage, resistance, continuity, or current), move the related wiring and connectors several times and check that there is no change in the reading of the tester.
   ★ If there is any change, there is probably defective contact in that circuit.

3. POINTS TO REMEMBER WHEN HANDLING HYDRAULIC EQUIPMENT

With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

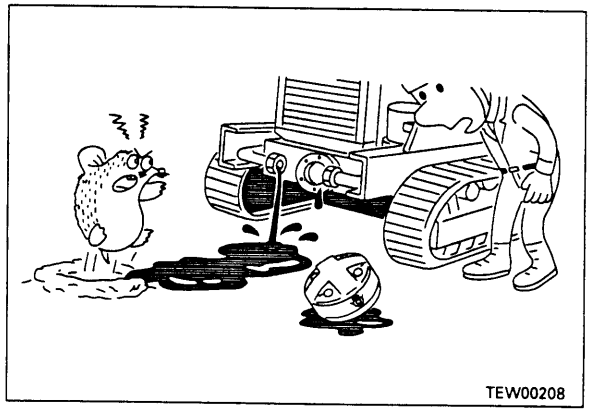
1) **Be careful of the operating environment.**
Avoid adding hydraulic oil, replacing filters, or repairing the machine in rain or high winds, or places where there is a lot of dust.

2) **Disassembly and maintenance work in the field**
If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to confirm the performance after repairs, so it is desirable to use unit exchange. Disassembly and main-tenance of hydraulic equipment should be carried out in a specially prepared dustproof workshop, and the performance should be confirmed with special test equipment.

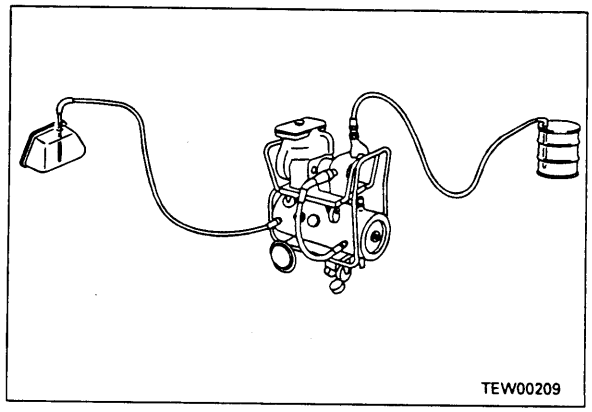

TEW00207

020905

3) **Sealing openings**
After any piping or equipment is removed, the openings should be sealed with caps, tapes, or vinyl bags to prevent any dirt or dust from entering. If the opening is left open or is blocked with a rag, there is danger of dirt entering or of the surrounding area being made dirty by leaking oil so never do this.
Do not simply drain oil out on to the ground, collect it and ask the customer to dispose of it, or take it back with you for disposal.

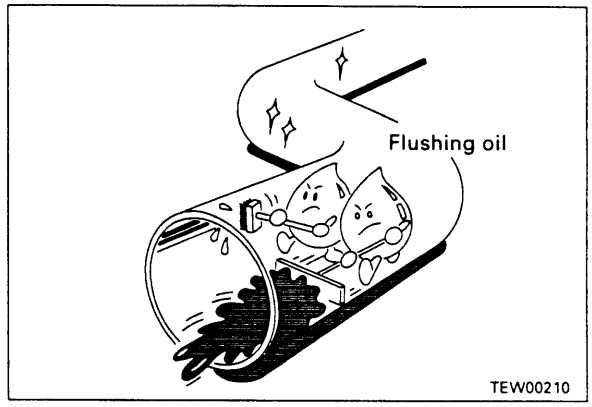

TEW00208

4) **Do not let any dirt or dust get in during refilling operations.**
Be careful not to let any dirt or dust get in when refilling with hydraulic oil. Always keep the oil filler and the area around it clean, and also use clean pumps and oil containers. If an oil cleaning device is used, it is possible to filter out the dirt that has collected during storage, so this is an even more effective method.


TEW00209

5) **Change hydraulic oil when the temperature is high.**
When hydraulic oil or other oil is warm, it flows easily. In addition, the sludge can also be drained out easily from the circuit together with the oil, so it is best to change the oil when it is still warm. When changing the oil, as much as possible of the old hydraulic oil must be drained out. (Do not drain the oil from the hydraulic tank; also drain the oil from the filter and from the drain plug in the circuit.) If any old oil is left, the contaminants and sludge in it will mix with the new oil and will shorten the life of the hydraulic oil.

6) **Flushing operations**
After disassembling and assembling the equipment, or changing the oil, use flushing oil to remove the contaminants, sludge, and old oil from the hydraulic circuit.
Normally, flushing is carried out twice: primary flushing is carried out with flushing oil, and secondary flushing is carried out with the specified hydraulic oil.



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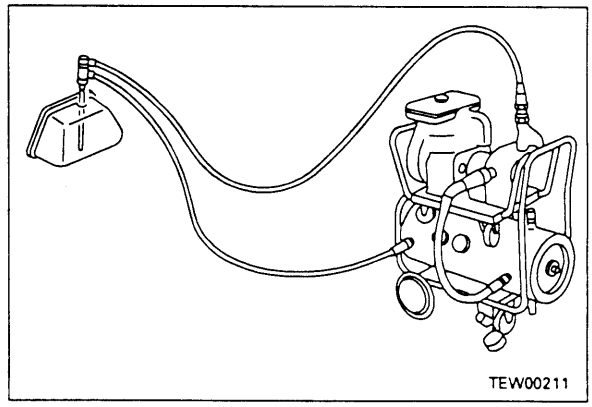
7) **Cleaning operations**
After repairing the hydraulic equipment (pump, control valve, etc.) or when running the machine, carry out oil cleaning to remove the sludge or contaminants in the hydraulic oil circuit.
The oil cleaning equipment is used to remove the ultrafine (about 3μ) particles that the filter built into the hydraulic equipment cannot remove, so it is an extremely effective device.



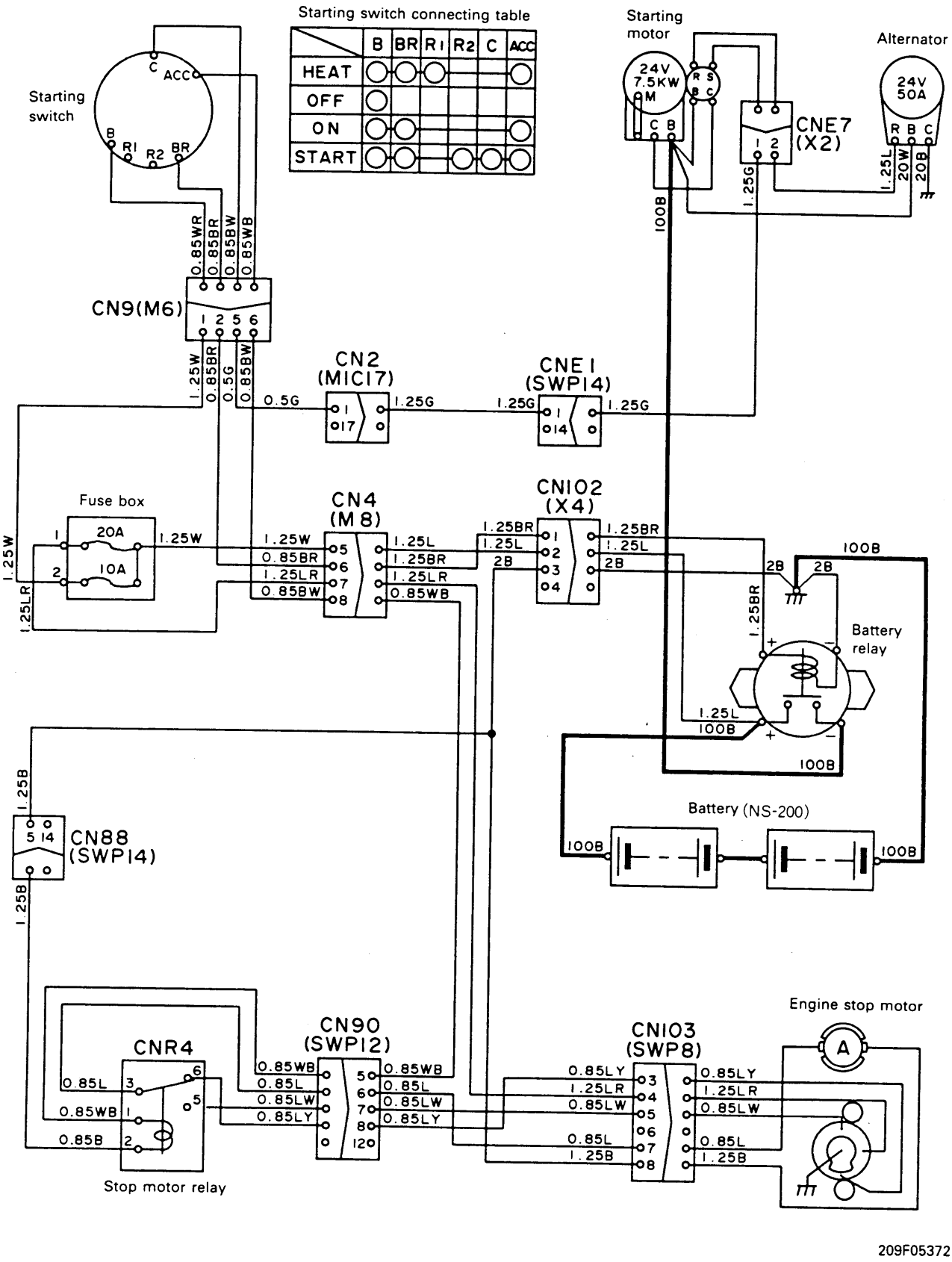
CHECKS BEFORE TROUBLESHOOTING

	Item	Judgement value	Action
Lubricating oil, coolant	1. Check fuel level, type of fuel	—	Add fuel
	2. Check for impurities in fuel	—	Clean, drain
	3. Check hydraulic oil level	—	Add oil
	4. Check hydraulic strainer	—	Clean, drain
	5. Check swing machinery oil level	—	Add oil
	6. Check engine oil level (oil pan oil level), type of oil	—	Add oil
	7. Check coolant level	—	Add water
	8. Check dust indicator for clogging	—	Clean or replace
	9. Check hydraulic filter	—	Replace
Electrical equipment	1. Check for looseness, corrosion of battery terminal, wiring	—	Tighten or replace
	2. Check for looseness, corrosion of alternator terminal, wiring	—	Tighten or replace
	3. Check for looseness, corrosion of starting motor terminal, wiring	—	Tighten or replace
Hydraulic, mechanical equipment	1. Check for abnormal noise, smell	—	Repair
	2. Check for oil leakage	—	Repair
	3. Carry out air bleeding	—	Bleed air
Electrics, electrical equipment	1. Check battery voltage (engine stopped)	20 – 30V	Replace
	2. Check battery electrolyte level	—	Add or replace
	3. Check for discolored, burnt, exposed wiring	—	Replace
	4. Check for missing wiring clamps, hanging wiring	—	Repair
	5. Check for water leaking on wiring (be particularly careful attention to water leaking on connectors or terminals)	—	Disconnect connector and dry
	6. Check for blown, corroded fuses	—	Replace
	7. Check alternator voltage (engine running at 1/2 throttle or above)	After running for several minutes: 27.5 - 29.5 V	Replace
	8. Check operating sound of battery (when switch is turned ON/OFF)	—	Replace

020905

ELECTRICAL CIRCUIT DIAGRAM

ENGINE START AND STOP SYSTEM



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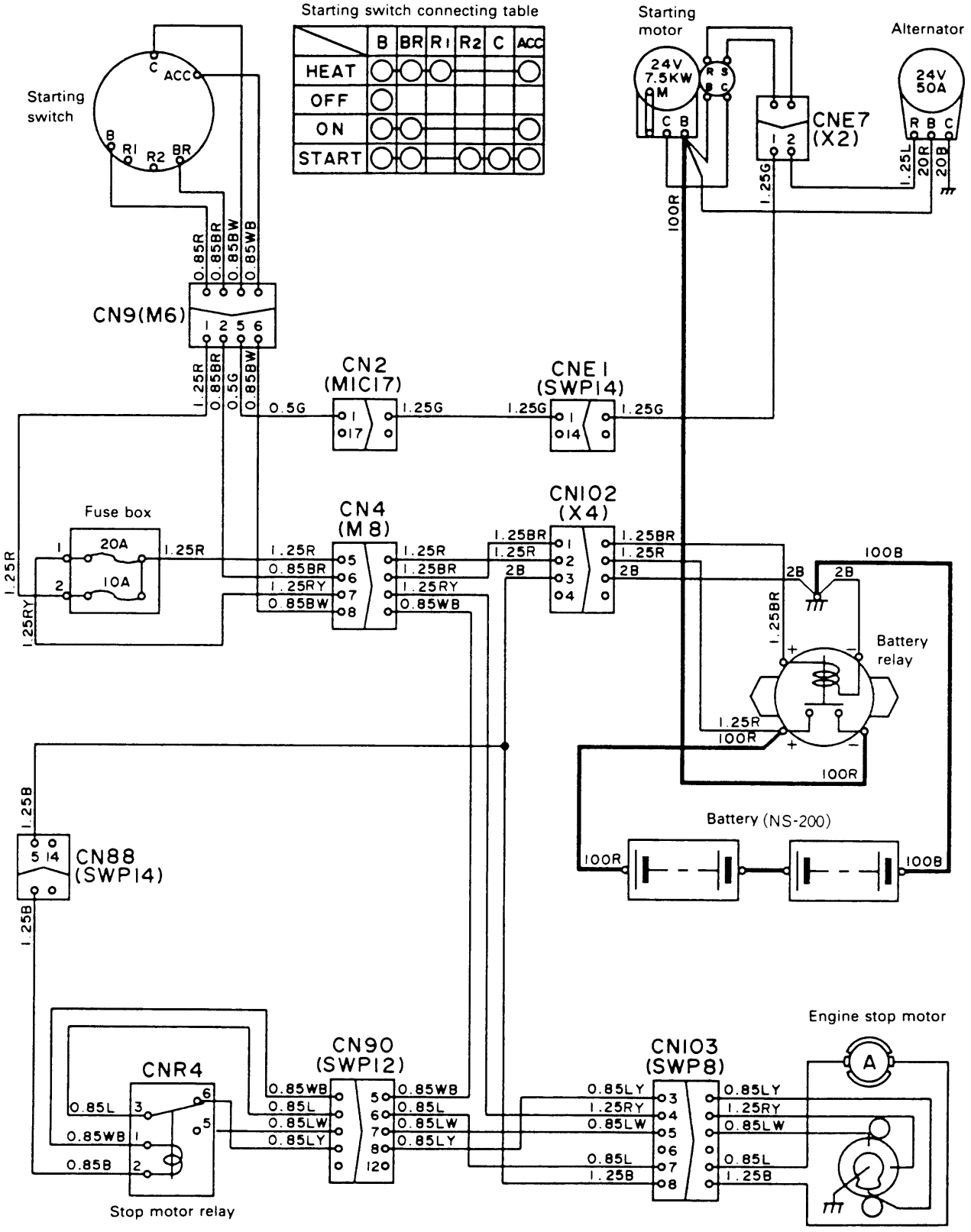
ENGINE START AND STOP SYSTEM

REGULATION OF EC INCLUSION



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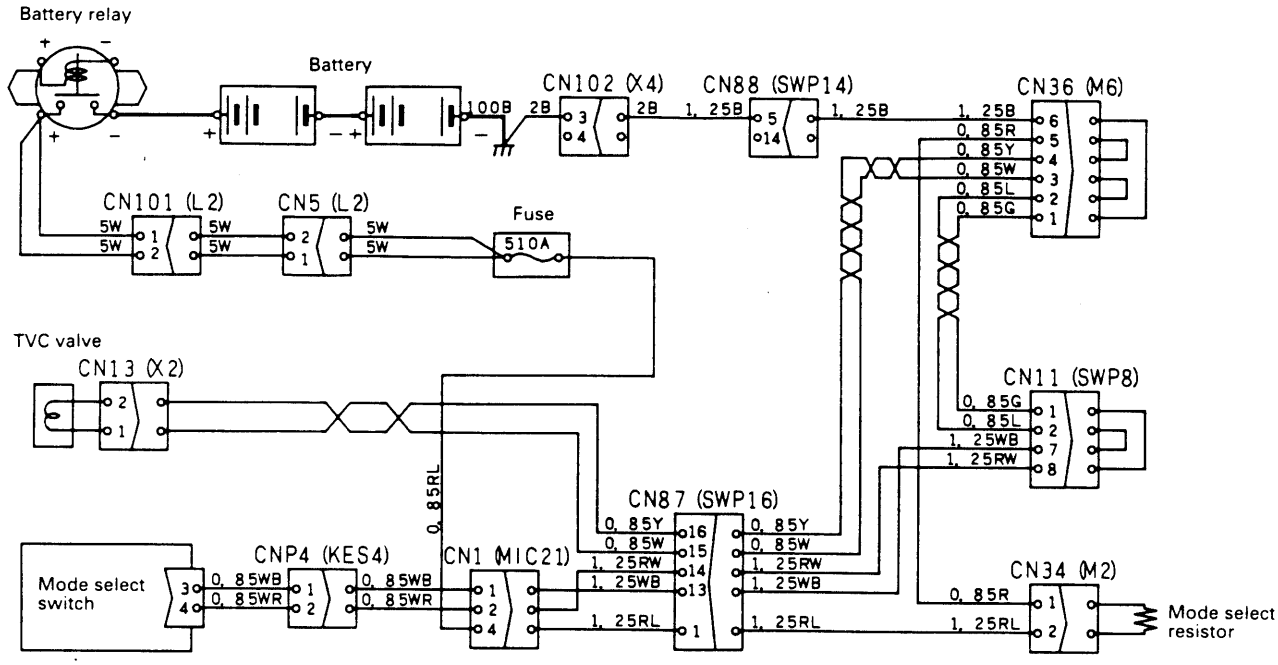
020905

ELECTRIC OLSS SYSTEM

★ **FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS**



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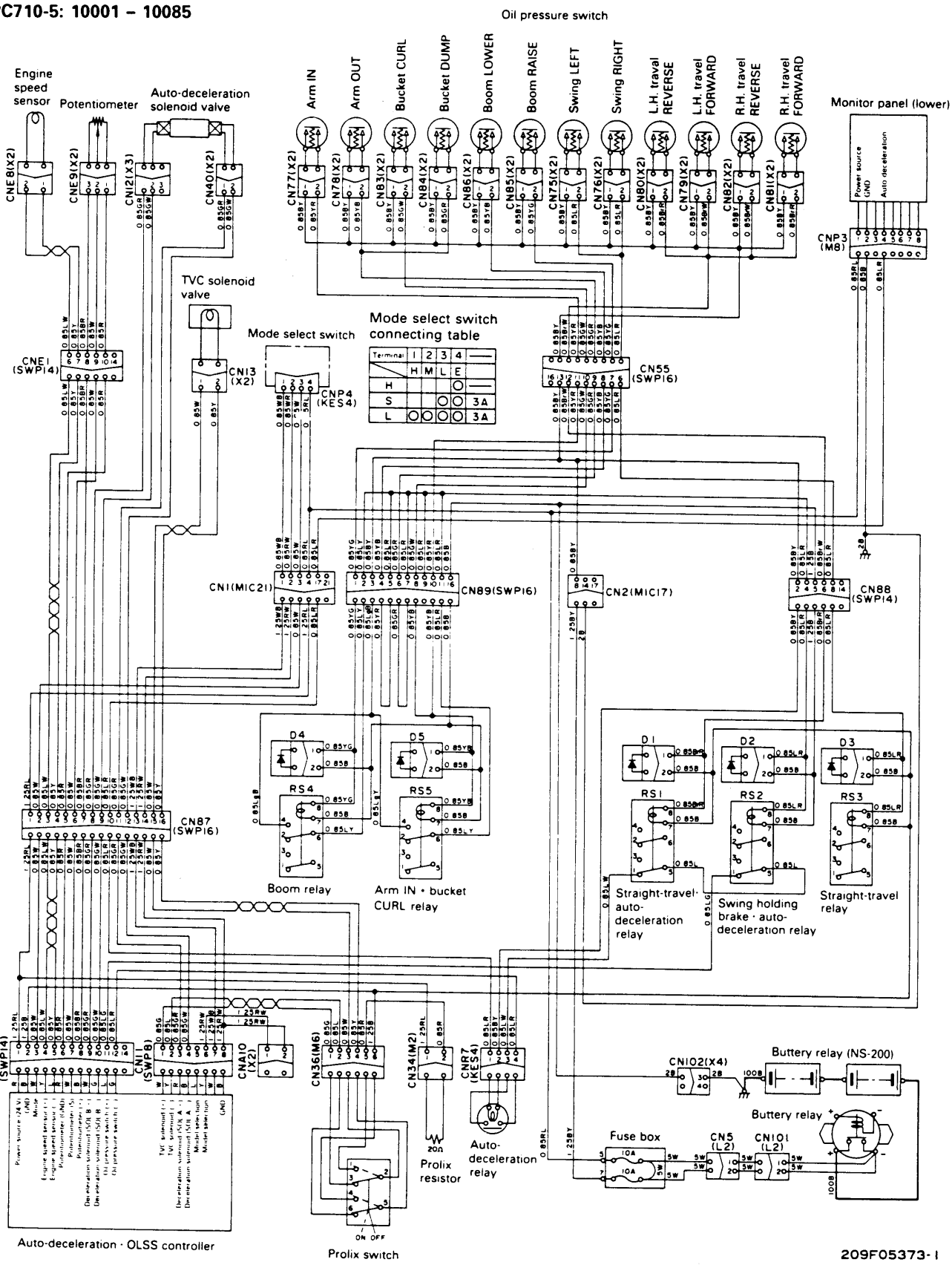
020905

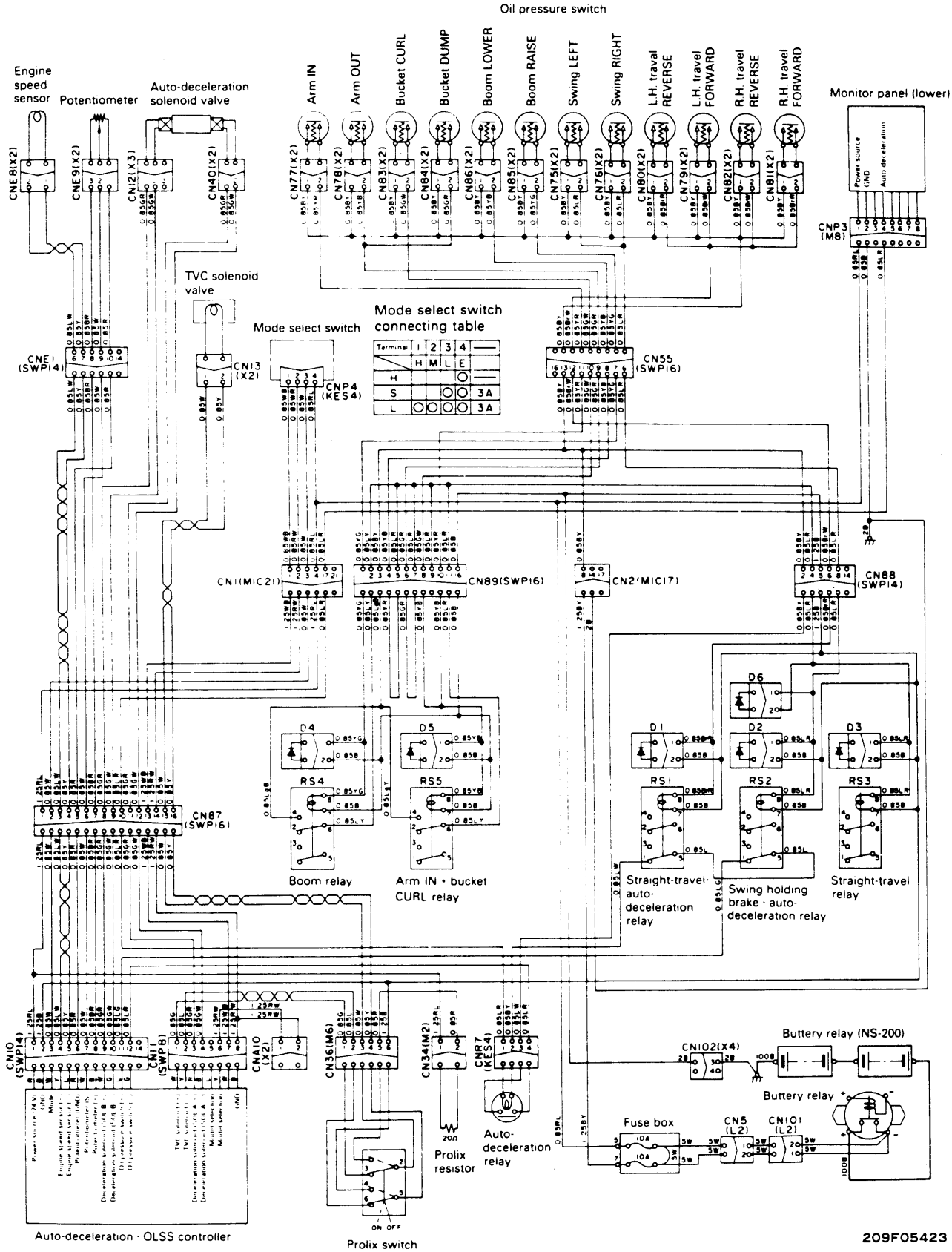
AUTO-DECELERATION • ELECTRONIC OLSS SYSTEM

PC650: 20001 – 20096, 20099 – 20103, 20106 – 20108
PC710-5: 10001 – 10085



020905

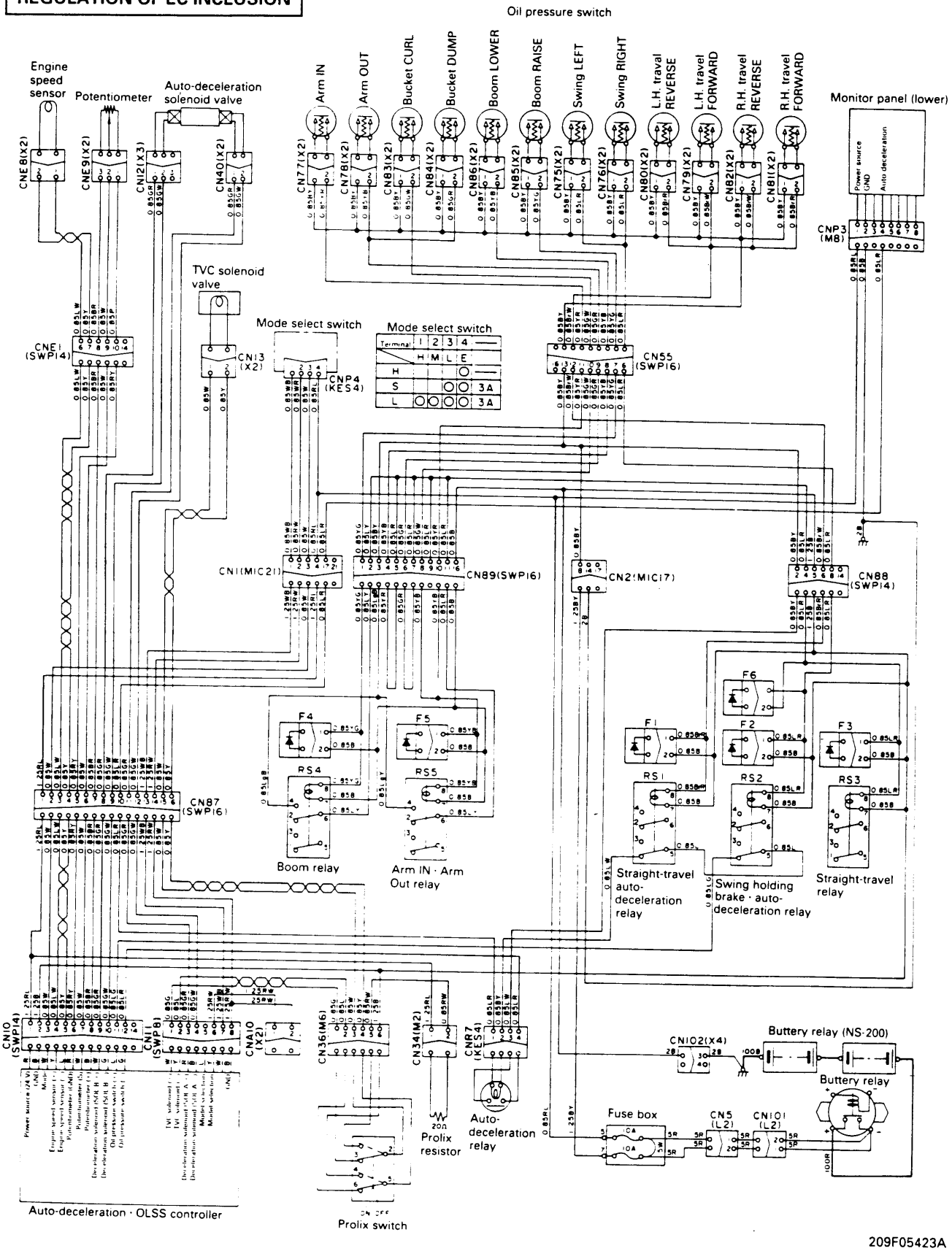
PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up



020905

PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up

REGULATION OF EC INCLUSION



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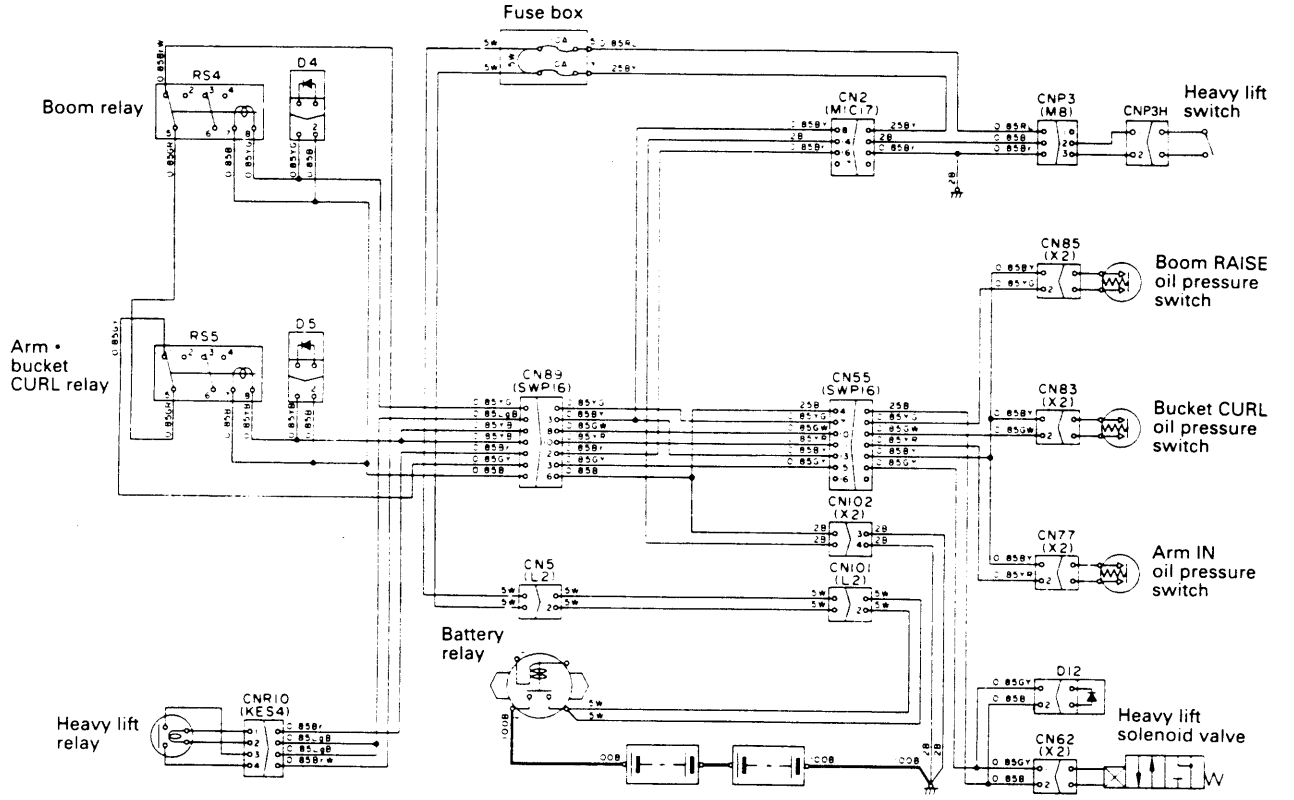
020905

HEAVY LIFT SYSTEM

BACK HOE

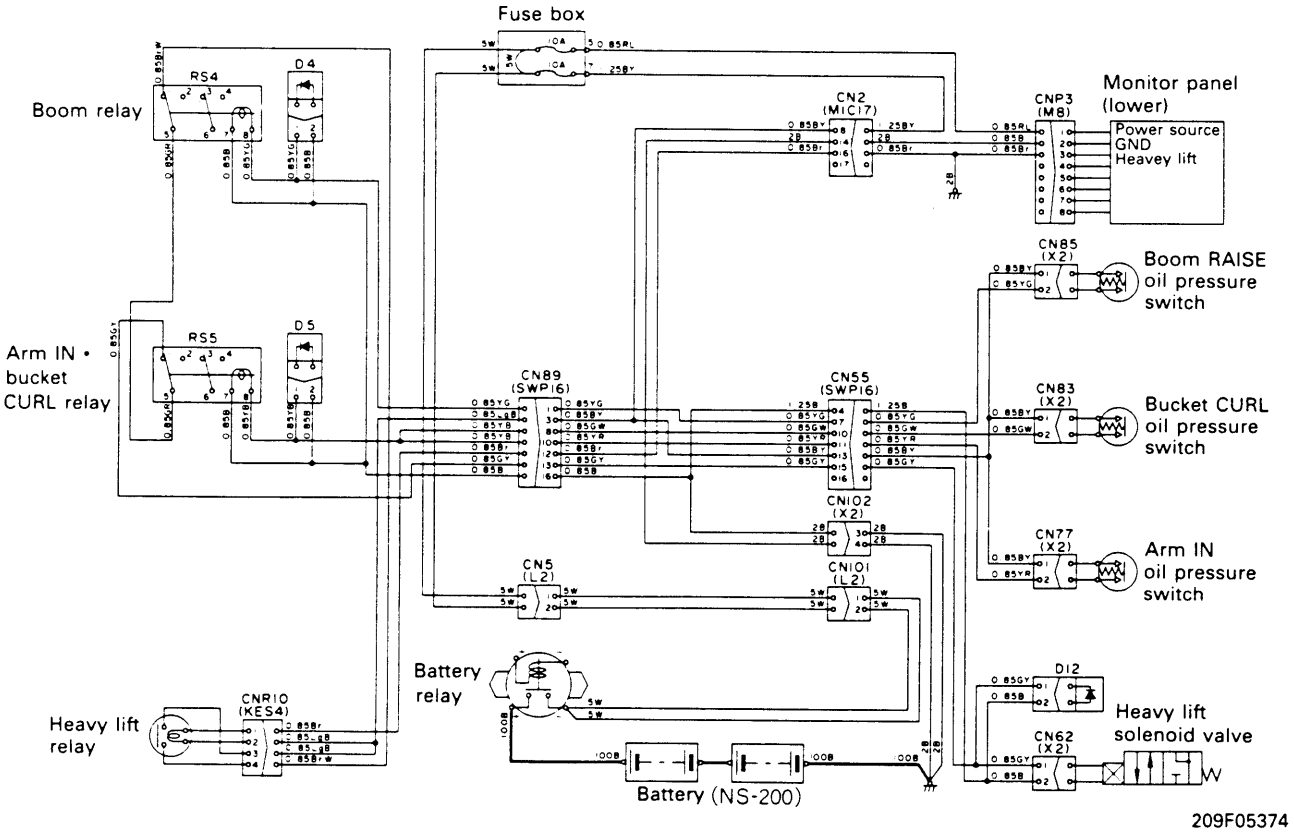
★ **FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS**



F20905097

020905

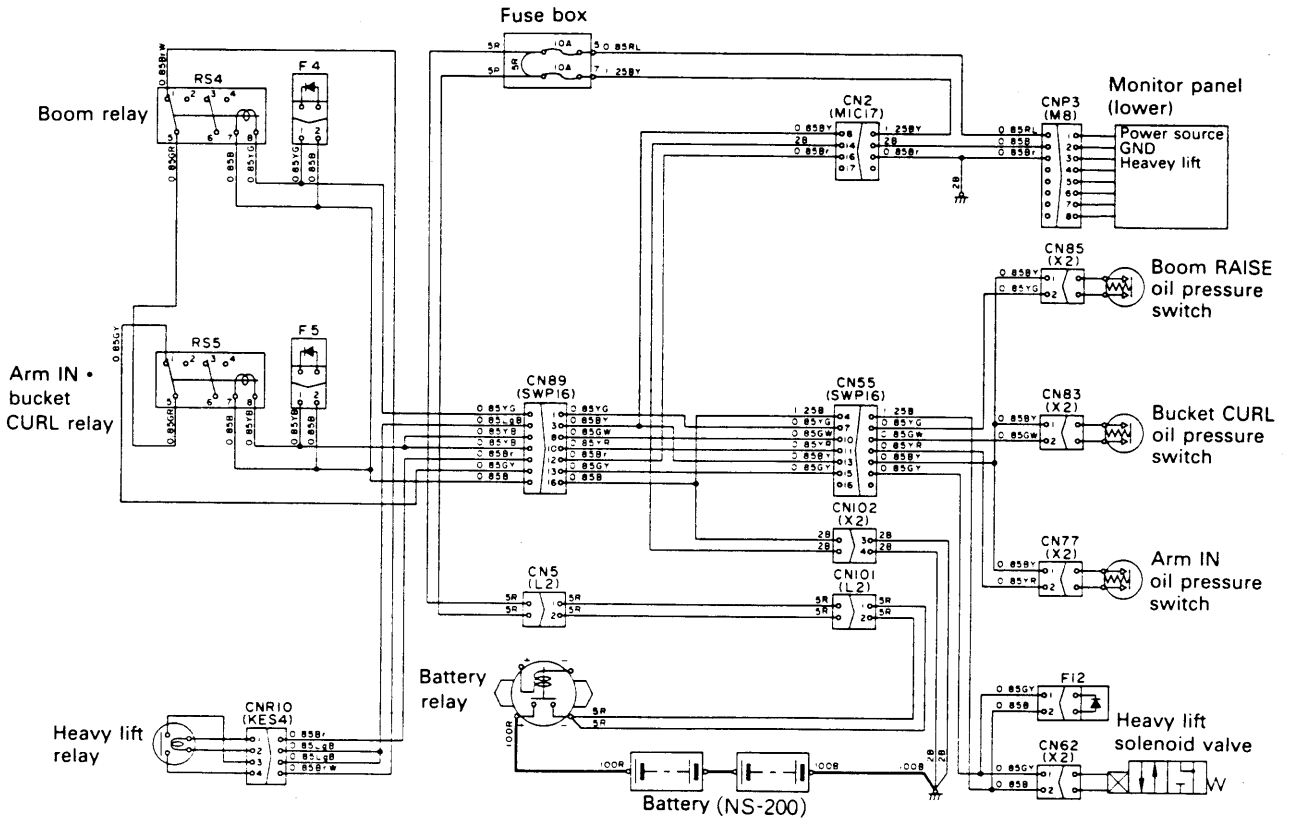
★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**



209F05374

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

REGULATION OF EC INCLUSION



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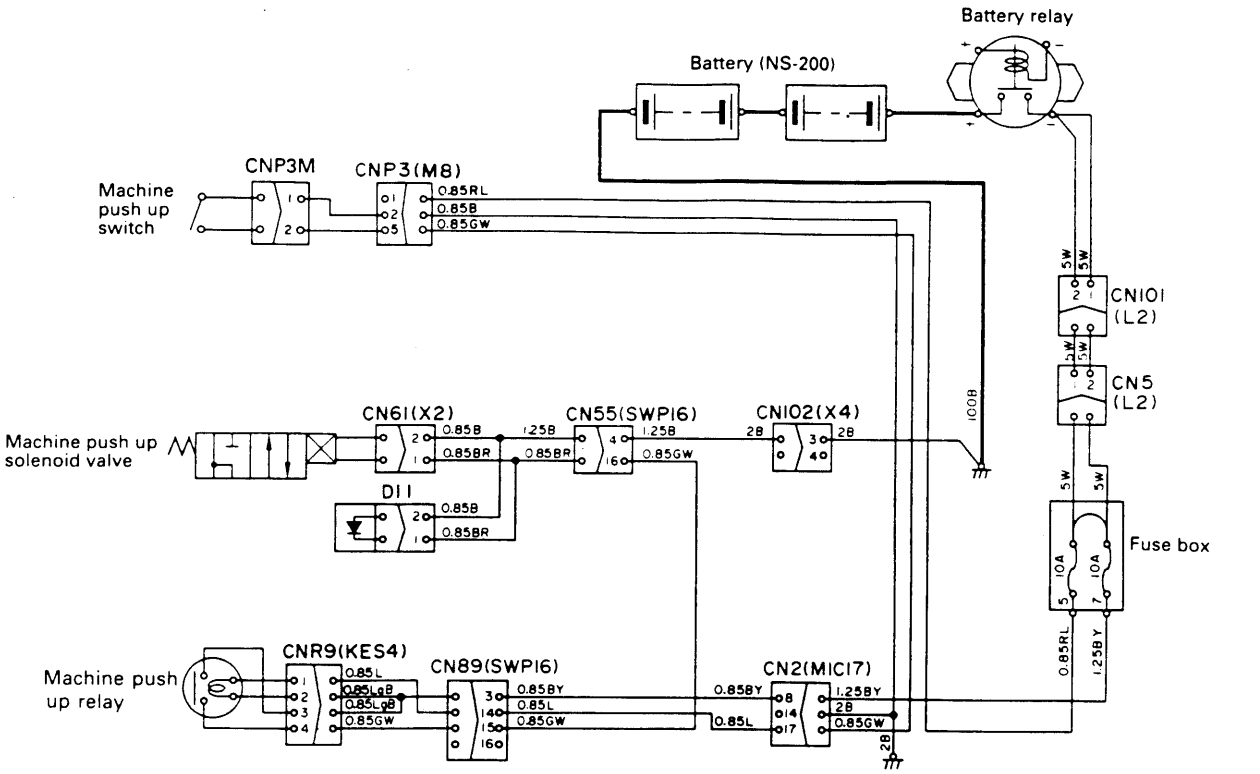
020905

MACHINE PUSH UP SYSTEM

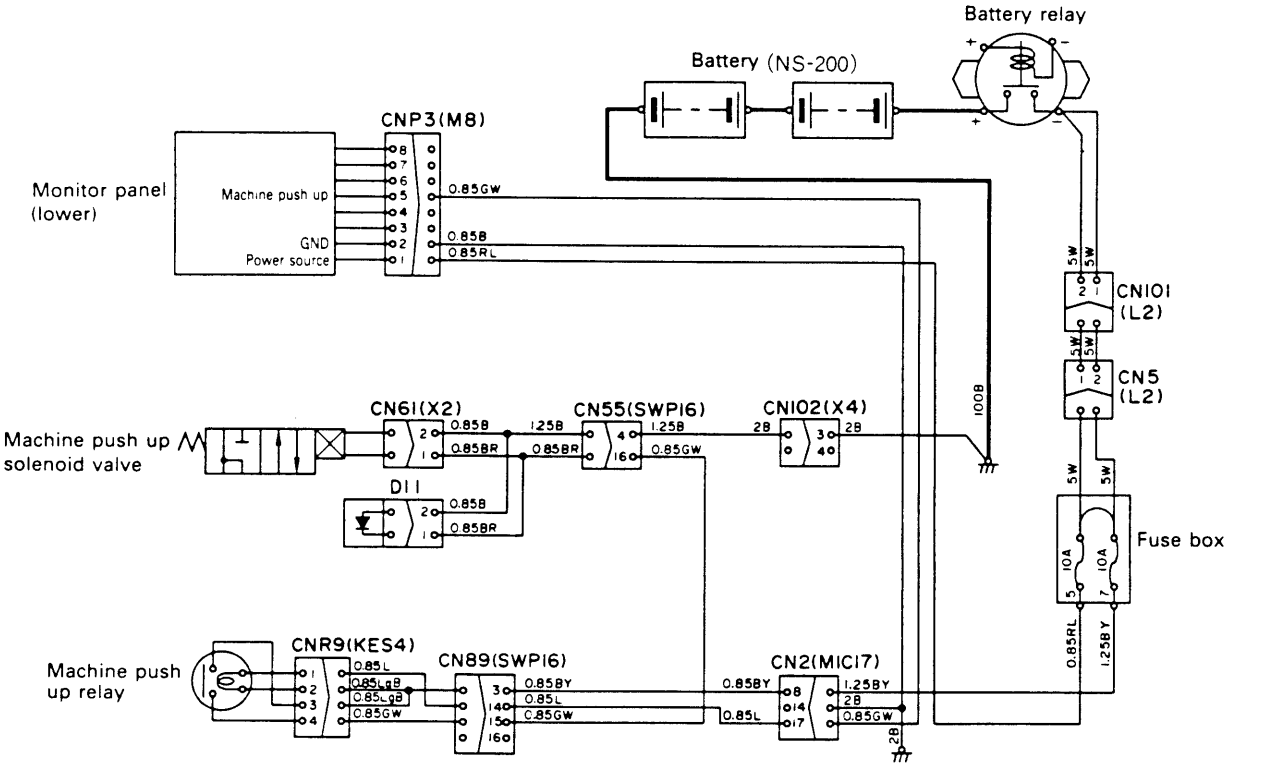
★ **FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS**



020905

F20905098

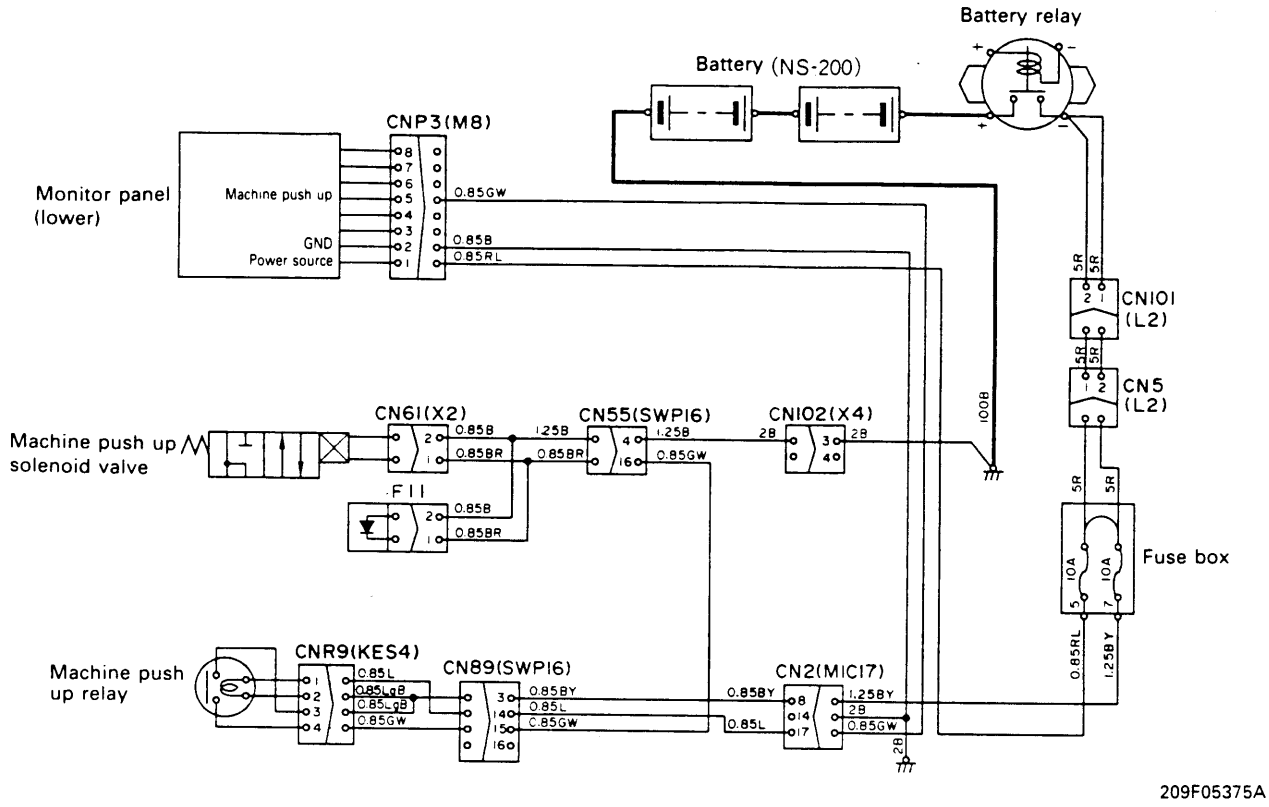
★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**



209F05375

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

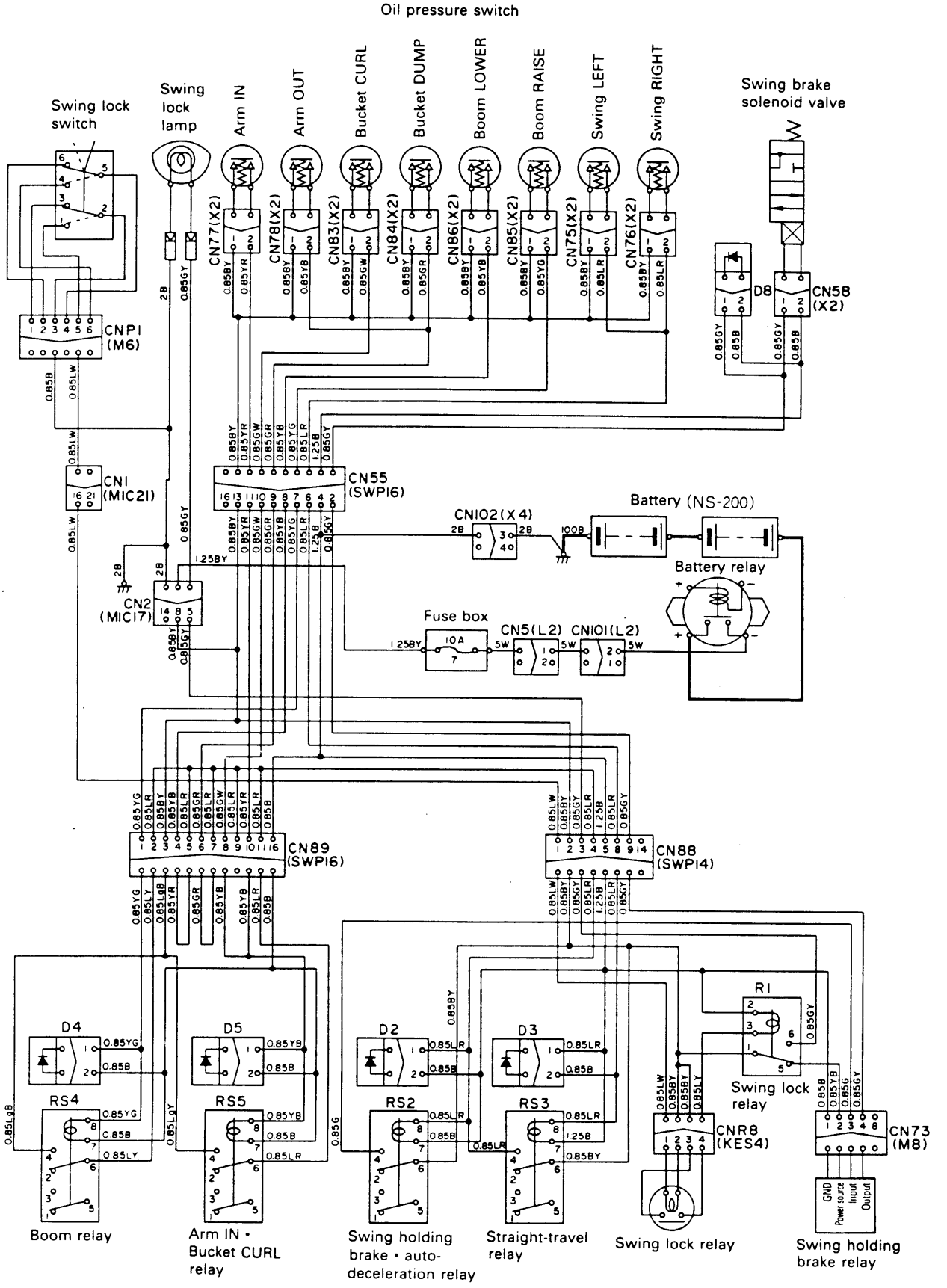
REGULATION OF EC INCLUSION



020905

SWING LOCK•SWING HOLDING BRAKE SYSTEM

PC650-5: 20001 – 20096, 20099 – 20103, 20106 – 20108
PC710-5: 10001 – 10085



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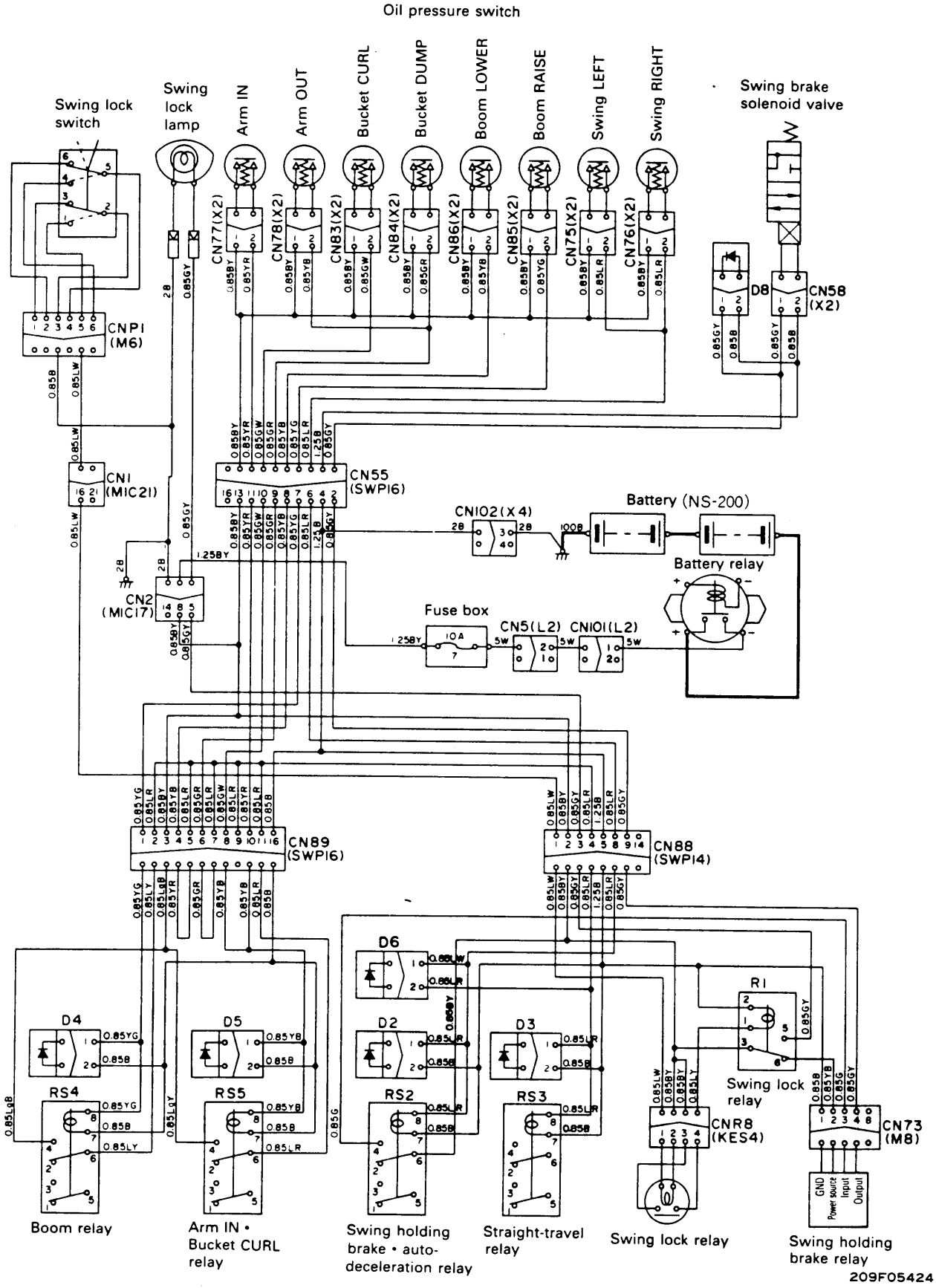
020905

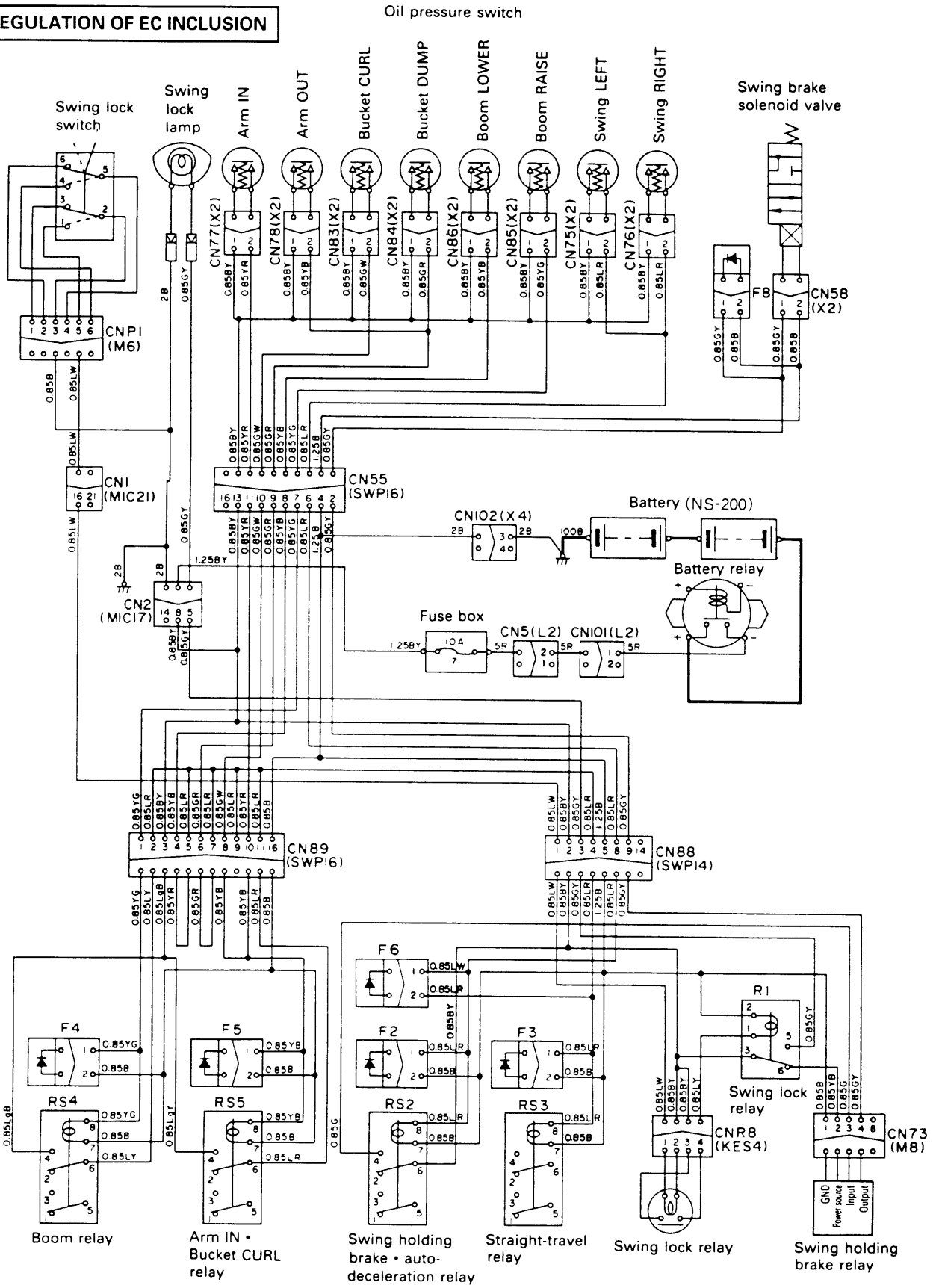
PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up



020905

PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up

REGULATION OF EC INCLUSION



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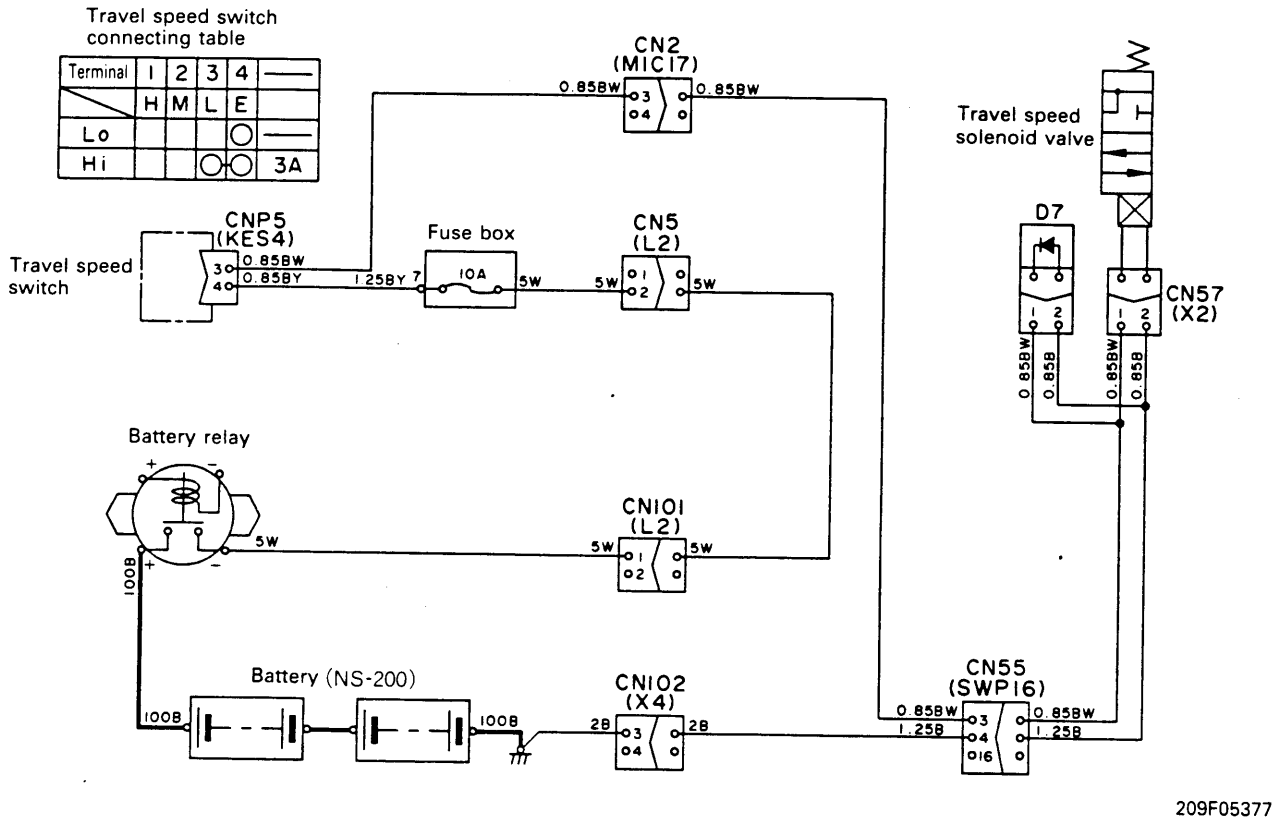
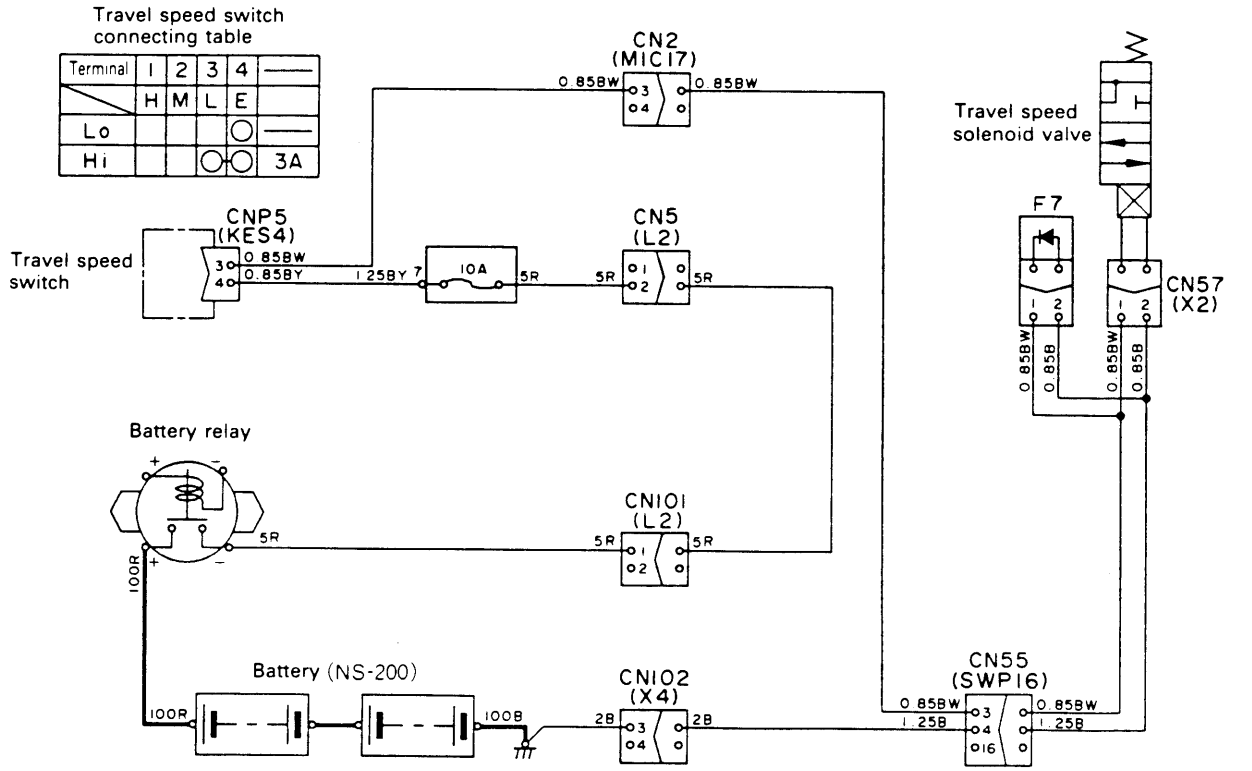
020905

TRAVEL SPEED SYSTEM



020905

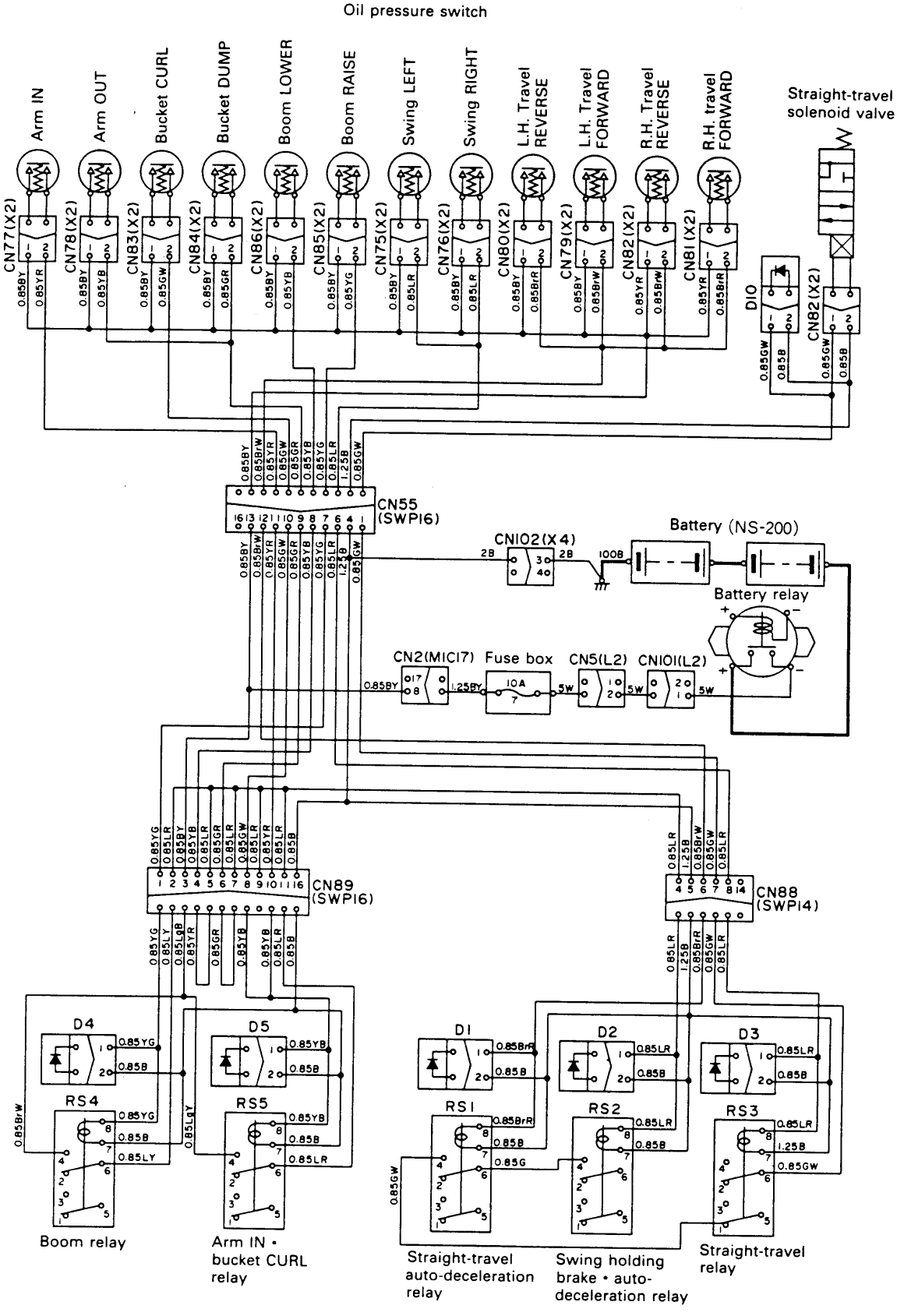
REGULATION OF EC INCLUSION



020905

STRAIGHT-TRAVEL SYSTEM

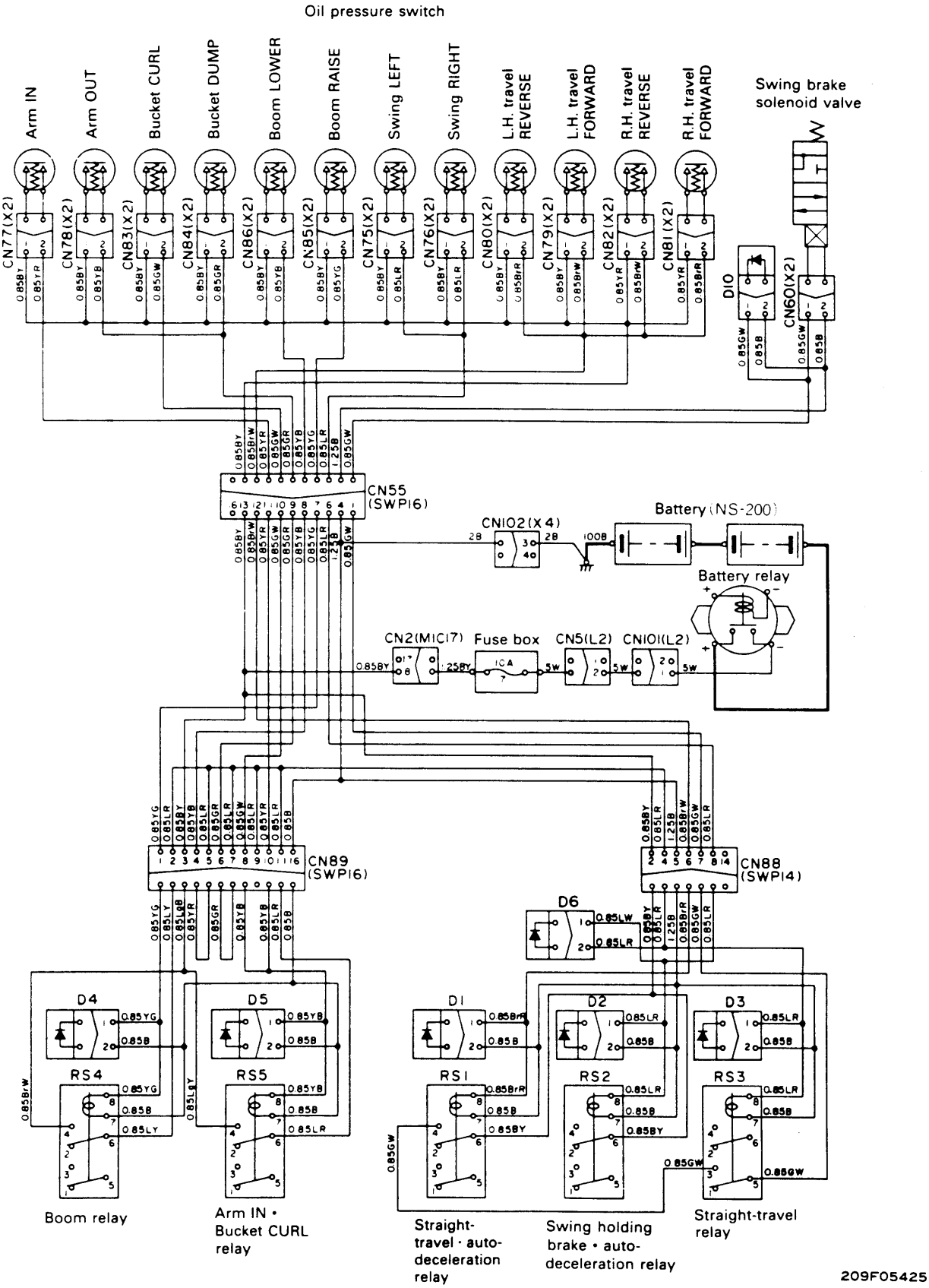
PC650-5: 20001 – 20096, 20099 – 20103, 20106 – 20108
PC710-5: 10001 – 10085



020905

209F05378

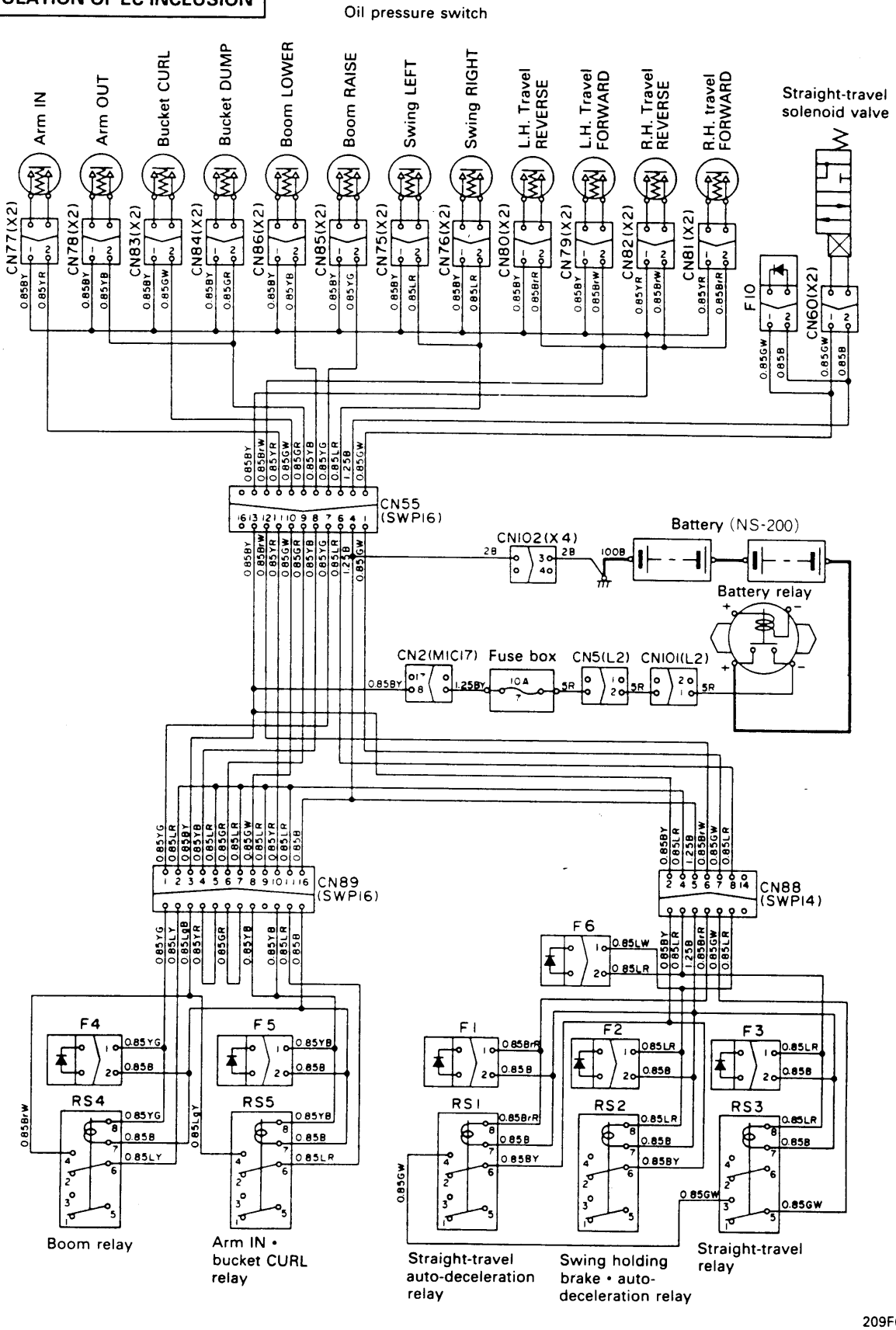
PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up



020905

PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up

REGULATION OF EC INCLUSION



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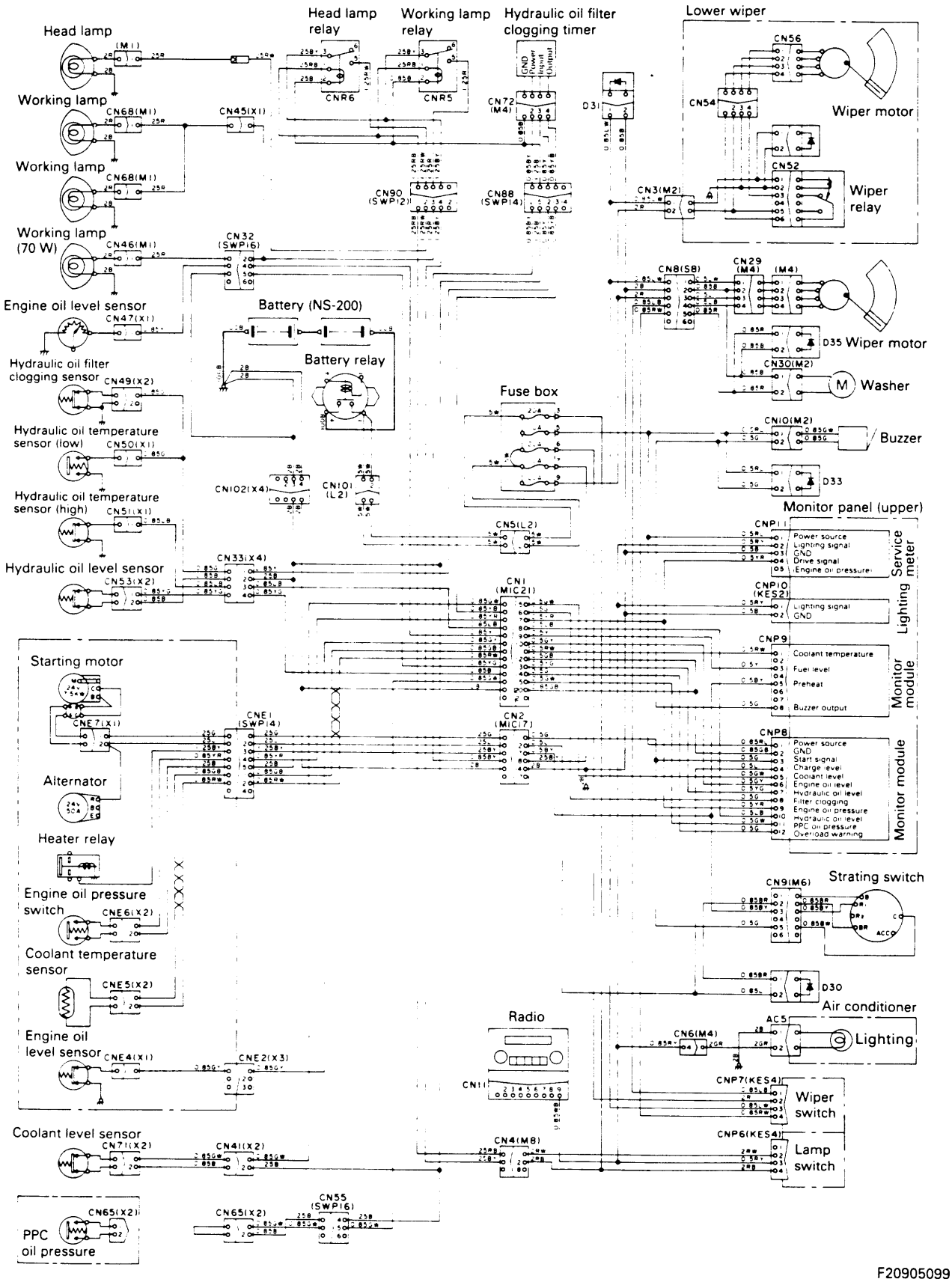
020905

MACHINE MONITORING SYSTEM

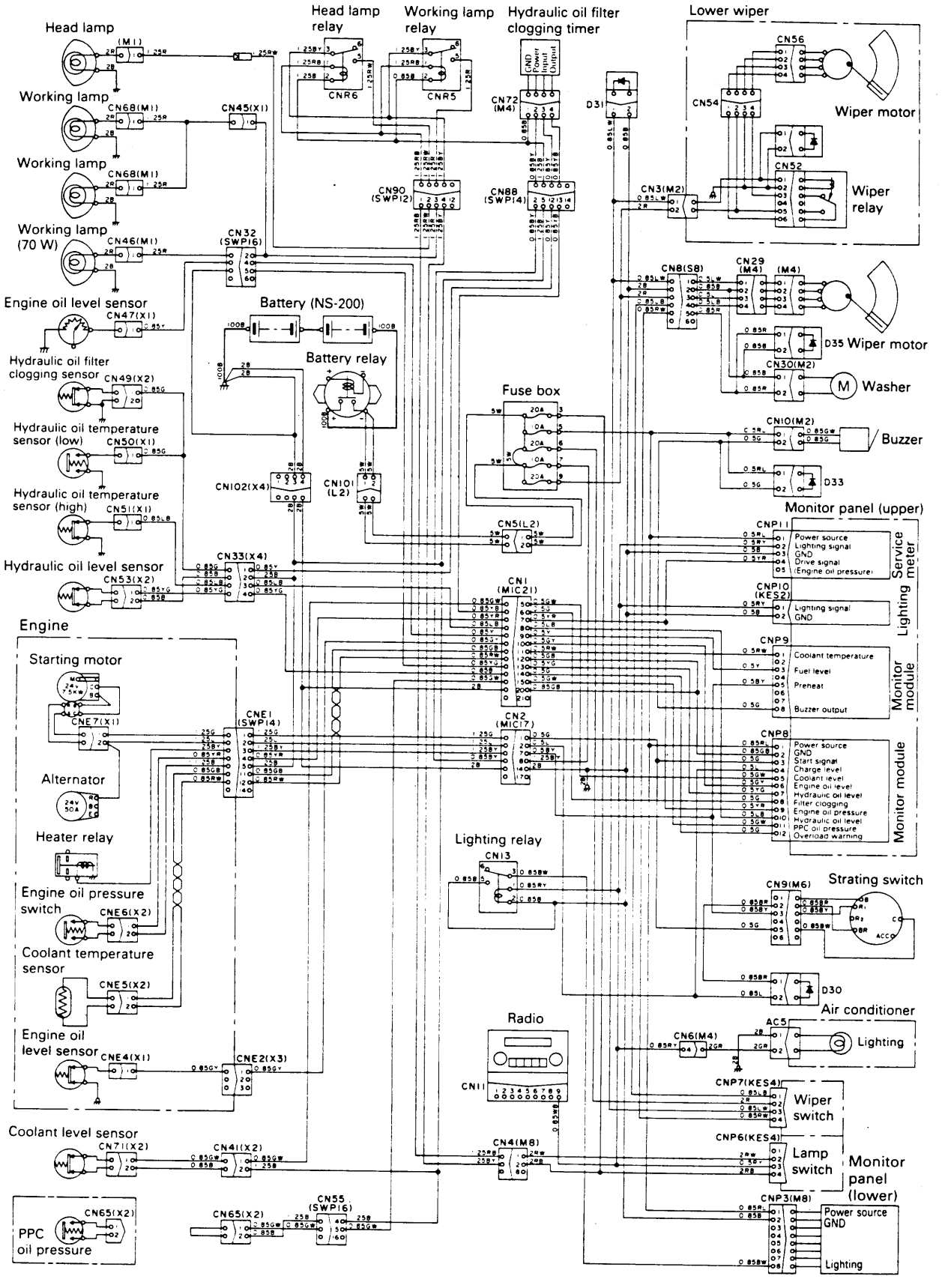
★ FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS



020905

F20905099

★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION



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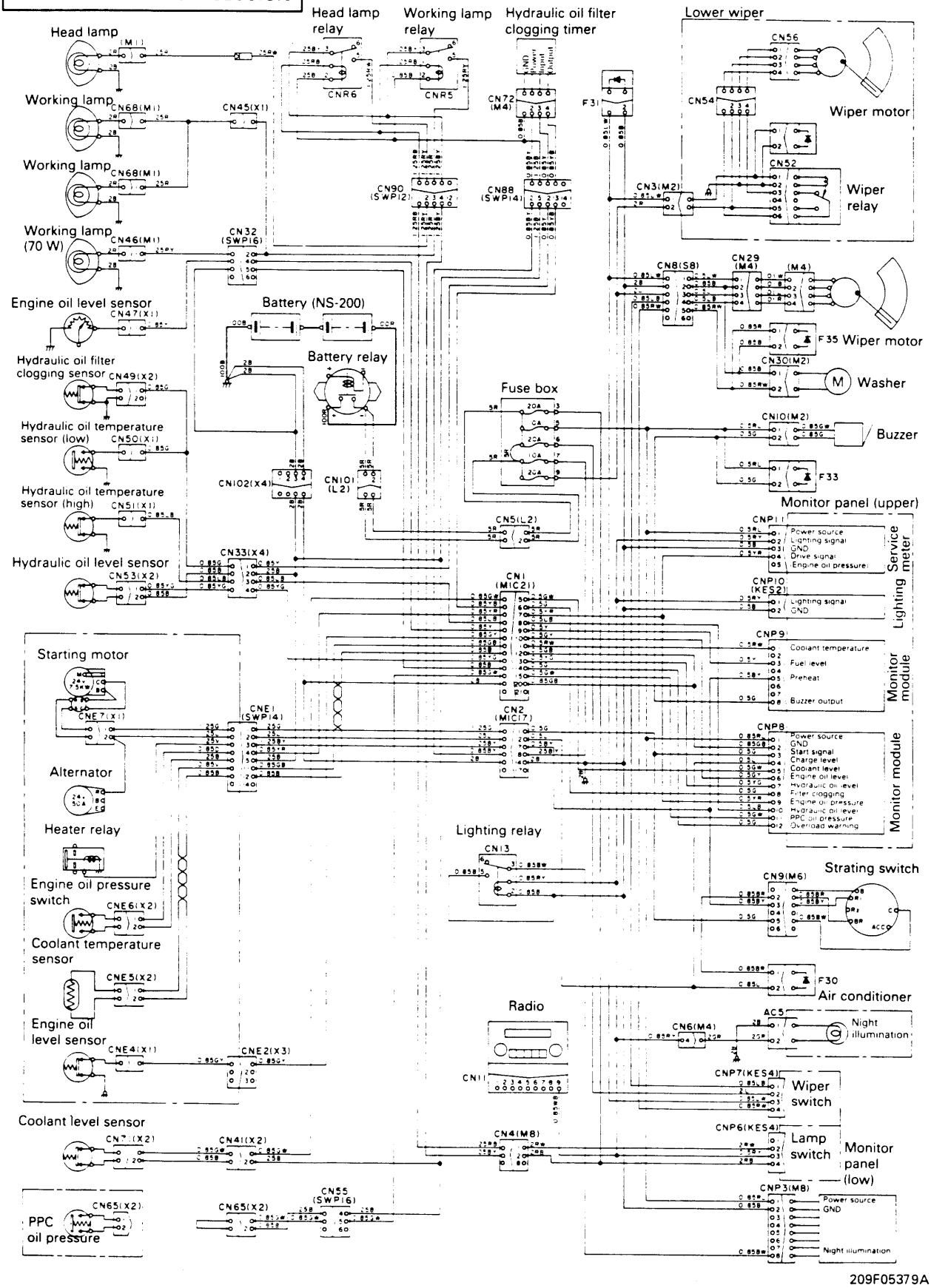
020905

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

REGULATION OF EC INCLUSION



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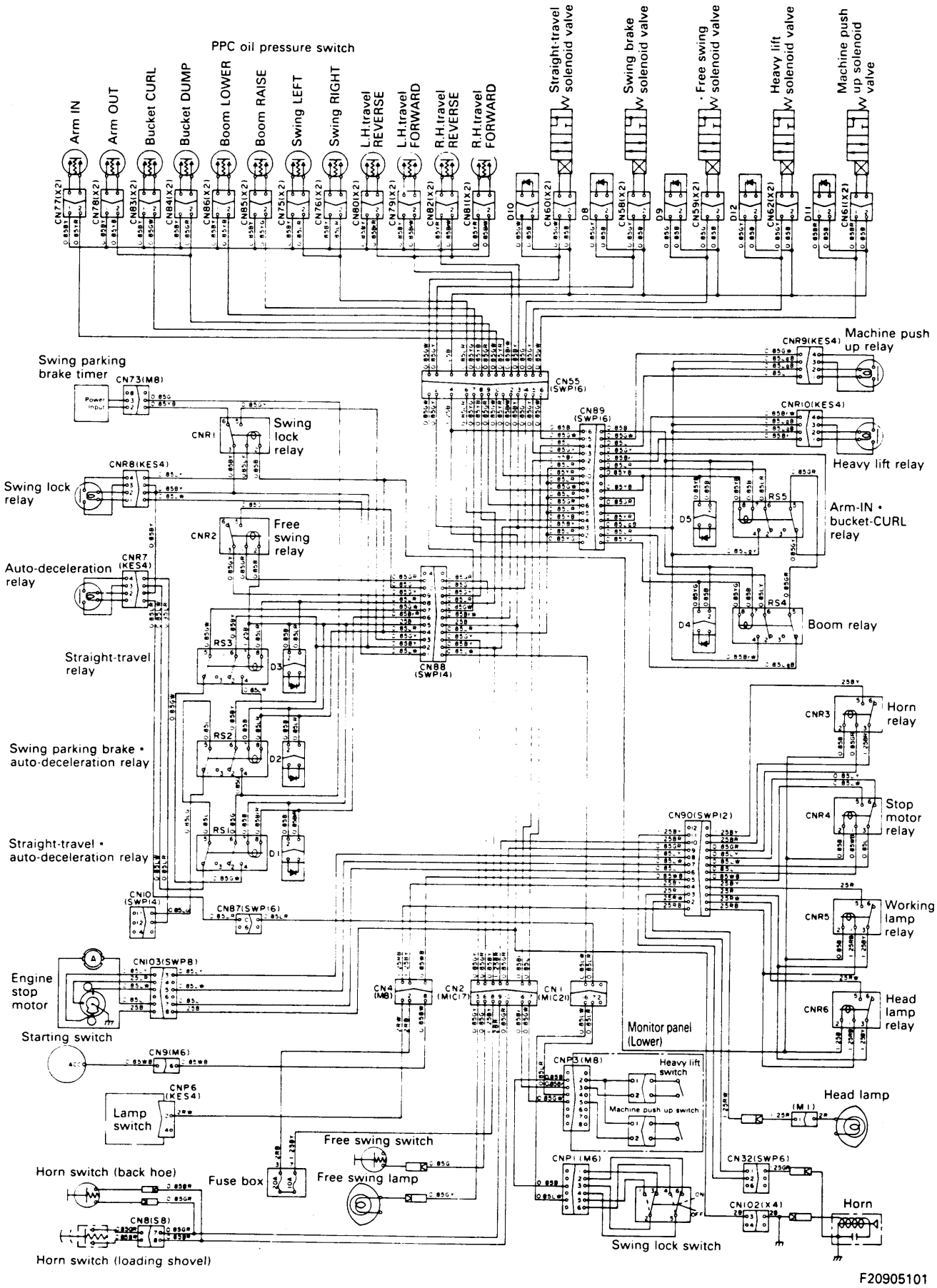
020905

RELAY CIRCUIT

BACK HOE

★ **FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS**



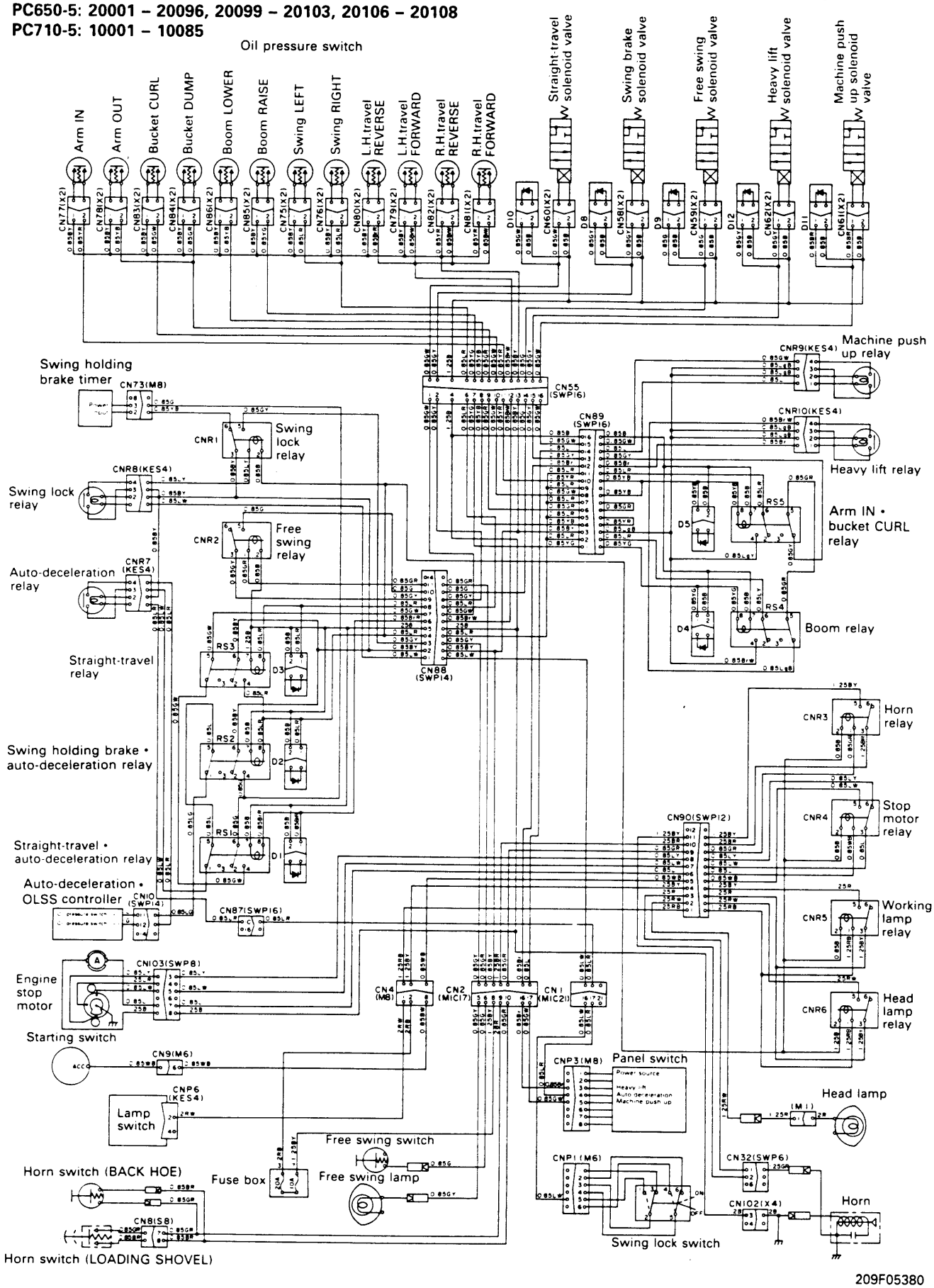
020905

F20905101

★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION

PC650-5: 20001 – 20096, 20099 – 20103, 20106 – 20108

PC710-5: 10001 – 10085



209F05380

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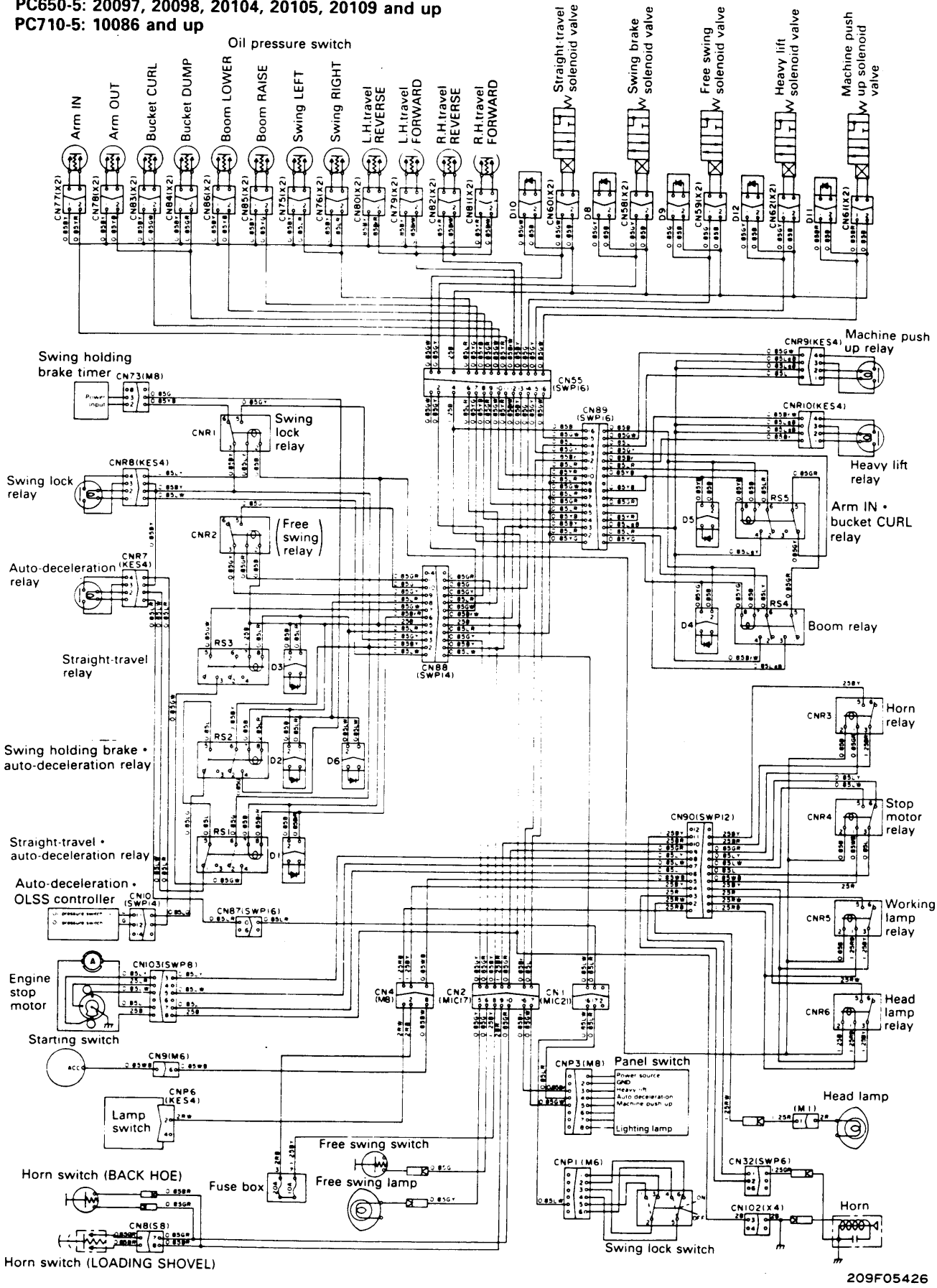
★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

PC650-5: 20097, 20098, 20104, 20105, 20109 and up

PC710-5: 10086 and up



209F05426

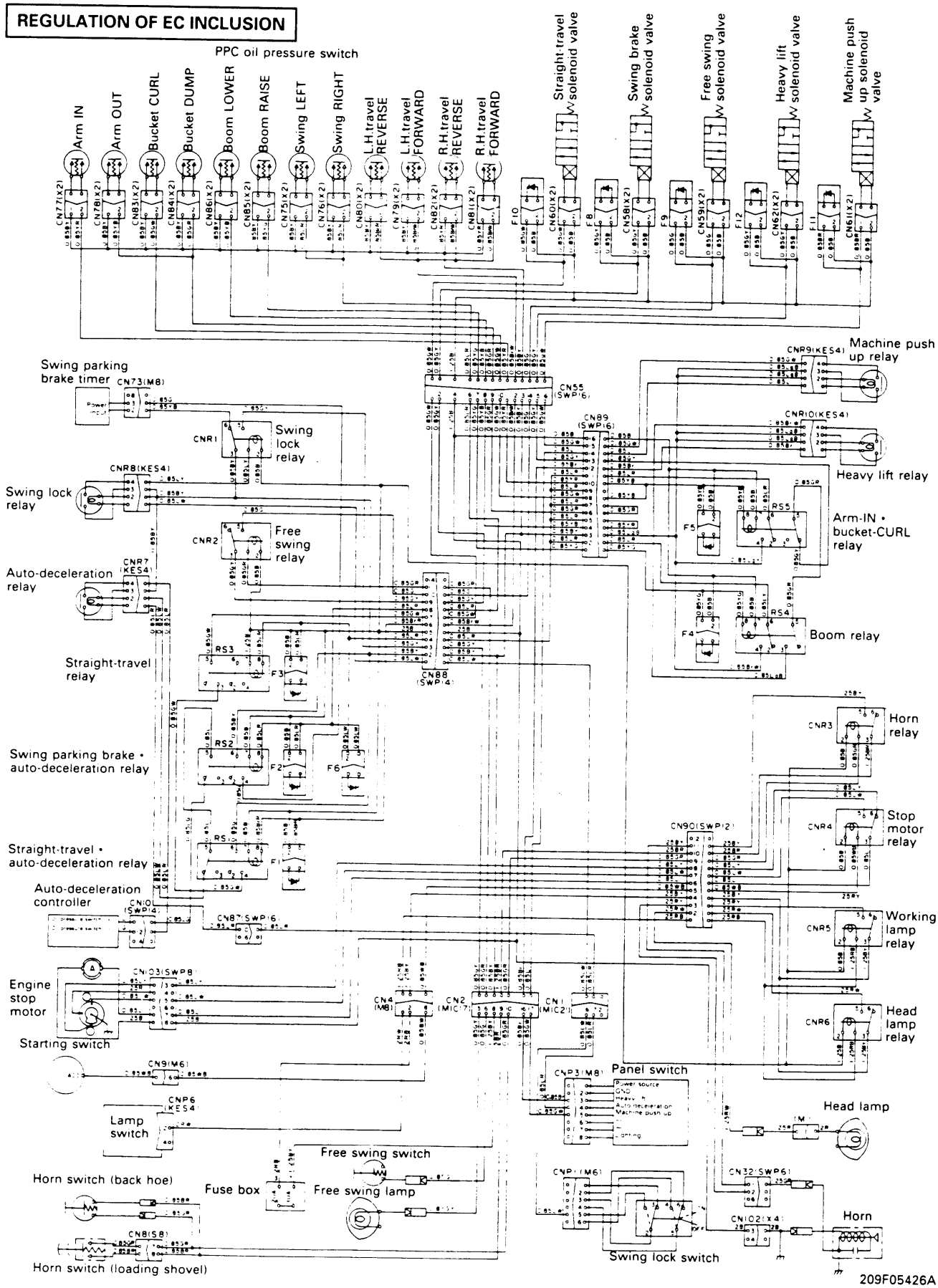
020905

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

PC650-5: 20097, 20098, 20104, 20105, 20109 and up

PC710-5: 10086 and up

REGULATION OF EC INCLUSION



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POSITION OF CONNECTORS FOR TROUBLESHOOTING

BACK HOE

Connector No.	Type	No. of pins	Name of component-E	Location
CN1	MIC	21	Intermediate connector	D7,N1
CN2	MIC	17	Intermediate connector	D7,L1
CN3	M	2	Intermediate connector	C7
CN4	S	8	Intermediate connector	E8,O1
CN5	L	2	Intermediate connector	E8,O2
CN6	M	4	Air conditioner unit	D7,N1
CN7	M	6	Intermediate connector	D9
CN8	S	8	Intermediate connector	C7
CN9	M	6	Starting switch	C7
CN10	M	2	Buzzer	E9
CN10	SWP	14	Auto-deceleration•OLSS controller ★	B3
CN11	SWP	8	Auto-deceleration•OLSS controller ★	B3
CN11	–	9	Radio	E9
CN12	X	3	Auto-deceleration solenoid valve A ★	T6
CN12	KES	2	Speaker	B7
CN13	X	2	TVC solenoid	T5
CN13	–	5	Lighting relay	C7
CN29	M	4	Intermediate connector	C7,K2
CN30	M	2	Window washer	J2
CN32	SWP	6	Intermediate connector	R3
CN33	X	4	Intermediate connector	M9
CN34	M	2	Prolix resistor (TVC resistor)	C4
CN35	X	2	Air conditioner compressor switch	P2
CN36	M	6	Prolix switch ★	C4
CN40	X	2	Auto-deceleration solenoid valve B ★	T5
CN41	X	2	Intermediate connector	P9
CN45	X	1	Intermediate connector	R3
CN46	M	1	Working lamp	I2
CN47	X	1	Fuel level sensor	J2
CN49	X	2	Hydraulic oil filter sensor	M8
CN50	X	1	Hydraulic oil temperature sensor (low temperature)	L8
CN51	X	1	Hydraulic oil temperature sensor (high temperature)	L8
CN53	X	2	Hydraulic oil lever sensor	K8
CN55	SWP	16	Intermediate connector	E2
CN56	SWP	8	Intermediate connector	E2

Connector No.	Type	No. of pins	Name of component-E	Location
CN57	X	2	Travel speed solenoid valve	E4
CN58	X	2	Swing brake solenoid valve	F4
CN59	X	2	Free swing solenoid valve	F4
CN60	X	2	Straight-travel solenoid valve	F3
CN61	X	2	Machine push up solenoid valve	F3
CN62	X	2	Heavy lift solenoid valve	F3
CN65	X	2	PPC oil pressure switch	F2
CN68	M	1	Work equipment lamp	I8,J8
CN71	X	2	Coolant level sensor	N8
CN72	M	4	Hydraulic filter clogging timer	C4
CN73	M	8	Swing holding brake timer	C4
CN75	X	2	Swing LEFT oil pressure switch	F3
CN76	X	2	Swing RIGHT oil pressure switch	F3
CN77	X	2	Arm IN oil pressure switch	F2
CN78	X	2	Arm OUT oil pressure switch	F3
CN79	X	2	L.H. travel FORWARD oil pressure switch	F3
CN80	X	2	L.H. travel REVERSE oil pressure switch	F4
CN81	X	2	R.H. travel FORWARD oil pressure switch	F4
CN82	X	2	R.H. travel REVERSE oil pressure switch	E4
CN83	X	2	Bucket CURL oil pressure switch	E4
CN84	X	2	Bucket DUMP oil pressure switch	E4
CN85	X	2	Boom RAISE oil pressure switch	E4
CN86	X	2	Boom LOWER oil pressure switch	E5
CN87	SWP	16	Intermediate connector	D4
CN88	SWP	14	Intermediate connector	D4
CN89	SWP	16	Intermediate connector	E2
CN90	SWP	12	Intermediate connector	E2
CN91	SWP	16	Intermediate connector	E2
CN101	L	2	Intermediate connector	Q3
CN102	X	4	Intermediate connector	Q3
CN103	SWP	8	Engine stop motor	R8
CNA10	X	2	Intermediate connector	C4
CNE1	SWP	4	Intermediate connector	S7

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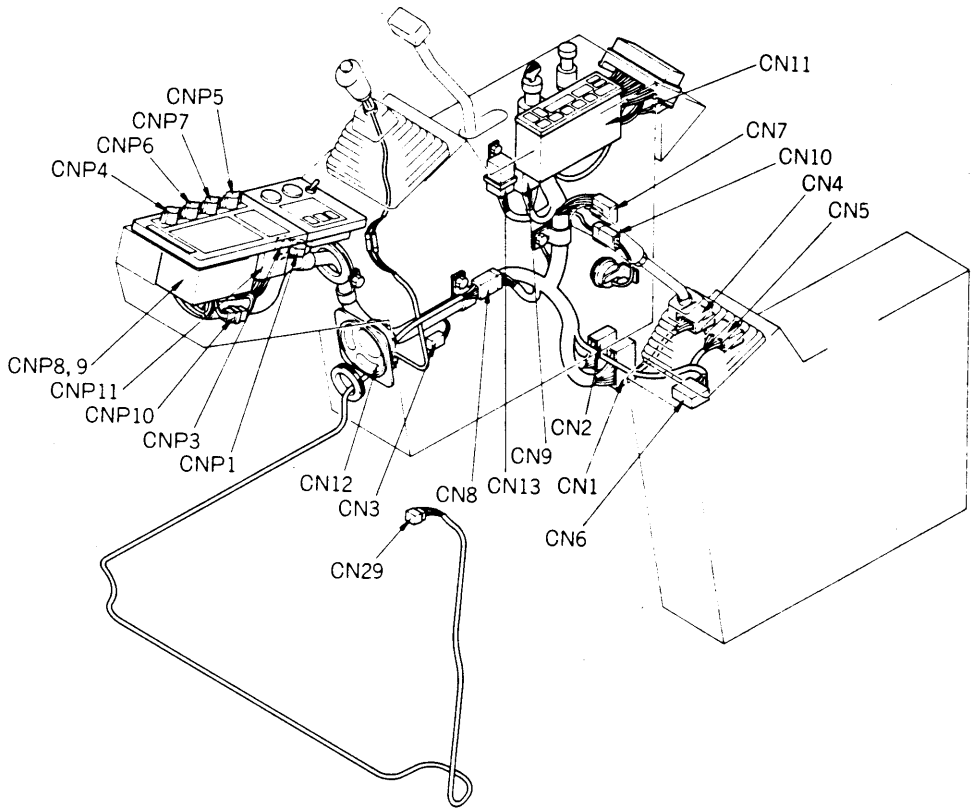
Connector No.	Type	No. of pins	Name of component-E	Location
CNE2	X	3	Intermediate connector	Q9
CNE4	X	1	Engine oil level sensor	Q8
CNE5	X	2	Coolant temperature sensor	R8
CNE6	X	2	Engine oil pressure sensor	S7
CNE7	X	1	Starting motor	R8
CNE8	X	2	Engine speed sensor ★	T7
CNE9	X	2	Potentiometer ★	T6
CNP1	M	6	Swing lock switch	B7
CNP3	M	8	Monitor panel (lower)	B7
CNP4	KES	4	Mode selector switch	A8
CNP5	KES	4	Travel speed switch	B9
CNP6	KES	4	Lamp switch	B9
CNP7	KES	4	Wiper switch	B9
CNP8	–	12	Monitor panel (upper)	A8
CNP9	–	8	Monitor panel (upper)	A8
CNP10	KES	2	Monitor panel (upper)	A7
CNP11	–	5	Monitor panel (upper)	A7
CNR1	–	5	Swing lock relay	E2
CNR2	–	5	Free swing relay	E2
CNR3	–	5	Horn relay	D1
CNR4	–	5	Stop motor relay	D1
CNR5	–	5	Working lamp relay	D1
CNR6	–	5	Head lamp relay	D1
CNR7	KES	4	Auto-deceleration relay	D1
CNR8	KES	4	Swing lock relay	C1
CNR9	KES	4	Machine push up relay	C1
CNR10	KES	4	Heavy lift relay	C1
RS1	–	8	Straight-travel • auto-deceleration relay	B2
RS2	–	8	Swing holding brake • auto-deceleration relay	B2
RS3	–	8	Straight-travel cancel relay	B2
RS4	–	8	Boom relay	C1
RS5	–	8	Arm IN • bucket CURL relay	C1

020905

★ Marked: for machine equipped with 3-stage mode selector OLSS and auto-deceleration



View Y

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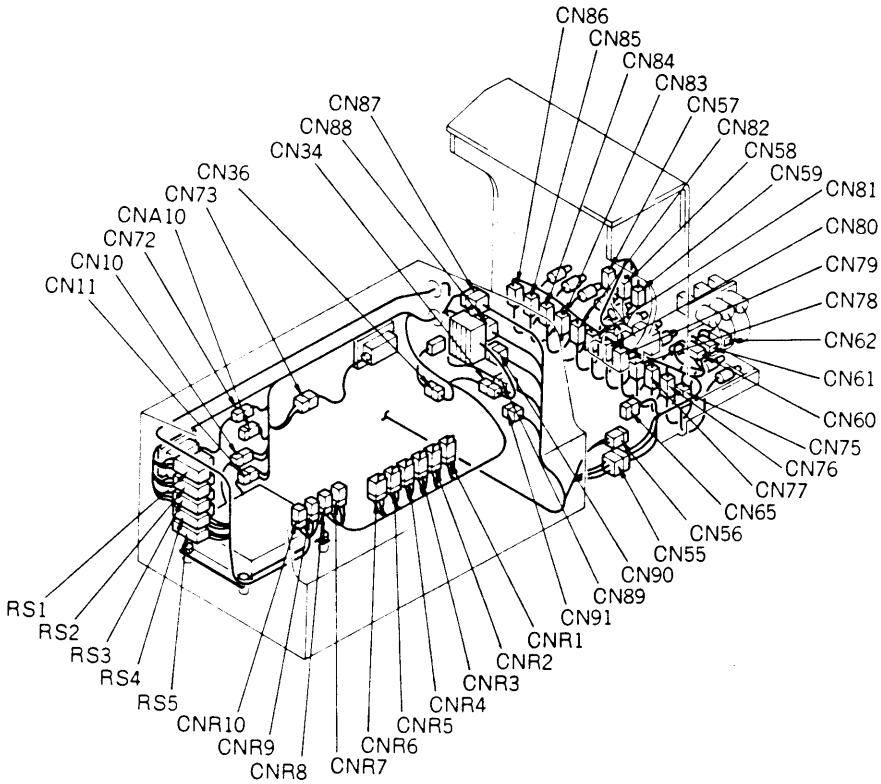

View Z

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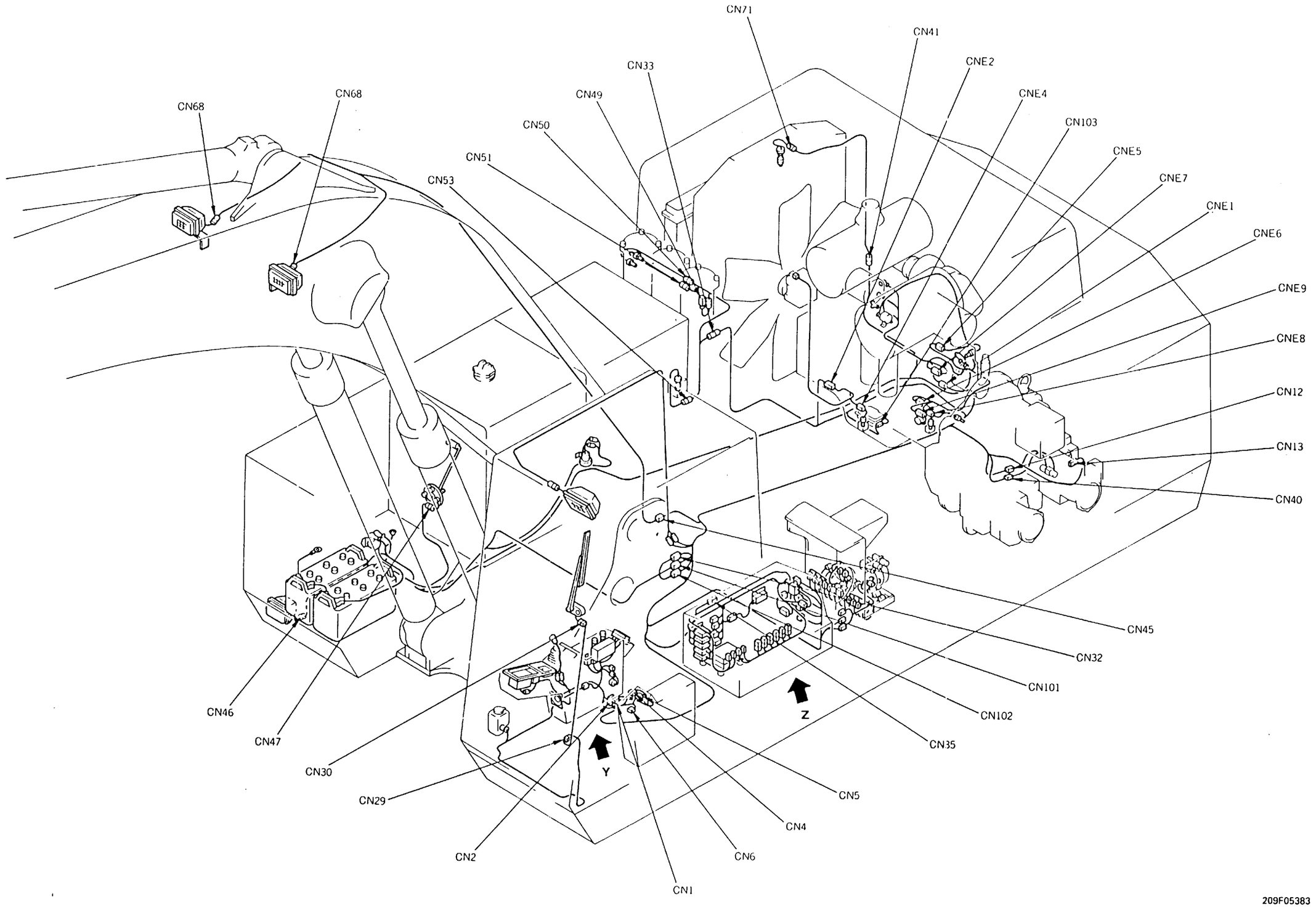
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CN41
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CNE2
CN49
CNE4
CN68
CN68
CN50
CN103
CN51
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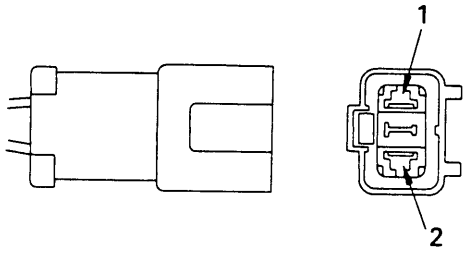
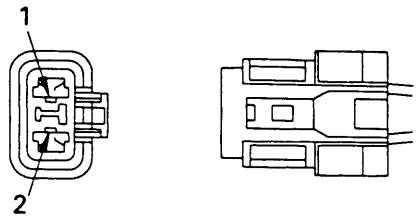
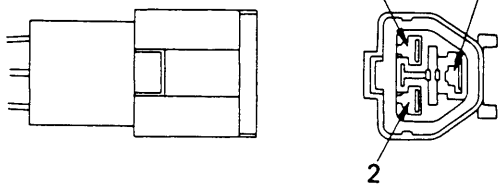
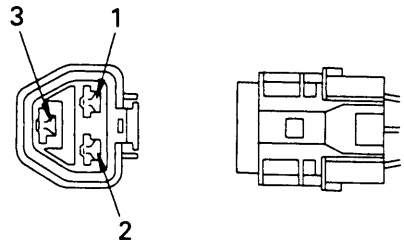
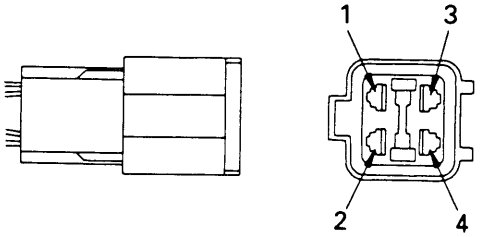
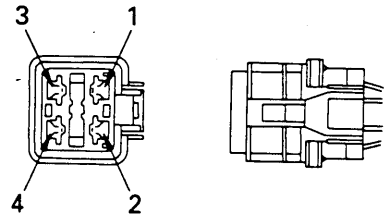
CNE6
CNE9
CNE8
CN12
CN13
CN40
CN45
CN32
CN101
CN102
CN35
CN46
CN47
CN30
CN29
CN2
CN1
CN6
CN4
CN5
Y
Z

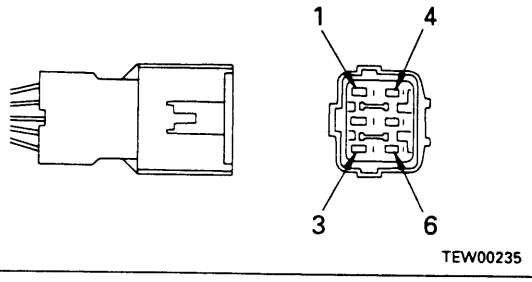
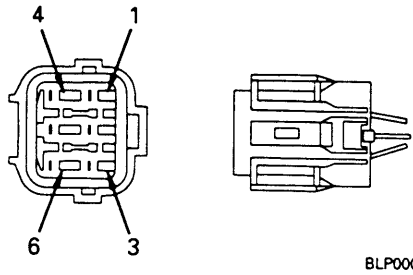
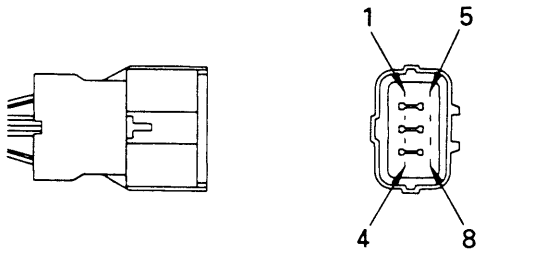
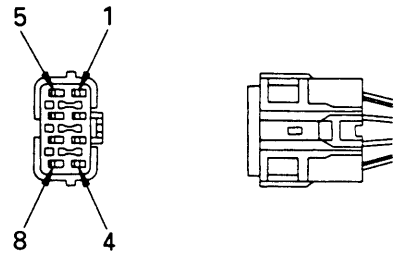
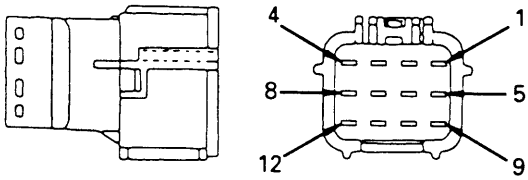
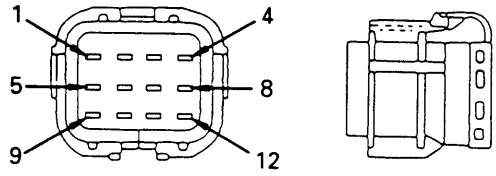
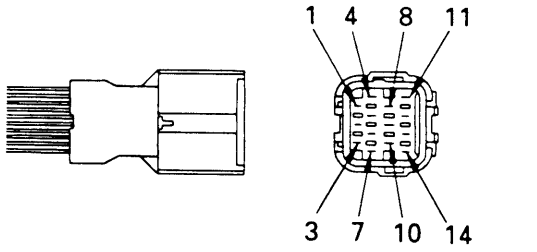
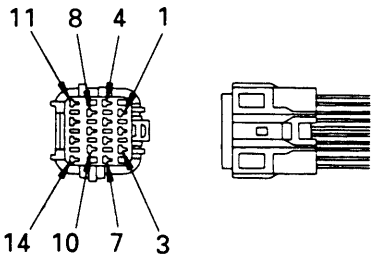
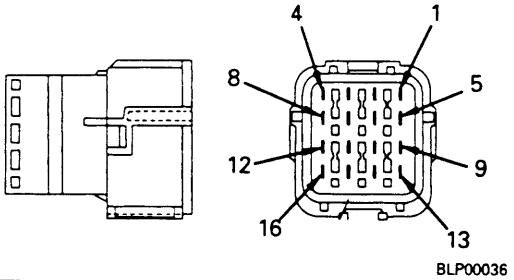
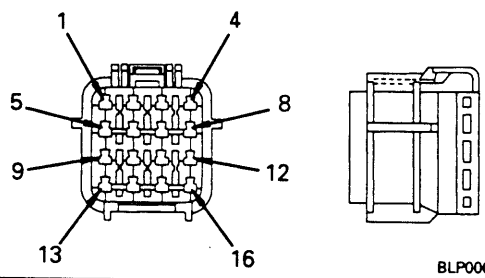
209F05383

CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

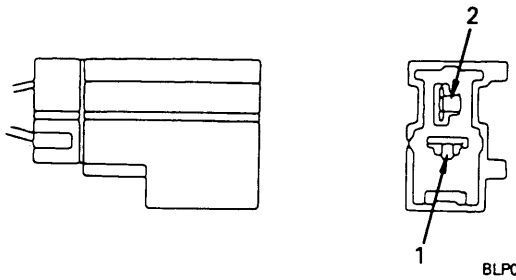
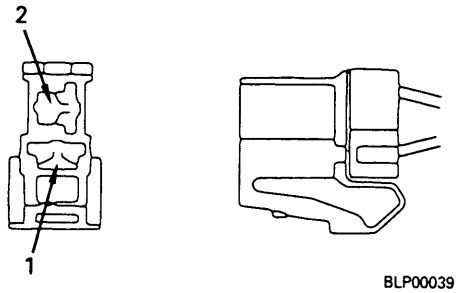
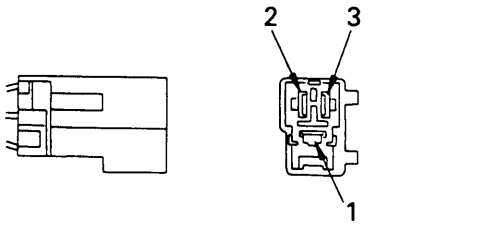
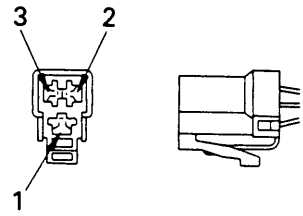
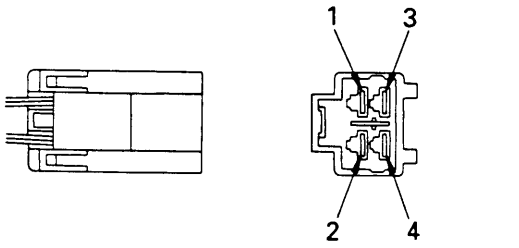
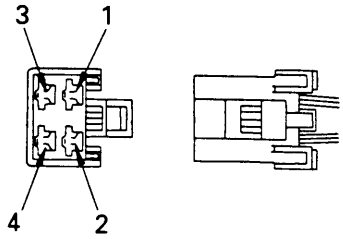
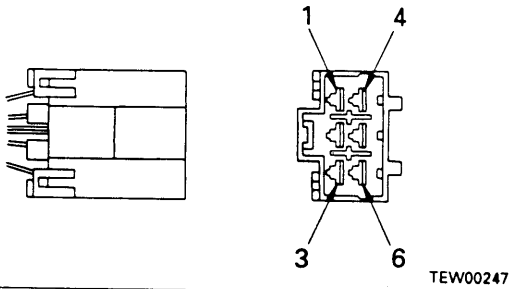
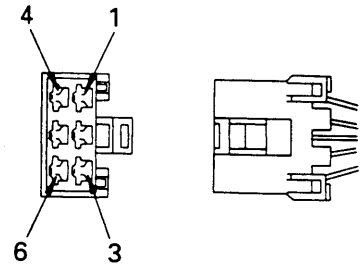
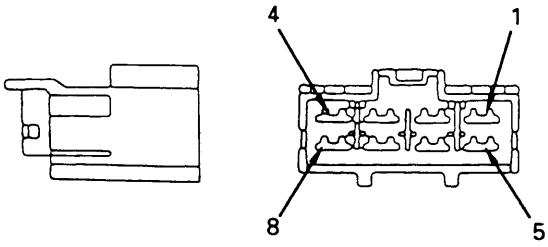
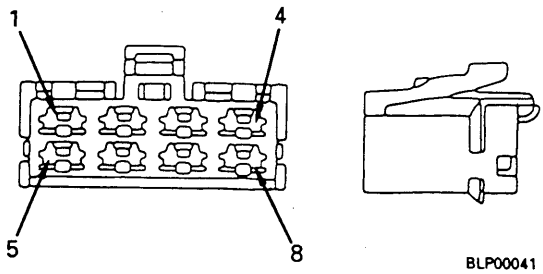
★ The terms male and female refer to the pins, while the terms male housing and female housing refer to the mating portion of the housing.

No. of pins	X type connector	
	Male (female housing)	Female (male housing)
2	 TEW00221	 TEW00222
3	 TEW00223	 TEW00224
4	 TEW00225	 TEW00226

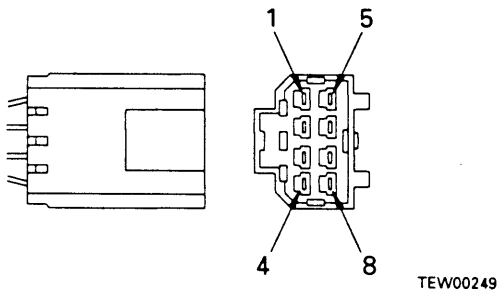
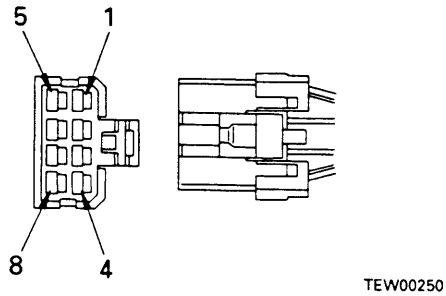
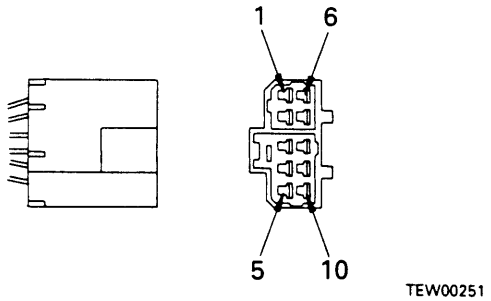
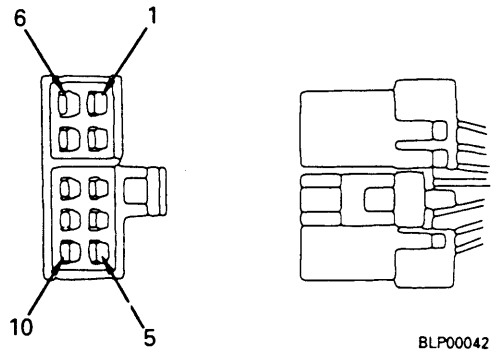
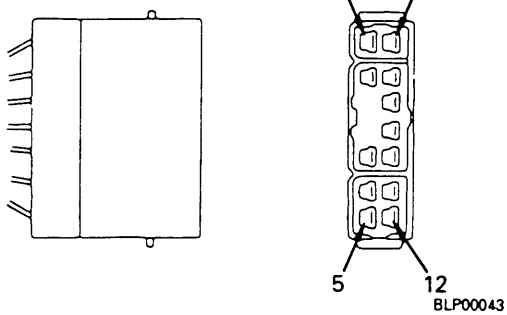
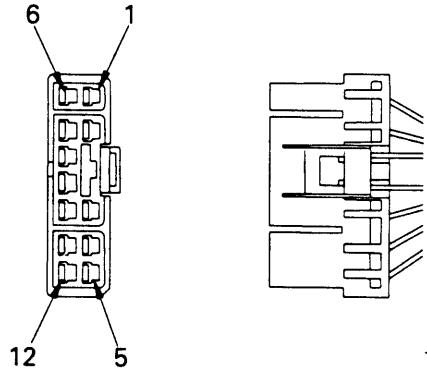
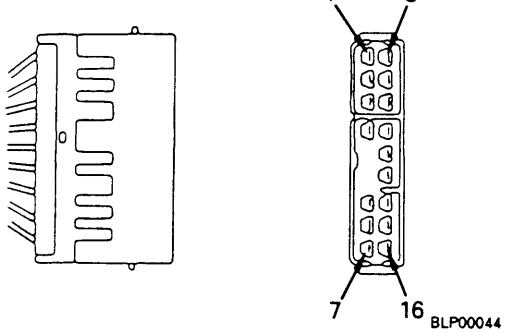
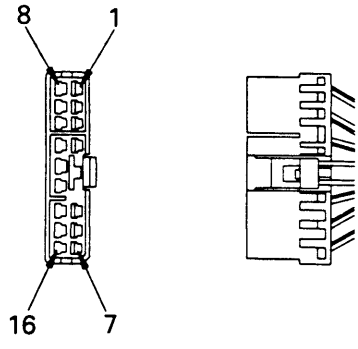
020905

No. of pins	SWP type connector	
	Male (female housing)	Female (male housing)
6	 TEW00235	 BLP00033
8	 TEW00237	 TEW00238
12	 BLP00034	 BLP00035
14	 TEW00239	 TEW00240
16	 BLP00036	 BLP00037

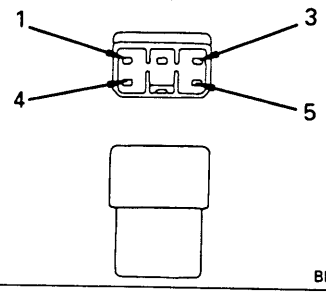
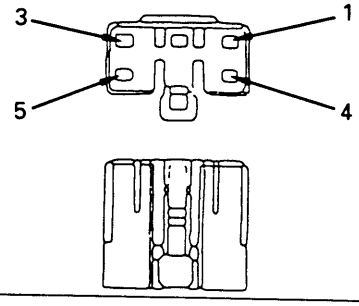
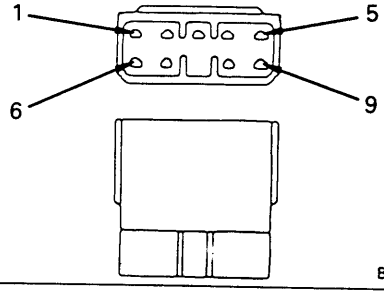
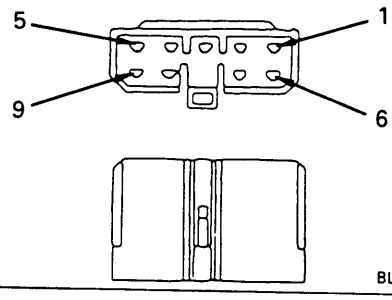
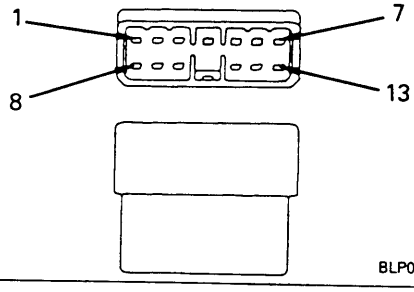
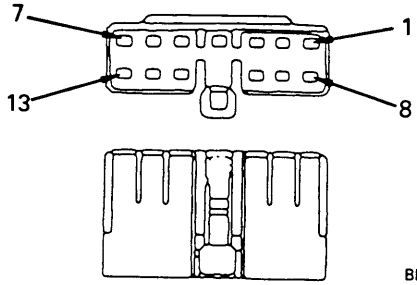
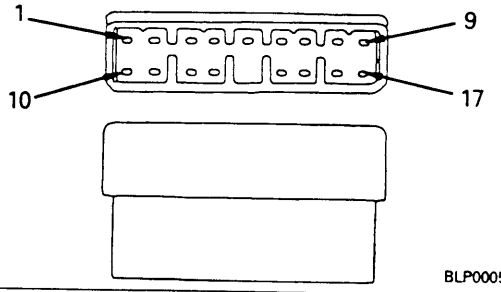
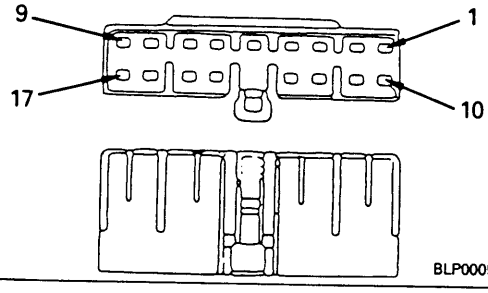
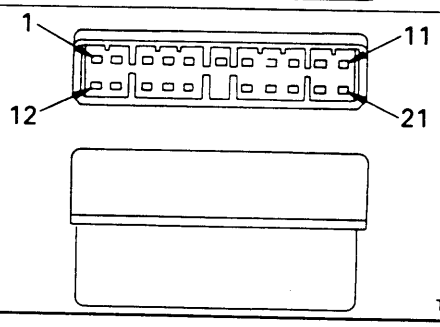
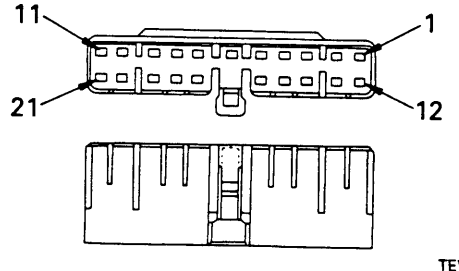
020905

No. of pins	M type connector	
	Male (female housing)	Female (male housing)
2	 BLP00038	 BLP00039
3	 TEW00243	 TEW00244
4	 TEW00245	 TEW00246
6	 TEW00247	 TEW00248
8	 BLP00040	 BLP00041

020905

No. of pins	S type connector	
	Male (female housing)	Female (male housing)
8		
10		
12		
16		

020905

No. of pins	MIC connector	
	Male (female housing)	Female (male housing)
5	 BLP00045	 BLP00046
9	 BLP00047	 BLP00048
13	 BLP00049	 BLP00050
17	 BLP00051	 BLP00052
21	 TEW00259	 TEW00260

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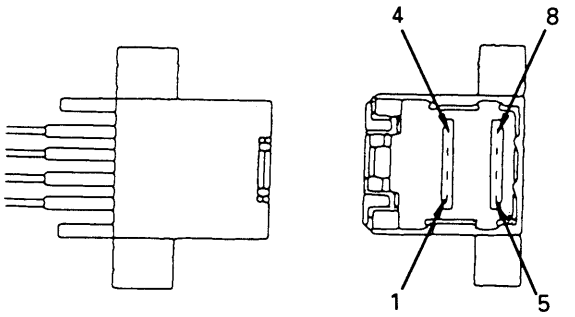
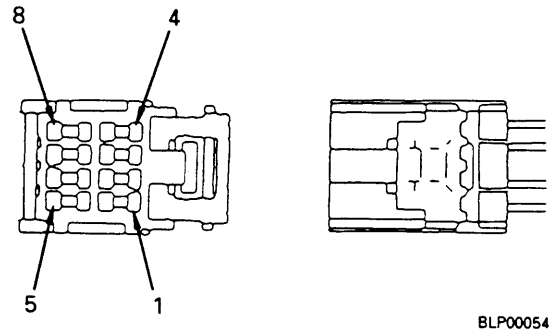
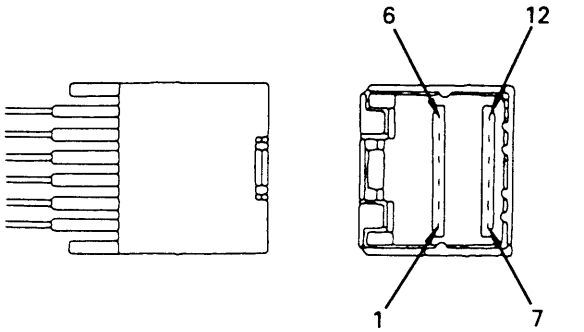
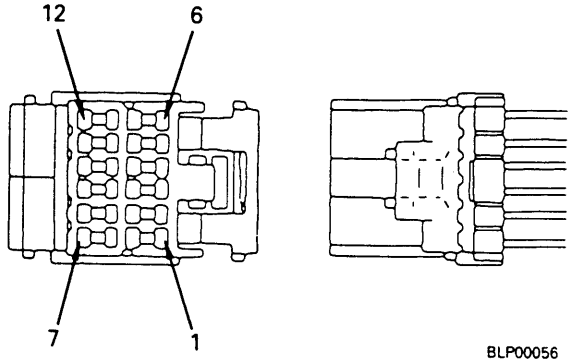
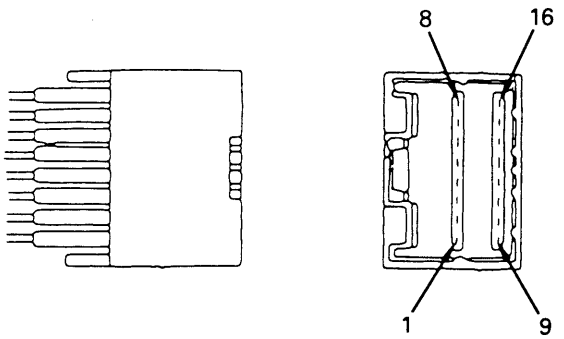
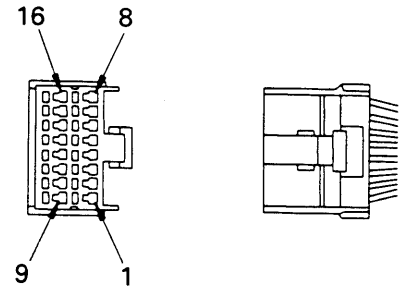
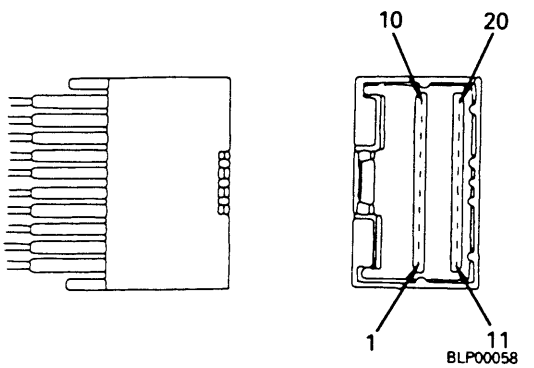
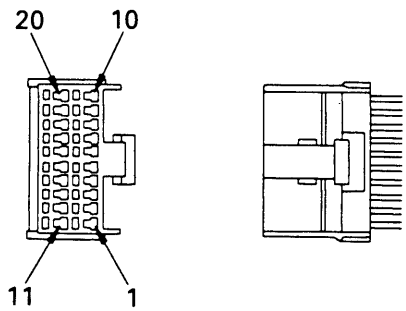
No. of pins	AMP040 type connector	
	Male (female housing)	Female (male housing)
8	 BLP00053	 BLP00054
12	 BLP00055	 BLP00056
16	 BLP00057	 TEW00232
20	 BLP00058	 TEW00234

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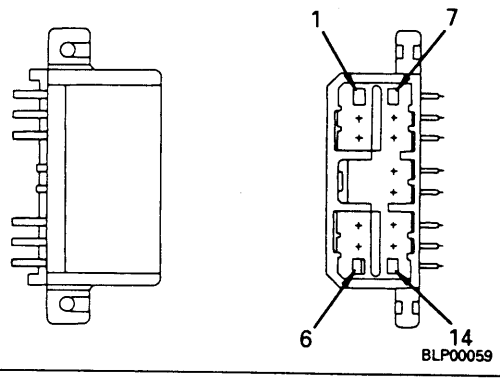
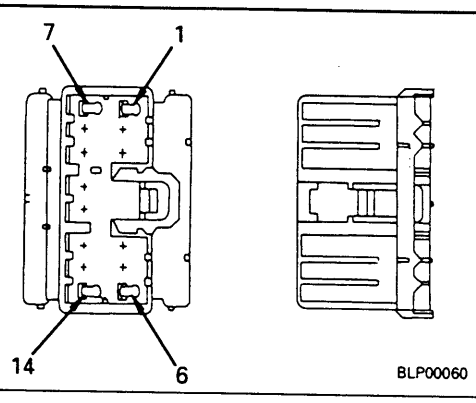
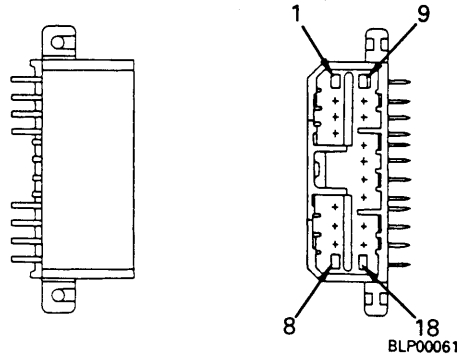
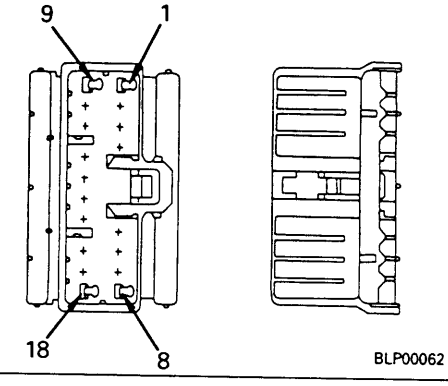
No. of pins	AMP070 type connector	
	Male (female housing)	Female (male housing)
8		
12		

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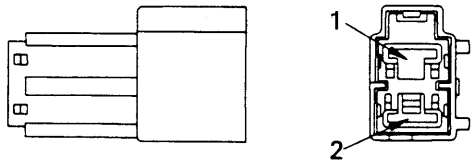
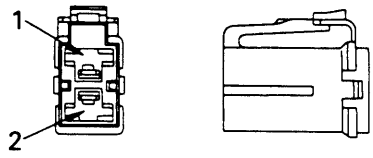
No. of pins	L type type connector	
	Male (female housing)	Female (male housing)
2	 TEW00257	 TEW00258

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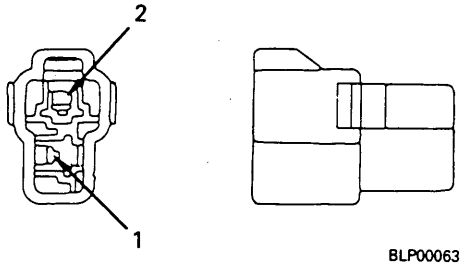
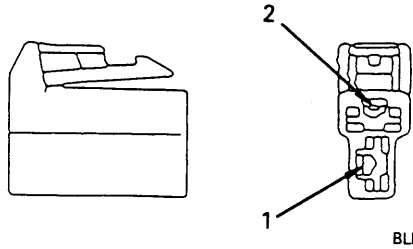
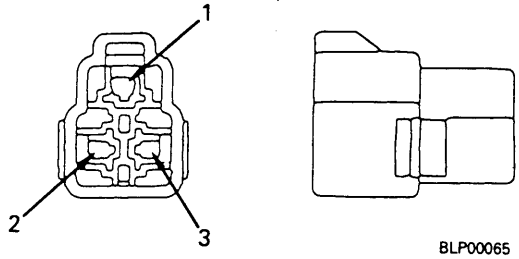
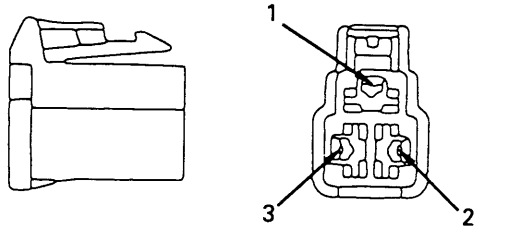
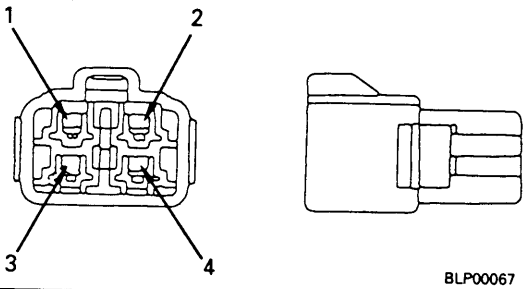
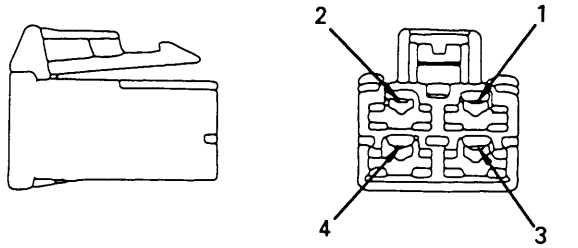
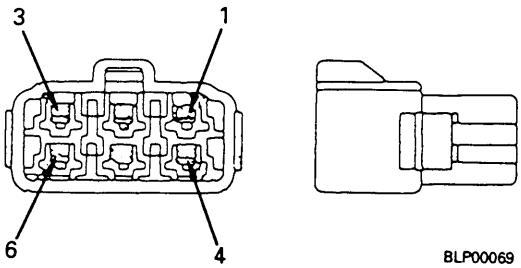
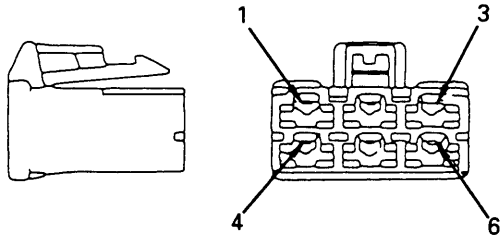
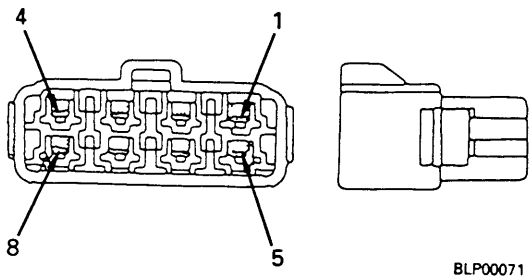
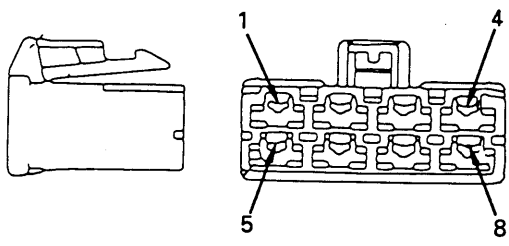
No. of pins	Automobile connector	
	Male (female housing)	Female (male housing)
2	 BLP00063	 BLP00064
3	 BLP00065	 BLP00066
4	 BLP00067	 BLP00068
6	 BLP00069	 BLP00070
8	 BLP00071	 BLP00072

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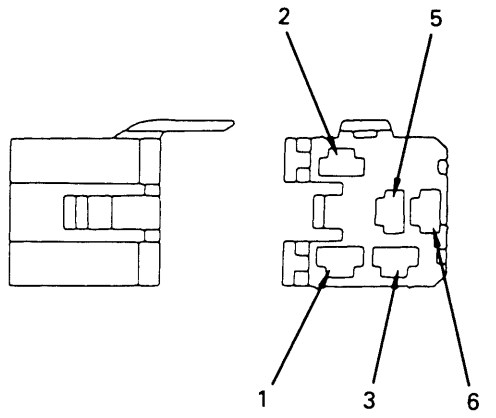
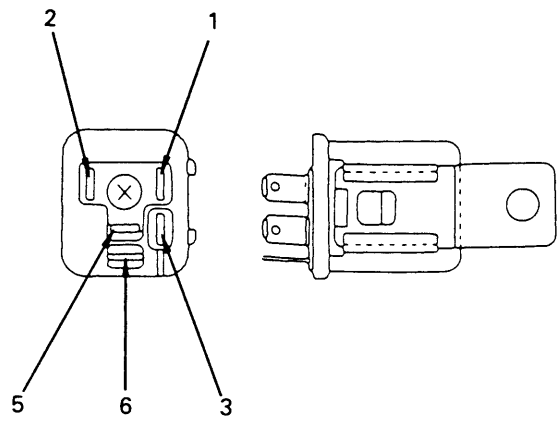
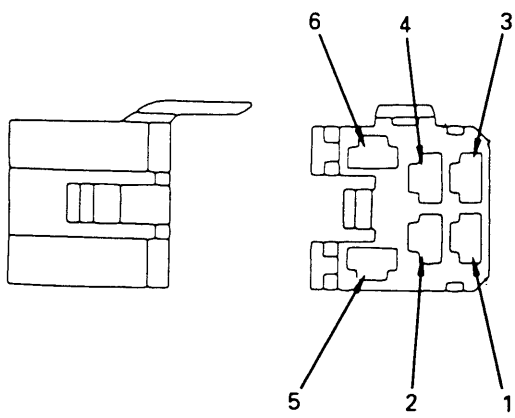
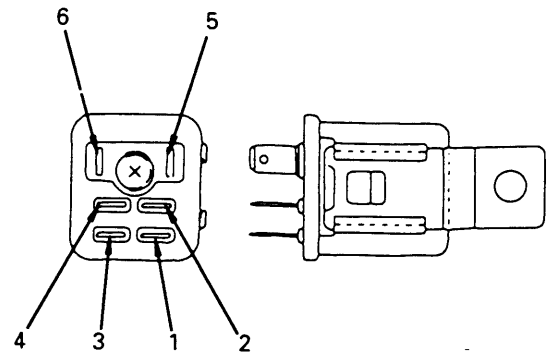
No. of pins	Relay connector	
	Male (female housing)	Female (male housing)
5	 BLP00073	 BLP00074
6	 BLP00075	 BLP00076

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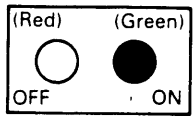
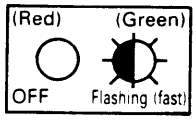
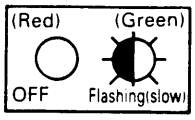
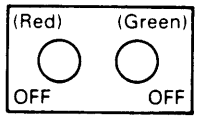
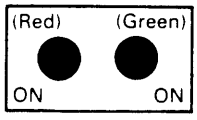
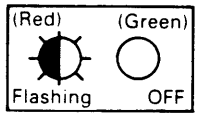
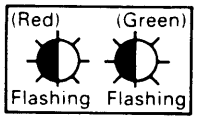
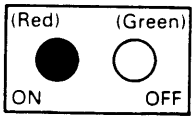
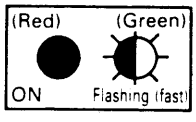
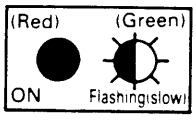
SELF-DIAGNOSTIC DISPLAY OF CONTROLLERS

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

• NORMAL DISPLAY

Normal display	Nature of display	Remarks
	In S mode except during deceleration	
	In H mode or L mode except during deceleration	
	During deceleration	

• ABNORMAL DISPLAY

Abnormal display	Abnormal system	Detection of abnormalities and action
	Abnormality in power source	If the voltage of the power source is less than 15V or more than 36V because of a failure in the alternator or other part, a protection circuit in the electrical circuit is actuated to cut the circuit inside the controller, so both the displays go out.
	Abnormality in controller	If an abnormality occurs in the computer system inside the controller, both displays stay on.
	Abnormality in TVC solenoid system	If there is a short circuit or disconnection in the TVC solenoid system, the solenoid current is set to 0, and the abnormality display is given.
	Abnormality in engine speed sensor system	If there is no output signal or pulse from the sensor for more than the specified time, this is detected, and an abnormality display is given. If this display is given, the TVC solenoid current is increased and the display is continued for 3 minutes. When the engine is started, and when there is a temporary abnormality, the abnormality display is given for 3 minutes, and the display then returns to the normal display.
	Abnormality in potentiometer system	If the input signal from the potentiometer is less than 2V or more than 4V, an abnormality display is given. (The voltage when normal is 2.5 – 3.3 V) When an abnormality is detected, the controller acts in the same way as when the engine is at high idling.
	Abnormality in auto-deceleration solenoid A system	If there is a short circuit or disconnection in the auto-deceleration solenoid A system, the solenoid current is set to 0 and the abnormality display is given. However, if there is an abnormality in both the A and B systems, only the abnormality for the A system is displayed.
	Abnormality in auto-deceleration solenoid B system	If there is a short circuit or disconnection in the auto-deceleration solenoid B system, the solenoid current is set to 0 and the abnormality display is given. However, if there is an abnormality in both the A and B systems, only the abnormality for the A system is displayed.

★ Flashing, flashing (slow): Approx. 2 times per second
Flashing (fast): Approx. 5 times every second

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METHOD OF USING JUDGEMENT TABLE

This judgement table is a tool to judge if the failure in any of the components of the machine control system is due to an abnormality in the electrical system or an abnormality in the hydraulic or mechanical system. This judgement is made before starting the main troubleshooting, and is used to determine from each abnormality the troubleshooting table in the electrical system (E- ○○) or the hydraulic and mechanical system (H- ○○) to go to. There are three types of checks: checks using the self-diagnostic display, checks made by switching the prolix circuit, and checks of the solenoid voltage. Use two of these (marked ● in the chart on the next page) to determine which troubleshooting item to go to.

★ The machine monitor system goes to the main troubleshooting (M- ○○) for the machine monitor directly from the abnormality displayed on the monitor. (See the list of contents of troubleshooting items for the machine monitor system.)

1. **Checks using self-diagnostic display**
   Check if the ● mark matches the abnormality display or normal display on the self-diagnostic display, then follow the arrow (- - →) to go to H-○○ or the next check.
   ★ For details of the self-diagnostic display, see SELF-DIAGNOSTIC DISPLAY OF CONTROLLER.
   ★ Troubleshooting modes Nos. 10 – 18 in the judgement table are not displayed by the self-diagnostic display.
   ★ If the controller is defective and the system is switched to the prolix circuit, the self-diagnostic display will display "Abnormality in controller". If the system is switched to the prolix circuit when the display is giving a normal display, it will display "Abnormality in TVC solenoid system".
   If the prolix switch is turned from ON to OFF, always turn the starting switch off first.

2. **Checks made by switching prolix circuit**
   Check if the problem is removed when the prolix switch is used, and follow the arrow (- - →) to go to E- ○○ or H- ○○ for the main troubleshooting.

3. **Checking solenoid voltage**
   Check at the connector portion of each solenoid to see if the input voltage is normal, then follow the arrow (- - →) to go to E- ○○ or H- ○○ for the main troubleshooting.

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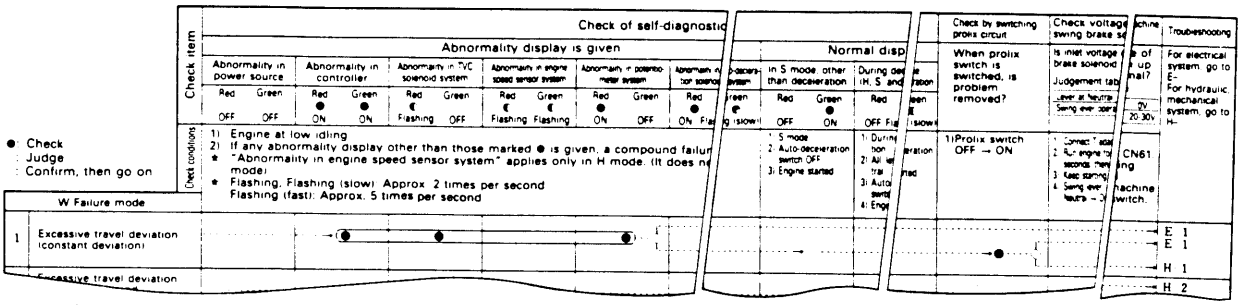
<Example> When failure symptom is [Excessive travel deviation (constant deviation)]

JUDGEMENT TABLE FOR ELECTRICAL SYSTEM OR HYDRAULIC, MECHANICAL SYSTEM

★ Before going to the main trobleshooting chart, judge the location of the failure from the table below.
If it is judged that the failure is in the electrical system, go to troubleshooting for E mode, and if it is judged that the failure is in the hydraulic or mechanical system, go to troubleshooting for H mode.



Procedure 1: Check self-diagnostic display.

Check if the controller is displaying any of the abnormality displays that match any of the ● marks.

Judgement

- If there is related abnormality display ⟶ YES ⟶ Go to troubleshooting E-1
- If there is no related abnormality display ⟶ NO ⟶ Go to Inspection (inspection by switching prolix circuit) for the following ●.

Procedure 2: Checks by switching prolix circuit

Switch the prolix switch, then carry out the same operation as when the problem occurred to see if the same problem occurs again (or to see if the problem has been removed).

Judgement

- Same problem does not appear (original problem has been removed ⟶ YES ⟶ Go to E-1
- Same problem appears (original problem has not been removed ⟶ YES ⟶ Go to E-1

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METHOD OF USING TROUBLESHOOTING CHART

(1) Troubleshooting No. and problem

The top left of the troubleshooting chart gives the troubleshooting number and the problem with the machine.

Categories of failure number

Failure No.	System for troubleshooting
E- ○○	Troubleshooting of electrical system for machine control system
H- ○○	Troubleshooting of hydraulic, mechanical system for machine control system
M- ○○	Troubleshooting of machine monitor system

(2) General precautions

When using the troubleshooting chart, precautions that apply to all items are given at the top of the page under the title and marked with ★.

The precautions marked ★ are not given below the box, but must always be followed when carrying out the check inside the box, or the preparatory work under the box.

(3) Distinguishing conditions

Even with the same problem, the method of troubleshooting may differ according to the model, component, or problem. In such cases, the troubleshooting chart is further divided into sections marked with small letters (for example, a)), so go to the appropriate section to carry out troubleshooting. If the troubleshooting table is not divided into sections, start troubleshooting from the first check item.

(4) Method of following troubleshooting chart

- Check or measure the item inside the box, and according to the answer, follow either the YES line or the NO line to go to the next the box. (Note: the number written at the top right corner of the box is an index number; it does not indicate the order to follow.)
- Following the YES or NO lines according to the results of the check or measurement will lead finally to the Cause column. Check the cause and take the action given in the Remedy column on the right.
- Inside the box there are the methods and locations for inspection or measurement, and the judgment values. If the judgment values below the box are correct or the answer to the question inside the box is YES, follow the YES line; if the judgment value is not correct, or the answer to the question is NO, follow the NO line.
- Below the box are given the preparatory work needed for inspection and measurement, the methods of operation and handling, and the judgment values. If this preparatory work is neglected, or the method of operation or handling is mistaken, there is danger that it may cause mistaken judgment, or the equipment may be damaged. Therefore, before starting inspection or measurement, always read the instructions carefully, and start the work in order from Item 1).

(5) Troubleshooting Tools

When carrying out the troubleshooting, prepare the necessary troubleshooting tools. For details, see TOOLS FOR TESTING, ADJUSTING, AND TROUBLESHOOTING.

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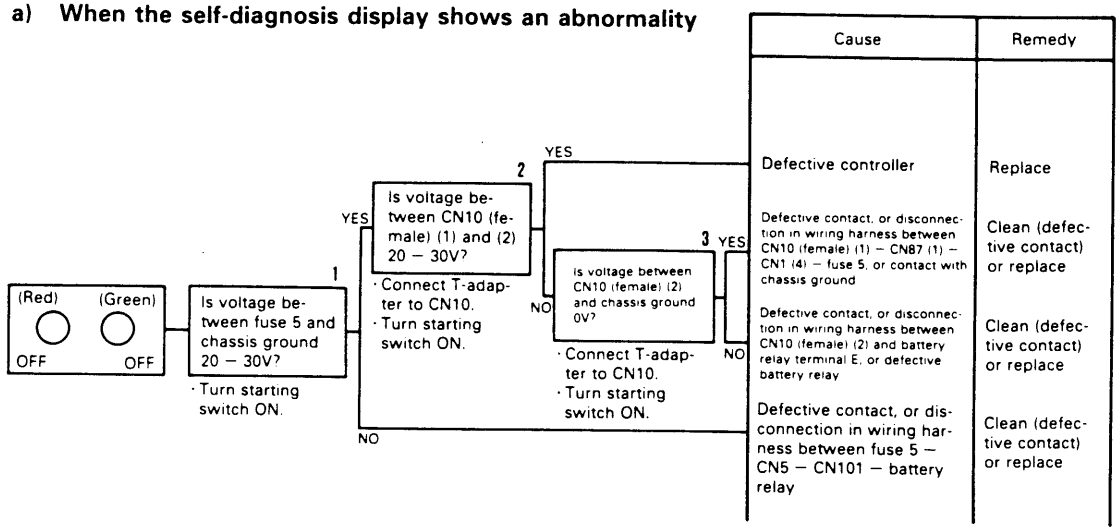
[Example]

(1) ⟶ **E-2 speed of work equipment, swing, travel is extremely slow or lacks power**

(2) ⟶
- ★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
- ★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).
- ★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

(3) ⟶ **a) When the self-diagnosis display shows an abnormality**

(4) ⟶



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TROUBLESHOOTING OF ELECTRICAL SYSTEM (E MODE)

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JUDGEMENT TABLE FOR ELECTRICAL SYSTEM OR HYDRAULIC, MECHANICAL SYSTEM

★ **FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS**

★ Before going to the main troubleshooting chart, judge the location of the failure from the table below. If it is judged that the failure is in the electrical system, go to troubleshooting for E mode, and if it is judged that the failure is in the hydraulic or mechanical system, go to troubleshooting for H mode.

●: Check
: Judge
: Confirm, then go on

	Failure mode	Check item: Check voltage of swing brake solenoid Is inlet voltage of swing brake solenoid normal? Judgement table Lever at Neutral 0V Swing lever operated 20-30V Check conditions: 1) Connect T-adapter to CN58. 2) Run engine for at least 10 seconds, then stop engine. 3) Keep starting switch ON. 4) Swing lever Neutral → Operated	Check item: Check votage of straight-travel solenoid Is inlet voltage of straight-travel solenoid normal? Judgement table Independent operation 0V Compound operation 20-30V Check conditions: 1) Connect T-adapter to CN60. 2) Run engine for at least 10 seconds, then stop engine. 3) Keep starting switch ON. 4) Independent travel operation Compound operation with work equipment	Check item: Check voltage of travel speed solenoid Is inlet voltage of travel speed solenoid normal? Judgement table Lo 0V Hi 20-30V Check conditions: 1) Connect T-adapter to CN57. 2) Keep starting switch ON. 3) Operate travel speed switch.	Check item: Check voltage of heavy lift solenoid Is inlet voltage of heavy lift solenoid normal? Judgement table Boom RAISE 0V Lever at Neutral 20-30V Check conditions: 1) Connect T-adapter to CN62. 2) Run engine for at least 10 seconds, then stop engine. 3) Keep heavy lift switch ON. 4) Raise boom.	Check item: Check voltage of machine push up solenoid Is inlet voltage of machine push up solenoid normal? Judgement table Switch ON 0V Switch OFF 20-30V Check conditions: 1) Connect T-adapter to CN61. 2) Keep starting switch ON. 3) Operate machine pushup switch.	Check item: Check voltage of TVC solenoid Is inlet voltage of TVC solenoid normal? Judgement table S mode 0V L mode 10-14V Check conditions: 1) Connect T-adapter to CN13. 2) Keep starting switch ON. 3) Operate mode selection switch.	Troubleshooting For electrical system, go to E- For hydraulic, mechanical system, go to H-
1	Excessive travel deviation (constant deviation)							H-1
2	Excessive travel deviation (during compound operations)		●					H-2 E-9
3	Excessive travel deviation (when starting)							H-3
4	Control levers are heavy							H-4
5	Work equipment, travel, swing start to move suddenly							H-5
6	Speed of work equipment, swing, travel is extremely slow or lacks power.							H-6
7	Engine stalls or engine speed drops during operations							H-7
8	Output does not change when mode selector switch is operated						●	H-8 E-4
9	Abnormal noise is generated from around pump							H-10
10	Swing speed is slow, or there is excessive overrun when stopping swing							H-11
11	Upper structure does not swing	●						H-12 E-6
12	Excessive hydraulic drift of swing	●						H-13 E-6
13	Excessive hydraulic drift of work equipment							H-14
14	Excessive time lag of work equipment							H-15
15	Travel speed does not change			●				H-16 E-10
16	Defective actuation of heavy lift function (boom RAISE pressure does not increase, or increases but does not go down)				●			H-17 E-11
17	Defective actuation of machine push up function (boom LOWER pressure does not increase, or increases but does not go down: BACK HOE)					●		H-18 E-8

★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION

★ Before going to the main trobleshooting chart, judge the location of the failure from the table below.
If it is judged that the failure is in the electrical system, go to troubleshooting for E mode, and if it is judged that the failure is in the hydraulic or mechanical system, go to troubleshooting for H mode.

●: Check
◌: Judge
○: Confirm, then go on

Failure mode		Check item / Check conditions	Abnormality in power source (Red ○ OFF, Green ○ OFF)	Abnormality in controller (Red ● ON, Green ● ON)	Abnormality in TVC solenoid system (Red ◐ Flashing, Green ○ OFF)	Abnormality in engine speed sensor system (Red ◐ Flashing, Green ◐ Flashing)	Abnormality in potentiometer system (Red ● ON, Green ○ OFF)	Abnormality in auto-deceleration solenoid A system (Red ●, Green ◐ Flashing (fast))	Abnormality in auto-deceleration solenoid B system (Red ●, Green ◐ Flashing (slow))	Normal display: In S mode, other than deceleration (Red ◌ OFF, Green ● ON)	Normal display: During deceleration (H, S, and L mode) (Red ◌ OFF, Green ◐ Flashing (fast))	Normal display: In H or L mode, other than deceleration (Red ◌ OFF, Green ◐ Flashing (slow))	Check by switching prolix circuit: When prolix switch is switched, is problem removed?	Check voltage of swing brake solenoid: Is inlet voltage of swing brake solenoid normal? Judgement table (Lever at Neutral: 0V; Swing lever operated: 20-30V)	Check voltage of straight-travel solenoid: Is inlet voltage of straight-travel solenoid normal? Judgement table (Independent operation: 0V; Compound operation: 20-30V)	Check voltage of travel speed solenoid: Is inlet voltage of travel speed solenoid normal? Judgement table (Lo: 0V; Hi: 20-30V)	Check voltage of heavy lift solenoid: Is inlet voltage of heavy lift solenoid normal? Judgement table (Boom RAISE: 0V; Lever at Neutral: 20-30V)	Check voltage of machine push up solenoid: Is inlet voltage of machine push up solenoid normal? Judgement table (Switch ON: 0V; Switch OFF: 20-30V)	Troubleshooting: For electrical system, go to E-○○. For hydraulic, mechanical system, go to H-○○
		Check conditions	1) Engine at low idling 2) If any abnormality display other than those marked ● is given, a compound failure has occurred. ★ "Abnormality in engine speed sensor system" applies only in H mode. (It does not apply in S or L mode) ★ Flashing, Flashing (slow): Approx. 2 times per second Flashing (fast): Approx. 5 times per second								1) S mode 2) Auto-deceleration switch OFF 3) Engine started	1) During deceleration 2) All levers at Neutral 3) Auto-deceleration switch ON 4) Engine started	1) H, L mode 2) Auto-deceleration switch OFF 3) Engine started	1) Prolix switch OFF → ON	1) Connect T-adapter to CN58. 2) Run engine for at least 10 seconds, then stop engine. 3) Keep starting switch ON. 4) Swing lever Neutral → Operated	1) Connect T-adapter to CN60. 2) Run engine for at least 10 seconds, then stop engine. 3) Keep starting switch ON. 4) Independent travel operation Compound operation with work equipment	1) Connect T-adapter to CN57. 2) Keep starting switch ON. 3) Operate travel speed switch.	1) Connect T-adapter to CN62. 2) Run engine for at least 10 seconds, then stop engine. 3) Keep heavy lift switch ON. 4) Raise boom.	1) Connect T-adapter to CN61. 2) Keep starting switch ON. 3) Operate machine push-up switch.	
1	Excessive travel deviation (constant deviation)		●	●	●	●	●	◇					● ◇						E-1 E-1 H-1
2	Excessive travel deviation (during compound operations)													● ◇					H-2 E-9
3	Excessive travel deviation (when starting)																		H-3
4	Control levers are heavy																		H-4
5	Work equipment, travel, swing start to move suddenly																		H-5
6	Speed of work equipment, swing, travel is extremely slow or lacks power.		●	●	●	●	●	◇		○				● ◇					E-2 H-6 E-2
7	Engine stalls or engine speed drops during operations		●	●	●	●	●	◇		○			● ◇						E-3 E-3 H-7
8	Output does not change when mode selector switch is operated		●	●	● ◇					○	● ◇								E-4 H-8 E-4
9	Auto-deceleration function does not work properly (there is no deceleration or deceleration stays on)		●	●				●	◇	○	● ◇								E-5 H-9 E-5
10	Abnormal noise is generated from around pump																		H-10
11	Swing speed is slow, or there is excessive overrun when stopping swing																		H-11
12	Upper structure does not swing									○				● ◇					H-12 E-6
13	Excessive hydraulic drift of swing									○				● ◇					H-13 E-6
14	Excessive hydraulic drift of work equipment																		H-14
15	Excessive time lag of work equipment																		H-15
16	Travel speed does not change															● ◇			H-16 E-10
17	Defective actuation of heavy lift function (boom RAISE pressure does not increase, or increases but does not go down)																● ◇		H-17 E-11
18	Defective actuation of machine push up function (boom LOWER pressure does not increase, or increases but does not go down.) (BACK HOE)																	● ◇	H-18 E-8

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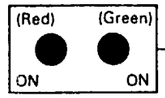
E-1 Excessive deviation when traveling (constant deviation)

★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

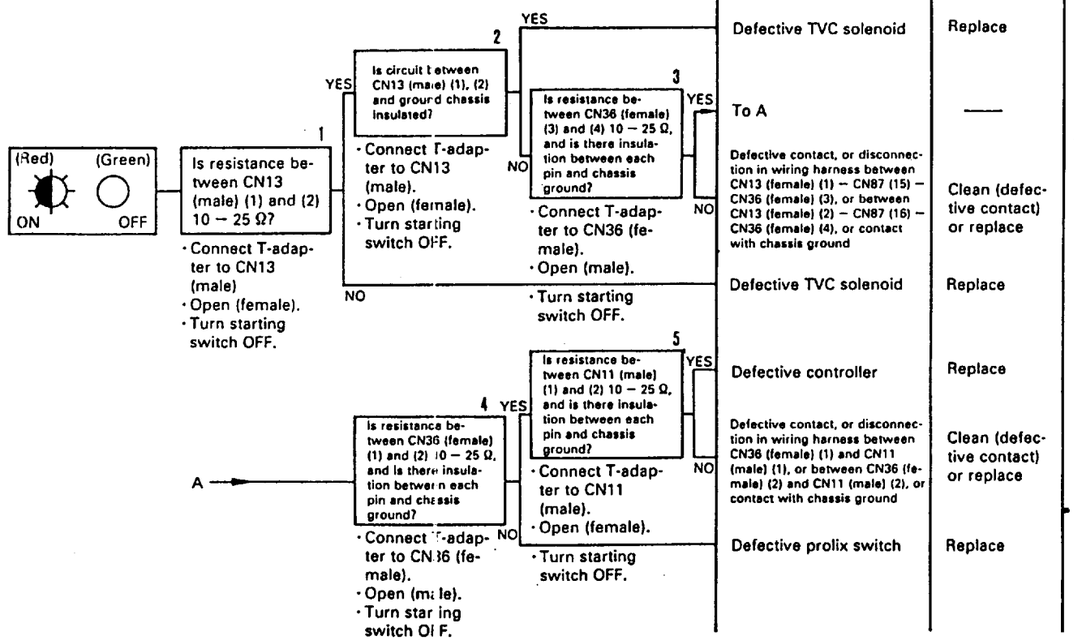
a) When the self-diagnosis display shows an abnormality

· **Abnormality in controller**



Cause	Remedy
Defective controller	Replace

· **Abnormality in TVC solenoid system**



Cause	Remedy
Defective TVC solenoid	Replace
To A	——
Defective contact, or disconnection in wiring harness between CN13 (female) (1) – CN87 (15) – CN36 (female) (3), or between CN13 (female) (2) – CN87 (16) – CN36 (female) (4), or contact with chassis ground	Clean (defective contact) or replace
Defective TVC solenoid	Replace
Defective controller	Replace
Defective contact, or disconnection in wiring harness between CN36 (female) (1) and CN11 (male) (1), or between CN36 (female) (2) and CN11 (male) (2), or contact with chassis ground	Clean (defective contact) or replace
Defective prolix switch	Replace

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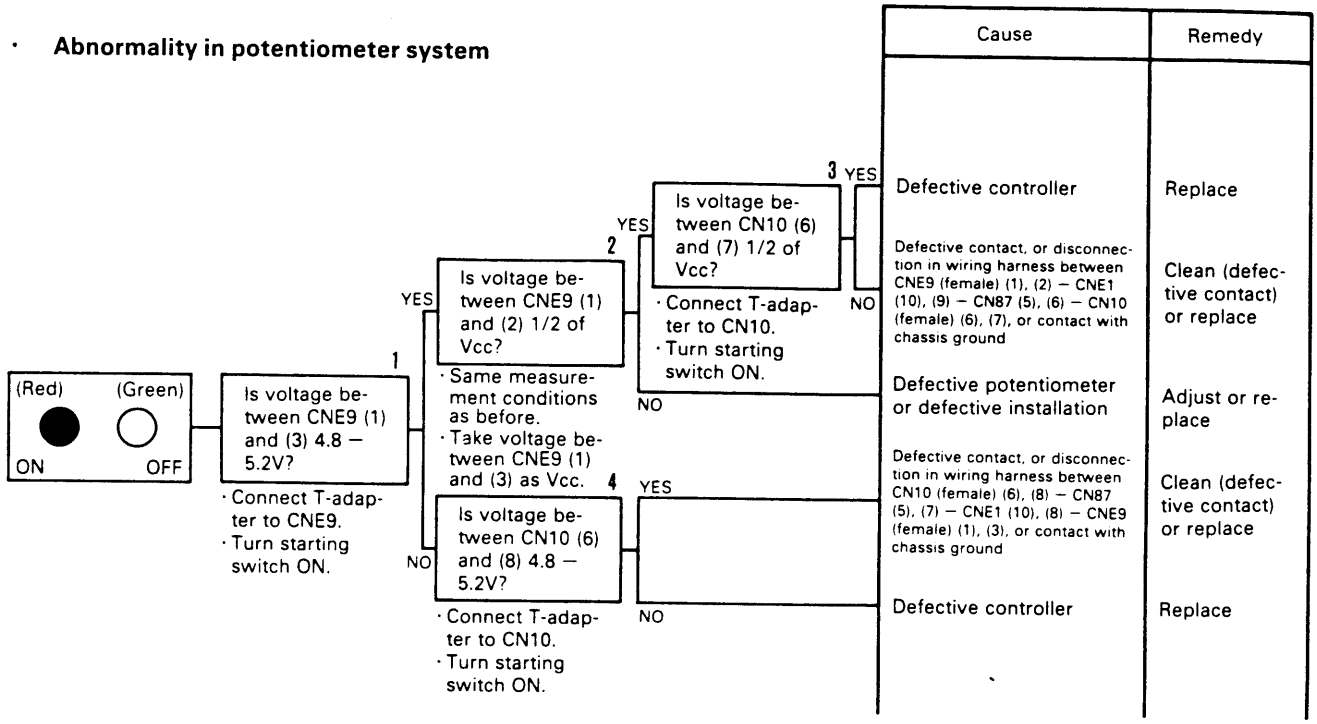
- **Abnormality in potentiometer system**



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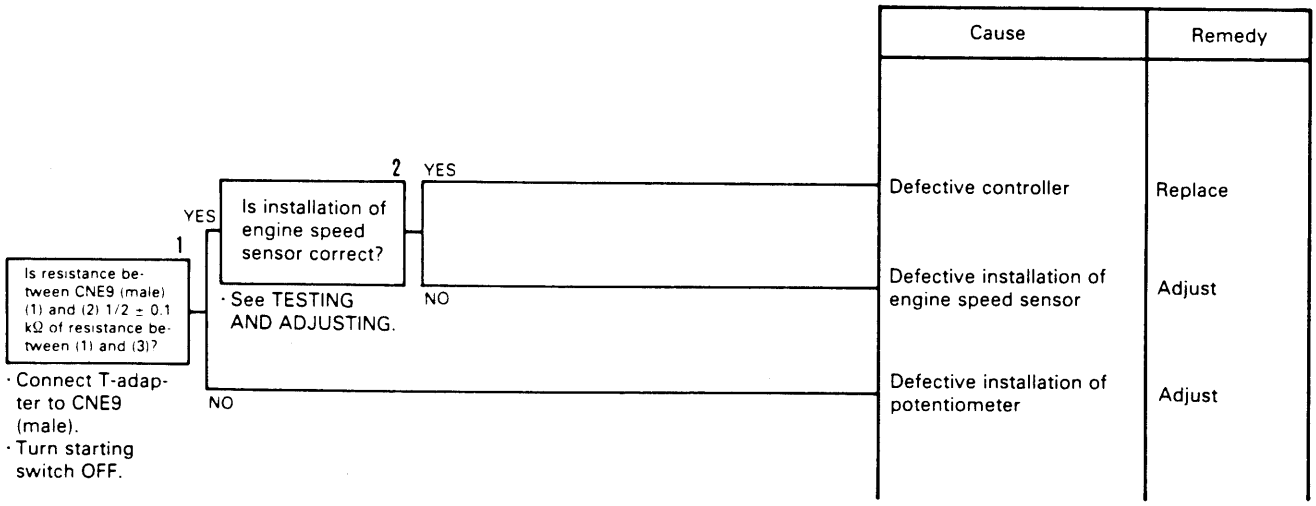
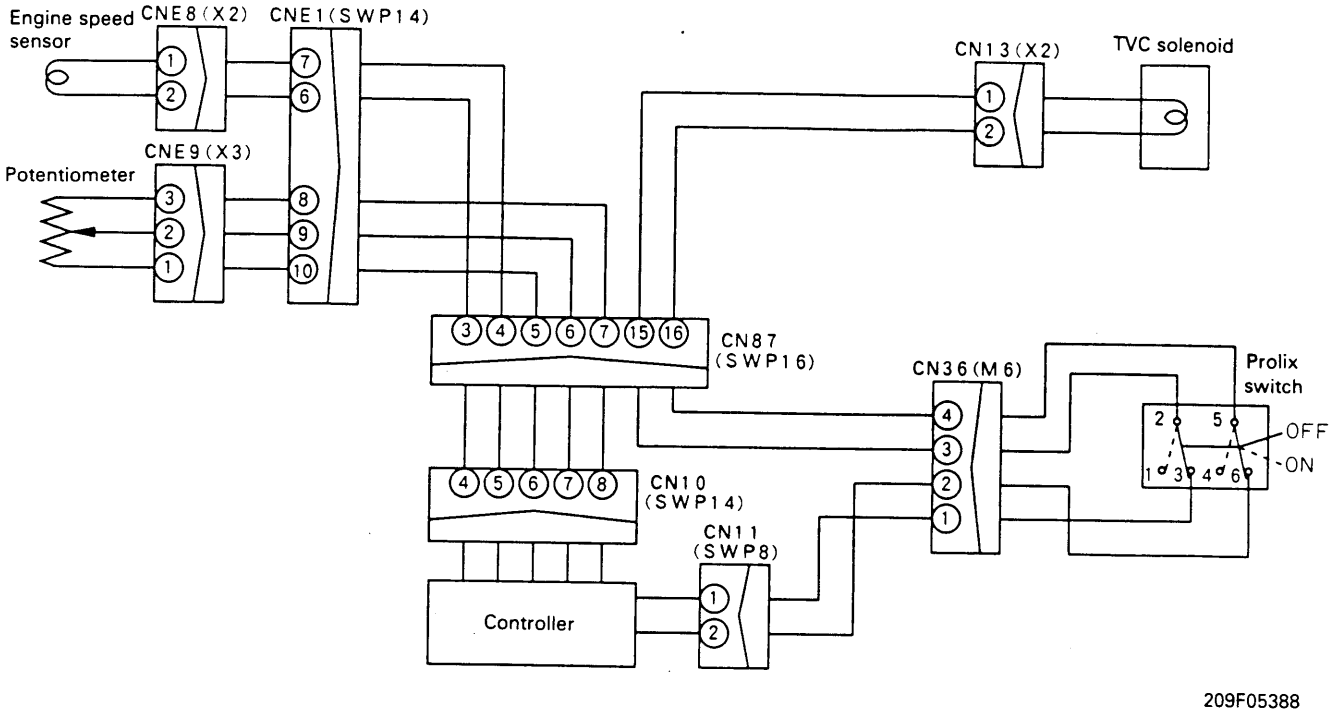
b) When switching to prolix circuit and condition changes (but self-diagnosis display shows normal display)




Engine speed sensor
CNE8 (X2)
CNE1 (SWP14)
CNE9 (X3)
Potentiometer
CN13 (X2)
TVC solenoid
CN87 (SWP16)
CN36 (M6)
Prolix switch
OFF
ON
CN10 (SWP14)
CN11 (SWP8)
Controller
209F05388

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E-2 Speed of work equipment, swing, travel is extremely slow or lacks power

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

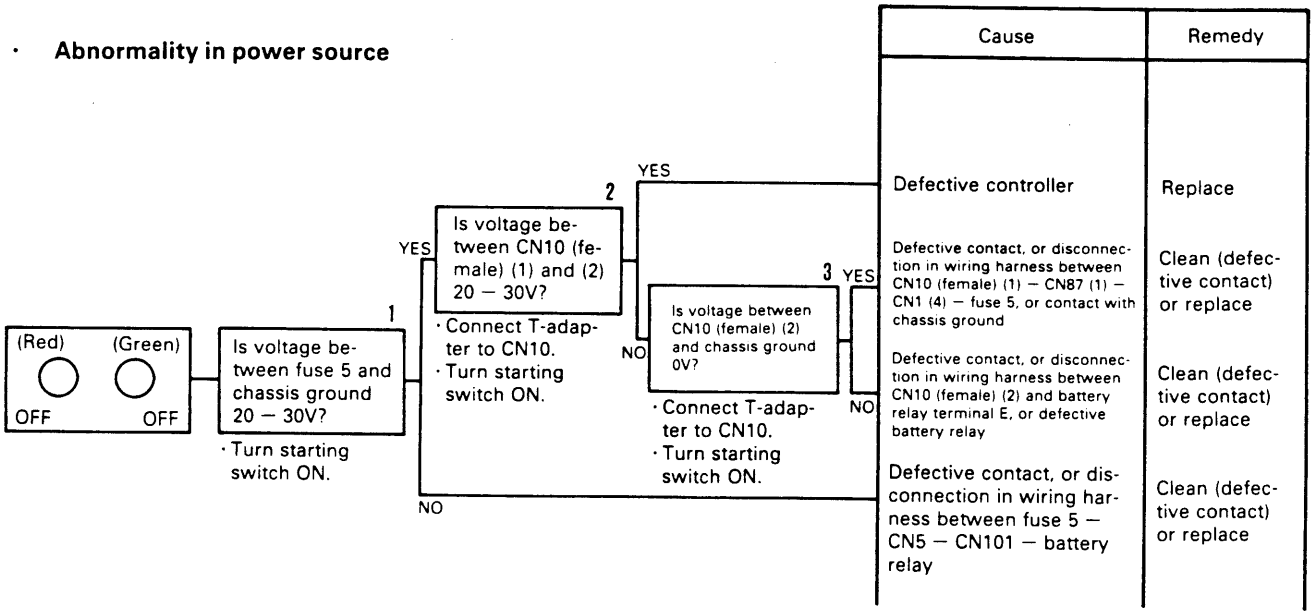
★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.

★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).

★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

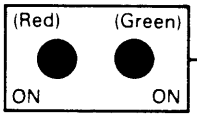
a) When the self-diagnosis display shows an abnormality

· **Abnormality in power source**



Cause	Remedy
Defective controller	Replace
Defective contact, or disconnection in wiring harness between CN10 (female) (1) — CN87 (1) — CN1 (4) — fuse 5, or contact with chassis ground	Clean (defective contact) or replace
Defective contact, or disconnection in wiring harness between CN10 (female) (2) and battery relay terminal E, or defective battery relay	Clean (defective contact) or replace
Defective contact, or disconnection in wiring harness between fuse 5 — CN5 — CN101 — battery relay	Clean (defective contact) or replace

· **Abnormality in controller**



Cause	Remedy
Defective controller	Replace

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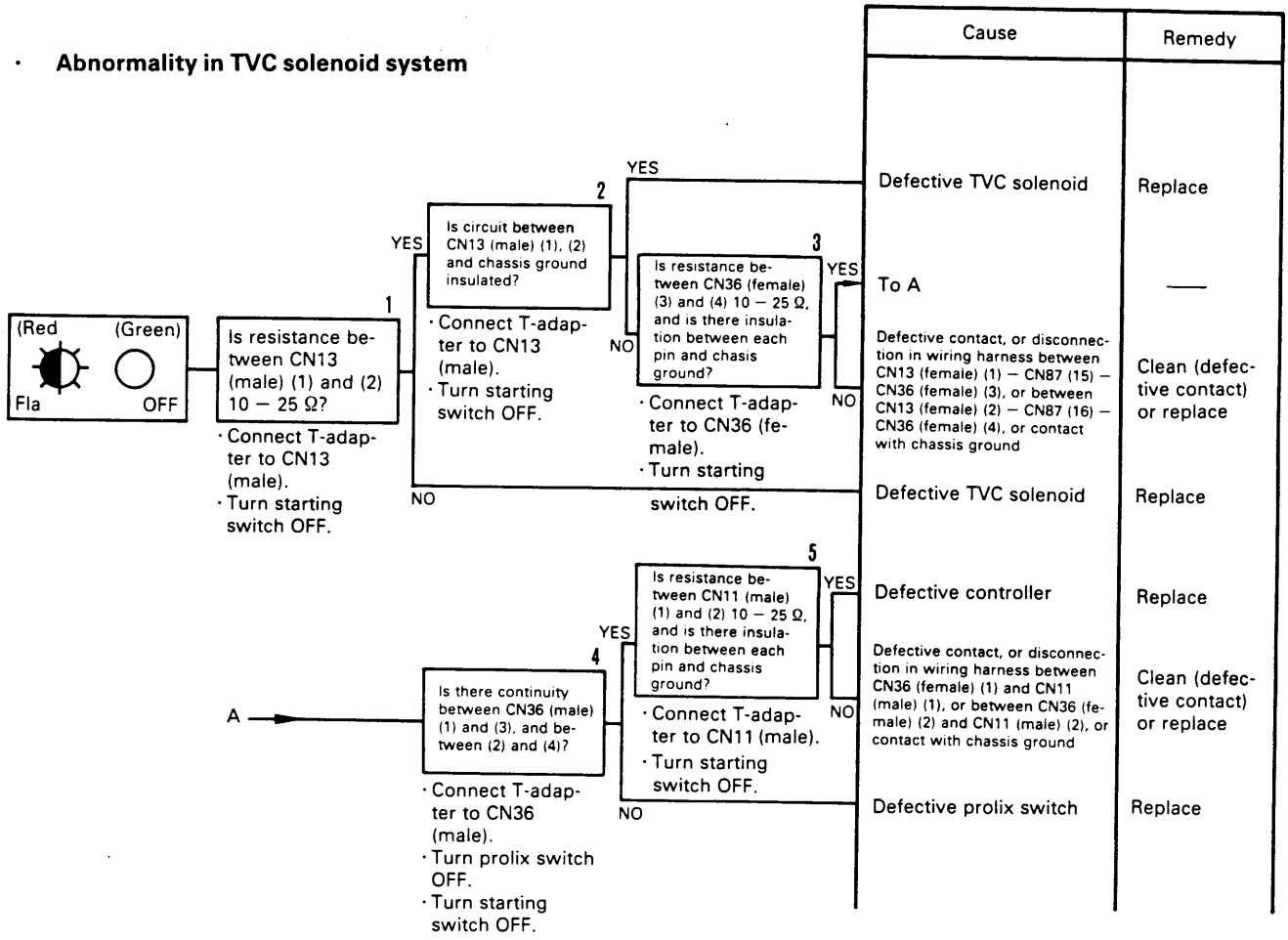
· Abnormality in TVC solenoid system



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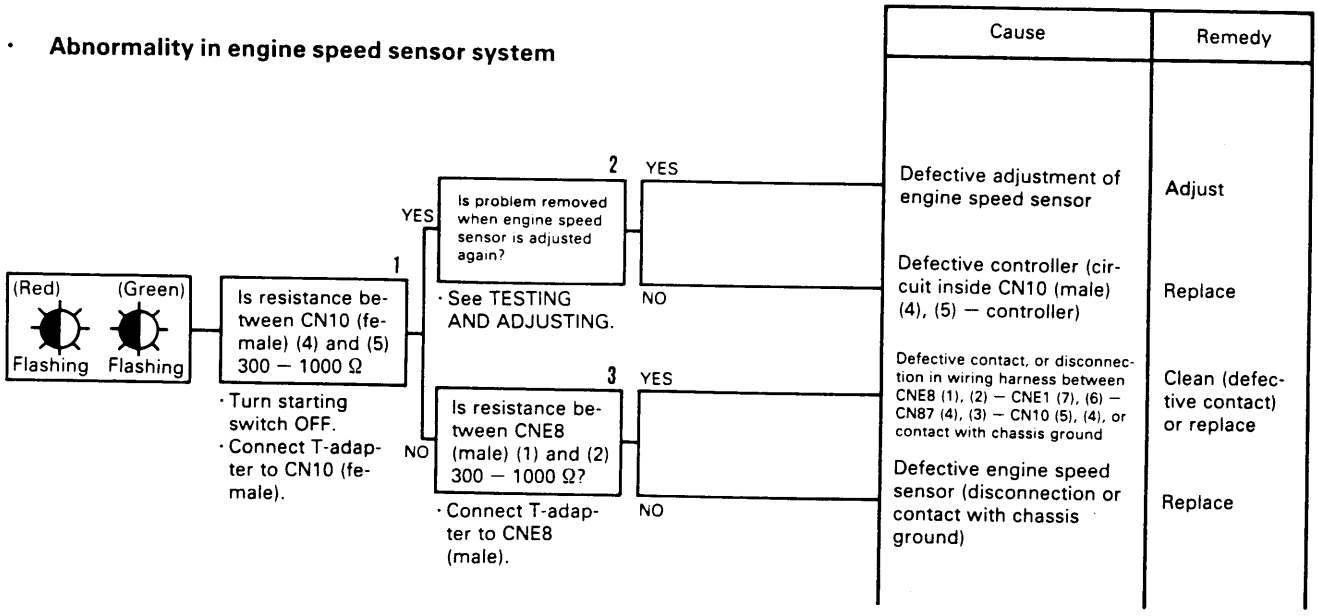
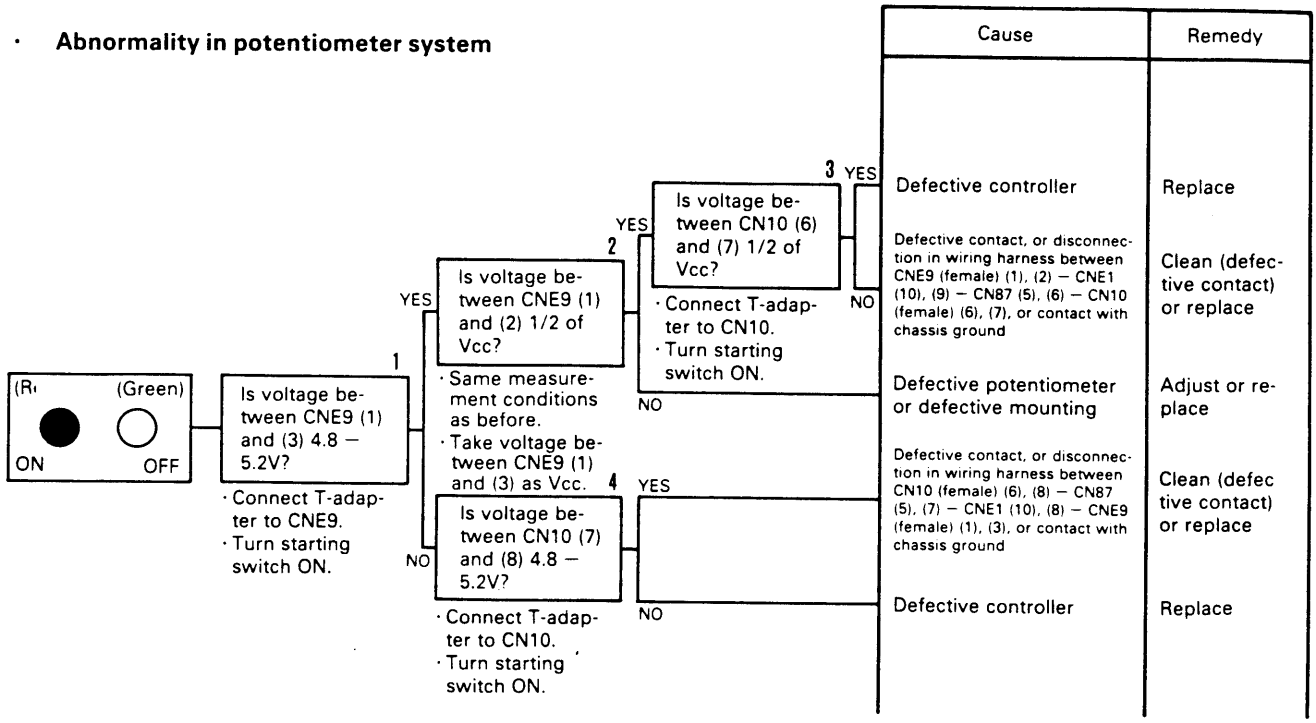
· Abnormality in engine speed sensor system



- **Abnormality in potentiometer system**



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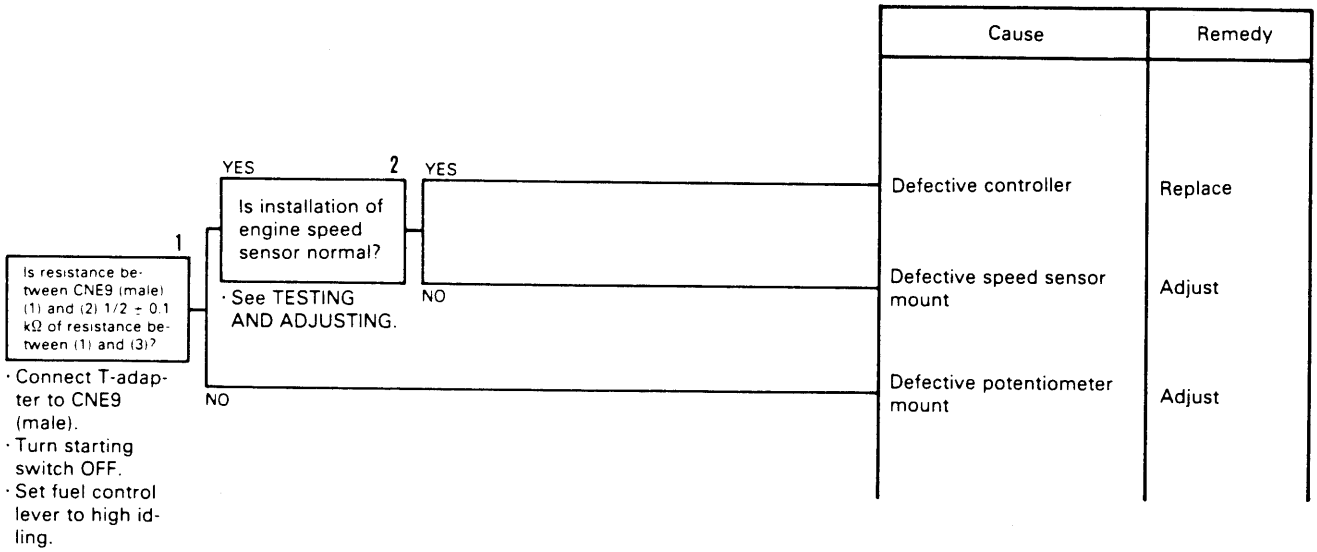
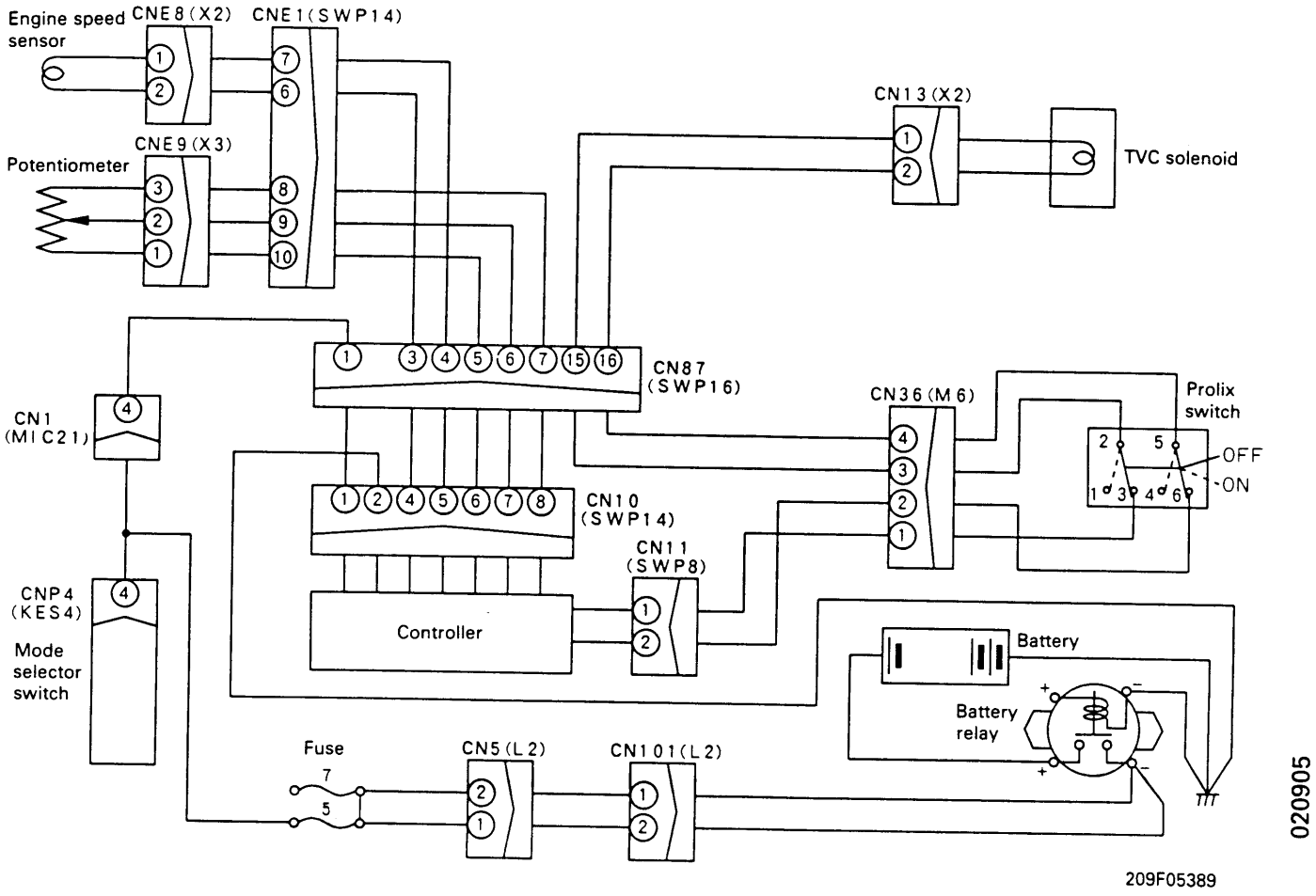
b) When switching to prolix circuit and condition changes




Engine speed sensor
CNE8 (X2)
CNE1 (SWP14)
CNE9 (X3)
Potentiometer
CN13 (X2)
TVC solenoid
CN87 (SWP16)
CN1 (MIC21)
CN36 (M6)
Prolix switch
OFF
ON
CN10 (SWP14)
CN11 (SWP8)
CNP4 (KES4)
Mode selector switch
Controller
Battery
Battery relay
Fuse
CN5 (L2)
CN101 (L2)
209F05389

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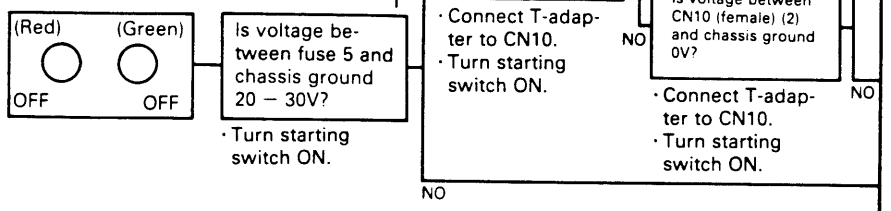
E-3 Engine stalls during operations or engine speed drops

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connecor specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

a) When the self-diagnosis display shows an abnormality

· **Abnormality in power source**



Cause	Remedy
Defective controller	Replace
Defective contact, or disconnection in wiring harness between CN10 (female) (1) – CN87 (1) – CN1 (female) (4) – fuse 5, or contact with chassis ground	Clean (defective contact) or replace
Defective contact, or disconnection in wiring harness between fuse 5 – CN5 – CN101 – battery relay	Clean (defective contact) or replace
Defective contact, or disconnection in wiring harness between CN1 (male) (4) – fuse 5 – CN5 (1), (2) – CN101 (2), (1) – battery relay	Clean (defective contact) or replace

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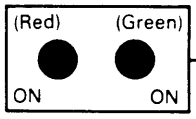
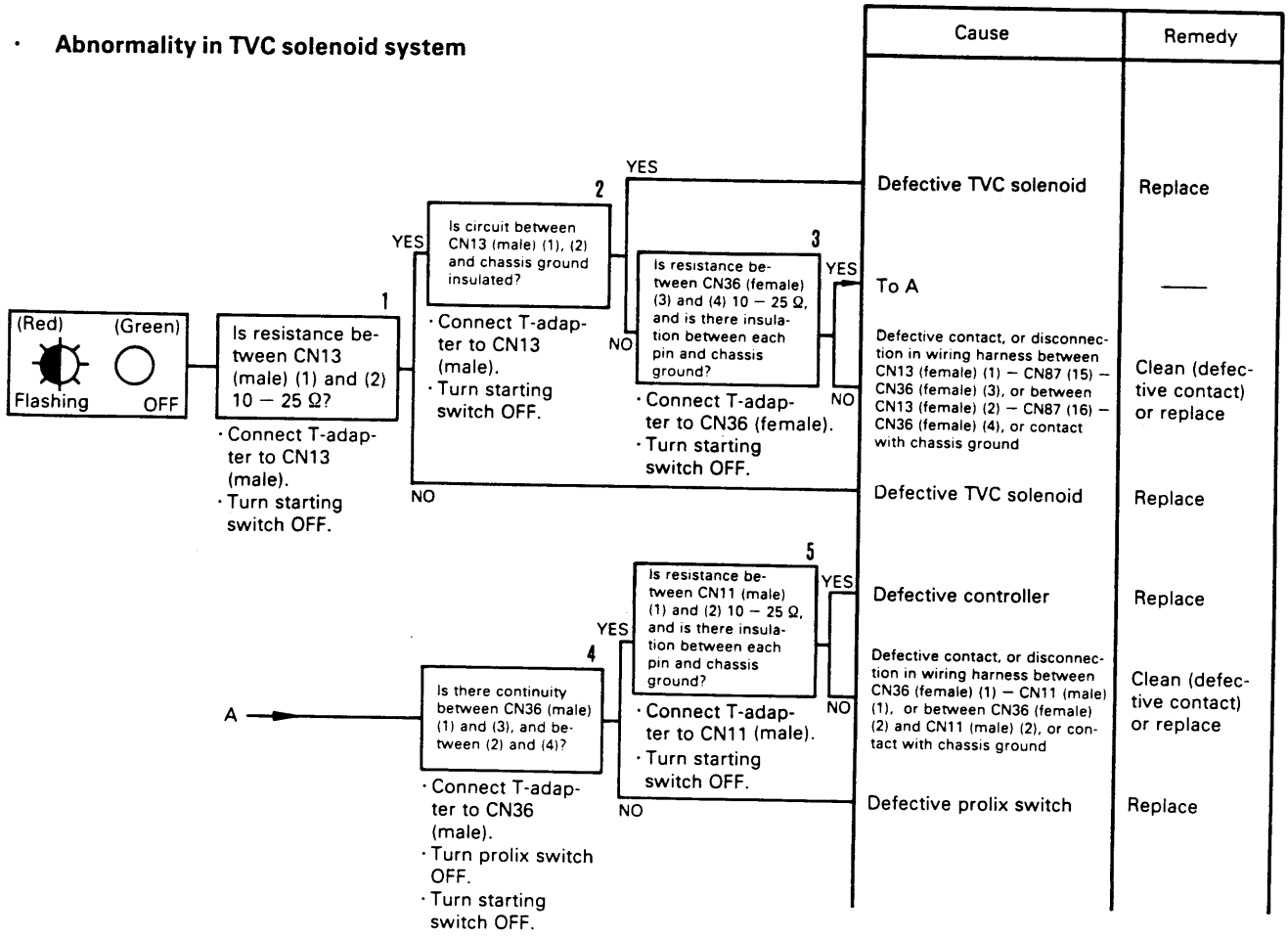
· **Abnormality in controller**



Cause	Remedy
Defective controller	Replace

- **Abnormality in TVC solenoid system**



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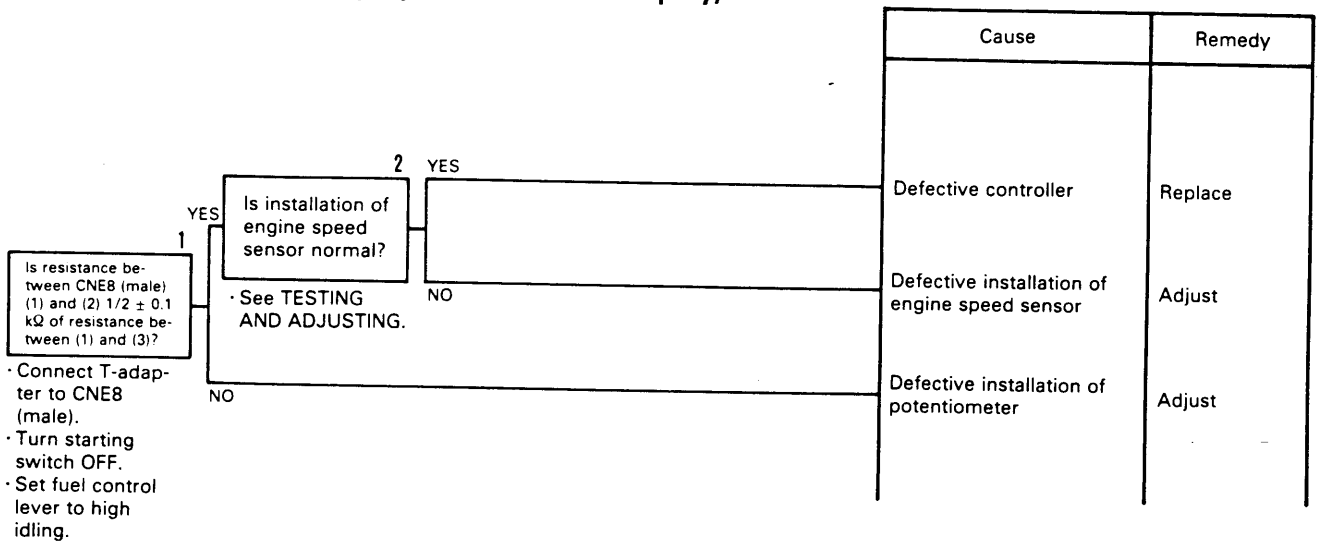
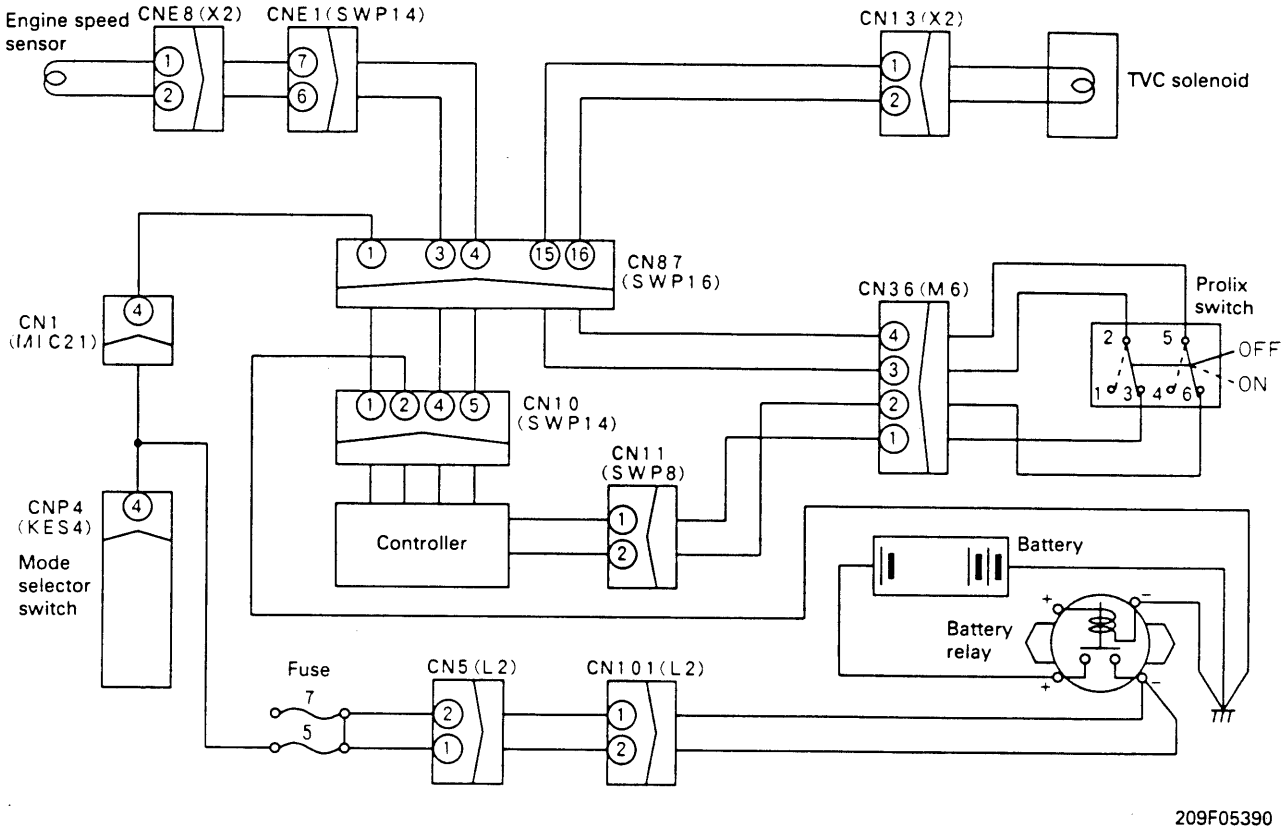
b) When switching to prolix circuit and condition changes (but self-diagnosis display shows normal display)




Engine speed sensor
CNE8 (X2)
CNE1 (SWP14)
CN13 (X2)
TVC solenoid
CN87 (SWP16)
CN1 (MIC21)
CN36 (M6)
Prolix switch
OFF
ON
CN10 (SWP14)
CN11 (SWP8)
CNP4 (KES4)
Mode selector switch
Controller
Battery
Battery relay
Fuse
CN5 (L2)
CN101 (L2)
209F05390

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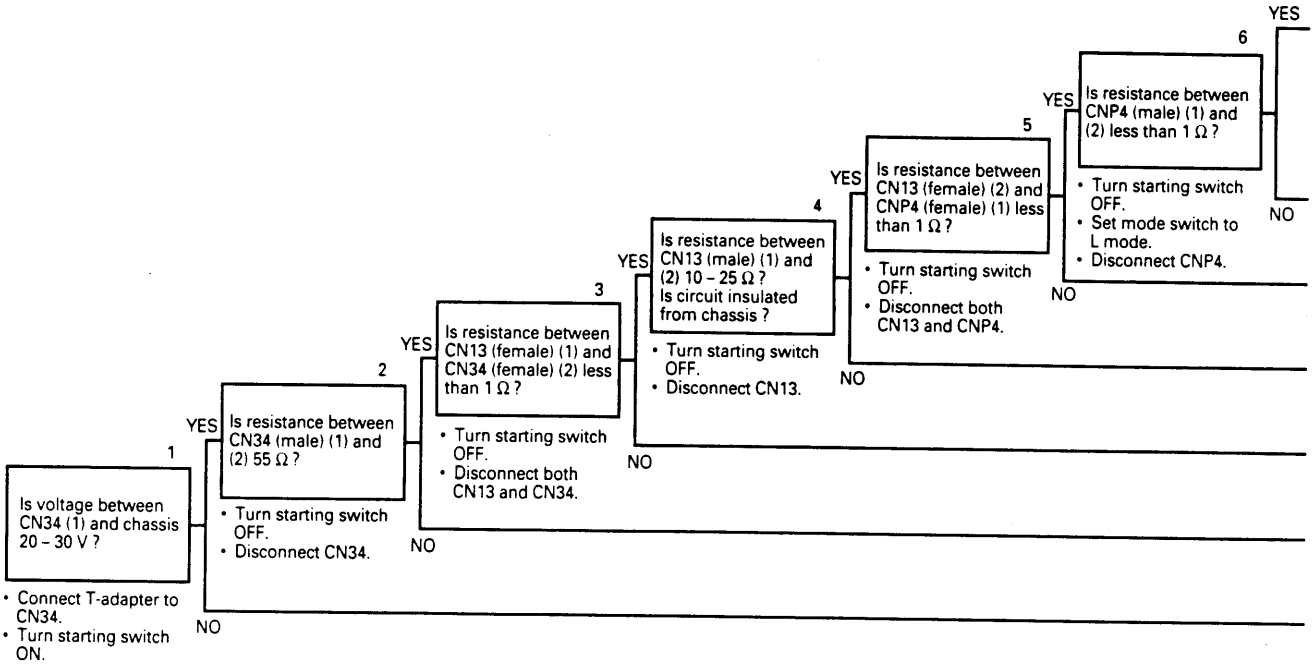
E-4 Even when mode selector switch is switched, output does not change

★ **FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS**

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

a) Stays in S mode and does not change to L mode

★ The monitor panel works normally.



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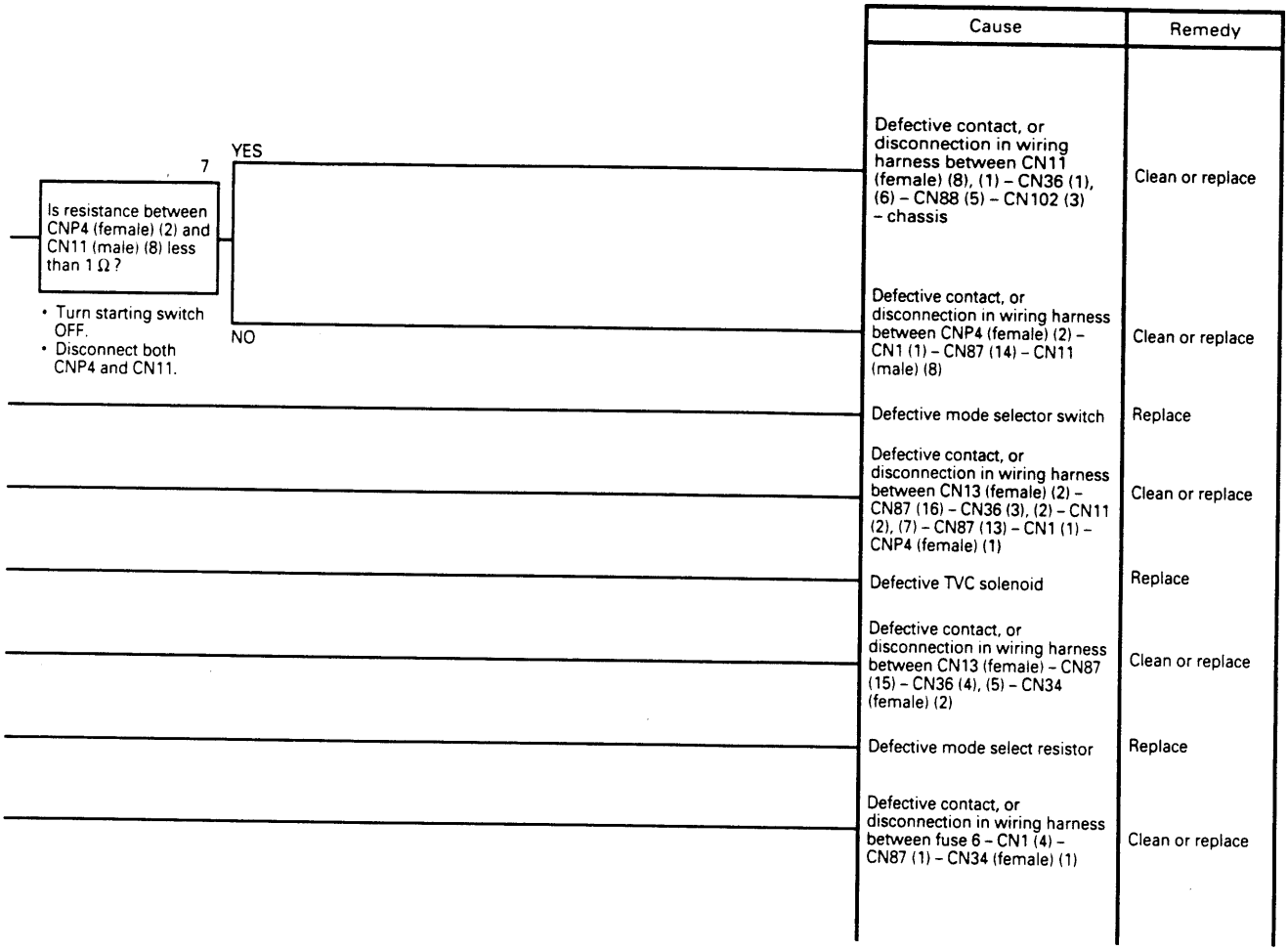

Cause	Remedy
Defective contact, or disconnection in wiring harness between CN11 (female) (8), (1) – CN36 (1), (6) – CN88 (5) – CN102 (3) – chassis	Clean or replace
Defective contact, or disconnection in wiring harness between CNP4 (female) (2) – CN1 (1) – CN87 (14) – CN11 (male) (8)	Clean or replace
Defective mode selector switch	Replace
Defective contact, or disconnection in wiring harness between CN13 (female) (2) – CN87 (16) – CN36 (3), (2) – CN11 (2), (7) – CN87 (13) – CN1 (1) – CNP4 (female) (1)	Clean or replace
Defective TVC solenoid	Replace
Defective contact, or disconnection in wiring harness between CN13 (female) – CN87 (15) – CN36 (4), (5) – CN34 (female) (2)	Clean or replace
Defective mode select resistor	Replace
Defective contact, or disconnection in wiring harness between fuse 6 – CN1 (4) – CN87 (1) – CN34 (female) (1)	Clean or replace

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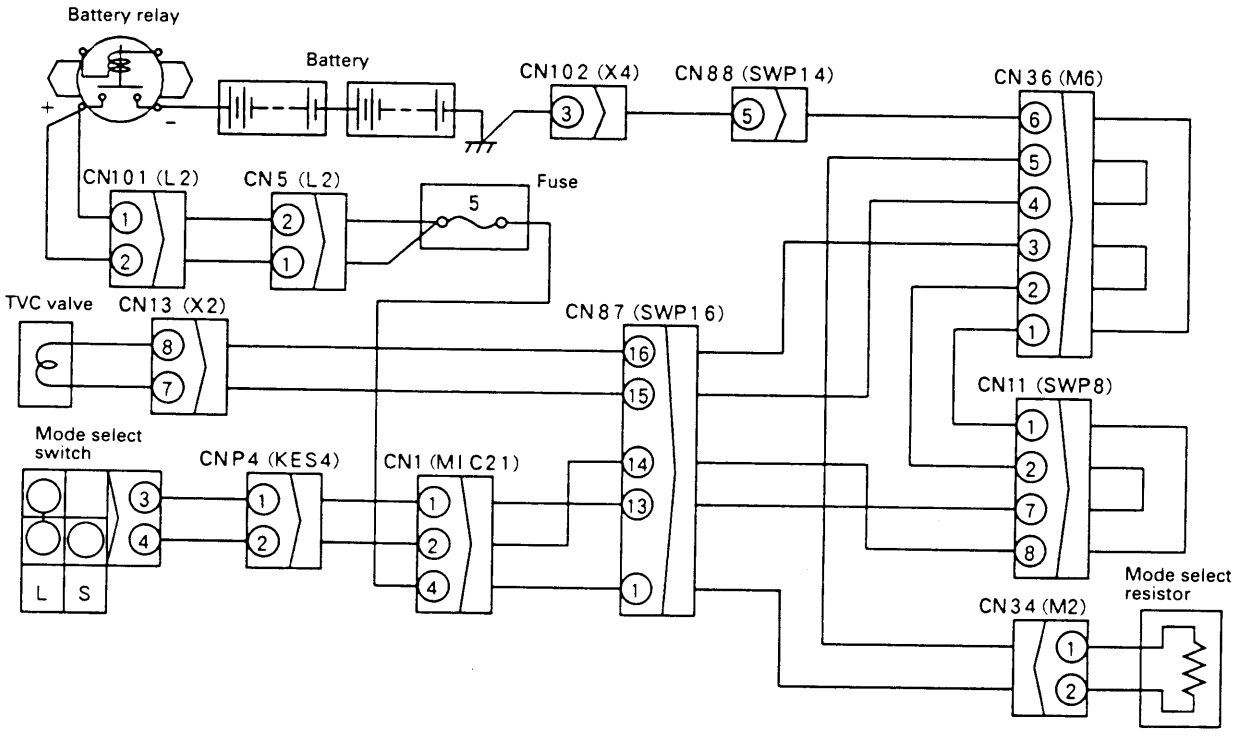
b) Stays in L mode and does not change to S mode

	Cause	Remedy
1 Does mode selector switch work as shown in Table 1 ? • Connect T-adapter to CNP4 (male). • Turn starting switch OFF.	YES: Contact with ground cable, or short circuit with ground in wiring harness between CNP4 (female) (1) – CN1 (1) – CN87 (13) – CN11 (7), (2) – CN36 (2), (3) – CN87 (16) – CN13 (female) (2)	Clean or replace
	NO: Defective mode selector switch	Replace

Table 1

Mode selector switch	Resistance between CNP4 (male) (1) and (2)
L mode	Max. 1 Ω
S mode	Min. 1 MΩ



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020905

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.

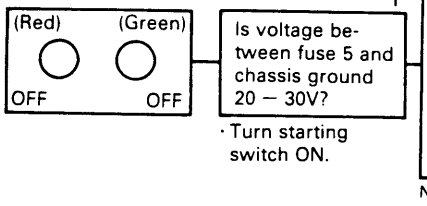
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).

★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

a) When the self-diagnosis display shows an abnormality

· **Abnormality in power source**

· **Abnormality in power source**



1 Is voltage between fuse 5 and chassis ground 20 — 30V?
· Turn starting switch ON.

YES

2 Is voltage between CN10 (female) (1) and (2) 20 — 30V?
· Connect T-adapter to CN10.
· Turn starting switch ON.

NO

YES

3 Is voltage between CN10 (female) (2) and chassis ground 0V?
· Connect T-adapter to CN10.
· Turn starting switch ON.

NO

Cause	Remedy
Defective controller	Replace
Defective contact, or disconnection in wiring harness between CN10 (female) (1) — CN87 (1) — CN1 (4) — fuse 5, or contact with chassis ground	Clean (defective contact) or replace
Defective contact, or disconnection in wiring harness between CN10 (female) (2) and battery relay terminal E, or contact with chassis ground	Clean (defective contact) or replace
Defective contact, or disconnection in wiring harness between fuse 5 — CN5 — CN101 — battery relay	Clean (defective contact) or replace

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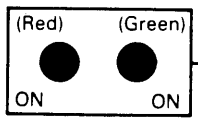
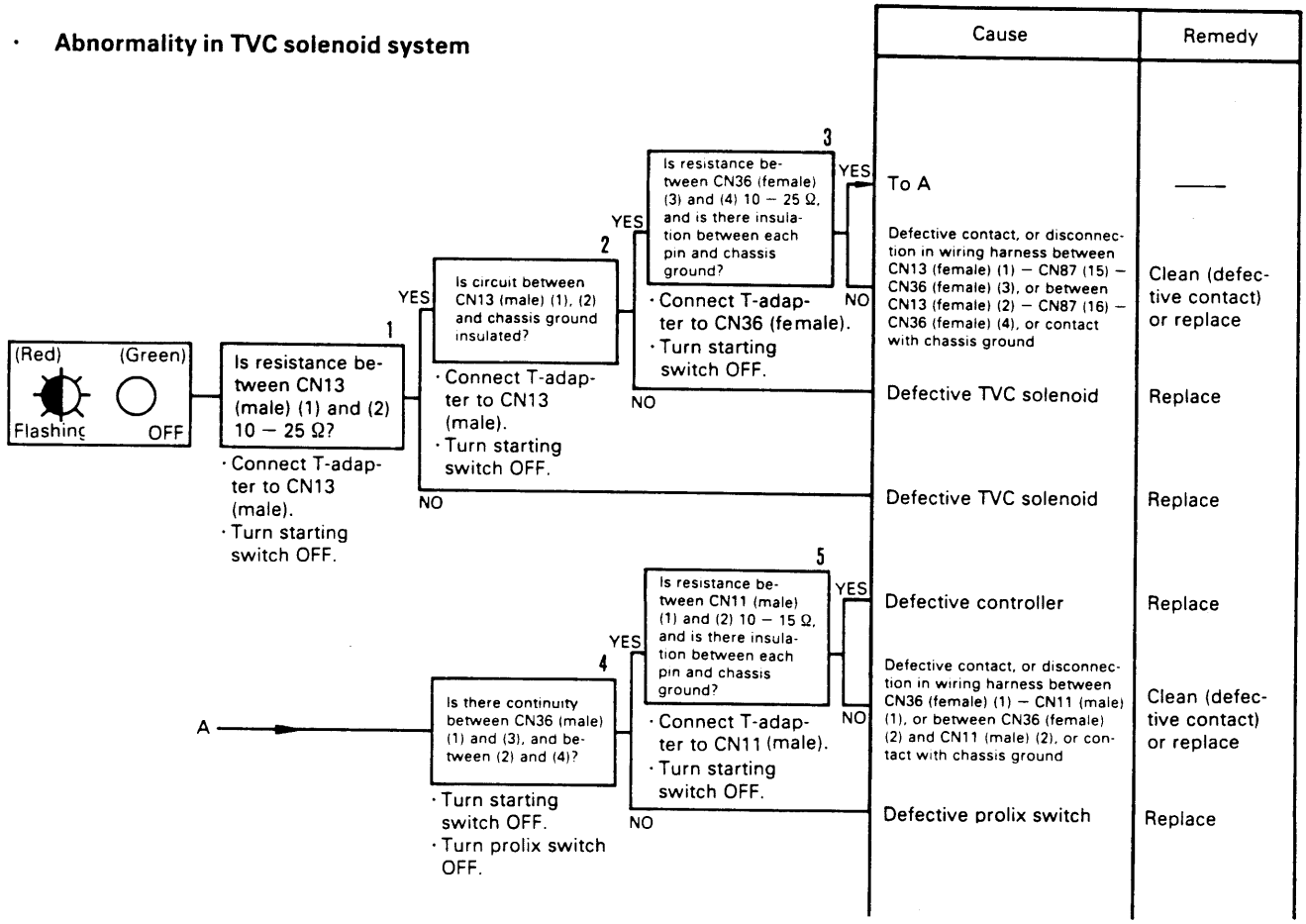
· **Abnormality in controller**



Cause	Remedy
Defective controller	Replace

- **Abnormality in TVC solenoid system**



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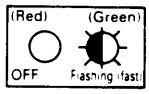
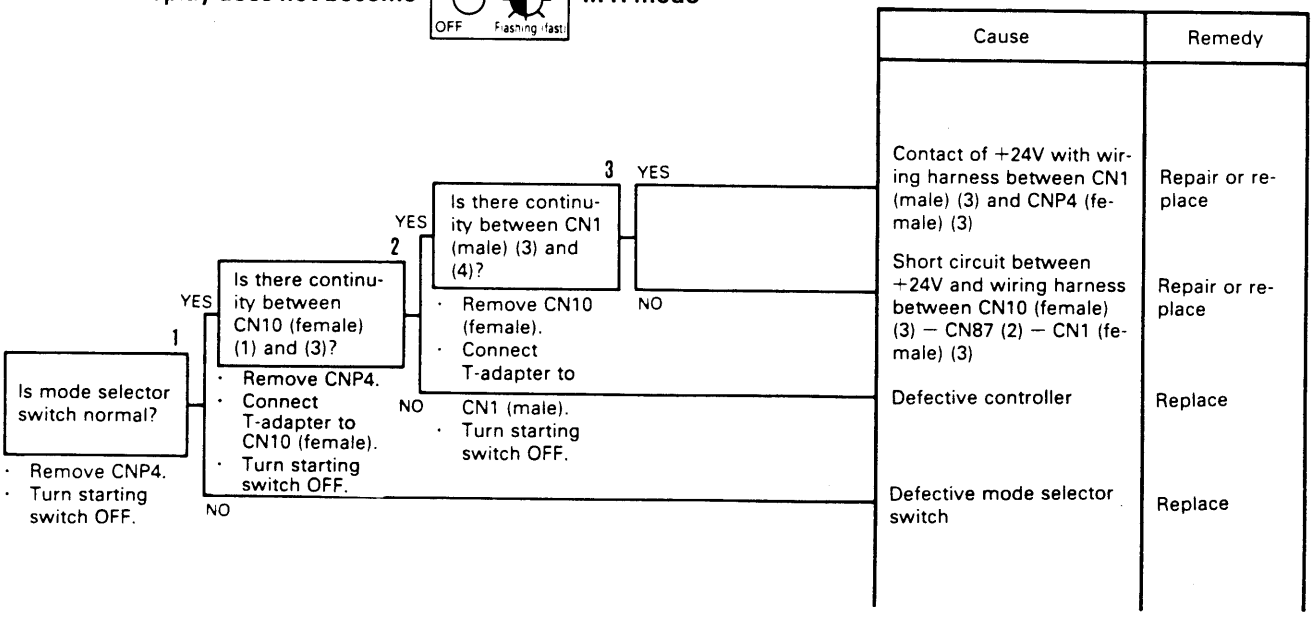
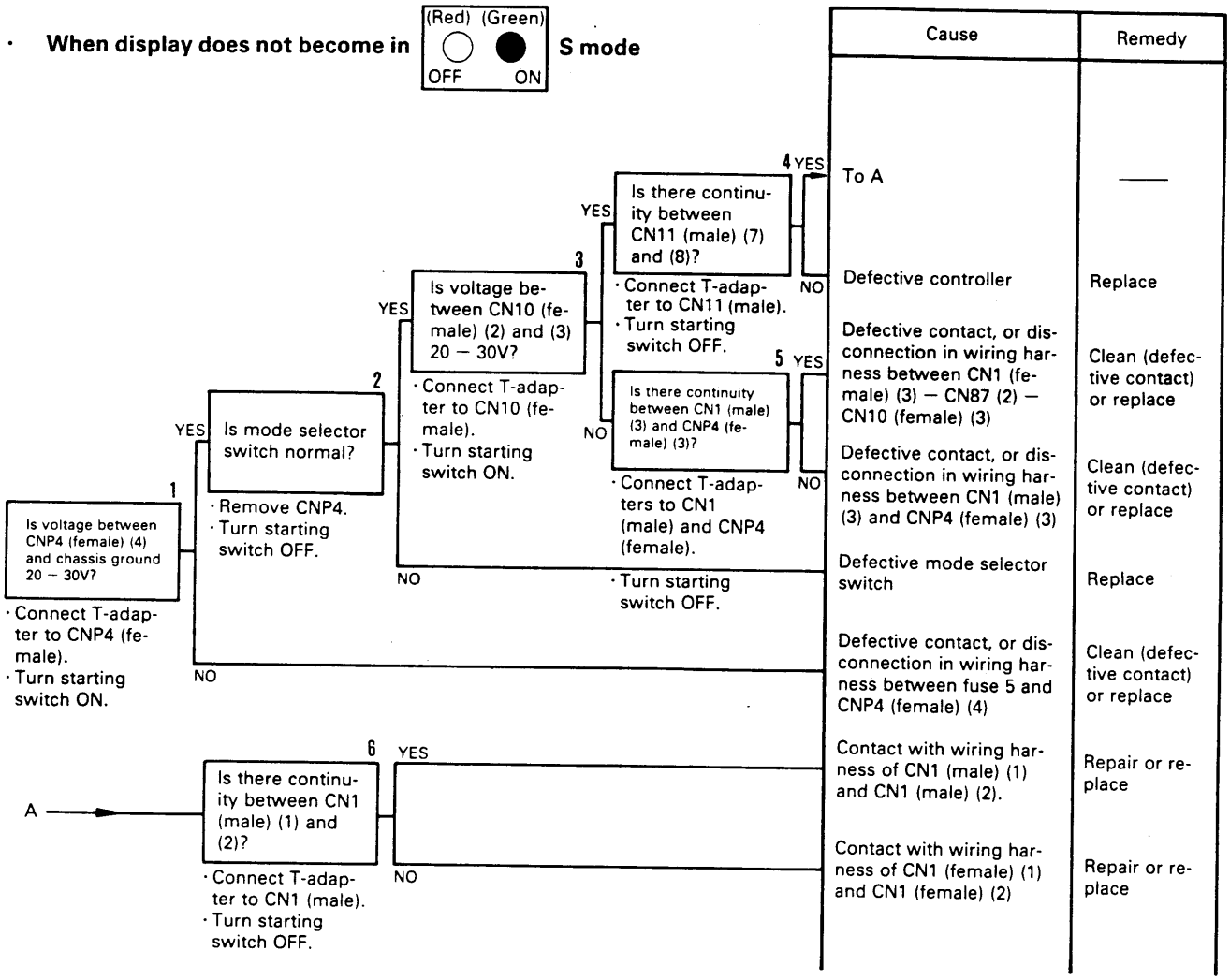
b) When self-diagnosis display does not show abnormal display

- **When display does not become** 

in H mode



· When display does not become in (Red) (Green) OFF ON S mode



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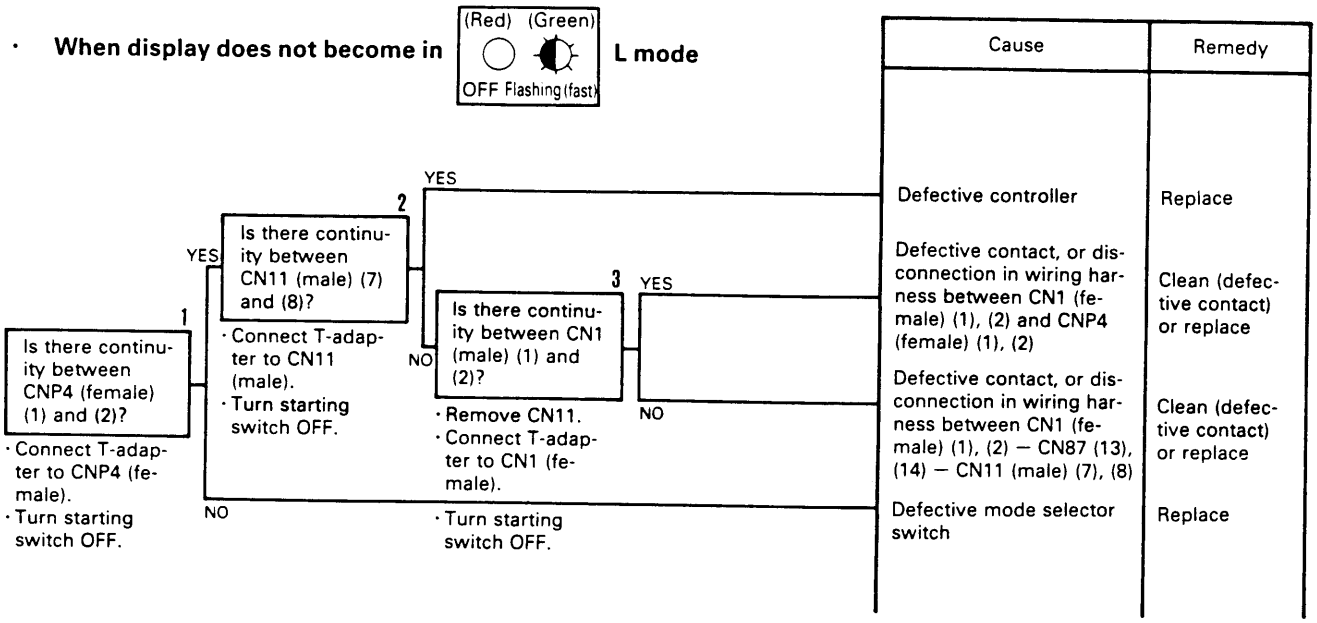
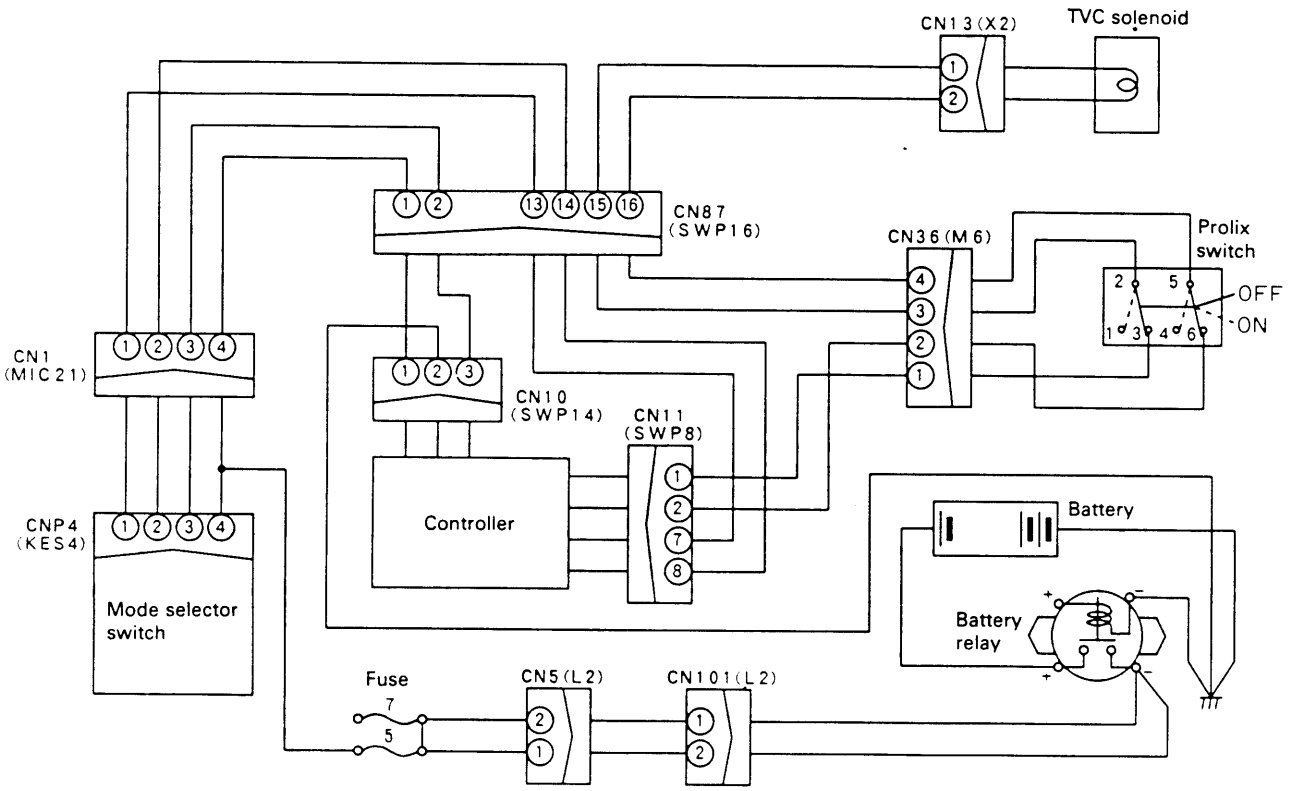
· When display does not become in (Red) (Green) OFF Flashing (fast) L mode




CN13 (X2)
TVC solenoid
CN87 (SWP16)
CN36 (M6)
Prolix switch
OFF
ON
CN1 (MIC21)
CN10 (SWP14)
CN11 (SWP8)
Controller
CNP4 (KES4)
Mode selector switch
Battery
Battery relay
Fuse
CN5 (L2)
CN101 (L2)
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020905

E-5 Auto-deceleration function does not work properly (there is no deceleration, or deceleration stays on)

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

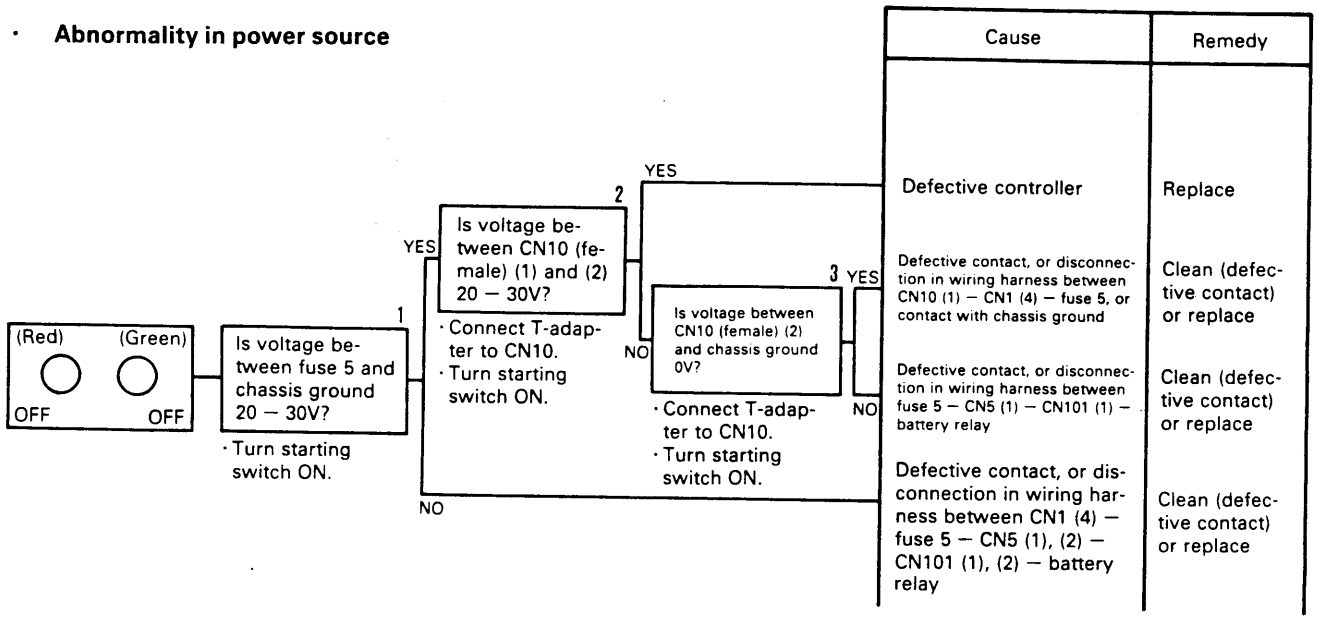
★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.

★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).

★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

a) When the self-diagnosis display shows an abnormality

· **Abnormality in power source**



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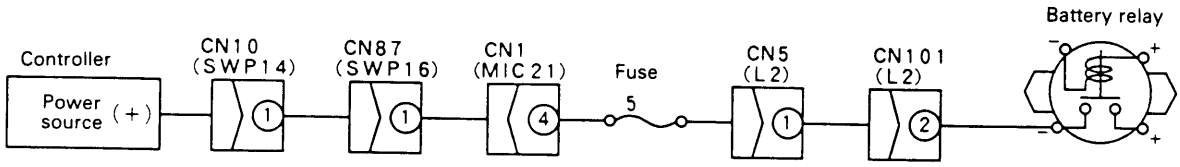

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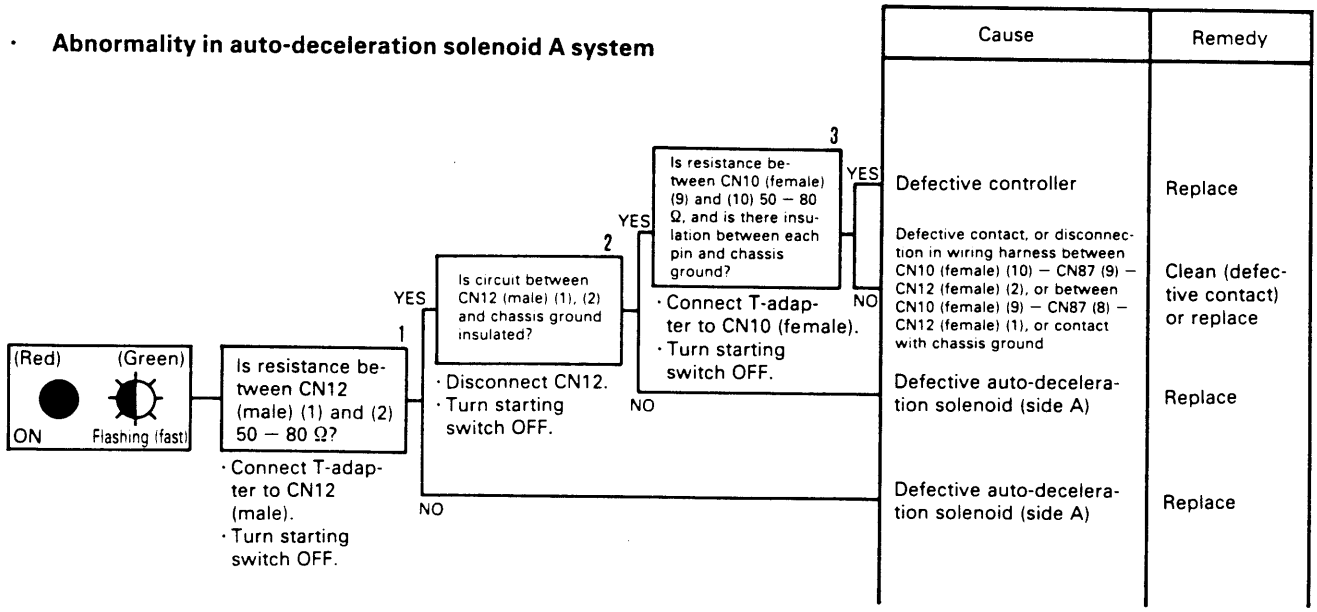
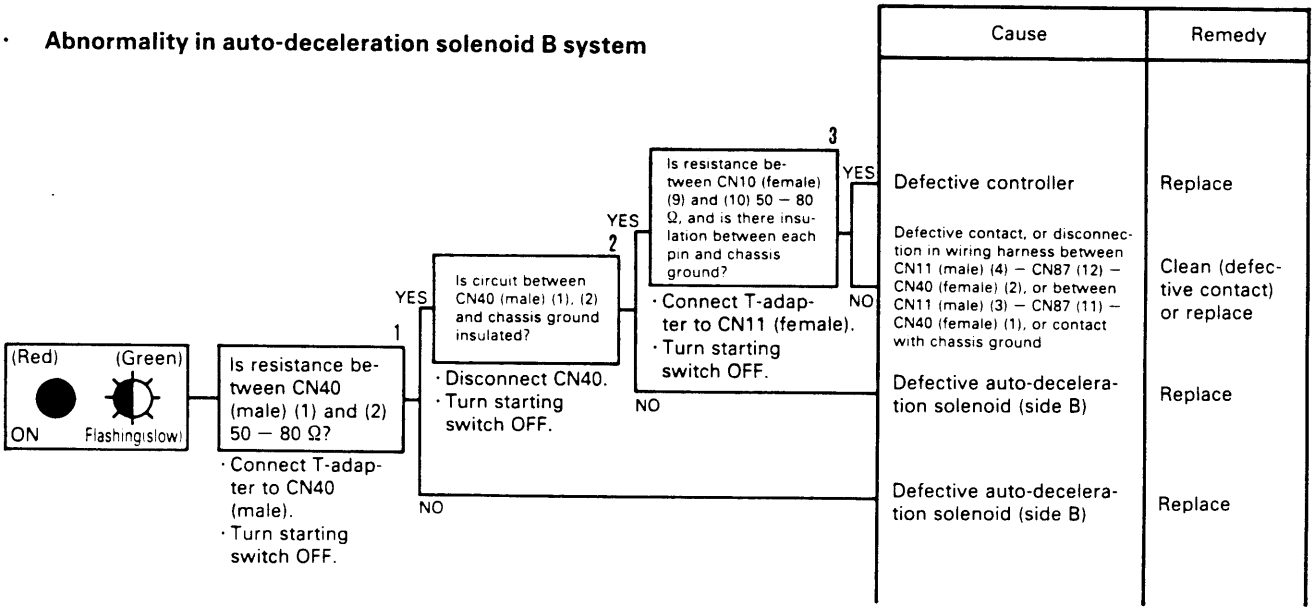
- **Abnormality in auto-deceleration solenoid A system**



- **Abnormality in auto-deceleration solenoid B system**



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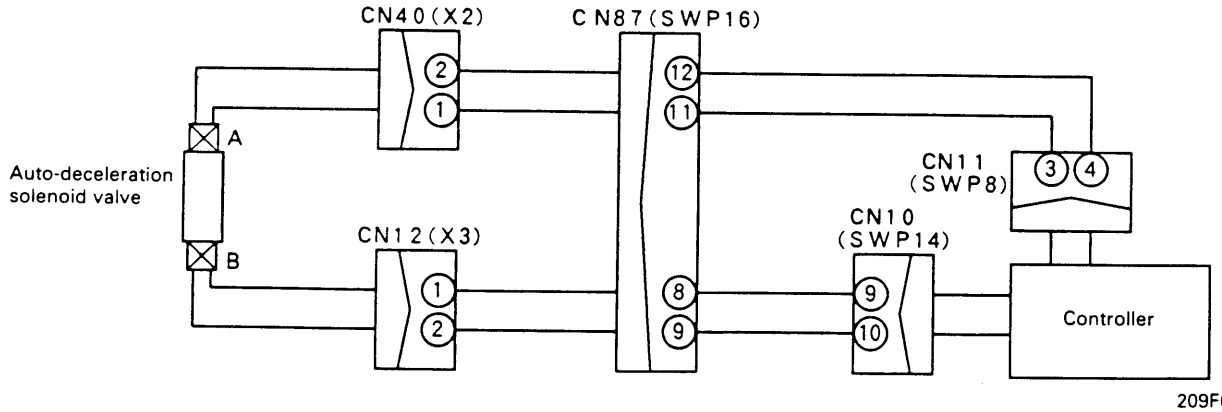
Note: If both sides A and B of the auto-deceleration solenoid become abnormal at the same time, an abnormality is displayed for side A.



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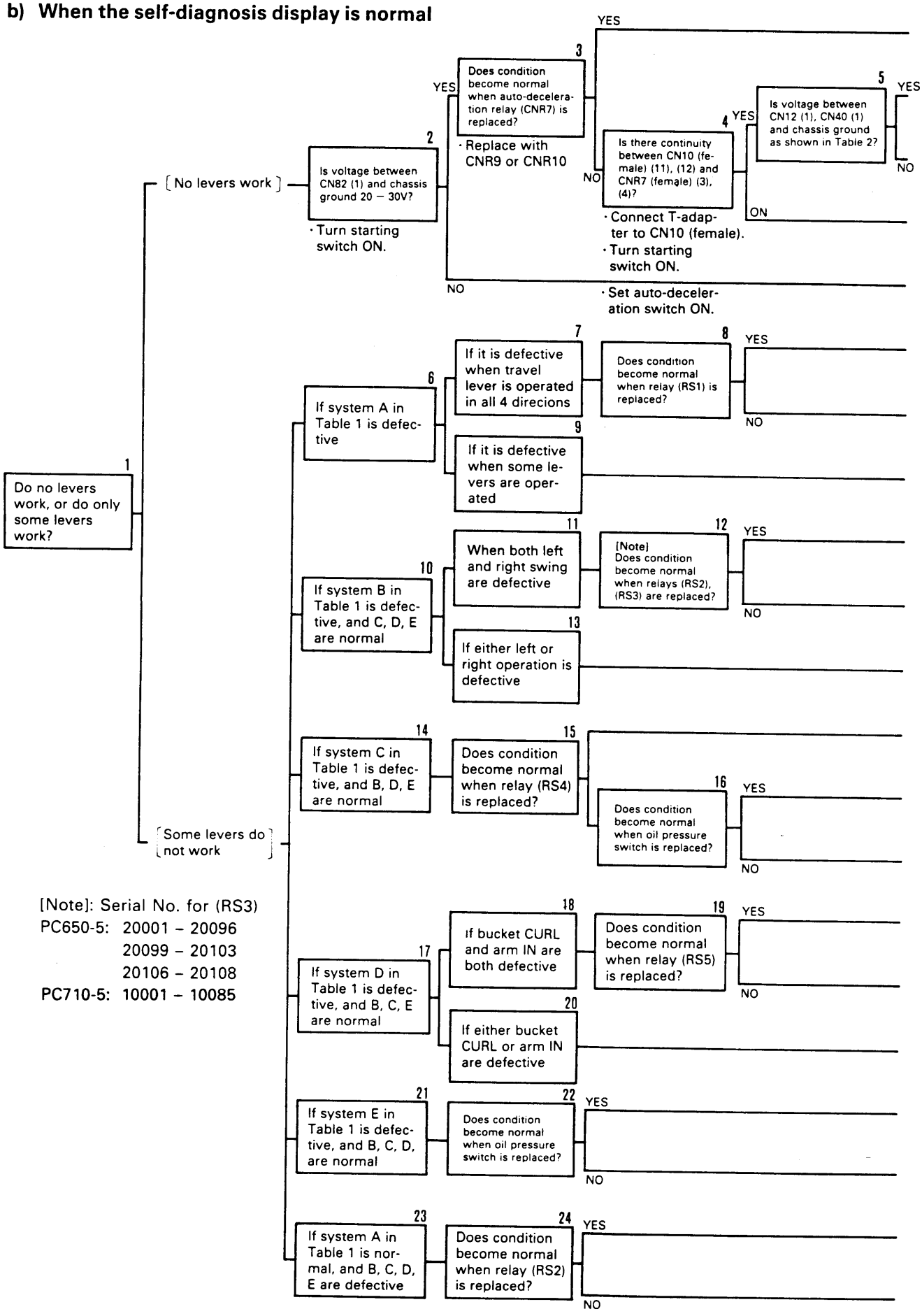
b) When the self-diagnosis display is normal



[Note]: Serial No. for (RS3)
PC650-5: 20001 – 20096
20099 – 20103
20106 – 20108
PC710-5: 10001 – 10085

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Cause	Remedy
Defective auto-deceleration relay (CNR7)	Replace
Defective controller	Replace
Defective auto-deceleration solenoid	Replace
Defective contact, or disconnection in wiring harness between CN10 (female) (11) – RS2 (1), (5) – RS1 (5), (1) – CNR7 (female) (3), or between CN10 (female) (12) and CNR7 (female) (4)	Clean or replace
Defective contact, or disconnection in wiring harness between CN82 (female) (1) – CN55 (13) – CN2 (8) – fuse 5	Clean or replace
Defective straight-travel auto-deceleration relay (RS1)	Replace
Defective contact, or disconnection in wiring harness between CN79 (female) (2) – CN55 (12) – CN88 (6) – RS1 (8)	Clean or replace
Defective related oil pressure switch	Replace
[Note] Defective swing brake • auto deceleration relay (RS2) or straight-travel relay (RS3)	Replace
Defective related oil pressure switch	Replace
Defective contact, or disconnction in wiring harness between CN76 (female) (2) – CN55 (6) – CN88 (8) – RS3 (8)	Clean or replace
Defective boom relay (RS4)	Replace
Defective related oil pressure switch	Replace
Defective contact, or disconnection in wiring harness between CN85 (female) (2) – CN55 (7) – CN89 (1) – RS4 (8)	Clean or replace
Defective arm IN · bucket CURL relay (RS5)	Replace
Defective contact, or disconnection in wiring harness between CN83 (female) (2) – CN55 (10) – CN89 (8) – RS5 (8), or between CN77 (female) (2) – CN55 (11) – CN89 (10) – RS5 (8)	Clean or replace
Defective related oil pressure switch	Replace
Defective related oil pressure switch	Replace
Defective contact, or disconnection in wiring harness between CN86 (female) (2) – CN55 (8) – CN89 (4) – (5), or between CN34 (CN78) (female) (2) – CN55 (9) – CN89 (6) – (7)	Clean or replace
Defective swing holding brake · auto-deceleration relay (RS2)	Replace
Defective contact, or disconnection in wiring harness between CN2 (female) (8) – CN88 (2) – RS3 (6)	Clean or replace

020905

Table 1 Combinations of oil pressure switches and relays
PC650-5: 20001 – 20096, 20099 – 20103, 20106 – 20108
PC710-5: 10001 – 10085

System	Oil pressure switch			Relay (for switch)	Relay (for auto-deceleration, swing brake, straight-travel)
A	L.H. travel	(FORWARD)	CN79	–	RS 1
		(REVERSE)	CN80		
	R.H. travel	(FORWARD)	CN81		
		(REVERSE)	CN82		
B	Swing	(LEFT)	CN75	–	RS 3
		(RIGHT)	CN76		RS 2
C	Boom	(RAISE)	CN85	RS4	RS 2
D	Bucket	(CURL)	CN83	RS 5	
	Arm	(IN)	CN77		
E	Boom	(LOWER)	CN86	–	
	Bucket	(DUMP)	CN84		
	Arm	(OUT)	CN78		

PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up

System	Oil pressure switch			Relay (for switch)	Relay (for auto-deceleration, swing brake, straight-travel)
A	L.H. travel	(FORWARD)	CN79	–	RS 1
		(REVERSE)	CN80		
	R.H. travel	(FORWARD)	CN81		
		(REVERSE)	CN82		
B	Swing	(LEFT)	CN75	–	RS 2
		(RIGHT)	CN76		
C	Boom	(RAISE)	CN85	RS4	RS 2 RS 3
D	Bucket	(CURL)	CN83	RS 5	
	Arm	(IN)	CN77		
E	Boom	(LOWER)	CN86	–	
	Bucket	(DUMP)	CN84		
	Arm	(OUT)	CN78		

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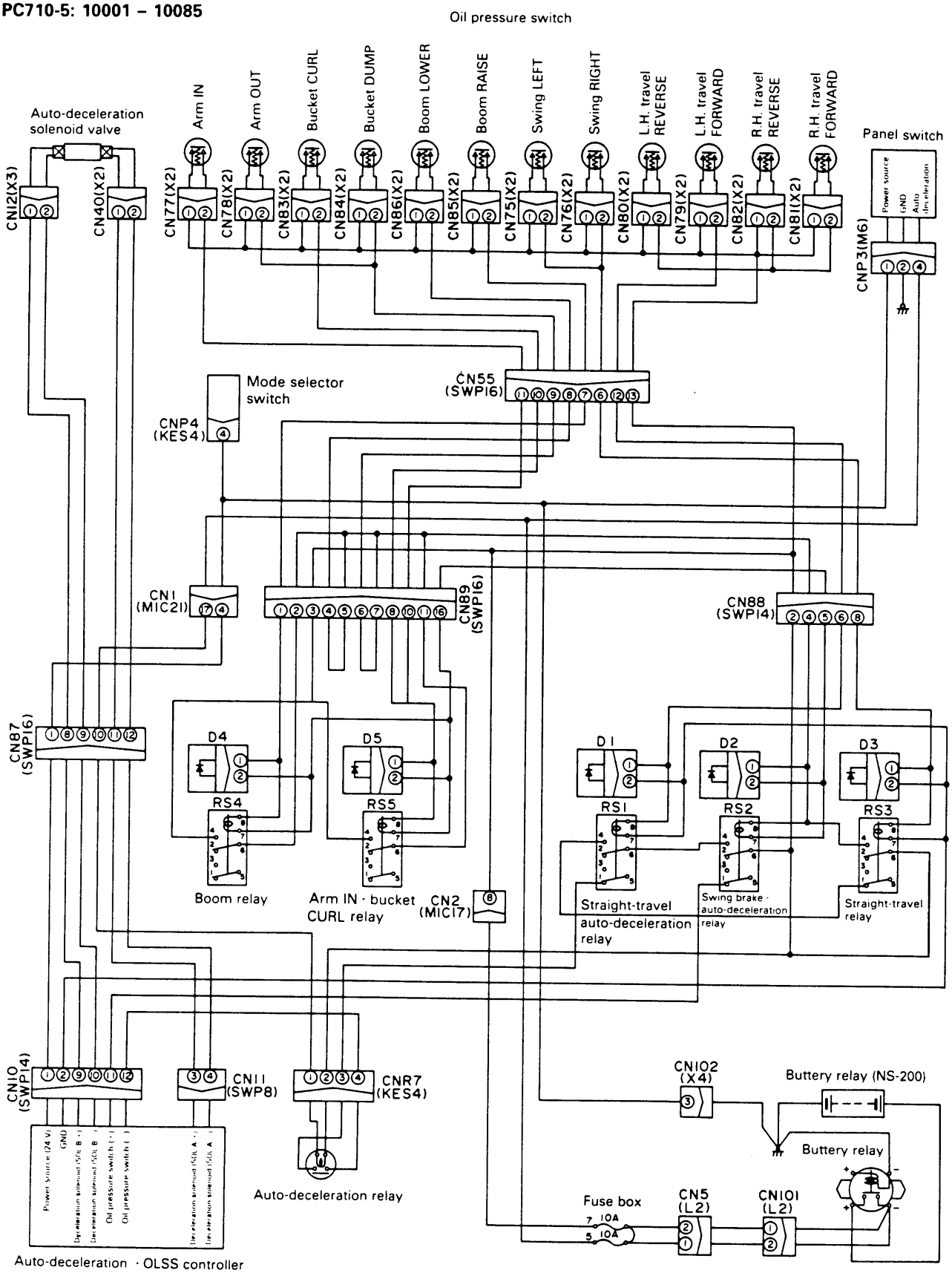
Table 2

	Between CN12 (1) and chassis ground	Between CN40 (1) and chassis ground
Control lever at neutral	20 – 30 V	Max. 1 V
Control lever operated	Max. 1 V	20 – 30 V

PC650-5: 20001 – 20096, 20099 – 20103, 20106 – 20108
PC710-5: 10001 – 10085



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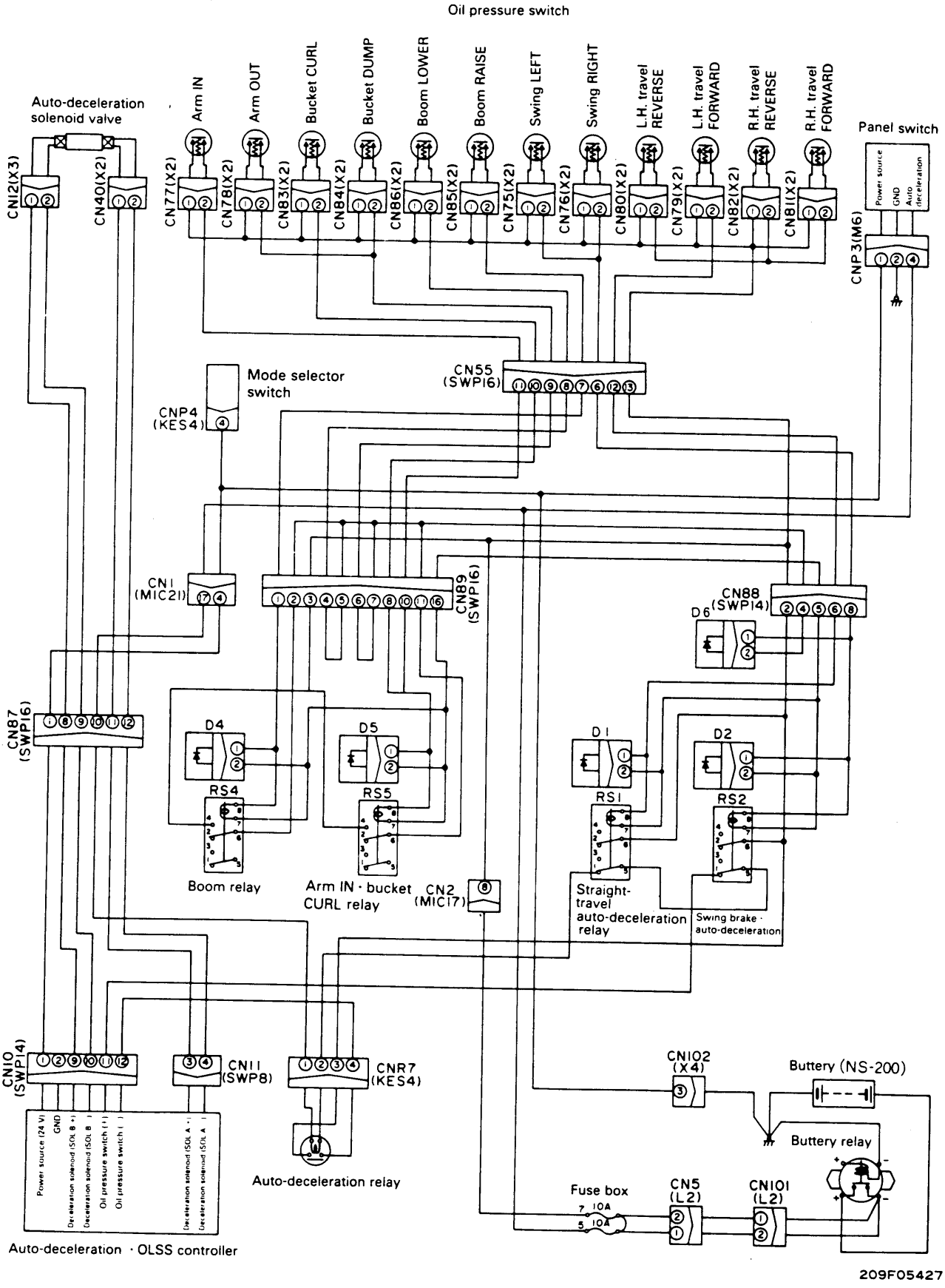
PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up



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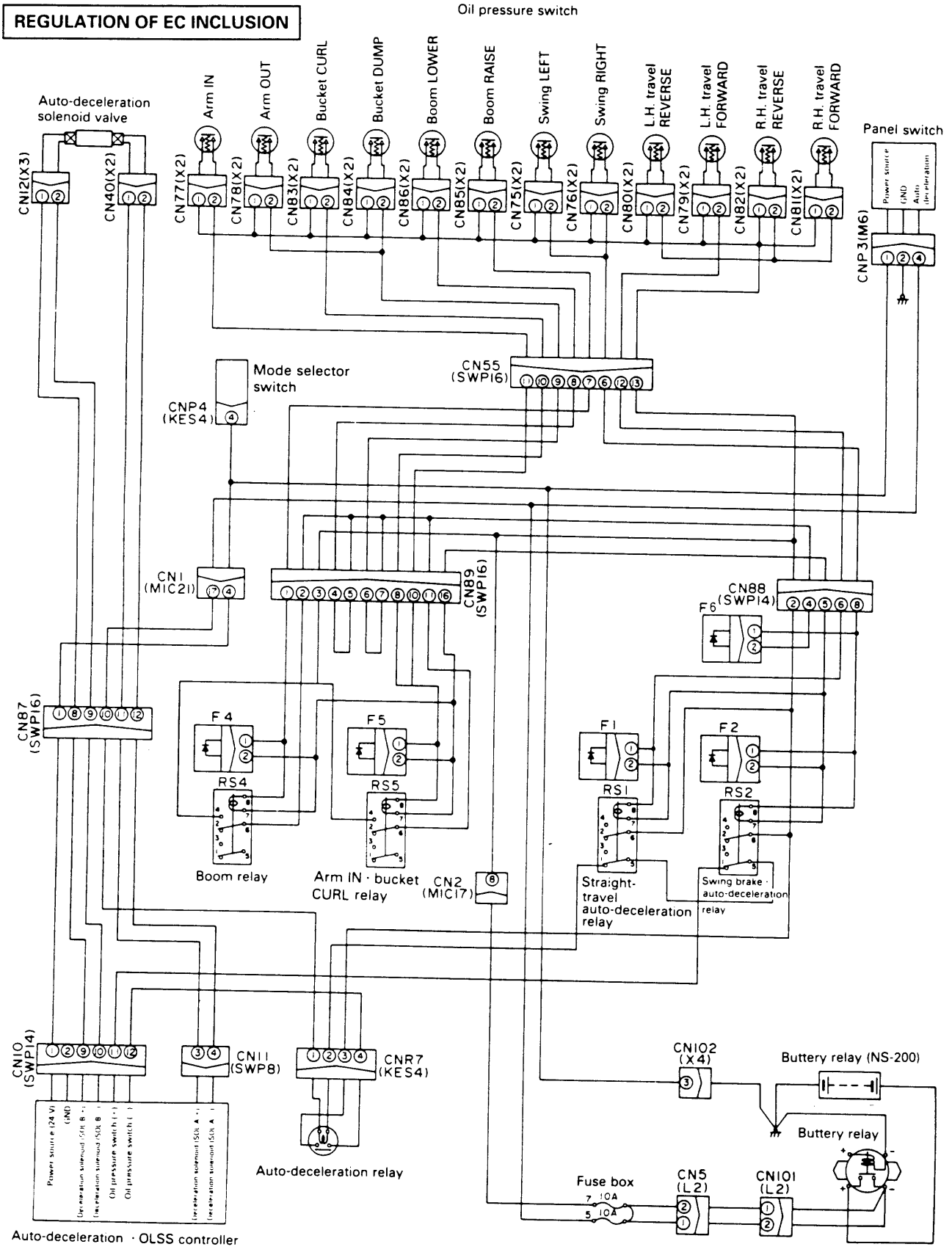
PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up

REGULATION OF EC INCLUSION



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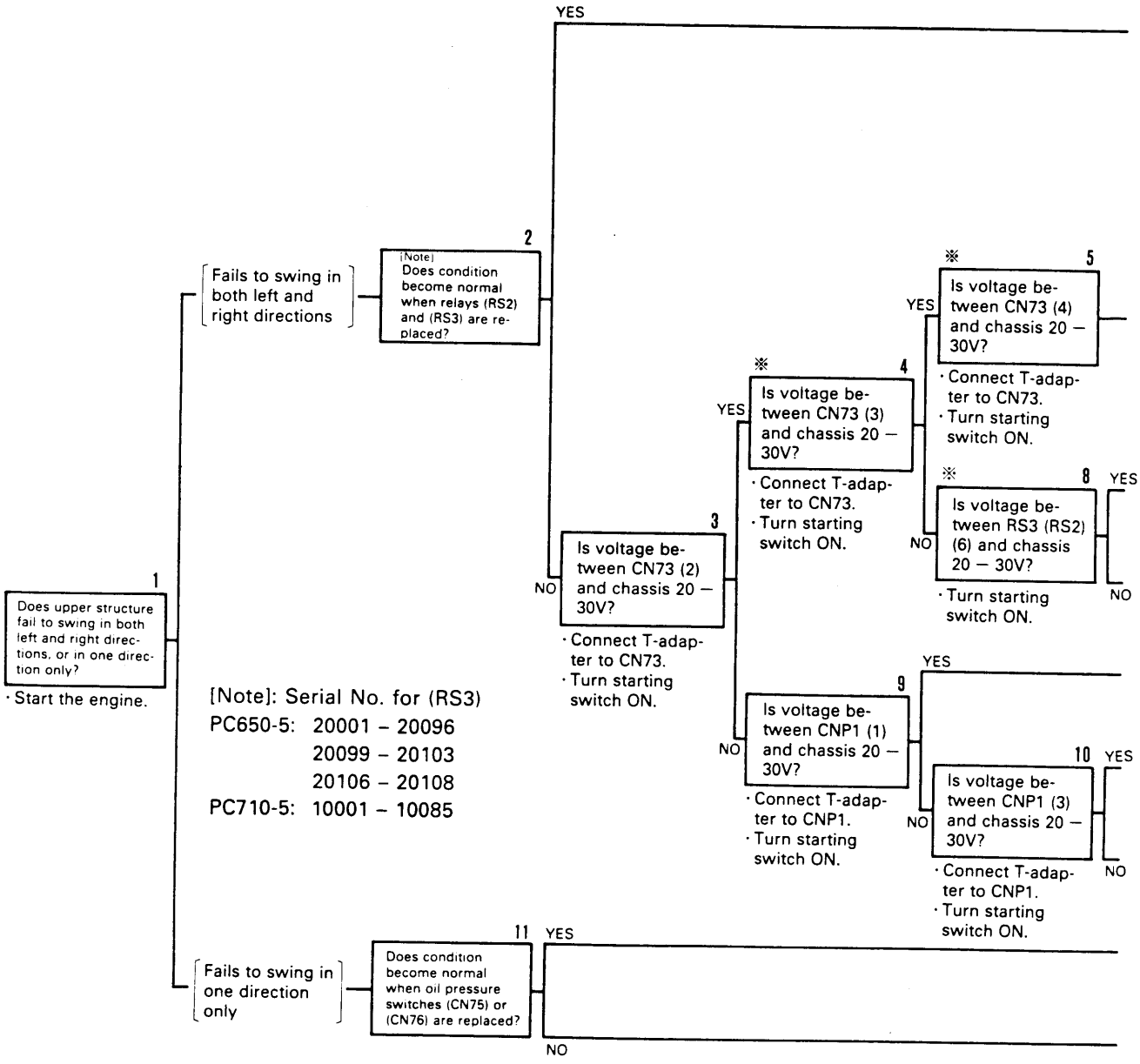
E-6 Upper structure does not swing

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.
★ For checks marked ※, run the engine for approx. 10 sec. to charge the accumulator, then stop the engine and carry out the check.
★ Check that fuse 7 is not blown before starting troubleshooting.
★ Always set the swing lock switch OFF.



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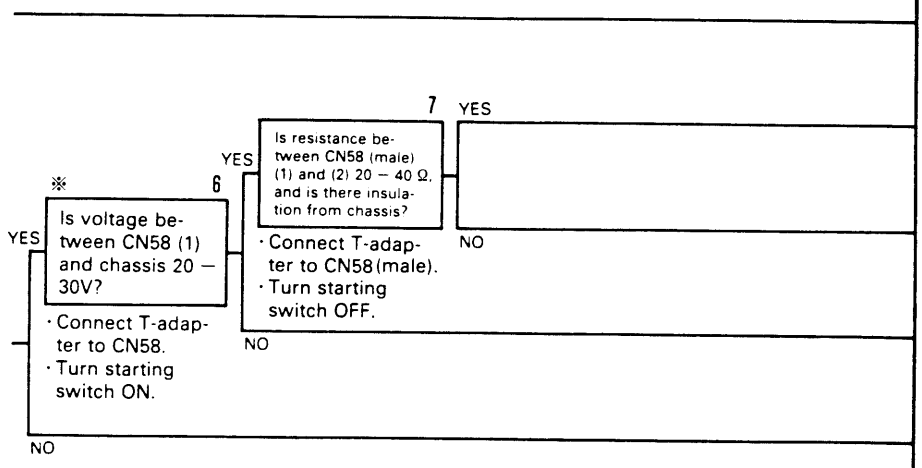

Cause	Remedy
[Note] Defective relays (RS2) or (RS3)	Replace
Defective contact, or disconnection in wiring harness between CN76 (CN75) (female) (2) — CN55 (6) — CN88 (8) — RS3 (8)	Clean or replace
Defective swing brake solenoid	Replace
Defective contact, or disconnection in wiring harness between CN58 (female) (1) — CN55 (2) — CN88 (9) — CN73 (female) (4)	Clean or replace
Defective swing holding brake timer	Replace
Defective contact, or disconnection in wiring harness between CN73 (female) (3) and RS2 (4)	Clean or replace
[Note] Defective contact, or disconnection in wiring harness between fuse 7 — CN2 (8) — CN88 (2) — RS3 (RS2) (6)	Clean or replace
Defective contact, or disconnection in wiring harness between CNP1 (female) (1) — CN1 (16) — CN88 (1) — CN73 (female) (2)	Clean or replace
Defective swing lock switch	Replace
Defective contact, or disconnection in wiring harness between CNP1 (female) (3) and fuse 7	Clean or replace
Defective oil pressure switches (CN75) or (CN76)	Replace
Defective hydraulic system (see H-12)	—

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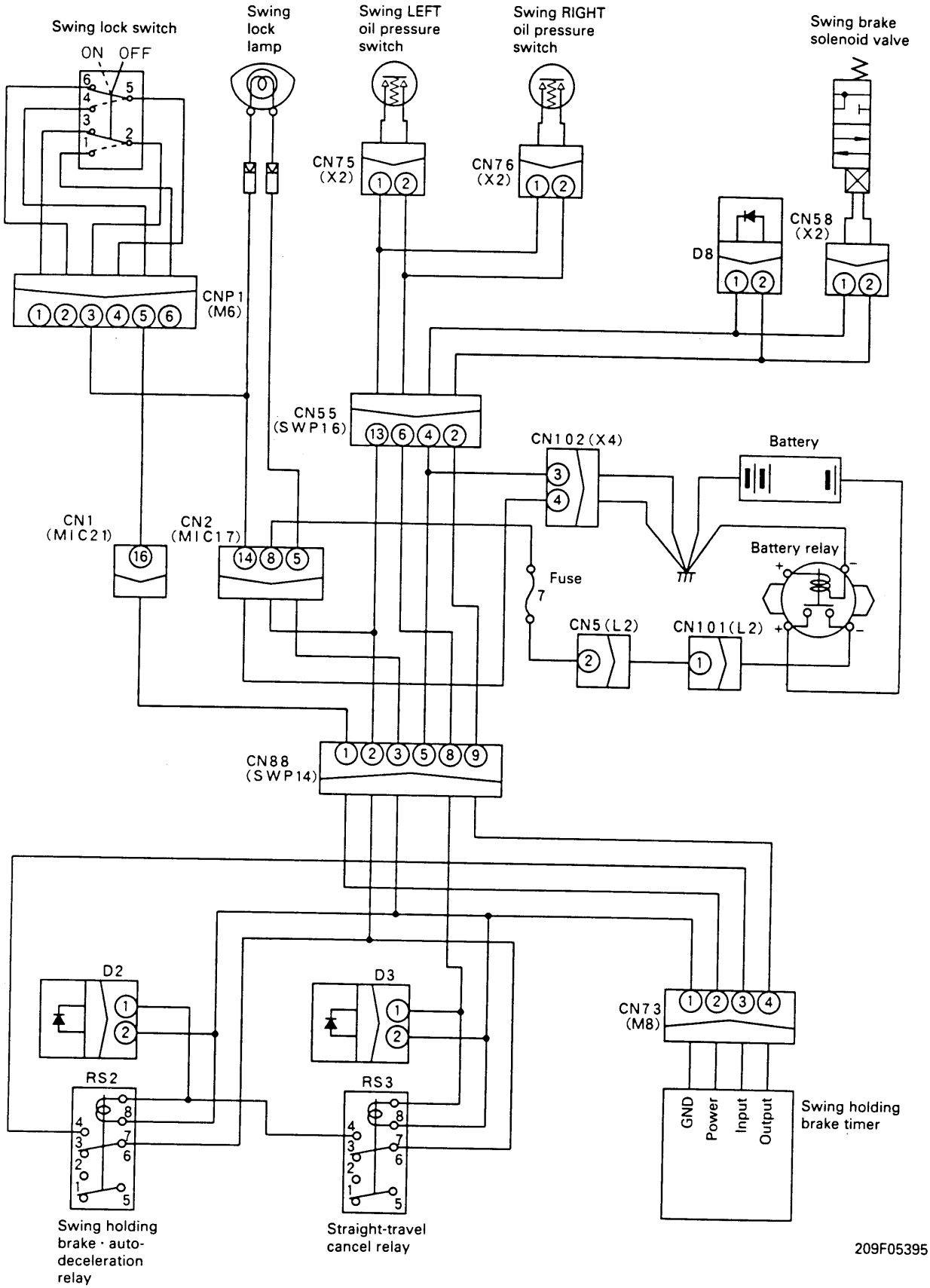
PC650-5: 20001 – 20096, 20099 – 20103, 20106 – 20108
PC710-5: 10001 – 10085



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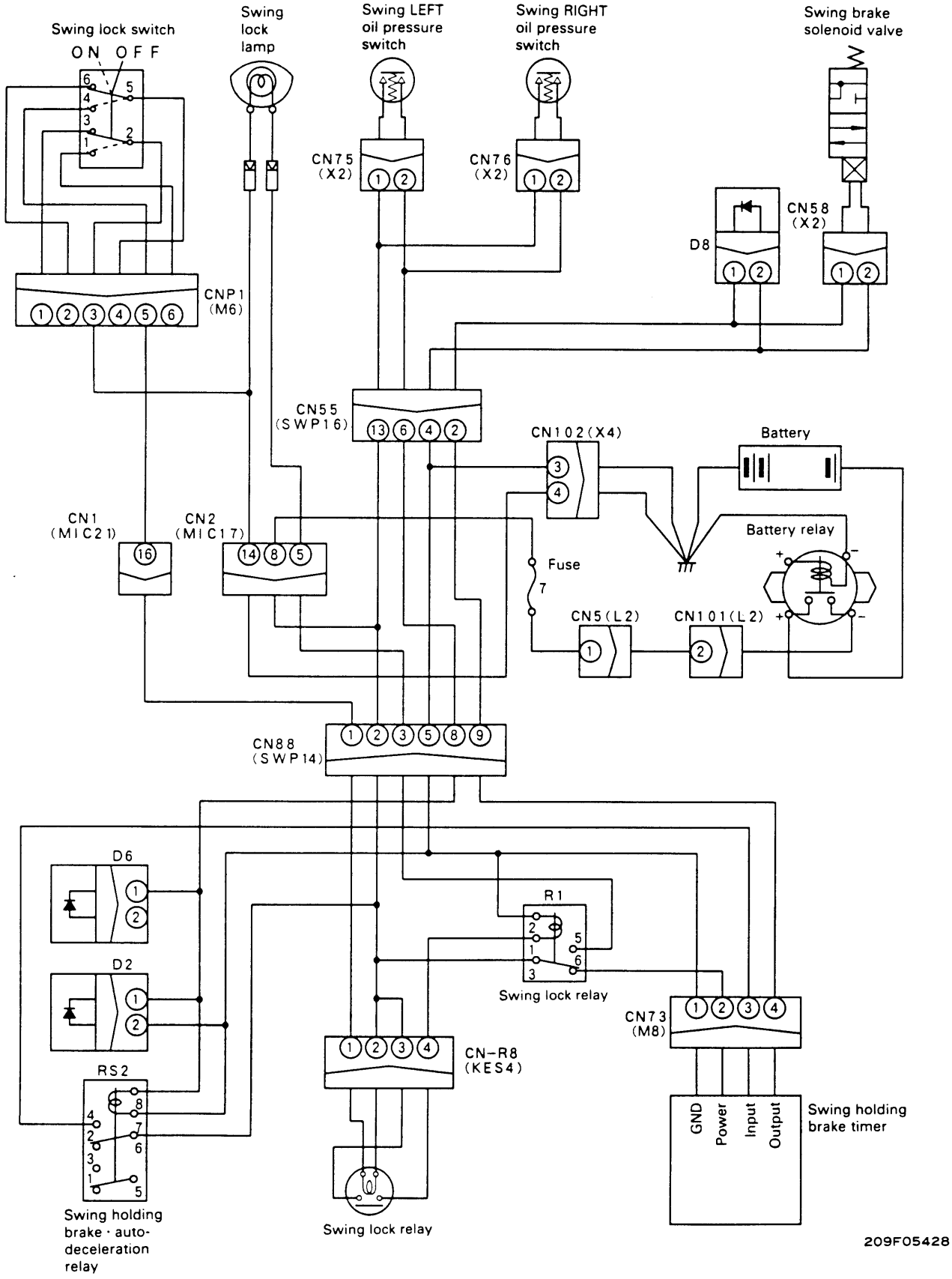
PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up



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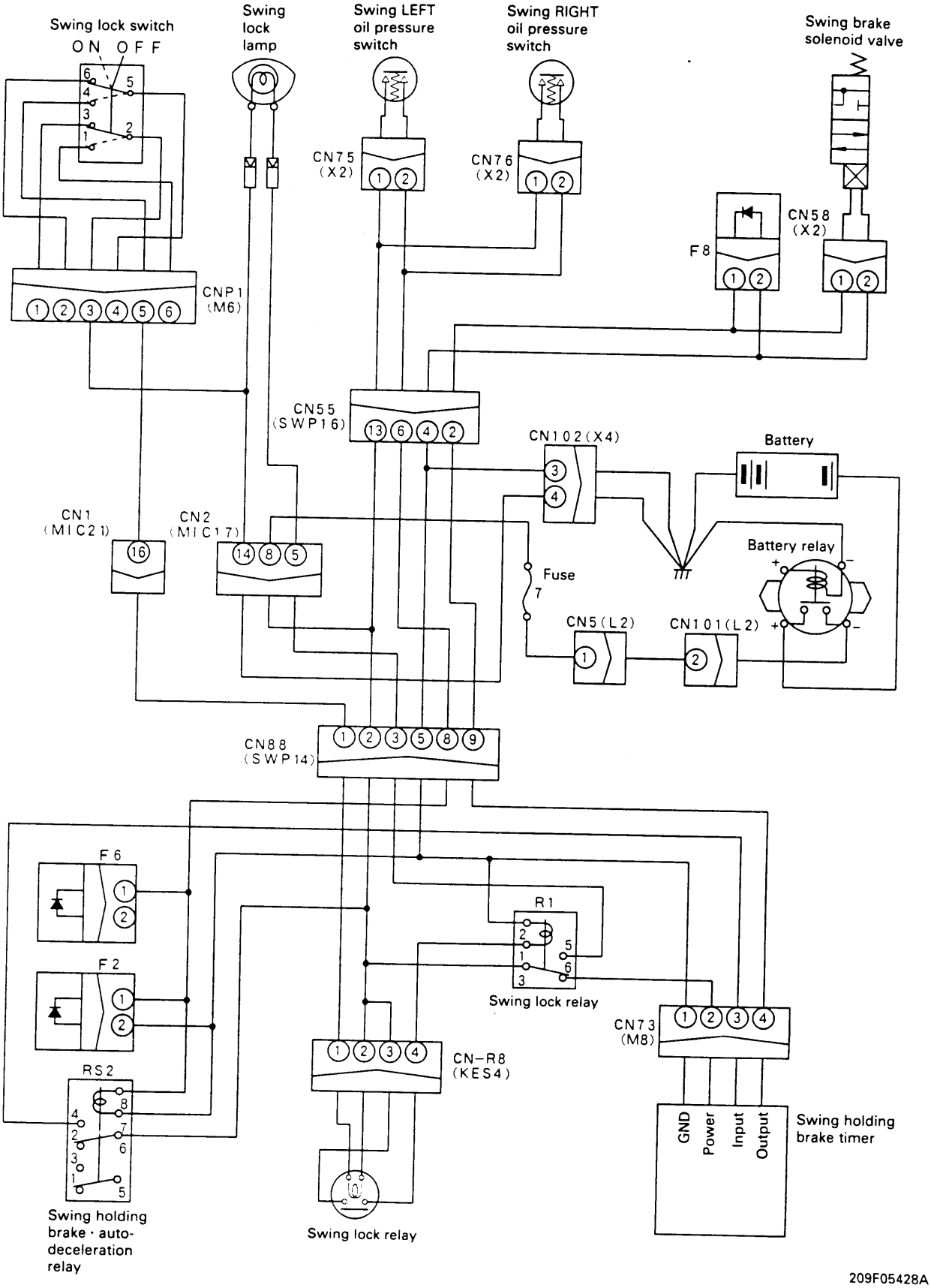
PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up

REGULATION OF EC INCLUSION



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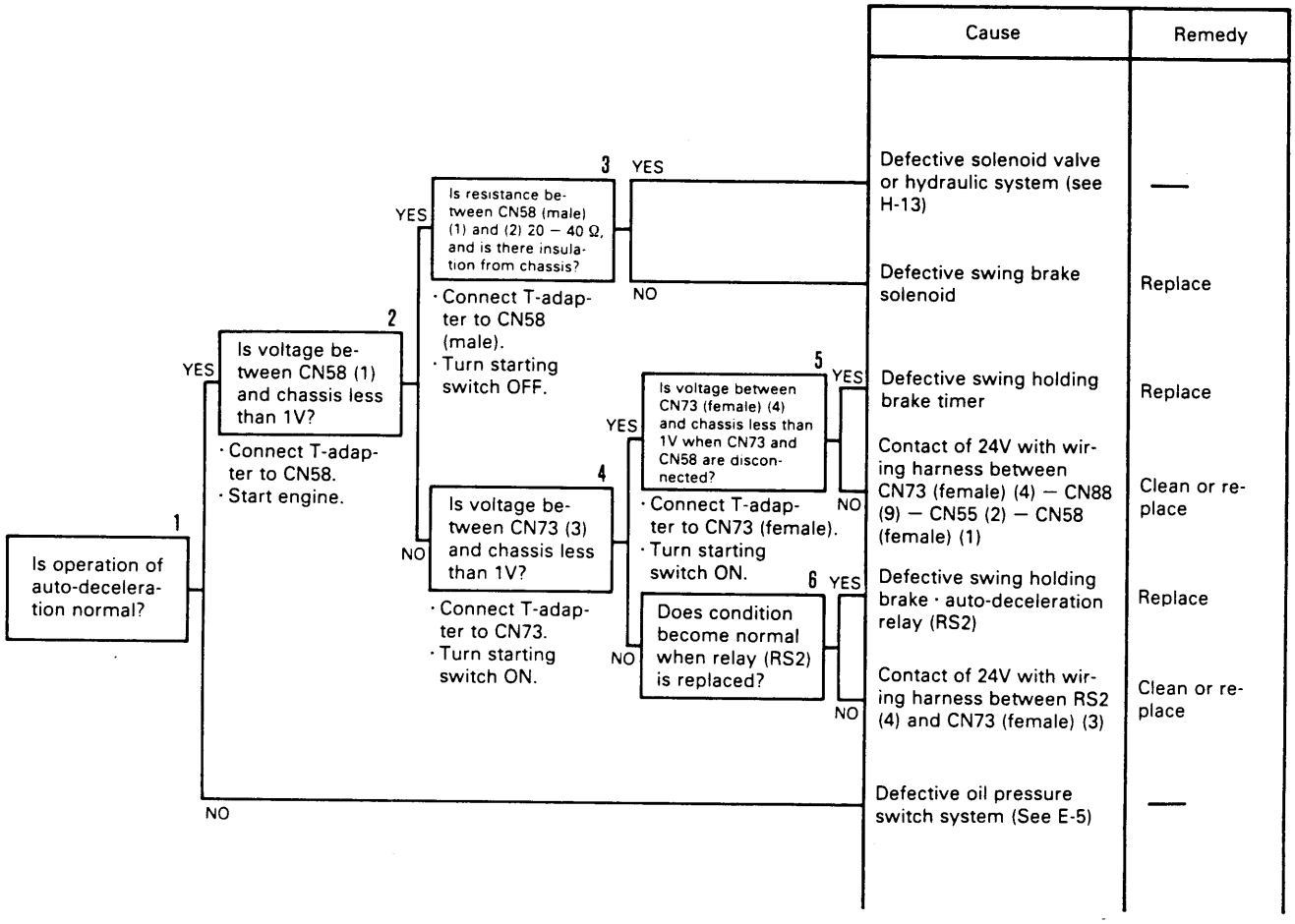
E-7 Excessive hydraulic drift of swing

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.
★ Carry out all checks with the swing lever at NEUTRAL.



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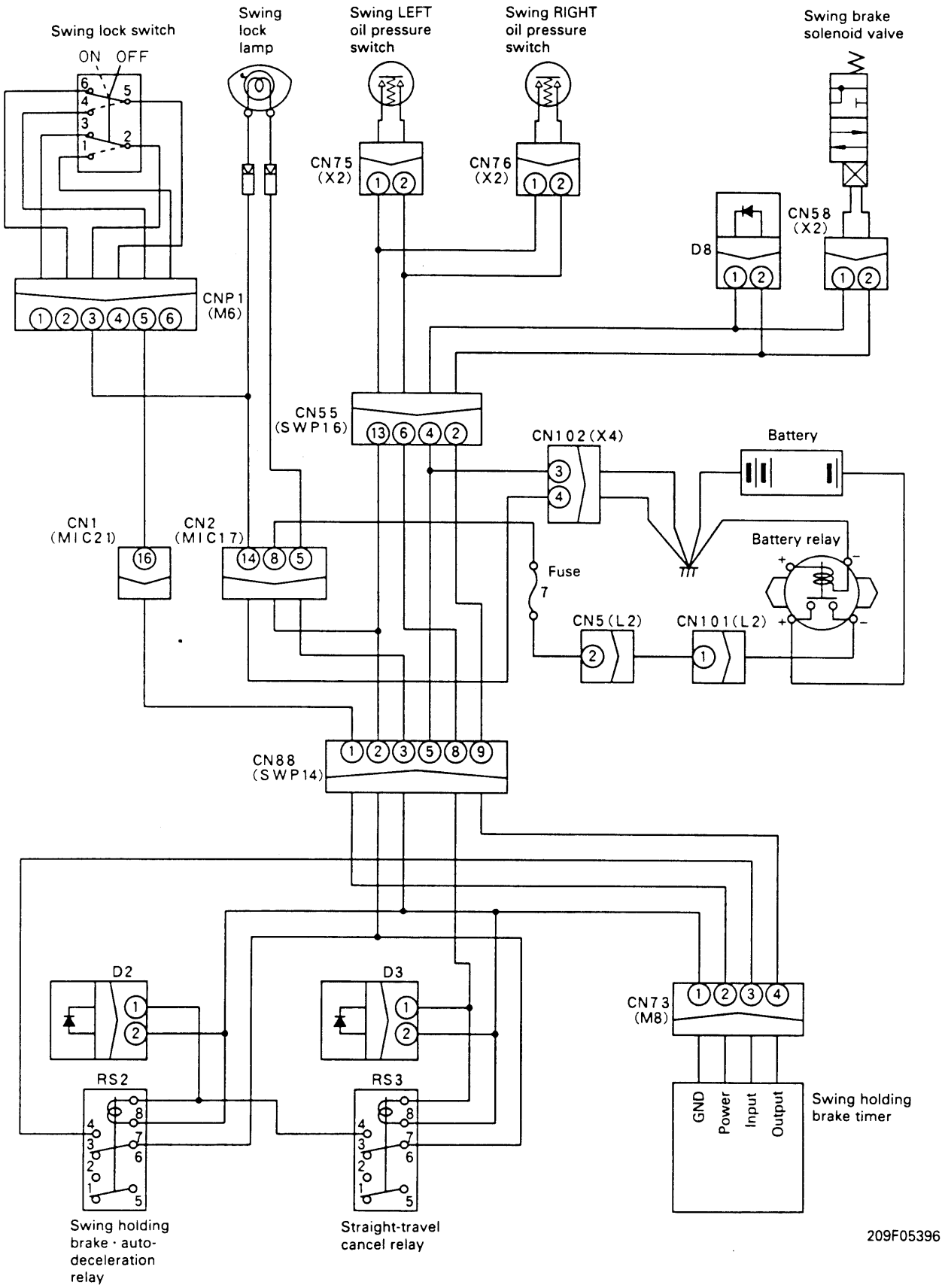
PC650-5: 20001 – 20096, 20099 – 20103, 20106 – 20108
PC710-5: 10001 – 10085



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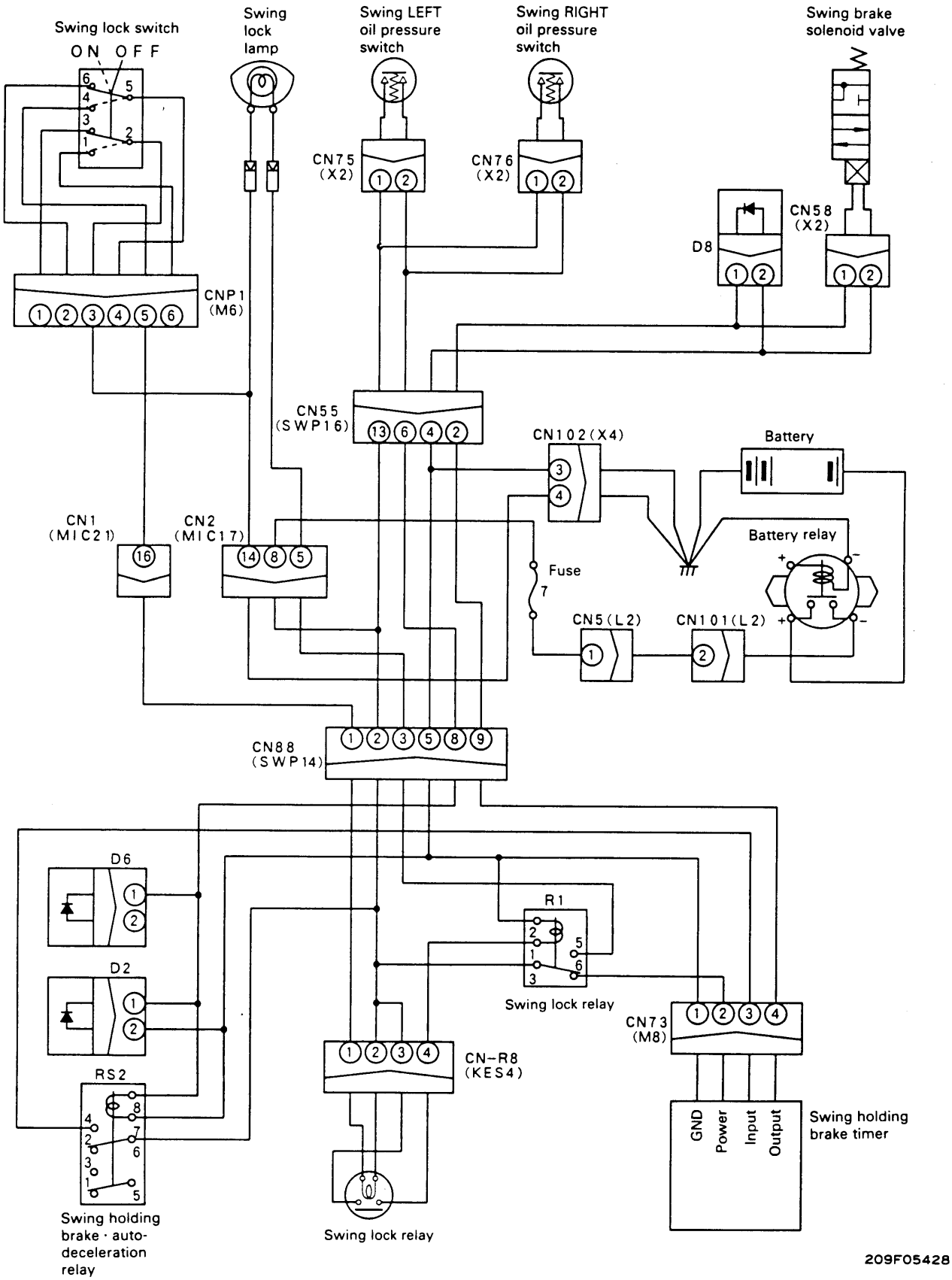
PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up



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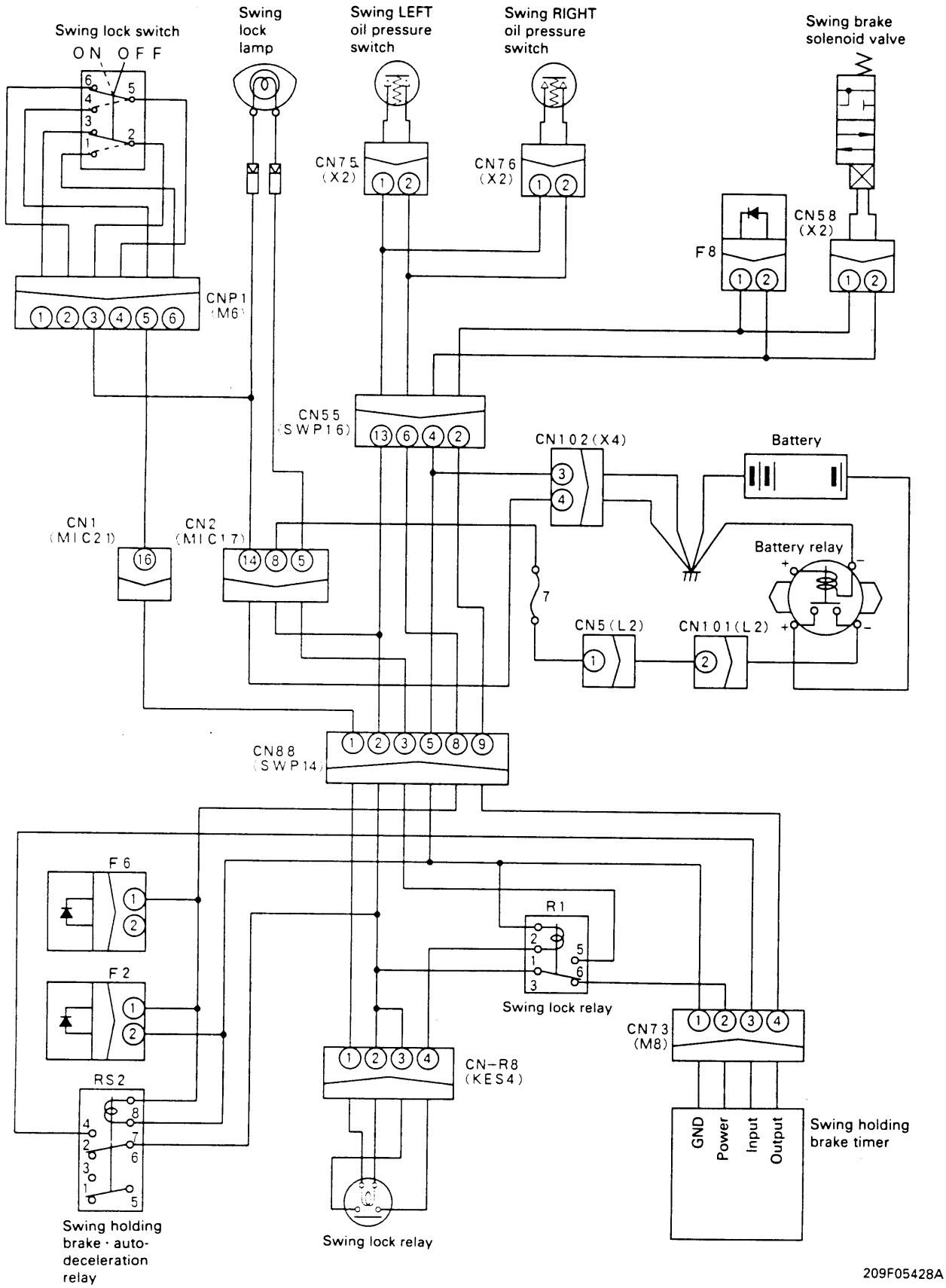
PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up

REGULATION OF EC INCLUSION



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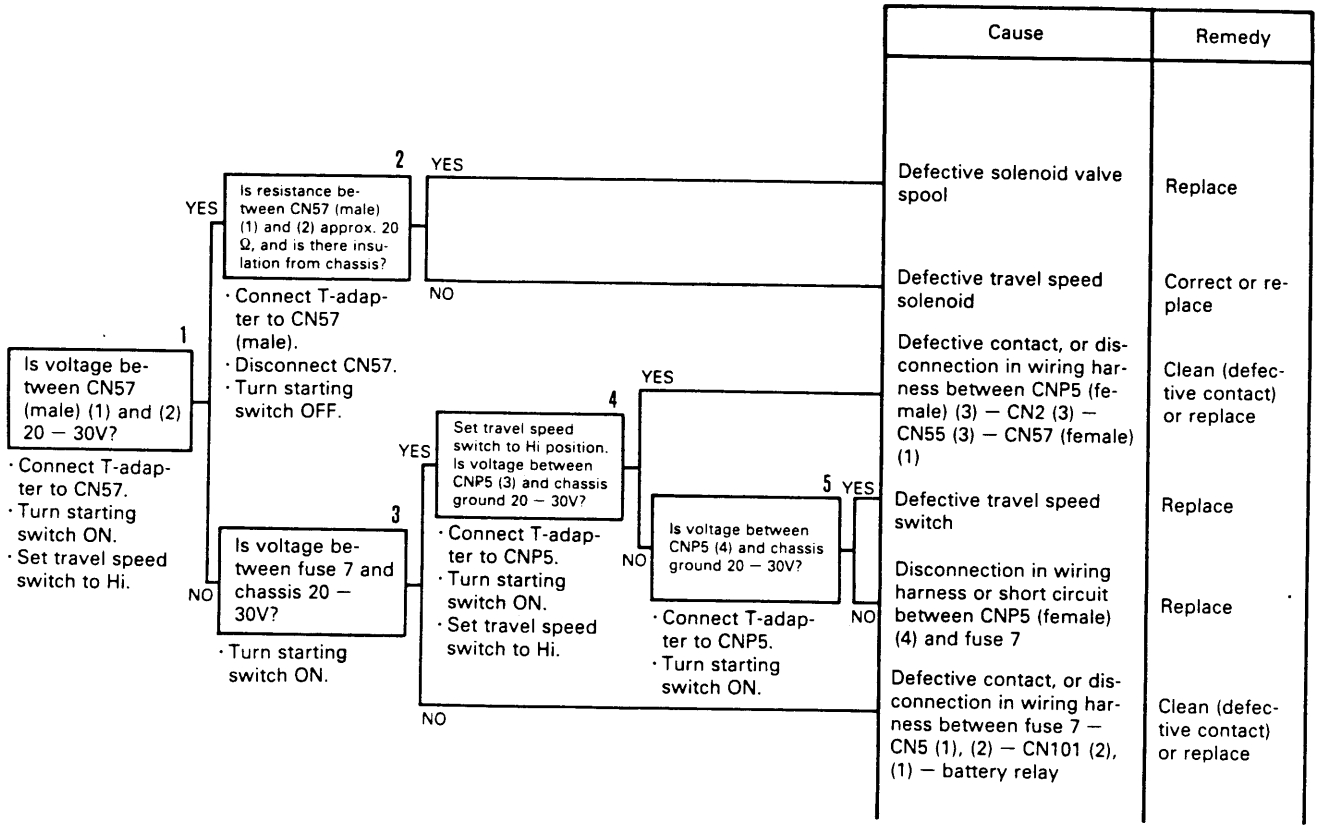
E-8 Travel speed does not change

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

a) Travel speed does not become faster even when travel speed switch is set to Hi. (Does not change to Hi)



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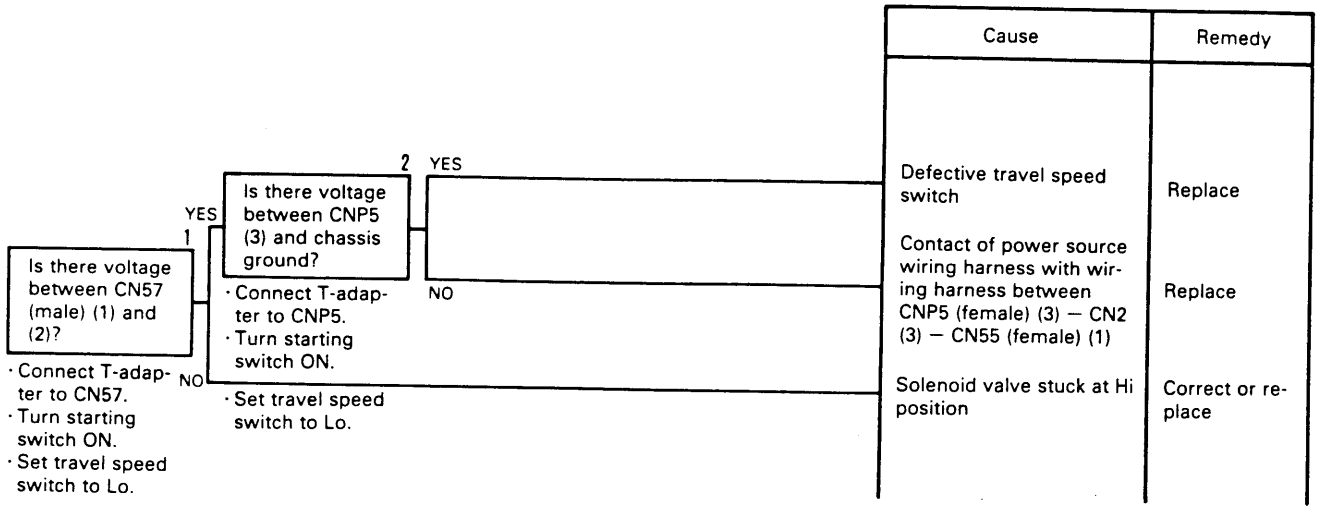
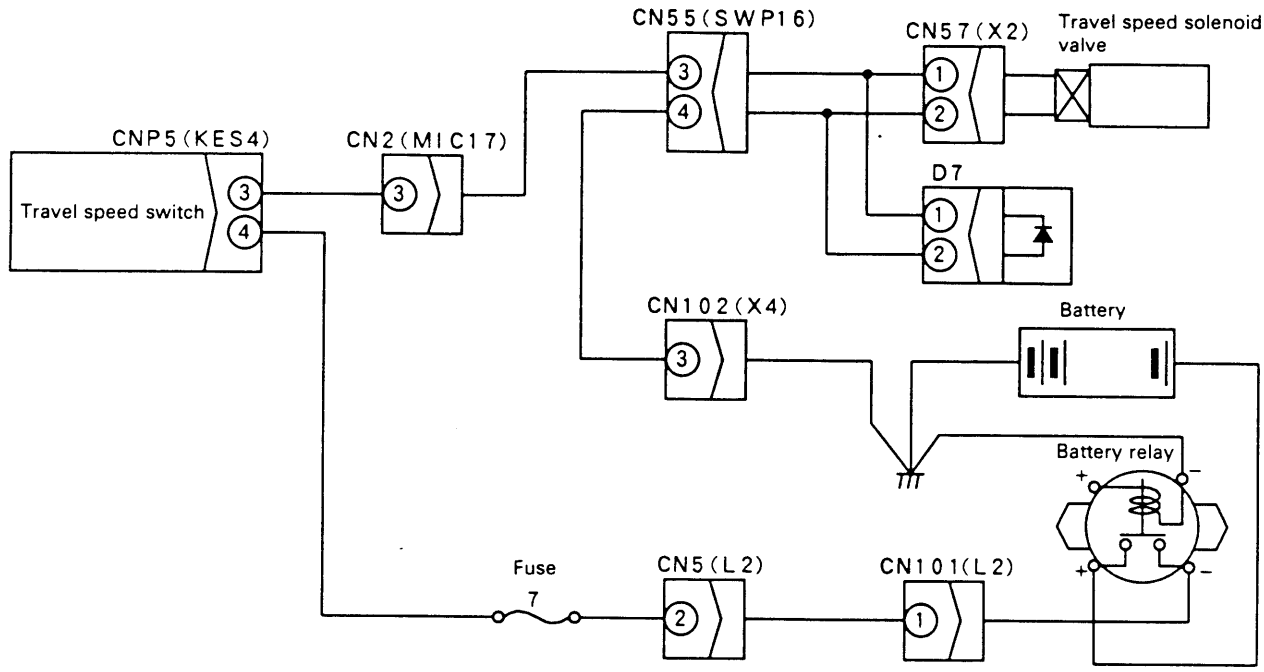
b) Travel speed does not become slower even when travel speed switch is set to Lo. (Does not change to Lo)





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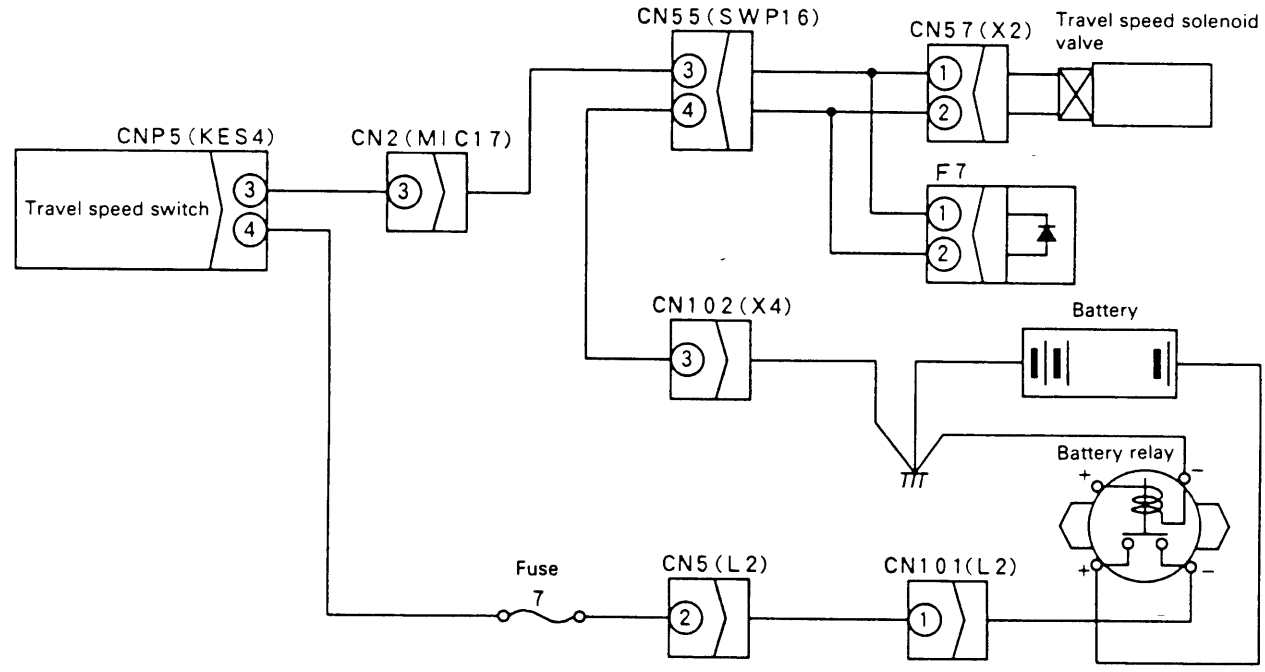
REGULATION OF EC INCLUSION



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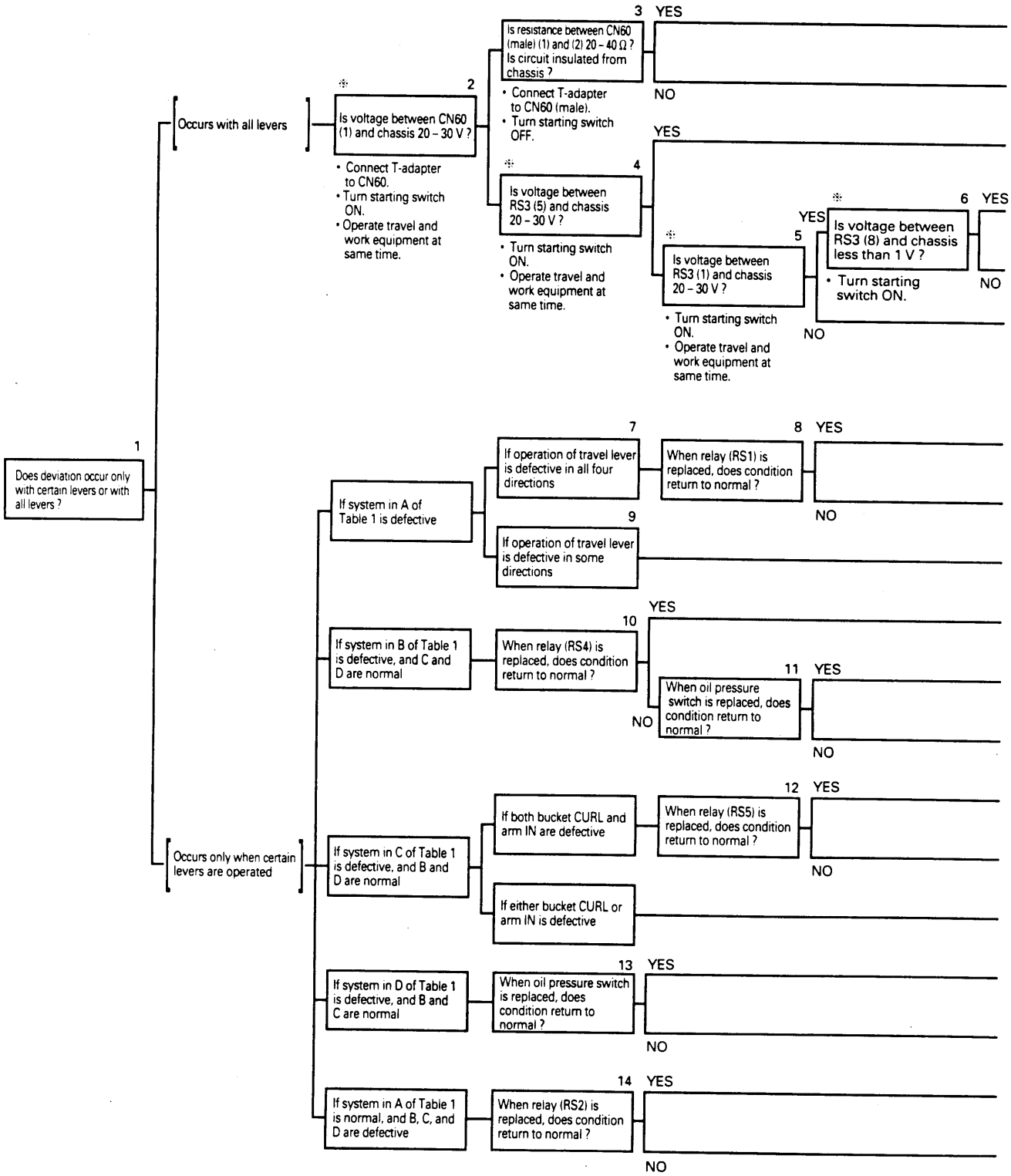
E-9 Excessive travel deviation during compound operations (but only for combination of travel and work equipment)

★ **FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS**
★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.
★ For checks marked ※, run the engine for approx. 10 sec. to charge the accumulator, then stop the engine and carry out the check.



020905

Cause	Remedy
Defective hydraulic system (see H-2)	———
Defective straight-travel solenoid	Replace
Defective contact, or disconnection in wiring harness between CN60 (female) (1) – CN55 (1) – CN88 (7) – RS3 (5)	Clean or replace
Defective swing oil pressure switch	Replace
Defective relay (RS3)	Replace
Defective contact, or disconnection in wiring harness between RS1 (4) and RS3 (1)	Clean or replace
Defective contact, or disconnection in wiring harness between CN79 (female) (2) – CN55 (12) – CN88 (6) – RS1 (8)	Clean or replace
Defective relay (RS1)	Replace
Defective oil pressure switch	Replace
Defective relay (RS4)	Replace
Defective oil pressure switch	Replace
Defective contact, or disconnection in wiring harness between CN85 (female) (2) – CN55 (7) – CN89 (1) – RS4 (8)	Clean or replace
Defective relay (RS5)	Replace
Defective contact, or disconnection in wiring harness between CN83 (female) (2) – CN55 (10) – CN89 (8) – RS5 (8), or between CN77 (female) (2) – CN55 (11) – CN89 (10) – RS5 (8)	Clean or replace
Defective oil pressure switch	Replace
Defective oil pressure switch	Replace
Defective contact, or disconnection in wiring harness between CN86 (female) (2) – CN55 (8) – CN89 (4) – (5), or between CN34 (2) (female) (2) – CN55 (9) – CN89 (6) – (7)	Clean or replace
Defective relay (RS2)	Replace
Defective contact, or disconnection in wiring harness between CN2 (female) (8) – CN88 (2) – RS3 (6)	Clean or replace

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Table 1. Combinations of oil pressure switches and relays

System	Oil pressure switch			Relay (for switch)	Relay (for swing brake, straight-travel)
A	L.H. travel	(FORWARD)	CN79	–	RS1
		(REVERSE)	CN80		
	R.H. travel	(FORWARD)	CN81		
		(REVERSE)	CN82		
B	Boom	(RAISE)	CN85	RS4	RS2
C	Bucket	(CURL)	CN83	RS5	
	Arm	(IN)	CN77		
D	Boom	(LOWER)	CN86	–	
	Bucket	(DUMP)	CN84		
	Arm	(OUT)	CN78		

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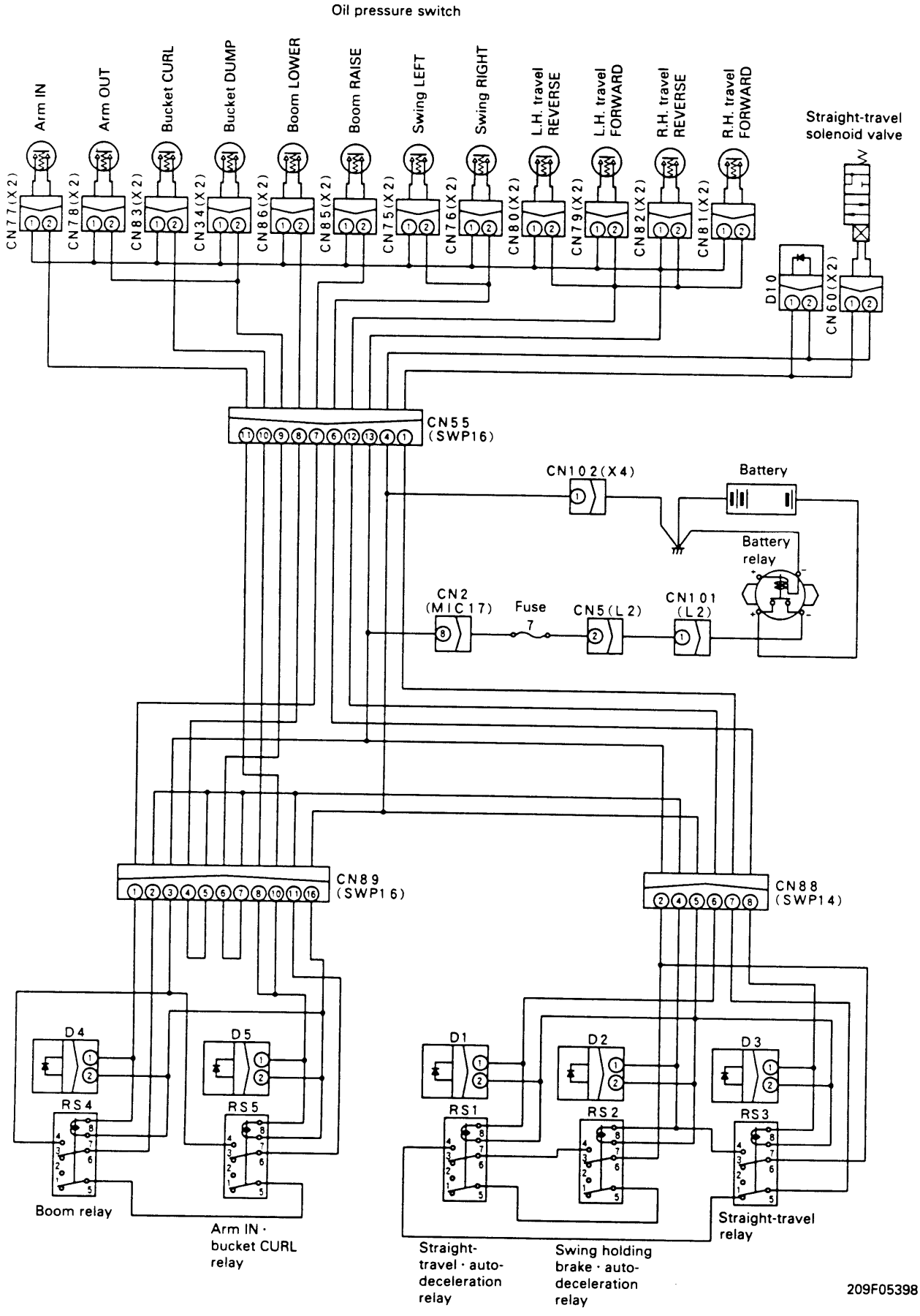
Oil pressure switch
Arm IN
Arm OUT
Bucket CURL
Bucket DUMP
Boom LOWER
Boom RAISE
Swing LEFT
Swing RIGHT
L.H. travel REVERSE
L.H. travel FORWARD
R.H. travel REVERSE
R.H. travel FORWARD
Straight-travel solenoid valve
CN77(X2)
CN78(X2)
CN83(X2)
CN34(X2)
CN86(X2)
CN85(X2)
CN75(X2)
CN76(X2)
CN80(X2)
CN79(X2)
CN82(X2)
CN81(X2)
D10
CN60(X2)
CN55 (SWP16)
CN102(X4)
Battery
Battery relay
CN2 (MIC17)
Fuse 7
CN5(L2)
CN101 (L2)
CN89 (SWP16)
CN88 (SWP14)
D4
D5
D1
D2
D3
RS4
RS5
RS1
RS2
RS3
Boom relay
Arm IN · bucket CURL relay
Straight-travel · auto-deceleration relay
Swing holding brake · auto-deceleration relay
Straight-travel relay
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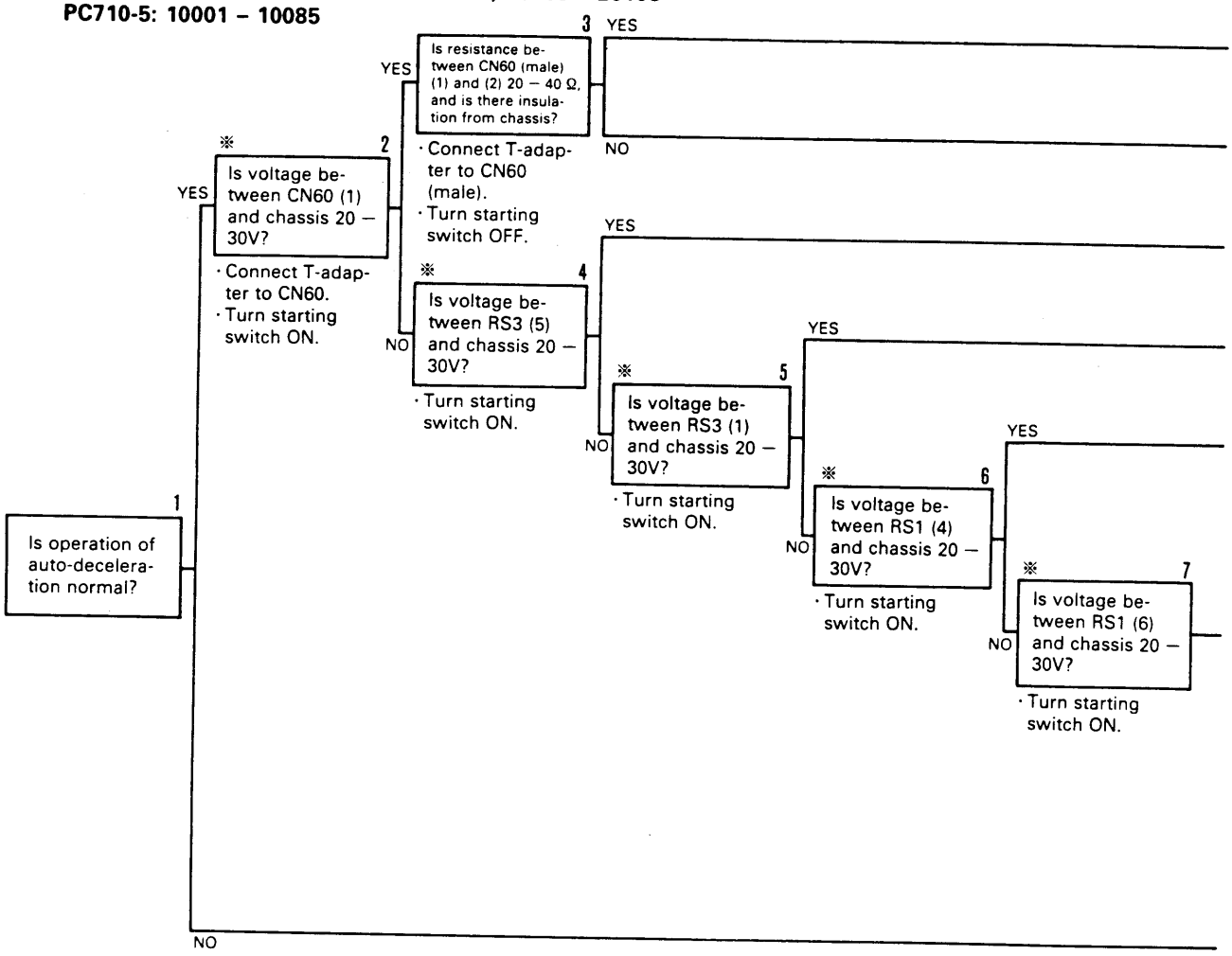
★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.
★ For checks marked ※, run the engine for approx. 10 sec. to charge the accumulator, then stop the engine and carry out the check.

PC650-5: 20001 – 20096, 20099 – 20103, 20106 – 20108
PC710-5: 10001 – 10085



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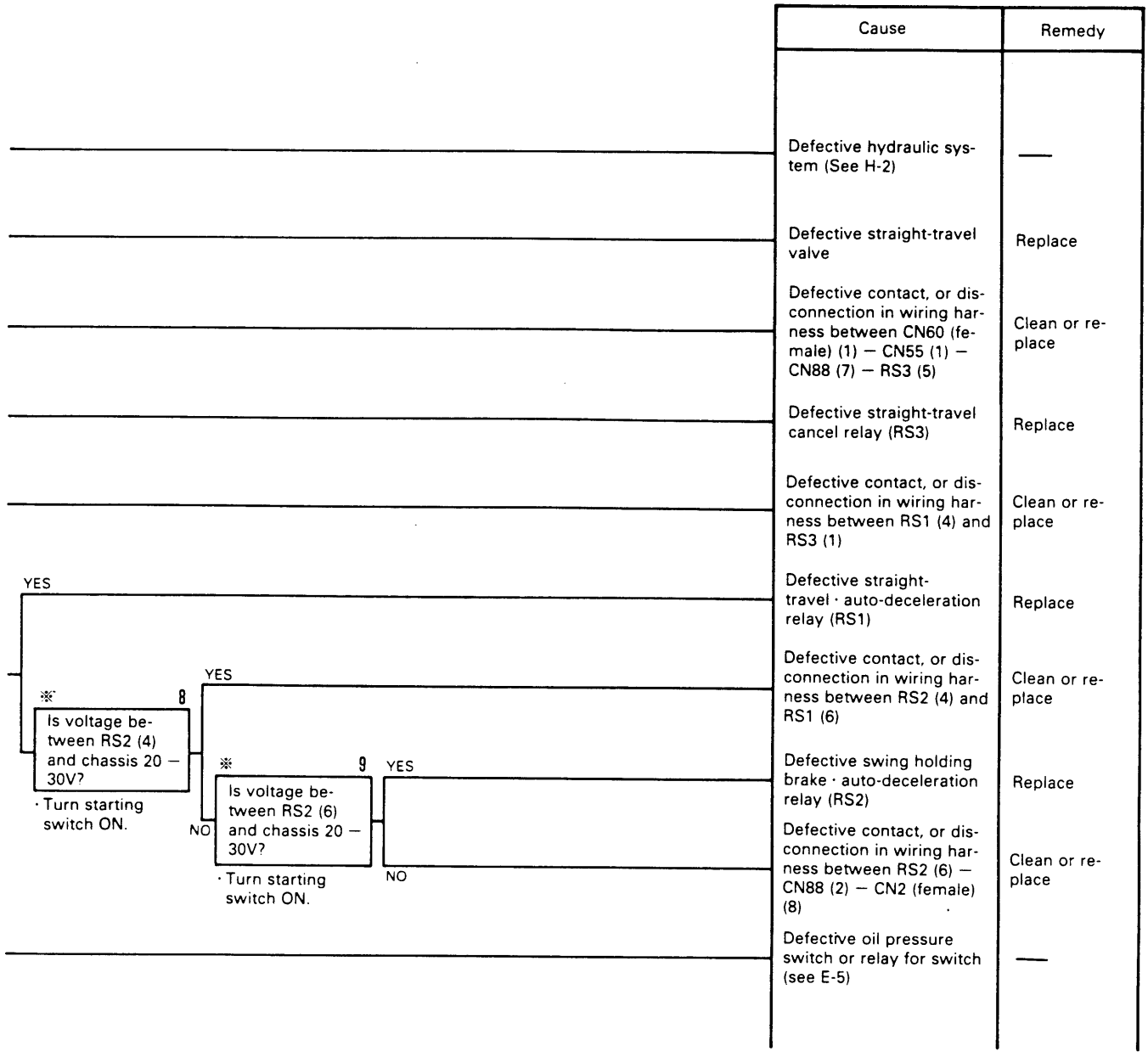
Cause
Remedy
Defective hydraulic system (See H-2)
—
Defective straight-travel valve
Replace
Defective contact, or disconnection in wiring harness between CN60 (female) (1) — CN55 (1) — CN88 (7) — RS3 (5)
Clean or replace
Defective straight-travel cancel relay (RS3)
Replace
Defective contact, or disconnection in wiring harness between RS1 (4) and RS3 (1)
Clean or replace
YES
Defective straight-travel · auto-deceleration relay (RS1)
Replace
※ 8
Is voltage between RS2 (4) and chassis 20 — 30V?
· Turn starting switch ON.
YES
Defective contact, or disconnection in wiring harness between RS2 (4) and RS1 (6)
Clean or replace
※ 9
Is voltage between RS2 (6) and chassis 20 — 30V?
· Turn starting switch ON.
YES
Defective swing holding brake · auto-deceleration relay (RS2)
Replace
NO
Defective contact, or disconnection in wiring harness between RS2 (6) — CN88 (2) — CN2 (female) (8)
Clean or replace
NO
Defective oil pressure switch or relay for switch (see E-5)
—

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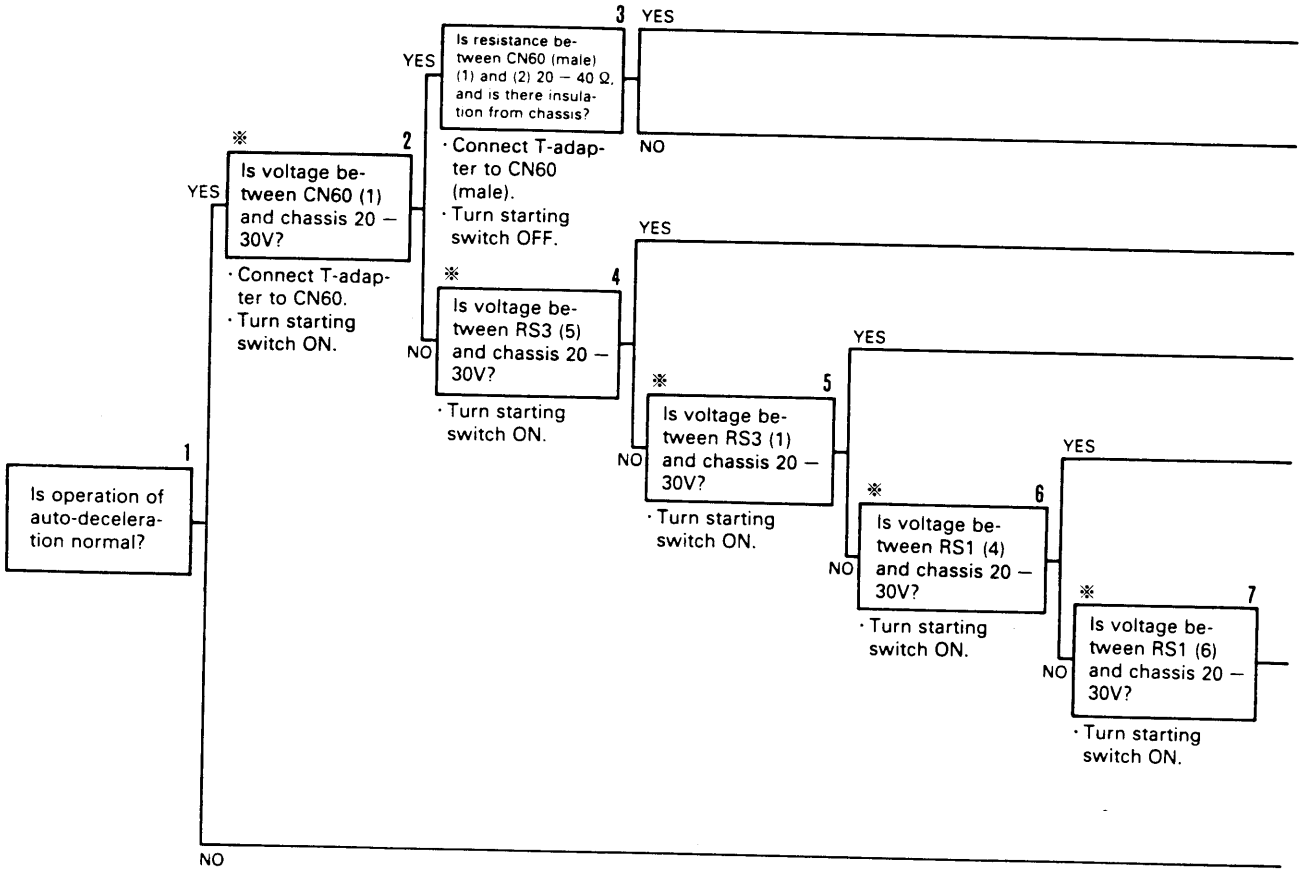
★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.
★ For checks marked ※, run the engine for approx. 10 sec. to charge the accumulator, then stop the engine and carry out the check.

PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up



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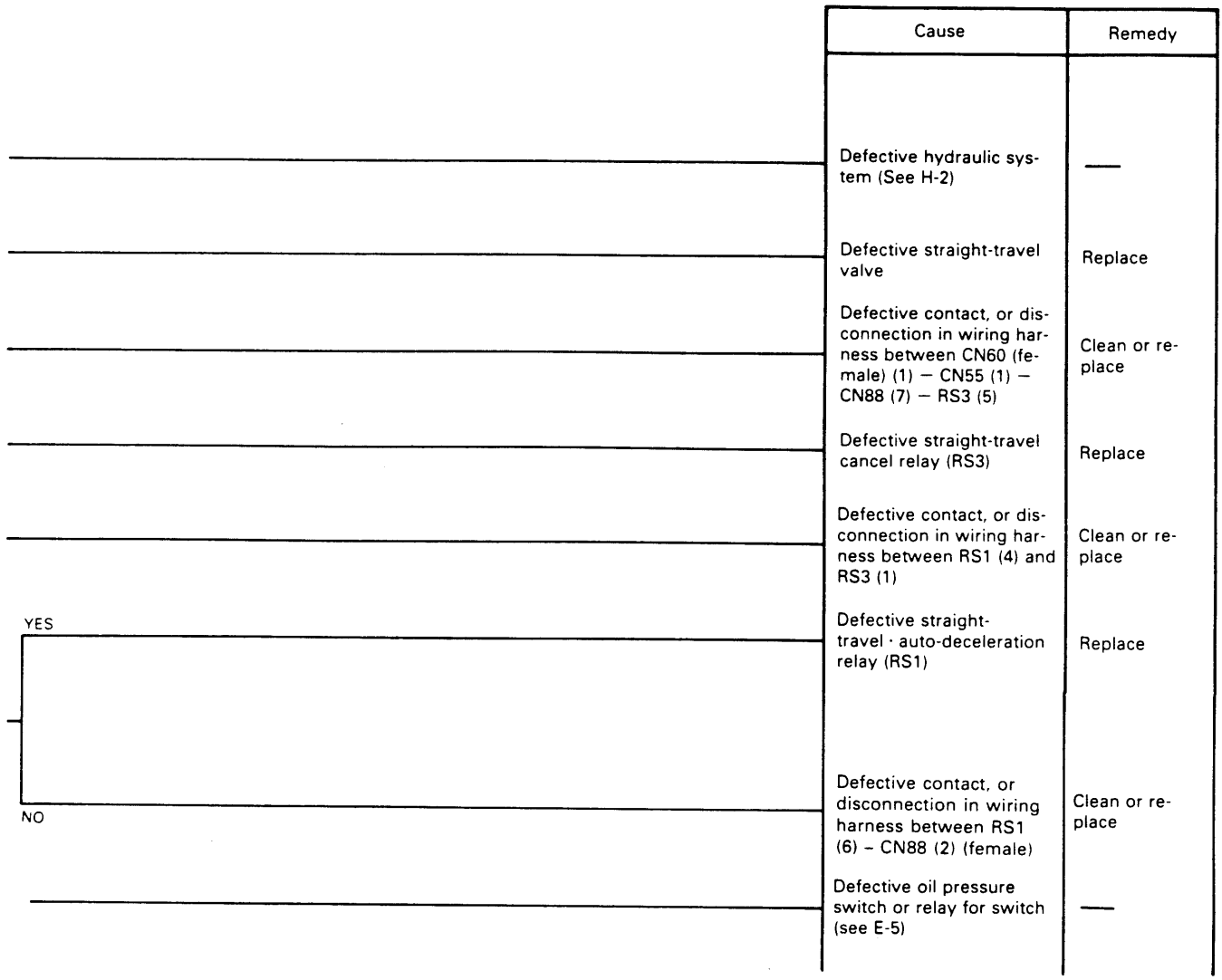
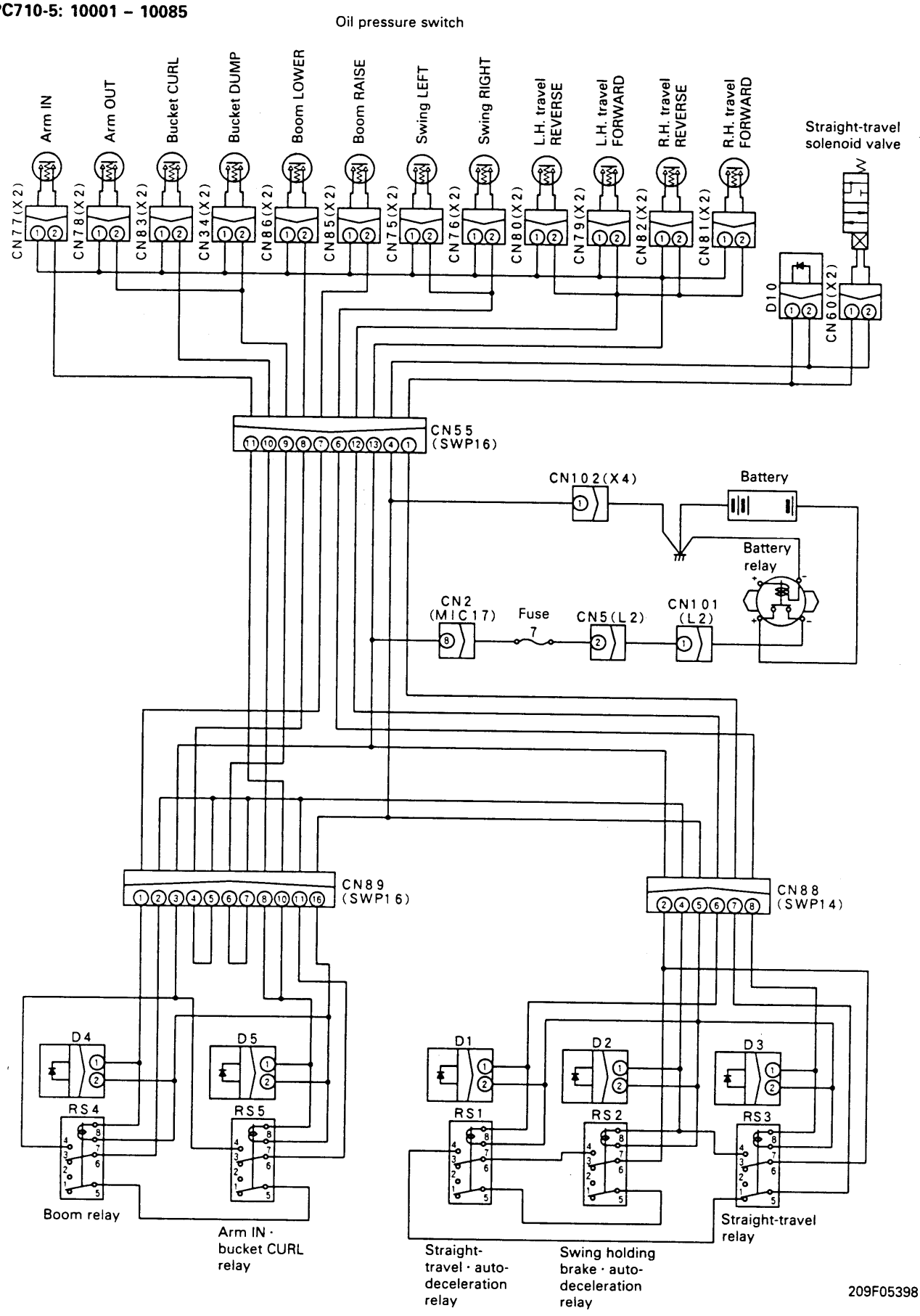


Cause	Remedy
Defective hydraulic system (See H-2)	—
Defective straight-travel valve	Replace
Defective contact, or disconnection in wiring harness between CN60 (female) (1) – CN55 (1) – CN88 (7) – RS3 (5)	Clean or replace
Defective straight-travel cancel relay (RS3)	Replace
Defective contact, or disconnection in wiring harness between RS1 (4) and RS3 (1)	Clean or replace
Defective straight-travel · auto-deceleration relay (RS1)	Replace
Defective contact, or disconnection in wiring harness between RS1 (6) – CN88 (2) (female)	Clean or replace
Defective oil pressure switch or relay for switch (see E-5)	—

PC650-5: 20001 – 20096, 20099 – 20103, 20106 – 20108
PC710-5: 10001 – 10085



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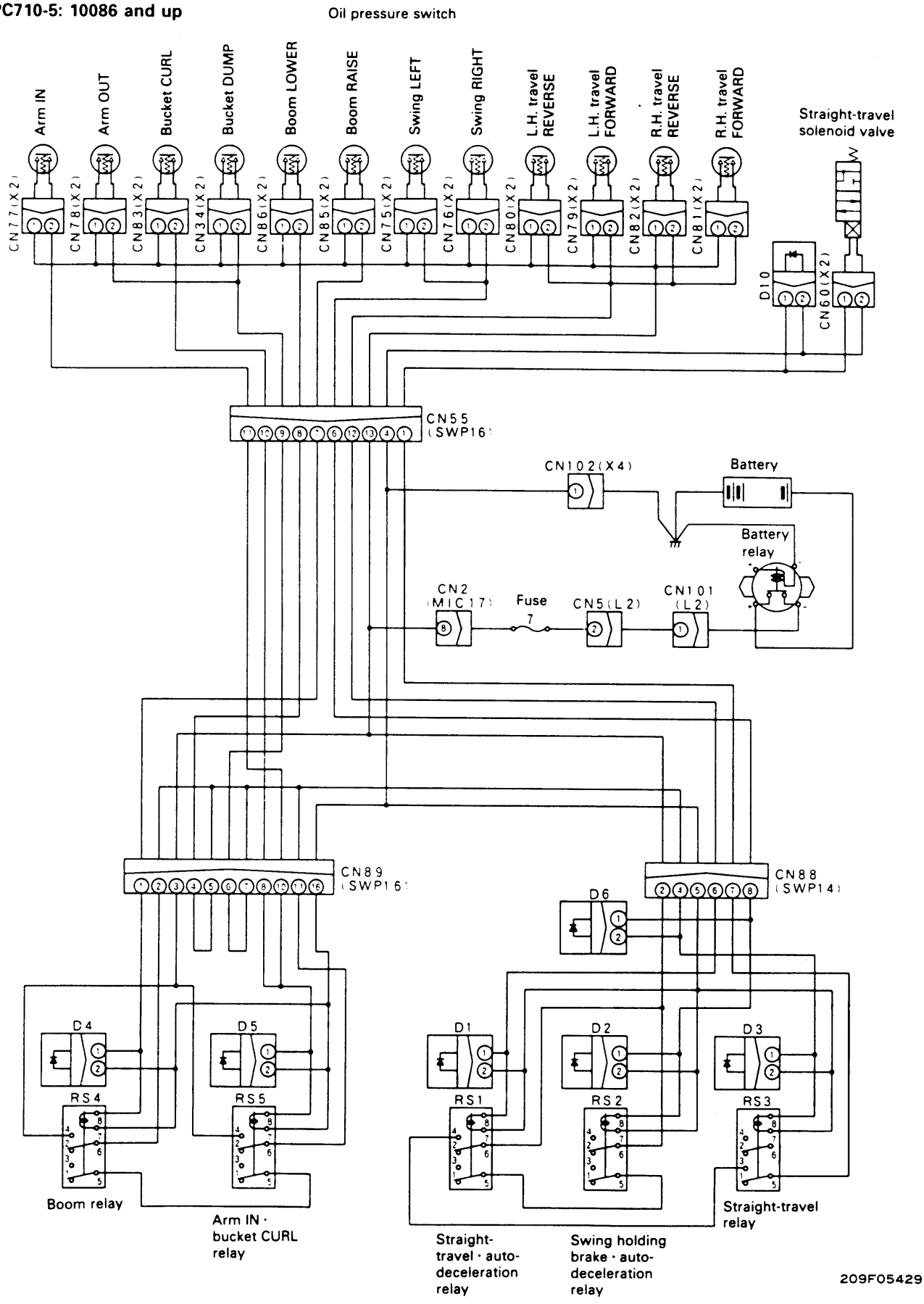
PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up



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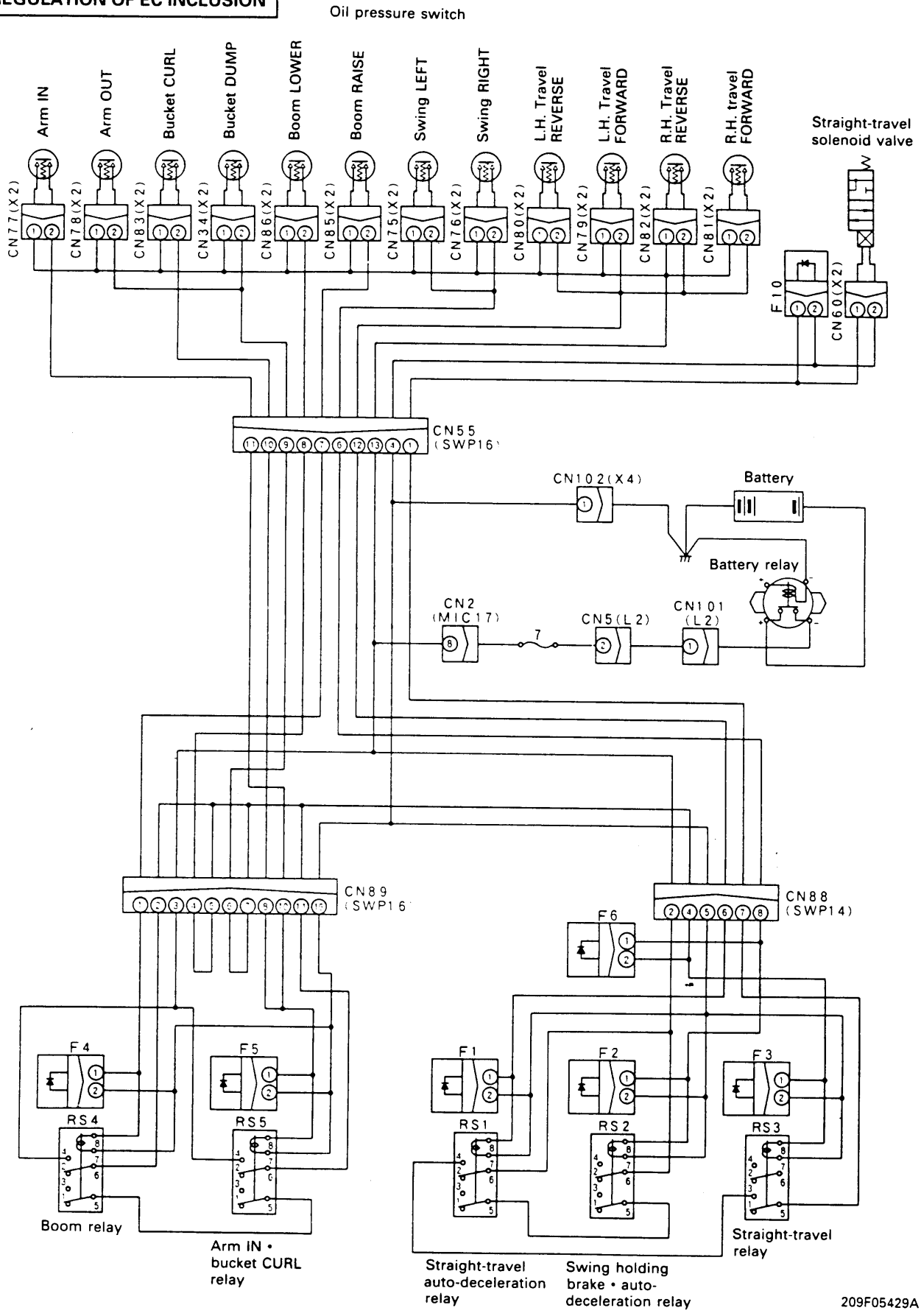
PC650-5: 20097, 20098, 20104, 20105, 20109 and up
PC710-5: 10086 and up

REGULATION OF EC INCLUSION



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E-10 Defective operation of heavy lift function

BACK HOE

★ **FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS**

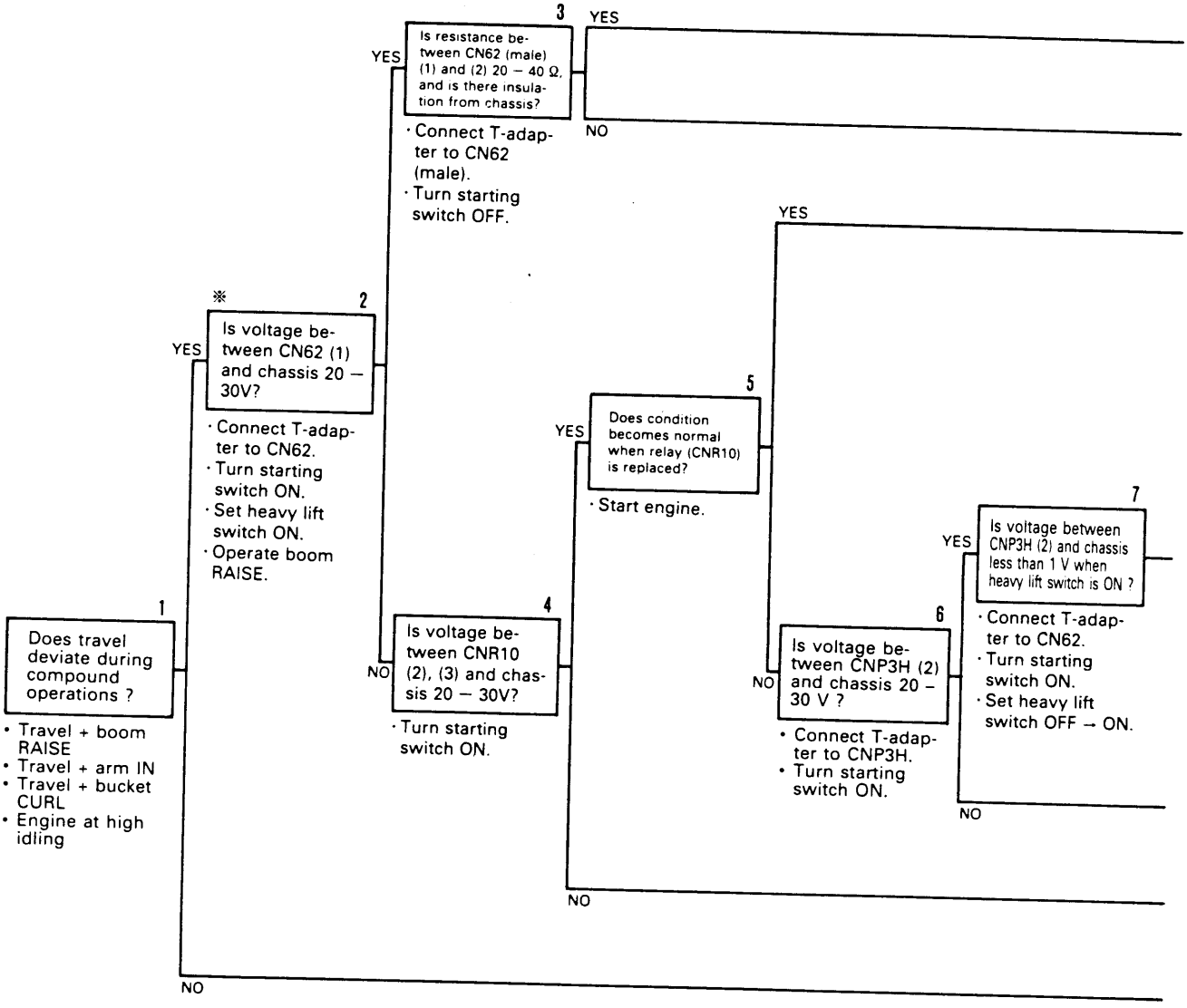
★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.

★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).

★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

★ For checks marked ※, run the engine for approx. 10 sec. to charge the accumulator, then stop the engine and carry out the check.

a) Heavy lift function is not actuated (boom RAISE set pressure does not increase)



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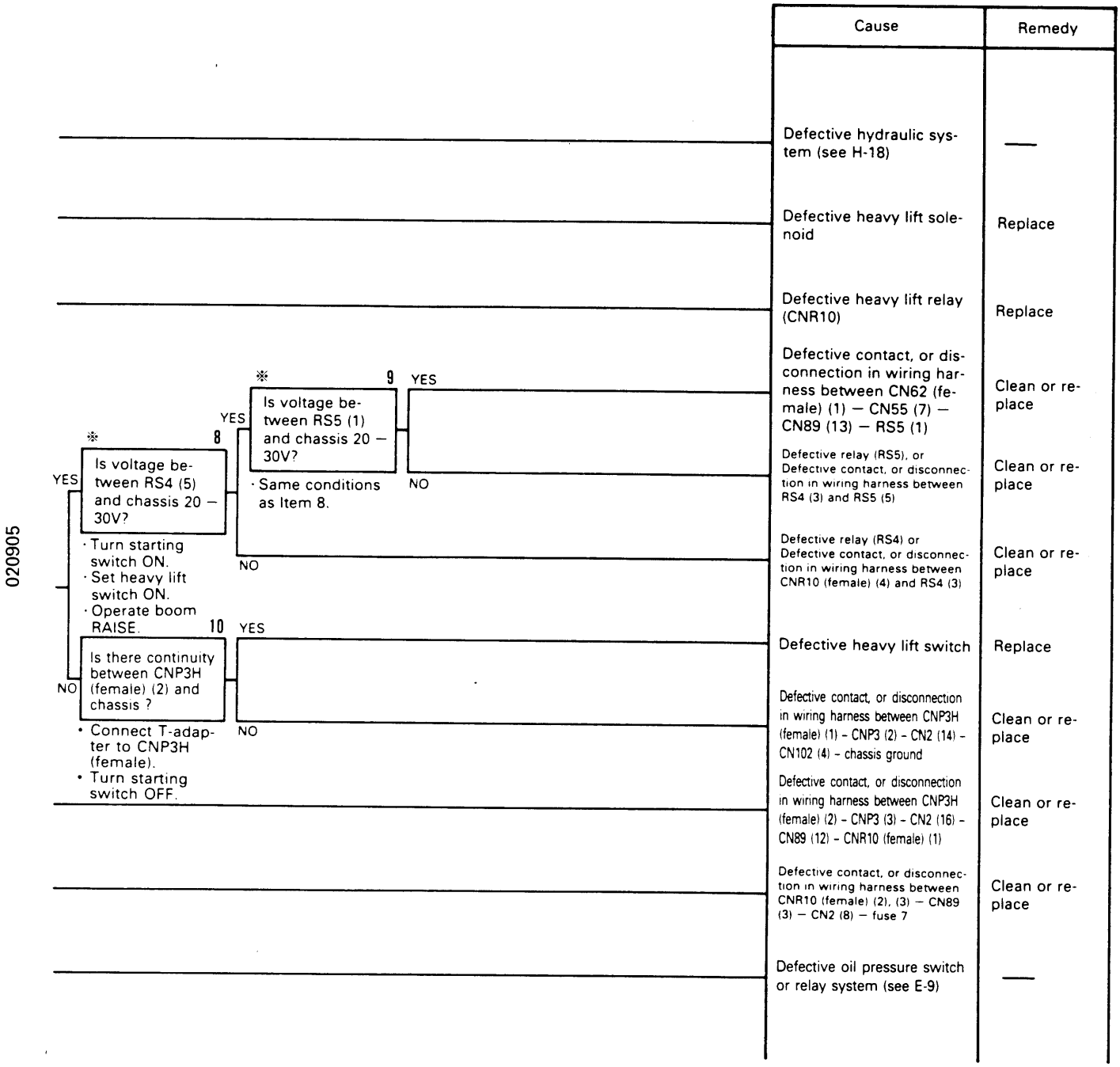
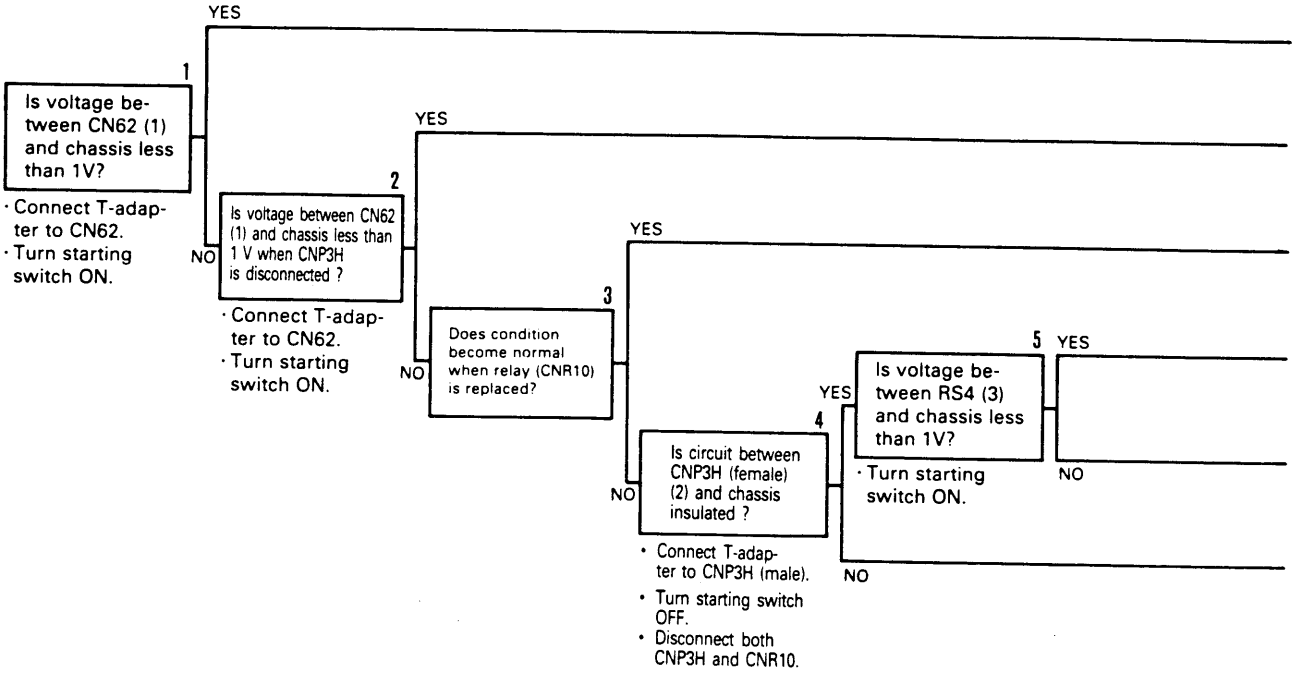
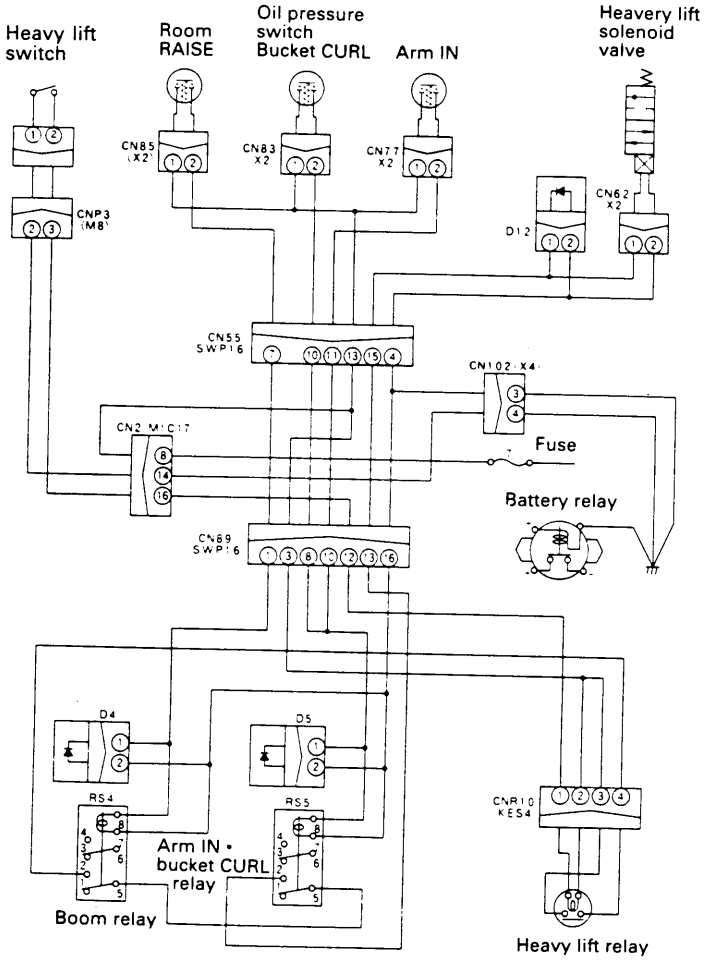


Cause	Remedy
Defective hydraulic system (see H-18)	—
Defective heavy lift solenoid	Replace
Defective heavy lift relay (CNR10)	Replace
Defective contact, or disconnection in wiring harness between CN62 (female) (1) – CN55 (7) – CN89 (13) – RS5 (1)	Clean or replace
Defective relay (RS5), or Defective contact, or disconnection in wiring harness between RS4 (3) and RS5 (5)	Clean or replace
Defective relay (RS4) or Defective contact, or disconnection in wiring harness between CNR10 (female) (4) and RS4 (3)	Clean or replace
Defective heavy lift switch	Replace
Defective contact, or disconnection in wiring harness between CNP3H (female) (1) - CNP3 (2) - CN2 (14) - CN102 (4) - chassis ground	Clean or replace
Defective contact, or disconnection in wiring harness between CNP3H (female) (2) - CNP3 (3) - CN2 (16) - CN89 (12) - CNR10 (female) (1)	Clean or replace
Defective contact, or disconnection in wiring harness between CNR10 (female) (2), (3) – CN89 (3) – CN2 (8) – fuse 7	Clean or replace
Defective oil pressure switch or relay system (see E-9)	—

b) Heavy lift function does not go off (boom RAISE set pressure stays increased)





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Cause	Remedy
Defective hydraulic system (see H-18)	—
Defective heavy lift switch	Replace
Defective heavy lift relay (CNR10)	Replace
Contact of +24V with wiring harness between CN62 (female) (1) — CN55 (15) — CN89 (13) — RS5 (1)	Replace harness
Contact of +24V with wiring harness between CNR10 (female) (4) and RS4 (3)	Replace harness
Short circuit between ground and wiring harness between CNP3H (female) (2) - CNP3 (3) - CN2 (16) - CN89 (12) - CNR10 (female) (1)	Replace harness

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★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

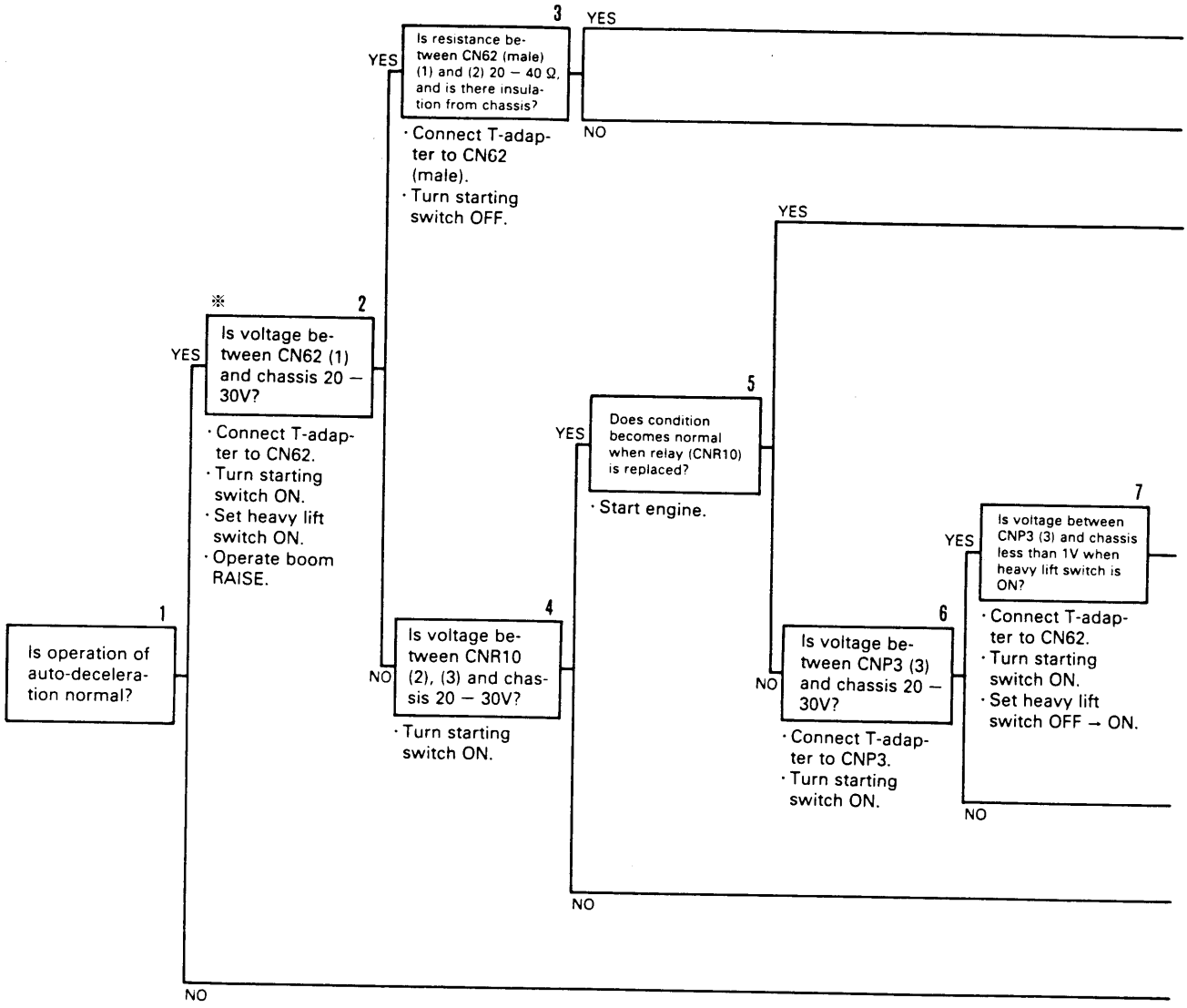
★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.

★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).

★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

★ For checks marked ※, run the engine for approx. 10 sec. to charge the accumulator, then stop the engine and carry out the check.

a) Heavy lift function is not actuated (boom RAISE set pressure does not increase)



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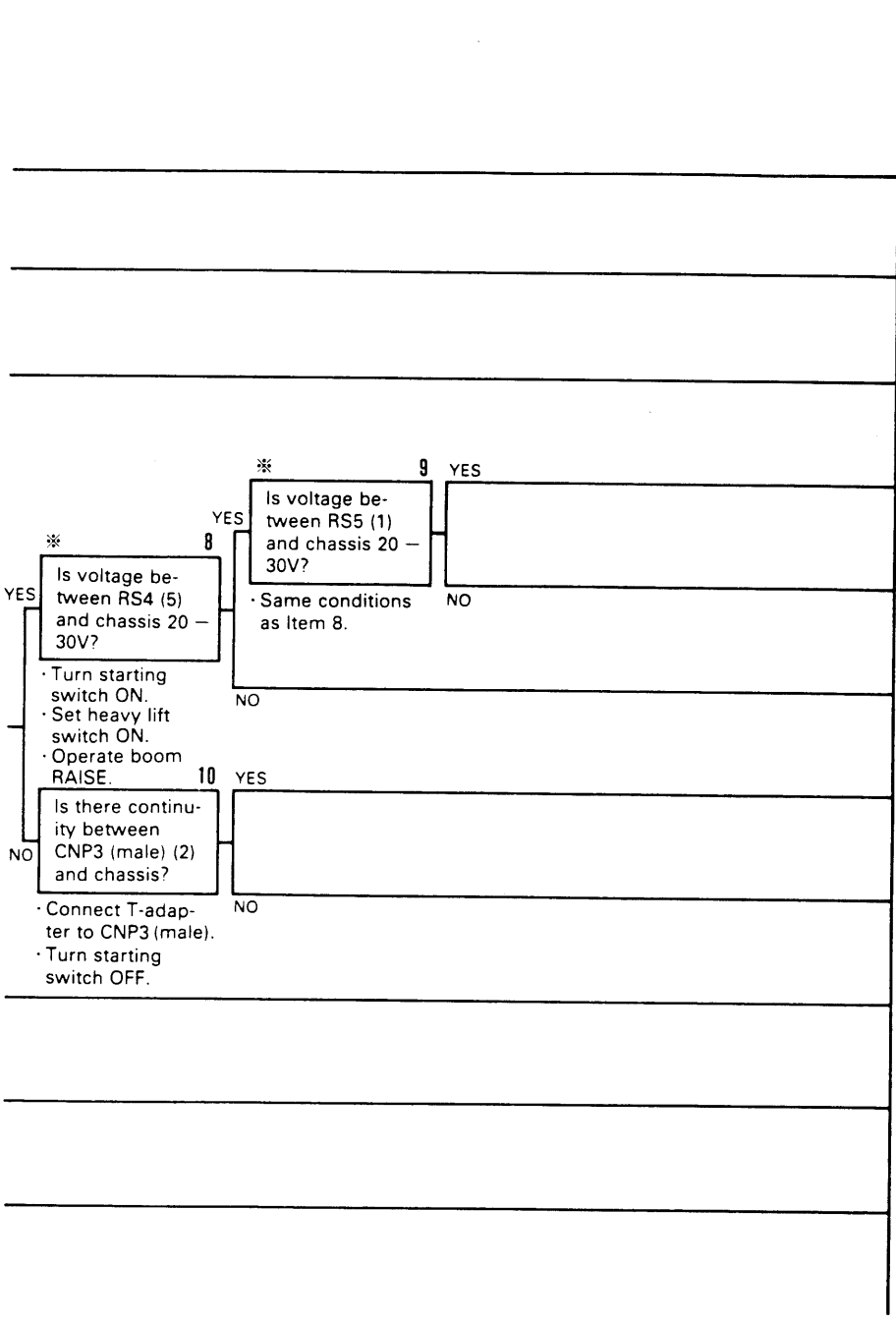

Cause	Remedy
Defective hydraulic system (see H-18)	—
Defective heavy lift solenoid	Replace
Defective heavy lift relay (CNR10)	Replace
Defective contact, or disconnection in wiring harness between CN62 (female) (1) — CN55 (7) — CN89 (13) — RS5 (1)	Clean or replace
Defective relay (RS5), or Defective contact, or disconnection in wiring harness between RS4 (3) and RS5 (5)	Clean or replace
Defective relay (RS4) or Defective contact, or disconnection in wiring harness between CNR10 (female) (4) and RS4 (3)	Clean or replace
Defective heavy lift switch	Replace
Defective contact, or disconnection in wiring harness between CNP3 (male) (2) — CN2 (14) — CN102 (4) — chassis ground	Clean or replace
Defective contact, or disconnection in wiring harness between CNP3 (male) (3) — CN2 (16) — CN89 (12) — CNR10 (female) (1)	Clean or replace
Defective contact, or disconnection in wiring harness between CNR10 (female) (2), (3) — CN89 (3) — CN2 (8) — fuse 7	Clean or replace
Defective oil pressure switch or relay system (see E-5)	—

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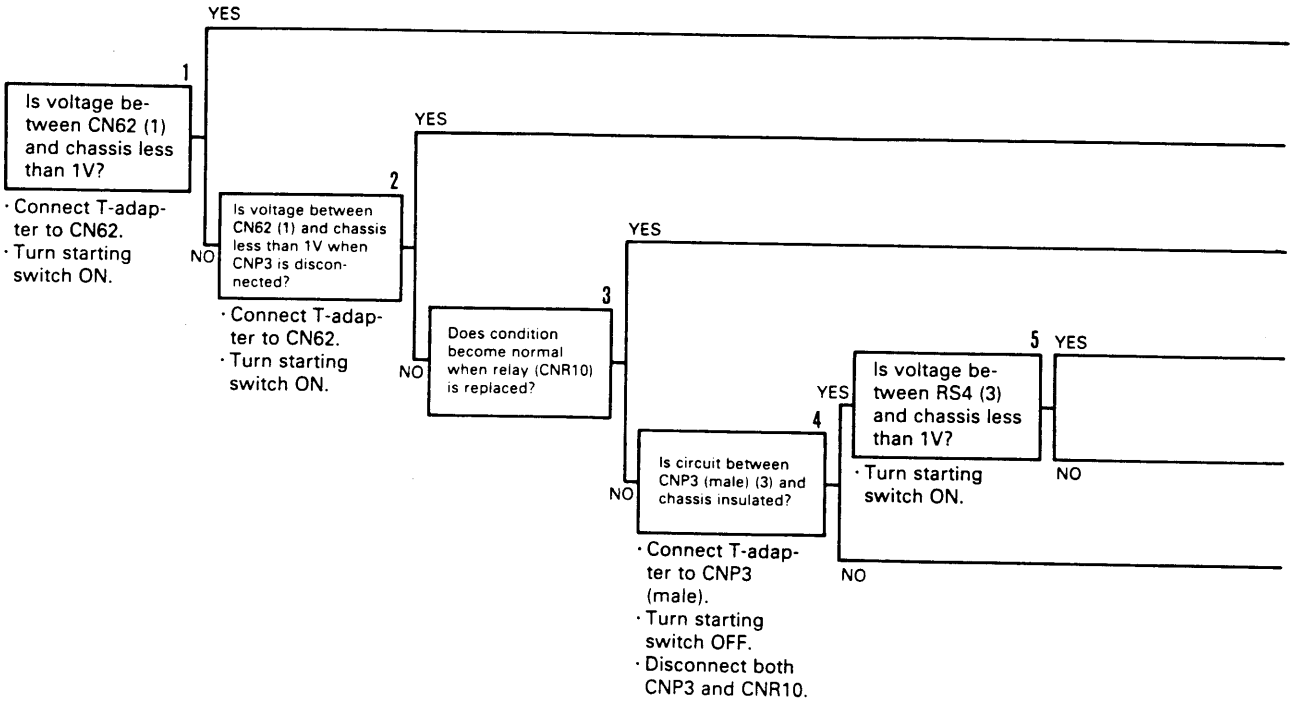
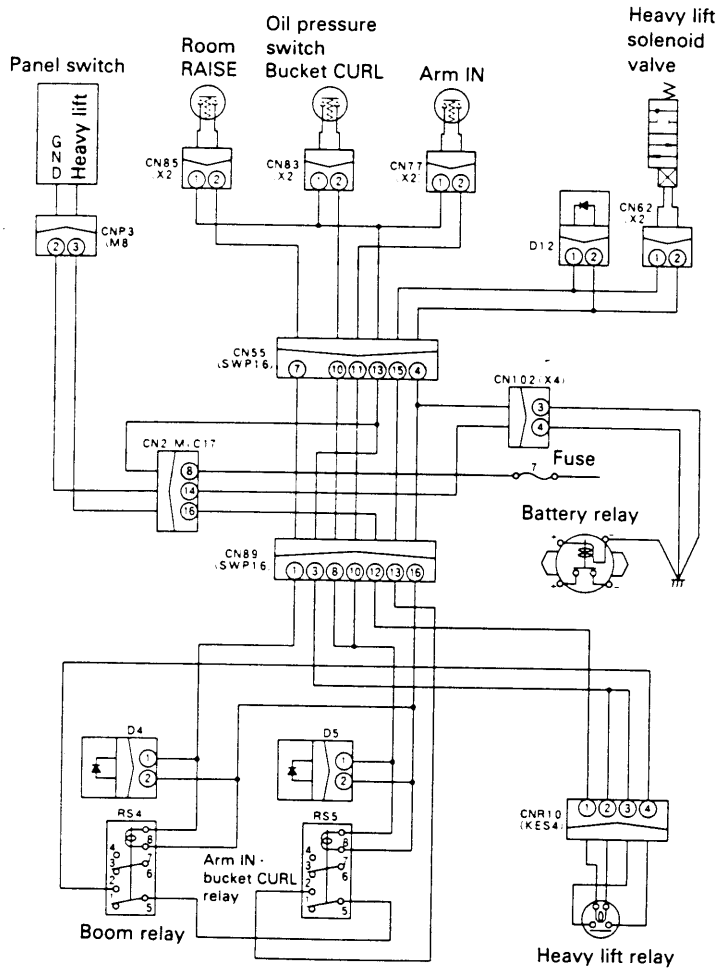
b) Heavy lift function does not go off (boom RAISE set pressure stays increased)





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Cause	Remedy
Defective hydraulic system (see H-18)	—
Defective heavy lift switch	Replace
Defective heavy lift relay (CNR10)	Replace
Contact of +24V with wiring harness between CN62 (female) (1) – CN55 (15) – CN89 (13) – RS5 (1)	Replace harness
Contact of +24V with wiring harness between CNR10 (female) (4) and RS4 (3)	Replace harness
Short circuit between ground and wiring harness between CNP3 (male) (3) – CN2 (16) – CN89 (12) – CNR10 (female) (1)	Replace harness

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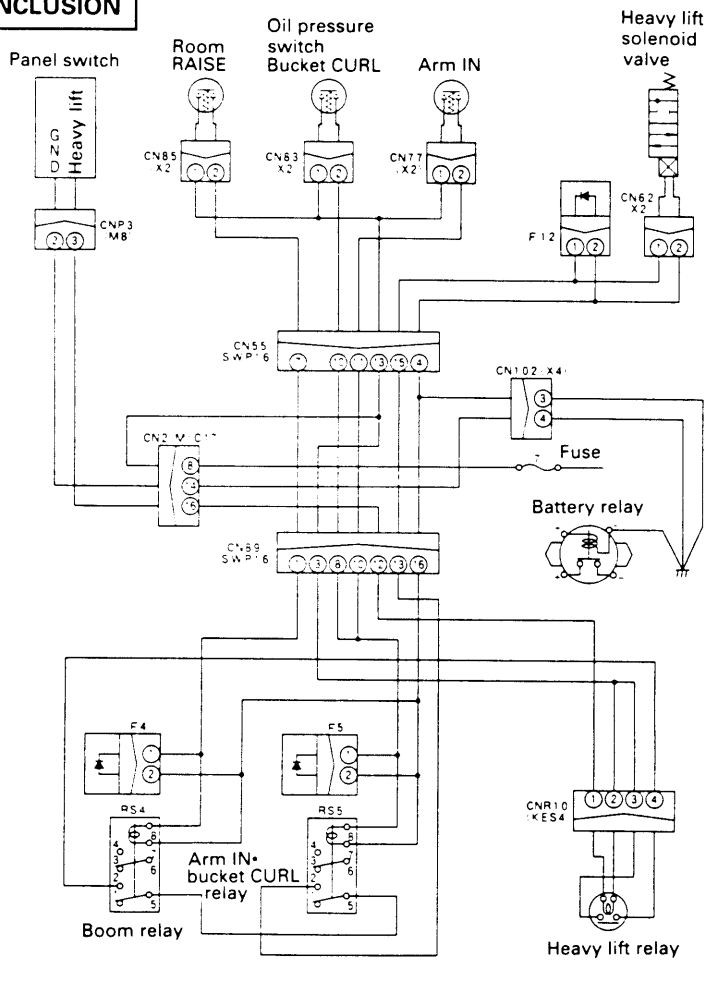
REGULATION OF EC INCLUSION



E-11 Machine push up function is not actuated

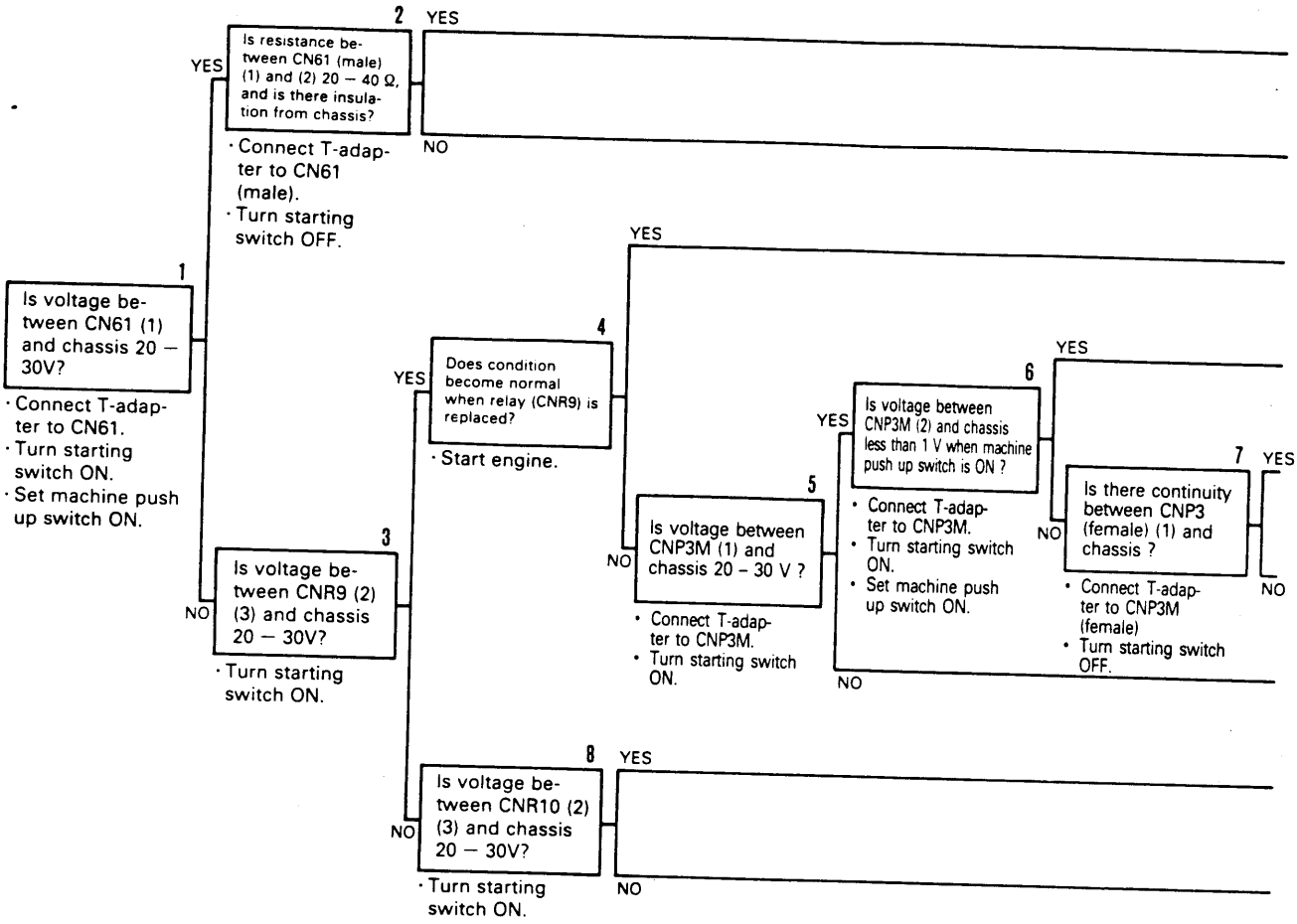
★ **FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS**

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.

★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).

★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

a) Machine push up function is not actuated (boom LOWER set pressure does not increase)



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Cause	Remedy
Defective hydraulic system (see H-19)	—
Defective machine push up solenoid	Replace
Defective machine push up relay (CNR9)	Replace
Defective contact, or disconnection in wiring harness between CN61 (female) (1) — CN55 (16) — CN89 (15) — CNR9 (female) (4)	Clean or replace
Defective machine push up switch	Replace
Defective contact, or disconnection in wiring harness between CNP3M (female) (1) -CNP3 (2) - CN2 (14) - CN102 (4) - chassis ground	Clean or replace
Defective contact, or disconnection in wiring harness between CNP3M (female) (2) - CNP3 (5) - CN2 (17) - CN89 (14) - CNR9 (female) (1)	Clean or replace
Defective contact, or disconnection in wiring harness between CN89 (male) (3) and CNR9 (female) (2), (3)	Clean or replace
Defective contact, or disconnection in wiring harness between fuse 7 — CN2 (8) — CN89 (3) — CNR9 (female) (2), (3)	Clean or replace

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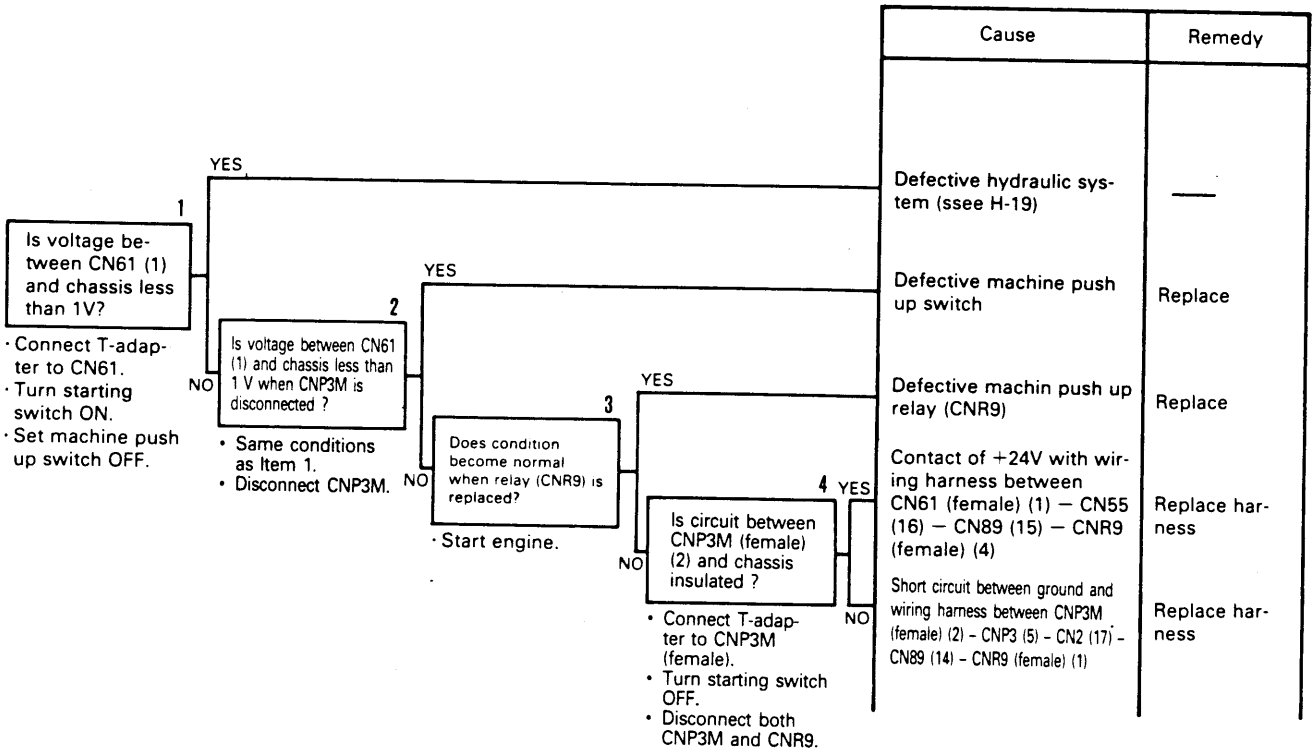
b) Machine push up function does not go OFF (boom LOWER set pressure stays increased)



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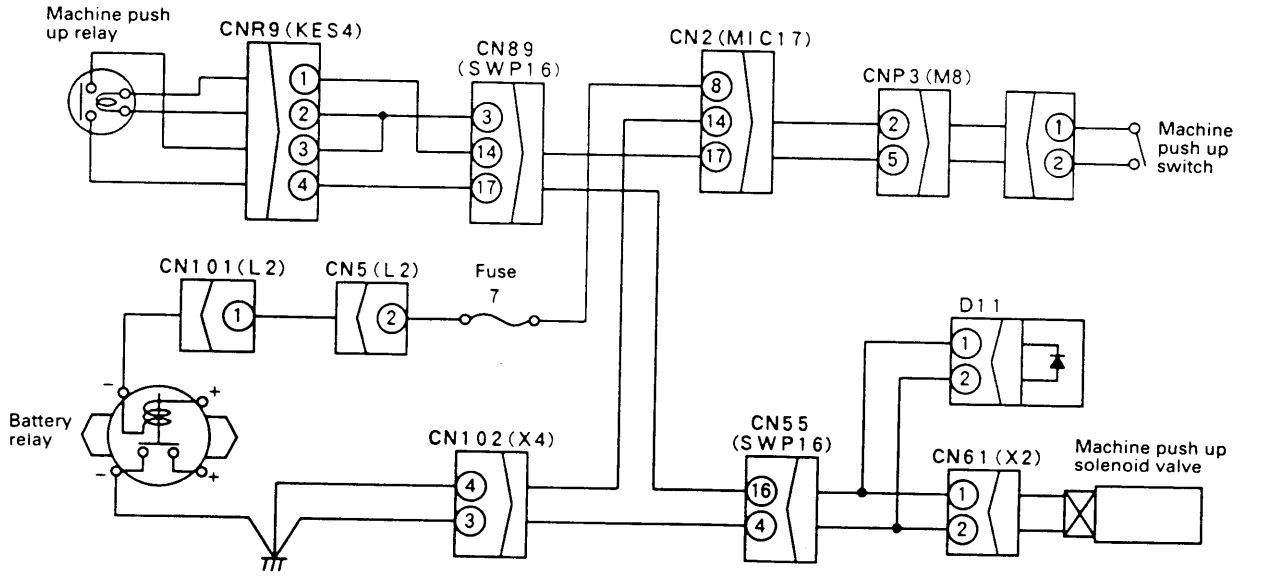

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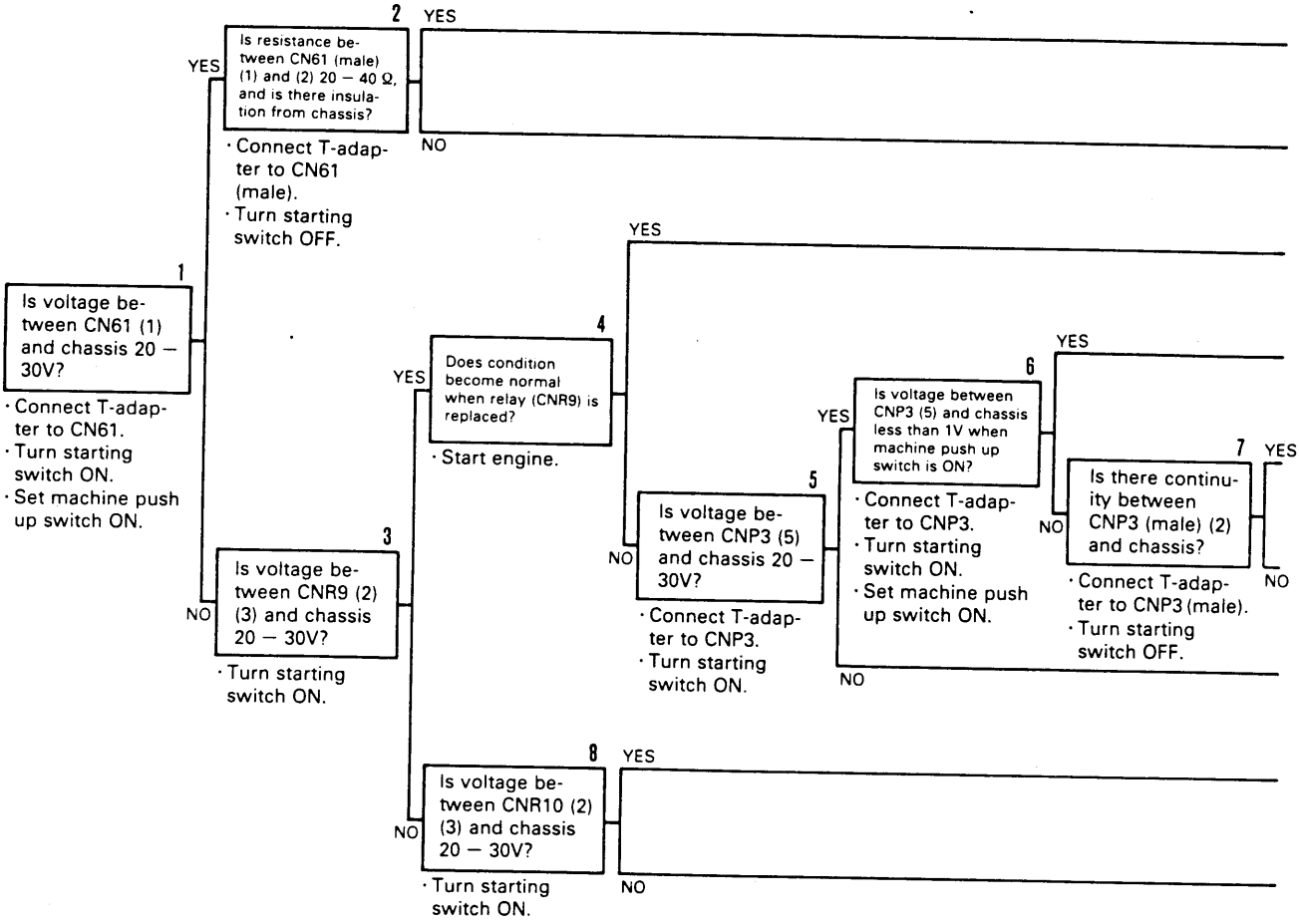
★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOER OLSS AND AUTO-DECELERATION**

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.

★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).

★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

a) Machine push up function is not actuated (boom LOWER set pressure does not increase)



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Cause	Remedy
Defective hydraulic system (see H-19)	—
Defective machine push up solenoid	Replace
Defective machine push up relay (CNR9)	Replace
Defective contact, or disconnection in wiring harness between CN61 (female) (1) – CN55 (16) – CN89 (15) – CNR9 (female) (4)	Clean or replace
Defective machine push up switch	Replace
Defective contact, or disconnection in wiring harness between CNP3 (male) (2) – CN2 (14) – CN102 (4) – chassis ground	Clean or replace
Defective contact, or disconnection in wiring harness between CNP3 (male) (5) – CN2 (17) – CN89 (14) – CNR9 (female) (1)	Clean or replace
Defective contact, or disconnection in wiring harness between CN89 (male) (3) and CNR9 (female) (2), (3)	Clean or replace
Defective contact, or disconnection in wiring harness between fuse 7 – CN2 (8) – CN89 (3) – CNR9 (female) (2), (3)	Clean or replace

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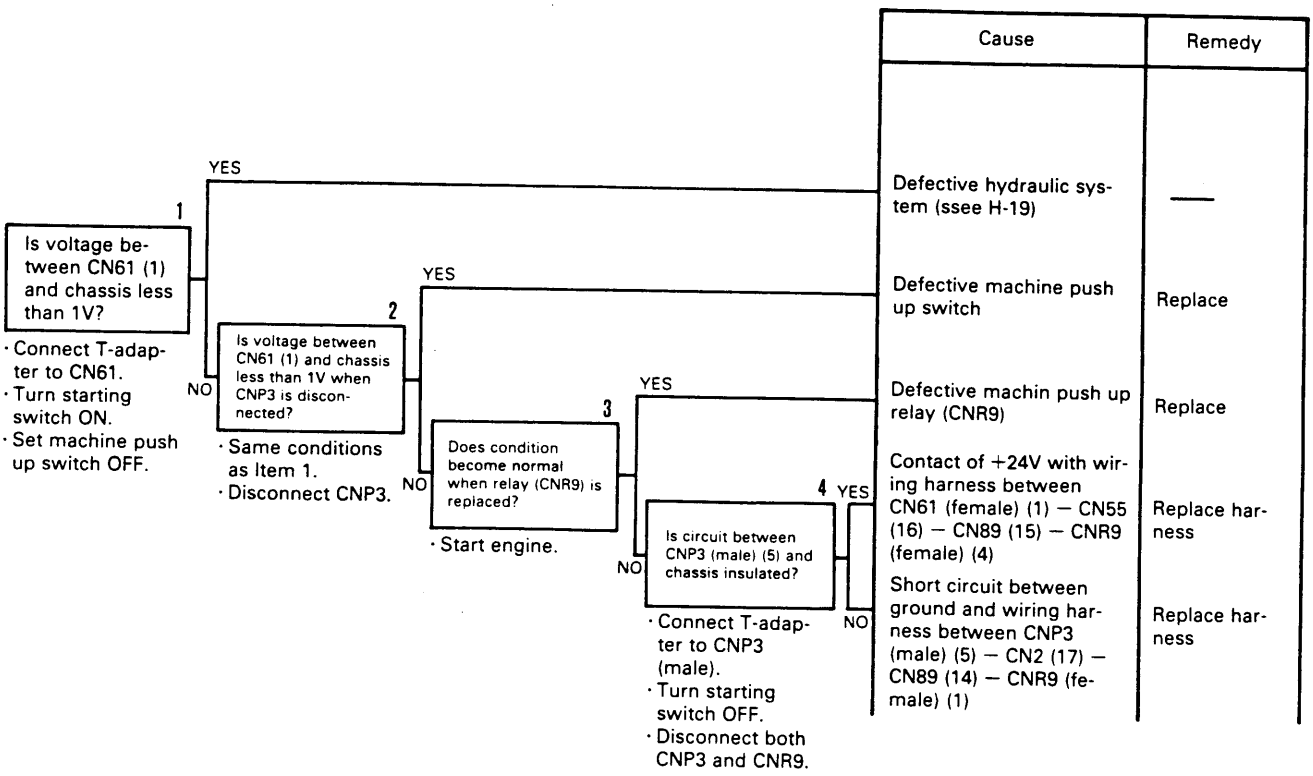
b) Machine push up function does not go OFF (boom LOWER set pressure stays increased)



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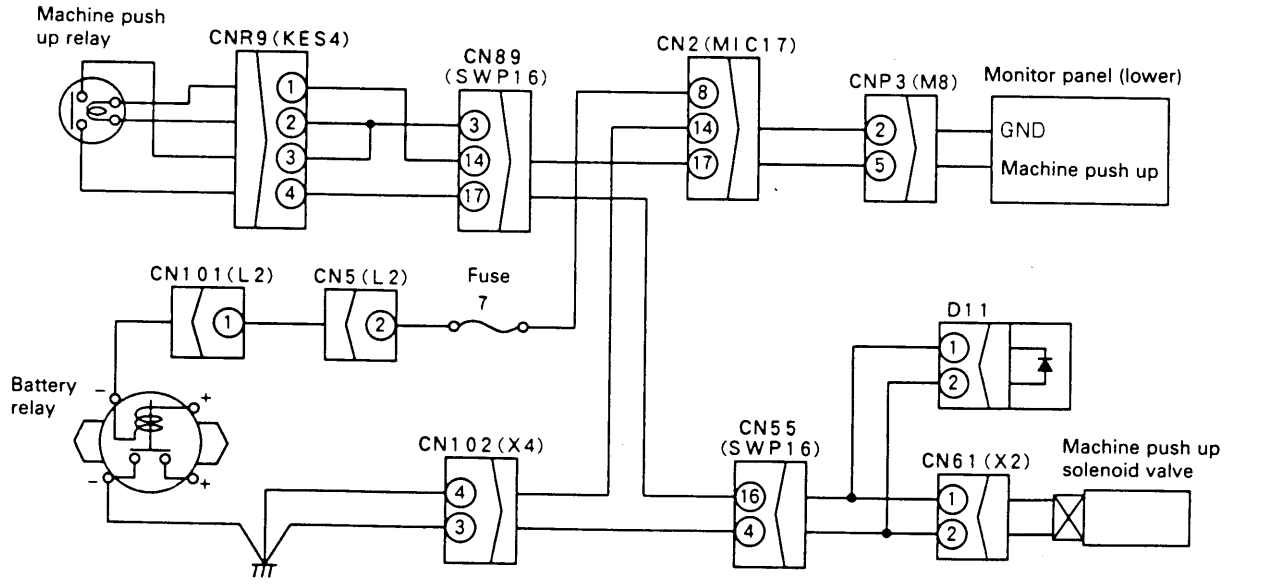

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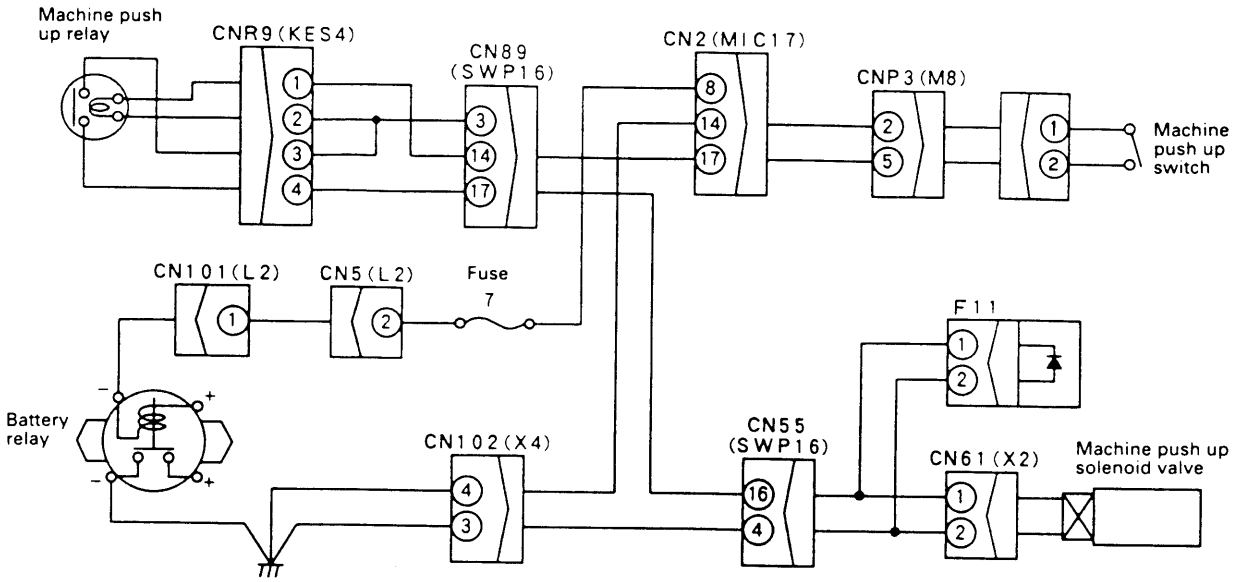
REGULATION OF EC INCLUSION



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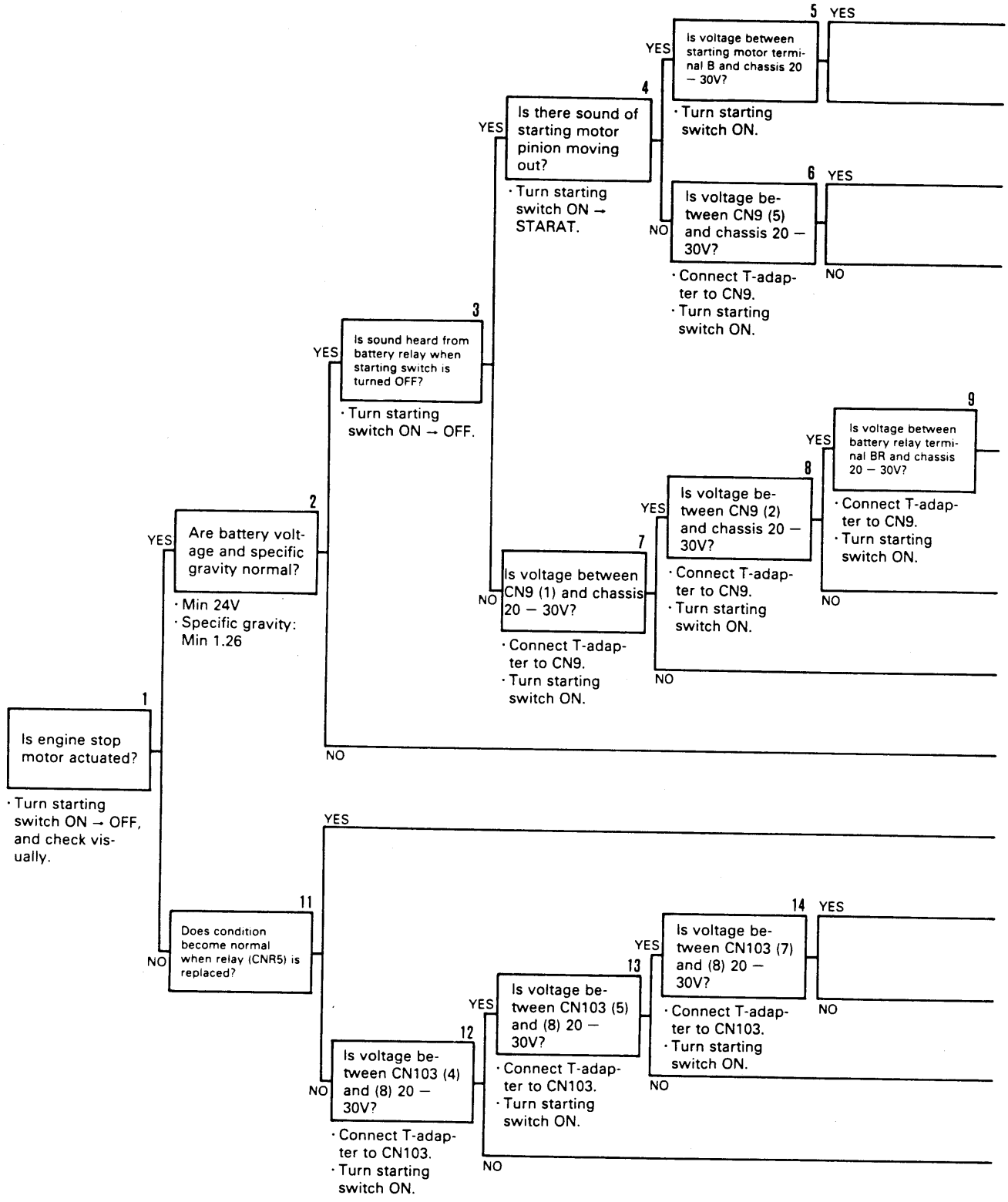
E-12 Engine does not start

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.



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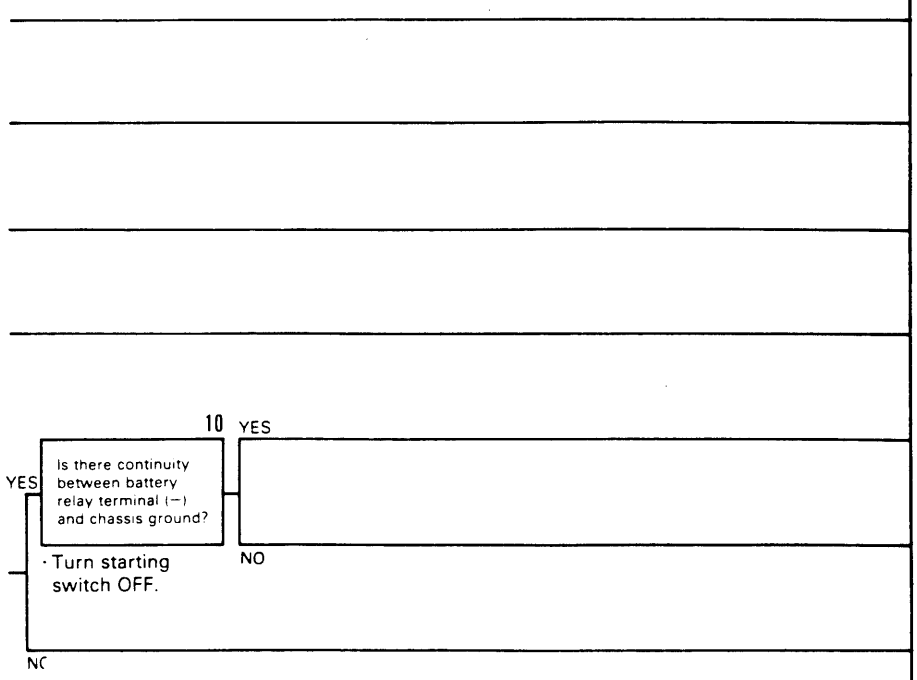

Cause	Remedy
Defective starting motor	Replace
Defective contact of wiring harness between battery relay and starting motor terminal B	Correct
Defective contact, or disconnection in wiring harness between CN9 (female) (5) — CN2 (1) — CNE1 (1) — CNE7 — starting motor terminal S	Clean or replace
Defective starting switch (between terminal B and C)	Replace
Defective battery relay	Replace
Defective contact of wiring harness between battery terminal (−) and chassis ground	Correct
Defective contact, or disconnection in wiring harness between CN9 (female) (2) — CN4 (6) — CN102 (1) — battery relay terminal BR	Clean or replace
Defective starting motor switch (between B and BR)	Replace
Defective contact, or disconnection in wiring harness between fuse 2 and CN9 (female) (1)	Clean or replace
Battery capacity too low	Charge or replace
Defective stop motor relay (CNR4)	Replace
Defective engine stop motor	Replace
Defective contact, or disconnection in wiring harness between CN103 (male) (5) — CN90 (7) — CNR4 (5), (3) — CN90 (6) — CN103 (male) (7)	Clean or replace
Defective engine stop motor	Replace
Defective contact, or disconnection in wiring harness between fuse 1 — CN4 (7) — CN103 (female) (4) or between CN9 (6) — CN4 (8) — CN90 (5) — CNR4 (1)	Clean or replace

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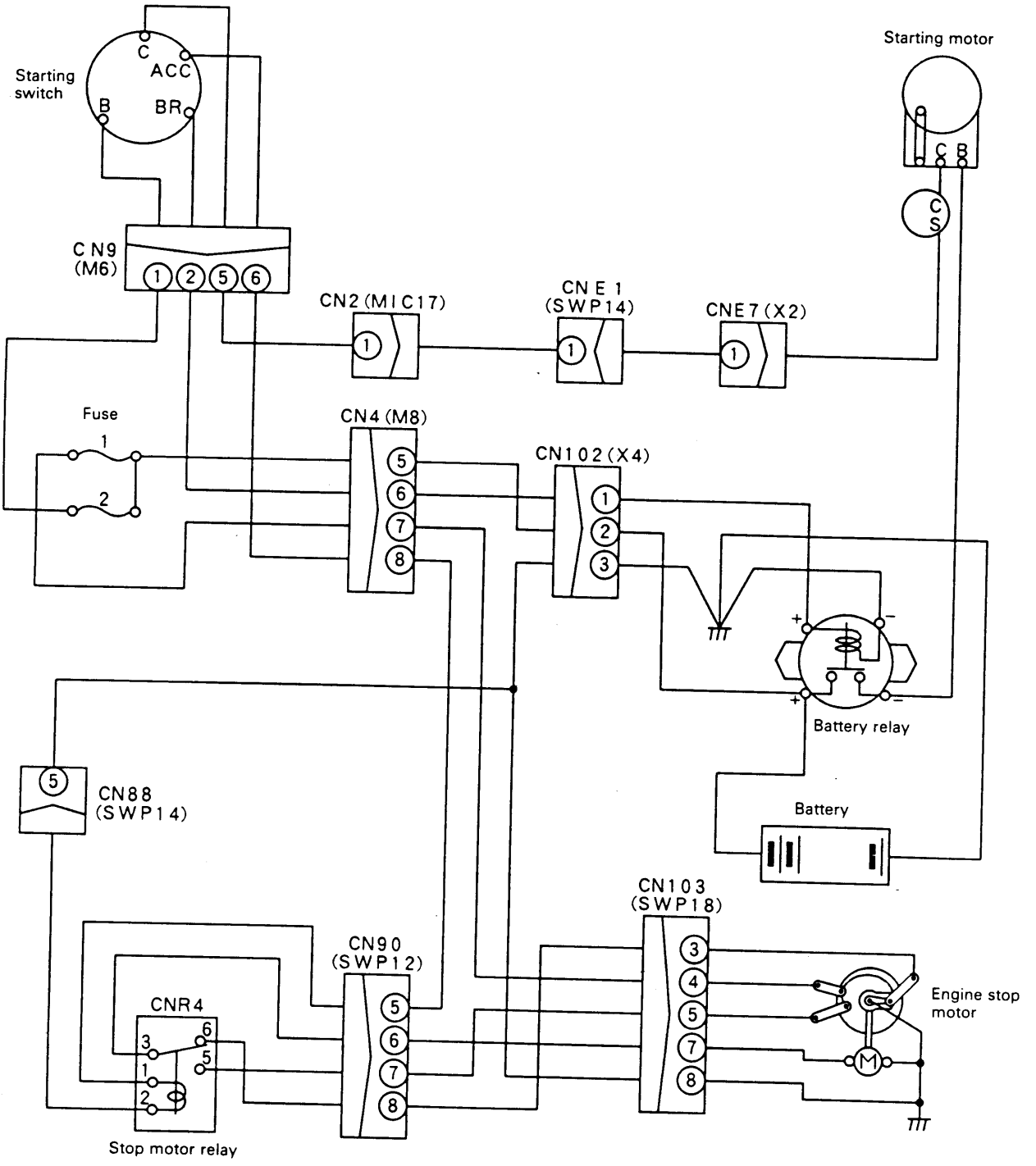

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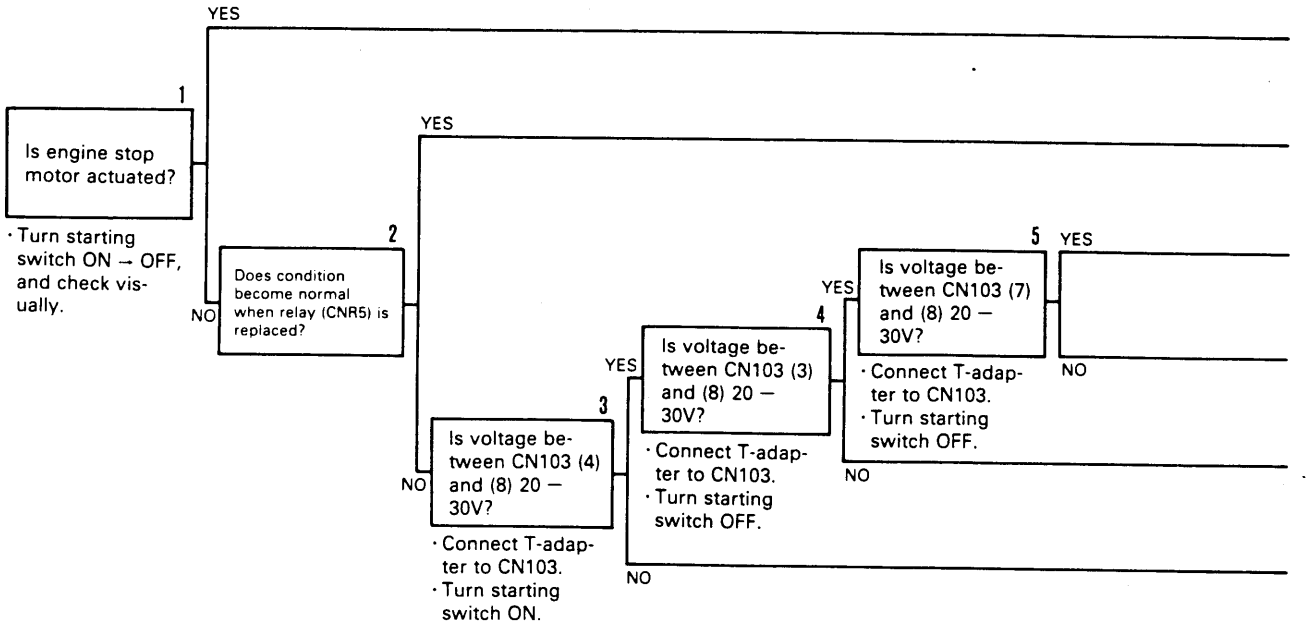
E-13 Engine does not stop

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.



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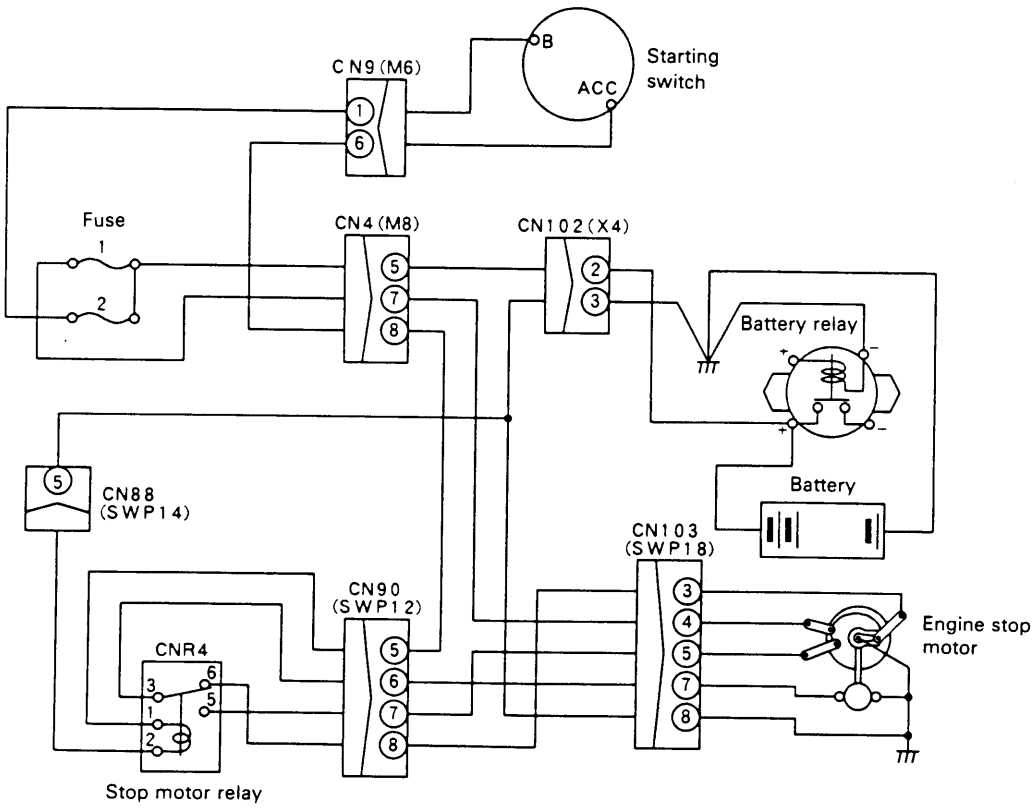

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Cause	Remedy
Defective adjustment of linkage between engine stop motor and injecion pump	Adjust
Defective engine stop relay (CNR4)	Replace
Defective engine stop motor	Replace
Defective contact, or disconnection in wiring harness between CN103 (male) (7) – CN90 (6) – CNR4 (3), (6) – CN90 (8) – CN103 (male) (3) or CN103 (male) (8) – CN102 (male) (3)	Clean or replace
Defective engine stop motor	Replace
Defective contact, or disconnection in wiring harness between fuse 1 – CN4 (7) – CN103 (male) (4)	Clean or replace

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TROUBLESHOOTING OF HYDRAULIC AND MECHANICAL SYSTEM (H MODE)

020905

BEFORE CARRYING OUT TROUBLESHOOTING OF HYDRAULIC SYSTEM (H MODE)

1. Combination and actuation of main pumps

The work equipment and travel circuit use two HPV90 + 90 piston pumps. No. 1 front pump and No. 2 front pump merge and flow to the R.H. 4-spool control valve, and No. 1 rear pump and No. 2 rear pump merge and flow to the L.H. 5-spool control valve.

Both the front and rear No. 2 pumps are equipped only with a servo valve, and are controlled together with the No. 1 pump by the control pressure (NC valve output pressure) from the No. 1 pump. For this reason, if there is any degect in the differential pressure of the jet sensor or the output pressure of the NC valve is defective, the effect is felt by the No. 1 front pump (rear pump) and No. 2 front pump (rear pump) at the same time.

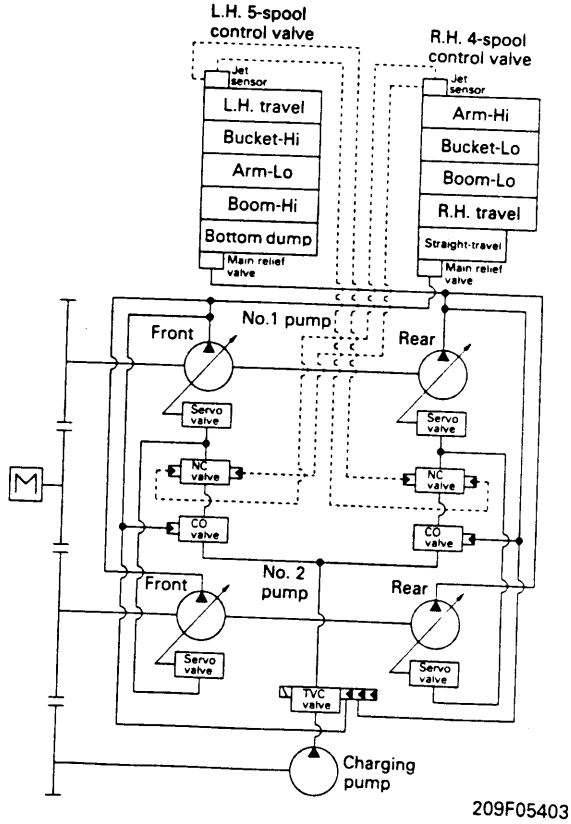
Therefore, if the work equipment or travel system lacks speed or power, or the machine deviates when traveling, use the following procedure and the matrix on the following page to inspect and decide which of the four pumps is causing the prblem, or if the cause is in the control valves.

2. Procedure for judging

If the work equipment is slow or the machine deviates to the left, the possible causes are:

1) Drop in main relief pressure of L.H. 5-spool control valve.
2) Defective defferential pressure of jet sensor of L.H. 5-spool control valve.
3) Defective output pressure of NC valve for No. 1 rear pump.
4) Defective No. 1 rear pump or No. 2 rear pump.

It is possible to judge if the main relief pressure, jet sensor differential pressure, and NC valve output pressure are defective or not by measuring the hydraulic pressure. However, in the case of the pumps, as explained in Item 1, the No. 2 pump is controlled at the same time by the output pressure of the NC valve installed to the No. 1 pumps so it is not possible to judge if the problem is in the No. 1 front pump or in the No. 2 front pump.



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To overcome this problem interchange the outlet hoses of the No. 2 front and rear pumps to judge which pump is defective.

1) If the machine deviated to the left, the No. 1 rear pump is defective.
2) If the machine deviated to the right, the No. 2 rear pump is defective.
3) If the travel speed becomes slow on both the left and right, the output pressure of the NC valve of the No. 1 rear pump is defective, or the jet sensor of the L.H. 5-spool control valve is defective. (Assuming that the main relief pressure for both the left and right travel relief system is normal.)

If the No. 1 rear pump or No. 2 rear pump is judged to be defective, and the output pressure of the NC valve is normal, interchange the servo valve to judge if the pump itself is defective or if the servo valve is defective.

(The servo valves are interchangeable between No. 1 front pump and No. 2 rear pump, and No. 2 rear pump and No. 2 front pump.)

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If the work equipment lacks speed or power (swing is normal);

★ Machine also deviates (no abnormality in auto-deceleration)

1) If there is a big drop in speed, and it is thought that there is an abnormality in the pump, check the line filter.
2) If there is only a small drop in speed, and the condition does not return to normal when each equipment is adjusted, check the line filter also.
3) In Troubleshooting Items 2 and 4, it is also possible to measure the main relief pressure.
4) If the condition does not return to normal even when the servo valve is replaced, there is probably some abnormality in the pump itself (servo piston).
5) When checking the action of the servo piston, remove the caps on both sides and move by hand.
6) Troubleshooting Item 1 applies only to the loading shovel.

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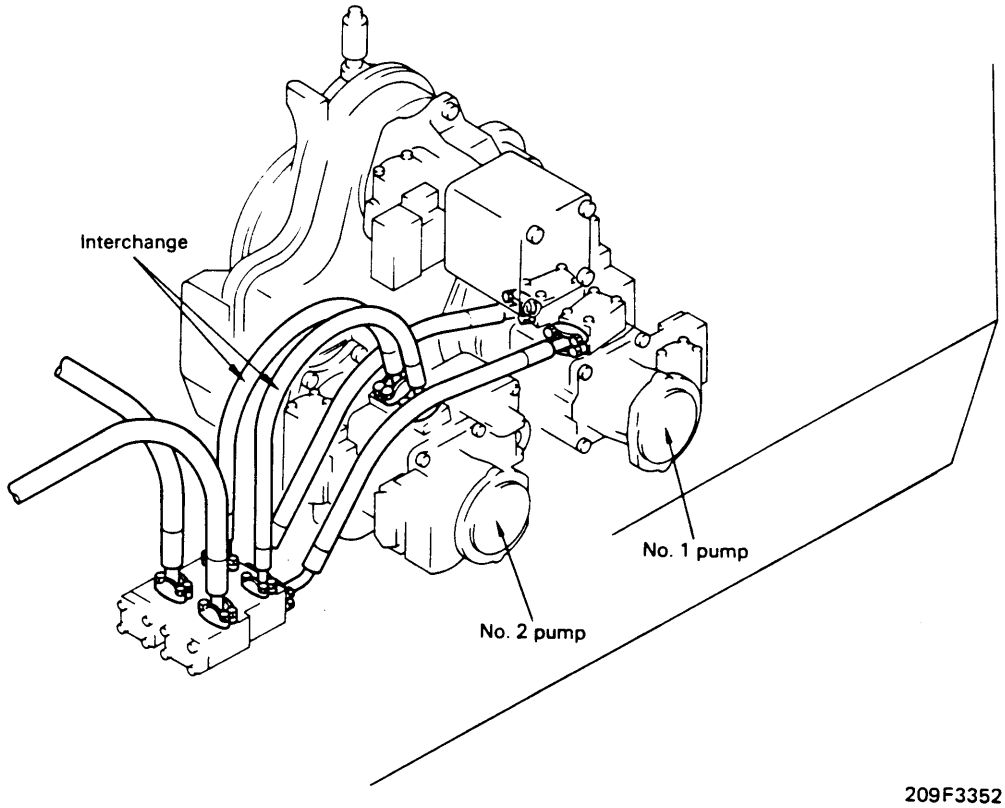
No.	Troubleshooting / Remedy	Causes: Defective CO-NC valve	Defective servo valve	Defective pump proper	Defective CO-NC valve	Defective servo valve	Defective pump proper	Defective servo valve	Defective pump proper	Defective servo valve	Defective pump proper	Drop in set pressure of main relief valve	Defective jet sensor	Drop in set pressure of main relief valve	Defective jet sensor	Drop in set pressure of L.H. travel relief valve	Drop in set pressure of R.H. travel relief valve
		Front pump		Rear pump			Front pump		Rear pump								
		No. 1 pump					No. 2 pump					L.H. 5-spool control valve		R.H. 4-spool control valve			
		a	b	c	d	e	f	g	h	i	l	k	l	m	n	o	p
		X	X	X	X	X	X	X	X	X	X	ACX	ACX	ACX	ACX	ACX	ACX
1	Machine deviates to left and bottom dump speed is particularly slow (LOADING SHOVEL)				○				○		○						
2	No deviation in item 1, but speed is particularly slow, or hydraulic pressure at work equipment relief is low.										○						
3	Machine deviates to right and BOOM LOWER speed is particularly slow		○					○						○			
4	No deviation in item 3, but speed is particularly slow, or hydraulic pressure at work equipment relief is low										○						
5	If item 1 is defective, interchange the left and right outlet hoses of No. 2 pump — Machine deviates to left				○										○		
6	If item 1 is defective, interchange the left and right outlet hoses of No. 2 pump — Machine deviates to right									○							
7	If item 1 is defective, interchange the left and right outlet hoses of No. 2 pump — Travel speed for both left and right becomes slower			○								○					
8	In item 7, difference pressure of jet sensor is defective (also possible to interchange front and rear hoses)											○					
9	Item 8 is normal, but output pressure of front NC valve is defective	○															
10	If item 3 is defective, interchange the left and right outlet hoses of No. 2 pump — Machine deviates to right		○													○	
11	If item 3 is defective, interchange the left and right outlet hoses of No. 2 pump — Machine deviates to left			○													
12	If item 3 is defective, interchange the left and right outlet hoses of No. 2 pump — Travel speed for both left and right becomes slower		○											○			
13	In item 12, difference pressure of jet sensor is defective (also possible to interchange front and rear hoses)													○			
14	Item 13 is normal, but output pressure of rear NC valve is defective				○												
15	In item 5, when servo valves of No. 1 front pump and No. 2 rear pump are interchanged, machine deviates to opposite side.				○												
16	Same as item 15, but no change					○											
17	In item 6, when servo valves of No. 1 front pump and No. 2 rear pump are interchanged, machine deviates to opposite side.								○								
18	Same as item 17, but no change		○														
19	In item 10, when servo valves of No. 1 rear pump and No. 2 front pump are interchanged, machine deviates to opposite side.		○														
20	Same as item 19, but no change									○							
21	In item 11, when servo valves of No. 1 rear pump and No. 2 front pump are interchanged, machine deviates to opposite side.						○										
22	Same as item 21, but no change							○									

- **Method of interchanging hoses**



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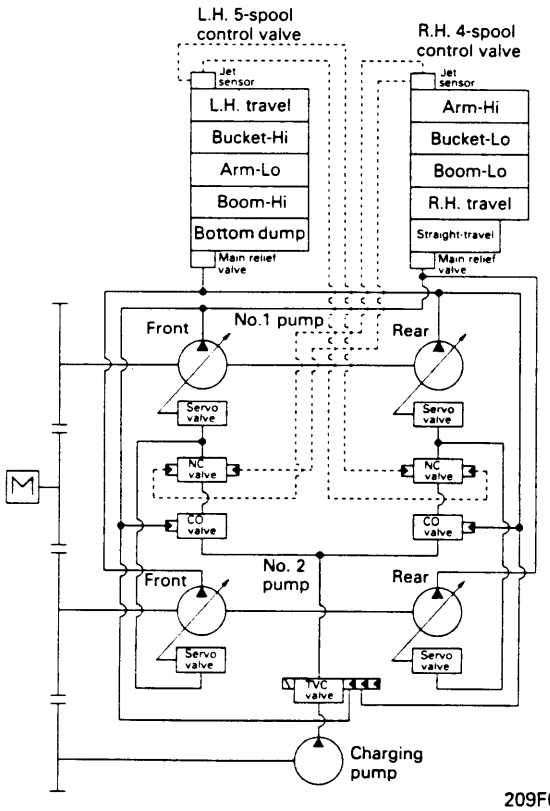
- **Hydraulic circuit diagram after interchanging foses**



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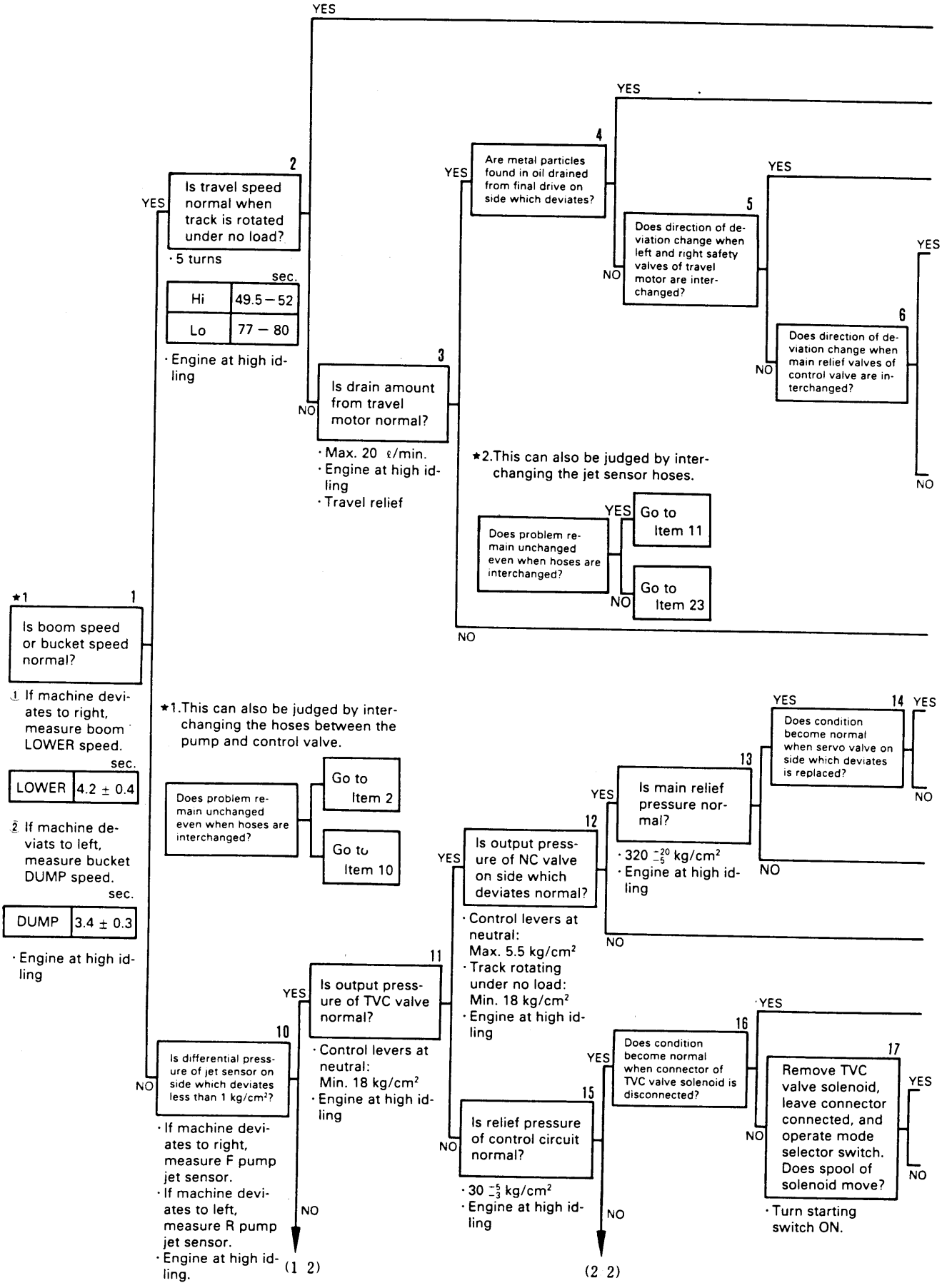
H-1 Excessive travel deviation (goes outside standard only during travel operations, when travel lever is operated to end of stroke)

★ For details of measuring the travel deviation, see TESTING AND ADJUSTING.

★ The judgement values in the troubleshooting chart are the values for S mode (for 2-stage mode selector OLSS) or H mode (for 3-stage mode selector OLSS).



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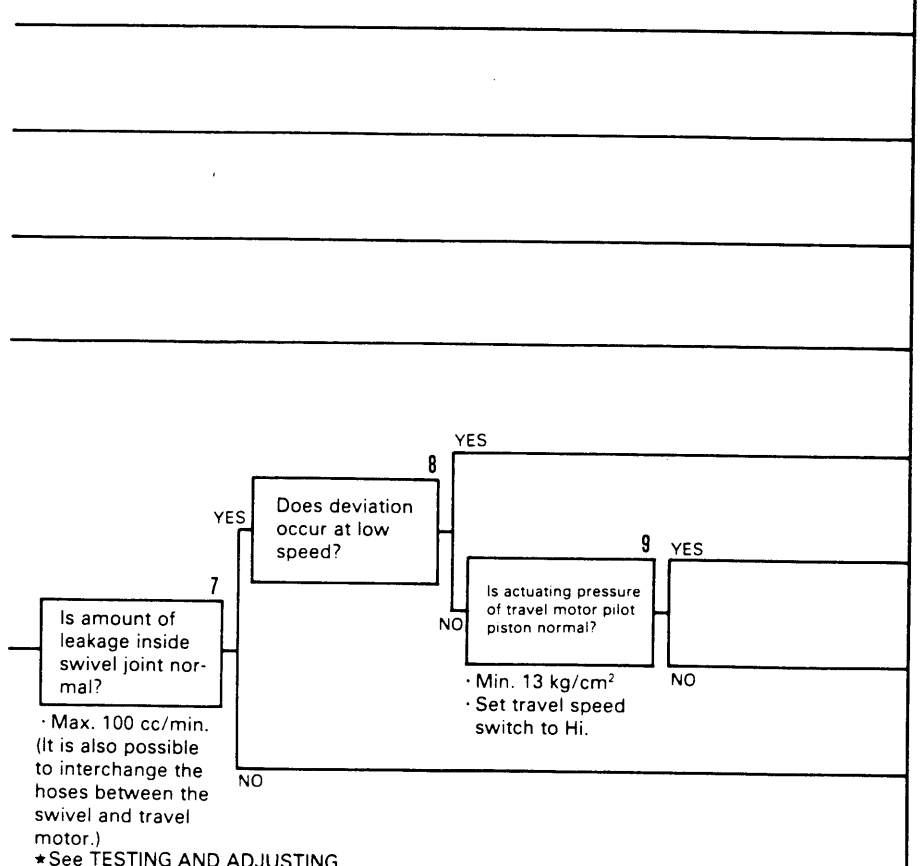

Cause	Remedy
Improper track tension	Adjust
Defective final drive	Disassemble, replace damaged parts
Excessive leakage from safety valve of motor	Clean or replace
Defective main relief valve	Clean or replace
Defective travel motor	Replace
Defective travel motor, clogged drain piping, dirt in piping	Replace
Defective travel speed solenoid valve	Replace
Defective center swivel shaft seal	Replace seal or replace swivel assembly
Drop in motor efficiency	Replace motor assembly
Defect inside of servo valve	Replace servo valve assembly
Defective front or rear pump	Replace F or R pump sub assembly
Defective adjustment of main relief valve	Adjust
Defective operation of CO · NC valve	Clean or replace
Drop in engine output	See troubleshooting for engine
TVC valve stuck	Replace
Seizure of TVC valve solenoid	Replace

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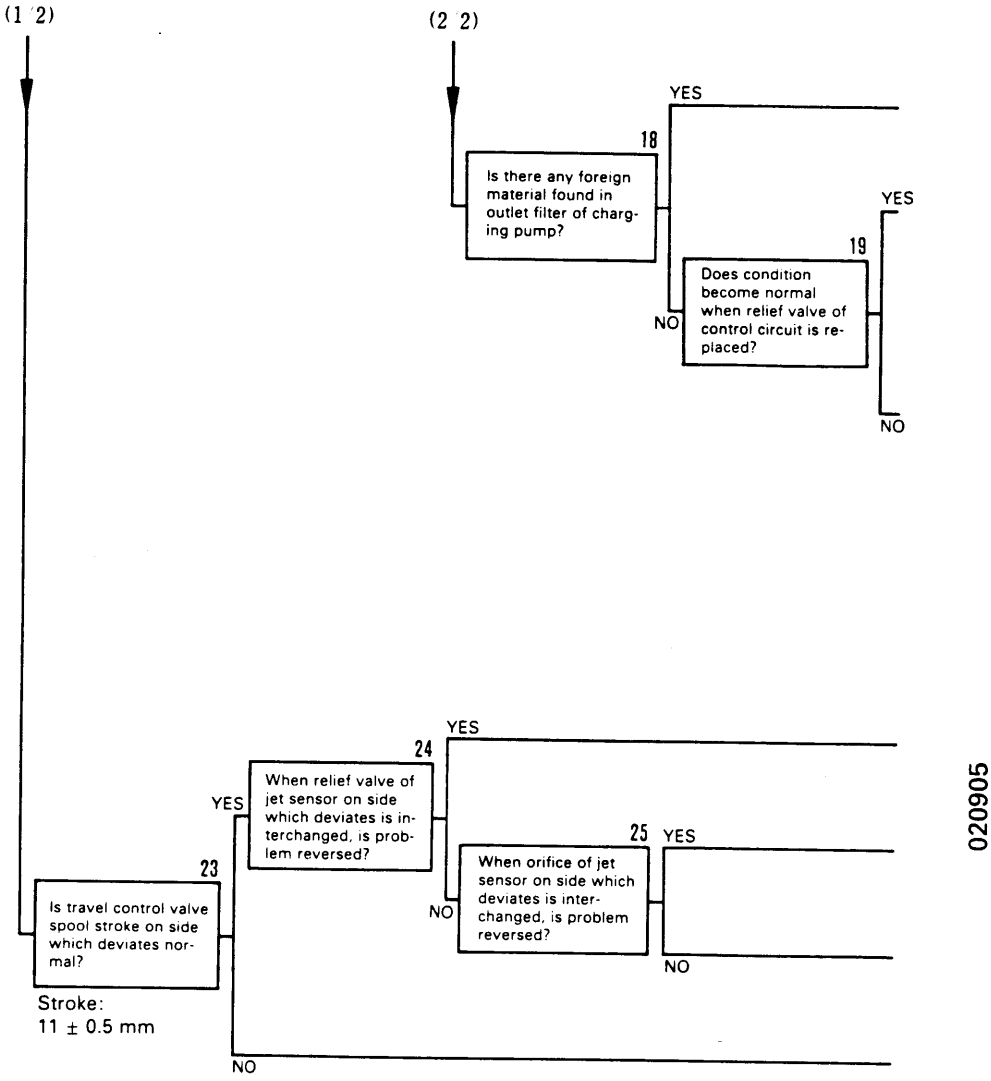
(1 2)
(2 2)
18
Is there any foreign material found in outlet filter of charging pump?
YES
NO
19
Does condition become normal when relief valve of control circuit is replaced?
YES
NO
23
Is travel control valve spool stroke on side which deviates normal?
Stroke:
11 ± 0.5 mm
YES
NO
24
When relief valve of jet sensor on side which deviates is interchanged, is problem reversed?
YES
NO
25
When orifice of jet sensor on side which deviates is interchanged, is problem reversed?
YES
NO

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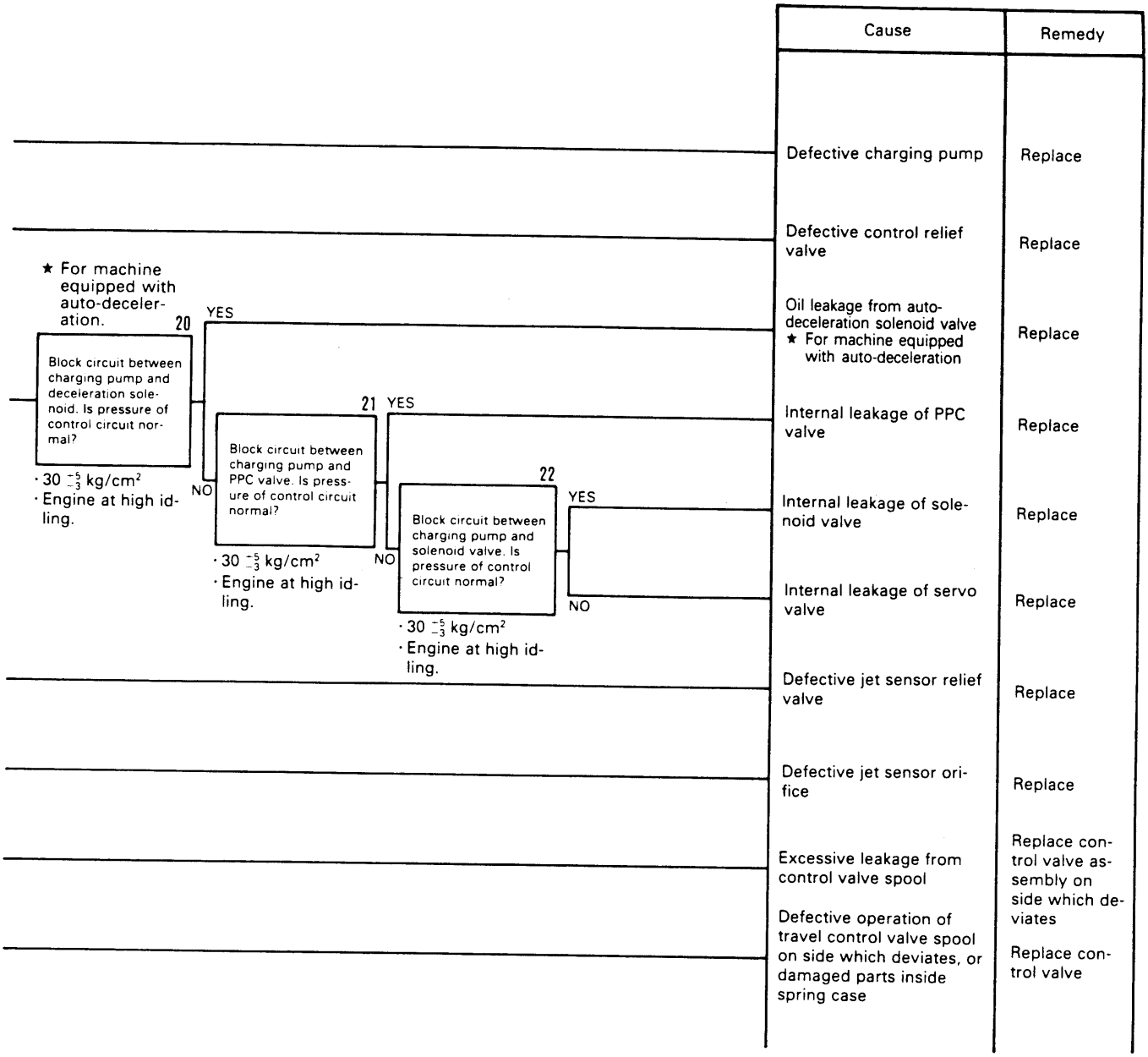
★ For machine equipped with auto-deceleration.
20
Block circuit between charging pump and deceleration solenoid. Is pressure of control circuit normal?
· 30 $^{-5}_{-3}$ kg/cm²
· Engine at high idling.
YES
NO
21
Block circuit between charging pump and PPC valve. Is pressure of control circuit normal?
· 30 $^{-5}_{-3}$ kg/cm²
· Engine at high idling.
YES
NO
22
Block circuit between charging pump and solenoid valve. Is pressure of control circuit normal?
· 30 $^{-5}_{-3}$ kg/cm²
· Engine at high idling.
YES
NO
Cause
Remedy
Defective charging pump
Replace
Defective control relief valve
Replace
Oil leakage from auto-deceleration solenoid valve
★ For machine equipped with auto-deceleration
Replace
Internal leakage of PPC valve
Replace
Internal leakage of solenoid valve
Replace
Internal leakage of servo valve
Replace
Defective jet sensor relief valve
Replace
Defective jet sensor orifice
Replace
Excessive leakage from control valve spool
Replace control valve assembly on side which deviates
Defective operation of travel control valve spool on side which deviates, or damaged parts inside spring case
Replace control valve

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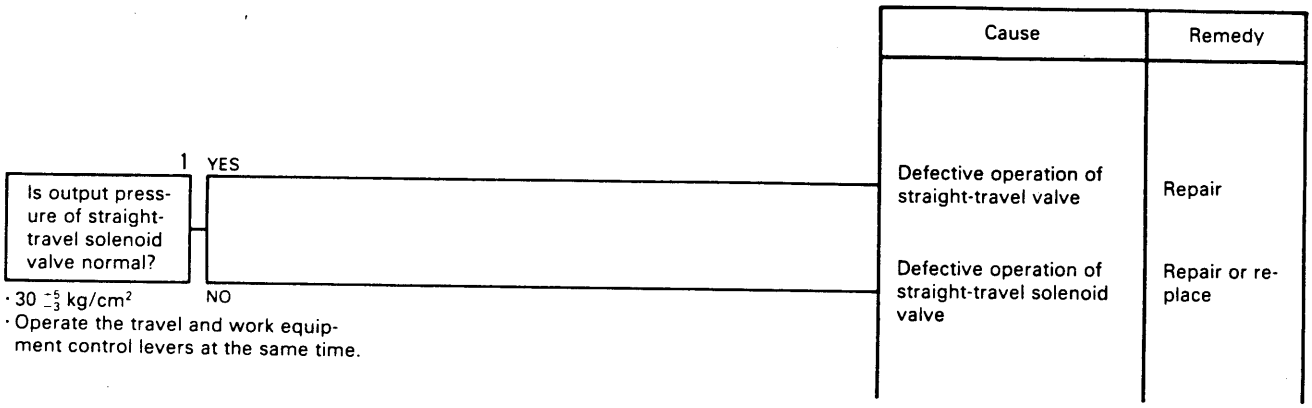
H-2 Excessive travel deviation during compound operations

★ The judgement values in the troubleshooting chart are the values for S mode (for 2-stage mode selector OLSS) or H mode (for 3-stage mode selector OLSS).

★ When electrical system is normal.

★ When travel and work equipment (boom, arm, bucket) are operated at the same time.
(The swing system is independent so it is not actuated for travel + swing)

⚠ The travel and work equipment are operated at the same time, so check that there is no one in the surrounding area before starting the operation.



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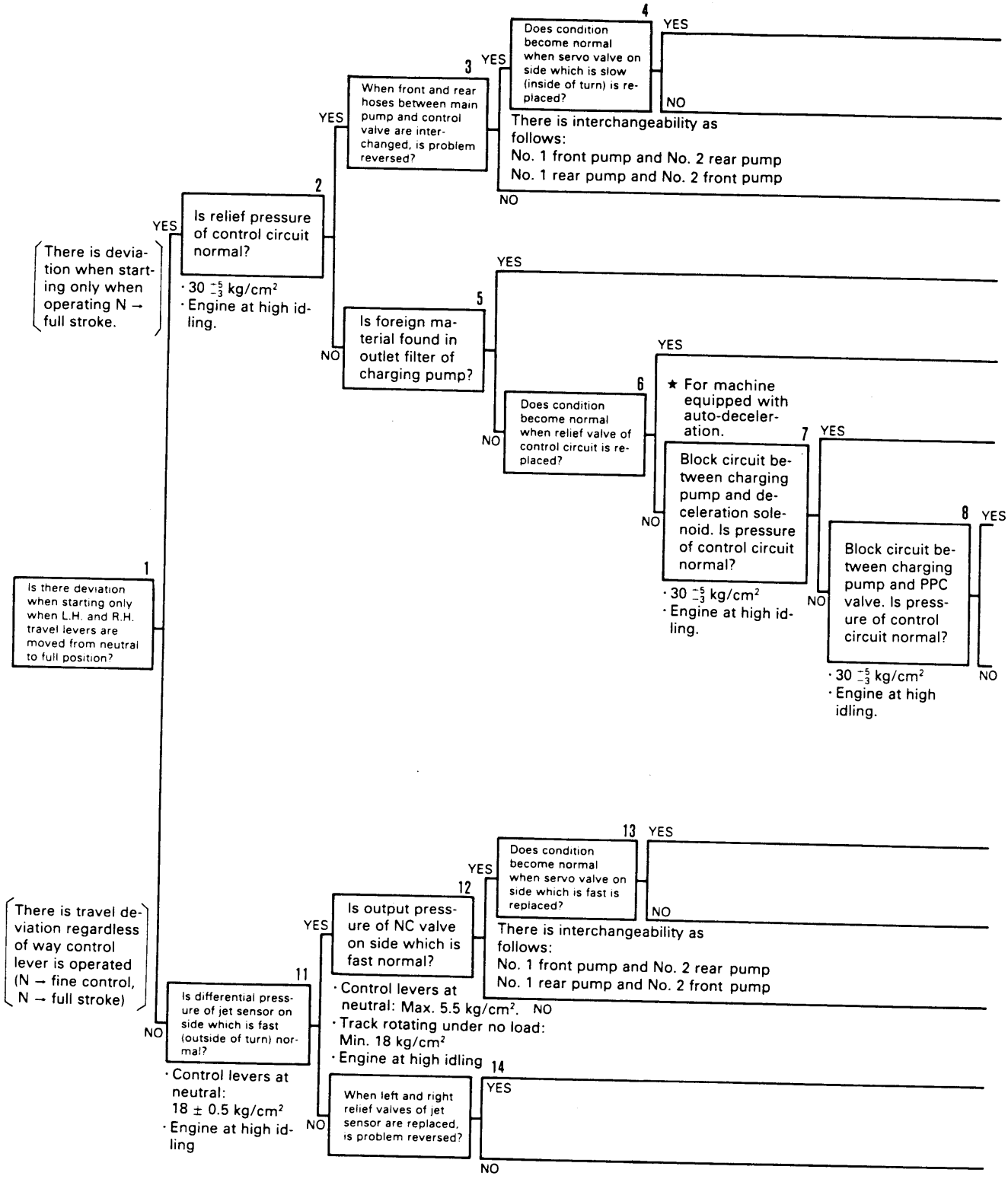
H-3 Excessive deviation when starting

★ If there is also a constant deviation, go to H-1 Excessive travel deviation.
★ If there is travel deviation when using the work equipment at the same time, go to H-2 Excessive travel deviation during compound operations.
★ Bleed the air from the circuit.
★ The judgement values in the troubleshooting chart are the values for S mode (for 2-stage mode selector OLSS) or H mode (for 3-stage mode selector OLSS).



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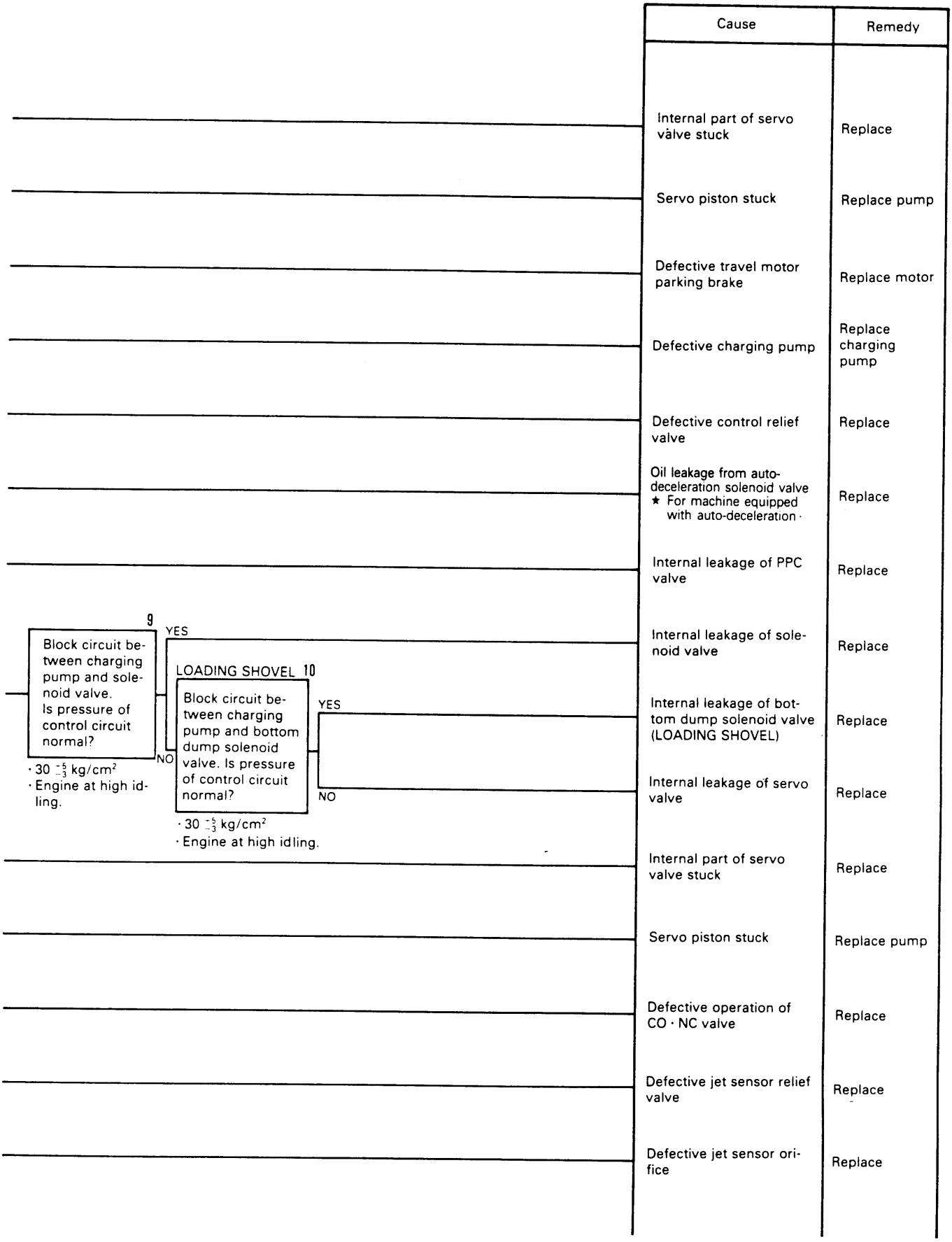
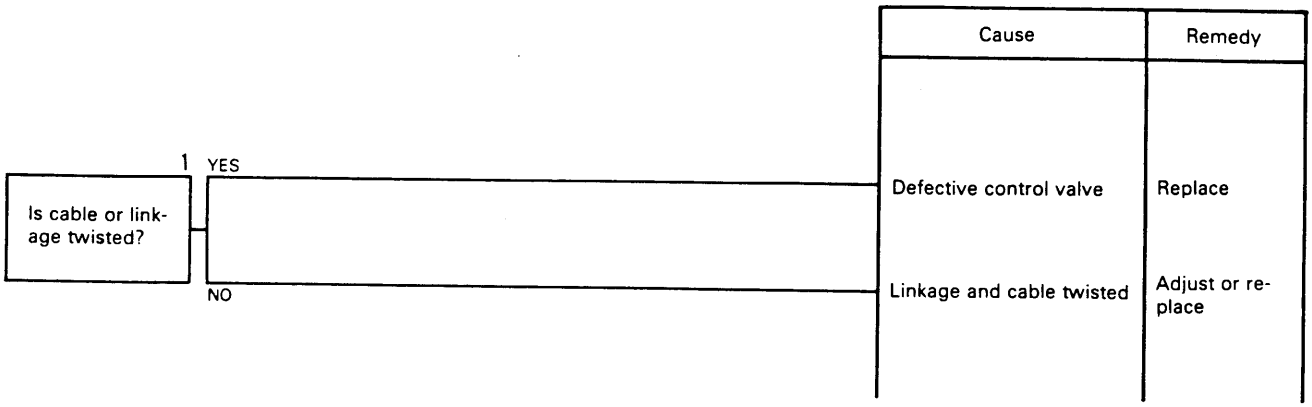


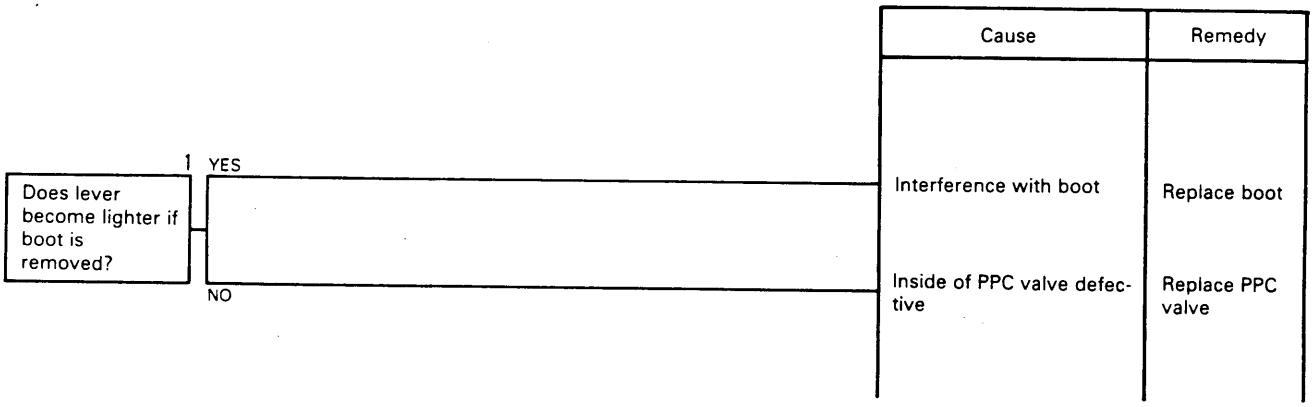
Cause	Remedy
Internal part of servo valve stuck	Replace
Servo piston stuck	Replace pump
Defective travel motor parking brake	Replace motor
Defective charging pump	Replace charging pump
Defective control relief valve	Replace
Oil leakage from auto-deceleration solenoid valve ★ For machine equipped with auto-deceleration ·	Replace
Internal leakage of PPC valve	Replace
Internal leakage of solenoid valve	Replace
Internal leakage of bottom dump solenoid valve (LOADING SHOVEL)	Replace
Internal leakage of servo valve	Replace
Internal part of servo valve stuck	Replace
Servo piston stuck	Replace pump
Defective operation of CO · NC valve	Replace
Defective jet sensor relief valve	Replace
Defective jet sensor orifice	Replace

H-4 Control levers are extremely heavy

a) If travel lever is heavy



b) If work equipment levers are heavy



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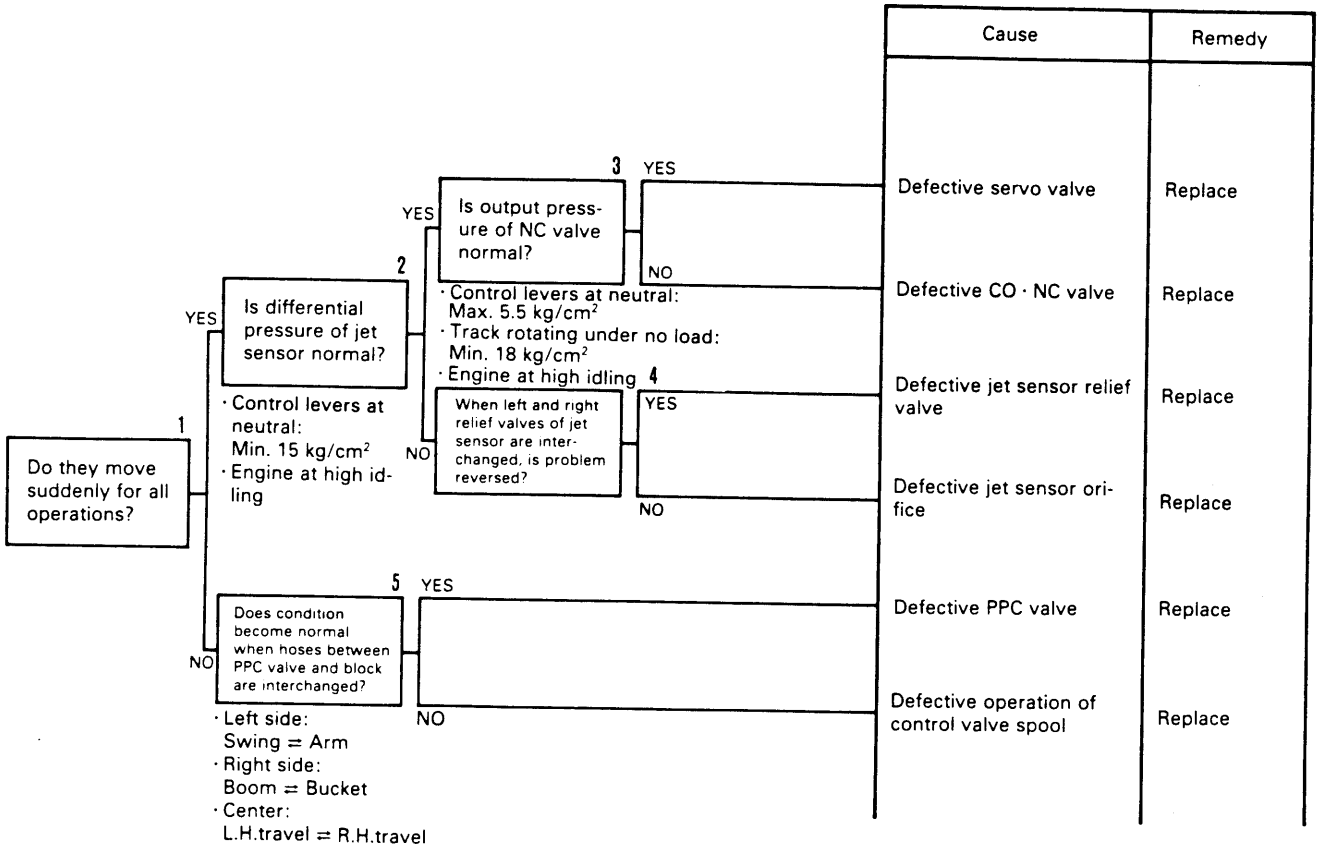
H-5 Work equipment, travel, swing start to move suddenly (in fine control range)

★ The judgement values in the troubleshooting chart are the values for S mode (for 2-stage mode selector OLSS) or H mode (for 3-stage mode selector OLSS).



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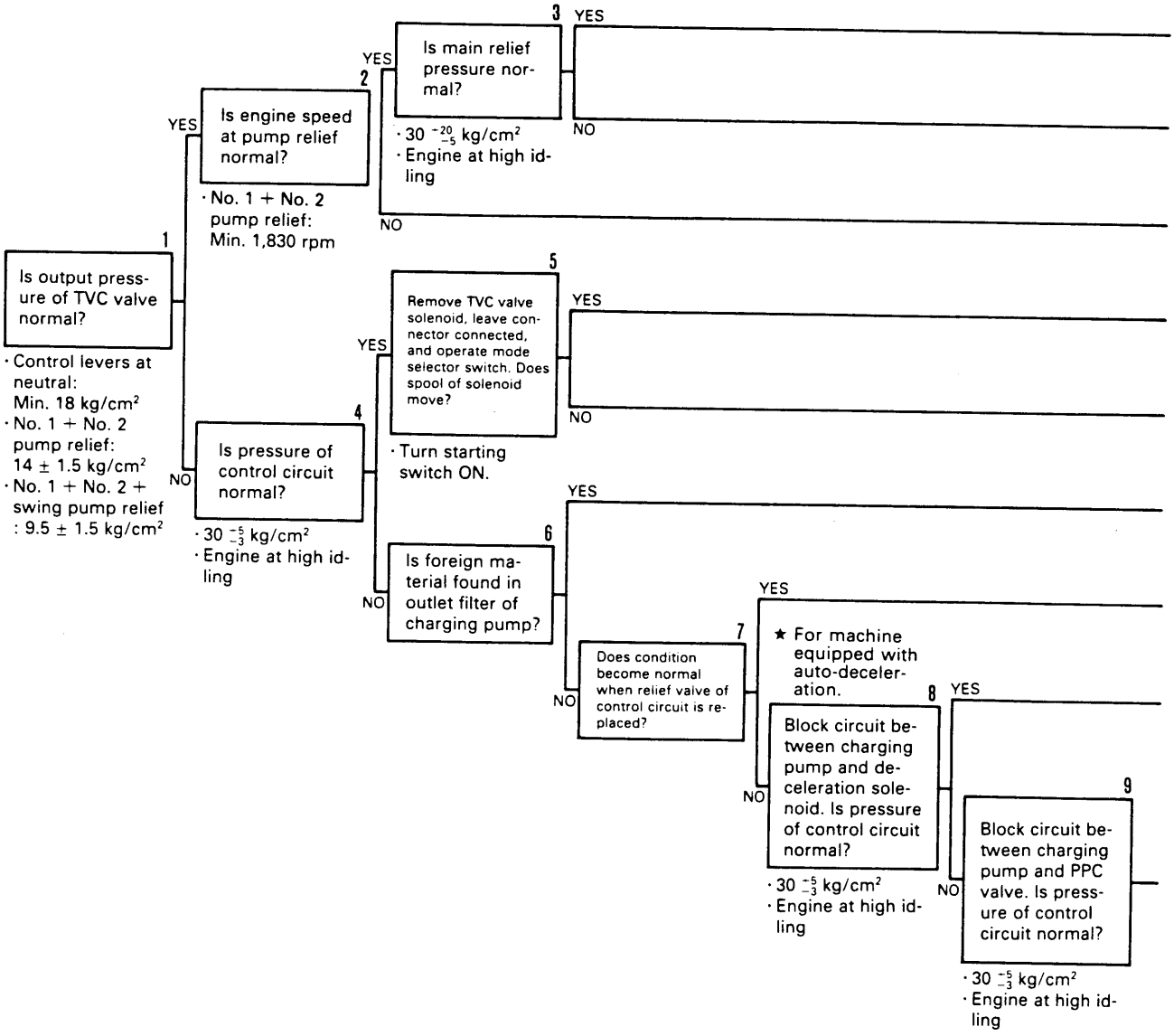
H-6 Speed of work equipment, swing, travel is extremely slow or lacks power

★ If there is any abnormality in the auto-deceleration function, go to H-9 Auto-deceleration function does not work properly. (For machine equipped with auto-deceleration)
★ If there is lack of engine power (black exhaust smoke), go to troubleshooting for the engine.
★ The judgement values in the troubleshooting chart are the values for S mode (for 2-stage mode selector OLSS) or H mode (for 3-stage mode selector OLSS).

a) The machine hardly moves



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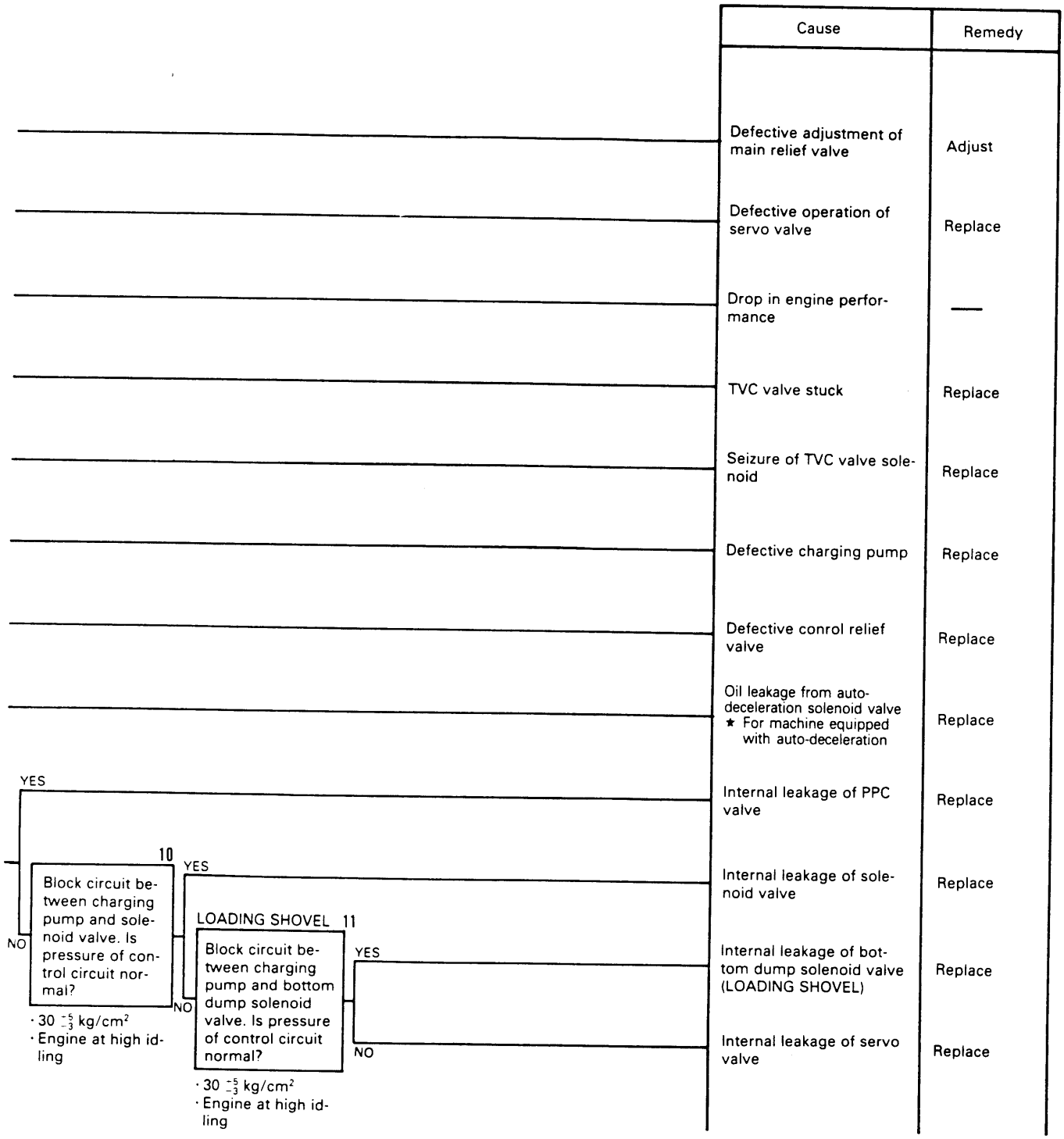
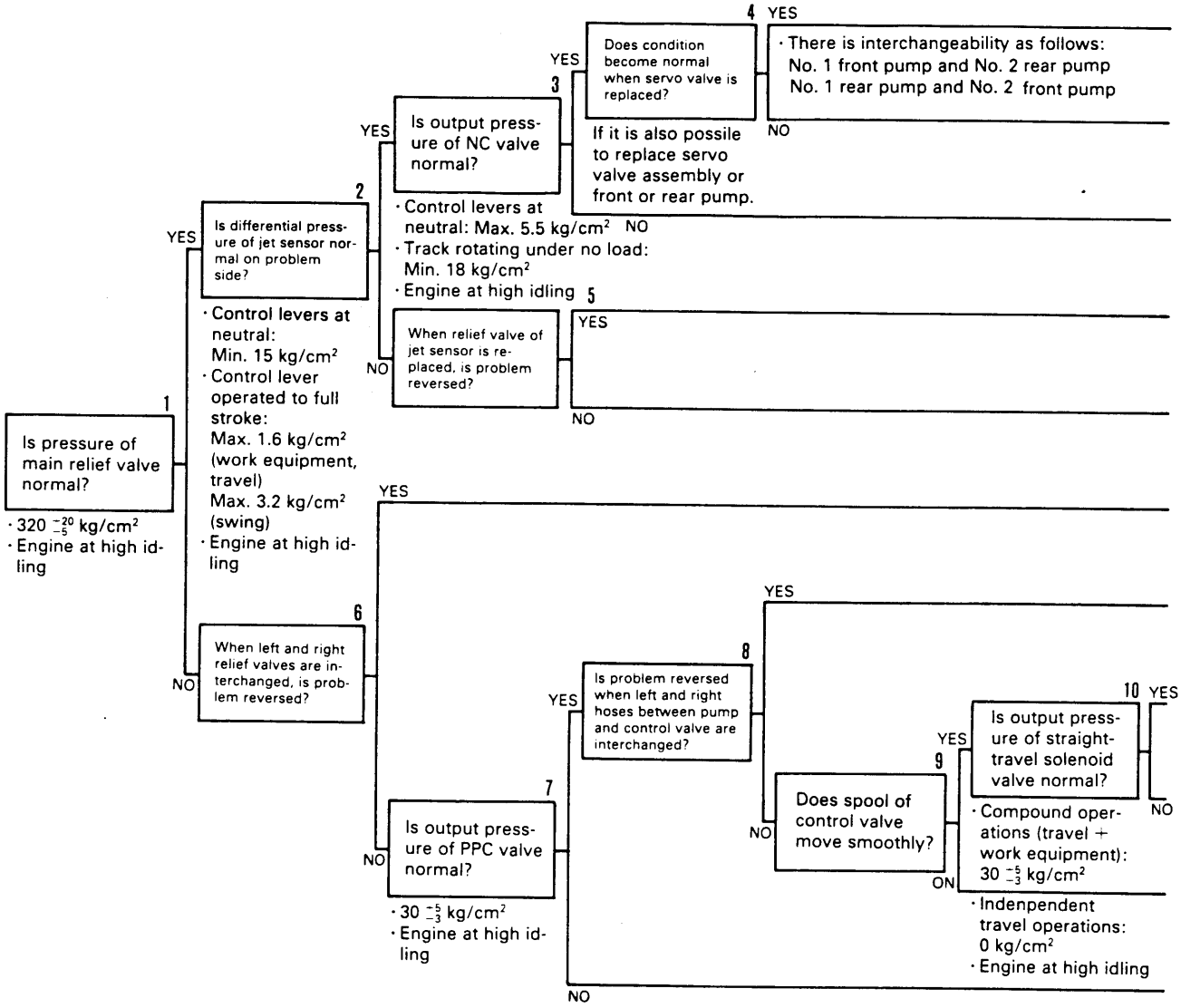


Cause	Remedy
Defective adjustment of main relief valve	Adjust
Defective operation of servo valve	Replace
Drop in engine performance	—
TVC valve stuck	Replace
Seizure of TVC valve solenoid	Replace
Defective charging pump	Replace
Defective conrol relief valve	Replace
Oil leakage from auto-deceleration solenoid valve ★ For machine equipped with auto-deceleration	Replace
Internal leakage of PPC valve	Replace
Internal leakage of solenoid valve	Replace
Internal leakage of bottom dump solenoid valve (LOADING SHOVEL)	Replace
Internal leakage of servo valve	Replace

b) There is abnormality in some part (abnormality in system on one side)

- Swing, travel, bucket speed is slow. Boom, arm speed is reduced.



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c) Individual problems

★ When only swing speed is slow, go to H-11 swing speed is slow.

★ If only the travel speed is slow, check if there is any travel deviation. If there is no deviation, check the swivel joint.

★ If any of the work equipment speeds is slow, go to the next page.

Cause	Remedy
Defective servo valve	Replace
Defective pump	Replace
Defective NC valve	Replace
Defecive jet sensor relief valve	Replace
Defective jet sensor orifice	Replace
Defective main relief valve	Replace
Defective pump	Replace
Defective straight-travel solenoid valve	Replace
Defective straight-travel valve	Replace
Control valve spool stuck	Replace control valve
Defective PPC valve	Replace

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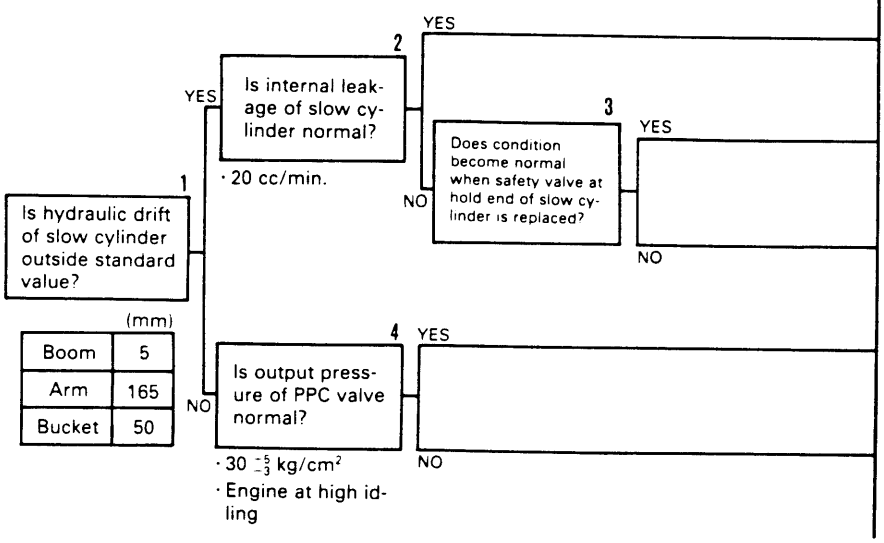
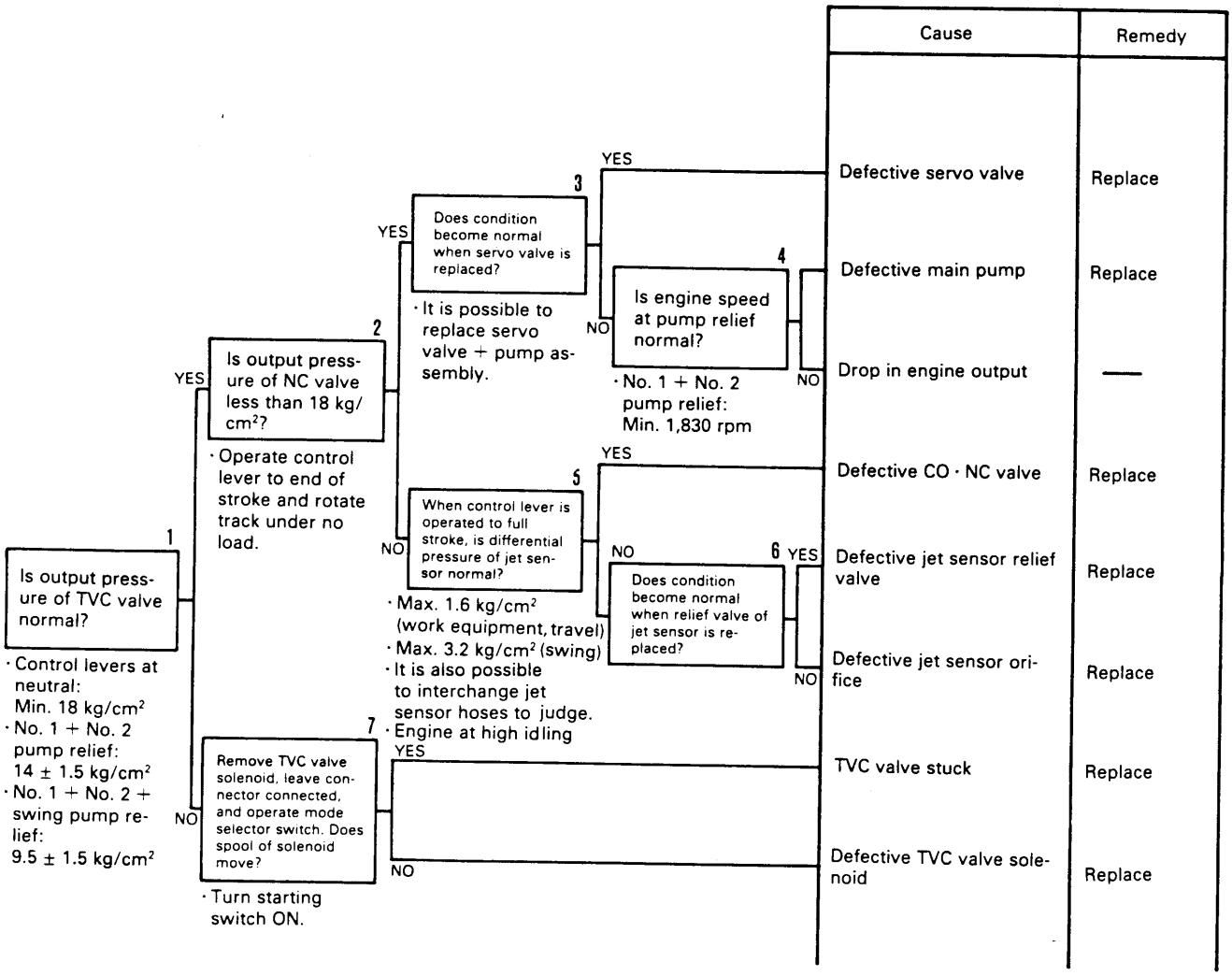
d) One of work equipment speeds is slow



Cause	Remedy
Defective cylinder piston packing	Replace piston packing
Defective safety valve	Replace
Defective control valve	Replace
Defective control valve	Replace
Defective operation of PPC valve	Replace

H-7 Engine stalls or engine speed drops during operation

★ If it is thought that there is lack of engine power (black exhaust smoke), go to troubleshooting fot the engine.
★ If the work equipment speed is slow or the work equipment does not move, go to H-6 a).
★ The judgement values in the troubleshooting chart are the values for S mode (for 2-stage mode selector OLSS) or H mode (for 3-stage mode selector OLSS).



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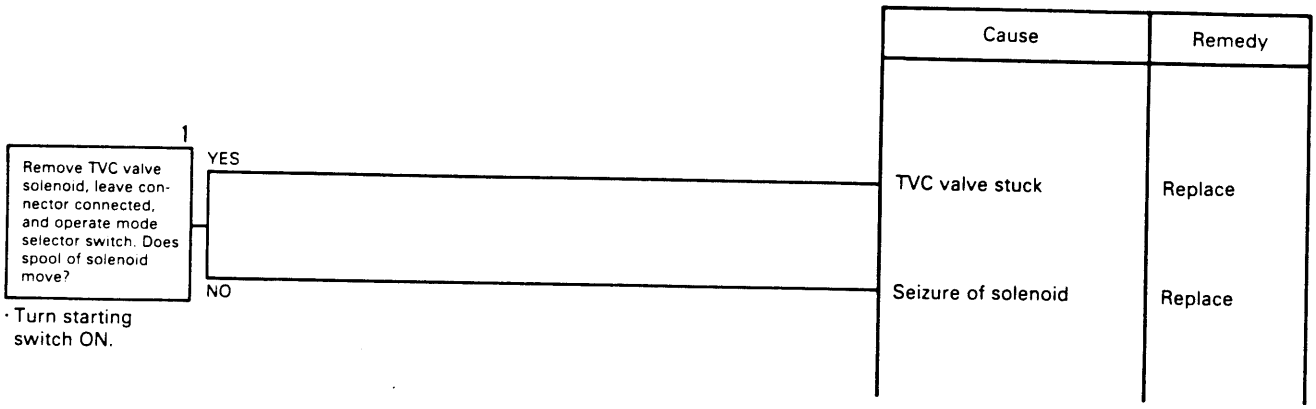
H-8 Output does not change when mode selector switch is operated

★ Use the swing speed to compare.



H-9 Auto-deceleration funcion does not work properly (There is no deceleration or deceleration stays on)

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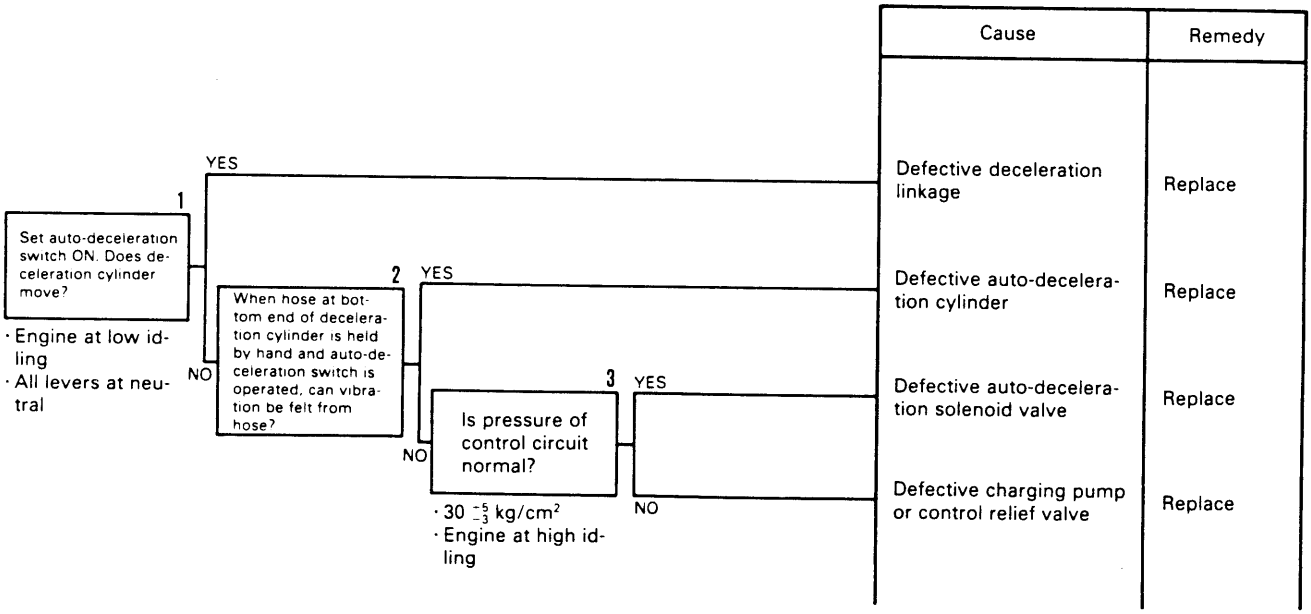
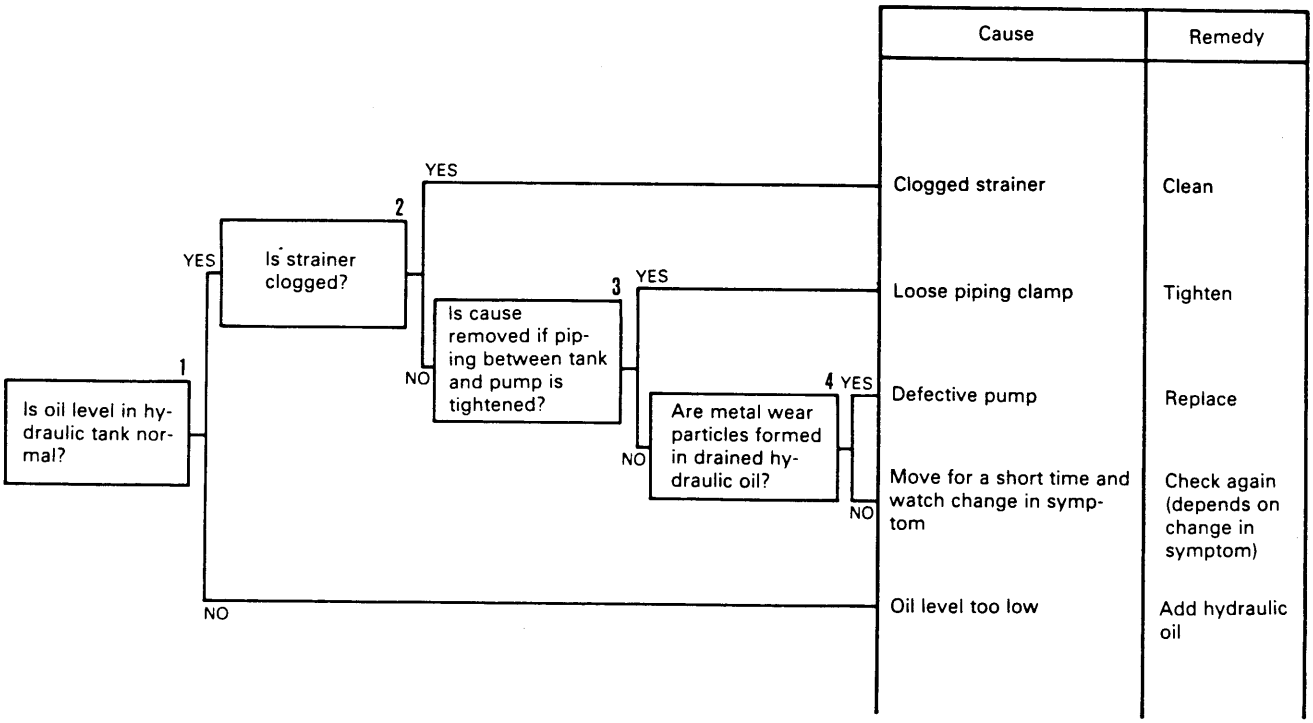
★ **FOR MACHINE EQUIPPED WITH AUTO-DECELERATION**

★ If the work equipment speed is slow or the work equipment does not work, go to H-6 a).



H-10 Abnormal noise comes from around pump



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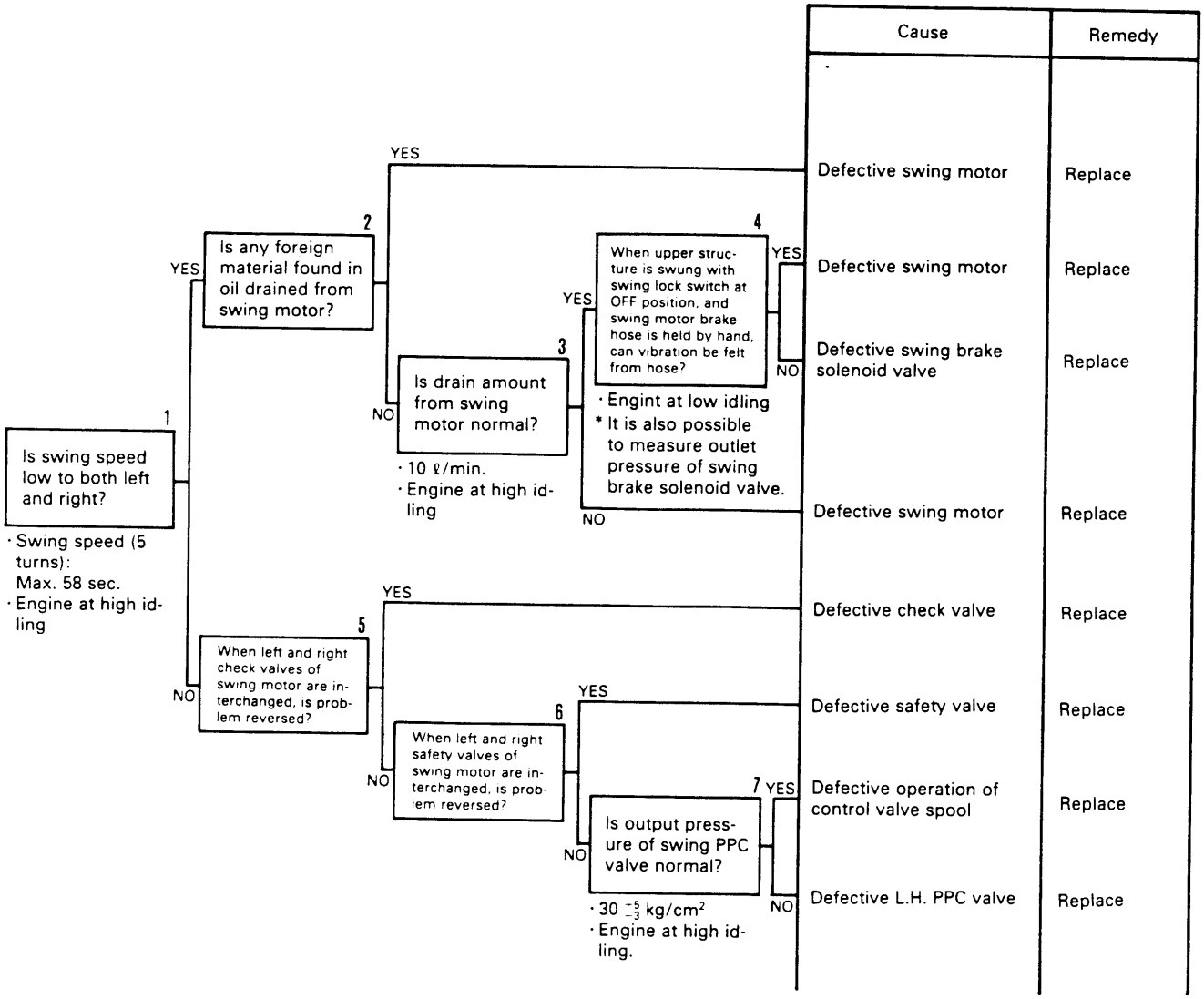
H-11 Swing speed is slow, or there is excessive overrun when stopping swing.

★ If any speeds other than the swing are slow, go to H-6 Speed of work equipment, swing, travel is extremely slow or lacks power



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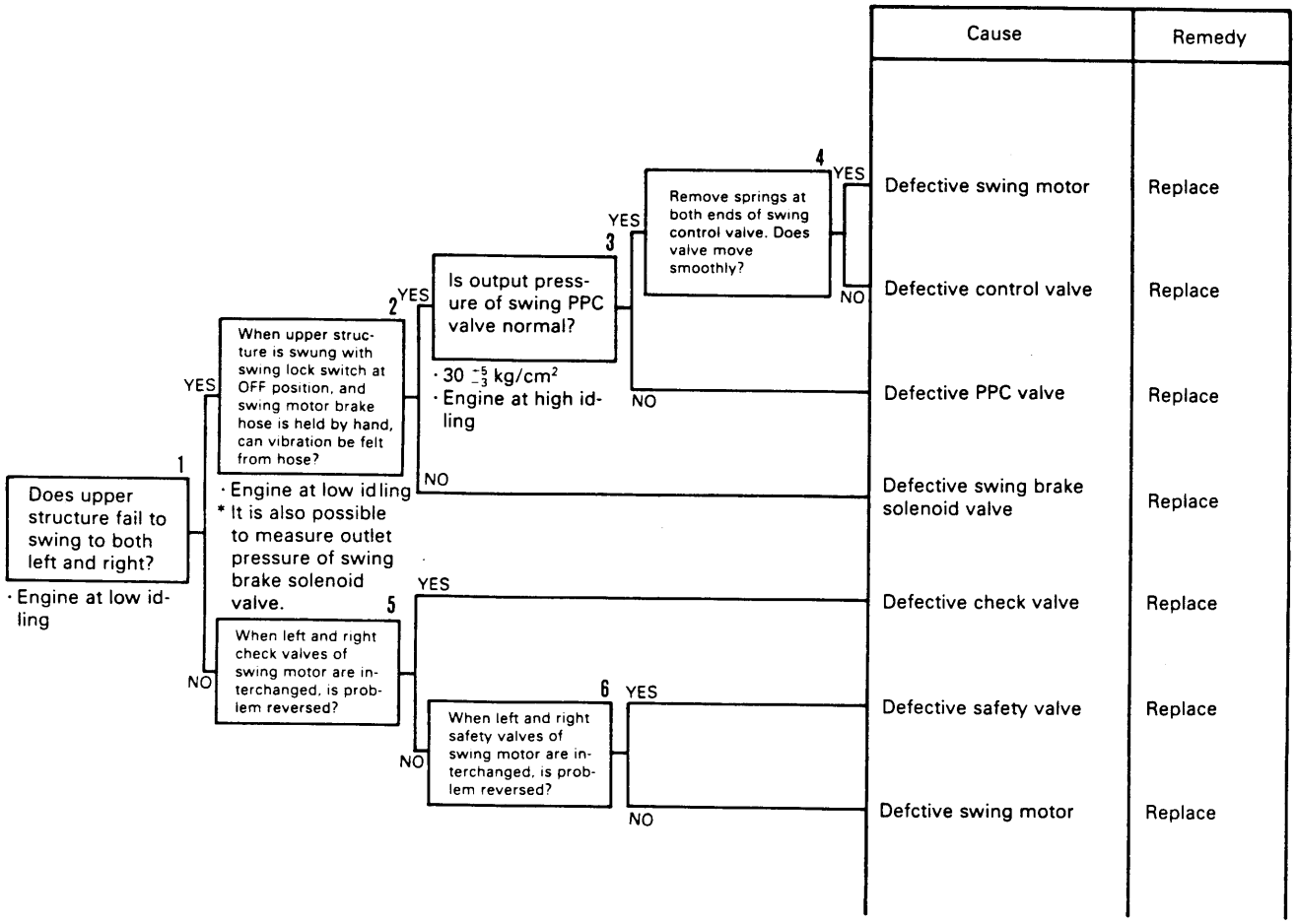
H-12 Upper structure does not swing

★ Set the swing lock switch OFF.



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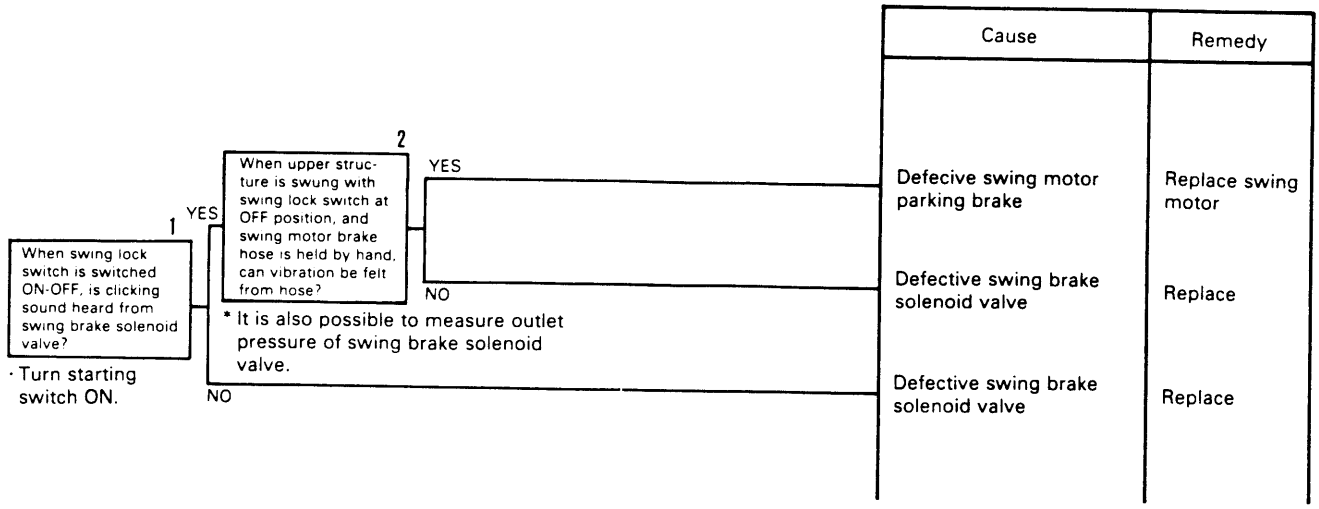
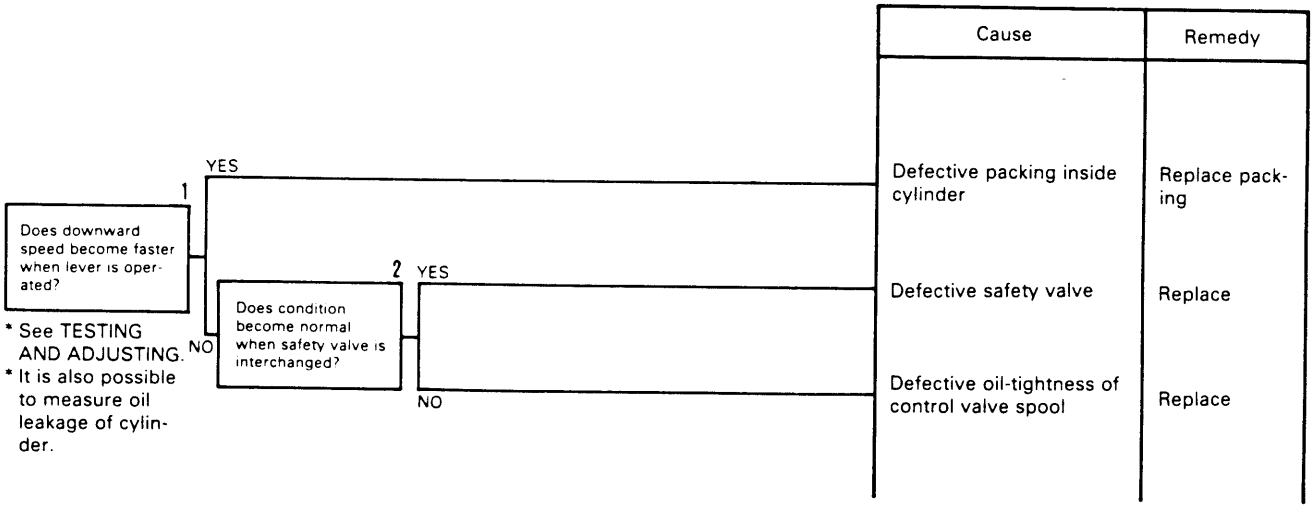
H-13 Excessive hydraulic drift of swing



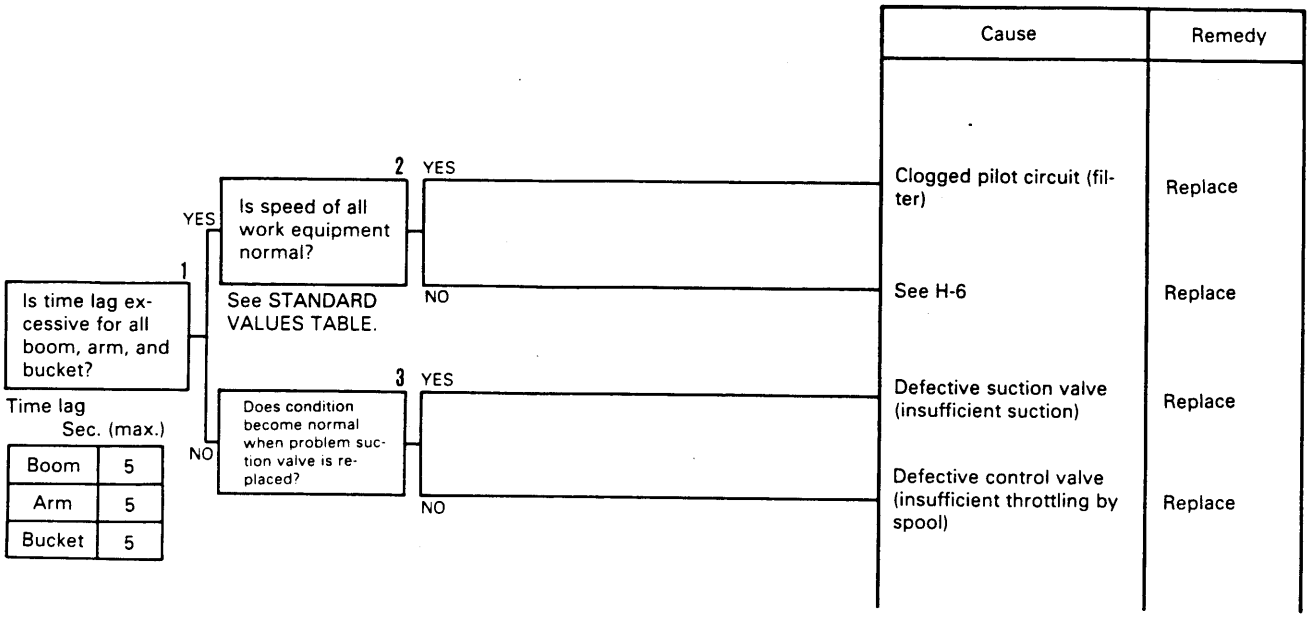
020905

H-14 Excessive hydraulic drift of work equipment



H-15 Excessive time lag of work equipment

★ Bleed the air from the cylinder.



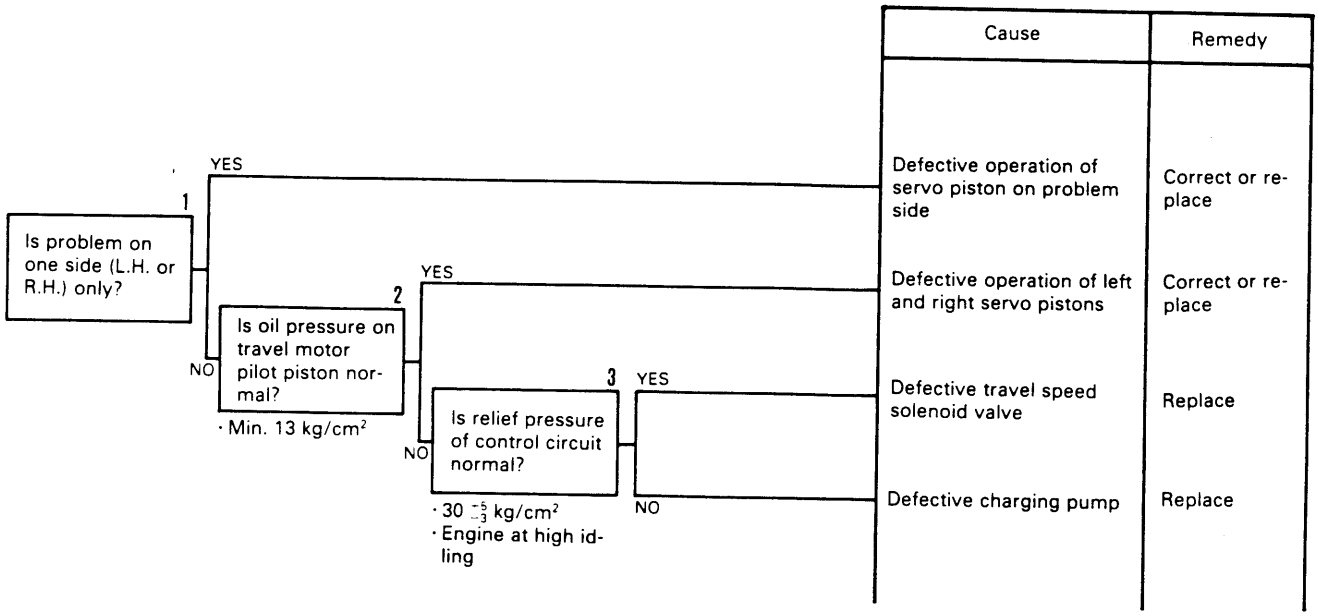
Time lag

Sec. (max.)	
Boom	5
Arm	5
Bucket	5

020905

H-16 Travel speed does not change

a) Travel speed does not become faster even when speed is set to Hi.



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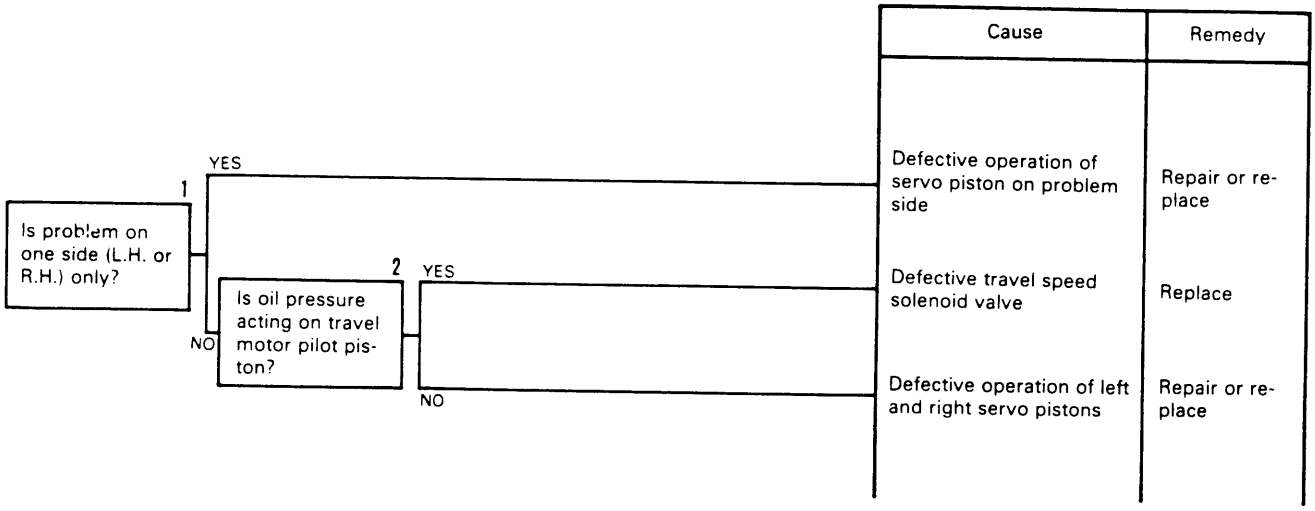
b) Travel speed does not become slower even when speed is set to Lo.



H-17 Defective actuation of heavy-lift function (boom RAISE set pressure does not increase, or increases but does not go down)

BACK HOE

★ The judgement values in the troubleshooting chart are the values for H mode.
★ When the electrical system is normal.

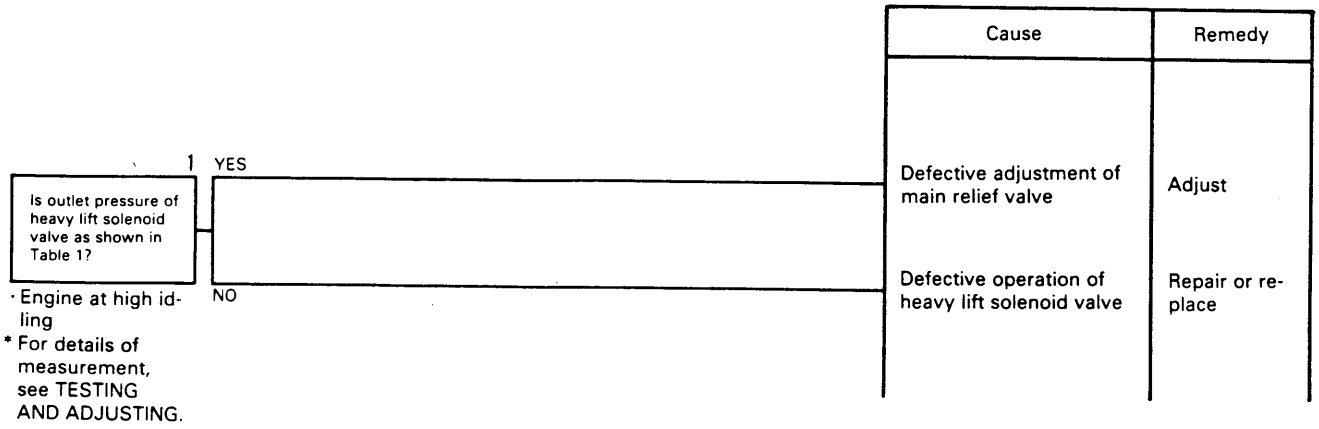


Table 1

Heavy lift switch	Boom lever (RAISE)	Hydraulic oil pressure (kg/cm²)
ON	Operated	30^{-5}_{-3}
	Neutral	0
OFF	Both operated and at neutral	0

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H-18 Defective actuation of machine push up function (boom LOWER set pressure does not increase, or increases but does not go down)

★ The judgement values in the troubleshooting chart are the values for H mode.
★ When the electrical system is normal.

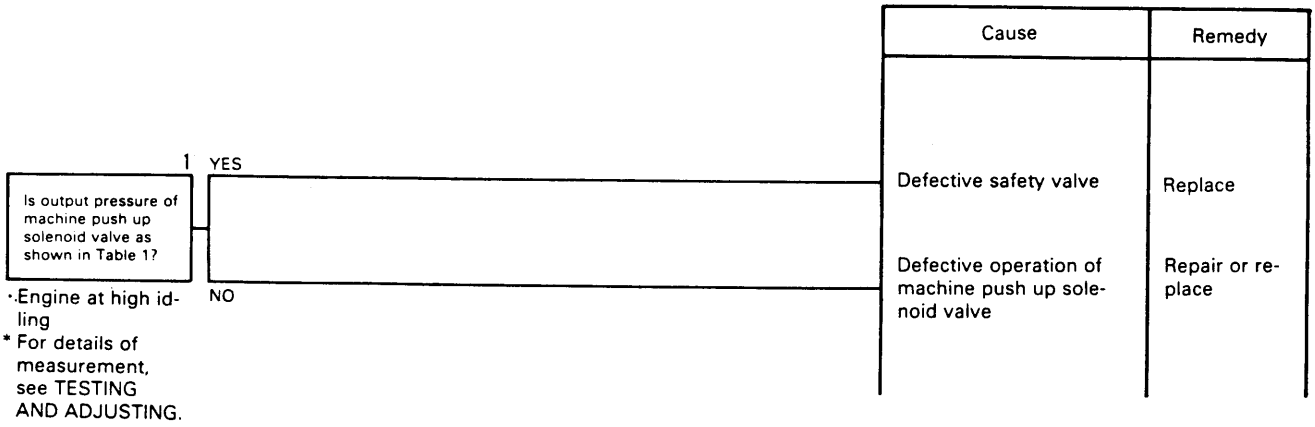

Table 1

Machine push up switch	Hydraulic oil pressure (kg/cm²)
ON	30^{-5}_{-3}
OFF	0

TABLE OF FAILURE MODES AND CAUSES

★ FOR MACHINE EQUIPPED WITH 2-STAGE MODE SELECTOR OLSS

		Electrical system																Hydraulic system																																				Mechanical system			
	Parts causing failure			Electrical OLSS		Swing brake					Travel speed selection		Straight-travel								Pump control				Charging pump		Control valve							PPC valve			Swing motor					Travel motor															
	Failure mode	Power source line	Wiring harness (including connector)	TVC solenoid	Mode selector switch	Swing brake solenoid	Timer	Oil pressure switch	Swing lock switch	Relay	Travel speed solenoid	Travel speed switch	Oil pressure switch	Straight-travel solenoid	Relay	Heavy lift solenoid (BACK HOE)	Machine push up solenoid	No. 1 pump	No. 2 pump	Swing pump	Servo valve	NC valve	CO valve	TVC valve	Pump	Relief valve	Jet sensor	Main relief valve	Suction valve	Safety valve	Spool (including spring case)	Straight-travel valve	Straight-travel solenoid valve	For arm, swing	For arm, bucket	For travel	Motor	Safety valve	Check valve	Swing shaft brake	Swing brake solenoid valve	Motor	Safety valve	Check valve	Servo piston	Travel shaft brake	Travel speed solenoid valve	Heavy lift solenoid valve (BACK HOE)	Machine push up solenoid valve	Center swivel joint	Hydraulic cylinder	Hydraulic oil tank (including oil level)	Strainer, filter	Engine	Swing machinery, swing circle	Final drive	Linkage
1	Excessive travel deviation (constant deviation)		○	○														○	○		○	○	○	○		○	○	○		○	○					○					○	○	○				○			○				○		○	
2	Excessive travel deviation (during compound operations)												○	○	○																	○	○	○	○	○																					
3	Excessive travel deviation (when starting)																	○	○		○	○	○		○	○		○								○					○					○											
4	Control levers are heavy																														○			○	○	○																					○
5	Work equipment, travel, swing start to move suddenly																				○	○	○				○				○			○	○	○																					
6	Speed of work equipment, swing, travel is extremely slow or lacks power (no travel deviation)	○	○	○									○	○	○			○	○	○	○	○		○	○	○	○	○		○	○	○	○	○	○						○										○						
7	Engine stalls or engine speed drops during operations	○	○	○														○	○	○	○		○	○			○																														
8	Output does not change when mode selector switch is operated	○	○	○	○																																																				
9	Abnormal noise is generated from around pump																	○	○	○																																○	○				
10	Swing speed is slow, or there is excessive overrun when stopping swing (auto-deceleration is normal)																			○											○			○			○	○	○		○																
11	Upper structure does not swing (work equipment, travel are normal)					○	○	○	○	○																					○			○			○	○	○		○																
12	Excessive hydraulic drift of swing					○	○	○	○	○																														○	○																
13	Excessive hydraulic drift of work equipment																													○	○																				○						
14	Excessive time lag of work equipment																												○		○																						○				
15	Travel speed does not change										○	○																																	○		○										
16	Defective actuation of heavy lift function (boom RAISE pressure does not increase, or increases but does not go down) (BACK HOE)	○	○													○												○																				○									
17	Defective actuation of machine push up (boom LOWER pressure does not increase, or increases but does not go down)	○	○														○													○																			○								

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★ FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION

No.	Failure mode \ Parts causing failure	Electrical system																							
				Electronic OLSS, auto-deceleration										Swing brake					Travel speed selection		Straight-travel				
				Electronic OLSS						Auto-deceleration															
		Power source line	Wiring harness (including connector)	Controller	Engine speed sensor	Potentiometer	TVC solenoid	Mode selector switch	Prolix switch	Oil pressure switch	Auto-deceleration solenoid	Relay	Auto-deceleration switch	Swing brake solenoid	Timer	Oil pressure switch	Swing lock switch	Relay	Travel speed solenoid	Travel speed switch	Oil pressure switch	Straight-travel solenoid	Relay	Heavy lift solenoid	Machine push up solenoid
1	Excessive travel deviation (constant deviation)		○	○	○	○	○		○		○														
2	Excessive travel deviation (during compound operations)																				○	○	○		
3	Excessive travel deviation (when starting)																								
4	Control levers are heavy																								
5	Work equipment, travel, swing start to move suddenly																								
6	Speed of work equipment, swing, travel is extremely slow or lacks power (no travel deviation)	○	○	○	○	○	○		○												○	○	○		
7	Engine stalls or engine speed drops during operations	○	○	○	○	○	○																		
8	Output does not change when mode selector switch is operated	○	○	○			○	○	○																
9	Auto-deceleration does not work properly (there is no deceleration or deceleration stays on)	○	○	○						○	○	○	○												
10	Abnormal noise is generated from around pump																								
11	Swing speed is slow, or there is excessive overrun when stopping swing (auto-deceleration is normal)																								
12	Upper structure does not swing (work equipment, travel are normal)													○	○	○	○	○							
13	Excessive hydraulic drift of swing													○	○	○	○	○							
14	Excessive hydraulic drift of work equipment																								
15	Excessive time lag of work equipment																								
16	Travel speed does not change																	○	○						
17	Defective actuation of heavy lift functio. (boom RAISE pressure does not increase, or increases but does not go down)	○	○																					○	
18	Defective actuation of machine push up (boom LOWER pressure does not increase, or increases but does not go down)	○	○																						○

No.	Failure mode \ Parts causing failure	Hydraulic system																									
					Pump control				Charging pump		Control valve								PPC valve				Swing motor				
		No. 1 pump	No. 2 pump	Swing pump	Servo valve	NC valve	CO valve	TVC valve	Pump	Relief valve	Jet sensor	Main relief valve	Suction valve	Safety valve	Spool (including spring case)	Straight-travel valve	Straight-travel solenoid valve	Auto-deceleration solenoid valve	For arm, swing	For arm, bucket	For travel	Auto-deceleration cylinder	Motor	Safety valve	Check valve	Swing shaft brake	Swing brake solenoid valve
1	Excessive travel deviation (constant deviation)	○	○		○	○	○	○		○	○	○		○	○						○						○
2	Excessive travel deviation (during compound operations)															○	○		○	○	○						
3	Excessive travel deviation (when starting)	○	○		○	○	○		○	○		○						○			○						○
4	Control levers are heavy														○				○	○	○						
5	Work equipment, travel, swing start to move suddenly				○	○	○				○				○				○	○	○						
6	Speed of work equipment, swing, travel is extremely slow or lacks power (no travel deviation)	○	○	○	○	○		○	○	○	○	○		○	○	○	○	○	○	○							○
7	Engine stalls or engine speed drops during operations	○	○	○	○		○	○			○																
8	Output does not change when mode selector switch is operated																					○					
9	Auto-deceleration does not work properly (there is no deceleration or deceleration stays on)								○	○								○									
10	Abnormal noise is generated from around pump	○	○	○																							
11	Swing speed is slow, or there is excessive overrun when stopping swing (auto-deceleration is normal)			○											○				○				○	○	○		○
12	Upper structure does not swing (work equipment, travel are normal)														○				○				○	○	○		○
13	Excessive hydraulic drift of swing																									○	○
14	Excessive hydraulic drift of work equipment													○	○												
15	Excessive time lag of work equipment												○		○												
16	Travel speed does not change																										
17	Defective actuation of heavy lift functio. (boom RAISE pressure does not increase, or increases but does not go down)											○															
18	Defective actuation of machine push up (boom LOWER pressure does not increase, or increases but does not go down)													○													

No.	Failure mode \ Parts causing failure	Hydraulic system												Mechanical system			
		Travel motor															
		Motor	Safety valve	Check valve	Servo piston	Travel shaft brake	Travel speed solenoid valve	Heavy lift solenoid valve	Machine push up solenoid valve	Center swivel joint	Hydraulic cylinder	Hydraulic oil tank (including oil level)	Strainer, filter	Engine	Swing machinery, swing circle	Final drive	Linkage
1	Excessive travel deviation (constant deviation)	○	○				○			○				○		○	
2	Excessive travel deviation (during compound operations)																
3	Excessive travel deviation (when starting)					○											
4	Control levers are heavy																○
5	Work equipment, travel, swing start to move suddenly																
6	Speed of work equipment, swing, travel is extremely slow or lacks power (no travel deviation)										○						
7	Engine stalls or engine speed drops during operations																
8	Output does not change when mode selector switch is operated																
9	Auto-deceleration does not work properly (there is no deceleration or deceleration stays on)																○
10	Abnormal noise is generated from around pump											○	○				
11	Swing speed is slow, or there is excessive overrun when stopping swing (auto-deceleration is normal)																
12	Upper structure does not swing (work equipment, travel are normal)																
13	Excessive hydraulic drift of swing																
14	Excessive hydraulic drift of work equipment										○						
15	Excessive time lag of work equipment												○				
16	Travel speed does not change				○		○										
17	Defective actuation of heavy lift functio. (boom RAISE pressure does not increase, or increases but does not go down)							○									
18	Defective actuation of machine push up (boom LOWER pressure does not increase, or increases but does not go down)								○								

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TROUBLESHOOTING OF MACHINE MONITOR SYSTEM (M MODE)

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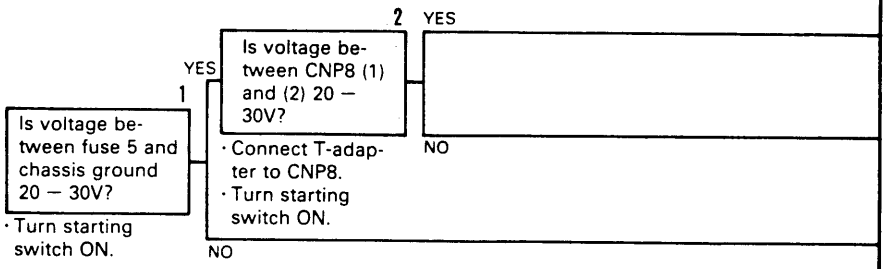
M-1 When starting switch is turned ON, monitor panel display does not appear

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity) connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

a) No display appears on monitor panel (gauges and monitor items)



Cause	Remedy
Defective monitor module	Replace
Defective contact, or disconnection in wiring harness between fuse 5 and CNP8 (female) (1), or CNP8 (female) (2) — CN1 (20) — CN102 (4) — chassis ground	Clean (defective contact) or replace
Defective contact, or disconnection in wiring harness between fuse box — CN5 (2) — CN101 (1) — battery relay	Clean (defective contact) or replace

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b) Display does not appear on part of monitor panel assembly.

Cause	Remedy
Defective monitor module	Replace

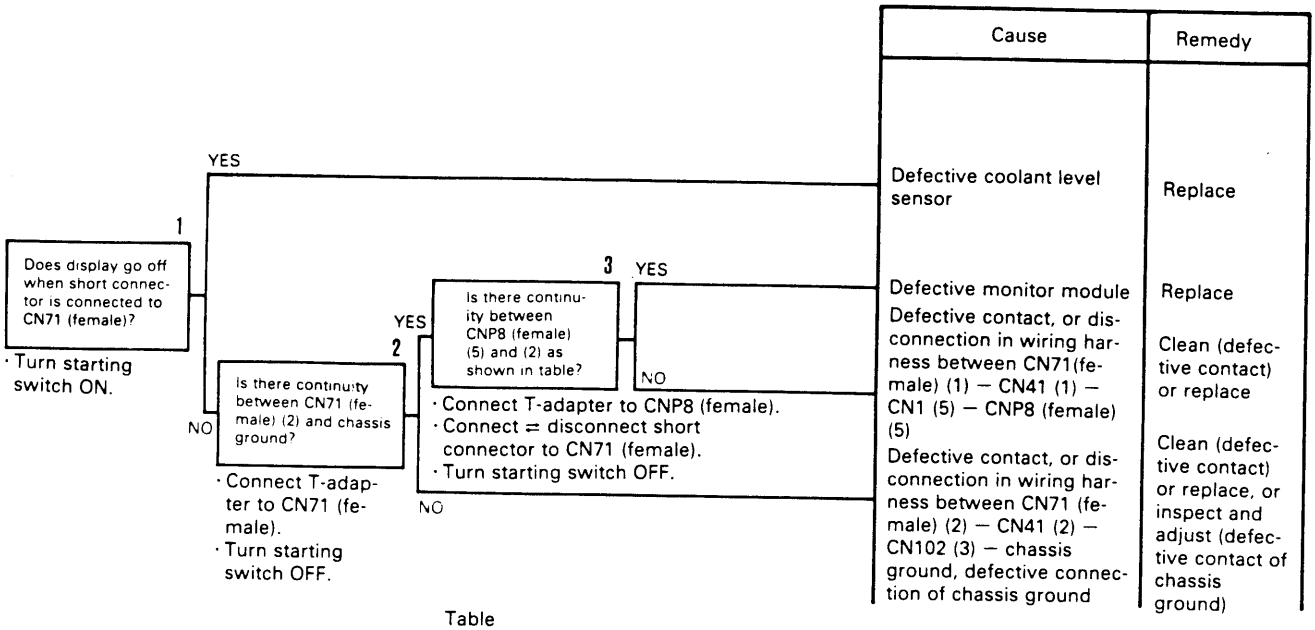
M-2 When starting switch is turned ON, monitor panel display does not go out

Cause	Remedy
Defective monitor module	Replace

M-3 When starting switch is turned ON (engine stopped), CHECK items flash. (Fluid level of CHECK items are correct)

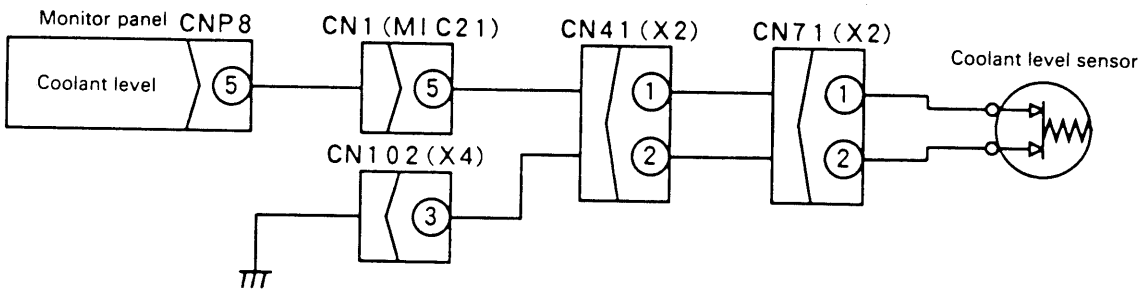
★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity) connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

a) (coolant level) flashes



Table

Short connector	Continuity
Connect	Yes
Disconnect	No



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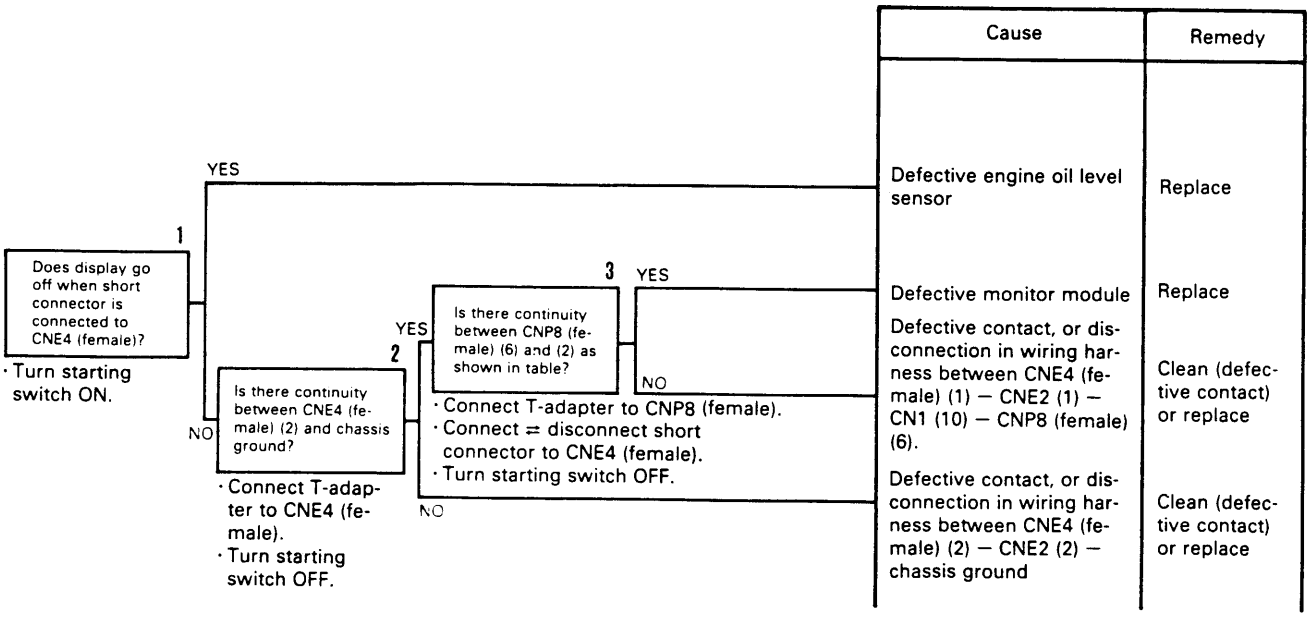
b) (engine oil level) flashes



Table

Short connector	Continuity
Connect	Yes
Disconnect	No

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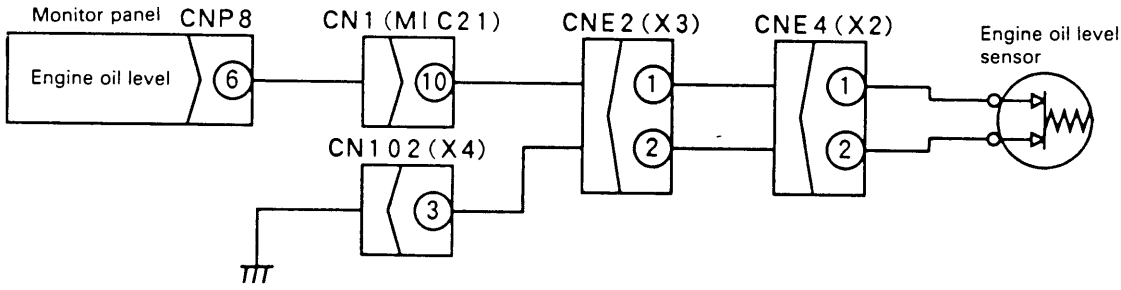

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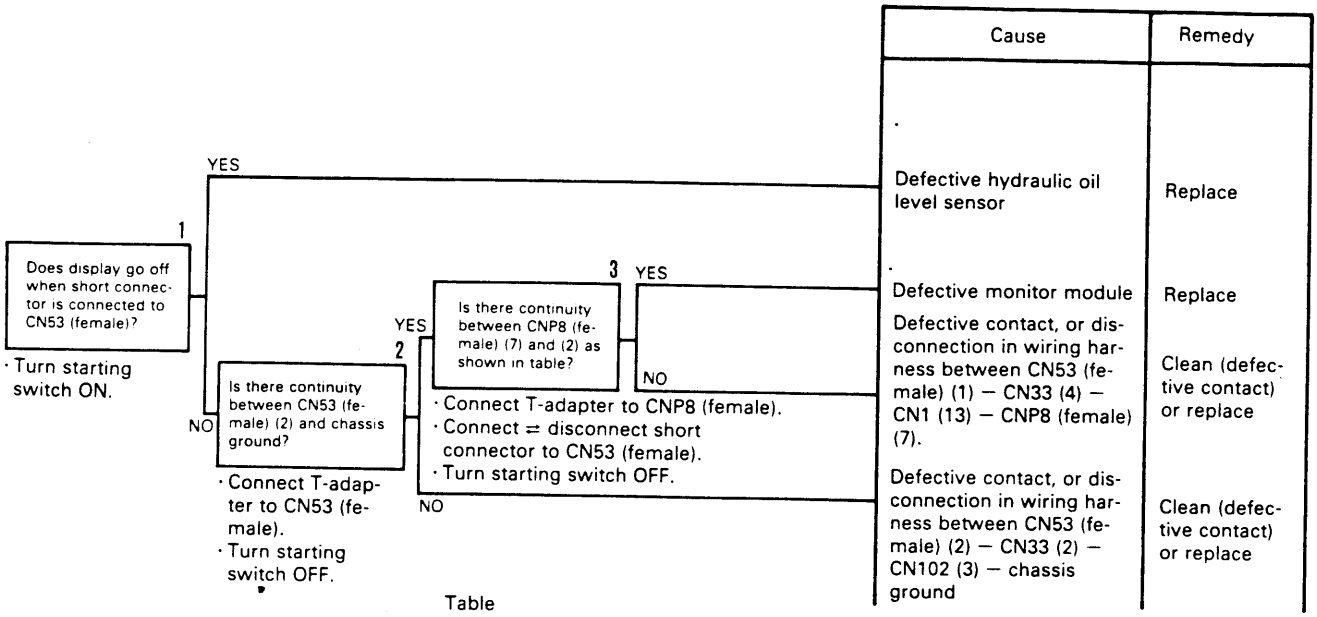
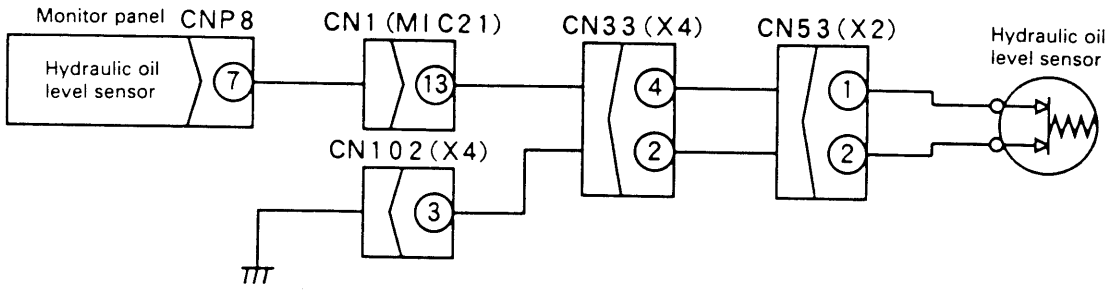
c) (hydraulic oil level) flashes



Table

Short connector	Continuity
Connect	Yes
Disconnect	No

020905



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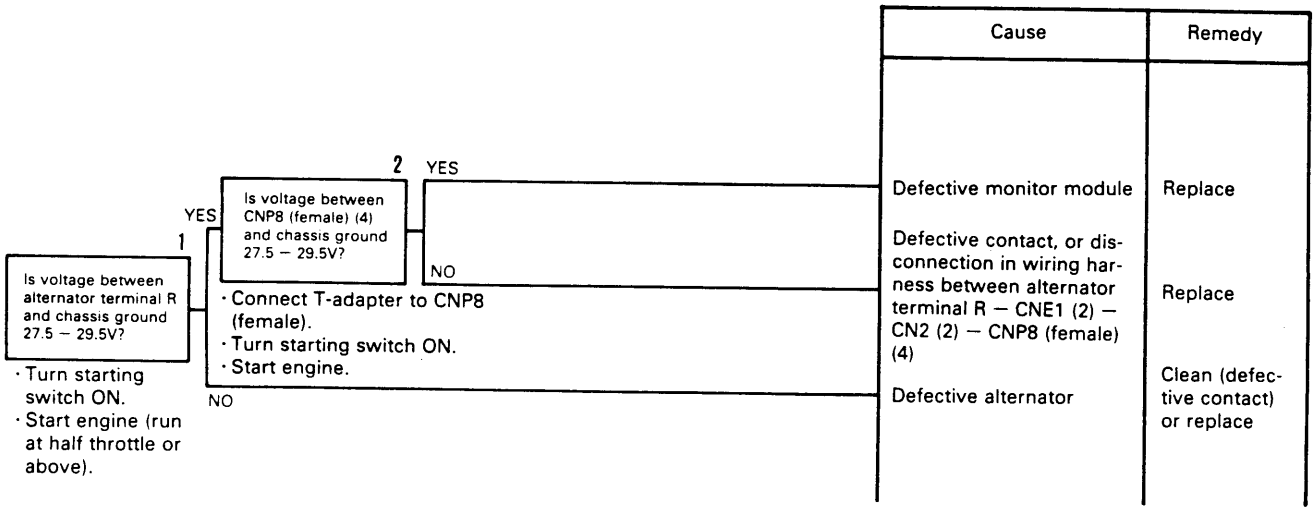
M-4 When starting switch is turned ON and engine is started, CHECK items flash

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity) connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.
★ Check both the alternator system and the engine oil pressure sensor system.

a) Alternator system



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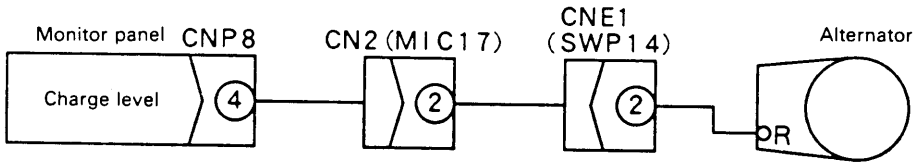

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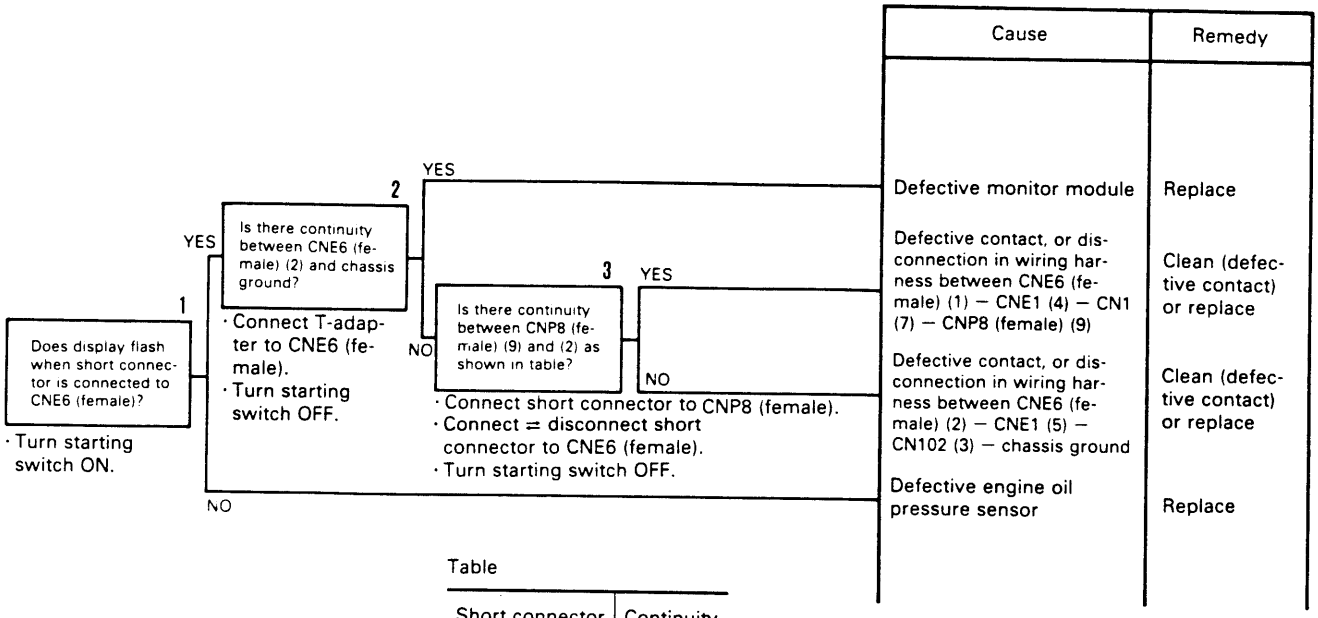
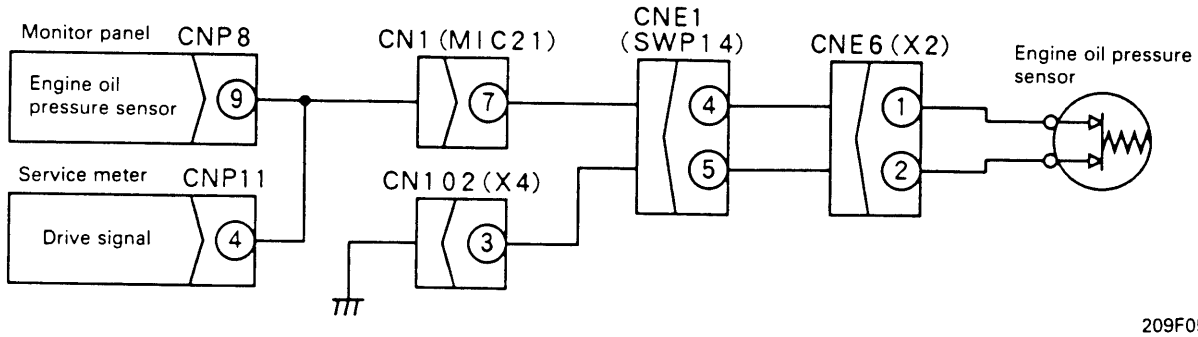
b) Engine oil pressure sensor system



Table

Short connector	Continuity
Connect	Yes
Disconnect	No

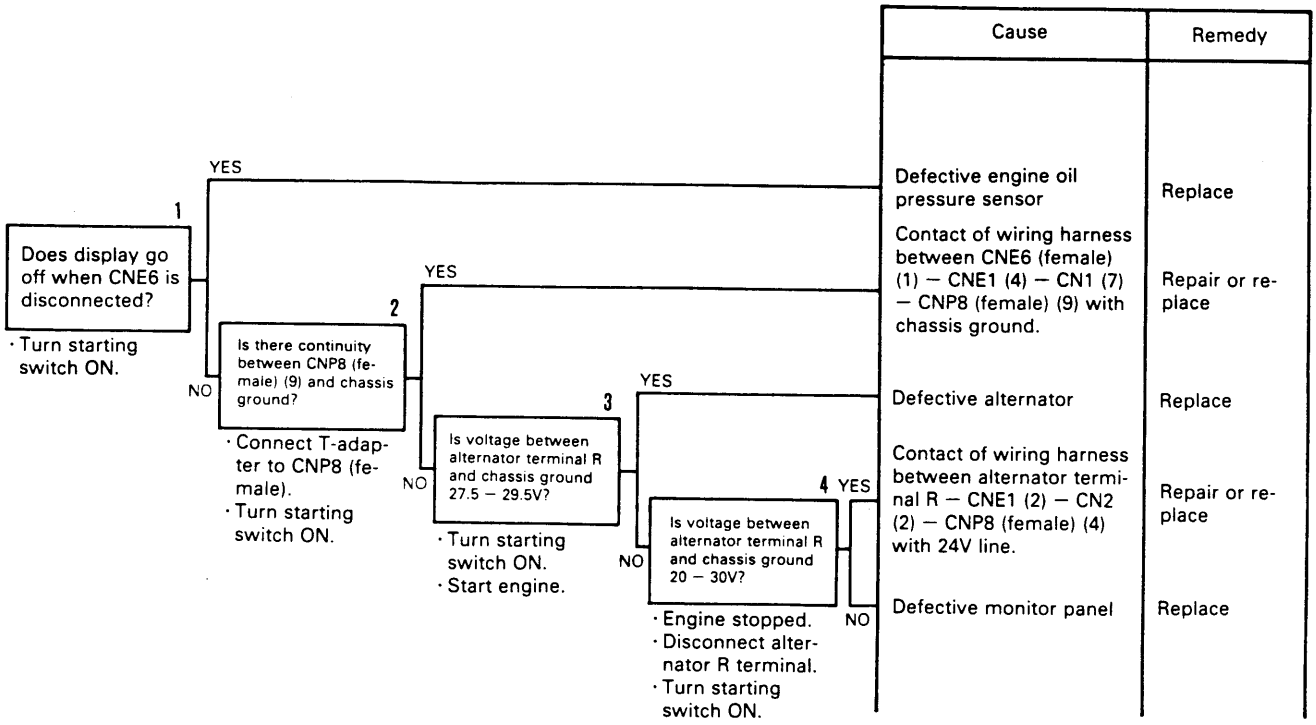
020905



209F05409

M-5 When starting switch is turned ON (engine stopped), CAUTION items flash

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity) connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.
★ If  (engine oil levl), or  (coolant level) flash, go to M-3 a) and b).



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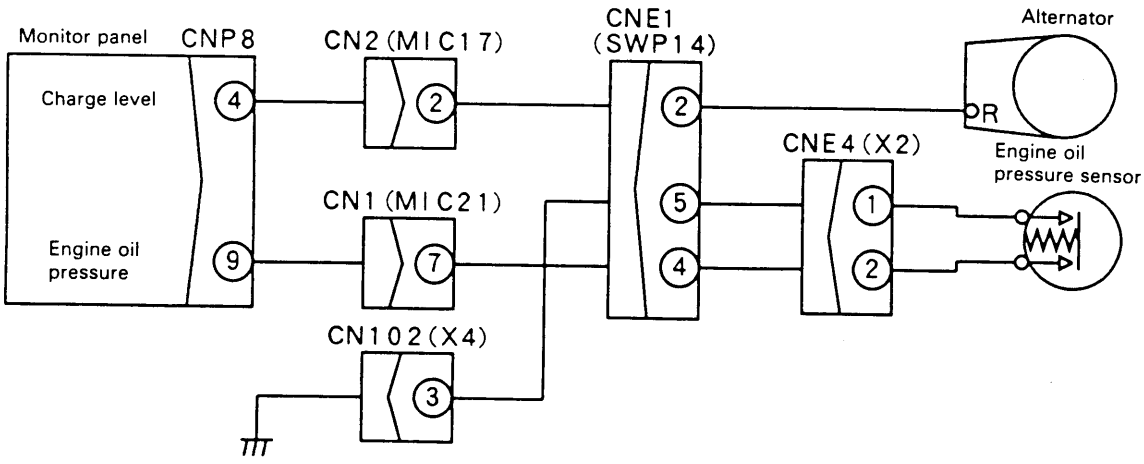

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M-6 When starting switch is turned ON and engine is started, CAUTION items flash

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity) connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

a) (engine oil pressure) flashs

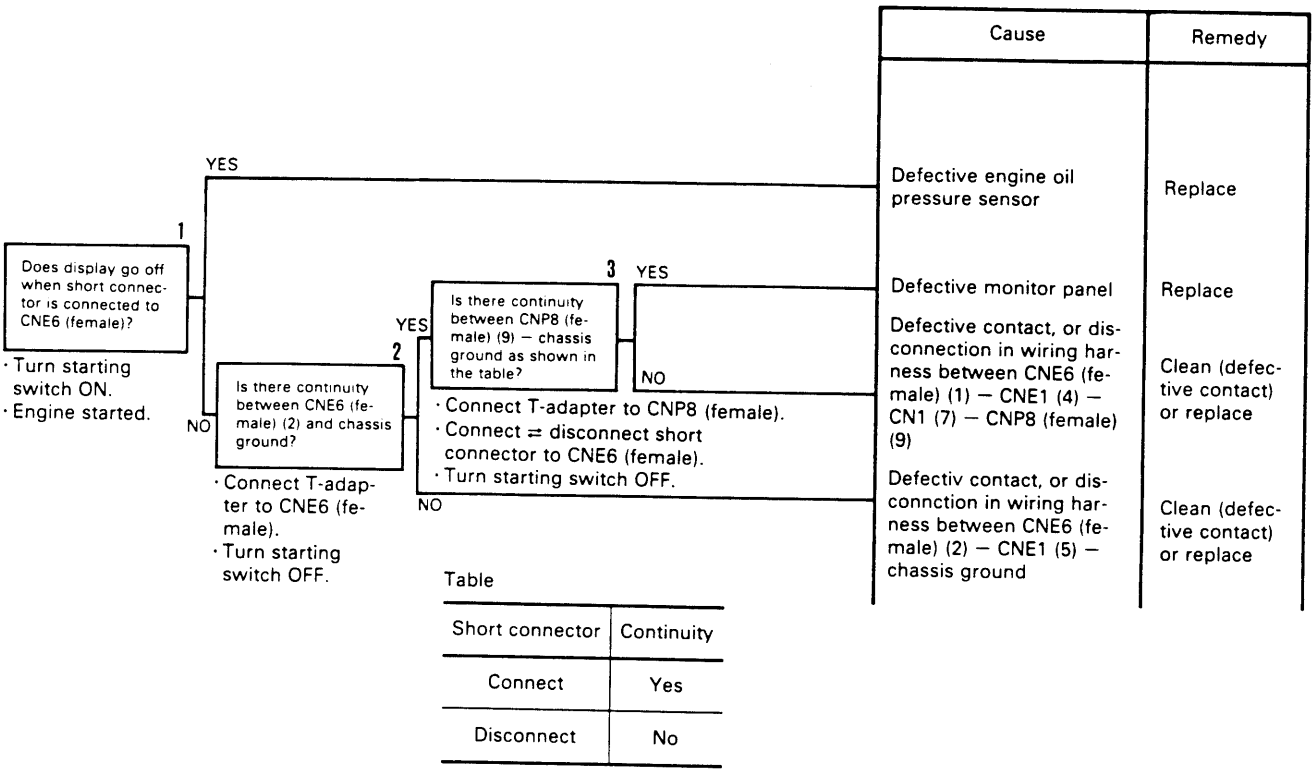

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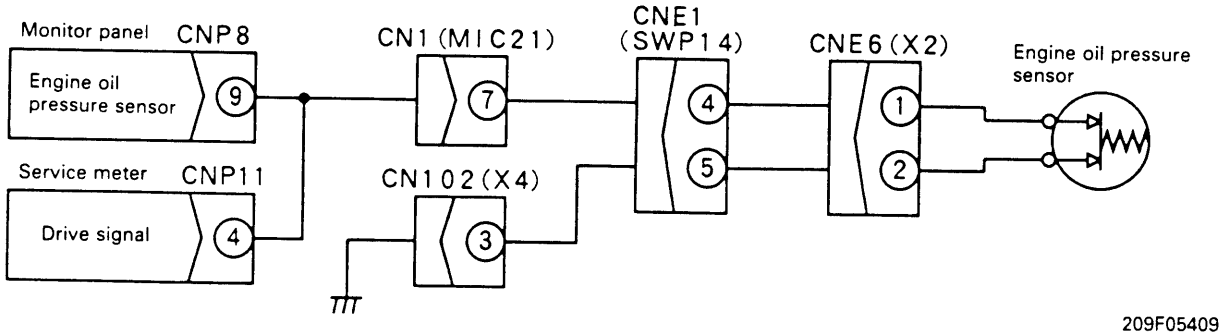
Table

Short connector	Continuity
Connect	Yes
Disconnect	No



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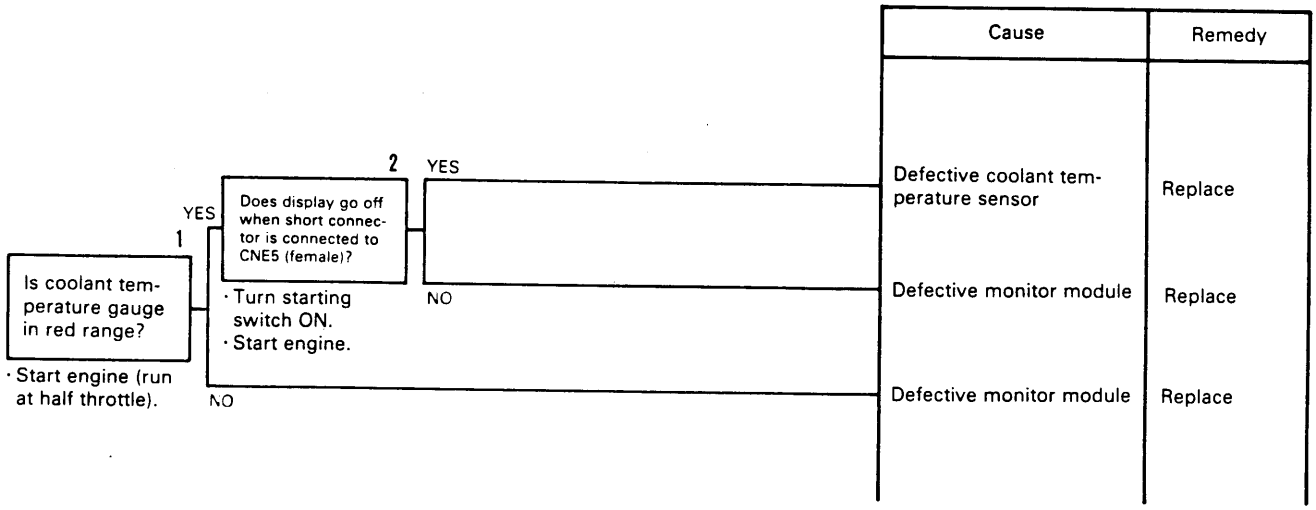
b)  **(coolant level) flashes**

See M-3 a)

c)  **(coolant temperature) flashes**



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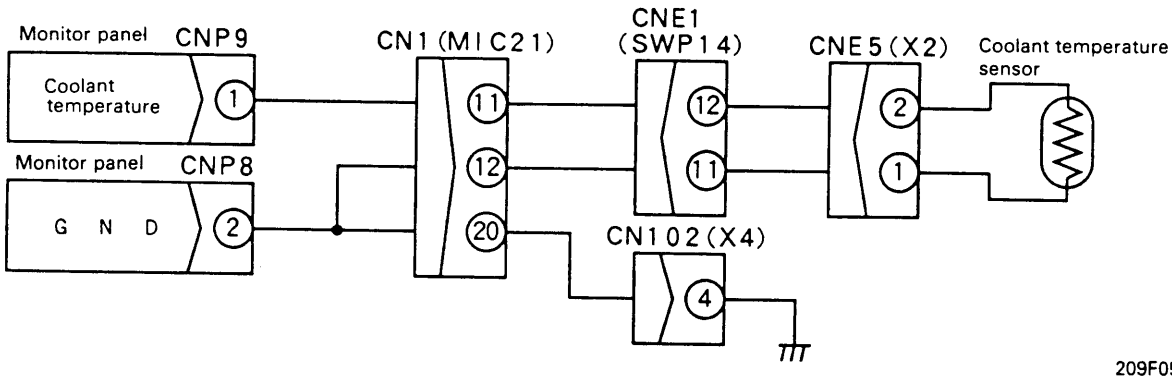

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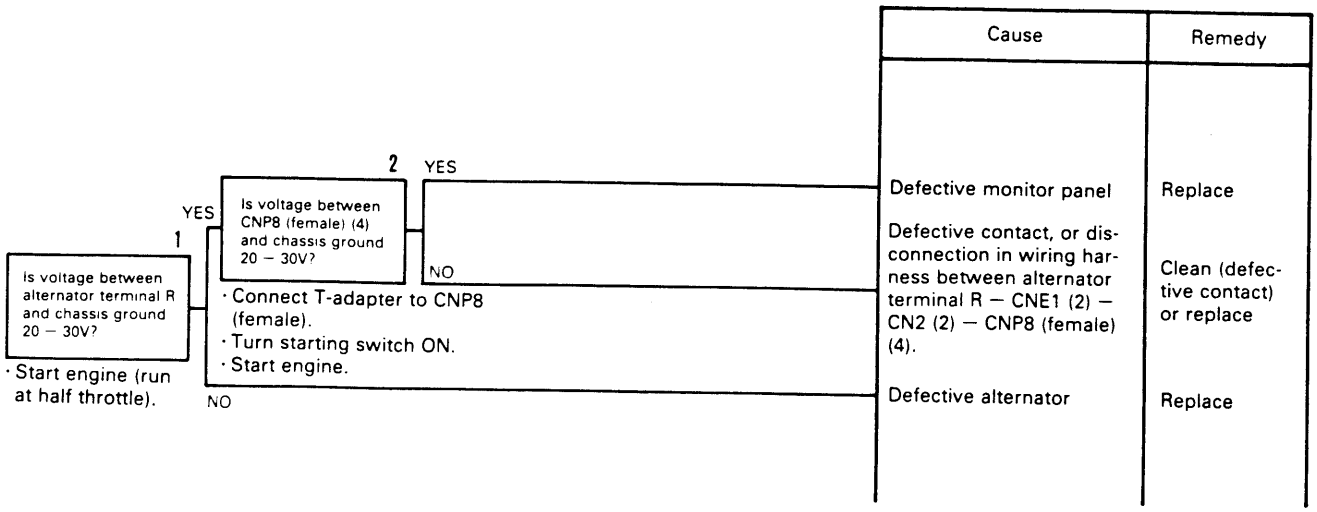
d) (charge level) flashes



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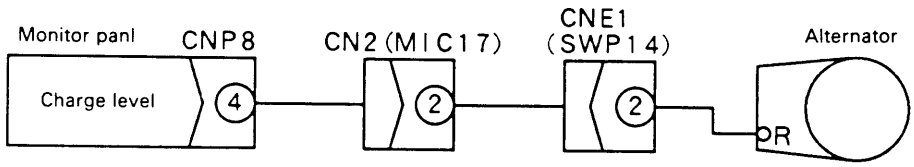
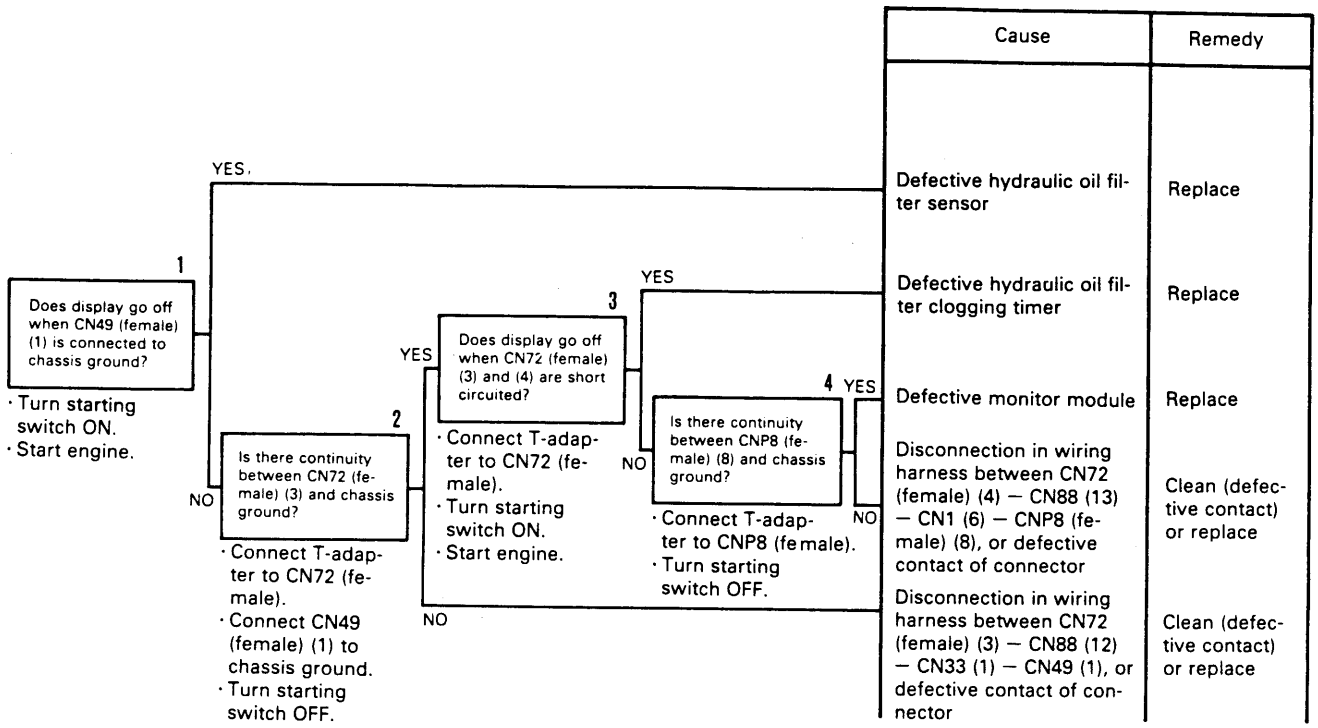


209F05408

e) (hydraulic oil filter) flashes



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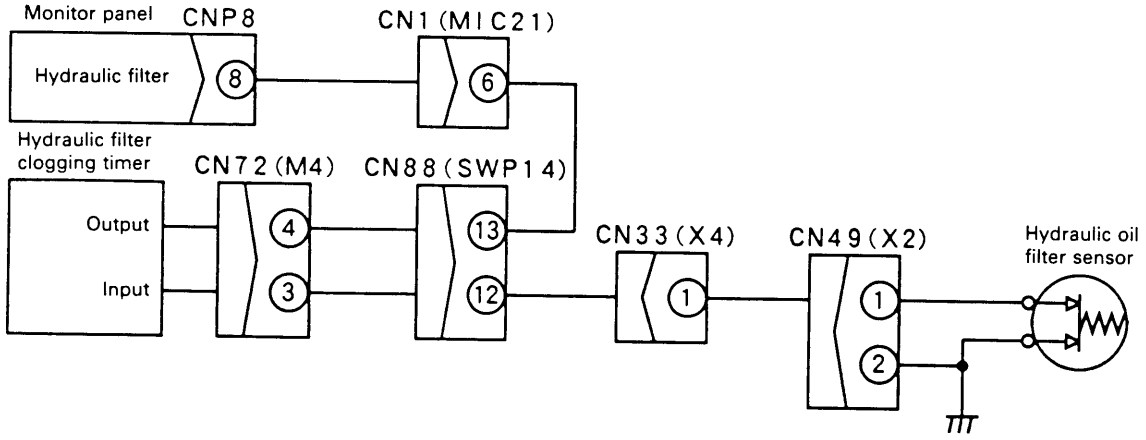
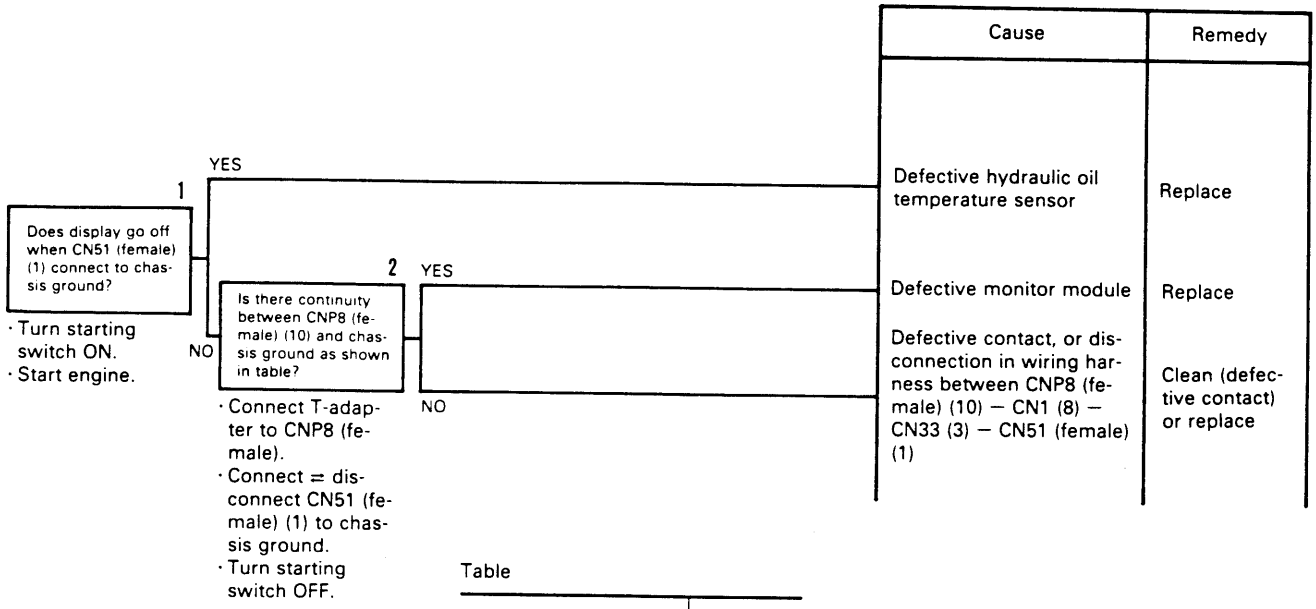


209F05412

f) (hydraulic oil temperature) flashes



Table

CN51 (female) (1)	Continuity
Connect to chassis ground	Yes
Disconnect from chassis ground	No

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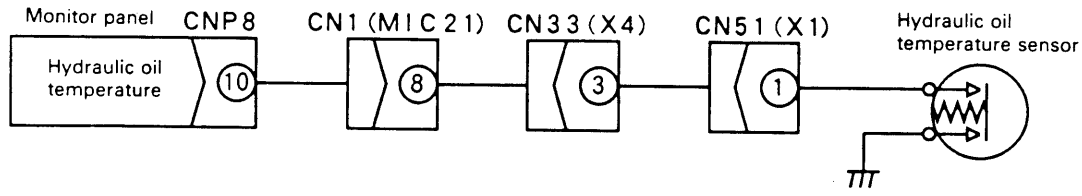
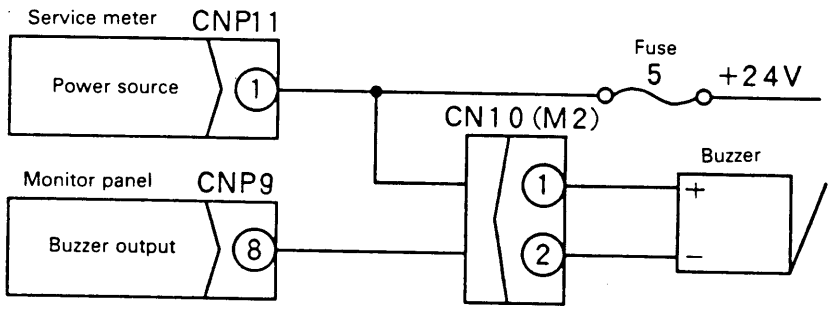


209F05413

M-7 When starting switch is turned ON (engine stopped) for 1 second, or when CAUTION items are flashing, warning buzzer does not sound

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity) connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.
★ Of the CAUTION items, the buzzer does not sound if there is any abnormality in the charge level.

		Cause	Remedy
1 Does buzzer sound when CNP9 (female) (8) is connected to chassis ground? · Connect T-adapter to CNP9 (female). · Turn starting switch ON.	YES	Defective monitor module	Replace
	NO	Disconnection in wiring harness between CNP9 (female) (8) and CN10 (female) (2), or fuse 5 and CN10 (female) (1), or defective buzzer	Replace



209F05414

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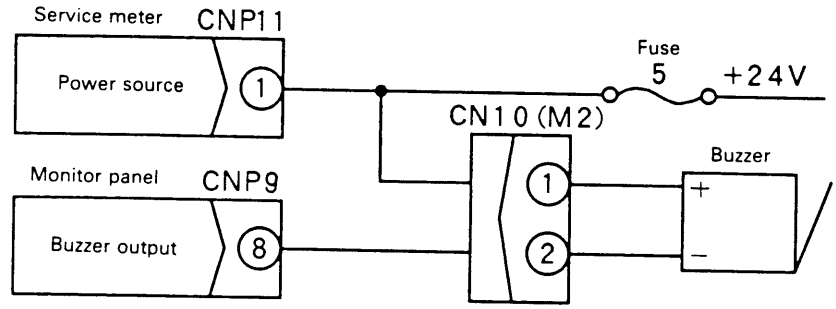
M-8 No abnormal display on monitor but warning buzzer sounds

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity) connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

	Cause	Remedy
1 Does buzzer sound when CNP9 is disconnected? · Turn starting switch ON.	YES: Contact of chassis ground and wiring harness between CNP9 (female) (8) and CN10 (female) (2)	Repair or replace
	NO: Defective monitor module	Replace



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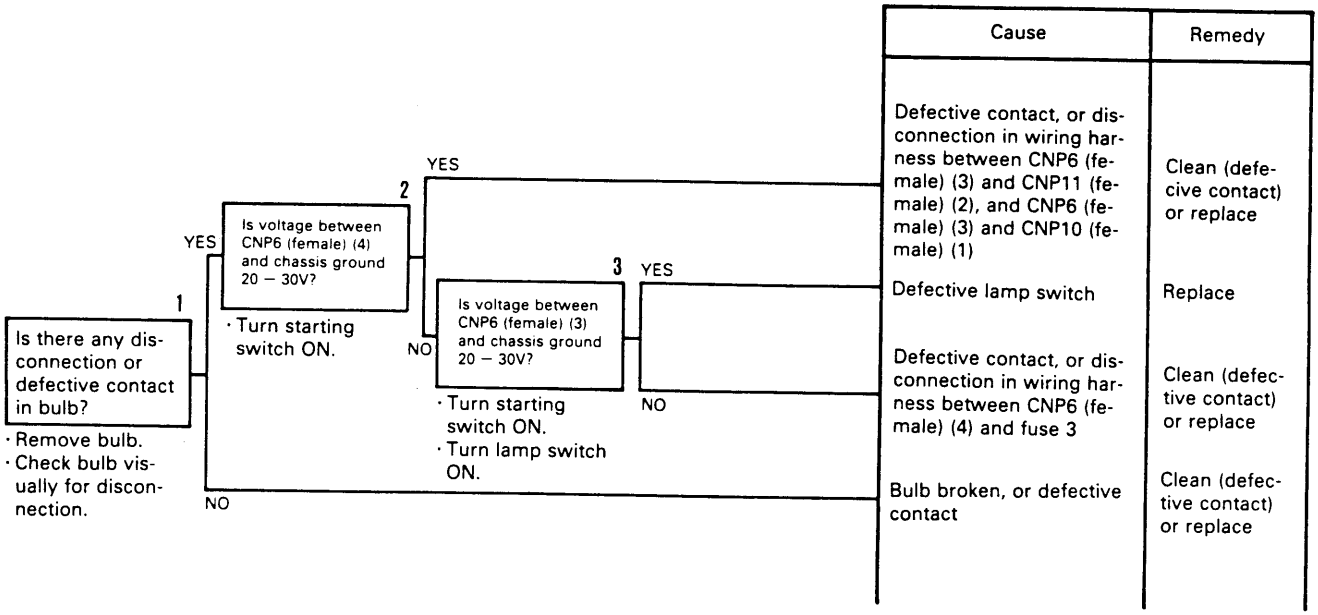
M-9 Panel lighting of monitor panel does not light up (liquid crystal display is normal)

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity) connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

a) Upper panel (monitor panel) does no light up



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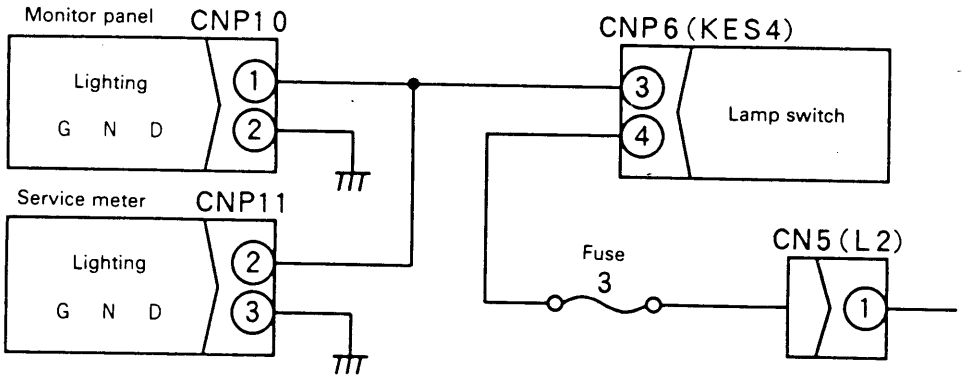

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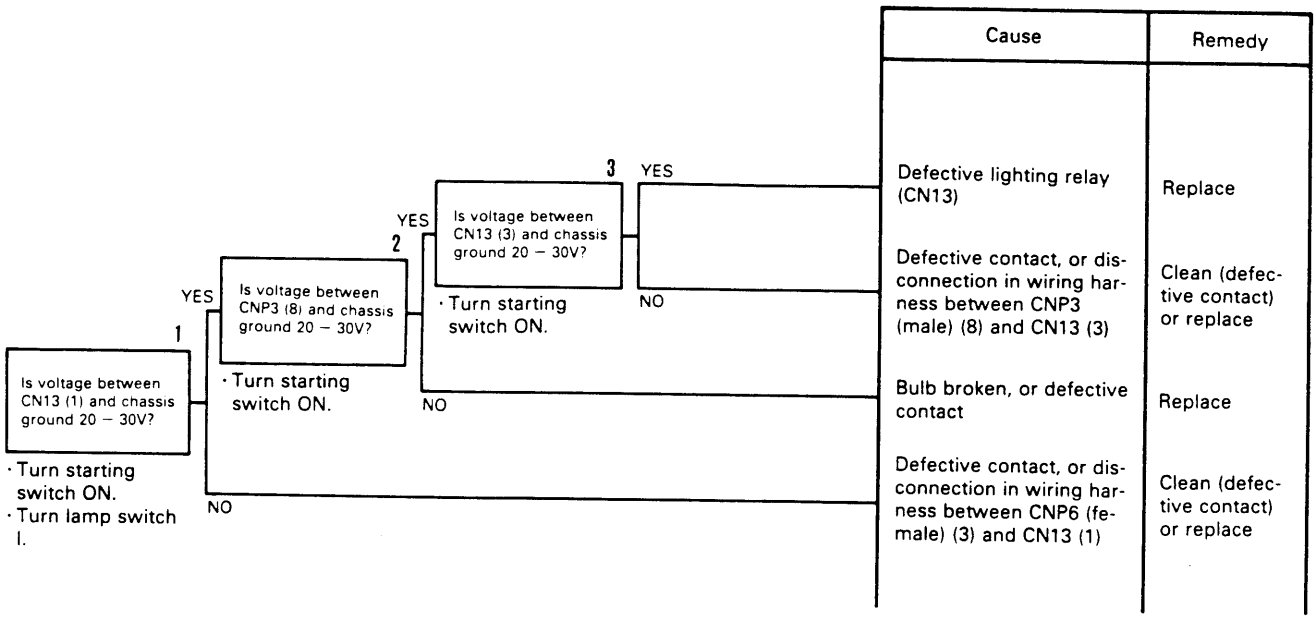
b) Lower panel (seat switch) does not light up

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

★ When operation of panel switch is normal and head lamp light up (If head lamp does not light up, go first to M-15).



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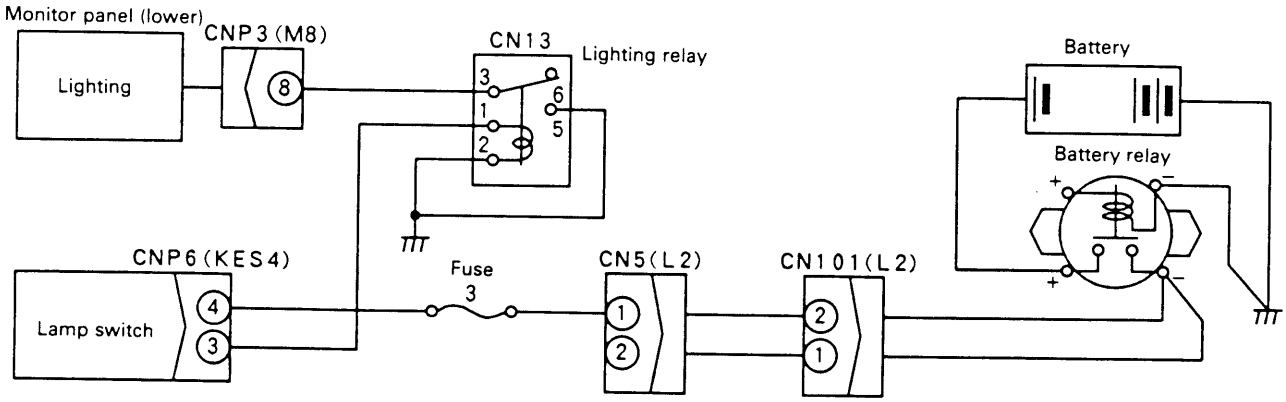
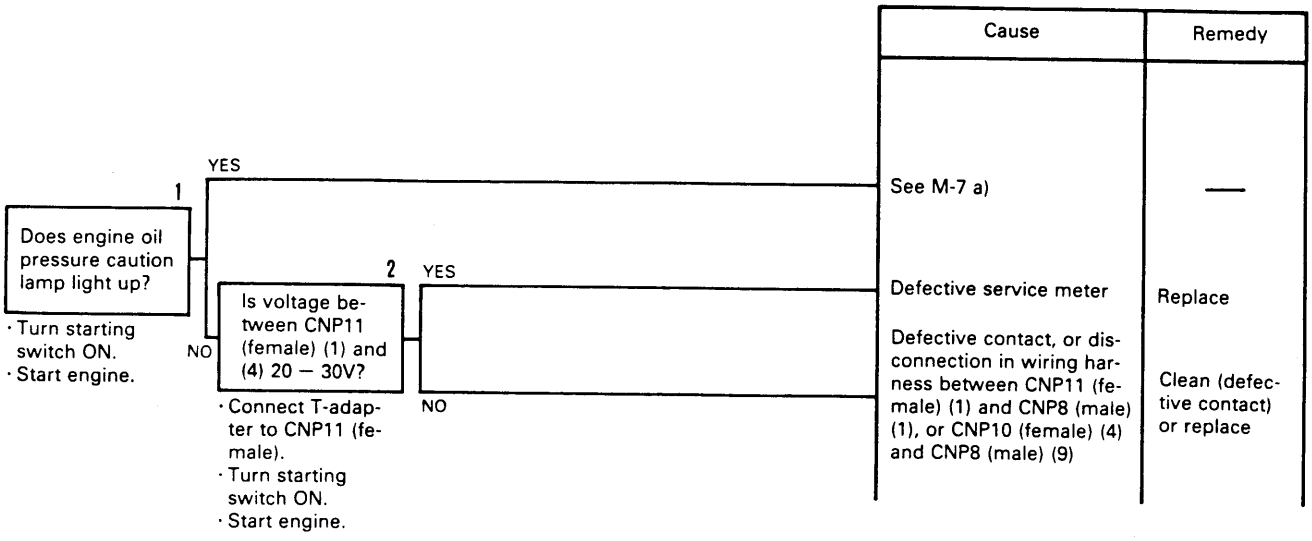


209F05416

M-10 When engine is started, service meter does not move When engine is stopped, service meter moves

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity) connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

a) Service meter does not move when engine is started



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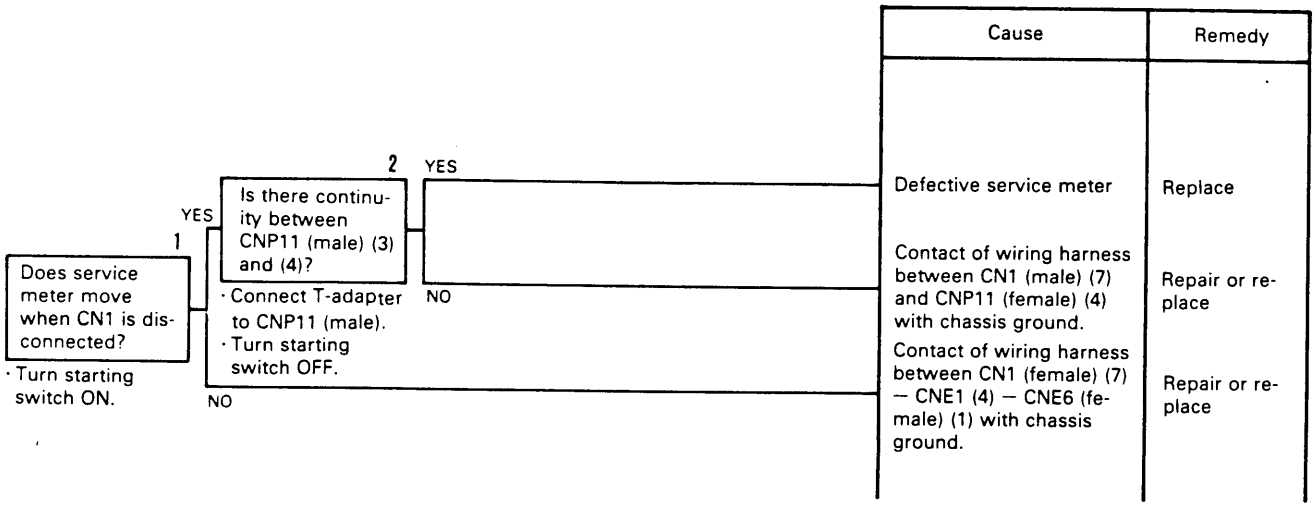
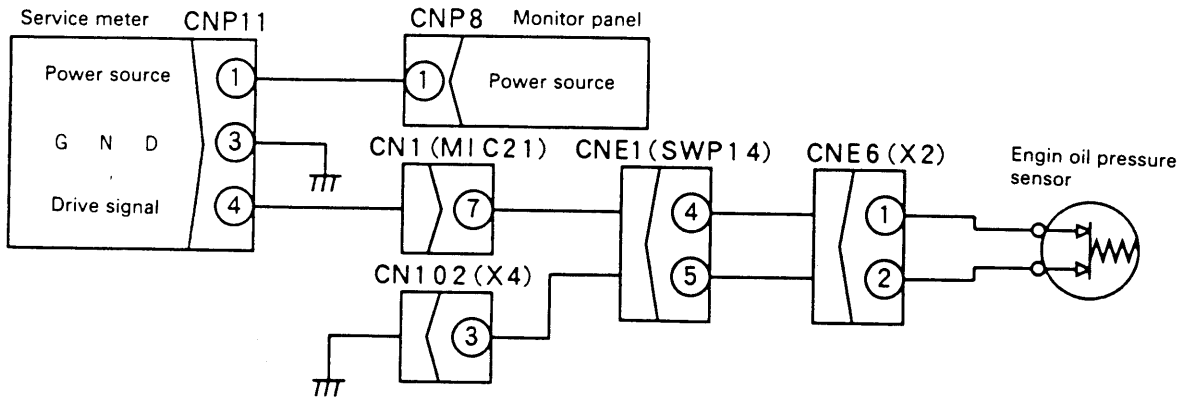
b) Service meter moves when engine is stopped





209F05417

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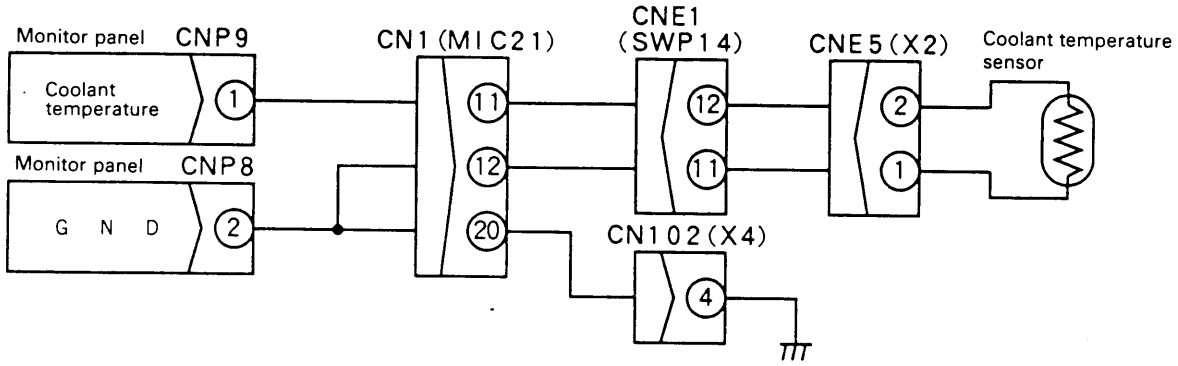
M-11 Coolant temperature gauge shows abnormally low temperature

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity) connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

	Cause	Remedy
1 Does display go off when short connector is connected to CNE5 (female)? · Turn starting switch ON. — YES	Defective coolant temperature sensor	Replace
NO	Defective contact, or disconnection in wiring harness between CNE5 (female) (1), (2) — CNE1 (11), (12) — CN1 (12), (11) — CNP9 (female) (1), CNP8 (female) (2)	Clean (defective contact) or replace



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M-12 Coolant temperature gauge gives no display

★ Before connecting the T-adapter or disconnecting the connecor, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity), connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.

	Cause	Remedy
1 Does display appear when CNE5 is disconnected? · Turn starting switch ON. — YES	Defective coolant temperature sensor	Replace
NO	Defective contact or disconnection in wiring harness between CNE5 (female) (1), (2) — CNE1 (11), (12) — CN1 (12), (11) — CNP9 (female) (1), CNP8 (female) (2)	Repair or replace

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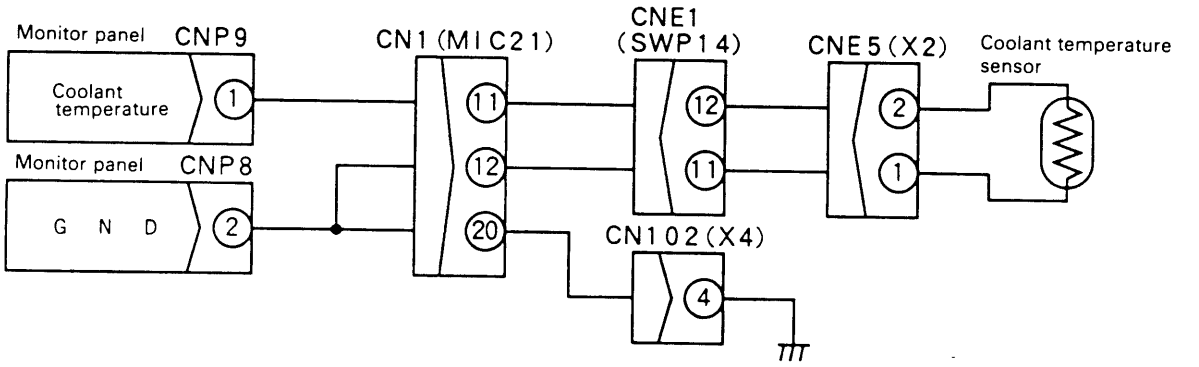
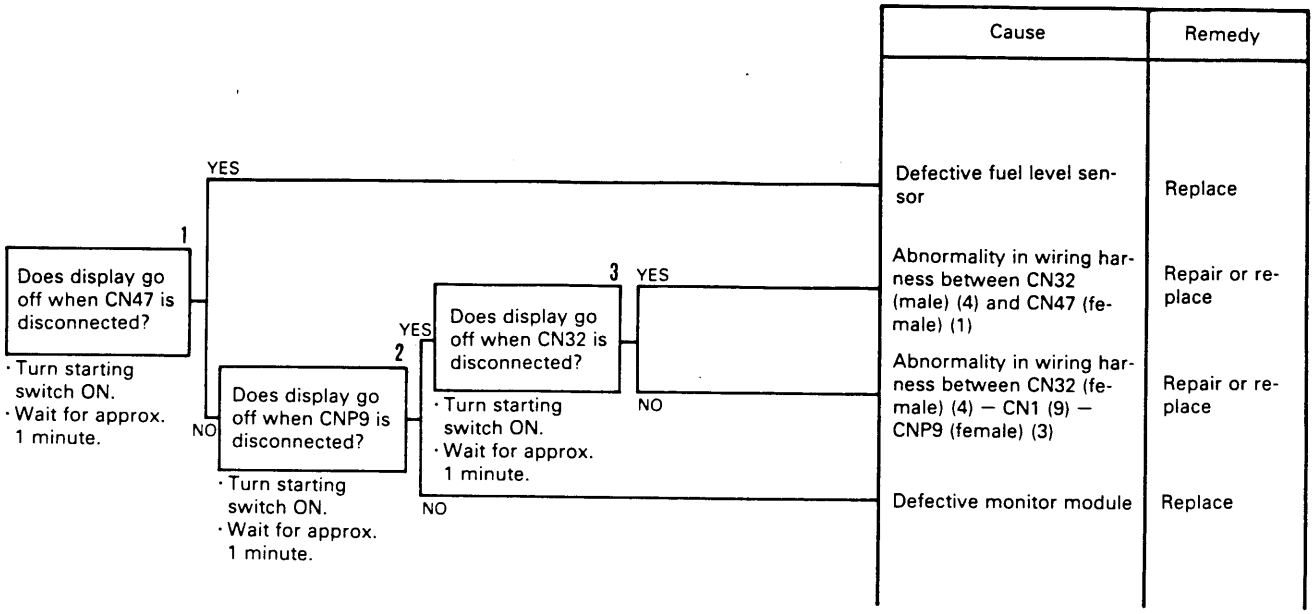


209F05411

M-13 Fuel level gauge always displays FULL

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity) connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.



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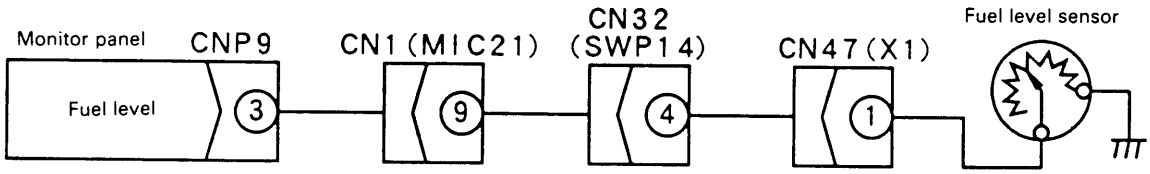
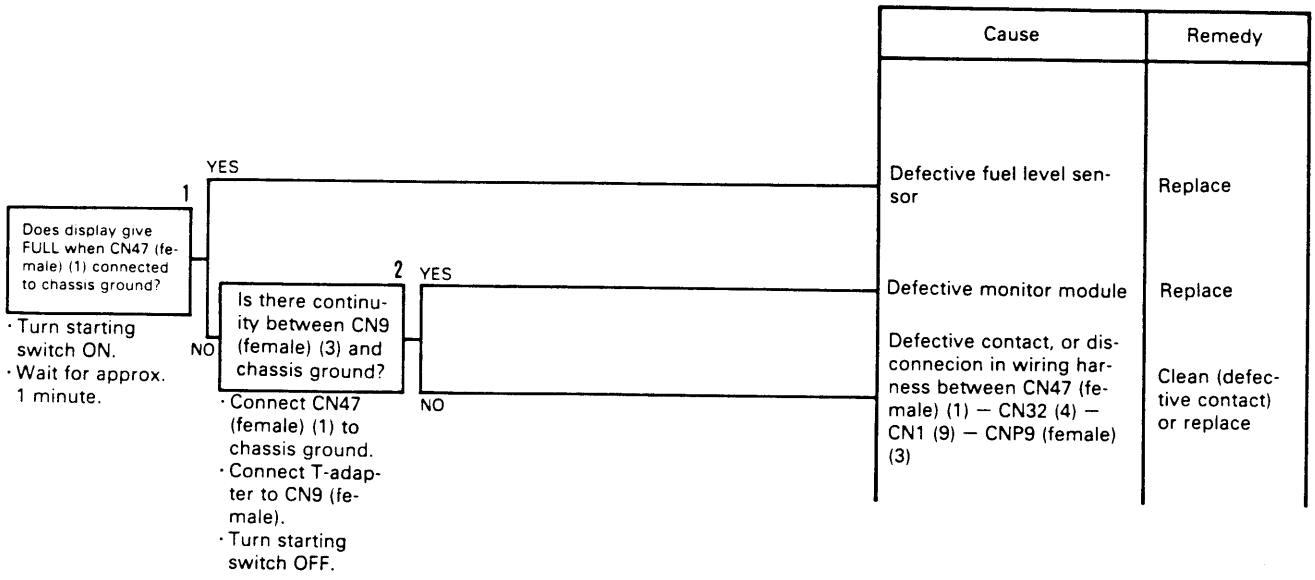


209F05418

M-14 Fuel level gauge gives no display

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and femalee, and when measuring resistance (continuity) connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.



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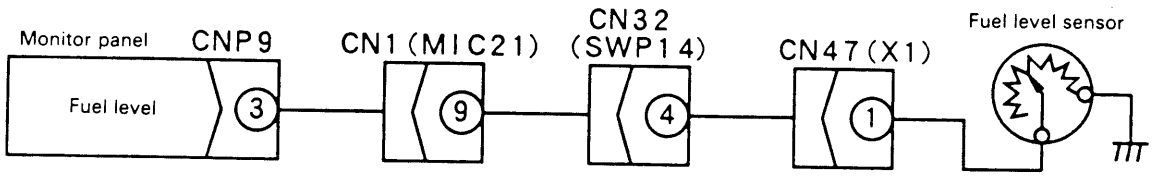
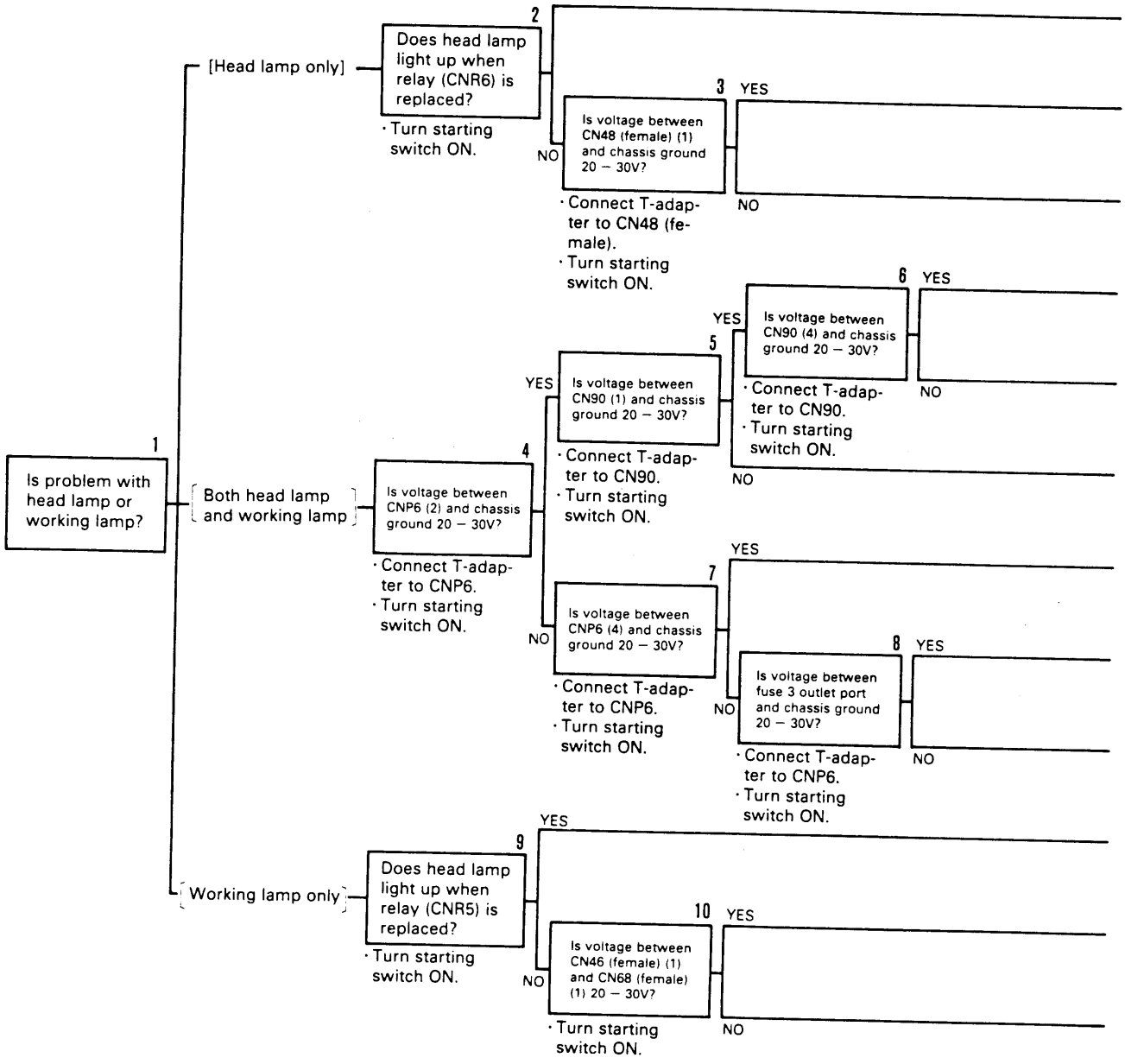


209F05418

M-15 Head lamp, working lamp do not light up

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity) connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.
★ Check that the fuse 3 is not blown.



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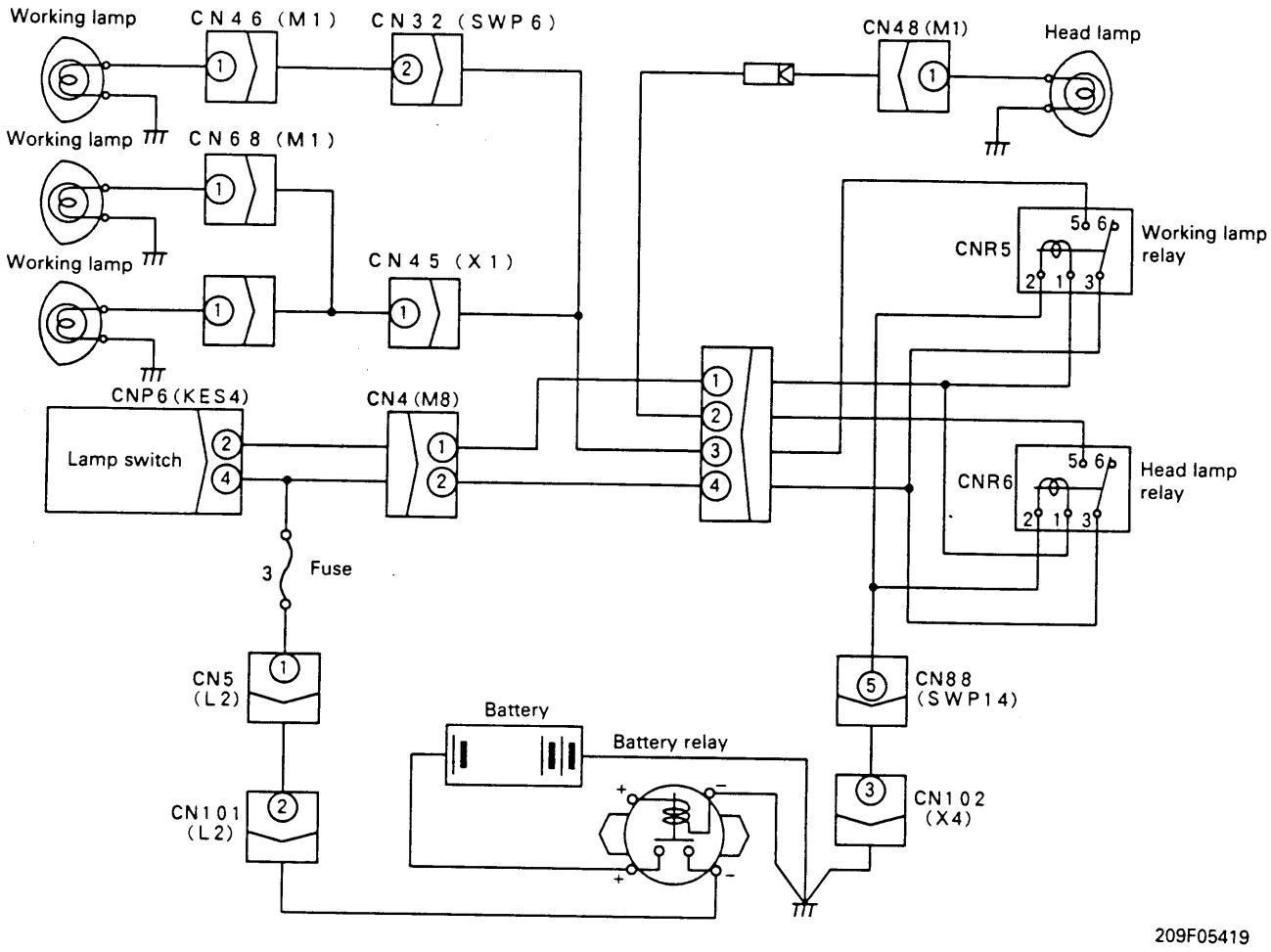
Cause	Remedy
Defective head lamp relay (CNR6)	Replace
Broken bulb of head lamp	Replace
Defective contact, or disconnection in wiring harness between CN90 (female) (2) and CN48 (female) (1)	Clean (defective contact) or replace
Defective contact, or disconnection in wiring harness between CNR5 (2), CNR6 (2) and CN88 (male) (5)	Clean (defective contact) or replace
Defective contact, or disconnection in wiring harness between CN90 (female) (4) — CN4 (2) — fuse 3	Clean (defective contact) or replace
Defective contact, or disconnection in wiring harness between CNP6 (female) (2) — CN4 (1) — CN90 (female) (1)	Replace
Defective lamp switch	Replace
Defective contact, or disconnecion in wiring harness between fuse 3 and CNP6 (female) (4)	Clean (defective contact) or replace
Defective contact, or disconnection in wiring harness between fuse box CN5 (1) — CN101 (2) — battery relay	Clean (defective contact) or replace
Defective working lamp relay (CNR5)	Replace
Broken bulb of working lamp	Replace
Defective contact, or disconnection in wiring harness between CN90 (female) (3) — CN32 (2) → CN46 (female) (1), or CN90 (female) (3) — CN45 (1) — CN68 (female) (1)	Clean (defective contact) or replace


Working lamp
CN46 (M1)
CN32 (SWP6)
CN48 (M1)
Head lamp
Working lamp
CN68 (M1)
CNR5
Working lamp relay
Working lamp
CN45 (X1)
CNP6 (KES4)
CN4 (M8)
Lamp switch
CNR6
Head lamp relay
3
Fuse
CN5 (L2)
CN88 (SWP14)
Battery
Battery relay
CN101 (L2)
CN102 (X4)
209F05419
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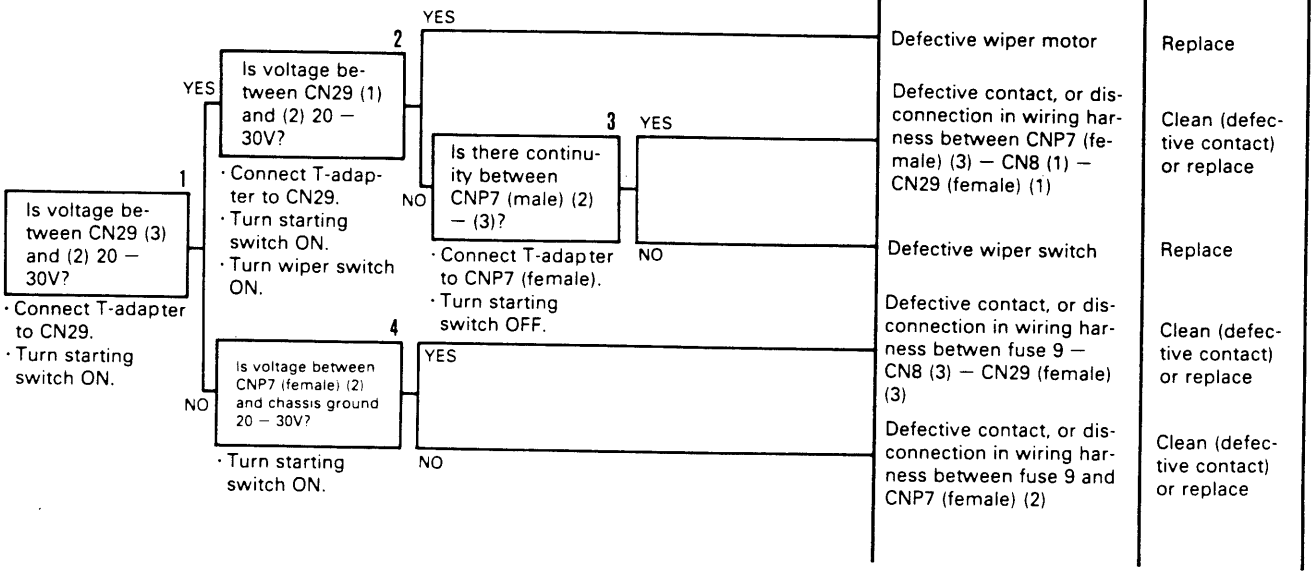
M-16 Wipers do not work

★ Before connecting the T-adapter or disconnecting the connector, always turn the starting switch OFF.
★ When measuring the voltage connect the T-adapter to both male and female, and when measuring resistance (continuity) connect to the connector specified in ( ).
★ After checking, connect the disconnected connectors again immediately unless otherwise specified.
★ Check that the fuse 9 is not blown.
★ Operation of radio and horn are normal.



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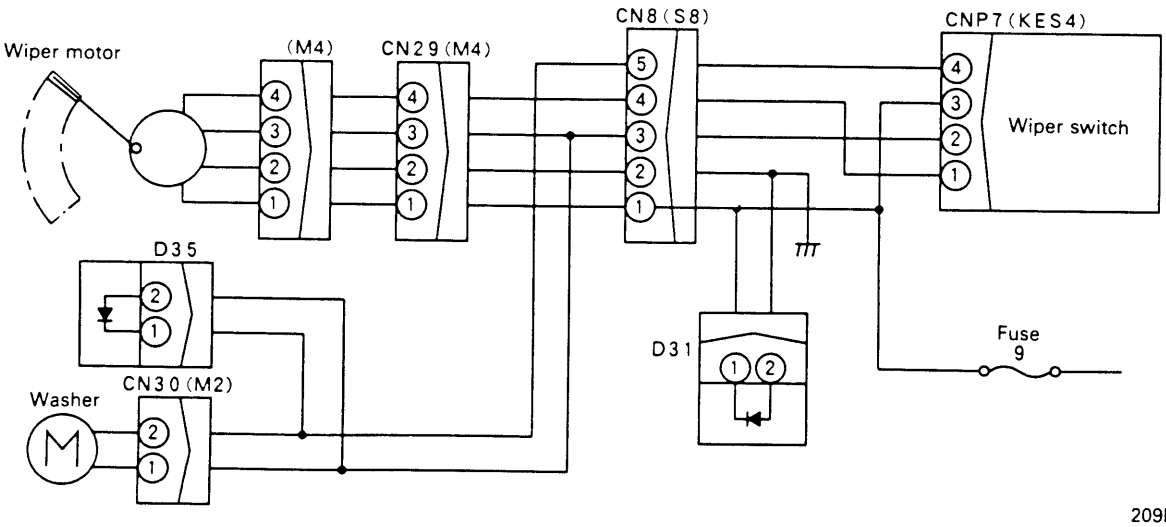

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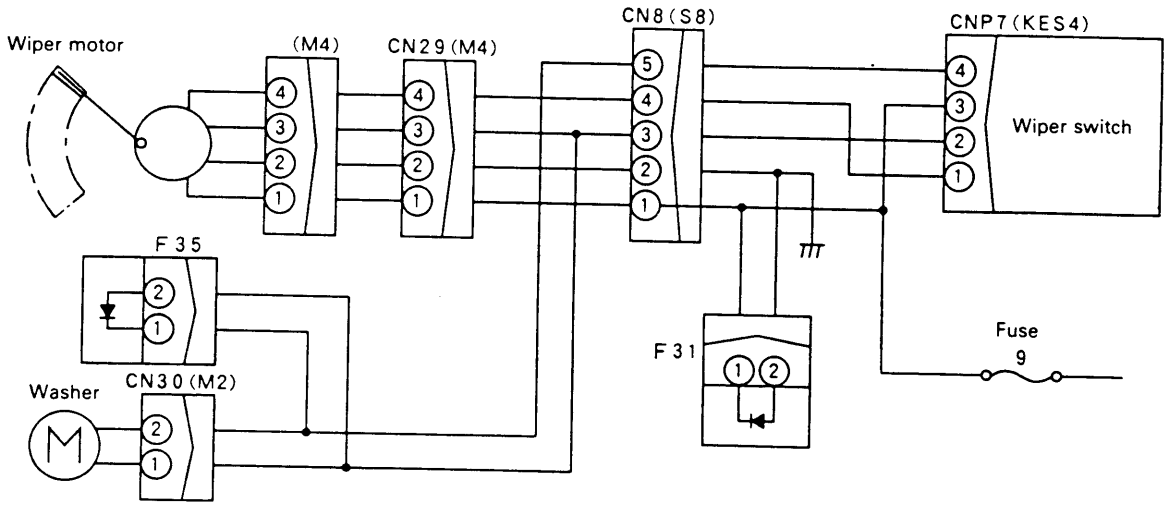
REGULATION OF EC INCLUSION



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30 DISASSEMBLY AND ASSEMBLY

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METHOD OF USING MANUAL

1. When removing or installing unit assemblies

(1) When removing or installing a unit assembly, the order of work and techniques used are given for the removal operation; the order of work for the installation operation is not given.

(2) Any special techniques applying only to the installation procedure are marked ※1, and the same mark is placed after the relevant step in the removal procedure to indicate which step in the installation procedure it applies to.

(Example)

REMOVAL OF ○ ○ ○ ASSEMBLY ..... Title of operation

⚠ ..... Precautions related to safety when carrying out the operation

1. XXXX (1) ..... Step in operation

★ ..... Technique or important point to remember when removing XXX (1).

2. △ △ △ (2): ..... ※1 Indicates that a technique is listed for use during installation

3. □ □ □ □ assembly (3)

 ..... See Lubricant and Coolant Table

INSTALLATION OF ○ ○ ○ ASSEMBLY .... Title of operation

• Carry out installation in the reverse order to removal.

※1 ..... Technique used during installation

★ ..... Technique or important point to remember when installing △ △ △ (2)

• Adding water, oil ..... Step in operation

★ ..... Point to remember when adding water or oil

 ..... Quantity of filling oil and water.

2. General precautions when carrying out installation or removal (disassembly or assembly) of units are given together as PRECAUTIONS WHEN CARRYING OUT OPERATION, so be sure to follow these precautions when carrying out the operation.

3. Listing of special tools

(1) For details of the description, part number, and quantity of any tools (**A**1, etc.) that appear in the operation procedure, see the SPECIAL TOOLS LIST given in this manual.

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PRECAUTIONS WHEN CARRYING OUT OPERATION

[When carrying out removal or installation (disassembly or assembly) of units, be sure to follow the general precautions given below when carrying out the operation.]

1. Precautions when carrying out removal work

- Lower the work equipment completely to the ground.
- If the coolant contains antifreeze, dispose of it correctly.
- After disconnecting hoses or tubes, cover them or fit blind plugs to prevent dirt or dust from entering.
- When draining oil, prepare a container of adequate size to catch the oil.
- Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.
- To prevent any excessive force from being applied to the wiring, always hold the connectors when disconnecting the connectors.
- Fit wires and hoses with tags to show their installation position to prevent any mistake when installing.
- Check the number and thickness of the shims, and keep in a safe place.
- When raising components, be sure to use lifting equipment of ample strength.
- When using forcing screws to remove any components, tighten the forcing screws alternately.
- Before removing any unit, clean the surrounding area and fit a cover to prevent any dust or dirt from entering after removal.
- When removing hydraulic equipment, first release the remaining pressure inside the hydraulic tank and the hydraulic piping.

★ **Precautions when handling piping during disassembling**

Fit the following blind plugs into the piping after disconnecting it during disassembly operations.

1) Hoses and tubes using sleeve nuts

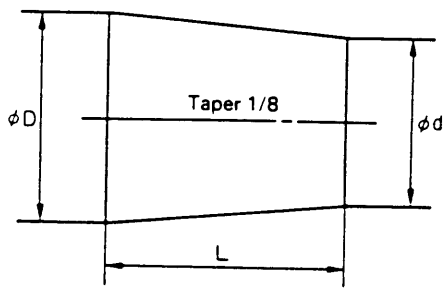
Nominal number	Plug (nut end)	Sleeve nut (elbow end) Use the two items below as a set
02	07376-50210	07221-20210 (Nut), 07222-00210(Plug)
03	07376-50315	07221-20315 (Nut), 07222-00312(Plug)
04	07376-50422	07221-20422 (Nut), 07222-00414(Plug)
05	07376-50522	07221-20522 (Nut), 07222-00515(Plug)
06	07376-50628	07221-20628 (Nut), 07222-00616(Plug)
10	07376-51034	07221-21034 (Nut), 07222-01018(Plug)
12	07376-51234	07221-21234 (Nut), 07222-01219(Plug)

2) Split flange type hoses and tubes

Nominal number	Flange (hose end)	Sleeve head (tube end)	Split flage
04	07379-00400	07378-10400	07371-30400
05	07379-00500	07378-10500	07371-30500

3) If the part is not under hydraulic pressure, the following corks can be used.

Nominal number	Part number	Dimensions		
		D	d	L
06	07049-00608	6	5	8
08	07049-00811	8	6.5	11
10	07049-01012	10	8.5	12
12	07049-01215	12	10	15
14	07049-01418	14	11.5	18
16	07049-01620	16	13.5	20
18	07049-01822	18	15	22
20	07049-02025	20	17	25
22	07049-02228	22	18.5	28
24	07049-02430	24	20	30
27	07049-02734	27	22.5	34



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2. Precautions for installation operations

- Tighten all bolts and nuts (sleeve nuts) to the specified (KES) torque.
- Install the hoses without twisting or interference.
- Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
- Bend the cotter pin or lock plate securely.
- When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2 – 3 drops of adhesive.
- When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
- Clean all parts, and correct any damage, dents, burrs, or rust.
- Coat rotating parts and sliding parts with engine oil.
- When press fitting parts, coat the surface with antifriction compound (LM-P).
- After 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).
- When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
- When using eyebolts, check that there is no deformation or deterioration, and screw them in fully.
- When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.

★ When operating the hydraulic cylinders for the first time after repairing and reassembling the hydraulic cylinders, pumps, or other hydraulic equipment or piping, always bleed the air from the hydraulic cylinders as follows:

(Note: If the hydraulic cylinder has been replaced, carry out this procedure before assembling the rod to the work equipment.)

1. Start the engine and run at low idling.
2. Operate the control lever and actuate the hydraulic cylinder 4 – 5 times, stopping 100 mm 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.

★ Carry out the same operation on machines that have been in storage for a long time after completion of repairs.

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3. Precautions when completing the operations

- If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the water level again.
- If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- If the piping or hydraulic equipment, such as hydraulic cylinders, pumps, or motors, have been removed for repair, always bleed the air from the system after reassembling the parts.
  ★ For details, see TESTING AND ADJUSTING, Bleeding air.
- Add the specified amount of grease (molybdenum disulphide grease) to the work equipment related parts.

SPECIAL TOOL LIST

Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks
Removal, installation of cylinder head	A		790-331-1110	Wrench	1	Angle tightening torque
Removal, installation of travel motor assembly	B		791-475-5170	Guide bolt	2	
Disassembly, assembly of final drive assembly	C	1	790-201-2830	Spacer	1	Pulling out shaft of carrier (large)
			790-201-2630	Plate	1	
		2	790-201-2710	Spacer	1	Pulling out shaft of carrier (small)
			790-201-2610	Plate	1	
		3	790-201-2760	Spacer	1	Press fitting of outer race of carrier (large)
			790-201-2660	Plate	1	
		4	796-627-1060	Spacer	1	
		5	790-201-2730	Spacer	1	Press fitting of outer race of carrier (small)
			790-201-2630	Plate	1	
		6	796-627-1030	Push tool	1	Press fitting of hub outer race
		7	796-627-1050	Installer	1	Press fitting of floating seal
		8	796-627-1040	Plate	1	Adjustment of clearance of bearing
Disassembly, assembly of recoil spring assembly	D	1	796-630-1110	Plate	1	
		2	791-685-8500	Compressor	1	
			01010-51640	Bolt	2	
			796-630-1120	Spacer	1	
			790-101-4300	Cylinder (150 ton)	1	
			790-101-1102	Pump	1	
Disassembly, assembly of track shoe assmbly	E		791-680-9501	Remover & Installer	1	Removal, press fitting of master pin
			790-101-1102	Pump	1	
			790-101-4300	Cylinder (150 ton)	1	
Removal, installation of carrier roller assembly	F		790-401-1700	Lifting tool	1	
			790-401-1760	Adapter	1	
Removal, installation of track roller assembly	G		790-401-1700	Lifting tool	1	
			790-401-1760	Adapter	1	

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Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks
Disassembly, assembly of carrier roller assembly	H	1	791-630-1270	Wrench	1	Removal, installation of round nut
		2	791-515-1520	Installer	1	Installatuion of floating seal
		3	791-630-1280	Push tool	1	Press fitting of collar
		4	791-601-1000	Oil pump	1	Filling with oil and checking seal
Disassembly, assembly of track roller assembly	I	1	790-201-2670	Plate	1	Press fitting of bushing
		2	791-580-1520	Installer	1	Installation of floating seal
		3	791-601-1000	Oil pump	1	Filling with oil and checking seal
Disassembly, assembly of idler assembly	J	1	796-675-1510	Installer	1	Installation of floating seal
		2	790-101-2680	Plate	1	Press fitting of bushing
		3	791-601-1000	Oil pump	1	Filling with oil and checking seal
Disassembly, assembly of hydraulic cylinder assembly	K	1	790-720-1000	Expander	1	
		2	796-720-1680	Ring	1	Installation of piston ring (Piston O.D.: 140 mm)
			07281-01589	Clamp	1	
		3	796-720-1690	Ring	1	Installation of piston ring (Piston O.D.: 180 mm)
			07281-01919	Clamp	1	
		4	796-720-1690	Ring	1	Installation of piston ring (Piston O.D.: 200 mm)
			07281-02169	Clamp	1	
		5	796-720-1720	Ring	1	Installation of piston ring (Piston O.D.: 225 mm)
			07281-02429	Clamp	1	
		6	790-201-1840	Push tool	1	Press fitting of coil bushing (Piston rod O.D.: 90 mm)
			790-101-5021	Grip	1	
			01010-50816	Bolt	1	
		7	791-863-1130	Push tool	1	Press fitting of coil bushing (Piston rod O.D.: 120 mm)
			790-101-5221	Grip	1	
			01010-51225	Bolt	1	
		8	796-663-1110	Push tool	1	Press fitting of coil bushing (Piston rod O.D.: 130 mm)
			790-101-5421	Grip	1	
			01010-51240	Bolt		

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Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks
Disassembly, assembly of hydraulic cylinder assembly	K	9	791-863-1120	Push tool	1	Press fitting of coil bushing (Piston rod O.D.: 140 mm)
			790-101-5421	Grip	1	
			01010-51240	Bolt	1	
		10	792-103-4102	Push tool	1	Press fitting of coil bushing (Piston rod O.D.: 160 mm)
			790-101-5421	Grip	1	
			01010-51240	Bolt	1	
		11	790-201-1650	Plate	1	Installation of dust seal (Piston rod O.D.: 90 mm)
			790-101-5021	Grip	1	
			01010-50816	Bolt	1	
		12	790-201-1680	Plate	1	Installation of dust seal (Piston rod O.D.: 120 mm)
			790-101-5021	Grip	1	
			01010-50816	Bolt	1	
		13	790-445-4230	Push tool	1	Installation of dust seal (Piston rod O.D.: 130 mm)
			790-101-5421	Grip	1	
			01010-51240	Bolt	1	
		14	790-201-1690	Push tool	1	Installation of dust seal (Piston rod O.D.: 140 mm)
			790-101-5021	Grip	1	
			01010-50816	Bolt	1	
		15	792-103-4102	Push tool	1	Installation of dust seal (Piston rod O.D.: 160 mm)
			792-103-0400	Grip	1	

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Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks	
Removal, installation of hydraulic pump, control valve	L		796-770-1311	Oil stopper	1		
Removal, installation of work equipment, hydraulic cylinder	M		790-445-4100	Remover	1		
			790-101-4200	Puller (30 ton)	1		
			790-101-1102	Pump	1		
Disassembly, assembly of hydraulic pump assembly	O	1	790-501-5200	Repair stand	1		
			790-901-2110	Bracket	1		
			790-901-2150	Plate	1		
		2	790-345-1020	Plate	1	For rear pump	
		3	796-730-2120	Screwdriver	1	Removal, installation of shoe retainer mounting screw	
			796-720-2220	Socket	1		
			795-630-1803	Torque wrench set	1		
		4	796-720-2210	Screwdriver	1	Removal and installation of impeller	
			796-720-2220	Socket	1		
			795-630-1803	Torque wrench set	1		
		5	791-746-2270	Hook	1	Measurement of shoe clearance	
		6	790-445-2800	Gauge (Max. angle side)	1	Adjustment of stroke of servo piston	
		7	790-445-2900	Gauge (Min. angle side)	1		
		8	796-720-3800	Wrench	1	Measurement of rotating torque	
			795-630-1803	Torque wrench set	1		
		9	796-720-3520	Cap	1	For front	Adjustment of end play of drive shaft
			790-345-1050	Cap	1	For rear	
Disassembly, assembly of swing pump assembly	P	1	790-501-5200	Repair stand	1		
			790-901-2110	Bracket	1		
		2	796-720-2250	Screwdriver	1	Removal, installation of shoe retainer mounting screw	
			796-720-2220	Socket	1		
			795-630-1803	Torque wrench set	1		

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Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks
Disassembly, assembly of swing pump assembly	P	3	796-730-2120	Screwdriver	1	Removal, installation of cam plate mounting screw
			796-720-2220	Socket	1	
			795-630-1803	Torque wrench set	1	
		4	791-746-2270	Hook	1	Measurement of shoe clearance
		5	790-445-2500	Gauge	1	Adjustment of stroke of servo piston for maximum swash plate angle
		6	790-445-3100	Gauge	1	Adjustment of stroke of servo piston for minimum swash plate angle
		7	796-720-3800	Wrench	1	Adjustment of rotating torque of drive shaft
			795-630-1803	Torque wrench set	1	
		8	790-445-2900	Cap	1	Adjustment of end play of drive shaft
Disassembly, assembly of hydraulic pump assembly	Q	1	790-501-5200	Repair stand	1	
			790-901-2110	Bracket	1	
			790-901-1470	Plate	1	
		2	796-730-2120	Screwdriver	1	Removal, installation of retainer mounting screw
			796-720-2220	Socket	1	
		3	790-201-2840	Push tool	1	Press fitting of main bearing and sub-bearing
		4	796-766-1110	Guide	1	Assembly of drive shaft
		5	790-201-2860	Push tool	1	Press fitting of sub-bearing outer race
		6	796-720-3800	Wrench	1	Measurement of rotating torque
			795-630-1803	Torque wrench set	1	
		7	799-301-1500	Oil leak checker	1	Removal of brake piston Checking of brake sealing
Disassembly, assembly of travel motor assembly	R	1	790-445-5930	Bolt	1	Removal of valve plate
		2	790-445-5960	Bolt	1	Assembly of rod, piston, cylinder portion
		3	790-445-5980	Guide bar	13	Assembly of cylinder assembly
		4	790-445-5910	Push tool	1	Press fitting of needle bearing
		5	790-445-5970	Spacer	1	Shim adjustment for taper roller bearing
		6	790-445-5920	Push tool	1	Press fitting of oil seal

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Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks
Track link remover	KD	1	791-680-9580	Adapter	1	
			791-680-9590	Guide	1	
			01010-52760	Bolt	2	
			01010-51440	Bolt	2	
		2	790-101-1102	Pump	1	
			790-101-4300	Cylinder	1	150 tons
		3	791-685-9510	Frame	1	
			791-685-9520	Frame	1	
			791-685-9530	Rod	1	
			791-685-9550	Nut	1	
			791-685-9560	Bolt	4	
			791-680-9570	Adapter	1	
			01010-51030	Bolt	1	
			04530-12030	Eye bolt	1	
			790-101-1102	Pump	1	
			790-101-4300	Cylinder	1	150 tons
		4	791-685-9540	Rod	1	
			791-685-9550	Nut	3	
		5	791-685-9510	Frame	1	
			791-685-9520	Frame	1	
			791-685-9530	Rod	1	
			791-685-9550	Nut	1	
			791-685-9560	Bolt	4	
			791-126-0150	Adapter	1	
			791-680-5520	Guide	1	
			791-126-0140	Pusher	1	
			791-680-9570	Adapter	1	
			01010-51030	Bolt	1	
			04530-12030	Eye bolt	1	
			791-685-9620	Extension	1	
			790-101-1102	Pump	1	
			790-101-4300	Cylinder	1	150 tons
		6	790-101-1102	Pump	1	
			790-101-4200	Puller	1	30 tons

Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks
Track link installer	KE	1	791-680-5542	Adapter	1	Press fitting of regular pin
			791-632-1110	Adapter	1	Press fitting of bushing
		2	791-680-5580	Guide	1	
		3	791-685-9510	Frame	1	
			791-685-9520	Frame	1	
			791-685-9530	Rod	1	
			791-685-9540	Rod	1	
			791-685-9550	Nut	3	
			791-685-9560	Bolt	4	
			791-126-0150	Adapter	1	
			01010-51030	Bolt	1	
			791-685-9620	Extension	1	
			791-680-5542	Adapter	1	
			791-680-5560	Guide	1	
			790-101-1102	Pump	1	
			790-101-4300	Cylinder	1	150 tons
		4	791-685-9510	Frame	1	
			791-685-9520	Frame	1	
			791-685-9530	Rod	1	
			791-685-9540	Rod	1	
			791-685-9550	Nut	3	
			791-685-9560	Bolt	4	
			791-126-0150	Adapter	1	
			01010-51030	Bolt	1	
			791-685-9620	Extension	1	
			791-680-5560	Guide	1	
			791-632-1110	Adapter	1	
			791-680-9630	Adapter	1	
			790-101-1102	Pump	1	
			790-101-4300	Cylinder	1	150 tons
		5	791-680-1520	Guide	1	
		6	791-685-9510	Frame	1	
			791-685-9520	Frame	1	
			791-685-9530	Rod	1	

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Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks
Track link installer	KE	6	791-685-9540	Rod	1	
			791-685-9550	Nut	3	
			791-685-9560	Bolt	4	
			791-126-0150	Adapter	1	
			791-680-5560	Guide	1	
			791-680-9570	Adapter	1	
			01010-51030	Bolt	1	
			791-680-1520	Guide	1	
			790-101-1102	Pump	1	
			790-101-4300	Cylinder	1	150 tons
		7	790-101-1102	Pump	1	
			790-101-4200	Puller	1	30 tons
Track link remover & installer	KF		791-680-9501	Remover & installer	1	KIT
			790-101-1102	Pump	1	
			790-101-4200	Puller	1	30 tons
			790-101-4300	Cylinder	1	150 tons

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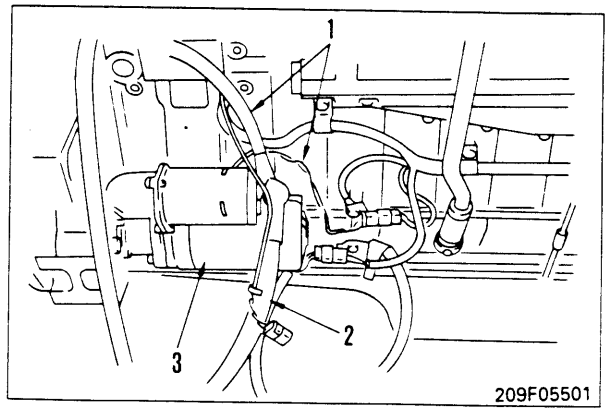
REMOVAL OF STARTING MOTOR ASSEMBLY

⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Disconnect wiring (1) and (2).
2. Remove starting motor assembly (3). ※ 1



INSTALLATION OF STARTING MOTOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

★ Be careful not to damage the gasket when installing.

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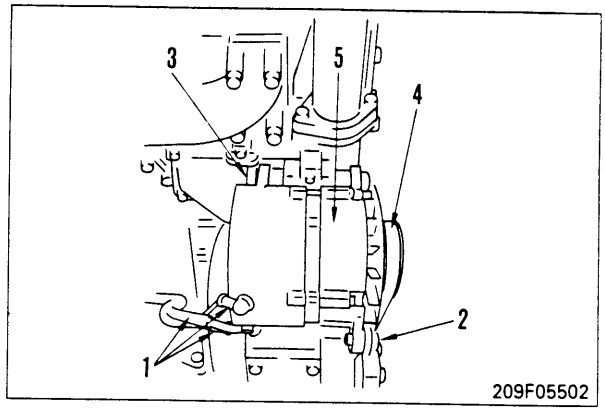
REMOVAL OF ALTERNATOR ASSEMBLY

⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove wiring (1).
2. Loosen adjustment bolt (2).
3. Loosen mount bolt and nut (3).
4. Remove belt (4).
5. Remove bolts (2) and (3).
6. Remove alternator assembly (5). ※1



INSTALLATION OF ALTERNATOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

★ Adjust the alternator belt tension.
For details, see TESTING AND ADJUSTING, Adjusting belt tension.

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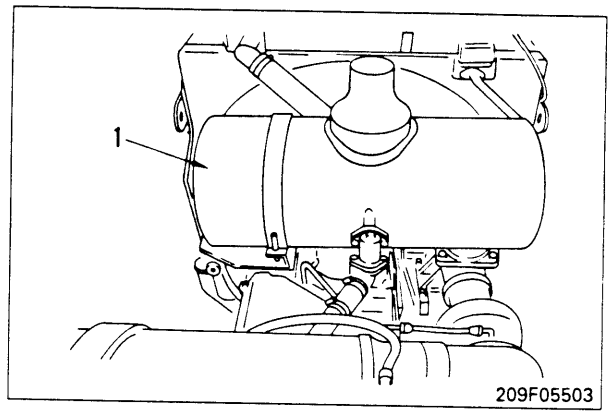
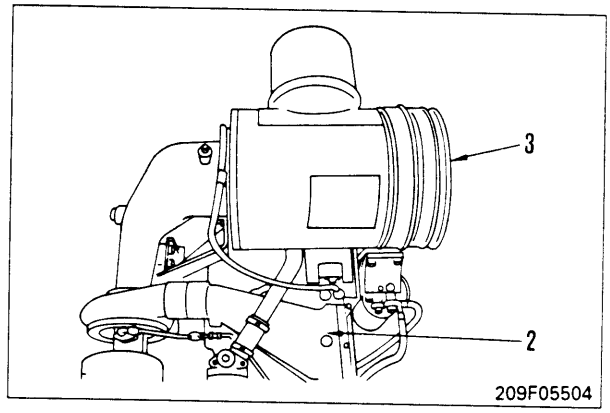
REMOVAL OF NOZZLE HOLDER ASSEMBLY

1. Remove muffler assembly (1) when removing No. 1, No. 2, and No. 3 nozzle holder assemblies.



2. Remove intake connector (2) when removing No. 4 nozzle holder assembly.

3. Remove air cleaner assembly (3) when removing No. 5 and No. 6 nozzle holder assemblies.



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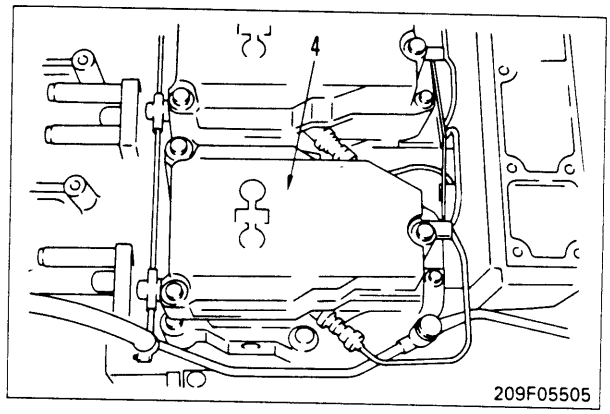
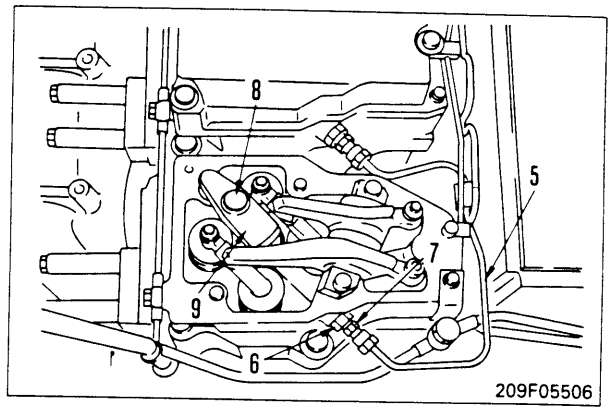
4. Remove head cover (4). ※ 1



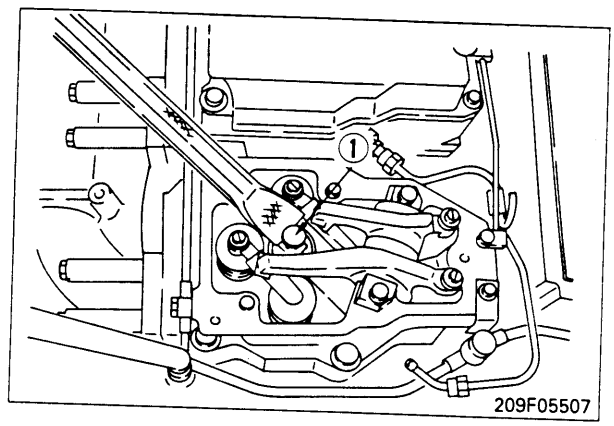
5. Disconnect injection tube (5)

6. Loosen locknut (6), and remove connection (7). ※ 2

7. Remove bolt (8) and holder (9).



8. Remove nozzle holder assembly (10).
   - ★ Screw bolt ① into the nozzle holder fully, then using a bar, lever bolt ① to remove nozzle holder assembly (10).
   - ★ When removing the nozzle holder assembly, clean the surrounding area and be careful not to let any dirt or dust get in.
   - ★ Check that the gasket is fitted to the tip of the nozzle holder.



INSTALLATION OF NOZZLE HOLDER ASSEMBLY

- Carry out installation in the reverse order to removal.
- ★ Check that there is no dirt or dust inside the nozzle holder sleeve.
- ★ Check that the gasket is fitted to the tip of the nozzle holder.

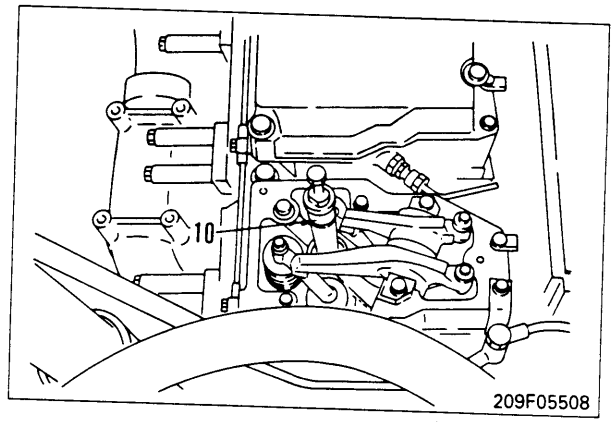
※ 1

kgm Mounting bolt: 0.4 ± 0.1 kgm

※ 2

kgm Connection: 3.8 ± 0.3 kgm

kgm Lock nut: 6.5 ± 0.3 kgm



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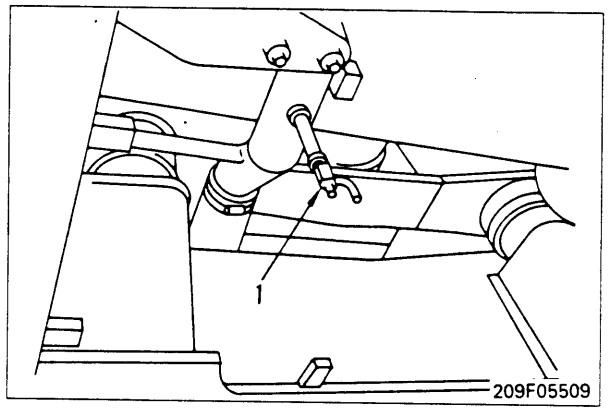
REMOVAL OF ENGINE OIL COOLER ASSEMBLY

1. Drain cooling water

   ★ Loosen the radiator drain valve and drain valve (1) of the oil cooler connector pipe, and drain the cooling water.
   ★ If the coolant contains antifreeze, dispose of it correctly.

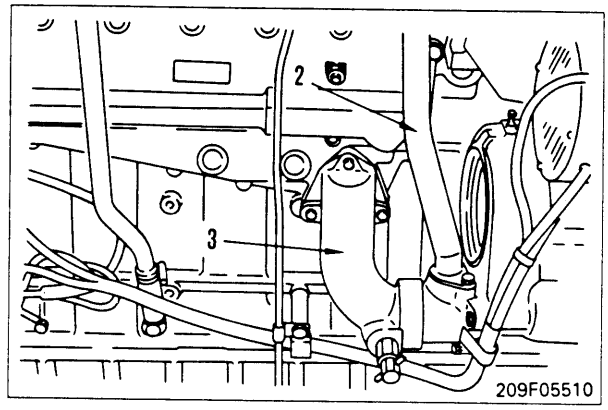


2. Remove pipes (2) and (3).

3. Remove tube (4).

4. Remove tube (5).

5. Remove engine oil cooler assembly (6).
   ★ If the engine oil cooler assembly is stuck and difficult to remove, insert a wedge in the joint between the cylinder block and oil cooler.



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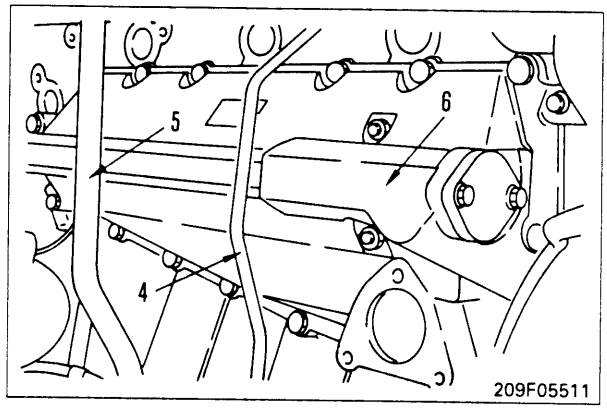
INSTALLATION OF ENGINE OIL COOLER ASSEMBLY

- Carry out installation in the reverse order to removal.

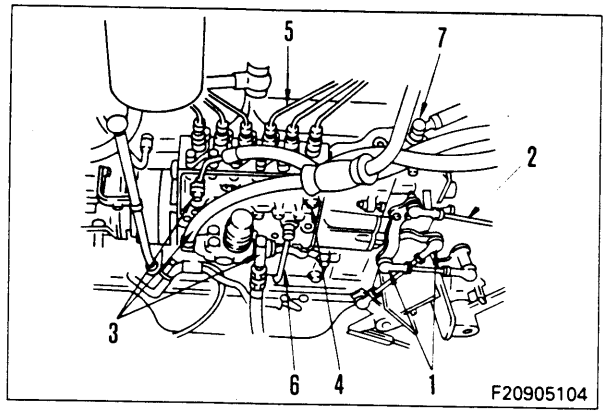
★ Run the engine to circulate the water through the system.
Then check the water level again.

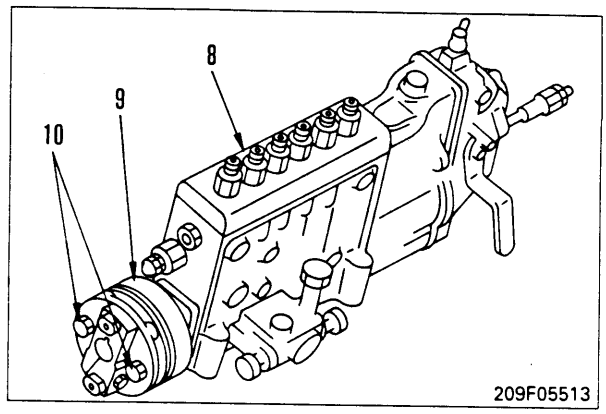


REMOVAL OF FUEL INJECTION PUMP ASSEMBLY

- Close the fuel supply valve.

1. Remove fuel injection pump coupling cover.
2. Disconnect rod (1).
3. Disconnect rod (2).
   ★ For machine equipped with 3-stage mode selector OLSS and auto-deceleration
4. Disconnect fuel hoses (3) and (4).
5. Disconnect 6 fuel injection tubes (5). ※ 1
6. Disconnect lubrication tubes (6) and (7).
7. Remove fuel injection pump assembly (8). ※ 2
   ★ 1) Align injection timing of engine damper.
   2) Align position of lines on weight (9) and injection pump body.
   3) Remove laminated coupling bolt (10).
   4) Remove fuel injection pump assembly (8).





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INSTALLATION OF FUEL INJECTION PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

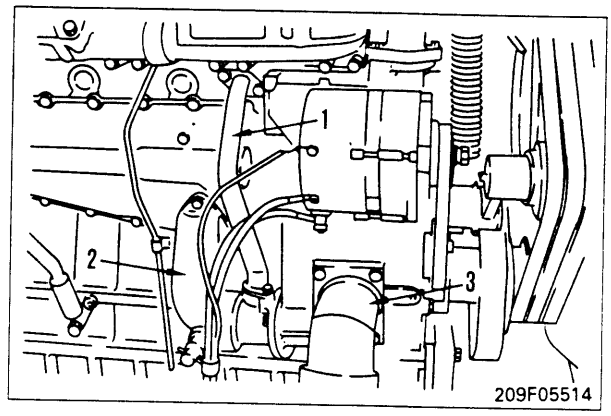
kgm Sleeve nut: 2.4 ± 0.1 kgm

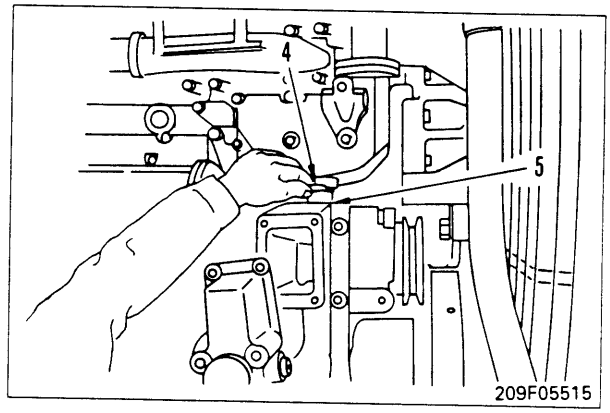
※ 2

★ Adjust the fuel injection timing.
For details, see TESTING AND ADJUSTING.

REMOVAL OF WATER PUMP ASSEMBLY

1. Remove alternator assembly.
   - For details, see REMOVAL OF ALTERNATOR ASSEMBLY.
2. Drain cooling water.
3. Remove connector pipes (1) and (2).
4. Disconnect connector (3).
5. Pull out spring (4).
6. Disconnect tube (5).
   ★ Lever tube (5) up with a bar, and disconnect it from the water pump.
7. Remove pulley (6).
8. Remove water pump assembly (7).





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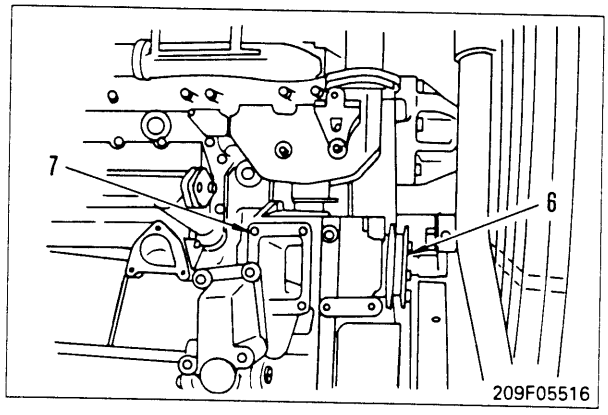
INSTALLATION OF WATER PUMP ASSEMBLY

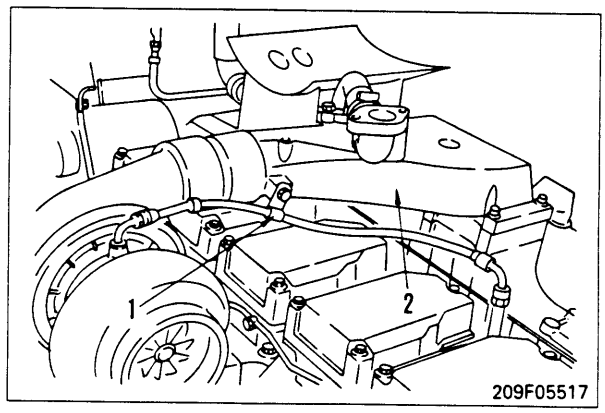
- Carry out installation in the reverse order to removal.
- Refilling with water
  ★ Add water to the specified level from filler port, and run the engine to circulate the water through the system. Then check the water level again.

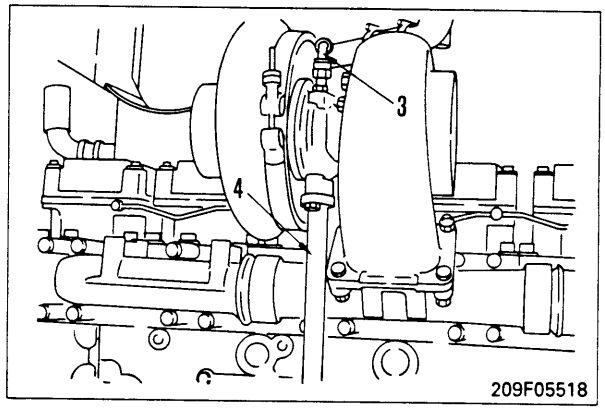


REMOVAL OF TURBOCHARGER ASSEMBLY

★ Remove the muffler assembly and air cleaner assembly.
For details, see REMOVAL OF CYLINDER HEAD ASSEMBLY.

1. Rémove clamp (1) and intake connector (2).
2. Disconnect hose (3) and drain pipe (4).
3. Remove turbocharger assembly (5). ※ 1





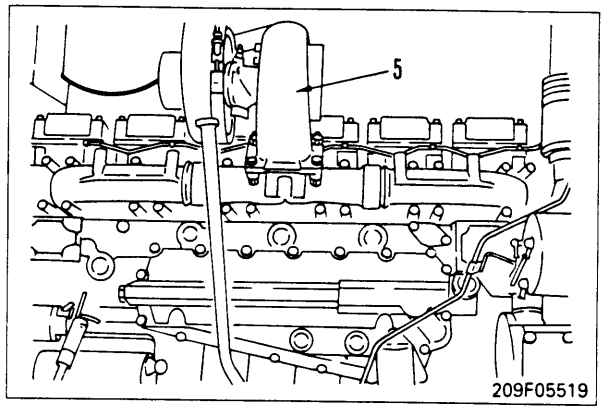
INSTALLATION OF TURBOCHARGER ASSEMBLY

• Carry out installation in the reverse order to removal.

※ 1

★ Fit the gasket with the UP mark at the top.

kgm Mounting bolt: 6.75 ± 0.75 kgm



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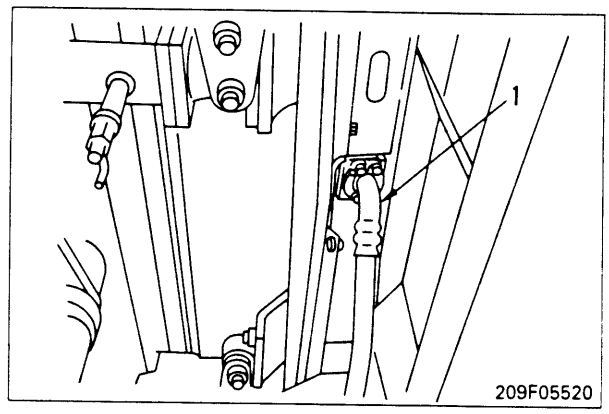
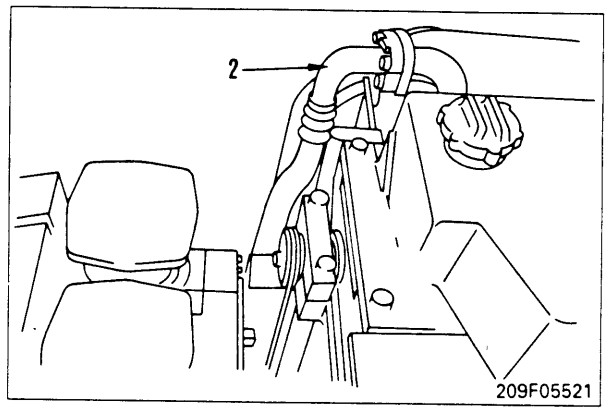
REMOVAL OF HYDRAULIC COOLER ASSEMBLY

Lower the work equipment to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Disconnect hose (1).
   ★ When the hose is disconnected, the oil inside the cooler will flow out, so prepare a container to catch it.
2. Disconnect hose (2).
3. Remove left and right clamps (3).
   ★ Check the number and thickness of the shims assembled in the clamps, and keep in a safe place.
4. Lift off hydraulic cooler assembly (4).
   kg Hydraulic cooler assembly: 115 kg





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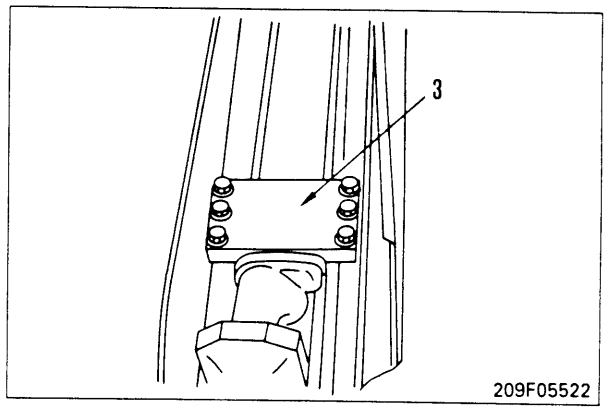
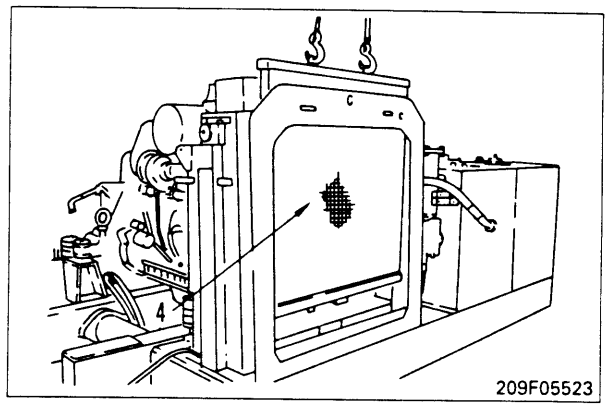
INSTALLATION OF HYDRAULIC COOLER ASSEMBLY

- Carry out installation in the reverse order to removal.
- Refilling with oil
  Run the engine to circulate the oil through the system.
  Then check the oil level in the hydraulic tank again.

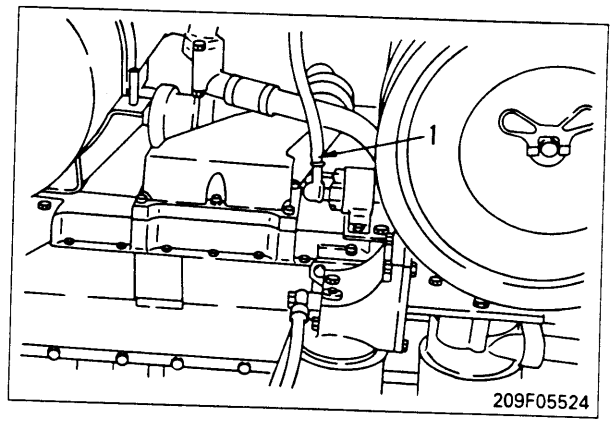


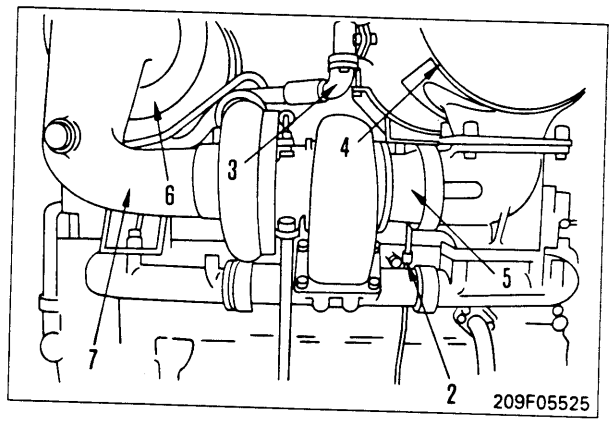


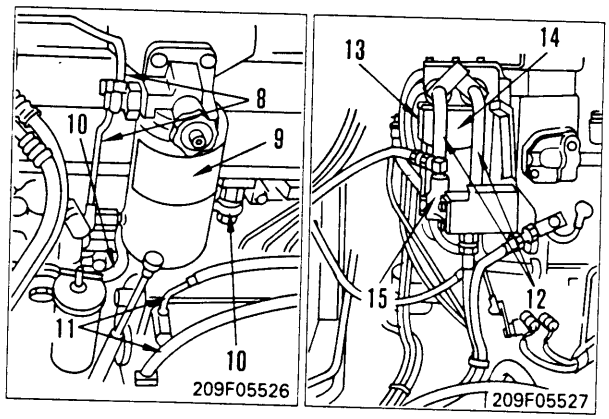
REMOVAL OF CYLINDER HEAD ASSEMBLY

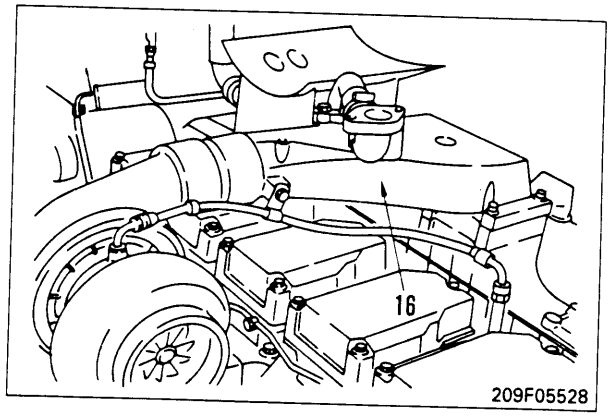
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Drain cooling water.
2. Disconnect wiring (1).
3. Remove tube (2).
4. Remove pipe (3).
5. Remove muffler assembly (4) and connector pipe (5).
   ★ Remove the muffler assembly together with the connector pipe.
6. Remove air cleaner assembly (6) and connector (7).
   ★ Remove the air cleaner assembly together with the connector.
7. Remove tube (8) and corrosion resistor assembly (9).
8. Remove tube (10).
9. Disconnect hose (11).
10. Remove tube (12).
11. Remove fuel filter assembly (13) and oil filter assembly (14).
    ★ Remove together with the bracket.
12. Remove fuel strainer assembly (15).
    ★ Disconnect together with the bracket at the engine end.
13. Remove connector (16). ※1









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14. Remove tube (17).

15. Remove tube (18).

16. Remove after-cooler assembly (19). ※ 2
    ★ Sling the intake manifold assembly, remove mounting bolts (20), then remove the after-cooler assembly.

17. Remove fuel injection tube (21). ※ 3

18. Remove spill tube (22). ※ 4

19. Remove hose (23).

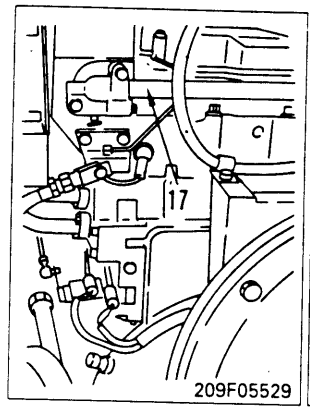
20. Remove tube (24).

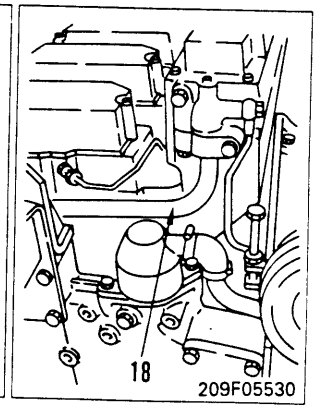
21. Remove turbocharger and exhaust manifold assembly (25). ※ 5
    ★ Sling the turbocharger and exhaust manifold assembly, remove mounting bolts (26), then remove the turbocharger and exhaust manifold assembly.

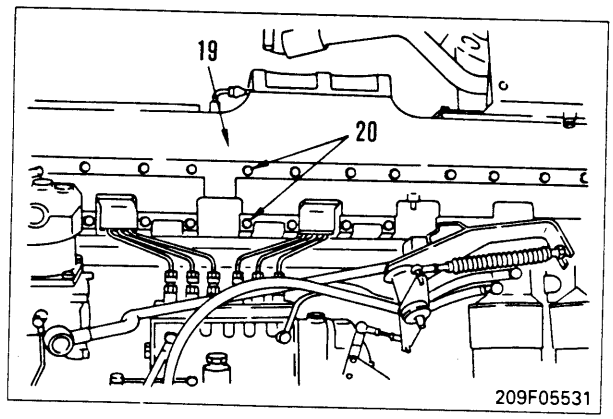
22. Remove tube (27). ※ 6

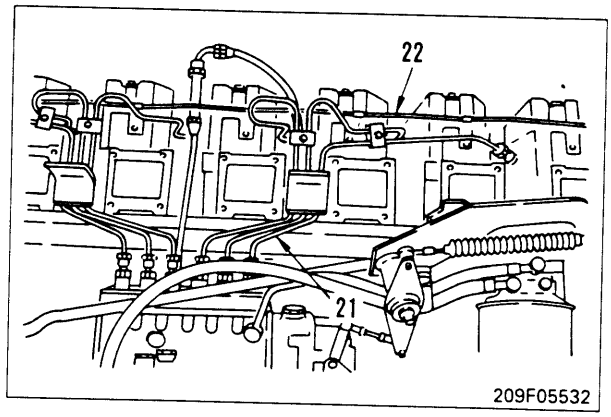
23. Remove head cover. ※ 7

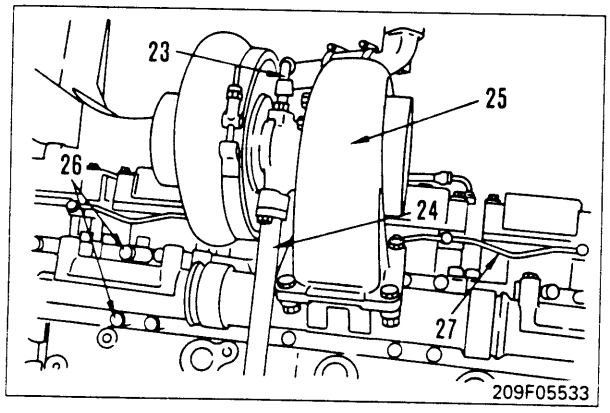
24. Remove rocker lever assembly (28). ※ 8
    ★ Remove mounting bolts (29), then remove the rocker lever assembly.
    ★ To prevent pressure on the push rod when installing the rocker lever, loosen the locknut and turn the adjustment screw back 2 to 3 turns before removing the rocker arm assembly.

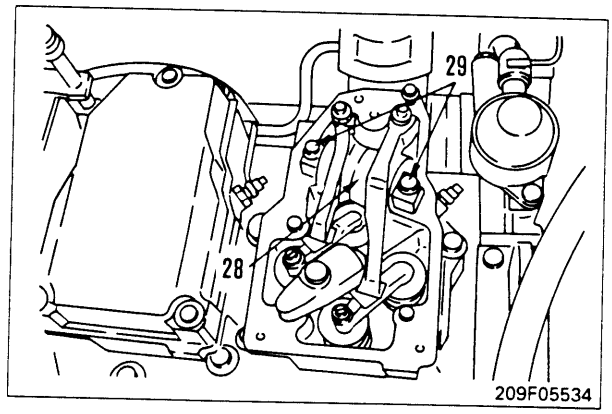












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25. Remove holder (30). ※9
    ★ Remove mounting bolts (31), then remove the holder.

26. Remove connection (32). ※10
    ★ Loosen the locknut, then remove the connection.

27. Remove nozzle holder assembly (33). ※11
    ★ Screw bolt ① into the nozzle holder fully, then using a bar, lever bolt ① to remove the nozzle holder assembly (33).
    ★ Be careful not to hit the tip of the nozzle holder assembly.
    ★ When removing the nozzle holder assembly, clean the surrounding area and be careful not to let any dirt or dust get in.
    ★ Check that the gasket is fitted to the tip of the nozzle holder.

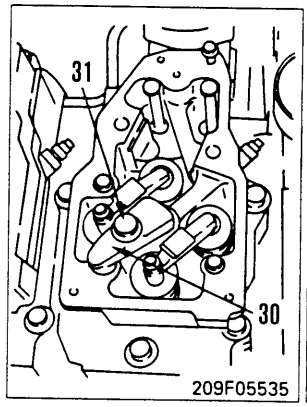
28. Remove push rod (34). ※12

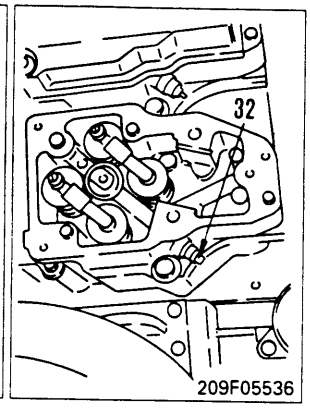
29. Remove rocker housing (35). ※13
    ★ Remove mounting bolts (36), then remove the rocker housing.

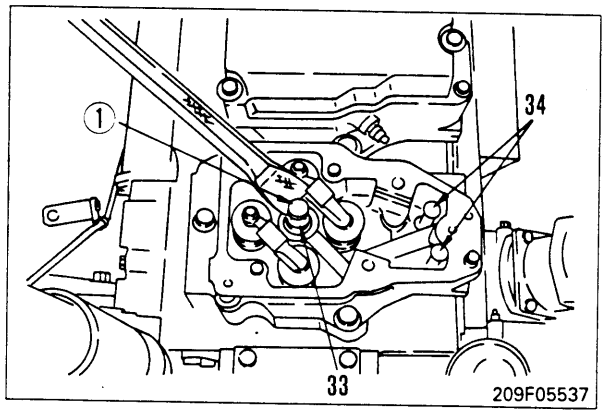
30. Remove cross head (37). ※14

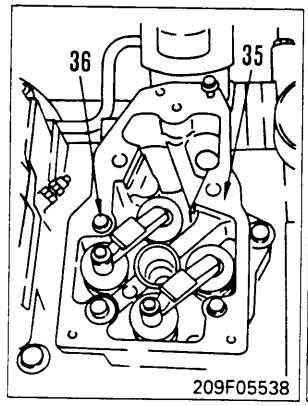
31. Remove head assembly (38). ※15
    ★ Remove mounting bolts (39), then remove the head assembly.

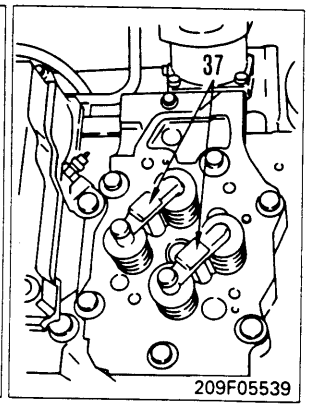
32. Remove cylinder head gasket (40). ※16

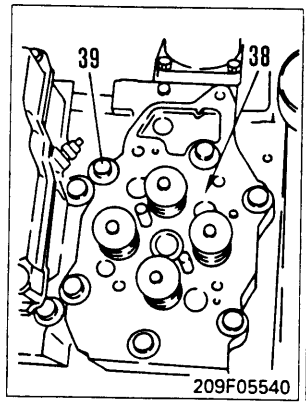


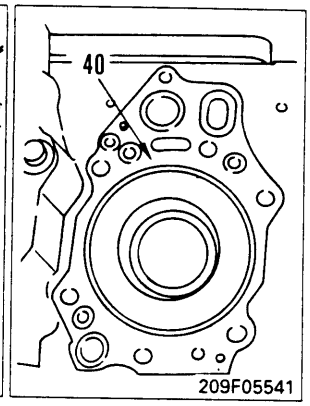












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INSTALLATION OF CYLINDER HEAD ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

★ After installing the intake connector, clamp the turbocharger oil filler hose to the connector to secure it.

※ 2

★ Tighten the mounting bolts of the after-cooler uniformly in turn, starting from the inside and working to the outside.

kgm Mounting bolt: 6.75 ± 0.75 kgm

※ 3

kgm Sleeve nut: 2.4 ± 0.1 kgm

※ 4

kgm Joint bolt: 1.15 ± 0.15 kgm

※ 5

★ Tighten the mounting bolts of the exhaust manifold uniformly in turn, starting from the inside and working to the outside.

kgm Mounting bolt: 6.75 ± 0.75 kgm

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※ 6

kgm Joint bolt: 1.2 ± 0.1 kgm

※ 7

kgm Mounting bolt: 0.5 ± 0.1 kgm

※ 8

★ Check that the ball of the adjustment screw is fitted securely in the socket of the push rod.

※ 9

kgm Mounting bolt: 10 ± 0.5 kgm

※10

kgm Connection: 3.8 ± 0.3 kgm

kgm Lock nut: 6.5 ± 0.5 kgm

※11

★ Check that there is no dirt or dust inside the nozzle holder sleeve.

★ Check that the copper gasket is fitted to the tip of the nozzle holder.

※12

★ Check that the push rod is fitted securely in the cam follower.

※13

kgm Mounting bolt: 10 ± 0.5 kgm

※14

★ Adjust the cross head as follows.
1) Loosen the locknut, and turn back the adjustment screw.
2) Press down lightly with a finger on the top of the crosshead and screw in the adjustment screw until it contacts the valve stem.
3) Tighten the adjustment screw a further 20°, then tighten the locknut to hold it in position.
kgm Lock nut: 6.0 ± 0.6 kgm

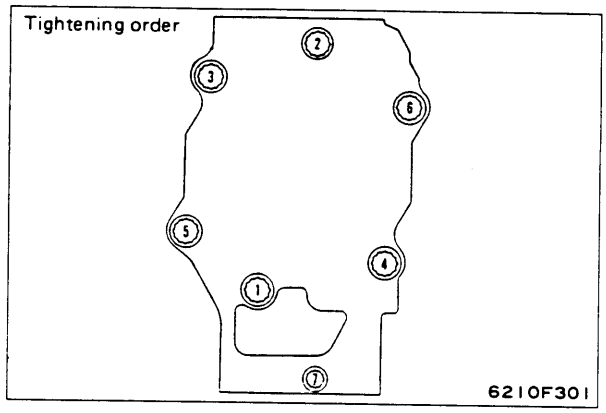
※15

Mounting bolt: Anti-friction compound (LM-P)

★ Screw in the cylinder head mounting bolts 2 – 3 turns by hand, then tighten as shown in the diagram.

kgm Cylinder head mounting bolt

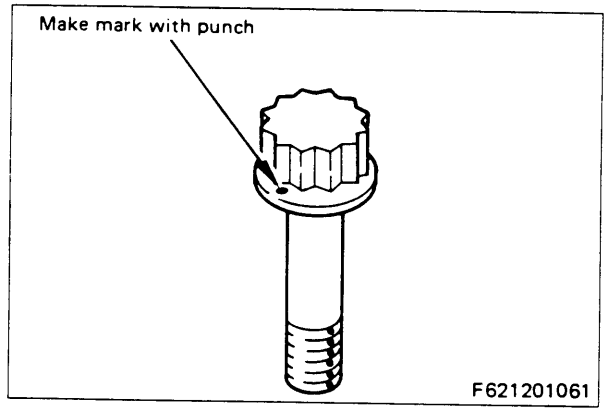
1st step:	Tighten to 15 ± 1 kgm
2nd step:	Tighten to 22 ± 0.5 kgm
3rd step:	Using tool **A**, tighten bolt a further $90^{\circ}\ ^{+30^{\circ}}_{0}$.



★ Tighten bolt ⑦ to 6.75 ± 0.75 kgm.

★ After tightening, make one punch mark on the bolt head to indicate the number of times that the bolt has been used.

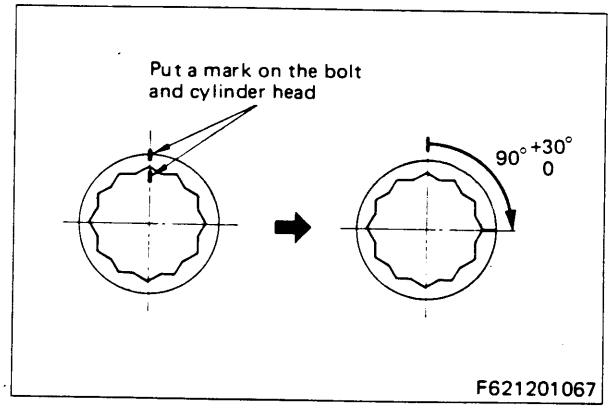
• If any bolt has 5 punch marks, do not reuse it. Replace it with a new bolt.



• Refilling with water
★ Add water to the specified level from filler port, and run the engine to circulate the water through the system. Then check the water level again.

※16

★ Check that the grommet does not come out when the gasket is installed.



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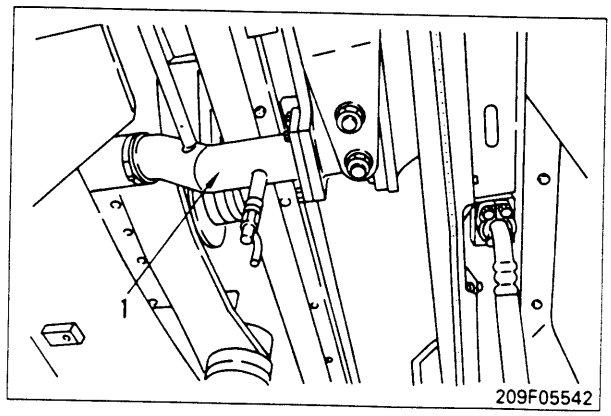
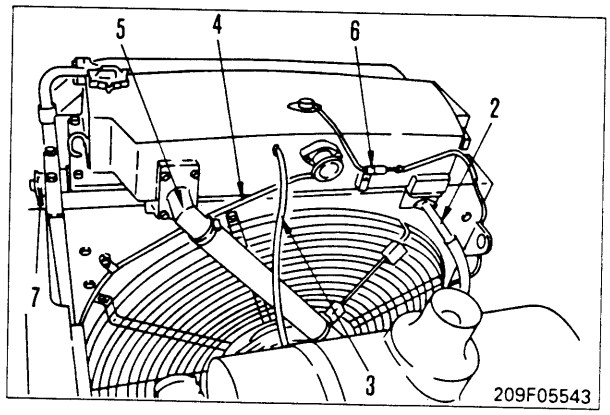
REMOVAL OF RADIATOR ASSEMBLY

⚠ Lower the work equipment completely to the ground.

1. Drain cooling water.
2. Disconnect tube (1).
   ★ Disconnect at the radiator end.
3. Disconnect tube (2).
4. Disconnect hoses (3) and (4).
5. Disconnect tube (5).
6. Disconnect wiring (6).
7. Remove isolators (7).
   ★ Remove one each on the left and right.
8. Remove mounting bolts (8) and (9).
9. Remove radiator assembly (10).
   kg Radiator assembly: 650 kg





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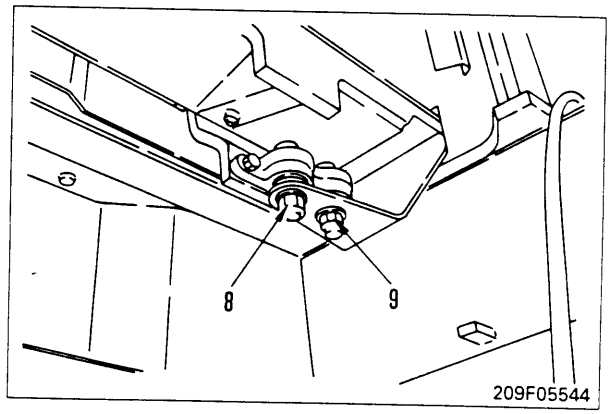
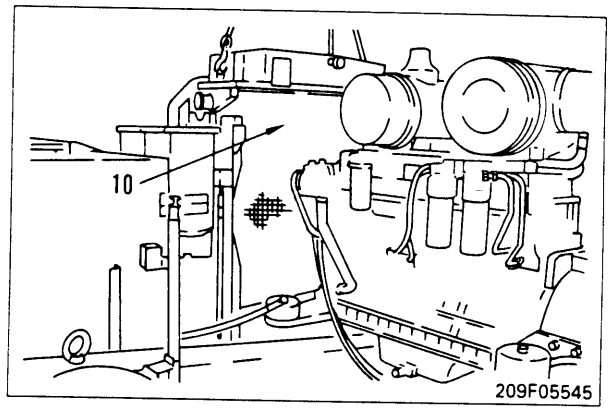
INSTALLATION OF RADIATOR ASSEMBLY

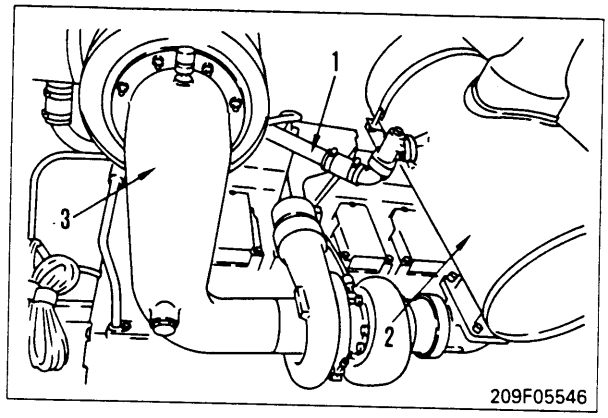
- Carry out installation in the reverse order to removal.
- Refilling with water
  ★ Add water to the specified level from filler port, and run the engine to circulate the water through the system. Then check the water level again.

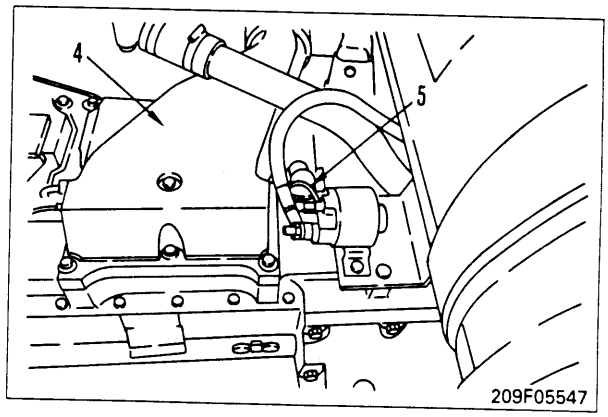




REMOVAL OF AFTER-COOLER CORE

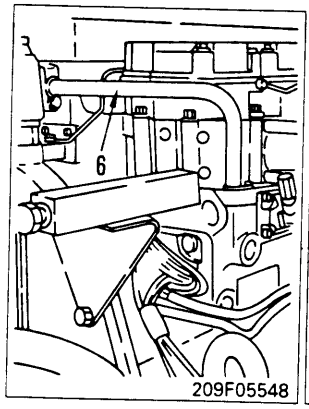
1. Drain cooling water.
2. Remove tube (1), muffler (2), and air cleaner (3).
   ★ Remove the engine top cover.
3. Remove connector (4).
4. Disconnect wiring (5).
5. Remove tubes (6) and (7).
6. Pull out connectors (8) and (9).
7. Remove cover (10).
8. Remove core (11).
   ★ Be careful not to damage the cover.

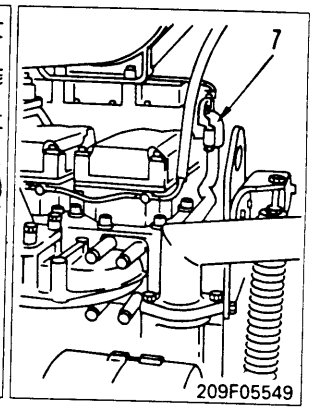


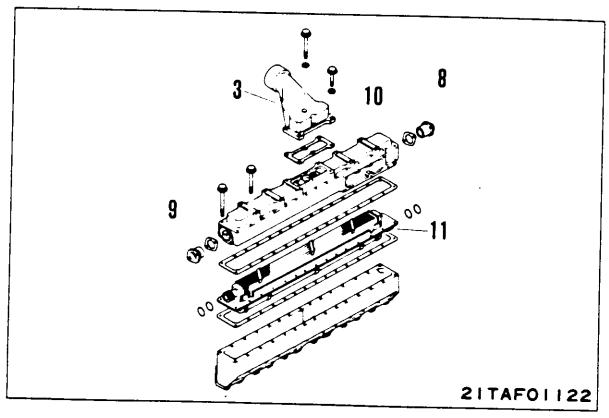


INSTALLATION OF AFTER-COOLER CORE

- Carry out installation in the reverse order to removal.
- Refilling with water
  ★ Add water to the specified level from filler port, and run the engine to circulate the water through the system. Then check the water level again.







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REMOVAL OF ENGINE, PTO, HYDRAULIC PUMP ASSEMBLY

⚠ Disconnect the cable from the negative (–) terminal of the battery.

⚠ Lower the work equipment completely to the ground and stop the engine.

1) Release the remaining pressure in the hydraulic piping.
   For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit of machines equipped with PPC valve.
2) Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

★ After disconnecting hoses, fit blind plugs to prevent dirt or dust from entering, and mark with tags to prevent mistakes in the mounting position when connecting.

1. Remove strainer.

2. Set tool **L** to rod.
   ★ Remove the strainer from the rod, install tool **L** in place of the strainer, assemble inside the hydraulic tank again, then fit the spring and install the cover.
   ★ When not using tool **L**, loosen the drain valve under the hydraulic tank and drain the oil from the hydraulic tank.

   Hydraulic tank: Approx. 480 ℓ

3. Drain oil from PTO case.

   PTO case: Approx. 10 ℓ

4. Drain engine cooling water.
   ★ Open drain valve (2).

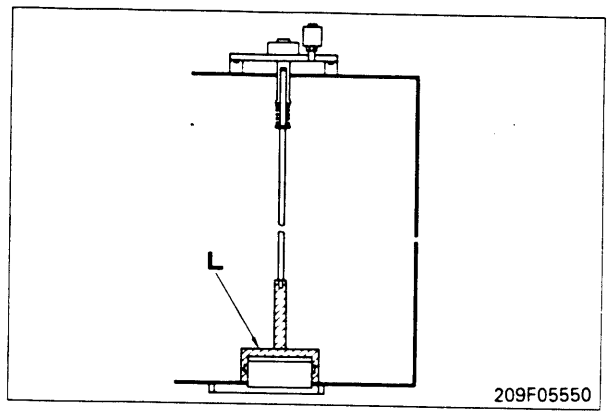
5. Lift off hood (3).

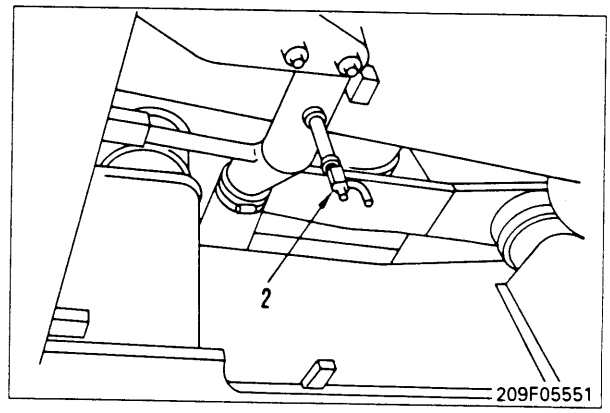
6. Disconnect hose (4) and wiring (5).

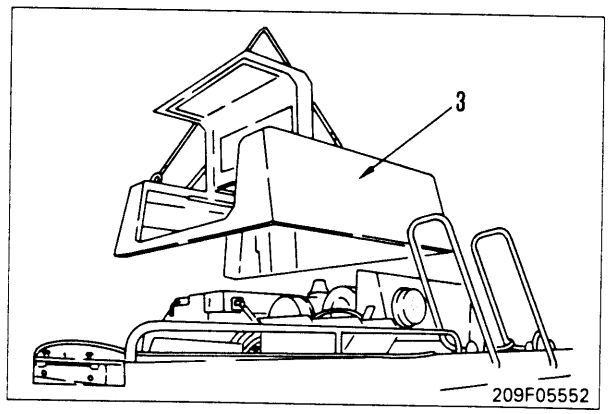
7. Disconnect hoses (6) and (7).

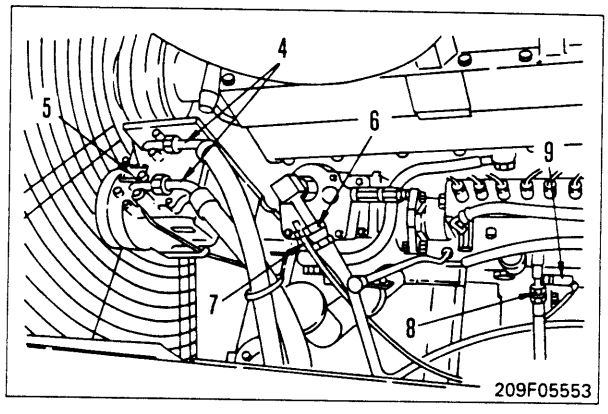
8. Disconnect hose (8).

9. Disconnect sensor wiring (9).









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10. Disconnect hoses (10) and (11).
    ★ For machine equipped with 3-stage mode selector OLSS and auto-deceleration.

11. Disconnect cable (12).

12. Disconnect engine speed sensor (13).
    ★ For machine equipped with 3-stage mode selector OLSS and auto-deceleration.

13. Disconnect engine throttle sensor (14).
    ★ For machine equipped with 3-stage mode selector OLSS and auto-deceleration.

14. Disconnect hoses (15) and (16).

15. Disconnect hoes (17).

16. Disconnect wiring (18).

17. Disconnect wiring (19).

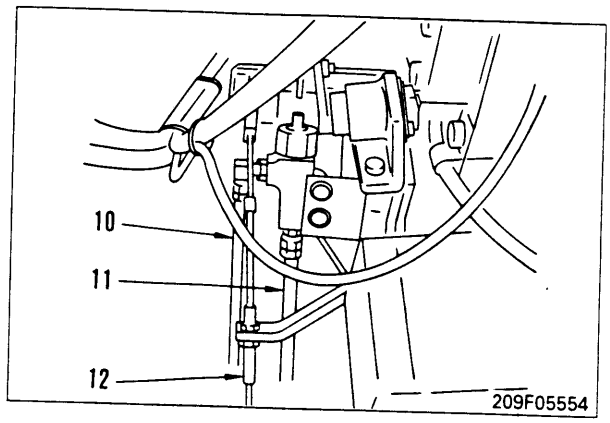
18. Disconnect hoes (20).
    ★ Disconnect at the flange end.

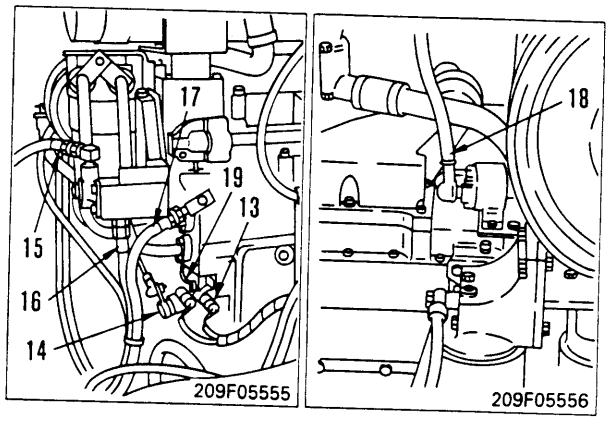
19. Disconnect hoes (21).

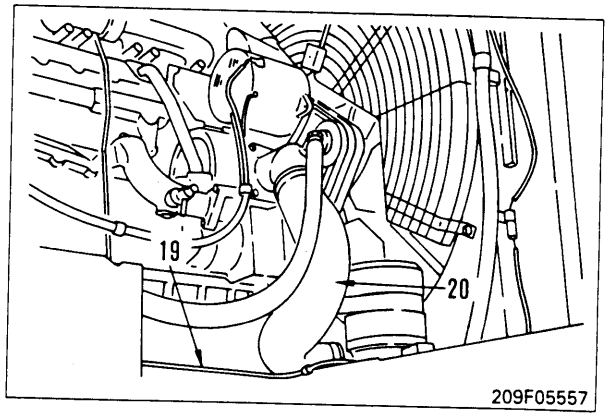
20. Disconnect hoes (22).

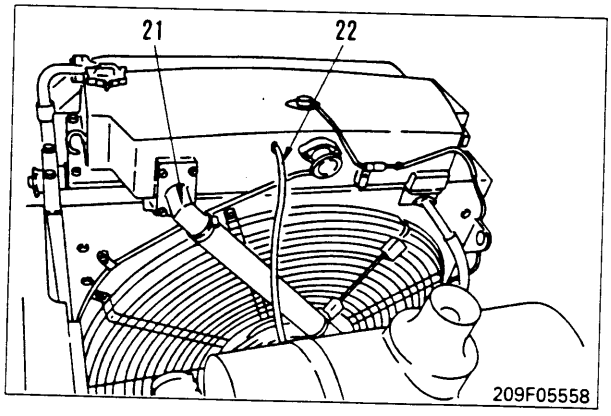
21. Remove fan belt (23). ※ 1
    ★ Raise tension pulley (24), loosen the belt tension then remove the fan belt.

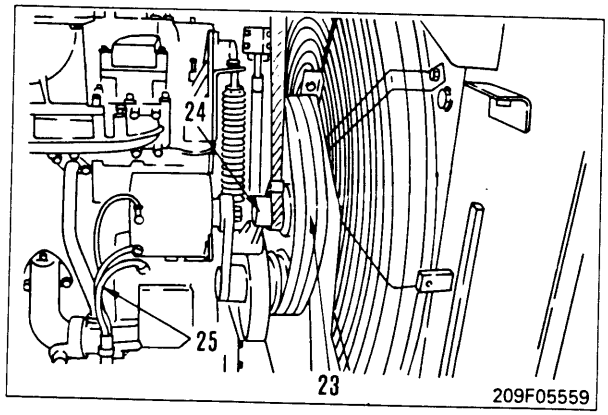
22. Disconnect wiring (25).











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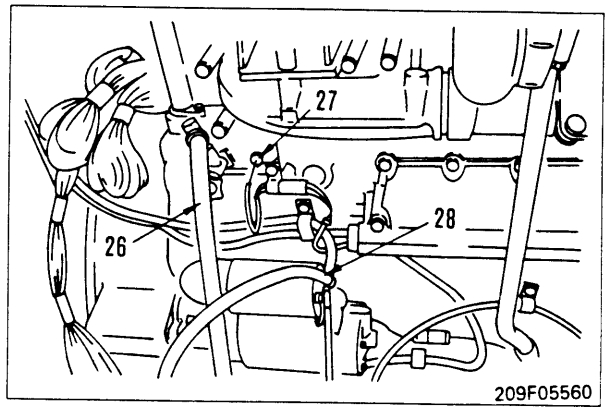
23. Disconnect hose (26).

24. Disconnect wiring (27).

25. Disconnect wiring (28).



26. Disconnect hose (29).

27. Disconnect hose (30).

28. Disconnect tube (31).

29. Disconnect hose (32).

30. Disconnect hose (33).

31. Disconnect hoses (34), (35), and (36).

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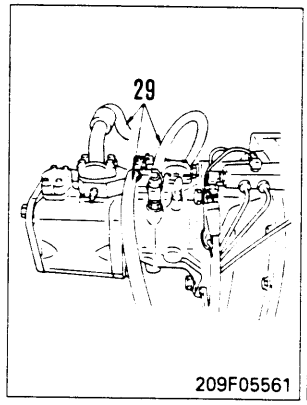
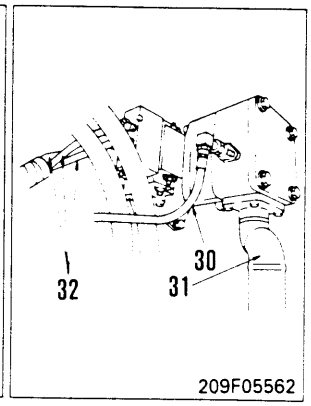
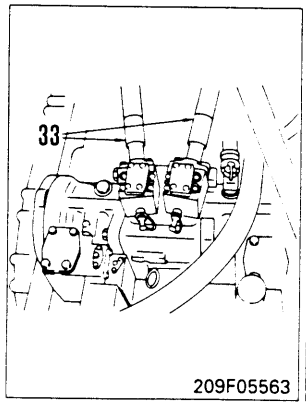
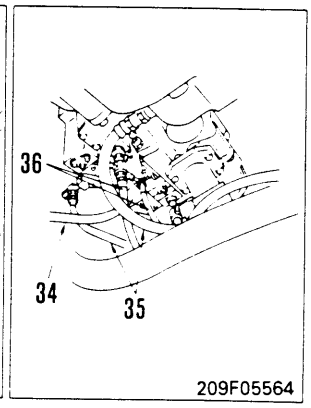


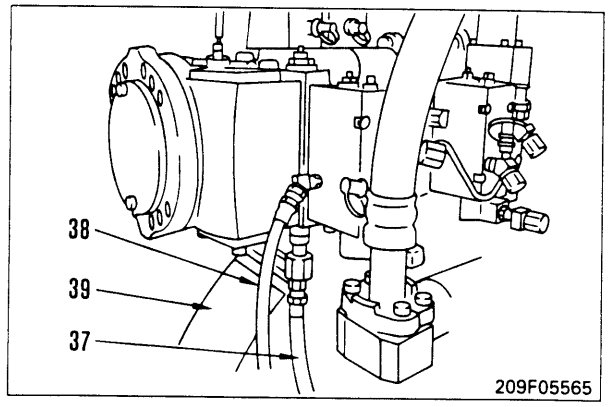






32. Disconnect hoses (37) and (38).

33. Remove hose (39).



34. Disconnect hose (40).

35. Disconnect hoses (41), (42), and (43).

36. Remove hose (44).

37. Disconnect hoses (45) and (46).

38. Remove tube (47).

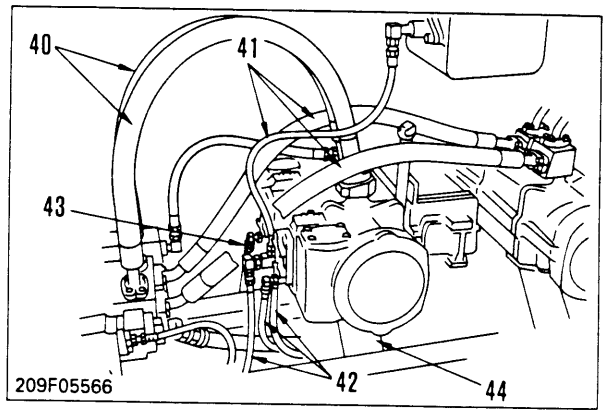
39. Disconnect ground connection (48).

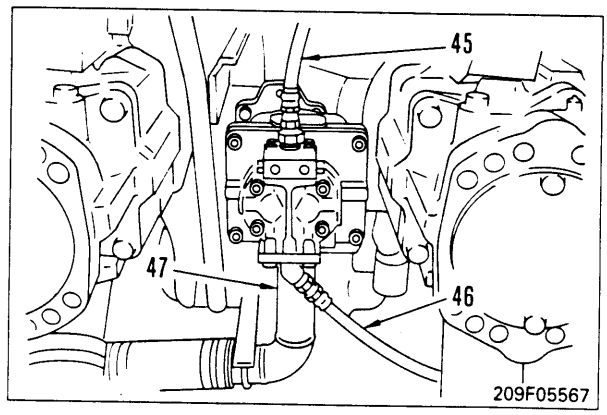
40. Remove rear mount bolts (49). ※ 2
★ Remove the bolts on both the left and right.

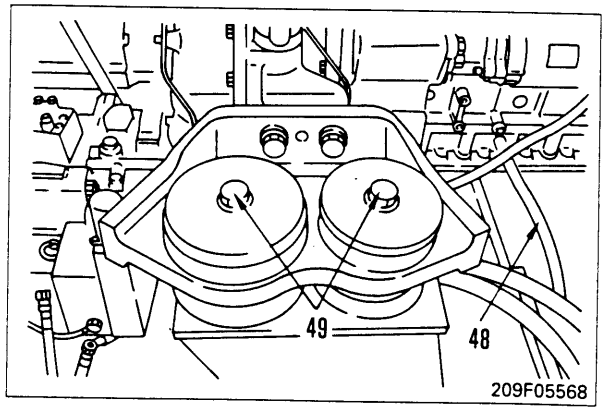
41. Remove front mount bolts (50). ※ 2
★ Remove the bolts on both the left and right.

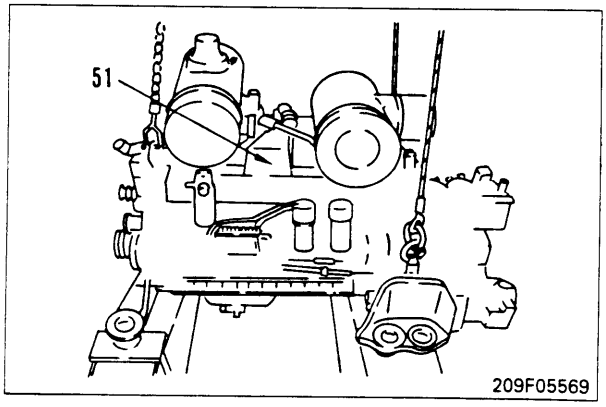
42. Lift off engine, PTO, and pump assembly (51).
★ Before removing the engine, PTO, and hydraulic pump assembly, check that all the piping and wiring has been removed.

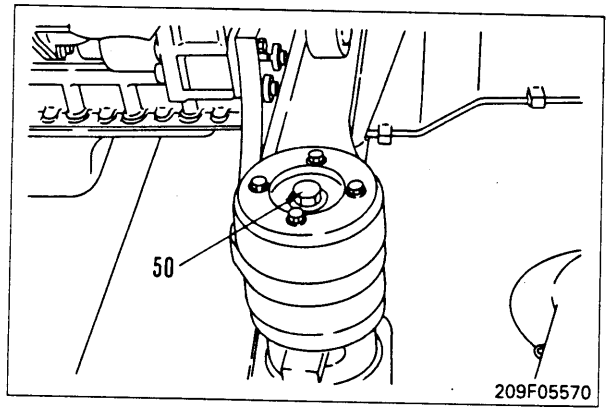
kg Engine, PTO, pump assembly: 2,600 kg











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INSTALLATION OF ENGINE, PTO, HYDRAULIC PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

★ Adjust the fan belt tension.
For details, see TESTING AND ADJUSTING, Adjusting belt tension.

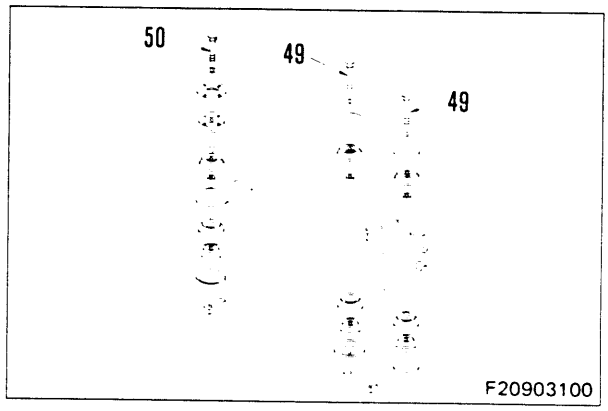
※ 2

Mounting bolts: Thread tightener (LT-2)
Mounting bolts: 95 ± 10 kgm

- Refilling with oil
  ★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.

- Refilling with water
  ★ Add water to the specified level from filler port, and run the engine to circulate the water through the system. Then check the water level again.

- Bleeding air
  Bleed the air from the main pump.
  For details, see TESTING AND ADJUSTING, Bleeding air from main pump.



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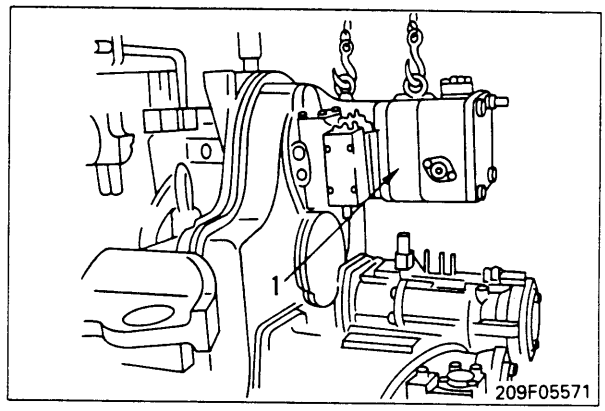
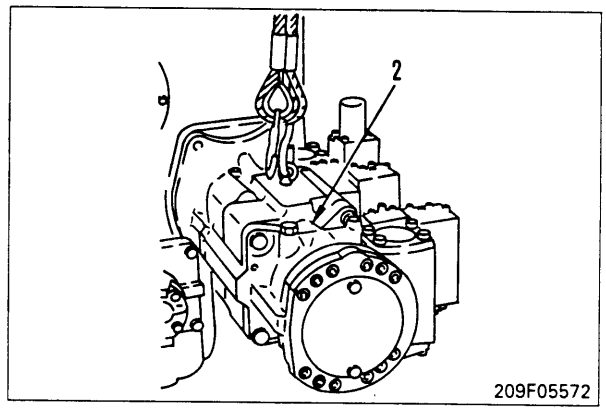
REMOVAL OF PTO ASSEMBLY

1. Remove engine, PTO, and hydraulic pump assembly. For details, see REMOVAL OF ENGINE, PTO, HYDRAULIC PUMP ASSEMBLY.

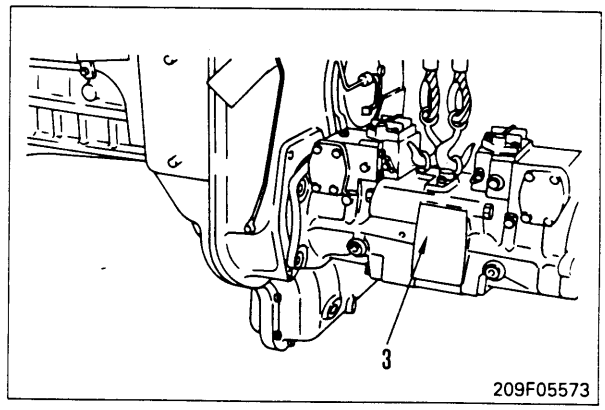
2. Lift off swing pump assembly (1).
   kg Swing pump assembly: 140 kg



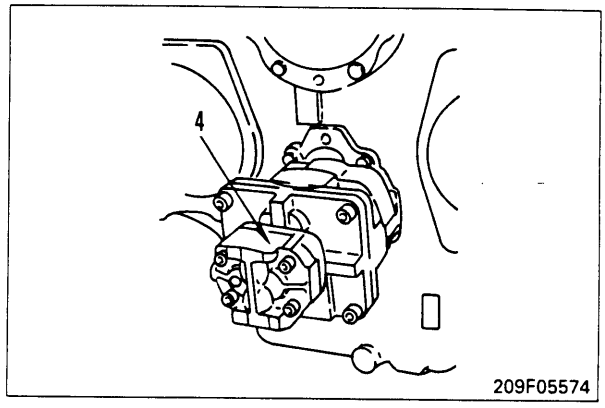
3. Lift off No. 1 pump assembly (2).
   kg No. 1 pump assembly: 165 kg



4. Lift off No. 2 pump assembly (3).
   kg No. 2 pump assembly: 150 kg



5. Lift off charging, PTO, and lubrication pump assembly (4).



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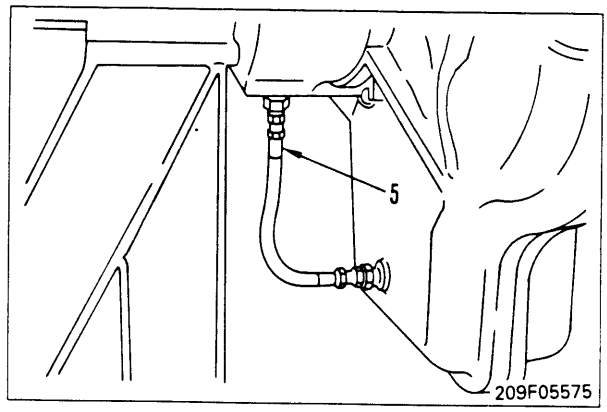
6. Remove hose (5).



7. Remove lubrication tubes (6), (7), (8), (9), (10), (11), (12), (13), and (14).

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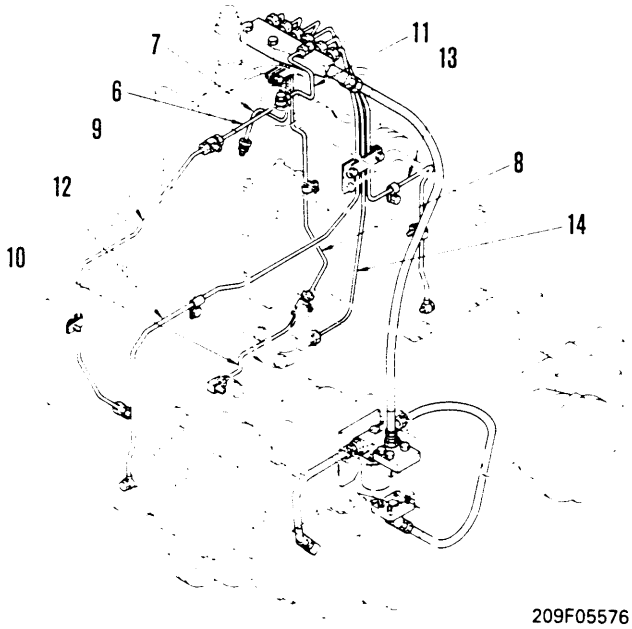
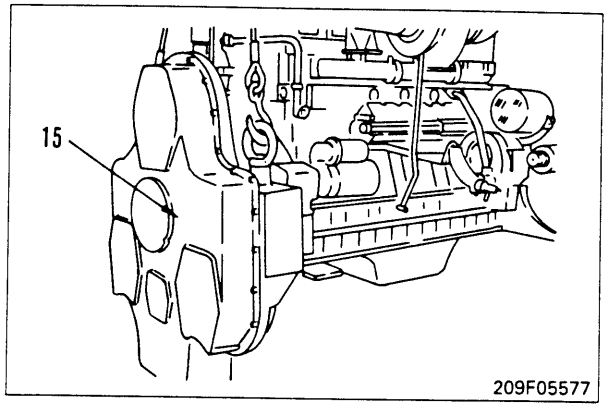
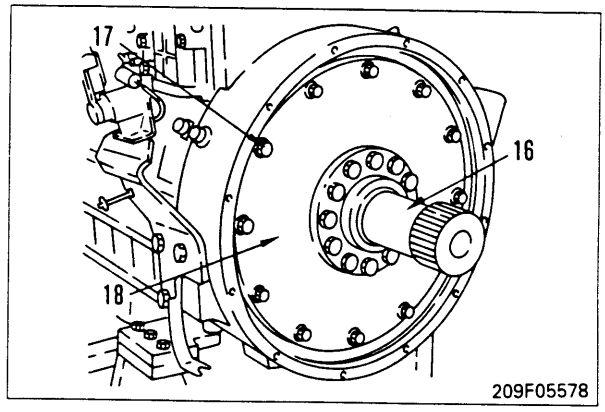


8. Lift off PTO assembly (15).

kg PTO assembly: 520 kg



9. Lift off shaft (16), remove mounting bolts (17), then remove plate (18).



INSTALLATION OF PTO ASSEMBLY

- Carry out installation in the reverse order to removal.

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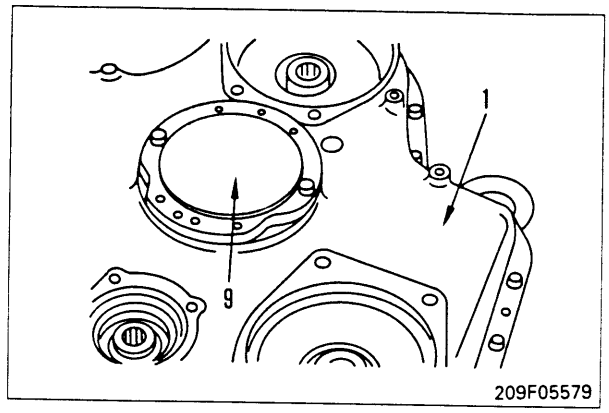
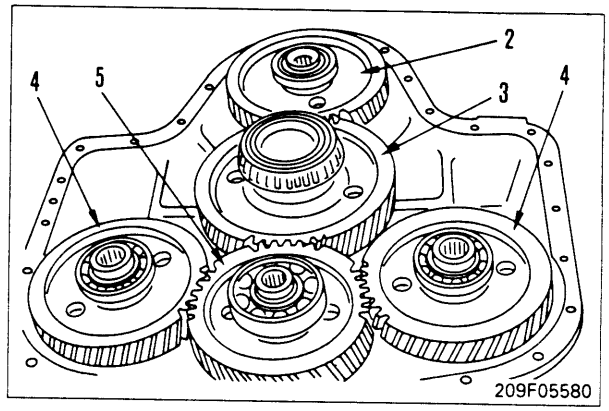
DISASSEMBLY OF PTO ASSEMBLY

1. Screw in forcing screws and remove case (1), then remove cover (9) from case.
   ★ Check the number and thickness of the shims, and keep in a safe place.



2. Remove gear assemblies (2), (3), (4), and (5).



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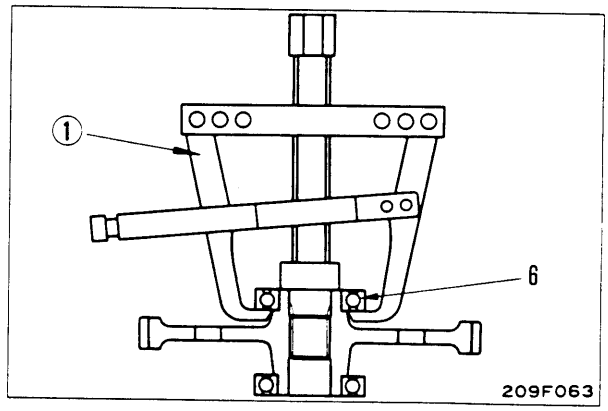
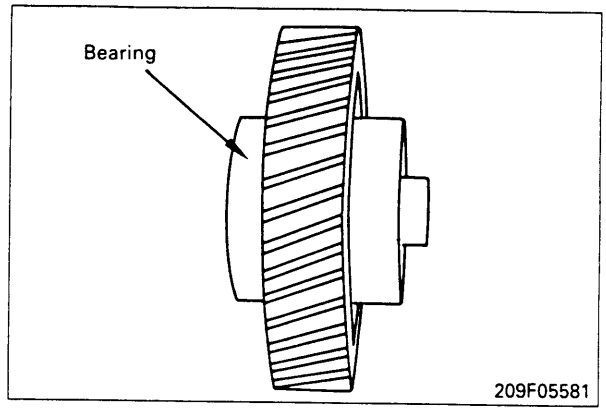
3. Using puller ①, remove bearings (6) from gears (2), (3), (4), and (5).

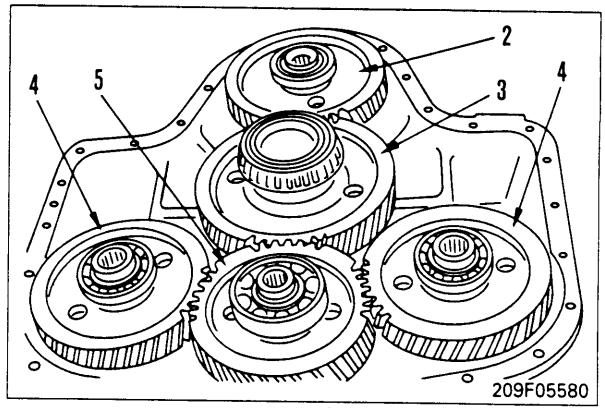


ASSEMBLY OF PTO ASSEMBLY

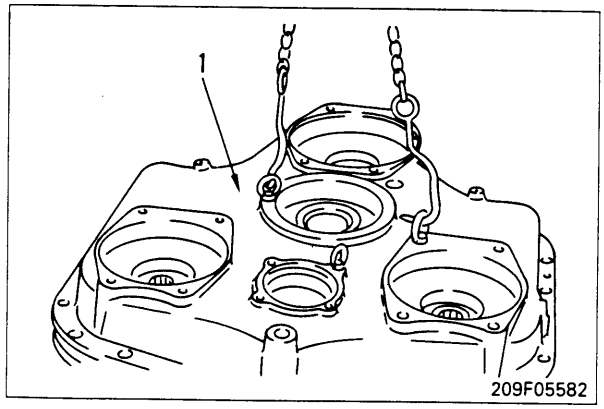
1. Fit bearings to gears (2), (3), (4), and (5).
   - ★ Inside diameter of bearing of gear (2): 65 mm
   - ★ Inside diameter of bearing of gear (3): 120 mm
   - ★ Inside diameter of bearing of gear (4): 65 mm
   - ★ Inside diameter of bearing of gear (5): 65 mm



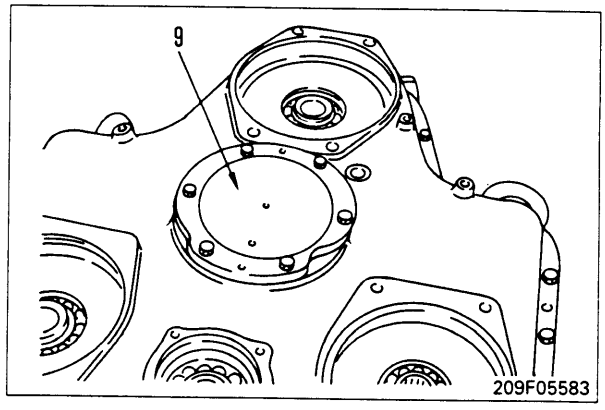
2. Install gears (5), (4), (3), and (2).
   Bearing: Grease (G2-LI)



3. Fit gasket and install case (1).
   kgm Mounting bolt: 11.5 ± 1 kgm



4. Fit O-ring and shim, and install cover (9).



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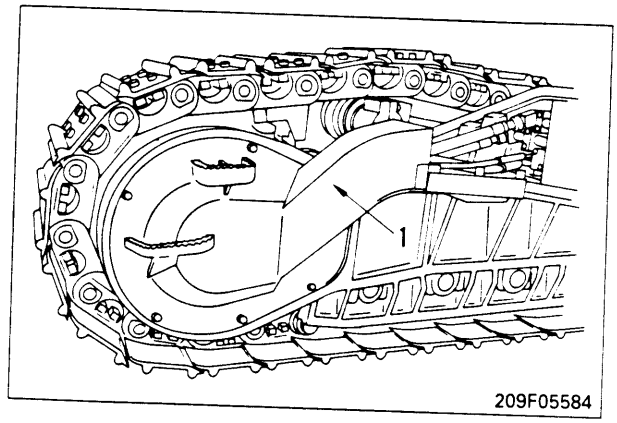
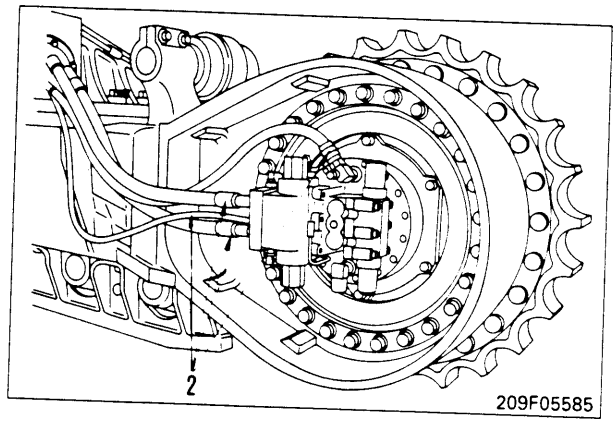
REMOVAL OF FINAL DRIVE ASSEMBLY

Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. For details, see REMOVAL OF TRACK SHOE ASSEMBLY.
2. Lift off cover (1).
   kg Cover: 100 kg
3. Disconnect hose (2).
4. Remove sprocket.
5. Sling final drive assembly (3), and remove mounting bolts, then remove final drive assembly. ※ 1
   kg Final drive assembly: 1,155 kg





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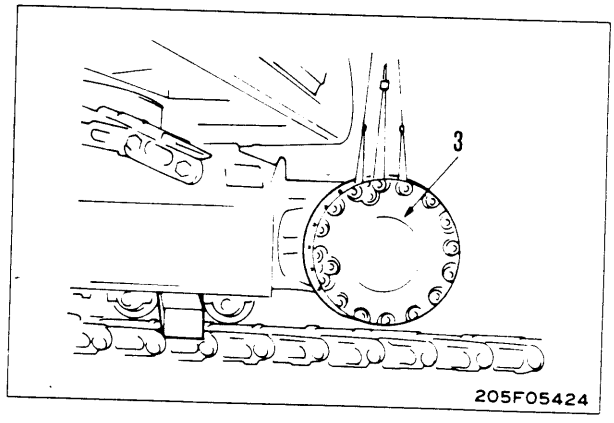
INSTALLATION OF FINAL DRIVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

Mounting bolts: Thread tightener (LT-2)
kgm Mounting bolts: 94.5 ± 10.5 kgm

- Bleeding air
  - ★ Bleed the air from the travel motor.
    For details, see TESTING AND ADJUSTING, Bleeding air.
  - ★ After bleeding the air from the travel motor, check the level of the hydraulic tank.



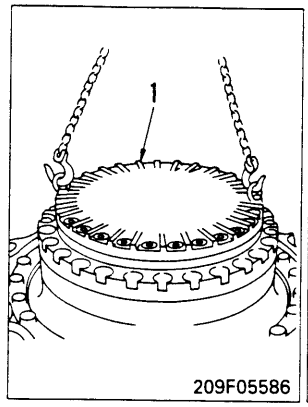
DISASSEMBLY OF FINAL DRIVE ASSEMBLY

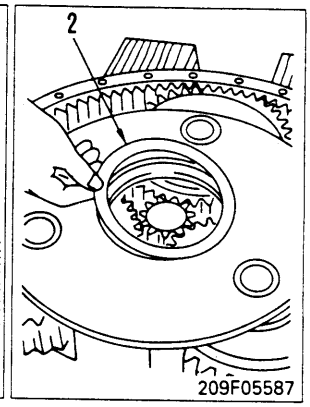
1. **Draining oil**
   Remove drain plug and drain oil from final drive case.
   Final drive case: Approx. 17 ℓ

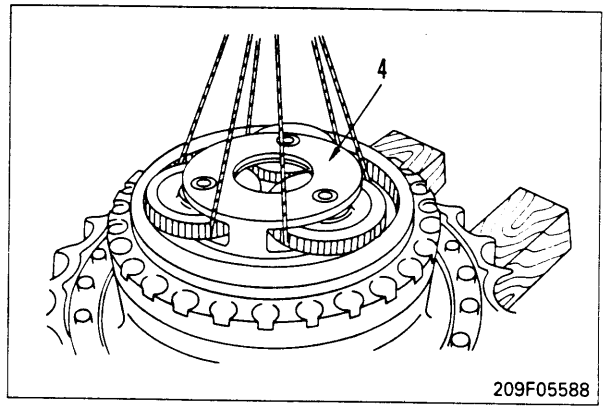
2. **Cover**
   Using forcing screws and eyebolts, remove cover (1).

3. **Thrust washer**
   Remove thrust washer (2).

4. **No. 1 carrier assembly**
   1) Raise planetary gear and remove carrier assembly (4).







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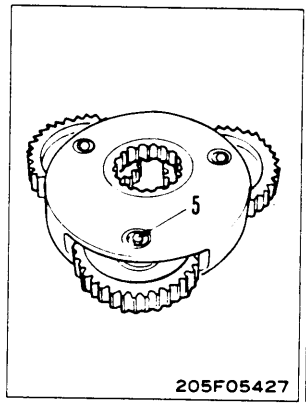
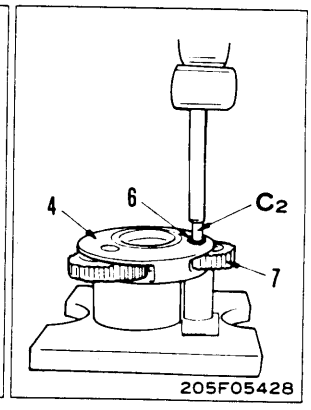
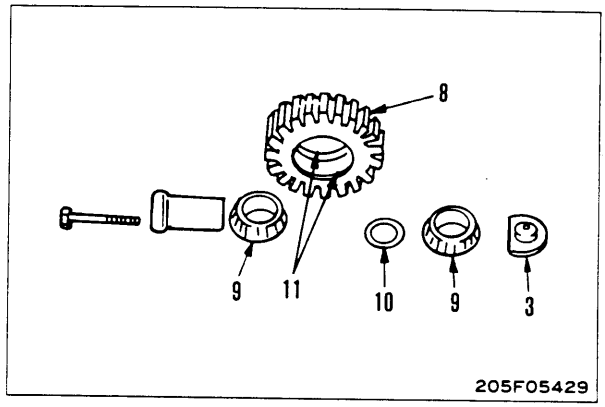
   2) Disassembly of carrier assembly.
      i) Remove mounting bolts (5), then remove holder (3).
      ii) Set carrier assembly (4) in press, then using tool **C2**, remove pin (6), then remove gear assembly (7).



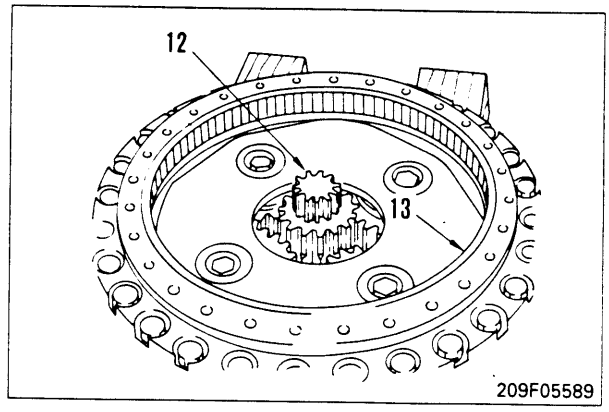


      iii) Remove bearing (9) and spacer (10) from gear (8).
         ★ If the parts are to be used again, make match marks to make sure that there is no change in the combination with the outer race.
      iv) Remove outer race (11).



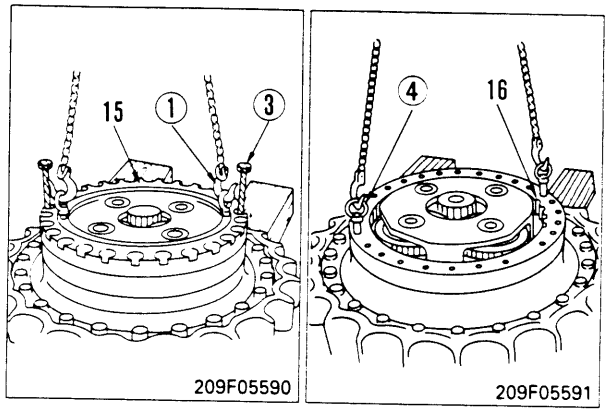
5. **No. 1 sun gear shaft**
   Remove sun gear shaft (12).

6. **No. 1 ring gear**
   Remove ring gear (13).



7. **Spacer**
   Using forcing screws ① and eyebolts ③ , remove spacer (15).

8. **No. 2 ring gear**
   Using eyebolts ④ , remove ring gear (16).



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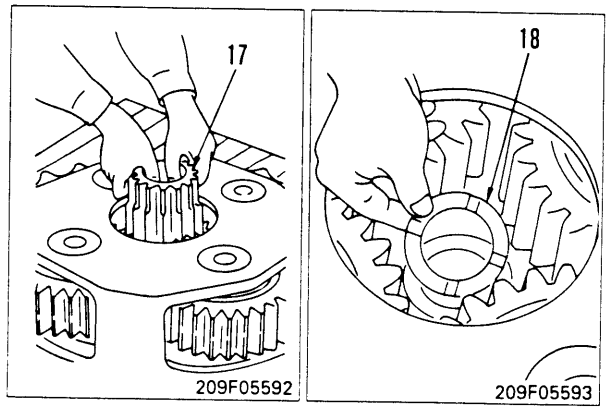
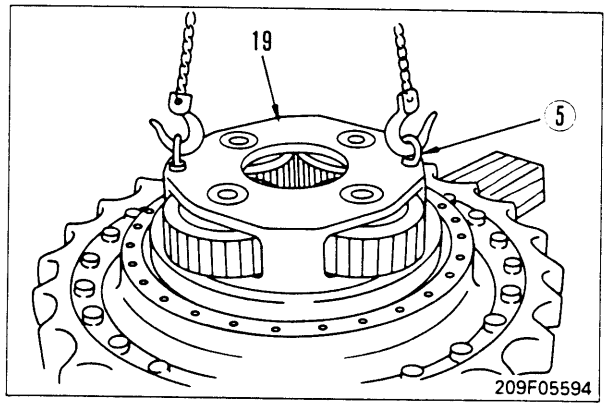
9. **No. 2 sun gear**
   Remove sun gear (17).

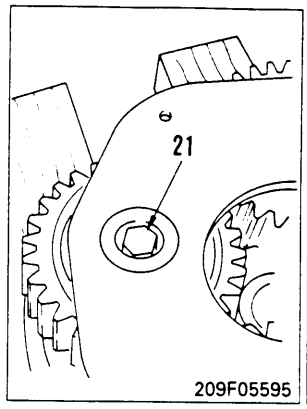
10. **Thrust washer**
    Remove thrust washer (18).

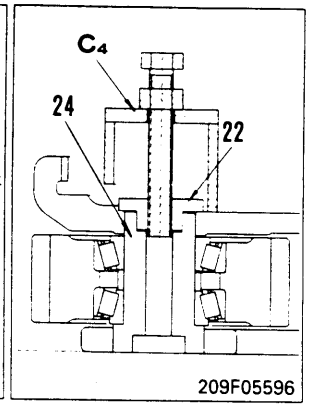


11. **No. 2 carrier assembly**
    1) Using eyebolts ⑤ , remove carrier assembly (19).

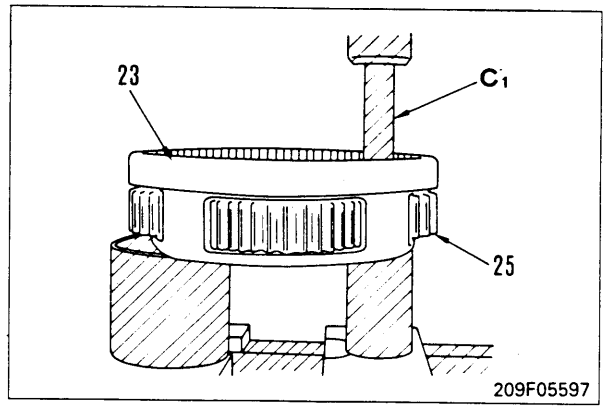


2) Disassembly of carrier assembly
   i) Remove mounting bolts (21).
   ii) Using tool **C4**, remove holder (22).

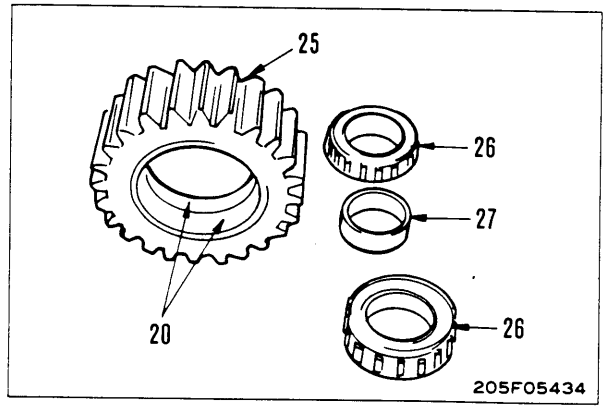




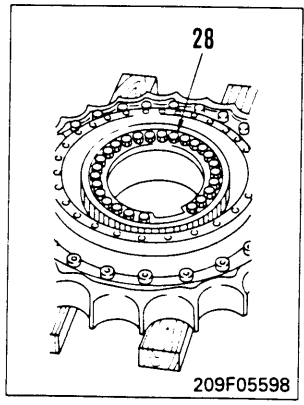
iii) Set carrier assembly (23) in press, then using tool **C1**, remove pin (24), then remove gear assembly (25).

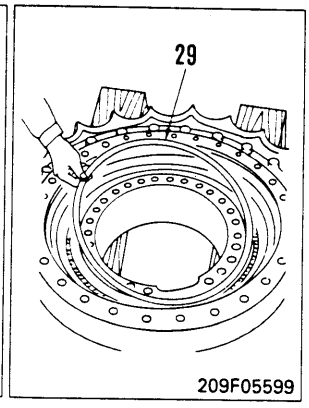


iv) Remove bearing (26) and spacer (27) from gear (25).
   ★ If the parts are to be used again, make match marks to make sure that there is no change in the combination with the outer race.
v) Remove outer race (20) from gear (25).



12. Hub assembly
1) Remove retainer (28).
2) Remove spacer (29).





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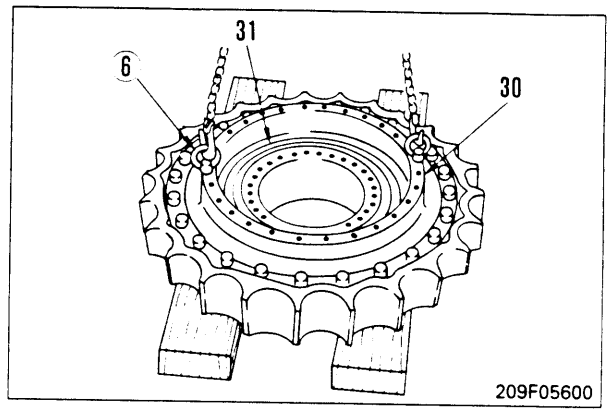
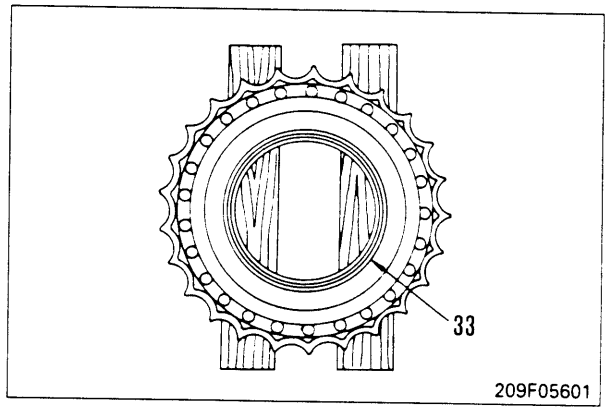
3) Using eyebolts ⑥ , remove hub assembly (30) together with bearing (31).
4) Remove bearing (31) from hub (30).



5) Remove floating seal (33) from hub.



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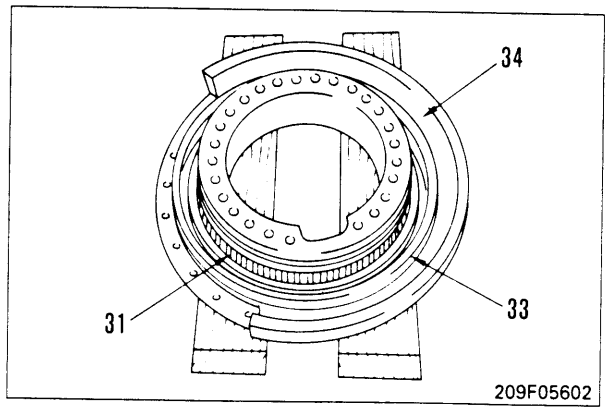
13. Floating seal
Remove floating seal (33) from shaft (34).

14. Bearing
Remove bearing (31) from shaft (34).

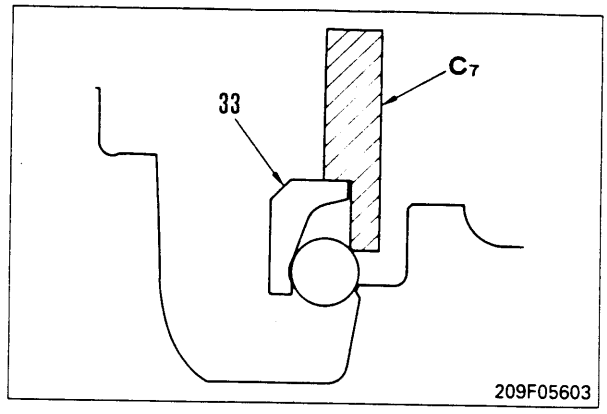


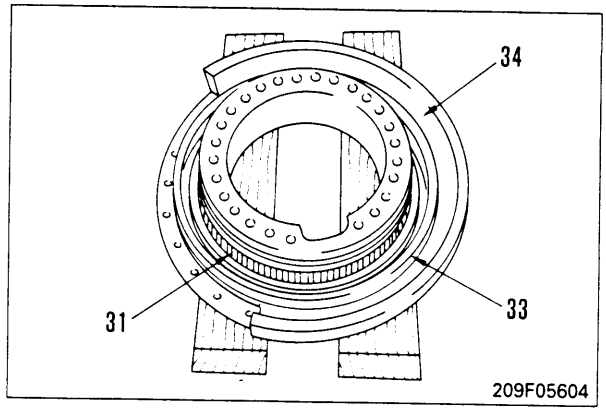
ASSEMBLY OF FINAL DRIVE ASSEMBLY

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. Shaft assembly

1) Using tool **C7**, install floating seal (33) to shaft (34).
   - ★ Remove all grease and oil from the O-ring and O-ring contact surface of the floating seal, and dry before installing.
   - ★ After installing the floating seal, coat the sliding surface thinly with engine oil.
2) Install bearing (31).





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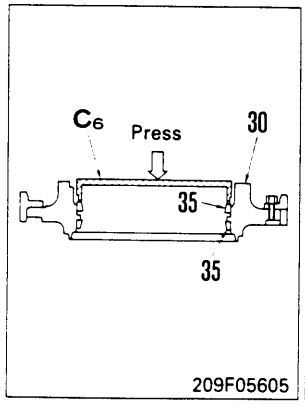
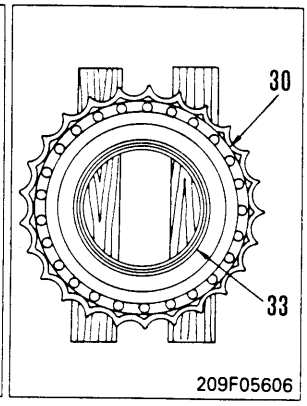
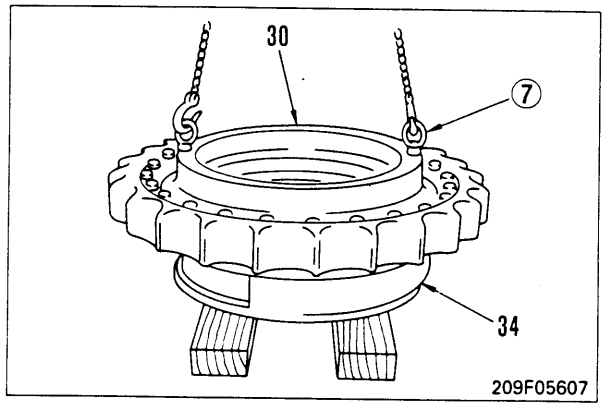
2. Hub assembly

1) Assembly of hub assembly
   i) Using tool **C6**, press fit outer race (35) to hub (30).
   ii) Using tool **C7**, install floating seal (33) to hub (30).
   - ★ For details of the installation procedure, see Step 1-1).

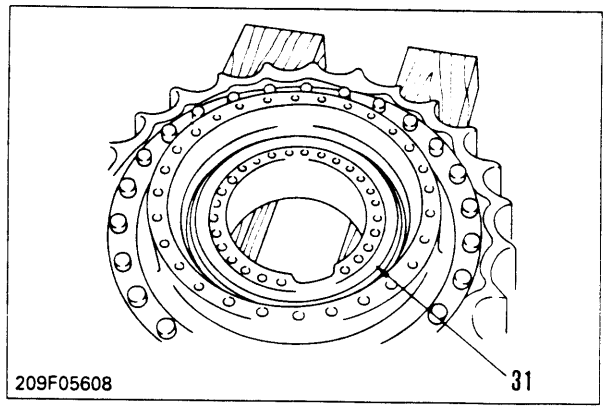




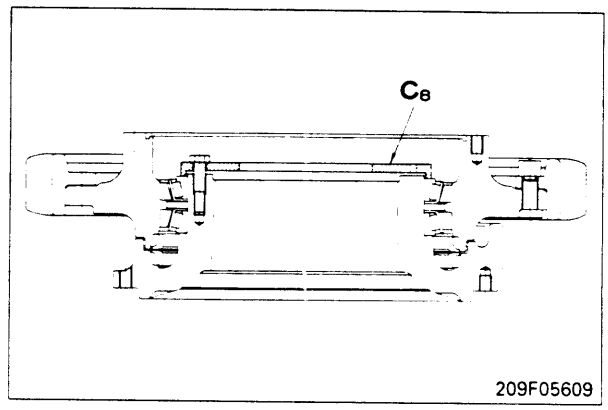
2) Using eyebolts (7), install hub assembly (30) to shaft assembly (34).

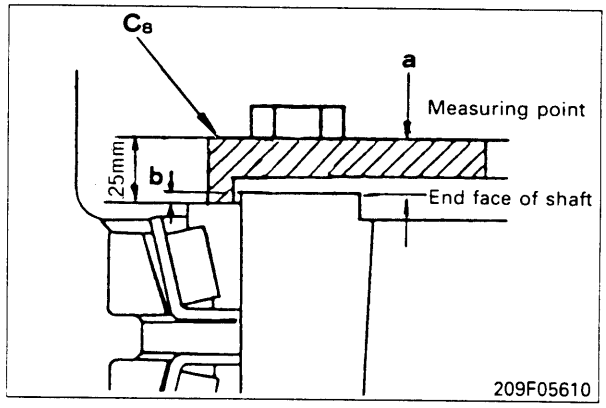


3) Install bearing (31).

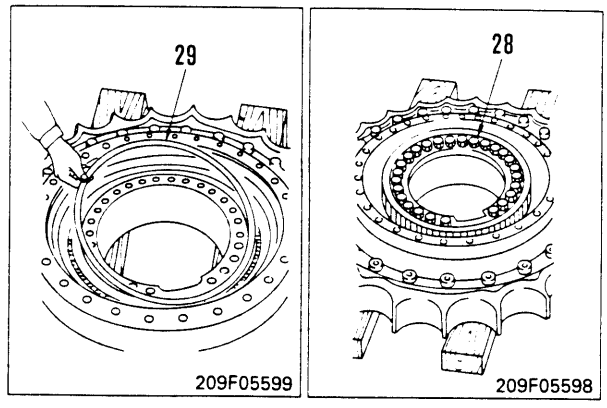


4) Select thickness of spacer for preload of bearing as follows.
   i) Install tool **Cs**, and tighten temporarily with 2 bolts.
      ★ Tighten the bolts uniformly to 8 kgm.
   ii) Rotate hub assembly and settle bearing.
   iii) Measure dimension **b** from top surface of tool **Cs** to end face of shaft.
      ★ Measure at two places and take the average.
      • Tool **Cs** thickness 25 mm – (measured dimension **a**) = clearance **b** between end face of shaft and bearing inner race.
      • When selecting the thickness of the spacer, select a thickness of **b** – (0.07 to 0.27 mm).
      ★ There are 8 types of spacer available in steps of 0.15 mm from 3.70 mm to 4.75 mm.





5) Assemble spacer (29) selected in Step 4), and install retainer (28).
   Mounting bolt: Thread tightener (LT-2)
   Mounting bolt: 105 ± 5 kgm



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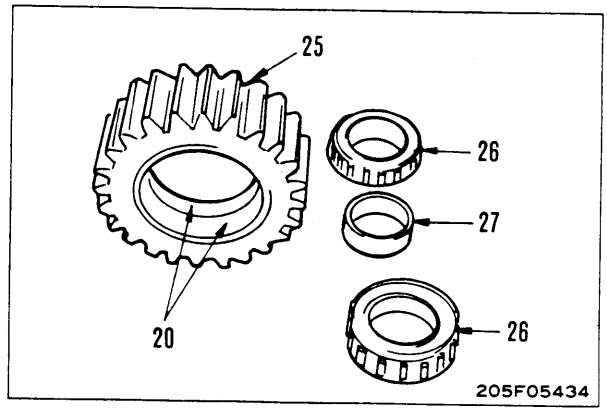
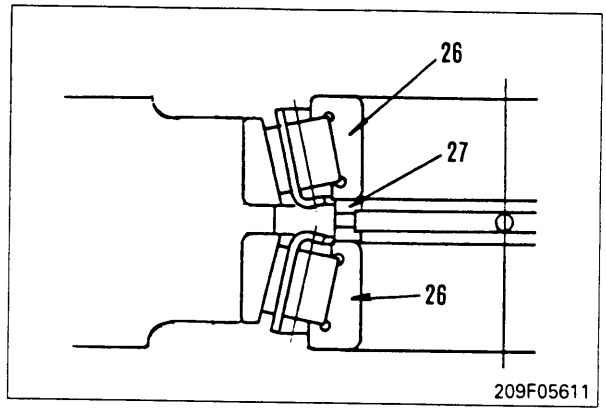
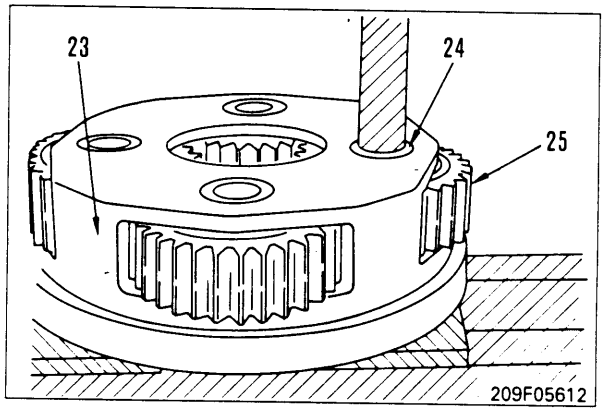
3. No. 2 carrier assembly

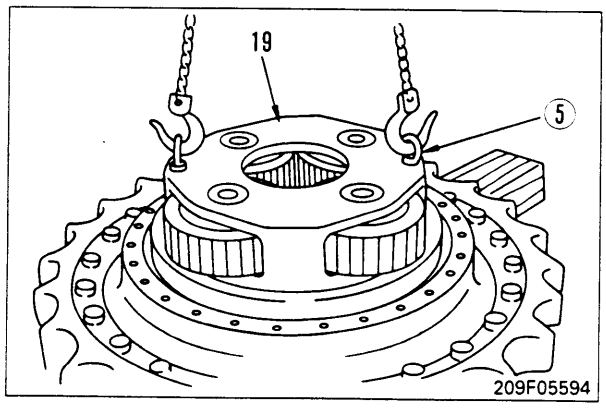
1) Assembly of carrier assembly
   - ★ The inner race, outer race, and spacer form one set for the taper roller bearing, so assemble the sets with the same marks.
   - i) Using tool **C3**, press fit outer race (20) in gear (25).
   - ii) Assemble spacer (27) and bearing (26).
   - iii) Set carrier assembly (23) in press, assemble gear assembly (25), then using push tool, press fit pin (24).
     - ★ When press fitting the pin, be extremely careful of the angle of the pin, and rotate the gear while press fitting.
   - iv) Fit holder (22) and tighten with mounting bolts (21).
     - Mounting bolt: Thread tightener (LT-2)
     - Mounting bolt: 76 ± 8 kgm

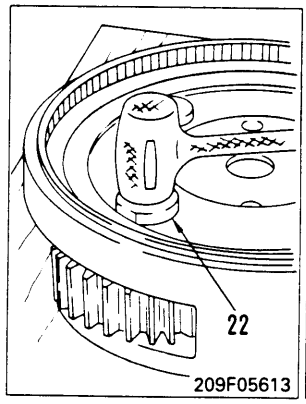
2) Using eyebolts ⑤ , align center of one planetary gear with top of shaft, then install No. 2 carrier assembly (19).
   - ★ Assemble the shaft so that the notched portion on the outside is at the bottom.

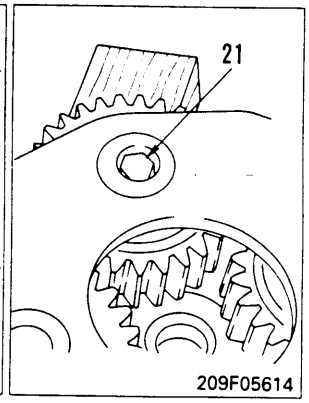












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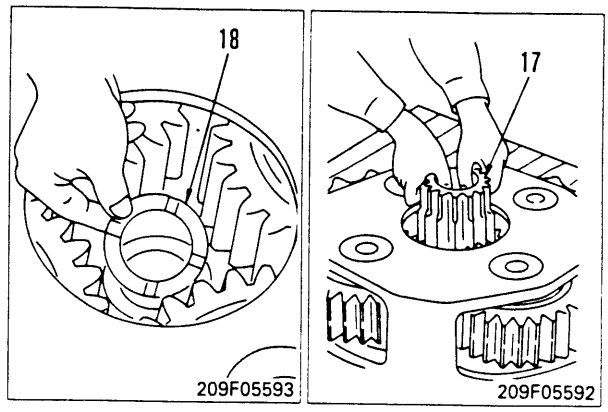
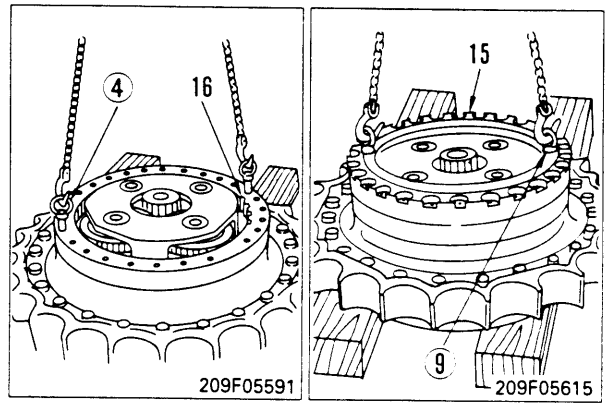
4. **Thrust washer**
Install thrust washer (18).

5. **No. 2 sun gear**
Install No. 2 sun gear (17).
★ Be careful not to get your fingers caught.



6. **No. 2 ring gear**
Using eyebolts ④ , install spacer (16).

7. **Spacer**
Using eyebolts ⑨ , install spacer (15).
Spacer mounting surface: Gasket sealant (LG-6)
Mounting bolt: Thread tightener (LT-2)
Mounting bolt: 76 ± 8 kgm



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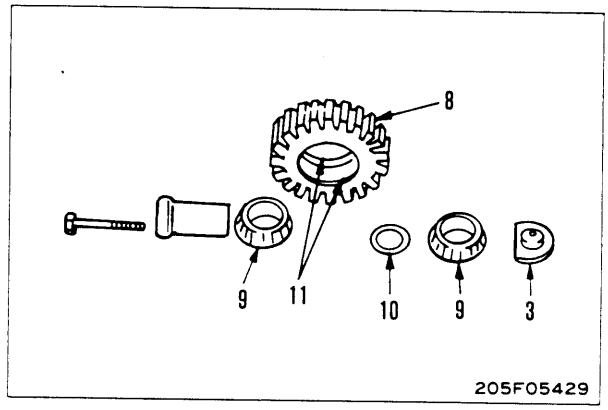
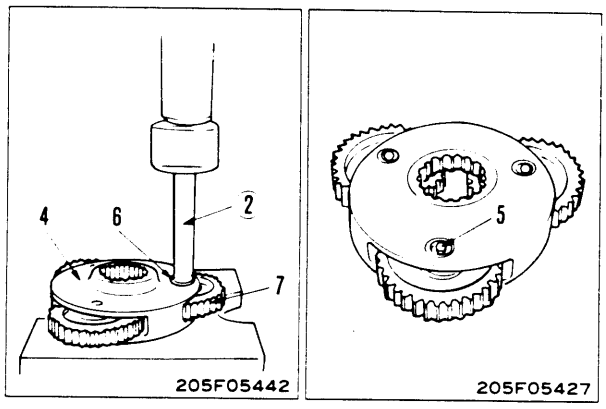
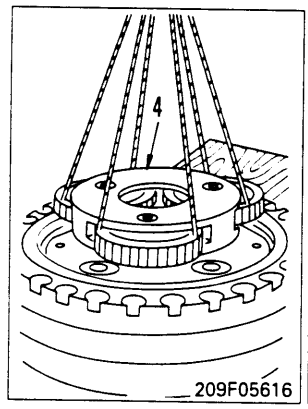
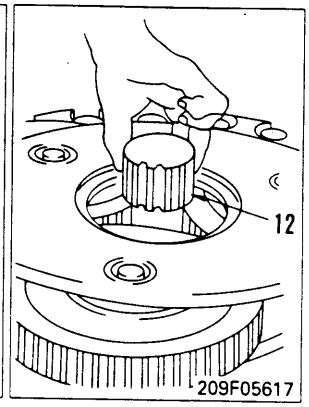
8. **No. 1 carrier assembly**
1) Assembly of carrier assembly
★ The inner race, outer race, and spacer form one set for the taper roller bearing, so assemble the sets with the same marks.
• See the procedure for No. 2 carrier.
i) Using tool **C**5, press fit outer race (11) in gear (8).
ii) Assemble spacer (10) and bearing (9).
iii) Set carrier assembly (4) in press, assemble gear assembly (7), then using push tool ② , press fit pin (6).
★ When press fitting the pin, be extremely careful of the angle of the pin, and rotate the gear while pressing fitting.
iv) Fit holder (3) and tighten with mounting bolts (5).
Mounting bolt: Thread tightener (LT-2)
Mounting bolt: 11.25 ± 1.25 kgm





2) Raise planetary gear, and install carrier assembly (4).



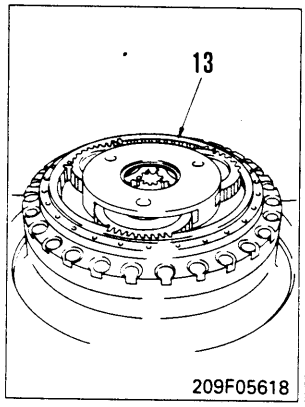


9. No. 1 sun gear

Install No. 1 sun gear (12).

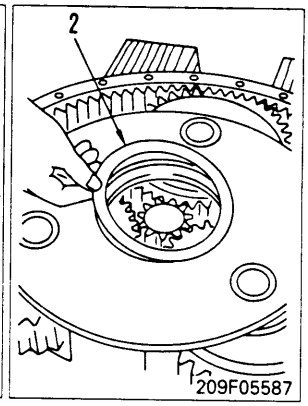
10. No. 1 ring gear

Install No. 1 ring gear (13).



11. Thrust washer

Install thrust washer (2).



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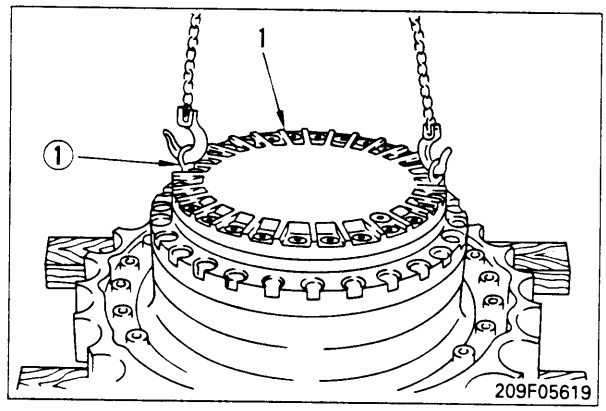
12. Cover

Using eyebolts ① , install cover (1).

Cover mounting surface: Gasket sealant (LG-6)

Mounting bolt: 25.75 ± 2.25 kgm



REMOVAL OF REVOLVING FRAME ASSEMBLY

1. Remove work equipment assembly from chassis.
   For details, see REMOVAL OF WORK EQUIPMENT ASSEMBLY.

2. Remove counterweight assembly.
   For details, see REMOVAL OF COUNTERWEIGHT ASSEMBLY.

3. Disconnect 4 grease tubes (1).

4. Leaving 3 – 4 bolts at front and rear, remove mounting bolts (2) of revolving frame. ※ 1
   - ★ Start the engine, and swing to remove the mounting bolts.
   - ★ If the engine is not started, remove the swing motor and use a crane to rotate the revolving frame.

5. Disconnect swivel joint pipes (3), (4), and (5).
   - ★ Disconnect pipes (3) and (4) at the control valve end.

6. Pull out pin (6), and move link (7) towards frame.

7. Revolving frame assembly ※ 1 ※ 2
   1) Fit wires to counterweight mounting frame and boom mount, and sling revolving frame assembly.
   2) Remove remaining mounting bolts, then remove revolving frame assembly (8).
   - ★ Check that the wire is not damaged, and fit protective material at the corners.
   - ★ The assembly will tilt towards the operator's cab, so adjust it with a lever block.

   kg Revolving frame assembly:
   Approx. 14,000 kg

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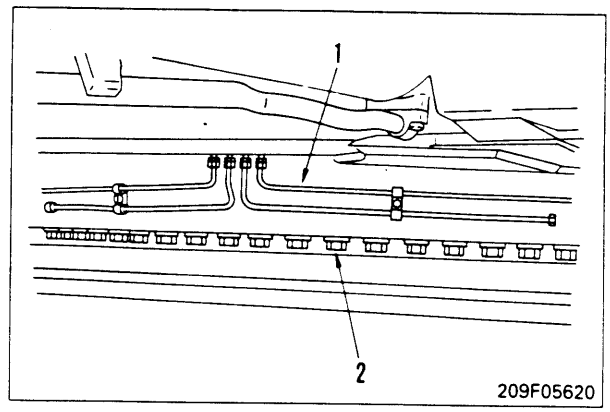

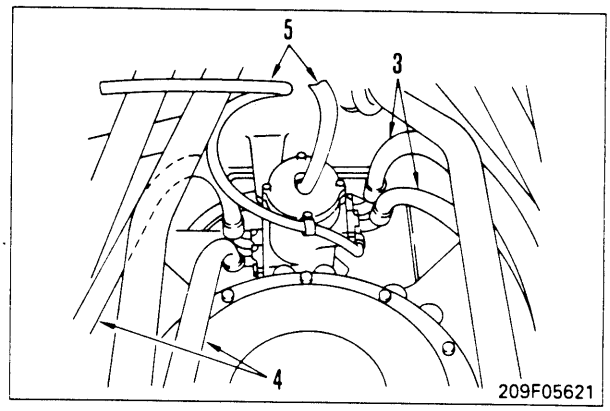

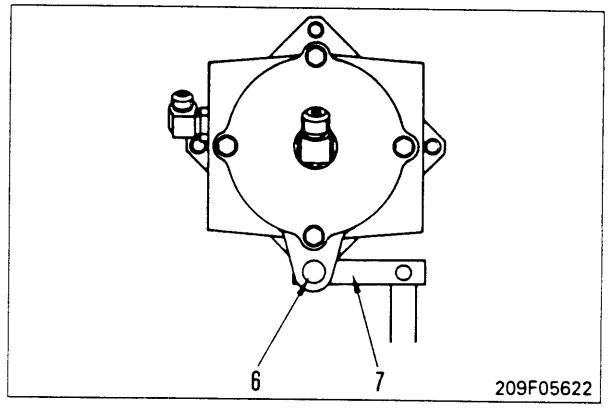

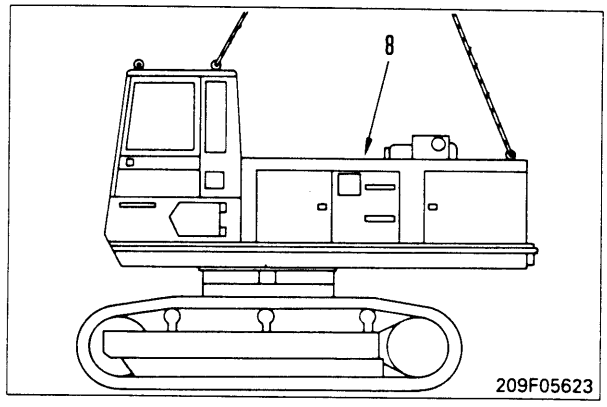

INSTALLATION OF REVOLVING FRAME ASSEMBLY

- Carry out installation in the reverse order to removal.

※1
Mounting bolts: Thread tightener (LT-2)
Mounting bolts: 175 ± 20 kgm

※2
Top surface of swing circle:
Gasket sealant (LG-6)

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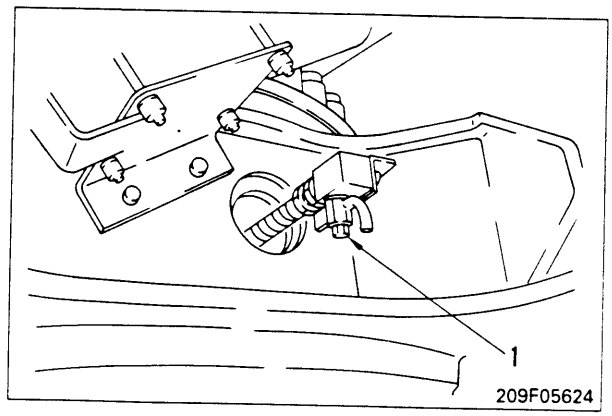
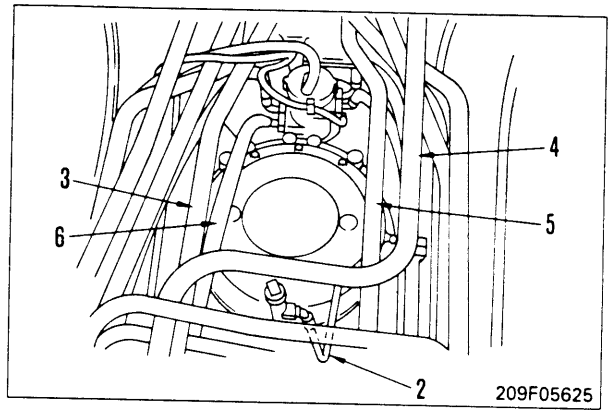
REMOVAL OF SWING MACHINERY ASSEMBLY

1. Remove swing motor assembly.
   For details, see REMOVAL OF SWING MOTOR ASSEMBLY.
2. Drain oil
   Swing machinery case: Approx. 37 ℓ
3. Disconnect drain valve (1).
4. Disconnect hose (2).
5. Remove tubes (3), (4), and (5).
6. Disconnect hose (6).
   ★ Move the hose towards the frame.
7. Sling swing machinery assembly (7), then screw in forcing screws, pull out pilot and remove. ※ 1
   Swing machinery assembly: 870 kg





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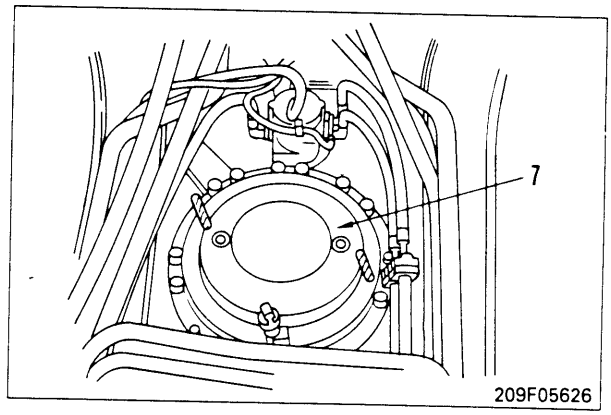
INSTALLATION OF SWING MACHINERY ASSEMBLY

- Carry out installation in the reverse order to removal

※ 1
Mounting bolts: 175 ± 20 kgm

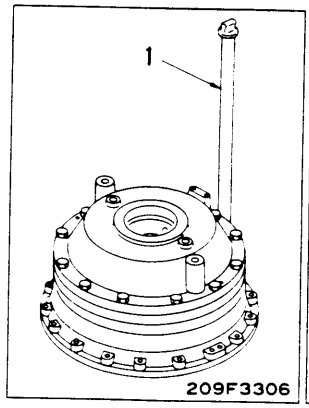
- Refilling with oil
  Add oil through the oil filler to the specified level.
  Swing machinery case: Approx. 37 ℓ

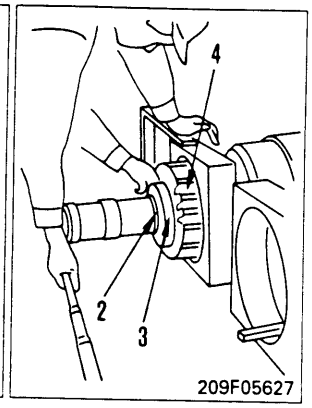


DISASSEMBLY OF SWING MACHINERY ASSEMBLY

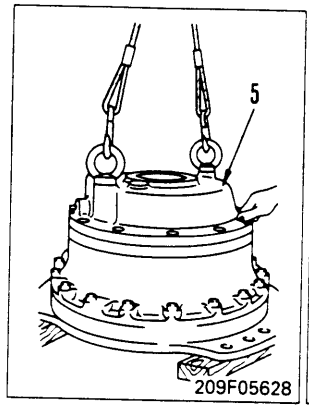
1. **Oil filler**
   Remove oil filler (1).

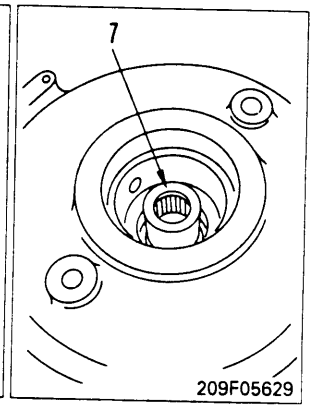
2. **Pinion gear**
   Remove bolt (2), then remove holder (3) and pinion gear (4).



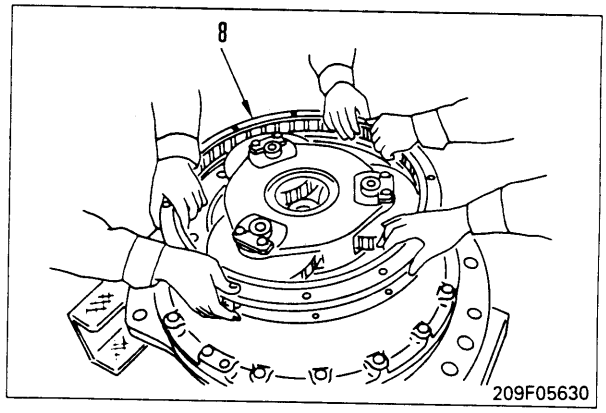


3. **Case**
   1) Turn over machinery assembly, screw in forcing screws, then remove case (5).
   2) Remove sun gear (7).

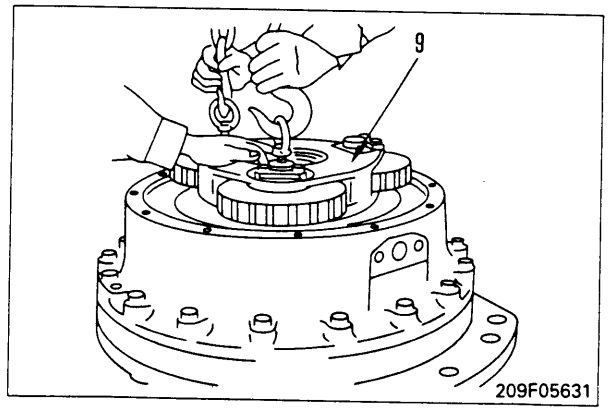




4. **Ring gear (small)**
   Remove ring gear (8).



5. **Carrier assembly (small)**
   1) Using eyebolts, lift off carrier assembly (9).



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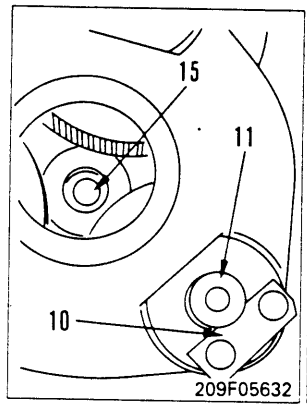
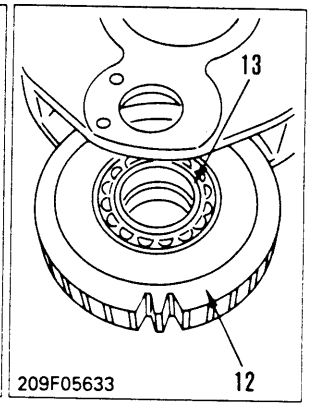
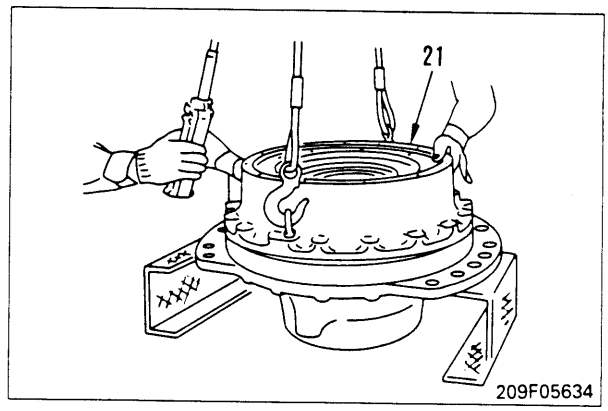
2) Disassemble carrier assembly as follows.
   i) Remove lock plate (10), and pull out shaft (11), then remove gear (12), bearing (13), and thrust washer.
   ii) Remove bolts (15), then remove shaft from carrier.





6. Case

Using eyebolts, remove case (21).



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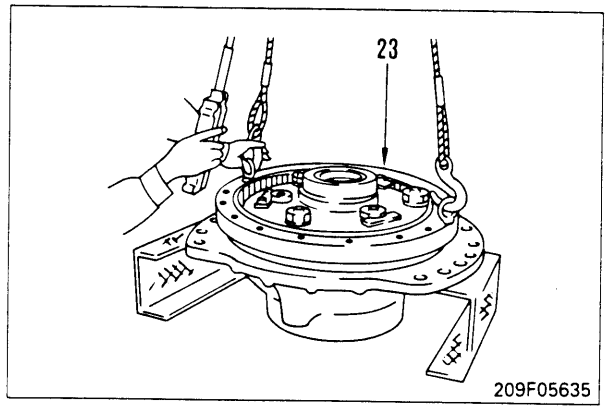
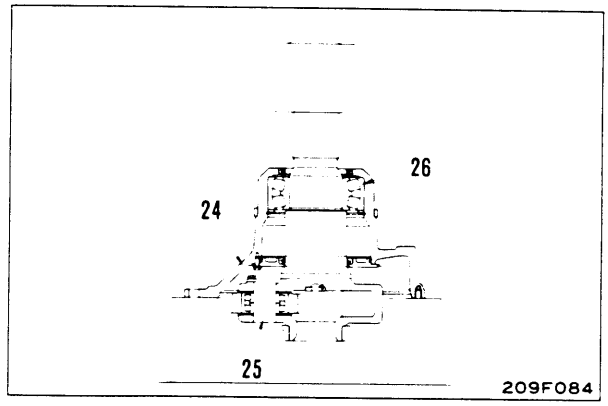
7. Ring gear (large)

Using eyebolt, remove ring gear (23).

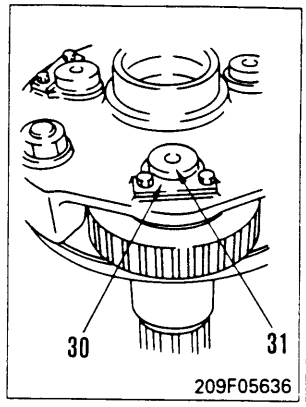


8. Carrier assembly (large)

1) Move to a press, and support case (24).
2) Push shaft, and pull out carrier assembly (25) from bearing (26) to remove.



3) Remove lock plate (30), and pull out shaft (31), then remove gear (32), bearing (33), and thrust washer.
   ★ Do not disassemble the carrier if it is to be used again.



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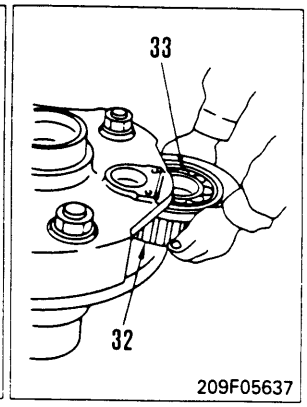
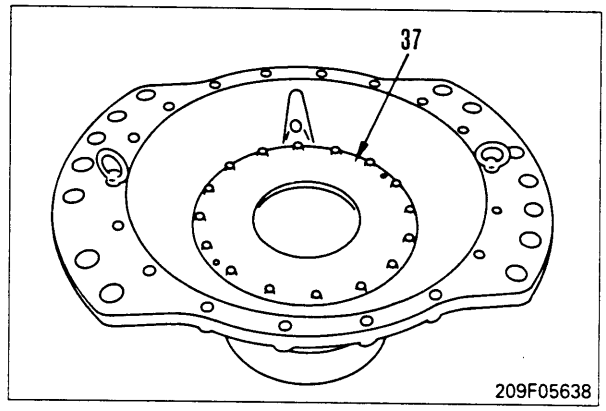


209F05637

9. Cover, bearing

1) Remove cover (37).



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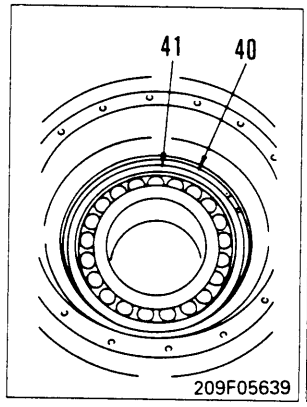
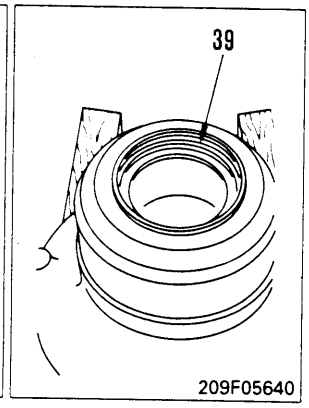
2) Remove snap ring (40) and spacer (41).

3) Remove oil seal (39).



209F05639



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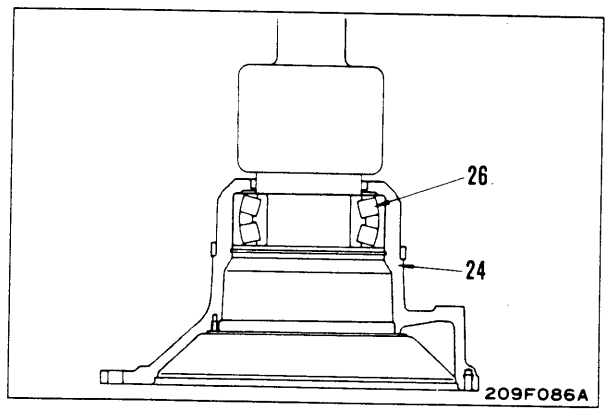
4) Support case (24), and push bearing (26) with press to remove.

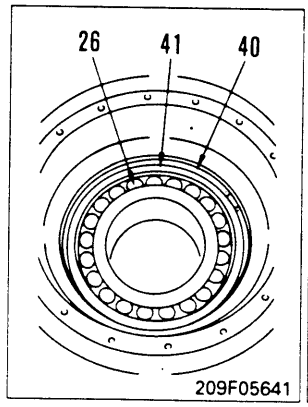


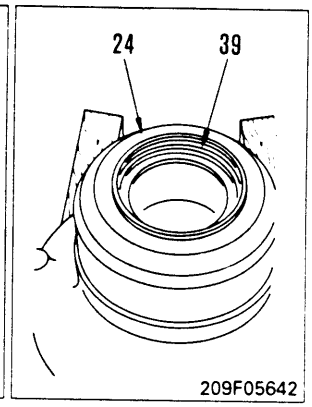
209F086A

ASSEBMLY OF SWING MACHINERY ASSEMBLY

1. Bearing, cover

1) Expand fit or press fit bearing (26) to case (24), then install spacer (41) and snap ring (40).
2) Install oil seal (39) to case (24).
   Oil seal: Grease (G2-LI)

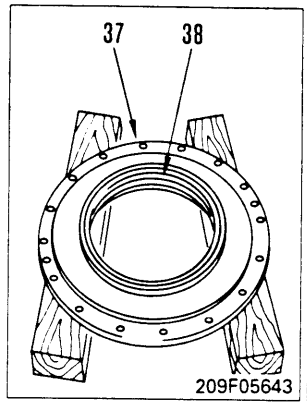


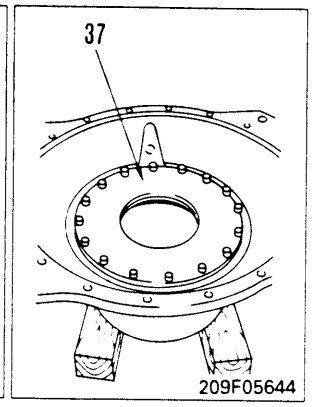


3) Install oil seal (38) to cover (37).
   Oil seal: Grease (G2-LI)

4) Fit gasket sealant and install cover (37).
   Case end: Gasket sealant (LG-6)
   Bolt: Thread tightener (LT-2)

5) Fill inside of case with grease (G2-LI).
   ★ Amount of grease: 6ℓ





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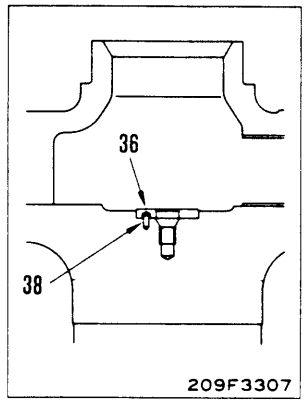
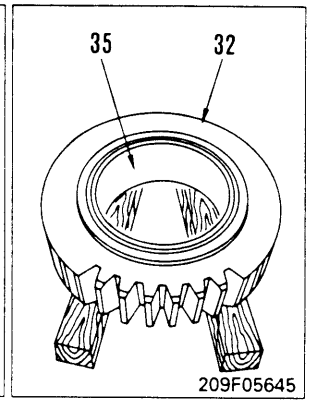
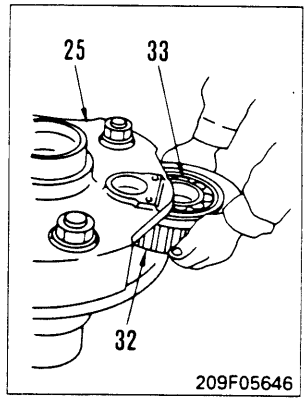
2. Carrier assembly (large)

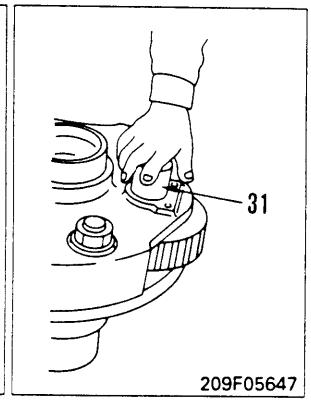
1) Assemble carrier assembly as follows.
   i) Align thrust washer (36) with dowel pin (38) then install to carrier.
   ii) Install outer race (35) to gear (32).





   iii) Assemble bearing (33) in gear (32), put thrust washers in contact at both ends, then set in carrier (25).
      ★ Be careful not to change the combination of bearings.
   iv) Expand fit shaft (31).
      ★ Fit a lock plate to the shaft, align the bolt holes and install.

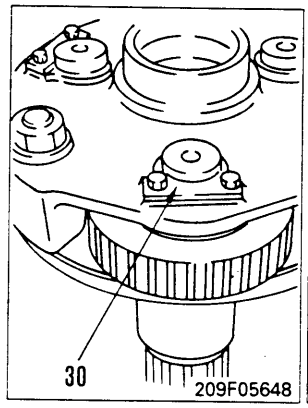


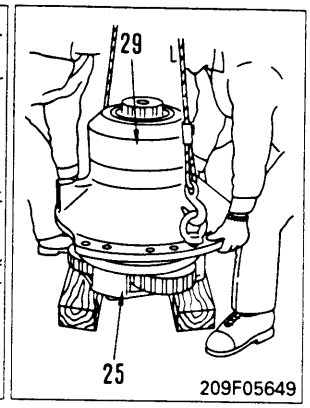


v) Secure lock plate (30) with bolt.
Bolt: Thread tightener (LT-2)
Bolt: 11.5 ± 1 kgm

2) Set carrier assembly (29) with planetary gear side at bottom.

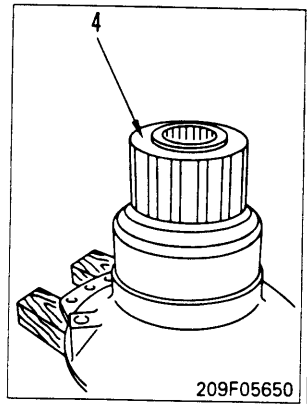
3) Raise case assembly (29) and set in carrier assembly (25).

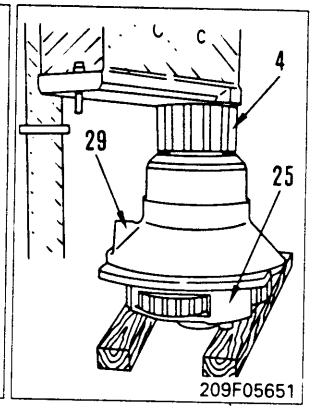




4) Install gear (4) to carrier.

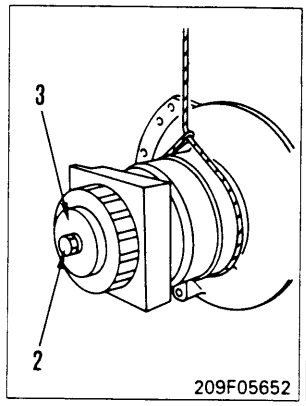
5) Push gear (4) with press (push inner race of bearing), and install carrier assembly (25) to case assembly (29).

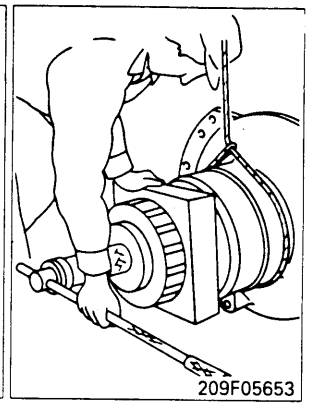




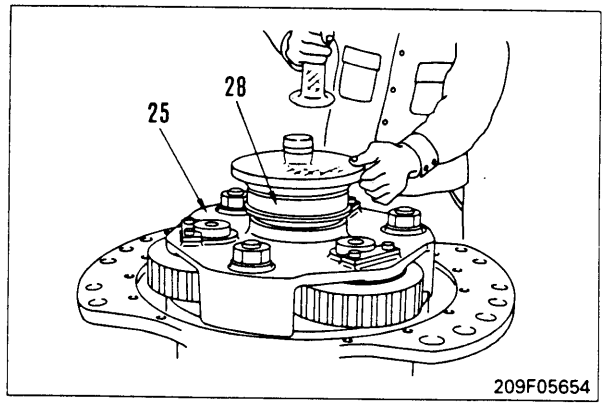
6) Fit O-ring and align holder (3) with dowel pin, then install to gear.

7) Tighten bolts (2).
Bolt: 175 ± 20 kgm





8) Install inner race (28) to carrier (25).



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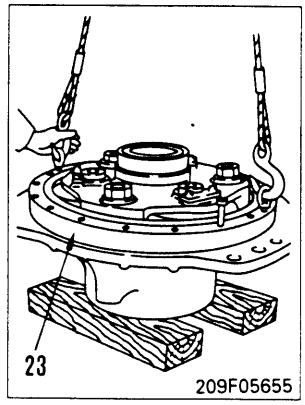
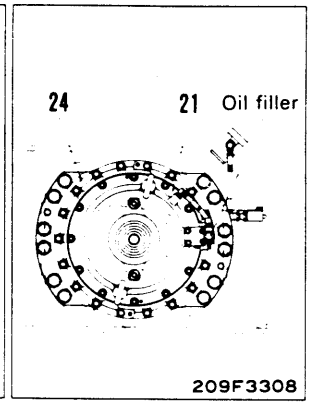
3. **Ring gear (large)**

Fit gasket sealant and install ring gear (23).

Case end: Gasket sealant (LG-6)

★ Compared to the drain of case (24), align the bolt holes and install so that the oil filler of case (21) is 87° to the left (as seen from the drain side).



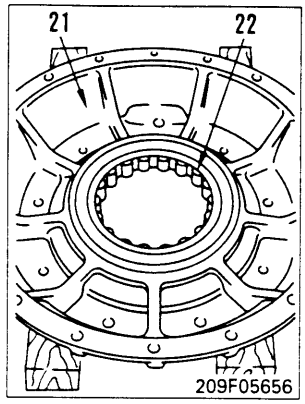


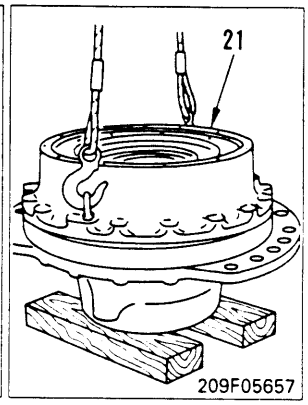
4. **Case**

1) Install bearing (22) to case (21).
2) Fit gasket sealant and align bearing with inner race of carrier, then install case (21).
   ★ Check that the position of the oil filler is 87° to the left (as seen from the drain) of the drain.

Ring gear end: Gasket sealant (LG-6)

kgm Bolt: 28.5 ± 3 kgm





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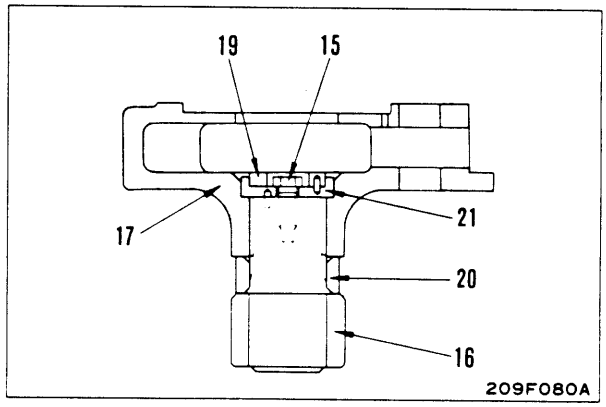
5. **Carrier assembly (small)**

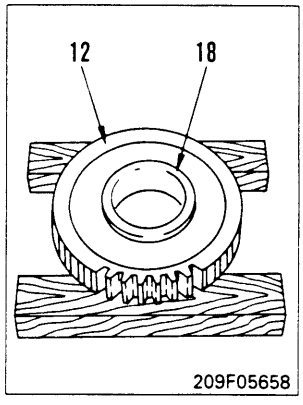
1) Assemble carrier assembly as follows.
   i) Assemble collar (20) in shaft (16).
   ii) Assemble shaft in carrier (17), put holder (21) in contact and tighten bolts (15).

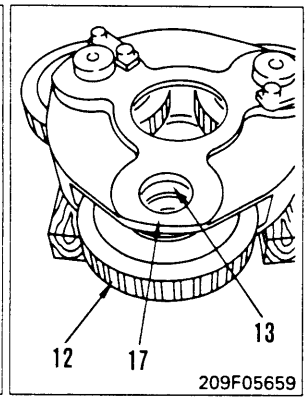
Bolt: Thread tightener (LT-2)

kgm Bolt: 28.5 ± 3 kgm

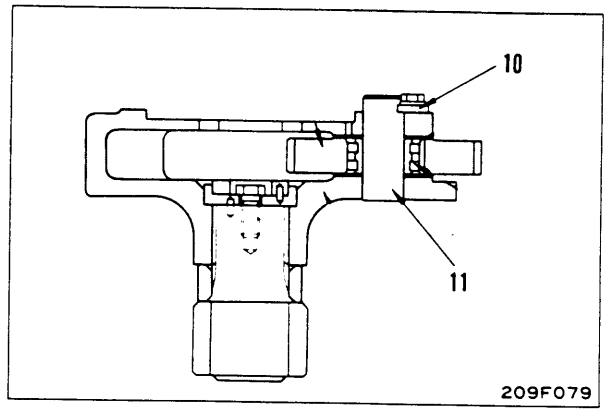
   iii) Install thrust washer (19).
   iv) Install outer race (18) to gear (12).
   v) Assemble bearing (13) in gear (12), put thrust washers in contact at both ends, then set in carrier (17).
      ★ Be careful not to change the combination of the bearing.





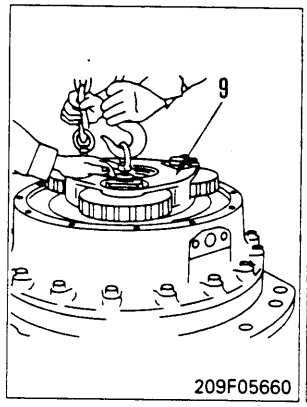


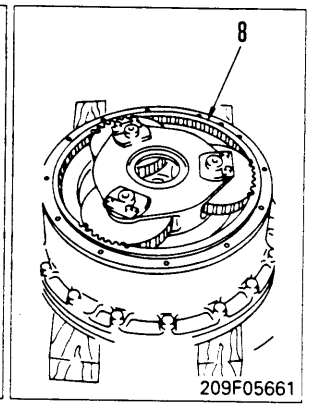
vi) Expand fit shaft (11).
★ Fit lock plate to shaft, align bolt hole and install.
vii) Secure lock plate (10) with bolt.
Bolt: Thread tightener (LT-2)
Bolt: 11.5 ± 1 kgm



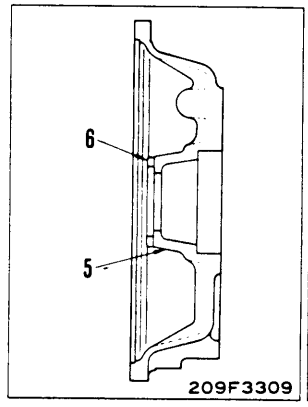
2) Raise carrier assembly (9) and install.

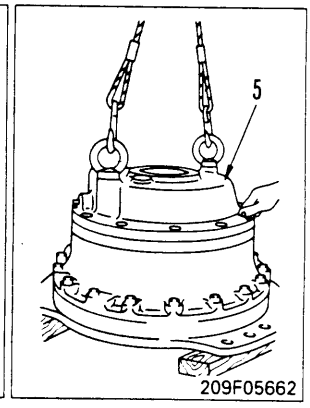
6. Ring gear (small)
Fit gasket sealant and install ring gear (8).
Case end: Gasket sealant (LG-6)





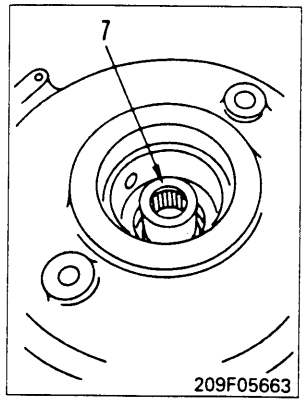
7. Case
1) Install thrust washer (6) to case (5).
2) Fit gasket sealant and install case (5).
★ Align the holes of the oil filler bracket mounting bolts with the oil filler.
Case: Gasket sealant (LG-6)
Bolt: 11.5 ± 1 kgm

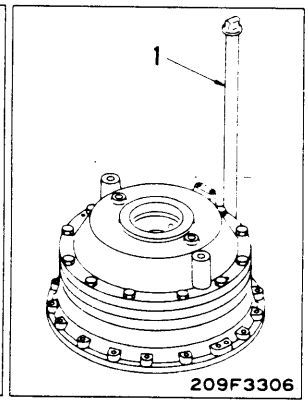




3) Install sun gear (7).

8. Oil filler
Fit O-ring and install oil filler (1).





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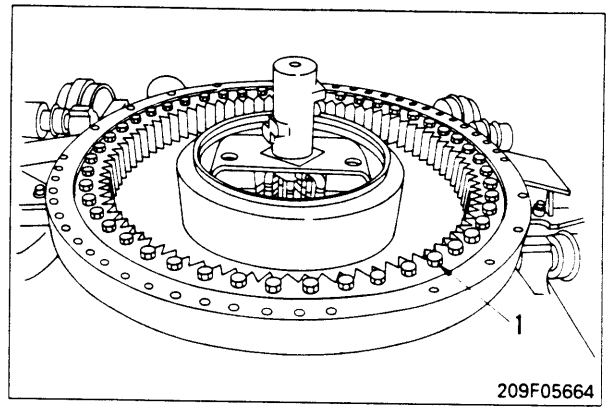
REMOVAL OF SWING CIRCLE ASSEMBLY

1. For details, see REMOVAL OF REVOLVING FRAME ASSEMBLY.
2. Remove mounting bolts (1). ※ 1
3. Pass a round bar through revolving frame mount hole, fit wire, then lift off swing circle assembly (2). ※ 2

   kg Swing circle assembly: 1,400 kg
4. Remove seal (3).



INSTALLATION OF SWING CIRCLE ASSEMBLY

- Carry out installation in the reverse order to removal.

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※ 1

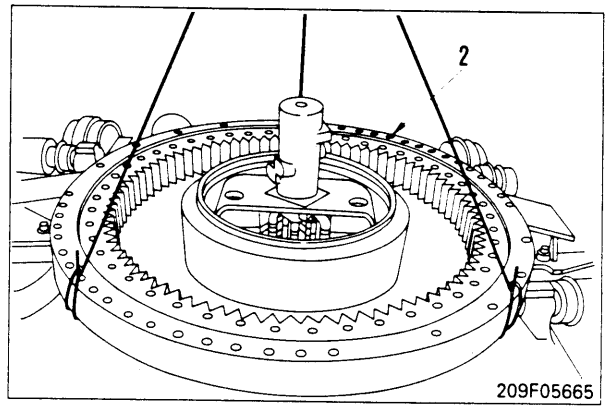
Mounting bolt: Thread tightener (LT-2)

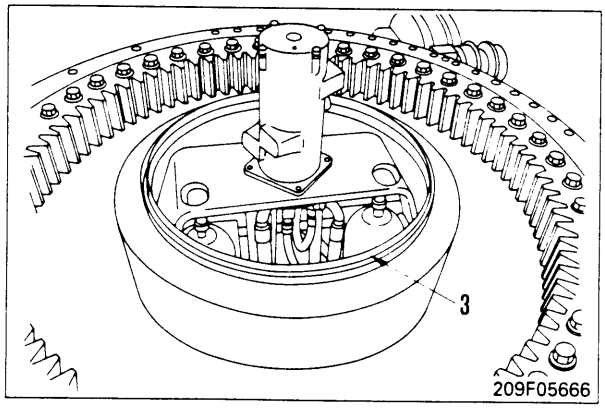
kgm Mounting bolt: 175 ± 20 kgm

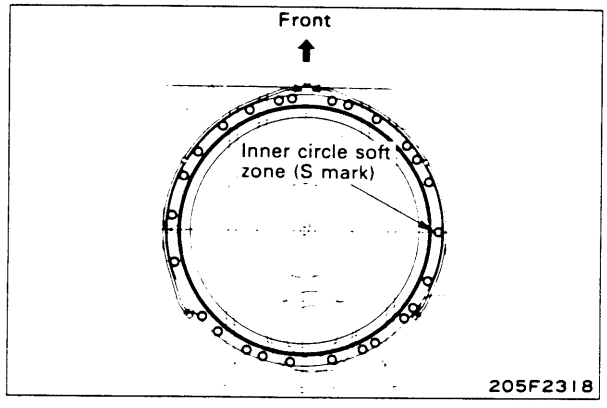
※ 2

Swing circle mounting surface: Gasket sealant (LG-6)

★ Volume of grease in oil bath (G2-LI): Approx. 95ℓ
★ Coat the inside teeth with grease (G2-LI).
★ Set with the inner circle soft zone facing the left, then install.

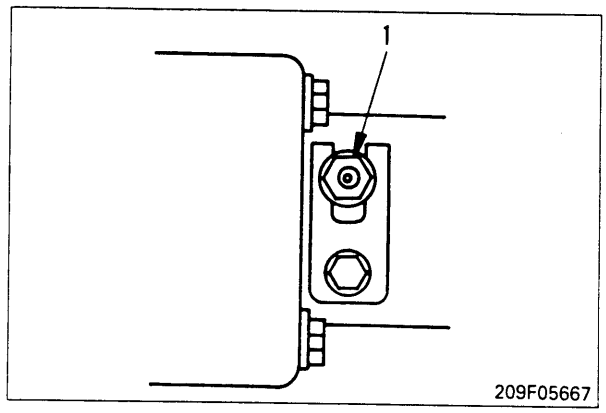






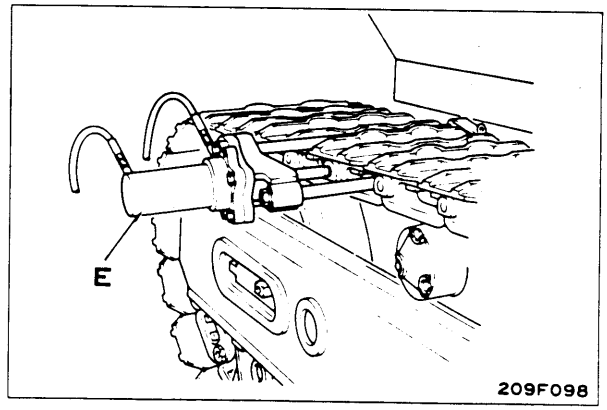
REMOVAL OF TRACK SHOE ASSEMBLY

1. Positioning master pin
   ★ Move the master pin to a position midway between the idler and carrier roller. Leave enough space for the track shoe assembly to be laid out to the rear.

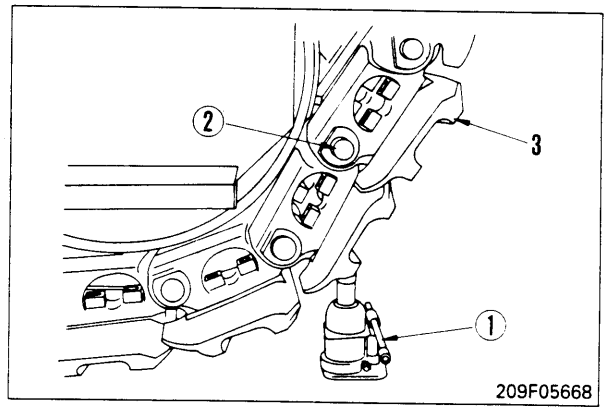


2. Loosen tension of the track shoe. ※1
   ⚠ When loosening lubricator (1), never loosen it more than one turn.
   ★ If the track tension is not relieved when the lubricator is loosened, move the machine backwards and forwards.

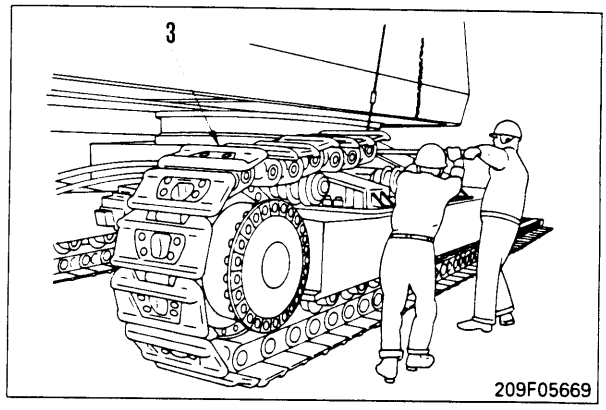
3. Using tool **E**, remove master pin.



4. Set block or hydraulic jack ① (10 ton) under shoe at idler, and remove guide pin ② . ※2



5. Raise tip of track shoe with crane, move chassis slowly in reverse, and lay out track shoe assembly (3).



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INSTALLATION OF TRACK SHOE ASSEMBLY

- Carry out installation in the reverse order to removal.

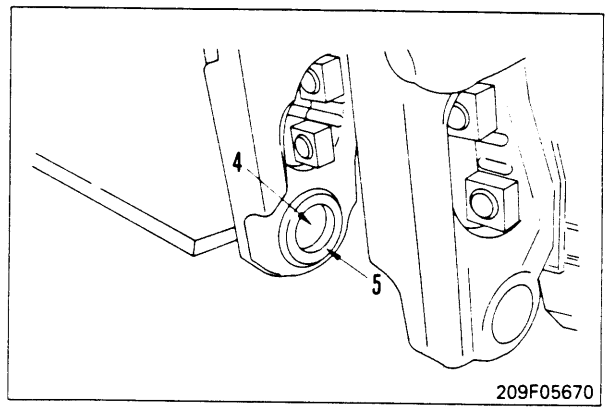
※ 1

★ For details of the track shoe tension, see TESTING AND ADJUSTING, Adjusting track shoe tension.

kgm Lubricator: 7.5 ± 1.5 kgm

※ 2

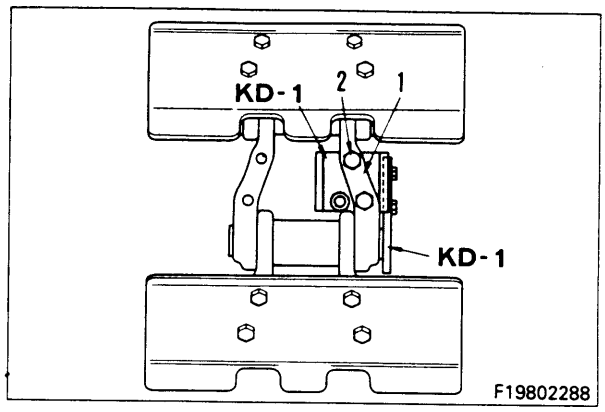
★ Assemble spacer (4) and washer (5) to the link, join with the link at the bottom, then install the guide pin.



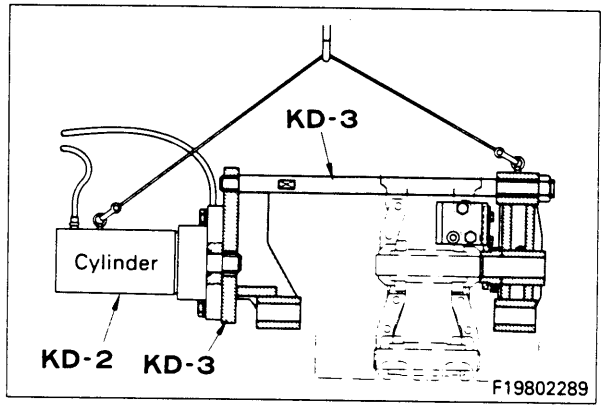
020905

FIELD DISASSEMBLY OF ONE LINK

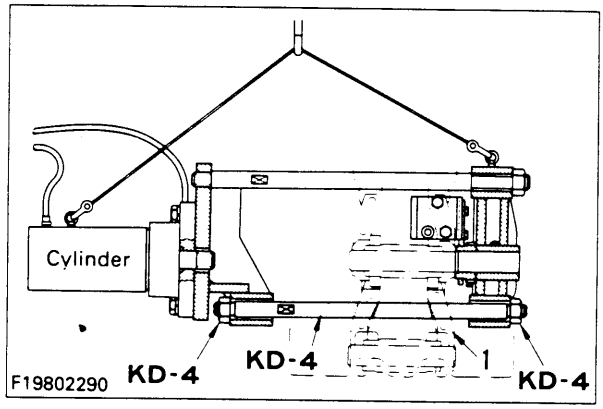
1. Using two bolts (2), install tool **KD-1** (adapter, guide bolt) to link (1).



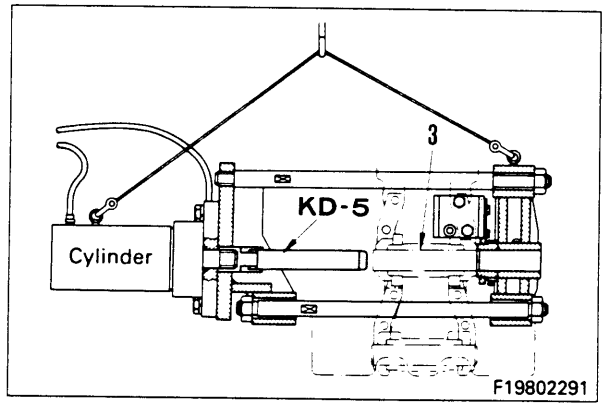
2. Assemble tool **KD-2** (pump, cylinder 150 t) and tool **KD-3** (frame, rod, adapter, bolt x 1, eyebolt), then raise the assembly and set on the track.



3. Insert the rod of tool **KD-4** from the cylinder end, and install with two nuts.



4. Set tool **KD-5** (adapter, guide, pusher) in position, then apply hydraulic pressure and remove pin (3). When the cylinder reaches the end of its stroke, insert extension **KD-5** between the adapter and guide, and repeat the operation.



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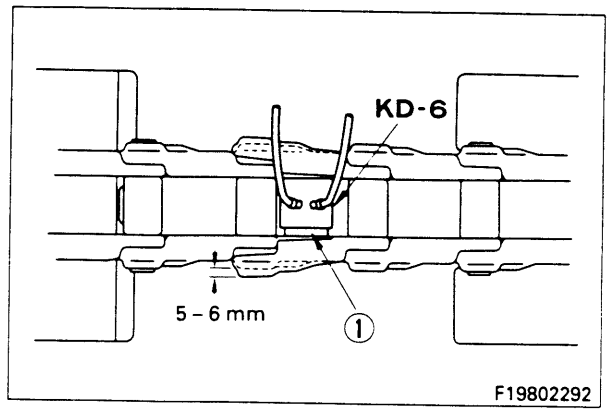
5. Set tool **KD-6** (30 t puller) and spacer ① to the center of the roller tread of the link to be disassembled, then apply hydraulic pressure to the puller, open the link 5 – 6 mm, and disconnect the link.



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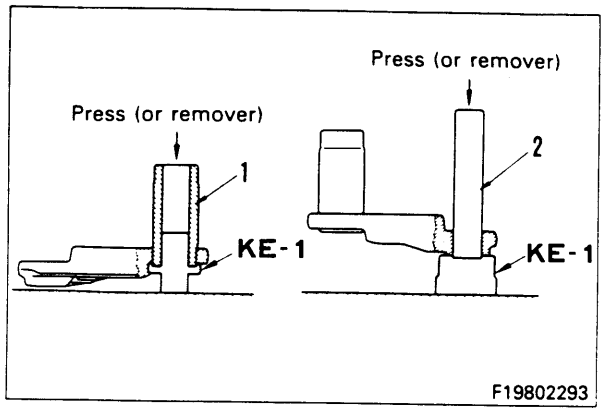
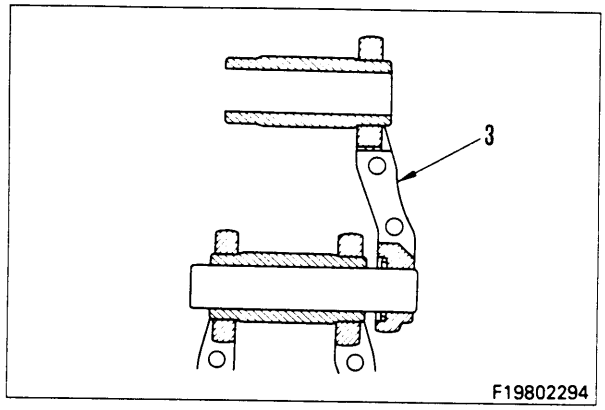
FIELD ASSEMBLY OF ONE LINK

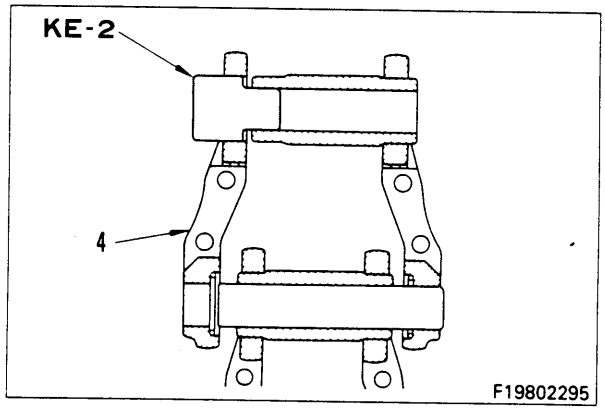
1. Assemble the link sub-assembly.
   1) Set tool **KE-1** to the end face of the link, then press fit bushing (1).
   2) Set tool **KE-1** to the end face of the link (pin end), and press fit pin (2).



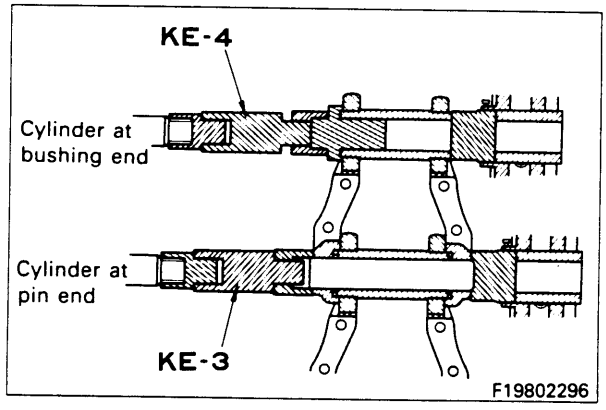
2. Set link sub-assembly (3) on the link to be connected.



3. Set link (4) on the opposite side, and support with tool **KE-2** (guide).



4. Set tools **KE-3** and **KE-4** in the same way as for the operation to remove the pin, then use tool **KE-3** (adapter, extension, guide, adapter, bolt) for press fitting the pin, and tool **KE-4** (extension, guide, adapter, bolt) for press fitting the bushing, and press fit in turn.



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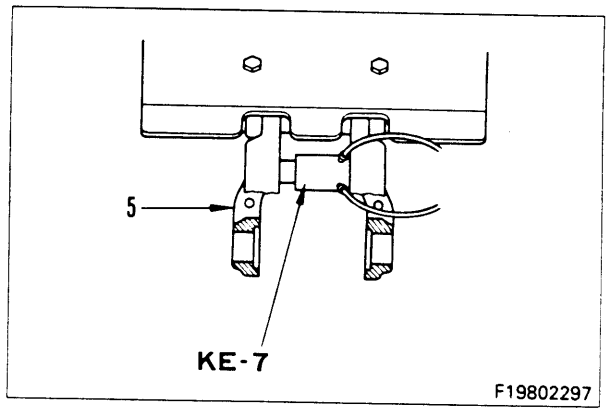
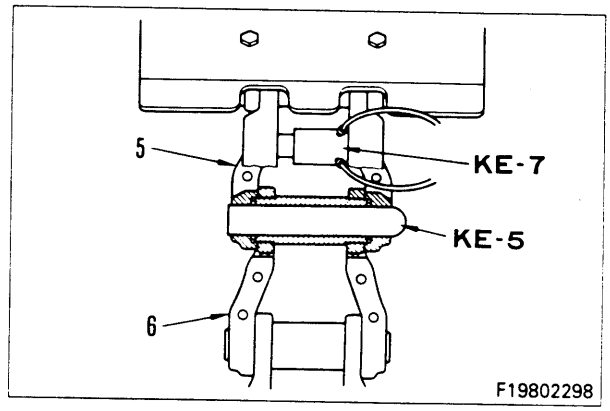
5. Use tool **KE-7** (30 t puller) in the same way as when disassembling, and push open link (5) at the bushing end.



6. Set link (6) at the pin end to link (5) at the bushing end, connect with tool **KE-5** (guide), then remove tool **KE-7** (puller).



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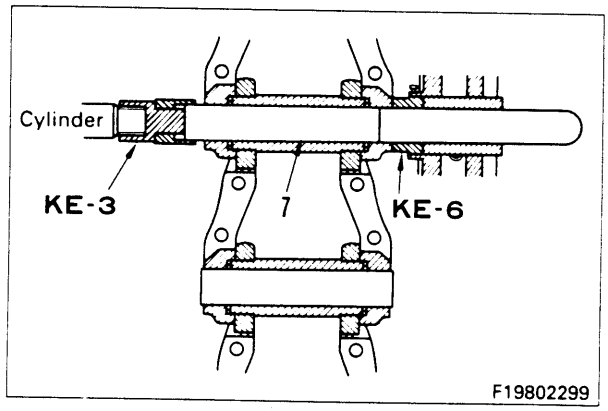
7. Set tool **KE-3** at pin (7) end, then use tool **KE-6** (adapter, bolt and guide) to press fit pin (7).
   Pin press fitting hole in link: Gasket sealant (LG-1)

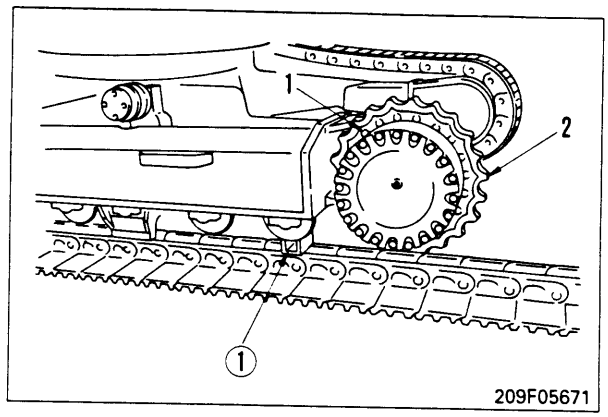


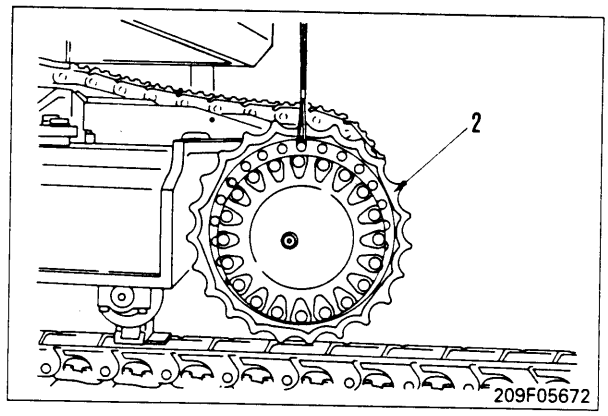
REMOVAL OF SPROCKET

1. Disassemble track shoe assembly.
   For details, see DISASSEMBLY OF TRACK SHOE ASSEMBLY.

2. After swinging work equipment 90°, raise chassis, set block ① under crawler, then lower chassis slowly.
   ⚠ Lower the work equipment completely to the ground.

3. Remove mounting bolts (1), then raise sprocket (2) and remove. ※ 1
   kg Sprocket: 130 kg





INSTALLATION OF SPROCKET

- Carry out installation in the reverse order to removal.

※ 1
kgm Mounting bolt: 137.5 ± 12.5 kgm

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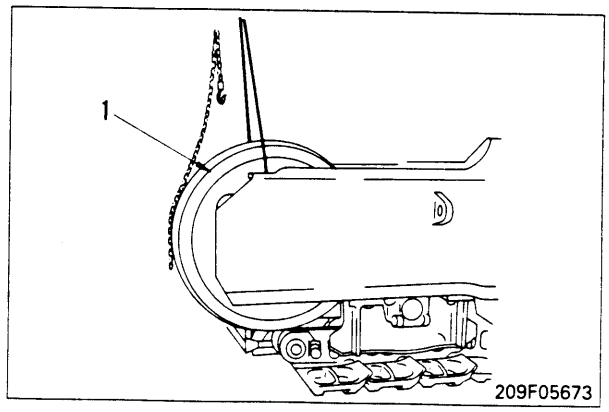
REMOVAL OF IDLER ASSEMBLY

1. For details, see REMOVAL OF TRACK SHOE ASSEMBLY.

2. Remove idler assembly (1).
   ★ Pull out the idler assembly, and lift off the idler and adjustment cylinder.
   kg Front idler assembly: 500 kg



INSTALLATION OF IDLER ASSEMBLY

- Carry out installation in the reverse order to removal.

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DISASSEMBLY OF IDLER ASSEMBLY

1. Remove plug and drain oil.

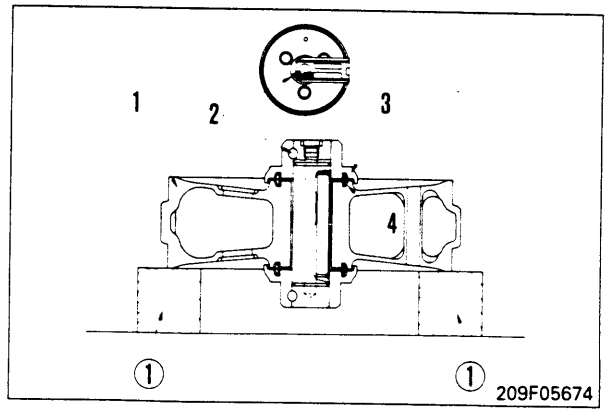
   Idler: Approx. 550 – 630 cc

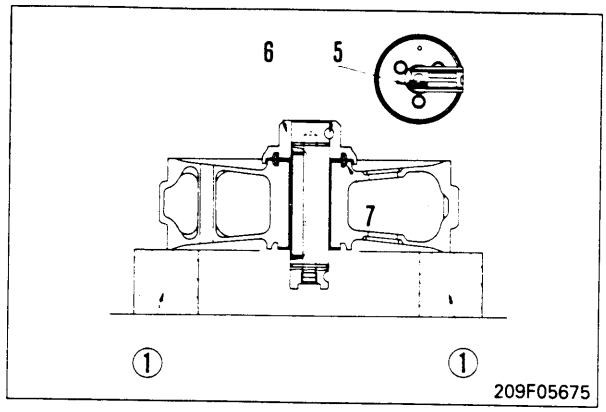
2. Set idler assembly (1) to block ①, and remove bolt and nut (2), then remove support (3).

3. Remove floating seal (4).

4. Turn over idler assembly, and remove bolt and nut (5), then remove support (6).

5. Remove floating seal (7).





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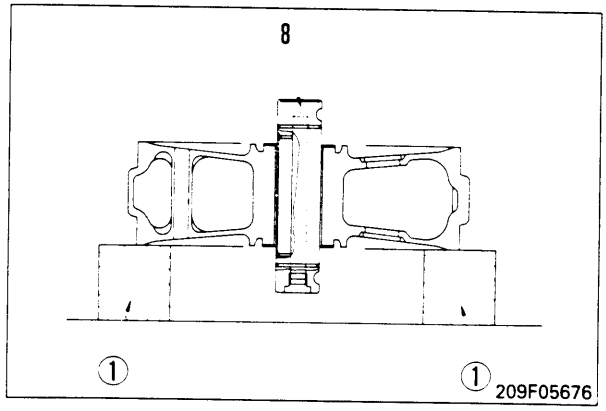
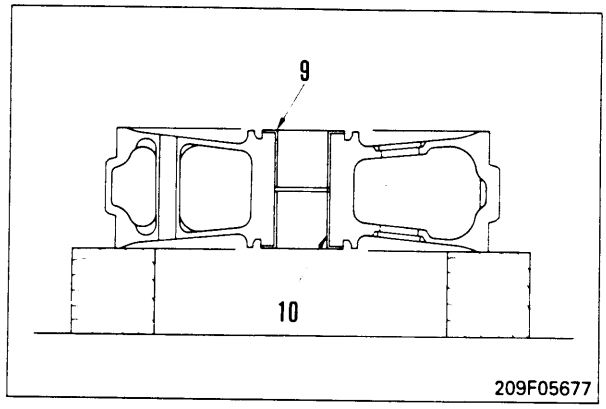
6. Remove shaft (8) from idler.

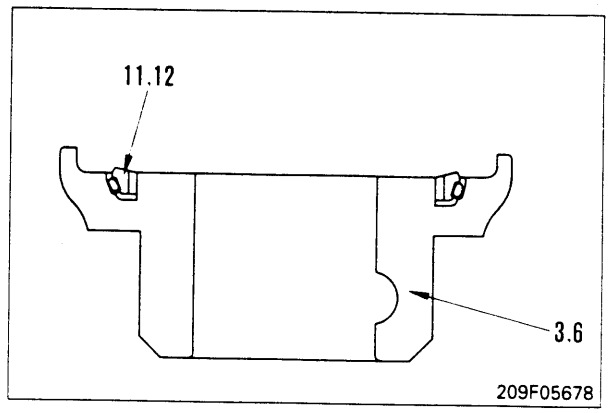


7. Remove bushings (9) and (10) from idler.



8. Remove floating seal (11) from support (3).

9. Remove floating seal (12) from support (6).



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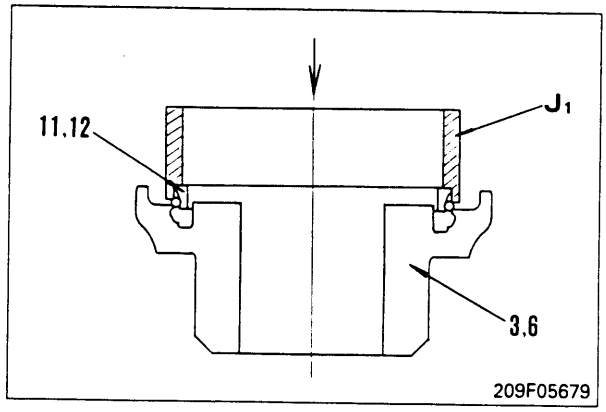
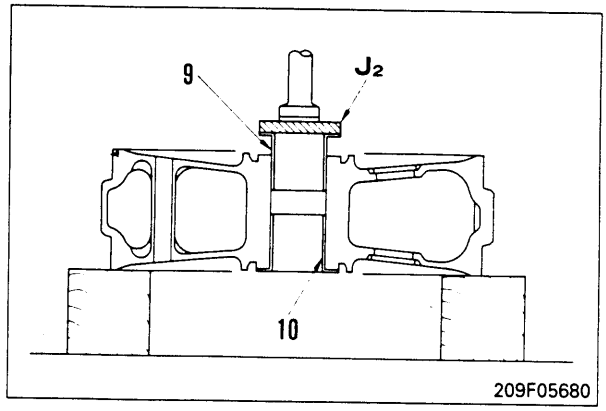
ASSEMBLY OF IDLER ASSEMBLY

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

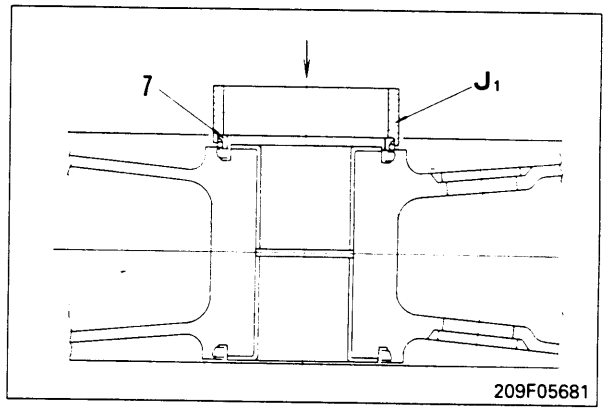
1. Using tool J_1, assemble floating seals (12) and (11) to supports (6) and (3).



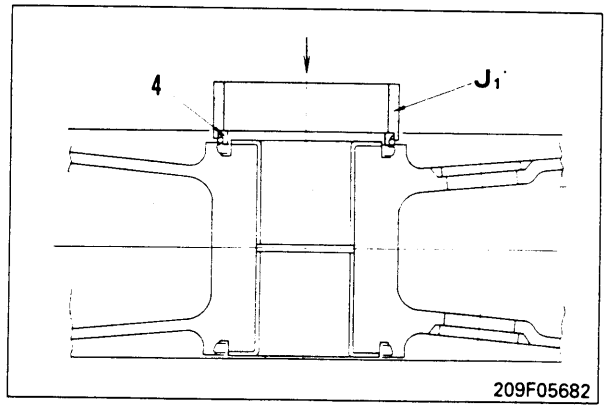
2. Using tool J_2, press fit bushings (10) and (9) to idler.



3. Using tool J_1, assemble floating seal (7) to idler.



4. Turn over idler, then using tool J_1, assemble floating seal (4).



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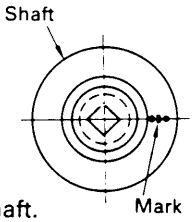
5. Install shaft (8) to idler.
   ★ Pay careful attention to the following points when installing the shaft.
      1) Assemble so that the ●+● mark on the end face of the shaft is at the rear.
      2) Direction for shaft oil filler plugs
         ★ Right side of chassis: Facing outside
         ★ Left side of chassis: Facing inside



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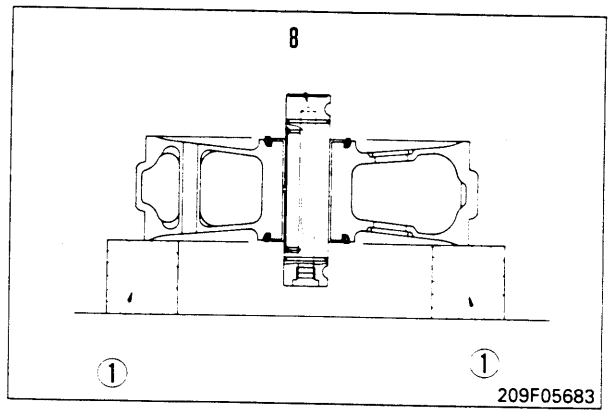
6. Assemble support (6) to shaft.
   ★ Align the cut groove in the shaft with the cut groove in the support, then assemble.

7. Install bolt and nut (5), and secure support (6).



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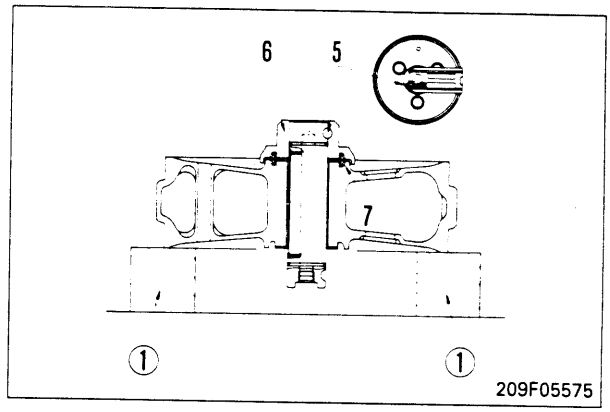

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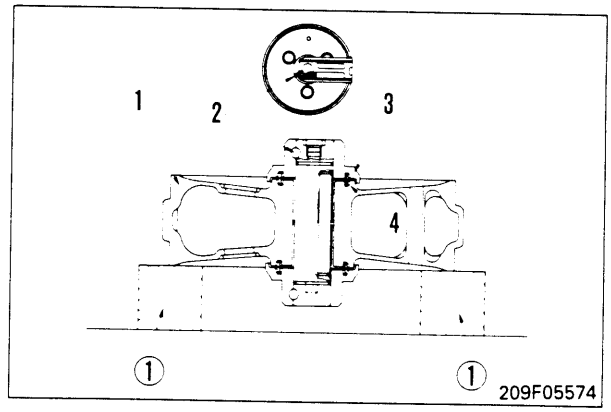
8. Turn over idler, and assemble support (3) to shaft.
   ★ Align the cut groove in the shaft with the cut groove in the support, then assemble.

9. Install bolt and nut (2), and secure support (3).



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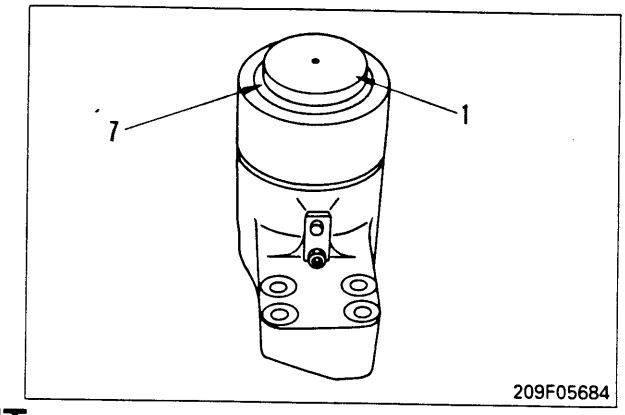
10. Using tool J3, add oil to the specified level, and tighten plug.
    Idler: 550 – 630 cc (GO140B)
    Plug: 21.5 ± 3 kgm

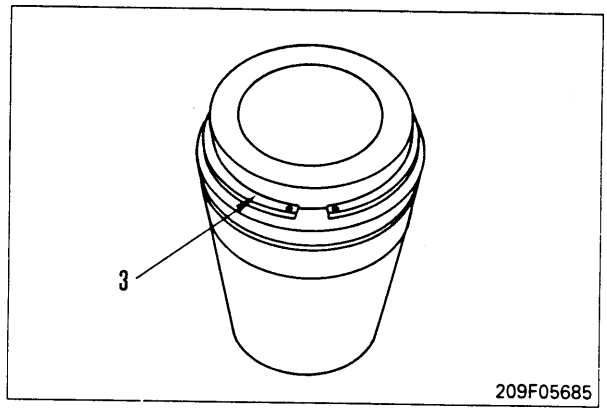
DISASSEMBLY OF IDLER ADJUSTMENT CYLINDER ASSEMBLY

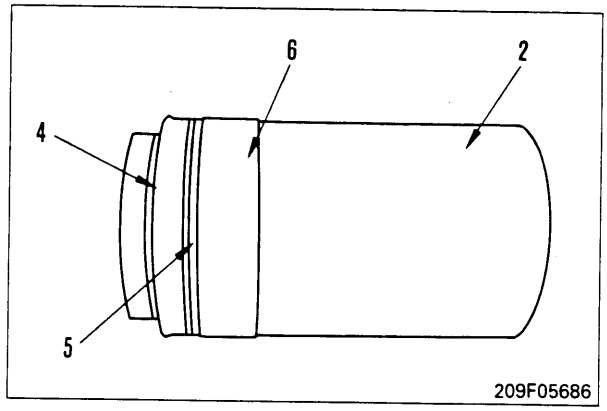
1. Remove plunger assembly (1).
2. Remove snap ring (3), then remove packing (4), backup ring (5), and wear ring (6) from plunger (2).
3. Remove dust seal (7).



ASSEMBLY OF IDLER ADJUSTMENT CYLINDER ASSEMBLY

1. Install wear ring (6) to plunger (2).
2. Fit backup ring (5) and packing (4) to plunger (2), and install snap ring (3).
3. Fill inside with grease (G2-LI), and assemble plunger assembly (1) to piston.
4. Install dust seal (7).





020905

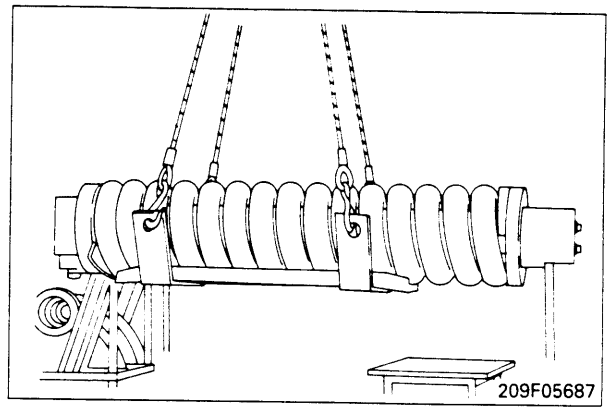
REMOVAL OF RECOIL SPRING ASSEMBLY

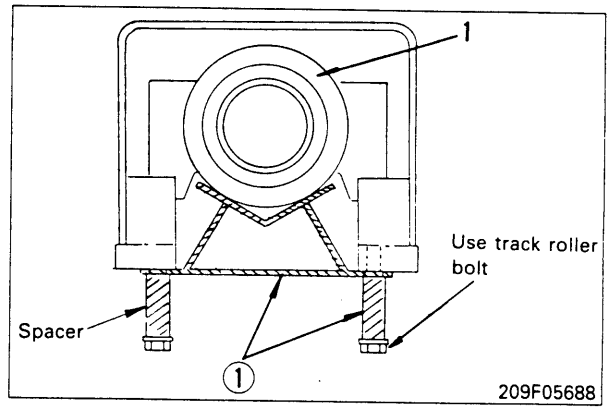
★ The coil portion of the recoil spring assembly catches on the rib inside the track frame, so make a special tool, then disassemble.

1. For details, see REMOVAL OF TRACK SHOE ASSEMBLY.

2. Remove idler assembly.
   For details, see REMOVAL OF IDLER ASSEMBLY.

3. Recoil spring assembly
   1) Remove No. 2 and No. 3 track roller assemblies.
      For details, see REMOVAL OF TRACK ROLLER ASSEMBLY.
   2) After removing track roller assembly, install tool ①.
      ★ Refer to Fig. 1 when making the tool ①.
      ★ Lower the track frame on to the track shoe assembly.
   3) Using eyebolts (Thread dia.=16 mm, Pitch=2.0 mm), pull out recoil spring assembly (1), and lift off.
      kg Recoil spring assembly: 250 kg





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INSTALLATION OF RECOIL SPRING ASSEMBLY

• Carry out installation in the reverse order to removal.

※1

★ Check through the hole (at the 5th track roller from the front) at the side on the inside that the spring is fitted securely in the track frame.

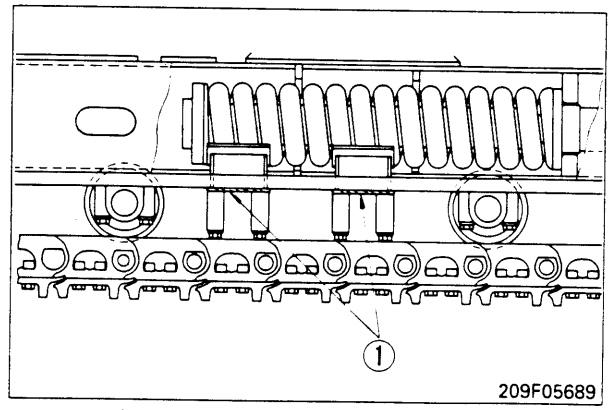
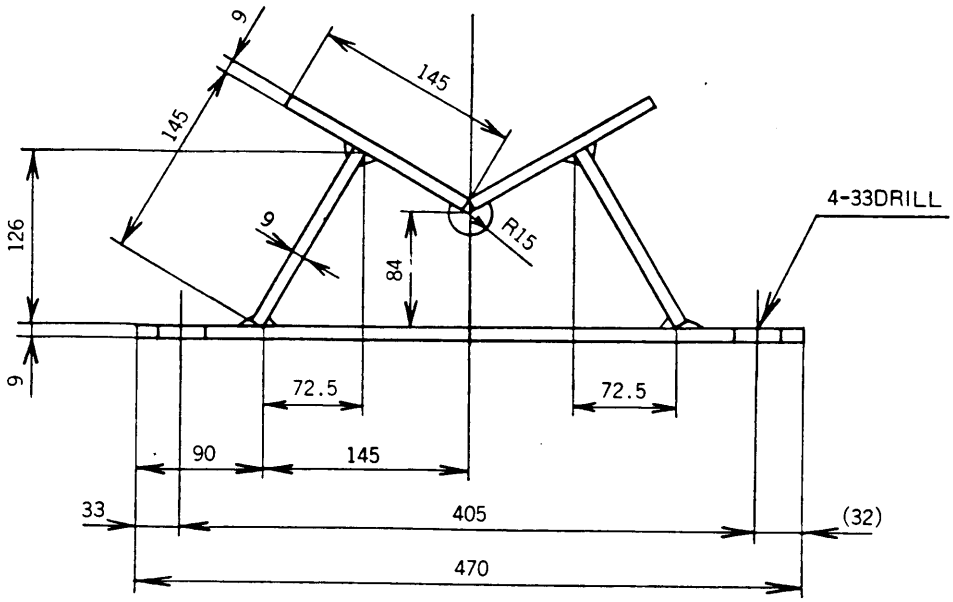
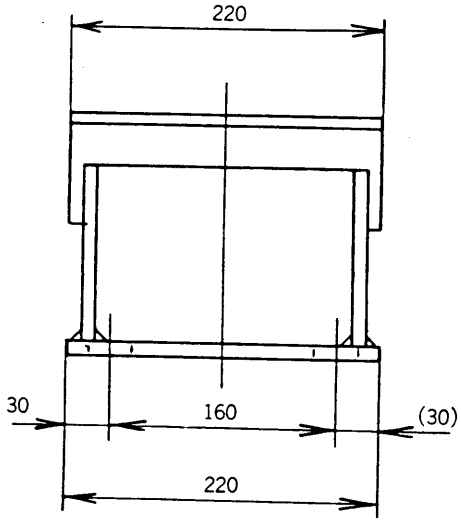
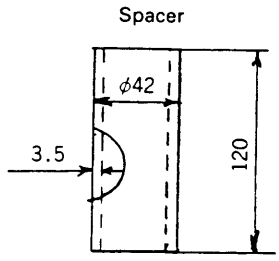


Fig. 1 (For tool ①)







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DISASSEMBLY OF RECOIL SPRING ASSEMBLY

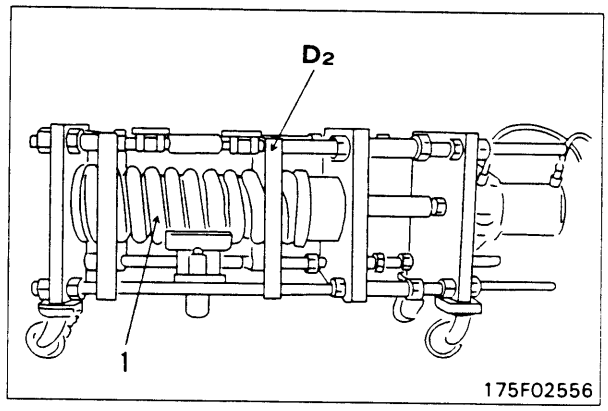
1. Set recoil spring assembly (1) to tool **D2**.
   ⚠ The spring is under a large installed load. This is dangerous, so be sure to set properly.

   ★ Installed load of spring: 50,000 kg

2. Apply hydraulic force slowly to compress spring, then remove lock plate and remove nut (2).

3. Release hydraulic pressure slowly to reduce tension of spring completely, then remove recoil spring assembly (1) from tool **D2**.

4. Remove rear pilot (4) and rod (5) from spring (3).



ASSEMBLY OF RECOIL SPRING ASSEMBLY

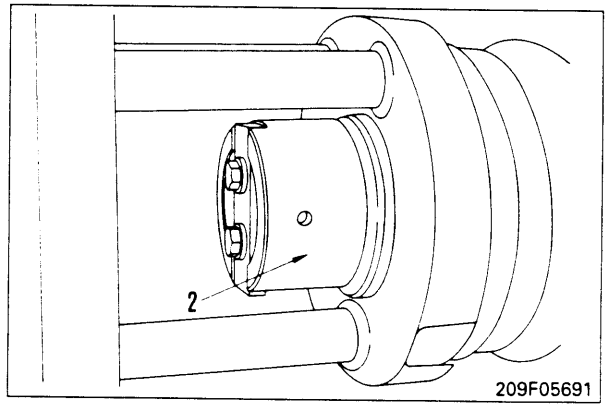
1. Install tool **D1** to tip of rod (5).
   ★ Tool **D1** is to prevent damage to the threads when the rear pilot is inserted.

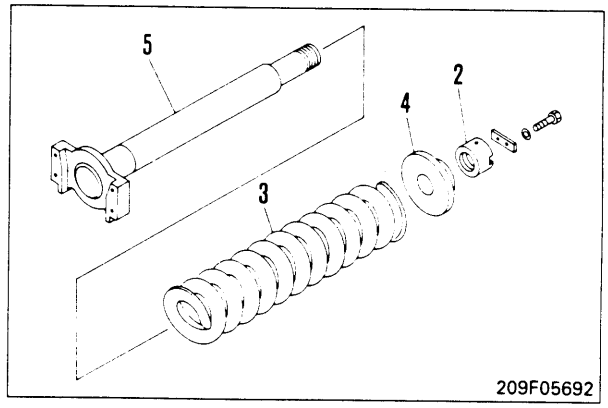
2. Install rod (5) to spring (3).
   Assemble rear pilot (4) and set to tool **D2**.
   ⚠ The spring is under a large installed load. This is dangerous, so be sure to set all parts properly.

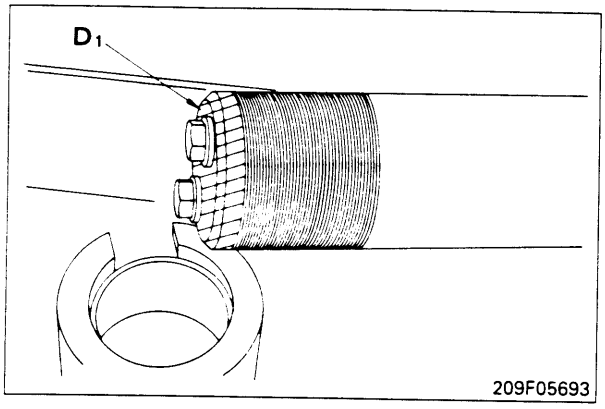
3. Apply hydraulic force slowly to compress spring, then set so that installed length of spring is standard value.
   ★ Installed length "**a**": 1,290 mm.

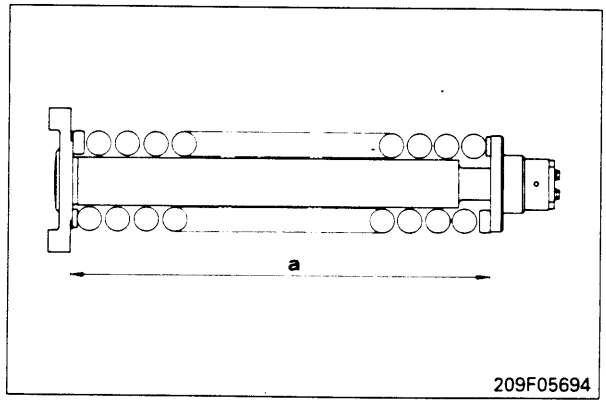
4. Fit nut (2), and secure with lock plate.

5. Release hydraulic pressure slowly to reduce tension of spring completely, then remove recoil spring assembly (1) from tool **D2**.









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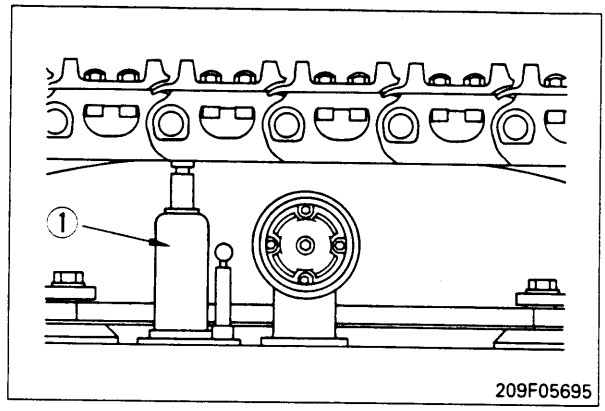
REMOVAL OF CARRIER ROLLER ASSEMBLY

1. Using hydraulic jack ① (10 ton), push up track shoe.

2. Carrier roller assembly.
   1) Loosen bolt (1).
   2) Using tool **F**, support carrier roller assembly.
   3) Open bracket (2) with a screwdriver, push out from inside, and remove carrier roller assembly (3).

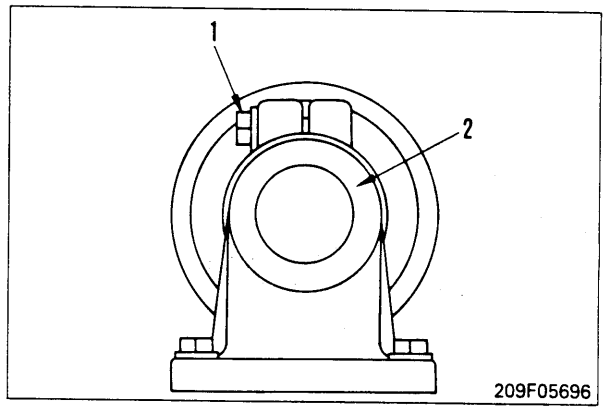
      ⚠ When the roller assembly comes off from the bracket, be careful not to get your fingers caught between the roller and tool **F**.

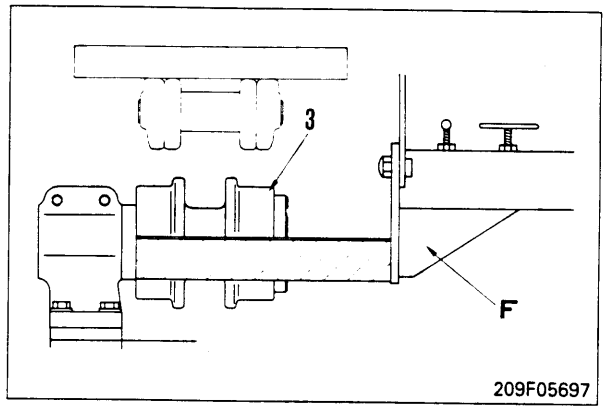
      kg Carrier roller assembly: 70 kg



INSTALLATION OF CARRIER ROLLER ASSEMBLY

- Carry out installation in the reverse order to removal.





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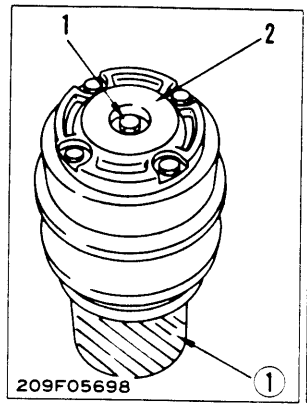
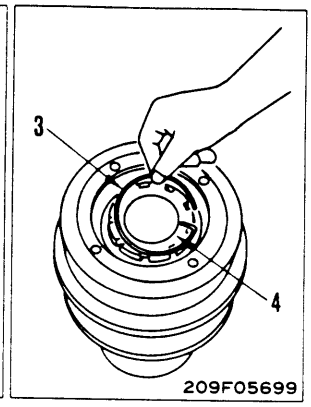
DISASSEMBLY OF CARRIER ROLLER ASSEMBLY

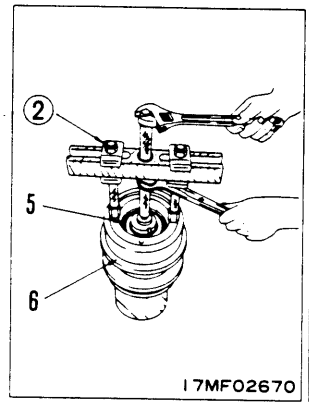
1. Remove plug (1) and drain oil.

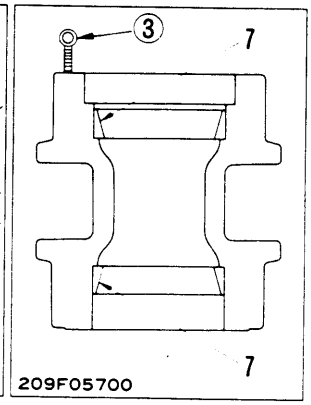
   Carrier roller assembly: Approx. 620 – 730 cc

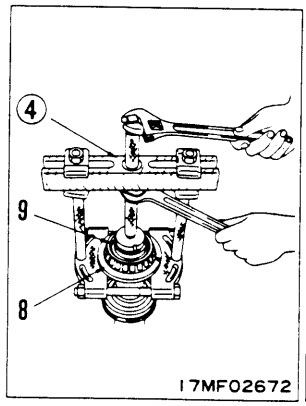
2. Set carrier roller assembly on stand ①.
3. Remove cover (2).
4. Remove ring (3), then using tool **H1**, remove nut (4).
5. Using puller ②, remove bearing (5) together with roller (6) from shaft.
6. Using eyebolts ③, lift off roller (6)
7. Remove 2 outer races (7) from roller.
8. Using puller ④, remove seal guide (8) together with bearing (9) from shaft.
9. Remove floating seal (10) from seal guide (8).
   ★ Be careful not to damage the floating seal, and keep it in a safe place.
10. Using push tool ⑤, remove seal guide (11) from shaft.
11. Remove floating seal (12) from seal guide (11).
    ★ Be careful not to damage the floating seal, and keep it in a safe place.

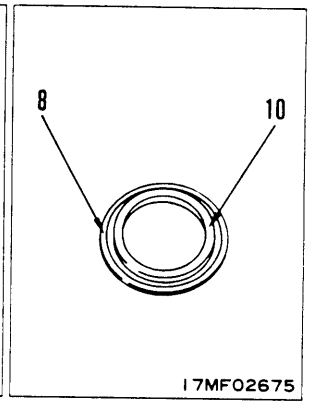


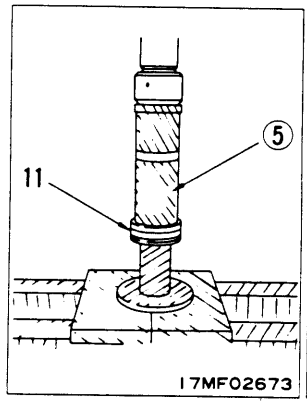


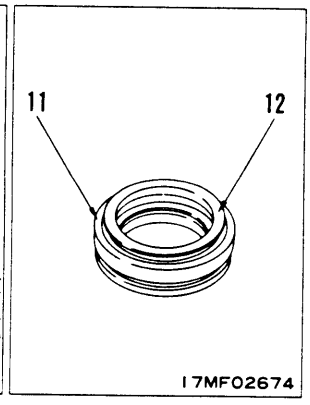












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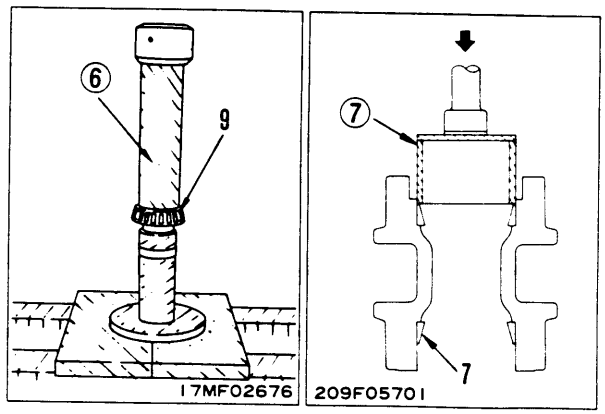
ASSEMBLY OF CARRIER ROLLER ASSEMBLY

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

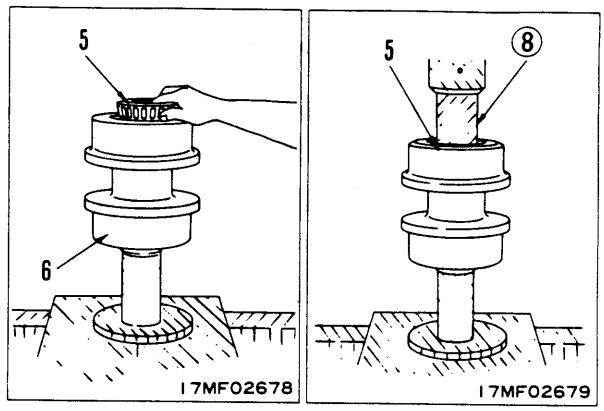
1. Using push tool ⑥ , press fit bearing (9) on shaft.

2. Using push tool ⑦ , press fit 2 outer races (7) to roller.

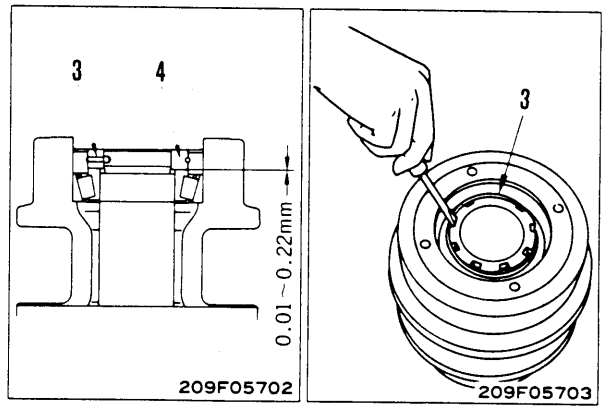


3. Set roller (6) and bearing (5) on shaft.

4. Using push tool ⑧ , press fit bearing (5) on shaft.
   ★ Rotate the roller when press fitting the bearing. Press fit the bearing until the rotation of the bearing becomes slightly heavy.

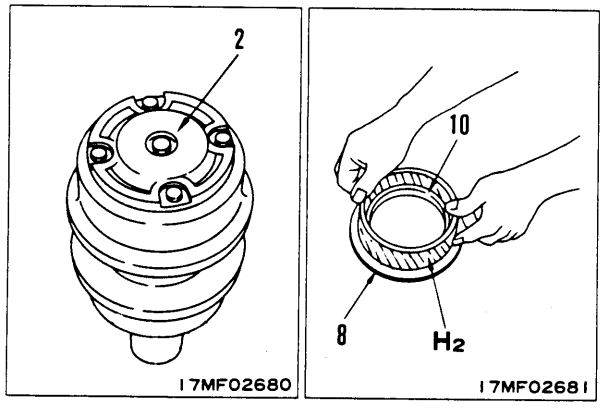


5. Adjust end play of bearing as follows.
   1) Tighten nut (4) temporarily at a torque of 10 kgm. or less.
   2) Loosen nut (4), and align drill hole of shaft and drill hole of nut.
   3) Install ring (3).
   4) Check that end play (total of both ends) is within range of 0.01 – 0.22 mm.



6. Fit O-ring and install cover (2).

7. Using tool H2, install floating seal (10) to seal guide (8).



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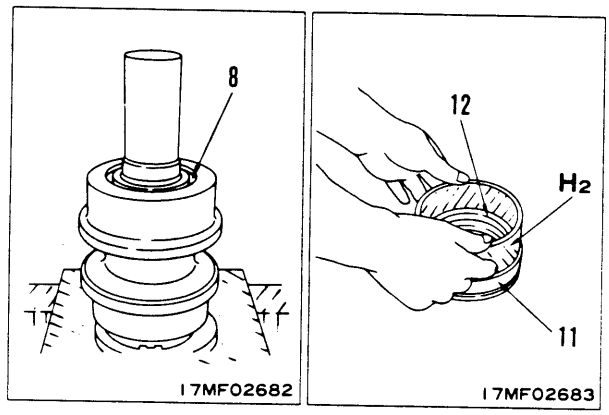
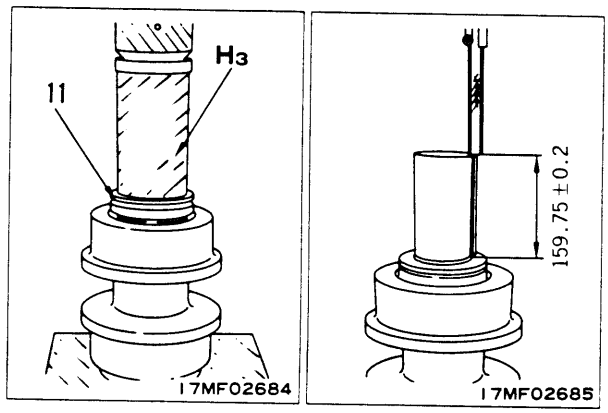
★ Do not coat the O-ring of the floating seal or the O-ring contact surface with oil or grease.

8. Turn over carrier roller assembly, then fit O-ring and install seal guide (8).

9. Using tool **H2**, fit floating seal (12) to seal guide (11), then set on shaft.
   ★ Do not coat the O-ring of the floating seal or the O-ring contact surface with oil or grease.

10. Using tool **H3**, press fit seal guide (11).
    ★ Press fit so that the distance from the end face of the shaft to the top face of the seal guide is 159.75 ± 0.2 mm.





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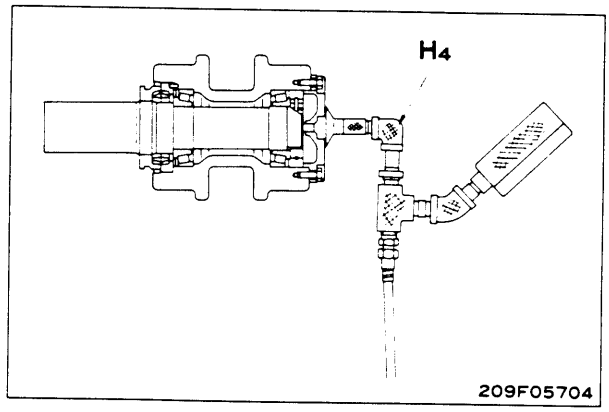
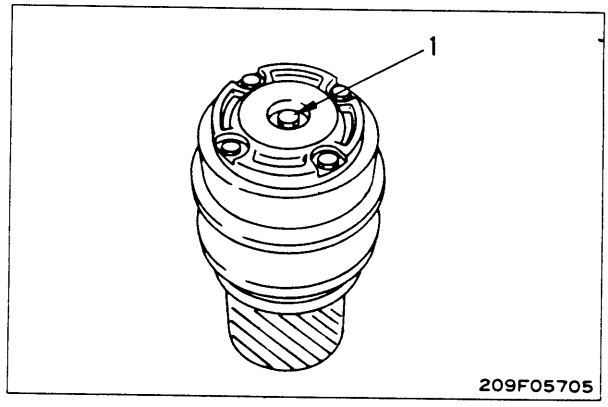
11. Using tool **H4**, apply standard pressure to roller oil filler port, and check for any leakage of air from the seal.
    ★ Standard pressure: 1 kg/cm²
    ★ Method of checking
    The standard pressure must be maintained for 10 seconds, and the gauge reading must not go down.



12. After filling carrier roller assembly with oil, tighten plug (1).
    kgm Plug: 21 ± 5 kgm



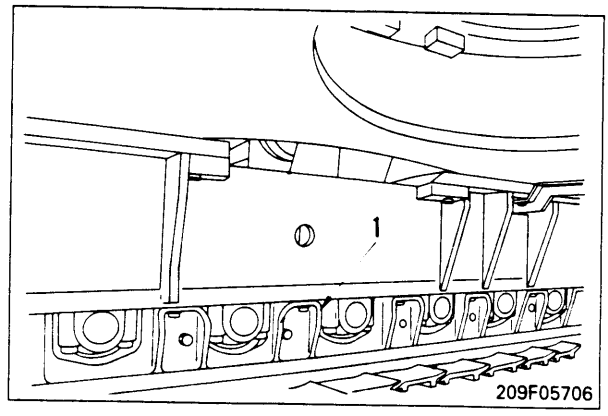
REMOVAL OF TRACK ROLLER ASSEMBLY

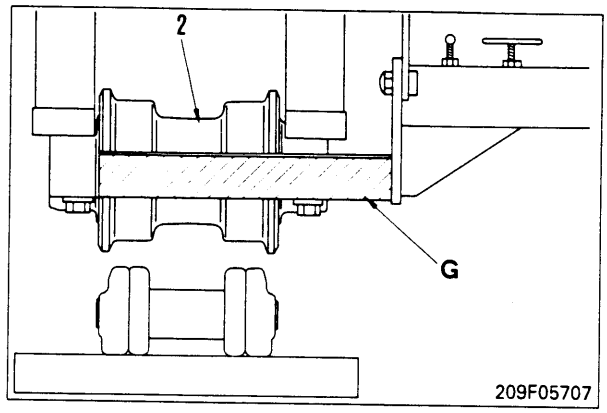
1. Loosen tension of track shoe.
   For details, see REMOVAL OF TRACK SHOE ASSEMBLY.

2. Remove track roller guard (1).
   kg Track roller guard: 170 kg

3. Using work equipment, push up track frame on side which is to be removed.
   ⚠ After jacking up the machine, set a block on top of the track shoe.

4. Using tool **G**, remove track roller assembly (2). ※ 1
   kg Track roller assembly (single flange): 140 kg





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INSTALLATION OF TRACK ROLLER ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

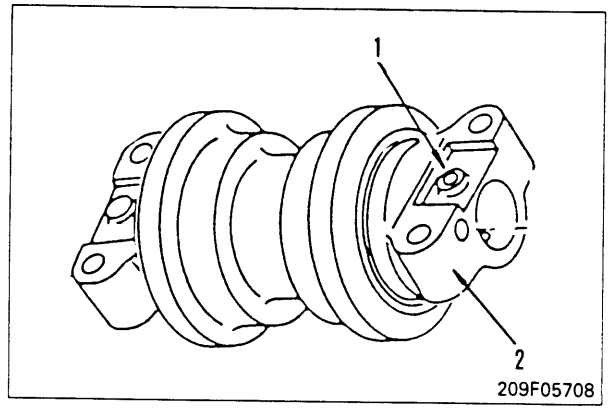
kgm : Roller mounting bolt: 140 ± 10 kgm

DISASSEMBLY OF TRACK ROLLER ASSEMBLY

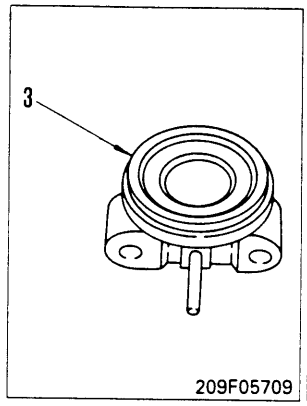
1. Remove plug, and drain oil.
   ★ Rotate the shaft while draining the oil.

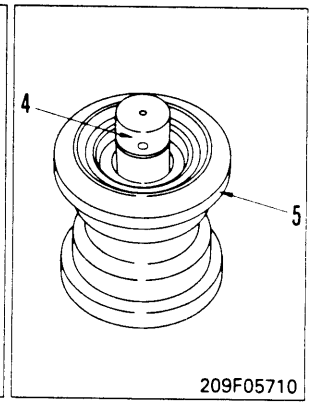
   Track roller assembly: Approx. 420 – 480 cc

2. Pull out pin (1), and remove collar (2).



3. Remove floating seal (3) from collar.
4. Remove roller (5) from shaft assembly (4).





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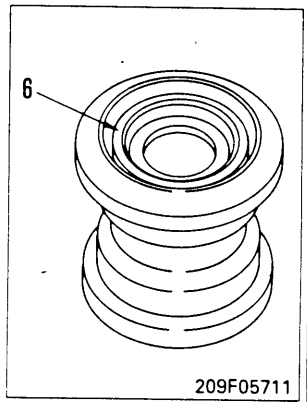
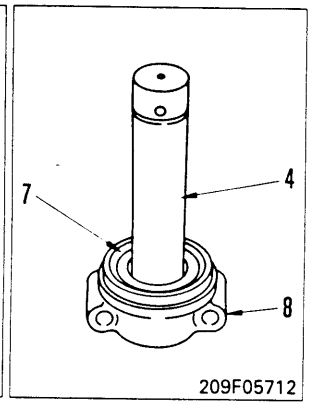
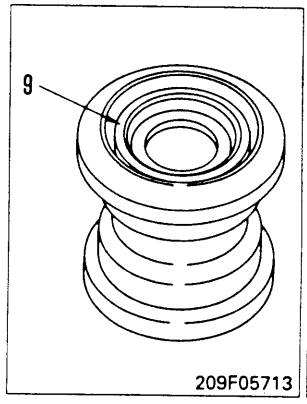
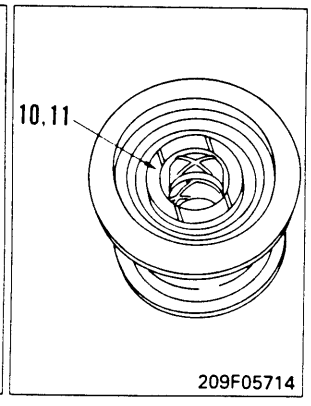
5. Remove floating seal (6) from roller.
6. Remove floating seal (7) from shaft assembly (4).
7. Remove collar (8) from shaft.
   ★ Remove the pin in the same way as Step 2.





8. Remove floating seal (9) from roller.
9. Remove bushings (10) and (11) from roller.

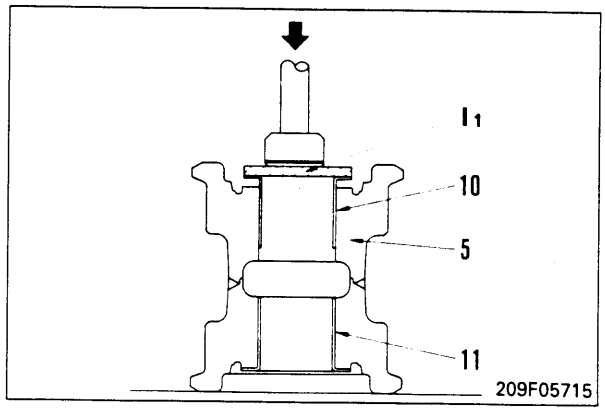




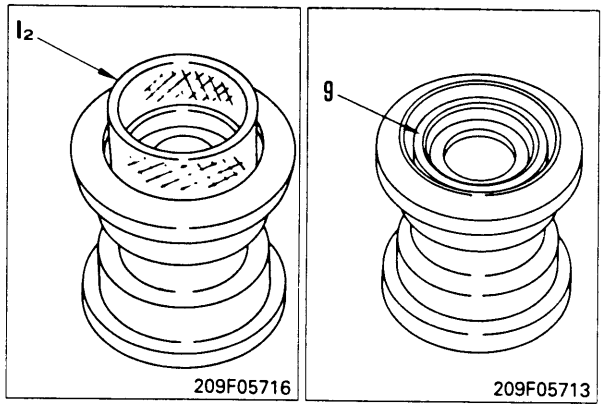
ASSEMBLY OF TRACK ROLLER ASSEMBLY

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. Using tool I1, press fit bushings (11) and (10) to roller (5).

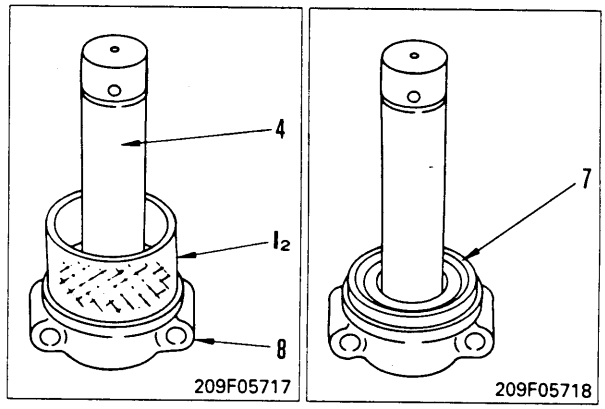


2. Using tool I2, assemble floating seal (9) to roller.



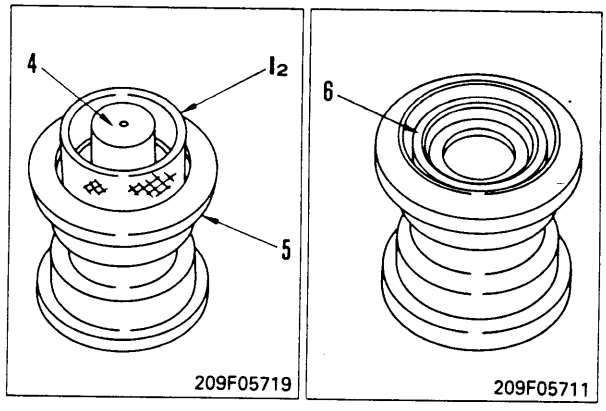
3. Assemble collar (8) to shaft (4), and secure with pin.

4. Using tool I2, assemble floating seal (7) to collar (8), and install O-ring.



5. Assemble shaft assembly (4) in roller (5).

6. Using tool I2, assemble floating seal (6).



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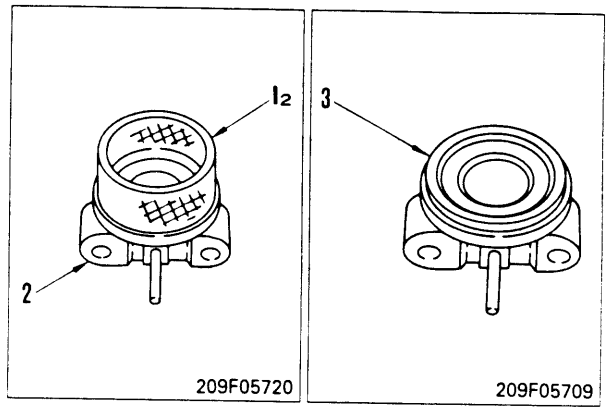
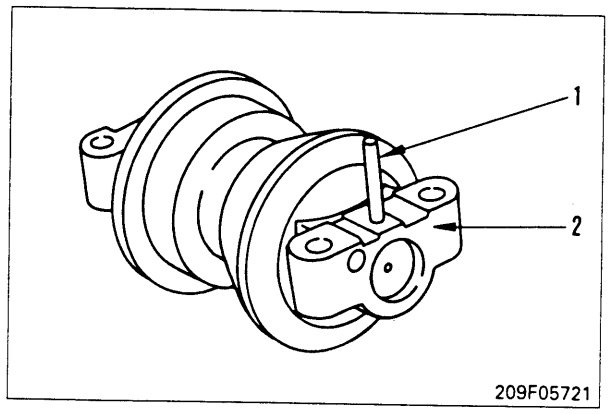
7. Using tool I2, assemble floating seal (3) to collar (2).



8. Push collar (2) on to roller shaft, and secure with pin (1).



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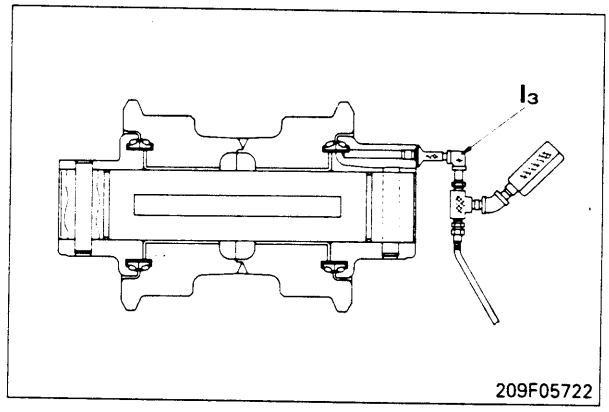
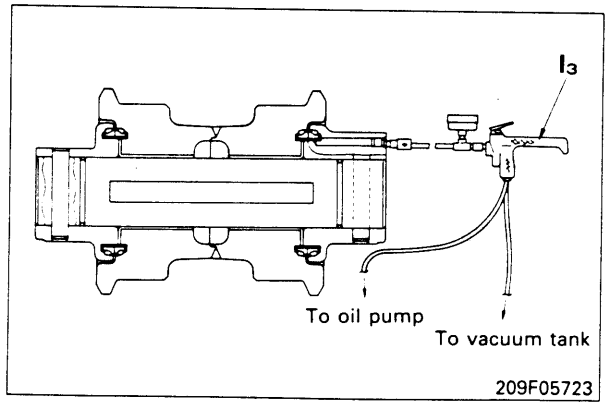
9. Using tool I3, apply standard pressure to roller oil filler port, and check for any leakage of air from the seal.
   - ★ Standard pressure: 1 kg/cm²
   - ★ Method of checking
     The standard pressure must be maintained for 10 seconds, and the gauge reading must not go down.



10. Using tool I3, fill track roller assembly with oil, then tighten plug.
    - Track roller: Approx. 420 – 480 cc
    - Plug: 2.75 ± 1.1 kgm



REMOVAL OF NO. 1 PUMP ASSEMBLY

Lower the work equipment to the ground and stop the engine. Operate the control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

★ After disconnecting hoses, fit blind plugs to prevent dirt or dust from entering, and mark with tags to prevent mistakes in the mounting position when connecting.

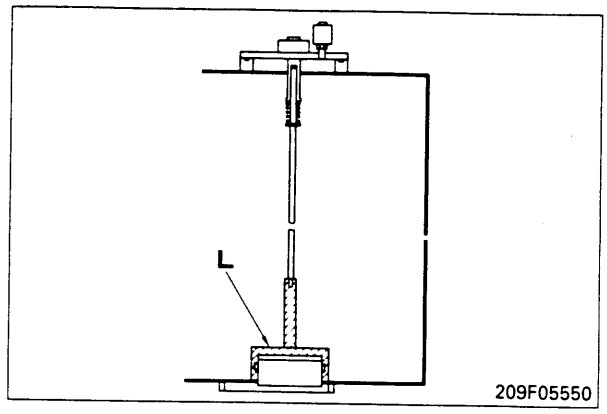
1. Remove cover, then remove strainer from inside tank.
2. Remove strainer from rod, install tool **L** in place of strainer, assemble inside hydraulic tank again, then fit spring and install cover.
   ★ When not using tool **L**, loosen the drain valve under the hydraulic tank and drain the oil from the hydraulic tank.

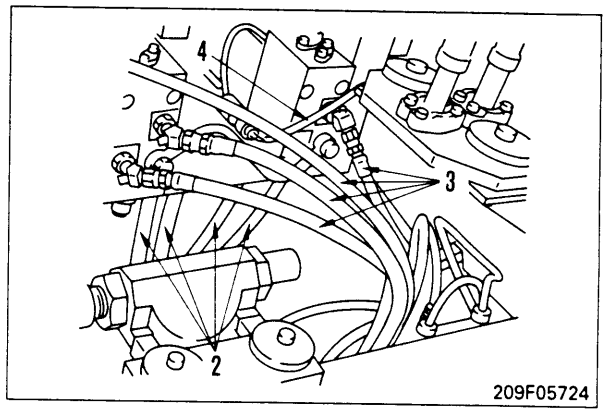
   Hydraulic tank: Approx. 480ℓ
3. Remove drain plug under PTO case, and drain oil from PTO case.

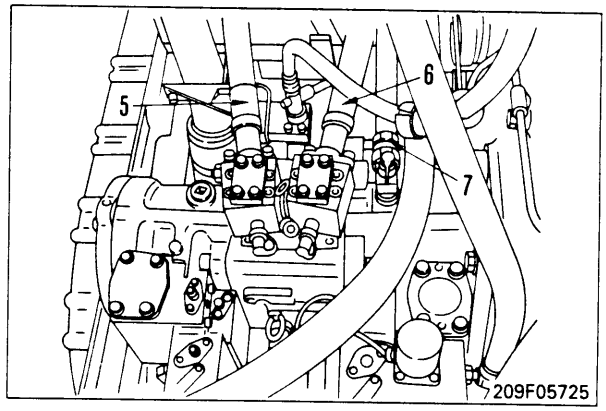
   PTO case: Approx. 10ℓ
4. Disconnect hose (2).
5. Disconnect hose (3).
6. Disconnect wiring (4) at connector.
7. Disconnect hose (5).
8. Disconnect hose (6).
9. Disconnect hose (7).
10. Disconnect pump inlet hose (8).
    ★ When the pump inlet hose is disconnected, the oil inside the piping will flow out, so catch it in an oil pan.
11. Sling No. 1 pump assembly, and remove mounting bolts, then remove No. 1 pump assembly (9).

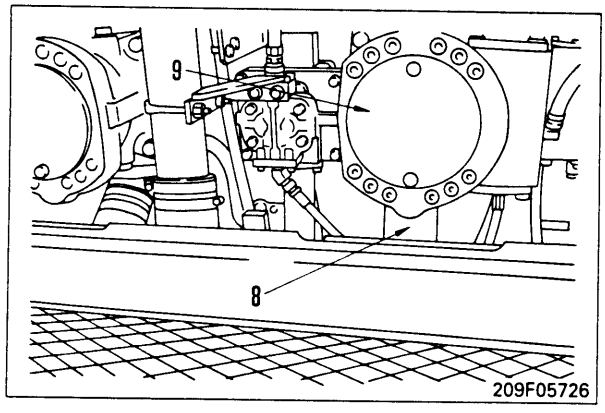
    No. 1 pump assembly: 165 kg

    ★ When removing the pump assembly, check that all the hoses have been disconnected.









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INSTALLATION OF NO. 1 PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.
- ★ After adding oil to the hydraulic tank to the specified level, run the engine to circulate the oil through the system. Then check the oil level in the hydraulic tank again.
- ★ Bleed the air from the main pump.
  For details, see TESTING AND ADJUSTING, Bleeding air from main pump.

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DISASSEMBLY OF HYDRAULIC PUMP ASSEMBLY (HPV090 + 090)

★ Precautions when disassembling pump
The direction of the maximum (minimum) swash plate angle is the opposite for No. 1 pump (with TVC valve) and No. 2 pump. This means that the direction of inserting the service piston spring is also opposite. For this reason, when disassembling both sets of pumps at the same time, always keep the parts for each pump in separate places.

Note: The procedure for disassembly is basically the same for the No. 1 pump and No. 2 pump at both the front and rear, so this section describes the disassembly of the front No. 1 pump only. When there are differences, however, they will be noted at the appropriate place in the description.

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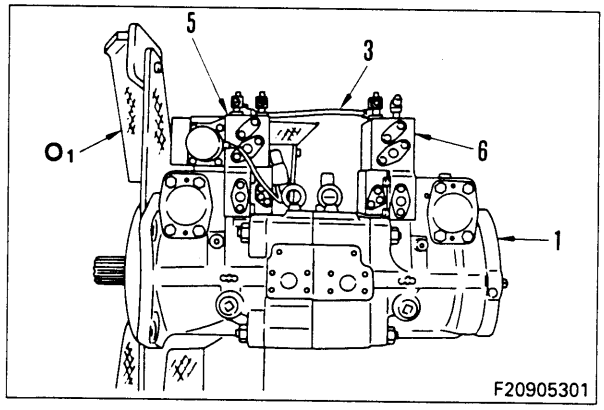
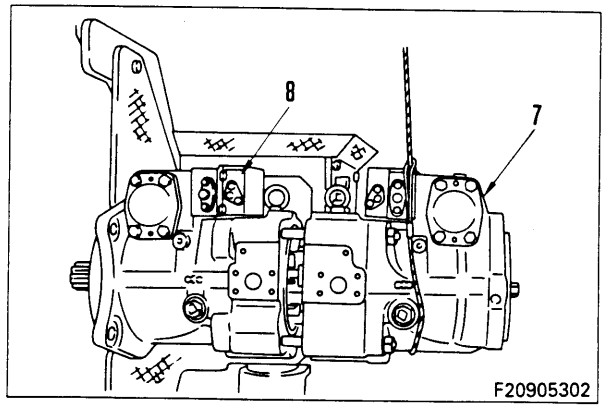
1. **TVC and CO, NC valve assembly**
   1) Set pump assembly (1) in tool **O1**.
   2) Remove tube (3).
   3) Disconnect wiring, then remove TVC and CO, NC valve assembly (5). (Rear pump)
   4) Remove CO, NC valve assembly (6). (Front pump)

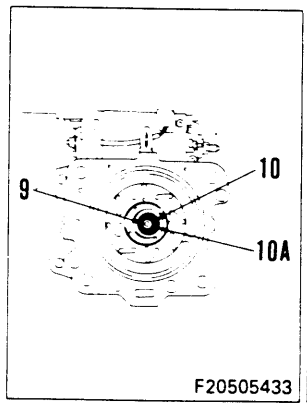


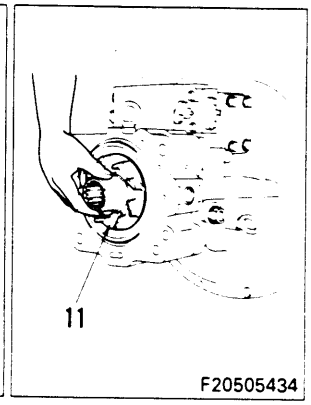
2. **Rear pump assembly**
   1) Sling rear pump assembly (7).
   2) Remove 4 nuts at front pump assembly end, then remove rear pump assembly (7).
      ★ Disconnect at the middle of the end caps.
   ★ The front pump is disassembled as it is; however, for the rear pump, remove the servo valve and use tool **O2** to disassemble.

3. **Servo valve assembly**
   Remove servo valve assembly (8).



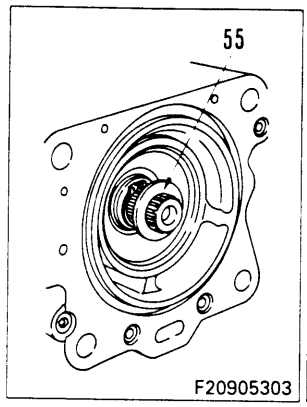
4. **Impeller**
   1) Using tool **O4**, remove bolt (9), then remove plate (10), washer (10A) and impeller (11).
      ★ Check the number and thickness of the shims, and keep in a safe place.

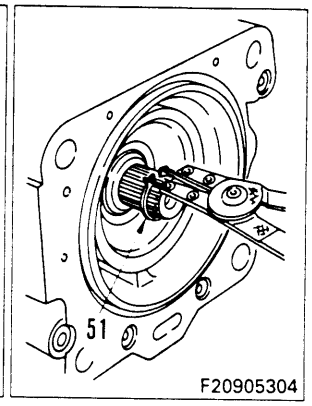




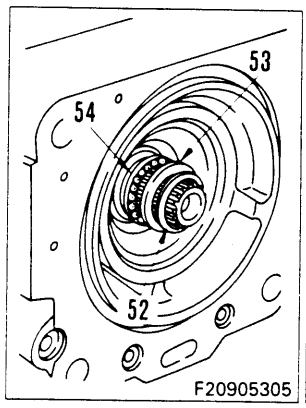
   2) Remove retainer (55).

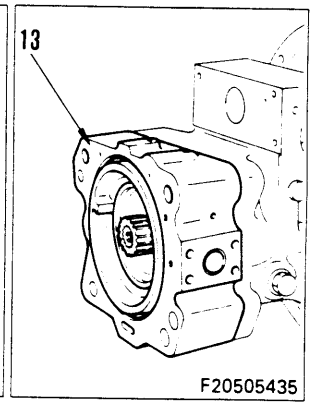
5. **End cap**
   1) Remove snap ring (51).



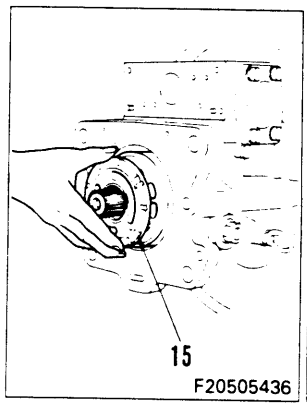


   2) Remove washer (52), inner race (53), and bearing (54).
   3) Remove 4 bolts, then remove end cap (13).

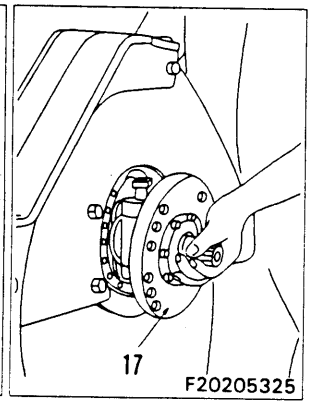




6. **Valve plate**
   Remove valve plate (15).
   ★ The valve plate is in tight contact with the cylinder block, so be careful not to cause any damage when removing it.
   ★ If the valve plate and cylinder block are to be used again, keep them in sets.



7. **Pump sub-assembly**
   Support cylinder block and shaft, then remove pump sub-assembly (17).



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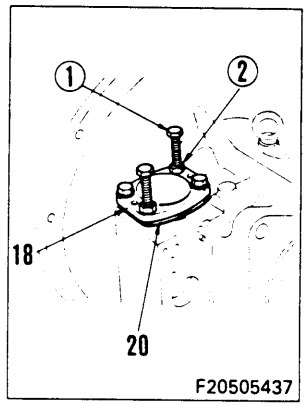
8. Servo piston

1) Using forcing screws ① (Dia. = 10 mm, Pitch = 1.5 mm) and nut ②, remove cap (18) and shim (20).
2) Remove spring (22).



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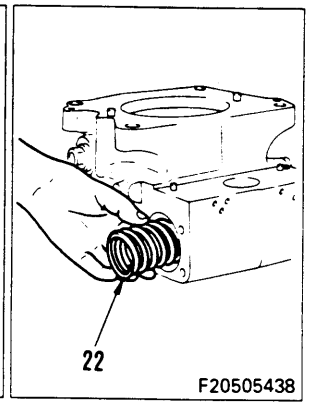

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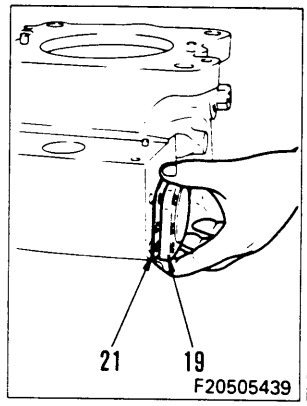
3) Screw in forcing screws, and remove cap (19) and shim (21).
4) Remove servo piston (23).
   ★ The servo pistons used for the front and rear are not the same part, so mark them to distinguish them.



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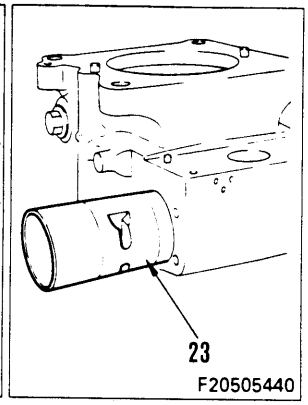

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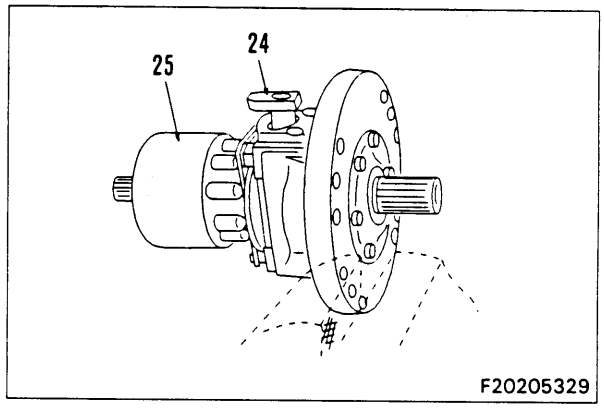
DISASSEMBLY OF PUMP SUB-ASSEMBLY

9. Slider

Remove slider (24).

10. Cylinder block

1) Remove cylinder block (25).



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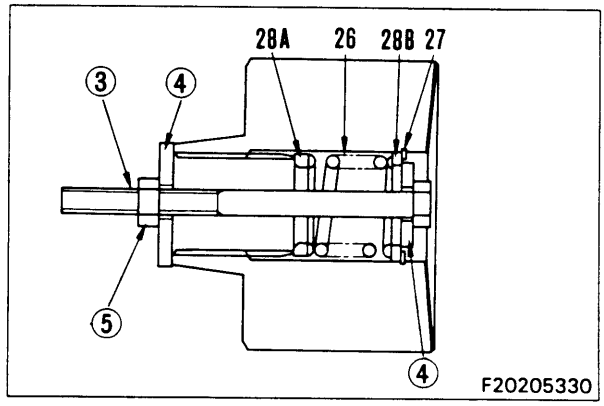
2) Disassemble cylinder block as follows.
   i) Using bolt ③ (10 mm or 12 mm) and washers ④, compress spring (26).
      ★ Installed load: Approx. 130 kg
   ii) Remove snap ring (27).
   iii) Loosen nut ⑤ slowly, and allow spring to expand until tension is removed.
   iv) Remove washers (28A) and (28B), and spring (26).



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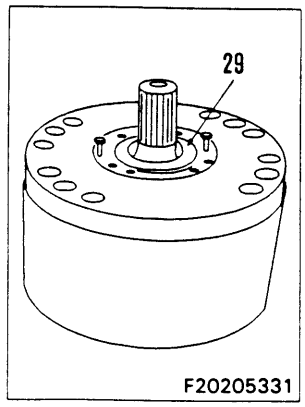
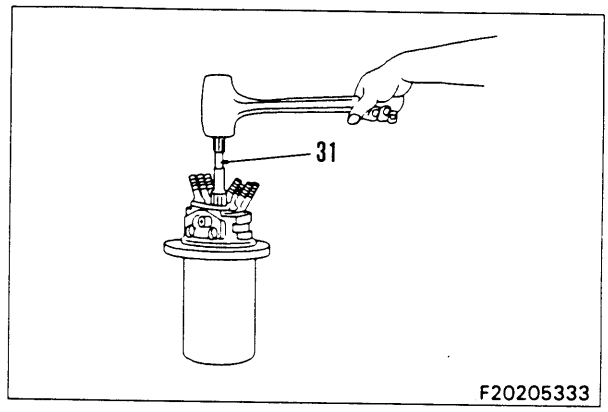
11. Drive shaft assembly

1) Screw in forcing screws, and remove housing (29) and shim.
   - ★ Check the number and thickness of the shims, and keep in a safe place.
   - ★ Remove the cover from rear pump, but there is no shim.



2) Knock out drive shaft (31) from piston end to remove.



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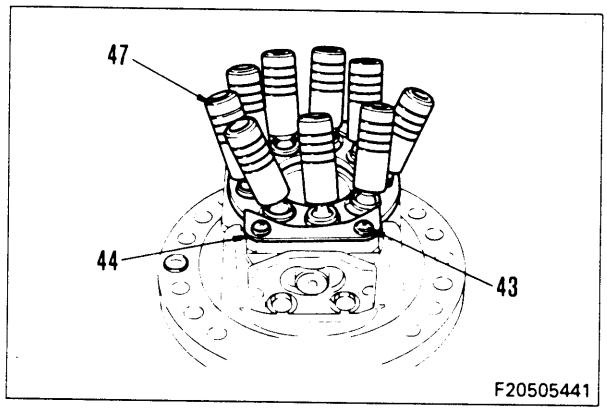
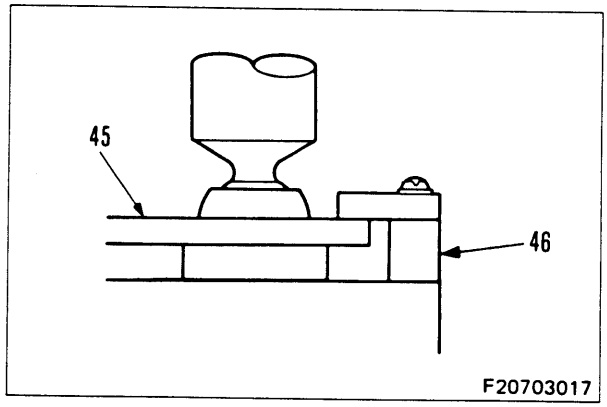
12. Piston

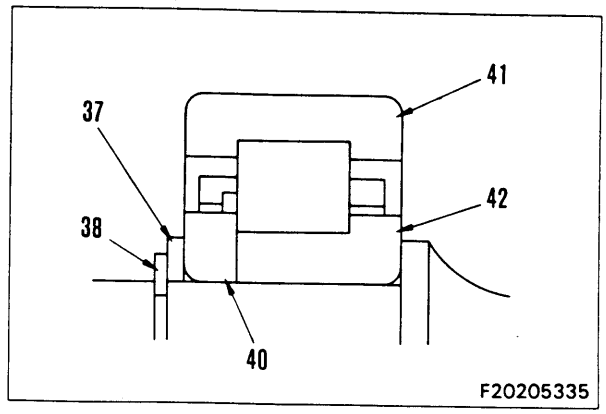
Use tool **O3** to remove 4 screws (43), then remove bearing retainer (44), shoe retainer (45), spacer (46), and piston (47).

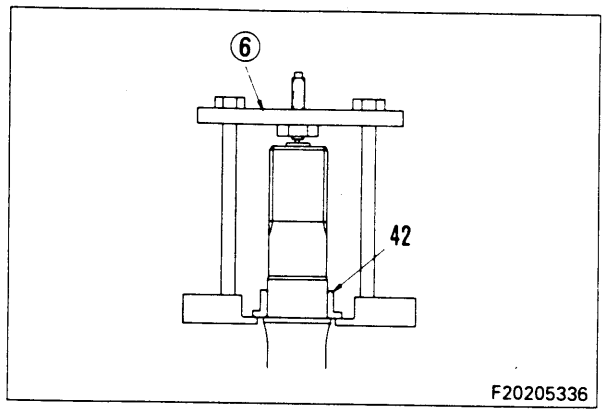




WHEN REUSING PUMP DRIVE SHAFT AND END CAP

1) Removal of inner race from pump drive shaft.
   i) Remove snap ring (38), then remove washer (37), inner race (B) (40), and bearing (41).
   ii) Using bearing race puller 6 , remove inner race(A), (42).





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ASSEMBLY OF HYDRAULIC PUMP ASSEMBLY (HPV090 + 090)

Precautions at time of assembly

1) Clean each part thoroughly and remove all sharp edge and rough edges.
2) Apply engine oil (EO10-CD) to the rotating and sliding parts before assemblying them.
3) The direction of the maximum (minimum) swash plate angle is the opposite for No. 1 pump (with TVC valve) and No. 2 pump. This means that the direction of inserting the service piston spring is also opposite.
   For this reason, always check the direction of the swash plate angle for the pump when assembling.

★ Be sure to use the following parts as a set.
   i) Cradle and rocker cam
   ii) Cylinder block and valve plate

Note: The procedure for disassembly is basically the same for the No. 1 pump and No. 2 pump at both the front and rear, so this section describes the disassembly of the front No. 1 pump only. When there are differences, however, they will be noted at the appropriate place in the description.

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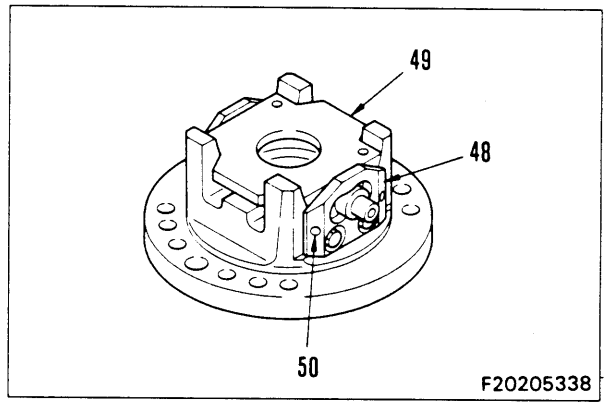
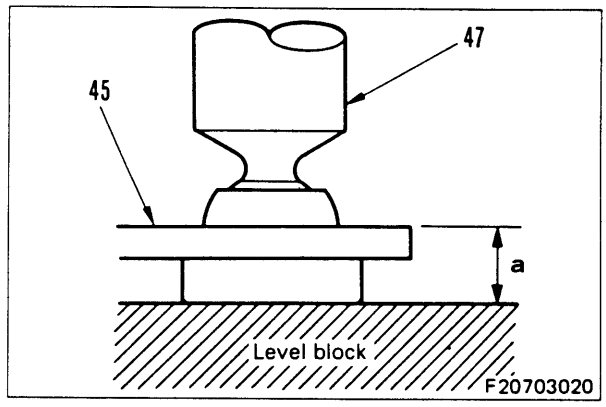
ASSEMBLY OF PUMP SUB-ASSEMBLY

1. Cradle piston assembly

1) Fit dowel pin (50) to cradle, set rocker cam (49) in position, then install plate (48).
   ★ The side of the rocker cam with the groove faces the oil hole side of the cradle.
   Plate bolt:
   Thread tightener (LT-2) (Loctite #262)
   Plate bolt: 3.15 ± 0.35 kgm
   ★ After tightening the bolts, check that the rocker cam moves smoothly.



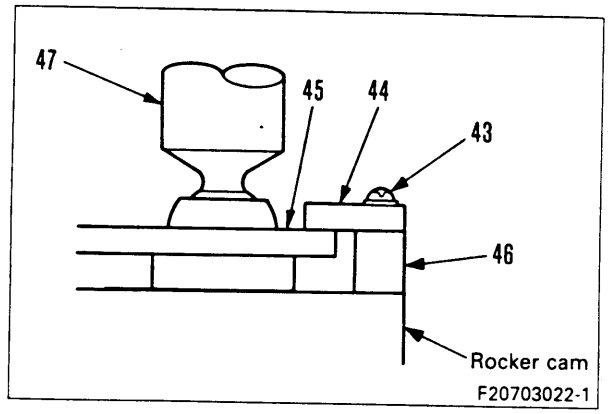
2) Select the spacer thickness as follows.
   i) Assemble shoe retainer (45) to piston (47), put on the level block, then measure distance **a** to top surface of shoe retainer.
   ii) Select spacer thickness as follows.
   Spacer thickness = distance **a** + (0.03 to 0.07 mm)
   ★ There are three types of spacer.



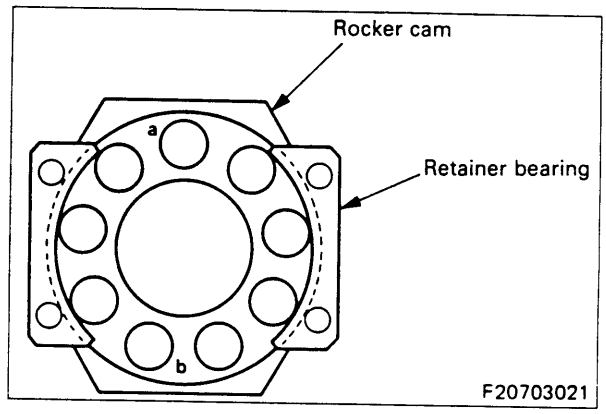
3) Install spacer (46) selected in Step 2)-i) and ii), then install piston (47), shoe retainer (45) and bearing retainer (44). Using tool **O3**, install screws (43).

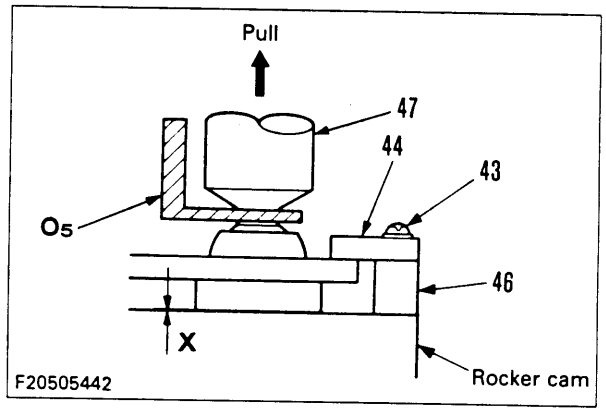
Bearing retainer screw:
Thread tightener (LT-2) (Loctite #262)

Bearing retainer screw: 1.35 ± 0.15 kgm



4) Hold rocker cam in position, then using tool **O5** pull piston (47) with a force of 2 – 3 kg, and measure clearance **x** between piston shoe and rocker cam.
   - ★ Measure the clearance with the rocker cam at position **a** or **b**, and measure for all nine piston.
   - ★ Clearance: 0.03 – 0.07 mm
   - ★ If clearance **x** is not within the standard range, adjust the spacer again.





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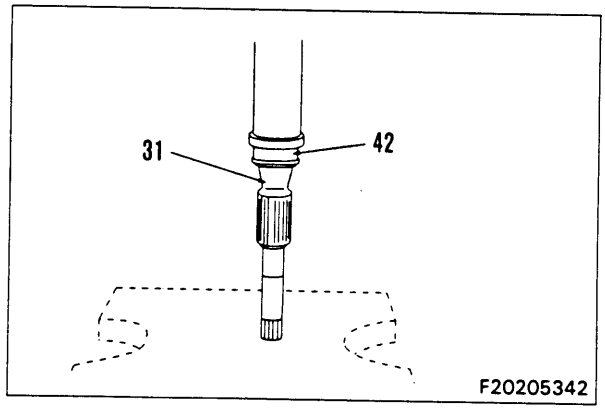
2. Drive shaft assembly

1) Press fit inner race (A), (42) to drive shaft (31).



2) Install bearing (41), inner race (B) (40) and washer (37).

Select washer (37) as follows.

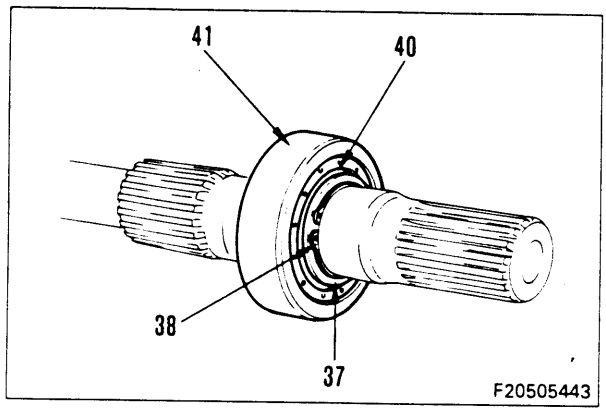
i) Install inner race (B), (40), then install snap ring (38).

★ Check that the snap ring is not deformed or damaged, and correct any burrs before installing. Install with the cut inside part facing the opposite direction from the inner race.

ii) Using a thickness gauge, measure clearance **a** between snap ring (38) and inner race (B), (40).

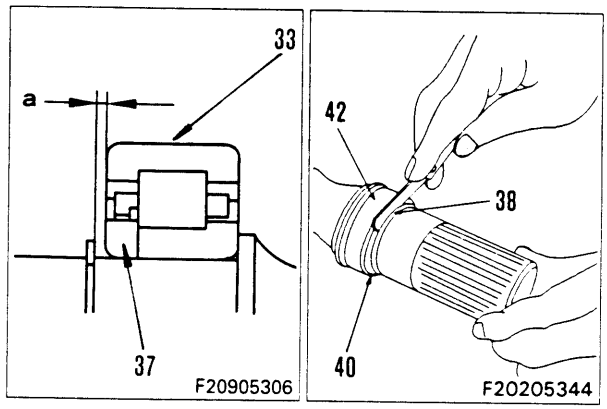
★ Push the snap ring securely into the groove on the opposite side from the inner race.

iii) Install selected washer (37).
Washer thickness = clearance **a** + (0 to 0.1 mm)

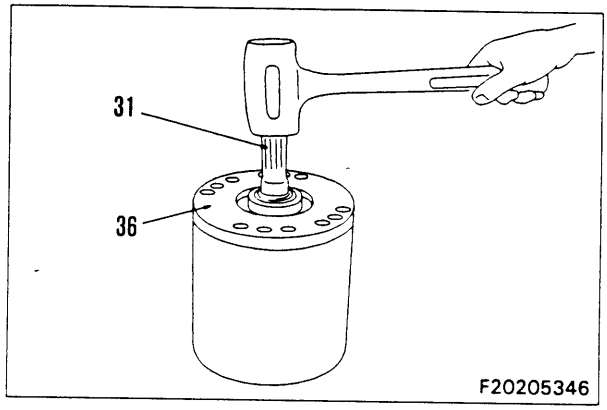


3) Install snap ring (38).

★ Check that there is no play between the snap ring and the washer. There are three types of washer.

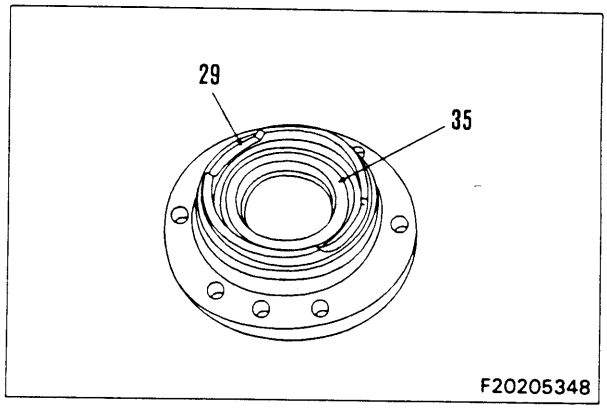


4) Press fit drive shaft (31) to cradle (36).



5) Install oil seal (35) to housing (29).

Lip of oil seal: Grease (G2-LI)



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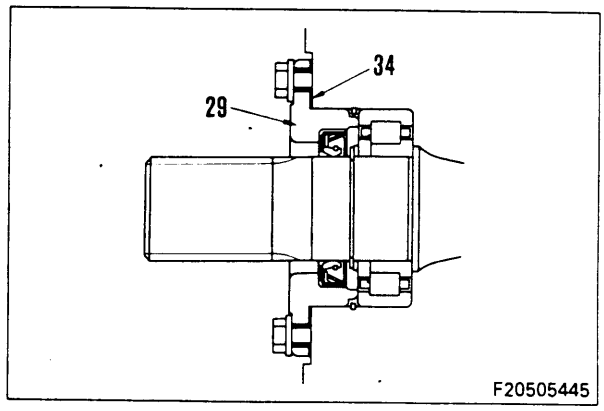
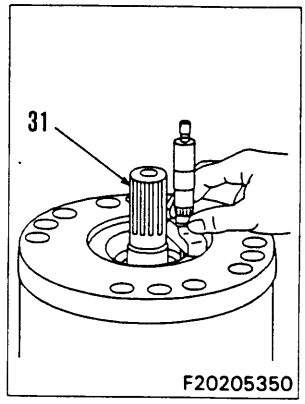
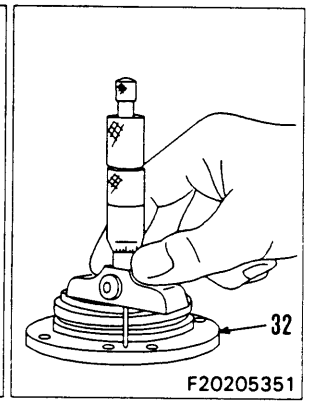
6) Fit O-ring and shim (34), and install housing (29) to cradle.
   Mounting bolt: 3.15 ± 0.35 kgm
   ★ Wind the shaft with tape to prevent damage to the oil seal lip surface.
   ★ Install cover to rear pump.
   Cover mounting bolt: 11.25 ± 1.25 kgm

   Reference: When using tool **O9**, do not install.
   (When assembling with tool **O9**, see the final reference item.)

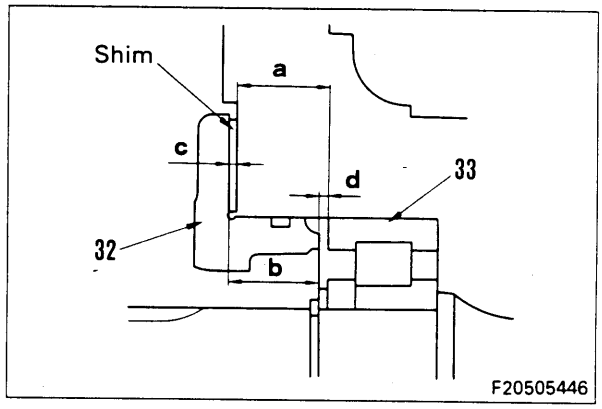


7) Select shim for housing as follows.
   i) Push drive shaft (31) in completely, and measure dimension **a** of end face of bearing outer race (33) and cradle.
   ii) Measure dimension **b** of housing (32).





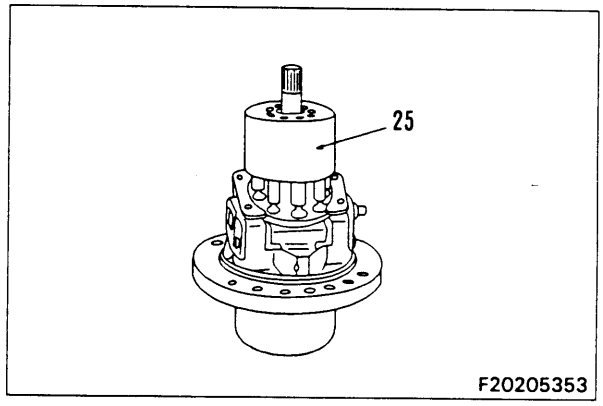
   iii) Select shim to give following thickness.
   ★ Shim thickness: **b** − **a** = **c** + 0.05 − 0.15 mm.
   ★ Therefore, there is a clearance of 0.05 − 0.15 mm at portion **d**.
   ★ There is no shim at the rear pump.



3. Cylinder block

Align with drive shaft and piston, and install cylinder block (25).
   ★ Always keep the cylinder block and valve plate in a set, or make match marks to prevent mistakes when assembling.
   ★ Install the spring and washer inside the cylinder block after adjusting the preload.

Reference: When using tool **O9**, assemble them before.
(When assembling with tool **O9**, see the final reference item.)



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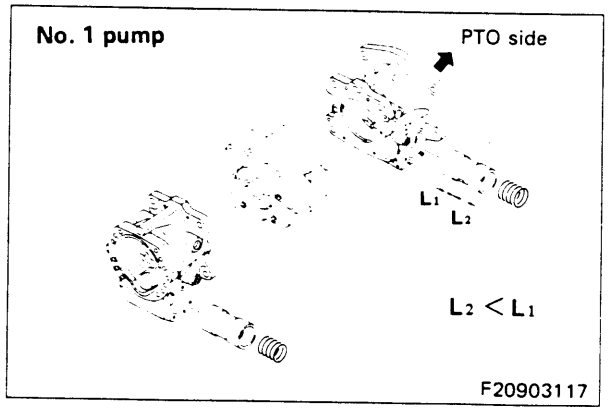
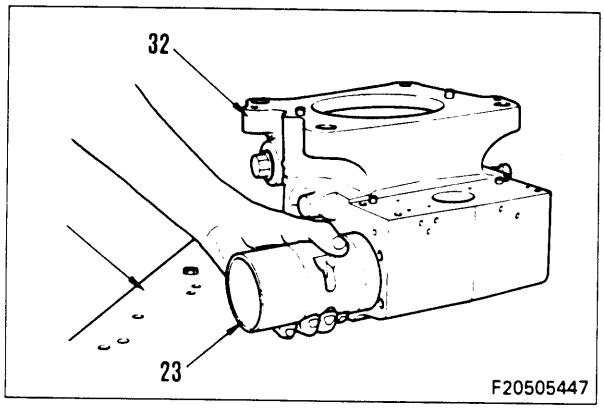
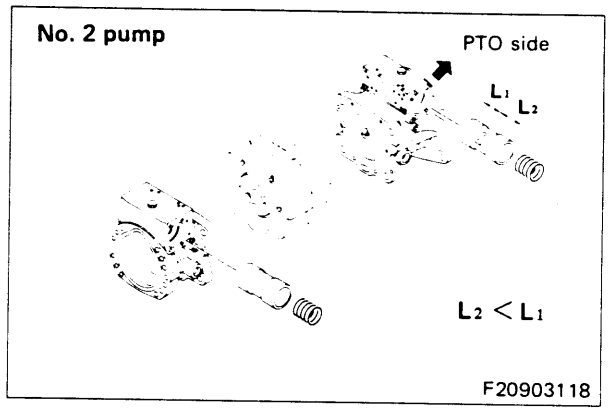
ASSEMBLY OF PUMP

4. Servo piston

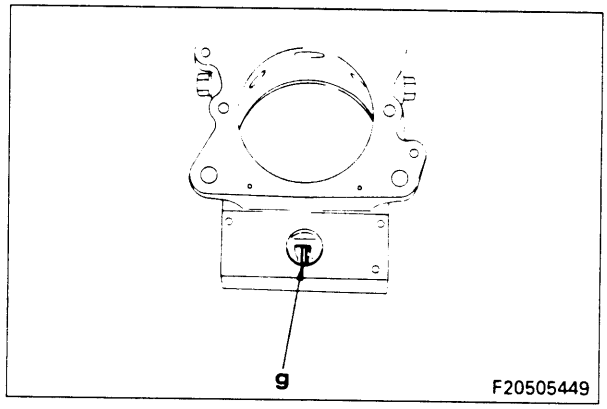
1) Set pump case (32) in tool **O1**.
2) Install servo piston (23).
   ★ The servo pistons used for the front and rear are not the same part, and the springs for the No. 1 pump and No. 2 pump are inserted in the opposite direction.

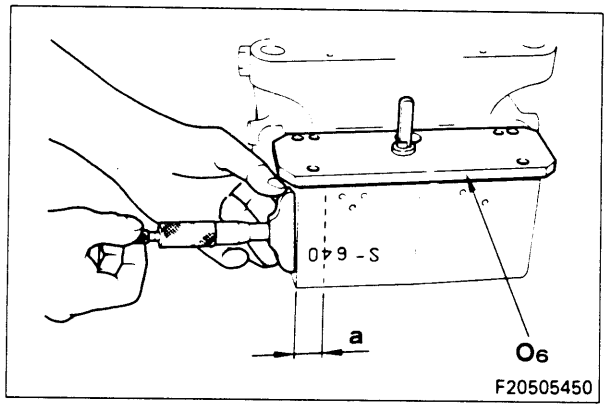






3) Adjust servo piston as follows.
   • Max. swash plate angle side
   i) Align groove **g** for servo valve arm of servo piston and dowel pin, then set tool **O6** in position.
   ★ As seen from the rear of the pump, the maximum swash plate angle is on the left side for the No. 1 pump, and on the right side for the No. 2 pump (this is the top when installed on the machine, the side where the spring is inserted).
   Note: The same tool is used reversed for the rear pump. Tool **O7** is used on the minimum swash plate angle side.
   ii) Measure distance **a** between servo piston and case.





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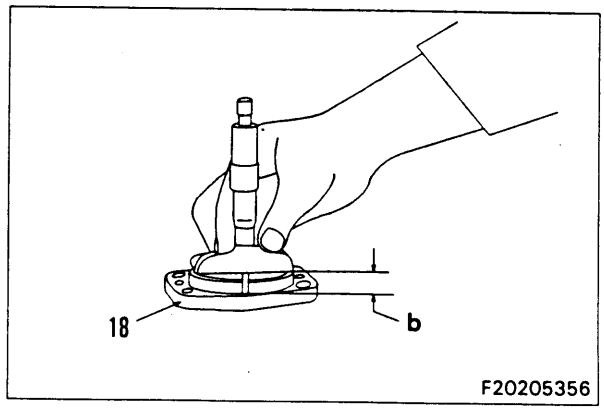
iii) Measure distance **b** of cap (18).

iv) Select shims so that the clearance between dimension **b** (–) at the cap side and dimension a at the servo side is ± 0.05 mm.

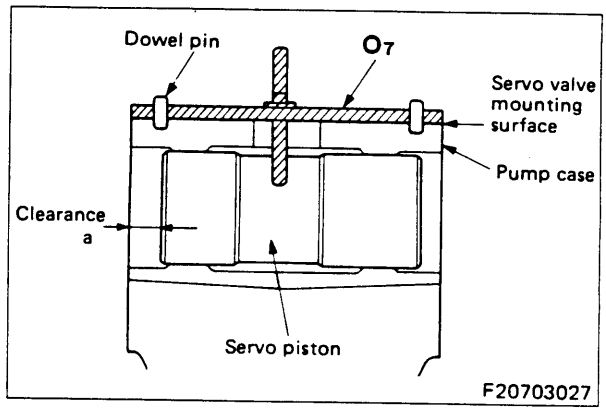
b – **a** = [**c** ± 0.05] → shim thickness

★ After adjusting the shim, put it in a set with the cap.

★ When adjusting the minimum swash plate angle side, replace tool **O6** with tool **O7** (for minimum angle), and carry out the same procedure as in Steps i) – iv) above. However, the direction of the case is the opposite from the maximum swash plate angle.



Note: This section explains only the adjustment of the shim thickness; do not install the cap.



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5. Pump sub-assembly

1) Install slider and O-ring.

★ Fit the O-ring in the pilot portion and the joint portion.

2) Install 2 joints on case.

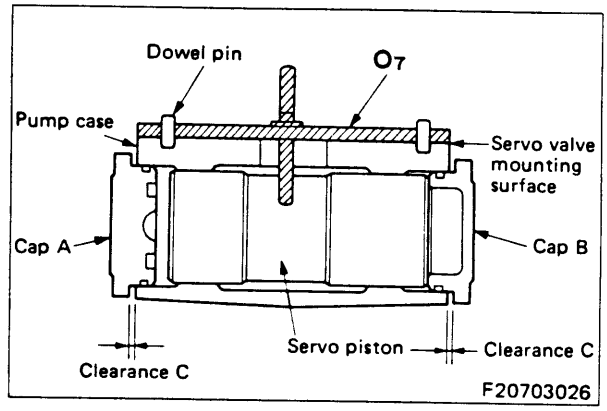
★ Install with the small hole facing the cradle side.

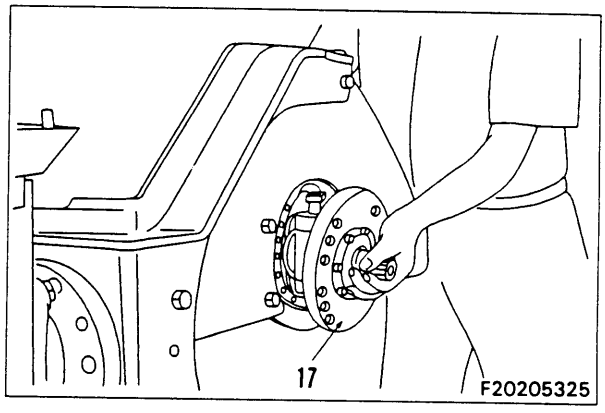
3) Align the slider with the servo piston, and install pump sub-assembly (17).

★ Be careful not to get the O-ring caught.

kgm Mounting bolt: 11.5 ± 1 kgm

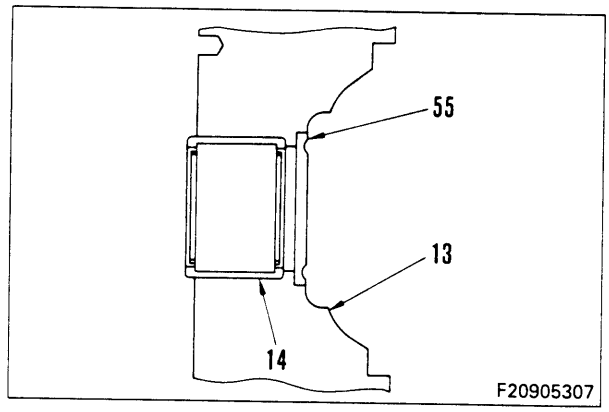
★ Assemble rear pump using tool **O2**.





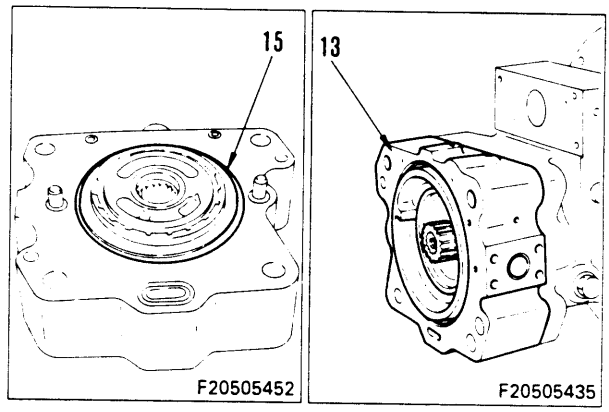
6. Adjusting end play of bearing

1) Press fit bearing (14) to end cap (13).



2) Install outer race (55) to end cap (13).
3) Install joint and O-ring.
   ★ Install the joint with the large hole facing the end cap.

4) Coat with engine oil, align with pin and bearing, and install valve plate (15).
   ★ Check that it is aligned with the end cap port, and that there is no interference with the pin and bearing.

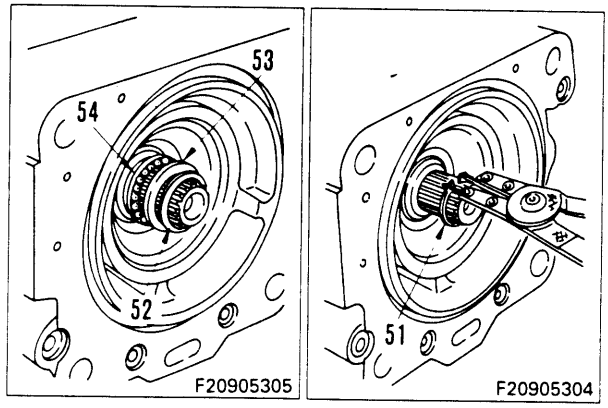


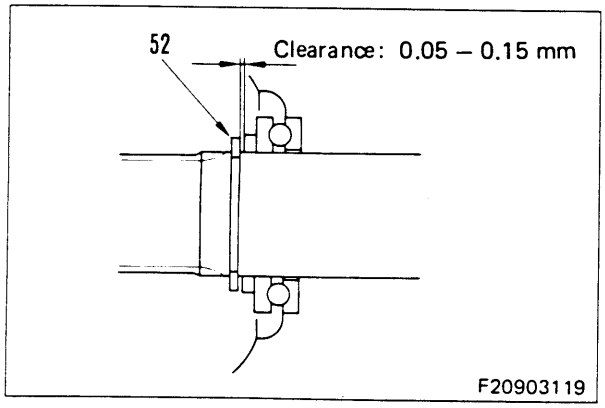
5) Install end cap (13).
   Mounting bolt: 7 ± 0.5 kgm (Front)
   Mounting nut: 28.5 ± 3 kgm (Rear)

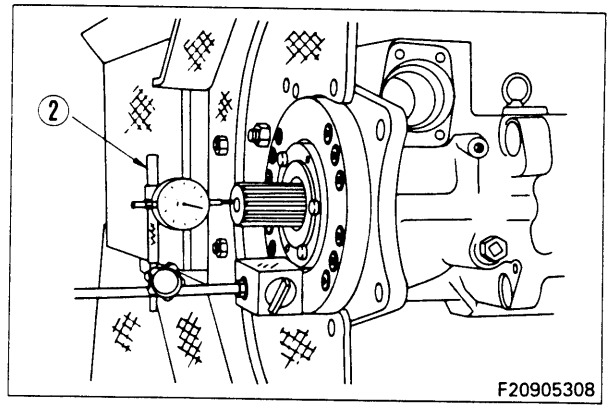
6) Install bearing (54) and inner race (53).

7) Fit washer (52), and install snap ring (51).

8) Put dial gauge ② in contact with end face of shaft, move shaft in axial direction, and select washer (52) so that movement is 0.05 – 0.15 mm.
   ★ After selecting the washer, remove the end cap. However, this is not necessary when using tool **O9**.







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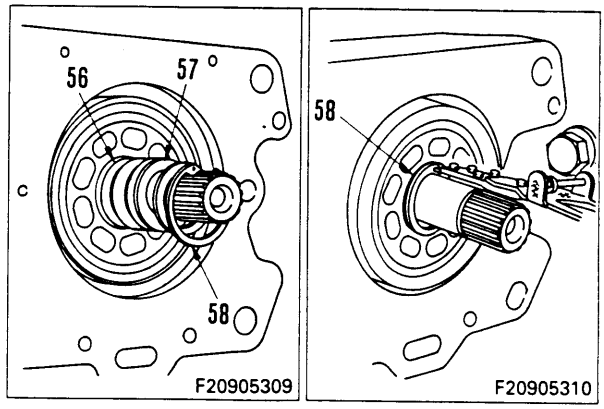
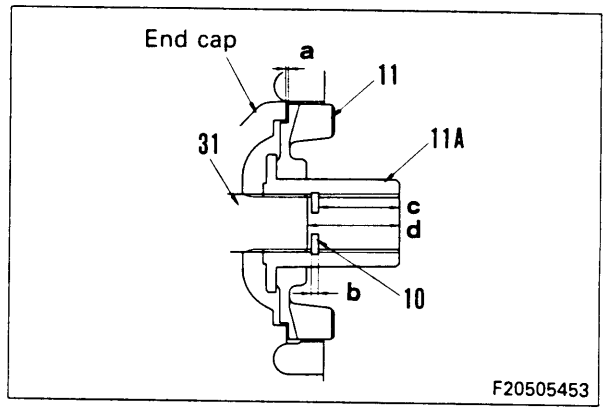
7. End cap assembly

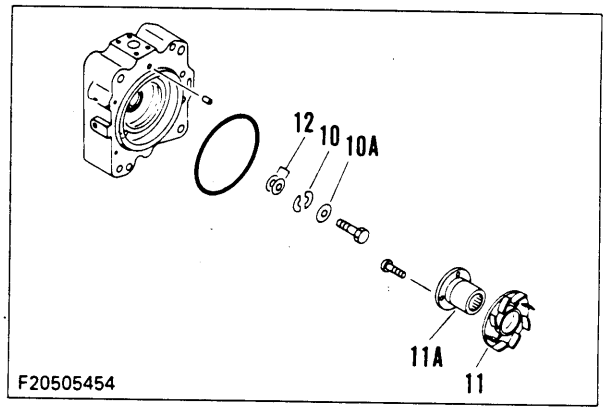
1) Assemble spring (56) and washer (57) in cylinder block, and install snap ring (58).
   ★ Be careful not to damage the contact surface of the valve plate.
2) Install end cap.
   ★ For details, see Adjusting end play of bearing in Step 6.

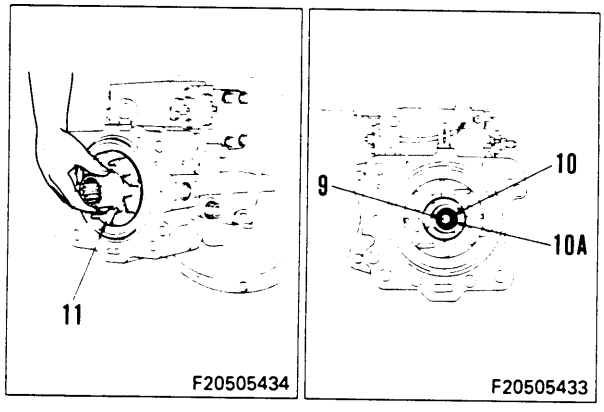


8. Impeller

1) Adjust clearance between impeller and end cap portion **a** as follows.
   i) Measure thickness **b** of plate (10).
   ii) Assemble plate (10) to coupling, and install impeller.
      ★ Check that impeller (11) and end cap portion **a** are in contact.
   iii) Measure dimension **c** from end face of coupling (11A) to plate (10).
   iv) Measure dimension **d** from end face of coupling to shaft (31).
   v) Use measured values **d**, **c**, and **b** as follows to select shim.
   • **d** – (**c** + **b**) + (0.5 ± 0.1) mm = shim thickness
2) Assemble washer (10A) to coupling (11A), and fit shim (12) selected in Step 1), then using tool (**O**$_4$, install impeller (11).
   kgm Mounting bolt:
   Thread tightener (LT-2) (Loctite #262)
   kgm Mounting bolt: 7 ± 0.5 kgm







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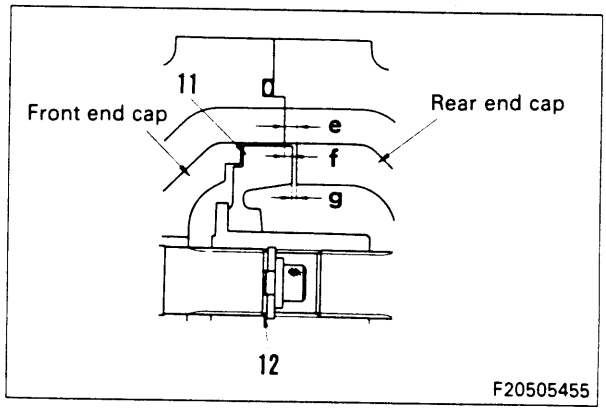
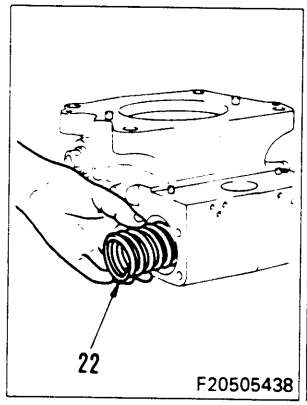
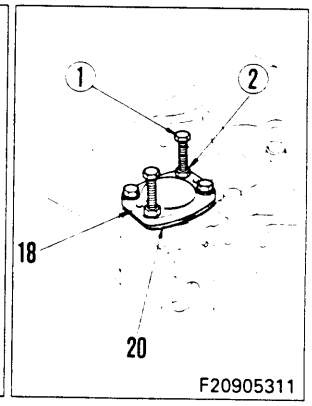
3) Check interference or impeller (11) and rear end cap as follows.
   i) Measure dimension of end face of rear end cap to end face of front end cap portion **e**.
   ii) Measure protrusion dimension **f** of impeller vane from front end cap.
   iii) Check that measured dimension is **e** > **f**.
   ★ If the above dimension is **f** < **e**, there is no clearance at portion **g**, so the impeller vane will contact the rear end cap at the time of assembly. To prevent this, repeat the procedure at step 7 -1) and adjust the shim (12) again.



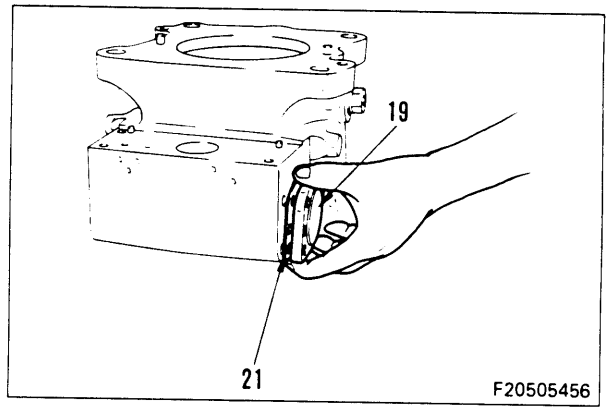
9. Servo piston cap

1) For No. 1 pump, assemble spring on left as seen from rear of pump; for No. 2 pump, assemble spring on right as seen from rear of pump.
2) Fit O-ring, and shims (20) and (21) selected in step 4, then install caps (18) and (19).
   ★ Be careful not to change the combinations of the cap and shim when installing.
   ★ When installing cap (18) at the spring end, use 2 each of forcing screws ① (Thread Dia. = 10 mm, Pitch = 1.25 mm) and nut ② .
   kgm Mounting bolt: 7 ± 0.5 kgm



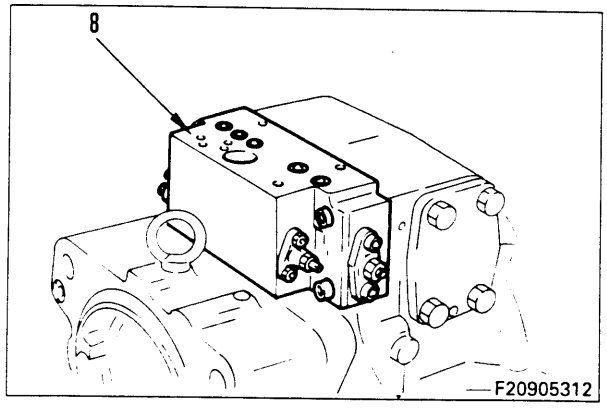


   ★ After installing the cap, measure the rotating torque of pump using tool **O8**.
   i) There must be no variation in the rotating torque (Range of variation: Max. 0.3 kgm) and the rotating torque must be less than 1.4 kgm.
   ii) If the rotating torque or range of variation are not within the standard value, disassemble the pump assembly and assemble it again.



10. Servo valve assembly

Fit O-ring, align arm with servo piston, then install servo valve assembly (8).
★ Be careful not to let the O-ring drop out. Tighten the bolts gradually on opposite sides in turn.
kgm Mounting bolt: 3.15 ± 0.35 kgm



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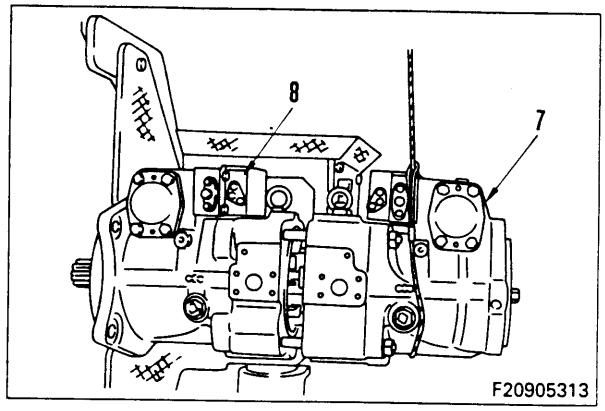
11. Rear pump assembly

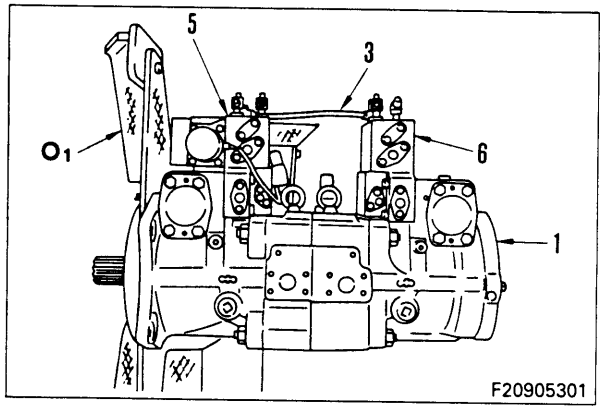
1) Install O-rings to front and rear end caps.
2) Raise rear pump assembly (7), align spline, and install.
   kgm Mounting nut: 28.5 ± 3 kgm



12. TVC and CO, NC valve assembly

1) Fit O-ring and install CO, NC valve assembly (6). (Front pump)
   kgm Mounting bolt: 3.2 ± 0.3 kgm
2) Fit O-ring, install TVC and CO, NC valve assembly (5), then clamp wiring. (Rear pump)
   kgm Mounting bolt: 3.2 ± 0.3 kgm
3) Fit O-ring and install tube (3).
   kgm Joint bolt: 1.8 ± 0.2 kgm
4) Install strainer, then install hose (2).
   kgm Sleeve nut: 8 ± 2 kgm

★ After completion of assembly, check the quality of the parts.
After completing the assembly of the pump assembly, use a test stand (A type or C type) to check the quality.
★ For details of the procedure for checking quality, see TESTING METHOD.



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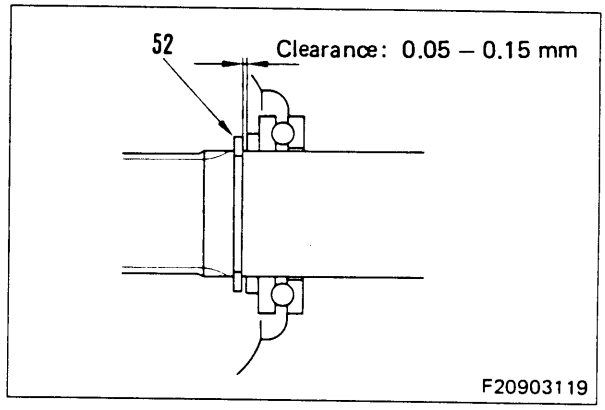
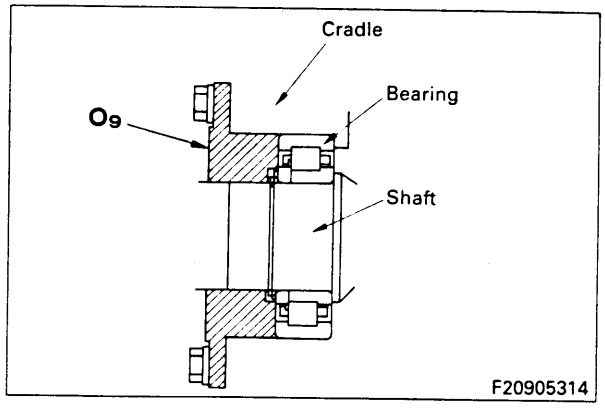
Reference: Assembly procedure when using tool **O9**

- Assemble spring in cylinder block.
  ★ See Assembly Step 7-1).
- Do not install the housing to the cradle.

1. Install tool **O9** in mounting position for housing.
2. Assemble up to Step 6-6).
3. Select a washer so that the clearance between washer (52) and snap ring (51) is 0.05 – 0.15 mm.
4. Remove tool **O9**, and install housing to cradle.
5. For the rest of the assembly, see the procedure from Step 8.





CHECKING CONTACT BETWEEN CYLINDER BLOCK AND VALVE PLATE, AND ROCKER CAM AND CRADLE

1. **Checking contact between cylinder block and valve plate.**
   1) Make a centering tool for the cylinder block and valve plate.
      ★ The tool can be made of a soft material such as plastic or bakelite.
   2) Remove grease from the parts to be checked.
      ★ Do not wipe with a cloth.
   3) Set the tool in position, and coat the cylinder block side with inspection paint.
      ★ Apply the paint thinly.
   4) Put the valve plate on top, push with a force of 4 – 5 kg, and rotate 2 – 3 times.
   5) Remove the valve plate, transfer the contact surface to tape, and check the contact surface.

   ★ The standards for the contact surface are as follows.

Valve plate	a. Seal	Min. 80%
Cylinder block	a. Seal	Min. 80%

2. **Checking contact between rocker cam and cradle**
   1) Remove grease from the parts to be checked.
      ★ Do not wipe with a cloth.
   2) Set the tool in position, and coat the cradle side with inspection paint.
      ★ Apply the paint thinly.
   3) Put the rocker cam on top, push with a force of 4 – 5 kg, and move 2 – 3 times from the stopper contact position to the maximum angle.
   4) Remove the rocker cam, transfer the contact surface to tape, and check the contact surface.

   ★ The standard for the contact surface are as follows.

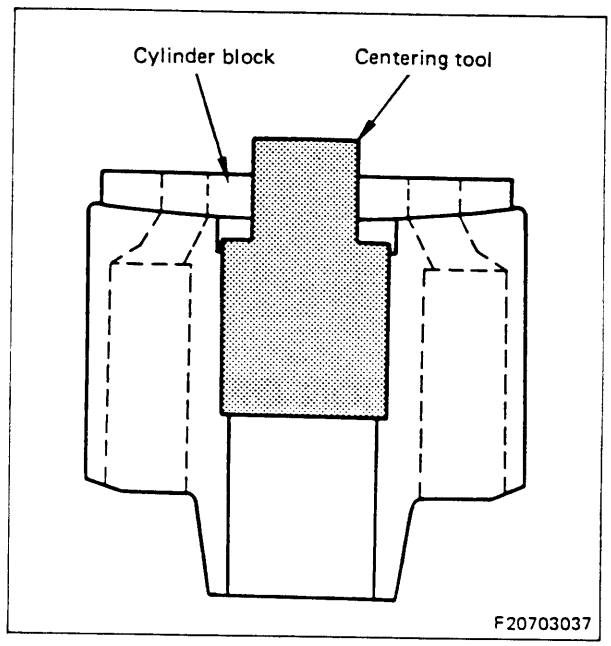
Pump Model	Dimension **a** (mm)	Contact surface	Contact **b** from **a** to outside
HPV 090	72	Min. 80%	Min. 50%

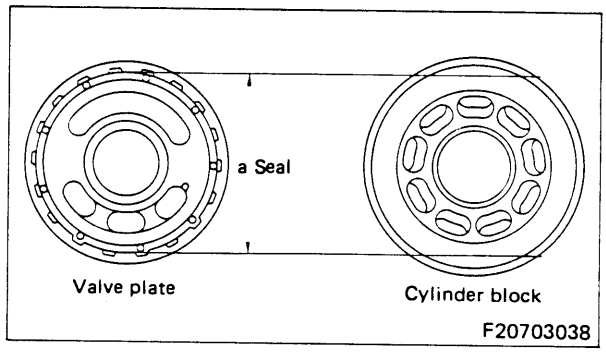
   ★ If there is no contact at the center but only at the outside, the contact is no good.

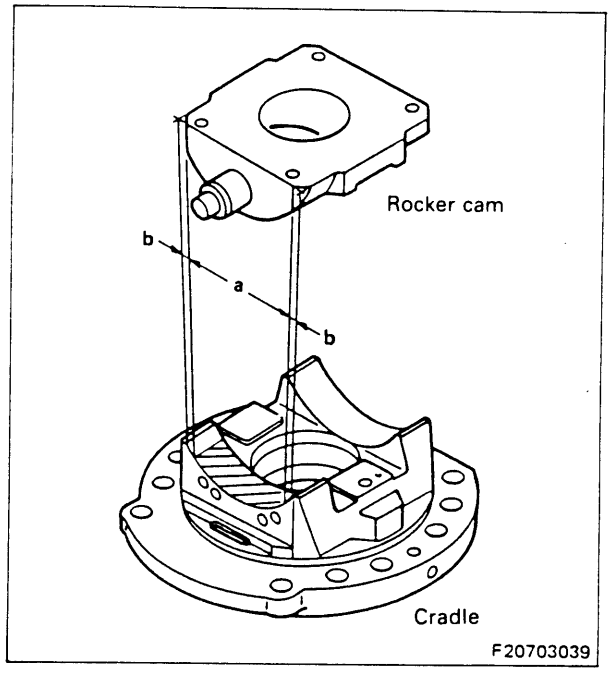
Reference:

If the contact is not within the contact standard value, when carrying, always lap both parts together.

★ Parts with scratches cannot be reused.







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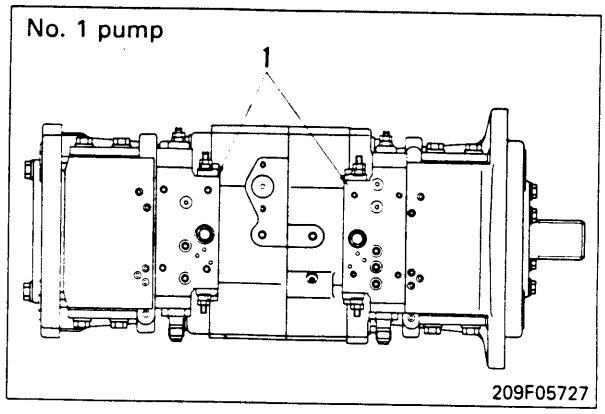
REMOVAL OF SERVO VALVE ASSEMBLY

1. Remove CO•NC assembly.
   For details, see REMOVAL OF CO•NC VALVE ASSEMBLY.

2. Remove servo valve assembly (1). ※ 1



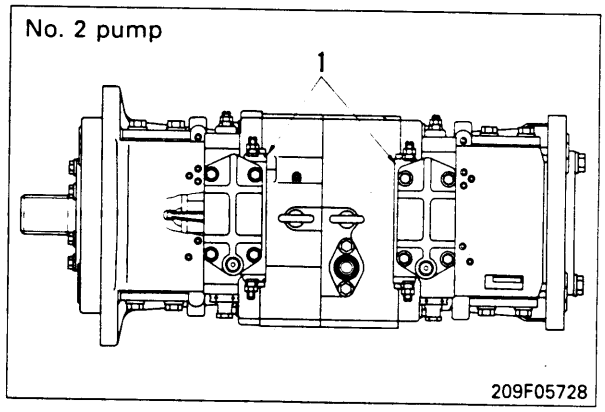
INSTALLATION OF SERVO VALVE ASSEMBLY

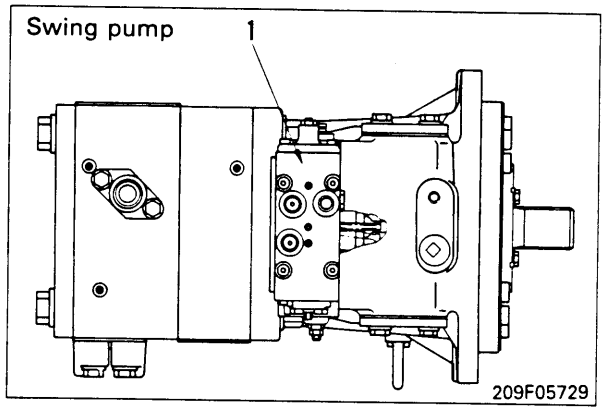
- Carry out installation in the reverse order to removal.

※ 1

★ Push in by hand until the dowel pin is completely inserted, then tighten the mounting bolts.

kgm Mounting bolt: 3.2 ± 0.3 kgm





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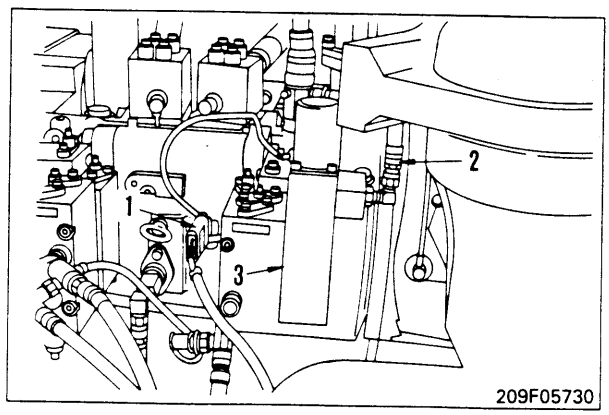
REMOVAL OF TVC VALVE ASSEMBLY

1. Disconnect wiring connector (1).
2. Disconnect hose (2).
3. Remove TVC valve assembly (3). ※1



INSTALLATION OF TVC VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

kgm Mounting bolt: 3.2 ± 0.3 kgm

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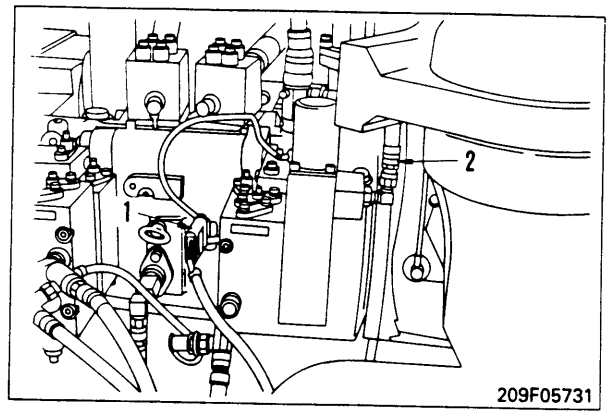
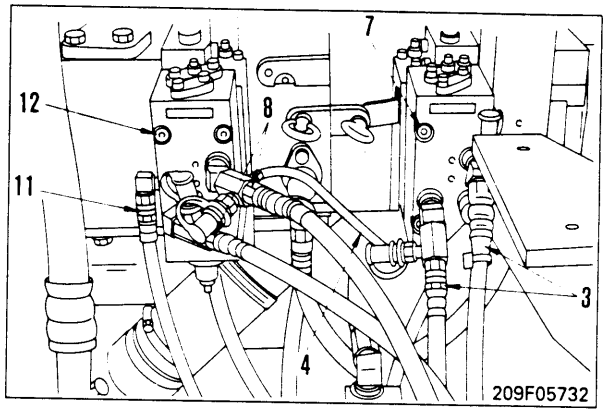
REMOVAL OF CO•NC VALVE ASSEMBLY

- **For front No. 1 pump**
  1) Disconnect wiring (1) and hose (2).
  2) Disconnect jet sensor hose (3).
  3) Disconnect tube (4).
  4) Disconnect CO cancel hose (5).
  5) Disconnect No. 2 pump control hose (6).
  6) Remove CO•NC valve assembly (7) together with TVC valve.
- **For rear No. 1 pump**
  1) Disconnect jet sensor hose (8).
  2) Disconnect tube (4).
  3) Disconnect CO cancel hose (9).
  4) Disconnect No. 2 pump control hose (10).
  5) Disconnect TVC output pressure hose (11).
  6) Remove CO•NC valve assembly (12).
- **For swing pump**
  1) Disconnect jet sensor hose (13).
  2) Disconnect TVC output pressure hose (14).
  3) Remove CO•NC valve assembly (15).





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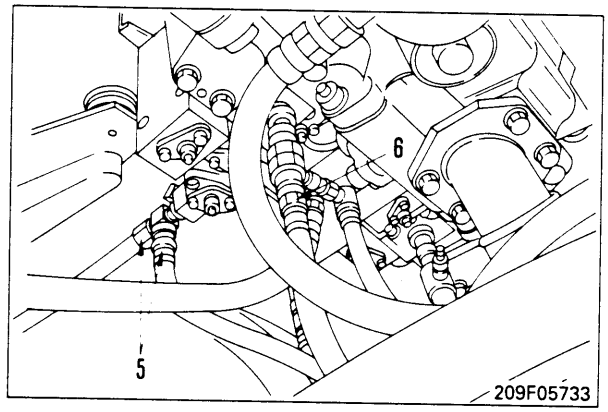
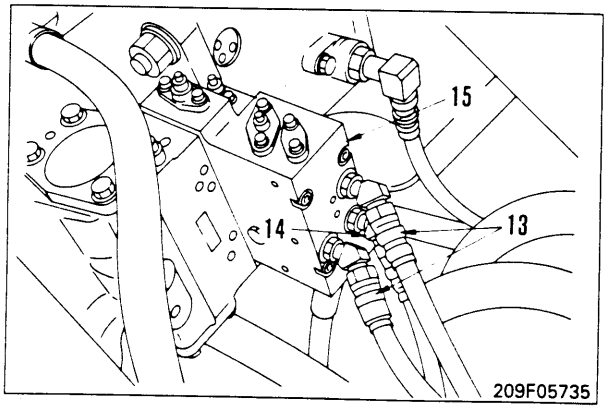
INSTALLATION OF CO•NC VALVE ASSEMBLY

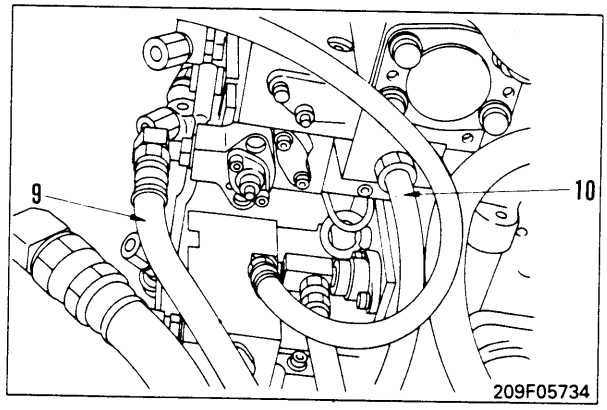
- Carry out installation in the reverse order to removal.

※1

Mounting bolts: 3.2 ± 0.3 kgm







REMOVAL OF NO. 2 PUMP ASSEMBLY

Lower the work equipment to the ground and stop the engine. Operate the control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

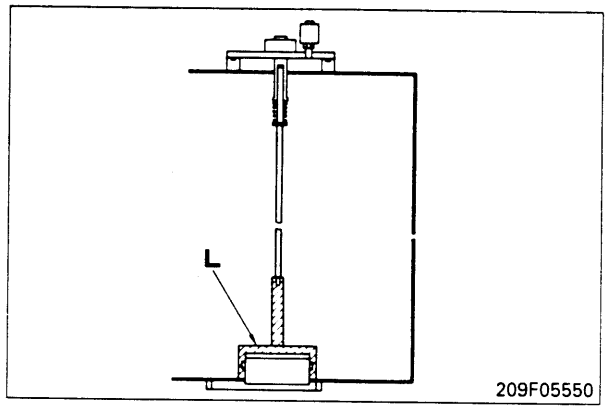
★ After disconnecting hoses, fit blind plugs to prevent dirt or dust from entering, and mark with tags to prevent mistakes in the mounting position when connecting.

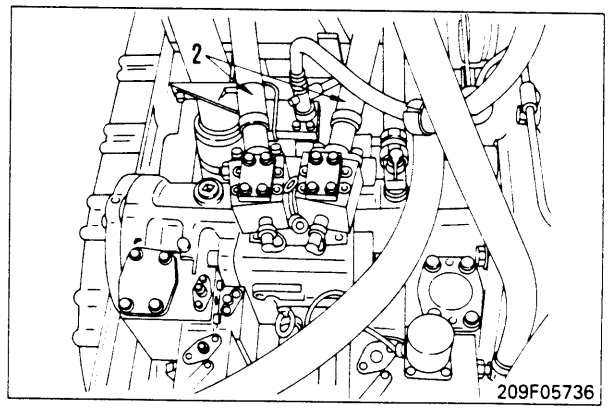
1. Remove cover, then remove strainer from inside tank.
2. Remove strainer from rod, install tool **L** in place of strainer, assemble inside hydraulic tank again, then fit spring and install cover.
   ★ When not using tool **L**, loosen the drain valve under the hydraulic tank and drain the oil from the hydraulic tank.

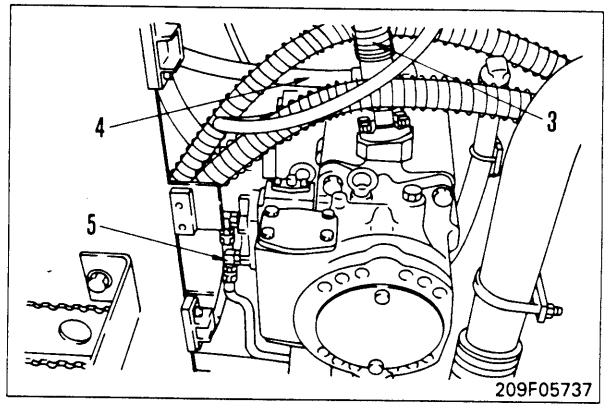
   Hydraulic tank: Approx. 480 ℓ
3. Remove drain plug under PTO case, and drain oil from PTO case.

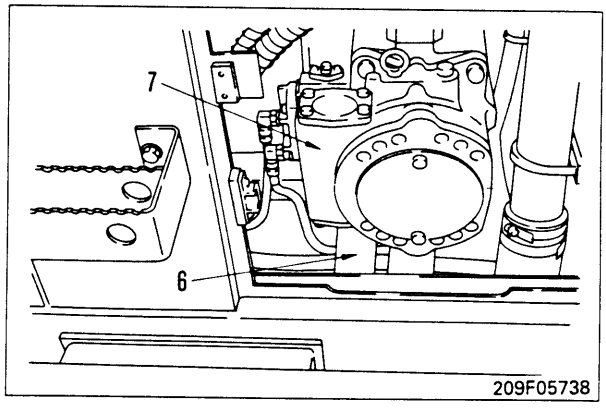
   PTO case: Approx. 10 ℓ
4. Disconnect No. 1 pump outlet hose (2).
5. Disconnect No. 2 pump outlet hoses (3) and (4).
6. Disconnect 4 hoses (5) for safety lock valve.
7. Disconnect pump inlet tube (6).
   ★ When the pump inlet tube is disconnected, the oil inside the piping will flow out, so catch it in an oil pan.
8. Sling No. 2 pump assembly, and remove mounting bolts, then remove No. 2 pump assembly (7).

   No. 2 pump assembly: 150 kg
   ★ When removing the pump assembly, check that all the hoses have been disconnected.









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INSTALLATION OF NO. 2 PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

★ After adding oil to the hydraulic tank to the specified level, run the engine to circulate the oil through the system. Then check the oil level in the hydraulic tank again.

★ Bleed the air from the main pump.
For details, see TESTING AND ADJUSTING, Bleeding air from main pump.

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REMOVAL OF SWING PUMP ASSEMBLY

Lower the work equipment to the ground and stop the engine. Operate the control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

★ After disconnecting hoses, fit blind plugs to prevent dirt or dust from entering, and mark with tags to prevent mistakes in the mounting position when connecting.

1. Remove cover, then remove strainer from inside tank.

2. Remove strainer from rod, install tool **L** in place of strainer, assemble inside hydraulic tank again, then fit spring and install cover.
   ★ When not using tool **L**, loosen the drain valve under the hydraulic tank and drain the oil from the hydraulic tank.

   Hydraulic tank: Approx. 480 ℓ

3. Disconnect pump outlet hose (2).

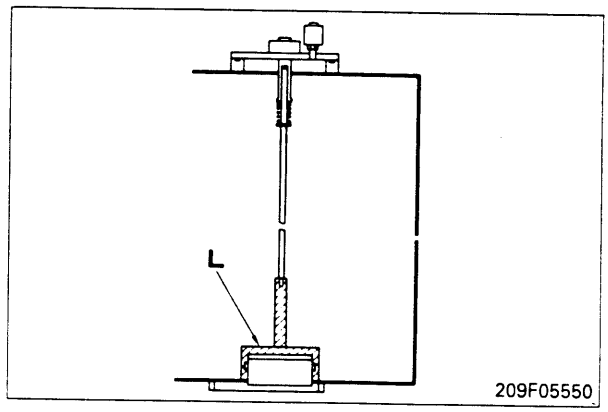
4. Disconnect hose (3).

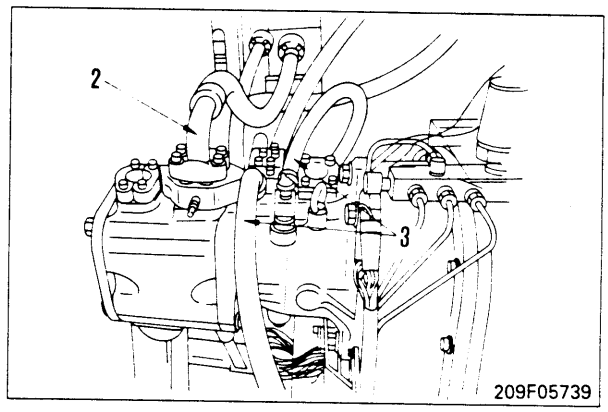
5. Disconnect hoses (4) and (5).

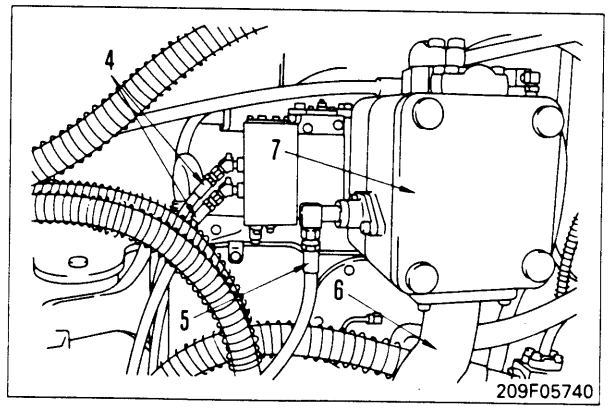
6. Loosen clamp, and disconnect pump inlet tube (6).
   ★ When the pump inlet tube is disconnected, the oil inside the piping will flow out, so catch it in an oil pan.

7. Sling swing pump assembly, and remove mounting bolts, then remove swing pump assembly (7).

   kg Swing pump assembly: 140 kg







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INSTALLATION OF SWING PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

★ After adding oil to the hydraulic tank to the specified level, run the engine to circulate the oil through the system. Then check the oil level in the hydraulic tank again.

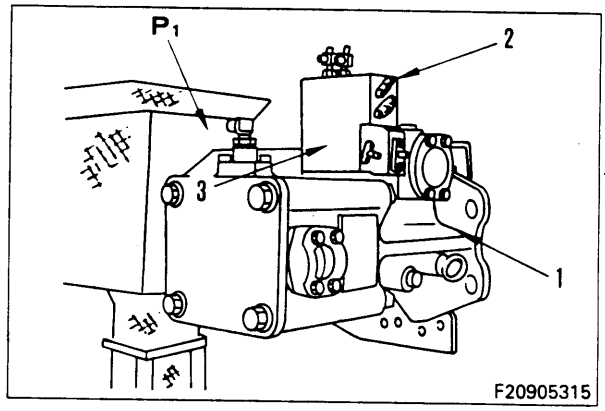
★ Bleed the air from the swing pump.
For details, see TESTING AND ADJUSTING, Bleeding air from swing pump.

DISASSEMBLY OF SWING PUMP ASSEMBLY (HPV 160)

DISASSEMBLY OF PUMP BODY

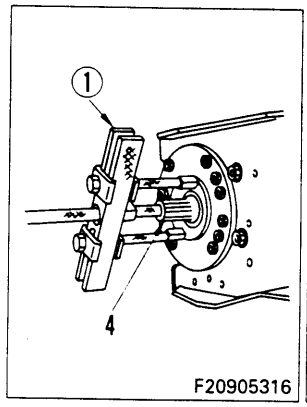
1. CO•NC valve and servo valve assembly

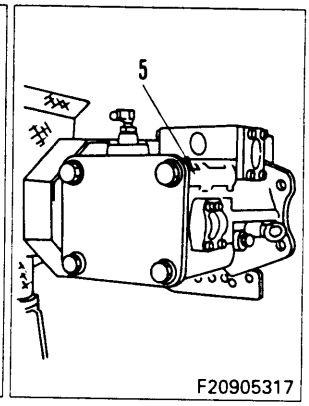
1) Set pump assembly (1) in tool P_1.
2) Remove CO•NC valve (2) and servo valve assembly (3) as a set.



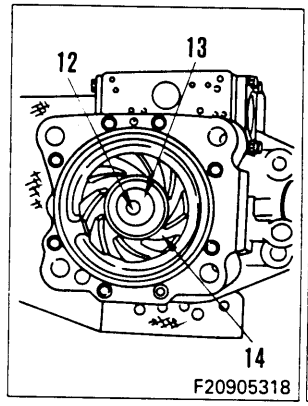
2. End cap

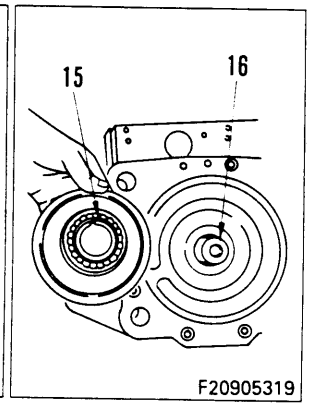
1) Using puller ① , push shaft (4) to end cap side, then stop effect of spring inside cylinder block.
2) Remove nut, then remove end cap (5).



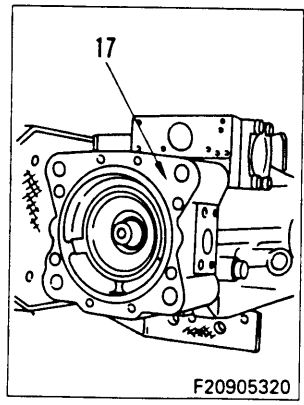


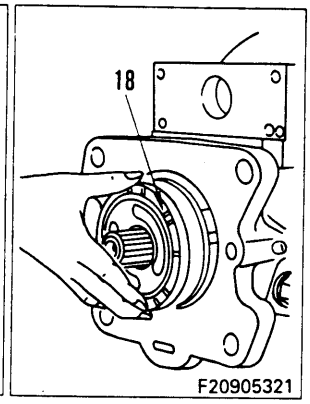
3) Remove bolt (12), then remove plate (13), shim, impeller (14), bearing (15), and key (16).
   ★ Check the number and thickness of the shims, and keep in a safe place.





4) Remove 7 bolts, then remove end cap (17).
5) Remove valve plate (18).
   ★ This is stuck to the cylinder block, so lever it off and be careful not to damage it.
6) Remove puller ① installed at Step 2-1).





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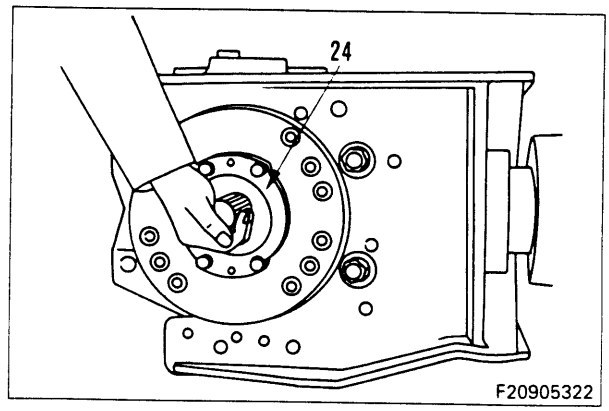
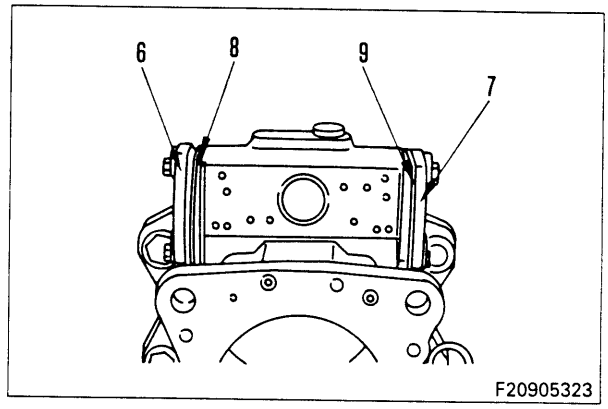
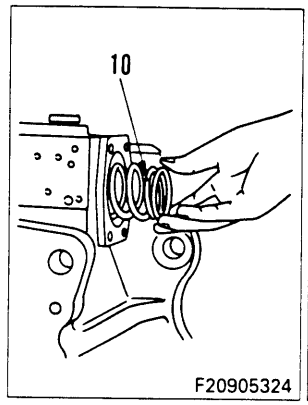
3. **Pump subassembly**
   Remove pump subassembly (24).

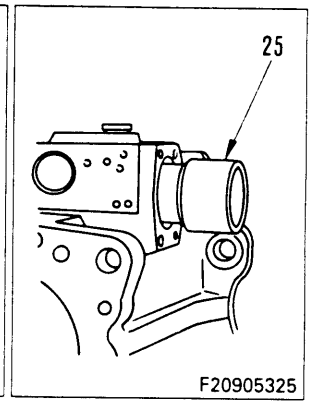


4. **Servo piston**
   1) Loosen left and right cap mounting bolts at the same time, then remove caps (6) and (7), and shims (8) and (9).



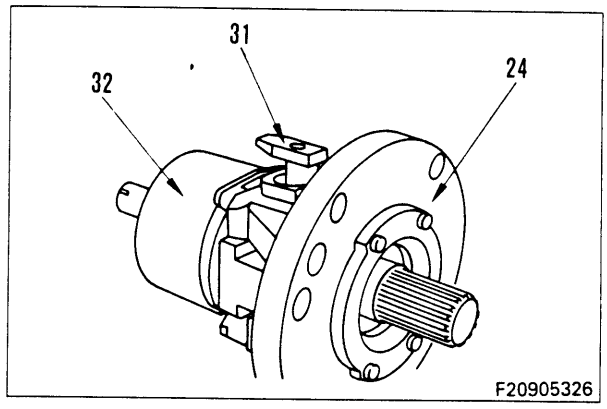
   2) Remove spring (10).
   3) Remove servo pistion (25).





DISASSEMBLY OF PUMP SUBASEMBLY

5. **Cylinder block, shaft**
   1) Set pump subassembly (24) in vice.
      ★ Be careful not to damage the cradle.
   2) Remove slider (31) and cylinder block (32).



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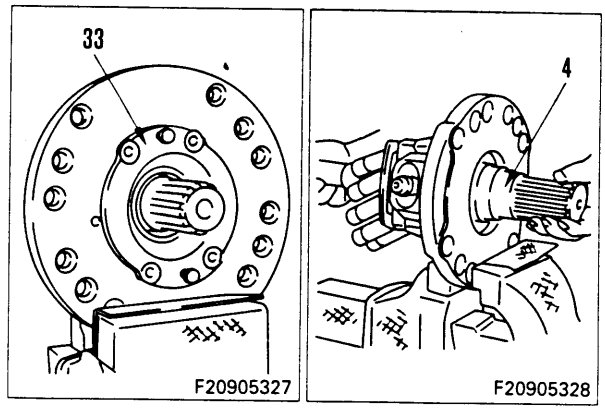
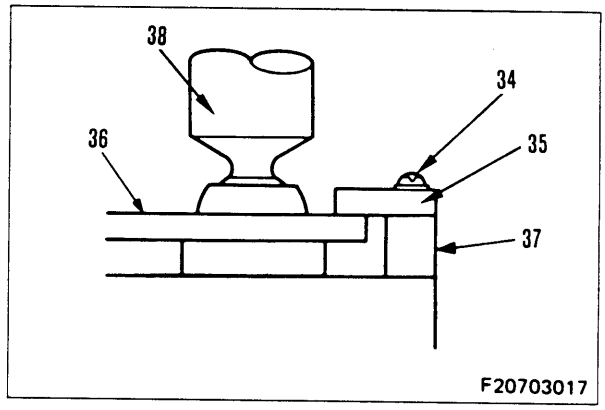
3) Screw in forcing screw, and remove housing (33).
4) Remove shaft (4).



6. **Piston**
Remove 4 screws (34), then remove retainer bearing (35), shoe retainer (36), spacer (37), and piston (38), by using tool **P2**.



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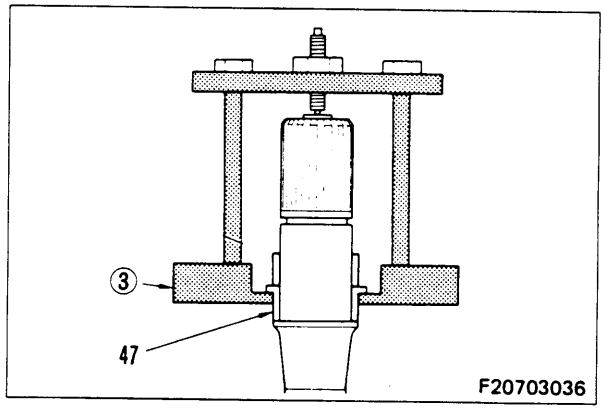
WHEN USING PUMP DRIVE SHAFT AGAIN

1. **Removal of inner race from pump drive shaft**
Using bearing race puller ③ , remove inner race (47).



ASSEMBLY OF SWING PUMP ASSEMBLY (HPV 160)

Precautions when assembling

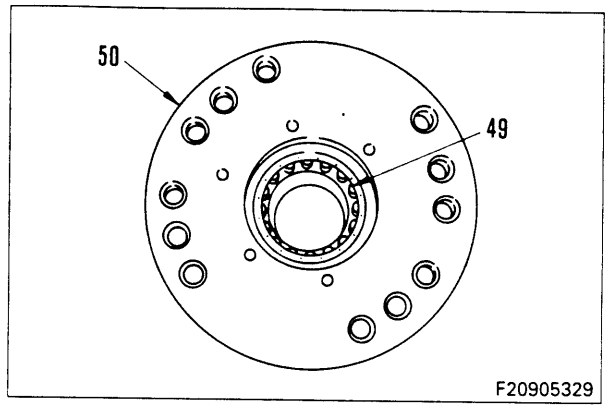
1) Clean all parts, and check for dirt or damage.
2) Coat the rotating and sliding surfaces of all parts with engine oil (EO10-CD) before installing.

★ Use the following parts as a set.
   i) Cradle and rocker cam
   ii) Cylinder block and valve plate

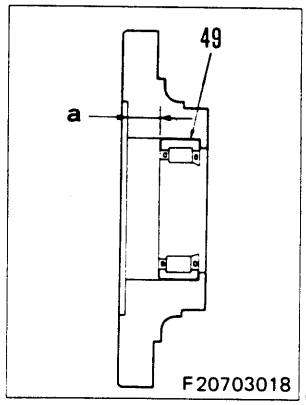
ASSEMBLY OF PUMP SUBASSEMBLY

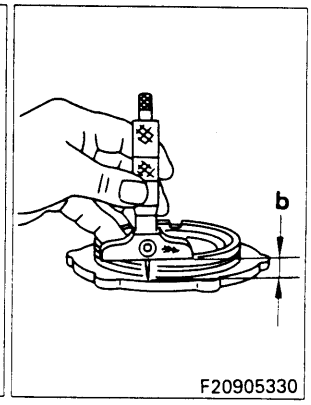
1. Cradle, piston assembly

1) Install bearing (49) (outside diameter: 110 mm) to cradle (50).
   Bearing mounting surface: Grease (G2-LI)

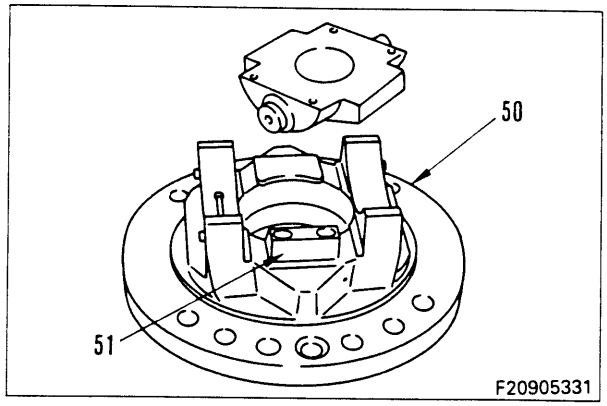


2) Select lock shim for bearing (49) as follows.
   i) Measure dimension **a** between bearing (49) and end face of cradle.
   ii) Measure dimension **b** of housing.
   iii) Select shim of same thickness as clearance dimension of measured dimensions **a** – **b**.
   ★ There are three types of shim thickness: 0.15, 0.1, 0.05 mm





3) Fit dowel pin and install rocker cam stopper (51) to cradle (50).
   Stopper bolt: Thread tightener (LT-2) (Loctite #262)
   Stopper bolt: 1.35 ± 0.15 kgm



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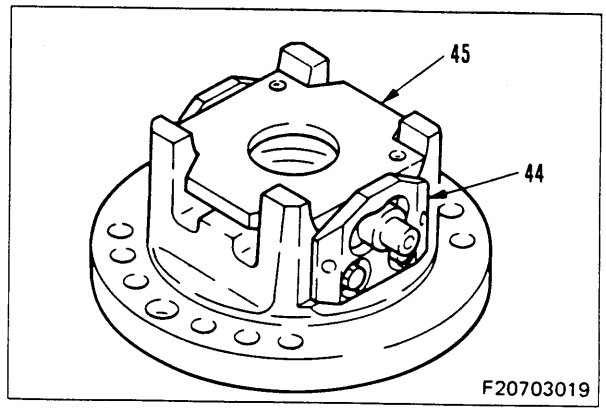
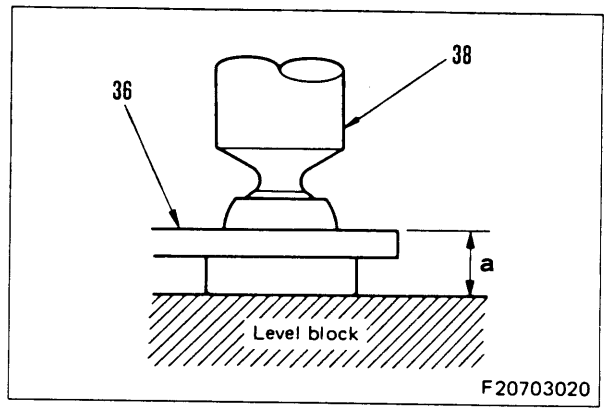
4) Fit dowel pin to cradle, and set rocker cam (45) in position, then using tool **P3**, install plate (44).
   ★ Set so that the side of the rocker cam with the groove faces the side of the cradle with the oil hole.
   Plate bolt: Thread tightener (LT-2) (Loctite #262)
   Plate bolt: 3.25 ± 0.3 kgm

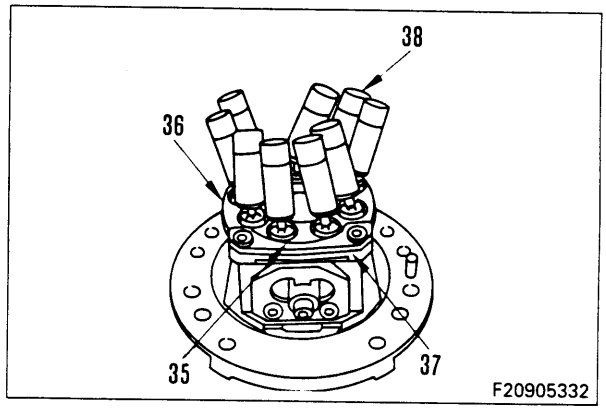
   ★ After tightening the bolts, check that the rocker cam moves smoothly.



5) Select spacer thickness as follows.
   ★ This is the clearance between the rocker cam and the shoe retainer.
   i) Assemble piston (38) to shoe retainer (36), put on a level block, then measure dimension **a** to the top surface of the shoe retainer.
   ii) Select spacer dimension of measured dimension **a** + (0.03 to 0.07) mm.
   ★ There are three types of spacers.



6) Fit spacer (37) selected in Steps 5)-i) and ii), and assemble piston (38), shoe retainer (36), and retainer bearing (35), then using tool **P2**, tighten screw (34).
   Bearing retainer bolt: Thread tightener (LT-2)
   Bearing retainer bolt: 3.2 ± 0.3 kgm



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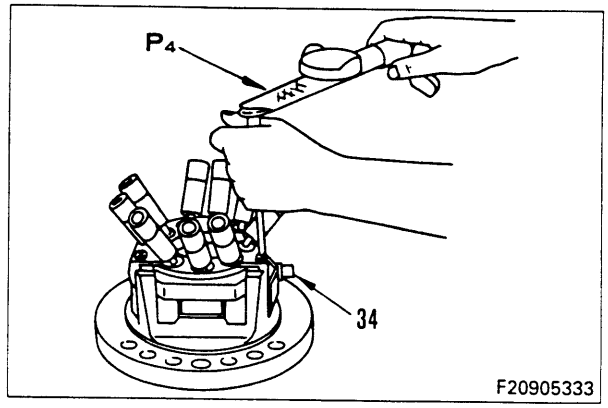
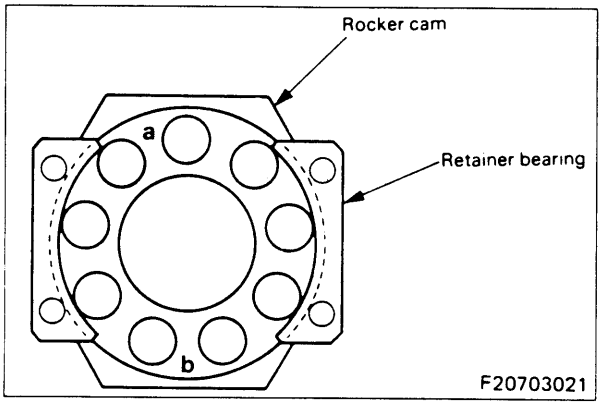
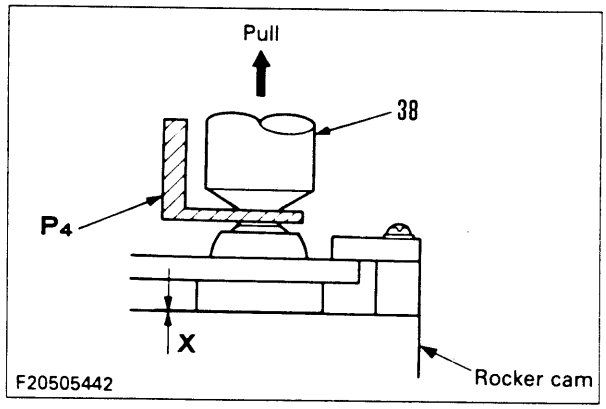
7) Secure rocker cam, then using tool **P4**, pull piston (38) with a force of 5 – 6 kg, and measure clearance **x** between piston shoe and rocker cam.
   - ★ Carry out the measurement at position **a** or **b** of the rocker cam, and measure for all 9 pistons.
   - ★ Clearance: 0.03 – 0.07 mm
   - ★ If clearance **x** is not within the standard range, adjust the spacer again.







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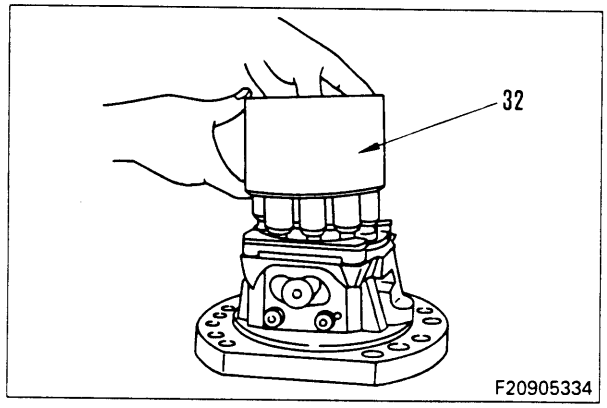
2. Cylinder block

Align piston, and install cylinder block (32).
- ★ Install the spring and washer inside the cylinder block after adjusting the preload of the bearing.
- ★ Always keep the valve plates and cylinder blocks in their correct sets. Make the sets to prevent any mistake in the combination.

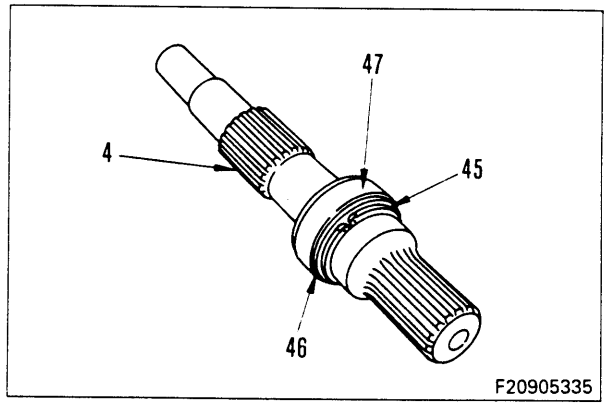
Reference:

When using tool **P8**, assemble them before. (When assembling with tool **P8**, see the final reference item.)



3. Shaft

1) Press fit inner race (47) (inside diameter: 60 mm) to shaft (4), then fit washer (46) and install snap ring (45).
   - ★ Assemble the inner race so that the side with the flange faces the PTO.



Select washer (46) as follows.

i) Install inner race (47).

ii) Install snap ring (52).

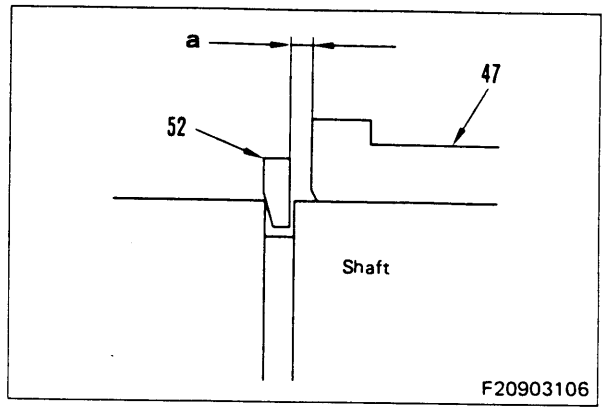
★ Check that the snap ring is not deformed or scratched. Correct any burrs and install with the side cut on the inside facing the opposite side from the inner race.

iii) Measure clearance **a** between snap ring (52) and inner race with clearance gauge.

★ Push the snap ring securely into the groove on the opposite side from the inner race.

iv) Select washer of measured thickness **a** + (0 to 0.1)mm and install.

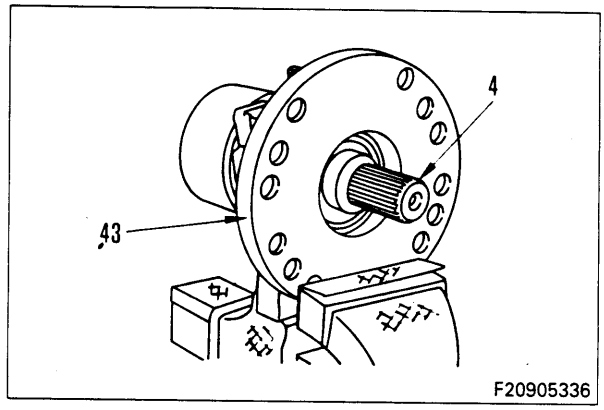
★ Check that there is no play between the snap ring and washer. There are four types of washers.



2) Set cradle and piston assembly (43) in vice.

★ Put a block under the cylinder block, and support the cylinder.

3) Align with cylinder and install shaft (4).



4) Install housing as follows.

i) Install oil seal (42) (outside diameter: 95 mm) to housing (33).

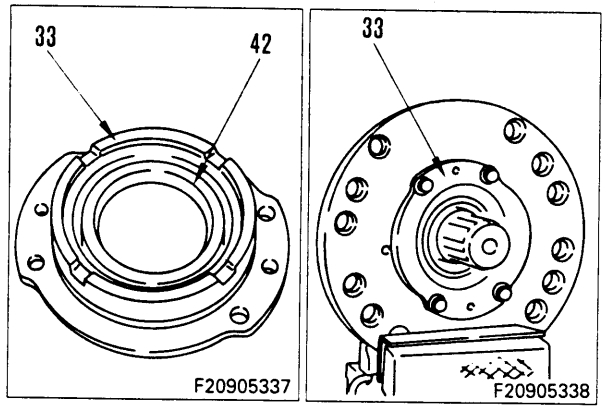
Lip of oil seal: Grease (G2-LI)

ii) Fit O-ring and shim selected in Step 1-2), then install housing (33).

★ Be careful not to damage the lip of the oil seal.

Reference:

When using tool **P8**, do not install. (When assembling with tool **P8**, see the final reference item.)



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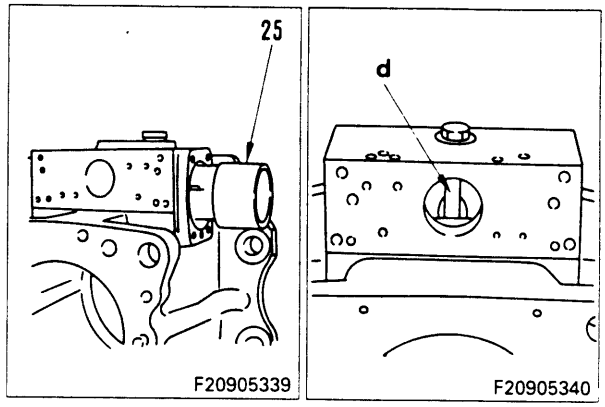
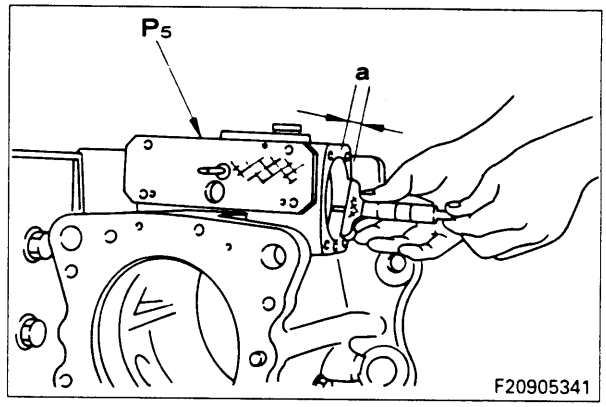
ASSEMBLY OF PUMP BODY

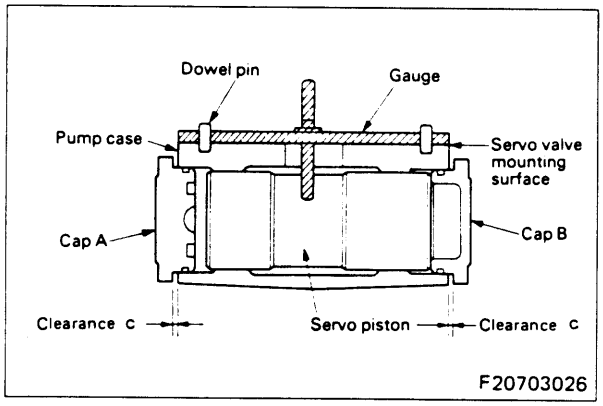
4. Servo piston

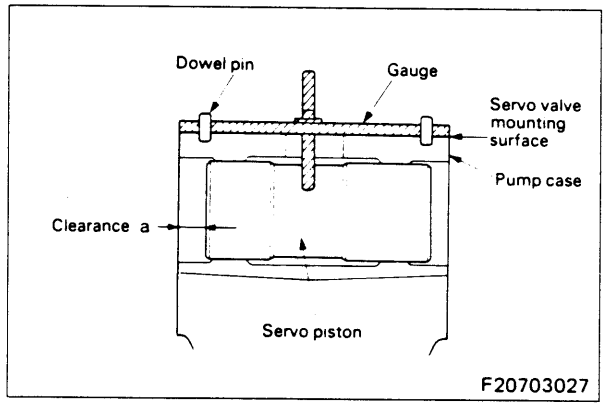
1) Install servo piston (25) to case.
   ★ The parts are common at the front and rear.

2) Adjust stroke of servo piston as follows.
   i) Align with groove **d** for servo valve arm of servo piston and dowel pin, and set tool **P5** in position.
      ★ As seen from the rear of the pump, the right side (the side with the spring) is the maximum rocker cam angle.
   ii) Measure dimension **a** between servo piston and case.
   iii) Measure dimension **b** of cap (7).
   iv) Select shim thickness equal to dimension **b** at cap end – dimension **a** at servo = clearance ± 0.05 mm.
   Shim thickness: **b** – **a** = **c** ± 0.05 mm
      ★ Make the adjusted shim thickness a set with the cap.

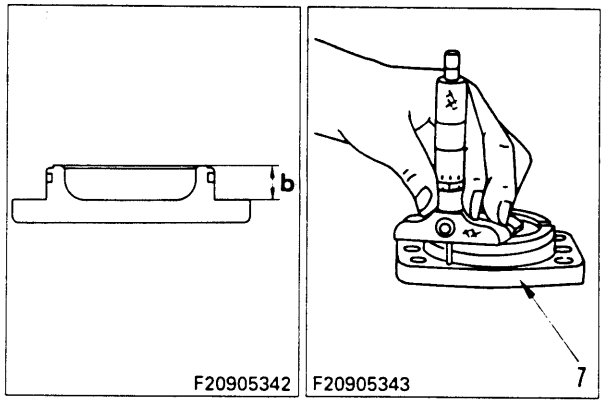








★ To adjust the minimum rocker cam angle, move the tool **P6** to the minimum rocker cam angle side and adjust in the same way at Steps i) – iv) above. However, the direction of the case is the opposite to the direction when adjusting the maximum swash plate angle.



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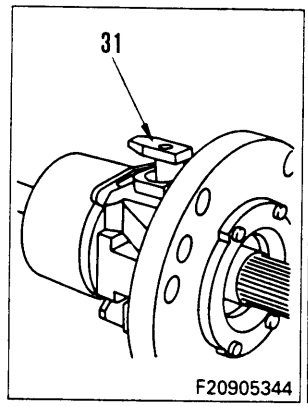
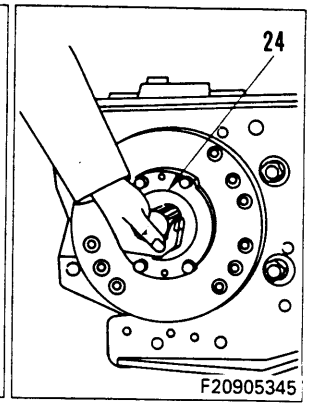
5. Pump subassembly

1) Install slider (31) and O-ring.
   ★ Fit O-rings to the pilot and the joint.

2) Install joint to case end.
   ★ The smaller hole faces the cradle end.

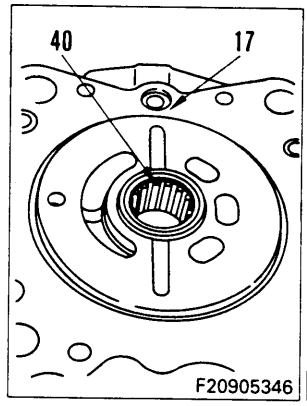
3) Align slider with servo piston, and support shaft from front and rear, then install pump subassembly (24).
   ★ Be careful not to get the O-rings caught.
   kgm Mounting bolt: 18 ± 2 kgm

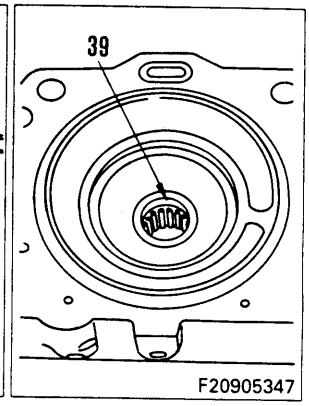




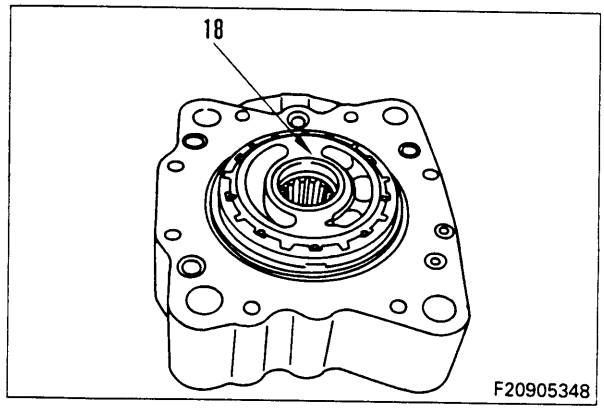
6. End cap

1) Install bearing (40) and outer race (39) of thrust bearing to end cap (17).





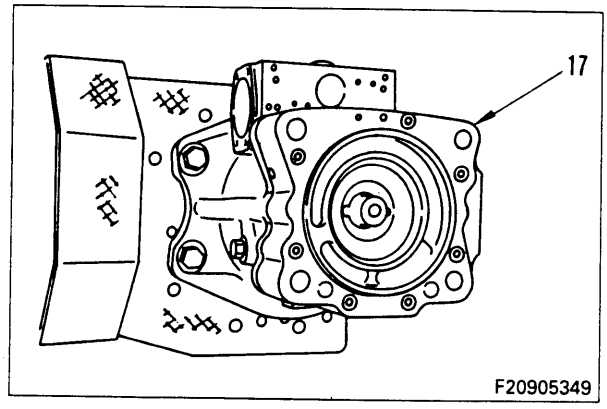
2) Coat with grease (G2-LI), align dowel pin with bearing, then install valve plate (18).



7. Adjust end play of pump drive shaft bearing

1) Install joint to case.
   ★ The smaller hose faces the opposite side to the end cap.

2) Install end cap (17) to case.
   kgm Bolt: 5.5 ± 0.7 kgm



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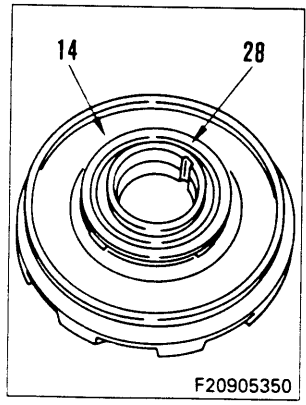
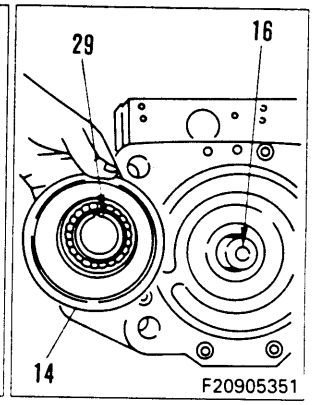
3) Install inner race (28) to impeller (14).

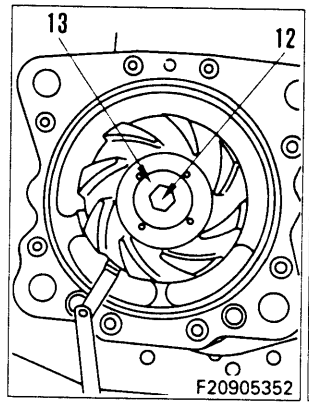
4) Coat with grease (G2-LI), and install bearing (29) to impeller (14).

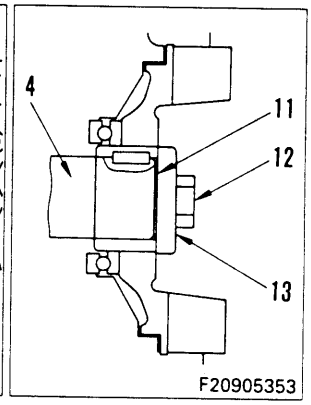
5) Install key (16) to shaft.



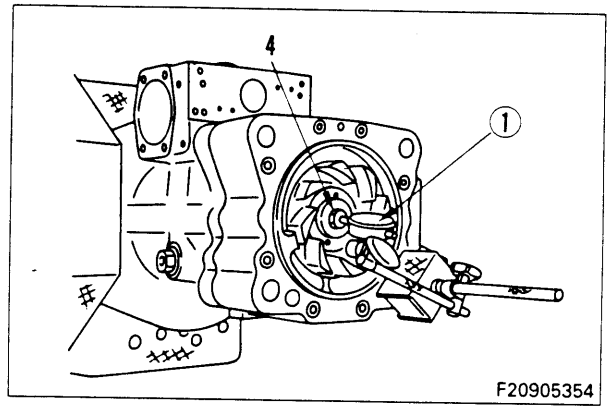


6) Install impeller, fit shim (11) and plate (13), then tighten bolt (12).
kgm Mounting bolt: 11.5 ± 1 kgm



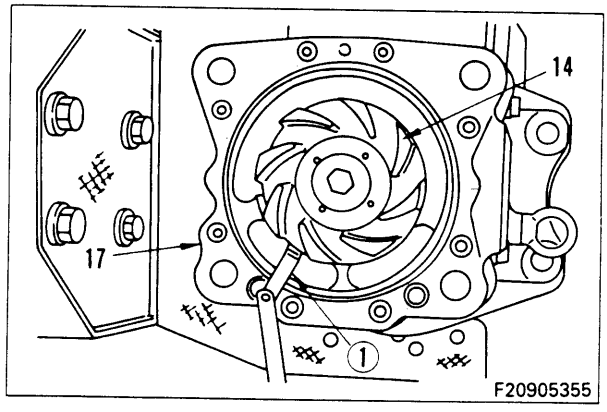


7) Set dial gauge ① to end cap, then adjust with shims (11) so that dimension is 0.1 – 0.4 mm when shaft (4) is moved to front and rear.



8) After adjusting shim, measure clearance between impeller (14) and end cap (17) using thickness gauge ① .
★ Clearance: 0.65 ± 0.18 mm

★ After completing all the measurements, remove the impeller and end cap.



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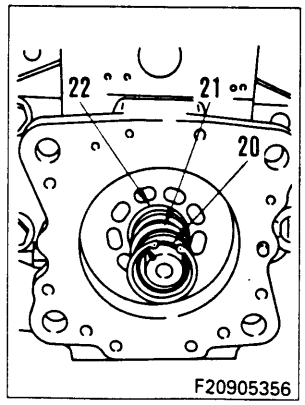
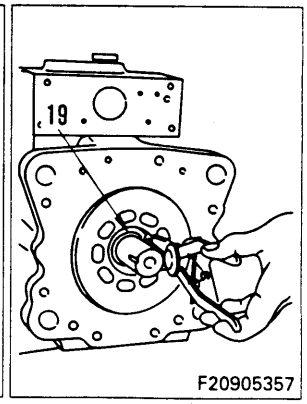
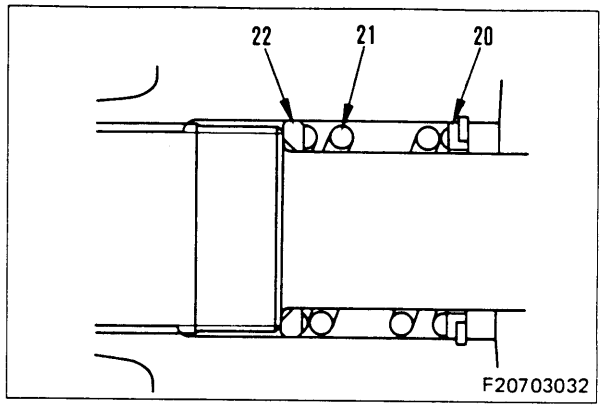
8. **Washer, spring, snap ring**
   Assemble washer (22), spring (21), and washer (20) in cylinder block, then install snap ring (19).
   ★ Be careful of the direction of the washer.







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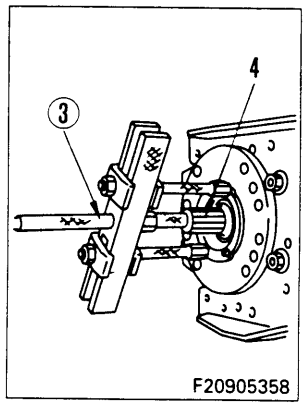
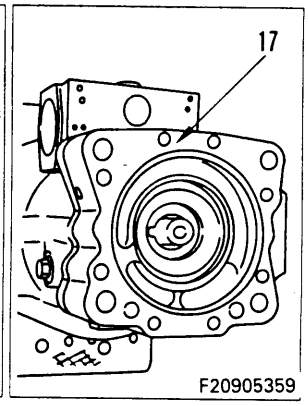
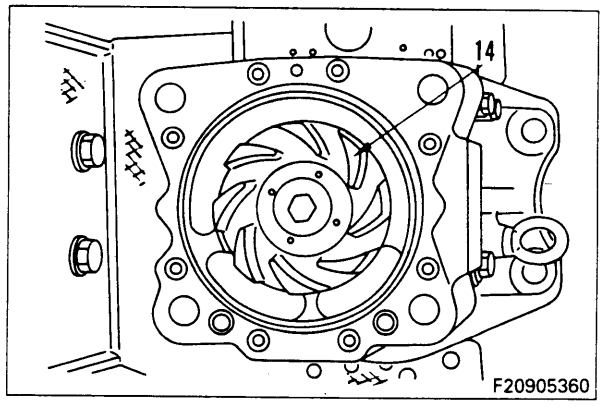
9. **Impeller**
   1) Using puller ③ , lock shaft (4).
      ★ When installing the end cap, the shaft is pushed by the cylinder block spring and contacts the oil seal, so keep pushing the shaft until the impeller is installed.
   2) Fit O-ring and install end cap (17).
      ★ For installation, see Steps 6 and 7-1), 2).





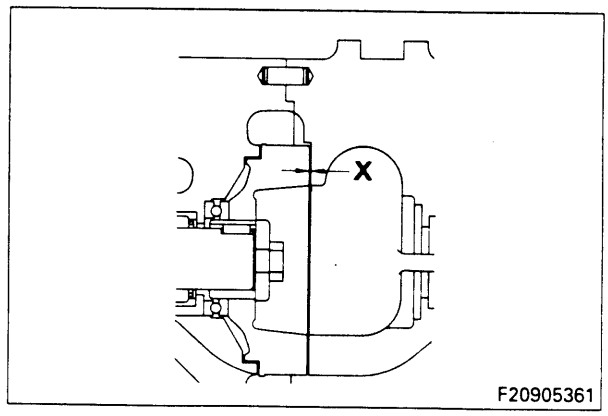
   3) Install impeller (14).
      For details, see steps 7-3) to 6).
      Mounting bolt: Thread tightener (LT-2)
      Mounting bolt: 11.5 ± 1 kgm



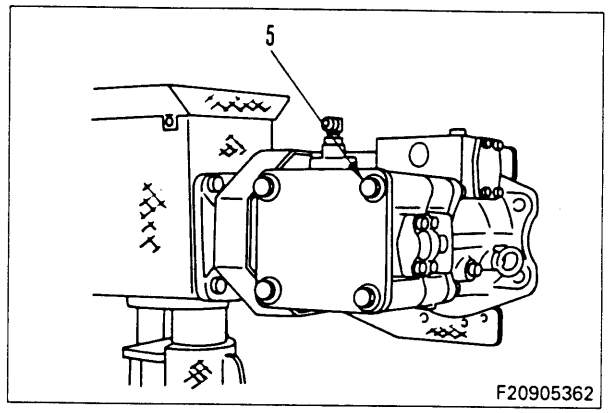
   4) Remove puller ③ installed in Step 1).

10. Rear end cap

1) Check that clearance **x** between rear end cap and impeller is 0.65 ± 0.21 mm.



2) Fit O-ring and install rear end cap (5).
   kgm Mounting nut: 48 ± 4 kgm



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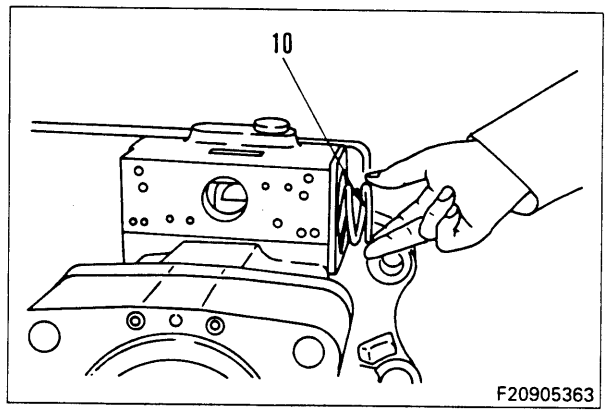
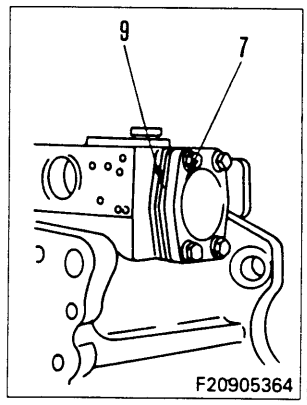
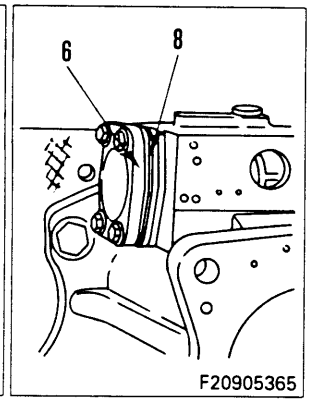
11. Servo piston cap

1) Align with servo piston, and install spring (10).
   ★ Install on the right side as seen from the rear of the pump.



2) Fit O-rings and shims (9) and (8) selected in Step 4, then install caps (7) and (6).
   kgm Mounting bolt: 6.7 ± 0.7 kgm
   ★ Push the cap and screw in the bolt on the side where the spring is.

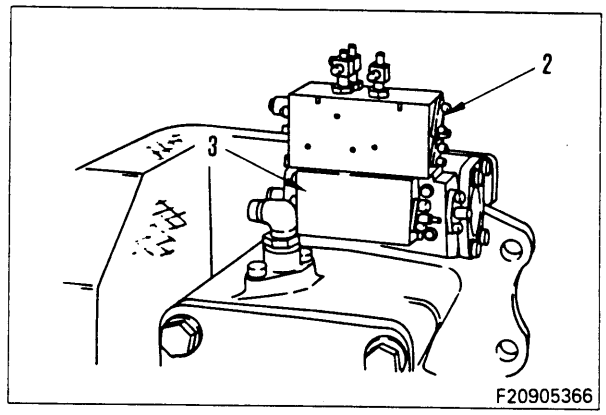




12. Revolution torque check of pump

i) Rotate the pump at a speed of about 3 – 5 sec/turn and measure the rotating torque at this point by using tool **P7**.

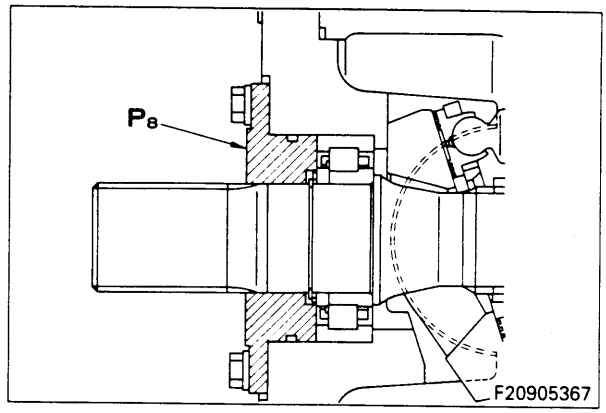
ii) It must rotate with no variation in rotating torque (variation width: Max. 0.3 kgm) at within 1.2 kgm (at minimum swash plate angle).



13. Servo valve, CO•NC valve

1) Fit O-ring and align lever of servo valve with groove of servo piston, then assemble servo valve (3) and CO•NC valve (2) as a set.

kgm Mounting bolt: 3.2 ± 0.3 kgm



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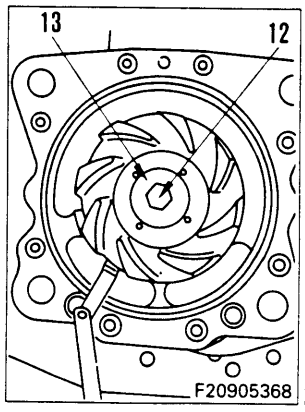
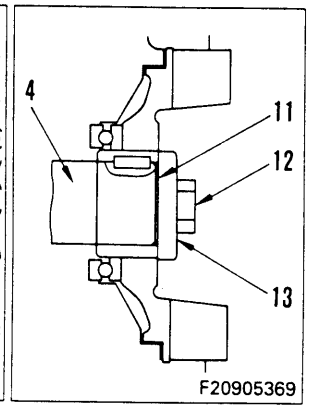
Reference: Assembly procedure when using tool **P8**

- Assemble spring in cylinder block.
- ★ See Assembly Step 8.
- Do not install the housing to the cradle.

1. Install tool **P8** in mounting position for housing.
2. See Steps 6 – 7-6), and install up to impeller.
3. Select a shim so that clearance between plate (13) and impeller is 0 – 0.2 mm.
4. Remove tool **P8**, and install dial gauge to impeller.
5. Move shaft in axial direction with a force of 200 ±10 kgm, and check that movement of shaft is 0.1 – 0.4 mm.
6. Remove dial gauge, and install housing to cradle.
7. For the rest of the assembly, see the procedure from Step 10.





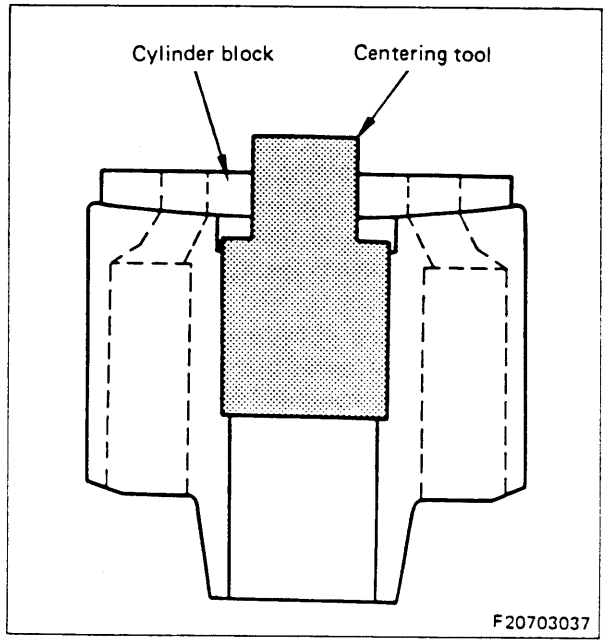
CHECKING CONTACT BETWEEN CYLINDER BLOCK AND VALVE PLATE, AND ROCKER CAM AND CRADLE

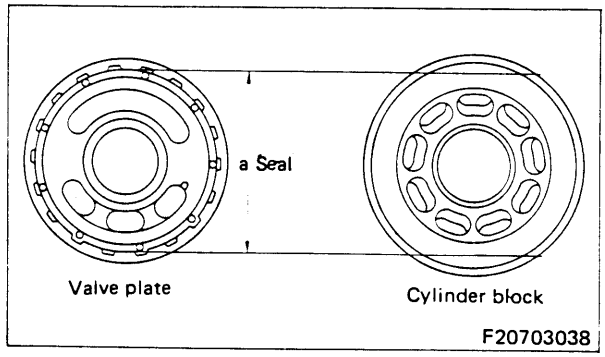
1. Checking contact between cylinder block and valve plate

1) Make a centering tool for the cylinder block and valve plate.
   ★ The tool can be made of a soft material such as plastic or bakelite.
2) Remove grease from the parts to be checked.
   ★ Do not wipe with a cloth.
3) Set the tool in position, and coat the cylinder block side with inspection paint.
   ★ Apply the paint thinly.
4) Put the valve plate on top, push with a force of 4–5 kg, and rotate 2–3 times.
5) Remove the valve plate, transfer the contact surface to tape, and check the contact surface.

★ The standards for the contact surface are as follows.

Valve plate	Seal	Min. 80%
Cylinder block	Seal	Min. 80%





2. Checking contact between rocker cam and cradle

1) Remove grease from the parts to be checked.
   ★ Do not wipe with a cloth.
2) Set the tool in position, and coat the cradle side with inspection paint.
   ★ Apply the paint thinly.
3) Put the rocker cam on top, push with a force of 4 – 5 kg, and move 2 – 3 times from the stopper contact position to the maximum angle.
4) Remove the rocker cam, transfer the contact surface to tape, and check the contact surface.

★ The standards for the contact surface are as follows.

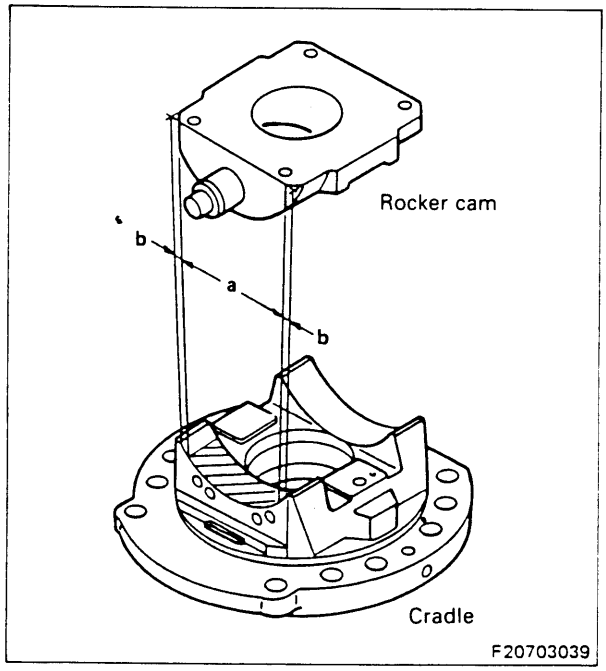
Pump Model	Dimension **a** (mm)	Contact surface	Contact **b** from **a** to outside
HPV160	70	Min. 90%	Min. 50%

★ If there is no contact at the center but only at the outside, the contact is no good.

Reference:

If the contact is not within the contact standard value, when carrying, always lap both parts together.

★ Parts with scratches cannot be reused.



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REMOVAL OF CHARGING, PTO LUBRICATION PUMP ASSEMBLY

⚠ Lower the work equipment completely to the ground and stop the engine.

1) Release the remaining pressure in the hydraulic piping.
   For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit of machines equipped with PPC valve.
2) Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Replace strainer of hydraulic tank with tool **L**.
   ★ When not using tool **L**, loosen the drain valve under the hydraulic tank and drain the oil from the hydraulic tank.

   Hydraulic tank: Approx. 480 ℓ

2. Drain oil from PTO case.

   PTO case: Approx. 10 ℓ

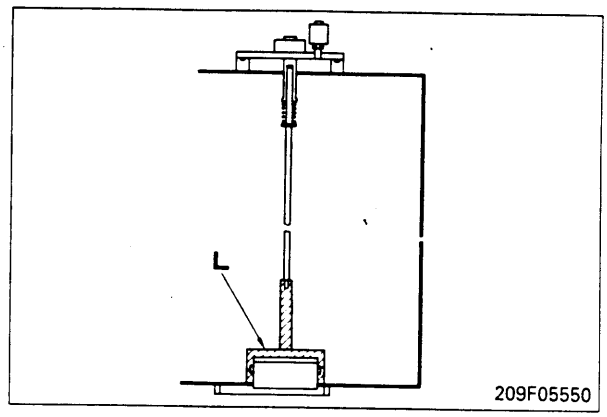
3. Disconnect hoses (1) and (2).

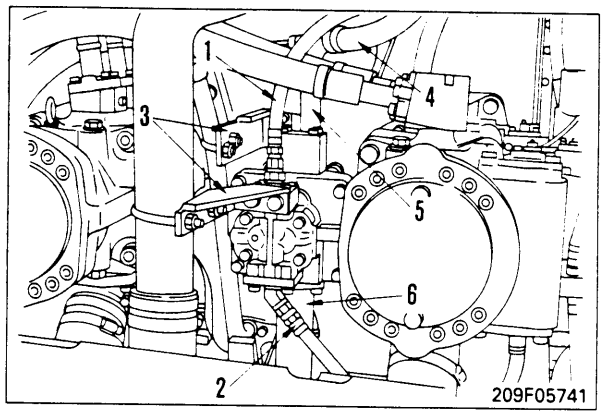
4. Remove bracket (3).

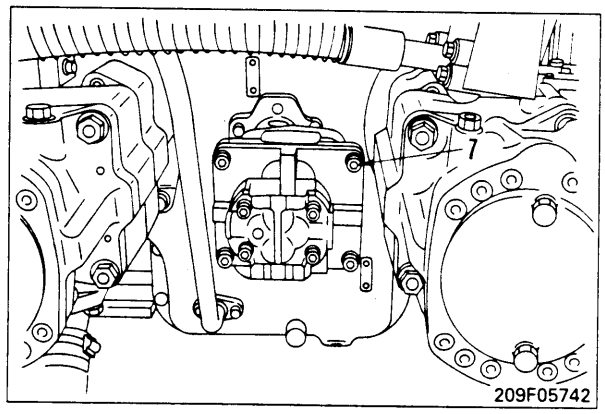
5. Disconnect hose (4).

6. Disconnect tubes (5) and (6).
   ★ When the tubes are disconnected, the oil inside the piping will flow out, so catch it in an oil pan.

7. Sling charging and PTO lubrication pump assembly (7), and remove mounting bolts, then remove assembly.







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INSTALLATION OF CHARGING, PTO LUBRICATION PUMP ASSEMBLY

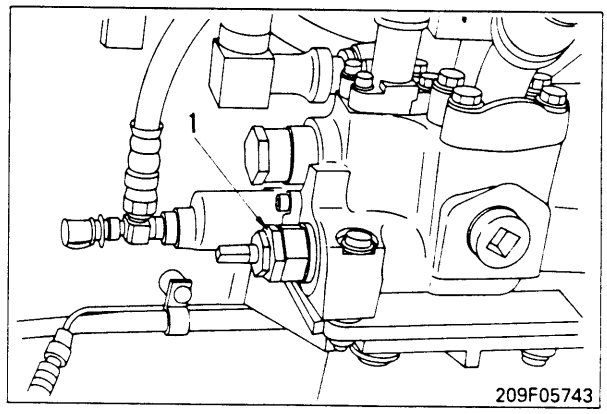
- Carry out installation in the reverse order to removal.
- Refilling with oil
  ★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.
  ★ Add oil to replace the amount that leaked out when the pump was removed.

REMOVAL OF MAIN RELIEF VALVE ASSEMBLY (FOR SWING CONTROL VALVE)

★ Before removing the main relief valve assembly, clean the surrounding area and be careful not to let any dirt or dust get into the control valve.

Stop the engine, then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Remove main relief valve assembly (1). ※ 1



INSTALLATION OF MAIN RELIEF VALVE ASSEMBLY (FOR SWING CONTROL VALVE)

- Carry out installation in the reverse order to removal.

※ 1

★ Measure and adjust the relief pressure.
For details, see TESTING AND ADJUSTING, Measuring and adjusting work equipment, travel, swing circuit pressure.

kgm Main relief valve assembly:
32.75 ± 4.75 kgm

- Refilling with oil
  - ★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.
  - ★ Add oil to replace the amount that leaked out when valve was removed.

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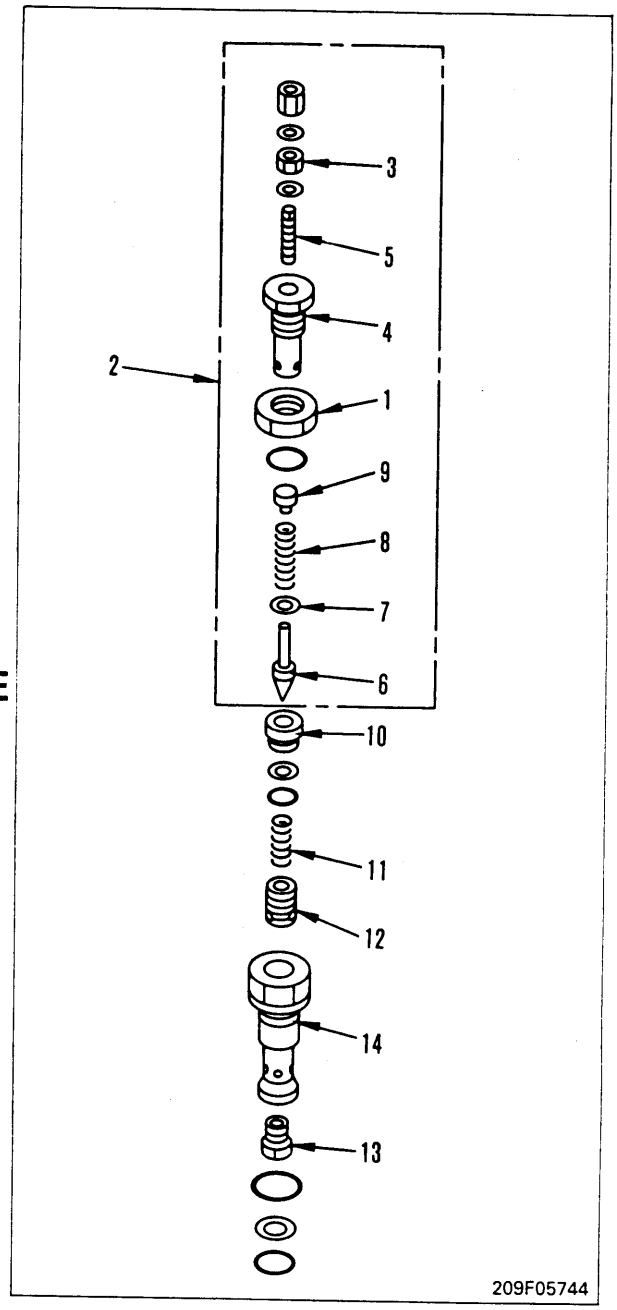
DISASSEMBLY OF MAIN RELIEF VALVE ASSEMBLY (FOR SWING CONTROL VALVE)

1. Loosen nut (1), and remove holder assembly (2).
   ★ When loosening nut (3), measure the dimension of protrusion between end face of holder (4) and adjustment screw (5).
   ★ Do not loosen the nut except when replacing parts.
2. Remove poppet (6), spacer (7), spring (8), and retainer (9) from holder (4).
3. Pull out seat (10), spring (11), and valve (12) from sleeve (14).
4. Remove plug (13).



ASSEMBLY OF MAIN RELIEF VALVE ASSEMBLY (FOR SWING CONTROL VALVE)

1. Install plug (13) to sleeve (14).
2. Assemble valve (12) and spring (11) in sleeve (14).
3. Fit O-ring and backup ring, and assemble seat (10) in sleeve (14).
4. Install nut (1) to holder (4).
   ★ If nut (3) has been loosened, adjust the dimension of protrusion of adjustment screw (5) to the same dimension as before disassembly, then tighten nut (3).
5. Assemble retainer (9), spring (8), spacer (7), and poppet (6) in holder.
6. Install holder assembly (2) to sleeve (14), and tighten nut (1).

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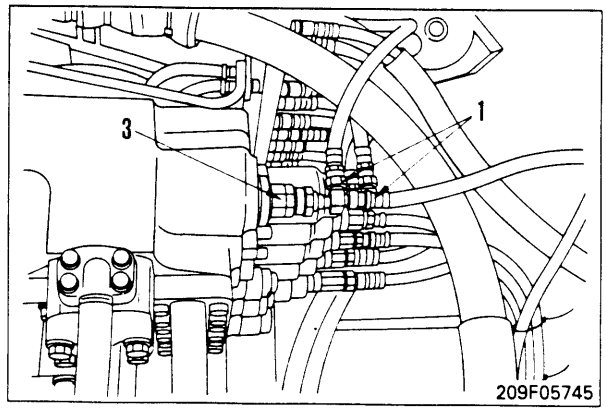
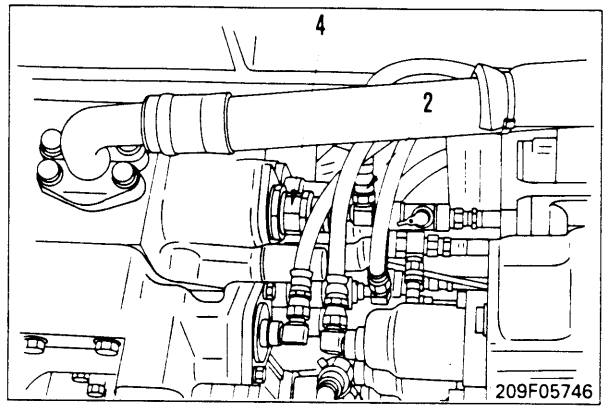
REMOVAL OF MAIN RELIEF VALVE ASSEMBLY (FOR WORK EQUIPMENT 4-, 5-SPOOL CONTROL VALVE)

★ Before removing the main relief valve assembly, clean the surrounding area and be careful not to let any dirt or dust get into the control valve.

⚠ Stop the engine, then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Disconnect hose (1) and (2).
2. Remove main relief valve assembly (3) and (4). ※1





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INSTALLATION OF MAIN RELIEF VALVE ASSEMBLY (FOR WORK EQUIPMENT 4-, 5-SPOOL CONTROL VALVE)

- Carry out installation in the reverse order to removal.

※1

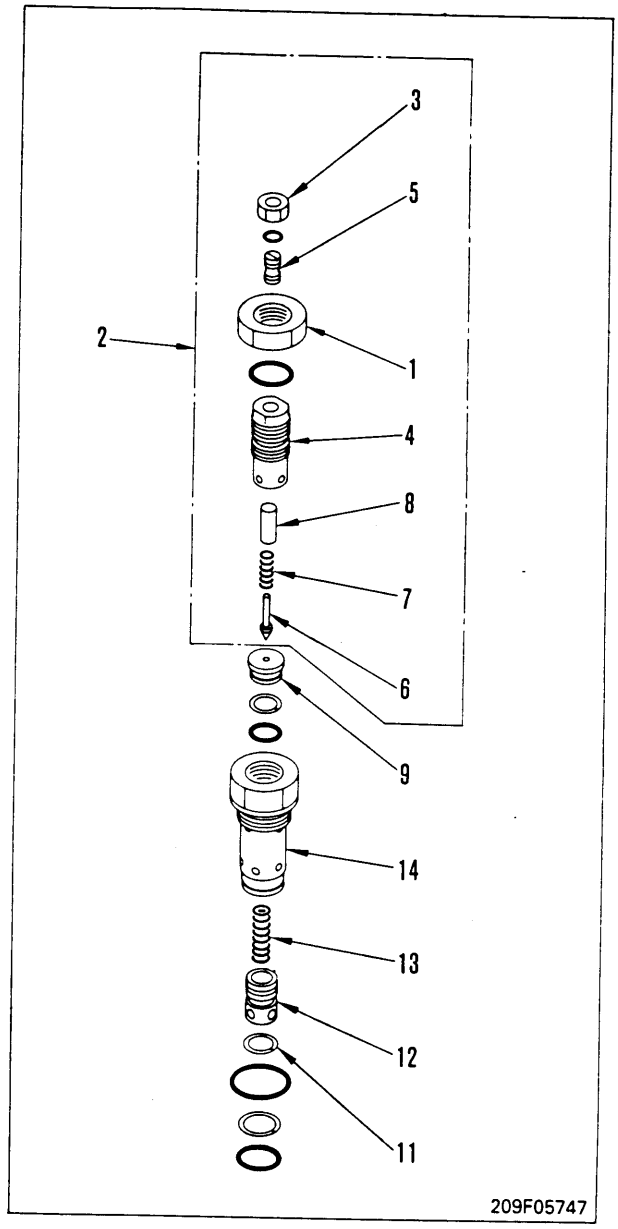
★ Measure and adjust the relief pressure.
For details, see TESTING AND ADJUSTING, Measuring and adjusting work equipment, travel, swing circuit pressure.

kgm Main relief valve assembly: 32.75 ± 4.75kgm

- Refilling with oil
  - ★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.
  - ★ Add oil to replace the amount that leaked out when the valve was removed.

DISASSEMBLY OF MAIN RELIEF VALVE ASSEMBLY (FOR WORK EQUIPMENT 4-, 5-SPOOL CONTROL VALVE)

1. Loosen nut (1), and remove holder assembly (2).
   ★ When loosening nut (3), measure the dimension of protrusion between end face of holder (4) and adjustment screw (5).
   ★ Do not loosen the nut except when replacing parts.
2. Remove poppet (6), spring (7), and retainer (8).
3. Remove seat (9).
4. Remove snap ring (11), then remove valve (12) and spring (13) from sleeve (14).



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ASSEMBLY OF MAIN RELIEF VALVE ASSEMBLY (FOR WORK EQUIPMENT 4-, 5-SPOOL CONTROL VALVE)

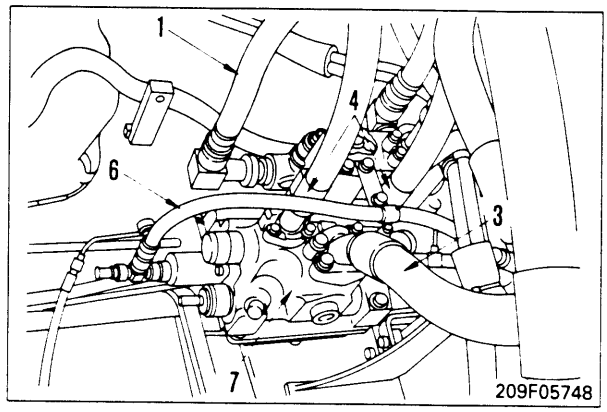
1. Assemble spring (13) and valve (12) in sleeve (14), then install snap ring (11).
2. Fit O-ring and backup ring, and assemble seat (9) in sleeve (14).
3. Install nut (1) to holder (4).
   ★ If nut (3) has been loosened, adjust the dimension of protrusion of adjustment screw (5) to the same dimension as before disassembly, then tighten nut (3).
4. Assemble retainer (8), spring (7), and poppet (6) in holder (4).
5. Install holder assembly (2) to sleeve (14), and tighten nut (1).

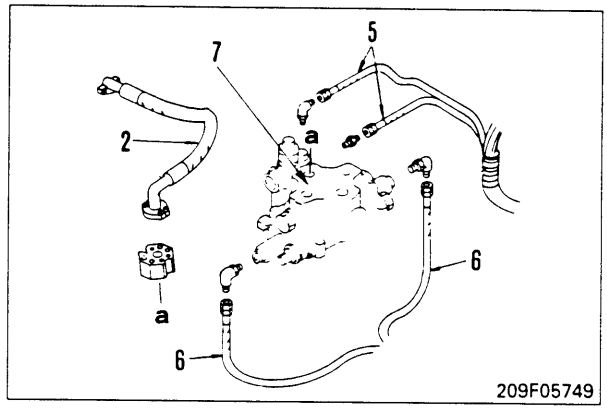
REMOVAL OF SWING CONTROL VALVE ASSEMBLY

⚠ Lower the work equipment completely to the ground and stop the engine.

1) Release the remaining pressure in the hydraulic piping.
   For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit of machines equipped with PPC valve.
2) Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Remove top machine cover.
2. Disconnect control valve outlet hoses (1) and (2).
3. Disconnect control valve inlet hose (3).
4. Disconnect swing motor hose (4).
5. Disconnect jet sensor hose (5).
6. Disconnect PPC hose (6).
7. Lift off swing control valve assembly (7).
   kg Swing control valve assembly: 40 kg





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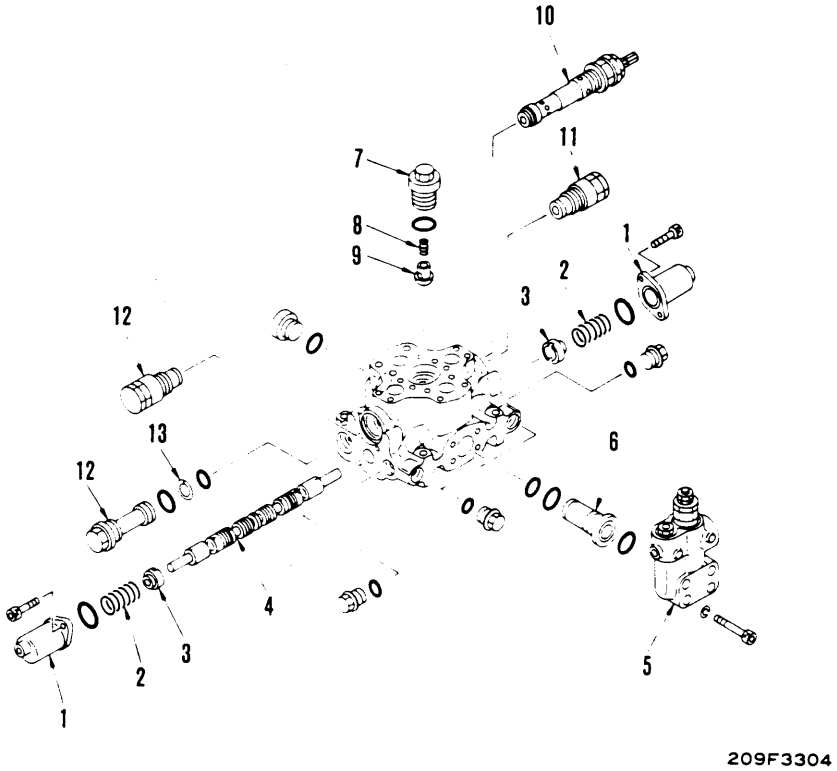
INSTALLATION OF SWING CONTROL VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

- Refilling with oil
  ★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.
  ★ Add oil to replace the amount that leaked out when the control valve was removed.

DISASSEMBLY OF SWING CONTROL VALVE ASSEMBLY



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1. Pull out spool from valve body as follows.
   1) Remove case (1), then remove spring (2) and retainer (3).
   2) Pull out spool (4) from valve body.
2. Remove jet sensor assembly (5).
3. Remove flange (6).
4. Remove plug (7), then remove spring (8) and check valve (9).
5. Remove main relief valve assembly (10).
6. Remove suction valve (11).
7. Remove plug (12), then remove backup ring (13).

ASSEMBLY OF SWING CONTROL VALVE ASSEMBLY

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. Fit O-ring and backup ring (13), and install plug (12) to valve body.
   kgm Plug: 19 ± 1 kgm

2. Fit O-ring and install suction valve (11).
   kgm Suction valve: 19 ± 1 kgm

3. Fit O-ring and install main relief valve assembly (10).
   kgm Main relief valve: 19 ± 1 kgm

4. Assemble check valve (9) and spring (8) to valve body, and tighten plug (7).

5. Fit O-ring and assemble flange (6) to valve body.

6. Fit O-ring and install jet sensor assembly (5).

7. Install spool to valve body as follows.
   1) Assemble spool (4) in valve body.
   2) Assemble retainer (3) and spring (2), then fit O-ring and install case (1).

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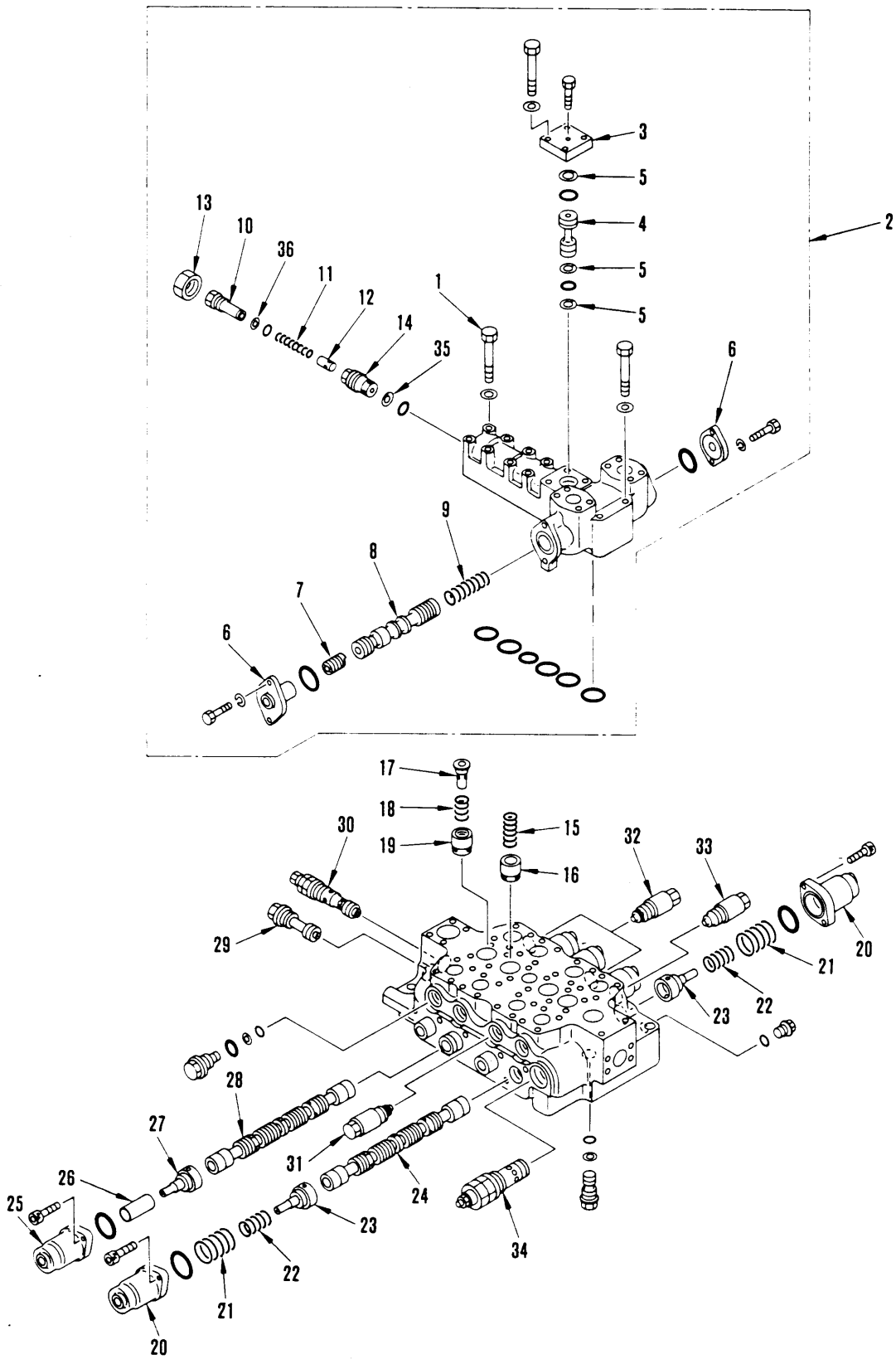
DISASSEMBLY OF CONTROL VALVE ASSEMBLY (FOR WORK EQUIPMENT)



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★ The operation for the R.H. 4-spool control valve assembly (with straight-travel valve) is basically the same as for the L.H.5-spool control valve assembly.

1. Remove mounting bolts (1), then remove straight-travel valve assembly (2).

2. Disassemble straight-travel valve assembly as follows.
   1) Remove cover (3).
   2) Pull out plug (4), and remove backup ring (5).
   3) Remove sleeve (6), then pull out piston (7), spool (8), and spring (9).
   4) Remove plug (10), then pull out spring (11) and check valve (12).
   5) Loosen nut (13), and remove sleeve (14).

3. Remove spring (15) and check valve (16).

4. Remove seat (17), spring (18), and check valve (19).

5. Pull out spool from valve body as follows.
   1) Remove case (20), then remove springs (21) and (22), and retainer (23).
   2) Pull out spool (24) from valve body.

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6. Pull out spool from valve body as follows.
   1) Remove case (25), then remove tube (26) and retainer (27).
   2) Pull out spool (28) from valve body.

7. Remove jet sensor orifice (29) and jet sensor relief valve (30).

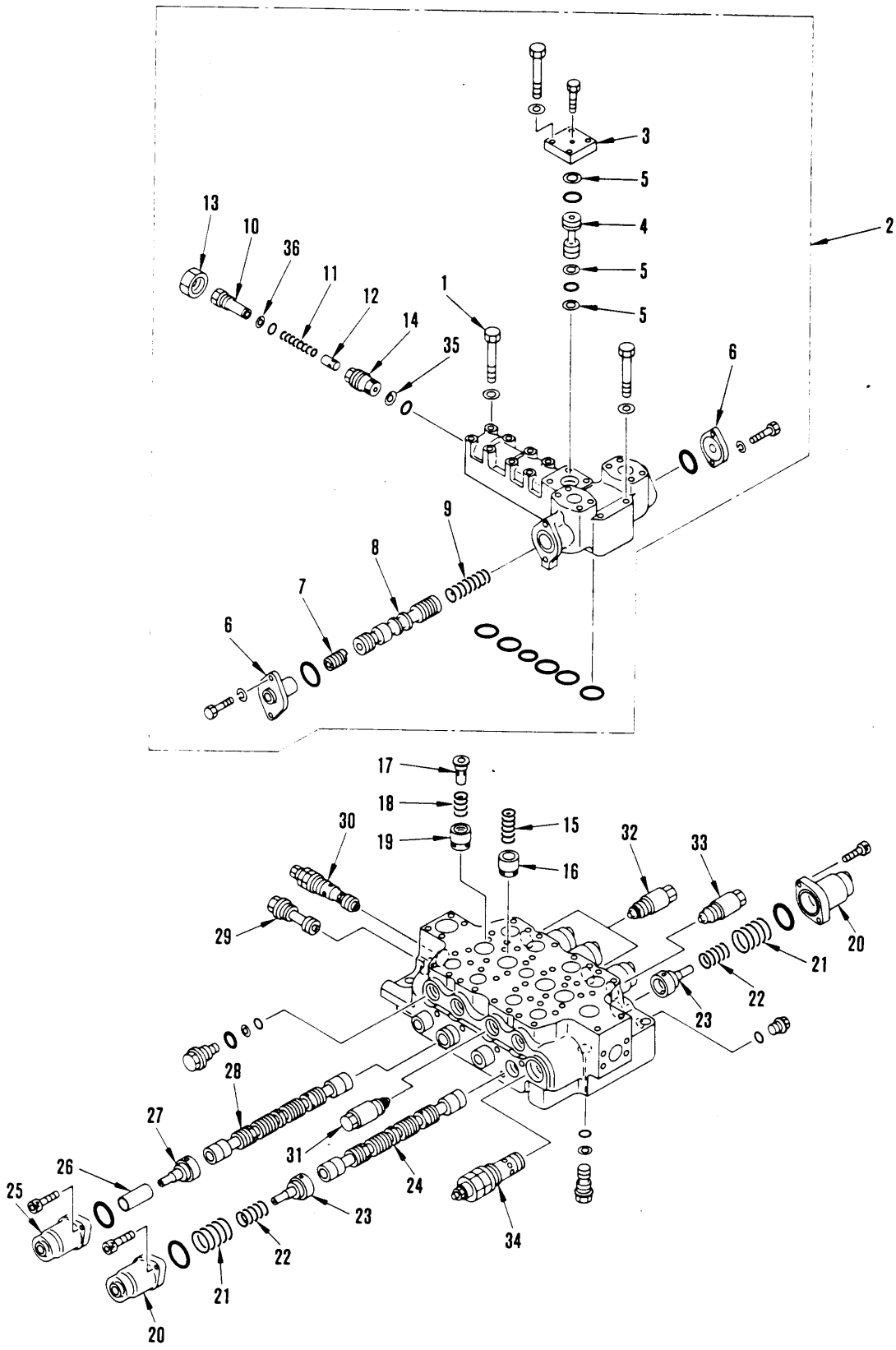
8. Remove safety valve (31).

9. Remove safety-suction valve (32).

10. Remove suction valve (33).

11. Remove main relief valve (34).

ASSEMBLY OF CONTROL VALVE ASSEMBLY (FOR WORK EQUIPMENT)



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209F3310

★ The operation for the R.H. 4-spool control valve assembly (with straight-travel valve) is basically the same as for the L.H. 5-spool control valve.
★ Coat the sliding surfaces of all parts with engine oil before installing.

1. Fit O-ring and install main relief valve (34).
   kgm Main relief valve: 19 ± 1 kgm

2. Fit O-ring and install suction valve (33).
   kgm Suction valve: 19 ± 1 kgm

3. Fit O-ring and install safety-suction valve (32).
   kgm Safety-suction valve: 19 ± 1 kgm

4. Fit O-ring and install safety valve (31).
   kgm Safety valve: 19 ± 1 kgm

5. Fit O-ring and install jet sensor relief valve (30) and jet sensor orifice (29).
   kgm Jet sensor relief valve: 19 ± 1.0 kgm
   kgm Jet sensor orifice: 15.5 ± 2.5 kgm

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6. Install spool to valve body as follows.
   1) Assemble spool (28) in valve body.
   2) Assemble retainer (27) and tube (26), then fit O-ring and install case (25).

7. Install spool to valve body as follows.
   1) Assemble spool (24) in valve body.
   2) Assemble retainer (23) and springs (22) and (21), then fit O-ring and install case (20).

8. Assemble check valve (19), spring (18), and seat (17) in valve body.

9. Install check valve (16) and spring (15).

10. Assemble straight-travel valve as follows.
    1) Fit O-ring and backup ring (35), install sleeve (14), then tighten nut (13).
    2) Assemble check valve (12) and spring (11), then fit O-ring and backup ring (36) and install plug (10).
    3) Assemble spring (9), spool (8), and piston (7) in valve body, then fit O-ring and install sleeve (6).
    4) Fit backup ring (5) and install plug (4).
    5) Install cover (3).

11. Fit O-ring and straight-travel valve assembly (2), then tighten mounting bolts (1).

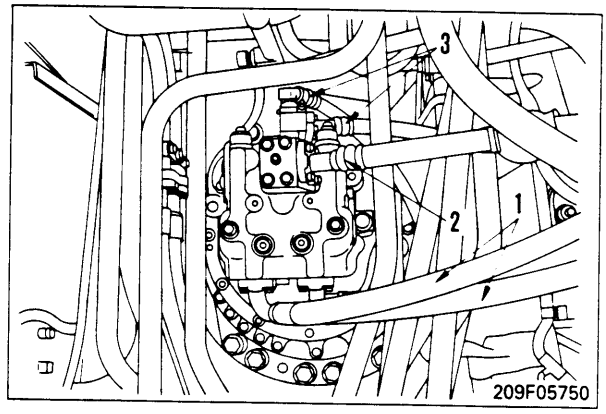
REMOVAL OF SWING MOTOR ASSEMBLY

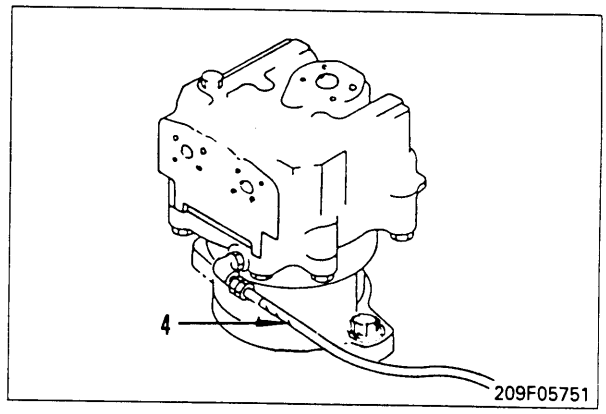
⚠ Lower the work equipment completely to the ground and stop the engine.

1) Release the remaining pressure in the hydraulic piping.
   For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit of machines equipped with PPC valve.
2) Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Disconnect hoses (1), (2), (3), and (4).

2. Lift off swing motor assembly (5).
   kg Swing motor assembly: 120 kg

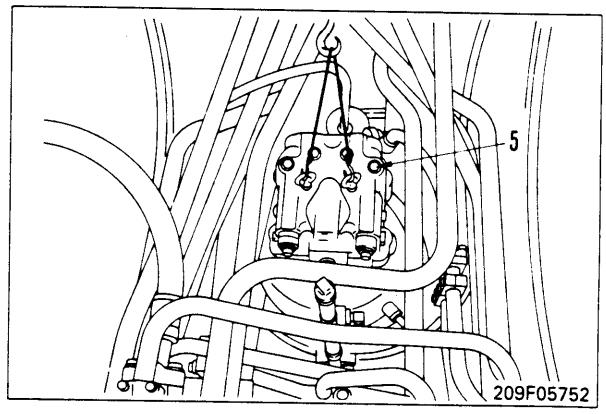




INSTALLATION OF SWING MOTOR ASSEMBLY

- Carry out installation in the reverse order to removal.

- Refilling with oil
  - ★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.
  - ★ Add oil to replace the amount that leaked out when the motor assembly was removed.



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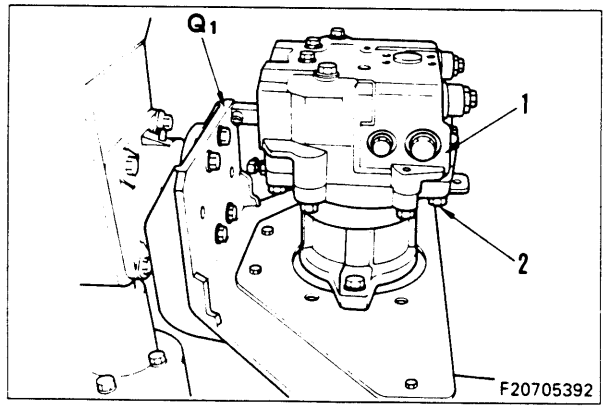
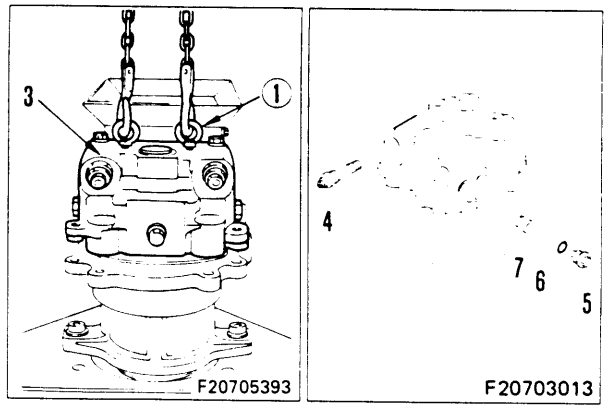
DISASSEMBLY OF SWING MOTOR ASSEMBLY (KMF160)

1. **Motor assembly**
   Set swing motor assembly (1) on tool Q_1.



2. **Valve case assembly**
   1) Remove mounting bolts (2) of valve case.

   2) Using eyebolts 1 (Thread dia. = 12 mm, Pitch = 1.75 mm), lift off valve case (3).



3. **Relief valve**
   Remove relief valve assembly (4).

4. **Check valve**
   Remove plug (5), then remove spring (6) and valve (7).

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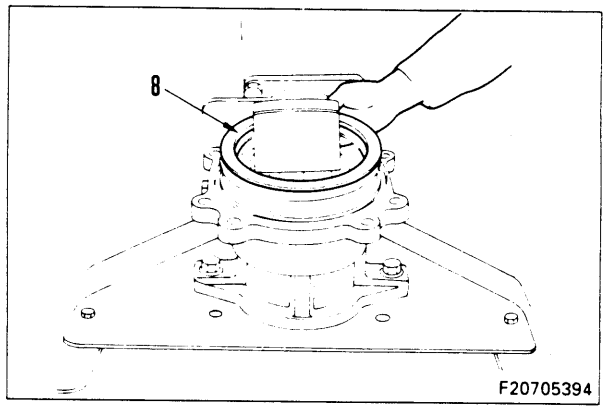
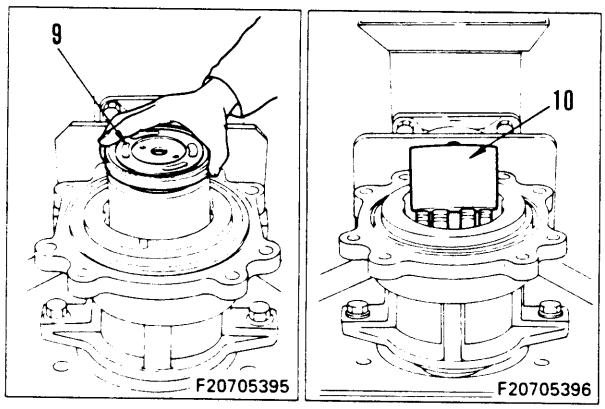
5. **Belleville spring**
   Remove belleville spring (8).



6. **Valve plate**
   Remove valve plate (9).

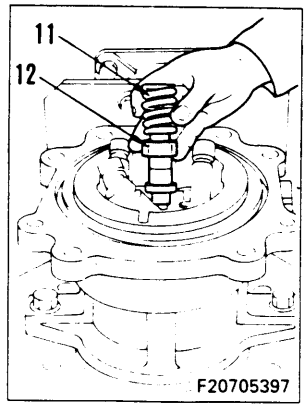
7. **Cylinder block**
   Remove cylinder block (10).

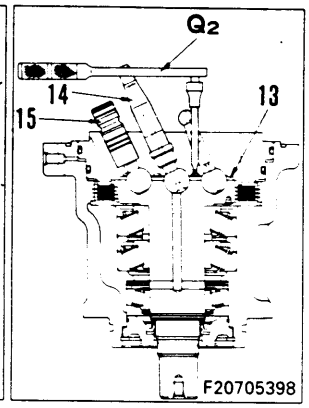


8. **Spring**
   Remove spring (11) and center ring (12).

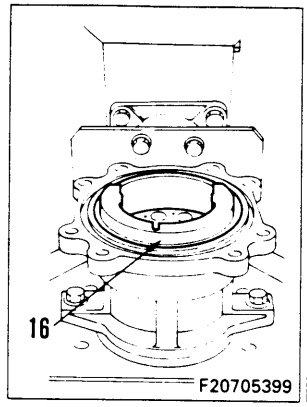
9. **Retainer**
   Using tool Q2, remove 7 mounting screws, then remove retainer (13).

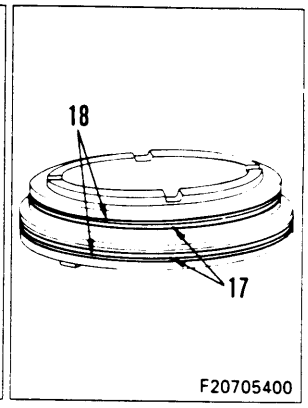
10. **Shaft, piston**
    Remove center shaft (14) and 7 pistons (15).



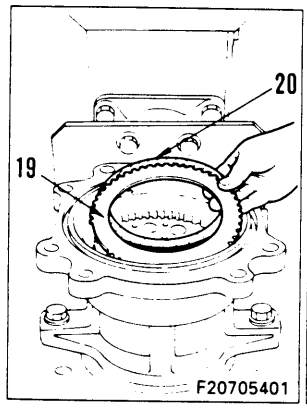


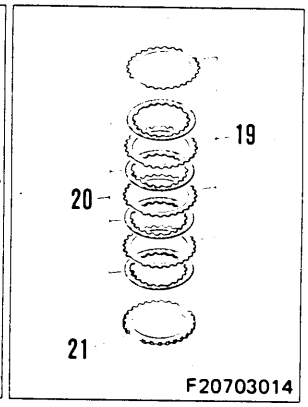
11. **Brake piston**
    1) Remove brake piston (16).
       ★ Using an oil leak tester, supply air under pressure through the oil port and remove the brake piston.
       ★ If the air pressure is too high, the piston will fly out, so raise the air pressure slowly.
    2) Remove O-ring (17) and backup ring (18) from piston.





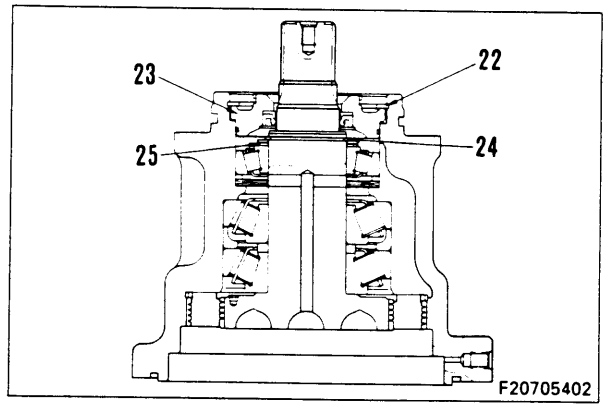
12. **Plate, disc**
    1) Remove plate (19) and disc (20).
    2) Remove plate (21).





13. **Cover**
    1) Remove case assembly from tool Q1 and turn over.
    2) Remove snap ring (22), then remove cover (23).

14. **Shaft assembly**
    1) Remove snap ring (24), then remove spacer (25).



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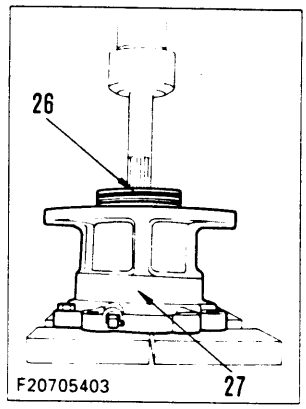
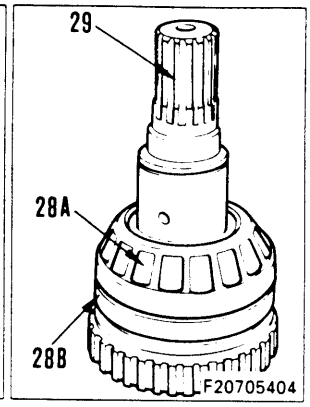
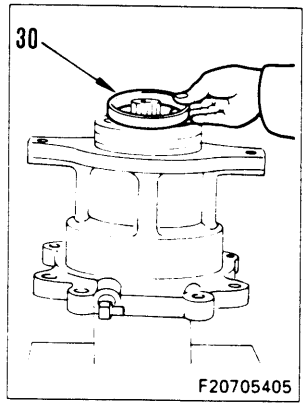
2) Set case assembly in press, then remove shaft assembly (26) from case (27).
3) Remove bearing (28A) and (28B) from shaft (29).

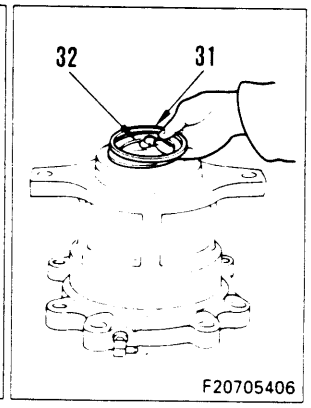




15. Bearing, spacer, belleville spring

1) Remove bearing and outer race (30).
2) Remove spacer (31) and belleville spring (32).





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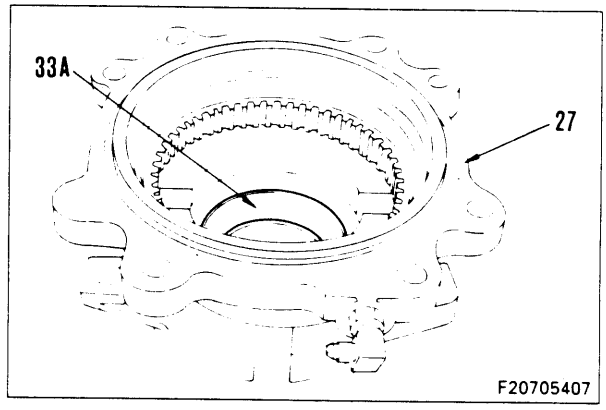
16. Outer race

Remove outer race (33A).



ASSEMBLY OF SWING MOTOR ASSEMBLY (KMF160)

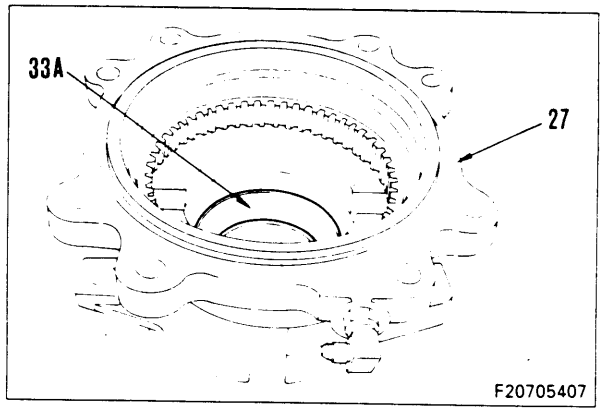
Precautions when assembling

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

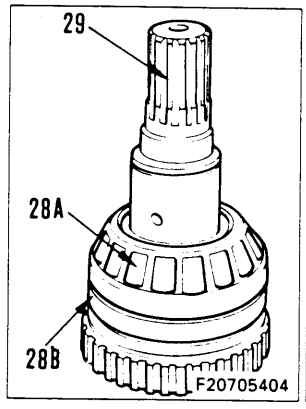
★ Always use all the parts supplied in the kit. Do not reuse the retainer mounting screw.

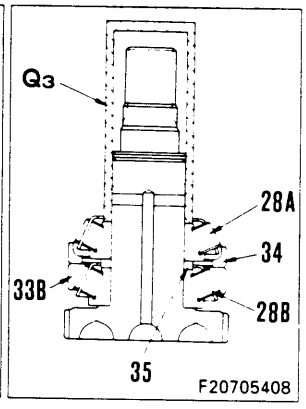
1. Shaft assembly

1) Install bearing outer race (33A). (Outside diameter: 140 mm) to brake case (27).

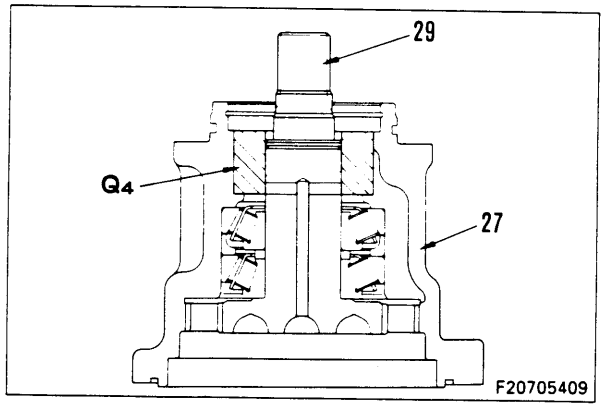


2) Using tool Q3, press fit bearing (28B) (Inside diameter: 65 mm) to shaft (29).
   ★ Press fit until the end face of the bearing inner race is in tight contact with the shaft.
3) Install outer race (33B) and spacers (34) and (35).
4) Using tool Q3, press fit bearing (28A) (Inside diameter: 65 mm).
   ★ Do not use any bearing if it is uncertain which set it belongs to.





5) To prevent the drive shaft from being at an angle, set tool Q4 in position, and install shaft (29) to brake case (27).
   ★ Push in the outer race with a plastic bar from groove ② . (Do not use a metal bar; this will damage the outer race.)



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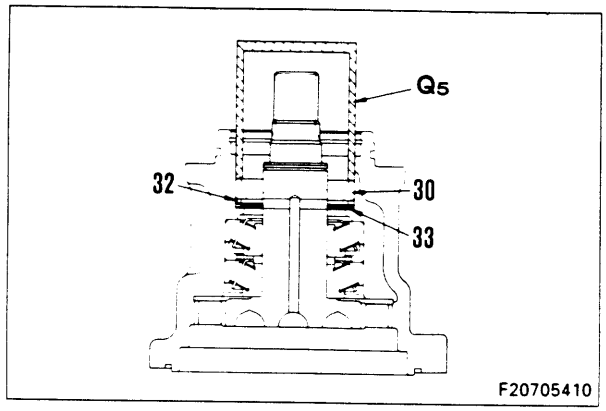
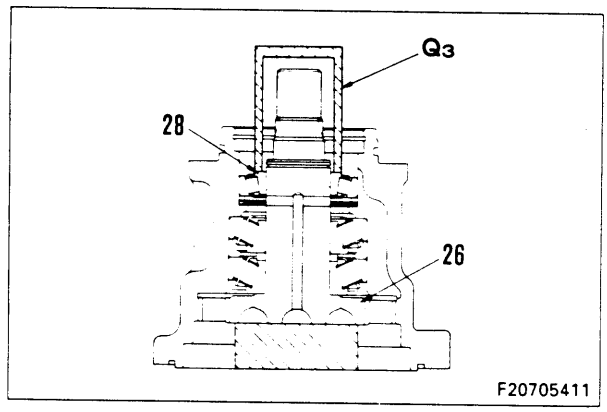
6) Assemble spring (33) and spacer (32), then using tool Q5, install outer race (30). (Outside diameter: 120 mm).
   ★ Align the inside diameter (shaft end) to install the spring. (With the outside diameter open)



7) Support shaft (26) at both ends, then use tool Q3 to press fit bearing (28) (inside diameter: 65 mm).
   ★ The press-fitting force is 400 – 2035 kg, but up to 2200 kg is possible (when coated with engine oil).
   ★ If the press-fitting force is less than 2200 kg, always push in at 2200 kg after press fitting.
   ★ Press fit until the spacer is in tight contact.



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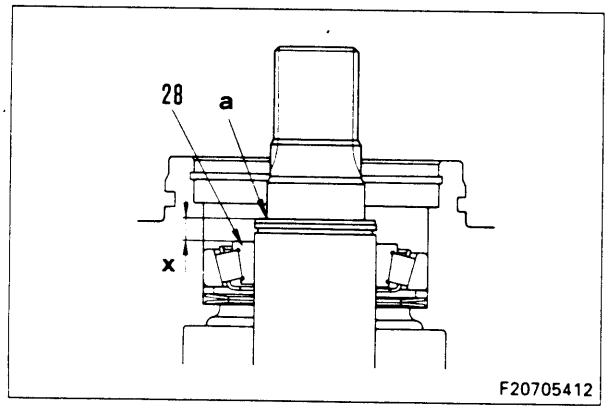
8) Select thickness of 2 spacers (25) using procedure and table below.
   i) Measure dimension **x** between seat portion **a** of shaft and end face of inner race of bearing (28), then select 2 spacers from table below.

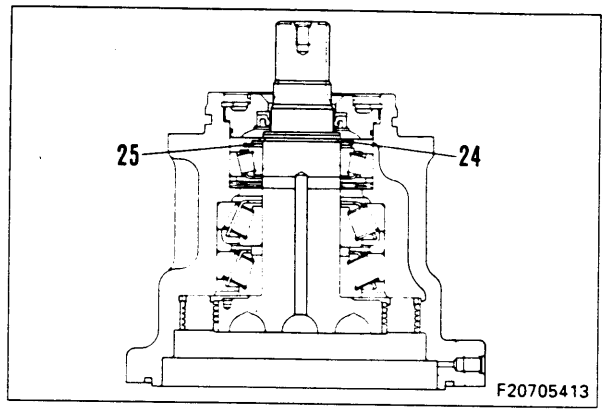


Spacer selection table

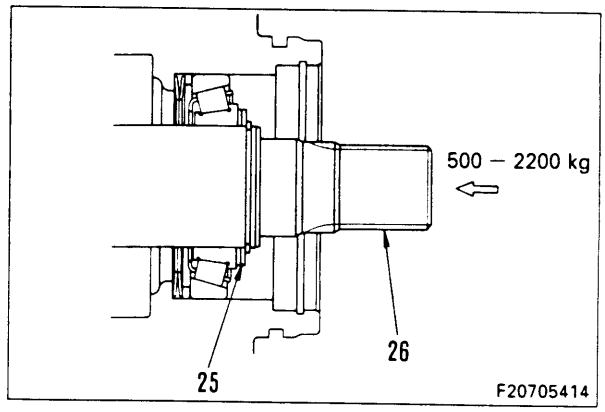
Unit: mm

No.	Measured value of dimension **a**	Necessary spacer thickness (possible as thickness of 2 spacers)	Select 2 spacers marked ○ or ◎ from table below.		
			Spacer thickness		
			2.3	2.5	2.7
1	12.250 – 12.449	4.6	○ ○		
2	12.450 – 12.649	4.8	○	○	
3	12.650 – 12.849	5.0	○	◎ ◎	○
4	12.850 – 13.049	5.2		○	○
5	13.050 – 13.249	5.4			○ ○
Spacer part number			706-77-42440	706-77-42450	706-77-42460

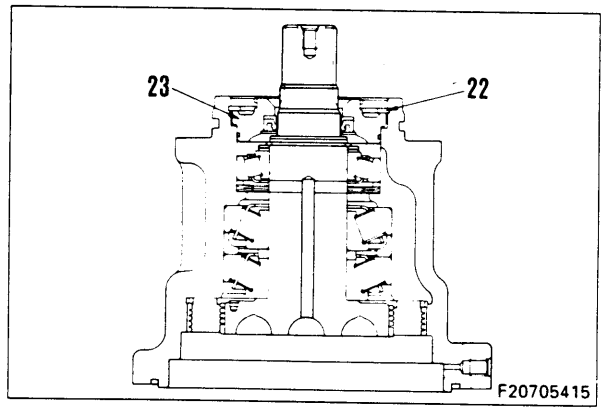
9) Assemble spacer (25), then install snap ring (24).
   ★ Check that the snap ring is fitted securely in the groove.



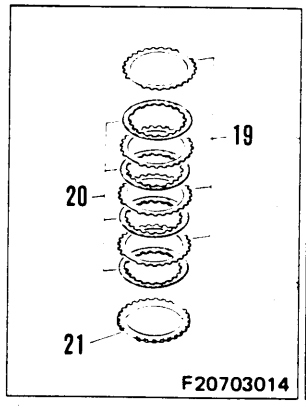
10) Support motor case, push end face of shaft (26) at 500 – 2200 kg in direction of arrow, and check that movement when doing this is 0.1 – 0.4 mm.
   ★ When doing this, check that the spacer (25) cannot be moved by hand.
   ★ If the movement of the shaft is not within the standard value, adjust the spacer so that it comes within the standard value.
11) Rotate shaft at a speed of 1 turn every approx. 5 seconds and measure the rotating torque.
   ★ Rotating torque: 0.15 – 0.5 kgm
   ★ Supply the bearing with ample oil when measuring.
   ★ If the rotating torque is not within the standard value, replace the bearing with a new bearing.

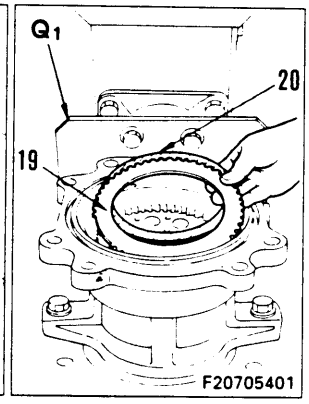


2. Cover
1) Press fit oil seal and fit O-ring, then install cover (23).
2) Install snap ring (22).



3. Plate, disc
1) Set case assembly on tool Q_1.
2) Install plate (21).
3) Install disc (20) and plate (19).





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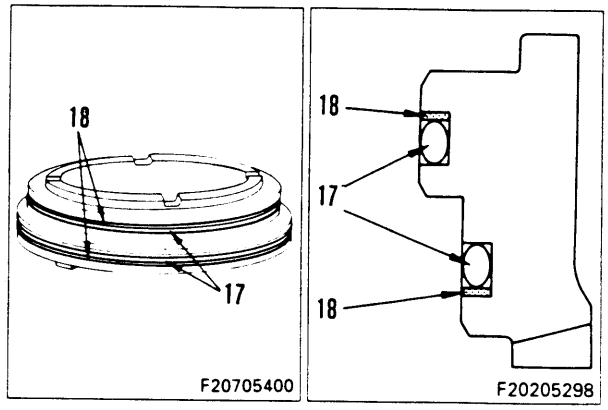
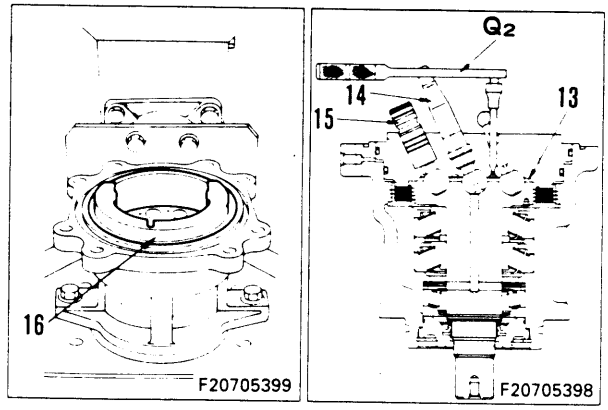
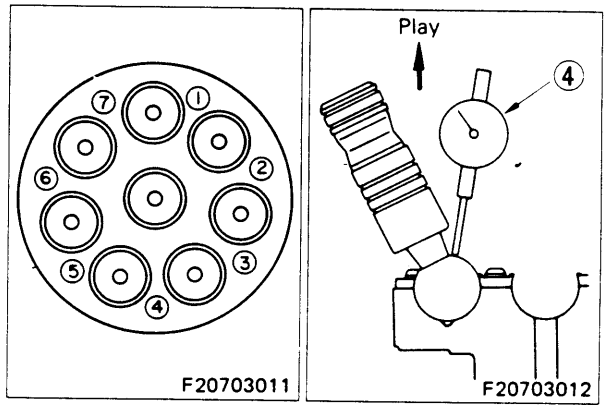
4. **Brake piston**
   1) install O-ring (17) and backup ring (18) to piston.
      ★ See illustration for direction of installation of O-ring and backup ring.



   2) Install brake piston (16).

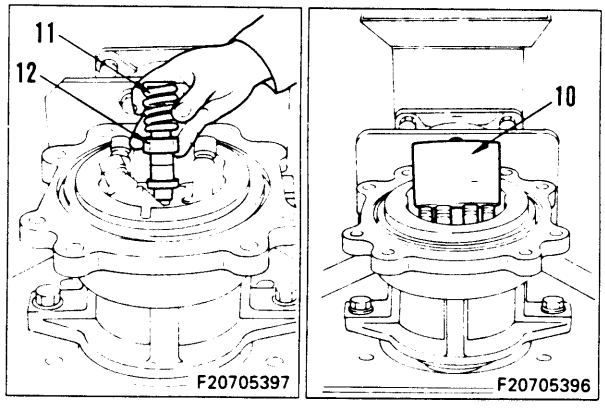


5. **Piston, shaft**
   1) Set 7 pistons (15) and center shaft (14).
   2) Install retainer (13) and using tool Q2, tighten 7 mounting screws.
      Mounting screw: Adhesive (LT-2)
      Mounting screw:
      See Tightening Torques and Standard Values Table
      ★ Direction of installation may be clockwise or counter-clockwise.
      ★ After installing, check that the pistons move smoothly and can fall under its own weight. If the movement is not smooth, loosen, then tighten again.
      ★ The screws must not be used again.
   3) After installing mounting screws, measure clearance of piston ball.
      i) Set dial gauge ④ on ball.
      ii) Pull piston in axial direction of pump subassembly, and measure clearance between ball and retainer.
      ★ Ball clearance: Max. 0.25 mm



6. **Spring**
   Fit center ring (12) and install spring (11).

7. **Cylinder block**
   Install cylinder block (10).



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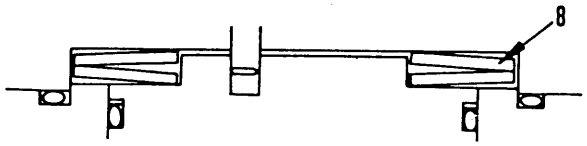
8. Valve plate

Install valve plate (9).

9. Belleville spring

Set belleville spring (8).

★ See illustration for direction of installation of belleville spring.



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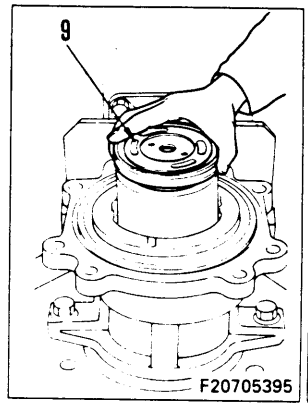

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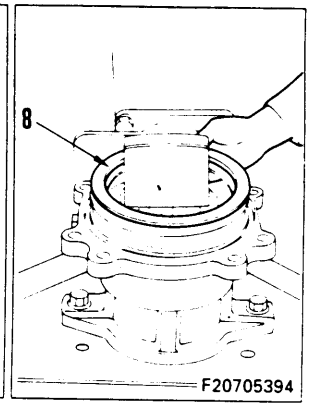

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10. Check valve

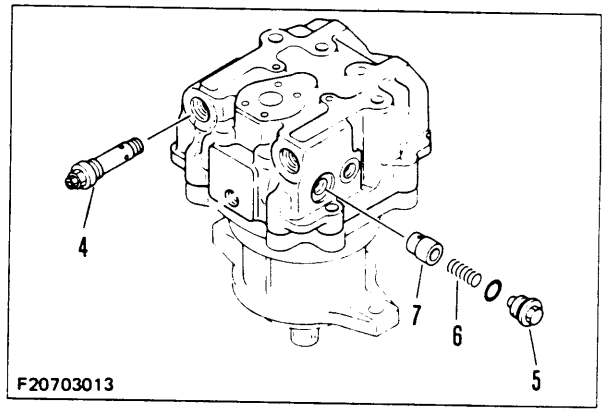
Fit valve (7) and spring (6), fit O-ring, then install plug (5).

kgm Plug: See Tightening Torques and Standard Values Table

11. Relief valve

Fit O-ring and install relief valve assembly (4).

kgm Relief valve: See Tightening Torques and Standard Values Table



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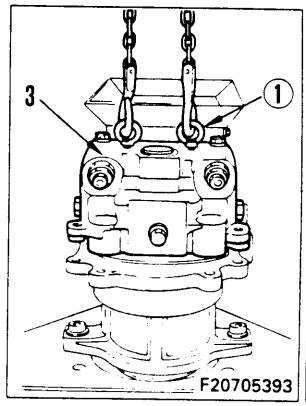
12. Valve case assembly

1) Fit O-ring and using eyebolts ① (Thread dia. = 12 mm, Pitch = 1.75 mm), set valve case (3).
   ★ Correctly match dowel pin and valve plate.
2) Tighten mounting bolts (2).
   kgm Mounting bolt: See Tightening Torques and Standard Values Table



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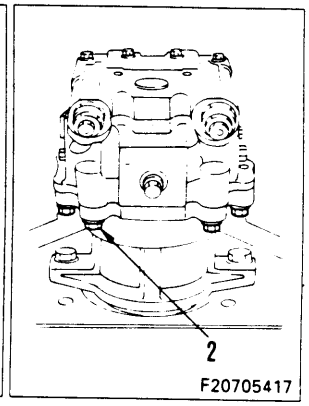

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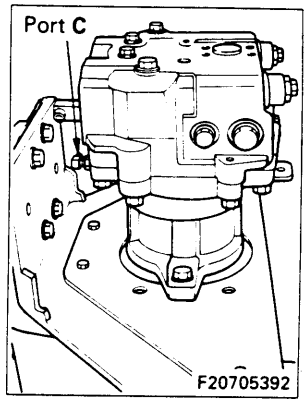
13. Inspection of rotating torque of drive shaft

1) From **C** port, apply more than 25 ± 5 kg/cm² pressure, then release brake.
2) Set tool **Q6** and rotate drive shaft at a speed of 1 turn every approx. 5 seconds and measure the rotating torque.
   ★ Check that there is no uneven rotation in rotating torque.
   Uneven width: **Within 0.15 kgm**
   Rotating torque: **0.6 – 15.5 kgm range**
   ★ If the uneven width is more, reassemble.



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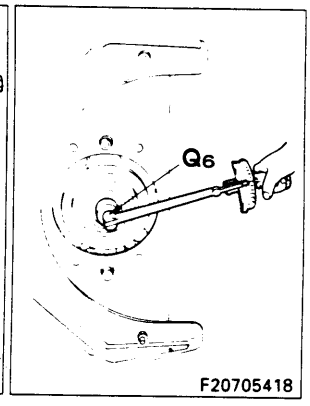

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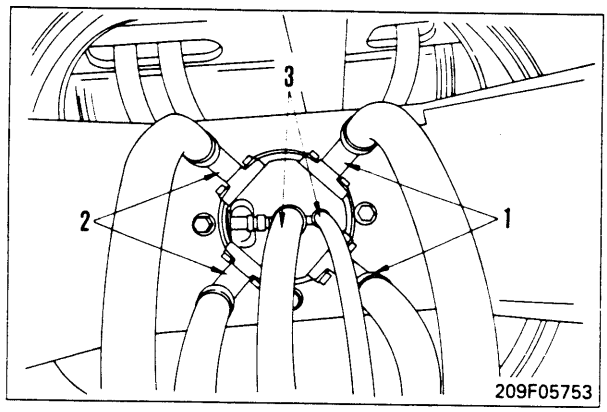
REMOVAL OF CENTER SWIVEL JOINT ASSEMBLY

⚠ Lower the work equipment completely to the ground and stop the engine.

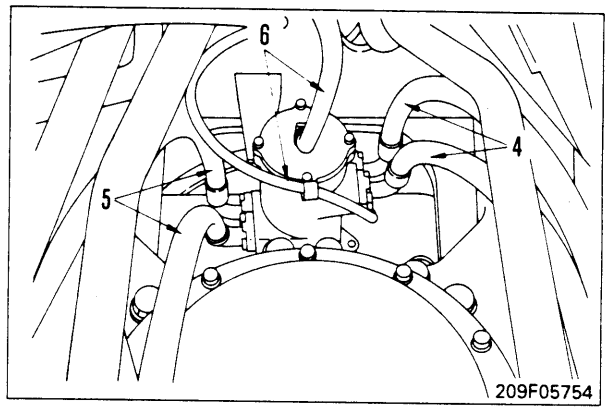
1) Release the remaining pressure in the hydraulic piping.
   For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit of machines equipped with PPC valve.
2) Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.



1. Disconnect hoses (1), (2) and (3).

2. Disconnect hoses (4), (5) and (6).

3. Pull out pin (7), and move link (8) towards frame.
   ★ Disconnect at the swivel joint end.



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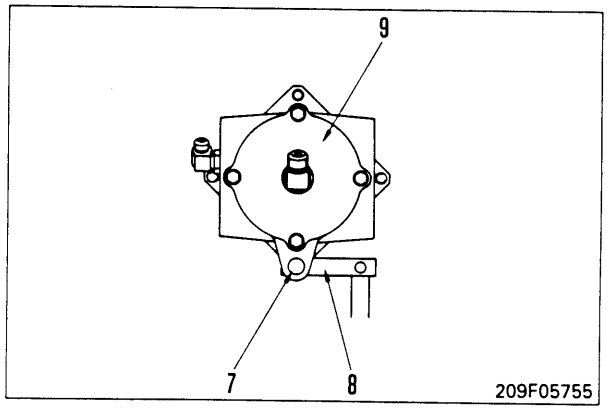
4. Center swivel joint assembly ※1
   1) Remove top cover, then fit eyebolts, and sling.
   2) Remove mounting bolts, then remove center swivel joint assembly (9).

   kg Center swively joint assembly: 70 kg



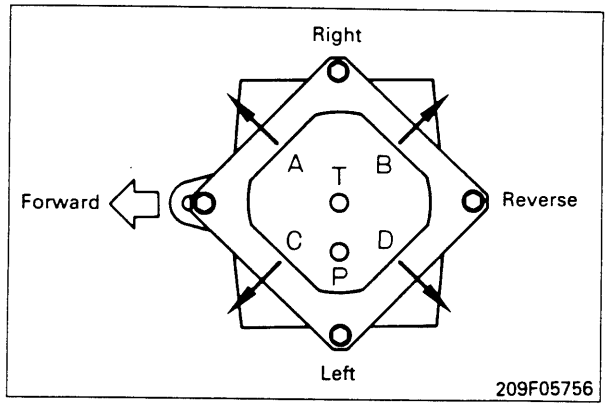
INSTALLATION OF CENTER SWIVEL JOINT ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

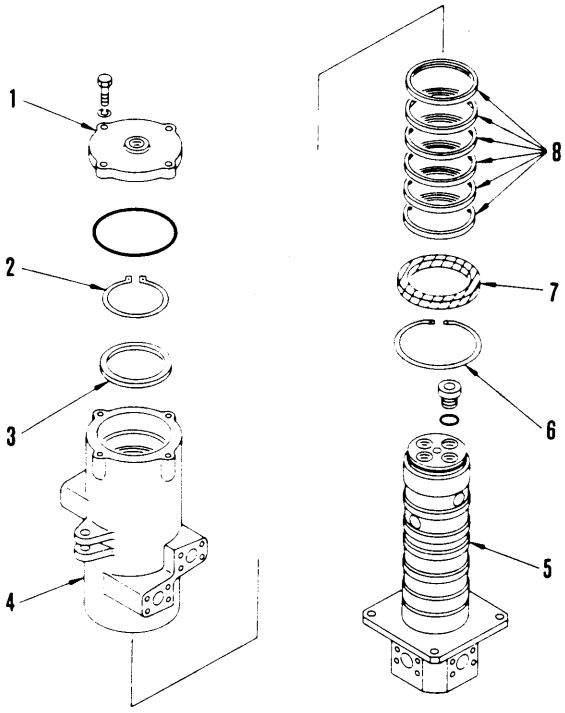
★ Install the swivel joint assembly with port **A** facing the front right of the chassis.

- Refilling with oil
  ★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.
  ★ Add oil to replace the amount that leaked out when the swivel joint was removed.



DISASSEMBLY OF CENTER SWIVEL JOINT ASSEMBLY

1. Remove cover (1).
2. Remove snap ring (2).
3. Using push tool ①, remove swivel rotor (4) and ring (3) from swivel shaft (5).
4. Remove snap ring (6), then remove oil seal (7) and 6 slipper seals (8).



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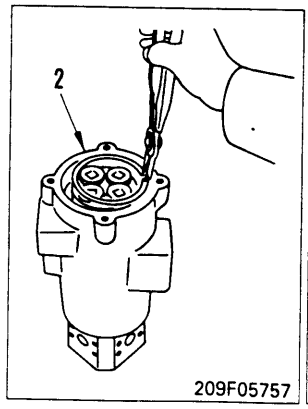

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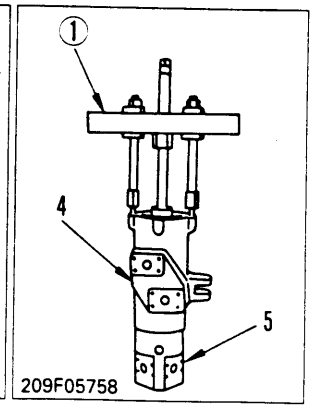

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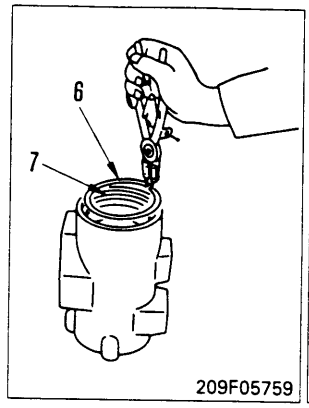

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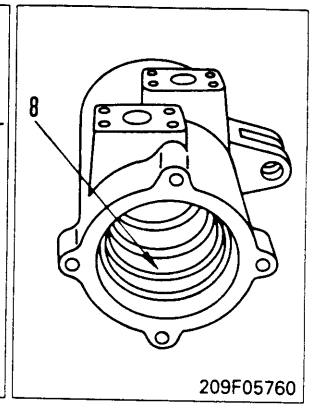

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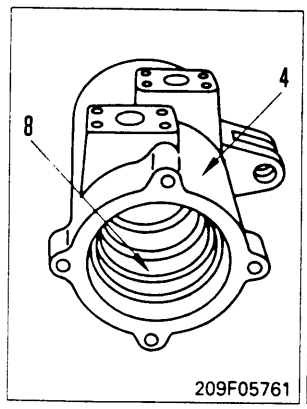
ASSEMBLY OF CENTER SWIVEL JOINT ASSEMBLY

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil or grease (G2-LI) before installing.

1. Assemble 6 slipper seals (8) in swivel rotor (4).



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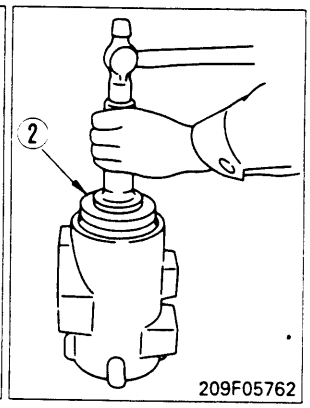

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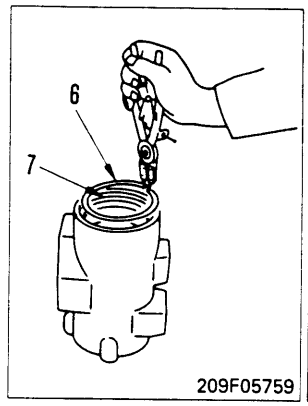
2. Using push tool ② (Outside diameter: 110 mm), press fit oil seal (7) in swivel rotor (4), then install snap ring (6).
   Oil seal lip: Grease (G2-LI)



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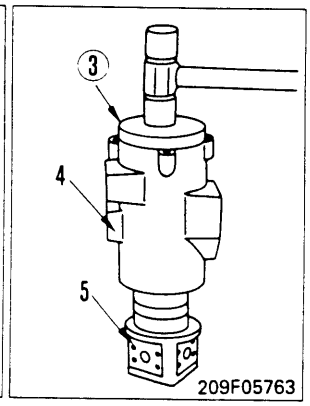
3. Set swivel shaft (5) on block, then using push tool ③ (outside diameter: 130 mm), tap swivel rotor (4) with a plastic hammer to install.
   ★ When installing the rotor, be careful not to damage the lip of the slipper seals or oil seal.



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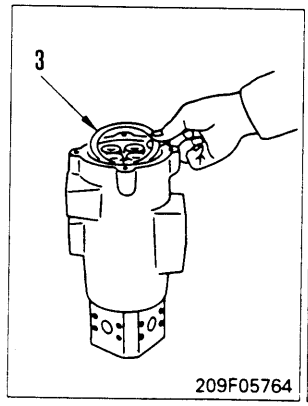
4. Install ring (3), then secure with snap ring (2).

5. Fit O-ring and install cover (1).



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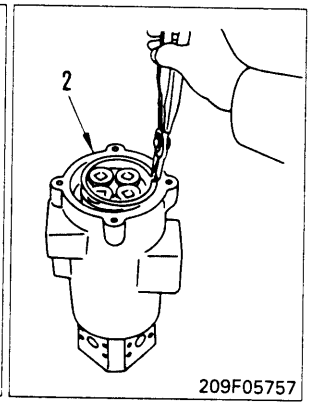

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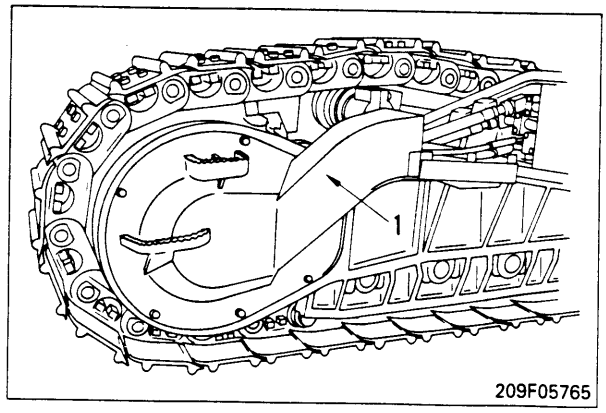
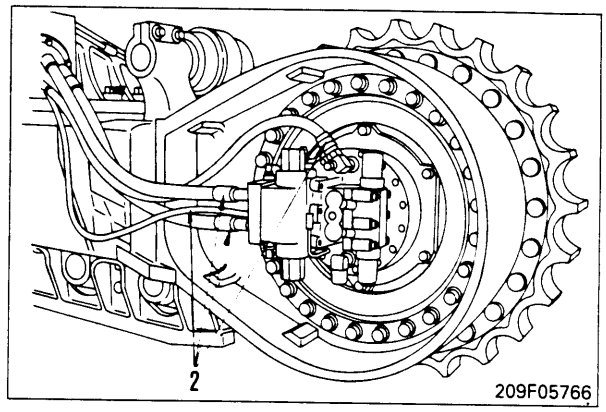
REMOVAL OF TRAVEL MOTOR ASSEMBLY

⚠ Swing the work equipment 90° and lower it completely to the ground.

⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Lift off cover (1).
   kg Cover: 100 kg
2. Disconnect hoses (2).
   ★ Fit blind plugs to the disconnected hoses.
3. **Travel motor assembly** ※ 1
   1) Remove mounting bolts of travel motor, and set tool **B** in position.
   2) Remove mounting bolts, then pull out travel motor assembly (3), and sling.
   3) Lift off travel motor assembly (3).
      kg Travel motor assembly: 220 kg





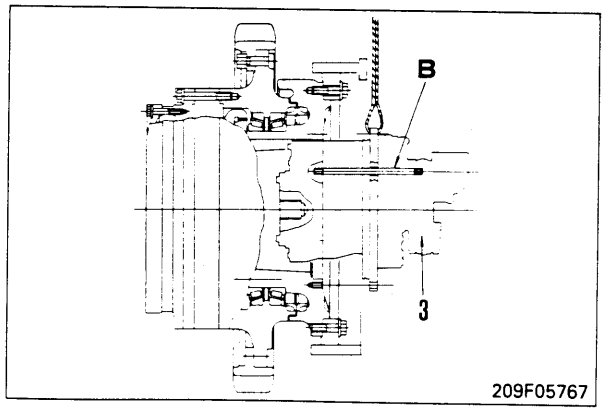
INSTALLATION OF TRAVEL MOTOR ASSEMBLY

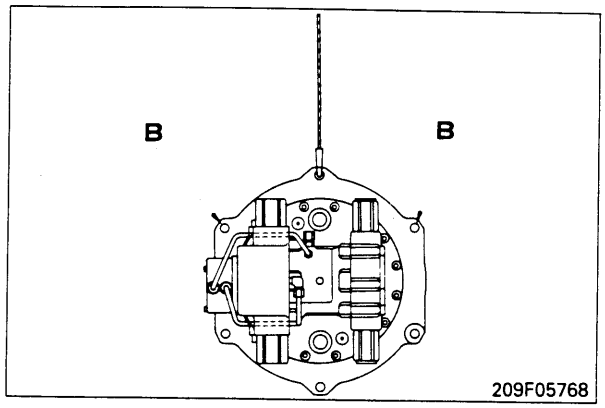
- Carry out installation in the reverse order to removal.

※ 1

kgm Mounting bolt: 28.25 ± 3.25 kgm

★ Run the engine to circulate the oil through the system. Then add engine oil to the hydraulic tank to the specified level.
Bleed the air.
For details, see TESTING AND ADJUSTING, Bleeding air from travel motor.





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DISASSEMBLY OF TRAVEL MOTOR ASSEMBLY

★ **Precautions during operation**

1) All parts are machined to extremely high precision, so be extremely careful when handling them, and do not drop them or let them hit against each other.
2) During operation do not forcibly hit or twist any parts that are stiff. This will cause burrs or other damage, and may cause a drop in performance, or may even make it impossible to assemble the parts again.
3) If the parts left lying about after disassembly or during the disassembly operation, the moisture or dirt may cause the parts to start rusting, so if any parts must be left in this way, take action to protect them from rust or dust.

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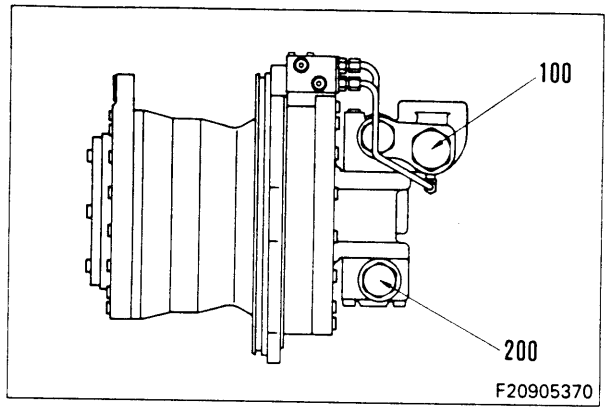
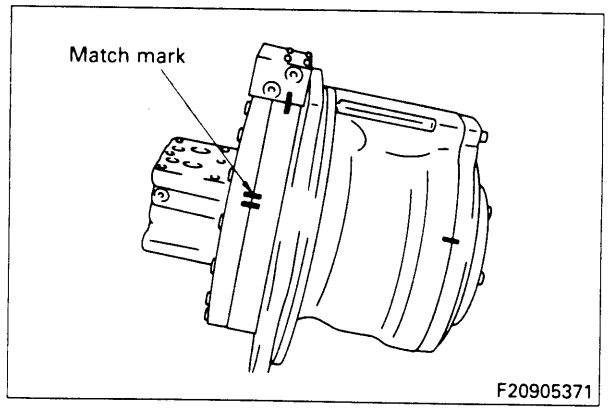
1. **Counterbalance valve assembly, safety valve assembly**
   Remove counterbalance valve assembly (100) and safety valve assembly (200) from motor assembly.

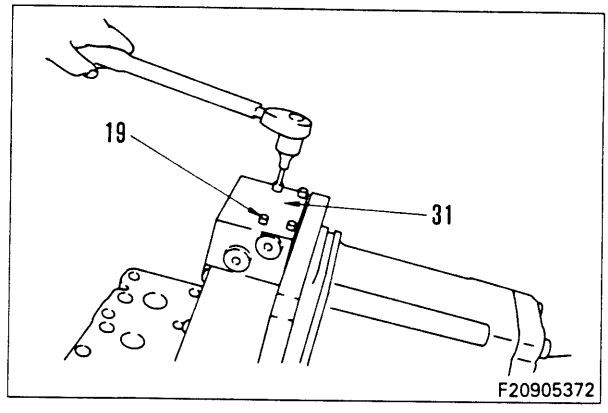


Disassembly of motor assembly

2. **Preparatory work**
   Make match marks on all mating surfaces of motor.

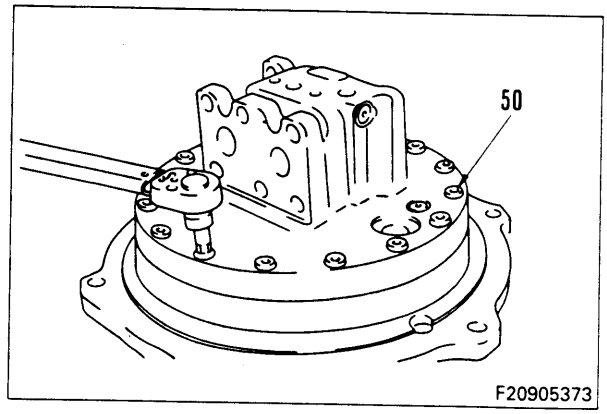


3. **Control valve assembly**
   Remove 4 mounting bolts (19), then remove control valve assembly (31).

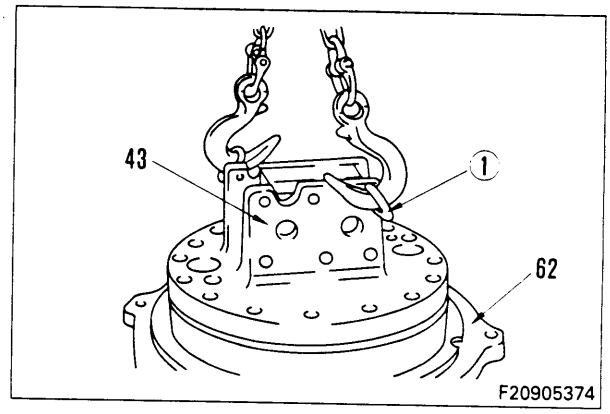


4. Cover assembly

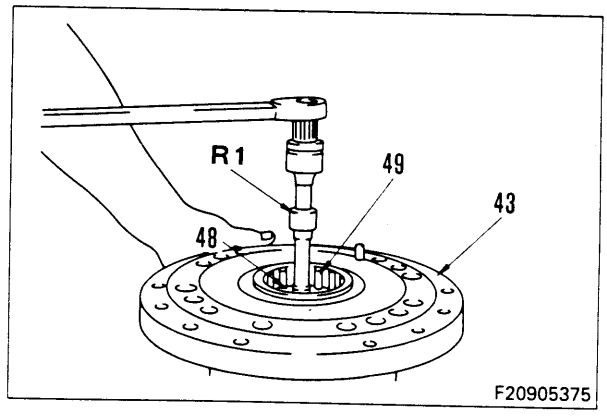
1) Remove 16 mounting bolts (50).



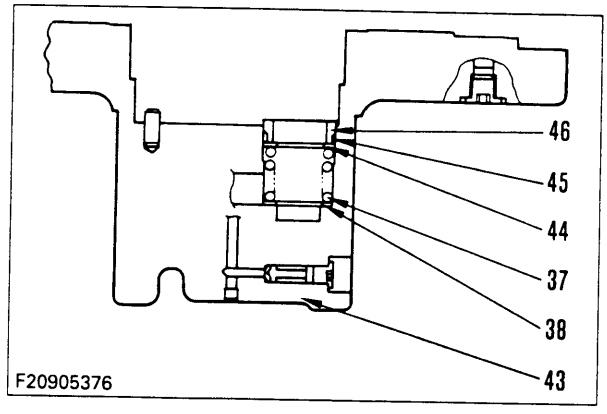
2) Install eyebolts ① (Thread diameter: 12 mm) to tap hole in cover port face, then lift cover assembly (43) and remove from housing (62).
   ★ There is a shoe in tight contact with the sliding surface of the cover, so rotate the cover several times by hand, then raise it carefully.



3) Screw tool **R1** into tap hole of valve plate (48), and remove needle bearing (49) and valve plate (48) from cover (43).
   ★ Valve plate (48) must be installed facing in the correct direction, so make match marks on the cover and valve plate.



4) Remove bushing (46) with teflon ring (45) fitted to it, spacer (44), spring (37), and spacer (38) from cover (43).
   ★ Note that the inside diameter and outside diameter of spacers (44) and (38) are different.



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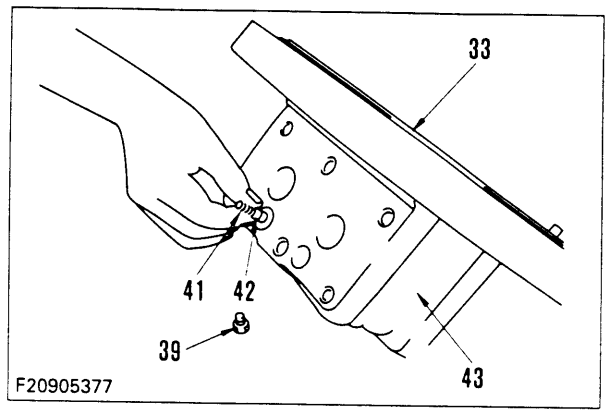
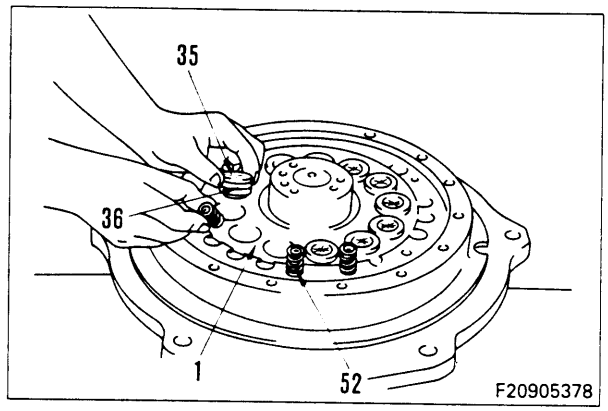
5) Remove O-ring (33) from cover (43).
6) Remove plug (39), then remove spring (41) and check valve (42).



7) Remove shoe (35) with teflon ring (36) fitted to it, and spring (52).
   ★ Mark numbers on the piston holes of cylinder (1) and shoe (35).



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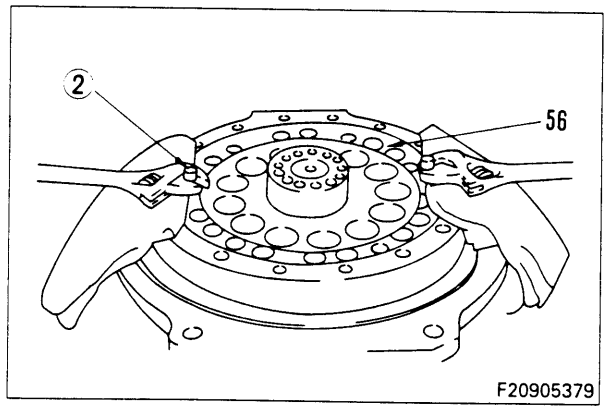
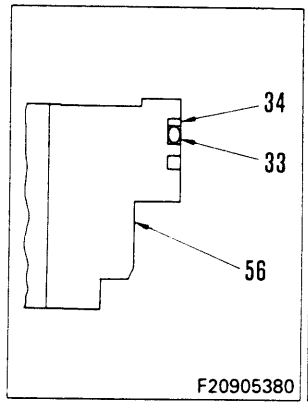
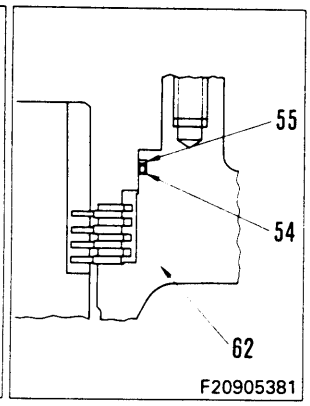
5. Brake

1) Using bolt ② (Thread diameter: 10 mm), remove brake piston (56).
   ★ The pin on the cover side and the hole on brake piston (56) side must be positioned exactly when assembling, so make a match mark with as thin a pen as possible.

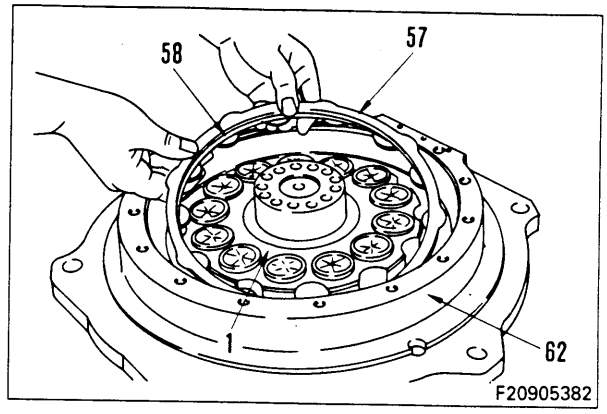


2) Remove O-ring (33) and backup ring (34) from brake piston (56).
3) Remove O-ring (54) and backup ring (55) from housing (62).



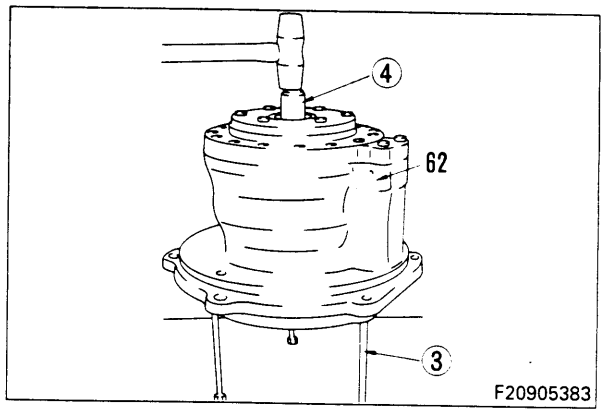


4) Remove 4 discs (58) and 4 plates (57) from housing (62) and cylinder (1).



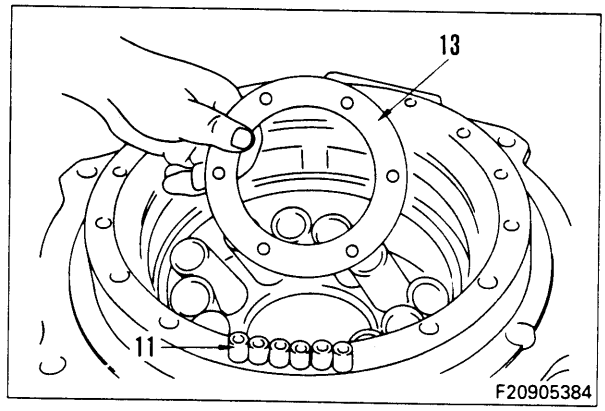
6. Cylinder assembly

1) Screw in 3 bolts ③ (Thread diameter: 12 mm, Pitch: 1.75 mm, Length: Min.150 mm) uniformly into screw holes for mounting cover to housing (62), then set housing with output shaft at the top.
2) Put guide bar ④ in contact with tip of shaft of cylinder assembly (1), tap with a hammer to disconnect mating of cylinder assembly (1) and taper roller bearing (26), then remove cylinder assembly.
   ★ Put a thick cloth under the housing to protect the tip of the shaft at the bottom of the cylinder from damage.

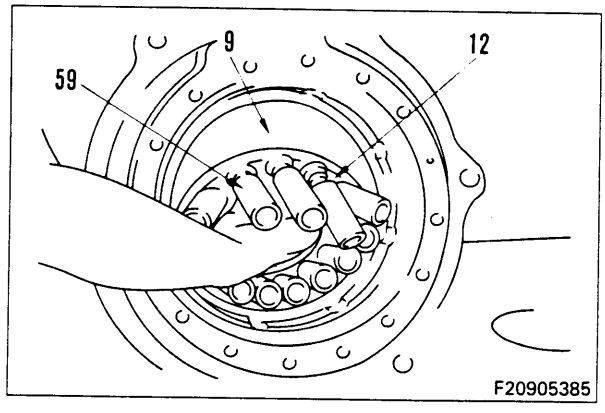


7. Piston assembly

1) Turn over motor.
2) Remove 6 mounting bolts and washers, then remove plate (13) and spacer (11) from cam.



3) Turn motor on side, and remove plate (12) and piston assembly (59) together from cam (9).
   ★ Be careful not to damage piston assembly (59).
   ★ Mark numbers on piston (59) and the holes in plate (12).



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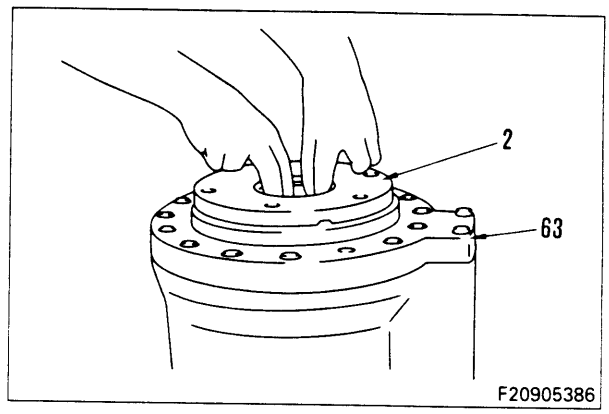
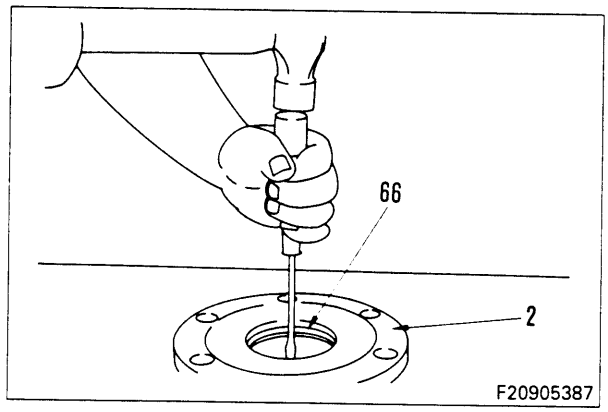
4) Remove 6 mounting bolts, then remove retainer (2) from flange (63).



5) Remove oil seal (66) from retainer (2).
   ★ Be careful not to damage the oil seal mount.



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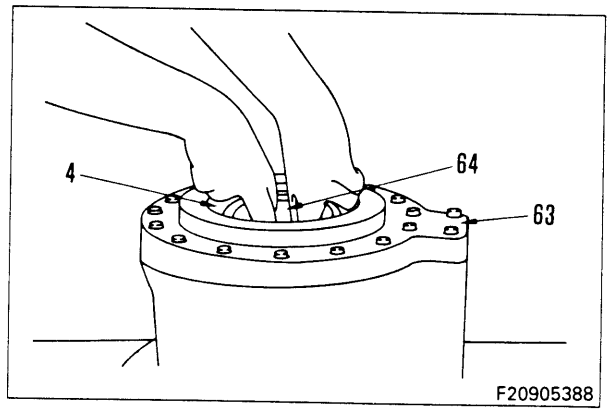
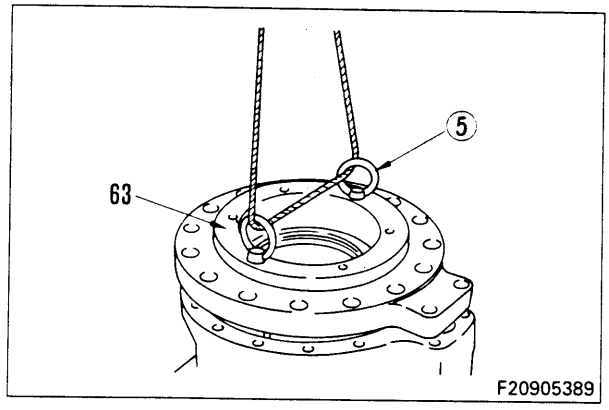
6) Remove shim (4) and taper roller bearing (64) from flange (63).

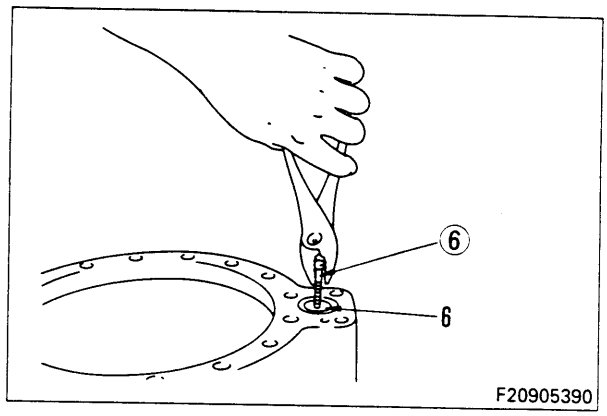


8. Cam assembly

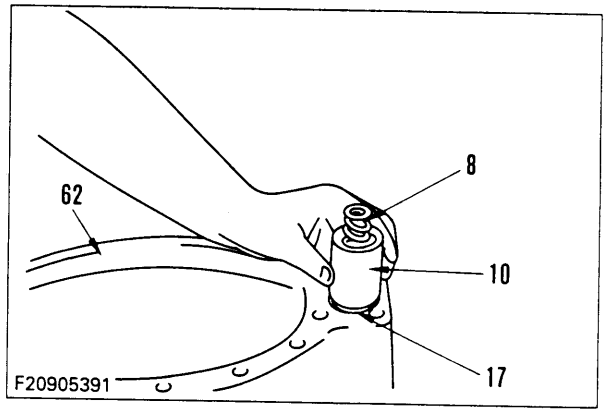
1) Remove 16 mounting bolts.
2) Install eyebolts ⑤ (Thread diameter: 12 mm) in tap holes for mounting flange retainer, then lift off flange (63).
   ★ Be careful not to damage the shoe sliding surface of the cam.



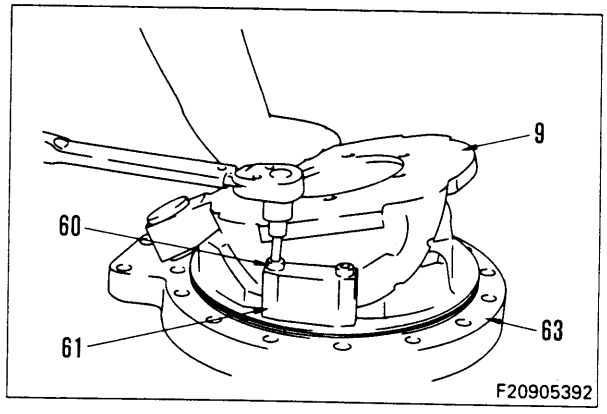
3) Screw in bolt ⑥ (Thread diameter: 6 mm), and remove cap (6).
4) Remove O-ring from cap (6).



5) Remove 2 springs (8), 2 pistons (10), and 2 plates (17) from housing (62).



6) Remove mounting bolts (60) and guide (61), then disassemble flange (63) and cam (9).



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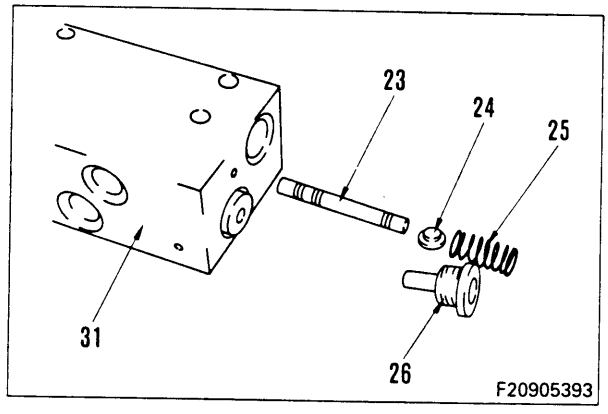
Disassembly of control valve assembly

9. Selector valve

Remove plug (26), then remove spool (23), guide (24), and spring (25) from housing (31).

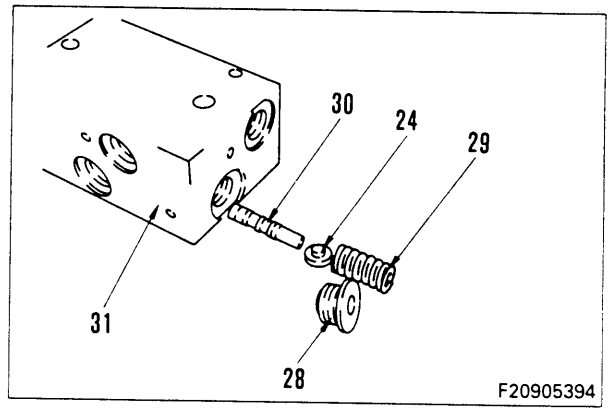
★ Keep these parts in a set and be careful not to mix them with the parts removed in Step 10.



10. Reducing valve

Remove plug (28), then remove poppet (30), guide (24), and spring (29) from housing (31).

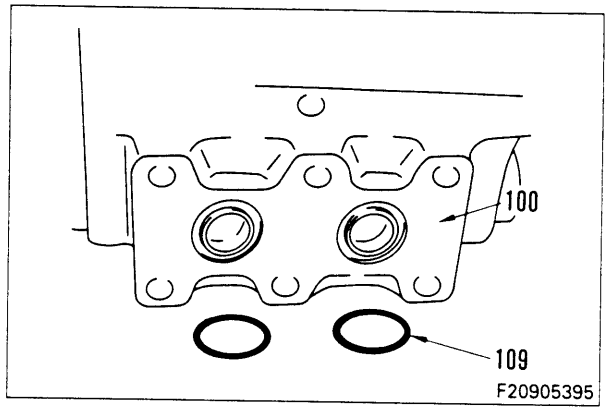
★ Keep these parts in a set and be careful not to mix them with the parts removed in Step 9.



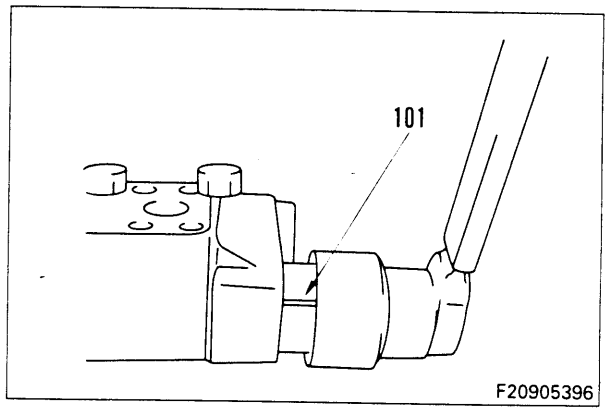
Disassembly of counterbalance valve assembly

11. Counterbalance valve

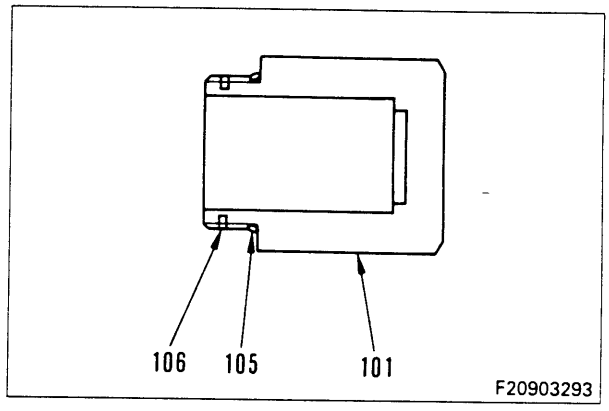
1) Remove O-ring (109) at mating surface with motor.



2) Remove cap (101).



3) Remove O-ring (105) and insert (106) from cap (101).



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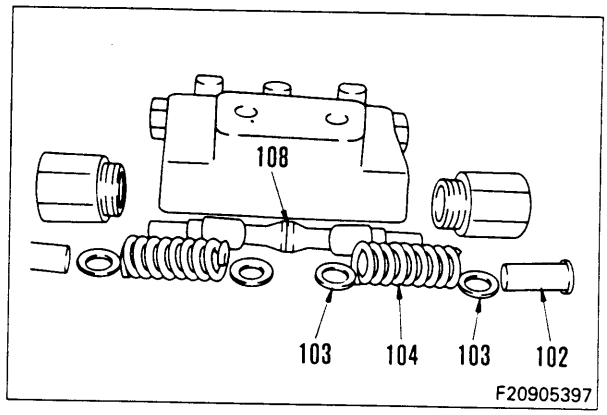
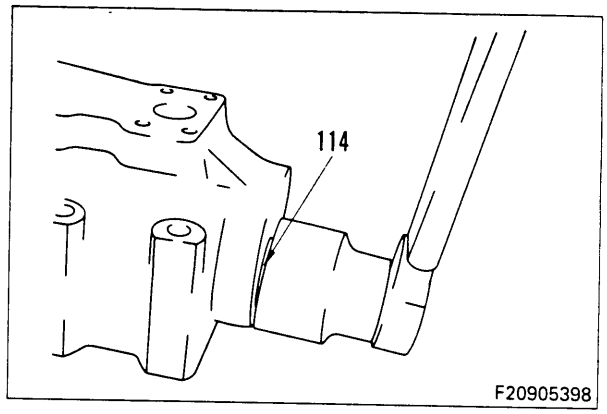
4) Remove sleeve (102), spacer (103), spring (104), spacer (103), and spool (108).

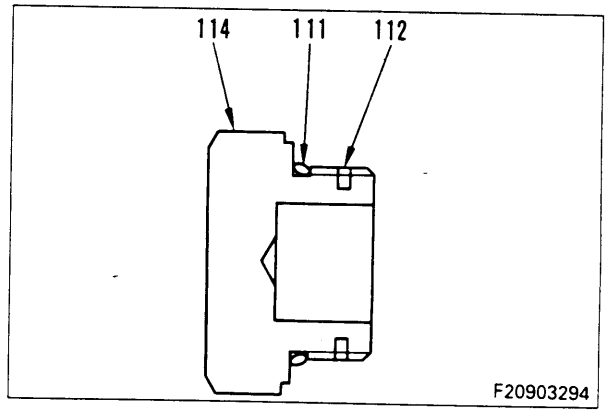


12. Check valve

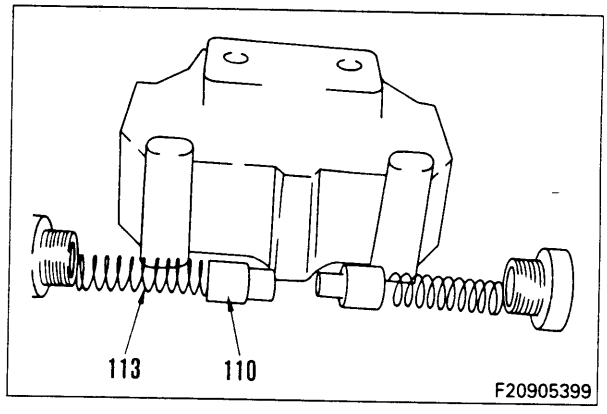
1) Remove cap (114).



2) Remove O-ring (112) and insert (111) from cap (114).



3) Remove spring (113) and check valve (110).



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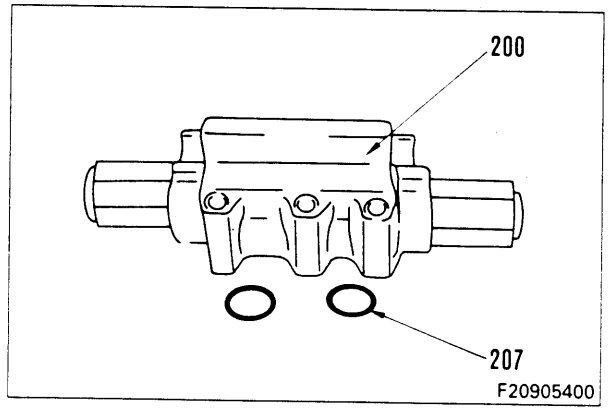
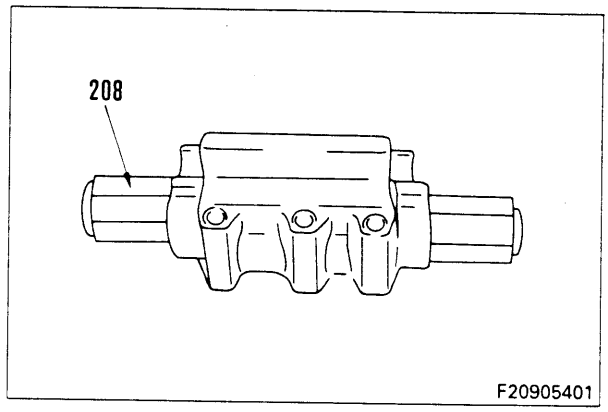
Disassembly of safety valve assembly

13. Safety valve

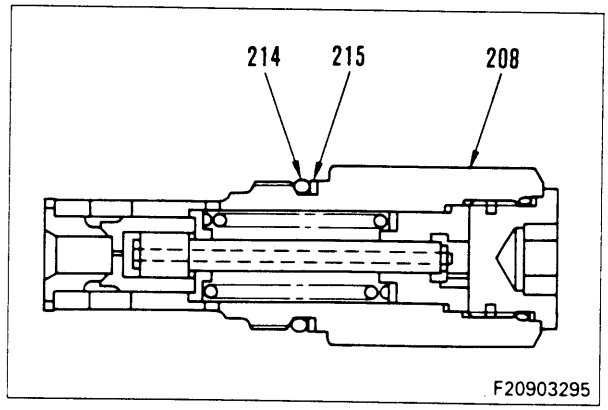
1) Remove O-ring (207) from mating surface with motor.



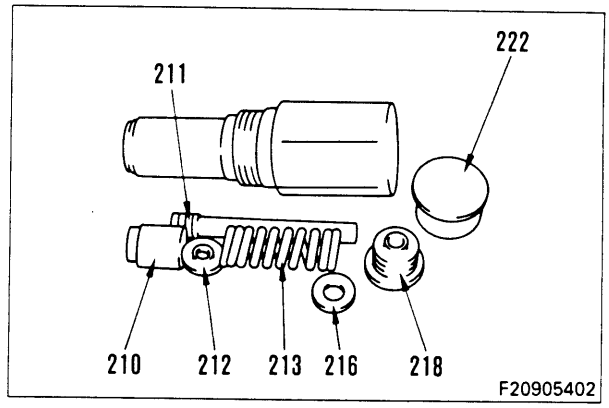
2) Remove valve (208).



3) Remove O-ring (214) and backup ring (215) from valve assembly (208).



4) Remove cap (222) from valve assembly, then remove piston (218), spacer (216), spring (213), rod (211), retainer (212), and poppet (210).



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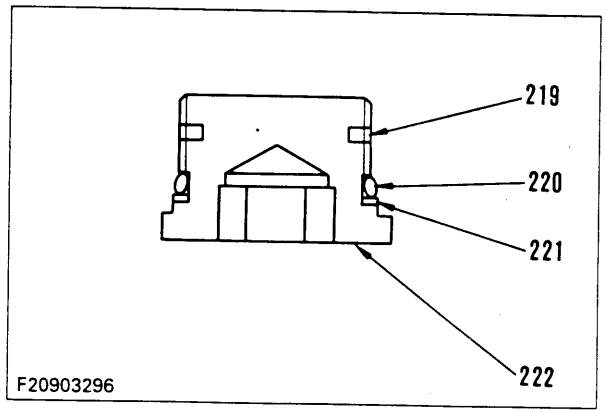
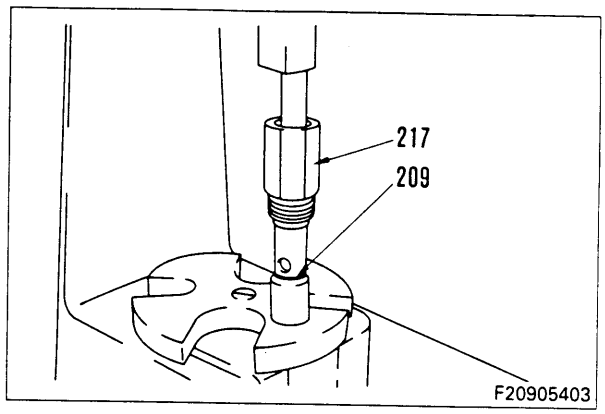
5) Remove insert (219), O-ring (220), and backup ring (221) from cap (222).



6) Using a press, remove seat (209) from sleeve (217).
   ★ Put some soft material in contact with the seat to prevent damage to the seat surface.



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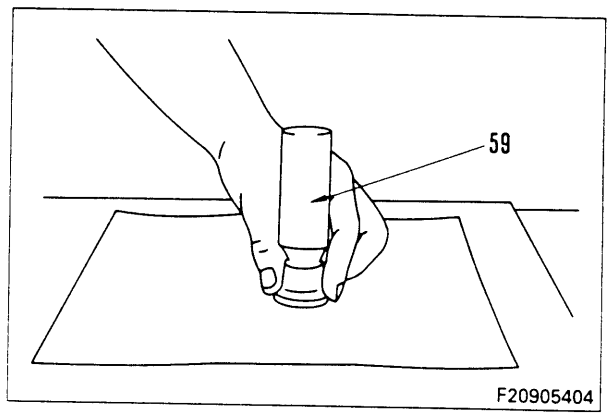
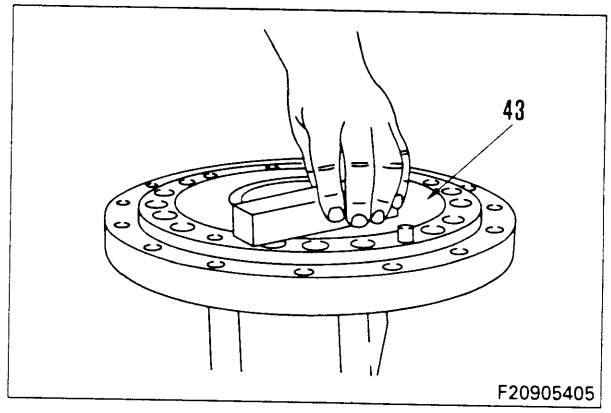
ASSEMBLY OF TRAVEL MOTOR ASSEMBLY

★ Before assembling, remove dirt or metal particles from all parts, and check that there are no burrs or dents in any part. If any damage is found, use an oilstone to remove the damage.
★ Replace all O-rings, backup rings, and oil seals with new parts.
★ When assembling sliding parts, coat with hydraulic oil.
Coat seal parts with grease.
★ Carry out paper lapping with No. 2000 sandpaper on the sliding surface of piston (59), shoe (35), and valve plate (48).
★ Carry out paper lapping with No. 2000 sandpaper on the sliding surface of cam (9) and cover (43).





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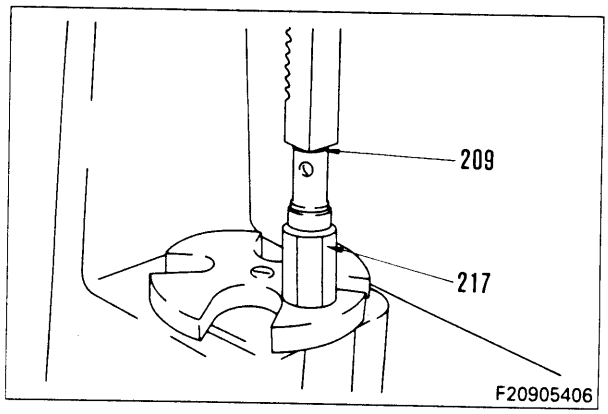
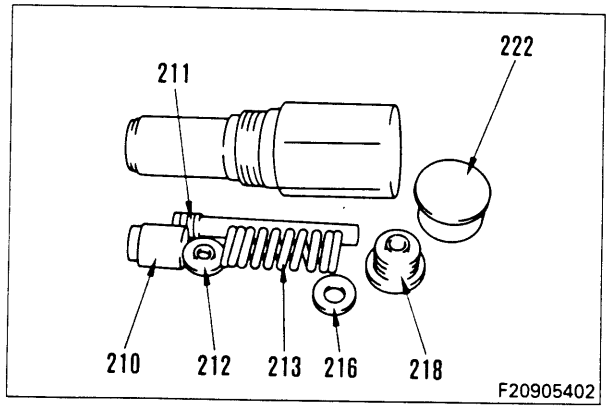
Assembly of safety valve assembly

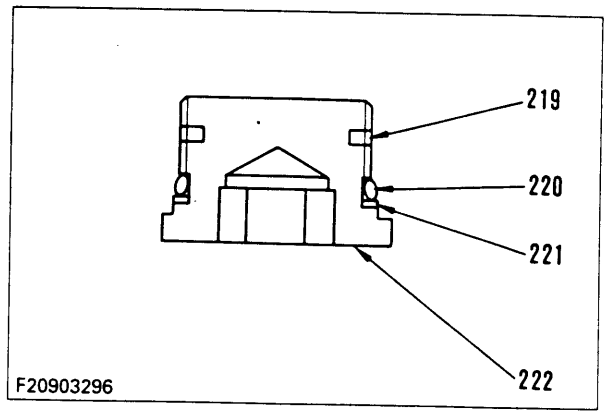
1. **Safety valve**
   1) Press fit seat (209) in sleeve (217).



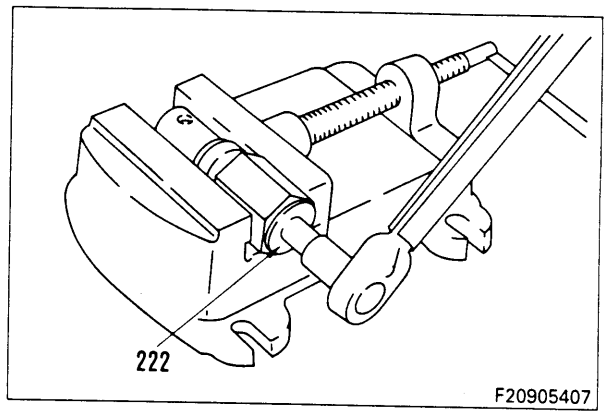
   2) Install poppet (210), retainer (212), rod (211), spring (213), spacer (216), and piston (218), in sleeve.
      ★ Install the spacer with the part chamfered on the inside facing the piston.



3) Install insert (219), O-ring (220), and backup ring (221) to cap (222).



4) Install cap (222) to sleeve.
kgm Cap: 225.4 Nm (23 kgm)



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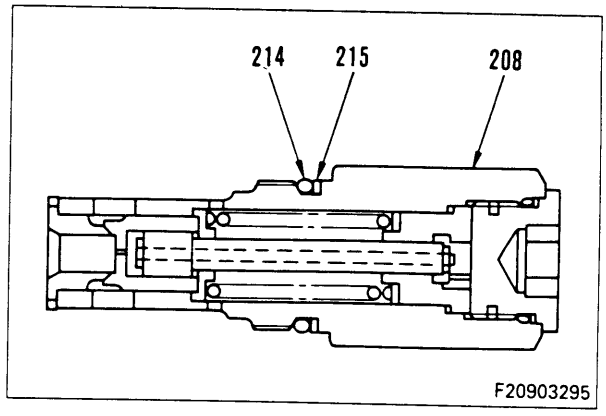
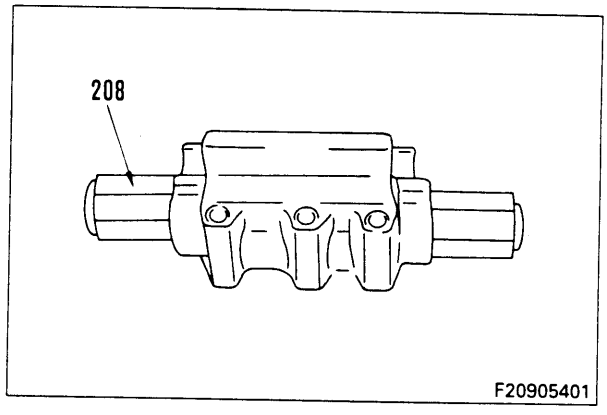
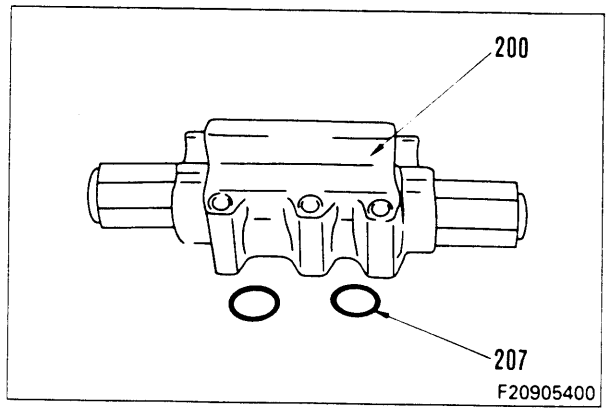
5) Insert O-ring (214) and backup ring (215) to valve assembly (208).



6) Install valve assembly (208) to housing.
kgm Valve assembly: 117.6 Nm (12 kgm)



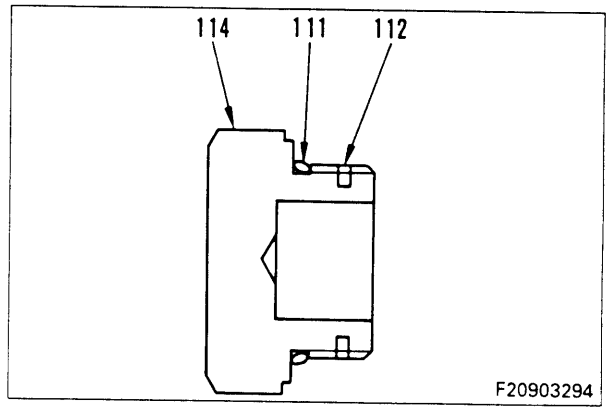
7) Fit O-ring (207) to mating surface with motor.



Assembly of counterbalance valve assembly

2. Check valve

1) Install insert (112) and O-ring (111) to cap (114).



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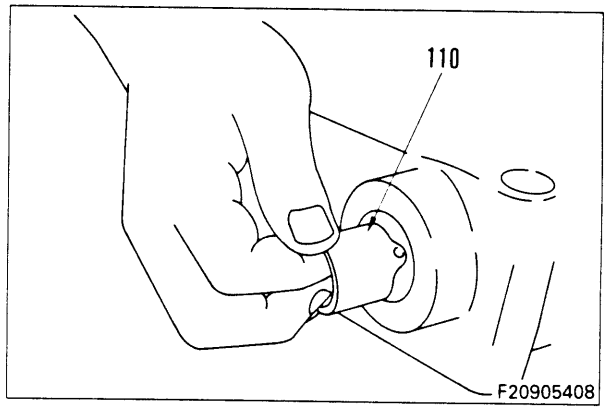
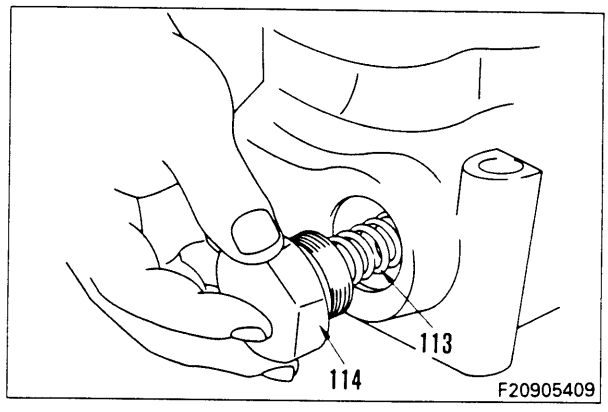
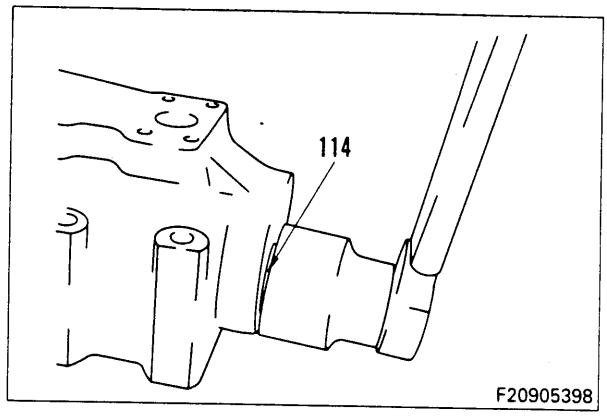
2) Install check valve (110) in housing.



3) Install spring (113) and cap (114) in housing.

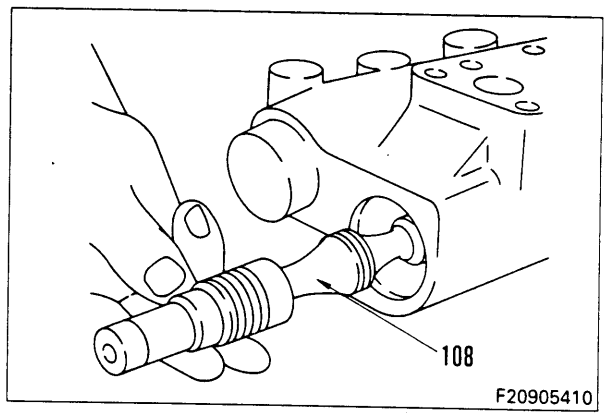


4) Tighten cap (114) to specified torque.
   kgm Cap: 294 Nm (30 kgm)



3. Counterbalance valve

1) Install spool (108) in housing.



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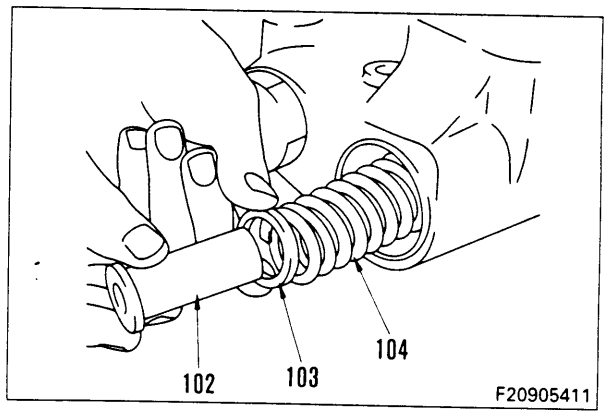
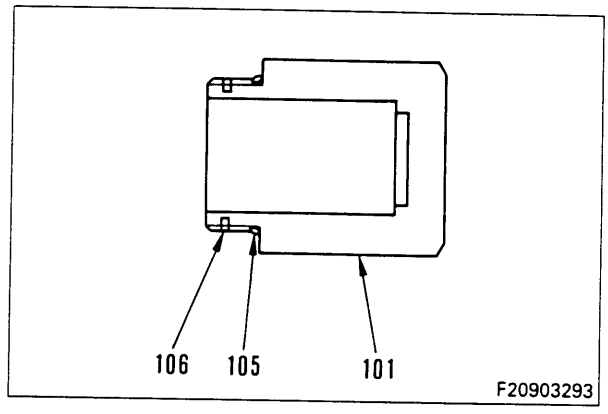
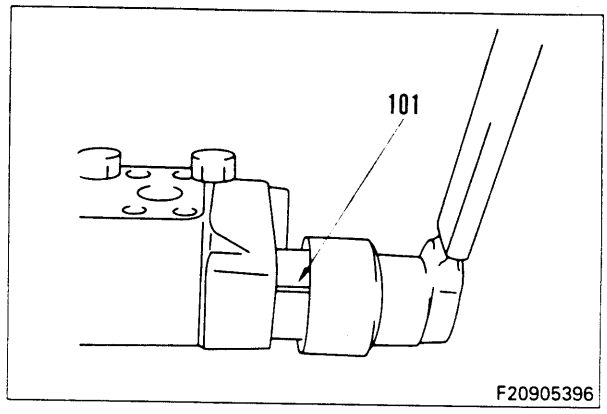
2) Install spacer (103), spring (104), spacer (103), and sleeve (102) in housing.



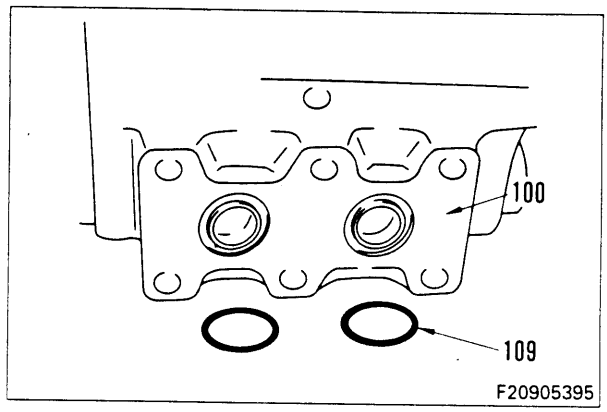
3) Install insert (106) and O-ring (105) to cap (101).



4) Install cap (101) to housing.
   kgm Cap: 382.2 Nm (39 kgm)



5) Fit O-ring (109) to mating surface with motor.



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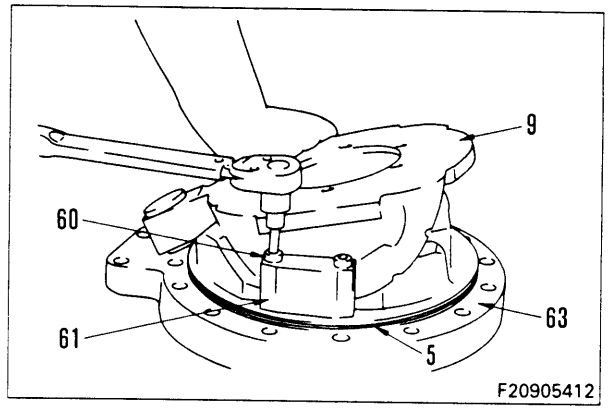
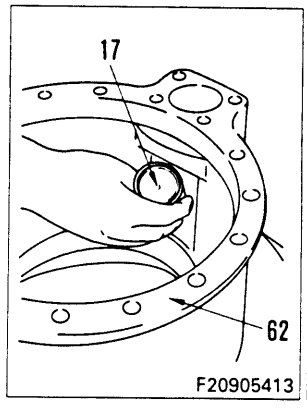
Assembly of motor assembly

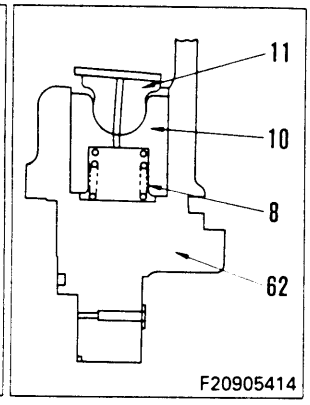
4. Cam assembly

1) Coat sliding surface of flange (63) and cam (9) with hydraulic oil, then assemble cam (9) to flange (63).
2) Install guide (61), and secure with mounting bolts (60).
   kgm Bolt: 32.4 Nm (3.3 kgm)
3) Install O-ring (5).

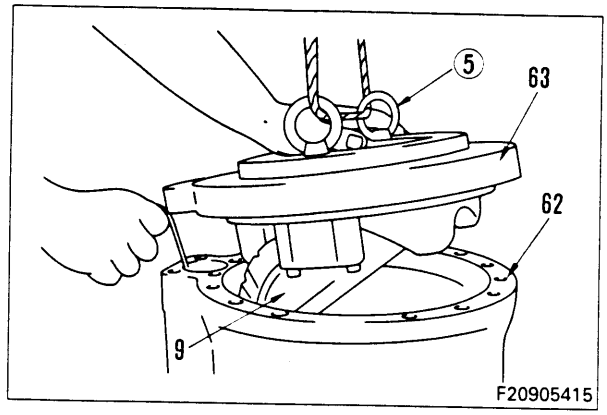


4) Set housing (62) with output shaft at the top.
5) Assemble springs (8), pistons (10), and plates (17) in turn from servo piston hole at bottom.
   ★ Coat the outside circumference and spherical portion of piston (10) with hydraulic oil.

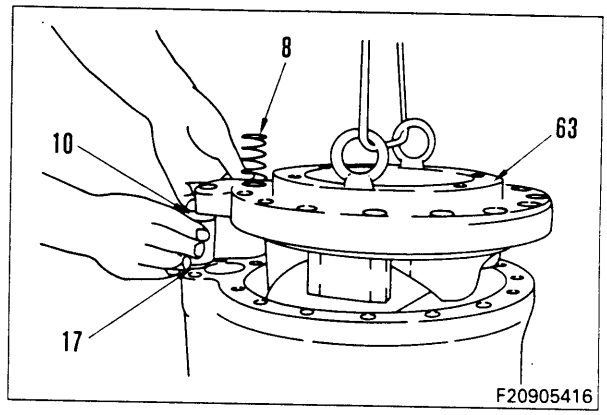




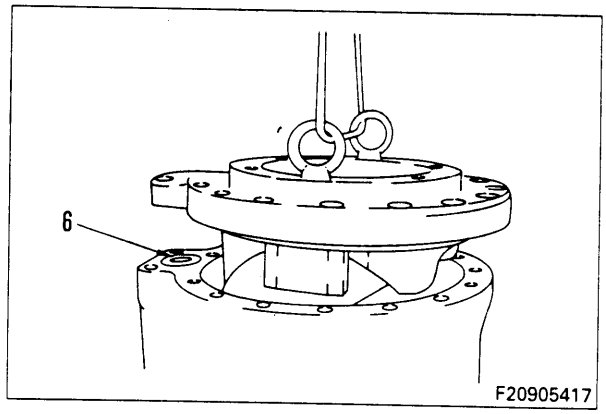
6) Install eyebolts ⑤ (Thread diameter: 12 mm) in tap hole for mounting flange retainer, then raise flange (63) and assemble temporarily to housing.
   ★ Piston (10) is being pushed up by spring (8), so use a thin wooden rod to push plate (17), and install so that the tip of cam (9) is on top of the plate.



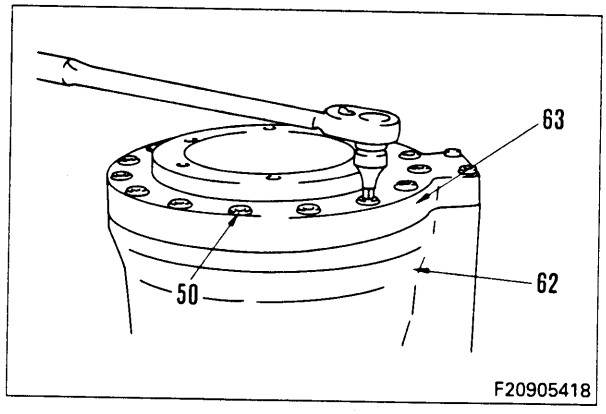
7) Keep flange (63) raised, and assemble plate (17) and piston (10) on the opposite side.
   ★ Coat the spherical portion of piston (10) with grease, then fit plate (17) to the piston, and assemble.
8) Install spring (8).



9) Fit O-ring, then install cap (6).



10) Lower flange (63), assemble to housing (62), align position of bolt holes, then push in.
   ★ To prevent breakage of O-ring (5), push in flange (63) in one movement.
11) Tighten 16 mounting bolts (50) to specified torque.
   ⇦kgm Bolt: 102.9 Nm (10.5 kgm)



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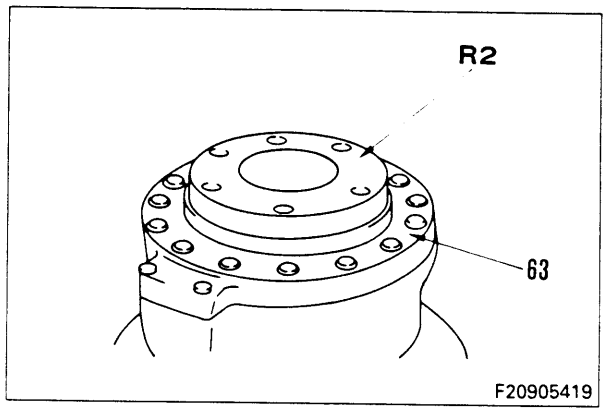
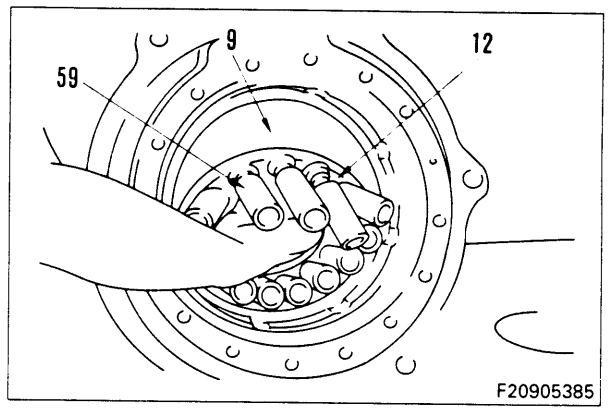
12) Install tool **R2** to flange (63).



5. Piston assembly

1) Place housing on side.
2) Coat sliding portion of cam (9) with hydraulic oil, temporarily assemble piston (59) to plate (12), then install to cam (9).
   ★ Match the numbers made on the cam and piston during disassembly.
   ★ Be careful not to damage the piston.



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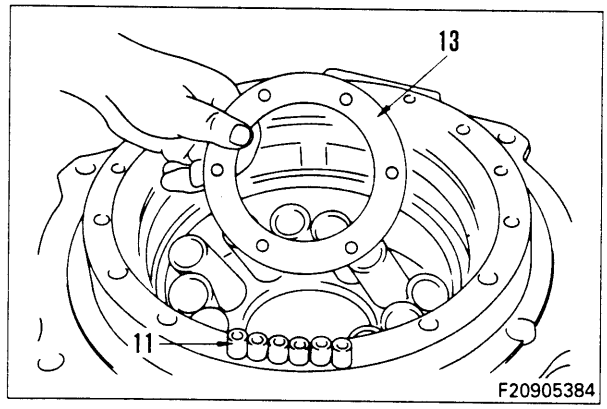
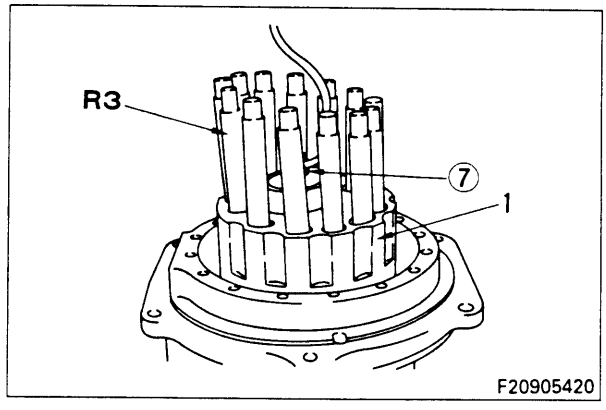
3) Set housing with tool **R2** facing down.
4) Install spacer (11) and plate (13), then secure with 6 mounting bolts and washers.
   kgm Bolt: 19.6 Nm (2 kgm)
   ★ After tightening the bolts, check that piston assembly (59) slides smoothly on the sliding surface of cam (9).

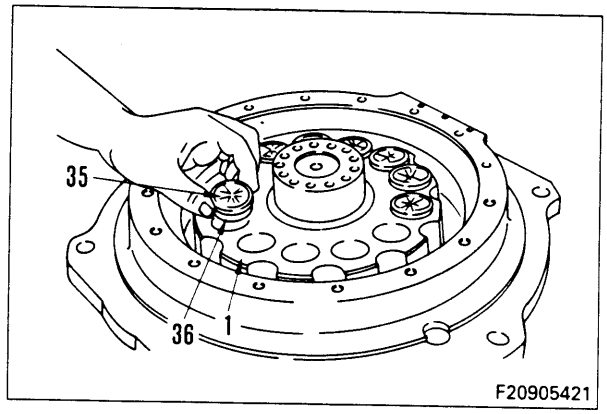


6. Cylinder assembly

1) Screw eyebolts ⑦ into tap hole in tip of cylinder assembly (1), and sling cylinder assembly (1).
2) Pass tool **R3** through piston hole in cylinder assembly (1), and insert into inside diameter of piston assembly (59).
3) Moving cylinder assembly (1) and tool **R3** to and fro, lower cylinder assembly (1) gradually, and assemble to piston assembly (59).
   ★ Coat the outside diameter of the piston and the inside diameter of the cylinder with hydraulic oil, and match the numbers made during disassembly.

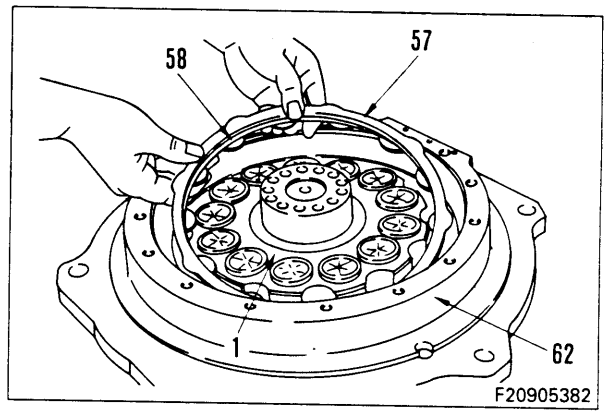


4) Coat inside diameter of cylinder with hydraulic oil, then install shoe (35) with teflon ring (36) to cylinder (1).
   ★ Match the numbers made during disassembly.

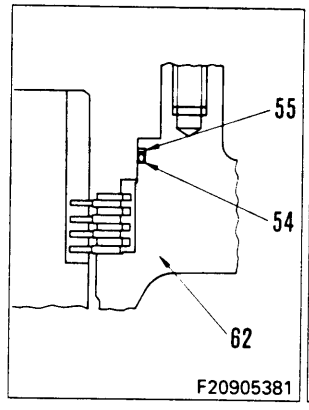


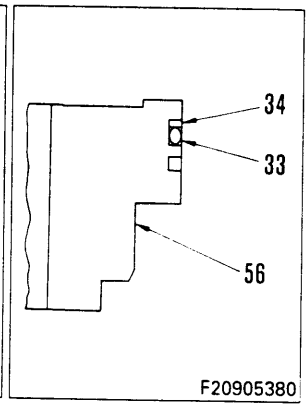
7. Brake

1) Install 4 discs (58) and 4 plates (57) in turn to housing (62) and cylinder (1).

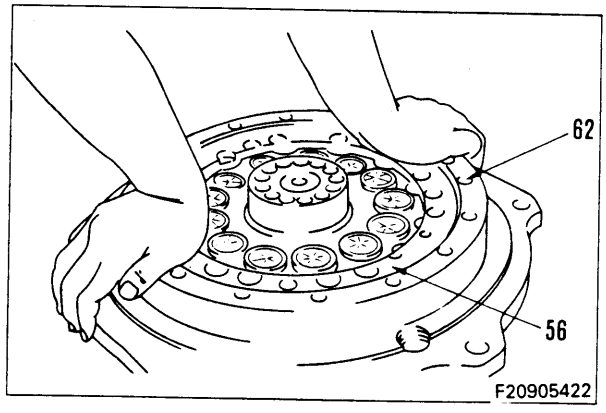


2) Install O-ring (54) and backup ring (55) to housing (62).
   ★ Coat O-ring (54) thinly with grease.
3) Install O-ring (33) and backup ring (34) to brake piston (56).
   ★ Coat O-ring (33) thinly with grease.





4) Install brake piston (56) to housing (62).
   ★ Coat the sliding surface of brake piston (56) and housing (62) thinly with grease.
   ★ Align the match marks made during assembly exactly when installing.
   ★ Center the brake piston and housing, then push in the brake piston in one movement. If it is difficult to assemble, tap the top of the brake piston in turn on opposite sides to assemble.



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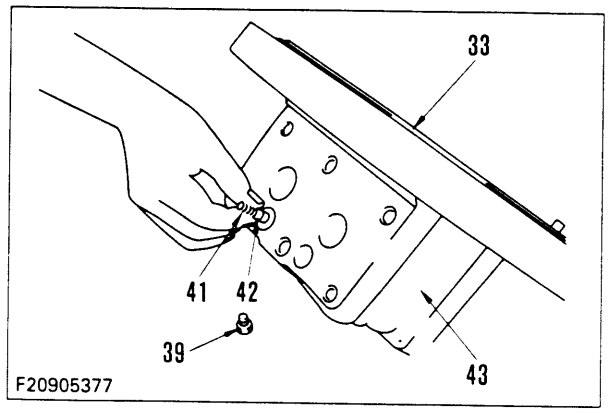
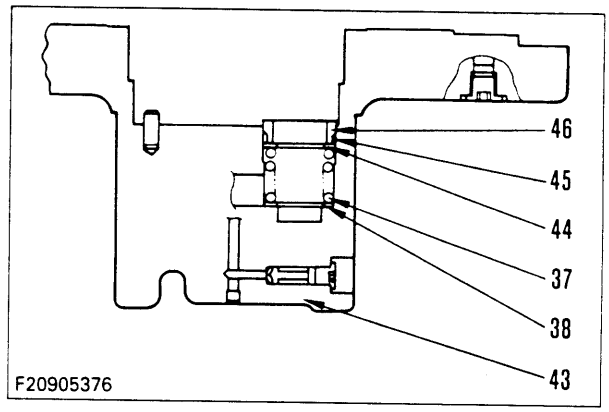
8. Cover assembly

1) Assemble check valve (42) and spring (41) in order to cover (43).
2) Fit O-ring, then install plug (39).
   kgm Plug: 7.8 Nm (0.8 kgm)
3) Install O-ring (33) to cover (43).



4) Install spacer (38), spring (37), and spacer (44) to cover (43).
   ★ Insert spacer (38) with the smaller outside diameter on the inside.
5) Install bushing (46) with teflon ring (45).



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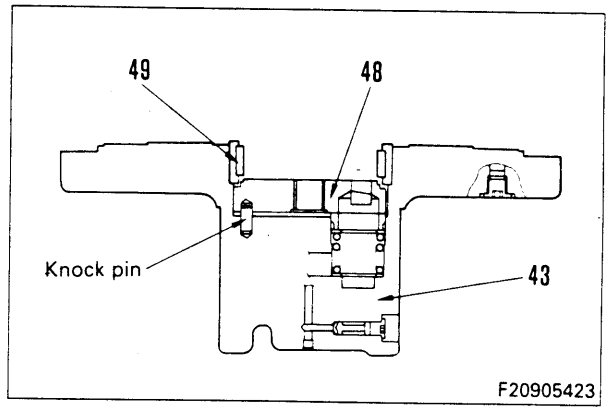
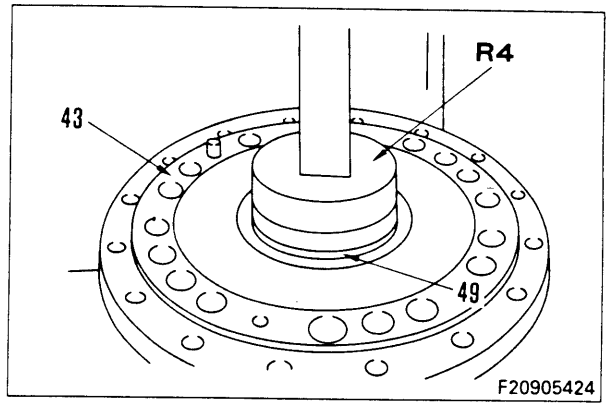
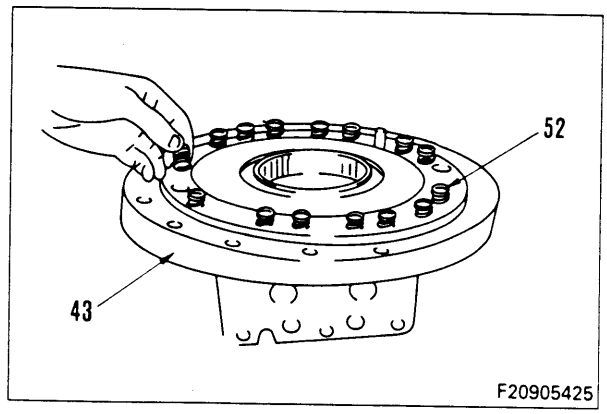
6) Install valve plate (48) to cover (43).
   ★ Align the match marks made during disassembly exactly, and align the dowel pin on the cover side with the pin hole on the valve plate side when installing.



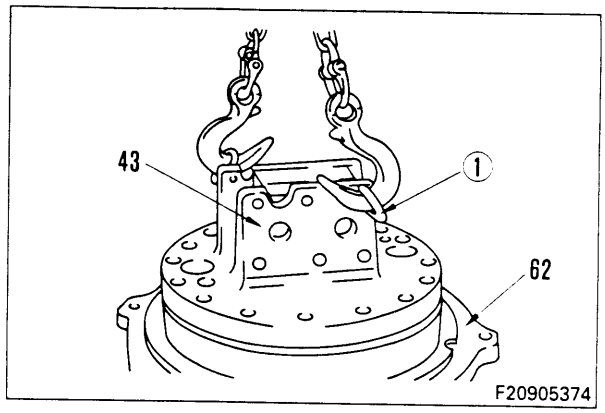
7) Using tool **R4**, press fit needle bearing (49) to cover (43) with a press.
   ★ After press fitting, put a round bar of approx. ϕ35 in contact with the center of valve plate (48), push lightly with the press, and after releasing the press force, check that the valve plate is pushed back by the spring.
   Be careful not to damage the sliding surface.



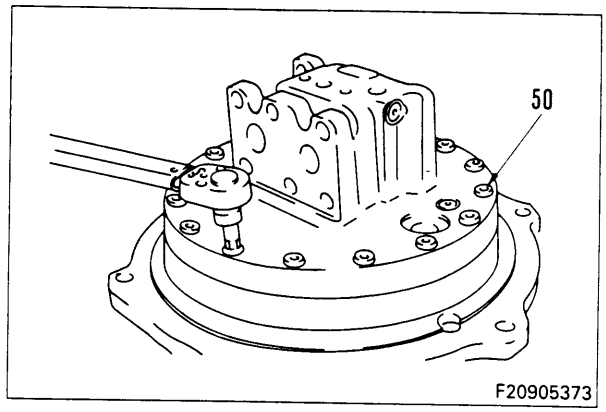
8) Put a small amount of grease on spring (52), then install to cover (43).
   ★ Apply the grease to stick the spring to the cover and prevent it from falling off when installing the cover assembly to the body.



9) Screw in eyebolts ① (Thread diameter: 12 mm) into tap holes in cover port surface, then raise cover assembly (43) and install to housing (62).
   ★ Align the match marks made during disassembly.

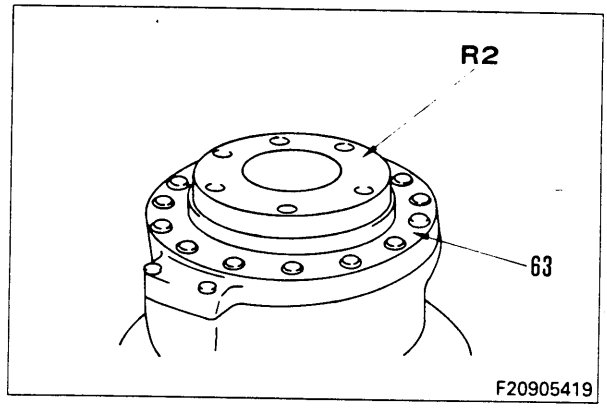


10) Tighten 16 mounting bolts (50) to specified torque.
    kgm Bolt: 102.9 Nm (10.5 kgm)
    ★ The cover is being pushed by the spring, so first tighten 2 bolts on opposite sides, then tighten the remaining bolts.



9. Flange assembly

1) Set motor with output shaft facing up, then remove tool **R2**.



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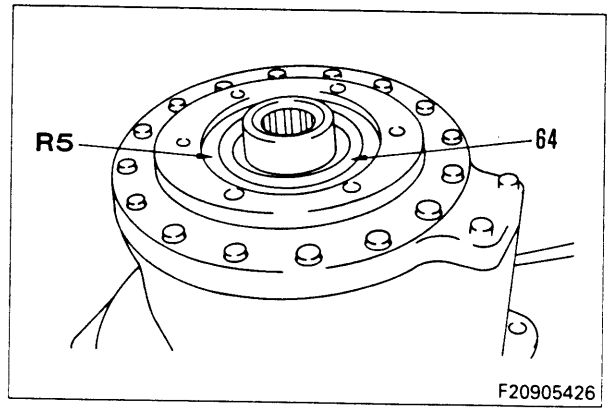
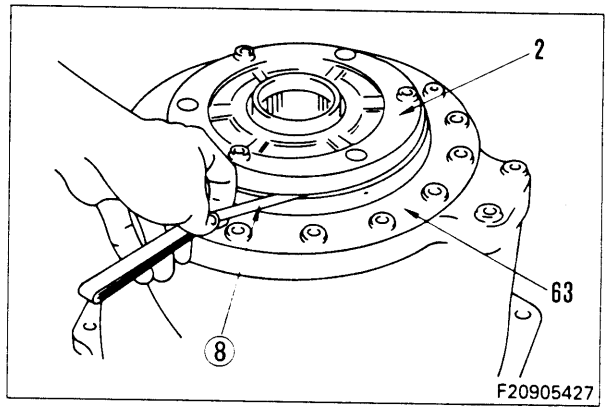
2) Warm up taper roller bearing (64) to 70 – 80°C, and install to output shaft.
3) Select shim (4) as follows.
   i) Install tool **R5** to top of taper roller bearing (64).
   ii) Assemble retainer (2), then tighten 3 mounting bolts (65) uniformly at 0.5 kgm.
      ★ To prevent breakage of the retainer oil seal, carry out this operation without assembling the oil seal to the retainer.
   iii) Use clearance gauge ⑧ to measure clearance X between flange (63) and retainer (2), then use the following formula to select shim (4).
      • Shim thickness: $3.2^{+0.1}_{0}$ – X (mm)
   iv) After completing operation, remove retainer (2) and tool **R5**.





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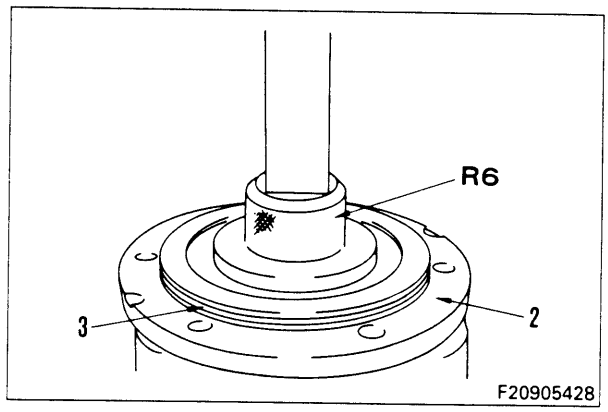
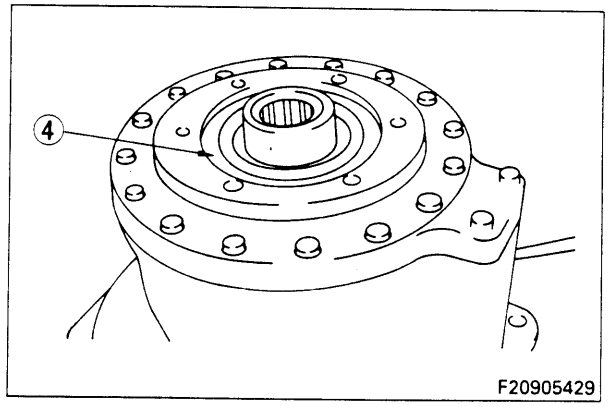
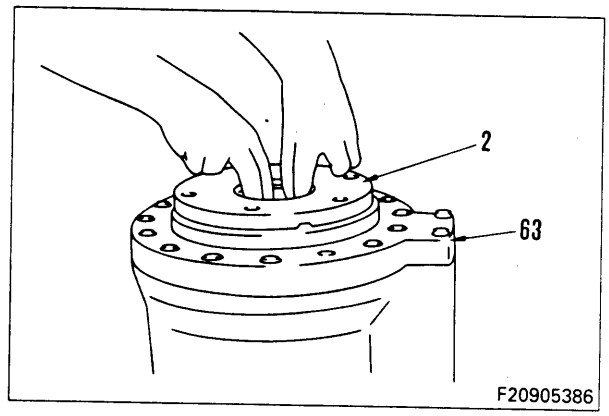
4) Coat mating portion on retainer (2) for oil seal (66) with adhesive, then use tool **R6** to press fit oil seal (66).
   ★ Be careful to install the oil seal facing in the correct direction.
   ★ Coat the lip of the oil seal thinly with grease.
5) Install O-ring (3) to retainer (2).



6) Assemble selected shim (4).



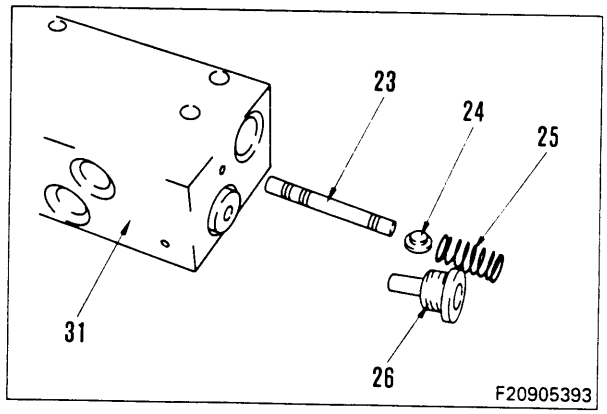
7) Install retainer (2) to flange (63), then tighten mounting bolts to specified torque.
kgm Bolt: 102.9 Nm (10.5 kgm)



Assembly of control valve

10. Selector valve

1) Install spool (23), guide (24), and spring (25) in order to housing (31).
★ Coat spool (23) with hydraulic oil.
2) Fit O-ring, then tighten plug (26) to specified torque.
kgm Plug: 49 Nm (5 kgm)



11. Reducing valve

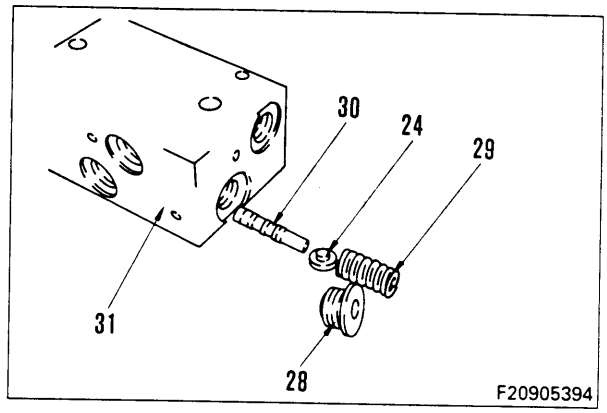
1) Assemble poppet (30), guide (24), and spring (29) in order to housing (31).
★ Coat poppet (30) with hydraulic oil.
2) Fit O-ring, then tighten plug (28) to specified torque.
kgm Plug: 49 Nm (5 kgm)

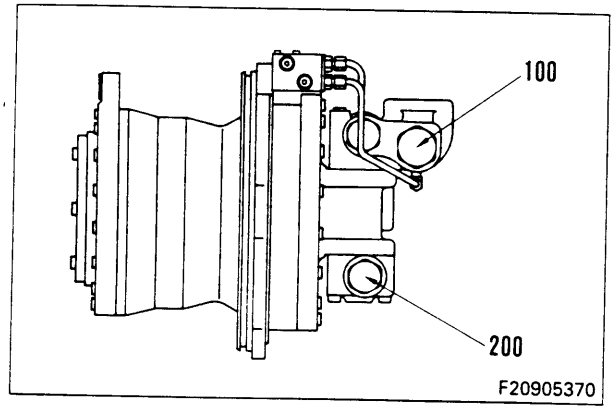
12. Control valve assembly

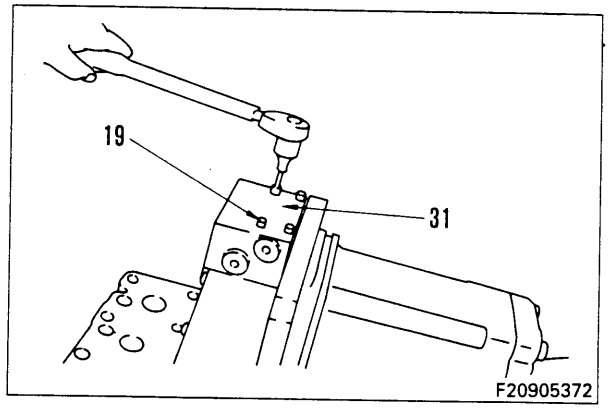
Install control valve assembly (31) to motor.
kgm Bolt: 11.8 Nm (1.2 kgm)

13. Counterbalance valve assembly, safety valve assembly

Install counterbalance valve assembly (100) and safety valve assembly (200) to motor.







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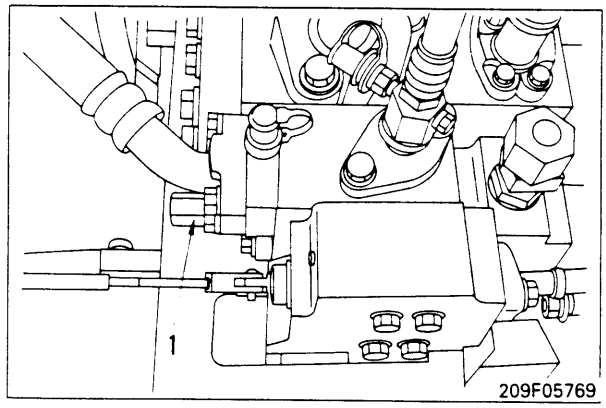
REMOVAL OF CHARGING PUMP RELIEF VALVE ASSEMBLY

★ Before removing the relief valve assembly, clean the surrounding area and be careful not to let any dirt or dust get into the control valve.

Stop the engine, then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Remove relief valve assembly (1). ※ 1



INSTALLATION OF CHARGING PUMP RELIEF VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

★ Measure and adjust the relief pressure.
For details, see TESTING AND ADJUSTING, Measuring and adjusting control circuit pressure.

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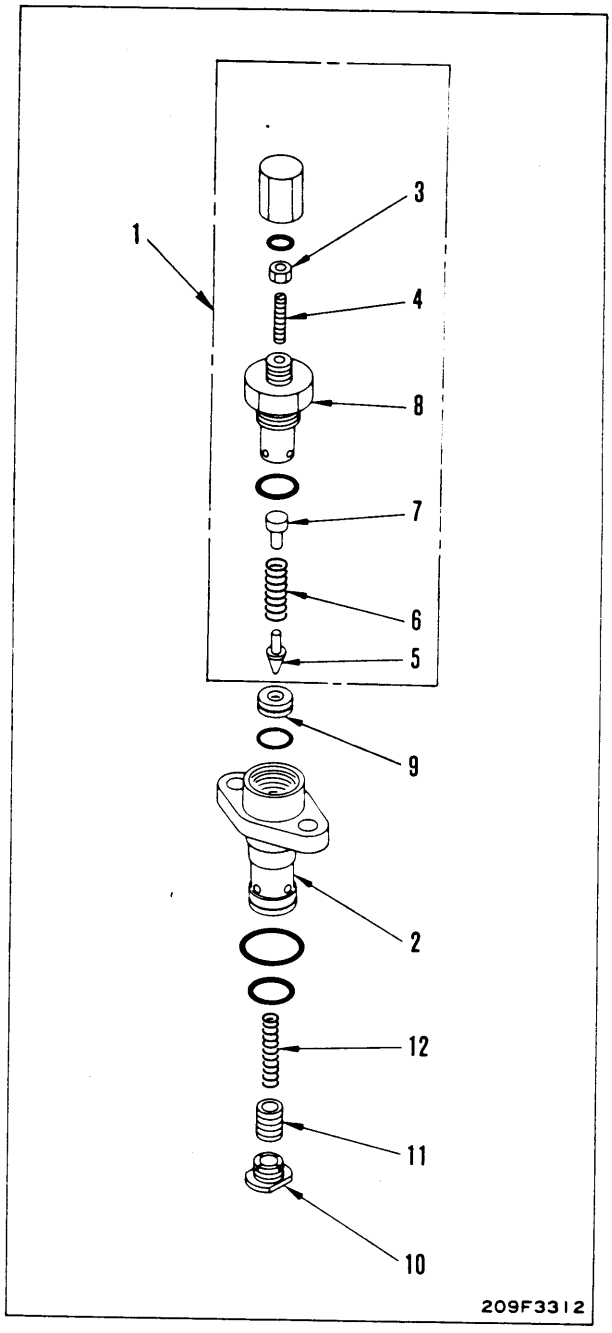
- Refilling with oil
  - ★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.
  - ★ Add oil to replace the amount that leaked out when the valve was removed.

DISASSEMBLY OF CHARGING PUMP RELIEF VALVE ASSEMBLY

1. Remove holder assembly (1) from sleeve (2).
   ★ When loosening nut (3), measure the dimension of protrusion between end face of the holder and adjustment screw (4).
2. Remove poppet (5), spring (6), and retainer (7) from holder (8).
3. Remove seat (9) from sleeve (2).
4. Remove plug (10), then remove valve (11) and spring (12) from sleeve (2).



ASSEMBLY OF CHARGING PUMP RELIEF VALVE ASSEMBLY

1. Assemble spring (12) and valve (11) in sleeve (2), and install plug (10).
2. Fit O-ring and install seat (9) to sleeve (2).
3. Assemble holder (7), spring (6), and poppet (5) to holder (8).
   ★ If nut (3) has been loosened, adjust the dimension of protrusion of adjustment screw (4) to the same dimension as before disassembly, then tighten nut (3).
4. Fit O-ring and install holder assembly (1) to sleeve (2).

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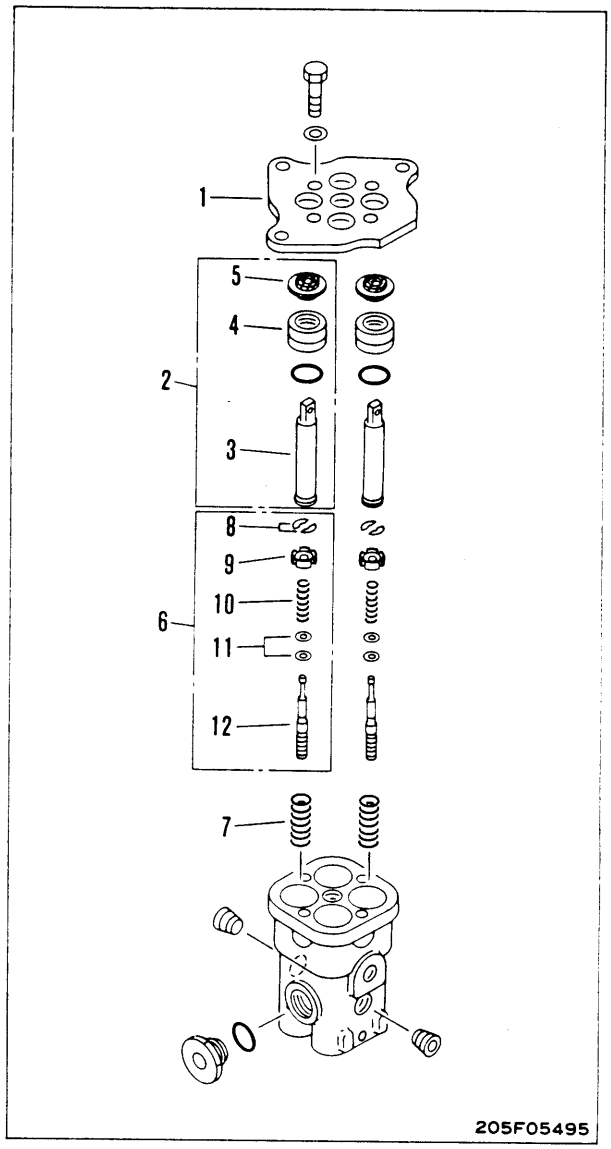
DISASSEMBLY OF PPC VALVE ASSEMBLY (FOR TRAVEL)

1. Remove plate (1), then remove piston assembly (2).
2. **Disassembly of piston assembly**
   Remove collar (4) from piston (3), then remove seal (5).
3. Remove valve assembly (6), then remove spring (7).
4. **Disassembly of valve assembly**
   Push retainer (9) to remove collar (8), then remove retainer (9), spring (10), and shim (11) from valve (12).



ASSEMBLY OF PPC VALVE ASSEMBLY (FOR TRAVEL)

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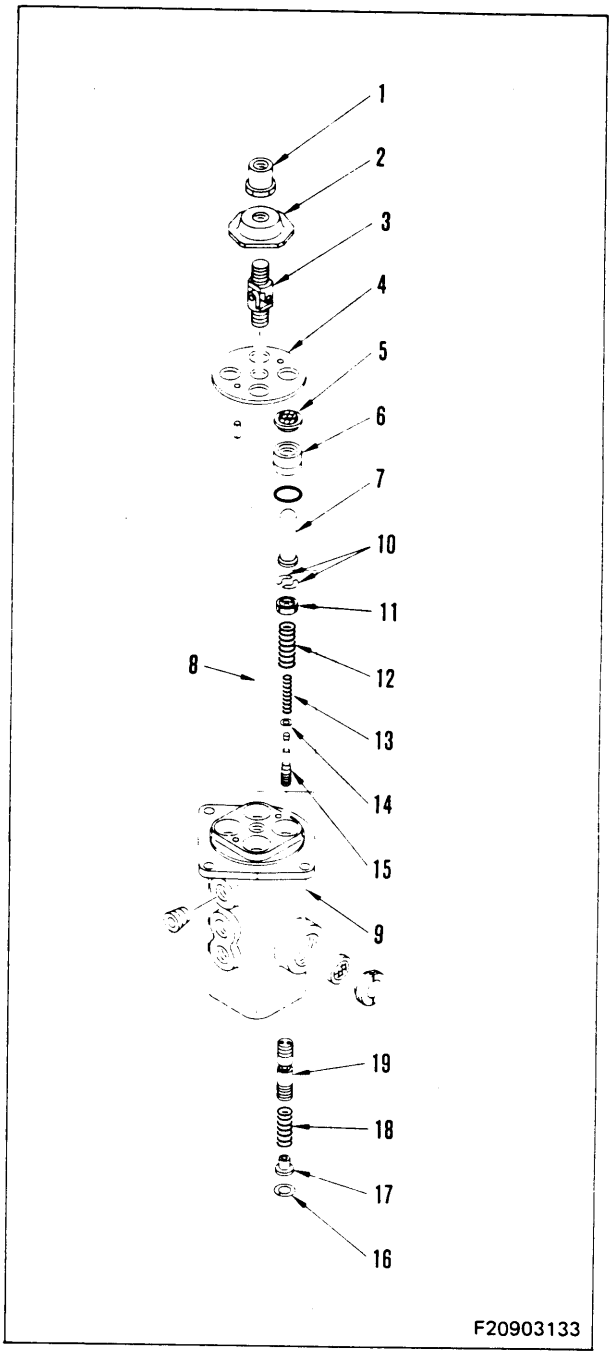
1. **Assembly of valve assembly**
   Assemble shim (11), spring (10), and retainer (9) in valve (12), then push down retainer (9) to install collar (8).
2. Assemble spring (7), and install valve assembly (6).
3. **Assembly of piston assembly**
   Assemble seal (5) to collar (4), and install to piston (3).
4. Assemble piston assembly (2), and install plate (1).

DISASSEMBLY OF PPC VALVE ASSEMBLY (FOR WORK EQUIPMENT, SWING)

1. Remove nut (1), then remove disc (2).
2. Remove joint (3).
3. Remove plate (4).
4. Remove seal (5), then remove collar (6).
5. Remove piston (7).
6. Remove valve assembly (8) from valve body (9).
7. Remove collar (10), then remove retainer (11), springs (12) and (13), and shim (14) from piston (15).
8. Remove snap ring (16), then remove retainer (17), spring (18), and valve (19) from valve body (9).



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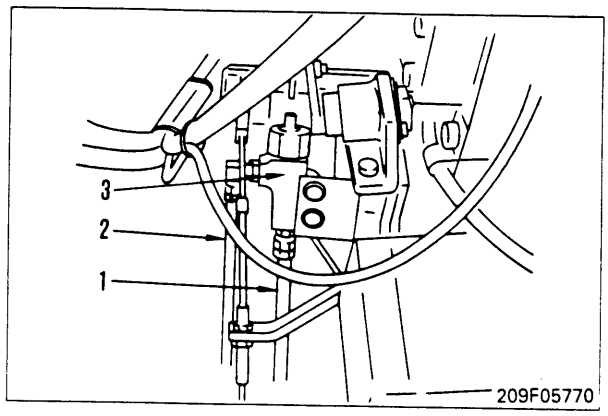
ASSEMBLY OF PPC VALVE ASSEMBLY (FOR WORK EQUIPMENT, SWING)

1. Assemble valve (19), spring (18), and retainer (17) in valve body (9), and secure with snap ring (16).
   ★ Check that the snap ring is fitted securely in the ring groove.
2. Assemble shim (14), springs (13) and (12), and retainer (11) to piston (15), and install collar (10).
   ★ Check that the collar is fitted securely in the cotter groove of the piston.
3. Assemble valve assembly (8) in valve body (9).
4. Install piston (7).
5. Fit O-ring and install collar (6) and seal (5).
6. Install plate (4).
7. Install joint (3).
8. Fit disc (2) and tighten nut (1).
   ★ Adjust the clearance between disc (12) and piston (7).
   For details, see TESTING AND ADJUSTING, Adjusting PPC valve for work equipment, swing.

REMOVAL OF AUTO-DECELERATION CYLINDER ASSEMBLY

★ **FOR MACHINE EQUIPPED WITH AUTO-DECELERATION**

1. Disconnect hose (1).
2. Disconnect hose (2).
3. Remove auto-deceleration cylinder assembly (3). ※1



INSTALLATION OF AUTO-DECELERATION CYLINDER ASSEMBLY

★ **FOR MACHINE EQUIPPED WITH AUTO-DECELERATION**

- Carry out installation in the reverse order to removal.

※1

★ Adjust auto-deceleration linkage
See TESTING AND ADJUSTING, Adjusting fuel control linkage.

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REMOVAL OF BOOM CYLINDER ASSEMBLY

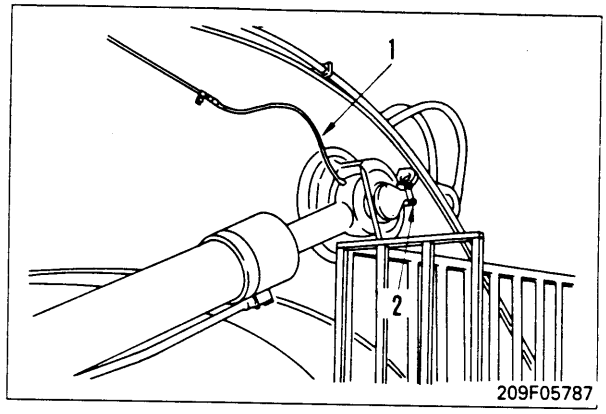
BACK HOE

⚠ Extend the arm and bucket fully, lower the work equipment completely to the ground and stop the engine.

★ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

1. Disconnect greasing tube (1).

2. Remove lock bolt, then remove plates (2).

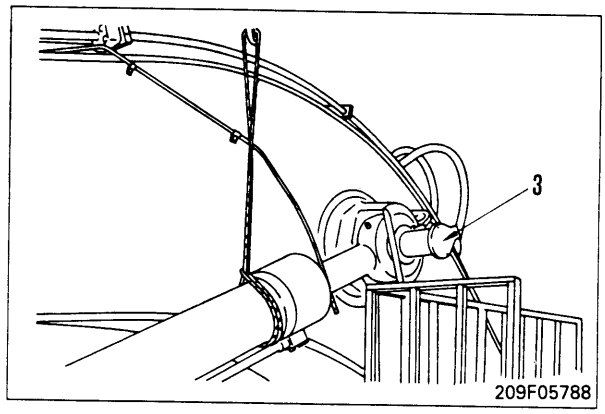


3. Sling boom cylinder assembly, then pull out pin (3), and disconnect piston rod from boom. ※ 1

4. Start engine and retract piston rod fully.

⚠ Tie the rod with wire to prevent it from coming out.

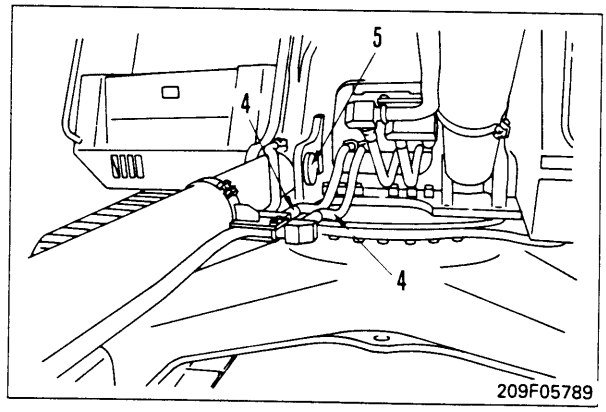
⚠ After stopping the engine, release the pressure inside the piping.
For details, see TESTING AND ADJUSTING, Releasing pressure in PPC circuit.



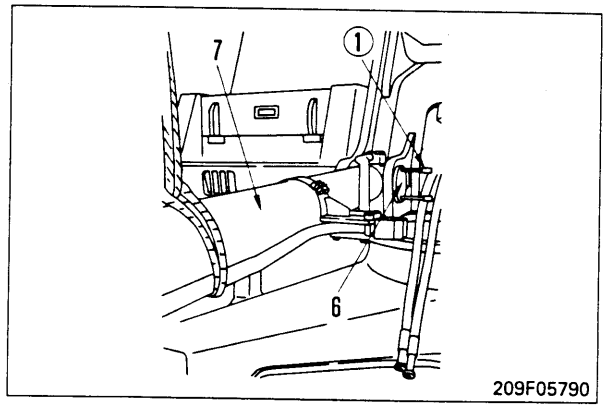
5. Lower boom cylinder assembly on stand, and disconnect hose (4).

6. Sling boom cylinder assembly, and remove plate (5), then using forcing screws ① , pull out foot pin (6). ※ 2

★ Check the number and thickness of the shims, and keep in a safe place.



7. Remove boom cylinder assembly (7).
kg Boom cylinder assembly: 785 kg



020905

INSTALLATION OF BOOM CYLINDER ASSEMBLY

BACK HOE

- Carry out installation in the reverse order to removal.

※ 1

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ 2

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

★ Adjust with shims so that the clearance at the cylinder bottom end is less than 1 mm.

★ Bleed the air from the work equipment circuit.
For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder (work equipment circuit).

- Refilling with oil

★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.

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REMOVAL OF ARM CYLINDER ASSEMBLY

BACK HOE

⚠ Set stand ① under the arm, lower the work equipment completely to the ground and stop the engine.

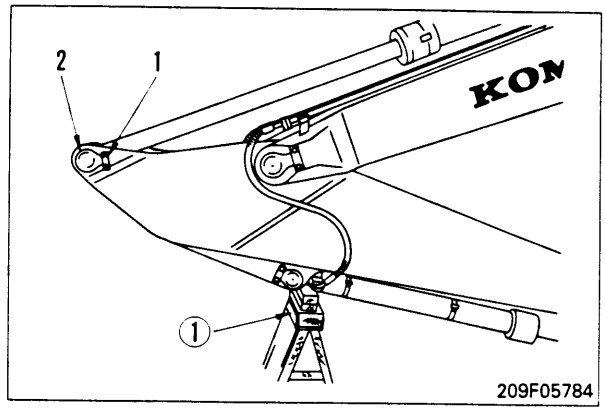
★ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

1. Sling arm cylinder assembly, remove lock plate (1), then pull out pin (2). ※ 1
2. Start engine and retract piston rod fully.

   ⚠ Tie the rod with wire to prevent it from coming out.

   After stopping the engine, release the pressure inside the piping.
   For details, see TESTING AND ADJUSTING, Releasing pressure in PPC circuit.
3. Disconnect greasing tube (3).
4. Disconnect arm cylinder hoses (4) at cylinder end.
5. Remove lock plate (5), pull out pin (6), then lift off arm cylinder assembly (7). ※ 2

   kg Arm cylinder assembly: 865 kg



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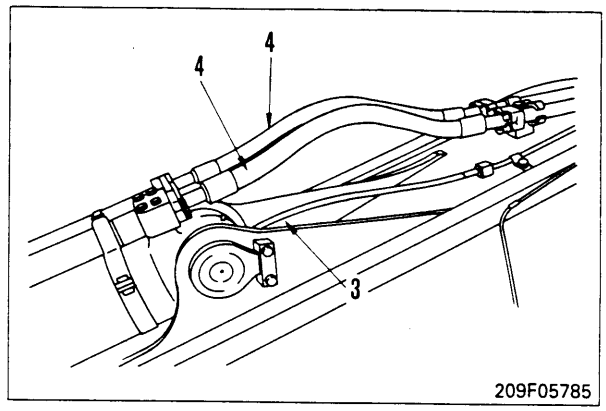

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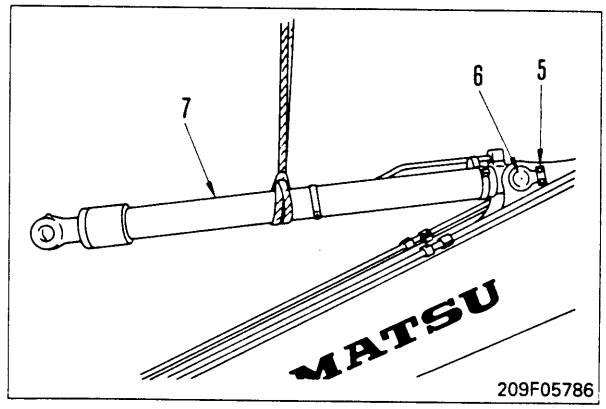

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INSTALLATION OF ARM CYLINDER ASSEMBLY

BACK HOE

- Carry out installation in the reverse order to removal.

※ 1

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ 2

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

★ Adjust with shims so that the clearance at the cylinder bottom end is less than 1 mm.

★ Bleed the air from the work equipment circuit.
For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder (work equipment circuit).

- Refilling with oil

★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.

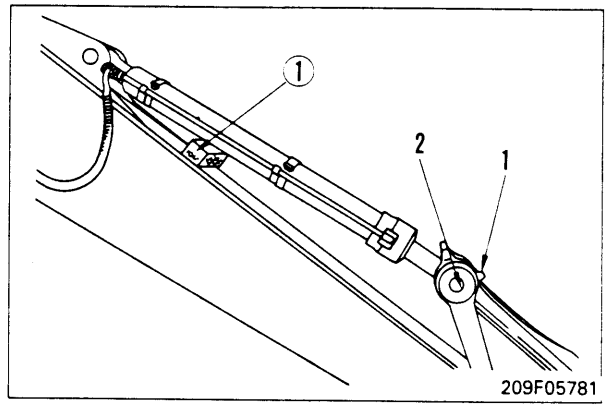
REMOVAL OF BUCKET CYLINDER ASSEMBLY

BACK HOE

⚠ Expand the arm and bucket fully, lower the work equipment completely to the ground and stop the engine.

★ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

1. Set block ① between bucket cylinder and arm.



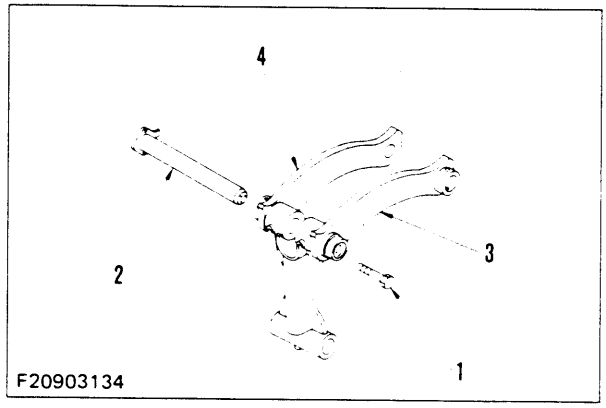
2. Remove 3 pin lock bolts (1), and using forcing screws, pull out pin (2). ※ 1

⚠ When the pin is removed, links (3) and (4) will drop, so sling the links before removing the pin.

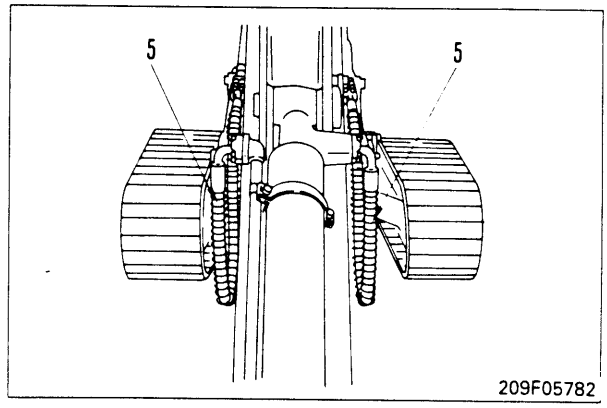
3. Start engine and retract piston rod fully.

⚠ Tie the rod with wire to prevent it from coming out.

After stopping the engine, release the pressure inside the piping.
For details, see TESTING AND ADJUSTING, Releasing pressure in PPC circuit.

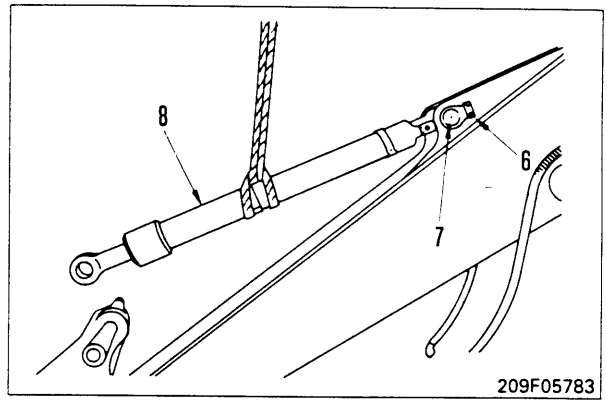


4. Disconnect hose (5).



5. Sling bucket cylinder assembly, and remove plate (6), then pull out pin (7). ※ 2

6. Remove bucket cylinder assembly (8).
kg Bucket cylinder assembly: 580 kg



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INSTALLATION OF BUCKET CYLINDER ASSEMBLY

BACK HOE

- Carry out installation in the reverse order to removal.

※1

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※2

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

★ Adjust with shims so that the clearance at the cylinder bottom end is less than 1 mm.

★ Bleed the air from the work equipment circuit.
For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder (work equipment circuit).

- Refilling with oil

★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.

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REMOVAL OF BOOM CYLINDER ASSEMBLY

LOADING SHOVEL

⚠ Extend the arm and bucket fully, lower the work equipment completely to the ground and stop the engine. Operate the control levers several times to release the remaining pressure in the hydraulic piping.

⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

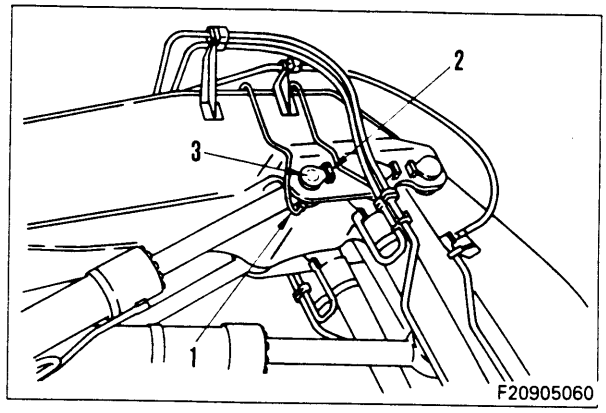
★ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

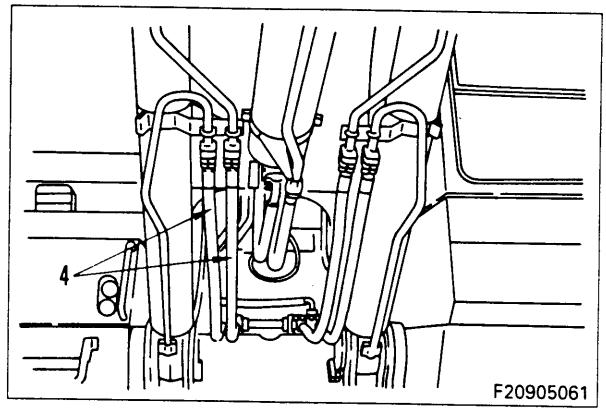
1. Disconnect grease hose (1).
2. Remove plate (2).
3. Sling boom cylinder assembly, then using forcing screws (Thread dia. = 16 mm, Pitch = 2.0 mm), pull out pin (3), and disconnect piston rod from boom.
   ※ 1
4. Start engine and retract piston rod fully.

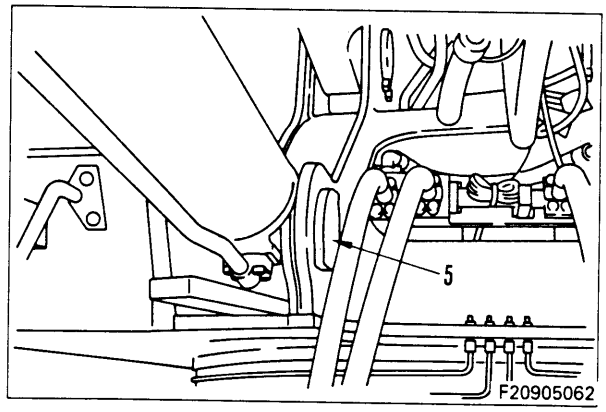
⚠ Tie the rod with wire to prevent it from coming out.

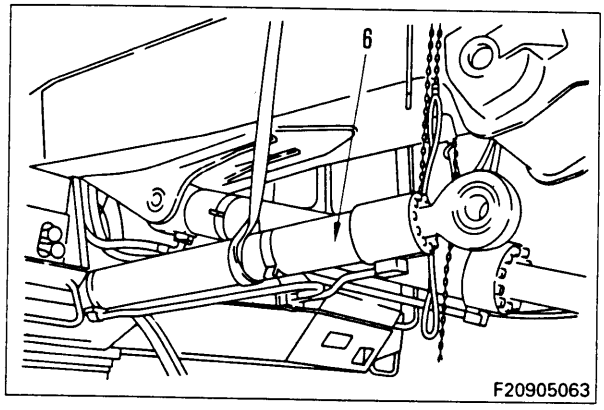
⚠ After stopping the engine, release the pressure inside the piping.
For details, see TESTING AND ADJUSTING, Releasing pressure in PPC circuit.

5. Lower boom cylinder assembly onto stand, then disconnect hose (4).
6. Sling boom cylinder assembly, and remove plate, then using forcing screws (Thread dia. = 16 mm, Pitch = 2.0 mm), pull out foot pin (5).
   ※ 2
7. Remove boom cylinder assembly (6).
   kg Boom cylinder assembly: 782 kg









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INSTALLATION OF BOOM CYLINDER ASSEMBLY

LOADING SHOVEL

- Carry out installation in the reverse order to removal.

※ 1

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ 2

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

★ Adjust with shims so that the clearance at the cylinder bottom end is less than 1 mm.

★ Bleed the air from the work equipment circuit.
For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.

- Refilling with oil

★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.

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REMOVAL OF ARM CYLINDER ASSEMBLY

LOADING SHOVEL

⚠ Retract boom cylinder fully, and extend arm cylinder, then set the bottom of the bucket horizontal, lower the work equipment completely to the ground and stop the engine. Operate the control levers several times to release the remaining pressure in the hydraulic piping.

⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

★ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

1. Disconnect grease tube (1) at piston rod end.

2. Sling arm cylinder assembly, and remove plate, then using forcing screws (Thread dia. = 16 mm, Pitch = 2.0 mm), pull out pin (2). ※ 1
   ★ Pull out the pin to a position where the piston rob can be disconnected.
   kg Pin: 56 kg

3. Start engine and retract piston rod fully.

   ⚠ Tie the rod with wire to prevent it from coming out.

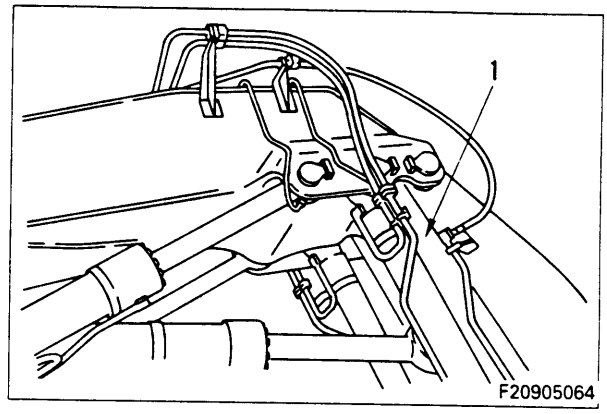
   ⚠ After stopping the engine, release the pressure inside the piping.
   For details, see TESTING AND ADJUSTING, Releasing pressure in PPC circuit.

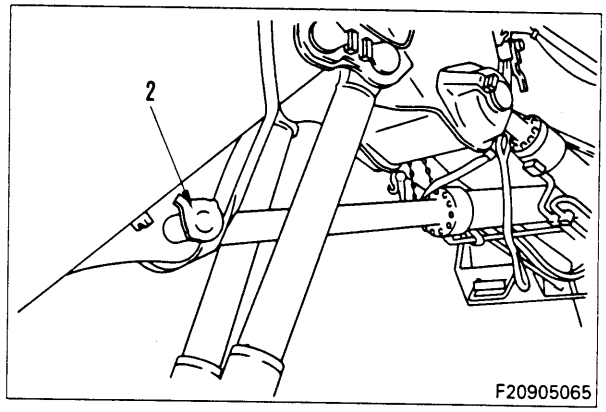
4. Disconnect hose (3).

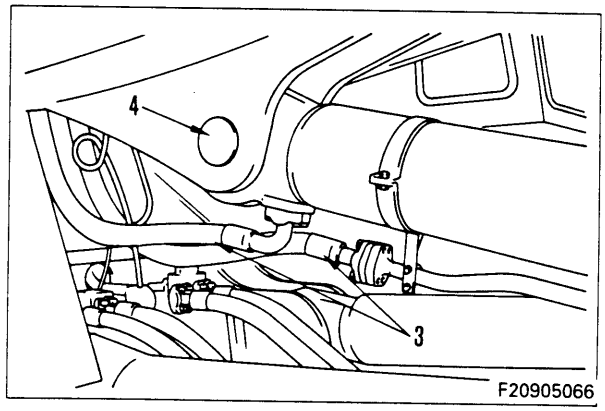
5. Sling piston rod end and bottom end, and remove plate, then using forcing screws (Thread dia. = 16 mm, Pitch = 2.0 mm), pull out pin (4). ※ 2
   ★ Pull out the pin to a position where the cylinder bottom can be disconnected.
   kg Pin: 56 kg

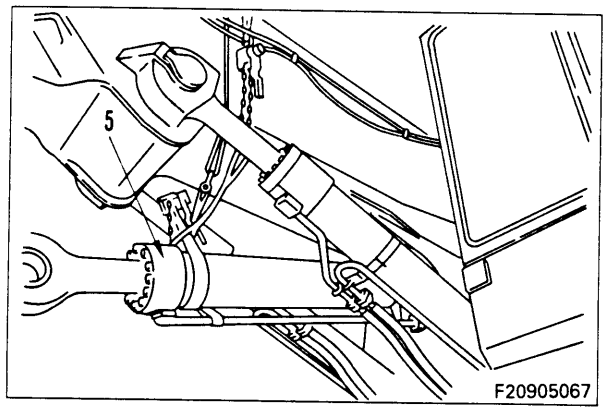
6. Lift off arm cylinder assembly (5) carefully.

   kg Arm cylinder assembly: 865 kg









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INSTALLATION OF ARM CYLINDER ASSEMBLY

LOADING SHOVEL

- 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.

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

★ Adjust with shims so that the clearance at the cylinder bottom end is less than 1 mm.

★ Bleed the air from the work equipment circuit.
For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.

- Refilling with oil

★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.

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REMOVAL OF BUCKET CYLINDER ASSEMBLY

LOADING SHOVEL

⚠ Extend the arm cylinder fully, set the bottom of the bucket horizontal, lower the work equipment completely to the ground and stop the engine. Operate the control levers several times to release the remaining pressure in the hydraulic piping.

⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

★ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

1. Sling bucket cylinder assembly, and remove 3 mounting bolts, then using forcing screws (Thread dia. =16 mm, Pitch = 2.0 mm), remove pin (1). ※ 1

   ⚠ When the pin is removed, links (2) and (3) will drop, so sling the links before removing the pin.

   kg Pin: 37 kg

2. Start engine and retract piston rod fully.

   ⚠ Tie the rod with wire to prevent it from coming out.

   ⚠ After stopping the engine, release the pressure inside the piping.
   For details, see TESTING AND ADJUSTING, Releasing pressure in PPC circuit.

3. Disconnect grease tube (4).

4. Disconnect hose (5).

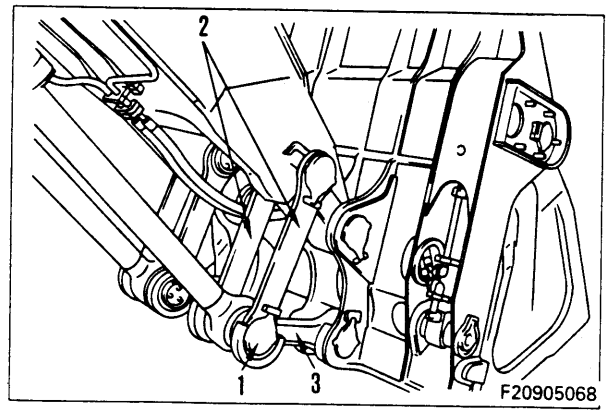
5. Sling piston rod end and bottom end, and remove plate, then using forcing screws (Thread dia. = 16 mm, Pitch = 2.0 mm), pull out pin (6). ※ 2

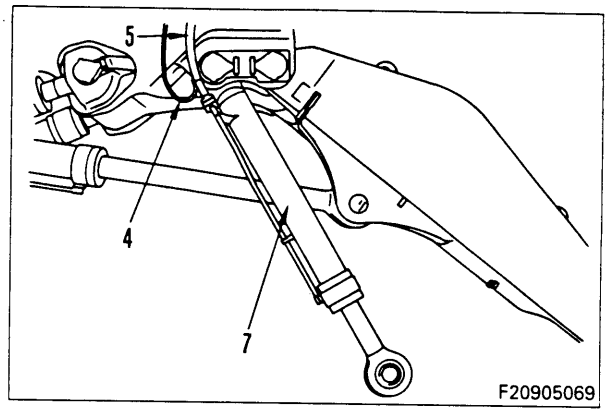
   ★ Pull out the pin to a position where the cylinder bottom can be disconnected.

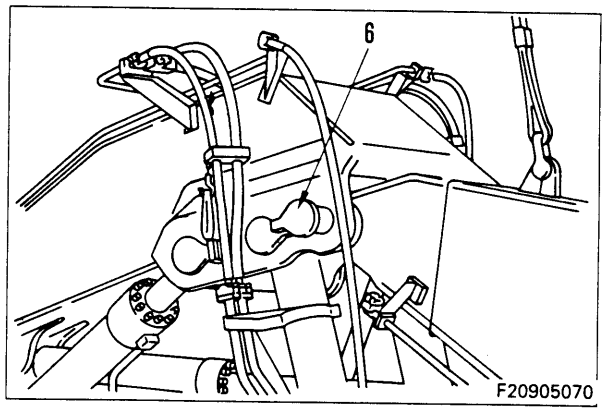
   kg Pin: 35 kg

6. Raise bucket cylinder assembly (7) carefully and remove.

   kg Bucket cylinder assembly: 530 kg







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INSTALLATION OF BUCKET CYLINDER ASSEMBLY

LOADING SHOVEL

- Carry out installation in the reverse order to removal.

※ 1

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ 2

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

★ Adjust with shims so that the clearance at the cylinder bottom end is less than 1 mm.

★ Bleed the air from the work equipment circuit.
For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.

- Refilling with oil

★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.

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ROMOVAL OF BOTTOM DUMP CYLINDER ASSEMBLY

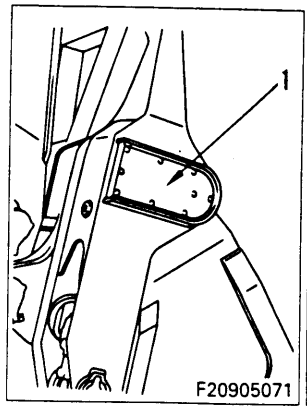
LOADING SHOVEL

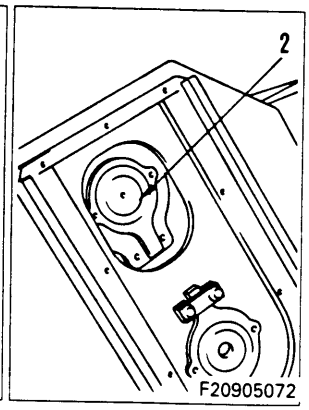
⚠ Set the bottom of the bucket horizontal, and retract the rod to a position where the rod connecting pin of the bottom dump cylinder can be removed. Then fit a block under the bucket, lower the work equipment completely to the ground and stop the engine.

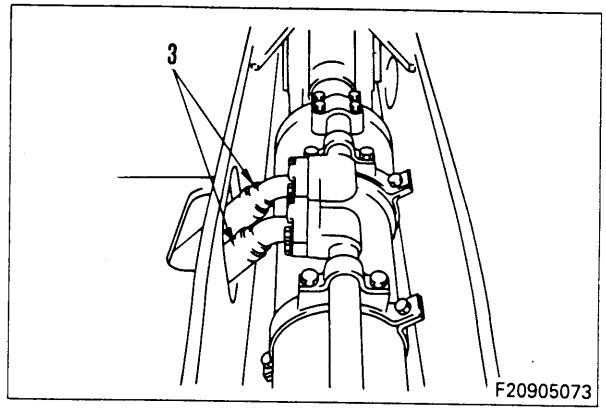
★ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

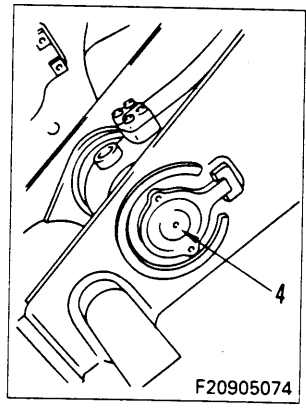
1. Remove cover (1).
2. Sling bottom dump cylinder assembly, and remove lock plate, then using forcing screws (Thread dia. = 16 mm, Pitch = 2.0 mm), pull out pin (2). ※ 1
3. Start engine and retract piston rod fully.
   ⚠ After stopping the engine, release the pressure inside the piping.
   For details, see TESTING AND ADJUSTING, Releasing pressure in PPC circuit.
4. Remove hose (3).
5. Remove 3 mounting bolts, then using forcing screws (Thread dia. = 16 mm, Pitch = 2.0 mm), pull out pin (4). ※ 2
6. Lift off bottom dump cylinder assembly (5).

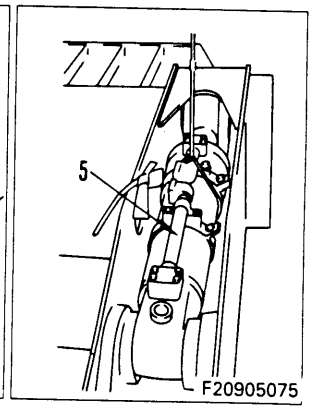
   kg Bottom dump cylinder assembly: 140 kg











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INSTALLATION OF BOTTOM DUMP CYLINDER ASSEMBLY

LOADING SHOVEL

• Carry out installation in the reverse order to removal.

※ 1

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ 2

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

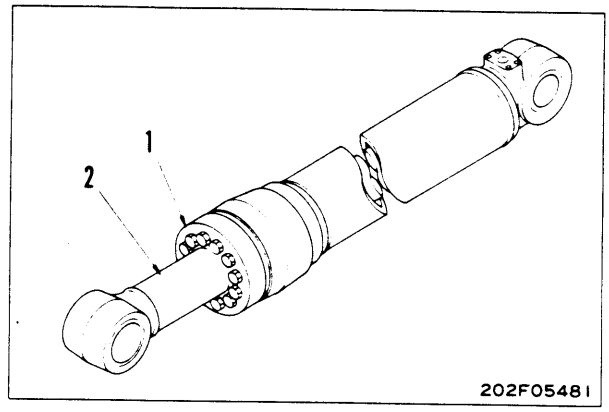
★ Bleed the air from the work equipment circuit.
For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.

• Refilling with oil
  ★ Add oil to the specified level, and run the engine to circulate the oil through the system. Then check the oil level again.

DISASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

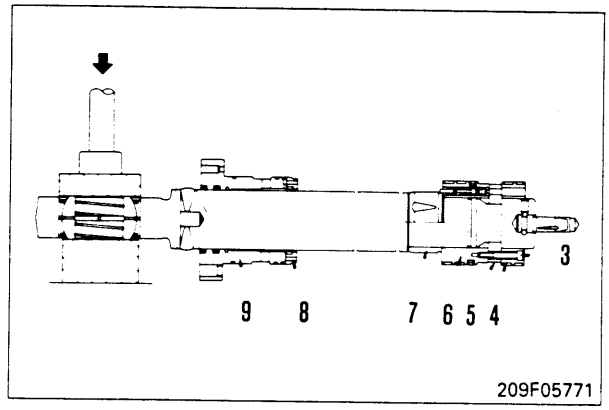
1. Cylinder assembly

1) Set cylinder assembly in press, then remove mounting bolts, and disconnect head assembly (1).
2) Pull out piston rod assembly (2).
   ★ Set a container under the cylinder to catch the oil.



2. Piston rod assembly

1) Set piston rod assembly (2) in press.
2) Remove bolt (3), then remove piston (4) and spacer (5).
3) Remove piston (6) and plunger (7).
4) Remove collar (8) and head assembly (9).



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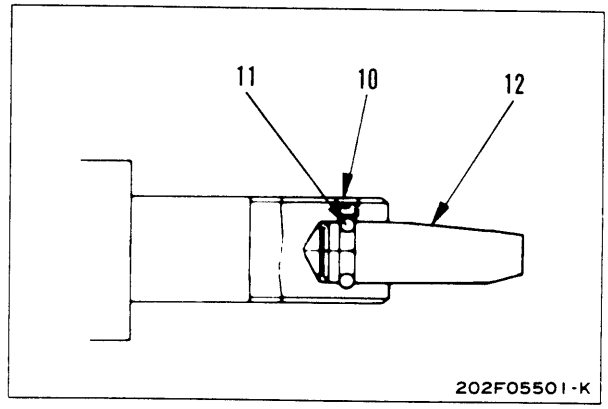
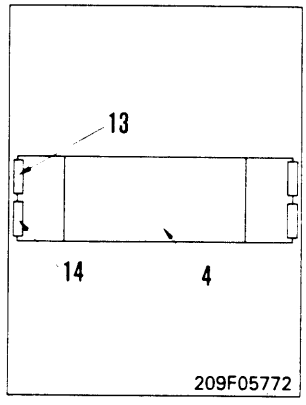
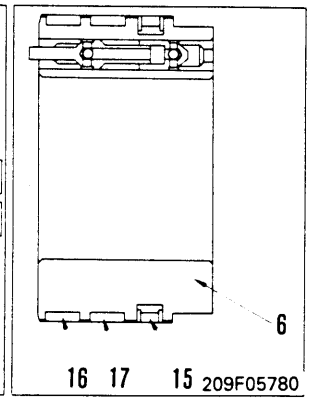
5) Remove cap (10), and pull out 10 balls (11), then remove plunger (12).
   ★ Be careful not to lose balls (11), and keep them in a safe place.
   ★ Arm cylinder only



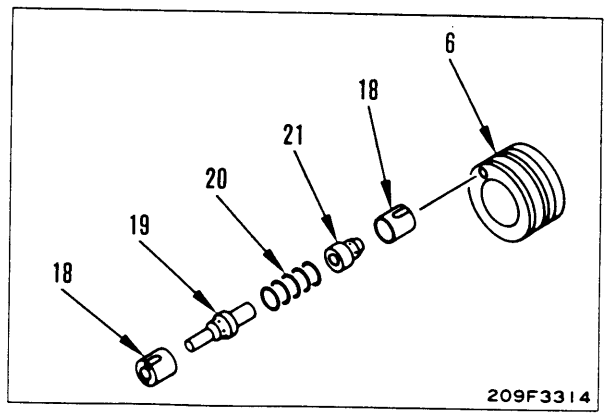
3. Disassembly of piston assembly

1) Disassembly of piston (4)
   Remove wear rings (13) and (14) from piston (4).
2) Disassembly of piston (6)
   i) Remove piston ring (15) and wear rings (16) and (17).



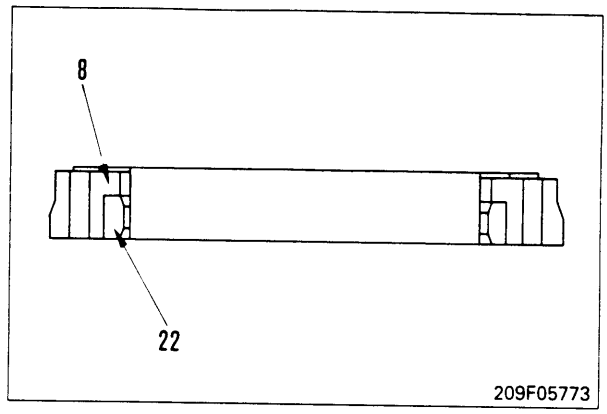


ii) Remove seat (18), valve (19), spring (20), piston valve (21), seat (18) from piston (6).



4. Disassembly of cylinder head assembly

1) Remove ring (22) from collar (8).



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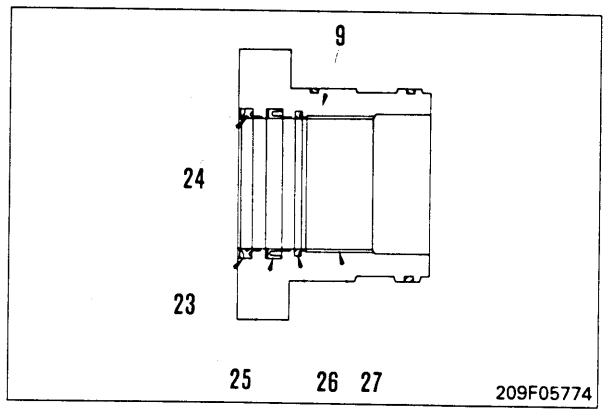
2) Remove snap ring (23) from head assembly (9), then remove dust seal (24).
3) Remove packing (25).
4) Remove rod packing (26).
5) Remove bushing (27).



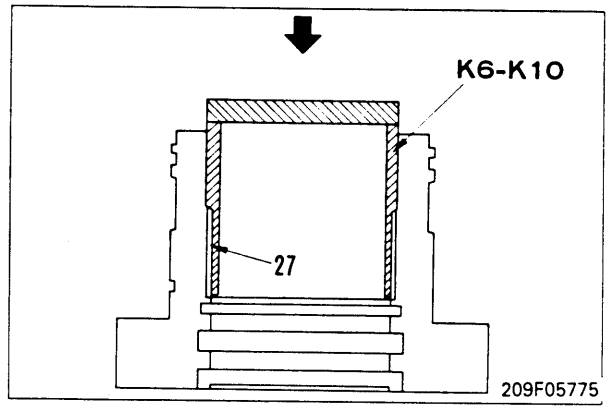
ASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

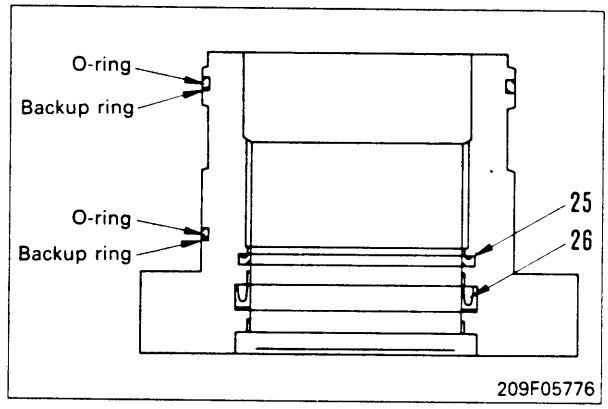
★ Coat the sliding surfaces of all parts with engine oil and be careful not to damage the U-packings, dust seals or O-rings when assembling.

1. Assemble cylinder head assembly as follows.
   1) Using tools **K6 – K10**, press fit bushing (27) to cylinder head.
      ★ Tool

Model		Boom	Arm	Bucket	Bottom dump
BACK HOE	PC650	**K9**	**K9**	**K8**	–
	PC650SE	**K9**	**K9**	**K9**	–
LOADING SHOVEL	PC650	**K7**	**K10**	**K8**	**K6**

      ★ Be careful not to deform the bushing when press fitting.
   2) Assemble rod packing (26).
      ★ Be careful to install the rod packing facing in the correct direction.
   3) Install packing (25).
   4) Assemble O-ring and backup ring.
      ★ Do not try to force the backup ring into position. Warm it in warm water (50 – 60°C) before fitting it.





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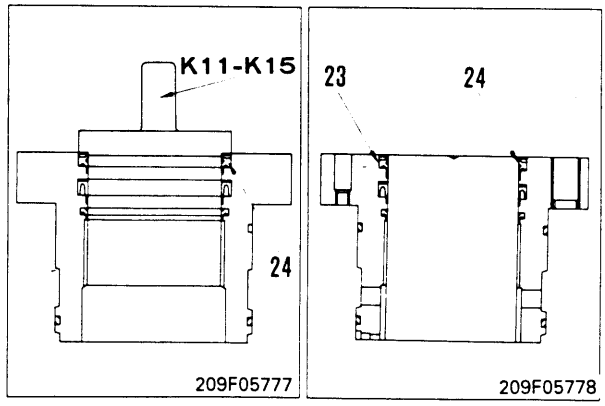
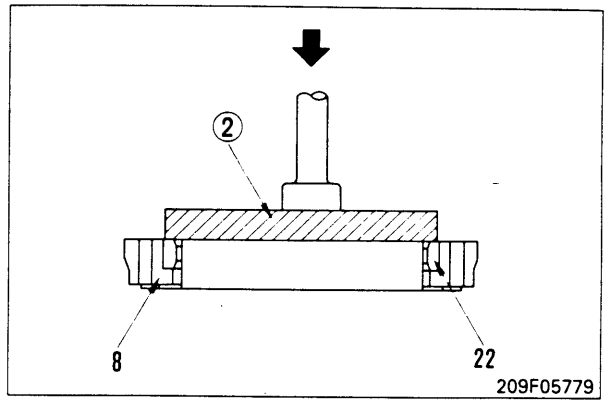
   5) Using tools **K11 – K15**, install dust seal (24) to cylinder head, and secure with snap ring (23).
      ★ Tool

Model		Boom	Arm	Bucket	Bottom dump
BACK HOE	PC650	**K14**	**K14**	**K13**	–
	PC650SE	**K14**	**K14**	**K14**	–
LOADING SHOVEL	PC650	**K12**	**K15**	**K13**	**K11**



2. Using push tool ②, press fit ring (22) to collar (8).



3. Piston assembly

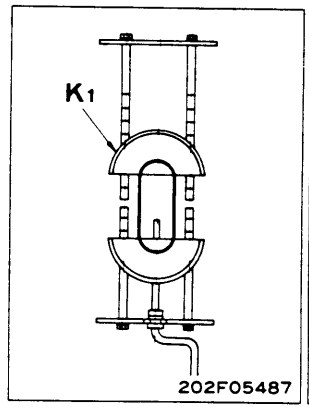
1) Assembly of piston (6)
   i) Using tool **K1**, expand piston ring (15).
      ★ Set the piston ring on the expander and turn the handle 8 – 10 times to expand the ring.
   ii) Remove piston ring from tool **K1**, and assemble to piston (6).
   iii) Set tools **K2 – K5** in position, and compress piston ring.

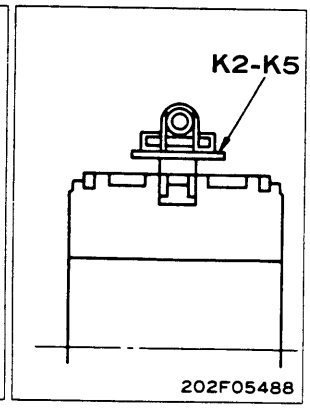
   ★ Tool

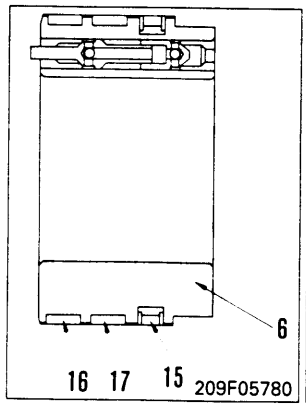
Model		Boom	Arm	Bucket	Bottom dump
BACK HOE	PC650	K4	K4	K3	-
	PC650SE	K4	K4	K4	-
LOADING SHOVEL	PC650	K3	K5	K3	K2

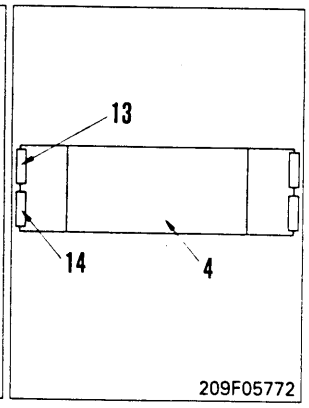
   iv) Assemble wear rings (17) and (16).
      ★ When installing the wear rings, do not put the end gaps of the two wear rings at the same place; assemble so that the end gaps are 180° apart.
   v) Assemble seat (18), piston valve (21), spring (20), valve (19), and seat (18) to piston (6).

2) Assembly of piston (4)
   Assemble wear rings (13) and (14) to piston (4).
   ★ When installing the wear rings, do not put the end gaps of the two wear rings at the same place; assemble so that the end gaps are 180° apart.









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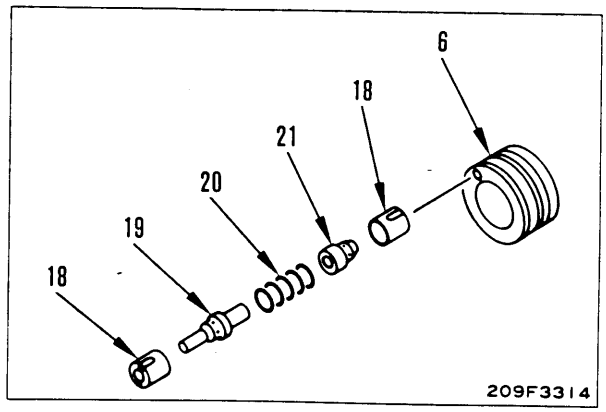
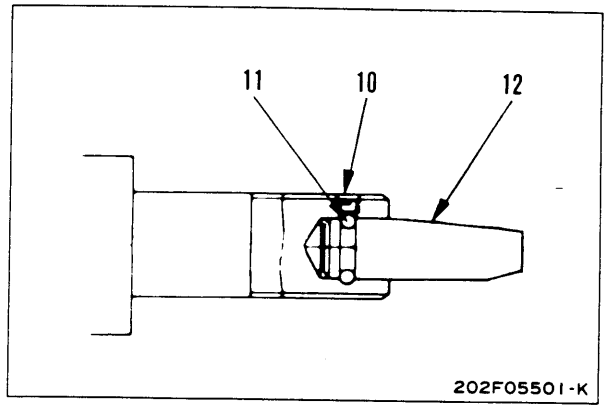
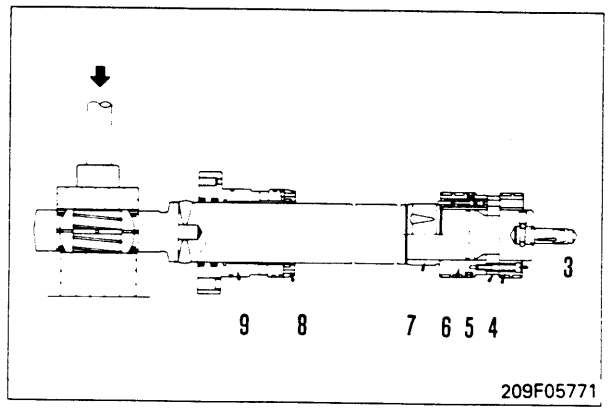


4. Piston rod assembly

1) Set plunger (12) in piston rod, then assemble 10 balls (11), and secure with cap (10).
   ★ Check that there is a certain amount of plug at the tip of the plunger.
   • Arm cylinder only

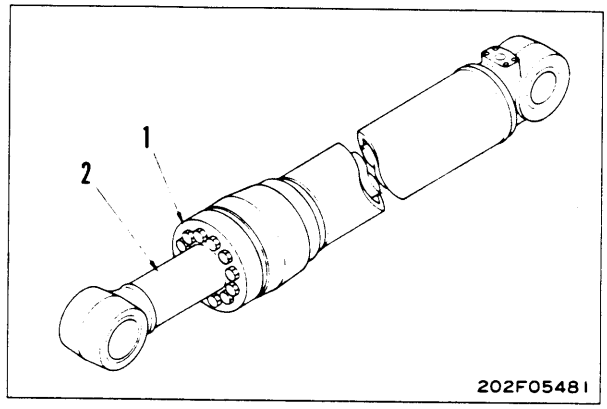


2) Assemble head assembly (9).
3) Assemble collar (8).
4) Assemble plunger (7).
   ★ Assemble so that the stepped portion of the plunger is facing the piston end.
5) Assemble piston (6), spacer (5), and piston (4), and tighten with bolts (3).
   Threaded hole of piston: Hardening agent (Primer T)
   Mounting bolt: Thread tightener (LT-2)
   Mounting bolt: 18 ± 2.0 kgm



5. Cylinder assembly

1) Assemble piston rod assembly (2).
   Seal: Grease (G2-LI)
   ★ Set the end gap of the ring at the horizontal (side) position, align the center of shaft and cylinder tube, then insert.
   ★ After inserting, check that the ring is not broken and has not come out, then push in fully.
2) Tighten head assembly (1) with mounting bolts.



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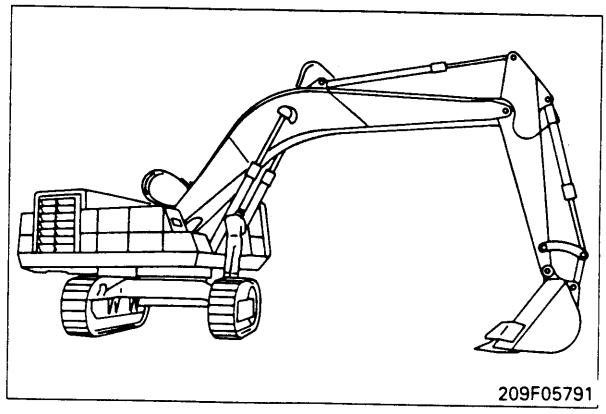
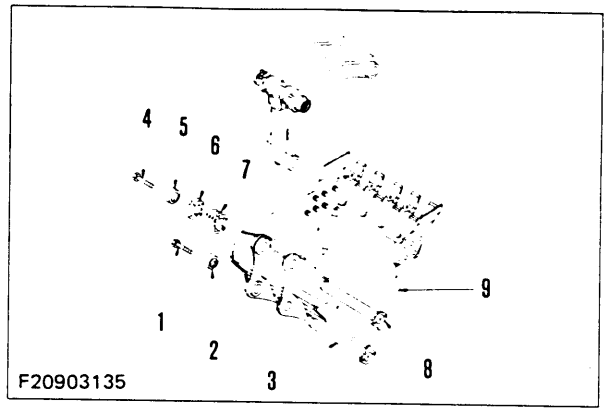
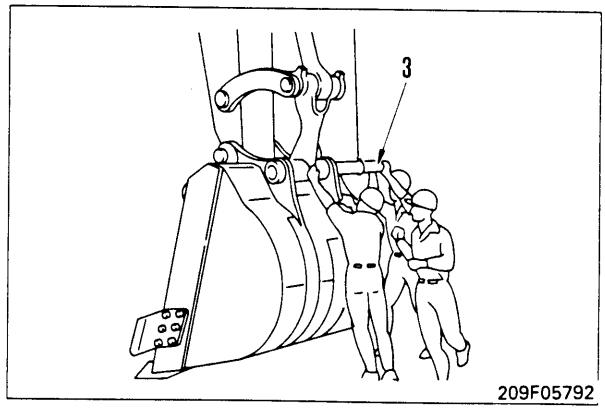
REMOVAL OF BUCKET ASSEMBLY

BACK HOE

1. Lower work equipment completely to ground with back of bucket facing down.
2. Remove 3 pin lock bolts (1), then remove stopper (2).
3. Using forcing screws, pull out link connecting pin (3) about half way, then lift off. ※ 1
   kg Link connecting pin: 55 kg
4. Start engine and retract piston rod fully.
   ⚠ Tie the rod with wire to prevent it from coming out.
5. Remove 3 pin lock bolts (4), then remove stopper (5).
6. Remove cover (6), then remove shim (7). ※ 2
   ★ Check the number and thickness of the shims, and keep in a safe place.
7. Using forcing screws, pull out arm connecting pin (8) about half way, then lift off. ※ 3
   kg Arm connecting pin: 61 kg
8. Start the engine, raise work equipment, disconnect arm from bucket, then lift off bucket assembly (9).
   kg Bucket assembly: 2,200 kg







INSTALLATION OF BUCKET ASSEMBLY

BACK HOE

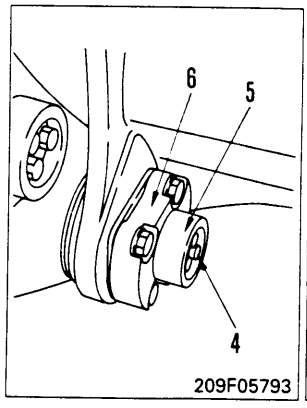
- Carry out installation in the reverse order to removal.

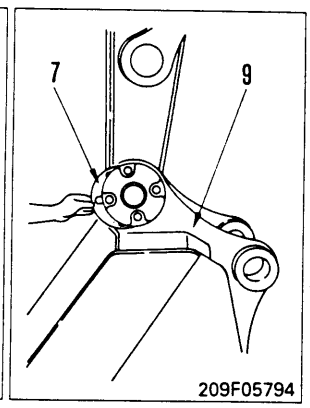
※ 1 ※ 3

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ 2

★ Adjust the bucket clearance
For details, see TESTING AND ADJUSTING, Adjusting bucket clearance.





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REMOVAL OF ARM ASSEMBLY

BACK HOE

★ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

1. Remove bucket assembly.
   For details, see REMOVAL OF BUCKET ASSEMBLY.

2. Retract rod of bucket cylinder fully.

   Release the pressure inside the piping.
   For details, see TESTING AND ADJUSTING, Releasing pressure from PPC circuit.

   ⚠ Secure the bucket cylinder assembly to the arm with wire.

   ⚠ Tie the rod with wire to prevent it from coming out.

3. Disconnect bucket cylinder hose (1).
   ★ When the hose is disconnected, oil may spurt out.

   ⚠ Fit blind plugs in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.

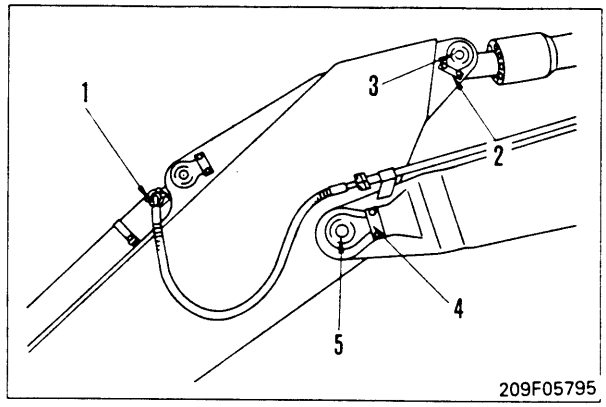
4. Sling arm cylinder assembly, remove plate (2), and using forcing screws, pull out pin (3). ※ 1

5. Sling arm assembly, remove plate (4), and using forcing screws, pull out boom connecting pin (5) about half way, then lift off. ※ 2

   kg Boom connecting pin: 92 kg

6. Disconnect arm assembly (6) from boom mount and remove.

   kg Arm assembly: 2,780 kg
   (including bucket cylinder assembly)



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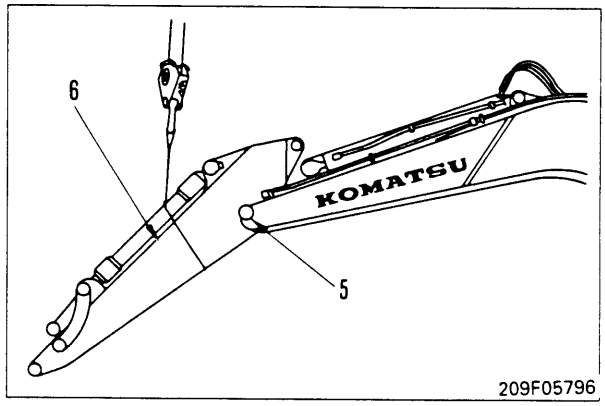

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INSTALLATION OF ARM ASSEMBLY

BACK HOE

- Carry out installation in the reverse order to removal.

※1 ※2

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

★ Bleed the air from the work equipment circuit.
For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder (work equipment circuit).
After completion of the air bleeding operation, add engine oil to the hydraulic tank to the specified level.

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REMOVAL OF BOOM ASSEMBLY

BACK HOE

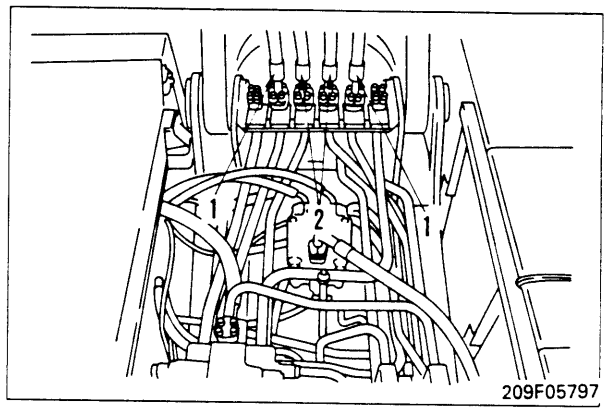
1. Remove arm and bucket assembly.
   For details, see REMOVAL OF ARM AND BUCKET ASSEMBLY.

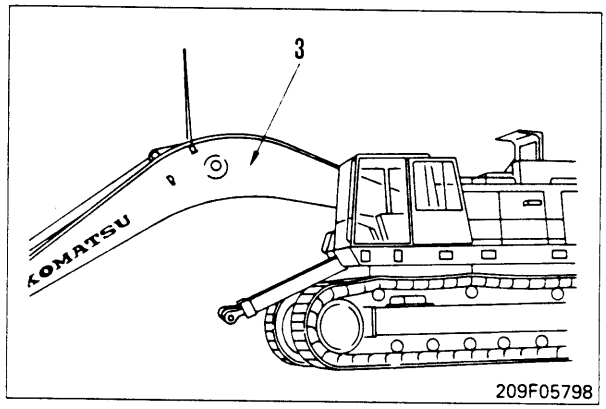
2. Remove boom cylinder assembly from boom.
   For details, see REMOVAL OF BOOM CYLINDER ASSEMBLY.

3. Disconnect head lamp wiring.

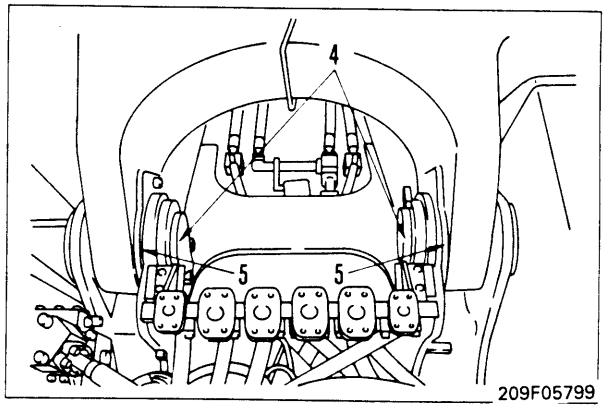
4. Disconnect bucket cylinder hose (1) and arm cylinder hose (2).
   ★ When the hoses are disconnected, oil may spurt out.

5. Sling boom assembly (3).





6. Using forcing screws, pull out left and right boom foot pins (4), then remove boom assembly. ※ 1
   ★ Check the number and thickness of the shims (5), and keep in a safe place.
   kg Boom assembly: 7,000 kg
   (including arm cylinder assembly)



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INSTALLATION OF BOOM ASSEMBLY

BACK HOE

- Carry out installation in the reverse order to removal.

※ 1

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

REMOVAL OF BUCKET AND ARM ASSEMBLY

BACK HOE

⚠ Extend the arm and bucket fully, and lower the work equipment completely to the ground.

★ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

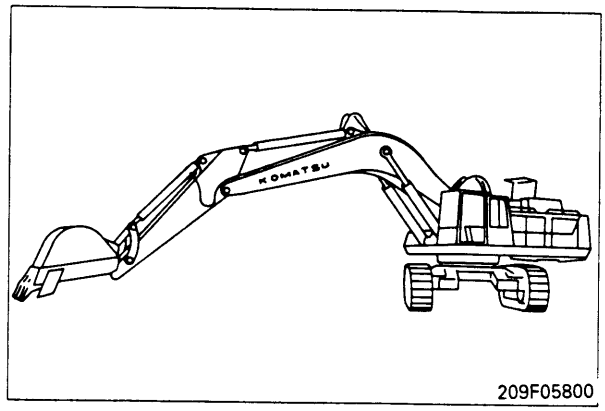
⚠ Release the pressure inside the piping.
For details, see TESTING AND ADJUSTING, Releasing pressure from PPC circuit.

1. Disconnect bucket cylinder hose (1).
   ★ When the hose is disconnected, oil may spurt out.
   ⚠ Tie the rod with wire to prevent it from coming out.

2. Sling arm cylinder assembly, remove plate (2), and using forcing screws, remove rod connecting pin (3). ※ 1

3. Sling bucket arm assembly, remove plate (4), then using forcing screws, pull out boom connecting pin (5) about half way, and lift off. ※ 2
   kg Boom connecting pin: 92 kg

4. Lift off bucket and arm assembly (6).
   kg Bucket and arm assembly: 5,000 kg



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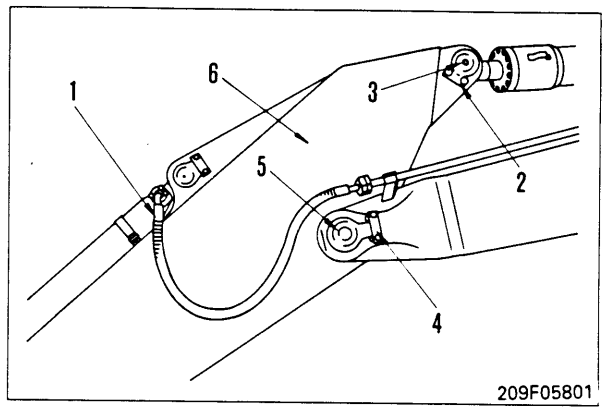

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INSTALLATION OF BUCKET AND ARM ASSEMBLY

BACK HOE

- Carry out installation in the reverse order to removal.

※ 1 ※ 2

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

★ Bleed the air from the work equipment circuit.
For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder (work equipment circuit).
After completion of the air bleeding operation, add engine oil to the hydraulic tank to the specified level.

REMOVAL OF WORK EQUIPMENT ASSEMBLY

BACK HOE

⚠ Lower the work equipment completely to the ground and stop the engine. Operate the control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

★ Release the pressure inside the PPC circuit.
For details, see TESTING AND ADJUSTING, Releasing pressure from PPC circuit.

1. Disconnect boom cylinder assembly.
For details, see REMOVAL OF BOOM CYLINDER ASSEMBLY.

2. Disconnect head lamp wiring.

3. Disconnect bucket cylinder hose (1) and arm cylinder hose (2).
   ★ When the hose is disconnected, oil may spurt out.

   ⚠ Fit blind plugs in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.

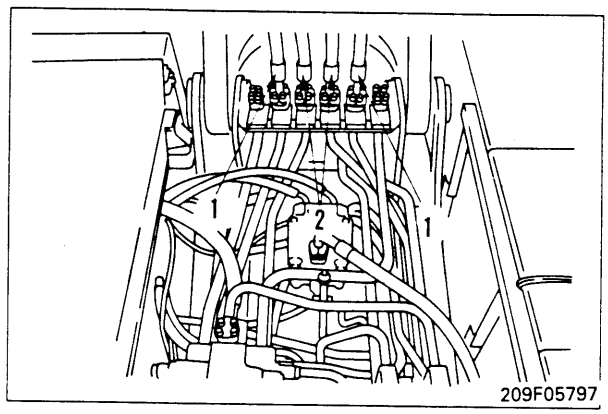
4. Lower the bucket completely to the ground, and sling boom assembly (3).

5. Using tool **M**, pull out left and right boom foot pins (4), and disconnect work equipment assembly from body. ※1
   ★ Check the number and thickness of shims (5), and keep in a safe place.

6. Start engine, drive machine slowly in reverse, then operate crane to lower boom foot to ground.

   ⚠ When driving the machine in reverse, check that the boom foot is completely separated from the chassis before moving the machine.

kg Work equipment assembly: 12,400 kg



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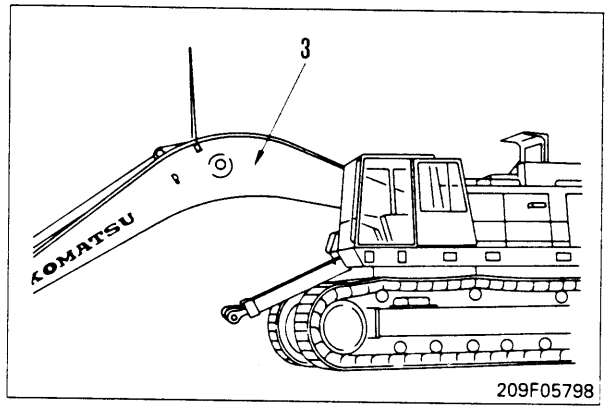

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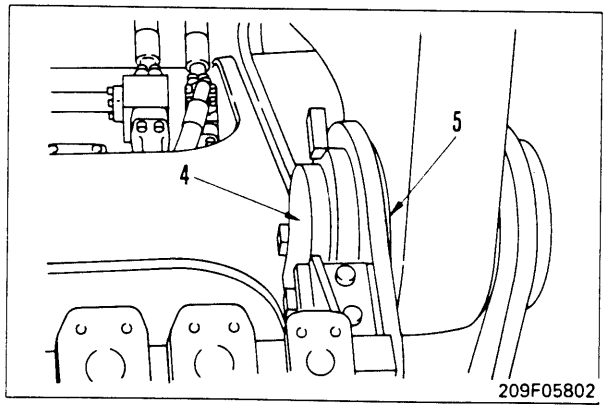

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INSTALLATION OF WORK EQUIPMENT ASSEMBLY

BACK HOE

- Carry out installation in the reverse order to removal.

※1

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

★ Adjust the lifting height of the boom assembly so that the boom foot is at the height of the mount on the chassis.

★ Bleed the air from the work equipment circuit.
For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder (work equipment circuit).
After completion of the air bleeding operation, add engine oil to the hydraulic tank to the specified level.

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REMOVAL OF BUCKET ASSEMBLY

LOADING SHOVEL

⚠ Set the bottom of the bucket horizontal, lower the work equipment completely to the ground and stop the engine. Operate the control levers several times to release the remaining pressure in the hydraulic piping.

⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

★ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

1. Disconnect bottom dump cylinder hose (1).

2. Sling bucket cylinder assembly, and remove 3 mounting bolts, then using forcing screws (Thread dia. = 16 mm, Pitch = 2.0 mm), pull out pin (2).
   ★ Remove the pin on the other side in the same way. ※ 1

   ⚠ When the pin is removed, link (3) will drop, so sling the links before removing the pin.

   kg Pin: 37 kg

   kg Link: 440 kg

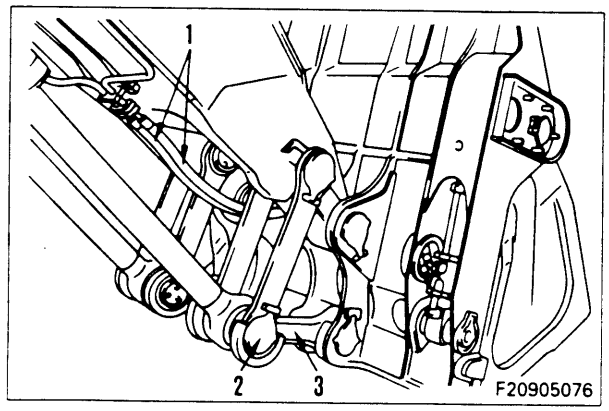
3. Sling bucket assembly, and remove 3 mounting bolts, then using forcing screws (Thread dia. = 16 mm, Pitch = 2.0 mm), pull out pin (4). ※ 2

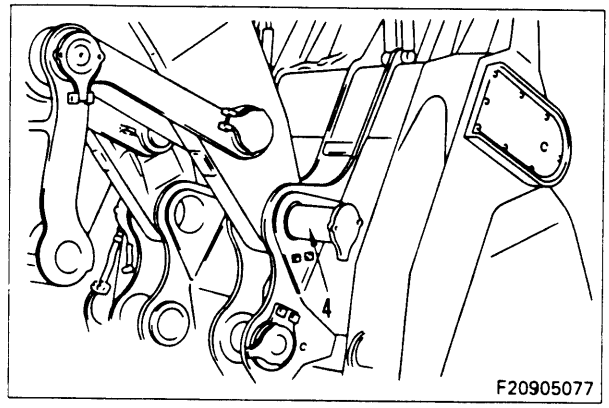
   ★ Remove the pin on the other side in the same way.

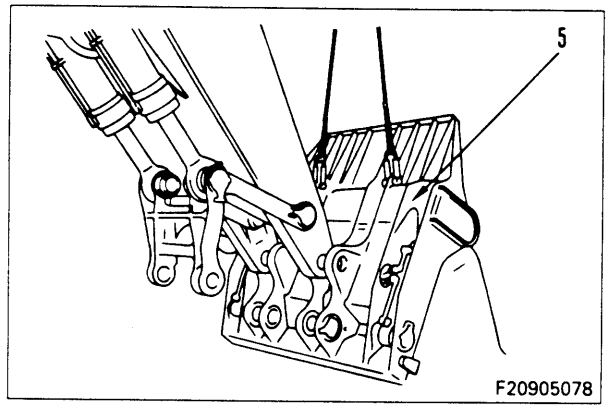
   kg Pin: 52 kg

4. Lift off bucket assembly (5).

   kg Bucket assembly: 5500 kg







INSTALLATION OF BUCKET ASSEMBLY

LOADING SHOVEL

• Carry out installation in the reverse order to removal.
※ 1 ※ 2

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

★ Bleed the air from the work equipment circuit.
For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.
After completion of the air bleeding operation, add engine oil to the hydraulic tank to the specified level.

020905

REMOVAL OF ARM ASSEMBLY

LOADING SHOVEL

1. Remove bucket assembly.
   For details, see REMOVAL OF BUCKET ASSEMBLY.

2. Start engine, and set work equipment so that bucket cylinder is perpendicular.

3. Remove 3 mounting bolts, then using forcing screws (Thread dia. = 16 mm, Pitch = 2.0 mm), pull out pin (1). ※1
   ★ Remove the pin on the other side in the same way, then secure the link to the arm with wire so that it cannot move.

4. Disconnect left and right bottom dump cylinder hoses (2).

5. Remove cover (3), and disconnect wiring (4) of potentiometer.

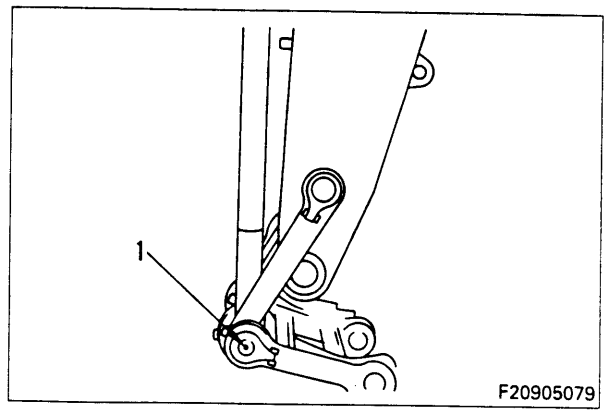
6. Remove 3 mounting bolts (5), then remove potentiometer (6) together with bracket (7).

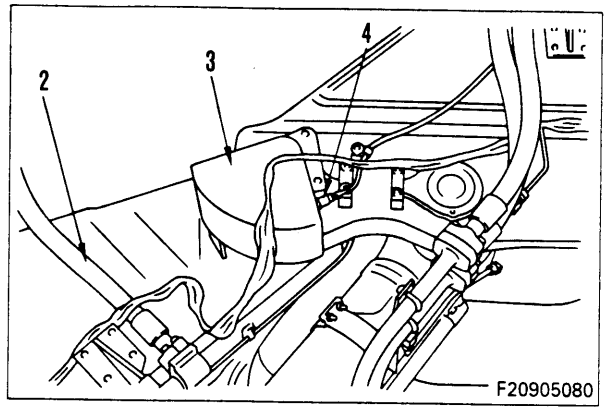
7. Remove arm cylinder from arm.
   For details, see REMOVAL OF ARM CYLINDER ASSEMBLY.
   ★ Secure the arm cylinder assembly to the boom with lever block ①.

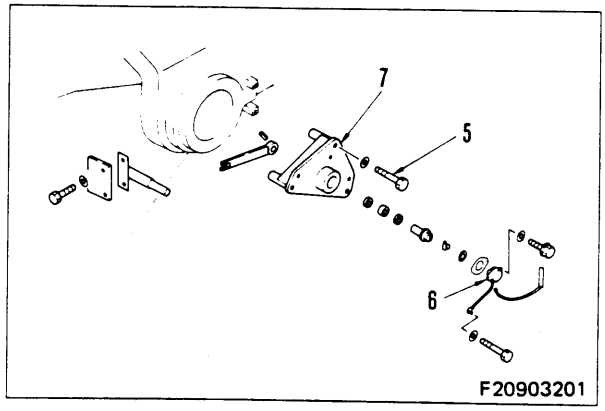
8. Sling arm assembly, and remove 3 mounting bolts, then using forcing screws (Thread dia. = 16 mm, Pitch = 2.0 mm), pull out pin (8). ※2
   ★ Pull out the pin on the other side in the same way to a position where the arm can be disconnected from the boom.

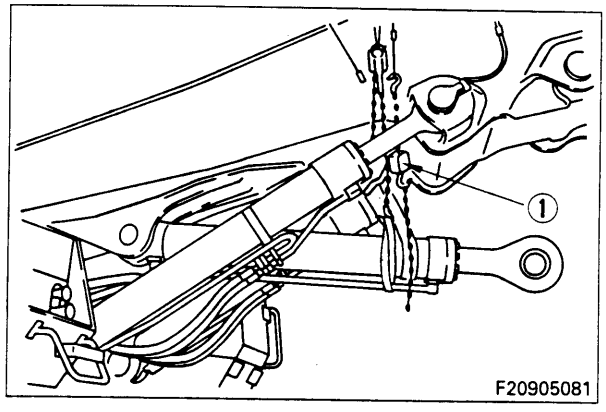
   kg Pin: 45 kg

9. Lift off arm assembly (9).
   kg Arm assembly: 2730 kg









020905

INSTALLATION OF ARM ASSEMBLY

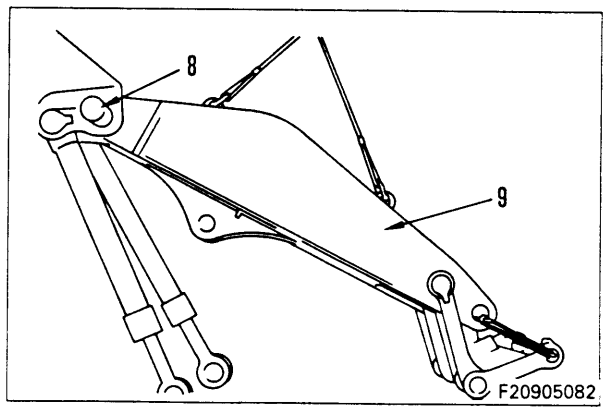
LOADING SHOVEL

- Carry out installation in the reverse order to removal.

※ 1

⚠ When aliging the mounting position of the pin, do not insert your fingers in the pin hole.

★ Bleed the air from the work equipment circuit.
For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder
After completion of the air bleeding operation, add engine oil to the hydraulic tank to the specified level.



020905

REMOVAL OF BOOM ASSEMBLY

LOADING SHOVEL

1. Remove arm assembly.
   For details, see REMOVAL OF ARM ASSEMBLY.

2. Sling bucket cylinder assembly (1), remove plate, then pull out pin (2), and remove bucket cylinder assembly.
   kg Pin: 35 kg ※1
   kg Bucket cylinder assembly: 530 kg
   ★ Remove the bucket cylinder on the other side in the same way.

3. Sling boom, set stand ① at tip of boom to support boom.

4. Remove boom cylinder from boom.
   For details, see REMOVAL OF BOOM CYLINDER ASSEMBLY.
   ★ Remove the boom cylinder on the other side from the boom in the same way.

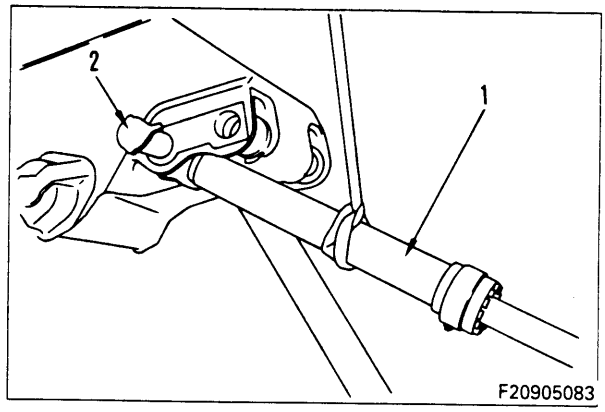
5. Disconnect bottom dump cylinder hose (3), bucket cylinder hose (4), and arm cylinder hose (5).
   ★ When the hoses are disconnected, oil may spurt out, so loosen the hose flanges slowly before disconnecting.

6. Disconnect head lamp wiring.

7. Remove cover (6), and disconnect wiring (7) of potentiometer and cable (8).

8. Remove 3 mounting bolts (9), then remove potentiometer assembly (10) together with bracket (11).

9. Using forcing screws (Thread dia. = 16 mm, Pitch = 2.0 mm), pull out left and right boom foot pins (12), then lift off boom (13). ※2
   ★ Check the number and thickness of the shims, and keep in a safe place.
   kg Boom: 4000 kg



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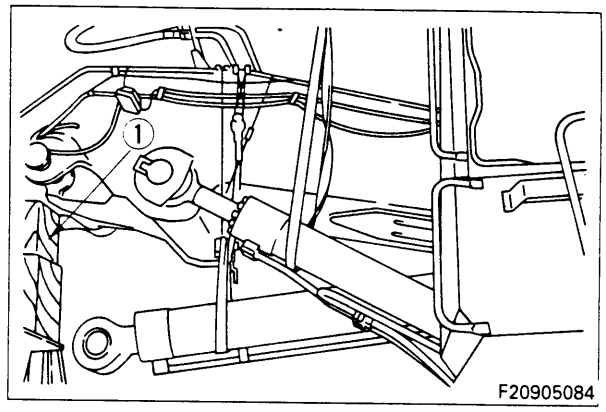

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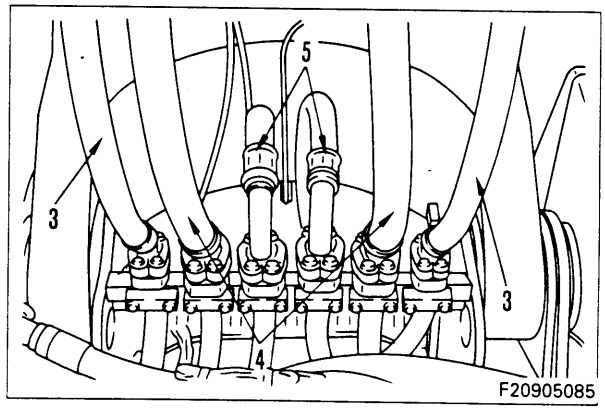

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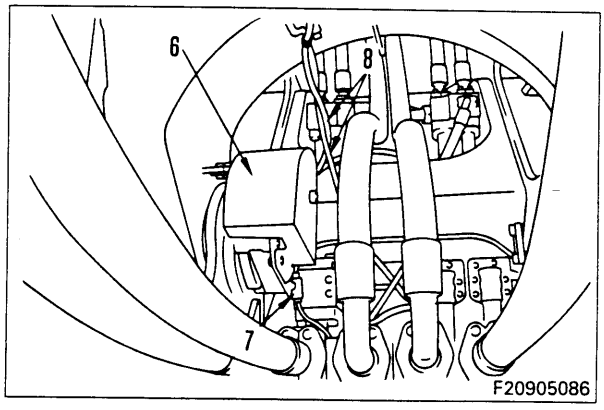

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020905

INSTALLATION OF BOOM ASSEMBLY

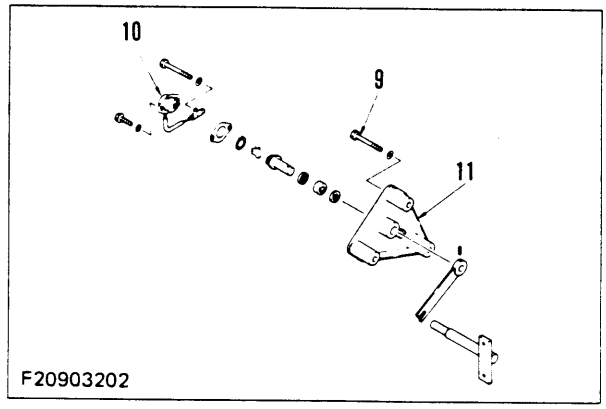
LOADING SHOVEL

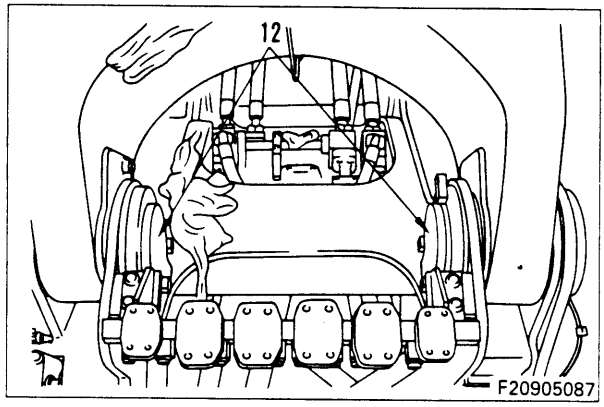
- Carry out installation in the reverse order to removal.

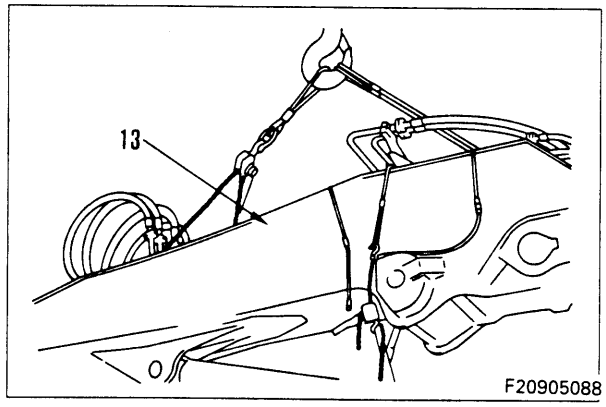
※1 ※2

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

★ Bleed the air from the work equipment circuit.
For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.
After completion of the air bleeding operation, add engine oil to the hydraulic tank to the specified level.







020905

REMOVAL OF WORK EQUIPMENT ASSEMBLY

LOADING SHOVEL

⚠ Retract the boom cylinder fully, extend the arm cylinder, set the bottom of the bucket horizontal, then lower the work equipment completely to the ground and stop the engine. Operate the control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

★ Release the pressure inside PPC circuit.
For details, see TESTING AND ADJUSTING, Releasing pressure in PPC circuit.

1. Disconnect boom cylinder from boom.
For details, see REMOVAL OF BOOM CYLINDER ASSEMBLY.

2. Disconnect bottom dump cylinder hose (1), bucket cylinder hose (2), and arm cylinder hose (3).
   ★ When the hoses are disconnected, oil may spurt out, so loosen the hose flanges slowly before disconnecting.

   ⚠ To prevent oil from spurting out when the engine is started, fit blind plugs securely in the piping at the chassis end.

3. Disconnect head lamp wiring.

4. Remove potentiometer assembly.
For details, see REMOVAL OF BOOM ASSEMBLY.

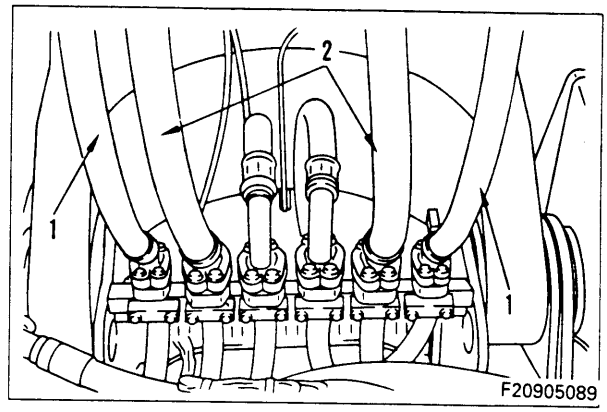
5. Set bottom of bucket horizontal, lower work equipment completely to ground, then sling boom assembly (4).

6. Using forcing screws (Thread dia. = 16 mm, Pitch = 2.0 mm), pull out left and right boom foot pins (5), then disconnect work equipment assembly from chassis end. ※ 1
   ★ Check the number and thickness of the shims, and keep in a safe place.

7. Start engine, drive machine slowly in reverse, and operate crane to lower boom foot to ground.

   ⚠ Before driving the machine in reverse, check that the boom foot is completely separated from the machine body.

kg Work equipment assembly: 15,000 kg



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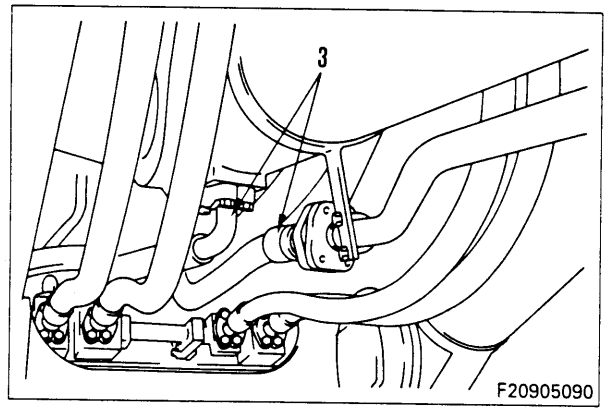

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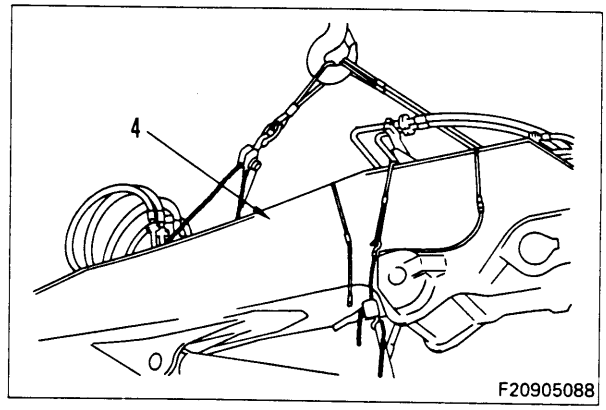

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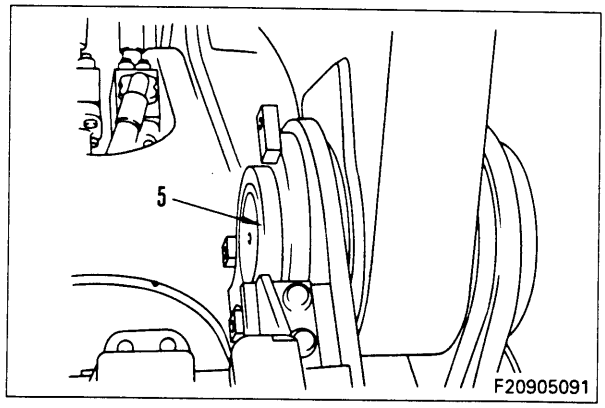

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020905

INSTALLATION OF WORK EQUIPMENT

LOADING SHOVEL

- Carry out installation in the reverse order to removal.

※ 1

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

★ Adjust the lifting height of the boom assembly so that the boom foot is at the height of the mount on the chassis.

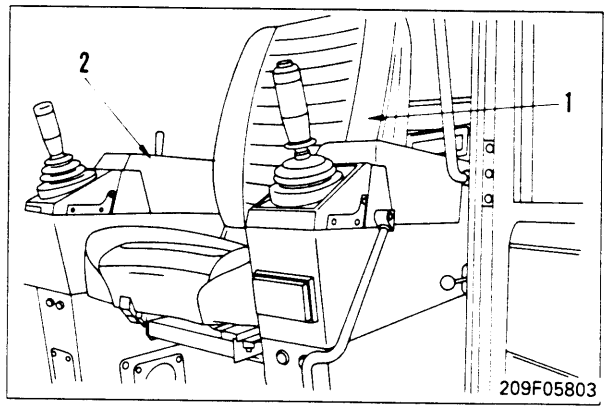
★ Bleed the air from the work equipment circuit.
For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.
After completion of the air bleeding operation, add engine oil to the hydraulic tank to the specified level.

020905

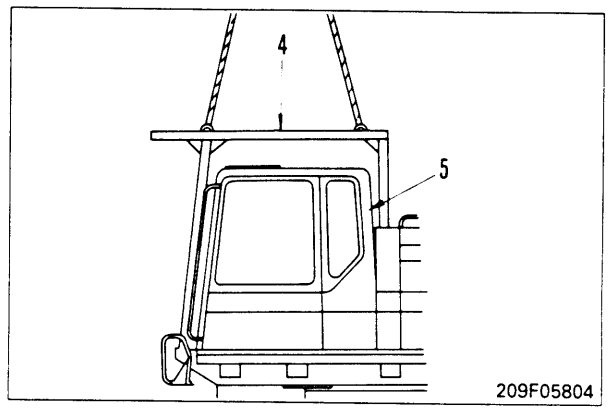
REMOVAL OF OPERATOR'S CAB ASSEMBLY

⚠ Lower the work equipment completely to the ground.

1. Remove seat (1).
2. Remove mounting bolts of right stand (2), and move it to inside.
3. Disconnect wiring of head lamp.



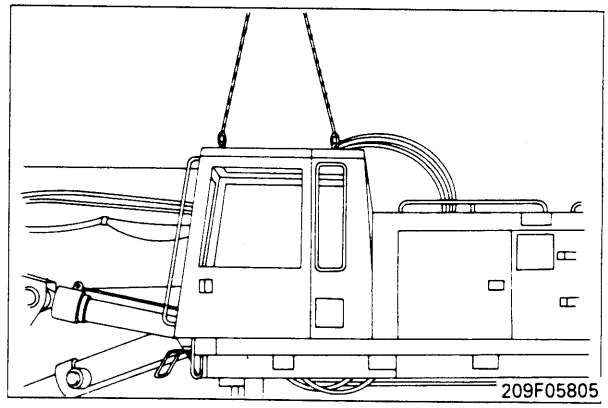
4. Sling guard (4), and remove mounting bolts, then lift off.
   kg Guard: 360 kg
5. Sling operator's cab assembly (5), and remove mounting bolt, then lift off.
   kg Operator's cab assembly: 240 kg



020905

INSTALLATION OF OPERATOR'S CAB ASSEMBLY

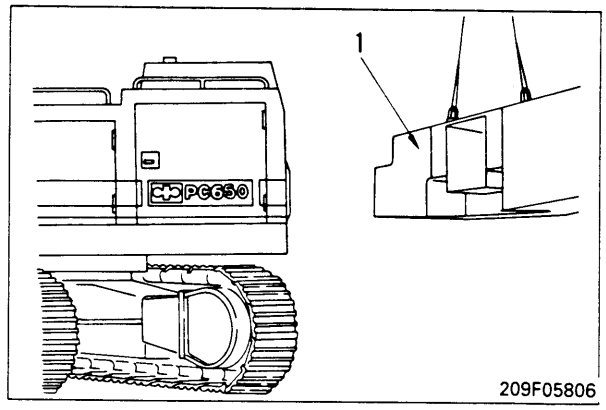
- Carry out installation in the reverse order to removal.



REMOVE OF COUNTERWEIGHT ASSEMBLY

1. Sling counterweight.
2. Remove mounting bolts, then remove counterweight (1). [※ 1]

   kg Counterweight: 8,650 kg



INSTALLATION OF COUNTERWEIGHT ASSEMBLY

- Carry out installation in the reverse order to removal.

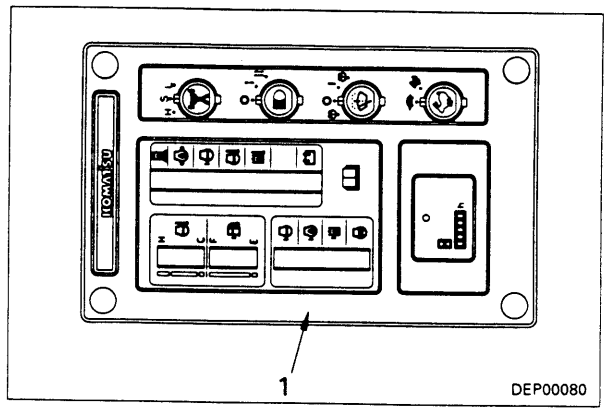
[※ 1]

kgm Mounting bolt: 390 ± 40 kgm

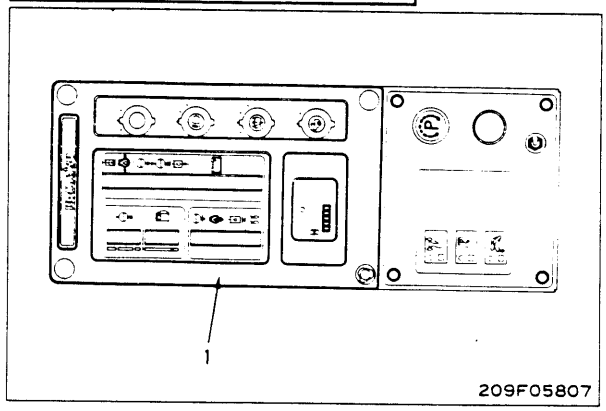
020905

REMOVAL OF MONITOR PANEL ASSEMBLY

1. Remove 4 mounting bolts, then remove monitor panel assembly (1) from stand.
2. Disconnect 8 connectors (2), then remove monitor panel assembly (1).



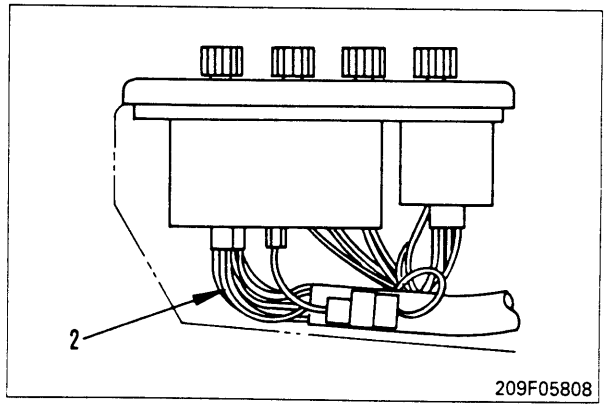
REGULATION OF EC INCLUSION



020905

INSTALLATION OF MONITOR PANEL ASSEMBLY

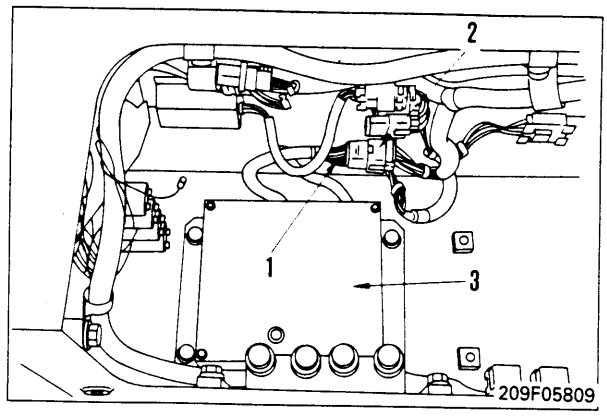
- Carry out installation in the reverse order to removal.



REMOVAL OF AUTO-DECELERATION • OLSS CONTROLLER

★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

1. Disconnect connecters (1) and (2).
2. Remove controller assembly (3).



INSTALLATION OF AUTO-DECELERATION • OLSS CONTROLLER

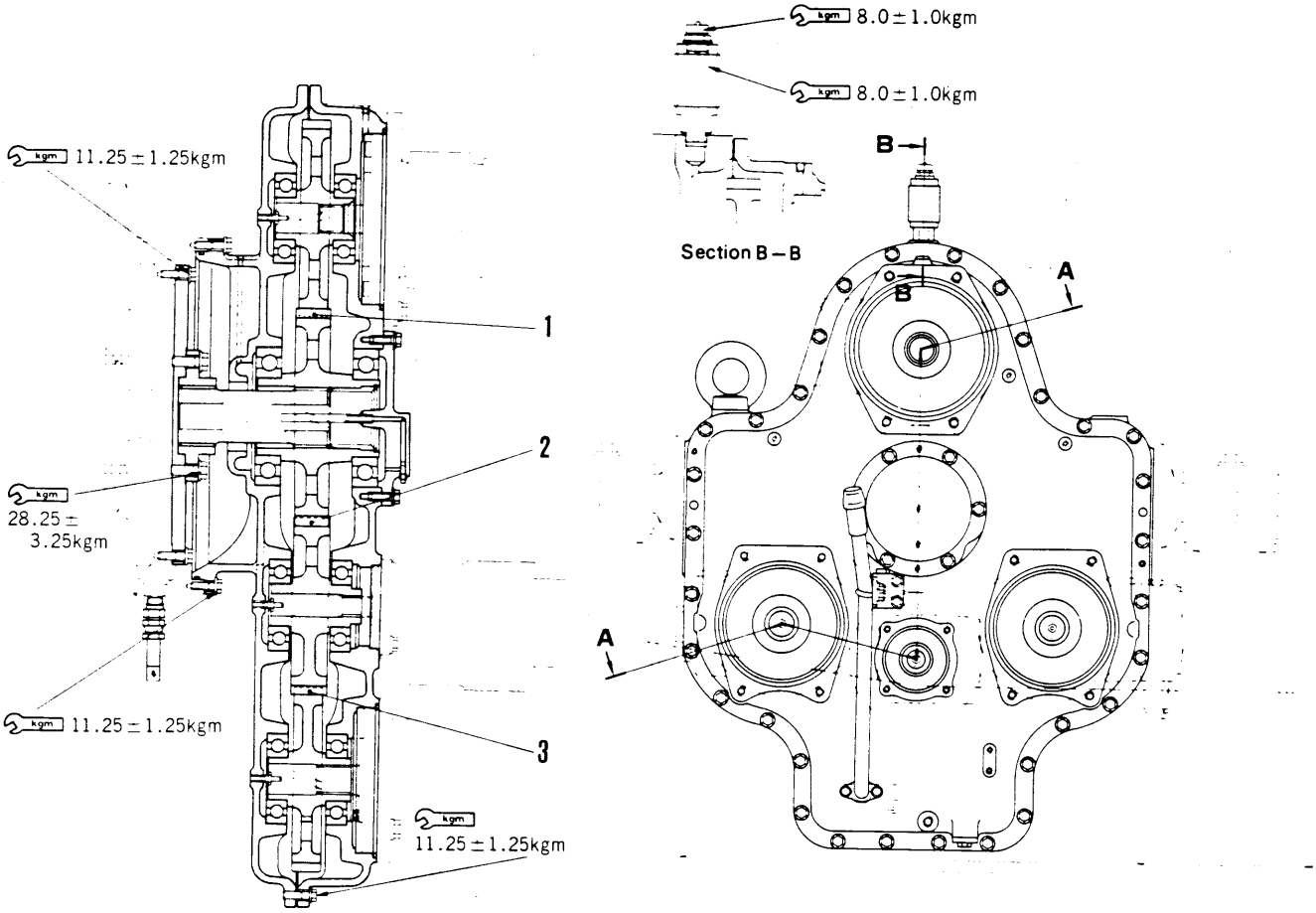
★ **FOR MACHINE EQUIPPED WITH 3-STAGE MODE SELECTOR OLSS AND AUTO-DECELERATION**

- Carry out installation in the reverse order to removal.

020905

40 MAINTENANCE STANDARD

020905



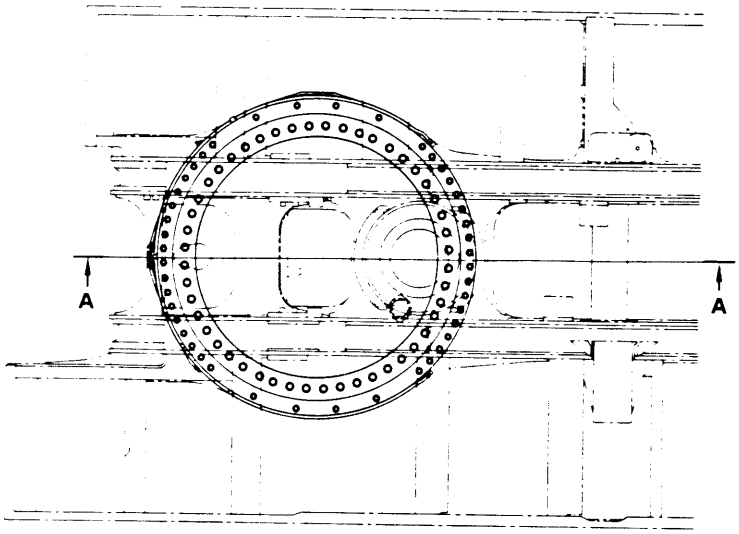
209F05129

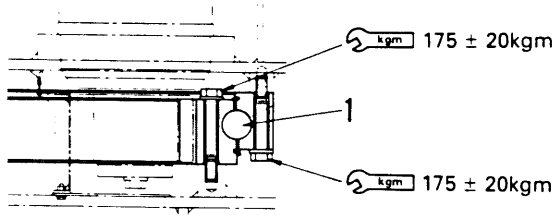
020905

Unit: mm

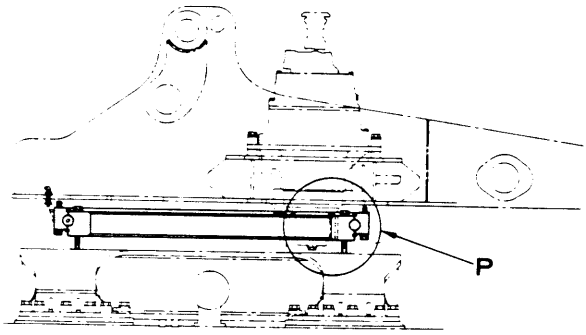
No.	Check item	Criteria		Remedy
1	Backlash between drive gear and driven gear (HPV160 pump shaft)	Standard clearance	Clerarance limit	Adjust
		0.23 – 0.74	–	
2	Backlash between drive gear and driven gear (HPV90 + 90 pump shaft)	0.23 – 0.74	–	
3	Backlash between driven gear (SAL63 + 8 pump shaft) and driven gear (HPV90 + 90 pump shaft)	0.23 – 0.74	–	

SWING CIRCLE





Detail P



Section A – A

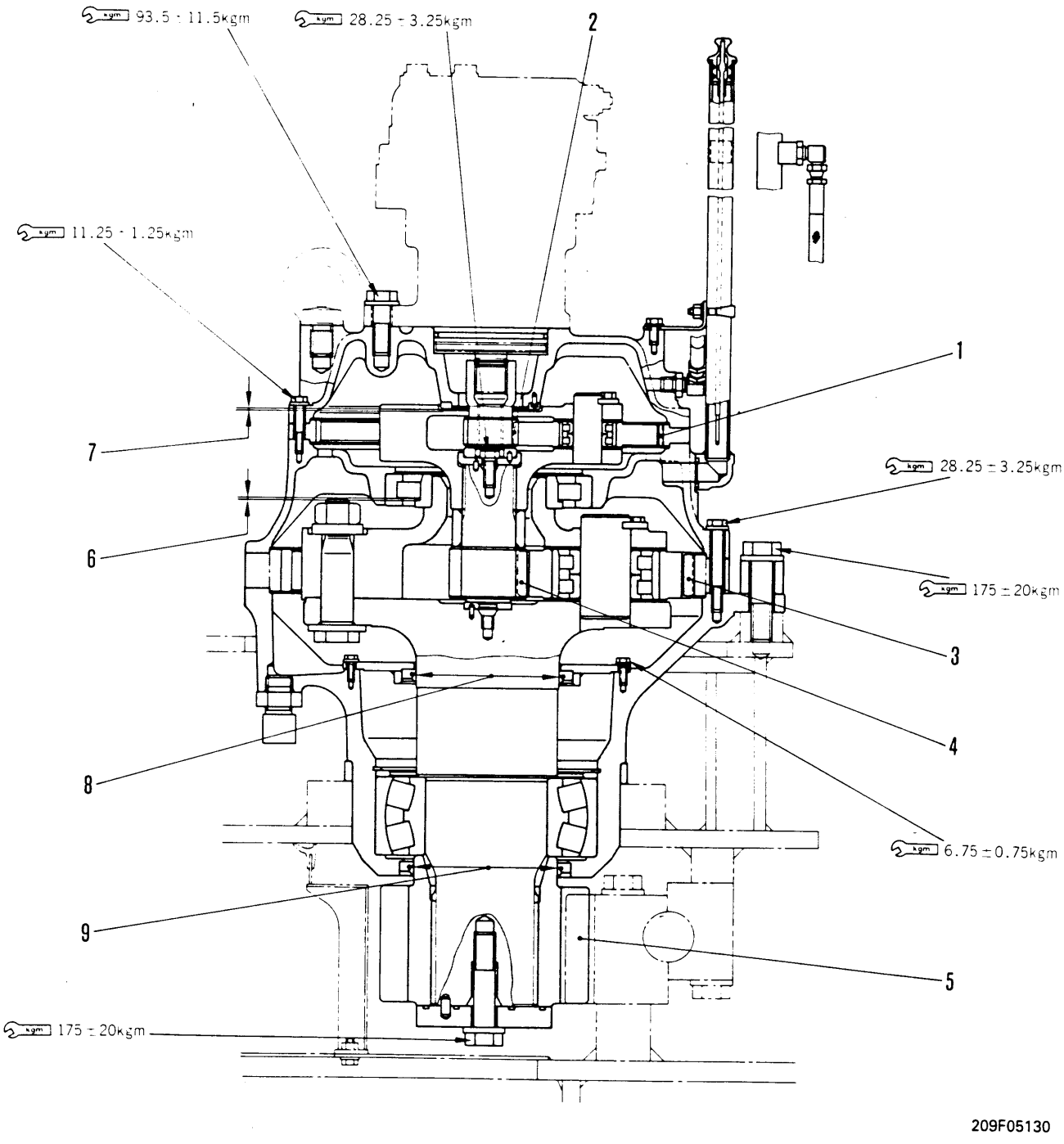
209F3160

020905

Unit: mm

No.	Check item	Criteria		Remedy
1	Axial clearance of bearing	Standard clearance	Clerarance limit	Replace
		0.5 - 1.8	3.6	

SWING MACHINERY



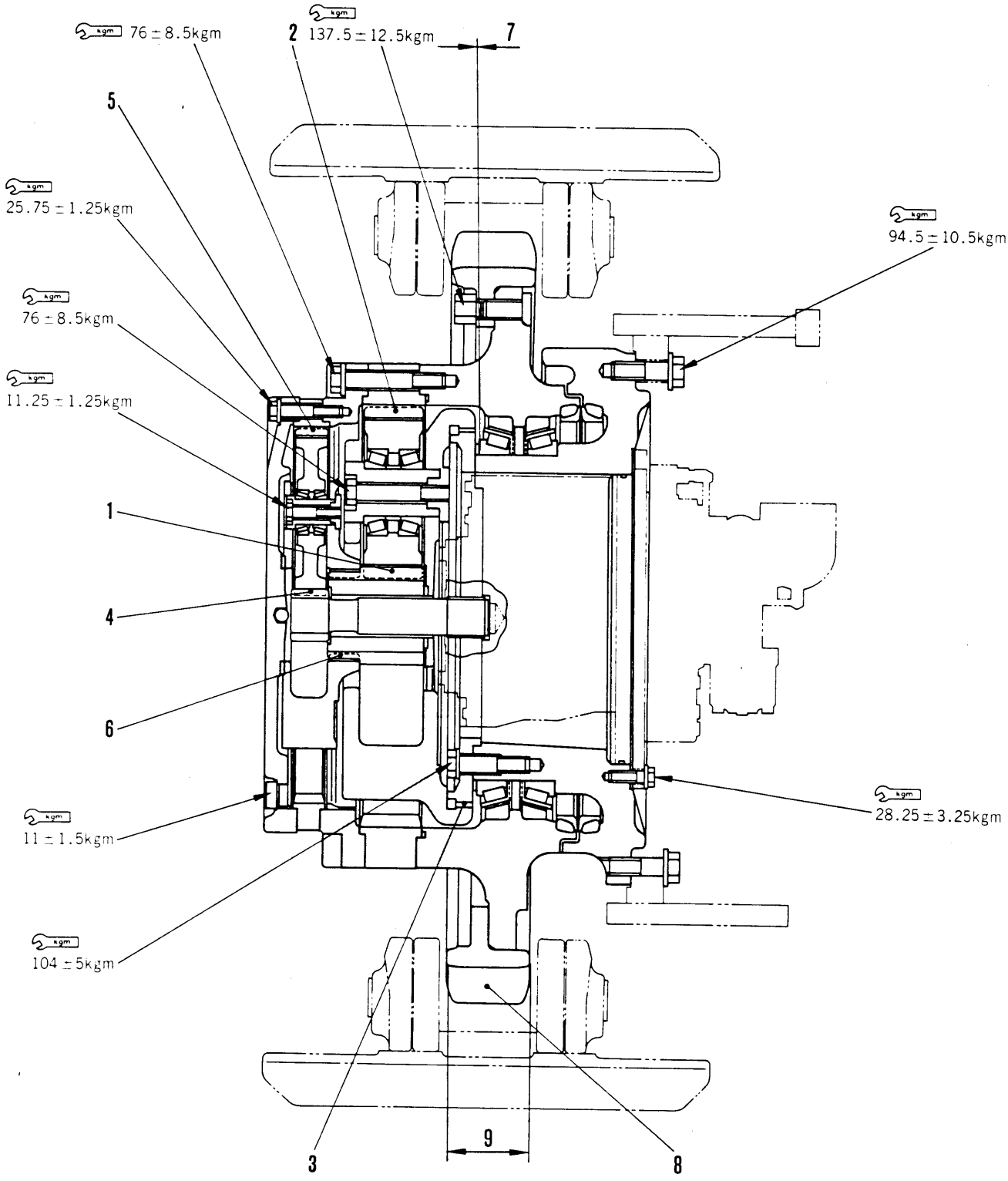
020905

020905

Unit: mm

No.	Check item	Criteria			Remedy
1	Backlash between No. 1 planetary gear and No. 1 ring gear	Standard clearance	Clearance limit		Replace
		0.19 – 0.56	–		
2	Backlash between No. 1 sun gear and No. 1 planetary gear	0.16 – 0.38	–		
3	Backlash between No. 2 planetary gear and No. 2 ring gear	0.24 – 0.70	–		
4	Backlash between No. 2 sun gear and No. 2 planetary gear	021 – 0.49	–		
5	Backlash between swing pinion and swing cricle	0.40 – 1.71	–		
6	End play of output shaft bearing	1.0 – 1.7	–		Adjust
7	End play of output washer lower part	1.0 – 1.8	–		
8	Wear of output shaft oil seal contact surface	Standard size	Tolerance	Repair limit	Appliy hard chrome plating, or replace
		200	0 –0.115	199.75	
9	Wear of swing pinion oil seal contact surface	200	0 –0.115	199.75	

FINAL DRIVE



020905

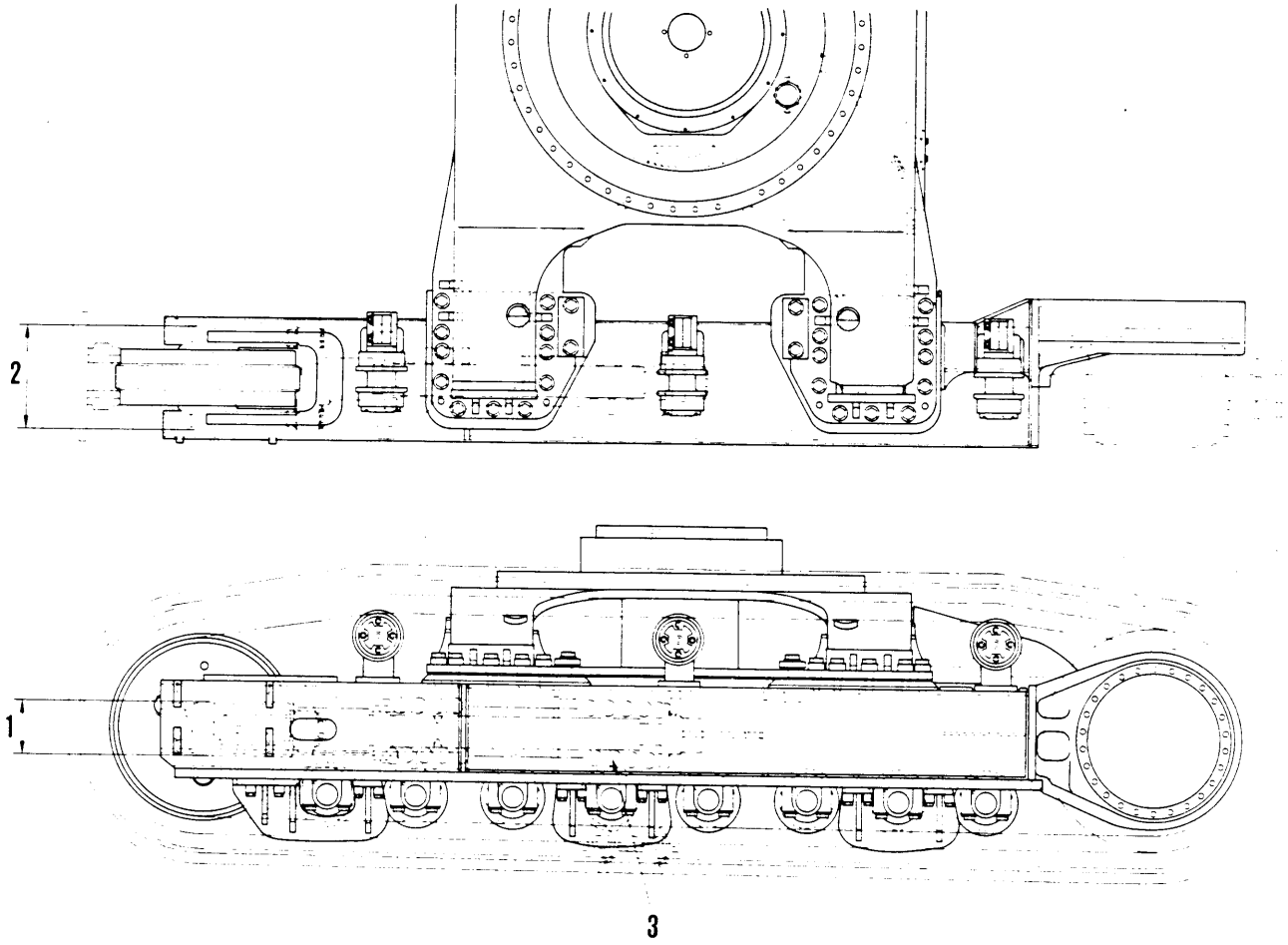
209F05131

020905

Unit: mm

No.	Check item	Criteria		Remedy
1	Backlash between No. 1 sun gear and No. 1 planetary gear	Standard clearance	Clearance limit	Replace
		0.23 – 0.68	–	
2	Backlash between No. 1 planetary gear and No. 1 ring gear	0.18 – 1.56	–	
3	Backlash between No. 1 planetary carrier and retainer	0.24 – 0.49	–	
4	Backlash between No. 2 sun gear and No. 2 planetery gear	0.20– 0.59	–	
5	Backlash between No. 2 planetary gear and No. 2 ring gear	0.21 – 0.63	–	
6	Backlash between No. 2 planetary carrier and No. 1 sun gear	0.21 – 0.57	–	
7	End play of sprocket shaft	–0.05 – –0.25 (preload)	–	
8	Amount of wear on sprocket tooth	Repair limit: 6		Rebuild or replace
9	Width of sprocket tooth	Standard size	Repair limit	
		114	108	

TRACK FRAME AND RECOIL SPRING



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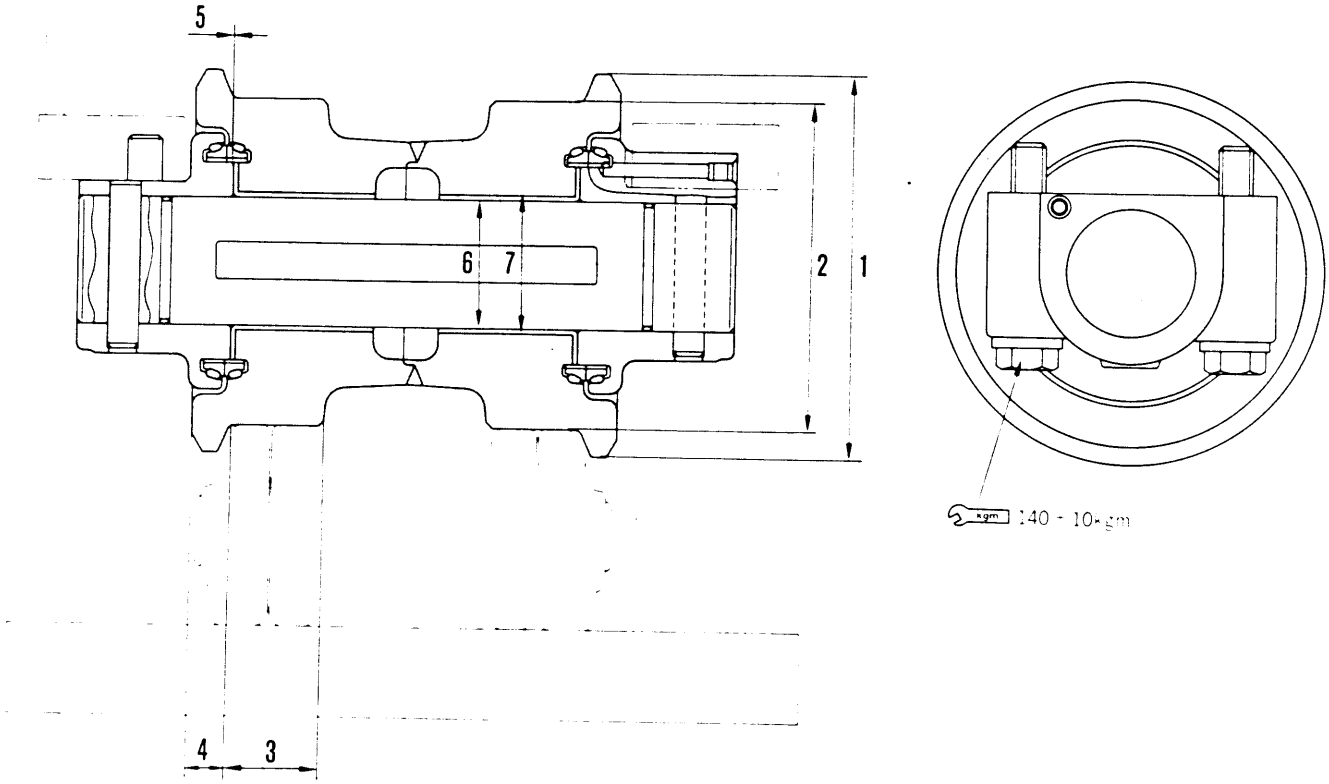
020905

Unit: mm

No.	Check item		Criteria			Remedy
1	Vertical width of idler guide	Track frame	Standard size	Tolerance	Repair limit	Rebuild
			185	185^{+3}_{-2}	190	
		Idler support	180	180 ± 0.5	175	Replace
2	Horizontal width of idler guide	Track frame	345	345^{+3}_{-2}	355	Rebuild
		Idler support	340	-	332	Replace

No.	Check item	Standard size			Rapair limit		Remedy
		Free length x O.D.	Installation length	Installation load	Free length	Installation load	
3	Recoil spring	1,553 x 310	1,290	49,986 kg	-	40,000 kg	Replace

TRACK ROLLER



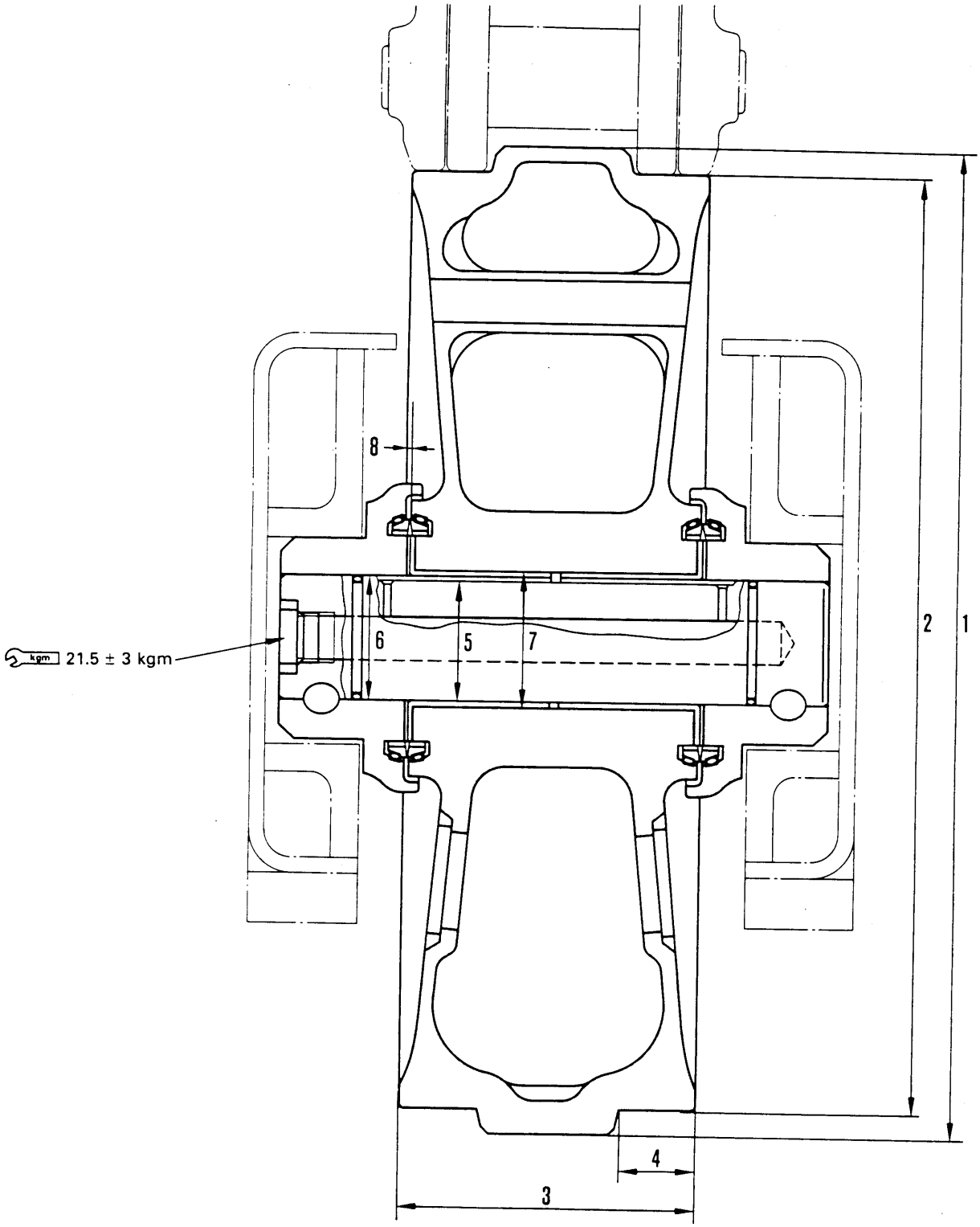
209F05133

020905

Unit: mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		298		–		
2	Outside diameter of tread	255		243		
3	Width of tread	72		81		
4	Width of flange	29		20		
5	Side clearance of roller (both side)	Standard clearance		Clearance limit		Replace
		0.42 – 0.99		1.5		
6	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole		
		100	–0.140 –0.207	+0.375 +0.235	0.375 – 0.582	1.5	
7	Interference between roller and bushing	Standard size	Tolerance		Standard interference	Interference limit	
			Shaft	Hole			
		107.5	+0.087 +0.037	+0.026 –0.015	0.017 – 0.102	–	

IDLER



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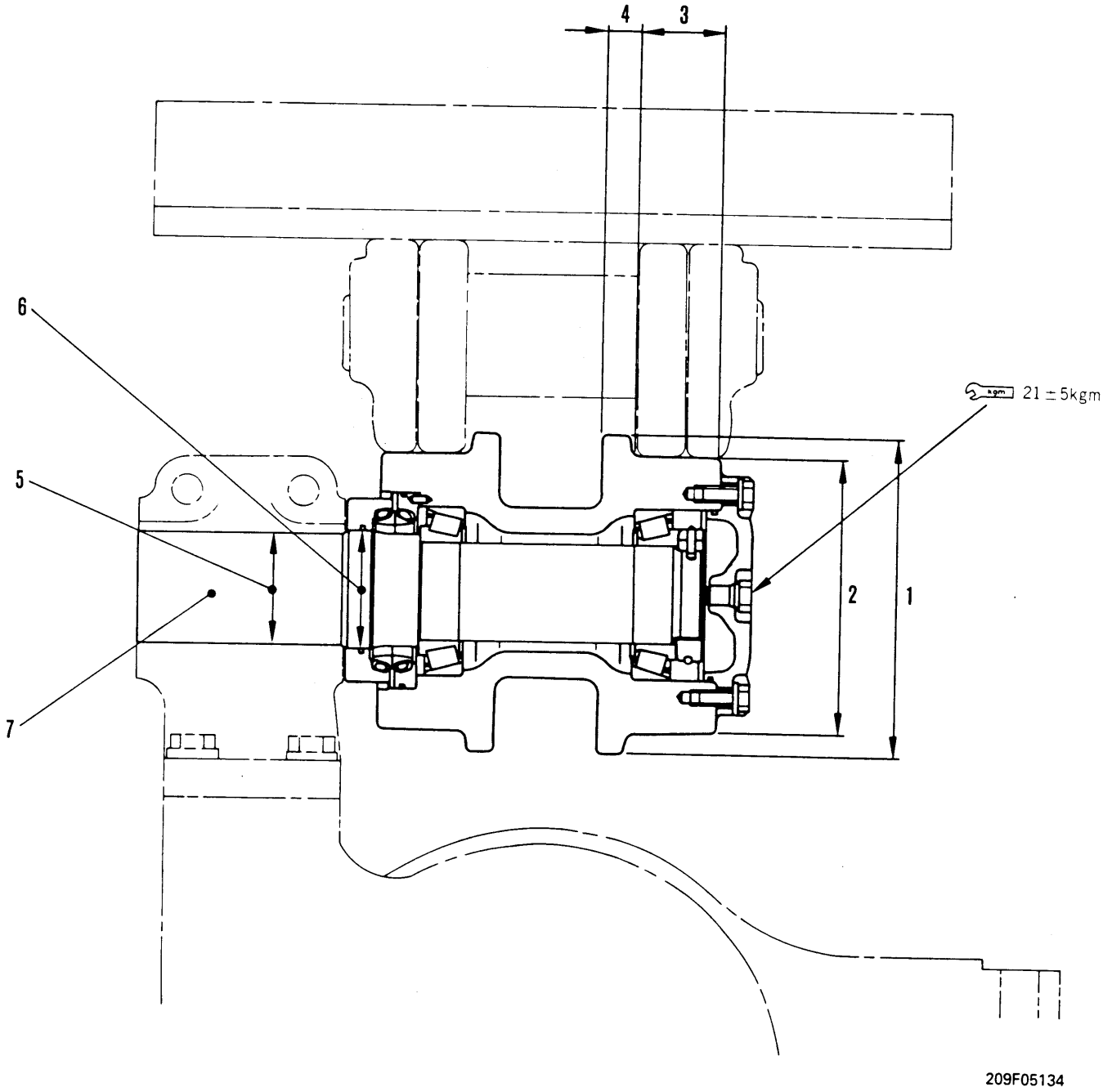
020905

020905

Unit: mm

No.	Check item	Criteria					Remedy
1	Outside diameter of protrusion	Standard size			Repair limit		
		875			–		
2	Outside diameter of tread	830			818		Rebuild or replace
3	Total width	266			–		
4	Width of tread	69.5			78		
5	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		110	–0.120 –0.207	+0.361 +0.281	0.401 – 0.568	1.5	
6	Clearance between shaft and support	110	–0.120 –0.207	+0.035 0	0.120 – 0.242	–	Replace
7	Interference between idler and bushing	Standard size	Tolerance		Standard interference	Interference limit	Replace bushing
			Shaft	Hole			
		120	+0.087 +0.037	–0.036 –0.136	0.073 – 0.223	–	
8	Side clearance of idler (both side)	Standard clearance			Clearance limit		
		0.66 – 1.06			1.5		

CARRIER ROLLER



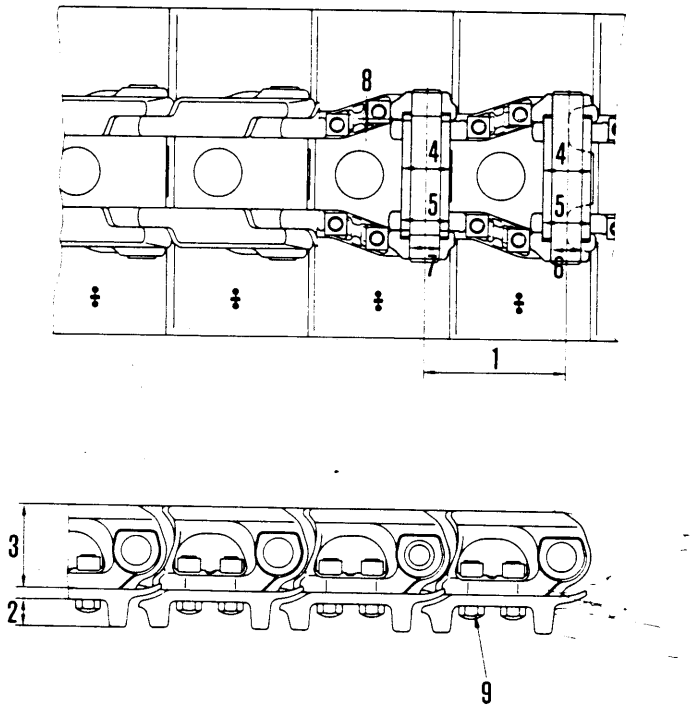
020905

020905

Unit: mm

No.	Check item	Criteria					Remedy
1	Outside diameter of flange	Standard size			Repair limit		
		242			–		
2	Outside diameter of carrier roller tread face	210			185		Rebuild or replace
3	Width of carrier roller tread face	68			79		
4	Width of flange	23			12		
5	Clearance between shaft and support	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		86	0 –0.2	+0.350 0	0 -0.550		
6	Interference between shaft and seal guard	Standard size	Tolerance		Standard interference	Interference limit	Replace
			Shaft	Hole			
		90	+0.245 +0.185	+0.035 0	0.150 – 0.245	–	
7	Free play of roller in the axial direction	Standard clearance			Clearance limit		
		0.01 – 0.22			0.3		

TRACK SHOE



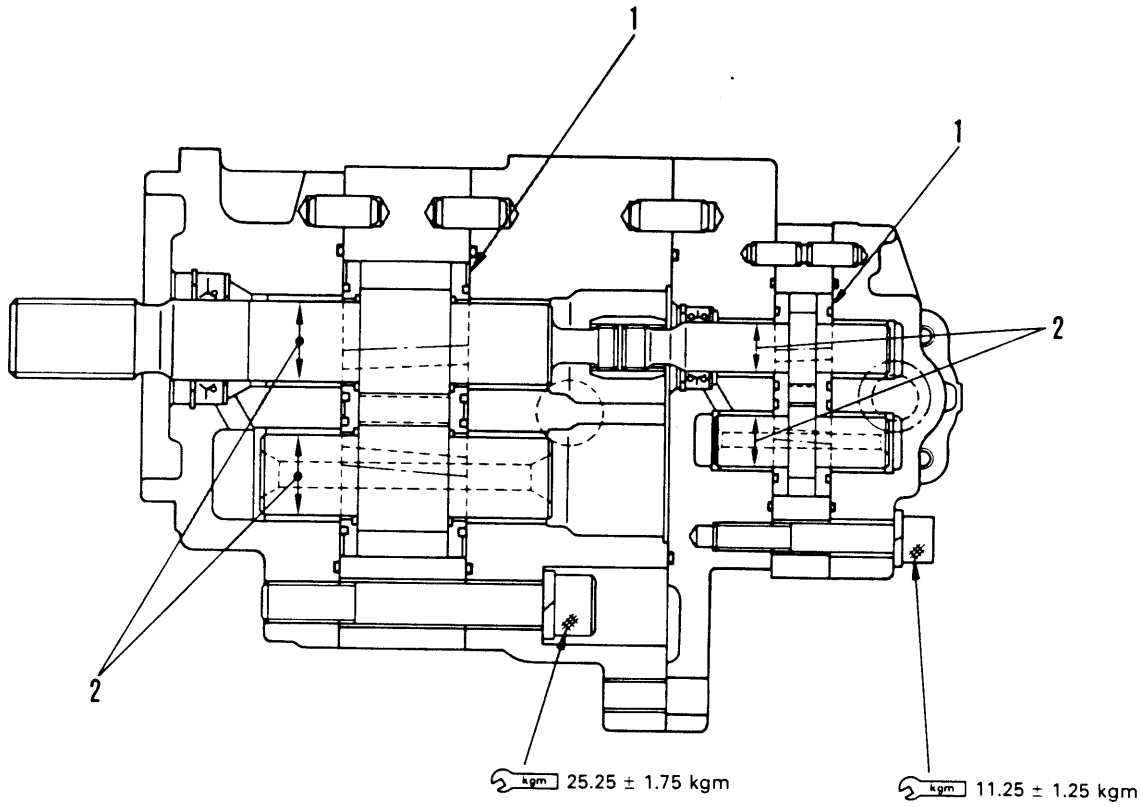
209F3365

020905

Unit: mm

No.	Check item	Criteria				Remedy
1	Link pitch	Standard size		Repair limit		Turn or replace
		260.60		263.60 265.60		
2	Height of grouser (Standard double shoe)	50.0		25		Lug welding rebuild or replace
3	Height of link	156		143		Rebuild or replace
4	Outside diameter of bushing	87.9		84.9		Turn or replace
5	Interference between bushing and link	Standard size	Tolerance		Standard interference	Interference limit	Repair or replace
			Shaft	Hole		
		87.5	+0.472 +0.372	+0.087 0	0.285 – 0.472	0.100	
6	Interference between regular pin and link	55.3	+0.296 +0.146	–0.126 –0.200	0.272 – 0.496	0.138	
7	Interference between master pin and link	55.3	+0.242 +0.212	+0.074 0	0.138 – 0.242	0.080	
8	Clearance of link contact surface	Standard clearance (one side)		Standard clearance (both side)		Clearance limit (both side)	Replace
		0 – 0.14		0 – 0.28		–	
9	Tightening torque of shoe bolt (Tightening angle method)	180 ± 15 kgm (Initial tightening torque: 50 ± 5 kgm Additional tightening angle: 120 ± 10°)					Tighten

CHARGING AND PTO LUBRICATION PUMP



020905

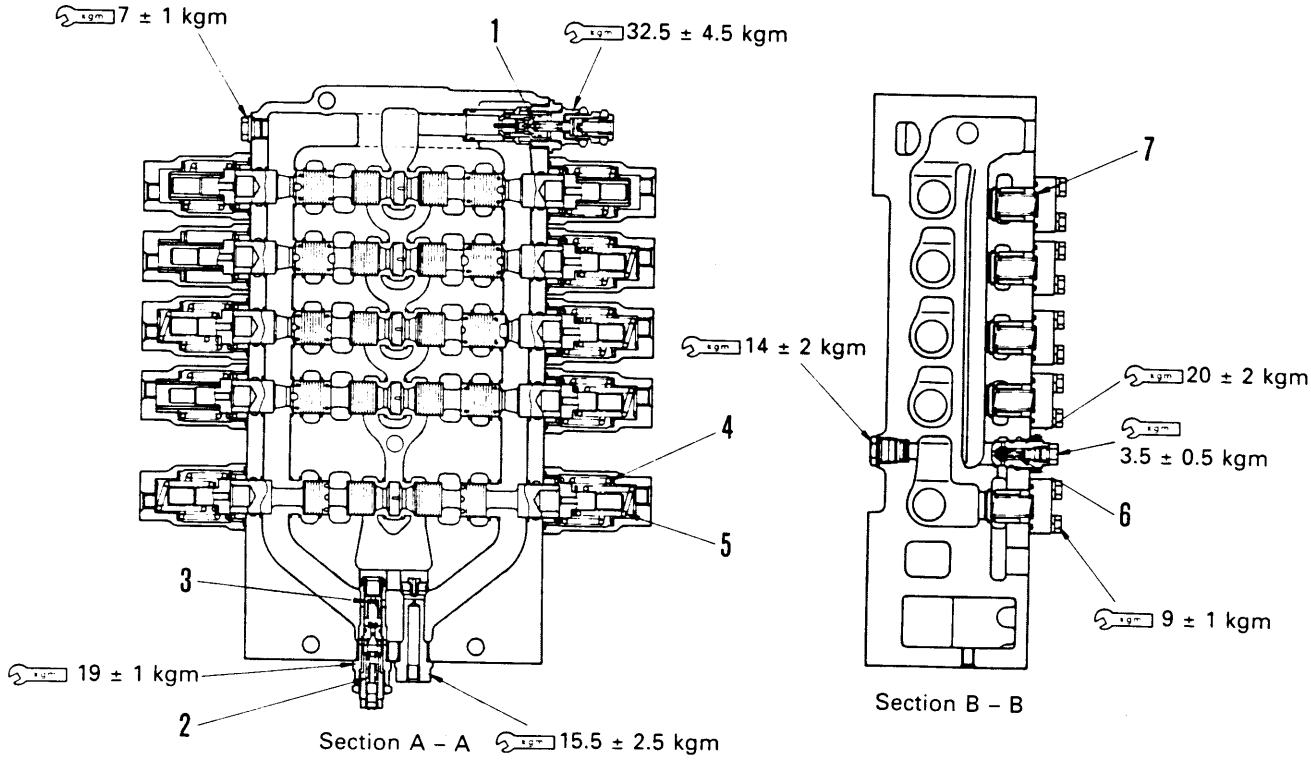
209F3165

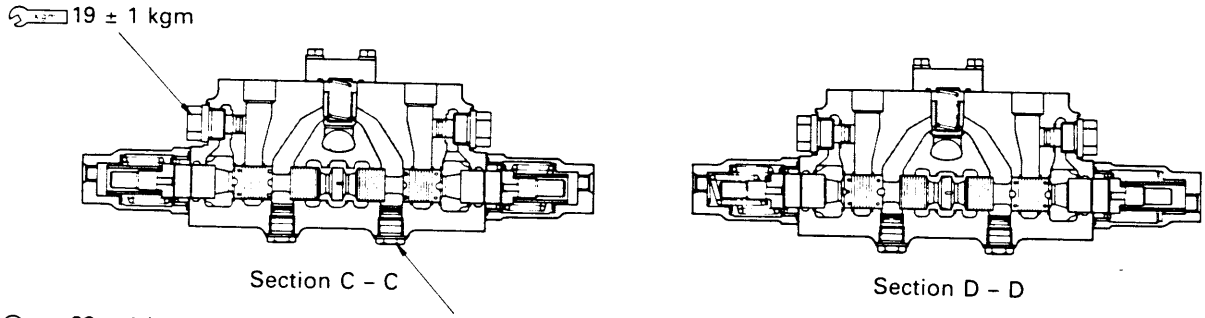
Unit: mm

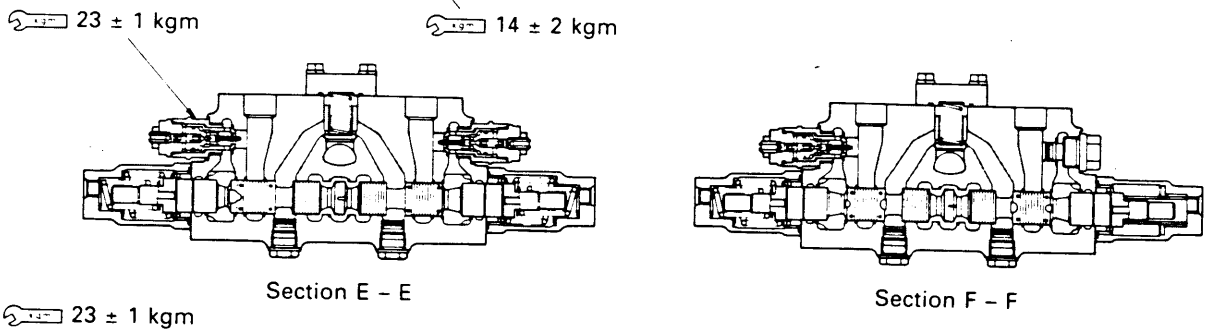
No.	Check item		Criteria				Remedy
1	Clearance between gear case and side plate	Model	Standard clearance		Clerarance limit		Replace
		SAL63	0.10 – 0.50		0.19		
		SAL8	0.10 – 0.15		0.19		
2	Clearance between bearing I.D. and gear shaft O.D.	SAL63	0.06 – 0.149		0.20		
		SAL8	0.06 – 0.144		0.20		
–	Performance (EO10-CD 45 – 55°C)	SAL63	Pump speed (rpm)	Dischagre pressure (kg/cm²)	Standard discharge volume (ℓ/min)	Discharge volume limit (ℓ/min)	
			2,500	30	151	138	
		SAL8	2,500	30	18	16	

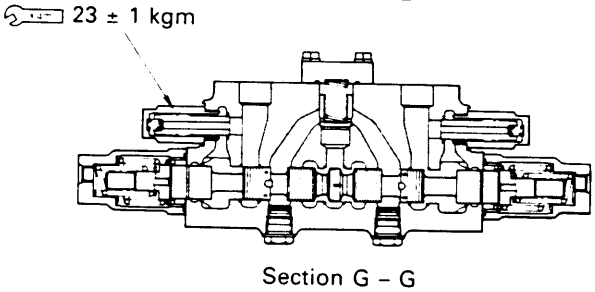
L.H. 5-SPOOL CONTROL VALVE

BACK HOE









020905

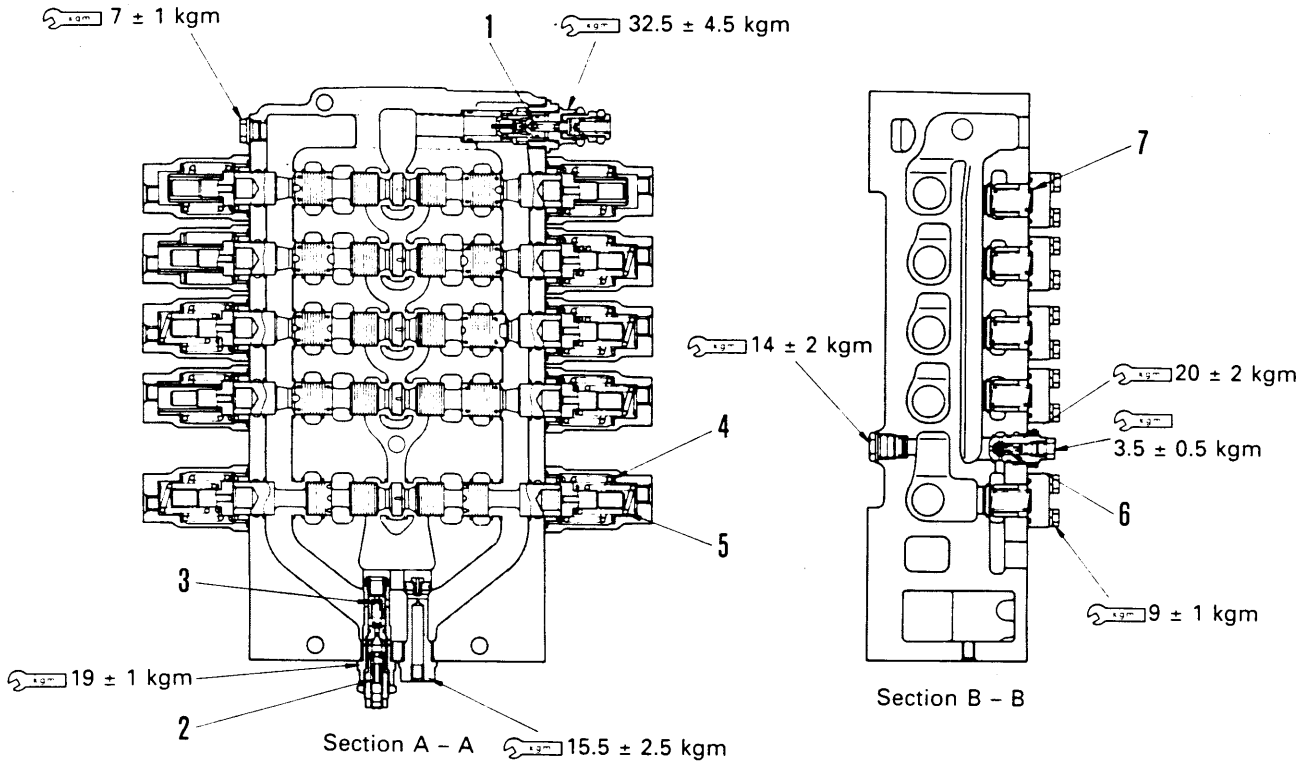
F20905092

020905

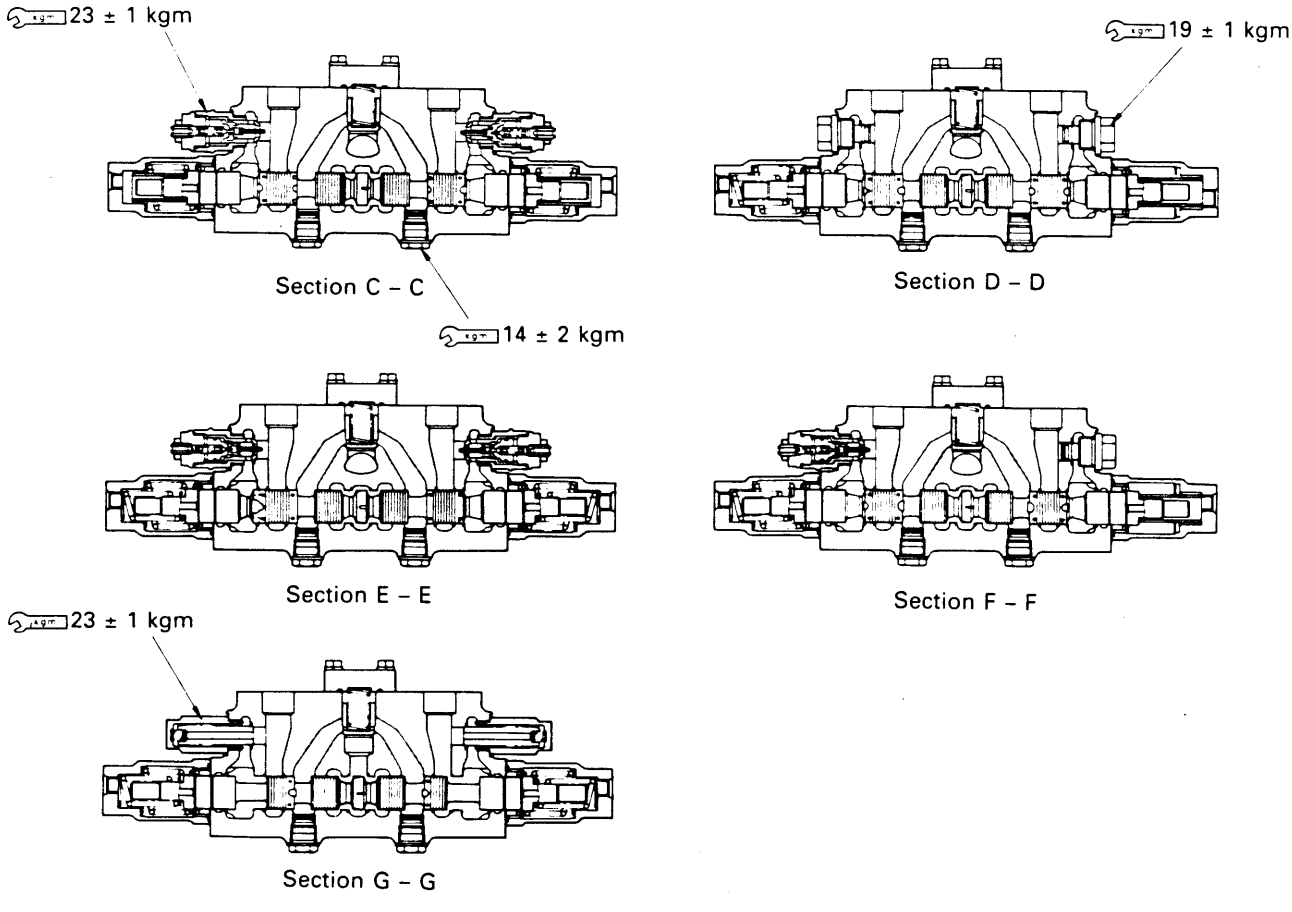
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Main relief valve main valve spring	Free length x O.D.	Installed length	Installed load	Free length	Installed load	
		52.3 x 16.5	36	10 kg			
2	Jet sensor relief valve pilot poppet spring	34.5 x 8.8	34	0.29 kg			
3	Jet sensor relief valve main valve spring	37.4 x 11.4	33	5.0 kg			Replace spring if any damages or deformation are found
4	Spool return spring	69.9 x 57	63	44 kg			
5	Spool return spring	75 x 37	75	0 kg			
6	Throttle valve spring	31.8 x 7.6	26.5	0.1 kg			
7	Check valve spring	78.2 x 26.6	52	1.95 kg			

LOADING SHOVEL



020905



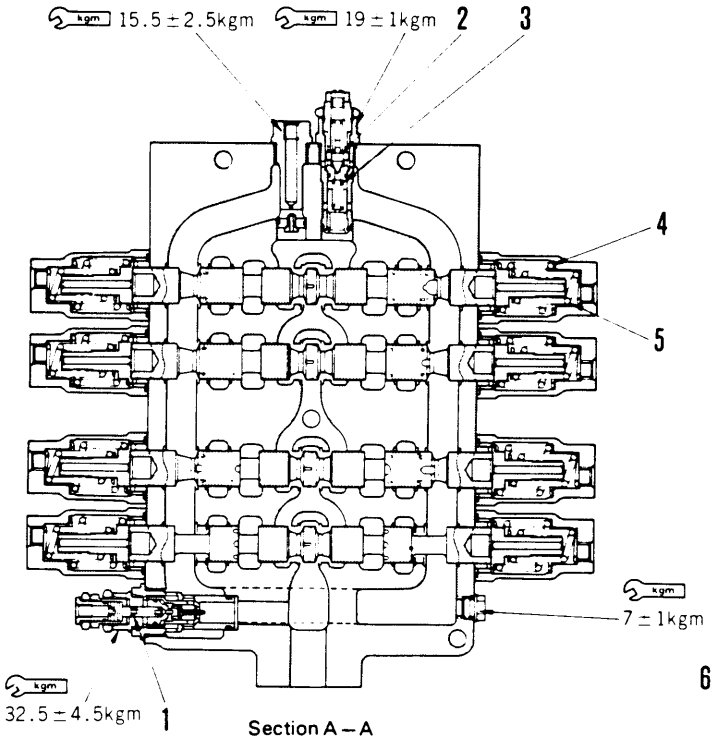
F20905093

020905

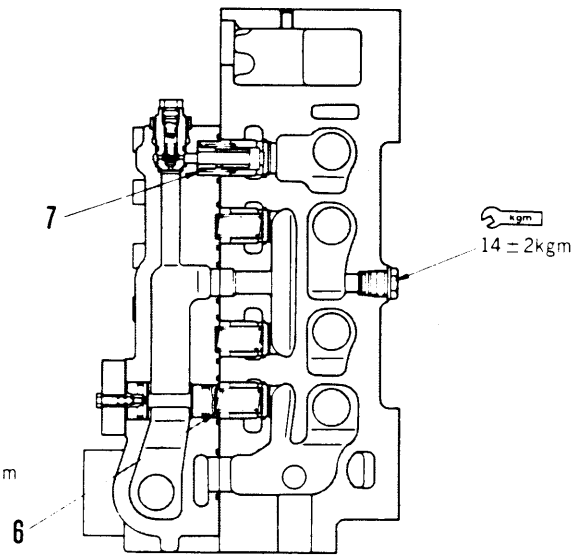
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Main relief valve main valve spring	Free length x O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformation are found
		52.3 x 16.5	36	10 kg			
2	Jet sensor relief valve pilot poppet spring	34.5 x 8.8	34	0.29 kg			
3	Jet sensor relief valve main valve spring	37.4 x 11.4	33	5.0 kg			
4	Spool return spring	69.9 x 57	63	44 kg			
5	Spool return spring	75 x 37	75	0 kg			
6	Throttle valve spring	31.8 x 7.6	26.5	0.1 kg			
7	Check valve spring	78.2 x 26.6	52	1.95 kg			

R.H. 4-SPOOL CONTROL VALVE

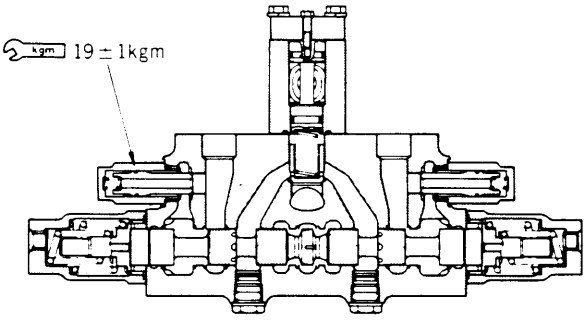


Section A – A

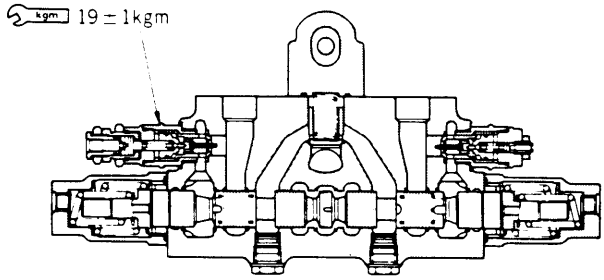


Section B – B

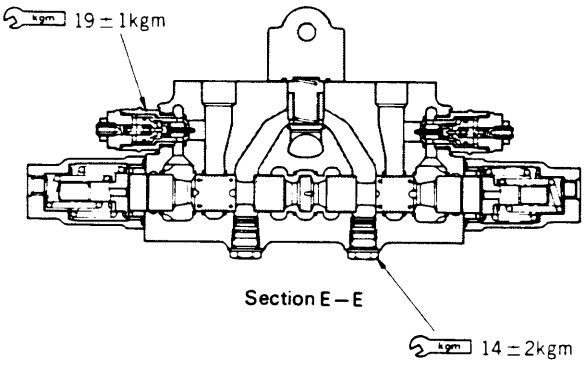
020905



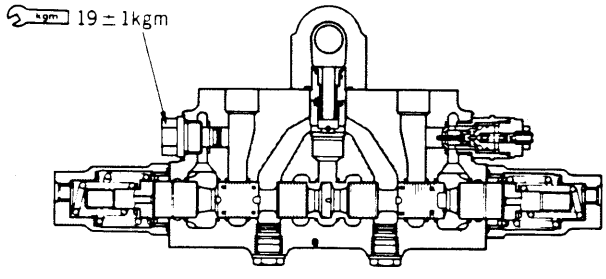
Section C – C



Section D – D



Section E – E



Section F – F

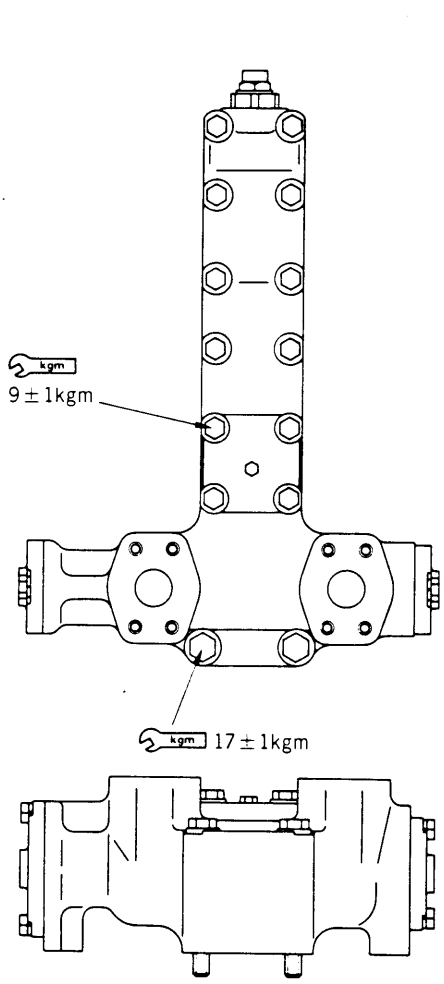
209F05136

020905

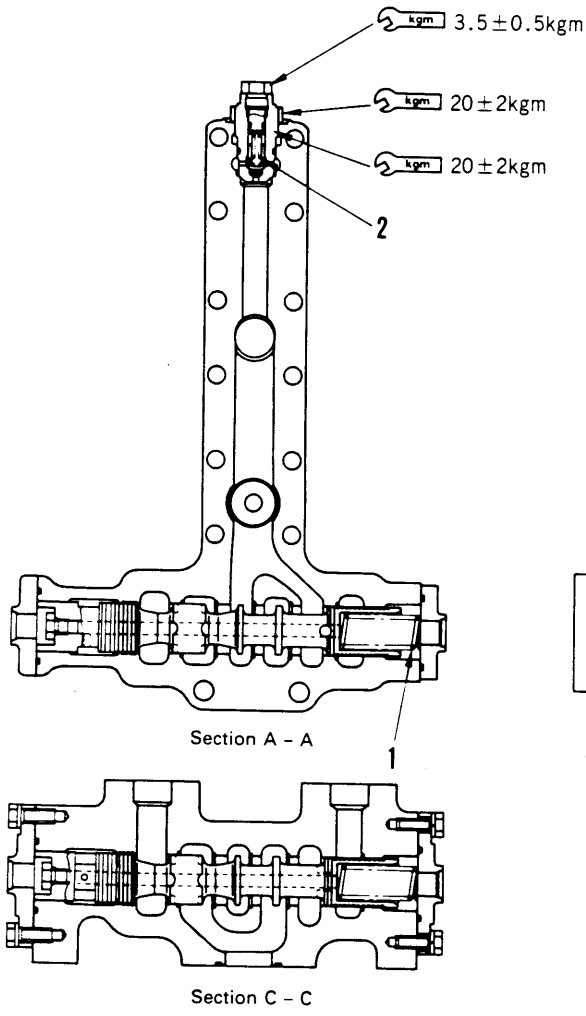
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Main relief valve main valve spring	Free length x O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformation are found
		52.3 x 16.5	36	10 kg			
2	Jet sensor relief valve pilot poppet spring	34.5 x 8.8	34	0.29 kg			
3	Jet sensor relief valve main valve spring	37.4 x 11.4	33	5.0 kg			
4	Spool return spring	69.9 x 57	63	44 kg			
5	Spool return spring	75 x 37	75	0 kg			
6	Check valve spring	78.2 x 26.6	52	1.92 kg			
7	Check valve spring	53.6 x 31	39	1.92 kg			

STRAIGHT-TRAVEL VALVE



209F3154



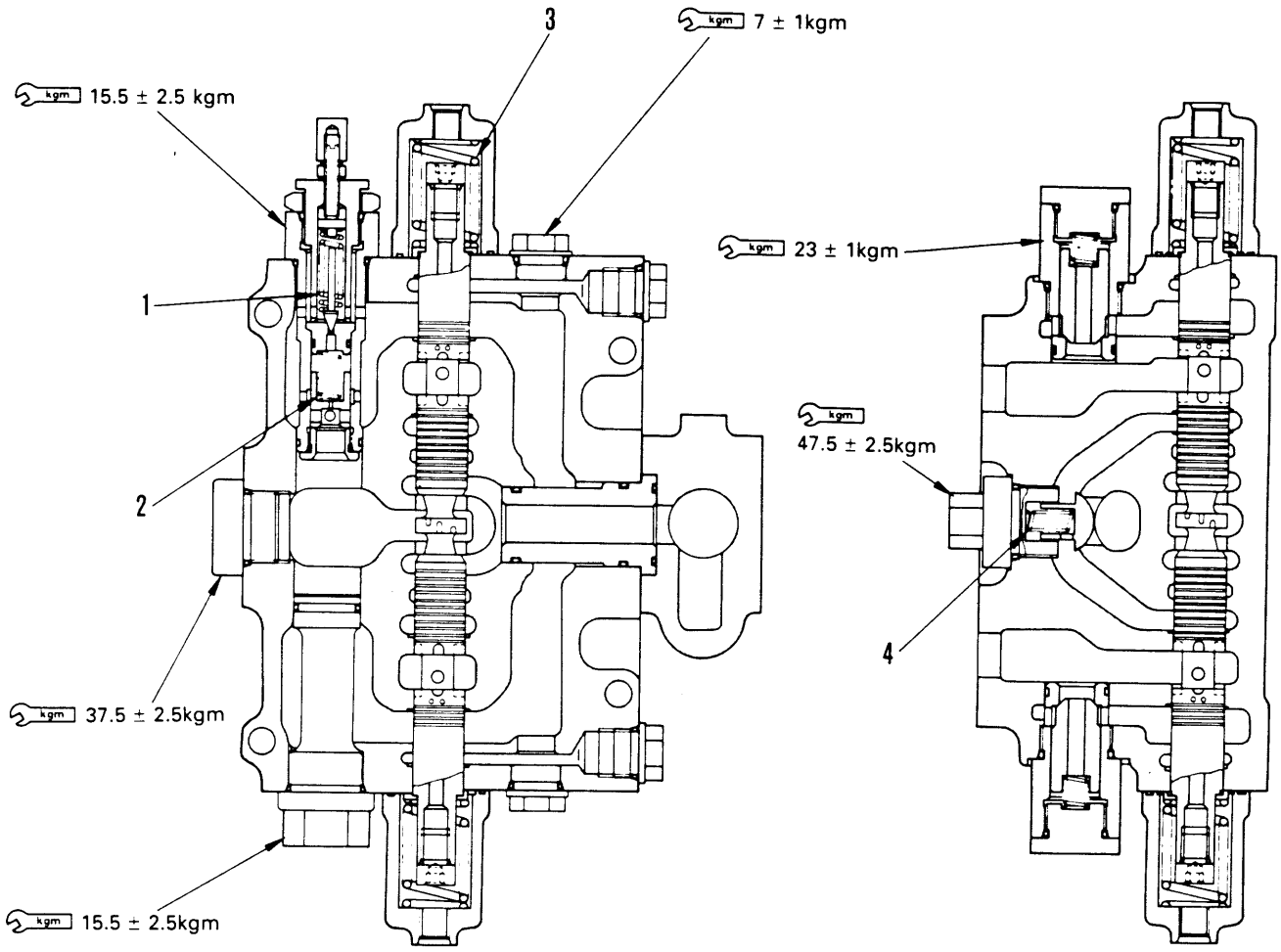
209F05137

020905

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Spool return spring	Free length x O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformation are found
		117.5 x 27.9	68	16 kg			
2	Throttle valve spring	31.8 x 7.6	26.5	0.1 kg			

SWING CONTROL VALVE



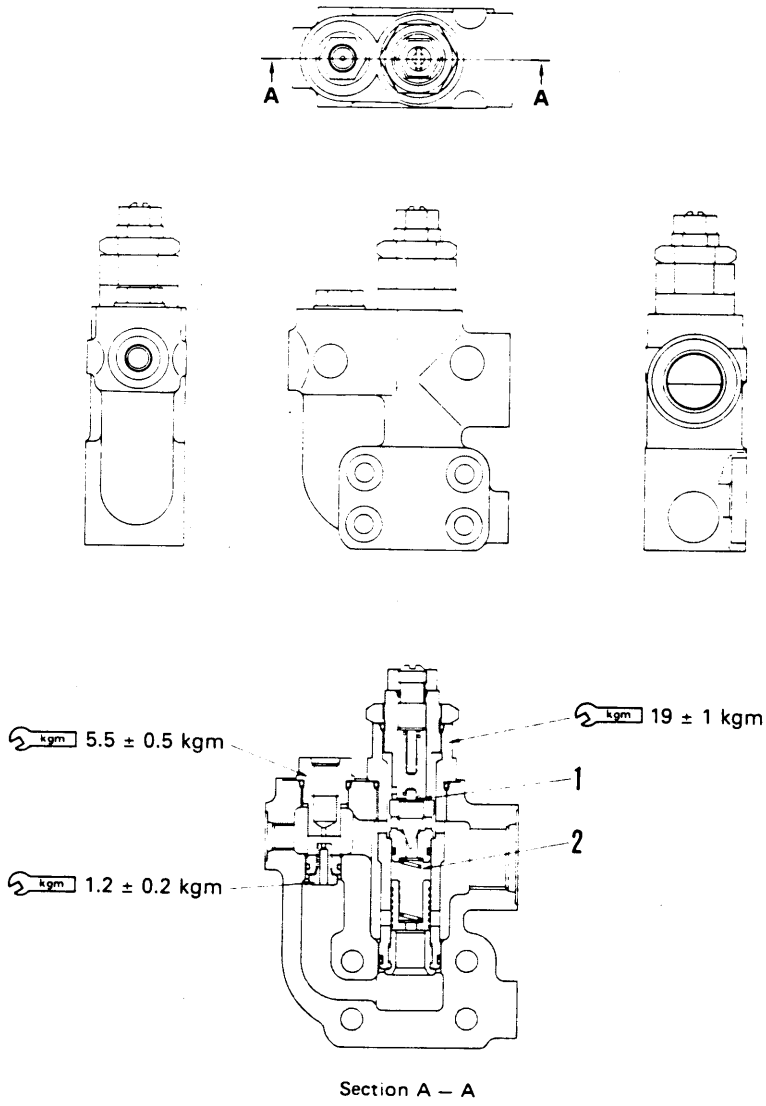
209F3157

020905

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Main relief valve pilot poppet spring	Free length x O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformation are found.
		49.3 x 12.8	39.5	35.2 kg			
2	Main relief valve main valve spring	39.5 x 11.2	25	3.0 kg			
3	Spool return spring	54.8 x 34	53.5	12.7 kg			
4	Check valve spring	32.6 x 10.9	24.5	4.5 kg			

JET SENSOR



Section A – A

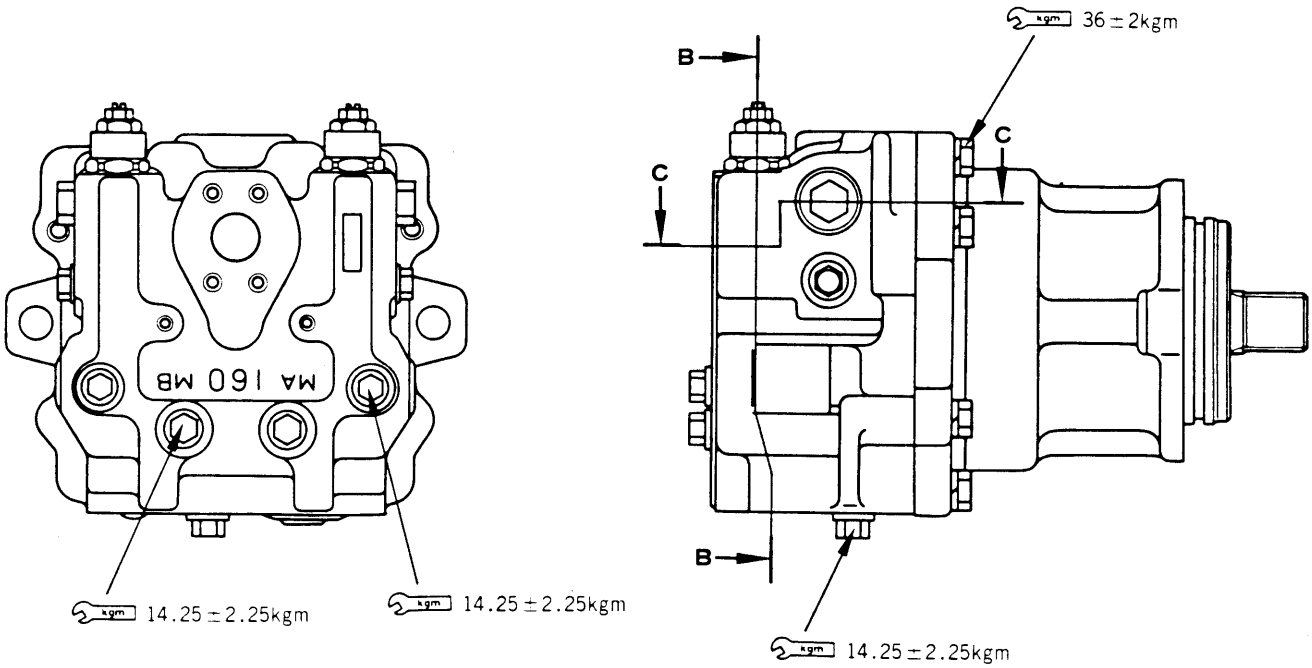
209F3158

020905

Unit: mm

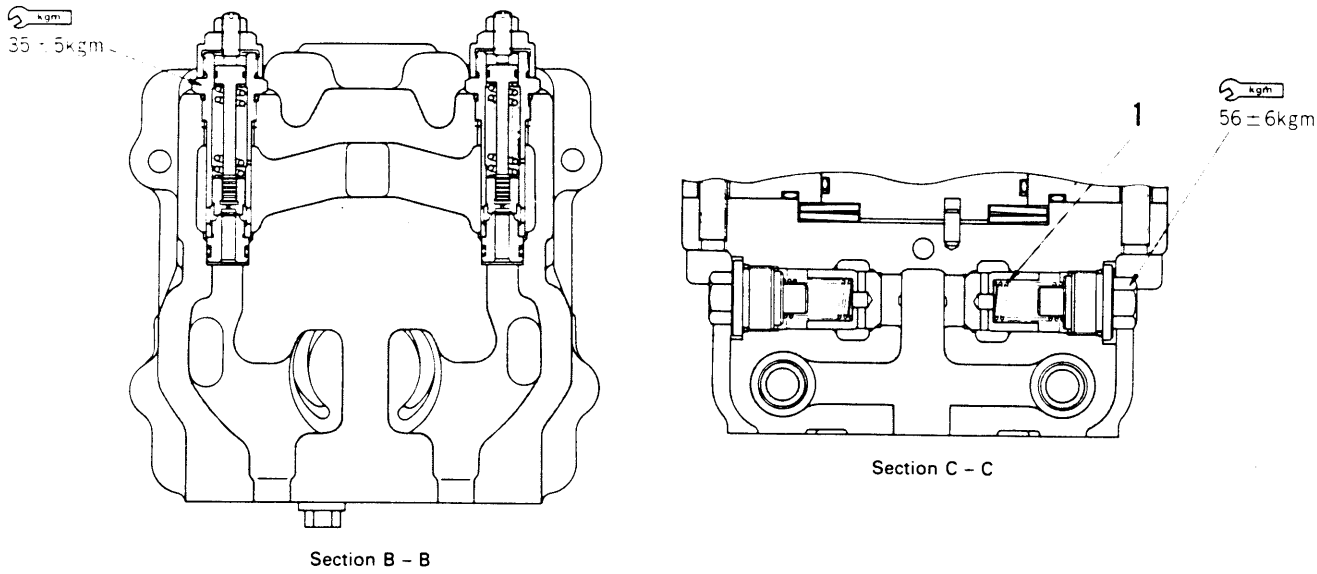
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Relief valve pilot poppet spring	Free length x O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformation are found
		34.5 x 8.8	34	0.29 kg			
2	Relief valve main valve spring	37.4 x 11.4	33	5.0 kg			

SWING MOTOR



209F05138

020905



Section B – B

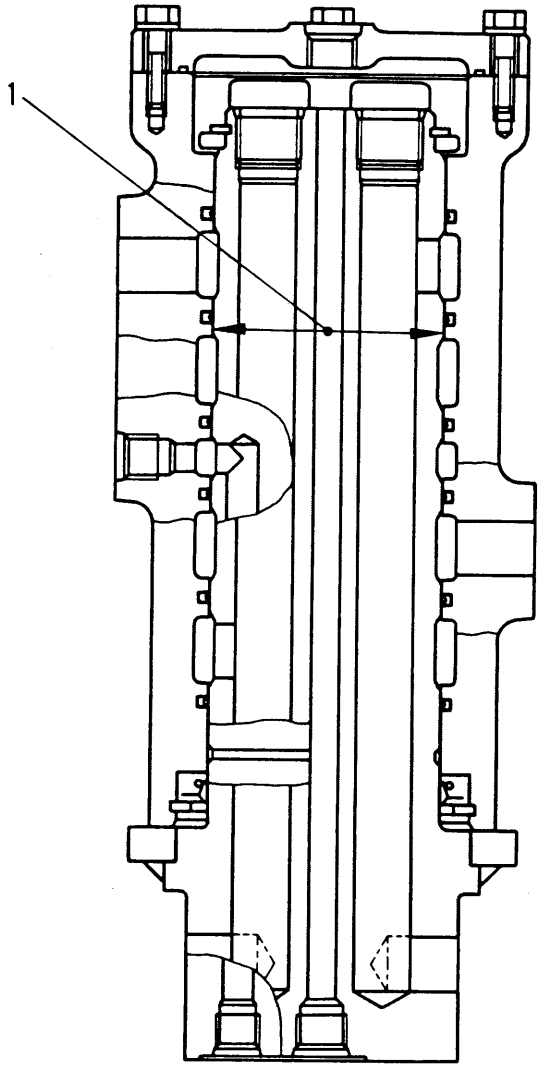
Section C – C

209F05139

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Check valve spring	Free length x O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformation are found
		66.5 x 25.6	45.0	0.71 kg	–	0.57 kg	

CENTER SWIVEL JOINT



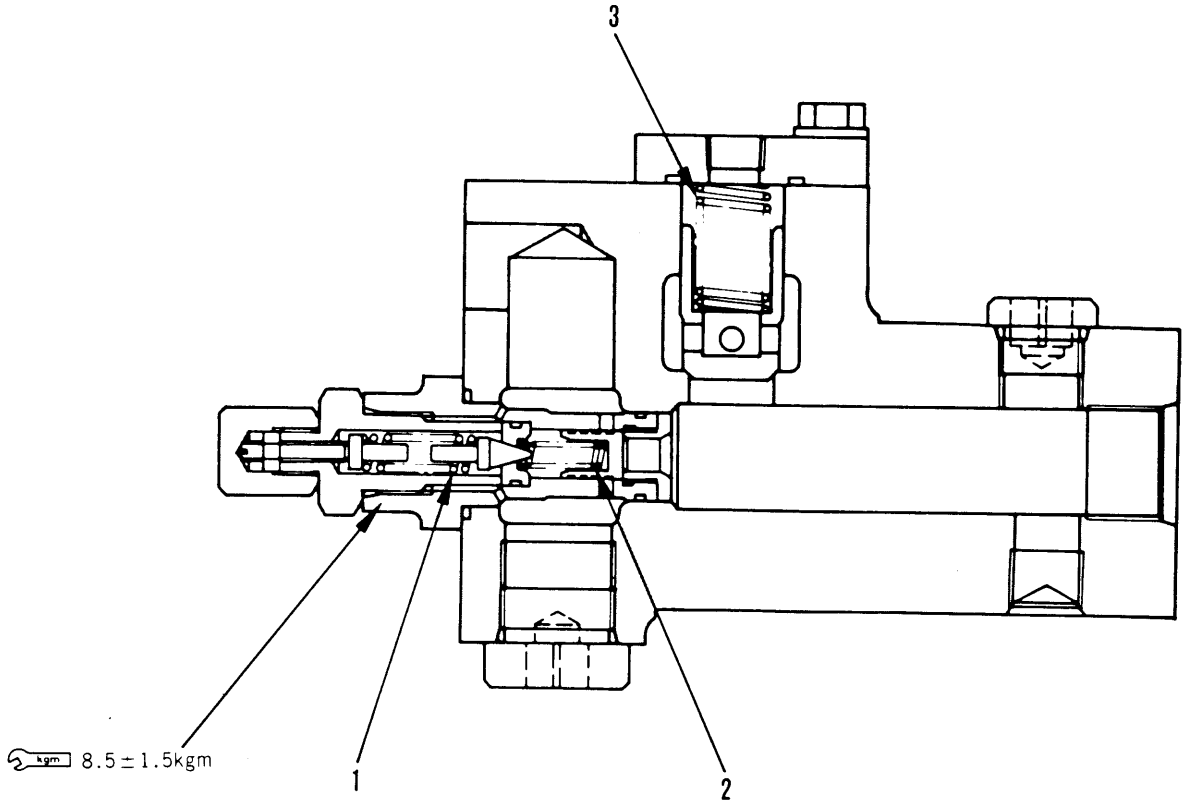
209F05140

020905

Unit: mm

No.	Check item	Criteria			Remedy
1	Clearance between rotor and shaft	Standard size	Standard clearance	Clerarance limit	Replace
		110	0.056 – 0.105	0.111	

PILOT RELIEF VALVE



020905

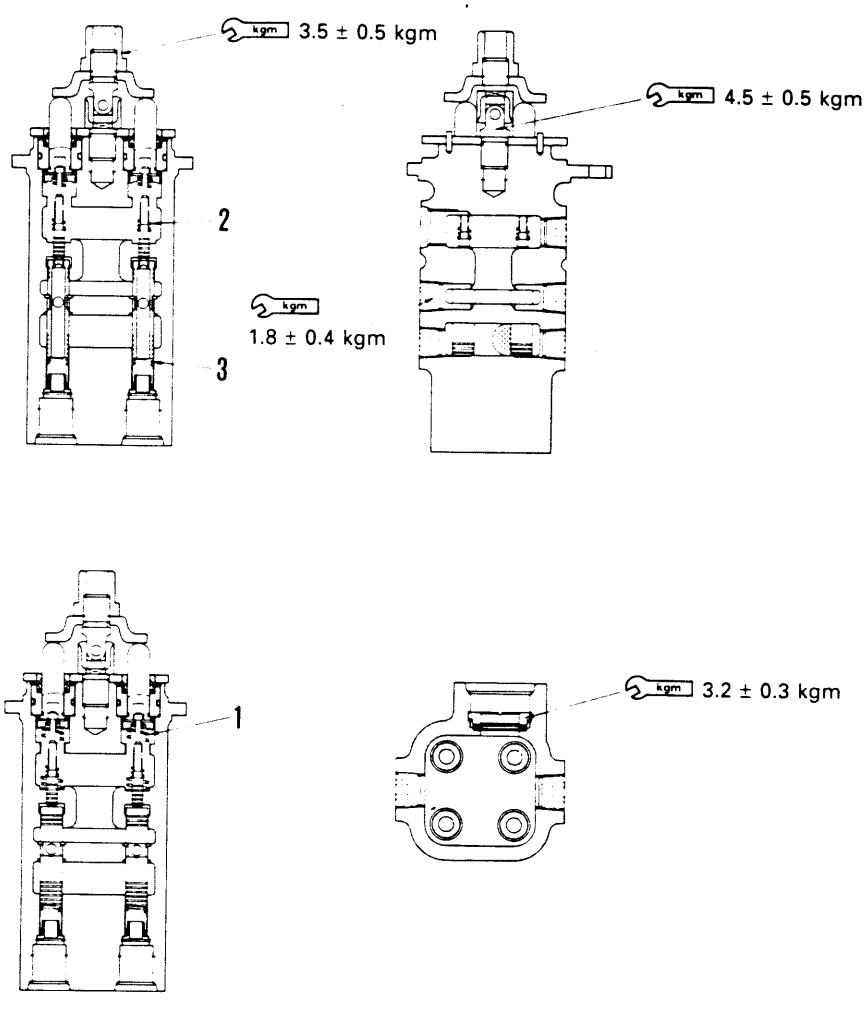
209F05141

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Relief valve pilot poppet spring	Free length x O.D.	Installed length	Installed load	Free length	Installed load	Replace
			30.4	6.25 kg			
2	Relief valve main valve spring		26	2.1 kg			
3	Check valve spring	56 x 21.4	37	0.7 kg	–	0.4 kg	

PPC VALVE

FOR WORK EQUIPMENT SWING



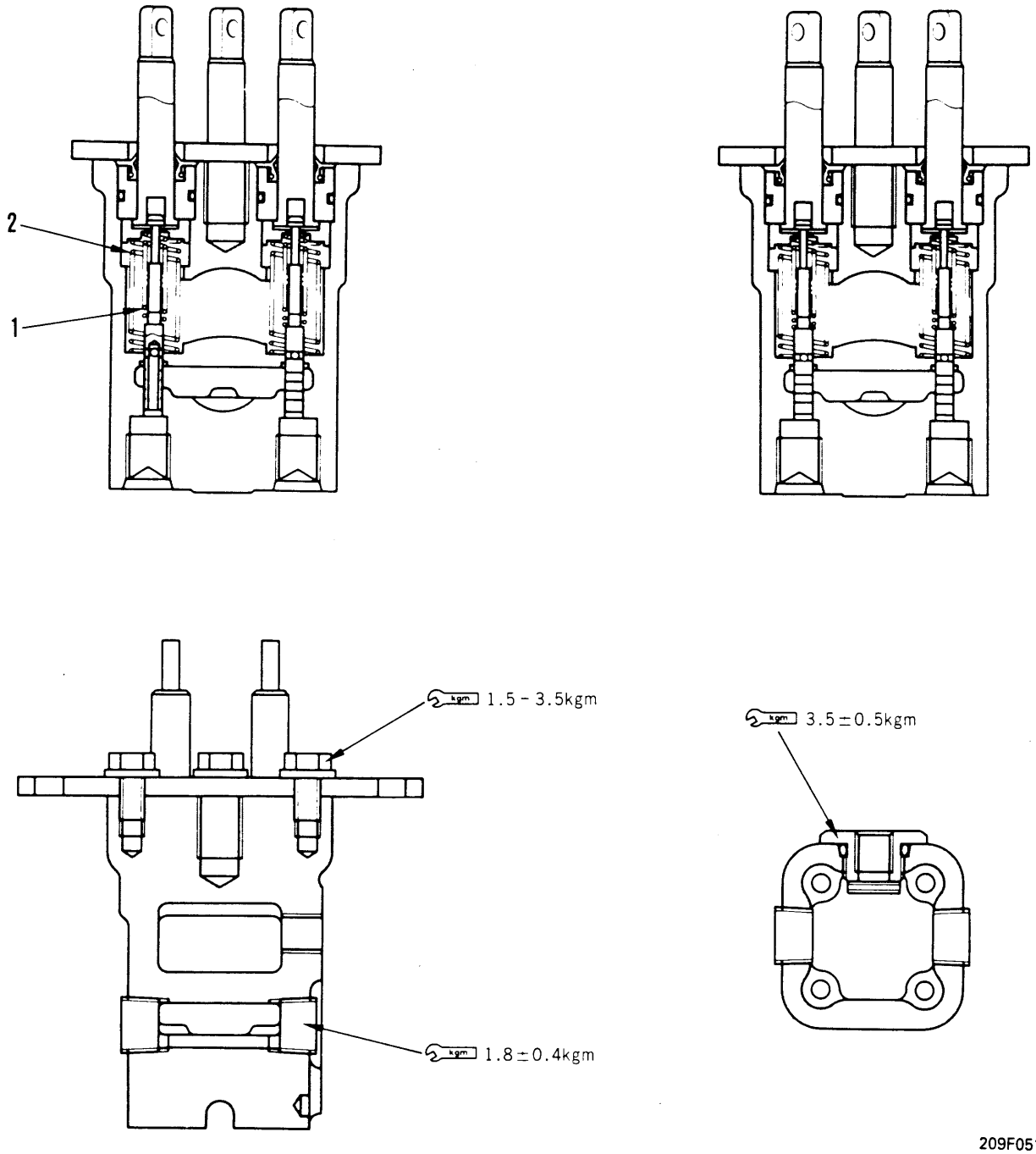
209F3168

020905

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Centering spring	Free length x O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformations are found
			34.5	0.92 kg			
2	Metering spring		29.4	3.4 kg			
3	Return spring		17.5	1.5 kg			

FOR TRAVEL



209F05142

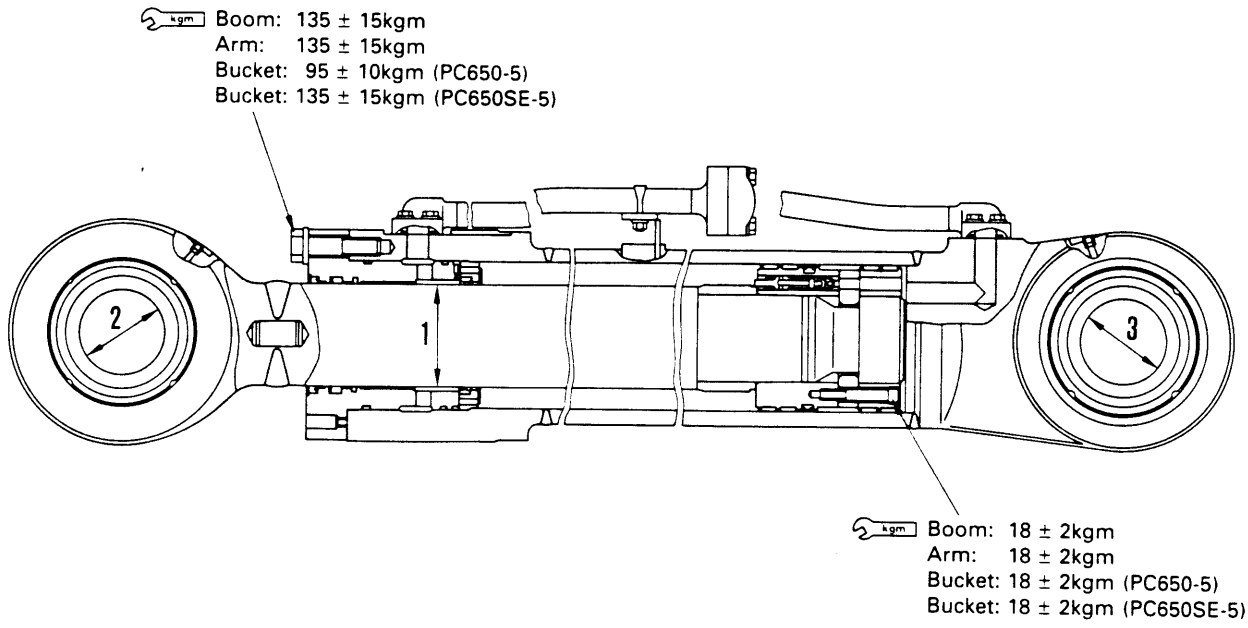
020905

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Metering spring	Free length x O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformations are found
		31.4 x 7.4	29.4	1.7 kg	–	1.4 kg	
2	Centering spring	45.5 x 16.2	36.5	1.0 kg	–	0.8 kg	

HYDRAULIC CYLINDER

BACK HOE



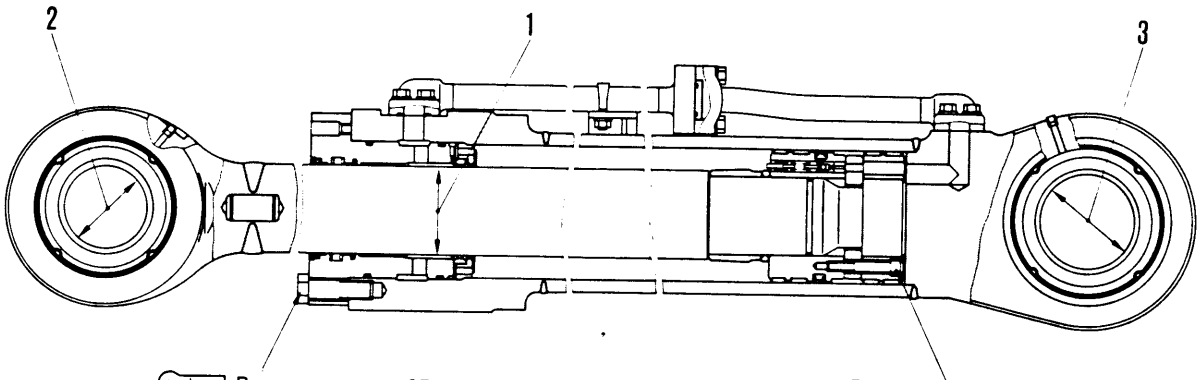
209F05143

020905

Unit: mm

No.	Check item	Cylinder	Standard size	Tolerance		Standard clearance	Clearance limit	Remedy
				Shaft	Hole			
1	Clearance between piston rod and bushing	Boom	140	−0.043 −0.106	+0.256 +0.039	0.082 – 0.362	0.662	Replace bushing
		Arm	140	−0.043 −0.106	+0.256 +0.039	0.082 – 0.362	0.662	
		Bucket (PC650-5)	130	−0.043 −0.106	+0.256 +0.039	0.082 – 0.362	0.662	
		Bucket (PC650SE-5)	140	−0.043 −0.106	+0.256 +0.039	0.082 – 0.362	0.662	
2	Clearance between piston rod support shaft and bushing	Boom	115	−0.036 −0.090	+0.464 +0.400	0.436 – 0.554	1.5	Replace pin or bushing
		Arm	115	−0.036 −0.090	+0.464 +0.400	0.436 – 0.554	1.5	
		Bucket (PC650-5)	115	−0.036 −0.090	+0.464 +0.400	0.436 – 0.554	1.5	
		Bucket (PC650SE-5)	115	−0.036 −0.090	+0.025 0	0.036 – 0.115	1.5	
3	Clearance between cylinder bottom support shaft and bushing	Boom	130	−0.043 −0.106	+0.025 0	0.043 – 0.131	1.5	
		Arm	130	−0.043 −0.106	+0.025 0	0.043 – 0.131	1.5	
		Bucket (PC650-5)	130	−0.043 −0.106	+0.025 0	0.043 – 0.131	1.5	
		Bucket (PC650SE-5)	130	−0.043 −0.106	+0.025 0	0.043 – 0.131	1.5	

LOADING SHOVEL



209050094

Unit: mm

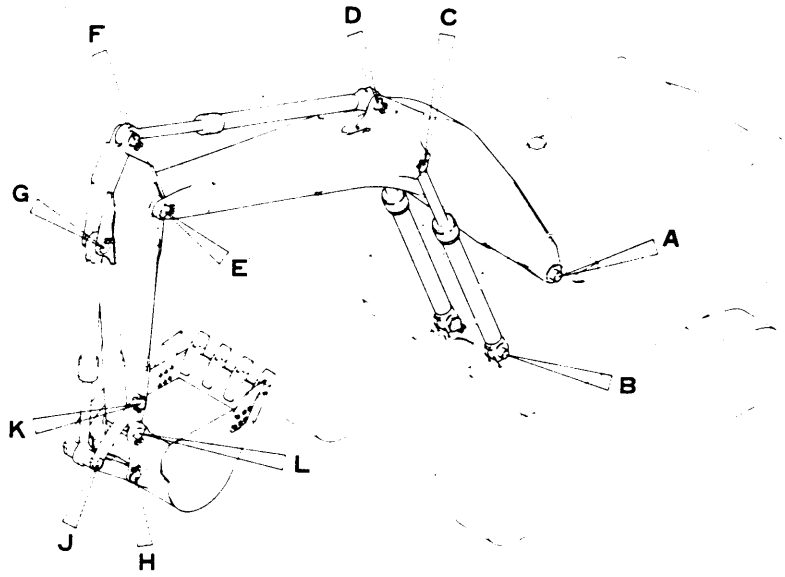
No.	Check item	Cylinder	Standard size	Tolerance		Standard clearance	Clearance limit	Remedy
				Shaft	Hole			
1	Clearance between piston rod and bushing	Boom	120	−0.036 −0.090	+0.256 +0.040	0.076 – 0.346	0.646	Replace bushing
		Arm	160	−0.043 −0.106	+0.256 +0.039	0.082 – 0.362	0.662	
		Bucket	130	−0.043 −0.106	+0.256 +0.040	0.083 – 0.362	0.662	
		Bottom dump	90	−0.036 −0.090	+0.256 +0.039	0.075 – 0.344	0.644	
2	Clearance between piston rod support shaft and bushing	Boom	115	−0.036 −0.090	0 −0.020	0.016 – 0.090	1.5	Replace pin or bushing
		Arm	140	−0.043 −0.106	+0.263 +0.200	0.246 – 0.369	1.5	
		Bucket	115	−0.036 −0.090	0 −0.020	0.016 – 0.090	1.5	
		Bottom dump	90	−0.036 −0.090	+0.457 +0.370	0.406 – 0.547	1.5	
3	Clearance between cylinder bottom support shaft and bushing	Boom	130	−0.043 −0.106	+0.025 0	0.043 – 0.131	1.5	
		Arm	140	−0.043 −0.106	+0.263 +0.200	0.246 – 0.369	1.5	
		Bucket	115	−0.036 −0.090	0 −0.020	0.016 – 0.090	1.5	
		Bottom dump	90	−0.036 −0.090	+0.457 +0.370	0.406 – 0.547	1.5	

020905

WORK EQUIPMENT

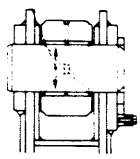
BACK HOE

PC650-5

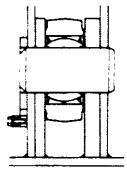


209F05144

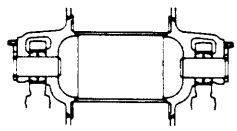
1



Section A – A

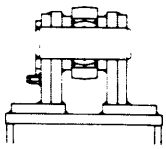


Section B – B

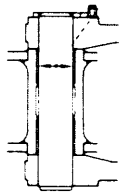


Section C – C

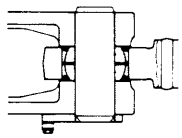
2



Section D – D



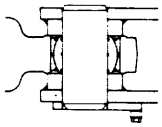
Section E – E



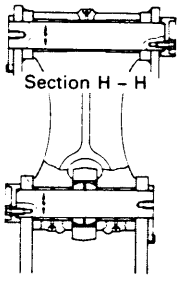
Section F – F

6

3



Section G – G

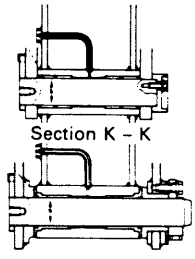


Section H – H

Section J – J

5

4



Section K – K

Section L – L

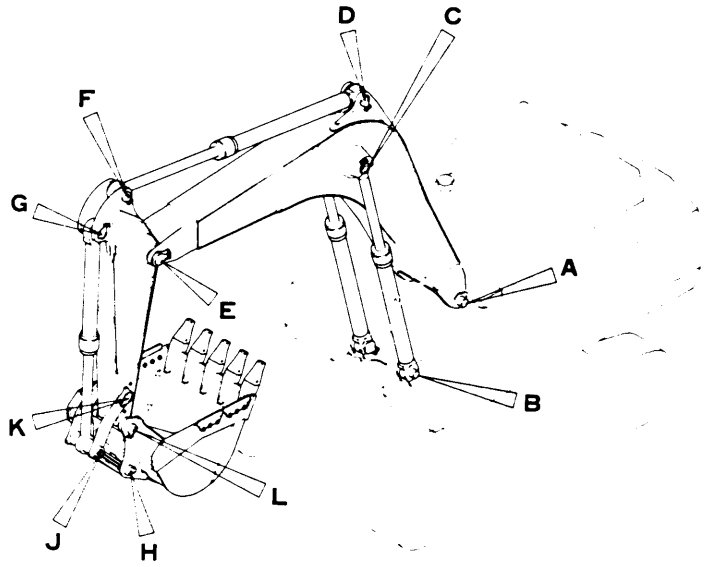
209F05145

020905

020905

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between boom-revolving frame mounting pin and bushing	140	−0.043 −0.106	+0.542 +0.442	0.485 – 0.648	1.5	
2	Clearance between boom-arm mounting pin and bushing	140	−0.043 −0.106	+0.542 +0.442	0.485 – 0.648	1.5	
3	Clearance between arm-link mounting pin and bushing	115	−0.036 −0.090	+0.351 +0.271	0.307 – 0.441	1.5	
4	Clearance between arm-bucket mounting pin and bushing	115	−0.036 −0.090	+0.351 +0.271	0.307 – 0.441	1.5	
5	Clearance between bucket cylinder-link mounting pin and bushing	115	−0.036 −0.090	+0.351 +0.271	0.307 – 0.441	1.5	
6	Clearance between arm-bucket mounting pin and bushing	115	−0.036 −0.090	+0.351 +0.271	0.307 – 0.441	1.5	



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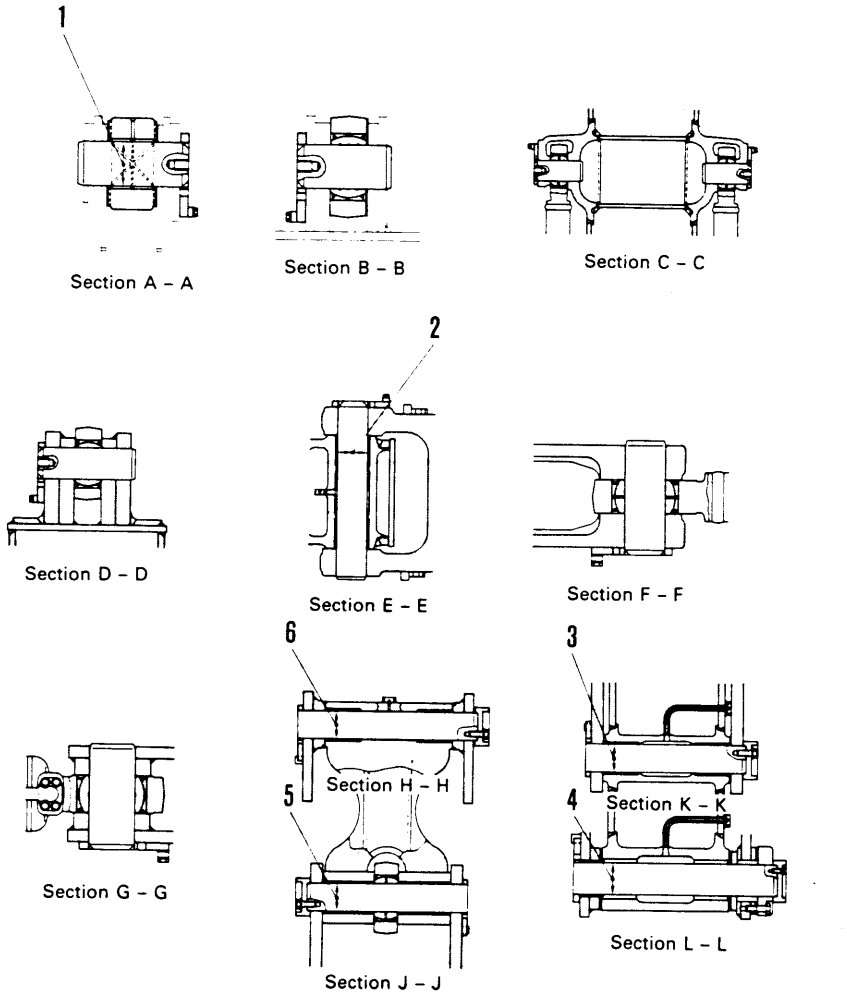


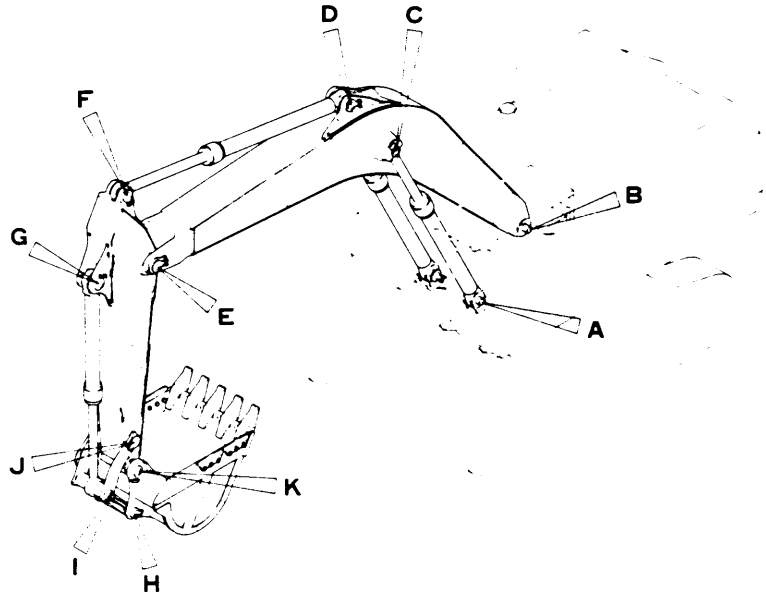
209F05149

020905

020905

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between boom-revolving frame mounting pin and bushing	140	−0.043 −0.106	+0.542 +0.442	0.485 – 0.648	1.5	
2	Clearance between boom-arm mounting pin and bushing	140	−0.043 −0.106	+0.542 +0.442	0.485 – 0.648	1.5	
3	Clearance between arm-link mounting pin and bushing	115	−0.036 −0.090	+0.351 +0.271	0.307 – 0.441	1.5	
4	Clearance between arm-bucket mounting pin and bushing	130	−0.043 −0.106	+0.393 +0.293	0.336 – 0.499	1.5	
5	Clearance between bucket cylinder-link mounting pin and bushing	115	−0.036 −0.090	+0.351 +0.271	0.307 – 0.441	1.5	
6	Clearance between link-bucket mounting pin and bushing	115	−0.036 −0.090	+0.351 +0.271	0.307 – 0.441	1.5	



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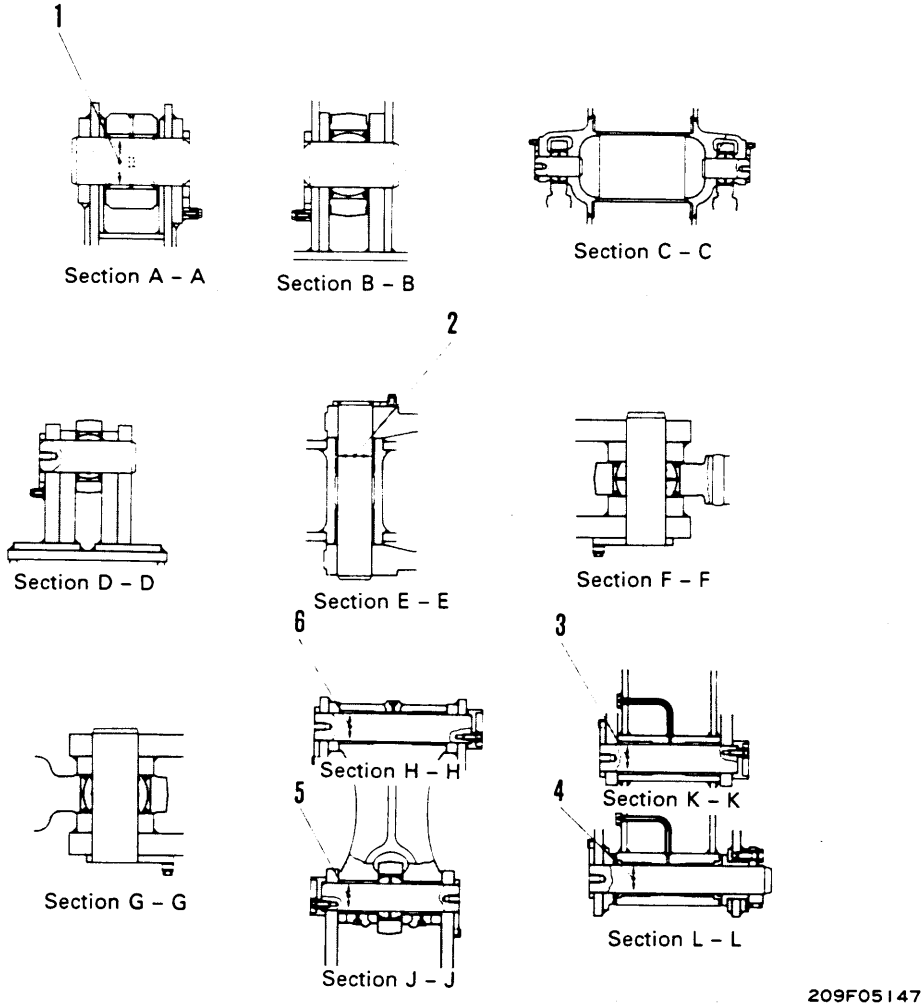


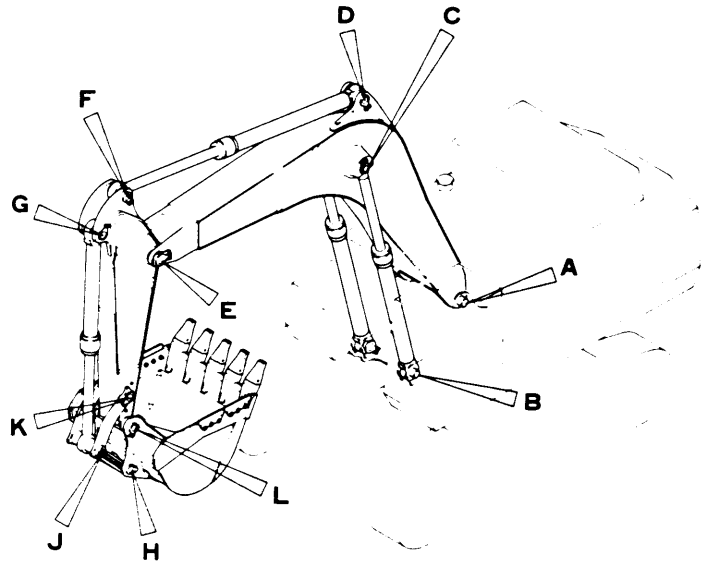
209F05147

020905

020905

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between boom-revolving frame mounting pin and bushing	140	–0.043 –0.106	+0.542 +0.442	0.485 – 0.648	1.5	
2	Clearance between boom-arm mounting pin and bushing	140	–0.043 –0.106	+0.542 +0.442	0.485 – 0.648	1.5	
3	Clearance between arm-link mounting pin and bushing	115	–0.036 –0.090	+0.351 +0.271	0.307 – 0.441	1.5	
4	Clearance between arm-bucket mounting pin and bushing	130	–0.043 –0.106	+0.393 +0.293	0.336 – 0.441	1.5	
5	Clearance between bucket cylinder-link mounting pin and bushing	115	–0.036 –0.090	+0.351 +0.271	0.307 – 0.441	1.5	
6	Clearance between arm-bucket mounting pin and bushing	115	–0.036 –0.090	+0.351 +0.271	0.307 – 0.441	1.5	



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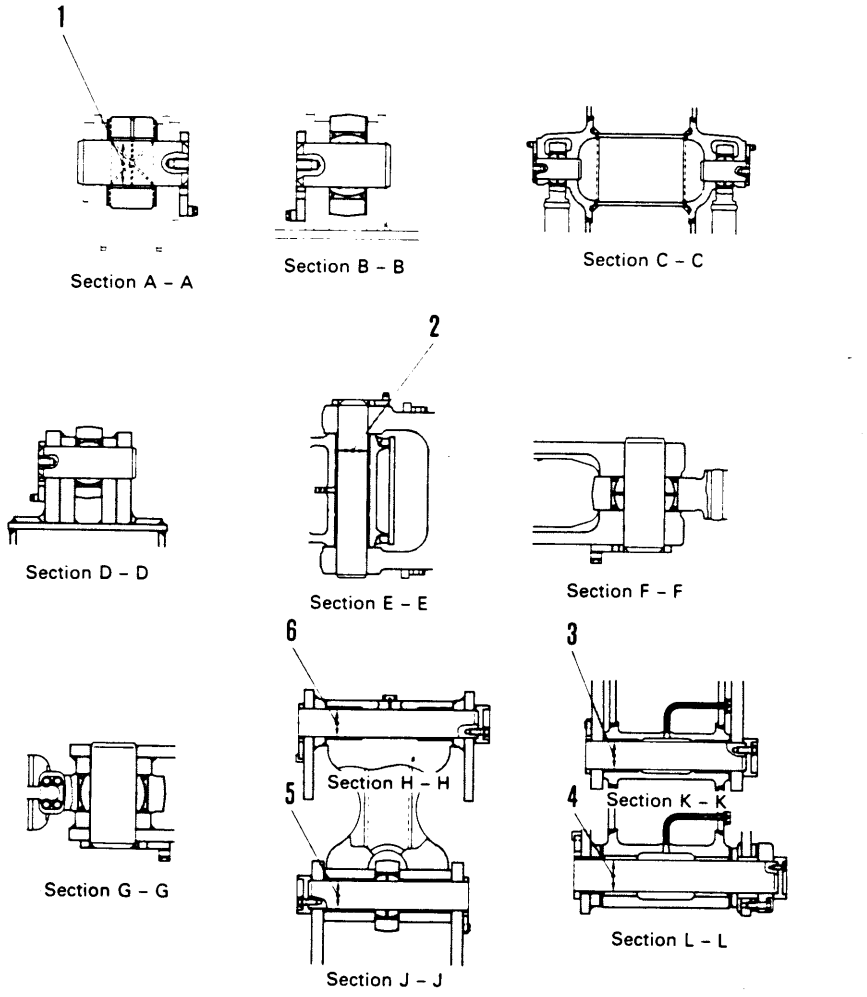


209F05149

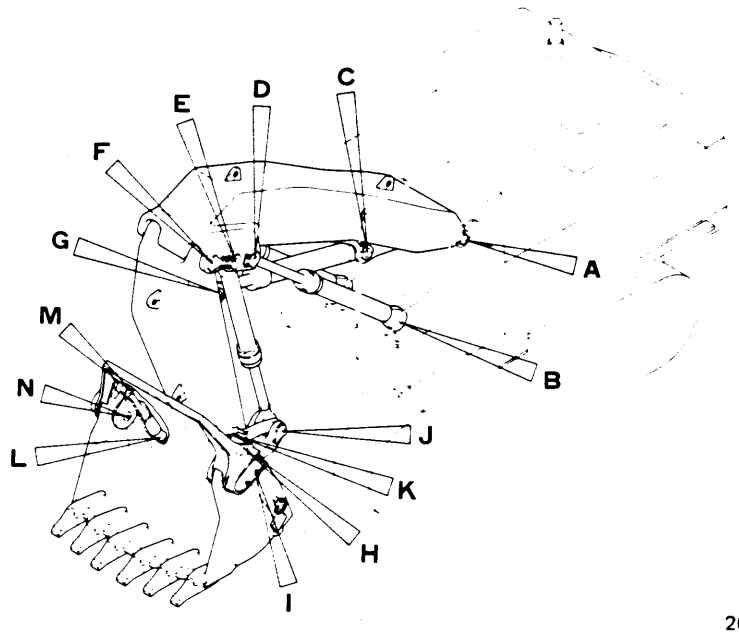
020905

020905

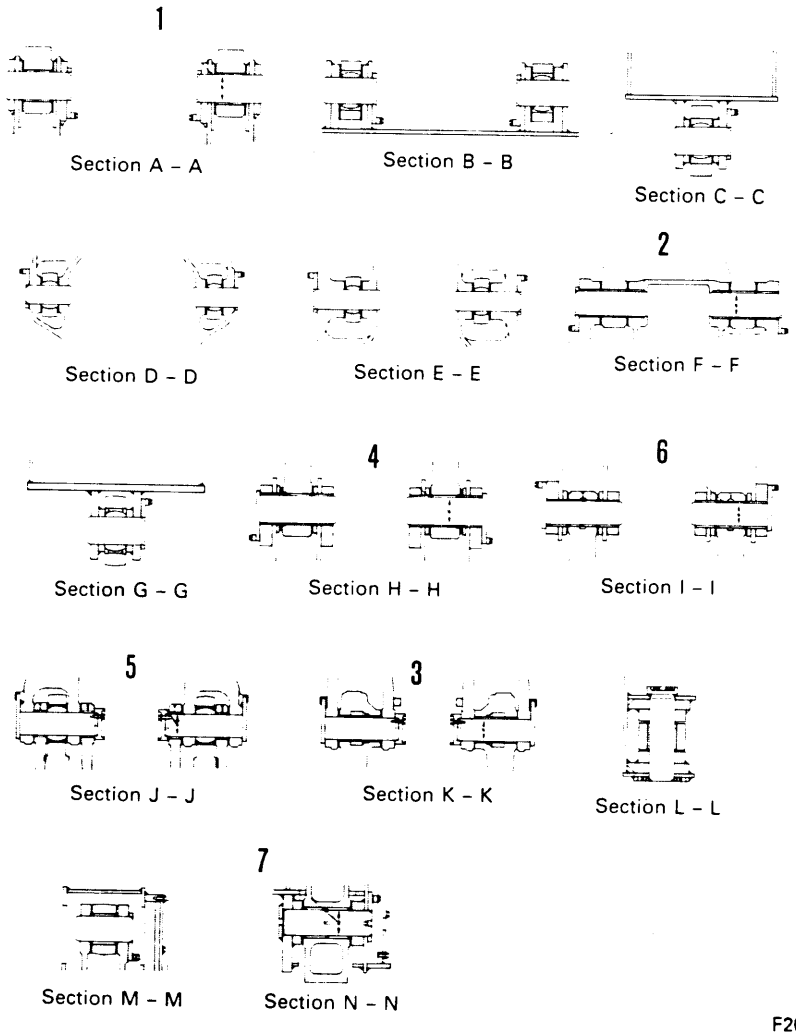
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between boom-revolving frame mounting pin and bushing	140	−0.043 −0.106	+0.542 +0.442	0.485 – 0.648	1.5	
2	Clearance between boom-arm mounting pin and bushing	140	−0.043 −0.106	+0.542 +0.442	0.485 – 0.648	1.5	
3	Clearance between arm-link mounting pin and bushing	115	−0.036 −0.090	+0.351 +0.271	0.307 – 0.441	1.5	
4	Clearance between arm-bucket mounting pin and bushing	130	−0.043 −0.106	+0.393 +0.293	0.336 – 0.499	1.5	
5	Clearance between bucket cylinder-link mounting pin and bushing	115	−0.036 −0.090	+0.351 +0.271	0.307 – 0.441	1.5	
6	Clearance between link-bucket mounting pin and bushing	115	−0.036 −0.090	+0.351 +0.271	0.307 – 0.441	1.5	

LOADING SHOVEL



209F3236



F20905095

020905

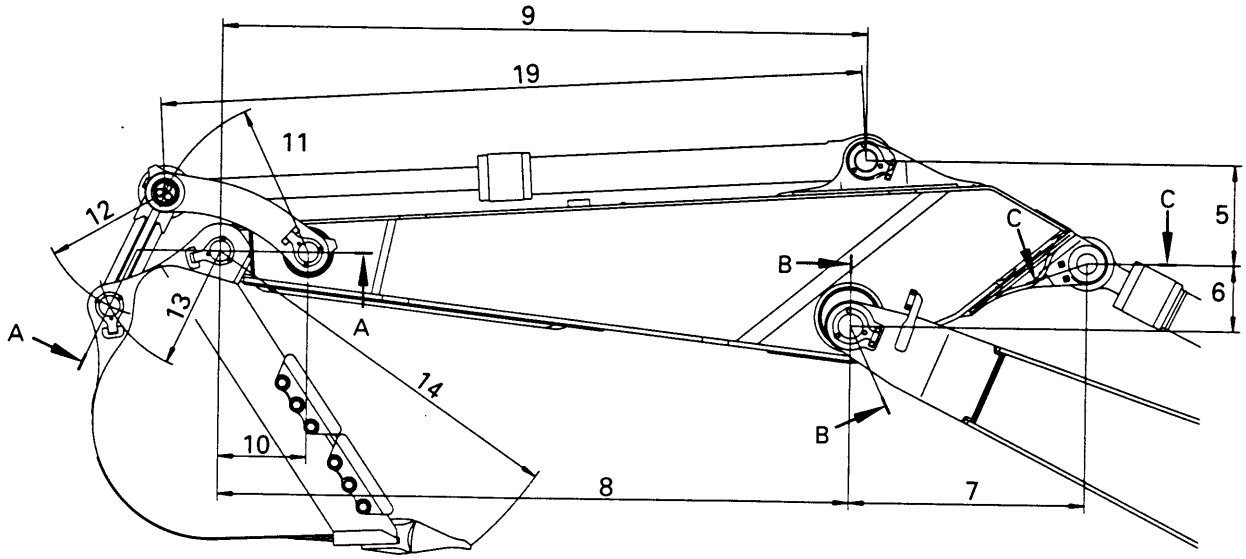
020905

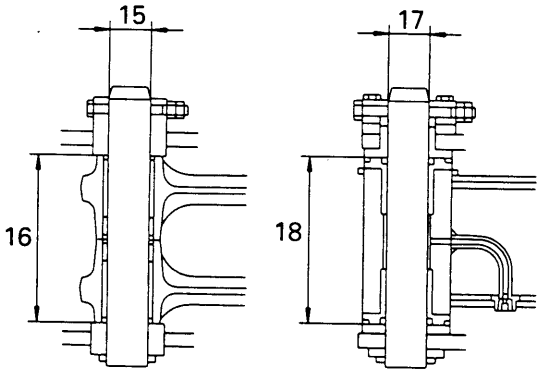
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between boom-revolving frame mounting pin and bushing	140	−0.043 −0.106	+0.424 +0.320	0.363 – 0.530	1.5	
2	Clearance between boom-arm mounting pin and bushing	140	−0.043 −0.106	+0.100 0	0.043 – 0.206	1.5	
3	Clearance between arm-link mounting pin and bushing	115	−0.036 −0.090	+0.351 +0.271	0.307 – 0.441	1.5	
4	Clearance between arm-bucket mounting pin and bushing	140	−0.043 −0.106	+0.351 +0.271	0.314 – 0.475	1.5	
5	Clearance between link-link mounting pin and bushing	115	−0.036 −0.090	+0.351 +0.271	0.307 – 0.441	1.5	
6	Clearance between link-bucket mounting pin and bushing	115	−0.036 −0.090	+0.351 +0.271	0.307 – 0.441	1.5	
7	Clearance between front bucket-rear bucket mounting pin and bushing	95	−0.036 −0.090	+0.344 0	0.308 – 0.434	1.5	

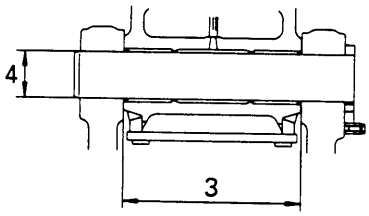
DIMENSION OF WORK EQUIPMENT

1. ARM PORTION

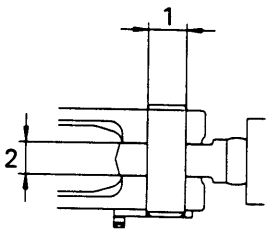




A – A



B – B



C – C

SDP00502

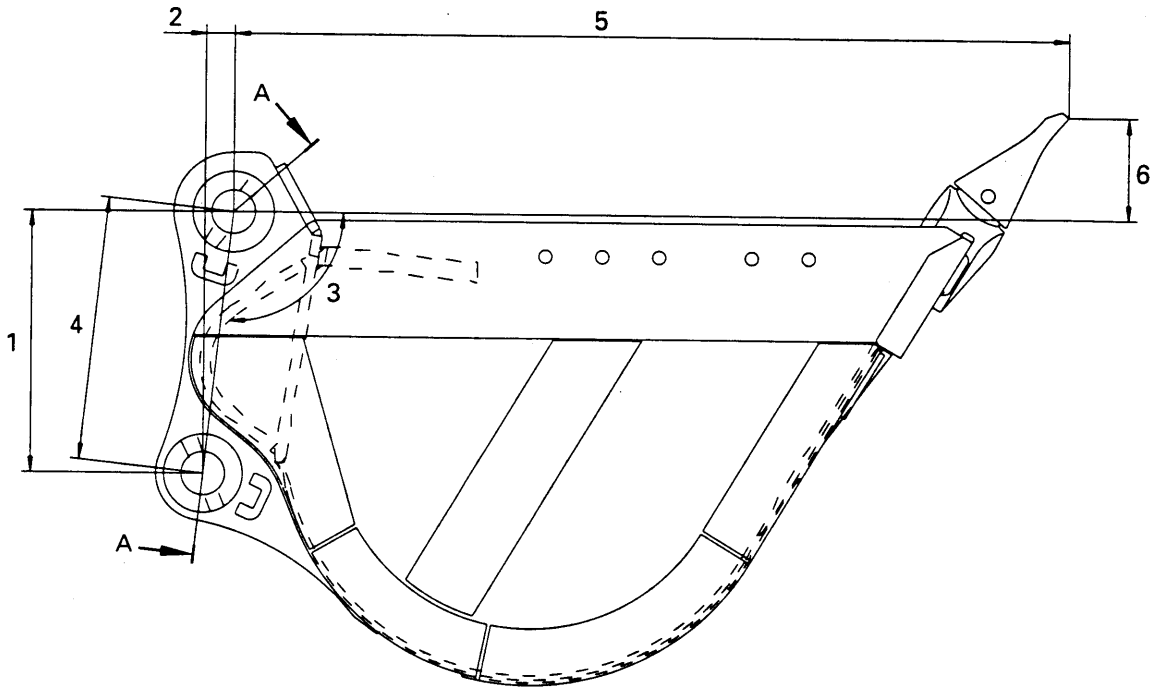
020905

Unit: mm

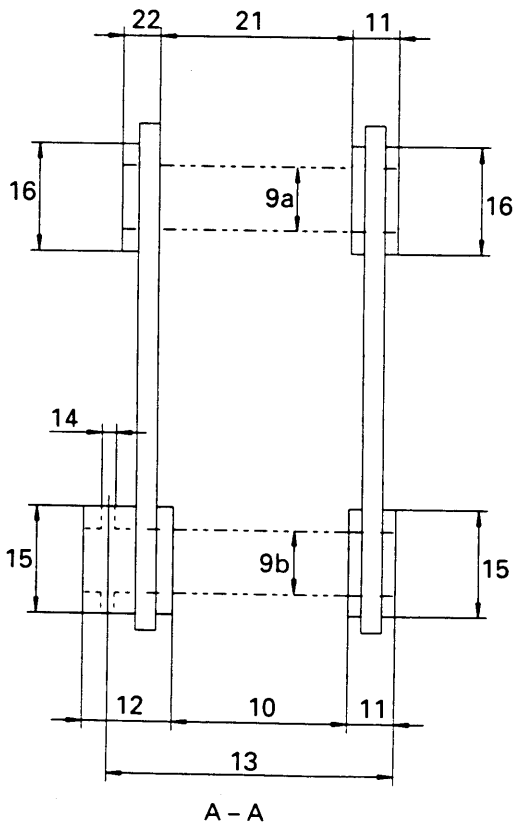
No. \ Applicable machine	PC650-5 PC650LC-5		PC710-5		PC650SE-5 PC710SE-5	PC650SE-5 PC710SE-5
	With 3.6 m arm	With 5.1 m arm	With 3.6 m heavy duty arm	With 3.1 m heavy duty arm	Serial Number PC650SE-5: 20001 - 20163 PC710SE-5: 10001 - 10117	Serial Number PC650SE-5: 20164 and up PC710SE-5: 10118 and up
1	φ 130		φ 130		φ 130	φ 130
2	111		111		111	111
3	436		531		436	531
4	φ 140		φ 140		φ 140	φ 140
5	570	610	570	583	490	490
6	375	420	375	370	551	551
7	1,275	1,300	1,338	1,396	1,305	1,305
8	3,580	5,082	3,580	3,078	2,816	2,816
9	3,670	3,665	3,657	3,677	3,670	3,670
10	500		500	520	490	490
11	840		880	840	840	840
12	700		720	700	700	700
13	683		700		700	700
14	2,268		2,200		2,200	2,200
15	φ 115		φ 115		φ 115	φ 115
16	441		520		441	520
17	φ 115		φ 130		φ 130	φ 130
18 Arm width	424		519		424	519
18 Bushing installed	440		535		440	535
19 Min.	2,440		2,440		2,440	2,440
19 Max.	3,980		3,980		3,980	3,980

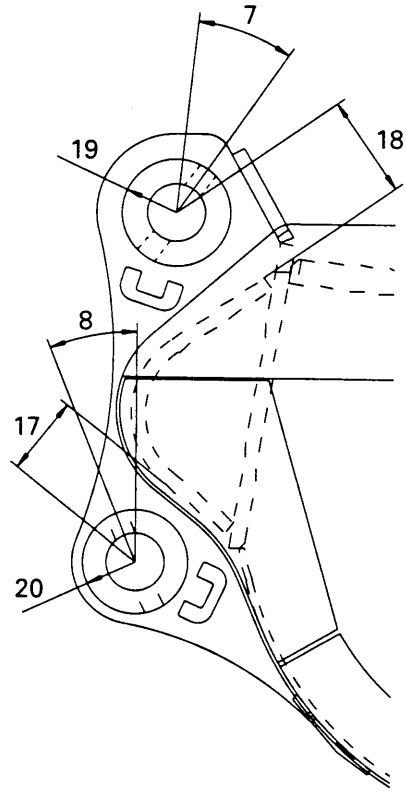
020905

2. BUCKET PORTION



020905





SDP00503

Unit: mm

Applicable machine / No.	PC650-5 PC650LC-5	PC710-5	PC650SE-5 PC710SE-5	PC650SE-5 PC710SE-5
	With 2.5 m³ bucket	With 2.6 m³ bucket	Serial Number PC650SE-5: 20001 – 20163 PC710SE-5: 10001 – 10117	Serial Number PC650SE-5: 20164 and up PC710SE-5: 10118 and up
1	680	696	698	696
2	59	75.5	59	75.5
3	95°	96°	96°	96°
4	683	700	700	700
5	2,247	2,178	2,179	2,174
6	304	306	360	337
7	—	—	—	—
8	—	—	—	—
9 a	ϕ 115	ϕ 130	ϕ 130	ϕ 130
9 b		ϕ 115	ϕ 115	ϕ 115
10	441	520	441	520
11	80.5	80.5	80.5	80.5
12	80.5	80.5	80.5	80.5
13	—	—	—	—
14	—	—	—	—
15	—	—	—	—
16	ϕ 260	ϕ 275	ϕ 275	ϕ 275
17	188	157	157	157
18	180	174	203	203
19	150	157.5	157.5	157.5
20	120	125	125	125
21	464.5	559.5	464.5	559.5
22	79	79	79	79

020905