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CEBM000102

Shop Manual

PC200,200LC-6
PC210LC-6
PC220LC-6
PC250LC-6
HYDRAULIC EXCAVATOR

SERIAL NUMBERS

PC200-6 - A82001
PC200LC-6 - A82001
PC210LC-6 - A82001
PC220LC-6 - A82001 and up
PC250LC-6 - A82001

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October 1996

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SAFETY

SAFETY NOTICE

IMPORTANT SAFETY NOTICE

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

To prevent injury to workers, the symbols ⚠ and ⚠ are 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 & 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, glasses, 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 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

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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 on to 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 part 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.

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FOREWARD

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 sections. These sections are further divided into each main group of components.

GENERAL

This section lists the general machine dimensions, performance specifications, component weights, and fuel, coolant and lubricant specification charts.

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. Contact your distributor for the latest information.

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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: Each issued as one to cover all models
Attachment volume: Each issued as one to cover all models

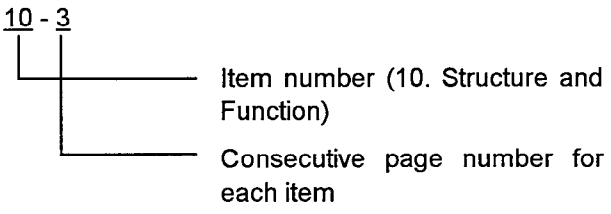
These various volumes are designed to avoid duplication of information. Therefore to deal with all repairs for any model, it is necessary that chassis, engine electrical and attachment be available.

DISTRIBUTION AND UPDATING

Any additions, amendments or other changes will be sent to your 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):
   Refer to the pertinent engine manual.

3. Additional pages: Additional pages are indicated by a hyphen (-) and numbered after the page number. File as in the example.
   Example:
   10-4
   10-4-1 } Added pages
   10-4-2 }
   10-5

REVISED EDITION MARK

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

REVISIONS

Revised pages are shown at the LIST OF REVISED PAGES between the title page and SAFETY page.

SYMBOLS

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

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

HOISTING INSTRUCTIONS

HOISTING

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



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

WIRE ROPES

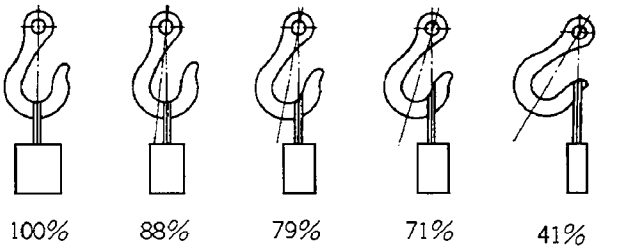
1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

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

Rope diameter (mm)	Allowable load (tons)
10.0	1.0
11.2	1.4
12.5	1.6
14.0	2.2
16.0	2.8
18.0	3.6
20.0	4.4
22.4	5.6
30.0	10.0
40.0	18.0
50.0	28.0
60.0	40.0

★ The allowable load value is estimated to be 1/6 or 1/7 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.

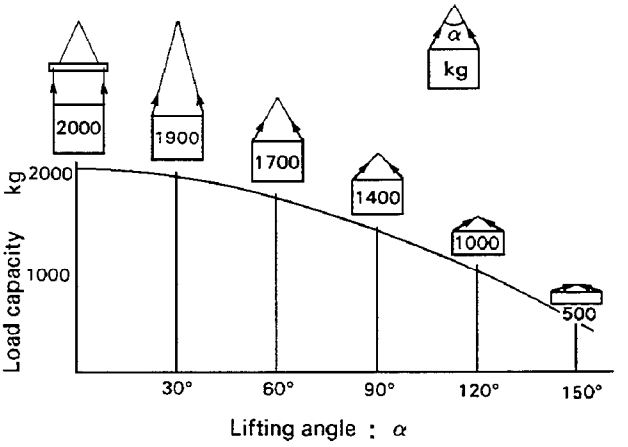


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3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.

⚠ 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 (kg) when hoisting is made with two ropes, each of which is allowed to sling up to 1000 kg vertically, at various hanging angles. When two ropes sling a load vertically, up to 2000 kg of total weight can be suspended. This weight becomes 1000 kg when two ropes make a 120° hanging angle. On the other hand, two ropes are subject to an excessive force as large as 4000 kg if they sling a 2000 kg load at a lifting angle of 150°.



FS0065

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COATING MATERIALS

The recommended coating materials prescribed in the shop manuals are listed below.

Category	Code	Part No.	Qty	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 hardening agent	Adh 1 kg Hard agt 500 kg	Can	• Used as adhesive or sealant for metal, glass or 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 packing 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 at high temperature locations such as engine pre-combustion chamber, exhaust pipe.
	LG-4	790-129-9020	200 g	Tube	• Features: Resistance towater, 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, resistant 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	---	09940-00051	60 g	Can	• Used as lubricant for sliding parts (to prevent squeaking).
Molybdenum disulfide lubricant	---	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-L1	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 disulfide grease	---	SYG2-400M	400 g (10/case)	Bellows type	• Used for places with heavy load.

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STANDARD TIGHTENING TORQUE

STANDARD TIGHTENING TORQUE OF BOLTS AND NUTS

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

1 kgm = 9.806 Nm

Thread diameter of bolt	Width across flat		
mm	mm	kgm	Nm
6	10	1.35 ±0.15	13.2 ±1.4
8	13	3.20 ±0.3	31.4 ±2.9
10	17	6.70 ±0.7	65.7 ±6.8
12	19	11.5 ±1.0	112 ±9.8
14	22	18 ±2.0	177 ±19
16	24	28.5 ±3	279 ±29
18	27	39 ±4	383 ±39
20	30	56 ±6	549 ±58
22	32	76 ±8	745 ±78
24	36	94.5 ±10	927 ±98
27	41	135 ±15	1320 ±140
30	46	175 ±20	1720 ±190
33	50	225 ±25	2210 ±240
36	55	280 ±30	2750 ±290
39	60	335 ±35	3280 ±340

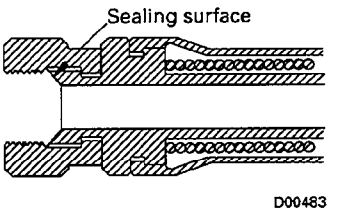
★ This torque table does not apply to the bolts with which nylon packing or other non-ferrous metal washers are to be used, or which require tightening to otherwise specified torque.

TIGHTENING TORQUE OF SPLIT FLANGE BOLTS

Use these torques for split flange bolts.

Thread diameter of bolt	Width across flat	Tightening torque	
mm	mm	kgm	Nm
10	14	6.70 ±0.7	65.7 ±6.8
12	17	11.5 ±1.0	112 ±9.8
16	22	28.5 ±3	279 ±29

TIGHTENING TORQUE FOR FLAIRED NUTS



Use these torques for flaired part of nut.

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

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: 05WB indicates a cable having a nominal number 05 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 strand (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	Instruments	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 TABLES

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 millimeters = 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 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 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

mm	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

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Millimeters to Inches

1 mm = 0.03937 in

mm	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

kg	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

ℓ	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

ℓ	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	7.699	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

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kgm to ft. lb

1 kgm = 7.233 ft. lb

kgm	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

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kg/cm² to lb/in²

1kg/cm² = 14.2233 lb/in²

kg/cm²	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

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Temperature

Fahrenheit Centigrade Conversion; a simple way to convert a Fahrenheit temperature reading into a Centigrade temperature reading or vise 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

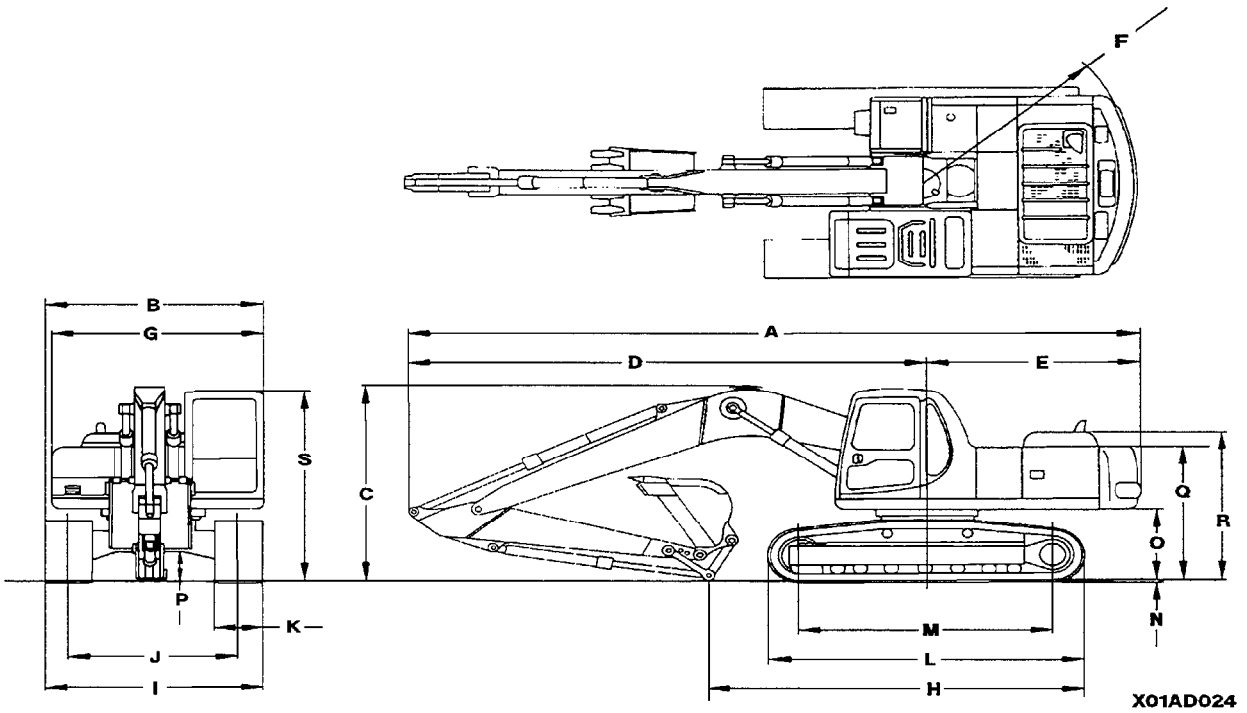
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01 GENERAL

General assembly drawing (PC200-6, PC200LC-6, PC210LC-6) 01- 2
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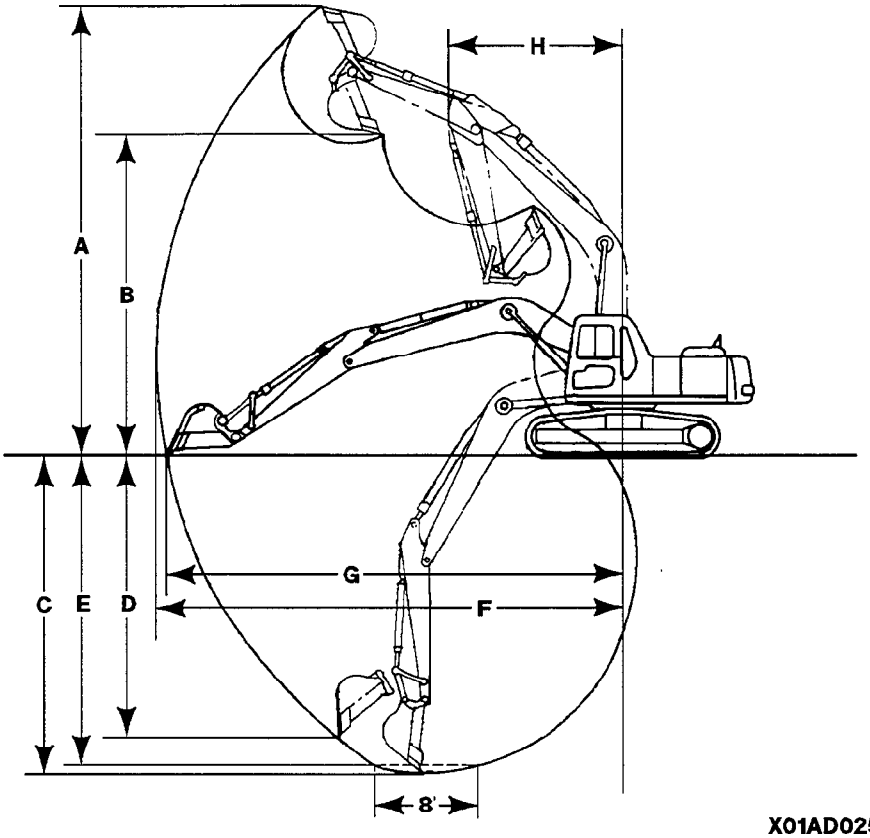
PC200-6, PC200LC-6, PC210LC-6



Unit: mm

Dimension	Description	PC200-6	PC200LC-6	PC210LC-6
A	Overall length	9,425	9,425	9,515
B	Overall width	2,800	3,080	2,980
C	Overall height (to top of boom)	2,970	2,970	2,970
D	Boom swing radius	6,685	6,685	6,665
E	Tail swing radius	2,740	2,740	2,850
F	Counterweight swing radius	2,750	2,750	2,860
G	Width of machine cab	2,710	2,710	2,710
H	Length on ground	4,830	5,020	5,020
I	Width of crawler	2,880	3,080	2,980
J	Track gauge	2,180	2,380	2,380
K	Shoe width	700	700	600
L	Track length	4,080	4,450	4,450
M	Length of track on ground	3,270	3,640	3,640
N	Grouser height	26	26	26
O	Ground clearance, counterweight	1,085	1,085	1,085
P	Ground clearance, undercarriage	440	440	440
Q	Machine cab height	2,020	2,020	2,020
R	Engine compartment height	2,255	2,255	2,255
S	Operator's cab height	2,905	2,905	2,905

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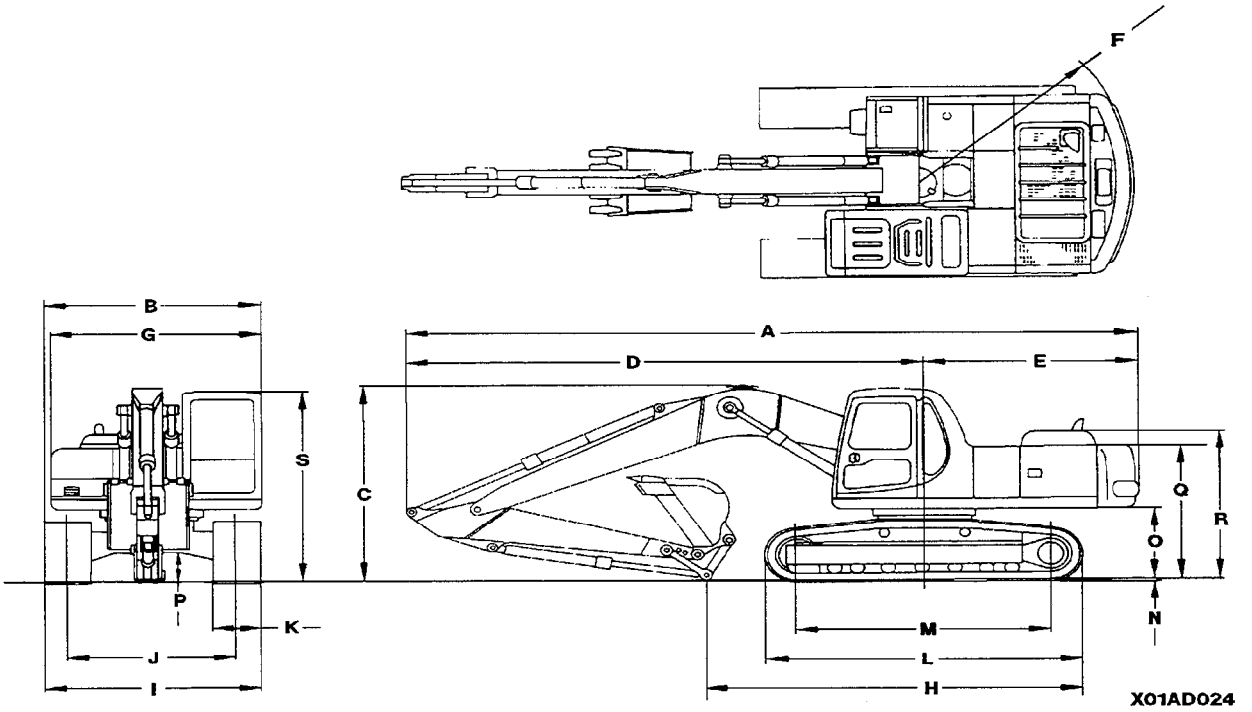
Unit: mm

PC200-6, PC200LC-6 PC210LC-6		Arms			
		1.84 m	2.4 m	* 2.93 m	** 4.06 m
A	Maximum digging height	8,895	9,050	9,305	9,700
B	Maximum dumping height	6,065	6,255	6,475	6,970
C	Maximum digging depth	5,535	6,095	6,602	7,725
D	Maximum vertical wall digging depth	4,965	5,315	5,980	7,075
E	Maximum digging depth of cut for 8 ' level	5,160	5,840	6,435	7,590
F	Maximum digging reach	8,915	9,395	9,875	10,880
G	Maximum digging reach at ground	8,720	9,205	9,700	10,705
H	Minimum swing radius	3,640	3,710	3,630	3,630
Bucket digging force ***		† 14,900 kg	12,700 kg	12,700 kg	12,700 kg
Arm crowd force ***		13,200 kg	11,700 kg	10,000 kg	8,200 kg

* - PC210LC-6 available with only this arm
** - 1.13 m Extension + 2.93 m arm
*** - At power max
† - Optional bucket cylinder is required

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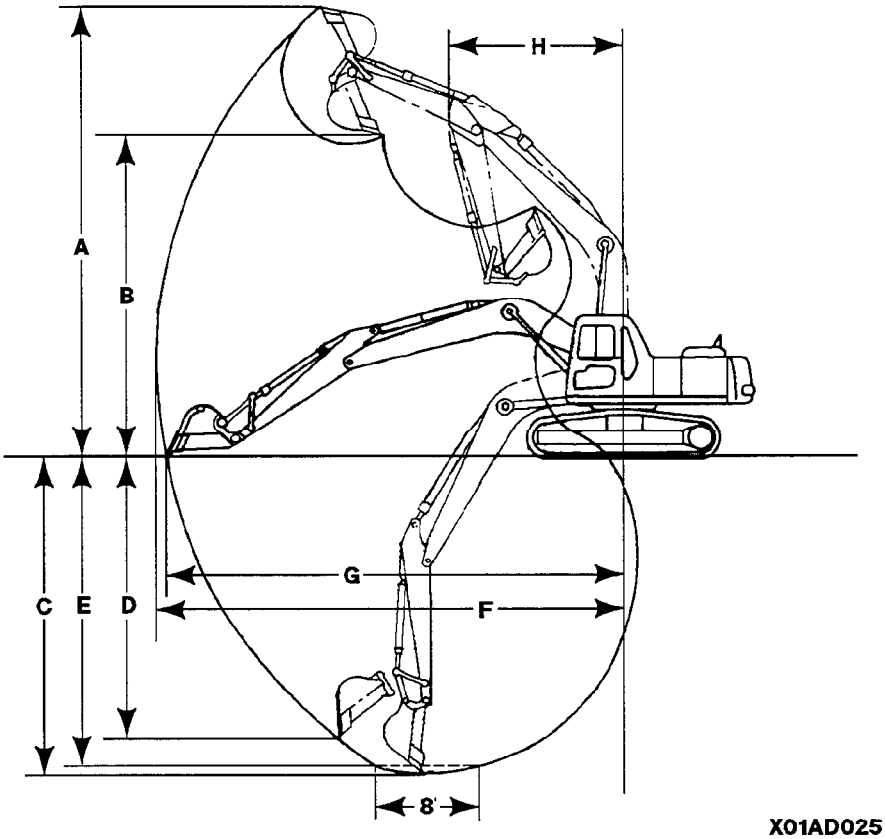
PC220LC-6, PC250LC-6



Unit: mm

Dimension	Description	PC220LC-6	PC250LC-6
A	Overall length	9,780	9,780
B	Overall width	3,280	3,280
C	Overall high (to top of boom)	3,160	3,220
D	Boom swing radius	6,930	6,930
E	Tail swing radius	2,850	2,850
F	Counterweight swing radius	2,860	2,860
G	Width of machine cab	2,710	2,710
H	Length on ground	5,390	5,420
I	Width of crawler	3,280	3,290
J	Track gauge	2,580	2,590
K	Shoe width	700	700
L	Track length	4,640	4,855
M	Length of track on ground	3,830	3,945
N	Grouser height	26	31
O	Ground clearance, counterweight	1,085	1,205
P	Ground clearance, undercarriage	440	500
Q	Machine cab height	2,020	2,140
R	Engine compartment height	2,255	2,375
S	Operator's cab height	2,905	3,020

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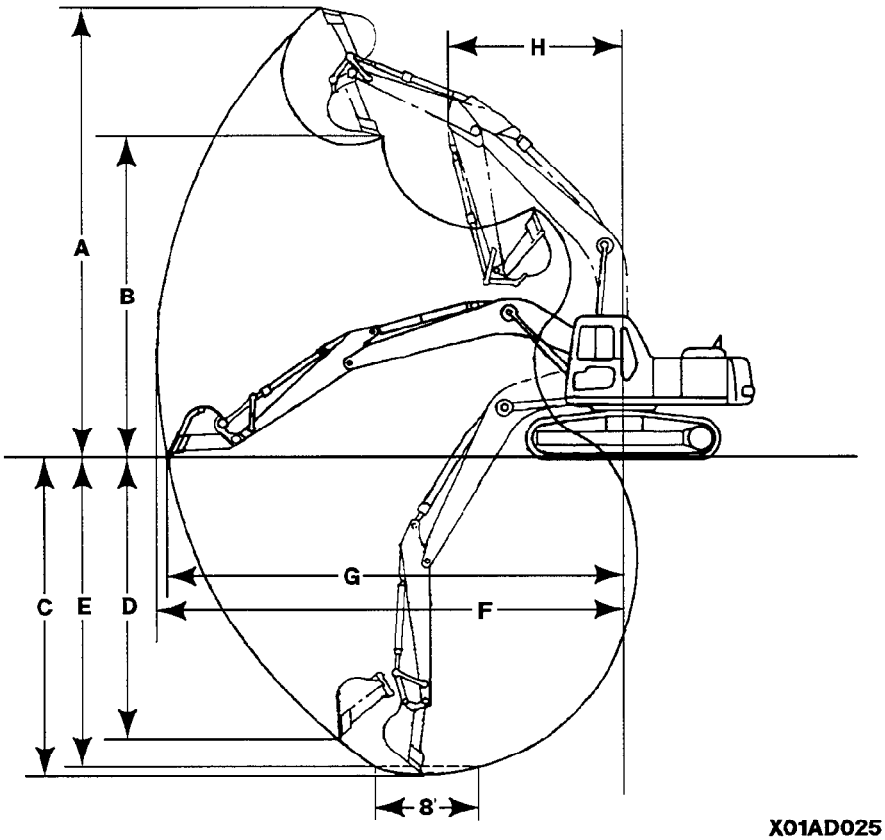
Unit: mm

PC220LC-6		Arms			
		2.0 m	2.5 m	3.05 m	3.5 m
A	Maximum digging height	9,070	9,150	9,380	9,620
B	Maximum dumping height	6,120	6,215	6,515	6,720
C	Maximum digging depth	5,720	6,220	6,770	7,220
D	Maximum vertical wall digging depth	4,955	5,455	6,005	6,455
E	Maximum digging depth of cut for 8 ' level	5,550	6,170	6,440	7,210
F	Maximum digging reach	9,285	9,655	10,180	10,625
G	Maximum digging reach at ground	9,090	9,470	10,000	10,460
H	Minimum swing radius	3,950	3,925	3,860	3,890
Bucket digging force *		†16,700 kg	14,500 kg	14,500 kg	14,500 kg
Arm crowd force *		14,700 kg	13,600 kg	11,900 kg	10,300 kg

* -At power max

† - Optional bucket cylinder is required

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Unit: mm

PC250LC-6		Arms			
		2.0 m	2.5 m	3.05 m	3.5 m
A	Maximum digging height	9,300	9,340	9,660	9,780
B	Maximum dumping height	6,505	6,350	6,750	7,125
C	Maximum digging depth	5,610	6,105	6,650	7,105
D	Maximum vertical wall digging depth	4,930	5,055	5,860	6,165
E	Maximum digging depth of cut for 8 ' level	5,380	5,895	6,475	6,950
F	Maximum digging reach	9,285	9,655	10,180	10,625
G	Maximum digging reach at ground	9,035	9,445	9,980	10,385
H	Minimum swing radius	3,950	3,925	3,860	3,890
Bucket digging force *		†16,700 kg	14,500 kg	14,500 kg	14,500 kg
Arm crowd force *		14,700 kg	13,600 kg	11,900 kg	10,300 kg

* -At power max

† - Optional bucket cylinder is required

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PC200-6, PC200LC-6

				PC200-6	PC200LC-6
Machine Model				PC200-6	PC200LC-6
Serial numbers				A82001 and up	A82001 and up
Bucket capacity			(m^3)	0.8	0.8
Operating weight			(kg)	19,900	21,300
PERFORMANCE	WORKING RANGE	Maximum digging depth	(mm)	6,620	6,620
		Maximum vertical wall depth	(mm)	5,980	5,980
		Maximum digging reach	(mm)	9,875	9,875
		Maximum digging reach at ground level	(mm)	9,700	9,700
		Maximum digging height	(mm)	9,305	9,305
		Maximum dumping height	(mm)	6,475	6,475
	Maximum digging force (when using power max.)		(Kn(kg))	111.7 (11,400) (124.5 (12,700))	111.7 (11,400) (124.5 (12,700))
	Swing speed		(rpm)	11.5	11.5
	Swing maximum slope angle		(deg.)	20	20
	Travel speed		(km/h)	Lo: 3.0 Mi: 4.1 Hi: 5.5	Lo: 3.0 Mi: 4.1 Hi: 5.5
	Gradeability		(deg.)	35	35
	Ground pressure / (standard triple shoe width: mm)		(MPa(kg/cm^2))	0.045 (0.46) / (600)	0.037 (0.38) / (700)
DIMENSIONS	Overall length (for transport)		(mm)	9,425	9,425
	Overall width		(mm)	2,800	2,800
	Overall width of track		(mm)	2,780	3,080
	Overall height (for transport)		(mm)	2,970	2,970
	Overall height to top of cab		(mm)	2,905	2,905
	Ground clearance of counterweight		(mm)	1,085	1,085
	Minimum ground clearance		(mm)	440	440
	Tail swing radius		(mm)	2,750	2,750
	Minimum swing radius of work equipment		(mm)	3,630	3,630
	Height of work equipment at minimum swing radius		(mm)	7,570	7,570
	Length of track on ground		(mm)	3,270	3,340
	Track gauge		(mm)	2,180	2,380
	Height of machine cab		(mm)	2,255	2,255

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Machine model				PC200-6	PC200LC-6
Serial numbers				A82001 and up	A82001 and up
ENGINE	Model			S6D102-1	
	Type			4-cycle, water-cooled, in-line, vertical, direct injection, with turbocharger	
	No. of cylinders - bore x stroke		(mm)	6 - 102 x 120	
	Piston displacement		(cc)	5,880	
	PERFORMANCE	Flywheel horsepower	(kW(HP)/rpm)	108.1 (145) / 2,200	
		Maximum torque	(Nm(kgm)/rpm)	576.6 (58.8) / 1,600	
		High idle in H/O mode	(rpm)	2130 ± 60	
		Low idle in H/O mode	(rpm)	1066 ± 60	
		Minimum fuel consumption ratio	(g/kWh(g/HPh)	210 (155)	
	Cranking motor			24 V, 5.5 kW	
	Alternator			24 V, 45 A	
	Battery			12V, 150 Ah x 2	
	Type of radiator core			CWX-4	
UNDER-CARRIAGE	Carrier roller			2 on each side	2 on each side
	Track roller			7 on each side	9 on each side
	Track shoe			Assembly-type triple grouser	Assembly-type triple grouser
HYDRAULIC SYSTEM	HYDRAULIC PUMP	Type, number		Variable displacement piston type x 2, gear type x 1	
		Delivery	(ℓ/min)	Piston type: 206 x 2 gear type: 30	
		Set pressure	(MPa(kg/cm^2))	Piston type: 34.79 (355) gear type: 3.33 (34)	
	CONTROL VALVE	Type, number		6-spool type x 1	
		Control method		Hydraulic type	
	HYDRAULIC MOTOR	Travel motor		Piston type (with brake valve, parking brake) x 2	
		Swing motor		Piston type (with safety valve, parking brake) x 1	
	Hydraulic cylinder			Reciprocating piston	
	Hydraulic tank			Box-shaped, open	
	Hydraulic filter			Tank return side	
	Hydraulic cooler			Air cooled (SF-3)	

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PC210LC-6

Machine Model				PC210LC-6
Serial numbers				A82001 and up
Bucket capacity			(m^3)	0.8
Operating weight			(kg)	23,210
PERFORMANCE	WORKING RANGE	Maximum digging depth	(mm)	6,620
		Maximum vertical wall depth	(mm)	5,355
		Maximum digging reach	(mm)	9,875
		Maximum digging reach at ground level	(mm)	9,700
		Maximum digging height	(mm)	9,180
		Maximum dumping height	(mm)	6,475
	Maximum digging force (when using power max.)		(Kn(kg))	111.7 (11,400) (124.5 (12,700))
	Swing speed		(rpm)	11.5
	Swing maximum slope angle		(deg.)	20
	Travel speed		(km/h)	Lo: 3.0 Mi: 4.1 Hi: 5.5
	Gradeability		(deg.)	35
	Ground pressure / (standard triple shoe width: mm)		($MPa(kg/cm^2)$)	0.053 (0.54) / (600)
DIMENSIONS	Overall length (for transport)		(mm)	9,515
	Overall width		(mm)	2,800
	Overall width of track		(mm)	3,080
	Overall height (for transport)		(mm)	2,970
	Overall height to top of cab		(mm)	2,905
	Ground clearance of counterweight		(mm)	1,085
	Minimum ground clearance		(mm)	440
	Tail swing radius		(mm)	2,750
	Minimum swing radius of work equipment		(mm)	3,630
	Height of work equipment at minimum swing radius		(mm)	7,570
	Length of track on ground		(mm)	3,640
	Track gauge		(mm)	2,380
	Height of machine cab		(mm)	2,255

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Machine model				PC210LC-6
Serial numbers				A82001 and up
ENGINE	Model			S6D102-1
	Type			4-cycle, water-cooled, in-line, vertical, direct injection, with turbocharger
	No. of cylinders - bore x stroke		(mm)	6 - 102 x 120
	Piston displacement		(cc)	5,880
	PERFORMANCE	Flywheel horsepower	(kW(HP)/rpm)	108.1 (145) / 2,200
		Maximum torque	(Nm(kgm)/rpm)	576.6 (58.8) / 1,600
		High idle in H/O mode	(rpm)	2130 ± 60
		Low idle in H/O mode	(rpm)	1066 ± 60
		Minimum fuel consumption ratio	(g/kWh(g/HPh)	210 (155)
	Cranking motor			24 V, 5.5 kW
	Alternator			24 V, 45 A
	Battery			12V, 150 Ah x 2
	Type of radiator core			CWX-4
UNDER-CARRIAGE	Carrier roller			2 on each side
	Track roller			9 on each side
	Track shoe			Assembly-type triple grouser
HYDRAULIC SYSTEM	HYDRAULIC PUMP	Type, number		Variable displacement piston type x 2, gear type x 1
		Delivery	(ℓ/min)	Piston type: 206 x 2 gear type: 30
		Set pressure	(MPa(kg/cm²))	Piston type: 34.79 (355) gear type: 3.33 (34)
	CONTROL VALVE	Type, number		7-spool type x 1
		Control method		Hydraulic type
	HYDRAULIC MOTOR	Travel motor		Piston type (with brake valve, parking brake) x 2
		Swing motor		Piston type (with safety valve, parking brake) x 1
	Hydraulic cylinder			Reciprocating piston
	Hydraulic tank			Box-shaped, open
	Hydraulic filter			Tank return side
	Hydraulic cooler			Air cooled (SF-3)

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PC220LC-6

Machine Model				PC220LC-6
Serial numbers				A82001 and up
Bucket capacity			(m^3)	1.0
Operating weight			(kg)	23,550
PERFORMANCE	WORKING RANGE	Maximum digging depth	(mm)	6,920
		Maximum vertical wall depth	(mm)	6,010
		Maximum digging reach	(mm)	10,180
		Maximum digging reach at ground level	(mm)	10,000
		Maximum digging height	(mm)	9,380
		Maximum dumping height	(mm)	6,515
	Maximum digging force (when using power max.)		(Kn(kg))	130.3 (13,300) (142.1 (14,500))
	Swing speed		(rpm)	11.5
	Swing maximum slope angle		(deg.)	17.5
	Travel speed		(km/h)	Lo: 3.0 Mi: 4.1 Hi: 5.5
	Gradeability		(deg.)	35
	Ground pressure / (standard triple shoe width: mm)		($MPa(kg/cm^2)$)	0.040 (0.41) / (700)
DIMENSIONS	Overall length (for transport)		(mm)	9,780
	Overall width		(mm)	3,280
	Overall width of track		(mm)	3,280
	Overall height (for transport)		(mm)	3,160
	Overall height to top of cab		(mm)	2,905
	Ground clearance of counterweight		(mm)	1,085
	Minimum ground clearance		(mm)	440
	Tail swing radius		(mm)	2,860
	Minimum swing radius of work equipment		(mm)	3,860
	Height of work equipment at minimum swing radius		(mm)	7,760
	Length of track on ground		(mm)	3,830
	Track gauge		(mm)	2,580
	Height of machine cab		(mm)	2,255

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Machine model				PC220LC-6
Serial numbers				A82001 and up
ENGINE	Model			SA6D102-1
	Type			4-cycle, water-cooled, in-line, vertical, direct injection, with turbocharger
	No. of cylinders - bore x stroke		(mm)	6 - 102 x 120
	Piston displacement		(cc)	5,880
	PERFORMANCE	Flywheel horsepower	(kW(HP)/rpm)	129.8 (174) / 2,300
		Maximum torque	(Nm(kgm)/rpm)	624.7 (63.7) / 1,500
		High idle in H/O mode	(rpm)	2300 ± 60
		Low idle in H/O/ mode	(rpm)	1066 ± 60
		Minimum fuel consumption ratio	(g/kWh(g/HPh)	212 (156)
	Cranking motor			24 V, 5.5 kW
	Alternator			24 V, 45 A
	Battery			12V, 150 Ah x 2
	Type of radiator core			CWX-4
UNDER-CARRIAGE	Carrier roller			2 on each side
	Track roller			10 on each side
	Track shoe			Assembly-type triple grouser
HYDRAULIC SYSTEM	HYDRAULIC PUMP	Type, number		Variable displacement piston type x 2, gear type x 1
		Delivery	(ℓ/min)	Piston type: 215 x 2 gear type: 31
		Set pressure	(MPa(kg/cm^2))	Piston type: 34.79 (355) gear type: 3.33 (34)
	CONTROL VALVE	Type, number		6-spool type x 1
		Control method		Hydraulic type
	HYDRAULIC MOTOR	Travel motor		Piston type (with brake valve, parking brake) x 2
		Swing motor		Piston type (with safety valve, parking brake) x 1
	Hydraulic cylinder			Reciprocating piston
	Hydraulic tank			Box-shaped, open
	Hydraulic filter			Tank return side
	Hydraulic cooler			Air cooled (SF-3)

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PC250LC-6

Machine Model				PC250LC-6
Serial numbers				A82001 and up
Bucket capacity			(m^3)	1.0
Operating weight			(kg)	27,500
PERFORMANCE	WORKING RANGE	Maximum digging depth	(mm)	6,650
		Maximum vertical wall depth	(mm)	6,580
		Maximum digging reach	(mm)	10,180
		Maximum digging reach at ground level	(mm)	9,980
		Maximum digging height	(mm)	9,660
		Maximum dumping height	(mm)	6,750
	Maximum digging force (when using power max.)		(Kn(kg))	130.3 (13,300) (142.1 (14,500))
	Swing speed		(rpm)	11.5
	Swing maximum slope angle		(deg.)	17.5
	Travel speed		(km/h)	Lo: 2.2 Mi: 4.1 Hi: 5.1
	Gradeability		(deg.)	35
	Ground pressure / (standard triple shoe width: mm)		(MPa(kg/cm^2))	0.045 (0.46) / (700)
DIMENSIONS	Overall length (for transport)		(mm)	9,780
	Overall width		(mm)	3,290
	Overall width of track		(mm)	3,290
	Overall height (for transport)		(mm)	3,250
	Overall height to top of cab		(mm)	3,050
	Ground clearance of counterweight		(mm)	1,205
	Minimum ground clearance		(mm)	500
	Tail swing radius		(mm)	2,860
	Minimum swing radius of work equipment		(mm)	3,860
	Height of work equipment at minimum swing radius		(mm)	7,880
	Length of track on ground		(mm)	3,945
	Track gauge		(mm)	2,580
	Height of machine cab		(mm)	2,375

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Machine model				PC250LC-6
Serial numbers				A82001 and up
ENGINE	Model			SA6D102-1
	Type			4-cycle, water-cooled, in-line, vertical, direct injection, with turbocharger
	No. of cylinders - bore x stroke		(mm)	6 - 102 x 120
	Piston displacement		(cc)	5,880
	PERFORMANCE	Flywheel horsepower	(kW(HP)/rpm)	129.8 (174) / 2,300
		Maximum torque	(Nm(kgm)/rpm)	624.7 (63.7) / 1,500
		High idle in H/O/ mode	(rpm)	2300 ± 60
		Low idle in H/O mode	(rpm)	1066 ± 60
		Minimum fuel consumption ratio	(g/kWh(g/HPh)	212 (156)
	Cranking motor			24 V, 5.5 kW
	Alternator			24 V, 45 A
	Battery			12V, 150 Ah x 2
	Type of radiator core			CWX-4
UNDER-CARRIAGE	Carrier roller			2 on each side
	Track roller			10 on each side
	Track shoe			Assembly-type triple grouser
HYDRAULIC SYSTEM	HYDRAULIC PUMP	Type, number		Variable displacement piston type x 2, gear type x 1
		Delivery	(ℓ/min)	Piston type: 215 x 2 gear type: 31
		Set pressure	(MPa(kg/cm²))	Piston type: 34.79 (355) gear type: 3.33 (34)
	CONTROL VALVE	Type, number		6-spool type x 1
		Control method		Hydraulic type
	HYDRAULIC MOTOR	Travel motor		Piston type (with brake valve, parking brake) x 2
		Swing motor		Piston type (with safety valve, parking brake) x 1
	Hydraulic cylinder			Reciprocating piston
	Hydraulic tank			Box-shaped, open
	Hydraulic filter			Tank return side
	Hydraulic cooler			Air cooled (SF-3)

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PC200-6, PC200LC-6

Unit: kg

Machine model	PC200-6	PC200LC-6
Serial number	A82001 and up	A82001 and up
Engine assembly	684	684
• Engine	480	480
• Damper	6	6
• Hydraulic pump	142	142
Radiator • oil cooler assembly	144	144
Hydraulic tank • filter assembly (excl. oil)	133	133
Fuel tank assembly (excl. fuel)	114	114
Revolving frame	1,637	1,637
Operator's cab	287	287
Operator's seat	29	29
Counterweight	3,280	3,280
Swing machinery	205	205
Control valve	230	230
Swing motor	9	9
Travel motor	123 x 2	123 x 2
Center swivel joint	42	42
Track frame assembly	4,666	5,308
• Track frame	2,374	2,864
• Swing circle	276	276
• Idler	140 x 2	140 x 2
• Idler cushion	135 x 2	135 x 2
• Carrier roller	21 x 4	21 x 4
• Track roller	38 x 14	38 x 18
• Travel motor • final drive	425 x 2	425 x 2
Track shoe assembly		
Standard triple grouser shoe (600 mm)	1,310 x 2	1,425 x 2
Standard triple grouser shoe (700 mm)	1,435 x 2	1,565 x 2
Wide triple grouser shoe (800 mm)	1,565 x 2	1,705 x 2
Wide triple grouser shoe (900 mm)	1,690 x 2	1,840 x 2

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Unit: kg

Machine model	PC200-6	PC200LC-6
Serial number	A82001 and up	A82001 and up
Boom assembly	1,334	1,334
Arm assembly	620	620
Bucket assembly	623	623
Boom cylinder assembly	187 x 2	187 x 2
Arm cylinder assembly	251	251
Bucket cylinder assembly	155	155
Link (large) assembly	78	78
Link (small) assembly	22 x 2	22 x 2
Boom pin	43 + 10 x 2 + 25 + 10 + 20	43 + 10 x 2 + 25 + 10 + 20
Arm pin	10 x 2	10 x 2
Bucket pin	20 x 2	20 x 2
Link pin	13 x 2	13 x 2

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PC210LC-6

Unit: kg

Machine model	PC210LC-6
Serial number	A82001 and up
Engine assembly	685
• Engine	480
• Damper	6
• Hydraulic pump	142
Radiator • oil cooler assembly	144
Hydraulic tank • filter assembly (excl. oil)	133
Fuel tank assembly (excl. fuel)	114
Revolving frame	1,982
Operator's cab	290
Operator's seat	29
Counterweight	4,730
Swing machinery	205
Control valve	230
Swing motor	9
Travel motor	123 x 2
Center swivel joint	42
Track frame assembly	5,318
• Track frame	2,870
• Swing circle	280
• Idler	140 x 2
• Idler cushion	135 x 2
• Carrier roller	21 x 4
• Track roller	38 x 18
• Travel motor • final drive	425 x 2
Track shoe assembly	
Standard triple grouser shoe (600 mm)	1,425 x 2
Standard triple grouser shoe (700 mm)	1,565 x 2
Wide triple grouser shoe (800 mm)	—
Wide triple grouser shoe (900 mm)	—

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Unit: kg

Machine model	PC210LC-6
Serial number	A82001 and up
Boom assembly	1,420
Arm assembly	758
Bucket assembly	753
Boom cylinder assembly	187 x 2
Arm cylinder assembly	251
Bucket cylinder assembly	155
Link (large) assembly	78
Link (small) assembly	22 x 2
Boom pin	43 + 10 x 2 + 32 + 10 + 26
Arm pin	10 x 2
Bucket pin	20 x 2
Link pin	13 x 2

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PC220LC-6, PC250LC-6

Unit: kg

Machine model	PC220LC-6	PC250LC-6
Serial number	A82001 and up	A82001 and up
Engine assembly	699	699
• Engine	495	495
• Damper	6	6
• Hydraulic pump	142	142
Radiator • oil cooler assembly	163	163
Hydraulic tank • filter assembly (excl. oil)	133	133
Fuel tank assembly (excl. fuel)	114	114
Revolving frame	1,965	1,910
Operator's cab	287	287
Operator's seat	29	29
Counterweight	4,300	4,730
Swing machinery	205	205
Control valve	230	230
Swing motor	9	9
Travel motor	123 x 2	123 x 2
Center swivel joint	42	42
Track frame assembly	5,809	7,682
• Track frame	3,286	4,312
• Swing circle	280	716
• Idler	140 x 2	166 x 2
• Idler cushion	135 x 2	257 x 2
• Carrier roller	21 x 4	31 x 4
• Track roller	38 x 20	52 x 16
• Travel motor • final drive	425 x 2	426 x 2
Track shoe assembly		
Standard triple grouser shoe (600 mm)	1,480 x 2	3,730 x 2
Standard triple grouser shoe (700 mm)	1,625 x 2	4,090 x 2
Wide triple grouser shoe (800 mm)	1,770 x 2	4,455 x 2
Wide triple grouser shoe (900 mm)	—	—

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Unit: kg

Machine model	PC220LC-6	PC250LC-6
Serial number	A82001 and up	A82001 and up
Boom assembly	1,627	1,627
Arm assembly	710	710
Bucket assembly	747	747
Boom cylinder assembly	215 x 2	215 x 2
Arm cylinder assembly	296	296
Bucket cylinder assembly	183	183
Link (large) assembly	80	80
Link (small) assembly	22 x 2	22 x 2
Boom pin	51 + 10 x 2 + 31 + 10 + 26	51 + 10 x 2 + 31 + 10 + 26
Arm pin	10 x 2	10 x 2
Bucket pin	20 x 2	20 x 2
Link pin	17 x 2	17 x 2

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RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE -22 -4 14 32 50 68 86 104°F -30 -20 -10 0 10 20 30 40°C	CAPACITY (ℓ) Specified	CAPACITY (ℓ) Refill
Engine oil pan	Engine oil	SAE 30 / SAE 10 W / SAE 10W-30 / SAE 15W-40	23.5	22.5
Damper case			0.75	—
Swing machinery case		SAE 30	6.8	6.8
Final drive case (each)			6.3 PC250LC-6 8.0	5.5 PC250LC-6 7.4
Idler (each)			0.07 - 0.08	0.07 - 0.08
Track roller (each)		SAE 30	0.19 - 0.21	0.19 - 0.21
Carrier roller (each)			0.23 - 0.25	0.23 - .025
Hydraulic system		SAE 10W / SAE 15W-40 / SAE 10W-30	PC200,PC210 239 PC220,PC250 246	166
Fuel tank	Diesel fuel	ASTM D975 No. 2 / ASTM D975 No. 1	310	—
Cooling system	Coolant	See "Coolant" on page 01-23	PC200,PC210 22.6 PC220,PC250 22.8	—

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.

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

REMARK

- When fuel sulphur content is less than 0.5%, change the engine oil at the normal periodic maintenance interval described in the Operation and Maintenance Manual.
  Change engine 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%	½ of regular interval
Above 1.0%	¼ of regular interval

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OIL

- When starting the engine in an atmospheric temperature of lower than 0°C (32°F), be sure to use an engine oil grade of SAE 10W, SAE 10W-30, or SAE 15W-40, even though the atmospheric temperature goes up to 10°C (50°F) more or less in the day time.

- We recommend genuine Komatsu oil which has been specifically formulated and approved for use in engine and hydraulic work equipment application.

- Oil performance recommendations are as follows:

  The use of a quality engine lubricating oil combined with appropriate oil and filter change intervals are critical factors in maintaining engine performance and durability.
  SAE 15W-40 multi-viscosity oil meeting the American Petroleum Institute (API) performance classification of CE or CF-4 is recommended.
  NOTE: CD or CD/SF oils may be used with the interval given in the maintenance schedule in areas where CE or CF-4 is not yet available.
  A sulfated ash limit of 1.0 mass percent is suggested for optimum valve and piston deposit and oil consumption control. The sulfated ash must not exceed 1.85 mass percent. The sulfated ash limit of 1.85 mass percent has been placed on all engine lubricating oils recommended for use in the engine. Higher ash oils can cause valve and/or piston damage and lead to excessive oil consumption.
  The API service symbol displays the appropriate oil categories; the lower half may contain words to describe oil energy conserving features. The center section identifies the SAE oil viscosity grade.

- Oil viscosity recommendations are as follows:

  The use of multi-graded lubricating oil has been found to improve oil consumption control and improve engine cranking in cold temperatures while maintaining lubrication a high operating temperatures.
  While SAE 15W-40 multi-viscosity oil is recommended for most operating climates, refer to the previous chart for oil viscosity recommendations for extreme climates.
  NOTE: Single graded oils may be used if multi-graded oil is not available, but be sure to use oil that matches the temperature in the table.
  Special "break-in" lubricating oils are not recommended for a new or rebuilt engine. Use the same type of oil during the "break-in" as specified for normal operation.

  Additional information regarding lubricating oil availability throughout the world is available in the "E.M.A. Lubricating Oils Data Book For Heavy Duty Automotive and Industrial Engines." The data book may be ordered from the Engine Manufacturers Association, 401 North Michigan Avenue, Chicago, IL U.S.A. 60611. The telephone number is (312) 644-6610.

ARCTIC OPERATION

If an engine is operated in ambient temperatures consistently below -23°C (-10°F) and there is no provisions to keep the engine warm when it is not in operation, use a synthetic API performance oil classification CE or CF-4 engine oil with adequate low temperature properties such as SAE 5W-20 or 5W-30.
The oil supplier must be responsible for meeting the performance service specifications.

IMPORTANT: The use of a synthetic base oil does not justify extended oil change intervals. Extended oil change intervals can decrease engine life due to factors such as; corrosion, deposits and wear.

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COOLANT

- River water contains large amounts of calcium and other impurities, so if it is used, scale will stick to the engine and radiator, and this will decrease heat exchange and cause overheating.
  Water should meet the following guidelines.

  Total Hardness - Not to exceed 170 parts per million (10 grains/gallon maximum) to prevent scale deposits. Water containing dissolved magnesium and calcium (the usual reason for water hardness) above the specified amount will cause scale deposits to develop in the engine.

  Chlorides - Not to exceed 40 parts per million (2.5 grains/gallon maximum) to prevent corrosion.

  Sulfites - Not to exceed 100 parts per million (5.8 grains/gallon maximum) to prevent corrosion.

  Dissolved Solids - Not to exceed 340 parts per million (20 grains/gallon maximum) to minimize sludge deposits, scale deposits, corrosion or a combination of these.

  If any of the above requirements cannot be met, use distilled, de-ionized, or de-mineralized water. To determine if local water supplies meet these standards, water samples can be tested by water treatment laboratories. "Softened" water that is prepared using common salt (sodium chloride) contains excessive amounts of chlorides and should not be used.

- When using anti-freeze, always observe the precautions given in the Operation and Maintenance Manual.

- Komatsu machines are supplied with Komatsu original anti-freeze in the coolant when the machine is shipped.
  This anti-freeze is effective in preventing corrosion of the cooling system.
  The anti-freeze can be used continuously for two years or 2000 hours. Therefore, it can be used as is even in hot areas.

- Anti-freeze is inflammable, so be extremely careful not to expose it to flame or fire.

- The proportion of anti-freeze to water differs according to the ambient temperature.
  For details of the mixing proportions, see the Operation and Maintenance Manual.

- If the engine overheats, wait for the engine to cool before adding coolant.

- If the coolant level is low, it will cause overheating and will also cause problems with corrosion from the air in the coolant.

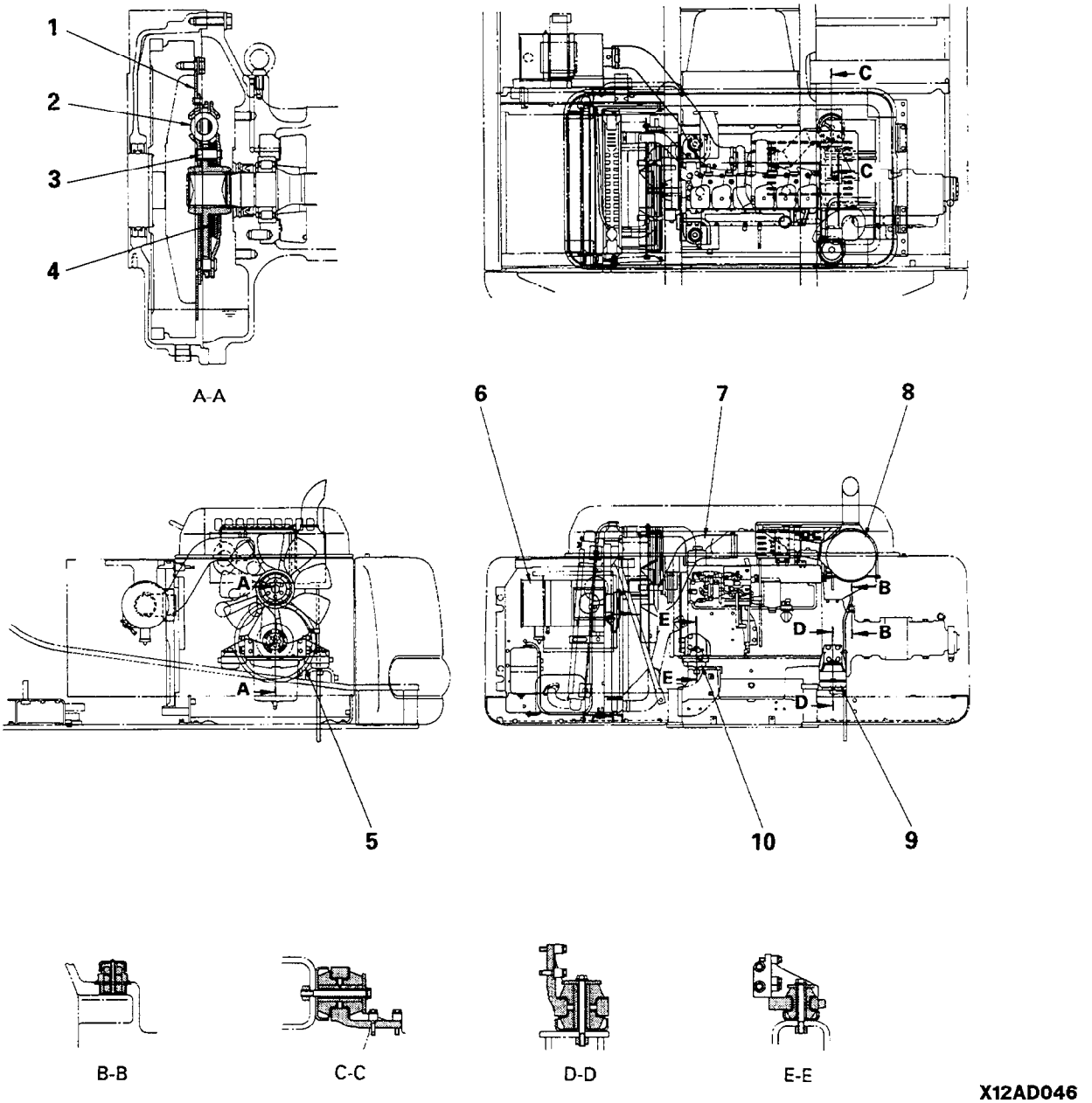
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10 STRUCTURE AND FUNCTION

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ENGINE RELATED PARTS



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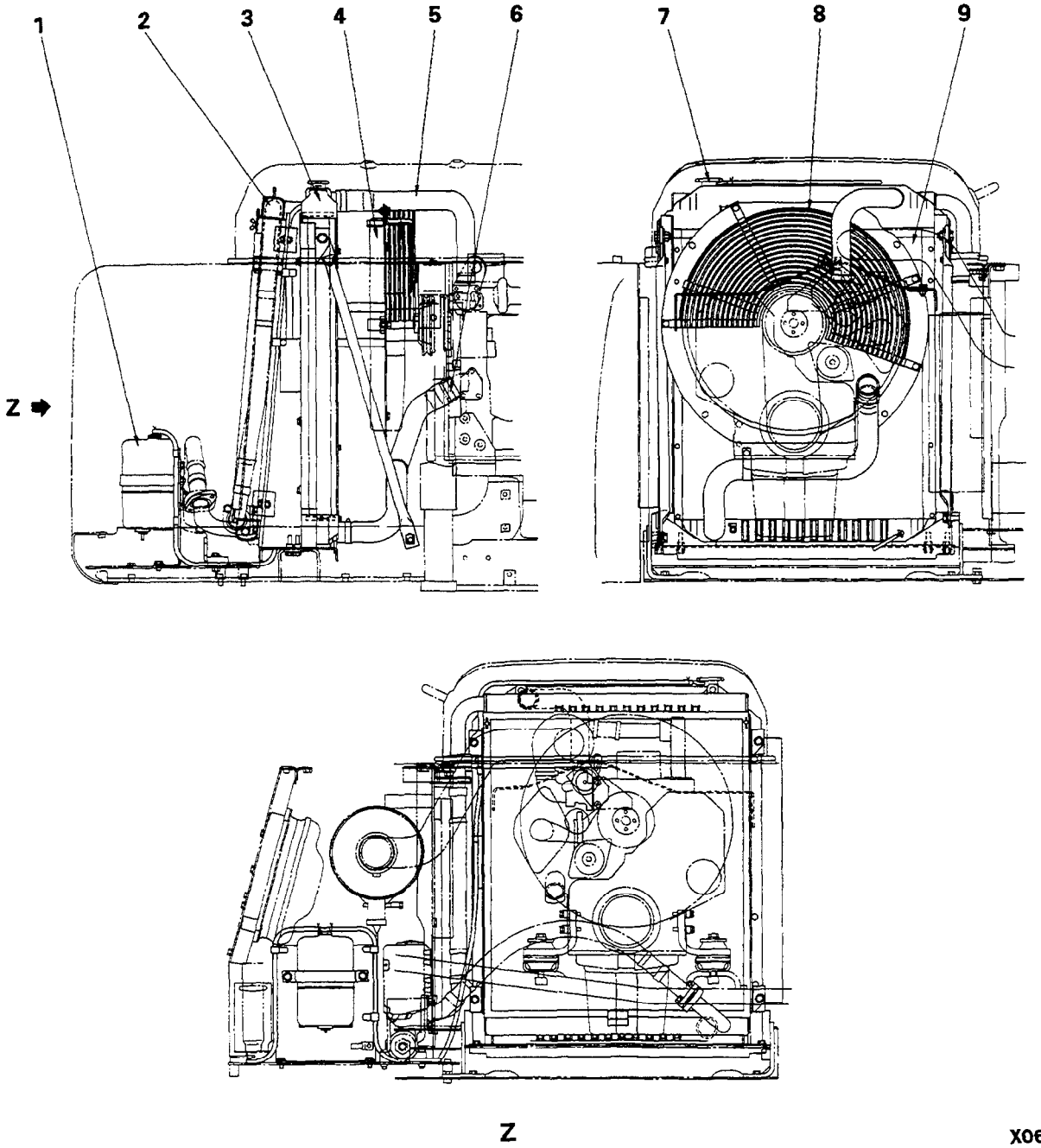
1. Drive plate
2. Torsion spring
3. Stopper pin
4. Friction plate
5. Damper assembly
6. Air cleaner
7. Intake connector
8. Muffler
9. Rear engine mount
10. Front engine mount

OUTLINE

- The damper assembly is a wet type.
  Oil capacity: 0.75 ℓ

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RADIATOR • OIL COOLER • AFTERCOOLER



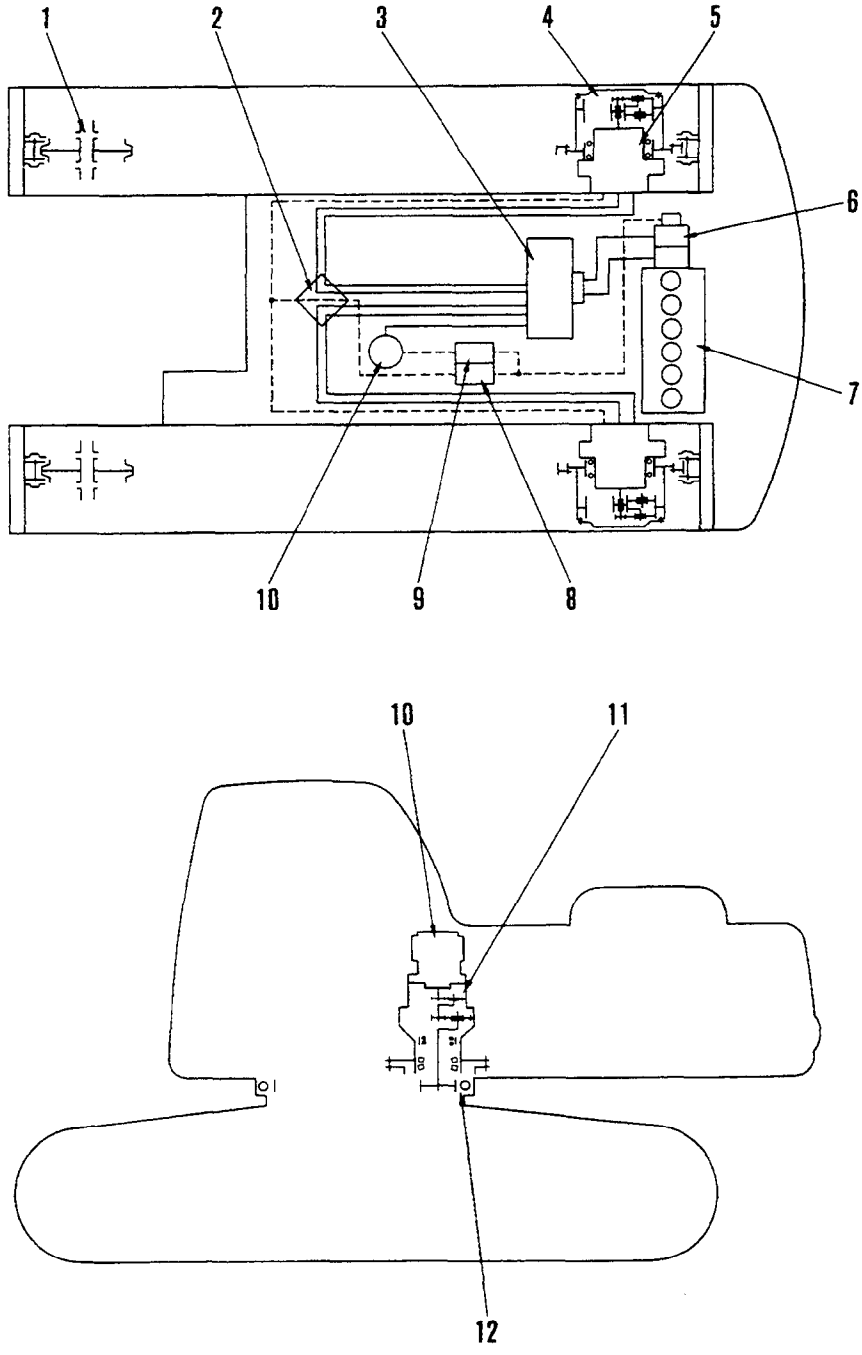
X06AD009

1. Reservoir tank
2. Oil cooler
3. Radiator
4. Fan
5. Radiator inlet hose
6. Radiator outlet hose
7. Radiator cap
8. Net
9. Shroud

SPECIFICATIONS
Radiator: CWX-4
Oil cooler: SF-3

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POWER TRAIN



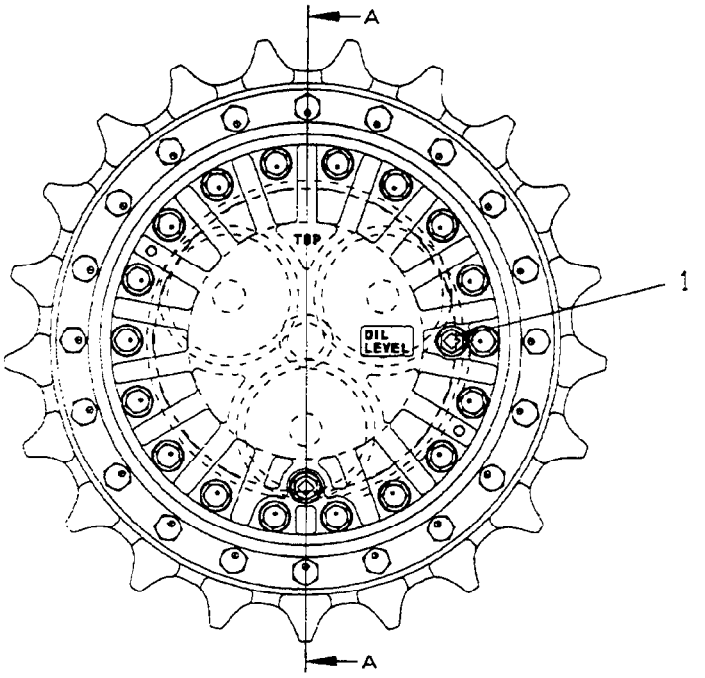
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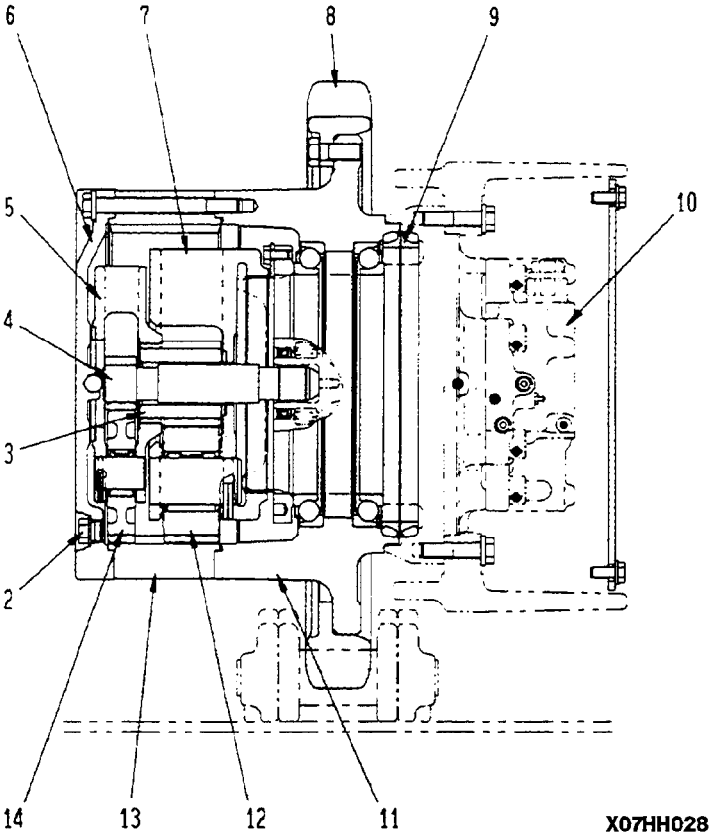
1. Idler
2. Center swivel joint
3. Control valve
4. Final drive
5. Travel motor
6. Hydraulic pump
7. Engine
8. Travel speed solenoid valve
9. Swing brake solenoid valve
10. Swing motor
11. Swing machinery
12. Swing circle

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FINAL DRIVE

PC200-6, PC200LC-6
PC210LC-6, PC220LC-6





1. Level plug
2. Drain plug
3. No. 2 sun gear (12 teeth)
4. No. 1 sun gear (21 teeth)
5. No. 1 planetary carrier
6. Cover
7. No. 2 planetary carrier
8. Sprocket
9. Floating seal
10. Travel motor
11. Hub
12. No. 2 planetary gear (36 teeth)
13. Ring gear (84 teeth)
14. No. 1 planetary gear (31 teeth)

SPECIFICATIONS

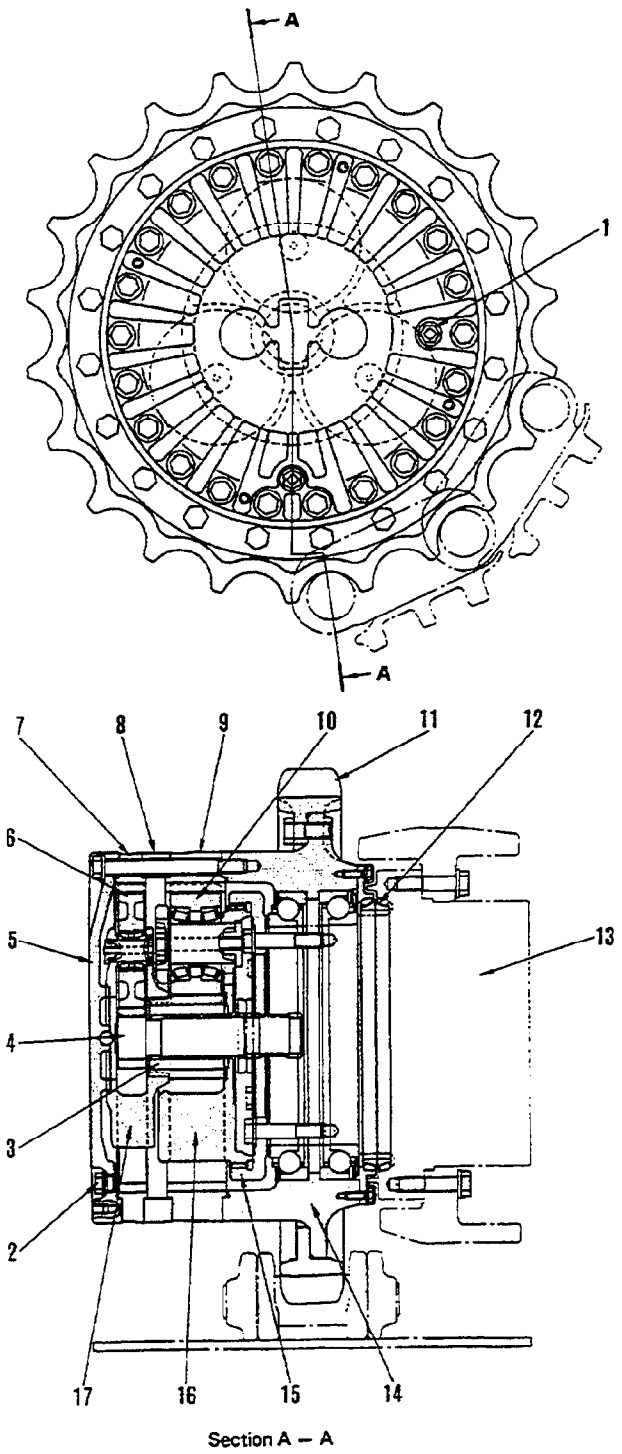
Reduction ratio:

$$-\left(\frac{12+84}{12}\right) \times \left(\frac{21+84}{21}\right) + 1 = -39.000$$

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FINAL DRIVE

PC250LC-6



Section A – A

X07HH029

1. Level plug
2. Drain plug
3. No. 1 sun gear (13 teeth)
4. No. 2 sun gear (19 teeth)
5. Cover
6. No. 2 planet gear (30 teeth)
7. No. 2 ring gear (80 teeth)
8. Spacer
9. No. 1 ring gear (80 teeth)
10. No. 1 planet gear (33 teeth)
11. Sprocket
12. Floating seal
13. Travel motor
14. Hub
15. Retainer
16. No. 1 planetary carrier
17. No. 2 planetary carrier

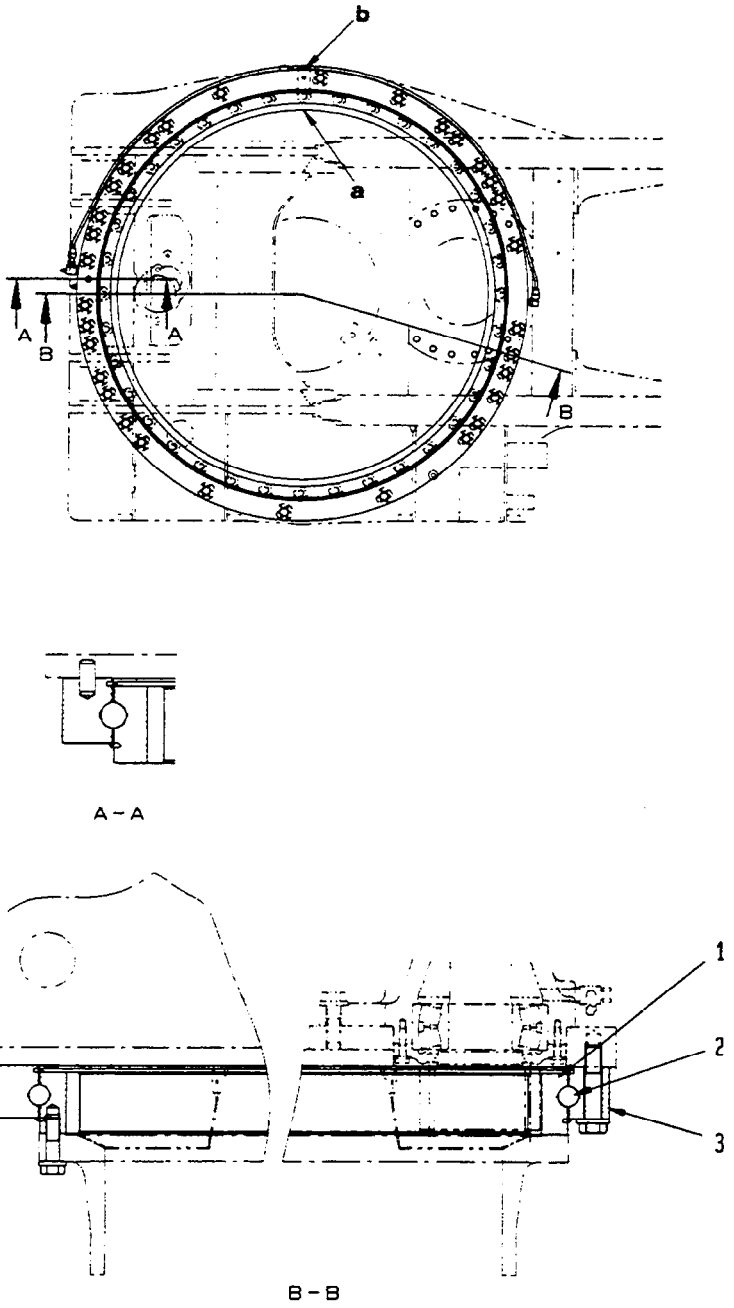
SPECIFICATIONS

Reduction ratio:

$$-\left(\frac{80+13}{13}\right) \times \left(\frac{80+19}{19}\right) + 1 = -36.275$$

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SWING CIRCLE



X09DD022

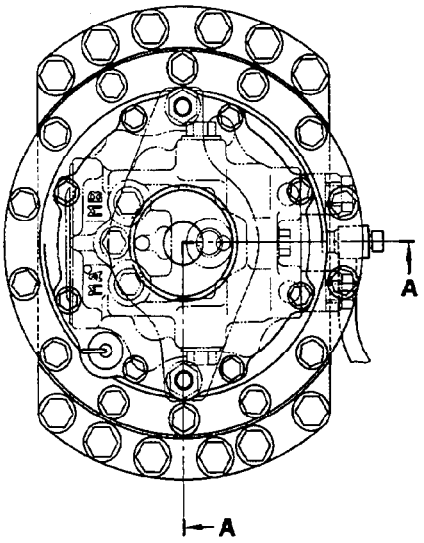
1. Swing circle inner race (110 teeth)
2. Ball
3. Swing circle outer race (115 teeth)

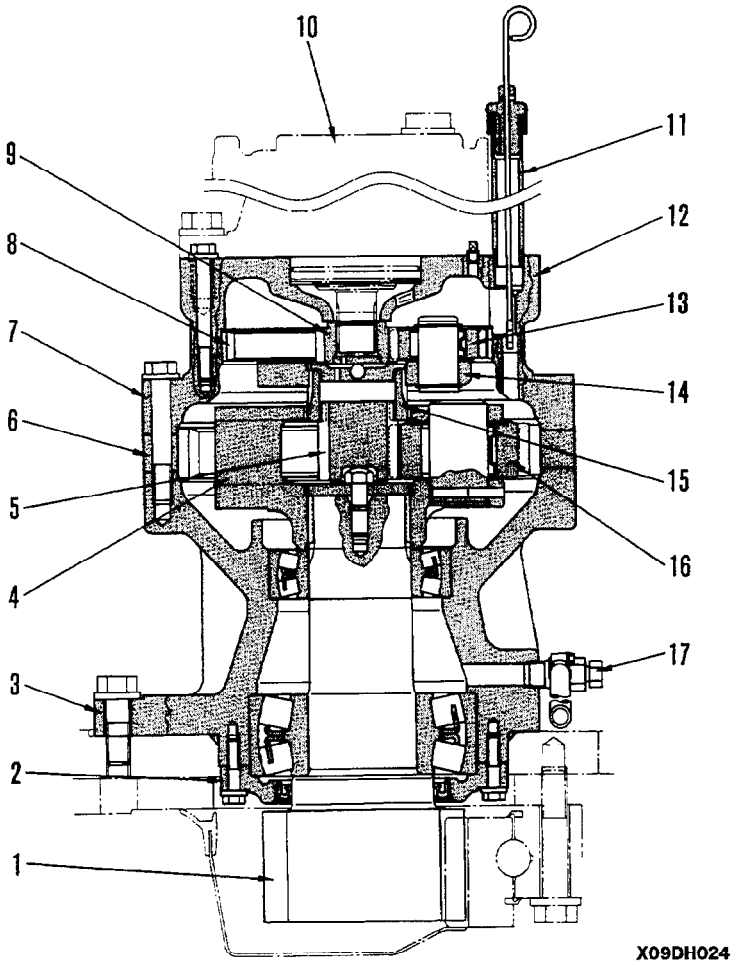
a. Inner race soft zone S position
b. Outer race soft zone S position

SPECIFICATIONS	PC200-6, PC200LC-6 PC210LC-6, PC220LC-6	PC250LC-6
Reduction ratio	110/115 = 7.333	
Amount of grease	21 ℓ (G2-L1)	34 ℓ (G2-L1)

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SWING MACHINERY





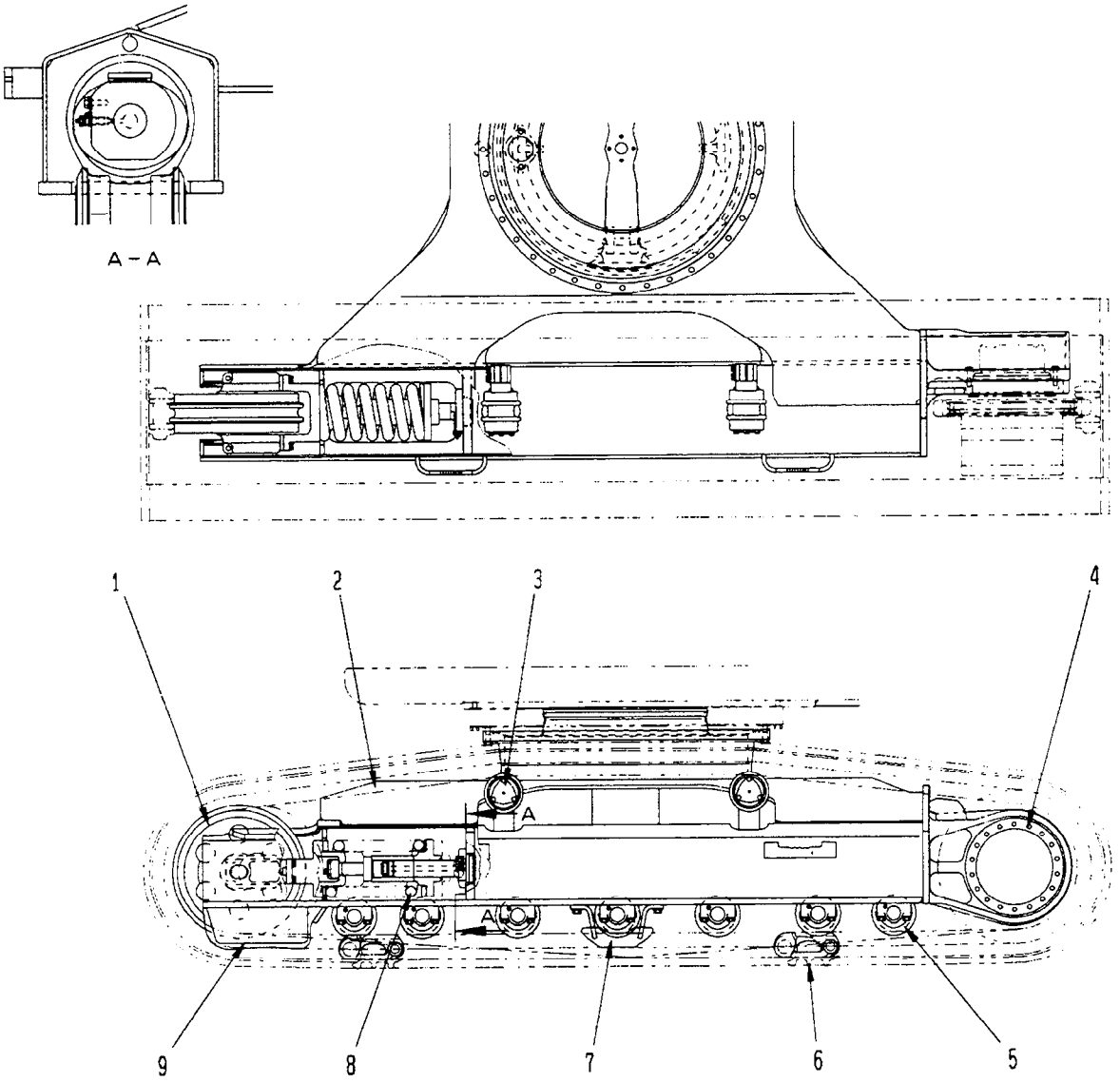
1. Swing pinion (15 teeth)
2. Cover
3. Case
4. No. 2 planetary carrier
5. No. 2 sun gear (15 teeth)
6. No. 2 ring gear (72 teeth)
7. Case
8. No. 1 ring gear (72 teeth)
9. No. 1 sun gear (21 teeth)
10. Oil level gauge
12. Cover
13. No. 1 planetary gear (25 teeth)
14. No. 1 planetary carrier
15. Coupling
16. No. 2 planetary gear (28 teeth)
17. Drain plug

SPECIFICATIONS

$$\left(\frac{21+72}{21}\right) \times \left(\frac{15+72}{15}\right) = 25.686$$

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TRACK FRAME ● RECOIL SPRING



X14AH022

1. Idler
2. Track frame
3. Carrier roller
4. Final drive
5. Track roller
6. Track shoe
7. Center guard
8. Recoil spring
9. Front guard

- The dimensions and number of track rollers may differ according to the model, but the basic structure is the same.
- No. of track rollers

Model	No. of rollers (each side)
PC200-6	7
PC200LC-6 PC210LC-6	9
PC220LC-6	10
PC250LC-6	8

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TRACK SHOE

STANDARD SHOE

Item / Model	PC200-6	PC200LC-6	PC210LC-6	PC220LC-6	PC250LC-6
Shoe width (triple shoe)	600 mm	700 mm	600 mm	700 mm	700 mm
Link pitch	190 mm	190 mm	190 mm	190 mm	203 mm
No. of rollers (each side)	45	49	49	51	50

SELECTION OF TRACK SHOE

- Select the most suitable track shoe from the following table.

	PC200-6		PC220LC-6		PC210LC-6		PC220LC-6, PC250LC-6	
Standard	Specifications	Category	Specifications	Category	Specifications	Category	Specifications	Category
Option	600 mm triple	A	600 mm triple	A	600 mm triple	A	600 mm triple	A
Option	700 mm triple	B	700 mm triple	B	—	—	700 mm triple	B
Option	800 mm triple	C	800 mm triple	C	—	—	800 mm triple	C
Option	—	—	900 mm triple	C	—	—	—	—

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Category	Use	Precautions when using
A	Rocky ground, normal river soil	• Travel in Lo speed when traveling on rough ground with obstacles such as large boulders and fallen trees.
B	Normal soil, soft land	• Cannot be used on rough ground where there are large obstacles such as boulders and fallen trees. • Travel in Hi speed only on flat ground, and when it is impossible to avoid traveling obstacles, lower the travel speed to approx. half of Lo speed.
C	Extremely soft ground (swampy ground)	• Use only for ground where **"A"** and **"B"** sink and are impossible to use. • Cannot be used on rough ground where there are large obstacles such as boulders and fallen trees. • Travel in Hi speed only on flat ground, and when it is impossible to avoid traveling obstacles, lower the travel speed to approx. half of Lo speed.

★ Categories **"B"** and **"C"** are wide shoes, so there are restrictions on their use. Therefore, before using, check the restrictions and consider carefully the conditions of use before recommending a suitable shoe width. If necessary, give the customer guidance in their use.

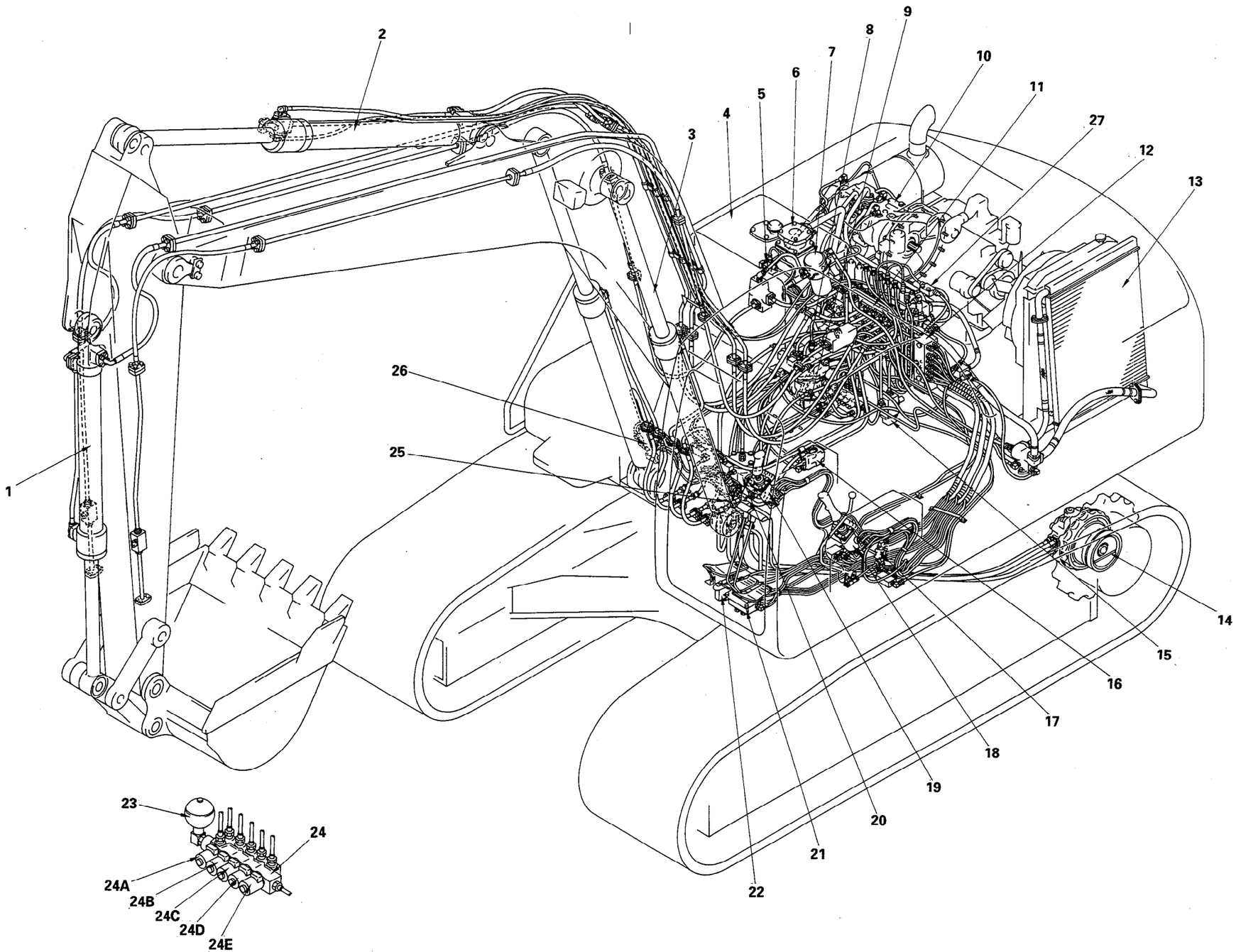
★ When selecting the shoe width, select the narrowest shoe possible within the range that will give no problem with floatation and ground pressure.
If a wider shoe that necessary is used, there will be a large load on the shoe, and this may lead to bending of the shoe, cracking of the links, breakage of the pins, loosening of the shoe bolts, or other problems.

HYDRAULIC PIPING DIAGRAM

PC200-6, PC200LC-6
PC210LC-6, PC220LC-6
PC250LC-6

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FOLDOUT 1



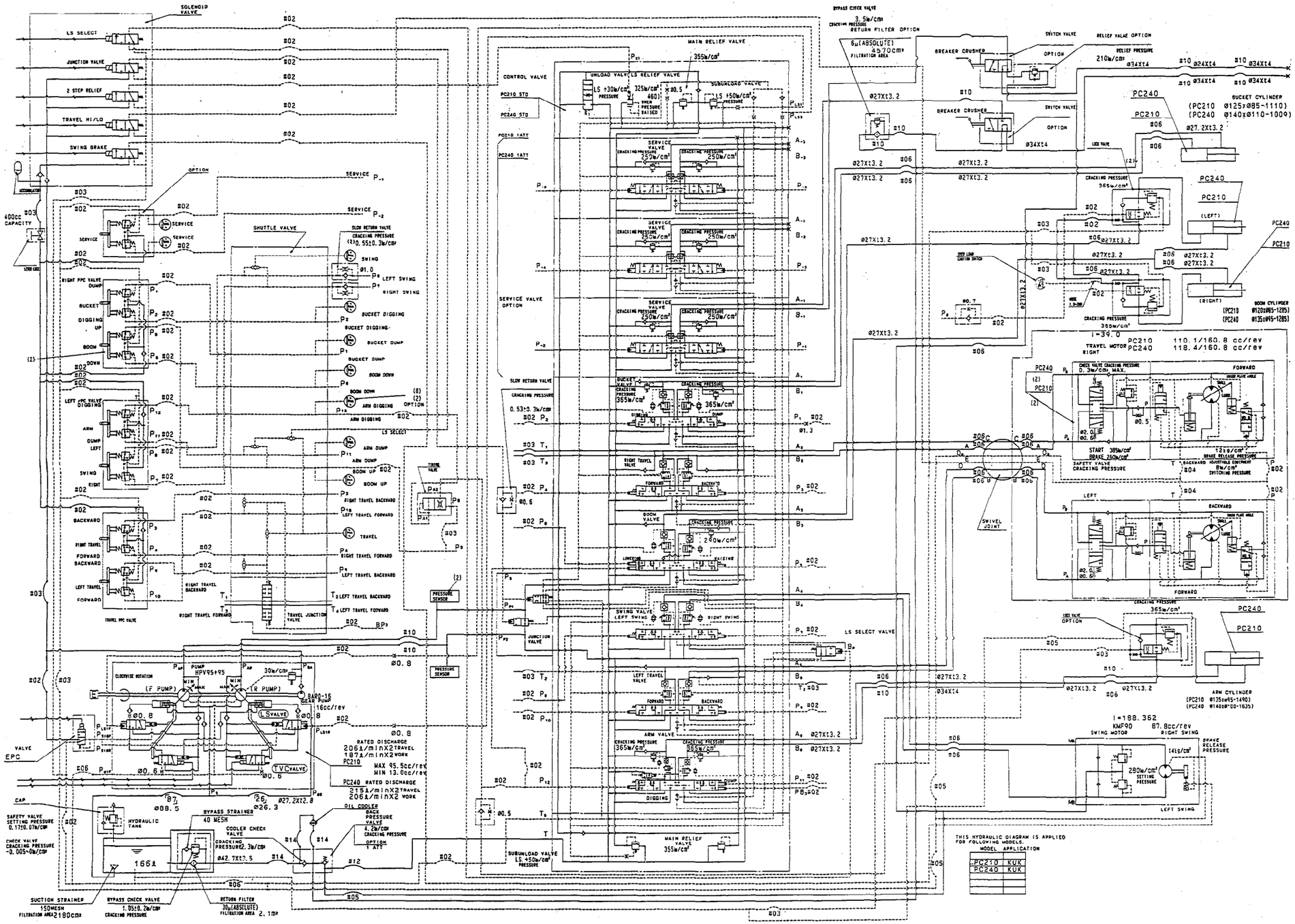
1. Bucket cylinder
2. Arm cylinder
3. Boom cylinder
4. Hydraulic tank
5. LS control EPC valve
6. Hydraulic filter
7. Filter (for breaker)
8. Swing motor
9. R.H. travel motor
10. Hydraulic pump
11. Control valve
12. PPC shuttle. travel junction valve
13. Oil cooler
14. L.H. travel motor
15. Arm holding valve
16. Boom holding valve
17. PPC safety valve
18. L.H. PPC valve
19. R.H. PPC valve
20. Center swivel joint
21. Travel PPC valve
22. Service PPC valve
23. Accumulator
24. Solenoid valve
    - 24A. LS select solenoid valve
    - 24B. 2-stage relief solenoid valve
    - 24C. Pump merge-divider solenoid valve
    - 24D. Travel speed solenoid valve
    - 24E. Swing brake solenoid valve
25. L.H. hose burst valve
26. R.H. hose burst valve
27. Timing valve

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FOLDOUT 2

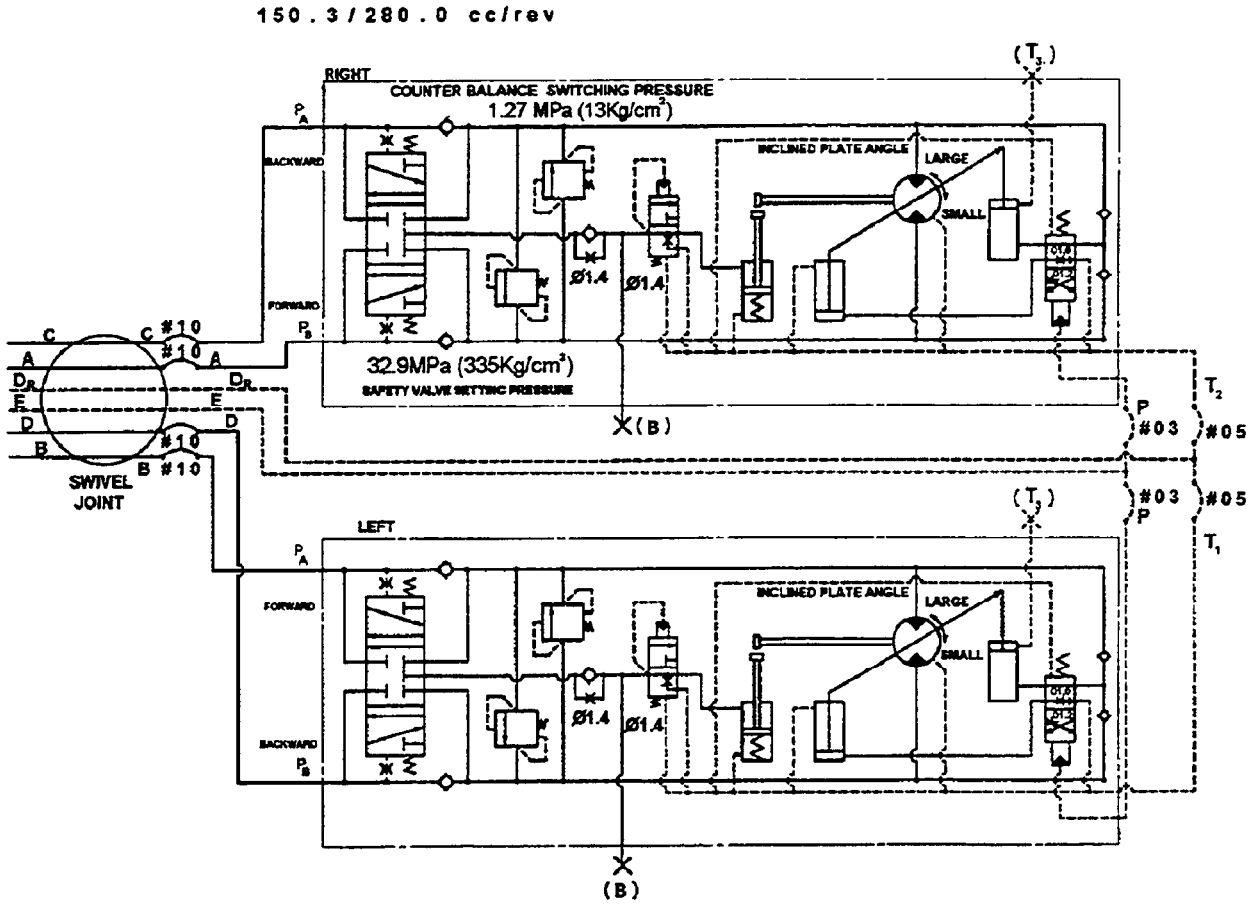
HYDRAULIC CIRCUIT DIAGRAM (1/2)

PC200-6, PC200LC-6
PC210LC-6, PC220LC-6
PC250LC-6



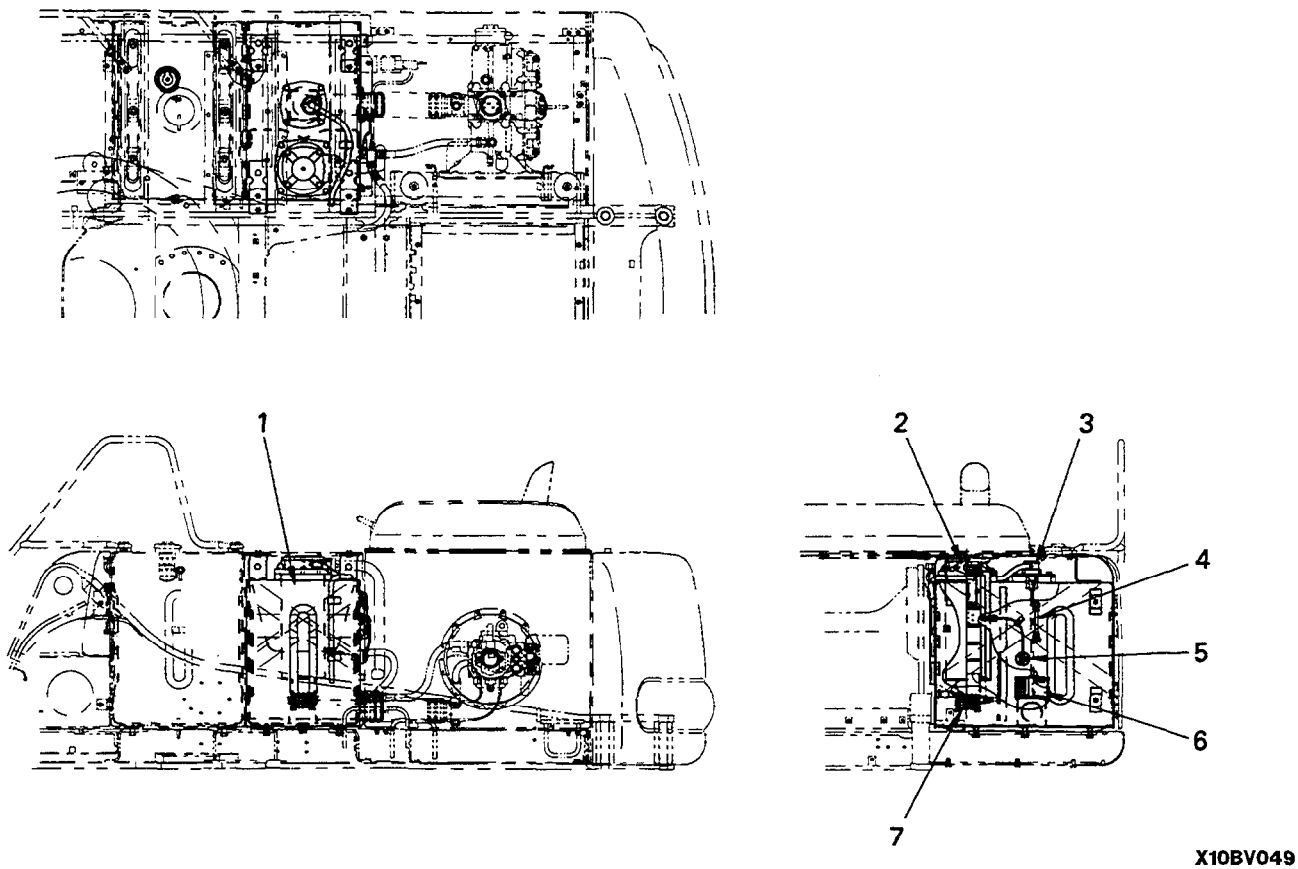
https://truckmanualshub.com/

HYDRAULIC CIRCUIT DIAGRAM (2/2)
PC250LC-6 TRAVEL MOTOR



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HYDRAULIC TANK



X10BV049

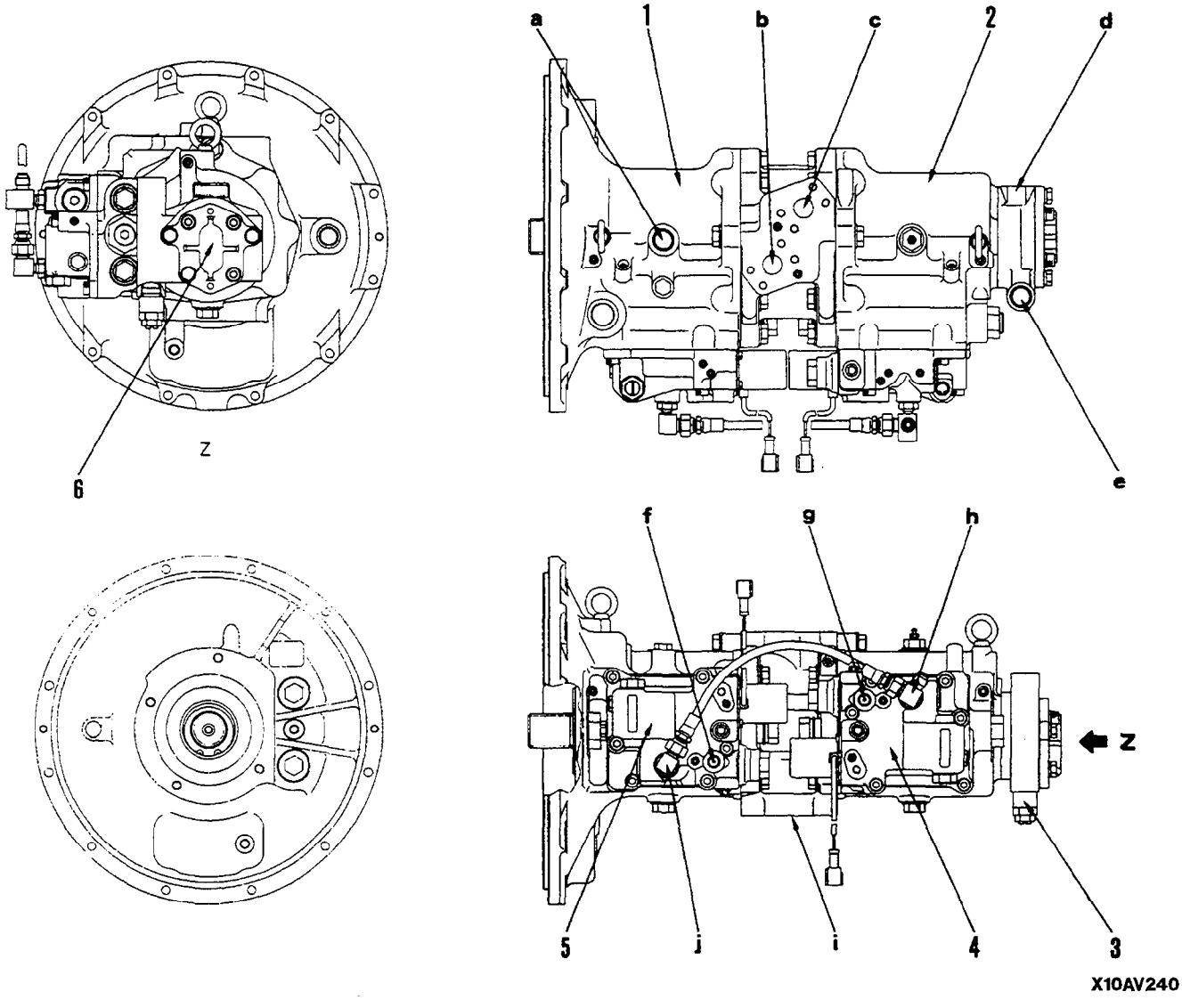
1. Hydraulic tank
2. Bypass valve
3. Oil filler cap
4. Sight gauge
5. Hydraulic oil level sensor
6. Suction strainer
7. Filter element

SPECIFICATIONS

Tank capacity: 230 ℓ	
Amount of oil inside tank: 166 ℓ	
Pressure valve	
Relief cracking pressure:	0.017 ± 0.004 MPa (0.17 ± 0.04 kg/cm^2)
Suction cracking pressure:	0 - 0.0005 MPa (0 - 0.005 kg/cm^2)
Bypass valve set pressure:	0.103 ± 0.02 MPa (1.05 ± 0.2 kg/cm^2)

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HYDRAULIC PUMP

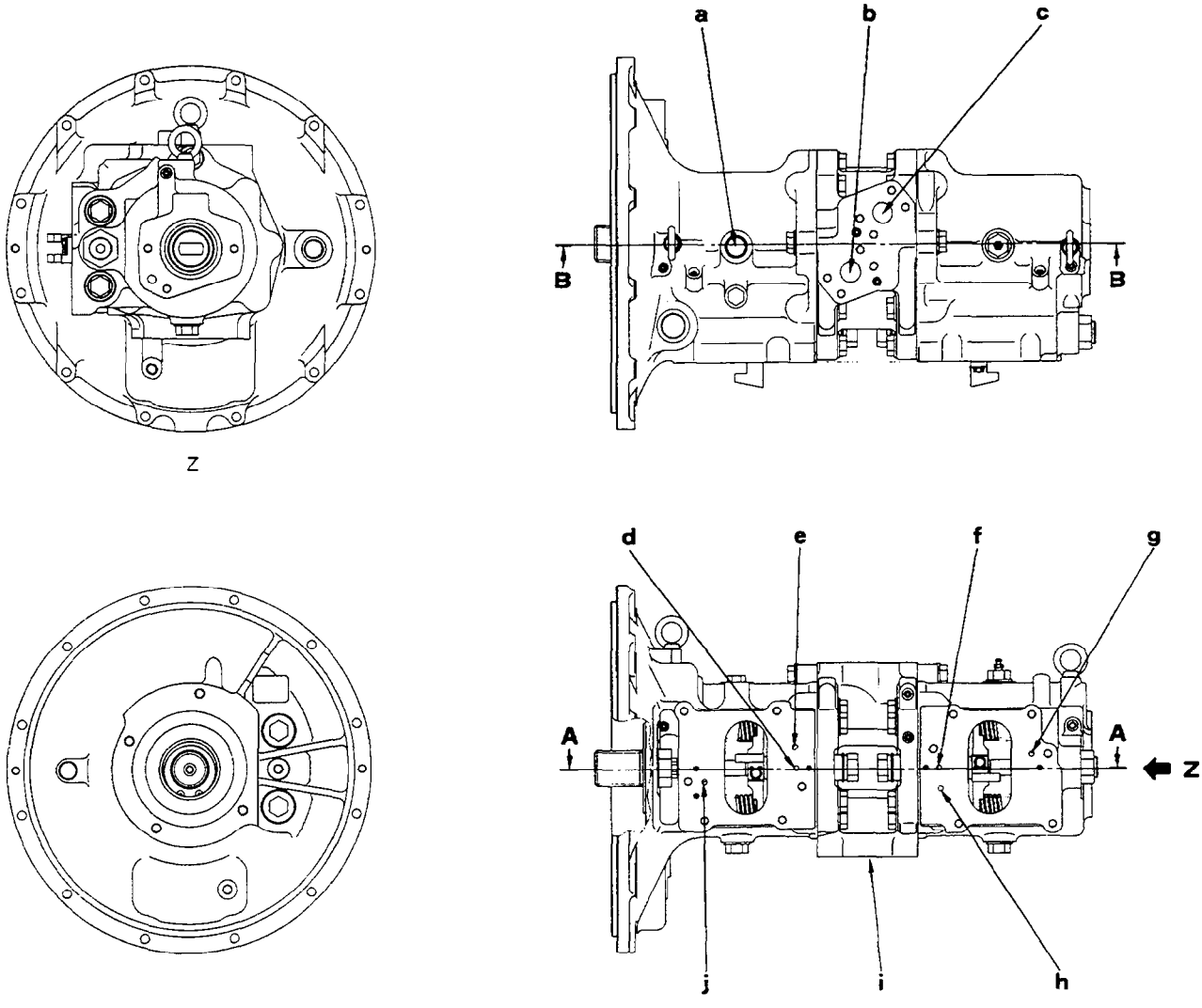


a. Pump drain port **PDF**
b. Front delivery port **PAF**
c. Rear delivery port **PAR**
d. Control pump suction port **PGS**
e. Control pump delivery port **PGA**
f. Front LS pressure port **PLSF**
g. Rear LS pressure port **PLSR**
h. LS control EPC pressure port **PSIGR**
i. Main pump suction port **PS**
j. LS control EPC pressure port **PSIGF**

1. Front main pump
2. Rear main pump
3. Control relief valve
4. Rear TVC•LS valve
5. Front TVC•LS valve
6. Control pump

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1. MAIN PUMP (HPV95+95)



X10AV241

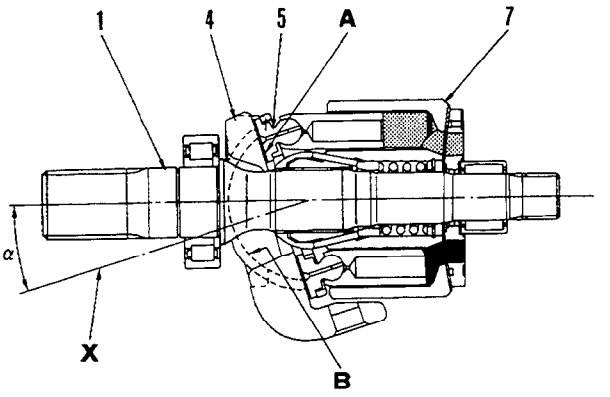
a. Pump drain port **PDF**
b. Front delivery port **PAF**
c. Rear delivery port **PAR**
d. Front control pressure port **PANF**
e. Rear delivery pressure port **PA2R**
f. Front delivery pressure port **PA2F**
g. Rear delivery pressure port **PA1R**
h. Rear control pressure port **PENR**
i. Suction port **PS**
j. Front delivery pressure port **PA1F**

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OPERATION

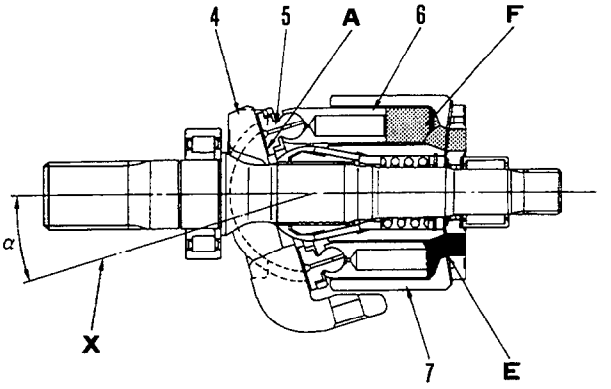
1. Operation of pump

1) Cylinder block (7) rotates together with shaft (1), and shoe (5) slides on flat surface **A**. When this happens, rocker cam (4) moves along cylindrical surface **B**, so angle α between center line **X** of rocker cam (4) and the axial direction of cylinder block (7) changes. (Angle α is called the swash plate angle.)



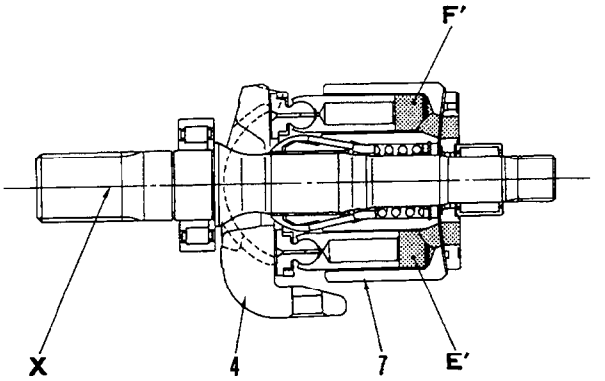
X10AV242

2) Center line **X** of rocker cam (4) maintains swash plate angle α in relation to the axial direction of cylinder block (7), and flat surface **A** moves as a cam in relation to shoe (5).
In this way, piston (6) slides on the inside of cylinder block (7), so a difference between volume **E** and **F** is created inside cylinder block (7). The suction and discharge is carried out by this difference **F - E**.
In other words, when cylinder block (7) rotates and the volume of chamber **E** becomes smaller, the oil is discharged during that stroke. On the other hand, the volume of chamber **F** becomes larger, and as the volume becomes bigger, the oil is sucked in.



X10AV243

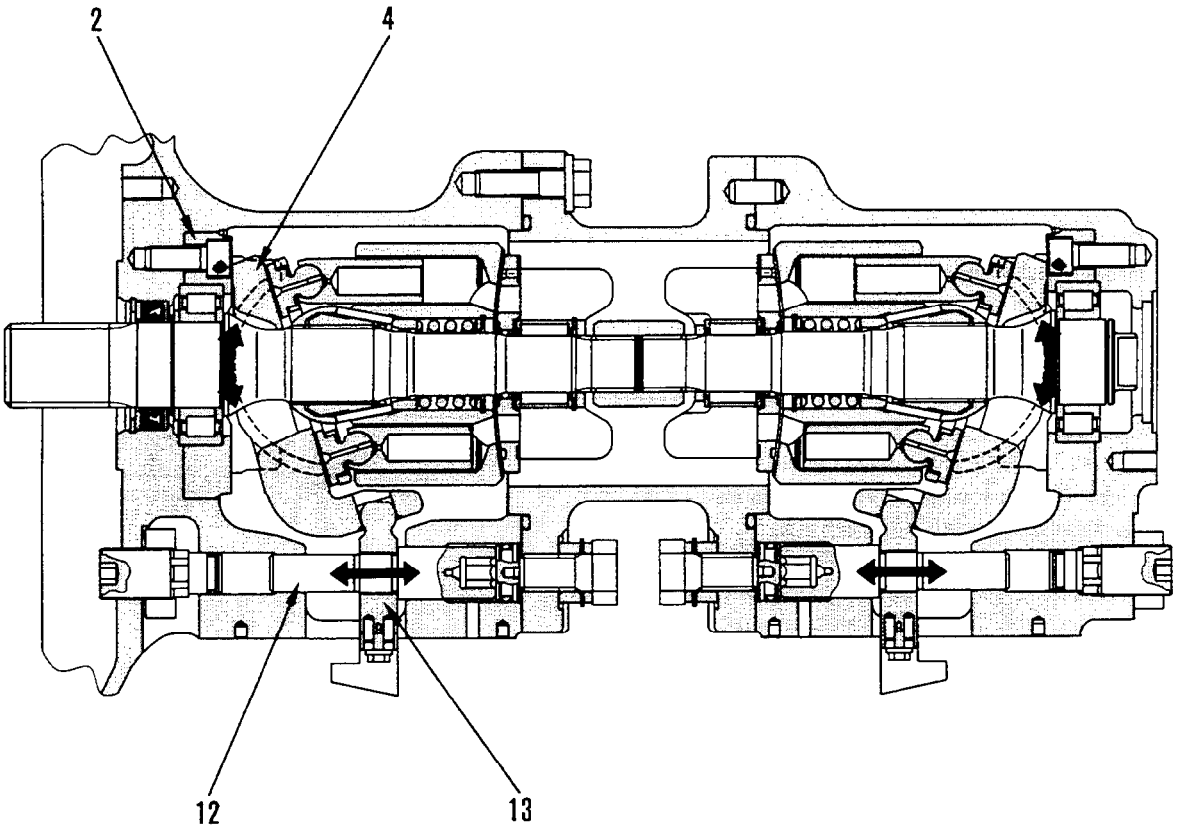
3) If center line **X** of rocker cam (4) is in line with the axial direction of cylinder block (7) (swash plate angle = 0), the difference between volumes **E`** and **F`** inside cylinder block (7) becomes 0, so the pump does not carry out any suction or discharge of oil. (In actual fact, the swash plate angle never becomes 0.)



X10AV244

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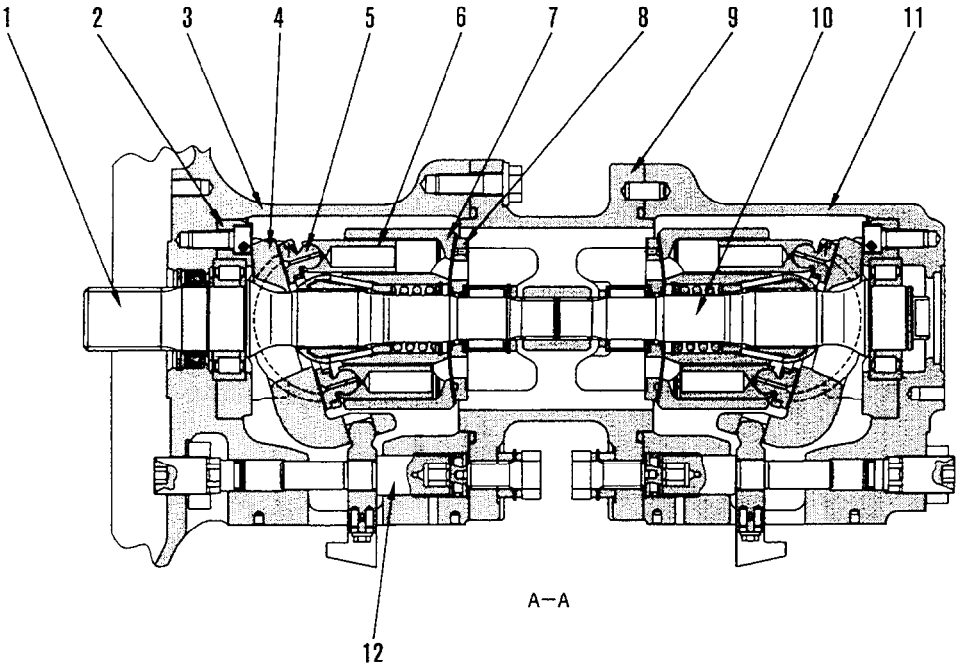
2. Control of discharge amount

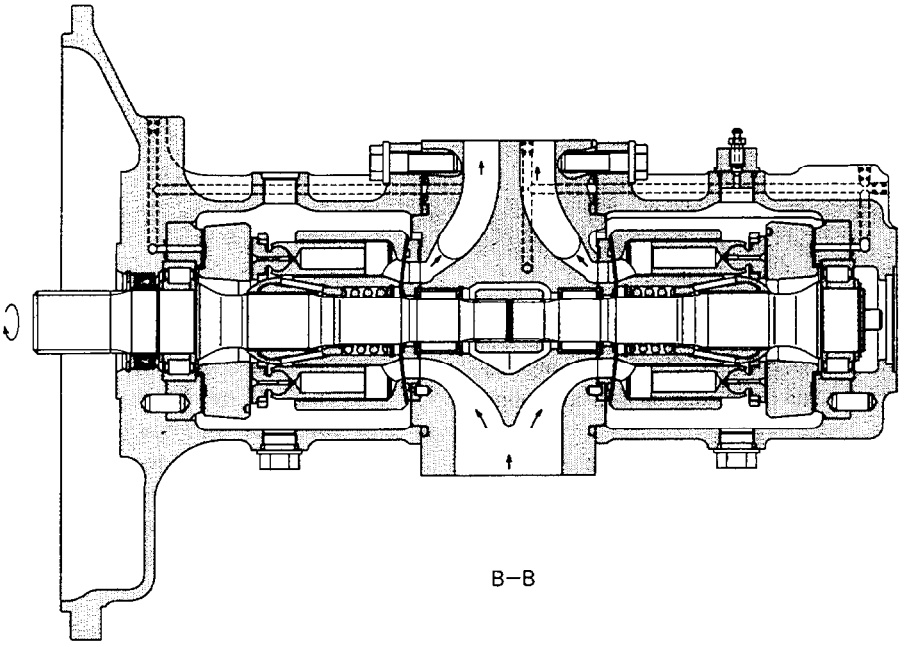


X10AV245

- If swash plate angle α become larger, the difference in volumes **E** and **F** becomes larger and discharge volume **Q** increases.
- Swash plate angle α is changed by servo piston (12).
- Servo piston (12) moves in a reciprocal movement (↔) according to the command from the TVC • LS valve.
- This straight line movement is transmitted through rod (13) to rocket cam (4), and rocker cam (4), which is supported by the cylindrical surface to cradle (2), moves in a swinging movement on the cylindrical surface in (↕ direction).
- With servo piston (12), the area receiving the pressure is different on the left and right, so main pump discharge pressure (self-pressure) **PP** is always connected to the chamber receiving the pressure on the small diameter piston side (the self-pressure is brought in).
- Output pressure **PEN** of the LS valve is brought to the chamber receiving the pressure at the large diameter piston end.
- The relationship in the size of self-pressure **PP** and the pressure at the small diameter piston end, and the ratio between the area receiving the pressure of the small diameter piston and the large diameter piston controls the movement of the servo piston (12).

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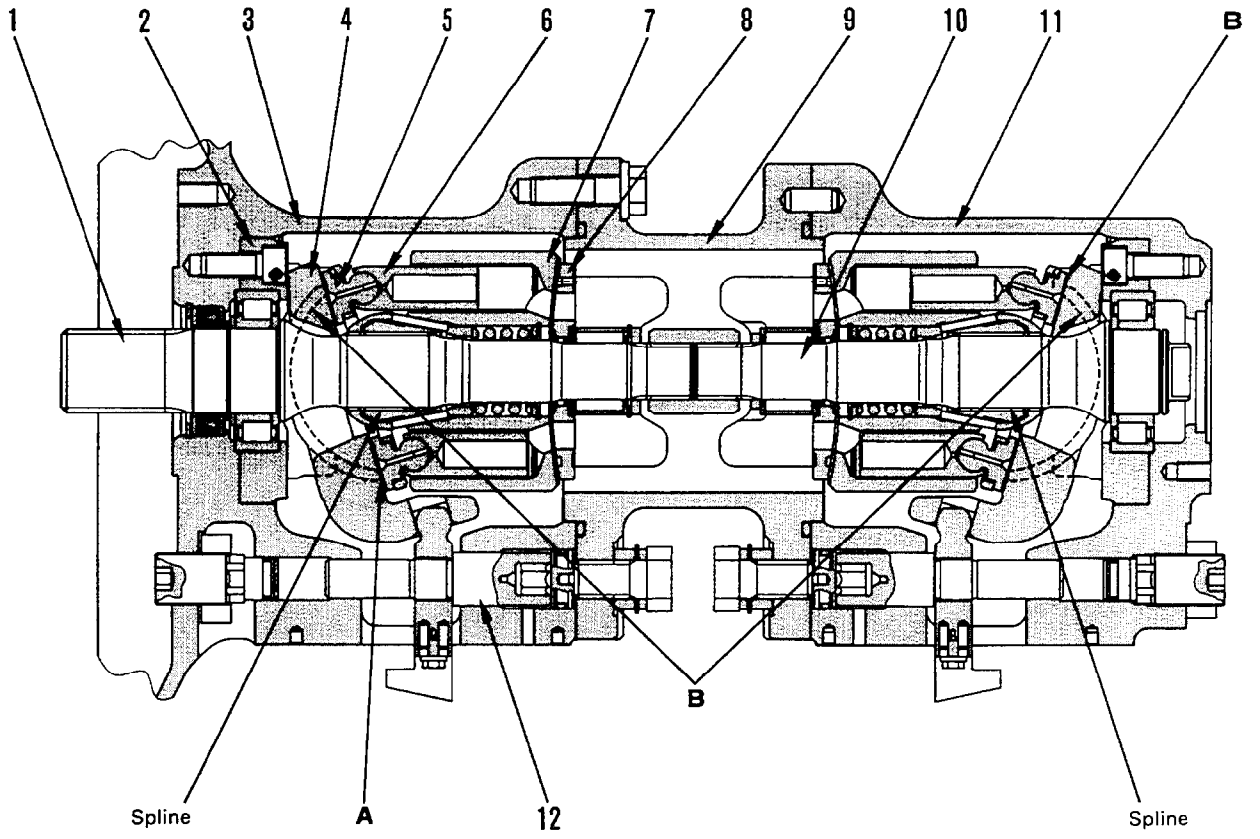




X10AV246

1. Front shaft
2. Cradle
3. Front case
4. Rocker cam
5. Shoe
6. Piston
7. Cylinder block
8. Valve plate
9. End cap
10. Rear shaft
11. Rear case
12. Servo piston

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X10AV247

FUNCTION

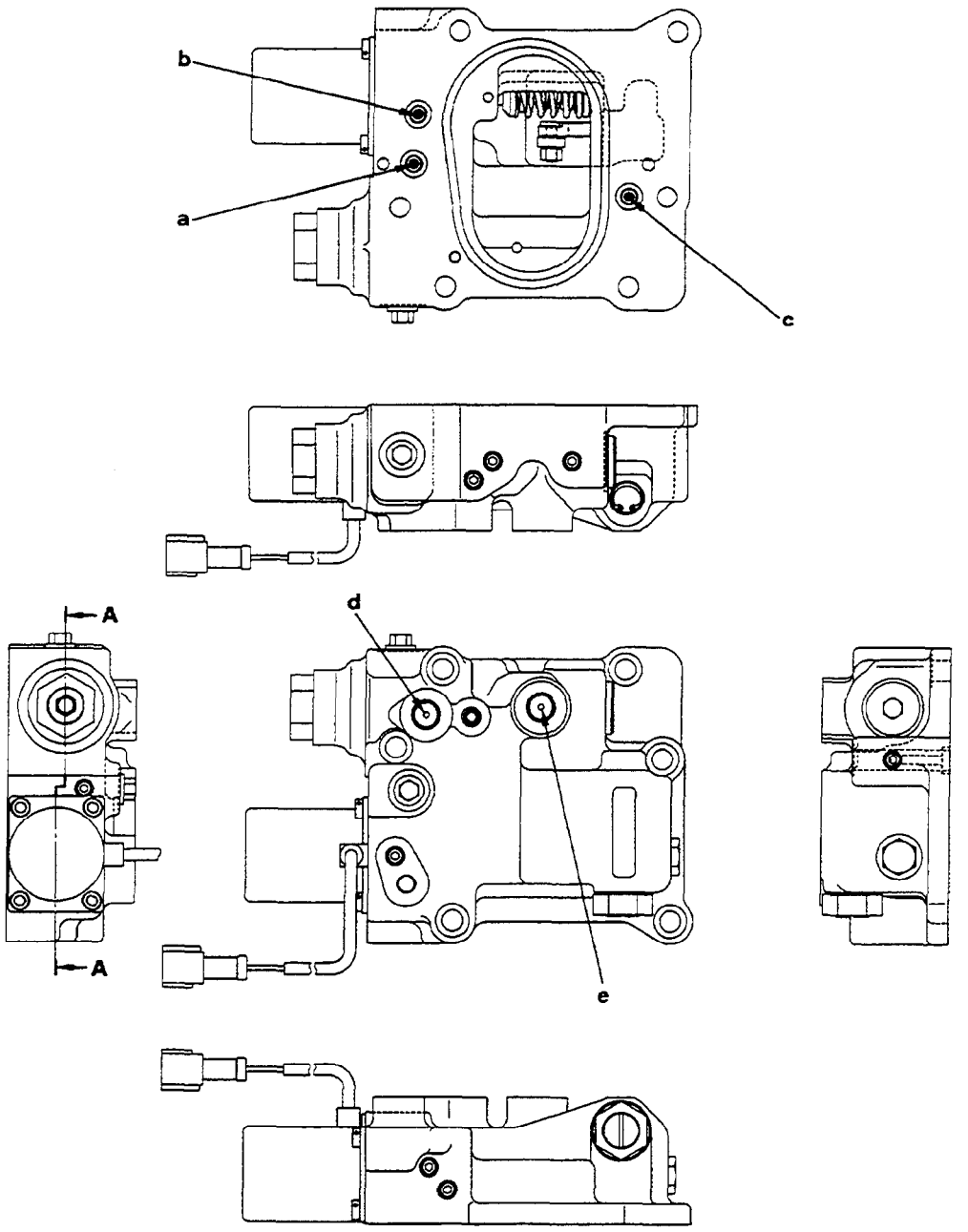
- The engine rotation and torque transmitted to the pump shaft is converted into hydraulic energy, and pressurized oil is discharged according to the load.
- It is possible to change the delivery amount by changing the swash plate angle.

STRUCTURE

- Cylinder block (7) is supported to shaft (1) by a spline, and shaft (1) is supported be the front and rear bearings.
- The tip of piston (6) is a concave ball, and shoe (5) is caulked to it to form on unit. Piston (6) and shoe (5) form a spherical bearing.
- Rocker cam (4) has a flat surface **A**, and shoe (5) is always pressed against this surface while sliding in a circular motion.
- Rocker cam (4) brings high pressure oil at cylindrical surface **B** with cradle (2), which is secured to the case, and forms a static pressure bearing when it slides.
- Piston (6) carries out relative movement in the axial direction inside each cylinder chamber of cylinder block (7).
- The cylinder block seals the pressure oil to valve plate (8) and carries out relative rotation. This surface is designed so that the oil pressure balance is maintained at a suitable level.
  The oil inside each cylinder chamber of cylinder block (7) is sucked in and discharged through valve plate (8).

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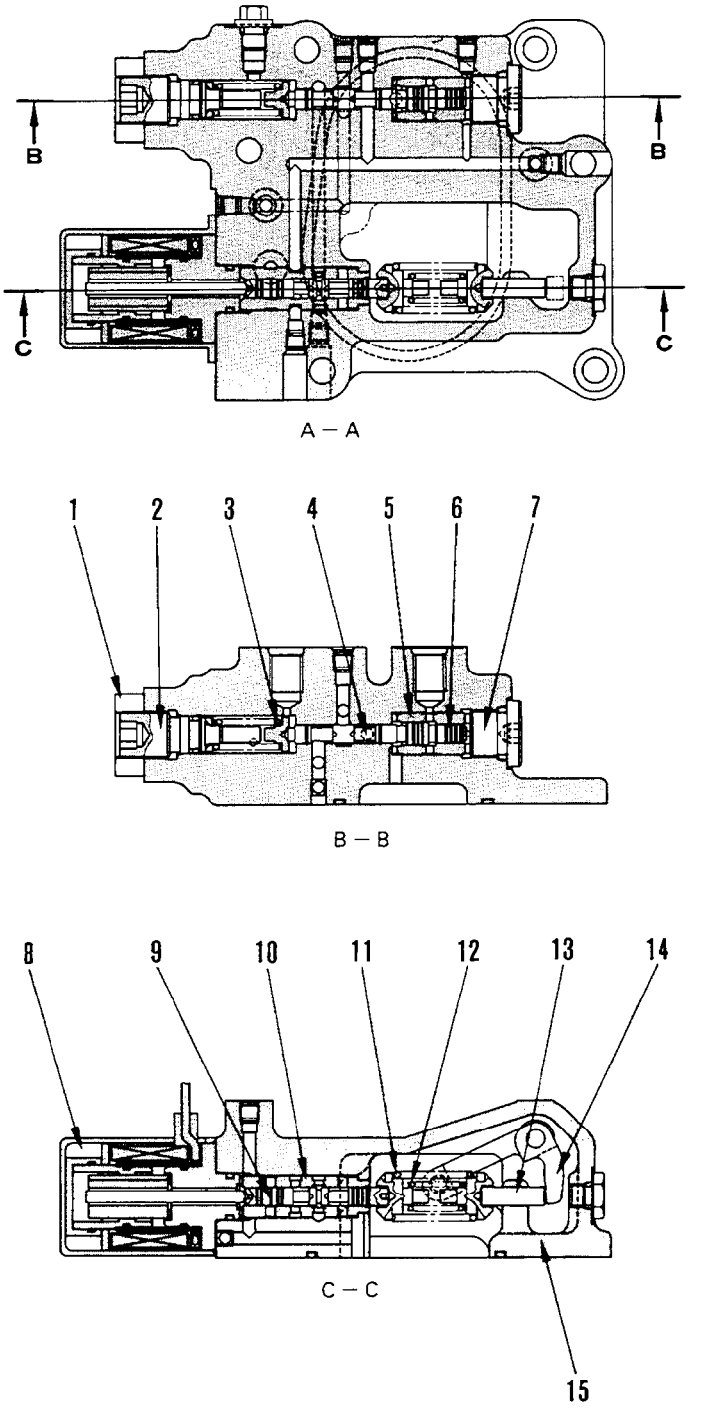
2. TVC • LS VALVE



X10AV248

a. Port **PA2** (Pump delivery pressure inlet port)
b. Port **PEN** (TVC • LS valve signal pressure outlet port)
c. Port **PA1** (Pump delivery pressure inlet port)
d. Port **PLS** (Control valve LS pressure inlet port)
e. Port **PSIG** (LS control EPC valve pressure inlet port)

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X10AV249

LS VALVE
1. Locknut
2. Plug
3. Spring
4. Spool
5. Sleeve
6. Piston
7. Plug

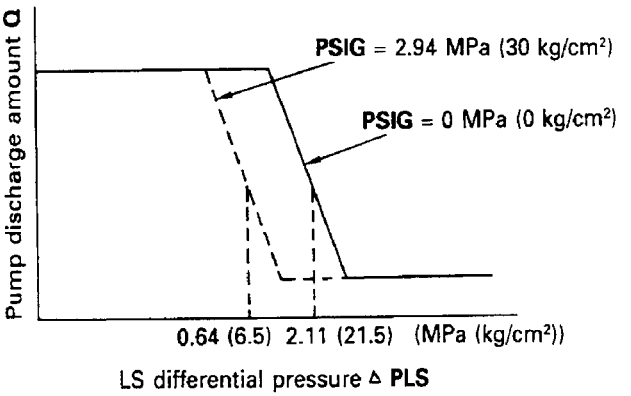
TVC VALVE
8. Solenoid
9. Piston
10. Sleeve
11. Spring
12. Spring
13. Piston
14. Lever
15. Valve body

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FUNCTION

1. LS VALVE

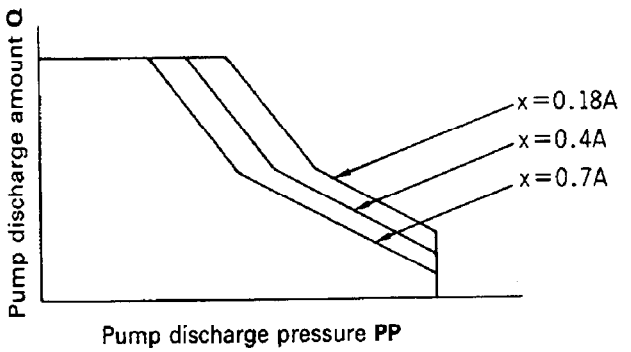
- The **LS** valve detects the load and controls the discharge amount.
  This valve controls the main pump discharge amount **Q** according to the differential pressure Δ **PLS** (=**PP** - **PLS**) (the difference between main pump pressure **PP** and control valve outlet port pressure **PLS**) {called the **LS** differential pressure}.
- Main pump pressure **PP**, pressure **PLS** {called the **LS** pressure} coming from the control valve output, and pressure **PSIG** {called the **LS** selection pressure} from the proportional solenoid valve enter this valve. The relationship between discharge amount **Q** and differential pressure Δ **PLS**, (the difference between main pump pressure **PP** and LS pressure **PLS**) (=**PP** - **PLS**) changes as shown in the diagram on right according to LS selector pressure **PSIG**.
- When **PSIG** changes between 0 and 2.94 MPa (0 and 30 kg/cm^2), the spool load changes according to this, and the selector point for the pump discharge amount changes at the rated central value between 0.64 and 2.11 MPa (6.5 and 21.5 kg/cm^2).



X10AV250

2. TVC VALVE

- When the pump discharge pressure **PP1** (self-pressure) and **PP2** (other pump pressure) are high, the TVC valve controls the pump so that no more oil that the constant flow (in accordance with the discharge pressure) flows even if the stroke of the control valve becomes larger. In this way it carries out equal horsepower control so that the horsepower absorbed by the pump does not exceed the engine horsepower.
- In other words, if the load during the operation becomes larger and the pump discharge pressure rises, it reduces the discharge amount from the pump; and if the pump discharge pressure drops, it increases the discharge amount from the pump. The relationship between the average of the front and rear pump discharge pressures (**PP1** + **PP2**)/2 and pump discharge amount **Q** is shown on the right, with the current given to the TVC valve solenoid shown as a parameter. However, in the heavy-duty operation mode, there are cases where it is given the function of sensing the actual speed of the engine, and if the speed drops because of an increase in the load, it reduces the pump discharge amount to allow the speed to recover. In other words, when the load increases and the engine speed drops below the set value, the command to the TVC valve solenoid from the controller increases according to the drop in the engine speed to reduce the pump swash plate angle.



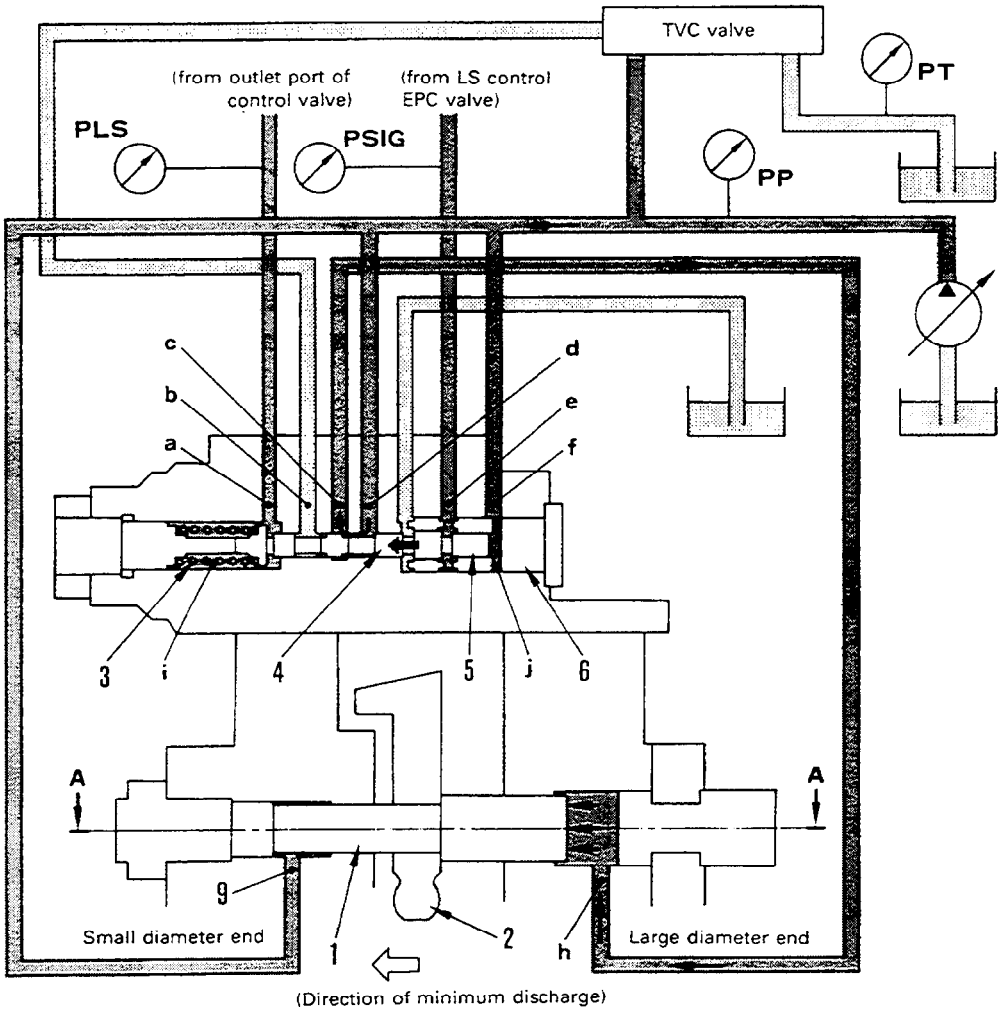
X10AV251

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OPERATION

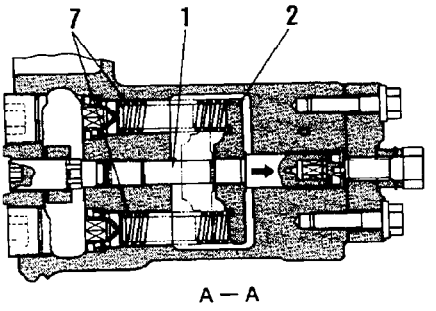
1. LS VALVE

1) When control valve is at neutral position



X10AV252

- The LS valve is a three-way selector valve, with pressure **PLS** (LS pressure) from the outlet port of the control valve brought to spring chamber **i**, and main pump discharge pressure **PP** brought to chamber **j** of plug (6). The size of this LS pressure **PLS** + force **F** of spring (3) and the main pump pressure (self pressure) **PP** determines the position of spool (4). However, the size of the output pressure **PSIG** (the LS selection pressure) of the EPC valve for the LS valve entering port **e** also changes the position of spool (4). (The set pressure of the spring changes.)
- Before the engine is started, servo piston (1) is pushed to the right by the spring (7) installed to rod (2). (See the diagram on the right)
- When the engine is started and the control lever is at the neutral position, LS pressure **PLS** is 0 MPa (0 kg/cm^2). (It is interconnected with the drain circuit through the control valve spool.)

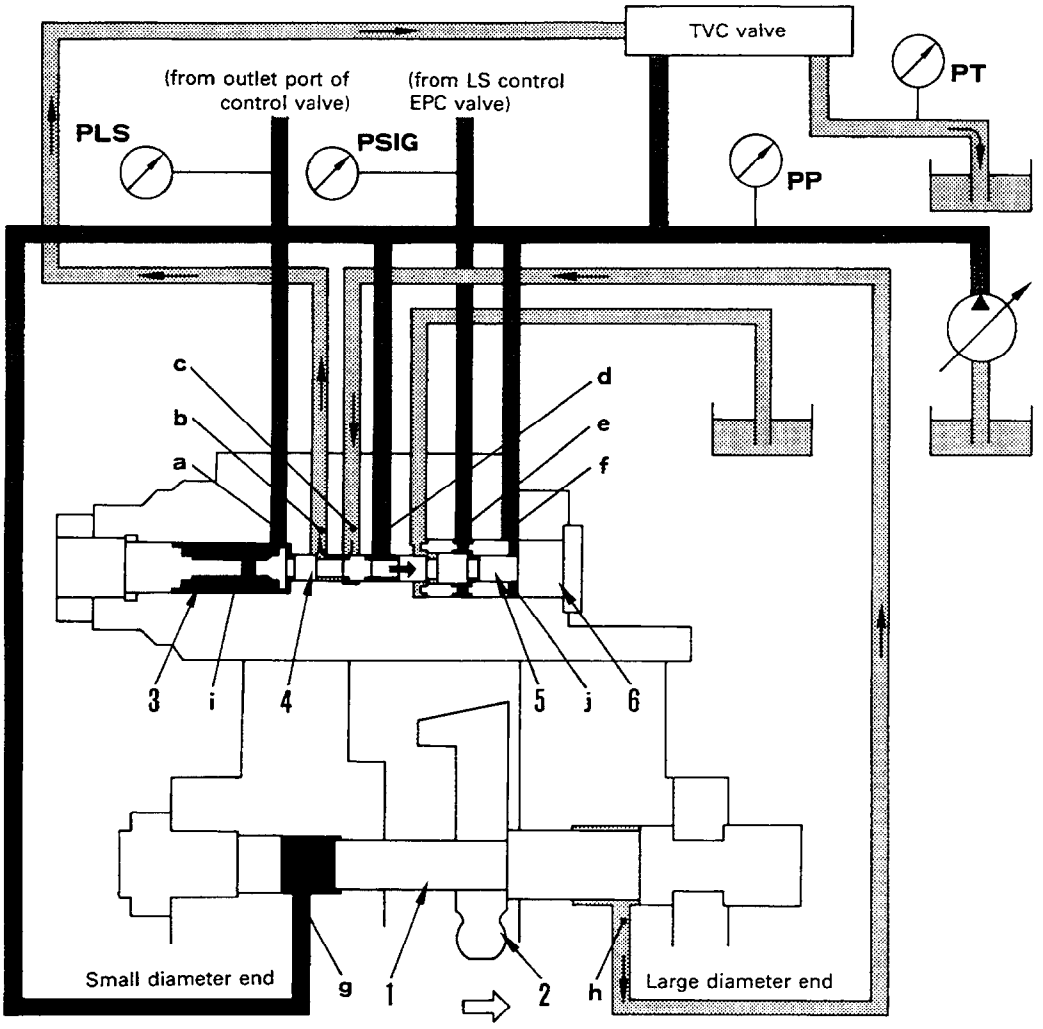


X10AV253

- At this point, spool (4) is pushed to the left, and port **d** and port **c** are connected. Pump pressure **pp** enters the large diameter end of the piston from port **h**, and the same pump pressure **pp** also enters the small diameter end of the piston, so the swash plate is moved to the minimum angle by the difference in area of piston (1).

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2) Operation in maximum direction for pump discharge amount

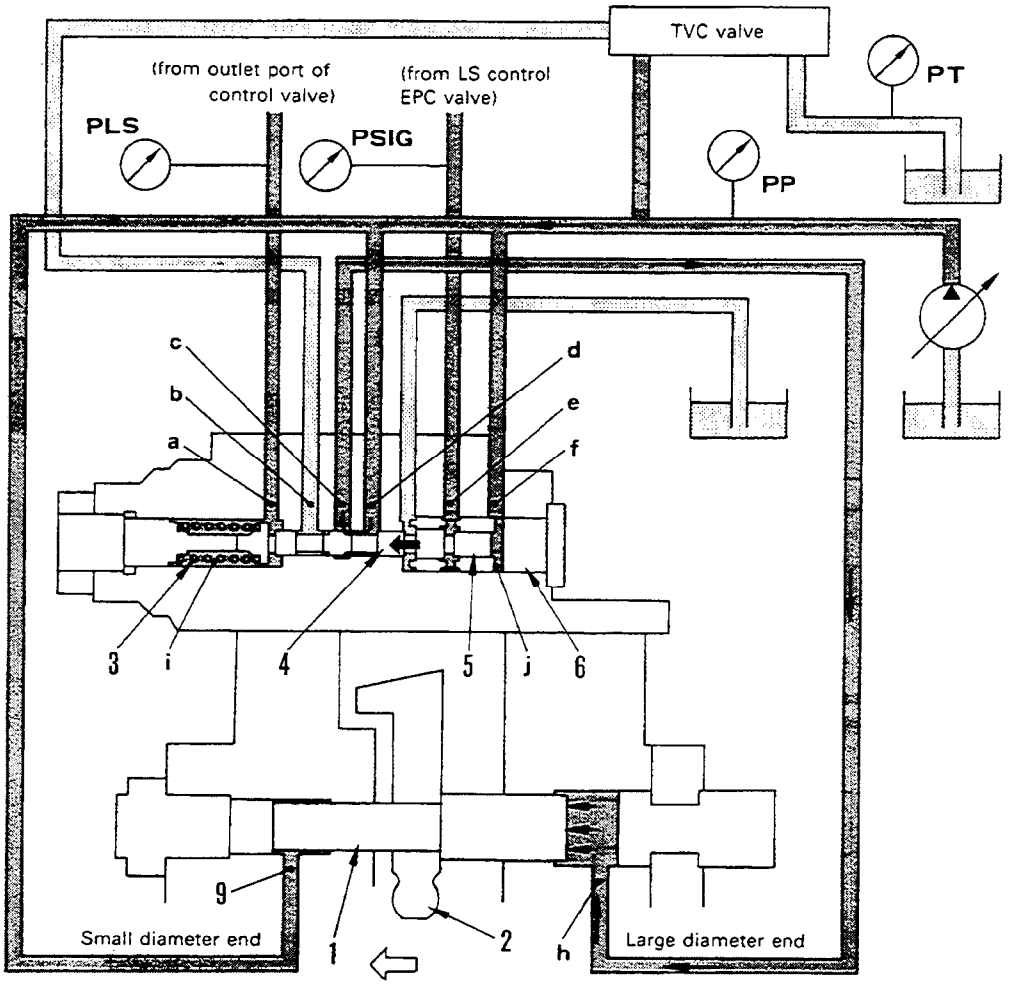


X10AV254

- When the difference between main pump pressure **PP** and LS pressure **PLS**, in other words, LS differential pressure Δ **PLS**, becomes smaller (for example, when the area of opening of the control valve becomes larger and pump pressure **PP** drops), spool (4) is pushed to the right by the combined force of LS pressure **PLS** and the force of spring (3).
- When spool (4) moves, port **b** and port **c** are joined and connected to the TVC valve. When this happens, the TVC valve is connected to the drain port, so circuit **c** - **h** becomes drain pressure **PT**. (The operation of the TVC valve is explained later.)
- For this reason, the pressure at the large piston diameter end of the servo piston (1) becomes drain pressure **PT**, and pump pressure **PP** enters the small diameter end, so servo piston (1) is pushed to the right. Therefore, rod (2) moves to the right and moves the swash plate in the direction to make the discharge amount larger.
- If the output pressure **PSIG** of the EPC valve for the LS valve enters port **e**, this pressure creates a force to move piston (5) to the left. If piston (5) is pushed to the left, it acts to make the set pressure of spring (3) weaker, and the difference between **PLS** and **PP** changes when ports **b** and **c** of spool (4) are connected.

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3) Operation in minimum direction for pump discharge amount

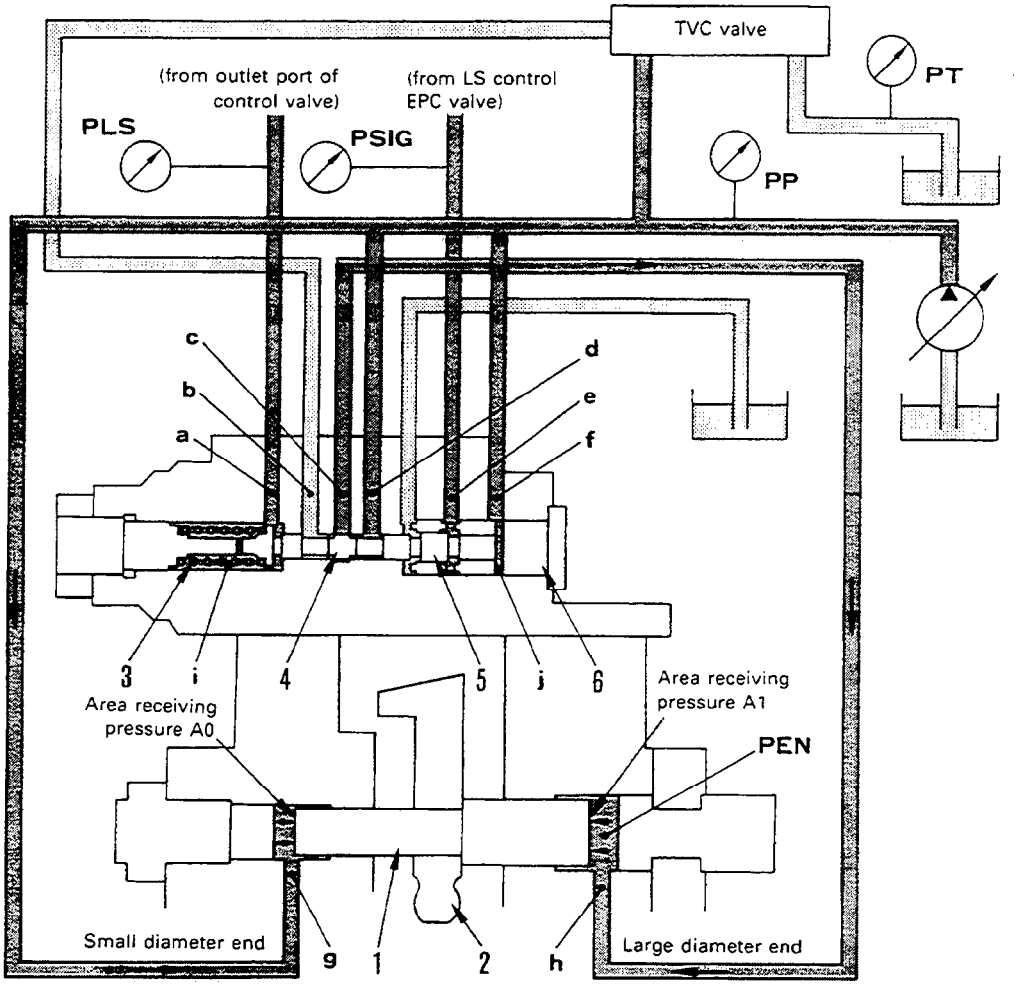


X10AV255

- The following explains the situation if servo piston (1) moves to the left (the discharge amount becomes smaller). When **LS** differential pressure Δ **PLS** becomes larger (for example, when the area of opening of the control valve becomes smaller and pump pressure **PP** rises), pump pressure **PP** pushes spool (4) to the left.
- When spool (4) moves, main pump pressure **PP** flows from port **d** to port **c**, and from port **h**, it enters the large piston diameter end.
- Main pump pressure **PP** also enters the small piston diameter end, but because of the difference in area between the large piston diameter end of servo piston (1) and the small piston diameter end, servo piston (1) is pushed to the left. As a result, rod (2) moves in the direction to make the swash plate angle smaller.
- If LS selection pressure **PSIG** enters port **e**, it acts to make the set pressure of spring (3) weaker.

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4) When servo piston is balanced



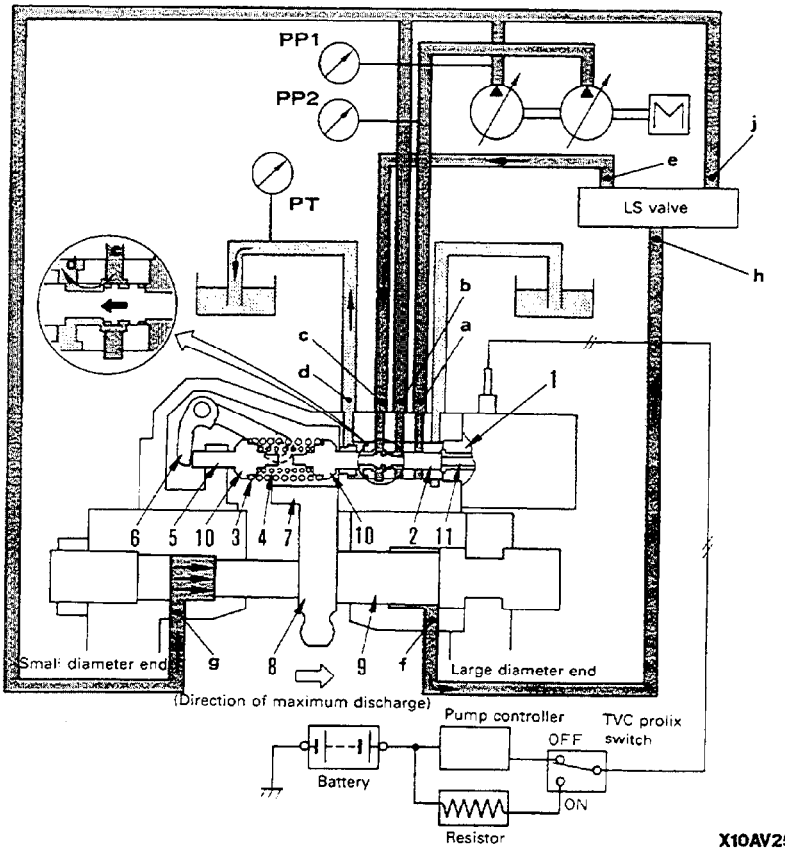
X10AV256

- Let us take the area receiving the pressure at the large piston diameter end as **A1**, the area receiving the pressure at the small end as **A0**, and the pressure flowing into the large piston diameter as **PEN**. If the main pump pressure **PP** of the LS valve and the combined force of force **F** of spring (3) and LS pressure **PLS** are balanced, and the relationship is **A0 x PP = A1 x PEN**, servo piston (1) will stop in that position, and the swash plate will be kept at an intermediate position. (It will stop at a position where the opening of the throttle from port **b** to port **c** and from port **d** to port **c** of spool (4) is approximately the same. At this point, the pressure of port **c** is approximately ½ pump pressure **PP**.)
- At this point, the relationship between the area receiving the pressure at both ends of piston (1) is A0:A1 = 1:2, so the pressure applied to both ends of the piston when it is balanced becomes **PP:PEN**≒ 2:1. The position where spool (4) is balanced and stopped is the standard center, and the force of spring (3) is adjusted so that it is determined when **PP - PLS** = 2.11 MPa (21.5 kg/cm^2). However, if **PSIG** (the output pressure of 0 - 2.94 MPa (0 - 30 kg/cm^2) of the EPC valve of the LS valve) is applied to port **e**, the balance stop position will change in proportion to pressure **PSIG** between **PP - PLS** = 2.11 - 0.64 MPa (21.5 - 6.5 kg/cm^2).

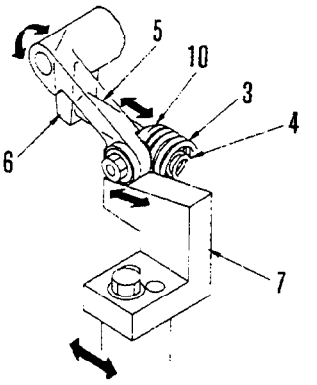
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TVC VALVE

1) When pump controller is normal



X10AV257



X10AV258

★ Other pump pressure. This is the pressure of the pump at the opposite end. For the Front pump, it is the Rear pump pressure. For the Rear pump, it is the Front pump pressure.

a. When the load on the actuator is small and pump pressures PP1 and PP2 are low

(1) Movement of solenoid (1)

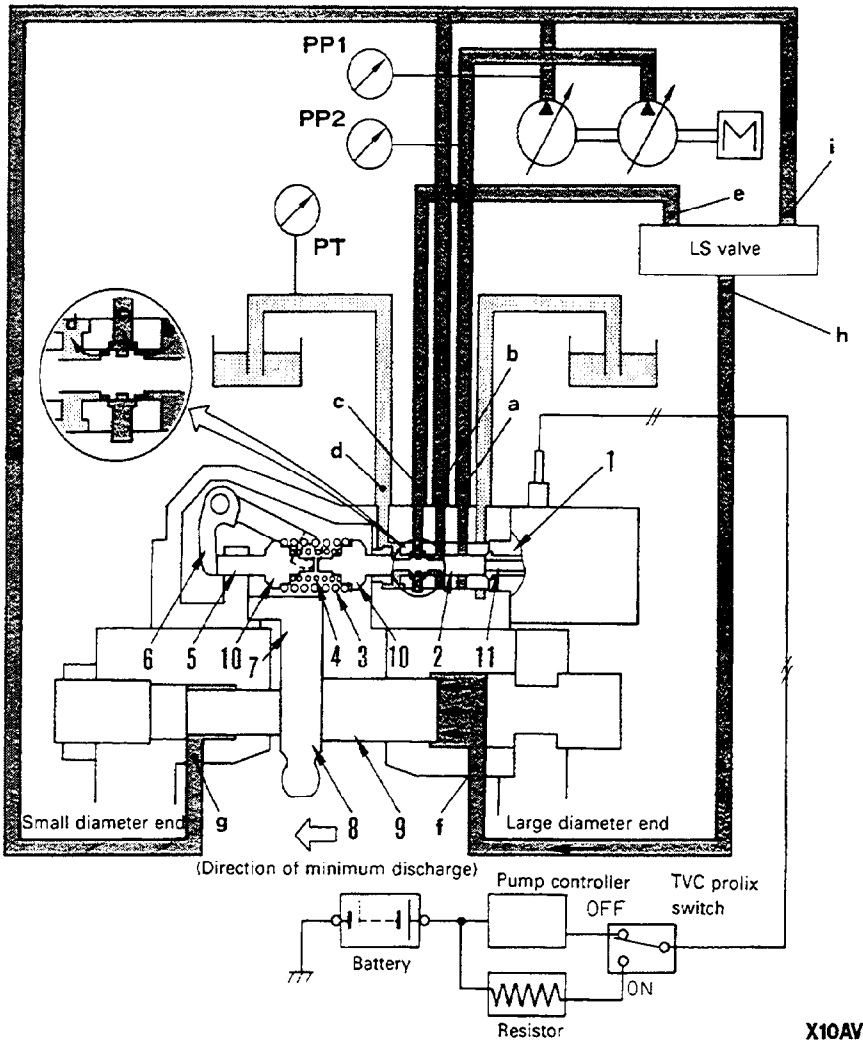
- Command current **X** from the pump controller flows to solenoid (1). This command current changes the internal force pushing solenoid push pin (11).
- On the opposite side to the force pushing this solenoid push pin (11) is the spring set pressure of springs (3) and (4) and pump pressure **PP1** and other pump (see ★) pressure **PP2**. Piston (2) stops at a position where the combined force pushing piston (2) is balanced, and the pressure (pressure of port **c**) output from the TVC valve changes according to this position.
- The size of command current **X** is determined by the nature of the operation (lever operation), the selection of the working mode, and the set valve and actual value for the engine speed.

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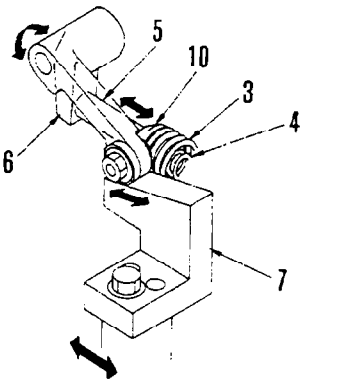
(2) Movement of spring

- The spring load of springs (3) and (4) in the TVC valve is determined by the swash plate position.
- When servo piston (9) moves, cam (7), which is connected to rod (8), also moves. When this happens, lever (6) is rotated by the angle of cam (7), and piston (5) moves to the right and left.
- If piston (5) moves to the right, spring (3) is compressed, and if it moves further to the right, spring (4) contact seat (10), so both spring (3) and spring (4) function. In other words, the spring load is changed be piston (5) extending or contraction springs (3) and (4).
- If command current **X** input to solenoid (1) changes further, the force pushing solenoid push pin (11) changes, and the spring load of springs (3) and (4) also changes according to the value of the solenoid command current.
- Port **c** of the TVC valve is connected to port **e** of the LS valve (see 1. LS valve).
  Self pressure **PP1** enters port **b** and the small piston diameter end of servo piston (9), and the other pump pressure enters port **a**.
- When pump pressures **PP1** and **PP2** are small, piston (2) is on the right. At this point, port **c** and port **d** are connected, and the pressure entering the LS valve becomes drain pressure **PT.** If port **h** and port **e** of the LS valve are connected (see 1. LS valve), the pressure entering the large piston diameter end from port **f** becomes drain pressure **PT**, and servo piston (9) moves to the right. In this way, the pump discharge amount moves in the direction of increase.
- As servo piston (9) moves further, piston (5) is moved to the left by rod (8), cam (7), and lever (6). Springs (3) and (4) expand and the spring force becomes weaker. When the spring force becomes weaker, piston (2) moves to the left, so the connection between port **c** and port **d** is cut, and the pump discharge pressure is connected to port **b**. As a result, the pressure at port **c** rises, and the pressure at the large piston diameter end also rises, so the movement of piston (9) to the right is stopped. In other words, the stop position for piston (9) (= pump discharge amount) is decided at the point where the force of springs (3) and (4) and the pushing force from the solenoid and the pushing force created by pressures **PP1** and **PP2** acting on piston (2) are in balance.

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X10AV259



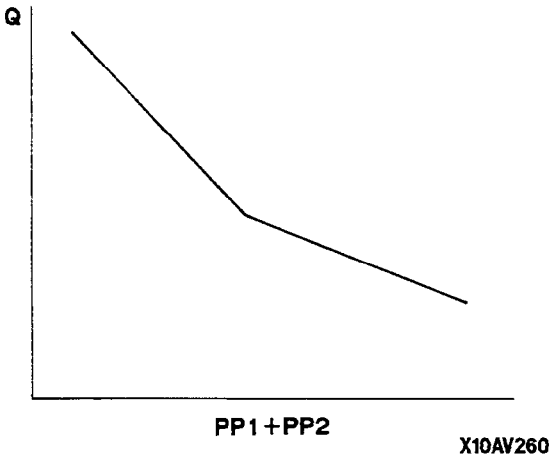
X10AV258

b. When load on actuator is small and pump discharge pressure is high

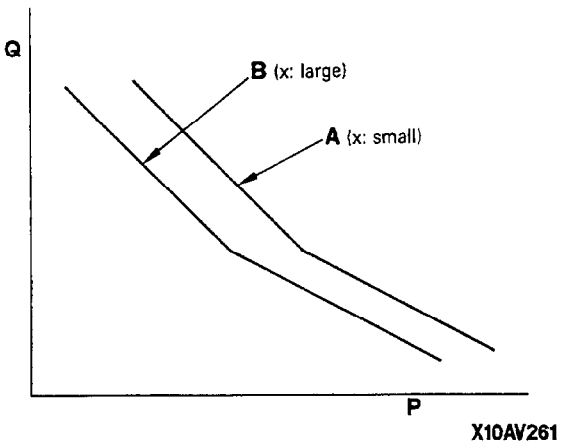
- When the load is large and pump discharge pressures **PP1** and **PP2** are high, the force pushing piston (2) to the left becomes larger and piston (2) moves to the position shown in the diagram above.
- When this happens, as shown in the diagram above, part of the pressurized oil from port **b** flows out to port **d** and the pressurized oil flowing from port **c** to the LS valve becomes approximately half of main pump pressure **PP1**.
  When port **h** and port **e** of the LS valve are connected (see 1. LS valve), the pressure from port **f** enters the large piston diameter end of servo piston (9), and servo piston (9) stops.
- If main pump pressures **PP1** and **PP2** increase further and piston (2) moves further to the left, main pump pressure **PP1** flows to port **c** and acts to make the discharge amount the minimum. When piston (9) moves to the left, piston (5) is moved to the right by cam (7) and lever (6). For this reason, springs (3) and (4) are compressed push back piston (2). Because of this force, piston (2) cuts off the connection from port **b** to port **c**, and port **c** and port **d** are connected. As a result, the pressure at port **c** (=**f**) drops, and piston (9) stops moving to the left. The position in which piston (9) stops when this happens is further to the the left than the position when pump pressures **PP1** and **PP2** are low.

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- The relation of pump pressures **PP1 + PP2** and the position of servo piston (9) forms a bent line because of the double-spring effect of springs (3) and (4). The relationship between pump pressures **PP1 + PP2** and pump discharge amount **Q** is shown in the figure on the right.

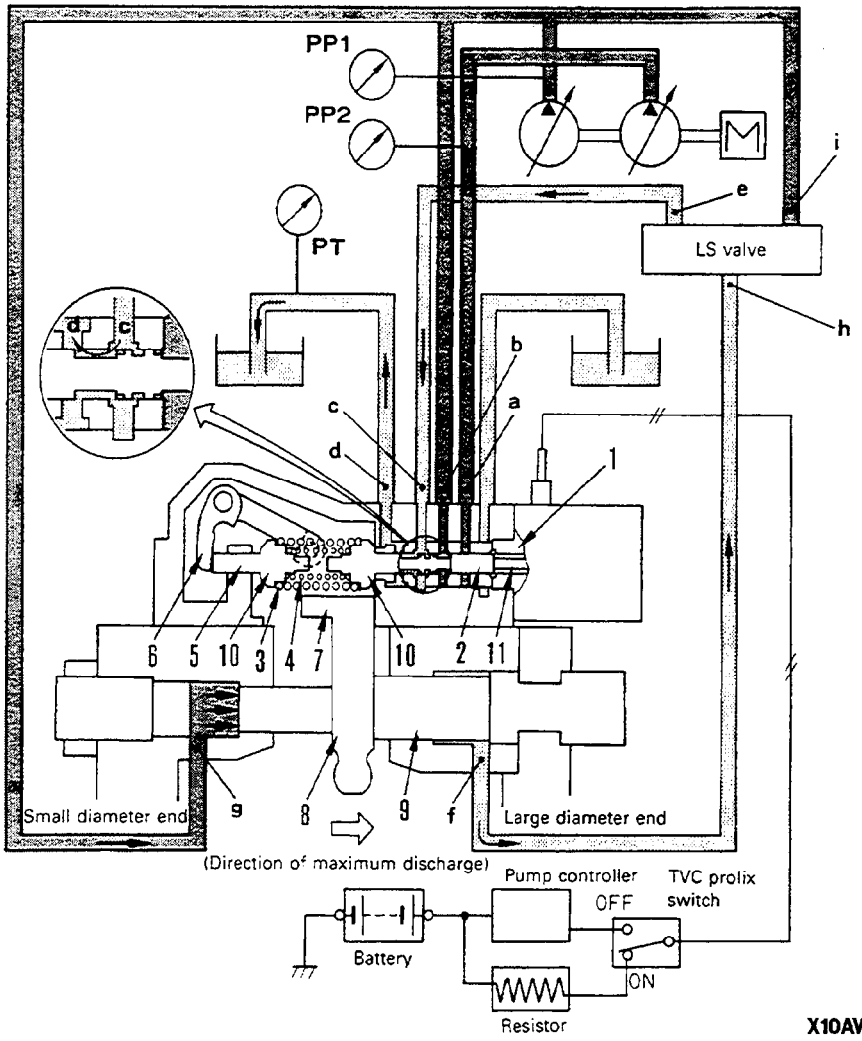


- If command voltage **X** sent to solenoid (1) increases further, the relationship between pump pressures **PP1** and **PP2**, and pump discharge amount **Q** is proportional to the pushing force of the solenoid and moves in parallel. In other words, if the pushing force of solenoid (1) is added to the force pushing to the left because of the pump pressure applied to the piston (2), the relationship between **PP** and **Q** moves from **A** to **B** in accordance with the increase in **X**.

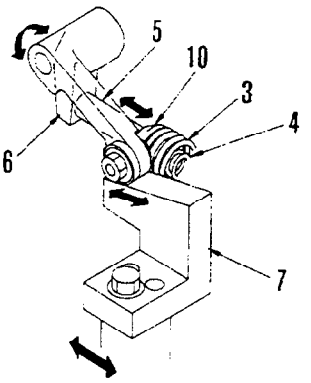


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2) When pump controller is abnormal and TVC prolix switch is ON



X10AV262

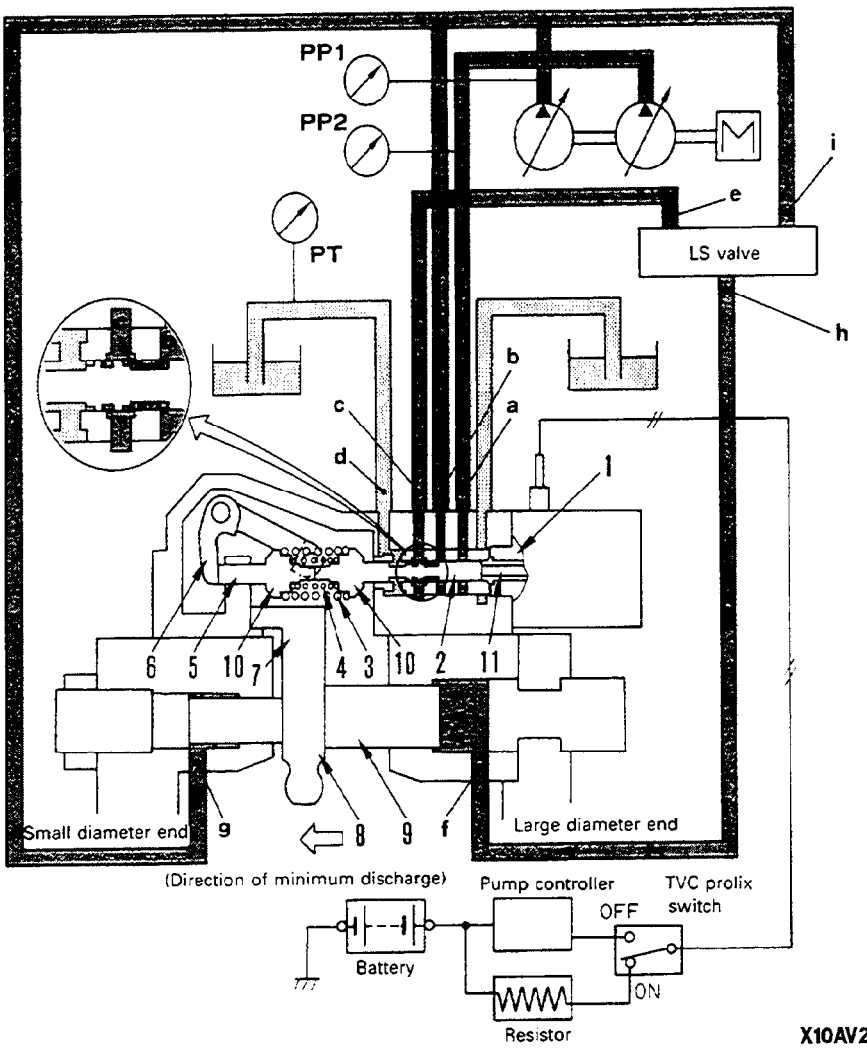


X10AV258

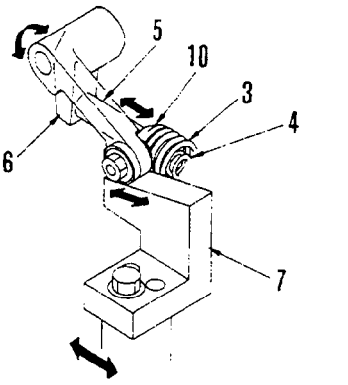
a. When load on main pump is light

- If there is a failure in the pump controller, turn TVC prolix switch ON to switch to the resistor side. In this case, the power source is taken directly from the battery. But if the current is used as is, it is too large, so use the resistor to control the current flowing to solenoid (1).
- When this is done, the current becomes constant, so the force pushing on solenoid push pin (11) is also constant.
- If main pump pressures **PP1** and **PP2** are low, the combined force of the pump pressure and the force of solenoid (1) is weaker that the spring set force, so piston (2) is balanced at a position to the right.
- At this point, port **c** is connected to the drain pressure of port **d**, and the large piston diameter end of servo piston (9) also becomes the drain pressure **PT** through the LS valve. When this happens, the pressure at the small piston diameter end is large, so servo piston (9) moves in the direction to make the discharge amount larger.

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X10AV263

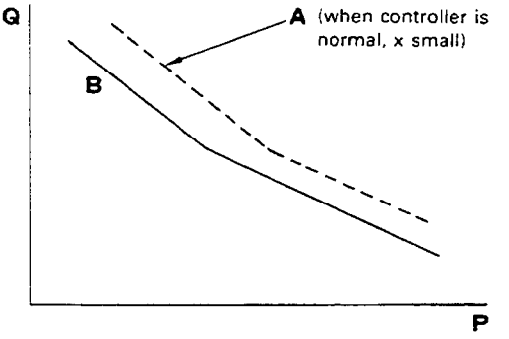


X10AV258

b. When main pump load is heavy

- In the same way as in the previous item, when the TVC prolix switch is ON, the command current **X** sent to solenoid (1) becomes constant. For this reason, the force of solenoid push pin (11) pushing piston (2) is constant.
- If main pump pressures **PP1** and **PP2** increase, piston (2) moves further to the left than when the main pump load is light, and is balanced at a position towards the left.
- In this case, the pressure from port **b** flows to port **c**, so servo piston (9) moves to the left (to make the discharge amount smaller) by the same mechanism as explained in item 2.1)-b. In other words, even when the TVC prolix switch is ON, the curve for the pump pressure **P** and discharge amount **Q** is determined as shown in the diagram for the value of the current sent to the solenoid through the resistor.

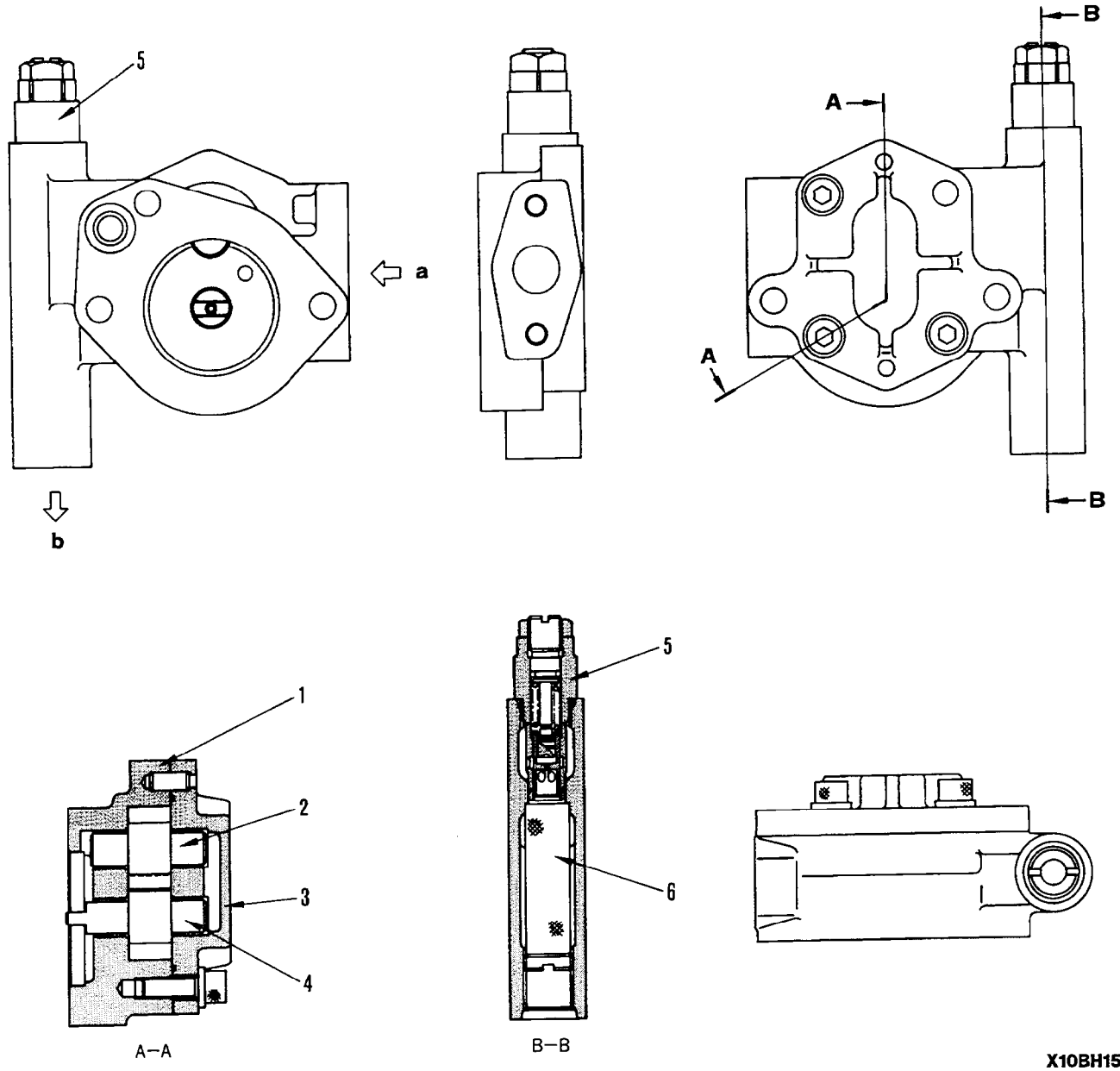
The curve when the TVC prolix switch in ON is curve **B**, which is to the left of curve **A** for when the pump controller is normal.



X10AV264

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3. CONTROL PUMP (BAR-016)



X10BH152

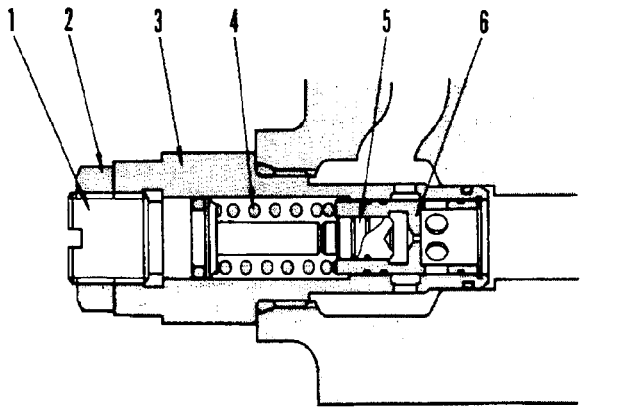
1. Body
2. Driven gear
3. Housing
4. Drive gear
5. Relief valve
6. Filter

a. Suction port
b. Delivery port

SPECIFICATIONS
Type: BAR-016
Theoretical delivery: 16.0 cc/rev
Max. delivery pressure: 3.23 MPa (33 kg/cm^2)

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RELIEF VALVE



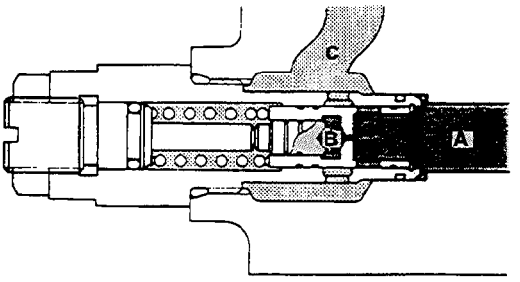
X10BH141

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

Set pressure: 3.33 MPa (34 kg/cm^2) (at 33 ℓ/min)

FUNCTION

The relief valve is assembled in the body of the control pump, and when the PPC valve is at neutral, the oil sent from the pump is relieved through this valve. (It sets the maximum pressure in the circuit during operations)

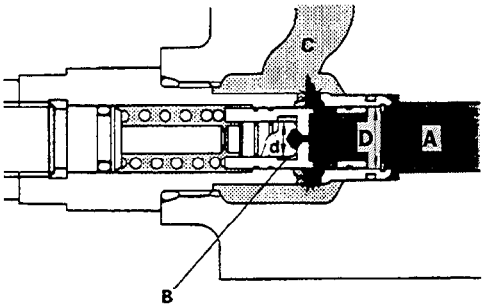


X10BH142

OPERATION

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

- If any abnormal pressure is generated, and the differential pressure [π/4(D^2 - d^2) x pressure of chamber **A**] created by the difference in the area of **d** and diameter **D** reaches the pressure set by the main valve spring, the main valve opens, and the oil in chamber **A** is released to chamber **C**. This suppresses the rise in the pressure in chamber **A**.

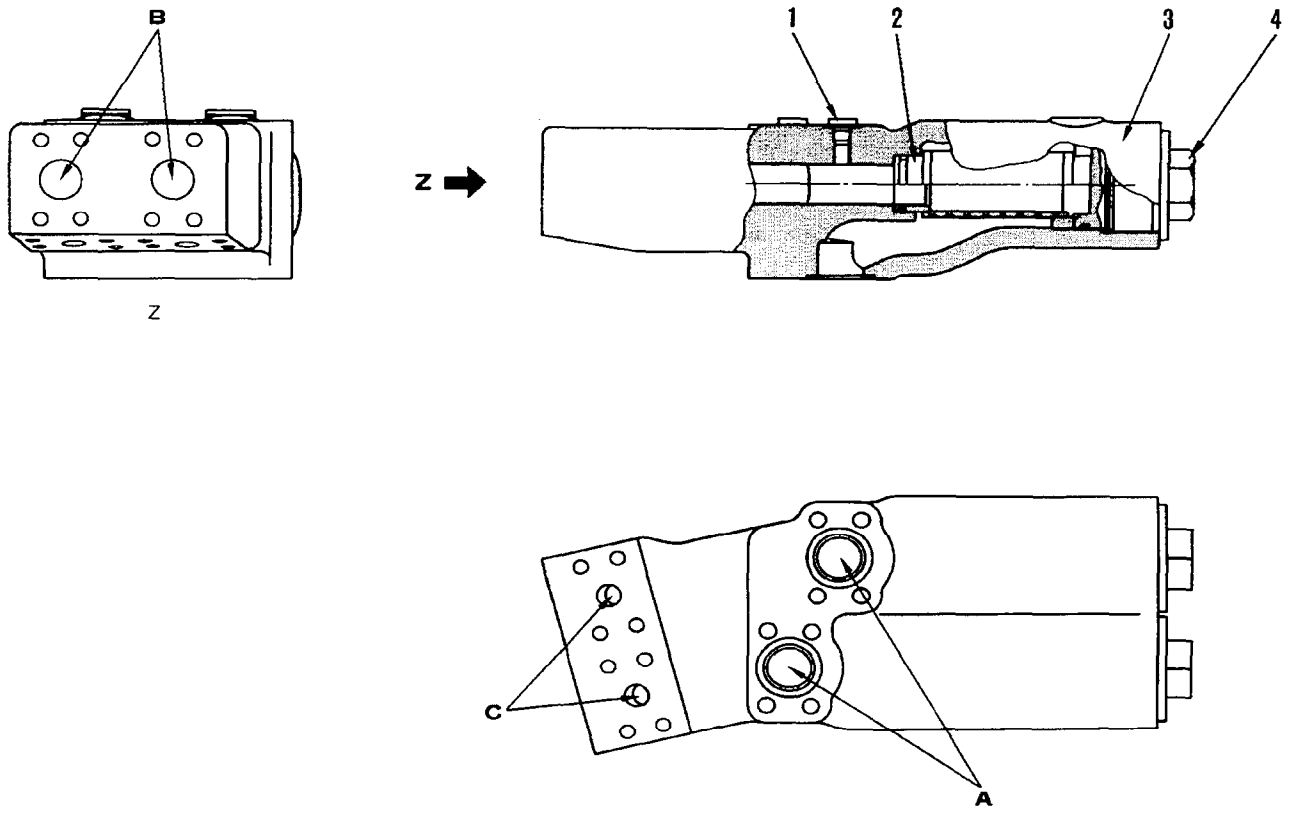


X10BH143

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LINE OIL FILTER

★ FOR MACHINES EQUIPPED WITH LINE OIL FILTER



X10BV050

1. Pressure pick-up plug
2. Element (x2)
3. Case
4. Plug

A. From pump
B. To control valve
C. To branch hose

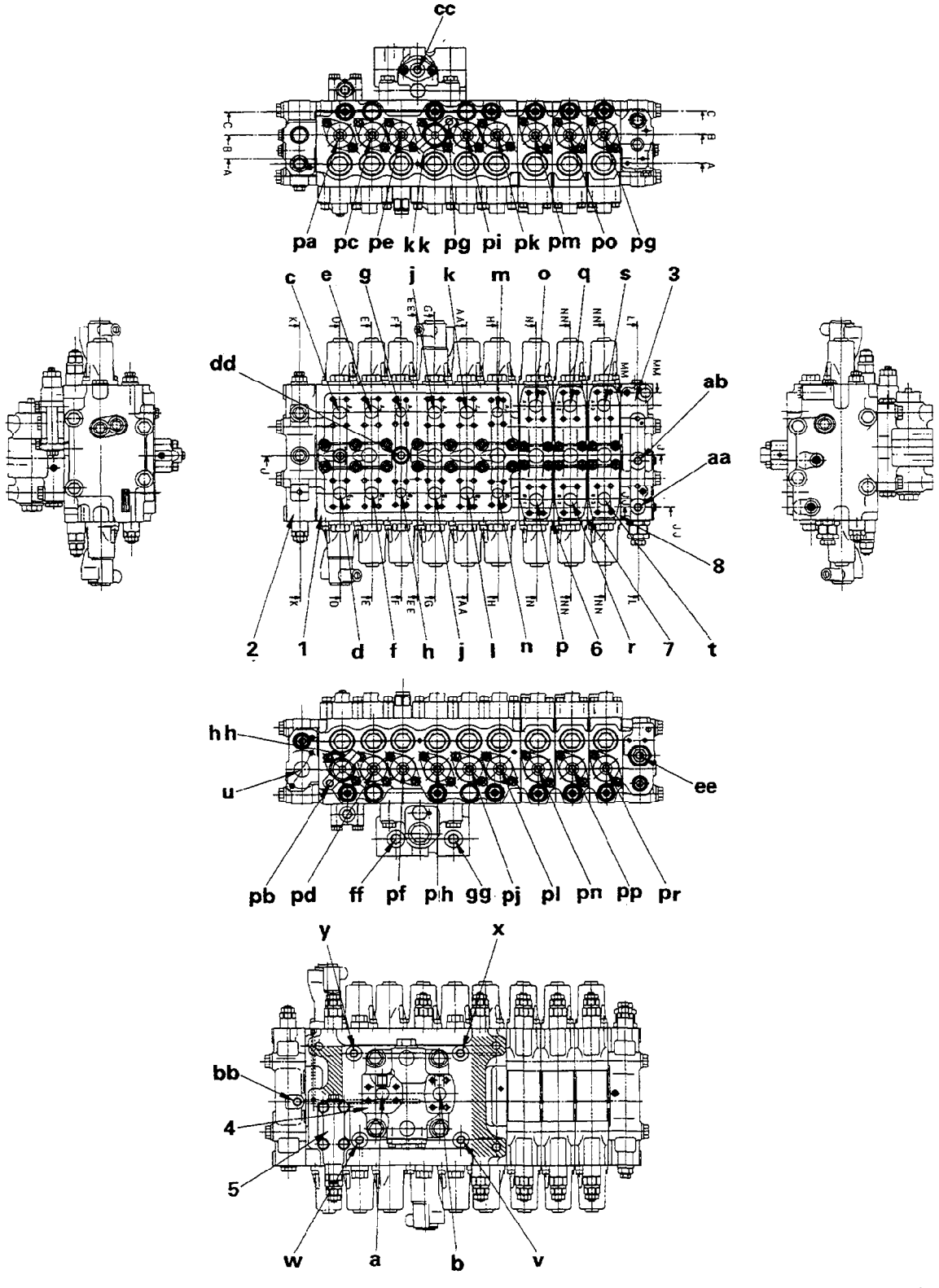
OUTLINE

- One line oil filter is installed to discharge side of the main pump to prevent the entry of dirt and dust, and to protect the circuit and equipment.

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CONTROL VALVE

9-SPOOL VALVE (STANDARD + 3 SERVICE VALVE)



X10BH144

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1. 6-spool valve
2. Cover 1
3. Cover 2
4. Pump merge-divider valve
5. Arm counterbalance valve
6. No. 1 Service valve
7. No. 2 Service valve
8. No. 3 Service valve

OUTLINE

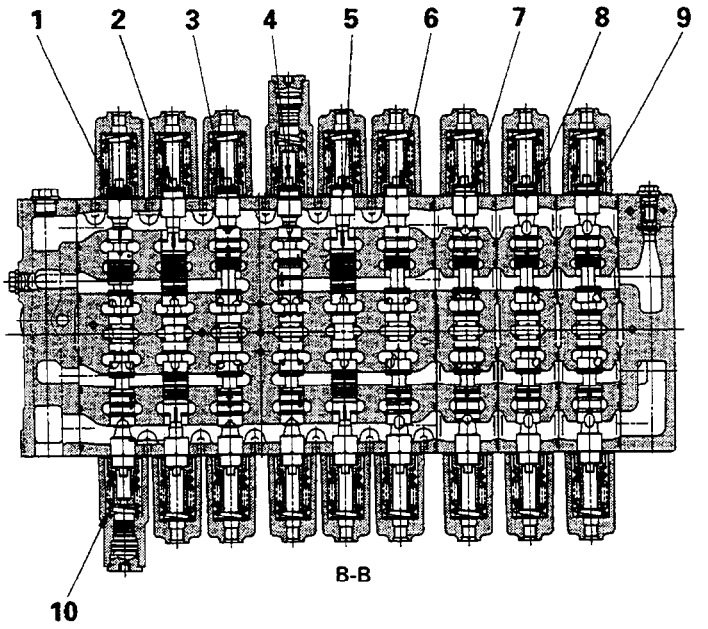
- This control valve consists of the 6-spool valve (an integrated composition) and 3 service valves. The pump merge-divider valve and arm counterbalance valve are installed to this.
- Each valve forms one unit with the connection bolt, and the passages are internally connected, so the structure is compact and is very easy to service.
- This control valve consists of one spool for one item of the work equipment, so it has a simple structure.

a. Port **PP1** (from rear main pump)
b. Port **PP2** (from front main pump)
c. Port **A6** (to arm cylinder head)
d. Port **B6** (to arm cylinder bottom)
e. Port **A5** (to L.H. travel motor)
f. Port **B5** (to L.H. travel motor)
g. Port **A4** (to swing motor)
h. Port **B4** (to swing motor)
i. Port **A3** (to boom cylinder bottom)
j. Port **B3** (to boom cylinder head)
k. Port **A2** (to R.H. travel motor)
l. Port **B2** (to R.H. travel motor)
m. Port **A1** (to bucket cylinder head)
n. Port **B1** (to bucket cylinder bottom)
o. Port **A-1** (to attachment)
p. Port **B-1** (to attachment)
q. Port **A-2** (to attachment)
r. Port **B-2** (to attachment)
s. Port **A-3** (to attachment)
t. Port **B-3** (to attachment)
u. Port **T** (to tank)
v. Port **T1** (to travel junction valve)
w. Port **T2** (to travel junction valve)
x. Port **T3** (to travel junction valve)
y. Port **T4** (to travel junction valve)

aa. Port **PLS1** (to rear pump control)
ab. Port **PLS2** (to front pump control)
bb. Port **TS** (to tank)
cc. Port **PS** (from solenoid valve)
dd. Port **BP** (from solenoid valve)
ee. Port **PX** (from solenoid valve)
pa. Port **P12** (from arm PPC/EPC valve)
pb. Port **P11** (from arm PPC/EPC valve)
pc. Port **P10** (from L.H. travel PPC valve)
pd. Port **P9** (from L.H. travel PPC valve)
pe. Port **P8** (from swing PPC/EPC valve)
pf. Port **P7** (from swing PPC/EPC valve)
pg. Port **P6** (from boom PPC/EPC valve)
ph. Port **P5** (from boom PPC/EPC valve)
pi. Port **P4** (from R.H. travel PPC valve)
pj. Port **P3** (from R.H. travel PPC valve)
pk. Port **P2** (from bucket PPC/EPC valve)
pl. Port **P1** (from bucket PPC/EPC valve)
pm. Port **P-2** (from service PPC valve)
pn. Port **P-1** (from service PPC valve)
po. Port **P-4** (from service PPC valve)
pp. Port **P-3** (from service PPC valve)
pq. Port **P-6** (from service PPC valve)
pr. Port **P-5** (from service PPC valve)
ff. Port **SA** (pressure sensor mount port)
gg. Port **SB** (pressure sensor mount port)
hh. Port **BP3** (from travel PPC)
kk. Port **BP2** (from arm PPC)

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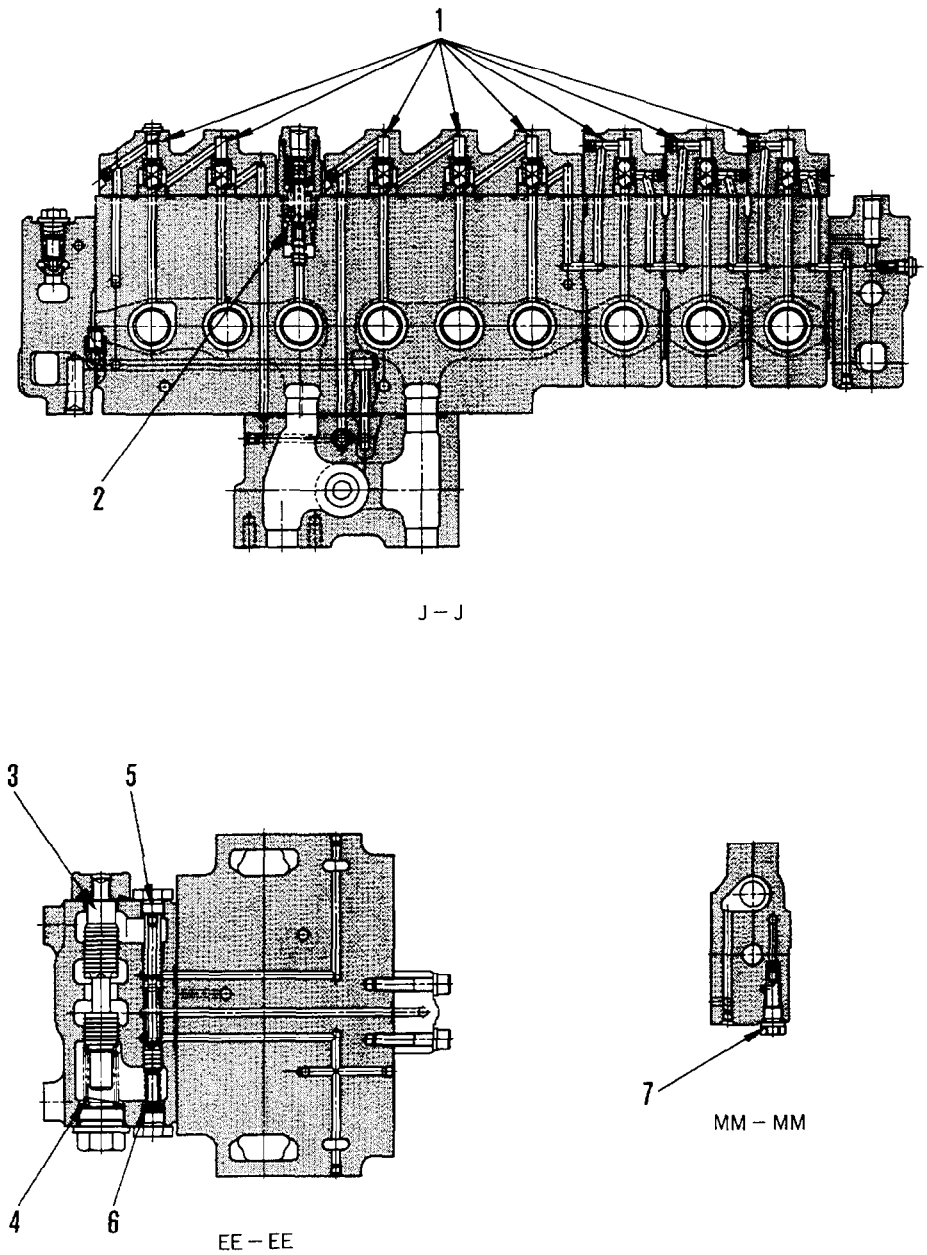
MAIN STRUCTURE



X10BH145

1. Spool (arm)
2. Spool (L.H. travel)
3. Spool (swing)
4. Spool (boom)
5. Spool (R.H. travel)
6. Spool (bucket)
7. Spool (service 1)
8. Spool (service 2)
9. Spool (service 3)
10. Spool return spring
11. Main unload • LS relief valve
12. Main relief valve (bucket end group)
13. Sub-unload valve (bucket end group)
14. Main relief valve (arm end group)
15. Sub-unload valve (arm end group)

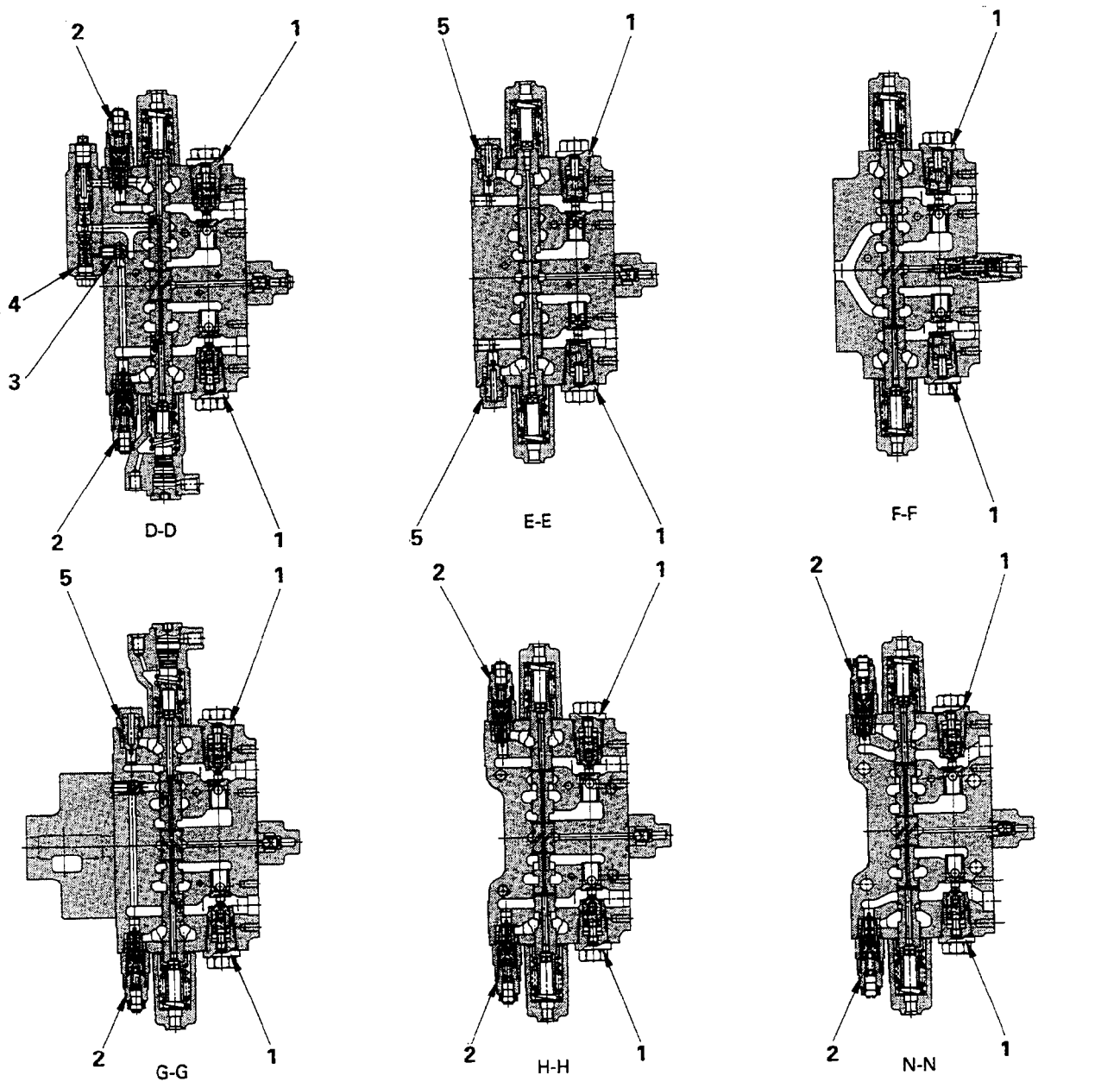
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X10BH146

1. LS shuttle valve
2. LS select valve
3. Pump merge-divider valve (for main)
4. Return spring
5. Pump merge-divider valve (for LS)
6. Return spring
7. LS bypass valve

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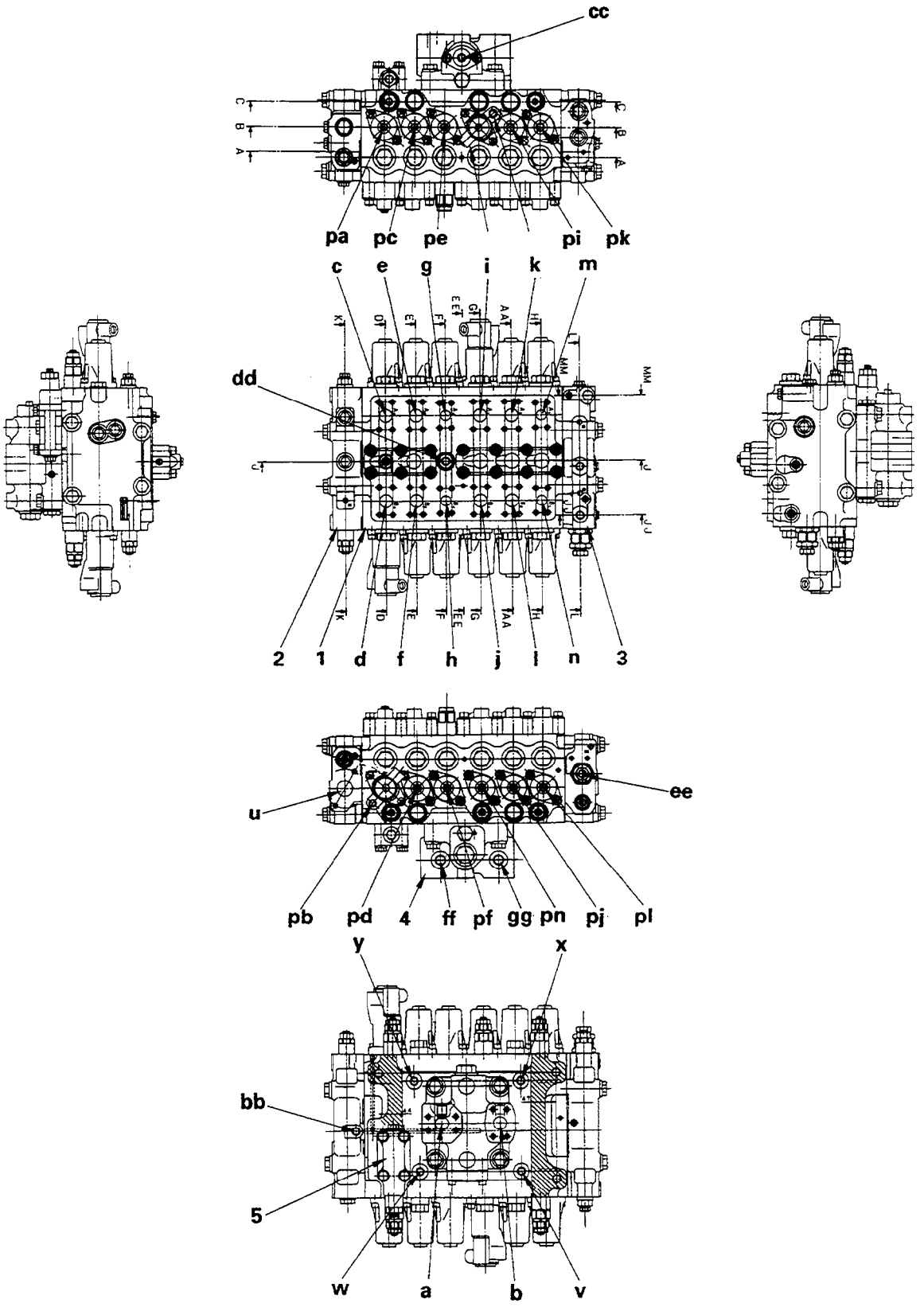
X10BH147

1. Pressure compensation valve
2. Safety-suction valve
3. Check valve for arm regeneration circuit
4. Arm counterbalance valve
5. Suction valve
6. Check valve for boom regeneration circuit

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6-SPOOL VALVE (STANDARD)

★ For details of the names of the ports and the main structure, see 9-SPOOL VALVE.

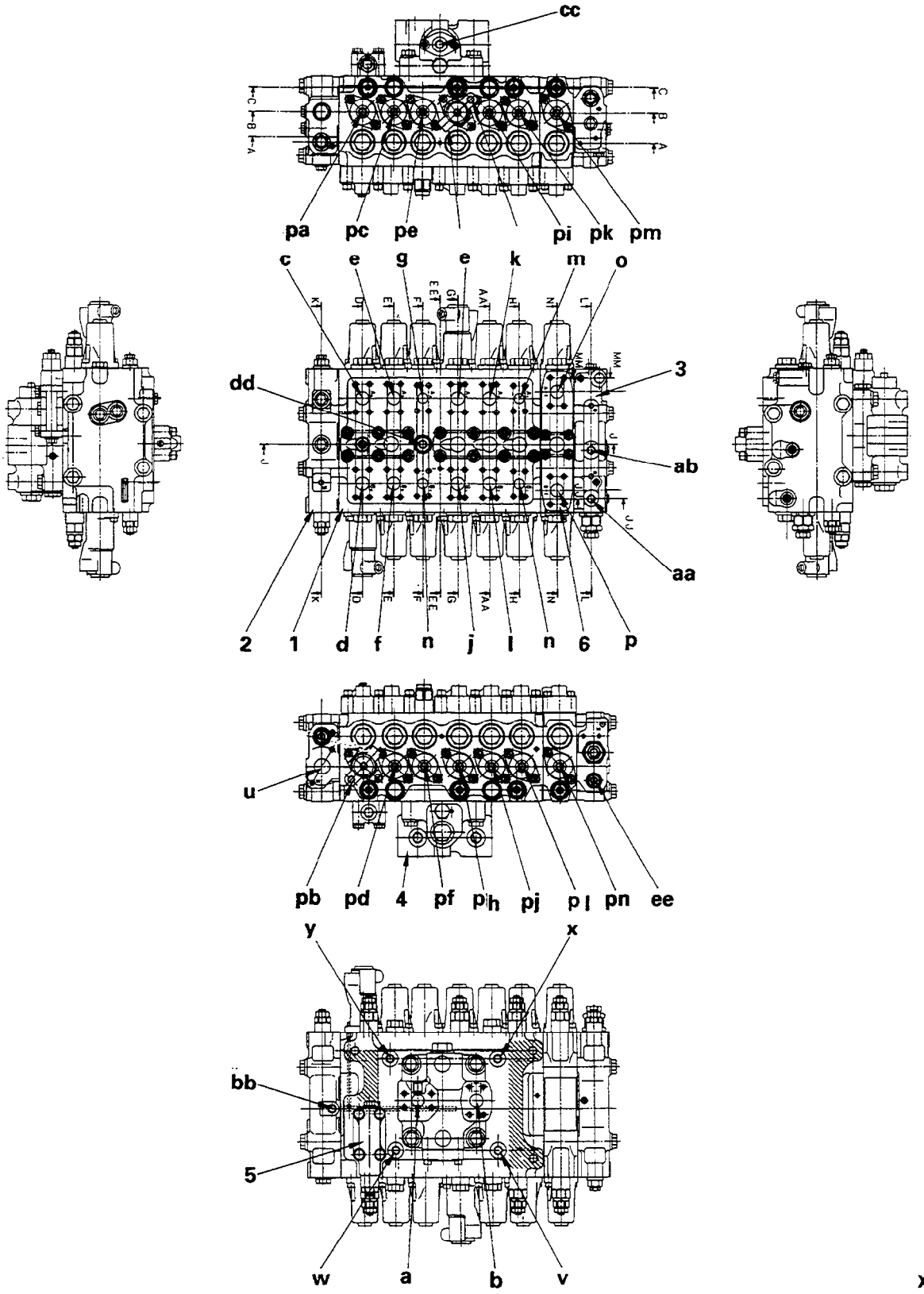


X10BH148

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7-SPOOL VALVE (STANDARD + 1 SERVICE VALVE)

★ For details of the names of the ports and the main structure, see 9-SPOOL VALVE.

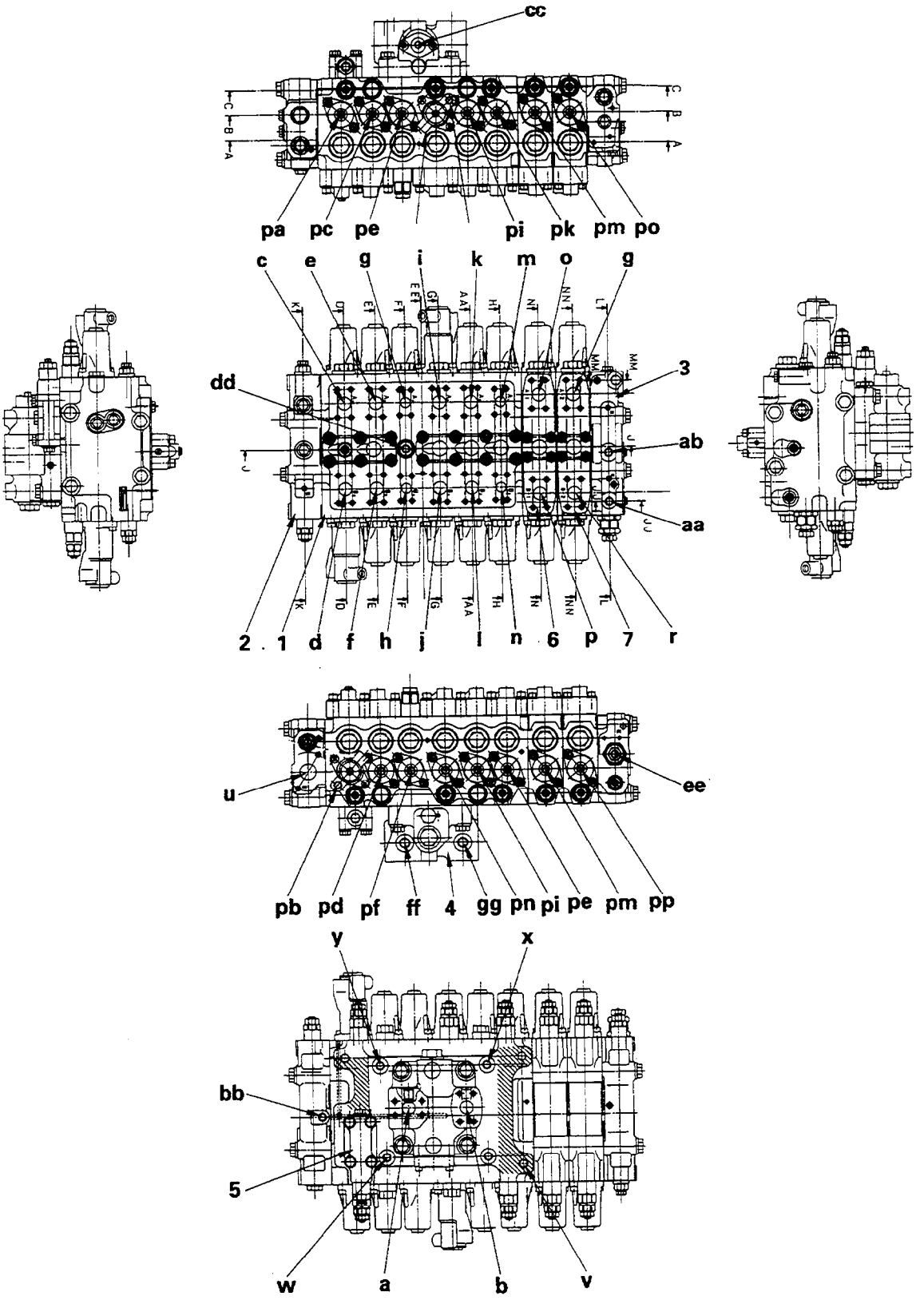


X10BH149

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8-SPOOL VALVE (STANDARD + 2 SERVICE VALVE)

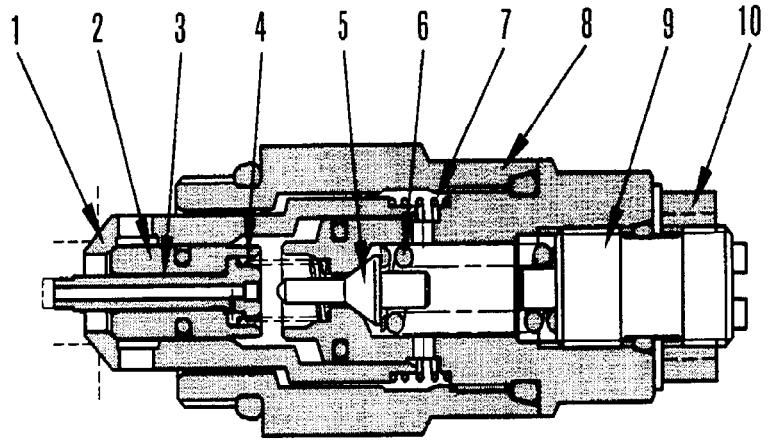
★ For details of the names of the ports and the main structure, see 9-SPOOL VALVE.



X10BH150

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SAFETY-SUCTION VALVE FOR SERVICE VALVE



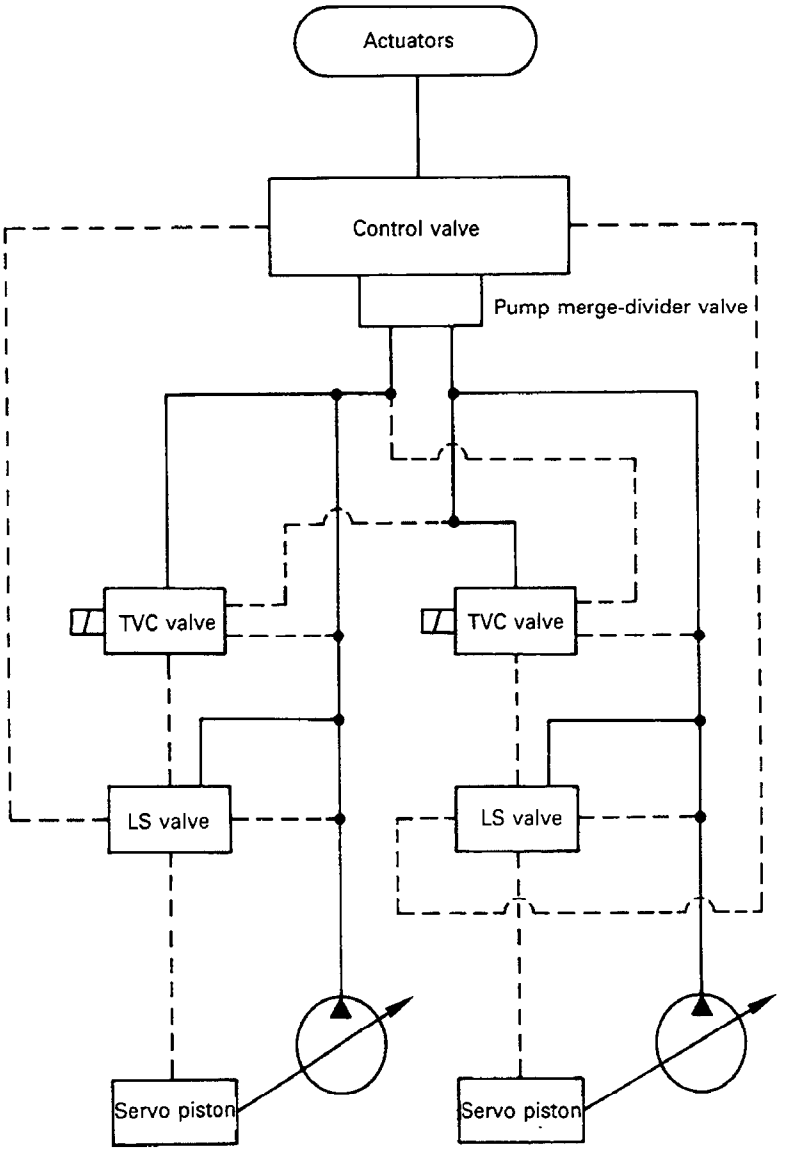
X10BH151

1. Suction valve
2. Main valve
3. Piston
4. Piston spring
5. Poppet
6. Poppet spring
7. Suction valve spring
8. Sleeve
9. Adjustment screw
10. Locknut

Part No.	Set Pressure	Use
709-70-74600	24.5 MPa (250 kg/cm^2) at 5 ℓ/min	For crusher (Okada)

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CLSS
OUTLINE OF CLSS



X10DD013

Features

- CLSS stands for **C**losed center **L**oad **S**ensing **S**ystem, and has the following features.

1) Fine control not influenced by load
2) Control enabling digging even with fine control
3) Ease of compound operation ensured by flow divider function using area of opening of spool during compound operations
4) Energy saving using variable pump control

Structure

- The CLSS consists of a main pump (2 pumps), control valve, and actuators for the work equipment.
- The main pump body consists of the pump itself, the TVC valve and LS valve.

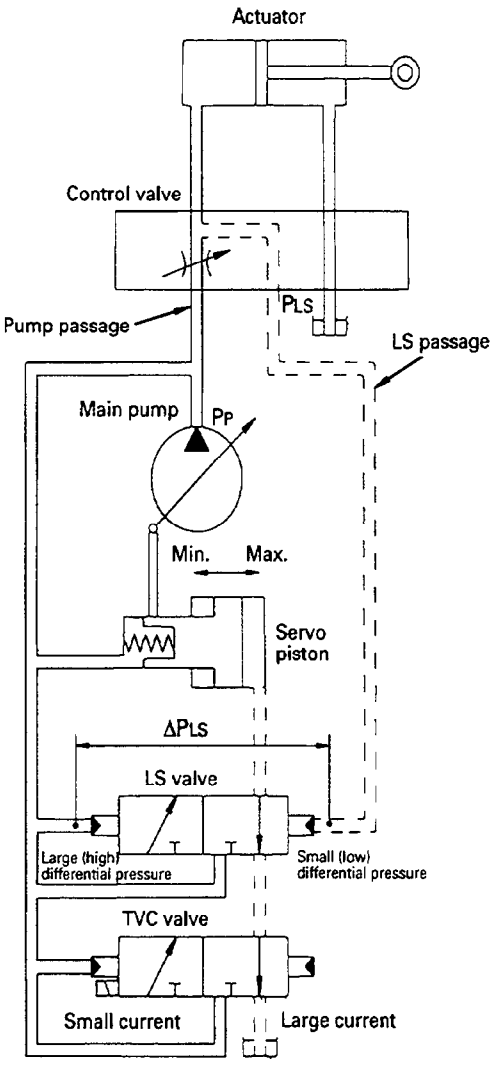
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Basic principle

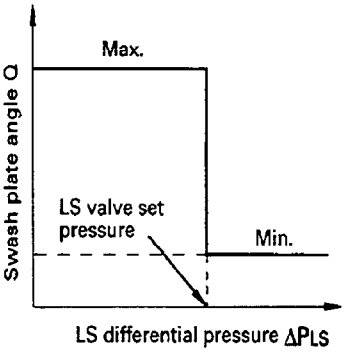
1) Control of pump swash plate angle

- The pump swash plate angle (pump discharge amount) is controlled so that LS differential pressure ΔPLS (the difference between pump pressure PP and control valve outlet port LS pressure PLS) (load pressure of actuator) is constant. (LS pressure ΔPLS = Pump discharge pressure PP - LS pressure PLS)

- If LS differential pressure ΔPLS becomes lower than the set pressure of the LS valve(when the actuator load pressure is high), the pump swash plate moves toward the maximum position; if it becomes higher than the set pressure of the LS valve (when the actuator load pressure is low), the pump swash plate moves towards the minimum position.



X10DD014

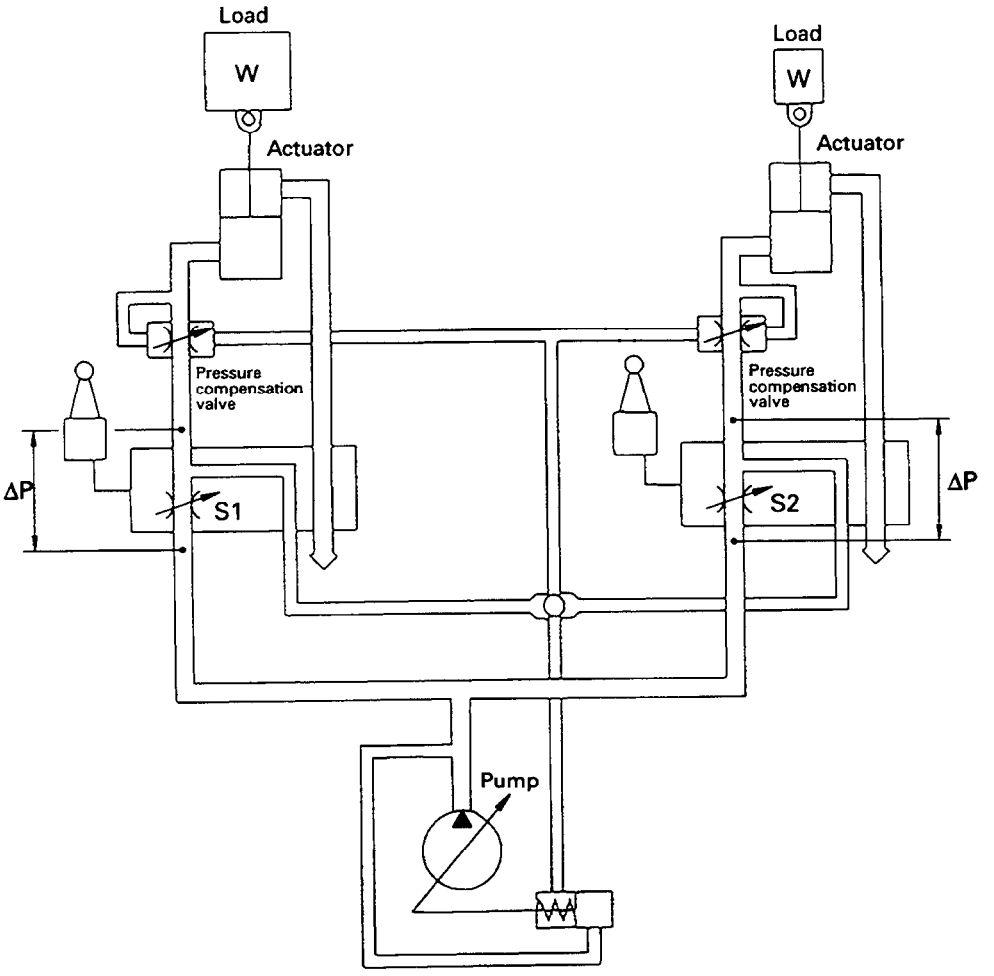


X10DD015

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2) Pressure compensation

- A pressure compensation valve is installed to the outlet port side of the control valve to balance the load. When two actuators are operated together, this valve acts to make the pressure difference ΔP between the upstream (inlet port) and downstream (outlet port) of the spool of each valve the same regardless of the size of the load (pressure).
  In this way, the flow of oil from the pump is divided (compensated) in proportion to the area of openings **S1** and **S2** of each valve.

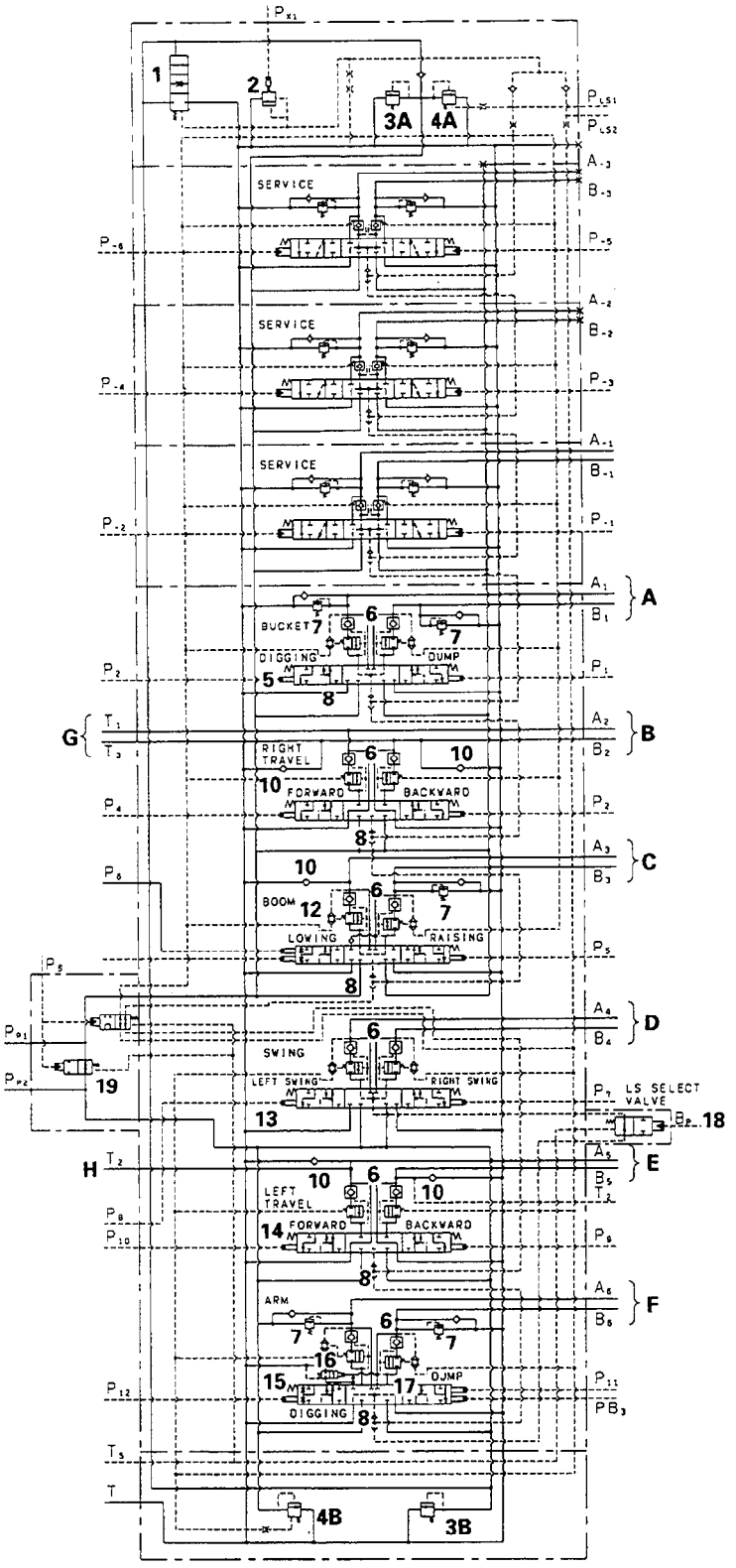


X10DD016

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OPERATION FOR EACH FUNCTION OF CLSS

Hydraulic circuit diagram for system



X10DD017

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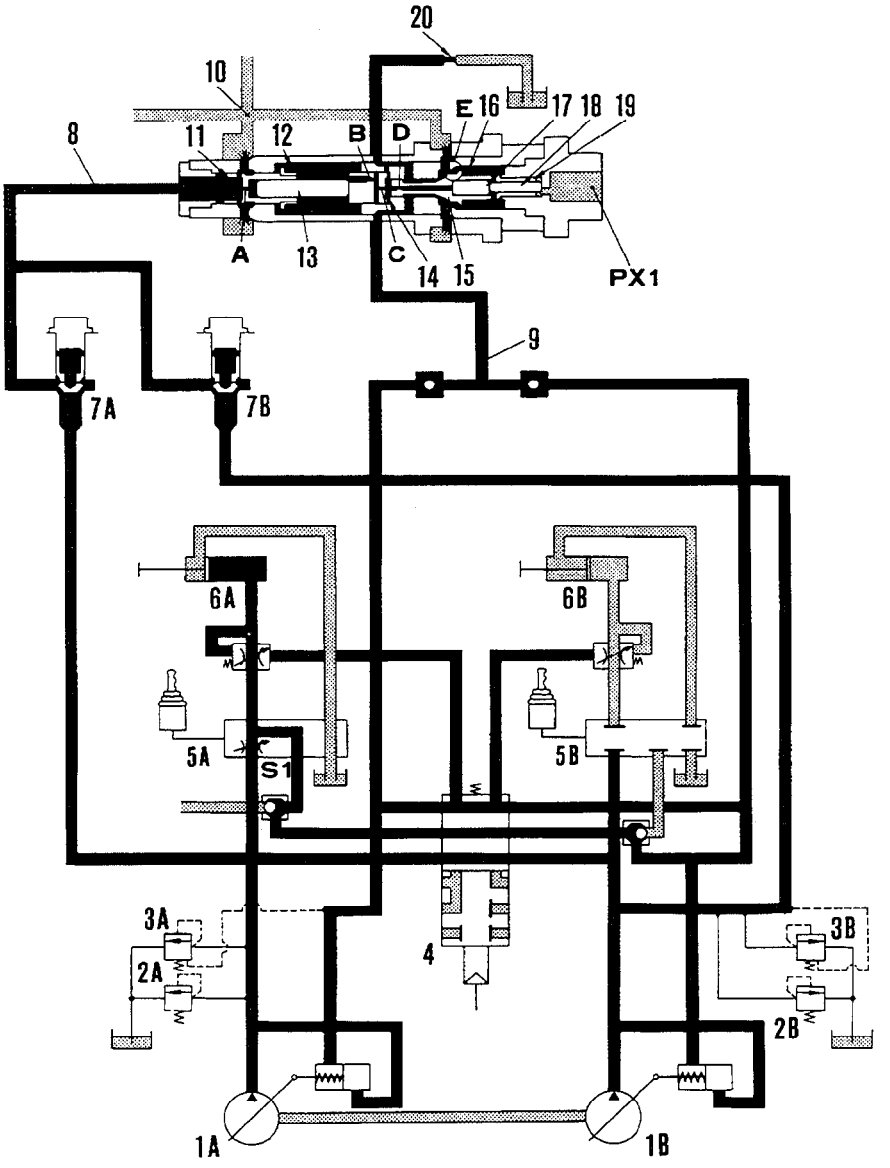
1. Main unload valve
2. LS relief valve
3A. Main relief valve (group at bucket end)
3B. Main relief valve (group at arm end)
4A. Sub-unload valve (group at bucket end)
4B. Sub-unload valve (group at arm end)
5. Bucket spool
6. Pressure compensation valve
7. Safety-suction valve
8. LS shuttle valve
9. R.H. travel spool
10. Suction valve
11. Boom spool
12. Check valve (for boom regeneration circuit)
13. Swing spool
14. L.H. travel spool
15. Arm spool
16. Arm counterbalance valve
17. Check valve (for arm regeneration circuit)
18. LS select valve
19. Pump merge-divider valve

A. To bucket cylinder
B. To R.H. travel motor
C. To boom cylinder
D. To swing motor
E. To L.H. travel motor
F. To arm cylinder
G. To travel junction valve
H. To travel junction valve

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SYSTEM DIAGRAM

★ This shows actuator (6A) and the stroke end relief in the merge mode.



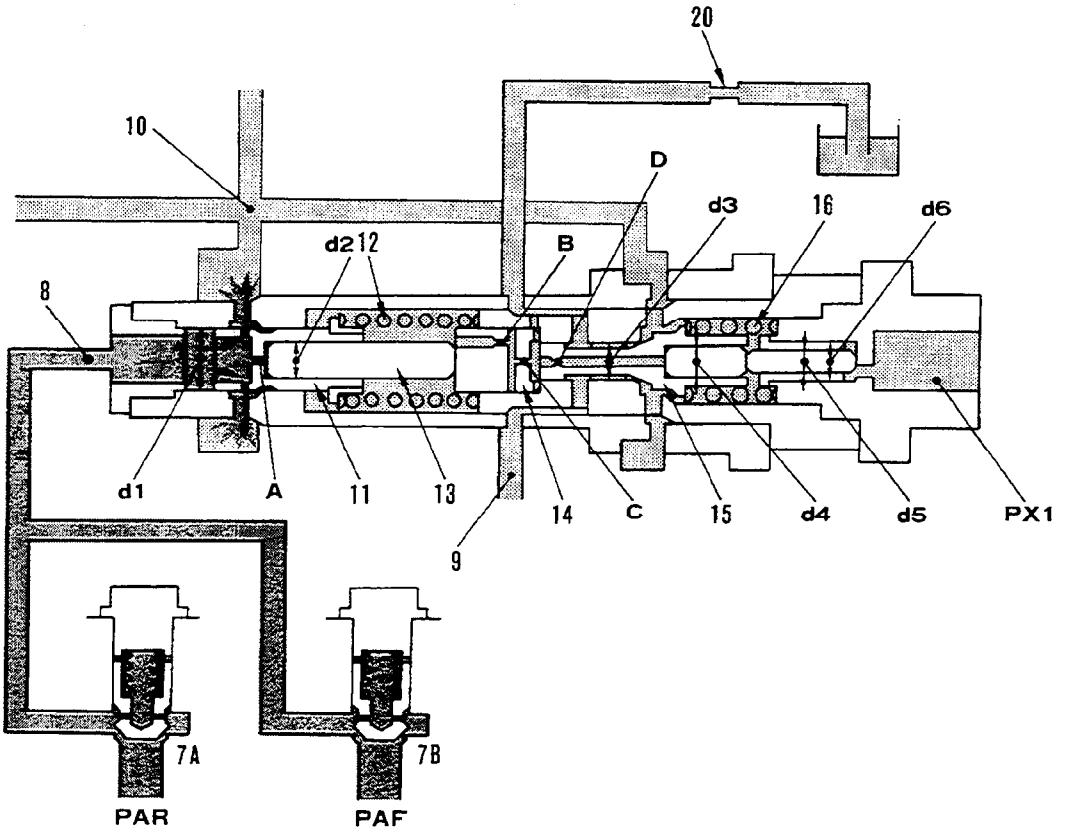
X10DD018

1A. Main pump
1B. Main pump
2A. Main relief valve (for power max.)
2B. Main relief valve (for power max.)
3A. Sub unload valve
3B. Sub unload valve
4. Pump merge-divider valve
5A. Control valve
5B. Control valve
6A. Actuator
6B. Actuator
7A. Check valve
7B. Check valve
8. Pump passage
9. LS circuit
10. Tank pressure
11. Valve
12. Spring
13. Piston
14. Clearance filter
15. Poppet
16. Spring
17. Piston
18. Piston
19. Piston
20. LS bypass valve

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1. Main unload valve + LS relief valve

1) When main unload valve is actuated



X10DD019

Function

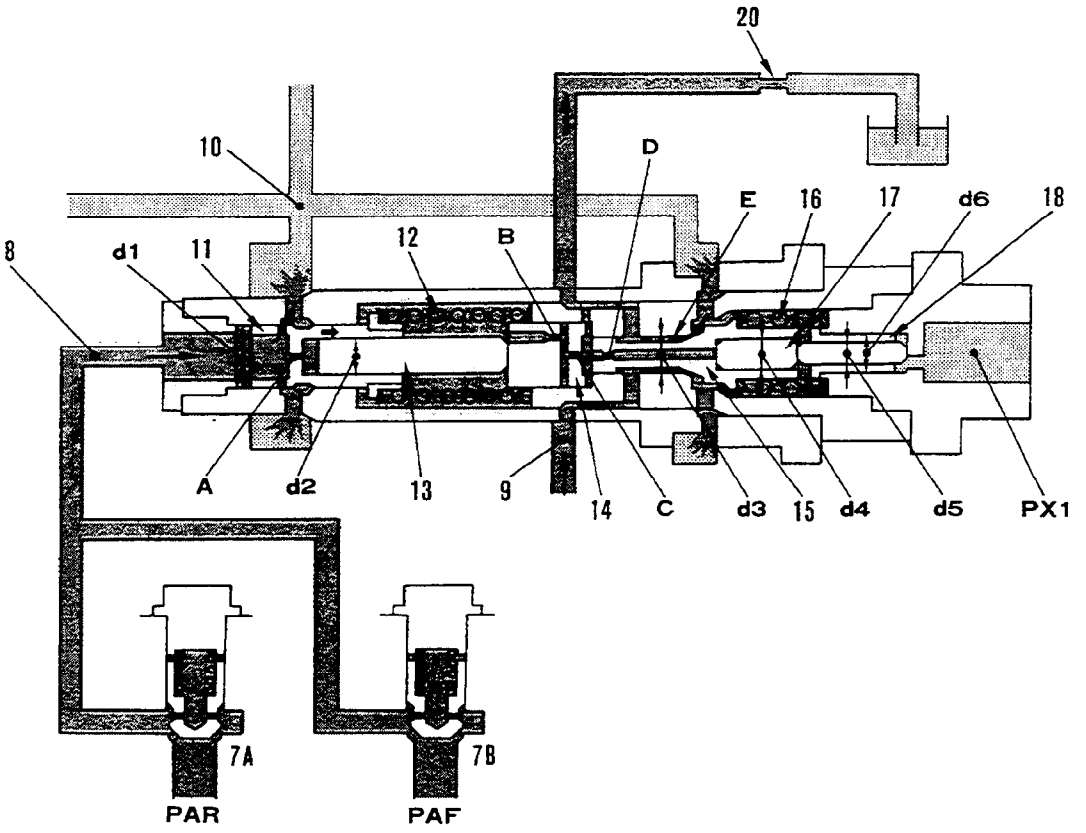
- When all the control valves are at neutral, the oil discharged when the pump is at the minimum swash plate angle is drained. When this happens, the pump pressure becomes a pressure a that matches the set load of spring (12) inside the valve (**P1** pressure). The LS pressure is drained from LS bypass valve (20), so LS pressure ≒ tank pressure ≒ 0 MPa (0 kg/cm^2).
- When operated (for operations in the discharge range for the minimum swash plate angle), the discharge pressure of the oil discharged with the pump at the minimum swash plate angle is LS pressure + **P1** pressure. In other words, the LS control differential pressure (Δ **PLS**) of the oil discharged at the minimum swash plate angle is the **P1** pressure.

Operation

- The pressure in pump passage (8) is received by area **d1** at the end face of the valve and area **d2** at the end face of piston (13). The pressure in LS circuit (9) is drained to the tank from LS bypass valve (20), so LS pressure ≒ 0 MPa (0 kg/cm^2).
- There is no way for the pressurized oil discharged by the pump to escape, so the pressure in pump passage (8) rises. This pressure acts on surface differential portion **A1** between area **d1** at the end face of the valve and area **d2** at the end face of piston (13), and this is received by force **F1** of spring (12) (condition: **d1** > **d2**). Therefore, if passage pressure **P1** x area difference **A1** > spring force **F1**, the valve is pushed to the right, and the pressurized oil flows from the valve to tank passage (10).
- The LS differential pressure (pump discharge pressure - LS circuit pressure) is greater that the pump LS control pressure at the time of the unload operation, so a signal is sent to move the pump swash plate in the direction of the minimum angle.

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2) At LS relief (standard mode relief, cut-off control)



X10DD020

Function

- When the control valve is actuated, the maximum pressure in LS circuit (9) is controlled to the specified pressure (the specified maximum pressure for the pump circuit). That is, the cut-off control is carried out.

Operation

(1) When the control valve is operated, the LS pressure passes through throttle **S1** of spool (5A) and is sent to LS circuit (9). This LS pressure goes from clearance filter (14) through orifice **B** to spring chamber (12). Part also goes through orifices **C** and **D**, and the poppet end portion **d3**, and is sent to end portion **d4** of piston (17). Piston (19) acts as a stopper for piston (17). Therefore, the LS pressure is applied to area difference **A2** between area **d3** at the end of the poppet and area **d4** at the end of the piston, and this is received by force **F2** of spring (16) (condition: **d3** > **d4**).

(2) When the LS pressure rises, and the condition becomes LS pressure x area difference **A2** > force **F2** of spring (16), the poppet moves to the right and seat **E** opens. As a result the pressurized oil in LS circuit (9) passes through the notched groove in the outside circumference of poppet (15) and flows to tank passage (10).

★ Clearance filter (14) is set to diameter clearance < orifice diameter, and prevents the entry of dirt which might block the orifice.

Pump circuit pressure

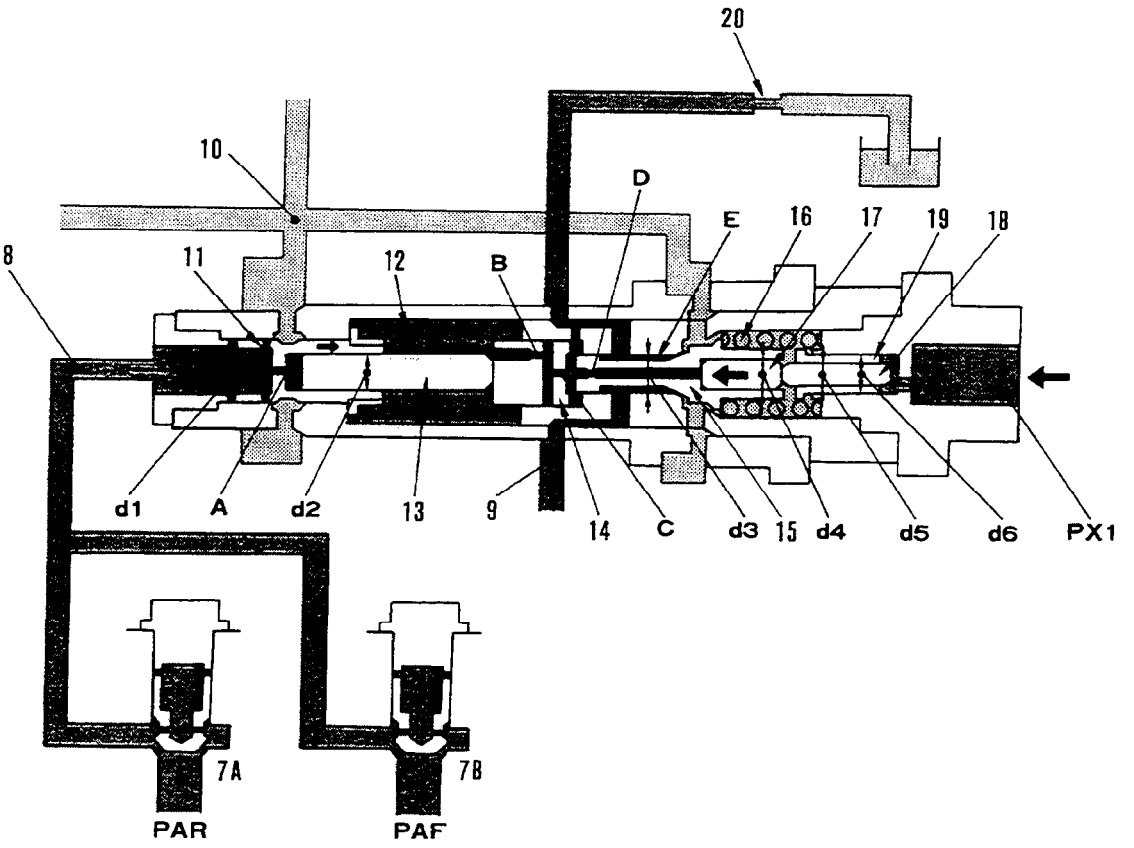
(3) When the pressurized oil in LS circuit (9) flows to tank passage (10) in operation (2) above, the pressure difference from the pump passage becomes greater because of the pressure loss in the LS circuit.

(4) When the pressure difference becomes **P1** pressure as explained in Item 1) "When main unload valve is actuated", the valve moves to the right, and the pressurized oil is discharged from the pump flows to tank passage (10). In this way, the maximum pressure of the pump passage is controled.

(5) When this unload operation is carried out, pump discharge pressure - LS circuit pressure is greater than the pump LS control pressure, so a signal is sent to set the pump swash plate to the minimum angle.

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3) When power max. function is actuated

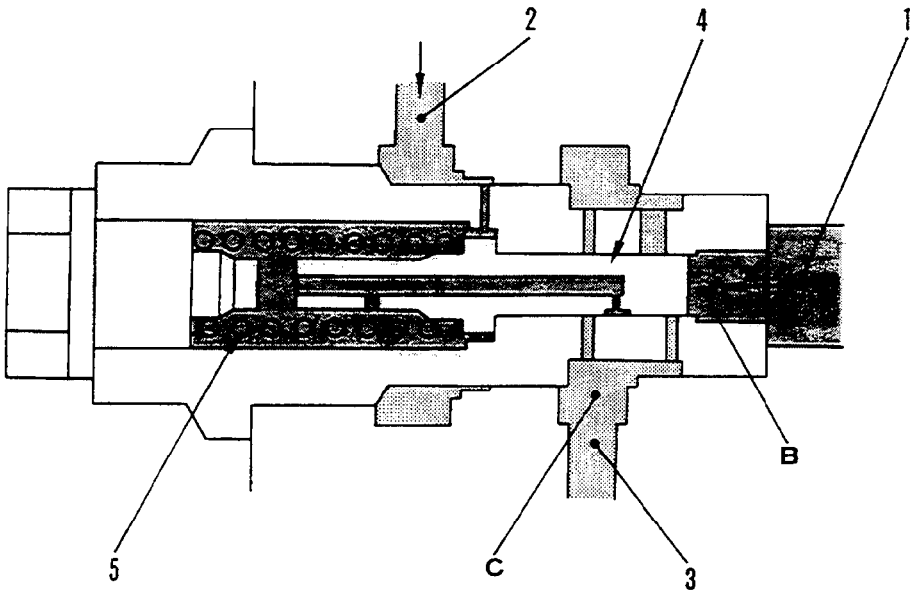


X10DD021

- When the pilot pressure is applied to port **PX1**, piston (18) and piston (19) move to the left, and poppet (15) and piston (17) are brought into close contact, so poppet (15) cannot move and the LS control pressure rises.

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2. Sub-unload valve



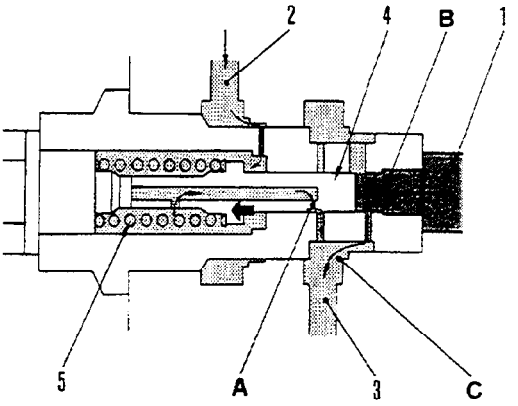
X10BH153

Function

- When the pump flow is divided and the control valve group on one side is actuated (with the remaining control valve group at neutral), the sub-unload valve drains the pump flow to the group that is at neutral.

Operation

- The pressure in pump passage (1) is received at the end portion of valve (4). The control valve is at neutral, so the pressure of LS circuit (2) is 0 MPa (0 kg/cm^2).
- The pressurized oil in pump passage (1) is stopped by valve (4) and cannot escape, so the pressure rises. When this pressure becomes larger than the force of spring (5), valve (4) moves to the left, ports **B** and **C** are interconnected, and the pump pressure flows to tank passage (3). In addition, the pressurized oil in LS circuit (2) passes from orifice **A** through port **C** and is drained to tank passage (3). Therefore, in this operation, LS pressure = tank pressure.
- In this unload operation, pump discharge pressure - LS circuit pressure is greater than the pump LS control pressure, so a signal is sent to set the pump swash plate to the minimum angle.

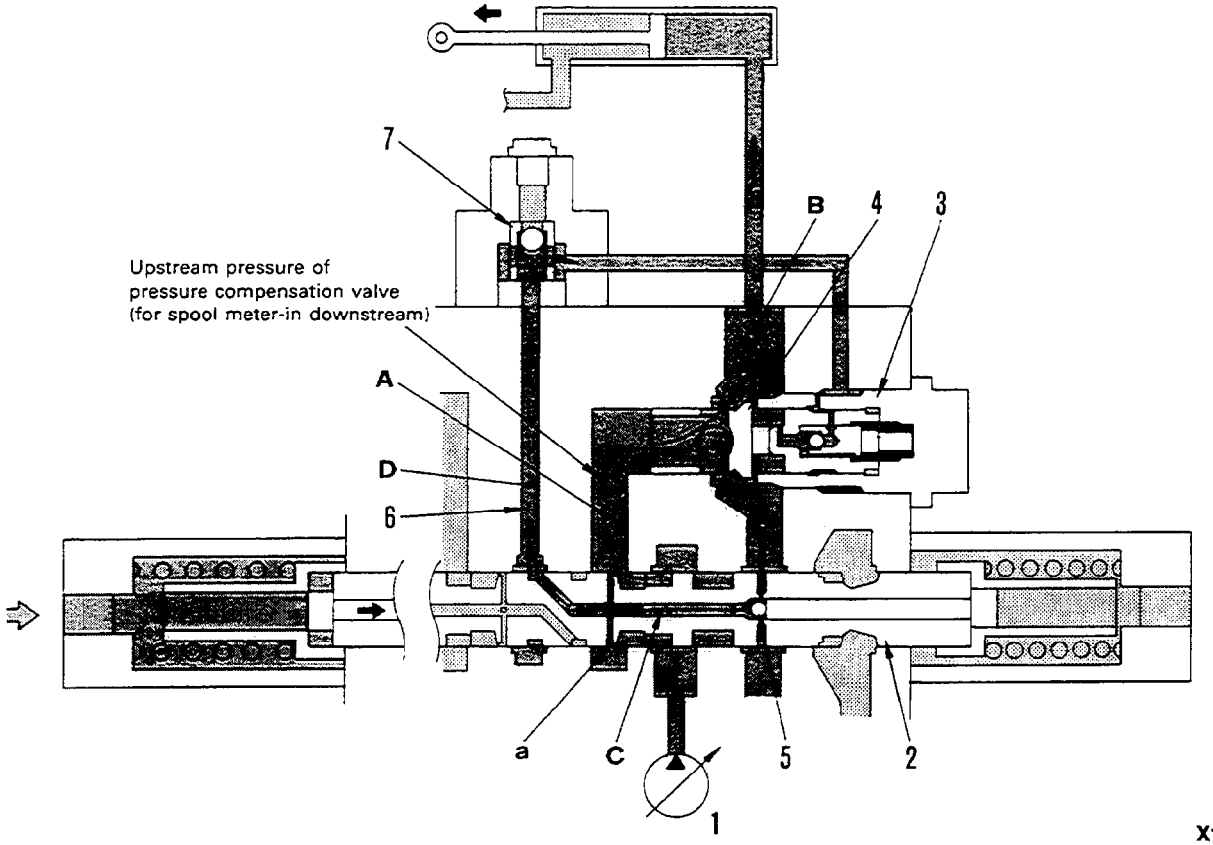


X10BH154

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3. Introduction of LS pressure

★ The diagram shows the condition for arm IN.



X10DD022

1. Main pump
2. Main spool
3. Pressure compensation valve
4. Valve
5. Ball valve
6. LS shuttle valve

Function

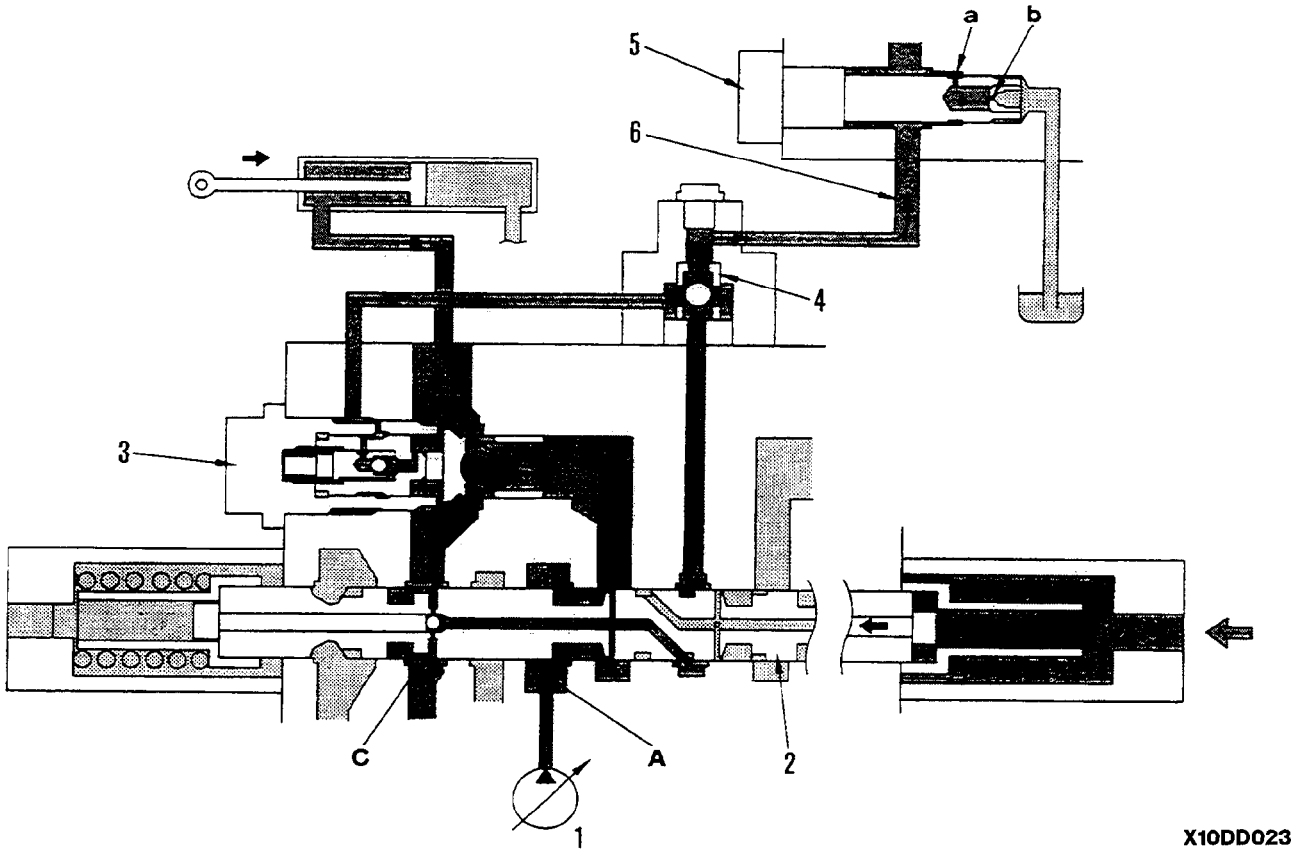
- The upstream pressure (= spool meter-in downstream pressure) of pressure compensation valve (3) is introduced and goes to shuttle valve (7) as the LS pressure. When this happens, it is connected to port **B** of the actuator through valve (4), and LS pressure ≒ actuator load pressure. Introduction hole **a** inside the spool has a small diameter, so it also acts as a throttle.

Operation

- When spool (2) is operated, the pump pressure passes through introduction hole **a**, enters port **C**, and is taken to the LS circuit. When the pump pressure rises ans reaches the load pressure of port **B**, ball valve (5) opens.

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4. LS bypass valve



X10DD023

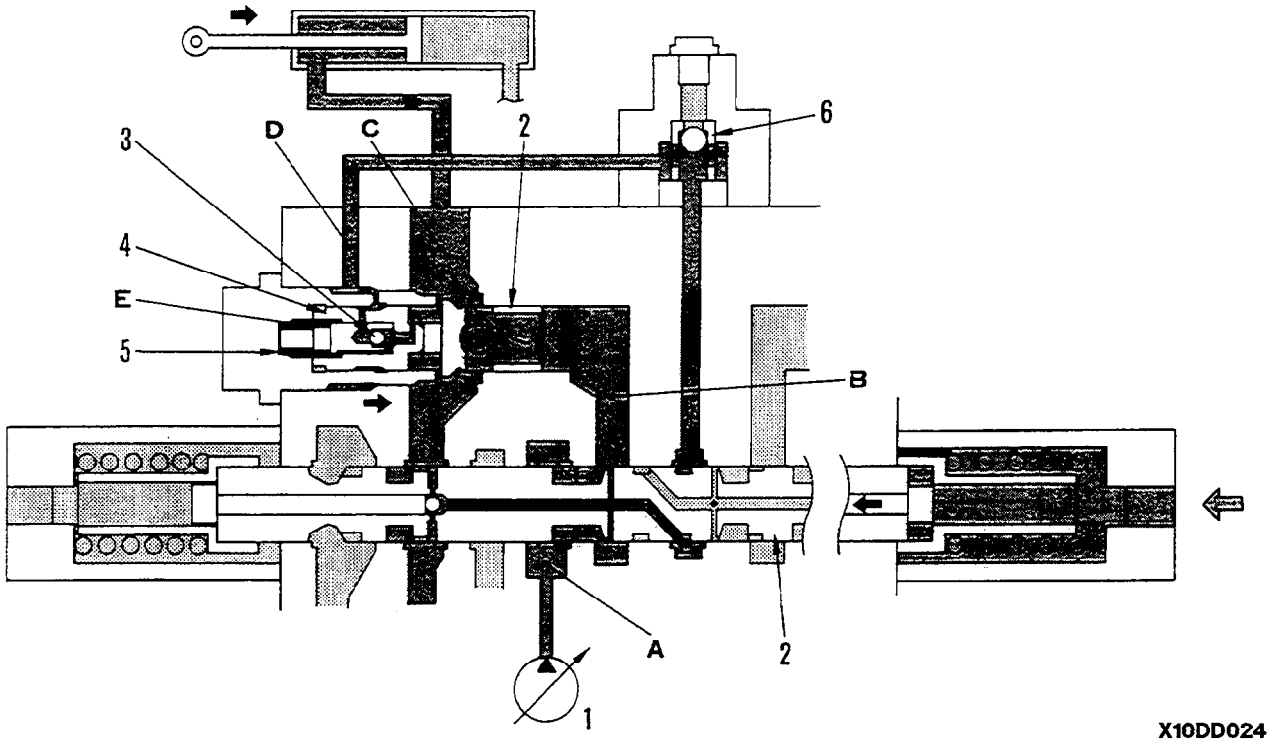
1. Main pump
2. Main spool
3. Pressure compensation valve
4. LS shuttle valve
5. LS bypass valve
6. LS circuit

Function

- The residual pressure in LS circuit (6) is released from orifices **a** and **b**.
- This reduces the speed of the rise in the LS pressure, and prevents any sudden change in the oil pressure. Furthermore, a pressure loss is generated by the circuit resistance between LS shuttle valve (4) and throttle **c** of main spool (2) according to the bypass flow from LS bypass valve (5). As a result, the effective LS differential pressure drops, and the dynamic stability of the actuator is increased.

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5. Pressure compensation valve



X10DD024

1. Main pump
2. Valve
3. Shuttle valve
4. Piston
5. Spring
6. LS shuttle valve

Function

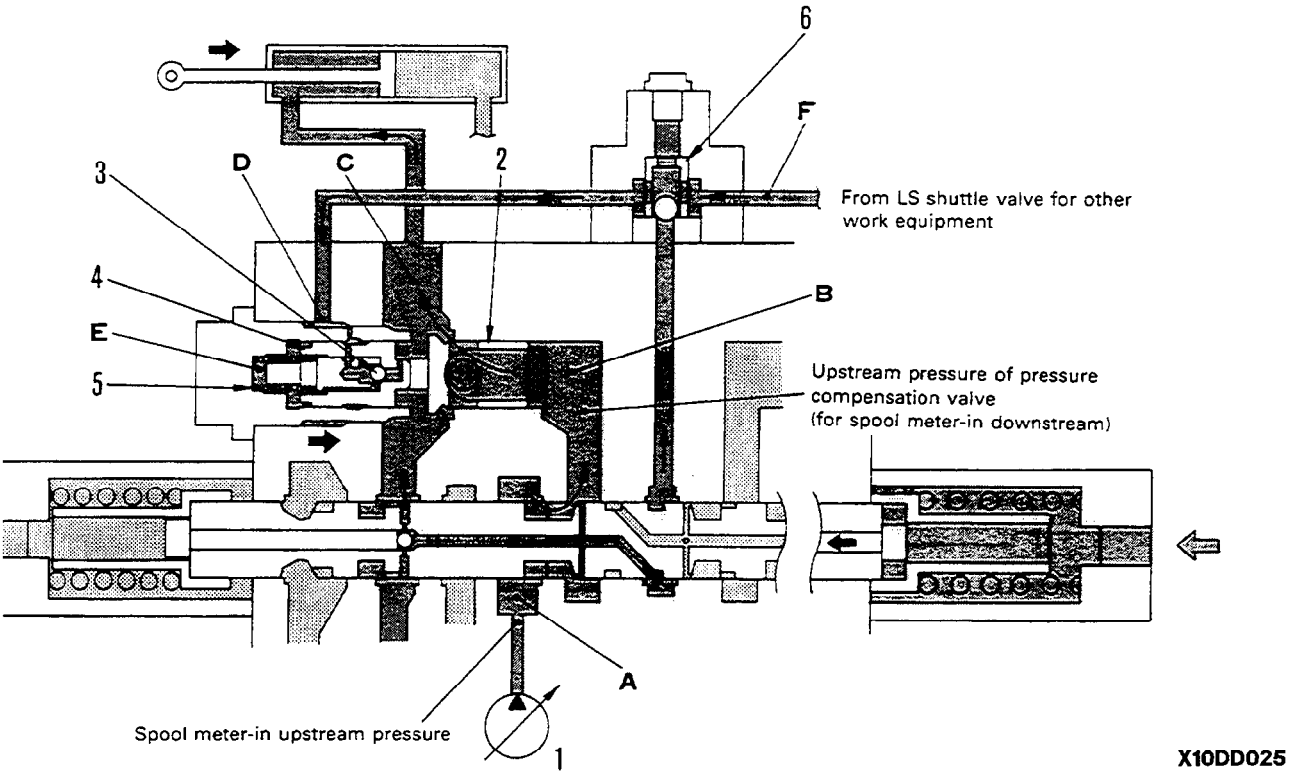
1) During independent operation and at maximum load pressure (during compound operations, when load pressure is higher than other work equipment)

- The pressure compensation valve acts as a load check valve.

Operation

- If the pump pressure (LS pressure) is lower than the load pressure at port **C**, shuttle valve (3) inside pressure compensation valve piston (4) moves to interconnect spring chamber **E** and port **C**.
  From this condition, the force of spring (5) acts to move piston (4) and valve (2) in the direction of closing.

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X10DD025

2) When receiving compensation (during compound operations, when load pressure is lower than other work equipment)

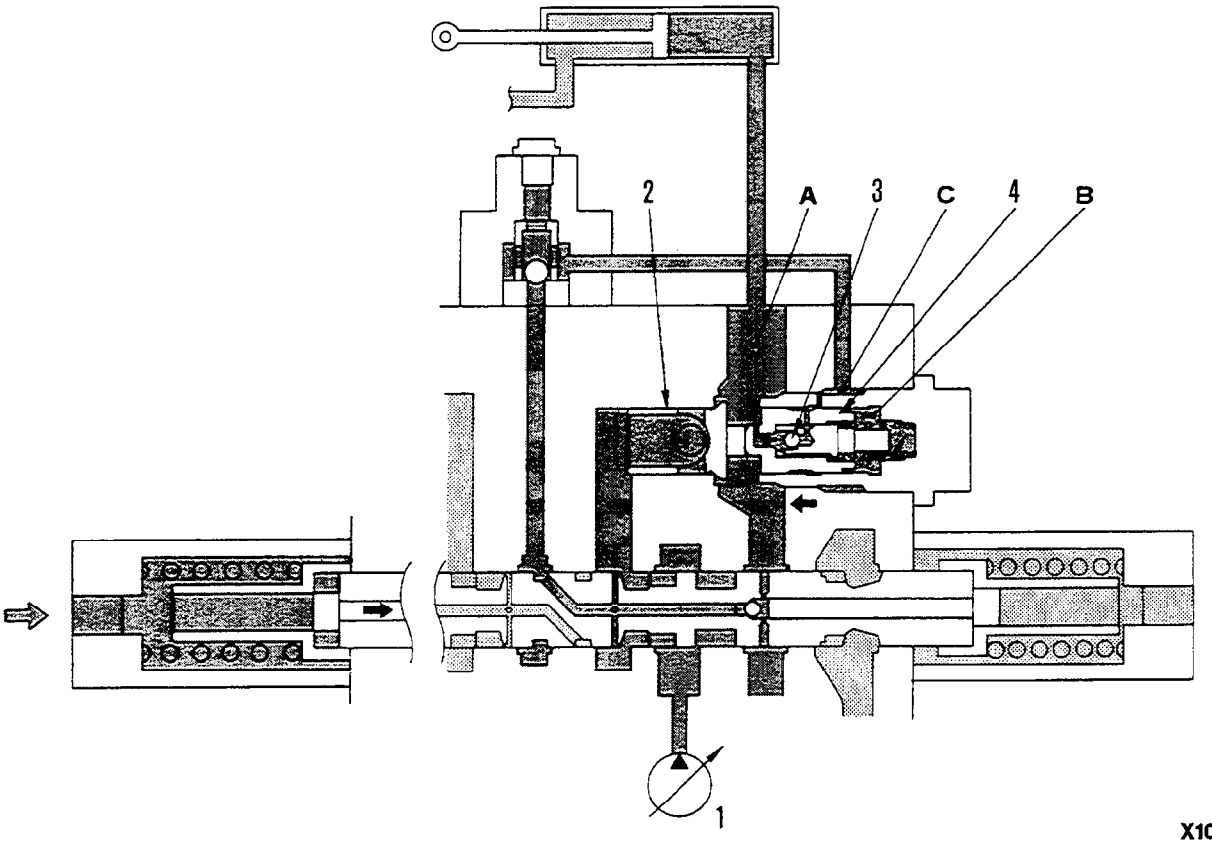
- The pressure compensation valve is closed by the LS pressure of port **D**, and the spool meter-in downstream pressure of port **B** becomes the same as the maximum pressure of the other work equipment.
  The spool meter-in upstream pressure of port **A** is the pump pressure, so spool meter-in differential pressure (upstream pressure (pressure of port **A**) - downstream pressure (pressure of port **B**)) becomes the same for all spools that are being operated. Therefore, the pump flow is divided in proportion to the area of the meter-in opening.

Operation

- Spring chamber **E** is interconnected with port **D**. Piston (4) and valve (2) are actuated by the LS circuit pressure from the other work equipment at port **F** in the direction of closing (to the right). In other words, the valve upstream pressure if port **B** (= spool meter-in downstream pressure) is controlled by the LS pressure.

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6. Shuttle valve inside pressure compensation valve



X10DD026

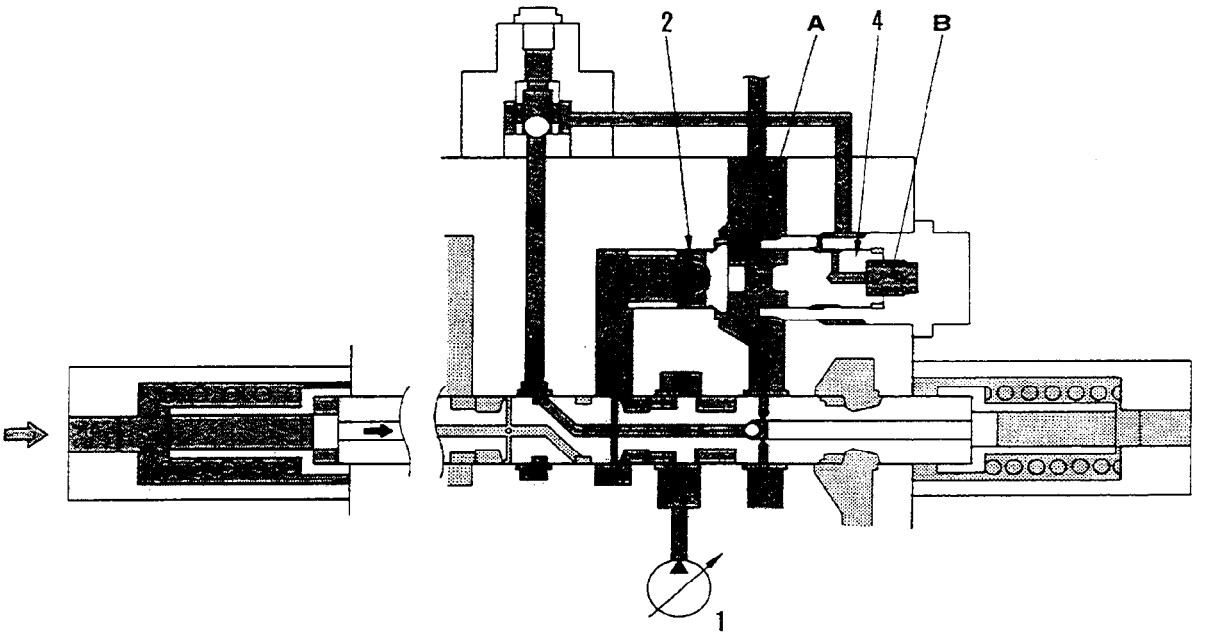
1. Main pump
2. Valve
3. Shuttle valve inside pressure compensation valve
4. Piston

Function

When holding pressure at port A > LS pressure in spring chamber B

- Shuttle valve (3) is pushed to the right by the pressure of port **A**, and the circuit between ports **A** and **C** is shut off. In this condition, the holding pressure at port **A** is taken to spring chamber **B**, and pushes piston (4) to the left to prevent piston (4) and valve (2) from separating.

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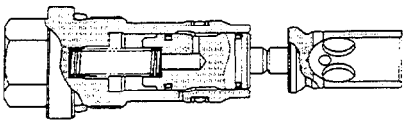


X10DD027

For travel, swing

Travel: No holding pressure is generated at port **A** in the travel circuit, so a pressure compensation valve without a shuttle valve is used.

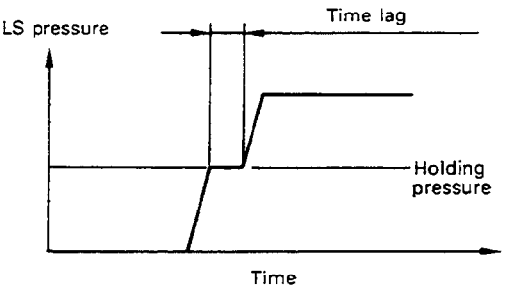
Swing: The holding pressure at the swing port is low, so a pressure compensation valve without a shuttle valve is used.



X10DD028

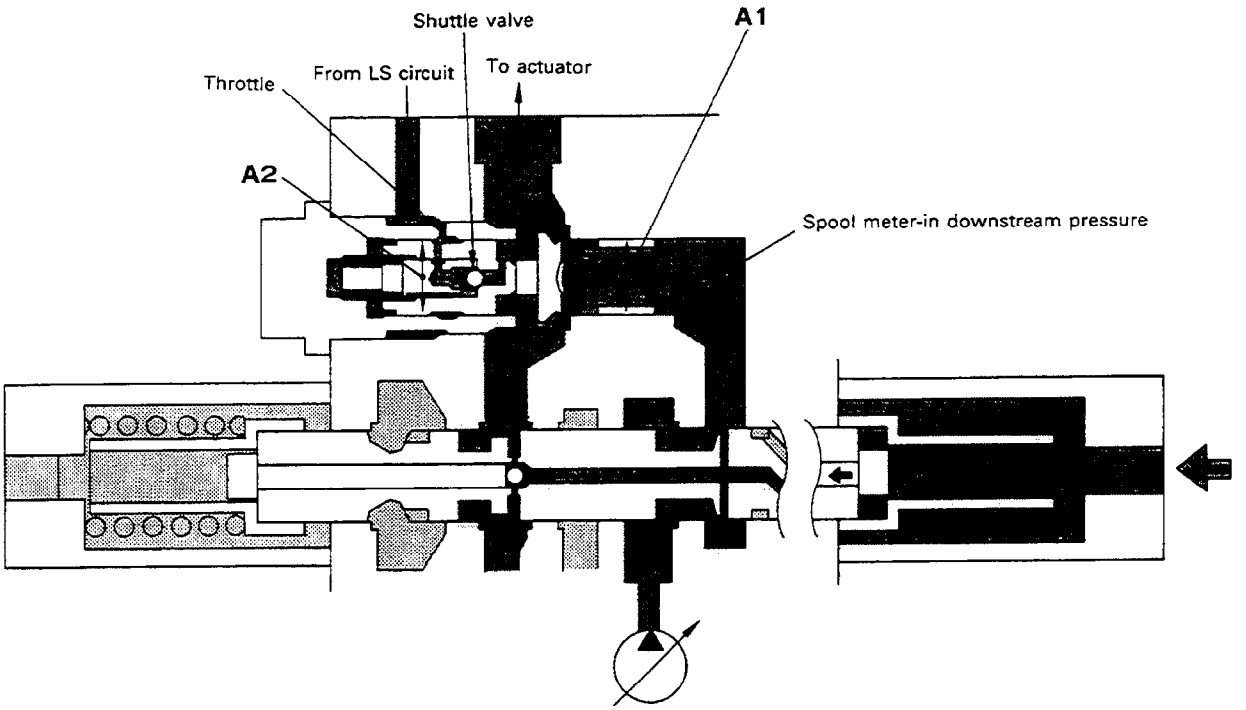
Reference: When there is no shuttle valve

- If there is no shuttle valve, piston (4) and valve (2) will separate. In this condition, if another actuator is operated, the piston acts as an accumulator, so there is a time lag.



X10DD029

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X10DD030

Surface area ratio of pressure compensation valve

The condition of the flow division changes according to the ratio of the area of portion **A1** and portion **A2** of the pressure compensation valve.

Area ratio = **A2/A1**

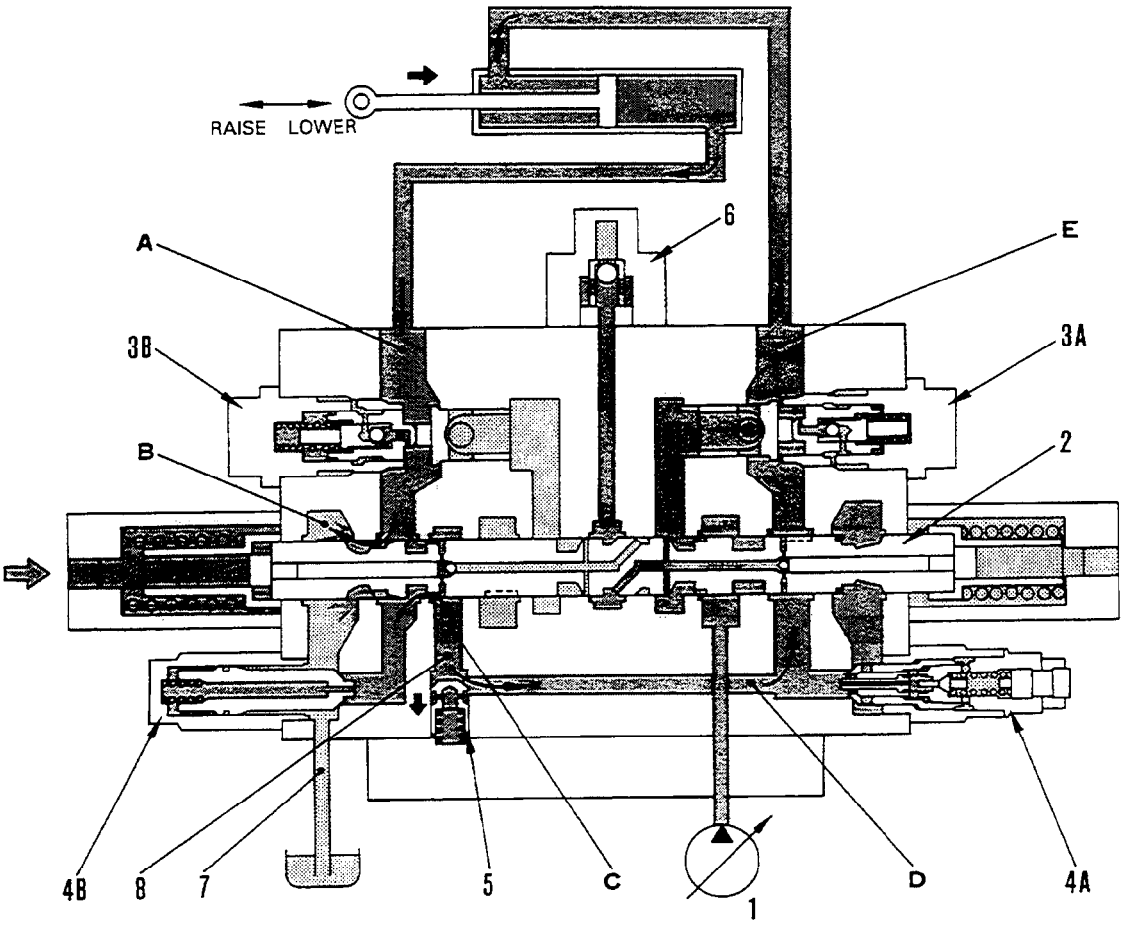
- When area ratio = 1:
  Spool meter-in downstream pressure = Max. load pressure, and oil flow is divided in proportion to area of opening of spool.
- When ratio is more than 1:
  Spool meter-in downstream pressure > Max. load pressure, and oil flow is divided in a proportion less than the area of opening of spool.
- When ratio is less than 1:
  Spool meter-in downstream pressure < Max. load pressure, and oil flow is divided in a proportion more than the area of opening of spool.

Area ratio for each part of work equipment

	Port A		Port B	
	Area ratio	Throttle diameter	Area ratio	Throttle diameter
Bucket	0.98 (Dump)	Ø 2.0	0.98 (Curl)	Ø 2.0
L.H./R.H. travel	0.98	Ø 2.0	0.98	Ø 2.0
Boom	0.95 (Raise)	Ø 2.0	0.98 (Lower)	Ø 2.0
Swing	0.98	Ø 0.5	0.98	Ø 0.5
Arm	0.95 (Out)	Ø 2.0	0.95 (In)	Ø 2.0
Service	0.98	Ø 2.0	0.98	Ø 2.0

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7. Boom regeneration circuit



X10DD031

1. Main pump
2. Main spool
3A. Pressure compensation valve
3B. Pressure compensation valve
4A. Safety-suction valve
4B. Suction valve
5. Check valve
6. LS shuttle valve
7. Drain circuit
8. Regeneration circuit

Function

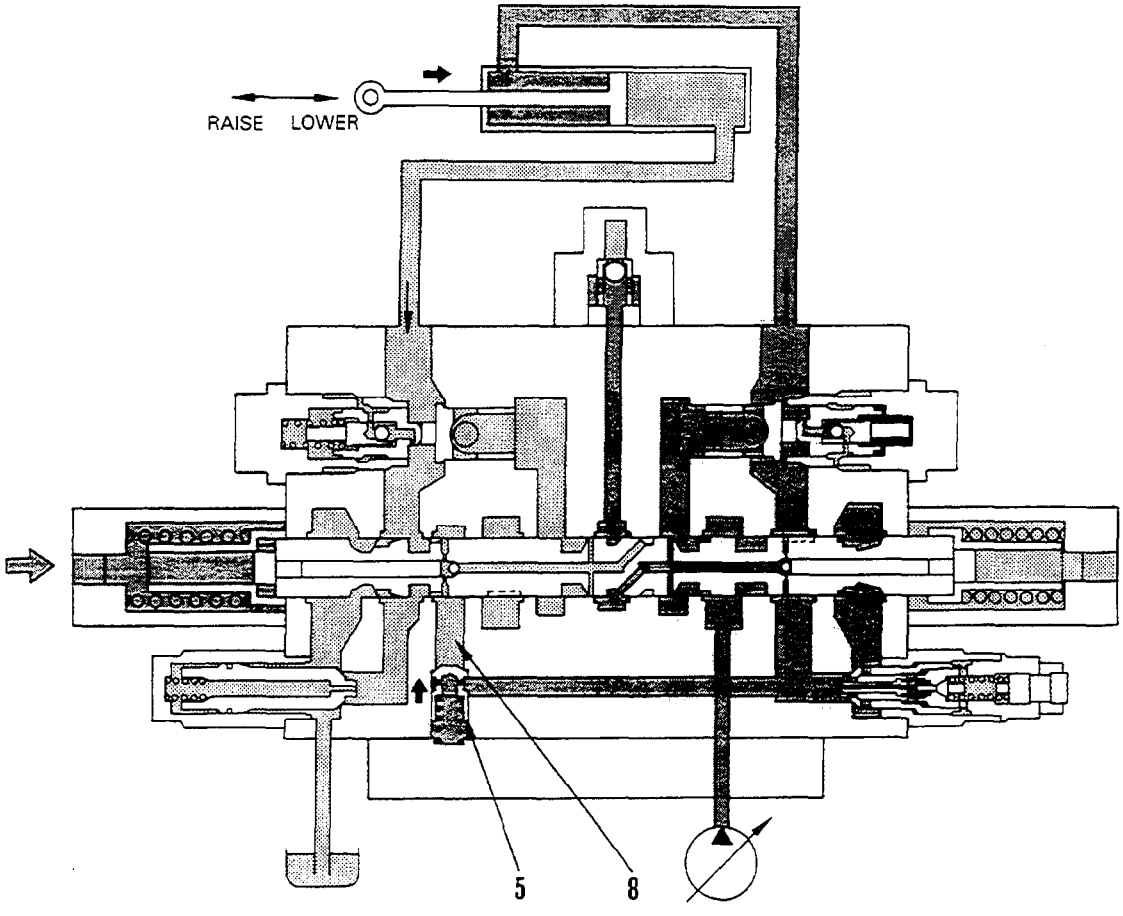
1) Cylinder head pressure < cylinder bottom pressure (free fall, etc.)

- A return flow circuit is provided from the cylinder bottom to the cylinder head so that when the boom is lowered, the return flow can be used to increase the flow of oil from the pump to the cylinder bottom.

Operation

- When the cylinder head pressure < cylinder bottom pressure, part of the pressurized oil from the cylinder bottom passes through the notch in spool (2), goes through port **B**, and enters drain circuit (7). The rest of the oil goes from port **C**, enters regeneration circuit (8), opens check valve (5), and passes through ports **C** and **D** to flow back to the cylinder head.

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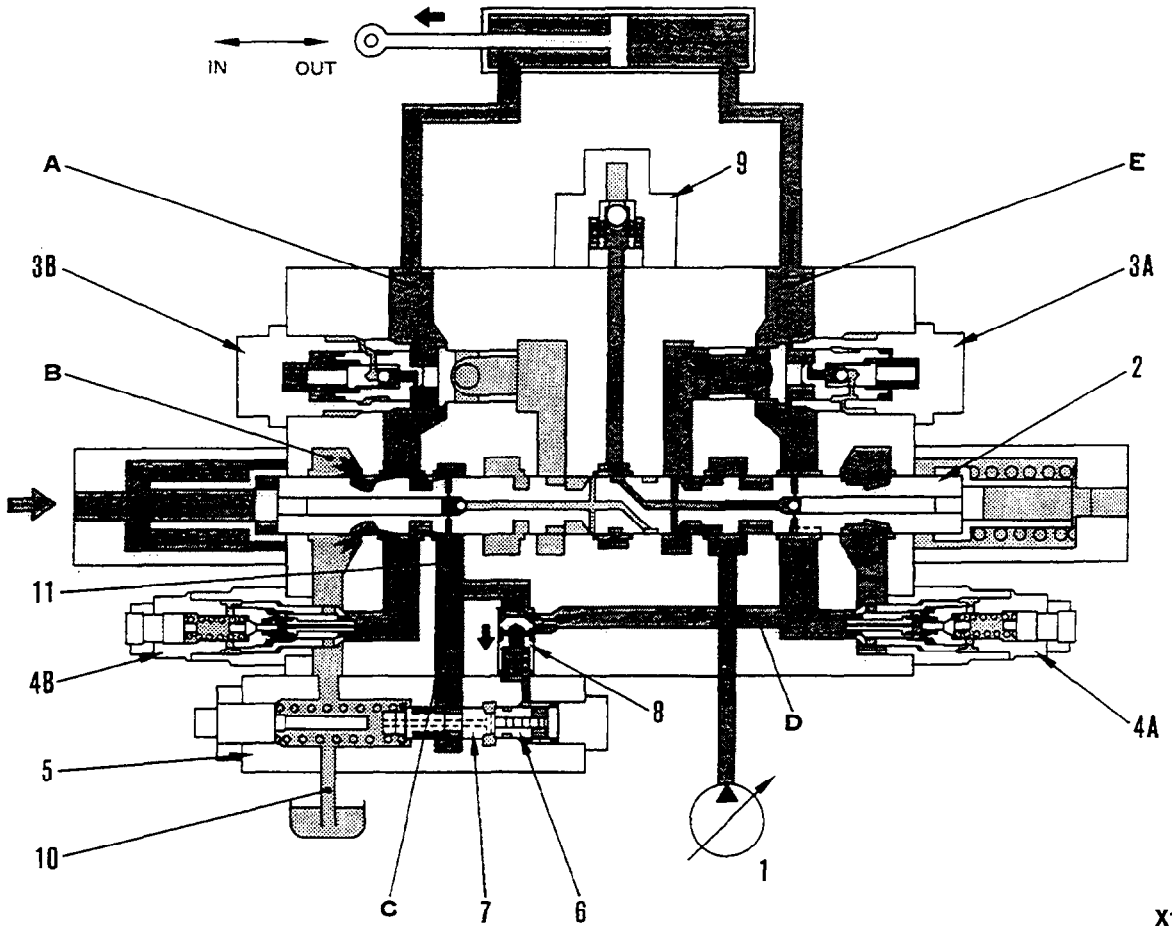
X10DD032

2) Cylinder head pressure > Cylinder bottom pressure (digging operations, etc.)

- Check valve (5) in regeneration circuit (8) acts to shut off the flow from the cylinder head to the cylinder bottom.

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8. Arm regeneration circuit



X10DD033

1. Main pump
2. Main spool
3A. Pressure compensation valve
3B. Pressure compensation valve
4A. Safety valve
4B. Safety valve
5. Arm counterbalance valve
6. Piston
7. Spool
8. Check valve
9. LS shuttle valve
10. Drain circuit
11. Regeneration circuit

Function

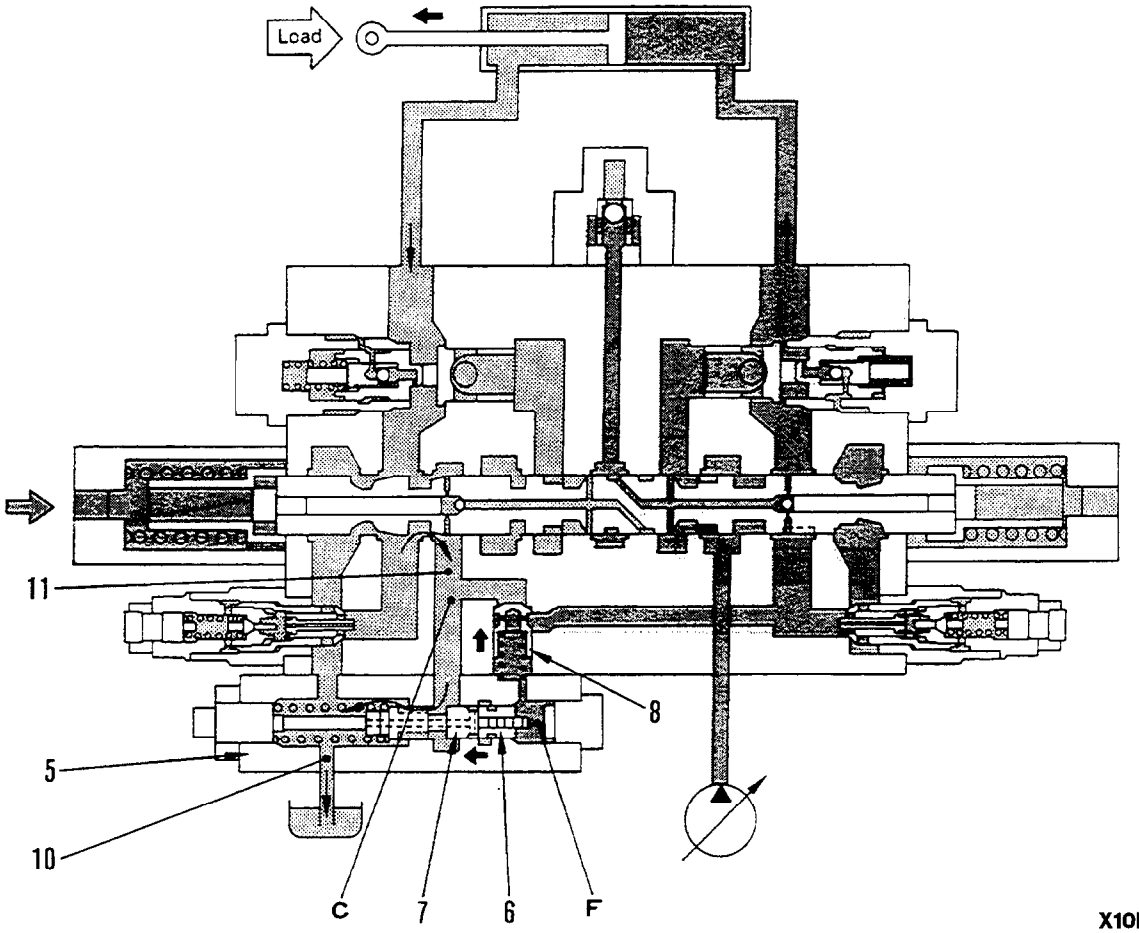
1) Cylinder head pressure > cylinder bottom pressure

- A return flow circuit is provided from the cylinder head to the cylinder bottom so that when the arm is moved in, the flow of oil to the cylinder becomes the pump discharge amount + the return flow, and this increases the cylinder speed.

Operation

- When the cylinder head pressure > cylinder bottom pressure, the pressurized oil from the cylinder head passes through the notch in spool (2), enters port **C** and opens check valve (8), then passes through ports **D** and **E** to flow back to to the cylinder bottom.

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X10DD034

2) When load is large

- During arm IN operations, if the load increases and the cylinder bottom pressure exceeds 16.6 MPa (170 kg/cm^2), counterbalance valve (5) is actuated to increase the meter-out opening at the cylinder head. This reduces the pressure loss between the cylinder head and the hydraulic tank, and ensures the digging force.

Operation

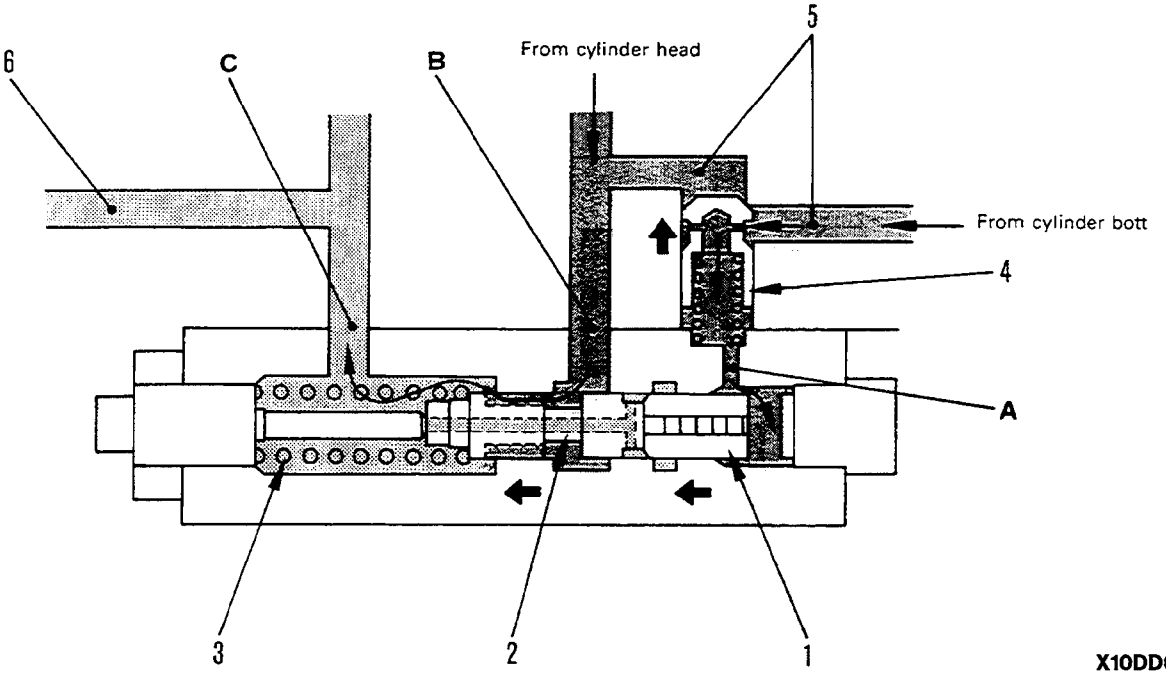
- The cylinder bottom pressure enters port **F** and pushes piston (6) to the left. Spool (7) moves fully to the left and interconnects port **C** of regeneration circuit (11) and tank drain circuit (10). As a result, the pressure loss in the drain circuit is reduced.

3) Cylinder bottom pressure > Cylinder head pressure

- When the cylinder bottom pressure > cylinder head pressure, check valve (8) is closed by the cylinder bottom pressure and prevents any oil flowing back from the cylinder bottom to the head end.

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9. Arm counterbalance valve



X10DD035

1. Piston
2. Spool
3. Spring
4. Check valve
5. Regeneration circuit
6. Tank drain circuit

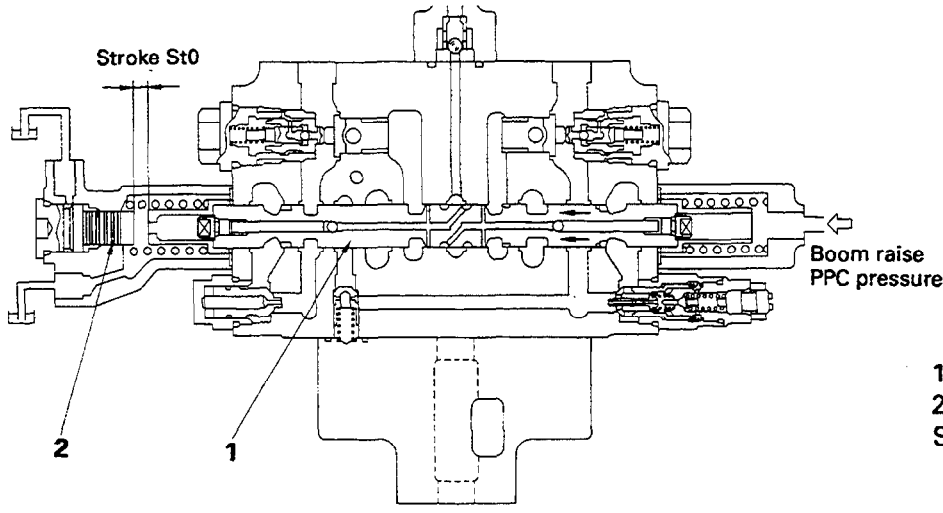
Operation

- During arm IN operations, if the actuating pressure at the arm cylinder bottom rises, the pressure at port **A** also rises. When the force received by piston (1) from the pressure at port **A** becomes greater than the force of spring (3), piston (1) moves to the left.
- Spool (2) is pushed by piston (1) and also moves to the left, so ports **B** and **C** are interconnected. When this happens, the pressurized oil from the cylinder head passes through ports **B** and **C**, and flows directly to drain circuit (6). (The pressure loss is removed when draining)
- When this happens, check valve (4) is closed by the pressure at port **A**, so it shuts off regeneration circuit (5), and prevents the oil from flowing back from the cylinder bottom to the head end.

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10. Spool stroke modulation

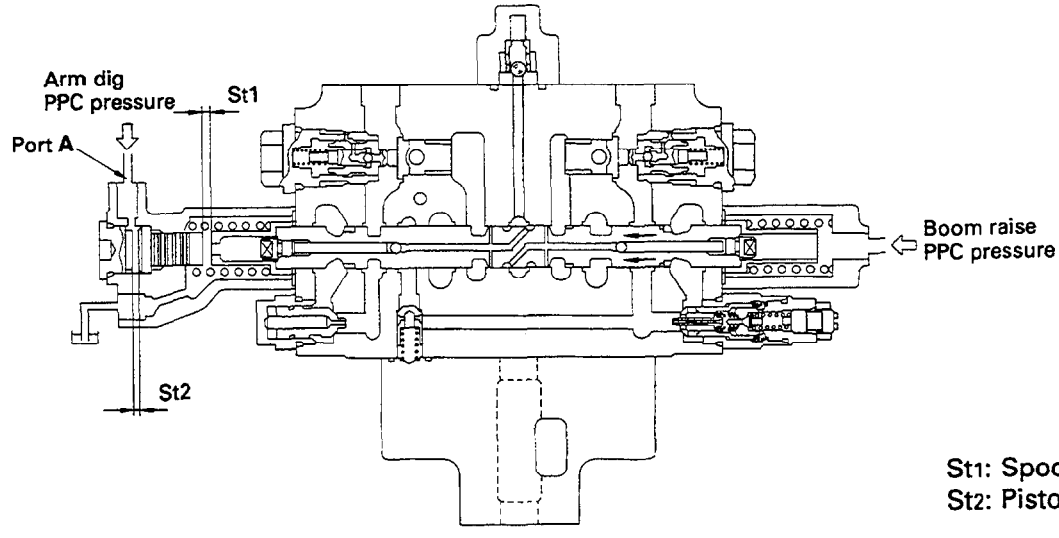
(1) Boom raise modulation



1. Spool
2. Piston

St0: Spool stroke

No arm operation



St1: Spool stroke
St2: Piston stroke

Boom and arm simultaneous operation

X10DD036

Function

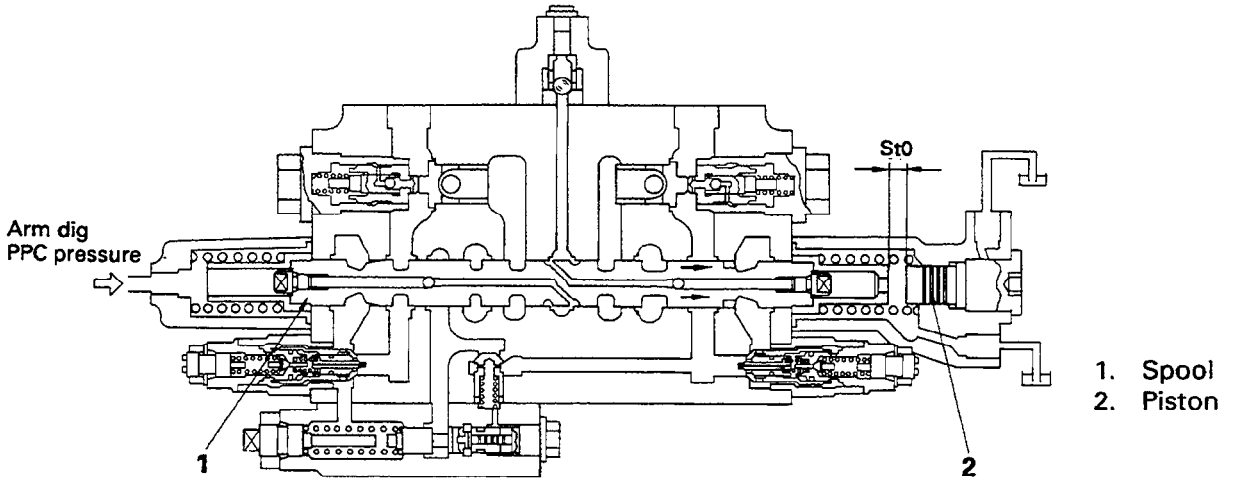
When boom RAISE and arm DIG are operated simultaneously, good simultaneous operation is achieved by restriction of boom spool max. stroke.

Operation

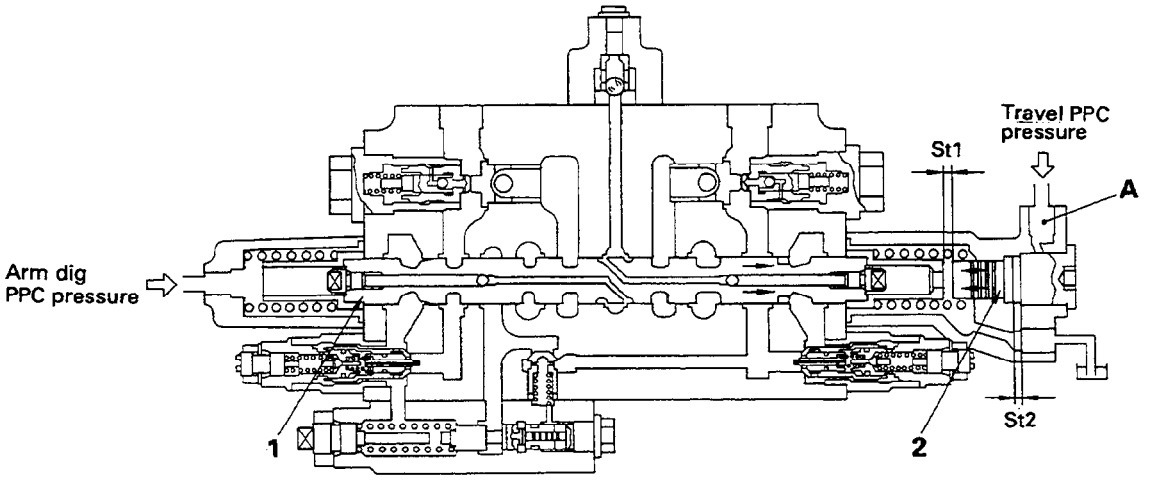
1. When no arm operation
   When boom raises, spool (1) goes to the left (←) by stroke **Sto** to touch piston (2).
2. When arm digs
   (1) Arm DIG PPC pressure goes to L.H. of piston (2) from port **A**, and pushes piston (2) to the right (→).
   (2) When boom raises, spool (1) goes to the left (←), but spool max. stroke is restricted to **St1** because piston (2) moves by **St2.**

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(2) Arm dig modulation



No travel operation



Arm and travel simultaneous operation

X10DD037

Function

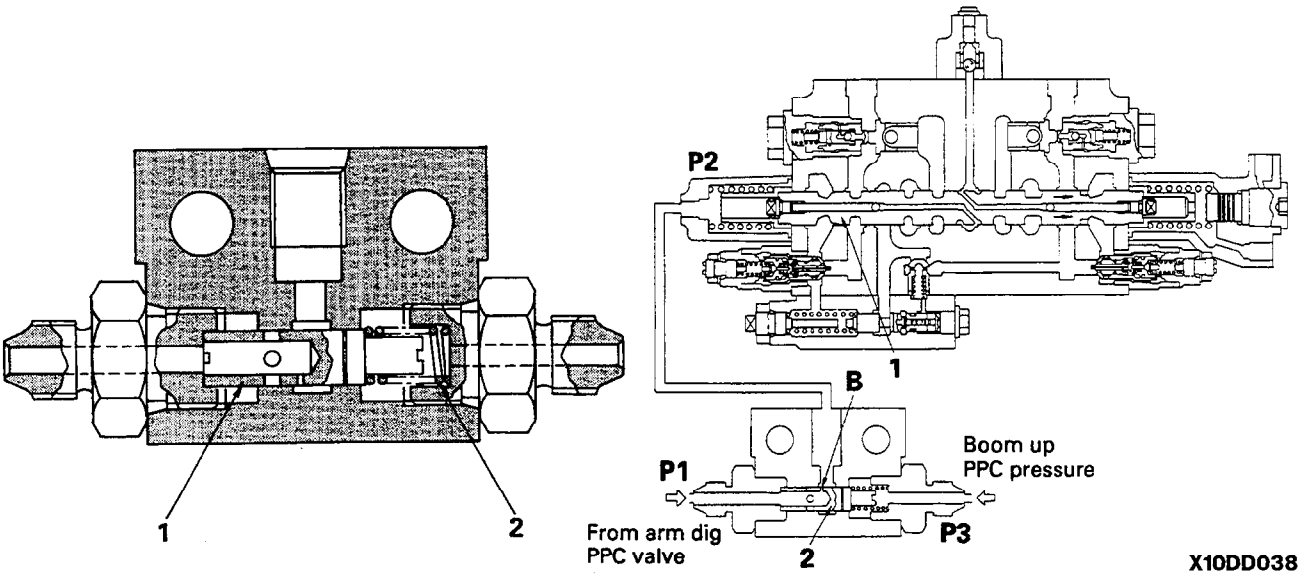
When machine goes up high slope and arm digs, flow to arm cylinder is restricted by limitation of arm spool stroke to avoid pressure drop of pump. **F** pump flow goes to L.H. travel motor through travel junction valve.

Operation

1. With no travel operation
   When arm digs, spool (1) goes to the left (→) by stroke **St0** to touch piston (2).
2. With travel operation
   (1) Travel PPC pressure goes to the right of piston (2) from port **A**, and pushes piston (2) to the left.
   (2) When arm digs, spool (1) goes to the right (←), but spool max. stroke is restricted to **St1** because piston (2) moves by **St2**.

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(4) Arm dig modulation (Arm dig PPC timing valve)

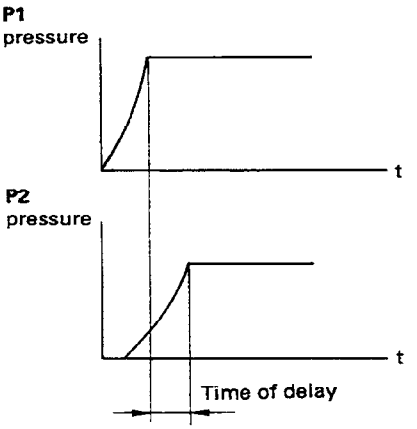


X10DD038

Function
In simultaneous operation of boom and arm, such as finishing, arm spool speed is delayed to prevent sudden speed change of arm and machine operates smoothly.

Operation
When arm digs and boom raises simultaneously, spool is delayed because PPC circuit is reduced by arm timing valve and pressure which forces spool (1) is reduced.

8. Movement of arm timing valve



During simultaneous operation X10DD039

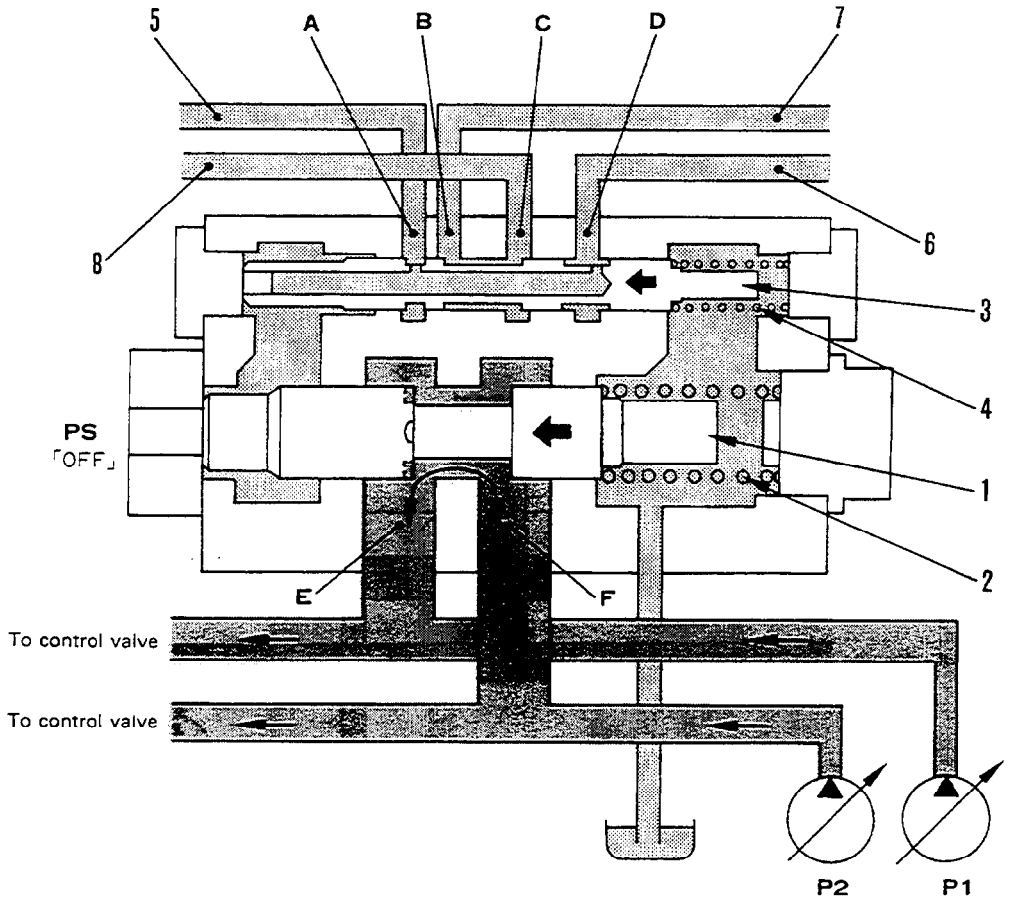
Function
Reduce arm PPC pressure to M/V for simultaneous operation of arm dig and boom up.

Operation

1. **Simple operation of arm dig**
   PPC pressure goes to port **P1** and pushes spool (1) to the right against spring (2) and port **P1** through port **P2** via **B**.
2. **Simultaneous operation of arm dig and boom up**
   (i) When boom raises, PPC pressure goes to port **P3** and pushes spool (1) to the left. When levers are fully stroked towards arm dig and boom raise simultaneously, spool (1) is pushed to the left by force according to the following formula. **P1** pressure ≤ **P2** pressure + spring force (**P1** pressure = **P2** pressure)
   (ii) Then **B** is intercepted and PPC pressure of arm dig goes to port **P2** from port **P1** via orifice **A**.

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11. Pump merge-divider valve



X10DD040

1. Main spool
2. Spring
3. LS spool
4. Spring
5. LS circuit (bucket end)
6. LS circuit (arm end)
7. LS circuit (arm end)
8. LS circuit (bucket end)

Function

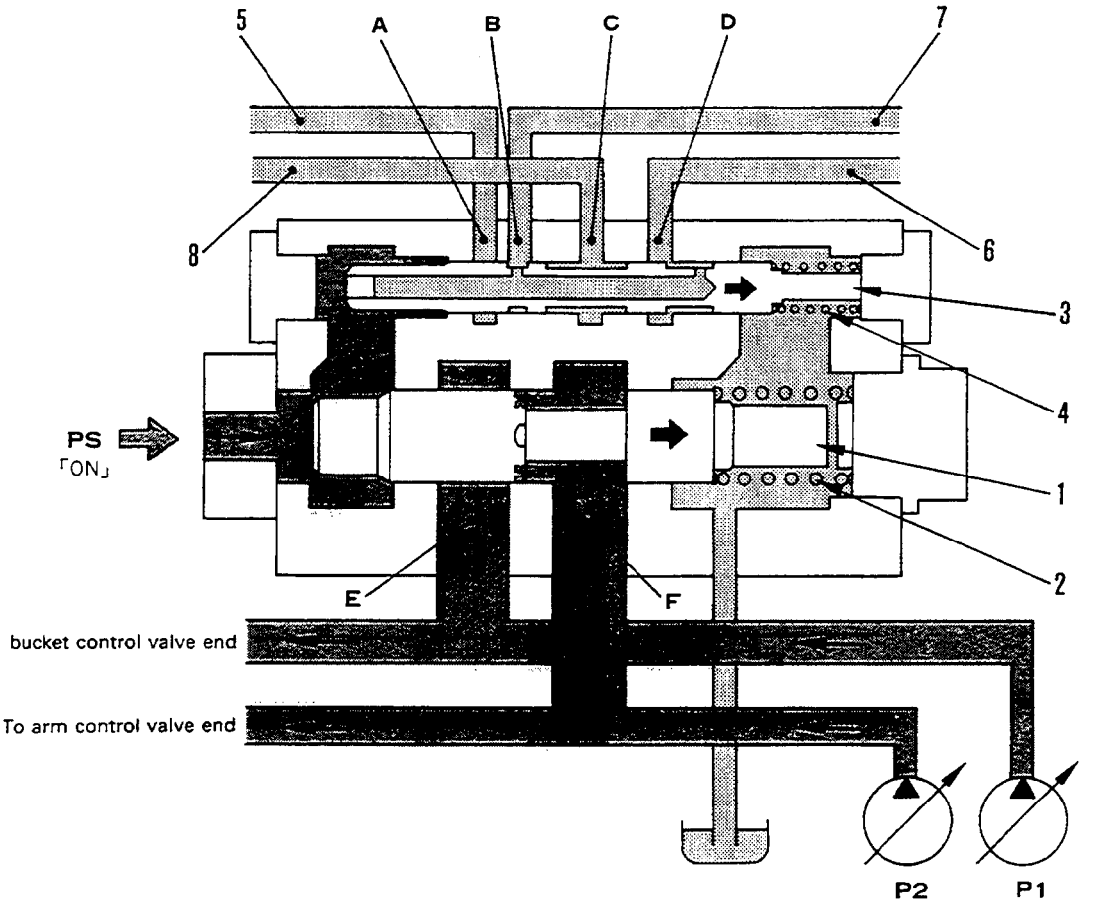
- This acts to merge or divide (send to its own control valve group) oil flows **P1** and **P2** of pressurized oil discharged from the two pumps.
- At the same time, it also carries out merging and dividing of LS circuit pressure.

Operation

1) When merging pump flow (when pilot pressure PS is OFF)

- Pilot pressure **PS** is OFF, so main spool (1) is pushed to the left by spring (2), and ports **E** and **F** are interconnected.
  Therefore, pressurized oil **P1** and **P2** discharged from the two pumps is merged at ports **E** and **F**, and is sent to the control valve that demands the oil.
- In the same way, LS spool (3) is also pushed to the left by spring (4), so the ports are connected as follows.
  Connected ports: **A** ↔ **D**, **B** ↔ **C**
- Therefore, the LS pressure supplied from the spools of each control valve to LS circuits (5), (6), (7), and (8) is all sent to the pressure compensation valve and other valves.

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X10DD041

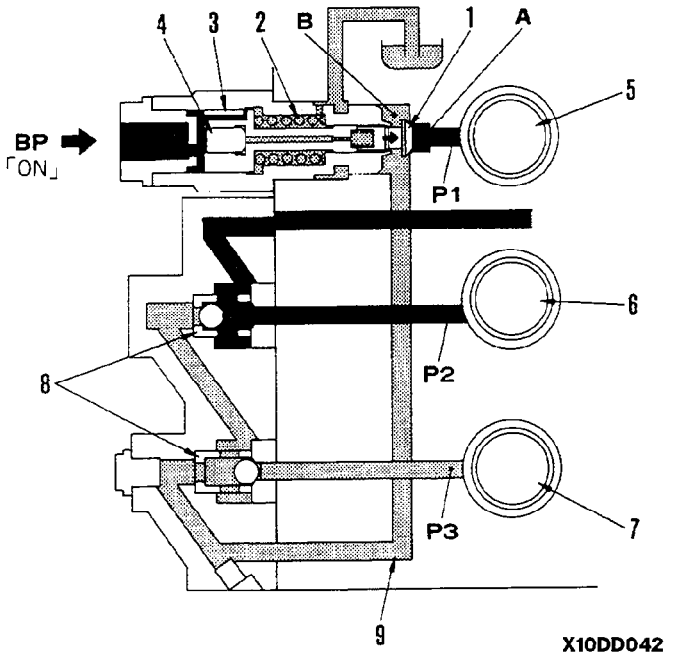
2) When dividing pump flow (when pilot pressure PS is ON)

- When pilot pressure **PS** is ON, main spool (1) is moved to the right by the **PS** pressure, and ports **E** and **F** are disconnected.
  Therefore, the pressurized oil discharged from each pump is sent to its own control valve group.
  Pressure **P1**: To bucket, R.H. travel, boom group
  Pressure **P2**: To swing, L.H. travel, arm group
- In the same way, LS spool (3) is also moved to the right by the **PS** pressure, and the ports are connected as follows.
  Connected ports: **B** ↔ **D**, others are not connected. Therefore, LS circuits (5), (6), (7), and (8) are all sent to their own control valve group.

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11. LS select valve

★ The diagram shows the situation when the swing and left travel are operated at the same time. (**BP** pressure ON)



X10DD042

1. Valve
2. Spring
3. Piston
4. Piston
5. Swing spool
6. L.H. travel spool
7. Arm spool
8. L.H. shuttle valve
9. LS circuit

Function

- This valve is used to increase the ease of operating the work equipment. It prevents high pressure from being generated when the swing is operated. It also prevents the high LS pressure from the swing circuit from flowing into any other LS circuit when the swing is operated together with the work equipment.

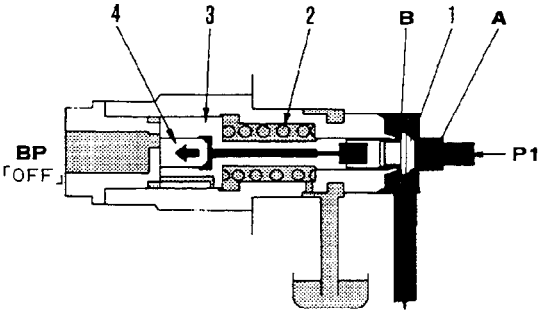
Operation

1) When pilot pressure BP is OFF

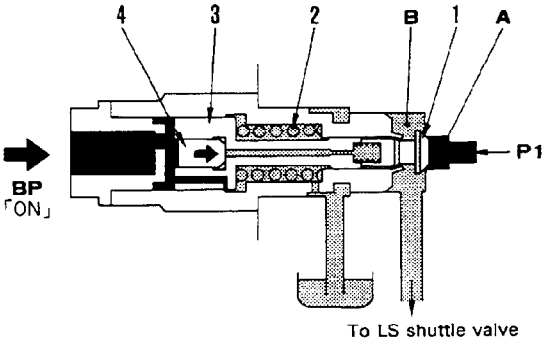
- Pilot pressure **BP** is OFF, so piston (3) is pushed to the left by spring (2). If the swing is then operated, swing LS pressure **P1** passes through swing spool (5), and enters port **A**. It pushes valve (1) to the left and connects ports **A** and **B**. Therefore, swing LS pressure **P1** flows to LS shuttle valve (8).

2) When pilot pressure is ON

- When pilot pressure **BP** is ON, piston (3) is moved to the right against spring (2) by the **BP** pressure. It pushes valve (1) to the right and closes the circuit between ports **A** and **B**. As a result, swing LS pressure **P1** stops flowing to LS shuttle valve (8), and even if swing LS pressure **P1** rises to a high pressure, it does not influence any other LS circuit.



X10DD043



X10DD044

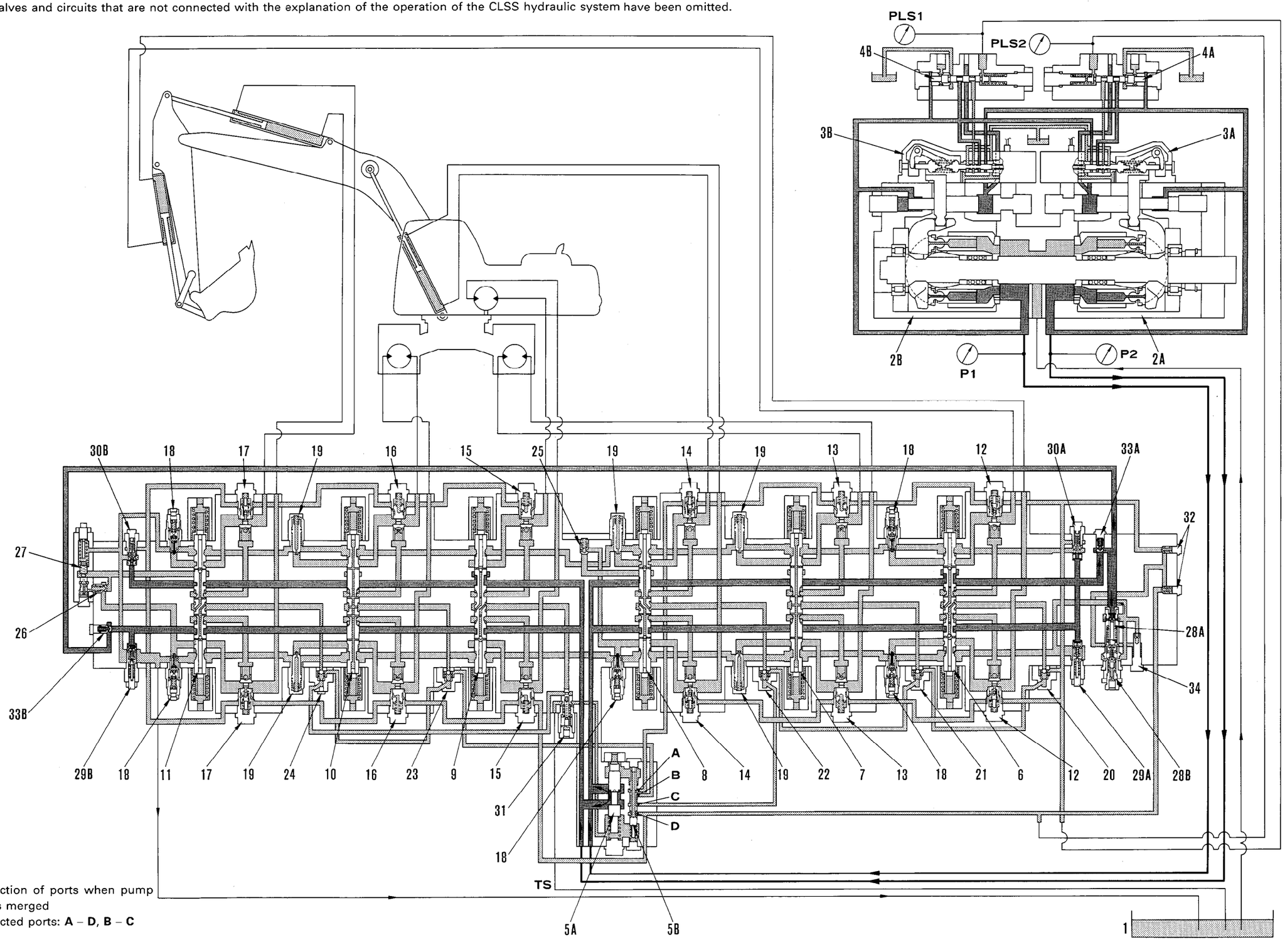
OPERATION OF CLSS SYSTEM AS A WHOLE

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1. When all work equipment is at neutral

★ The diagram shows the situation when all work equipment is at neutral.

★ The valves and circuits that are not connected with the explanation of the operation of the CLSS hydraulic system have been omitted.



- Connection of ports when pump flow is merged
  Connected ports: **A** – **D**, **B** – **C**

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1. Hydraulic tank
2A. Main pump (front)
2B. Main pump (rear)
3A. TVC valve (front)
3B. TVC valve (rear)
4A. LS valve (front)
4B. LS valve (rear)
5A. Pump merge-divider valve (for main)
5B. Pump merge-divider valve (for LS)
6. Bucket spool
7. R.H. travel spool
8. Boom spool
9. Swing spool
10. L.H. travel spool
11. Arm spool
12. Pressure compensation valve (bucket)
13. Pressure compensation valve (R.H. travel)
14. Pressure compensation valve (boom)
15. Pressure compensation valve (swing)
16. Pressure compensation valve (L.H. travel)
17. Pressure compensation valve (arm)
18. Safety-suction valve
19. Suction valve
20. LS shuttle valve (bucket)
21. LS shuttle valve (R.H. travel)
22. LS shuttle valve (boom)
23. LS shuttle valve (L.H. travel)
24. LS shuttle valve (arm)
25. Check valve (for boom regeneration circuit)
26. Check valve (for arm regeneration circuit)
27. Arm counterbalance valve
28A. Main unload valve
28B. LS relief valve
29A. Main relief valve (bucket group)
29B. Main relief valve (arm group)
30A. Sub-unload valve (bucket group)
30B. Sub-unload valve (arm group)
31. LS select valve
32. LS check valve
33A. Main check valve (bucket group)
33B. Main check valve (arm group)
34. LS bypass valve

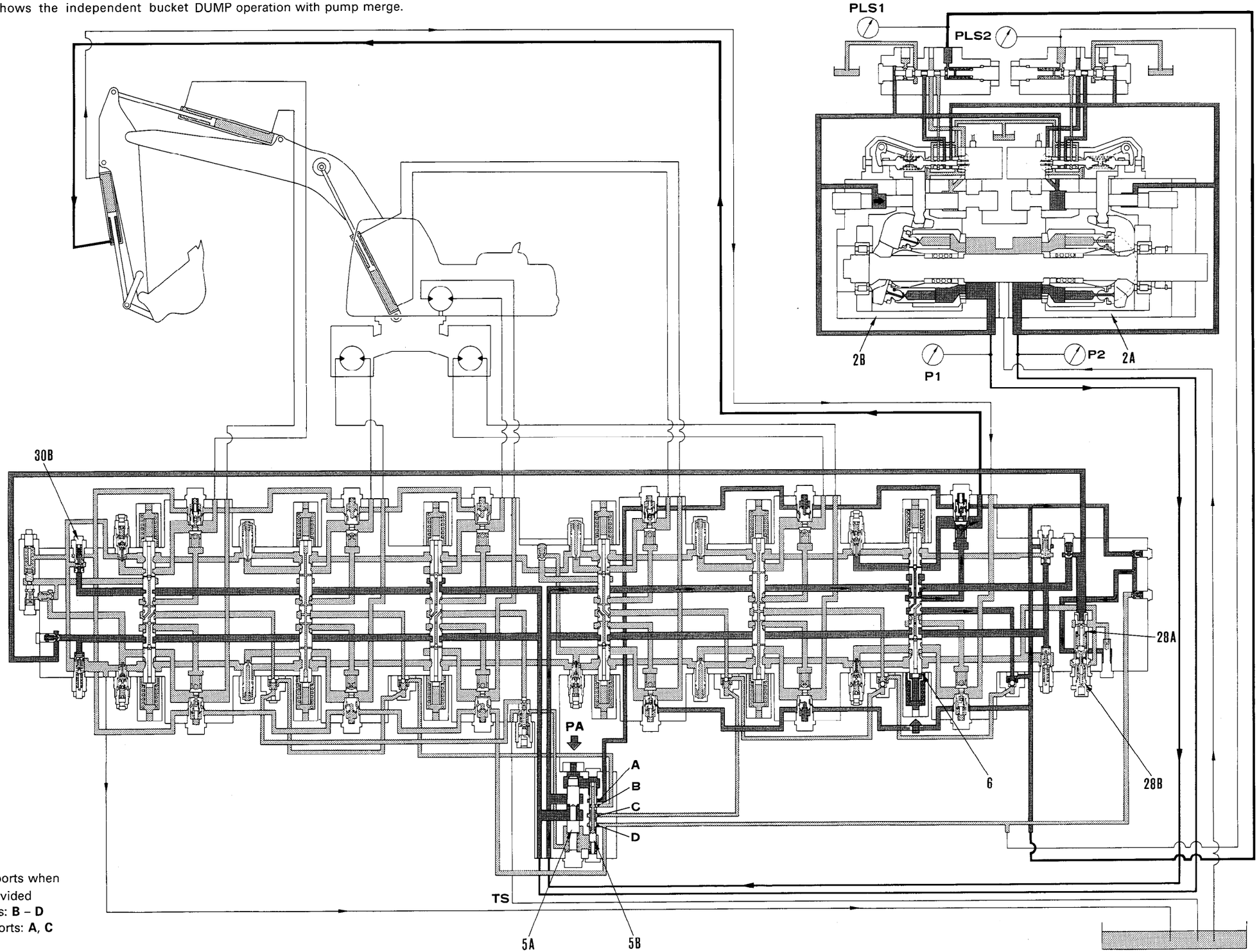
Note: Groups of control valves by main pump circuit
- Bucket group: Bucket, R.H. travel, boom
- Arm group: Swing, L.H. travel, arm

Operation
- When the levers are at neutral, the pump is at the minimum swash plate angle, and the oil flow is drained from main unload valve (28A).
- The LS pressure is connected to hydraulic tank (1) by LS bypass valve (34). The LS differential pressure Δ **PLS** (unload pressure - tank pressure) at this point is Δ **PLS** > pump LS control pressure, so the pump swash plate angle is the minimum.

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2. Pump flow divided, one side actuated, other side neutral

★ The diagram shows the independent bucket DUMP operation with pump merge.



- Connection of ports when pump flow is divided
  Connected ports: **B – D**
  Disconnected ports: **A, C**

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Operation

- Pilot pressure **PA** of pump merge-divider valve (5A) ON

1) Bucket group

- When the bucket is operated, pressurized oil from main pump (2B) flows to the bucket group. The swash plate angle of main pump (2B) is controlled to match the operation of bucket spool (6).
- The LS pressure passing through the inside of bucket spool (6) goes to main unload spool (28A), and the main unload valve is closed.

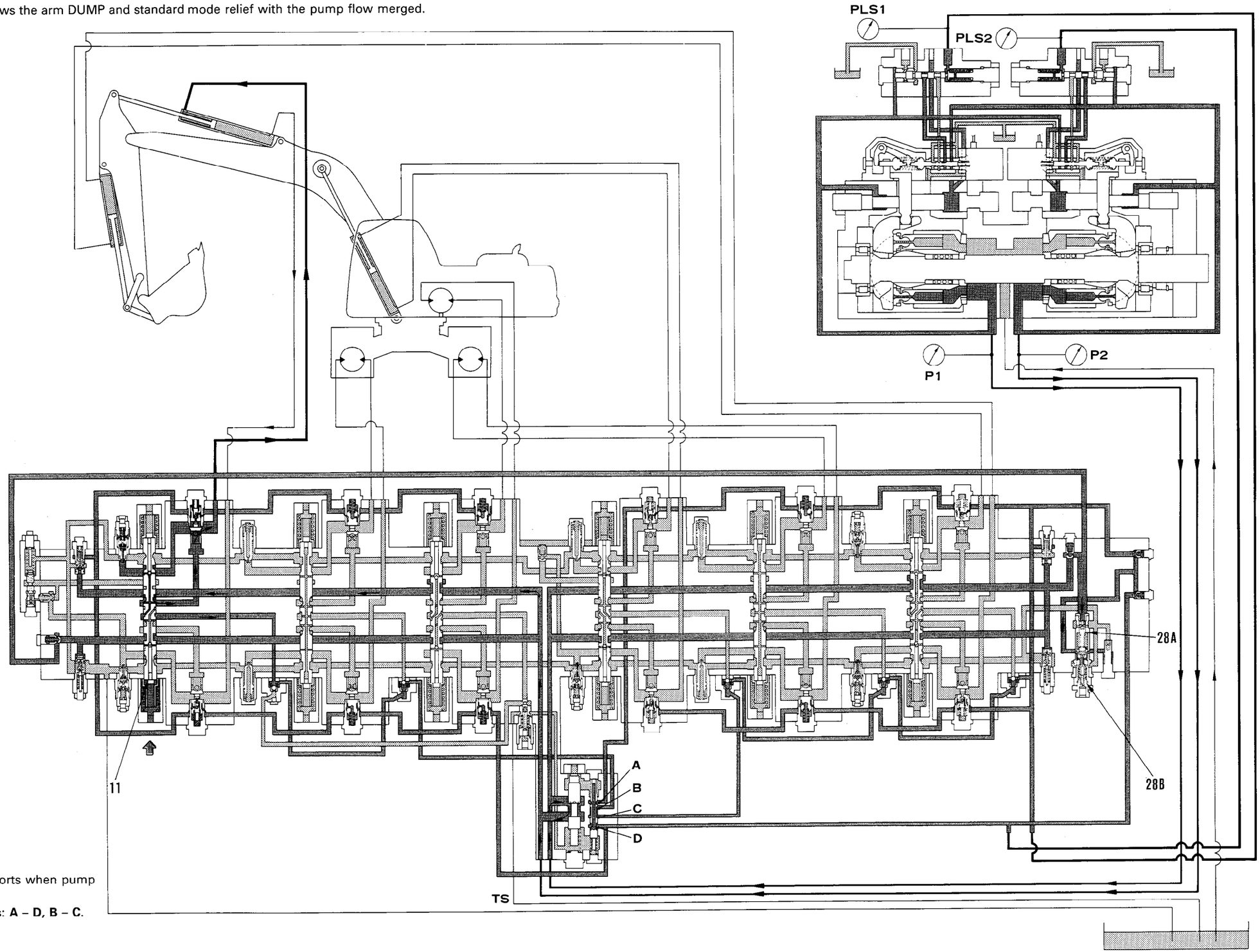
2) Arm group

- When the pump flow is merged, all spools are at neutral, so the oil flow from the minimum swash plate angle of main pump (2A) is all drained from sub-unload valve (30B) of the arm group. All spools in the arm group are at neutral, so no LS pressure is generated.
- If the pump pressure - LS pressure becomes greater than the set pressure of sub-unload valve (30B), the sub-unload valve is actuated and the oil is drained. The LS differential pressure Δ **PLS** at this point is Δ **PLS** > pump LS control pressure, so the pump swash plate angle is the minimum.

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3. Pump flow merged, arm OUT, standard mode relief (cut-off control)

★ The diagram shows the arm DUMP and standard mode relief with the pump flow merged.



- Connection of ports when pump flow is merged
  Connected ports: **A – D, B – C.**

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Operation

1) When pump swash plate angle is at a minimum (LS relief valve actuate in standard mode)

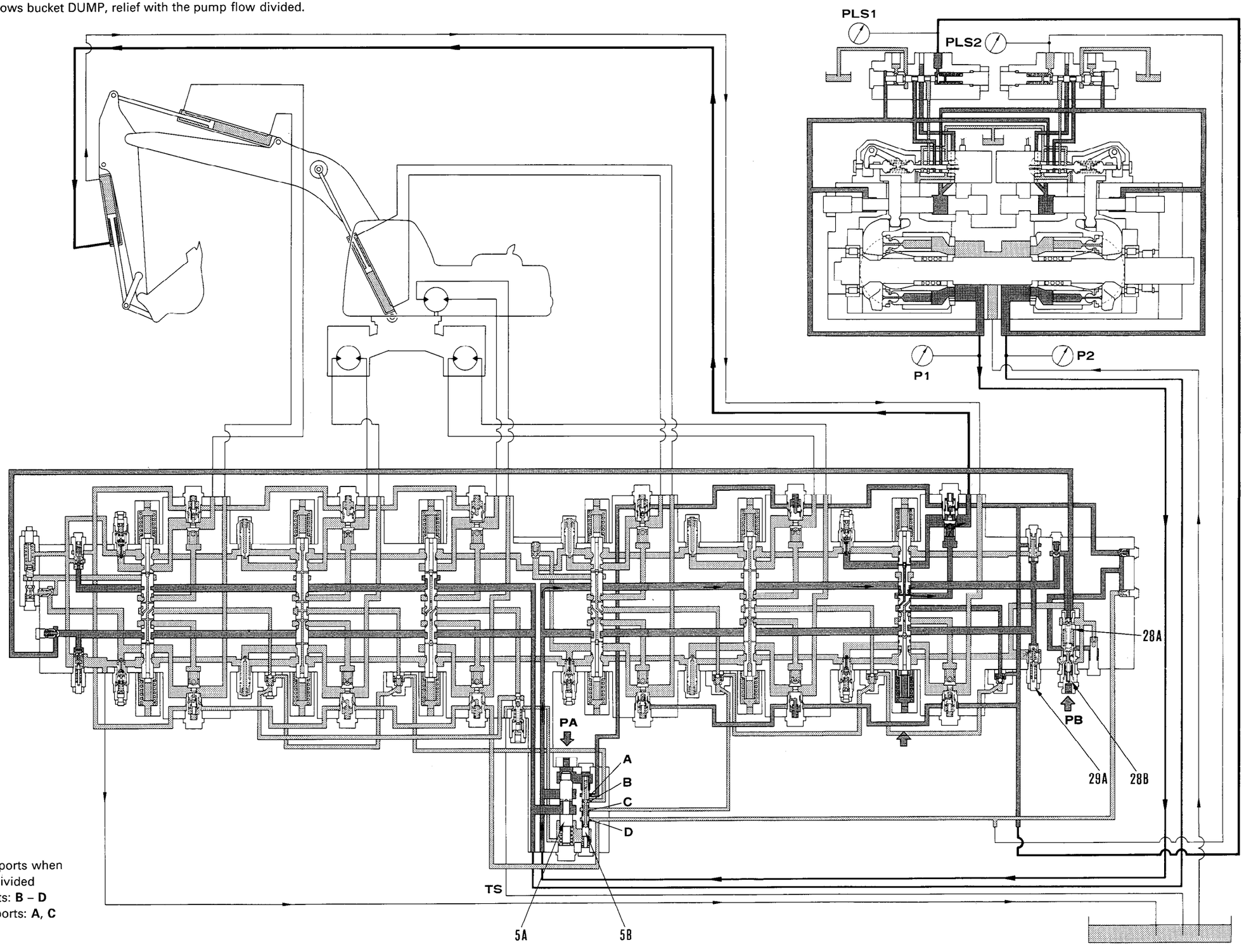
- When the arm OUT is operated, if the load becomes larger, the LS pressure passing through the inside of arm spool (11) rises. The LS circuit pressure is controlled by LS relief valve (28B).
- When the difference (Δ **PLS**) between the pump pressure and LS pressure becomes large, main unload valve (28A) is actuated to suppress the rise in the main circuit pressure and regulate it to the standard mode relief pressure.

2) The LS differential pressure Δ **PLS** at this point is Δ **PLS** > pump LS control pressure, so the pump swash plate angle is the minimum. In other words, the automatic cut-off control is carried out.

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4. Pump flow divided, bucket DUMP, power max. relief

★ The diagram shows bucket DUMP, relief with the pump flow divided.



- Connection of ports when pump flow is divided
  Connected ports: **B – D**
  Disconnected ports: **A, C**

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Operation

- Pilot pressure **PA** of pump merge-divider valve (5A) ON
  Pilot pressure **PB** of LS relief valve (28B) ON

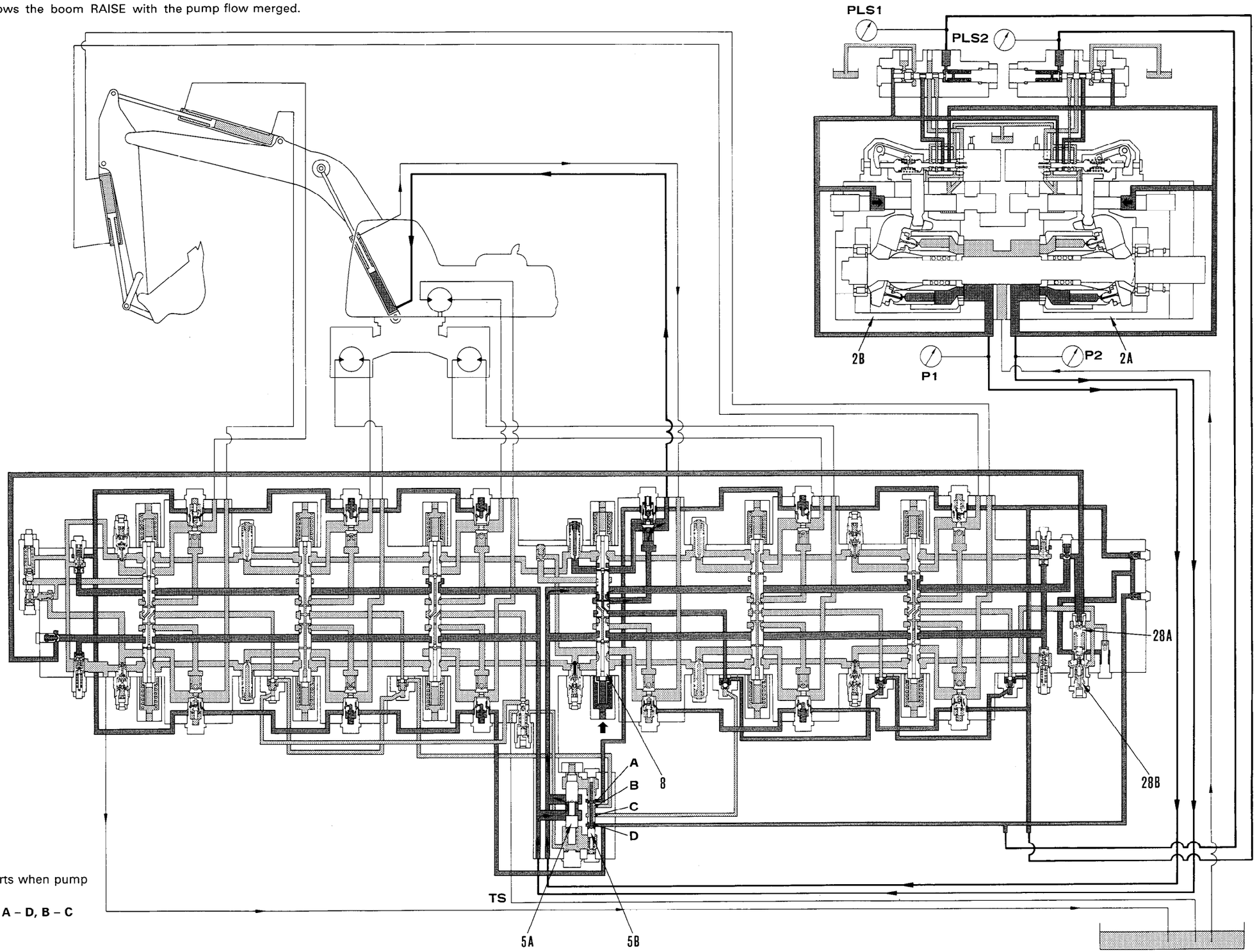
1) When the bucket is operated, if the power max. function is ON, pilot pressure **PB** acts on LS relief valve (28B), so the LS relief valve is not actuated.

2) When the bucket DUMP is operated and the load pressure becomes greater, pump pressure **P1** and LS pressure **PLS1** both rise. Pilot pressure **PB** is preventing LS relief valve (28B) from operating at this point, so main relief valve (29A) of the bucket group is actuated and controls the relief while the power max. function is being used.

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5. Pump flow merged, boom RAISE

★ The diagram shows the boom RAISE with the pump flow merged.



- Connection of ports when pump flow is merged
  Connected ports: **A – D, B – C**

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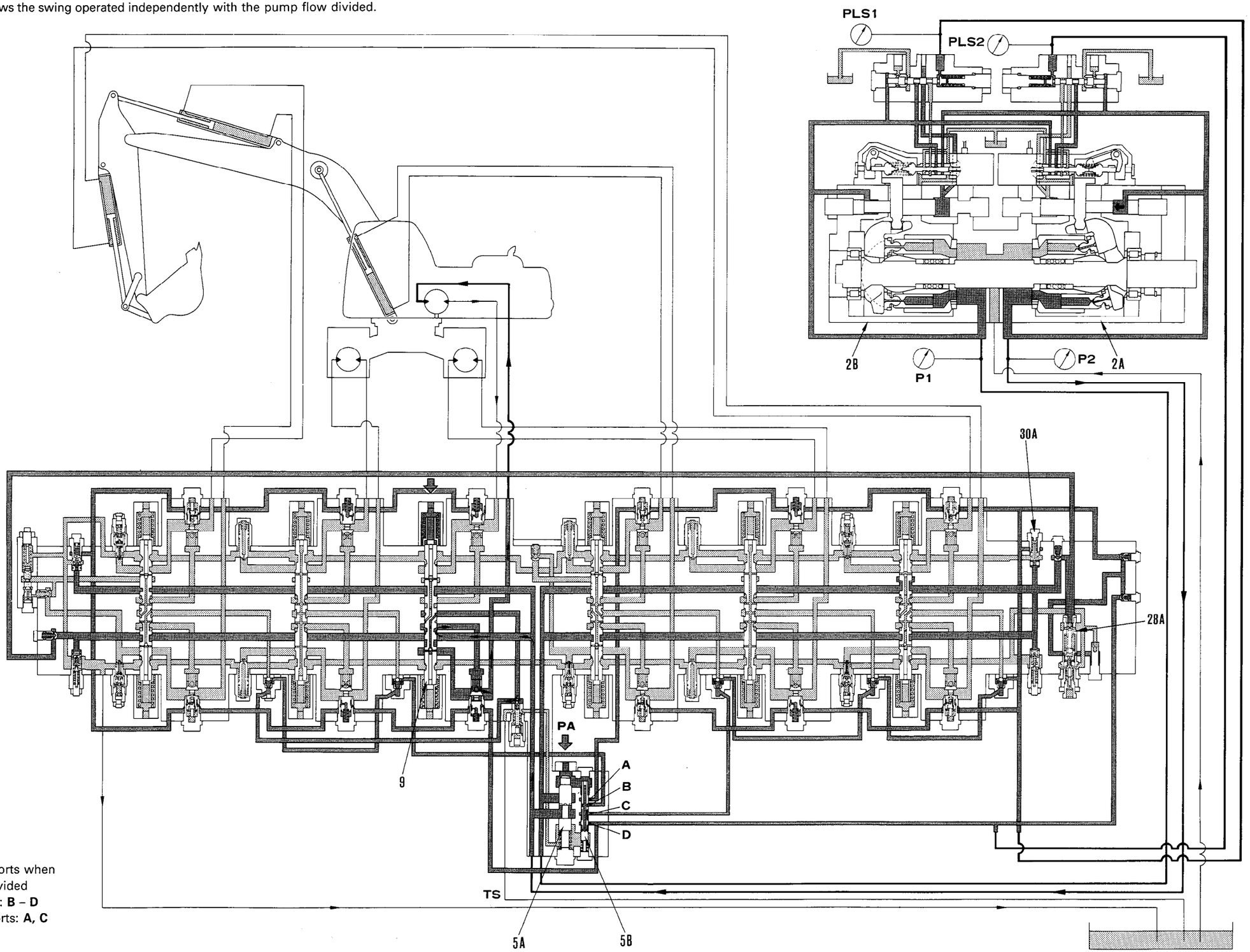
Operation

- When the boom RAISE is operated, main pumps (2A) and (2B) are both at the maximum swash plate angle, and main unload valve (28A) is closed.
- At this point, for the meter-in opening of boom spool (8), even if both pumps are at the maximum swash plate angle, the LS differential pressure is set to be smaller than the pump LS control pressure.
  In other words, LS differential pressure Δ **PLS** is Δ **PLS** < pump LS control pressure, so the pump swash plate angle becomes the maximum.
- In addition, the flow of main pump (2A) passes through pump merge-divider valve (5A) and flows to boom spool (8).

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6. Pump flow merged, swing operated independently

★ The diagram shows the swing operated independently with the pump flow divided.



- Connection of ports when pump flow is divided
  Connected ports: **B – D**
  Disconnected ports: **A, C**

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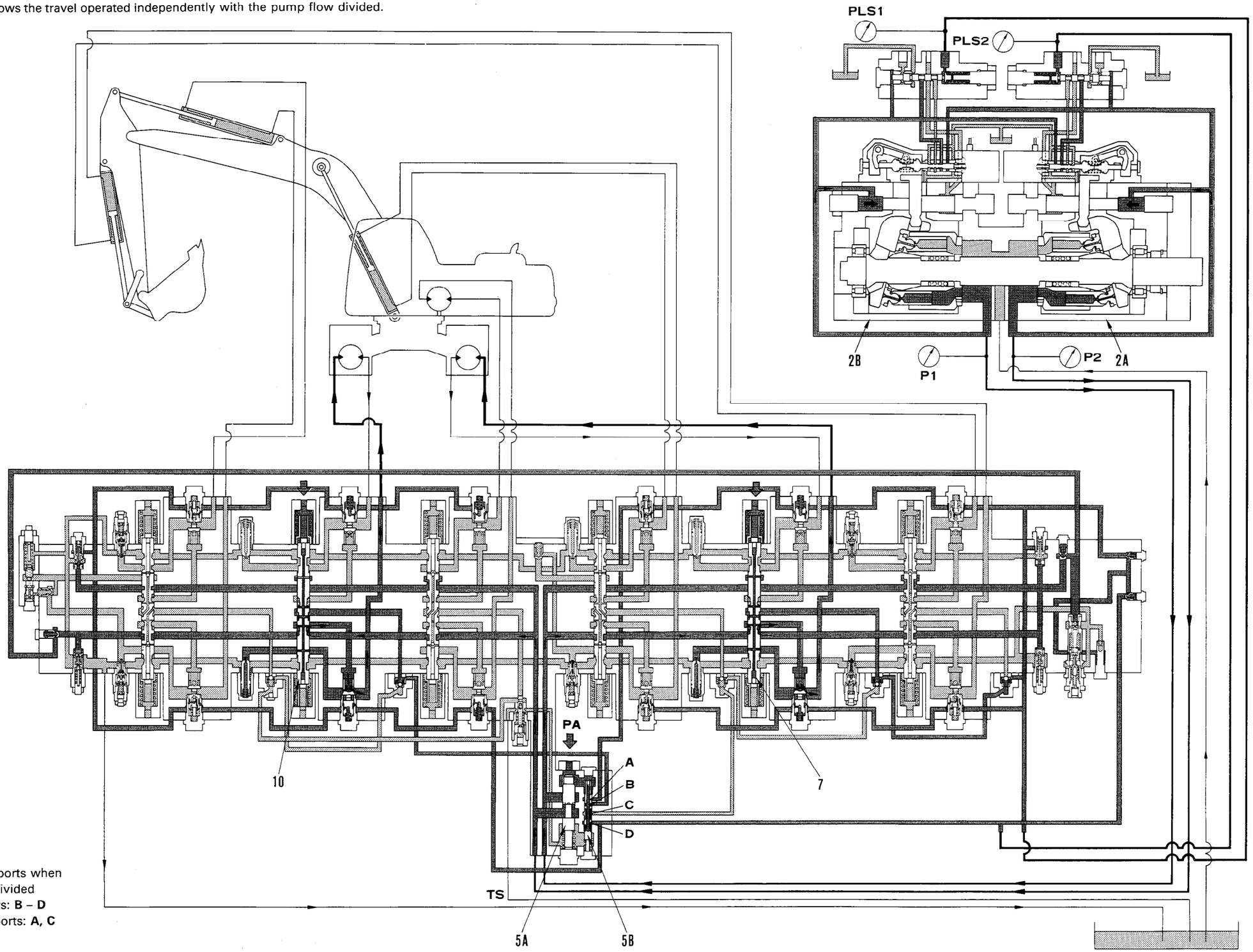
Operation

- Pilot pressure **PA** of pump merge-divider valve (5A) ON
- When the swing is operated, main pump (2A) of the arm group is at the maximum swash plate angle, and main unload valve (28A) is closed.
- At this point, for the meter-in opening of swing spool (9), even if main pump (2A) is at the maximum swash plate angle, the LS differential pressure is set to be smaller than the pump LS control pressure.
  In other words, LS differential pressure Δ **PLS** is Δ **PLS** < pump LS control pressure, so the pump swash plate angle of main pump (2A) becomes the maximum.
- All spools in the bucket group are at neutral, so main pump (2B) is at the minimum swash plate angle, and sub-unload valve (30A) is actuated. For details of the actuation, see 2. Pump flow merged, one side actuated, other side neutral.

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7. Pump flow divided, travel operated independently

★ The diagram shows the travel operated independently with the pump flow divided.



- Connection of ports when pump flow is divided
  Connected ports: **B – D**
  Disconnected ports: **A, C**

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Operation

- Pilot pressure **PA** of pump merge-divider valve (5A) ON

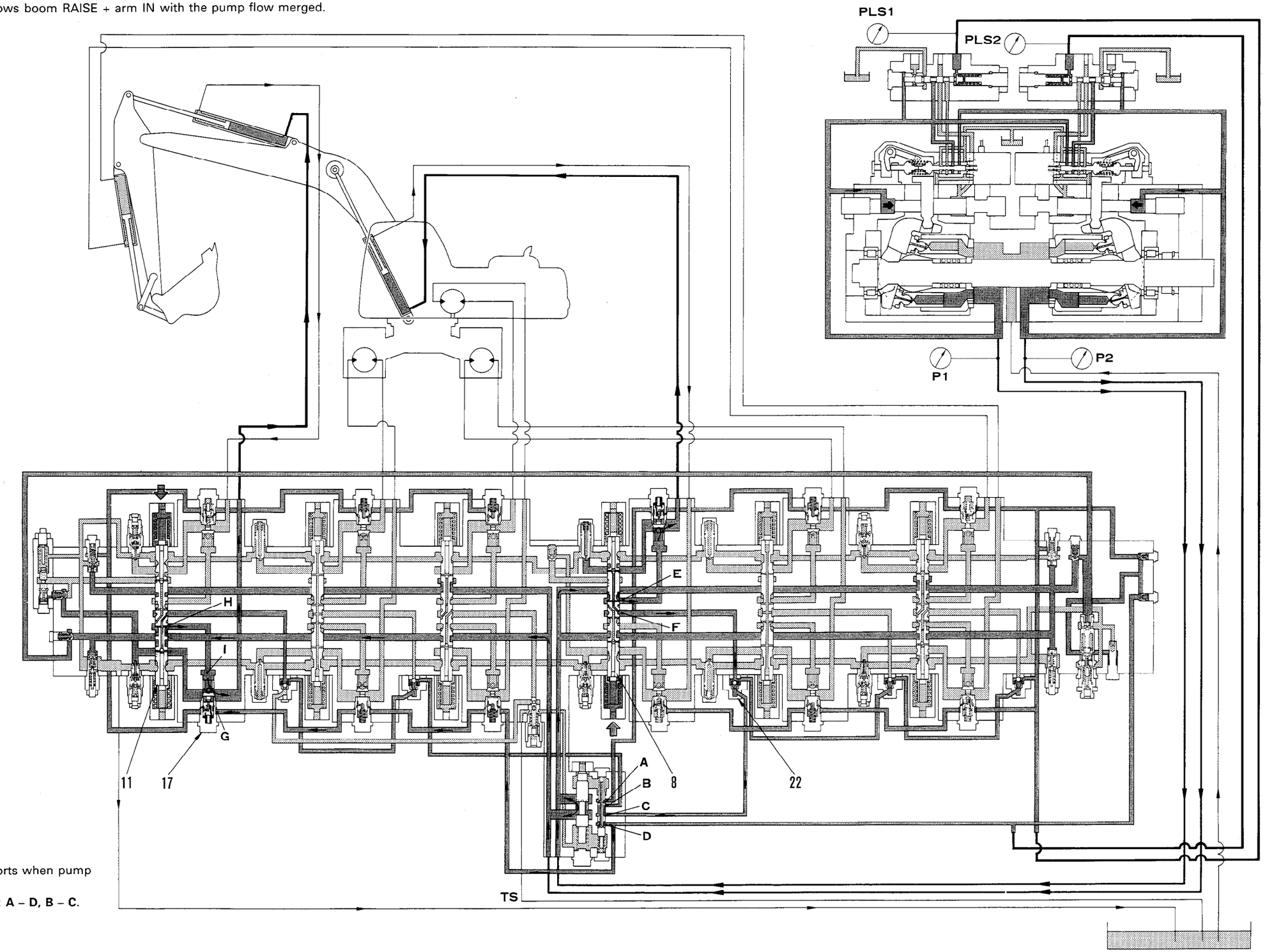
1) When the straight travel is operated, a flow of oil is supplied from the main pump to match the stroke of the left and right travel spools (10) and (7).
   Flow of oil from main pump (2A):
   To L.H. travel spool (10) (arm group)
   Flow of oil from main pump (2B):
   To R.H. travel spool (7) (bucket group)
   The straight travel is compensated by the travel junction valve.

2) From the condition in 1) above, if the lever on the side being steered is returned (the oil flow becomes small) or the lever on the other side is operated (in the opposite direction (forward or reverse)), the oil flow from the pump is being divided, so the left and right travel circuits are controlled independently and the machine is steered.

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8. Pump flow merged, compound operation

★ The diagram shows boom RAISE + arm IN with the pump flow merged.



- Connection of ports when pump flow is merged
  Connected ports: **A – D, B – C**.

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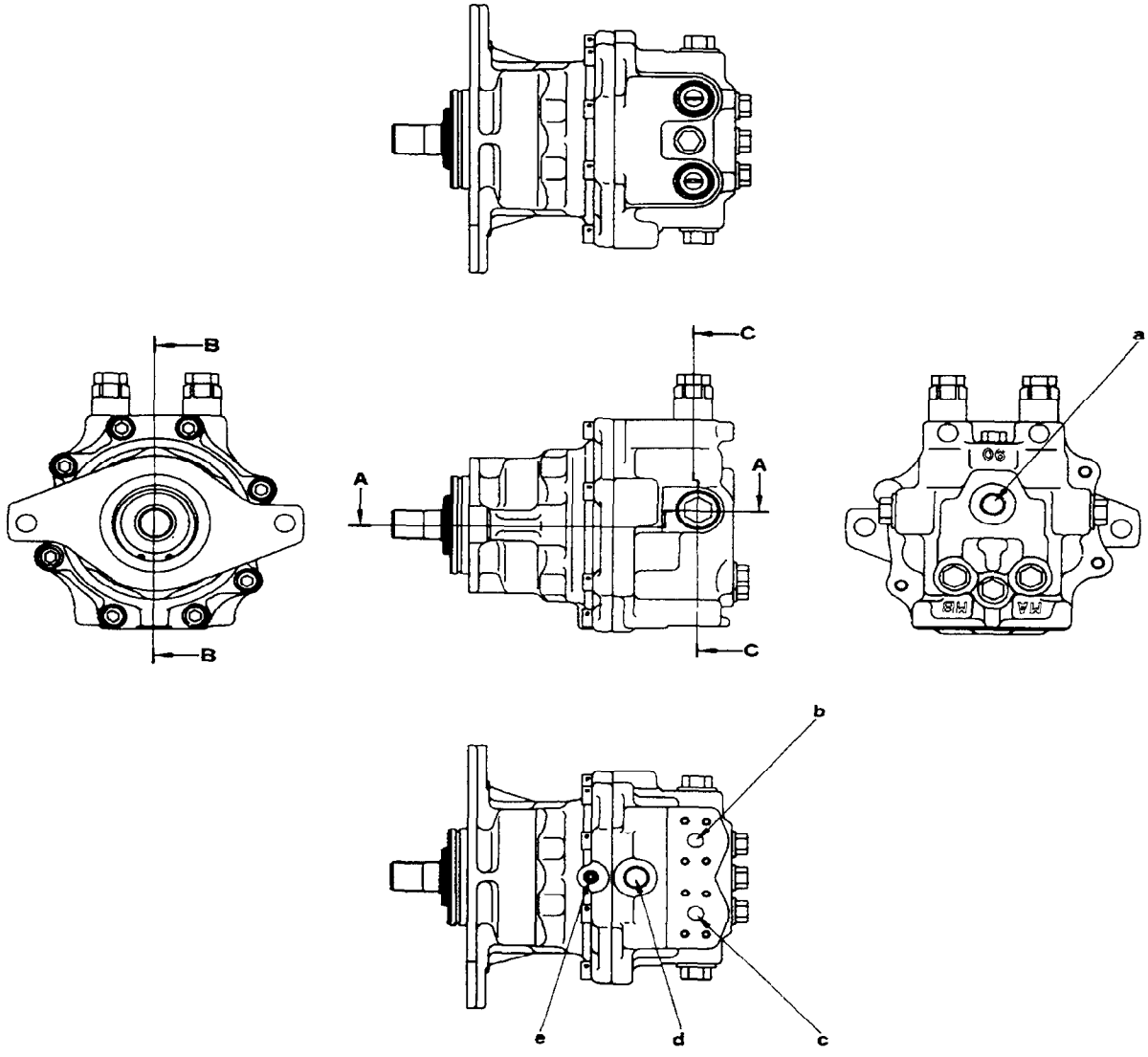
Operation

1) When the arm and boom are operated simultaneously, the swash plate angle for both pumps becomes the maximum. When this happens, the load pressure at the boom RAISE side is higher than at the arm side, so the LS pressure passes through ports **E** and **F** of boom spool (8), enters LS shuttle valve (22) and is sent to the LS circuit. This LS pressure is transmitted to port **G** of arm pressure compensation valve (17), and acts to increase the set pressure of the pressure compensation valve. Because of this, the pressure between port **H** or arm spool (11) and port **I** or pressure compensation valve (17) rises, and spool meter-in LS differential pressure (pump pressure - LS pressure = Δ **PLS**) becomes the same as that at the boom end.

2) Because of the above operation, the oil flow is divided in proportion to the size of the opening area of boom spool (8) and the opening area of arm spool (11). Meter-in differential pressure Δ **PLS** during boom RAISE + arm IN is Δ **PLS** < boom LS control pressure, so the main pump swash plate angle is set to maximum.

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SWING MOTOR

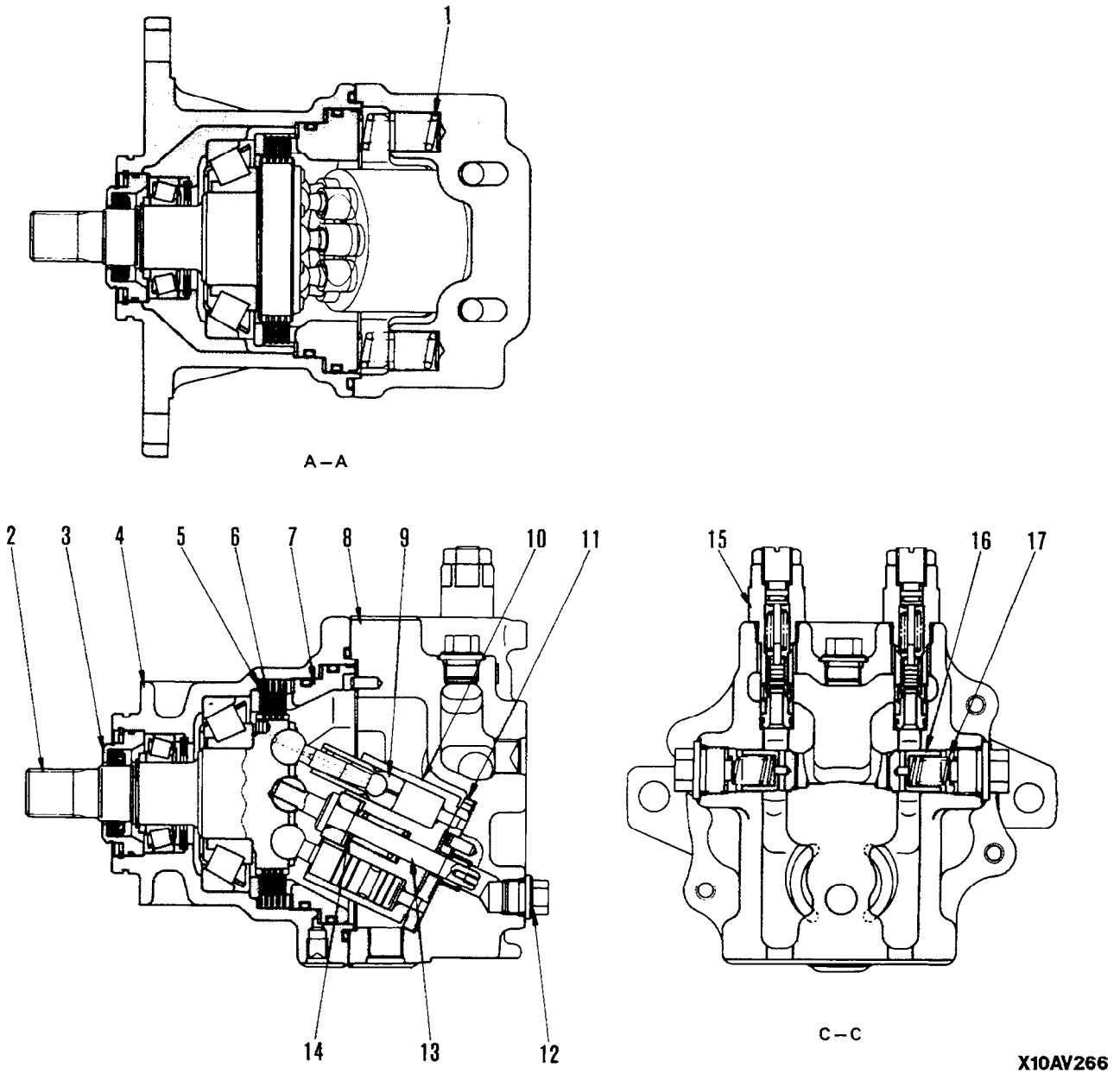


X10AV265

a. Port **S**
b. Port **MB** (from control valve)
c. Port **MA** (from control valve)
d. Port **T** (to tank)
e. Port **B** (from swing brake solenoid valve)

Model / Item	PC200-6 PC200LC-6 PC210LC-6	PC220LC-6 PC250LC-6
Type	KMF90AB-2	
Theoretical delivery	87.8 cc/rev	
Safety valve set pressure	27.44 MPa (280 kg/cm^2)	
Rated speed	2,298 rpm	2,403 rpm
Brake releasing pressure	1.37 MPa (14 kg/cm^2)	

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1. Brake spring
2. Drive shaft
3. Cover
4. Case
5. Disc
6. Plate
7. Brake piston
8. End cover
9. Piston
10. Cylinder
11. Valve plate
12. Air bleed plug
13. Center shaft
14. Center spring
15. Safety valve
16. Check valve
17. Check valve spring

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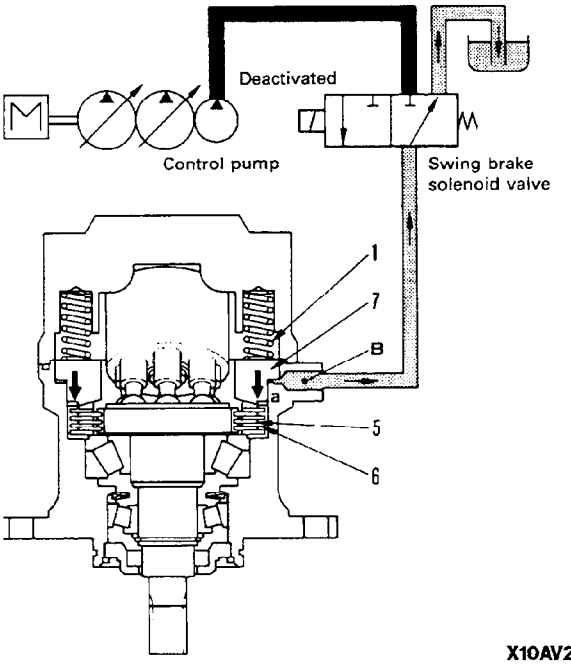
SWING HOLDING BRAKE

OPERATION

1) When swing brake solenoid valve is deactivated

When the swing brake solenoid valve is deactivated, the pressurized oil from the control pump is shut off and port **B** is connected to the tank circuit.

Because of this, brake piston (7) is pushed down in the direction of the arrow by brake spring (1), so disc (5) and plate (6) are pushed together and the brake is applied.

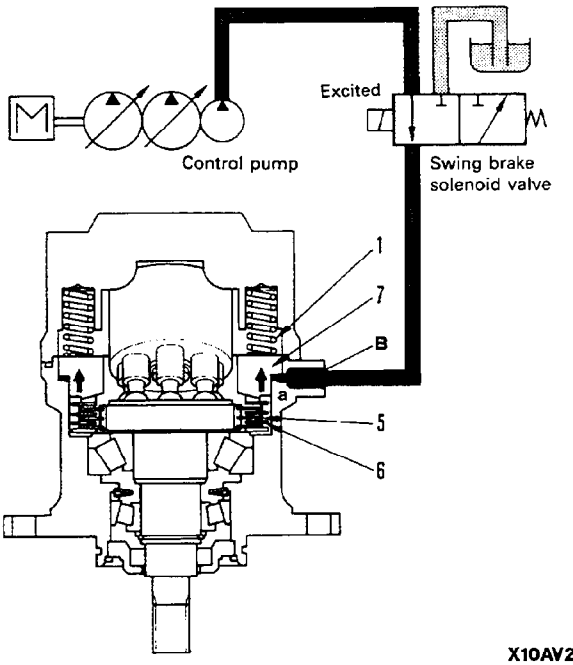


X10AV267

2) When swing brake solenoid is excited

When the swing brake solenoid valve is excited, the valve is switched, and the pressurized oil from the control pump enters port **B** and flows to brake chamber **a**.

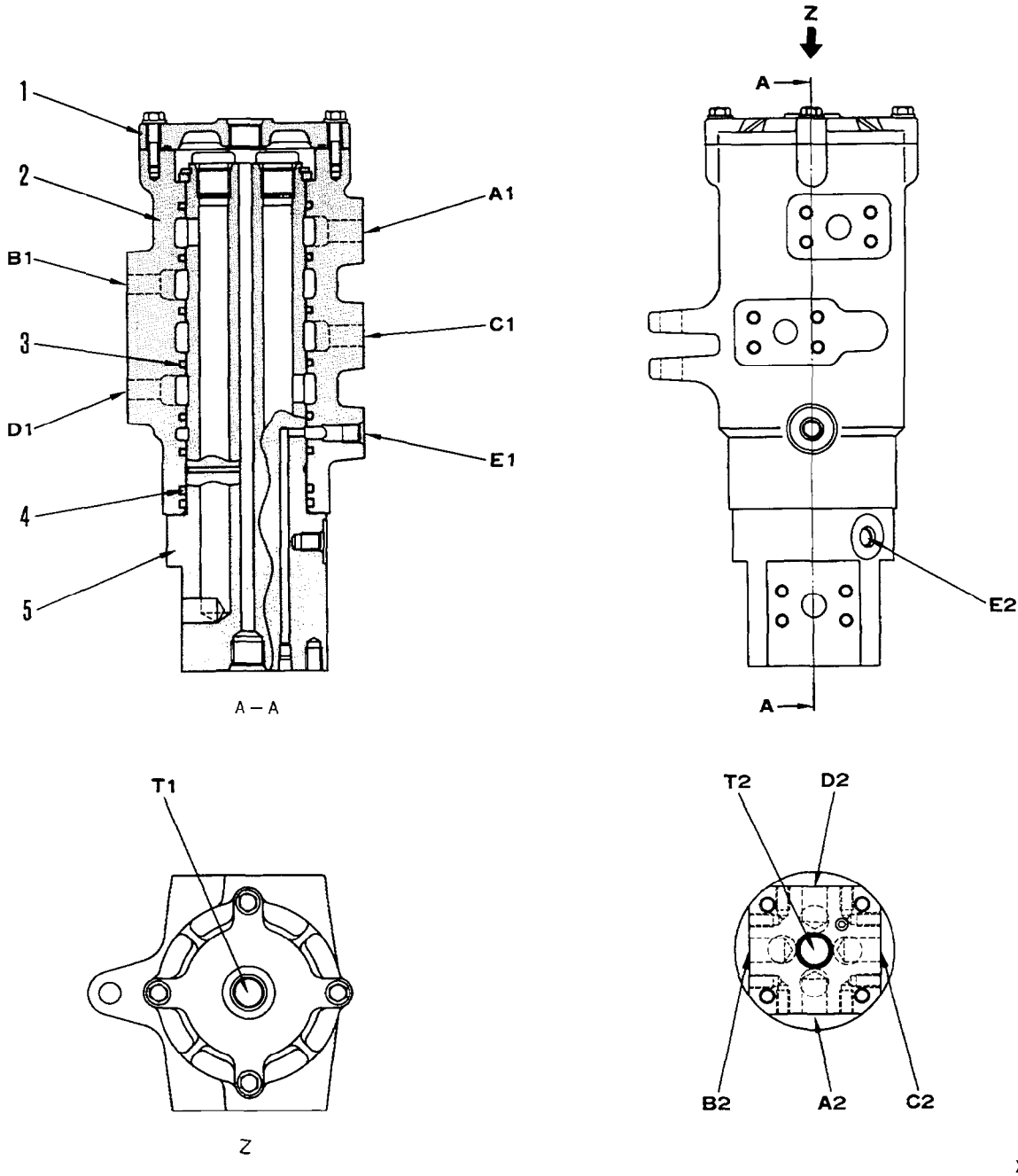
The pressurized oil entering chamber **a** overcomes the force of brake spring (1), and brake piston (7) is pushed up in the direction of the arrow. Because of this, disc (5) and plate (6) separate, and the brake is released.



X10AV268

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CENTER SWIVEL JOINT
4-PORT SWIVEL



X10ZZ020

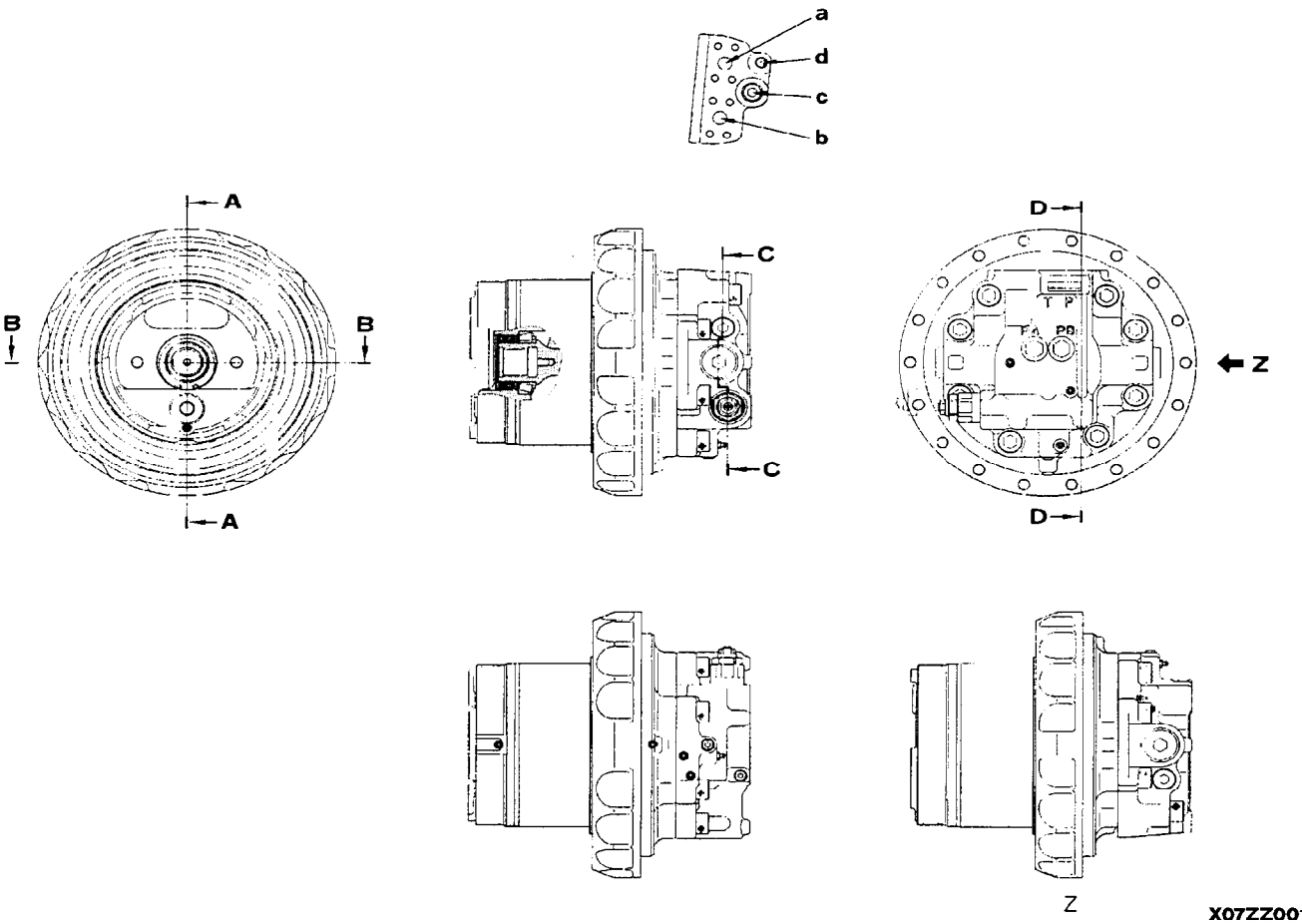
1. Cover
2. Body
3. Slipper seal
4. O-ring
5. Shaft

A1. From control valve port **B2**
A2. To R.H. travel motor port **PB**
B1. From control valve to port **B5**
B2. To L.H. travel motor port **PA**
C1. From control valve port **A2**
C2. To R.H. travel motor port **PA**
D1. From control valve port **A5**
D2. To L.H. travel motor port **PB**
E1. From travel speed solenoid valve
E2. To L.H. and R.H. travel motors port **P**
T1. To tank
T2. From L.H. and R.H. travel motors port **T**

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TRAVEL MOTOR

PC200-6, PC200LC-6
PC210LC-6, PC220LC-6



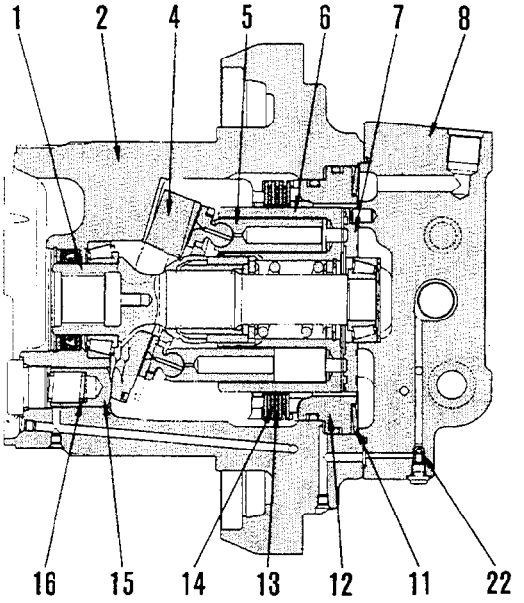
X07ZZ001

a. Port **PB** (from control valve)
b. Port **PA** (from control valve)
c. Port **T** (to tank)
d. Port **P** (from travel speed solenoid valve)

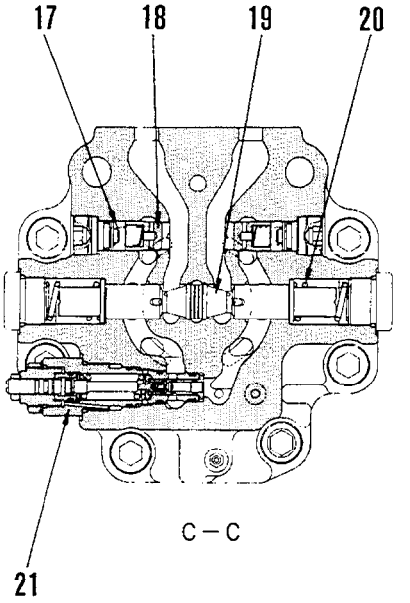
SPECIFICATIONS

Item	Model	PC200-6 PC200LC-6 PC210LC-6	PC220LC-6
Type		HMV160ADT-2	
Theoretical delivery	Min.	110.1 cc/rev	118.4 cc/rev
	Max.	160.8 cc/rev	
Set pressure		34.79 MPa (355 kg/cm^2)	
Rated speed	Min. capacity	1,834 rpm	1,780 rpm
	Max. capacity	1,004 rpm	1,048 rpm
Brake releasing pressure		1.18 MPa (12 kg/cm^2)	
Travel speed switching pressure	Differential pressure	0.78 MPa (8 kg/cm^2)	

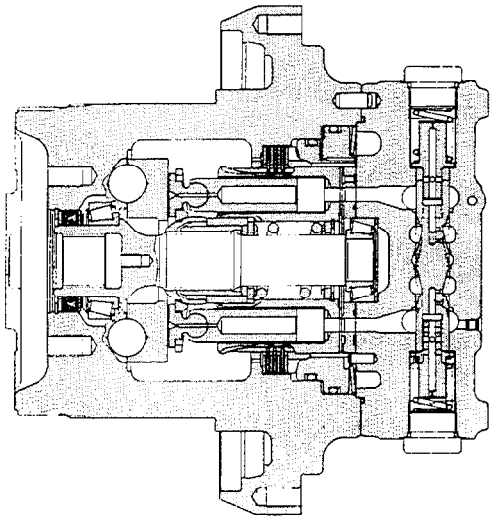
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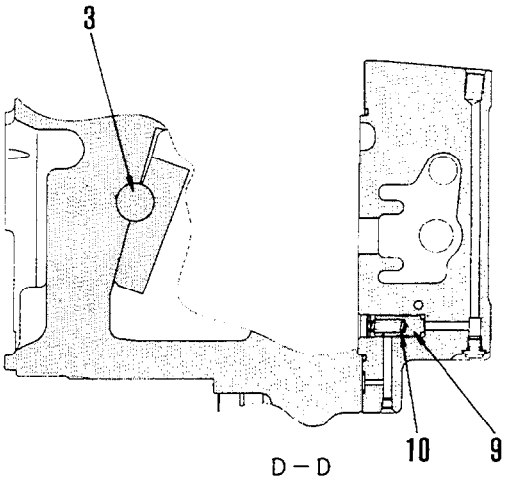
A – A



C – C



B – B



D – D

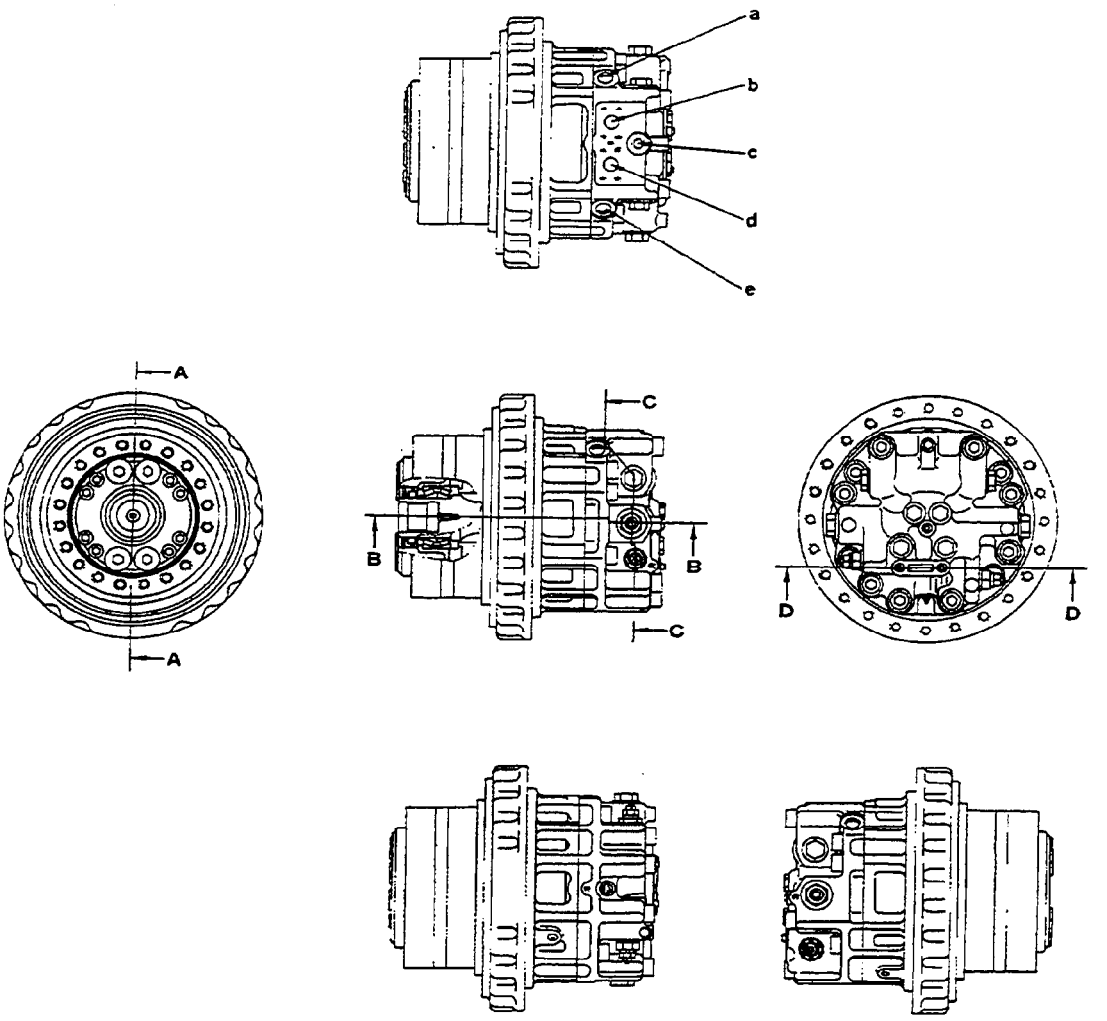
X07ZZ002

1. Output shaft
2. Motor case
3. Ball
4. Rocker cam
5. Piston
6. Cylinder
7. Valve plate
8. End cover
9. Regulator valve
10. Spring
11. Brake spring
12. Brake piston
13. Plate
14. Disc
15. Regulator piston
16. Spring
17. Check valve spring
18. Check valve
19. Counterbalance valve
20. Spool return spring
21. Safety valve
22. Slow return valve

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TRAVEL MOTOR

PC250LC-6



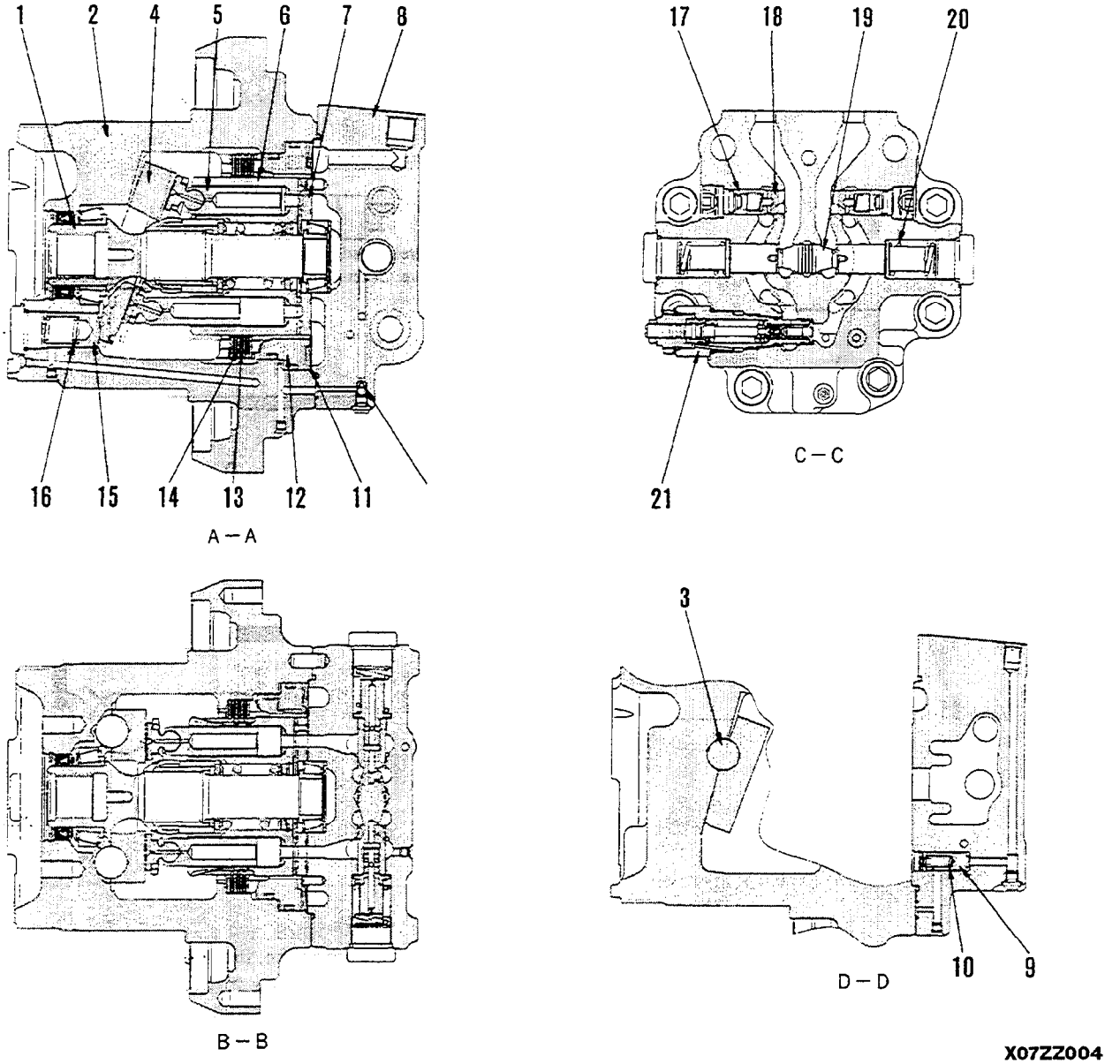
X07ZZ003

a. T_2 port (To tank)
b. **PB** port (From control valve)
c. **P** port (From travel speed solenoid valve)
d. **PA** port (From control valve)
e. T_1 port (To tank)

SPECIFICATIONS

Item	Model	PC250LC-6
Type		HMV280ADT
Theoretical delivery	Min.	150.3 cc/rev
	Max.	280.0 cc/rev
Rated pressure		325 kg/cm^2
Rated speed	Min.	895 rpm
	Max.	1,430 rpm
Brake releasing pressure		1.27 ± 0.29 MPa (13 ± 3 kg/cm^2)
Hi-Lo switching pressure		0.78 $^{+0.39}_{-0.10}$ MPa (8 $^{+4}_{-1}$ kg/cm^2)

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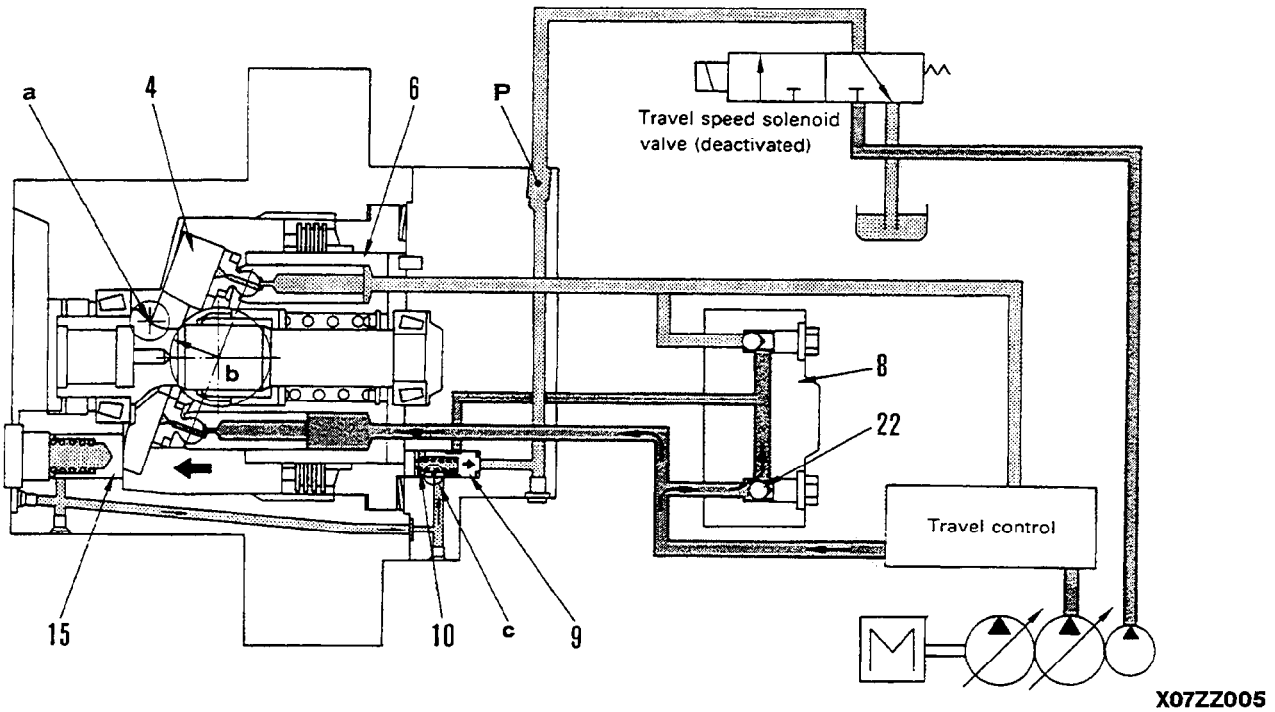
X07ZZ004

1. Output shaft
2. Motor case
3. Ball
4. Rocker cam
5. Piston
6. Cylinder
7. Valve plate
8. End cover
9. Regulator valve
10. Spring
11. Brake spring
12. Brake piston
13. Plate
14. Disc
15. Regulator piston
16. Spring
17. Check valve spring
18. Check valve
19. Counterbalance valve
20. Spool return spring
21. Safety valve
22. Slow return valve

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OPERATION OF MOTOR

1) Motor swash plate angle (capacity) at maximum

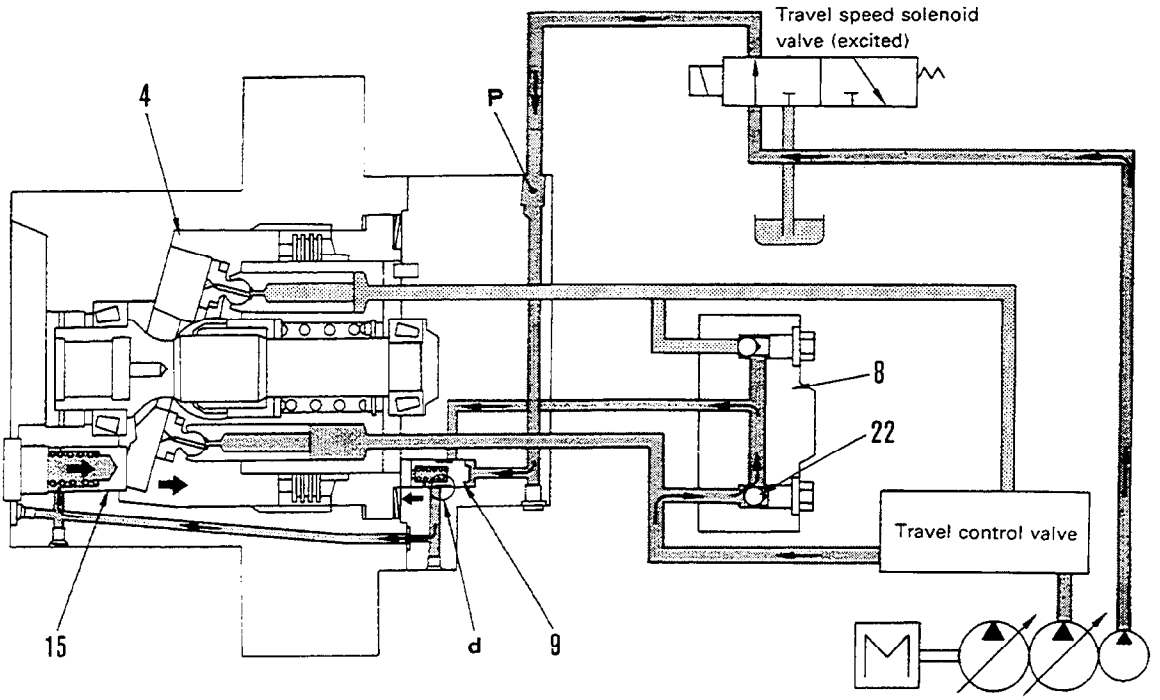


X07ZZ005

- The solenoid valve is deactivated, so the pilot pressure oil from the control pump does not flow to port **P**.
  For this reason, regulator valve (9) is pushed to the right in the direction of the arrow by spring (10).
- Because of this, it pushes check valve (22), and the main pressure oil from the control valve going to end cover (8) is shut off by regulator valve (9).
- Fulcrum **a** of rocker cam (4) is eccentric to point of force **b** of the combined force of the propulsion force of cylinder (6), so the combined force of the piston propulsion force acts as a moment to angle rocker cam (4) in the direction of the maximum swash plate angle.
- At the same time, the pressurized oil at regulator piston (15) passes through orifice **c** in regulator valve (9) and is drained to the motor case.
- As a result, rocker cam (4) moves in the maximum swash plate angle direction, the motor capacity becomes maximum.

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2) Motor swash plate angle (capacity) at minimum



X07ZZ006

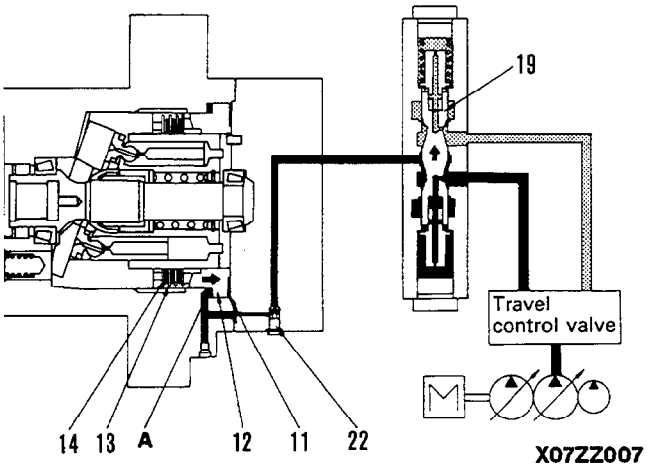
- When the solenoid valve is excited, the pilot pressure oil from the control pump flows to port **P**, and pushes regulator valve (9) to the left in the direction of the arrow.
- Because of this, the main pressure oil from the control valve passes through passage **d** in regulator valve (9), enters regulator piston (15) at the bottom, and pushes regulator piston (15) to the right in the direction of the arrow.
- As a result, rocker cam (4) moves in the minimum swash plate angle direction, the motor capacity becomes minimum.

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OPERATION OF PARKING BRAKE

1) When starting to travel

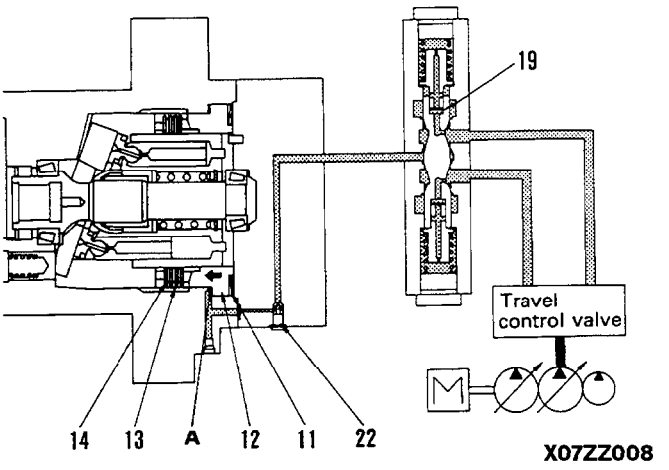
When the travel lever is operated, the pressure oil from the pump actuates counterbalance valve spool (19), opens the circuit to parking brake, and flows into chamber **A** of brake piston (12).
It overcomes the force of spring (11), and pushes piston (12) to right in the direction of the arrow.
When this happens, the force pushing plate (13) and disc (14) together is lost, so plate (13) and disc (14) separate and the brake is released.



X07ZZ007

2) When stopping travel

When the travel lever is placed in neutral, counterbalance valve spool (19) returns to the neutral position and circuit to the parking brake is closed.
The pressurized oil in chamber **A** of brake piston (12) is drained to the case from the orifice in the brake piston, and brake piston (12) is pushed to the left in the direction of the arrow by spring (11).
As a result, plate (13) and disc (14) are pushed together, and the brake is applied.
A time delay is provided by having the pressurized oil pass through a throttle in slow return valve (22) when the brake piston returns, and this ensures that the brake still effective after the machine stops.

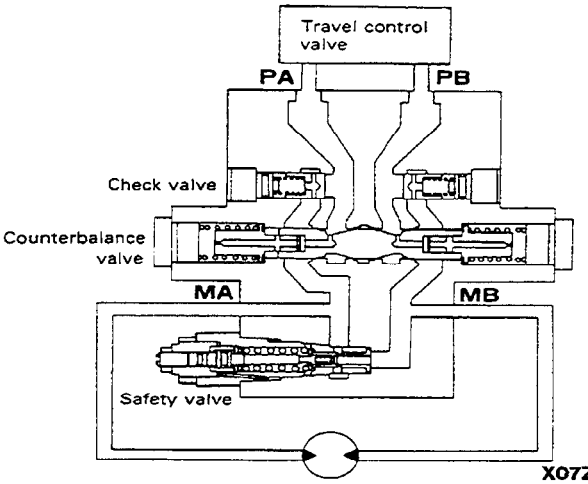


X07ZZ008

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OPERATION OF BRAKE VALVE

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

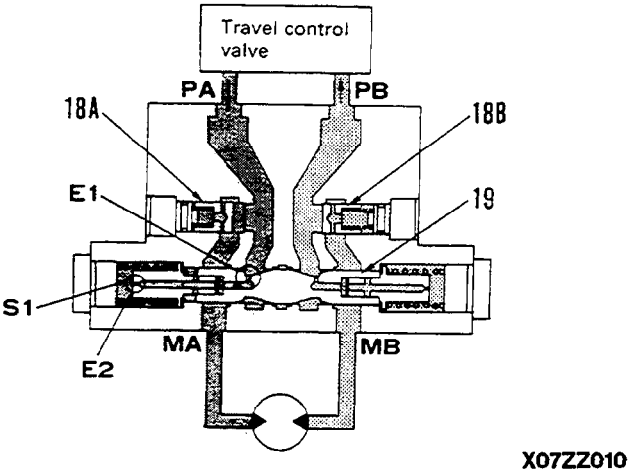


(Fig. 1)

1) Counterbalance valve, check valve

Function

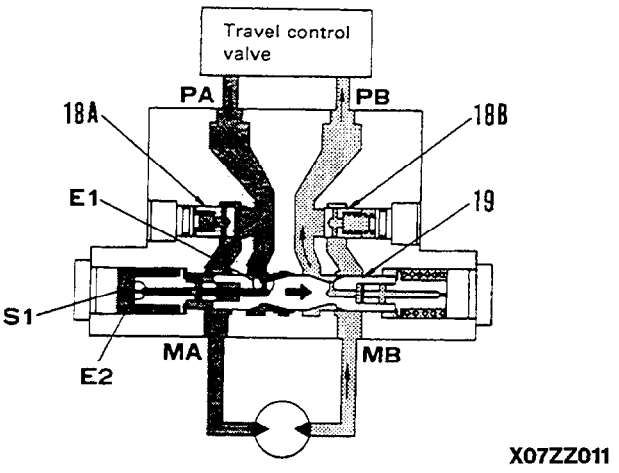
- When traveling downhill, the weight of the machine makes it try to travel faster than the speed of the motor.
  As a result, if the machine travels with the engine at low speed, the motor will rotate without load and the machine will run away, which is extremely dangerous.
  To prevent this, these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



(Fig. 2)

Operation when pressure oil 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 (18A) and flows from motor to inlet port **MA** to motor outlet port **MB**.
  However, the motor outlet port is closed by check valve (18B) and spool (19), so the pressure at the supply side rises. (Fig. 2)
- The pressurized oil at the supply side flows from orifice **E1** in spool (19) and orifice **E2** in the piston to chamber **S1**. When the pressure in chamber **S1** goes above the spool switching pressure, spool (19) 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)

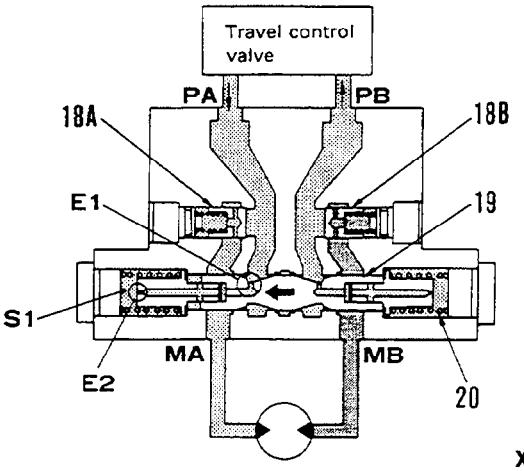


(Fig. 3)

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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 **S1** through orifices **E1** and **E2** will also drop. When the pressure in chamber **S1** drops below the spool switching pressure, spool (19) is returned to the left in the direction of the arrow by spring (20), 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 the machine from running away.
  In other words, the spool moves 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 travel speed according to the amount of oil discharged from the pump. (Fig. 4)

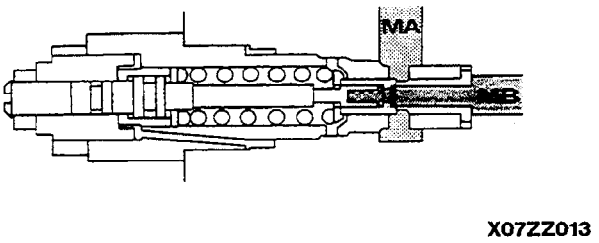


(Fig. 4)

2) Safety valve (2-way operation, 2-stage set safety valve

Function

- When travel is stopped (or when traveling downhill), the circuits 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.



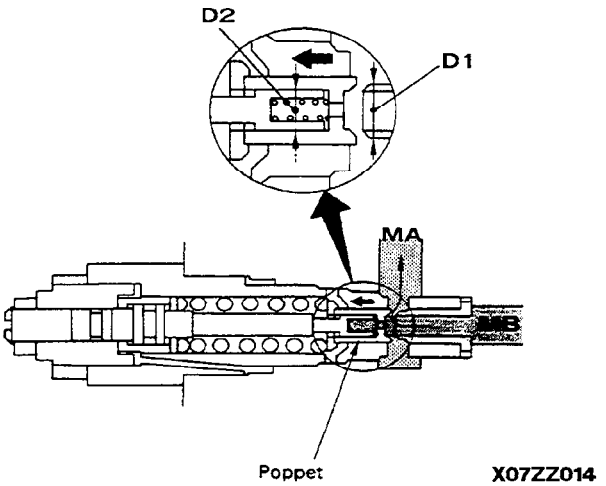
(Fig. 5)

Operation in both directions

1) When pressure in chamber MB has become high (when rotating clockwise)

- When the travel is stopped (of when traveling downhill), chamber **MB** 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 **D1** and **D2** [$\pi/4(D1^2 - D2^2)$ X pressure] overcomes the force of the spring and moves the poppet to the left, so the oil flows to chamber **MA** in the circuit on the opposite side. (Fig. 6)

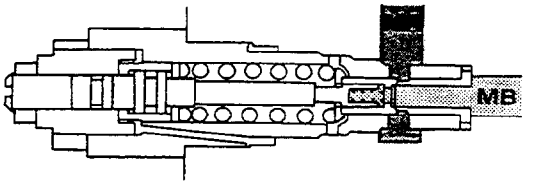


(Fig. 6)

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2) When pressure in chamber MA has become high (when rotating counterclockwise)

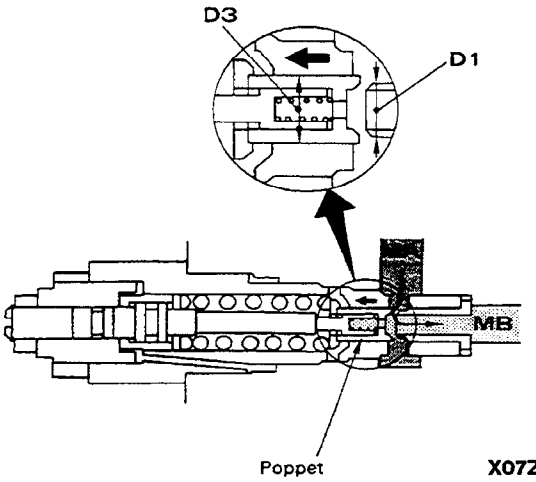
- When the travel is stopped (or when traveling downhill), chamber **MA** in the outlet port circuit is closed be the check valve of the counterbalance valve, but the pressure at the outlet port rises because of inertia. (Fig. 7)



X07ZZ015

(Fig. 7)

- If the pressure goes above the set pressure, the force produced by the difference in area between **D1** and **D3** [$\pi/4(D3^2 - D1^2)$ X pressure] overcomes the force of the spring and moves the poppet to the left, so the oil flows to chamber **MB** in the circuit on the opposite side. (Fig. 8)



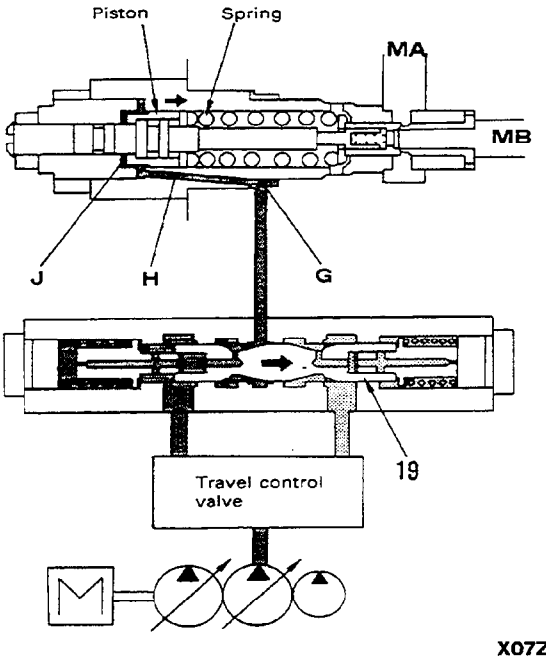
X07ZZ016

(Fig. 8)

Operation of mechanism for varying set pressure

1) When starting travel (high pressure setting)

When the travel lever is operated, the pressurized oil from the pump actuates counterbalance valve spool (19), and opens the pilot circuit to the safety valve. The oil passes from chamber **G** to passage **H** and flows into chamber **J**, pushes the piston to the right in the direction of the arrow, and compresses the spring to make the set load larger. Because of this, the set pressure of the safety valve is switched to the high pressure setting, and a large drawbar pull is made available.



X07ZZ017

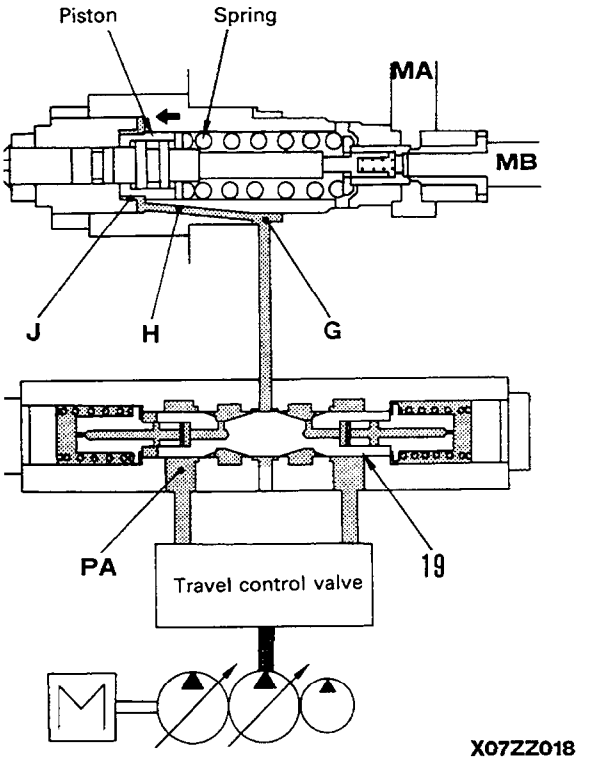
(Fig. 9)

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2) When stopping travel (low pressure setting)
When the travel lever is placed at neutral, the pressure in chamber **PA** drops and counterbalance valve spool (19) returns to the neutral position. While the counterbalance valve spool is returning to the neutral position, the pressurized oil in chamber **J** passes through passage **H**, and escapes to chamber **PA** from chamber **G**. The piston moves to the left in the direction of the arrow, and the set load becomes smaller. Because of this, the set pressure of the safety valve is switched to the low pressure setting in order to relieve the shock when reducing speed.

[Set pressure of safety valve]

When starting, when traveling	When stopping
High pressure setting 37.73 MPa (385 kg/cm^2)	Low pressure setting 27.44 MPa (280 kg/cm^2)

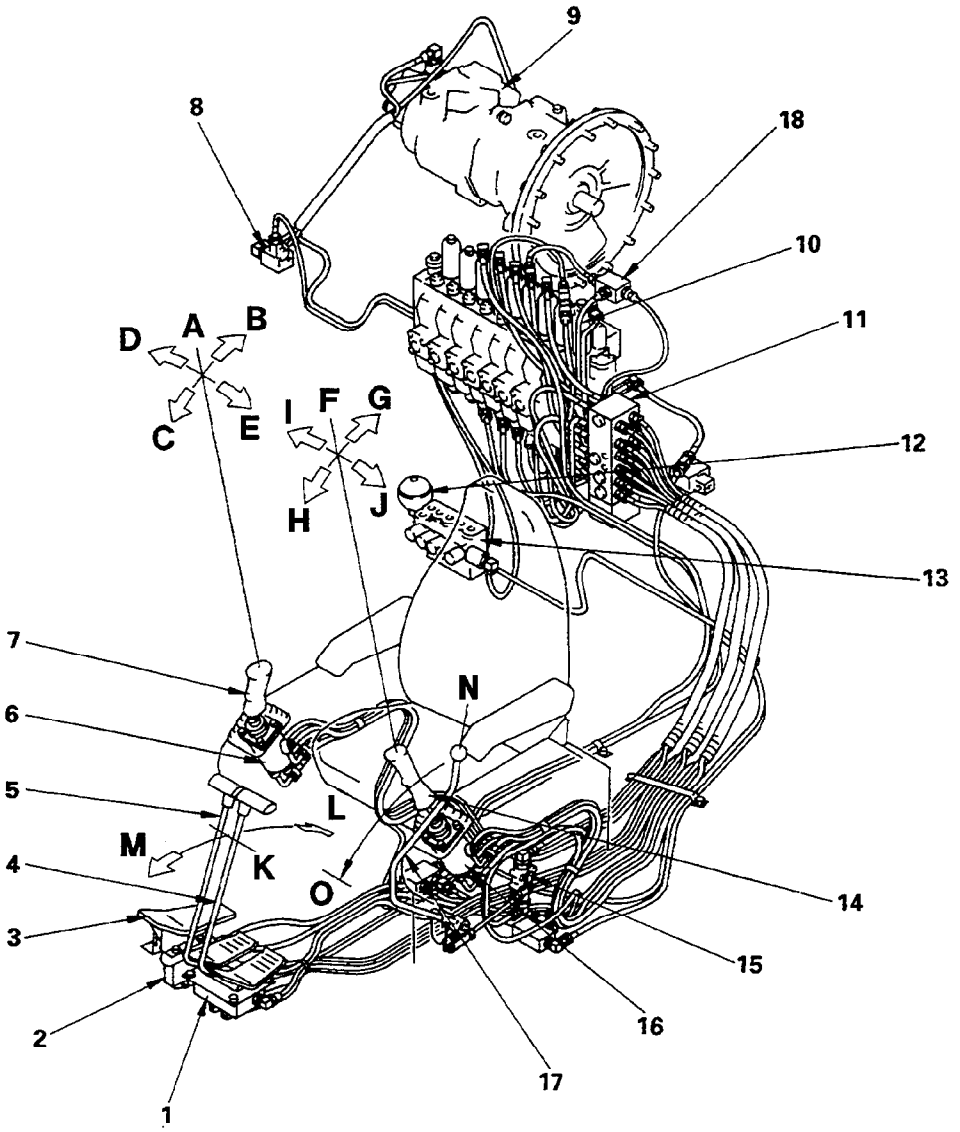


(Fig. 10)

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VALVE CONTROL

PC200-6, PC200LC-6
PC210LC-6, PC220LC-6
PC250LC-6



X10AZ066

1. Travel PPC valve
2. Service PPC valve
3. Service pedal
4. L.H. travel lever
5. R.H. travel lever
6. R.H. PPC valve
7. R.H. work equipment lever
8. LS control EPC valve
9. Hydraulic pump
10. Control valve
11. PPC shuttle valve
12. Accumulator
13. Solenoid valve
14. L.H. work equipment lever
15. Safety lock valve
16. L.H. PPC valve
17. Safety lock lever
18. Timing valve

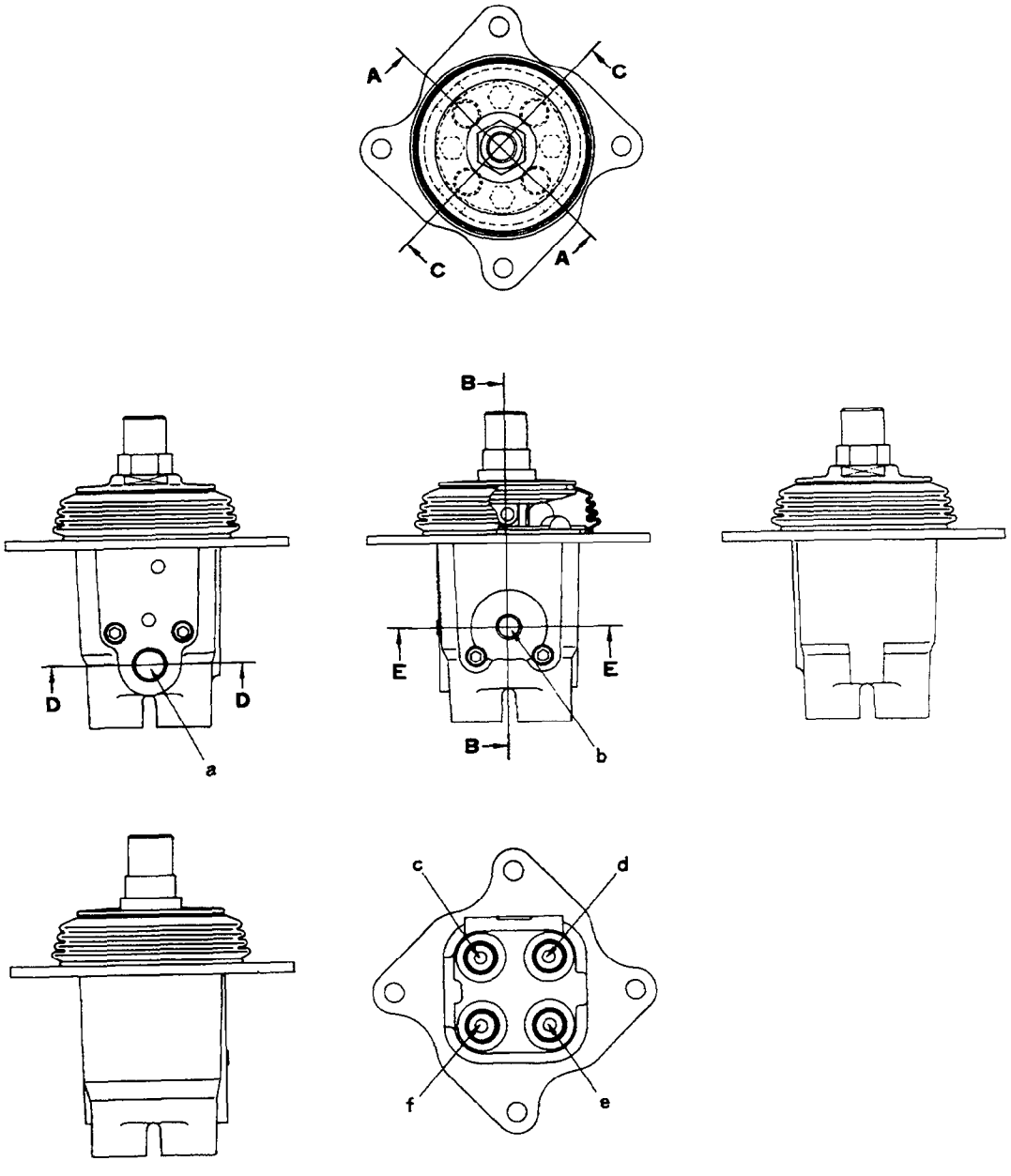
Lever positions

A. Neutral
B. Boom RAISE
C. Boom LOWER
D. Bucket DUMP
E. Bucket CURL
F. Neutral
G. Arm IN
H. Arm OUT
I. Swing RIGHT
J. Swing LEFT
K. Neutral
L. Travel REVERSE
M. Travel FORWARD
N. LOCK
O. FREE

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WORK EQUIPMENT • SWING PPC VALVE

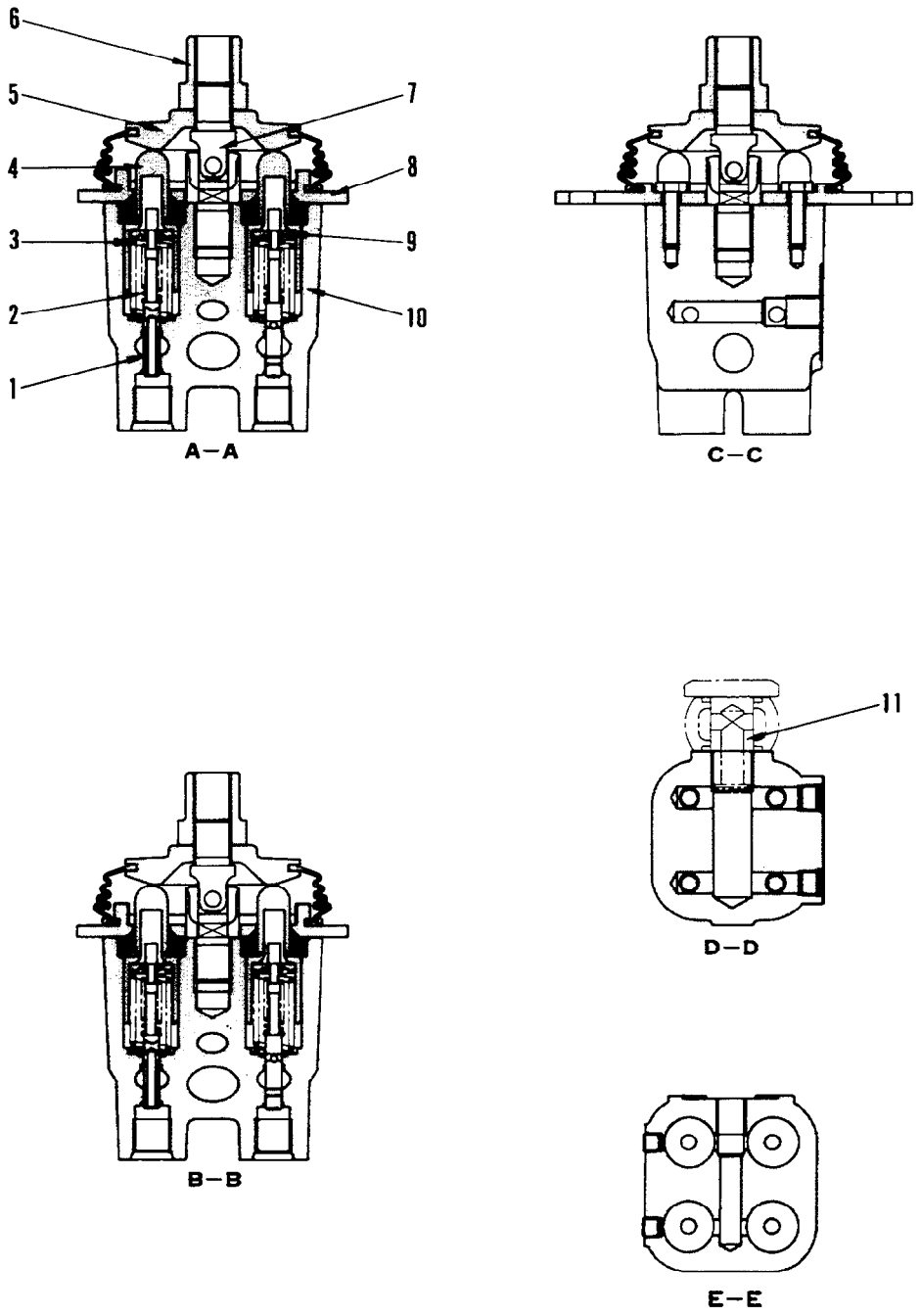
PC200-6, PC200LC-6
PC210LC-6, PC220LC-6
PC250LC-6



X09DH025

a. Port **P** (from control pump)
b. Port **T** (to tank)
c. Port **P2** (L.H.: Arm IN/R.H.: Boom RAISE)
d. Port **P4** (L.H.: Swing LEFT/R.H.: Bucket DUMP)
e. Port **P1** (L.H.: Arm OUT/R.H.: Boom LOWER)
f. Port **P3** (L.H.: Swing RIGHT/R.H.: Bucket CURL)

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X09DH026

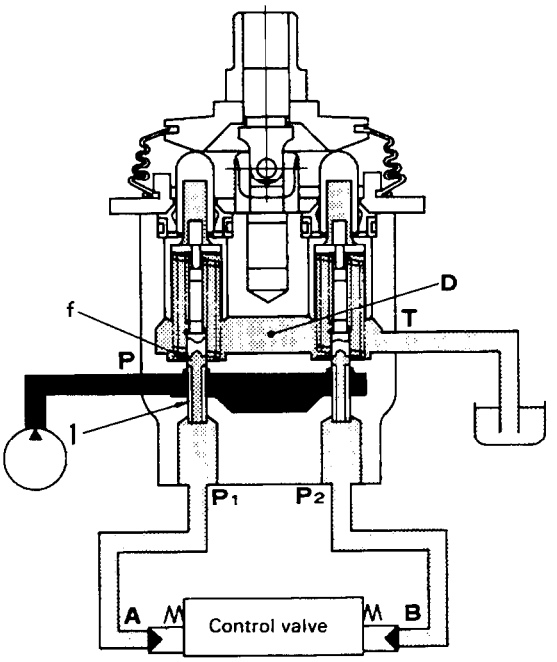
1. Spool
2. Metering spring
3. Piston
4. Disc
5. Nut (for connecting lever)
7. Joint
8. Plate
9. Retainer
10. Body
11. Filter

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OPERATION

1) At neutral

Ports **A** and **B** of the control valve and ports P_1 and P_2 of the PPC valve are connected to drain chamber **D** through fine control hole **f** in spool (1). (Fig. 1)



X09DH027

(Fig. 1)

2) During fine control (neutral → fine control)

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

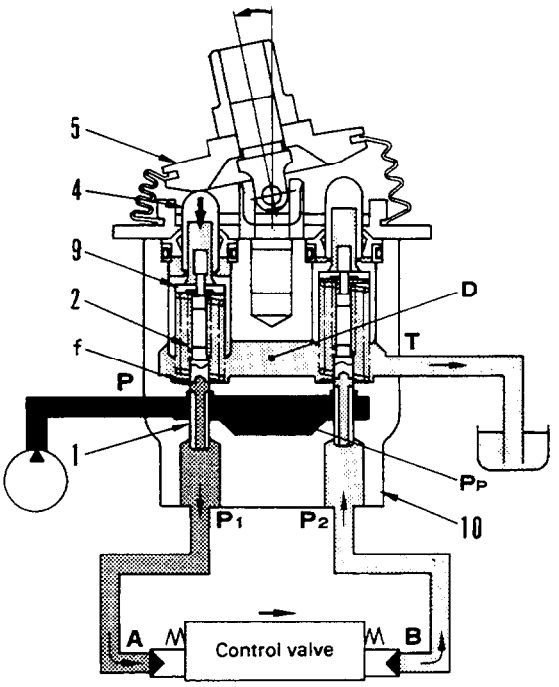
When this happens, fine control hole **f** is shut off from drain chamber **D**, and at almost the same time, it is connected to pump pressure chamber P_P, so pilot pressure oil from the control pump passes through fine control hole **f** and goes from port P_1 to port **A**.

When the pressure at port P_1 becomes higher, spool (1) is pushed back and fine control hole **f** is shut off from pump pressure chamber P_P. At almost the same time, it is connected to drain chamber **D** to release the pressure at port P_1.

When this happens, spool (1) moves up or down so that the force of metering spring (2) is balanced with the pressure at port P_1. The relationship in the position of spool (1) and body (10) (fine control hole **f** is at a point midway between drain hole **D** and pump pressure chamber P_P) does not change until retainer (9) contacts spool (1).

Therefore, metering spring (2) is compressed proportionally to the amount of movement of the control lever, so the pressure at port P_1 also rises in proportion to the travel of the control lever.

In this way, the control valve spool moves to a position where the pressure in chamber **A** (the same as the pressure at port P_1) and the force of the control valve spool return spring are balanced. (Fig. 2)



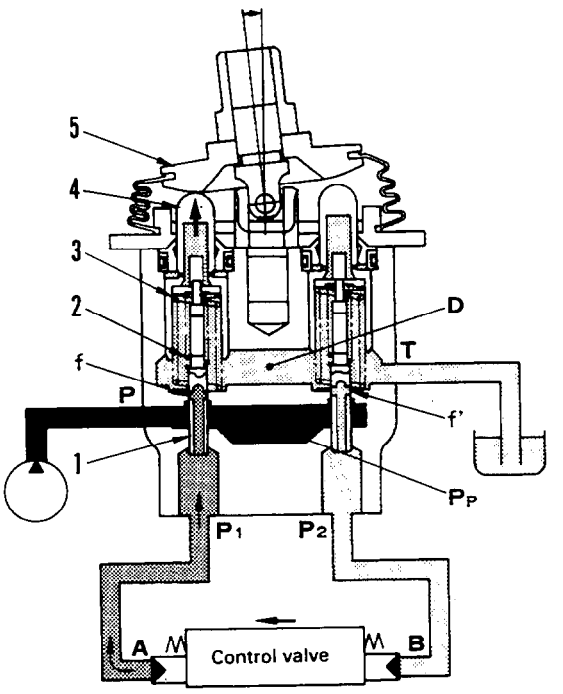
X09DH028

(Fig. 2)

https://truckmanualshub.com/

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

When disc (5) starts to be returned, spool (1) is pushed up by the force of centering spring (3) and the pressure at port P_1.
When this happens, fine control hole **f** is connected to drain chamber **D** and the pressure oil at port P_1 is released.
If the pressure at port P_1 drops too far, spool (1) is pushed down by metering spring (2), and fine control hole **f** is shut off from drain chamber **D**. At almost the same time, it is connected to pump pressure chamber P_P, and the pump pressure is supplied until the pressure at port P_1 recovers to a pressure that corresponds to the lever position.
When the spool of the control valve returns, oil in drain chamber **D** flows in from fine control hole **f´** in the valve on the side that is not working. The oil passes through port P_2 and enters chamber **B** to fill the chamber with oil. (Fig. 3)

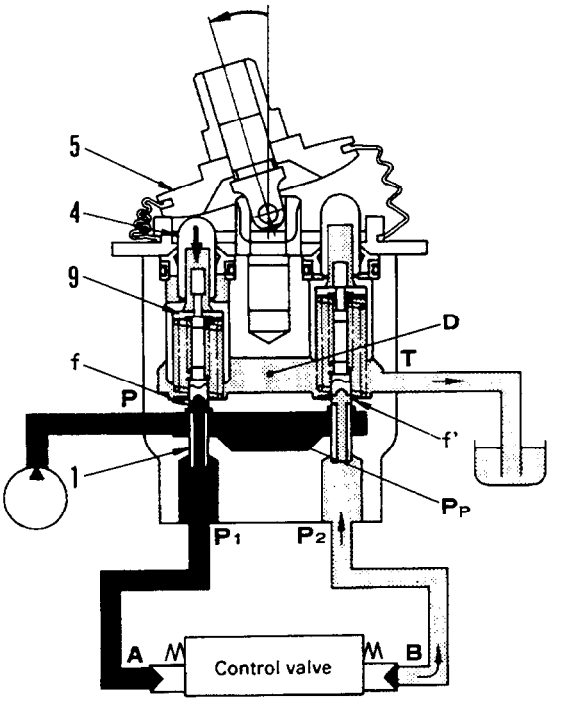


X09DH029

(Fig. 3.)

4) At full stroke

When disc (5) pushes down piston (4), and retainer (9) pushes down spool (1), fine control hole **f** is shut off from drain chamber **D**, and is connected with pump pressure chamber P_P.
Therefore, the pilot pressure oil from the control pump passes through fine control hole **f** and flows to chamber **A** from port P_1, and pushes the control valve spool.
The oil returning from chamber **B** passes from port P_2 through fine control hole **f´** and flows to drain chamber **D**. (Fig. 4)

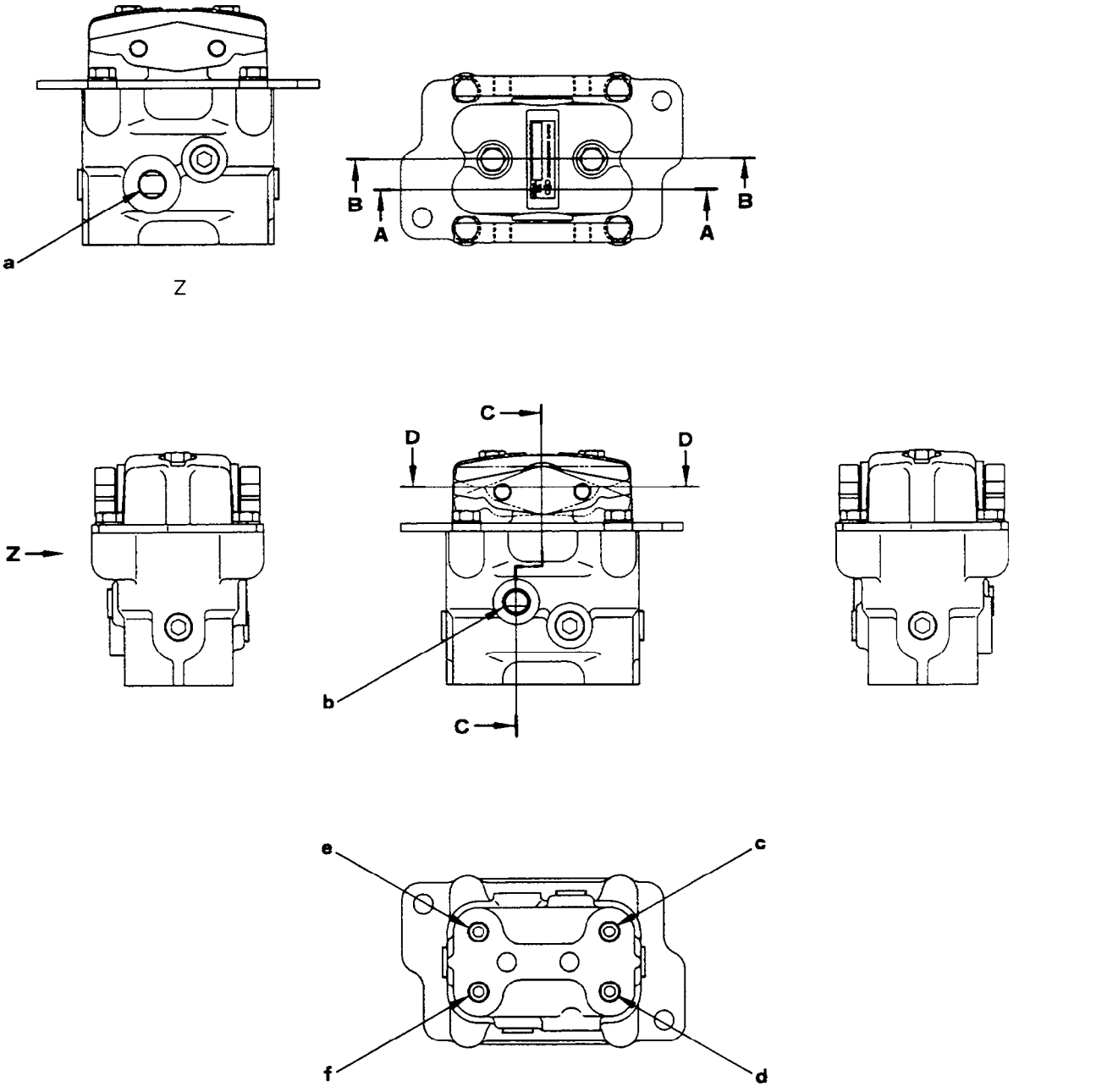


X09DH030

(Fig. 4)

https://truckmanualshub.com/

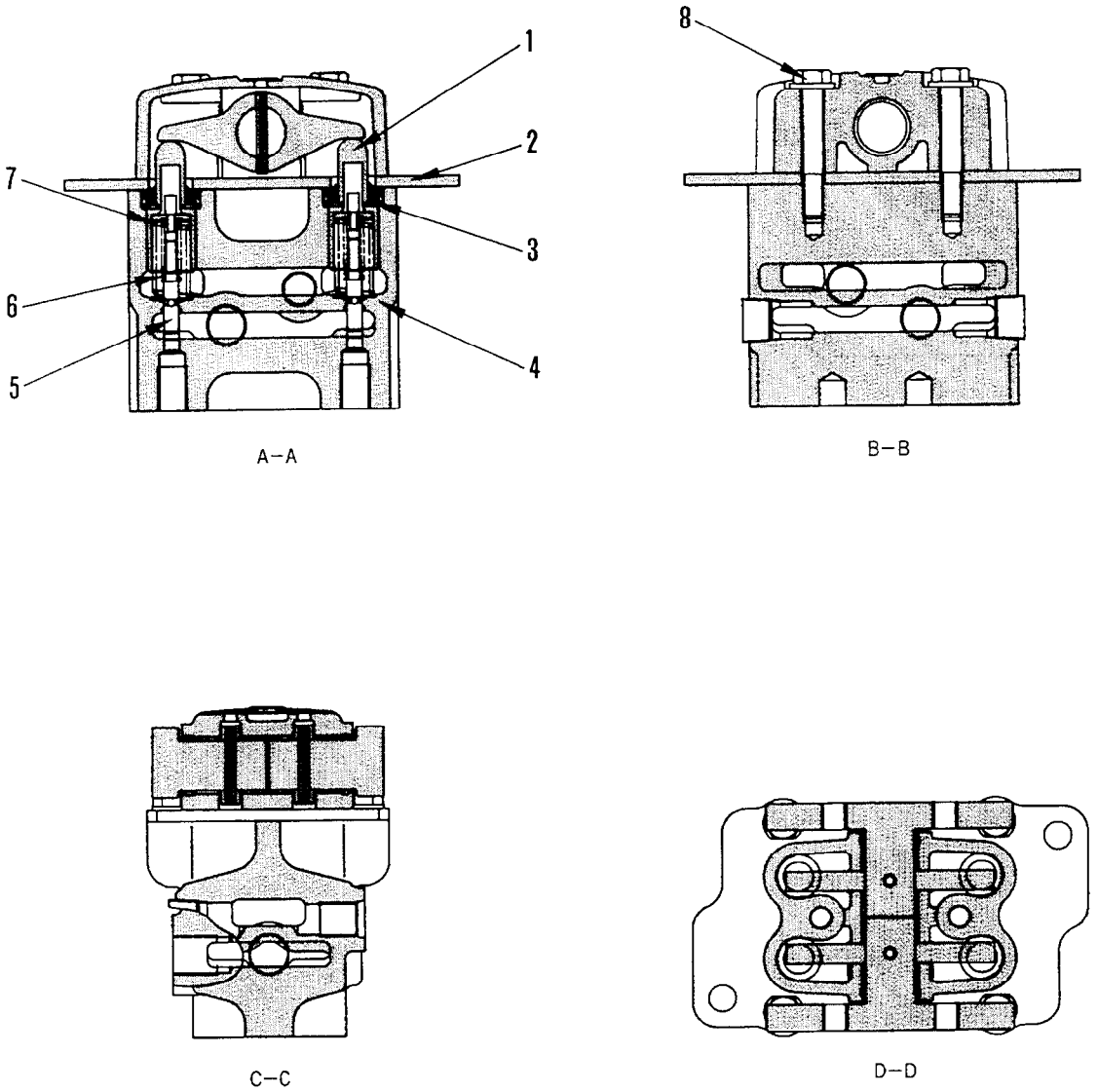
TRAVEL PPC VALVE



X10BH155

a. Port **P** (from control pump)
b. Port **T** (to tank)
c. Port **P1** (L.H. travel REVERSE)
d. Port **P3** (R.H. travel REVERSE)
e. Port **P2** (L.H. travel FORWARD)
f. Port **P4** (R.H. travel FORWARD)

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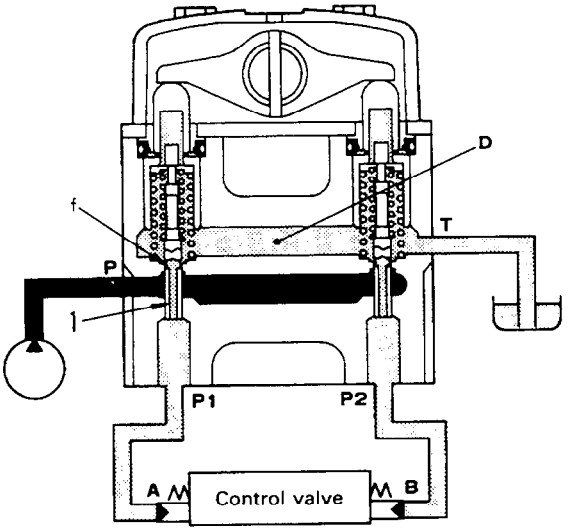
X10BH156

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

https://truckmanualshub.com/

OPERATION

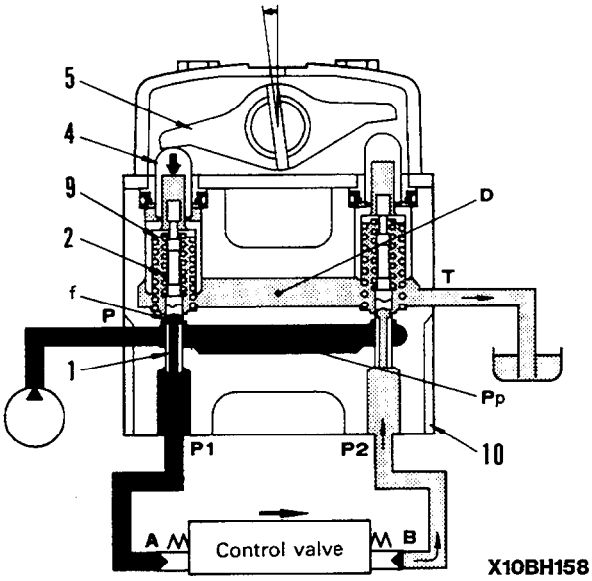
1. **At neutral**
   Ports **A** and **B** of the control valve and ports **P1** and **P2** of the PPC valve are connected to drain chamber **D** through fine control hole **f** in spool (1). (Fig. 1)



X10BH157

(Fig. 1)

2. **Fine control (neutral → fine control)**
   When piston (4) starts to be pushed by disc (5), retainer (9) is pushed. Spool (1) is also pushed by metering spring (2) and moves down.
   When this happens, fine control hole **f** is shut off from drain chamber **D**. At almost the same time, it is connected to pump pressure **PP**, and the pilot pressure of the control pump is sent from port **A** through fine control hole **f** to port **P1**. When the pressure at port **P1** rises, spool (1) is pushed back. Fine control hole **f** is shut off from pump pressure chamber **PP**. At almost the same time, it is connected to drain chamber **D**, so the pressure at port **P1** escapes.
   As a result, spool (1) moves up and down until the force of metering spring (2) is balanced with the pressure of port **P1**.
   The relationship of the positions of spool (1) and body (10) (fine control hole **f** is in the middle between drain hole **D** and pump pressure chamber **PP**) does not change until retainer (9) contacts spool (1).
   Therefore, metering spring (2) is compressed in proportion to the travel of the control lever, so the pressure at port **P1** also rises in proportion to the travel of the control lever.
   In this way, the spool of the control valve moves to a position where the pressure of chamber **A** (same as pressure at port **P1**) and the force of the return spring of the control valve spool are balanced. (Fig. 2)



X10BH158

(Fig. 2)

https://truckmanualshub.com/

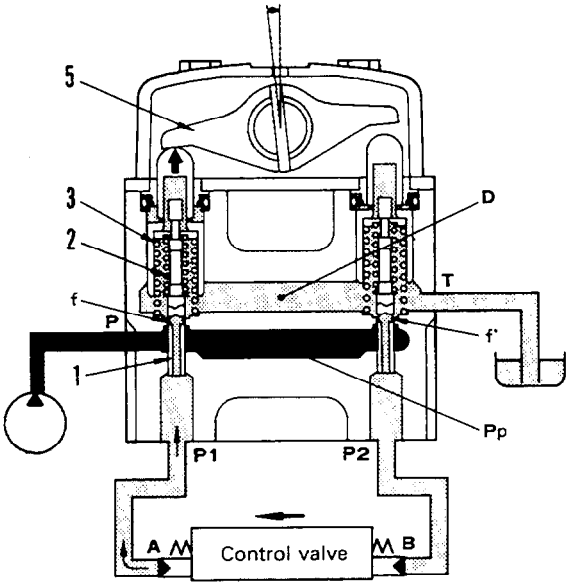
3. Fine control (control lever returned)

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

Because of this, fine control hole **f** is connected to drain chamber **D**, and the pressurized oil at port **P1** is released.

If the pressure at port **P1** drops too much, spool (1) is pushed up by metering spring (2), so fine control hole **f** is shut off from drain chamber **D**. At almost the same time, it is connected to pump pressure chamber **PP**, so the pressure at port **P1** supplies the pump pressure until the pressure recovers to a pressure equivalent to the position of the lever.

When the control valve returns, oil in drain chamber **D** flows in from fine control hole **f ´** of the valve on the side that is not moving. It passes through port **P2** and goes to chamber **B** to charge the oil. (Fig. 3)

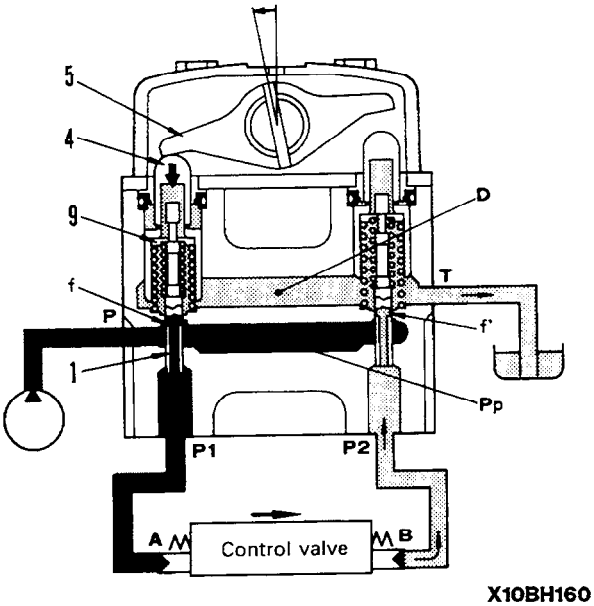


X10BH159

(Fig. 3)

4) At full stroke

Disc (5) pushes down piston (4), and retainer (9) pushes down spool (1). Fine control hole **f** is shut off from drain chamber **D**, and is connected to pump pressure chamber **PP**. Therefore, the pilot pressure oil from the control pump passes through fine control hole **f** and flows to chamber **A** from port **P1** to push the control valve spool. The return oil from chamber **B** passes from port **P2** through fine control hole **f ´** and flows to drain chamber **D**. (Fig. 4)

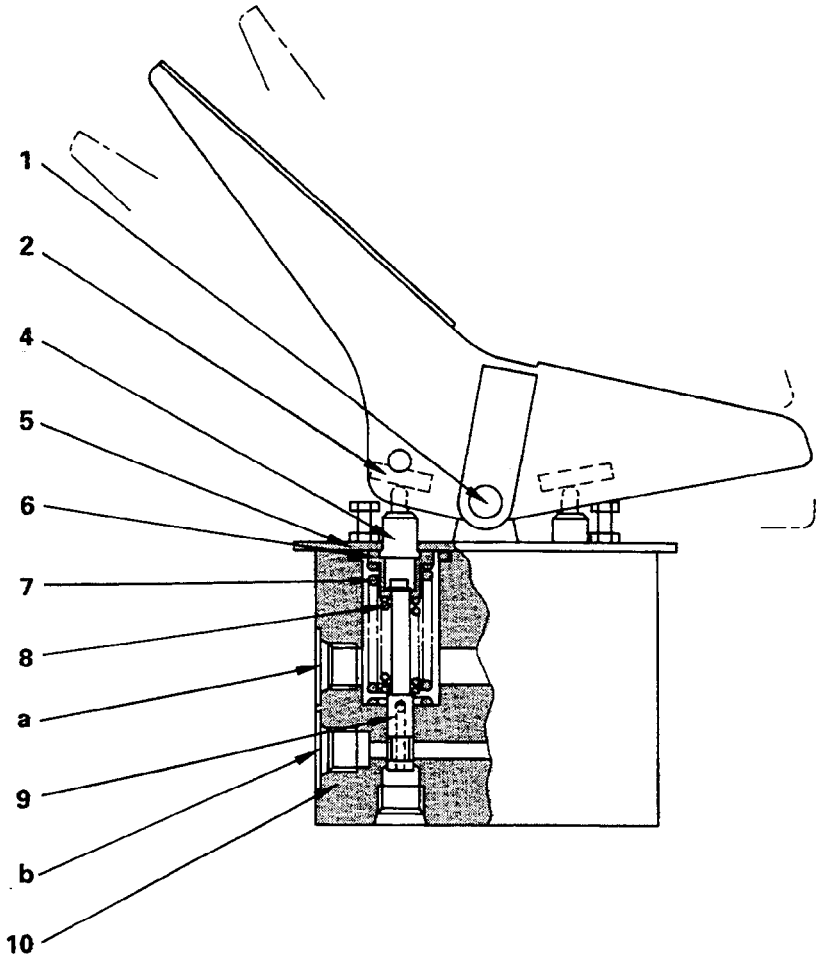


X10BH160

(Fig. 4)

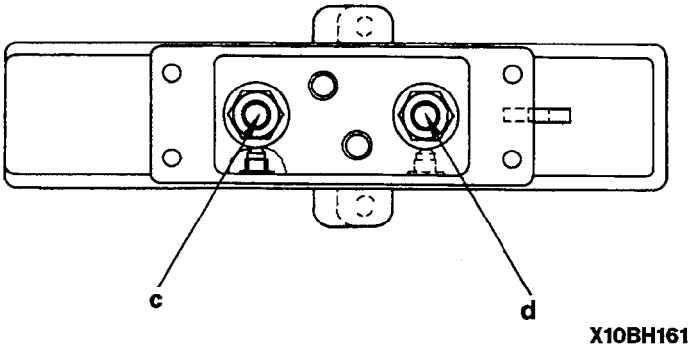
https://truckmanualshub.com/

SERVICE PPC VALVE



1. Pin
2. Cam
3. Ball
4. Piston
5. Cover
6. Sleeve
7. Centering spring
8. Metering spring
9. Spool
10. Body

a. Port **T** (to tank)
b. Port **P** (from control pump)
c. Port **A** (to service valve P_1)
d. Port **B** (to service valve P_2)



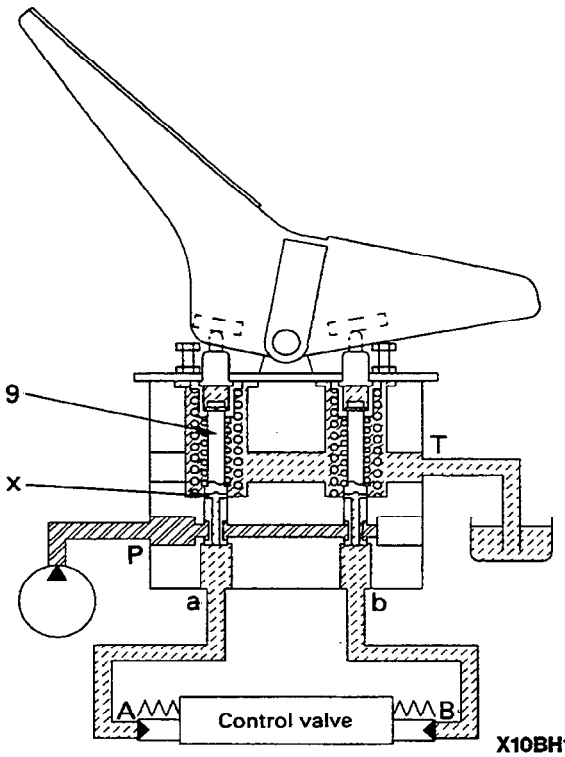
X10BH161

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OPERATION

At neutral

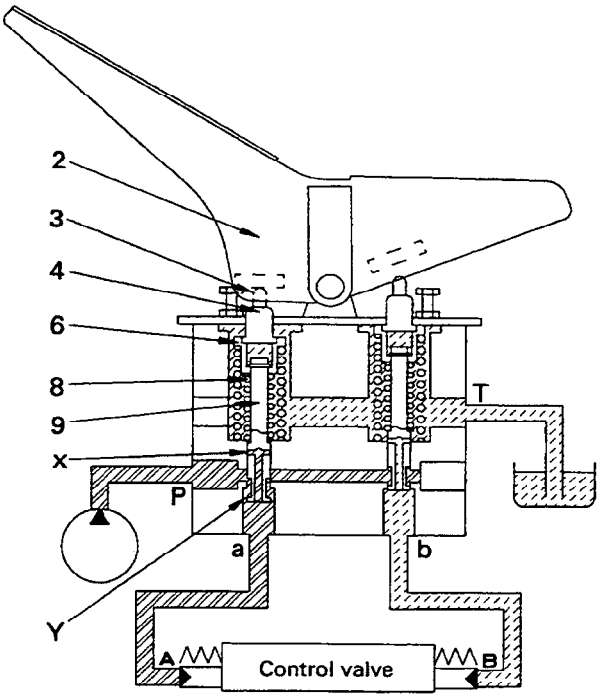
- The pressurized oil from the control pump enters from port **P** and is blocked by spool (9).
- Port **A** and **B** of the control valve and port **a** and **b** of the PPC valve are connected to drain port **T** through fine control hole **X** of spool (9).



X10BH162

When operated

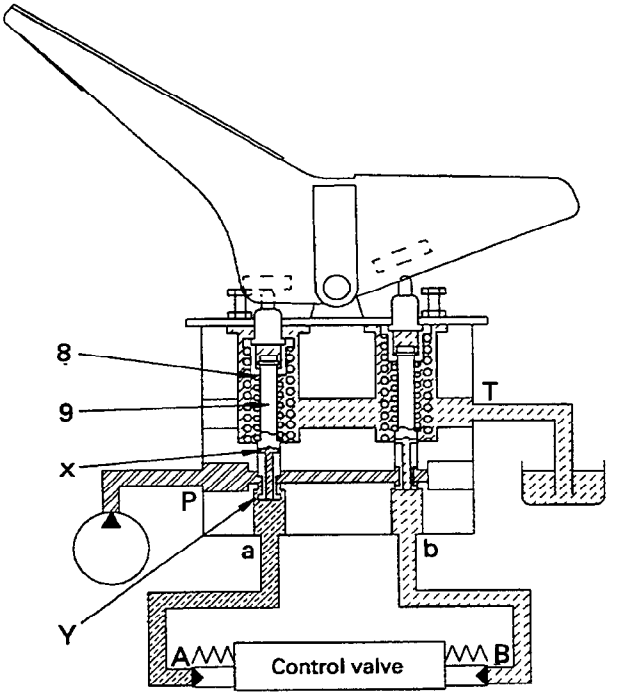
- When cam (2) is moved, metering spring (8) is pushed by ball (3), piston (4) and sleeve (6), and spool (9) is also pushed down by this.
- As a result, fine control hole **X** is shut off from the drain circuit. At almost the same time, fine control portion **Y** is connected with port **a**, and the pressurized oil from port **A** of the control valve.



X10BH163

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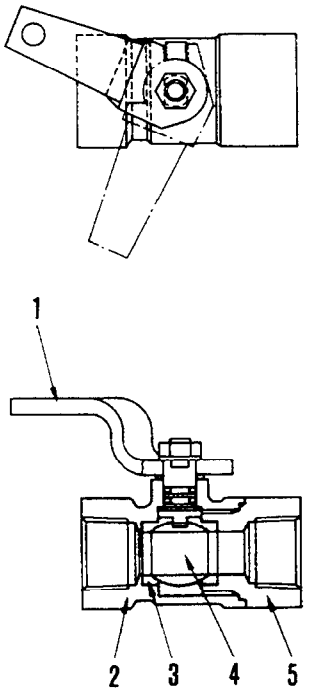
- When the pressure at port **a** becomes higher, spool (9) is pushed back by the force acting on the end of the spool. When fine control portion **Y** closes, fine control hole **X** is connected to the drain circuit at almost the same time.
- As a result, spool (9) moves up and down to balance the force at port **a** and the force at metering spring (8).
- Therefore, metering spring (8) is compressed in proportion to the amount the control lever is moved. The spring force becomes larger, so the pressure at port **a** also increases in proportion to the amount the control lever is operated.
- In this way, the control valve spool moves to a position where the pressure of port **A** (the same as the pressure at port **a**) is balanced with the force of the return spring of the control valve spool.



X10BH164

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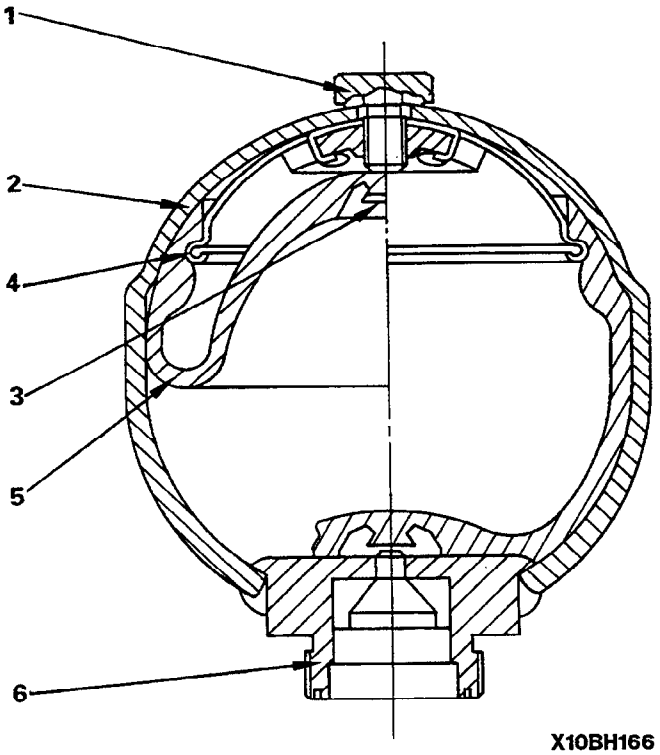
SAFETY LOCK VALVE



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

X10BH165

PPC ACCUMULATOR



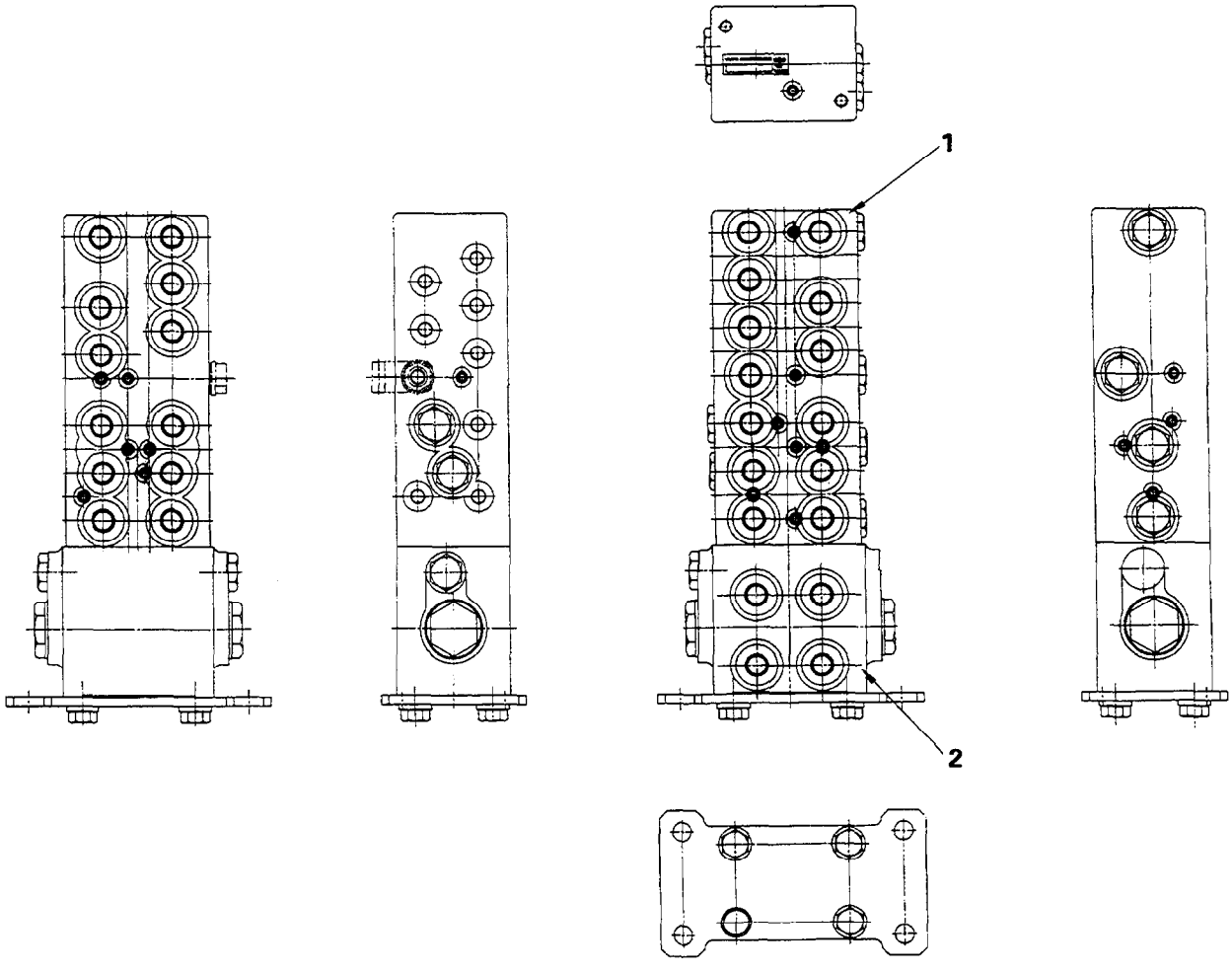
1. Gas plug
2. Shell
3. Poppet
4. Holder
5. Bladder
6. Oil port

SPECIFICATIONS
Gas capacity: 400 cc

X10BH166

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PPC SHUTTLE • TRAVEL JUNCTION VALVE



X10BH167

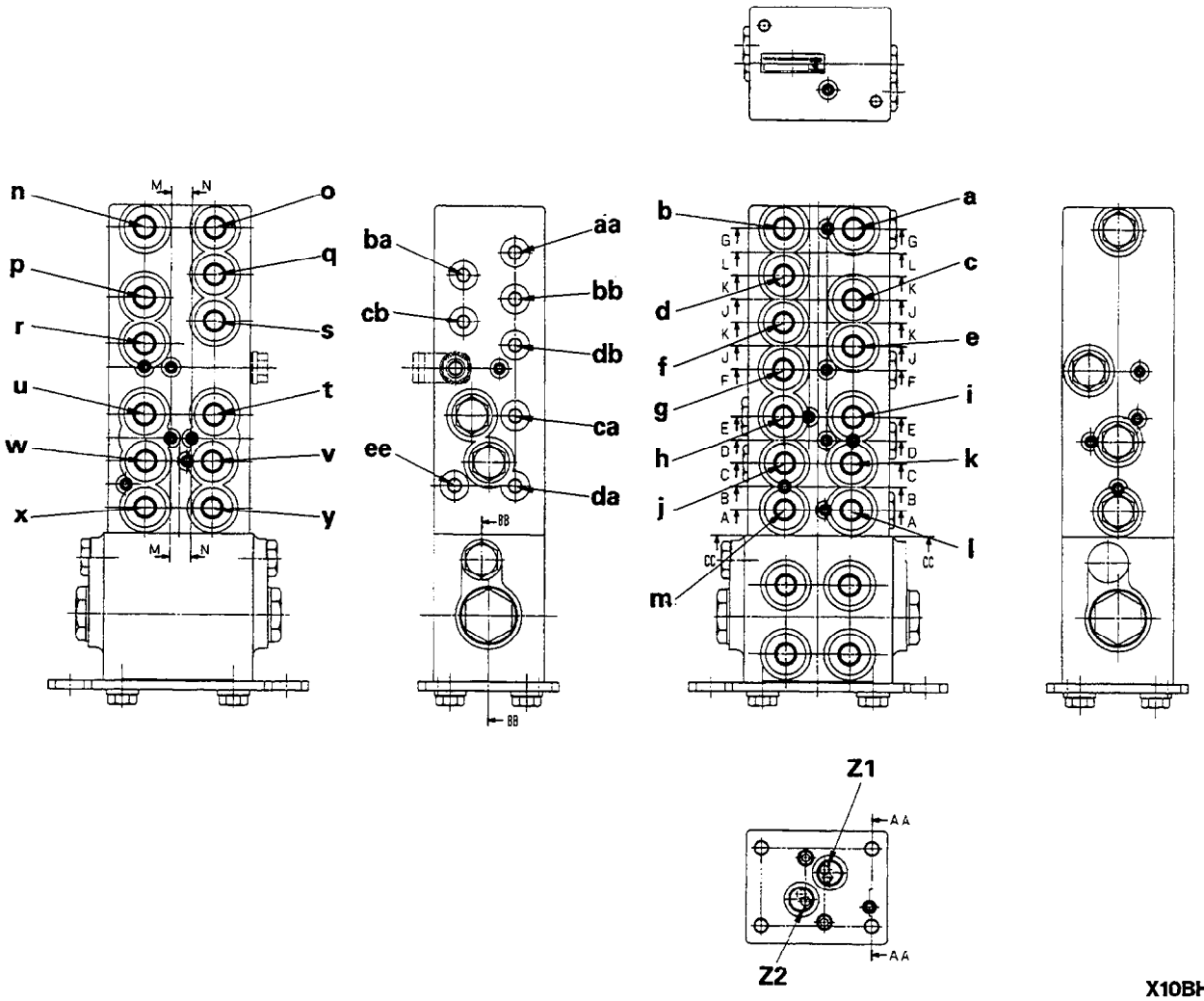
1. PPC shuttle valve
2. Travel junction valve

OUTLINE

- The PPC shuttle valve and travel junction valve form a combined structure.

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PPC SHUTTLE VALVE



X10BH168

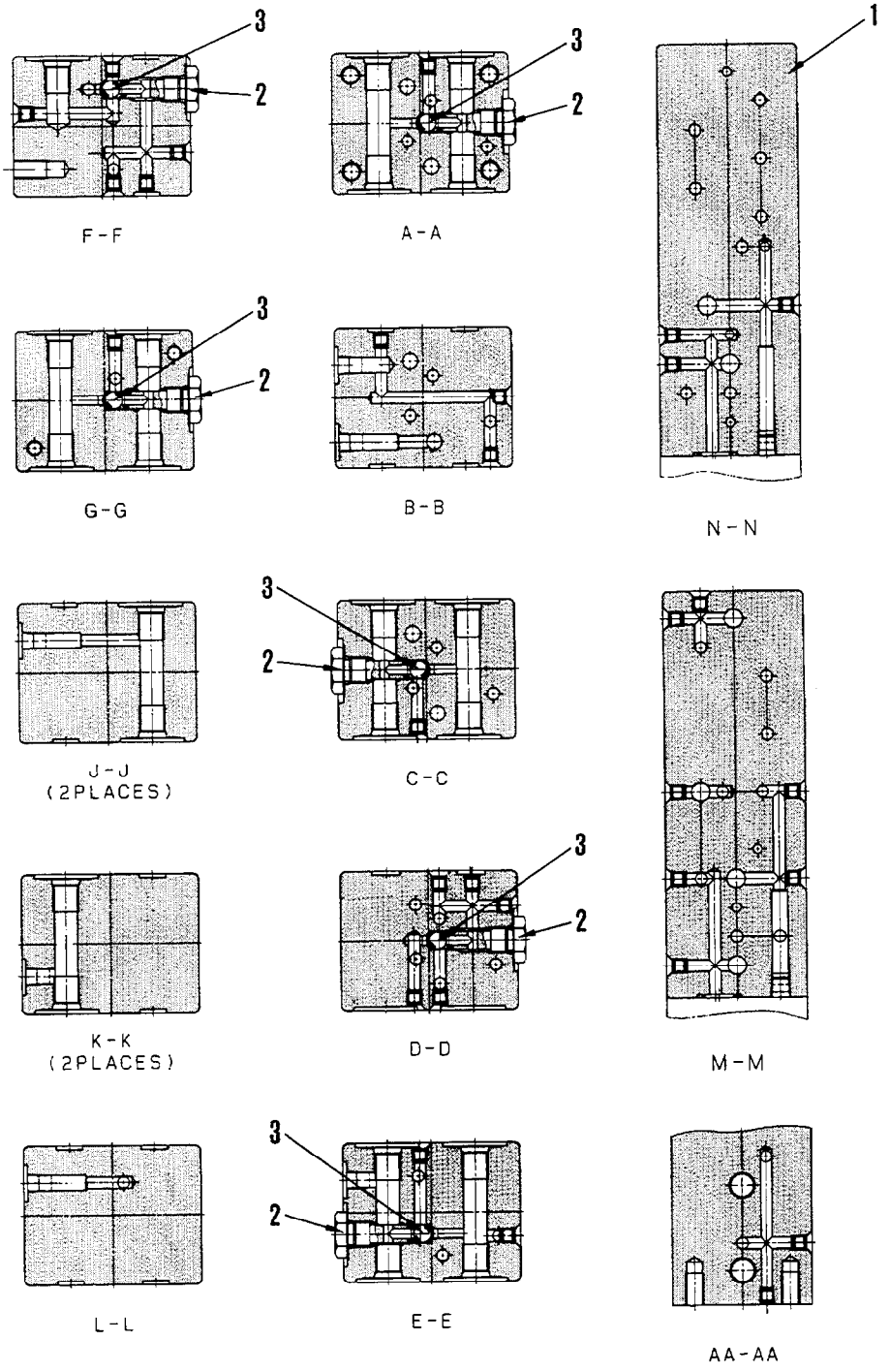
FUNCTION

This sends the PPC valve output pressure or EPC valve output pressure to the control valve and travel junction valve. It is provided with a mount port for the pressure switch for detecting the pilot pressure.

https://truckmanualshub.com/

a. Port **P11** (from swing PPC valve)
b. Port **P21** (from swing PPC valve)
c. Port **P31** (from bucket PPC valve)
d. Port **P41** (from bucket PPC valve)
e. Port **P51** (from boom PPC valve)
f. Port **P61** (from arm PPC/EPC valve)
g. Port **PLS** (from LS select valve)
h. Port **P71** (from arm PPC/EPC valve)
i. Port **P81** (from boom PPC/EPC valve)
j. Port **PA1** (from R.H. travel PPC valve)
k. Port **PB1** (from L.H. travel PPC valve)
l. Port **PC1** (from L.H. travel PPC valve)
m. Port **P91** (from R.H. travel PPC valve)
n. Port **P12** [to control valve (swing)]
o. Port **P22** [to control valve (swing)]
p. Port **P32** [to control valve (bucket)]
q. Port **P42** [to control valve (bucket)]
r. Port **P52** [to control valve (boom)]
s. Port **P62** [to control valve (arm)]
t. Port **P72** [to control valve (arm)]
u. Port **P82** [to control valve (boom)]
v. Port **PA2** [to control valve (R.H. travel)]
w. Port **PB2** [to control valve (L.H. travel)]
x. Port **PC2** [to control valve (L.H. travel)]
y. Port **P92** [to control valve (R.H. travel)]
z1. Port **PR** (to travel junction valve)
z2. Port **PF** (to travel junction valve)
aa. Port **A1** (mount port for swing oil pressure switch)
bb. Port **A8** (mount port for bucket DUMP oil pressure switch)
ca. Port **A2** (mount port for arm OUT oil pressure switch)
cb. Port **A4** (mount port for arm IN oil pressure switch)
da. Port **A5** (mount port for boom RAISE oil pressure switch)
db. Port **A7** (mount port for boom LOWER oil pressure switch)
ee. Port **A6** (mount port for travel oil pressure switch)

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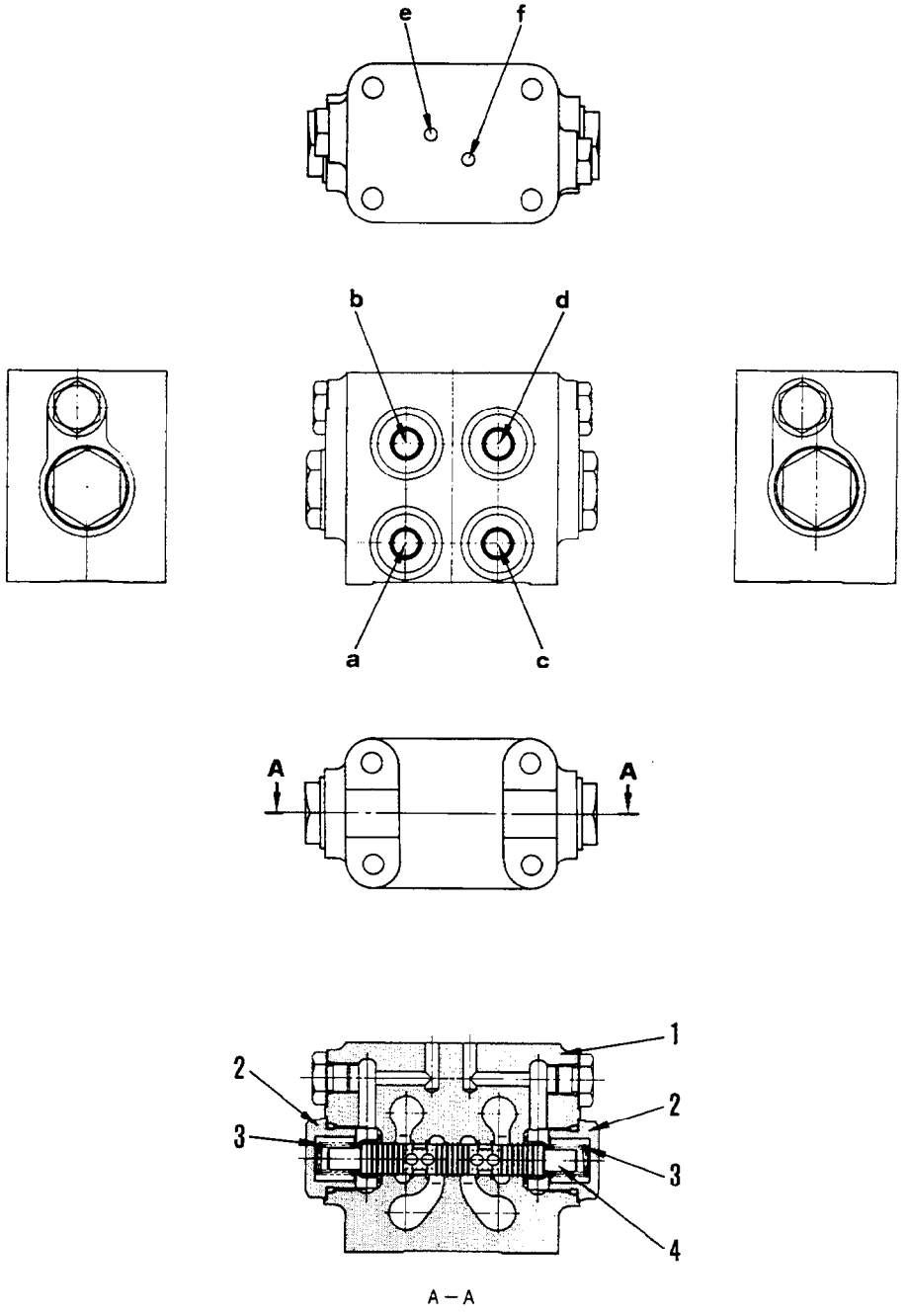


X10BH169

1. Body
2. Plug
3. Ball

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TRAVEL JUNCTION VALVE



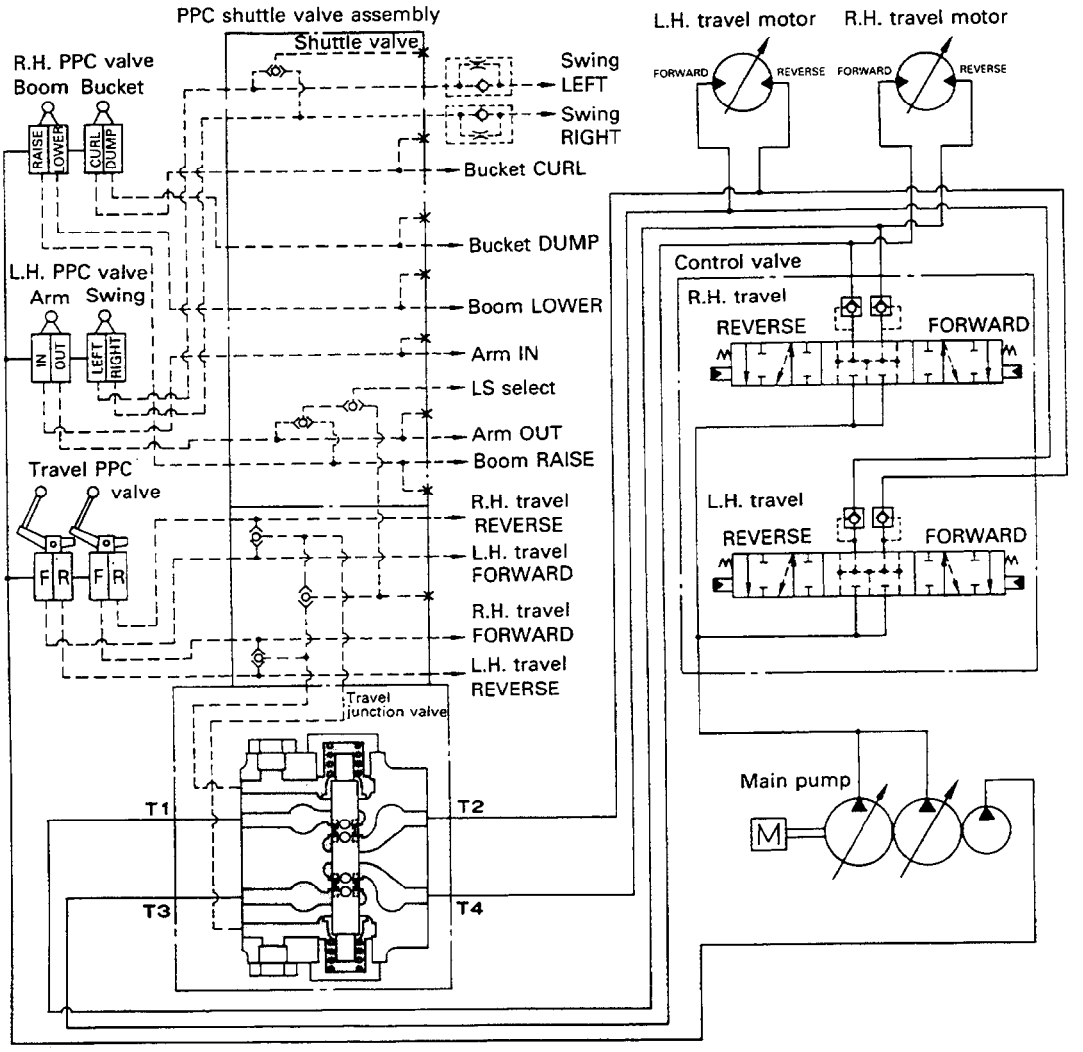
X10BH170

1. Body
2. Plug
3. Spring
4. Spool

a. Port **T1** (from R.H. travel control valve)
b. Port **T2** (from L.H. travel control valve)
c. Port **T3** (from R.H. travel control valve)
d. Port **T4** (from L.H. travel control valve)
e. Port **PF** (from PPC shuttle valve)
f. Port **PR** (from PPC shuttle valve)

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STRAIGHT-TRAVEL SYSTEM



X10DD045

FUNCTION

- A travel junction valve is installed between the travel valve and travel motor to compensate for any difference in the oil flow to the left and right travel circuits when traveling in a straight line.
- Because of this, the flow of oil to the left and right travel motors when traveling in a straight line is almost the same, so there is no travel deviation.
- The travel junction valve interconnects the travel circuits when the straight-travel is operated independently or when the straight travel + another actuator are operated simultaneously.
- When steering, if the difference in the movement of the travel levers is more that approximately 10 mm, the travel junction valve is switched, and the left and right travel circuits are shut off.

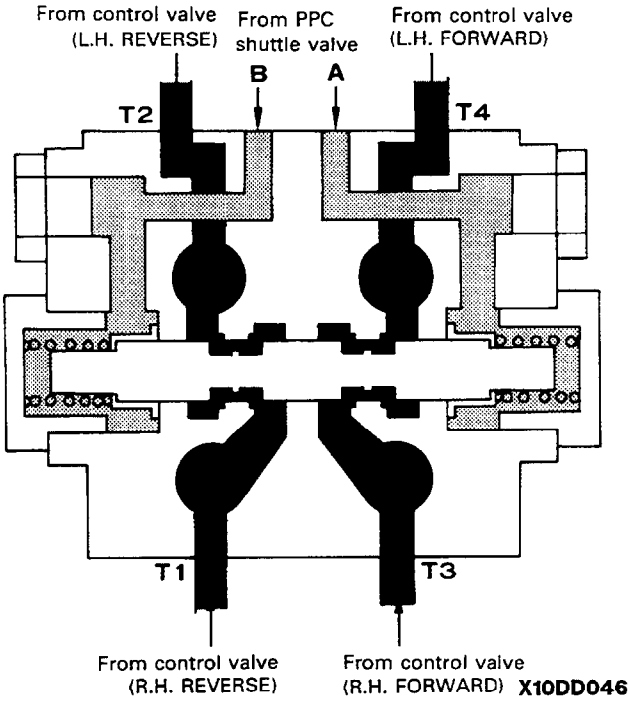
https://truckmanualshub.com/

OPERATION

A: PPC output pressure (R.H. travel REVERSE or L.H. travel FORWARD)
B: PPC output pressure (R.H. travel FORWARD or L.H. travel REVERSE)

When traveling in a straight line in forward or reverse

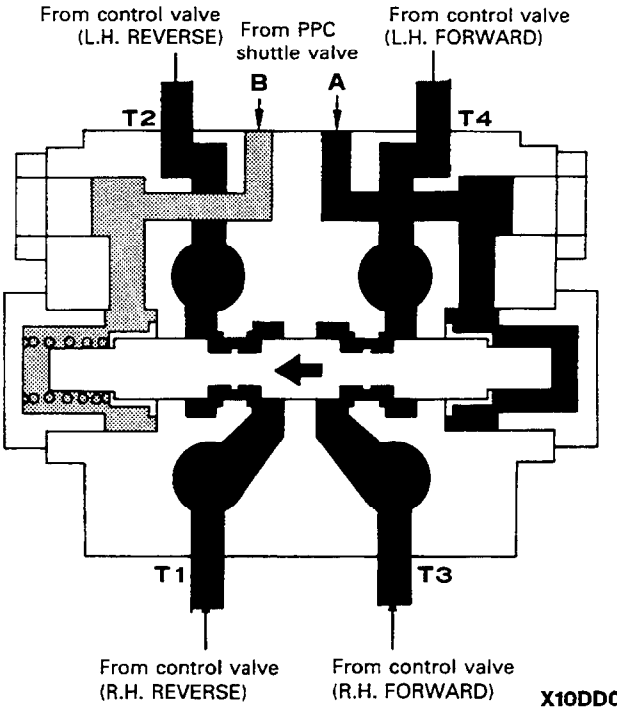
- When traveling forward (or in reverse), there is no difference in the pilot pressure from the PPC shuttle valve (the output pressure of each PPC valve), so the spool is balanced in the middle. In this condition, the R.H. FORWARD and L.H. FORWARD, and R.H. REVERSE and L.H. REVERSE are interconnected through the spool.



X10DD046

When steering in forward or reverse

- When the steering is operated in forward (or reverse), if the difference in the pilot pressure from the PPC shuttle valve becomes greater than the switching pressure (spring force), the spool moves to the right or left and the L.H. and R.H. forward and L.H. and R.H. reverse passages are separated. Because of this, a difference in pressure is created in the L.H. and R.H. circuits, and the steering can be operated.

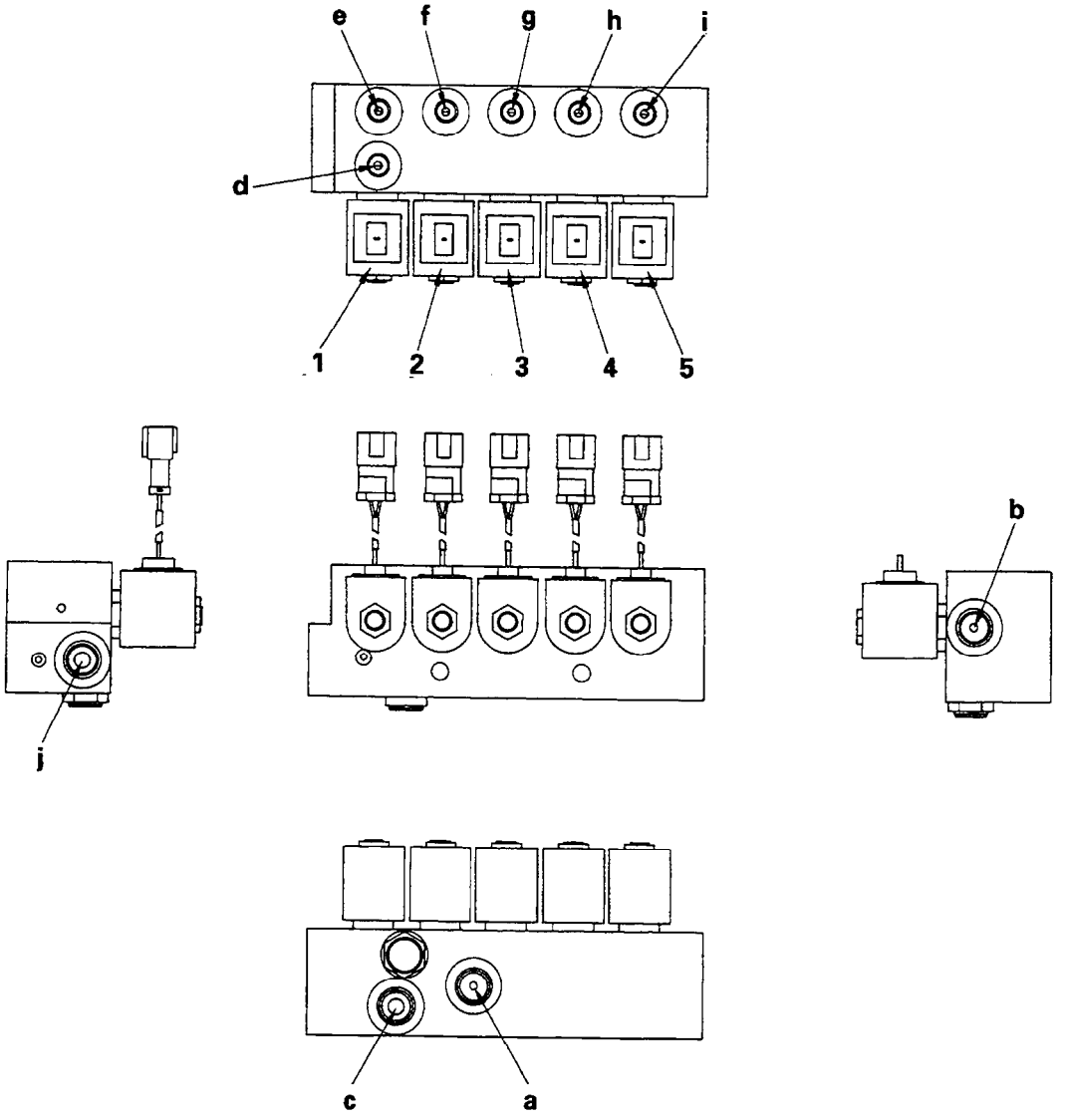


X10DD047

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EPC ● SOLENOID VALVE

LS SELECT, PUMP MERGE-DIVIDER, 2 STAGE RELIEF, TRAVEL SPEED, SWING BRAKE SOLENOID VALVE

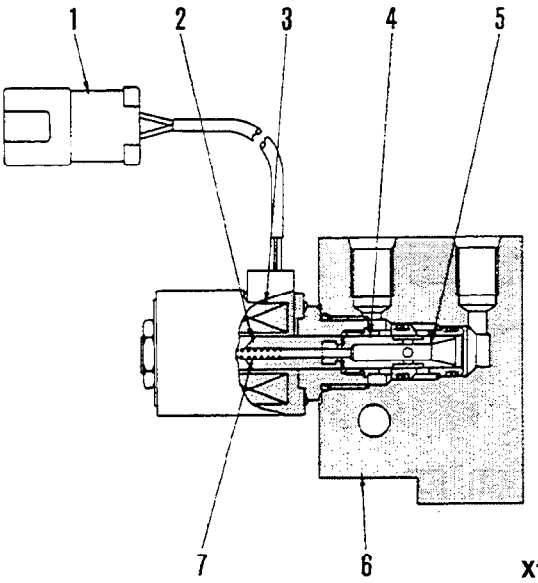


X10BH171

1. LS select solenoid valve
2. 2-stage relief solenoid valve
3. Pump merge-divider solenoid valve
4. Travel speed solenoid valve
5. Swing brake solenoid valve

a. To tank
b. From control pump
c. To PPC/EPC valve
d. From PPC shuttle valve
e. To LS select valve
f. To LS relief valve
g. To pump merge-divider valve
h. To L.H. and R.H. travel motor
i. To swing motor
j. To accumulator

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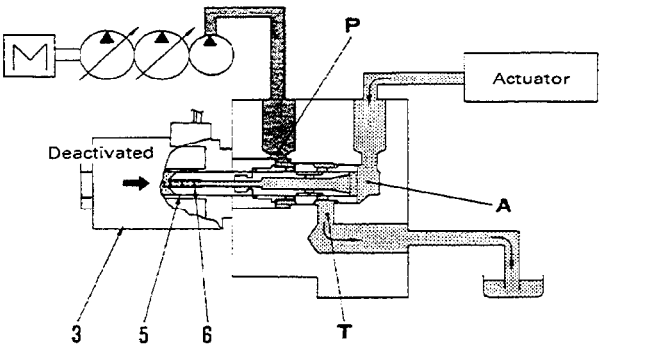
X10BH172

1. Connector
2. Variable core
3. Coil
4. Cage
5. Spool
6. Block
7. Spring

OPERATION

When solenoid is deactivated

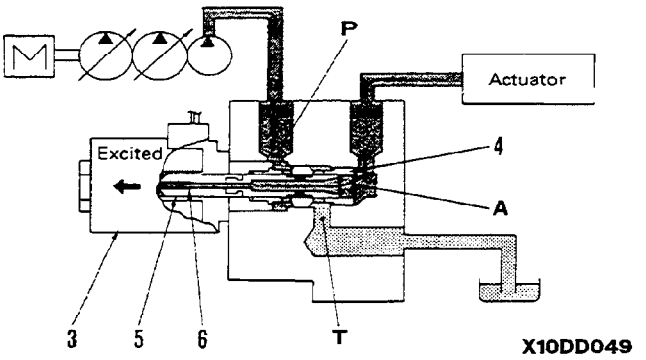
- The signal current does not flow from the controller, so coil (3) is deactivated.
  For this reason, spool (5) is pushed to the right in the direction of the arrow by spring (6).
  As a result, the circuit between ports **P** and **A** closes and the pressurized oil from the control pump does not flow to the actuator.
  At the same time, the pressurized oil from the actuator flows from port **A** to port **T**, and is then drained to the tank.



X10DD048

When solenoid is excited

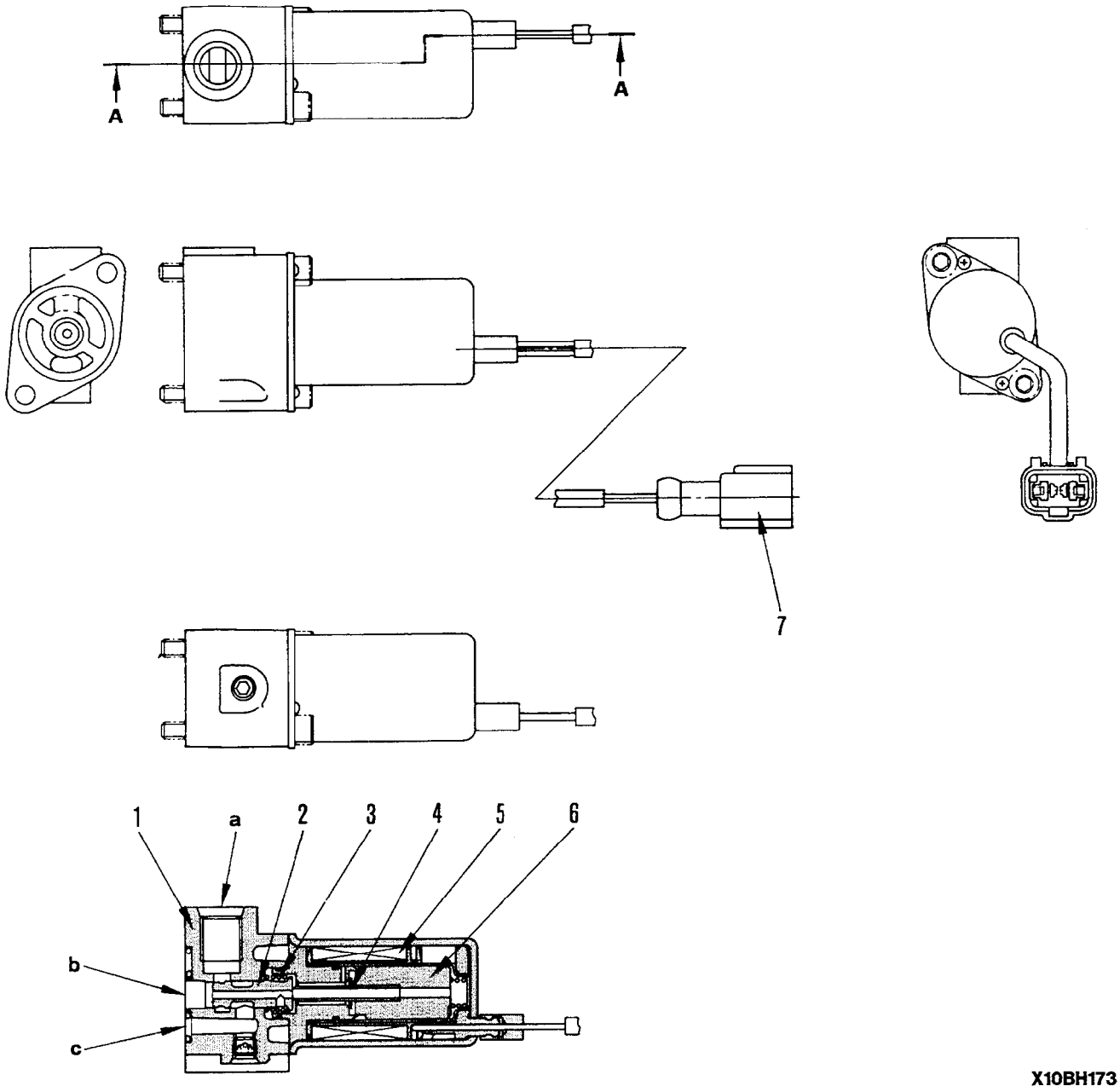
- When the signal current flows from the controller to coil (3), coil (3) is excited.
  For this reason, spool (5) is pushed to the left in the direction of the arrow.
  As a result, the pressurized oil from the control pump flows from port **P** through the inside of spool (5) to port **A**, and then flows to the actuator.
  At the same time, port **T** is closed, and this stops the oil from flowing to the tank.



X10DD049

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LS CONTROL EPC VALVE



X10BH173

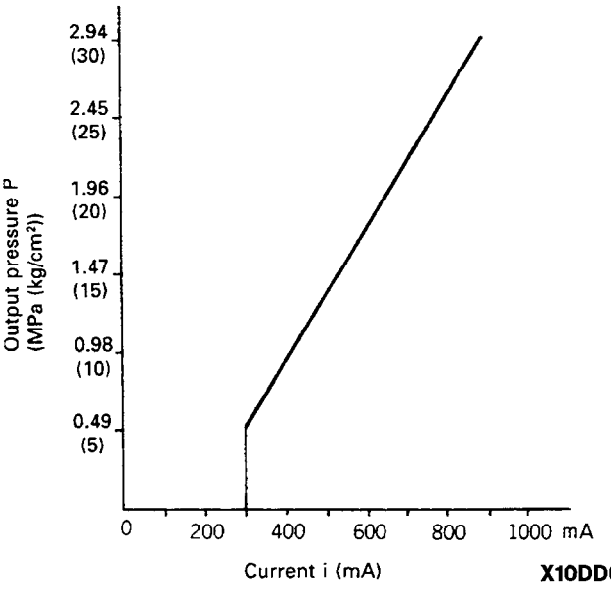
1. Body
2. Spool
3. Spring
4. Push pin
5. Coil
6. Plunger
7. Connector

a. Port **C** (to LS valve)
b. Port **T** (to tank)
c. Port **P** (from control pump)

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FUNCTION

- The EPC valve consists of the proportional solenoid portion and the hydraulic valve portion.
- When it receives signal current **i** from the valve controller, it generates the EPC output pressure in proportion to the size of the signal, and outputs it to the control valve.

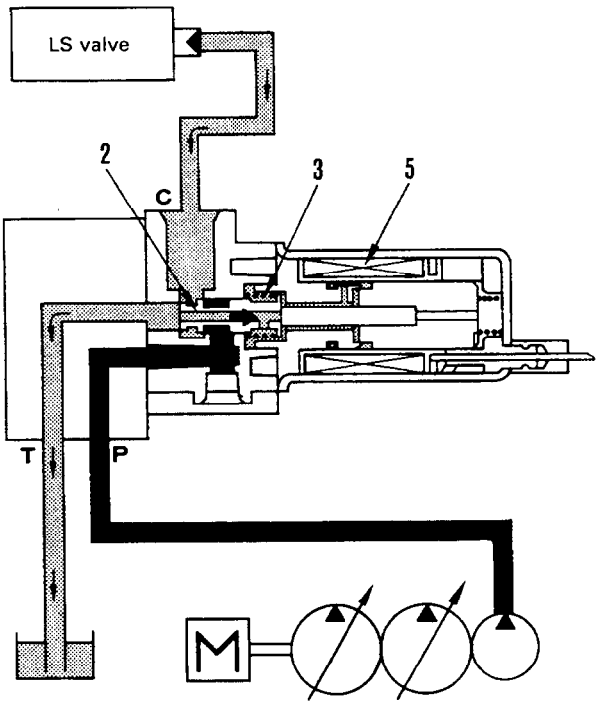


X10DD050

OPERATION

1. When signal current is 0 (coil deactivated)

- There is no signal current flowing from the controller to coil (5), coil (5) is deactivated.
- For this reason, spool (2) is pushed to the right in the direction of the arrow by spring (3).
- As a result, port **P** closes and the pressurized oil from the control pump does not flow to the LS valve.
  At the same time, the pressurized oil from the LS valve passes from port **C** through port **T** and is drained to the tank.

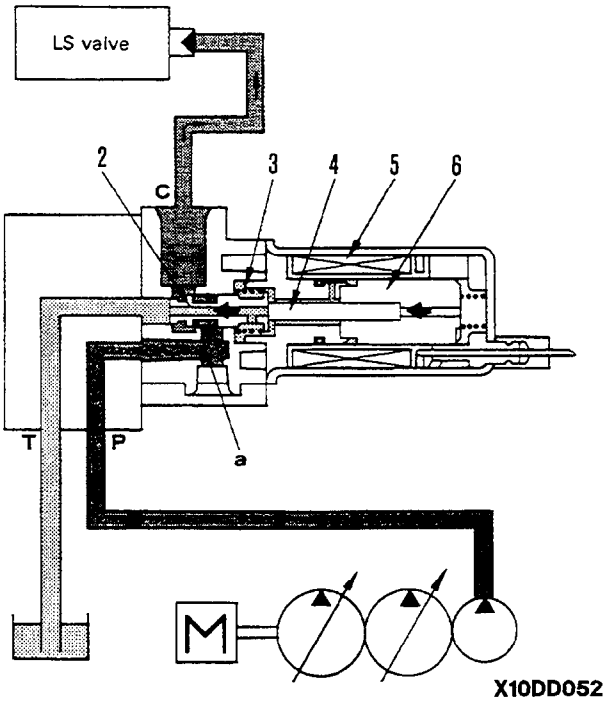


X10DD051

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2. When signal current is very small (coil excited)

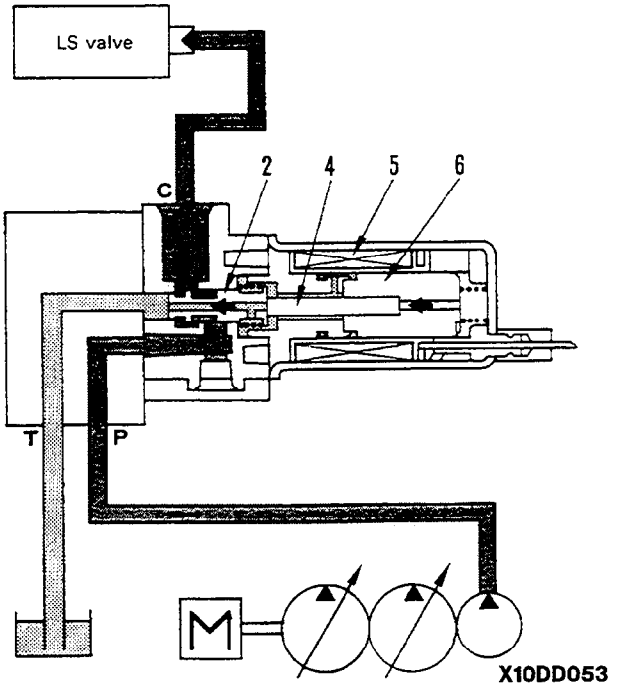
- When a very small signal current flows to coil (5), coil (5) is excited, and a propulsion force is generated, which pushes plunger (6) to the left in the direction of the arrow.
- Push pin (4) pushes spool (2) to the left in the direction of the arrow, and pressurized oil flows from port **P** to port **C**.
- When the pressure at port **C** rises and the load of spring (3) + the force acting on the surface **a** of spool (2) becomes greater than the proportion force of plunger (6), spool (2) is pushed to the right in the direction of the arrow. The circuit between port **P** and port **C** is shut off, and at the same time, port **C** and port **T** are connected.
- As a result, spool (2) is moved to the left or right until the propulsion force of plunger (6) is balanced with the load of spring (3) + pressure of port **C**.
- Therefore, the circuit pressure between the EPC valve and the LS valve is controlled in proportion to the size of the signal current.



X10DD052

3. When the signal current is maximum (coil excited)

- When the signal current flows to coil (5), coil (5) is excited.
- When this happens, the signal current is at its maximum, so the propulsion force of plunger (6) is also at its maximum.
- For this reason, spool (1) is pushed to the left in the direction of the arrow by push pin (4).
- As a result, the maximum flow of pressurized oil from port **P** flows at its maximum to port **C**, and the circuit pressure between the EPC valve and LS valve becomes the maximum.
  At the same time, port **T** closes and stops the oil from flowing to the tank.

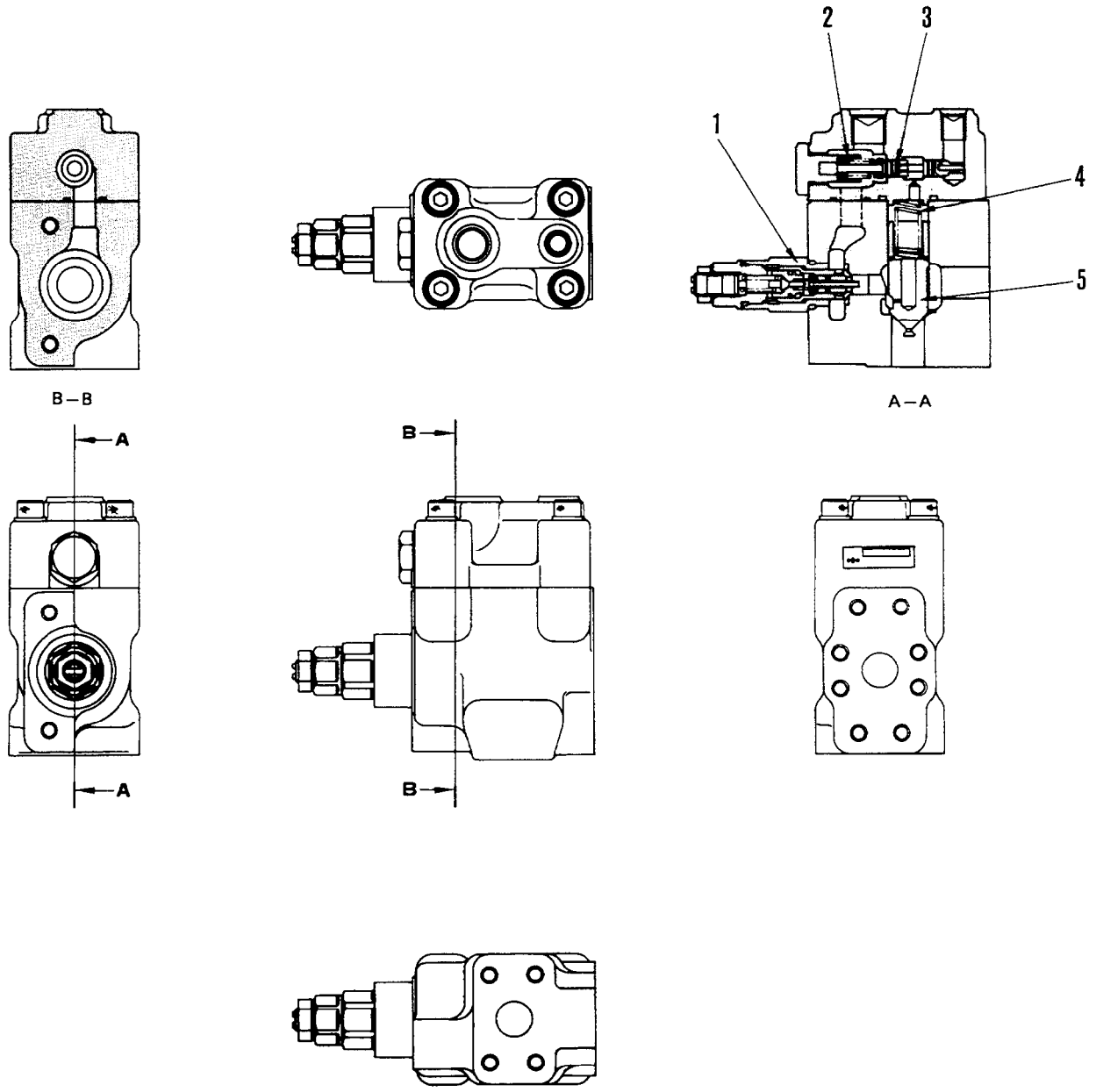


X10DD053

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BOOM HOLDING VALVE

★ For machine equipped with arm holding valve, the structure and function of the arm holding valve is the same as this valve.



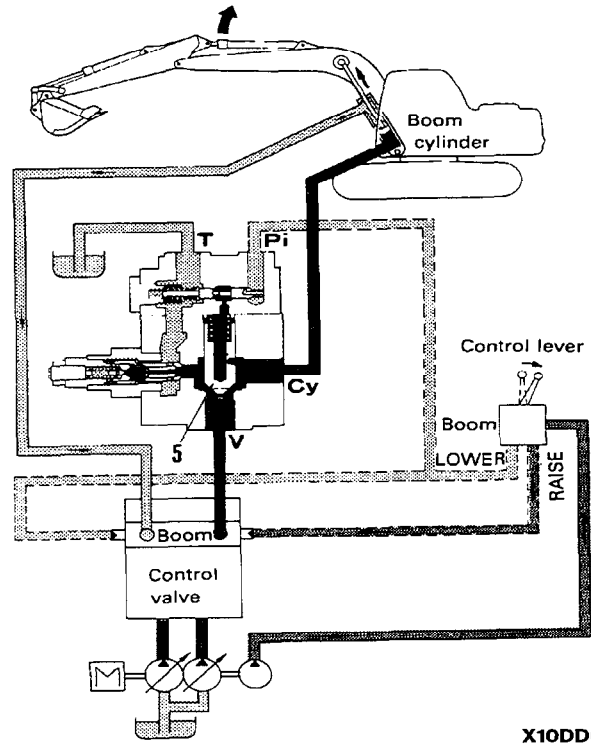
X10BH174

1. Safety-suction valve
2. Pilot spring
3. Pilot spool
4. Poppet spring
5. Poppet

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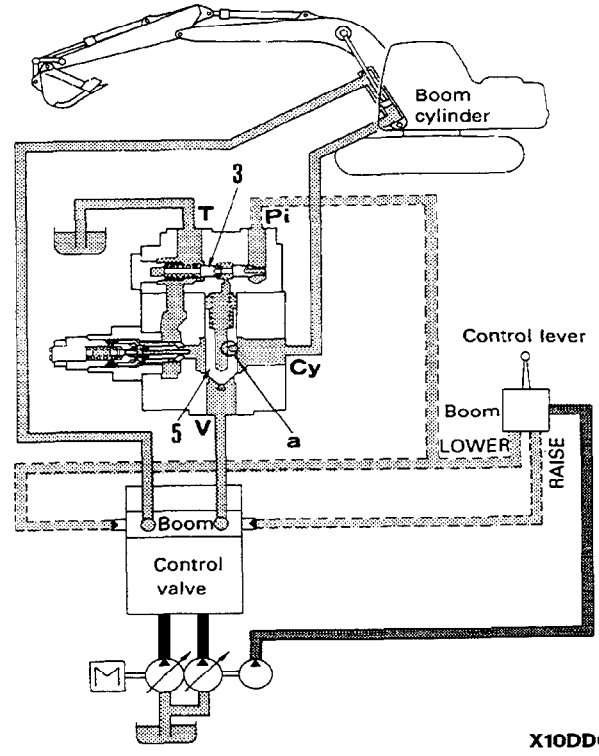
OPERATION

1) **At boom RAISE**
When the boom is raised, the main pressure from the control valve pushes poppet (5) up in the direction of the arrow.
Because of this, the main pressure from the control valve passes through the valve and flows to the bottom end of the boom cylinder.



X10DD054

2) **Boom lever at NEUTRAL**
When the boom is raised and the control lever is returned to NEUTRAL, the circuit for the holding pressure at the bottom end of the boom cylinder is closed by poppet (5), and at the same time, the oil flowing into poppet (5) through orifice **a** of poppet (5) is closed by pilot spool (3). As a result, the boom is held in position.



X10DD055

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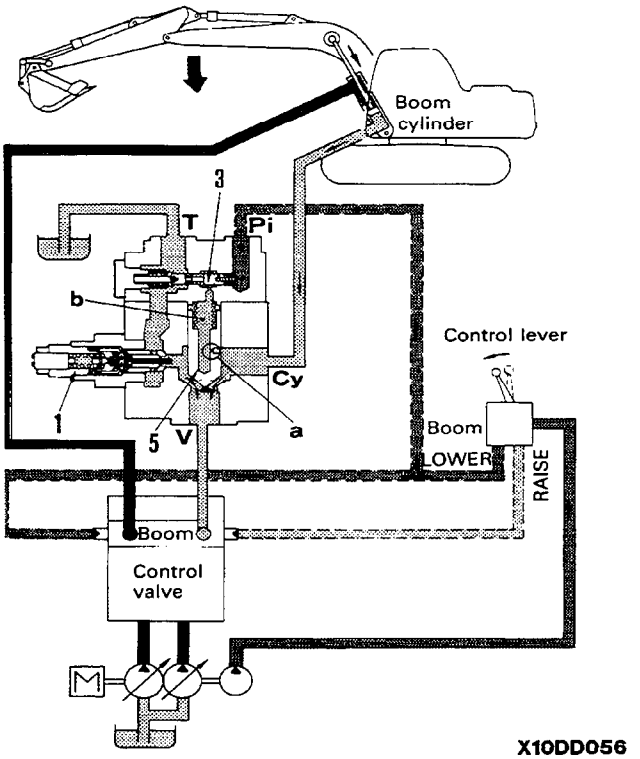
3) At boom LOWER

When the boom is lowered, the pilot pressure from the PPC valve pushes pilot spool (3) and the pressurized oil in chamber **b** inside the poppet is drained.

When the pressure at port C_Y rises because of the pressurized oil from the bottom end of the boom cylinder, the pressure of the pressurized oil in chamber **b** is lowered by orifice **a**.

If the pressure in chamber **b** drops below the pressure at port **V**, poppet (5) opens, the pressurized oil flows from port C_Y to port **V**, and then flows to the control valve.

If any abnormal pressure is generated in the circuit at the bottom end of the boom cylinder, safety valve (1) is actuated.



X10DD056

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HYDRAULIC CYLINDER

SPECIFICATIONS

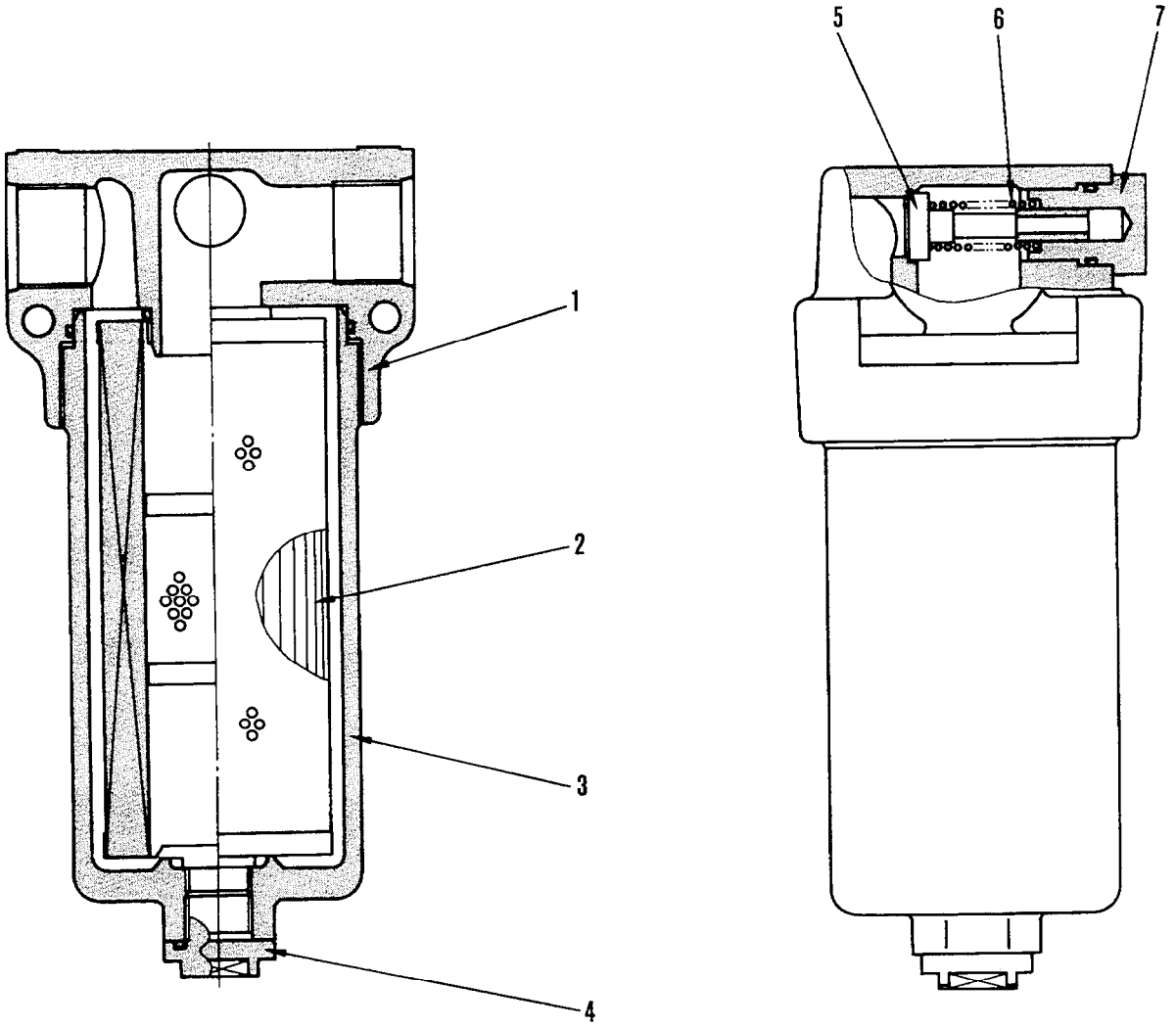
Unit: mm

Item	Boom		Arm		Bucket	
	PC200-6 PC200LC-6 PC210LC-6	PC220LC-6 PC250LC-6	PC200-6 PC200LC-6 PC210LC-6	PC220LC-6 PC250LC-6	PC200-6 PC200LC-6 PC210LC-6	PC220LC-6 PC250LC-6 PC210LC-6 Demolition Spec.
Outside diameter of piston rod	130	140	135	140	115	130
Inside diameter of cylinder	90	100	95	100	80	90
Stroke	1,285	1,285	1,490	1,635	1,120	1,020
Max. stroke	3,155	3,155	3,565	3,870	2,800	2,625
Min. stroke	1,870	1,870	2,075	2,235	1,680	1,605
Width across flats of piston nut	95	95	95	95	95	95

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ADDITIONAL FILTER FOR BREAKER

★ FOR MACHINES EQUIPPED WITH BREAKER



X10BV051

1. Head cover
2. Element
3. Case
4. Drain plug
5. Valve
6. Spring
7. Spring set plug

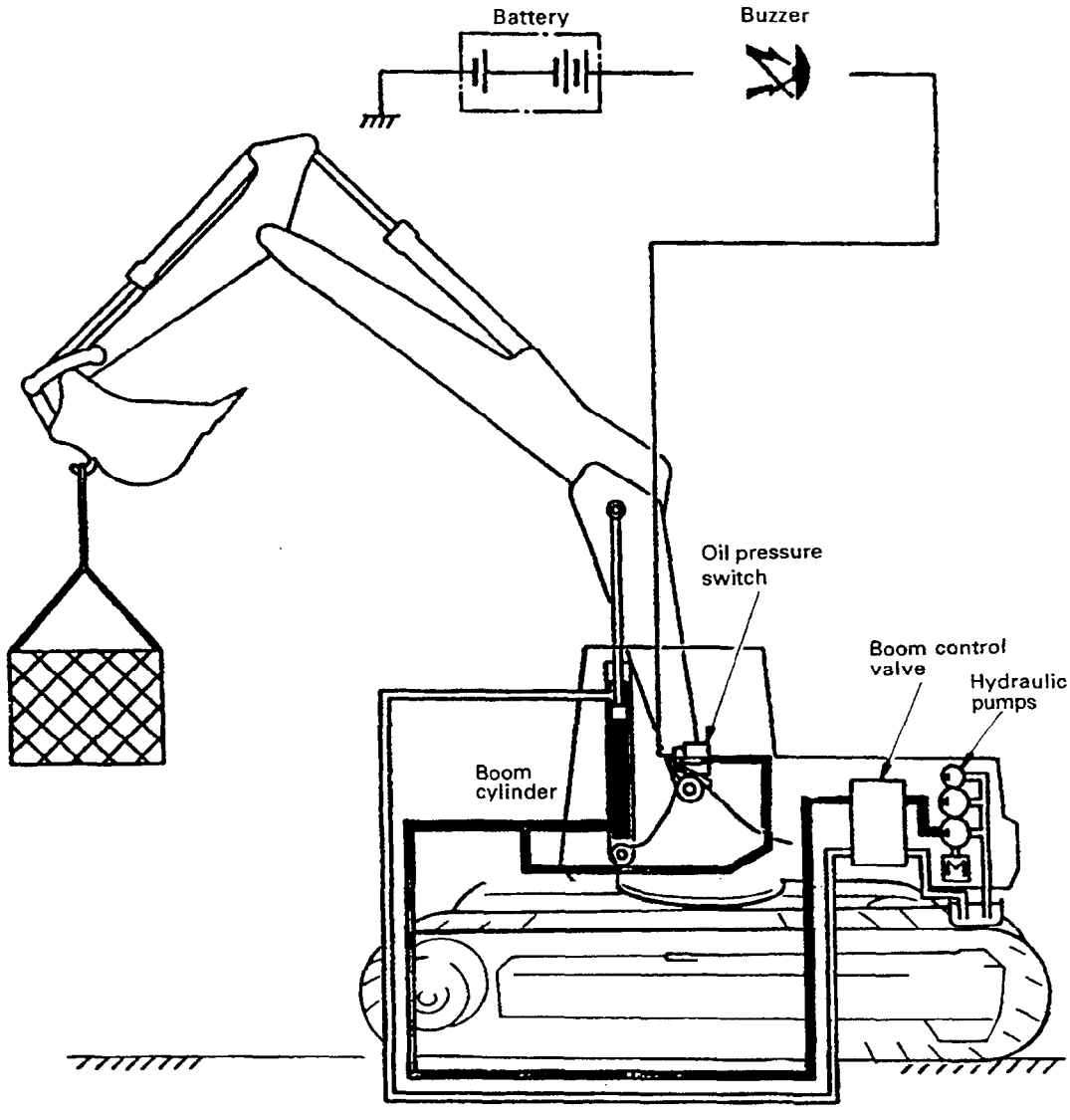
SPECIFICATIONS

Rated pressure	:	6.86 MPa (70 kg/cm^2)
Flow	:	107 ℓ/min
Relief valve cracking pressure	:	0.34 ± 0.049 MPa (3.5 ± 0.5 kg/cm^2)
Filter mesh size	:	6 µm
Filtering area	:	3160 cm^2

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OVERLOAD WARNING DEVICE

1. OUTLINE



X08BT001

FUNCTION

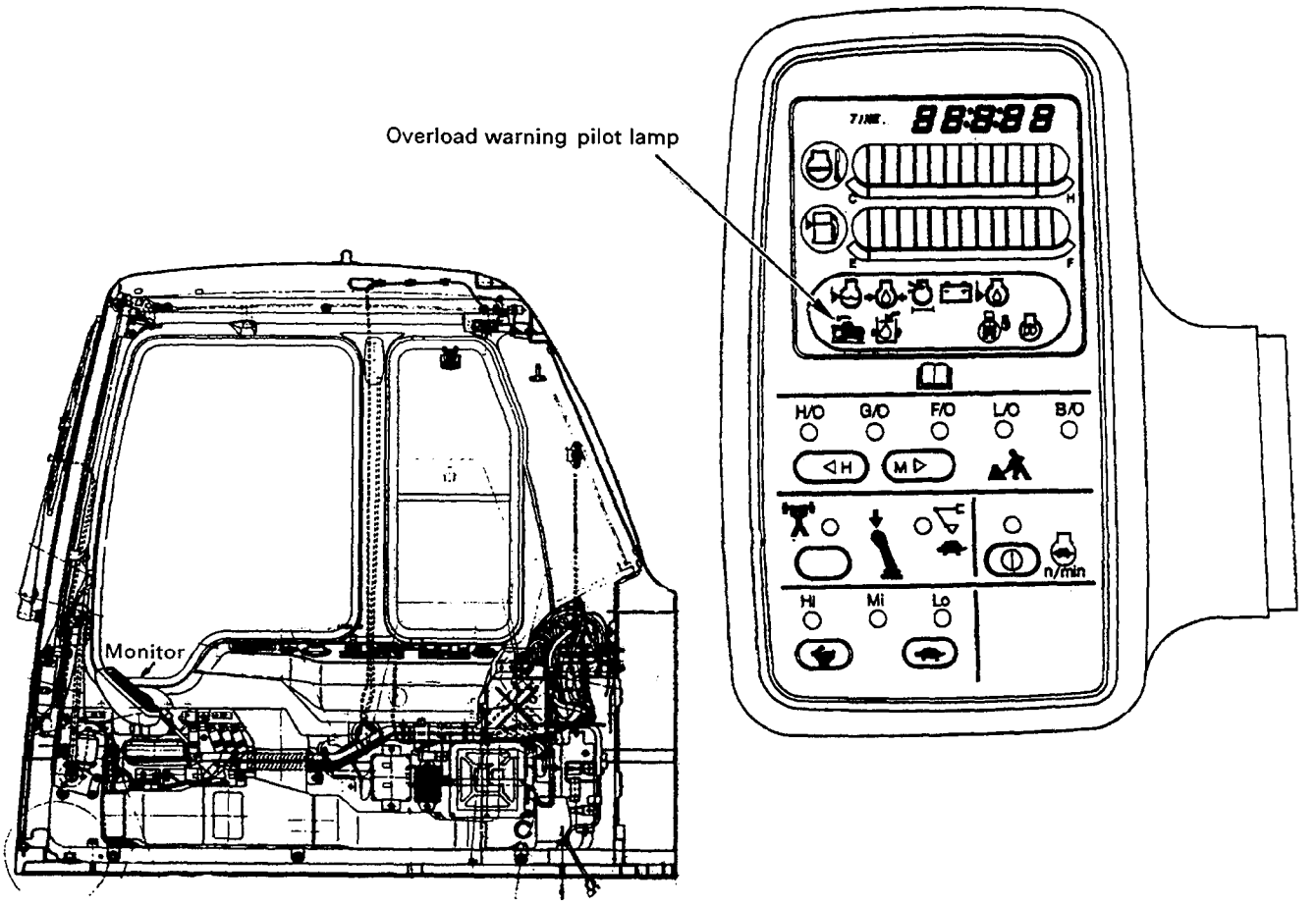
- This device is installed to warn the operator when the machine is close to tipping over when it lifts an excessive weight while being used as a crane.

STRUCTURE

- When an excessive weight is lifted, the oil pressure goes up at the bottom side of the boom cylinders. When this happens, the pressure switch senses the rising pressure, turns the pressure switch on, and lights the monitor lamp to warn the operator. When the monitor lamp lights, immediately lower the weight to the ground or bring the arm closer in to the operator to prevent the machine from tipping over.

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Control panel



X11AH003

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2. OPERATION

- Hose (2) directs the oil pressure from the bottom side of the boom cylinders to pressure switch (3).

a. When the boom is in the lowest position

- When boom (5) is in the lowest position, lever (4) takes position **A** in Fig. 1 and the pressure to activate its switch (closed and open) becomes 60 kg/cm^2.

b. When the boom is in the highest position

- When the boom is in the highest position, lever (4) takes position **B** in Fig. 1 and the pressure to activate the switch becomes 360 kg/cm^2.

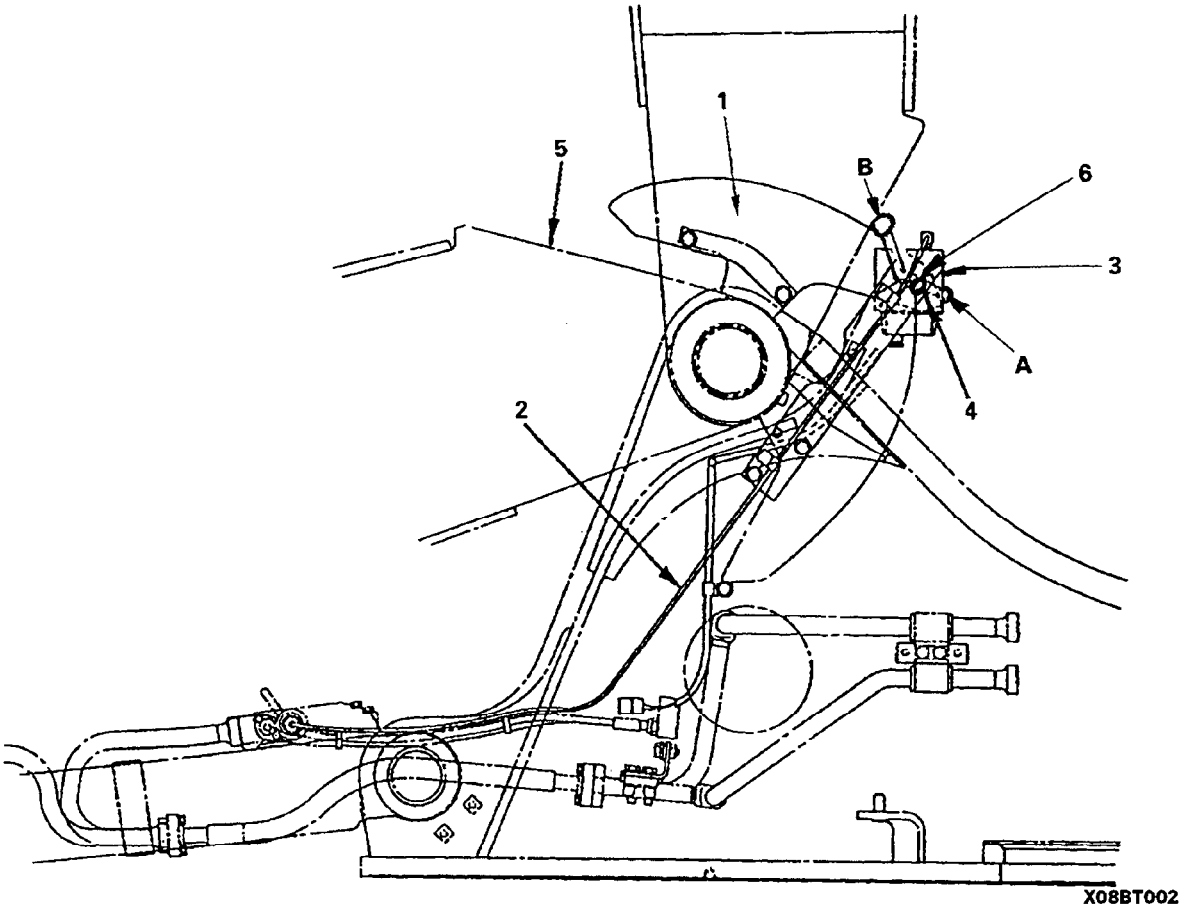
c. When the boom is in an arbitrary position

- When the boom is in a position anywhere between the lowest and the highest points, the operating pressure of switch (3) will be somewhere between 60 kg/cm^2 and 360 kg/cm^2, based on the boom position.

For instance, when the boom is in a certain position between the lowest and the highest points, lever (4) takes a position which corresponds to that boom position.

If lever (4) is in the position to make the operating pressure of the pressure switch 150 kg/cm^2 (which is the same pressure as the bottom side of the boom cylinder), the pressure switch will turn on when excessive weight is lifted by the boom and the oil pressure of the bottom of the boom cylinders exceeds 150 kg/cm^2.

⚠ When the machine is performing any kind of operation other than lifting loads, fasten the pressure switch lever (4) with the bolt (6) to prolong the life at the pressure switch.

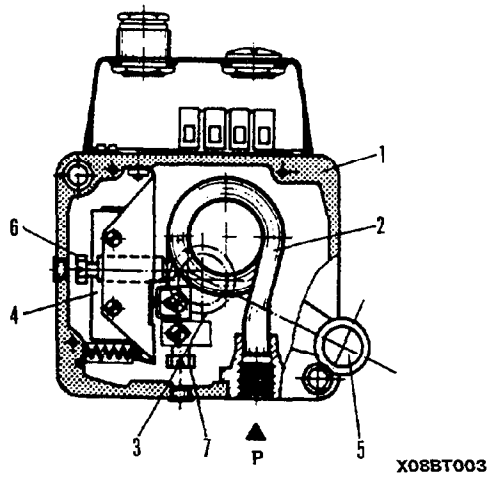


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3. ADJUSTING PRESSURE OF THE OIL PRESSURE SWITCH

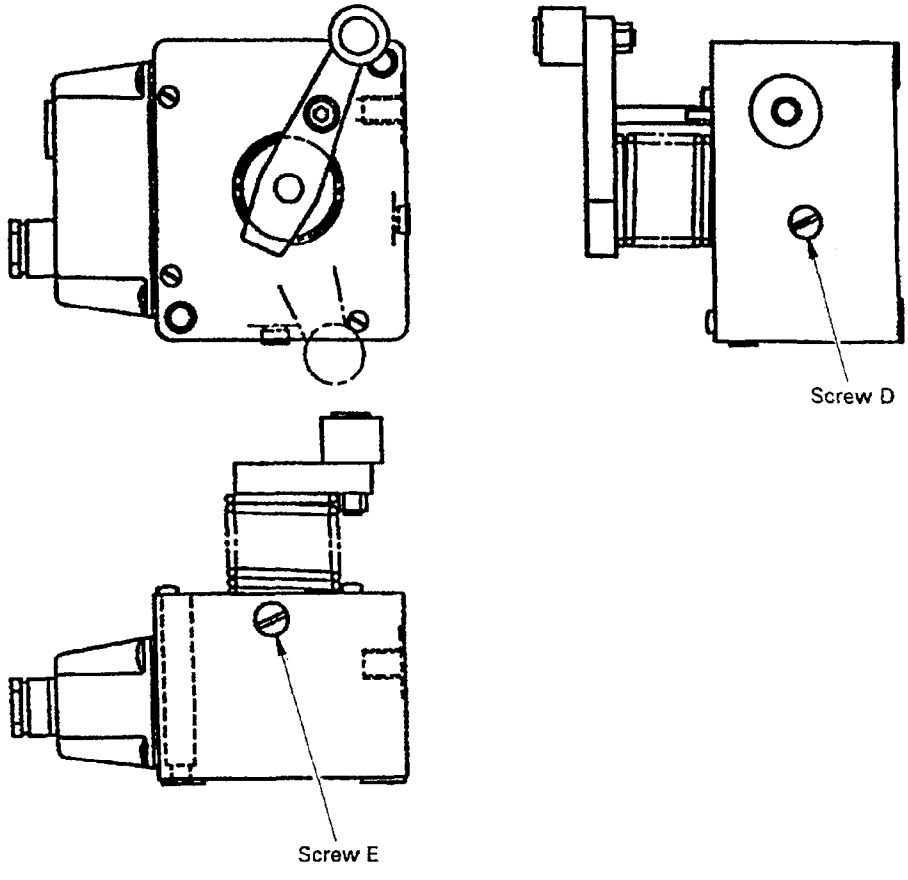
- **Screw D:** **Pressure range adjustment screw**
  To make an adjustment so that the oil pressure switch acts normally when checking the operation of the overload warning device.
  Turning to the left makes the pressure range wider.
- **Screw E:** **Zero point adjustment screw**
  Turning to the right one complete turn raises the pressure by 57 kg/cm^2.
  Each complete turn to the left lowers the pressure by 57 kg/cm^2.

⚠ When an adjustment is required, contact your Komatsu distributor and have him make the adjustment.



X08BT003

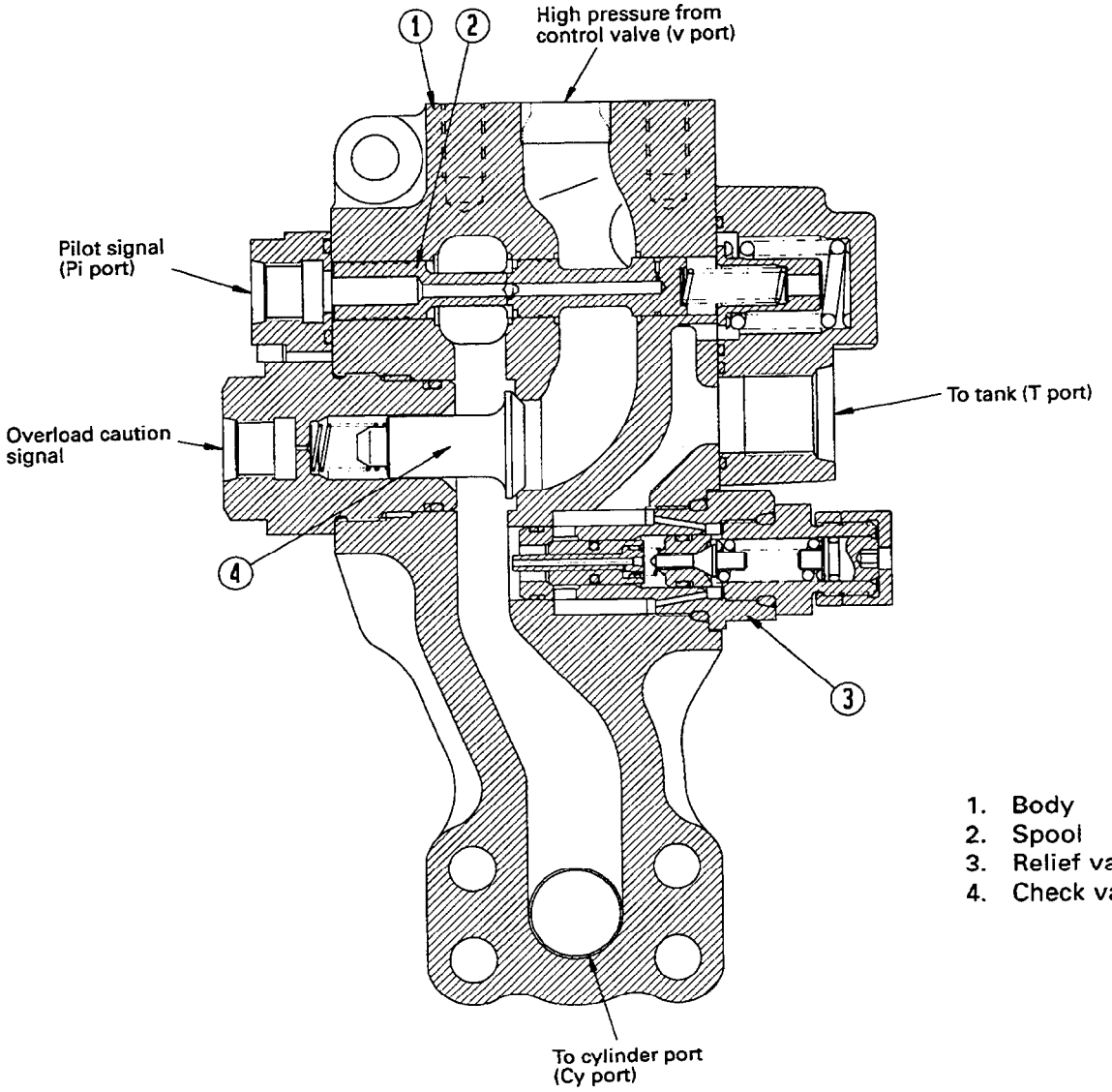
1. Body
2. Bourdon tube
3. Eccentric disc
4. Microswitch
5. Lever and roller
6. Adjustment screw (E)
7. Adjustment screw (D)



X08BT004

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HOSE BURST PROTECTION VALVE (BOOM)



1. Body
2. Spool
3. Relief valve
4. Check valve

X10BH175

FUNCTION

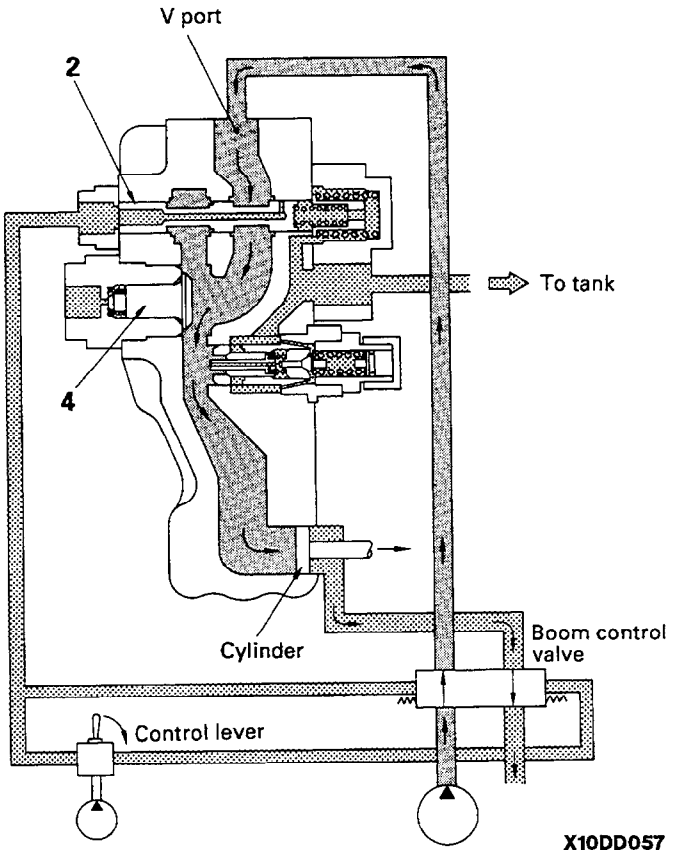
- This valve prevents sudden uncontrolled lowering of the boom, when lifting, due to the burst of a hose in the boom cylinder line. In such a condition this valve will hold the load until the operator lowers the boom in a controlled way using the normal wrist control.

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OPERATION

BOOM RAISE

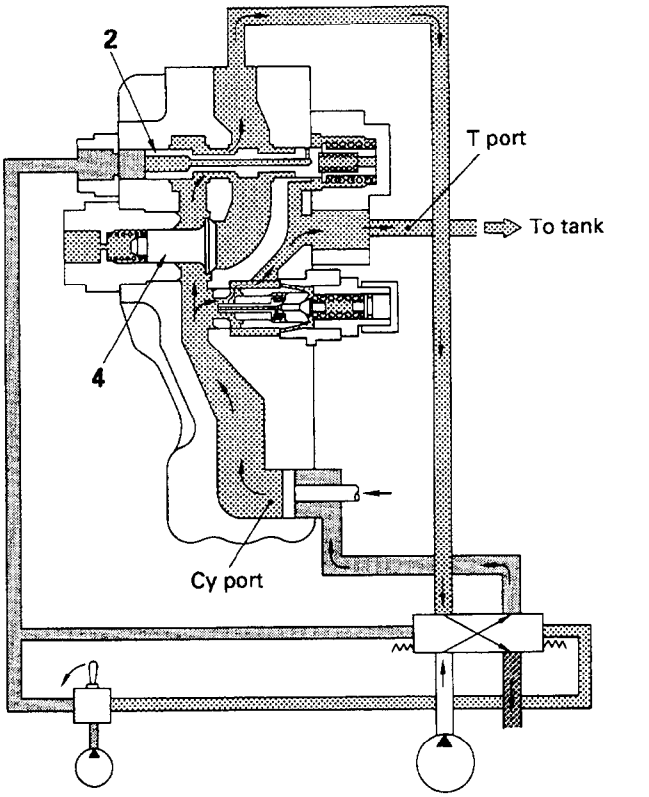
- During boom raising the pilot signal from wrist control operates control valve spool to direct high pressure oil to port **V** of hose burst valve.
- This pressure lifts check valve (4) from seat and high pressure oil flows in the bottom of the cylinder, raising the boom



X10DD057

BOOM LOWER

- During boom lowering, the pilot signal reverses the front through the control valve spool. High pressure oil flows to the head side of the cylinder. Oil in the bottom side of the cylinder flows through the port C_Y of the valve but cannot flow past the check valve. The pilot signal also opens the spool (2) of the hose burst valve and allows oil to flow back to tank.

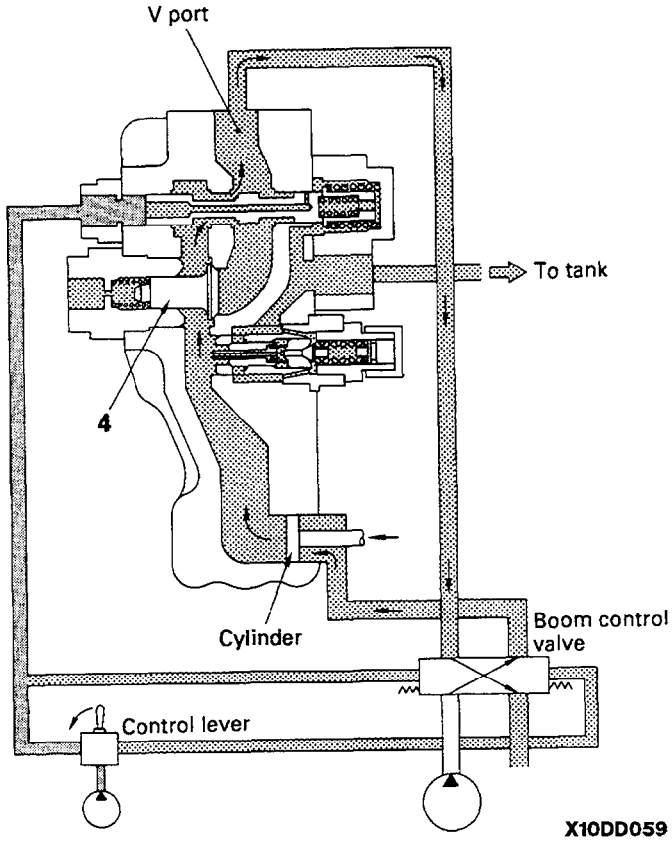


X10DD058

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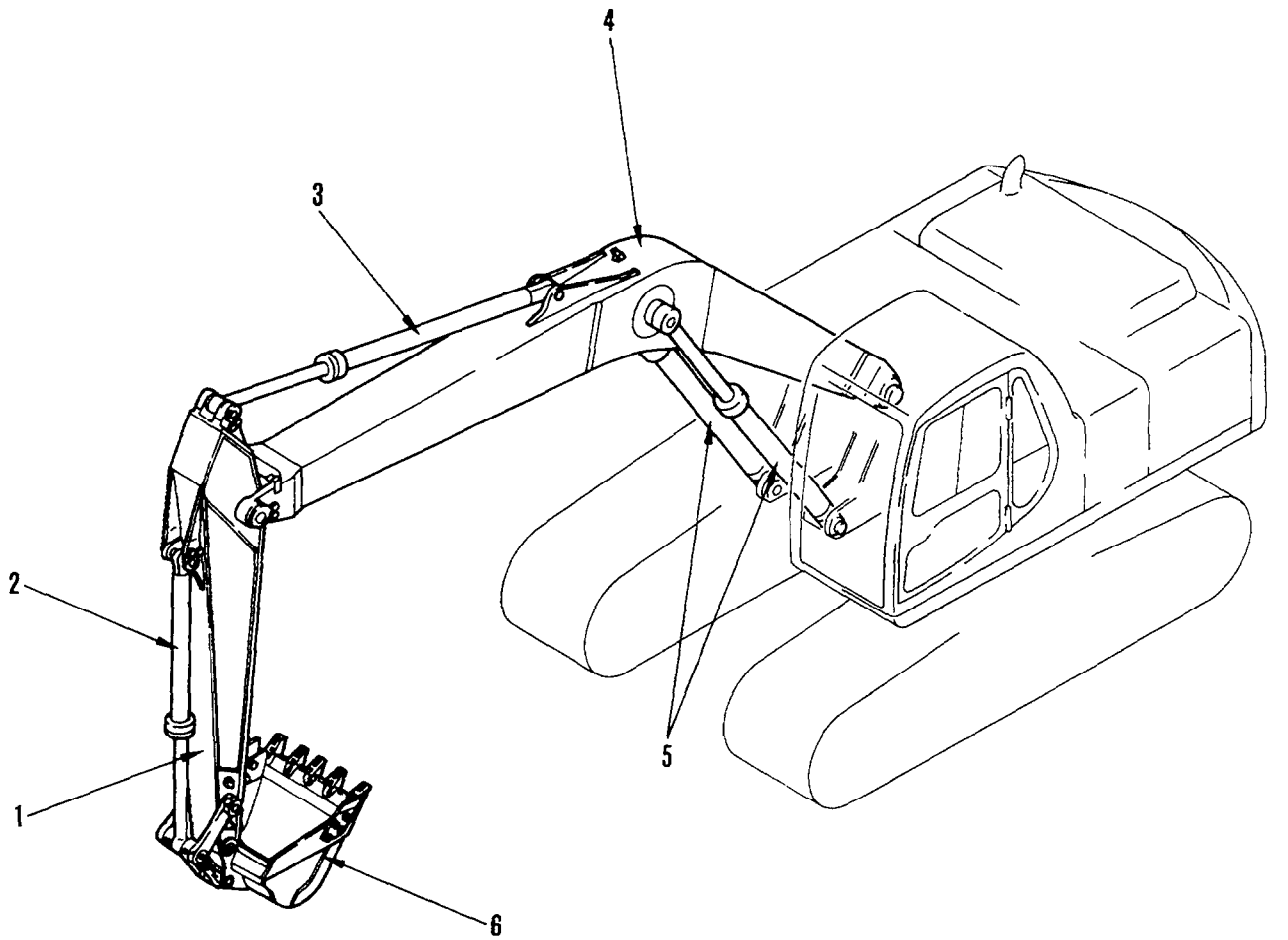
When hose burst occurs (Operation to lower safety)

- The sudden loss of pressure at port **V** will cause check valve (4) to re-seat and so the valve is locked.
- The boom can be lowered in a controlled way by operating the wrist control in the normal way.



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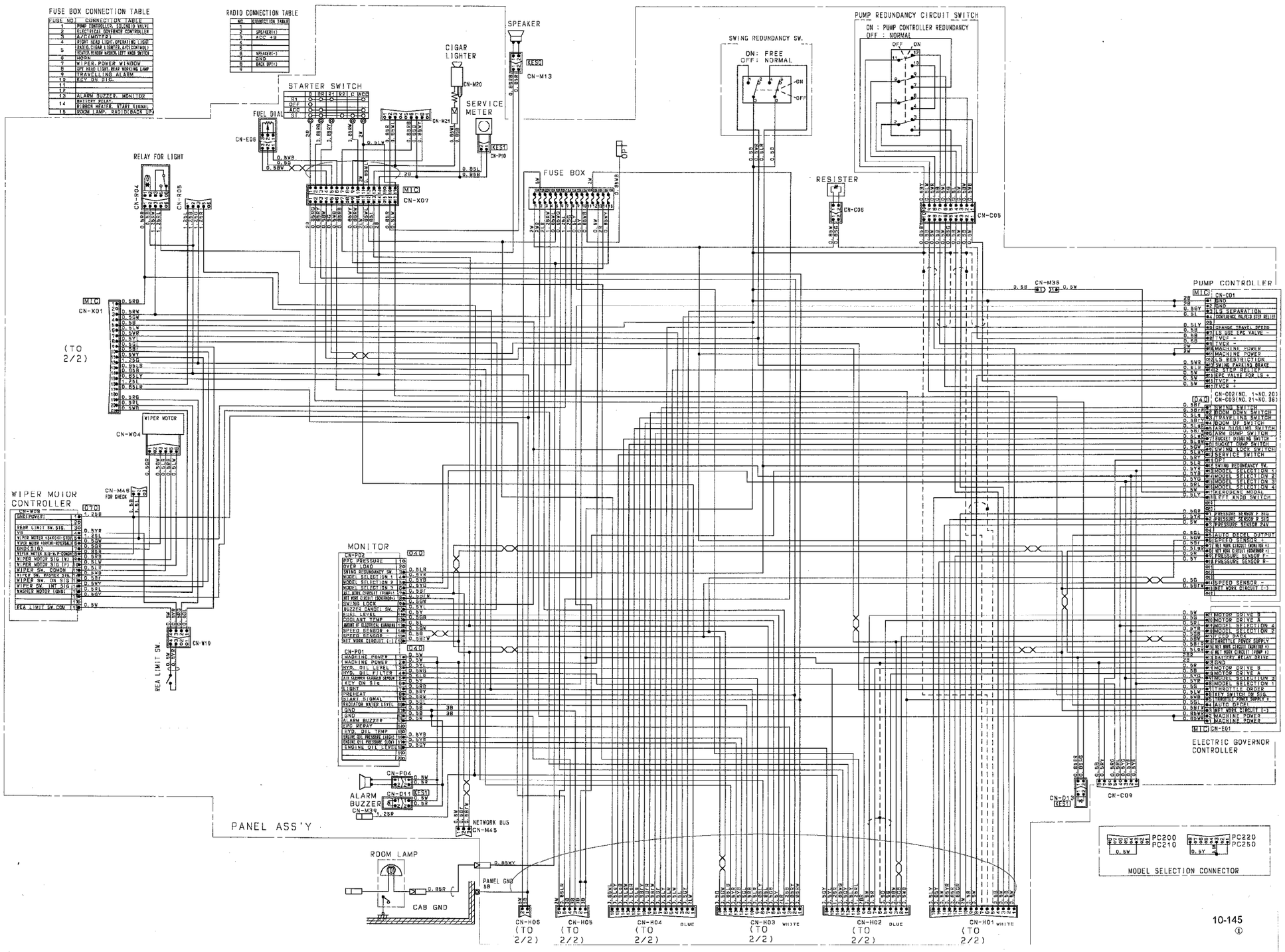
WORK EQUIPMENT



X17ZZ023

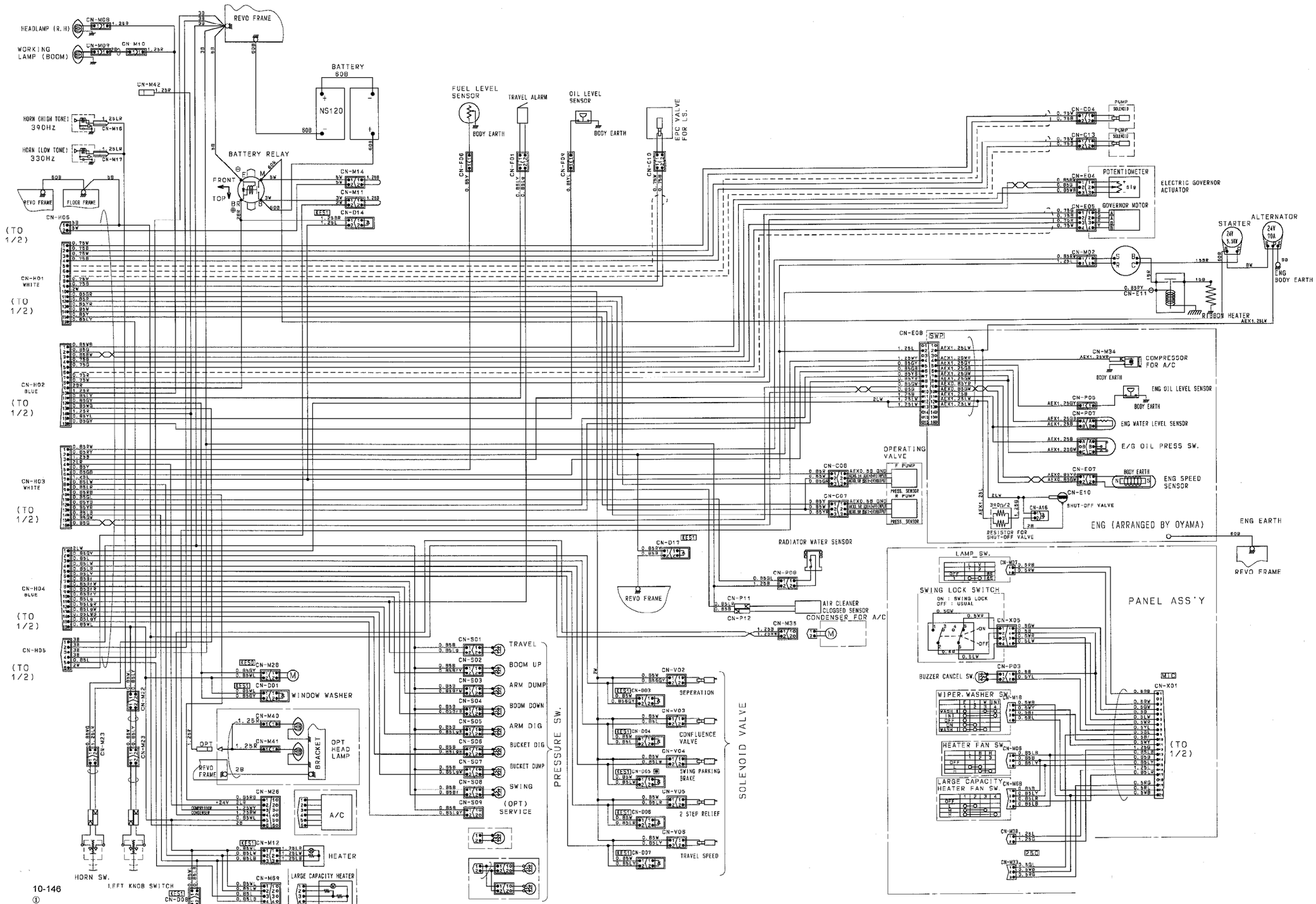
1. Arm
2. Bucket cylinder
3. Arm cylinder
4. Boom
5. Boom cylinder
6. Bucket

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ELECTRICAL CIRCUIT DIAGRAM (2/2)

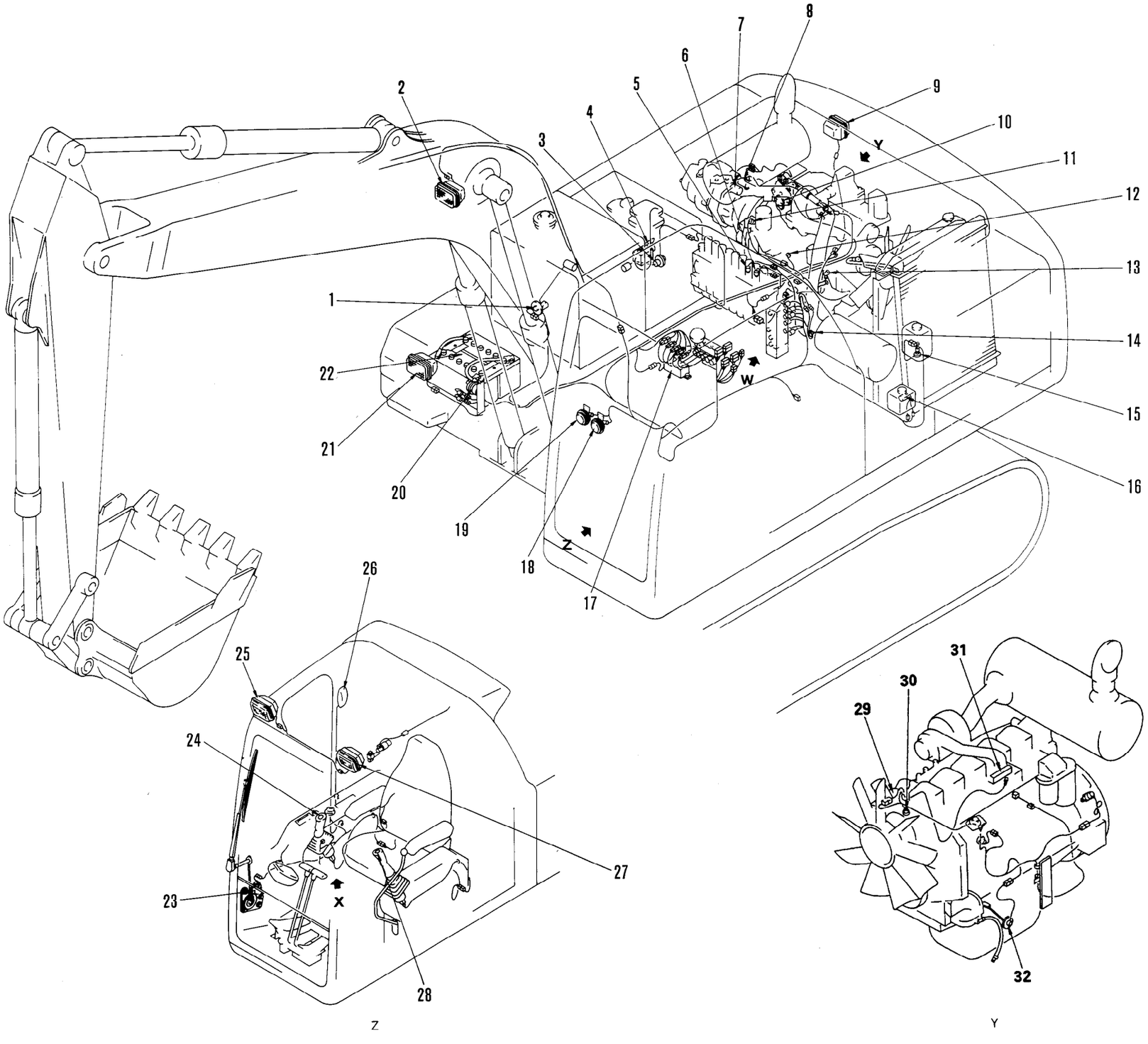
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ELECTRICAL WIRING DIAGRAM

PC200-6, PC200LC-6
PC210LC-6, PC220LC-6
PC250LC-6

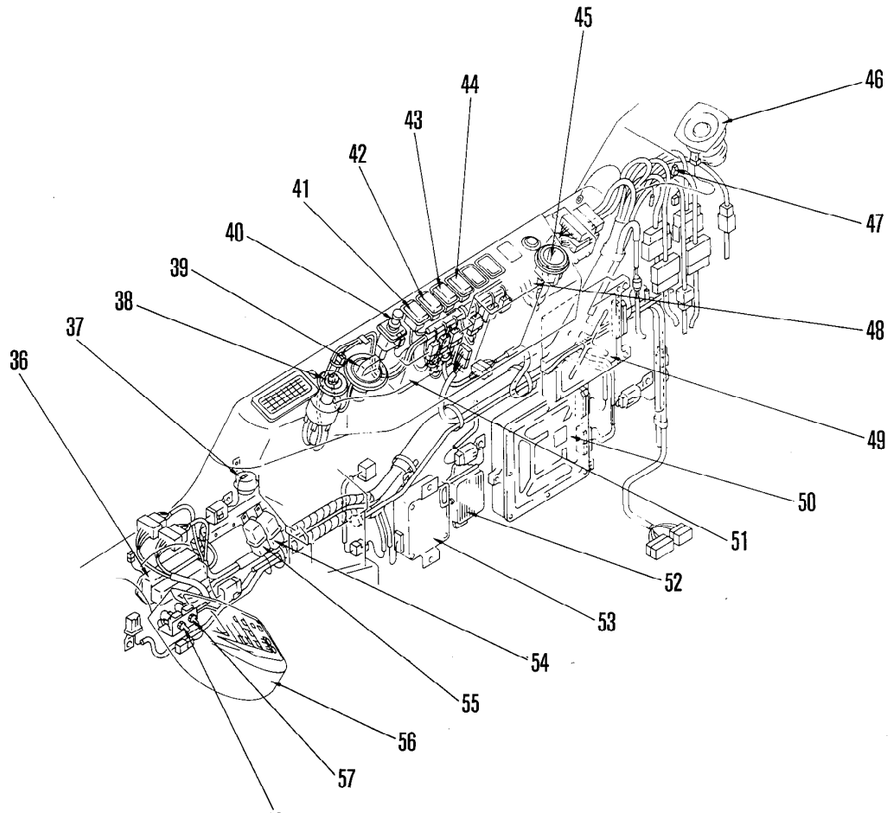
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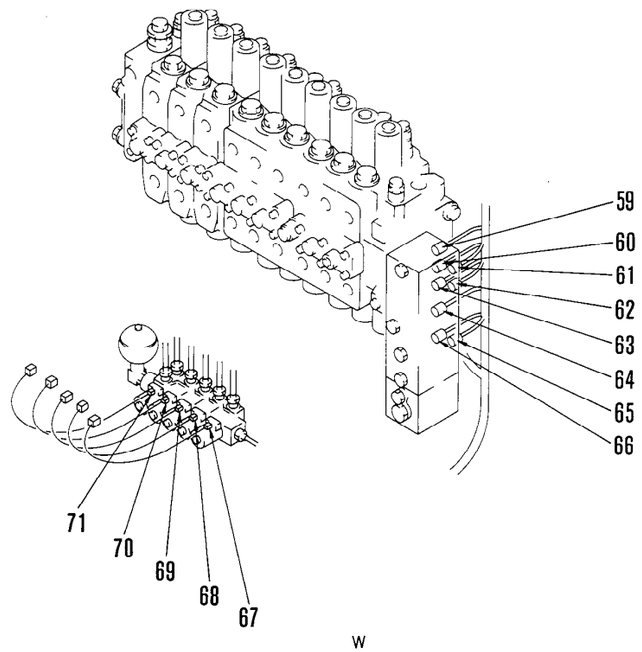
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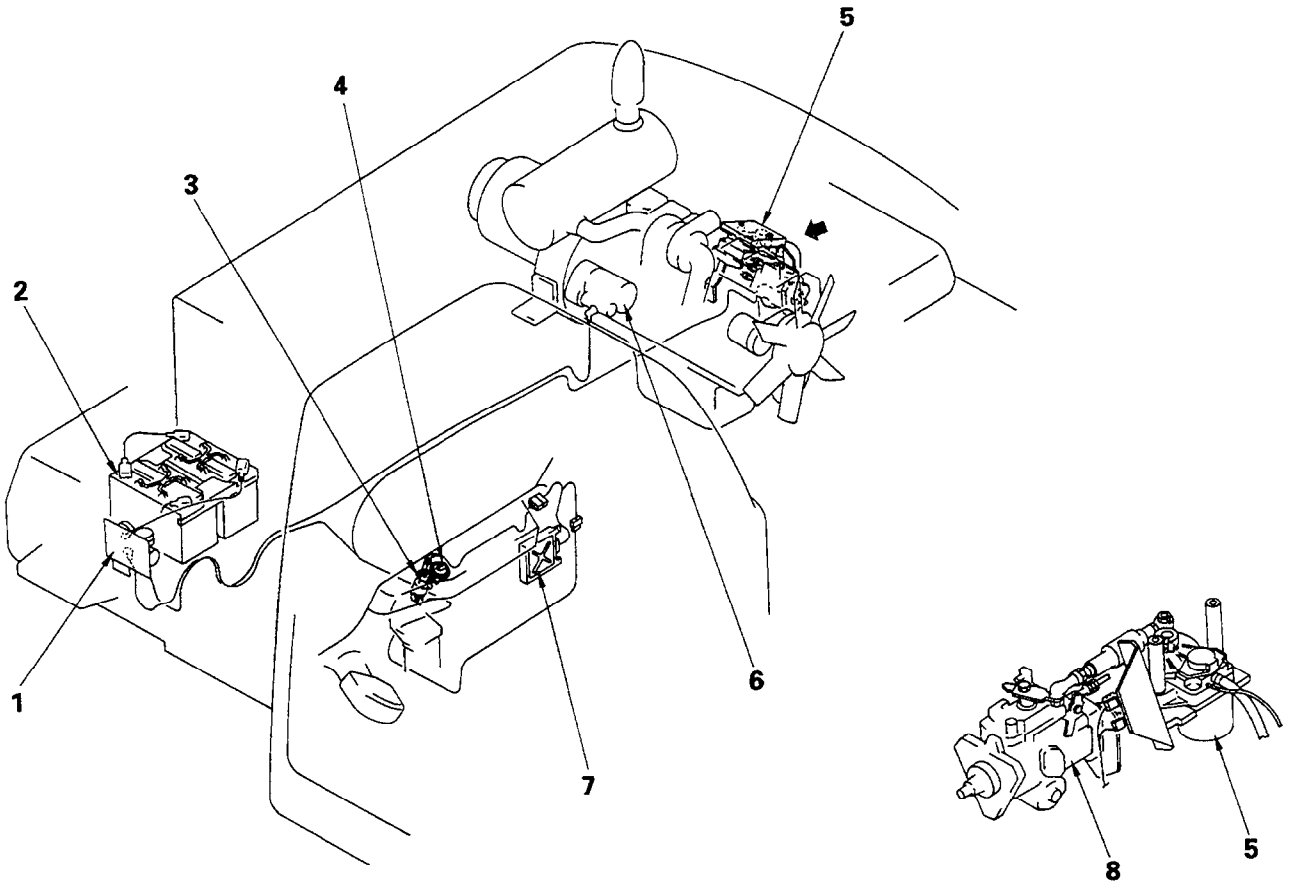


205F06292

1. Fuel level sensor
2. Working lights
3. Hydraulic oil level sensor
4. LS control EPC valve
5. Rear pump pressure sensor
6. Front pump pressure sensor
7. Rear pump TVC valve
8. Front pump TVC valve
9. Rear working light
10. Governor motor
11. Engine speed sensor
12. Engine oil pressure sensor (Hi)
13. Engine oil pressure sensor (Lo)
14. Air cleaner clogging sensor
15. Coolant level sensor
16. Window washer motor
17. Travel alarm
18. Horn (high tone)
19. Horn (low tone)
20. Battery relay
21. R.H. head light
22. Battery
23. Wiper motor
24. Horn switch
25. R.H. additional light
26. Room lamp
27. L.H. additional light
28. L.H. knob switch
29. Alternator
30. Coolant temperature sensor
31. Electrical intake air heater
32. Engine oil level sensor
36. Fuse box
37. Caution buzzer
38. Starting switch
39. Fuel control dial
40. Cigarette lighter
41. Swing lick switch
42. Wiper switch
43. Light switch
44. Buzzer cancel switch
45. Service meter
46. Speaker
47. Kerosene mode connector
48. Air conditioner control panel
49. Engine throttle controller
50. Pump controller
51. Radio
52. TVC prolix resistor
53. Wiper motor controller
54. Additional light relay
55. Light relay
56. Monitor panel
57. Swing lock prolix switch
58. TVC prolix switch
59. Swing oil pressure switch
60. Bucket CURL oil pressure switch
61. Bucket DUMP oil pressure switch
62. Arm IN oil pressure switch
63. Boom LOWER oil pressure switch
64. Arm OUT oil pressure switch
65. Travel oil pressure switch
66. Boom RAISE oil pressure switch
67. Swing brake solenoid valve
68. Travel speed solenoid valve
69. Pump merge-divider solenoid valve
70. 2-stage relief solenoid valve
71. LS select solenoid valve

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ENGINE CONTROL SYSTEM



X12BV078

1. Battery relay
2. Battery
3. Starting switch
4. Fuel control dial
5. Governor motor
6. Starting motor
7. Engine throttle controller
8. Fuel injection pump

FUNCTION

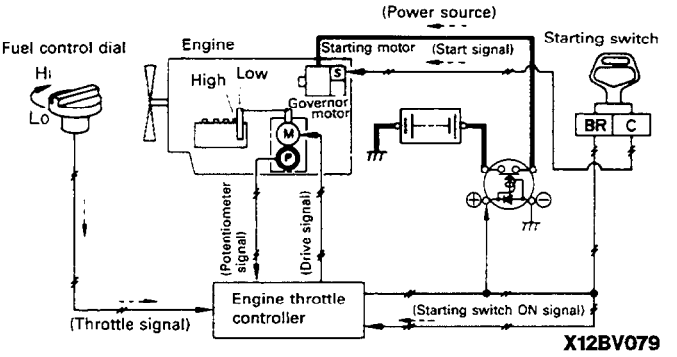
- The engine can be started and stopped simply by using the starting switch.
- A dial type engine control is used to control the engine speed. The engine throttle controller receives the control signal from the fuel control dial, sends a drive signal to the governor motor, and controls the angle of the governor lever in the fuel injection pump.
- At the same time, the engine throttle controller also receives signals from other controllers to control the engine speed.

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1. OPERATION OF SYSTEM

Starting engine

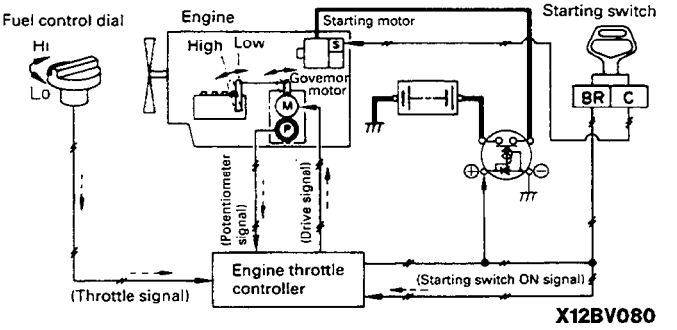
- When the starting switch is turned to the START position, the starting signal flows to the starting motor, and the starting motor turns to start the engine.
  When this happens, the engine throttle controller checks the signal from the fuel control dial and sets the engine speed to the speed set by the fuel control dial.



X12BV079

Engine speed control

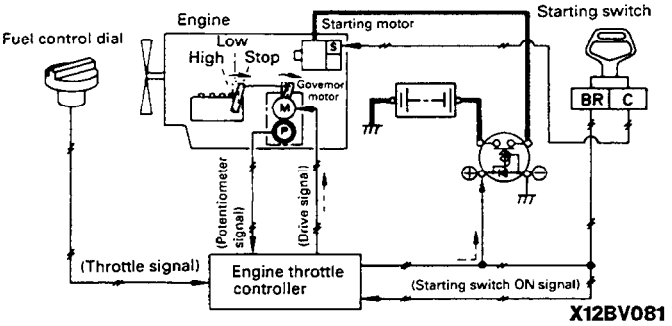
- The fuel control dial sends a signal to the engine throttle controller according to the position of the dial. The engine throttle controller calculates the angle of the governor motor according to this signal, and send a signal to drive the governor motor so that it is at that angle.
  When this happens, the operating angle of the governor motor is detected by the potentiometer, and feedback is sent to the engine throttle controller, so that it can observe the operation of the governor motor.



X12BV080

Stopping engine

- When the starting switch is turned to the STOP position, the engine throttle controller drives the governor motor so that the governor lever is set to the NO INJECTION position.
- When this happens, to maintain the electric power in the system until the engine stops completely, the engine throttle controller itself drives the battery relay.



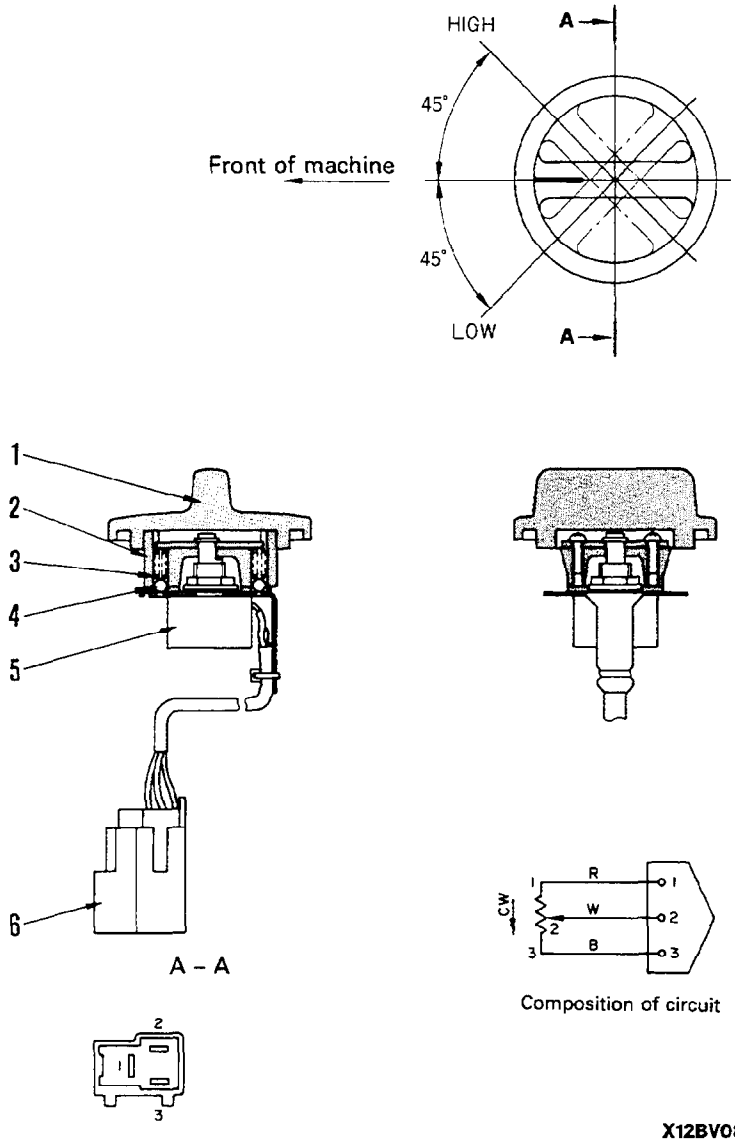
X12BV081

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2. COMPONENTS OF SYSTEM

1) FUEL CONTROL DIAL

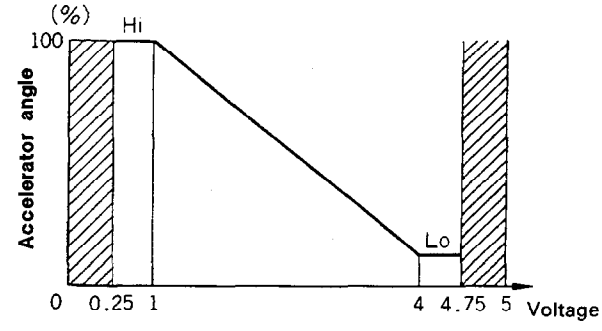
1. Knob
2. Dial
3. Spring
4. Ball
5. Potentiometer
6. Connector



X12BV082

FUNCTION

- The fuel control dial is installed at the bottom of the monitor panel. A potentiometer is installed under the knob, and when the knob is turned, it rotates the potentiometer shaft.
  When the shaft rotates, the resistance of the variable resistor inside the potentiometer changes, and the desired throttle signal is sent to the engine throttle controller.
  The shaded area in the graph on the right is the abnormality detection area and the engine speed is set at low idling.



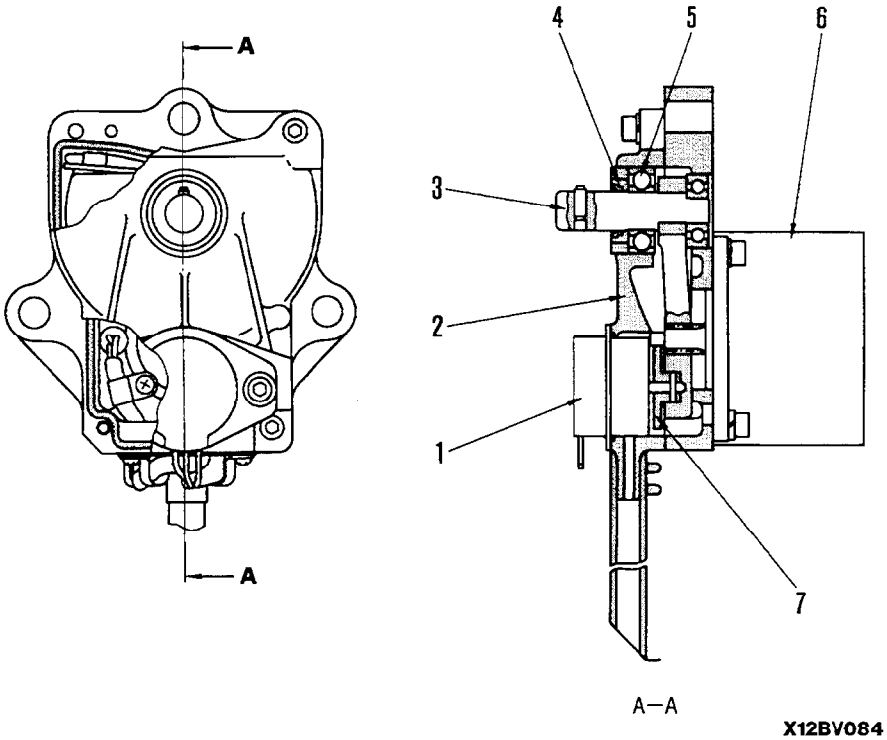
Characteristics of throttle voltage

X12BV083

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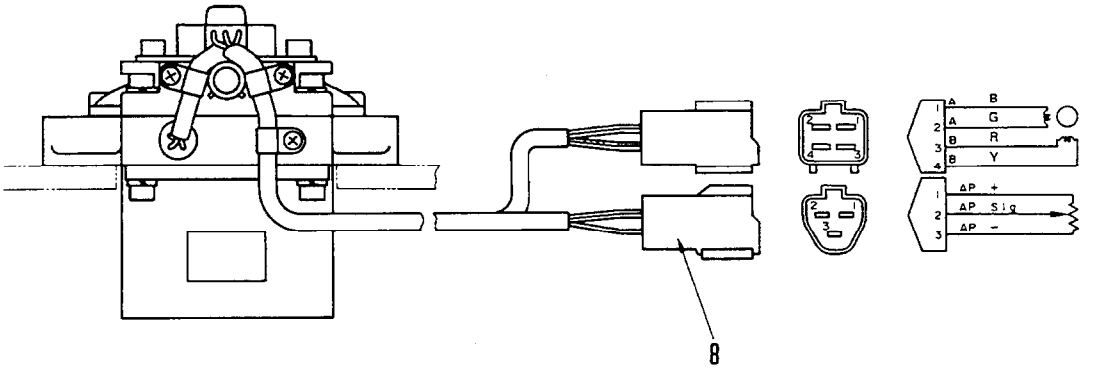
2) GOVERNOR MOTOR

1. Potentiometer
2. Cover
3. Shaft
4. Dust seal
5. Bearing
6. Motor
7. Gear
8. Connector



A–A

X12BV084



X12BV085

FUNCTION

- The motor is rotated and the governor lever of the fuel injection pump is controlled by the drive signal from the engine throttle controller.
- A stepping motor is used for the motor which provides the motive power. In addition, a potentiometer for giving feedback is installed to allow observation of the operation of the motor.
- The rotation of the motor is transmitted to the potentiometer through a gear.

OPERATION

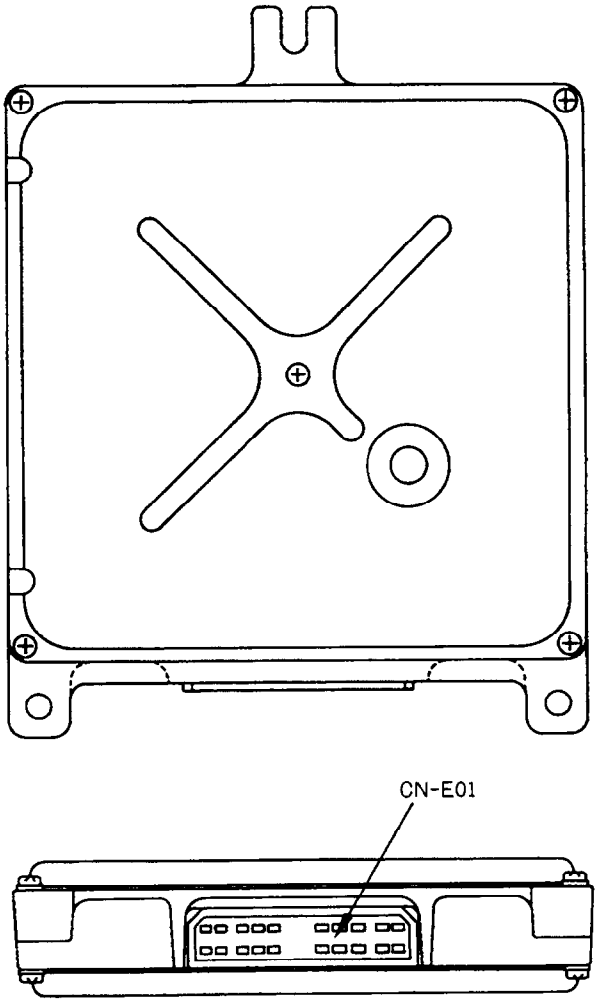
Motor stationary

- Both A phase and B phase of the motor are continuous, and a holding torque is generated in the motor.

Motor rotating

- A pulse current is applied to the A phase and B phase from the engine throttle controller to give synchronous rotation with the pulse.

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X12BV086

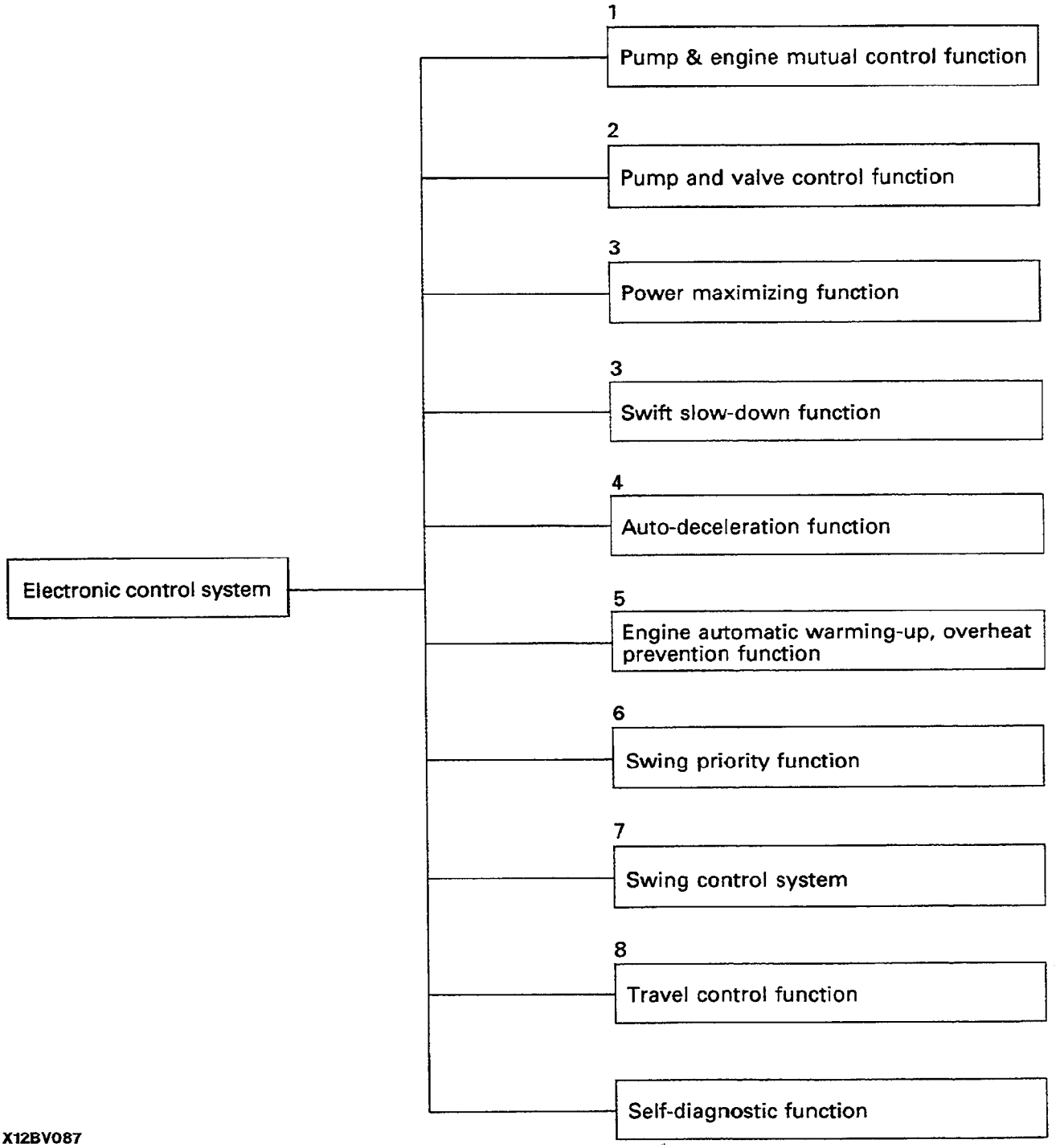
Input and output signals
CN-E01

No.	Name of signal	Input/output
1	Controller power source (24V)	–
2	Controller power source (24V)	–
3	Network circuit (-)	–
4	Auto deceleration	Input
5	Potentiometer power source (5V)	–
6	Starting switch ON signal	Input
7	Fuel control dial	Input
8	Model selection 1	Input
9	Model selection 3	Input
10	Governor motor drive A (+)	Output
11	Governor motor drive B (+)	Output

No.	Name of signal	Input/output
12	GND	Input
13	Battery relay drive	Output
14	Network circuit (pump +)	–
15	Network circuit (monitor +)	–
16	Potentiometer GND	–
17	Governor motor potentiometer signal	Input
18	Model selection 2	Input
19	Model selection 4	Input
20	Governor motor drive A (-)	Output
21	Governor motor drive B (-)	Output

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ELECTRONIC CONTROL SYSTEM
CONTROL FUNCTION

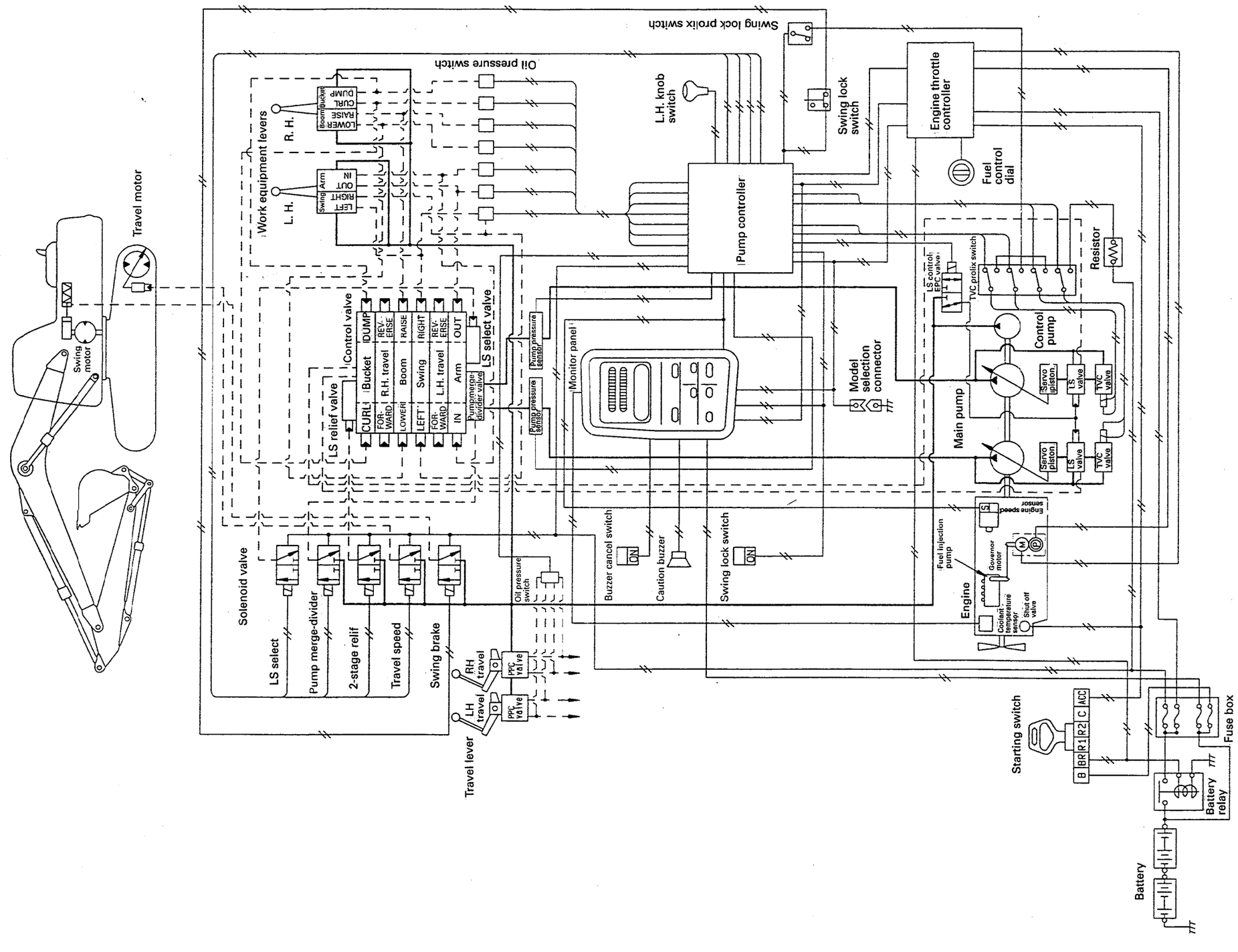


X12BV087

★ For details of the self-diagnostic function, see TROUBLESHOOTING.

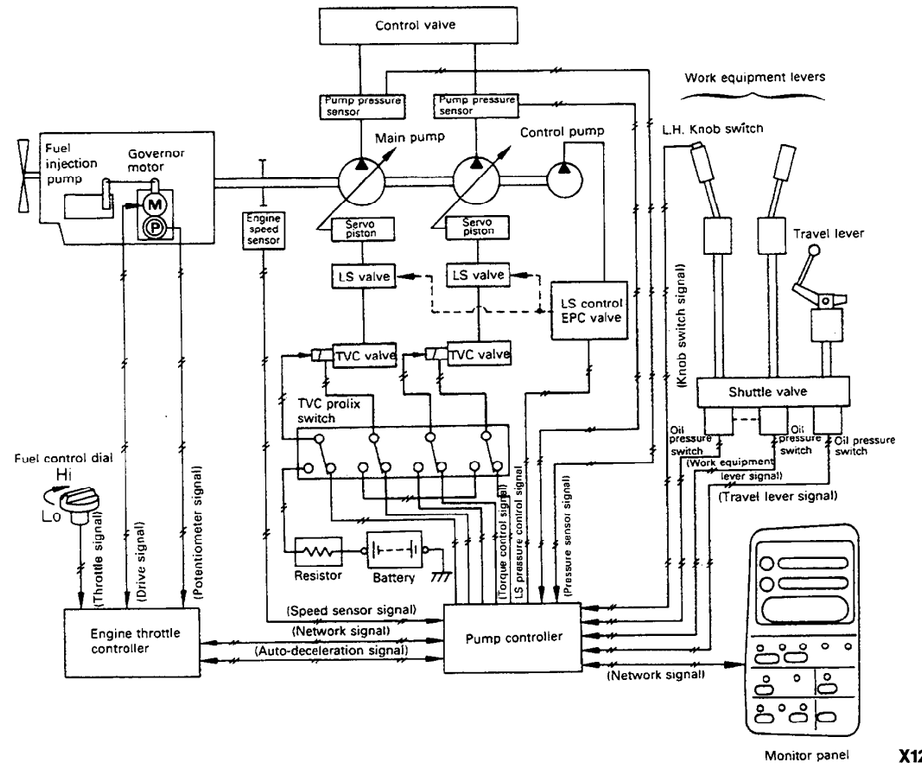
https://truckmanualshub.com/

TOTAL SYSTEM DIAGRAM



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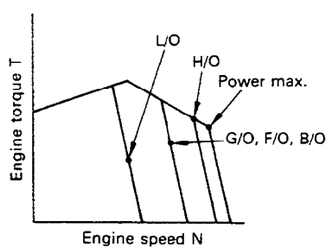
1. PUMP AND ENGINE MUTUAL CONTROL FUNCTION



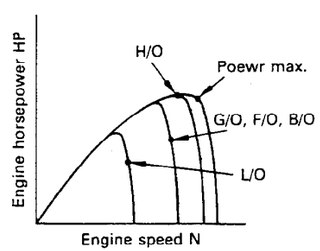
FUNCTION

- There are five modes available for selection with the working mode switch on the monitor panel. These modes are the heavy-duty operation (H/O) mode, general operation (G/O) mode, finishing operation (F/O) mode, and the breaker operation (B/O) mode. It is possible to select the most suitable engine torque and pump absorption torque to match the nature of the work.
- The pump controller detects the actual engine speed and the speed set by the engine governor through the fuel control dial in accordance with the pump absorption torque set for each mode, and carries out control so that the pump absorbs all of the torque at each output point of the engine.

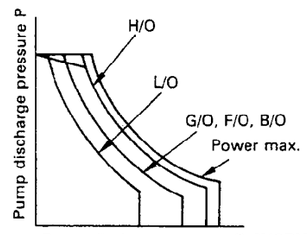
- **Engine torque corve**



- **Engine horsepower curve**



- **Pump output curve**

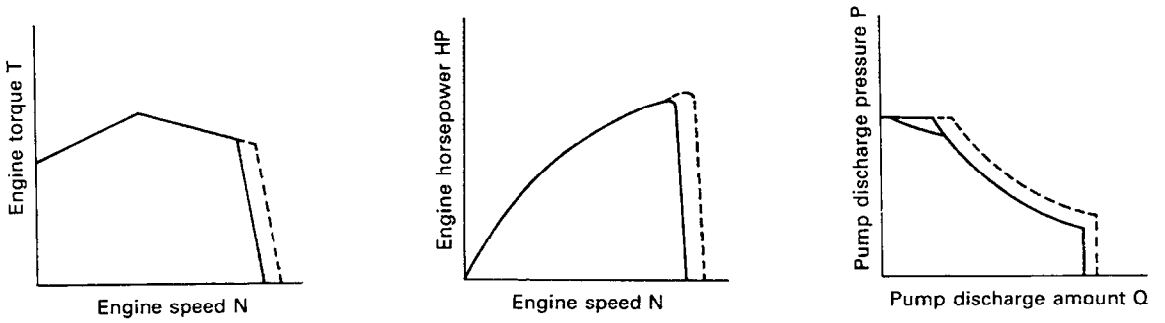


X12BV089

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1) Control method in each mode

Heavy-duty operation (H/O) mode



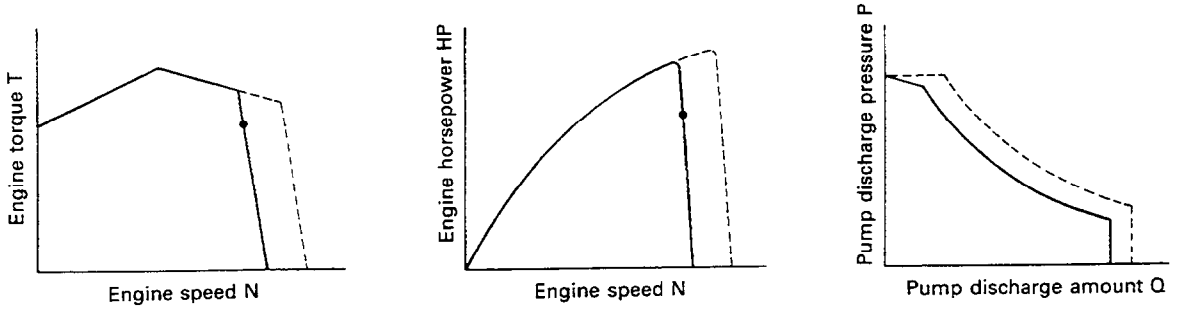
X12BV090

- Matching point in heavy-duty operation mode:
  96 % partial output point

Mode \ Model	PC200-6 PC200LC-6 PC210LC-6	PC220LC-6 PC250LC-6
Heavy-duty operation (H/O)	96 kW (128 HP) / 2,000 rpm	114 kW (153 HP) / 2,200 rpm

- When the load on the pump rises and the pressure rises, the engine speed goes down.
  When this happens, the pump discharge amount is reduced, and the engine speed is controlled so that it becomes near the 96% partial output point. If the reverse happens and the pressure goes down, the system is controlled so that the pump discharge amount is increased until the engine speed becomes near the 96% partial output point. By repeating this control, the engine can always be used at near the 96% partial output point.

General operation (G/O), finishing operation (F/O), breaker operation (B/O) mode



X12BV091

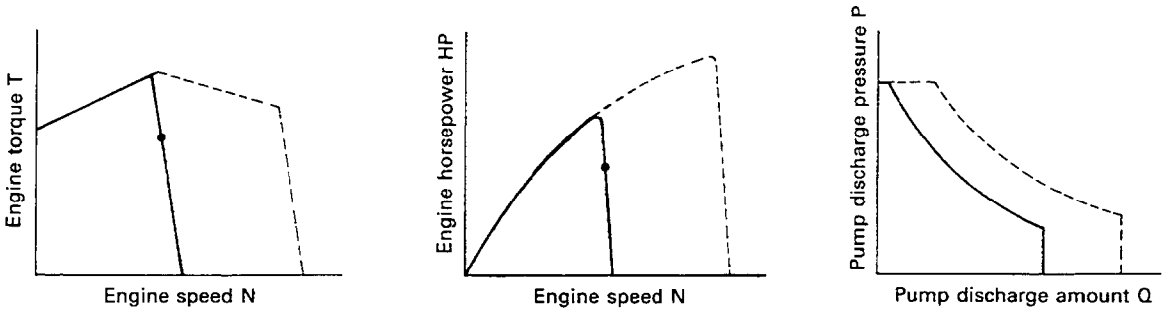
- Matching point in general operation, finishing operation, and breaker operation modes:
  80 % partial output point.

Mode \ Model	PC200-6 PC200LC-6 PC210LC-6	PC220LC-6 PC250LC-6
General operation (G/O), finishing operation (F/O), breaker operation (B/O)	81 kW (108 HP) / 1,900 rpm	96 kW (128 HP) / 2,000 rpm

- When the load on the pump rises and the pressure rises, the engine speed goes down.
  When this happens, mutual control of the engine and pump is used to control the system so that the pump absorption torque follows the equal horsepower curve of the engine, and the engine speed is lowered while keeping the torque constant.
  In this way, the engine is used in a range which provides good fuel efficiency.

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Lifting operation (L/O) mode



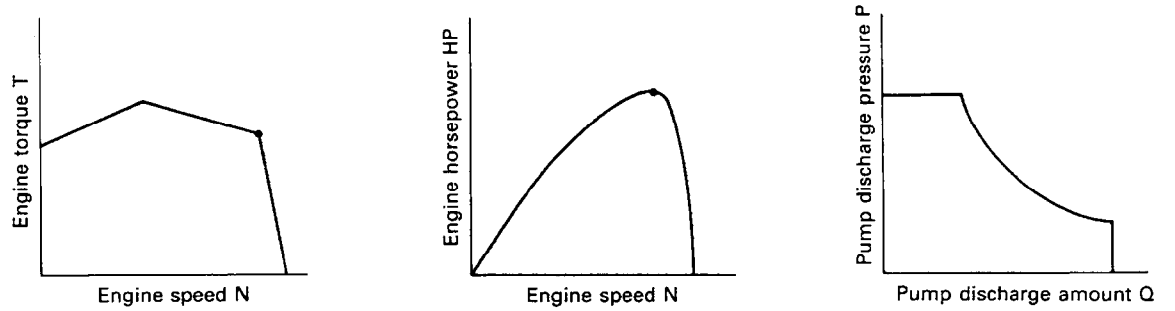
X12BV092

- Matching point in lifting operation mode:
  60 % partial output point

Mode \ Model	PC200-6 PC200LC-6 PC210LC-6	PC220LC-6 PC250LC-6
Lifting operation (L/O)	57 kW (76 HP) / 1,500 rpm	76 kW (102 HP) / 1,500 rpm

- When the lifting operation mode is selected, the engine speed is automatically lowered to the partial position.
  In this condition, control is carried out in the same way as for the general operation, finishing operation, and breaker operation modes to match the load in the pump.
  In this way, the fuel consumption is reduced and the fine control ability is improved.

Power maximizing mode



X12BV093

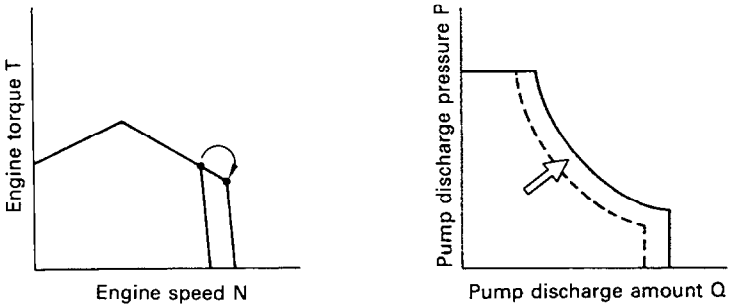
- Matching point in power max. mode:
  Rated output point

Mode \ Model	PC200-6 PC200LC-6 PC210LC-6	PC220LC-6 PC250LC-6
Power Max.	99 kW (133 HP) / 2,200 rpm	117 kW (158 HP) / 2,300 rpm

- When the pump load increases, the engine speed drops.
  When this happens, the pump discharge is reduced to prevent the engine speed from going down and to ensure that the engine is used at near the rated output point.

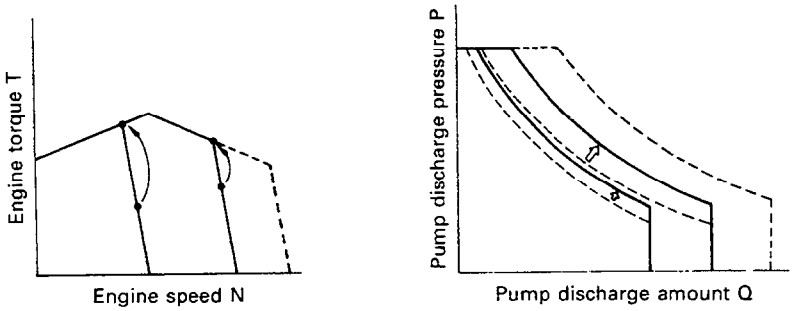
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2) Pump control function when traveling



X12BV094

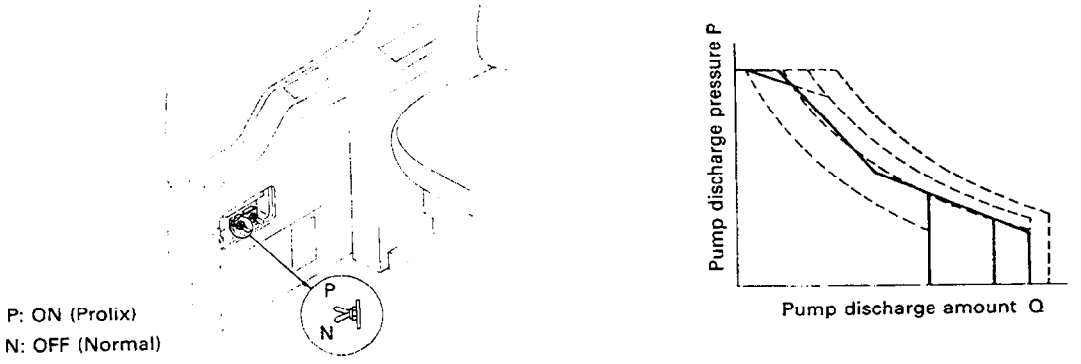
- When the machine travels in the heavy-duty operation (H/O) mode, the engine speed rises, and the pump is controlled in the same way as when in the power maximizing mode.



X12BV095

- When the machine travels in any mode other than the heavy-duty operation (H/O) mode, the working mode and engine speed are kept as they are, and the pump absorption torque is increased.

3) Control function when TVC prolix switch is ON

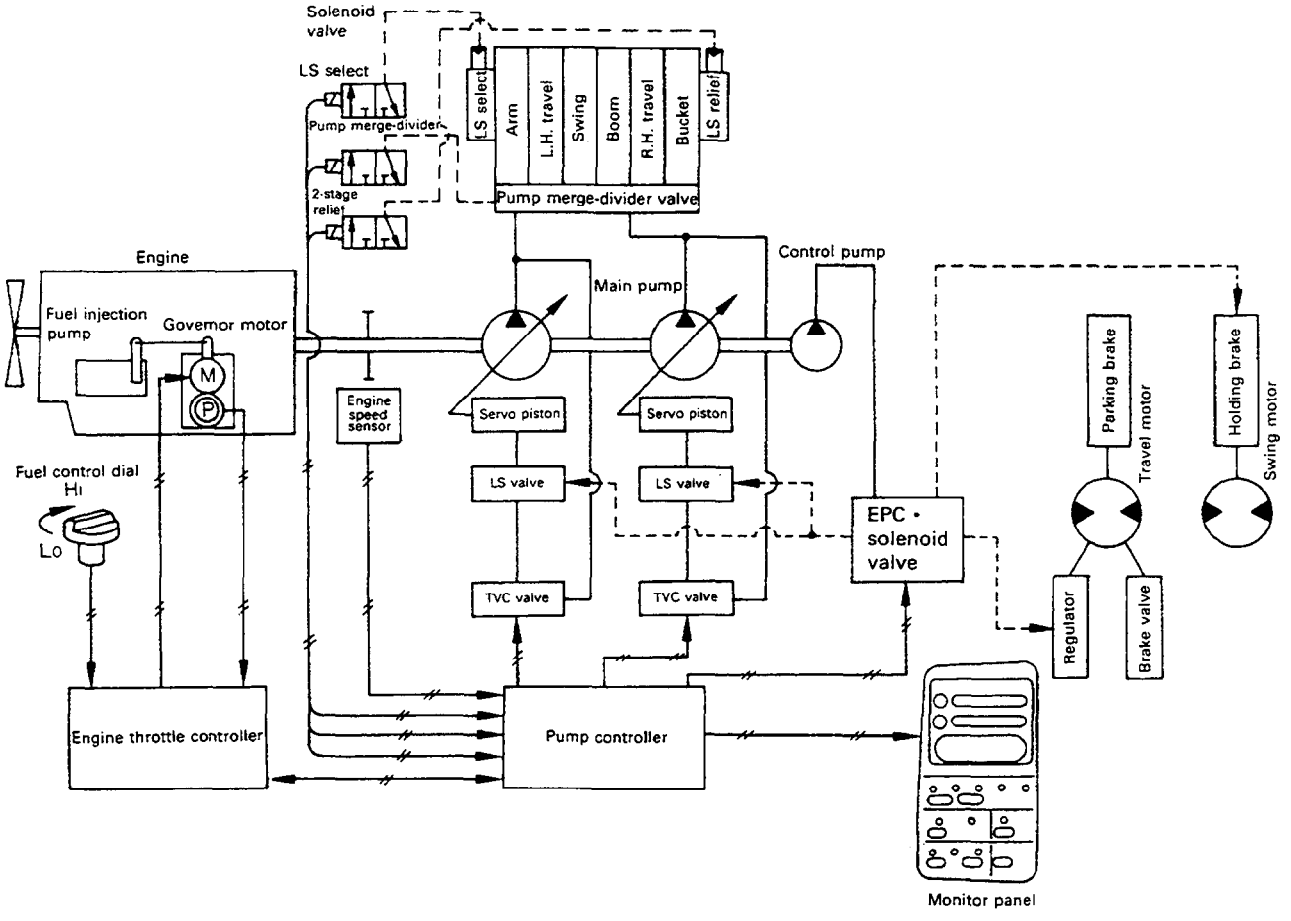


X12BV096

- Even if any abnormality should occur in the controller or sensor, the TVC prolix switch can be turned ON to provide an absorption torque more or less equivalent to the general operation (G/O) mode, thereby allowing the machine to maintain its functions.
- In this case, it is designed to allow a constant current to flow from the battery to the TVC valve, so oil pressure sensing is carried out only by the TVC valve.

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2. PUMP AND VALVE CONTROL FUNCTION



X12BV097

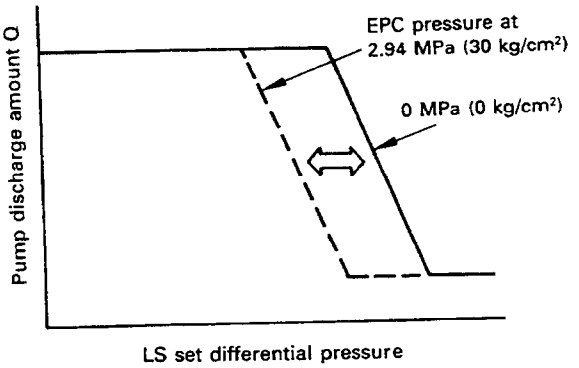
FUNCTION

- The following two functions are available to provide the optimum matching under various working conditions: a 2-stage relief function which increases the digging power, and a fine control mode function which improves the ease of fine control.

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1) LS control function

- The switching point (LS set differential pressure) for the pump discharge amount inside the LS valve is changed by changing the output pressure from the LS control EPC valve to the LS valve according to the engine speed and operating condition of the actuator.
- Because of this, the timing of starting the discharge amount from the pump can be optimized, to give excellent ease of compound operation and fine control.



X12BV098

2) Cut-off function

For details of the operation, see CLSS

3) 2-stage relief function

- The relief pressure for normal operation is 31.85 MPa (325 kg/cm^2), but when the 2-stage relief function is actuated, the relief pressure rises to approximately 34.79 MPa (255 kg/cm^2). Because of this, the hydraulic pressure is increased by one stage.

- Actuating conditions for 2-stage relief function

Conditions	Relief pressure
• When traveling • When swing lock switch is ON • In lifting operation (L/O) mode • When power max. function or swift slow-down function are actuated	31.85 MPa (325 kg/cm^2) ⇩ 34.79 MPa (355 kg/cm^2)

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4) Fine control node function

- When the finishing operation (F/O) mode is selected from the working mode, the pump LS valve is controlled, and the pump discharge amount is reduced to improve the ease of fine control and the precision when finishing.

- Relationship between working mode and pump discharge amount (for independent operation)

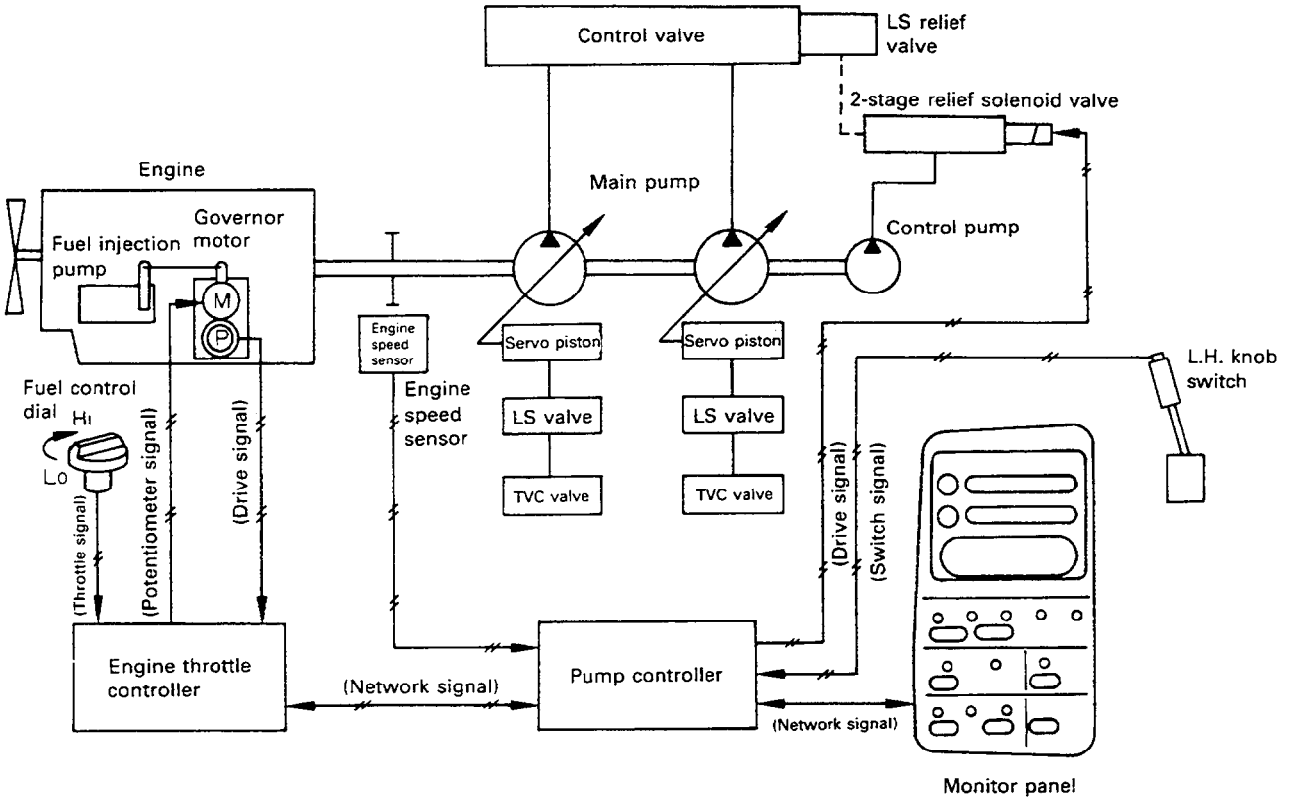
(%)

Actuator / Mode	Boom		Arm		Bucket	Swing	Breaker
	RAISE	LOWER	IN	OUT			
Heavy-duty operation (H/O)	100	40	100	100	50	50	-
General operation (G/O)							
Finishing operation (F/O)	100 <50>	40	50	100	40 (50)	40 (50)	-
Lifting operation (L/O)	50		50	50	35	35	-
Breaker operation (B/O)	100	40	100	100	50	50	60

★ The figures in ( ) are for the PC200
★ The figures in < > are for when arm IN is operated.
★ In each working mode, the full flow of the pump at the set engine speed is taken as 100%.

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3. POWER MAXIMIZING, SWIFT SLOW-DOWN FUNCTION



X12BV099

FUNCTION

- This function provides an increase in the digging power for a certain time or switches the working mode to the lifting operation (L/O) and reduces the speed. It is operated using the L.H. knob switch to momentarily match the operating conditions.

★ The power max. function and swift slow-down function are operated with the same switch. Only one of these functions can be selected at any time; they cannot both be operated together.

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1) Power maximizing function

- During digging operations, when that extra bit of digging power is needed (for example, when digging up boulders), the L.H. knob switch can be pressed to raise the hydraulic pressure by approx. 10% and increase the digging force.
- If the L.H. knob switch is pressed ON when the working mode is at H/O or G/O, each function is automatically set as follows.



Working mode	Engine pump control	2-stage relief function	Actuating time
Heavy-duty operation	Matching at rated output point	Actuated (31.85 → 34.79 MPa) (325 → 355 kg/cm^2)	Automatically canceled after 8.5 sec.

2) Swift slow-down function

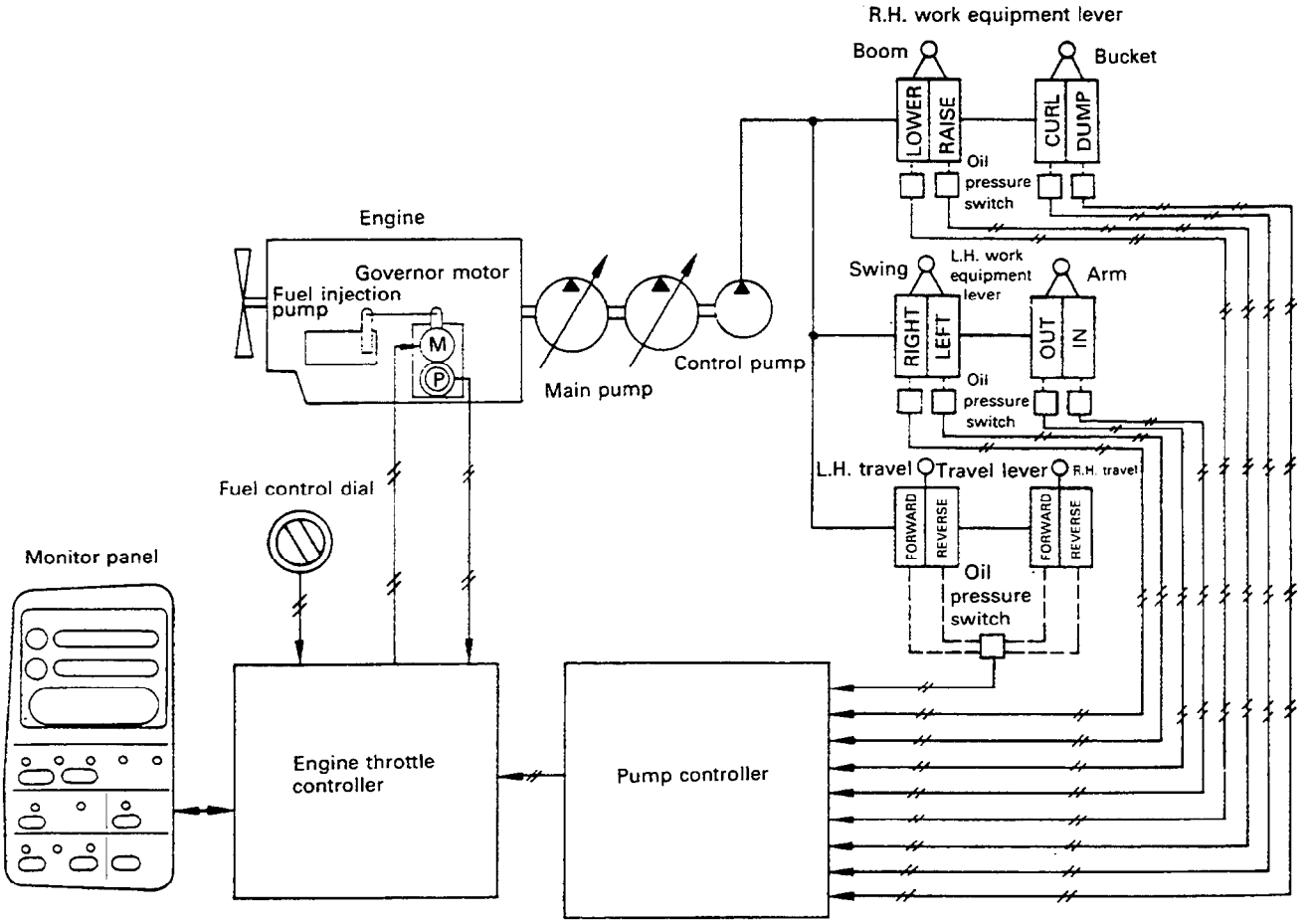
- During normal operations, if it is desired to carry out lifting operations or finishing operations for a moment, the working mode can be switched to lifting operation (L/O) mode by operating the L.H. knob switch.
- If the L.H. knob switch is pressed ON when the working mode is at H/O or G/O, each function is automatically set as follows.



Working mode	Actuating time
Lifting operation	While switch is kept pressed

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4. AUTO-DECELERATION FUNCTION



X12BV100

FUNCTION

- If all the control levers are at neutral when waiting for work or waiting for a dump truck, the engine speed is automatically reduced to a midrange speed to reduce fuel consumption and noise.
- If any lever is operated, the engine speed returns immediately to the set speed.

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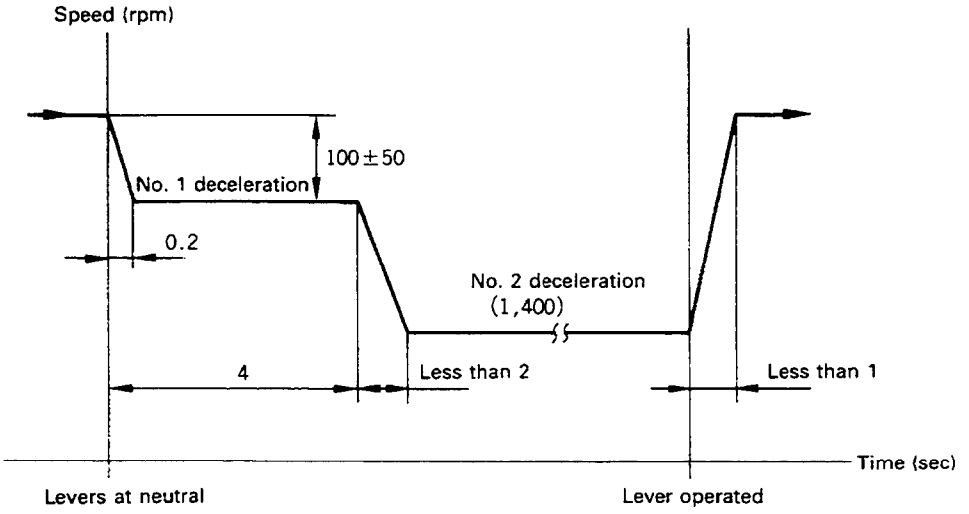
OPERATION

Control levers at neutral

- If the engine is running at above the deceleration actuation speed (approx. 1400 rpm), and all the control levers are returned to neutral, the engine speed drops immediately to approx. 100 rpm below the set speed to the No. 1 deceleration position.
- If another 4 seconds passes, the engine speed is reduced to the No. 2 deceleration position (approx. 1400 rpm), and is kept at that speed until a lever is operated.

When control lever is operated

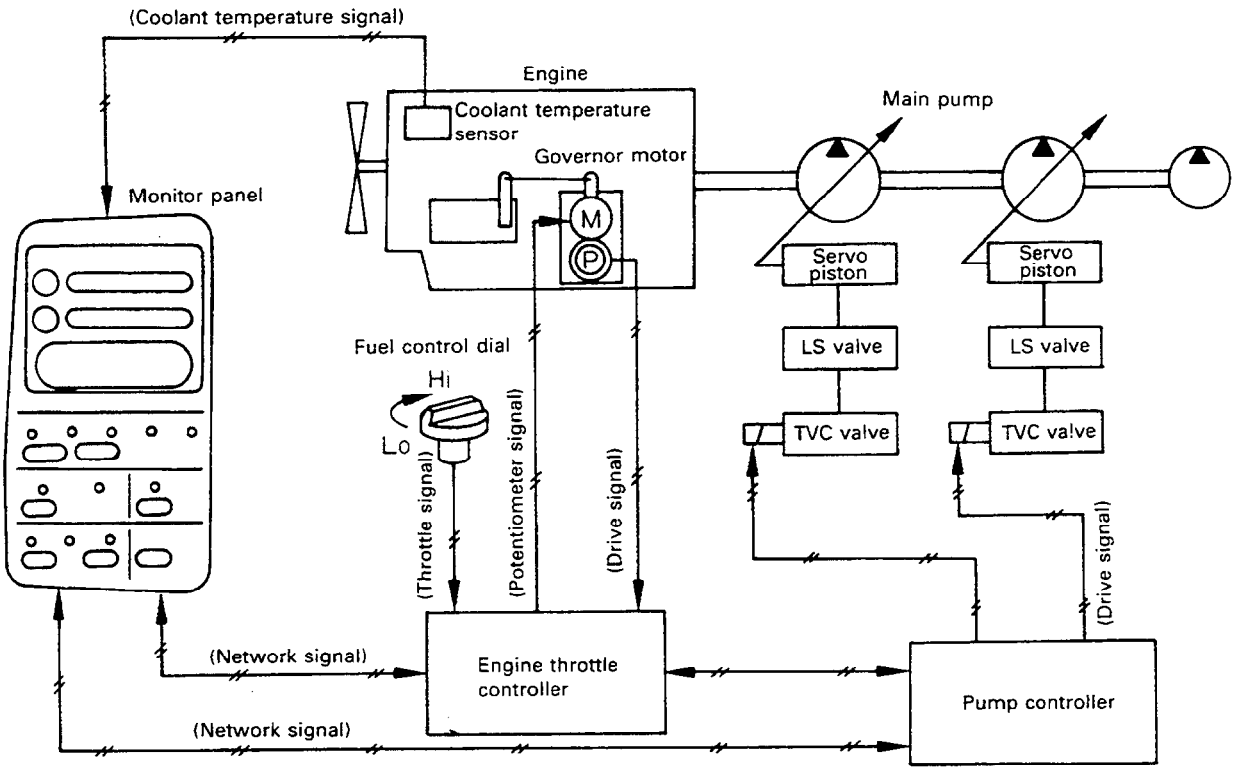
- If any control lever is operated when the engine speed is at No. 2 deceleration, the engine speed will immediately rise to the speed set by the fuel control dial.



X12BV101

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5. AUTOMATIC WARMING-UP AND ENGINE OVERHEAT PREVENTION FUNCTION



X12BV102

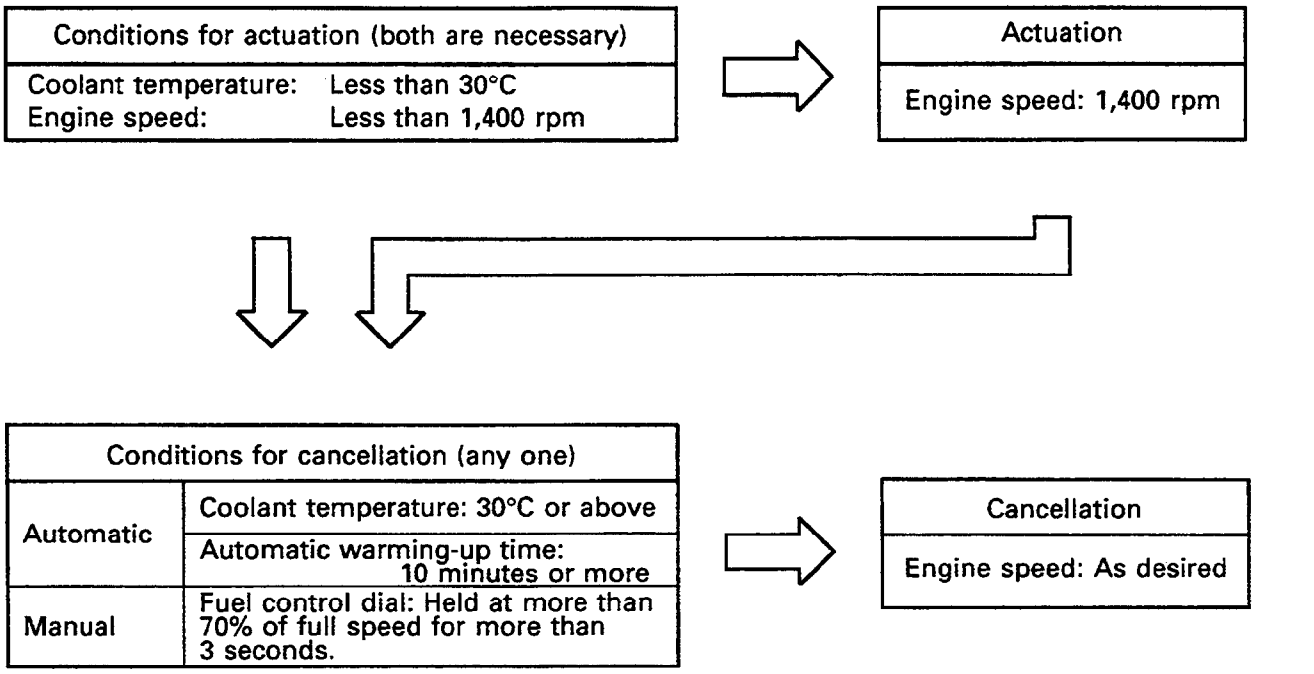
FUNCTION

- If the coolant temperature is low, this automatically raises the engine speed to warm up the engine after it is started. (Automatic warming-up function)
  In addition, if the coolant temperature rises too high during operations , it reduces the load of the pump to prevent overheating. (Engine overheat prevention function)

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1) Engine automatic warming-up function

- After the engine is started, if the engine coolant temperature is low, the engine speed is automatically raised to warm up the engine.

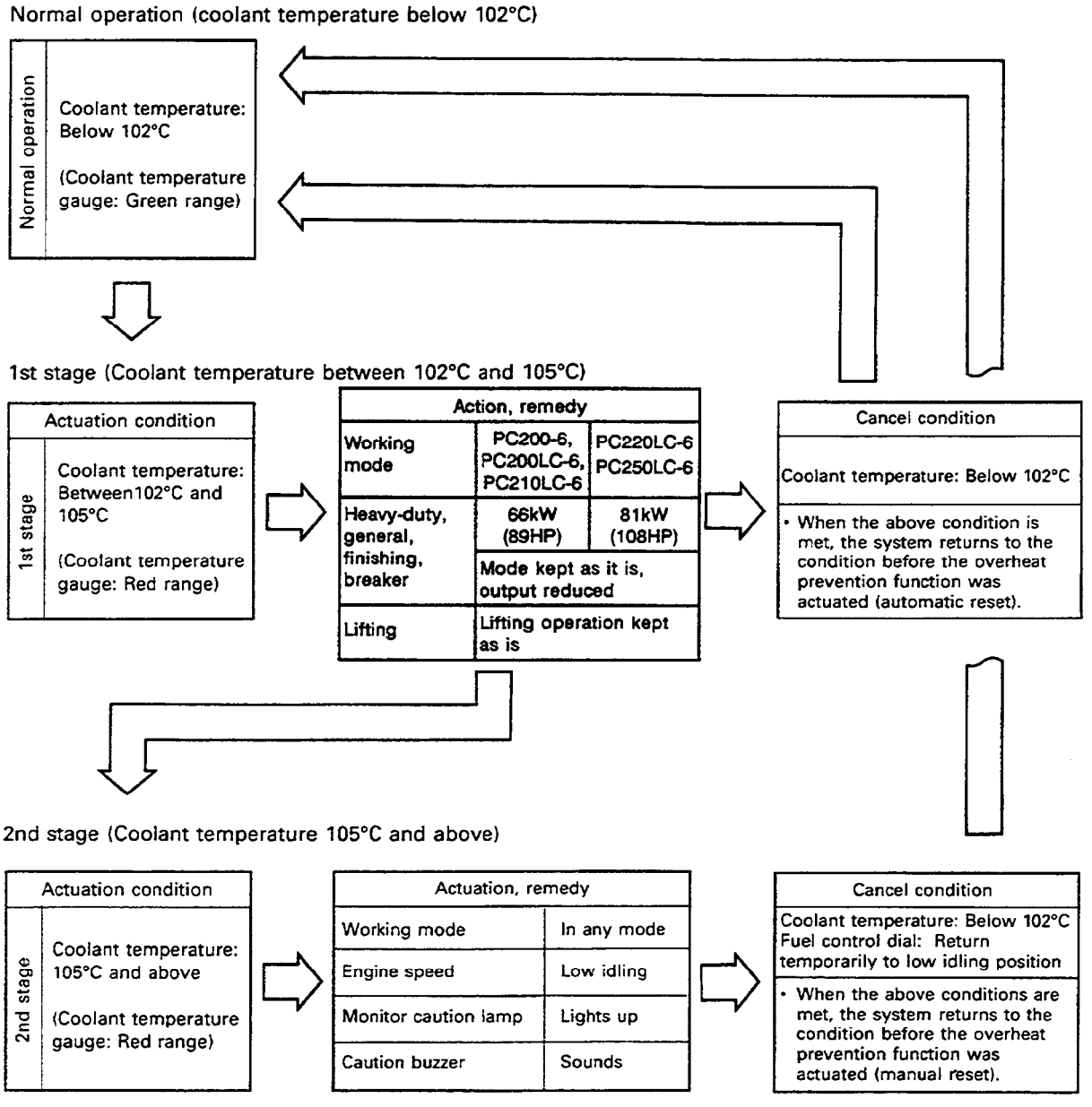


X12BV103

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2) Engine overheat prevention function

- This function protects the engine by lowering the pump load and engine speed to prevent overheating when the engine coolant temperature has risen too far.
- This system is actuated in two stages. The first stage is when the water temperature is between 102°C and 105°C, and the second stage is when the water temperature is 105°C and above.

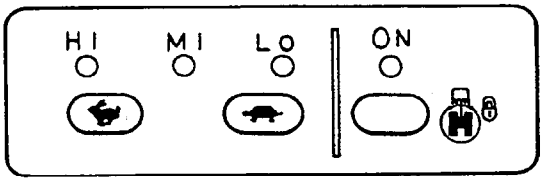


X12BV104

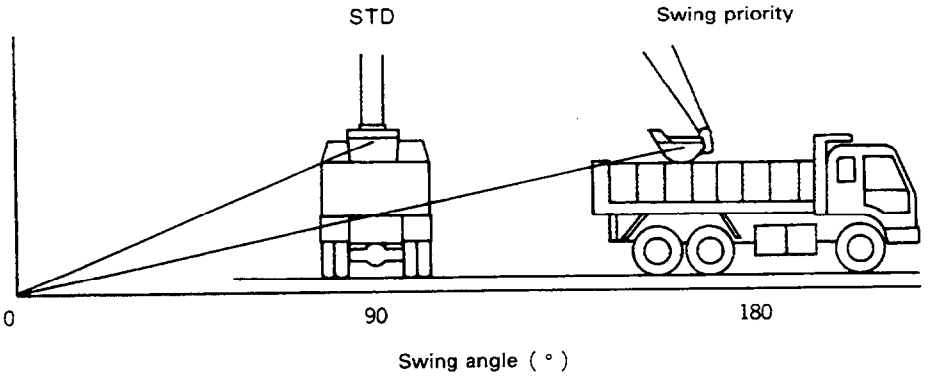
https://truckmanualshub.com/

6. SWING PRIORITY FUNCTION

- There is a SWING ACCEL switch on the monitor panel for the boom/swing priority selection mode. This switch can be turned ON or OFF to change the matching of the boom RAISE and swing operations.
  The oil flow is divided and sent to the swing to match the swing angle to allow compound operations to be carried out easily.
  Boom/swing priority selection mode OFF:
  90° swing and loading of dump truck
  Boom/swing priority selection mode ON:
  180° swing and loading of dump truck



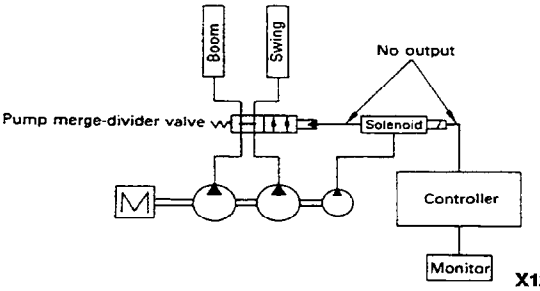
X12BV106



X12BV105

- The change in the matching between the boom RAISE and swing is carried out by changing the signal to the pump merge-divider valve.

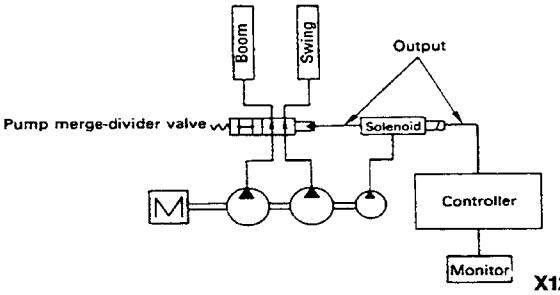
When boom/swing priority selection mode is OFF



X12BV107

Boom RAISE and swing are parallel

When boom/swing priority selection mode is ON

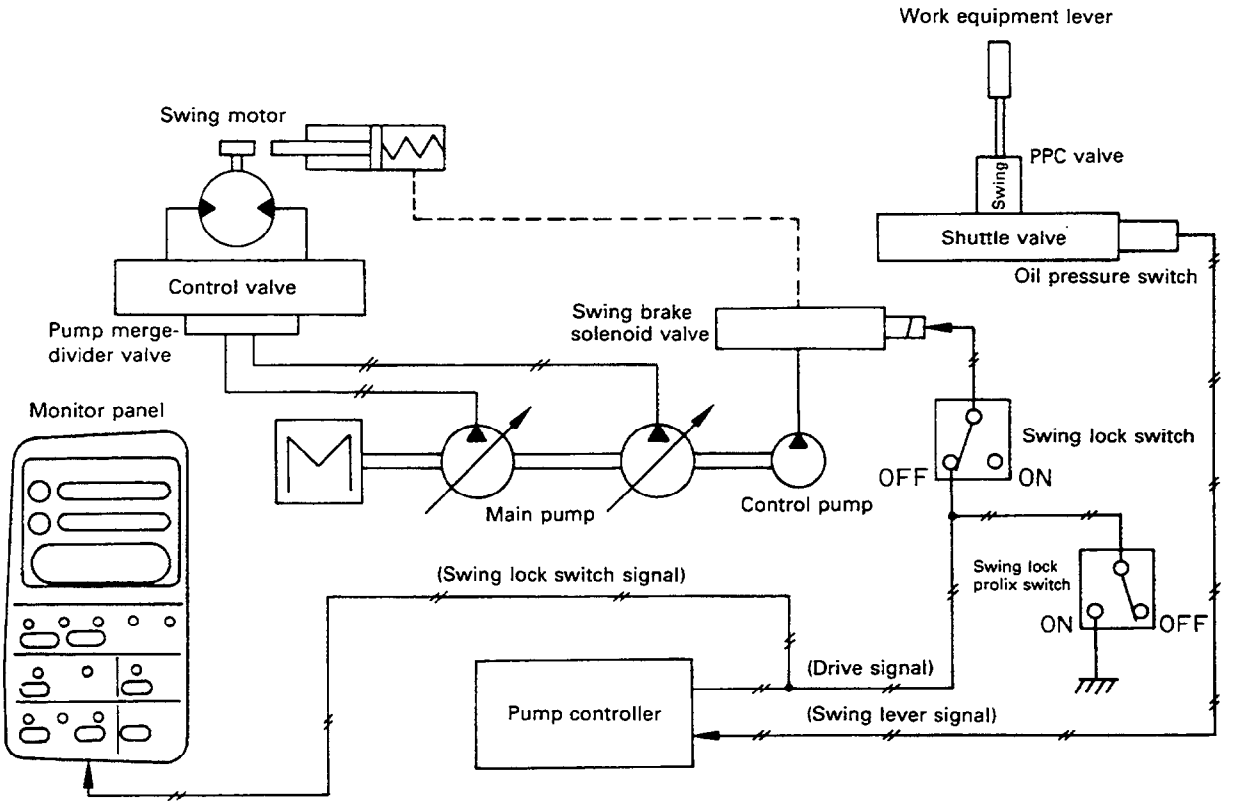


X12BV108

The boom RAISE and swing use separate pumps, so swing is independent

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7. SWING CONTROL FUNCTION



X12BV109

FUNCTION

- The system is provided with a swing lock and swing holding brake function.

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1) Swing lock, swing holding brake function

- The swing lock (manual) can be locked at any desired position, and the swing holding brake (automatic) is interconnected with the swing, so it prevents any hydraulic drift after the swing is stopped.

Lock switch	Lock lamp	Function	Operation
OFF	OFF	Swing holding brake	When swing lever is placed at neutral, swing brake is applied after approx. 4 sec; when swing lever is operated, brake is canceled and swing can be operated freely
ON	ON	Swing lock	Swing lock is actuated and swing is held in position. Even when swing lever is operated, swing lock is not canceled and swing does not move.

☆ **Operation of swing lock prolix switch**

- If any abnormality should occur in the controller, and the swing holding brake is not actuated normally and the swing cannot be operated to cancel the swing lock and allow the swing to be operated.

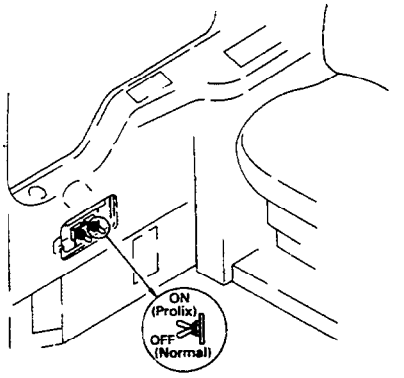
★ Even when the swing lock prolix switch is turned ON, the swing lock switch stays ON and the swing brake is not canceled.

★ When the swing brake is canceled, the swing has only a hydraulic brake operated by the safety valve, so if the swing is stopped on a slope, there may be hydraulic drift.

Swing lock prolix switch	ON (when controller is abnormal)		OFF (when controller is normal)	
Swing lock switch	ON	OFF	ON	OFF
Swing brake	Swing lock applied	Swing lock canceled	Swing lock applied	Swing holding brake applied

2) Hydraulic oil quick warm-up function when swing lock switch in ON

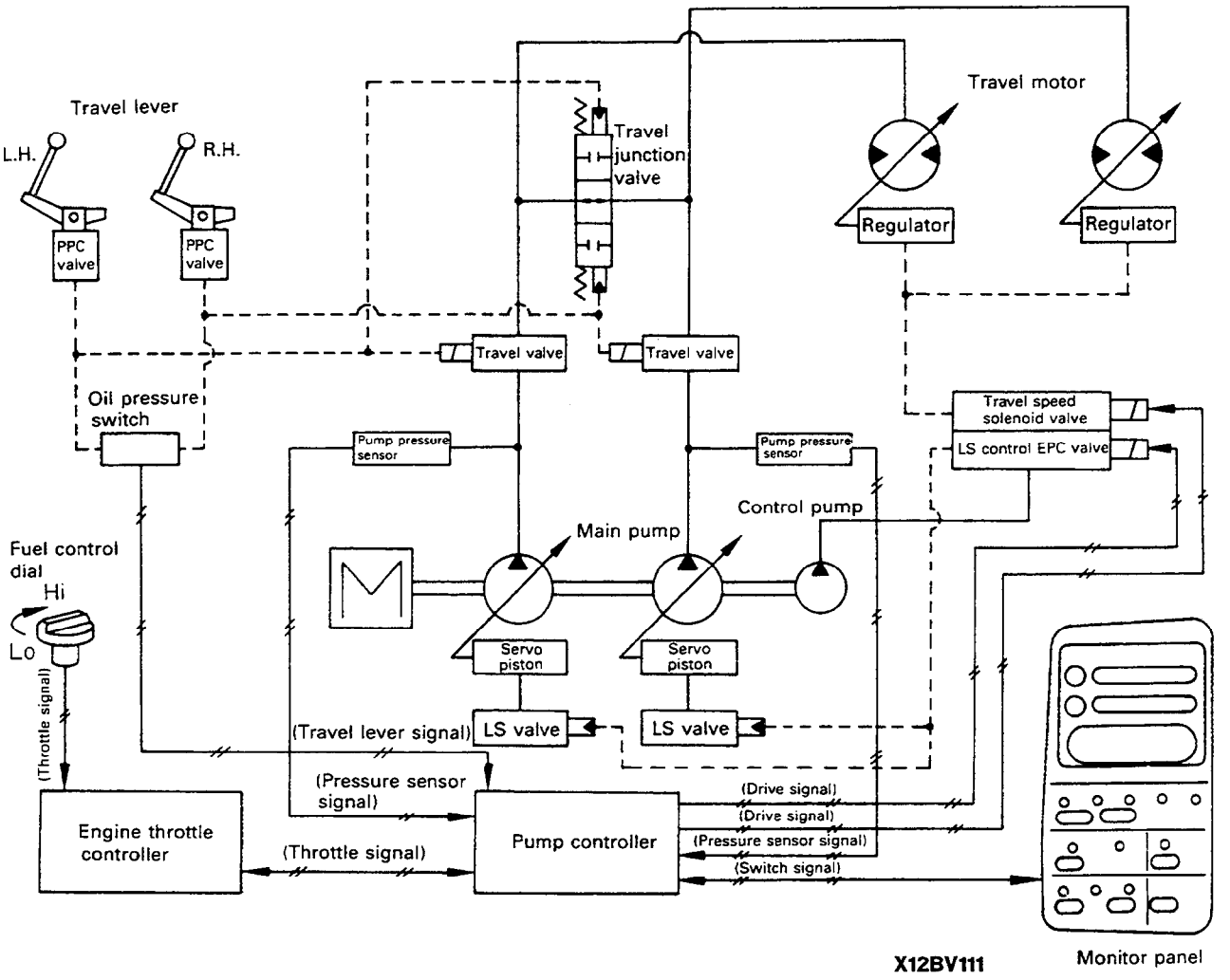
- When the swing lock is turned ON, the relief pressure rises from 31.85 MPa (325 kg/cm^2). If the work equipment is relieved in this condition, the hydraulic oil temperature will rise more quickly and the warming-up time can be reduced.



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8. TRAVEL CONTROL FUNCTION



FUNCTION

- When traveling, the pump control is carried out, and the travel speed can be selected manually or automatically to give a travel performance that suits the nature of the work at the jobsite.

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1) Pump control function when traveling

- If the travel is operated in any working mode other than the heavy-duty (H/O) mode, this increases the pump absorption torque while keeping the working mode and engine speed as they are.

★ For details, see PUMP AND ENGINE MUTUAL CONTROL SYSTEM.

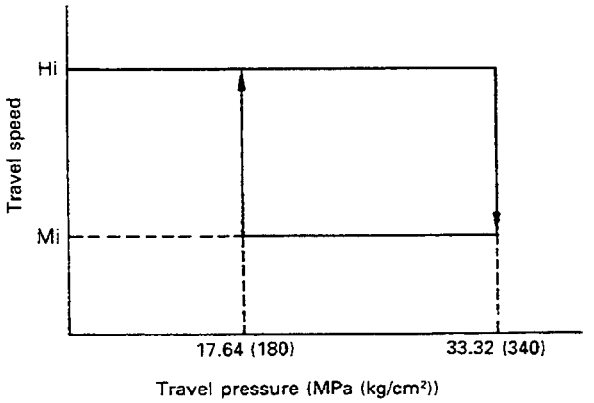
2) Travel speed selection function

i) Manual selection using travel speed switch
If the travel speed switch is set to Lo, Mi, or Hi, the pump controller controls the pump flow and motor volume at each speed range as follows to switch the travel speed.

ii) Automatic selection according to engine speed
If the engine speed is reduced to below 1400 rpm by the fuel control dial:
- If the machine is traveling in Lo, it will not shift even if Mi or Hi are selected.
- If the machine is traveling in Mi, it will not shift even if Hi is selected.
- If the machine is traveling in Hi, it will automatically shift to Mi.

iii) Automatic selection according to pump discharge pressure
If the machine is traveling with the travel speed switch at Hi, and the load increases, such as when traveling up a steep hill, if the travel pressure continues at 33.32 MPa (340 kg/cm^2) for more than 0.5 sec, the motor volume is automatically switched and the travel speed changes to Mi.
(The travel speed switch stays at Hi.)
The machine continues to travel in Mi, and when the load is reduced, such as when the machine travels again on flat ground or goes downhill, and the travel pressure stays at 17.64 MPa (180 kg/cm^2) or less for more than 0.5 sec, the motor volume is automatically switched and the travel speed returns to Hi.

Travel speed switch	Lo (Low speed)		Mi (Mid-range speed)	Hi (High speed)	
Pump flow (%)	80		80	100	
Motor volume	Max.		Min.	Min.	
Travel speed (km/h)	PC200-6 PC200LC-6 PC210LC-6 PC220LC-6	PC250LC-6	PC200-6 PC200LC-6 PC210LC-6 PC220LC-6 PC250LC-6	PC200-6 PC200LC-6 PC210LC-6 PC220LC-6	PC250LC-6
	3.0	2.2	4.1	5.5	5.1

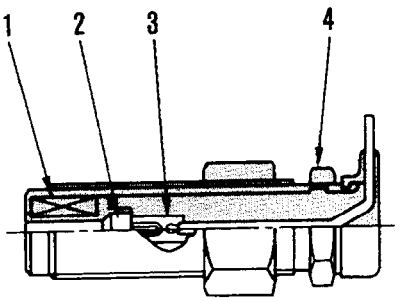


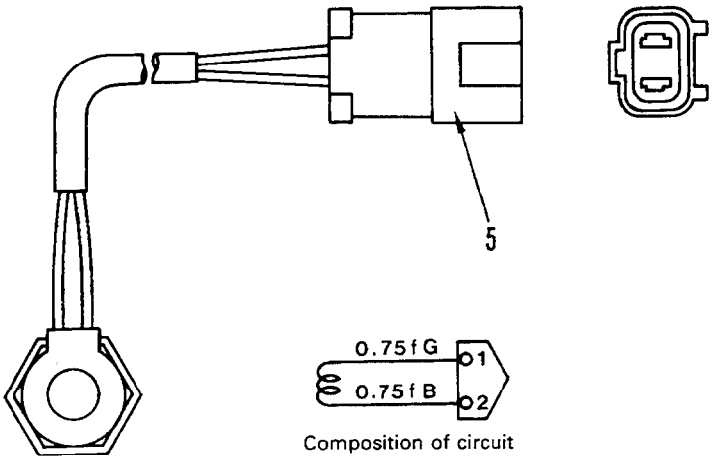
X12BV112

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9. COMPONENTS OF SYSTEM

1) ENGINE SPEED SENSOR





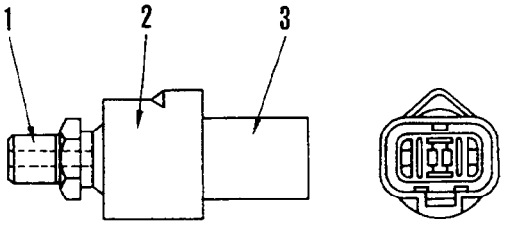
X12BV113

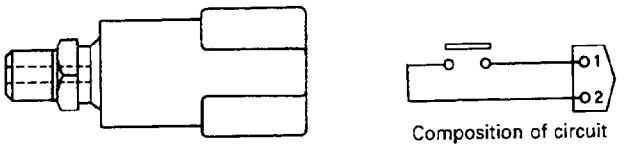
1. Wire
2. Magnet
3. Terminal
4. Housing
5. Connector

FUNCTION

- The engine speed sensor is installed to the ring gear portion of the engine flywheel. It counts electrically the number of gear teeth that pass in front of the sensor, and sends the results to the pump controller.
- This detection is carried out by a magnet, and an electric current is generated every time the gear tooth passes in front of the magnet.

2) PPC OIL PRESSURE SWITCH





X12BV114

1. Plug
2. Switch
3. Connector

SPECIFICATIONS

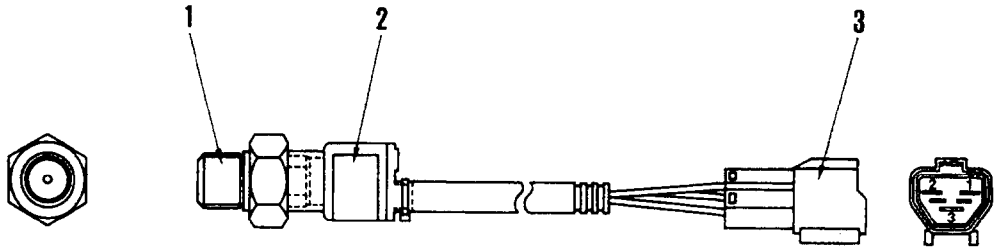
Composition of points	: N.O. points
Actuation (ON) pressure	: 0.49 ± 0.1 MPa (5.0 ± 1.0 kg/cm^2)
Reset (OFF) pressure	: 0.29 ± 0.05 MPa (3.0 ± 0.5 kg/cm^2)

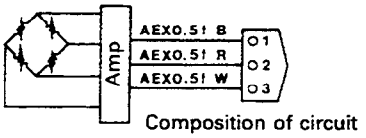
FUNCTION

- There are 8 switches installed to the PPC shuttle valve. The operating conditions of each actuator is detected from the PPC pressure, and this is sent to the pump controller.

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3) PUMP PRESSURE SENSOR



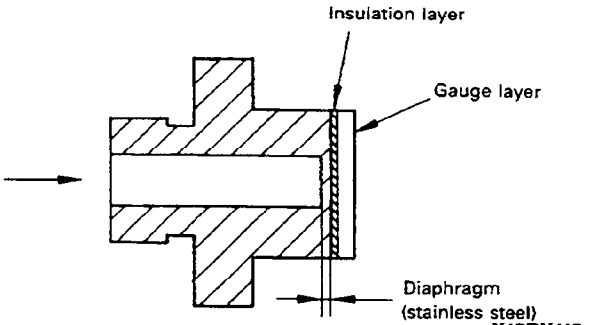


Composition of circuit

X12BV115

FUNCTION

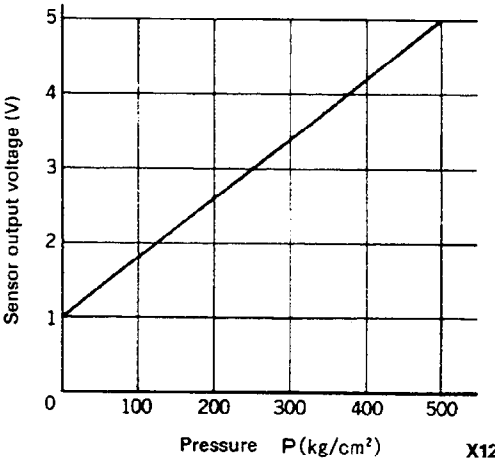
This sensor is installed to the inlet port circuit of the control valve. It converts the pump discharge pressure to a voltage and sends this to the controller.



X12BV116

OPERATION

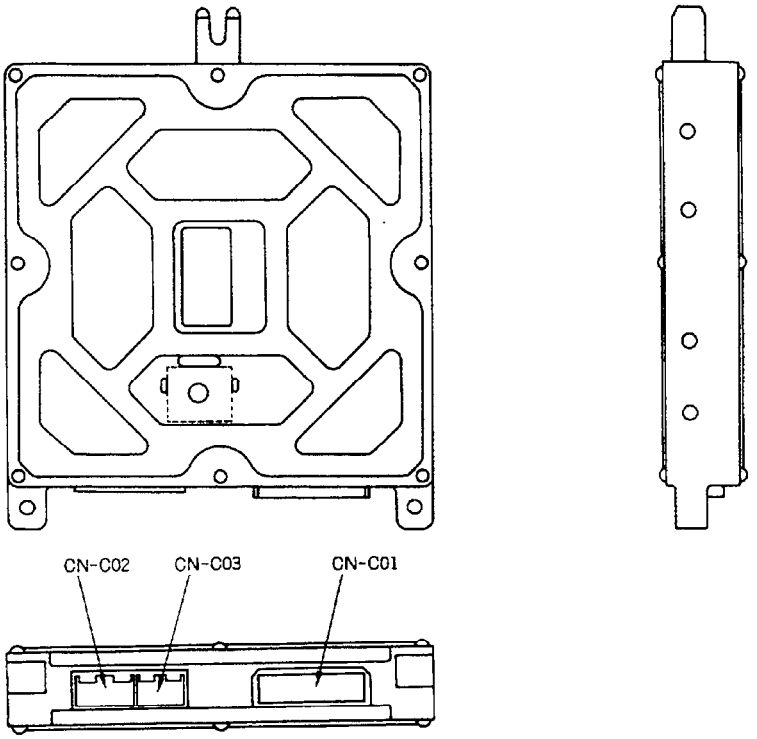
- When the pressurized oil entering from the pressure introduction portion pressurizes the diaphragm of the pressure detection portion, the diaphragm deflects and changes shape.
  A gauge layer is installed to the face opposite the diaphragm, and the resistance of the gauge layer converts the deflection on the diaphragm into an output voltage and sends it to the amp (voltage amplifier).
- The voltage is further amplified by the amplifier and is sent to the pump controller.
- Relationship between P (kg/cm^2) and output voltage(V).
  V = 0.008 X P + 1.0
  ★ 1 kg/cm^2 = 0.098 MPa



X12BV117

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4) PUMP CONTROLLER



X12BV118

Input and output signals

CN-C01

No.	Name of signal	Input/ Output
1	GND	—
2	GND	—
3	LS select solenoid	Output
4	Pump merge-divider solenoid	Output
5	—	—
6	Travel speed solenoid	Output
7	LC control EPC (-)	Output
8	TVC1 (-)	Output
9	TVC2 (-)	Output
10	Controller power source 24V	—
11	Controller power source 24V	—
12	LS bypass solenoid	Output
13	Swing brake solenoid	Output
14	2-stage relief solenoid	Output
15	LS control EPC (+)	Output
16	TVC1 (+)	Output
17	TVC2 (+)	Output

CN-C02

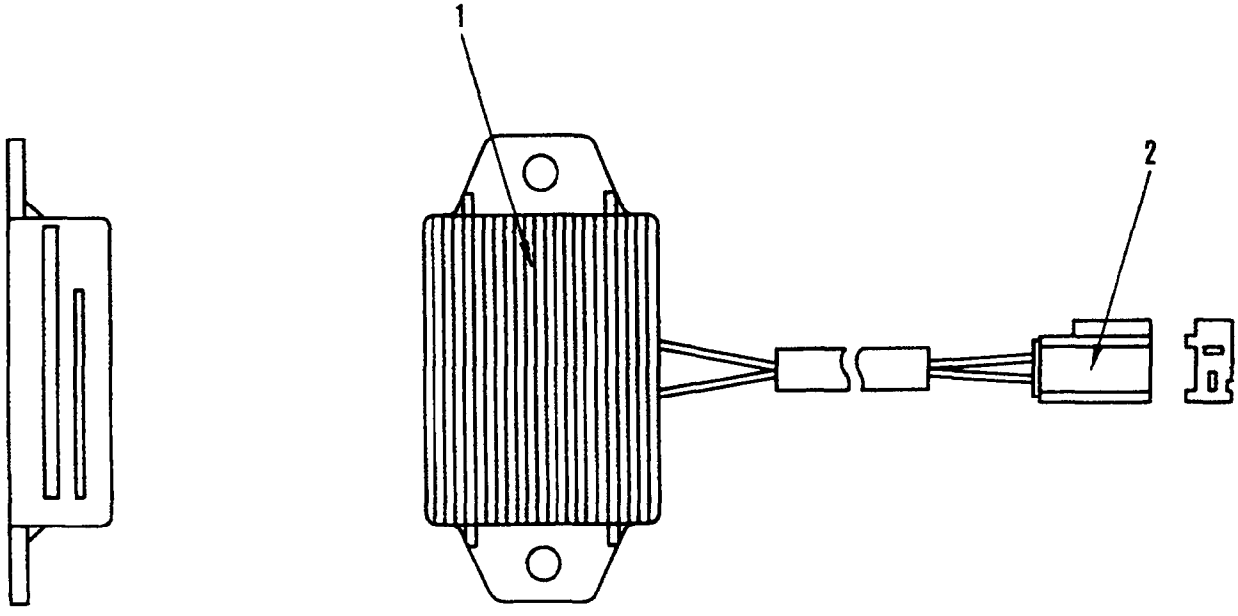
No.	Name of signal	Input/ Output
1	Swing switch	Input
2	Boom LOWER switch	Input
3	Travel switch	Input
4	Boom RAISE switch	Input
5	Arm IN switch	Input
6	Arm OUT switch	Input
7	Bucket CURL switch	Input
8	Bucket DUMP switch	Input
9	Swing lock switch	Input
10	Service switch	Input
11	Model selection 5	Input
12	Swing lock prolix switch	Input
13	Model selection 1	Input
14	Model selection 2	Input
15	Model selection 3	Input
16	Model selection 4	Input
17	—	—
18	L.H. knob switch	Input
19	—	—
20	—	—

CN-C03

No.	Name of signal	Input/ Output
21	Pressure sensor 1 (SIG)	Input
22	Pressure sensor 2 (SIG)	Input
23	Pressure sensor power 24 V	—
24	—	—
25	Auto deceleration	Output
26	Speed sensor (+)	Input
27	Network circuit (monitor +)	—
28	Monitor circuit (engine +)	—
29	Pressure sensor 1 (GND)	—
30	Pressure sensor 2 (GND)	—
31	—	—
32	—	—
33	—	—
34	Speed sensor (-)	Input
35	Network circuit (-)	—
36	—	—

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5) TVC PROLIX RESISTOR



X12BV119

1. Resistor
2. Connector

SPECIFICATION
Resistance; 30 Ω

FUNCTION
- This resistor acts to allow a suitable current to flow to the TVC solenoid when the TVC prolix switch is ON.
- No current flows when the TVC prolix switch is OFF.

6) FUEL CONTROL DIAL, GOVERNOR MOTOR, ENGINE THROTTLE CONTROLLER
★ See ENGINE CONTROL SYSTEM.

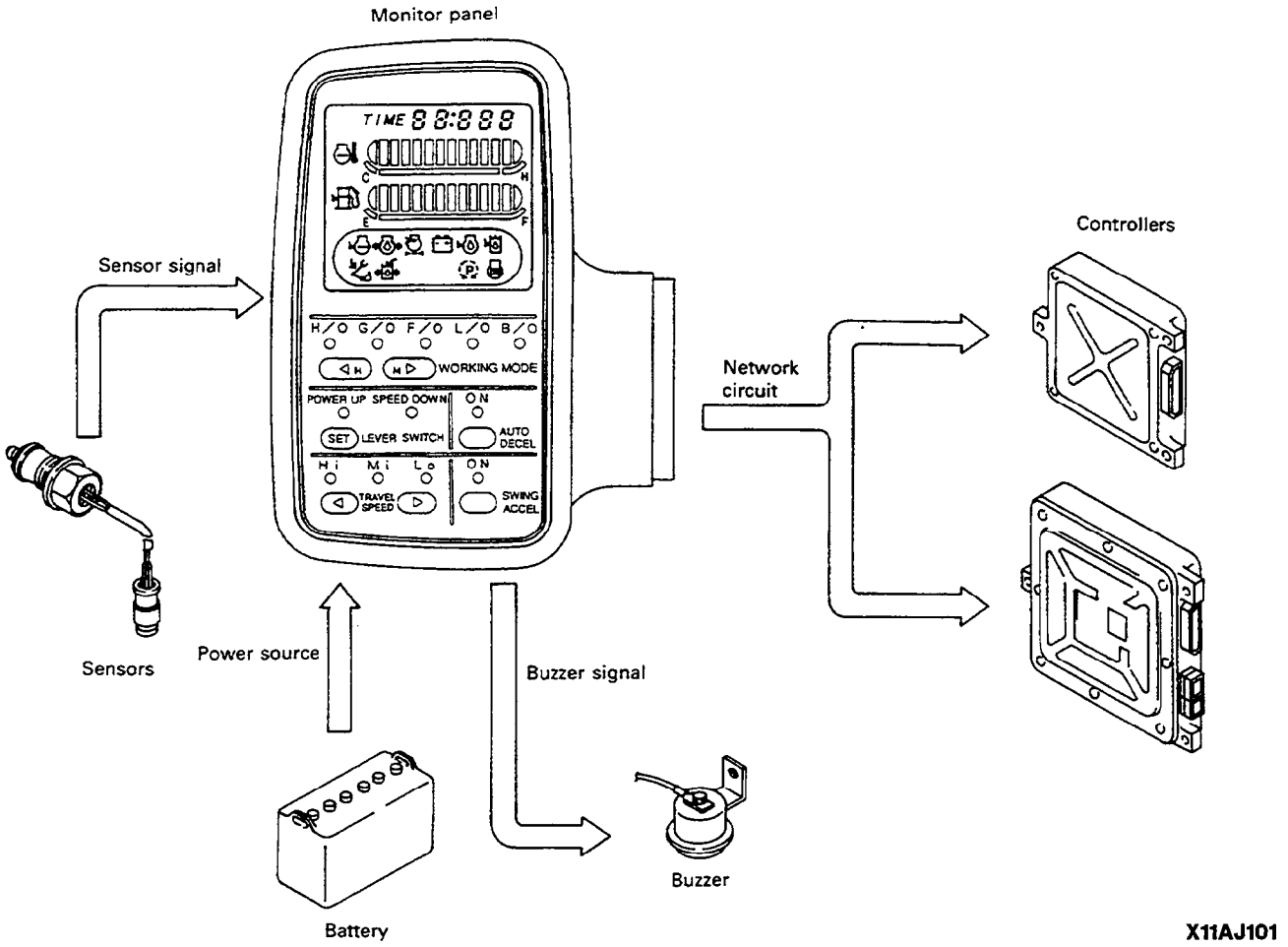
7) MONITOR PANEL
★ See MONITORING SYSTEM.

8) TVC VALVE
★ See HYDRAULIC PUMP.

9) LS CONTROL EPC VALVE
LS SELECT SOLENOID VALVE
PUMP MERGE-DIVIDER SOLENOID VALVE
2-STAGE RELIEF SOLENOID VALVE
TRAVEL SPEED SOLENOID VALVE
SWING BRAKE SOLENOID VALVE
★ See EPC, SOLENOID VALVE

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MACHINE MONITOR SYSTEM



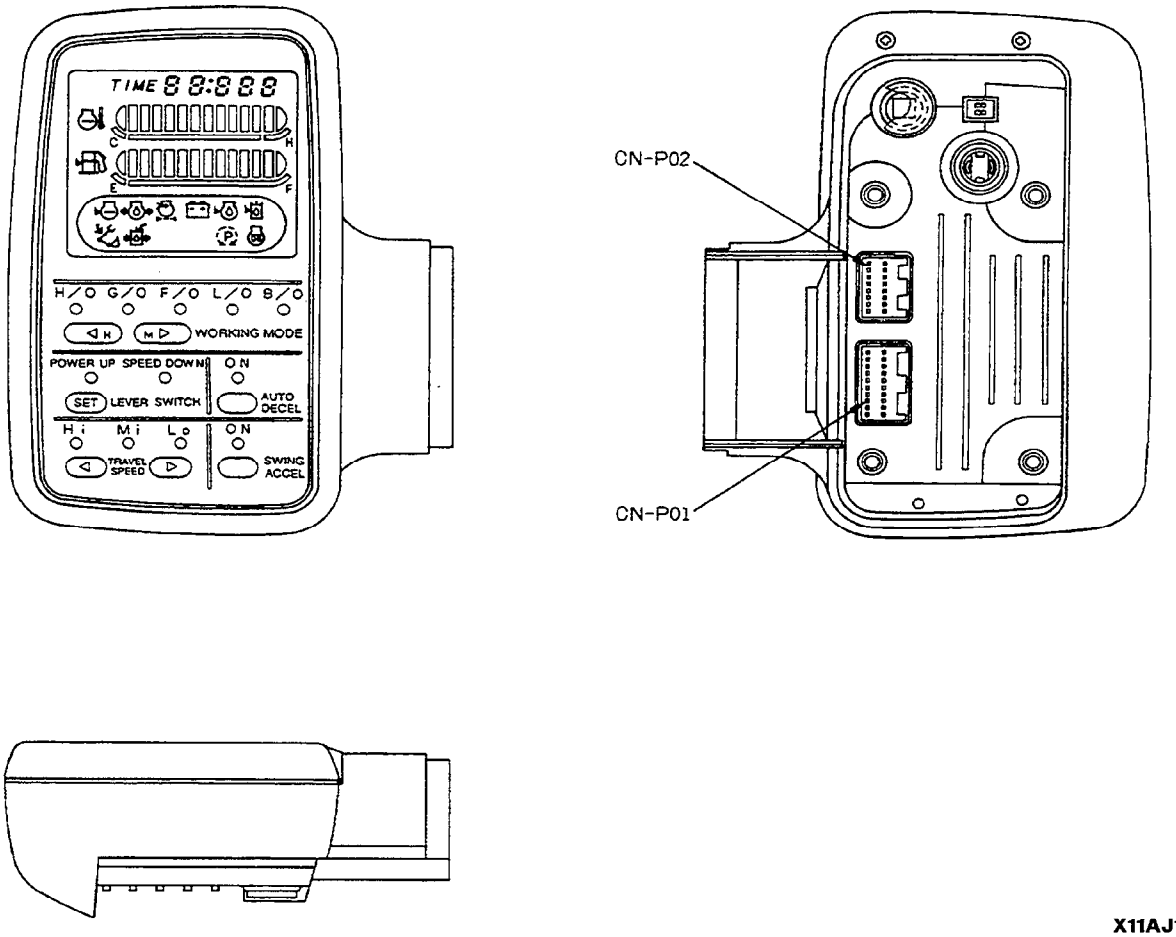
FUNCTION

- The machine monitor system uses the network circuits between the controllers and sensors installed to all parts of the machine to observe the condition of the machine. It processes this information, and displays it on a panel to inform the operator of the condition of the machine.
- The content of the information displayed on the machine can broadly be divided as follows.
  1. Monitor portion
     This gives an alarm if any abnormality occurs in the machine.
  2. Gauge portion
     This always displays the coolant temperature and fuel level.
  3. Time display
     1) This normally displays the time,.
     2) If this is set to the machine data monitoring mode, internal data from each controller, including the monitor panel itself, are displayed.
     3) If it is set to the trouble data memory mode, the trouble data for each controller, including the monitor itself, are displayed.
     4) It displays that the system has been set to the governor motor adjustment mode and automatic vibration offset adjustment mode.
     5) In emergencies, it displays abnormalities in any controller.

     ★ For details of the content of the display and the method of operation, see TROUBLESHOOTING.
- The monitor panel has various built-in mode selector switches, and also functions as the control panel for the electronic control system.

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1. MONITOR PANEL



X11AJ102

Outline

- The monitor panel consists of the time display, monitor display, and mode selector switches.
- It has a built-in CPU (Central Processing Unit), and processes, displays, and outputs the data from the sensors and controllers.
- The time display and monitor display panels use a liquid crystal display (LCD).
  The mode switches are flat sheet switches.

Input and output signals

CN-P01

Pin No.	Name of signal	Input/output
1	Monitor power source	—
2	Monitor power source	—
3	Hydraulic oil level	Input
4	Model selection 5	Input
5	Air cleaner clogging	Input
6	Starting switch ON	Input
7	Lamp	Input
8	Preheating	Input
9	Start signal	Input
10	Coolant level	Input
11	GND	—
12	GND	—
13	Buzzer	Output
14	EPC relay	Input
15	Model selection 4	Input
16	Engine oil pressure Hi	Input
17	Engine oil pressure Lo	Input
18	Engine oil level	Input
19	—	—
20	—	—

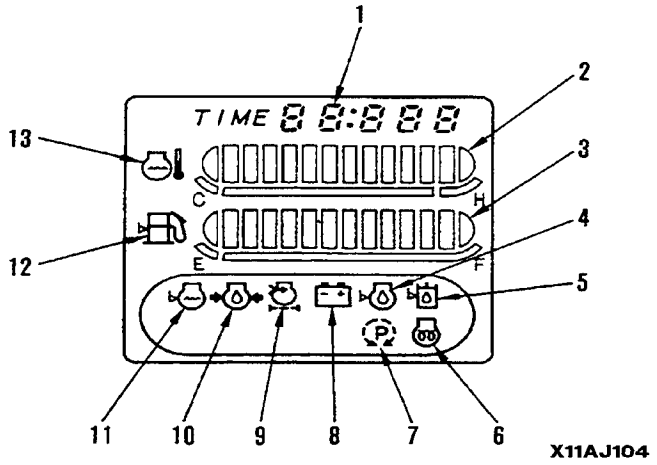
CN-P02

Pin No.	Name of signal	Input/output
1	PPC oil pressure	Input
2	Overload	Input
3	Swing prolix	Input
4	Model selection 1	Input
5	Model selection 2	Input
6	Model selection 3	Input
7	Network (pump +)	Input
8	Network (engine +)	Input
9	Swing lock	Input
10	Buzzer cancel	Input
11	Fuel level	Input
12	Coolant temperature	Input
13	Charge level	Input
14	Engine speed (–)	Input
15	Engine speed (+)	Input
16	Network (–)	—

X11AJ103

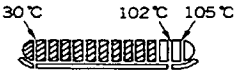
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MONITOR DISPLAY



1. Clock
2. Coolant temperature gauge
3. Fuel level gauge
4. Engine oil level caution lamp
5. Hydraulic oil level caution lamp
6. Preheating pilot lamp
7. Swing holding brake pilot lamp
8. Battery charge caution lamp
9. Air cleaner clogging caution lamp
10. Engine oil pressure caution lamp
11. Coolant level caution lamp
12. Fuel level caution lamp
13. Coolant temperature caution lamp

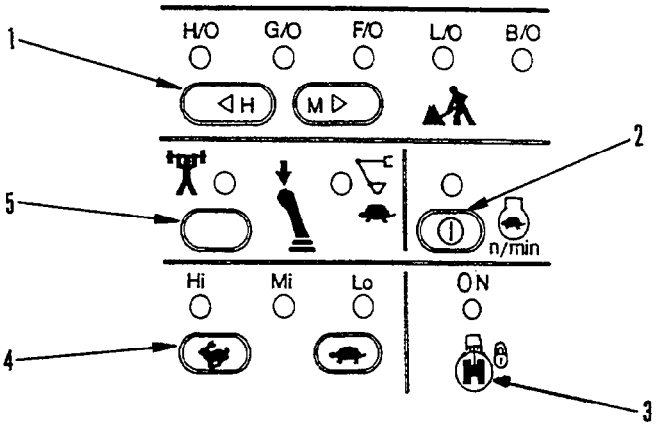
Content of display

Symbol	Display item	Display range	When engine is stopped	When engine is running
	Coolant level	Below low level	Flashes when abnormal	Flashes and buzzer sounds when abnormal
	Engine oil pressure	Below 1500 rpm: below 0.05 MPa (0.5 kg/cm^2) Above 1500 rpm: below 0.15 MPa (1.5 kg/cm^2)	Lights up when normal (goes out when engine starts)	Flashes and buzzer sounds when abnormal
	Air cleaner clogging	When clogged	OFF	Flashes when abnormal
	Charge level	When charging is defective	Lights up when normal (goes out when engine starts)	Flashes when abnormal
	Engine oil level	Below low level	Flashes when abnormal	OFF
	Hydraulic oil level	Below low level	Flashes when abnormal	OFF
	Swing lock	When swing is locked	Lights up when swing lock switch is ON, flashes when swing lock prolix switch in ON	
	Preheating	During preheating	Lights up for 30 seconds when starting switch is at HEAT, then flashes for 10 seconds to indicate that preheating is completed	
	Coolant temperature	Flashes when above 102°C, flashes and buzzer sounds when above 105 °C		
	Fuel level	Flashes when below low level		

★ When the starting switch is turned ON, the buzzer sounds for 1 second, all the monitor display lamps light up for 3 seconds, and after this, all lamps except “Engine oil pressure” and “Charge level” go out.
The “Engine oil pressure” and “Charge level” go out when the engine is started.

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SWITCHES



X11AJ105

1. Working mode switch
2. Auto-deceleration switch
3. Boom/swing priority mode switch
4. Travel speed switch
5. Power max./Swift slow-sown switch

- The switch portion consists of five mode selection switches, and the condition of the machine changes each time that any switch is pressed. The LED above the switch lights up to display the present condition of the machine.

Switch actuation table

Symbol	Item	Action
	WORKING MODE	H/O ↔ **G/O** ↔ F/O ↔ L/O ↔ B/O
	KNOB BUTTON	**POWER UP** ↔ SPEED DOWN
	AUTO DECEL	**ON** ↔ OFF
	TRAVEL SPEED	Hi ↔ Mi ↔ **Lo**
	SWING ACCEL	**OFF** ↔ ON

★ The bold letters indicate the default position of the switch when the starting switch is turned ON.

X11AJ106

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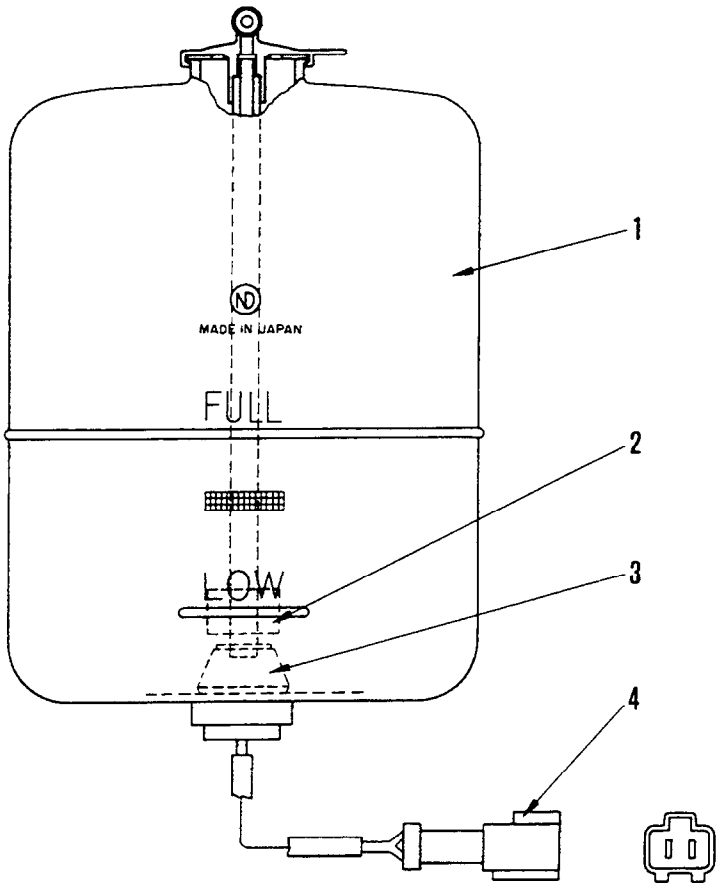
2. SENSORS

- The signals from the sensors are input directly to the monitor panel.
  The contact type sensors are always connected at one end to the chassis GND.

Name of sensor	Type of sensor	When normal	When abnormal
Coolant level	Contact type	ON (close)	OFF (open)
Engine oil level	Contact type	ON (close)	OFF (open)
Hydraulic oil level	Contact type	ON (close)	OFF (open)
Engine oil pressure	Contact type	OFF (open)	ON (close)
Coolant temperature	Resistance type	—	—
Fuel level	Resistance type	—	—
Air cleaner clogging	Contact type	ON (close)	OFF (open)

1) COOLANT LEVEL SENSOR

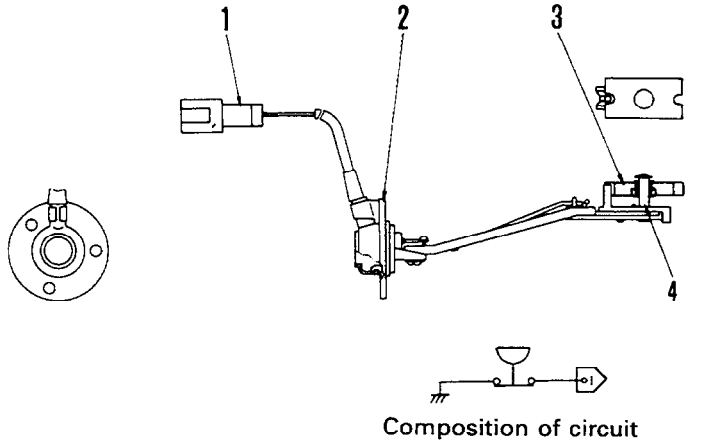
1. Sub tank
2. Float
3. Sensor
4. Connector



X11AJ107

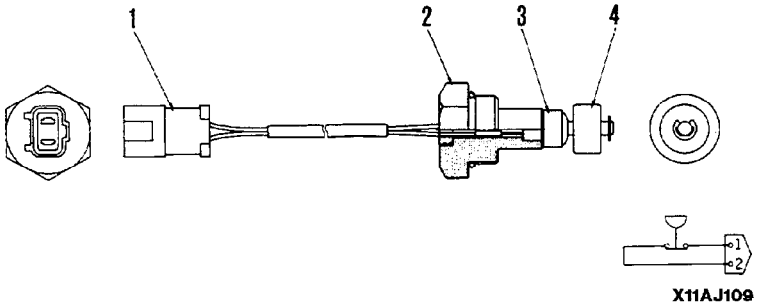
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2) ENGINE OIL LEVEL SENSOR



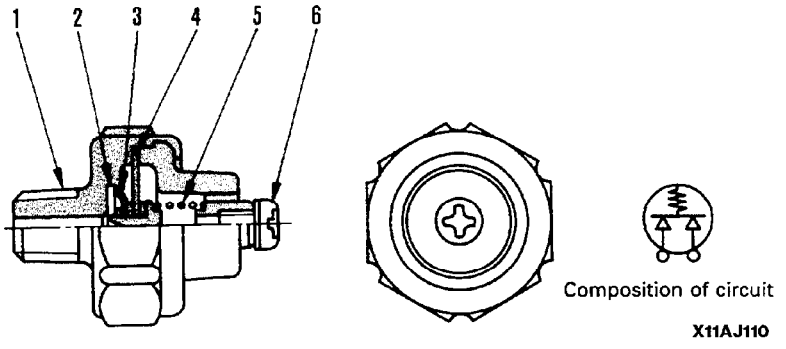
1. Connector
2. Bracket
3. Float
4. Switch

3) HYDRAULIC OIL LEVEL SENSOR



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

4) ENGINE OIL PRESSURE SENSOR (COMMON FOR BOTH Lo AND Hi)

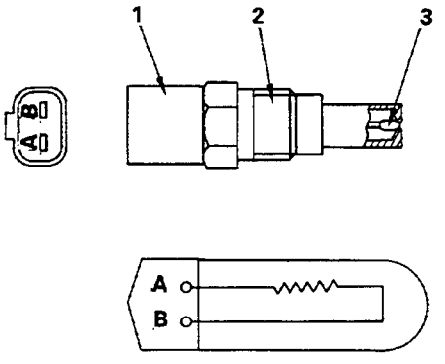


1. Plug
2. Contact ring
3. Contact
4. Diaphragm
5. Spring
6. Terminal

Actuation (ON) pressure
Lo: 0.05 ± 0.02 MPa
(0.5 ± 0.2 kg/cm^2) or less
Hi: 0.15 ± 0.02 MPa
(1.5 ± 0.2 kg/cm^2) or less

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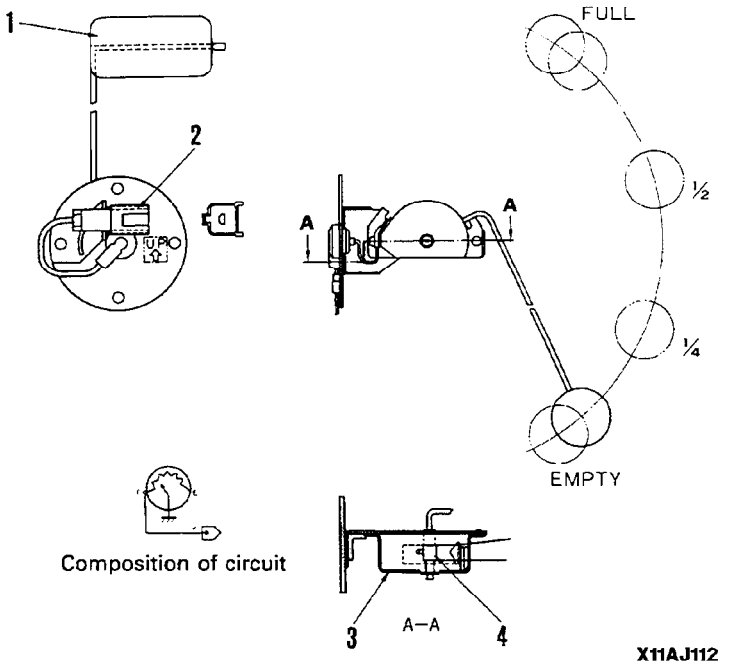
5) COOLANT TEMPERATURE SENSOR



X11AJ111

1. Connector
2. Plug
3. Thermistor

6) FUEL LEVEL SENSOR

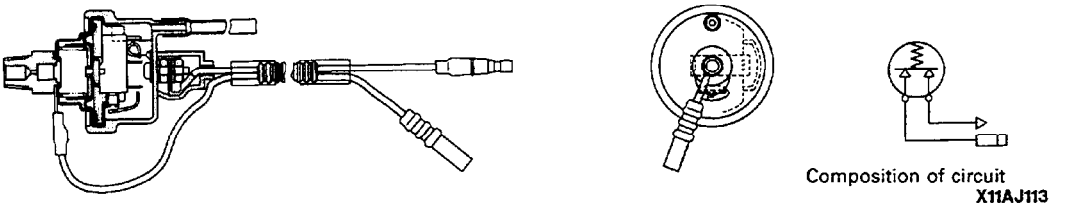


X11AJ112

1. Float
2. Connector
3. Cover
4. Variable resistor

7) AIR CLEANER CLOGGING SENSOR

Actuation (OFF) pressure: -7.47 ± 0.49 kPa (-762 ± 50 mm H_2O)



X11AJ113

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20 TESTING AND ADJUSTING

Table of judgment standard values 20- 2
Standard value table for electrical parts 20-14
Tools for testing, adjusting and troubleshooting 20-23
Measuring engine speed 20-24
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⚠ When carrying out testing, adjusting, or troubleshooting, park the machine on level ground and use the safety pins and blocks to prevent the machine from moving.
⚠ When carrying out work together with other workers, always use signals and do not let unauthorized people near the machine.
⚠ When checking the coolant level, always wait for the coolant to cool down. If the radiator cap is removed when the coolant is still hot, the coolant will spurt out and cause burns.
⚠ Be careful not to get caught in the fan, fan belt, or other rotating parts.

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TABLE OF JUDGEMENT STANDARD VALUE

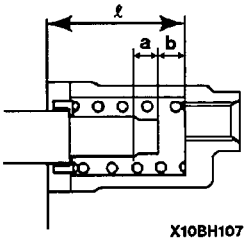
• FOR ENGINE

Machine Model				PC200-6, PC200LC-6 PC210LC-6		PC220LC-6 PC250LC-6	
Engine model				S6D102-1		SA6D102-1	
Item	Measurment Conditions		Unit	Standard Value	Permissible Value	Standard Value	Permissible Value
Engine speeds	High idle	H/O mode	rpm	2130 ± 60	2130 ± 60	2300 ± 60	2300 ± 60
		G/O mode		2050 ± 60	2050 ± 60	2120 ± 60	2120 ± 60
		F/O mode		2050 ± 60	2050 ± 60	2120 ± 60	2120 ± 60
		L/O mode		1710 ± 60	1710 ± 60	1800 ± 60	1800 ± 60
	Low idle in H/O mode			1066 ± 60	1066 ± 60	1066 ± 60	1066 ± 60
Engine rating	Rated gross power / rated speed		kW/rpm	145/2200	145/2200	174/2300	174/2300
Intake manifold pressure	At rated speed ★★		mm Hg	850 - 1100	850 - 1100	960 - 1020	960 - 1020
Intake air restriction	New element - At all speeds		mm H_2O	380	635	380	635
Lubricating oil pressure	With SAE 15W-40 oil and coolant temperature in operating range: Minimum at low idle Minimum at rated speed ★★		kPa (kg/cm^2)	69 (0.70) 207 (2.11)	69 (0.70) 207 (2.11)	69 (0.70) 207 (2.11)	69 (0.70) 207 (2.11)
Fuel filter inlet restriction	Maximum restriction		kPa (kg/cm^2)	34 (0.35)	34 (0.35)	34 (0.35)	34 (0.35)
Blowby pressure	Service tool orifice size of 5.613 mm (0.221 in) and coolent temperature in operating range: At rated speed ★★		mm H_2O	114	508	114	508
Exhaust back pressure	Maximum at any condition		mm Hg	76	76	76	76
Coolant temperature	Maximum operating temperature		° C	100	100	100	100
Valve clearance	Engine cold: Intake valves Exhaust valves		mm	0.25 0.51	0.25 0.51	0.25 0.51	0.25 0.51

★ For further detailed information, refer to Engine Shop Manual.
★ ★ Rated speed for S6D102-1 - 1950 rpm ; for SA6D102-1 - 2100 rpm.

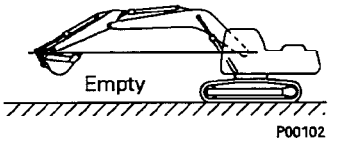
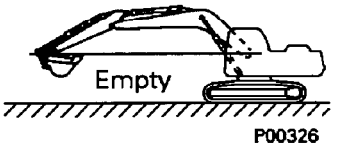
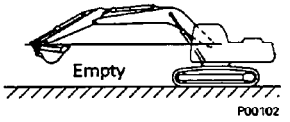
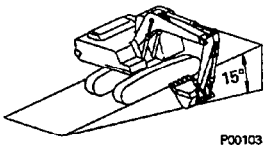
• FOR CHASSIS

★ The standard values and permissible value shown in this table are all values for H/O (heavy-duty operation) mode.

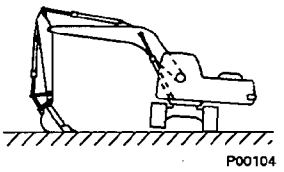
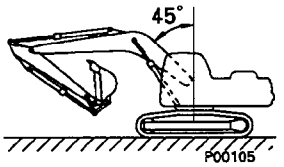
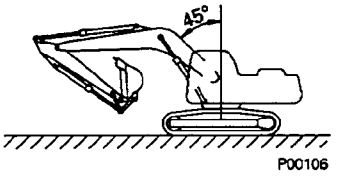
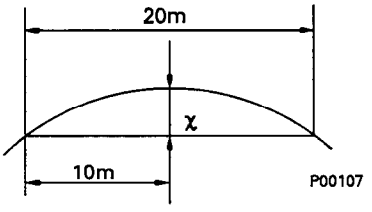
Machine model					PC200-6, PC200LC-6, PC210LC-6, PC220LC-6, PC250LC-6			
					Standard value		Permissible value	
Category	Item		Measurement conditions	Unit	PC200 PC200LC PC210LC	PC220LC PC250LC	PC200 PC200LC PC210LC	PC220LC PC250LC
Engine speed	At 2-pump relief	Normal	• Engine at high idling • Hydraulic oil temperature: 45 - 55° C • Coolant temperature: Within operating range • 2-pump relief: Arm relief	rpm	2,100 ± 100	2,250 ± 100	—	—
		At travel lever operate	• Arm relief • Travel lever operated in small movements • Engine at high idle		2,150 ± 100	2,250 ± 100	2,200 ± 100	2,250 ± 100
	Speed when auto-deceleration is operated		• Fuel control dial at MAX. • Control lever at neutral		1,400 ± 120		1,400 ± 120	
Spool stroke	Boom control valve		 X10BH107	mm	ℓ: —	a: 9.5 ± 0.5	b: 9.5 ± 0.5	ℓ: — a: 9.5 ± 0.5 b: 9.5 ± 0.5
	Arm control valve							
	Bucket control valve							
	Swing control valve							
	Travel control valve							
Travel of control levers	Boom control lever		• Center of lever knob • Read max. value to end of travel • Engine stopped • Excluding neutral play	mm	85 ± 10		Max. 95 Min. 75	
	Arm control lever				85 ± 10		Max. 95 Min. 75	
	Bucket control lever				85 ± 10		Max. 95 Min. 75	
	Swing control lever				85 ± 10		Max. 95 Min. 75	
	Travel control lever				115 ± 12		Max. 127 Min. 103	
	Play of control lever				Max. 10		Max. 15	
Operating force of control levers	Boom control lever		• Engine at high idle • Oil temperature: 45 - 55° C • Fit push-pull scale to center of control lever knob to measure • Measure max. value to end of travel	N (kg)	15.7 ± 3.9 (1.6 ± 0.4)		Max. 24.5 (Max. 2.5)	
	Arm control lever				15.7 ± 3.9 (1.6 ± 0.4)		Max. 24.5 (Max. 2.5)	
	Bucket control lever				12.7 ± 2.9 (1.3 ± 0.3)		Max. 21.6 (Max. 2.2)	
	Swing control lever				12.7 ± 2.9 (1.3 ± 0.3)		Max. 21.6 (Max. 2.2)	
	Travel control lever	Lever			24.5 ± 5.9 (2.5 ± 0.6)		Max. 39.2 (Max. 4.0)	
		Pedal			74.5 ± 18.6 (7.6 ± 1.9)		Max. 107.8 (Max. 11)	

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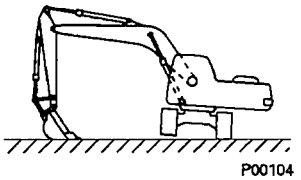
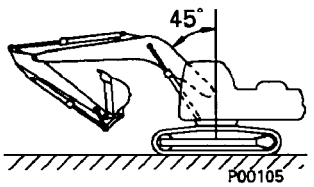
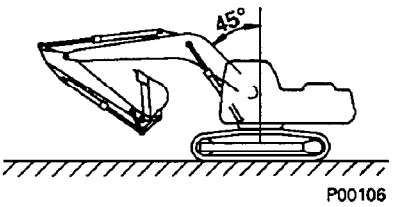
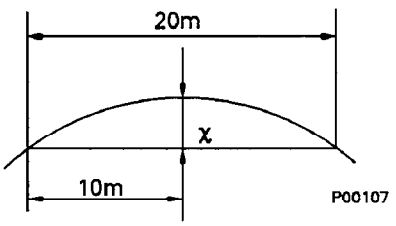
Applicable model					PC200-6, PC200LC-6, PC210LC-6 PC220LC-6, PC250LC-6	
Cate-gory	Item	Measurement conditions		Unit	Standard value	Permissible value
Hydraulic pressure	Unload pressure	• H/O mode • Oil temp: 45 - 55 °C • Engine at high idling • All levers at neutral		MPa (kg/cm²)	3.92 ± 0.98 (40 ± 10)	3.92 ± 0.98 (40 ± 10)
	Boom	• Hydraulic oil temp: 45 - 55 °C • Relief pressure with engine at high idling (Relieve only circuit to be measured) • In H/O mode • Figures in [ ] are used when power max function is used (reference) • Pump outlet port pressure ★1: For travel, measure oil pressure for relief on one side. ★2: For swing, measure oil pressure with swing lock switch on. ★3: The boom pressure is the oil pressure at RAISE and at the high pressure setting (active mode)			31.85 ± 0.98 (325 ± 10) [34.79 $^{+1.47}_{-0.98}$ (355 $^{+15}_{-10}$)]	Max 33.81 (Max 345) Min 30.38 (Min 310) [Max 37.24 (Max 380) Min 33.81 (Min 345)]
	Arm					
	Bucket					
	Swing				30.89 $^{+1.47}_{-0.98}$ (315 $^{+15}_{-10}$)	Max 32.85 (Max 335) Min 29.42 (Min 300)
	Travel				34.79 $^{+1.47}_{-0.98}$ (355 $^{+15}_{-10}$)	Max 37.24 (Max 380) Min 33.81 (Min 345)
	Control pump				2.94 $^{+0.59}_{0}$ (30 $^{+6}_{0}$)	Max 3.53 (Max 36) Min 2.94 (Min 30)
	LS differential pressure	• Hydraulic oil temp: 45 - 55 °C • Engine at high idling • In H/O mode	Levers in neutral		2.94 ± 0.98 (30 ± 10)	2.94 ± 0.98 (30 ± 10)
			Travel speed HI, rotating under no load		2.16 ± 0.098 (22 ± 1)	2.16 ± 0.098 (22 ± 1)

Machine Model					PC200-6, PC200LC-6, PC210LC-6, PC220LC-6, PC250LC-6			
Category	Item	Measurement conditions		Unit	Standard value		Permissible value	
					PC200 PC200LC PC210LC	PC220LC PC250LC	PC200 PC200LC PC210LC	PC220LC PC250LC
Swing	Swing break angle	Work equipment posture - Max. reach  ● Engine at high idling ● Hydraulic oil temp: 45 - 55°C ● Stop after swinging one turn and measure distance that swing circle moves		Deg (mm)	Max 100	Max 130	Max 130	Max 160
	Time taken to start swing	Work eqipment posture - Max.reach  ● Engine at high idling ● Hydraulic oil temp: 45 - 55°C ● In H/O mode ● Time taken to swing 90° and 180° from starting positions	90°	Sec.	3.1 ± 0.3	3.2 ± 0.3	Max 3.7	Max 3.8
			180°		4.4 ± 0.8	4.5 ± 0.8	Max 5.6	Max 5.7
	Time taken to swing	Work equipment posture - Max. reach  ● Engine at high idling ● Hydraulic oil temp: 45 - 55°C ● In H/O mode ● Swing on turn, and measure time taken to swing next 5 turns		Sec.	24 ± 3.5	24 ± 3.5	Max 30	Max 30
	Hydraulic drift of swing	 ● Engine stopped ● Hydraulic oil temp: 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 track frame. ● Measure distance that match marks move apart after 5 min.		mm	0		0	
	Leakage from swing motor	● Engine at high idling ● Hydraulic oil temp: 45 - 55°C ● Swing lock switch ON ● Relieve swing circuit		ℓ/min.	Max 5		Max 10	

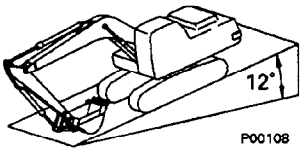
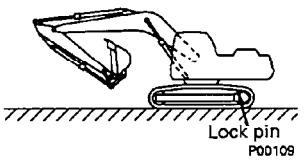
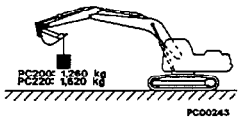
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Machine model					PC200-6, PC200LC-6, PC210LC-6, PC220LC-6			
Cate-gory	Item	Measurement conditions		Unit	Standard value		Permissible value	
					PC200 PC200LC PC210LC	PC220LC	PC200 PC200LC PC210LC	PC220LC
Travel	Travel speed (1)	 P00104 ● Engine at high idling ● Hydraulic oil temp: 45 - 55°C ● In H/O mode ● Raise track on one side at a time, rotate one turn, then measure time taken for 5 turns with no load	Lo	Sec	STD: 50 ± 7 LC: 54.5 ± 8	STD: 52 ± 7 LC: 56.5 ± 8	STD: 43 - 61 LC: 46.5 - 66.5	STD: 45 - 63 LC: 48.5 - 68.5
			Mi		STD: 36.5 ± 5.5 LC: 39.5 ± 5.5	STD: 38 ± 5.5 LC: 41.5 ± 5.5	STD: 31 - 44 LC: 34 - 47	STD: 32.5 - 45.5 LC: 32.5 - 49
			Hi		STD: 27.5 ± 2 LC: 30 ± 2.5	STD: 29 ± 2 LC: 31 ± 2.5	STD: 25.5 - 31.5 LC: 27.5 - 35	STD: 27 - 33 LC: 28.5 - 36
	Travel speed (2)	 P00105 ● Engine at high idling ● Hydraulic oil temp: 45 - 55°C ● In H/O mode ● Run up for at least 10m, and measure time taken to travel next 20 m on flat ground	Lo	Sec	23.5 ± 3.5	23.5 ± 3.5	20 - 28	20 - 28
			Mi		17 ± 2.5	17 ± 2.5	14.5 - 21	14.5 - 21
			Hi		13 ± 1	13 ± 1	12 - 15	12 - 15
	Travel devia-tion	 P00106 ● Engine at high idling ● Hydraulic oil temp: 45 - 55°C ● Run up for at least 10 m, and measure time taken to travel next 20 m on flat ground ★ Use a hard horizontal surface.  P00107 ★ Measuer dimension X		mm	Max 200		300	

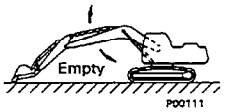
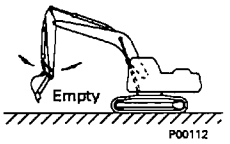
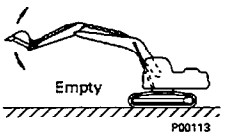
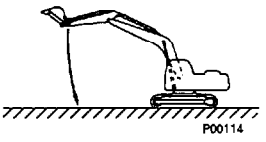
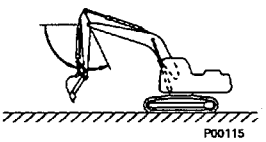
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Machine model					PC250LC-6	
Cate-gory	Item	Measurement conditions		Unit	Standard value	Permissible value
Travel	Travel speed (1)	 P00104 ● Engine at high idling ● Hydraulic oil temp: 45 - 55°C ● In H/O mode ● Raise track on one side at a time, rotate one turn, then measure time taken for 5 turns with no load	Lo	Sec	83 ± 5	78 - 93
			Mi		45 ± 3	42 - 50
			Hi		36 ± 2	34 - 40
	Travel speed (2)	 P00105 ● Engine at high idling ● Hydraulic oil temp: 45 - 55°C ● In H/O mode ● Run up for at least 10 m, and measure time taken to travel next 20 m on flat ground	Lo	Sec	33 ± 3	30 - 39
			Mi		17 ± 2	15.5 - 21.5
			Hi		14 ± 2	12 - 18
	Travel deviation	 P00106 ● Engine at high idling ● Hydraulic oil temp: 45 - 55°C ● Run up for at least 10 m, and measure time taken to travel next 20 m on flat ground ★ Use a hard horizontal surface.  P00107 ★ Measuer dimension x		mm	Max 200	300

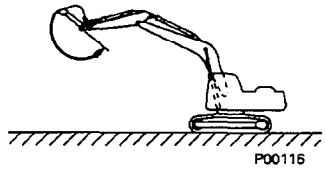
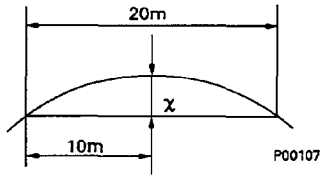
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Machine Model				PC200-6, PC200LC-6, PC210LC-6, PC220LC-6, PC250LC-6			
Cate-gory	Item	Measurement conditions	Unit	Standard value		Permissible value	
Travel	Hydraulic drift of travel	 ● Engine stopped ● Hydraulic oil temp: 45 - 55°C ● Stop machine on 12° slope with spocket facing straight up the slope. ● Measure the distance the machine moves in 5 min.	Sec	0		0	
	Leakage of travel motor	 ● Engine at high idling ● Hydraulic oil temp: 45 - 55°C ● Lock shoes and relieve travel circuit.	ℓ/min.	PC200 PC200LC PC210LC PC220LC	PC250LC	PC200 PC200LC PC210LC PC220LC	PC250LC
				13.6	20	27.2	40
Work equipment	Hydraulic drift of work equipment: Total work equipment (hydraulic drift at tip of bucket teeth)	Posture for measurement  ● Place in above posture and measure extension or retraction of each cylinder and downward movement at tip of bucket teeth. ● Bucket: Rated load ● Horizontal, flat ground ● Levers at neutral ● Engine stopped ● Hydraulic oil temp: 45 - 55°C ● Start measuring immediately after setting. ● Measure hydraulic drift every 5 min, and judge from results for 15 min.	mm	Max. 600		Max. 900	
	Hydraulic drift of work equipment: Boom cylinder (amount of retraction of cylinder)			Max. 18		Max. 27	
	Hydraulic drift of work equipment: Arm cylinder (amount of extension of cylinder)			Max. 160		Max. 240	
	Hydraulic drift of work equipment: Bucket cylinder (amount of retraction of cylinder)			Max. 35		Max. 53	

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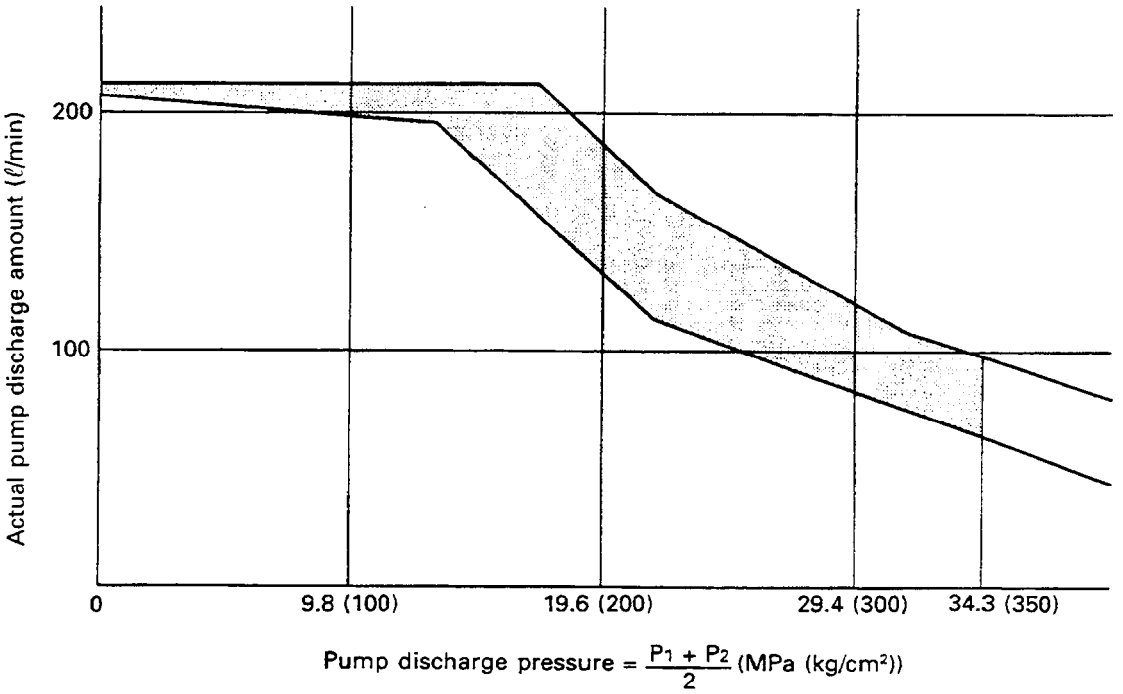
Machine model					PC200-6, PC200LC-6, PC210LC-6, PC220LC-6, PC250LC-6					
Category	Item	Measurement conditions		Unit	Standard value			Permissible value		
					PC200	PC210	PC220 PC250	PC200	PC210	PC220 PC250
Work equipment	Work equipment speed: Boom Bucket teeth in contact with ground ↕ Cylinder fully extended	 • Engine at high idling • Hydraulic oil temp: 45 - 55 °C • In H/O mode	RAISE	Sec	3.5 ± 0.4	4.5 ± 0.4	3.4 ± 0.4	Max 4.3	Max 5.3	Max 4.3
			LOWER		2.8 ± 0.3	3.4 ± 0.3	3.1 ± 0.3	Max 3.2	Max 3.8	Max 3.5
	Work equipment speed: Arm Cylinder fully retracted ↕ Fully extended	 • Engine at high idling • Hydraulic oil temp: 45 - 55 °C • In H/O mode	IN		3.6 ± 0.4	3.8 ± 0.4	3.8 ± 0.4	Max 4.5	Max 4.7	Max 4.7
			OUT		2.9 ± 0.3	3.0 ± 0.3	3.1 ± 0.3	Max 3.5	Max 3.6	Max 3.7
	Work equipment speed: Bucket Cylinder fully retracted ↕ Fully extended	 • Engine at high idling • Hydraulic oil temp: 45 - 55 °C • In H/O mode	CURL		2.8 ± 0.4	2.8 ± 0.4	2.9 ± 0.4	Max 3.5	Max 3.6	Max 3.6
			DUMP		2.1 ± 0.3	2.1 ± 0.3	2.2 ± 0.3	Max 2.7	Max 2.7	Max 2.8
	Time lag: Boom	 • Lower boom and measure time taken from point where bucket contacts ground to point where chassis rises from the ground • Engine at low idling • Hydraulic oil temp: 45 - 55°C			Max 1.0			Max 1.2		
	Time lag: Arm	 • Stop arm suddenly and measure time for arm to stop • Engine at low idling • Hydraulic oil temp: 45 - 55°C			Max 1.0			Max 2.8		

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Machine model					PC200-6, PC200LC-6, PC210LC-6, PC220LC-6, PC250LC-6			
Category	Item		Measurement conditions	Unit	Standard value		Permissible value	
Work equipment	Time lag	Bucket	 P00116 • Stop bucket suddenly and measure time taken for bucket to stop at bottom and then start again • Engine at low idling • Hydraulic oil temp: 45 - 55°C	Sec	Max 1.0		Max 3.6	
	Internal leakage	Cylinders	• Hydraulic oil temp: 45 - 55°C • Engine at high idling • Relieve circuit to be measured	cc/min	4.5		20	
		Center swivel joint			10		50	
Performance in compound operation	Travel deviation when work equipment and travel are operated		• Engine at high idling • Hydraulic oil temp: 45 - 55°C ★ Use a hard horizontal surface  P00107 ★ Measure dimension X	mm	PC200 PC200LC PC210LC PC220LC	PC250LC	PC200 PC200LC PC210LC PC220LC	PC250LC
					Max 200	Max 400	Max 220	Max 440
Performance of hydraulic pump	Hydraulic pump delivery	Control pump	• Hydraulic oil temp: 45 - 55°C • Measure with engine at rated speed • At relief valve set pressure 3.14 MPa (32 kg/cm²)	ℓ/min	PC200 PC200LC PC210LC	PC220LC PC250LC	PC200 PC200LC PC210LC	PC220LC PC250LC
					Min 27.2	Min 29.9	Min 24.5	Min 26.9
		Main pump	See next page		See next page			

Category	PC200, PC210: Discharge amount of main piston pump (in H/O mode)

Performance of hydraulic pump



● Pump speed: At 2200 rpm, TVC current 180 mA

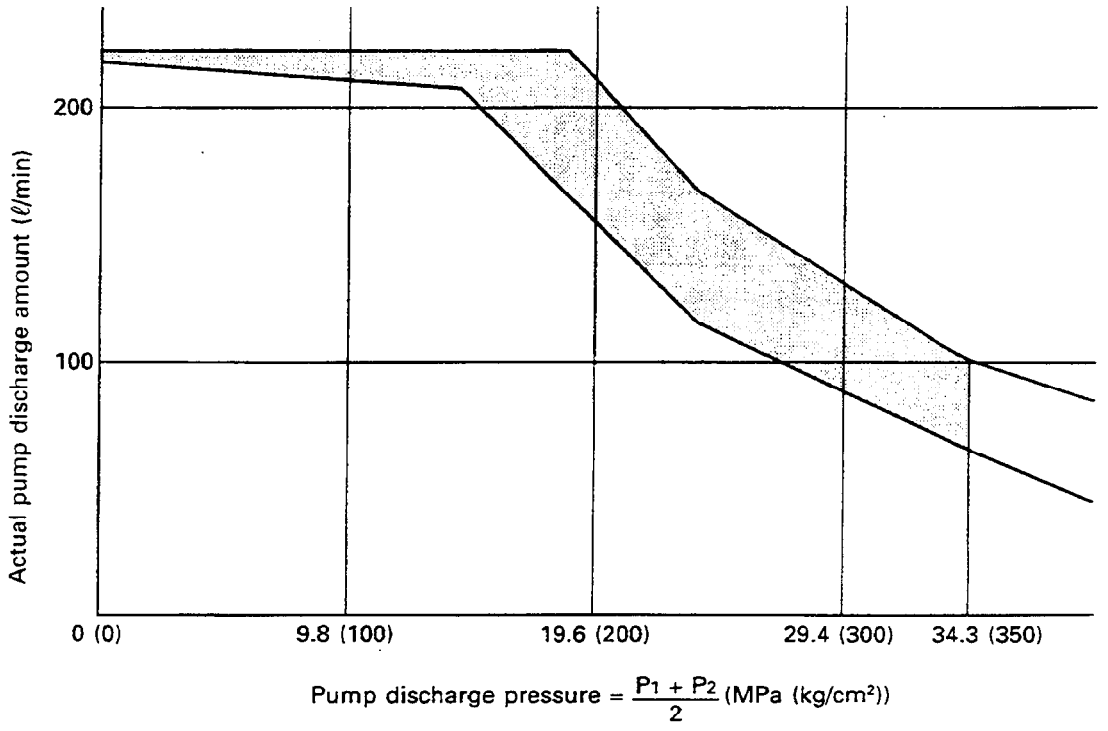
Check Point	Test pump discharge pressure (MPa (kg/cm²))	Discharge pressure of other pump (MPa (kg/cm²))	Average pressure (MPa (kg/cm²))	Standard value for discharge amount Q (ℓ/min)	Judgement standard lower limit Q (ℓ/min)
As desired	P_1	P_2	$\frac{P_1 + P_2}{2}$	See graph	See graph

★ As far as possible, bring pump discharge pressure P_1 and P_2 as close as possible to the average pressure when measuring.
The error is large near the point where the graph curves, so avoid measuring at this point.

★ When measuring with the pump mounted on the machine, if it is impossible to set the engine speed to the specified speed with the fuel control dial, take the pump discharge amount and the engine speed at the point of measurment, and use them as a base for calculating the pump discharge amount at the specified speed.

Category	PC220, PC250: Discharge amount of main piston pump (in H/O mode)

Performance of hydraulic pump



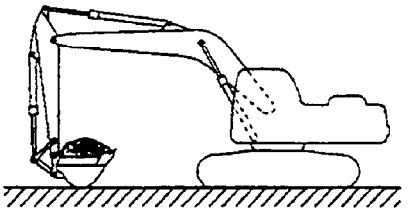
• Pump speed: At 2300 rpm, TVC current 180 mA

Check Point	Test pump discharge pressure (MPa (kg/cm²))	Discharge pressure of other pump (MPa (kg/cm²))	Average pressure (MPa (kg/cm²))	Standard value for discharge amount Q (ℓ/min)	Judgement standard lower limit Q (ℓ/min)
As desired	P_1	P_2	$\frac{P_1 + P_2}{2}$	See graph	See graph

★ As far as possible, bring pump discharge pressure P_1 and P_2 as close as possible to the average pressure when measuring.
The error is large near the point where the graph curves, so avoid measuring at this point.
★ When measuring with the pump mounted on the machine, if it is impossible to set the engine speed to the specified speed with the fuel control dial, take the pump discharge amount and the engine speed at the point of measurment, and use them as a base for calculating the pump discharge amount at the specified speed.

Flow control characteristics of TVC valve (STD)

★ The values in this table are used as reference values when carrying out troubleshooting.

Cate-gory	Item	Measurement conditions	Unit	PC200 PC200LC PC210LC	PC220LC PC250LC
Performance in compound operations	Time taken for swing for boom RAISE and starting swing	 PC00246 ● Engine at high idling ● Hydraulic oil temp: 45 - 55°C ● In H/O mode ● Load the bucket with the rated load and measure the time taken from the position of starting the swing to the point of passing the 90°position.	Sec	4.2 ± 0.4	4.6 ± 0.4

STANDARD VALUE TABLE FOR ELECTRICAL PARTS

System	Component		Connector No.	Inspection method	Judgement table	Measurement conditions
Engine throttle controller system	Fuel control dial		E06 (male)	Measure resistance	If the condition is as shown in the table below, it is normal Between (1) - (2): 0.25 - 7 k Ω Between (2) - (3): 0.25 - 7 k Ω Between (1) - (3): 4 - 6 k Ω	1) Turn starting switch OFF. 2) Disconnect connector E06.
	Governor motor	Potentiometer	E04 (male)	Measure resistance	If the condition is as shown in the table below, it is normal Between (1) - (2): 0.25 - 7 k Ω Between (2) - (3): 0.25 - 7 k Ω Between (1) - (3): 4 - 6 k Ω	1) Turn starting switch OFF. 2) Disconnect connector E04.
		Motor	E05 (male)	Measure resistance	If the condition is as shown in the table below, it is normal Between (1) - (2): 2.5 - 7.5 Ω Between (3) - (4): 2.5 - 7.5 Ω Between (1) - (3): No continuity Between (1) - chassis: No continutiy Between (3) - chassis: No continutiy	1) Turn starting switch OFF. 2) Disconnect connector E05.
	Engine throttle controller	Power source voltage	E01	Measure voltage	If the condition is as shown in the table below, it is normal Between (1) - (12): 20 - 30 V Between (2) - (12): 20 - 30 V	1) Turn starting switch ON. 2) Insert T-adapter.
		Fuel control dial		Measure voltage	Between (5) - (16), Power source: 4.75 - 5.25 V Between (7) - (16), Low idling: 4.0 - 4.75 V Between (7) - (16), High idling: 0.25 - 1.0 V	1) Turn starting switch ON. 2) Insert T-adapter.
		Potentiometer		Measure voltage	If the condition is as shown in the table below, it is normal Between (17) - (16), Low idling: 2.9 - 3.3 V Between (17) - (16), Hgh idling: 0.5 - 0.9 V Between (5) - (16): 4.75 - 5.25 V	1) Turn starting switch ON. 2) Insert T-adapter.
		Warming-up signal	Network		There must be no network error messages on the monitor display.	

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<table>
<tr><th>System</th><th colspan="2">Component</th><th>Connector No.</th><th>Inspection method</th><th>Judgement table</th><th>Measutement conditions</th></tr>
<tr><td rowspan="4">Engine throttle controller system</td><td rowspan="4">Engine throttle controler</td><td>Auto-deceleration signal</td><td rowspan="3">E01</td><td>Measure voltage</td><td>If the condition is as shown on the table below, it is normal.<table><tr><td rowspan="2">Between (4) - (12)</td><td>At deceleration</td><td>Max. 1 V</td></tr><tr><td>When canceled</td><td>8 - 12 V</td></tr></table></td><td>1) Turn starting switch ON.
2) Insert T-adapter.</td></tr>
<tr><td>Governor motor</td><td>Measure voltage</td><td>If the condition is as shown on the table below, it is normal.<table><tr><td>Between (10) - (20)</td><td>1.8 - 4.6 V</td></tr><tr><td>Between (11) - (21)</td><td>1.8 - 4.6 V</td></tr></table></td><td>1) Turn starting switch ON.
2) Insert T-adapter.</td></tr>
<tr><td>Battery relay</td><td>Measure voltage</td><td>If the condition is as shown on the table below, it is normal.<table><tr><td>Between (13)- (12)</td><td>20 - 30 V</td></tr></table>★ This is only for 2.5 sec after the starting switch is operated ON→OFF: at other times it must be 0 V.</td><td>1) Turn starting switch ON.
2) Insert T-adapter.</td></tr>
<tr><td>Model selection</td><td>E01 (female)</td><td>Continuity</td><td><table><tr><th></th><th>PC200
PC200LC
PC210LC</th><th>PC220LC
PC250LC</th></tr><tr><td>Between (8) - (12) selection 1</td><td>No continutiy</td><td>Continuity</td></tr><tr><td>Between (8) - (12) selection2</td><td>No continutiy</td><td>No continutiy</td></tr><tr><td>Between (9) - (12) selection 3</td><td>Continuity</td><td>Continuity</td></tr><tr><td>Between (19) - (12) selection 4</td><td>No continutiy</td><td>No continutiy</td></tr></table></td><td>1) Turn starting switch OFF.
2) Disconnect connector E01.</td></tr>
</table>

System	Component	Connector No.	Inspection method	Judgement table	Measurement conditions
Pump controller system	Network (monitor, engine, throttle control)	C03	Measure voltage	If the condition is as shown on the table below, it is normal. Between (7), (8) - (15): 4 - 8 V	1) Turn starting swithch ON. 2) Insert T-adapter.
	Engine speed sensor	E07	Measure resistance	If the condition is as shown on the table below, it is normal. Between female (1) - (2): 500 - 1000 Ω Betweem female (1) - chassis: Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector E07.
			Measure voltage	Measure with AC range Between (1) - (2): 0.5 - 3.0 V	1) Start engine 2) Insert T-adapter.
			Adjust	1) Screw in rotation sensor until it contacts ring gear, then turn back one turn. 2) It must work normally when adjusted as above.	
	PPC oil pressure switch	Travel S01 Boom raise S02 Arm out S03 Boom lower S04 Arm in S05 Bucket curl S06 Bucket dump S07 Swing S08	Measure resistance	If the condition is as shown on the table below, it is normal. Between (1) - (2): Levers at neutral: Min 1M Ω; Lever operated: Max 1 Ω Between (1), (2) - chassis: Min 1 M Ω	1) Start engine (charge accumulator) 2) Disconnect connectors S01 - S08.
	Pump pressure sensor	C07 (rear) C08 (front)	Measure voltage	If the condition is as shown on the table below, it is normal. Between (1) - (2): 18 - 28 V Between (1) - (3): All levers at neutral: 0.5 - 1.5 V; At arm IN relief: 3.1 - 4.5 V	1) Start engine 2) Turn fuel control dial to MAX position. 3) Insert T-adapter.
	Swing lock switch	C02 (female)	Measure resistance	If the condition is as shown on the table below, it is normal. Between (9) - GND: When switch is OFF: Min 1 MΩ; When switch is ON: Max 1 Ω	1) Turn starting switch OFF. 2) Disconnect connector C02.
	TVC valve	C04 (rear) (male) C13 (front) (male)	Measure resistance	If the condition is as shown on the table below, it is normal. Between (1) - (2): 10 - 22 Ω Between (2) - chassis: Min 1 MΩ	1) Set TVC prolix switch OFF. 2) Turn starting switch OFF. 3) Disconnect connectors C04, C13.
	Swing brake solenoid valve	V04 (male)	Measure resistance	If the condition is as shown on the table below, it is normal. Between (1) - (2): 20 - 60 Ω Between (2) - chassis: Min 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connectorV04.

System	Component		Connector no.	Inspection method	Judgement table	Measurement conditions
Pump controller system	Travel speed solenoid valve		V06 (male)	Measure resistance	If the condition is as shown on the table below, it is normal. Between (1) - (2): 20 - 60 Ω Between (2) - chassis: Min 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector V06.
	2-stage relief solenoid valve		V05 (male)	Measure resistance	If the condition is as shown on the table below, it is normal. Between (1) - (2): 20 - 60 Ω Between (2) - chassis: Min 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector V05
	LS select solenoid valve		V02 (male)	Measure resistance	If the condition is as shown on the table below, it is normal. Between (1) - (2): 20 - 60 Ω Between (2) - chassis: Min 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector V02.
	Pump merge-divider solenoid valve		V03 (male)	Measure resistance	If the condition is as shown on the table below, it is normal. Between (1) - (2): 20 - 60 Ω Between (2) - chassis: Min 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector V03.
	LS control EPC valve		C10 (male)	Measure resistance	If the condition is as shown on the table below, it is normal. Between (1) - (2): 7 - 14 Ω Between (2) - chassis: Min 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector C10.
	Pump controller	Power source voltage	C01	Measure voltage	If the condition is as shown on the table below, it is normal. Between (12), (13) -(3), (4): 20 - 30 V	1) Turn starting switch ON. 2) Insert T-adapter.
		L.H. knob switch	C02	Measure voltage	If the condition is as shown on the table below, it is normal. Between (18) - GND: When switch is OFF: 20 - 28 V Between (18) - GND: When switch is ON: 0 - 1 V	1) Turn starting switch ON. 2) Insert T-adapter.
		Model selection	C02 (female)	Measure voltage	If the condition is as shown on the table below, it is normal. Between (13) - GND: PC200 PC200LC PC210LC: No continuity; PC220LC PC250LC: Continuity Between (14) - GND: No continuity; No continuity Between (15) - GND: Continuity; Continuity Between (16) - GND: No continuity; No continuity	1) Turn starting switch ON. 2) Disconnect connector C02.

System	Component		Connector No.	Inspection method	Judgement table	Measurement conditions
Pump controller system	Pump controller	Auto-deceleration output signal	C03	Measure voltage	If the condition is as shown on the table below, it is normal. Auto-deceleration switch OFF: Between (5)-GND: 8 - 12 V Auto-deceleration switch ON: Between (5)-GND: 0 - 1 V	1) Start engine. 2) Insert T-adapter. 3) Place all levers at neutral.
		Kerosene mode	C02	Measure voltage	If the condition is as shown on the table below, it is normal. Standard mode: Between (17)-GND: 20 - 28 V Kerosene mode: Between (17)-GND: 0 - 2 V	1) Turn startting switch ON. 2) Insert T-adapter.
		No. 2 throttle signal	Monitoring code 16,10	Engine speed	If the condition is as shown on the table below, it is normal. High idling speed (rpm) H/O (working): PC200 PC210 Approx 2230; PC220 PC250 Approx 2420 H/O (traveling): Approx 2420; Approx 2530 G/O: Approx 2100; Approx 2200 F/O: Approx 2100; Approx 2200 L/O: Approx 1700; Approx 1750 Power Max (H/O)(G/O): Approx 2420; Approx 2530 Swift slow-down (H/O)(G/O): Approx 1700; Approx 1750	1) Turn startting switch ON. 2) Set monitor panel to monitoring code 10 or 16. 3) Operate working mode switch and L.H. knob switch.
		Swing brake solenoid valve	C01	Measure voltage	If the condition is as shown on the table below, it is normal. Approx 4 sec after swing lever is placed at neutral: Between (13)-(1), (2): 20 - 30 V Swing Operated: Between (13)-(1), (2): 0 - 3 V	1) Start engine. 2) Turn swing lock switch OFF. 3) Set swing lock prolix switch OFF. 4) Insert T-adapter.
		Travel brake solenoid valve	C01	Measure voltage	If the condition is as shown on the table below, it is normal. Travel speed switch at LO: Between (6)-(1), (2): 20 - 30 V Travel speed at Hi: Between (6)-(1), (2): 0 - 3 V	1) Start engine. 2) Insert T-adapter. 3) Turn fuel conrtol dial to Max postion. 4) Travel on level ground.
		2-stage relief solenoid valve	C01	Measure voltage	If the condition is as shown on the table below, it is normal. All levers at nuetral: Between (14)-(1), (2): 20 - 30 V Travel lever operated: Between (14)-(1), (2): 0 - 3 V	1) Turn starting switch ON. 2) Insert T-adapter. 3) Charge accumulator.
		LS select solenoid valve	C01	Measure voltage	If the condition is as shown on the table below, it is normal. All levers at neutral: Between (3)-(1), (2): 20 - 30 V Swing and travel operated simultaneously: Between (3)-(1), (2): 0 - 3 V	1) Turn starting switch ON. 2) Insert T-adapter. 3) Charge accumulator.

<table>
<tr><th>System</th><th colspan="2">Component</th><th>Connector No.</th><th>Inspection method</th><th>Judgement table</th><th>Measurement conditions</th></tr>
<tr><td rowspan="3">Pump controller system</td><td rowspan="3">Pump controller</td><td>Pump merge-divider solenoid valve</td><td>C02</td><td>Measure voltage</td><td>If the condition is as shown on the table below, it is normal.<table><tr><td>Lever at neutral</td><td rowspan="2">Between (4)-(1), (2)</td><td>20 - 30 V</td></tr><tr><td>S/O mode</td><td>0 - 3 V</td></tr></table></td><td>1) Turn starting switch ON.
2) Insert T-adapter.</td></tr>
<tr><td>TVC valve (default value)</td><td>C01</td><td>Measure current</td><td>If the condition is as shown on the table below, it is normal.
● Working in G/O mode.<table><tr><td></td><td>PC200
PC210</td><td>PC220
PC250</td></tr><tr><td>Front:between (16)-(8)</td><td rowspan="2">510 ± 80 mA</td><td rowspan="2">410 ± 80 mA</td></tr><tr><td>Rear:between (17)-(9)</td></tr></table></td><td>1) Turn starting switch ON.
2) Turn fuel control dial to MAX postion.</td></tr>
<tr><td>LS control EPC valve (default value)</td><td>C01</td><td></td><td>If the condition is as shown on the table below, it is normal.
● Working in G/O mode.<table><tr><td>Between (15)-(7)</td><td>900 ± 80</td></tr></table></td><td>1) Turn starting switch ON.
2) Turn feul control dial to MAX postion.</td></tr>
</table>

Sys-tem	Component		Connector No.	Inspection method	Judgement table	Measurement conditions
Machine monitor system	Monitor panel	Guage			If the conditions is as shoen in the table below, it is normal.	1) Insert a dummy resistance with the starting switch OFF, or measure the resistance of the sensor. 2) Check the display with the starting switch ON.

Guages

	Position of guage display		Display level resistance (Monitor panel input resistance)
	Starting swtich ON		Starting switch OFF
			Min. - Max. (kΩ)
Coolant temp guage Measure resistance between P02 (female) (12) - P01 (famale) (11)	Right side	All OFF	0 - 0.646
	Dlsplay position	14	0.575 - 3.409
		13	3.242 - 3.691
		12	3.515 - 4.000
		11	3.805 - 4.328
		10	4.119 - 4.681
		9	4.456 - 5.063
		8	4.820 - 5.744
		7	5.466 - 6.420
		6	6.106 - 7.192
		5	6.834 - 8.212
		4	7.795 - 9.263
		3	8.775 - 10.890
		2	10.286 - 39.336
	Left side	1	34.927 - Disconnection

	Position of guage display		Display level resistance (Monitor panel input resistance)
	Starting swtich ON		Starting switch OFF
			Min. - Max. (kΩ)
Fuel level guage Measure resistance between P01 (female) (11) - P02 (female) (11)	Right side	14	0 - 13.82
	Display position	13	11.71 - 17.43
		12	15.18 - 21.25
		11	18.90 - 25.05
		10	22.59 - 28.45
		9	25.82 - 31.85
		8	29.18 - 35.22
		7	32.45 - 39.91
		6	37.00 - 44.60
		5	41.77 - 48.72
		4	45.52 - 55.14
		3	50.42 - 64.35
		2	60.61 - 77.07
		1	72.98 - 691.5
	Left side	All OFF	638.00 - Disconnection

System	Component	Connector No.	Inspection method	Judgement table	Measurement conditions
Machine monitor system	Alternator	Between alternator terminal R and chassis	Measure voltage	When engine is running (half throttle or above) →27.5 - 29.5 V ☆If the battery is old, or after starting in cold areas, the voltage may not rise for some time.	1) Start engine.
	Air cleaner clogging sensor	P11 (male) P12 (female)	Continuity	If the condition is as shown in the table below, it is normal. Air cleaner normal — Between P11 - P12 — Continuity Air cleaner clogged — Between P11 - P12 — No continuity	1) Start engine. 2) Disconnect P11, P12.
	Engine speed sensor	E07	Measure resistance	If the condition is as shown in the table below, it is normal. Between female (1)-(2): 500 - 1000 Ω Between female (2)-chassis: Min 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector E07.
			Measure voltage	Measure with AC range Between (1)-(2): 0.5 - 3.0 V	1) Start engine. 2) Insert T-adapter.
			Adjust	1) Screw in rotation sensor until it contacts the ring gear, then turn back one turn. 2) It must work normally when adjusted as above.	
	Coolant level sensor	P08 (male)	Measure resistance	If the condition is as shown in the table below, it is normal. Above LOW level in reservoir tank: Max 1 Ω Below LOW level in reservoir tank: Min 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector P08. 3) Insert T-adapter into connector at sensor end.
	Engine oil level sensor	P05 (male)	Measure resistance	If the condition is as shown in the table below, it is normal.  BLP00002 — Raise float: Max 1 Ω  BLP00003 — Lower float: Min 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector P05. 3) Drain oil, then remove sensor. 4) Insert T-adapter into sensor. ★ Connect the T-adapter to the connector and sensor flange.
	Coolant temperature sensor	P07 (male)	Measure resistance	If the condition is as shown in the table below, it is normal. Normal temperature (25 °C): Approx 37 - 50 kΩ 100 °C: Approx 3.5 - 4.0 kΩ	1) Turn starting switch OFF. 2) Disconnect connector P07. 3) Insert T-adapter into sensor.

System	Component	Connector No.	Inspection method	Judgement table	Measurment conditions
Machine monitor system	Engine oil pressure sensor	–	Measure resistance	If the condition is as shown in the table below, it is normal. Low pressure sensor Engine oil pressure above 0.07 MPa (0.7 kg/cm²) — Min 1 MΩ Engine oil pressure below 0.03 MPa (0.3 kg/cm²) — Max 1 Ω High pressure sensor Engine oil pressure above 0.17 MPa (1.7 kg/cm²) — Min 1 MΩ Engine oil pressure below 0.13 MPa (1.3 kg/cm²) — Max 1 Ω	1) Install oil pressure measuring guage. 2) Remove wiring harness terminal. 3) Start engine. 4) Put tester in contact between sensor terminal screw and chassis.
	Fuel level sensor	P06 (male)	Measure resistance	If the condition is as shown in the table below, it is normal.  BLP00004 — Raise float to stopper — Approx 12 Ω or below  BLP00005 — Lower float to stopper — Approx 85 - 110 Ω	1) Trun starting switch OFF. 2) Disconnect connector P06. 3) Drain fuel, then remove sensor. 4) Insert T-adapter into sensor. ★ Connect the T-adapter to the coonnector and sensor flange.
	Hydraulic oil level sensor	P09 (male)	Measure resistance	If the condition is as shown in the table below, it is normal.  Raise float — Max 1 Ω  Lower float — Min 1 MΩ	1) Trun starting switch OFF. 2) Disconnect connector P09. 3) Drain oil, then remove sensor. 4) Insert T-adapter into sensor.
	Air cleaner clogging sensor	P11 (female) P12 (male)	Measure resistance	If the condition is as shown in the table below, it is normal. Air cleaner normal — Continuity Air cleaner clogged — No continuity	1) Start engine. 2) Disconnect P11, P12. 3) Put tester in contact with connector at sensor end to measure.

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TOOLS FOR TESTING, ADJUSTING AND TROUBLESHOOTNG

Check or measurment item	Symbol		Part No.	Part Name	Remarks
Engine speeds	A	1	799-203-8001	Multi-tachometer	Digital display L: 60 - 2,000 rpm H: 60 - 19,999 rpm
		2	799-203-8901	Clamp set	● Kit part no. : 799-203-9000
			6210-81-4111	Gear box	
Intake manifold pressure				Pressure gauge	See Engine Shop Manual
Intake air restriction				Water manometer	See Engine Shop Manual
Lubricating oil pressure				Pressure gauge	See Engine Shop Manual
Fuel filter inlet restriction				Vacuum gauge	See Engine Shop Manual
Blow-by pressure				Tool, adapter & manometer	See Engine Shop Manual
Exhaust back pressure				Mercury manometer	See Engine Shop Manual
Coolant temperature				Digital temperature guage	See Engine Shop Manual
Valve clearance			Commercially available	Feeler gauge	
Exhaust gas color	G	1	799-264-9000	Smoke detector	Discoloration: 0 - 70% with standard color % x 1/10 = Bosch index
		2	Commercially available	Smoke meter	
Oil pressure	C	1	799-101-5002	Hydraulic tester	Pressure gauge: 2.45 (25), 5.88 (60), 39.2 (400), 58.8 (600) MPa (kg/cm^2)
			790-261-1203	Digital hydraulic tester	Pressure gauge: 68.6 MPa (700 kg/cm^2)
		2	799-401-2320	Hydraulic gauge	0.98 MPa (10 kg/cm^2)
		3	● 790-261-1311	Adapter	Both male and female 14 x 1.5 (female PT 1/8)
			● 790-261-1321		Both male and female 18 x 1.5 (female PT 1/8)
			● 790-261-1331		Both male and female 22 x 1.5 (female PT 1/8)
		4	799-401-2700	Differential pressure gauge	
		5	790-261-1360	Adapter	Both male and female 14 x 1.5 (female PT 1/8)
			790-261-1370	Nut	For 14 x 1.5 blind
			07003-31419	Gasket	For blind
		6	—	Hose	
Operating force	H		79A-264-0020	Push-pull scale	0 - 294 N (0 - 30 kg)
			79A-264-0090		0 - 490 N (0 - 50 kg)
Stroke, hydraulic drift	I		Commercially available	Scale	
Work equipment speed	J		Commercially available	Stop watch	
Measuring voltage and resistance values	K		79A-264-0210	Tester	
Troubleshooting of wiring harnesses and sensors	L	1	799-601-2600	T-adapter box	● Kit part no.: T-adapter kit 799-601-8000
		2	—	Adapter assembly	
		3	—	Adapter	
Main pump delivery	M		790-303-1003	Flowmeter kit	

MEASURING ENGINE SPEED

⚠ When removing or installing the measuring equipment, be careful not to touch any high temperature parts.

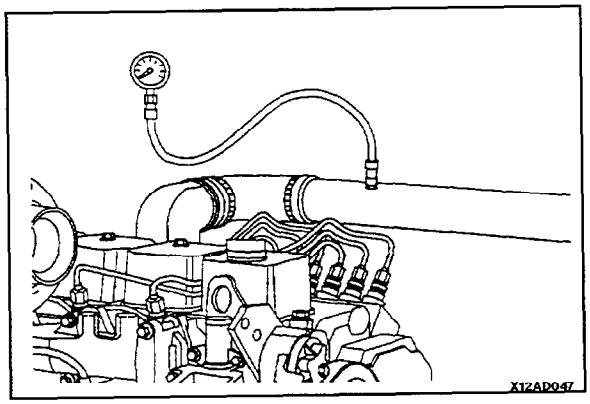
★ Measure the engine speed under the following conditions.
- Coolant temperature: Within operating range
- Hydraulic oil temperature: 45 - 55 °C

1. Install the digital optical tachometer using the instructions supplied with it.
2. Start the engine, and measure the engine speed when it is set to the conditions for measuring.
   1) Measuring at low idling and high idling:
      Measure the engine speed with the fuel control dial set to low idling and high idling.
      ★ When measuring at high idling with the work equipment operated, operate the work equipment lever, but not enough to make the work equipment move.
      ★ When measuring at high idling with the travel (power max.) operated, operate the travel lever, but not enough to make the machine move.
   2) Measure the speed at near the rated speed.
      i) Set the working mode to the H/O mode.
      ii) Set the power max./swift slow-down switch to the power max. position.
      iii) Run the engine at high idling, set the L.H. knob switch to the ON or OFF position, operate the arm lever, and measure the speed when the arm circuit is relieved.
         ★ Measuring speed when work equipment is operated: L.H. Knob switch OFF
         ★ Measuring speed when travel is operated: L.H. Knob switch ON
   3) Measuring speed at pump relief:
      Run the engine at high idling and measure the engine speed when each pump is relieved.
      ★ For details of the pump to relieve, see the TABLE OF JUDGEMENT STANDARD VALUE.

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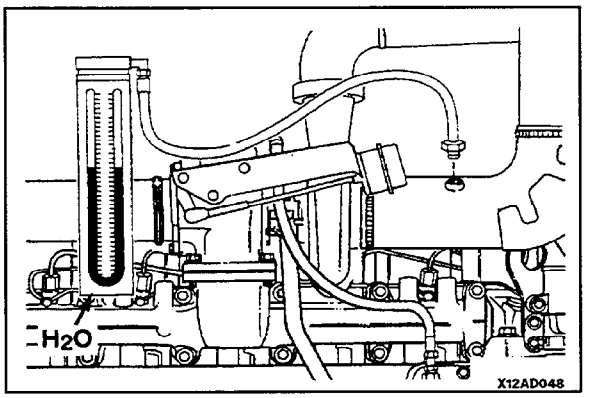
MEASURING INTAKE MANIFOLD PRESSURE

★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure



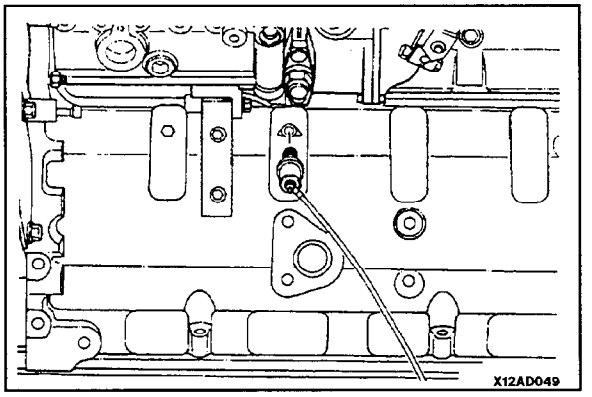
MEASURING INTAKE AIR RESTRICTION

★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.



MEASURING LUBRICATING OIL PRESSURE

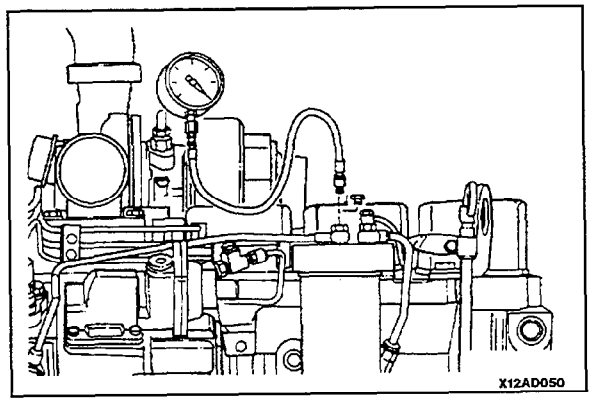
★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.



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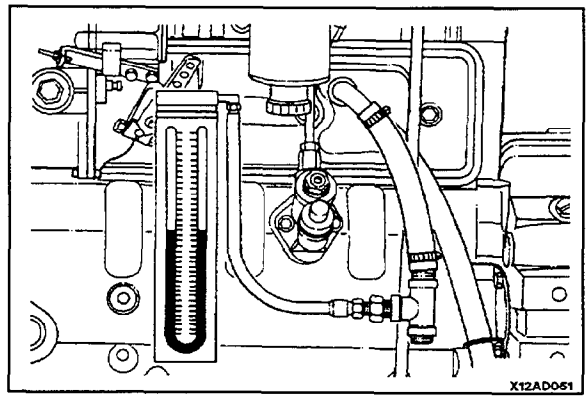
MEASURING FUEL (FILTER) INLET RESTRICTION

★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.



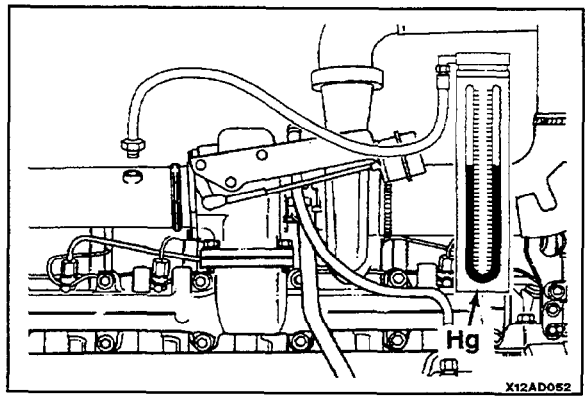
MEASURING BLOWBY PRESSURE

★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.



MEASURING ENGINE BACK PRESSURE

★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.



MEASURING EXHAUST COLOR

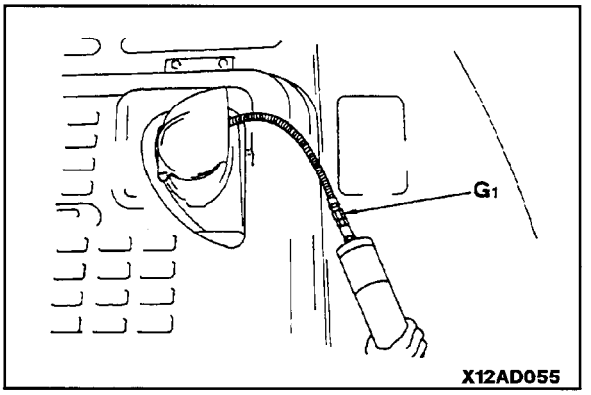
- When measuring in the field when there is no air or power supply, use smoke checker **G1**; when recording official data, use smoke meter **G2**.

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

⚠ When removing or installing the measuring equipment, be careful not to touch any high temperature part.

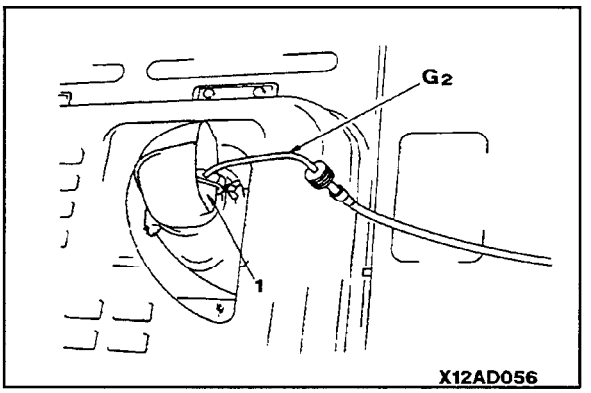
1. Measuring with handy smoke checker G1

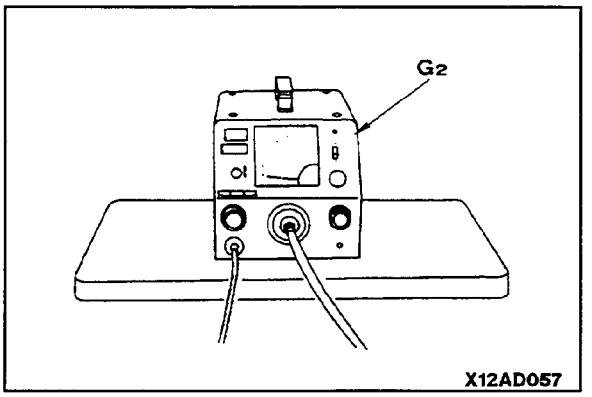
1) Fit filter paper in tool **G1**.
2) Insert exhaust gas intake port into the exhaust pipe, accelerate the engine suddenly, and at the same time operate the handle of tool **G1** to catch the exhaust gas on the filter paper.
3) Remove the filter paper and compare it with the scale provided to judge the condition.



2. Measuring with smoke meter G2

1) Insert probe ① into the outlet port of exhaust pipe (1), then tighten the clip to secure it to the exhaust pipe.
2) Connect the probe hose, accelerator switch plug, and air hose to tool **G2**.
   ★ The pressure of the air supply should be less than 1.47 MPa (15 kg/cm^2)
3) Connect the power cord to the AV 100V outlet.
   ★ When connecting the port, check first that the power switch of tool **G2** is OFF.
4) Loosen the cap nut of the suction pump, then fit the filter paper.
   ★ Fit the filter paper securely so that the exhaust gas does not leak.
5) Turn the power switch of tool **G2** ON.
6) Accelerate the engine suddenly, and at the same time, depress the accelerator pedal of tool **G2** and catch the exhaust gas color on the filter paper.
7) Lay the filter paper used to catch the exhaust gas color on top of unused filter paper (10 sheets or more) inside the filter paper holder, and read the indicated value.

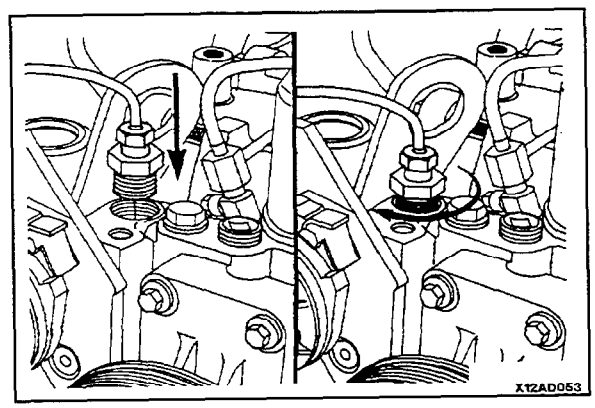




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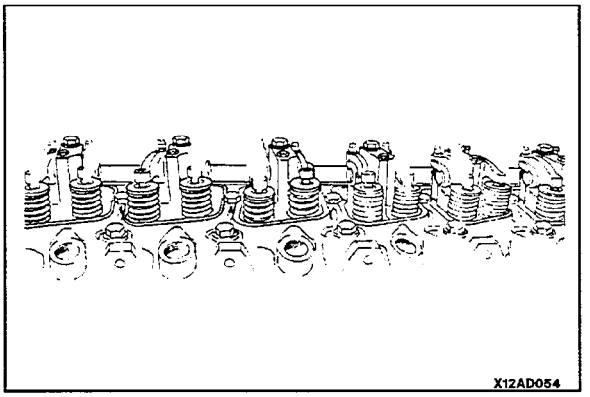
MEASURING COOLANT TEMPERATURE

★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.



MEASURING VALVE CLEARANCE

★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.

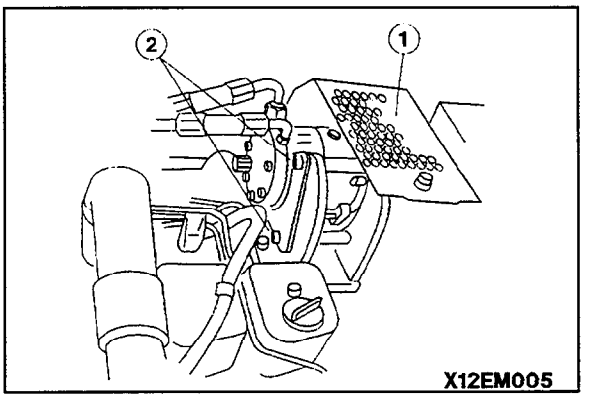


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CHECKING AND ADJUSTING BELT TENSION FOR AIR CONDITIONER COMPRESSOR

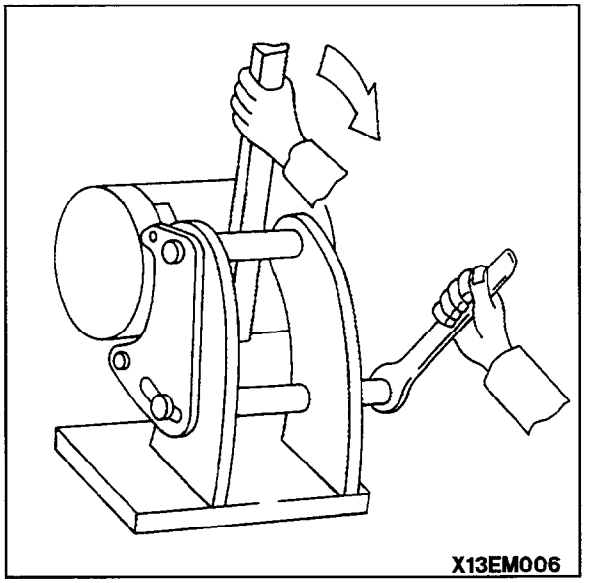
CHECKING

1. Remove belt guard ①.
2. Press compressor drive belt midway between fan pulley and compressor pulley. The belt should normally deflect by about 15 ~ 18 mm when pressed with the finger (with a force of approxiamately 6kg).



ADJUSTING

1. Lossen two nuts and bolts ②.
2. Carefully lever compressor housing as shown to tighten belt to tightness criteria. Tighten lower bolt to hold in position.
3. Tighten upper bolt.
4. Check each pulley for damage, wear of the V-groove and wear of the V-belt. In particular, be sure to check the V-belt is not touching the bottom of the V-groove.
5. Replace belt if it has streched, leaving no allowance for adjustment, or if there is a cut or crack on the belt.
6. Refit belt guard.
7. When the new belt is set, readjust after operating for one hour.



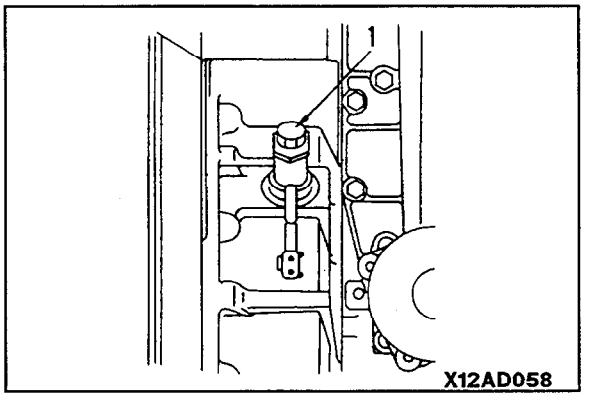
①

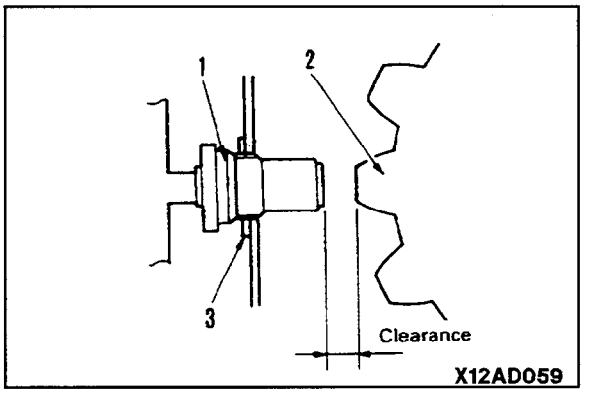
ADJUSTING ENGINE SPEED SENSOR

1. Screw in until the tip of sensor (1) contacts gear (2).
2. When gear (2) contacts sensor (1), turn back one turn.
3. Tighten locknut (3).

★ Be particularly careful when securing the sensor wiring to ensure that no excessive force is brought to bear on the wiring.

★ Be careful not to let the tip of the sonsor be scratched or to let any iron particles stick to the sensor tip.





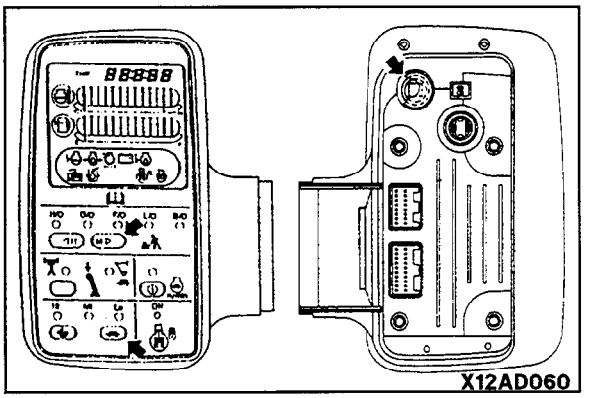
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TESTING AND ADJUSTING GOVERNOR MOTOR LEVER STROKE

TESTING

★ Use the governor motor adjustment mode.

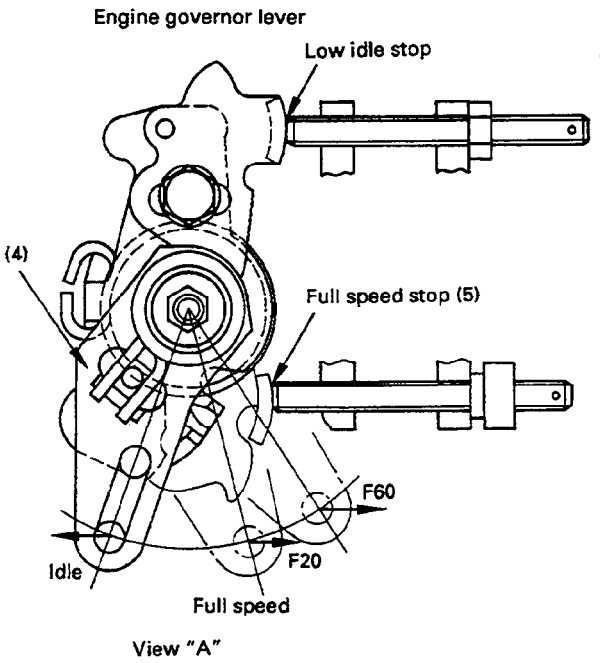
1. In the time mode display, keep the time switch + travel speed R.H. switch + working mode R.H. switch pressed for 2.5 seconds.
2. In this condition, check the governor lever and spring rod.
3. After checking, repeat the procedure in Step 1) to finish the governor motor adjustment mode.

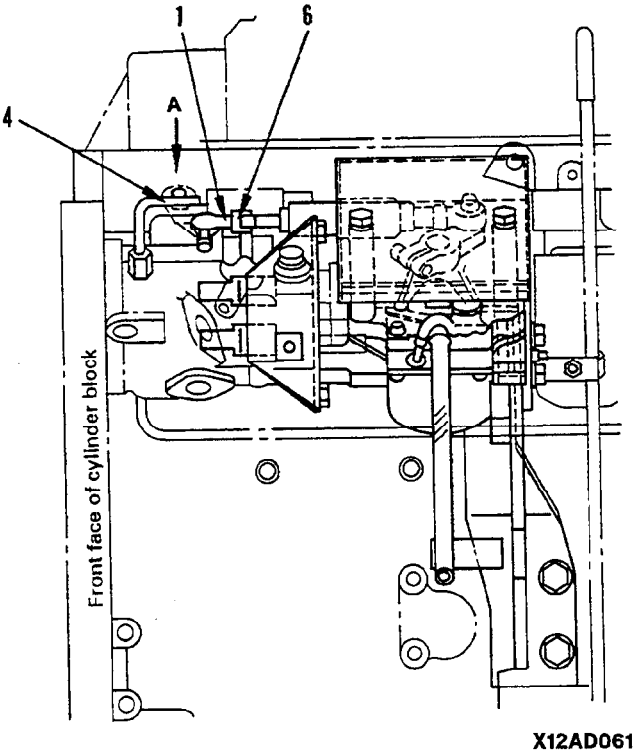


ADJUSTING

1. Turn the starting switch OFF, then remove the nut and disconnect joint (1) from governor lever (4).
2. Repeat the procedure in Step 1 - 1) above to set to the governor adjustment mode.
3. Set governor lever (4) to a postion where it contacts the full speed stopper (5) of the injection pump, then adjust the length of spring assembly (2) and rod (3), and connect joint (1) with the nut.
4. From the above position, turn joint (1) back 4 turns, and secure in position with locknut (6).

★ **Caution**
When the spring assembly is removed and the starting switch is at the OFF position, if the governor motor lever is moved suddenly, the governor motor will generate electricity, and this may cause a failure in the engine throttle controller.



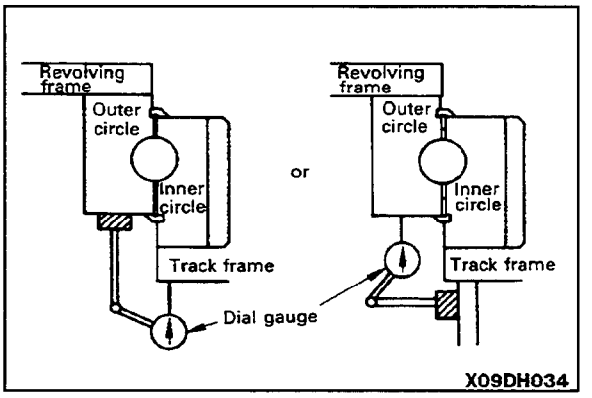


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TESTING CLEARANCE OF SWING CIRCLE BEARING

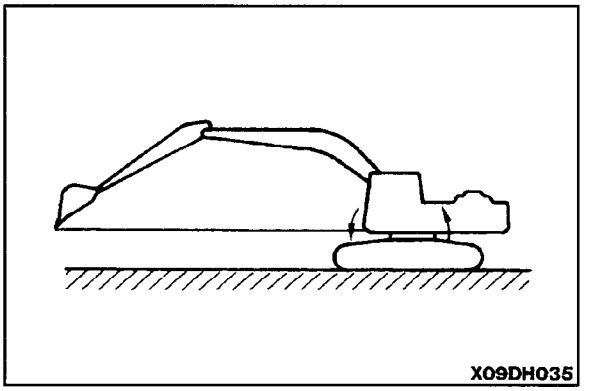
Method of testing clearance of swing circle bearing when mounted on machine

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



2. Extend the work equipment to the maximum reach, and set the tip of the bucket to the same height as the bottom of the revolving frame.
   When this is done, the upper structure will tilt forward, so the front will go down and the rear will rise.

3. Set the dial gauge to the zero point.

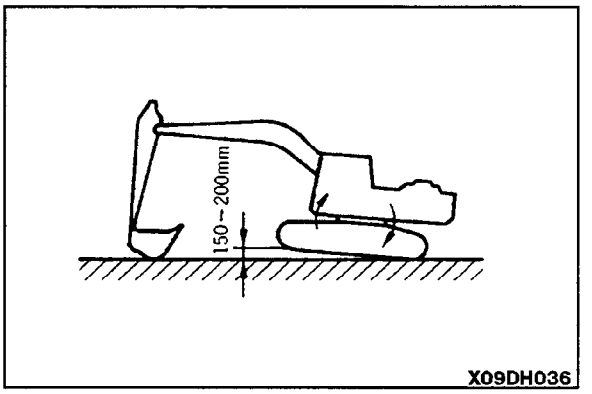


4. Set the arm more or less at right angles to the ground surface, then lower the boom until the front of the machine comes off the ground.

5. Read the value on the dial gauge at the point. The value on the dial gauge is the clearance of the swing circle bearing.

⚠ When carrying out the measurment, do not put your hand or feet under the undercarriage.

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

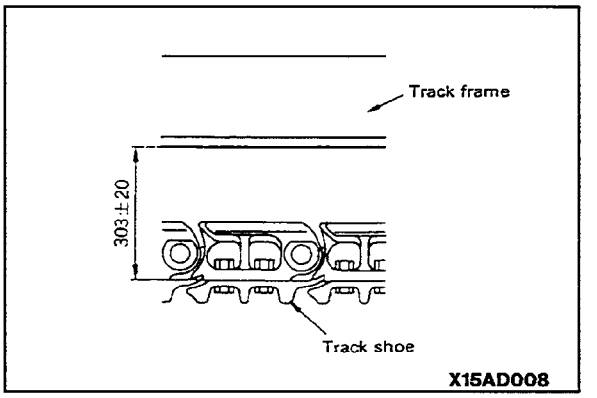


TESTING AND ADJUSTING TRACK SHOE TENSION

TESTING

1. Raise the track frame using the arm and boom, and measure the clearance between the bottom of the track frame and the top of the track shoe.
   - Clearance: 303 ± 20 mm

   Measurement position
   PC200 : 4th track roller from sprocket
   PC200LC : 5th track roller from sprocket
   PC210LC : 5th track roller from sprocket
   PC220LC : Midway between the 5th and 6th track roller from sprocket
   PC250LC : Midway between the 4th and 5th track roller from sprocket

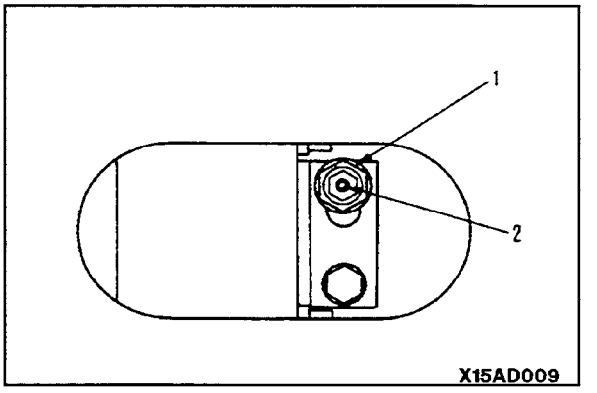


ADJUSTING

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

1. When the tension is too high:
   Loosen plug (1) gradually, and release the grease.
   ⚠ There is danger that the plug may fly out under the high internal pressure of the grease, so never loosen plug (1) more than one turn.
   ★ If the grease does not come out easily, move the machine backwards or forwards slowly.

2. If track is too loose:
   Pump in grease through grease fitting (2).
   ★ If the grease cannot be pumped in easily, move the machine backwards and forwards slowly.



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TESTING AND ADJUSTING HYDRAULIC PRESSURE IN WORK EQUIPMENT, SWING, TRAVEL CIRCUIT

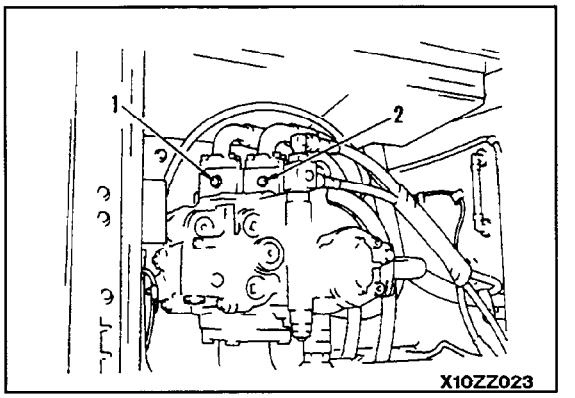
MEASURING

★ Hydraulic oil temperature when measuring: 45 - 55°C

⚠ Lower the work equipment to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then put the safety lock lever in the LOCK position.

Remove pressure pick-up plug (1) or (2) (Thread dia. = 10mm, Pitch = 1.25 mm) from the circuit to be measured, then install oil pressure gauge **C1** (58.8 MPa (600 kg/cm^2)).

- Measuring main unload pressure
  - ★ Unload pressure when front and rear pump flows are merged.
    Measure the oil pressure in H/O mode with the engine at high idling and the control levers at neutral.
- Measuring sub-unload pressure
  - ★ The unload pressure in the circuit which is not under load when the front and rear pump flows are divided.
  1. Set to H/O mode + boom/swing priority selection mode ON.
  2. Measure the pressure in the pump circuit on the opposite side when the arm or bucket circuit is relieved.
     Arm relief: Load on front pump, rear pump unloaded.
     Bucket relief: Load on rear pump, front pump unloaded.
- Measuring pump relief pressure
  1. When LS relief valve is actuated
     When hydraulic pressure is 31.9 MPa (325 kg/cm^2)
     1) Measure the pressure when each actuator except the travel actuator is relieved in H/O mode with the engine at high idling.
        ★ Note that the set pressure of the safety valve for the swing motor and head end of the boom is lower that the LS relief pressure, so the valve measured will be the relief pressure of the safety valve.
        If the swing lock switch is ON, the pressure will rise, so always keep the lock switch OFF when measuring.



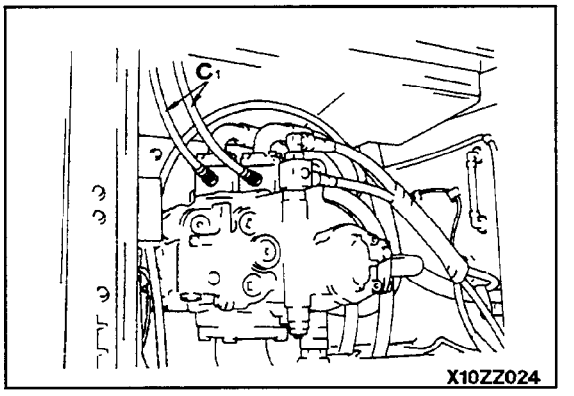
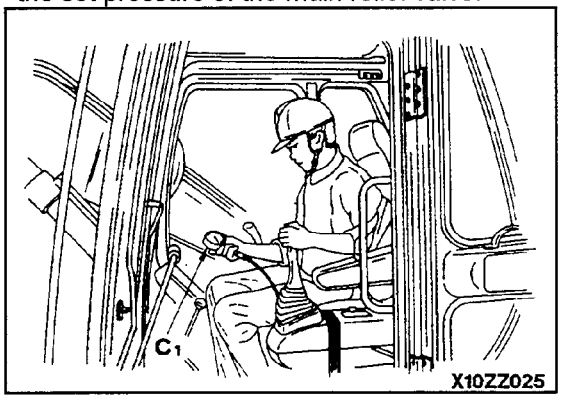


Table 1 Combination of pumps and actuators controlled when flow from front and rear pump is divided.

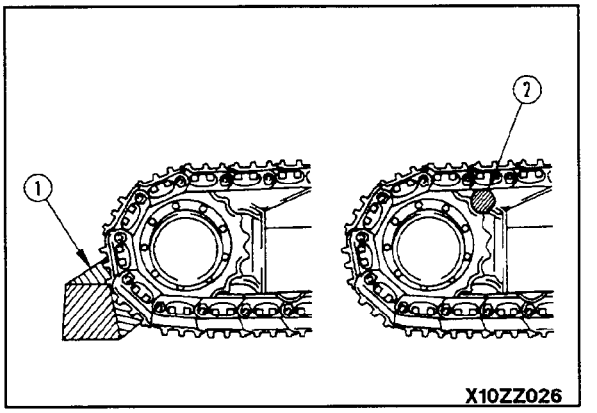
Pump	Controlled actuator
Front pump	● Arm cylinder ● Swing motor ※ ● L.H. travel motor
Rear pump	● Boom cylinder ※ ● Bucket cylnder ● R.H. travel motor

※ The set pressure of the safety valve at the head end and the swing motor is lower than the set pressure of the main relief valve.



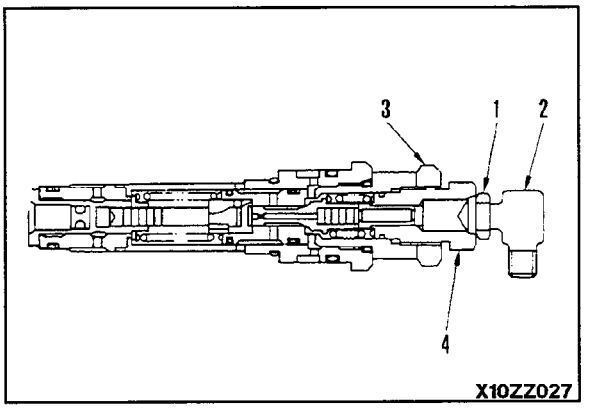
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2. When pressure rises to 34.8 MPa (355 kg/cm^2)
   ★ Main relief valve actuated.
   1) When travel is operated.
      Measure the hydraulic pressure when the travel is relieved on each side seperately in H/O mode with the engine at high idling.
      ★ To relieve the travel circuit, put block ① under the track shoe grouser, or put block ② between the sprocket and frame to lock the track.
   2) When power max. function is actuated.
      When measuring the oil pressure in G/O or H/O mode with the engine at high idling and the power max. function actuated, relieve one of the boom, arm, or bucket circuits, and measure the oil pressure.

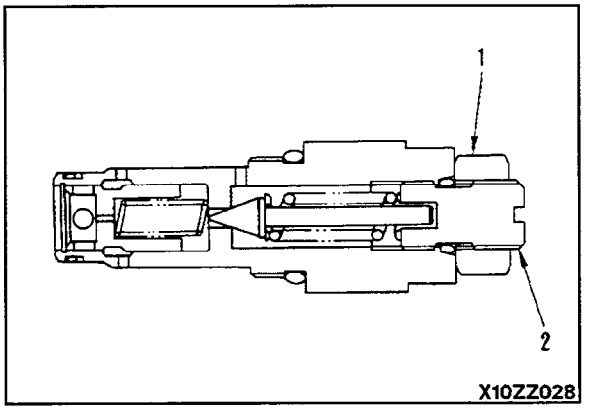


ADJUSTING

1. LS relief valve
   1) Loosen nut (1) so that elbow (2) can move.
   2) Loosen locknut (3), then turn holder (4) to adjust.
      ★ Turn the holder to adjust as follows.
      - To INCREASE pressure, turn CLOCKWISE
      - To DECREASE pressure, turn COUNTERCLOCKWISE.

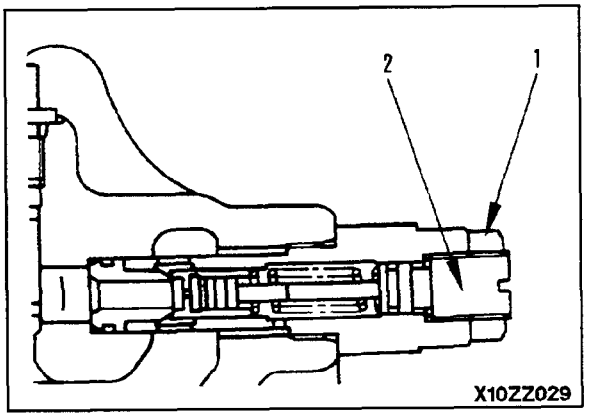


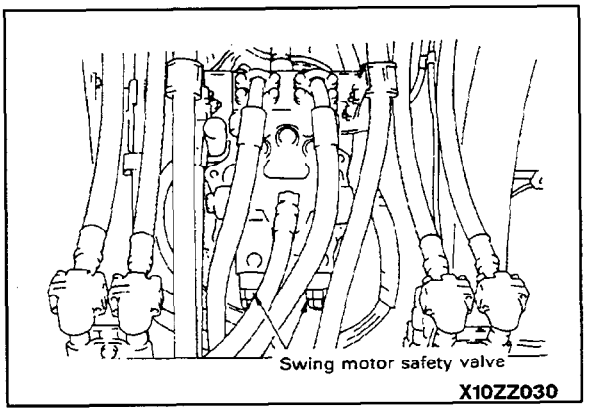
2. Main relief valve
   - Loosen locknut (1), then turn adjustment screw (2) to adjust.
     ★ Turn the adjustment screw to adjust as follows.
     To INCREASE pressure, turn CLOCKWISE.
     To DECREASE pressure, turn COUNTER-CLOCKWISE.
     ★ Amount of adjustment for one turn of adjustment screw: 12.6 MPa (128 kg/cm^2).



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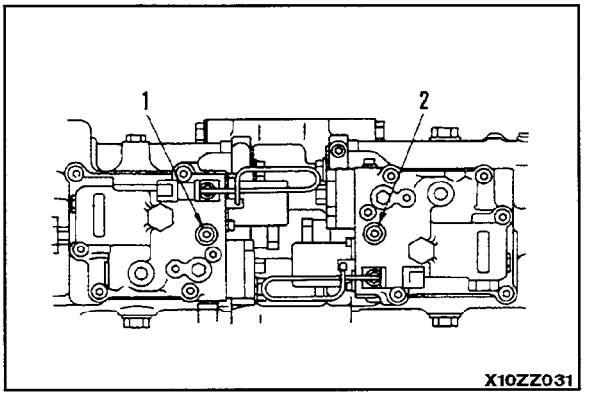
3. Swing motor safety valve
   - Loosen locknut (1), then turn adjustment screw (2) to adjust.
     ★ Turn the adjustment screw to adjust as follows.
     - To INCREASE pressure, turn CLOCKWISE.
     - To DECREASE pressure, turn COUNTERCLOCKWISE.





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TESTING AND ADJUSTING TVC VALVE OUTPUT PRESSURE (SERVO PISTON INPUT PRESSURE)



MEASURING

★ Hydraulic oil temperature when measuring : 45 - 55°C

● Measure the oil pressure when the circuit is relieved in the power max. mode.

1) Remove pressuremeasurement plugs (1), (2), (3), and (4) (Thread dia. = 10 mm, Pitch = 1.5 mm), and install oil pressure gauge **C1**.

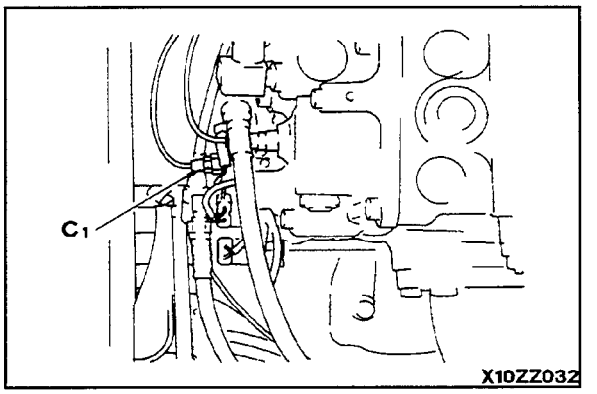
★ Install a 39.2 MPa (400 kg/cm^2) gauge to the servo valve end, and a 58.8 MPa (600 kg/cm^2) gauge to the pump outlet port end.

2) Set the swing lock switch ON.

3) Set the working mode to H/O mode.

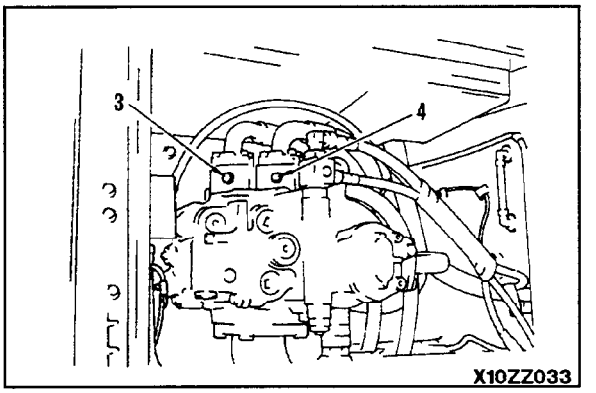
4) Run the engine at high idling, turn the L.H. knob switch ON, and measure the oil pressure when the arm IN circuit is relieved.

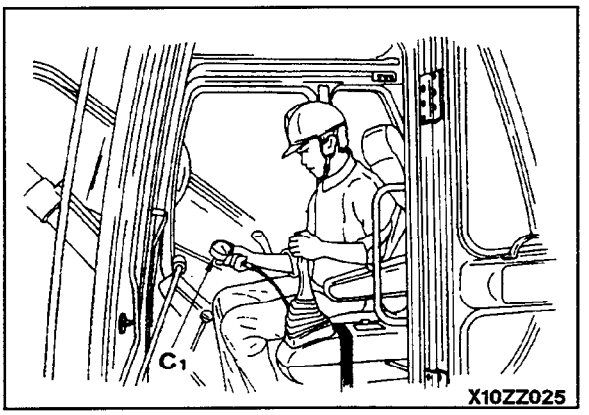
★ Check that the servo piston input pressure is ½ of the pump discharge pressure.

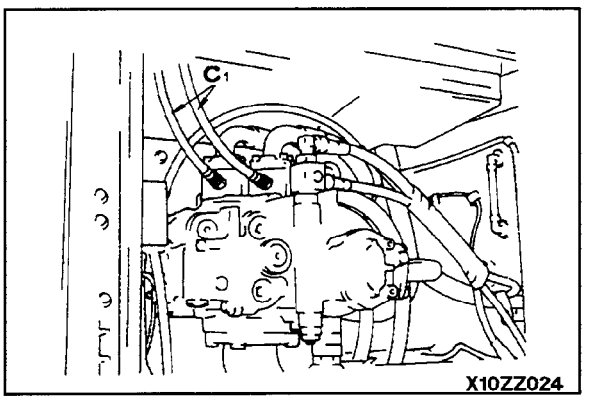


[Reference]

If there is any abnormality in the LS valve or servo piston, the servo piston input pressure will be almost the same or 0 of the pump discharge pressure.







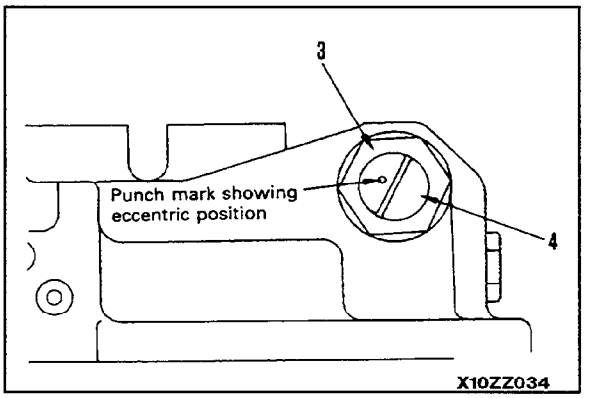
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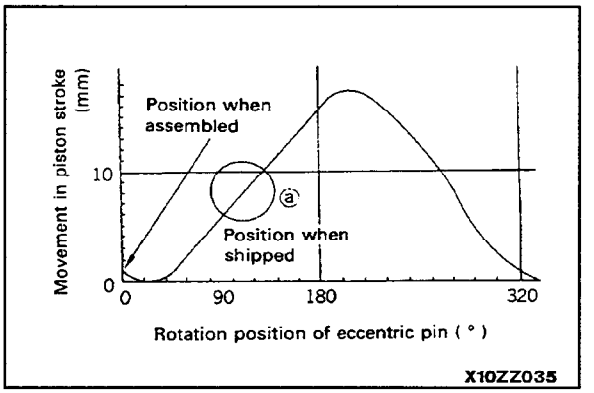
ADJUSTING

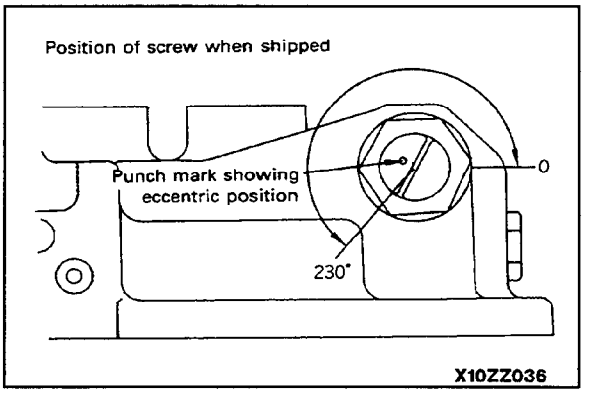
★ If the load becomes larger, the engine speed will drop. Or if the engine speed remains normal, the work equipment speed will drop. In such cases, if the pump discharge pressure and LS differential pressure are normal, adjust the TVC valve as follows.
  ★ There are two sets, so adjust both the front and rear to the same angle.

1. Loosen locknut (3), and if the speed is slow, turn screw (4) to the left; if the engine speed drops, turn the screw to the right.
   ★ If the screw is turned to the left, the pump absorption torque will be increased, and if it is turned to the right, the pump absorption torque will be reduced.
   There is also a connection with the angle, so see Note below.
   ★ The adjustment range for the screw is a maximum of 90° to both the left and right.
2. After completing the adjustment, tighten the locknut.
   Locknut: 29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)

Note: The screw is an eccentric cam, so if it is turned from position ⓐ in the graph, the stroke of the servo piston will move as shown in the graph. If it is turned on full turn, it will return to the original position, but the screw will become looser, so there will be play in the screw. Therefore, turn the screw a maximum of 90° to the left and right from the position ⓐ set when the machine was shipped.







TESTING AND ADJUSTING LS VALVE OUTPUT PRESSURE (SERVO PISTON INPUT PRESSURE) AND LS DIFFERENTIAL PRESSURE

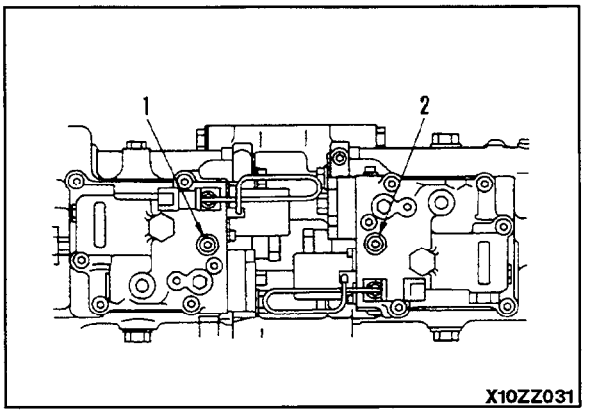
★ Hydraulic oil temperature when measuring: 45 - 55°C

Measuring

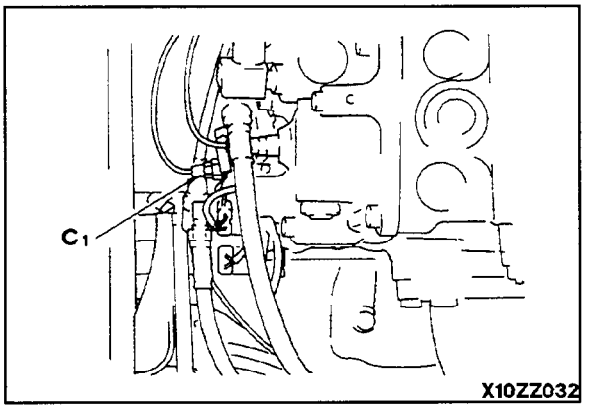
1. Measuring LS valve output pressure (servo piston input pressure)
   1) Remove pressure measurement plugs (1),(2),(3), and (4) (Thread dia. = 10 mm, Pitch 1.5 mm), and install oil pressure gauge **C1**.
      ★ Install a 39.2 MPa (400 kg/cm^2) gauge to the servo valve end, and a 58.8 MPa (600 kg/cm^2) gauge to the pump outlet port end.
   - Oil pressure when travel is rotating under no load on one side.
      i) Set the working mode to H/O mode, and set the travel speed switch to **Hi**.
      ii) Use the work equipment to raise the track assembly on one side.
      iii) Measure the oil pressure with the engine at high idling and the travel lever operated to the end of its stroke to rotate the track under no load.
      Run the engine at high idling, operate the travel lever to the end of its stroke, and measure the oil pressure when the working mode and travel speed are switched as shown in Table 1.

Table 1

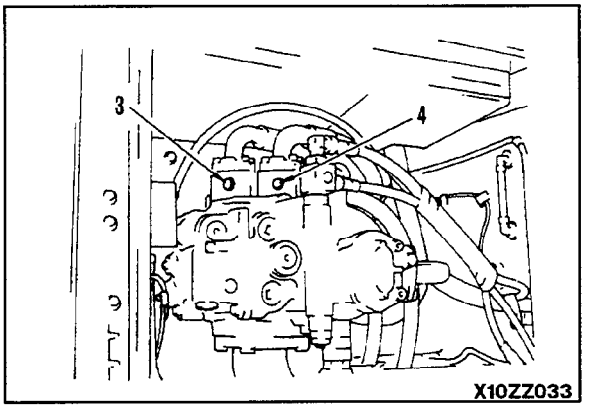
Working mode	Travel lever	Pump pressure (MPa (kg/cm^2))	Servo piston inlet port pressure (MPa (kg/cm^2))	Remarks
H/O mode	Neutral	3.72 ± 0.69 (38 ± 7)	3.72 ± 0.69 (38 ± 7)	About same pressure
H/O mode	Full	8.82 ± 1.96 (90 ± 20)	4.41 ± 0.98 (45 ± 10)	About ½ of pressure



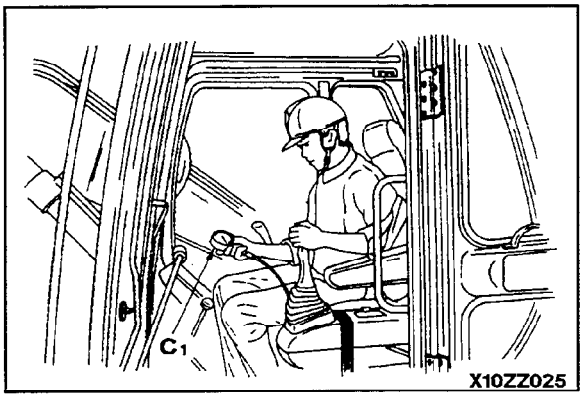
X10ZZ031



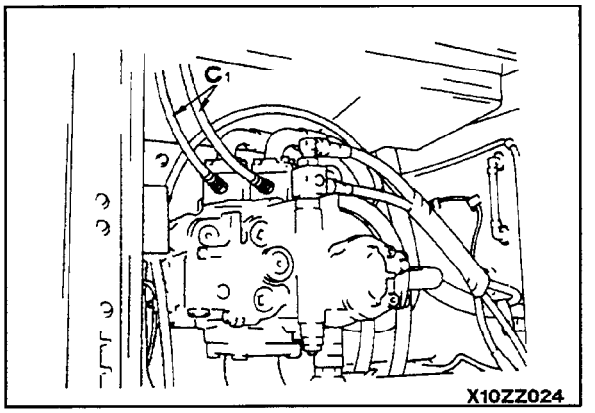
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X10ZZ033



X10ZZ025



X10ZZ024

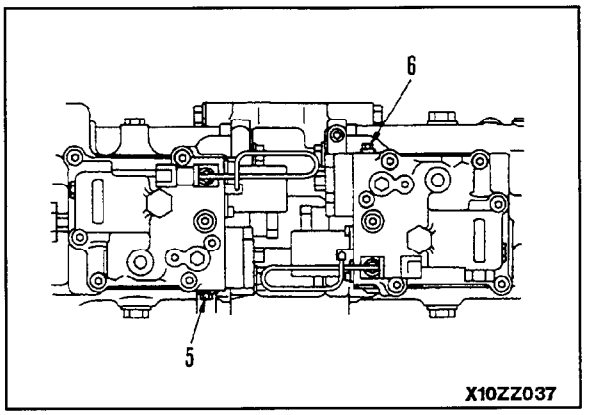
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2. Measuring LS differential pressure
   1) Measuring with a differential pressure gauge.
      i) Remove oil pressure measurment plugs (5) and (6) (Thread dia. = 10 mm, Pitch = 1.5 mm), and install differential pressure gauge **C4**.
      ii) Set to the conditions in Table 2 and measure the LS differential pressure.

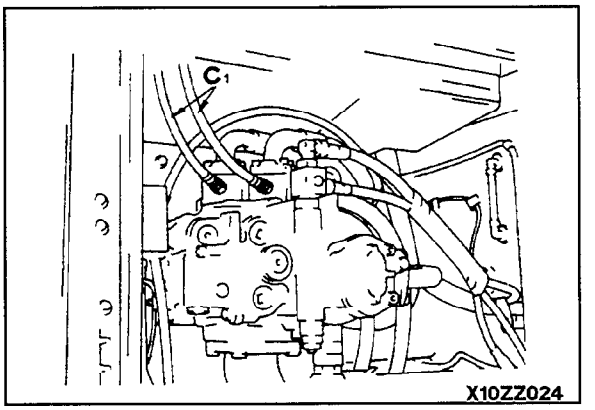
Table 2

Working mode	Fuel control dial	Operation	Differential pressure (MPa(kg/cm²))
H/O mode	MAX	Levers at neutral	2.94 ± 0.98 (30 ± 10)
H/O mode	MAX	Travel speed: Hi Travel circuit under no load (lever fully operated)	2.16 ± 0.1 (22 ± 1)

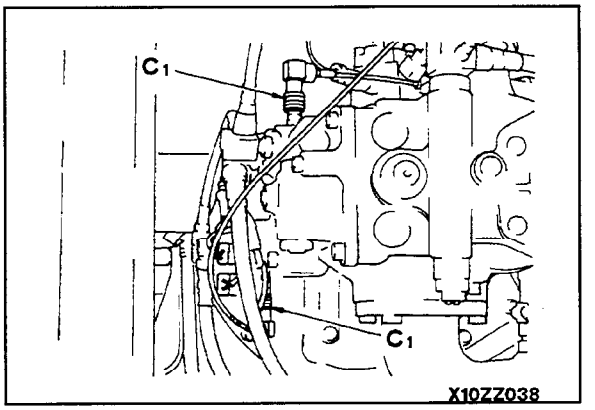
   2) Measuring with oil pressure gauge
      ★ The maximum differential pressure is 2.94 MPa (30 kg/cm²), so measure with the same gauge.
      i) Remove oil pressure measurement plugs (5) and (6) (Thread dia. = 10 mm, Pitch = 1.5 mm), and install the plug inside hydraulic tester **C1**.
      ii) Install oil pressure gauge **C1** (58.8 MPa (600 kg/cm²)) to the measurement plug for the pump discharge pressure.
         ★ Use a gauge with a scale in units of 0.98 MPa (10 kg/cm²). (If no 58.8 MPa (600 kg/cm²) pressure gauge is available, a 39.2 MPa (400 kg/cm²) pressure gauge can be used.)
      iii) Set to the conditions in Table 2 and measure the pump discharge pressure.
         ★ Stand directly in front of the indicator and be sure to read it correctly.
      iv) Remove oil pressure gauge **C1**, then install to the LS pressure measurement plug.
      v) Set to the conditions in Table 2 and measure the LS pressure.
         ★ Stand directly in front of the indicator and be sure to read it correctly.
         • Pump discharge pressure - LS pressure = Differential pressure.



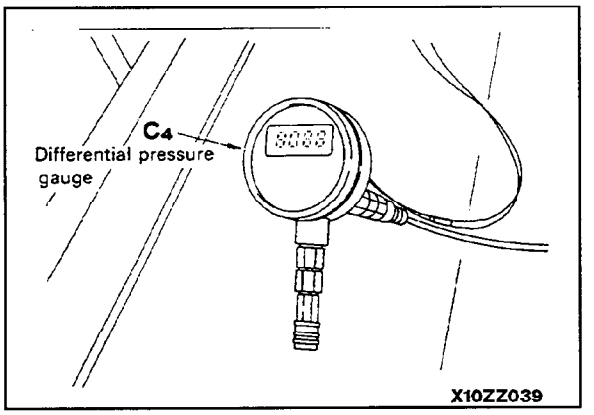
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X10ZZ024



X10ZZ038



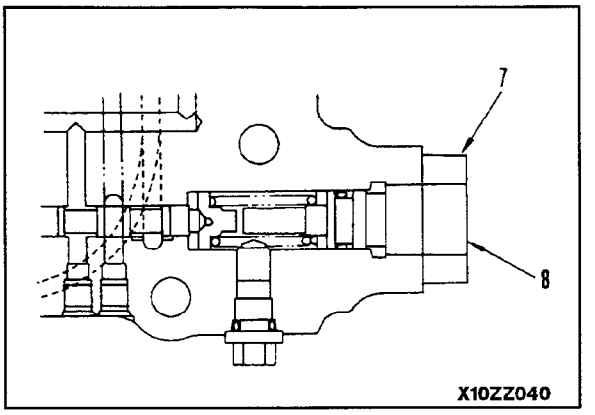
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ADJUSTING

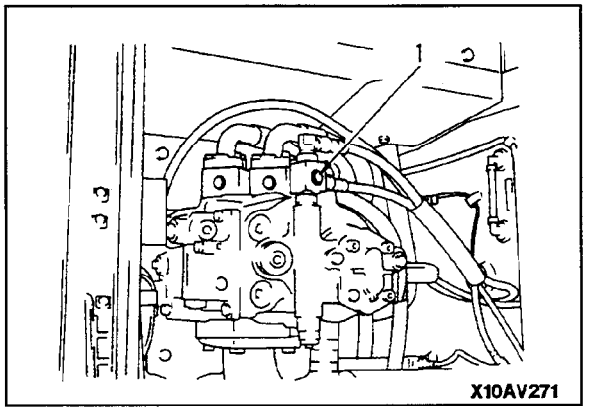
1. Adjusting LS valve
   When the differential pressure is measured under the conditions above, and the results show that the differential pressure is not within the standard value, adjust as follows.
   1) Loosen locknut (7) and turn screw (8) to adjust the differential pressure.
      ★ Turn the screw to adjust the differential pressure as follows.
      - To INCREASE pressure, turn CLOCKWISE.
      - To DECREASE pressure, turn COUNTERCLOCKWISE.
   2) After adjusting, tighten locknut (7).
      Locknut : 29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)

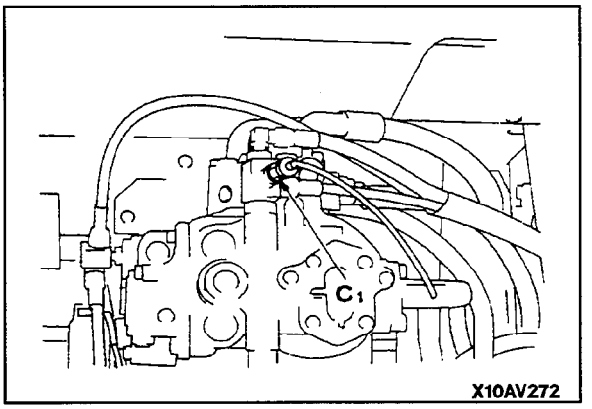
   Note: Always measure the differential pressure while adjusting.



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TESTING AND ADJUSTING CONTROL PUMP CIRCUIT OIL PRESSURE





MEASURING

★ Hydraulic oil temperature when measuring: 45 - 55°C

1. Remove pressure pick-up plug (1) (Thread dia.= 10mm, Pitch = 1.25 mm), and install oil pressure guage **C1** (5.88 MPa (60 kg/cm^2)).
2. Start the engine and measure with engine at high idling.

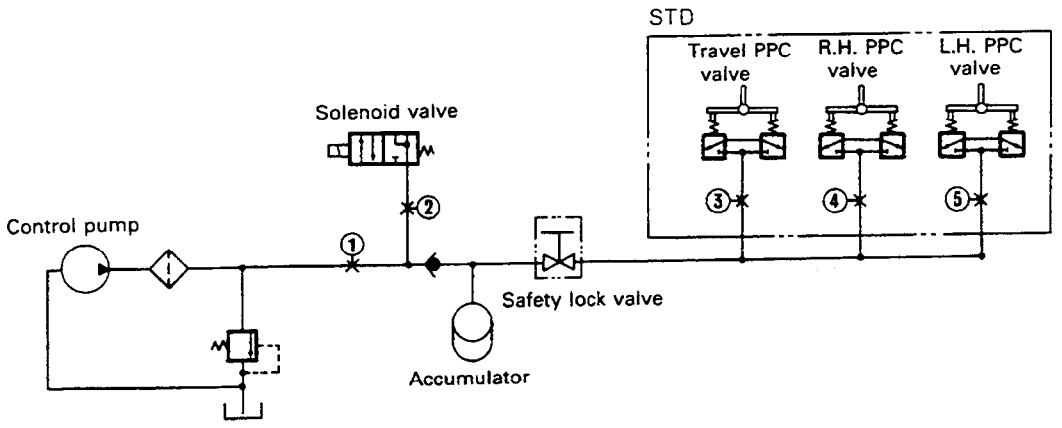
★ When testing for internal leakage of the equipment in the control circuit, use the parts given below to shut off the circuit for the follwing sections when measuring the relief pressure.

No.	Section of hydraulic circuit shut off	Component that can be checked
1	Control pump outlet port	Control pump
2	Solenoid valve inlet port	Solenoid valve
3	Travel PPC valve inlet port	Travel PPC valve
4	R.H. PPC valve inlet port	R.H. PPC valve
5	L.H. PPC valve inlet port	L.H. PPC valve

★ Items No. 2 and below can be checked if the equipment in the previous number is normal.

★ Use the following parts to shut off the circuit.

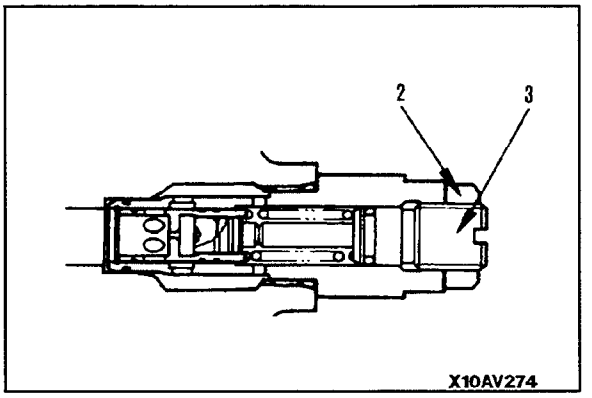
- For elbow
  Sleeve nut : 07221-20210, 07221-20315
  07221-20422
  Plug : 07222-00210, 07222-00315
  07222-00414
- For hose
  Plug : 07376-50210, 07376-50315
  07376-50422



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ADJUSTING

1. Loosen locknut (2) and turn adjustment screw (3) to adjust.
   - ★ Turn the adjustment screw as follows.
     - To INCREASE pressure, turn CLOCKWISE.
     - To DECREASE pressure, turn COUNTERCLOCKWISE.
   - ★ Amount of adjustment for one turn of adjustment screw: 0.53 MPa (5.4 kg/cm^2).
   - Locknut : 63.7 ± 9.8 Nm (6.5 ± 1.0 kgm)
   - ★ After completion of adjustment, repeat the procedure in Item 1 to check the set pressure again.



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TESTING EPC VALVE, SOLENOID VALVE OUTPUT PRESSURE

MEASURING

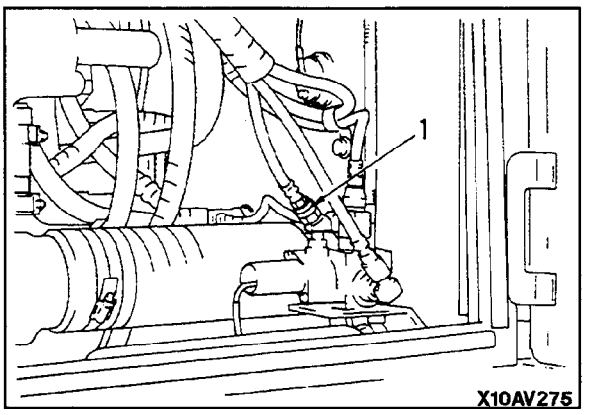
★ Hydraulic oil temperature when measuring: 45 - 55°C

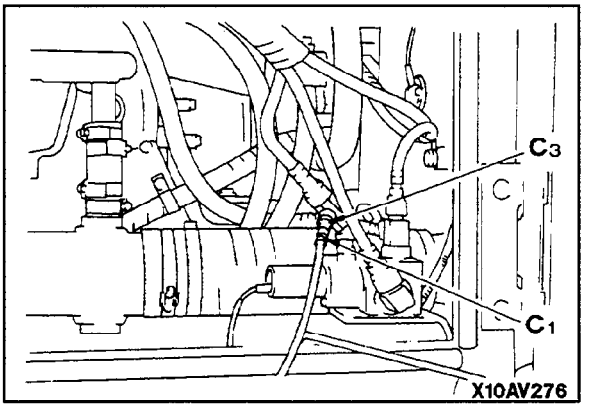
1. Measuring output pressure of LS control EPC valve
   1) Disconnect output hose (1) of the LS control EPC valve, then use adapter **C3** in the oil pressure gauge kit to install oil pressure **C1** (5.88 MPa (60 kg/cm²)).
   2) Measure the output pressure under the conditions in Table 1.

Table 1

Operation and working mode	Engine speed (rpm)	Output pressure (MPa (kg/cm²)	[Reference] Current (A)
All control levers at neutral	Min 1,500	2.94 (30)	900 ± 30
H/O mode or G/O mode Travel circuit at neutral, any work equipment lever is operated	Min 2,000	0 (0)	0

★ Monitoring code 10 or 40 for engine speed
Monitoring code 15 for LS control EPC current





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2. Measuring output pressure of ON/OFF solenoid valve
   1) Disconnect outlet hose (2) of the solenoid valve, then use adapter **C3** in the oil pressure gauge kit to install oil pressure gauge **C1** (5.88 MPa (60 kg/cm^2)).
   2) Measure the output pressure under the conditions in Table 2.

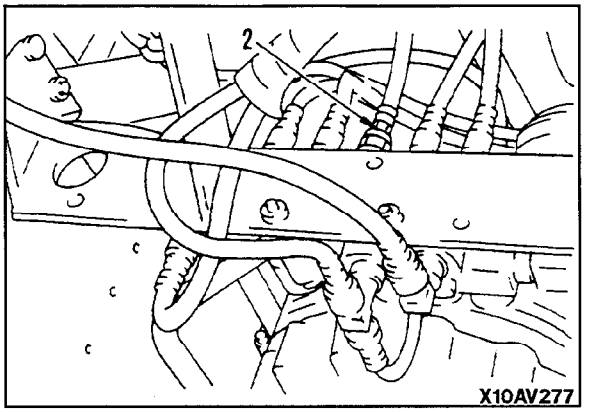
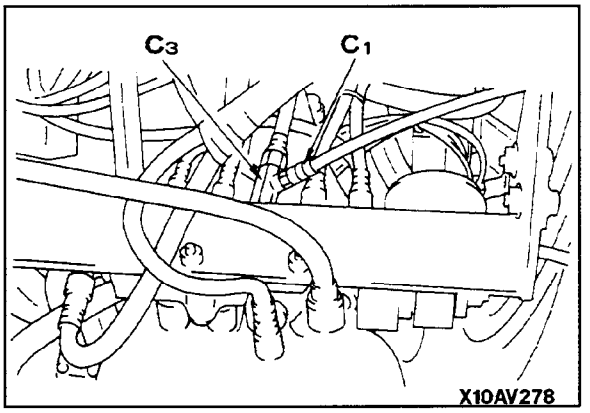


Table 2

Name of solenoid		Measurement conditions	Operating condition	Condition of solenoid	Oil pressure (MPa (kg/cm^2))	Remarks
1	Swing brake solenoid	Swing or work equipment operated	Brake cancelled	ON	Min 2.74 (Min 28)	
		All levers except travel at neutral (5 sec after returning to neutral)	Brake actuated	OFF	0 (0)	
2	Travel speed solenoid	Travel speed switch at Hi or Mi Engine speed 1500 rpm or above Travel lever operated	Travel speed Hi	ON	Min 2.74 (Min 28)	Motor swash plate angle at minimum
		Travel speed switch at Lo or engine speed 1500 rpm or below	Travel speed Lo	OFF	0 (0)	Motor swash plate angle at maximum
3	2-stage relief solenoid	Swing lock switch ON + work equipment lever operated	Pressure rise	ON	Min 2.74 (Min 28)	
		All levers at neutral	Normal pressure	OFF	0 (0)	
4	LS select solenoid	Swing lock switch OFF, compound operation of swing + travel or arm OUT or boom RAISE	LS circuit divided	ON	Min 2.74 (Min 28)	Divided only for compound operations of swing + travel, arm OUT, boom RAISE
		All levers at neutral	LS circuit not divided	OFF	0 (0)	
5	Pump merge-divider solenoid	Lever at neutral, or boom, arm bucket operated independently	Flow from front and rear pumps merged	OFF	0 (0)	LS pump merge-divider valve actuated at same time
		Travel or swing operated independently	Flow from front and rear pumps divided	ON	Min 2.74 (Min 28)	

★ The basic pressure of the LS select solenoid valve is supplied from the PPC shuttle valve. Therefore, the oil pressure is not supplied unless one of the travel or arm OUT or boom RAISE is operated.

★ Operation of solenoid valve
ON: Contunuous (oil pressure generated)
OFF: Not continous (oil pressure: 0)



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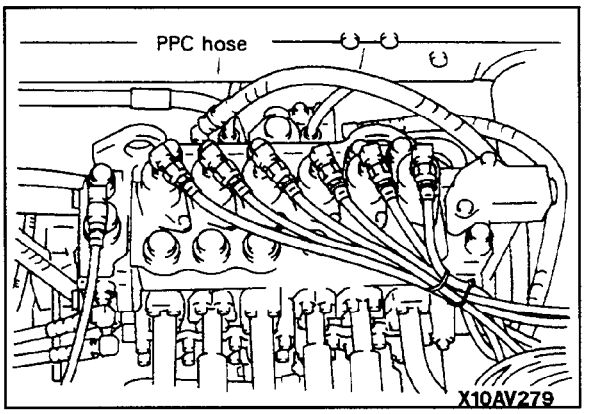
MEASURING PPC VALVE OUTPUT PRESSURE AND TESTING PPC SHUTTLE VALVE

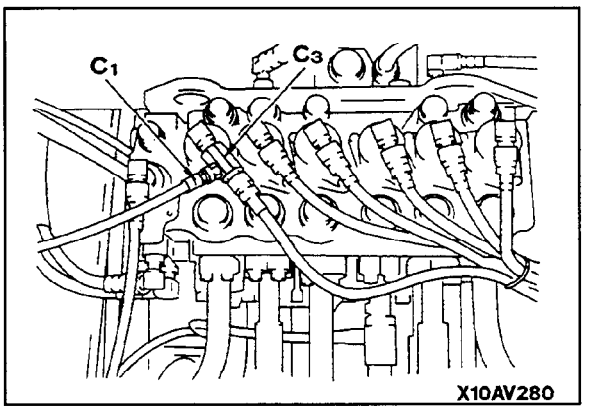
★ Hydraulic oil temperature when measuring: 45 - 55°C

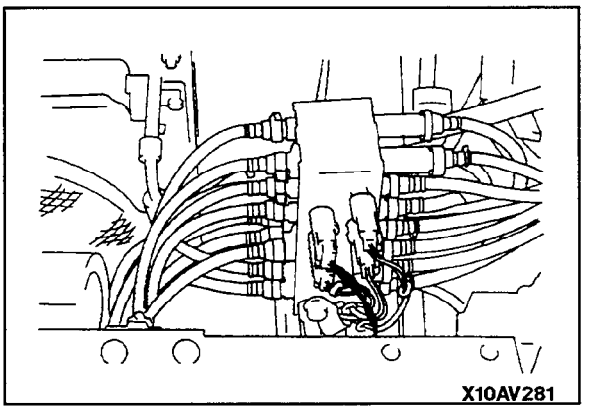
1. Measuring PPC valve output pressure
   1) Disconnect the hose of the circuit to be measured (see next page).
   2) Install adapter **C3** between the hose and elbow.
   3) Install oil pressure gauge **C1** (5.88 MPa (60 kg/cm^2)) to adapter **C3**.
   4) Run the engine at high idling, operate the control lever of the circuit to be measured, and measure the oil pressure.

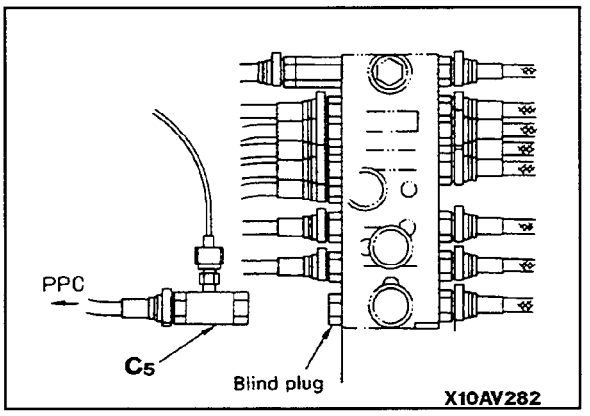
2. Checking PPC shuttle valve
   If the output pressure at the control valve end is low, check for leakage of oil from the PPC shuttle valve as follows.
   1) Disconnect the hose between the PPC valve and the shuttle block at the block end.
   2) Install an adapter for measuring the oil pressure to the tip of the hose, then install blind plugs to the tip and shuttle block end.
   3) Operate the control lever and measure the output pressure.
   ★ If the output pressure becomes normal, there is leakage from the PPC shuttle valve; if there is no change, the PPC valve is defective.

3. Checking defective operation of PPC shuttle valve
   1) Remove the oil pressure switch, fit adapter **C5**, then install oil pressure gauge **C1** (5.88 MPa (60 kg/cm^2)).
   2) Operate the applicable lever.
   If no oil pressure is generated or if oil pressure is generated when another lever is operated, the operation of the PPC shuttle valve is defective.



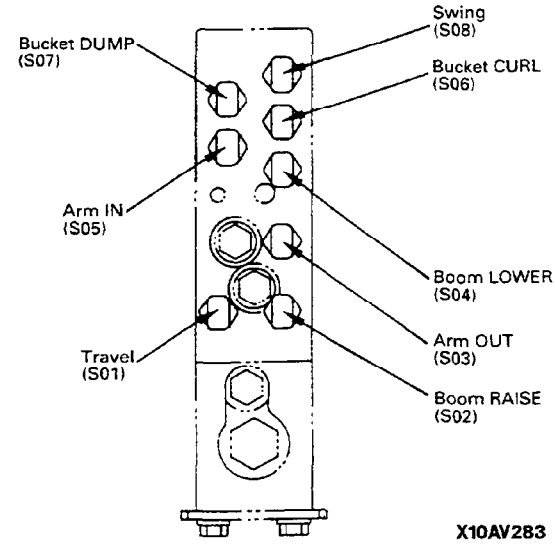




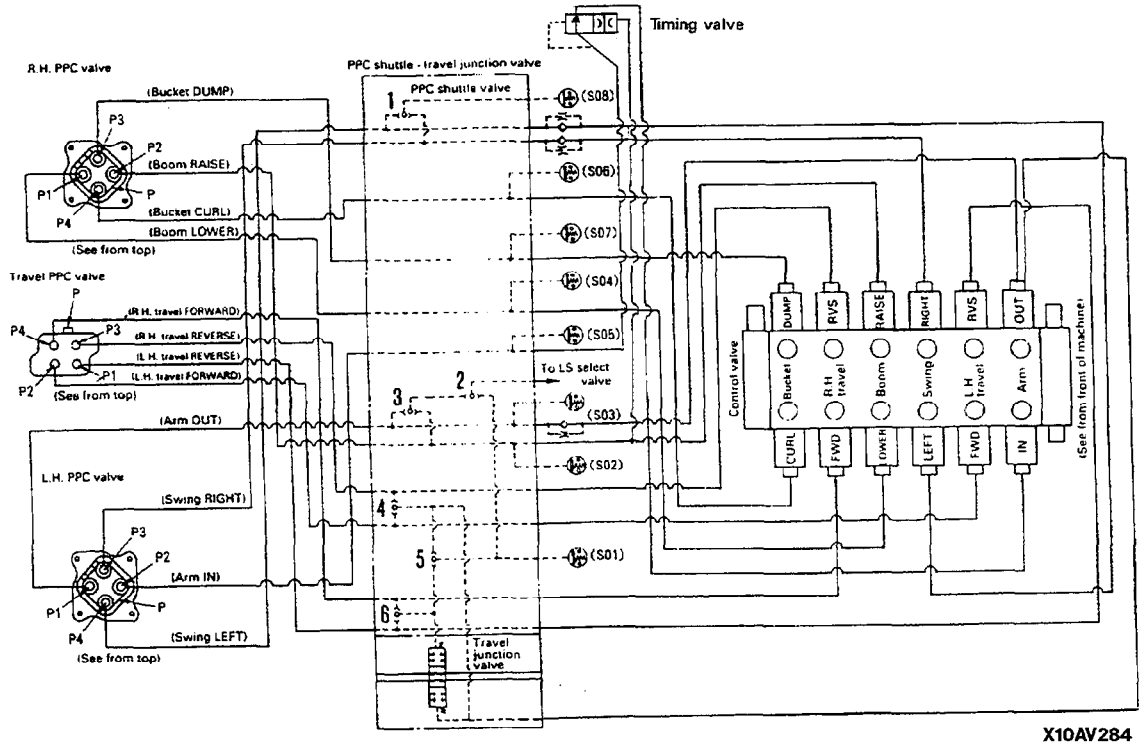


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Oil pressure switch location diagram
Shuttle block seen from rear of machine



- **Circuit diagram**



1. Swing PPC shuttle valve
2. PPC shuttle valve for LS select
3. PPC shuttle valve for OUT, boom RAISE
4. PPC shuttle valve for L.H. travel FOWARD, R.H. travel REVERSE
5. Travel PPC shuttle valve
6. PPC shuttle valve for R.H. travel FORWARD, L.H. travel REVERSE

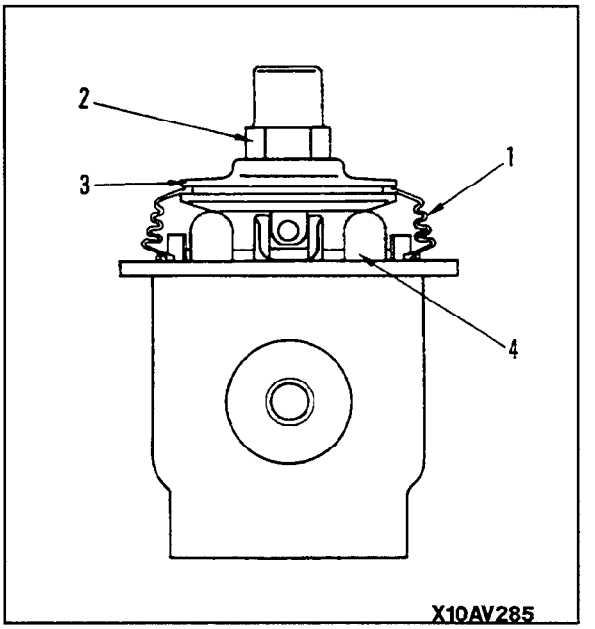
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ADJUSTING WORK EQUIPMENT • SWING PPC VALVE

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

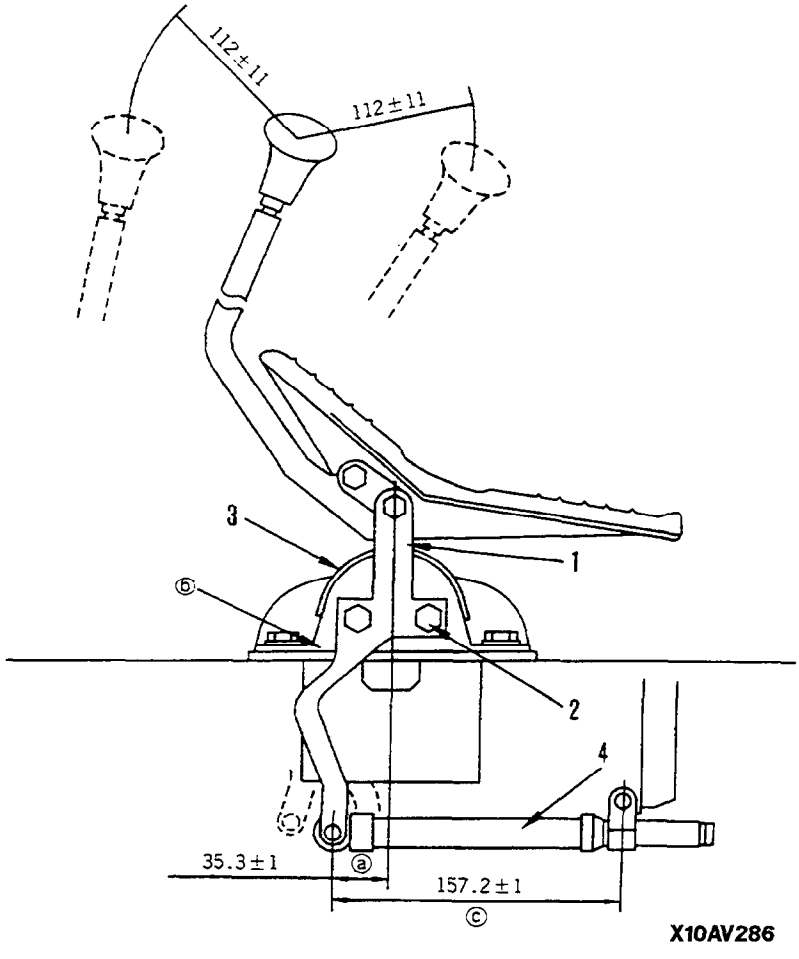
⚠ Lower the work equipment to the groud and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then set the safety lock lever to the LOCK position.

1. Remove the PPC valve.
2. Remove boot (1).
3. Loosen locknut (2), then screw in disc (3) until it contacts the 4 heads of piston (4).
   ★ When doing this, do not move the piston.
4. Secure disc (3) in position, then tighten locknut (2) to the specified torque.
   Locknut : 107.8 ± 9.8 Nm (11 ± 1 kgm)
5. Install boot (1).
   ★ With the above adjustment, the clearance between disc (3) and piston (4) becomes 0.

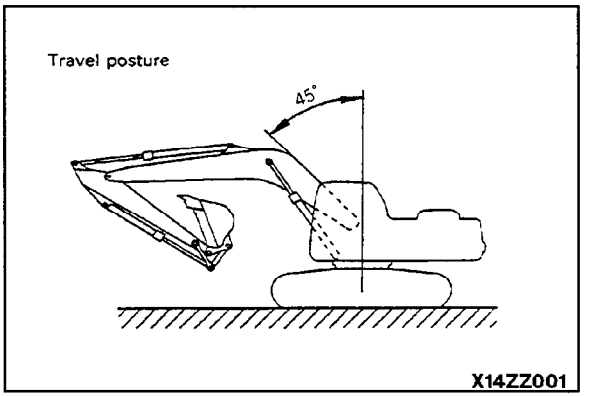


ADJUSTING TRAVEL LEVER

1. Use bolt (2) to install lever (1) to the PPC valve.
   ★ When doing this, install so that clearance ⓐ is 35.3 ± 1mm.
2. In this condition, move left and right travel levers (3) forward and backwards, and check that the levers are fitted securely in the stopper (bolt head) of the PPC valve.
3. Check also that cover (3) is not contacting portion ⓑ.
   ★ If it is contacting, adjust with the PPC mounting bolt or cover mounting bolt.
4. Install damper (4) and adjust so that dimension ⓒ is 157.2 ± 1mm when the lever is at neutral.

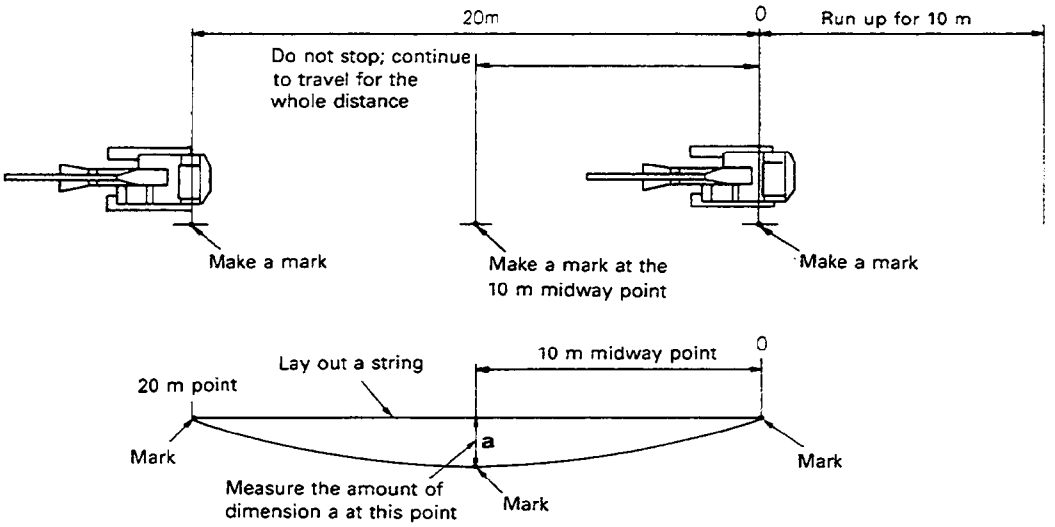


TESTING TRAVEL DEVIATION



★ When traveling on level ground.

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 10m, then measure the deviation when traveling for the next 20m.
   ★ Set to H/O mode and measure with the engine at high idling.
   ★ Install the hydraulic pressure gauge and measure the pump discharge pressure at the same time.



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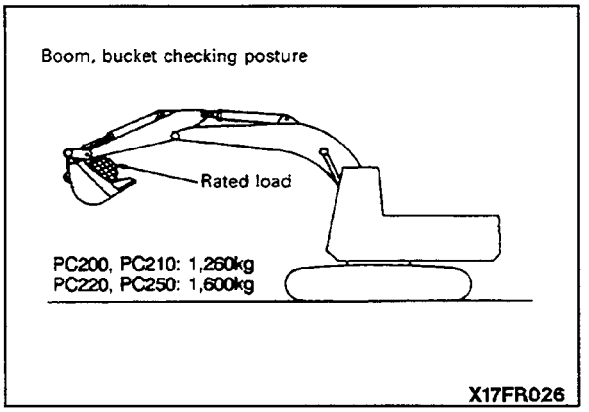
TESTING LOCATIONS CAUSING HYDRAULIC DRIFT OF WORK EQUIPMENT

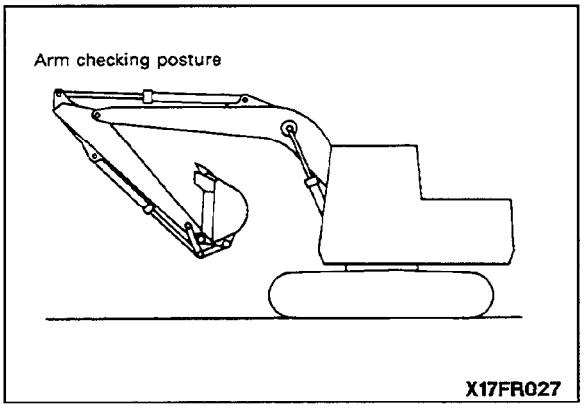
★ If there is any hydraulic drift in the work equipment (cylinders), check as follows to determine if the cause is in the cylinder packing or in the control valve.

1. Checking for defective cylinder packing
   1) Checking boom and bucket cylinders
      i) Set in the same posture as when measuring hydraulic drift, and stop the engine.
      ii) Operate the boom control lever to RAISE or the bucket control lever to CURL.
      - If the lowering speed increases, the packing is defective.
      - If there is no change, the boom holding valve (boom) or the control valve (bucket) is defective.
   2) Checking arm cylinder
      i) Operate the arm cylinder to move the arm in fully, then stop the engine.
      ii) Operate the control lever to arm IN.
      - If the lowering speed increases, the packing is defective.
      - If there is no change, the control valve is defective.
      - ★ If the pressure in the accumulator has dropped, run the engine for approx. 10 seconds to charge the accumulator again before operating.

[Reference] If the cause of the hydraulic drift is in the packing, and the above operation is carried out, the downward movement becomes faster for the following reasons.

1) If the work equipment is set to the above posture (holding pressure applied to the bottom end), the oil at the bottom end leaks to the head end. However, the volume at the head end is smaller that the volume at the bottom end by the volume of the rod, so the internal pressure at the head end increases because of the oil flowing in from the bottom end.
2) When the internal pressure at the head end increases, the pressure at the bottom end also rises in proportion to this. The balance is maintained at a certain pressure (this differs according to the amount of leakage) by repeating this procedure.
3) When the pressure is balanced, the downward movement becomes slower. If the lever is then operated according to the procedure given above, the circuit at the head end is opened to the drain circuit (the bottom end is closed by the check valve), so the oil at the head end flows to the drain circuit and the downward movement becomes faster.





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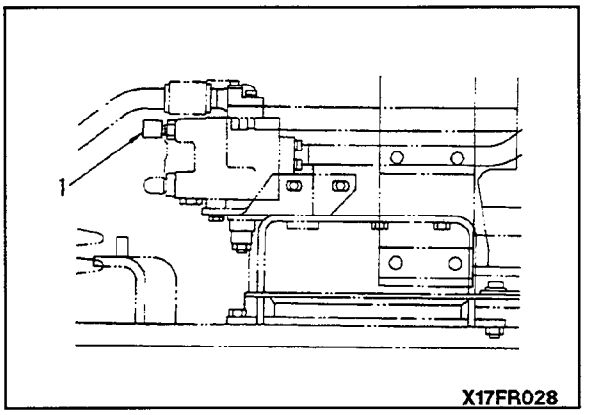
2. Checking boom holding valve

⚠ Set the work equipment at the maximum reach, and the top of the boom horizontal, then stop the engine. Lock the work equipment control levers and release the pressure inside the hydraulic tank.

1) Disconnect pilot hose (1) of the boom holding valve, and install a blind plug in the hose.
   - ★ Blind plug: 07376-50315
   - ★ Leave the boom holding valve end open.
2) Start the engine, charge the accumulator, then stop the engine.
3) Operate the boom control lever to the LOWER position.
   - ★ If any oil leaks from the port that is left open, the boom holding valve is defective.

3. Checking PPC valve

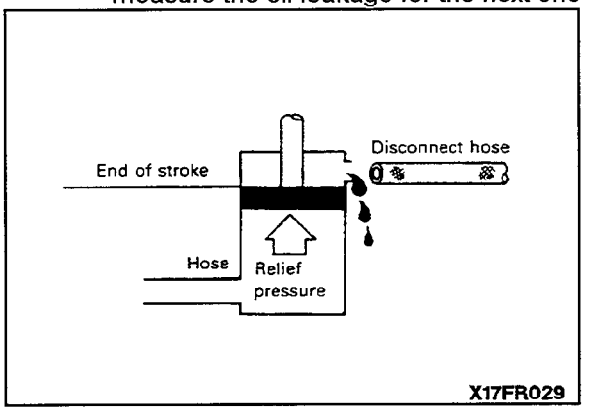
If the hydraulic drift differs when the safety lock lever is in the LOCK of FREE position, (engine running), the PPC valve is defective.



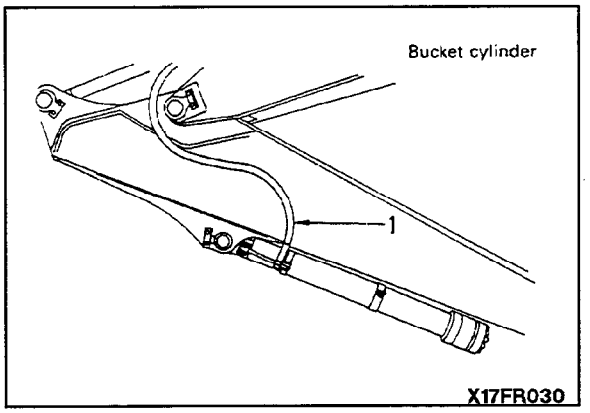
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MEASURING OIL LEAKAGE

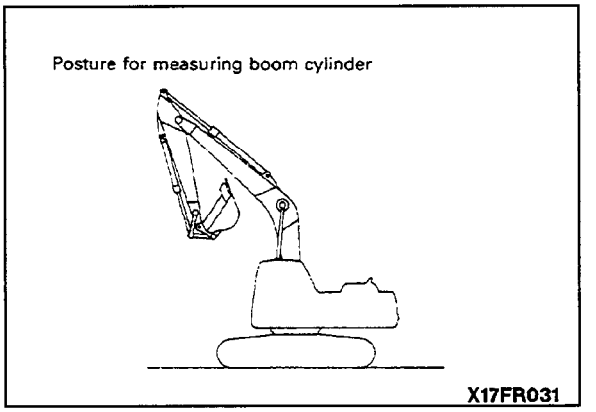
★ Hydraulic oil temperature when measuring: 45 - 55°C
1. Work equipment cylinder
★ If the hydraulic drift of the work equipment is outside the standard value, measure the leakage inside the cylinder as follows, and judge if the cause of the hydraulic drift is in the cylinder or in the control valve.
   - If the leakage is withing the standard value, the problem is in the control valve.
   - If the leakage is greater than the standard value, the problem is in the cylinder.
   1) Fully extend the rod of the cylinder to be measrued, then stop the engine.
   2) Disconnect piping (1) at the head end, the block the piping at the chassis end with a blind plug.
   ⚠ Be careful not to disconnect the piping at the bottom end.
   3) Start the engine and apply the relief pressure to the bottom end of the cylinder with the engine at high idling.
   4) Continue this condition for 30 seconds, then measure the oil leakage for the next one minute.



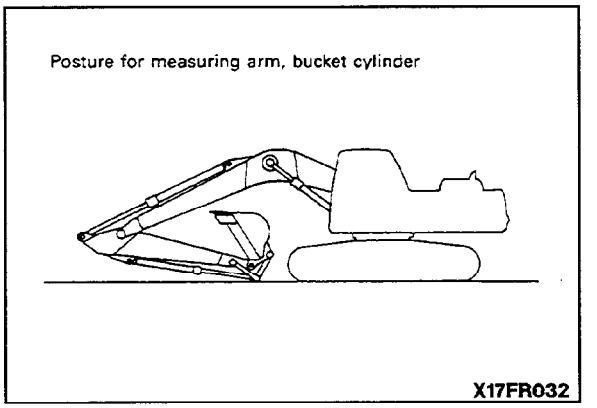
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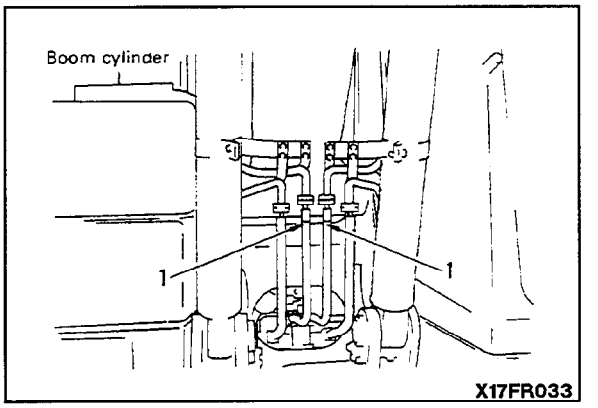
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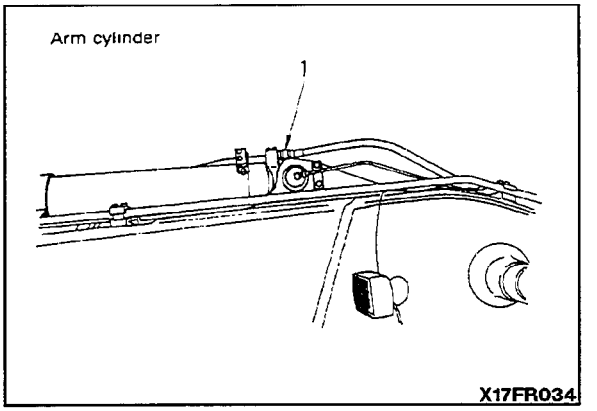
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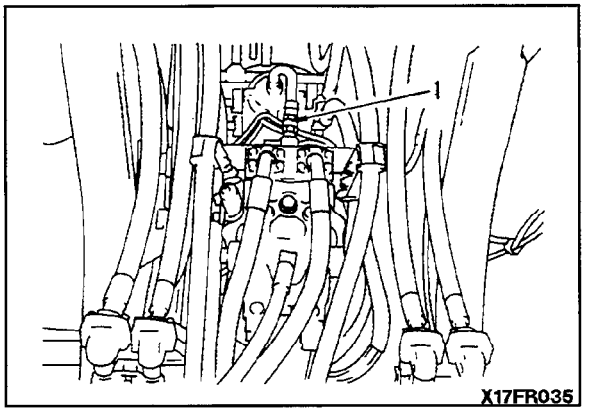


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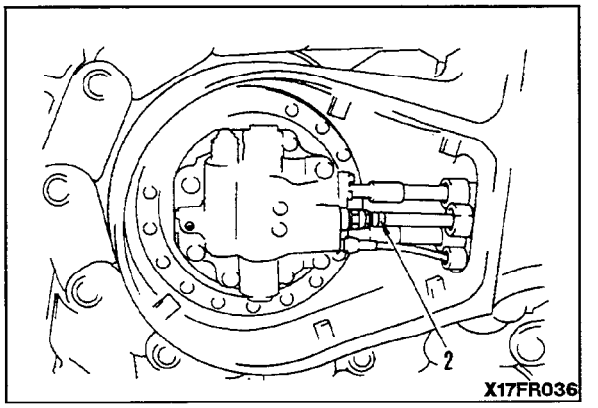


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2. Swing Motor
   1) Disconnect drain hose (1) from the swing motor, then fit a blind plug at the tank end.
   2) Set the swing lock switch ON.
   3) Start the engine and operate the swing relief with the engine at high idling.
   4) Continue this condition for 30 seconds, then measure the oil leakage for the next one minute.
   ★ After measuring, swing 180° and measure again.



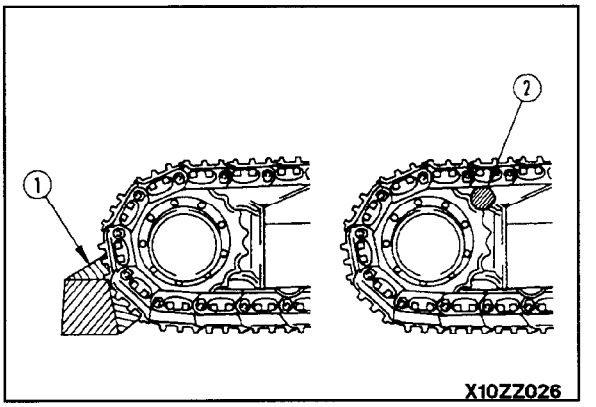
3. Travel motor
   1) Disconnect drain hose (2) from the travel motor, then fit a blind plug at the hose end.
   2) Fit block ① under the track shoe grouser, or fit block ② between the sprocket and frame to lock the track.
   3) Start the engine and operate the travel relief with the engine at high idling.
      ⚠ When measuring the oil leakage from the travel motor, mistaken operation of the control lever may lead to a serious accident, so always use signals and check when carrying out this operation.
   4) Continue this condition for 30 seconds, then measure the oil leakage for the next minute.
   ★ When measuring, move the motor slightly (to change the position between the valve plate and cylinder, and piston and cylinder), and measure several times.



RELEASING REMAINING PRESSURE IN HYDRAULIC CIRCUIT

★ If the piping between the hydraulic cylinder and the control valve is disconnected, release 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 the 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.



BLEEDING AIR

Order of operations and procedure for bleeding air (Note 2)

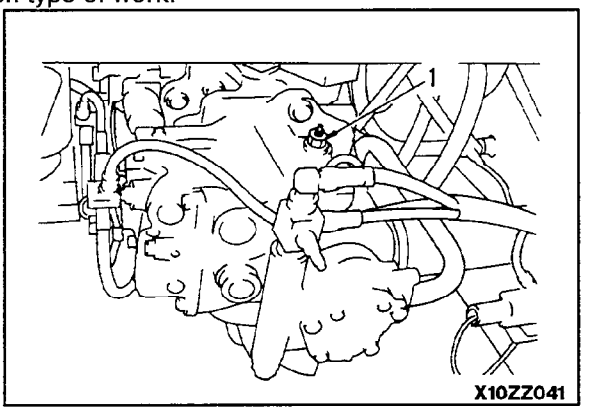
Air bleeding item / Nature of work	Air bleeding procedure						
	1	2	3	4	5	6	7
	Bleeding air from pump	Start engine	Bleeding air from cylinder	Bleeding air from swing motor	Bleeding air from travel motor	Start operations	Bleeding air between EPC valve and control valve
• Replace hydraulic oil • Clean strainer	○	○	○	○ (Note 1)	○ (Note 1)	○	
• Replace return filter element		○				○	
• Replace, repair pump • Remove suction piping	○	○	○			○	
• Replace, repair control valve		○	○			○	
• Replace cylinder • Remove cylinder piping		○	○			○	
• Replace swing motor • Replace swing motor piping		○		○		○	
• Replace travel motor,swivel • Remove travel motor,swivel piping		○			○	○	
• Replace EPC valve		○					○

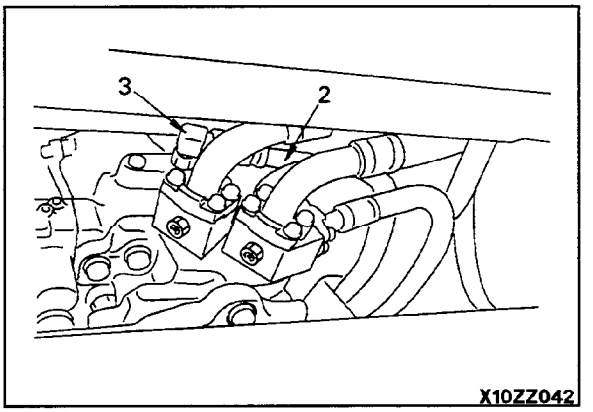
Note 1: Bleed air from the swing and travel motors only when the oil inside the motor case had been drained.
Note 2: Perform **only** those procedures marked with a ○ for each type of work.

1. Bleeding air from pump
   1) Loosen air bleed plug (1), and check that oil oozes from the plug.
   2) When oil oozes out, tighten plug (1).
      Plug : 17.15 ± 2.45 Nm
      (1.75 ± 0.25 kgm)
   ★ If no oil oozes out from the air bleed plug:
   3) Leave plug (1) loosened and remove hose (2) and elbow (3).
   4) Pour in oil through the elbow mount hole until oil oozes out from plug (1).
   5) Fit elbow (3) and install hose (2).
   6) Tighten air bleed plug (1)
      Plug : 17.15 ± 2.45 Nm
      (1.75 ± 0.25 kgm)

★ Precations when starting the engine
After completing the above procedure and starting the engine, run the engine at low idling for 10 minutes.

★ If the coolant temperature is low and automatic warming-up is carried out, cancel it by using the fuel control dial after starting the engine.

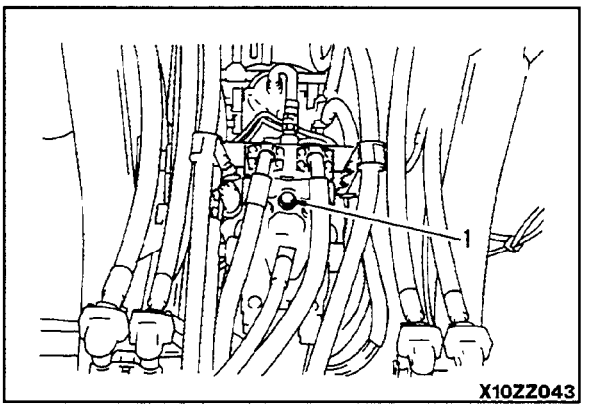


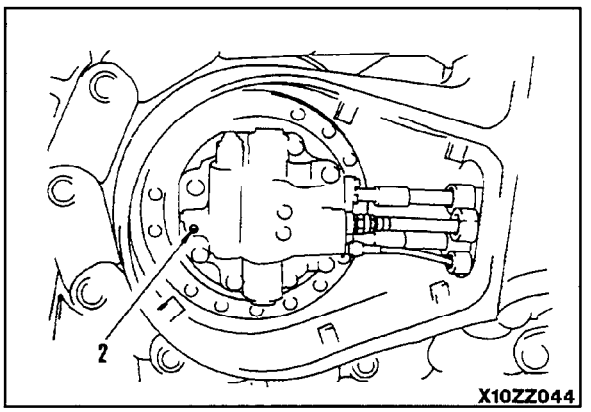


2. Bleeding air from hydraulic cylinders
   1) Start the engine and run at idling for approx. 5 minutes.
   2) Run the engine at low idling, then raise and lower the boom 4 ~ 5 times in succession.
      ★ Operate the piston rod to approx. 100 mm before the end of its stroke. Do not relieve the circuit under any circumstances.
   3) Run the engine at high idling and repeat Step 2). After that, run the engine at low idling, and operate the piston rod to the end of its stroke to relieve the circuit.
   4) Repeat Steps 2) and 3) to bleed the air from the arm and bucket cylinders.
      ★ When the cylinder has been replaced, bleed the air before connecting the piston rod. Be particularly careful not to operate the cylinder to the end of its stroke when the piston rod had been connected to the LOWER end of the boom cylinder.

3. Bleeding air from the swing motor
   1) Run the engine at low idling, loosen air bleed plug (1), and check that oil oozes out.
   ★ If no oil oozes out from the air bleed plug:
   2) Stop the engine, and pour oil into the motor case from plug (1).
   3) Tighten air bleed plug (1).
   Plug: 166.6 ± 19.6 Nm (17 ± 2 kgm)

4. Bleeding air from travel motor
   Run the engine at low idling, loosen air bleed plug (2), and when oil oozes out, tighten the plug again.





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TROUBLESHOOTING

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POINTS TO REMEMBER WHEN TROUBLESHOOTING

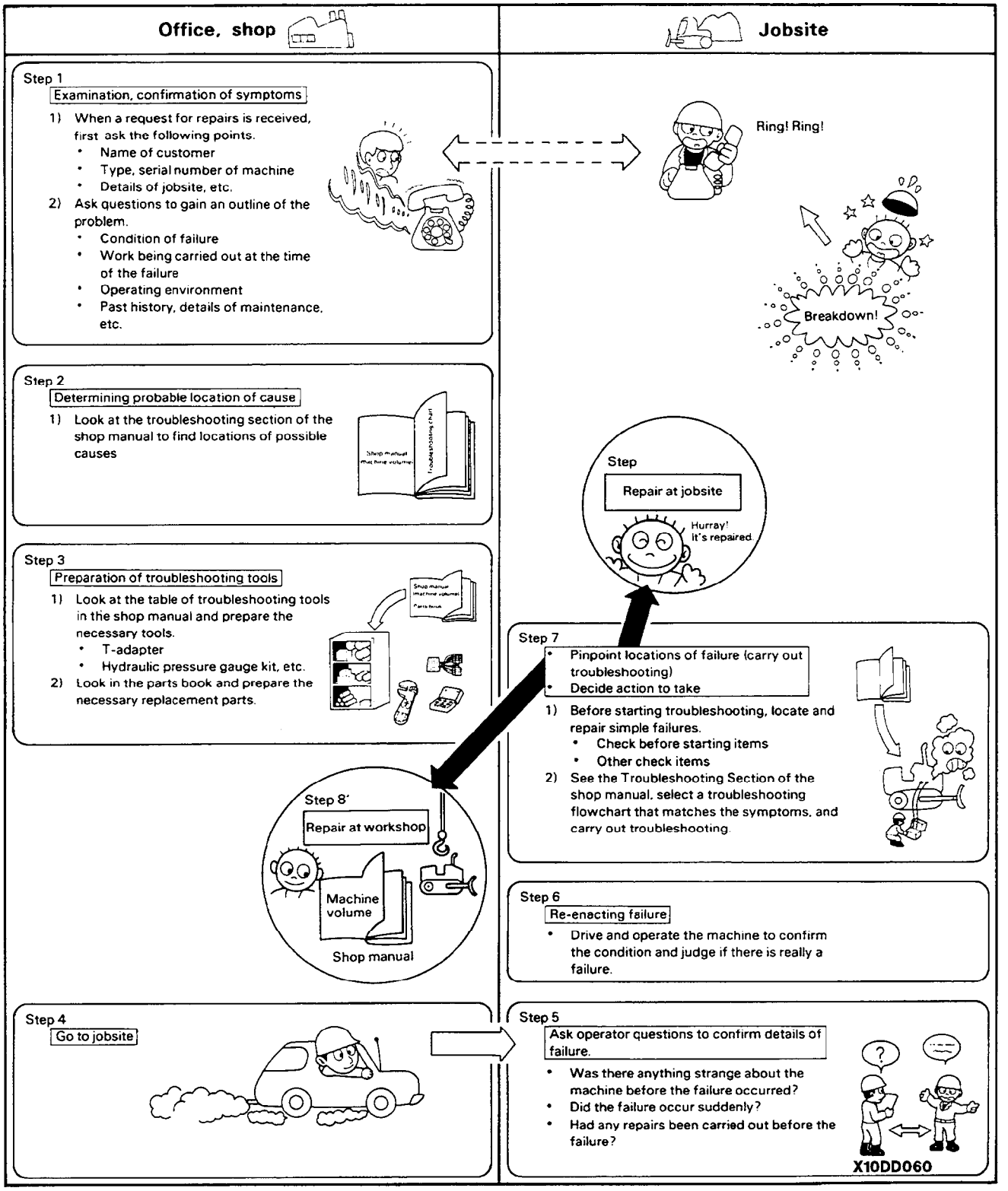
⚠ Stop the machine in a level place, and check that the safety pin, blocks, and parking brake are securly fitted.
⚠ When carrying out the operation with two or more workers, keep strictly to the agreed signals, and do not allow any unauthorized person to come near.
⚠ If the radiator cap is removed when the engine is hot, hot water may spurt out and cause burns, so wait for the engine to cool down before starting any 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 reoccurrance of the failure.
When carrying out troubleshooting, an inportant 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 possiable 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 diassembled immediately any failure occurs:
   - Parts that have no connection with the failure or other unnecessary parts will be diassembled.
   - 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 the user or operator.
   For this reason, when carrying out troubleshooting, it is necessary to carry out thorough prior investigation and to carry out troubleshooting in accordance with the fixed procedure.
2. Points to ask user or operator
   1) Have any other problems occured apart from the problem that has been reported?
   2) Was there anything strange about the machine before the failure occured?
   3) Did the failure occure 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 measurment 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 flowcharts to locate the postion 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 the root cause of failure
   - Even if the failure is repaired, if the root cause of the failure is not repaired, the same failure will occure again.
     To prevent this, always investigate why the problem occured. Then, remove the root cause.

SEQUENCE OF EVENTS IN TROUBLESHOOTING



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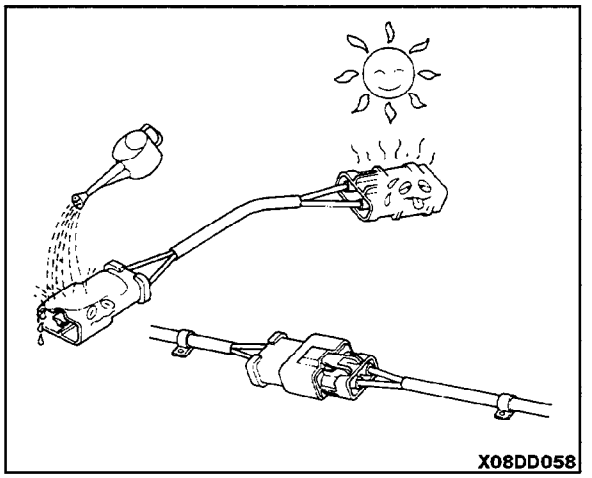
PRECAUTIONS WHEN CARRYING OUT MAINTENANCE

To maitain 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" (particlularly hydraulic oil).

1. PRECAUTIONS WHEN HANDLING ELECTRIC EQUIPMENT

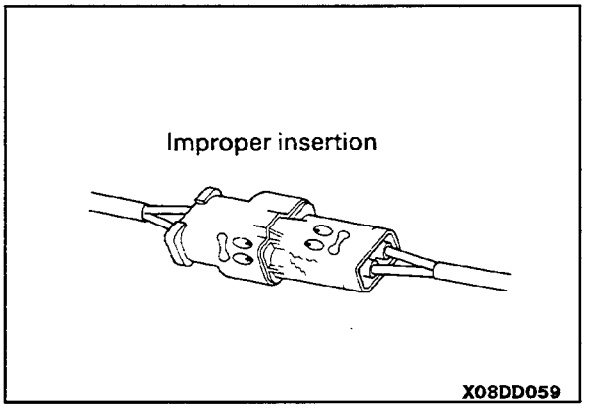
1) Handling wiring harnesses and connectors

Wiring harnesses consist of wiring connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protector 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. Furthemore, during inspection and repair operation they are frequently removed and installed again, so they are likely to suffer deformation or damage. For this reason, it is necssary to be extremely careful when handling wiring harnesses.


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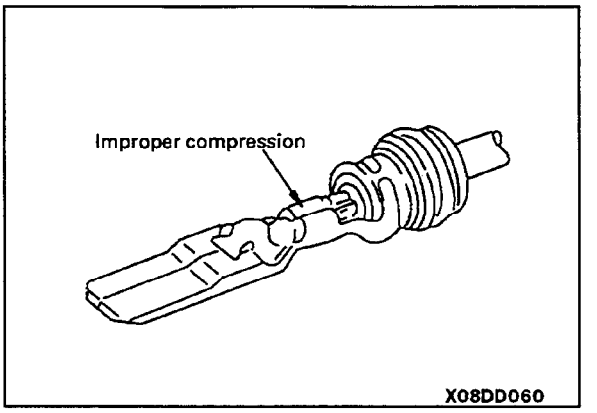
Main failures occuring in wiring harness

(1) Defective contact of connectors (defective contact between male and famale). 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 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.



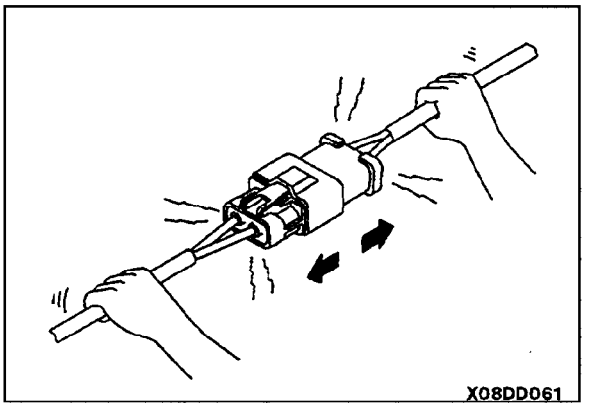
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(2) Defective compression or soldering of connectors
The pins of the male and female connectors are in contact at the compressed terminal or soldered portion, but there is excessive force on the wiring, and the plating peels to cause improper connection or breakage.

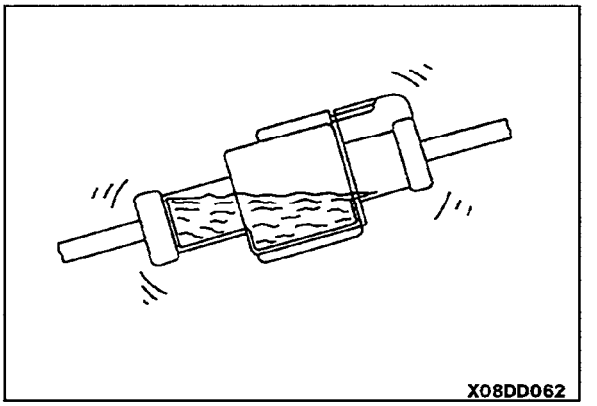


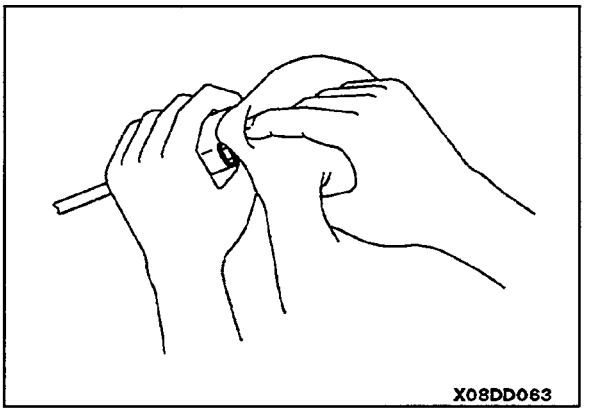
(3) Disconnections in wiring
If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the compression of the connector may be lost, or the soldering may be damaged, or the wiring may be broken.

(4) High pressure water entering connector
The connector is disigned 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. The connector is designed to prevent water from entering, but at the same time, if the 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. If any water gets in, immediately dry the connector or take other appropriate action before passing electricity through it.



(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 a defective contact. If there is oil or grease stuck to the connector, wipe it off with a dry cloth or blow dry with 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 water or oil in the air, it will increase the contamination of the points, so clean with air from which all the water and oil has been removed.

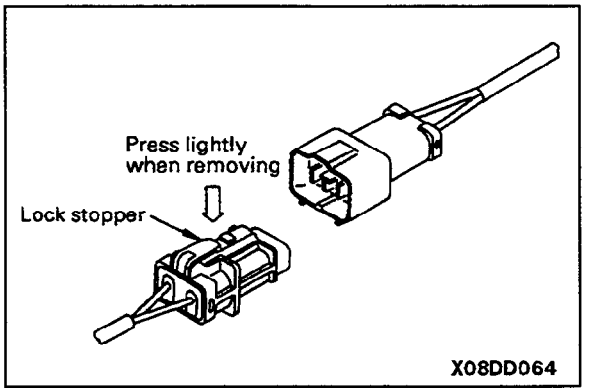




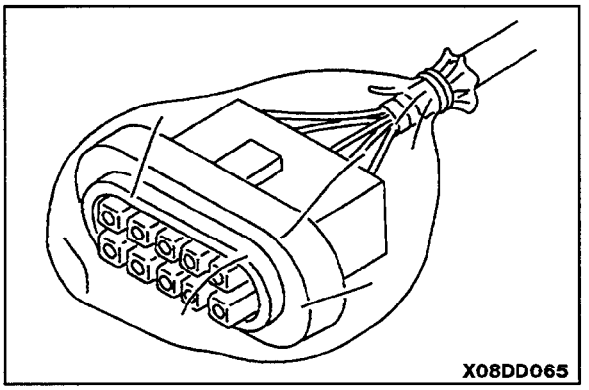
2) Removing, installing, and drying connectors and wiring harnesses

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.



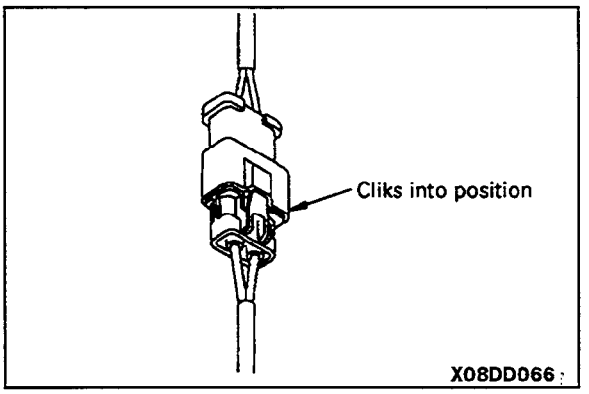
(2) Action to take after removing connectors
After removing any connector, cover it with a vinyl bag to prevent any dust, dirt, oil, or water from getting in the connector portion.



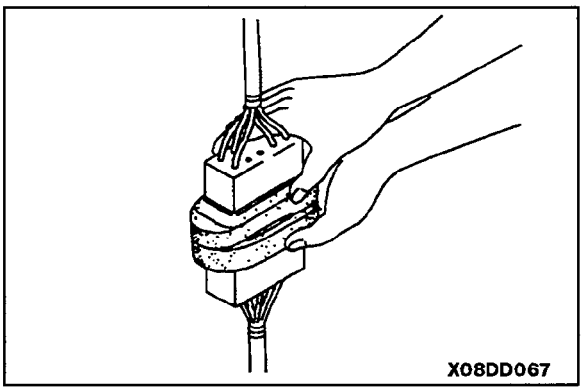
Connecting connectors

(1) Check the connector visually.
   a. Check that there is no oil, dirt, or water stuck to the connector pins (mating portion).
   b. Check that there is no deformation, defective contact, corrosion, or damage to the connector pins.
   c. 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 gotten 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.

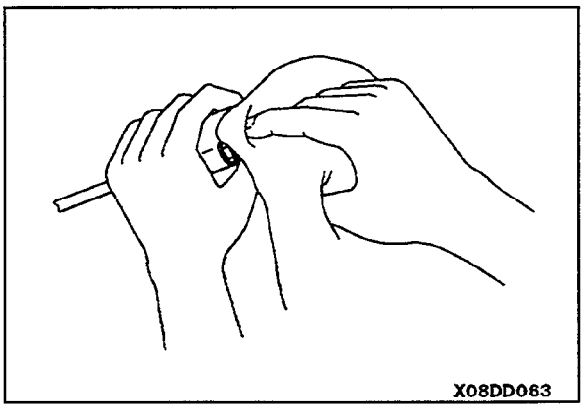
(2) Fix the connector securely.
Align the position of the connector correctly, then insert it securly. For connectors with lock stopper, push in the connector until the stopper clicks into position.

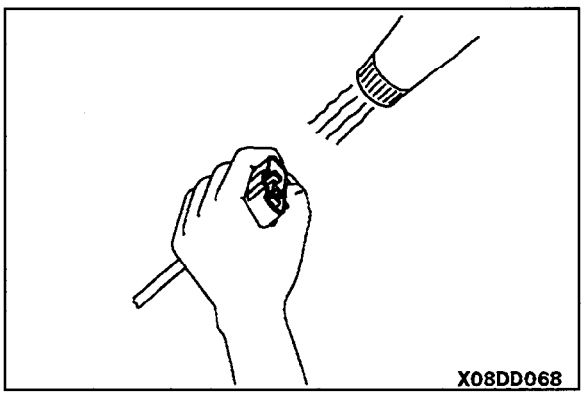


(3) Correct any protrusion of the boot and any misalignment of the wiring harness. For connectors fitted with boots, correct any protrusion of the boot. In addition, if the wiring harness is misaligned, or the clamp is out of postion, adjust it to its correct position.
★ When blowing with dry air, there is danger that the oil in the air may cause improper contact, so clean with air from which all the water and oil has been removed.



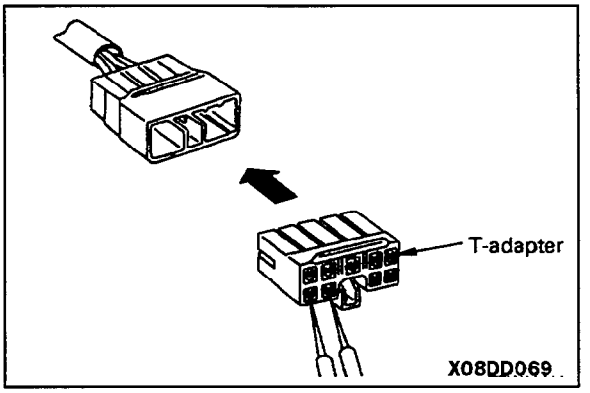
Drying wiring harness
If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high pressure water or steam directly on the wiring harness. If water gets directly on the connector, do as follows.
(1) Disconnect the connector and wipe off the water with a dry cloth.
★ If the connector is blown dry with air, there is the risk that oil in the air may cause defective contact, so avoid blowing with air.
(2) Dry the inside of the connector with a dryer.
If water gets inside the connector, use a dryer to dry the connector.
★ Hot air from the dryer can be used, but be careful not to make the connector or related parts too hot, as this will cause deformation or damage to the connector.





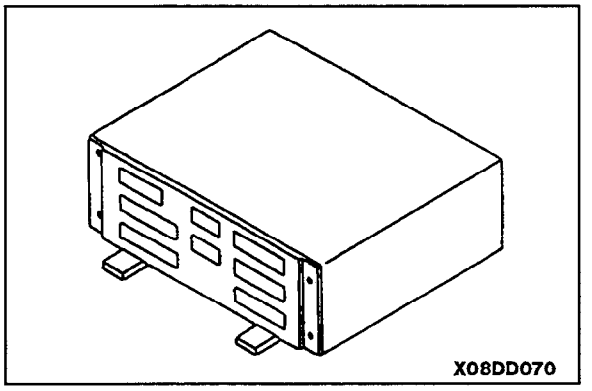
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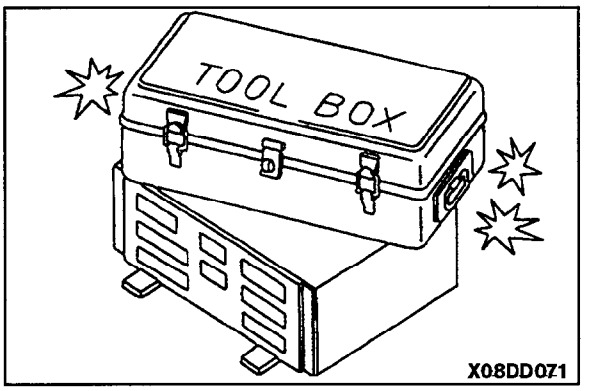
(3) Carry out a continuity test on the connector, After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.
★ After completely drying the connector, blow it with contact restorer and reassemble.

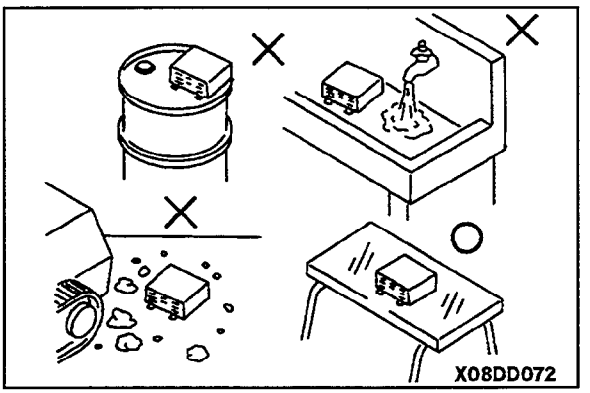


3) Handling control box

(1) The control box contains a microcomputer and electronic control circuits.
These control all of the electronic circuits on the machine, so be extremely careful when handling the control box.
(2) Do not open the cover of the control box unless necessary.
(3) Do not place objects on top of the control box.
(4) Cover the control connectors with tape or a vinyl bag.
(5) During rainy weather, do not leave the control box in a place where it is exposed to rain.
(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.







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2. POINTS TO REMEMBER WHEN HANDLING HYDRAULIC EQUIPMENT

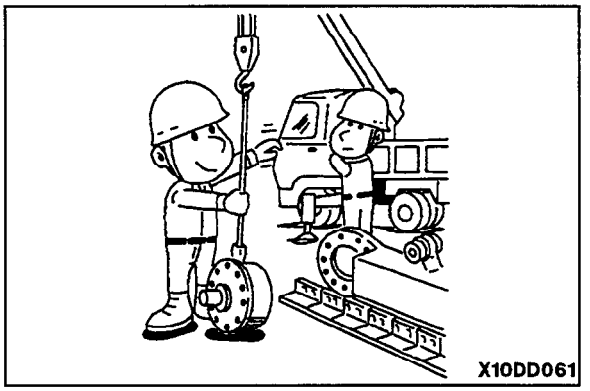
With the increase in pressure and precision of hydrauic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

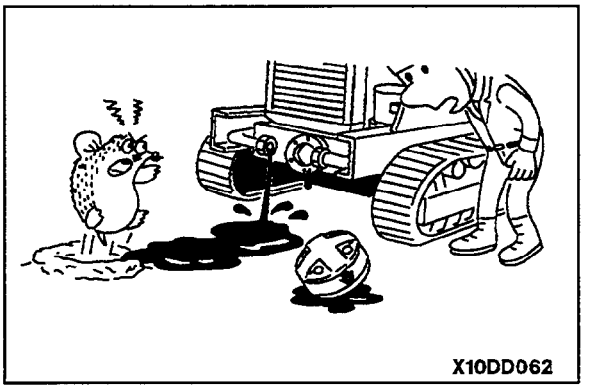
1) **Be careful of the operating environment**
Avoid adding hydraulic oil, replacing filters, or repairing the machine in rain or high winds, or places where there is a lot of dust.

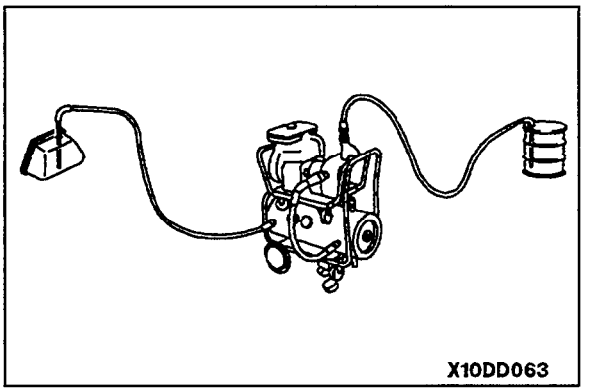
2) **Diassembly and maintenance work in the field**
If diassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to confirm the performance after repairs, so it is desirable to use unit exchange. Diassembly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

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 a danger of dirt entering, or of the surrounding area being made dirty by leaking oil. 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.

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.


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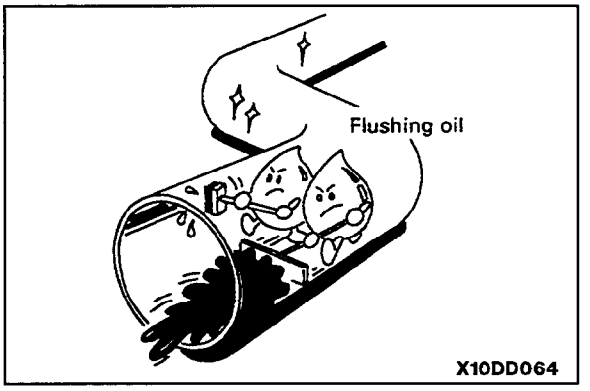
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5) Change hydraulic oil when the temperature is high.

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 only 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.

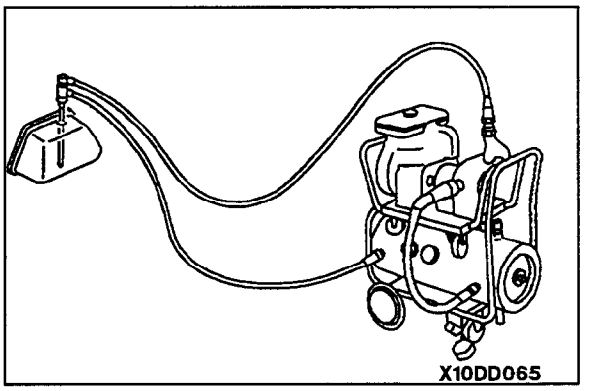
6) Flushing operations

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.



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 standard	Remedy
Lubricating oil, cooling water	1. Check fuel level	—	Add fuel
	2. Check for dirt or water in fuel	—	Clean, drain
	3. Check hydraulic oil level	—	Add oil
	4. Check hydraulic oil strainer	—	Clean, drain
	5. Check swing machinery oil level	—	Add oil
	6. Check engine oil level (Level of oil in oil pan)	—	Add oil
	7. Check cooling water level	—	Add coolant
	8. Check condition of dust indicator	—	Clean or replace
	9. Check hydraulic oil filter	—	Replace
Electrical equipment	1. Check for loose or corroded battery terminals	—	Tighten or replace
	2. Check for loose or corroded alternator terminals	—	Tighten or replace
	3. Check for loose or corroded straight motor terminals	—	Tighten or replace
Hydraulic, mechanical equipment	1. Check for abnormal noise or smell	—	Repair
	2. Check for oil leakage	—	Repair
	3. Bleed air from system	—	Bleed air
Electrical components	1. Check battery voltage (engine stopped)	20 - 30 V	Replace
	2. Check level of battery electrolyte	—	Add or replace
	3. Check for discolored, burnt, or bare wiring	—	Replace
	4. Check for missing wiring clamps, hanging wires	—	Repair
	5. Checks for getting wet onto wiring (check carefully getting wet at connectors and terminals)	—	Disconnect connector and dry connection
	6. Check for broken or corroded fuses	—	Replace
	7. Check alternator voltage (engine running at over half throttle)	27.5 - 29.6 V	Replace
	8. Noise when battery relay is operated (switch starting switch from ON to OFF)	—	Replace

CONNECTOR TYPES AND MOUNTING LOCATIONS

Connector No.	Type	No. of pins	Electrical component	Address
C01	MIC	17	Pump controller	R7
C02	040	20	Pump controller	R6
C03	040	16	Pump controller	R7
C04	X	2	Rear pump TVC valve	H9
C05	S	10	TVC prolix switch	O5
C06	M	2	Tvc prolix resistor	Q6
C07	X	3	Rear pump pressure sensor	I9
C08	X	3	Front pump pressure sensor	I5
C09	S	8	Model selection connector	R7
C10	X	2	LS control EPC solenoid valve	F8
C13	X	2	Front pump TVC valve	H9
D01	KES1	2	Window washer circuit	J5
D03	KES1	2	LS select solenoid circuit	—
D04	KES1	2	Pump merge-divider solenoid circuit	—
D05	KES1	2	Swing brake solenoid circuit	—
D06	KES1	2	2-stage relief solenoid circuit	—
D07	KES1	2	Travel speed solenoid circuit	—
D08	KES1	2	Heater circuit	—
D11	KES1	2	Alarm buzzer circuit	M6
D13	KES1	2	Battery relay drive circuit	R8
E01	MIC	21	Engine throttle controller	R8
E04	X	3	Governor potentiometer	H9
E05	X	4	Governor motor	I9
E06	M	3	Fuel control dial	O8
E07	X	2	Engine speed sensor	J2
E08	SWP	14	Intermediate connector	J3
E10	—	1	Fuel shut off	I2
F01	X	2	Travel alarm	G4
H01	S	16	Intermediate connector	R8
H02	S	16	Intermediate connector	R9
H03	S	16	Intermediate connector	Q9
H04	S	16	Intermediate connector	Q9
H05	M	6	Intermediate connector	R8
H06	L	2	Intermediate connector	R9

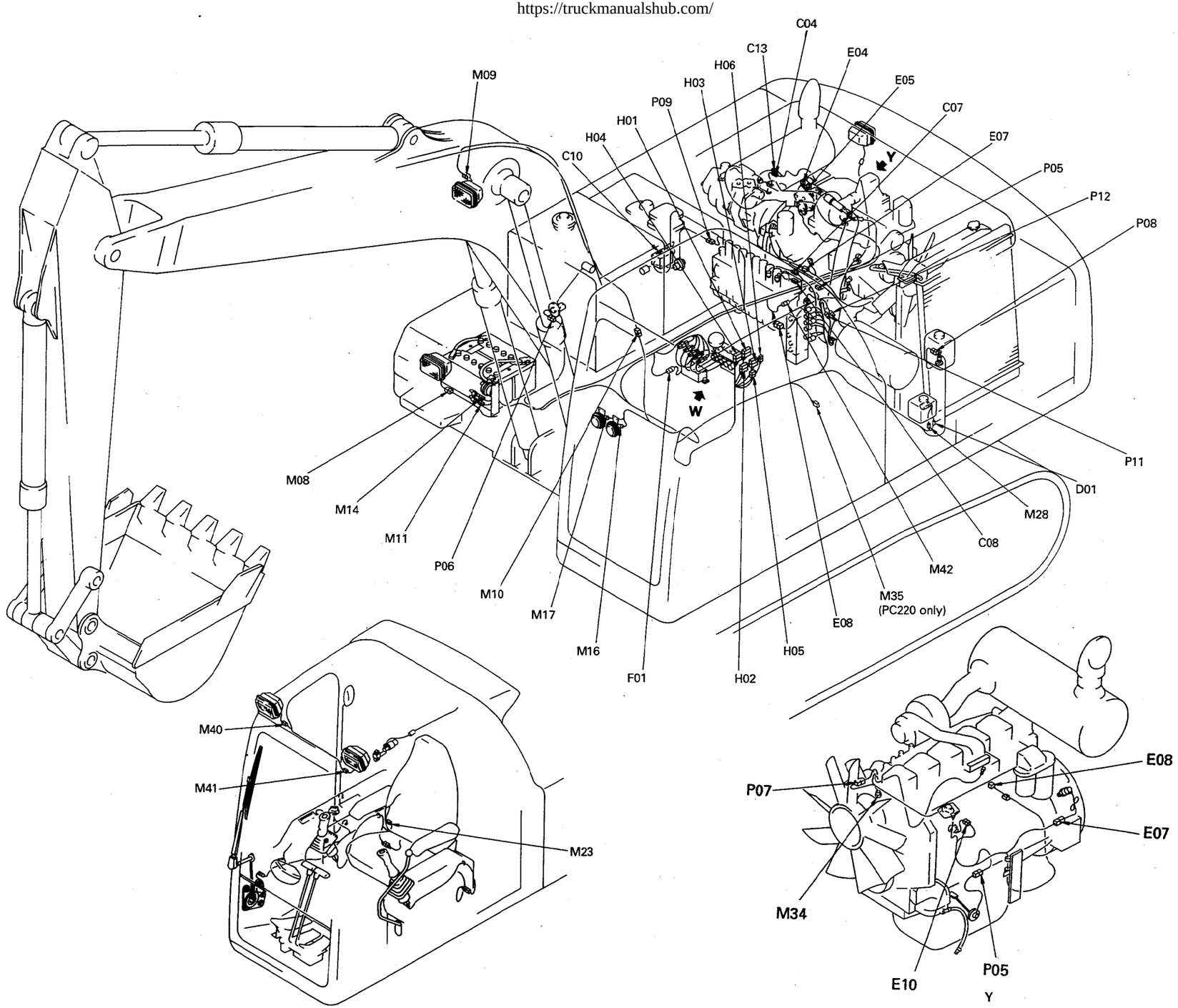
Connector No.	Type	No. of pins	Electrical component	Address
M02	X	2	Starting motor	J2
M06	M	3	Heater switch	O8
M07	M	2	Light switch	O8
M08	M	1	Right front light	D5
M09	M	1	Working lamp (boom)	F9
M10	M	1	Intermediate connector	F5
M11	L	2	Fusible link	E5
M12	KES1	3	Heater	—
M13	KES0	2	Speaker	Q9
M14	L	2	Fusible link	E5
M16	—	1	Horn (high sound)	G4
M17	—	1	Hoorn (low sound)	F4
M18	M	4	Wiper, washer switch	O8
M20	—	—	Cigarette lighter	O8
M21	PA	9	Radio	Q6
M22	M	2	Intermediate connector	—
M23	M	2	Horn switch, R.H. knob switch	F2
M26	M	6	Air conditioner	R6
M28	KES0	2	Window washer motor	J5
M34	Simple connector	1	Electromagnetic clutch for air conditioner compressor	I3
M35	X	2	Condenser for air conditioner (PC220)	I5
M38	M	2	Light switch	P8
M40	M	1	Right working light	D3
M41	M	1	Left working light	D3
M42	—	1	Intermediate connector	I5
M45	M	3	Network bus	M5
M46	M	3	For troubleshooting	M6
P01	040	20	Monitor panel	N7
P02	040	16	Monitor panel	N7
P03	M	2	Buzzer canel switch	O8
P04	M	2	Alarm buzzer	N7
P05	X	1	Engine oil level sensor	J2
P06	X	1	Fuel level sensor	F5
P07	—	2	Coolant temperature sensor	I3

★ The Address column in the table above shows the address in the connector arrangement drawing (2-dimensional drawing).
★ This table includes connectors that are not in the drawing.

Connector No.	Type	No. of pins	Electrical component	Address
P08	X	2	Coolant level sensor	K8
P09	X	1	Hydraulic oil level sensor	G9
P10	KES1	1	Service meter	P9
P11	—	1	Air cleaner clogging sensor	J6
P12	—	1	Air cleaner clogging sensor	J8
R04	Shinagwa	5	Light relay	P5
R05	Shinagwa	5	Light relay	P5
S01	X	2	Travel oil pressure switch	R2
S02	X	2	Boom RAISE oil pressure switch	R3
S04	X	2	Arm OUT oil pressure switch	R2
S05	X	2	Boom LOWER oil pressure switch	R3
S06	X	2	Bucket CURL oil pressure switch	R4
S07	X	2	Bucket DUMP oil pressure switch	R3
S08	X	2	Swing oil pressure switch	R4
S09	X	2	Service oil pressure switch	—
V02	X	2	LS select solenoid valve	N1
V03	X	2	Pump merge-divider solenoid valve	N1
V04	X	2	Swing brake solenoid valve	N1
V05	X	2	2-stage relief solenoid valve	M2
V06	X	2	Travel speed solenoid valve	N1
W04	M	6	Wiper motor	M6
W08	070	18	Wiper motor controller	P6
W10	M	4	Rear limit switch	P6
X01	MIC	21	Intermediate connector	P9
X05	M	4	Swing lock switch	O8
X07	MIC	17	Intermediate connector	P9

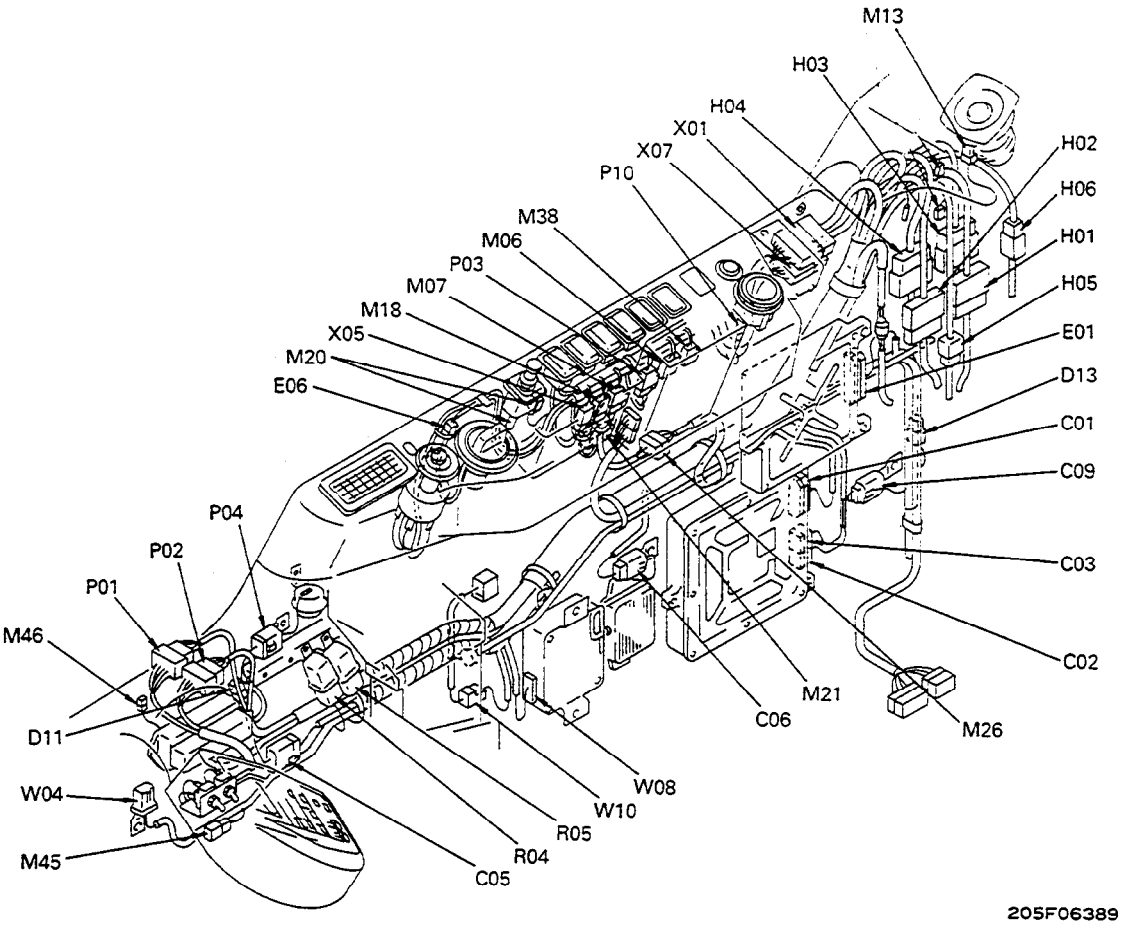
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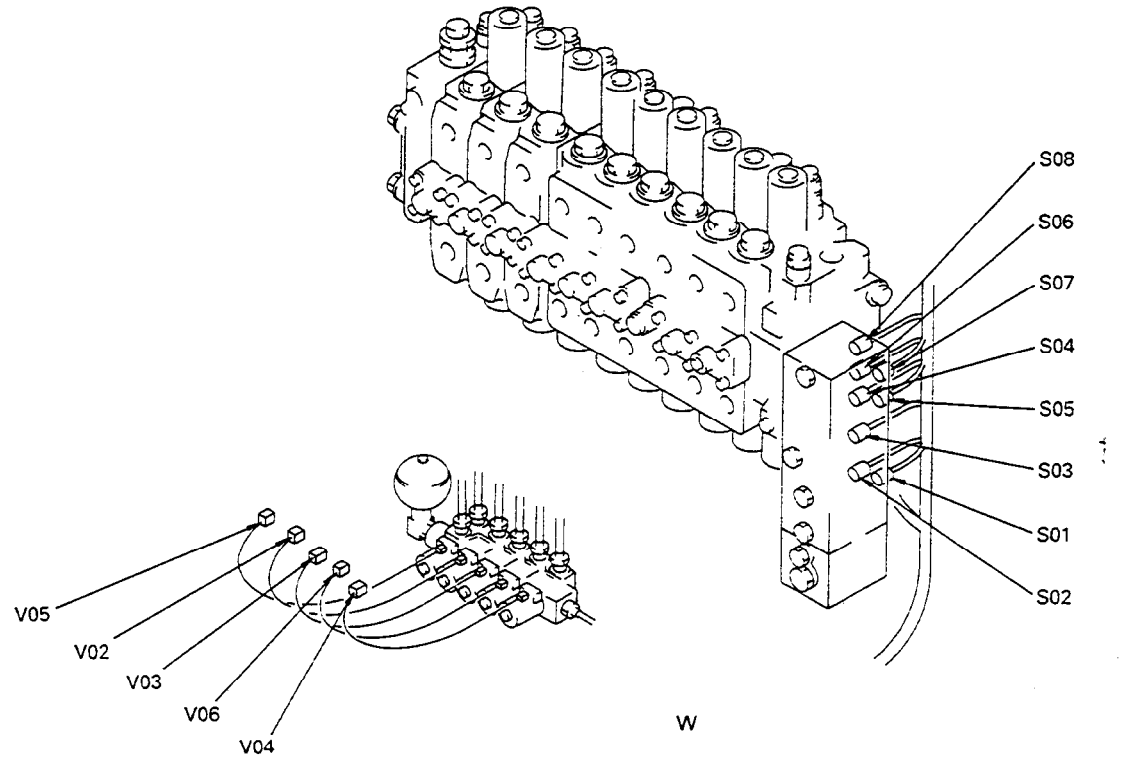


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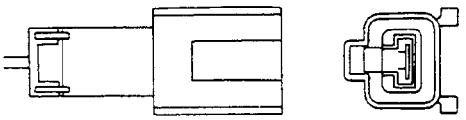
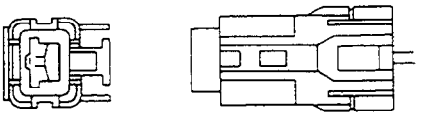
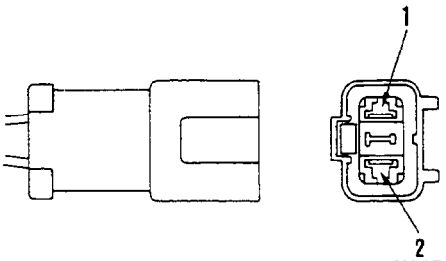
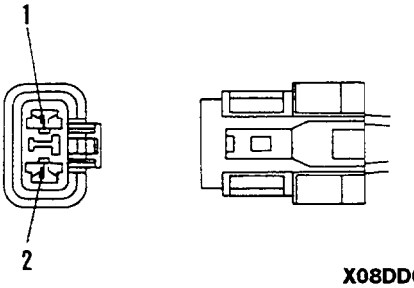
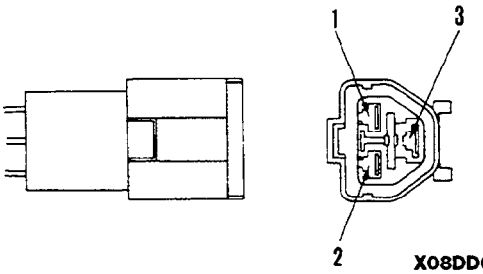
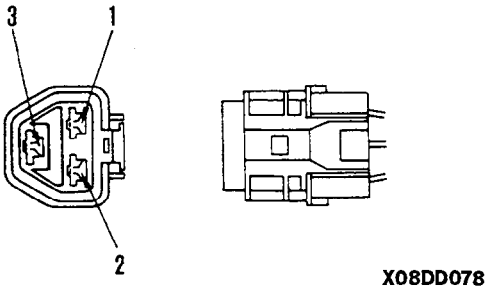
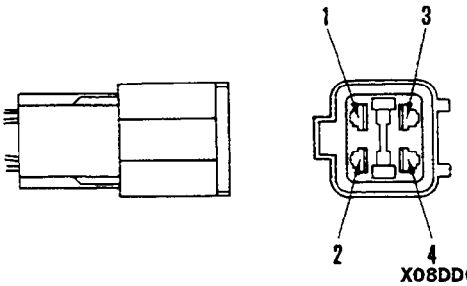
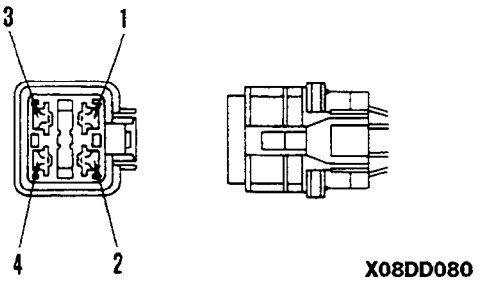
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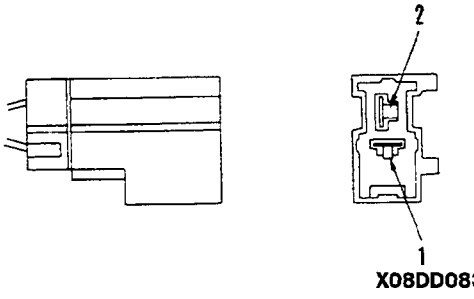
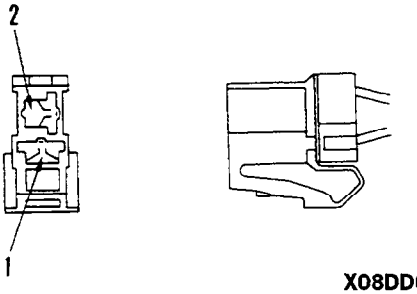
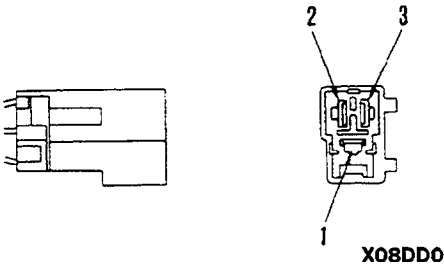
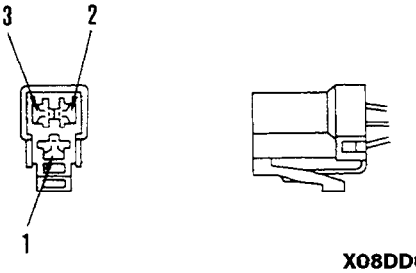
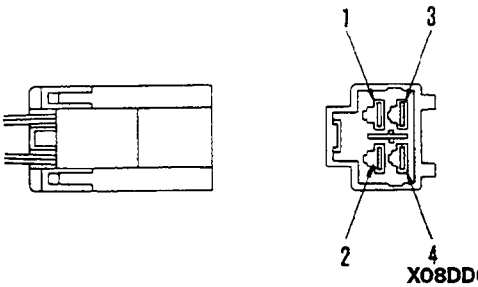
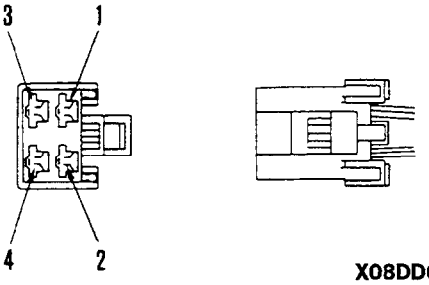
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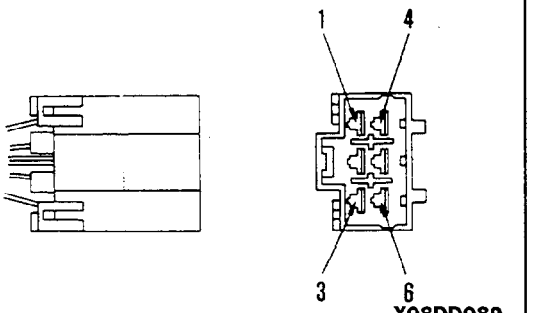
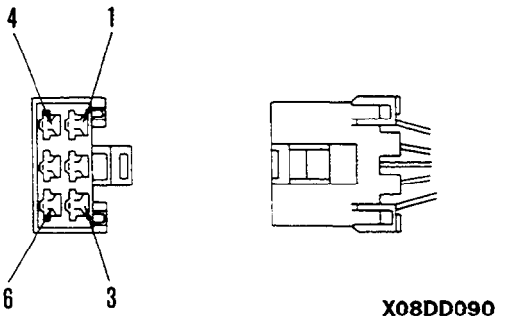
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

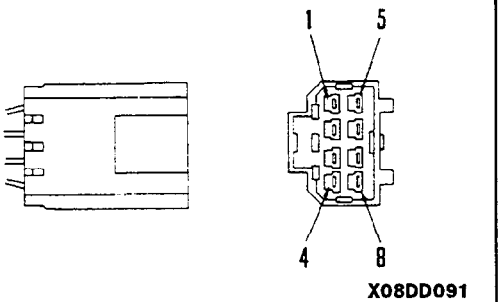
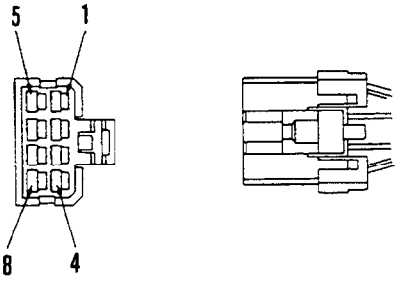
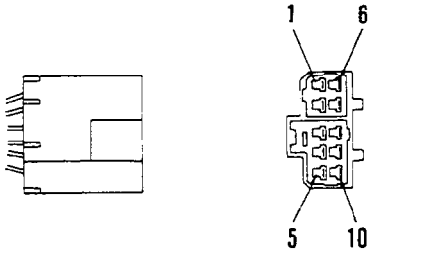
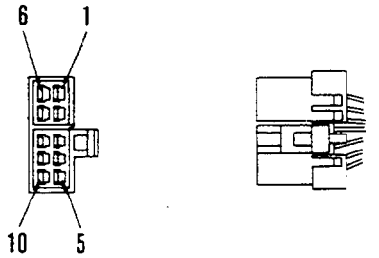
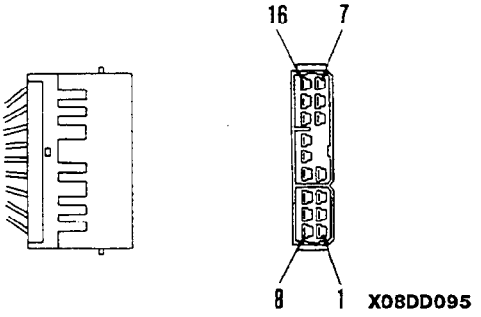
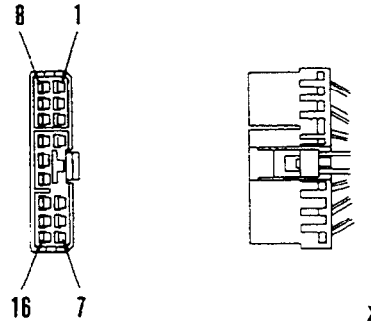
★ The terms male and female refer to the pins, while the terms male housing and female housing refer to the mating portions of the housing.

No. of pins	X type connector	
	Male (female housing)	Female (male housing)
1	 X08DD073	 X08DD074
2	 X08DD075	 X08DD076
3	 X08DD077	 X08DD078
4	 X08DD079	 X08DD080

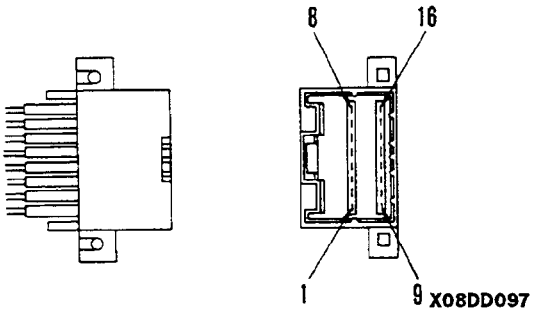
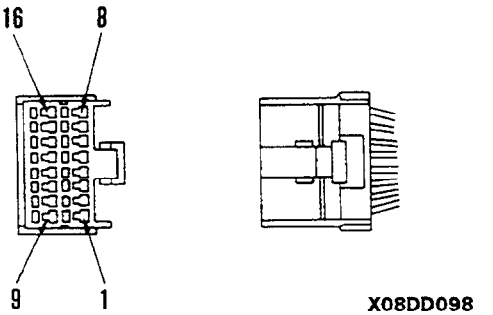
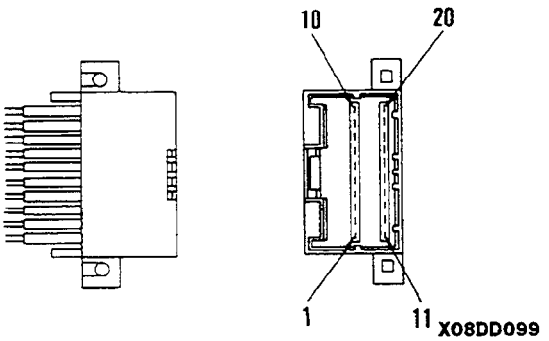
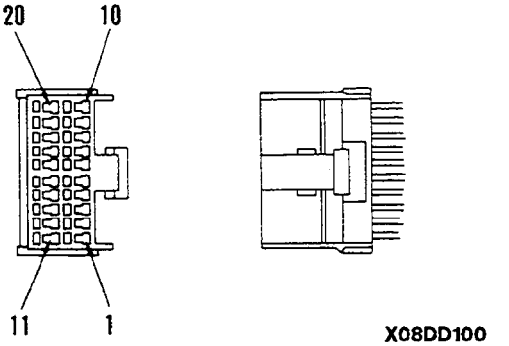
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No. of pins	M type connector	
	Male (female housing)	Female (male housing)
1	 X08DD081	 X08DD082
2	 X08DD083	 X08DD084
3	 X08DD085	 X08DD086
4	 X08DD087	 X08DD088

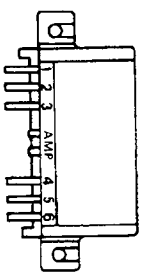
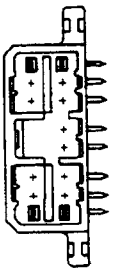
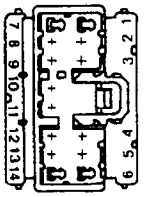
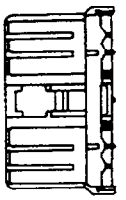
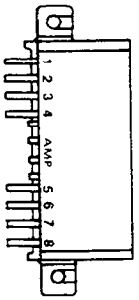
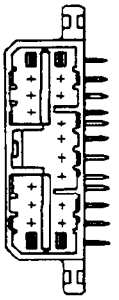
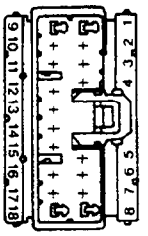
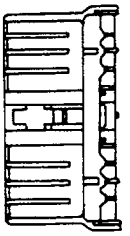
No. of pins	M type connector	
	Male (female housing)	Female (male housing)
6	 X08DD089	 X08DD090

No. of pins	S type connector	
	Male (female housing)	Female (male housing)
8	 X08DD091	 X08DD092
10	 X08DD093	 X08DD094
16	 X08DD095	 X08DD096

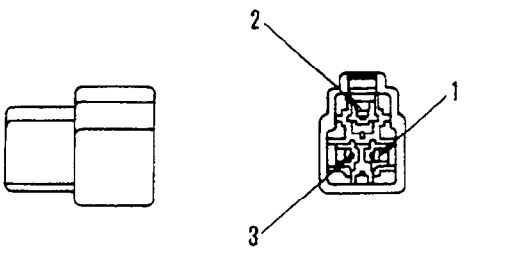
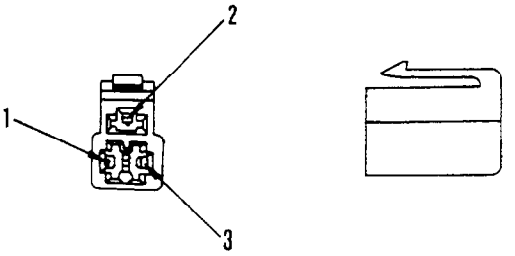
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No. of pins	AMP040 type connector	
	Male (female housing)	Female (male housing)
16	 X08DD097	 X08DD098
20	 X08DD099	 X08DD100

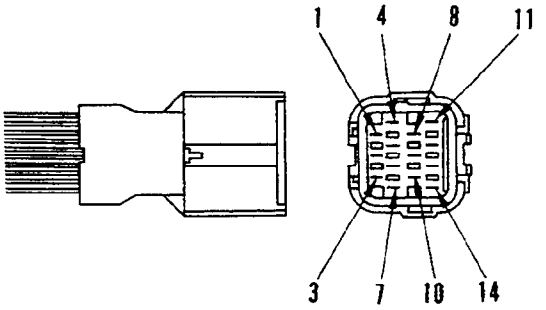
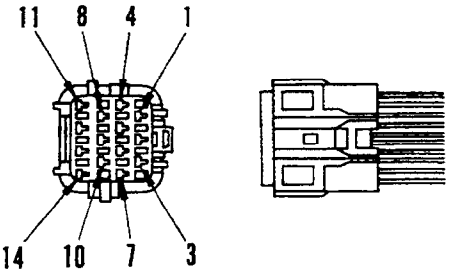
https://truckmanualshub.com/

No. of pins	AMP070 type connector	
	Male (female housing)	Female (male housing)
14	  X08DD101	  X08DD102
18	  X08DD103	  X08DD104

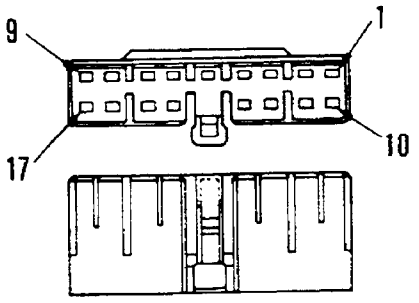
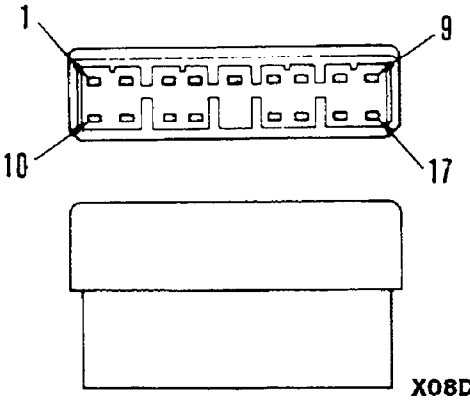
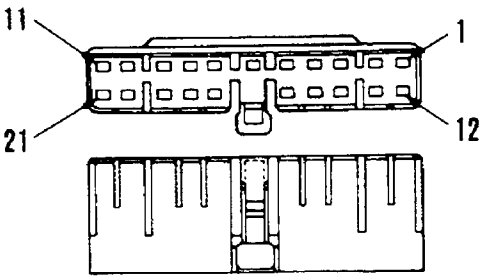
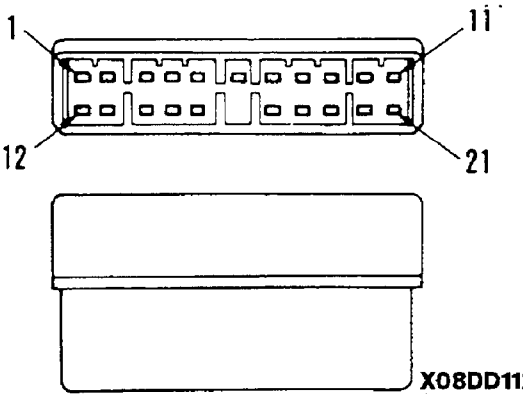
https://truckmanualshub.com/

No. of pins	AMP250 type connector	
	Male (female housing)	Female (male housing)
3	 X08DD105	 X08DD106

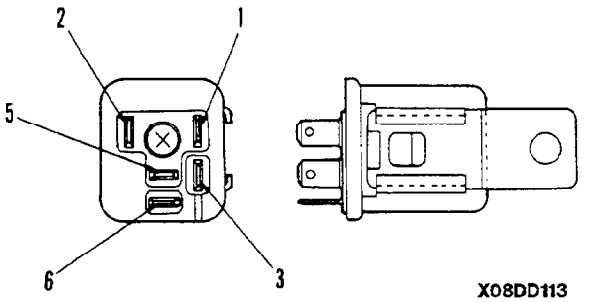
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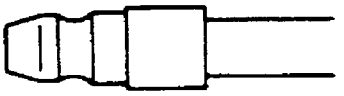
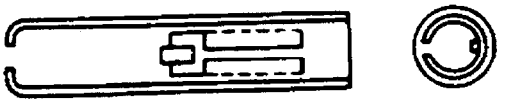
No. of pins	SWP type connector	
	Male (female housing)	Female (male housing)
14	 X08DD107	 X08DD108

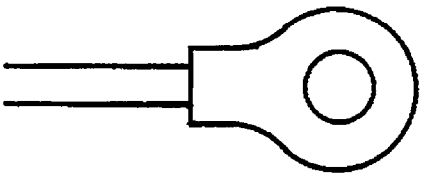
https://truckmanualshop.com/

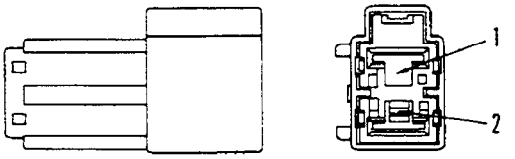
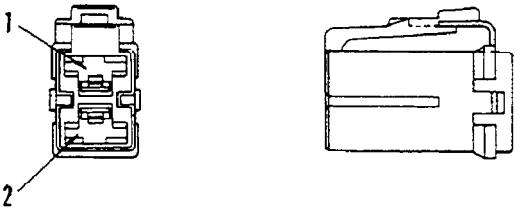
No. of pins	MIC type connector	
	Male (female housing)	Female (male housing)
17	 X08DD109	 X08DD110
21	 X08DD111	 X08DD112

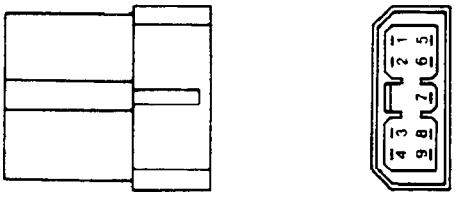
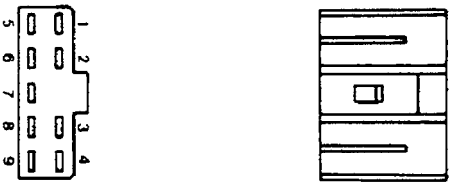
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No. of pins	Relay connector
5	 X08DD113

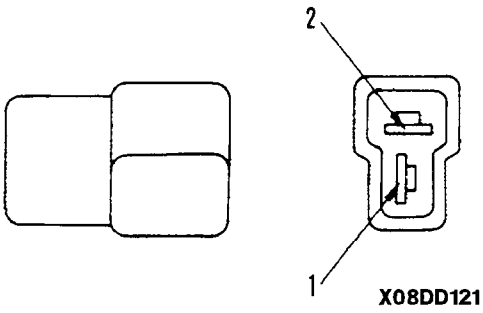
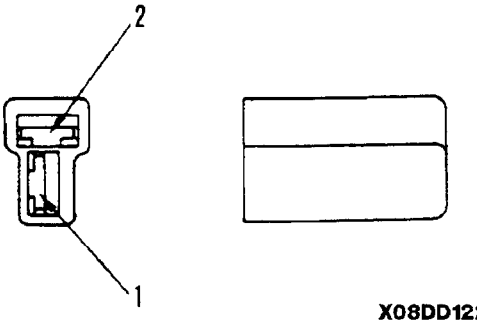
No. of pins	Simple connector	
	Male (male housing)	Female (female housing)
1	 X08DD114	 X08DD115

No. of pins	Ring connector
1	 X08DD116

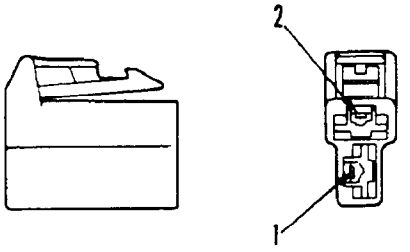
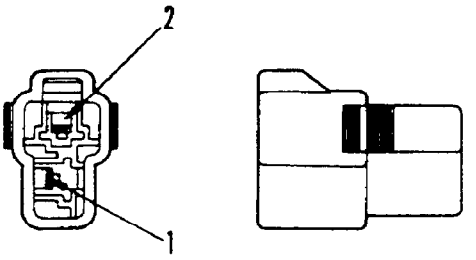
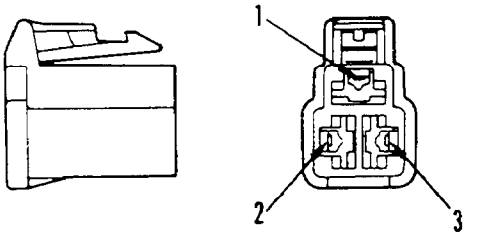
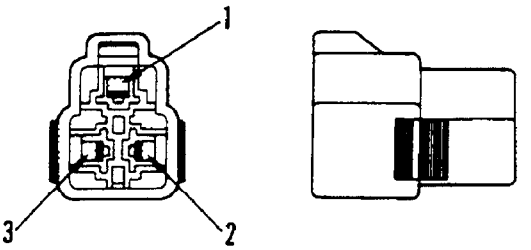
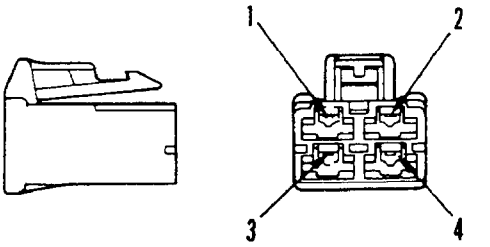
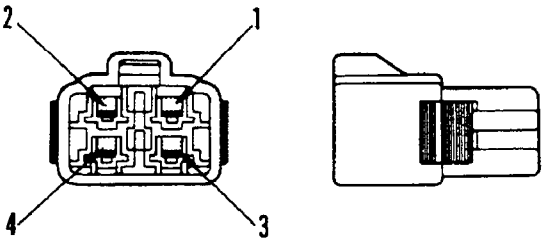
No. of pins	L type connector	
	Male (female housing)	Female (male housing)
2	 X08DD117	 X08DD118

No. of pins	PA type connector	
	Male (female housing)	Female (male housing)
9	 X08DD119	 X08DD120

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No. of pins	Automobile connector (KES0)	
	Male (female housing)	Female (male housing)
2	 X08DD121	 X08DD122

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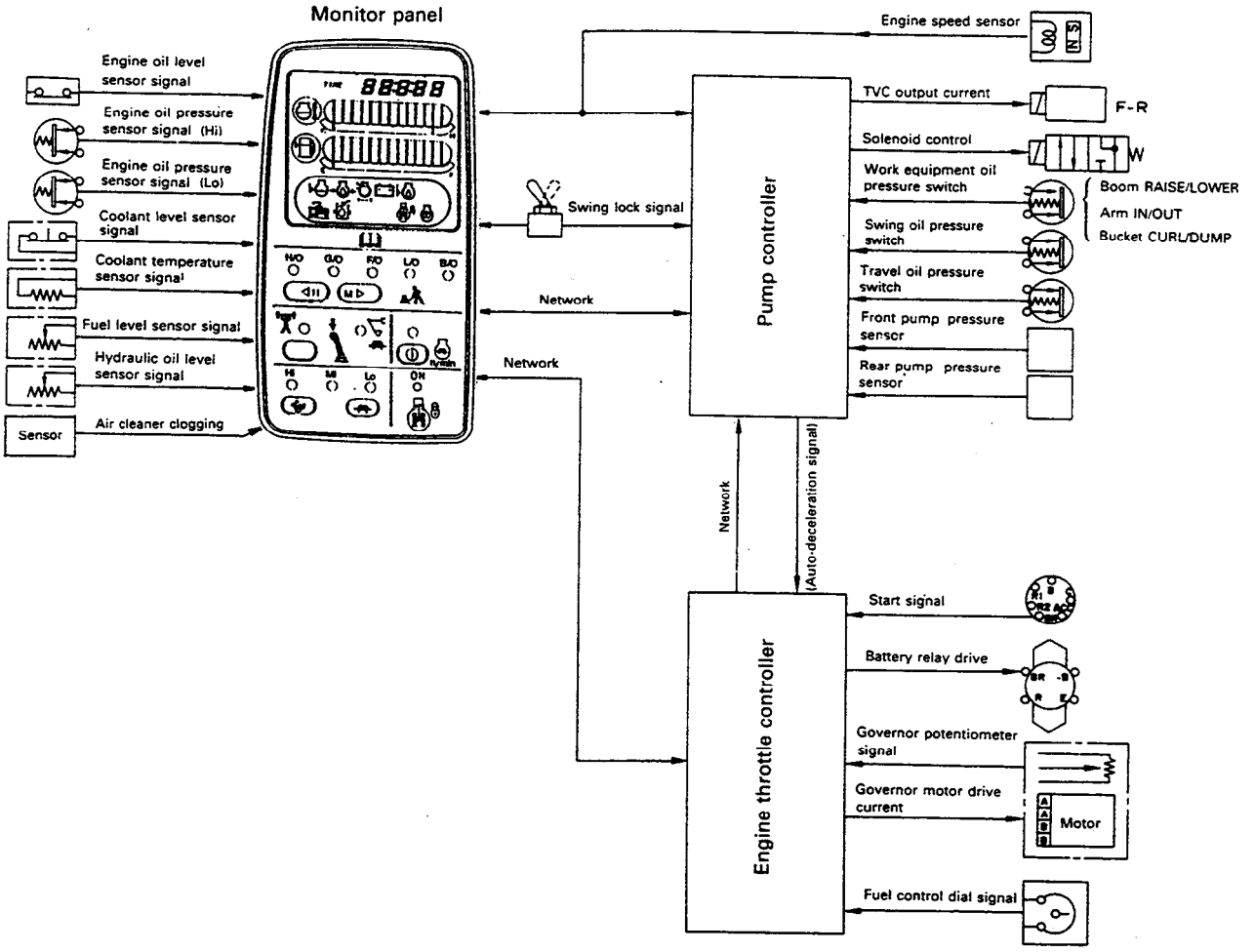
No. of pins	Automobile connector (KES1)	
	Female (female housing)	Male (male housing)
2	 X08DD123	 X08DD124
3	 X08DD125	 X08DD126
4	 X08DD127	 X08DD128

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EXPLANATION OF CONTROL MECHANISM FOR ELECTRICAL SYSTEM

1. Explanation of machine control functions

The control mechanism for the electrical system consistsj of the monitor panel, pump controller and engine throttle controller. The monitor panel and each controller all input the signals that are necessary, and together with the signals selected by the monitor panel, the controllers output or input the necessary signals and control the pump absorption torque and engine outout.



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2. Explanation of networking functions

With this system, a networking method has been adopted for the first time for the transmission and reception of data between the controllers. With the conventional system, the necessary data is transmitted and recieved through an independent signal line between each controller. With the new method, this system had been replaced by two dedicated networking wires; in the new system, all the data that is needed is transmitted and recieved between the controllers by usiing these networking wires.

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DISPLAY METHOD AND SPECIAL FUNCTIONS OF MONITOR PANEL

1. Display on machine monitor

When the starting switch is turned ON, all the monitor gauge lamps light up for approx. 3 seconds, and the buzzer sounds for approx. 1 second. During this time, the monitor itself carries out a self diagnosis, and after it has finished, it gives the normal display.

2. Recording of service codes and user code display function

1) All the abnormality date for the engine throttle controller and pump controller is received by the monitor panel. When the monitor panel receives this data, it records the abnormality date, and at the same time, depending on the nature of the abnormality, it displays the user code on the time display panel to advise the operator of the action to take.
However, in cases of abnormalities which are not urgent and do not require the user code to be displayed, only the content of the abnormality is recorded, and no display is given.

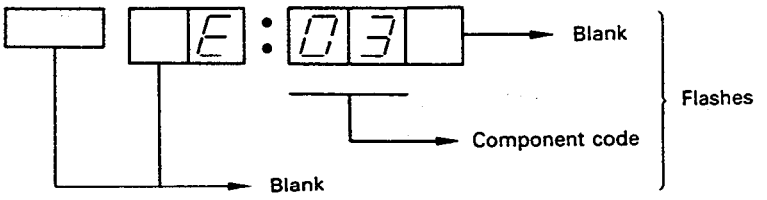
2) Type of user code and system

E02	Pump TVC system
E03	Swing holding brake system
E05	Governor motor system

★ For details of the service codes includes in the user code, see ACTION TAKEN BY THE CONTROLLER WHEN AN ABNORMALITY OCCURS, THE SYMPTOMS ON THE MACHINE or JUDGEMENT TABLE.

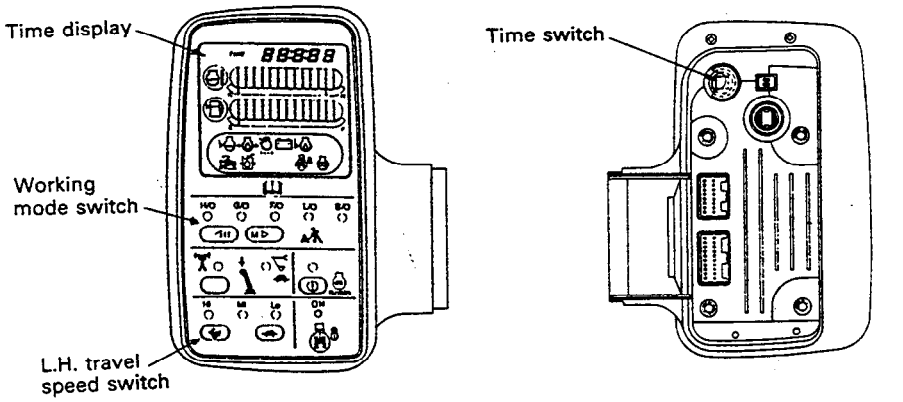
3) Displaying user code
If it becomes necessary to display the user code, the time displayed panel is automatically switched to advise the operator to take the necessary action.

- Actual display i) Example: Disconnection in the swing brake solenoid system



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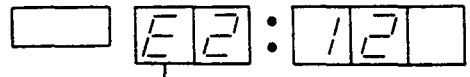
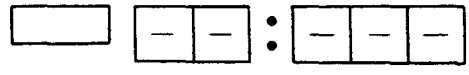
4) Display of service code
The monitor panel records both service codes which are included in the user code, and service codes which are not included. This data can be displayed on the time display as follows.
★ For details of the service codes that are not included in the user code, see ACTION TAKEN BY CONTROLLER WHEN ABNORMALITY COOURS AND PROBLEMS ON MACHINE.



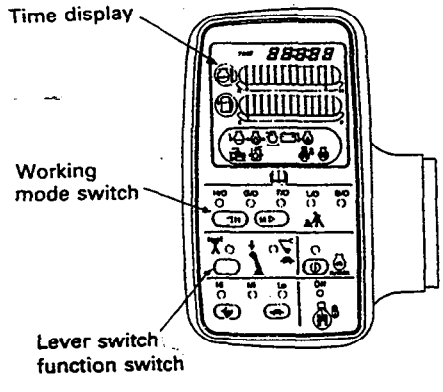
i) Method of displaying service code

Operation	Display
1. To set to the service code display mode, keep the time switch + L.H. travel speed switch pressed for 2.5 seconds. Note: It is possible to call it up at the following times. 1) In the time display mode (normal mode) 2) In the user code mode 3) In the machine data monitoring mode 4) In the time adjustment mode.	1. Time display goes out On the display panel, the service code and number of hours (service meter hours) since the occurence of the abnormality are displayed in turn. ★ Example of display When E2: 12 occurs 12 hours ago (service meter) 1) Display of service code 2) Elapsed time (service meter display)

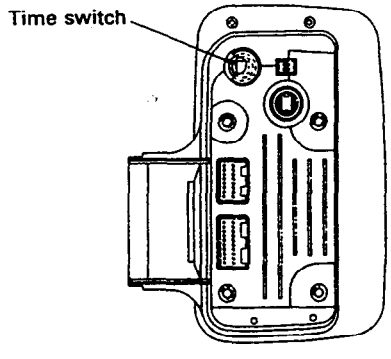
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Operation	Display
2. To go to the next service code display, Press the time switch + R.H. working mode switch. 3. To go back to the previous service code display, Press the time switch + L.H. working mode switch. 4. To finish with the service code mode, Use the same procedure as in Item 1. 5. To erase the memory, Keep the time switch pressed, turn the starting switch from OFF to ON, and keep the time switch pressed for 5 seconds.	3) If any abnormality exists at this time, the E mark is displayed.  If there is an abnormality, or the controller is carrying out self diagnosis, the output is shut off, and E is displayed. 4) If there is no service code in memory  is displayed.

3. **Machine data monitoring mode function**
The input signals from the monitor panel and controller sensors and the output signals to drive the solenoid can be checked by displaying them on the time display.



Front of monitor panel

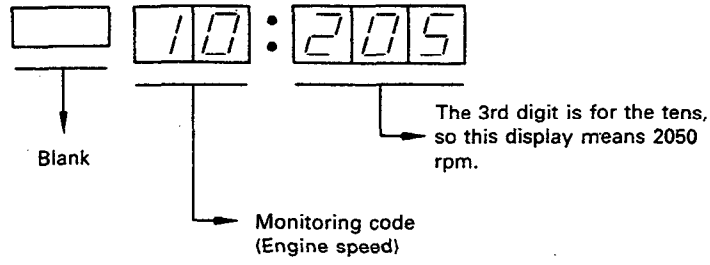
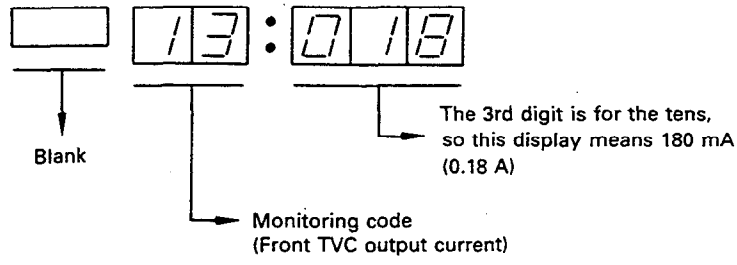
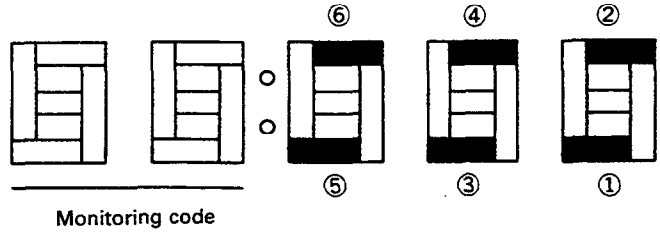


Rear of monitor panel

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1) Method of displaying monitoring mode

Operation	Display
1. To set to the monitoring mode, do as follows. Keep the time switch + lever switch function switch pressed for 2.5 seconds. Note: This is possible at the following times. 1) During the time display mode (normal mode) 2) During the user code mode 3) During the time adjustment mode 4) During the service code mode	1. Goes off the time display, and display as follows. 2. Example of display 1) When pump controller engine speed is monitored  2) When front TVC output current is displayed 
2. To go to the next monitoring code display, Press the time switch + R.H. working mode switch.	
3. To go back to the previous monitoring code display, Press the time switch + L.H. working mode switch.	
4. Bit pattern display 1) Set to the bit pattern display code	 205F06382
5. To finish with the machine data monitoring mode, use the same procedure as in Item 1.	3. Example of bit pattern display 1) For code 08 (connection of S-NET components) If the display is set to code 08, the applicable bits light up. 2) For code 20 (input condition of pump controller oil pressure switch) Set to code 20, and operate the lever of the system to be displayed. When the switch is turned ON, the applicable bits light up.

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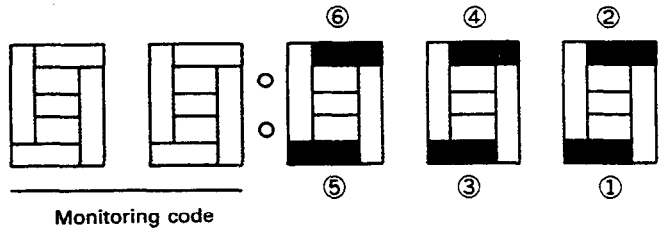
2) Table of machine data monitoring codes

★ For details of the B in the Unit column, see the bit pattern chart.

Code No.	Item	Unit	Name of component
01	Monitor panel model code	–	Monitor panel
02	Pump controller model code	–	Pump controller
03	Engine throttle controller model code	–	Engine throttle controller
08	S-NET condition display	B	Monitor panel
10	Engine speed	10rpm	Pump controller
11	Front pump discharge pressure input	kg/cm²	Pump controller
12	Rear pump discharge pressure input	kg/cm²	Pump controller
13	Front TVC current output	10mA	Pump controller
14	Rear TVC current output	10mA	Pump controller
15	LS control EPC current output	10mA	Pump controller
16	No. 2 throttle signal value	10rpm	Pump controller
20	Oil pressure switch input signal (1)	B	Pump controller
21	Oil pressure switch input signal (2)	B	Pump controller
22	Oil pressure switch input signal (3)	B	Pump controller
23	Pump controller solenoid actuation	B	Pump controller
30	Fuel control dial input value	10mV	Engine throttle controller
31	Governor potentiometer voltage	10mV	Engine throttle controller
32	VBB voltage (battery voltage)	100mV	Engine throttle controller
33	Governor motor A phase current	10mA	Engine throttle controller
34	Governor motor B phase current	10mA	Engine throttle controller
35	Battery relay output voltage	100mV	Engine throttle controller
36	Engine throttle controller input condition	B	Engine throttle controller
37	Engine throttle controller output condition	B	Engine throttle controller
38	Engine throttle controller internal condition	B	Engine throttle controller
40	Engine speed	10rpm	Monitor panel
41	Coolant temperature sensor voltage	10mV	Monitor panel
42	Fuel level sensor input voltage	10mV	Monitor panel
43	Battery charge input voltage	10mV	Monitor panel
44	Monitor panel input 1	B	Monitor panel
45	Monitor panel input 2	B	Monitor panel
46	Monitor panel input 3	B	Monitor panel
47	Monitor panel output	B	Monitor panel

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3) Bit pattern chart
As shown in the diagram below, the time display has bit numbers which light up to show that the signal is being transmitted. (For details, see method of displaying monitoring code.)



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Code No.	Content	Bit	Details (condition when lighted up)
08	Connection of S-NET components	①	Pump controller connected (ID=2)
		②	Engine throttle controller connected (ID=3)
		③	
		④	
		⑤	
		⑥	
20	Input condition of pump controller PPC oil pressure switches	①	Swing switch ON
		②	Travel switch ON
		③	Boom LOWER switch ON
		④	Boom RAISE switch ON
		⑤	Arm IN switch ON
		⑥	Arm OUT switch ON
21	Input condition of pump controller PPC oil pressure switches and other switches	①	Bucket CURL switch ON
		②	Bucket DUMP switch ON
		③	Swing lock switch ON
		④	Service switch ON
		⑤	TVC prolix switch ON
		⑥	Swing lock prolix switch ON
22	Input condition of pump controller model selection, etc.	①	Model selection 1 GND connected
		②	Model selection 2 GND connected
		③	Model selection 3 GND connected
		④	Model selection 4 GND connected
		⑤	Kerosene mode input GND connected
		⑥	L.H. knob switch ON

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Code No.	Content	Bit	Details (condition when lighted up)
23	Drive condition of pump controller ON/OFF solenoid valves	①	
		②	LS select solenoid ON
		③	Swing brake solenoid ON
		④	Pump merge-divider solenoid ON
		⑤	2-stage relief solenoid ON
		⑥	Travel speed solenoid ON
36	Input condition of engine throttle controller	①	Model selection 1 GND connected
		②	Model selection 2 GND connected
		③	Model selection 3 GND connected
		④	Model selection 4 GND connected
		⑤	Starting switch ON
		⑥	Auto-deceleration signal ON
37	Output condition of engine throttle controller	①	Battery relay drived
		②	
		③	
		④	
		⑤	
		⑥	
38	Internal condition of engine throttle controller	①	
		②	
		③	
		④	
		⑤	
		⑥	
44	Input condition of monitor panel 1.	①	Coolant level sensor OPEN
		②	Swing lock switch OFF
		③	Buzzer cancel switch OFF
		④	
		⑤	
		⑥	
45	Input condition 2 of monitor panel	①	
		②	Starting switch ON
		③	Swing lock prolix switch OFF
		④	Time set switch OFF
		⑤	Hydraulic oil level sensor OPEN
		⑥	

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Code No.	Content	Bit	Details (condition when lighted up)
46	Input condition of monitor panel 3.	①	Starting switch HEAT
		②	Light switch ON
		③	Air cleaner clogging sensor OPEN
		④	Engine oil level sensor OPEN
		⑤	Engine oil pressure Lo sensor OPEN
		⑥	Engine oil pressure Hi sensor OPEN
47	Output condition 1 of monitor panel	①	
		②	Alarm buzzer actuated
		③	
		④	
		⑤	
		⑥	
68	Input condition of valve controller (HYPER GX)	①	L.H. knob switch signal 1 ON
		②	L.H. knob switch signal 2 ON
		③	Model selection 1 GND connected
		④	Model selection 2 GND connected
		⑤	Model selection 3 GND connected
		⑥	Option selection terminal GND connected
69	Input condition of valve controller (HYPER GX)	①	Safety relay 1 actuated
		①	Safety relay 2 actuated
		③	
		④	
		⑤	
		⑥	

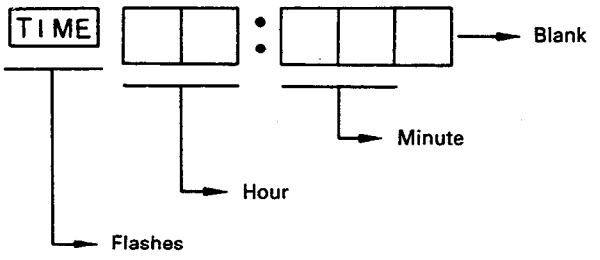
4. Governor motor adjustment mode

This is used when adjusting the linkage between the governor motor and the injection pump. For details of the procedure, see TESTING AND ADJUSTING.

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5. Time adjustment mode

To adjust the time, do as follows.

Operation	Display
1. To set to the time adjustment mode, Keep the time switch depressed for 2.5 seconds. 2. Use the L.H. working mode switch to advance the hour. 3. Use the R.H. working mode switch to advance the minute. 4. To return to the time display mode use the same procedure as in Step 1.	1. The time display flashes 

METHOD OF USING JUDGEMENT TABLE

This judgement table is a tool to determine if the problem with the machine is caused by an abnormality in the electrical system or by an abnormality in the hydraulic or mechanical system. The symptoms are then used to decide which troubleshooting table (E-OO, S-OO, F-OO, H-OO, K-OO, M-OO) matches the symptoms.

The judgement table is designed so that it is easy to determine from the user code and service code which troubleshooting table to go to.

★ The abnormality display (caution) given by the monitor panel leads directly to troubleshooting of the machine monitor (M-OO). (See troubleshooting of the machine monitor system)

1. When using judgement table for engine throttle controller and engine related parts

- If a service code is displayed on the monitor panel, go to the troubleshooting code at the bottom of the judgement table (E-OO).
  (A ● mark is put at the places where the failure mode and service code match.)
- If a problem has appeared but no service code is displayed on the monitor panel, go to the point where the failure mode matches the troubleshooting code on the right of the judgement table (E-OO or S-OO).

<Example> Failure mode "Engine does not start".

Procedure: Check if the service code is being displayed on the monitor panel.

Figure in○shows position of bit pattern

	Failure mode		Engine throttle controller, engine related parts (E3:system)										Checking monitoring, check items								Machine monitor check item			Troubleshooting code if no service code
			Abnormality in engine throttle controller power source system	Self-diagnostic display: Abnormality in fuel control dial input value	Abnormality (disconnection) in motor drive system	Abnormality (short circuit) in motor drive system	Abnormality in network signal reception system	Abnormality in model code	Abnormality in governor potentiometer system	Abnormality in pump throttle system	Abnormality (short circuit) in battery relay output	Abnormality (step-out) in motor	Auto-deceleration	Battery relay drive signal	No. 2 throttle signal value	Fuel control dial signal value	Governor motor potentiometer	Governor motor A phase current	Governor motor B phase current	Coolant temperature voltage	120C or above	105C or above	Does warning lamp turn?	
		User code											Bit pattern	Monitoring code							Is red range displayed?			
		Service code		E308	E317	E318	E301	E305	E306	E307	E315	E316	36	35	16	30	31	35	34	41				
1	Engine does not start easily																							S-1
2	Engine does not start																					○		S-2
3	Engine speed stays at low idling, and does not follow accelerator; or engine pickup is poor		●	●	●	●			●							✱	✱	✱	✱			○		S-3
4	Engine stops during operation																							S-4
5	Engine rotation is irregular	When idling speed is irregular																						E-12a) · S-5
		When there is hunting		●	●	●			●			●					✱							E-12a) · S-5
6	Lack of output (engine high idling speed is too low)			●					●						✱	✱				○				S-6
7	Auto-deceleration does not work												○											E-3 · E-4
8	Engine does not stop		●		●	●		●	●	●	●			○				✱	✱					E-14
9	Warming-up operation is defective																			○		○		E-3 · E-4
10	Exhaust gas is black																							S-7
11	Oil consumption is excessive, or exhaust gas is blue																							S-8
12	Oil becomes dirty prematurely																							S-9
13	Fuel consumption is excessive, or exhaust gas is blue																							S-10
14	Oil is mixed in coolant																							S-11
15	Oil pressure caution lamp lights up																							S-12
16	Oil level rises																							S-13
17	Coolant temperature rises too high																			○	○			S-14
18	Abnormal noise is generated																							S-15
19	There is excessive vibration																							S-16
20	Engine speed does not change even when working mode is switched						●								✱									E-3 · E-4
	Troubleshooting code when service code is displayed		E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-9	E-10	-	-	-	-	-	-	-	-	-	-	-	
	Troubleshooting code when there is abnormality in monitoring mode or machine monitor check		-	-	-	-	-	-	-	-	-	-	C-15	E-15	-	-	-	-	-	M-14	M-13	M-13	E-11	

●: This shows applicable item for service code ○: This shows item to check with monitoring mode or machine monitor
✱: This shows item that needs only checking with monitoring mode

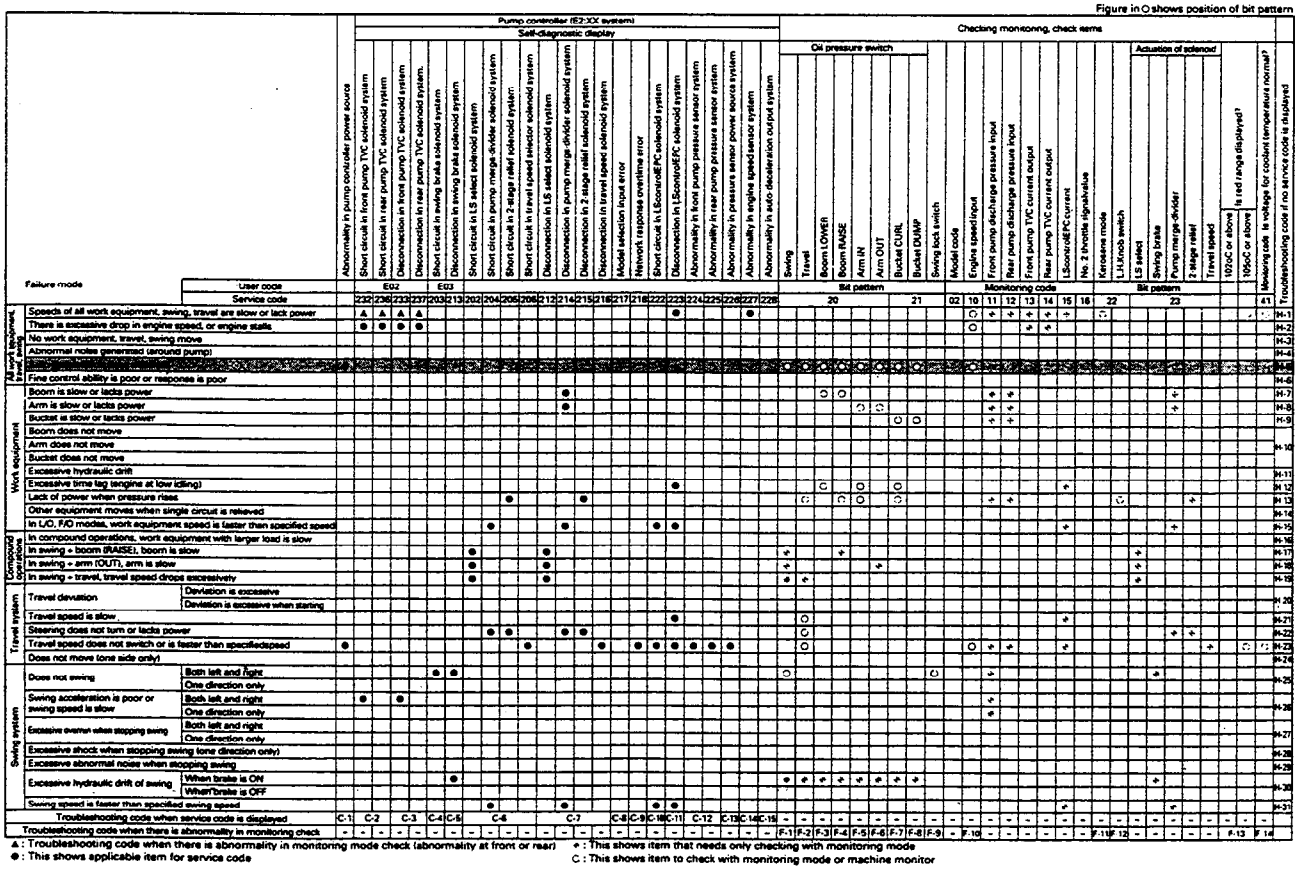
[Judgement]

1) If a service code is being displayed on the monitor panel:
   go to troubleshooting E-OO for the engine throttle controller system.
2) If no service code is displayed on the monitor panel, and the engine does not start:
   - Check that starting motor rotates
     - Starting motor rotates ... Go to troubleshooting S-2 of mechanical system
     - Starting motor does not rotate ... Go to troubleshooting E-11 of electrical system

2. **When using judgement table for pump controller and hydraulic related parts**
   - If a service code is displayed on the monitor panel, go to the troubleshooting code at the bottom of the judgement table (C-OO).
     (A ● mark is put at the places where the failure mode and service code match.)
   - If a problem has appeared but no service code is displayed on the monitor panel, go to the point where the failure mode matches the input signal, and check the display for the input signal (the display at the place with a ○ mark).
     - If it is displayed normally, go to the troubleshooting code on the right of the judgement table (H-OO).
     - If the input signal is not displayed on the monitor panel, go to the troubleshooting code at the bottom of the judgement table (F-OO).

<Example> Failure mode "Auto-deceleration does not work".

Procedure: Check if the service code is being displayed on the monitor panel.



[Judgement]

1) If a service code is being displayed on the monitor panel:
   go to troubleshooting C-OO for the pump controller system.
2) If no service code is displayed on the monitor panel, and the auto-deceleration does not work:
   - Check pump controller input signal
     - There is a signal ... Go to troubleshooting H-5 of mechanical system
     - There is no signal ... Go to troubleshooting F-OO of electrical system
       (F mode for applicable system)

METHOD OF USING TROUBLESHOOTING CHARTS

1. Category of troubleshooting code number

Troubleshooting Code No.	Component	Service code
E-OO	Troubleshooting of electrical system for engine throttle controller	E3: OO
S-OO	Troubleshooting of engine related parts	–
C-OO	Troubleshooting of electrical system for pump controller	E2: OO
F-OO	Troubleshooting of input signal system for pump controller	–
H-OO	Troubleshooting of hydraulic, mechanical system for pump controller	–
K-OO	Troubleshooting of electrical system for valve controller (HYPER GX)	E4: OO
M-OO	Troubleshooting of machine monitor system	E1: OO

2. Method of using troubleshooting table for each troubleshooting mode

1) Troubleshooting code number and problem
The title of the troubleshooting chart gives the troubleshooting code, service code, and failure mode (problem with the machine). (See Example (1))

2) Distinguishing conditions
Even with the same failure mode (problem), the method of troubleshooting may differ according to the model, component, or problem. In such cases, the failure mode (problem) 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 in the failure mode. (See Example (2))

3) Method of following troubleshooting chart
- Check or measure the item inside [ ] and according to the answer follow either the YES line or the NO line to go to the next [ ]. (Note: The number written at the top right corner of the [ ] 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.(See Example (3))
- Below the [ ] there are the methods for inspection or measurement, and the judgement values. If the judgement values below the [ ] are correct or the answer to the question inside the [ ] is YES, follow the YES line; if the judgement value is not correct, or the answer to the question is NO, follow the NO line.
- Below the [ ] is given the preparatory work needed for inspection and measurement, and the judgement values. If this preparatory work is neglected, or the method of operation or handling is mistaken, there is danger that it may cause mistaken judgement, or the equipment may be damaged. Therefore, before starting inspection or measurement, always read the instructions carefully, and start the work in order from Item 1).

4) General precautions
When carrying out troubleshooting for the failure mode (problem), precautions that apply to all items are given at the top of the page and marked with ★. (See Example (4))
The precautions marked ★ are not given in the [ ], but must always be followed when carrying out the check inside the [ ].

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

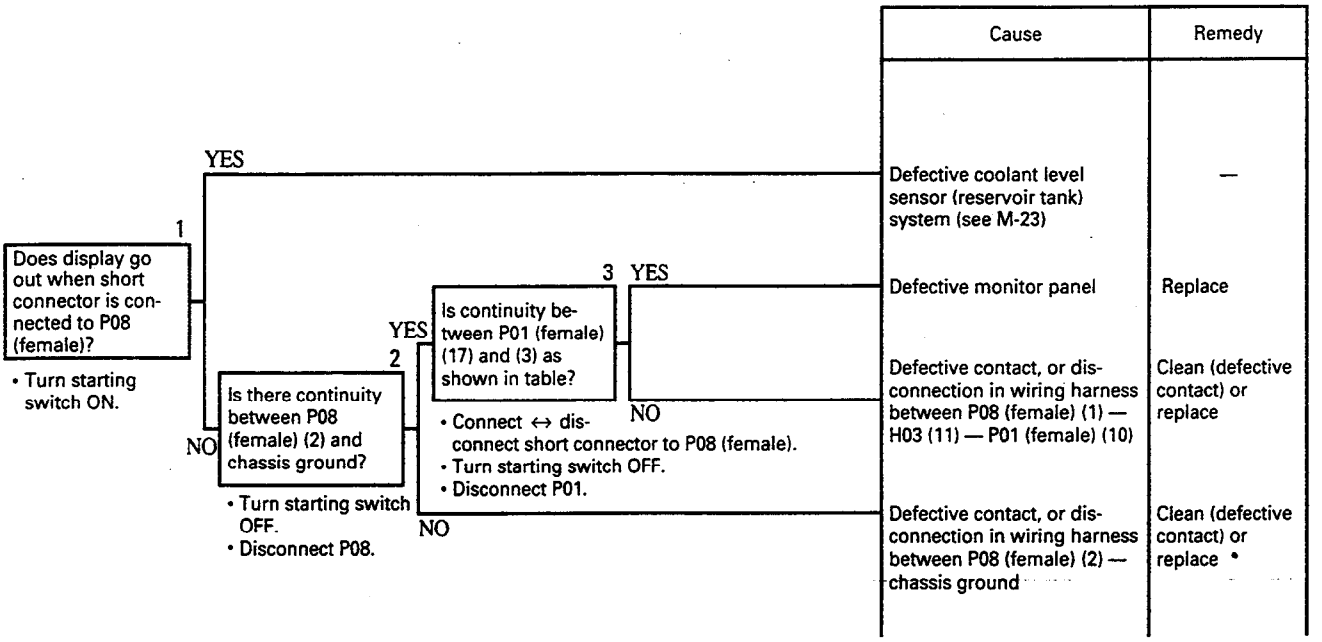
6) Installation position, pin number
A diagram or chart is given for the connector type, installation position, and connector pin number connection. When carrying out troubleshooting, see this chart for details of the connector pin number and location for inspection and measurement of the wiring connector number appearing in the trouble-shooting flow chart for each failure mode (problem).

<Example>
(1) **M-7 When starting switch is turned ON (engine stopped), check item flashes**

(4) ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.
★ Check that the coolant is at the specified level before carrying out troubleshooting

(2) **a)**  **(coolant level) flashes**
b)  **(engine oil level) flashes**
} Divided into sections a) and b)

(3)



Table

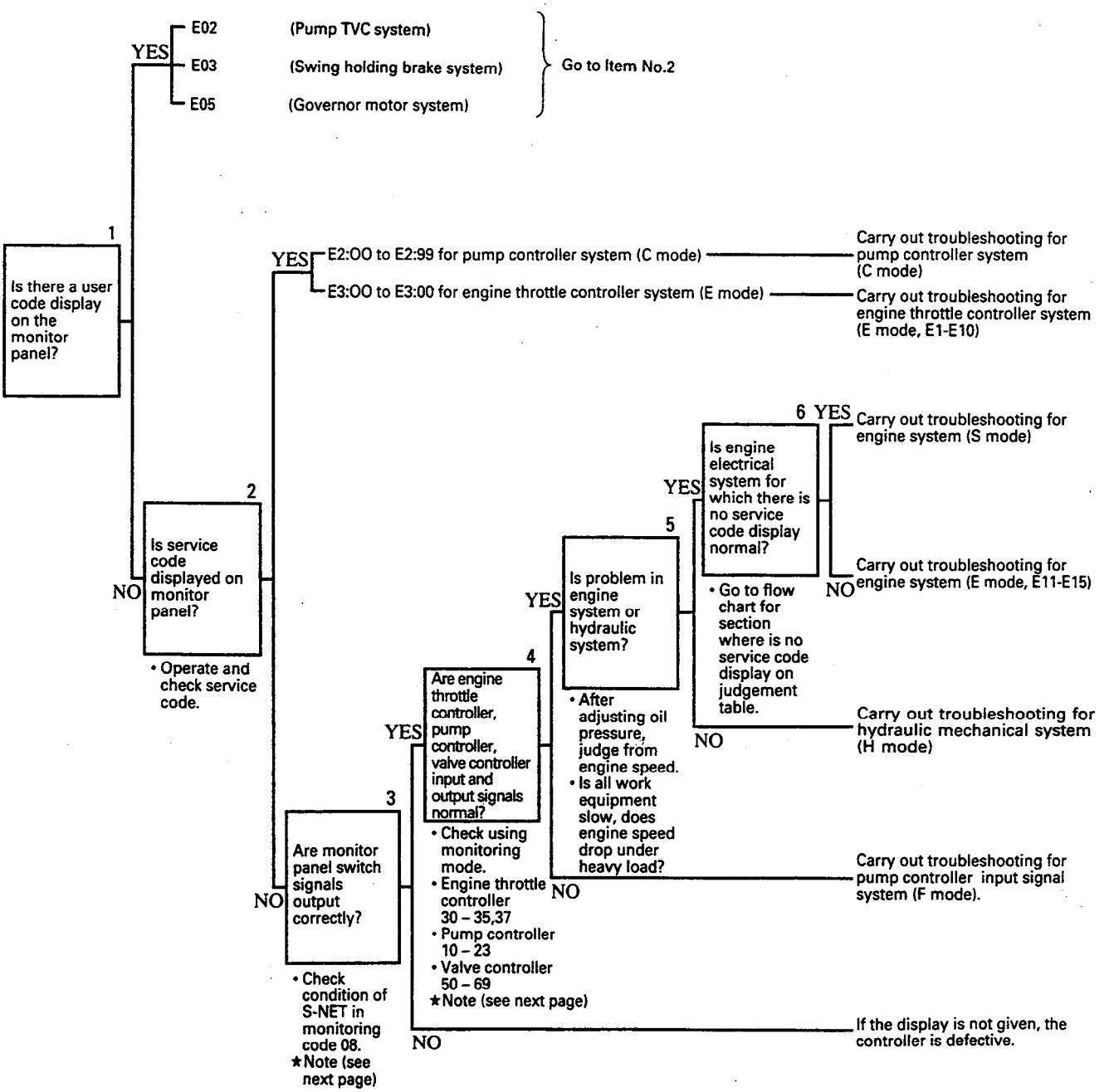
Short connector	Continuity
Connected	Yes
Disconnected	No

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DETAILS OF TROUBLESHOOTING AND TROUBLESHOOTING PROCEDURE

If any abnormality should occur, it is necessary to go to the correct troubleshooting chart in accordance with the judgement table for that type of failure (engine throttle controller, pump controller, valve controller). For details of the troubleshooting and troubleshooting procedure, refer to this flow chart. .
When carrying out troubleshooting, ask the operator as much as possible about the condition of the machine, and check the following items before starting.
(1) Condition of controller connection (check with monitoring code 02 – 04)
(2) Blown fuses (monitoring code 32)
(3) Battery voltage (monitoring code 32)
(4) Electricity generation (charge input) voltage (monitoring code 43)

The procedure for carrying out check items No. 3 and No. 4 in the flow chart below is given on the following pages.



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★ **NOTE**

If there is no abnormality display in the networking system transmitted in S-NET, it can be taken that the output signal from the monitor panel has been transmitted. However, even if there is no abnormality display, if the operation is defective, use the following procedure when checking directly.

If any abnormality occurs in the S-NET system, the system is automatically switched to the following default mode, so be careful when carrying out troubleshooting.

- **Default mode**

1. When networking cannot be carried out for the monitor and engine throttle controller + pump controller

Set mode		Pump controller	Engine throttle controller
1	Working mode	G/O mode	H/O mode
2	Throttle signal	FULL	FULL
3	Auto-deceleration	ON(deceleration mode)	ON(deceleration mode)
4	Coolant temperature signal	OFF	—
5	Priority mode	OFF	—
6	Power max. mode	ON (power max. possible)	—
7	Travel speed	LO	—
8	Automatic warming-up	—	ON (automatic warming-up mode)

2. When networking cannot be carried out for the monitor and engine throttle controller, only throttle signal is recognized as FULL; normal control is carried out for others.

- **Procedure for checking monitor panel output signal**

★ For details of operating the monitoring mode, see MONITOR PANEL DISPLAY AND SPECIAL FUNCTIONS.

1. Connection condition of components
   1) Set to the monitoring mode and display monitoring code 08.
   2) The time display (bits) will light up to display the components that are connected.
      ★ ① Pump controller, ② engine throttle controller, ③ valve controller will light up.

2. Checking working mode signal (check No. 2 throttle signal at the same time)
   1) Set to the monitoring mode and display monitoring code 40.
   2) Switch the working mode as shown in Table 1 and check that the engine speed changes.

(rpm)

Table 1		Engine speed (high idling) [The figures in ( ) are the rated speed]	
Working mode	Operation	PC200, PC210	PC220, PC250
H/O	Work equipment	Approx. 2,230 (2,000)	Approx. 2,420 (2,200)
	Travel	Approx. 2,420 (2,200)	Approx 2,520 (2,300)
G/O, F/O	Work equipment	Approx. 2,100 (1,900)	Approx. 2,200 (2,000)
	Travel	Approx. 2,100 (-)	Approx. 2,200 (-)
L/O	Work equipment	Approx. 1,700 (1,500)	Approx. 1,750 (1,500)
	Travel	Approx. 1,750 (-)	Approx. 1,750 (-)

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3. Checking travel speed selection signal
   1) Set to the monitoring mode and display monitoring code 23.
   2) Change the travel speed switch to Mi or Hi, run the engine at 1500 rpm or above, and operate the control lever. Check that bit ⑥ lights up when this is done.

4. Checking boom/swing priority selection mode signal
   ★ If the travel oil pressure switch signal is not input to the controller, the flow from the front and rear pumps will remain divided.
   1) Turn the boom/swing priority switch to ON.
   2) Set to the monitoring mode and disply monitoring code 23.
   3) Check that bit ④ lights up when the boom, arm, bucket, and swing are operated independently or together.
      ★ Check the operating condition of the pump merge-divider solenoid valve.

- **Checking input signal of engine throttle controller, pump controller**
  ★ Check the input signal for each controller as follows.
  - Pump controller
  1. Checking input signal
     1) Check oil pressure switch
        i) Set to the monitoring mode and display monitoring codes 20 and 21.
        ii) Operate each work equipment lever, and check how the bit pattern lights up.
            ★ For details of the bit pattern chart, see MONITOR PANEL DISPLAY AND SPECIAL FUNCTIONS.

     2) Check engine speed sensor (check engine speed)
        i) Set to the monitoring mode and display monitoring code 10.
        ii) Use the fuel control dial to change the speed, and measure the engine speed when this is done.

     3) Check pump pressure sensor
        i) Set to the monitoring mode and display monitoring code 11 and 12.
            ★ Code 11 is for the front pump, and code 12 is for the rear pump.
        ii) Refer to Table 2 and measure the hydraulic pressure at the front and rear pumps.

Table 2. Pump merge-divided flow logic and pumps actuated by control levers.

	Boom/swing priority selection mode OFF		Boom/swing priority selection mode ON ★	
	Basically flow is merged		Flow merged if there is no travel + compound operation input	
	Front pump	Rear pump	Front pump	Rear pump
L.H. travel	●		●	
Swing	●		●	
Arm	●	●	●	
Boom	●	●		●
Bucket	●	●		●
R.H. travel		●		●

★ When the travel is operated independently divided flow, travel + compound operations becomes the merged flow.

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4) Check L.H. knob switch input signal
   i) Set to the monitoring mode, and display monitoring code 22.
   ii) Push the L.H. knob switch ON and check that bit ⑥ lights up.

2. Check output signals

1) Check LS control EPC solenoid output current
   i) Set to the monitoring mode, and display monitoring code 15.
   ii) Run the engine at high idling with all the levers at neutral and in the G/O or H/O mode, and measure the current.
   ★ All levers at neutral: 900 ± 80 mA
   Engine at high idling, travel speed Hi, travel lever operated: 0 A

2) Check No. 2 throttle signal
   i) Set to the monitoring mode, and display monitoring code 16.
   ii) Use the procedure in Item 2 for checking the monitor panel output signal, and measure the engine speed.

3) Check ON ↔ OFF solenoid condition
   i) Set to monitoring mode, and display monitoring code 23.
   ii) Refer to Table 3 and check that the applicable bit lights up.

Table 3. Types of solenoid and conditions for actuation

Name of solenoid	Actuation condition	Bit that lights up
LS select	Swing + travel lever operated	②
Swing brake	Swing operated	③
Pump merge-divider	L/O mode	④
2-stage relief	Travel lever operated	⑤
Travel speed	Travel speed switch: Hi Fuel control dial at midway position or above Travel lever operated	⑥

4) Check TVC solenoid output current
   i) Set to the monitoring mode, and display monitoring codes 13 and 14.
   • Code 13 is for the front pump, and code 14 is for the rear pump.
   ii) With the starting switch kept at the ON position and in the G/O mode, measure the current when the fuel control dial is turned to the MAX position.
   PC200, PC210: 510 ± 80 mA
   PC220, PC250: 410 ± 80 mA

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- **Engine throttle controller**

1. Check input signal
   1) Check fuel control dial input voltage
      i) Set to the monitoring mode, and display monitoring code 30.
      ii) Measure the voltage when the fuel control dial is turned from low idling to high idling.
         ★ Voltage: 0.25 - 4.75 V

2. Check output signal
   1) Check governor motor drive current
      i) Set to the monitoring mode, and display monitoring codes 33 and 34.
         ★ Code 33 is the A phase (direction for increasing engine speed), and code 34 is the B phase (direction for reducing engine speed).
      ii) Measure the governor motor drive current when the fuel control dial is turned in the acceleration direction and deceleration direction.
         ★ Current: 700 ± 70mA

   2) Measure battery relay drive voltage
      i) Set to the monitoring mode, and display monitoring code 35.
      ii) Measure the battery relay drive voltage when the starting switch is turned from ON to OFF.
      or
      iii) Set to the monitoring mode, and display monitoring code 37.
      iv) Check that bit ① lights up when the starting switch is turned from ON to OFF.
      (Min. 4 seconds - Max. 7 seconds)

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TROUBLESHOOTING OF ENGINE THROTTLE CONTROLLER SYSTEM (E MODE)

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b) There is hunting 20-132
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E-14 Engine does not stop 20-136
E-15 Defective operation of battery relay system (engine does not stop) 20-138

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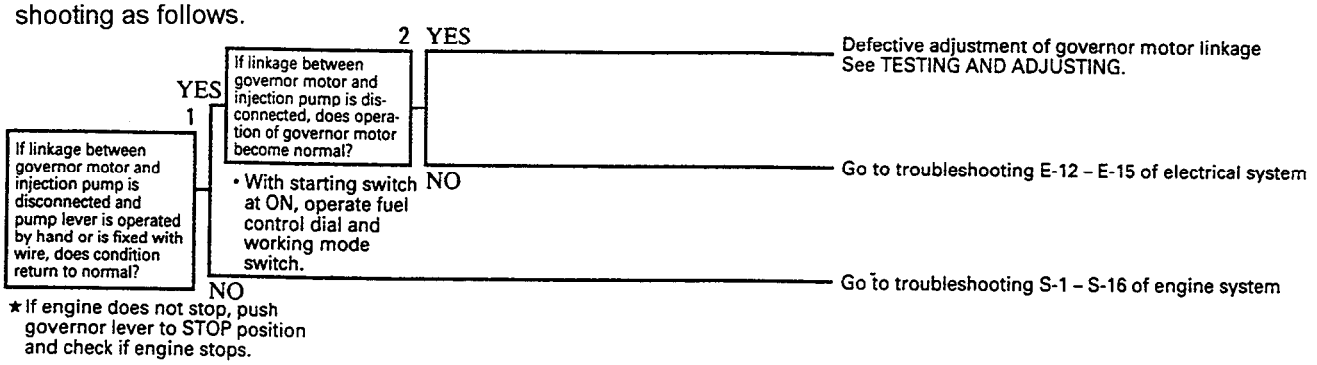
POINTS TO REMEMBER WHEN CARRYING OUT TROUBLESHOOTING OF ENGINE THROTTLE CONTROLLER SYSTEM

1. Points to remember when there is abnormality which is not displayed by code

The engine is controlled by engine throttle contoller.
The problems that may occur with this system include the following.

1. Idling speed is too high (too low)
2. High idling speed is too low
3. Auto-deceleration speed is too high (too low)
4. Engine speed for automatic warming-up operation is too high (too low)
5. There is hubting
6. Engine does not stop

If any abnormality occurs, and the abnormality is displayed on the time display portion of the monitor panel, use the troubleshooting table to determine the appropriate troubleshooting flow chart from E1 to E10.
However, if there is any abnormality in the machine and no abnormality display is given, it is necessary to determine whether the problem is in the mechanical system or in the electrical system. If the linkage between the governor motor and the injection pump is not properly adjusted, problems 1 to 6 listed above may occur. Therefore, if there is no abnormality display, but one of problems 1 to 6 above has occured, carry out trouble-shooting as follows.



Disconnect the linkage as explained above, or check the adjustment and go to the troubleshooting flow chart for the mechanical system or electrical system.

★ For details of the procedure for adjusting the linkage, see TESTING AND ADJUSTING.

2. Points to remember if abnormality returns to normal by itself

In the following cases, there is a high probability that the same problem will occur again, so it is desirable to follow up this problem carefully.

1) If any abnormality returns to normal by itself,
2) If the connector is disconnected and the T-adapter is inserted, or if the T-adapter is removed and the connector is returned to its original position when carrying out troubleshooting of the failure, and the service code is no longer displayed, or if the monitor display returns to normal.

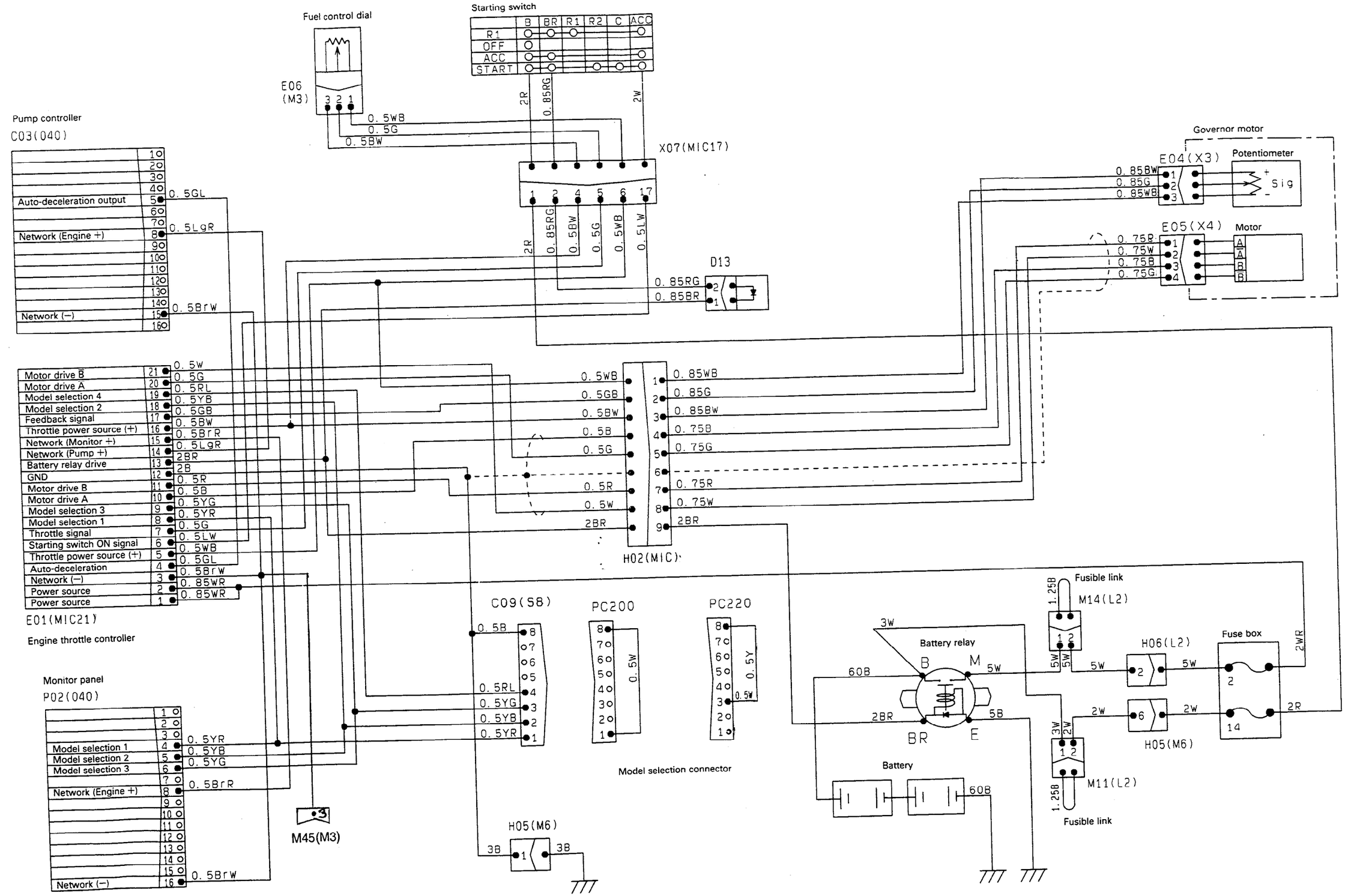
★ After completing troubleshooting, always erase the user code from memory.

3. Service code memory retention function

When displaying the service code in memory and carrying out troubleshooting, note down the content of the display, then erase the display. After trying to re-enact the problem, carry out troubleshooting according to the service code that is displayed.
(There are cases where mistaken operation or abnormalities that occur when the connector is disconnected are recorded by the memory retention function. Erasing the data in this way saves any wasted work.)

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ENGINE THROTTLE CONTROLLER SYSTEM CIRCUIT DIAGRAM



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<table>
<tr><th>User code</th><th>Service code</th><th>Abnormal system</th><th>Nature of abnormality</th><th>Condition when normal (voltage, current, resistance)</th><th>Action by controller when abnormality is detected</th><th>Problem that appears on machine when there is abnormality</th></tr>
<tr><td>–</td><td>E3:05</td><td>Abnormality in model code</td><td>1. Disconnection, short circuit in model selection wiring harness
2. Abnormality in engine throttle controller
3. Part No. for model selection connector is wrong</td><td>1. PC200
Value of resistance between
E01 (9) – (12) : Max. 1Ω
Value of resistance between
E01 (8) (18) (19) – (12) : Min. 1 MΩ
2. PC220
Value of resistance between
E01 (8),(9) – (12) : Max. 1Ω
Value of resistance between
E01 (18) (19) – (12) : Min. 1 MΩ</td><td>Detects abnormality in input
1) Retains data when starting switch is ON
2) Functions as PC100 when non-set conditions are input
3) When model code set by controller is input, functions as model that is input
[For PC200: PC220, 120, 100]
[For PC220: PC200, 120, 100]</td><td>1. In case of 1), when change occurs from midway point, initial data continues as it is, so there is no abnormal phenomenon
2. In case of 2), engine runs at high idling, but low idling speed is too high, or the engine cannot stop
3. In case of 3), for example when controller recognizes PC200 as PC100:
When there is excessive load, there is travel deviation</td></tr>
<tr><td>–</td><td>E3:06</td><td>Abnormality in governor potentiometer system</td><td>1. Short circuit in wiring harness between E01 (5) – (16), (5) – (17), (16) – (17)
2. Short circuit in wiring harness between E04 (1) – (2), (1) – (3), (2) – (3)
3. Short circuit in wiring harness between E06 (1) – (2), (1) – (3), (2) – (3)
4. Short circuit in wiring harness between E01 (5) – (7), (7) – (16)
5. Disconnection in wiring harness between E01 (5) – H02 (1) – E04 (1)
6. Disconnection in wiring harness between E01 (17) – H02 (2) – E04 (2)
7. Disconnection in wiring harness between E01 (16) – H02 (3) – E04 (3)
8. Defective governor potentiometer
9. Defective contact of E01, H02, E04 connectors</td><td><table><tr><th>E01 (female)</th><th>E04 (male)</th><th>Resistance value</th></tr><tr><td>(5) – (17)</td><td>(1) – (2)</td><td>0.25 – 7 kΩ</td></tr><tr><td>(17) – (16)</td><td>(2) – (3)</td><td>0.25 – 7 kΩ</td></tr><tr><td>(5) – (16)</td><td>–</td><td>2 – 3 kΩ</td></tr><tr><td>–</td><td>(1) – (3)</td><td>4 – 6 kΩ</td></tr><tr><td>Between each pin and chassis</td><td>–</td><td>Min. 1 MΩ</td></tr></table></td><td>Calculates position of motor and carries out control from value of voltage immediately before abnormality occurred</td><td>1. Precision of engine speed control may be reduced.
For example:
1) Engine does not change to high idling speed (a little too low)
2) Engine does not change to low idling speed (a little too high)
3) Defective engine speed for auto-deceleration or automatic warming-up (too high or too low)
4) Engine may not stop
★ The governor motor moves in the direction to stop the engine, but motor may not move completely to the position to stop the engine.
5) There are cases of hunting</td></tr>
<tr><td>–</td><td>E3:07</td><td>Abnormality in pump controller throttle system (No. 2 throttle signal)</td><td>1. If model selection input is different for the two controllers (pump controller and engine throttle controller)
2. Controller part number is different</td><td></td><td>Functions as PC100 when non-set conditions are input</td><td>Engine runs at high idling, but low idling speed is too high, or engine cannot stop</td></tr>
<tr><td>–</td><td>E3:15</td><td>Abnormality (short circuit) in battery relay output system</td><td>If excess current flows between E01 (13) and battery relay
★ This occurs only when turning starting switch to OFF, and stopping engine</td><td>Between E01 (13) and chassis : 20 – 30 V
★ Hold with the motor in the stop position for 2 – 2.5 sec, return to the low idling position, then turn the battery relay OFF.</td><td>Sets battery relay drive current to 0</td><td>Engine does not stop</td></tr>
<tr><td rowspan="3">–</td><td rowspan="3">E3:16</td><td rowspan="3">Abnormality (step-out) in governor motor system</td><td>1. Defective adjustment of rod or twisting of loose spring</td><td>1. Linkage adjustment correct</td><td rowspan="3">1. Displays when returning from high idling to low idling
★Start again (repeat step-out)
2. In some cases it may not display when returning from partial speed to low idling</td><td rowspan="3">Engine speed cannot be controlled (particularly at high idling), so there is hunting</td></tr>
<tr><td>2. Abnormality in governor motor</td><td>2. Must move lightly when connector is removed</td></tr>
<tr><td>3. Abnormality in engine throttle controller</td><td>3. Normal</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

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ACTION TAKEN BY CONTROLLER WHEN ABNORMALITY OCCURS AND PROBLEMS ON MACHINE

<table>
<tr><th>User code</th><th>Service code</th><th>Abnormal system</th><th>Nature of abnormality</th><th>Condition when normal (voltage, current, resistance)</th><th>Action by controller when abnormality is detected</th><th>Problem that appears on machine when there is abnormality</th></tr>
<tr><td rowspan="3">E : 05</td><td>E3:08</td><td>Abnormality in fuel control dial input value</td><td>1. Short circuit in wiring harness between E01 (5) – (16), (5) – (17), (16) – (17)
2. Short circuit in wiring harness between E04 (1) – (2), (1) – (3), (2) – (3)
3. Short circuit in wiring harness between E06 (1) – (2), (1) – (3), (2) – (3)
4. Short circuit in wiring harness between E01 (5) – (7), (7) – (16)
5. Disconnection in wiring harness between E01 (5) – X07 (6) – E06 (1)
6. Disconnection in wiring harness between E01 (7) – X07 (5) – E06 (2)
7. Disconnection in wiring harness between E01 (16) – X07 (4) – E06 (3)
8. Defective fuel control dial
9. Defective contact of E01, X07, E06 connectors</td><td><table><tr><th>E01 (female)</th><th>E06 (male)</th><th>Resistance value</th></tr><tr><td>(5) – (7)</td><td>(1) – (2)</td><td>0.25 – 7kΩ</td></tr><tr><td>(7) – (16)</td><td>(2) – (3)</td><td>0.25 – 7kΩ</td></tr><tr><td>(5) – (16)</td><td>–</td><td>2 – 3kΩ</td></tr><tr><td>–</td><td>(1) – (3)</td><td>4 – 6kΩ</td></tr><tr><td>Between each pin and chassis</td><td>–</td><td>Min. 1 MΩ</td></tr></table></td><td>Maintains engine speed at position of fuel control dial immediately before abnormality occurred</td><td>1. Does not become partial speed when set at high idling position
2. Does not reach high idling when set at partial speed
3. There are cases of hunting
4. Lacks output (max. speed of engine is too low)</td></tr>
<tr><td>E3:17</td><td>Abnormality (disconnection) in governor motor drive system</td><td>1. Disconnection inside governor motor
2. Disconnection in wiring harness between E01 (10) – H02 (4) – E05 (1)
3. Disconnection in wiring harness between E01 (11) – H02 (7) – E05 (3)
4. Disconnection in wiring harness between E01 (20) – H02 (5) – E05 (2)
5. Disconnection in wiring harness between E01 (21) – H02 (8) – E05 (4)
6. Defective contact of E01, H02, E05 connectors</td><td><table><tr><th>E05 (male)</th><th>E01 (female)</th><th>Resistance value</th></tr><tr><td>(1) – (2)</td><td>(10) – (20)</td><td>2.5 – 7Ω</td></tr><tr><td>(3) – (4)</td><td>(11) – (21)</td><td>2.5 – 7Ω</td></tr><tr><td>(1) – (3)</td><td>(10) – (11)</td><td>Min. 1 MΩ</td></tr><tr><td>(1) – (4)</td><td>(10) – (21)</td><td>Min. 1 MΩ</td></tr><tr><td>Between pins (1), (2), (3), (4) and chassis</td><td>Between pins (10), (11), (20), (21) and chassis</td><td>Min. 1 MΩ</td></tr></table>Motor drive current : Hold : 0.7 A
Start : 0.84 A</td><td>Takes no particular action</td><td>1. When there is a disconnection in both the A phase and B phase at the same time, the problem is the same as for a short circuit in the governor motor system
2. When there is a disconnection in only one of A phase or B phase
1) Engine does not stop
2) Stops moving at position immediately before failure, so engine speed cannot be controlled
3) There are cases of hunting</td></tr>
<tr><td>E3:18</td><td>Abnormality (short circuit) in governor motor drive system</td><td>1. Short circuit inside governor motor
2. Wiring harness between E01 (10) – H02 (4) – E05 (1) short circuiting with wiring harness between E01 (20) – H02 (5) – E05 (2)
3. Wiring harness between E01 (11) – H02 (7) – E05 (3) short circuiting with wiring harness between E01 (21) – H02 (8) – E05 (4)
4. Wiring harness in Items 2 and 3 short circuiting with ground</td><td><table><tr><th>E05 (male)</th><th>E01 (female)</th><th>Resistance value</th></tr><tr><td>(1) – (2)</td><td>(10) – (20)</td><td>2.5 – 7Ω</td></tr><tr><td>(3) – (4)</td><td>(11) – (21)</td><td>2.5 – 7Ω</td></tr><tr><td>(1) – (3)</td><td>(10) – (11)</td><td>Min. 1 MΩ</td></tr><tr><td>(1) – (4)</td><td>(10) – (21)</td><td>Min. 1 MΩ</td></tr><tr><td>Between pins (1), (2), (3), (4) and chassis</td><td>Between pins (10), (11), (20), (21) and chassis</td><td>Min. 1 MΩ</td></tr></table>Motor drive current : Hold : 0.7 A
Start : 0.84 A</td><td>Sets motor drive current to 0</td><td>1. If during operation
1) Set to low idling
2) Engine does not stop
3) There are cases of hunting
2. When stopped
1) Engine starts, but stays at low idling
2) Engine does not stop after starting
3) There are cases of hunting</td></tr>
<tr><td>–</td><td>E3:01</td><td>Abnormality in network reception system</td><td>1. Short circuit, disconnection in network wiring harness
2. Abnormality in pump controller
3. Abnormality in engine throttle controller</td><td></td><td>1. When monitor panel and pump controller cannot receive signal
1) Working mode: H/O
2) Automatic warming-up: ON
3) Overheat signal: OFF
2. Same as normal when only pump controller cannot receive signal</td><td>1. When monitor panel and pump controller cannot receive signal
1) Even when working mode is switched, engine speed does not change
2. Same as normal when only pump controller cannot receive signal</td></tr>
</table>

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JUDGEMENT TABLE FOR ENGINE THROTTLE CONTROLLER AND ENGINE RELATED PARTS

Figure in ○ shows position of bit pattern

	Failure mode		Abnormality in engine throttle controller power source system	Engine throttle controller, engine related parts (E3 : ○○ system) Self-diagnostic display: Abnormality in fuel control dial input value	Abnormality (disconnection) in governor motor drive system	Abnormality (short circuit) in governor motor drive system	Abnormality in network reception system	Abnormality in model code	Abnormality in governor potentiometer system	Abnormality in pump controller throttle system	Abnormality (short circuit) in battery relay output system	Abnormality (step-out) in governor motor system	Checking monitoring, check items: Auto-deceleration signal (Bit No.⑥)	Battery relay drive signal	No. 2 throttle signal	Fuel control dial signal	Governor potentiometer signal	Governor motor A phase signal	Governor motor B phase signal	Coolant temperature sensor signal	Machine monitor check item: Is red range displayed? 102°C or above	105°C or above	Does starting motor rotate?	Troubleshooting code if no service code display is given
		User code		E05			–						Monitoring code								Coolant temperature gauge			
		Service code		E3:08	E3:17	E3:18	E3:01	E3:05	E3:06	E3:07	E3:15	E3:16	36	35	16	30	31	33	34	41				
1	Engine does not start easily																							S-1
2	Engine does not start																						○	S-2
3	Engine speed stays at low idling, and does not follow accelerator, or engine pickup is poor		●	●	●	●			●							※	※	※	※			○		S-3
4	Engine stops during operation																							S-4
5	Engine rotation is irregular	When idling speed is irregular																						E-12a) , S-5
		When there is hunting		●	●	●			●			●					※			○				E-12a) , S-5
6	Lack of output (engine high idling speed is too low)			●					●						※	※				○				S-6
7	Auto-deceleration does not work												○											E-3 , E-4
8	Engine does not stop		●		●	●		●	●	●	●			○				※	※					E-14
9	Automatic warming-up operation is defective																			○		○		E-3 , E-4
10	Exhaust gas is black																							S-7
11	Oil consumption is excessive, or exhaust gas is blue																							S-8
12	Oil becomes dirty prematurely																							S-9
13	Fuel consumption is excessive, or exhaust gas is blue																							S-10
14	Oil is mixed in coolant																							S-11
15	Oil pressure caution lamp lights up																							S-12
16	Oil level rises																							S-13
17	Coolant temperature rises too high																			○	○			S-14
18	Abnormal noise is generated																							S-15
19	There is excessive vibration																							S-16
20	Engine speed does not change even when working mode is switched					●									※									E-3 , E-4
Troubleshooting code when service code is displayed			E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-9	E-10	–	–	–	–	–	–	–	–	–	–	–	
Troubleshooting code when there is abnormality in monitoring mode or machine monitor check			–	–	–	–	–	–	–	–	–	–	C-15	E-15	–	–	–	–	–	M-14	M-13	M-13	E-11	

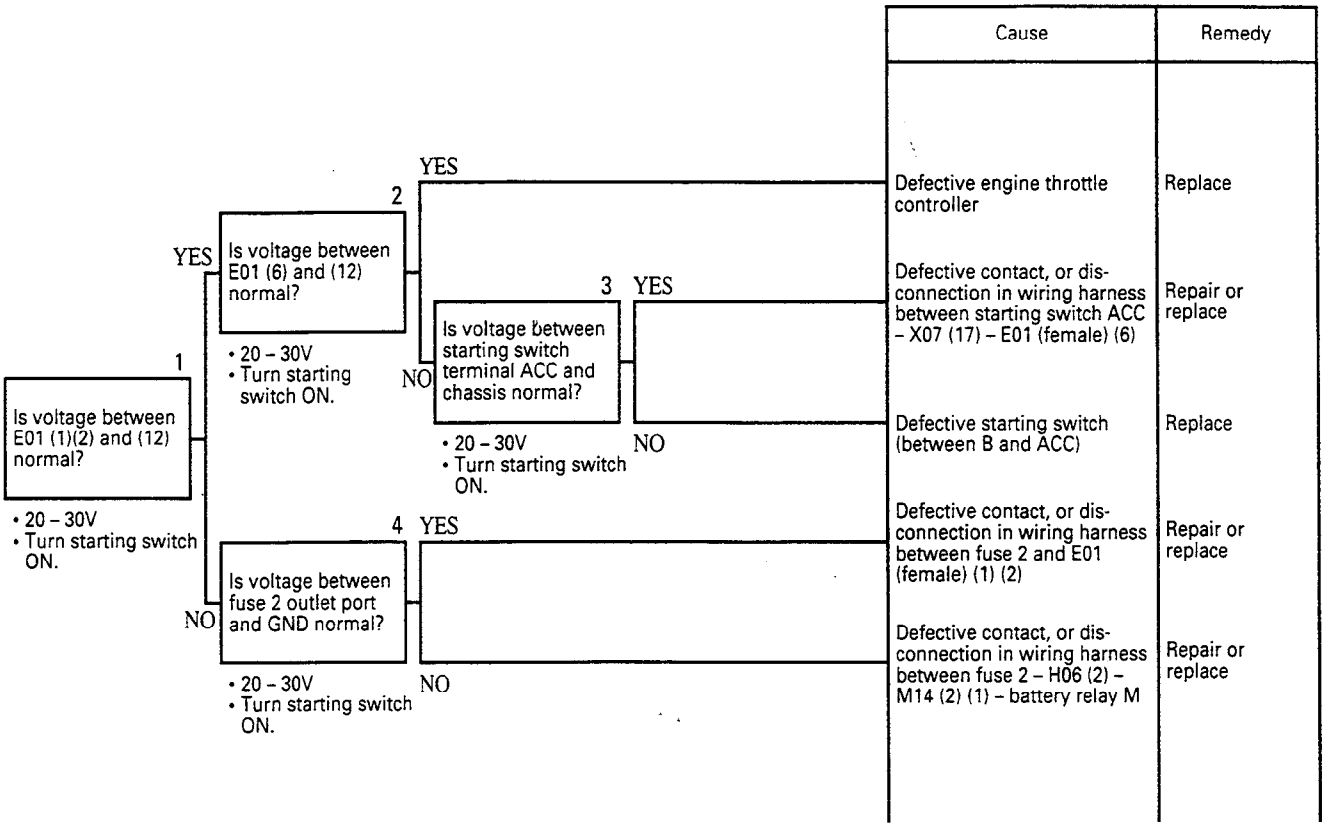
● : This shows applicable item for service code

※ : This shows item that needs only checking with monitoring mode

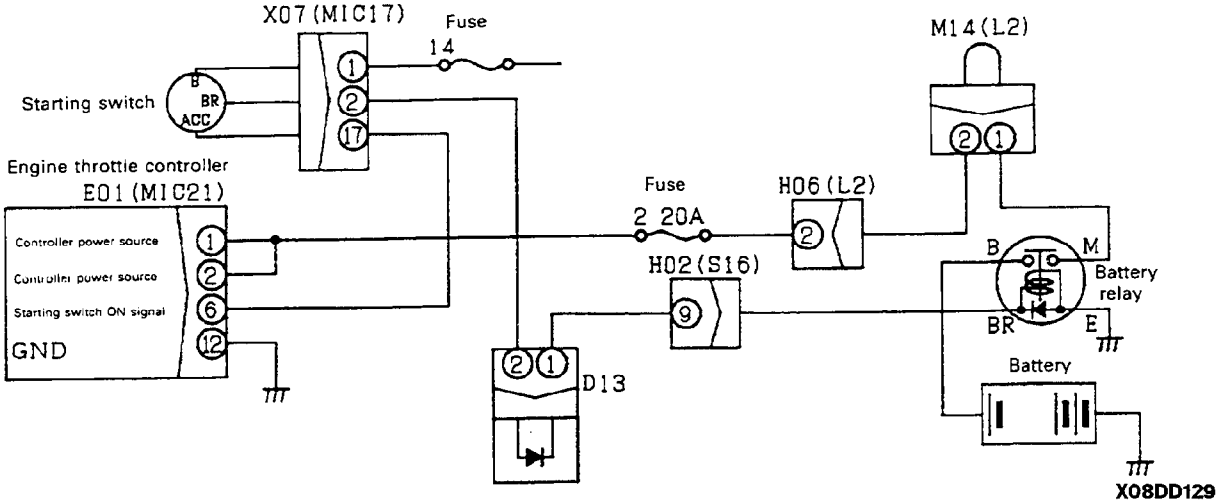
○ : This shows item to check with monitoring mode or machine monitor

E-1 Abnormality in engine throttle controller power source system (engine speed stays at low idling)

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ Check that fuses 2 and 14 are not blown.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.
★ When the starting motor rotates correctly. (If the starting motor also does not rotate, go to E-11.)

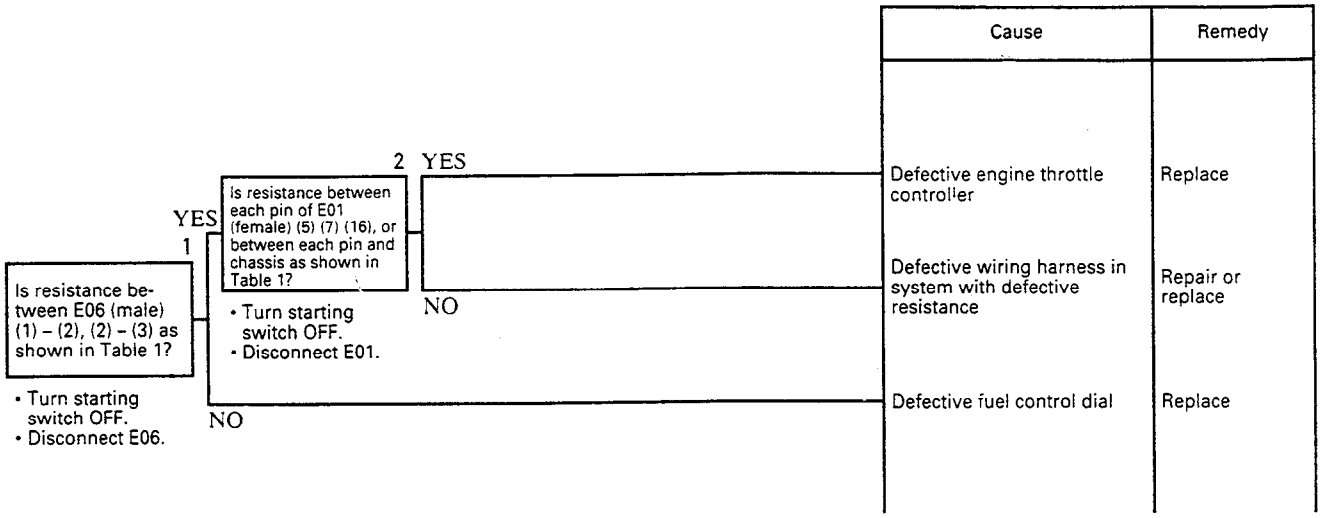


E-1 Related electric circuit diagram



E-2 [E3:08] Abnormality in fuel control dial input value is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

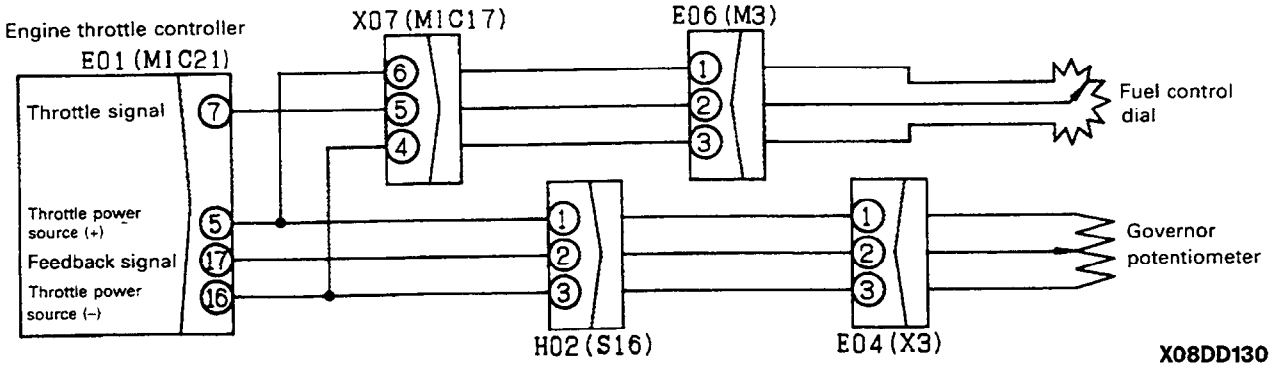


Note: If E3:06 also occurs at the same time, check the wiring harness below.
- Wiring harness between E01 (female) (5) - H02 (1) - E04 (female) (1) short circuiting with ground, or contact with other wiring harness.

Table 1

E01 (female)	E06 (female)	Resistance value
(5) - (7)	(1) - (2)	0.25 - 7kΩ
(7) - (16)	(2) - (3)	0.25 - 7kΩ
(5) - (16)	–	2 - 3 kΩ
–	(1) - (3)	4 - 6 kΩ
Between each pin and chassis	–	Min. 1 MΩ

E-2 Related electric circuit diagram



E-3 [E3:17] Abnormality (disconnection) in governor motor drive system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

★ During operation, if there is
1) a simultaneous disconnection in A phase and B phase:
① the engine will run at low idling
② the engine will not stop
2) a disconnection in either A phase or B phase:
the engine speed will remain the same as before the abnormality occured

★ If the problem occurs when the engine is stopped,
1) the engine can be started, but it stays in low idling, or 2) it will not stop after it is started.

⚠ Stop the engine (push the governor lever of the fuel injection pump to the NO INJECTION position) before checking.

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

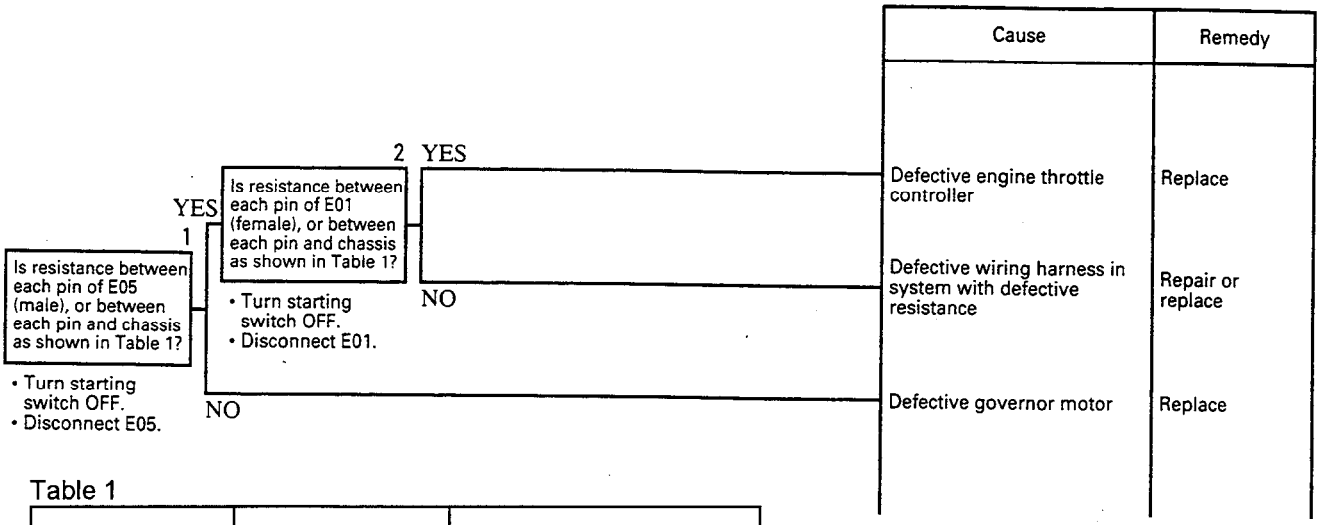
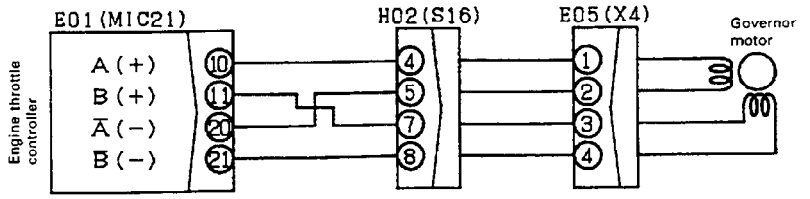


Table 1

E05 (male)	E01 (female)	Resistance value
(1) - (2)	(10) - (20)	2.5 - 7kΩ
(3) - (4)	(11) - (21)	2.5 - 7kΩ
(1) - (3)	(10) - (11)	Min. 1 MΩ
(1) - (4)	(10) - (21)	Min. 1 MΩ
Between pins (1) (2) (3) (4) and chassis	Between pins (10) (11) (20) (21) and chassis	Min. 1 MΩ

E-3 Related electric circuit diagram



X08DD131

E-4 [E3:18] Abnormality (short circuit) in governor motor drive system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ If the abnormality occurs during operation, because of the force of the spring,
1) the engine will run at low idling, or 2) the engine will not stop
★ If the problem occurs when the engine is stopped,
1) the engine can be started, but it stays in low idling, or 2) it will not stop after it is started.
⚠ Stop the engine (push the governor lever of the fuel injection pump to the NO INJECTION position) before checking.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

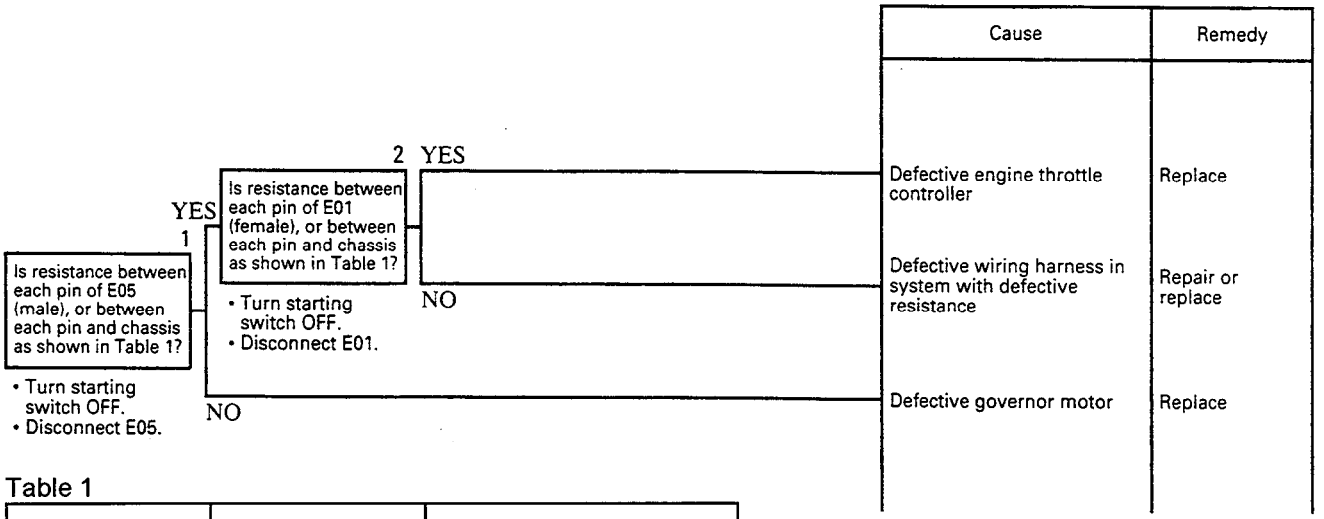
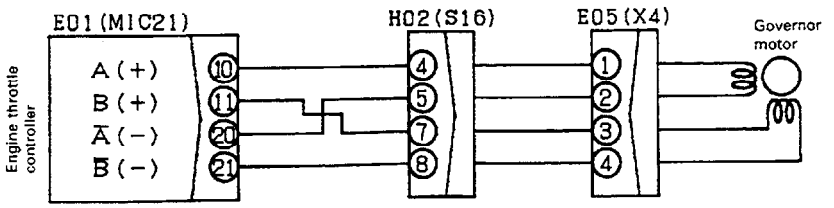


Table 1

E05 (male)	E01 (female)	Resistance value
(1) - (2)	(10) - (20)	2.5 - 7kΩ
(3) - (4)	(11) - (21)	2.5 - 7kΩ
(1) - (3)	(10) - (11)	Min. 1 MΩ
(1) - (4)	(10) - (21)	Min. 1 MΩ
Between pins (1) (2) (3) (4) and chassis	Between pins (10) (11) (20) (21) and chassis	Min. 1 MΩ

E-4 Related electric circuit diagram

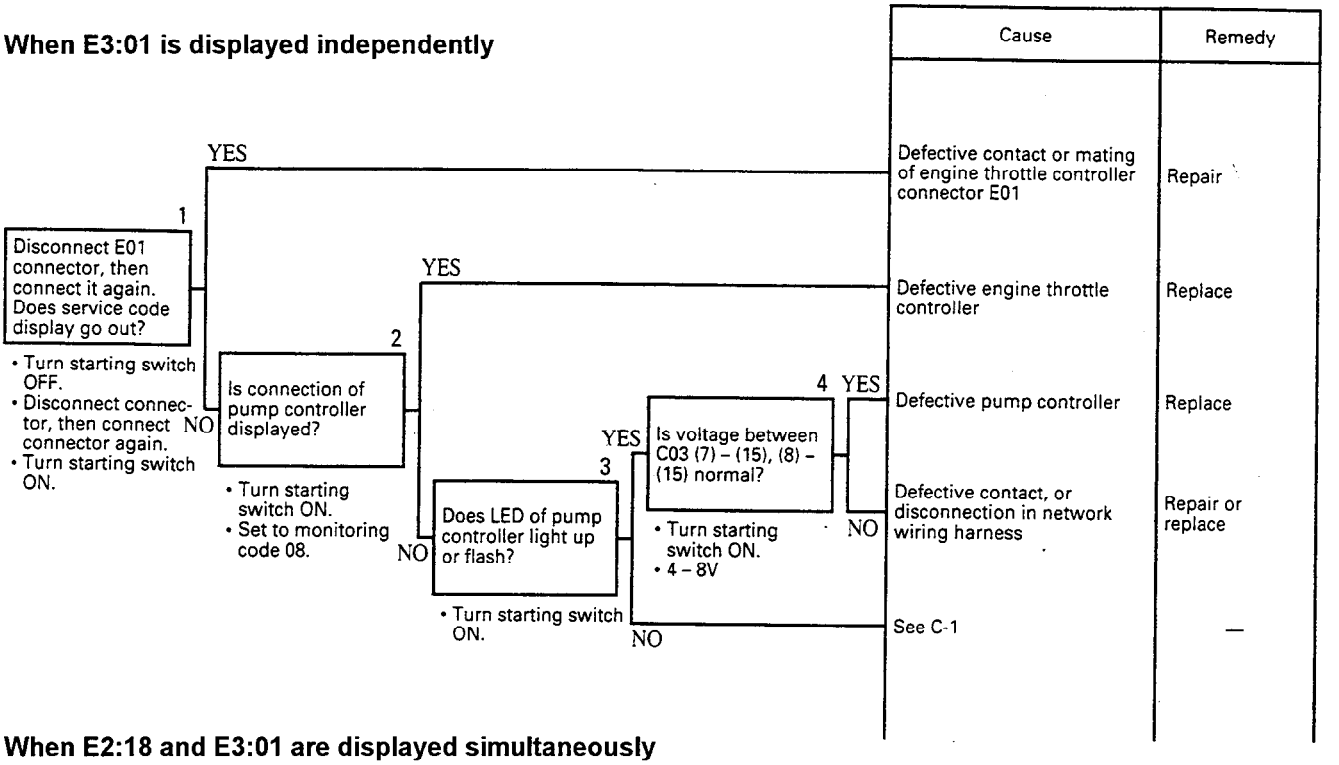


X08DD131

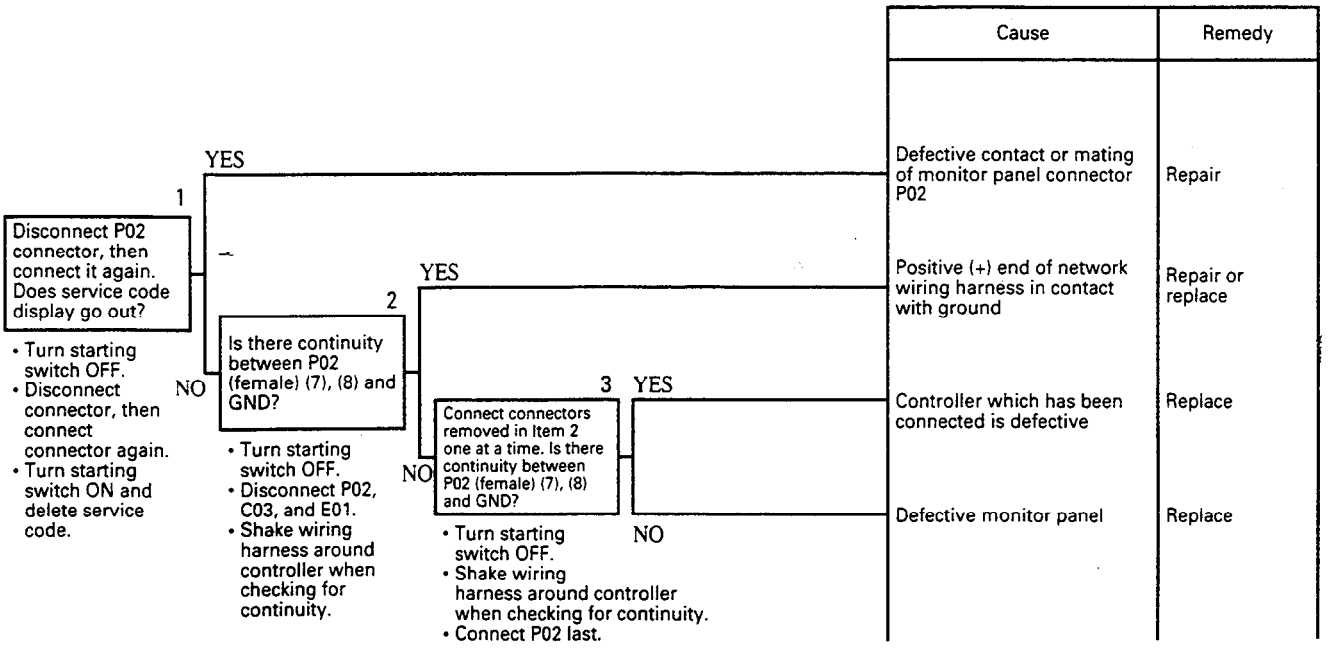
E-5 [E3:01] Abnormality in network reception system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ If the starting switch is turned ON when there is a disconnection in the wiring harness between the monitor panel and the controller, or the positive end (+) of the network wiring harness or the inside of the controller are short circuited, the controller cannot carry out networking, so the monitor panel does not display any abnormality.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

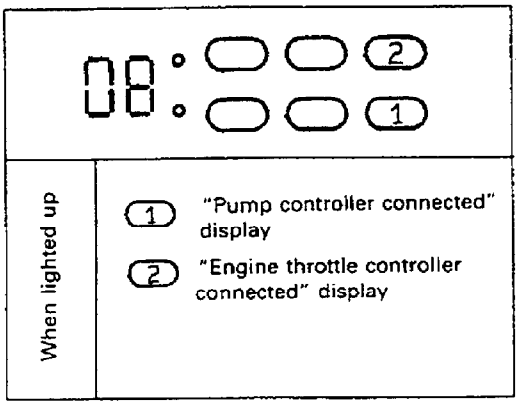
When E3:01 is displayed independently



When E2:18 and E3:01 are displayed simultaneously

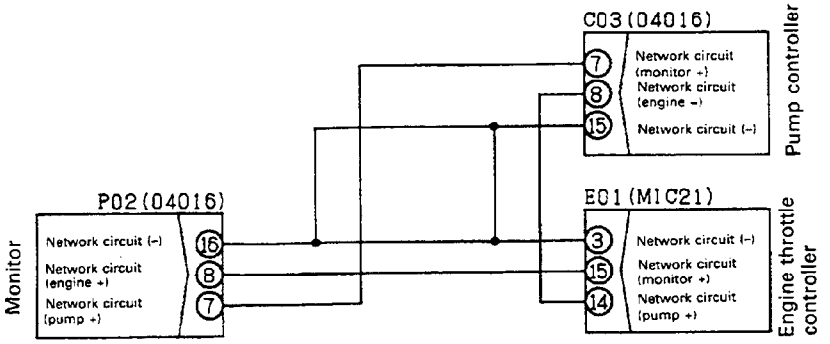


Monitoring display (Time display portion)



X08DD132

E-5 Related electric circuit diagram

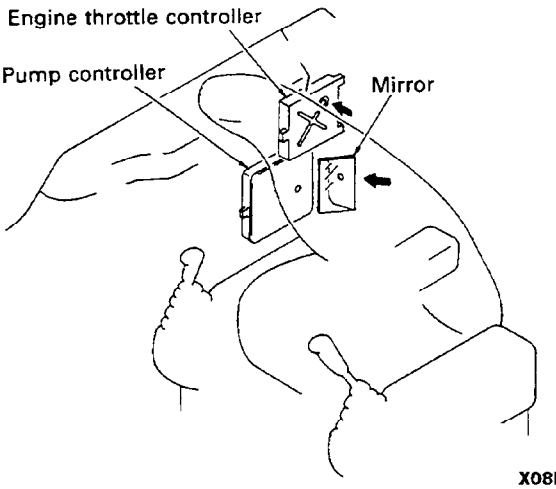


X08DD133

★ Check for the LED display for the engine throttle controller and pump controller from the direction of the arrow as shown in the diagram on the right.

Note 1: Push the operator's seat down to the front, then remove the two rear covers to check.

Note 2: The LED display for the pump controller is difficult to see, so use a mirror.



X08DD134

E-6 [E3:05] Abnormality in model code is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

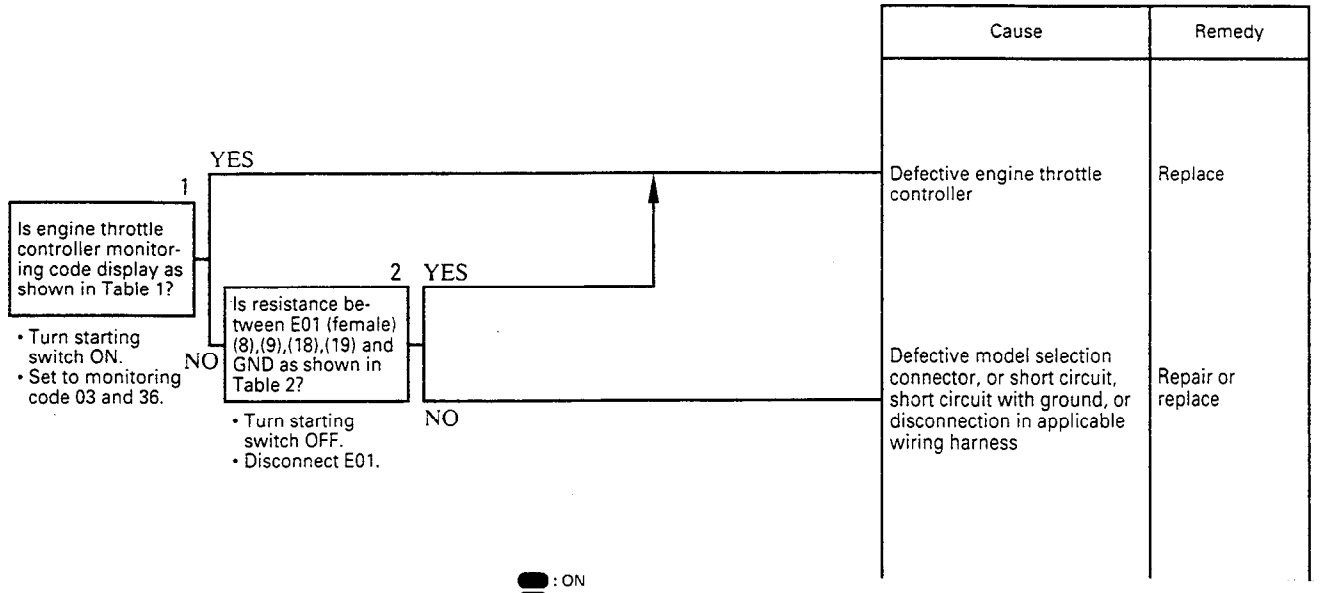


Table 1 Monitoring display (Time display portion)

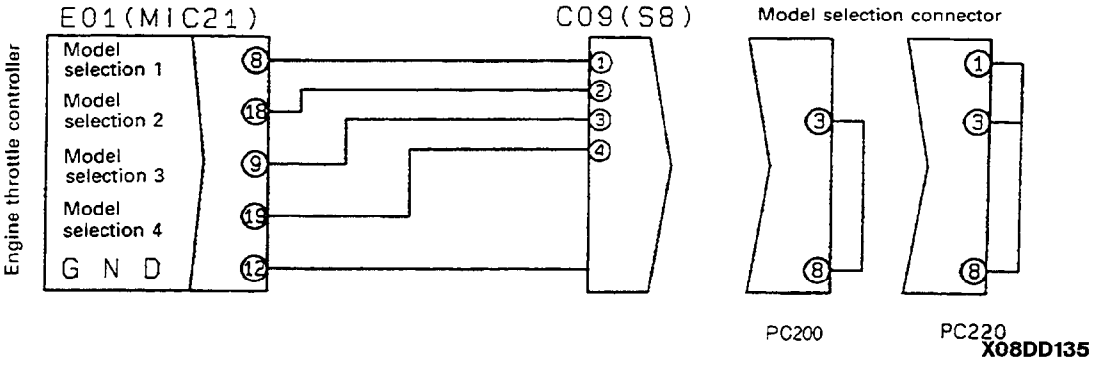
: ON : OFF

	Condition of engine throttle controller input	Engine throttle controller model code
PC200 PC210	36. ○ ● ○	03.200
PC220 PC250	36. ● ● ○	03.220

Table 2 Resistance value

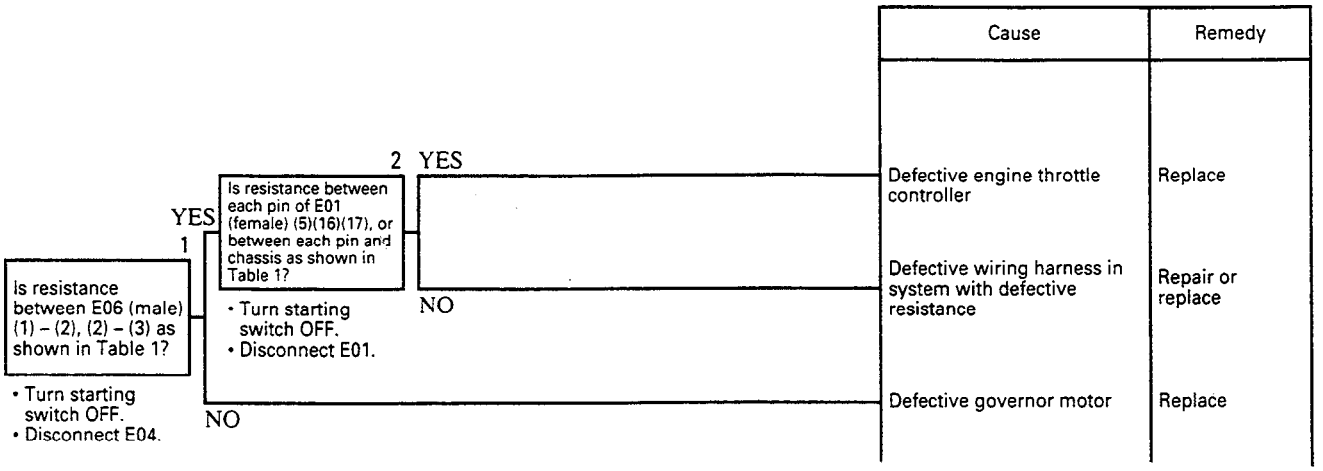
Applicable wiring harness	PC200 PC210	PC220 PC250
Between E01 (female) (8) and GND	Min. 1 MΩ	Max. 1 Ω
Between E01 (female) (18) and GND	Min. 1 MΩ	Min. 1 MΩ
Between E01 (female) (9) and GND	Max. 1 Ω	Max. 1 Ω
Between E01 (female) (19) and GND	Min. 1 MΩ	Min. 1 MΩ

E-6 Related electric circuit diagram



E-7 [E3:06] Abnormality in governor potentiometer system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

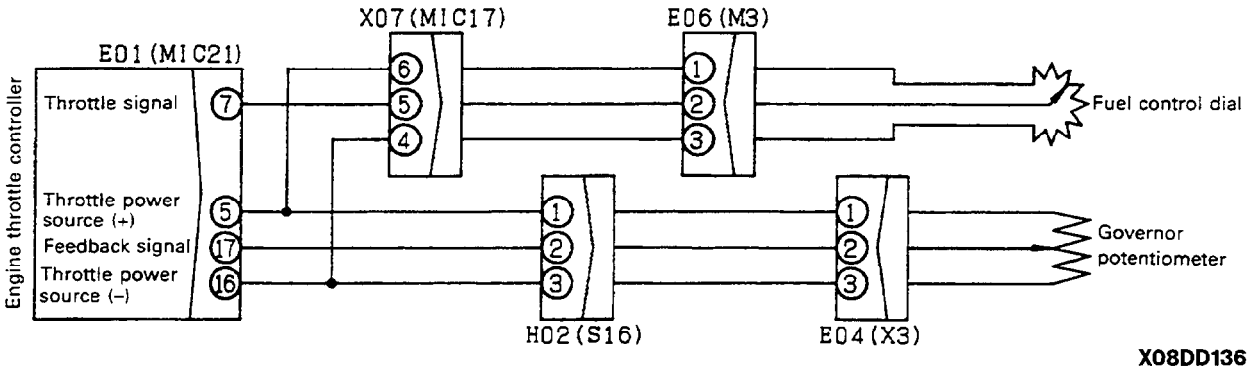


Note: If E3:08 also occurs at he same time, check the wiring harness below.
Wiring harness between E01 (female) (5) - X07 (6) - E06 (female) (1) short circuiting with ground, or contact with other wiring harness.

Table 1

E01 (female)	E04 (male)	Resistance value
(5) - (17)	(1) - (2)	0.25 - 7 kΩ
(17) - (16)	(2) - (3)	0.25 - 7 kΩ
(5) - (16)	–	2 - 3 kΩ
–	(1) - (3)	4 - 6 kΩ
Between each pin and chassis	–	Min. 1 MΩ

E-7 Related electric circuit diagram



E-8 [E3:07] Abnormality in pump controller throttle system is displayed

★ Start troubleshooting from E-6 [E3:05] or C8 [E2:17].

E-9 [E3:15] Abnormality (short circuit) in battery relay output system is displayed

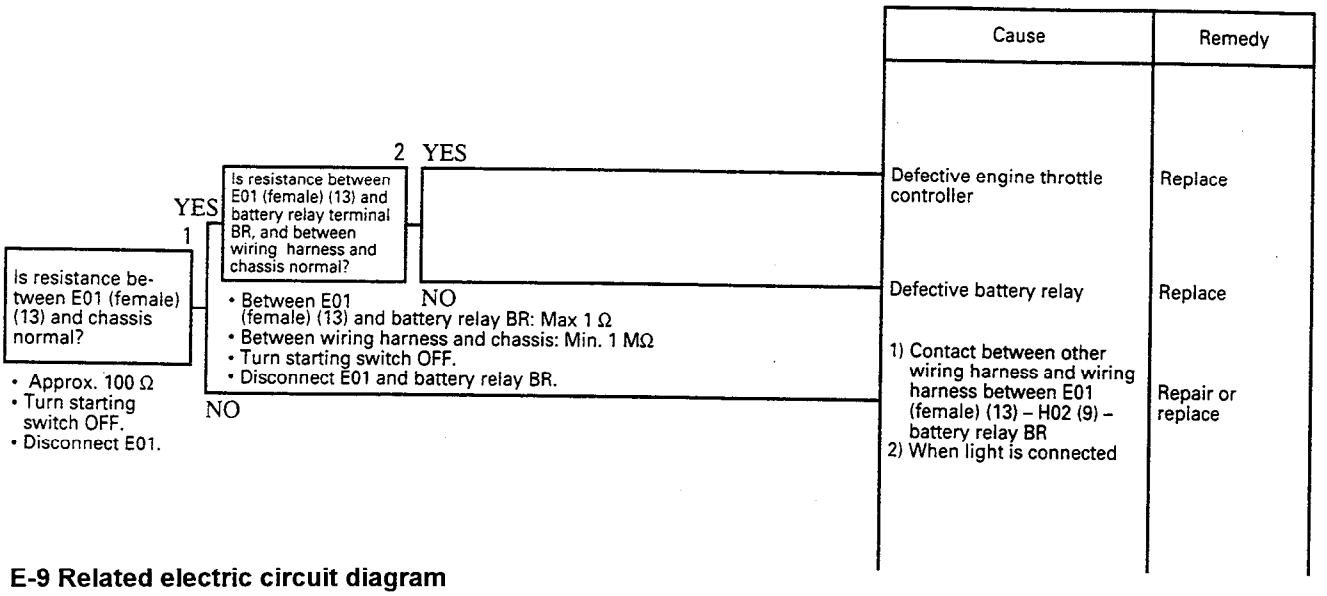
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

⚠ Stop the engine (push the governor lever of the fuel injection pump to the NO INJECTION position).

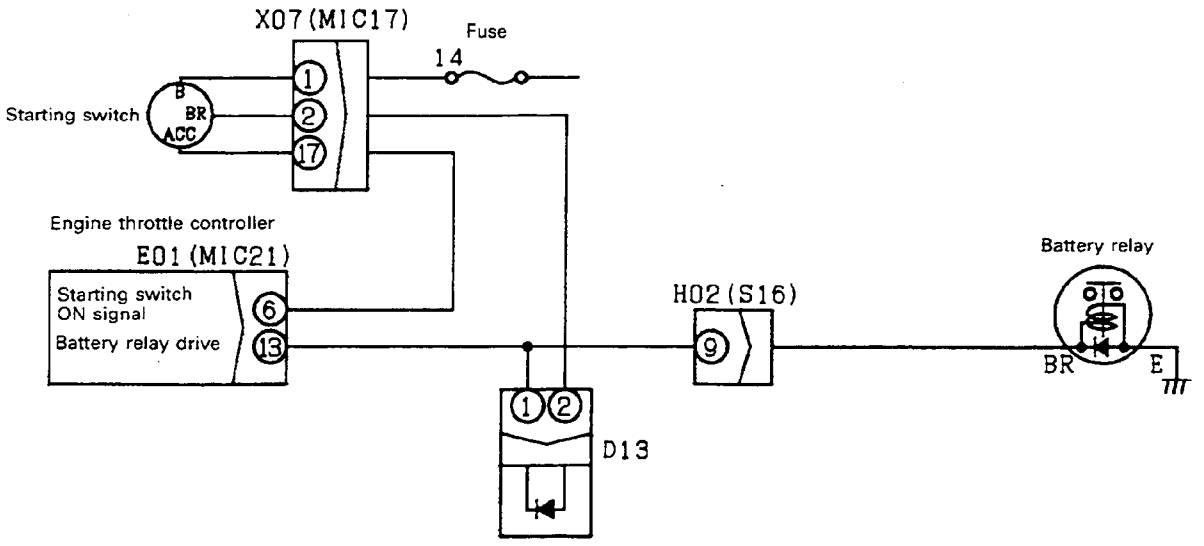
★ Before carrying out troubleshooting, check that all related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

Note: This only occurs when the engine is stopped and the starting switch is turned OFF.



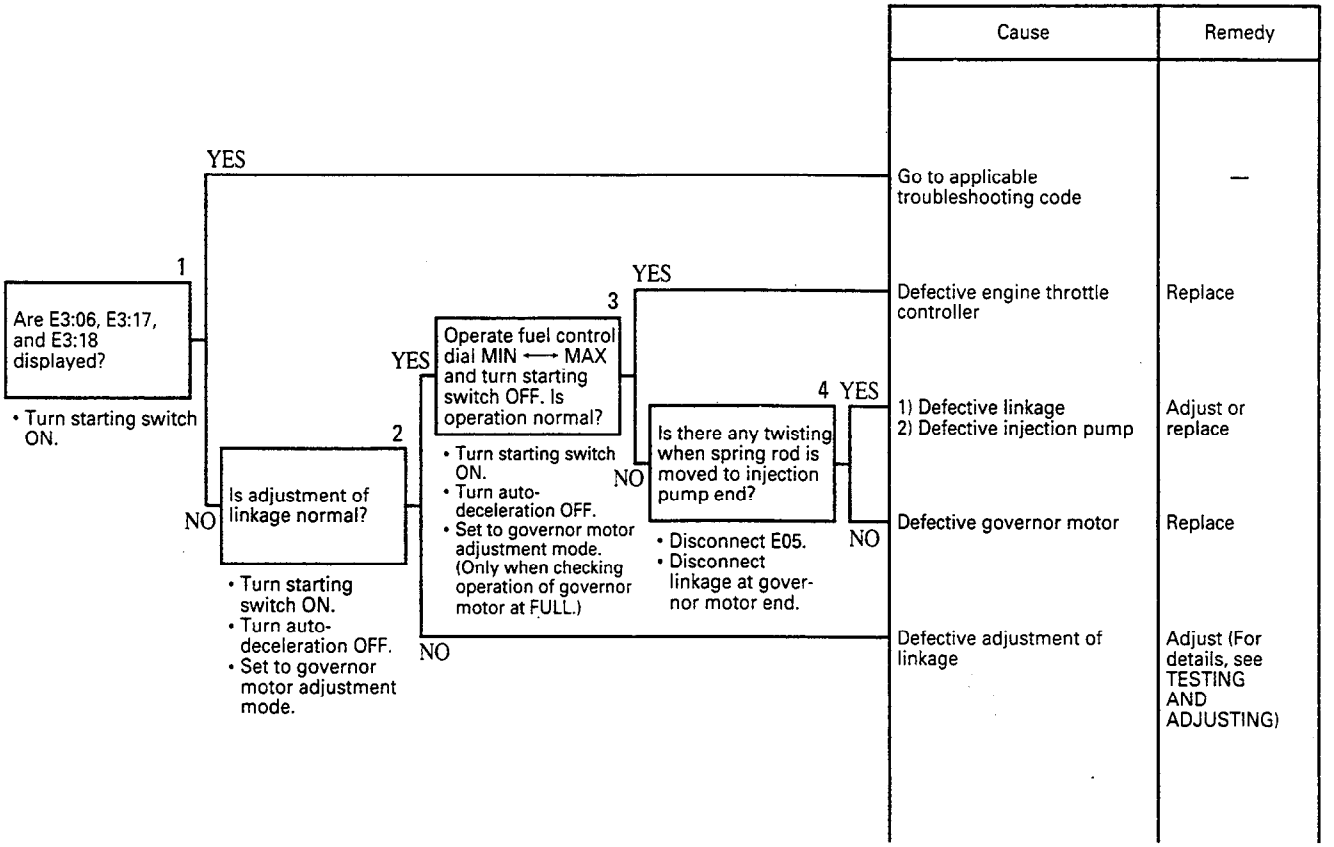
E-9 Related electric circuit diagram



X08DD137

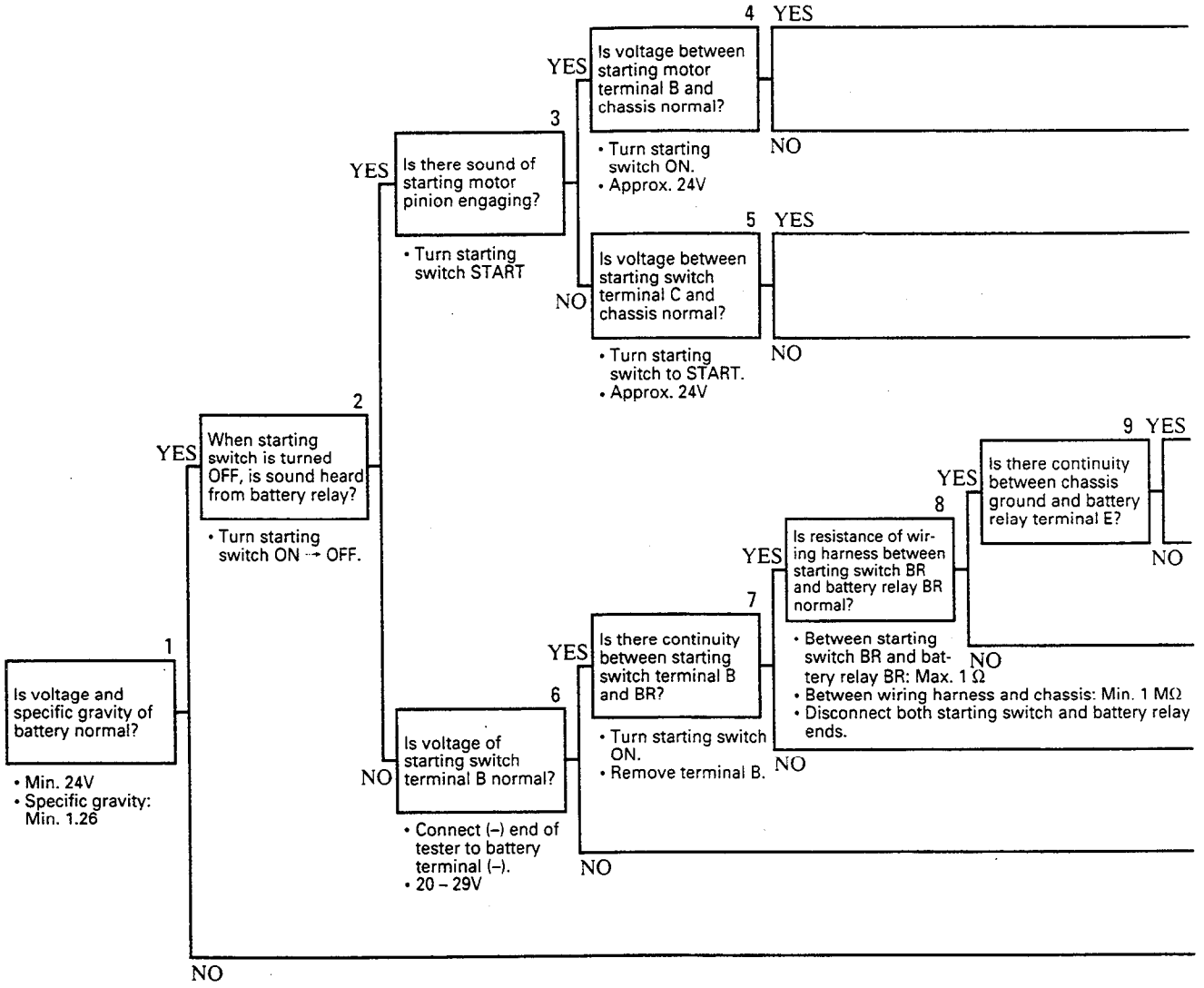
E-10 [E3:16] Abnormality (step-out) in governor motor system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ If any other service code [E3:01] - [E3:18] has occured at the same time, start troubleshooting from that code.
★ Check that fuse 2 is normal.
★ Read the precautions given in TESTING AND ADJUSTING, "Adjusting stroke of governor motor lever" before carrying out troubleshooting.
★ Before carrying out troubleshooting, check that all related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

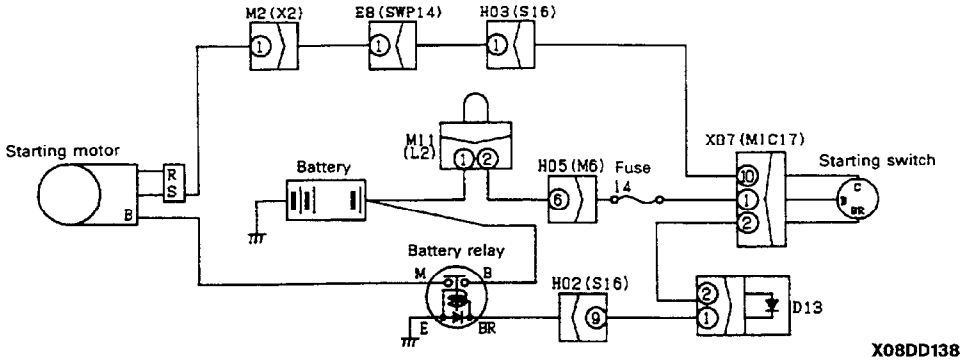


E-11 Engine does not start

★ When starting motor does not rotate.
★ Check that fuse 14 is not blown before starting troubleshooting.
★ Before carrying out troubleshooting, check that all related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.



E-11 Related electric circuit diagram



Cause	Remedy
Defective starting motor	Replace
Defective contact of wiring harness between battery (+) – battery relay B – battery relay M – starting motor terminal B (including battery relay)	Repair or replace
Defective contact, or disconnection in wiring harness between starting switch terminal C – X07 (10) – H03 (1) – E8 (1) – M2 (1) – starting motor terminal S	Repair or replace
Defective starting switch (between terminals B and C)	Replace
Defective battery relay	Replace
Defective contact of wiring harness between battery relay terminal E and revolving frame ground connection terminal	Repair or replace
Defective contact, or disconnection in wiring harness between starting switch terminal BR – D13 – H02 (9) – battery relay terminal BR	Repair or replace
Defective starting switch (between B and BR)	Replace
Defective contact, or disconnection in wiring harness between battery terminal (+) – M11 – H05 (6) – X07 (1) – starting switch terminal B (including fusible link)	Repair or replace
Lack of battery capacity	Charge or replace

E-12 Engine speed is irregular

★ Before carrying out troubleshooting, check that all related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

a) Idling speed is irregular

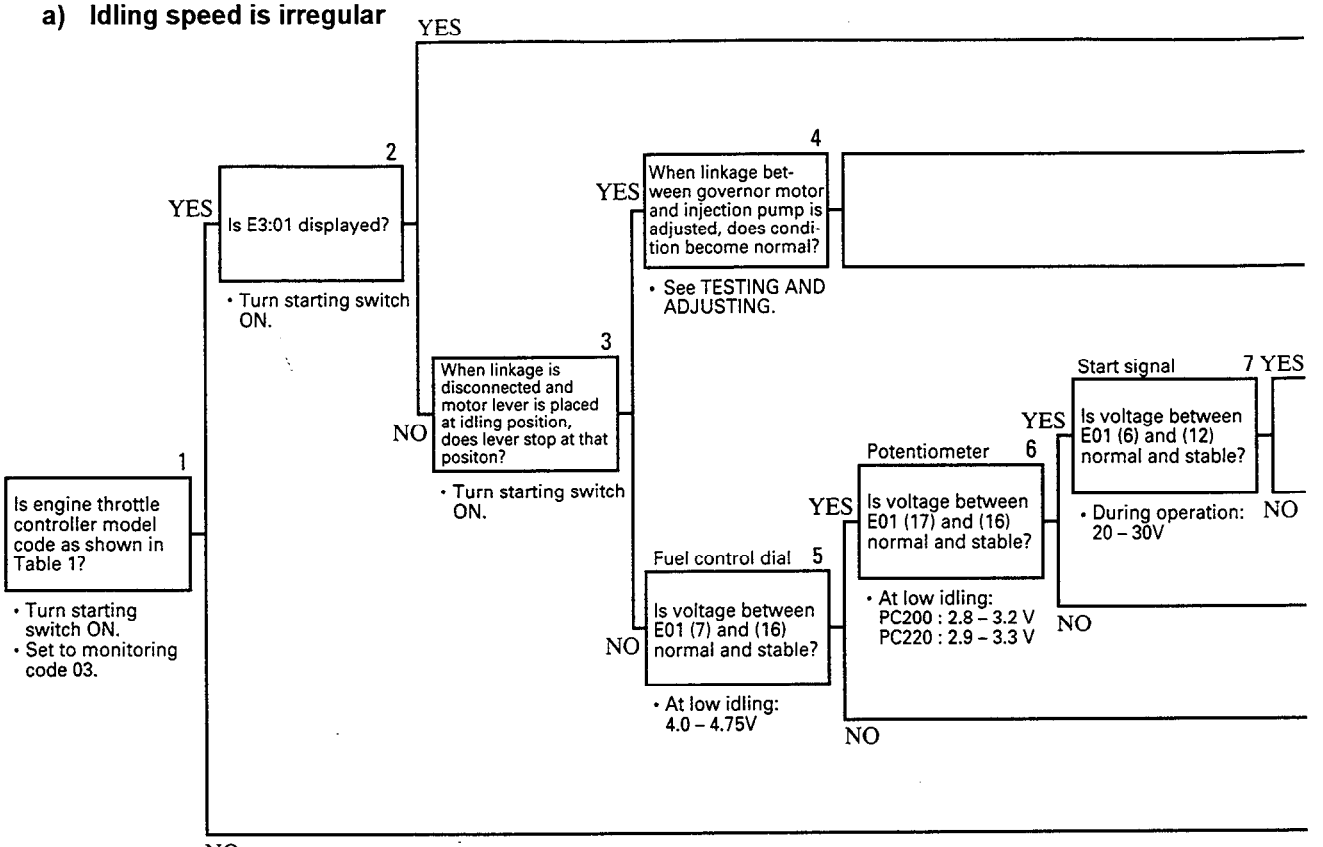
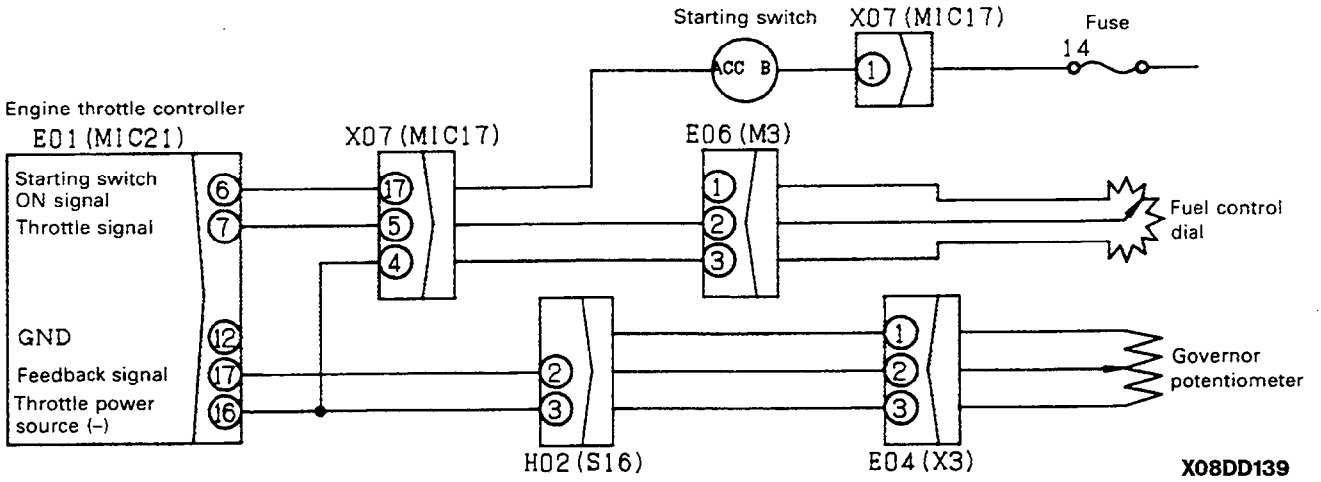


Table 1

	Engine throttle controller model code
PC200 PC210	03:200
PC220 PC250	03:220

Cause	Remedy
See E-5	—
Defective adjustment of linkage	Adjust
Defective injection pump	See S mode
Defective governor motor	Replace
Defective contact of wiring harness between starting switch ACC – X07 (17) – E01 (female) (6), or defective starting switch	Repair or replace
See E-7	—
See E-2	—
See E-6	—

E-12 Related electric circuit diagram



b) There is hunting

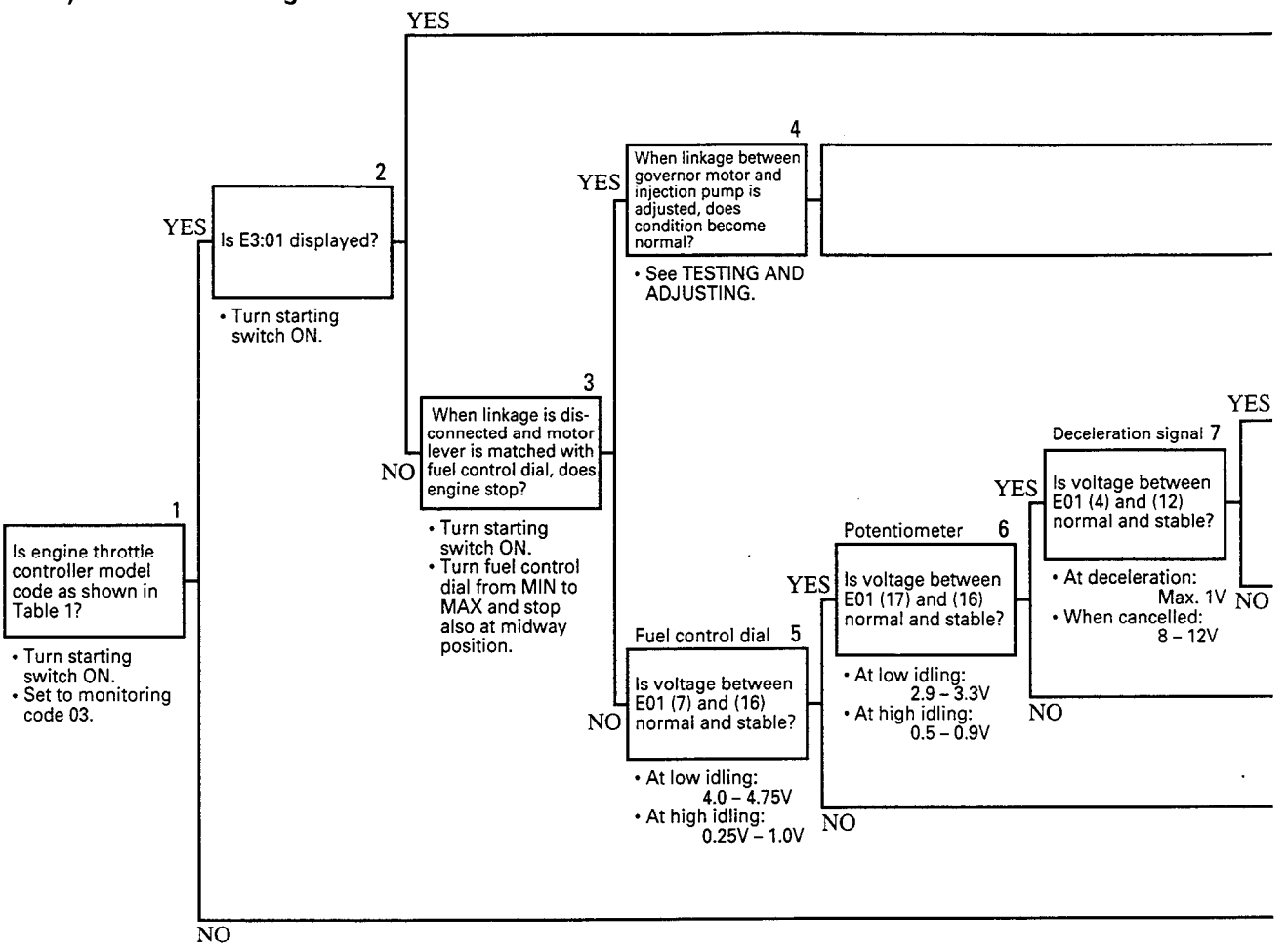
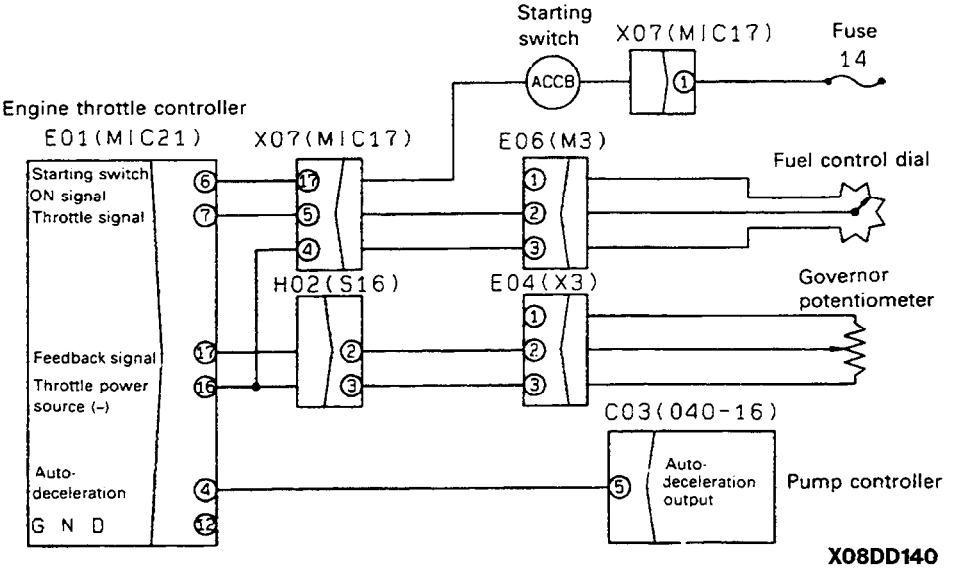


Table 1

	Engine throttle controller model code
PC200 PC210	03:200
PC220 PC250	03:220

	Cause	Remedy
	See E-5	—
	Defective adjustment of linkage	Adjust
	Defective injection pump	See S mode
Start signal 8 YES Is voltage between E01 (6) and (12) normal and stable? • During operation: 20 – 30V NO	Defective governor motor	Replace
	Defective contact of wiring harness between starting switch ACC – X07 (17) – E01 (female) (6), or defective starting switch	Repair or replace
	See C-15	—
	See E-7	—
	See E-2	—
	See E-6	—

E-12 Related electrical circuit diagram



E-13 Lack of output (engine high idling speed is too low)

★ Before carrying out troubleshooting, check that all related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

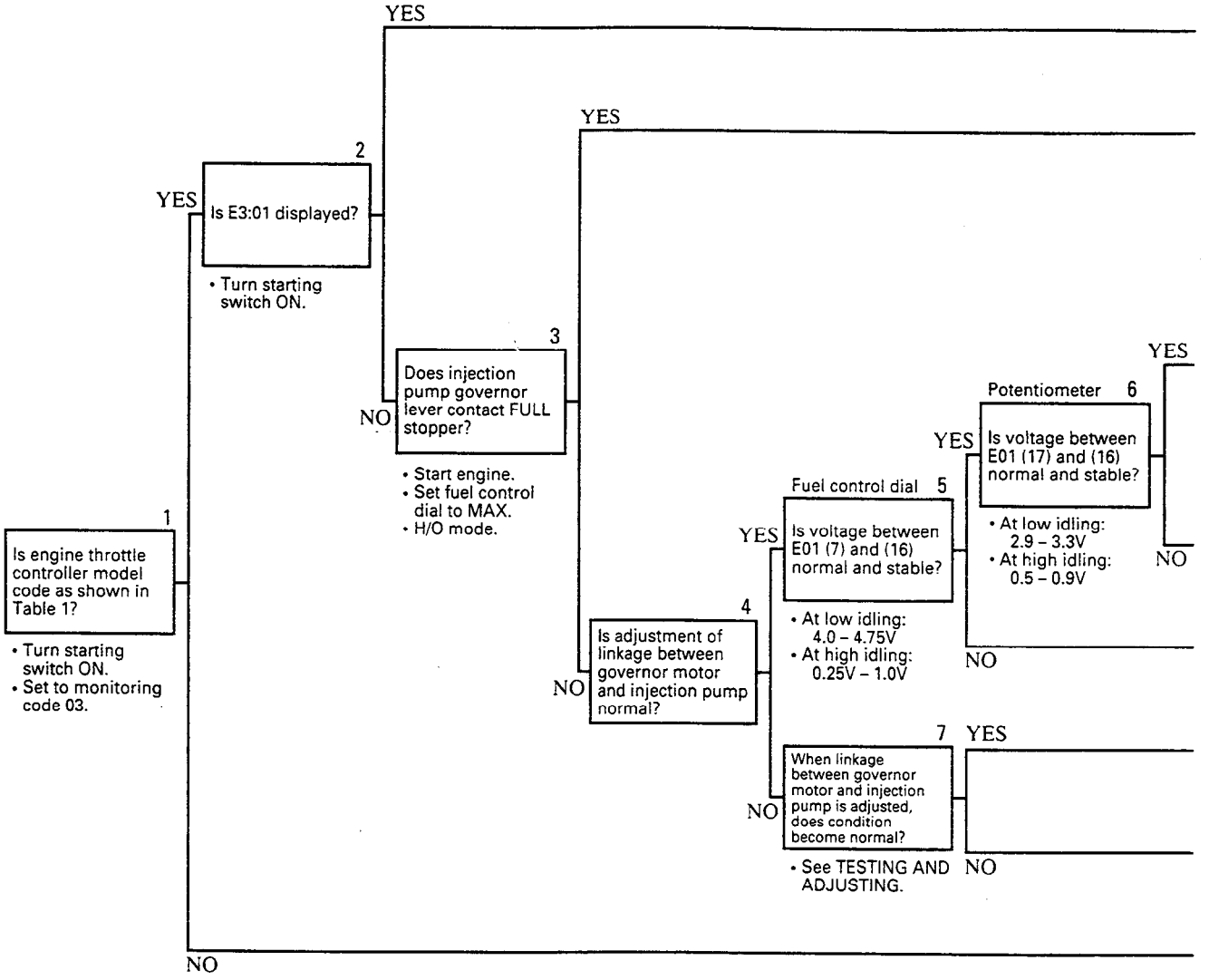
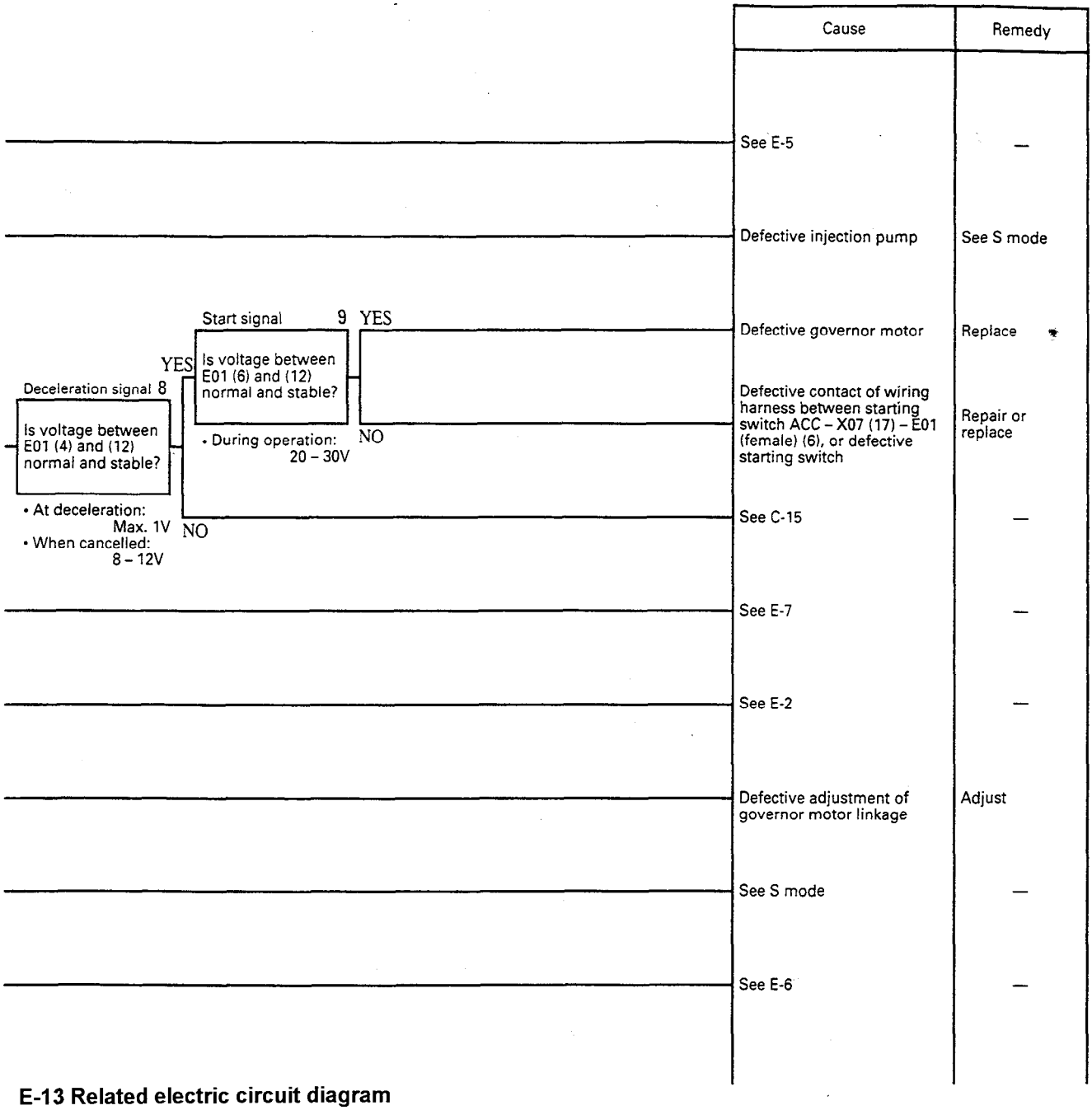


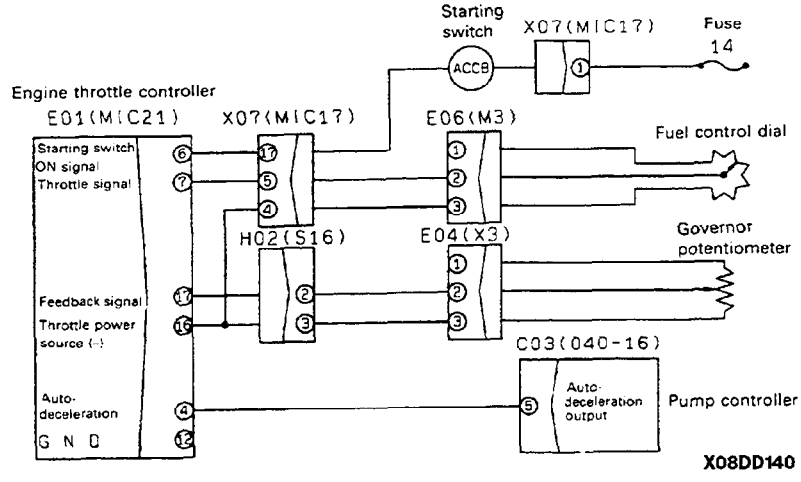
Table 1

	Engine throttle controller model code
PC200 PC210	03.200
PC220 PC250	03.220

https://truckmanualshub.com/



E-13 Related electric circuit diagram



E-14 Engine does not stop

⚠ Stop the engine (push the fuel control lever of the fuel injection pump to the NO INJECTION position) before checking.

★ Before carrying out troubleshooting, check that all related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

★ Read the precautions given in TESTING AND ADJUSTING, "Adjusting stroke of governor motor lever" before carrying out the troubleshooting.

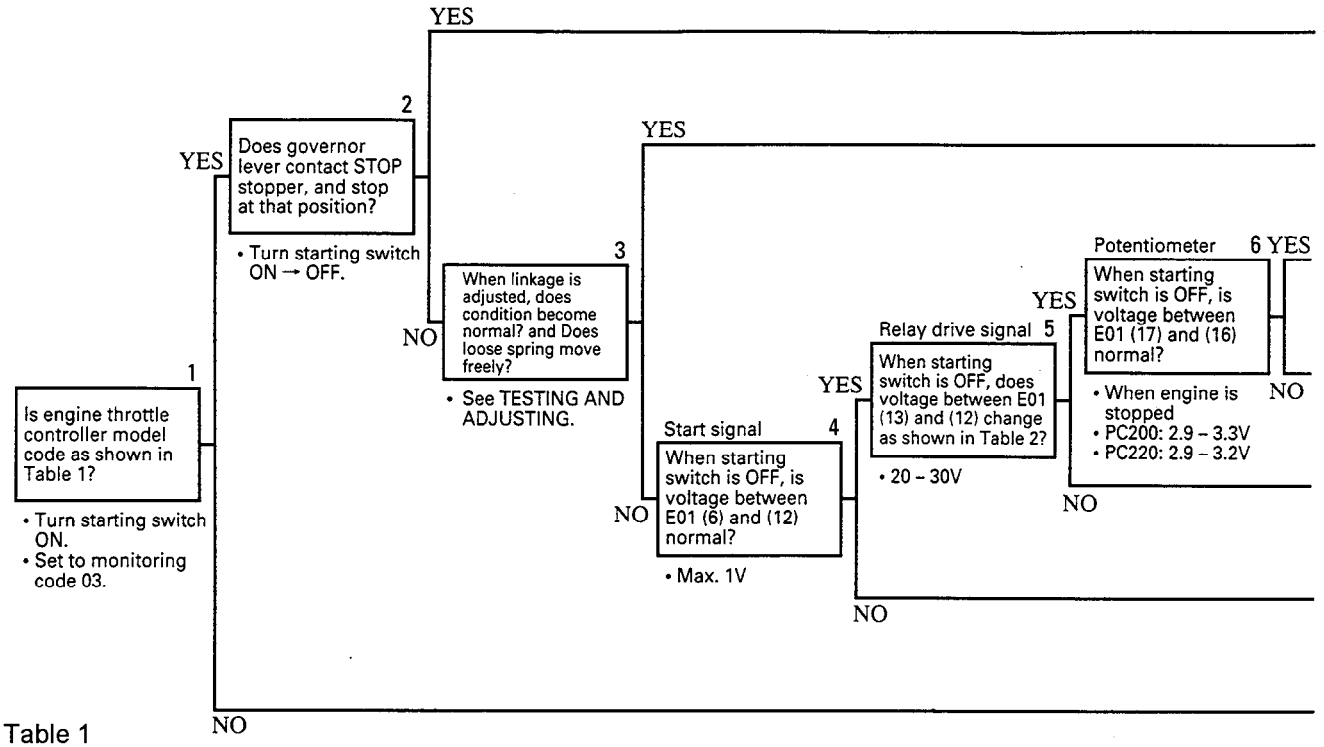
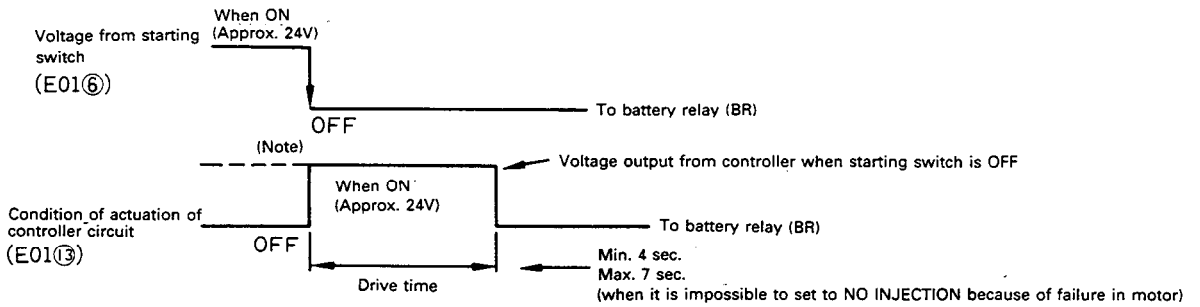


Table 1

	Engine throttle controller model code
PC200 PC210	03.200
PC220 PC250	03.220

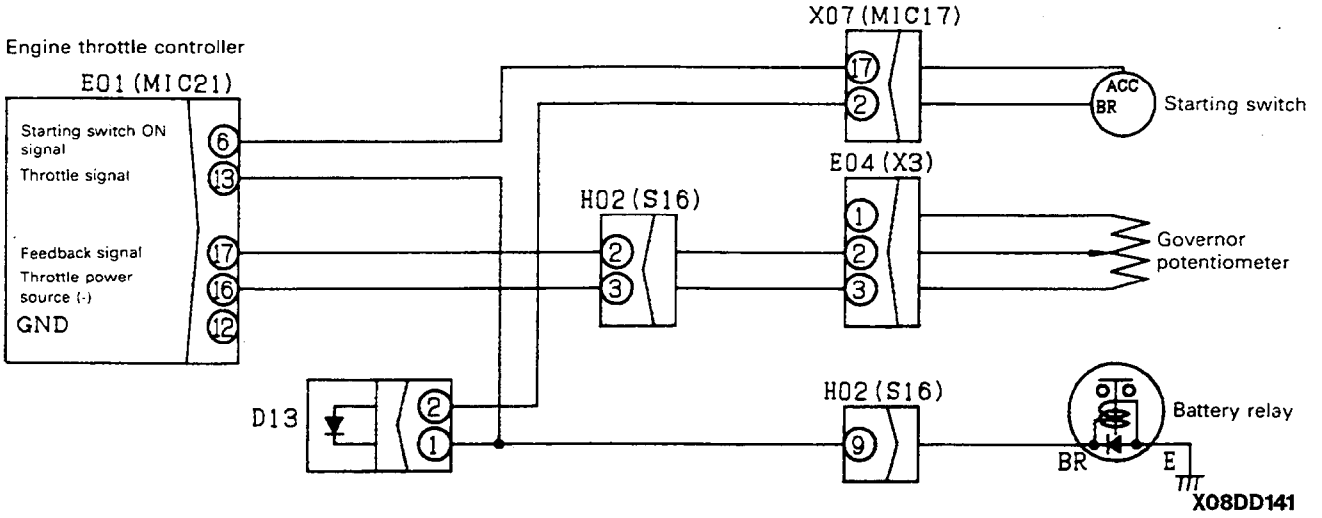
Table 2



Note: When the starting switch is ON, the controller end is OFF, but a voltage of approx. 20 - 30 V is always flowing from starting switch BR, so if the voltage is measured at E01 (13), there is a voltage of 20 - 30 V.

Cause	Remedy
Defective injection pump	See S mode
Defective adjustment of linkage	Adjust
Defective governor motor	Replace
See E-7	—
Defective engine throttle controller	Replace
Contact with 24V wiring harness of wiring harness between starting switch ACC – X07 (17) – E01 (female) (6), or defective starting switch	Repair or replace
See E-6	—

E-14 Related electric circuit diagram



E-15 Defective operation of battery relay system (engine does not stop)

Note: This only occurs when the engine is stopped and the starting swtich is turned OFF.

⚠ Stop the engine (push the governor lever of the fuel injection pump to the NO INJECTION position) before checking.

★ Before carrying out troubleshooting, check that all related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

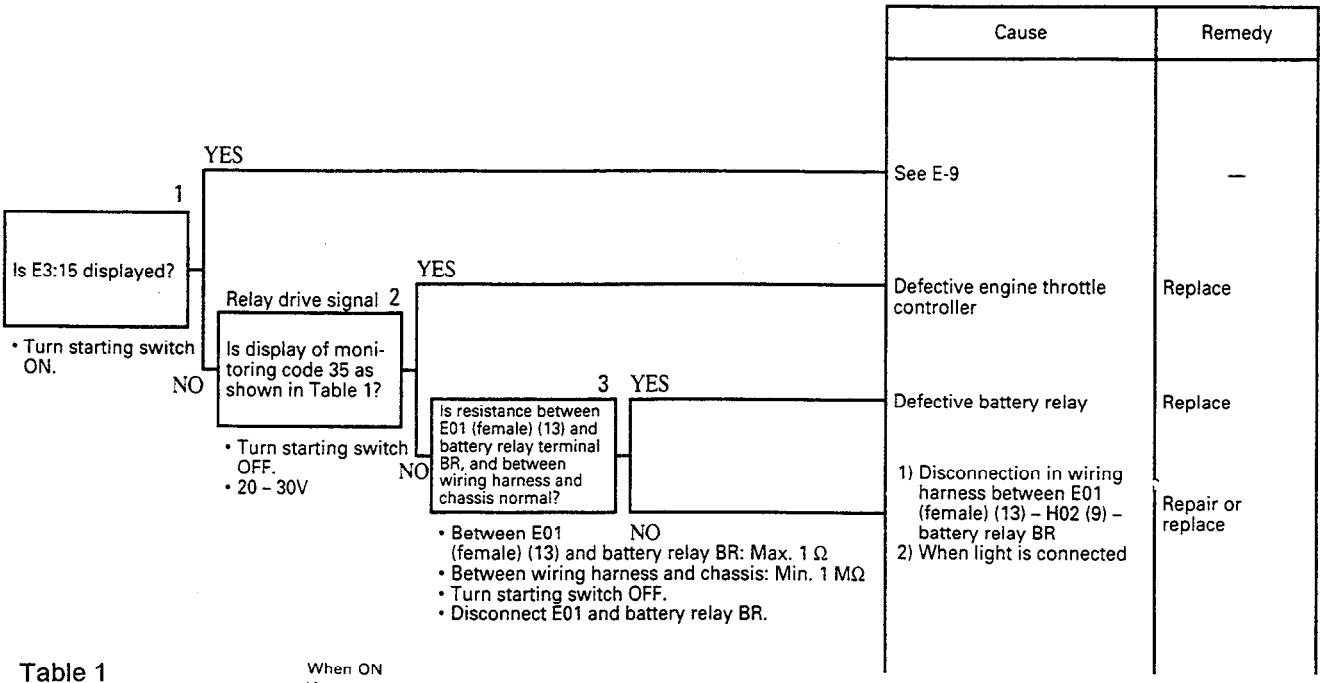
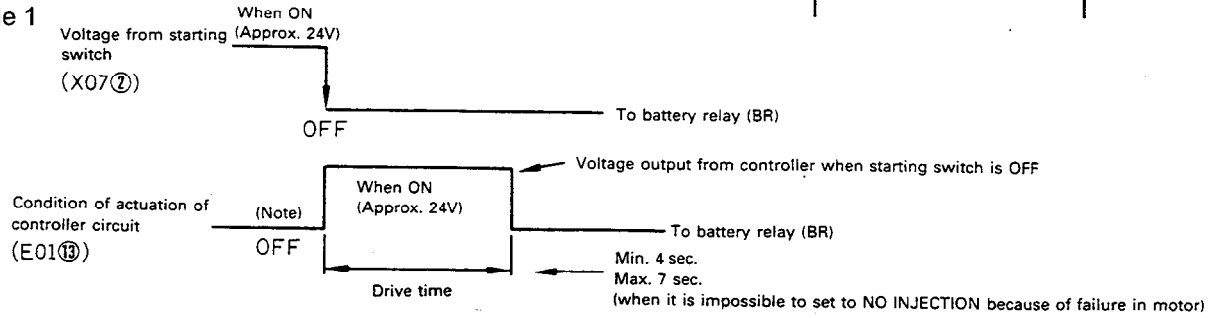
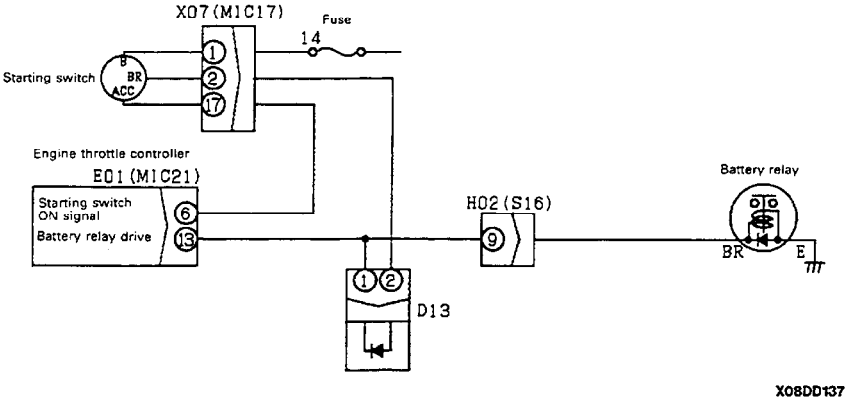


Table 1



Note: When the starting switch is ON, the controller end is OFF, but a voltage of approx. 20 - 30 V is always flowing from starting switch BR, so if the voltage is measured at E01 (13), there is a voltage of 20 - 30 V.

E-15 Related electric circuit diagram



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TROUBLESHOOTING OF ENGINE (S MODE)

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① Engine does not turn 20-145
② Engine turns but no exahaust gas comes out (Fuel is not being injected) 20-146
③ Exhaust gas comes out but engine does not start (Fuel is being injected) 20-147
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METHOD OF USING TROUBLESHOOTING CHART

This troubleshooting chart is divided into three sections: questions, check items, and troubleshooting. The questions and check items are used to pinpoint high probability causes that can be located from the failure symptoms or simple inspection without using troubleshooting tools.

Next, troubleshooting tools or direct inspection are used to check the high probability causes to make final confirmation.

[Questions]

Sections Ⓐ + Ⓑ in the chart on the right corresponds to the items where answers can be obtained from the user. The items in Ⓑ are items that can be obtained from the user, depending on the user's level.

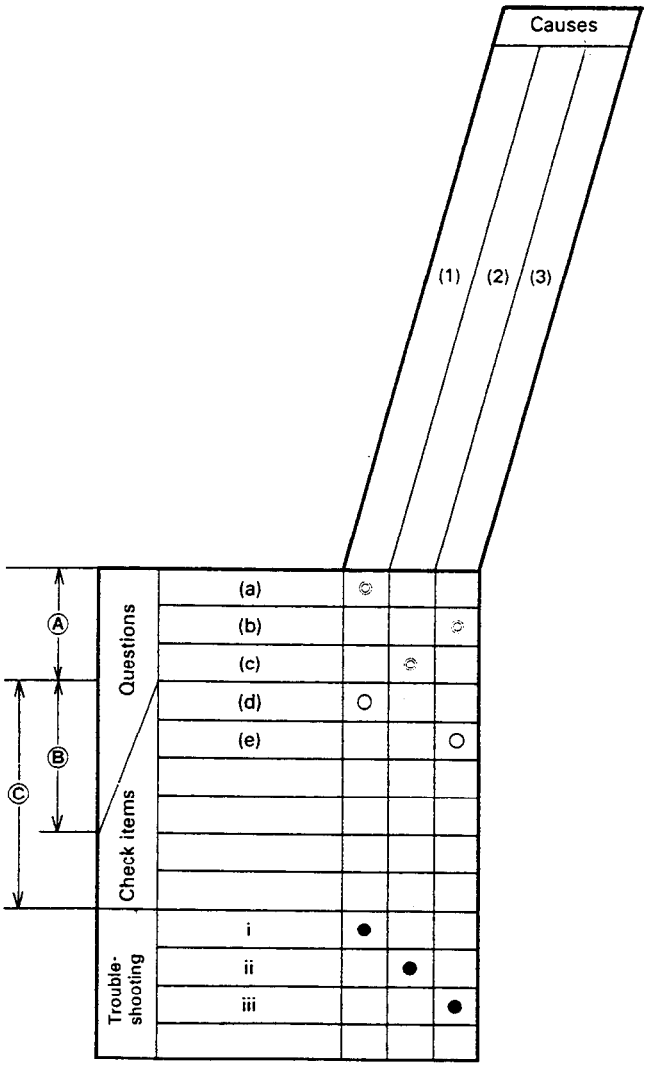
[Check items]

The serviceman carries out simple inspection to narrow down the causes. The items under Ⓒ in the chart on the right correspond to this.

The serviceman narrows down the causes from information Ⓐ that he has obtained from the user and the results of Ⓒ that he has obtained from his own inspection.

[Troubleshooting]

Troubleshooting is carried out in the order of probability, starting with the causes that have been marked as having the highest probability from information gained from [Questions] and [Check items].



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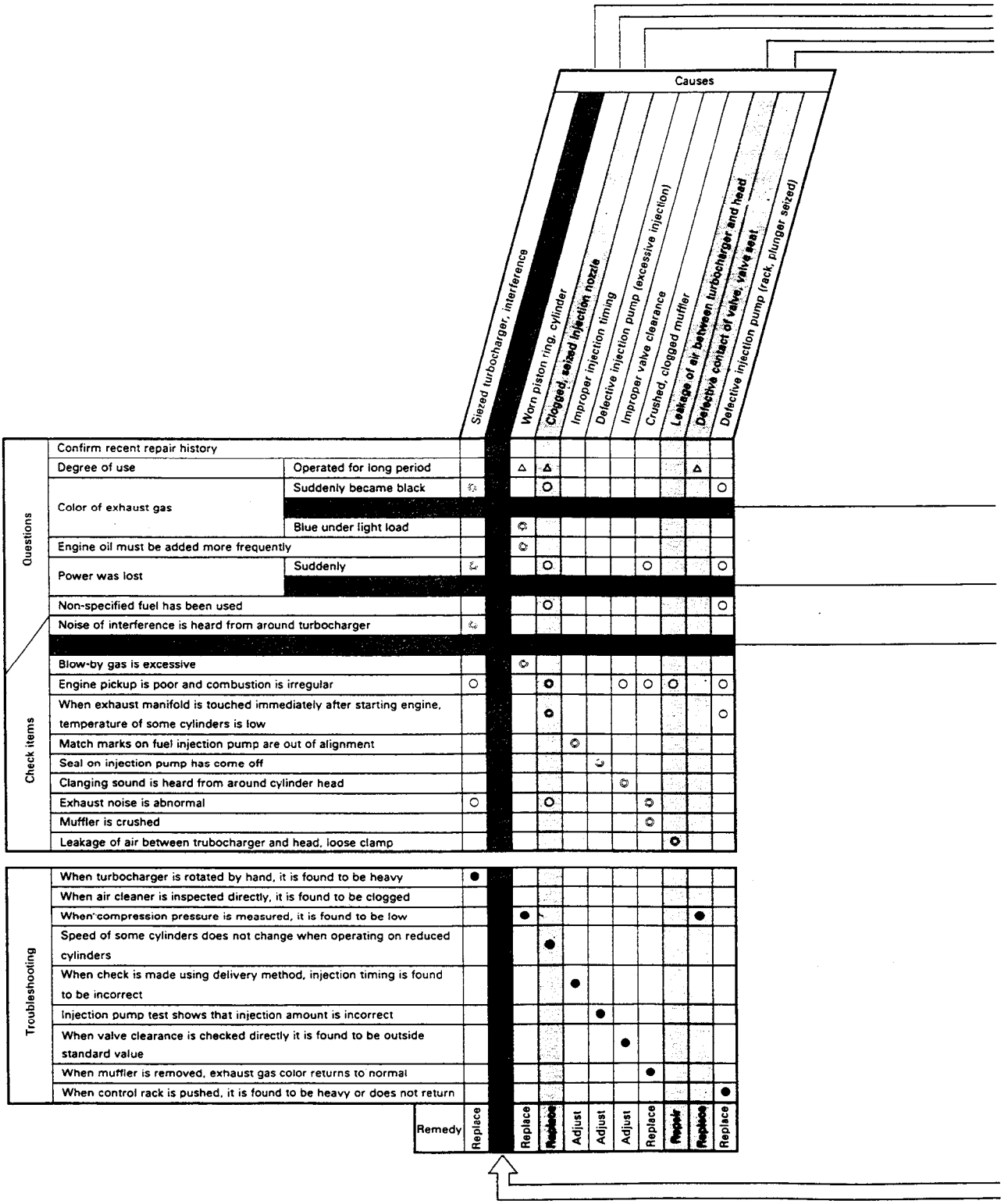
The basic method of using the troubleshooting chart is as follows.
Items listed for [Questions] and [Check items] that have a relationship with the Cause items marked with ◯, and of these, causes that have a high probability are marked with ◎.
Check each of the [Questions] and [Check items] in turn, and marked the ◯ or ◎ in the chart for items where the problem appeared. The vertical column (Causes) that has the highest number of points is the most probable cause, so start troubleshooting for that item to make final confirmation of the cause.

※1. For (Confirm recent repair history) in the [Questions] Section, ask the user, and mark the Cause column with △ to use as reference for locating the cause of the failure. However, do not use this when making calculations to narrow down the causes.
※2. Use the △ in the Cause column as reference for (Degree of use (Operated for long period)) in the [Questions] section as reference. As a rule, do not use it when calculating the points for locating the cause, but it can be included if necessary to determine the order for troubleshooting.

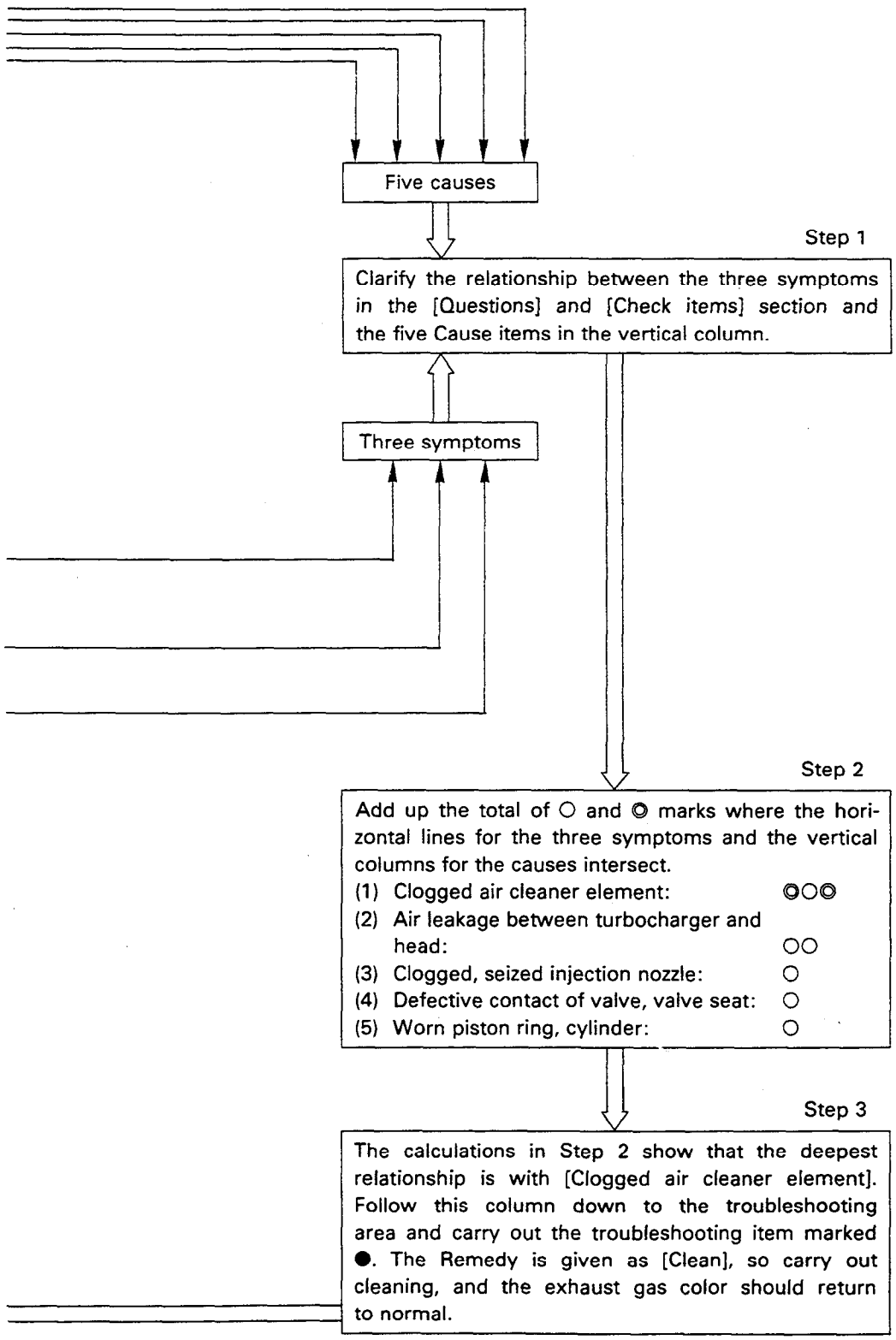
			Causes						
			Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)	
※1	Confirm recent repair history								
※2	Degree of use	Operated for long period		△	△	△			

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- **Example of troubleshooting when exhaust gas is black**
  Let us assume that [Clogged air cleaner] is taken to be the cause of black exhaust gas. Three symptoms have causal relationship with this problem: [Exhaust gas slowly became black], [Power slowly became weaker], and [Dust indicator is red].
  If we look from these three symptoms to find the cause, we find that there is a relationship with five causes.
  Let us explain here the methos of using this causal relationship to pinpoint the most probable cause.



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S-1 Starting performance is poor (Starting always takes time)

★ Check that there is no abnormality display for the engine throttle controller on the monitor panel.

General causes why starting performance is poor

- Defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel
  (At ambient temperature of - 10°C or below, use ASTM D975 No. 1, and - 10°C or above, use ASTM D975 No. 2 diesel fuel.)

★ Charging rate of battery.

Ambient temperature \ Charging rate	100%	90%	80%	75%	70%
20°C	1.28	1.26	1.24	1.23	1.22
0°C	1.29	1.27	1.25	1.24	1.23
−10°C	1.30	1.28	1.26	1.25	1.24

- The specific gravity should be for the charging rate of 70% or more in the above table.
- In cold weather the specific gravity must be for the charging rate of at least 75% in the above table.

			Causes: Worn piston ring, cylinder	Defective contact of valve, valve seat	Clogged air cleaner element	Clogged fuel filter, strainer	Clogged feed pump pre-filter	Intake heater (ribbon heater type)	Defective regulator	Defective alternator	Defective or deteriorated battery	Defective injection nozzle	Defective injection timing	Defective injection pump (rack, plunger stuck)	Leakage, clogging, air in fuel system	Clogged fuel tank air breather hole
Check items	Confirm recent repair history															
	Degree of use	Operated for long period			△	△	△				△					
	Ease of starting	Gradually became worse	◎	◎	○	○	○									
		Starts when warm					◎									
	Indicator lamp does not light up						◎									
	Engine oil must be added more frequently		◎													
	Replacement of filters has not been carried out according to operation manual				◎	◎	◎					○		○		
	Air cleaner cloging lamp lights up				◎											
	Non-specified fuel has been used					○	○					○		○		
	Battery charge lamp is ON							◎	◎							
	Starting motor cranks engine slowly									◎						
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low										◎					
	Engine does not pick up smoothly, and combustion is irregular		○	○							◎					
	Blow-by gas is excessive		◎													
	Match marks on fuel injection pump are out of alignment											◎				
	Mud is stuck to fuel tank cap															○
	When engine is cranked with starting motor, 1) Little fuel comes out even when injection pump sleeve nut is loosened												◎			
	2) Little fuel comes out even when fuel filter air bleed plug is loosened					◎	◎						◎			
	Leakage from fuel piping												○	◎		
	There is hunting from engine (rotation is irregular)					○	○							◎		○
Troubleshooting	When compression pressure is measured, it is found to be low		●	●												
	When air element is inspected directly, it is found to be clogged				●											
	When fuel filter, strainer are inspected directly, they are found to be clogged					●								●		
	When feed pump pre-filter is inspected directly, it is found to be clogged						●									
	Heater mount does not become warm															
	Voltage is 26 — 30V between alternator terminal B and terminal E with engine at low idling	Yes						●								
		No							●							
	Either specific gravity of electrolyte or voltage of battery is low									●						
	Speed of some cylinders does not change when operating on reduced cylinders										●					
	When check is made using delivery method, injection timing is found to be incorrect											●				
	When control rack is pushed, it is found to be heavy or does not return (when blind plug at rear of pump is removed, it can be seen that plunger control sleeve does not move)												●			
	When fuel cap is inspected directly, it is found to be clogged															●
	Remedy		Replace	Repair	Clean	Clean	Clean	Replace	Replace	Replace	Replace	Replace	Adjust	Replace	Repair	Clean

S-2 Engine does not start

① Engine does not turn

General causes why engine does not turn

- Internal parts of engine seized
  - ★ If internal parts of the engine are seized, carry out troubleshooting for "Engine stops during operations".
- Failure in power train
- Defective electrical system

			Causes: Defective wiring of starting circuit	Defective or deteriorated battery	Defective starting motor	Broken ring gear	Defective safety relay or safety switch	Defective battery relay	Defective battery terminal connection	Defective starting switch
Questions / Check items	Confirm recent repair history									
	Degree of use	Operated for long period		△		△				
	Condition of horn when starting switch is turned ON	Horn does not sound	◎						○	○
		Horn sound level is low		◎						
	When starting switch is turned to START, pinion moves out, but	Rotating speed is slow		◎						
		Makes grating noise			◎	◎				
		Soon disengages again					◎			
		Makes rattling noise and does not turn		○	○		○			
	When starting switch is turned to START, pinion does not move out		◎	○						○
	When starting switch is turned to ON, there is no clicking sound			○				◎		
	Battery terminal is loose								◎	
	When battery is checked, battery electrolyte is found to be low			○						
Troubleshooting	Specific gravity of electrolyte, voltage of battery is low			●						
	For the following conditions 1) – 5), turn the starting switch OFF, connect the cord, and carry out troubleshooting at ON		Carry out troubleshooting for defective wiring of starting circuit							●
	1) When terminal B and terminal C of starting switch are connected, engine starts									
	2) When ternimal B and terminal C of starting motor are connected, engine starts				●					
	3) When terminal B and terminal C of safety relay are connected, engine starts						●			
	4) When terminal of safety switch and terminal B of starting motor are connected, engine starts						●			
	5) There is no 24V voltage between terminal b and terminal E of battery relay							●		
	When ring gear is inspected directly, tooth surface is found to be chipped					●				
		Remedy	—	Replace	Replace	Replace	Replace	Replace	Replace	Replace

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② Engine turns but no exhaust gas comes out (Fuel is not being injected)

★ Check that there is no abnormality display for the engine throttle controller system on the monitor panel.

General causes why engine turns but no exhaust gas comes out

- Supply of fuel impossible
- Supply of fuel extremely small
- Improper selection of fuel (partucularly in winter)

Standards for use of fuel

Type of fuel	Ambient temperature −20	−10	0	10	20	30°C
Diesel fuel	No. 1		ASTM D975 No. 2			

		Causes							
		Broken injection pump drive shaft, key	Defective injection pump (rack, plunger seized)	Seized, broken feed pump lever/diaphragm	Clogged fuel filter, pre-filter	Clogged feed pump pre-filter	Clogged, leaking fuel piping	Clogged fuel tank air breather hole	Improper fuel used
Questions	Confirm recent history								
	Degree of use: Operated for long period				△	△		△	
	Exhaust gas suddenly (when starting again) stops coming out	◎	◎	◎					
	Replacement of filters has not been carried out according to operation manual				◎	◎			
	There is leakage from fuel piping						◎		
	Mud is stuck to fuel tank cap							◎	
Check items	When starting switch is turned ON, linkage does not move								
	When fuel filter is drained, fuel does not come out								◎
	When engine is cranked with starting motor, 1) injection pump coupling does not rotate	◎							
	2) No fuel comes out even when fuel filter air bleed plug is loosened	◎			○	○			○
	3) No fuel spurts out even when injection pipe sleeve nut is loosened	◎	◎	●					
	Rust and water are found when fuel is drained				○	○			
Troubleshooting	Check injection pump directly	●							
	When control rack is pushed, it is found to be heavy or does not return		●						
	Check feed pump directly			●					
	When fuel filter, strainer are inspected directly, they are found to be clogged				●				●
	When feed pump strainer is inspected directly, it is found to be clogged					●			
	When fuel cap is inspected directly, it is found to be clogged						●		
	Remedy	Replace	Replace	Replace	Clean	Clean	Repair	Repair	Replace

③ Exhaust gas comes out but engine does not start (Fuel is being injected)

General causes why exhaust gas comes out but engine does not start

- Lack of rotating force due to defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel

		Causes												
		Defective, broken valve system (valve, rocker lever, etc.)	Defective injection pump (rack, plunger stuck)	Piston ring, cylinder	Clogged fuel filter, pre-filter	Clogged feed pump pre-filter	Clogged air cleaner element	Intake heater (ribbon heater type)	Defective or deteriorated battery	Leakage, clogging, air in fuel system	Clogged injection nozzle, defective spray	Clogged fuel tank air breather hole	Improper fuel used	
Questions	Confirm recent repair history													
	Degree of use — Operated for long period			△	△	△				△				
	Suddenly failed to start	◎	◎											
	When engine is cranked, abnormal noise is heard from around head	◎												
	Engine oil must be added more frequently			◎							○			
	Non-specified fuel has been used		○							○				
	Replacement of filters has not been carried out according to operation manual				◎	◎	◎							
	Rust is found when fuel is drained				◎	◎								
	Air cleaner clogging lamp lights up						◎							
	Indicator lamp does not light up							◎						
Check items	Starting motor cranks engine slowly								◎					
	Mud is stuck to fuel tank cap											○		
	When fuel lever is placed at FULL position, it does not contact stopper		○											
	When engine is cranked with starting motor, 1) Little fuel comes out even when injection pump sleeve nut is loosened		◎											
	2) Little fuel comes out even when fuel filter air bleed plug is loosened				◎	◎								○
	There is leakage from fuel piping									◎				
	When exhaust monifold is touched immediately after starting engine, temperature of some cylinder is low										◎			
	When fuel filter is drained, no fuel comes out													◎
Troubleshooting	Remove head cover and check directly	●												
	When control rack is pushed, it is found to be heavy or does not return		●											
	When compression pressure is measured, it is found to be low			●										
	When fuel filter, pre-filter are inspected directly, they are found to be clogged				●									●
	When feed pump pre-filter is inspected directly, it is found to be clogged					●								
	When air element is inspected directly, it is found to be clogged						●							
	Heater mount does not become warm													
	Either specific gravity of electrolyte or voltage of battery is low								●					
	When feed pump is operated, there is no response or pump is heavy									●				
	Speed of some cylinders does not change when operating on reduced cylinders										●			
	When fuel cap is inspected directly, it is found to be clogged											●		
	Remedy	Replace	Replace	Replace	Clean	Clean	Clean	Replace	Replace	Repair	Clean	Clean	—	

S-3 Engine does not pick up smoothly (Follow-up is poor)

★ Check that there is no abnormality displayed for the engine throttle controller system on the monitor panel.

General causes why engine does not pick up smoothly

- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Use of improper fuel

			Causes: Clogged air cleaner element	Clogged fuel filter, pre-filter	Clogged feed pump pre-filter	Clogged injection nozzle, defective spray	Seized injection pump plunger	Worn pision ring, cylinder	Seized turbocharger, interference	Improper valve clearance	Clogged fuel tank air breather hole	Clogged, leaking fuel piping	Defective contact of valve, valve seat
Questions	Confirm recent repair history												
	Degree of use	Operated for long period	△	△	△			△					△
	Replacement of filters has not been carried out according to operation manual		◎	◎	◎								
	Non-specified fuel has been used			◎	◎	◎	◎						
	Engine oil must be added more frequently							◎					
	Rust and water are found when fuel is drained			◎	◎								
	Dust indicator is red		◎										
	Noise of interference is heard from around turbocharger								◎				
Check items	Engine pick-up suddenly became poor					○			◎		○	○	
	Color of exhaust gas	Blue under light load						◎					
		Black	◎			◎			◎				○
	Clanging sound is heard from around cylinder head									◎			
	Mud is stuck to fuel tank cap										◎		
	There is leakage from fuel piping											◎	
	High idling speed under no load is normal, but speed suddenly drops when load is applied			◎	◎						○		
	There is hunting from engine (rotation is irregular)			○	◎	○					○		
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎	○						
	Blow-by gas is excessive							◎					
Troubleshooting	When air element is inspected directly, it is found to be clogged		●										
	When fuel filter, pre-filter are inspected directly, they are found to be clogged			●									
	When feed pump pre-filter is inspected directly, it is found to be clogged				●								
	Speed of some cylinders does not change when operating on reduced cylinders					●							
	When control rack is pushed, it is found to be heavy or does not return						●						
	When compression pressure is measured, it is found to be low							●					●
	When turbocharger is rotated by hand, it is found to be heavy								●				
	When valve clearance is checked directly, it is found to be outside standard value									●			
	When fuel cap is inspected directly, it is found to be clogged										●		
	When feed pump is operated, operation is too light or too heavy											●	
		Remedy	Clean	Clean	Clean	Repair	Replace	Replace	Replace	Adjust	Clean	Repair	Replace

S-4 Engine stops during operations

★ Check that the display for the fuel level on the monitor panel indicates that there is still fuel left.

General causes why engine stops during operations

- Seized parts inside engine
- Insufficient supply of fuel
- Overheating
  - ★ If there is overheating and insufficient output, carry out troubleshooting for overheating.
- Failure of power train
  - ★ If the engine stops because of a failure in the power train, carry out troubleshooting for the chassis.

			Causes												
			Broken, seized piston, connecting rod	Broken, seized crankshaft bearing	Broken valve system (valve, rocker lever, etc.)	Broken, seized gear train	Broken fuel pump drive shaft, key	Clogged fuel filter, pre-filter	Clogged feed pump pre-filter	Broken, seized feed pump lever/diaphragm	Clogged, leaking fuel piping	Clogged fuel tank air breather hole	Defective injection pump (rack, plunger stuck)	Failure in main pump	
Questions	Confirm recent repair history														
	Degree of use	Operated for long period					△	△							
	Condition when engine stopped	Abnormal noise was heard and engine stops suddenly	◎	◎	◎	◎	◎		○			○		◎	
		Engine overheated and stopped	◎	○											
		Engine stopped slowly					○	○							
		There was hunting and engine stopped					○	○			○				
	Replacement of filters has not been carried out according to operation manual						◎	◎							
	Non-specified fuel has been used						○	○	○			○			
Check items	When feed pump is operated, there is no response or it is heavy						○	○		◎					
	Mud is stuck to fuel tank cap										◎				
	Try to turn by hand using bar ring tool	Does not turn at all	◎	◎											
		Turns in opposite direction			◎										
		Moves amount of backlash				◎									
		Shaft does not turn					◎								
	Rust and water are found when fuel is drained						◎	◎							
	Metal particles are found when oil is drained		◎	◎			○	○							
Troubleshooting	Remove oil pan and check directly		●	●											
	Remove head cover and check directly				●										
	When gear train is inspected, it does not turn					●									
	When fuel filter, pre-filter are inspected directly, they are found to be clogged						●								
	When feed pump pre-filter is inspected directly, it is found to be clogged							●							
	Check feed pump directly								●						
	When control rack is pushed, it is found to be heavy or does not return													●	
		Remedy	Replace	Replace	Replace	Replace	Replace	Clean	Clean	Replace	Repair	Clean	Replace	—	Go to troubleshooting for hydraulic, mechanical system

S-5 Engine does not rotate smoothly

★ Check that there is no abnormality displayed for engine throttle controller system on the monitor panel.

General causes why engine does not rotate smoothly (hunting)

- Air in fuel system
- Defective governor mechanism
- Defective electrically controlled throttle mechanism (electrically controlled throttle type)
  - ★ If there is no hunting when the electrically controlled throttle rod is disconnected, carry out trouble-shooting for the electrical system.

			Defective operation of governor	Defective adjustment of governor	Defective operation of control rack	Low speed is too low	Clogged feed pump pre-filter	Clogged fuel filter, pre-filter	Clogged, air in circuit between fuel tank and feed pump	Clogged, air in circuit between feed pump and nozzle	Clogged fuel tank air breather hole
Questions	Confirm recent repair history										
	Degree of use	Operated for long period				△	△				
	Condition of hunting	Occurs at fixed speed range	◎	◎	◎	○					
		Occurs at low idling	○			◎	○	○	○	○	
		Occurs even when speed is raised	○	○	○						○
		Occurs on slopes									
	Replacement of filters has not been carried out according to operation manual						◎	◎			
	Rust is found when fuel is drained						○	○			
Check items	Leakage from fuel piping								◎	◎	
	When feed pump is operated, 1) No response, light, return is quick								◎	◎	
	2) No response, light, return is normal								◎		
	Engine speed sometimes rises too high		◎	◎							
	Sometimes is difficult to stop engine		◎		◎						
	Seal on injection pump has come off			◎		◎					
Troubleshooting	When governor lever is moved it is found to be stiff		●		●						
	When injection pump is tested, governor is found to be improperly adjusted			●							
	When control rack is pushed, it is found to be heavy or does not return				●						
	When fuel cap is inspected directly, it is found to be clogged					●					●
	When feed pump pre-filter is inspected directly, it is found to be clogged						●				
	When fuel filter, pre-filter are inspected directly, they are found to be clogged							●			
		Remedy	Adjust	Adjust	Adjust	Adjust	Clean	Clean	Repair	Repair	Clean

S-6 Engine lacks output (no power)

★ Check that there is no abnormality displayed for the engine throttle controller system on the monitor panel.

General causes why engine lacks output

- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Use of improper fuel
  (if non-specified fuel is used, output drops)
- Lack of output due to overheating
  - ★ If there is overheating and insufficient output, carry out troubleshooting for overheating.

			Causes: Clogged air cleaner element	Seized turbocharger, interference	Worn piston ring, cylinder	Clogged fuel filter, pre-filter	Clogged feed pump pre-filter	Clogged injection nozzle, defective spray	Seized injection pump plunger	Improper valve clearance	Defective contact of valve, valve seat	Bent fuel lever linkage, defective adjustment	Clogged, leaking fuel piping	Clogged fuel tank air breather hole
Questions	Confirm recent repair history													
	Degree of use	Operated for long period	△		△	△	△			△				
	Power was lost	Suddenly		◎										
		Gradually	○		○	○	○	○		○				
	Engine oil must be added more frequently				◎									
	Replacement of filters has not been carried out according to operation manual		◎			◎	◎							
	Non-specified fuel has been used					◎	◎	◎	◎					
	Air cleaner clogging lamp lights up		◎											
	Color of exhaust gas	Black	◎	◎										
		Blue under light load			◎									
Check items	Noise of interference is heard from around turbocharger			◎										
	Blow-by gas is excessive				◎									
	Engine pickup is poor and combustion is irregular			◎			○					○	○	
	High idling speed under no load is normal, but speed suddenly drops when load is applied					◎	◎							○
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low						◎	○						
	There is hunting from engine (rotation is irregular)					○	○					○	○	
	Clanging sound is heard from around cylinder head								◎					
	High idling speed of engine is low							○			◎			
	Leakage from fuel piping											◎		
Troubleshooting	When air element is inspected directly, it is found to be clogged		●											
	When trubocharger is rotated by hand, it is found to be heavy			●										
	When compression pressure is measured, it is found to be low				●						●			
	When fuel filter, pre-filter are inspected directly, they are found to be clogged					●								
	When feed pump pre-filter is inspected directly, it is found to be clogged						●							
	Speed of some cylinders does not change when operating on reduced cylinders							●						
	When control rack is pushed, it is found to be heavy or does not return								●					
	When valve clearance is checked directly, it is found to be outside standard value									●				
	When lever is placed at FULL position, it does not contact stopper										●			
	When feed pump is operated, operation is too light or too heavy											●		
	When fuel cap is inspected directly, it is found to be clogged													●
		Remedy	Clean	Replace	Replace	Clean	Clean	Repair	Replace	Adjust	Replace	Adjust	Repair	Clean

S-7 Exhaust gas is black (incomplete combustion)

General causes why exhaust gas is black
- Insufficient intake of air
- Improper condition of fuel injection
- Excessive injection of fuel

			Causes: Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)	Improper valve clearance	Crushed, clogged muffler	Leakage of air between turbocharger and head	Defective contact of valve, valve seat	Defective injection pump (rack, plunger seized)
Questions	Confirm recent repair history												
	Degree of use	Operated for long period		△	△	△						△	
	Color of exhaust gas	Suddenly became black	◎			○							○
		Gradually became black		◎		○					○		
		Blue under light load			◎								
	Engine oil must be added more frequently				◎								
	Power was lost	Suddenly	◎			○				○			○
		Gradually		○	○						○	○	
	Non-specified fuel has been used					○							○
Check items	Noise of interference is heard from around turbocharger		◎										
	Air cleaner clogging lamp lights up			◎									
	Blow-by gas is excessive				◎								
	Engine pickup is poor and combustion is irregular		○			◎			○	○	○		○
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎							○
	Match marks on fuel injection pump are out of alignment						◎						
	Seal on injection pump has come off							◎					
	Clanging sound is heard from around cylinder head								◎				
	Exhaust noise is abnormal		○			○				◎			
	Muffler is crushed									◎			
	Leakage of air between trubocharger and head, loose clamp										◎		
Troubleshooting	When turbocharger is rotated by hand, it is found to be heavy		●										
	When air cleaner is inspected directly, it is found to be clogged			●									
	When compression pressure is measured, it is found to be low				●							●	
	Speed of some cylinders does not change when operating on reduced cylinders					●							
	When check is made using delivery method, injection timing is found to be incorrect						●						
	Injection pump test shows that injection amount is incorrect							●					
	When valve clearance is checked directly it is found to be outside standard value								●				
	When muffler is removed, exhaust gas color returns to normal									●			
	When control rack is pushed, it is found to be heavy or does not return												●
		Remedy	Replace	Clean	Replace	Replace	Adjust	Adjust	Adjust	Replace	Repair	Replace	Replace

S-8 Oil consumption is excessive (or exhaust gas is blue)

★ Do not run the engine at idling for more that 20 minutes continously. (Both low and high idling).

General causes why oil consumption is excessive

- Abnormal conbustion of oil
- External leakage of oil
- Wear of lubrication system

			Causes: Broken piston ring	Worn piston ring, cylinder liner	Clogged breather or breather hose	Leakage from oil filter, oil cooler	Leakage from oil piping	Leakage from oil drain plug	Leakage from oil pan, cylinder head, etc.	Broken oil cooler	Worn seal at turbine end	Worn seal at blower end	Turbocharger: Worn, broken rear seal, seal surface	Turbocharger: Dust sucked in from intake system	Turbocharger: Worn valve (stem, guide), broken seal
Questions	Confirm recent repair history														
	Degree of use	Operated for long period		△							△	△			△
	Oil consumption suddenly increased		◎							○					
	Engine oil must be added more frequently			◎						○					
	Engine oil becomes contaminated quickly		○	◎	○										
	Exhaust gas is blue under light load		◎	◎											
	Amount of blow-by gas	Abnormally excessive	◎	◎								○			○
		None			◎										
Check items	Area around engine is dirty with oil					◎	◎	◎	◎						
	There is oil in engine cooling water									◎					
	When exhaust pipe is removed, inside is found to be dirty with oil										◎				○
	Inside of turbocharger intake pipe is dirty with oil											◎			
	Oil level in clutch or TORQFLOW transmission damper chamber rises												◎		
	Clamps for intake system are loose													◎	
Troubleshooting	When compression pressure is measured, it is found to be low		●	●											
	When breather element is inspected, it is found to be clogged with dirty oil				●										
	There is external leakage of oil from engine					●	●	●	●						
	Pressure-tightness test of oil cooler shows there is leakage									●					
	Excessive play of turbocharger shaft										●	●			
	Check rear seal directly												●		
	When intake manifold is removed, dust is found inside													●	
	When intake manifold is removed, inside is found to be dirty with oil														●
		Remedy	Replace	Replace	Clean	Repair	Repair	Repair	Repair	Replace	Replace	Replace	Repair	Repair	Repair

S-9 Oil becomes contaminated quickly

General causes why oil becomes contaminated quickly
- Intake of exhaust gas due to internal wear
- Clogging of lubrication passage
- Improper combination
- Use of improper oil
- Operation under excessive load

			Causes: Worn piston ring, cylinder	Clogged breather, breather tube	Clogged oil filter	Worn valve, valve guide	Clogged oil cooler	Clogged turbocharger drain pipe	Defective seal at turbocharger turbine end	Defective safety valve	Exhaust gas is black
Questions	Confirm recent repair history										
	Degree of use	Operated for long period	△			△			△		
	Engine oil must be added more frequently		◎								
	Non-specified fuel has been used				○						
Check items	Color of exhaust gas	Blue under light load	◎								
		Black									◎
	Amount of blow-by gas	Abnormally excessive	◎			○		○	○		
		None		◎							
	Oil filter caution lamp stays on even when oil pressure rises				◎					○	
	When oil filter is inspected, metal particles are found		○		◎	○					
	When exhaust pipe is removed, inside is found to be dirty with oil					◎					
	Engine oil temperature rises quickly						◎				
Troubleshooting	When compression pressure is measured, it is found to be low		●			●					
	When breather element is inspected directly, it is found to be clogged with dirty oil, or hose is broken			●							
	When oil filter is inspected directly, it is found to be clogged				●						
	When oil cooler is inspected directly, it is found to be clogged						●				
	Turbocharger drain tube is clogged							●			
	Excessive play of turbocharger shaft								●		
	When safety valve is directly inspected, spring is found to be catching or broken									●	
			Carry out troubleshooting for "Exhaust is black".								
	Remedy		Replace	Clean	Replace	Replace	Clean	Clean	Replace	Replace	—

S-10 Fuel consumption is excessive

General causes why fuel consumption is excessive
- Leakage of fuel
- Improper condition of fuel injection
- Excessive injection of fuel

			Causes							
			Defective injection pump (excessive injection)	Defective injection nozzle spray	Defective injection pump plunger	Improper fuel injection timing	External leakage from fuel piping, fuel filter	Leakage of fuel inside head cover	Defective oil seal inside feed pump (piston)	Defective adjustment of fuel lever linkage
Questions	Confirm recent repair history									
	Degree of use	Operated for long period		△	△				△	
	Condition of fuel consumption	More than for other machines of same model	◎			○				
		Gradually increased		○	○					
		Suddenly increased					○	○		
	Exhaust gas color	Black	◎	○		○				○
		White						○		
Check items	Seal on injection pump has come off		◎							
	There is irregular combustion			◎						
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low			◎	○					
	Match mark on injection pump is misaligned					◎				
	There is external leakage of fuel from engine						◎			
	Engine oil level rises and smells of diesel fuel		○					◎	◎	
	Engine low idling speed is high		○							◎
Troubleshooting	Injection pump test shows that injection amount is incorrect		●							
	Speed of some cylinders does not change when operating on reduced cylinders			●						
	When control rack is pushed, it is found to be heavy or does not return				●					
	When check is made using delivery method, injection timing is found to be incorrect					●				
	Remove head cover and check directly							●		
	Remove feed pump and check directly								●	
	When engine speed is measured, low idling speed is found to be high									●
		Remedy	Adjust	Replace	Replace	Adjust	Repair	Repair	Repair	Adjust

S-11 Oil is in cooling water, or water spurts back, or water level goes down

General causes why oil is in cooling water
- Internal leakage in lubrication system
- Internal leakage in cooling system

			Causes: Broken oil cooler core, O-ring	Broken head, head gasket	Insufficient protrusion of liner	Broken oil cooler for power train	Broken liner O-ring, holes caused by pitting	Internal cracks in cylinder block
Questions	Confirm recent repair history							
	Degree of use	Operated for long period	△				△	
	Increase in oil level	Suddenly increased	○	○		○		
		Gradually increased					○	○
Check items	Hard water is being used as cooling water		○				○	
	Engine oil level has risen, oil is cloudy white		◎				○	○
	Excessive air bubbles inside radiator, spurts back			◎	◎			
	Hydraulic oil, torque converter transmission oil is cloudy white					◎		
	When hydraulic oil, torque converter transmission oil is drained, water comes out					◎		
Trouble-shooting	Pressure-tightness test of oil cooler shows there is leakage		●			●		
	Pressure-tightness test of cylinder head shows there is leakage			●				
	Remove cylinder head and check directly				●			
	Remove oil pan and check directly						●	●
		Remedy	Replace	Replace	Replace	Replace	Replace	Replace

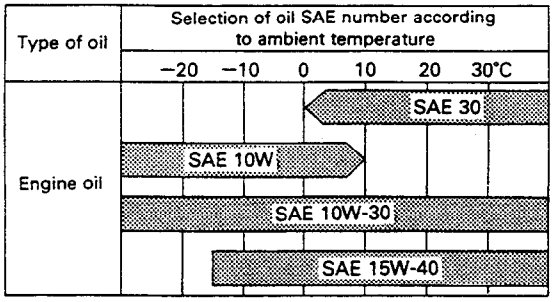
S-12 Oil pressure lamp lights up (drop in oil pressure)

★ If engine oil level lamp on monitor panel is not lighted up.
★ If oil pressure sensor is normal (see item for M mode).

General causes why oil pressure lamp lights up

- Leakage, clogging, wear of lubricating system
- Defective oil pressure control
- Use of improper oil (improper viscosity)
- Deterioration of oil due to overheating

★ Standards for engine oil selection



			Causes: Clogged oil filter	Worn bearing journal	Clogged strainer inside oil pan	Clogged, broken oil pipe inside oil pan	Broken suction pipe brazing	Defective oil pump	Defective regulator valve	Defective relief valve	Leaking, crushed hydraulic piping	Defective oil pressure sensor	Water, fuel in oil
Questions	Confirm recent repair history												
	Degree of use	Operated for long period	△	△				△					
	Replacement of filters has not been carried out according to operation manual		◎										
	Caution lamp lights up		◎							○			
	Non-specified fuel has been used		◎	○									
Check items	Condition when oil pressure	Lights up at low idling		◎						○			
		Lights up at low, high idling			◎	◎	◎	◎	○	○			
		Sometimes lights up							◎	◎		○	
	There is clogging, leakage from hydraulic piping (external)										◎		
	Metal particles are found when oil is drained			○									
	Metal particles are stuck to oil filter element			○				○					
	Oil is cloudy white or smells of diesel oil												○
Troubleshooting	When oil filter is inspected directly, it is found to be clogged		●	●									
	Remove oil pan and check directly				●	●	●						
	Oil pump rotation is heavy, there is play							●					
	There is catching of relief valve, regulator valve, spring, valve guide is broken								●	●			
	When oil pressure is measured, it is found to be within standard value											●	Carry out troubleshooting for "Oil level rises".
	Remedy		Clean	Clean	Clean	Clean	Repair	Replace	Adjust	Adjust	Repair	Replace	—

S-13 Oil level rises

★ If there is oil in the cooling water, carry out troubleshooting for "Oil is in cooling water".

- Water in oil (cloudy white)
- Fuel in oil (diluted, and smells of diesel fuel)
- Entry of oil from other component

		Causes											
		Broken oil cooler core, O-ring	Defective nozzle holder sleeve	Broken head, head gasket	Clogged water pump breather hole, defective seal	Worn, damaged rear seal surface	Defective seal of pump	Leakage of fuel from piping inside head cover	Defective inside injection pump (flange type)	Defective thermostat seat	Damaged liner O-ring, holes made by pitting	Cracks inside cylinder block
Questions	Confirm recent repair history											
	Degree of use — Operated for long period		△		△	△	△				△	
	There is oil in radiator cooling water	◎	○	○							○	○
Check items	Exhaust gas is white		◎				○			○		
	When engine is first started, drops of water come from muffler		◎									
	Leave radiator cap open. When engine is run at idling, an abnormal number of bubbles appear, or water spurts back			◎							○	
	Water pump breather hole is clogged with mud				◎							
	When water pump breather hole is clean, water comes out				◎							
	Oil level goes down in damper chamber					◎						
	Oil level goes down in hydraulic tank						◎					
	Engine oil smells of diesel fuel							◎	◎	◎		
	Fuel is added more frequently							◎	◎	◎		
Troubleshooting	Pressure-tightness test of oil cooler shows there is leakage	●										
	Pressure-tightness test of cylinder head shows there is leakage		●									
	When compression pressure is measured, it is found to be low			●								
	Remove water pump and check directly				●							
	Check rear seal directly					●						
	When pump is removed, seal is found to be broken						●					
	Remove head cover and check directly							●				
	Remove injection pump and check directly								●			
	There is improper contact of thermostat seat valve									●		
	Remove oil pan and check directly										●	●
	Remedy	Replace	Replace	Replace	Replace	Repair	Replace	Repair	Replace	Repair	Replace	Replace

S-14 Water temperature becomes too high (overheating)

★ If coolant level lamp on monitor panel is not lighted up.
★ If coolant temperature gauge on monitor panel is normal (see M mode).

General causes why water temperature becomes too high

- Lack of cooling water (deformation, damage of fan)
- Drop in heat dissipation efficiency
- Defect in cooling circulation system
- Rise in oil temperature of power train
  - ★ Carry out troubleshooting for chassis.

			Causes: Broken water pump	Clogged, crushed radiator fin	Clogged radiator core	Defective thermostat (does not open)	Defective water temperature gauge	Fan belt slipping, worn fan pulley	Clogged, broken oil cooler	Defective pressure valve	Broken head, head gasket	Damaged liner O-ring, holes made by pitting	External leakage from coolant piping
Questions	Confirm recent repair history												
	Degree of use	Operated for long period		△	△					△	△		
	Condition of overheating	Suddenly overheated	◎				○						
		Always tends to overheat		◎	◎	○	○						
	Water temperature gauge	Rises quickly				◎							
		Does not go down from red range					◎						
Check items	Fan belt whines under sudden load						◎						
	Cloudy white oil is floating on cooling water							◎					
	Cooling water flows out from overflow hose								◎				
	Excessive air bubbles inside radiator, water spurts back									◎			
	Engine oil level has risen, oil is cloudy white							○			◎		
	There is play when fan pulley is rotated		◎										
	Radiator shroud, inside of underguard are clogged with dirt or mud			◎			◎						
	When light bulb is held behind radiator, no light passes through			◎									
	Water is leaking because of cracks in hose or loose clamps												◎
	Belt tension is found to be slack						◎						
Troubleshooting	Temperature difference between top and bottom radiator tanks is excessive		●										
	Temperature difference between top and bottom radiator tanks slight			●									
	When water filler port is inspected, the core is found to be clogged				●								
	When a function test is carried out on the thermostat, it does not open even at the cracking temperature					●							
	When water temperature is measured, it is found to be normal						●						
	When oil cooler is inspected directly, it is found to be clogged							●					
	When measurement is made with radiator cap tester, set pressure is found to be low								●				
	When compression pressure is measured, it is found to be low									●			
	Remove oil pan and check directly										●		
		Remedy	Replace	Repair	Repair	Replace	Replace	Repair	Replace	Replace	Replace	Replace	—

S-15 Abnormal noise is made

★ Judge if noise is an internal noise or an external noise.

General causes why abnormal noise is made

- Abnormality due to defective parts
- Abnormal combustion noise
- Air sucked in from intake system

			Causes: Worn piston ring, cylinder liner	Seized turbocharger, interference	Missing, seized bushing	Clogged, seized injection nozzle	Defective injection pump (rack, plunger seized)	Defective injection pump (excessive injection)	Deformed fan, interference of fan belt	Improper adjustment of valve clearance	Broken valve system (valve, rocker lever, etc.)	Improper gear train backlash	Leakage of air between turbocharger and head	Defect inside muffler (dividing board out of position)
Questions	Confirm recent repair history													
	Degree of use	Operated for long period	△											
	Condition of abnormal noise	Gradually occurred	○						○					
		Suddenly occurred		○	○					○				
	Non-specified fuel has been used					○	○							
	Engine oil must be added more frequently		◎											
	Color or exhaust gas	Blue under light load	◎											
		Black		◎						○			○	
Check items	Metal particles are found in oil filter		◎		◎									
	Blow-by gas is excessive		◎											
	Noise of interference is heard from around turbocharger			◎										
	Engine pickup is poor and combustion is irregular					◎								
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎	○							
	Seal on injection pump has come off							◎						
	Abnormal noise is loud when accelerating engine					○	○	○	○	○		○		
	Clanging sound is heard from around cylinder head									◎	◎			
	Leakage of air between turbocharger and head, loose clamp												◎	
	Vibrating noise is heard from around muffler													◎
Troubleshooting	When compression pressure is measured, it is found to be low		●											
	When trubocharger is rotated by hand, it is found to be heavy			●										
	Remove gear cover and check directly				●							●		
	Speed of some cylinders does not change when operating on reduced cylinders					●								
	When control rack is pushed, it is found to be heavy or does not return						●							
	Injection pump test shows that injection amount is incorrect							●						
	Fan is deformed, or belt is loose								●					
	When valve clearance is checked directly, it is found to be outside standard value									●				
	Remove cylinder head cover and check directly										●			
	When muffler is removed, abnormal noise disappers													●
		Remedy	Replace	Replace	Replace	Replace	Replace	Adjust	Repair	Adjust	Replace	Repair	Repair	Replace

S-16 Vibration is excessive

★ If there is abnormal noise together with the vibration, carry out troubleshooting for "Abnormal noise is made".

General causes why vibration is excessive

- Defective parts (abnormal wear, breakage)
- Improper alignment
- Abnormal combustion

			Causes: Worn connecting rod, main bearing	Worn balancer, cam bushing	Worn support pilot	Loose engine mounting bolts, broken cushion	Broken part inside output shaft (damper)	Misalignment between engine and power train	Improper gear train backlash	Valve system (valve, rocker lever, etc.) stuck	Defective injection pump (excessive injection)
Questions	Confirm recent repair history										
	Degree of use	Operated for long period	△	△	△	△					
	Condition of vibration	Suddenly increased					○			○	
		Gradually increased	○	○	○	○					
	Non-specified fuel has been used		○	○							
Check items	Metal particles are found in oil filter		◎	◎							
	Metal particles are found when oil is drained		◎	◎							
	Oil pressure is low at low idling		○	○							
	Vibration occurs at mid-range speed					○	○				
	Vibration follows engine speed				○	○	○	○	○		
	Exhaust gas is black									◎	○
	Seal on injection pump has come off										◎
Troubleshooting	Remove oil pan and check directly		●								
	Remove side cover and check directly			●							
	Check directly for worn support pilot, play				●						
	Check directly for loose engine mounting bolts, broken cushion					●					
	Check inside of output shaft (damper) directly						●				
	When radial runout, face runout are measured, they are found to be outside standard							●			
	Remove front cover and check directly								●		
	Remove head cover and check directly									●	
	Injection pump test shows that injection amount is incorrect										●
		Remedy	Replace	Replace	Replace	Replace	Replace	Repair	Repair	Replace	Adjust

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TROUBLESHOOTING OF PUMP CONTROLLER SYSTEM (C MODE)

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1. Points to remember if abnormality returns to normal by itself

In the following cases, there is a high probability that the same problem will occur again, so it is desirable to follow up this problem carefully.

1) If any abnormality returns to normal by itself,
2) If the connector is disconnected and the T-adapter is inserted, or if the T-adapter is removed and the connector is returned to its original position when carrying out troubleshooting of the failure, and the service code is no longer displayed, or if the monitor display returns to normal.

★ After completing troubleshooting, always erase the user code from memory.

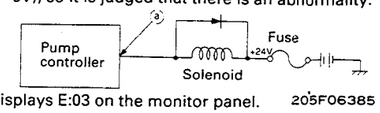
2. Service code memory retention function

When displaying the service code in memory and carrying out troubleshooting, note down the content of the display, then erase the display. After trying to re-enact the problem, carry out troubleshooting according to the service code that is displayed.

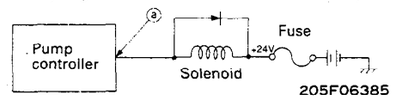
(There are cases where mistaken operation or abnormalities that occur when the connector is disconnected are recorded by the memory retention function. Erasing the data in this way saves any wasted work.)

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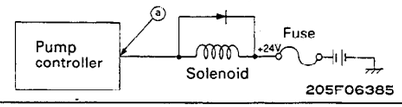
ACTION TAKEN BY CONTROLLER WHEN ABNORMALITY OCCURS AND PROBLEMS ON MACHINE

User code	Service code	Abnormal system	Nature of abnormality	Condition when normal (voltage, current, resistance)	Action by controller when abnormality is detected	Problem that appears on machine when there is abnormality
E02	E2:32	Short circuit in front pump TVC solenoid system	1. Short circuit in front pump TVC solenoid system 2. Short circuit in front pump TVC solenoid system or wiring harness between controller C01(16) and front pump TVC solenoid C13(1) short circuiting with chassis ground 3. Abnormality in pump controller	Resistance of solenoid: 10 – 22 Ω	Makes power to solenoid 0 Displays E:02 on monitor panel Resets power source to restore	1. No current flows to the front pump TVC solenoid, so when the load is large, there is a big drop in the engine speed which may result in the engine stalling. 2. The swing acceleration is poor
	E2:33	Disconnection in front pump TVC solenoid system	1. Disconnection inside TVC solenoid or disconnection in wiring harness between controller C01 (8), (16) and front pump TVC solenoid C13(1),(2) 2. Wiring harness between controller C01 (8) and front pump TVC solenoid C13 (2) short circuiting with ground 3. Abnormality in pump controller .	Resistance of solenoid: 10 – 22 Ω Current: 1000 mA (H/O mode, auto-deceleration ON, levers at neutral, fuel control dial at MAX.)	1. In the case of 1, the current stops flowing to the solenoid, so no particular action is taken. Therefore, if the abnormality is restored by the vibration of the machine, the condition will return to normal. ★However, the display does not go out. 2. In the case of 2, the current (approx. 1 A) continues to flow to the solenoid. Displays E:02 on the monitor panel.	1. In the case of 1, it is the same as E2:32. 2. In the case of 2, the current continues to flow to the front pump TVC solenoid (approx. 1 A), so the output pressure of the front pump TVC valve increases and the overall speed becomes slower.
	E2:36	Short circuit in rear pump TVC solenoid system	1. Short circuit in rear pump TVC solenoid system 2. Short circuit in rear pump TVC solenoid system or wiring harness between controller C01 (17) and rear pump TVC solenoid C04(1) short circuiting with chassis ground 3. Abnormality in pump controller	Resistance of solenoid: 10 – 22 Ω	Makes power to solenoid 0 Displays E:02 on monitor panel Resets power source to restore	Same as E2:32 (but for the rear pump)
	E2:37	Disconnection in rear pump TVC solenoid system	1. Disconnection inside TVC solenoid or disconnection in wiring harness between controller C01 (9), (17) and rear pump TVC solenoid C04(1), (2) 2. Wiring harness between controller C01 (9) and rear pump TVC solenoid C04 (2) short circuiting with ground 3. Abnormality in pump controller	Resistance of solenoid: 10 – 22 Ω Current: 1000 mA (H/O mode, auto-deceleration ON, levers at neutral, fuel control dial at MAX.	1. In the case of 1, the current stops flowing to the solenoid, so no particular action is taken. Therefore, if the abnormality is restored by the vibration of the machine, the condition will return to normal. ★However, the display does not go out. 2. In the case of 2, the current (approx. 1 A) continues to flow to the solenoid. Displays E:02 on the monitor panel.	Same as E2:33 (but for the rear pump)
E03	E2:03	Short circuit in swing brake solenoid system	1. Short circuit inside solenoid or between solenoid (1) and (2) (when internal resistance of solenoid is extremely low), and excess current is flowing. 2. Abnormality in pump controller	Resistance of solenoid: 20 – 60 Ω	Makes power to solenoid 0 Displays E:03 on monitor panel Resets power source to restore	When the swing is operated, the motor brake is not released, so the upper structure does not swing.
	E2:13	Disconnection in swing brake solenoid system	1. Short circuit inside solenoid (when internal resistance of solenoid is extremely high) 2. Disconnection in wiring harness between solenoid (2) and controller 3. Solenoid (2) short circuiting with ground 4. Abnormality in pump controller	Resistance of solenoid: 20 – 60 Ω	1. In the case of 1 and 2, the current stops flowing to the solenoid, so no particular action is taken. Therefore, if the abnormality is restored by the vibration of the machine, the condition will return to normal. ★However, the display does not go out. 2. In the case of 3, the current stops flowing to the solenoid, but the controller takes no particular action. Therefore, if the abnormality is restored by the vibration of the machine, the condition will return to normal. ★However, the display does not go out. ★If the controller gives a signal to turn the solenoid current OFF, the voltage at portion (a) should be 20 – 30V. If there is a disconnection or short circuit with the ground, the voltage at portion (a) is low (almost 0V), so it is judged that there is an abnormality.  Displays E:03 on the monitor panel. 20SF06385	1. In the case of 1 and 2, it is the same as E2:03. 2. In the case of 3, the brake remains released, so even when the levers are returned to neutral, the brake does not take effect (there is overrun of the swing on slopes).

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User code	Service code	Abnormal system	Nature of abnormality	Condition when normal (voltage, current, resistance)	Action by controller when abnormality is detected	Problem that appears on machine when there is abnormality
–	E2:02	Short circuit in LS select solenoid system	1. Short circuit inside solenoid or between solenoid (1) and (2) (when internal resistance of solenoid is extremely low), and excess current is flowing. 2. Abnormality in pump controller	Resistance of solenoid: 20 – 60 Ω	Makes power to solenoid 0 Resets power source to restore	1. With swing + boom RAISE, the boom is slow. 2. With swing + arm OUT, the arm OUT is slow. 3. With swing + travel, there is a big drop in the travel speed.
–	E2:04	Short circuit in pump merge-divider solenoid system	1. Short circuit inside solenoid or between solenoid (1) and (2) (when internal resistance of solenoid is extremely low), and excess current is flowing. 2. Abnormality in pump controller	Resistance of solenoid: 20 – 60 Ω	Makes power to solenoid 0 Resets power source to restore	The pump merge-divider valve continues to merge the oil flow. 1. In the L/O and S/O modes, the work equipment and swing speeds become faster. 2. The steering is difficult to turn.
–	E2:05	Short circuit in 2-stage relief solenoid system	1. Short circuit inside solenoid or between solenoid (1) and (2) (when internal resistance of solenoid is extremely low), and excess current is flowing. 2. Abnormality in pump controller	Resistance of solenoid: 20 – 60 Ω	Makes power to solenoid 0 Resets power source to restore	When traveling or using the power max. function, the relief pressure is not raised, so there is lack of power.
–	E2:06	Short circuit in travel speed solenoid system	1. Short circuit inside solenoid or between solenoid (1) and (2) (when internal resistance of solenoid is extremely low), and excess current is flowing. 2. Abnormality in pump controller	Resistance of solenoid: 20 – 60 Ω	Makes power to solenoid 0 Resets power source to restore	Even if the travel speed is switched, the travel speed does not change (remains at Lo)
–	E2:12	Disconnection in LS select solenoid system	1. Short circuit inside solenoid (when internal resistance of solenoid is extremely high) 2. Disconnection in wiring harness between solenoid (2) and controller 3. Solenoid (2) short circuiting with ground 4. Abnormality in pump controller	Resistance of solenoid: 20 – 60 Ω	1. In the case of 1 and 2, the current stops flowing to the solenoid, so no particular action is taken. Therefore, if the abnormality is restored by the vibration of the machine, the condition will return to normal. ★However, the display does not go out. 2. In the case of 3, the current continues to flow to the solenoid, but the controller takes no particular action. Therefore, if the abnormality is restored by the vibration of the machine, the condition will return to normal. ★However, the display does not go out. ★If the controller gives a signal to turn the solenoid current OFF, the voltage at portion (a) should be 20 – 30V. If there is a disconnection or short circuit with the ground, the voltage at portion (a) is low (almost 0V), so it is judged that there is an abnormality. 	1. In the case of 1 and 2, it is the same as E2:02. 2. In the case of 3, when the boom/swing priority selection mode is OFF and the travel is OFF, and there is combined operation with the swing (except for boom RAISE and arm OUT), pressure compensation cannot be carried out for the swing LS pressure.
–	E2:14	Disconnection in pump merge-divider solenoid system	1. Short circuit inside solenoid (when internal resistance of solenoid is extremely high) 2. Disconnection in wiring harness between solenoid (2) and controller 3. Solenoid (2) short circuiting with ground 4. Abnormality in pump controller	Resistance of solenoid: 20 – 60 Ω	1. In the case of 1 and 2, the current stops flowing to the solenoid, so no particular action is taken. Therefore, if the abnormality is restored by the vibration of the machine, the condition will return to normal. ★However, the display does not go out. 2. In the case of 3, the current continues to flow to the solenoid, but the controller takes no particular action. Therefore, if the abnormality is restored by the vibration of the machine, the condition will return to normal. ★However, the display does not go out. ★If the controller gives a signal to turn the solenoid current OFF, the voltage at portion (a) should be 20 – 30V. If there is a disconnection or short circuit with the ground, the voltage at portion (a) is low (almost 0V), so it is judged that there is an abnormality.	1. In the case of 1 and 2, it is the same as E2:04. 2. In the case of 3, the pump merge-divider valve remains divided, so the arm and boom are slow.
–	E2:15	Disconnection in 2-stage relief solenoid system	1. Short circuit inside solenoid (when internal resistance of solenoid is extremely high) 2. Disconnection in wiring harness between solenoid (2) and controller 3. Solenoid (2) short circuiting with ground 4. Abnormality in pump controller	Resistance of solenoid: 20 – 60 Ω		1. In the case of 1 and 2, it is the same as E2:05. 2. In the case of 3, it becomes the same condition as when the 2-stage relief is used, so the relief pressure remains increased (34.8MPa(355kg/cm²)). (The solenoid stays ON)

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User code	Service code	Abnormal system	Nature of abnormality	Condition when normal (voltage, current, resistance)	Action by controller when abnormality is detected	Problem that appears on machine when there is abnormality
–	E2:16	Disconnection in travel speed solenoid system	1. Short circuit inside solenoid (when internal resistance of solenoid is extremely high) 2. Disconnection in wiring harness between solenoid (2) and controller 3. Solenoid (2) short circuiting with ground 4. Abnormality in pump controller	Resistance of solenoid: 20 – 60 Ω	1. In the case of 1 and 2, the current stops flowing to the solenoid, so no particular action is taken. Therefore, if the abnormality is restored by the vibration of the machine, the condition will return to normal. ★However, the display does not go out. 2. In the case of 3, the current continues to flow to the solenoid, but the controller takes no particular action. Therefore, if the abnormality is restored by the vibration of the machine, the condition will return to normal. ★However, the display does not go out. ★If the controller gives a signal to turn the solenoid current OFF, the voltage at portion (a) should be 20 – 30V. If there is a disconnection or short circuit with the ground, the voltage at portion (a) is low (almost 0V), so it is judged that there is an abnormality. 	1. In the case of 1 or 2, it is the same as the E2:06 . 2. In the case of 3, the solenoid remains actuated, so the Lo speed is fast.
–	E2:17	Model selection input error	1. Disconnection, short circuit in model selection wiring harness 2. Abnormality in controller	1. PC210 Between C03 (15) and chassis: Max. 1 Ω Between C03 (13), (14), (16) and chassis: Min. 1 MΩ 2. PC240 Between C03 (13), (15) and chassis: Max. 1 Ω Between C03 (14), (16) and chassis: Min. 1 MΩ	Detects abnormality in input 1) Retains data when starting switch is ON 2) Functions as PC100 when non-set conditions are input	1. Travel deviation 2. Engine stalls
–	E2:18	Network response overtime error	1. Disconnection, short circuit, short circuit with ground in network wiring harness 2. Abnormality in engine throttle controller 3. Abnormality in pump controller		1. When networking are impossible with the monitor panel and engine throttle controller (1) Working mode: G/O (2) Priority mode: OFF (3) Travel speed: Lo (4) Auto-deceleration: ON (5) Power max. : ON (6) Automatic mode: OFF (HYPER GX) 2. When networking are impossible with engine throttle controller Control is carried out by recognizing the throttle signal as FULL (others are as usual)	1. (1) Even when travel is operated, the power does not increase (2) The swift slow-down function does not work (3) The auto-deceleration cannot be canceled (4) The travel speed does not increase (5) The priority mode has no effect (6) The automatic mode has no effect (HYPER GX) 2. The engine speed may drop
–	E2:22	Short circuit in LS control EPC solenoid system	1. Short circuit inside solenoid or between solenoid (1) and (2) (when internal resistance of solenoid is extremely low), and excess current is flowing. 2. Abnormality in pump controller	Resistance of solenoid: 7 – 14 Ω	Makes power to solenoid 0 Resets power source to restore	1. The Lo travel speed is too fast. 2. In L/O and F/O modes, the work equipment speed is too fast. 3. When the engine is running at low idling, the swing speed is too fast.
–	E2:23	Disconnection in LS control EPC solenoid system	1. Disconnection inside solenoid or disconnection in wiring harness between controller C01 (15), (7) and LS control EPC solenoid 2. Wiring harness between controller C01 (7) and LS control EPC solenoid C10 (2) short circuiting with ground 3. Abnormality in pump controller	Current: Approx. 800 mA (Levers at neutral, low idling)	1. In the case of 1, the current stops flowing to the solenoid, so no particular action is taken. Therefore, if the abnormality is restored by the vibration of the machine, the condition will return to normal. ★However, the display does not go out. 2. In the case of 2, the current continues to flow to the solenoid.	1. In the case of 1, it is the same as E2:22 2. In the case of 2, electric current continues to flow to the LS control EPC solenoid, so the work equipment, travel, and swing speeds are slow

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User code	Service code	Abnormal system	Nature of abnormality	Condition when normal (voltage, current, resistance)	Action by controller when abnormality is detected	Problem that appears on machine when there is abnormality
–	E2:24	Abnormality in front pump pressure sensor system	1. Abnormality in front pump pressure sensor 2. Disconnection, short circuit in wiring harness between C08 and C03 3. Abnormality in pump controller	1. Between C03 (1) and (9): 0.5 – 4.5 V 2. Resistance between C03 (female) (1) and (9), (1) and chassis : Min. 1 MΩ (Disconnect pressure sensor connector C08 and connector at C03)	Takes front pump pressure as 0 MPa (0 kg/cm²) when actuating. If abnormality is restored, it actuates as normal. ★However, the display does not go out.	1. The travel speed does not automatically shift (it does not change from Hi to Lo). ★If the button is operated manually, the panel display is switched.
–	E2:25	Abnormality in rear pump pressure sensor system	1. Abnormality in rear pump pressure sensor 2. Disconnection, short circuit in wiring harness between C07 and C03 3. Abnormality in pump controller	1. Between C03 (2) and (10): 0.5 – 4.5 V 2. Resistance between C03 (female) (2) and (10), (2) and chassis : Min. 1 MΩ (Disconnect pressure sensor connector C07 and connector at C03)	Takes rear pump pressure as 0 MPa (0 kg/cm²) when actuating. If abnormality is restored, it actuates as normal. ★However, the display does not go out.	1. The travel speed does not automatically shift (it does not change from Hi to Lo). ★If the button is operated manually, the panel display is switched.
–	E2:26	Abnormality in pressure sensor power source system	1. Defective pressure sensor 2. Wiring harness between pressure sensor (2) and controller short circuiting with ground	1. Voltage between C03 (3) and (9) and between C03 (3) and (10): 18 – 28 V	Takes front pump and rear pump pressure as 0 MPa (0 kg/cm²) when actuating. When abnormality is detected, it switches the output OFF, and when all levers are returned to neutral, it outputs again. ★This automatic resetting is repeated up to 3 times.	1. The travel speed does not automatically shift (it does not change from Hi to Lo). ★If the button is operated manually, the panel display is switched.
–	E2:27	Abnormality in engine speed sensor system	1. Disconnection, short circuit in speed sensor 2. Disconnection, short circuit in wiring harness between E7 and C02 3. Abnormality in pump controller	Resistance: 500 – 1000 Ω Voltage (AC range) : 0.5 – 3.0 V	1. It functions as the equivalent of the G/O mode (the speed rises) ★However, the display does not go out. 2. When the sensor is lost, such as when there is a disconnection inside the speed sensor, monitoring code 10 is not displayed.	It operates about the same as G/O mode (prolix) (the power is slightly lower)
–	E2:28	Abnormality in auto-deceleration output system	1. Disconnection, short circuit in wiring harness of C03 (5) and E01 (4). 2. Abnormality in engine throttle controller 3. Abnormality in pump controller	1. Voltage between C03 (5) and chassis At deceleration: 8 – 12 V When canceled: 0 – 1 V 2. Resistance between C03 (5) and chassis : Min 1 MΩ	When there is a short circuit, it stops the output, and restores by resetting the power. When there is a disconnection, it continues to move as it is.	It is controlled as usual (there may be a delay in response)

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JUDGEMENT TABLE FOR PUMP CONTROLLER AND HYDRAULIC RELATED PARTS

Figure in ○ shows position of bit pattern **FOLDOUT 19**

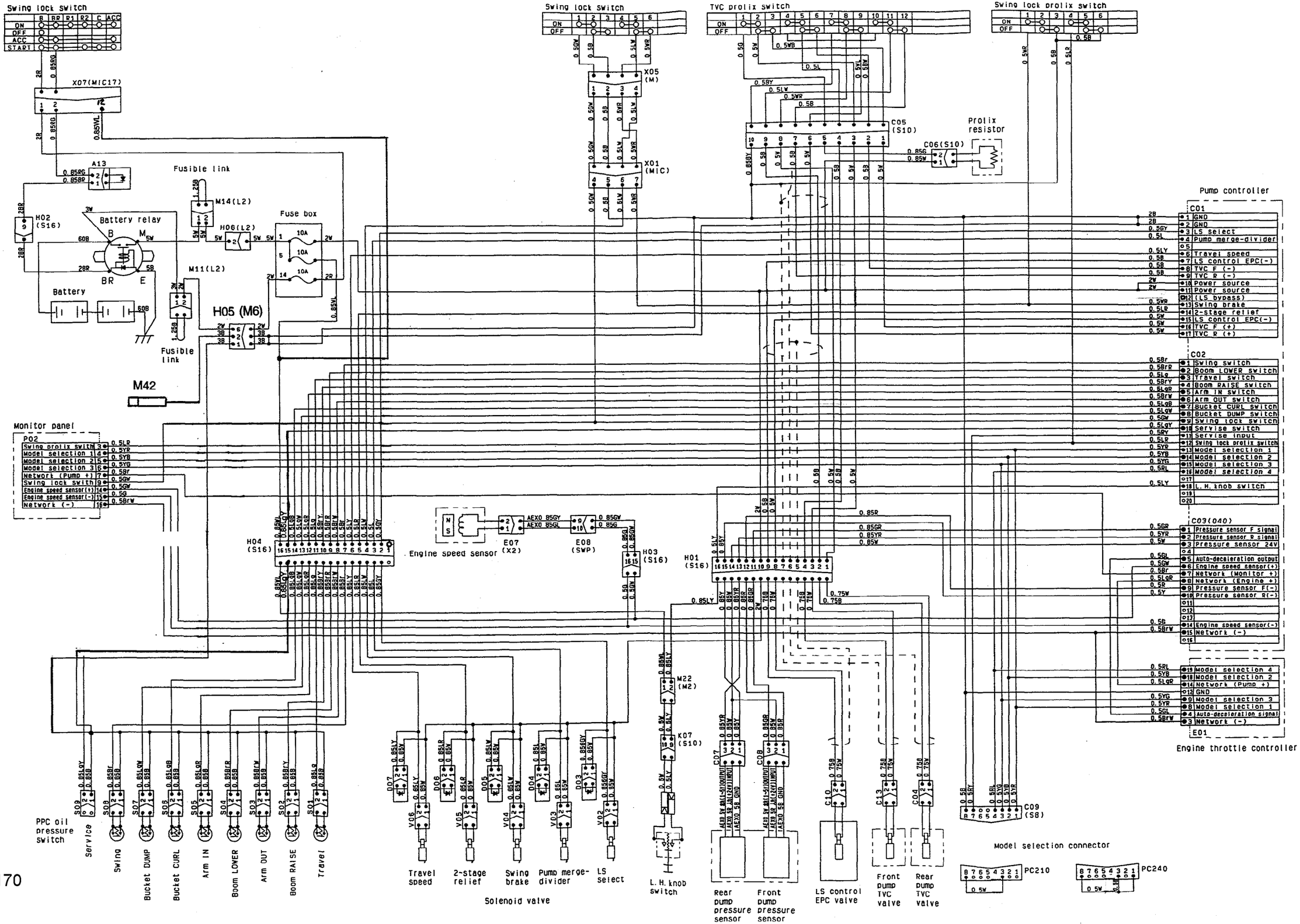
Category	Failure mode		Abnormality in pump controller power source system	Pump controller (E2:○○system) – Self-diagnostic display: Short circuit in front pump TVC solenoid system	Short circuit in rear pump TVC solenoid system	Disconnection in front pump TVC solenoid system	Disconnection in rear pump TVC solenoid system	Short circuit in swing brake solenoid system	Disconnection in swing brake solenoid system	Short circuit in LS select solenoid system	Short circuit in pump merge-divider solenoid system	Short circuit in 2-stage relief solenoid system	Short circuit in travel speed solenoid system	Disconnection in LS select solenoid system	Disconnection in pump merge-divider solenoid system	Disconnection in 2-stage relief solenoid system	Disconnection in travel speed solenoid system	Model selection input error	Network response overtime error	Short circuit in LS control EPC solenoid system	Disconnection in LS control EPC solenoid system	Abnormality in front pump pressure sensor system	Abnormality in rear pump pressure sensor system	Abnormality in pressure sensor power source system	Abnormality in engine speed sensor system	Abnormality in auto-deceleration output system
		User code		E02				E03		–																
		Service code		E2:32	E2:36	E2:33	E2:37	E2:03	E2:13	E2:02	E2:04	E2:05	E2:06	E2:12	E2:14	E2:15	E2:16	E2:17	E2:18	E2:22	E2:23	E2:24	E2:25	E2:26	E2:27	E2:28
All work equipment, travel, swing	Speeds of all work equipment, swing, travel are slow or lack power			▲	▲	▲	▲														●				●	
	There is excessive drop in engine speed, or engine stalls			●	●	●	●																			
	No work equipment, travel, swing move																									
	Abnormal noise generated (around pump)																									
	Auto-deceleration does not work		●																							
	Fine control ability is poor or response is poor																									
Work equipment	Boom is slow or lacks power														●											
	Arm is slow or lacks power														●											
	Bucket is slow or lacks power																									
	Boom does not move																									
	Arm does not move																									
	Bucket does not move																									
	Excessive hydraulic drift																									
	Excessive time lag (engine at low idling)																				●					
	Lack of power when pressure rises											●				●										
	Other equipment moves when single circuit is relieved																									
	In L/O, F/O modes, work equipment speed is faster than specified speed										●				●					●	●					
Compound operations	In compound operations, work equipment with larger load is slow																									
	In swing + boom RAISE, boom is slow									●				●												
	In swing + arm OUT, arm is slow									●				●												
	In swing + travel, travel speed drops excessively									●				●												
Travel system	Travel deviation	Deviation is excessive																								
		Deviation is excessive when starting																								
	Travel speed is slow																				●					
	Steering does not turn or lacks power										●	●			●	●										
	Travel speed does not switch or is faster than specified speed		●										●				●		●	●	●	●	●	●		
	Does not move (one side only)																									
Swing system	Does not swing	Both left and right						●	●																	
		One direction only																								
	Swing acceleration is poor or swing speed is slow	Both left and right		●		●																				
		One direction only																								
	Excessive overrun when stopping swing	Both left and right																								
		One direction only																								
	Excessive shock when stopping swing (one direction only)																									
	Excessive abnormal noise when stopping swing																									
	Excessive hydraulic drift of swing	When brake is ON							●																	
		When brake is OFF																								
	Swing speed is faster than specified swing speed										●				●					●	●					
Troubleshooting code when service code is displayed			C-1	C-2		C-3		C-4	C-5	C-6				C-7				C-8	C-9	C-10	C-11	C-12		C-13	C-14	C-15
Troubleshooting code when there is abnormality in monitoring check			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Category	Failure mode		Checking monitoring, check items – Oil pressure switch: Swing (Bit No. ①)	Travel (Bit No. ②)	Boom LOWER (Bit No. ③)	Boom RAISE (Bit No. ④)	Arm IN (Bit No. ⑤)	Arm OUT (Bit No. ⑥)	Bucket CURL (Bit No. ①)	Bucket DUMP (Bit No. ②)	Swing lock switch (Bit No. ③)	Model code	Engine speed input	Front pump discharge pressure input signal	Rear pump discharge pressure input signal	Front pump TVC output signal	Rear pump TVC output signal	LS control EPC signal	No. 2 throttle signal	Kerosene mode signal (Bit No. ⑤)	L.H.Knob switch signal (Bit No. ⑥)	Actuation of solenoid: LS select (Bit No. ②)	Swing brake (Bit No. ③)	Pump merge-divider (Bit No. ④)	2-stage relief (Bit No. ⑤)	Travel speed (Bit No. ⑥)	Is red range displayed? 102°C or above	Is red range displayed? 105°C or above	Is voltage for coolant temperature normal?	Troubleshooting code if no service code is displayed
		Monitoring code	20						21			02	10	11	12	13	14	15	16	22		23					Coolant temperature gauge		Monitoring code 41	
All work equipment, travel, swing	Speeds of all work equipment, swing, travel are slow or lack power												○	※	※	※	※	※		○							○	○	○	H-1
	There is excessive drop in engine speed, or engine stalls												○			※	※													H-2
	No work equipment, travel, swing move																													H-3
	Abnormal noise generated (around pump)																													H-4
	Auto-deceleration does not work		○	○	○	○	○	○	○	○			○																	H-5
	Fine control ability is poor or response is poor																													H-6
Work equipment	Boom is slow or lacks power				○	○								※	※									※						H-7
	Arm is slow or lacks power						○	○						※	※									※						H-8
	Bucket is slow or lacks power								○	○				※	※															H-9
	Boom does not move																													H-10
	Arm does not move																													
	Bucket does not move																													
	Excessive hydraulic drift																													H-11
	Excessive time lag (engine at low idling)				○		○		○									※												H-12
	Lack of power when pressure rises			○		○	○		○					※	※						○				※					H-13
	Other equipment moves when single circuit is relieved																													H-14
	In L/O, F/O modes, work equipment speed is faster than specified speed																	※						※						H-15
Compound operations	In compound operations, work equipment with larger load is slow																													H-16
	In swing + boom RAISE, boom is slow		※			※																※								H-17
	In swing + arm OUT, arm is slow		※					※														※								H-18
	In swing + travel, travel speed drops excessively		※	※																		※								H-19
Travel system	Travel deviation	Deviation is excessive																												H-20
		Deviation is excessive when starting																												
	Travel speed is slow			○														※												H-21
	Steering does not turn or lacks power			○																				※	※					H-22
	Travel speed does not switch or is faster than specified speed			○									○	※	※			※								※		○	○	H-23
	Does not move (one side only)																													H-24
Swing system	Does not swing	Both left and right	○								○			※									※							H-25
		One direction only																												
	Swing acceleration is poor or swing speed is slow	Both left and right												※																H-26
		One direction only												※																
	Excessive overrun when stopping swing	Both left and right																												H-27
		One direction only																												
	Excessive shock when stopping swing (one direction only)																													H-28
	Excessive abnormal noise when stopping swing																													H-29
	Excessive hydraulic drift of swing	When brake is ON	※	※	※	※	※	※	※	※													※							H-30
		When brake is OFF																												
	Swing speed is faster than specified swing speed																	※						※						H-31
Troubleshooting code when service code is displayed			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Troubleshooting code when there is abnormality in monitoring check			F-1	F-2	F-3	F-4	F-5	F-6	F-7	F-8	F-9	–	F-10	–	–	–	–	–	–	F-11	F-12	–	–	–	–	–	F-13		F-14	

▲ : Troubleshooting code when there is abnormality in monitoring mode check (abnormality at both front and rear)
● : This shows applicable item for service code
※ : This shows item that needs only checking with monitoring mode
○ : This shows item to check with monitoring mode or machine monitor

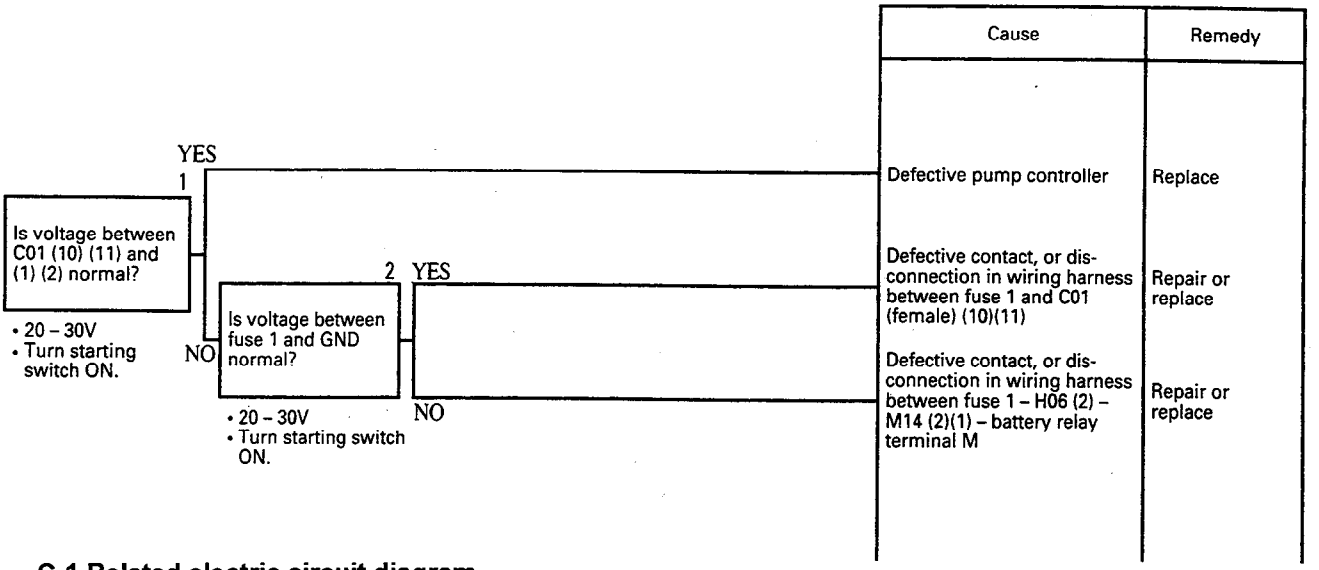
PUMP CONTROLLER SYSTEM CIRCUIT DIAGRAM

https://truckmanualshub.com/

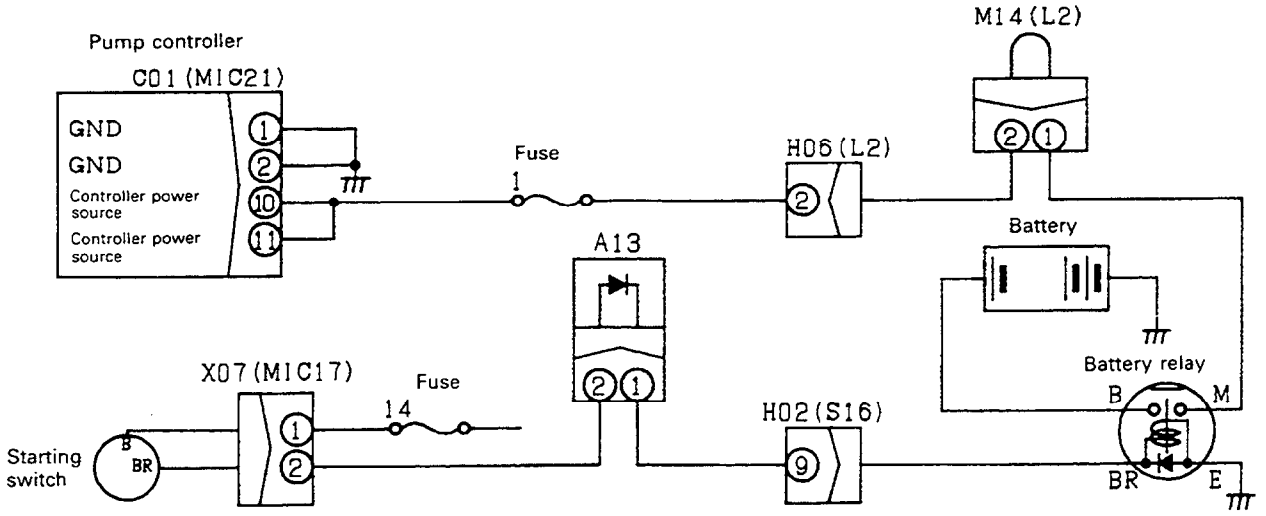


C-1 Abnormality in pump controller power source system (swing brake is not canceled, etc.)

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ Check that fuses 1 and 14 are not blown.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.
★ When the starting motor rotates correctly. (If the starting motor also does not rotate, go to E-11.)



C-1 Related electric circuit diagram



C-2 [E2:32] Short circuit in front pump TVC solenoid system is displayed [E2:36] Short circuit in rear pump TVC solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if E2:32 or E2:36 are displayed. (If they are not displayed, the problem has been removed.)
★ Always turn the TVC prolix switch OFF.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

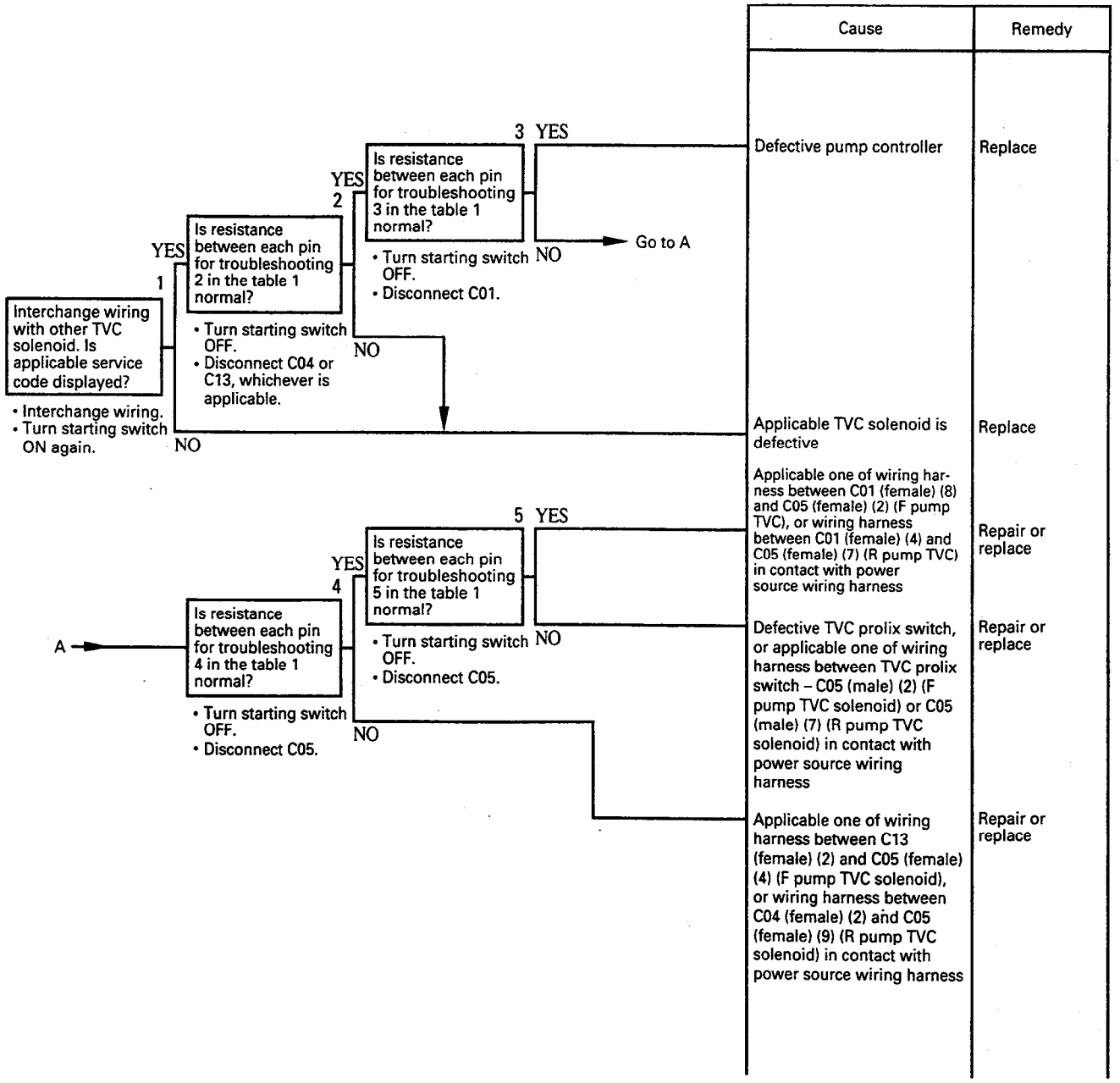
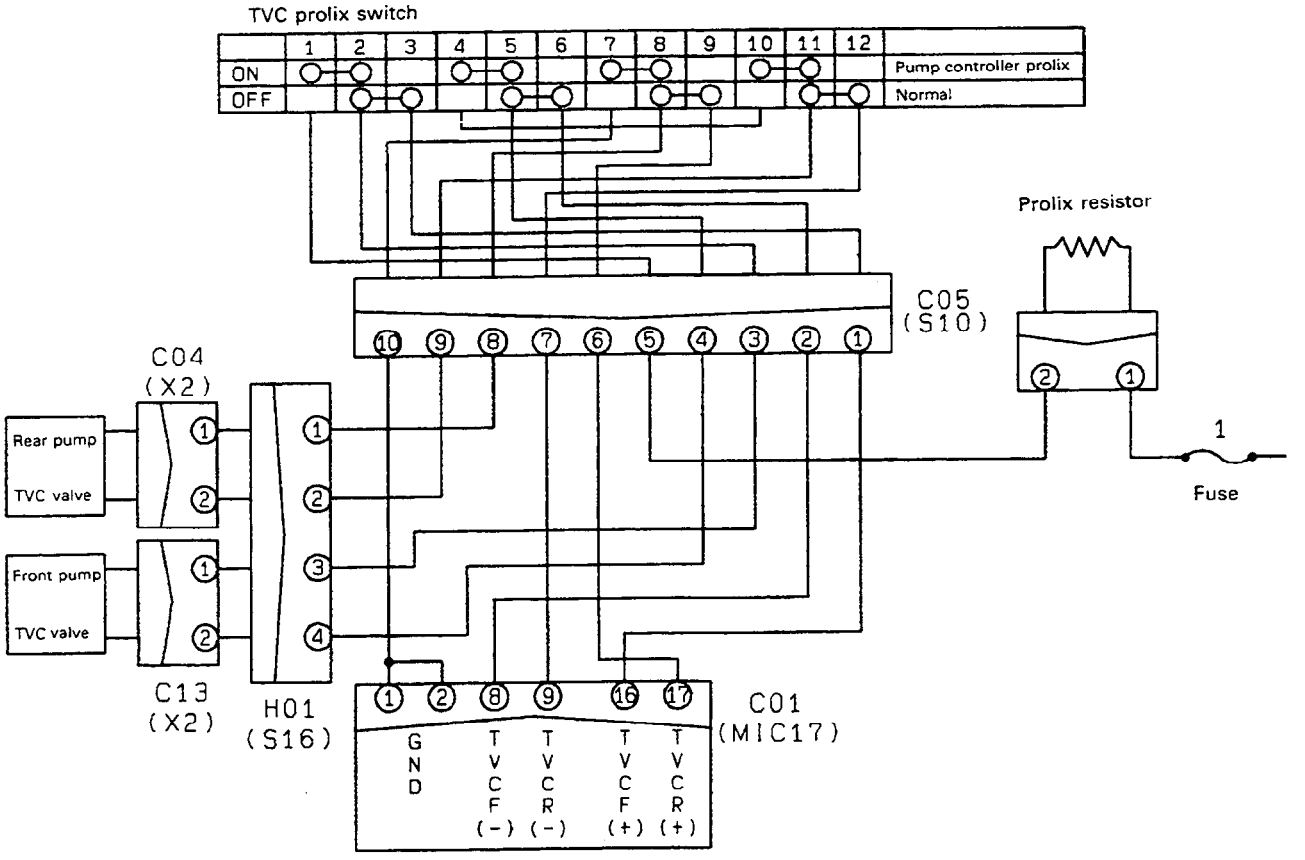


Table 1

Service code	Measurement location			Resistance value
Service code	Troubleshooting 2	Troubleshooting 3	Troubleshooting 4	
E2 : 32	Between C13 (male) (1) and (2)	Between C01 (female) (16) and (8)	Between C05 (female) (3) and (4)	10 - 22 Ω
	Between C13 (male) (2) and chassis	Between C01 (female) (8) and chassis	Between C05 (female) (4) and chassis	Min. 1 MΩ
E2 : 36	Between C04 (male) (1) and (2)	Between C01 (female) (17) and (9)	Between C05 (female) (8) and (9)	10 - 22 Ω
	Between C04 (male) (2) and chassis	Between C01 (female) (9) and chassis	Between C05 (female) (9) and chassis	Min. 1 MΩ
Troubleshooting 5:		Between C05 (male) (1) - (3), (2) - (4), (6) - (8), (7) - (9)		Max. 1Ω

C-2 Related electric circuit diagram



X08DD143

C-3 [E2:33] Disconnection in front pump TVC solenoid system is displayed [E2:37] Disconnection in rear pump TVC solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ If there is a disconnection in the solenoid or wiring harness, no current flows to the solenoid. If the No. 2 pin of the solenoid is short circuiting with the ground, the current (approx. 1 A) continues to flow to the solenoid.
★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if E2:33 or E2:37 are displayed. (If they are not displayed, the problem has been removed.)
★ Always turn the TVC prolix switch OFF.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.
★ Check that fuse 1 is normal.

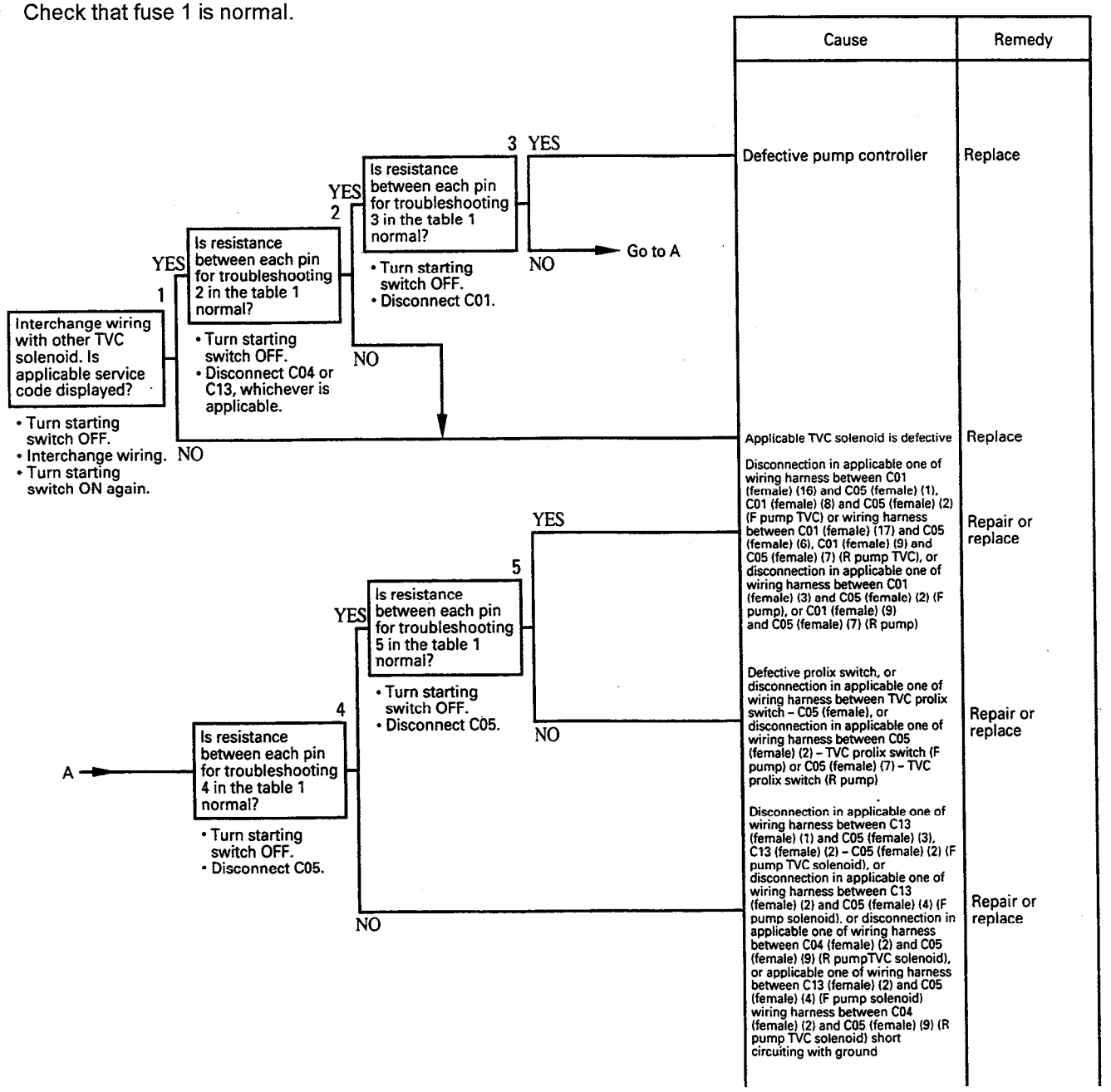
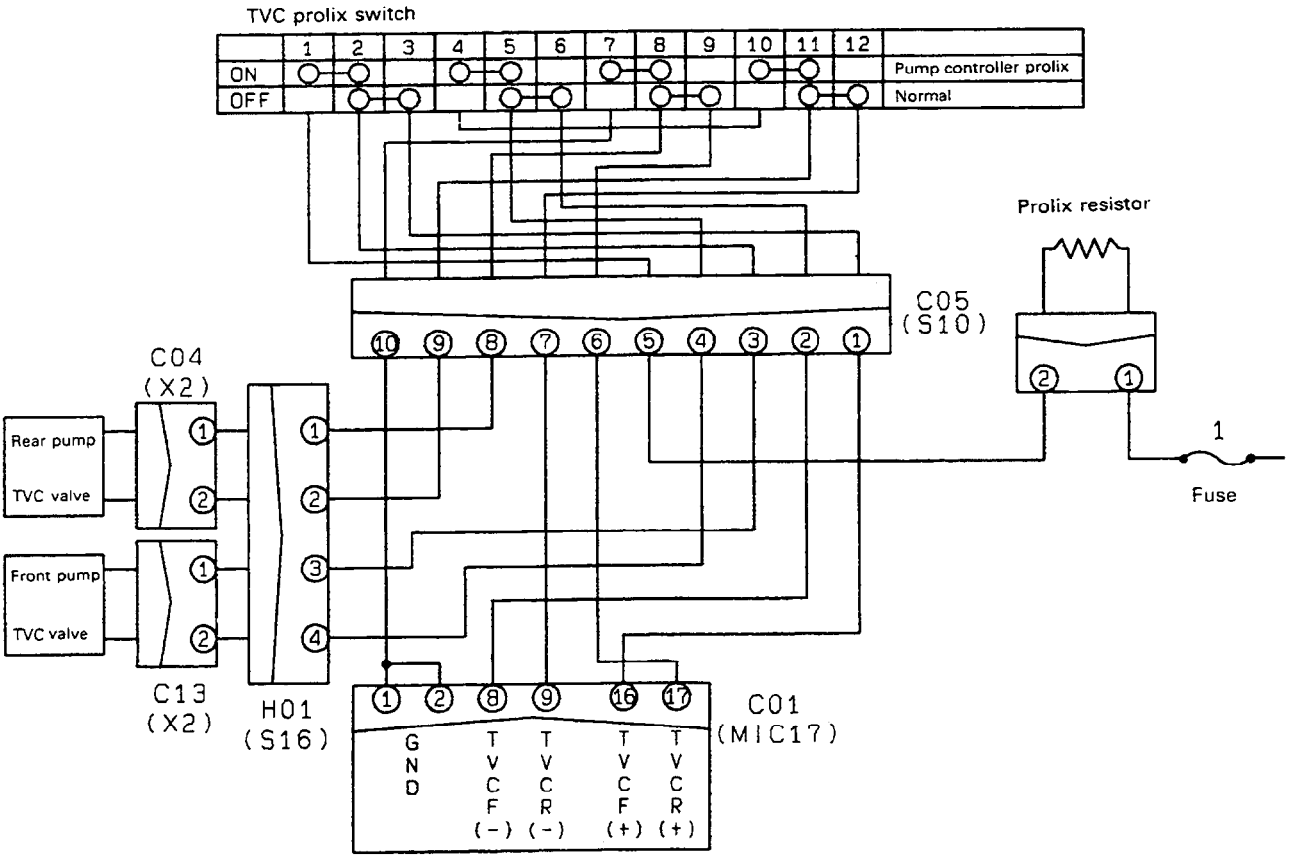


Table 1

Service code	Measurement location			Resistance value
Service code	Troubleshooting 2	Troubleshooting 3	Troubleshooting 4	
E2 : 33	Between C13 (male) (1) and (2)	Between C01 (female) (16) and (8)	Between C05 (female) (3) and (4)	10 - 22 Ω
	Between C13 (male) (2) and chassis	Between C01 (female) (8) and chassis	Between C05 (female) (4) and chassis	Min. 1 MΩ
E2 : 37	Between C04 (male) (1) and (2)	Between C01 (female) (17) and (9)	Between C05 (female) (8) and (9)	10 - 22 Ω
	Between C04 (male) (2) and chassis	Between C01 (female) (9) and chassis	Between C05 (female) (9) and chassis	Min. 1 MΩ
Troubleshooting 5:		Between C05 (male) (1) - (3), (2) - (4), (6) - (8), (7) - (9)		Max. 1Ω

C-3 Related electric circuit diagram



X08DD143

C-4 [E2:03] Short circuit in swing brake solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ If the starting switch is turned OFF after an abnormality occurs, start the engine, operate the swing, and check if E2:03 is displayed. (If it is not displayed, the problem has been removed.)
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.
★ Always turn the swing lock prolix switch OFF, then turn the swing lock switch OFF before checking.

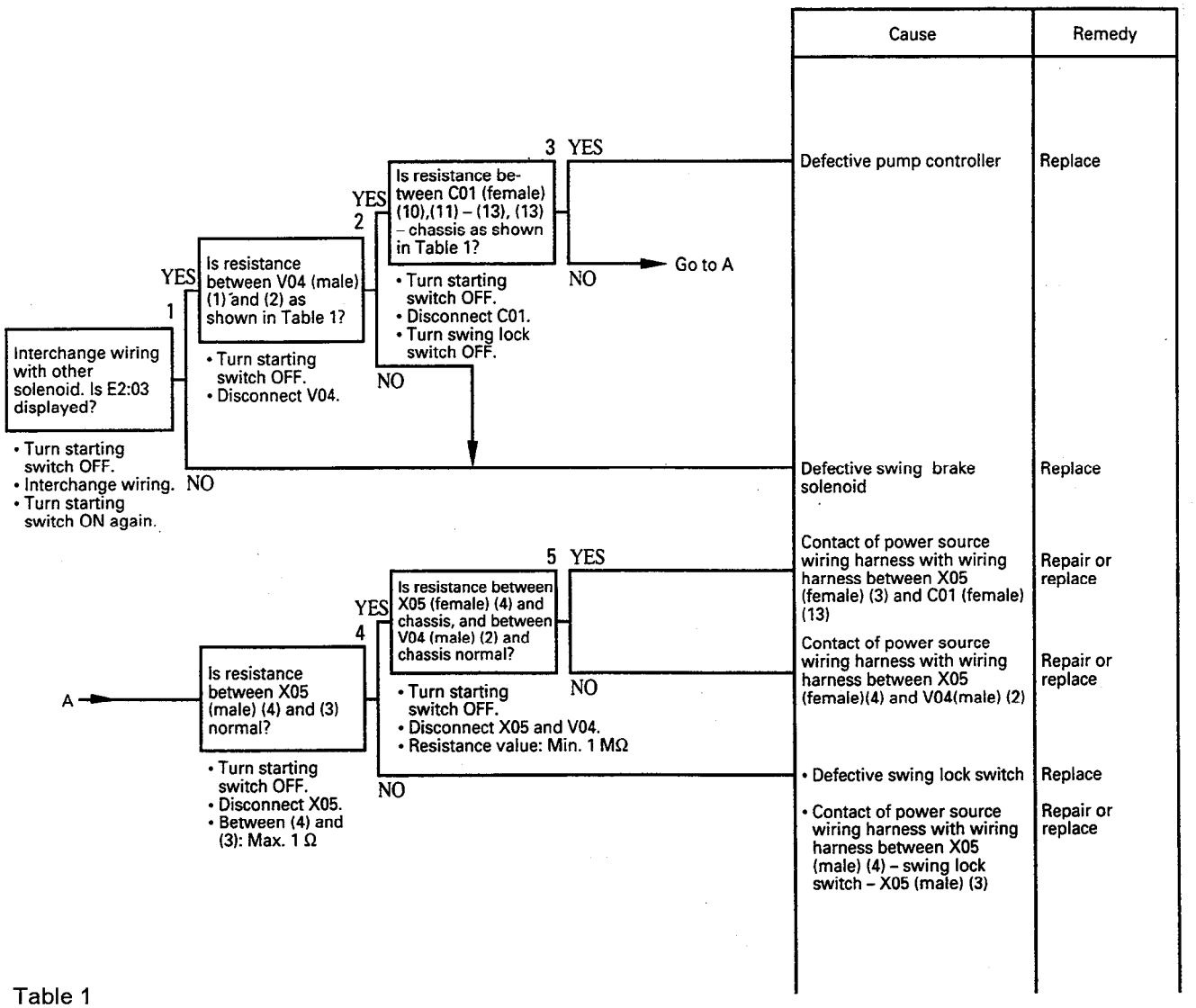
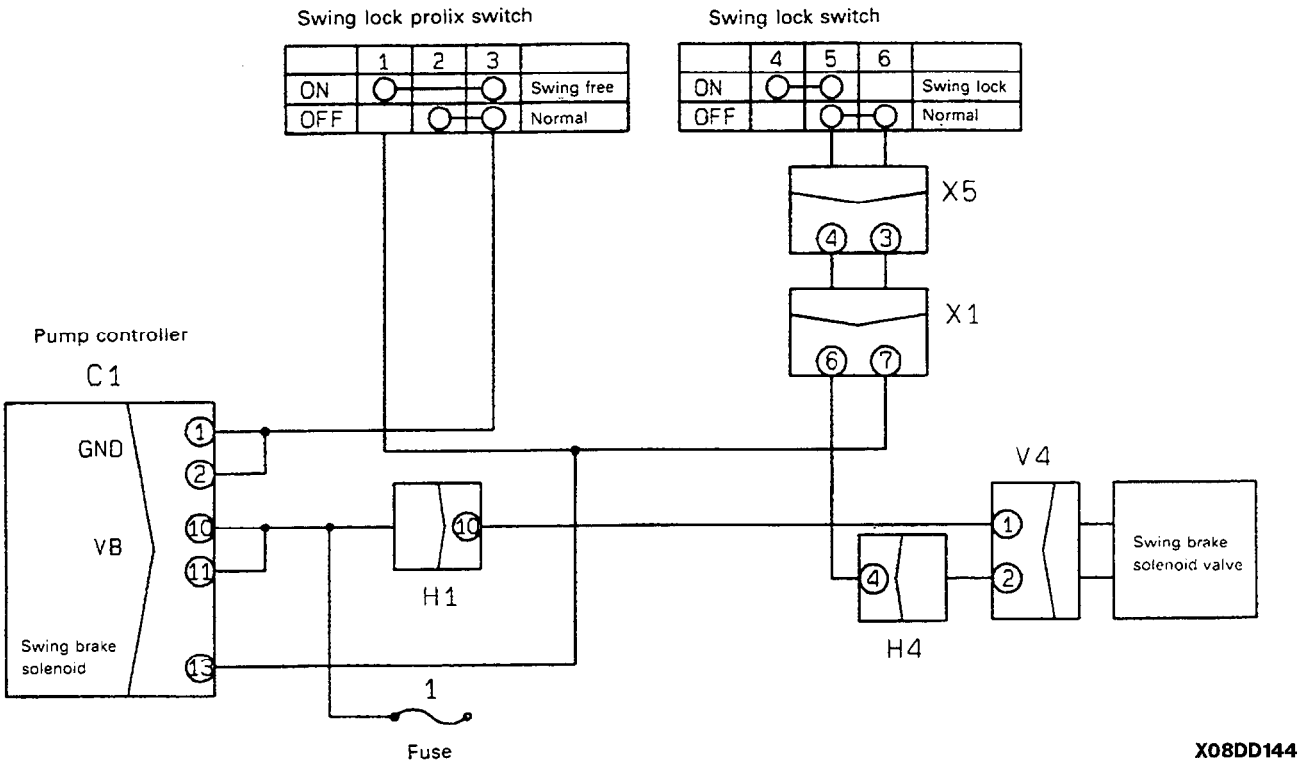


Table 1

V04 (male)	C01 (female)	Resistance value
Between (1) and (2)	Between (10) (11) and (13)	20 - 60 Ω
Between (2) and chassis	Between (13) and chassis	Min. 1 MΩ

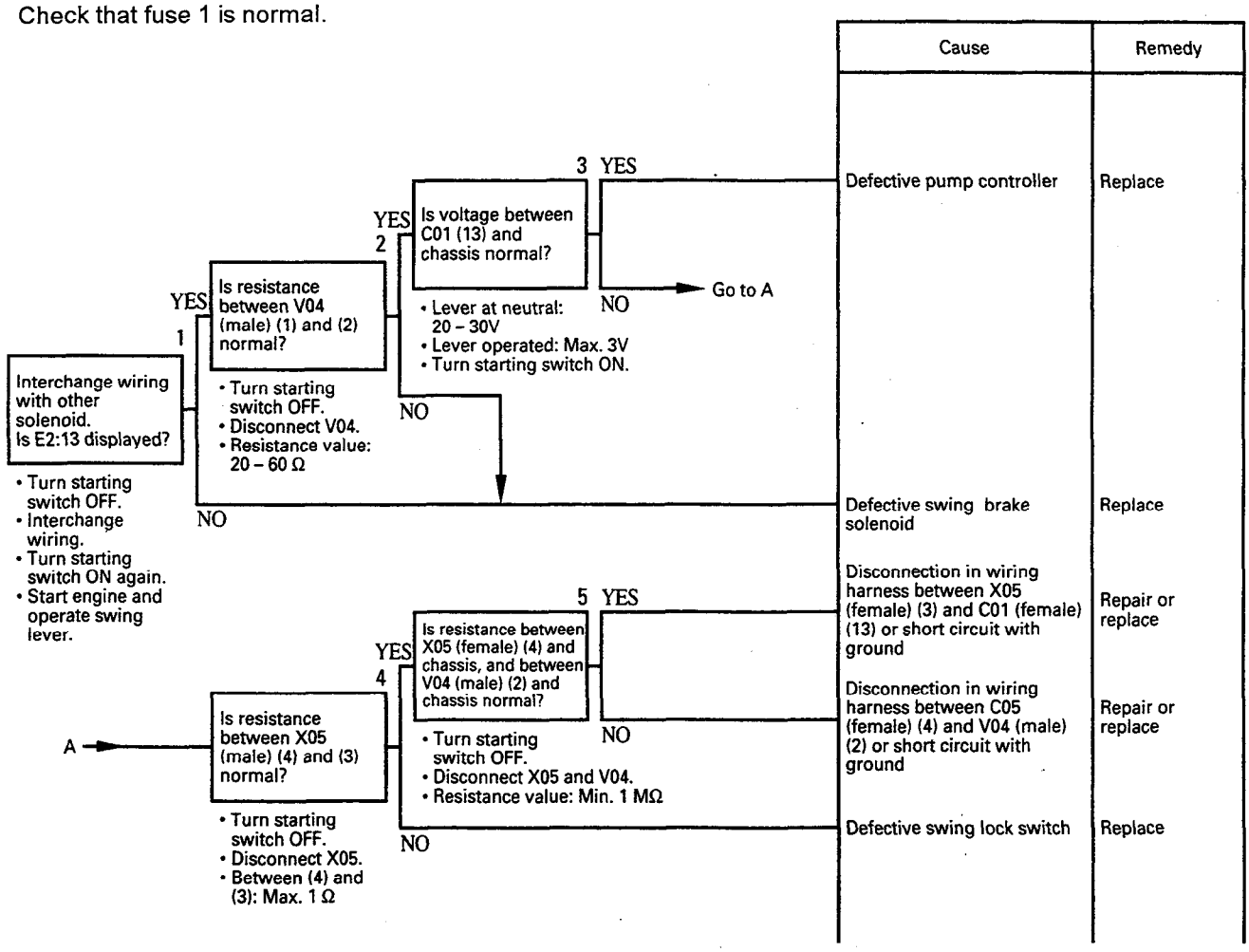
C-4 Related electric circuit diagram



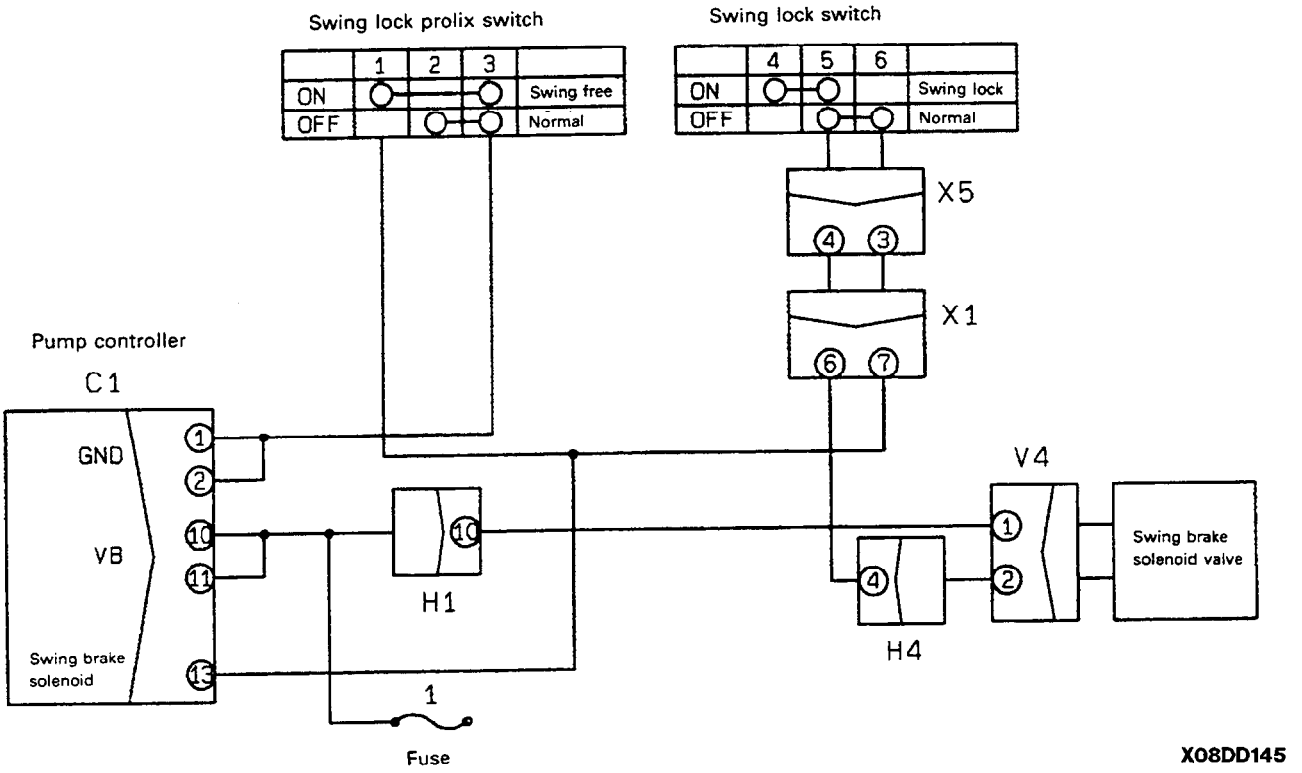
X08DD144

C-5 [E2:13] Disconnection in swing brake solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ If there is a disconnection in the solenoid or wiring harness, the solenoid is not actuated.
If the No. 2 pin of the solenoid is short circuiting with the ground, the solenoid continues to be actuated.
★ If the starting switch is turned OFF after an abnormality occcurs, start the engine, operate the swing lever slightly (not enough to move the swing), and check if E2:13 is displayed. (If it is not displayed, the problem has been removed.)
★ Always turn the swing lock prolix switch OFF, then turn the swing lock switch OFF before checking.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.
★ Check that fuse 1 is normal.



C-5 Related electric circuit diagram



X08DD145

C-6 [E2:02] Short circuit in LS select solenoid system is displayed [E2:04] Short circuit in pump merge-divider solenoid system is displayed [E2:05] Short circuit in 2-stage relief solenoid system is displayed [E2:06] Short circuit in travel speed solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if any service code is displayed. (If it is not displayed, the problem has been removed.)

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

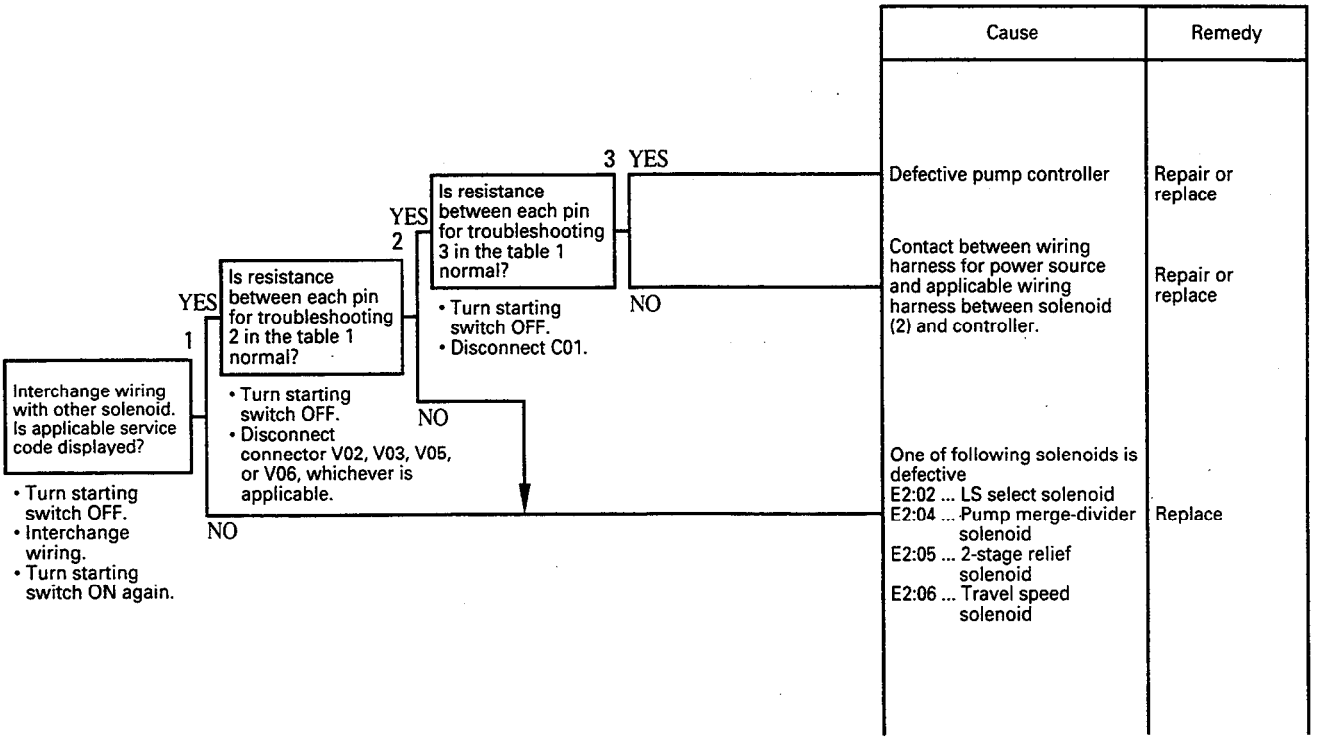
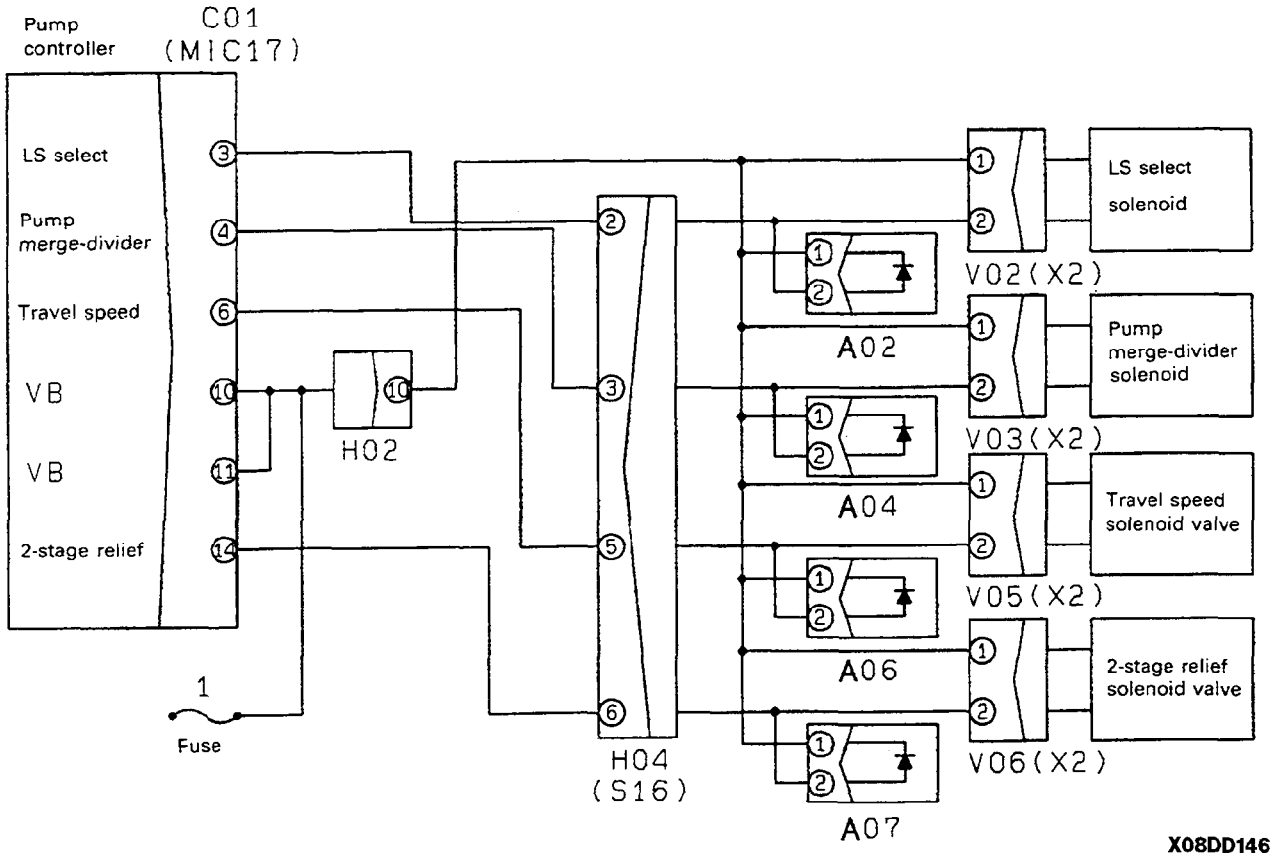


Table 1

Service code	Measurement location			
	Troubleshooting 2		Troubleshooting 3	
E2 : 02	Between V02 (male) (1) and (2)	20 - 60 Ω	Between C01 (female) (10), (11) and (3)	20 - 60 Ω
			Between C01 (female) (3) and chassis	Min. 1 MΩ
E2 : 04	Between V03 (male) (1) and (2)	20 - 60 Ω	Between C01 (female) (10), (11), and (4)	20 - 60 Ω
			Between C01 (female) (4) and chassis	Min. 1 MΩ
E2 : 05	Between V05 (male) (1) and (2)	20 - 60 Ω	Between C01 (female) (10), (11) and (14)	20 - 60 Ω
			Between C01 (female) (14) and chassis	Min. 1 MΩ
E2 : 06	Between V06 (male) (1) and (2)	20 - 60 Ω	Between C01 (female) (10), (11) and (6)	20 - 60 Ω
			Between C01 (female) (6) and chassis	Min. 1 MΩ

C-6 Related electric circuit diagram



C-7 [E2:12] Disconnection in LS select solenoid system is displayed [E2:14] Disconnection in pump merge-divider solenoid system is displayed [E2:15] Disconnection in 2-stage relief solenoid system is displayed [E2:16] Disconnection in travel speed solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ If there is a disconnection in the solenoid or wiring harness, the solenoid is not actuated.
If the No. 2 pin of the solenoid is short circuiting with the ground, the solenoid continues to be actuated.
★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON, operate according to Condition 2 in Table 1, and check if any service code is displayed. (If it is not displayed, the problem has been removed.)
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.
★ Check that fuse 1 is normal.

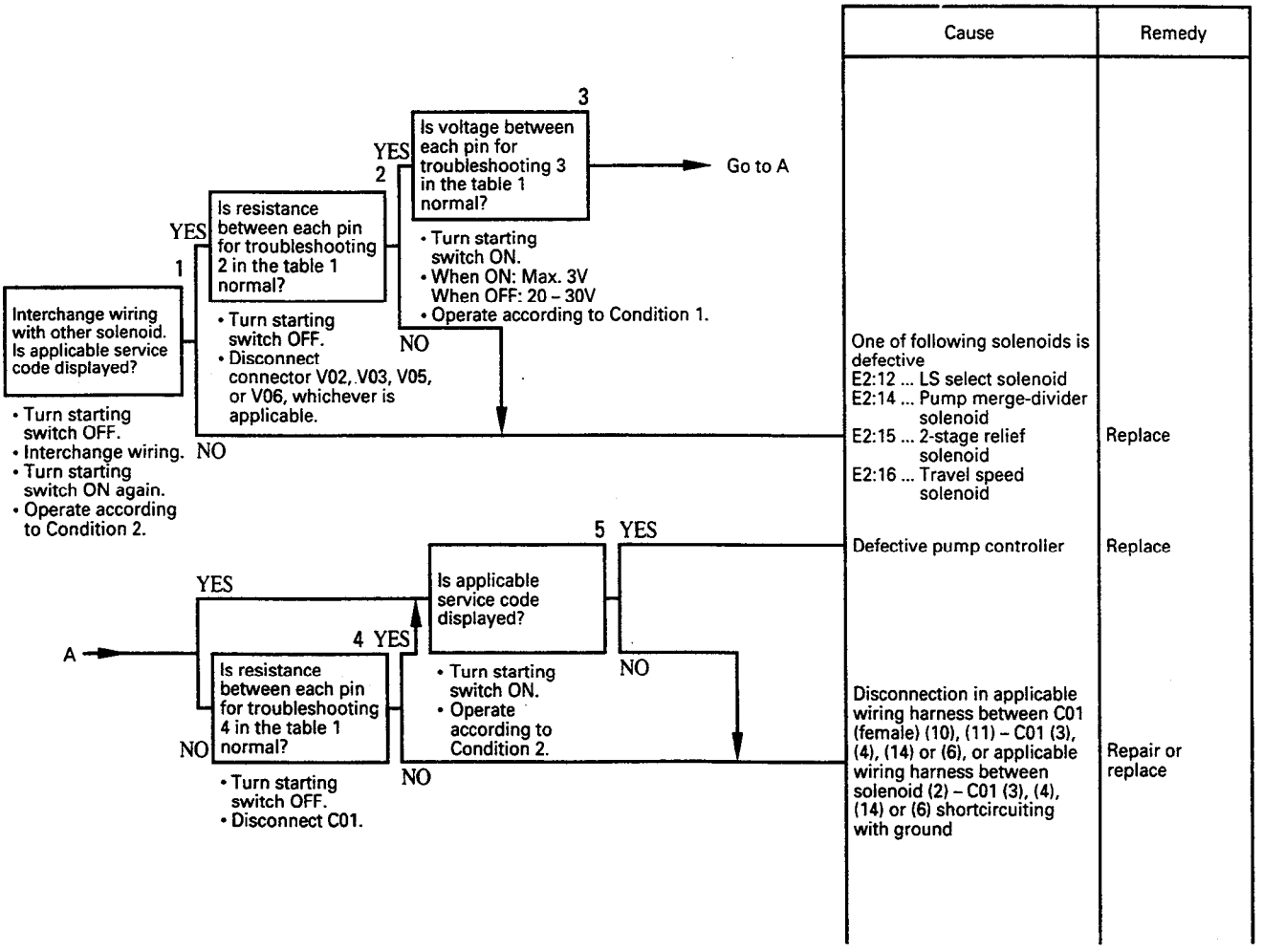
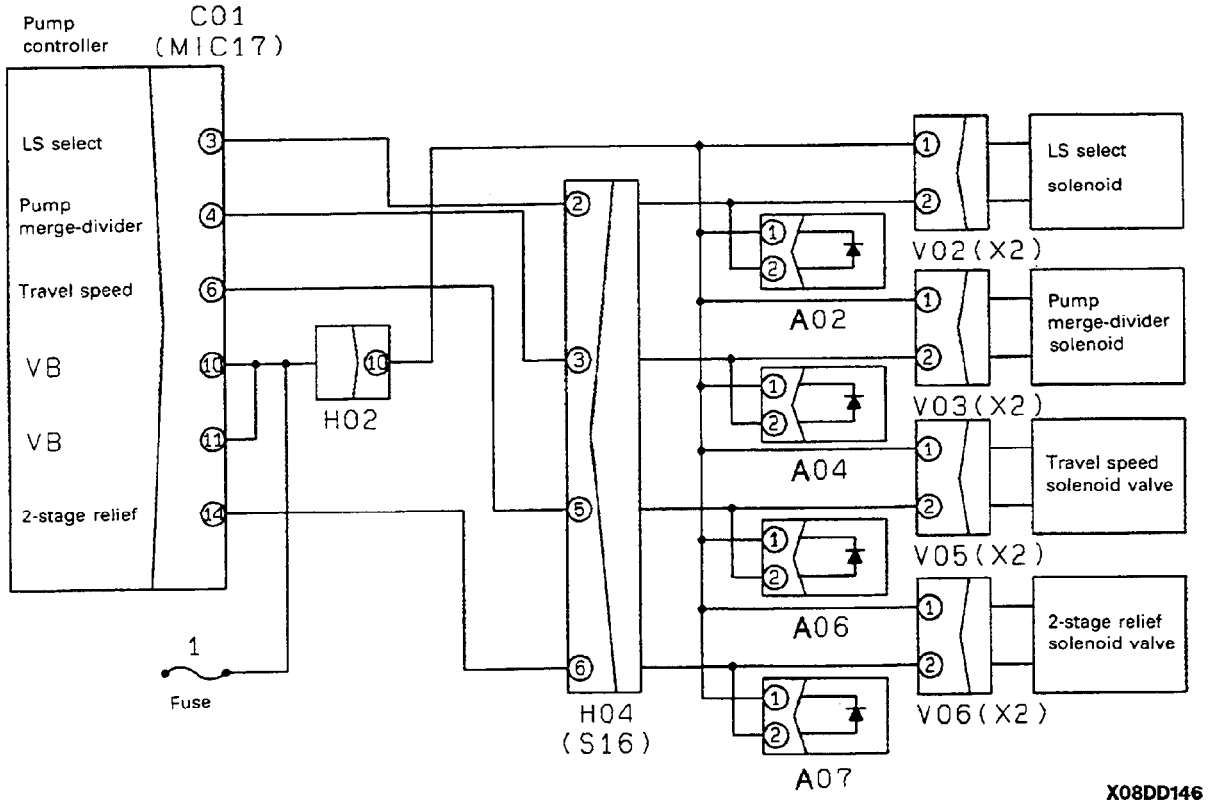


Table 1

Service code	Measurment location						Condition 2
	Troubleshooting 2		Troubleshooting 3		Troubleshooting 4		
			Voltage between each pin	Condition 1			
E2:12	Between V02 (male) (1) and (2)	20 - 60 Ω	Between C01 (female) (3) and chassis	When ON: same as Condition 2 When OFF: Swing lever at neutral	Between C01 (female) (10), (11) and (3)	20 - 60 Ω	Turn starting switch to START to start engine, then turn boom/swing priority selection mode OFF, and operate boom lever slightly to RAISE position (but do not move boom) ★ (Note)
					Between C01 (female) (3) and chassis	Min. 1 MΩ	
E2:14	Between V03 (male) (1) and (2)	20 - 60 Ω	Between C01 (famale) (4) and chassis	When ON: same as Condition 2 When OFF: When control levers are at neutral in mode other than L/O	Between C01 (female) (10), (11) and (4)	20 - 60 Ω	Set working mode switch to L/O mode
					Between C01 (female) (4) and chassis	Min. 1 MΩ	
E2:15	Between V05 (male) (1) and (2)	20 - 60 Ω	Between C01 (female) (14) and chassis	When ON: same as Condition 2 When OFF: Swing lock switch OFF	Between C01 (female) (10), (11) and (14)	20 - 60 Ω	Turn swing lock switch ON
					Between C01 (female) (14) and chasis	Min. 1 MΩ	
E2:16	Between V06 (male) (1) and (2)	20 - 60 Ω	Between C01 (female) (6) and chassis	When ON: same as Condition 2 When OFF: Travel levers at neutral	Between C01 (female) (6), (11) and (6)	20 - 60 Ω	Start engine, set travel speed switch to Mii, turn fuel
					Between C01 (female) (6) and chassis	Min. 1 MΩ	

Note: When the accumulator is charged, it is possible to carry out the same operation with the starting switch ON.

C-7 Related electric circuit diagram



C-8 [E2:17] Model selection input error is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if E2:17 is displayed. (If it is not displayed, the problem has been removed.)

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

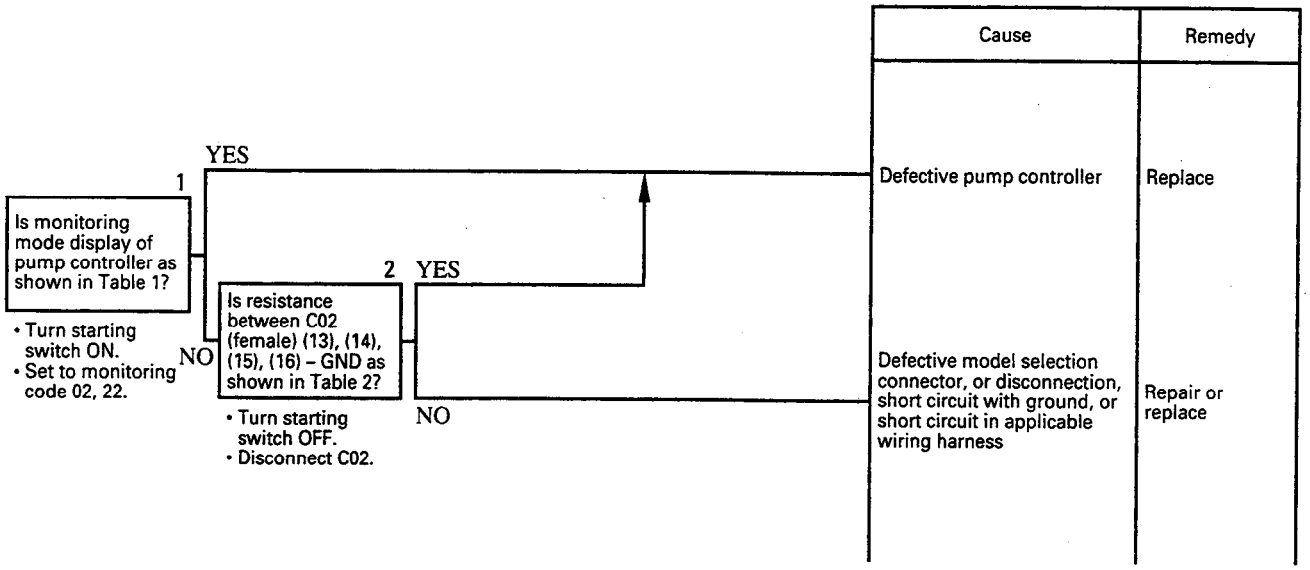


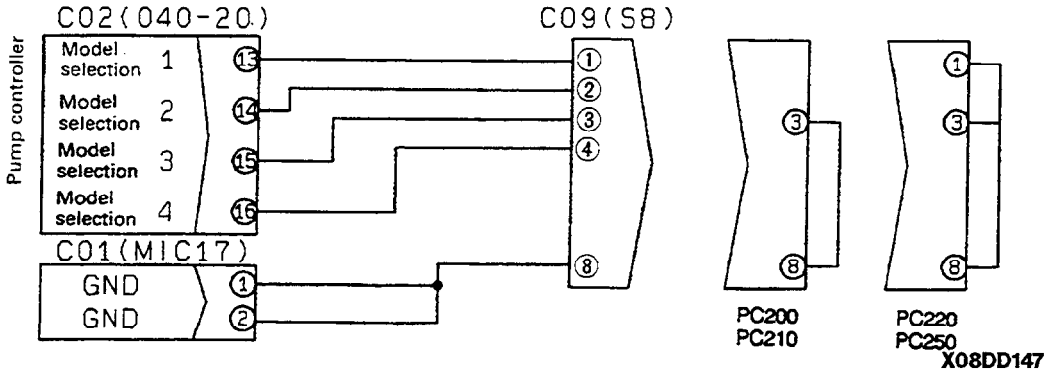
Table 1 Monitoring display (Time display portion) ■: ON □: OFF

	Condition of engine throttle controller input	Engine throttle controller model code
PC200 PC210	22° □□□ 22. □■□	02.200
PC220 PC250	22° □□□ 22. □■■	02.220

Table 2 Resistance value

Applicable wiring harness	PC200 PC210	PC220 PC250
Between C02 (female) (13) and GND	Min. 1 MΩ	Max. 1 Ω
Between C02 (female) (14) and GND	Min. 1 MΩ	Min. 1 MΩ
Between C02 (female) (15) and GND	Max. 1 Ω	Max. 1 Ω
Between C02 (female) (16) and GND	Min. 1 MΩ	Min. 1 MΩ

C-8 Related electric circuit diagram



C-9 [E2:18] Network response overtime error is displayed

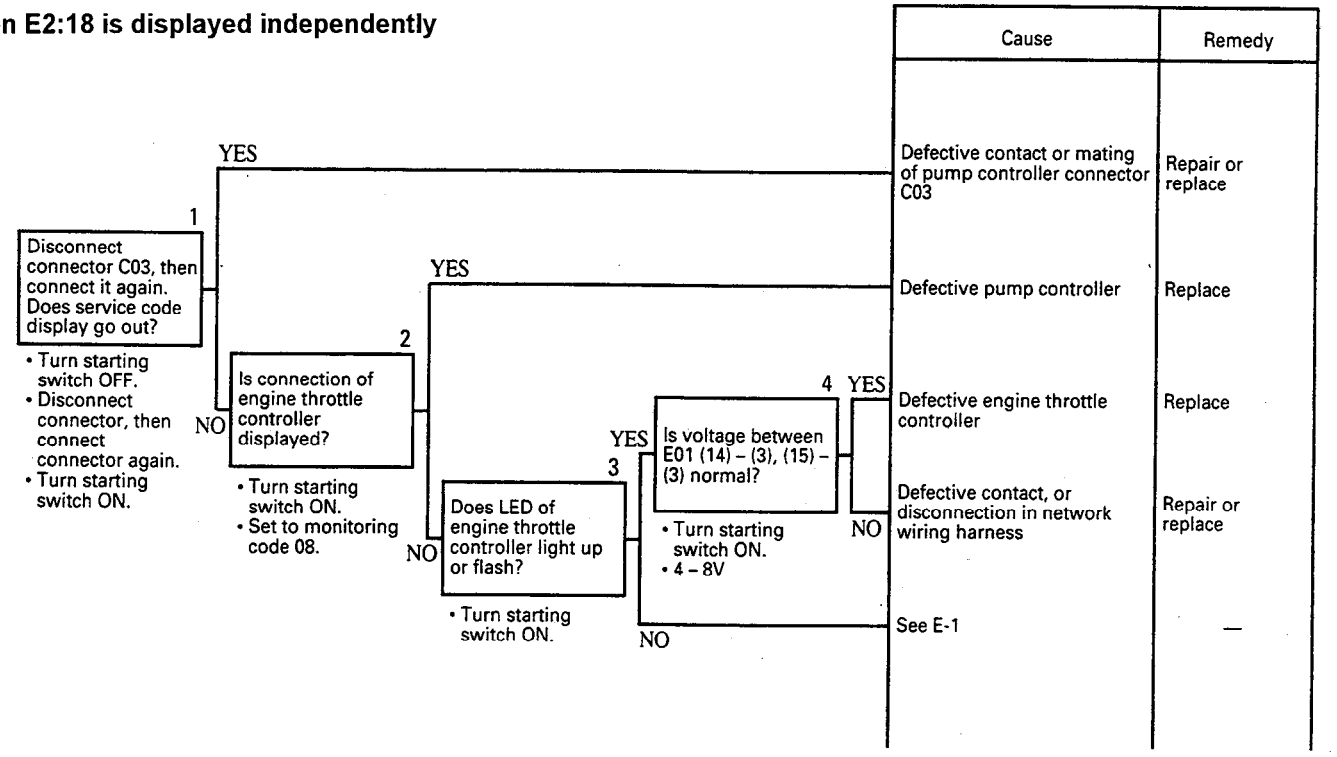
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

★ If the starting switch is turned ON when there is a disconnection in the wiring harness between the monitor panel and the controller, or the positive end (+) of the network wiring harness or the inside of the controller are short circuited, the controller cannot carry out networking, so the monitor panel does not display any abnormality.

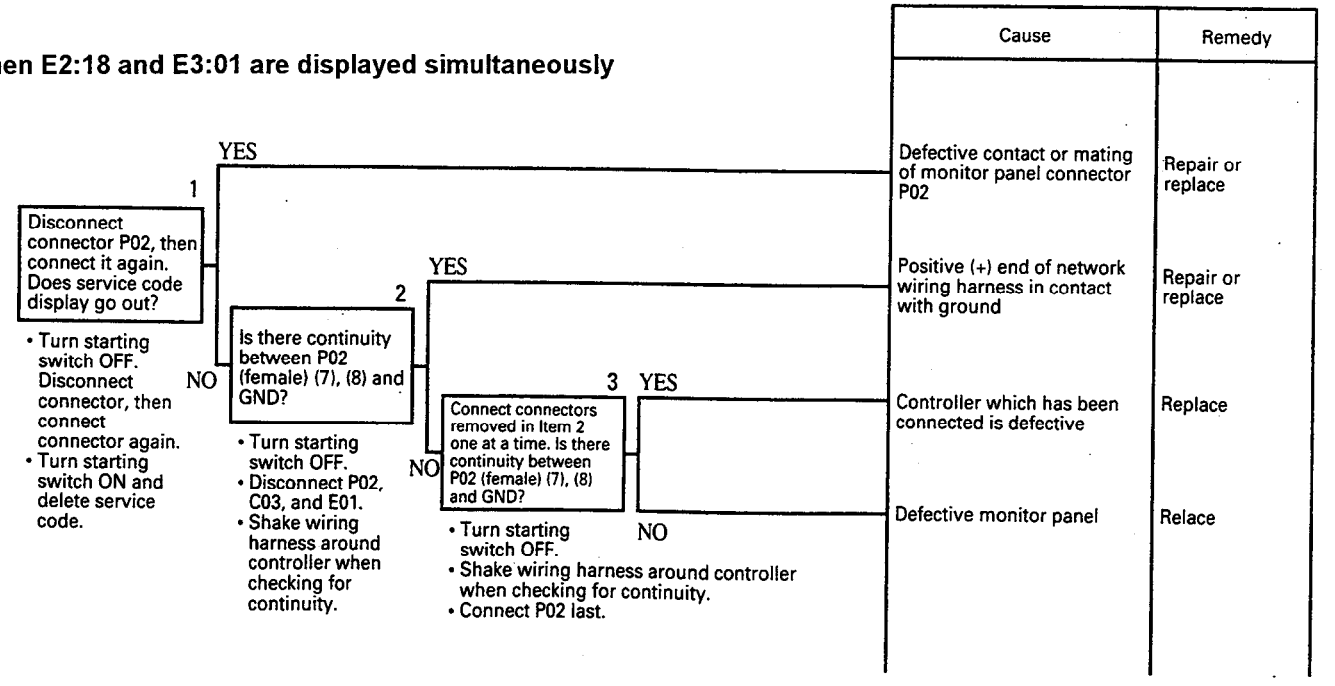
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

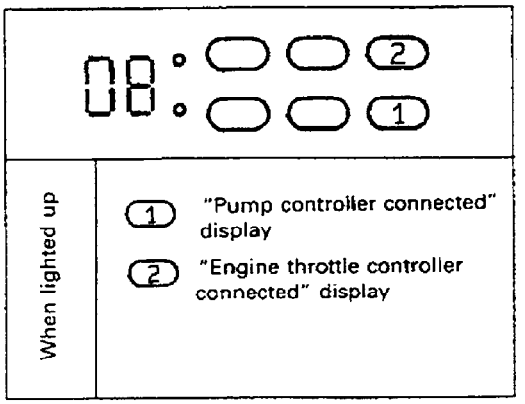
When E2:18 is displayed independently



When E2:18 and E3:01 are displayed simultaneously

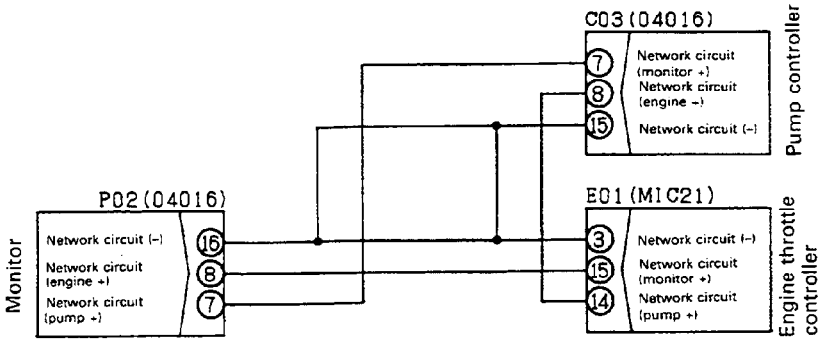


Monitoring display (Time display portion)



X08DD132

E-5 Related electric circuit diagram

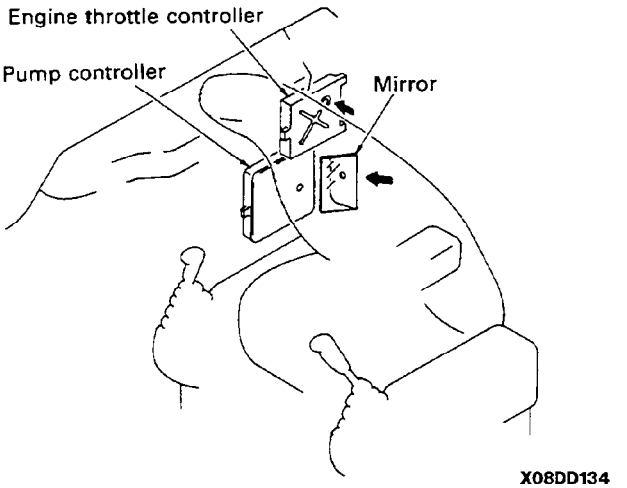


X08DD133

★ Check for the LED display for the engine throttle controller and pump controller from the direction of the arrow as shown in the diagram on the right.

Note 1: Push the operator's seat down to the front, then remove the two rear covers to check.

Note 2: The LED display for the pump controller is difficult to see, so use a mirror.



X08DD134

C-10 [E2:22] Short circuit in LS control EPC solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if E2:22 is displayed. (If it is not displayed, the problem has been removed.)

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

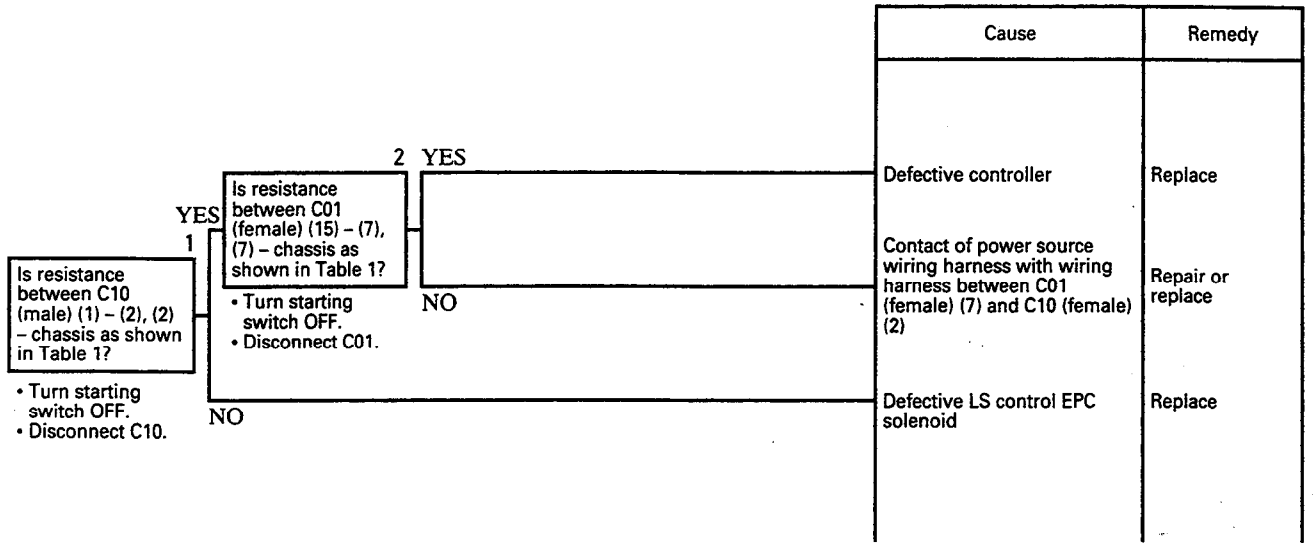
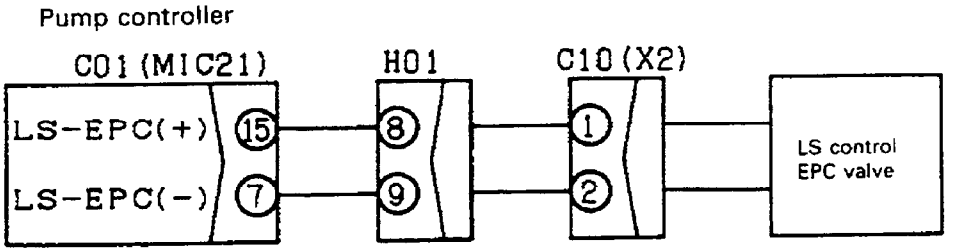


Table 1

C10 (male)	C01 (female)	Resistance value
Between (1) and (2)	Between (15) and (7)	7 - 14 Ω
Between (2) and chassis	Between (7) and chassis	Min. 1 MΩ

C-10 Related electric circuit diagram



X08DD148

C-11 [E2:23] Disconnection in LS control EPC solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if E2:23 is displayed. (If it is not displayed, the problem has been removed.)

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

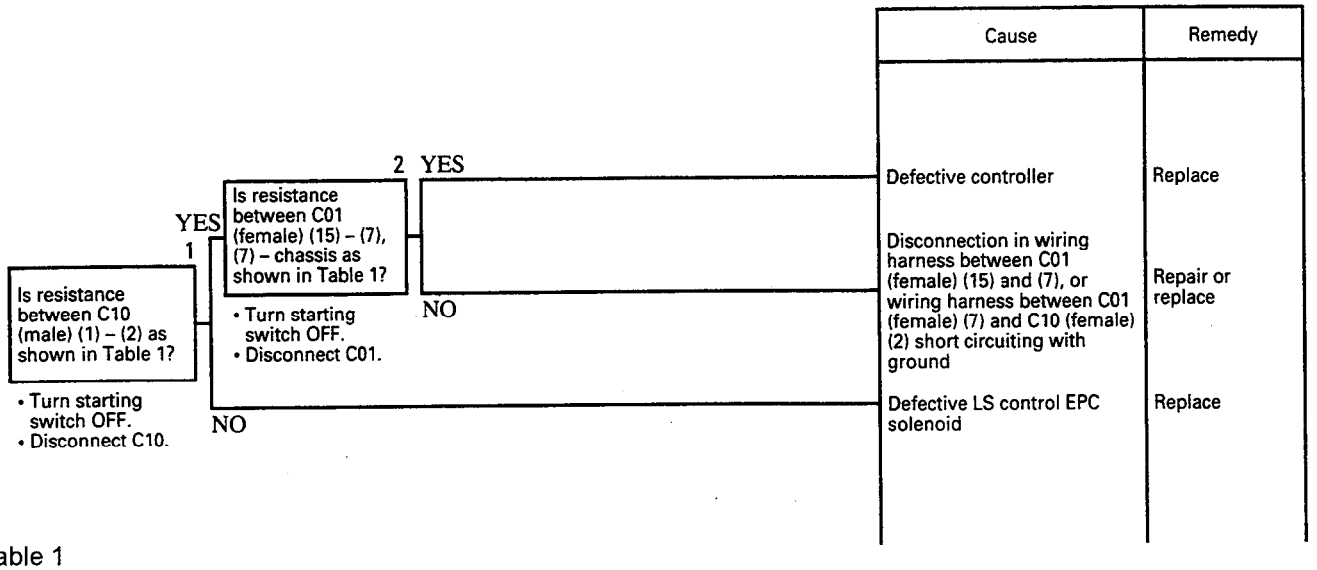
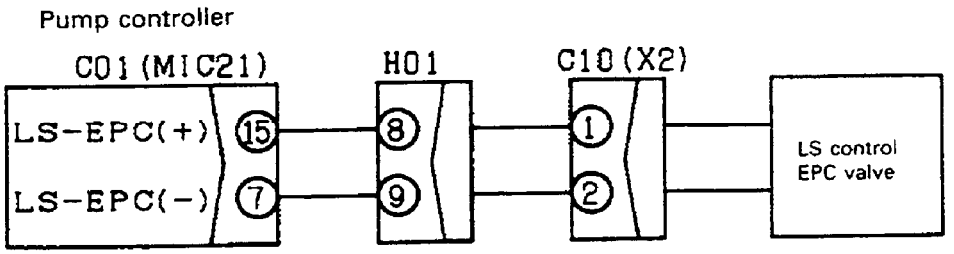


Table 1

C10 (male)	C01 (female)	Resistance value
Between (1) and (2)	Between (15) and (7)	7 - 14 Ω
Between (2) and chassis	Between (7) and chassis	Min. 1 MΩ

C-11 Related electric circuit diagram



X08DD148

C-12 [E2:24] Abnormality in front pump pressure sensor system is displayed
[E2:25] Abnormality in rear pump pressure sensor system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON, start the engine, and check if any service code is displayed. (If it is not displayed, the problem has been removed.)
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

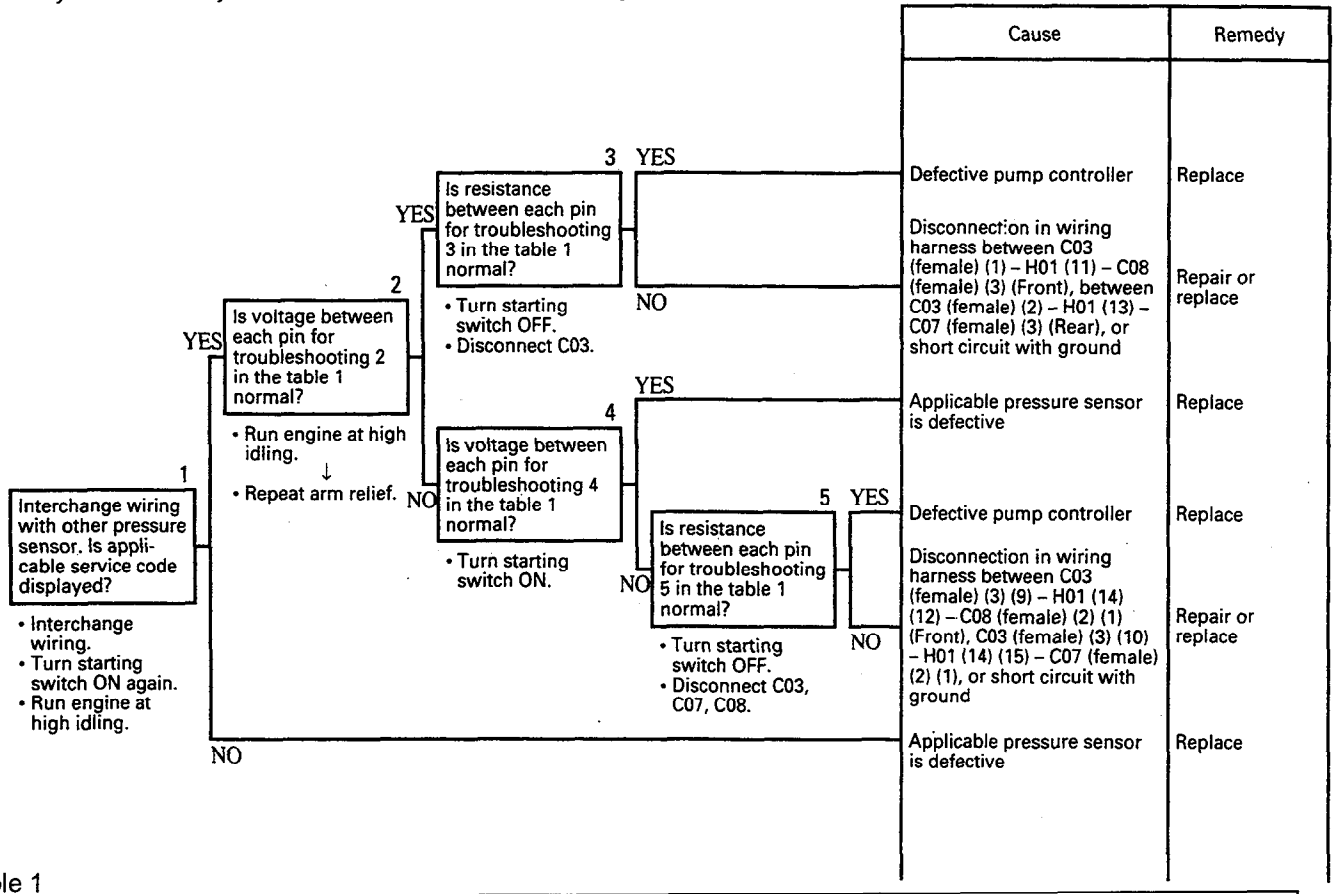
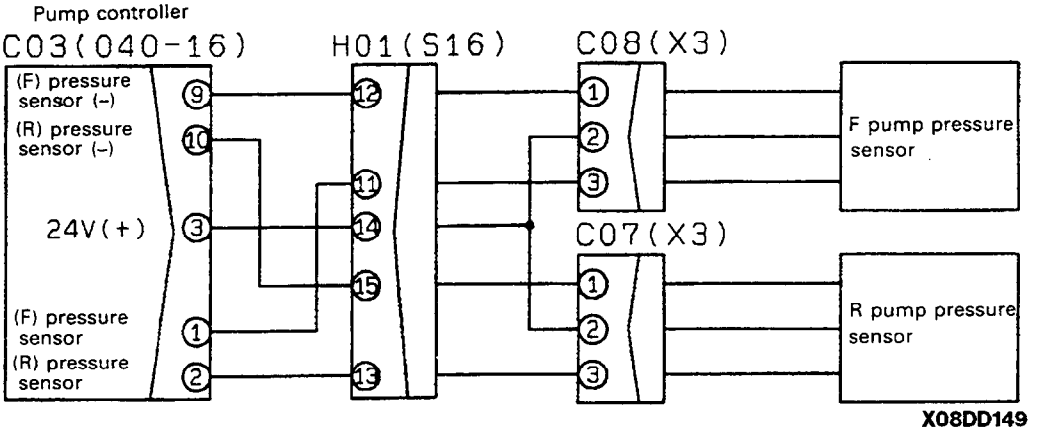


Table 1

Service code	Measurement location							
	Troubleshooting 2		Troubleshooting 3		Troubleshooting 4		Troubleshooting 5	
E2 : 24	Between C08 (3) and (1)	0.5 - 4.5 V	Between C03 (female) (1) and (9)	Min. 1 MΩ	Between C08 (2) and (1)	18 - 28 V	Between C03 (female) (3) and (9)	Min. 1 MΩ
			Between C03 (female) (1), (9) and chassis				Between C03 (female) (3), (9) and chassis	
E2 : 25	Between C07 (3) and (1)		Between C03 (female) (2) and (10)		Between C07 (2) and (1)		Between C03 (female) (3) and (10)	
			Between C03 (female) (2), (10) and chassis				Between C03 (female) (3), (10) and chassis	

C-12 Related electric circuit diagram



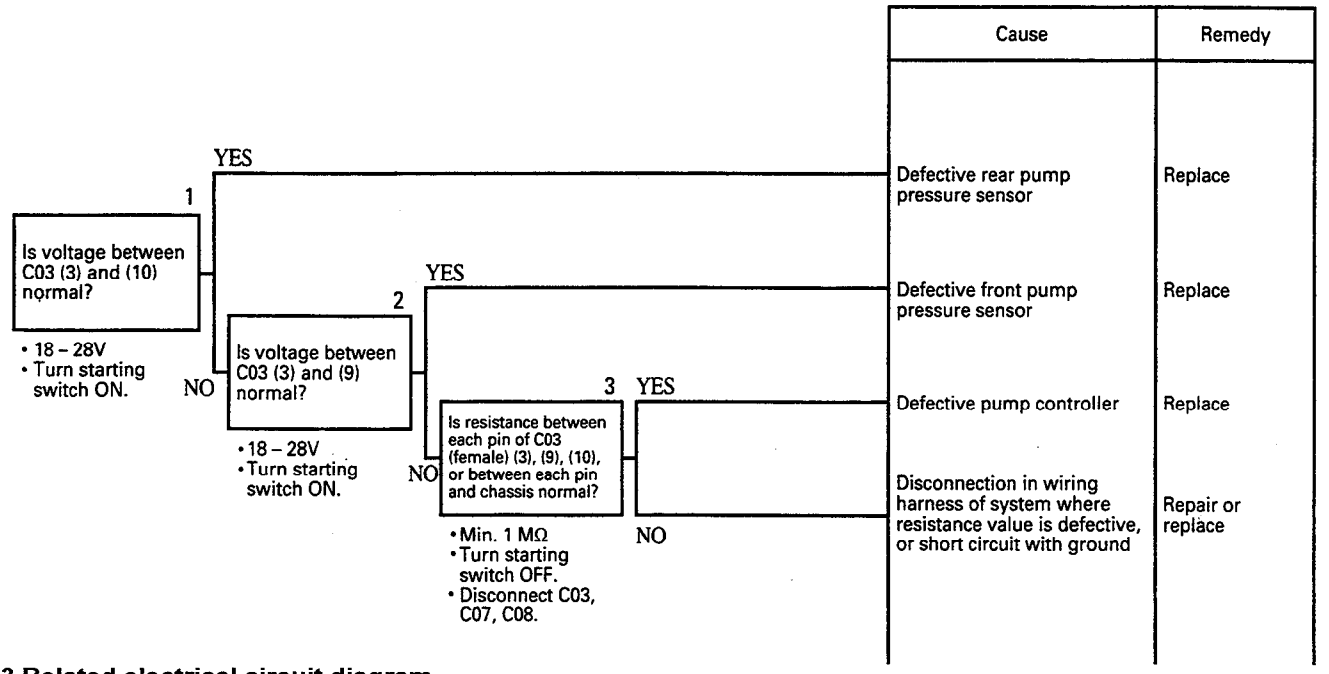
C-13 [E2:26] Abnormality in pump pressure sensor power source system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

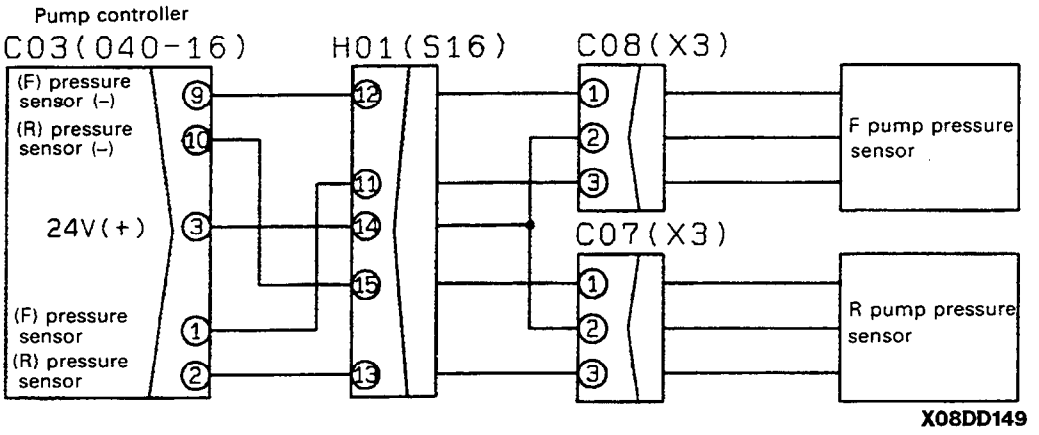
★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if E2:26 is displayed. (If it is not displayed, the problem has been removed.)

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.



C-13 Related electrical circuit diagram



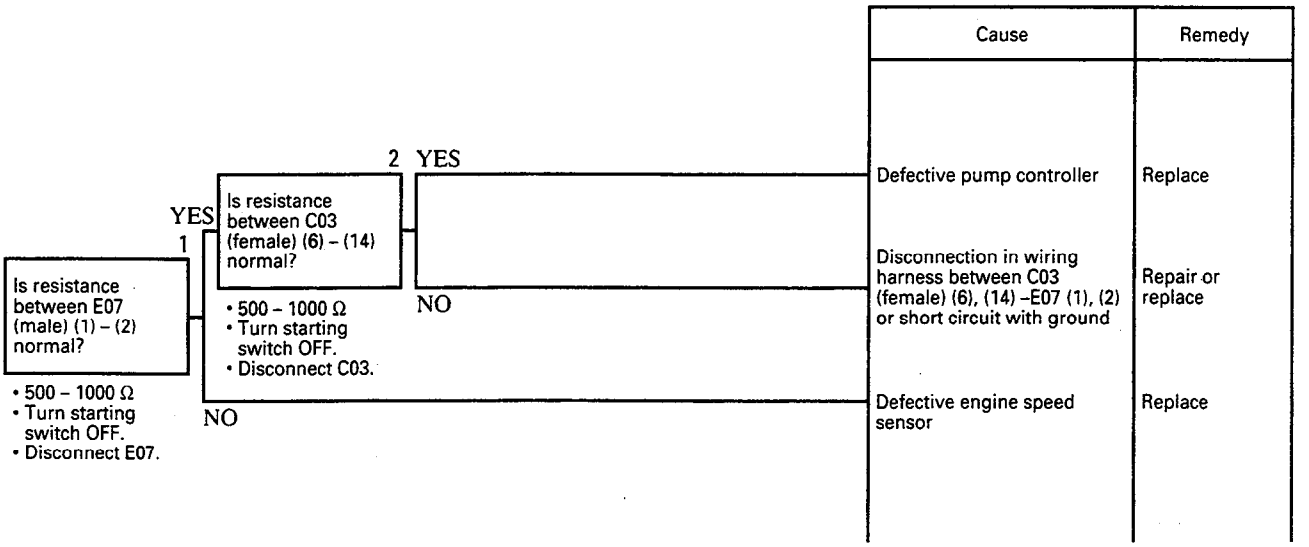
C-14 [E2:27] Abnormality in engine speed sensor system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

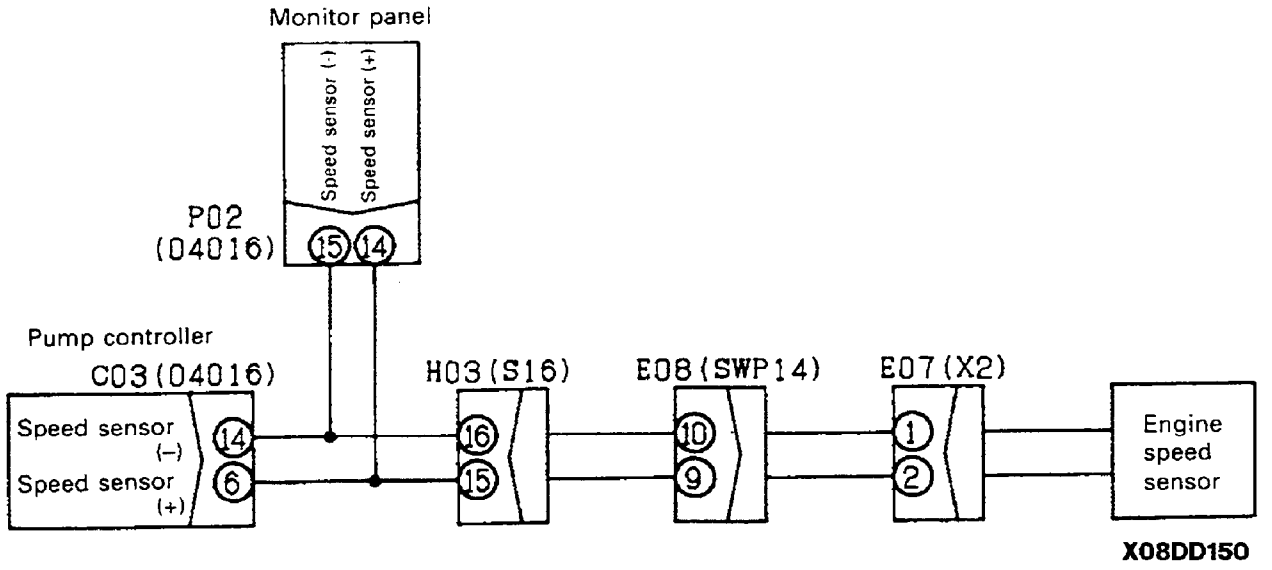
★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if E2:26 is displayed. (If it is not displayed, the problem has been removed.)

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.



C-14 Related electric circuit diagram



C-15 [E2:28] Abnormality in auto-deceleration output system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ When the auto-deceleration switch is ON.
★ If the starting switch is turned OFF after an abnormality occurs, start the engine, operate the control lever (neutral ↔ operated) with the auto-deceleration ON, and check if E2:28 is displayed. (If it is not displayed, the problem has been removed.)
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

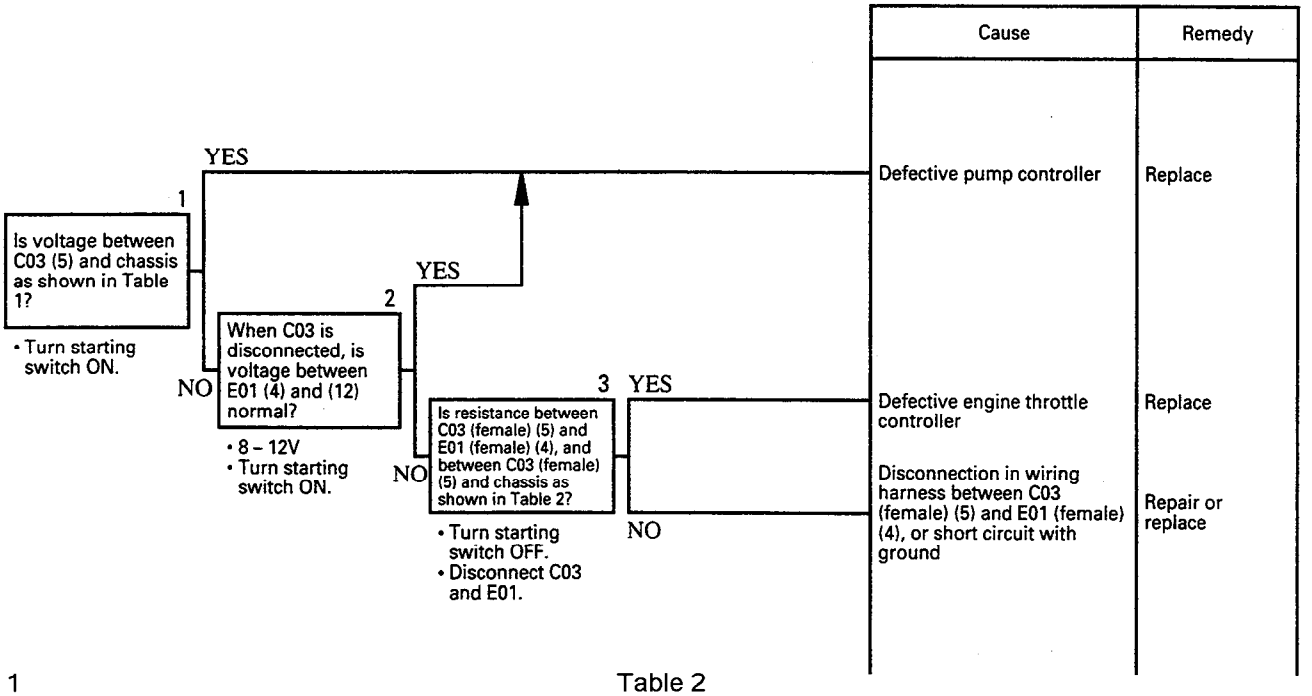


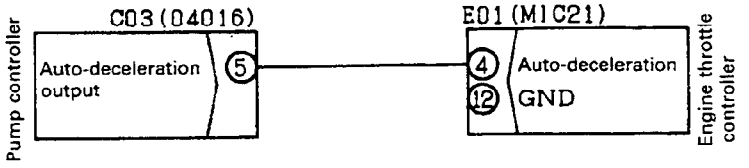
Table 1

Operation	Voltage between C03 (female) (5) and chassis
Auto-deceleration switch ON, levers at neutral	8 - 12 V
Auto-deceleration switch OFF, levers at neutral	0 - 1 V

Table 2

Connector	Resistance value
Between C03 (female) (5) and C01 (female) (4)	Max. 1 Ω
Between C03 (female) (5) and chassis	Min. 1 MΩ

C-15 Related electric circuit diagram



X08DD151

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TROUBLESHOOTING OF PUMP CONTROLLER INPUT SIGNAL SYSTEM (F MODE)

★ When the monitoring mode is checked, if the following input signals are not displayed or do not light up, carry out troubleshooting for that item.

Troubleshooting flow charts for each failure mode

F- 1 Bit pattern 20-(1) Swing oil pressure switch does not light up 20-196
F- 2 Bit pattern 20-(2) Travel oil pressure switch does not light up 20-197
F- 3 Bit pattern 20-(3) Boom LOWER oil pressure switch does not light up 20-198
F- 4 Bit pattern 20-(4) Boom RAISE oil pressure switch does not light up 20-199
F- 5 Bit pattern 20-(5) Arm IN oil pressure switch does not light up 20-200
F- 6 Bit pattern 20-(6) Arm OUT oil pressure switch does not light up 20-201
F- 7 Bit pattern 21-(1) Bucket CURL oil pressure does not light up 20-202
F- 8 Bit pattern 21-(2) Bucket DUMP oil pressure does not light up 20-203
F- 9 Bit pattern 21-(3) Swing lock switch does not light up 20-204
F-10 Engine speed is not displayed in monitoring code 10 (abnormality in engine speed sensor system) 20-205
F-12 Bit pattern 22-(6) L.H. knob switch does not light up 20-206

F-1 Bit pattern 20-(1) Swing oil pressure switch does not light up

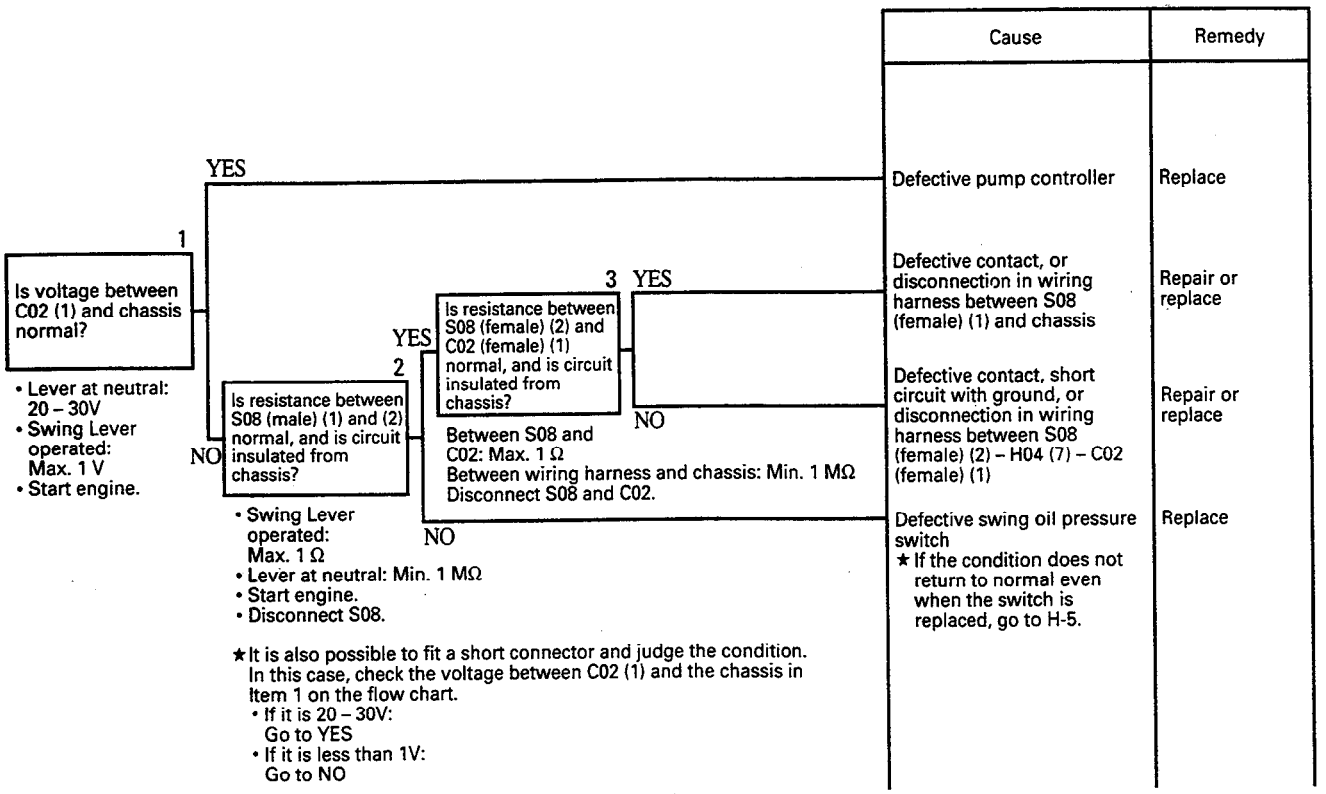
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

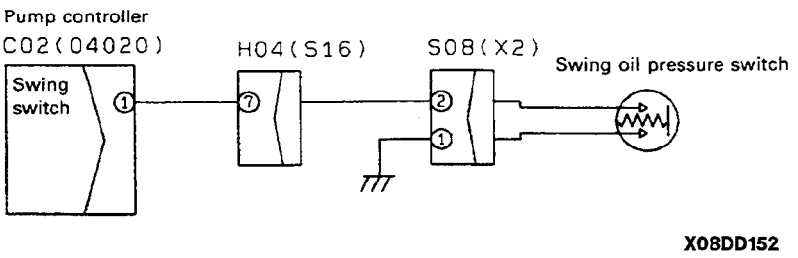
★ Always connect any disconnected connectors before going on to the next step.

⚠ Turn the swing lock ON before operating the swing lever.

★ If there is no display when the lever is operated on one side, the PPC shuttle valve is defective.



F-1 Related electric circuit diagram



X08DD152

F-2 Bit pattern 20-(2) Travel oil pressure switch does not light up

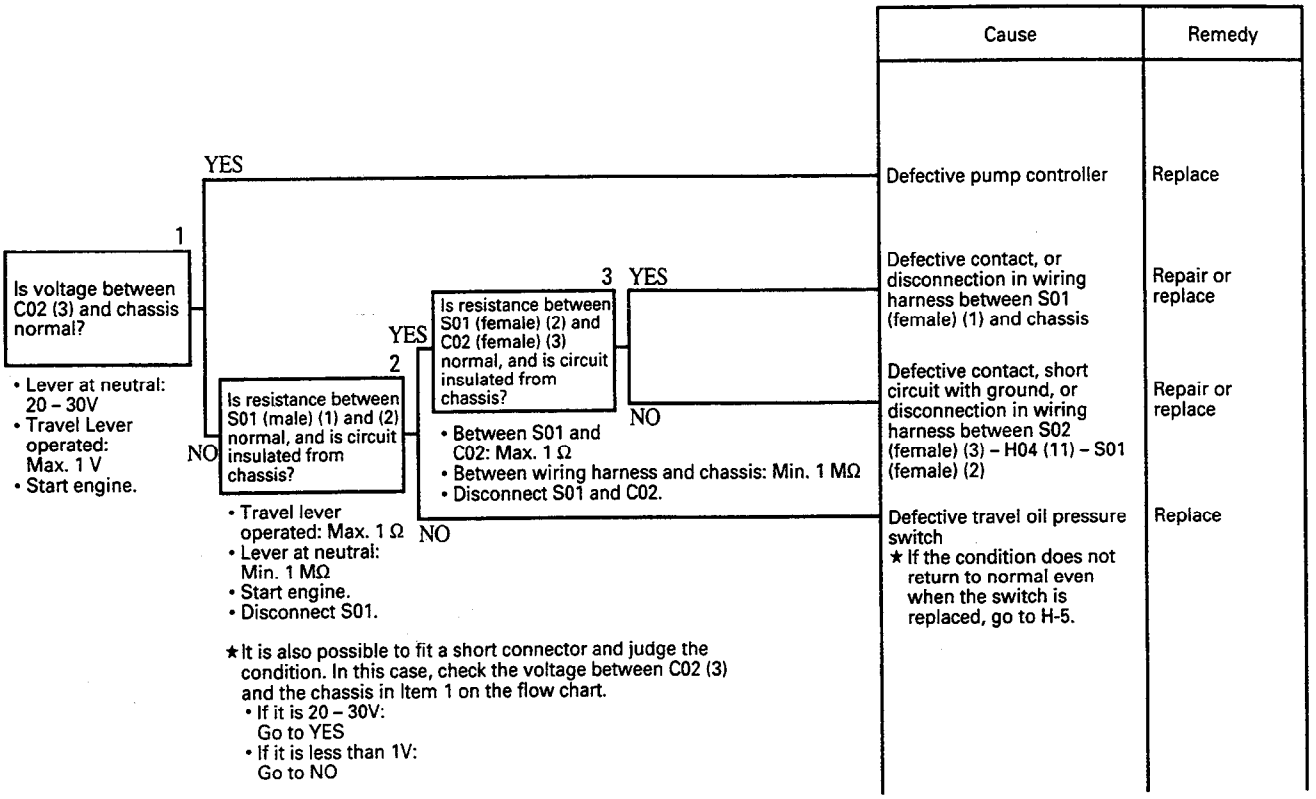
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

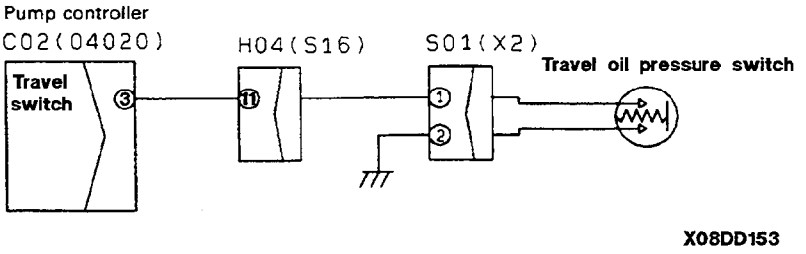
★ Always connect any disconnected connectors before going on to the next step.

⚠ Before operating the travel lever, check that the surrounding area is safe.

★ If there is no display when the travel lever is operated on one side, the PPC shuttle valve is defective.



F-2 Related electric circuit diagram



X08DD153

F-3 Bit pattern 20-(3) Boom LOWER oil pressure switch does not light up

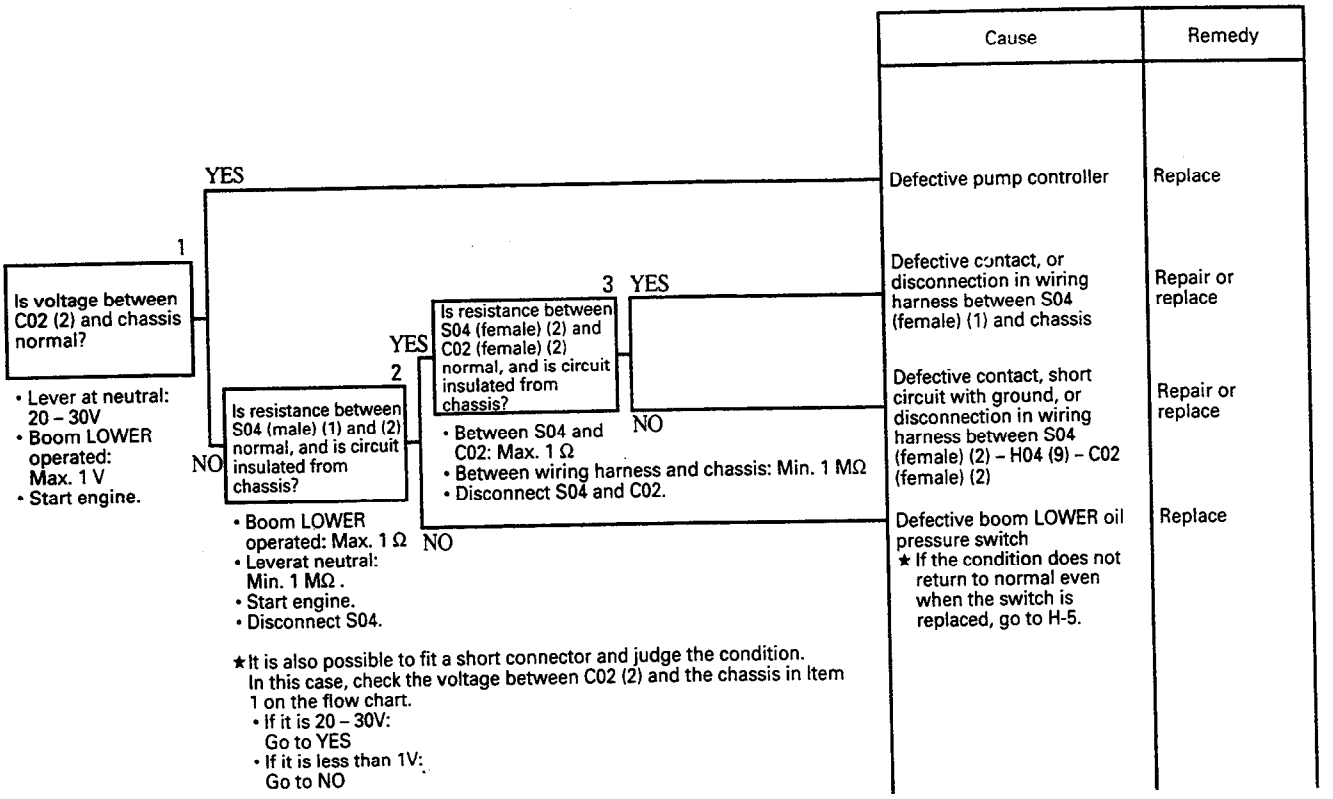
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

⚠ When measuring with the engine running, make sure that the work equipment does not move when the lever is operated.

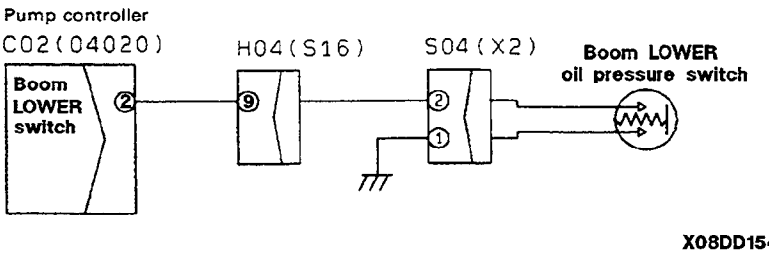
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

★ When mesuring with the engine stopped, charge the accumulator before starting.



F-3 Related electric circuit diagram



F-4 Bit pattern 20-(4) Boom RAISE oil pressure switch does not light up

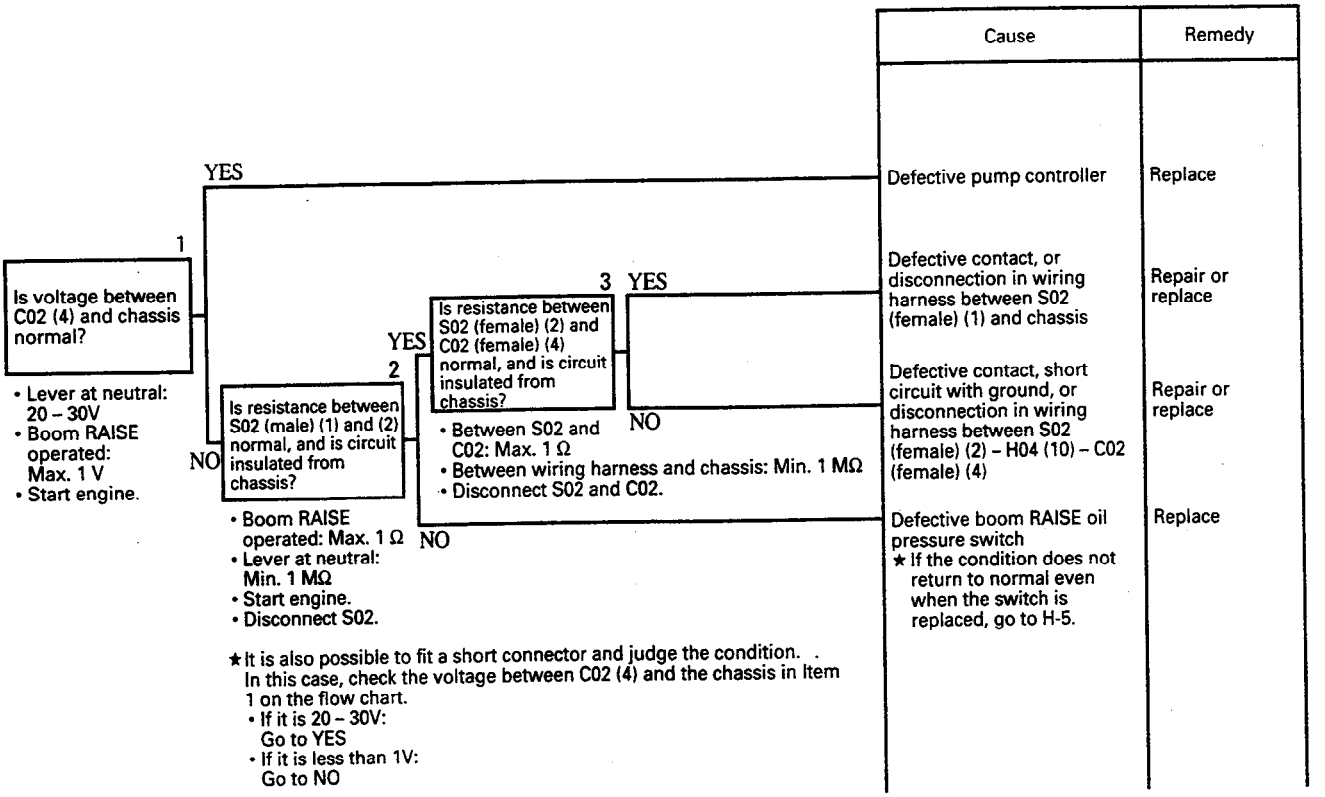
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

⚠ When measuring with the engine running, make sure that the work equipment does not move when the lever is operated.

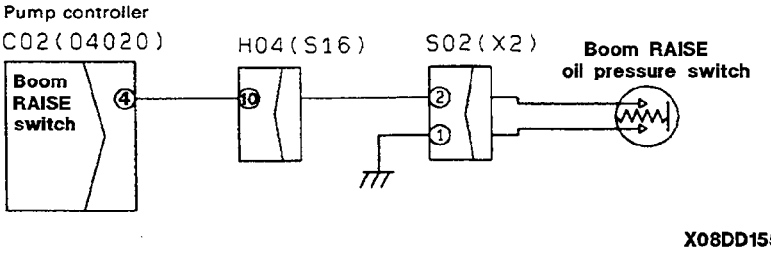
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

★ When mesuring with the engine stopped, charge the accumulator before starting.



F-4 Related electric circuit diagram



F-5 Bit pattern 20-(5) Arm IN oil pressure switch does not light up

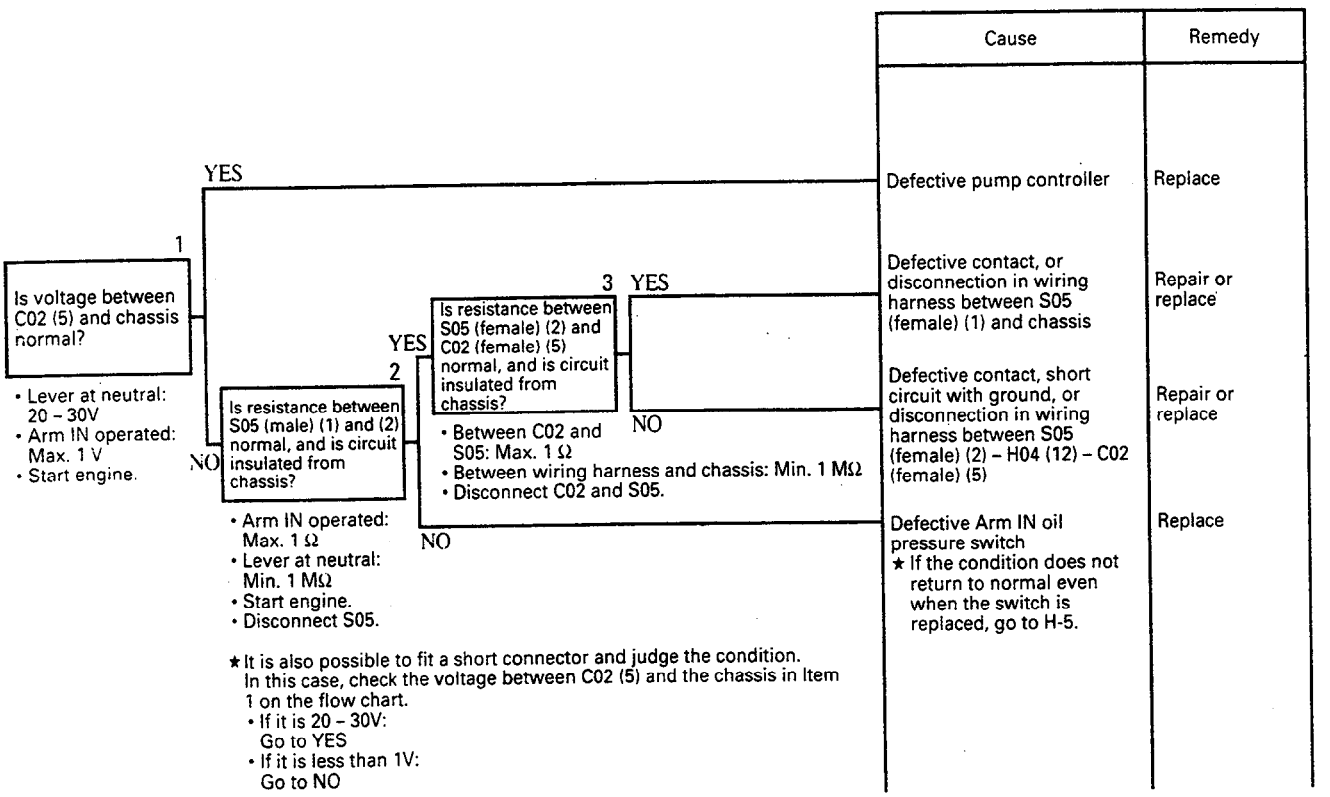
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

⚠ When measuring with the engine running, make sure that the work equipment does not move when the lever is operated.

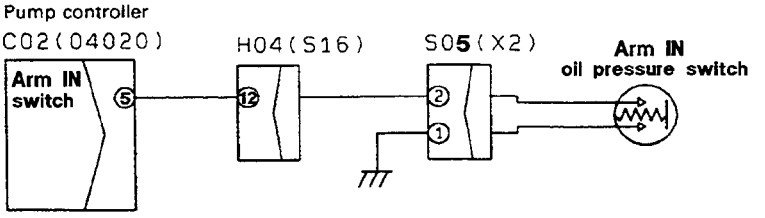
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

★ When mesuring with the engine stopped, charge the accumulator before starting.



F-5 Related electric circuit diagram



F-6 Bit pattern 20-(6) Arm OUT oil pressure switch does not light up

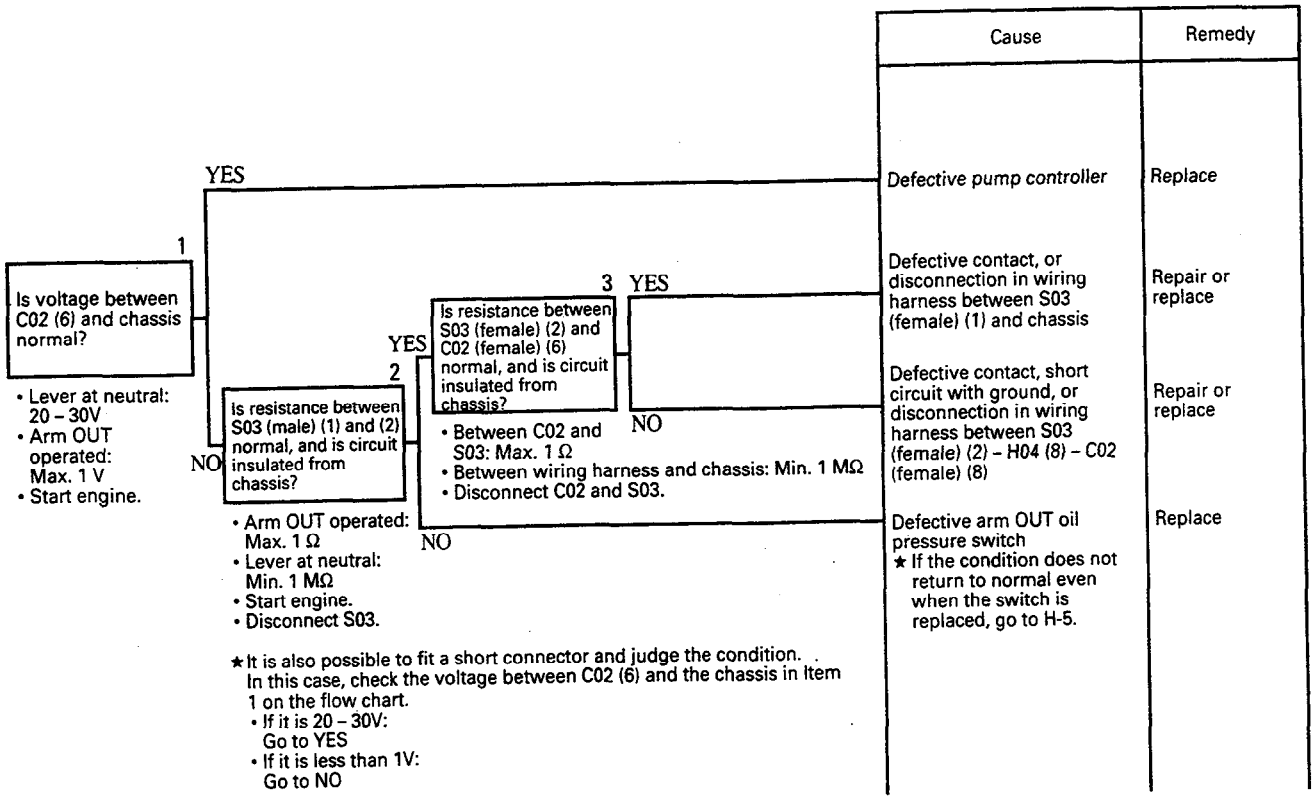
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

⚠ When measuring with the engine running, make sure that the work equipment does not move when the lever is operated.

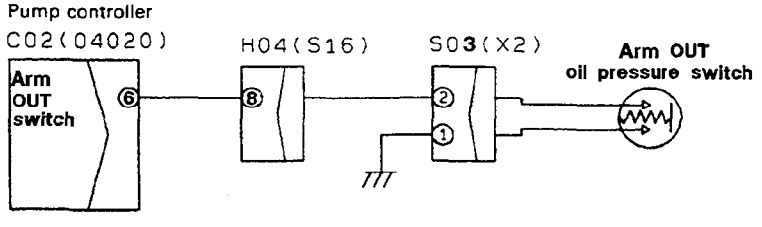
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

★ When mesuring with the engine stopped, charge the accumulator before starting.



F-6 Related electric circuit diagram



F-7 Bit pattern 21-(1) Bucket CURL oil pressure switch does not light up

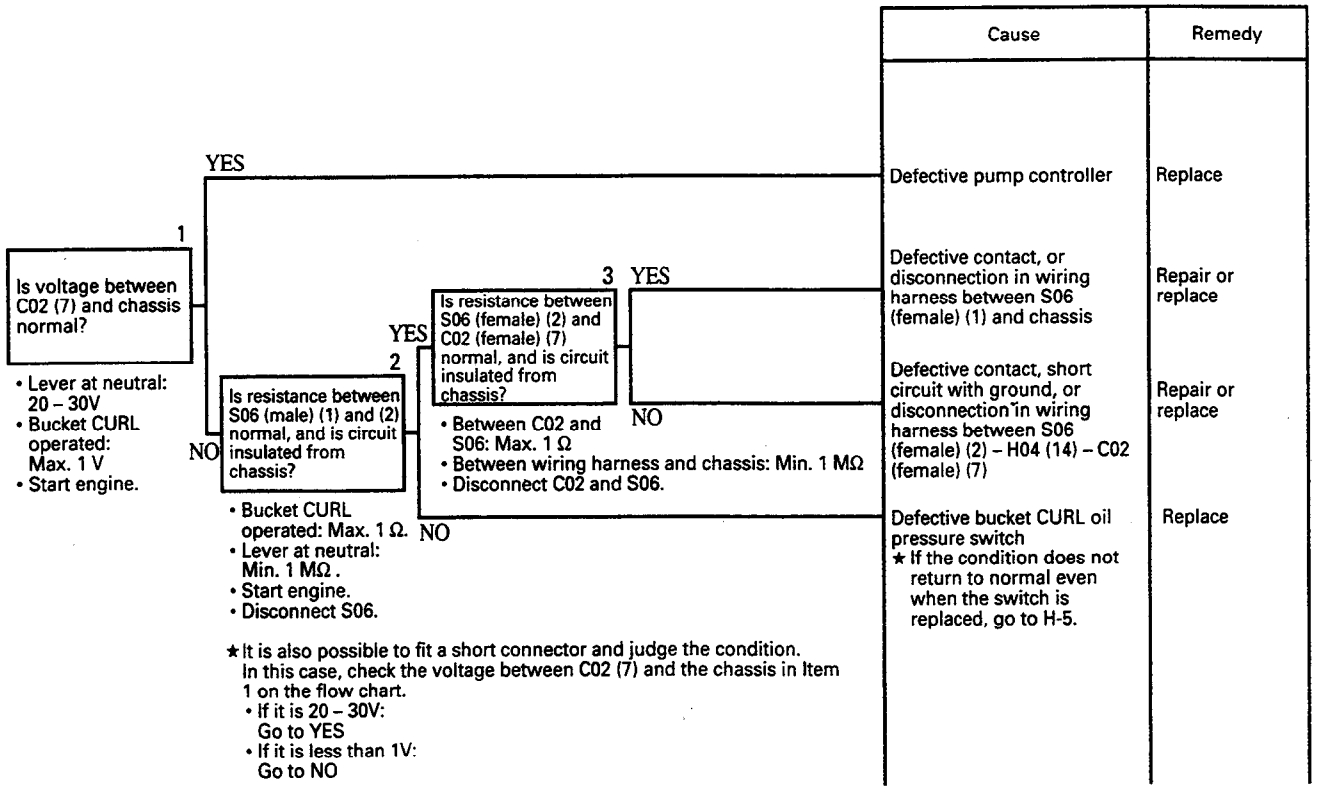
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

⚠ When measuring with the engine running, make sure that the work equipment does not move when the lever is operated.

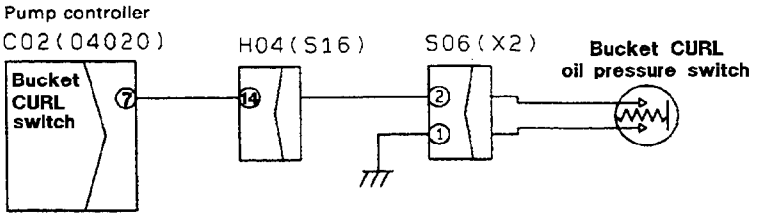
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

★ When mesuring with the engine stopped, charge the accumulator before starting.



F-7 Related electric circuit diagram



F-8 Bit pattern 21-(2) Bucket DUMP oil pressure switch does not light up

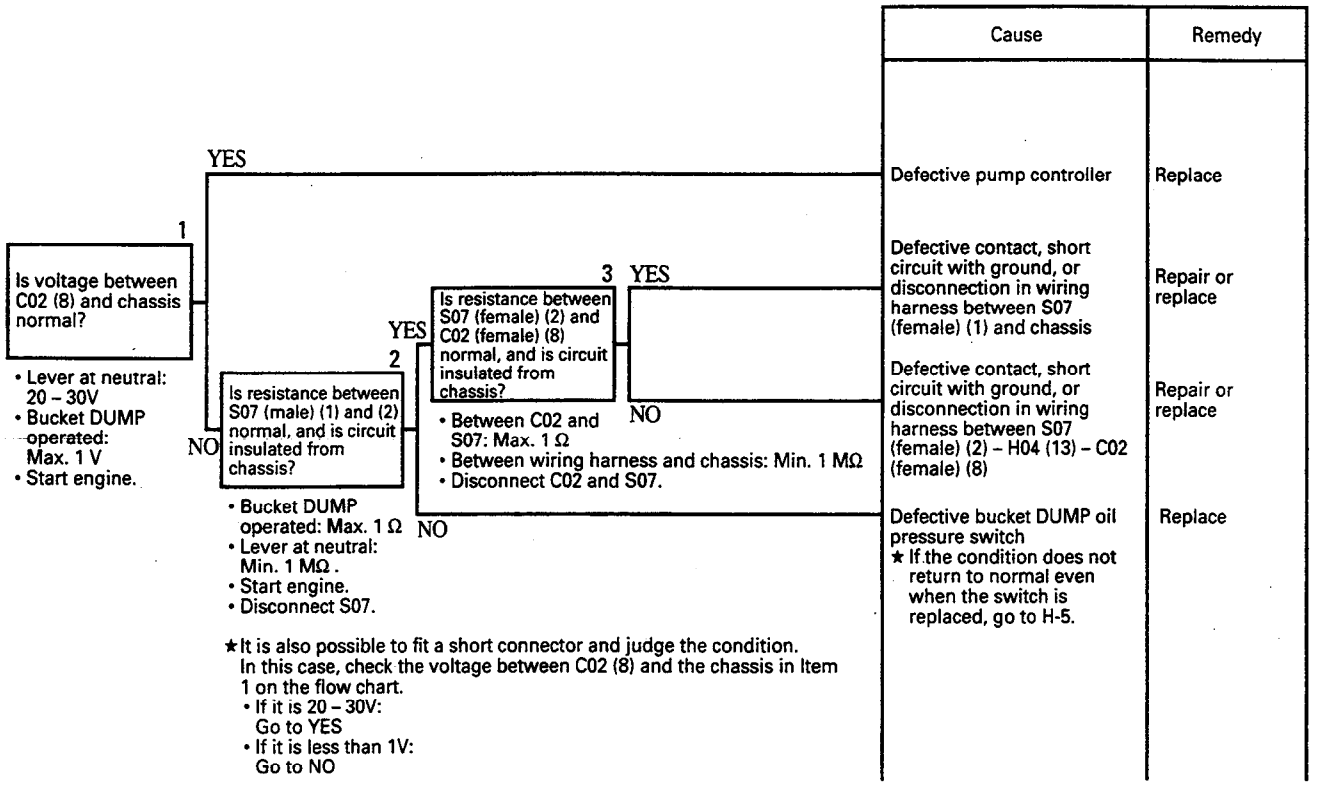
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**

⚠ When measuring with the engine running, make sure that the work equipment does not move when the lever is operated.

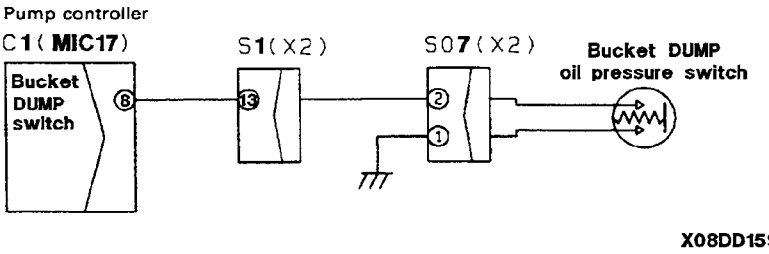
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on to the next step.

★ When mesuring with the engine stopped, charge the accumulator before starting.



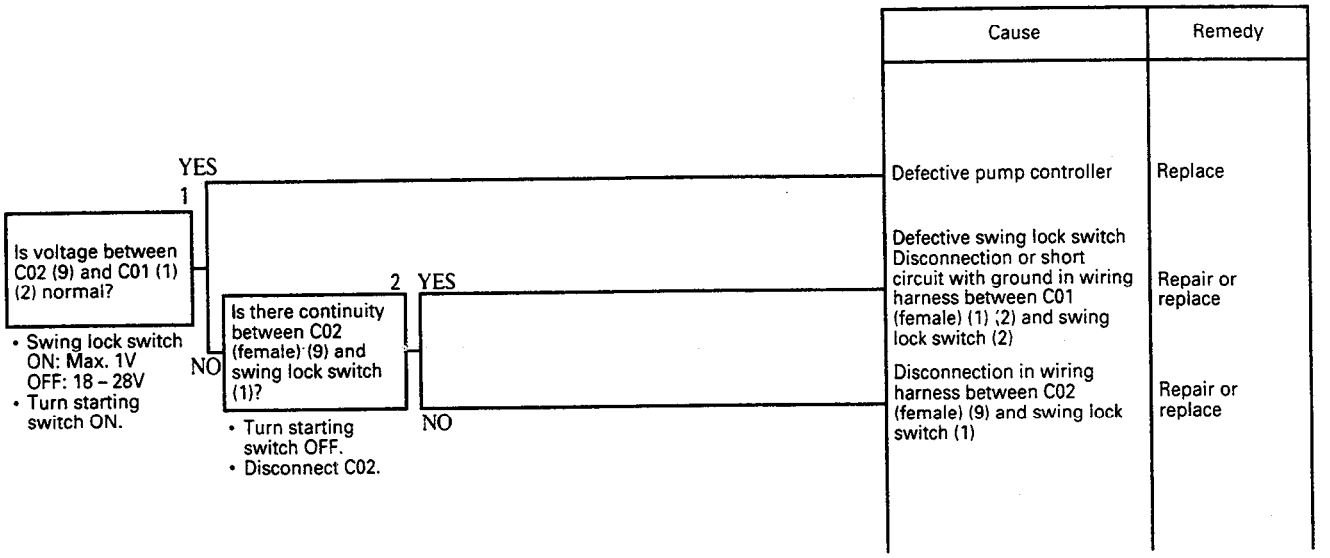
F-8 Related electric circuit diagram



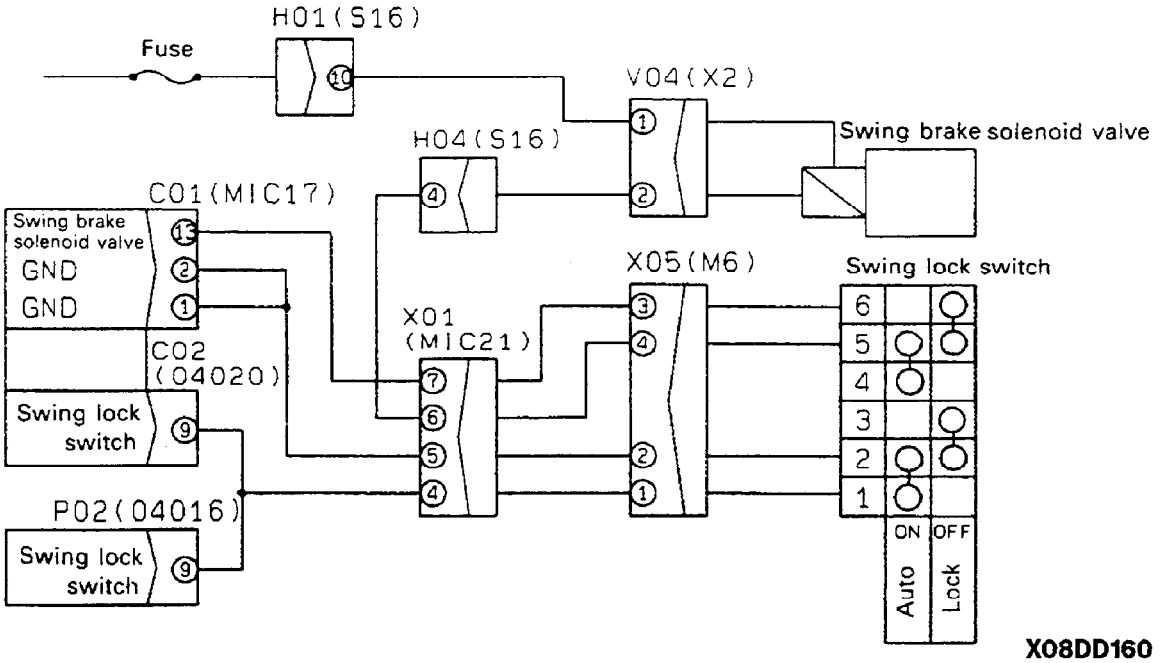
X08DD159

F-9 Bit pattern 21-(3) Swing lock switch does not light up

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ If the panel display is normal, go to M-22 when panel swing lock lamp does not light up.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

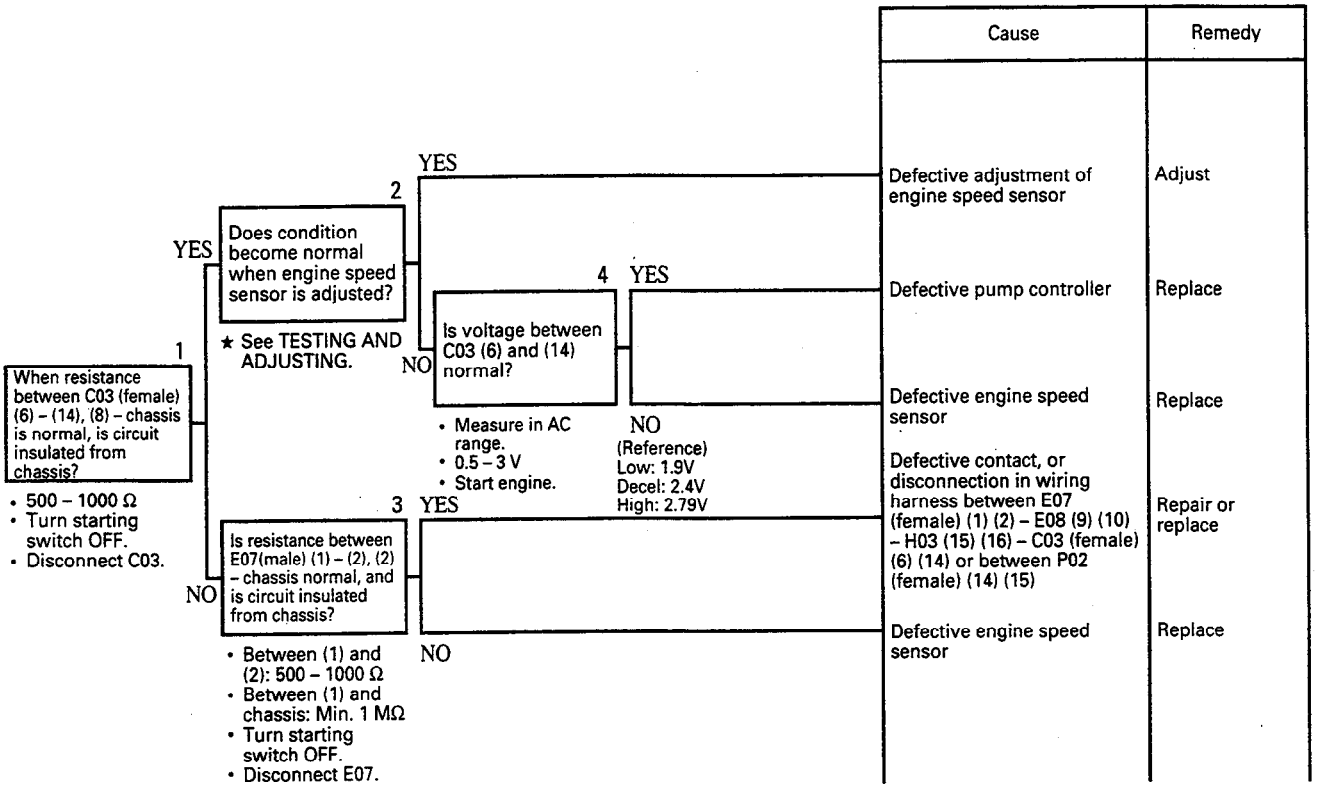


F-9 Related electric circuit diagram

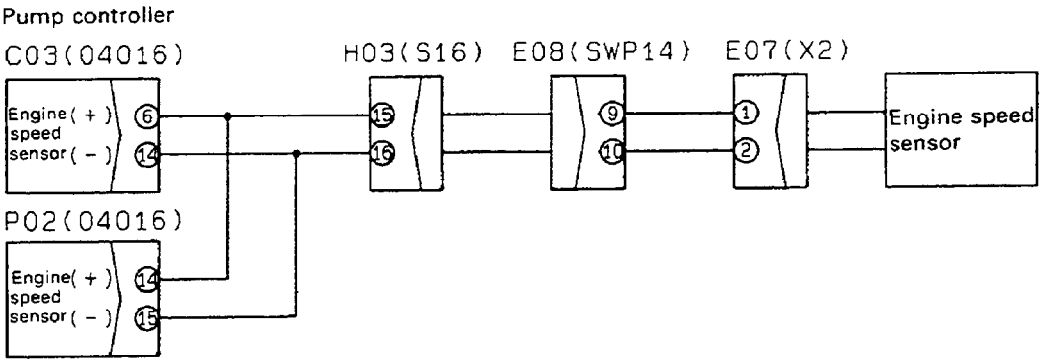


F-10 Engine speed is not displayed in monitoring code 10 (abnormality in engine speed sensor system)

★ Before carrying out troubleshooting, check that all related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.



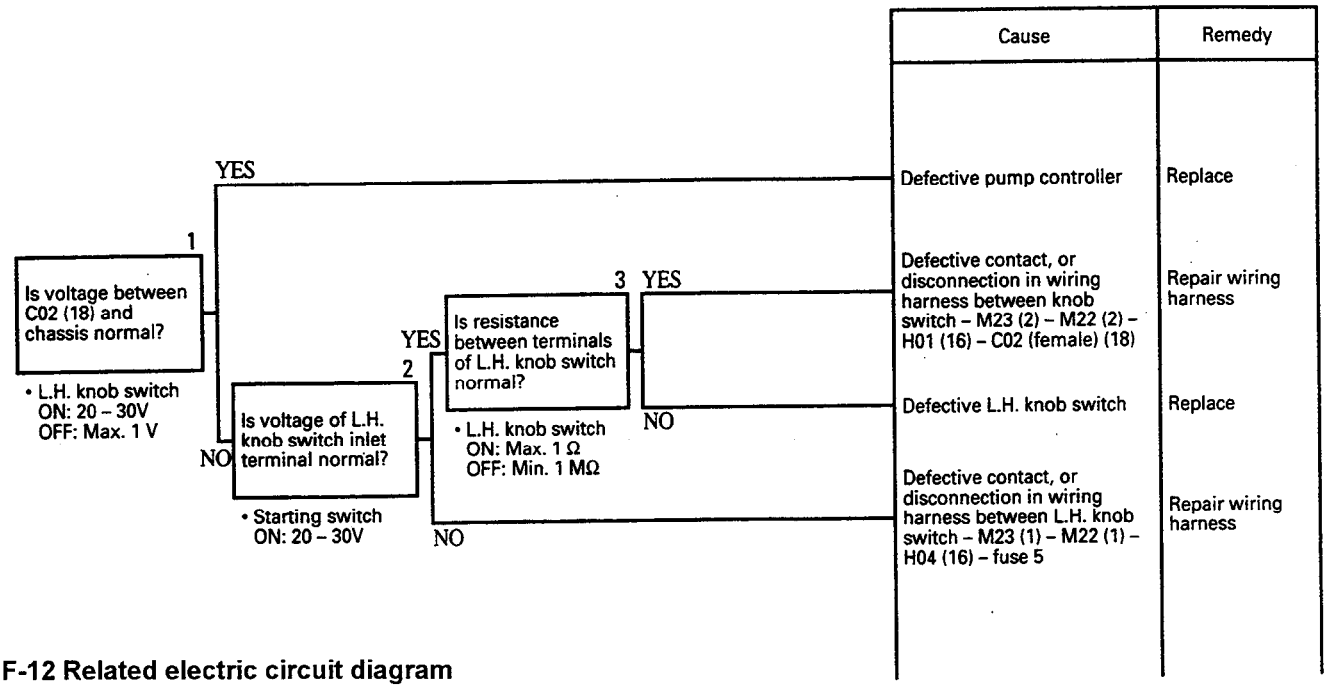
F-10 Related electric circuit diagram



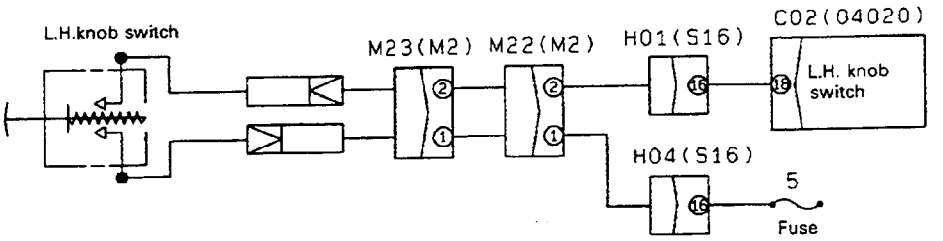
X08DD161

F-12 Bit pattern 22-(6) L.H. knob switch does not light up

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code is not displayed, the problem has been removed.**
★ Set the working mode to G/O or H/O and the power max. / swift slow-down to the power max. position.
★ When fuse 5 is not blown.
★ Before carrying out troubleshooting, check that all related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.



F-12 Related electric circuit diagram



X08DD162

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TROUBLESHOOTING OF HYDRAULIC AND MECHANICAL SYSTEM (H MODE)

Table of failure modes and causes for hydraulic and mechanical system 20-208
Pump merge-divider logic 20-211
Troubleshooting flow charts for each failure mode

All work equipment, travel, swing
H- 1 Speeds of all work equipment, swing, travel are slow or lack power 20-112
H- 2 There is excessive drop in engine speed, or engine stalls 20-114
H- 3 No work equipment, travel, swing move 20-115
H- 4 Abnormal noise generated (around pump) 20-115
H- 5 Auto-deceleration does not work (when PPC shuttle valve is cause) 20-116
H- 6 Fine control ability is poor or response is poor 20-116

Work Equipment
H- 7 Boom is slow or lacks power 20-218
H- 8 Arm is slow or lacks power 20-220
H- 9 Bucket is slow or lacks power 20-222
H-10 Work equipment (boom, arm, bucket) does not move (but travel and swing are normal) 20-223
H-11 Excessive hydraulic drift (boom, arm, bucket) 20-223
H-12 Excessive time lag (engine at low idling) 20-224
H-13 Lack of power when pressure rises 20-224
H-14 Other equipment moves when single circuit is relieved 20-224
H-15 In L/O, F/O modes, work equipment speed is faster that specified speed 20-225

Compound operations
H-16 In compound operations, work equipment with larger load is slow 20-225
H-17 In swing + boom RAISE, boom RAISE is slow 20-226
H-18 In swing + arm OUT, arm OUT is slow 20-226
H-19 In swing + travel, travel speed drops excessively 20-226

Travel system
H-20 Travel deviation 20-227
H-21 Travel speed is slow 20-228
H-22 Steering does not turn easily or lacks power 20-230
H-23 Travel speed does not switch or is faster than specified speed 20-232
H-24 Travel does not move (one side only) 20-232

Swing system
H-25 Does not swing 20-233
H-26 Swing acceleration is poor or swing speed is slow (both left and right, one direction only) 20-234
H-27 Excessive overrun when stopping swing 20-236
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H-29 Excessive abnormal noise when stopping swing 20-237
H-30 Excessive hydraulic drift of swing 20-238
H-31 Swing speed is faster than specified swing speed 20-239

TABLE OF FAILURE MODES AND CAUSES FOR HYDRAULIC AND MECHANICAL SYSTEM

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Parts causing failure / Failure mode			Piston pump: Front: TVC valve	Piston pump: Front: LS valve	Piston pump: Front: Servo piston	Piston pump: Front: Pump proper	Piston pump: Rear: TVC valve	Piston pump: Rear: LS valve	Piston pump: Rear: Servo piston	Piston pump: Rear: Pump proper	Control pump	Strainer	Damper	Control valve: Spool	Control valve: LS relief & main unload valve: Unload valve	Control valve: LS relief & main unload valve: LS relief valve	Control valve: For front pump: Main relief valve	Control valve: For front pump: Sub-unload valve	Control valve: For rear pump: Main relief valve	Control valve: For rear pump: Sub-unload valve	Control valve: Pressure compensation valve	Control valve: Pump merge-divider valve: For main	Control valve: Pump merge-divider valve: For LS	Control valve: Main circuit check valve	Control valve: LS circuit check valve	Control valve: LS shuttle valve	Control valve: LS select valve	Control valve: LS circuit throttle	Control valve: Arm counterbalance valve	Control valve: Regeneration circuit: Boom	Control valve: Regeneration circuit: Arm	Control valve: Safety-suction valve	Control valve: Suction valve	Control valve: Slow return valve for pump merge-divider	PPC valve	PPC shuttle	Safety lock valve	Swing PPC slow return valve	Swivel joint	Troubleshooting code
All work equipment, travel, swing	Speeds of all work equipment, swing, travel are slow or lack power		▲	▲		▲	▲	▲		▲	○				○	○	▲	▲	▲	▲																			H-1
	There is excessive drop in engine speed, or engine stalls		○	○	○		○	○	○																														H-2
	No work equipment, travel, swing move					△				△	○		○																								○			H-3
	Abnormal noise generated (around pump)					○				○		○																												H-4
	Auto-deceleration does not work																																			○				H-5
	Fine control ability is poor or response is poor			○				○																			○													H-6
Work equipment	Boom is slow or lacks power													○							○	○	○			○				○		○	○		○					H-7
	Arm is slow or lacks power													○							○	○	○			○			○		○	○		○					H-8
	Bucket is slow or lacks power													○							○										○			○					H-9
	Boom does not move													○																				○					H-10
	Arm does not move													○																				○					
	Bucket does not move													○																				○					
	Excessive hydraulic drift													○							○										○								H-11
	Excessive time lag (engine at low idling)															○	○		○												○							H-12
	Lack of power when pressure rises															○	○		○																			H-13
	Other equipment moves when single circuit is relieved																				○																	H-14
	In L/O or F/O mode, work equipment speed is faster than set speed			○				○														○	○														H-15
Compound operations	In compound operations, work equipment with larger load is slow																				○																	H-16
	In swing + boom RAISE, boom is slow																									○									○			H-17
	In swing + arm OUT, arm is slow																									○									○			H-18
	In swing + travel, travel speed drops excessively																									○									○			H-19
Travel system	Travel deviation	Deviation is excessive												○																					○	○			H-20
		Deviation is excessive when starting																																					
	Travel speed is slow													○							○					○						○		○	○			H-21
	Steering does not turn or lacks power																○		○		○	○	○	○	○	○						○						H-22
	Travel speed does not switch or is faster than set speed																																					H-23
	Does not move (one side only)																																○					H-24
Swing system	Does not swing	Both left and right																																				H-25
		One direction only												○																					○				
	Swing acceleration is poor or swing speed is slow	Both left and right	○	○																				○	○	○											H-26
		One direction only												○							○													○	○				
	Excessive overrun when stopping swing	Both left and right																																				H-27
		One direction only												○																					○		○		
	Excessive shock when stopping swing (one direction only)																																		○		○		H-28
	Excessive abnormal noise when stopping swing																																						H-29
	Excessive hydraulic drift of swing	When brake is ON																																				H-30
		When brake is OFF												○							○																	
	Swing speed is faster than specified swing speed			○																		○	○														H-31

★ In the failure modes, modes for compound operations are used when independent operations are normal. ▲: When there is an abnormality for both front and rear

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Failure mode \ Parts causing failure			EPC • Solenoid valve						Swing motor				Travel motor											Oil Pressure switch								Pump Pressure sensor			
																								Boom		Arm		Bucket							
			LS control EPC	LS select	Pump merge-divider	2-stage relief	Travel speed	Swing brake	Holding brake	Safety valve	Suction valve	Leakage, breakage inside body	Safety valve	Counterbalance valve	Check valve	Travel speed selector servo piston	Leakage, breakage inside body	Swing machinery	Final drive	Hydraulic cylinder	Boom holding valve	Lift check valve	Travel junction valve	RAISE	LOWER	IN	OUT	CURL	DUMP	Swing	Travel	Front pump	Rear pump	Engine system	Troubleshooting code
All work equipment, travel, swing	Speeds of all work equipment, swing, travel are slow or lack power		○																													○	H-1
	There is excessive drop in engine speed, or engine stalls																															○	H-2
	No work equipment, travel, swing move																																H-3
	Abnormal noise generated (around pump)																																H-4
	Auto-deceleration does not work																						○	○	○	○	○	○	○	○				H-5
	Fine control ability is poor or response is poor																																H-6
Work equipment	Boom is slow or lacks power																			○	○		○	○										H-7
	Arm is slow or lacks power			○																○					○	○								H-8
	Bucket is slow or lacks power			○																○							○	○						H-9
	Boom does not move																																	H-10
	Arm does not move																																	
	Bucket does not move																																	
	Excessive hydraulic drift																			○	○													H-11
	Excessive time lag (engine at low idling)																																	H-12
	Lack of power when pressure rises		○																					○		○		○						H-13
	Other equipment moves when single circuit is relieved					○																												H-14
	In L/O or F/O mode, work equipment speed is faster than set speed																																	H-15
Compound operations	In compound operations, work equipment with larger load is slow		○		○																													H-16
	In swing + boom RAISE, boom is slow																																	H-17
	In swing + arm OUT, arm is slow			○																														H-18
	In swing + travel, travel speed drops excessively			○																														H-19
Travel system	Travel deviation	Deviation is excessive		○													○						○											H-20
		Deviation is excessive when starting												○																				
	Travel speed is slow		○														○						○								○			H-21
	Steering does not turn or lacks power				○	○									○								○								○			H-22
	Travel speed does not switch or is faster than set speed		○				○									○																○	○	○	H-23
	Does not move (one side only)												○	○	○		○		○																H-24
Swing system	Does not swing	Both left and right						○	①			○						○													○				H-25
		One direction only								○																									
	Swing acceleration is poor or swing speed is slow	Both left and right										○																							H-26
		One direction only								○	○																								
	Excessive overrun when stopping swing	Both left and right										○																							H-27
		One direction only								○																									
	Excessive shock when stopping swing (one direction only)																																	H-28
	Excessive abnormal noise when stopping swing									○	○										○													H-29
	Excessive hydraulic drift of swing	When brake is ON						○	○																										H-30
		When brake is OFF								○	○	○																							
	Swing speed is faster than specified swing speed		○		○																														H-31

★ In the failure modes, modes for compound operations are used when independent operations are normal. ▲: When there is an abnormality for both front and rear

PUMP MERGE-DIVIDER LOGIC

<table>
<tr><td colspan="3">Category</td><td colspan="3">Flow divided</td><td colspan="2">Flow merged</td><td>Flow divided</td><td>Flow merged</td></tr>
<tr><td colspan="3" rowspan="2">Mode</td><td colspan="5">Boom/swing priority selection mode OFF</td><td colspan="2">Boom/swing priority selection mode ON</td></tr>
<tr><td colspan="3">Pump merge-divider solenoid ON</td><td colspan="2">Pump merge-divider solenoid OFF</td><td>Pump merge-divider solenoid ON</td><td>Pump merge-divider solenoid OFF</td></tr>
<tr><td rowspan="6">Working mode</td><td>L/O</td><td colspan="3">• All operations</td><td colspan="2">×</td><td rowspan="6">•Independent operation of travel
•Independent operation of boom, arm, bucket, service, swing with travel OFF, and compound operation of each of these</td><td rowspan="6">Compound operation with travel</td></tr>
<tr><td rowspan="5">F/O</td><td colspan="3">With travel ON
• Independent operation of travel
• Independent operation of swing

Operations A, B and C with travel OFF and swing lock switch OFF</td><td colspan="2">With travel ON
•Except independent operation of travel (compound operation with travel)
•Except independent operation of swing (compound operation with travel)

Operations except operations A, B and C with travel OFF and swing lock switch OFF</td></tr>
<tr><td>A</td><td>Arm IN</td><td rowspan="3">Except operations A, B, C</td><td rowspan="3">•Compound operation with travel
•Swing + arm IN
•Swing + arm OUT
•Swing + boom RAISE
•Independent operation of boom
•Independent operation of arm
•Independent operation of bucket
•Arm IN + bucket CURL with pressure less than 14.7 MPa (150 kg/cm²)or more than 24.5 MPa (250 kg/cm²) (except ★)
•Arm OUT + bucket DUMP and pressure less than 3.92 MPa (40kg/cm²)
•Arm OUT + service and pressure less than 19.6 MPa (200kg/cm²)
•All others</td></tr>
<tr><td>B</td><td>•Swing + boom LOWER
•Swing + bucket CURL
•Swing + bucket DUMP
•Swing + service
•Arm IN + bucket CURL when condition is ★
•Arm OUT + bucket DUMP and front or rear pump pressure more than 3.92 MPa (40 kg/cm²)
•Arm OUT + service and front or rear pump pressure more than 19.6MPa (200 kg/cm²)</td></tr>
<tr><td>C</td><td>•For HYPER GX :
Boom priority 2 mode + boom RAISE + arm OUT</td></tr>
<tr><td>G/O
H/O</td><td colspan="3">With travel ON
• Independent operation of travel
• Independent operation of swing
•Operations B and C with travel OFF and swing lock switch OFF } D</td><td colspan="2">Except operation D</td></tr>
<tr><td colspan="3">LS select</td><td colspan="5">With swing lock OFF:
•Separated for swing + travel, boom RAISE, arm OUT (solenoid ON), not separated for other operations</td><td colspan="2">With swing lock OFF:
•Separated for swing + travel (solenoid ON), not separated for other operations (solenoid OFF)</td></tr>
</table>

★ The pressure of the front or rear pumps is as follows:
When pressure rises: 24.5 MPa (250 kg/cm²), When pressure goes down: 14.7 MPa (150 kg/cm²)
(For details, see Fig. 1)

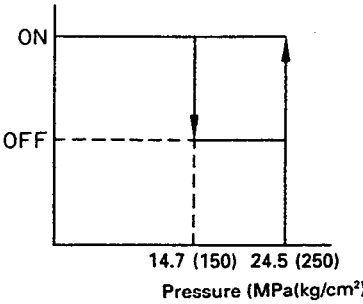
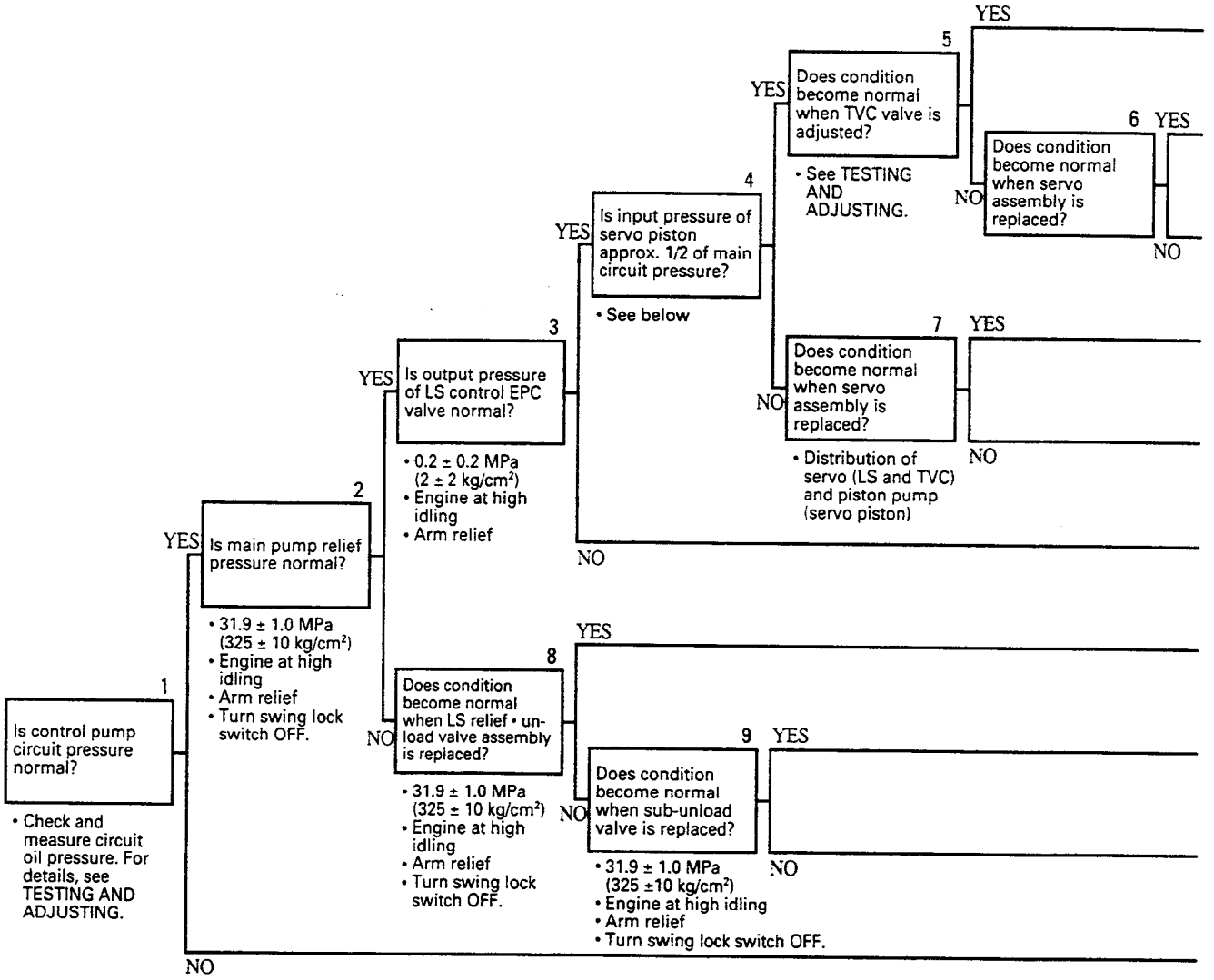


Fig. 1 205F06288

H-1 Speeds of all work equipment, swing, travel are slow or lack power

★ Carry out troubleshooting with the swing priority mode OFF and in the H/O mode.
★ Check that no abnormal noise is being generated from the main pump before carrying out troubleshooting. (If there is any abnormal noise, carry out troubleshooting for H-4.)



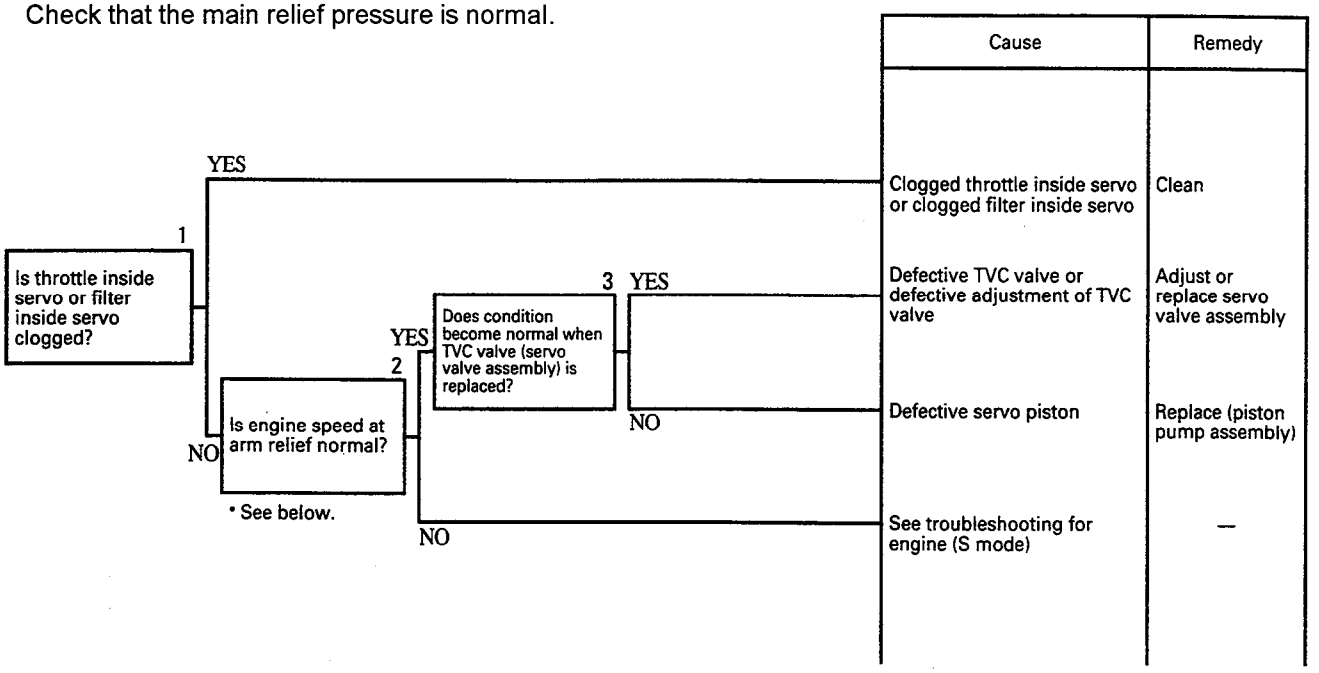
★ Measuring servo piston inlet port pressure
Measure the input pressure to the large diameter end of the servo piston when the pressure rises and the arm is relieved. (Approx. 17.64 MPa (Approx 180 kg/cm²))
[Basically, the pressure at the large diameter end is approx. ½ of the small diameter end. For details, see TESTING AND ADJUSTING.]

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Cause	Remedy
Defective adjustment of TVC valve	Adjust
Defective servo assembly	Repair or replace
Defective piston pump	Repair or replace
Defective servo assembly	Repair or replace
Defective piston pump (servo piston)	Correct or replace
Defective operation of LS control EPC solenoid valve	Replace
Defective operation of LS relief • main unload valve assembly	Replace
Defective operation of sub-unload valve	Repair or replace
Defective operation of main relief valve	Replace
Defective hydraulic equipment in control pump circuit (See TESTING AND ADJUSTING)	Adjust or replace

H-2 There is excessive drop in engine speed, or engine stalls

★ Carry out troubleshooting with the swing priority mode OFF and in the H/O mode.
★ Check that the main relief pressure is normal.

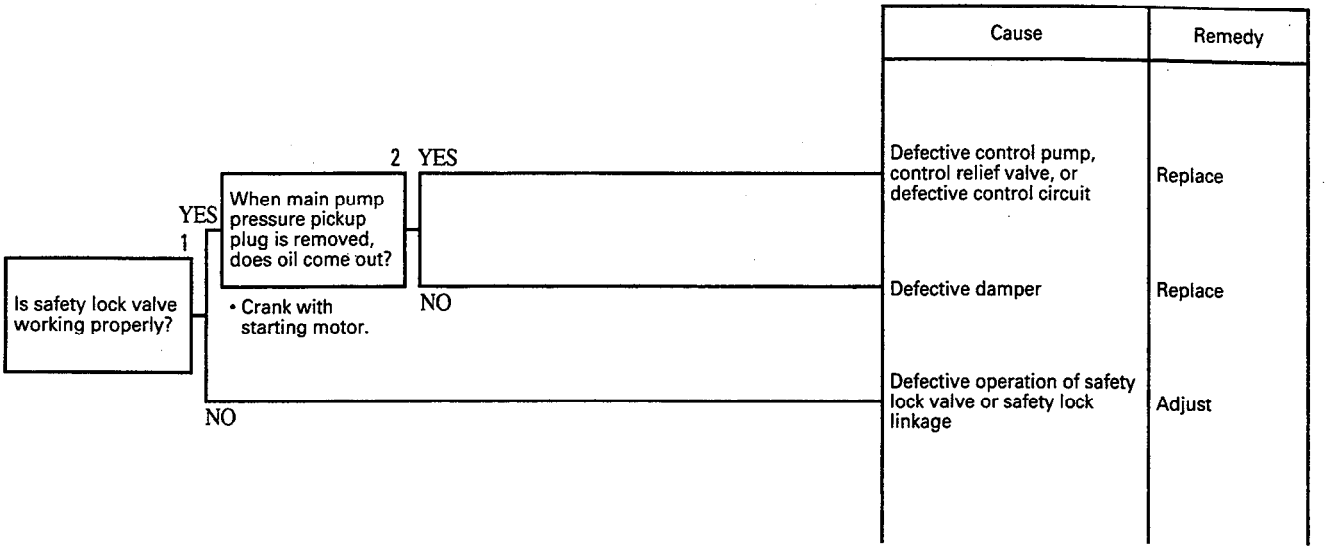


★ Replace the servo valve assembly on the defective side with a new part, and if the engine speed is lower than the reference value below, carry out troubleshooting for S mode. If it is higher, it can be judged that the TVC valve (servo valve assembly) is defective, so replace it.

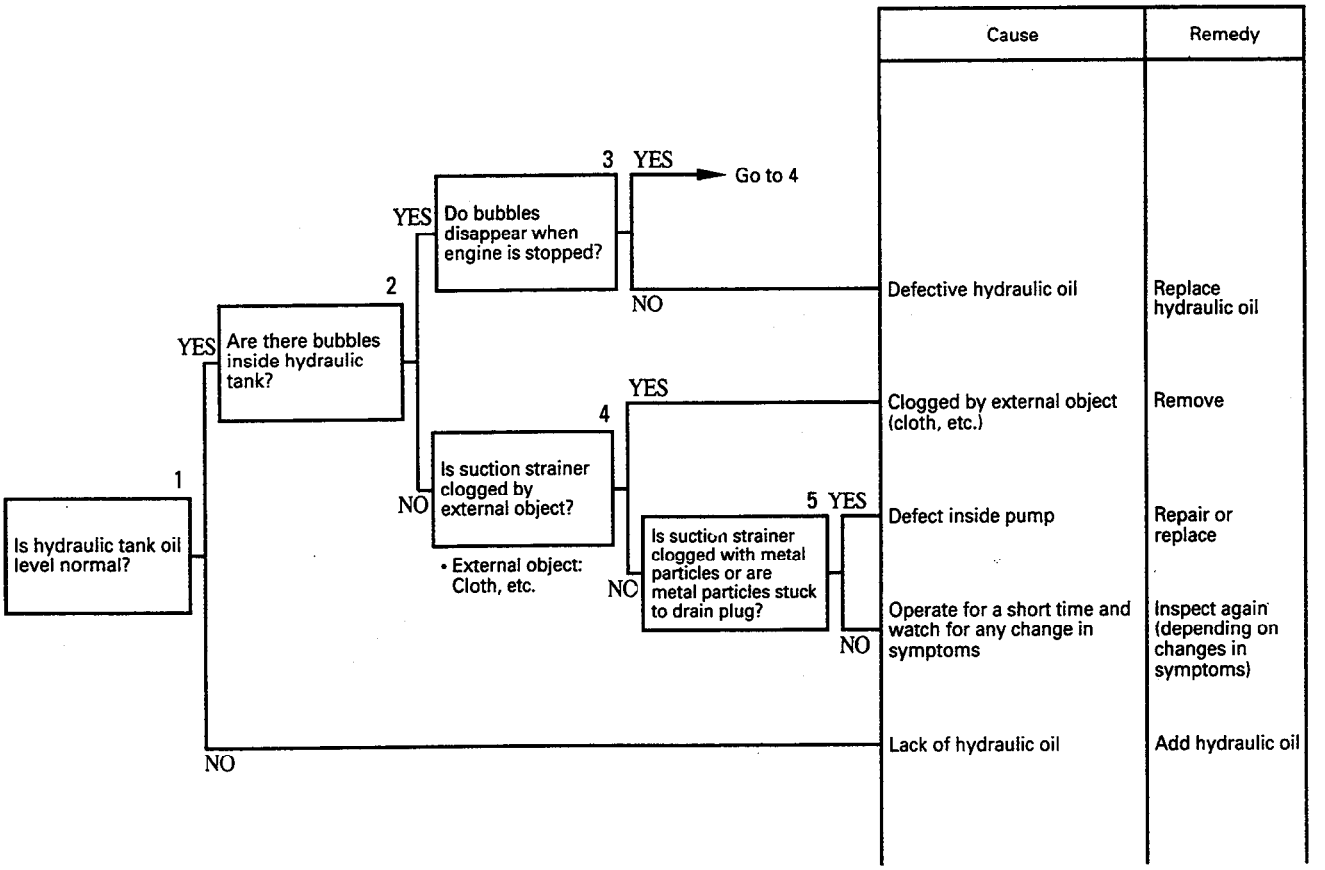
Engine speed (reference) at arm relief when engine and pump are normal

Model	Engine speed at arm relief	Conditions
PC200 PC210	Min. 2050 rpm	• Engine at high idling • Swing lock switch ON • Measure the speed at the point where the drop in engine speed is greatest when the arm cylinder is at the end of stroke and the lever is operated slowly to the full position.
PC220 PC250	Min. 2150 rpm	

H-3 No work equipment, travel, swing move

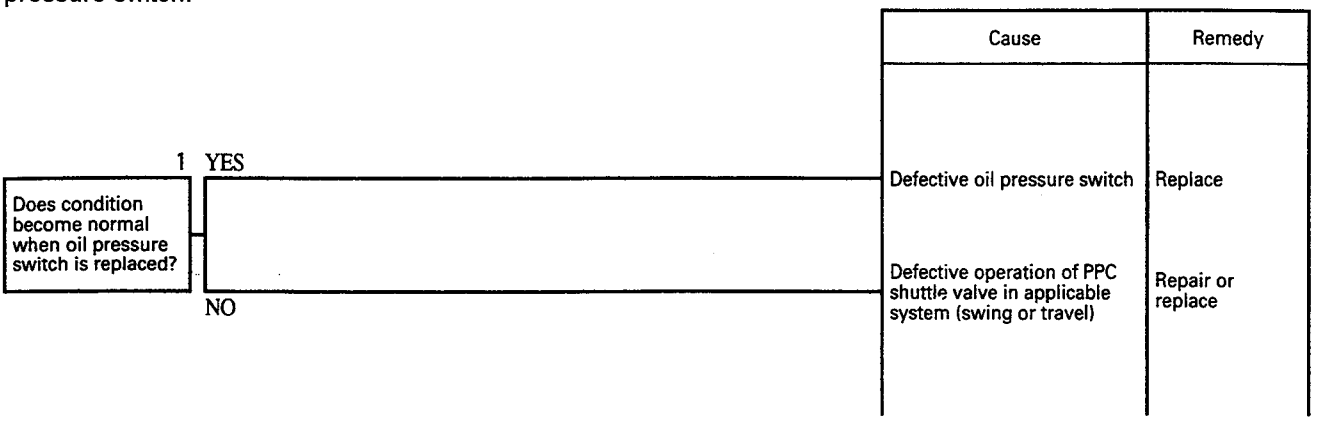


H-4 Abnormal noise generated (around pump)

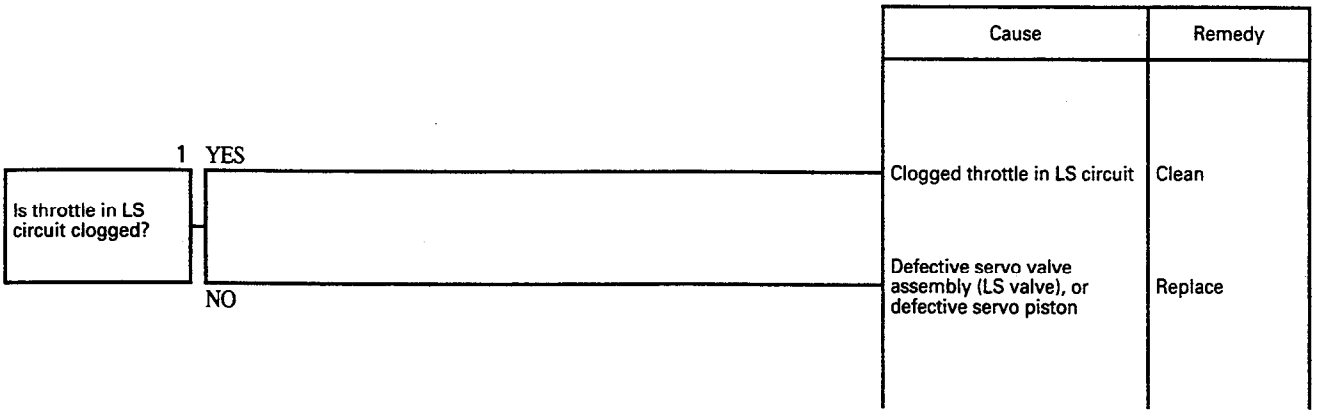


H-5 Auto-deceleration does not work (when PPC shuttle valve is cause)

★ The control pressure for the travel and swing passes through the PPC shuttle valve and is supplied to the oil pressure switch.



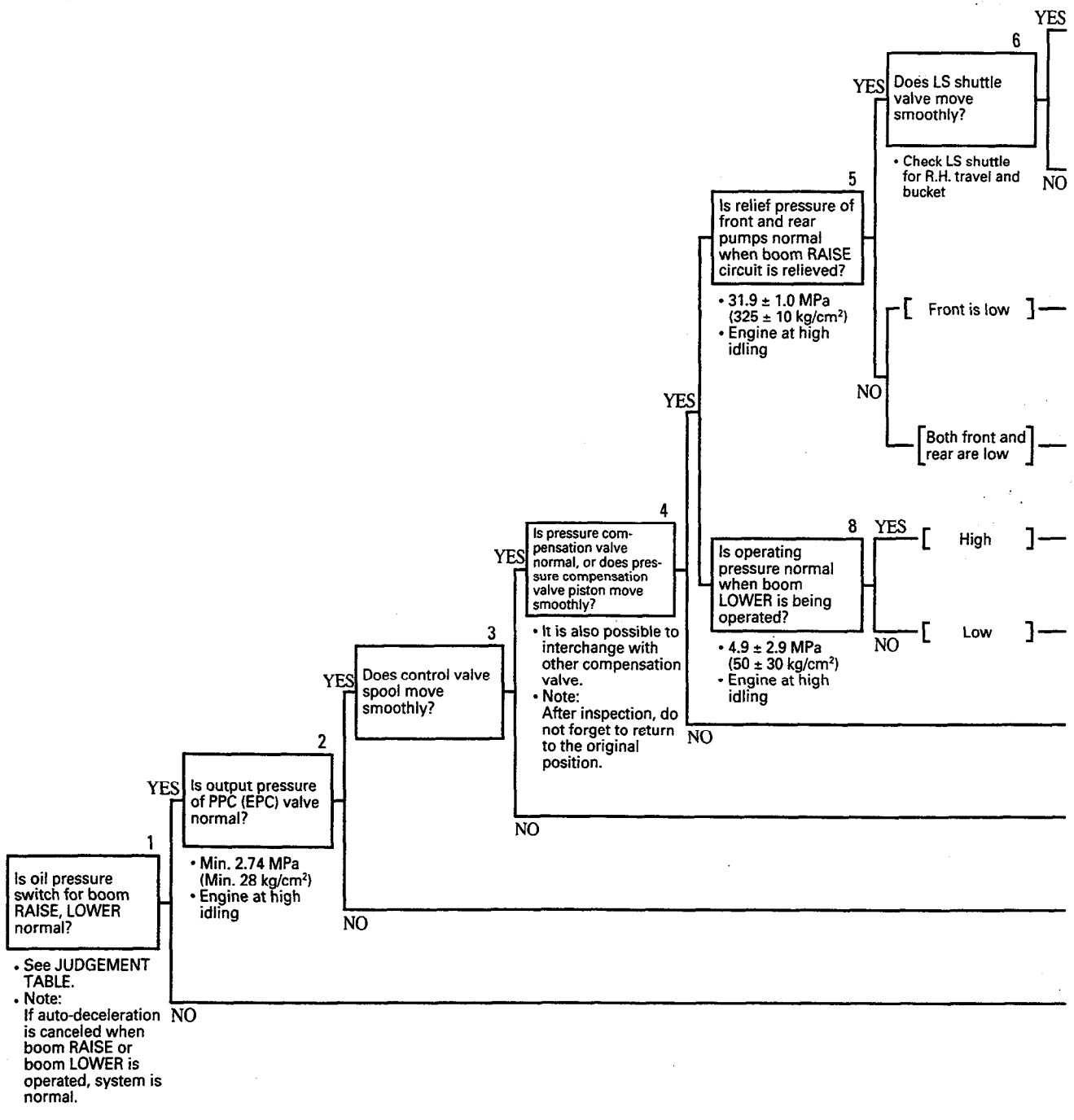
H-6 Fine control ability is poor or response is poor

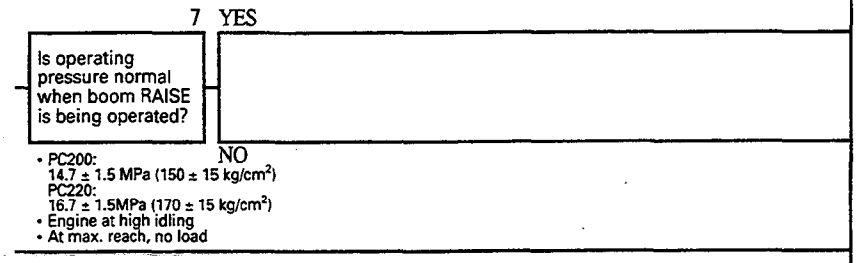


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H-7 Boom is slow or lacks power

★ When travel and swing speeds are normal
★ Carry out troubleshooting with the swing priority mode OFF and in the H/O mode.

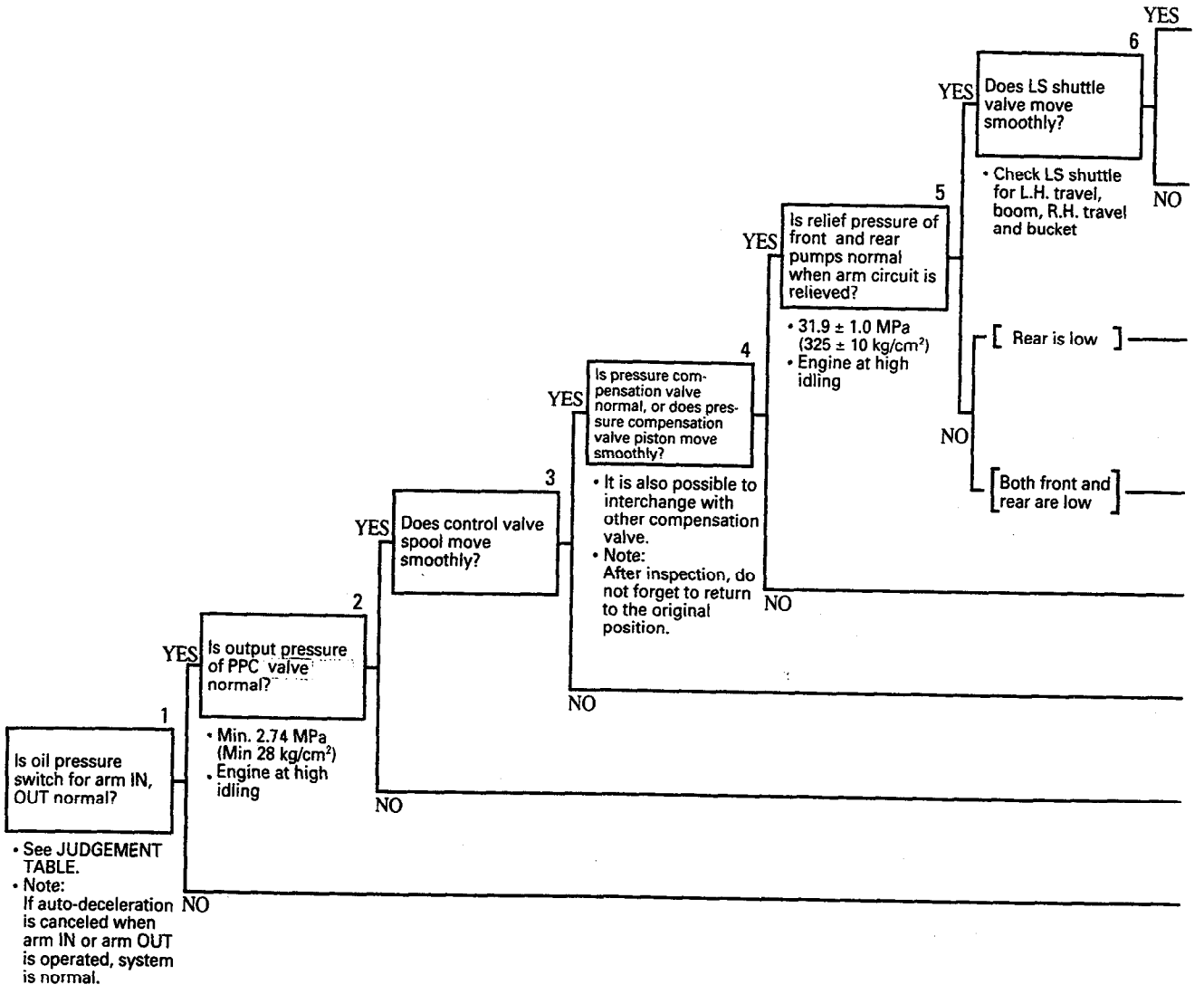


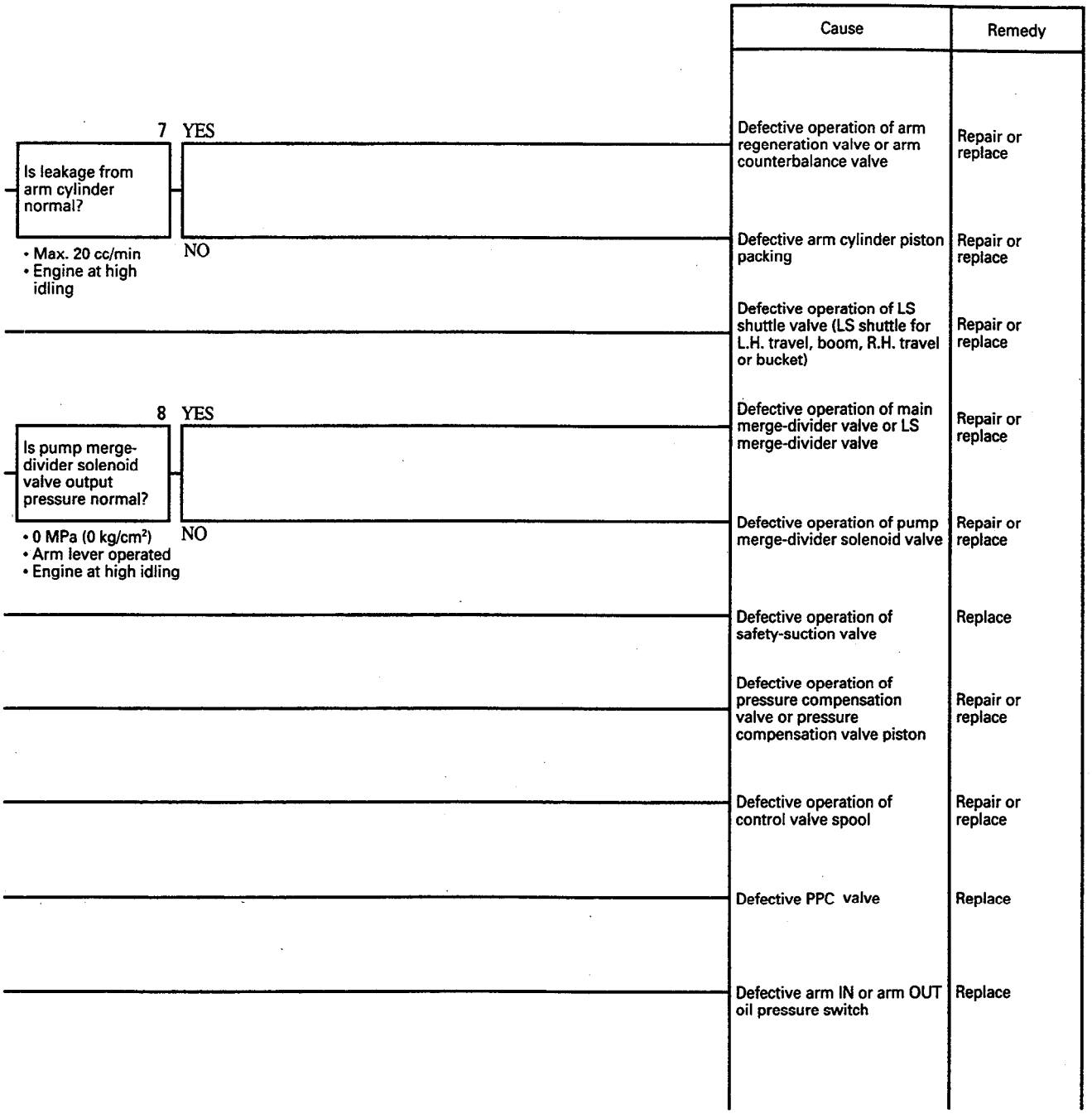


Cause	Remedy
Defective boom cylinder piston packing	Repair or replace
Defective operation of boom holding valve	Repair or replace
Defective operation of LS shuttle valve (LS shuttle for R.H. travel or bucket)	Repair or replace
Defective operation of main merge-divider valve or LS merge-divider valve	Repair or replace
Defective operation of pump merge-divider solenoid valve	Repair or replace
Defective boom holding valve or suction valve of control valve	Replace
Defective operation of boom holding valve	Repair or replace
Defective operation of boom regeneration valve	Repair or replace
Defective operation of pressure compensation valve or pressure compensation valve piston	Repair or replace
Defective operation of control valve spool	Repair or replace
Defective PPC valve	Replace
Defective boom RAISE or boom LOWER oil pressure switch	Replace

H-8 Arm is slow or lacks power

★ When travel and swing speeds are normal
★ Carry out troubleshooting with the swing priority mode OFF and in the H/O mode.

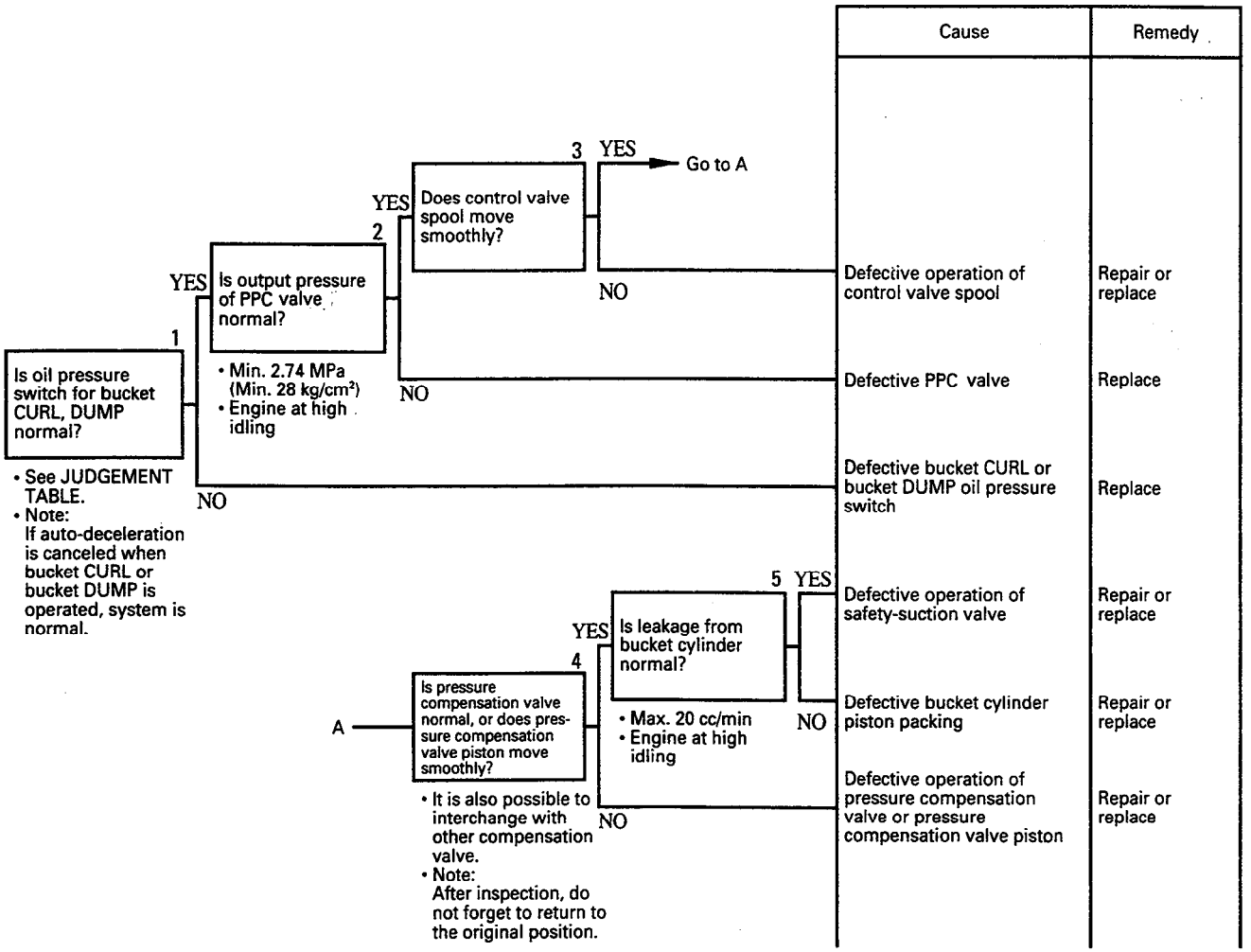




Cause	Remedy
Defective operation of arm regeneration valve or arm counterbalance valve	Repair or replace
Defective arm cylinder piston packing	Repair or replace
Defective operation of LS shuttle valve (LS shuttle for L.H. travel, boom, R.H. travel or bucket)	Repair or replace
Defective operation of main merge-divider valve or LS merge-divider valve	Repair or replace
Defective operation of pump merge-divider solenoid valve	Repair or replace
Defective operation of safety-suction valve	Replace
Defective operation of pressure compensation valve or pressure compensation valve piston	Repair or replace
Defective operation of control valve spool	Repair or replace
Defective PPC valve	Replace
Defective arm IN or arm OUT oil pressure switch	Replace

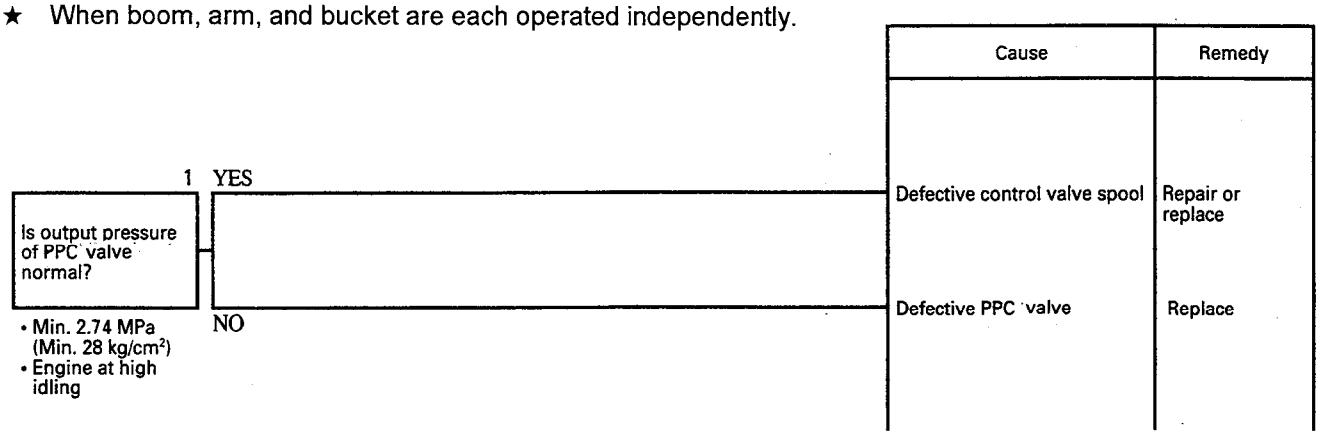
H-9 Bucket is slow or lacks power

★ When travel and swing speeds are normal.
★ Carry out troubleshooting with the swing priority mode OFF.

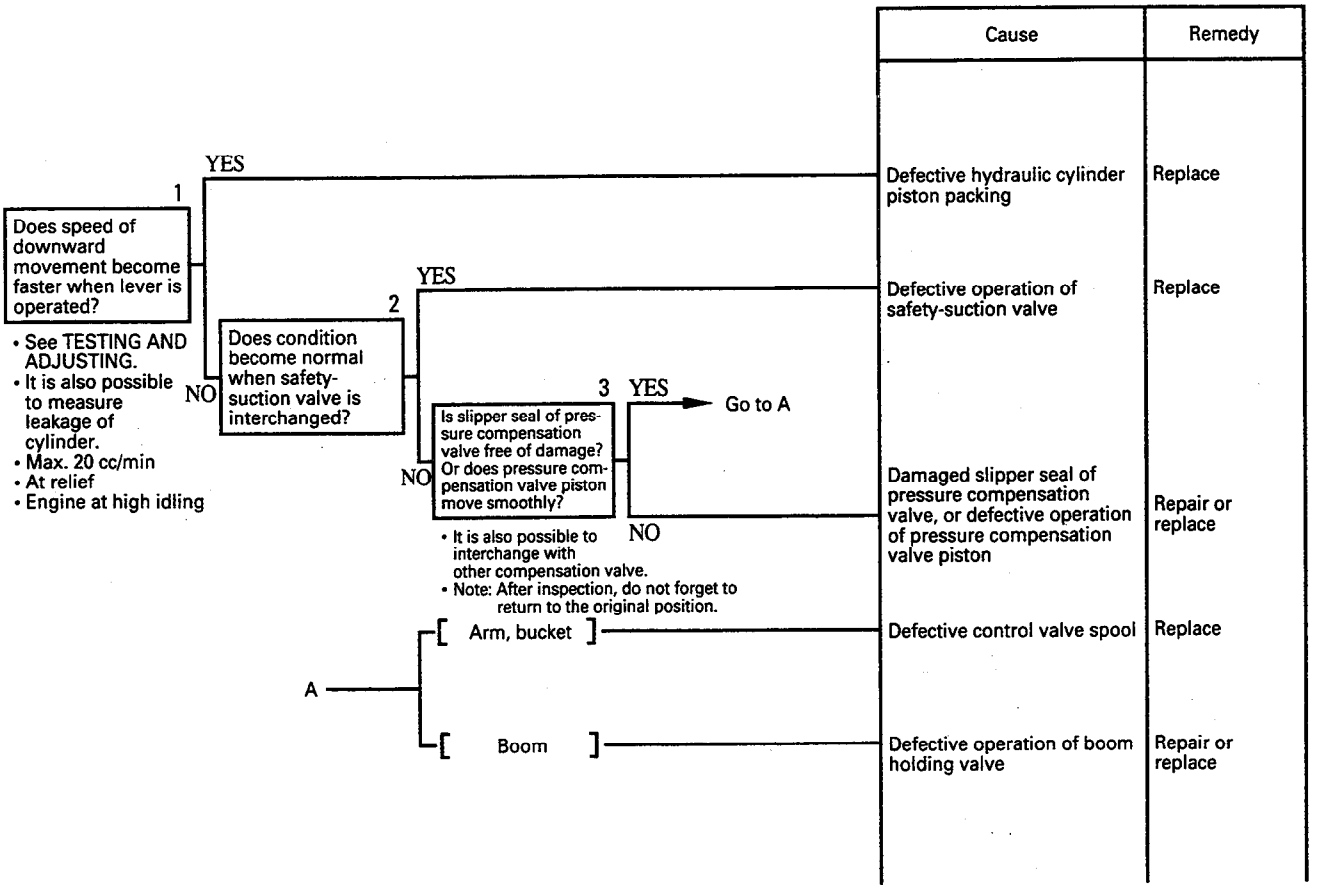


H-10 Work equipment (boom, arm, bucket) does not move (but travel and swing are normal)

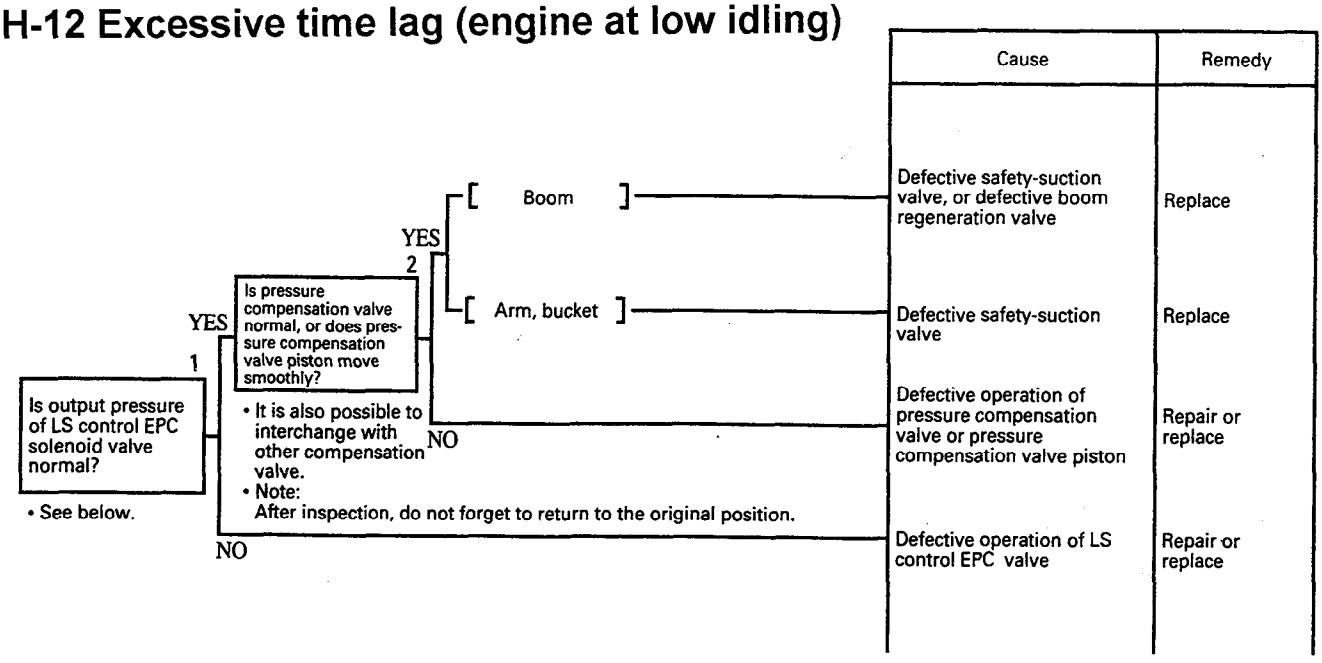
★ When boom, arm, and bucket are each operated independently.



H-11 Excessive hydraulic drift (boom, arm, bucket)



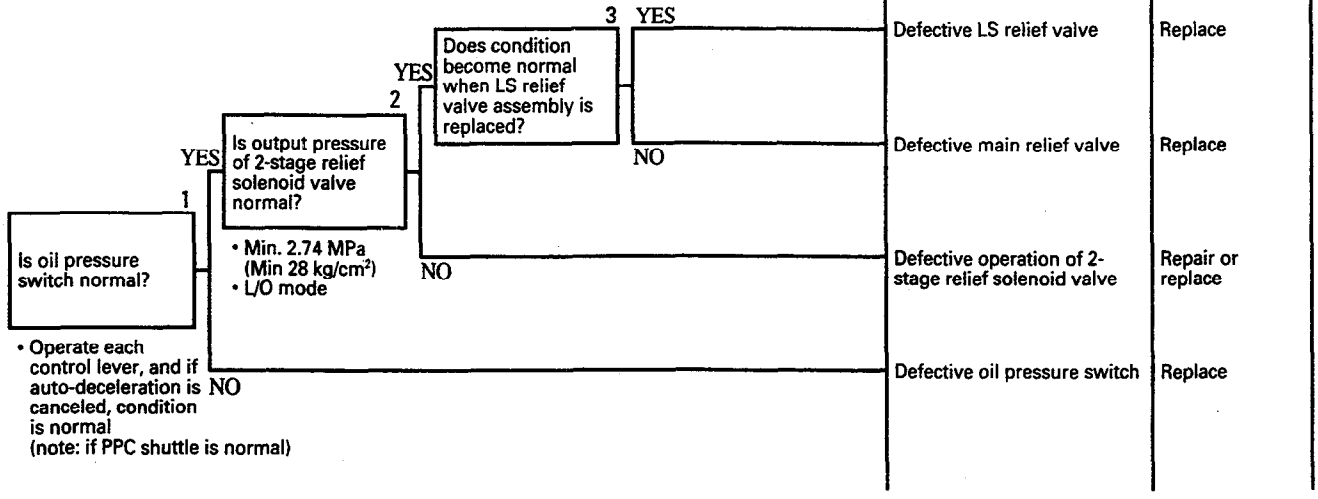
H-12 Excessive time lag (engine at low idling)



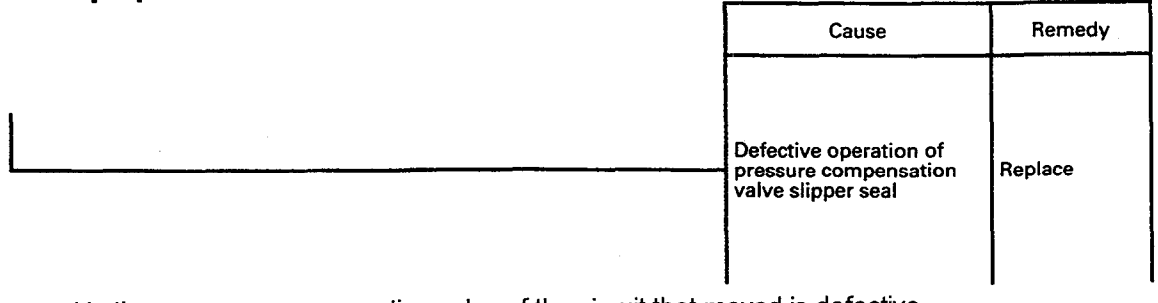
★ Output pressure of LS control EPC solenoid
Approx. 2.06 MPa (Approx. 21 kg.cm^2) output from the LS control EPC solenoid when the engine is at low idling (approx. 1300 rpm or below) regardless of the working mode.

H-13 Lack of power when pressure rises

★ If condition is normal except when pressure rises.
★ Carry out troubleshooting with the swing priority mode OFF.

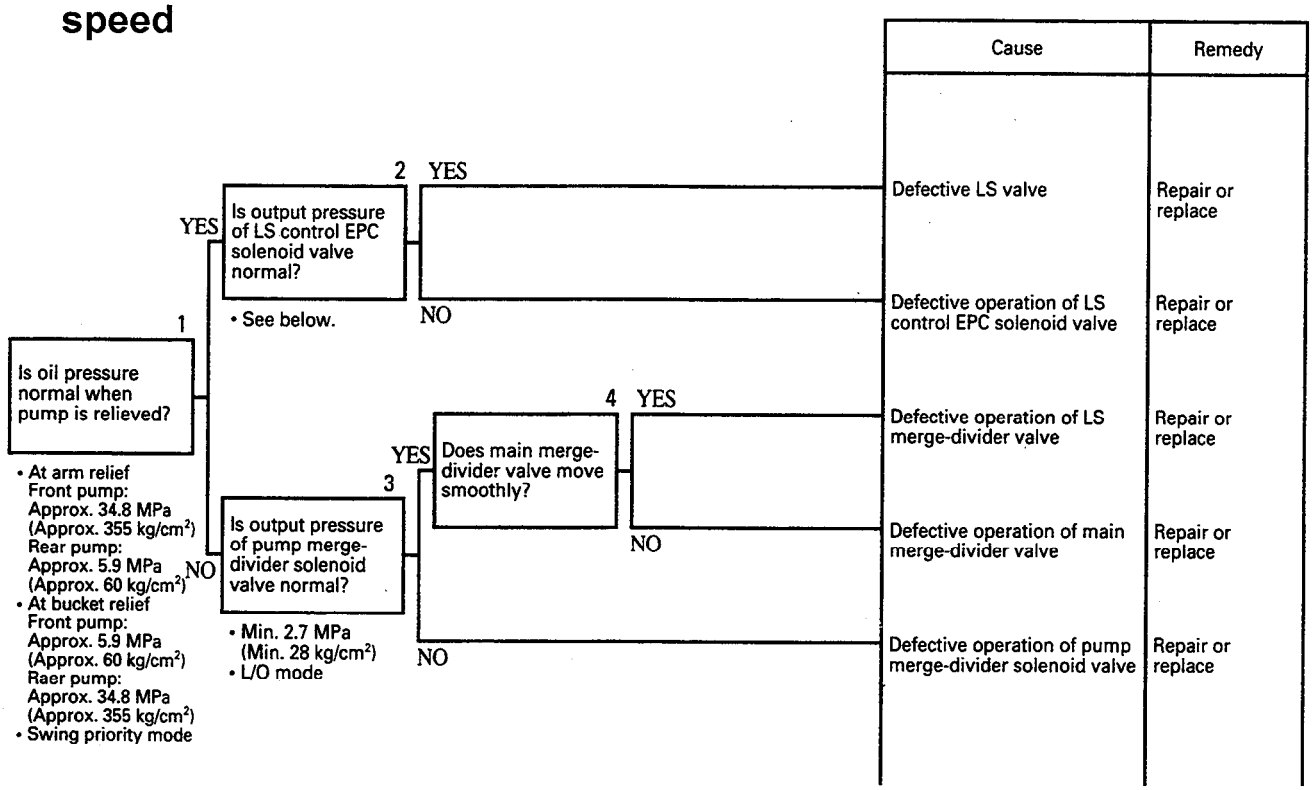


H-14 Other equipment moves when single circuit is relieved



★ The slipper seal in the pressure compensation valve of the circuit that moved is defective.

H-15 In L/O, F/O modes, work equipment speed is faster than specified speed



★ Output pressure of LS control EPC solenoid (travel OFF)

- Approx. 2.06 MPa (Approx. 21 kg/cm^2) is output from the LS control EPC solenoid when the engine is at low idling (approx. 1300 rpm or below) regardless of the working mode.

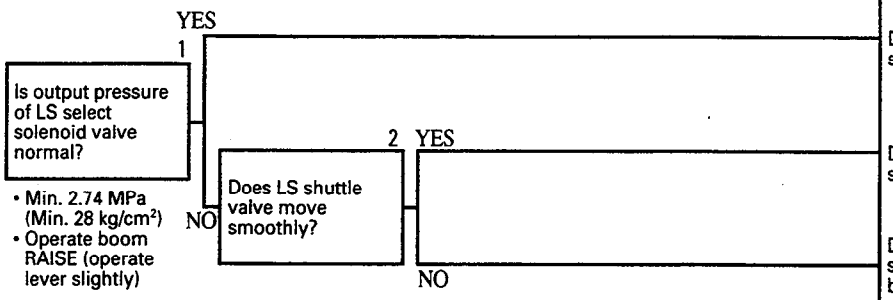
H-16 In compound operations, work equipment with larger load is slow

Cause	Remedy
Defective operation of pressure compensation valve	Replace (replace pressure compensation valve on side where load is lower)

	Combination of compound operation	Side where load is larger
1	Boom RAISE + arm IN	Boom RAISE
2	Boom RAISE + arm OUT	Arm OUT
3	Boom RAISE + bucket CURL	Boom RAISE
4	Arm OUT + bucket CURL	Arm OUT
5	Boom LOWER + arm OUT	Arm OUT

H-17 In swing + boom RAISE, boom RAISE is slow

★ If swing and boom RAISE work normally when operated independently.
★ Carry out troubleshooting with the swing priority mode OFF.



Cause	Remedy
Defective operation of LS select valve	Repair or replace
Defective operation of LS select solenoid valve	Repair or replace
Defective operation of LS shuttle valve (LS shuttle for boom RAISE, LS select)	Repair or replace

H-18 In swing + arm OUT, arm OUT is slow

★ See H-17

(If the operation is normal when the swing and arm OUT are operated independently, carry out troubleshooting with the swing priority mode OFF. If the Cause column shows that there is defective operation of the LS shuttle valve, the cause is in the shuttle valve for the arm OUT and LS select.)

H-19 In swing + travel, travel speed drops excessively

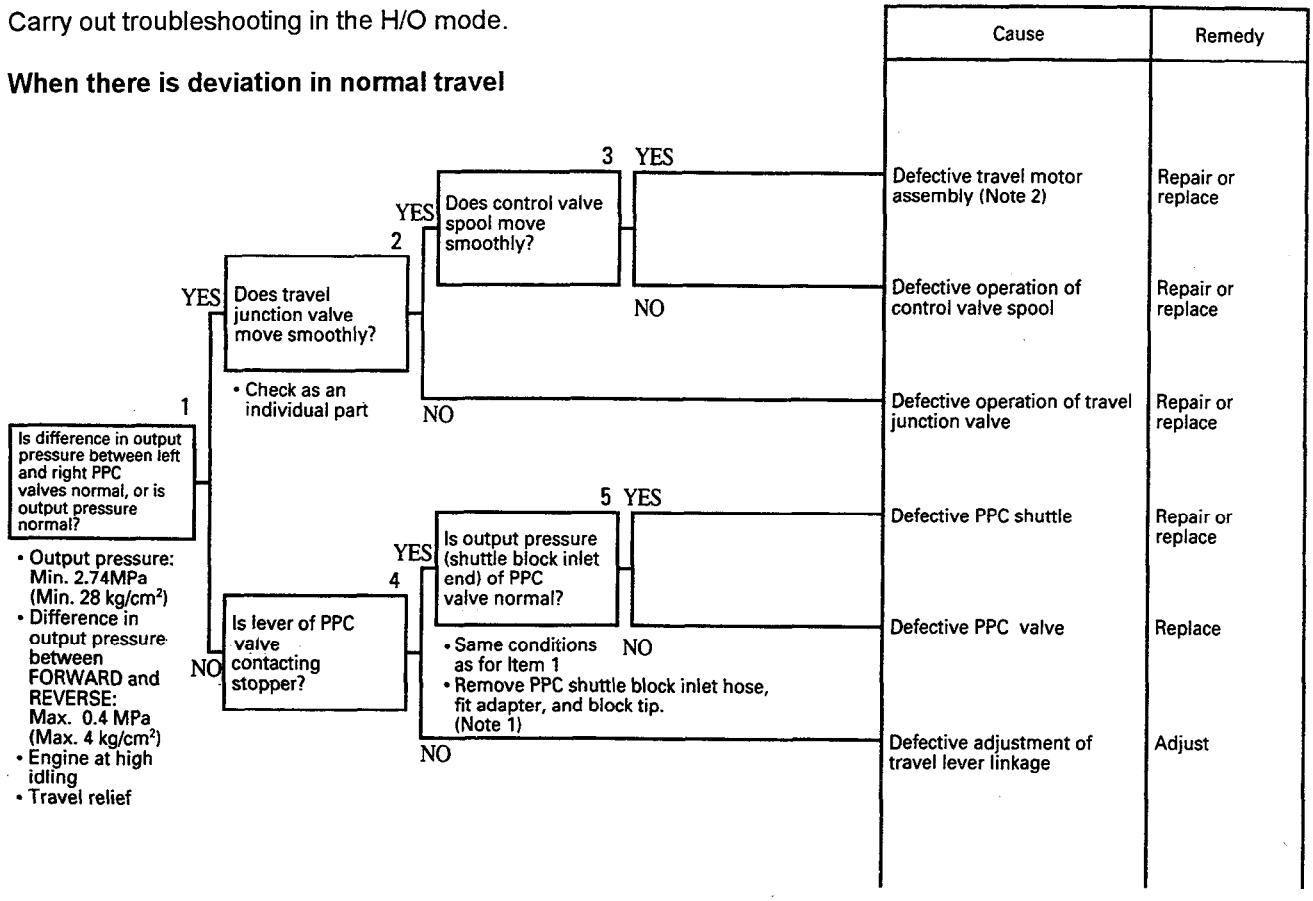
★ See H-17

(If the operation is normal when the swing and travel are operated independently, carry out troubleshooting with the swing priority mode OFF. If the Cause column shows that there is defective operation of the LS shuttle valve, the cause is in the shuttle valve for the LS select.)

H-20 Travel deviation

★ Carry out troubleshooting in the H/O mode.

a) When there is deviation in normal travel



Note 1: If the adapter for blocking the circuit is not available, interchange swing with one of arm (IN), boom (LOWER), or bucket (CURL, DUMP).

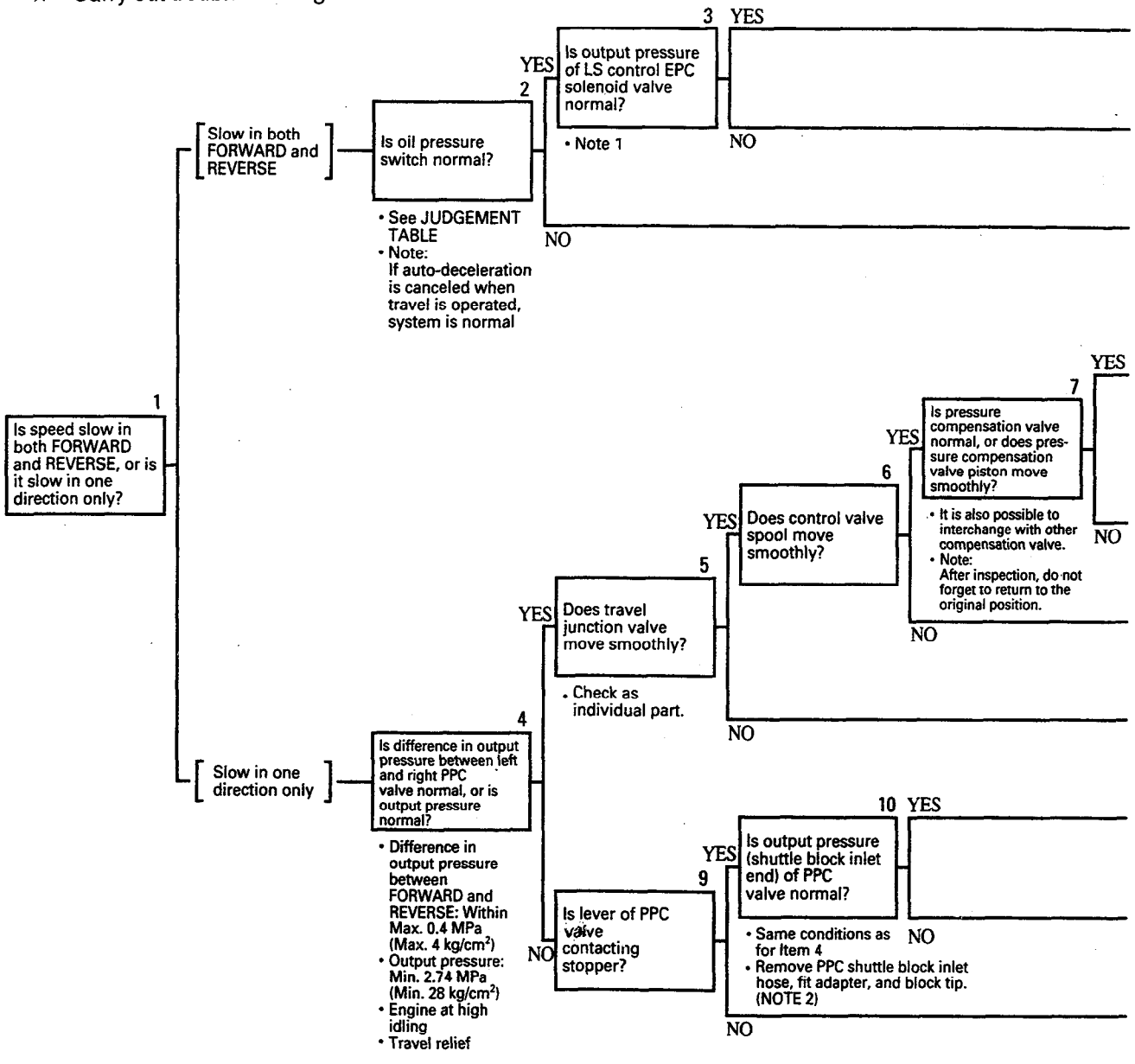
Note 2: When measuring the speed of the travel motor under no load ⇨ Remove connector of LS control EPC valve solenoid, and measure travel speed in Lo and Hi.

b) Excessive travel deviation when starting

Cause	Remedy
Defective operation of travel counterbalance valve	Repair or replace

H-21 Travel speed is slow

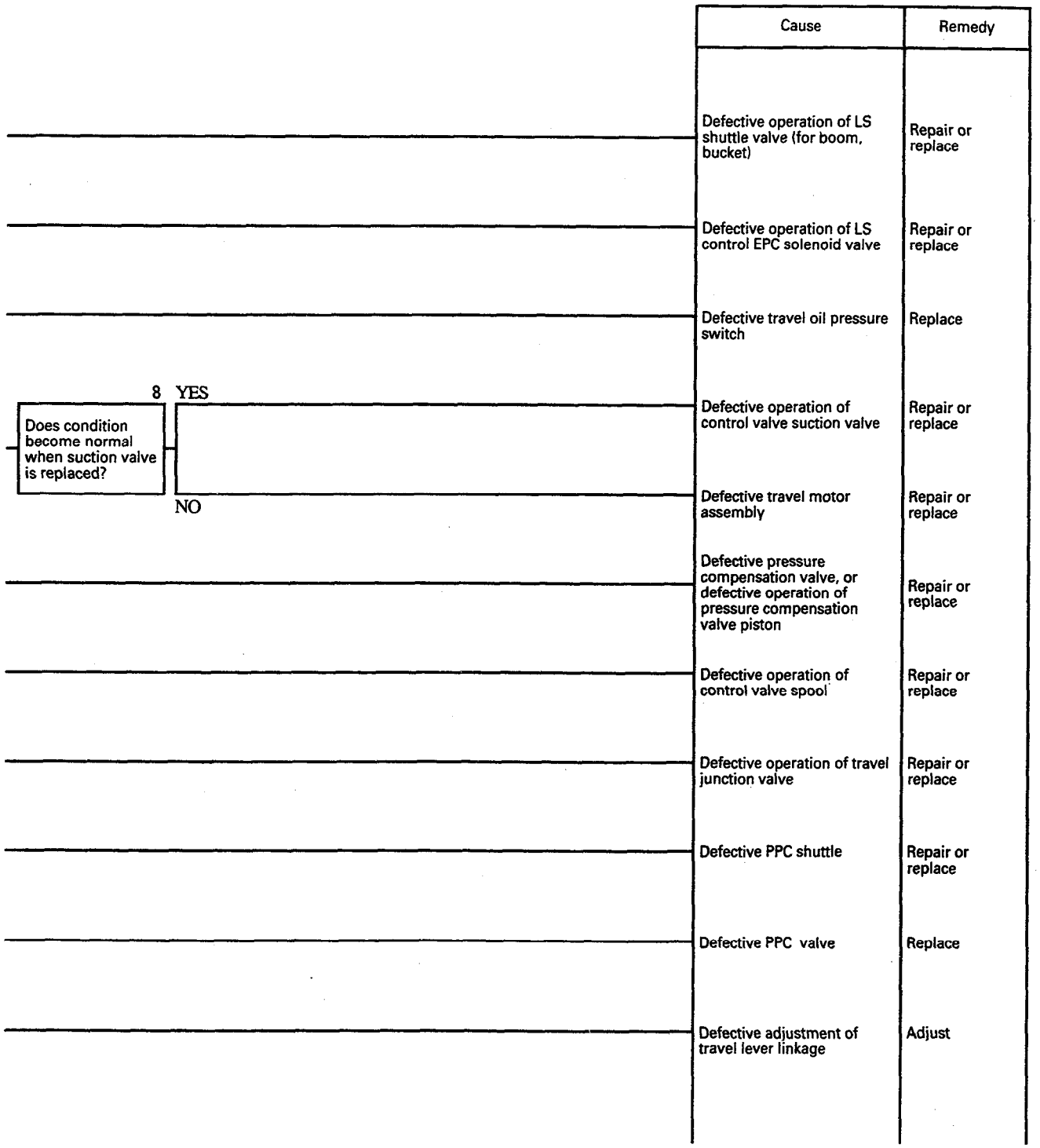
★ Check that the spool of the travel PPC valve is moving the full stroke before carrying out troubleshooting.
★ Carry out troubleshooting in the H/O mode.



Note 1: Output pressure of LS control EPC solenoid (travel OFF) Approx. 2.06 MPa. (Approx. 21 kg/cm²) is output from the LS control EPC solenoid when the engine is at low idling (approx. 1300 rpm) regardless of the working mode.

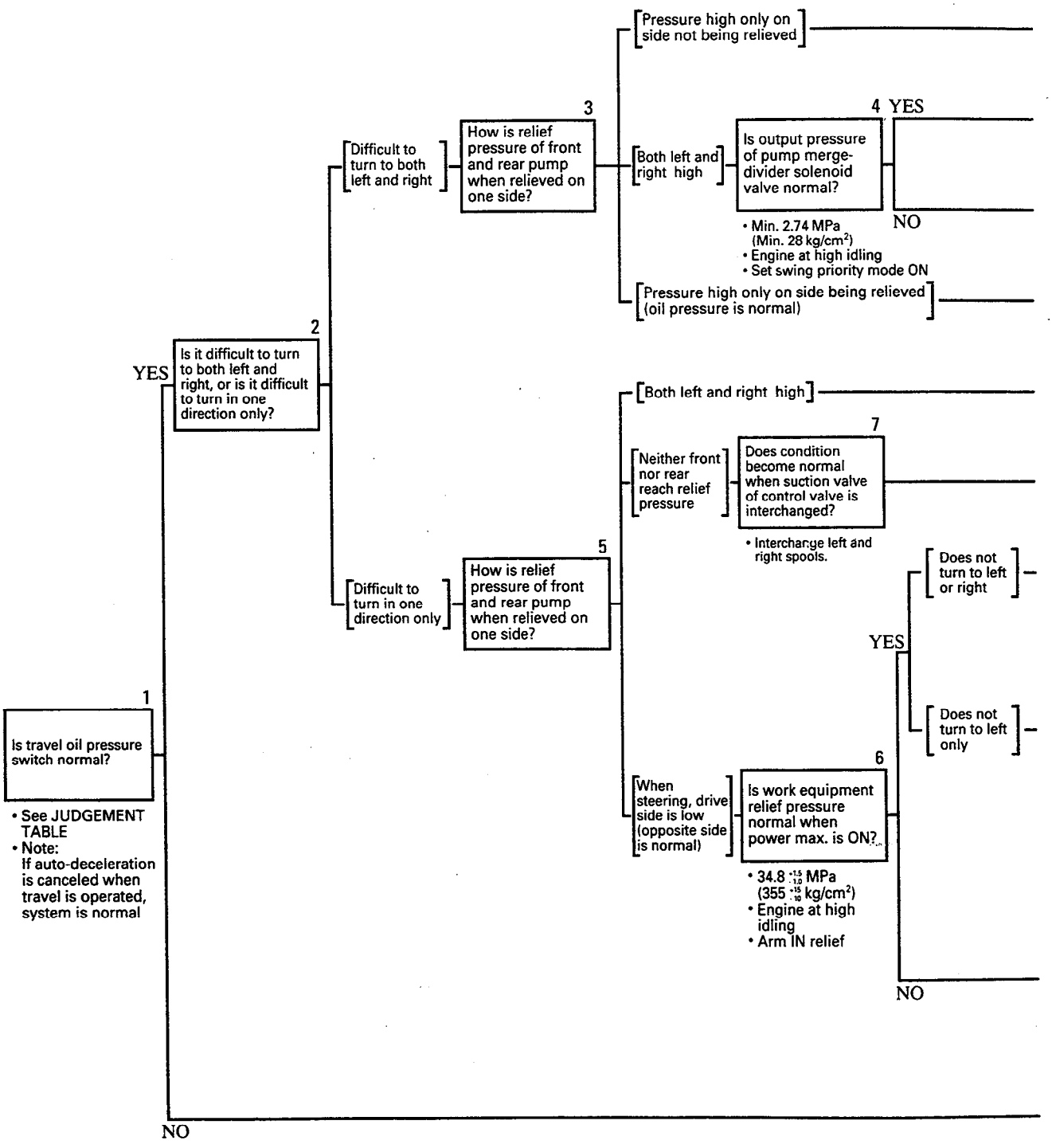
Note 2: When measuring the speed of the travel motor under no load ⇨ Remove connector of LS control EPC valve solenoid, and measure travel speed in Lo and Hi.

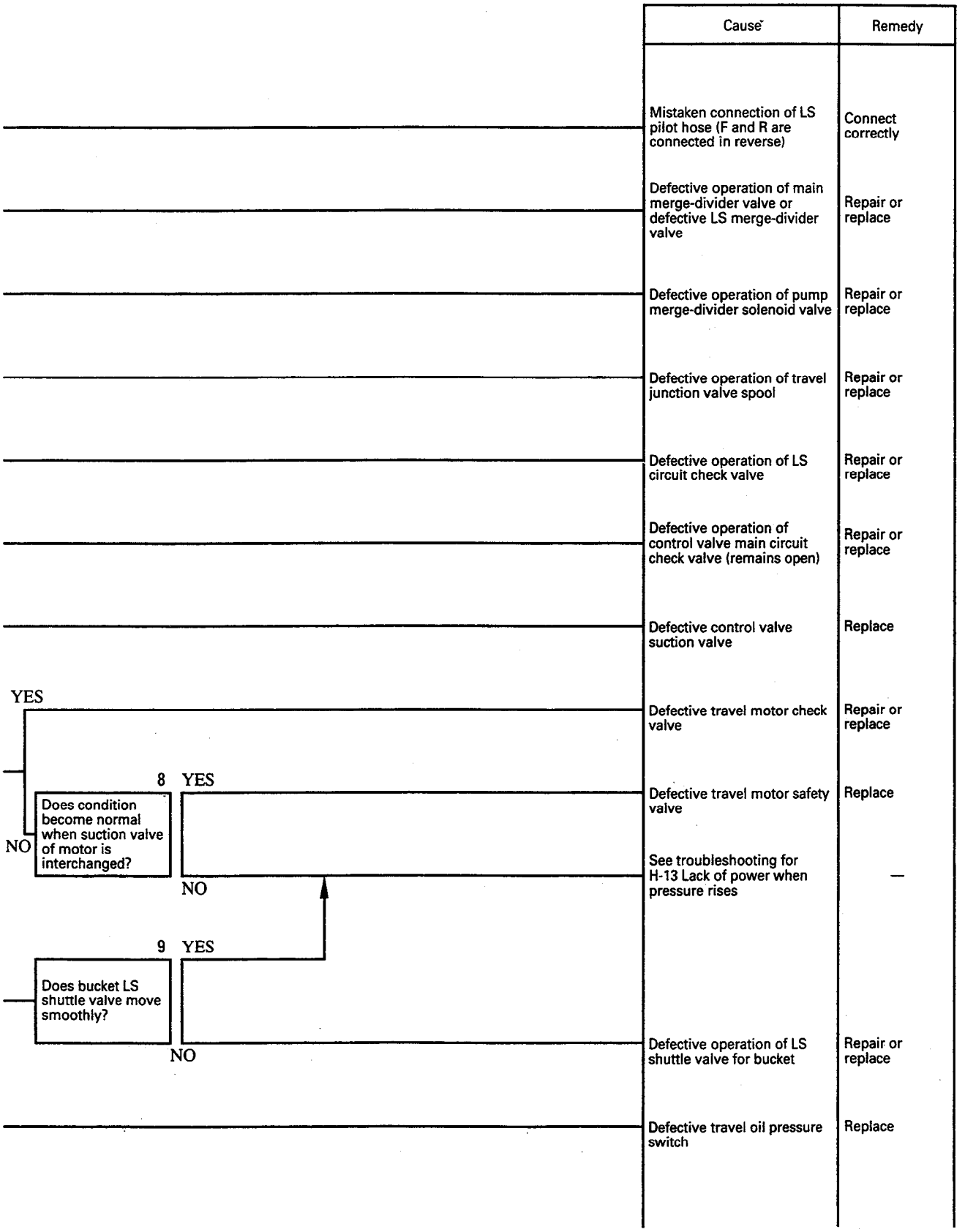
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H-22 Steering does not turn easily or lacks power

★ Carry out troubleshooting in the H/O mode.





Cause	Remedy
Mistaken connection of LS pilot hose (F and R are connected in reverse)	Connect correctly
Defective operation of main merge-divider valve or defective LS merge-divider valve	Repair or replace
Defective operation of pump merge-divider solenoid valve	Repair or replace
Defective operation of travel junction valve spool	Repair or replace
Defective operation of LS circuit check valve	Repair or replace
Defective operation of control valve main circuit check valve (remains open)	Repair or replace
Defective control valve suction valve	Replace
Defective travel motor check valve	Repair or replace
Defective travel motor safety valve	Replace
See troubleshooting for H-13 Lack of power when pressure rises	—
Defective operation of LS shuttle valve for bucket	Repair or replace
Defective travel oil pressure switch	Replace

H-23 Travel speed does not switch or is faster than specified speed

★ Carry out troubleshooting in the H/O mode.

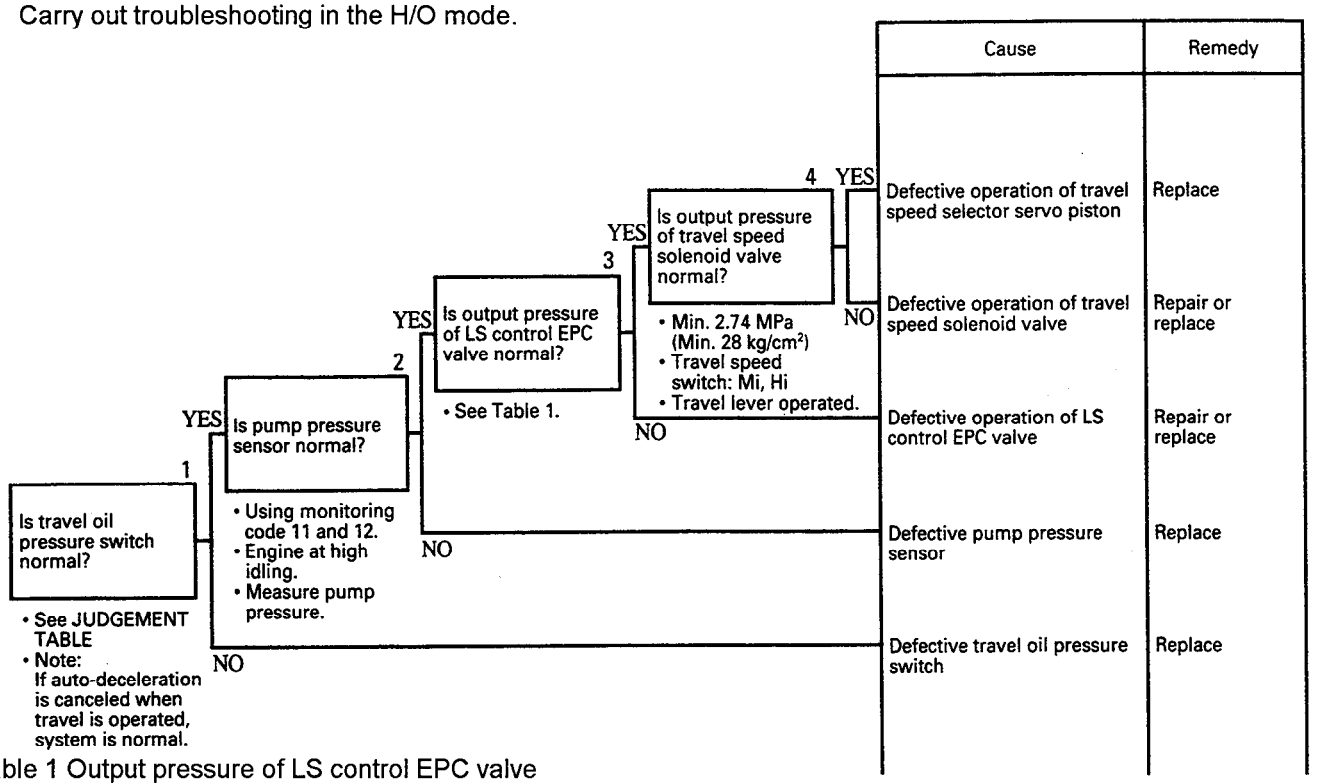
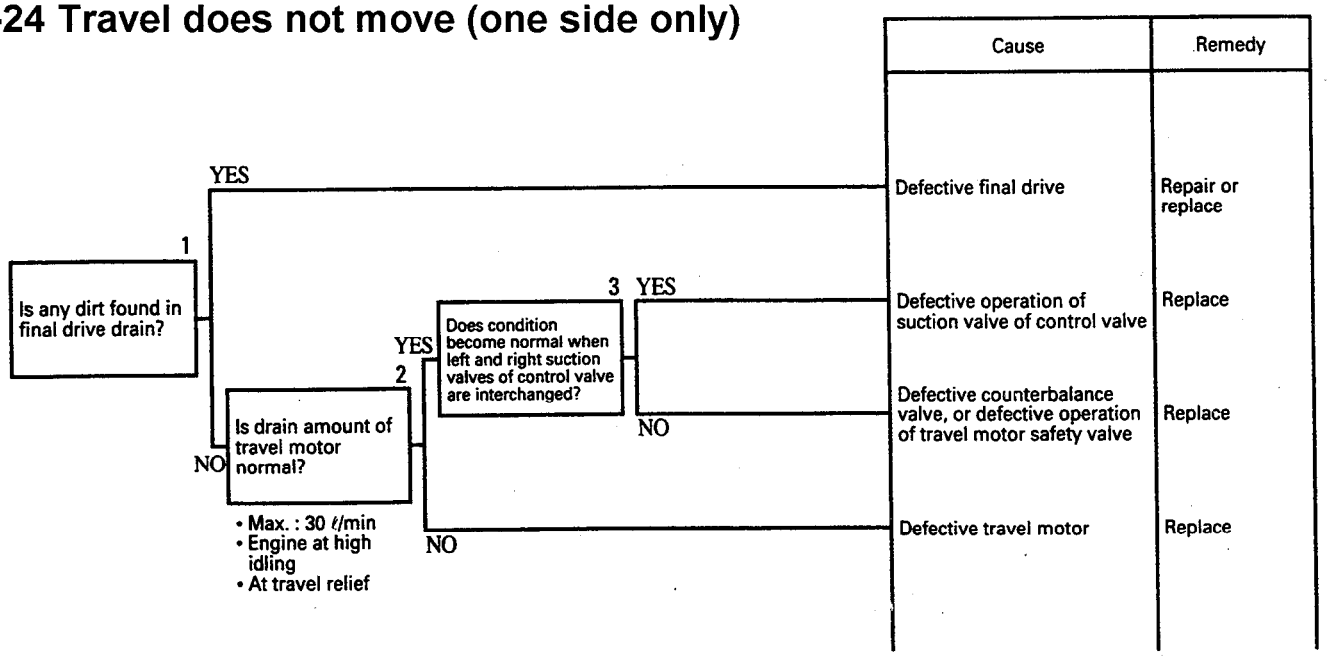


Table 1 Output pressure of LS control EPC valve

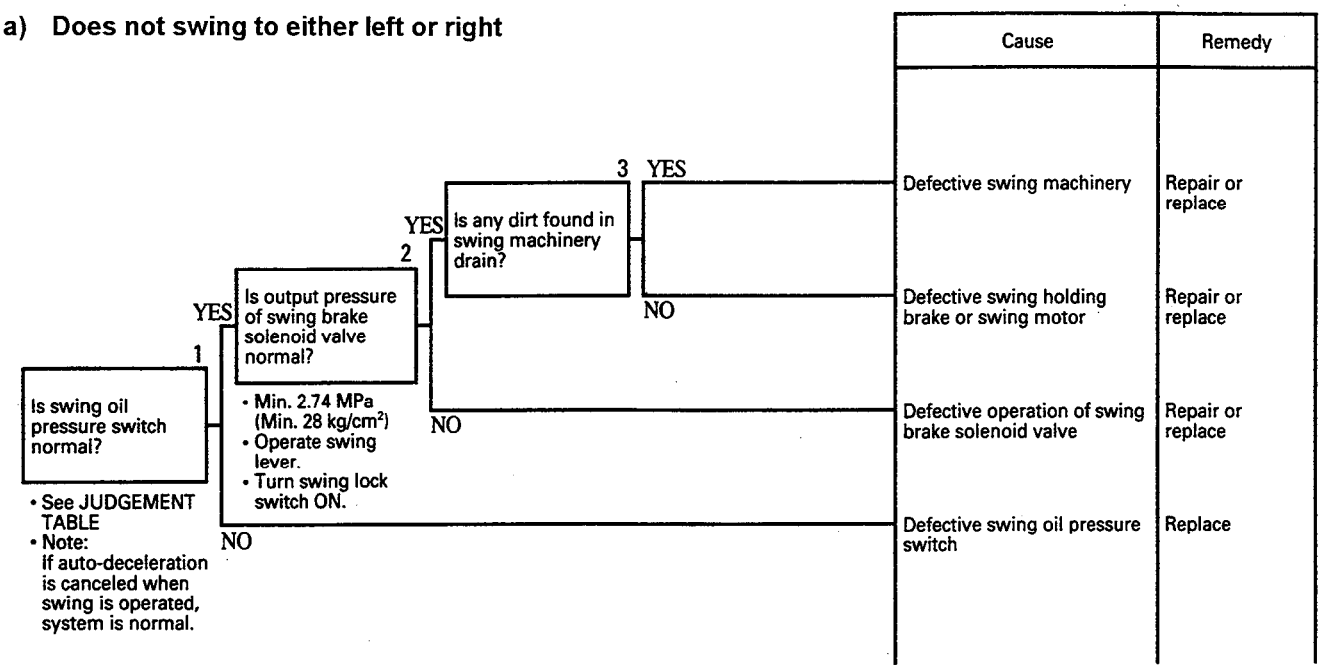
	Lo	Mi	Hi
PC200 PC210	2.0 ± 0.2 MPa (20 ± 2 kg/cm²)	2.0 ± 0.2 MPa (20 ± 2 kg/cm²)	0.2 ± 0.2 MPa (2 ± 2 kg/cm²)
PC220 PC250	1.8 ± 0.2 MPa (18 ± 2 kg/cm²)	1.8 ± 0.2 MPa (18 ± 2 kg/cm²)	0.2 ± 0.2 MPa (2 ± 2 kg/cm²)
Remarks	• Engine at high idling • Travel lever at fine control position (auto-deceleration canceled)		

H-24 Travel does not move (one side only)

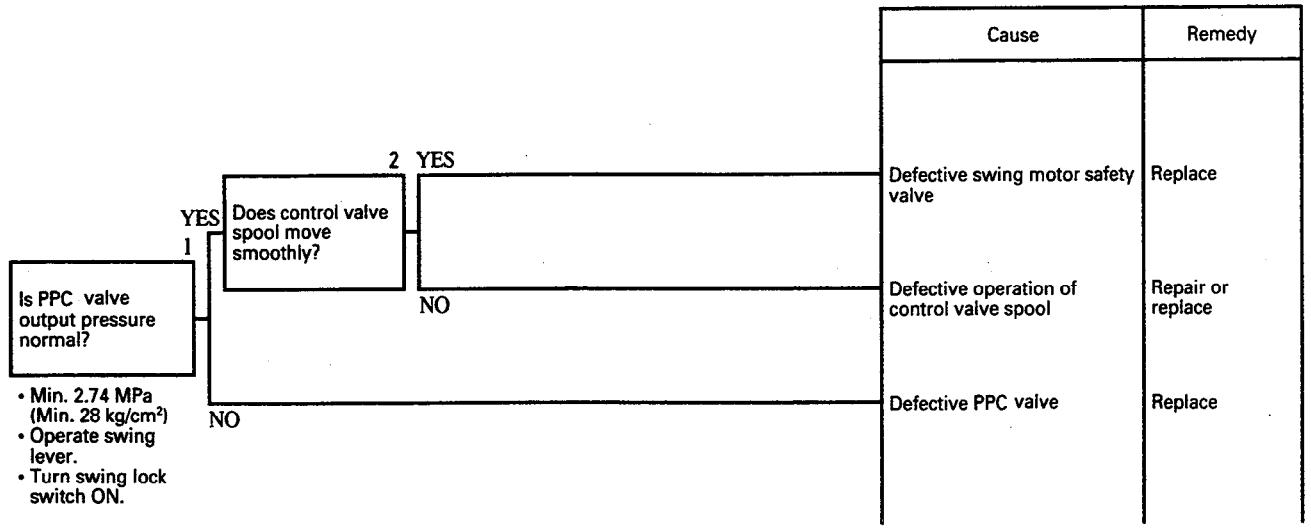


H-25 Does not swing

a) Does not swing to either left or right



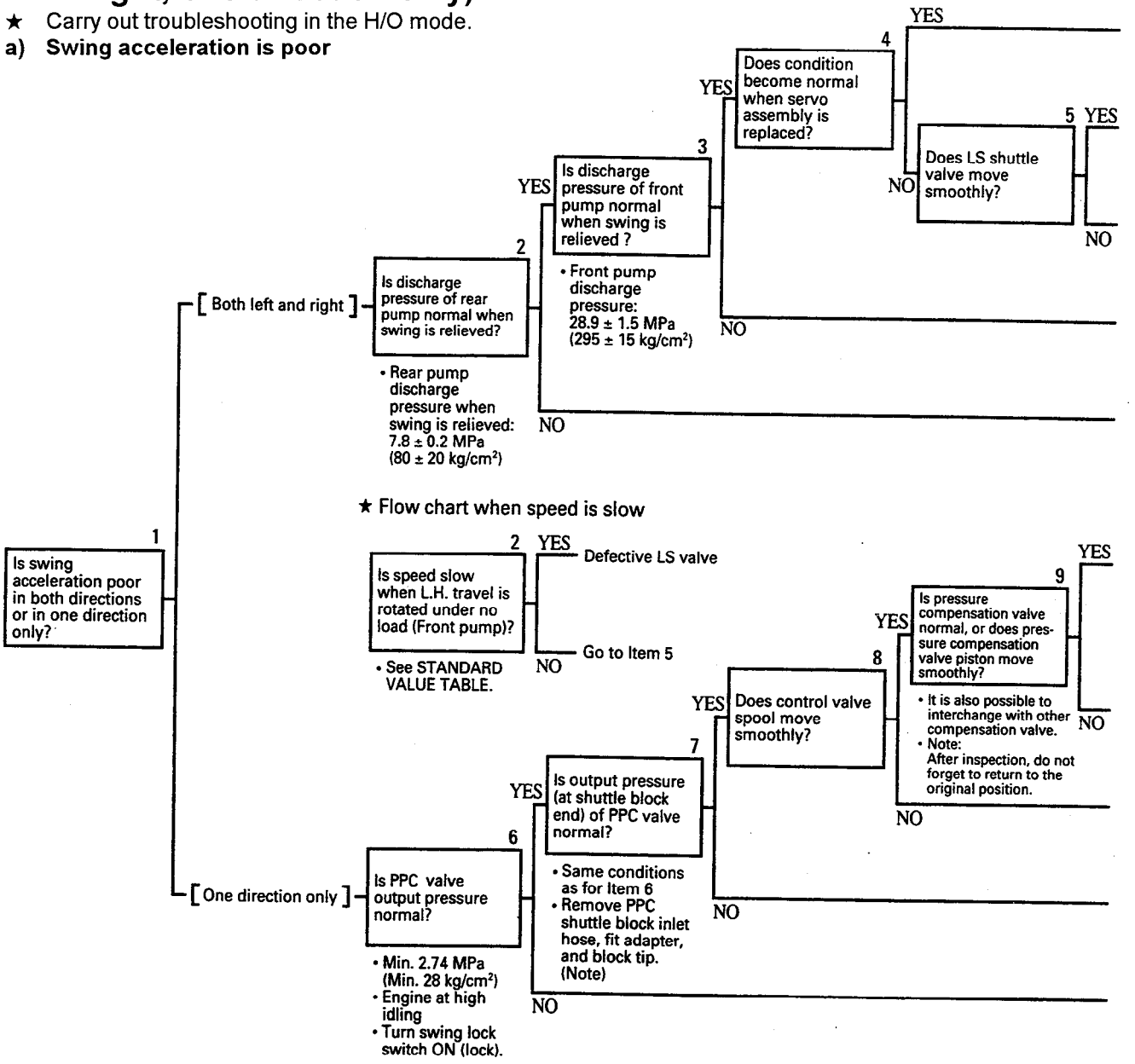
b) Does not swing in one direction



H-26 Swing acceleration is poor or swing speed is slow (both left and right, one direction only)

★ Carry out troubleshooting in the H/O mode.

a) Swing acceleration is poor



Note: If the adapter for blocking the circuit is not available, interchange PPC hose of swing with one of bucket (CURL, DUMP), boom (LOWER), or arm (IN).

b) When swing speed is slow

Change Item 2 marked with ★ under flow for a) Swing acceleration is poor, and omit Item 4 when carrying out troubleshooting.

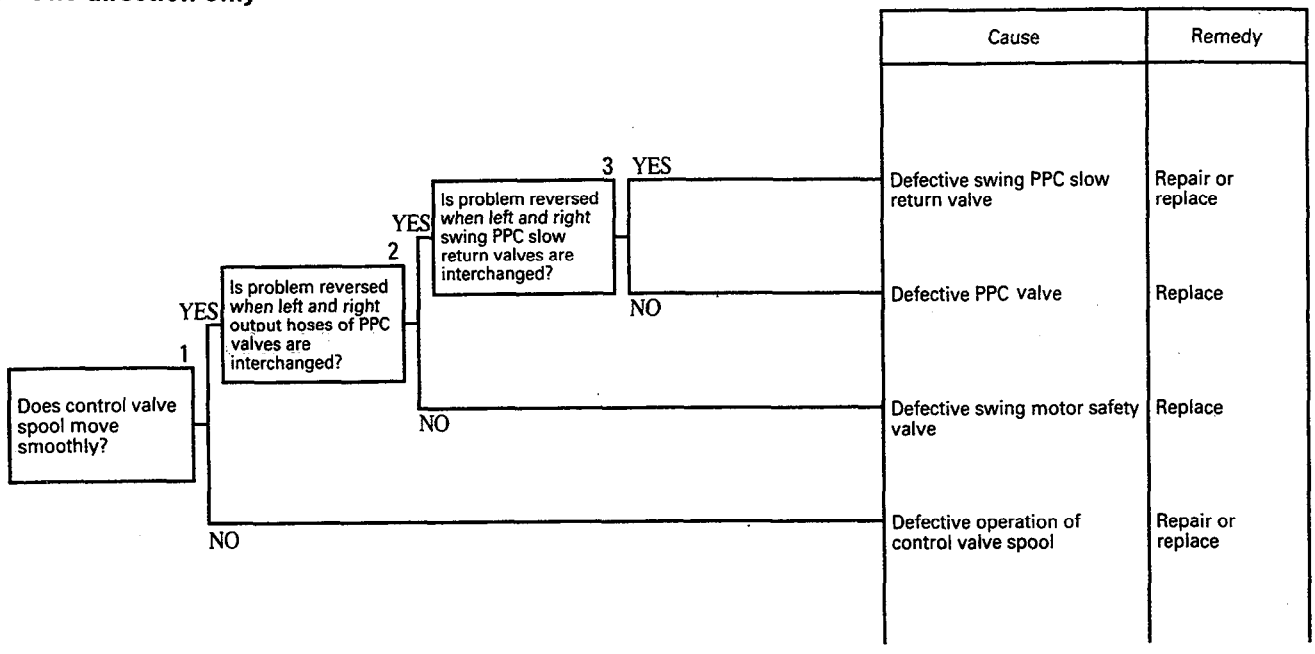
10 Does condition become normal when left and right safety valves of motor are interchanged?

- It is also possible to measure relief pressure of motor.
- Relief pressure: 27.4 –29.4 MPa (280 – 310 kg/cm^2)
- Note: After inspection, do not forget to return to the original position.

	Cause	Remedy
	Defective servo assembly	Replace
	Defective swing motor assembly	Replace
	Defective operation of LS shuttle valve (all LS shuttles)	Repair or replace
	Defective LS circuit check valve	Repair or replace
	Defective main circuit check valve	Repair or replace
YES	Defective swing motor safety valve	Replace
NO	Defective swing motor suction valve	Replace
	Defective pressure compensation valve, or defective operation of compensation valve piston	Repair or replace
	Defective operation of control valve spool	Repair or replace
	Defective operation of PPC shuttle valve	Repair or replace
	Defective PPC valve	Replace

H-27 Excessive overrun when stopping swing

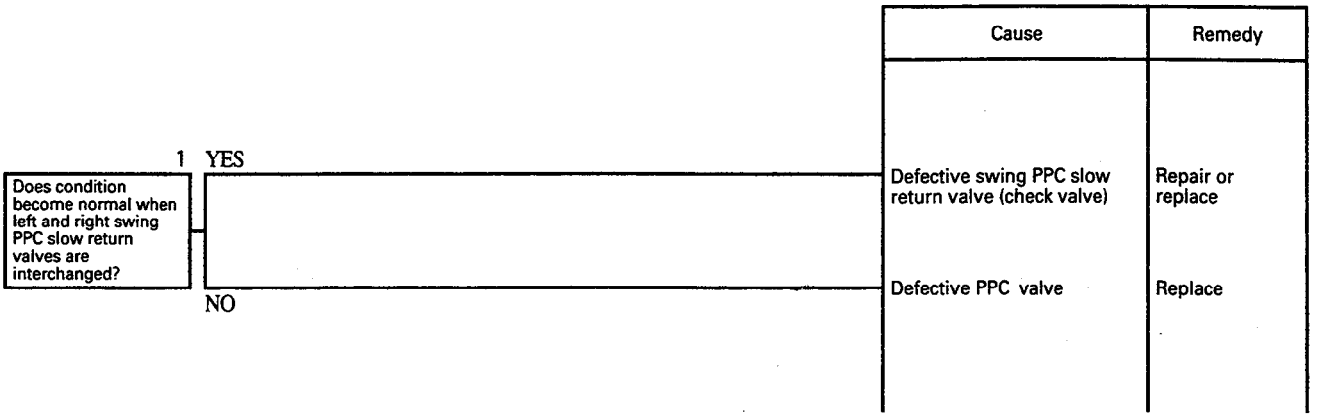
a) One direction only



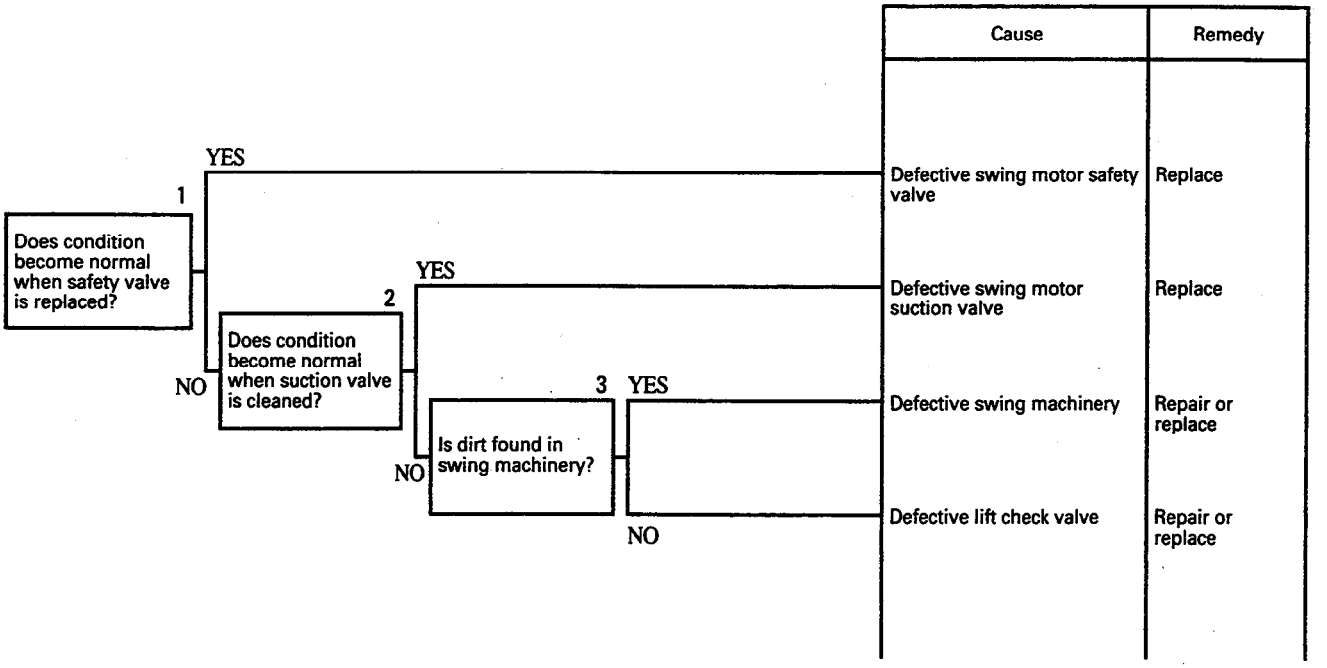
b) Both directions

Cause	Remedy
Defective swing motor	Correct or replace

H-28 Excessive shock when stopping swing (one direction only)



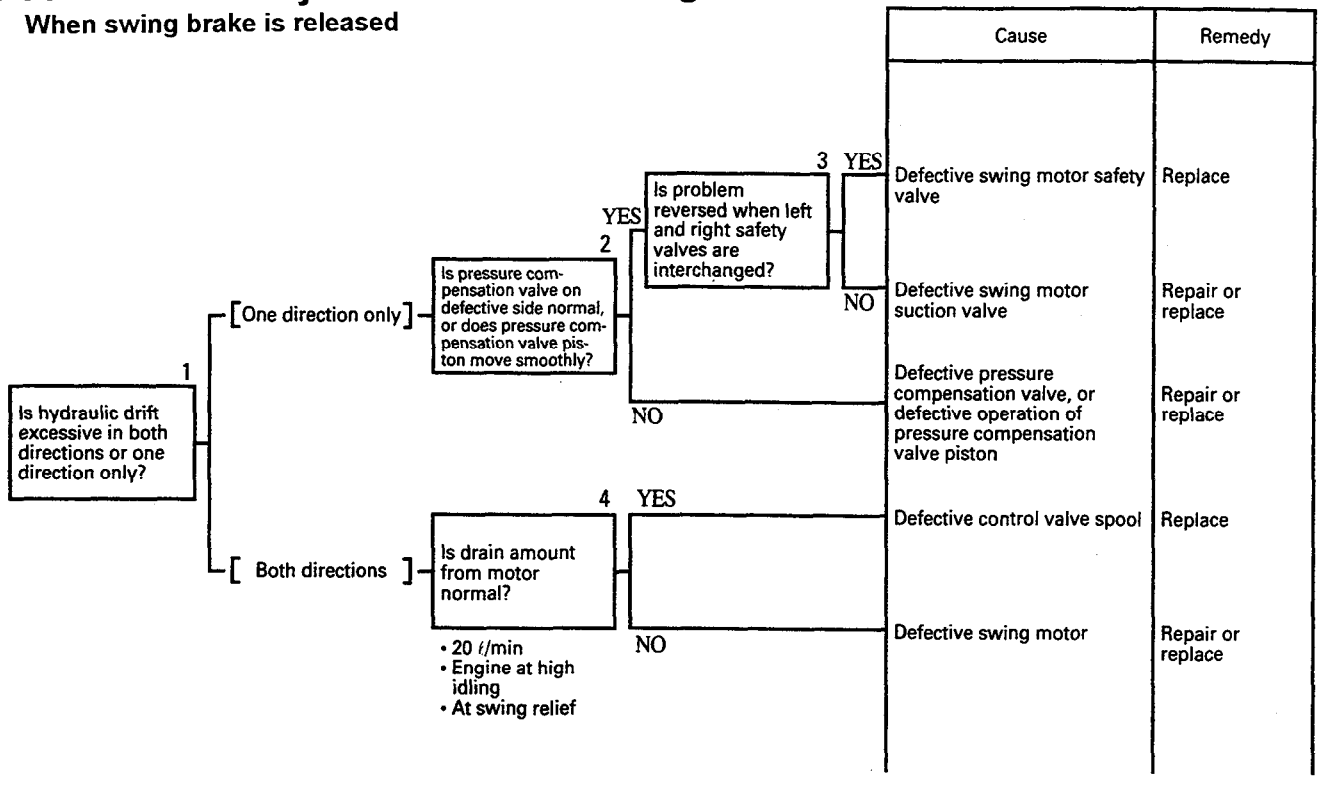
H-29 Excessive abnormal noise when stopping swing



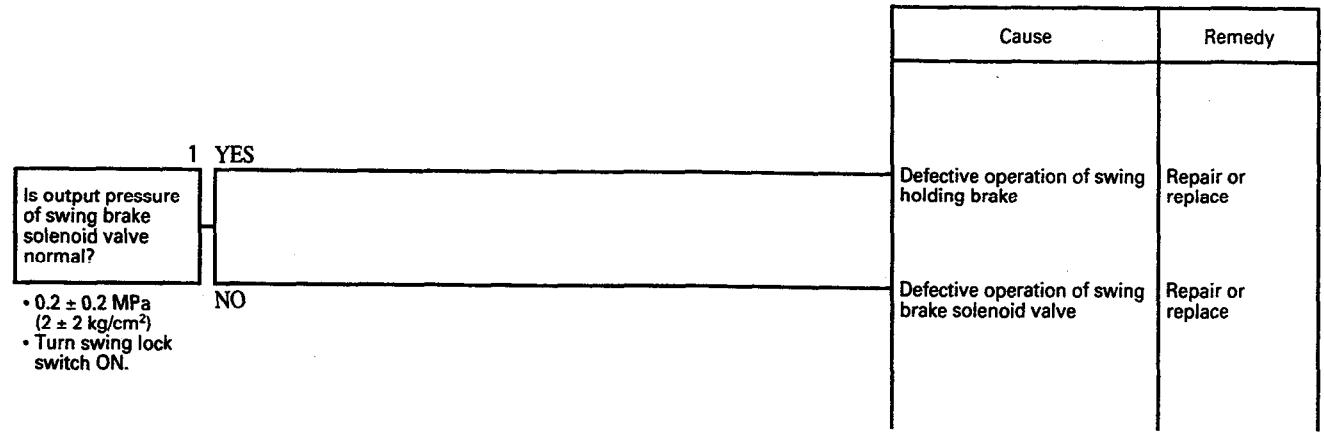
https://truckmanualshub.com/

H-30 Excessive hydraulic drift of swing

a) When swing brake is released



b) When swing brake is applied



H-31 Swing speed is faster than specified swing speed

★ Carry out troubleshooting in the H/O mode.

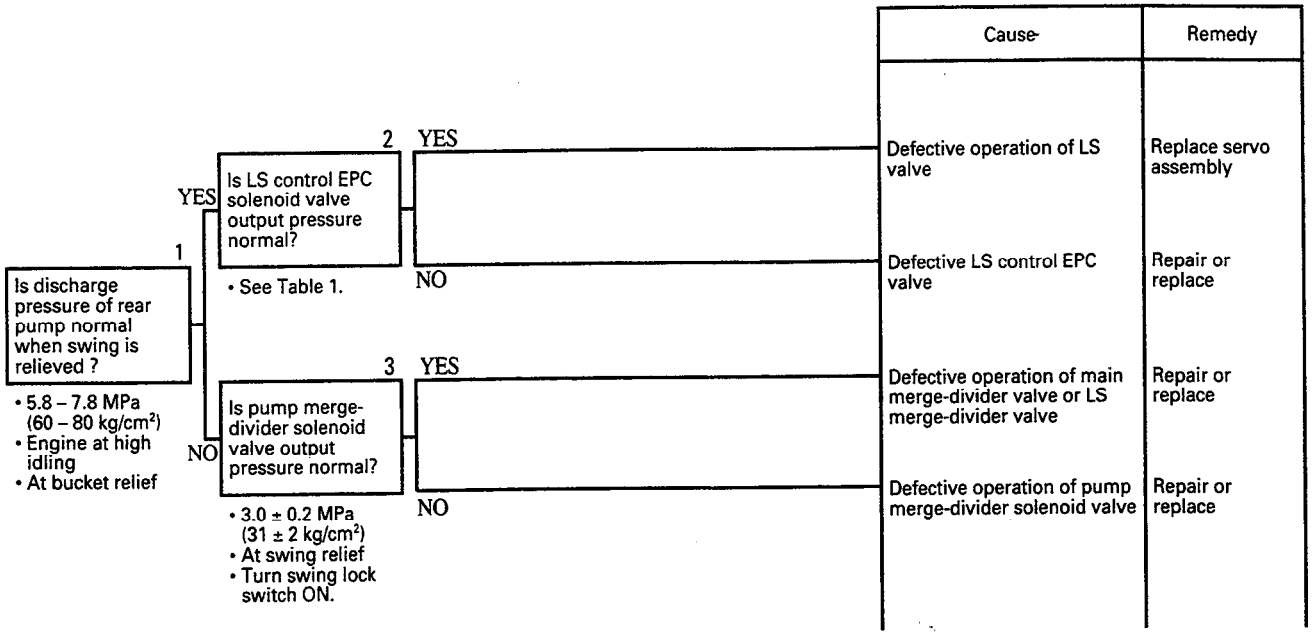


Table 1 Output pressure of LS control EPC valve

- Engine at high idling

	H/O mode	G/O mode	F/O mode	L/O mode
PC200 PC210	0.2 ± 0.2 MPa (2 ± 2 kg/cm²)	0.2 ± 0.2 MPa (2 ± 2 kg/cm²)	1.5 ± 0.2 MPa (15.5 ± 2 kg/cm²)	1.5 ± 0.2 MPa (15.5 ± 2 kg/cm²)
PC220 PC250	0.2 ± 0.2 MPa (2 ± 2 kg/cm²)	0.2 ± 0.2 MPa (2 ± 2 kg/cm²)	0.2 ± 0.2 MPa (2 ± 2 kg/cm²)	1.5 ± 0.2 MPa (15.5 ± 2 kg/cm²)

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TROUBLESHOOTING OF MACHINE MONITOR SYSTEM (M MODE)

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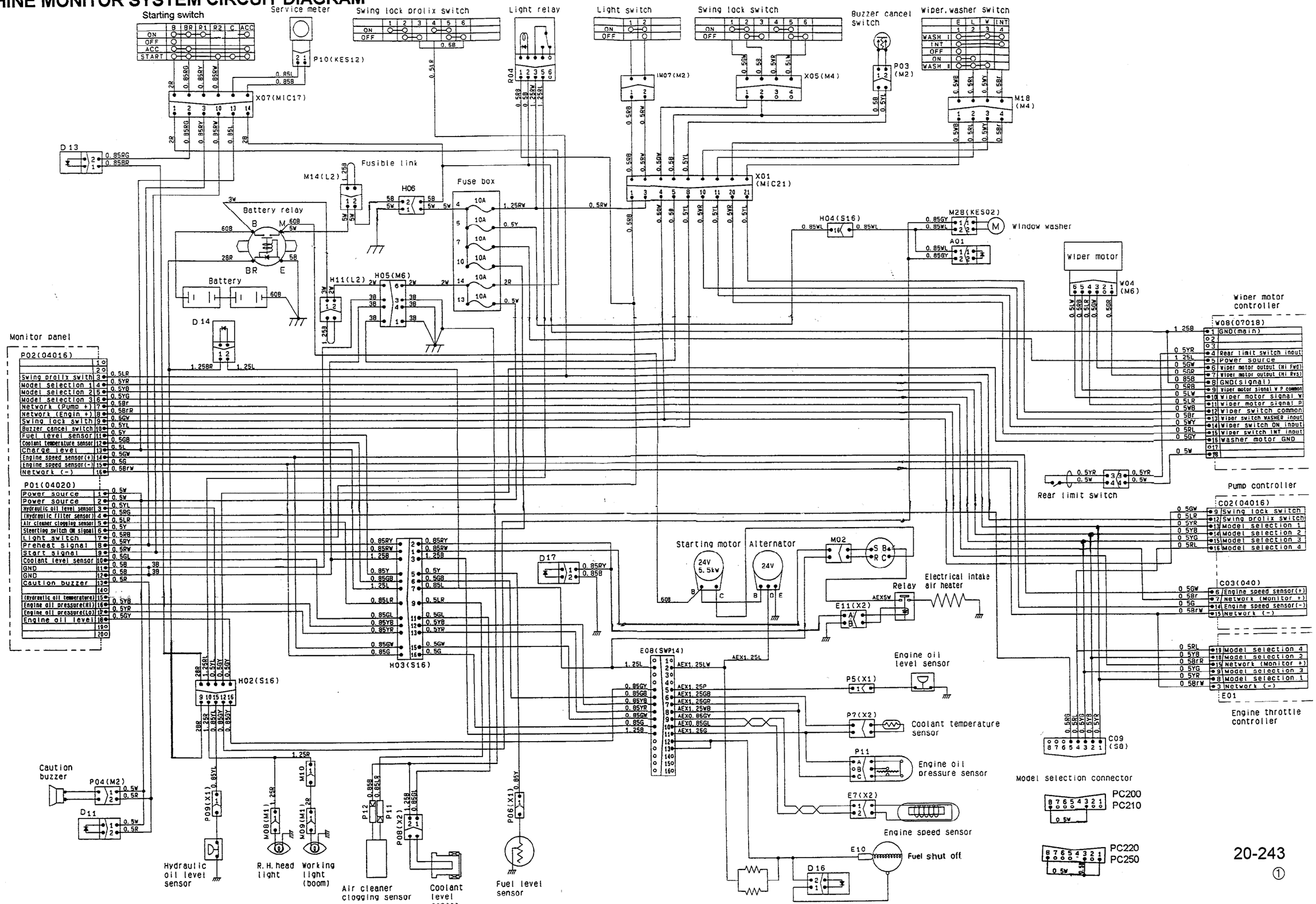
https://truckmanualshub.com/

ACTION TAKEN BY MONITOR PANEL WHEN ABNORMALITY OCCURS AND PROBLEMS ON MACHINE

User code	Service code	Abnormal system	Nature of abnormality	Condition when normal (voltage, current, resistance)	Action by controller when abnormality is detected	Problem that appears on machine when there is abnormality
–	E1:01	Abnormality in error data	1. Abnormality in internal memory 2. Excess voltage (more than 36V) has occurred 3. Low voltage (less than 12V) has occurred 4. Connector has separated	When starting switch is turned ON, keep time switch pressed for 5 seconds to actuate clear function	1. When there is abnormality in engine throttle controller, control cannot be carried out. 2. When there is abnormality in pump controller, the output is cut off, so control cannot be carried out.	1. Service code cannot be cleared 2. Time becomes 00:00.
–	E1:02	Abnormality in clock data	1. Abnormality in internal clock function 2. Excess voltage (more than 36V) has occurred 3. Low voltage (less than 12V) has occurred 4. Connector has separated			1. Service code cannot be cleared 2. Time becomes 00:00. 3. Clock does not advance.
–	E1:03	Short circuit in buzzer output system	1. Short circuit inside buzzer 2. Power line in contact with wiring harness between monitor panel P01(13) – buzzer 3. Abnormality in monitor panel	Voltage between P01 (13) – (11) (12) Buzzer ON: Max. 1V Buzzer OFF: 20 – 30V ★When there is disconnection, E1:03 is not displayed and buzzer does not sound		Buzzer does not sound

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MACHINE MONITOR SYSTEM CIRCUIT DIAGRAM



M-1 [E1:01] Abnormality in error data is displayed

★ This is not a mechanical failure.
It is not an abnormality if this occurs when the system has been reset after disconnecting connector P01 from the monitor panel, or after fuse 13 has blown, or after connector H05 has been disconnected.
- Turn the starting switch OFF. Then keep the time switch depressed, switch the starting switch ON again, and keep the time switch depressed for 5 seconds to return the system to normal.

M-2 [E1:02] Error in clock data is displayed

★ This is not a mechanical failure.
It is not an abnormality if this occurs when the system has been reset after disconnecting connector P01 from the monitor panel, or after fuse 13 has blown, or after connector H05 has been disconnected.
- Turn the starting switch OFF. Then keep the time switch depressed, switch the starting switch ON again, and keep the time switch depressed for 5 seconds to return the system to normal.

M-3 [E1:03] Short circuit in buzzer output or contact of 24V wirin harness with buzzer drive harness is displayed

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if E1:03 is displayed. (If it is not displayed, the system has been reset.)
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

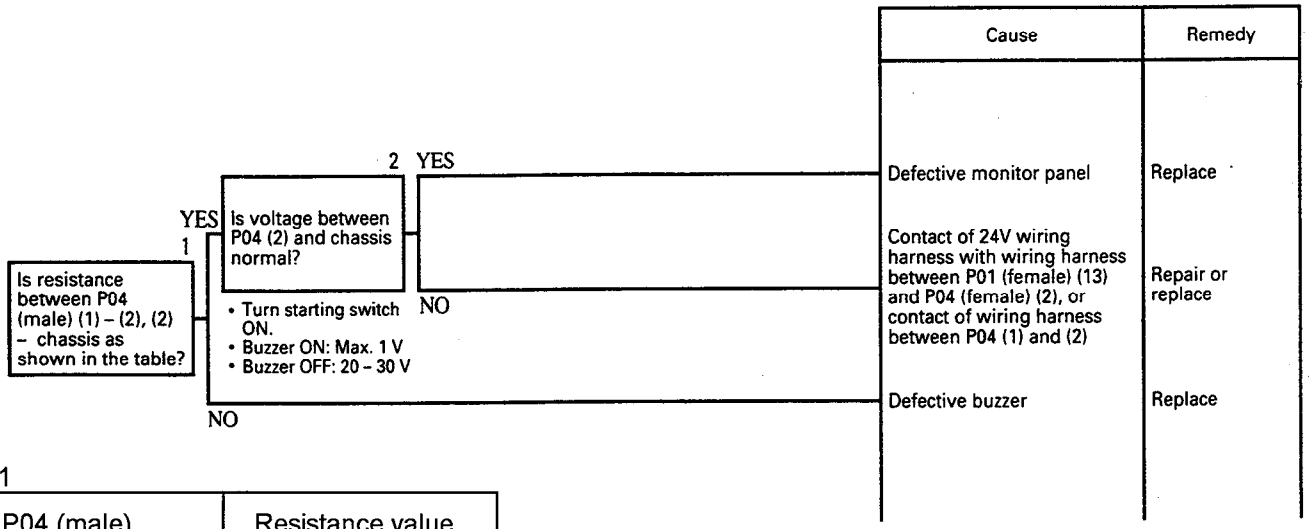
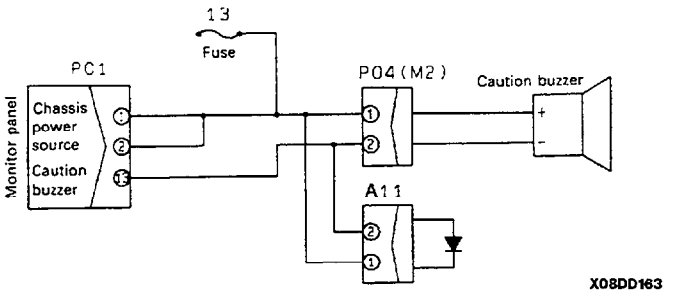


Table 1

P04 (male)	Resistance value
Between (1) and (2)	200 - 300 Ω
Between (2) and chassis	Min. 1 MΩ

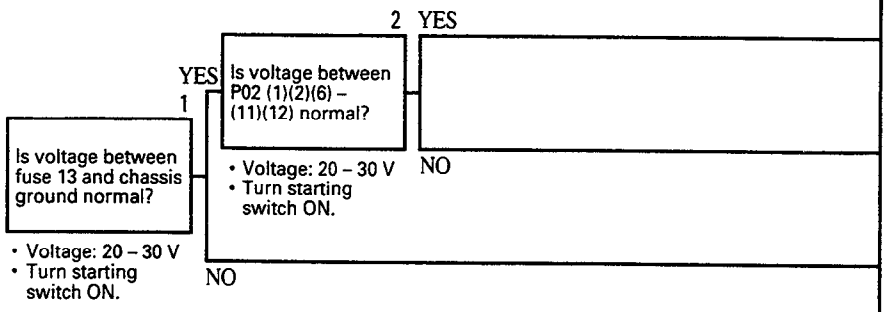
M-3 Related electric circuit diagram



M-4 When starting switch is turned ON, none of lamps on monitor panel light up

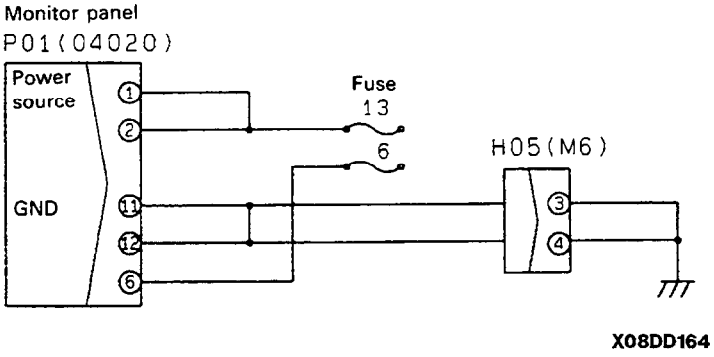
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

a) None of the lamps on monitor panel light up



Cause	Remedy
Defective monitor panel	Replace
Defective contact, or disconnection in wiring harness between fuse 13 – P01 (female) (1)(2) or P01 (female) (11)(12) – H05 (3)(4) – chassis ground, or between fuse 6 – P01 (6)	Repair or replace
Blown fuse	Check for cause of blown fuse, then replace

M-4 Related electric circuit diagram



b) Some of lamps on monitor panel (gauge display, time display) do not light up

Cause	Remedy
Defective monitor panel	Replace

M-5 When starting switch is turned ON, monitor panel lamps all stay lighted up and do not go out

Cause	Remedy
Defective monitor panel	Replace

M-6 When starting switch is turned ON, items lighted up on monitor panel are different from machine model

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

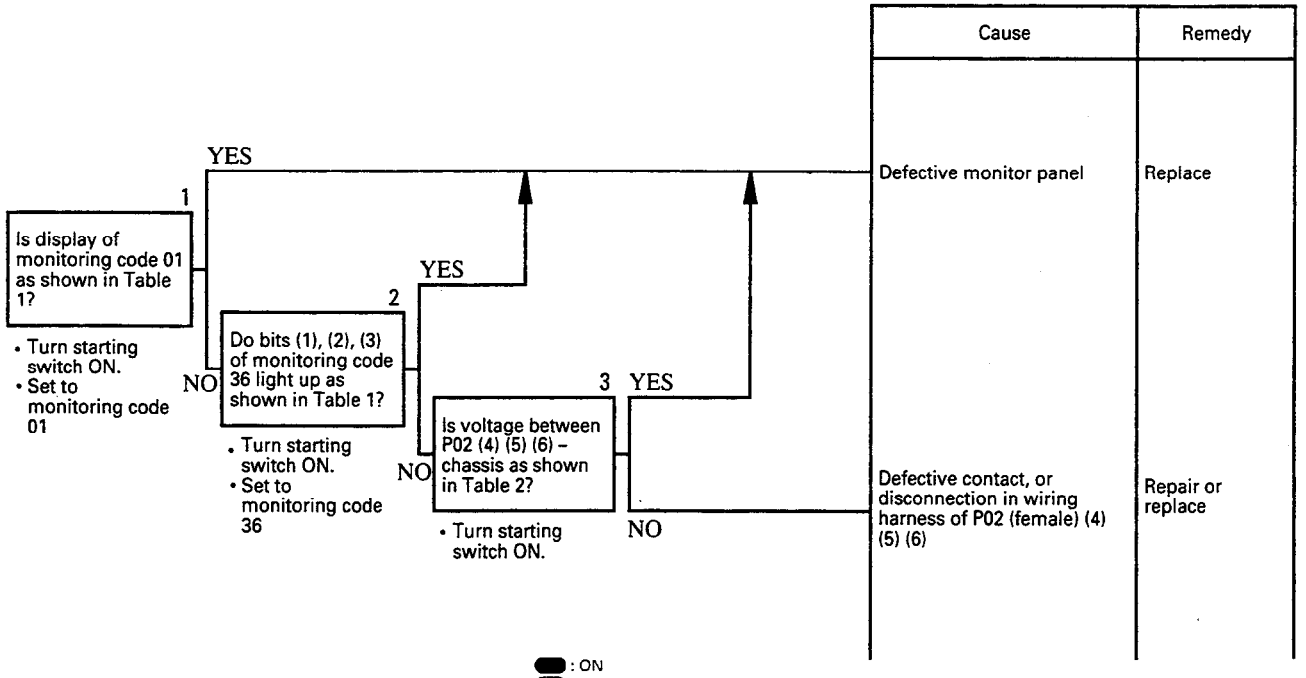


Table 1 ●: ON ○: OFF

Model	Monitor panel model code	
PC200 PC210	01.200	36. ○ ● ○
PC220 PC250	01.220	36. ● ●

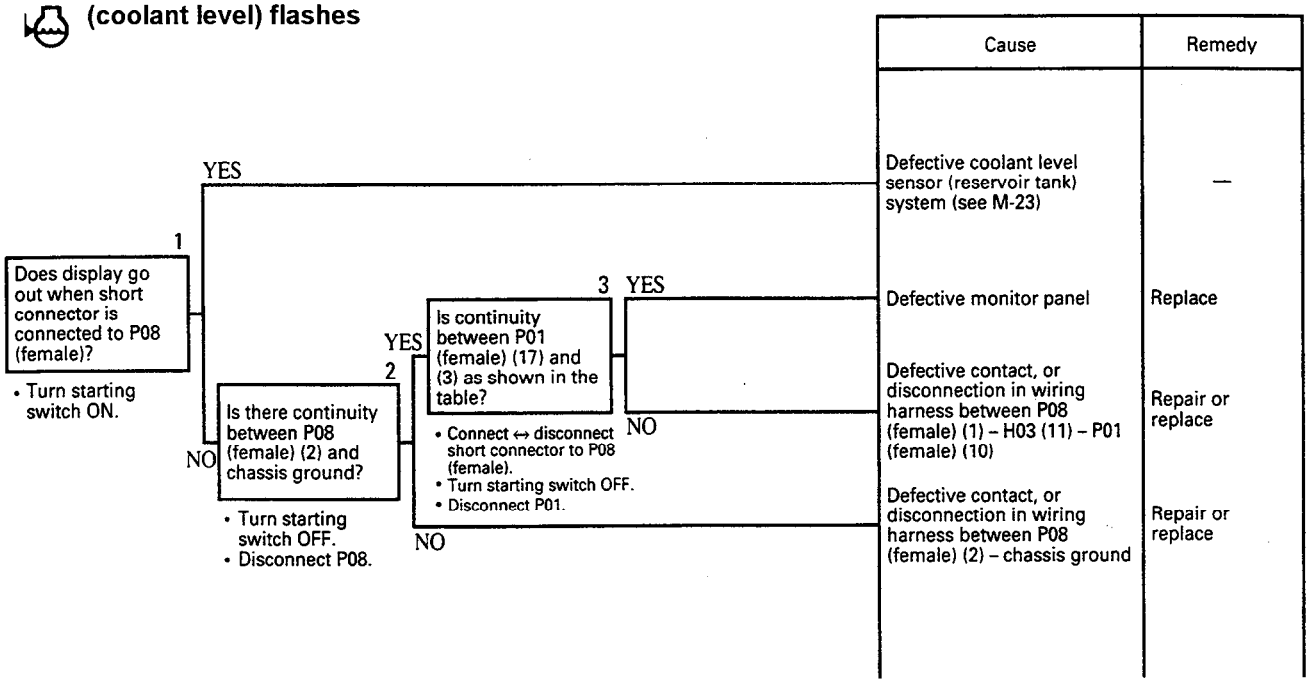
Table 2

Connector P02	PC200 PC210	PC220 PC250
Between (4) - GND	20 - 30 V	Max. 1 V
Between (5) - GND	20 - 30 V	20 - 30 V
Between (6) - GND	Max. 1 V	Max. 1 V

M-7 When starting switch is turned ON (engine stopped), CHECK items flash (Fluid levels for CHECK items are at specified level)

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.
★ Check that the coolant is at the specified level before carrying out troubleshooting.

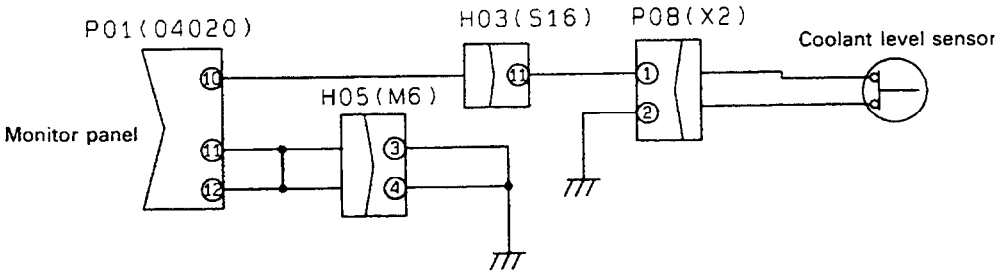
a) (coolant level) flashes



Table

Short connector	Continuity
Connected	Yes
Disconnected	No

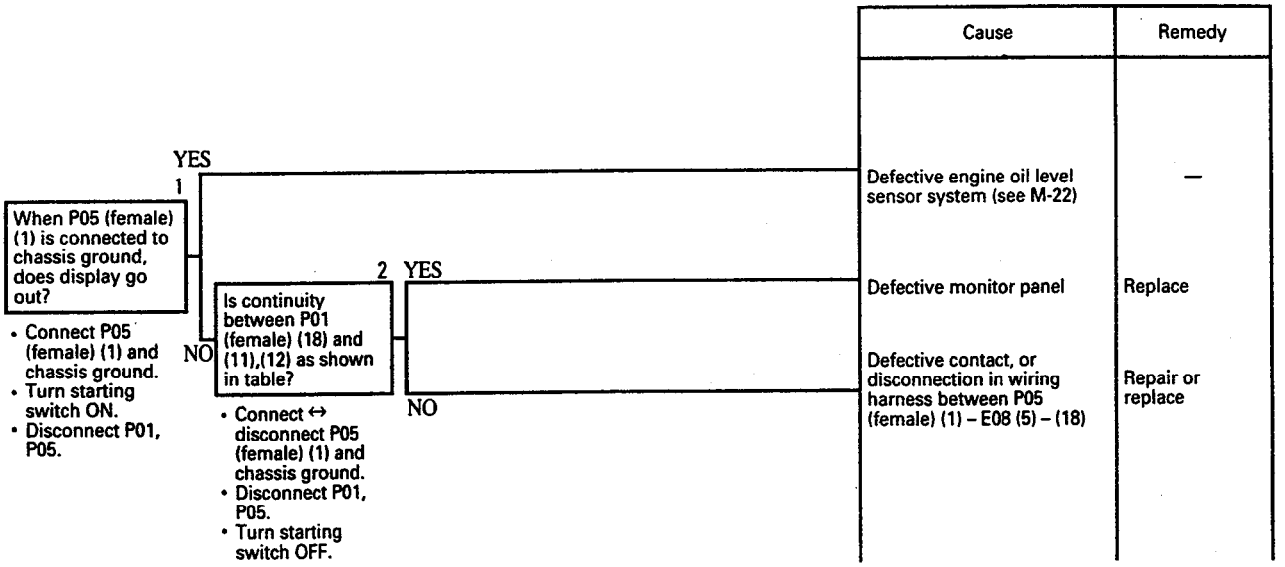
M-7 a) Related electric circuit diagram



X08DD165

b) (engine oil level) flashes

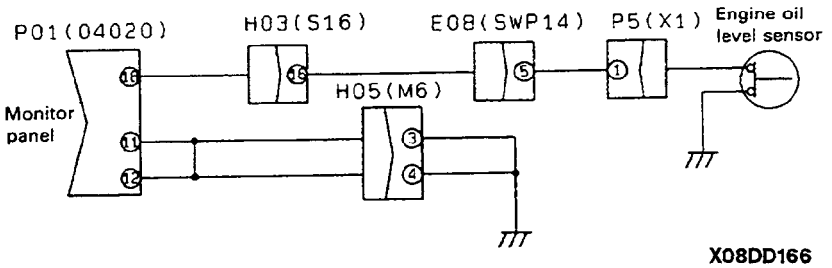
★ Use the level gauge to check that the engine oil level is correct before carrying out troubleshooting.



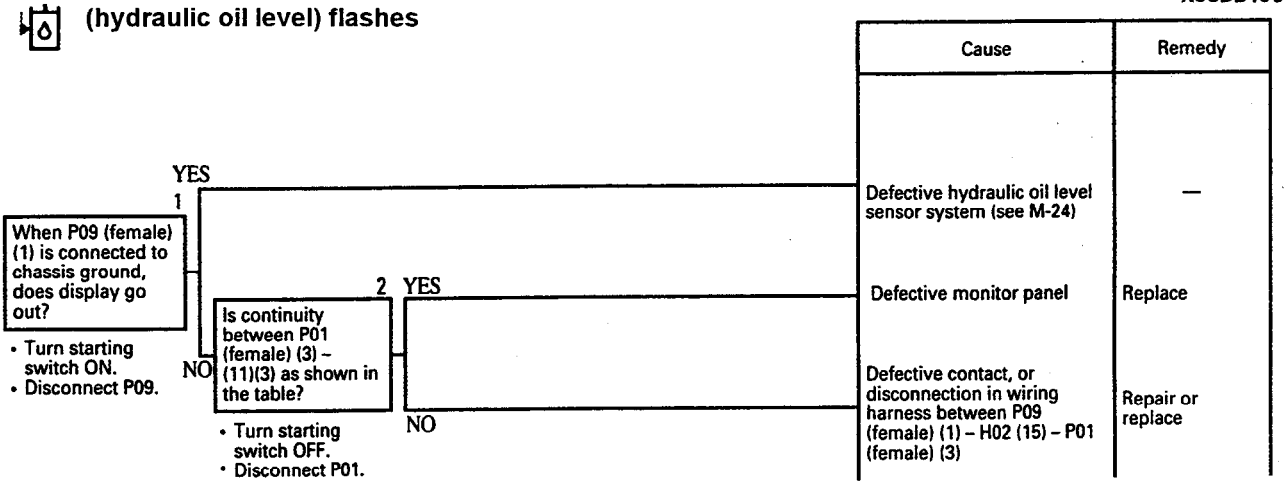
Table

Connection with ground	Continuity
Connected	Yes
Disconnected	No

M-7 b) Related electric circuit diagram



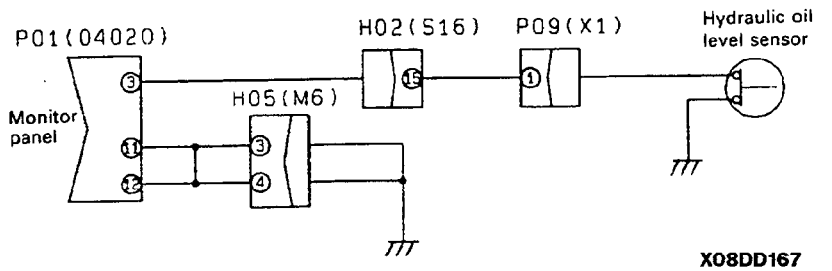
c) (hydraulic oil level) flashes



Table

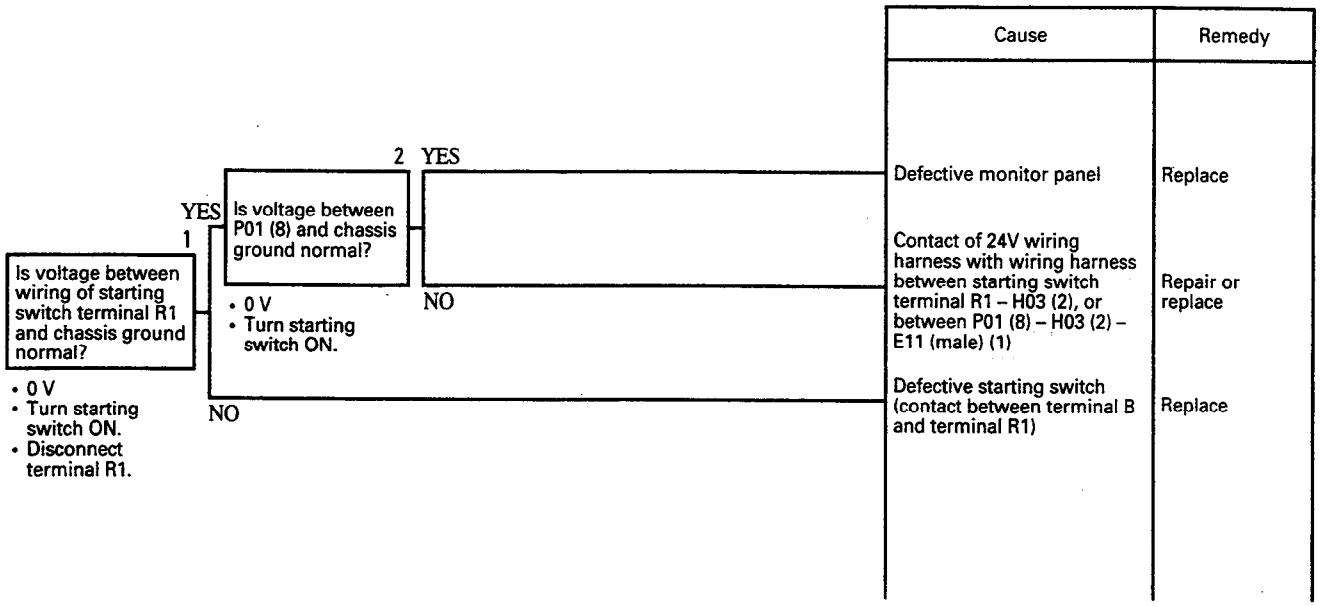
Between P09 (female) and chassis	Continuity
Connected	Yes
Disconnected	No

M-7 c) Related electric circuit diagram



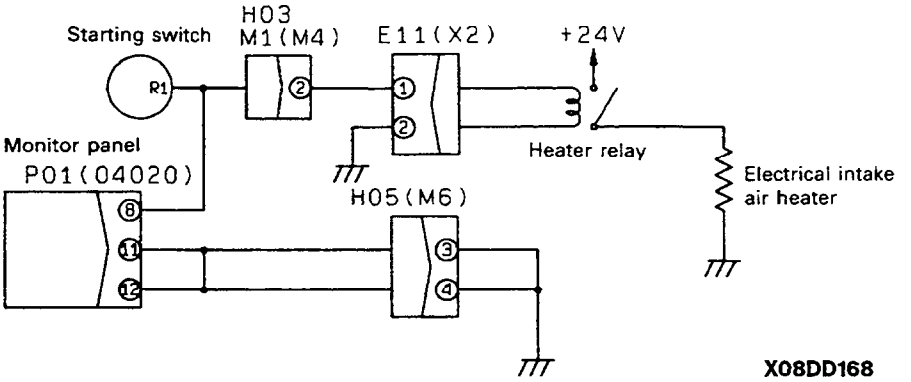
M-8 Preheating is not being used but preheating display lights up

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.



Cause	Remedy
Defective monitor panel	Replace
Contact of 24V wiring harness with wiring harness between starting switch terminal R1 – H03 (2), or between P01 (8) – H03 (2) – E11 (male) (1)	Repair or replace
Defective starting switch (contact between terminal B and terminal R1)	Replace

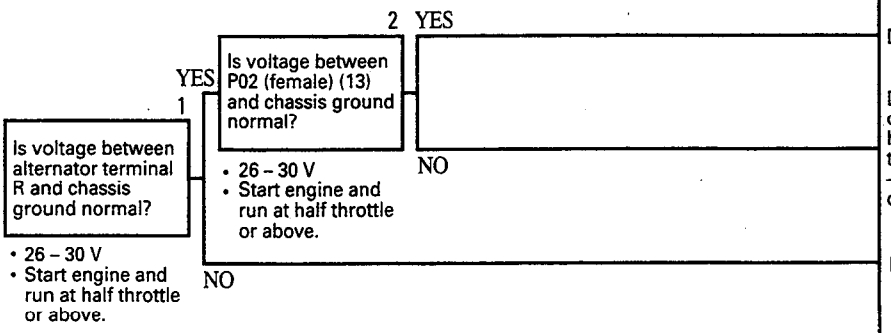
M-8 Related electric circuit diagram



M-9 When starting switch is turned ON and engine started, CHECK items flash

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.
★ Check both the alternator system and the engine oil pressure system.

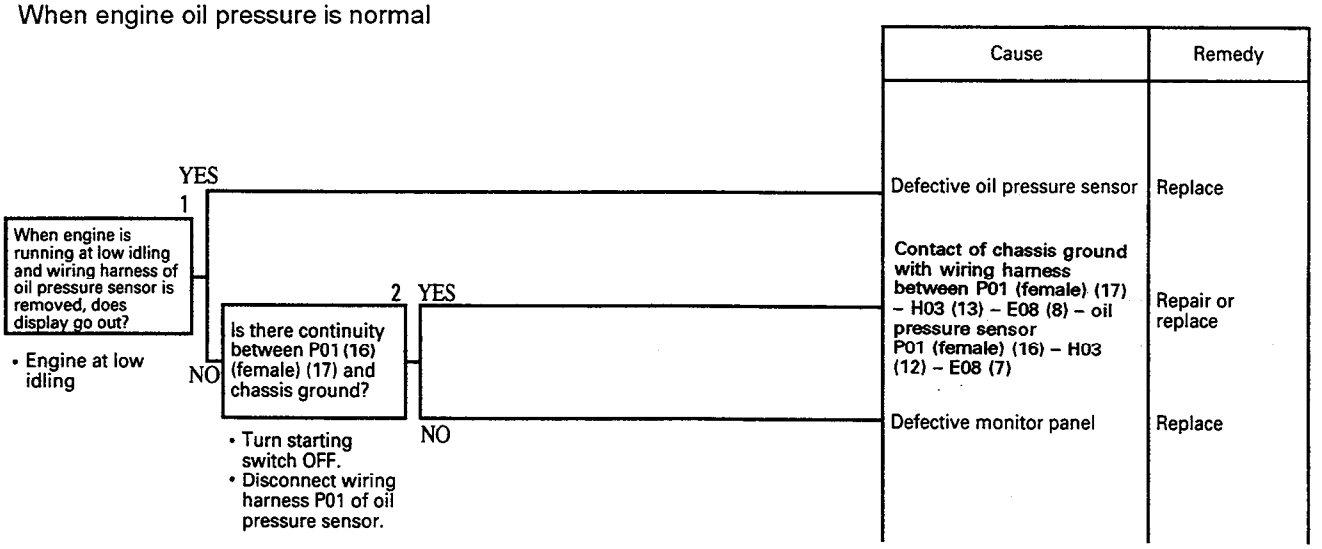
a) Alternator system



Cause	Remedy
Defective monitor panel	Replace
Defective contact, or disconnection in wiring harness between alternator terminal R – E08 (2) – H03 (7) – P02 (female) (13), or defective alternator	Repair or replace
Defective alternator	Replace

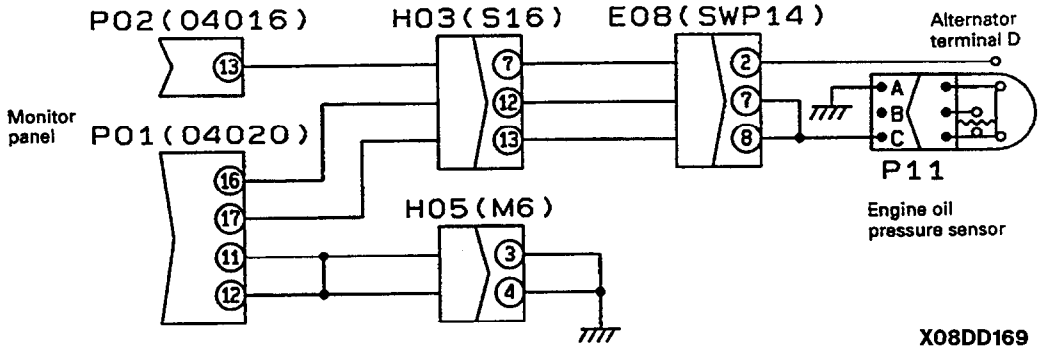
b) Engine oil pressure system

★ When engine oil pressure is normal



Cause	Remedy
Defective oil pressure sensor	Replace
Contact of chassis ground with wiring harness between P01 (female) (17) – H03 (13) – E08 (8) – oil pressure sensor P01 (female) (16) – H03 (12) – E08 (7)	Repair or replace
Defective monitor panel	Replace

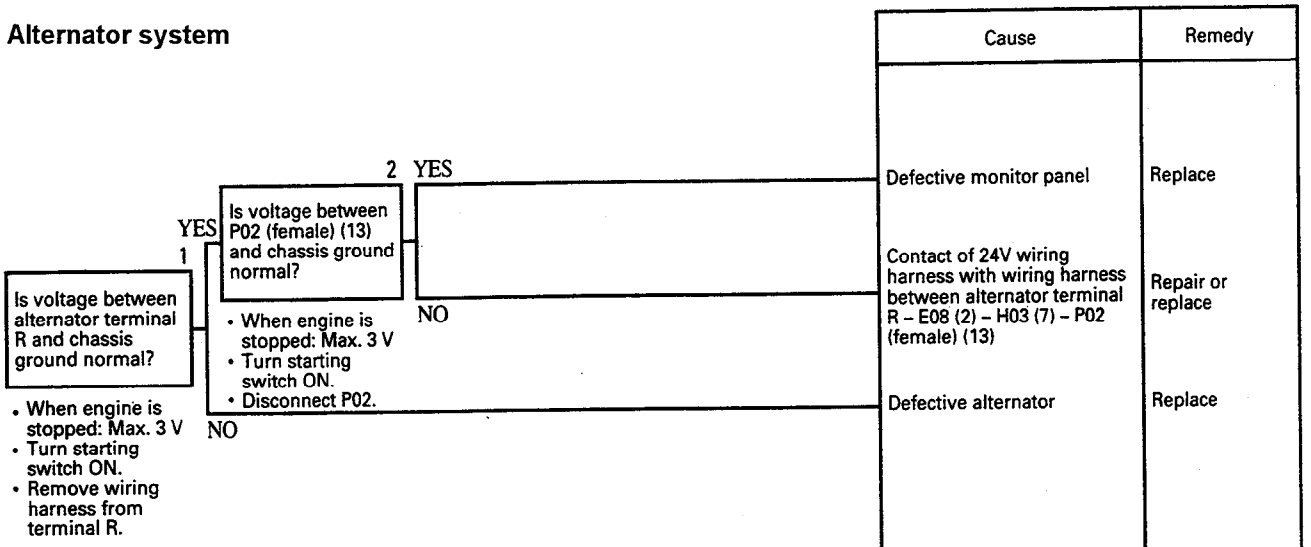
M-9 Related electric circuit diagram



M-10 When starting switch is turned ON (engine stopped), CAUTION items flash (but when charge level, engine oil pressure do not light up)

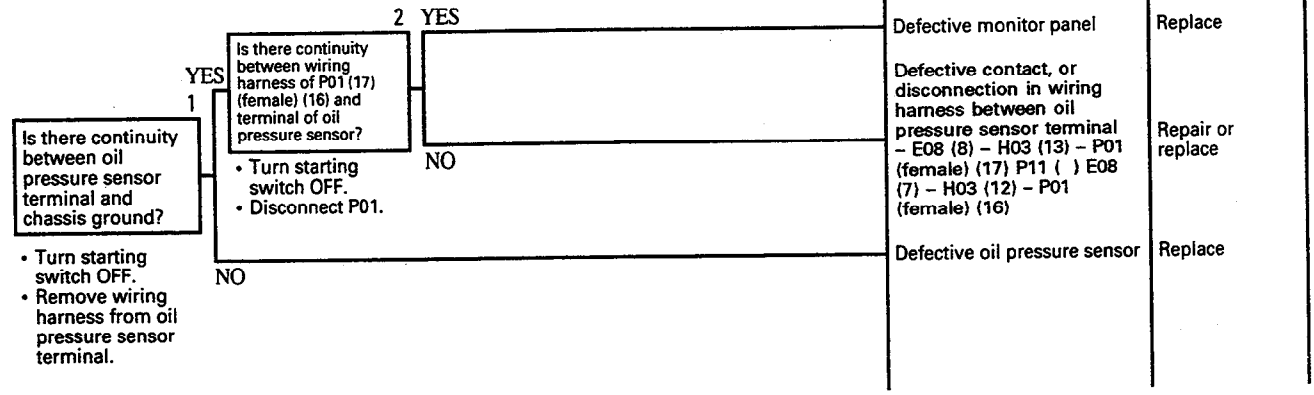
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

a) Alternator system



b) Engine oil pressure sensor system

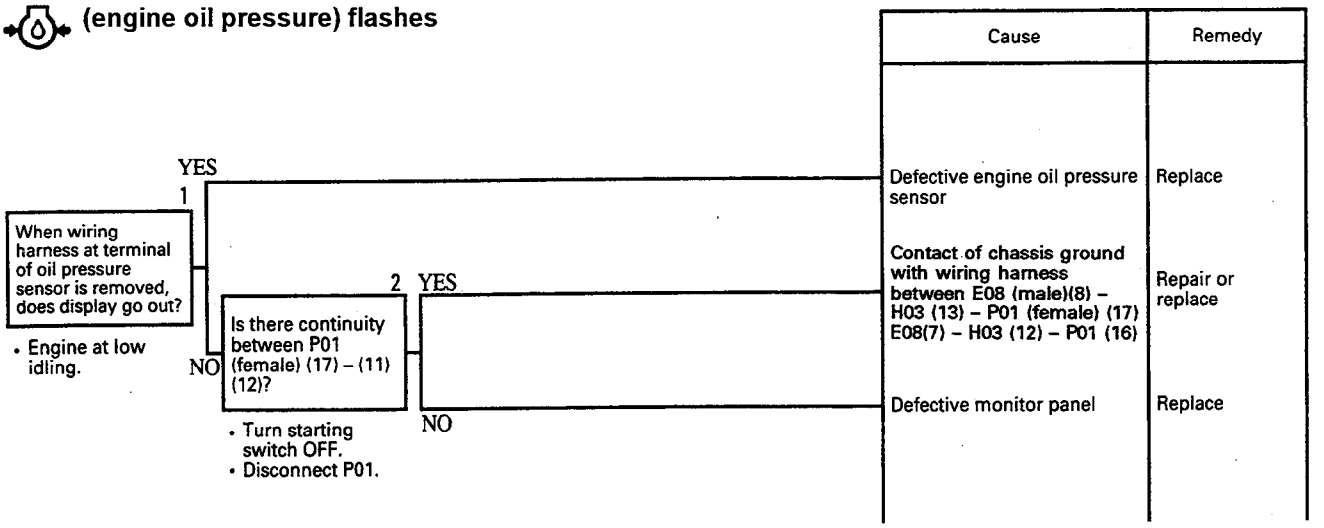
★ When engine oil pressure is normal



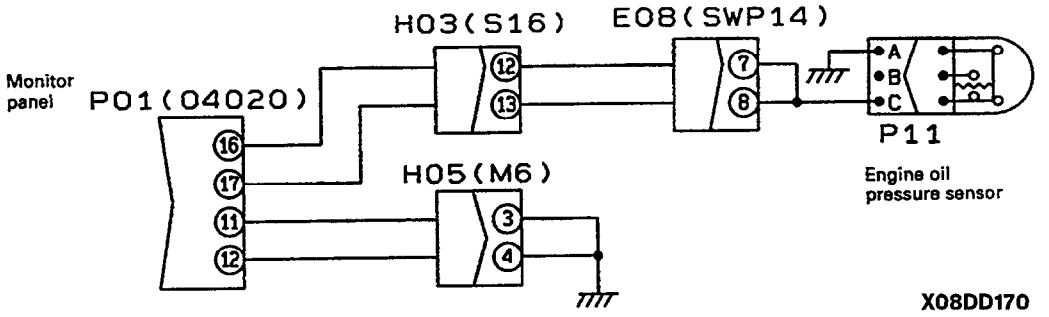
M-11 When starting switch is turned ON and engine is started, CAUTION items flash (but when there is no abnormality in engine or CHECK items)

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

a) (engine oil pressure) flashes



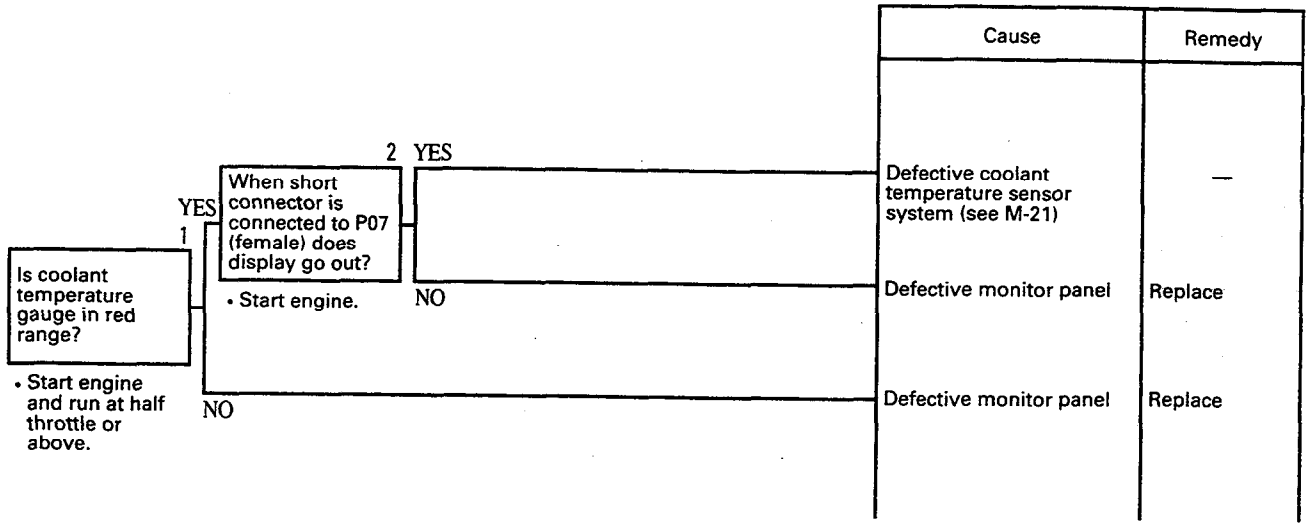
M-11 a) Related electric circuit diagram



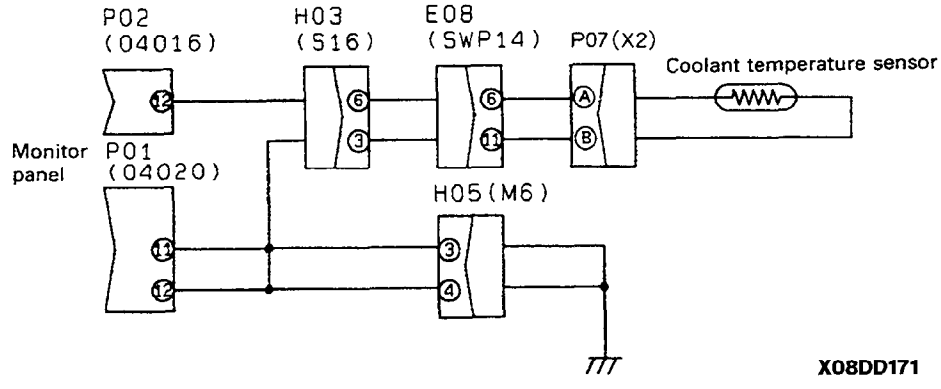
b) (coolant level) flashes

Cause	Remedy
See Item M-7 a).	—

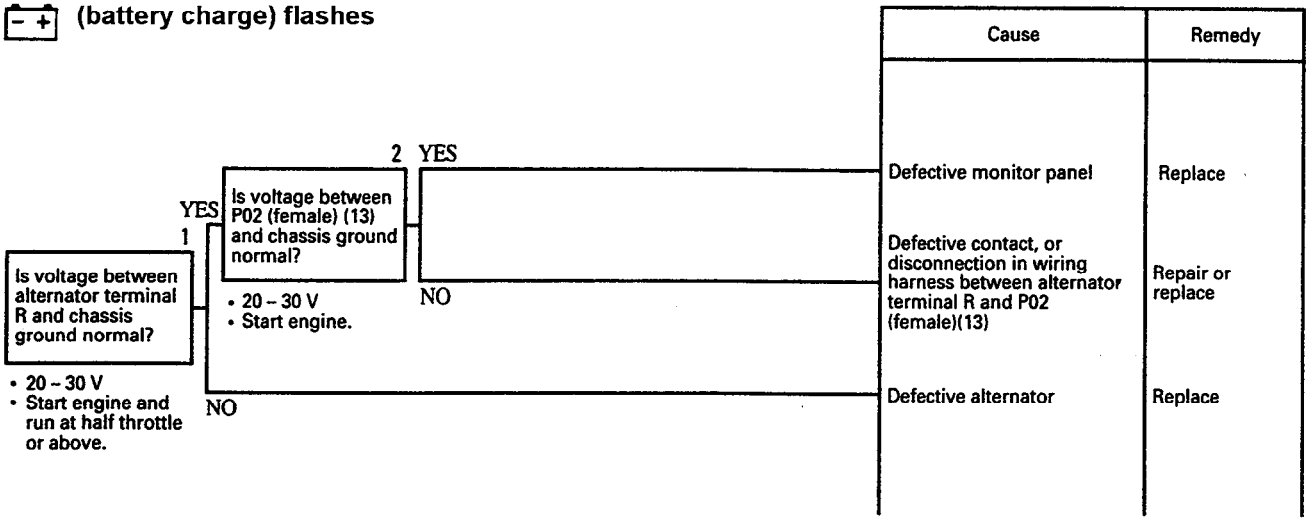
c) (coolant temperature) flashes



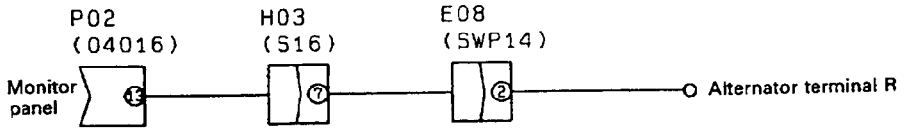
M-11 c) Related electric circuit diagram



d) (battery charge) flashes



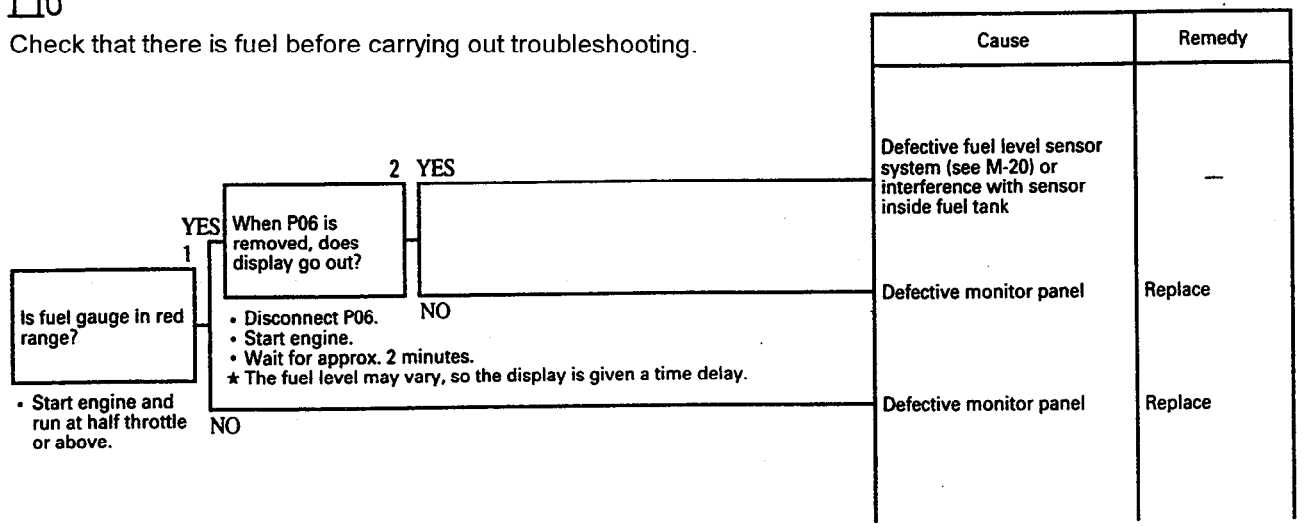
M-11 d) Related electric circuit diagram



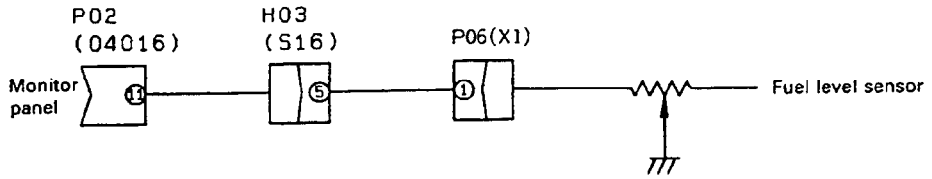
X08DD172

e) (fuel level) flashes

★ Check that there is fuel before carrying out troubleshooting.



M-11 e) Related electric circuit diagram



X08DD173

M-12 (a) When starting switch is turned ON (engine stopped), buzzer does not sound for 1 second, CAUTION items are flashing but buzzer does not sound

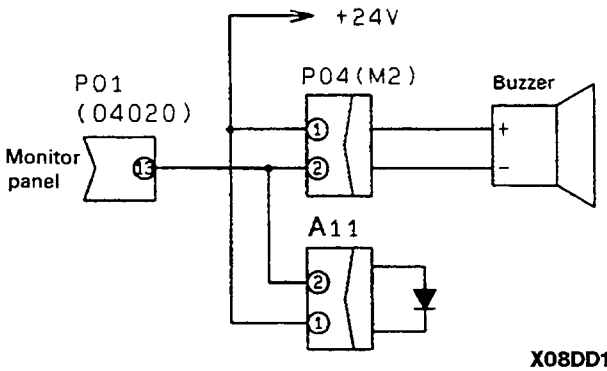
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.
★ Of the CAUTION items, the buzzer will not sound even if there is an abnormality in the battery charge or fuel level.

	Cause	Remedy
1 When P01 (female) (13) and chassis are connected, does buzzer sound? • Turn starting switch ON.		
YES	Defective monitor panel	Replace
NO	Disconnection in wiring harness between P01 (female) (13) – P04 (2) – buzzer, or between +24V – P04 (1) – buzzer +, or defective buzzer	Repair or replace

M-12 (b) No abnormality is displayed on monitor but buzzer sounds

	Cause	Remedy
1 When P01 is removed, does buzzer sound? • Remove P01. • Turn starting switch ON.		
YES	Contact of chassis ground with wiring harness between P01 (female) (13) and buzzer	Repair or replace
NO	Defective monitor panel	Replace

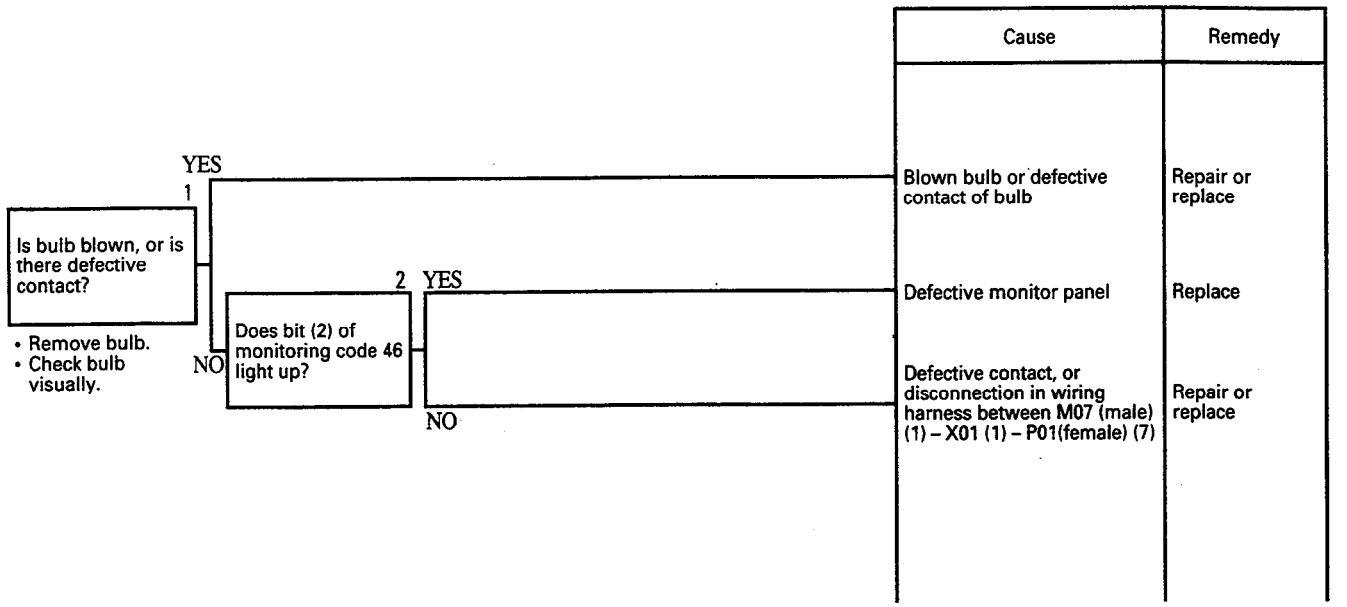
M-12 Related electric circuit diagram



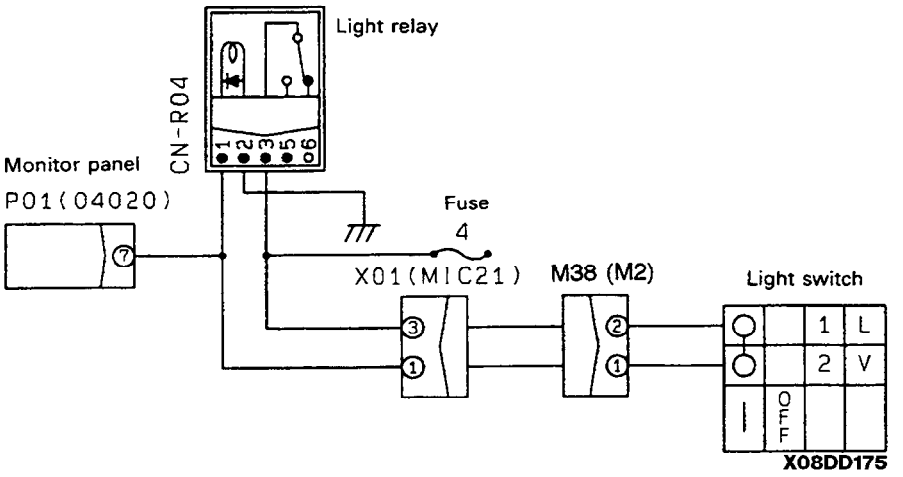
X08DD174

M-13 Liquid crystal night lighting on monitor panel does not light up (Liquid crystal display is normal)

★ When the working light lights up normally.

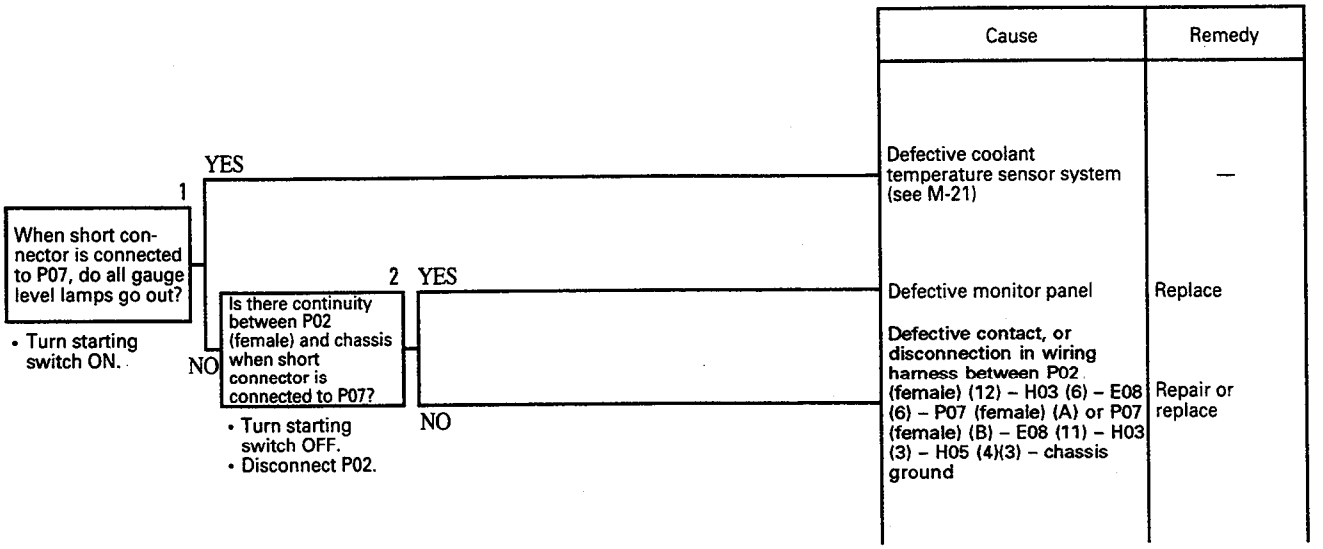


M-13 Related electric circuit diagram

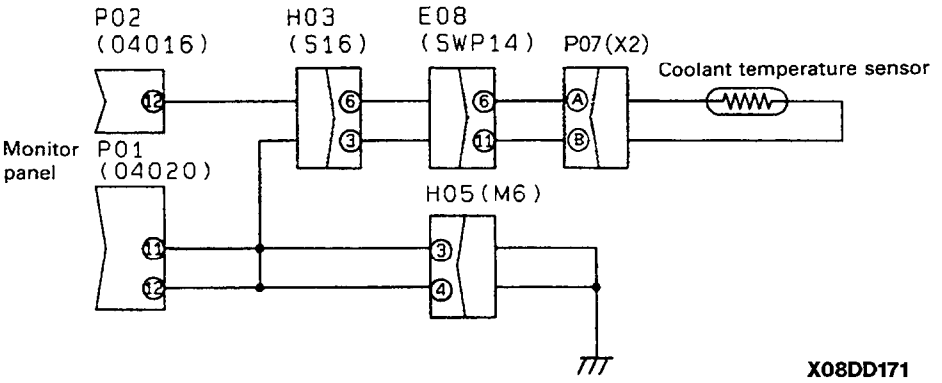


M-14 Coolant temperature gauge does not rise

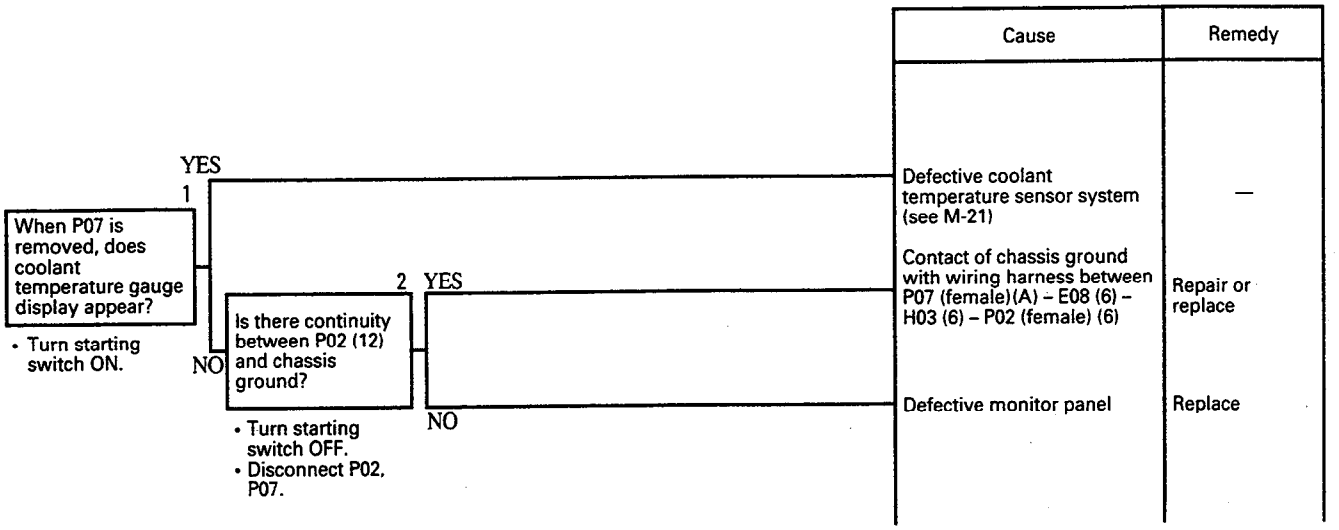
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.
★ If the coolant temperature actually does not rise, check the engine system.



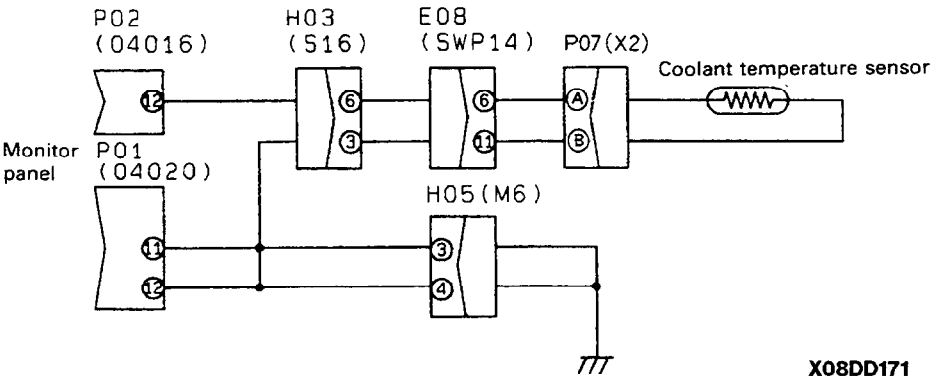
M-14 Related electric circuit diagram



M-15 Coolant temperature gauge does not give any display (none of gauge lamps light up during operation)

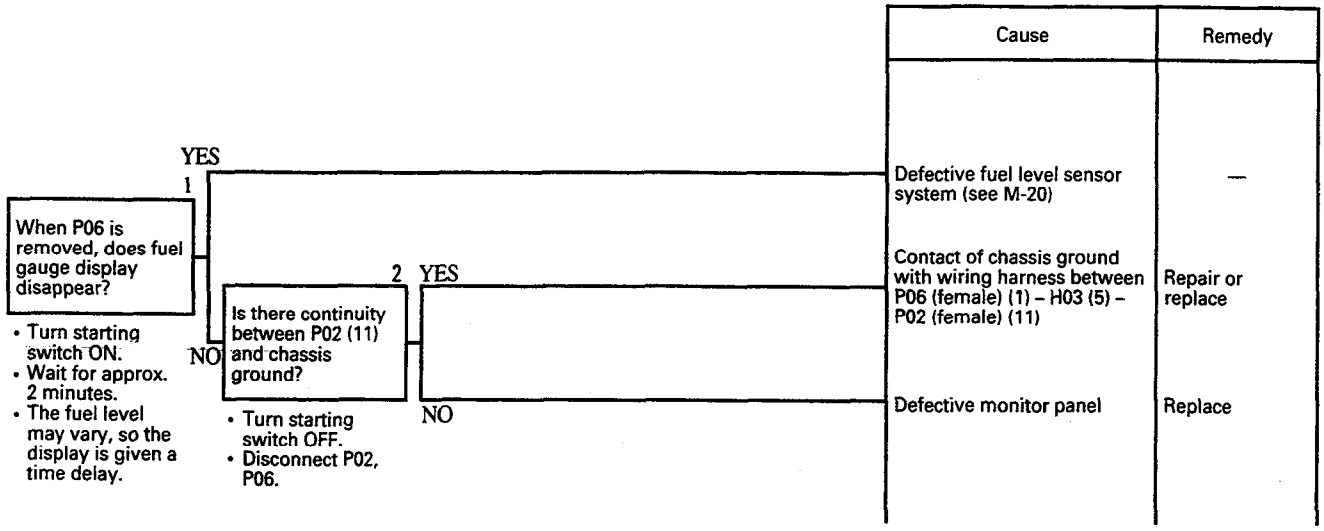


M-15 Related electric circuit diagram



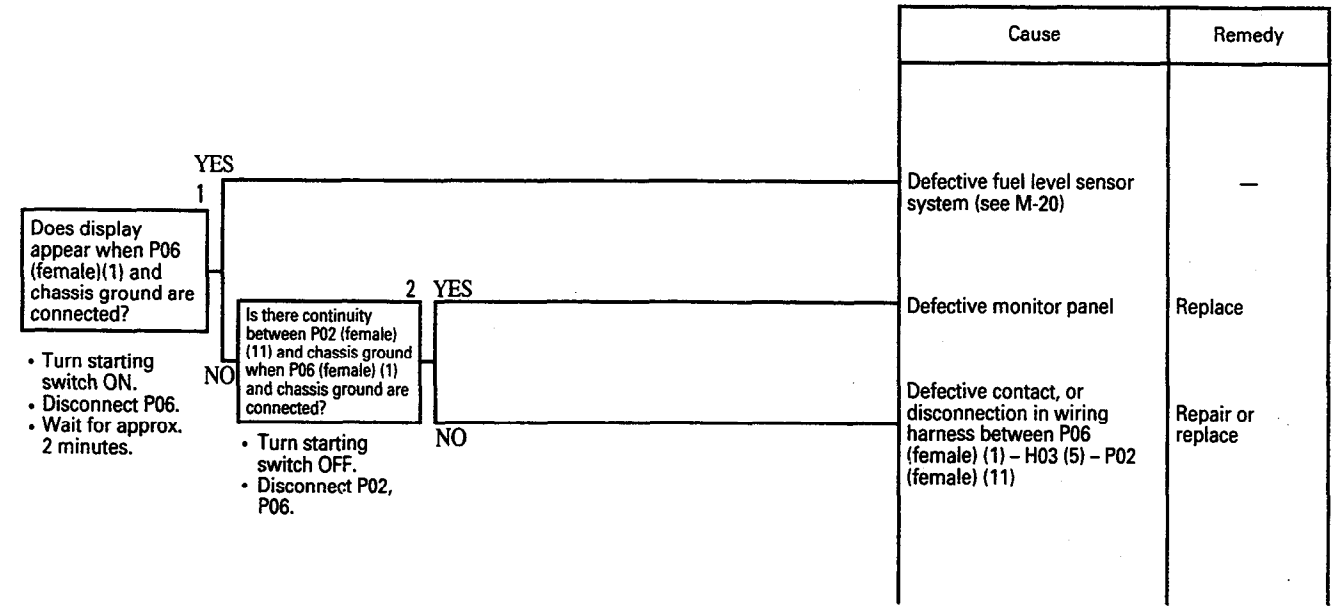
M-16 Fuel level gauge always displays FULL

★ Check if the tank is actually full before carrying out troubleshooting.

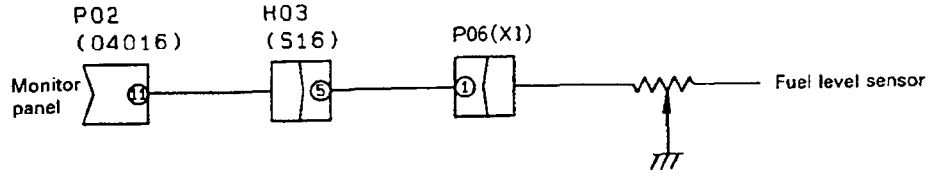


M-17 Fuel level gauge does not give display

★ Check that there is actually no fuel before carrying out troubleshooting.



M-16, M-17 Related electric circuit diagram



X08DD173

M-18 Swing lock switch is turned ON (LOCK) but monitor panel parking display does not light up

★ Carry out this troubleshooting only if the swing lock is actually being actuated.

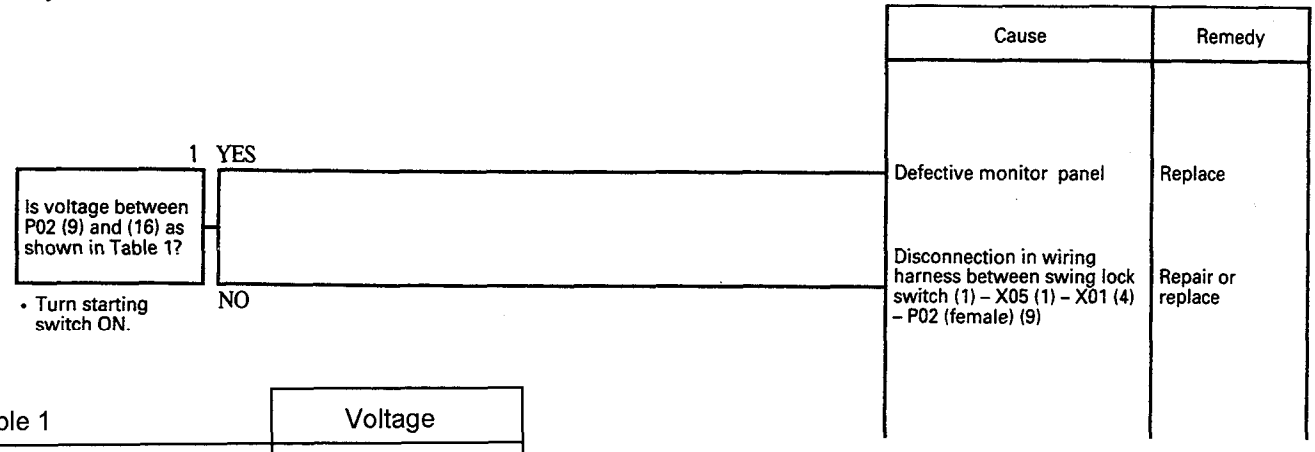
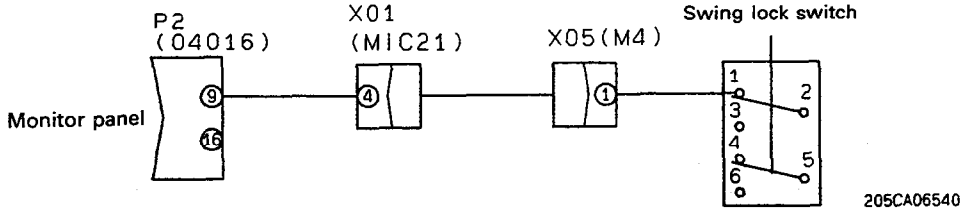


Table 1	Voltage
Swing lock switch ON	Max. 1 V
Swing lock switch OFF	20 - 30 V

M-18 Related electric circuit diagram



M-19 Swing lock prolix switch is ON (prolix), but monitor panel parking display does not flash

★ Carry out this troubleshooting only if the swing prolix is actually being actuated.

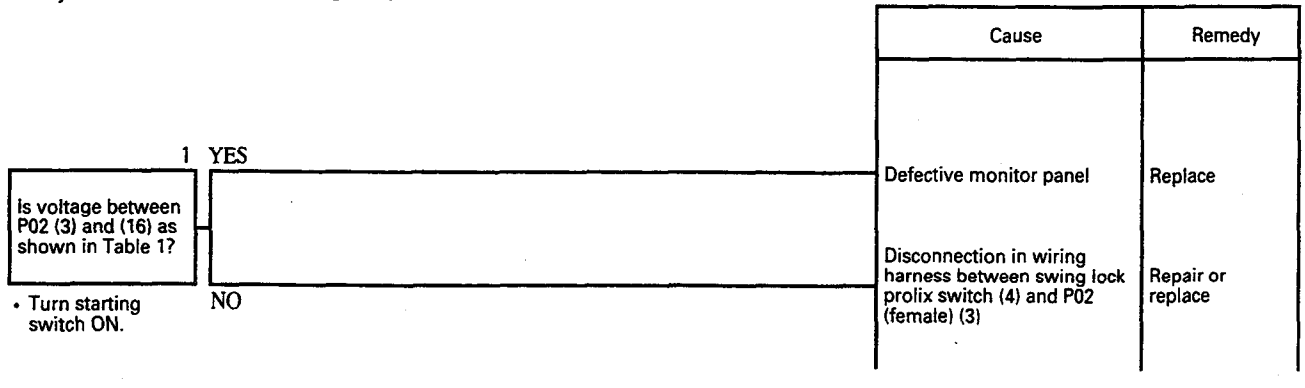
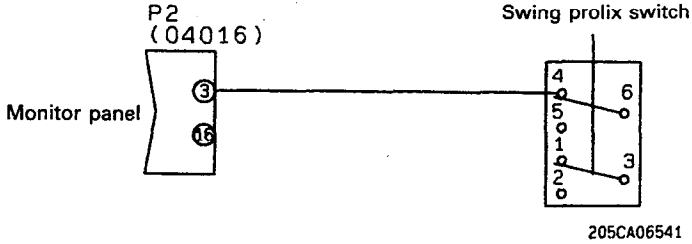


Table 1	Voltage
Swing lock prolix switch ON	Max. 1 V
Swing lock prolix switch OFF	20 – 30 V

M-19 Related electric circuit diagram



M-20 Defective fuel level sensor system

Note 1: Difference between fuel level and gauge display
For gauge display position 10 (F), the amount of fuel is 78 - 100%; and for display position 1 (E) it is below 14.5%. If the chassis is at an angle, the displayed amount of fuel will be different from the actual amount. Therefore, when checking, stop the machine at a horizontal place and wait for at least 2 minutes before checking the gauge. (The display is given a time delay so that the gauge can deal with sudden changes in the fuel level.)

★ Remove the fuel level sensor when carrying out the troubleshooting.

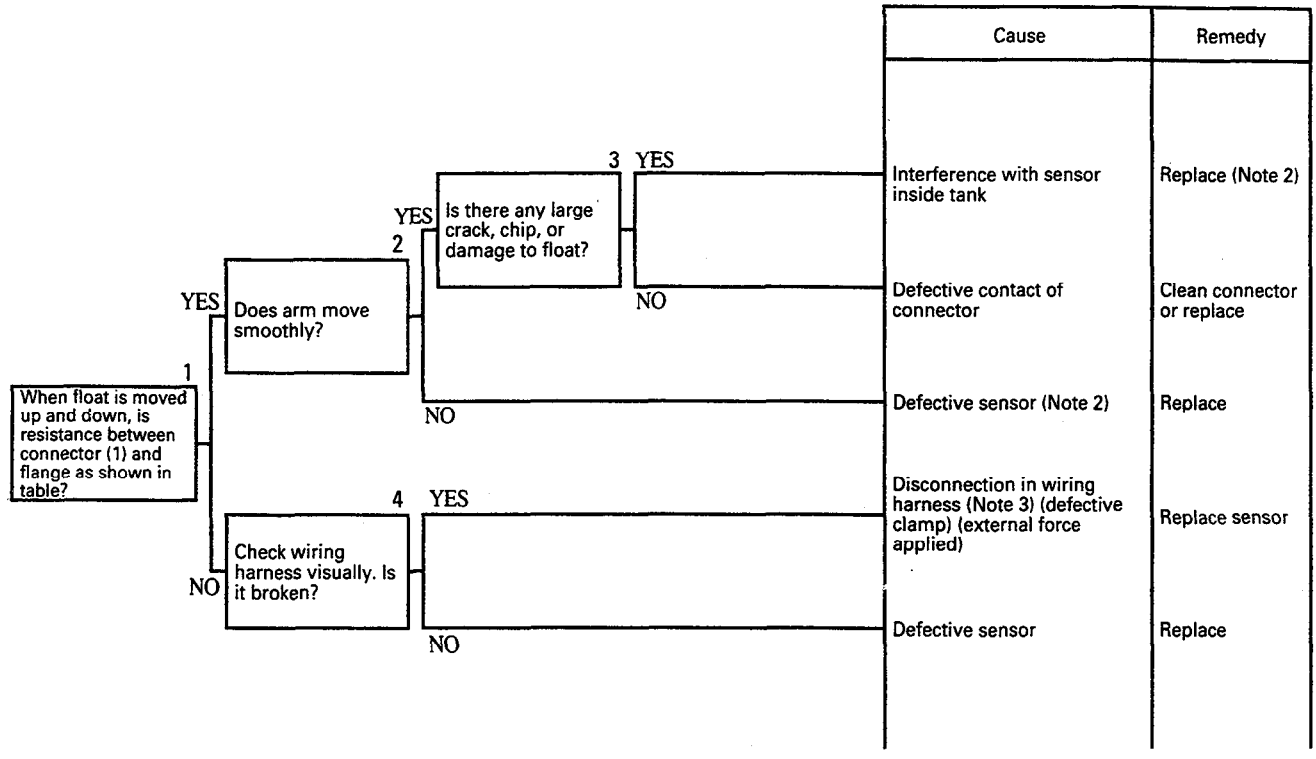
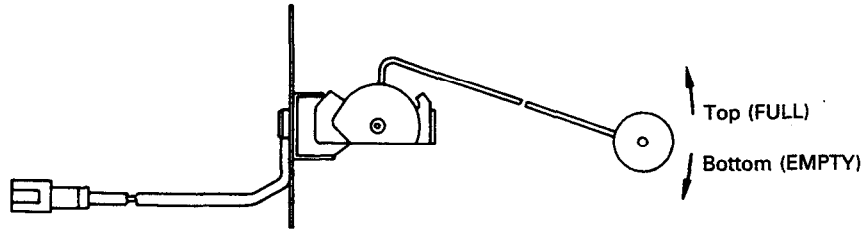


Table 1

Top (FULL) stopper position	Max.12Ω
Bottom (EMPTY) stopper position	Approx. 85 – 110 Ω



F20205053

Note 2: There is the possibility of defective installation or interference with the sensor inside the tank, so be careful when installing.

Note 3: Check for vibration at the connector mount. If there is excessive vibration, take the appropriate action.

M-21 Defective coolant temperature sensor system

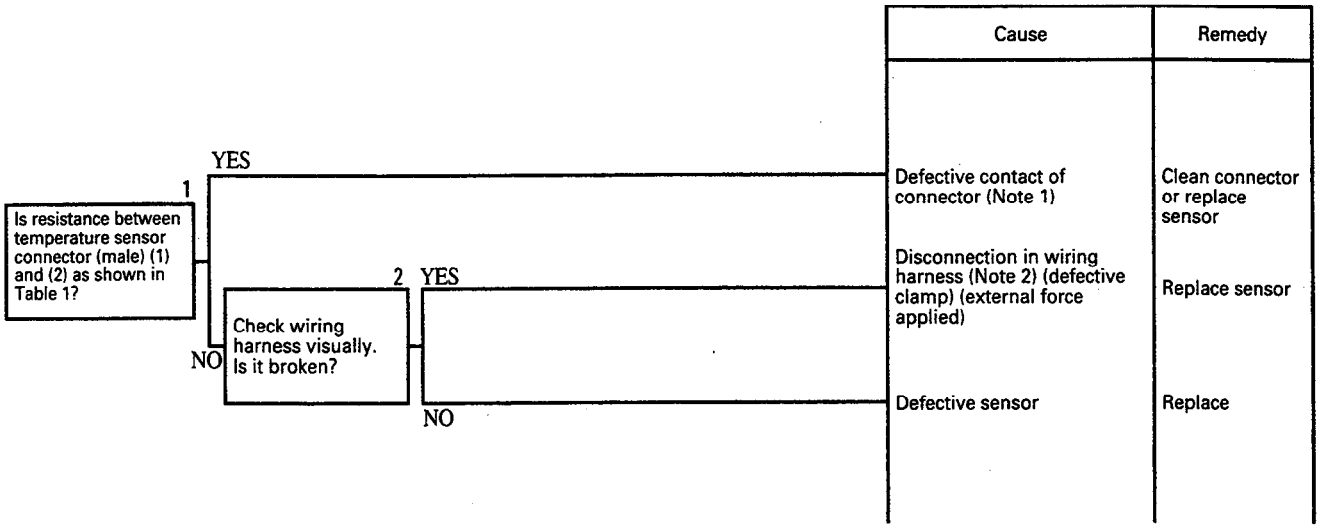
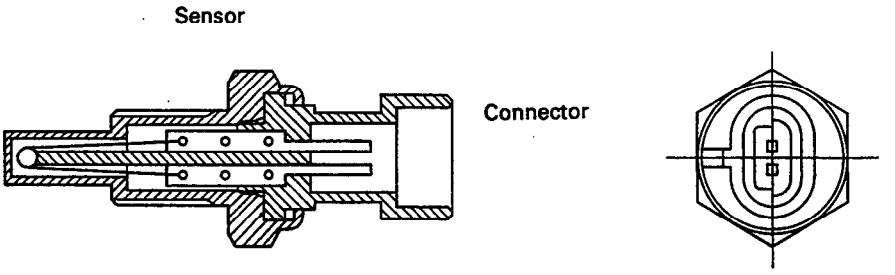


Table 1

Normal temperature (20°C)	Approx. 70 ~ 78 kΩ
100°C	Approx. 3 Ω



Note 1: If the problem occurs again, the connector (female) at the chassis end is probably defective, so check the connector and wiring harness at the chassis end.
Note 2: Check for vibration at the connector mount. If there is excessive vibration, take the appropriate action.

M-22 Defective engine oil level sensor system

Note 1: Variations in oil level
The oil level may change according to the angle of the machine, the engine speed, or the temperature of the oil, so if there is any display, check the oil level again with the machine at a horizontal place.

★ Remove the engine oil level sensor when carrying out troubleshooting.

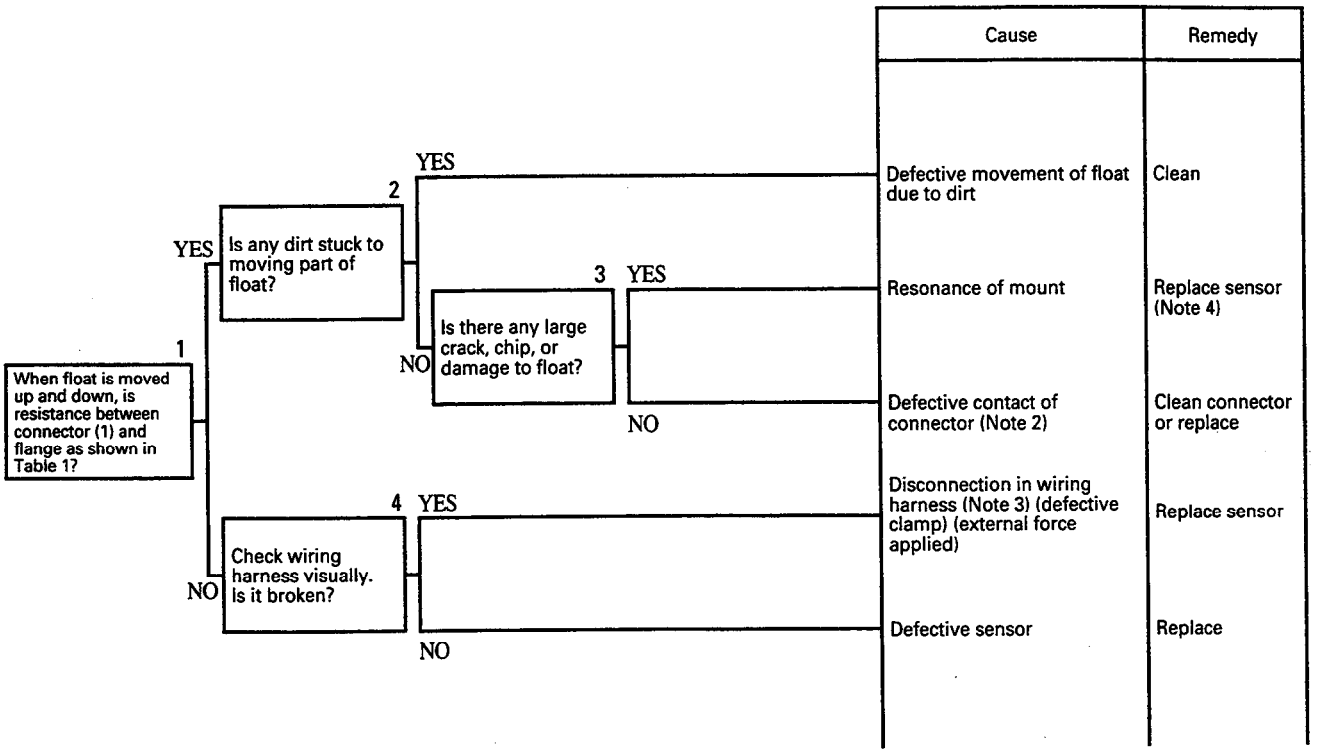
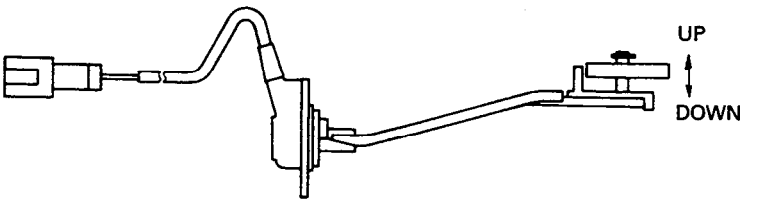


Table 1

Float UP	Max. 1 Ω
Float DOWN	Min.1 MΩ



Note 2: If the problem occurs again, the connector (female) at the chassis end is probably defective, so check the connector and wiring harness at the chassis end.

Note 3: Check for vibration at the connector mount. If there is excessive vibration, take the appropriate action.

Note 4: Defective installation is a possible cause, so be careful when installing. If the problem occurs again, check for any vibration of the mount, and if there is excessive vibration, take the appropriate action.

M-23 Defective coolant level sensor system

Note 1: Variations in coolant level
The coolant level may change according to the angle of the machine, or the swaying of the machine, so if there is any display, check the coolant level again with the machine at a horizontal place.

★ Remove the coolant level sensor when carrying out troubleshooting.

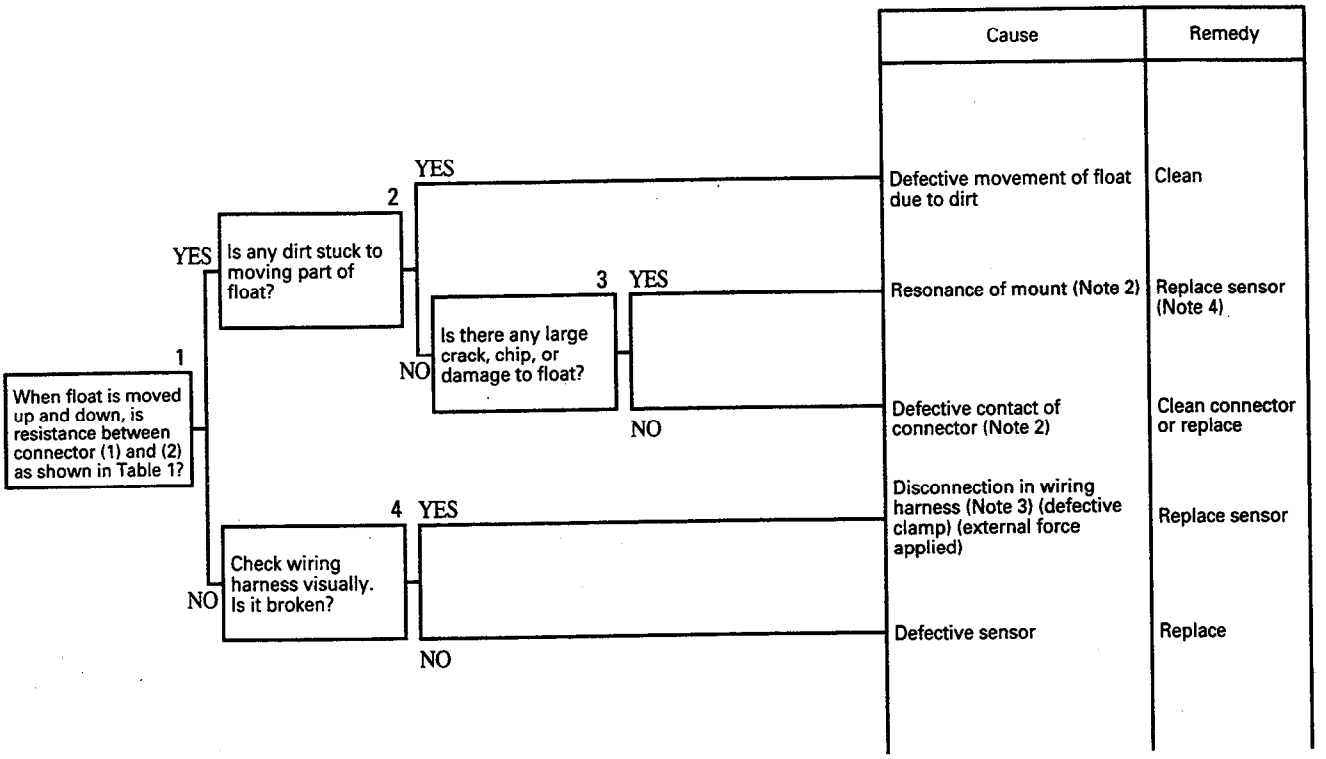
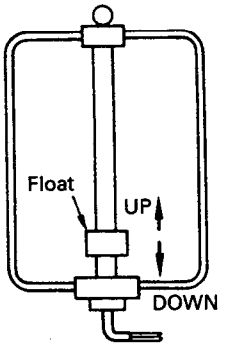


Table 1

Float UP	Max. 1 Ω
Float DOWN	Min.1 MΩ



F20205056

Note 2: If the problem occurs again, the connector (female) at the chassis end is probably defective, so check the connector and wiring harness at the chassis end.

Note 3: Check for vibration at the connector mount. If there is excessive vibration, take the appropriate action.

Note 4: Defective installation is a possible cause, so be careful when installing. If the problem occurs again, check for any vibration of the mount, and if there is excessive vibration, take the appropriate action.

M-24 Defective hydraulic oil level sensor system

Note 1: Variations in hydraulic oil level
The hydraulic oil level may change according to the angle of the machine, or the swaying of the machine, so if there is any display, check the hydraulic oil level again with the machine at a horizontal place.
★ Remove the hydraulic oil level sensor when carrying out troubleshooting.

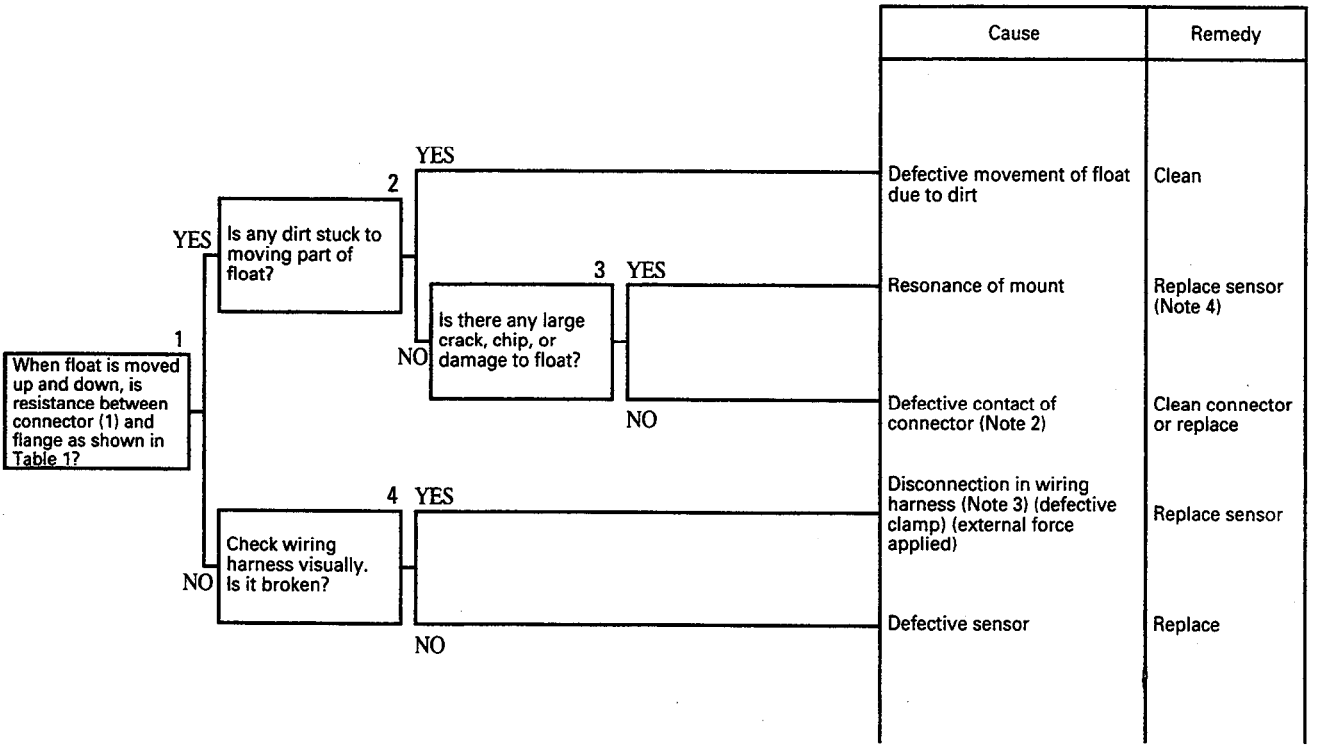
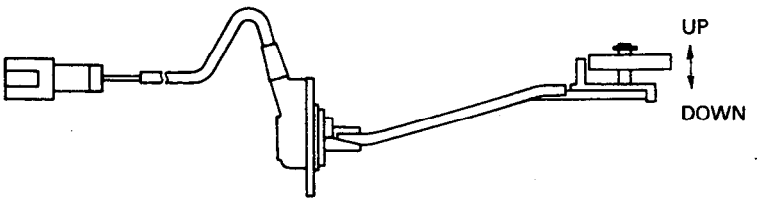


Table 1

Float UP	Max. 1 Ω
Float DOWN	Min.1 MΩ



F20205055

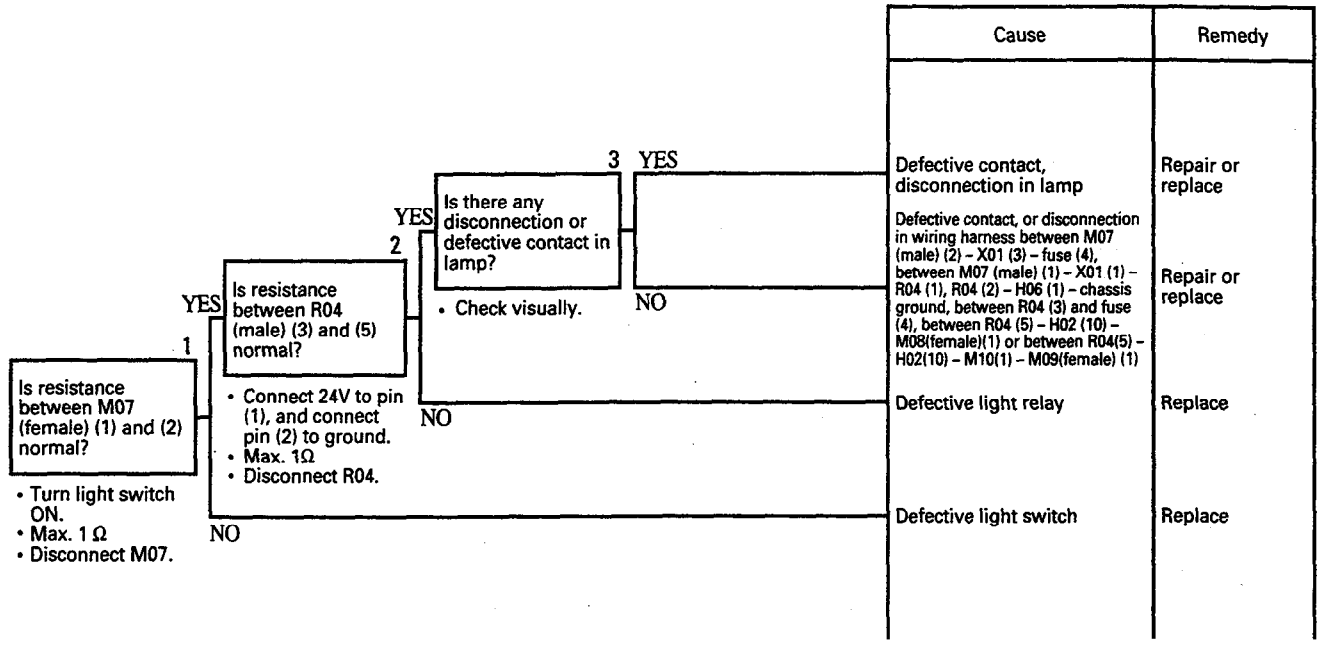
Note 2: If the problem occurs again, the connector (female) at the chassis end is probably defective, so check the connector and wiring harness at the chassis end.
Note 3: Check for vibration at the connector mount. If there is excessive vibration, take the appropriate action.
Note 4: Defective installation is a possible cause, so be careful when installing. If the problem occurs again, check for any vibration of the mount, and if there is excessive vibration, take the appropriate action.

https://truckmanualshub.com/

M-25 Working light, panel lighting do not light up, or switch is not being used but lights light up

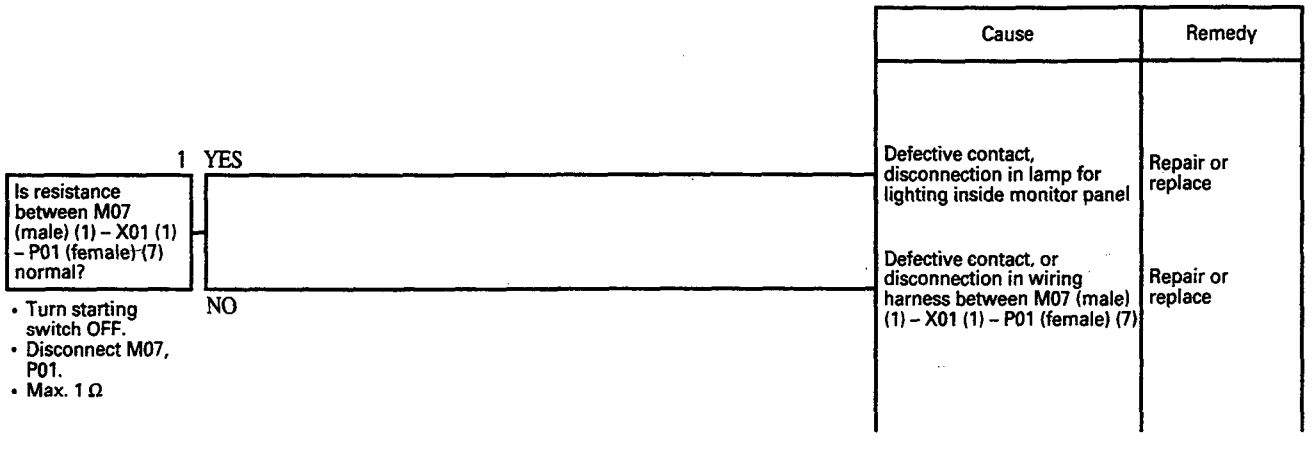
a) Working light does not light up

★ Check that fuse 4 is normal.

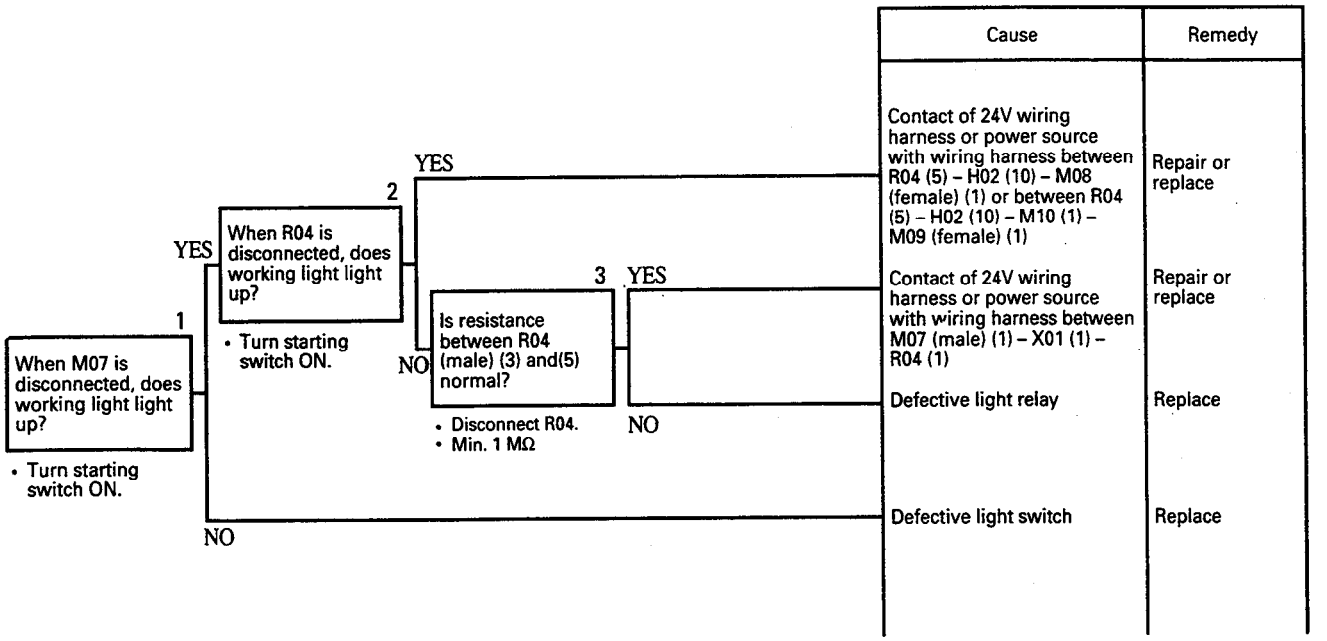


b) Panel lighting does not light up

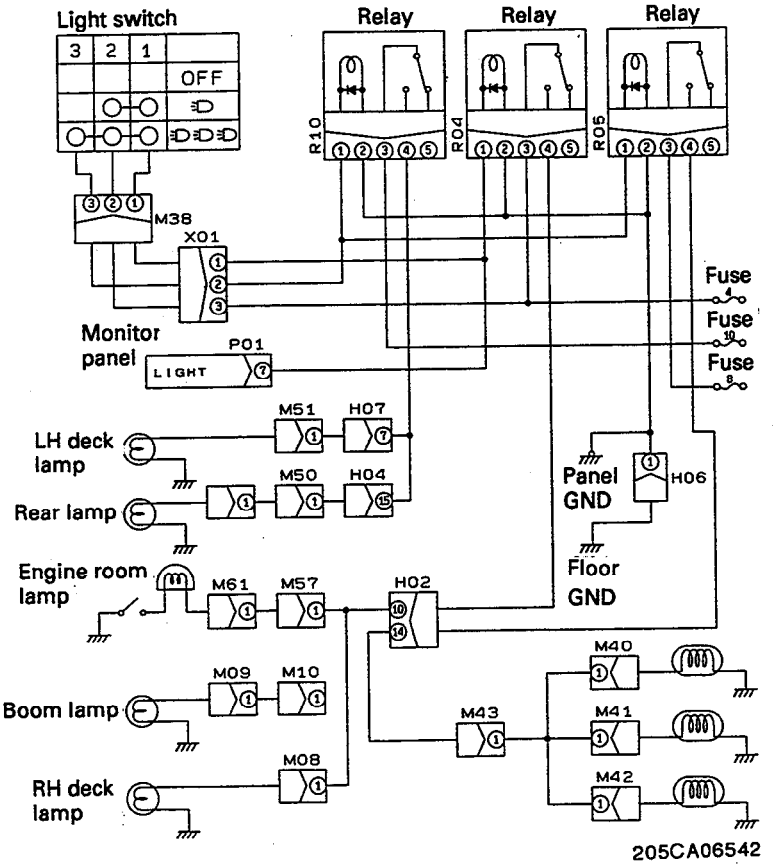
★ When the lamp light up normally.



c) Light switch is not being used but working light lights up



M-25 Related electric circuit diagram



M-26 Wiper does not work or switch is not being used but wiper is actuated

a) Wiper does not work

★ Check that fuse 7 is normal.

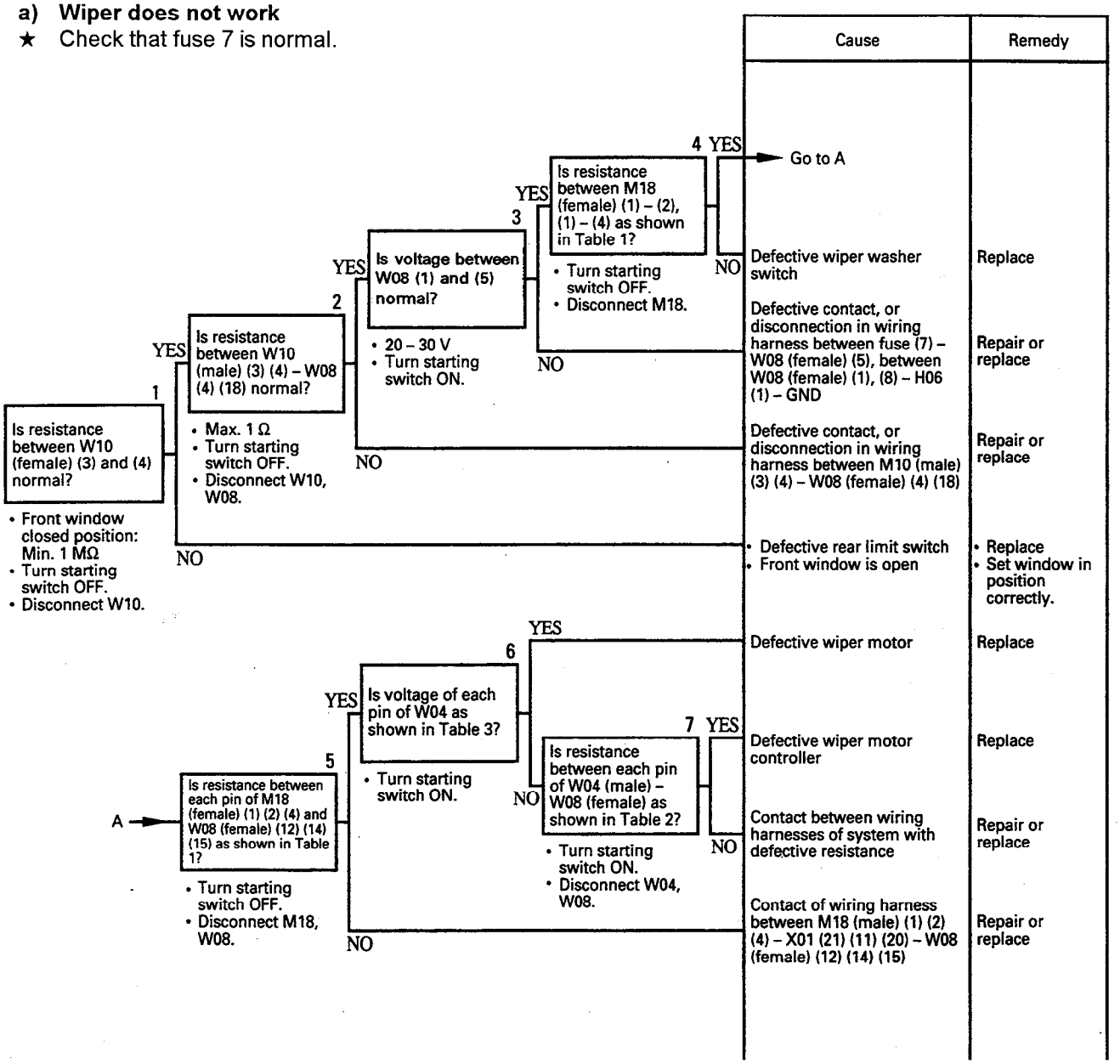


Table 1

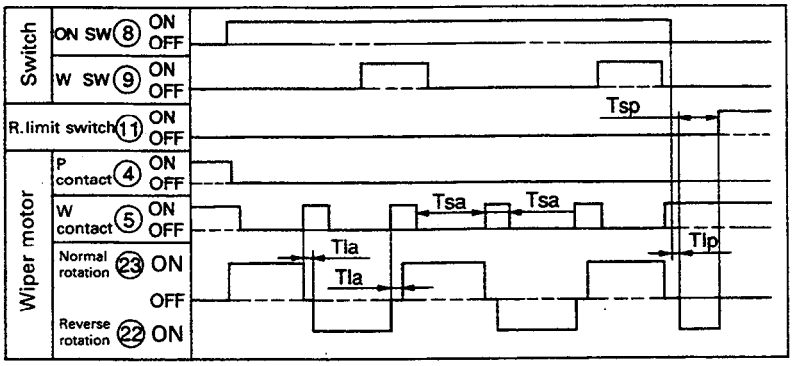
Actuation mode	M18 (female)	W08 (female)	Resistance
INT mode	Between (1) – (4)	Between (12) – (15)	Max. 1 Ω
	Between (1) – (2) Between (2) – (4)	Between (12) – (14) Between (14) – (15)	Min 1 MΩ
OFF mode	Between (1) – (2) Between (1) – (4) Between (2) – (4)	Between (12) – (14) Between (12) – (15) Between (14) – (15)	Min 1 MΩ
ON mode	Between (1) – (2)	Between (12) – (14)	Max. 1 Ω
	Between (1) – (4) Between (2) – (4)	Between (12) – (15) Between (14) – (15)	Min 1 MΩ

Table 2

Between W04 (female) (1) – W08 (female) (7) Between W04 (female) (3) – W08 (female) (6) Between W04 (female) (4) – W08 (female) (11) Between W04 (female) (5) – W08 (female) (9) Between W04 (female) (6) – W08 (female) (10)	Max. 1Ω
Between W04 (female) (1)(3)(4)(5)(6) – GND	Min. 1 MΩ

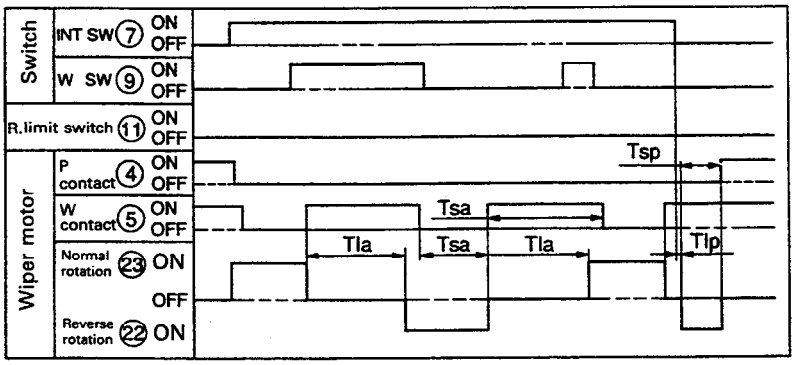
Table 3

Timing chart (when wiper switch is ON)



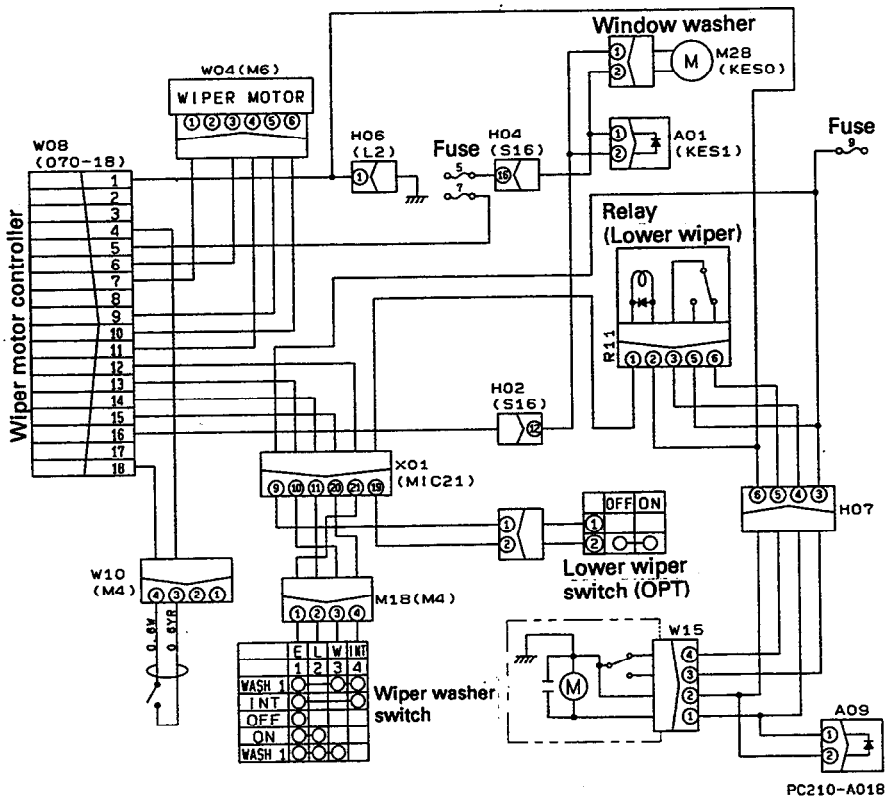
Item	Symbol	Set time
Length of pause until next actuation	Tla	0.13 sec
Safety circuit during operation of wiper [safety function (1)]	Tsa	10 sec
Length of pause when stowing wiper blade	Tlp	1.5 sec
Safety circuit during operation of wiper [safety function (2)]	Tsp	10 sec

Timing chart (when wiper switch is INT)



Item	Symbol	Set time
Length of pause until next actuation	Tla	4 sec
Safety circuit during operation of wiper [safety function (1)]	Tsa	10 sec
Length of pause when stowing wiper blade	Tlp	1.5 sec
Safety circuit during operation of wiper [safety function (2)]	Tsp	10 sec

M-26 Related electric circuit diagram



b) Wiper switch is not being used but wiper is actuated

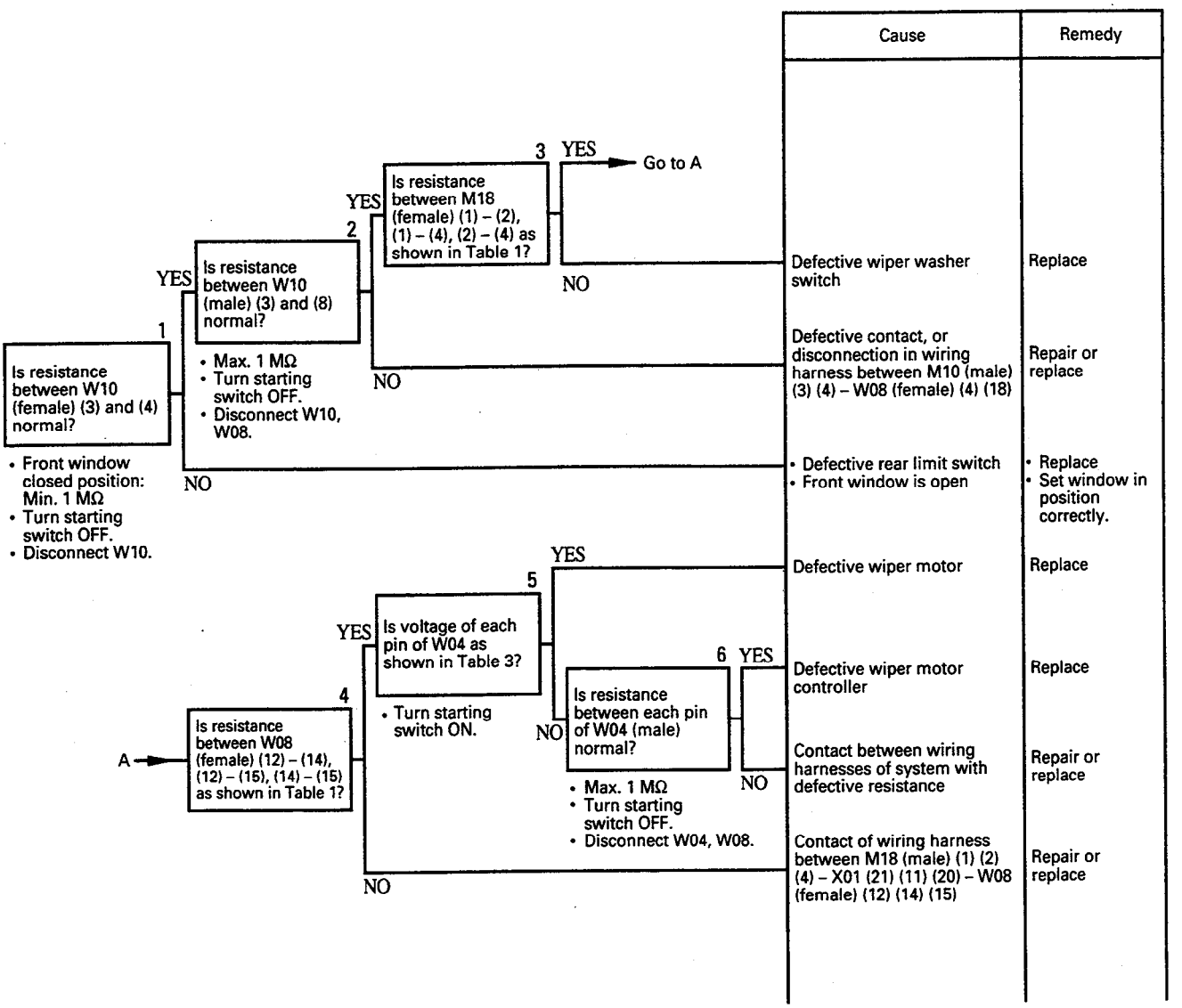
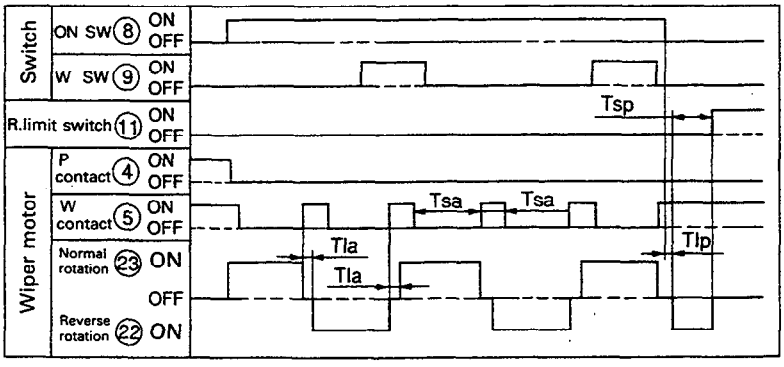


Table 1

Actuation mode	M18 (female)	W08 (female)	Resistance
INT mode	Between (1) – (4)	Between (12) – (15)	Max. 1 Ω
	Between (1) – (2) Between (2) – (4)	Between (12) – (14) Between (14) – (15)	Min 1 MΩ
OFF mode	Between (1) – (2) Between (1) – (4) Between (2) – (4)	Between (12) – (14) Between (12) – (15) Between (14) – (15)	Min 1 MΩ
ON mode	Between (1) – (2)	Between (12) – (14)	Max. 1 Ω
	Between (1) – (4) Between (2) – (4)	Between (12) – (15) Between (14) – (15)	Min 1 MΩ

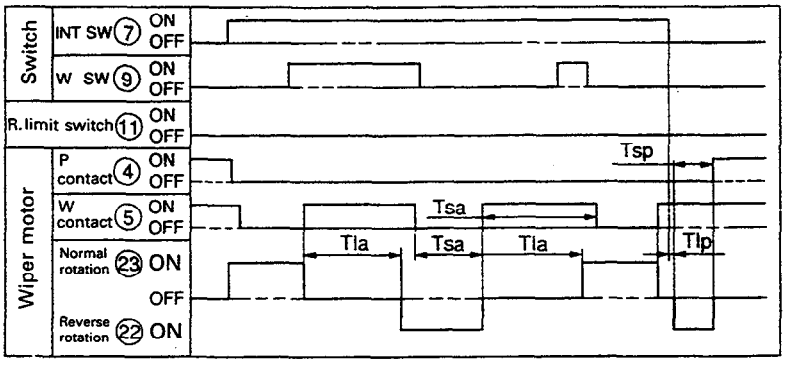
Table 3

Timing chart (when wiper switch is ON)



Item	Symbol	Set time
Length of pause until next actuation	Tla	0.13 sec
Safety circuit during operation of wiper [safety function (1)]	Tsa	10 sec
Length of pause when stowing wiper blade	Tlp	1.5 sec
Safety circuit during operation of wiper [safety function (2)]	Tsp	10 sec

Timing chart (when wiper switch is INT)



Item	Symbol	Set time
Length of pause until next actuation	Tla	4 sec
Safety circuit during operation of wiper [safety function (1)]	Tsa	10 sec
Length of pause when stowing wiper blade	Tlp	1.5 sec
Safety circuit during operation of wiper [safety function (2)]	Tsp	10 sec

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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 XXXX (1)
2. △ △ △ (2)	※1 indicates that a technique is listed for use during installation
3. □ □ □ □ assembly (3)	
	See Lubricant and Coolant Table
INSTALLATION OF ○ ○ ○ ASSEMBLY	Title of operation
• Carry out installation in the reverse order of removal.	
※1	Technique used during installation
★	Technique or important point to remember when installing △ △ △ (2) step in operation
• Adding water, oil	
★	Point to remember when adding water or oil
	Quantity of filling oil and water

2. General precautions when carrying out installation or removal (disassembly or assembly) of units are given together as PRECAUTION WHEN CARRYING OUT OPERATION, so be sure to follow these precautions when carrying out the operation.

3. Listing of special tools

(1) For details of the description, part number, and quantity of any tools (**A_1**, etc.) that appear in the operation procedure, see the SPECIAL TOOL LIST given in the 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

- 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.

★ **Precautions when handling piping during disassembling**

Fit the following blind plugs into the piping after disconnecting it during disassembly operations.

1) Hoses and tubes using sleeve nuts

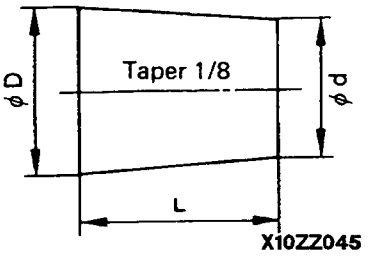
Nominal number	Plug (nut end)	Sleeve nut (elbow end) Use the two items below as a set
02	07376-50210	07221-20210 (Nut), 07222-00210 (Plug)
03	07376-50315	07221-20315 (Nut), 07222-00312 (Plug)
04	07376-50422	07221-20422 (Nut), 07222-00414 (Plug)
05	07376-50522	07221-20522 (Nut), 07222-00515 (Plug)
06	07376-50628	07221-20628 (Nut), 07222-00616 (Plug)
10	07376-51034	07221-21034 (Nut), 07222-01018 (Plug)
12	07376-51234	07221-21234 (Nut), 07222-01219 (Plug)

2) Split flange type hoses and tubes

Nominal number	Flange (hose end)	Sleeve head (tube end)	Split flange
04	07379-00400	07378-10400	07371-30400
05	07379-00500	07378-10500	07371-30500

3) If the part is not under hydraulic pressure, the following corks can be used.

Nominal number	Part number	Dimensions		
		D	d	L
06	07049-00608	6	5	8
08	07049-00811	8	6.5	11
10	07049-01012	10	8.5	12
12	07049-01215	12	10	15
14	07049-01418	14	11.5	18
16	07049-01620	16	13.5	20
18	07049-01822	18	15	22
20	07049-02025	20	17	25
22	07049-02228	22	18.5	28
24	07049-02430	24	20	30
27	07049-02734	27	22.5	34



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2. Precautions for installation operations

- Tighten all bolts and nuts (sleeve nuts) to the specified (KES) torque.
- Install the hoses without twisting or interference.
- Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
- Bend the cotter pin or lock plate securely.
- When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2-3 drops of adhesive.
- When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
- Clean all parts, and correct any damage, dents, burrs, or rust.
- Coat rotating parts and sliding parts with engine oil.
- When press fitting parts, coat the surface with antifriction compound (LM-P).
- After fitting snap rings, check that the snap ring is fitted securely in the ring groove.
- When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
- When using eyebolts, check that there is no deformation or deterioration, screw them fully, and align the direction of the hook.
- When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.
- When operating the hydraulic cylinders for the first time after reassembling cylinders, pumps and other hydraulic equipment removed for repair, always bleed the air as follows:
  1. Start the engine and run at low idling.
  2. Operate the work equipment control lever to operate the hydraulic cylinder 4 - 5 times, stopping 100 mm from end of its stroke.
  3. Next, operate the hydraulic cylinder 3 - 4 times to the end of its stroke.
  4. After doing this, run the engine at normal speed.

     ★ When using the machine for the first time after repair or long storage, follow the same procedure.

3. Precautions when completing the operations

- If the coolant has been drained, tighten the drain valve, and add coolant to the specified level. Run the engine to circulate the coolant through the system. Then check the coolant 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 air from the system after reassembling the parts.

  ★ For details, see TESTING AND ADJUSTING, Bleeding air.
- Add the specified amount of grease (molybdenum disulfide grease) to the work equipment related parts.

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SPECIAL TOOL LIST

Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks	
● Engine ● hydraulic pump ● Radiator ● hydraulic oil cooler ● Control pump ● Hydraulic pump ● Removal, installation of TVC ● LS valve assembly	B		796-460-1210	Oil stopper	1		
Disassembly of center swivel joint assembly	D		790-101-2501	Push-puller	1		
Removal, installation of swing circle	E		790-331-1110	Wrench	1	Tightening of circle bolt	
Disassembly, assembly of swing machinery assembly	F		796-426-1120	Push tool	1	Press fitting of bearing	
Disassembly, assembly of final drive assembly	G	1	796-427-1120	Wrench	1	PC200 PC200LC PC210LC PC220LC	Press fitting of bearing inner race
		2	796-427-1130	Push tool	1		
			790-101-2510	Block	1		
			792-104-3940	Bolt	2		
			01580-11631	Nut	2		
			01643-31645	Washer	2		
			790-105-2100	Jack	1		
			790-101-1102	Pump	1		
			796-570-1110	Plate	1	PC250LC	
		3	790-331-1110	Wrench	1	PC200 PC200LC PC210LC PC220LC	
		4	791-545-1510	Installer	1		
			791-580-1510	Installer	1	PC250LC	
Removal, installation of recoil spring assembly	H	1	791-600-2001 or 794-685-8005	Compressor (A) Compressor (B)	1 1	PC200 PC200LC PC210LC PC220LC	Removal, press fitting of master pin
			791-935-3160	Extension	1		
			790-101-1600	Cylinder (70 ton)	1		
			790-101-1102	Pump	1		
			791-600-2001 or 791-685-8003	Compressor (A) Compressor (B)	1 1	PC250LC	
			791-935-3160	Extension	1		
			790-101-1600	Cylinder (70 ton)	1		
			790-101-1102	Pump	1		
		2	790-201-1500 ● 790-201-1620 ● 790-101-5021 ● 01010-50816	Push tool kit ● Plate ● Grip ● Bolt	1 1 1 1	Installation of recoil spring piston dust seal	

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Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks	
Removal, installation of track shoe assembly	I		790-630-3000	Remover & installer	1	PC200 PC200LC PC210LC PC220LC	Remove press fitting of master pin
			790-101-1300	Cylinder (70 ton)	1		
			790-101-1102	Pump	1		
			791-630-3000	Remover & installer	1	PC250LC	
			790-101-1300	Cylinder (100 ton)	1		
			790-101-1102	Pump	1		
Assembly of idler assembly	J		790-434-1630	Installer	1	Installation of floating seal	
			791-601-1000	Oil pump	1	Charging with oil, checking for air leakage	
Disassembly, assembly of track roller assembly	K	1	790-434-1640	Installer	1	Installation of floating seal	
		2	791-601-1000	Oil pump	1	Charging with oil, checking for air leakage	
		3	790-331-1110	Wrench	1	Tightening of track roller mounting bolt	
Disassembly, assembly of carrier roller assembly	L	1	797-101-1121	Wrench	1	Removal, installation of nut	
		2	796-430-1110	Push tool	1	Press fitting of bearing	
		3	791-434-1650	Installer	1	Installation of floating seal	
		4	791-601-1000	Oil pump	1	Charging with oil, checking for air leakage	
Installation of track roller	M		790-331-1110	Wrench	1	Tightening of track roller bolt	
Replacement of pump shaft oil seal	N		791-463-1141	Push tool	1		
			790-201-2740	Spacer	1		

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Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks	
Hydraulic cylinder	O	1	790-502-1003	Cylinder repair stand	1		
			790-101-1102	Pump	1		
		2	790-302-1450	Socket (width across flats: 95 mm)	1	ARM PC200 PC200LC PC210LC PC220LC PC250LC BOOM PC200 PC200LC PC210LC PC220LC PC250LC BUCKET PC220LC PC250LC	Removal, installation of piston nut
			790-302-1350	Socket (width across flats: 85 mm)	1	BUCKET PC200 PC200LC PC210LC	
		3	790-720-1000	Expander	1	Expansion of piston ring	
		4	796-720-1680 07281-01589	Ring Clamp	1 1	ARM & BOOM PC220LC PC250LC	Installation of piston ring
			796-720-1670 07281-01279	Ring Clamp	1 1	BOOM PC200 PC200LC PC210LC BUCKET PC220LC PC250LC	
			796-720-1660 07281-01159	Ring Clamp	1 1	BUCKET PC200 PC200LC PC210LC	

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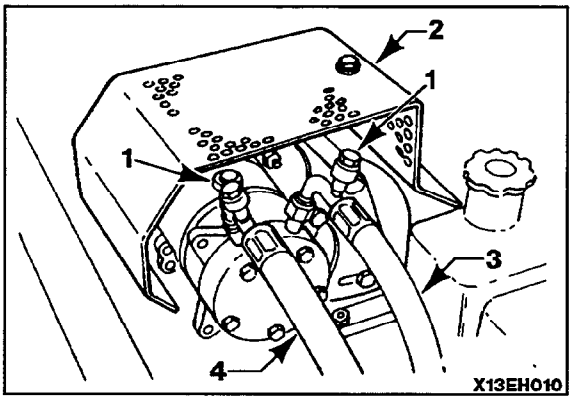
Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks	
Hydraulic cylinder	O	5	790-201-1702 • 790-201-1831 • 790-101-5021 • 01010-50816	Push tool kit • Push tool • Grip • Bolt	 1 1 1	BUCKET PC200 PC200LC PC210LC	Press fitting of bushing
			790-201-1702 • 790-201-1841 • 790-101-5021 • 01010-50816	Push tool kit • Push tool • Grip • Bolt	 1 1 1	BOOM PC200 PC200LC PC210LC BUCKET PC220LC PC250LC	
			790-201-1702 • 790-201-1851 • 790-101-5021 • 01010-50816	Push tool kit • Push tool • Grip • Bolt	 1 1 1	ARM & BOOM PC220LC PC250LC	
			790-201-1702 • 790-201-1930 • 790-101-5021 • 01010-50816	Push tool kit • Push tool • Grip • Bolt	 1 1 1	ARM PC200 PC200LC PC210LC	
		6	790-201-1500 • 790-201-1640 • 790-101-5021 • 01010-50816	Push tool kit • Push tool • Grip • Bolt	 1 1 1	BUCKET PC200 PC200LC PC210LC	Insertion of dust seal
			790-201-1500 • 790-201-1650 • 790-101-5021 • 01010-50816	Push tool kit • Push tool • Grip • Bolt	 1 1 1	BOOM PC200 PC200LC PC210LC BUCKET PC220LC PC250LC	
			790-201-1500 • 790-201-1660 • 790-101-5021 • 01010-50816	Push tool kit • Push tool • Grip • Bolt	 1 1 1	ARM PC220LC PC250LC BOOM PC220LC PC250LC	
			790-201-1990 790-101-5021 01010-50816	Plate Grip Bolt	1 1 1	ARM PC200 PC200LC PC210LC	
• Removal, installation of work equipment • Boom assembly	P		796-900-1200 790-101-4000 790-101-1102	Remover Puller (50 ton long) Pump (30 ton)	1 1 1	Removal of boom foot pin	

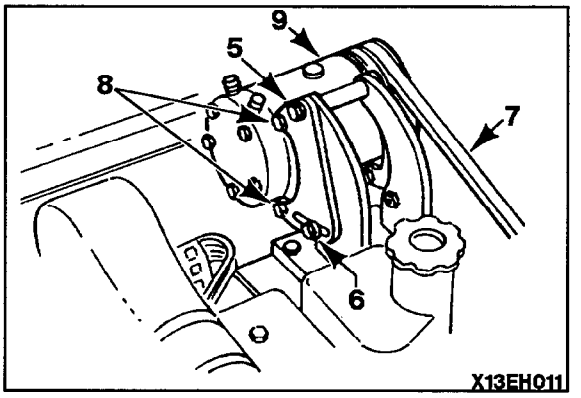
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REMOVAL OF AIR CONDITIONER COMPRESSOR ASSEMBLY

⚠ Under pressure, precautions must be taken to protect eyes and skin. Never loosen any part of the refrigerant circuit while charged with gas. The air conditioner system should only be serviced by qualified personnel.

1. Remove refrigerant gas (R134a) using discharge ports (1). Don't release gas into the atmosphere.
2. Remove fan guard (2).
3. Disconnect hoses (3) and (4) and disconnect electrical connector.
4. Loosen bolts (5) and (6) and rotate compressor about bolt (5) towards the engine and remove drive belt (7).
5. Remove bolts (8) then remove air conditioner compressor (9).





INSTALLATION OF AIR CONDITIONER COMPRESSOR ASSEMBLY

- Carry out installation in reverse order of removal.
  - ★ Check O-rings of hoses are not damaged or deteriorated.
  - ★ Adjust the belt tension (see TESTING AND ADJUSTING).
- Fill with refrigerant (R-134a).

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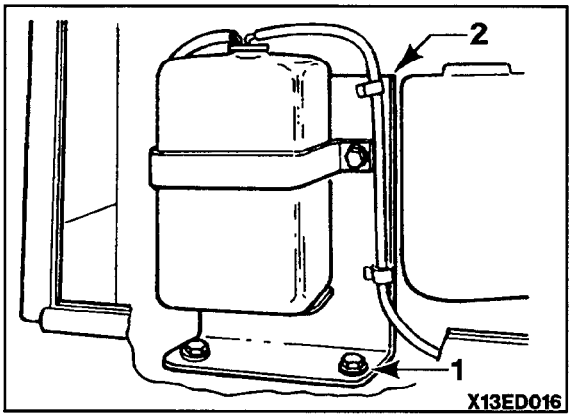
REMOVAL OF CONDENSER ASSEMBLY

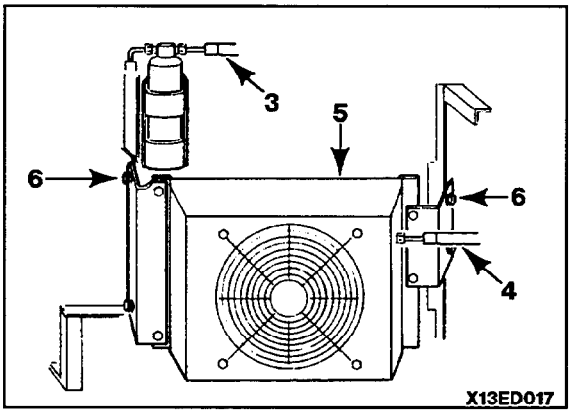
1. Open forward left side cover and remove top c over.

2. Remove overfill tank bracket (2) by removing bolts and washers (1).

3. Disconnect electrical connector and hoses (3) and (4).
   - ★ Loosen the sleeve nut slightly and release the refrigerant (R134a) completely before disconnecting hoses and tubes.
   - ★ Fit plugs to hoses and tubes to prevent ingress of moisture, dust or dirt.

4. Remove condenser assembly (5) by removing bolts and washers (6).



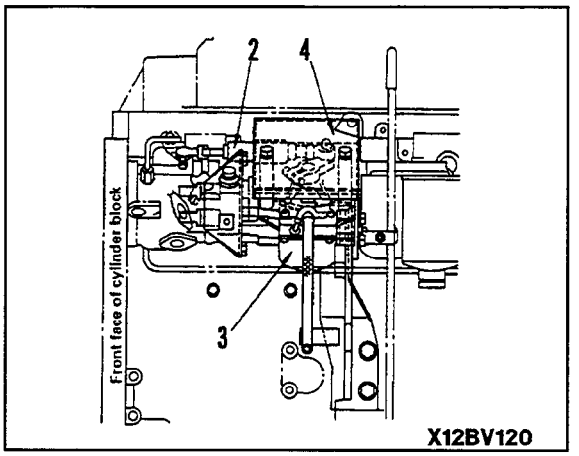


INSTALLATION OF CONDENSER ASSEMBLY

- Carry out installation in the reverse order to removal.
  - ★ Check that the O-ring is not damaged or deteriorated.
- Fill with refrigerant (R134a).

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REMOVAL OF GOVERNOR MOTOR ASSEMBLY



⚠ Disconnect the cable from the negative (-) terminal of the battery.

1. Open engine hood and disconnect governor motor connector (1).
2. Remove motor cover (4).
3. Remove motor rod (2).
4. Remove governor motor assembly (3). ※1
   ★ Rotate the shaft of the governor motor and do not stop it suddenly.

INSTALLATION OF GOVERNOR MOTOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※1
★ Adjust the rod. For details, see TESTING AND ADJUSTING, Testing and adjusting of governor motor lever stroke.

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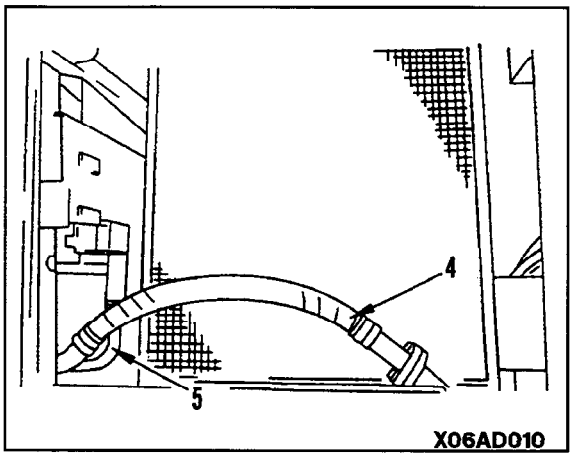
REMOVAL OF HYDRAULIC OIL COOLER ASSEMBLY

1. Remove tool box and under cover, and set oil container under chassis.

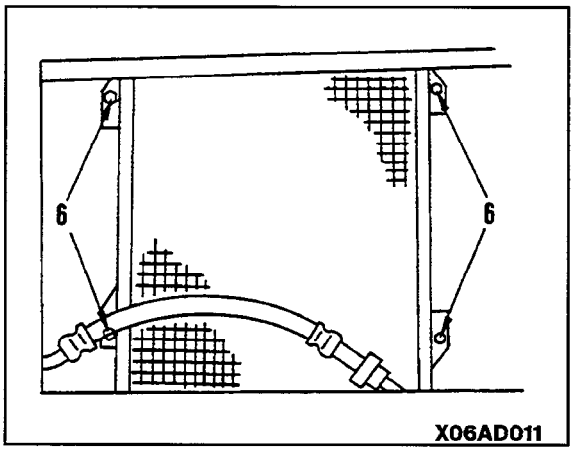
2. Disconnect hoses (4) and (5).
   ★ Disconnect hose (4) at the cooler end, and hose (5) at the chassis end.
   ★ Put blind plugs in the places that have been disconnected.

3. Remove mounting bolts (6) at side of hydraulic oil cooler assembly.

4. Sling hydraulic oil cooler assembly (7), remove 2 mounting bolts each on left and right, then lift off hydraulic oil cooler assembly (7).
   kg Hydraulic oil cooler assembly: 55 kg



X06AD010

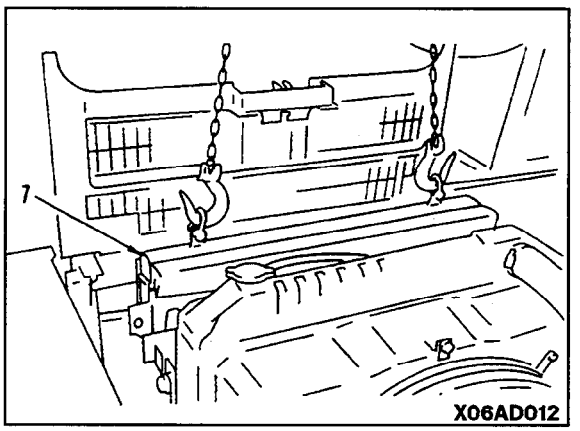


X06AD011

INSTALLATION OF HYDRAULIC OIL COOLER ASSEMBLY

- Carry out installation in the reverse order to removal.

- Refill with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.



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REMOVAL OF RADIATOR • HYDRAULIC OIL COOLER ASSEMBLY

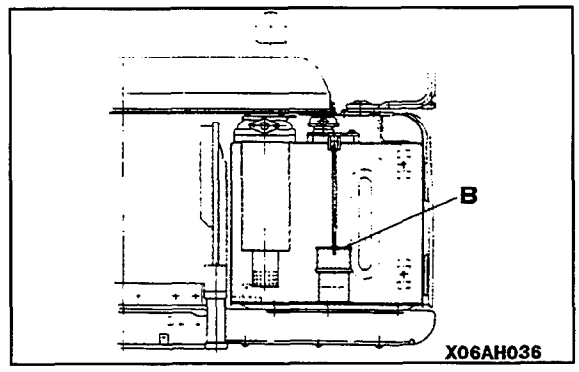
⚠ Lower the work equipment completely to the g round and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

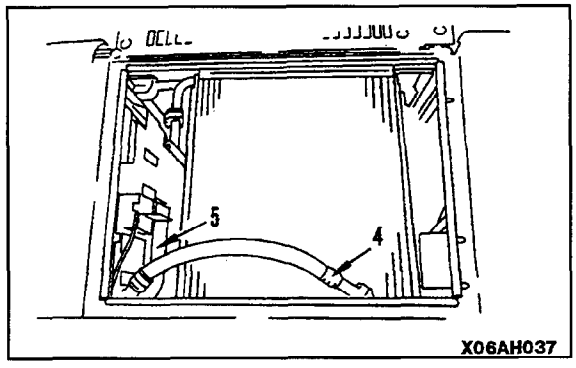
- Remove the hydraulic tank strainer, and using tool **B**, stop the oil.
  - When not using tool **B**, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.

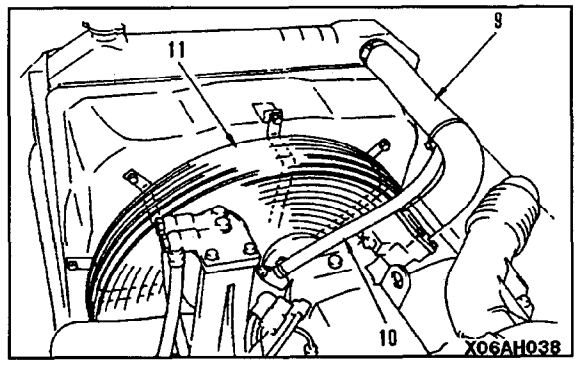
Hydraulic tank: Approx. 170 ℓ

- Drain engine coolant.

1. Remove undercover under radiator.
2. Disconnect small diameter from radiator (near cap) to reservoir tank.
3. Disconnect cooler hoses (4) and (5).
4. Disconnect radiator upper hose (9), and remove clamps of heater hose (10) from right side of radiator assembly.
5. Remove fan guard (11).







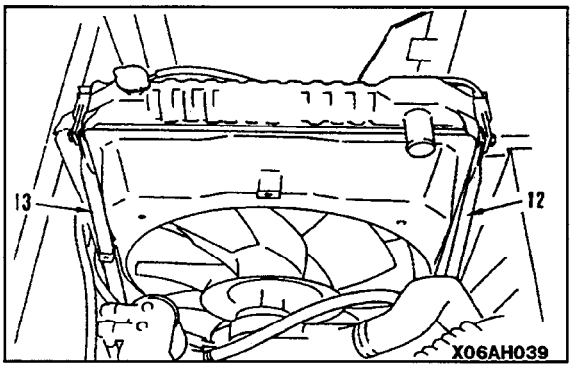
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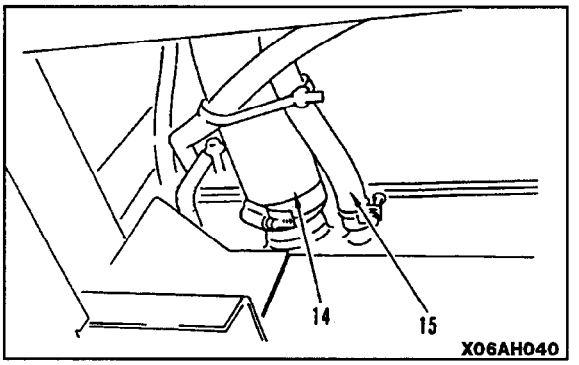
6. Disconnect radiator support rods (12) and (13).
   ★ Loosen the mounting bolts, then remove the top mounting bolts and move the rods toward the rear of the engine.

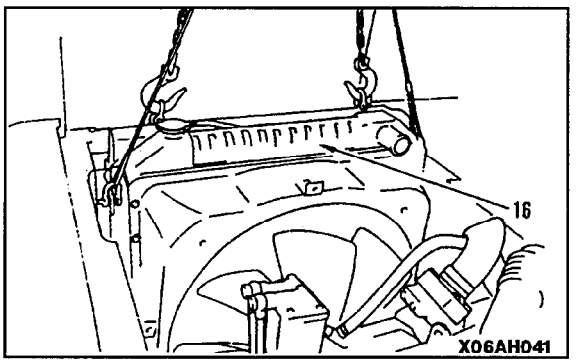
7. Disconnect radiator lower hose (14) and heater hose (15).
   ★ The radiator lower hose is fixed by a clamp to the radiator, so always disconnect the clamp.

8. Sling radiator and hydraulic oil cooler assembly (16), remove 4 bottom mounting bolts, then lift off radiator and hydraulic oil cooler assembly.
   ★ When raising the radiator and hydraulic oil cooler assembly, check the position carefully and do not let it hit the fan when removing it.

   kg — Radiator • hydraulic oil cooler assembly: 125 kg







INSTALLATION OF RADIATOR • HYDRAULIC OIL COOLER ASSEMBLY

- Carry out installation in the reverse order to removal.

- Refilling with coolant.
  ★ Add coolant through the water filler to the specified level. Run the engine to circulate the coolant through the system. Then check the coolant level again.

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

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REMOVAL OF ENGINE • HYDRAULIC PUMP ASSEMBLY

⚠ Disconnect the cable from the negative (-) terminal of the battery.

⚠ Lower the work equipment completely to the g round and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

- Remove the hydraulic tank strainer, and using tool **B**, stop the oil.
  - When not using tool **B**, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.

Hydraulic tank: Approx. 170 ℓ

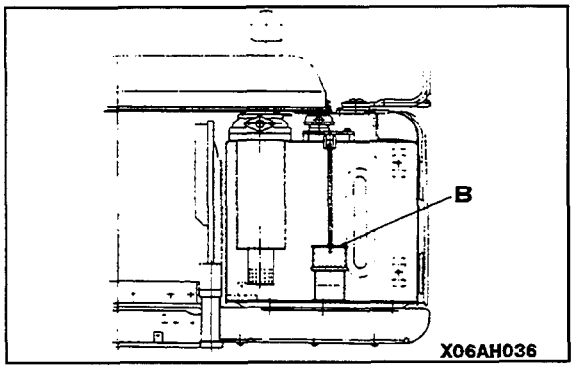
★ Mark all the piping with tags to prevent mistakes in the mounting position when installing.

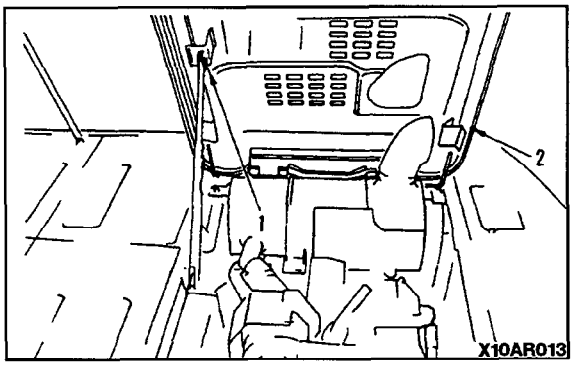
- Drain engine coolant.

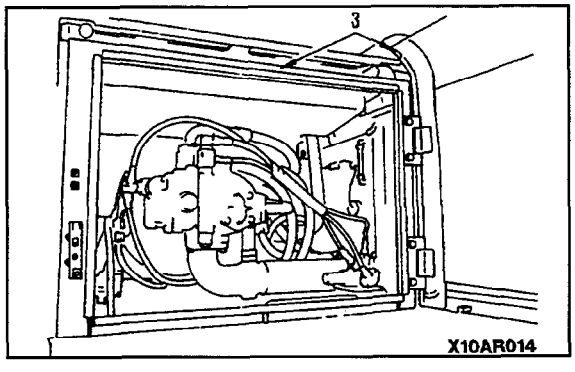
1. Remove cotter pin (1) of stopper, then remove engine hood (2).

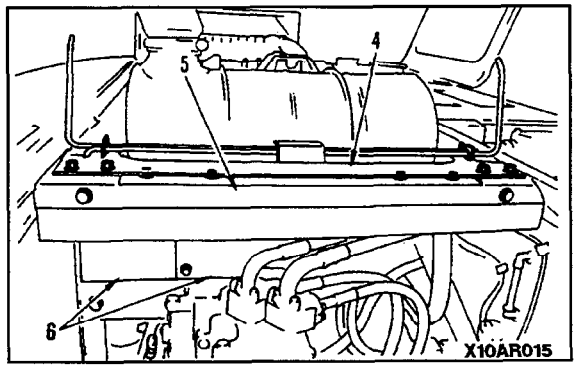
2. Remove side cover and mounting frame (3).

3. Remove engine hood mounting bracket (4), cover (5), and engine room partition plate (6).





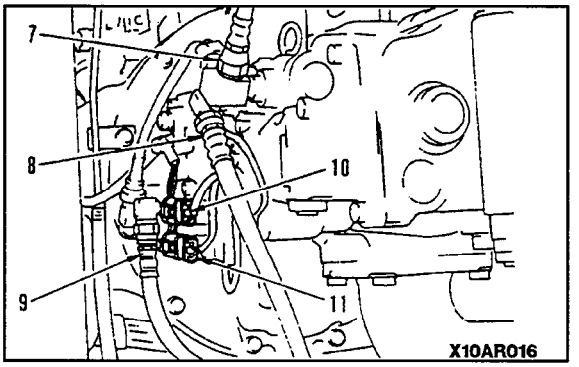




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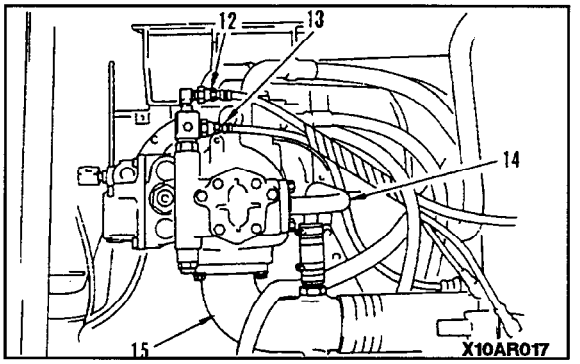
4. Disconnect hoses (7), (8), and (9) from TVC ● LS valve.

5. Pull out connectors (10) and (11) from holder and disconnect.
   ★ Remove the connector wiring clamps completely.



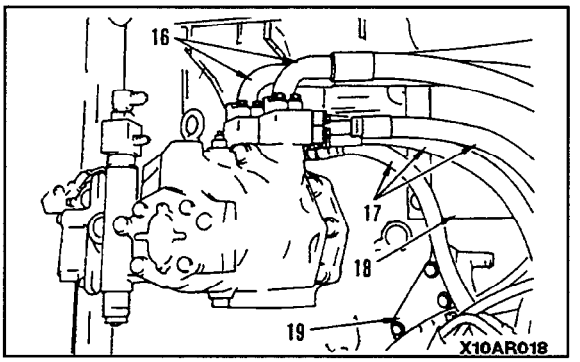
6. Disconnect hoses (12) and (13) from control pump.

7. Remove suction tubes (14) and (15).

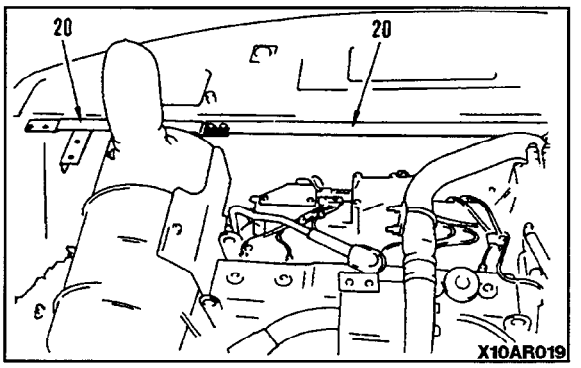


8. Disconnect hoses (16) and (17) installed to top of main pump assembly.

9. Remove cover (18), and disconnect hose bracket (19) from pump.

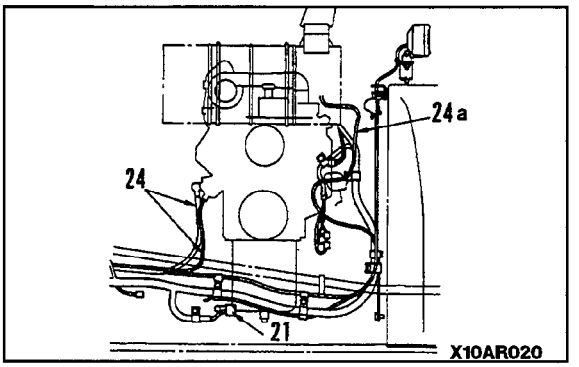


10. Remove bracket (20) at counterweight end.



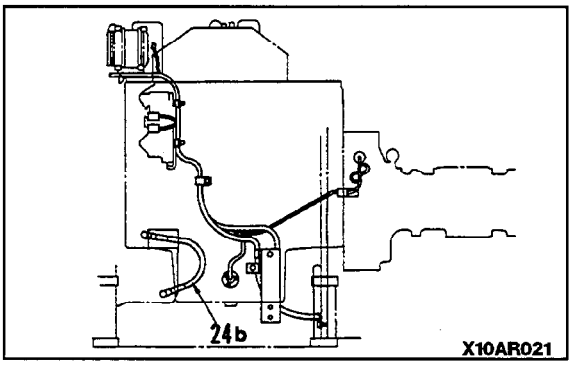
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11. Disconnect connector (21).



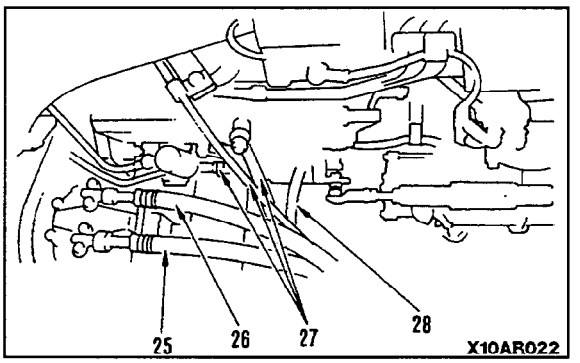
12. Disconnect governor motor connectors (22), and remove wiring clamp (23).

13. Disconnect starting motor wiring (24). Disconnect intake heat wiring (24A) and engine earth (24B).

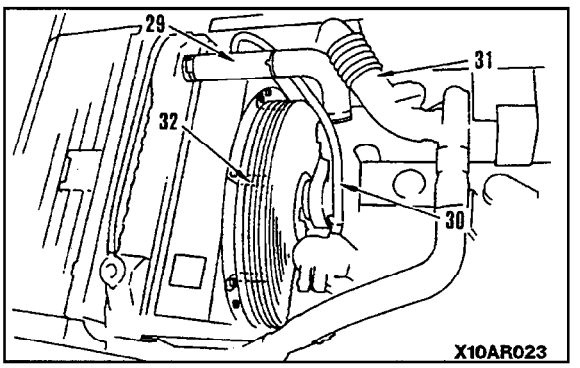


14. Disconnect air conditioner compressor hoses (25) and (26). (If fitted)
    - ★ Loosen the sleeve nut slightly and release the refrigerant (gas) completely before disconnecting the hoses.
    - ★ Fit blind plugs to prevent the entry of moisture, dust or dirt into the hoses.

15. Disconnect fuel hoses (27) and ground connection (28).



16. Remove radiator upper hose (29), heater hose (30), air cleaner connector (31) and fan guard (32).

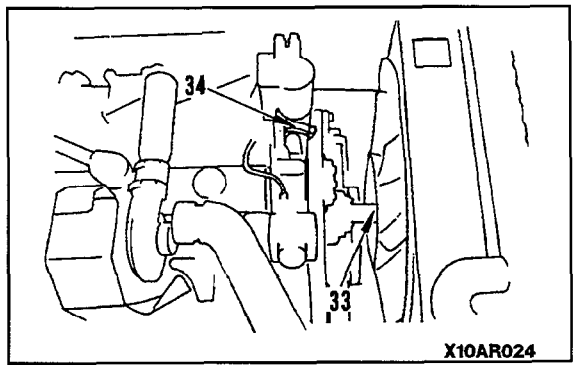


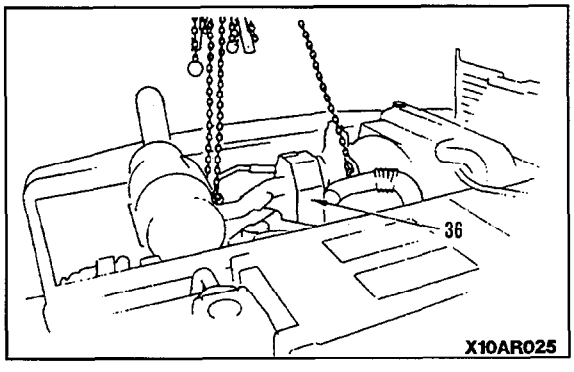
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17. Remove fan (33), and disconnect radiator lower hose (34).

18. Remove mount bolt, and raise engine and hydraulic pump assembly (36) slowly, then move to right side of chassis and lift off.
    ★ When removing the engine and hydraulic pump assembly, check that all the wiring and piping has been disconnected.

    kg Engine • hydraulic pump assembly: 750 kg





INSTALLATION OF ENGINE • HYDRAULIC PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

kgm Engine mount bolt: 276.9 ± 31.9 Nm (28.3 ± 3.3 kgm)

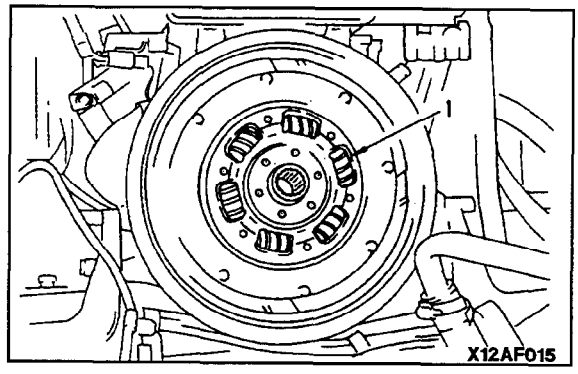
- Refilling with coolant.
  ★ Add coolant through the water filler to specified level. Run the engine to circulate the coolant through the system. Then check the coolant level again.

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air
  ★ Bleed air from the hydraulic pump. For details, see TESTING AND ADJUSTING, Bleeding air.

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REMOVAL OF DAMPER ASSEMBLY



1. Remove main pump assembly. For details, see REMOVAL OF MAIN PUMP ASSEMBLY.
2. Remove damper assembly (1).

INSTALLATION OF DAMPER ASSEMBLY

- Carry out installation in the reverse order to removal.

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REMOVAL OF FUEL TANK ASSEMBLY

⚠ Disconnect the cable from the negative (-) terminal of the battery.

1. Loosen drain valve (1) of fuel tank and drain fuel.

   Fuel tank: Approx. 315 ℓ (when tank is full)

2. Disconnect fuel supply hose (2) and return hose (3).

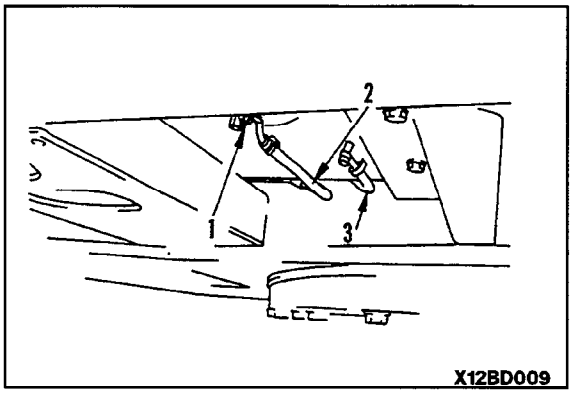
3. Remove handrail (4), battery case (5), and cover (6).

4. Remove connector (7) from holder, and disconnect it.
   ★ Remove the wiring from the clamp, then disconnect from the fuel tank.

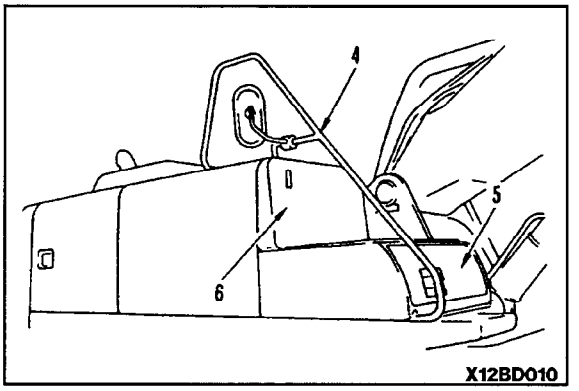
5. If refueling pump is fitted, disconnect hose (9) from tank tube.

6. Remove mounting bolts and lift off fuel tank assembly (8). ※1

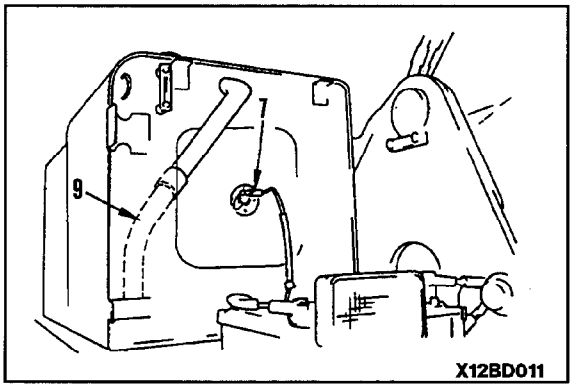
   kg Fuel tank assembly: 120 kg



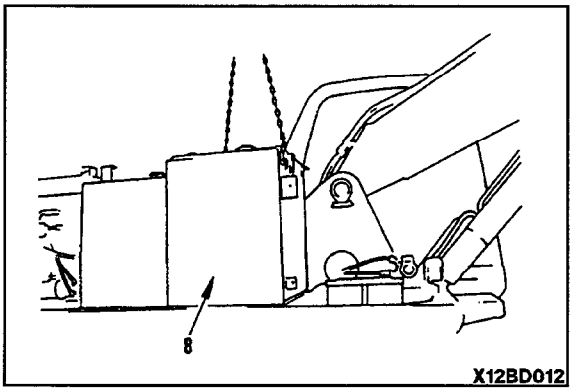
X12BD009



X12BD010



X12BD011



X12BD012

INSTALLATION OF FUEL TANK ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

kgm Fuel tank mounting bolt: 276.9 ± 31.9 Nm (28.25 ± 3.25 kgm)

- Refilling with oil (fuel tank)
  Add fuel.

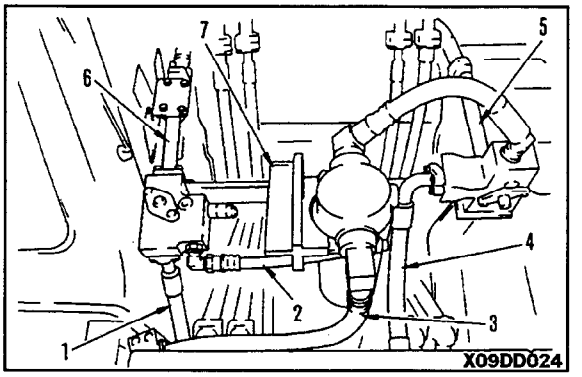
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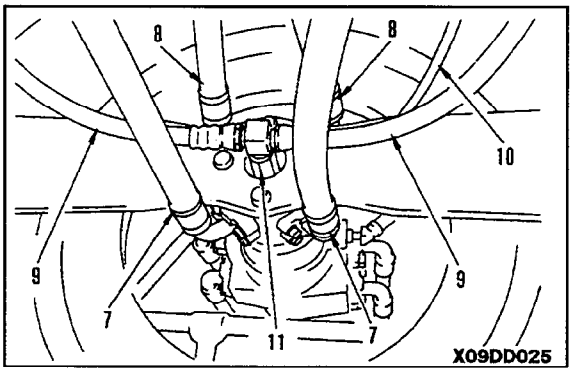
REMOVAL OF CENTER SWIVEL JOINT ASSEMBLY

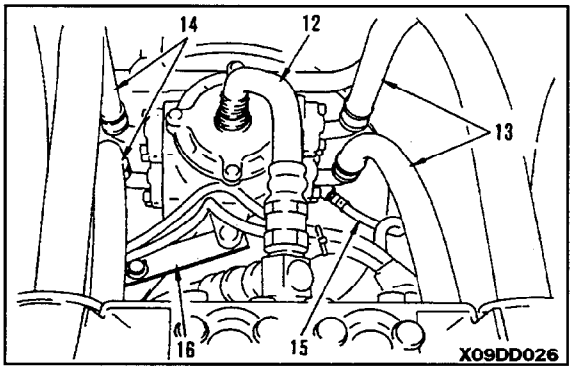
⚠ Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing remaining pressure from hydraulic circuit.

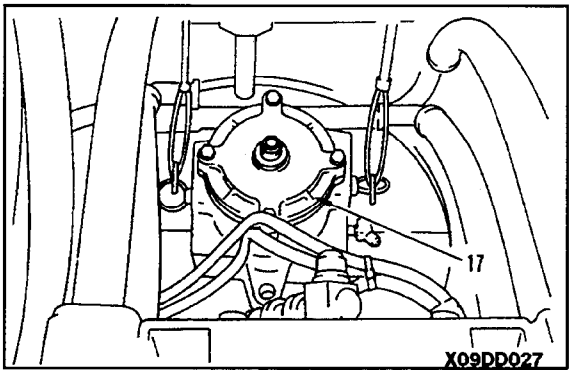
★ Mark all the piping with tags to prevent mistakes in the mounting position when installing.

1. Disconnect hoses (1), (2), (3), and (4) and tubes (5) and (6), and remove filter and bracket assembly.
   ★ Machines equipped with additional attachment circuit.
   kg Filter, bracket assembly: 95 kg
2. Disconnect hoses (7), (8), (9), and (10) between travel motor and swivel joint.
3. Remove elbow (11).
4. Disconnect drain hose (12).
5. Disconnect hoses (13) and (14) between control valve and swivel joint.
6. Disconnect travel speed selector hose (15).
7. Disconnect plate (16).
8. Remove center swivel joint assembly (17).
   kg Center swivel joint assembly: 45 kg







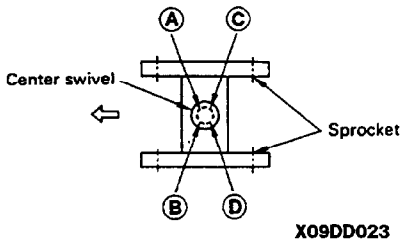


INSTALLATION OF CENTER SWIVEL JOINT ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

★ Assemble the center swivel as shown in the diagram below.



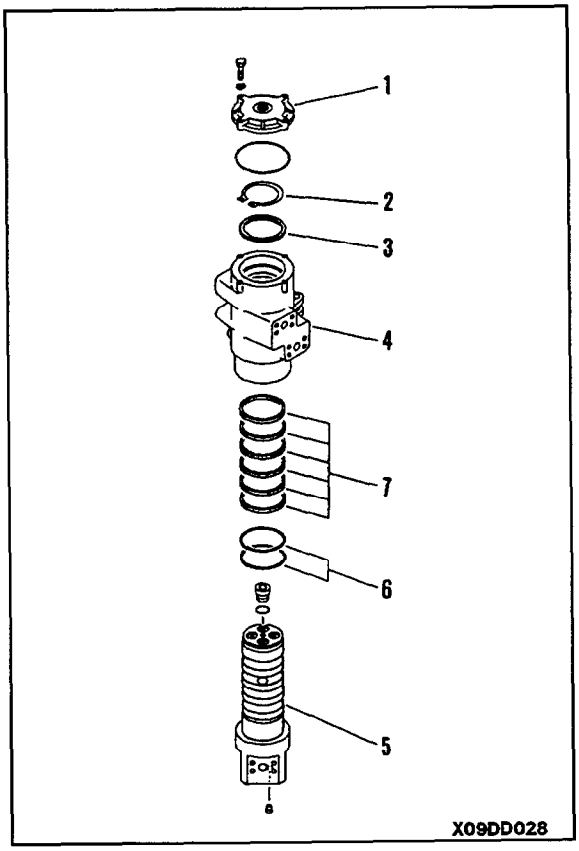
X09DD023

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- Bleeding air
  ★ Bleed the air from the travel motor. For details, see TESTING AND ADJUSTING, Bleeding air.

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DISASSEMBLY OF CENTER SWIVEL JOINT ASSEMBLY

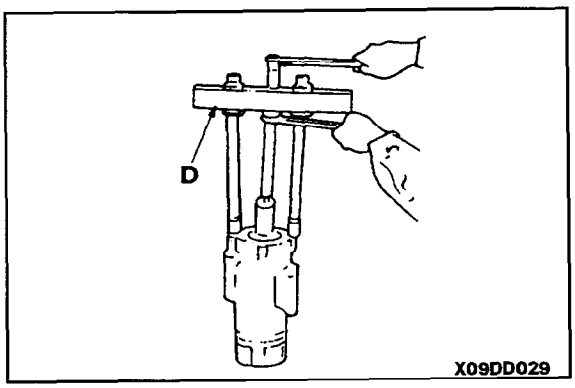
1. Remove cover (1).
2. Remove snap ring (2).
3. Using tool **D**, pull out swivel rotor (4) and ring (3) from swivel shaft (5).
4. Remove O-ring (6) and slipper seal (7) from swivel rotor.



ASSEMBLY OF CENTER SWIVEL JOINT ASSEMBLY

1. Assembly slipper seal (7) and O-ring (6) to swivel rotor.
2. Set swivel shaft (5) to block, then using push tool, tap swivel rotor (4) with a plastic hammer to install.
   Contact surface of rotor, shaft: Grease (G2-LI)

   ★ When installing the rotor, be extremely careful not to damage the slipper seal and the O-ring.
3. Install ring (3) and secure with snap ring (2).
4. Fit O-ring and install cover (1).
   Mounting bolt: 31.4 ± 2.9 Nm (3.2 ± 0.3 kgm)



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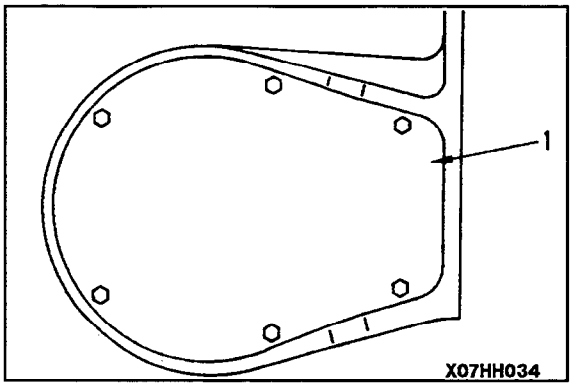
REMOVAL OF FINAL DRIVE ASSEMBLY

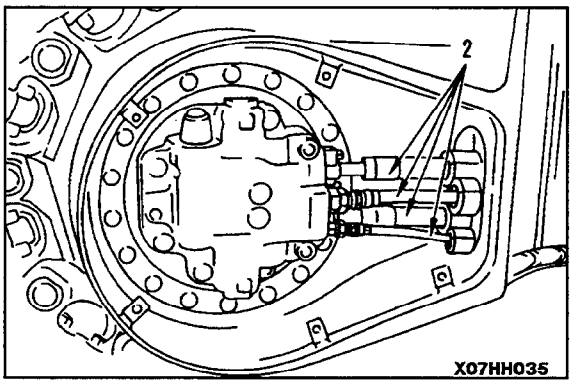
1. Remove sprocket. For details, see REMOVAL OF SPROCKET.

⚠ Lower the work equipment completely to the g round and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

2. Remove cover (1).
3. Disconnect 4 travel motor hoses (2), and lift off final drive assembly (3). ※1
   ★ Be extremely careful not to damage the nipple tool surface of the hose mount.

   kg Final drive assembly: 425 kg





INSTALLATION OF FINAL DRIVE ASSEMBLY

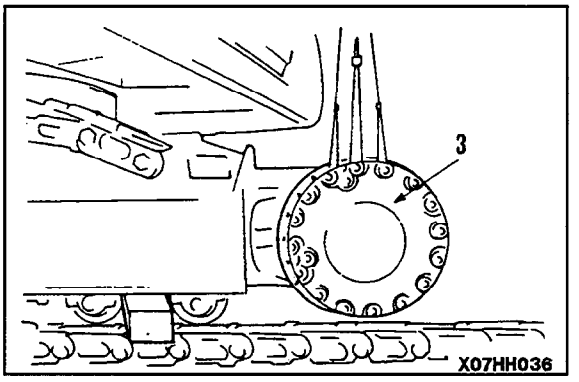
- Carry out installation in the reverse order to removal.

※1

kgm Final drive mounting bolt: 276.9 ± 31.9 Nm (28.25 ± 3.25 kgm)

- Bleeding air
  ★ Bleed the air from the travel motor. For details, see TESTING AND ADJUSTING, Bleeding air.

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.



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DISASSEMBLY OF FINAL DRIVE ASSEMBLY

PC200-6, PC200LC-6, PC210LC-6, PC220LC-6

1. **Draining oil**
   Remove drain plug and drain oil from final drive case.
   Final drive case: Approx. 5.5 ℓ

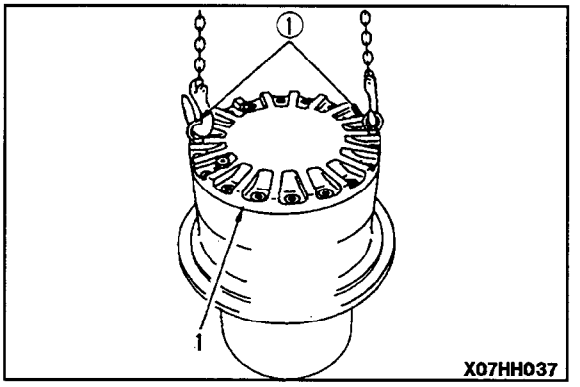
2. **Cover**
   Remove mounting bolts, then remove cover (1) using eyebolts ①.

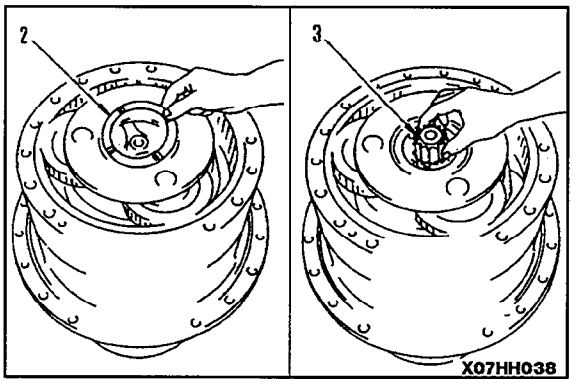
3. **Spacer**
   Remove spacer (2).

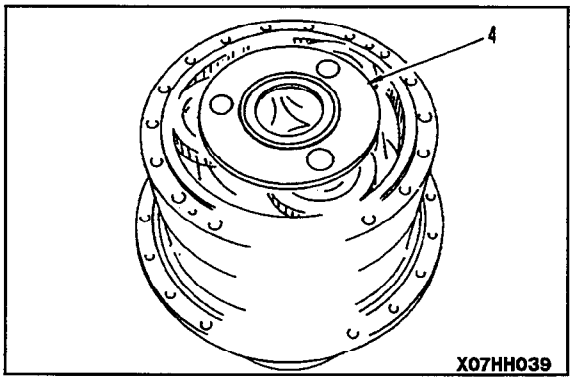
4. **No. 1 sun gear shaft**
   Remove No. 1 sun gear shaft (3).

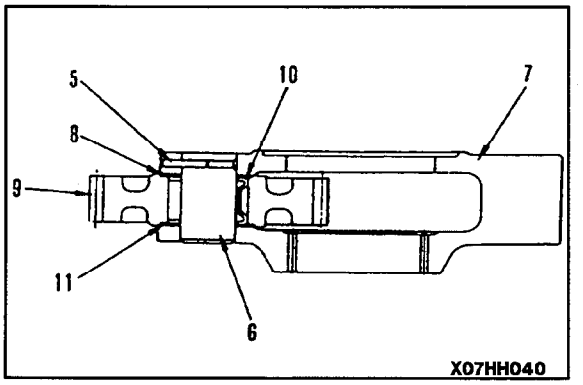
5. **No. 1 carrier assembly**
   1) Remove No. 1 carrier assembly (4).

   2) Disassembly No. 1 carrier assembly as follows.
      i) Push in pin (5), and pull out shaft (6) from carrier (7).
         ★ After removing the shaft, remove pin (5).
      ii) Remove thrust washer (8), gear (9), bearing (10), and thrust washer (11).





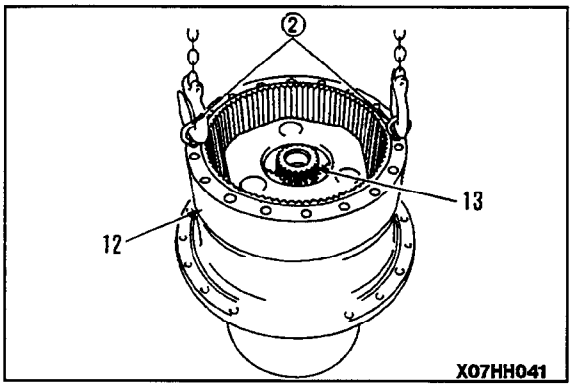




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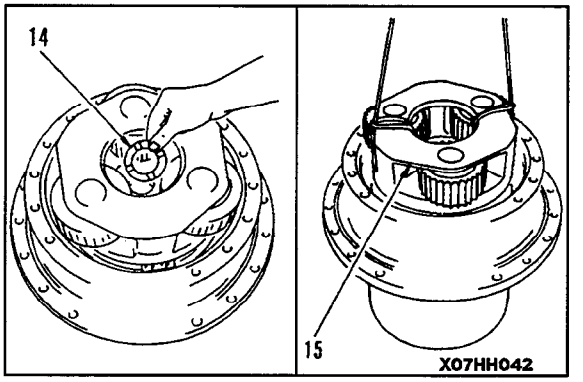
6. Ring gear
Using eyebolts ②, remove ring gear (12).

7. No. 2 sun gear
Remove No. 2 sun gear (13).

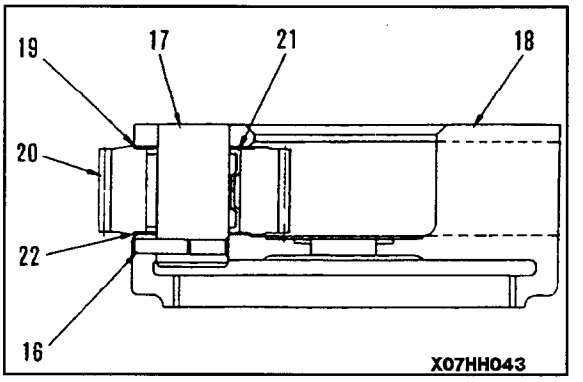


8. Thrust washer
Remove thrust washer (14).

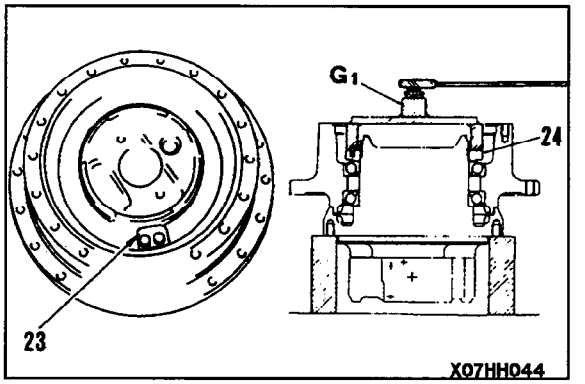
9. No. 2 carrier assembly
1) Remove No. 2 carrier assembly (15).



2) Disassemble No. 2 carrier assembly as follows.
   i) Push in pin (16) and pull out shaft (17) from carrier (18).
      ★ After removing the shaft, remove pin (16).
   ii) Remove thrust washer (19), gear (20), bearing (21), and thrust washer (22).



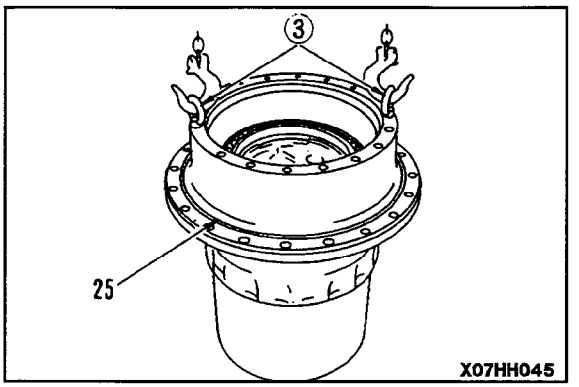
10. Nut
1) Remove lock plate (23).
2) Using tool **G_1**, remove nut (24).



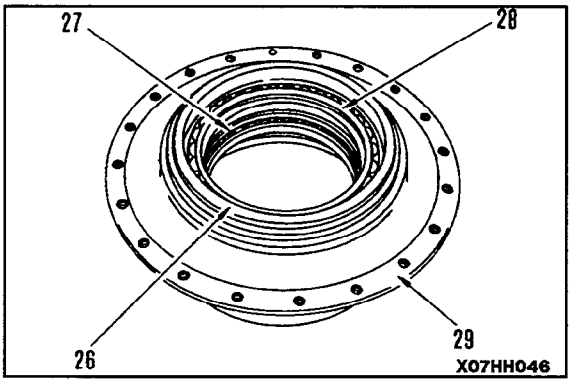
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11. Hub assembly

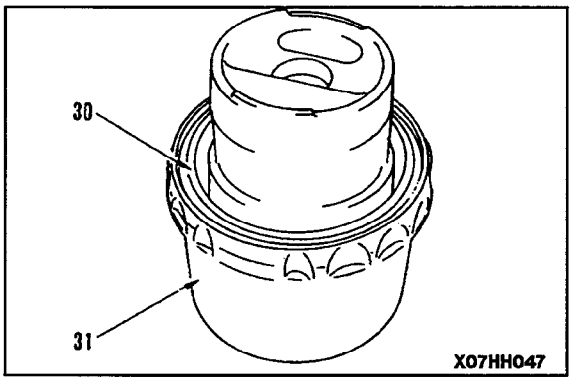
1) Using eyebolts ③, remove hub assembly (25) from travel motor.



2) Disassemble hub assembly as follows.
   i) Remove floating seal (26).
   ii) Remove bearings (27) and (28) from hub (29).



3) Remove floating seal (30) from travel motor (31).



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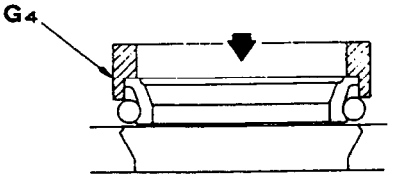
ASSEMBLY OF FINAL DRIVE ASSEMBLY

PC200-6, PC200LC-6, PC210LC-6, PC220LC-6

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. Hub assembly

1) Using push tool, press fit bearings (27) and (28) to hub (29).
2) Using tool **G_4**, install floating seal (26).



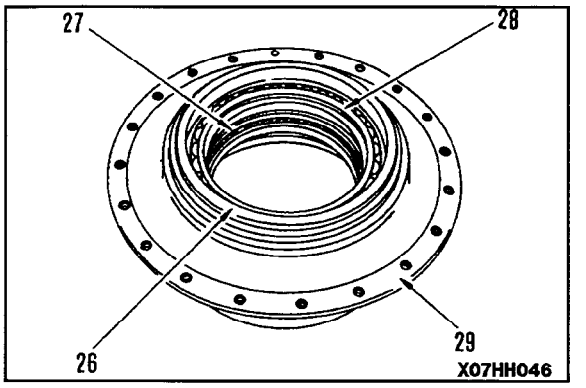
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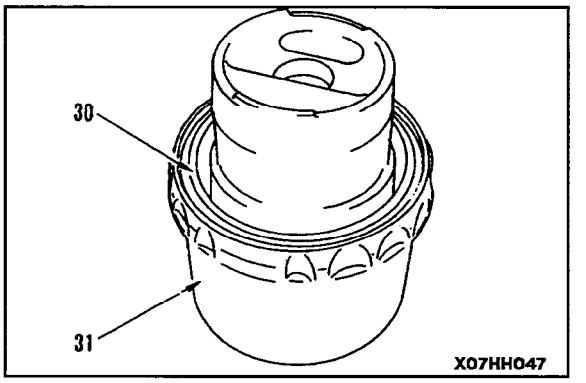
★ Remove all oil and grease from the O-ring and O-ring contact surface, and dry the parts before installing the floating seal.
★ After installing the floating seal, check that the angle of the floating seal is within 1mm.
★ After installing the floating seal, coat the sliding surface thinly with engine oil.

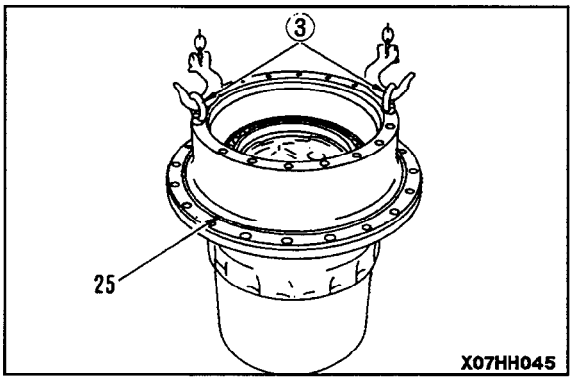
3) Using tool **G_4**, install floating seal (30) to travel motor (31).
★ The procedure for installation is the same as in Step 2) above.
4) Using eyebolts ③, set hub assembly (25) to travel motor, then using push tool, tap to press fit bearing portion.

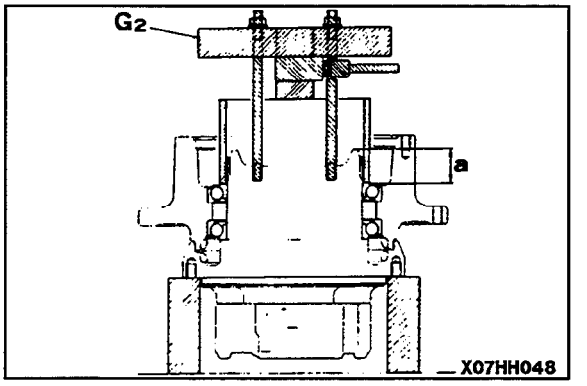
2. Nut

1) Install nut as follows.
i) Using tool **G_2**, push bearing inner race portion.
★ Pushing force: 8.82 - 12.74 kN (0.9 - 1.3 ton)
★ Rotate the hub 2 - 3 times before applying the pushing force to the bearing inner race.
ii) Measure dimension **"a"** in the condition in Step i) above.



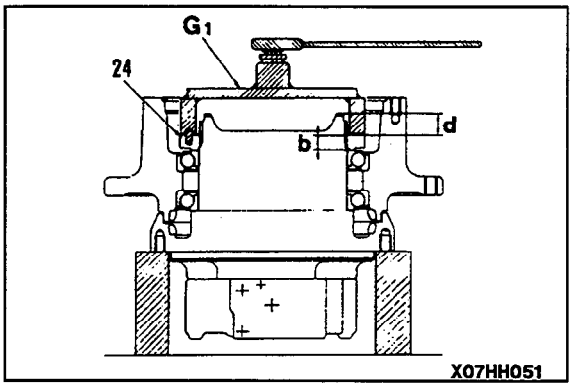




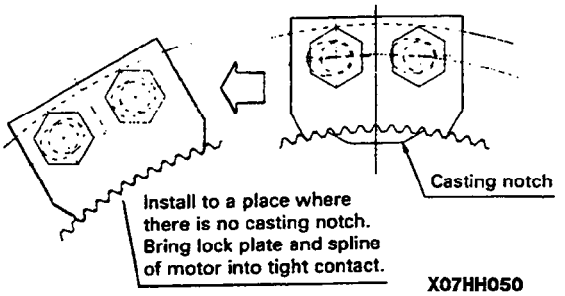


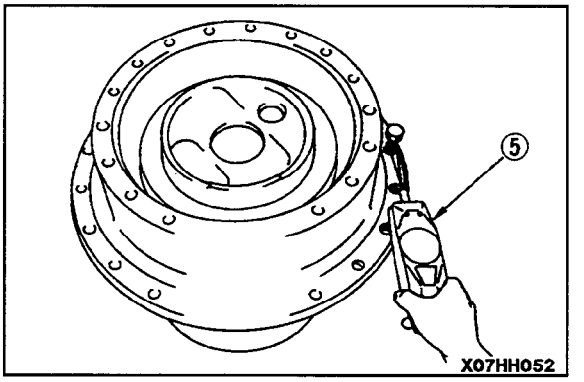
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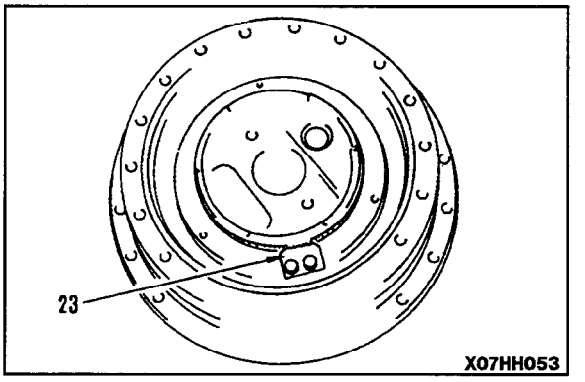
iii) Measure thickness **"b"** of nut itself.
iv) Calculate **a - b = c**.
v) Using tool G_1, tighten nut (24) to a point where dimension **"d"** is $c^{0}_{-0.1}$



vi) Using push-pull scale ⑤, measure tangential force in direction of rotation of hub in relation to motor case.
★ Tangential force: Max. 294.2 N (30 kg)
★ The tangential force is the maximum force when starting rotation.
vii) Install lock plate (23).
★ Install the lock plate as shown in the diagram below.

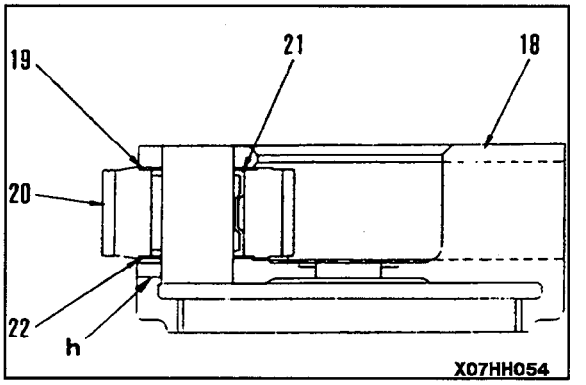






Thread of mounting bolt: Thread tightener (LT-2)

★ Do not coat the tap portion of the nut with thread tightener (LT-2).

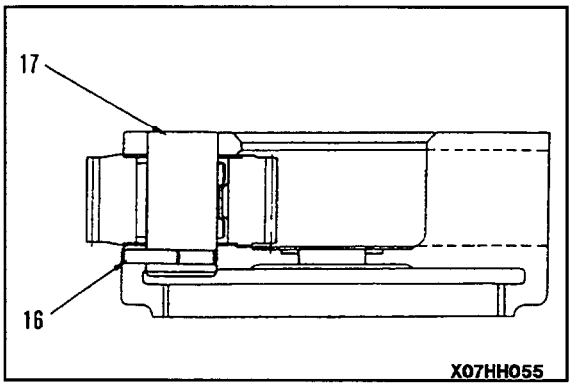


3. No. 2 carrier assembly

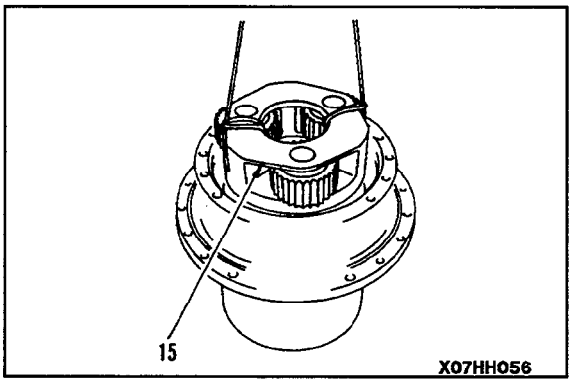
1) Assemble No. 2 carrier assembly as follows.
★ There are the remains of the caulking when the pin is inserted at the end face of hole **h** at the side of the carrier, so remove the caulked metal from the inside diameter of the hole before starting to assemble.
i) Assemble bearing (21) to gear (20), fit top and bottom thrust washers (19) and (20), and set gear assembly in carrier (18).

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ii) Align position of pin holes of shaft and carrier, then tap with a plastic hammer to install shaft (17).
★ When installing the shaft, rotate the planetary gear. Be careful not to damage the thrust washer.
iii) Insert pin (16).
★ After inserting the pin, caulk the pin portion of the carrier.
★ After assembling the carrier assembly, check that gear (20) rotates smoothly.

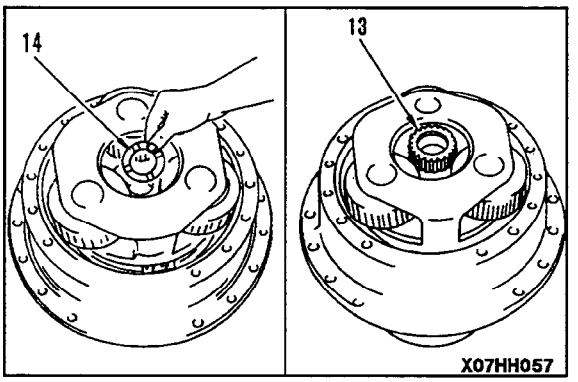


2) Install No. 2 carrier assembly (15).

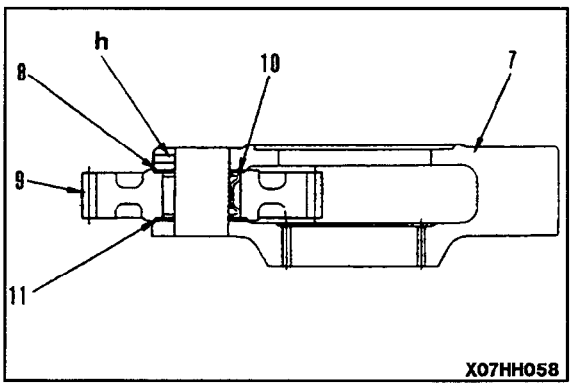


4. Thrust washer
Install thrust washer (14).

5. No. 2 sun gear
Install No. 2 sun gear (13).

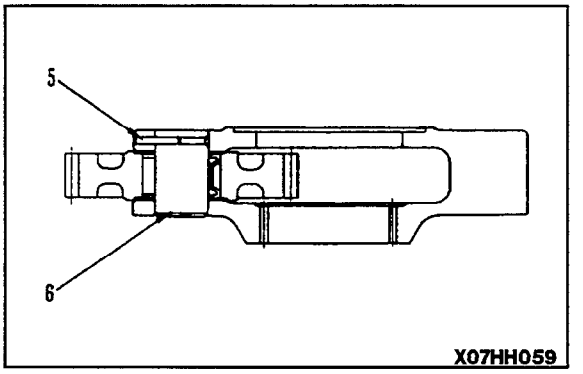


6. No. 1 carrier assembly
1) Assemble No. 1 carrier assembly as follows.
★ There are the remains of the caulking when the pin is inserted at the end face of hole **h** at the side of the carrier, so remove the caulked metal from the inside diameter of the hole before starting to assemble.
i) Assemble bearing (10) to gear (9), fit top and bottom thrust washers (8) and (11) and set gear assembly to carrier (7).



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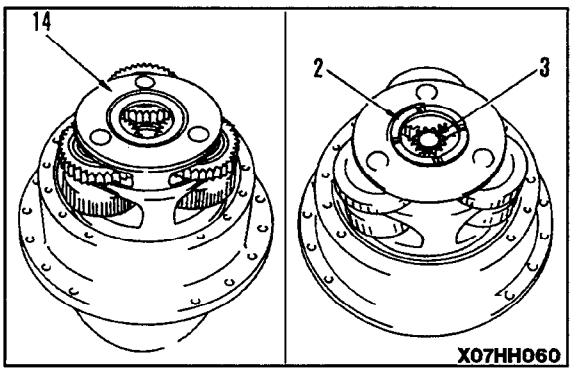
ii) Align position of pin holes of shaft and carrier, then tap with a plastic hammer to install shaft (6).
★ When installing the shaft, rotate the planetary gear. Be careful not to damage the thrust washer.
iii) Insert pin (5).
★ After inserting the pin, caulk the pin portion of the carrier.
★ After assembling the carrier assembly, check that gear (9) rotates smoothly.
2) Install No. 1 carrier assembly (14).



7. No. 1 sun gear shaft
Install No. 1 sun gear shaft (3).

8. Spacer
Install spacer (2).

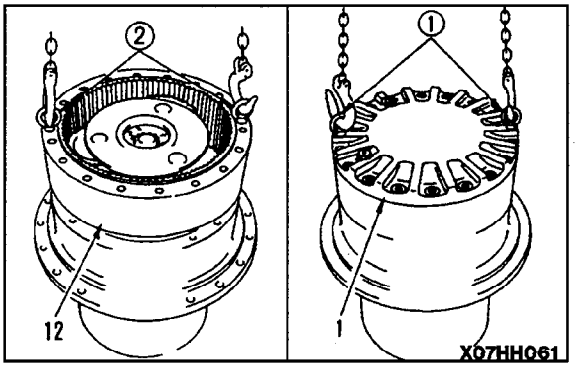
9. Ring gear
Fit O-ring to hub end, then using eyebolts ②, align position of bolt holes of hub and ring gear (12), and install.
★ Remove all grease and oil from the mating surface of the ring gear and hub.
★ Do not put any gasket sealant on the mating surface of the ring gear and hub under any circumstances.



10. Cover
Using eyebolts ①, fit cover (1), then tighten mounting bolts with angle tightening wrench **G_3**.

Mounting surface of cover: Gasket sealant (LG-6)

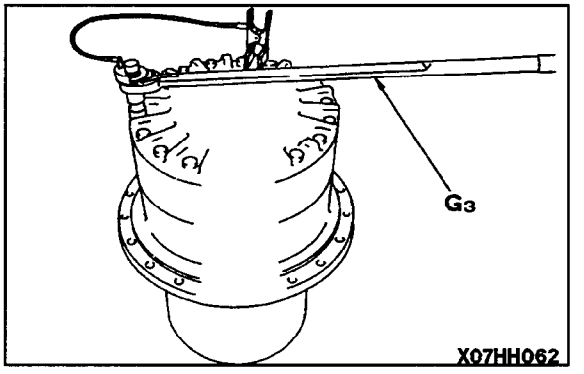
Mounting bolt: 1st pass 98 Nm (10 kgm) 2nd pass Turn 70 - 80°



11. Refilling with oil
Tighten drain plug and add engine oil through oil filler.

Final drive case: Approx. 5.5 ℓ

★ Carry out a final check of the oil level at the determined position after installing the final drive assembly to the chassis.



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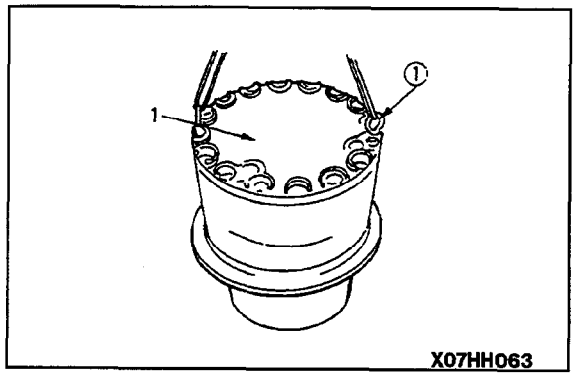
DISASSEMBLY OF FINAL DRIVE ASSEMBLY

PC250LC-6

1. Draining oil

Remove drain plug and drain oil from final drive case.

Final drive case: Approx. 8.0 ℓ



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2. Cover

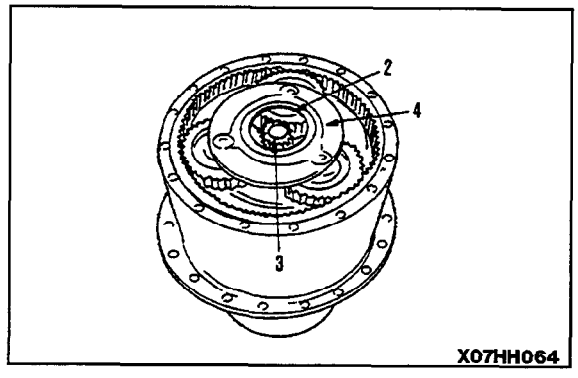
Using forcing screws and eyebolts ①, remove cover (1).

3. Thrust washer

Remove thrust washer (2).

4. No. 1 sun gear shaft

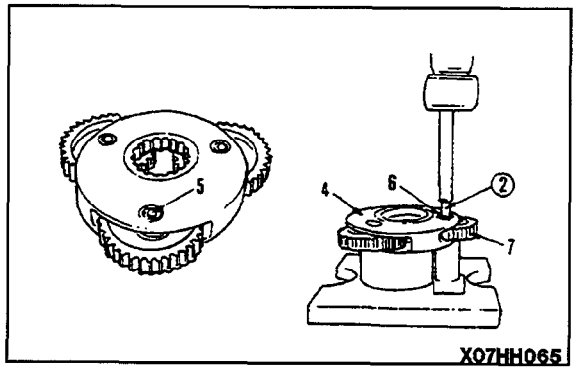
Remove No. 1 sun gear shaft (3).



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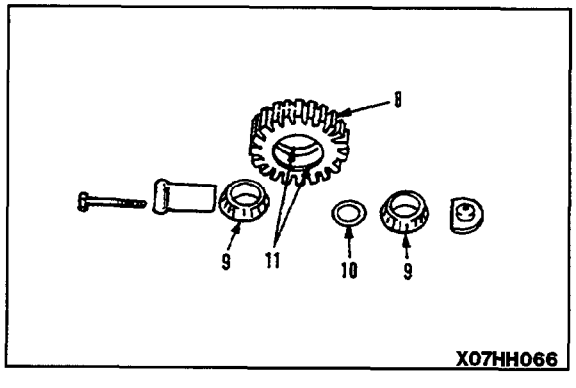
5. No. 1 carrier assembly

1) Remove carrier assembly (4).
2) Disassemble carrier assembly as follows.
   i) Remove mounting bolts (5), then remove holder.
   ii) Set carrier assembly (4) in press, then using push tool ②, pull out pin (6) and remove gear assembly (7).



X07HH065

   iii) Remove bearing (9) and spacer (10) from gear (8).
   iv) Remove outer race (11).



X07HH066

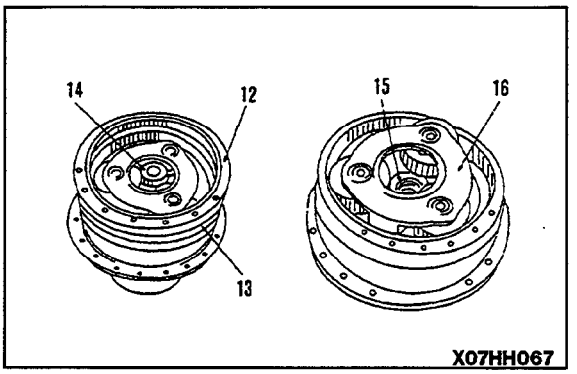
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6. Ring gear
1) Remove ring gear (12).
2) Remove ring (13).

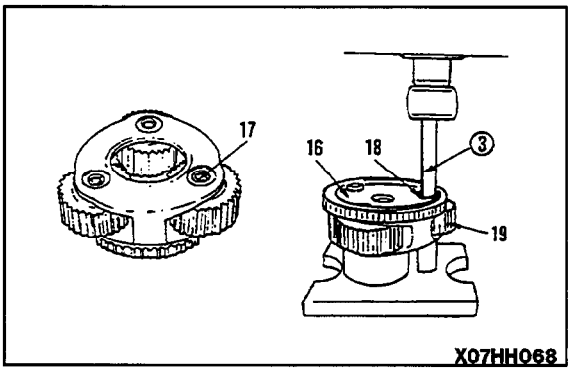
7. No. 2 sun gear
Remove sun gear (14).

8. Thrust washer
Remove thrust washer (15).

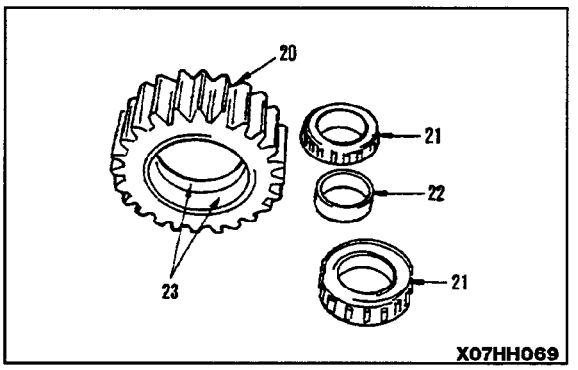
9. No. 1 carrier assembly
1) Remove carrier assembly (16).



2) Disassemble carrier assembly as follows.
   i) Remove mounting bolts (17), then remove holder.
   ii) Set carrier assembly (16) in press, then using push tool ③, pull out pin (18) and remove gear assembly (19).



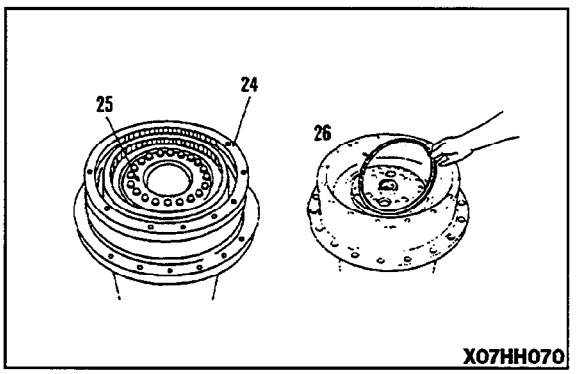
   iii) Remove bearing (21) and spacer(22) from gear (20).
   iv) Remove outer race (23).



10. No. 2 ring gear
Remove ring gear (24).

11. Gear coupling
Remove mounting bolts, then remove gear coupling (25).

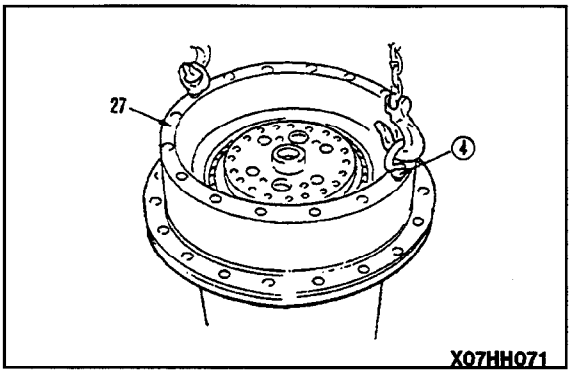
12. Spacer
Remove spacer (26).



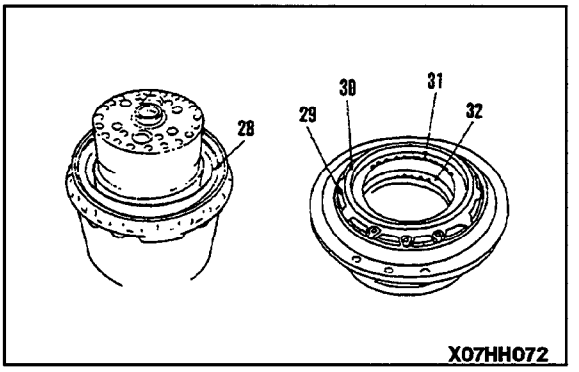
https://truckmanualshub.com/

13. Hub assembly

1) Using eyebolts ④, remove hub assembly (27) from travel motor.



2) Remove floating seal (28).
3) Remove cage (29), then remove floating seal (30).
4) Remove bearing (31) and (32).



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ASSEMBLY OF FINAL DRIVE ASSEMBLY

PC250LC-6

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. Hub assembly

1) Using push tool, press fit bearings (32) and (31).
2) Using tool **G_4**, install floating seal (30) to cage, then install cage (29).

Cage mounting surface: Gasket sealant (LG-6)

Mount bolt: 11.2 ± 7.4 Nm (6.75 ± .75 kgm)

★ Remove all oil and grease from the O-ring and O-ring contact surface, and dry the parts before installing the floating seal.

★ After installing the floating seal, check that the angle of the floating seal is within 1 mm.

★ After installing the floating seal, coat the sliding surface thinly with engine oil.

3) Using tool **G_4**, install floating seal (28).

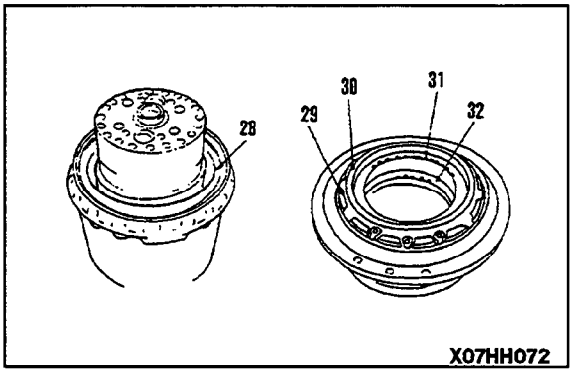
★ The procedure for installation is the same as in step 2) above.

4) Using eyebolts ④, set hub assembly (27) on travel motor, then using push tool, tap to press fit bearing.

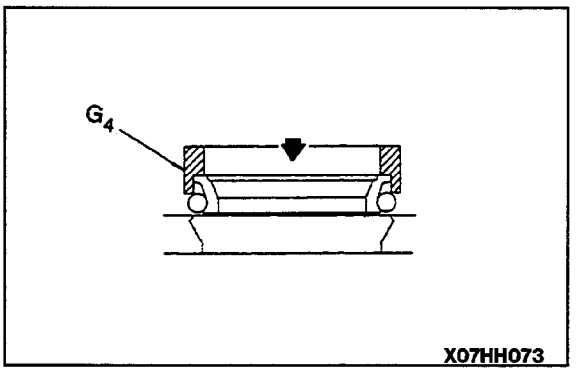
2. Adjusting bearing clearance

1) Using tool **G_2**, hold bearing and temporarily tighten 2 bolts.
2) Rotate hub 2 - 3 turns to settle bearing.
3) Loosen bolts of tool **G_2** and then tighten again.

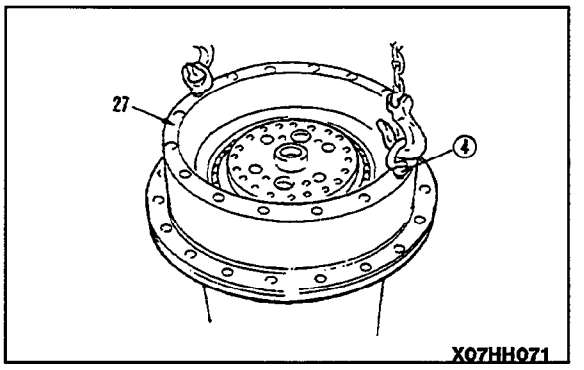
Bearing clearance bolts: 24.5 ± 4.9 Nm (2.5 ± 0.5 kgm)



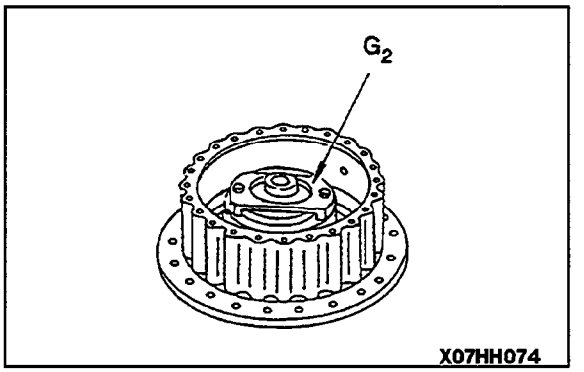
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X07HH073



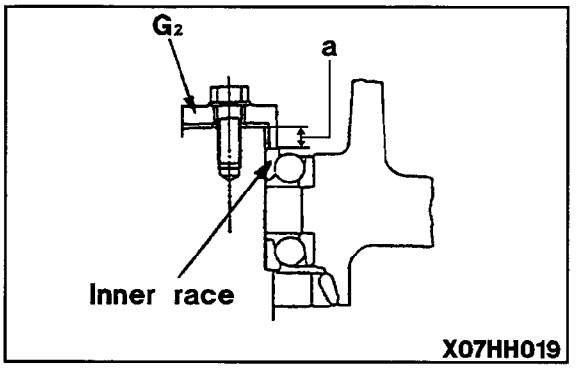
X07HH071



X07HH074

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4) Using a depth micrometer, measure stepped difference "a" between end face of shaft and inner race.
   ★ Measure two places and take the average value.
5) Select a spacer to give a value of "a" between 0.15 - 0.1 mm.
   ★ Select the suitable thickness of spacer from the 7 types of spacers.
6) Install the selected spacer (26).

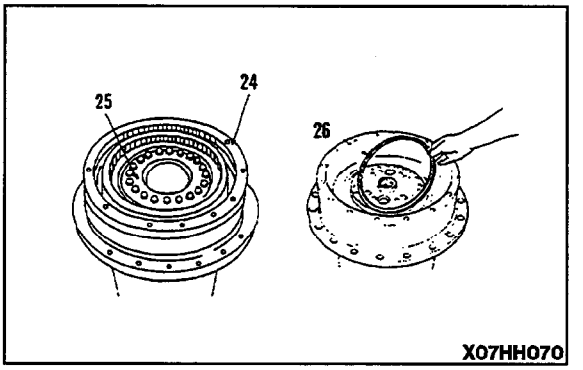


3. Gear coupling

1) Fit gear coupling (25), and tighten with the mount bolts.

   Mount bolt: Thread tightener (LT-2)

   Mount bolt: 720.3 ± 44 Nm (73.5 ± 4.5 kgm)

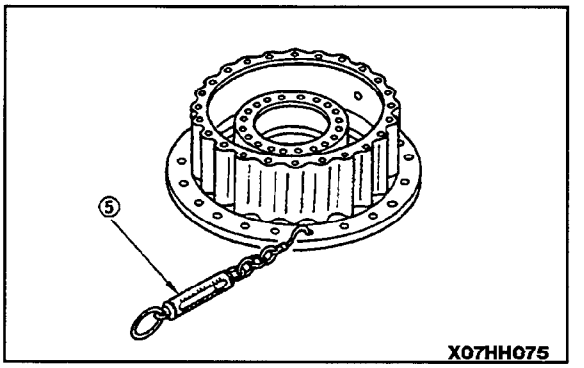


2) Check adjustment of bearing clearance again. Hook spring balance ⑤ in the tap hole for the sprocket mount bolt, pull to rotate the hub on the shaft and measure the starting force.
   ★ Starting force: See Tightening Torques and Standard Values Table.
   ★ If the starting force is higher than the standard value, there is a preload on the bearing, so adjust again.

4. No. 2 ring gear

Fit ring gear (24).

Ring gear mounting surface: Gasket sealant (LG-6)



★ Coat thread tightener only on ring gear upper surface.

★ Remove all grease and oil from the mating surface on the ring gear and hub.

★ Do not put any gasket sealant on the mating surface of the ring gear and hub under any circumstances.

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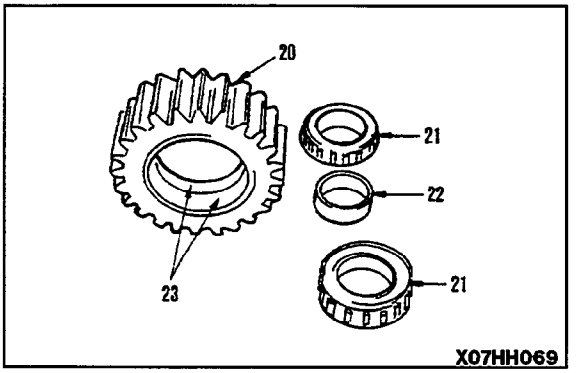
5. No. 2 carrier assembly

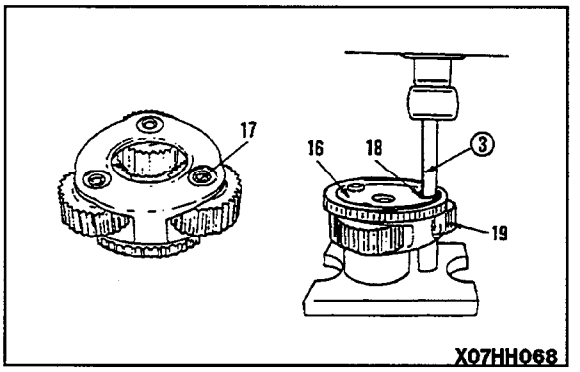
1) Assemble carrier assembly as follows.
   ★ The inner race, outer race and spacer from one set are similar to the other set, so assemble the sets with the same marks.
   i) Using push tool, press fit outer race (23) in gear (20).
   ii) Assemble spacer (22) and bearing (21).
   iii) Set carrier assembly (16) in press, assemble gear assembly (19), then using push tool ③, press fit pin (18).
      ★ When press fitting the pin, be ex tremely careful of the angle of the pin, and rotate the gear while press fitting.
      ★ After assembling the carrier assembly, check that gear (19) rotates smoothly.
   iv) Fit holder and tighten with mount bolts (17).

   Mount bolt: Thread tightener (LT-2)

   Mount bolt: 382.2 ± 39.2 Nm (39 ± 4 kgm)

2) Install carrier assembly (16).





6. Thrust washer

Assembly thrust washer (15).

7. No. 2 sun gear

Assemble sun gear (14).

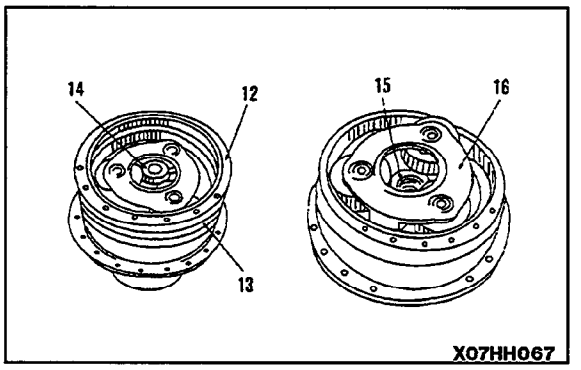
8. No. 1 ring gear

1) Install ring (13).

   Mounting surface of ring: Gasket sealant (LG-6)

2) Align with teeth surface of carrier, and install ring gear (12).

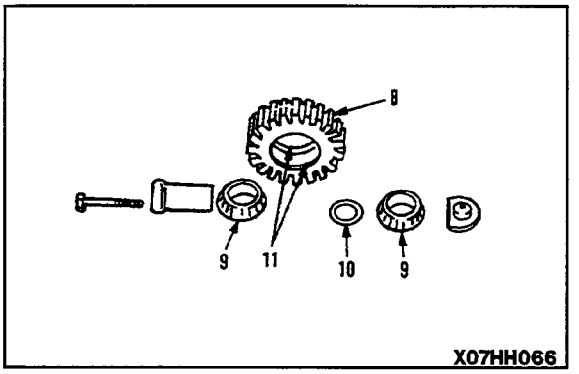
   Ring gear mounting surface: Gasket sealant (LG-6)



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9. No. 1 carrier assembly

1) Assemble carrier assembly as follows.
   ★ The inner race, outer race and spacer from one set are similar to the other set, so assemble the sets with the same marks.
   i) Using push tool, press fit outer race (11) in gear (8).
   ii) Assemble spacer (10) and bearing (9).



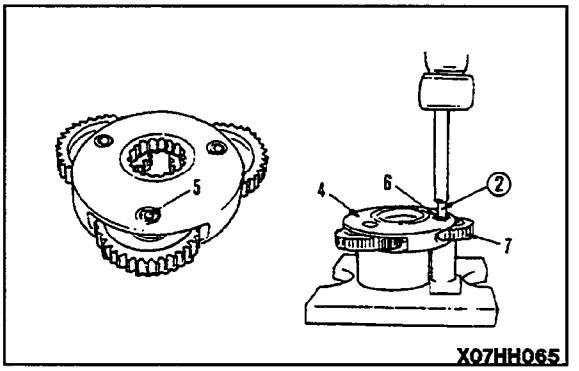
   iii) Set carrier assembly (4) in press, assemble gear assembly (7), then using push tool ②, press fit pin (6).
      ★ When press fitting the pin, be ex tremely careful of the angle of the pin, and rotate the gear while press fitting.
      ★ After assembling the carrier assembly, check that gear (19) rotates smoothly.
   iv) Fit holder and tighten with the mount bolts (5).



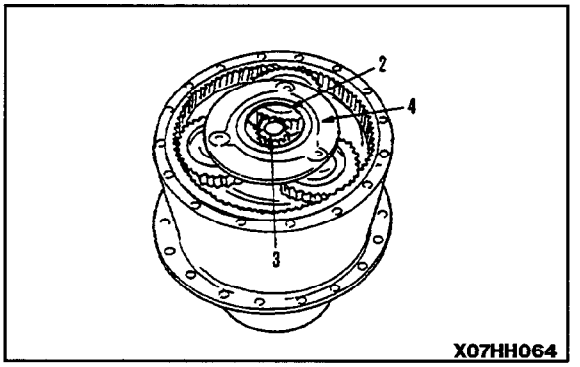
Mount bolt: Thread tightener (LT-2)



Mount bolt: 60.8 ± 7.4 Nm (6.75 ± 0.75 kgm)



2) Align with teeth surface of ring gear, and install carrier assembly (4).



10. No. 1 sun gear shaft

Assemble sun gear shaft (3).

11. Thrust washer

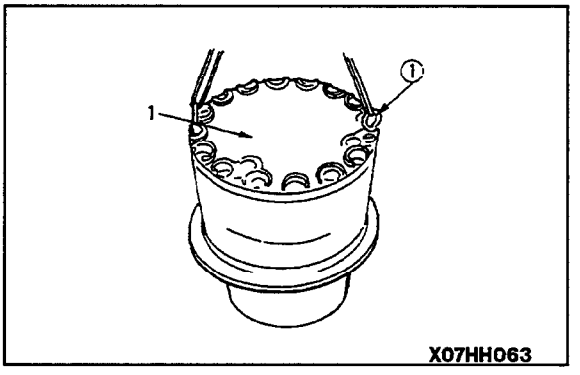
Assembly thrust washer (2).

12. Cover

1) Using eyebolts ①, install cover (1).



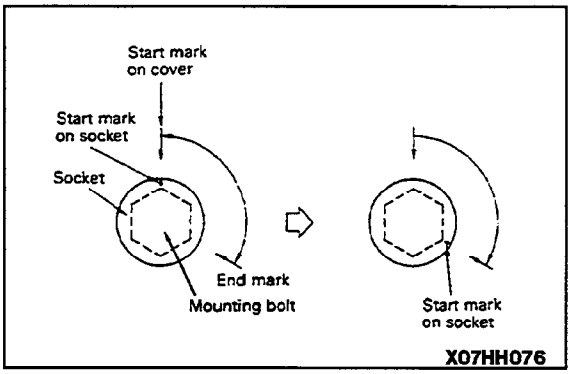
Cover mounting surface: Gasket sealant (LG-6)

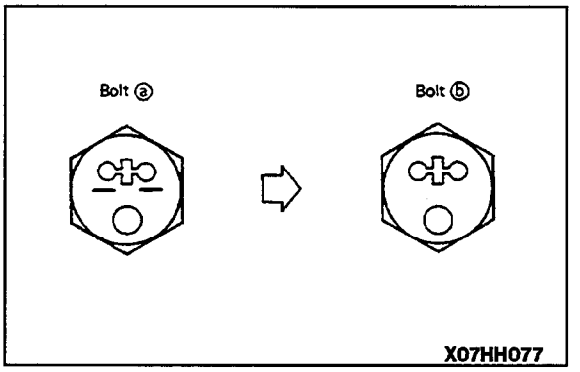


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2) Tighten bolts to specified initial torque.
   Mount bolt: 98 Nm (10 kgm)

3) Set angle of hexagonal head of bolt to standard, then make start marks on cover and socket.
4) Make end mark at specified angle from start mark.
   ★ Make the end mark only on the cover.
   ★ Bolt tightening angle: 120° - 130°
5) Tighten until start mark on socket is aligned with end mark on cover.
   ★ When disassembling or assembling the final drive, replace cover mounting bolt ⓐ with bolt ⓑ, and tighten according to the above procedure.





13. Refilling with oil

Tighten drain plug and add engine oil through oil filler to the specified level.
Final drive case: 8.0 ℓ

★ Carry out the final check of the oil level after installing the final drive assembly to the machine. Check the level again at the specified position.

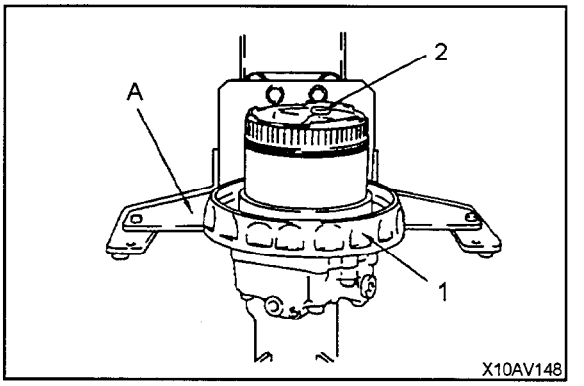
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DISASSEMBLY OF TRAVEL MOTOR ASSEMBLY

1. Travel motor assembly

Set travel motor assembly (1) on tool **A**.

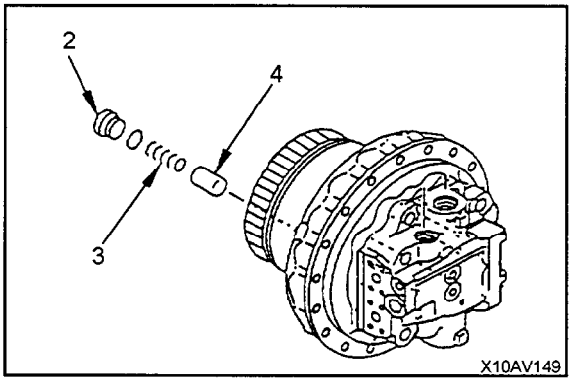
★ Tool **A**: Unit repair stand (790-501-5000)
Bracket (790-901-2110)
Plate (790-901-1350)



2. Piston plug

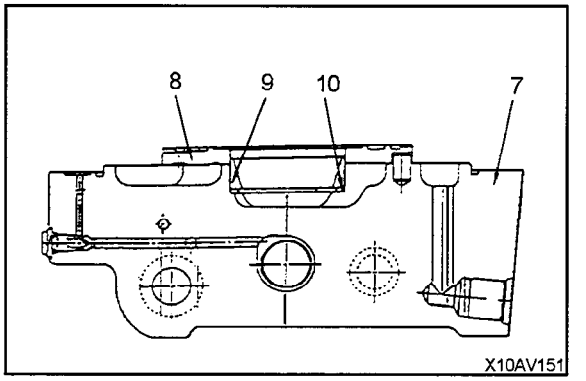
Loosen plug (2) slowly and remove, then remove spring (3) and piston (4).

⚠ There is a force of approx. 294 N (30 kg) applied to the plug, so push the removal tool at a right angle when loosening the plug.

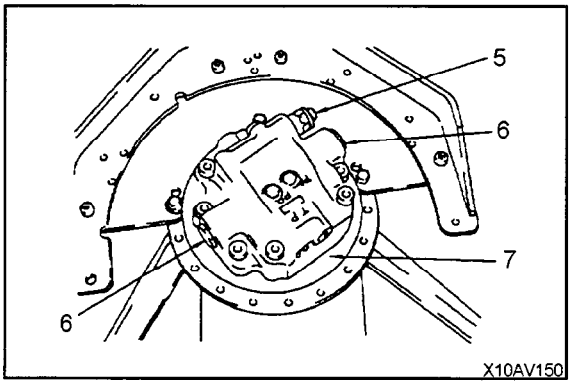


3. End cover assembly and valve plate

1) Turn over tool **A** and remove safety valve assembly (5).
2) Loosen plug (6) slowly.
3) Lift off end cover (7).
   ★ The valve plate may be stuck to the end cover, so be careful not to drop it.

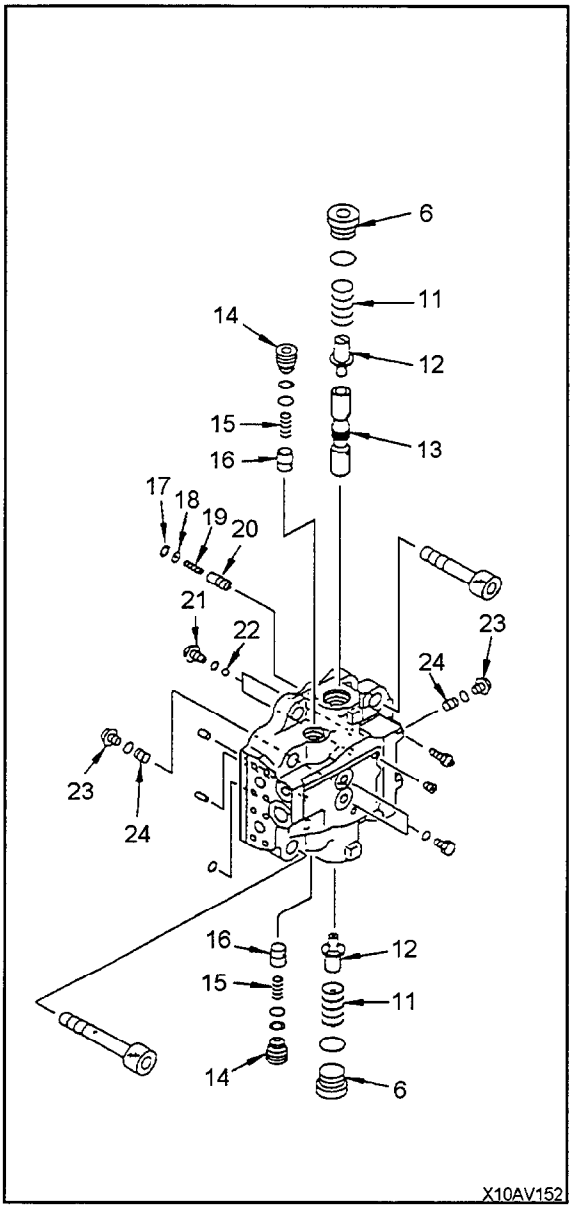


4) Remove valve plate (8).
   ★ When reusing, keep in a safe place and be careful not to scratch or damage the cylinder block contact surface.
5) Remove outer race (9), then remove spacer (10).

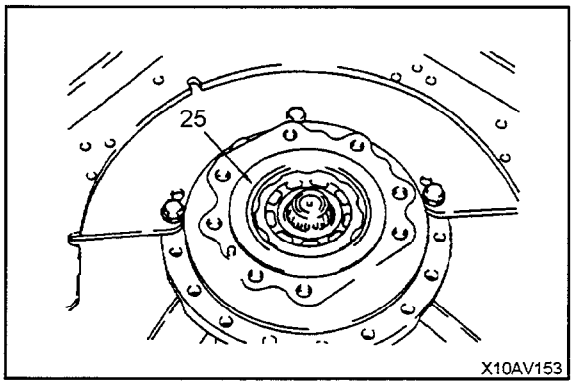


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6) Disassembly of end cover assembly
   i) Loosen plug (6) slowly and remove, then remove spring (11), piston (12) and spool (13).
   ⚠ There is a force of approx. 441 N (45 kg) applied to the plug, so push the removal tool at a right angle when loosening the plug.
   ii) Remove plug (14), then remove spring (15) and valve (16).
   iii) Remove ring (17), then remove seat (18), spring (19), and spool (20).
   iv) Remove plug (21), then remove ball (22).
   v) Remove plug (23), then remove valve (24).



4. Spring
Remove parking brake spring (25).

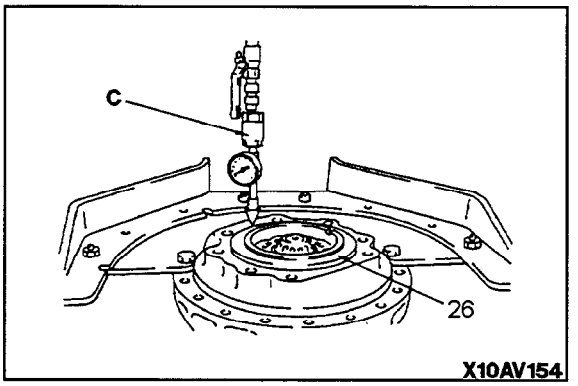


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5. Brake piston

Blow in compressed air with tool **C**, and remove brake piston (26).

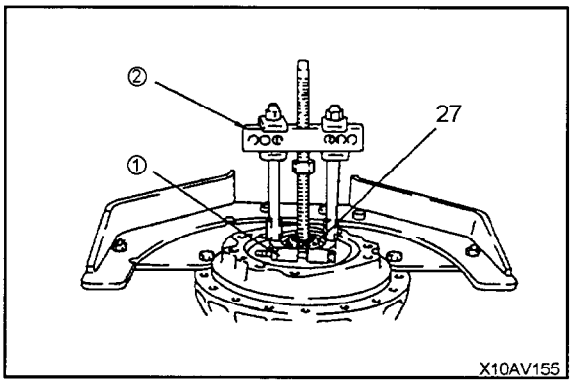
★ Tool **C**: Oil leak tester (799-301-1600)
★ Air pressure: 0.2 MPa (2 kg/cm^2)
★ Be careful that the air pressure is not too high. The brake piston will fly out.



6. Bearing

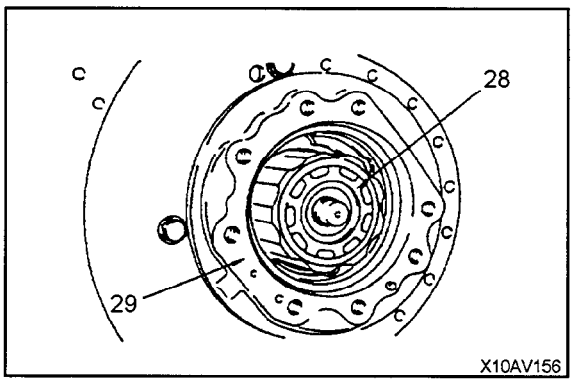
Using bearing race puller ① and gear puller ②, remove bearing (27).

★ Be careful not to apply force to the bearing holder.
★ When reusing the cylinder block, put gasket paper on the valve plate contact surface to protect the surface.
★ Never allow the puller to scratch or damage the cylinder block sliding surface.

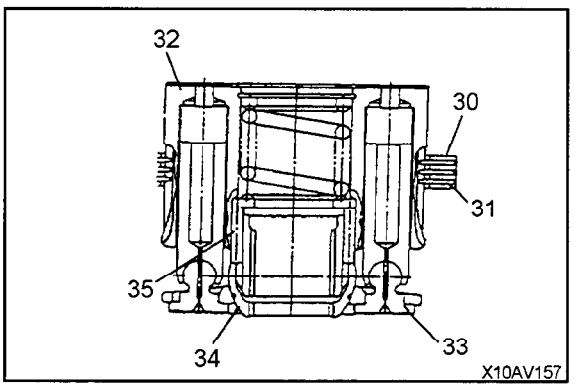


7. Cylinder block and piston assembly

1) Rotate tool **A** 90°, and remove cylinder block and piston assembly (28) from motor case (29).
★ The cylinder block and piston assembly may come off separately, so be careful not to drop them.

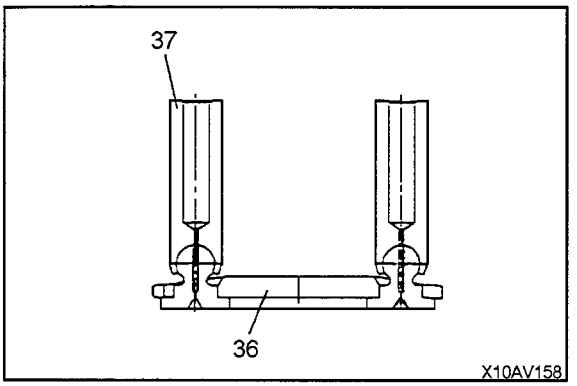


2) Disassemble piston assembly as follows.
i) Remove plate (30) and disc (31).
ii) Pull out piston assembly (33) from cylinder block (32), and remove retainer guide (34) and preload pin (35).
★ When removing the piston assembly from the cylinder block, the preload pin may come out, so be careful not to lose it.

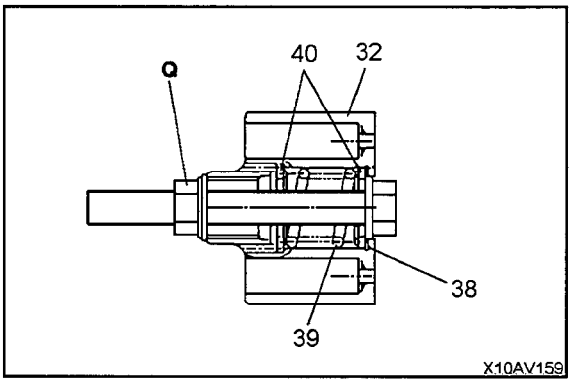


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iii) Pull out piston (37) from retainer shoe (36).

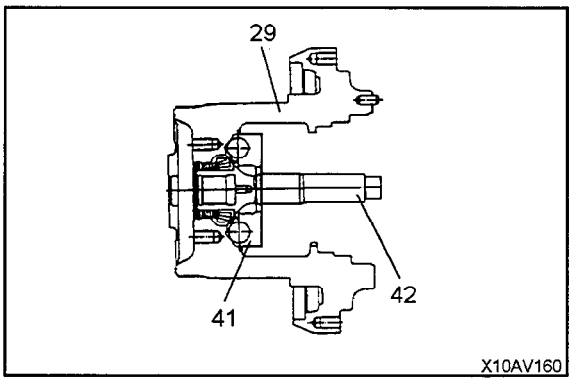


3) Disassemble cylinder block as follows.
   i) Set tool **Q** to cylinder block (32).
      ★ Tool **Q**: Bolt (790-201-3610)
      Washer (796-465-1110)
      Washer (01643-32460)
      Washer (01643-32060) x 2
      Nut (01582-02016)
   ii) Hold bolt of tool **Q** with wrench, tighten nut to compress spring, then remove snap ring (38).
   iii) Loosen nut slowly to relieve tension of spring (39), then remove tool **Q**.
   iv) Remove spacer (40), spring (39), and spacer (40) from cylinder block (32).

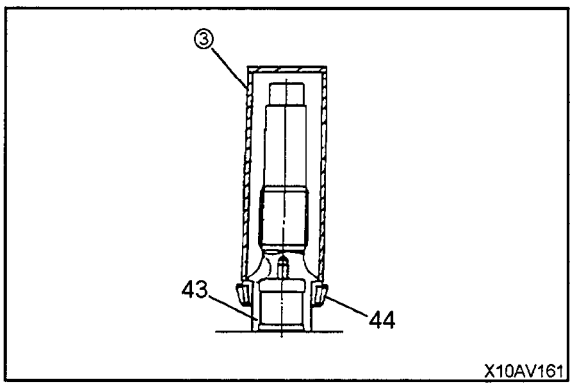


8. Rocker cam and shaft assembly

1) Remove rocker cam (41) together with shaft assembly (42) from motor case (29).



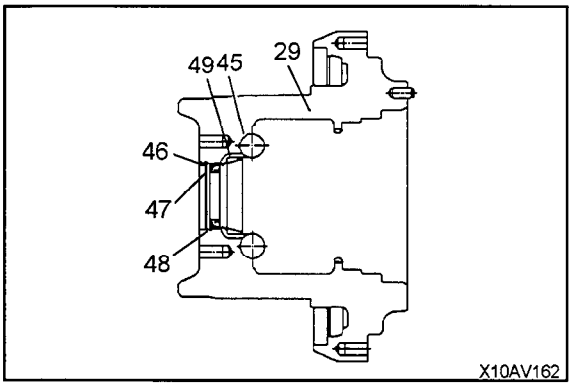
2) Using push tool ③, remove bearing (44) from shaft (43).



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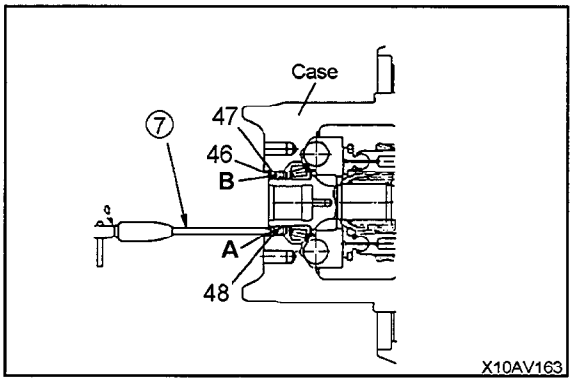
9. Disassembly of motor case

1) Remove ball (45).
2) Rotate tool **A** 90°, then remove snap ring (46) from motor case (29), then remove spacer (47).
3) Remove oil seal (48).
4) Remove outer race (49).



10. If above disassembly operation is not needed and only the oil seal is replaced, replace the oil seal as follows.

1) Remove snap ring (46) and spacer (47).
2) Using bar ⑦ (hit end face with hammer), hit through to core of oil seal (48), then twist to remove.
   - ★ Hit at a point midway between the inside and outside circumference of the oil seal, and twist at two places on opposite sides (**A** and **B** in diagram) to remove.
   - ★ Be careful not to damage the shaft case.



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ASSEMBLY OF TRAVEL MOTOR ASSEMBLY

Clean all parts, remove all burrs, and check for dirt or damage. Coat the rotating and sliding surfaces of all parts with engine oil before installing.

Always check the following parts before assembling.

★ This check is unnecessary if both the cylinder block and valve plate are replacement parts (new parts).

- **Check contact between cylinder block and valve plate (For details, see procedure for checking contact.)**

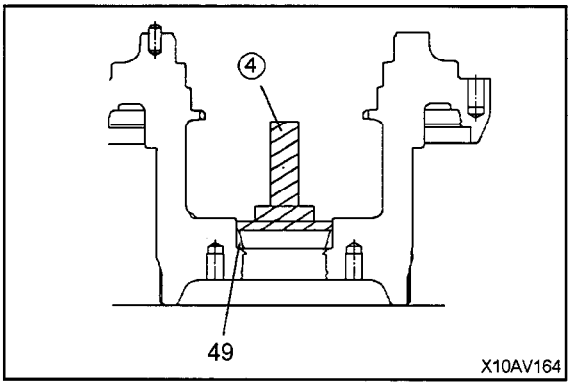
1. Motor case

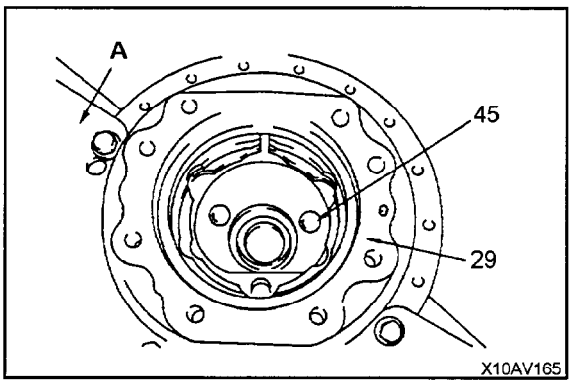
1) Using push tool ④, press fit outer race (49).
2) Set motor case (29) to tool **A**.
3) Install ball (45).

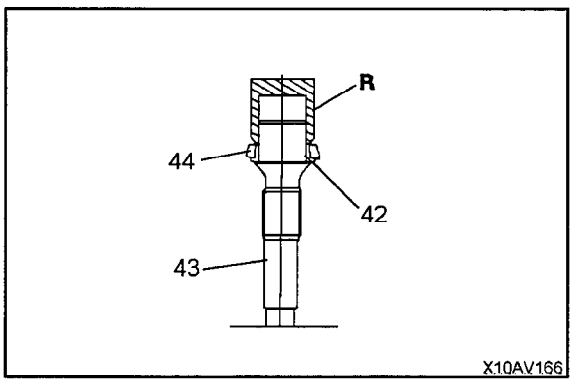
2. Rocker cam and shaft assembly

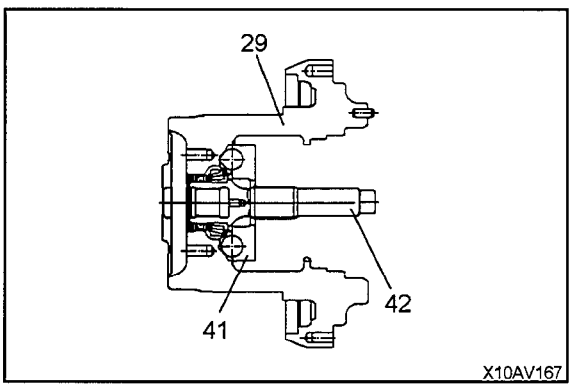
1) Using tool **R**, press fit bearing (44) to shaft (43) to make shaft assembly (42).
★ Tool **R**: Push tool (709-465-1120)
★ When press fitting the bearing, push the end face of the bearing inner race with tool **R** and press fit until it is in tight contact with the end face of the shaft.
★ Press fitting load: 2.39 - 9.69 kN (224 - 988 kg)
Press-fitting surface of bearing: Lubricating oil (EO-10CD)

2) Install rocker cam (41) together with shaft assembly (42) to motor case (29).
★ When installing three rocker cam, check the contact with the ball, and check that the rocker cam moves smoothly without interfering with the motor case or shaft.
★ Coat the ball hole in the rocker cam with g rease (G2-LI). (To prevent it from coming out when the cylinder block and piston assembly are assembled.)





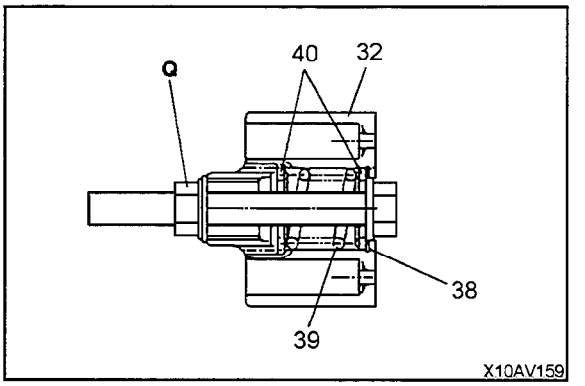




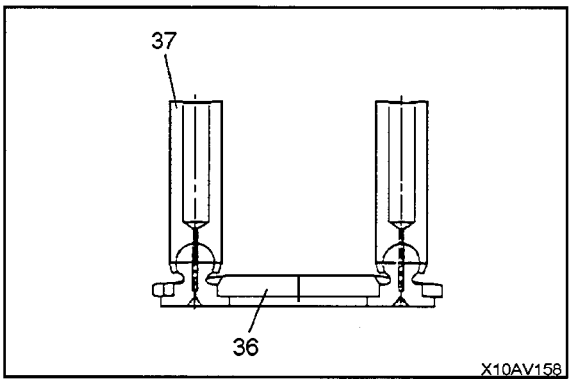
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3. Cylinder block and piston assembly

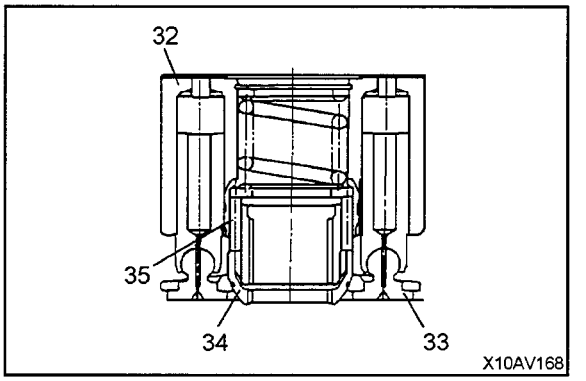
1) Assembly of cylinder block.
   i) Assembly spacer (40), spring (39), and spacer (40) to cylinder block (32).
   ii) Set tool **Q** to cylinder block (32).
   iii) Hold bolt of tool **Q** with wrench, tighten nut to compress spring (39), then install snap ring (38).
      ★ Check that the snap ring is fitting securely in the groove.
   iv) Remove tool **Q**.



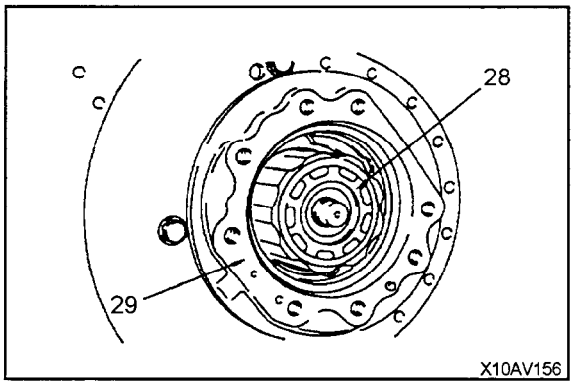
2) Assembly of piston assembly.
   Assemble piston (37) to retainer shoe (36).



3) Assembly of cylinder block and piston assembly.
   i) Assemble 3 preloaded pins (35) to cylinder block (32).
      ★ Coat the preloaded pins with grease (G2-L1) to prevent them from coming out.
   ii) Assemble retainer guide (34) to cylinder block (32), then assemble piston assembly (33) to make cylinder block and piston assembly (28).
      ★ Align the cylinder block and the spline of the retainer guide.



   iii) Install cylinder block and piston assembly (38) to motor case (29).



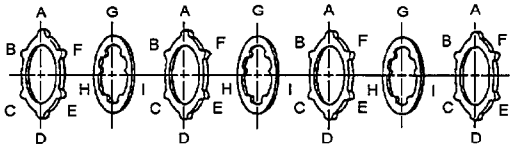
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4. Plate, disc and piston

1) Assemble plate (30) and disc (31) in order.
   - ★ Do not wash the discs in trichlene or drizol, or blow strongly with air.

   Front face of disc: Lubricating oil (EO10-CD)

   - **Method of placing plates and discs on top of each other.**
     i) Align cutout arc teeth areas G, H and I of the discs.
     ii) Protrusions A, B, C, D, E, and F on the outside of the plates can be set at any position in relation to discs G, H, and I.



X10AV172

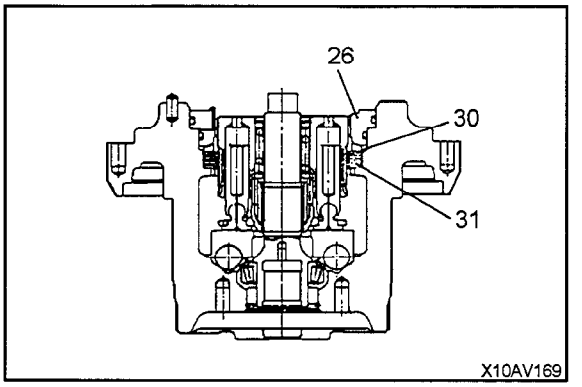
2) Fit O-ring and backup ring, and install brake piston (26).
   - ★ Assemble so that the grove in the brake piston is aligned with the dowel pin in the end cover.
   - ★ Assemble the backup ring in the direction shown in the diagram.

5. Adjusting end play of shaft

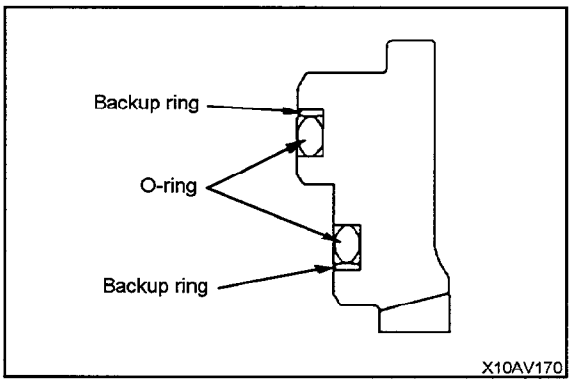
1) Using tool **S** and puller ⑤, press fit bearing (27) to shaft (43).
   - ★ Tool **S**: Push tool (796-460-1120)
   - ★ When press fitting the bearing, push the end face of the bearing inner race with tool **S** and press fit until it is in tight contact with the end face of the shaft.
   - ★ Press fitting load: 2.67 - 10.96 kN (272 - 1118 kg)

   Press fitting surface of bearing: Lubricating oil (EO10-CD)

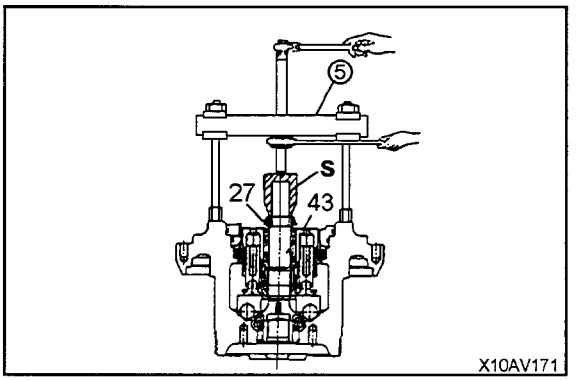
2) Assemble spacer (10) to end cover (7), and install outer race (9).
3) Align with dowel pin and install valve plate (8) to end cover (7).
   - ★ Check that there is no interference with the bearing and pin.
   - ★ Do not hit the valve plate or apply any impact when assembling. (There is danger that this will damage the sliding surface or cause distortion.)



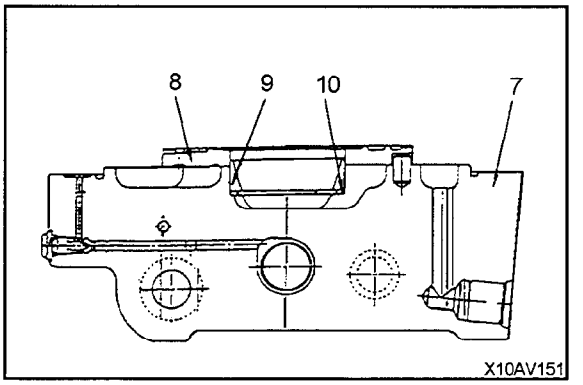
X10AV169



X10AV170



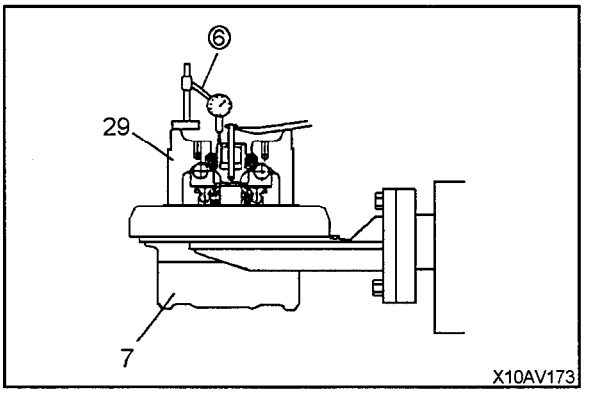
X10AV171



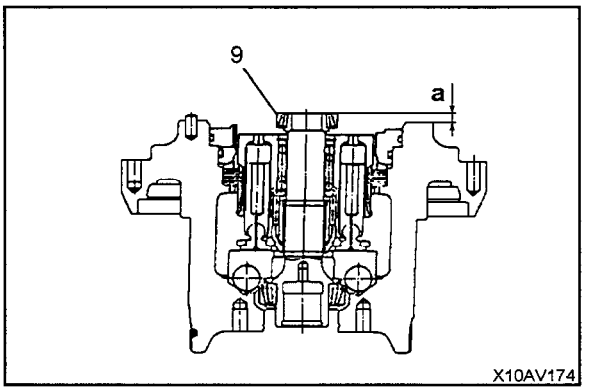
X10AV151

4) Install end cover (7) to motor case (29).
★ Do not install the O-ring and spring of the parking brake.
Mounting bolt: 460.9 ± 29.4 Nm (47 ± 3 kgm)

5) Fit dial gauge ⑥ to motor case (29), move shaft in axial direction, and measure end play between shaft and bearing.
★ End play: 0.05 - 0.25 mm



6) If dimension is not within standard value, adjust again as follows.
i) Remove end cover.
ii) Remove valve plate and outer race.
iii) Set outer race (9) to bearing, then measure dimension **a** between end face of outer race and case, and calculate spacer **b** from the following formula.
b = 12.95 - **a**
iv) Select spacer from table below.

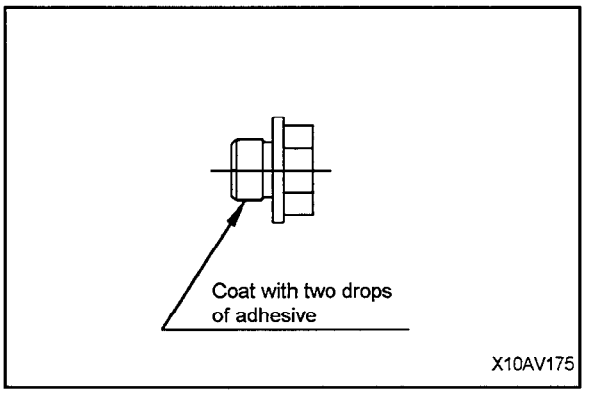


b (mm)	1.70 - 1.79	1.80 - 1.89	1.90 - 1.99	2.00 - 2.09	2.10 - 2.19	2.20 - 2.29	2.30 - 2.39
Spacer to select	708-8H-32220	708-8H-32230	708-8H-32240	708-8H-32250	708-8H-32260	708-8H-32270	708-8H-32280

v) Assemble selected spacer, then assemble again according to assembly Steps 5-2 thru 5-5, and measure end play.
vi) After completion of adjustment, remove end cover, then remove valve plate.

6. End cover assembly

1) Assembly of end cover assembly.
★ Precautions when installing plug.
- Remove all oil and grease from the plug and male thread (end cover), and dry completely.
- When coating with adhesive, coat with two drops (approx. 0.04 g) at a point 2-3 mm from the tip of the thread of the plug.
Plug: Thread tightener (loctite 638/648)
- Do not apply any pressure to the plug for 30 minutes after tightening.



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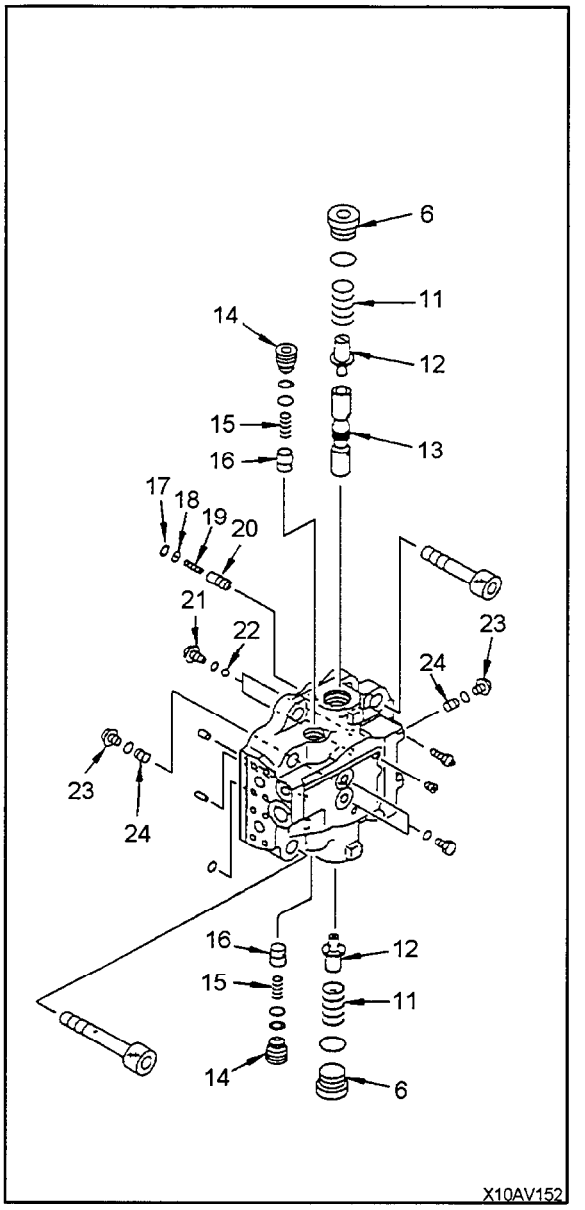
i) Assemble valve (24), then fit O-ring and install plug (23).
   Plug: 23.5 ± 3.9 Nm (2.4 ± 0.4 kgm)

ii) Assemble ball (22), then fit O-ring and install plug (21).
   Plug: 23.5 ± 3.9 Nm (2.4 ± 0.4 kgm)

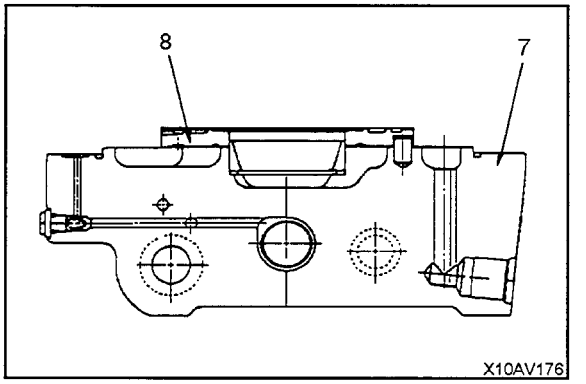
iii) Assemble spool (20), spring (19), and seat (18) in order, then fit O-ring and install ring (17).

iv) Assemble valve (16) and spring (15) in order, then fit backup ring and O-ring and install plug (14).
   Plug: 137.3 ± 14.7 Nm (14 ± 1.5 kgm)

v) Assemble spool (13), piston (12), and spring (11) in order, then fit O-ring and tighten plug (6) temporarily.

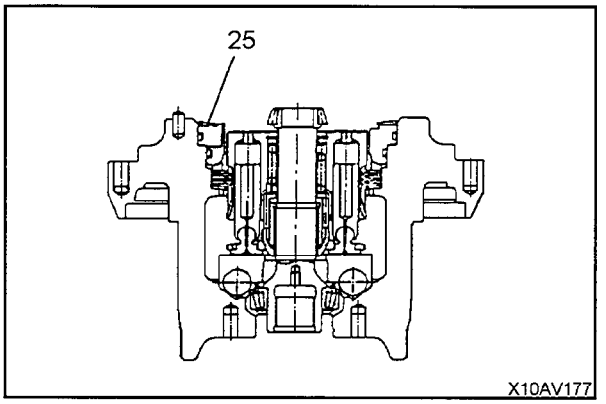


2) Align with dowel pin, and install valve plate (8) to end cover (7).
   ★ Check that there is no interference with the bearing and pin.
   ★ Do not hit the valve plate or apply any impact when assembling. (There is danger that this will damage the sliding surface or cause distortion.)



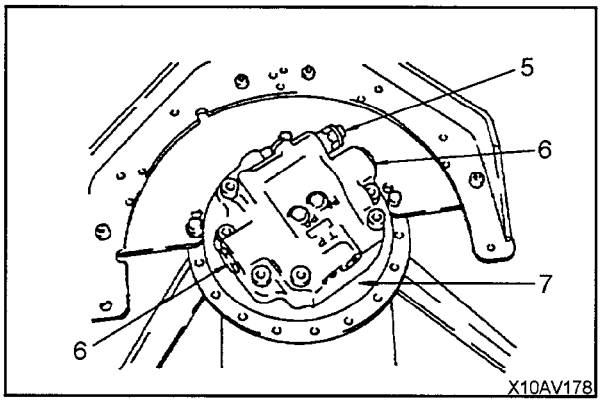
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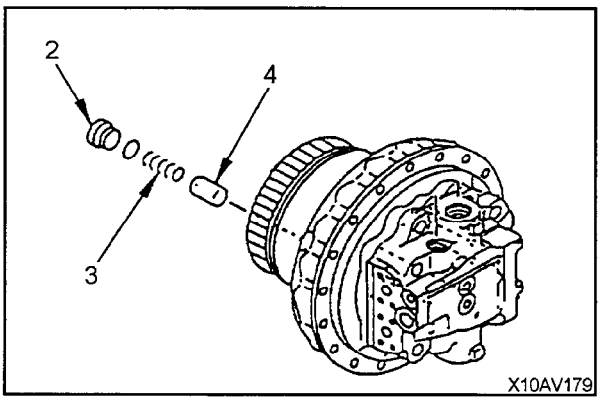
3) Install parking brake spring (25).
4) Fit O-ring, align dowel pin with groove portion of brake piston, and install end cover (7).
   ★ Be extremely careful that the O-ring does not come out or get caught.
   Mating surface of motor case: Gasket sealant (LG-7 or LG-5) (Loctite 572/575)
   Mounting bolt: 460.9 ± 29.4 Nm (47 ± 3 kgm)
5) Tighten plug (6).
   Plug: 419.2 ± 46.6 Nm (42.75 ± 4.75 kgm)
6) Fit backup ring and O-ring, and install safety valve assembly (5).
   Safety valve assembly: 318.7 ± 24.5 Nm (32.5 ± 2.5 kgm)



7. Piston plug

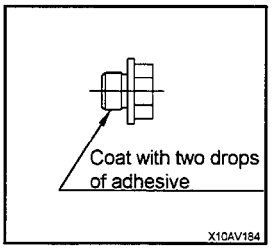
Assemble piston (4) and spring (3), then fit O-ring and install plug (2).
★ Precautions when installing plug.
1) Remove all oil and grease from the plug and male thread (motor case), and dry completely.
2) When coating with adhesive, coat with two drops (approx. 0.04 g) at a point 2-3 mm from the tip of the thread of the plug.
   Plug: Thread tightener (Loctite 638/648)
3) Do not apply any pressure to plug for 30 minutes after tightening.
   Plug: 362.8 ± 39.2 Nm (37 ± 4 kgm)

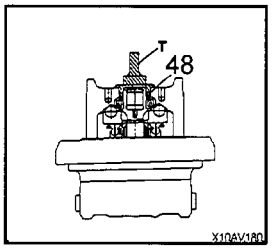




8. Installation of oil seal

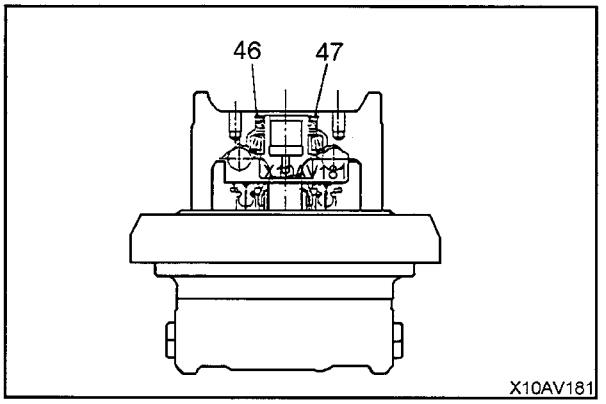
1) Check that there are no burrs or flashes at the corners of the shaft.
2) Using tool **T**, press fit oil seal (48).
   ★ Tool **T**: Push tool (796-465-1130)
   Grip (790-101-5221)
   Bolt (01010-51225)
   ★ Clean the oil seal lip.
   Tip of oil seal (whole circumference) Grease (G2-L1-S)





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3) Assemble spacer (47), and install snap ring (46).



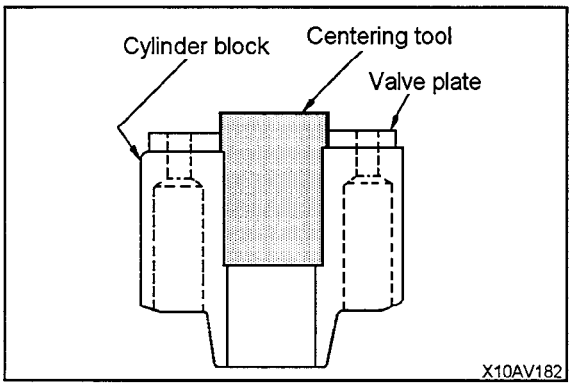
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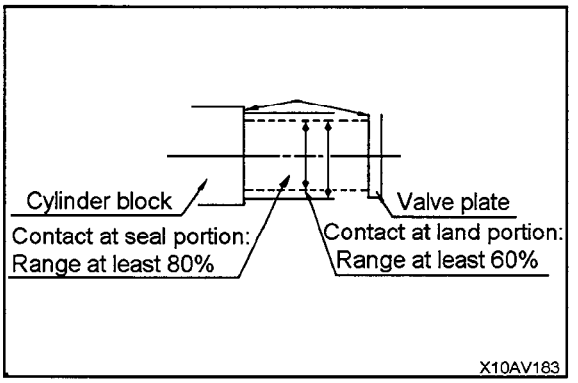
CHECKING CONTACT BETWEEN CYLINDER BLOCK AND VALVE PLATE

★ This check is unnecessary if both the cylinder block and valve plate are replacement parts (new parts).
★ This check applies if one of the parts is a replacement part or a restored part.
★ If the contact is defective, use a surface plate and correct by lapping.

1. Make a centering tool for the cylinder block and valve plate.
   ★ The tool can be made from plastic, bakelite or any other soft material.
2. Remove all oil and grease from the parts to be checked.
   ★ Do not wipe with a cloth.
3. Set the tool in position, then paint the cylinder block with inspection paint.
   ★ Coat thinly with paint.
4. Push the valve plate with a force of 39.2 - 49.0 N (4 - 5 kg) against the cylinder block, turn the valve plate 90°, then turn it back to the original position. Repeat this process two or three times.
5. Remove the valve plate, transfer the contact surface to a tape, and check the contact surface.
   ★ The contact of the plane surface of the valve plate and cylinder block must fulfill the condition below and cover the whole circumference without any break.
      1) The contact at the seal portion (range of Ø 84.4 - Ø 116.5 from the inside) must be at least 80%.
      2) The contact at the land portion (range of Ø 128 - Ø 142) must be at lease 60%.

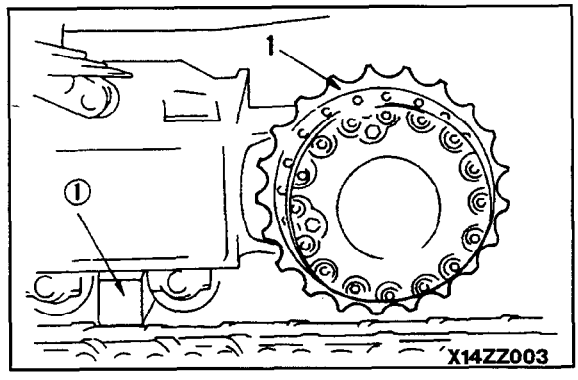
	Seal portion	Land portion
Valve plate	Min. 80%	Min. 60%
Cylinder block	Min. 80%	Min. 60%





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REMOVAL OF SPROCKET



1. Remove track shoe assembly. For details, see REMOVAL OF TRACK SHOE ASSEMBLY.
2. Swing work equipment 90°, then push up chassis with work equipment and set block ① between track frame and track shoe.
3. Lift off sprocket (1).

INSTALLATION OF SPROCKET

- Carry out installation in the reverse order to removal.

※1

Thread of sprocket mounting bolt: Thread tightener (LT-2)

Sprocket mounting bolt:

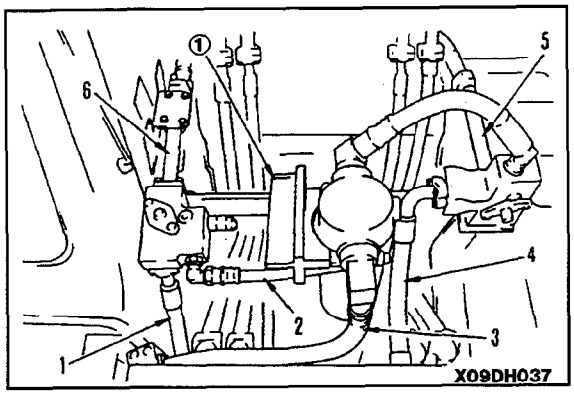
PC200-6, PC200LC-6, PC210LC-6, PC220LC-6	465.8 ± 24.5 Nm (47.5 ± 2.5 kgm)
PC250LC-6	637 ± 49 Nm (65 ± 5 kgm)

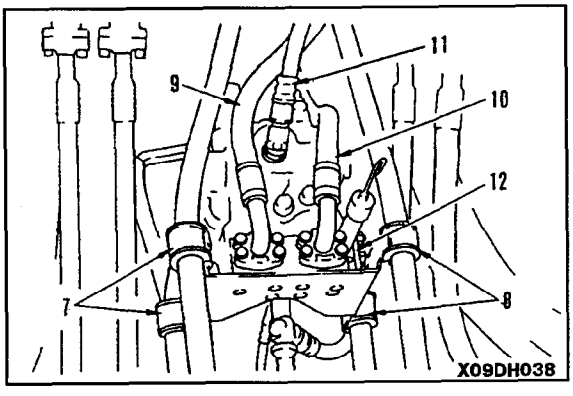
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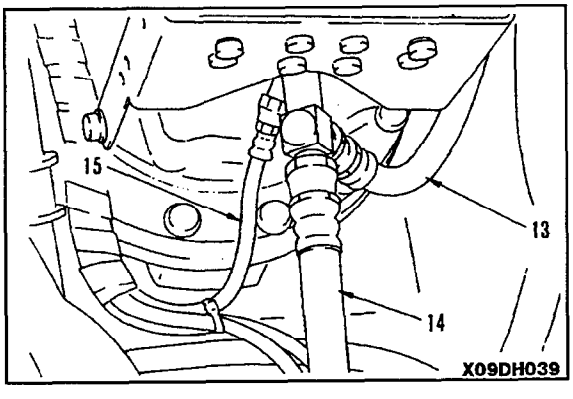
REMOVAL OF SWING MOTOR ASSEMBLY

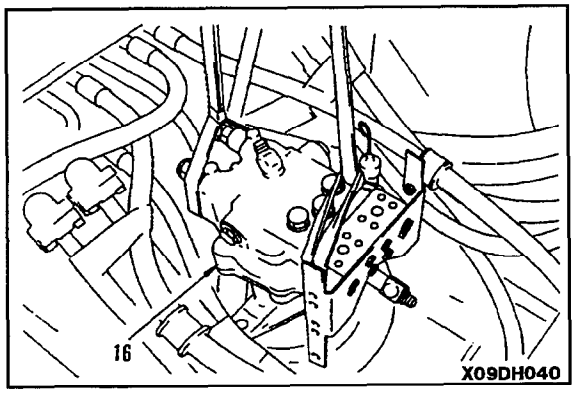
⚠ Lower the work equipment completely to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then set the safety lock lever to the LOCK position.

1. Disconnect hoses (1), (2), (3), and (4), and tubes (5) and (6), then remove filter and bracket assembly ①.
   ★ ① For machines equipped with additional attachment circuit.
   kg Filter, bracket assembly: 95 kg
2. Remove hose clamps (7) and (8).
3. Disconnect swing motor inlet and outlet hoses (9), (10), and (11).
4. Remove bracket (12).
5. Disconnect drain hoses (13) and (14).
6. Disconnect pilot hose (15).
7. Remove swing motor assembly (16).
   kg Swing motor assembly: 65 kg









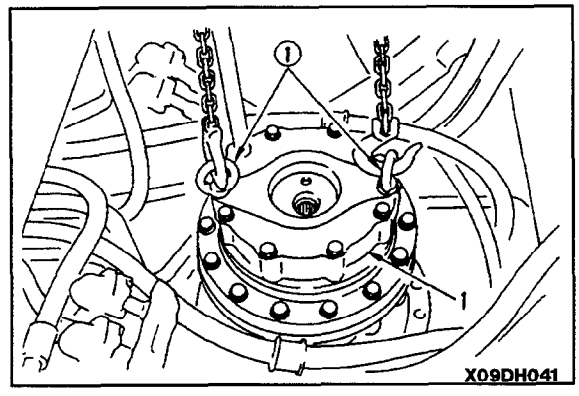
INSTALLATION OF SWING MOTOR ASSEMBLY

- Carry out installation in the reverse order to removal.
- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

★ Bleeding air
  ★ Bleed the air from the swing motor. For details, see TESTING AND ADJUSTING, Bleeding air.

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REMOVAL OF SWING MACHINERY ASSEMBLY



1. Remove swing motor assembly. For details, see REMOVAL OF SWING MOTOR ASSEMBLY.

2. Using eyebolts ①, remove swing machinery assembly (1). ※1
   ★ When removing the swing machinery assembly, lift off slowly and be careful not to damage the hoses.
   kg Swing machinery assembly: 215 kg

INSTALLATION OF SWING MACHINERY ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

kgm Swing machinery mounting bolt: 548.8 ± 49 Nm (56 ± 5 kgm)

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. There check the oil level again.

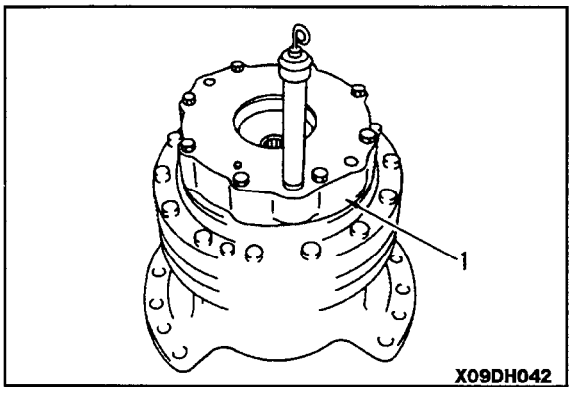
- Bleeding air
  ★ Bleed the air from swing motor. For details, see TESTING AND ADJUSTING, Bleeding air.

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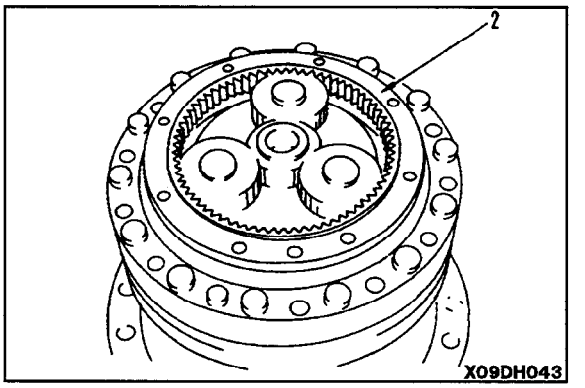
DISASSEMBLY OF SWING MACHINERY ASSEMBLY

1. **Draining oil**
   Remove drain plug and drain oil from swing machinery.
   Swing machinery case: Approx. 6.8 ℓ

2. **Cover**
   Remove mounting bolts, then remove cover (1).

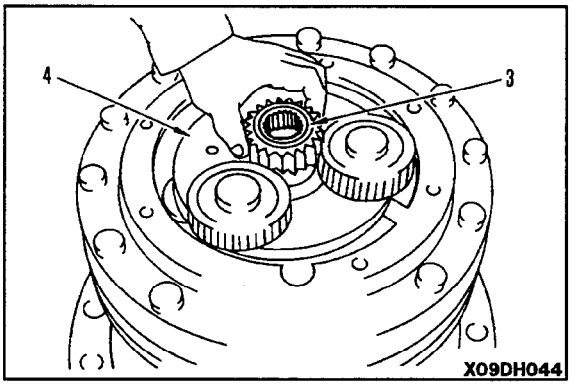


3. **No. 1 ring gear**
   Remove No. 1 ring gear (2).

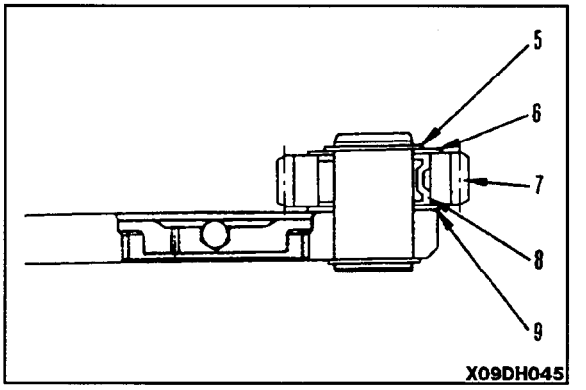


4. **No. 1 sun gear**
   Remove No. 1 sun gear (3).

5. **No. 1 carrier assembly**
   1) Remove No. 1 carrier assembly (4).

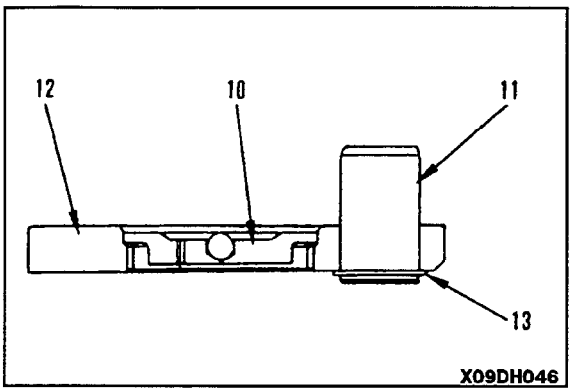


   2) Disassemble No. 1 carrier assembly as follows
      i) Remove snap ring (5), then remove thrust washer (6), gear (7), bearing (8), and thrust washer (9).



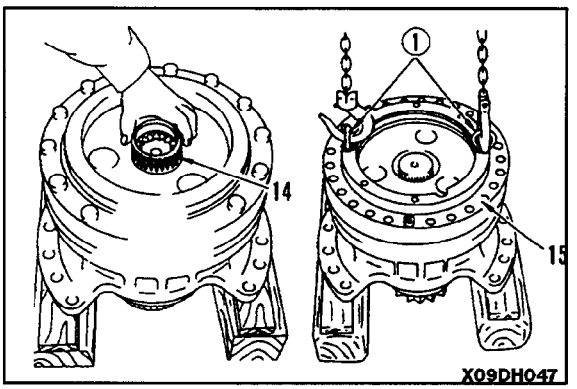
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ii) Remove holder (10).
iii) Remove shaft (11) from carrier (12).
iv) Remove snap ring (13) from shaft.



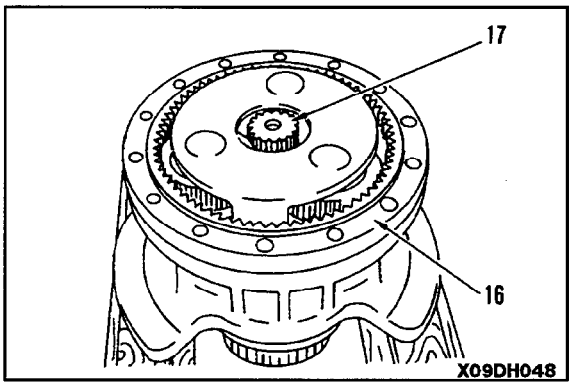
6. Coupling
Remove coupling (14).

7. Cover
Remove mounting bolts, then using eyebolts ①, remove cover (15).



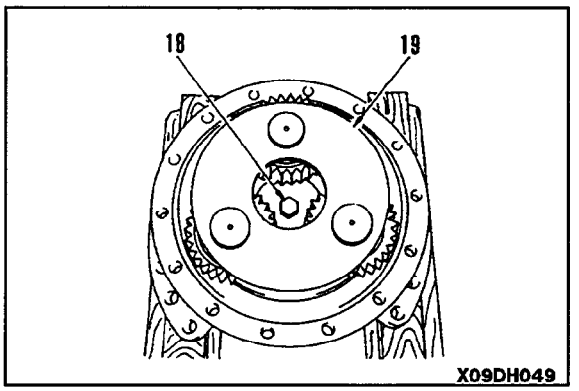
8. No. 2 ring gear
Remove No. 2 ring gear (16).

9. No. 2 sun gear
Remove No. 2 sun gear (17).



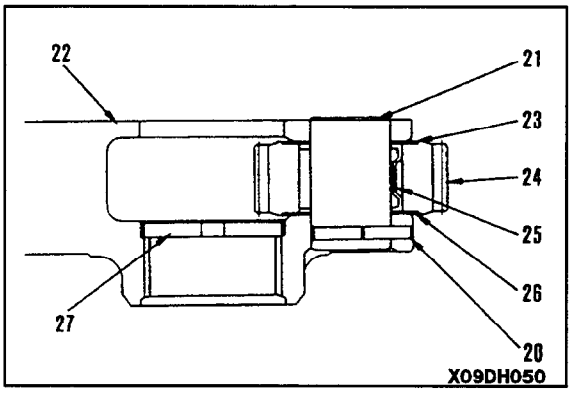
10. Bolt
Remove holder mounting bolt (18).

11. No. 2 carrier assembly
1) Remove No. 2 carrier assembly (19).



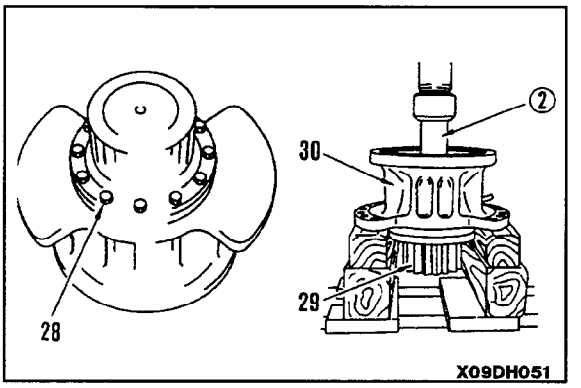
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2) Disassemble No. 2 carrier as follows.
   i) Push in pin (20), and knock out shaft (21) from carrier (22).
   ★ After removing the shaft, remove pin (20).
   ii) Remove thrust washer (23), gear (24), bearing (25), and thrust washer (26).
   iii) Remove plate (27).

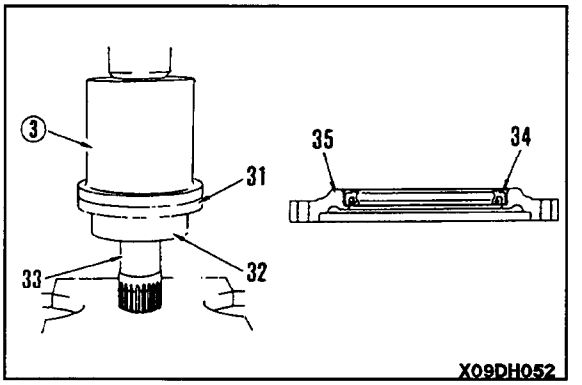


12. Shaft assembly

1) Remove mounting bolts (28).
2) Set shaft and case assembly to press, then using push tool ②, remove shaft assembly (29) from case assembly (30).

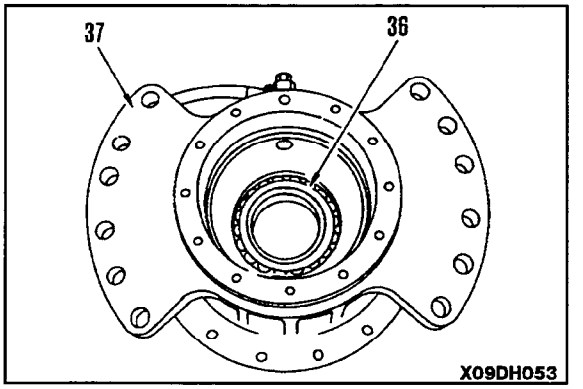


3) Disassemble shaft assembly as follows.
   i) Using push tool ③, remove cover assembly (31) and bearing (32) from shaft (33).
   ii) Remove oil seal (34) from cover (35).



13. Bearing

Using push tool, remove bearing (36) from case (37).



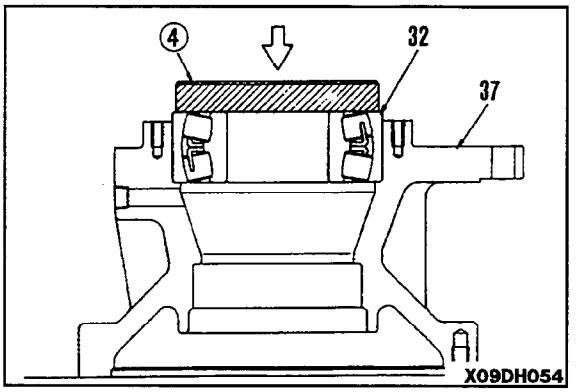
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ASSEMBLY OF SWING MACHINERY ASSEMBLY

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. Bearing

Using push tool ④, press fit bearing (32) to case (37).

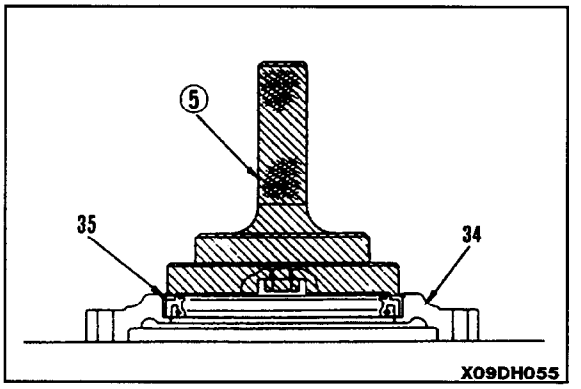


2. Cover assembly

1) Using push tool ⑤, press fit oil seal (334) to cover (35).

Outside circumference of oil seal: Gasket sealant (LG-6)

★ Be careful not to let the gasket sealant (LG-6) get on the oil seal lip when press fitting.

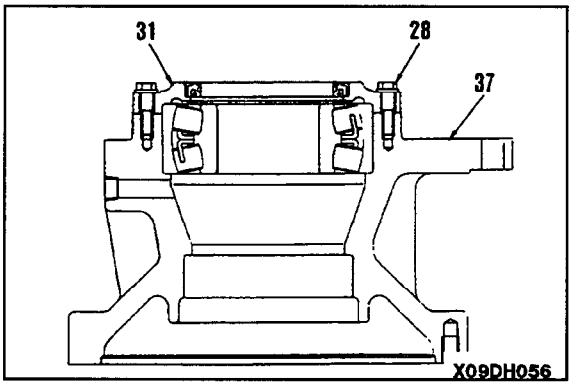


2) Fit cover assembly (31) to case (37), and tighten mounting bolts (28).

Cover mounting surface: Gasket sealant (LG-6)

Mounting bolt: 66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

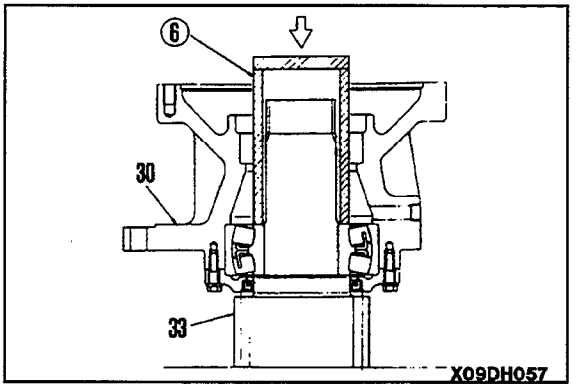
Lip of oil seal: Grease (G2-L1)



3. Case assembly

Set case assembly (30) to shaft (33), then using push tool ⑥, press fit bearing inner race portion.

★ When setting the case assembly to the shaft, be extremely careful not to damage the oil seal.



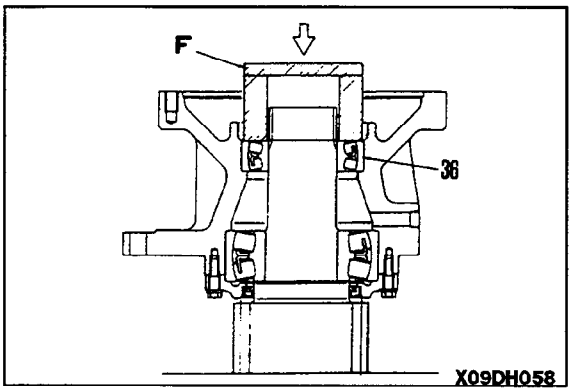
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4. Bearing

Using tool **F**, press fit bearing (36).

★ Press the bearing inner race and outer race at the same time when press fitting. Do not press only the inner race when press fitting.

★ After press fitting the bearing, check that the case rotates smoothly.



5. No. 2 carrier assembly

1) Assemble No. 2 carrier assembly as follows.

★ There are the remains of the caulking when the pin is inserted at the end face of hole **h** at the side of the carrier, so remove the caulked metal from the inside diameter of the hole before starting to assemble.

i) Assemble plate (27) to carrier (22).

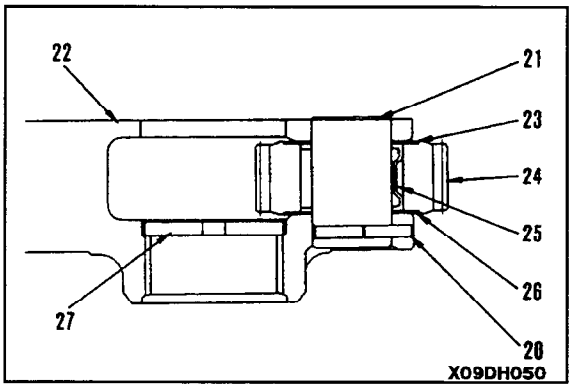
ii) Assemble bearing (25) to gear (24), fit top and bottom thrust washers (23) and (26) and set gear assembly to carrier (22).

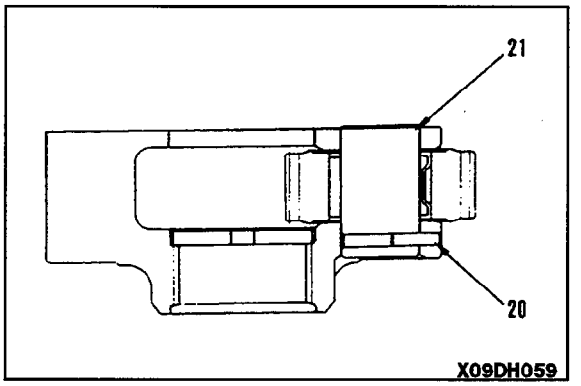
iii) Align position of pin holes of shaft and carrier, then tap with a plastic hammer to install shaft (21).

★ When installing the shaft, rotate the planetary gear. Be careful not to damage the thrust washer.

iv) Insert pin (20).

★ After inserting the pin, caulk the pin portion of the carrier.





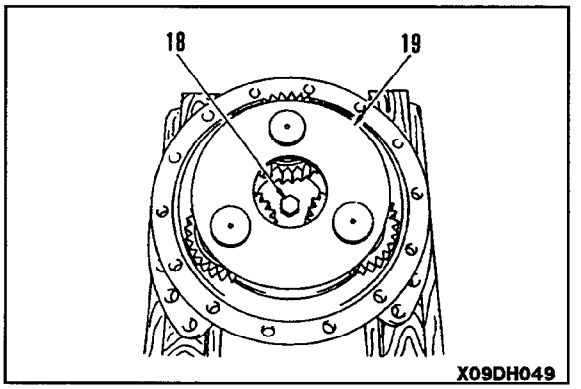
2) Install No. 2 carrier assembly (19).

6. Bolt

Tighten bolt (18).

Thread of mounting bolt: Thread tightener (LT-2)

Mounting bolt: 176.4 ± 19.6 Nm (18 ± 2.0 kgm)



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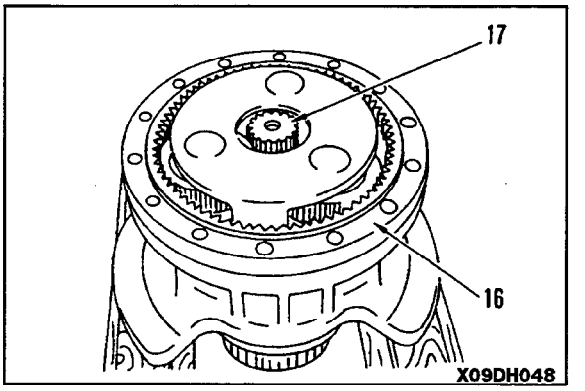
7. No. sun gear

Install No. sun gear (17).

8. No. 2 ring gear

Install No. 2 ring gear (16).

Ring gear mounting surface: Gasket sealant (LG-6)

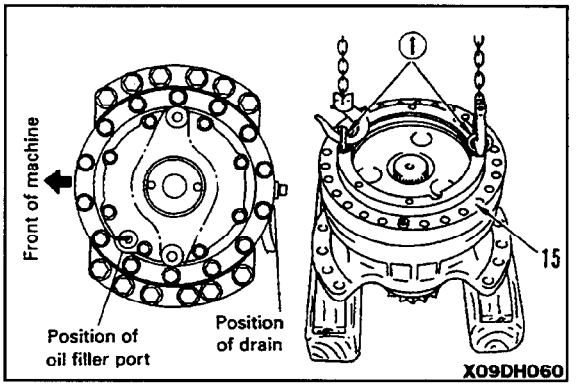


9. Cover

Using eyebolts ①, sling cover (15), align position of holes for oil filler port as shown in diagram, then install.

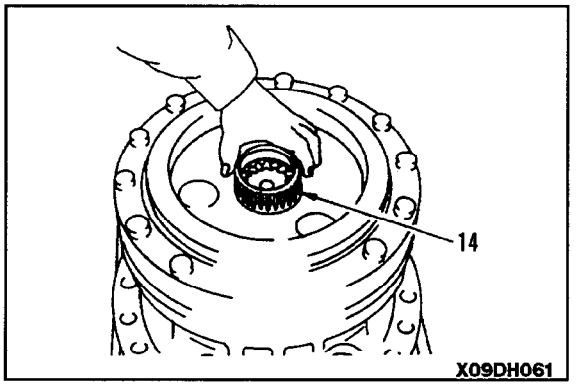
Cover mounting surface: Gasket sealant (LG-6)

Mounting bolt: 276 ± 31.9 Nm (28.25 ± 3.25 kgm)



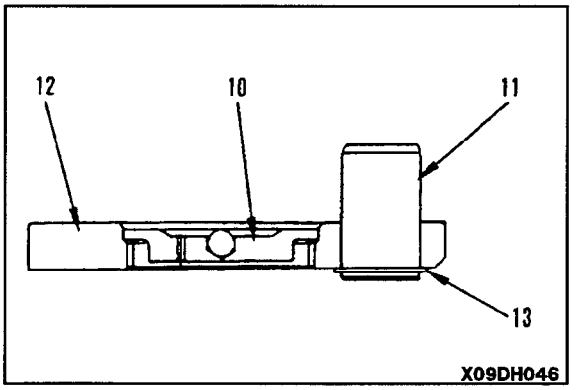
10. Coupling

Install coupling (14).



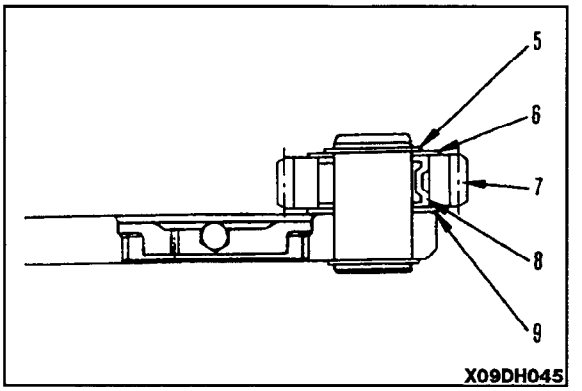
11. No. 1 carrier assembly

1) Assemble No. 1 carrier assembly as follows.
   i) Fit snap ring (13) to shaft (11), and tap with a plastic hammer to install shaft to carrier (12).
   ii) Assemble holder (10).

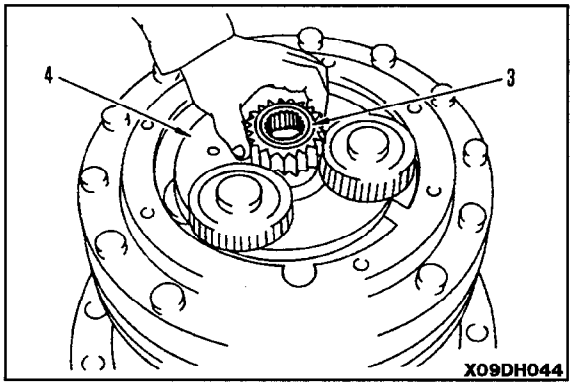


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iii) Assemble thrust washer (9), bearing (8), gear (7), and thrust washer (6), and install snap ring (5).
★ After assembling the carrier assembly, check that gear (7) rotates smoothly.
★ Replace thrust washer (6) with a new part.

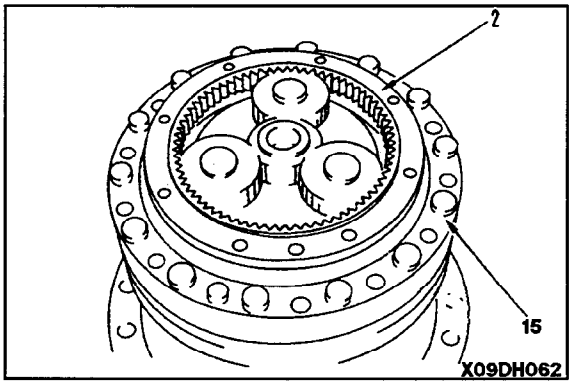


iv) Install No. 1 carrier assembly (4).



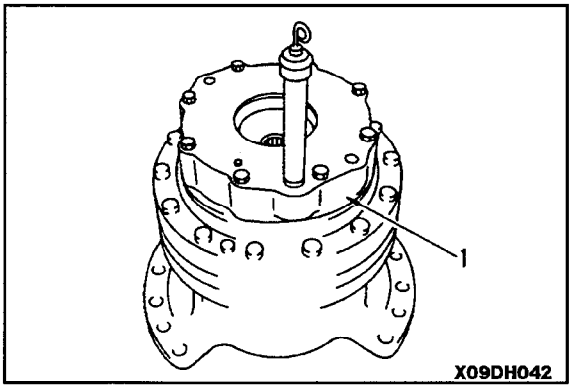
12. No. 1 sun gear
Install No. 1 sun gear (3).

13. No. 1 ring gear
Align position of holes for oil filler port of No. 1 ring gear (2) with cover (15), then install.
Ring gear mounting surface: Gasket sealant (LG-6)



14. Cover
Install cover (1).
Cover mounting surface: Gasket sealant (LG-6)

Mounting bolt: 110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)



15. Refilling with oil
Tighten drain plug and add engine oil through oil filler.
Swing machinery case: Approx 6.8 ℓ

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REMOVAL OF REVOLVING FRAME ASSEMBLY

1. Remove 2 boom cylinder assemblies. For details, see REMOVAL OF BOOM CYLINDER ASSEMBLY.

2. Remove work equipment assembly. For details, see REMOVAL OF WORK EQUIPMENT ASSEMBLY.

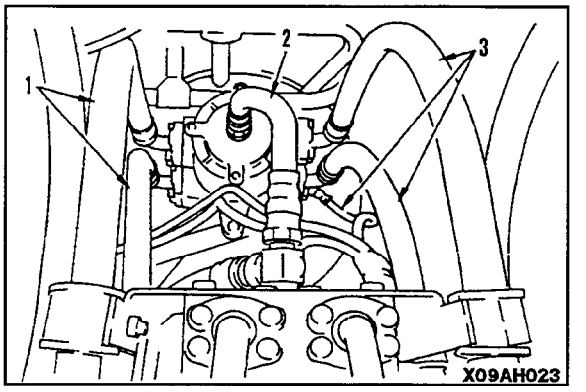
3. Remove counterweight assembly. For details, see REMOVAL OF COUNTERWEIGHT ASSEMBLY.

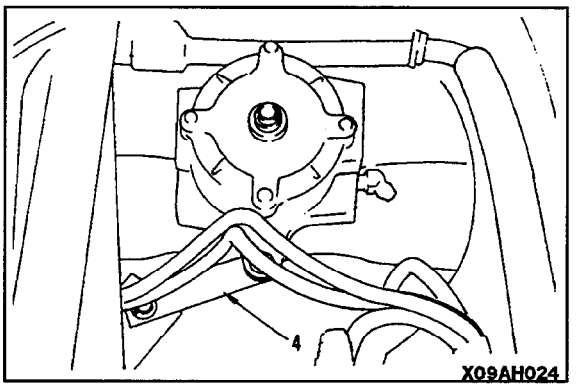
4. Disconnect top mounting hoses (1), (2), and (3) of swivel joint assembly at swivel joint assembly end.

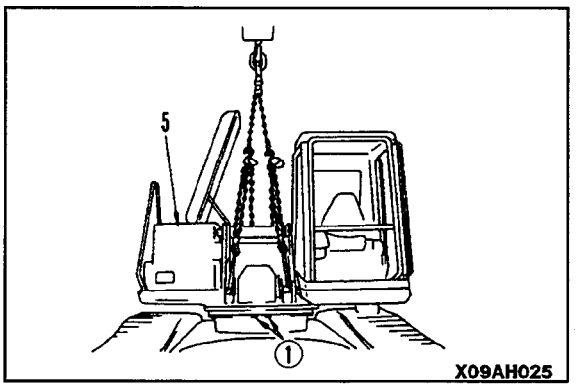
5. Remove stopper link (4).

6. Remove mounting bolts, then lift off revolving frame assembly (5). ※1
   - ★ Leave 2 bolts ① each at the front and rear, use a lever block to adjust the balance of the revolving frame assembly to the front and rear, and left and right, then remove the remaining bolts, and lift off.
   - ⚠ When removing the revolving frame assembly, be careful not to hit the center swivel joint assembly.

   kg Revolving frame assembly: 5,200 kg







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INSTALLATION OF REVOLVING FRAME ASSEMBLY

- Carry out installation in the reverse order to removal.

※1


Mating surface of swing circle: Gasket sealant (LG-1)


Thread of revolving frame mounting bolt: Thread tightener (LT-2)


Revolving frame mounting bolt:

Item / Model	Mounting bolt		Mounting bolt tightening torque
	Size	Qty	Nm(kgm)
PC200-6 PC210-6	22-110	32	804.4 ± 83.4 (82 ± 8.5)
PC220-6 PC250-6	24-150	32	1000.5 ± 103 (102 ± 10.5)

- Refilling with oil (hydraulic tank)
  - ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

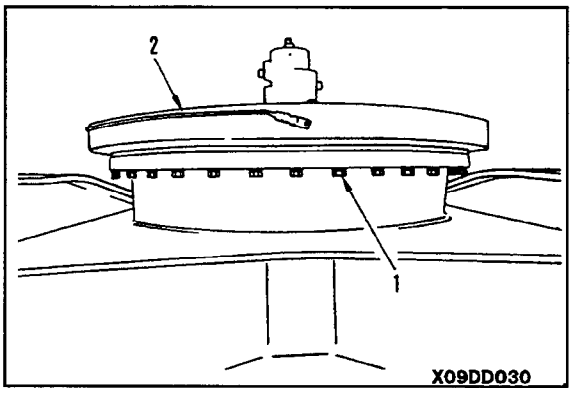
- Bleeding air
  - ★ Bleed the air. For details, see TESTING AND ADJUSTING, Bleeding air.

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REMOVAL OF SWING CIRCLE ASSEMBLY

1. Remove revolving frame assembly. For details, see REMOVAL OF REVOLVING FRAME ASSEMBLY.

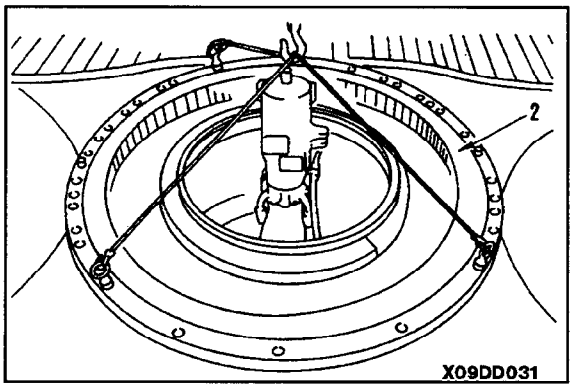
2. Remove swing circle mounting bolts (1), leaving 1 bolt each in front and rear direction ※1
   ★ Swing circle assembly mounting bolts: 36



3. Sling swing circle assembly (2) at three points, then remove remaining mounting bolts.

4. Lift off swing circle assembly (2). ※2
   kg Swing circle assembly:

PC200-6, PC200LC-6 PC210LC-6, PC220LC-6	280 kg
PC250LC-6	716 kg



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INSTALLATION OF SWING CIRCLE ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

Thread of swing circle mounting bolt: Thread tightener (LT-2)

Swing circle mounting bolt: PC200-6, PC200LC-6, PC210LC-6, PC220LC-6

1st pass: Tighten to 191.3 ± 19.6 Nm (19.5 ± 2 kgm)

2nd pass: 1) When using tool **E**.
- Set tool **E** to bolt (1), install clip to other bolt, then tighten bolt 48 ± 5°.

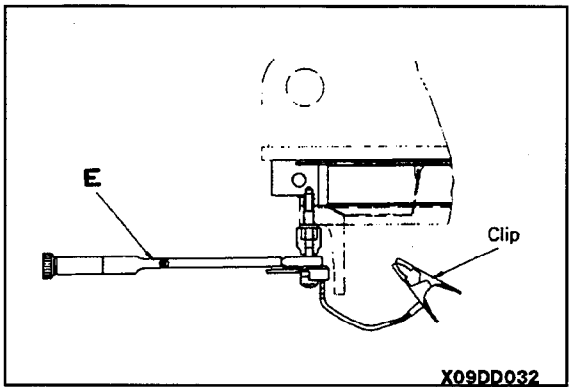
2) When not using tool **E**.
i) Using the angle of the bolt head as the base, make start marks on the swing circle and socket.
ii) Make an end mark at a point (on swing circle) 48 ± 5° from the start mark.
iii) Tighten so that the start mark on the socket is aligned with the end mark on the swing circle at the 48 ± 5° position.

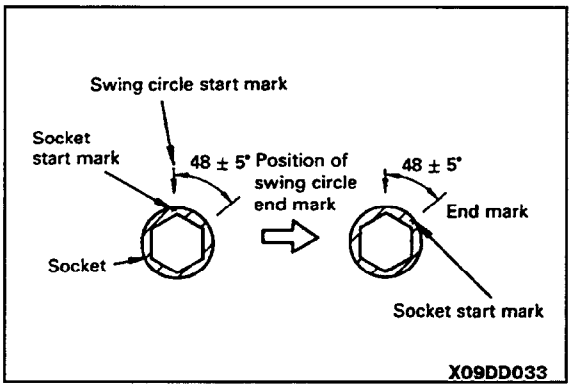
Swing circle mounting bolt: PC250LC-6 926.7 ± 103.0 Nm (94.5 ± 10.5 kgm)

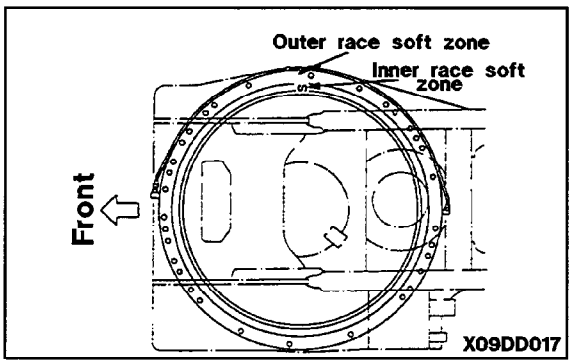
※2

★ Set the soft zone **S** mark on the inside ring of the inner race facing the right side as shown in the diagram, then install to the track frame.

Swing circle: Grease (G2-L1)
PC200-6, PC200LC-6, PC210LC-6, PC220LC-6 = 21 ℓ
PC250LC-6 = 34 ℓ







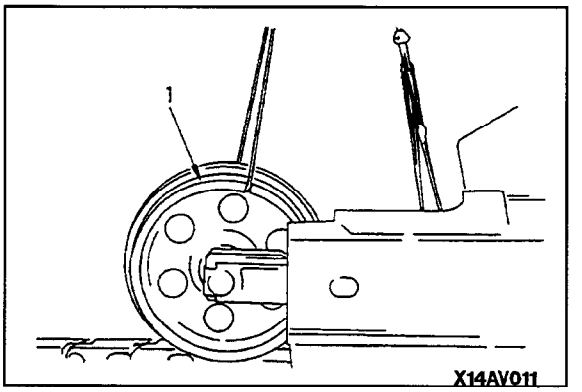
https://truckmanualshub.com/

REMOVAL OF IDLER ● RECOIL SPRING ASSEMBLY

1. Remove track shoe assembly. For details, see REMOVAL OF TRACK SHOE ASSEMBLY.

2. Sling idler and recoil spring assembly (1), and pull out to the front to remove.
   kg Idler ● recoil spring assembly:

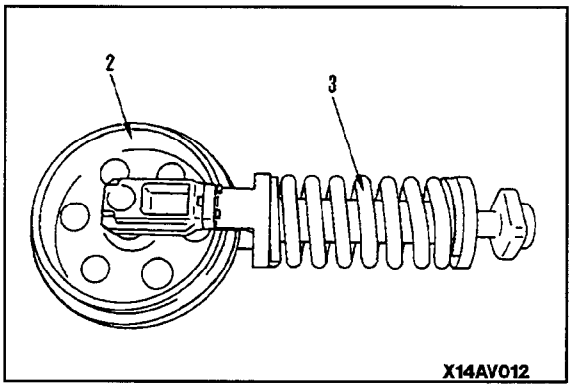
PC200-6, PC200LC-6 PC210LC-6, PC220LC-6	275 kg
PC250LC-6	423 kg



3. Disconnect recoil spring assembly (3) from idler assembly (2). ※1

kg

	Idler	Recoil spring
PC200-6, PC200LC-6 PC210LC-6, PC220LC-6	140 kg	135 kg
PC250LC-6	166 kg	257 kg



INSTALLATION OF IDLER ● RECOIL SPRING ASSEMBLY

- Carry out installation in the reverse order to removal.

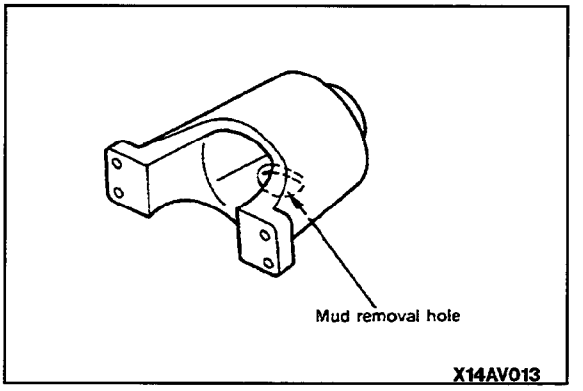
※1

PC200-6, PC200LC-6, PC210LC-6, and PC220LC-6

★ When installing the idler assembly and recoil spring assembly, assemble so that the position of the greasing plug on the idler is on the outside for the right side of the machine and on the inside for the left side of the machine.

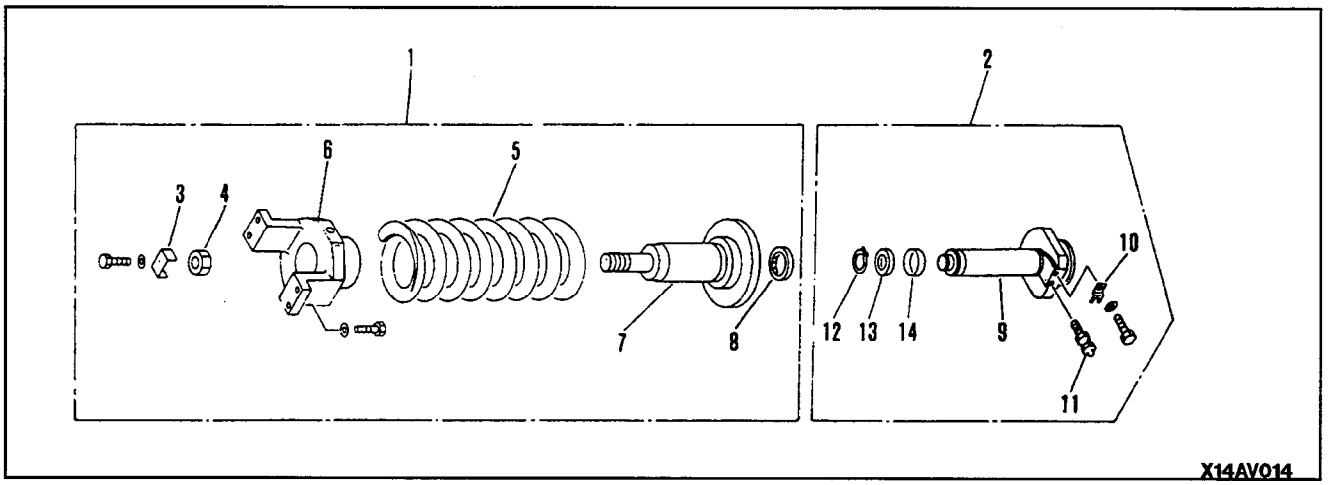
PC250LC-6

★ Install recoil spring assembly (3) to idler assembly (2) so that the mud removal hole in the yoke is at the bottom.



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DISASSEMBLY OF RECOIL SPRING ASSEMBLY



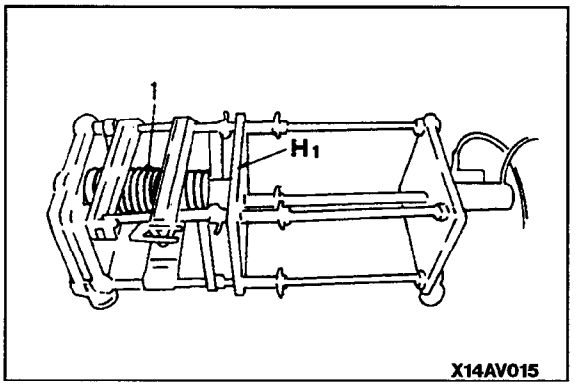
1. Remove piston assembly (2) from recoil spring assembly (1).

2. **Disassembly of recoil spring assembly**
   1) Set recoil spring assembly (1) to tool H_1.
   ⚠ The recoil spring is under large installed load, so be sure to set the tool properly. Failure to do this is dangerous.
   ★ Installed load of spring:

PC200: 108,780 N (11,100 kg).
PC200LC,PC210LC,PC220LC: 126,420 N (12,900 kg)
PC250LC: 173,260 N (17,680 kg)

   2) Apply hydraulic pressure slowly to compress spring, and remove lock plate (3), then remove nut (4).
      ★ Compress the spring to a point where the nut becomes loose.
      ★ Release the hydraulic pressure slowly and release the tension of the spring.
      ★ Free length of spring
      PC200: 558 mm
      PC200LC, PC210LC, PC220LC: 603.5 mm
      PC250LC: 795 mm
   3) Remove yoke (6), cylinder (7), and dust seal (8) from spring (5).

3. **Disassembly of piston assembly**
   1) Remove lock plate (10) from piston (9), then remove valve (11).
   2) Remove snap ring (12), then remove U-packing (13) and ring (14).



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ASSEMBLY OF RECOIL SPRING ASSEMBLY

1. Assembly of piston assembly

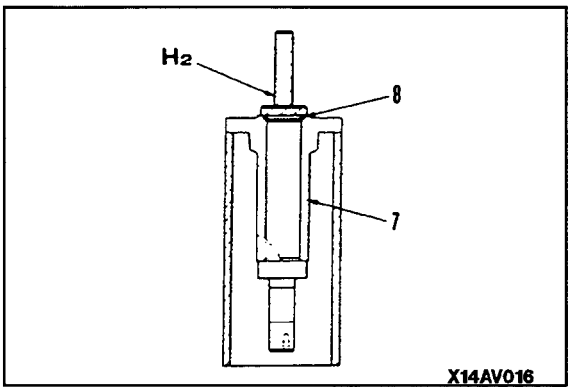
1) Assemble ring (14) and U-packing (13) to piston (9), and secure with snap ring (12).
2) Tighten valve (11) temporarily, and secure with lock plate (10).

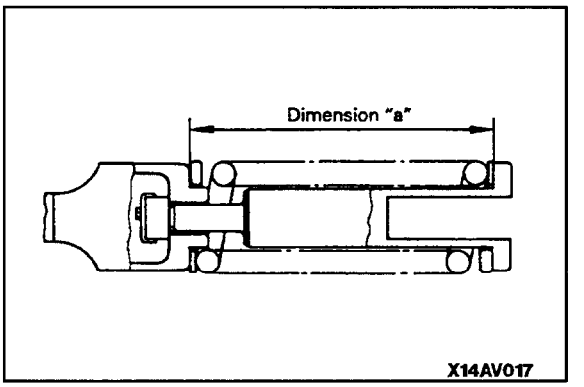
2. Assembly of recoil spring assembly

1) Using tool **H_2**, install dust seal (8) to cylinder (7).
2) Assemble cylinder (7) and yoke (6) to spring (5), and set in tool **H_1**.
   Sliding portion of cylinder: Grease (G2-L1)
3) Apply hydraulic pressure slowly to compress spring, and tighten nut (4) so that installed length of spring is dimension "**a**", then secure with lock plate (3).
   ★ Installed length "**a**" of spring:
   PC200: 437 mm
   PC200LC,PC210LC, PC220LC: 466 mm
   PC250LC: 648 mm
4) Remove recoil spring assembly (1) from tool **H_1**.

3. Assemble piston assembly (2) to recoil spring assembly (1).
   Sliding portion of piston, wear ring: Grease (G2-L1)

   ★ Assemble the cylinder assembly so that the mounting position of the valve is 90° to the side.
   ★ Fill the inside of the cylinder with 300 cc of grease (G2-L1), then bleed air and check that grease comes out of the grease hole.

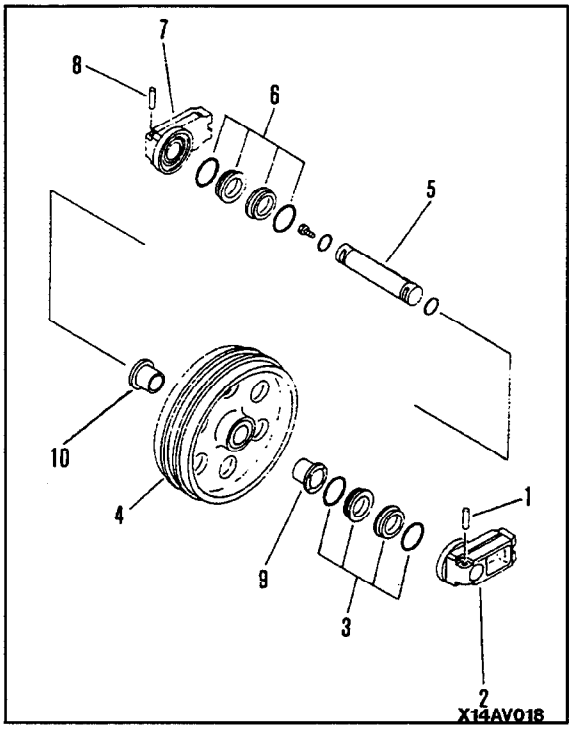




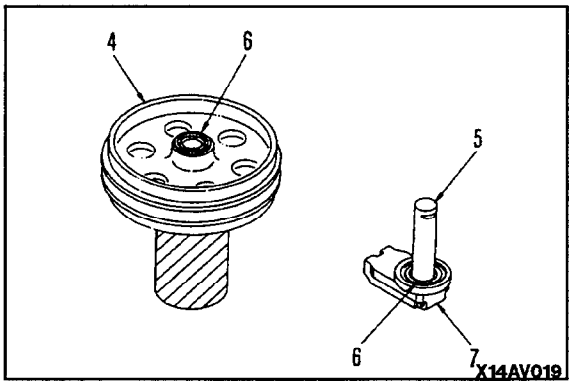
https://truckmanualshub.com/

DISASSEMBLY OF IDLER ASSEMBLY

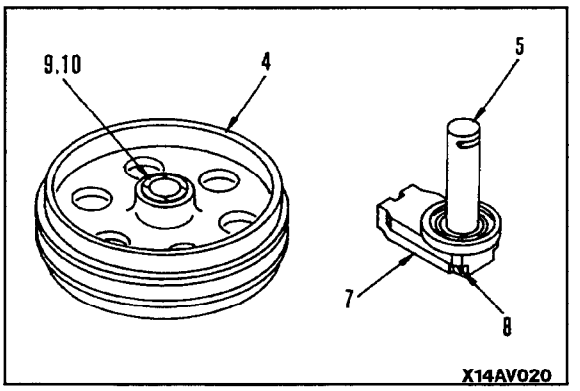
1. Remove dowel pin (1), then remove support (2).
2. Remove floating seal (3) from support (2) and idler (4).
3. Pull out idler (4) from shaft (5) and support (7) assembly.
   ★ It is filled with oil, so drain the oil at this point or lay a cloth to prevent the area from becoming dirty.



4. Remove floating seal (6) on opposite side from idler (4) and shaft (5) and support (7) assembly.



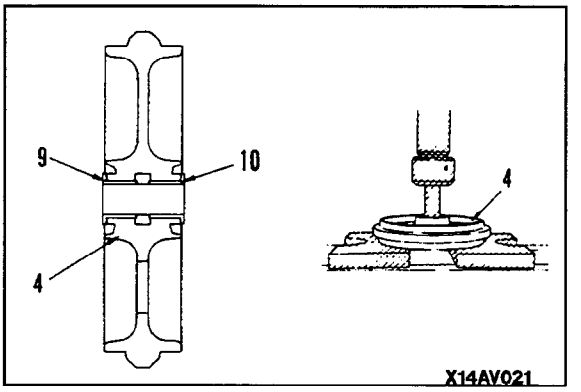
5. Remove dowel pin (8), then remove support (7) from shaft (5).
6. Remove bushings (9) and (10) from idler (4).



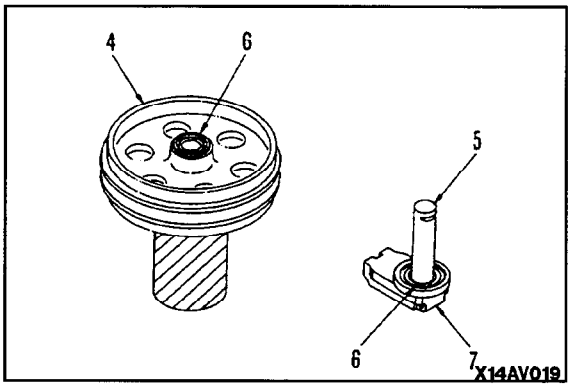
https://truckmanualshub.com/

ASSEMBLY OF IDLER ASSEMBLY

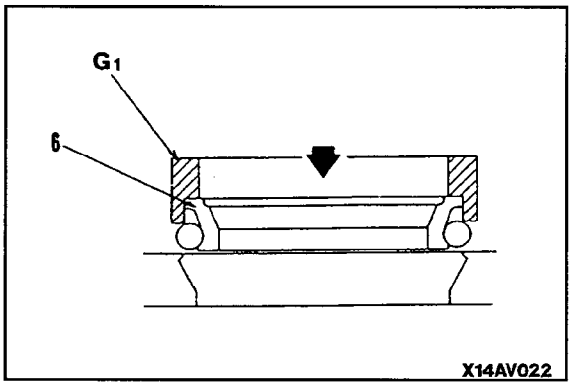
1. Press fit bushings (9) and (10) to idler (4).



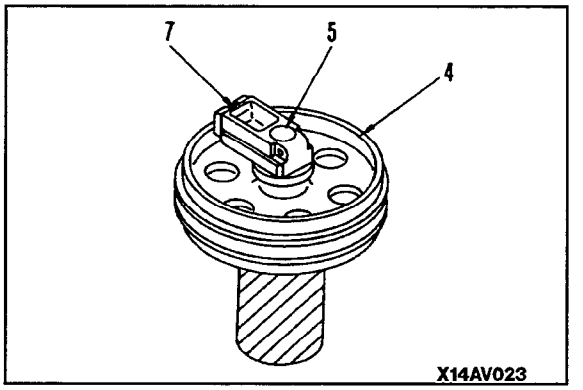
2. Fit O-ring and install support (7) to shaft (5) with dowel pin (8).



3. Using tool **G_1**, install floating seal (6) to idler (4) and shaft (5) and support (7) assembly.
   - ★ Coat the sliding surface of the floating seal with oil, and be careful not to let any dirt or dust get stuck to it.
   - ★ Remove all grease and oil from the contact surface of the O-ring and the floating seal.

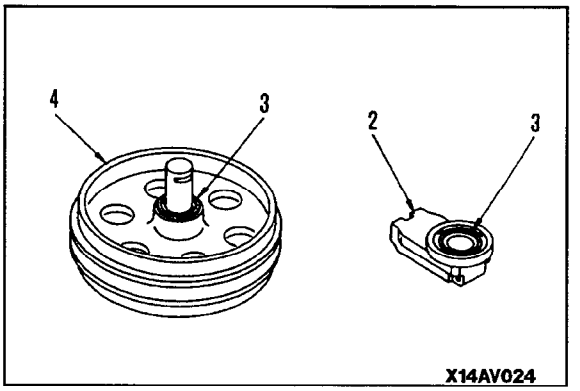


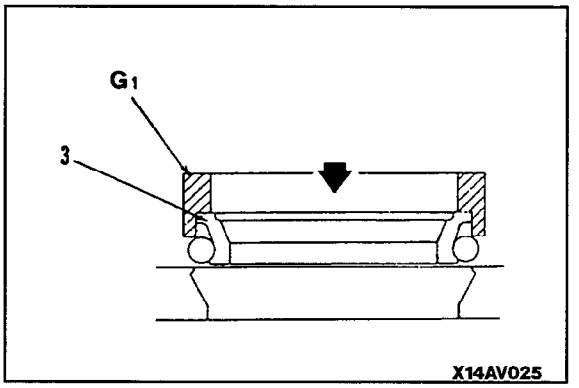
4. Assemble shaft (5) and support (7) assembly to idler (4).



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5. Using tool G_1, install floating seal (3) to idler (4) and support (2).
   - ★ Coat the sliding surface of the floating seal with oil, and be careful not to let any dirt or dust get stuck to it.
   - ★ Remove all grease and oil from the contact surface of the O-ring and the floating seal.



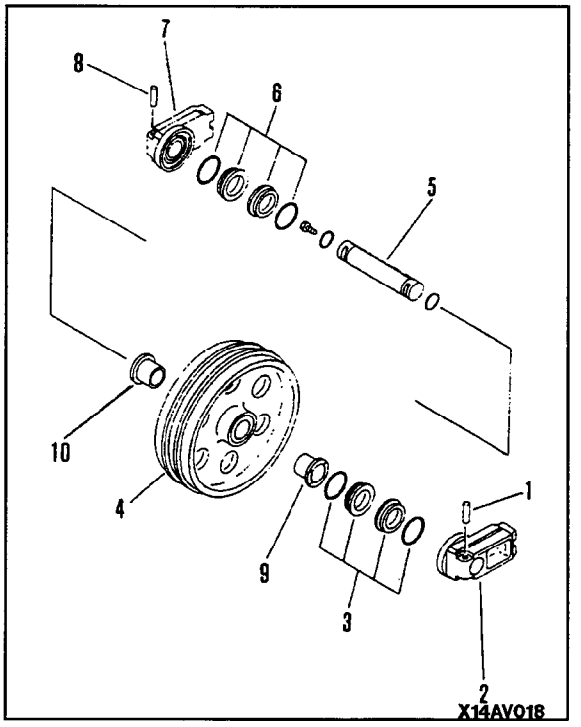


6. Install O-ring, then install support (2) with dowel pin (1).

7. Add oil and tighten plug.

   Oil:
   PC200, PC200LC, PC210LC, PC220LC
   Approx. 80 cc (SAE 30)
   PC250LC
   Approx. 230 cc (SAE 30)

   Plug:
   PC200, PC200LC, PC210LC, PC220LC
   205.9 ± 49 Nm (21 ± 5 kgm)
   PC250LC
   151.9 ± 24.5 Nm (15.5 ± 2.5 kgm)



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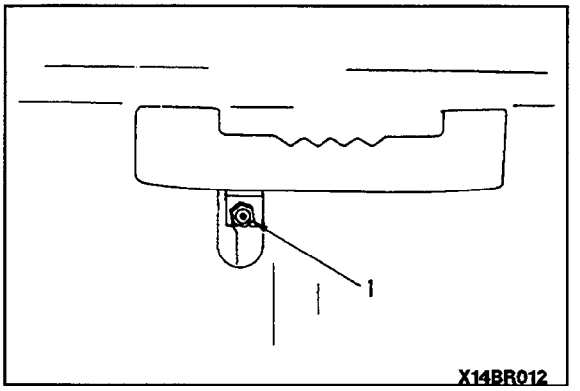
REMOVAL OF TRACK ROLLER ASSEMBLY

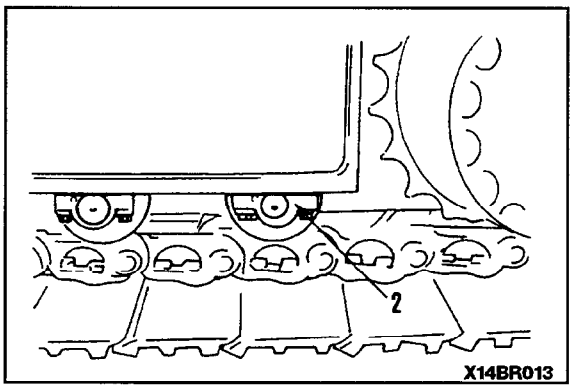
1. Lower work equipment, then loosen lubricator (1), and relieve track tension. ※1
   ⚠ The adjustment cylinder is under extremely high pressure. Never loosen the lubricator more than one turn. If the grease does not come out easily, move the machine backwards and forwards.
2. Remove mounting bolts of track roller, then swing work equipment 90°, jack up machine, and remove track roller assembly (2) towards outside of machine.

※2

kg

Track roller assembly:
PC200, PC200LC, PC210LC, PC220LC
40 kg
PC250LC
52 kg





INSTALLATION OF TRACK ROLLER ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

★ Adjust the track tension. For details, see TESTING AND ADJUSTING, Testing and adjusting track tension.

※2

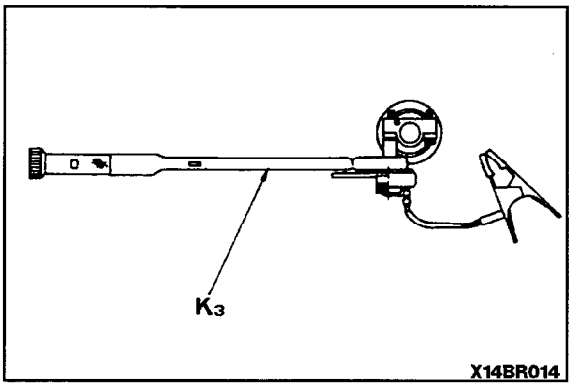
★ Place the plug on the outside of the chassis, and set the track roller assembly in the mounting position.
★ Operate the work equipment levers to lower the machine slowly, then tighten the mounting bolts temporarily.
★ Operate the work equipment levers to lower the machine completely to the ground, then tighten the mounting bolts fully.

kgm

Track roller assembly mounting bolt:
PC200, PC200LC, PC210LC, PC220LC

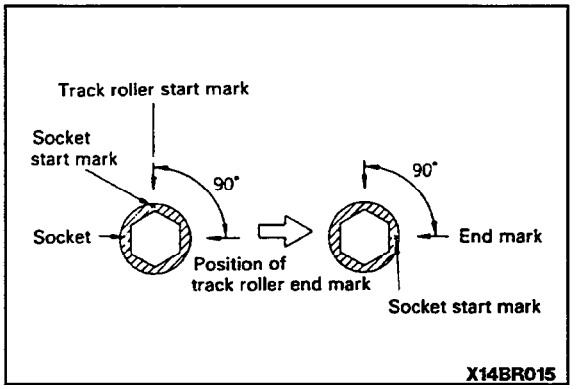
1st pass: Tighten to 196.1 ± 19.6 Nm (20 ± 2 kgm)
2nd pass: 1. When using tool K_3.
- Using an angle tightening wrench, tighten bolt 90 ± 5°.

2. When not using tool K_3.



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1) Using the angle of the bolt head as the base, make start marks on the track roller and socket.
2) Make an end mark at a point 90 ± 5° from the start mark.
3) Tighten so that the start mark on the socket is aligned with the end mark on the track roller.

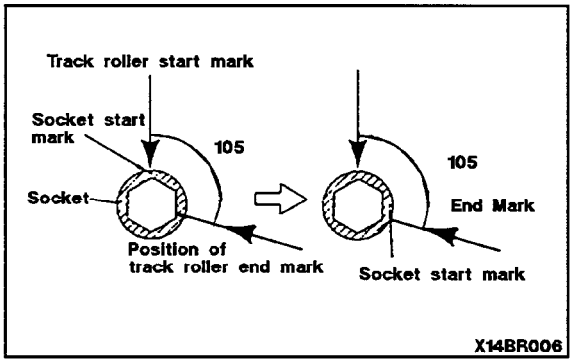


Track roller assembly mounting bolt: PC250LC

1st pass: Tighten to 196.1 ± 19.6 Nm (20 ± 2 kgm)

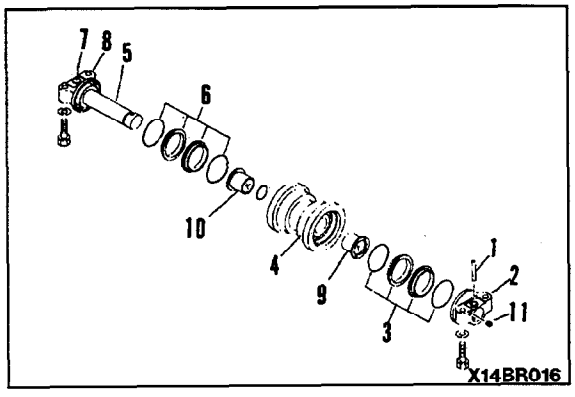
2nd pass:
1. When using tool K_3.
- Using an angle tightening wrench, tighten bolt 105 ± 5°.

2 When not using tool K_3.
1) Using the angle of the bolt head as the base, make start marks on the track roller and socket.
2) Make an end mark at a point 105 ± 5° from the start mark.
3) Tighten so that the start mark on the socket is aligned with the end mark on the track roller.

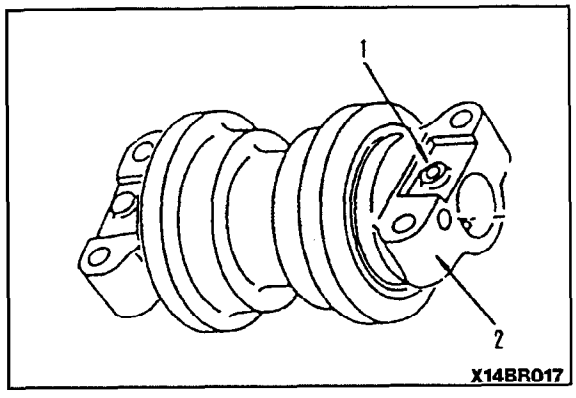


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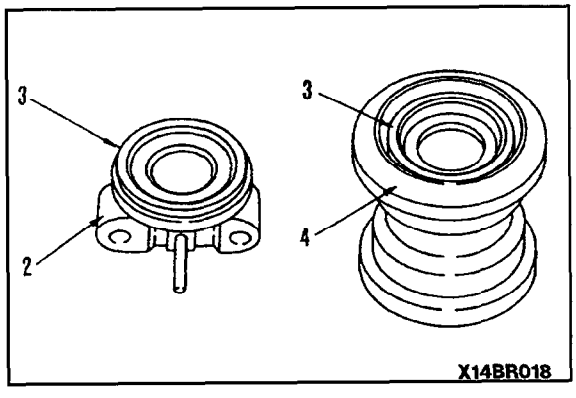
DISASSEMBLY OF TRACK ROLLER ASSEMBLY



1. Remove pin (1), then remove collar (2).

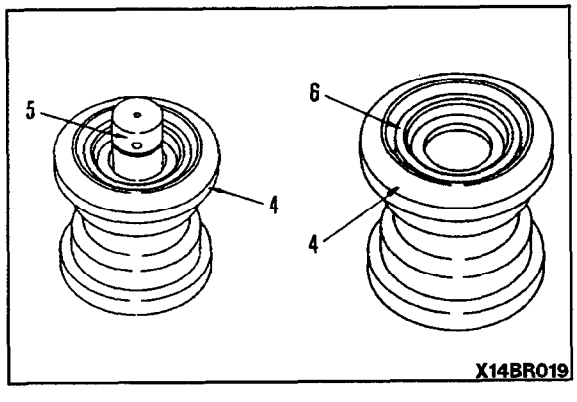


2. Remove floating seal (3) from collar (2) and roller (4).



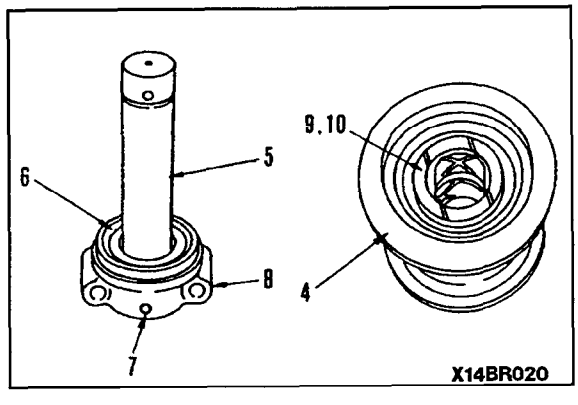
3. Pull out roller (4) from shaft (5).
   ★ It is filled with oil, so drain the oil at this point or lay a cloth to prevent the area from becoming dirty.

4. Remove floating seal (6) on opposite side from roller (4) and shaft (5).



5. Remove pin (7), then remove collar (8) from shaft (5).

6. Remove bushings (9) and (10) from roller (4).



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ASSEMBLY OF TRACK ROLLER ASSEMBLY

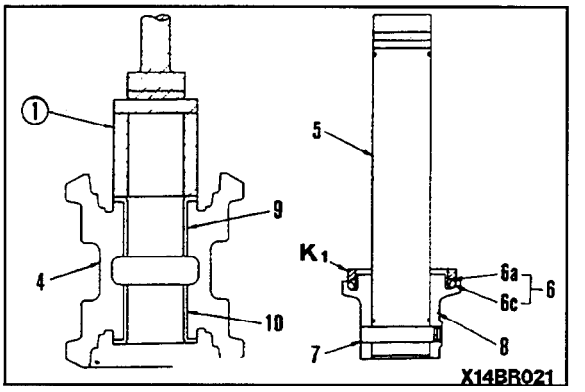
1. Using push tool ①, press fit bushings (9) and (10) to roller (4).

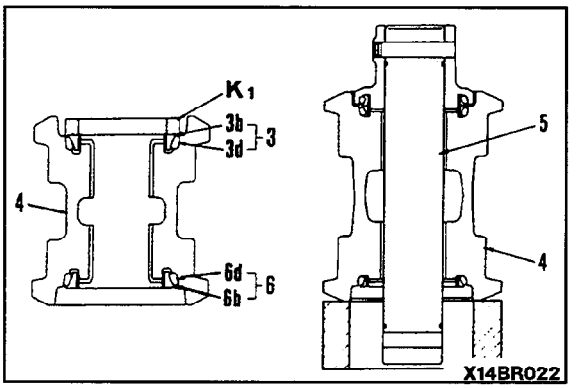
2. Assemble collar (8) to shaft (5), and install pin (7).

3. Using tool **K_1**, install floating seal (6) to shaft (5).
   ★ When assembling the floating seal, clean the contact surface of O-ring (6c) and floating seal (6a), remove all grease and oil, and dry it. Make sure that no dirt or dust sticks to the contact surface of the floating seal.

4. Using tool **K_1**, install floating seals (6) and (3) to the roller (4).
   ★ For details of the precautions when installing floating seals (6b) and (6d), and (3b) and (3d), see the precaution for Step 3.

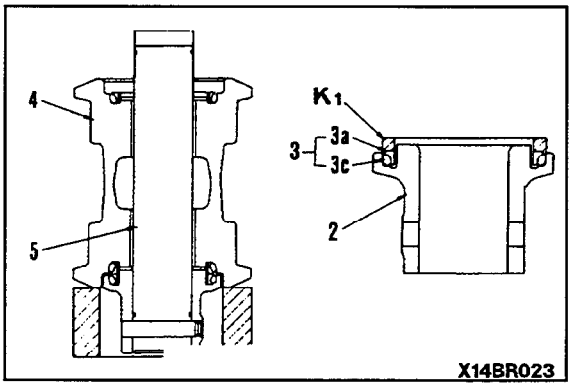
5. Assemble shaft (5) to roller (4).



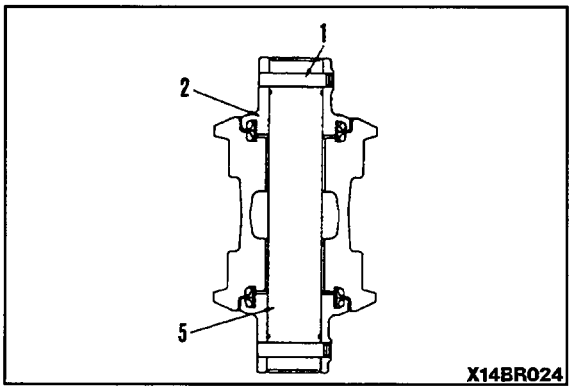


6. Turn over roller (4) and shaft (5) assembly.

7. Using tool **K_1**, install floating seal (3) to collar (2).
   ★ For details of the precautions when installing floating seals (3a) and (3c), see the precautions for Step 3.

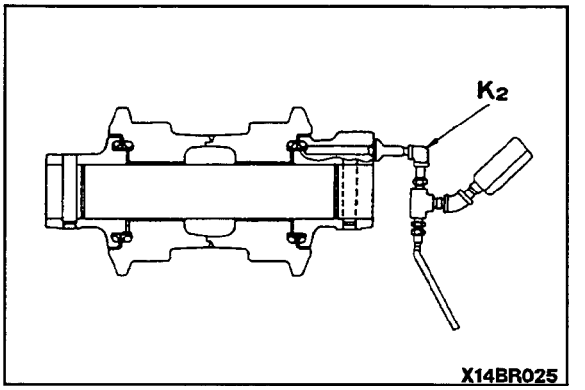


8. Assemble collar (2) to shaft (5), and install pin (1).



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9. Using tool K_2, apply basic pressure to roller oil filler port, and check for leakage of air from seal.
   - ★ Basic pressure: 98 kPa (1 kg/cm^2)
   - ★ Method of checking: The basic pressure shall be maintained for 10 seconds and the indicator of the gauge shall not go down.

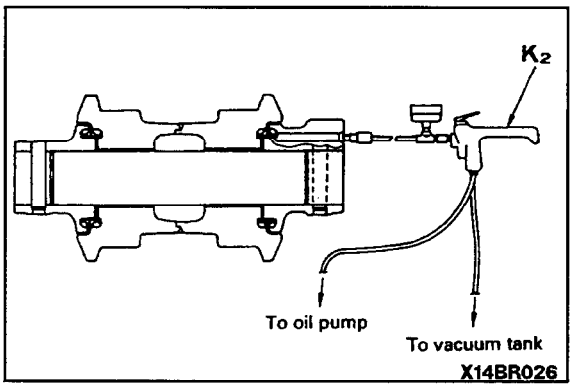


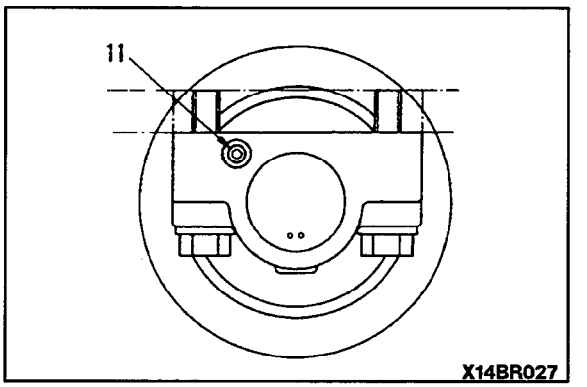
10. Using tool K_2, fill track roller assembly with oil, then tighten plug (11).

   kgm Plug: 14.7 ± 4.9 Nm (1.5 ± 0.5 kgm)

   Track roller oil:

   PC200, PC200LC, PC210LC, PC220LC
   190 - 215 cc (SAE30)
   PC250LC
   250 - 280 cc (SAE30)





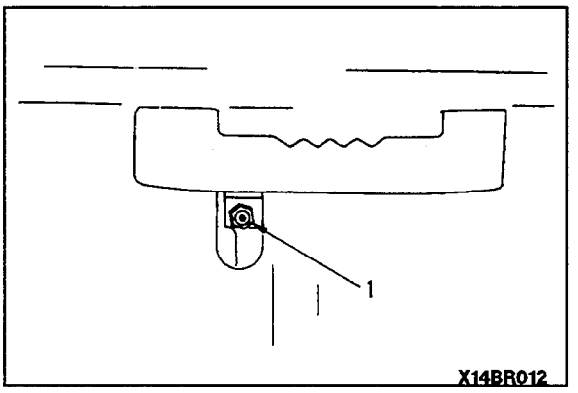
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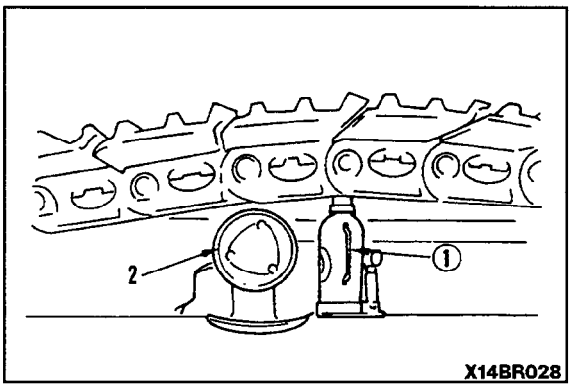
REMOVAL OF CARRIER ROLLER ASSEMBLY

1. Lower work equipment, then loosen lubricator (1), and relieve track tension. ※1
   ⚠ The adjustment cylinder is under extremely high pressure. Never loosen the lubricator more that one turn. If the grease does not come out, move the machine backwards and forwards.

   2. Using hydraulic jack ①, push up the track to a position where carrier roller assembly can be removed, then remove carrier roller assembly (2). ※2

   kg Carrier roller assembly:
   PC200, PC200LC, PC210LC, PC220LC
   21 kg
   PC250LC
   31 kg





INSTALLATION OF CARRIER ROLLER ASSEMBLY

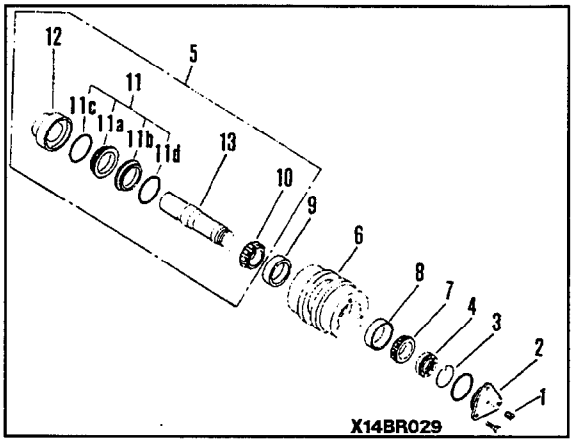
- Carry out installation in the reverse order to removal.

※1
★ Adjust the track tension. For details, see TESTING AND ADJUSTING, Testing and adjusting track tension.

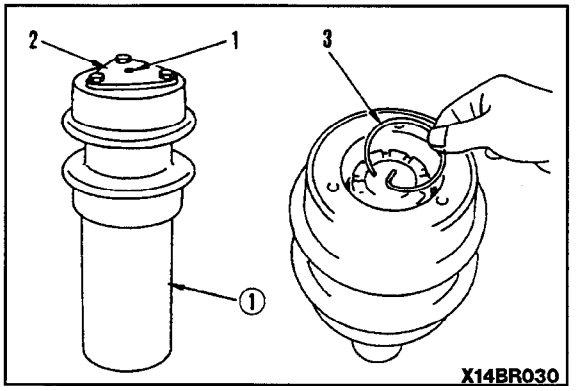
※2
Thread of carrier roller assembly mounting bolt: Thread tightener (LT-2)

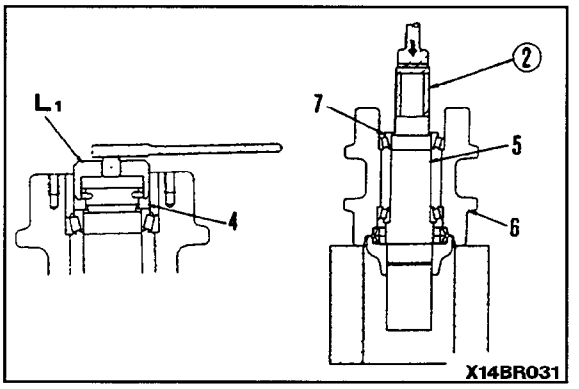
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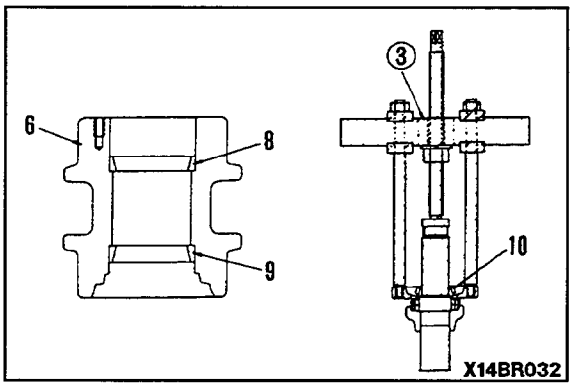
DISASSEMBLY OF CARRIER ROLLER ASSEMBLY

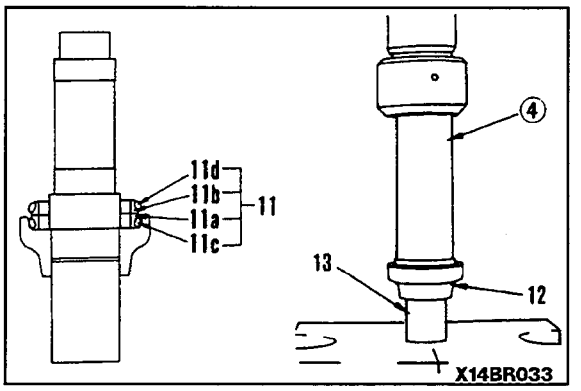


1. Remove plug (1) and drain oil.
   Carrier roller assembly:
   PC200, PC200LC, PC210LC, PC220LC
   230 - 250 cc
   PC250LC
   450 - 500 cc
2. Set carrier roller assembly on stand ①.
3. Remove cover (2).
4. Remove ring (3).
5. Using tool L_1, remove nut (4).
6. Using push tool ②, pull out shaft assembly (5) from roller (6) with press, then remove inner race (7).
7. Remove outer races (8) and (9) from roller (6).
8. **Disassembly of shaft assembly**
   1) Using puller ③, remove inner race (10).
   2) Remove floating seals (11).
   3) Using push tool ④, remove collar (12) from shaft (13).









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ASSEMBLY OF CARRIER ROLLER ASSEMBLY

1. Using push tool ⑤, press fit outer races (8) and (9) to roller (6).

2. **Assembly of shaft assembly**
   1) Using push tool ⑥, press fit collar (12) to shaft (13).
      ★ When press fitting, be careful that there is no scuffing.
      Fitting portion of shaft: SAE30
   2) Using tool L_3, assemble floating seals (11).
      ★ When assembling the floating seal, clean the contact surface of O-ring (11c) and floating seal (11a), remove all grease and oil, and dry it. Make sure that no dirt or dust sticks to the contact surface of the floating seal.
   3) Assemble floating seals (11), then using push tool ⑦, press fit inner race (10).
      ★ For details of the precautions when installing floating seals (11b) and (11d), see the precaution for Step 2).

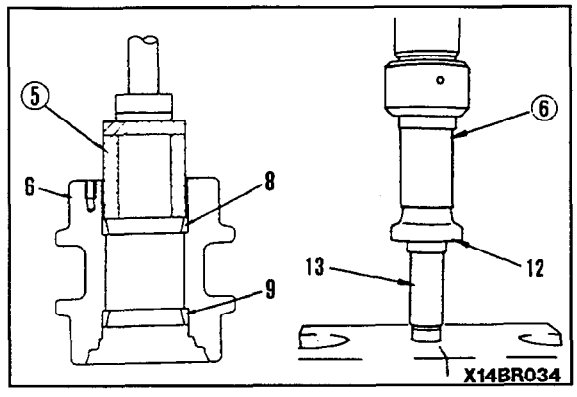
3. Assemble roller (6) to shaft assembly (5).

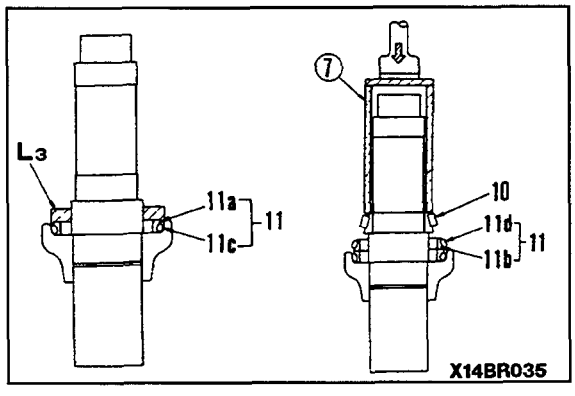
4. Using push tool ⑧, press fit inner race (7).
   ★ When press fitting the bearing, rotate the roller, and press fit to a point where the rotation becomes slightly heavier.

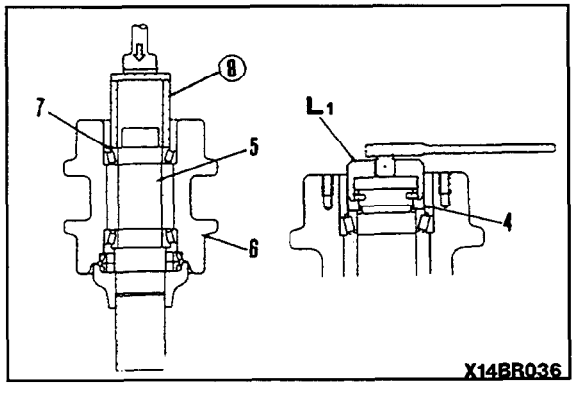
5. Using tool L_1, tighten nut (4) to a point where drill hole in shaft is aligned with drill hole in nut.

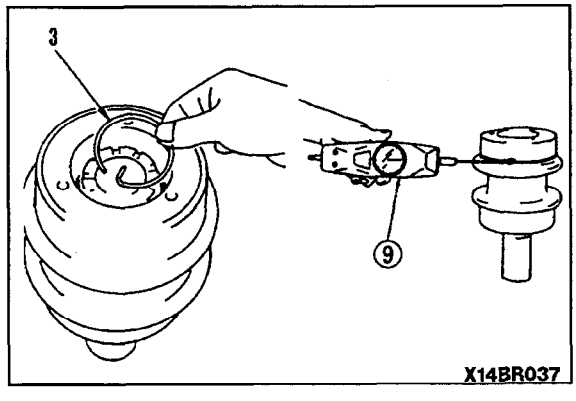
6. Install ring (3).

7. Using push scale ⑨, check that it rotates smoothly.

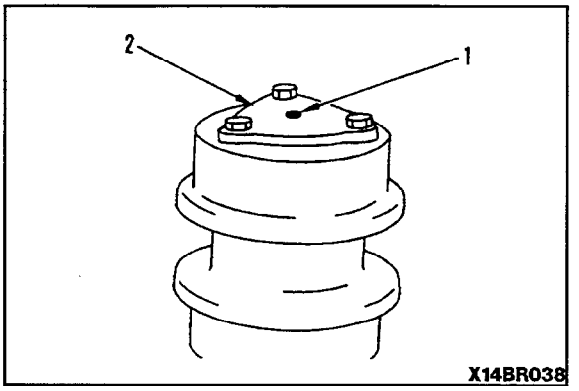




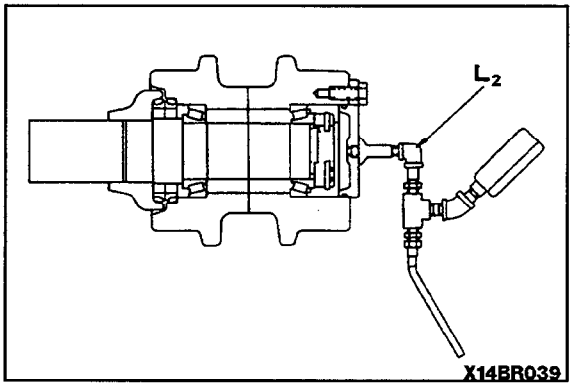




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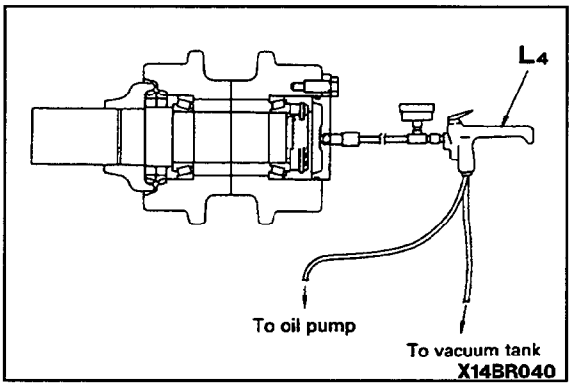


9. Using tool L_2, apply basic pressure to roller oil filler port, and check for leakage of air from seal.
   - ★ Basic pressure: 98 kPa (1 kg/cm^2)
   - ★ Method of checking: The basic pressure shall be maintained for 10 seconds and the indicator of the gauge shall not go down.



10. Using tool L_4, fill carrier roller assembly with oil, then tighten plug (1).

Carrier roller oil:
PC200, PC200LC, PC210LC, PC220LC
230 - 250 cc (SAE30)
PC250LC
450 - 500 cc (SAE30)



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REMOVAL OF TRACK SHOE ASSEMBLY

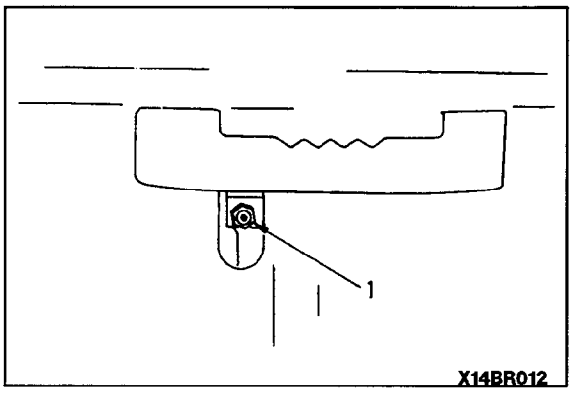
1. Stop machine at a point where master pin is midway between idler and carrier roller, and where there is space to lay out track assembly on ground.

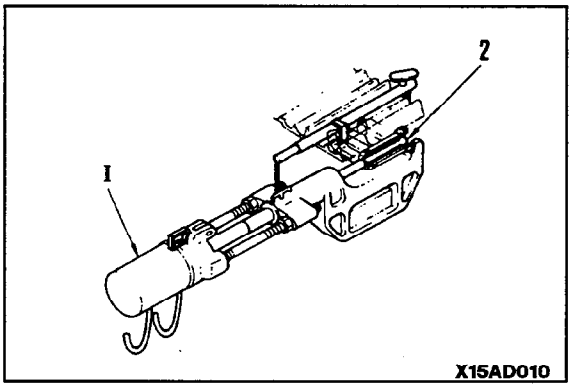
2. Lower work equipment, then loosen lubricator (1) and relieve track tension. ※1
   ⚠ The adjustment cylinder is under extremely high pressure. Never loosen the lubricator more than one turn. If the grease does not come out, move the machine backwards and forwards.

3. Using tool **I**, pull out master pin (2). ※2

4. Remove tool **I**, and move machine forward so that the position of temporary pin ② is at front of idler, and set block ① in position.

5. Remove temporary pin ②, and remove dust seal, then drive machine in reverse to lay out track (3). ※3





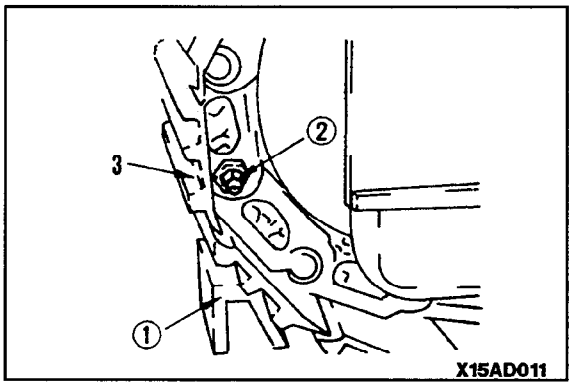
INSTALLATION OF TRACK SHOE ASSEMBLY

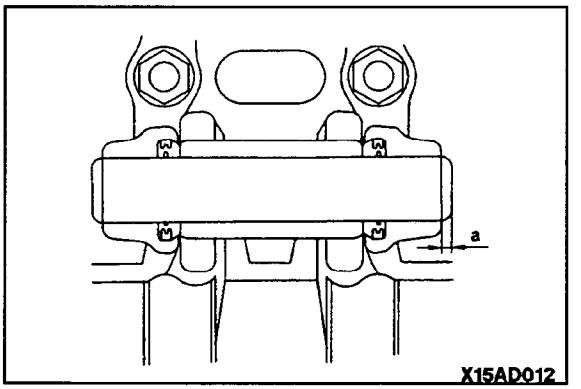
- Carry out installation in the reverse order to removal.

※1
★ Adjust the track tension. For details, see TESTING AND ADJUSTING, Testing and adjusting track tension.

※2
★ Use tool **I** and press fit so that the protrusion of the master pin is dimension "**a**".
Protrusion "**a**" of master pin:
PC200, PC200LC, PC210LC, PC220LC
4 ± 2 mm
PC250LC
4.2 ± 2 mm

※3
★ When assembling the dust seal, coat the bushing contact surface with grease (G2-L1).

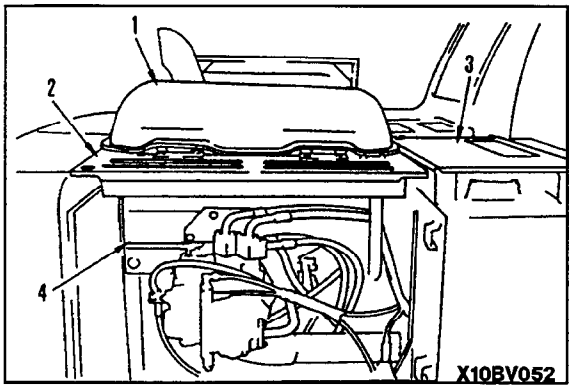


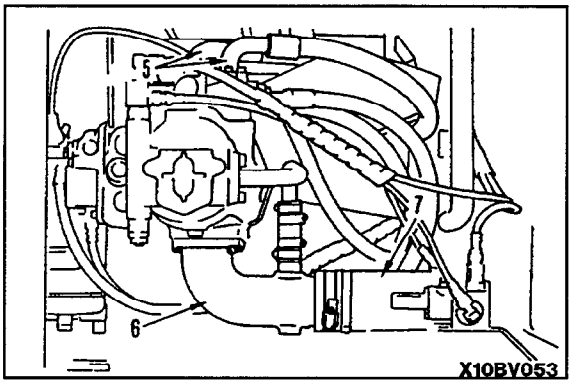


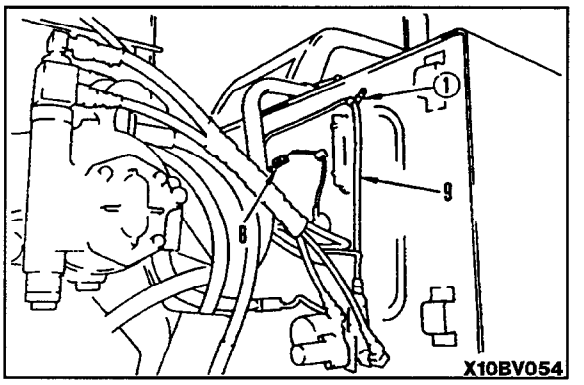
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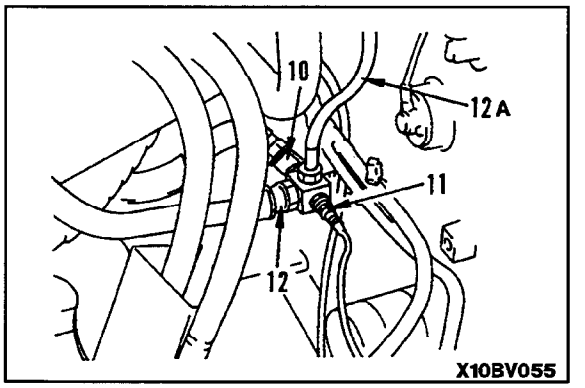
REMOVAL OF HYDRAULIC TANK ASSEMBLY

1. Drain oil from hydraulic tank.
   Hydraulic tank: 170 ℓ
2. Remove R.H. side cover together with cover mounting frame.
3. Remove engine hood (1), hood mounting bracket (2), cover (3), and engine room divider board (4).
4. Disconnect pump outlet hoses (5).
5. Remove pump suction tube (6) together with joint hose (7).
6. Remove connector (8) at side of hydraulic tank from holder and disconnect, then open wiring harness mounting clamp ① and disconnect wiring harness (9) from hydraulic tank.
7. Disconnect hoses (10), (11), (12) and (12A).







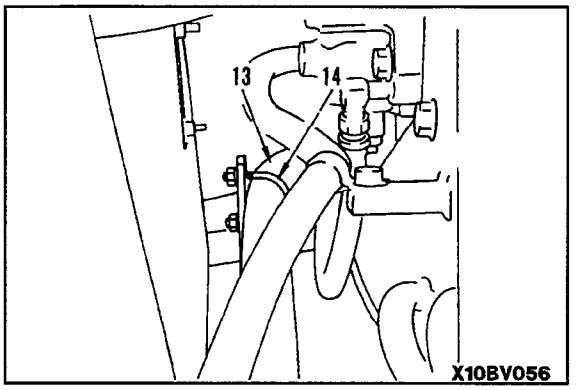


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8. Remove nut of U-bolt (14) for clamp of hydraulic oil return tube (13), then disconnect tube (13) from hydraulic tank, and pull towards muffler with rope.

9. Remove mounting bolts, and lift off hydraulic tank assembly (15). ※1

kg Hydraulic tank: 135 kg

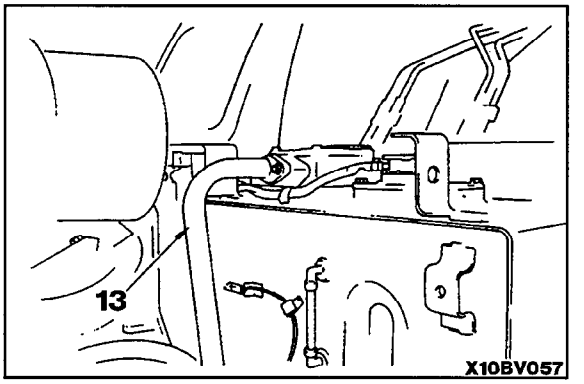


INSTALLATION OF HYDRAULIC TANK ASSEMBLY

- Carry out installation in the reverse order to removal.

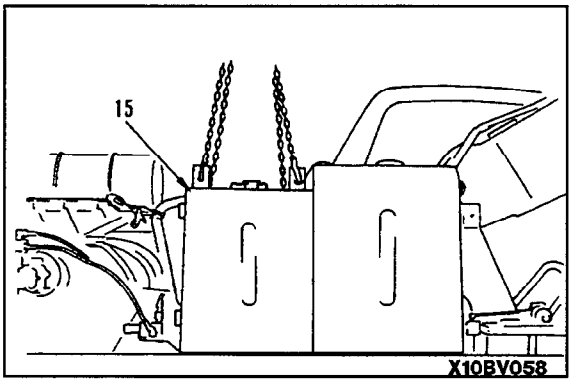
※1

kgm Hydraulic tank mounting bolt: 276.9 ± 31.9 Nm (28.25 ± 3.25 kgm)



- Refilling with oil (hydraulic tank)
  - ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air
  - ★ For details, see TESTING AND ADJUSTING, Bleeding air.



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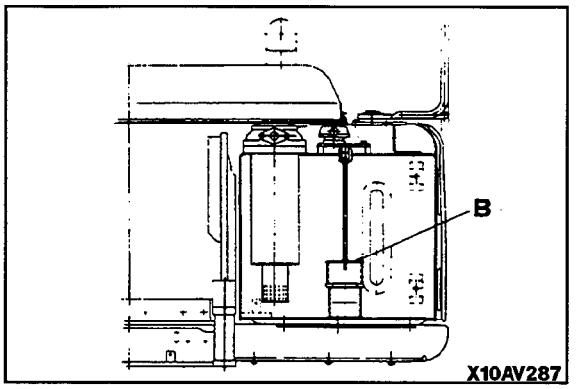
REMOVAL OF CONTROL PUMP ASSEMBLY

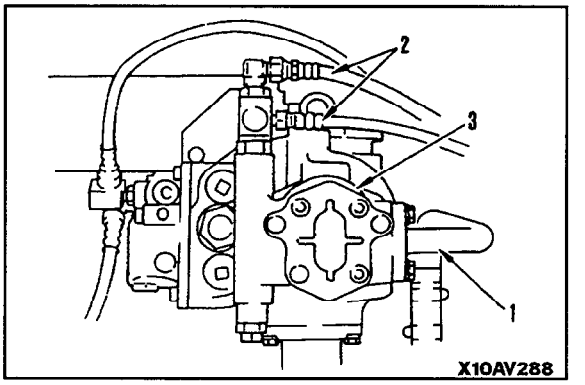
⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

- Remove the hydraulic tank strainer, and using tool **B**, stop the oil.
  - When not using tool **B**, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.

  Hydraulic tank: Approx. 170 ℓ

1. Remove control pump inlet tube (1).
2. Disconnect control pump outlet hoses (2).
3. Remove control pump assembly (3), then remove coupling (4). ※1





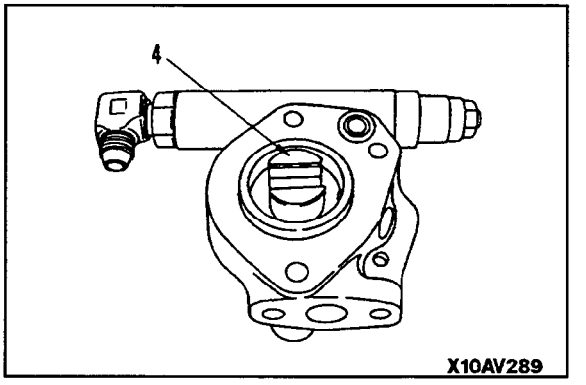
INSTALLATION OF CONTROL PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

Control pump mounting bolt: 66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

- Refilling with oil (hydraulic tank)
  - ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.



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REMOVAL OF MAIN PUMP ASSEMBLY

⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

- Remove the hydraulic tank strainer, and using tool **B**, stop the oil.
  - When not using tool **B**, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.
- Drain oil from damper case.

1. Remove engine hood cover, side cover by pump, chassis cover on top of main pump assembly, and mounting frame.

2. Disconnect control pump hoses (1) and (2), and **F** servo hoses (3) and (4), then disconnect tube (5) at pump end.

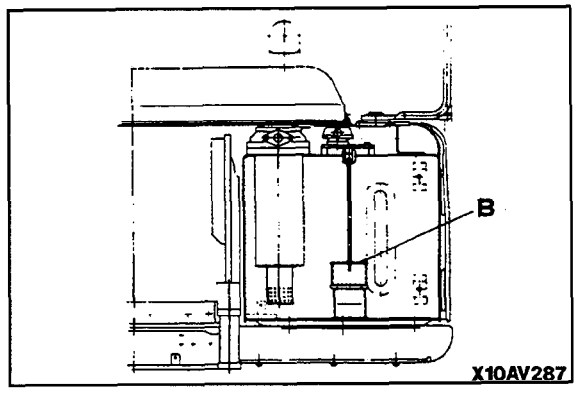
3. Remove connectors (6) and (7) from holder and disconnect.
   ★ Disconnect the clamps of the connector wiring from the body also.

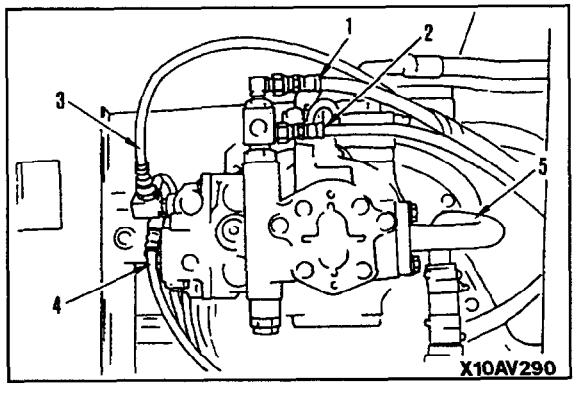
4. Disconnect **R** servo hose (8) and remove divider board (9) between engine and pump.

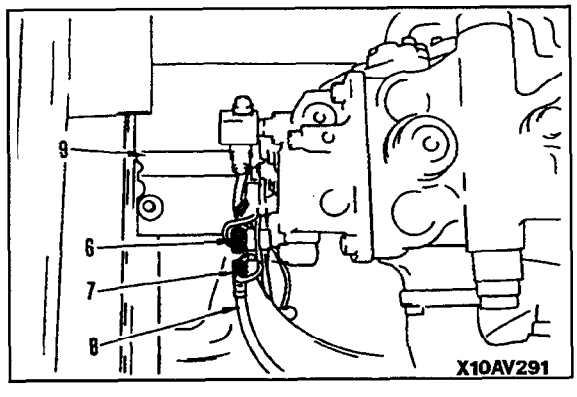
5. Disconnect top mounting hoses (10), (11), (12), (13), and (14) of main pump assembly.

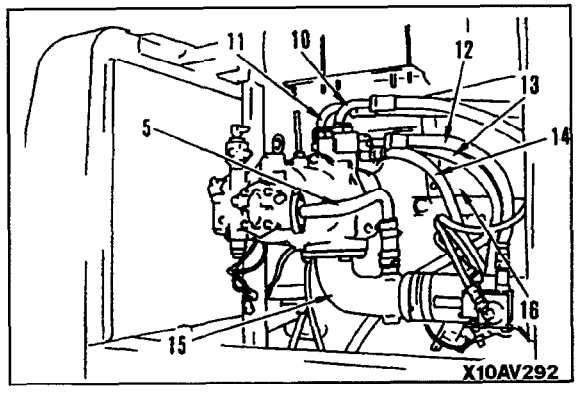
6. Disconnect suction tube (15) at bottom of main pump, move down together with tube (5) and secure.

7. Remove cover (16) behind hoses (10) - (15).





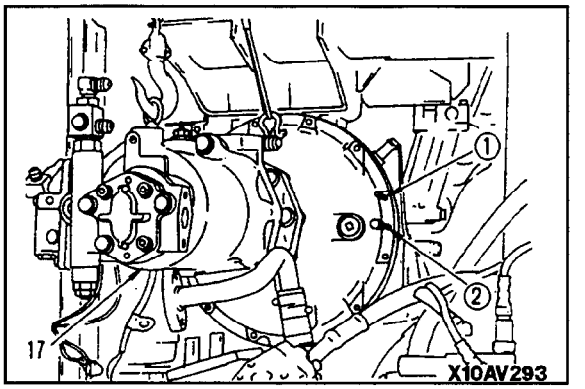




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8. **Remove main pump assembly as follows.**
   1) Leaving 2 - 3 bolts, remove mounting bolts.
   2) Sling main pump assembly (17) and remove remaining mounting bolts.
   3) Install 2 guide bolts ① on diametrically opposite sides.
   4) Using forcing screws ②, disconnect main pump assembly (17).
   5) Lift off main pump assembly (17). ※1

kg Main pump assembly: 147 kg



INSTALLATION OF MAIN PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

Involute spline of main pump: Anti-friction compound (LM-G)

Mating surface of main pump case: Gasket sealant (LG-6)

- Refilling with oil (damper)
  ★ Add engine oil through the oil filler to the specified level. Then check the oil level again.

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air
  ★ Bleed air from the main pump. For details, see TESTING AND ADJUSTING, Bleeding air.

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DISASSEMBLY OF MAIN PUMP ASSEMBLY (HPV95 + 95)

1. Pump assembly

Set pump assembly (1) to tool **A.**

★ Tool **A**: Unit repair stand (790-501-5000)
Bracket (790-901-2110)
Plate (790-901-2150)

2. Hose

Remove hose (2), elbow and tee.

3. Rear pump assembly

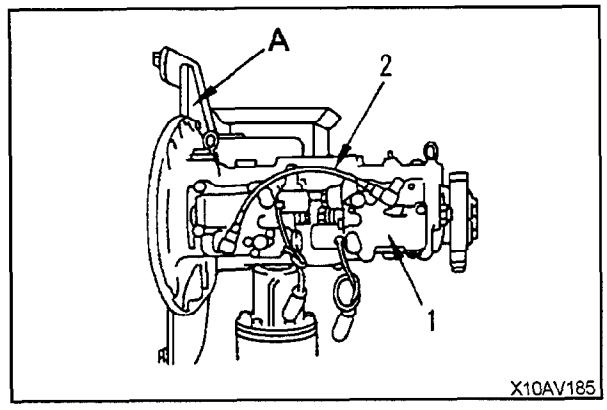
1) Sling rear pump assembly
2) Remove eight bolts at rear pump end, then remove rear pump assembly (3).
   ★ Leave the end cap at the front end.
   ★ Be careful not to drop the rear valve plate, cylinder block, piston assembly or other parts.

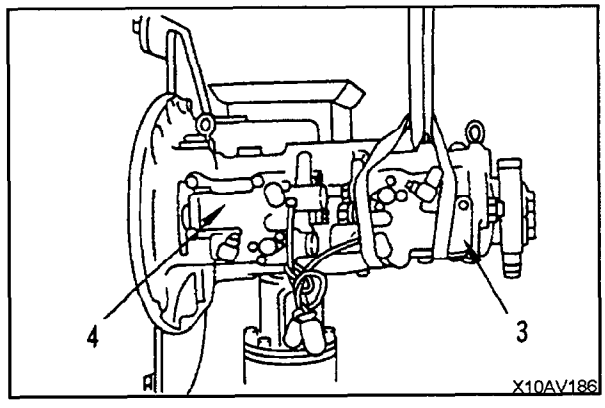
- **Disassembly of front pump assembly**

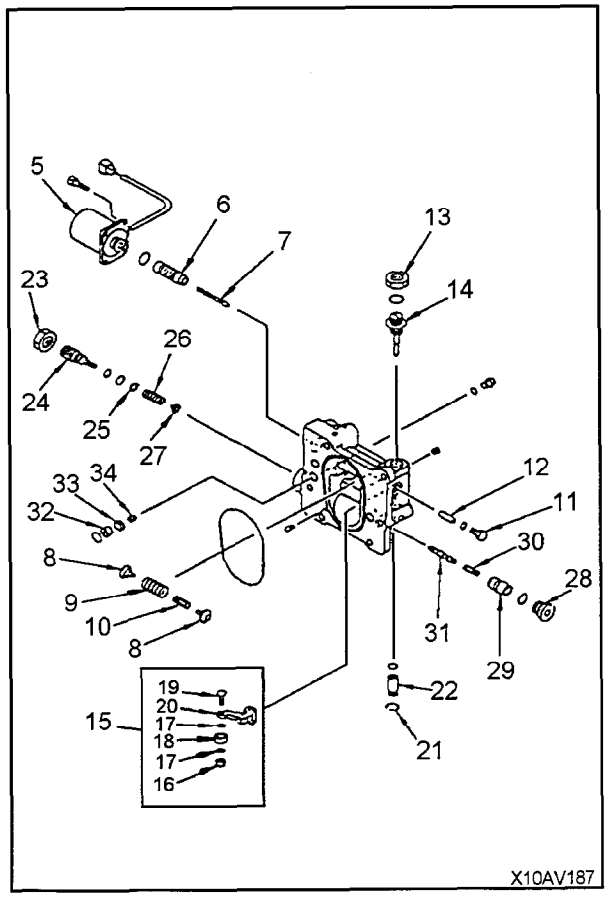
4. Control valve assembly

1) Remove control valve assembly (4).
2) Disassembly of control valve assembly.

- **TVC valve**
  i) Remove solenoid assembly (5), then remove sleeve (6) and spool (7).
  ii) Remove seat (8), then remove springs (9) and (10).
  iii) Remove plug (11), then remove piston (12).
  iv) Remove locknut (13), then remove plug (14) and lever assembly (15).
  v) Remove nut (16) from lever assembly (15), then remove washer (17), bearing (18), pin (19) and lever (20).
  vi) Remove snap ring (21), then remove plug (22).
- **LS valve**
  i) Remove locknut (23), then remove plug (24), seat (25), spring (26) and seat (27).
  ★ Measure the dimension between the end face of locknut (23) and the end face of plug (24).
  ii) Remove plug (28), then remove sleeve (29), piston (30) and spool (31).
- Remove filter (32), then remove spacer (33) and orifice (34).



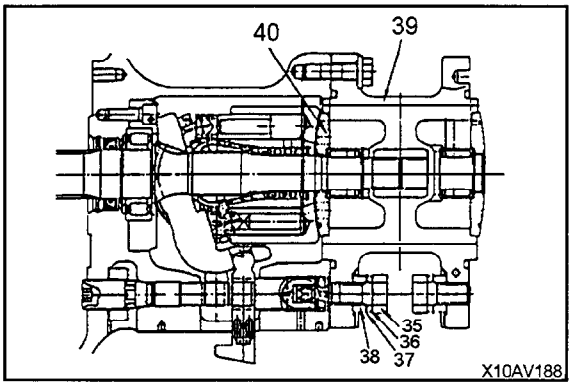




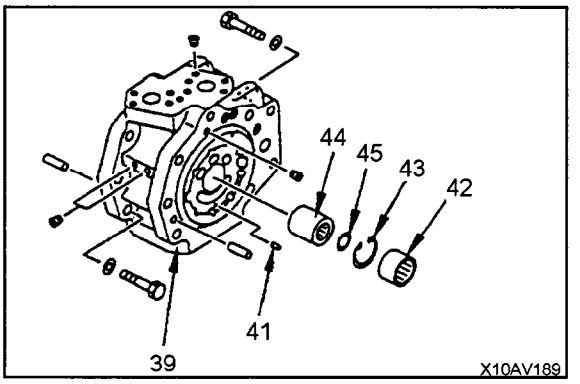
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5. End cap and valve plate

1) Remove bolt (35), then remove washer (36), shim (37) and seat (38).
   ★ Check the number and thickness of the shims, and keep in a safe place.
2) Remove end cap (39).
   ★ When the valve plate is stuck to the end cap, be careful not to drop it.
3) Remove valve plate (40).

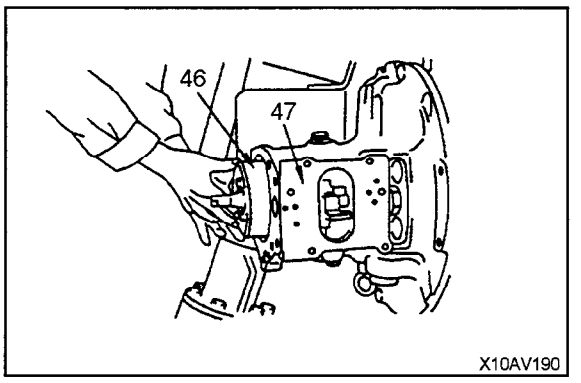


- **Disassembly of end cap**
  i) Remove dowel pin (41) from end cap (39).
  ii) Remove bearing (42).
  iii) Remove snap ring (43).
  iv) Remove coupling (44) and ring (45).



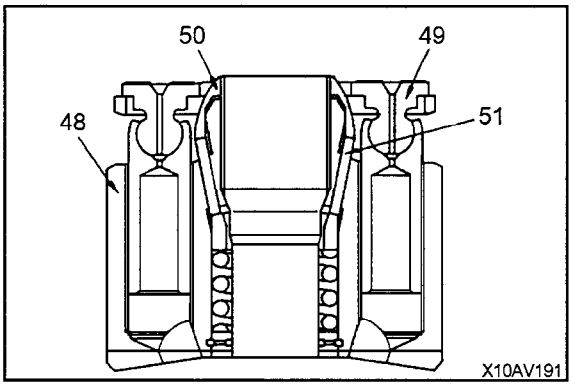
6. Cylinder block and piston assembly

Remove cylinder block and piston assembly (46) from pump case (47).
★ The cylinder block and piston assembly may come off separately, so be careful not to drop them.

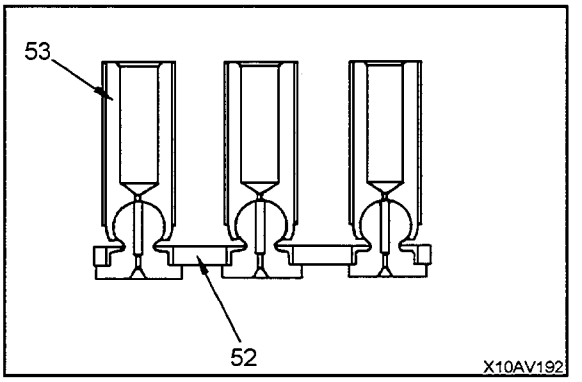


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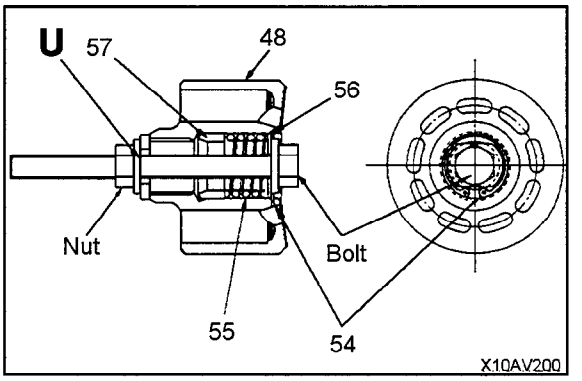
- **Disassembly of cylinder block and piston assembly**
  Pull out piston assembly (49) from cylinder block (48), and remove retainer guide (50) and preload pin (51).
  ★ When removing the piston assembly from the cylinder block, the preload pin may come out, so be careful not to lose it.



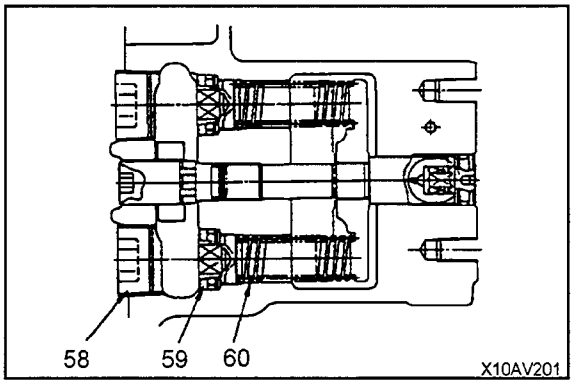
- **Disassembly of piston assembly**
  Pull out piston (53) from retainer shoe (52).



- **Disassembly of cylinder block**
  i) Set tool **U** to cylinder block (46).
     ★ Tool **U**:
     Bolt (790-201-3330)
     Washer (792-422-1120)
     Washer (01643-32460)
     Washer (01643-31845)
     Nut (01580-01815)
  ii) Hold bolt of tool **U** with wrench, tighten nut to compress spring, and remove snap ring (54).
  iii) Loose nut of tool **U** slowly to release tension of spring (55), then remove tool **U**.
  iv) Remove seat (56), spring (55) and seat (57) from cylinder block (48).
     ★ Check the assembly direction of seat (57).

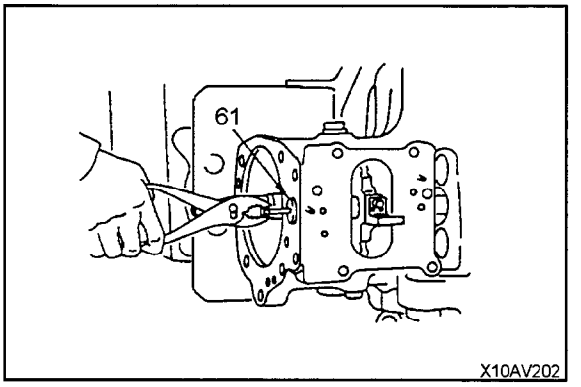


7. Servo piston assembly
1) Remove plug (58). (Front pump only)
2) Remove plug (59), then remove spring (60).

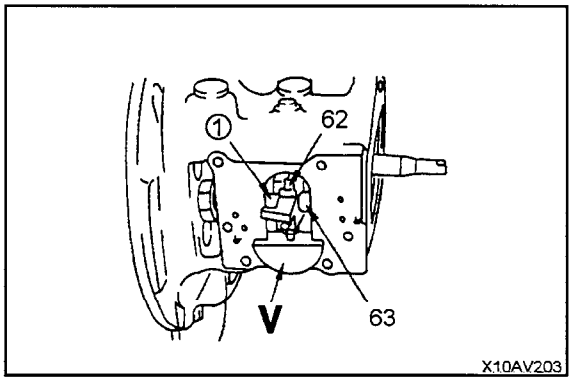


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3) Using bolt (6mm), remove stopper (61).

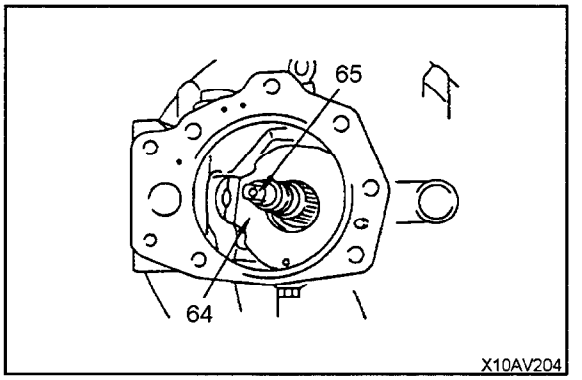


4) Set tool **V** in position, and assemble spacer ① to left side of rod (62).
   ★ Tool **V**:
   Holder assembly (791-463-1100)
   Plate (791-463-1150)
   Bolt (791-463-1160)
5) Move to side and loosen piston (63) so that width across flats of rocker cam comes off from width across flats of cradle.
6) Remove piston (63), then remove rod (62).
   ★ Check the assembly direction of rod (62).

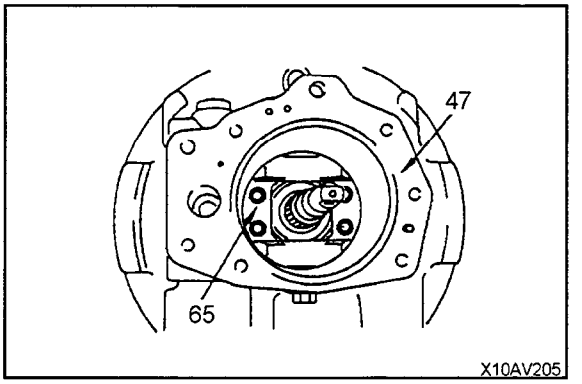


8. Shaft and cradle assembly

1) Remove rocker cam (64) from shaft and cradle assembly (65).

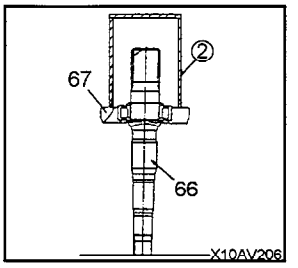


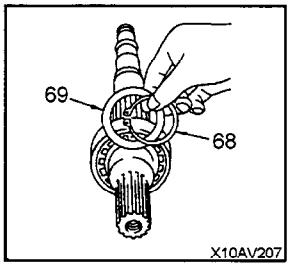
2) Remove four bolts, then remove shaft and cradle assembly (65) from pump case (47).



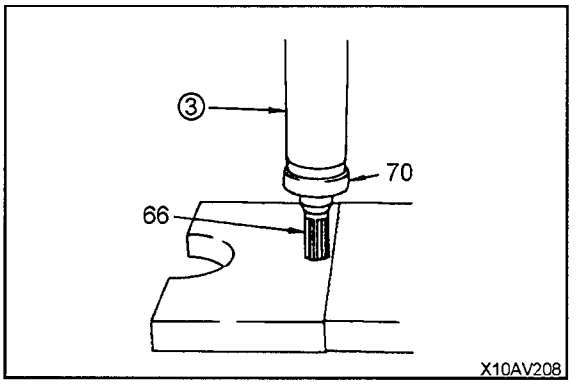
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- **Disassembly of shaft and cradle assembly**
  1) Push cradle (67) with push tool ② to remove it from shaft (66). When removing, be careful to keep cradle (67) straight.
  2) Remove snap ring (68), then remove washer (69).

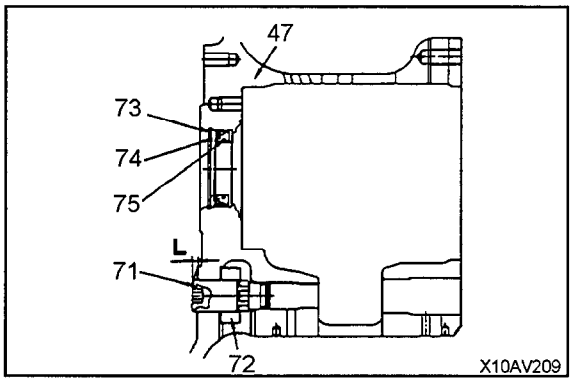




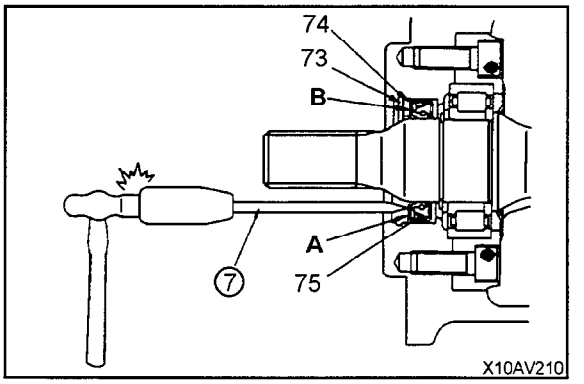
  3) Using push tool ③, remove bearing (70) from shaft (66).
     ★ Bearing (70) divides into the flange ring and the bearing, so be careful not to lose either part.
     ★ Check the installation direction of the bearing.



9. Disassembly of pump case.
  1) Loosen locknut (72) of minimum swash plate angle adjustment screw (71), and remove screw (71) and seal washer.\
     ★ Before loosening the locknut, measure dimension **L** between the end face of the case and the end face of the screw.
  2) Rotate tool **A** 90°, remove snap ring (73) from pump case (47), then remove spacer (74).
  3) Remove oil seal (75).



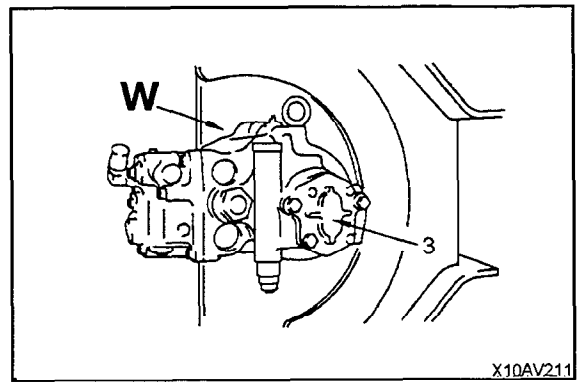
10. If above disassembly operation is not needed, and only oil seal is replaced, replace oil seal as follows.
  1) Remove snap ring (73) and spacer (74).
  2) Using bar ⑦, hit end face with hammer. Hit through to core of oil seal (75), then twist to remove.
     ★ Hit at a point midway between the inside and outside circumference of the oil seal, and twist at two places on opposite sides (**A** and **B** in diagram) to remove.
     ★ Be careful not to damage the shaft.



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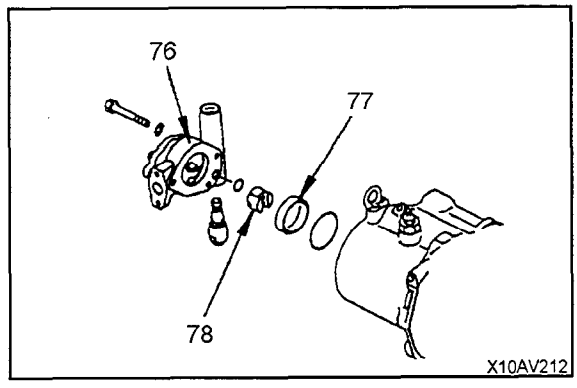
- **Disassembly of rear pump assembly**

11. Rear pump assembly
Set rear pump assembly (3) to tool **W**.
★ Tool **W**: Unit repair stand (790-501-5000)
Bracket (790-901-2110)
Plate (790-901-1371)
Plate (790-901-1390)



12. Control valve assembly
Same operation as in Item 4.

13. Control pump assembly
Remove control pump assembly (76), then remove collar (77) and coupling (78).

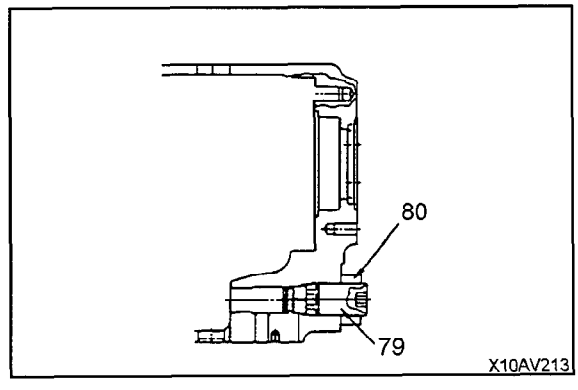


14. Cylinder block and piston assembly
Same operation as in Item 6.

15. Servo piston assembly
Same operation as in Item 7.

16. Shaft and cradle assembly
Same operation as in Item 8.

17. Disassembly of pump case
Loosen locknut (80) of minimum swash plate angle adjustment screw (79), then remove screw (79).
★ Before loosening the locknut, measure the dimension between the end face of the locknut and the end face of the screw.



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ASSEMBLY OF MAIN PUMP ASSEMBLY (HPV95 + 95)

Clean all parts, remove all burrs, and check for dirt or damage. Coat the rotating and sliding surfaces of all parts with engine oil (EO10-CD) before installing.

Always check the following parts before assembling.
I) Check contact of cradle and rocker cam (for details, see procedure for checking contact)
ii) Check contact between cylinder block and valve plate (for details, see procedure for checking contact).
iii) Check contact between valve plate and end cap (for details, see procedure for checking contact).

- **Assembly of front pump assembly**

1. Shaft and cradle assembly

- **Assembly of shaft and cradle assembly**

1) Assemble flange ring to shaft (66), then use push tool ④ to press fit bearing (70).

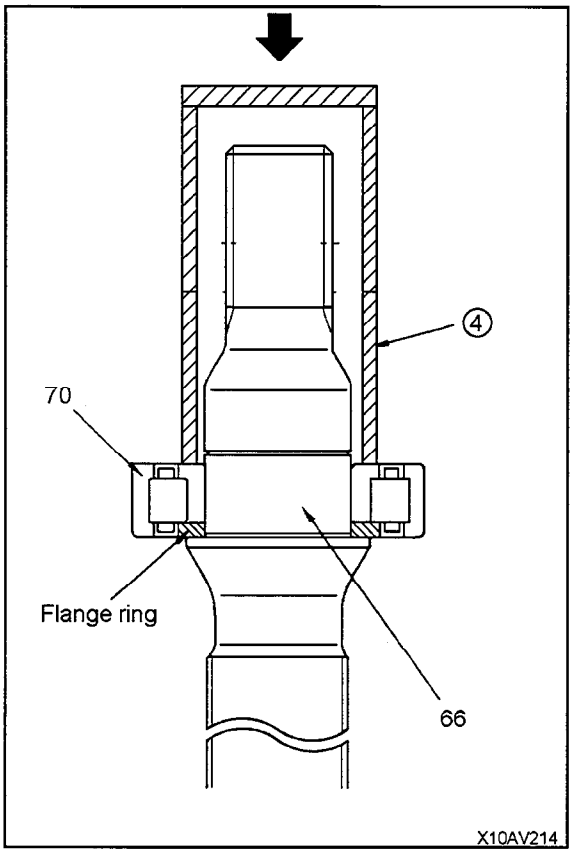
Press-fitting surface of bearing: Grease (G2-L1)

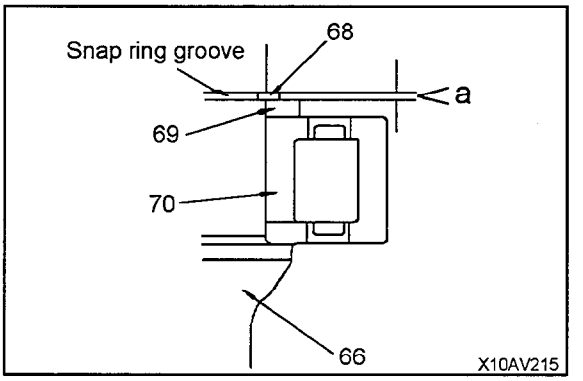
★ When press fitting the bearing, push the end face of the bearing inner race with push tool ④.

2) Assembly washer (69), and install snap ring (68).

- Method of selecting lock washer (69).
  I) After press fitting bearing (70) to shaft (66), assemble washer (69) (removed during disassembly).
  ii) Measure clearance dimension **a** between end face of assembled washer (69) and snap ring groove.
  ★ Clearance dimension **a**: 1.45 - 1.60 mm
  iii) If clearance is not within above standard value, select washer from table below and assemble.

Washer Part No.	708-2E-12160	708-2E-12170	708-2E-12180	708-2E-12190
Washer thickness (mm)	3.1	3.0	2.9	2.8

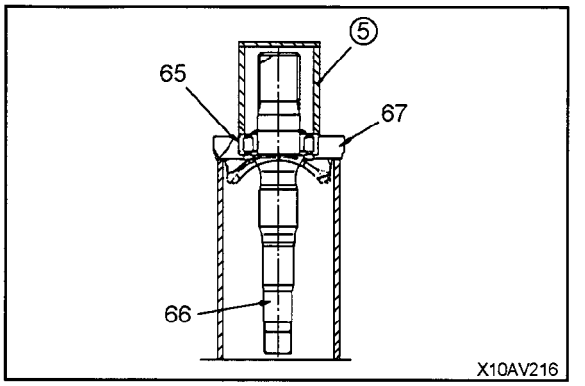




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3) Using push tool ⑤, press fit cradle (67) to shaft (66) to make shaft and cradle assembly (65).
   Press-fitting surface of bearing: Grease (G2-L1)

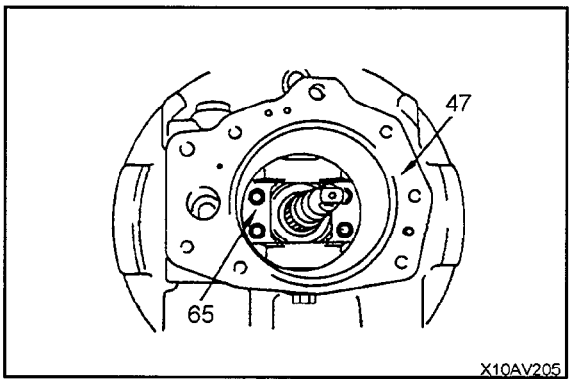
   ★ When press fitting the bearing, push the end face of the bearing outer race with push tool ⑤.



4) Set pump case (47) to tool **A**. (front pump only)
- Set the rear pump to tool **W**.

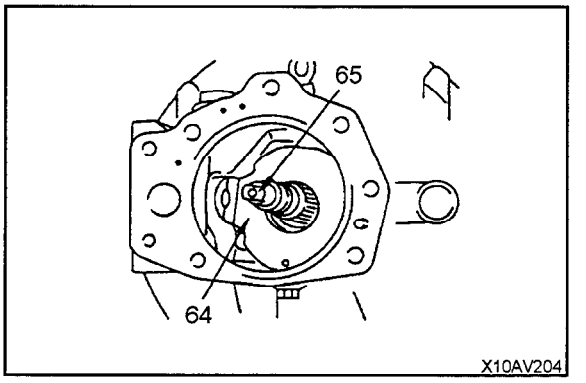
5) Fit dowel pin and O-ring to bottom surface of inside of pump case (47), then install shaft and cradle assembly (65).
   Cradle mounting bolt: 110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)

   ★ Be careful that there is no rising and that the pin does not fall out.
   ★ Be extremely careful that the O-ring does not come out or get caught.



2. Rocker cam

Assemble rocker cam (64) to shaft and cradle assembly (65).



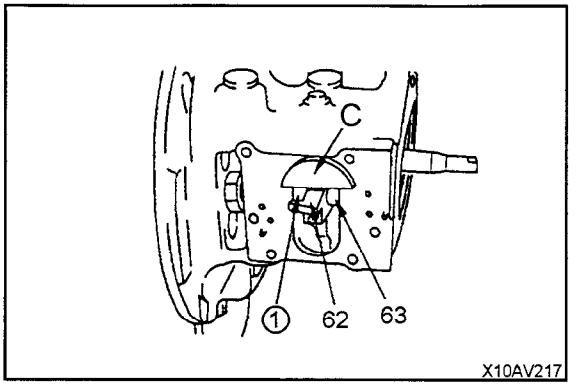
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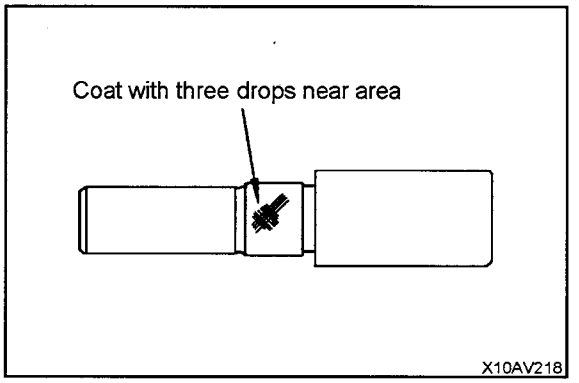
3. Piston

1) Assemble spherical portion of rod (62) to rocker cam.
   ★ When assembling the rod, assemble with the spring seat surface facing to the left.
2) Fit piston (63), set tool **V** on top of rod (opposite from when loosening), set spacer ① on left side of rod (62), and tighten piston (63).
   ★ Before tightening piston (63), move to the side so that the width across flats of the rocker cam comes out from the width across flats of the cradle. (This is to prevent damage to the rocker cam and cradle when tightening the piston.

   Near # area of piston thread in diagram on right. Coat with three drops of adhesive (Loctite 648).

   Piston: 318.7 ± 24.5 Nm (32.5 ± 2.5 kgm)





4. Positioning minimum swash plate angle.

1) Set tool **X** in position.
   ★ Tool **X**:
   Cage assembly (796-460-1400)
   Plate (796-460-1410)
   Plate (796-460-1420)
   Bolt (01010-51025) X2
   Bolt (01010-51435) X2
2) Assemble backup ring and O-ring, and tighten screw (71) until it contacts piston (63).
   ★ Install the seal washer and locknut (72) to screw (71) at position A in the diagram on the right before the tip of screw (71) enters the piston hole of the case.

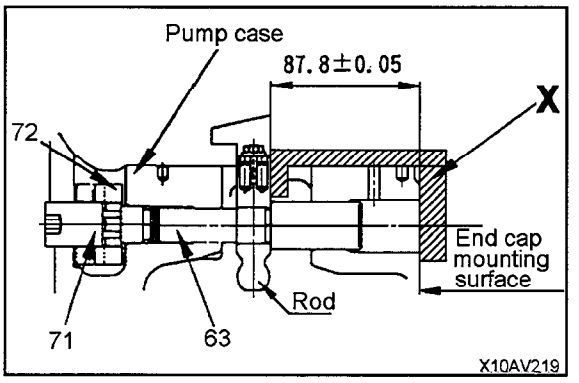
   Screw: 12.3 ± 2.5 Nm (1.25 ± 0.25 kgm)

3) Tighten locknut (72).

   Between case and screw: Gasket sealant (LG-7 or LG-5 (Loctite 572/575))

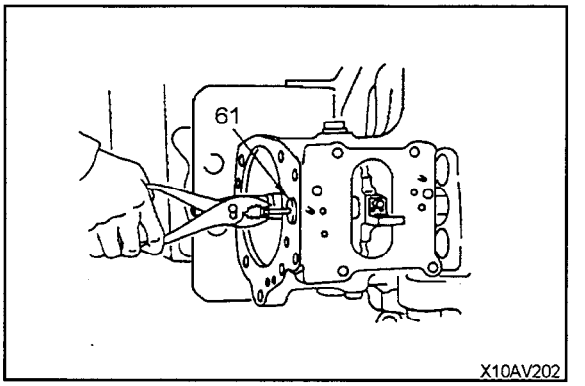
   Locknut: 220.6 ± 24.5 Nm (22.5 ± 2.5 kgm)

4) After completion of assembly, carry out a bench test to check the minimum flow.



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5) Assemble backup ring and O-ring to stopper (61), and install to case.

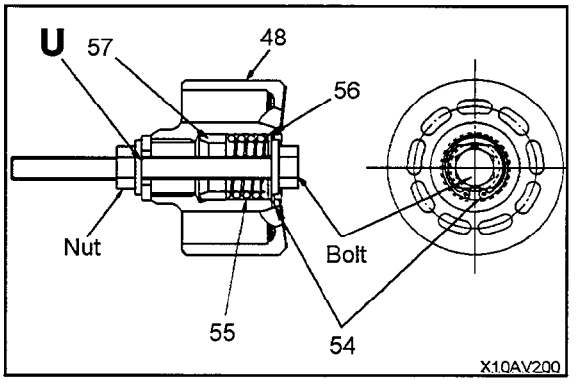


5. Cylinder block and piston assembly

- **Assembly of cylinder block**

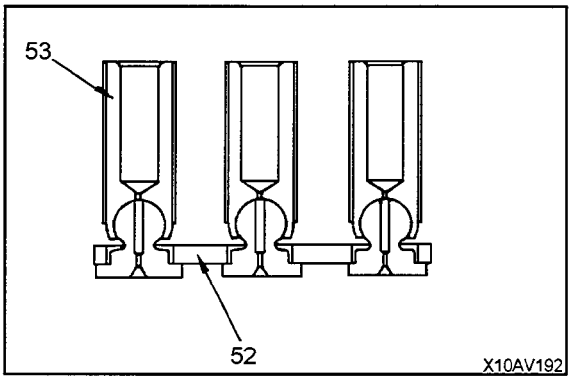
1) Assemble seat (57), spring (55) and seat (56) to cylinder block (48).
   ★ Assemble with the tapered portion on the inside of seat (57) facing down.

2) Set tool **U** to cylinder block (48).
3) Hold bolt of tool **U** with wrench, tighten nut to compress spring (55), then install snap ring (54).
   ★ Check that the snap ring is fitted securely in the groove.
4) Remove tool **U**.



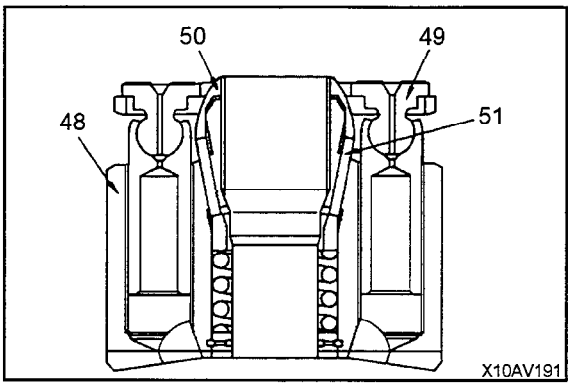
- **Assembly of piston assembly**

Assemble piston (53) to retainer shoe (52).

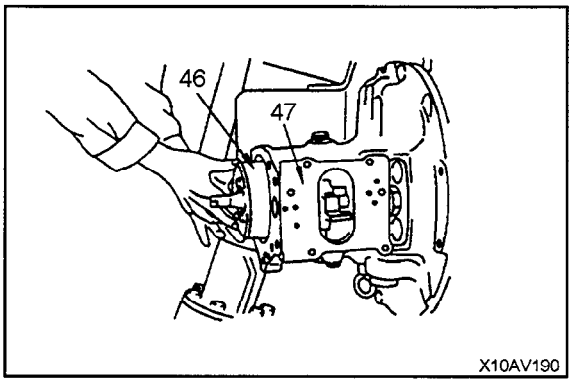


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5) Assemble three preload pins (51) to cylinder block (48).
   ★ To prevent the preload pin from coming out, coat the pin with grease (G2-L1).
6) Assemble retainer guide (50) to cylinder block (48), then install piston assembly (49) to make cylinder block and piston assembly (46).
   ★ Align the spline for the cylinder block and retainer guide.



7) Install cylinder block and piston assembly (46) to pump case (47).
   ★ Before assembling the cylinder block and piston assembly, assemble the width across flats of the rocker cam to the cradle securely.



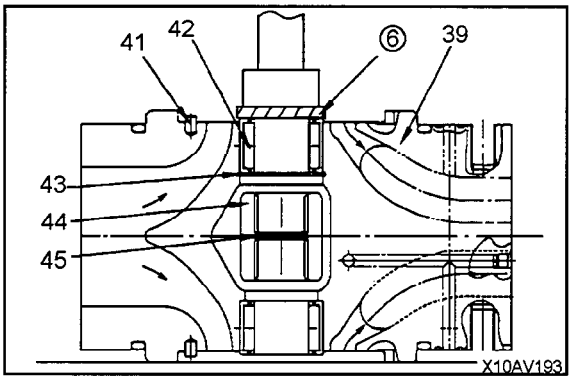
6. End cap and valve plate

1) Assembly of end cap
   i) Assemble ring (45) to coupling (44), then assemble to end cap (39).
   ii) Install snap ring (43).
   iii) Using push tool ⑥, press fit bearing (42) to end cap (39).

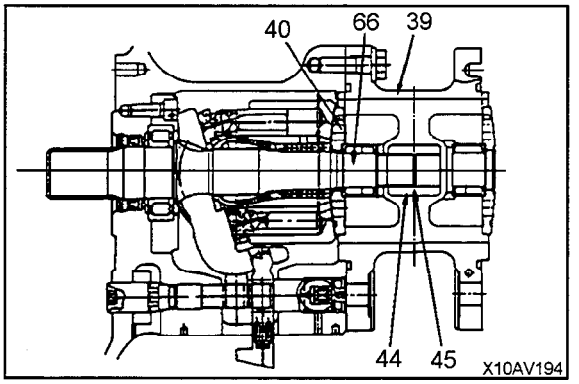


Press-fitting surface of bearing: Grease (G2-L1)

   iv) Install dowel pin (41) to end cap (39).



2) Assemble valve plate (40) to end cap (39), and install to pump case.
   ★ Check that there is no interference with the bearing and pin.
   ★ Do not hit the valve plate or apply any impact when assembling. (There is danger that this will damage the sliding surface or cause distortion.)



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3) Assemble dowel pin and O-ring to end cap (39), then assemble coupling (44) and ring (45) to shaft (66), and install pump case.
   ★ Be careful that there is no rising and that the pin does not fall out.
   ★ Be extremely careful that the O-ring does not come out or get caught.

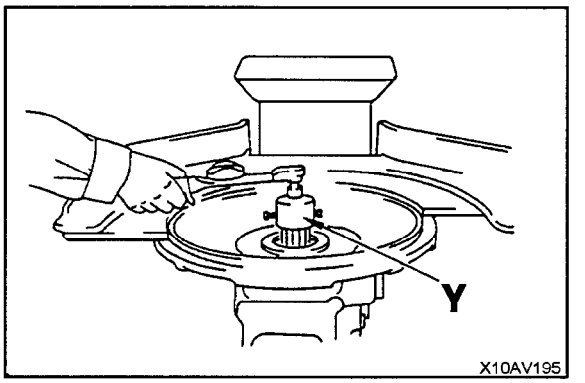
   Mating surface of pump case: Gasket sealant (LG-7 or LG-5 (Loctite 572/575))

   Mounting bolt: 176.5 ± 19.6 Nm (18 ± 2 kgm)

7. Measuring rotating torque of pump assembly

1) Set tool **Y** to pump shaft.
   ★ Tool **Y**:
   Bolt (01435-01014)
   Torque wrench (795-630-1803)
2) Set torque wrench to tool **Y**, rotate shaft at low speed (3 - 5 sec/1 turn) and measure rotating torque.
   ★ Check that the shaft rotates smoothly when measuring the rotating torque.
   - Variation range: Max. 0 - 2.9 Nm (0 - 0.3 kgm)
   - Rotating torque: Max. 0 - 24.5 Nm (0 - 2.5 kgm)

   ★ If there is any abnormality in the rotating torque, disassemble again and check.



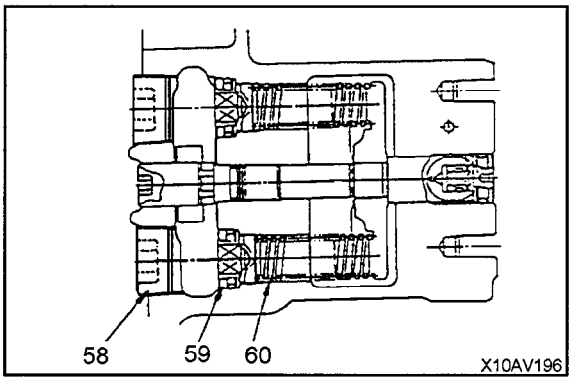
8. Spring and plug

1) Assemble spring (60), then fit O-ring and install plug (59).

   Plug (59): 107.9 ± 14.7 Nm (11 ± 1.5 kgm)

2) Install plug (58). Front only.

   Plug (58): 126.0 ± 39.7 Nm (12.85 ± 4.05 kgm)



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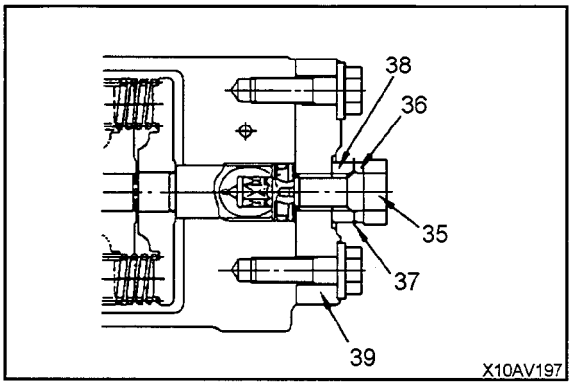
9. Positioning maximum swash plate angle

1) Install seat (38), shim (37), washer (36) and bolt (35) to end cap (39).
   ★ Install the same shim (37) (for determining position of max. swash plate angle) as was removed during disassembly, or assemble the standard shim shown below.

Shim part No.	Thickness (mm)	No. of standard shims
708-2I-24170	0.1	2
708-2I-24180	0.2	2
708-2I-24190	0.5	2

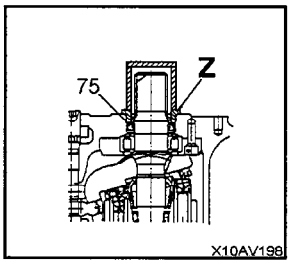
Bolt (35): 156.9 ± 9.8 Nm (16 ± 1 kgm)

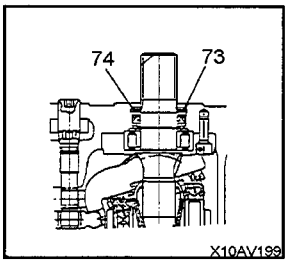
2) After completion of assembly, carry out a bench test of the performance, and make the final shim adjustment.



10. Installation of oil seal.

1) Check that there are no burrs or flashes at the corners of the shaft.
2) Using tool **Z**, press fit oil seal (75).
   ★ Tool **Z**:
   Push tool (791-463-1141)
   Spacer (790-210-2740)
3) Assemble spacer (74) and install snap ring (73).





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11. Control valve assembly

1) Assembly of control valve assembly

- **LS valve**
  - i) Assembly spool (31), piston (30) and sleeve (29) to body, then fit O-ring and install plug (28).

    Plug (28): 110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)

    ★ Check that the relative movements of the body and spool (31), sleeve (29) and piston (30) are smooth.
  - ii) Assemble seat (27), spring (26) and seat (25), then fit backup ring and O-ring and install plug (24).
  - iii) Install locknut (23).

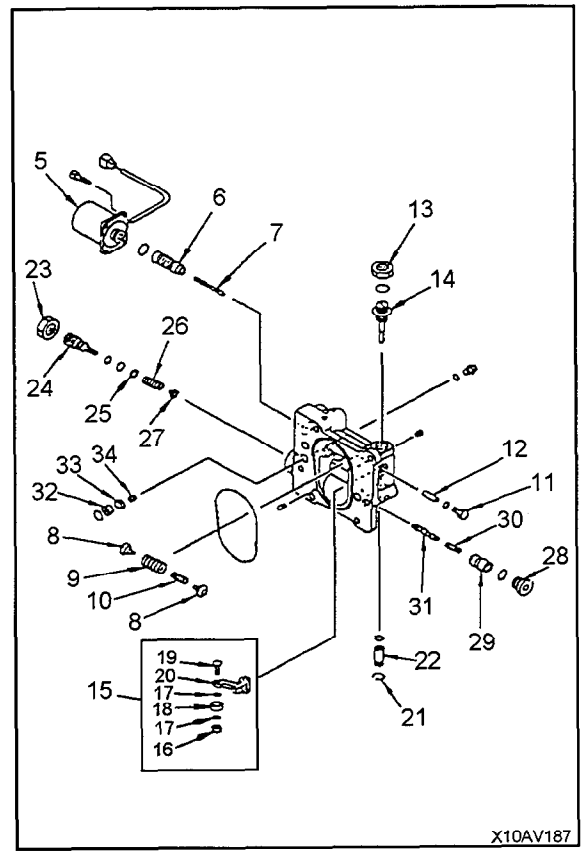
    Locknut (23): 68.6 ± 9.8 Nm (7 ± 1 kgm)

    ★ Install so that the dimension between the end face of locknut (23) and the end face of plug (24) is the dimension measured during disassembly.
  - iv) After completion of assembly, carry out a bench test of the performance and make final adjustment of plug (24).
- **TVC valve**
  - i) Fit O-ring and assemble plug (22), then install snap ring (21).
  - ii) Install pin (19), washer (17), bearing (18) and nut (16) to lever (20) to make lever assembly (15).

    Nut (16): 10.8 ± 1.0 Nm (1.1 ± 0.1 kgm)

    Nut (16): Thread tightener (Loctite 648)

    ★ Check that the movement of lever (20) and bearing (18) is smooth.



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iii) Fit O-ring to plug (14), then install to lever assembly (15) and body.
★ Tighten to a point where the tip of the plug is in contact with plug (22), then turn back at least 180° and move from the mark to the position in the diagram on the right ϕ=0.

iv) Install locknut (13).
Locknut (13): 29.4 ± 4.9 Nm (3 ± 0.5 kgm)

★ Check that the movement of lever (20), plug (22) and plug (14) is smooth.

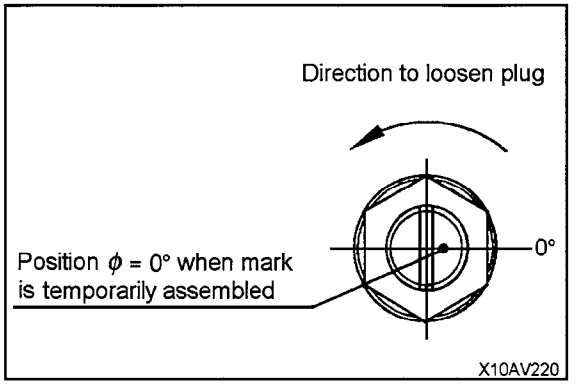
v) Assemble piston (12), then fit O-ring and install plug (11).
Plug (11): 11.3 ± 1.5 Nm (1.15 ± 0.15 kgm)

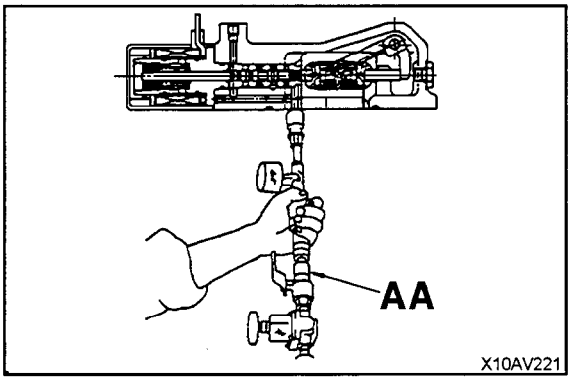
vii) Install O-ring, then install solenoid assembly (5).
Solenoid assembly mounting bolt: 13.2 ± 1.5 Nm (1.35 ± 0.15 kgm)

Mating surface of solenoid assembly: Gasket sealant (LG-7 or LG-5 (Loctite 572/575))

viii) Using tool **AA**, check that there is no leakage of oil or air from the mating surface with the solenoid assembly.
★ Tool **AA**:
Oil leak tester (799-301-1500)
★ Air pressure: 0.5 MPa (5 kg/cm^2)

ix) After completion of assembly, carry out a bench test of the performance and make final adjustment of plug (14).





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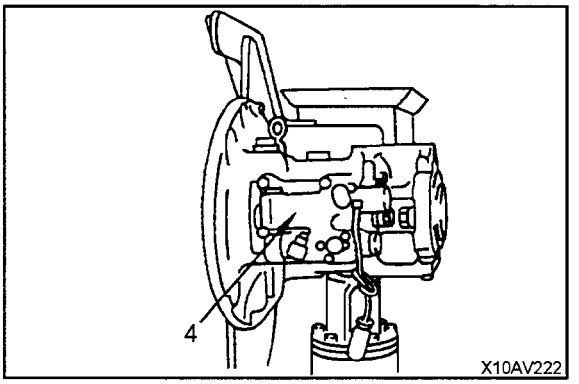
- Assemble orifice (34), and install spacer (33), filter (32) and O-ring.

  kgm Orifice (34): 9.8 ± 2.0 Nm (1.0 ± 0.2 kgm)

2) After completion of assembly, carry out bench test of servo valve assembly (4) as an individual part to check performance and carry out adjustment.
3) Fit O-ring and filter to control valve assembly (4) and install to pump case.
   - ★ Be extremely careful that the O-ring and filter do not fall out.
   - ★ Tighten the mounting bolts gradually in turn on opposite sides.

   kgm Mounting bolt: 66.2 ± 7.3 Nm (6.75 ± 0.75 kgm)

   Mating surface of servo valve: Gasket sealant (LG-7 or LG-5 (Loctite 572/575)



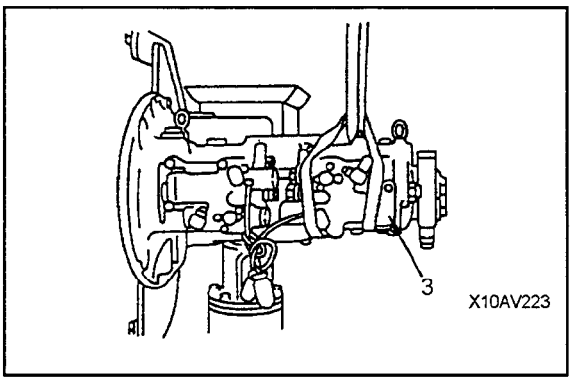
12. Rear pump assembly

Assemble dowel pin and O-ring to end cap, sling rear pump assembly (3), then align with spline of shaft and install.

- ★ When slinging, be careful not to drop the cylinder block, piston assembly, or other parts.

Mating surface of pump case: Gasket sealant (LG-7 or LG-5 (Loctite 572/575)

kgm Mounting bolt: 176.5 ± 19.6 Nm (18 ± 2 kgm)



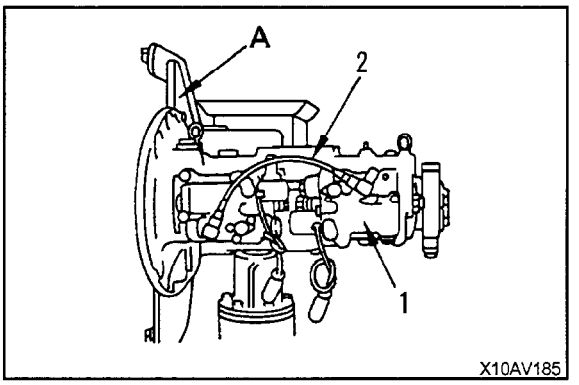
13. Hose

Install elbow, tee and hose (2).

kgm Hose: 24.5 ± 4.9 Nm (2.5 ± 0.5 kgm)

14. Pump assembly

Remove pump assembly from tool **A**.



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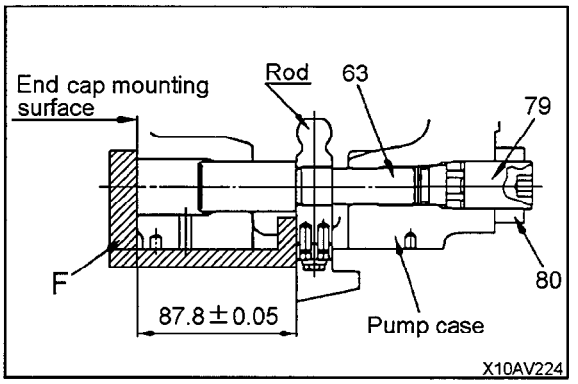
- **Assembly of rear pump assembly**

15. Shaft and cradle assembly
Same operation as in Item 1. (Set pump case to tool **W**.)

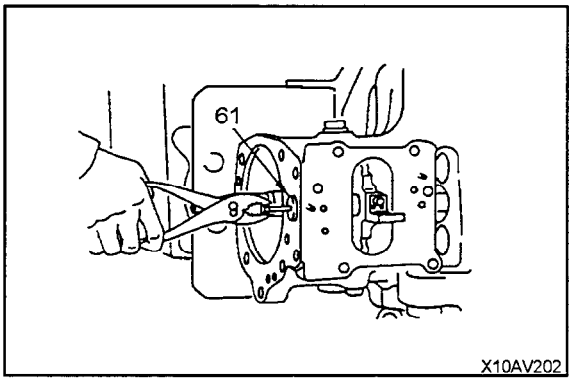
16. Rocker cam
Same operation as in Item 2.

17. Piston
Same operation as in Item 3.

18. Positioning minimum swash plate angle
1) Set tool **X** in position.
2) Assemble backup ring and O-ring, tighten screw (79) until it contacts piston (63), then tighten locknut (80).
   Screw: 12.3 ± 2.5 Nm (1.25 ± 0.25 kgm)
   Locknut: 220.6 ± 24.5 Nm (22.5 ± 2.5 kgm)



3) After completion of assembly, carry out a bench test to check the minimum flow.
4) Assemble backup ring and O-ring to stopper (61), and install to case.

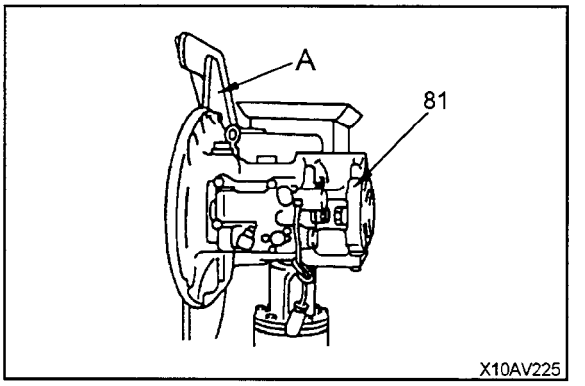


19. Cylinder block and piston assembly
Same operation as in Item 5.

20. Pump case
1) Remove rear pump case from tool **W**.

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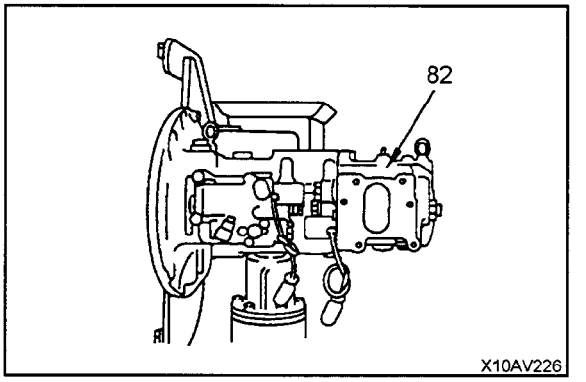
2) Set front pump and end cap assembly (81) to tool **A**.



3) Assemble dowel pin and O-ring to end cap, sling rear pump case (82), then align spline of shaft and install.
   ★ When slinging, be careful not to drop the cylinder block, piston assembly or other parts.

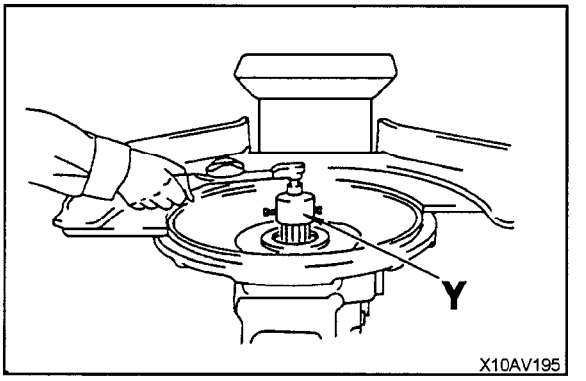
   Mating surface of pump case: Gasket sealant (LG-7 or LG-5 (Loctite 572/575)

   Mounting bolt: 176.5 ± 19.6 Nm (18 ± 2 kgm)



21. Measuring rotating torque of pump assembly
1) Set tool **Y** to pump shaft.
2) Set torque wrench to tool **Y**, rotate shaft at low speed (3 - 5 sec/1 turn) and measure rotating torque.
   ★ Check that the shaft rotates smoothly when measuring the rotating torque.
   - Variation range: Max. 0 - 2.9 Nm (0 - 0.3 kgm)
   - Rotating torque: Max. 0 - 49 Nm (0 - 5 kgm)

   ★ If there is any abnormality in the rotating torque, disassemble again and check.



22. Spring and plug
Same operation as in Item 8.

23. Positioning maximum swash plate angle
Same operation as in Item 9.

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24. Control pump assembly

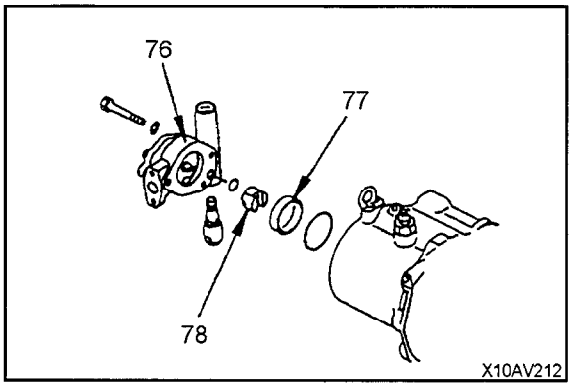
1) Install collar (77).
2) Fit coupling (78) to drive shaft, fit O-ring and install control pump assembly (76).



Mounting bolt: 66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)



Mating surface of control pump: Gasket sealant (LG-7 or LG-5 (Loctite 572/575))



25. Control valve assembly

Same operation as in Item11.

26. Hose

Same operation as in Item 13.

27. Pump assembly

Same operation as in Item 14.

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CHECKING CONTACT BETWEEN CYLINDER BLOCK AND VALVE PLATE, ROCKER CAM AND CRADLE

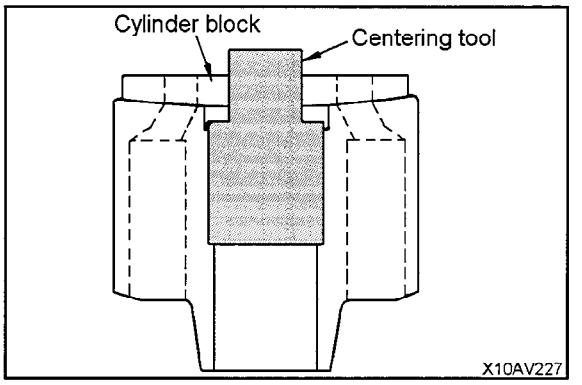
Valve plate and end cap

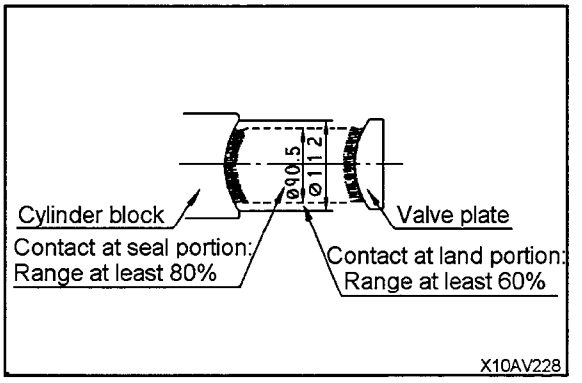
1. Checking contact between cylinder block and valve plate.

★ This check is unnecessary if both the cylinder block and valve plate are replacement parts (new parts).

★ This check applies if one of the parts is a replacement part or a restored part.

1) Make a centering tool for the cylinder block and valve plate.
   ★ The tool can be made from plastic, bakelite or any other soft material.
2) Remove all oil and grease from the parts to be checked.
   ★ Do not wipe with a cloth.
3) Set the tool in position, then paint the cylinder block with inspection paint.
   ★ Coat thinly with paint.
4) Push the valve plate with a force of 39.2 - 49.0 N (4 - 5 kg) against the cylinder block. Turn the valve plate 90°, then turn it back to the original position. Repeat this process 2 or 3 times.
5) Remove the valve plate, transfer the contact surface to a tape, and check the contact surface.
   ★ The contact of the spherical surface of the valve plate and cylinder block must fulfill the conditions below and cover the whole circumference without any break.
      I) The contact at the seal portion (range from bottom to ϕ90.5) must be at least 80%.
      ii) The contact at the land portion (range from ϕ90.5 to ϕ112) must be at least 60%.





	Seal portion	Land portion
Valve plate	Min. 80%	Min. 60%
Cylinder block	Min. 80%	Min. 60%

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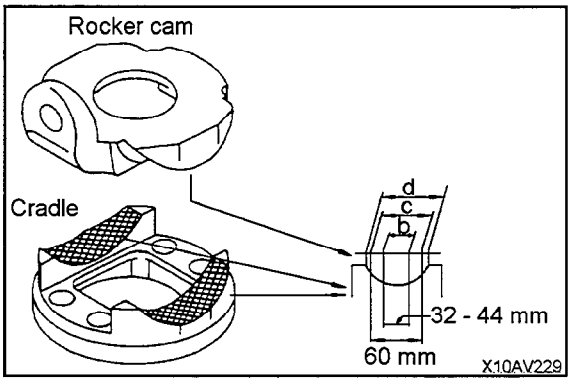
2. Checking contact of rocker cam and cradle

★ This check is unnecessary if both the rocker cam and cradle are replacement parts (new parts).

★ This check applies if one of the parts is a replacement part or a restored part.

1) Remove all oil and grease from the parts to be checked.
   ★ Do not wipe with a cloth.
2) Paint the cradle with inspection paint.
   ★ Coat thinly with paint.
3) Put the rocker cam on top and push with a force of 39.2 - 49.0 N (4 - 5 kg), and move it between the maximum swash plate angle and the position where it contacts the stopper. Repeat this process 2 or 3 times.
4) Remove the rocker cam, transfer the contact surface to a tape, and check the contact surface.
   ★ The standard for the contact surface is as given below.

   I) Contact within the central portion (32 - 44 mm) must be at least 90%.
   ii) Contact in range between central portion (32 - 44 mm) and 60 mm must be 50 - 90%.
   iii) Contact of area outside 60 mm width (outside) must be less than 50%. (It is not permitted to have contact only at the outside and no contact at the center.)



[Reference] If the contact is not within the standard value, and lapping is carried out, it must always be carried out for both parts together.

★ Parts with any scratches or damage must not be used.

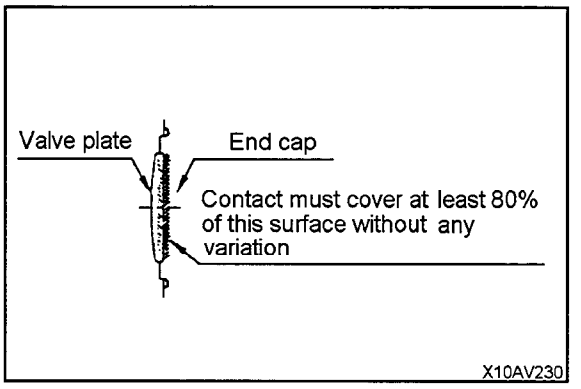
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3. Checking contact between valve plate and end cap.

★ This check is unnecessary if both the valve plate and end cap are replacement parts (new parts).

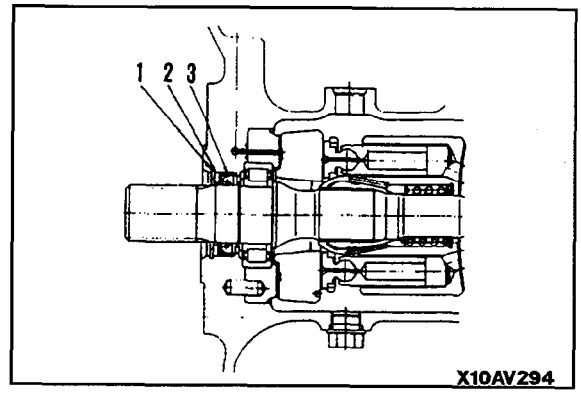
★ This check applies if one of the parts is a replacement part or a restored part.

1) Remove all oil and grease from the parts to be checked.
   ★ Do not wipe with a cloth.
2) Paint the end cap with inspection paint.
   ★ Coat thinly with paint.
3) Push the valve plate with a force of 39.2 - 49.0 N (4 - 5 kg) against the end cap, turn the valve plate 90°, then turn it back to the original position. Repeat this process 2 or 3 times.
4) Remove the valve plate, transfer the contact surface to a tape, and check the contact surface.
   ★ The contact of the plane surface between the valve plate and end cap must cover at least 80% without any variation.



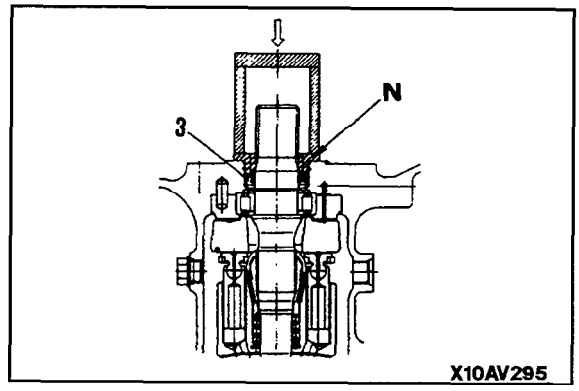
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REMOVAL OF MAIN PUMP INPUT SHAFT OIL SEAL



1. Remove main pump assembly. For details, see REMOVAL OF MAIN PUMP ASSEMBLY.
2. Remove snap ring (1), then remove spacer (2).
3. Lever up oil seal (3) with a screwdriver to remove. ※1
   ★ When removing the oil seal, be extremely careful not to damage the shaft.

INSTALLATION OF MAIN PUMP INPUT SHAFT OIL SEAL



- Carry out installation in the reverse order to removal.

※1

Lip of seal: Grease (G2-L1)

Coat the outside circumference of the oil seal with grease (G2-L1) thinly, then press fit.

★ Using tool **N**, press fit oil seal (3).

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REMOVAL OF CONTROL VALVE ASSEMBLY

⚠ Run the engine at low idling, operate the cylinder to the end of its stroke without relieving the circuit, lower the work equipment to the ground, then stop the engine. For details, see TESTING AND ADJUSTING, Releasing pressure in hydraulic circuit. After stopping the engine, do as follows.

- Loosen the oil filler cap slowly to release the pressure inside the tank.
- Operate the control levers.
  - ★ Operate the control levers several times to release the pressure in the accumulator.
- Start the engine and run at low idling for approx. 5 seconds, then stop the operation and operate the control levers.
  - ★ Repeat the above operation several times to release the remaining pressure completely.

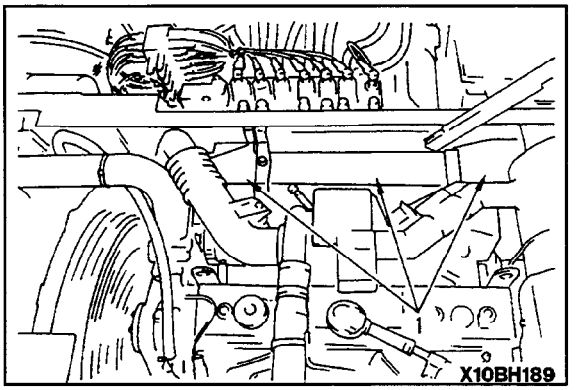
1. Open engine hood and remove divider covers (1), then disconnect intake connector.

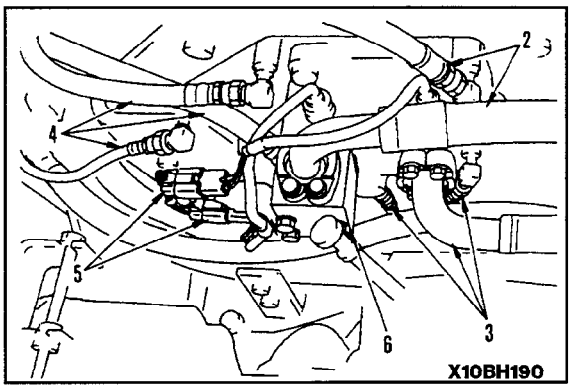
2. Disconnect hoses (2), (3), and (4), remove 2 connectors (5) from holder, then disconnect.
   - ★ Remove the hose mounting elbow from the valve body.

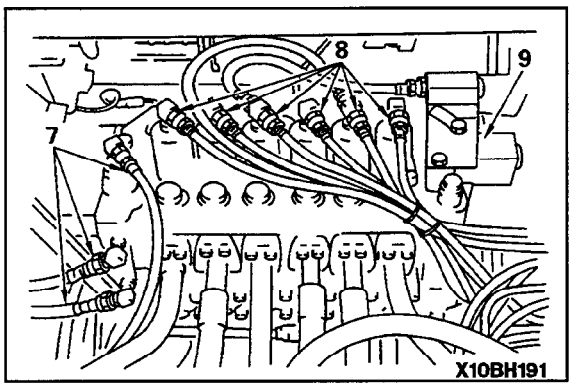
3. Remove block (6).

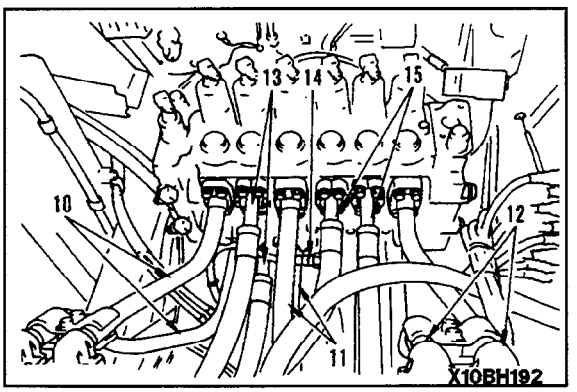
4. Disconnect hoses (7) and (8), and block (9).
   - ★ When disconnecting block (9), loosen the mounting bolts of the block tube flange first.

5. Disconnect tubes (10), (11), and (12), and hoses (13), (14), and (15).
   - ★ Disconnect 6 tubes and 7 hoses.
   - ★ With hoses (15), there is another hose under each of the hoses.



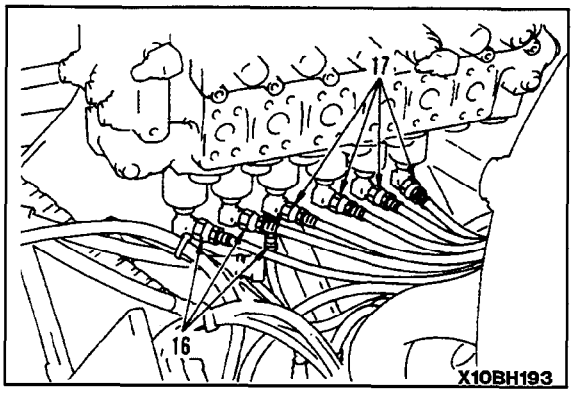




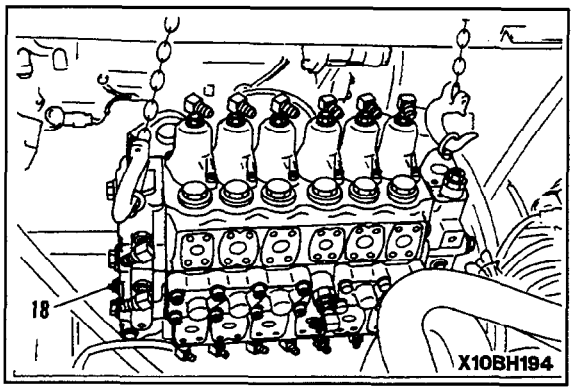


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6. Disconnect hoses (16) and (17).



7. Sling control valve assembly (18), then remove mounting bolts, and lift off control valve assembly.
   Control valve assembly: 170 kg



INSTALLATION OF CONTROL VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air
  ★ Bleed the air from the circuit between the valve and the hydraulic cylinder. For details, see TESTING AND ADJUSTING, Bleeding air.

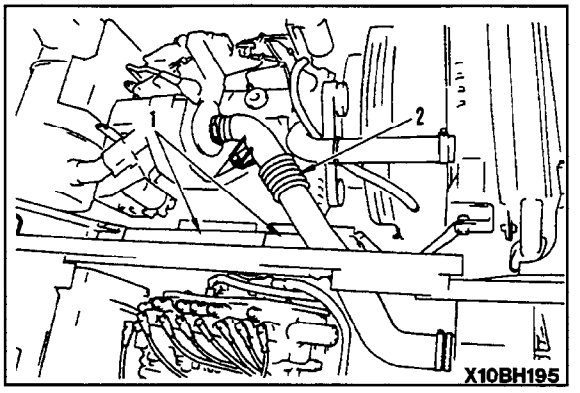
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REMOVAL OF CONTROL VALVE ASSEMBLY

★ **7-spool control valve (1 service valve)**

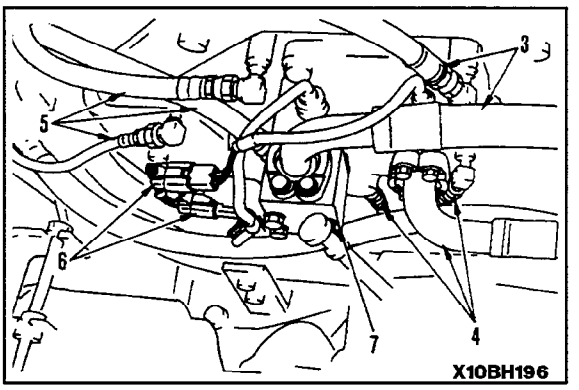
⚠ Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing pressure in hydraulic circuit.

1. Open engine hood and chassis bodywork cover, remove divider cover (1), then disconnect intake connector (2).



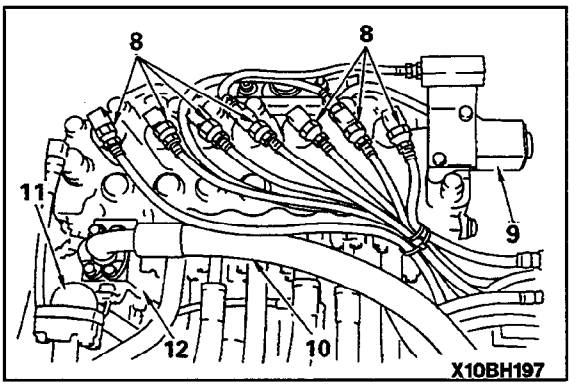
2. Disconnect hoses (3), (4), and (5), and remove 2 connectors (6) from clip, then disconnect.
   ★ Remove the hose mounting elbow from the valve body.

3. Remove block (7).

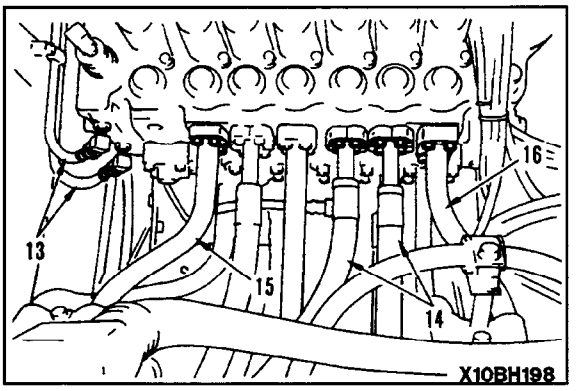


4. Disconnect hoses (8) and block (9).
   ★ When disconnecting block (9), loosen the mounting bolts of the flange for the tubes at the bottom first.

5. Disconnect hose (10), and remove tube (11) and block (12).

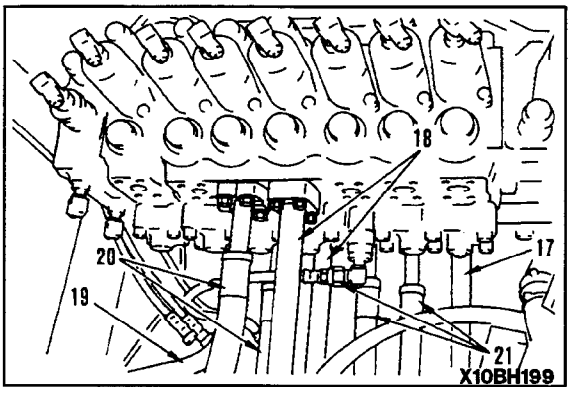


6. Disconnect hoses (13) and (14), and remove tubes (15) and (16).



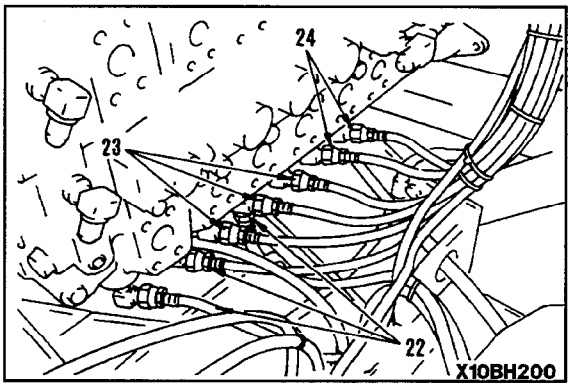
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7. Remove tubes (17), (18), and (19) and disconnect hoses (20) and (21).



8. Disconnect hoses (22), (23), and (24) mounted to bottom of valve.

9. Lift off control valve assembly (25).
   kg Control valve assembly: 185 kg



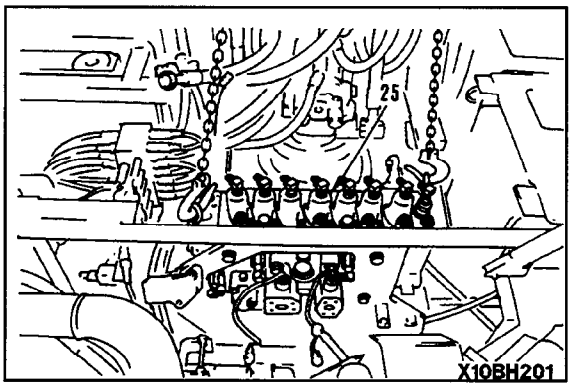
INSTALLATION OF CONTROL VALVE ASSEMBLY

★ **7-spool control valve (1 service valve)**

- Carry out installation in the reverse order to removal.

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air
  ★ Bleed the air from the circuit between the valve and the hydraulic cylinder. For details, see TESTING AND ADJUSTING, Bleeding air.



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DISASSEMBLY OF CONTROL VALVE ASSEMBLY

★ The set pressure of the safety valve and arm counterbalance valve cannot be adjusted when they are installed on the machine, so do not disassemble.
● The following explanation describes the 6-spool control valve.

1. Main relief valve, main unload ● LS relief valves
1) Remove main relief valve (1).
2) Remove main unload ● LS relief valve (3).

2. Unload valves, safety-suction valves, suction valves
1) Remove unload valves (4) and (5).
2) Remove safety-suction valves (6), (7), (8), (9), (10), and (11).
3) Remove suction valves (12), (13), (14), and (15).

3. Pressure compensation valves
★ Before moving any pressure compensation valve, check and mark its mounting position.
1) Remove bucket DUMP pressure compensation valve (16), R.H. travel REVERSE pressure compensation valve (17), boom RAISE pressure compensation valve (18), right swing pressure compensation valve (19), L.H. travel REVERSE pressure compensation valve (20), and arm IN pressure compensation valve (21).
★ After removing the pressure compensation valves, remove check valve (22) from each pressure compensation valve mount.
2) Remove bucket CURL pressure compensation valve (23), R.H. travel FORWARD pressure compensation valve (24), boom LOWER pressure compensation valve (25), left swing pressure compensation valve (26), L.H. travel FORWARD pressure compensation valve (27), and arm OUT pressure compensation valve (28).
★ After removing the pressure compensation valves, remove check valve (29) from each pressure compensation valve mount.

4. LS select valve
Remove LS select valve (30).

5. LS shuttle valves, pump merge-divider valve, arm counterbalance valve
1) Remove LS shuttle valves (31) and (32).
2) Remove pump merge-divider valve (33), then remove spring (57) and valve (58).
3) Remove arm counterbalance valve (34), then remove spring (59) and (60).

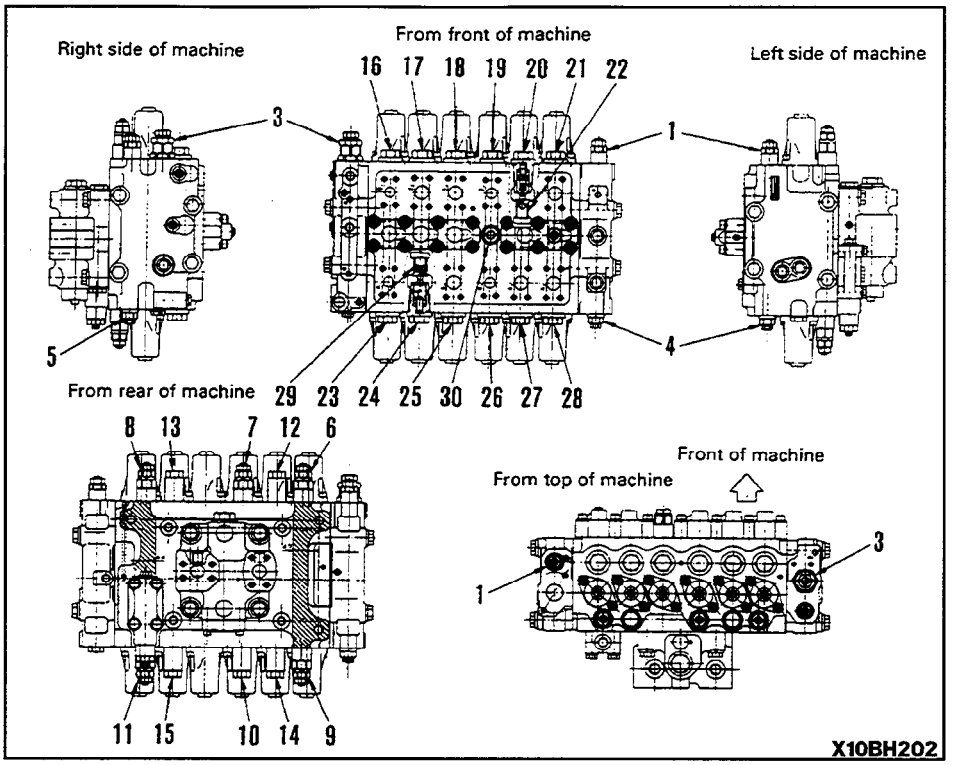
6. Remove covers (35) and (36).

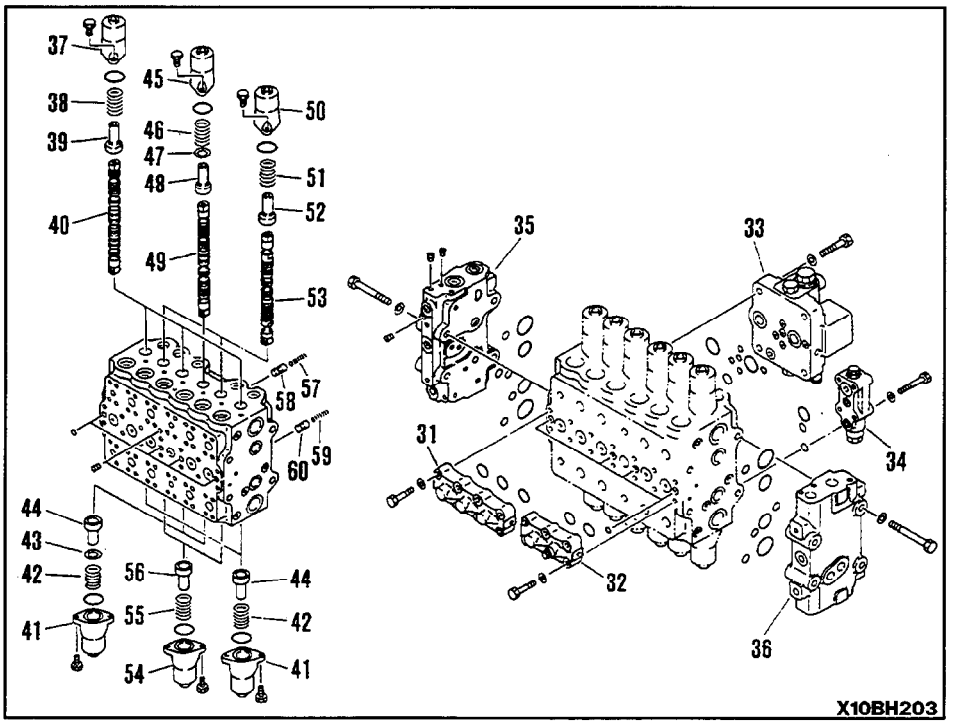
7. Arm control valve, boom control valve, bucket control valve
1) Remove case (37), then remove spring (38) and retainer (39).
2) Remove spool assembly (40).
★ Do not disassemble spool assembly (40).
3) Remove case (41), then remove spring (42), shim (43) and retainer (44).
★ Shim (43) is only for the boom control valve.

8. Swing control valve
1) Remove case (45), then remove spring (46), shim (47), and retainer (48).
2) Remove spool assembly (49).
★ Do not disassemble spool assembly (49).
3) Remove case (41), then remove spring (42) and retainer (44).

9. R.H. travel control valve, L.H. travel control valve
1) Remove case (50), then remove spring (51) and retainer (52).
2) Remove spool assembly (53).
★ Do not disassemble spool assembly (53).
3) Remove case (54), spring (55), and retainer (56).

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ASSEMBLY OF CONTROL VALVE ASSEMBLY

- **Before assembling, coat the sliding surface with engine oil.**

1. R.H. travel control valve, L.H. travel control valve

1) Assemble spool assembly (53) to valve body.
2) Assemble retainer (56) and spring (55) to spool, then fit O-ring to case (54) and install.
   Case mounting bolt: 30.9 ± 3.4 Nm (2.9 ± 0.5 kgm)
3) Assemble retainer (52) and spring (51) to spool, then fit O-ring to case (50) and install.
   Case mounting bolt: 30.9 ± 3.4 Nm (2.9 ± 0.5 kgm)

2. Swing control valve

1) Assemble spool assembly (49) to valve body.
2) Assemble retainer (44) and spring (42) to spool, then fit O-ring to case (41) and install.
   Case mounting bolt: 30.9 ± 3.4 Nm (2.9 ± 0.5 kgm)
3) Assemble retainer (48), shim (47) and spring (46) to spool, then fit O-ring to case (45) and install.
   Case mounting bolt: 30.9 ± 3.4 Nm (2.9 ± 0.5 kgm)

3. Arm control valve, boom control valve, bucket control valve

1) Assemble spool assembly (40) to valve body.
2) Assemble retainer (44), shim (43), and spring (42) to spool, then fit O-ring to case (41) and install.
   Case mounting bolt: 30.9 ± 3.4 Nm (2.9 ± 0.5 kgm)
   ★ Shim (43) is only for the boom control valve.
3) Assemble retainer (39) and spring (38) to spool, then fit O-ring to case (37) and install.
   Case mounting bolt: 30.9 ± 3.4 Nm (2.9 ± 0.5 kgm)

4. Covers

1) Fit O-ring to cover (36) and install.
2) Fit O-ring to cover (35) and install.
   Mounting bolt: 166.7 ± 9.8 Nm (17 ± 1 kgm)
   ★ Tighten the mounting bolts in the order shown in the diagram.

5. LS shuttle valve, pump merge-divider valve, arm counterbalance valve

1) Assemble valve (60) and spring (59) to valve body, and install arm counterbalance valve (34).
   Mounting bolt: 66.2 ± 7.4 Nm (6.8 ± 0.8 kgm)
   ★ Tighten the mounting bolts in the order shown in the diagram.
2) Assemble valve (58) and spring (57) to valve body, and install pump merge-divider valve (33).
   Mounting bolts: 166.3 ± 9.4 Nm (17 ± 1 kgm)
   ★ Tighten the mounting bolts in the order shown in the diagram.
3) Install LS shuttle valves (32) and (31).
   Mounting bolt: 66.2 ± 7.4 Nm (6.8 ± 0.8 kgm)

6. LS select valve

Install LS select valve (30).
LS select valve: 127.5 ± 19.6 Nm (13 ± 2 kgm)

7. Pressure compensation valves

- Check marks made on each pressure compensation valve when disassembling and install in correct position.

1) Before installing pressure compensation valves below, install check valves (29) and (22).
2) Fit O-rings, then install arm IN pressure compensation valve (28), L.H. travel FORWARD pressure compensation valve (27), left swing pressure compensation valve (26), boom LOWER pressure compensation valve (25), R.H. travel FORWARD pressure compensation valve (24), and bucket CURL pressure compensation valve (23).
3) Fit O-rings, then install arm OUT pressure compensation valve (21), L.H. travel REVERSE pressure compensation valve (20), right swing pressure compensation valve (19), boom RAISE pressure compensation valve (18), R.H. travel REVERSE pressure compensation valve (17), and bucket DUMP pressure compensation valve (16).
   Pressure compensation valve: 225.5 ± 19.6 Nm (23 ± 2 kgm)

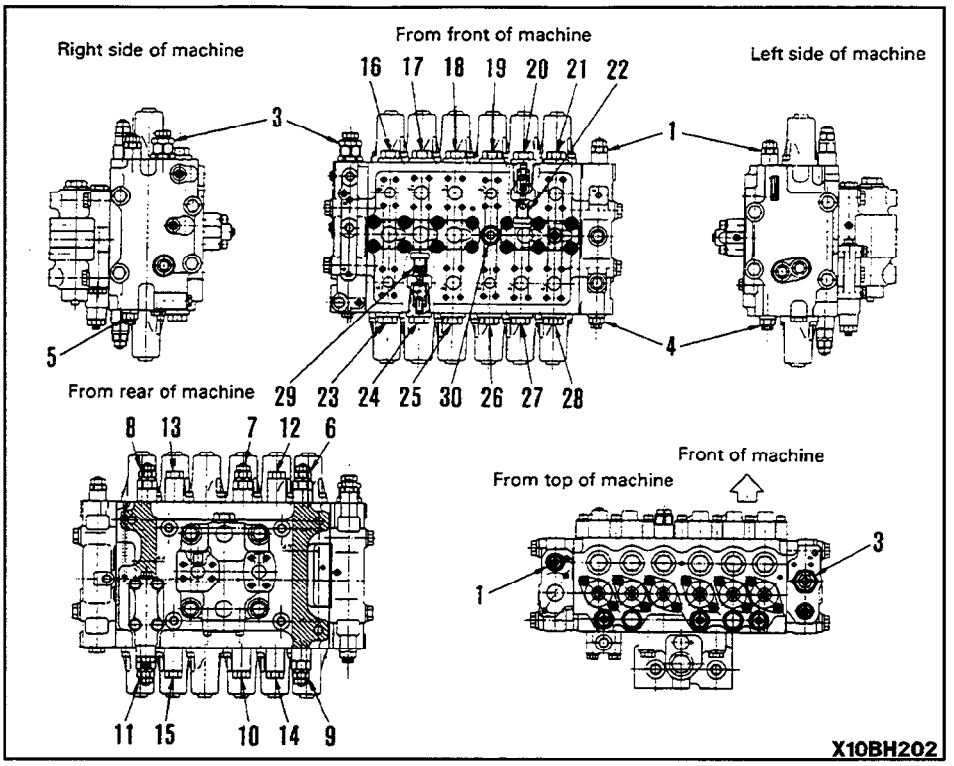
8. Unload valves, safety-suction valves, suction valves

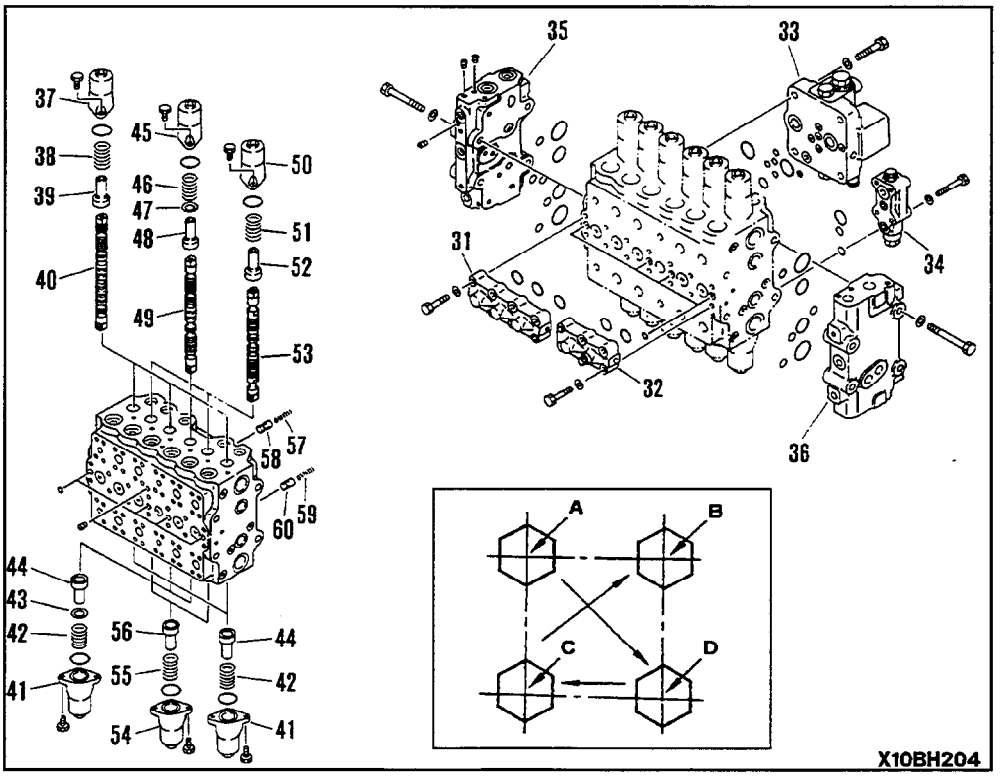
1) Fit O-rings and install suction valves (15), (14), (13) and (12).
   Suction valve: 147.1 ± 9.8 Nm (15 ± 1 kgm)
2) Fit O-ring and install safety-suction valves (11), (10), (9), (8), (7) and (6).
   Safety-suction valve: 147.1 ± 9.8 Nm (15 ± 1 kgm)
3) Fit O-ring and install unload valves (5) and (4).
   Unload valve: 98.1 ± 9.8 Nm (10 ± 1 kgm)

9. Main relief valve, main unload • LS relief valve

1) Fit O-ring and install main unload • LS relief valve (3).
   Main unload • LS relief valve: 85.9 ± 7.4 Nm (8.8 ± 0.8 kgm)
2) Fit O-ring and install main relief valve (1).
   Main relief valve: 53.9 ± 4.9 Nm (5.5 ± 0.5 kgm)

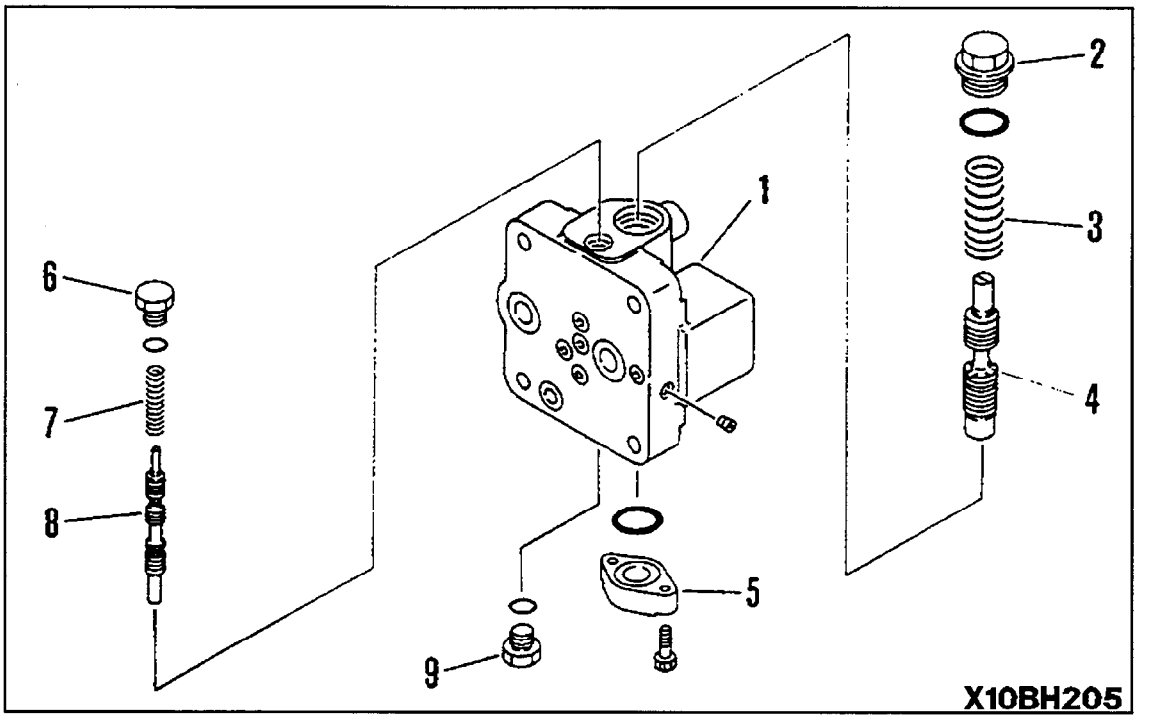
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DISASSEMBLY OF PUMP MERGE-DIVIDER VALVE ASSEMBLY



1. Remove plug (2) from valve body (1), then remove spring (3) and spool (4).
2. Remove plate (5).
3. Remove plug (6), then remove spring (7) and spool (8).
4. Remove plug (9).
   ★ After disassembling, if there is any abnormality in body (1) or spools (4) or (8), replace the whole pump merge-divider valve assembly.

ASSEMBLY OF PUMP MERGE-DIVIDER VALVE ASSEMBLY

- Before assembling, coat the sliding surface with engine oil.

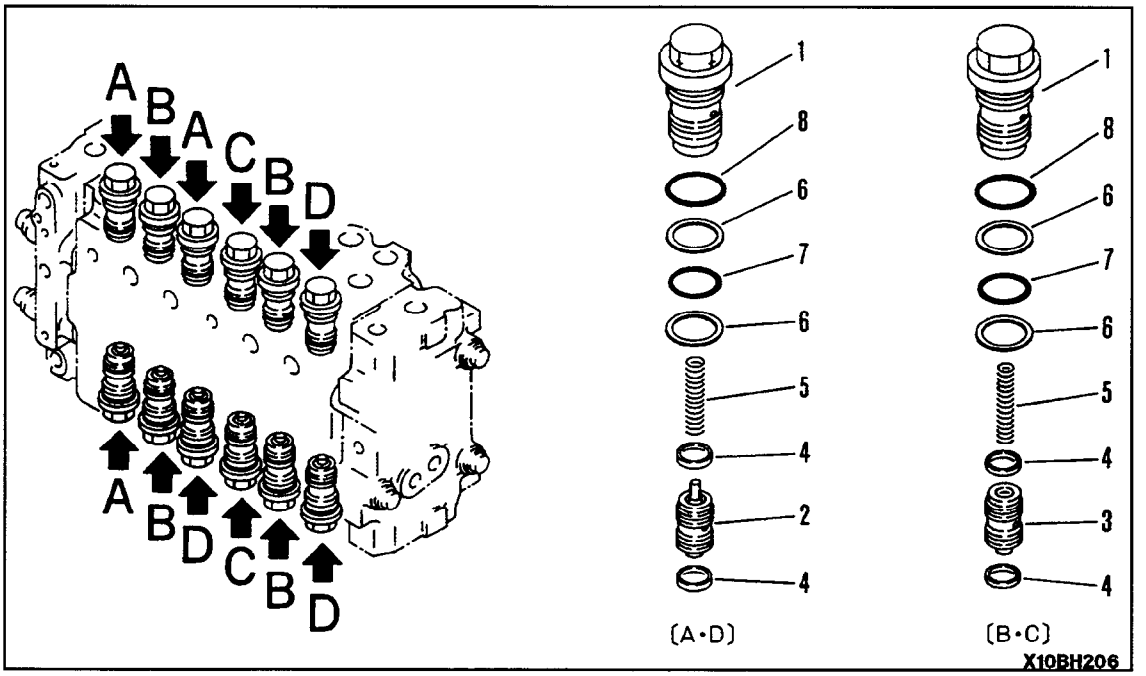
1. Fit O-ring to plug (9) and install to valve body (1).
   kgm Plug (9): 38.7 ± 5.4 Nm (4.0 ± 0.6 kgm)

2. Assemble spool (8) and spring (7), then fit O-ring to plug (6) and install.
   kgm Plug (6): 38.7 ± 5.4 Nm (4.0 ± 0.6 kgm)

3. Fit O-ring to plate (5) and install to valve body.
4. Assemble spool (4) and spring (3), then fit O-ring to plug (2) and install.
   kgm Plug (2): 152.3 ± 24.8 Nm (15.5 ± 2.5 kgm)

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DISASSEMBLY OF PRESSURE COMPENSATION VALVE ASSEMBLY



- The structure of the parts for pressure compensation valves A, B, C, and D is the same, but the part number for the assembly is different, so be careful when assembling.

1. Remove piston sub-assembly (2) and piston (3) from sleeve (1), then remove seals (4).
   ★ Sub-piston assembly (2) is assembled to pressure compensation valve A and D, and piston assembly (3) is assembled to pressure compensation valves B and C.
2. Remove spring (5), then remove ring (6) and O-rings (7) and (8) from sleeve (1).

★ After disassembling, if there is any abnormality in sleeve (1), seal (4), piston sub-assembly (2), or piston (3), replace the whole pressure compensation valve assembly.

1. Install O-rings (8) and (7), and ring (6) to sleeve (1).
2. Assemble spring (5), then assemble seals (4) to piston sub-assembly (2) and piston (3), and install to sleeve.

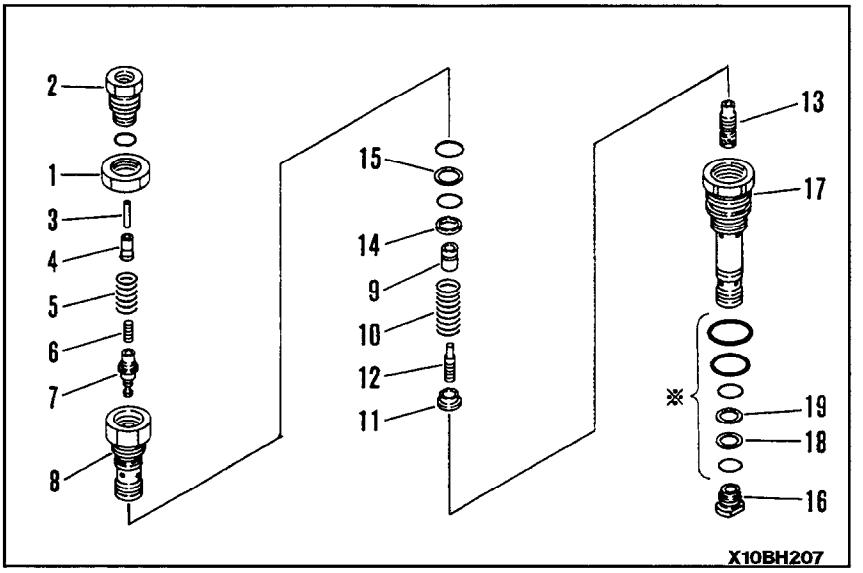
Pressure compensation valves
A: For bucket CURL/DUMP, boom RAISE
B: For R.H. travel FORWARD/REVERSE, L.H. travel FORWARD/REVERSE
C: For left/right swing
D: For boom LOWER, arm IN/OUT

ASSEMBLY OF PRESSURE COMPENSATION VALVE ASSEMBLY

- Before assembling, coat the sliding surface with engine oil.

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DISASSEMBLY OF MAIN RELIEF VALVE ASSEMBLY



1. Loosen nut (1), and remove sleeve (2), piston (3), retainer (4), spring (5), piston (6), and poppet (7), then remove nut (1) from sleeve (2).

2. Remove sleeve (8), then remove sleeve (9), spring (10), retainer (11), piston valve (12), and valve (13).

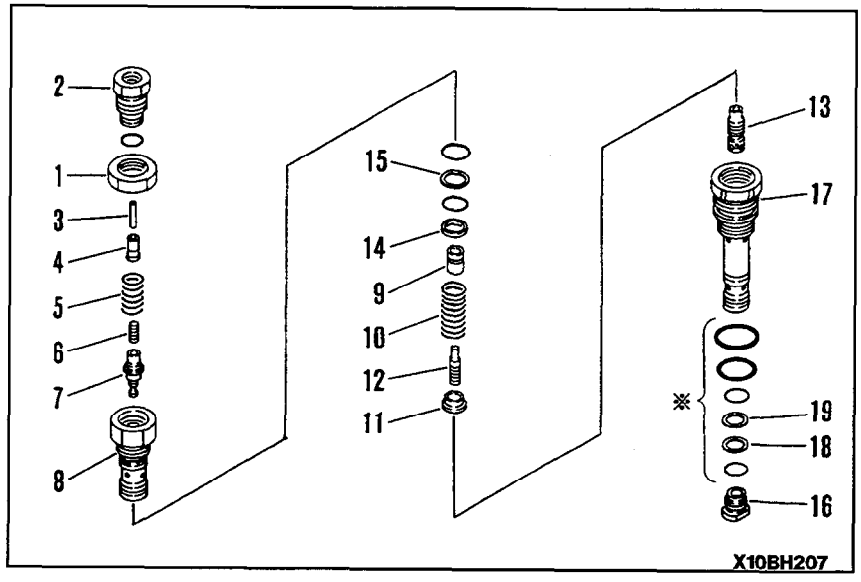
3. Remove seal (4), backup ring (15), and O-ring from sleeve (8).

4. Remove plug (16), then remove rings (18) and (19), and O-ring from sleeve (17).

★ After disassembling, if there is any abnormality in any part marked ※, replace the whole main relief valve assembly.

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ASSEMBLY OF MAIN RELIEF VALVE ASSEMBLY



- Before assembling, coat the sliding surface with engine oil.

1. Fit plug (16) to sleeve (17) and install rings (19) and (18), and O-ring.
   Plug: 22.1 ± 2.5 Nm (2.25 ± 0.25 kgm)

2. Assemble valve (13) to sleeve (17), and install piston (12), retainer (11), spring (10), and sleeve (9).

3. Install sleeve (8), and assemble poppet (7), piston (6), and spring (5).
   Sleeve: 85.9 ± 7.4 Nm (8.8 ± 0.8 kgm)

4. Assemble nut (1), O-ring, retainer (4), and piston (3) to sleeve (2), and install to sleeve (8).

5. Tighten nut (1) to specified torque.
   Nut: 68.7 ± 9.9 Nm (7 ± 1 kgm)

★ After installing to the control valve assembly, adjust the pressure. For details, see TESTING AND ADJUSTING, Testing and adjusting oil pressure of work equipment, swing, travel circuits.

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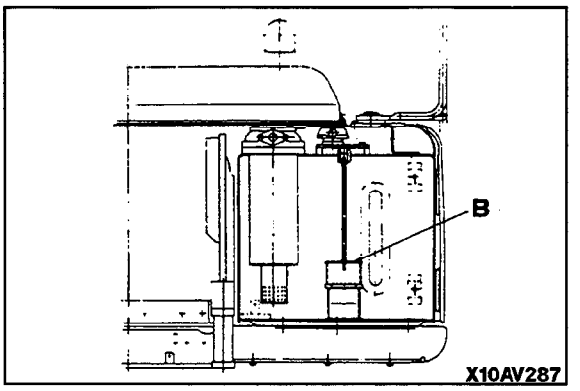
REMOVAL OF TVC • LS VALVE ASSEMBLY FOR FRONT PUMP

⚠ Disconnect the cable from the negative (-) terminal of the battery.

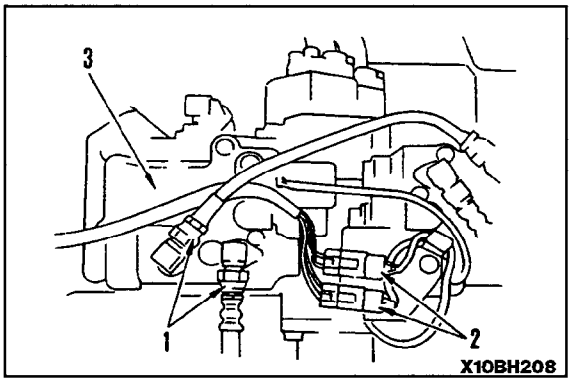
⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

- Remove the hydraulic tank strainer, and using tool **B**, stop the oil.
  - When not using tool **B**, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.

  Hydraulic tank: Approx. 170 ℓ



1. Disconnect TVC • LS valve inlet hose (1).
2. Disconnect TVC solenoid wiring connectors (2).
3. Remove TVC • LS valve assembly (3). ※1



INSTALLATION OF TVC • LS VALVE ASSEMBLY FOR FRONT PUMP

- Carry out installation in the reverse order to removal.

※1

★ Be careful not to let the O-ring or filter fall out when installing.

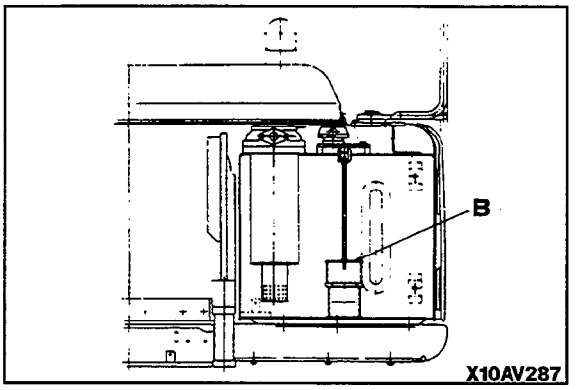
★ Tighten the mounting bolts gradually on opposite sides in turn.

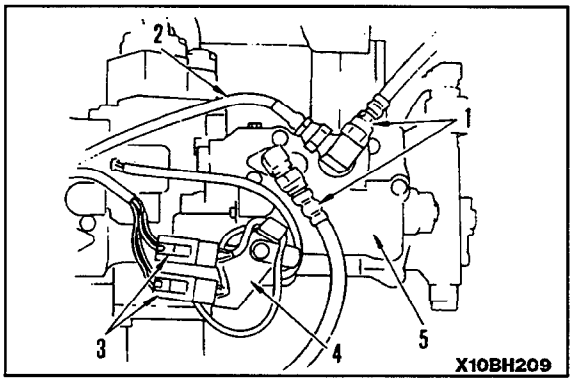
TVC • LS valve mounting bolts: 66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

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REMOVAL OF TVC • LS VALVE ASSEMBLY FOR REAR PUMP





⚠ Disconnect the cable from the negative (-) terminal of the battery.

⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

- Remove the hydraulic tank strainer, and using tool **B**, stop the oil.
  - When not using tool **B**, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.

  Hydraulic tank: Approx. 170 ℓ

1. Disconnect TVC • LS valve inlet hose (1).
2. Disconnect hose (2).
3. Disconnect TVC solenoid wiring connectors (3).
4. Remove bracket (4).
5. Remove TVC • LS valve assembly (5). ※1

INSTALLATION OF TVC • LS VALVE ASSEMBLY FOR REAR PUMP

- Carry out installation in the reverse order to removal.

※1

★ Be careful not to let the O-ring or filter fall out when installing.

★ Tighten the mounting bolts gradually on opposite sides in turn.

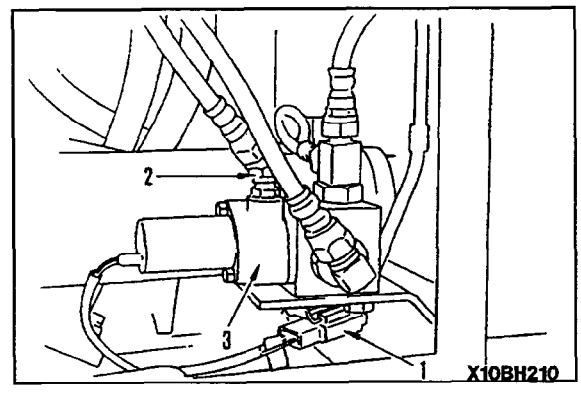
TVC • LS valve mounting bolts: 66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

- Refilling with oil (hydraulic tank)

★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

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REMOVAL OF LS CONTROL EPC VALVE ASSEMBLY



1. Remove cover.
2. Disconnect wiring connector (1).
3. Disconnect hose (2).
4. Remove LS control EPC valve assembly (3). ※1

INSTALLATION OF LS CONTROL EPC VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

LS control EPC valve mounting bolt: 11.3 ± 1.5 Nm (1.15 ± 0.15 kgm)

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REMOVAL OF SOLENOID VALVE ASSEMBLY

⚠ Disconnect the cable from the negative (-) terminal of the battery.

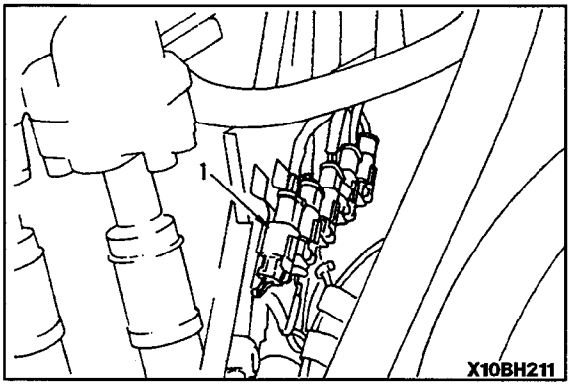
1. Remove 5 solenoid wiring connectors (1) from clip and disconnect.
   ★ Mark the male and female ends of each connector with tags to prevent mistakes when connecting.

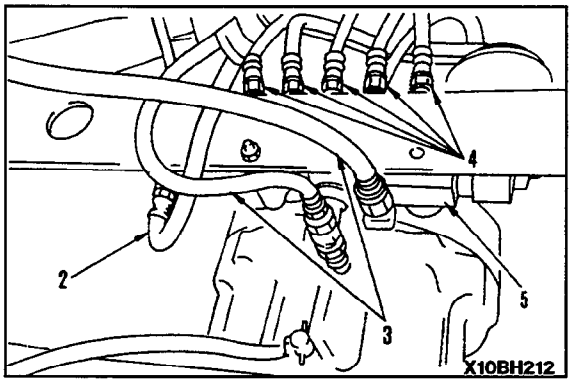
2. Disconnect hoses (2) and (3) installed to bottom of valve.
   ★ Fit tags on the hoses.

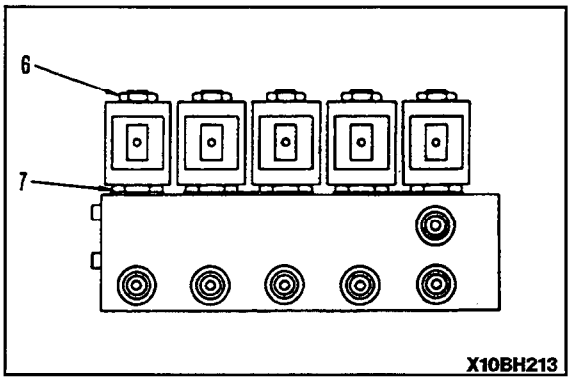
3. Disconnect hoses (4) installed to top of valve.
   ★ Fit tags on the hoses.

4. Remove mounting bolts, then remove solenoid valve assembly (5).

- When removing solenoid valve as an individual part.
  i) If mounting nut (6) is removed, only coil assembly needs to be removed. ※1
  ii) When washing valve, loosen mounting nut (7) and remove. ※2







INSTALLATION OF SOLENOID VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

kgm Nut (6): 7.4 ± 0.98 Nm (0.8 ± 0.1 kgm)

※2

kgm Nut (7): 50.5 ± 3.4 Nm (5.2 ± 0.35 kgm)

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REMOVAL OF WORK EQUIPMENT • SWING PPC VALVE ASSEMBLY

⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

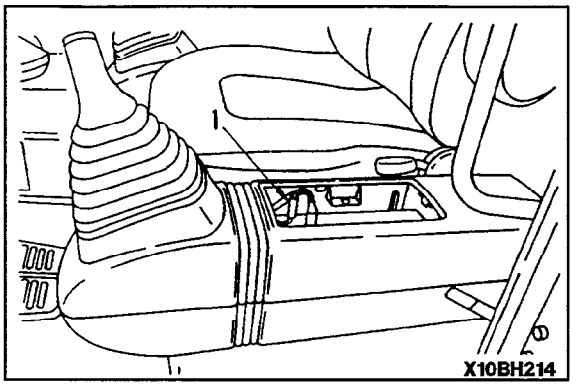
1. Remove armrest and rubber boot, remove cover, and disconnect wiring connector (1).

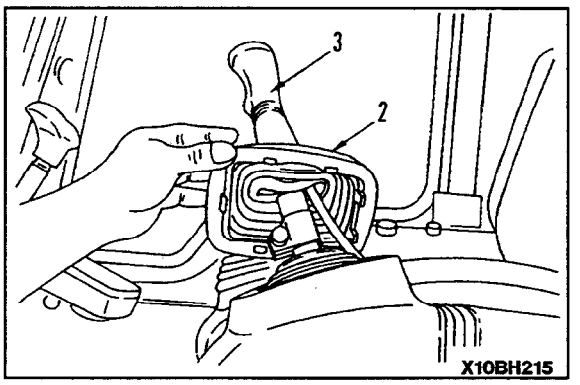
2. Remove boot (2) from cover, raise boot, then remove lever (3).
   ★ Mark the mounting position of the lever before removing.

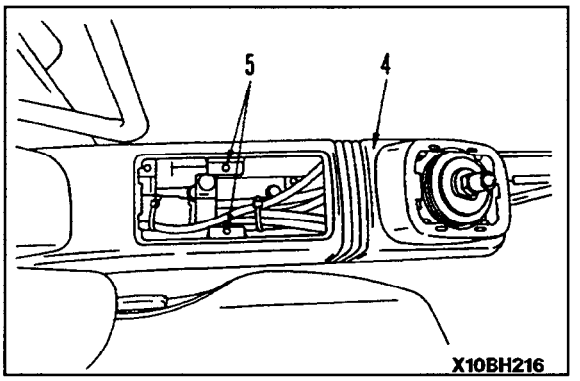
3. Remove 4 mounting bolts (5) of cover (4), then remove.
   ★ Remove the lock with a screwdriver and gradually lift the cover up to remove.

4. Remove joint bolt (6), and disconnect hose (7). ※1

5. Remove mounting bolts, raise PPC valve assembly (8), then disconnect hoses (9) and (10), and remove.
   ※2
   ★ Mark the connecting position of the hoses before disconnecting.







INSTALLATION OF WORK EQUIPMENT • SWING PPC VALVE ASSEMBLY

• Carry out installation in the reverse order to removal.

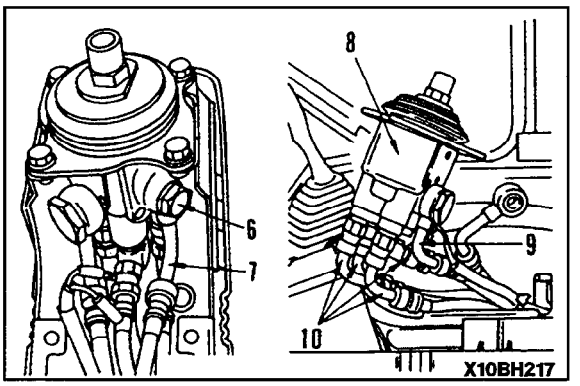
※1

kgm Hose mounting joint bolt: 29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)

※2

kgm Hose mounting joint bolt: 39.2 ± 4.9 Nm (4.0 ± 0.5 kgm)

★ If there is excessive play in the control levers, adjust the PPC valve. For details, see TESTING AND ADJUSTING, Adjusting PPC valve.



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DISASSEMBLY OF WORK EQUIPMENT • SWING PPC VALVE ASSEMBLY

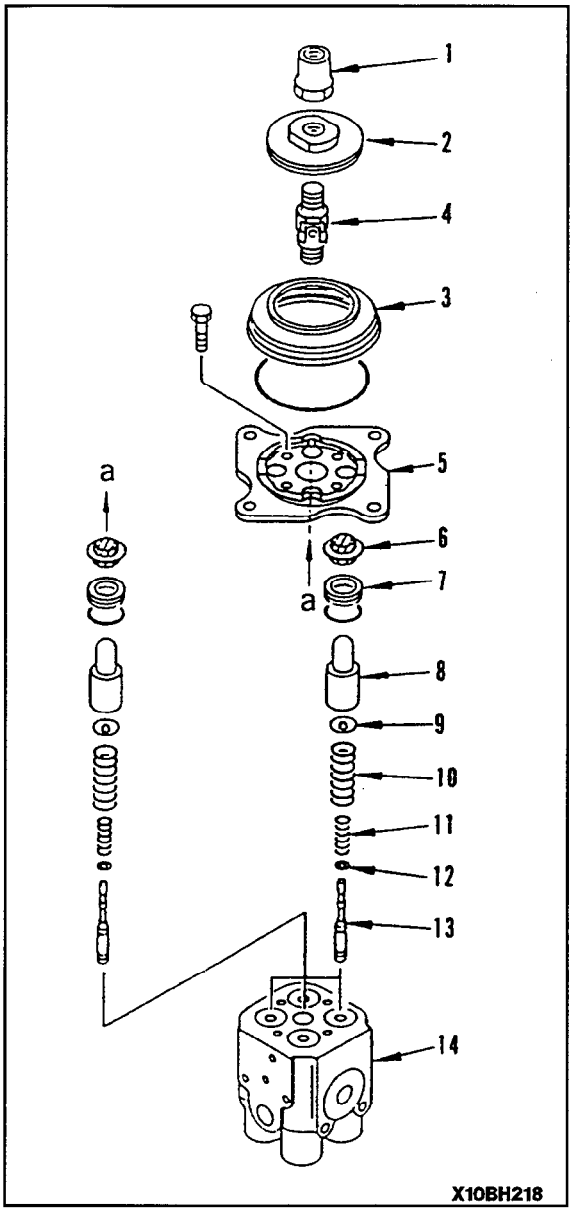
1. Remove nut (1), then remove disc (2) and boot (3).

2. Remove bolt, then remove plate (5).
   ★ Do not remove joint (4) unless it is to be replaced.

3. Remove seal (6) and collar (7).

4. Pull out piston (8), and remove retainer (9), springs (10) and (11), and shim (12).
   ★ Spring (1) consists of a set of two types of springs with different installed loads, so check the mounting position (oil port) and mark with tags to prevent mistakes when installing.

5. Pull out valve (13) from body (14).



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ASSEMBLY OF WORK EQUIPMENT • SWING PPC VALVE ASSEMBLY

1. Assemble valve (13) to body (14).

2. Assemble shim (12) and spring (11) to valve (13).
   ★ When assembling spring (11), set the end with the small coil diameter (inside diameter) at shim (12) end.

3. Assemble spring (10), retainer (9) and piston (8).
   ★ The number of loops in the coil for spring (10) is different for each of the hydraulic ports below, so be careful when installing.

Position of port	Free length of spring
P1, P2	44.4 mm
P3, P4	42.4 mm

   ★ The position of each port is marked on the bottom of the valve body.
   Piston: Grease (G2-L1)

   ★ When assembling piston (8), coat the outside of the piston and the inside of the hole in the body with grease.

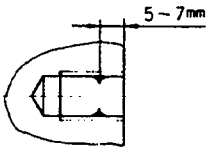
4. Fit O-ring to collar (7) and assemble in body (14), then install seal (6).

5. Install plate (5).
   Mounting bolt: 13.2 ± 1.5 Nm (1.35 ± 0.15 kgm)

6. Install joint (4).
   Sliding portion of joint: Grease (G2-L1)

   Female thread of body: Thread tightener (LT-2)

   ★ Coat two places on the female thread with one drop each of Loctite as shown in the diagram below.



X10BH219

   Joint: 44.1 ± 4.9 Nm (4.5 ± 0.5 kgm)

   ★ Keep strictly to the tightening torque.

7. Assemble boot (3) and disc (2), and tighten with nut (1).
   Nut: 112.7 ± 14.7 Nm (11.5 ± 1.5 kgm)

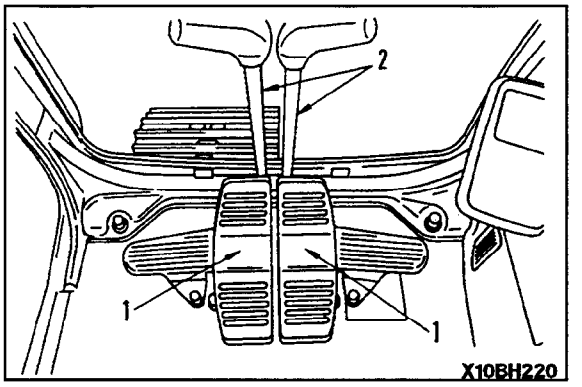
   ★ After assembling the disc, adjust the height of the disc. For details, see TESTING AND ADJUSTING, Adjusting PPC valve.

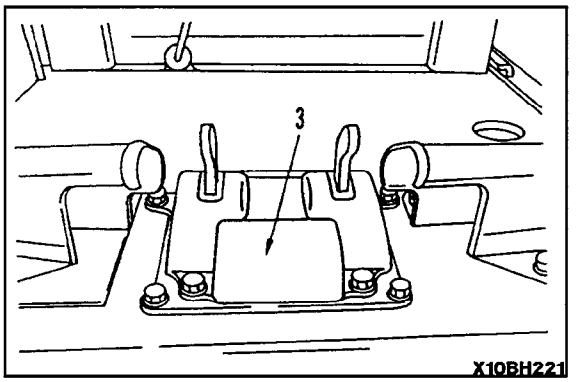
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REMOVAL OF TRAVEL PPC VALVE ASSEMBLY

⚠ Lower the work equipment completely to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then set the safety lock lever to the LOCK position.

1. Remove floor mat.
2. Remove travel PPC valve bottom cover.
3. Remove pedals (1) and levers (2). ※1
4. Remove cover (3). ※2
5. Remove covers (4), then remove springs (5).
6. Disconnect dampers (6). ※3
7. Disconnect 6 PPC hoses (7), and remove travel PPC valve assembly (8). ※4





INSTALLATION OF TRAVEL PPC VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※1
★ Adjust the travel lever. For details, see TESTING AND ADJUSTING, Adjusting travel lever.

※2

kgm Cover mounting bolt: 19.6 ± 2 Nm (2.0 ± 0.2 kgm)

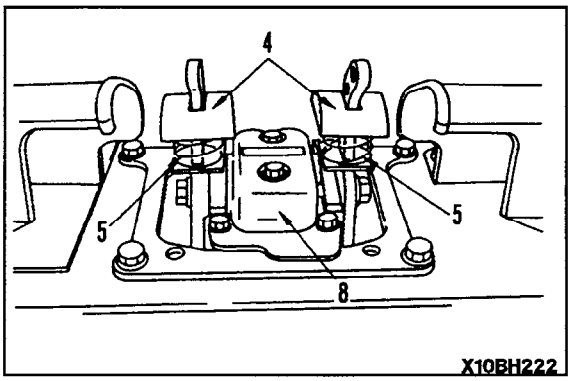
※3

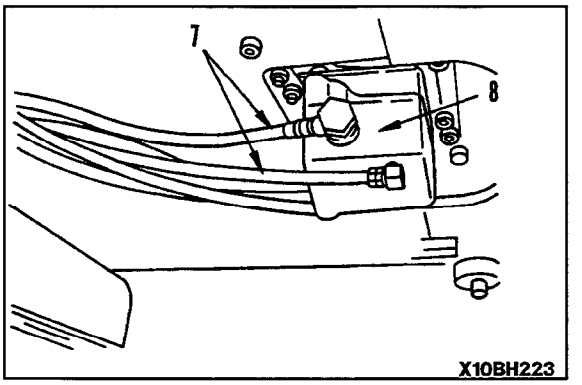
Sliding portion of pin: Grease (G2-L1)

※4

kgm Hose mounting joint bolt (width across flats: 30 mm): 39.2 ± 4.9 Nm (4.0 ± 0.5 kgm)

kgm Hose mounting joint bolt (width across flats: 22 mm): 29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)





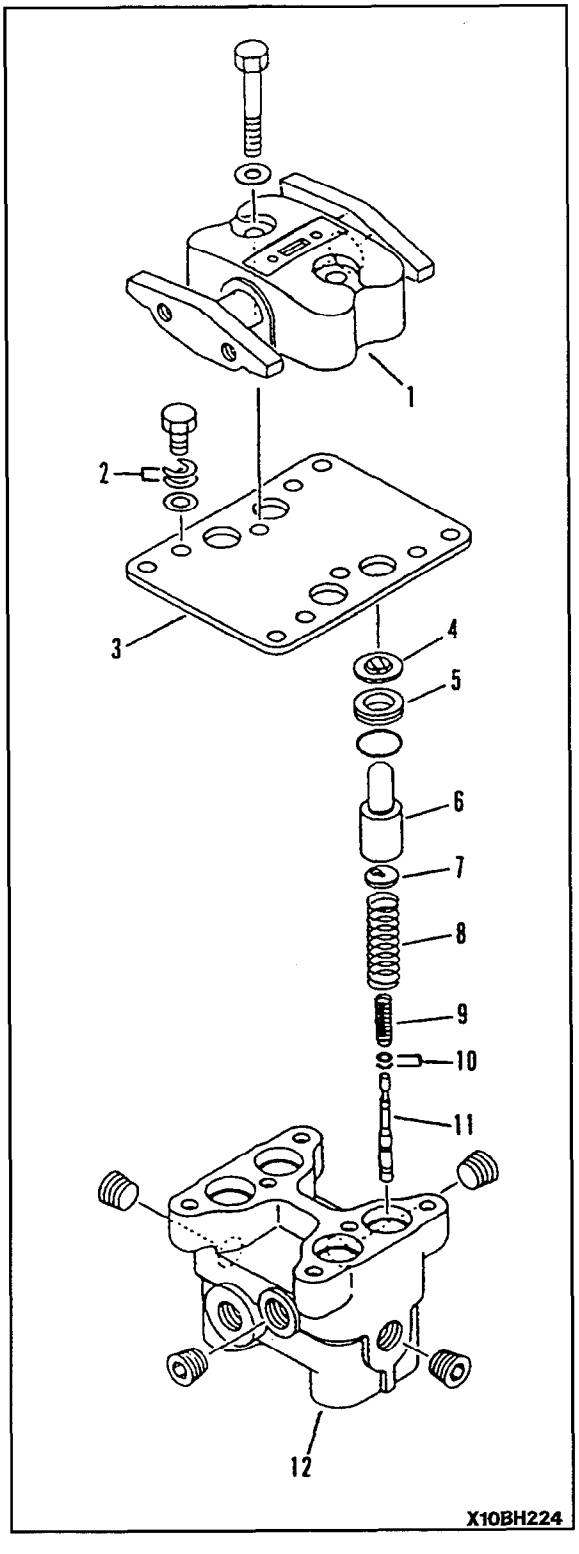
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DISASSEMBLY OF TRAVEL PPC VALVE ASSEMBLY

1. Remove cover and cam assembly (1), then remove shims (2).
   ★ Check the number and thickness of shims (2) for each mounting position, and keep in a safe place.
2. Remove plate (3).
3. Remove seal (4) and collar (5).
4. Pull out piston (6), and remove retainer (7), springs (8) and (9), and shims (10).
   ★ Check the number and thickness of shims (10) for each mounting position, and keep in a safe place.
5. Pull out valve (11) from body (12.)

ASSEMBLY OF TRAVEL PPC VALVE ASSEMBLY

1. Assemble valve (11) in body (12).
2. Assemble shims (10) and spring (9) to valve (11).
   ★ Assemble the same number and thickness of shims (10) as was removed during disassembly.
   Standard shim thickness: 0.3 mm
   ★ Spring (9) is not symmetrical at the top and bottom, so assemble with the small coil diameter (inside diameter) at the shim end.
3. Assemble spring (8), retainer (7), and piston (6).
   Outside circumference of piston, body hole: Grease (G2-L1)
4. Fit O-ring to collar (5) and assemble in body (11), then install seal (4).
5. Assemble plate (3).
6. Fit cover and cam assembly (1) and assemble shims (2), then tighten with bolt.
   Sliding portion of shaft, connecting portion of lever and piston: Grease (G2-L1)

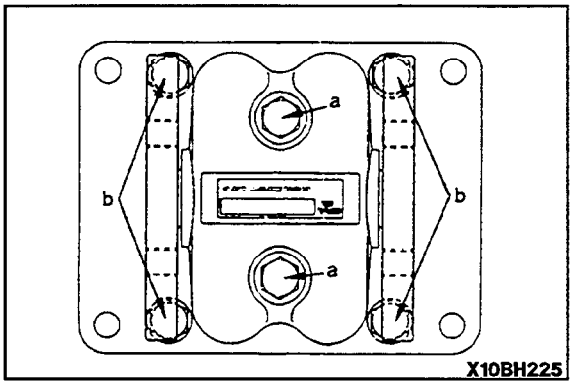


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★ Assemble the same number and thickness of shims (2) as was removed during disassembly.
Standard shim thickness: 1.6 mm

Mounting bolt (a): 27.9 ± 3.4 Nm (2.85 ± 0.35 kgm)

Mounting bolt (b): 30.9 ± 3.4 Nm (3.15 ± 0.35 kgm)

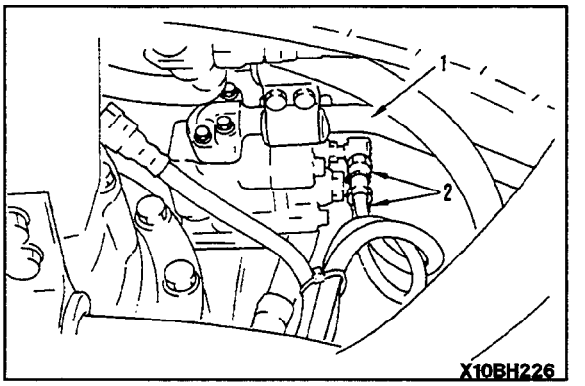


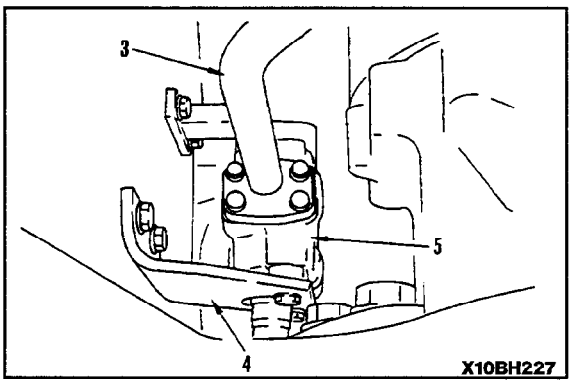
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REMOVAL OF BOOM LOCK VALVE ASSEMBLY

⚠ Lower the work equipment completely to the ground, then release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing pressure in hydraulic circuit.

1. Disconnect tube (1) and hoses (2).
2. Disconnect tube (3).
3. Remove mounting bolts of bracket (4), then remove boom lock valve (5) together with bracket (4).





INSTALLATION OF BOOM LOCK VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.
- Refilling with oil (hydraulic tank)
  - ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- Bleeding air
  - ★ Bleed the air. For details, see TESTING AND ADJUSTING, Bleeding air.

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REMOVAL OF BOOM CYLINDER ASSEMBLY

⚠ Extend the arm and bucket fully, lower the work equipment completely to the ground, and put the safety lock lever in the lock position.

1. Disconnect grease hose (1).

2. Sling boom cylinder assembly (2), and remove lock bolt (3). ※1

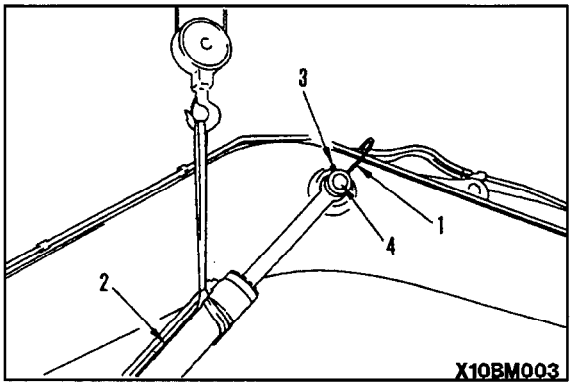
3. Remove plate, then remove head pin (4). ※2
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

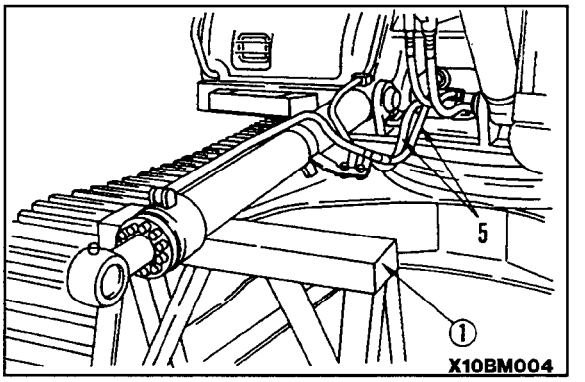
4. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out.
   ★ Set stand ① under the cylinder assembly, and adjust the position for slinging.
   ⚠ Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.

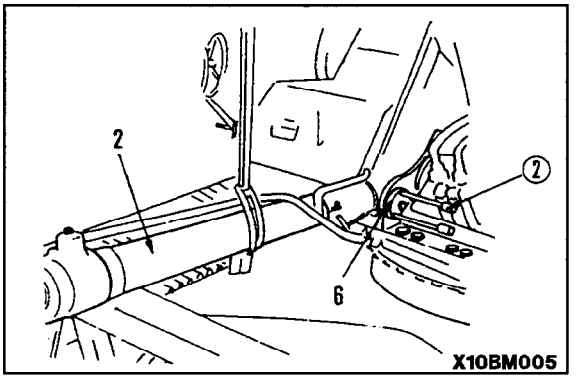
5. Disconnect hoses (5).

6. Remove plate, then using forcing screws ②, remove bottom pin (6), and remove boom cylinder assembly (2). ※3
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

   kg Boom cylinder assembly:
   PC200-6, PC210-6: 200 kg
   PC220-6, PC250-6: 255 kg







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INSTALLATION OF BOOM CYLINDER ASSEMBLY

- Carry out installation in the reverse order to removal.

※1
★ When tightening the locknut, tighten so that the clearance between the plate and nut is 0.5 - 1.5 mm.

※2

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Greasing after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.
★ Adjust the shim thickness so that the clearance between cylinder rod (7) and plate (8) is below 1 mm.
★ Standard shim thickness: 0.8 mm, 1.5 mm

※3

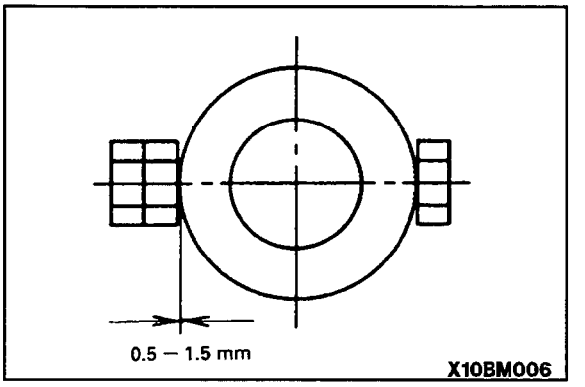
Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

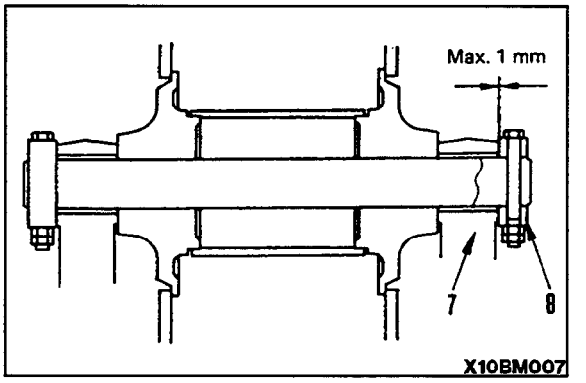
Greasing after assembling pin: Grease (LM-G)

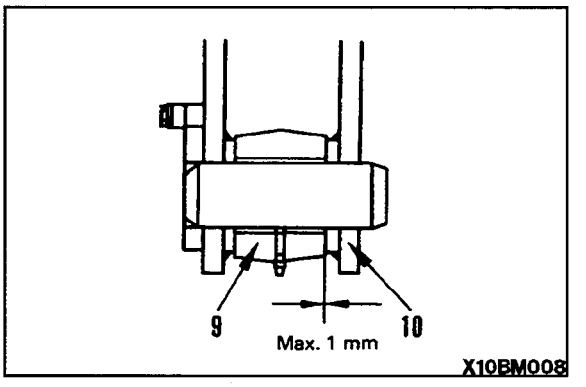
⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.
★ Adjust the shim thickness so that the clearance between cylinder bottom (9) and bracket (10) is below 1 mm.
★ Standard shim thickness: 0.8 mm, 1.5 mm

- Refilling with oil (hydraulic tank)
★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air
★ Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.

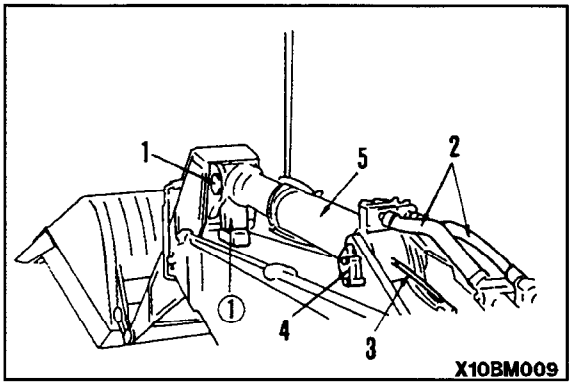






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REMOVAL OF ARM CYLINDER ASSEMBLY



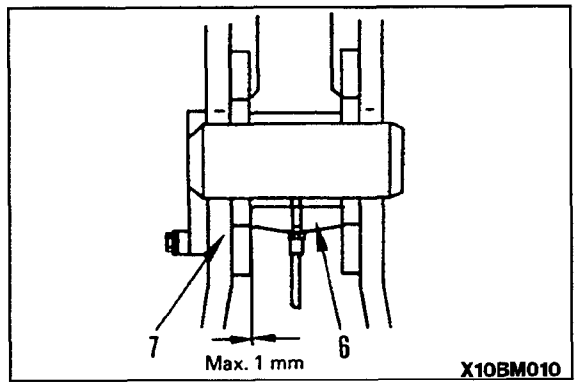
⚠ Extend the arm cylinder piston rod approx. 200 mm, lower the work equipment completely to the ground, then set the remaining safety lock lever to the LOCK position.

1. Set block ① between arm cylinder and boom.
2. Remove plate, then remove head pin (1). ※1
3. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out.
   ⚠ Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.
4. Disconnect hoses (2).
5. Disconnect grease hose (3).
6. Raise arm cylinder assembly, remove plate , remove bottom pin (4), then remove arm cylinder assembly (5). ※2
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

   kg Arm cylinder assembly:
   PC200-6, PC210-6: 270 kg
   PC220-6, PC250-6: 310 kg

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INSTALLATION OF ARM CYLINDER ASSEMBLY



- Carry out installation in the reverse order to removal.

※1

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Greasing after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

※2

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Greasing after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between cylinder boom (6) and bracket (7) is below 1 mm.
  ★ Standard shim thickness: 0.8 mm, 1.5 mm

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

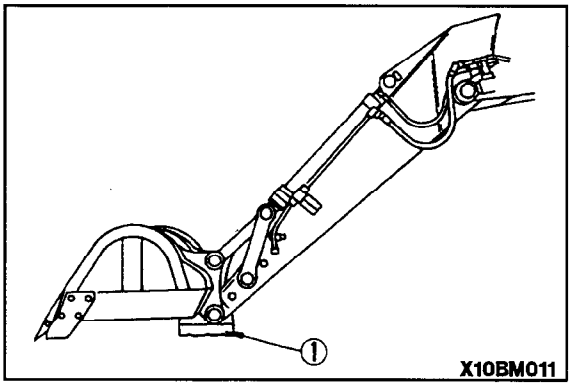
- Bleeding air
  ★ Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.

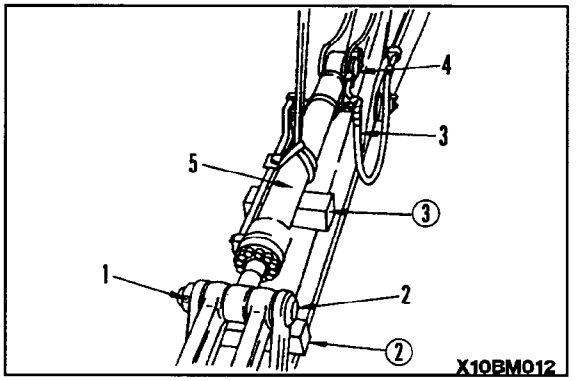
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REMOVAL OF BUCKET CYLINDER ASSEMBLY

⚠ Extend the bucket cylinder piston rod approx. 200 mm, lower the work equipment completely to the ground, then set the safety lock lever to the LOCK position.

1. Set block ① under arm top.
2. Set block ② between link and arm, and block ③ between bucket cylinder and arm.
3. Remove lock bolt (1). ※1
4. Remove plate, then remove head pin (2). ※2
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.
5. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out.
   ⚠ Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.
6. Disconnect 2 hoses (3).
7. Raise bucket cylinder assembly, remove plate, remove bottom pin (4), then remove bucket cylinder assembly (5). ※3
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.
   kg Bucket cylinder assembly:
   PC200-6, PC210-6: 170 kg
   PC220-6, PC250-6: 200 kg





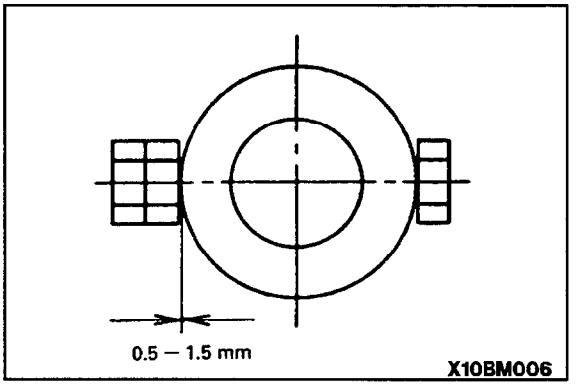
https://truckmanualshub.com/

INSTALLATION OF BUCKET CYLINDER ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

★ When tightening the locknut, tighten so that the clearance between the plate and nut is 0.5 - 1.5 mm.



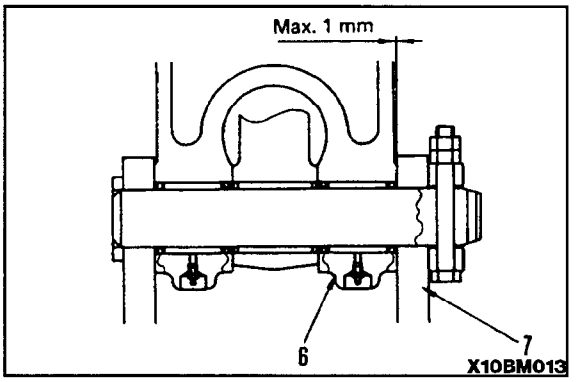
※2

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Greasing after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between link (6) and link (7) is below 1 mm.
  ★ Standard shim thickness: 0.8 mm, 1.5 mm



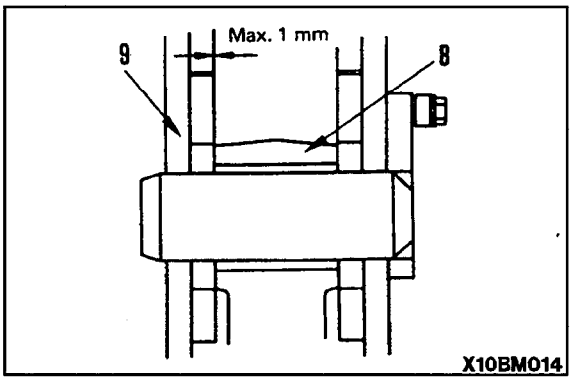
※3

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Greasing after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between the cylinder bottom (8) and bracket (9) is below 1 mm.
  ★ Standard shim thickness: 0.8 mm, 1.5 mm



- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air
  ★ Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.

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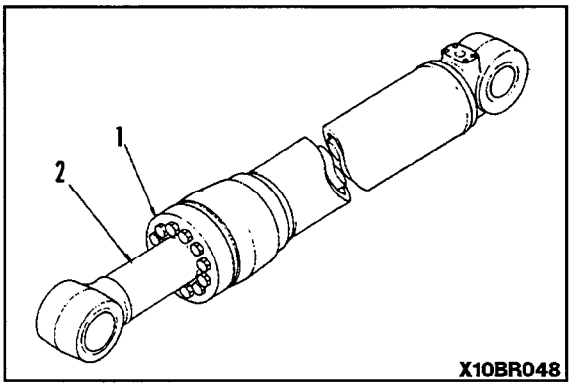
DISASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

1. Piston rod assembly

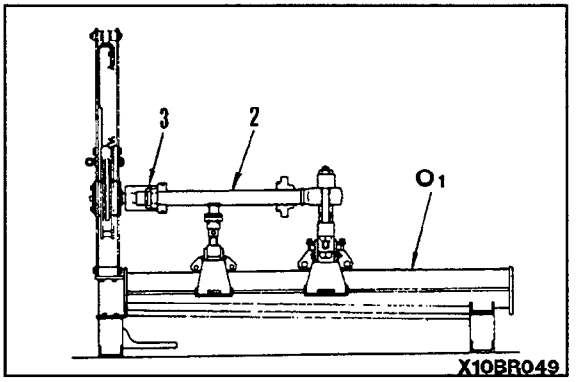
1) Remove piping from cylinder assembly.
2) Remove mounting bolts, and disconnect head assembly (1).
3) Pull out piston rod assembly (2).
   ★ Place a container to catch the oil under the cylinder.
4) Disassemble piston rod assembly as follows.
   i) Set piston rod assembly (2) in tool O_1.
   ii) Using tool O_2, remove nut (3).
   ★ Width across flats of nut. Unit: mm

Model	Cylinder		
	Boom	Arm	Bucket
PC200, PC210	95	95	85
PC220, PC250	95	95	95

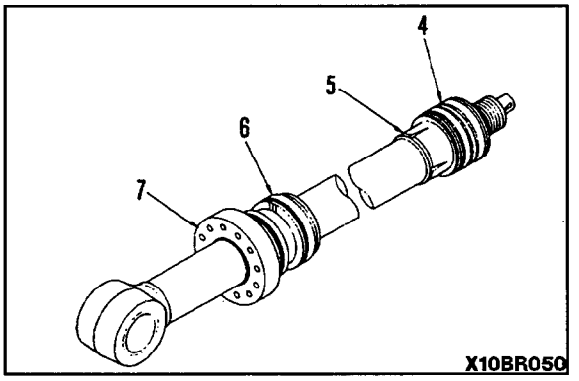
   iii) Remove piston assembly (4).
   iv) Remove plunger (5).
   ● Boom and arm cylinder only.
   v) Remove collar (6).
   ● Boom and arm cylinder only.
   vi) Remove head assembly (7).
   vii) Remove cap (8), and pull out 12 balls (9), then remove plunger (10).
   ● Arm cylinder only.



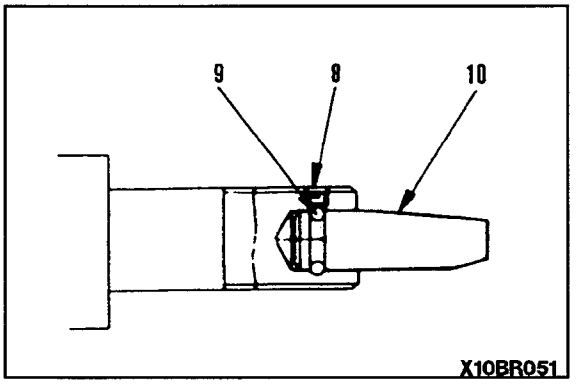
X10BR048



X10BR049



X10BR050

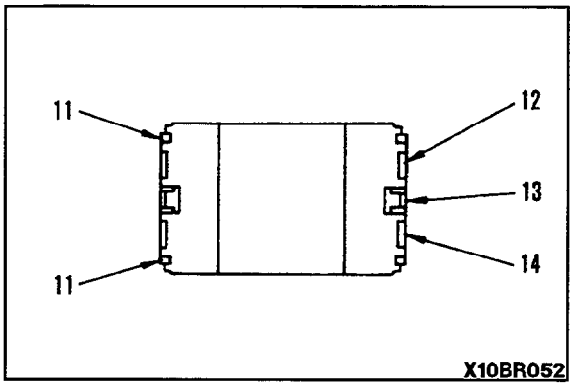


X10BR051

https://truckmanualshub.com/

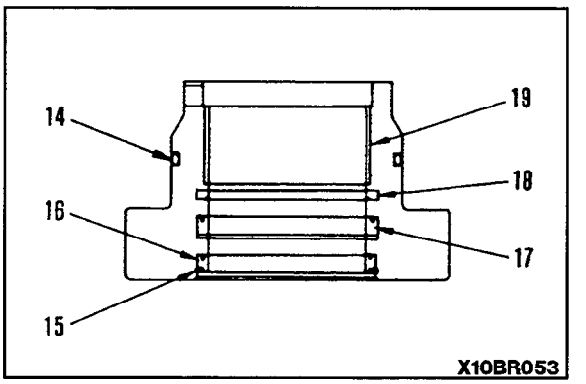
2. Disassembly of piston assembly

1) Remove rings (11).
2) Remove wear rings (12).
3) Remove piston ring (13).



3. Disassembly of cylinder head assembly

1) Remove O-ring and backup ring (14).
2) Remove snap ring (15), then remove dust seal (16).
3) Remove rod packing (17).
4) Remove buffer ring (18).
5) Remove bushing (19).



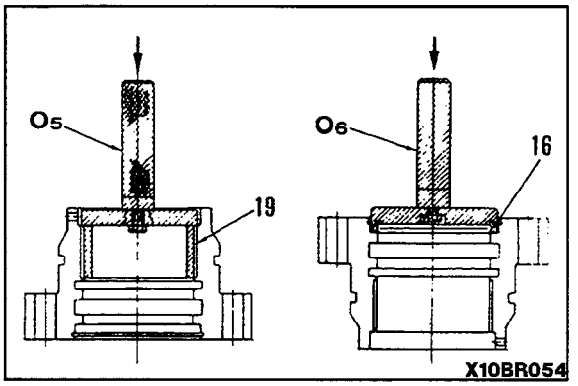
https://truckmanualshub.com/

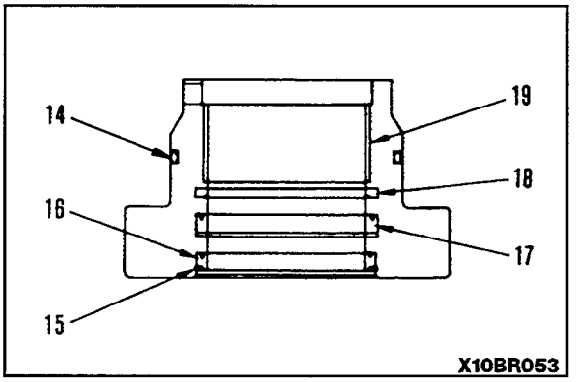
ASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

★ Be careful not to damage the packing, dust seals, and O-rings.
★ Do not try to force the backup ring into position. Warm it in warm water (50 - 60°C) before fitting it.

1. Assembly of cylinder head assembly

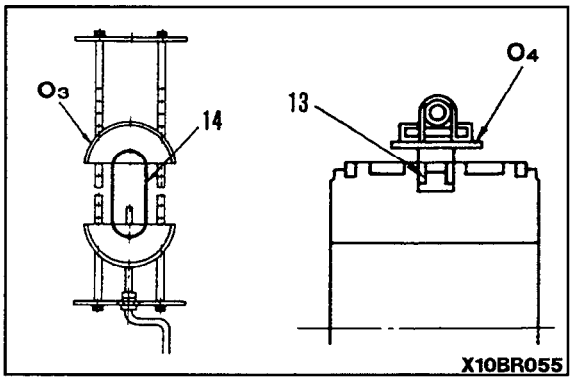
1) Using tool **O_5**, press fit bushing (19).
2) Assemble buffer ring (18).
3) Assemble rod packing (17).
4) Using tool **O_6**, install dust seal (16), and secure with snap ring (15).
5) Install backup ring and O-ring (14).





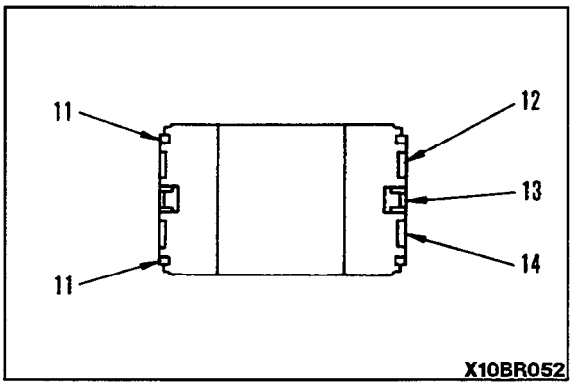
2. Assembly of piston assembly

1) Using tool **O_3**, expand piston ring (13).
   ★ Set the piston ring on the tool **O_3**, and turn the handle 8 - 10 times to compress the ring.
2) Set tool **O_4** in position, and retract piston ring (13).



3) Assemble wear ring (12).
4) Assemble ring (11).
   ★ Be careful not to open the end gap of the ring too wide.

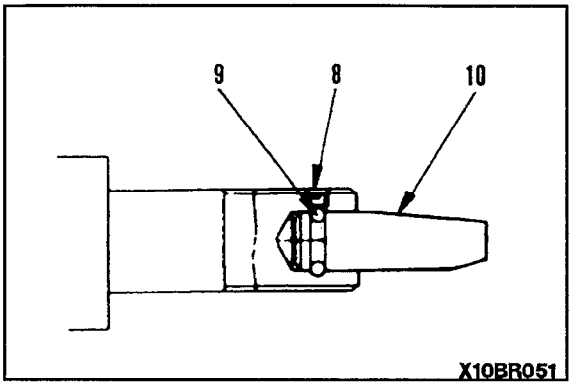
Ring groove: Grease (G2-L1)



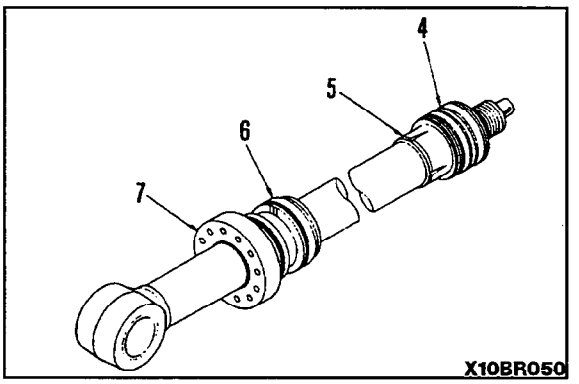
https://truckmanualshub.com/

3. Piston rod assembly

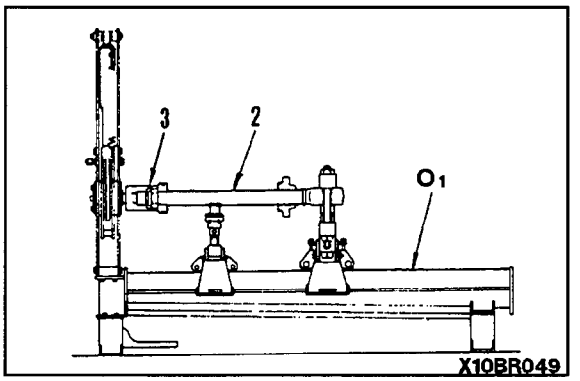
1) Set plunger (10) to piston rod, and assemble 12 balls (9), then secure with cap (8).
   ★ Check that there is a slight play at the tip of the plunger.
   • Arm cylinder only.



2) Assemble head assembly (7).
3) Fit O-ring and backup ring, and assemble collar (6).
   • Boom and arm cylinder only.
4) Assemble plunger (5).
   • Boom and arm cylinder only.
5) Assemble piston assembly (4).



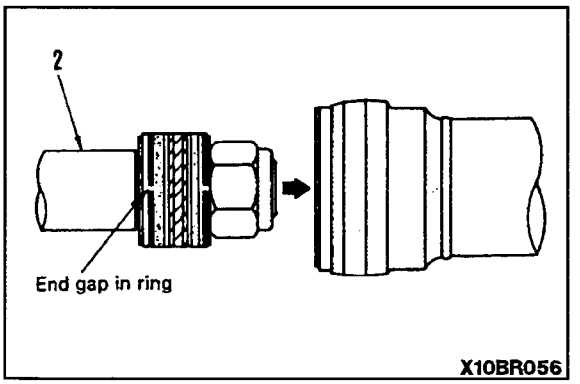
6) Set piston rod assembly (2) to tool **O₁**.
7) Using tool **O₂**, tighten nut (3).
   Nut: Thread tightener (LT-2)
   Nut:



Unit: Nm (kgm)

Model	Cylinder		
	Boom	Arm	Bucket
PC200 PC210	8.6 ± 0.9 (880 ± 88)	10.2 ± 1.0 (1,040 ± 104)	7.1 ± 0.7 (720 ± 72)
PC220 PC250	10.2 ± 1.0 (1,040 ± 104)	10.2 ± 1.0 (1,040 ± 104)	10.2 ± 1.0 (1,040 ± 104)

8) Assemble piston rod assembly (2).
   Seal: Grease (G2-L1)

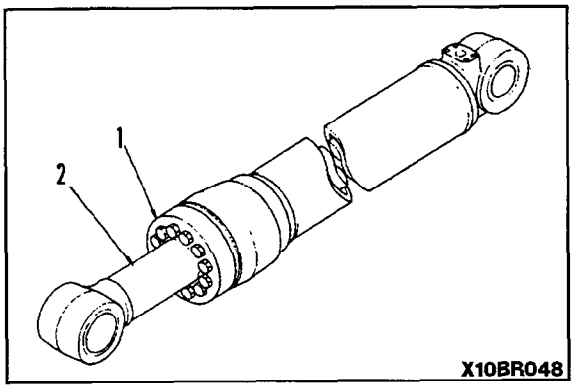


   ★ Set the end gap of the ring at the horizontal (side) position, align the center of shaft and cylinder tube, then insert.
   ★ After inserting, check that the ring is not broken and has not come out, then push in fully.

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9) Tighten head assembly (1) with mounting bolts.
Mounting bolt:

Cylinder	Tightening torque
PC200, PC210 Boom	270 ± 39 Nm (27.5 ± 4.0 kgm)
PC220, PC250 Boom	373 ± 54 Nm (38.0 ± 5.5 kgm)
Arm	373 ± 54 Nm (38.0 ± 5.5 kgm)
Bucket	270 ± 39 Nm (27.5 ± 4.0 kgm)



10) Install piping.

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REMOVAL OF WORK EQUIPMENT ASSEMBLY

⚠ Extend the arm and bucket fully, lower the work equipment to the ground, and set the safety lock lever to the LOCK position.

1. Disconnect grease hose (1).

2. Sling boom cylinder assembly (2), and remove lock bolt (3). ※1

3. Remove plate, then remove head pin (4). ※2
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

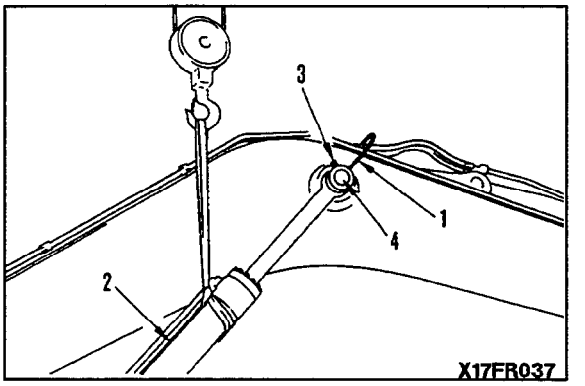
4. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out, and lower it onto block.
   ★ Disconnect the boom cylinder on the opposite side in the same way.
   ⚠ Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.

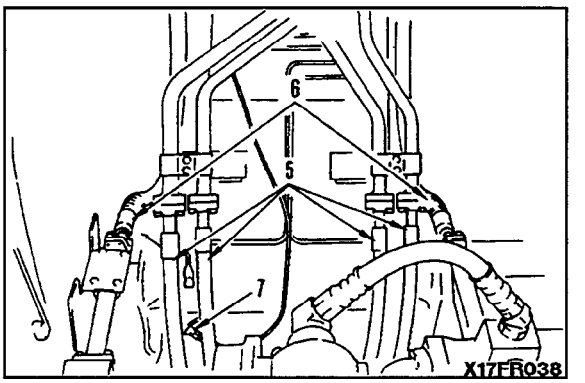
5. Disconnect hoses (5) and (6), and secure it to valve with rope.
   ★ Hoses (6) are for machines equipped with an additional attachment circuit.

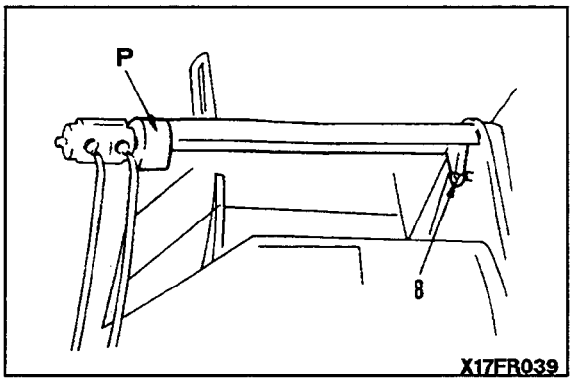
6. Disconnect wiring connector (7) for working lamp.

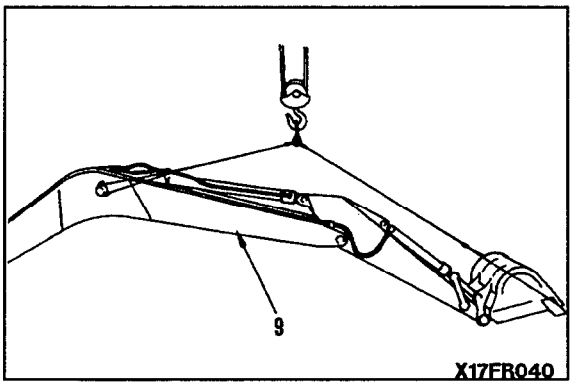
7. Sling work equipment assembly, remove plate, then remove foot pin (8) using tool **P**, and remove work equipment assembly (9). ※3
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

   kg
   Work equipment assembly:
   PC200-6: 3,300 kg
   PC210-6: 3,650 kg
   PC220-6: 3,850 kg
   PC250-6: 4,250 kg









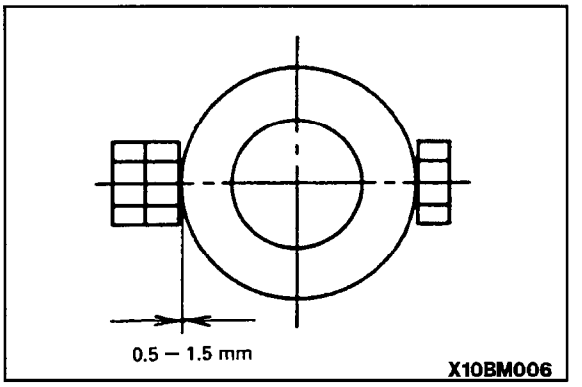
https://truckmanualshub.com/

INSTALLATION OF WORK EQUIPMENT ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

★ When tightening the locknut, tighten so that the clearance between the plate and nut is 0.5 - 1.5 mm.



※2

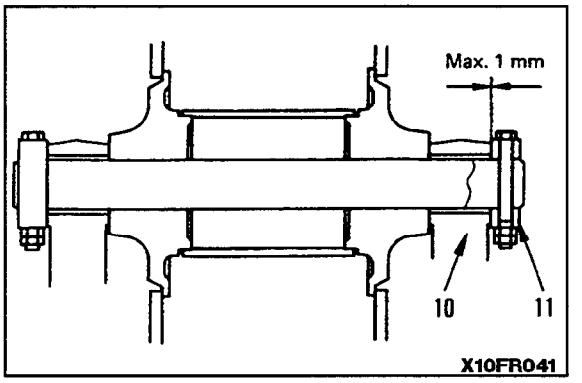
Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between cylinder rod (10) and plate (11) is below 1 mm.

★ Standard shim thickness: 0.8 mm, 1.5 mm



※3

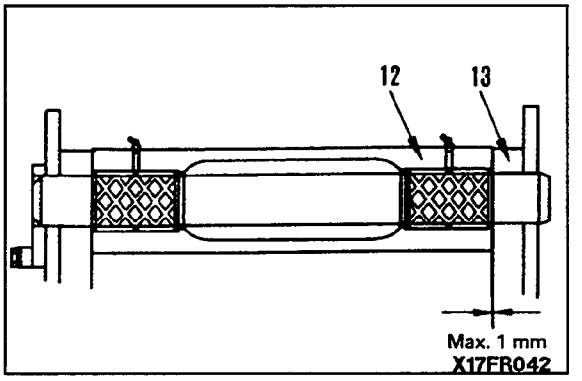
Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between boom (12) and bracket (13) is below 1 mm.

★ Standard shim thickness: 0.8 mm, 1.0 mm, 1.5 mm



- Refilling with oil (hydraulic tank)
  - ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

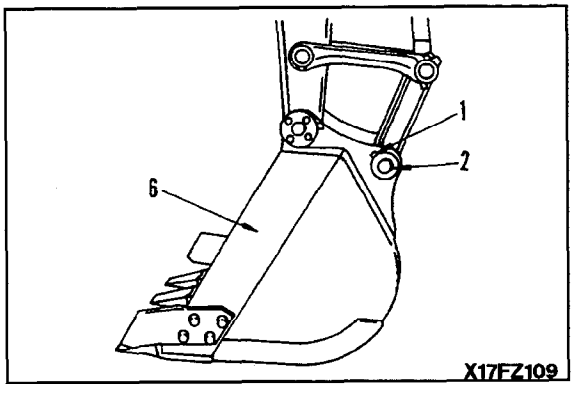
- Bleeding air
  - ★ Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.

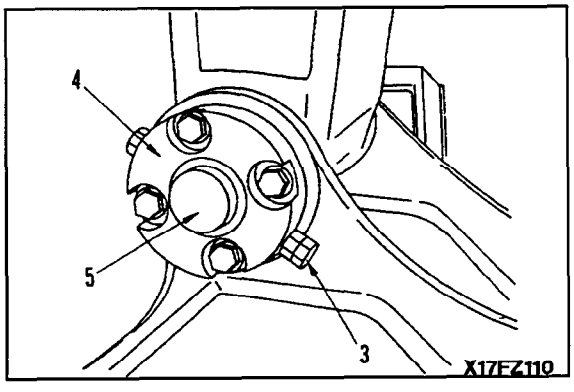
https://truckmanualshub.com/

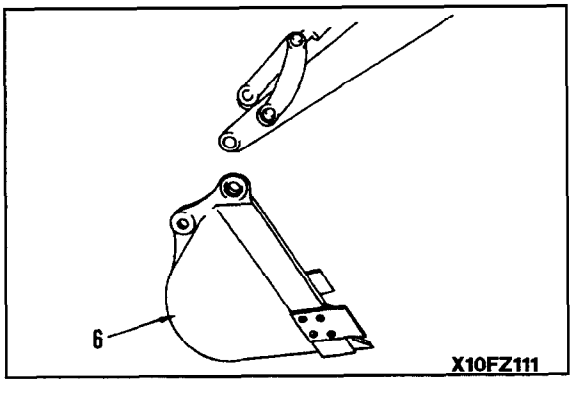
REMOVAL OF BUCKET ASSEMBLY

⚠ Set the back of the bucket facing down, lower the work equipment completely to the ground, and set the safety lock lever to the LOCK position.

1. Remove lock bolt (1). ※1
2. Remove connecting pin (2) between link and bucket. ※2
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.
3. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out.
4. Remove lock bolt (3). ※3
5. Remove plate (4), then remove connecting pin (5) between arm and bucket. ※4
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.
6. After raising work equipment, swing to disconnect bucket assembly (6).
   kg Bucket assembly: See your Operator's Manual, beginning on page 5-16.







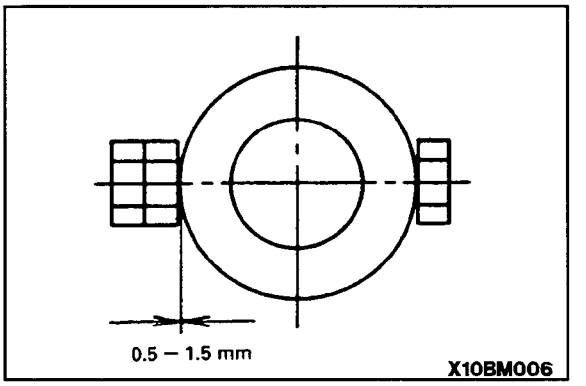
https://truckmanualshub.com/

INSTALLATION OF BUCKET ASSEMBLY

- Carry out installation in the reverse order to removal.

※1 ※3

★ When tightening the locknut, tighten so that the clearance between the plate and the nut is 0.5 - 1.5 mm.



※2

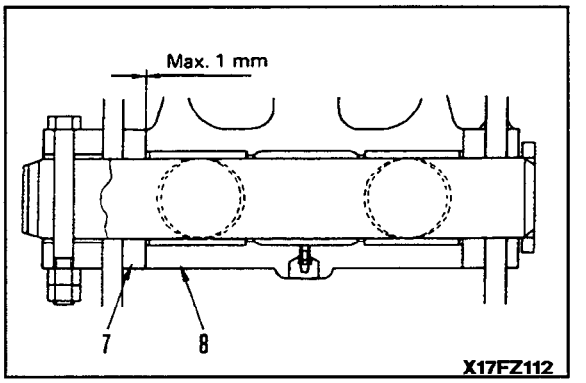
Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between bucket boss (7) and link (8) is below 1 mm.

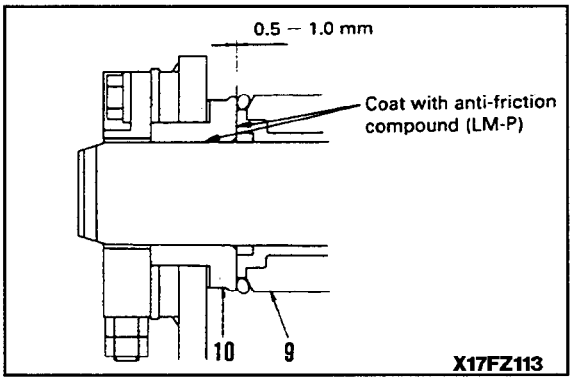
★ Standard shim thickness: 0.8 mm, 1.5 mm



※4

Inside surface of bushing when assembling pin, inside surface, end face of collar (10): Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)



⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

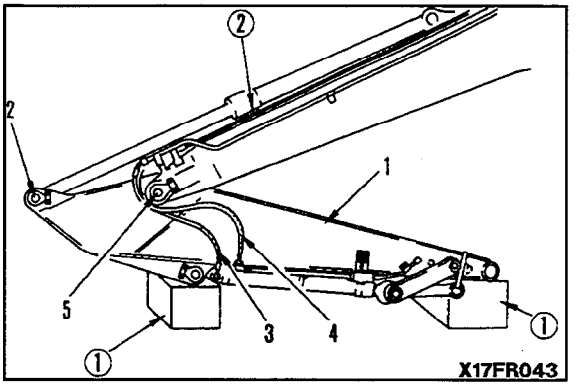
★ Set the O-ring at the end face of the bucket boss securely.

★ Adjust the shim thickness so that the clearance between arm top (9) and spacer (10) is 0.5 - 1.0 mm.

★ Standard shim thickness: 0.5 mm, 1.0 mm

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REMOVAL OF ARM ASSEMBLY



1. Remove bucket assembly. For details, see REMOVAL OF BUCKET ASSEMBLY.

2. Secure front link to arm with wire.

3. Pull in arm so that it is easy to remove pin at arm cylinder head, then lower arm and bucket cylinder assembly (1) on to block ①.
   ⚠ Set the safety lock lever to the LOCK position.

4. Set block ② between arm cylinder and boom.

5. Remove plate, then remove arm cylinder head pin (2). ※1

6. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out.
   ⚠ Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.

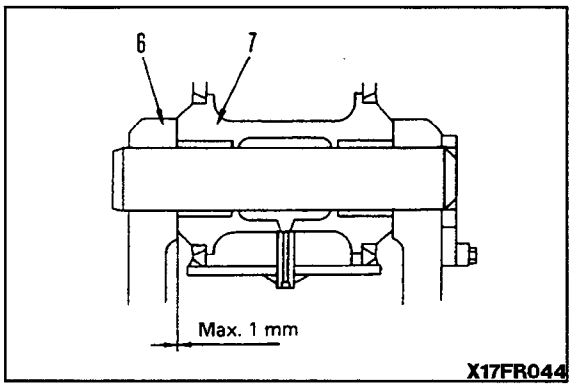
7. Disconnect 2 hoses (3) and 2 hoses (4).
   ★ Install blind plugs at the male end and in the disconnected hoses.
   ★ Hoses (4) are for machines equipped with an additional attachment circuit.

8. Remove plate, then remove connecting pin (5) between arm and boom. ※2
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

9. After raising boom, swing to remove arm and bucket cylinder assembly (1).
   kg
   Arm, bucket cylinder assembly:
   PC200-6: 950 kg
   PC210-6: 1,100 kg
   PC220-6: 1,100 kg
   PC250-6: 1,250 kg

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INSTALLATION OF ARM ASSEMBLY



- Carry out installation in the reverse order to removal.

※1

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

※2

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between boom top (6) and arm bottom (7) is below 1 mm.
  ★ Standard shim thickness: 0.8 mm

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air
  ★ Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.

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REMOVAL OF BUCKET • ARM ASSEMBLY

⚠ Extend the arm cylinder piston rod approx. 200 mm, lower the work equipment completely to the ground, then set the safety lock lever to the LOCK position.

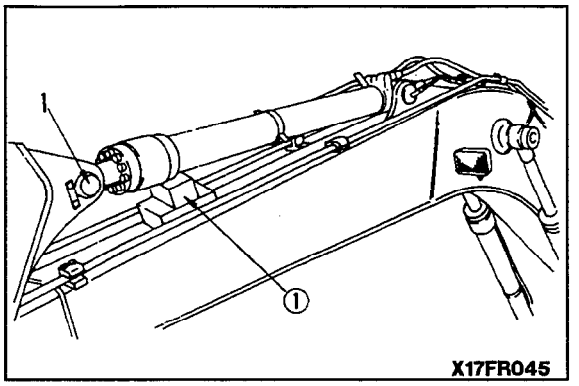
1. Set block ① between arm cylinder and boom.

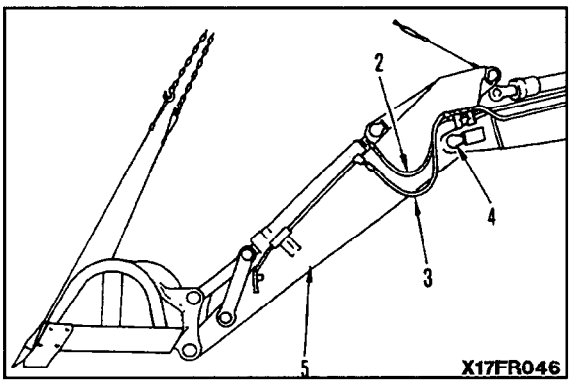
2. Remove plate, then remove arm cylinder head pin (1). ※1

3. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out.
   ⚠ Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.

4. Disconnect 2 hoses (2) and 2 hoses (3).
   ★ Install blind plugs at the male end and in the disconnected hoses.
   ★ Hoses (3) are for machines equipped with an additional attachment circuit.

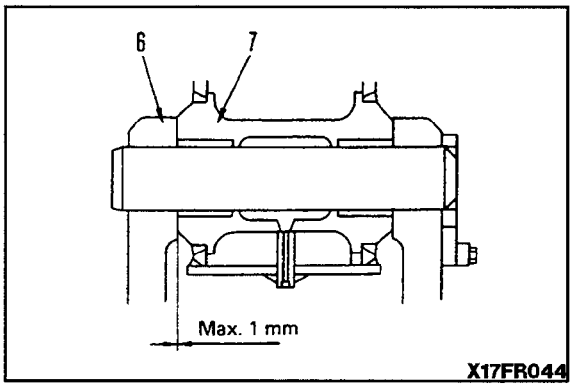
5. Raise bucket and arm assembly, remove plate, then remove connecting pin (4) between arm and boom, and remove bucket and arm assembly (5). ※2
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.
   kg Bucket, arm assembly: See your Operator's Manual for your specific application.





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INSTALLATION OF BUCKET • ARM ASSEMBLY



- Carry out installation in the reverse order to removal.

※1

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

※2

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between the boom top (6) and arm bottom (7) is below 1 mm.
  ★ Standard shim thickness: 0.8 mm

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air
  ★ Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.

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REMOVAL OF BOOM ASSEMBLY

1. Remove bucket and arm assembly. For details, see REMOVAL OF BUCKET, ARM ASSEMBLY.

2. Lower boom assembly completely to the ground and set safety lock lever to LOCK position.

3. Disconnect grease hose (1).

4. Sling boom cylinder assembly (2), and remove lock bolt (3). ※1

5. Remove plate, then remove head pin (4). ※2
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

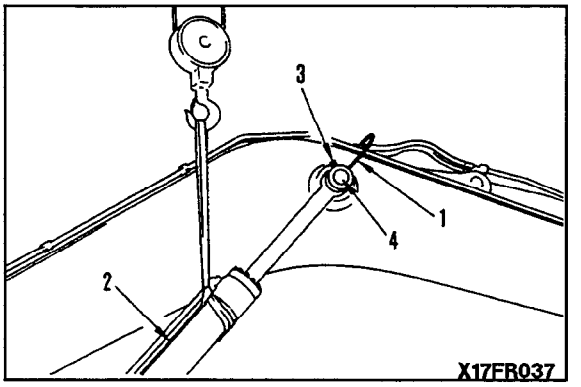
6. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out, and lower it onto block.
   ★ Disconnect the boom cylinder on the opposite side in the same way.
   ⚠ Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.

7. Disconnect hoses (5) and (6), and secure to valve with rope.
   ★ Hoses (6) are for machines equipped with an additional attachment circuit.

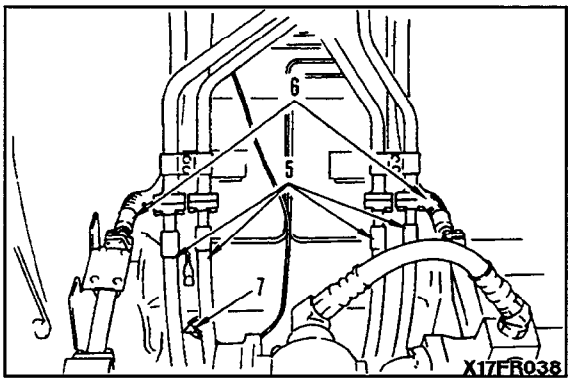
8. Disconnect wiring connector (7) for working lamp.

9. Raise boom assembly and remove plate, remove foot pin (8) using tool **P**, then remove boom assembly (9). ※3
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

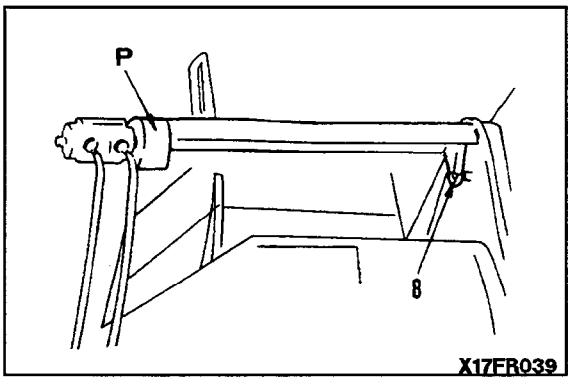
   kg
   Boom assembly:
   PC200-6: 1,650 kg
   PC210-6: 1,750 kg
   PC220-6: 1,950 kg
   PC250-6: 2,000 kg



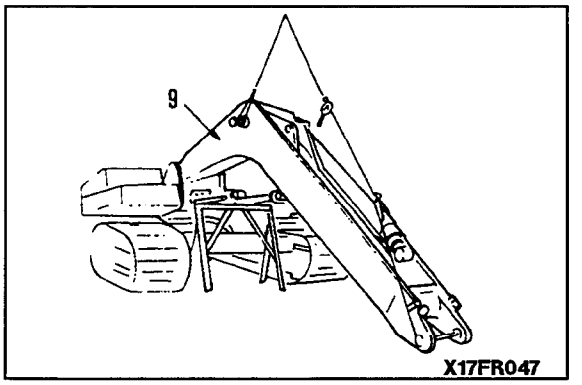
X17FR037



X17FR038



X17FR039



X17FR047

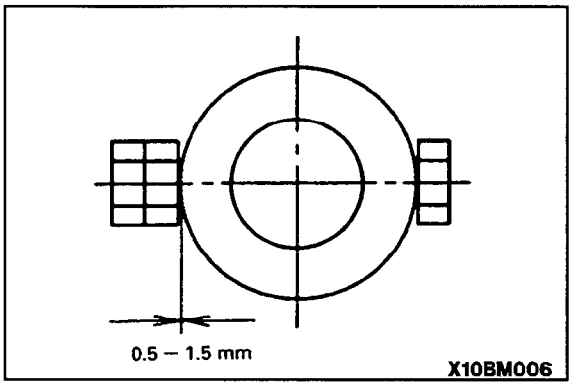
https://truckmanualshub.com/

INSTALLATION OF BOOM ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

★ When tightening the locknut, tighten so that the clearance between the plate and nut is 0.5 - 1.5 mm.



※2

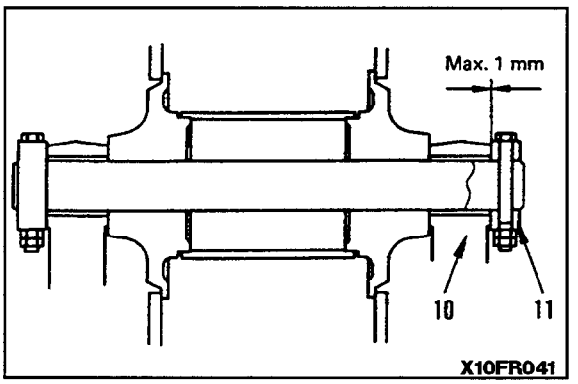
Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between cylinder rod (10) and plate (11) is below 1 mm.

★ Standard shim thickness: 0.8 mm, 1.5 mm



※3

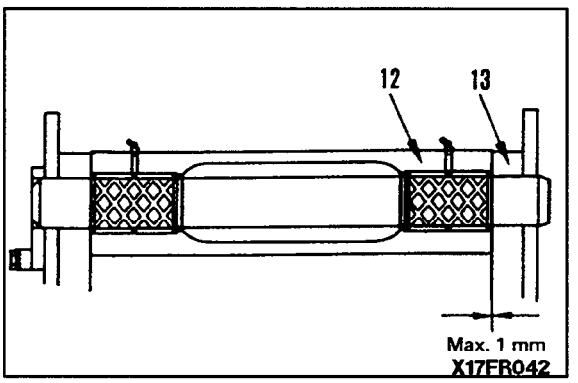
Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between boom (12) and bracket (13) is below 1 mm.

★ Standard shim thickness: 0.8 mm, 1.0 mm, 1.5 mm



- Refilling with oil (hydraulic tank)

★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air

★ Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.

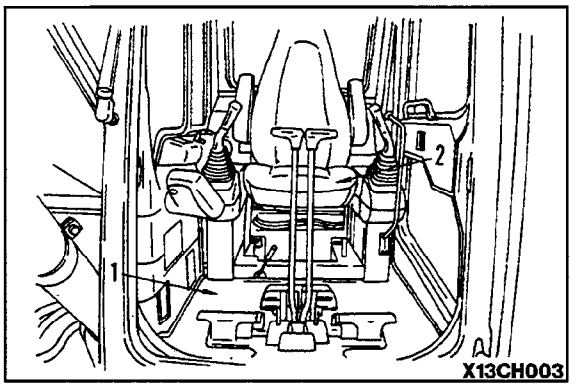
https://truckmanualshub.com/

REMOVAL OF OPERATOR'S CAB ASSEMBLY

⚠ Disconnect the cable from the negative (-) terminal of the battery.

1. Remove floor mat (1).

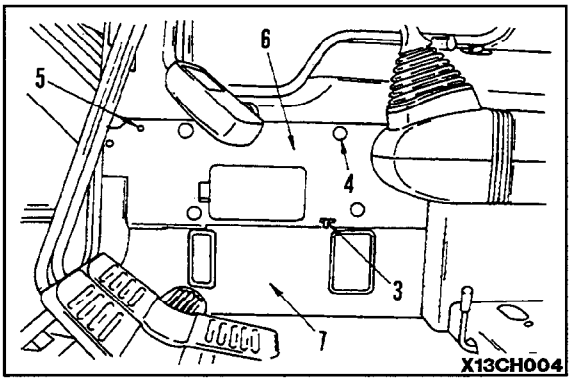
2. Remove operator's seat assembly (2).
   kg Operator's seat assembly: 40 kg



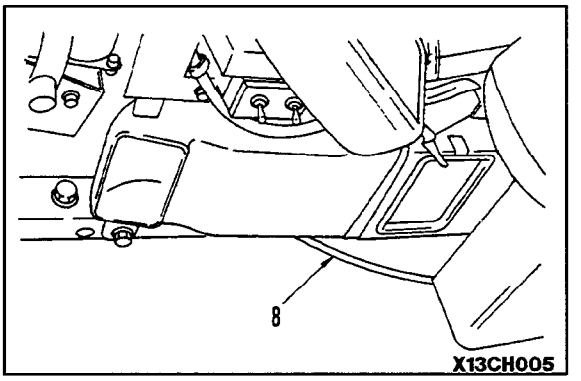
3. Remove knob (3).

4. Remove 4 caps (4) and clip (5), then remove middle panel (6).

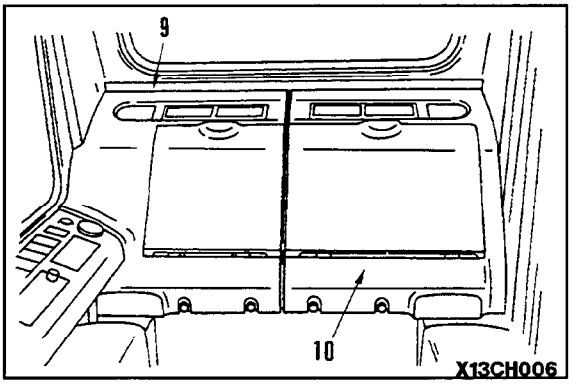
5. Remove bottom panel (7).
   ★ The panel is held by a clip, so remove the clip when removing the panel and be careful not to damage it.



6. Disconnect washer hose (8).

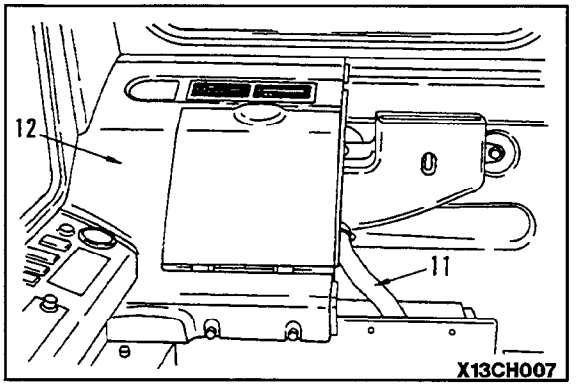


7. Remove plate (9), then remove cover (10).



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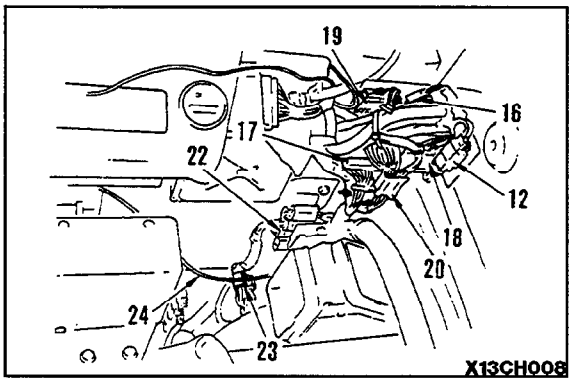
8. Disconnect air conditioner hose (11) and speaker wiring connector, then remove cover (12).
   ★ When removing the cover, the speaker wiring connector cannot be seen, so lift up the cover to disconnect the wiring.

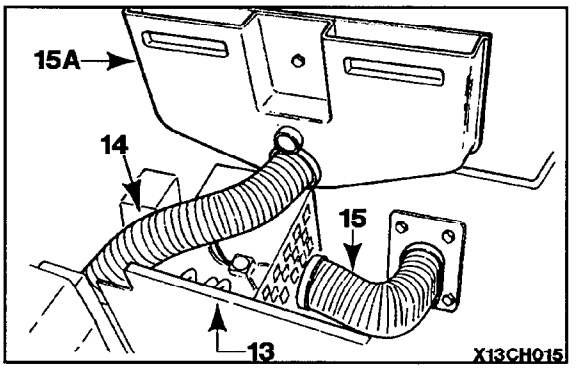


9. Remove divider board (13).

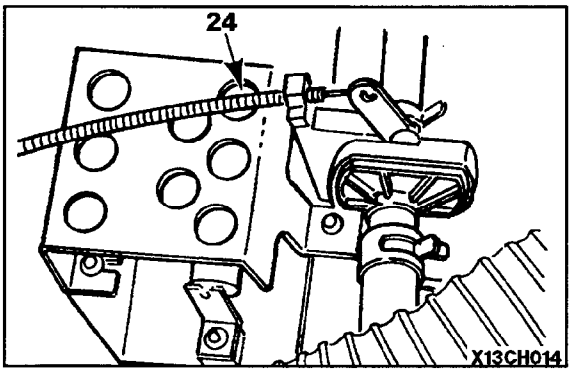
10. Remove air conditioner ducts (14), (15) and (15A).

11. Disconnect wiring connectors CN-H01 (16), CN-H02 (17), CN-H03 (18), CN-H04 (19), CN-H05 (20), CN-H06 (21), and CN-AC1-AC2 (23).





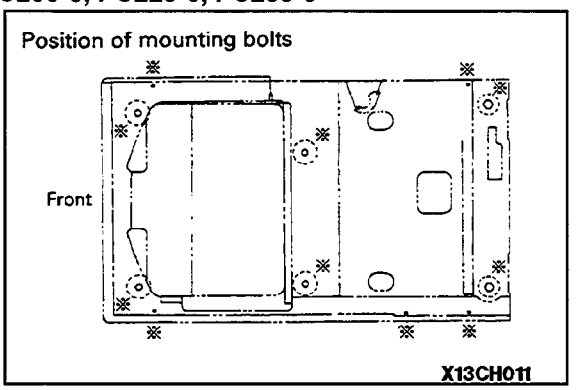
12. Disconnect air conditioner cable (24).



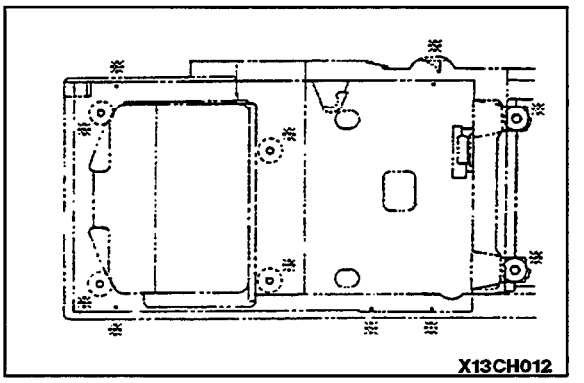
https://truckmanualshub.com/

13. Remove 11 cab mounting bolts (marked ※).

PC200-6, PC220-6, PC250-6



PC210-6

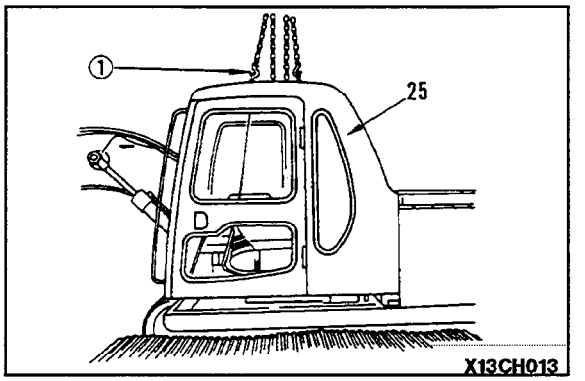


14. Using eyebolts ①, remove operator's cab assembly (25).

kg

Operator's cab assembly: 300 kg

★ When raising the cab assembly, check that all the wiring has been disconnected, then lift off slowly and be careful not to hit any part.



INSTALLATION OF OPERATOR'S CAB ASSEMBLY

- Carry out installation in the reverse order to removal.

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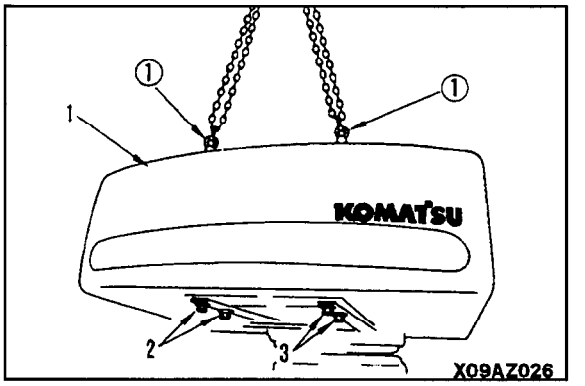
REMOVAL OF COUNTERWEIGHT ASSEMBLY

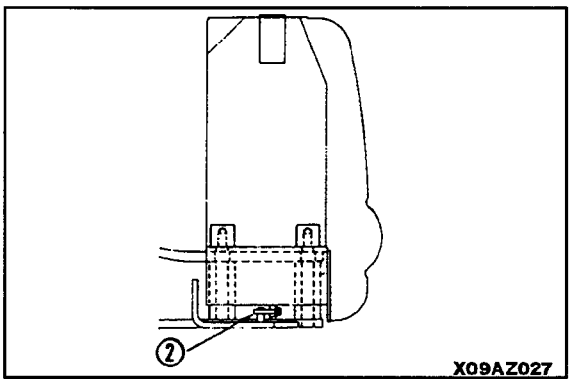
1. Set eyebolts ① to counterweight assembly (1), and sling.

2. Remove mounting bolts (2) and (3). ※1
★ Be careful not to lose the shims when removing.

3. Lift off counterweight (1) horizontally with wire or chain block. ※2
★ Be careful not to hit the engine, radiator and cooler assembly.

kg Counterweight assembly:
PC200: 3,600 kg
PC210, PC220, PC250: 4,730 kg





INSTALLATION OF COUNTERWEIGHT ASSEMBLY

- Carry out installation in the reverse order to removal.

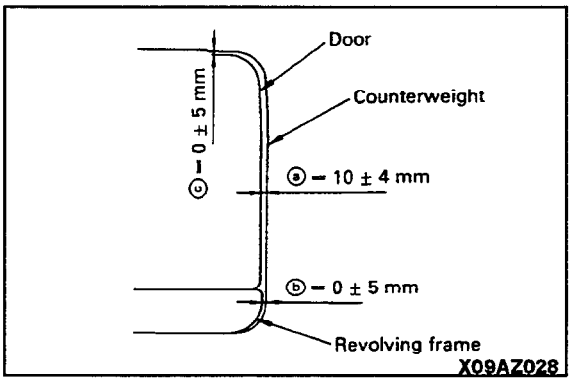
※1

Thread of counterweight mounting bolt: Thread tightener (LT-2)

kgm Counterweight mounting bolt: 1,325 ± 145 Nm (135 ± 15 kgm)

※2

★ Installing and adjusting counterweight
1) Sling counterweight with crane and set in position on frame.
2) Use counterweight pusher bolt ②, and align mounting bolts (2) and (3), and adjust to following dimensions.
   - Clearance from revolving frame: 10 ± 5 mm (left and right)
   - Clearance from bodywork door: 10 ± 5 mm (left and right)
   - Stepped difference ⓑ from revolving frame in left-to-right direction: Max. 5 mm
   - Stepped difference ⓐ from bodywork door in left-to-right direction: 10 ± 4 mm
   - Stepped difference ⓒ from bodywork top cover in up-down direction: Max. 5 mm
3) After adjusting, remove counterweight pusher bolt ②.

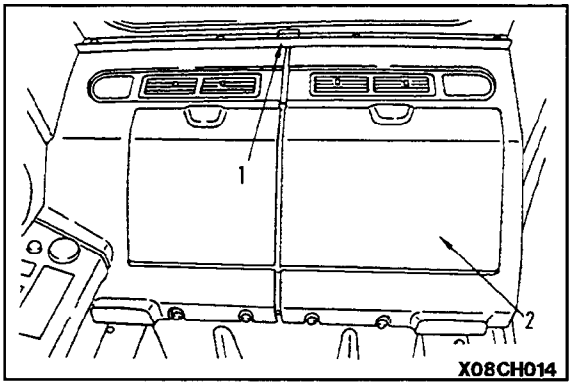


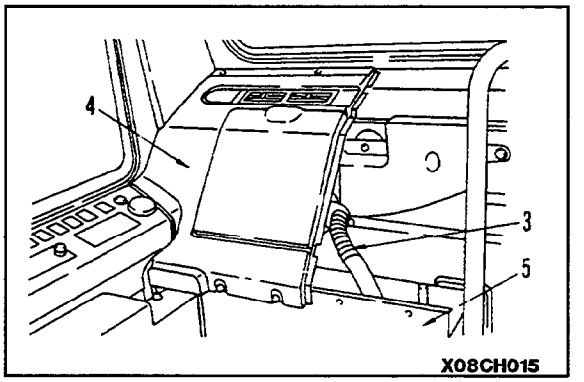
https://truckmanualshub.com/

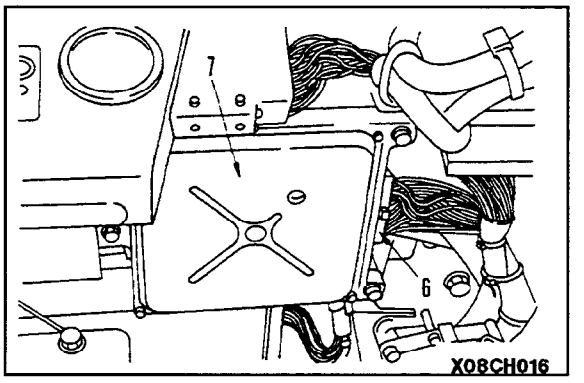
REMOVAL OF ENGINE THROTTLE CONTROLLER ASSEMBLY

⚠ Disconnect the cable from the negative (-) terminal of the battery.

1. Remove plate (1), then remove cover (2).
2. Disconnect air conditioner hose (3) and speaker wiring connector, then remove cover (4).
   ★ When removing cover (4), the speaker wiring connector cannot be seen, so be careful.
3. Remove divider board (5).
4. Disconnect wiring connector (6), and remove engine throttle controller assembly (7).







INSTALLATION OF ENGINE THROTTLE CONTROLLER ASSEMBLY

- Carry out installation in the reverse order to removal.

https://truckmanualshub.com/

REMOVAL OF PUMP CONTROLLER ASSEMBLY

⚠ Disconnect the cable from the negative (-) terminal of the battery.

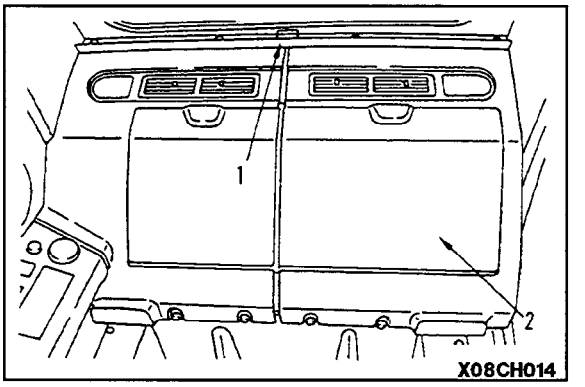
1. Remove plate (1), then remove cover (2).

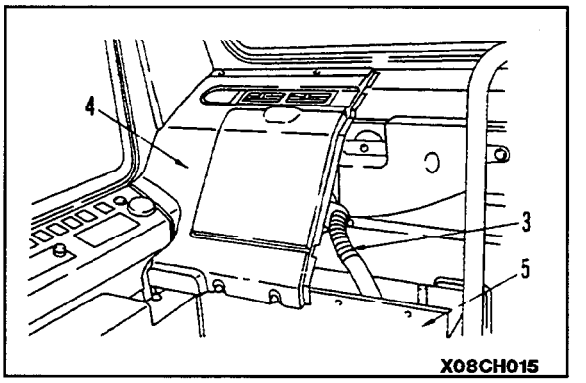
2. Disconnect air conditioner hose (3) and speaker wiring connector, then remove cover (4).
   ★ When removing cover (4), the speaker wiring connector cannot be seen, so be careful.

3. Remove divider board (5).

4. Remove air conditioner duct (7).

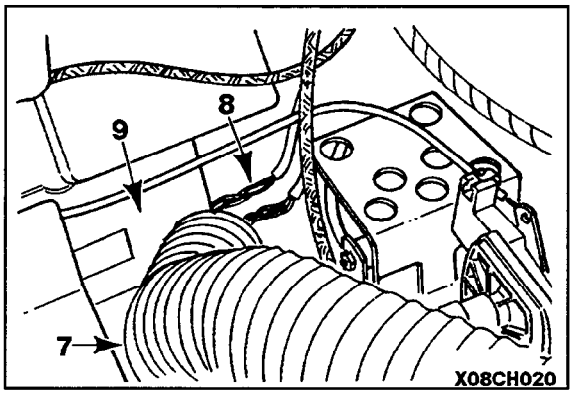
4. Disconnect 3 wiring connectors (8), then remove pump controller assembly (9).





INSTALLATION OF PUMP CONTROLLER ASSEMBLY

- Carry out installation in the reverse order to removal.

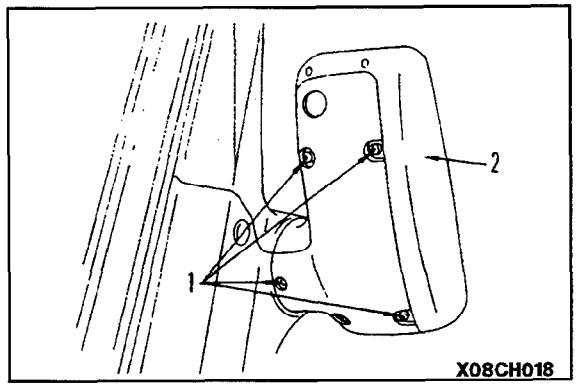


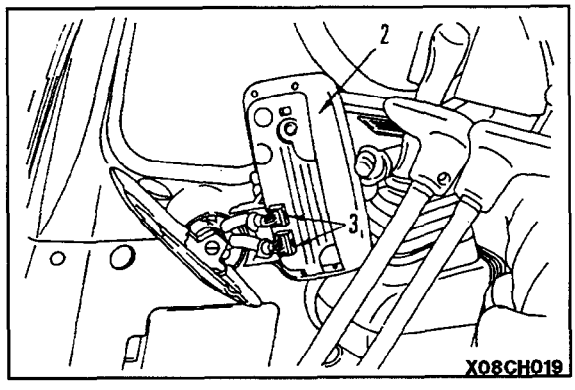
https://truckmanualshub.com/

REMOVAL OF MONITOR ASSEMBLY

⚠ Disconnect the cable from the negative (-) terminal of the battery.

1. Remove screws (1), then lift up monitor assembly (2).
2. Disconnect wiring connectors (3), then remove monitor assembly (2).





INSTALLATION OF MONITOR ASSEMBLY

- Carry out installation in the reverse order to removal.

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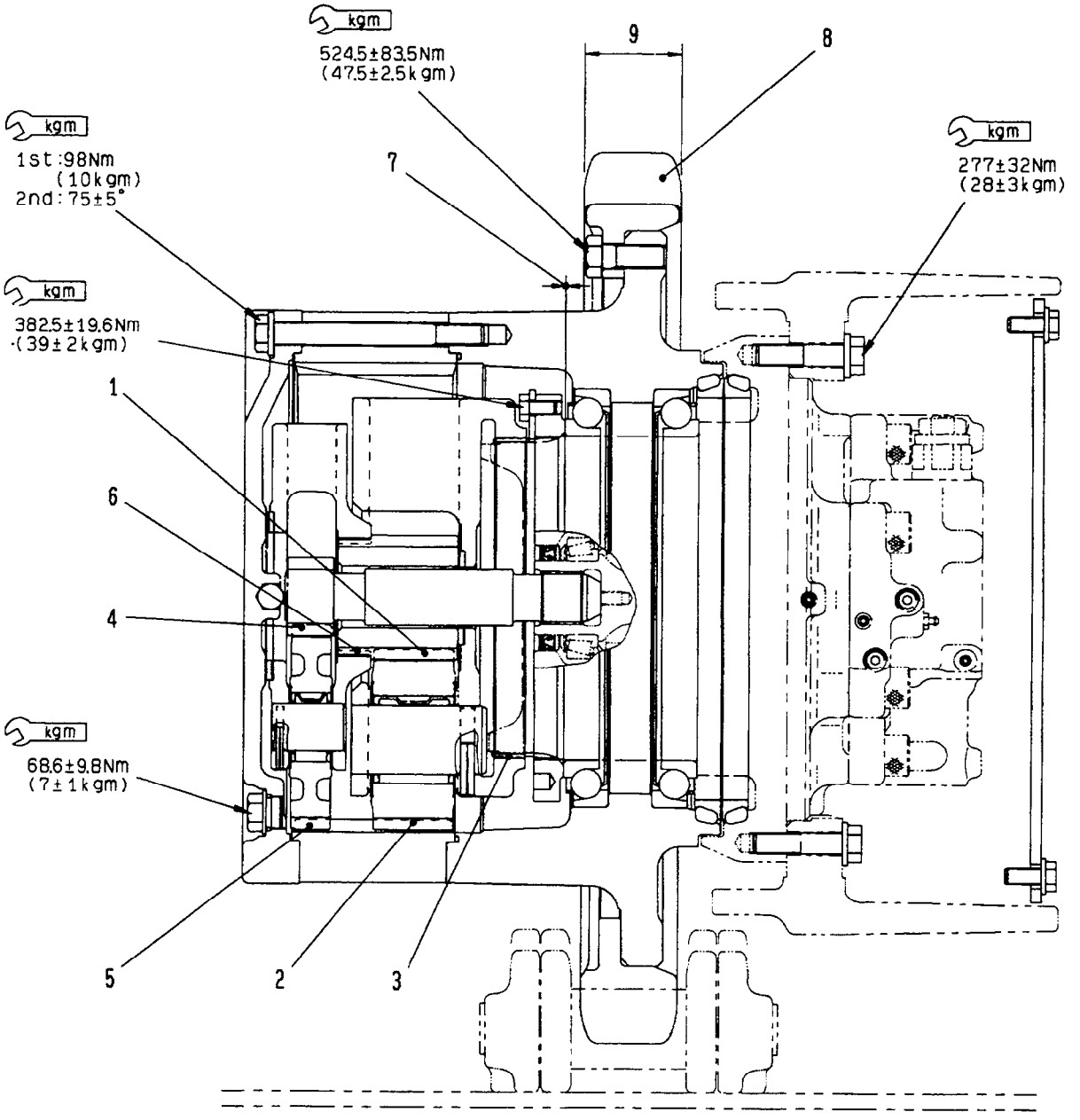
40 MAINTENANCE STANDARD

Final drive (PC200-6, PC200LC-6, PC210LC-6, PC220LC-6) 40- 2
Final drive (PC250LC-6) 40- 4
Swing machinery 40- 6
Swing circle 40- 8
Track frame, recoil spring (PC200-6, PC200LC-6, PC210LC-6, PC220LC-6) 40- 9
Track frame, recoil spring (PC250LC-6) 40- 10
Idler (PC200-6, PC200LC-6, PC210LC-6, PC220LC-6) 40- 11
Idler (PC250LC-6) 40- 13
Carrier roller (PC200-6, PC200LC-6, PC210LC-6, PC220LC-6) 40- 15
Carrier roller (PC250LC-6) 40- 16
Track roller (PC200-6, PC200LC-6, PC210LC-6, PC220LC-6) 40- 17
Track roller (PC250LC-6) 40- 18
Track shoe (PC200-6, PC200LC-6, PC210LC-6, PC220LC-6) 40- 19
Track shoe (PC250LC-6) 40- 21
Hydraulic pump 40- 23
Control valve 40- 25
Safety-suction valve for service valve 40- 31
Swing motor 40- 32
Travel motor (PC200-6, PC200LC-6, PC210LC-6, PC220LC-6) 40- 33
Travel motor (PC250LC-6) 40- 34
Work equipment, swing PPC valve 40- 35
Travel PPC valve 40- 36
Service PPC valve 40- 37
PPC shuttle, travel junction valve 40- 38
EPC, solenoid valve 40- 40
Center swivel joint 40- 41
Boom holding valve 40- 43
Hydraulic cylinder (PC200-6, PC200LC-6, PC210LC-6) 40- 44
Hydraulic cylinder (PC220LC-6, PC250LC-6) 40- 46
Work equipment 40- 48

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FINAL DRIVE

PC200-6, PC200LC-6
PC210LC-6, PC220LC-6



X07HH031

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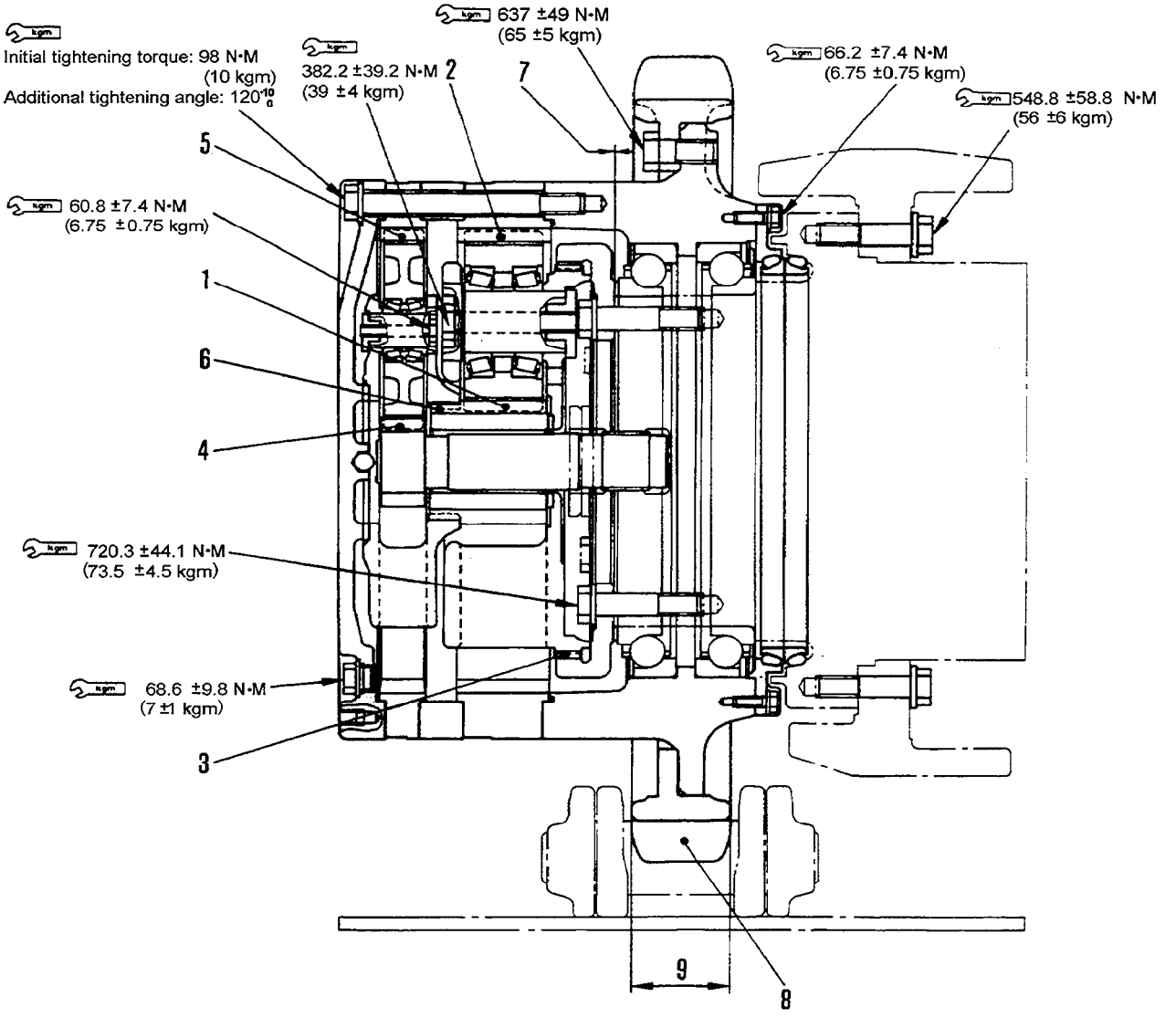
Unit: mm

No.	Check item	Criteria		Remedy
1	Backlash between No. 1 sun gear and No. 1 planetary gear	Standard clearance	Clearance limit	Replace
		0.19 - 0.52	1.00	
2	Backlash between No. 1 planetary gear and ring gear	0.20 - 0.61	1.10	
3	Backlash between No. 1 planetary carrier and motor	0.06 - 0.22	—	
4	Backlash between No. 2 sun gear and No. 2 planetary gear	0.15 - 0.49	1.00	
5	Backlash between No. 2 planetary gear and ring gear	0.19 - 0.60	1.10	
6	Backlash between No. 2 planetary carrier and No. 1 sun gear	0.15 - 0.44	1.00	
7	End play of sprocket shaft	0 - 0.10	—	
8	Amount of wear on sprocket tooth	Repair limit: 6		Rebuild or replace
9	Width of sprocket tooth	Standard size	Repair limit	
		71	68	

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FINAL DRIVE

PC250LC-6



X07HH020

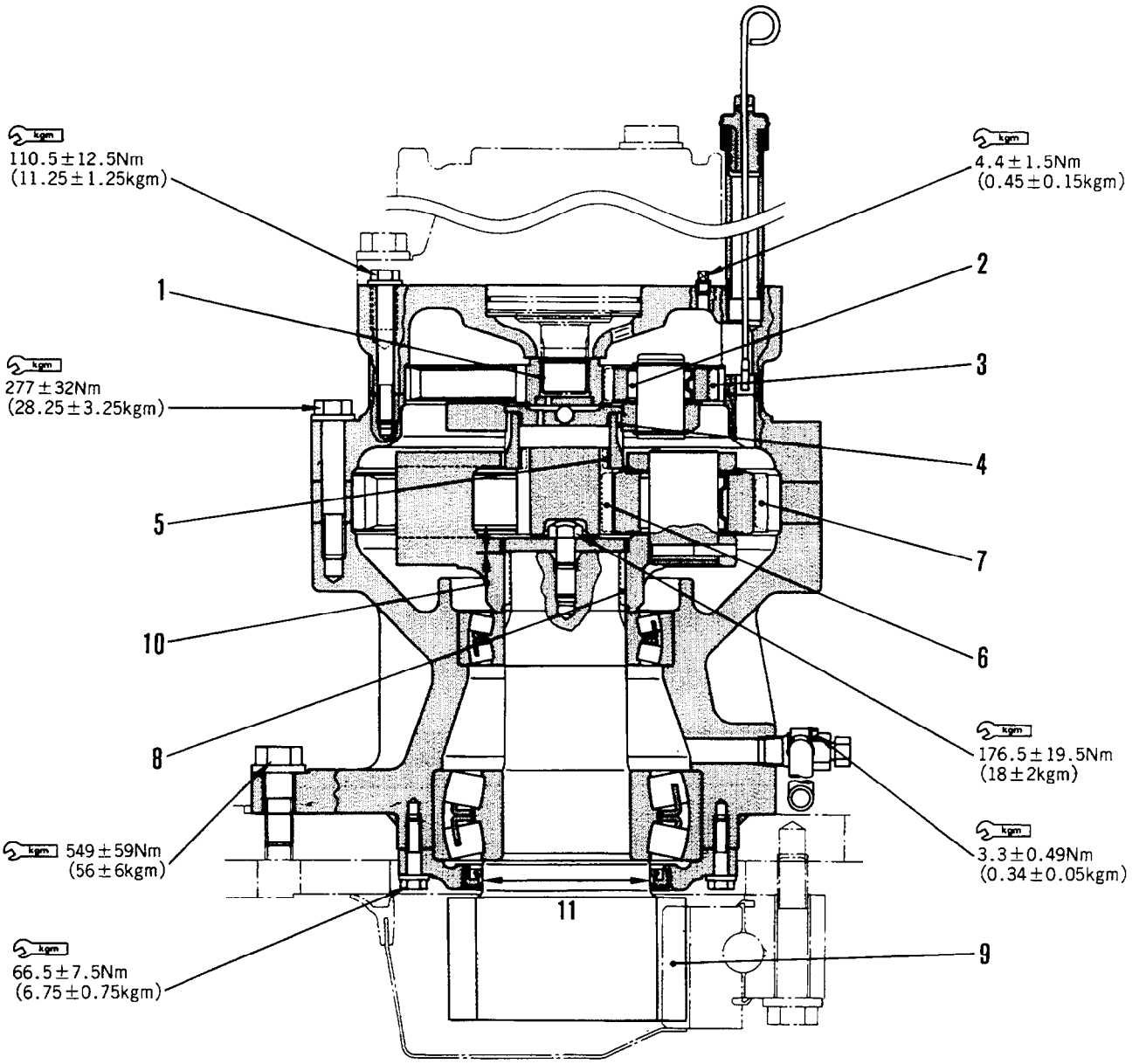
https://truckmanualshub.com/

Unit: mm

No.	Check item	Criteria		Remedy
1	Backlash between No. 1 sun gear and No. 1 planetary gear	Standard clearance	Clearance limit	Replace
		0.19 - 0.54	1.00	
2	Backlash between No. 1 planetary gear and ring gear	0.21 - 0.62	1.10	
3	Backlash between No. 1 planetary carrier and motor	0.06 - 0.22	—	
4	Backlash between No. 2 sun gear and No. 2 planetary gear	0.19 - 0.54	1.00	
5	Backlash between No. 2 planetary gear and ring gear	0.21 - 0.62	1.10	
6	Backlash between No. 2 planetary carrier and No. 1 sun gear	0.39 - 0.67	1.20	
7	End play of sprocket shaft	0.10 - 0.15	—	
8	Amount of wear on sprocket tooth	Repair limit: 6		Rebuild or replace
9	Width of sprocket tooth	Standard size	Repair limit	
		87	84	

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SWING MACHINERY



X09DH031

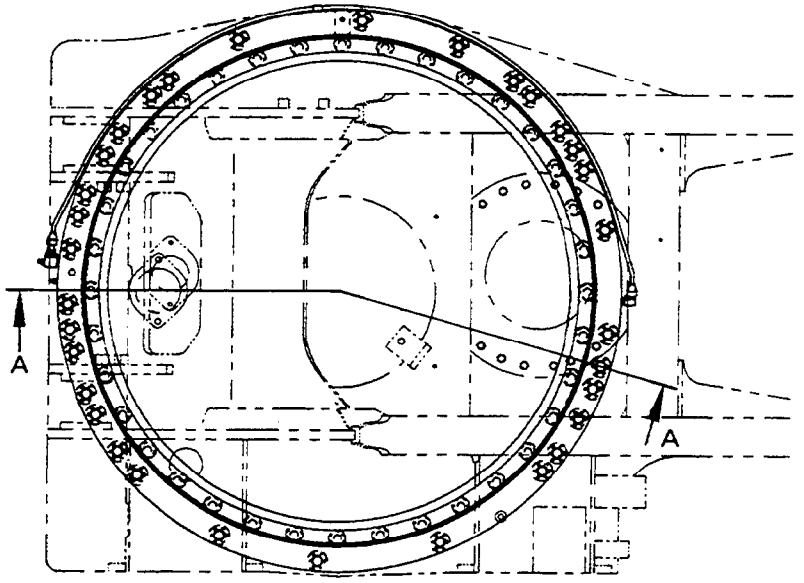
https://truckmanualshub.com/

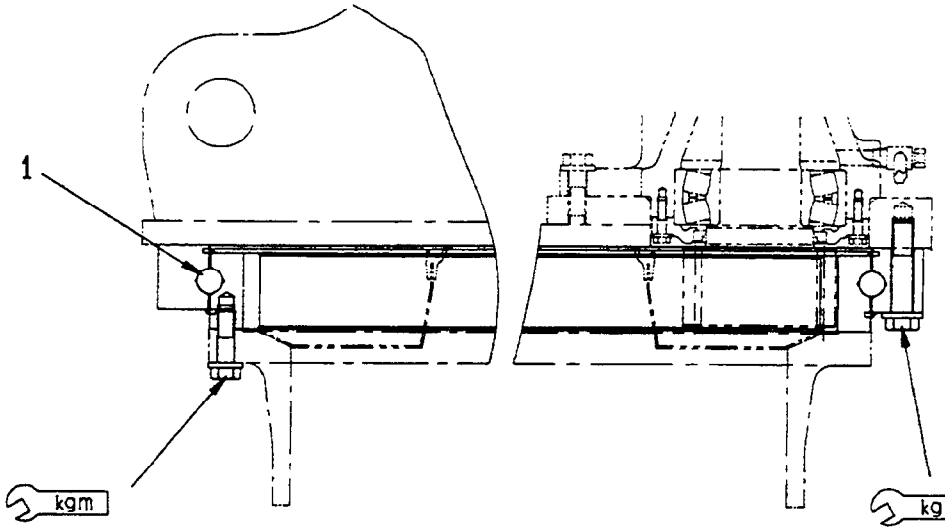
Unit: mm

No.	Check item	Criteria		Remedy
1	Backlash between swing motor shaft and No. 1 sun gear	Standard clearance	Clearance limit	Replace
		0.07 - 0.18	—	
2	Backlash between No. 1 sun gear and No. 1 planetary gear	0.13 - 032	0.90	
3	Backlash between No. 1 planetary gear and ring gear	0.14 - 0.43	0.90	
4	Backlash between No. 1 planetary carrier and coupling	0.09 - 0.19	—	
5	Backlash between coupling and No. 2 sun gear	0.35 - 0.58	1.10	
6	Backlash between No. 2 sun gear and No. 2 planetary gear	0.12 - 0.49	1.00	
7	Backlash between No. 2 planetary gear and ring gear	0.15 - 0.57	1.10	
8	Backlash between No. 2 planetary carrier and swing pinion	0.09 - 0.20	—	
9	Backlash between swing pinion and swing circle	0.22 - 1.32	2.00	
10	Clearance between plate and planetary carrier	0.38 - 1.16	—	Apply hard chrome plating, recondition, or replace
11	Wear of swing pinion surface contacting with oil seal	Standard size	Repair limit	
		$125\ ^{0}_{-0.100}$	124.7	

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SWING CIRCLE





PC200, PC210, PC220 1st: 191.3 ±19.6 Nm (19.5 ±2 kgm)
2nd: 48 ±5

PC250: 823.8~1029.7 Nm (84~105 kgm)

PC200, PC210: 804.4 ±83.4 Nm (82 ±8.5 kgm)

PC220: 999.6 ±102.9 Nm (102 ±10.5 kgm)

PC250: 823.8~1029.7 Nm (84~105 kgm)

A–A

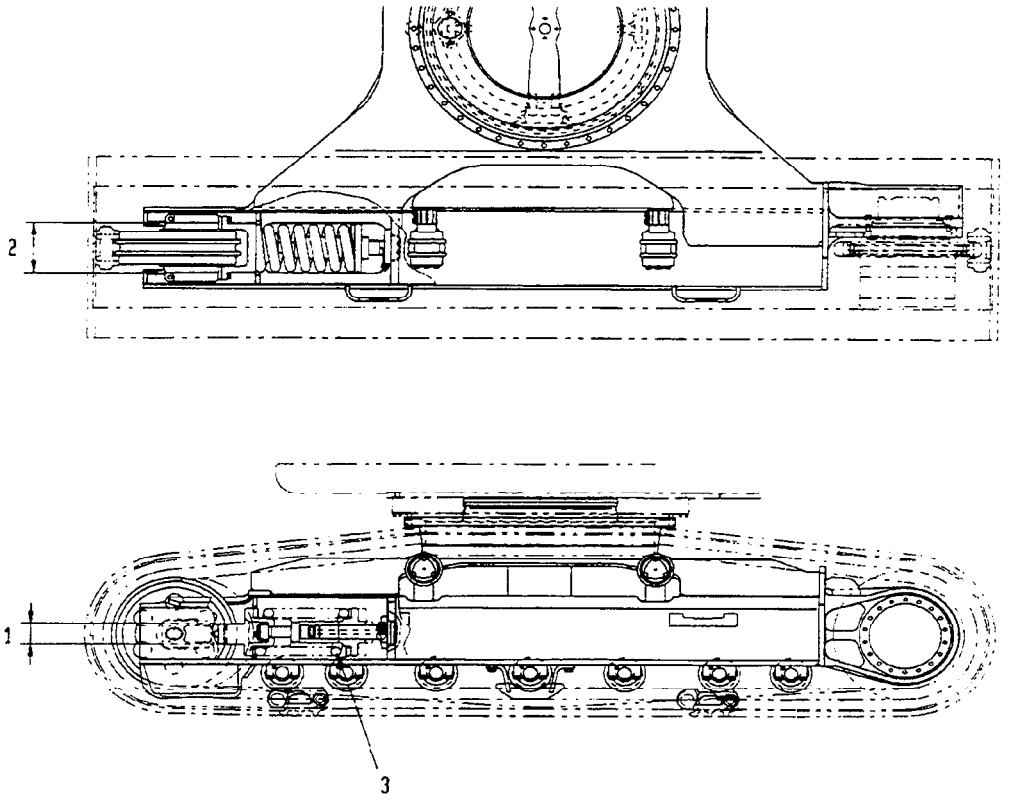
X09DH032

No.	Check Item	Criteria		Remedy
1	Axial clearance of bearing (when mounted on chassis)	Standard clearance	Clearance limit	Replace
		0.5 - 1.6	3.2	

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TRACK FRAME, RECOIL SPRING

PC200-6, PC200LC-6
PC210LC-6, PC220LC-6



X14AH012

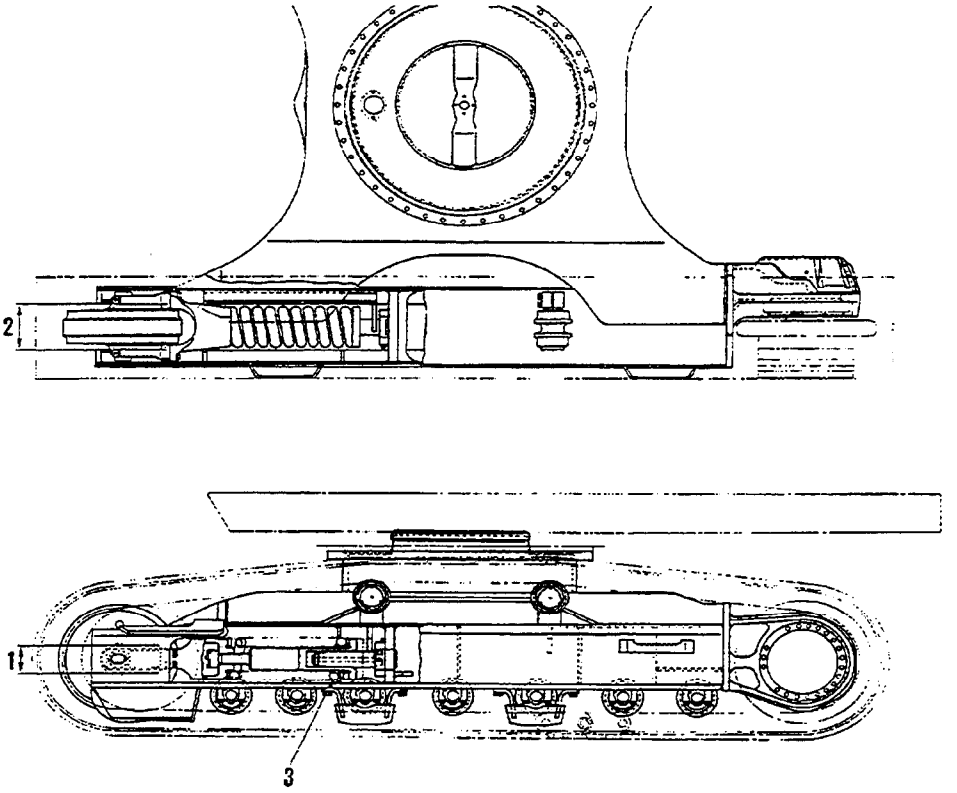
Unit: mm

No.	Check Item		Criteria					Remedy
				Standard size	Tolerance	Repair limit		
1	Vertical width of idler guide		Track frame	107				Rebuild or replace
			Idler support	105				
2	Horizontal width of idler guide		Track frame	250				
			Idler support	247.4				
3	Recoil spring			Standard size			Repair limit		Replace
				Free length X O.D.	Installed length	Installed load	Free length	Installed load	
		PC200		558 X 238	437	108.8 kN (11,100 kg)	534	87.2 kN (8,900 kg)	
		PC200LC PC210LC PC220LC		603.5 X 239	466	126.4 kN (12,900 kg)	576	100.9 kN (10,300 kg)	

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TRACK FRAME, RECOIL SPRING

PC250LC-6



X14AH013

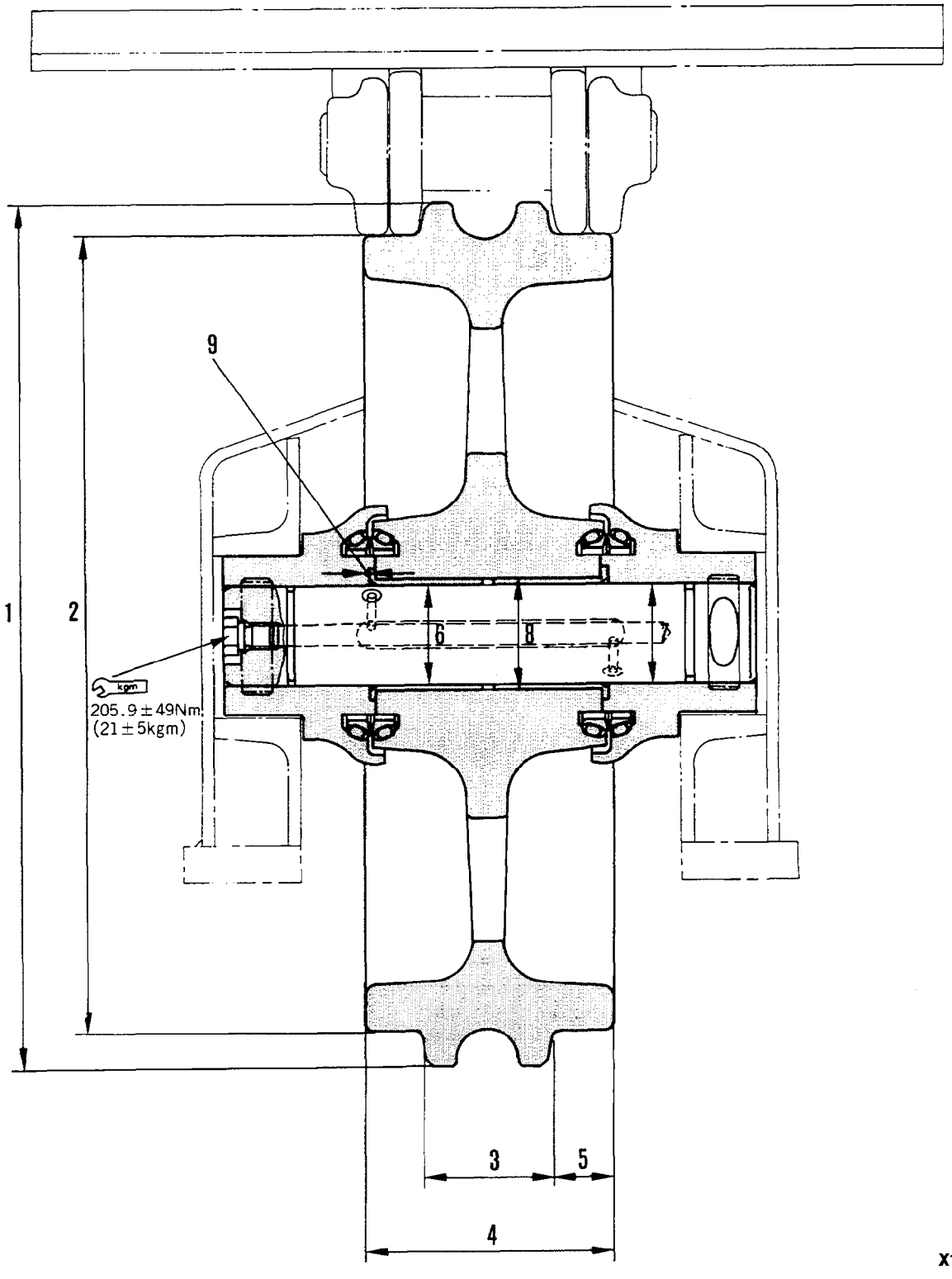
Unit: mm

No.	Check Item	Criteria					Remedy
			Standard size	Tolerance	Repair limit		
1	Vertical width of idler gear	Track frame	123	+2 -1	127		
		Idler support	120	± 0.5	118		Rebuild or replace
2	Horizontal width of idler guide	Track frame	266	+3 -1	271		
		Idler support	261	—	259		
3	Recoil spring	Standard size			Repair limit		Replace
		Free limit	Installed length	Installation load	Free length	Installation load	
		795 X 241	648	173.3 Nm (17,680 kg)	—	138.6 Nm (14,140 kg)	

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IDLER

PC200-6, PC200LC-6
PC210LC-6, PC220LC-6



X14AV008

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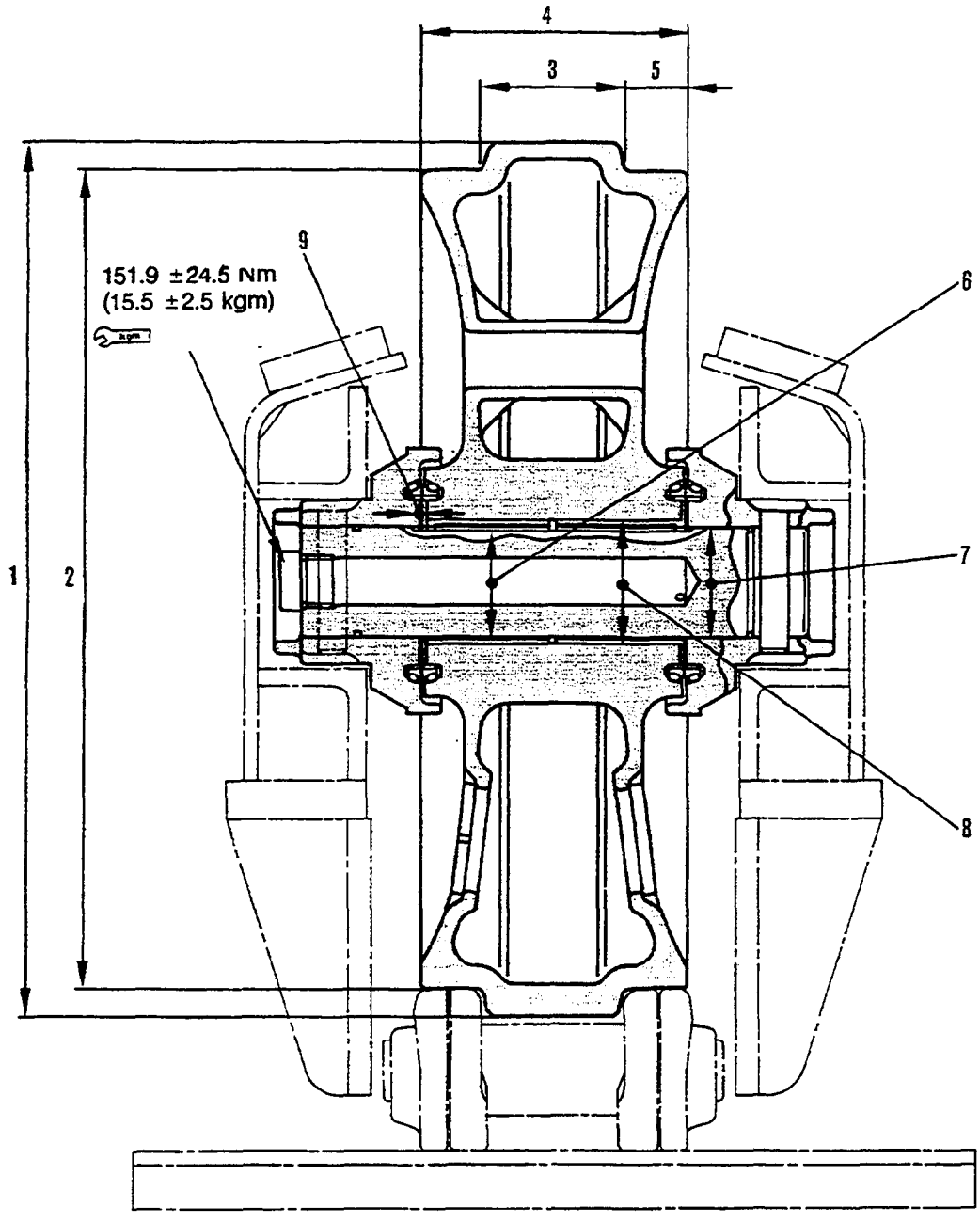
Unit: mm

No.	Check item	Criteria					Remedy
1	Outside diameter of protrusion	Standard size			Repair limit		Rebuild or replace
		560			—		
2	Outside diameter of tread	520			508		
3	Width of protrusion	85			—		
4	Total width	164			—		
5	Width of tread	39.5			45.5		
6	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		65	-0.250 -0.350	+0.074 -0.036	0.214 - 0.424	1.5	
7	Clearance between shaft and support	65	-0.250 -0.290	-0.110 -0.220	0.03 - 0.180	—	Replace
8	Interference between idler and bushing	Standard size	Tolerance		Standard interference	Interference limit	Replace bushing
			Shaft	Hole			
		72	+0.089 +0.059	-0.006 -0.072	0.065 - 0.161	—	
9	Side clearance of idler (each)	Standard clearance			Clearance limit		
		0.39 - 1.00			1.5		

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IDLER

PC250LC-6



X14AV009

https://truckmanualshub.com/

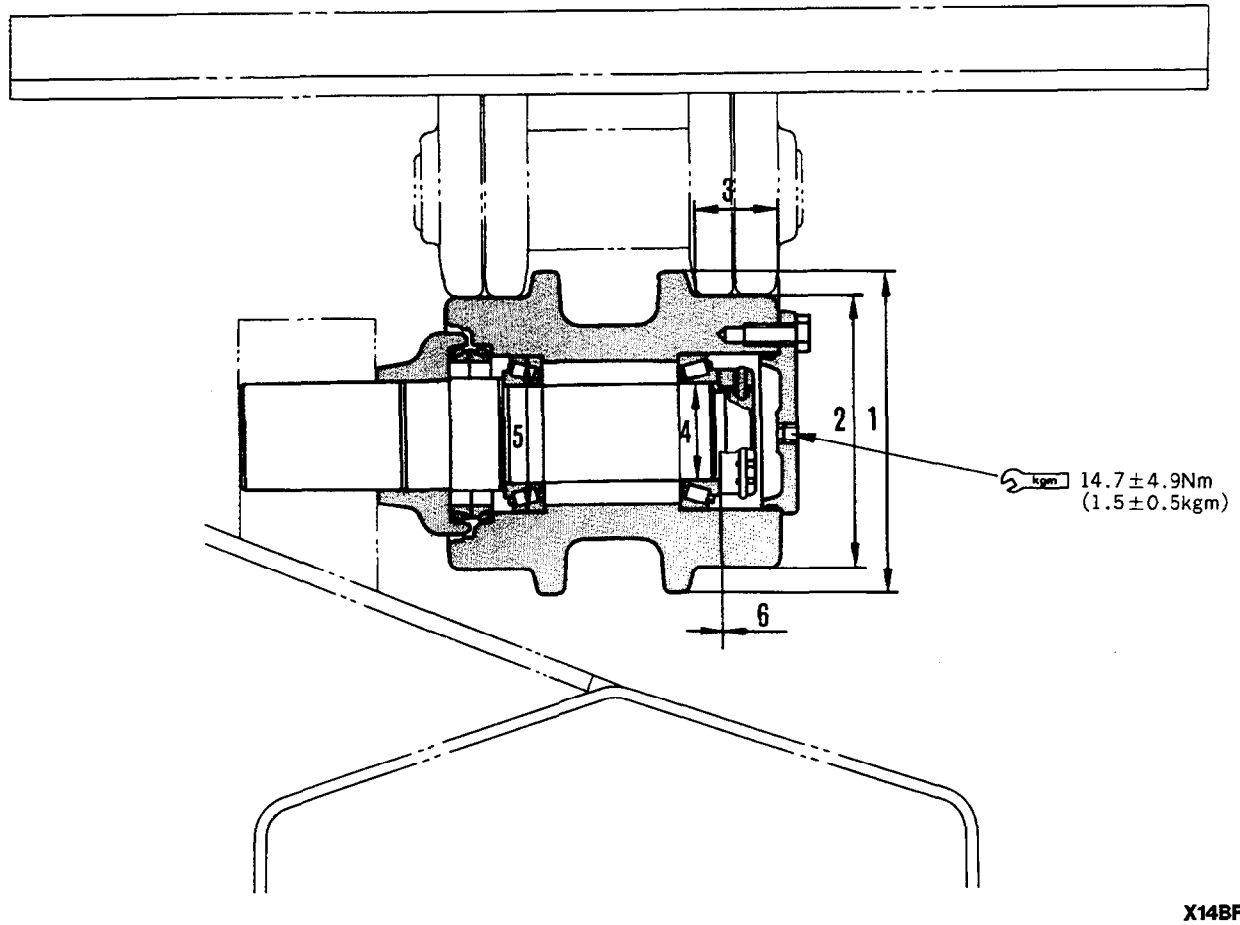
Unit: mm

No.	Check item	Criteria					Remedy
1	Outside diameter of protrusion	Standard size			Repair limit		Rebuild or replace
		630			—		
2	Outside diameter of tread	590			578		
3	Width of protrusion	101			—		
4	Total width	190			—		
5	Width of tread	44.5			50.5		
6	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		80	-0.225 -0.325	+0.130 -0.010	0.215 - 0.455	1.5	
7	Clearance between shaft and support	80	-0.225 -0.290	-0.085 -0.195	0.030 - 0.205	—	Replace
8	Interference between idler and bushing	Standard size	Tolerance		Standard interference	Interference limit	Replace bushing
			Shaft	Hole			
		87.6	+0.087 +0.037	-0.027 -0.079	0.064 - 0.166	—	
9	Side clearance of idler (each)	Standard clearance			Clearance limit		
		0.68 - 1.22			2		

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CARRIER ROLLER

PC200-6, PC200LC-6
PC210LC-6, PC220LC-6



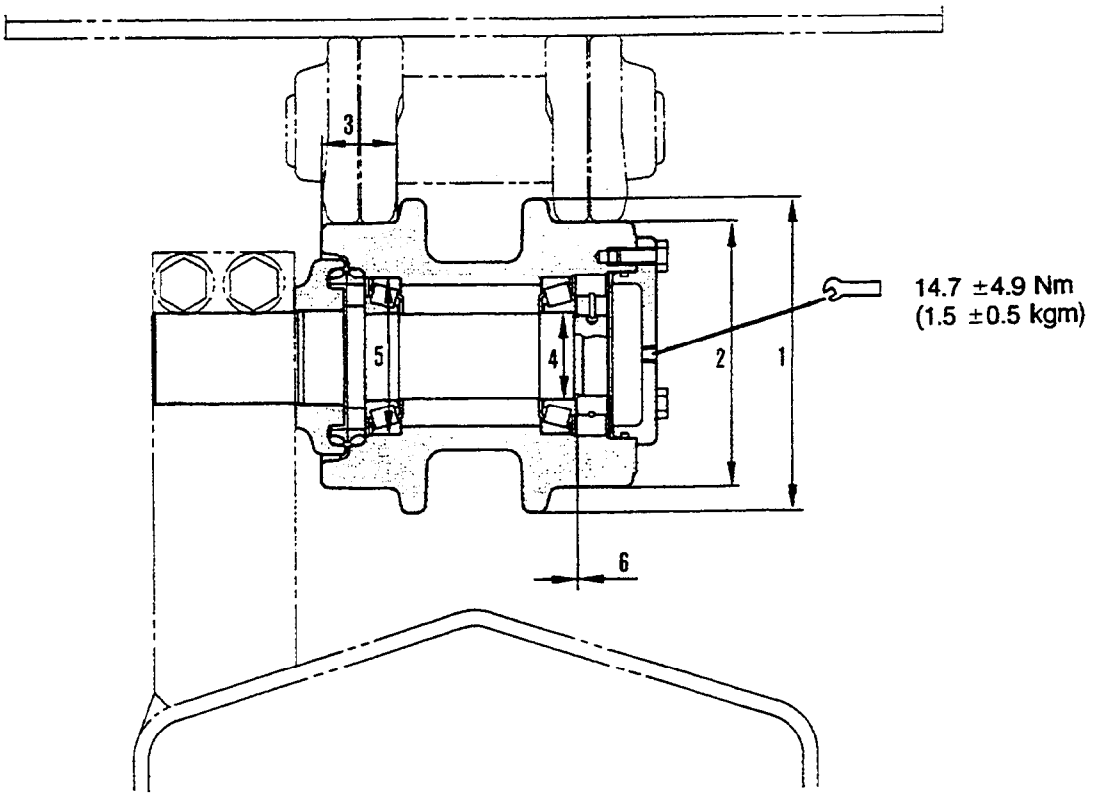
X14BR008

No.	Check item	Criteria					Remedy
1	Outside diameter of flange (outside)	Standard size			Repair limit		Rebuild or replace
		165			—		
2	Outside diameter of tread	140			130		
3	Width of tread	43			50		
4	Interference between shaft and bearing	Standard size	Tolerance		Standard interference	Interference limit	Replace
			Shaft	Hole			
		50	0 -0.016	0 -0.012	- 0.016 - 0.012	—	
5	Interference between roller and bearing	80	0 -0.013	-0.021 -0.051	0.008 - 0.051	—	
6	Side clearance of roller	Standard clearance			Clearance limit		
		0.01 - 0.18			—		

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CARRIER ROLLER

PC250LC-6



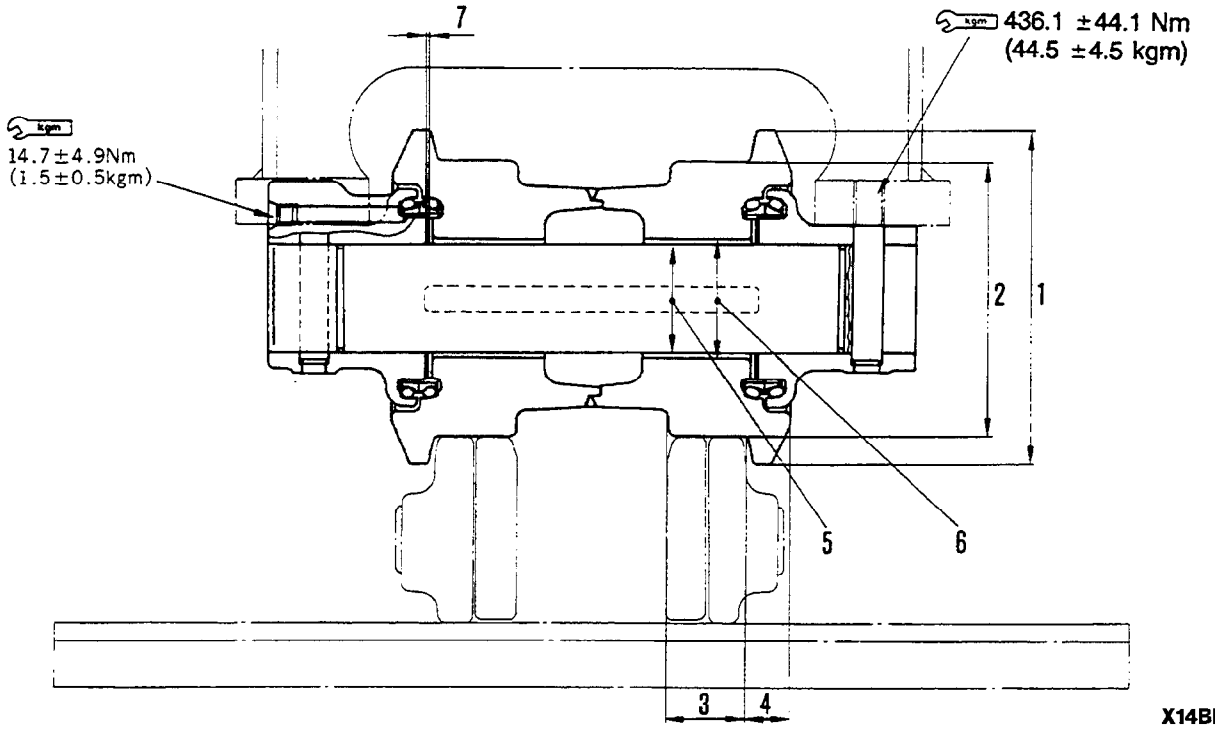
X14BR009

No.	Check item	Criteria					Remedy
1	Outside diameter of flange (outside)	Standard size			Repair limit		Rebuild or replace
		200			—		
2	Outside diameter of tread	168			158		
3	Width of tread	49.5			57.5		
4	Clearance between shaft and bearing	Standard size	Tolerance		Standard interference	Interference limit	Replace
			Shaft	Hole			
		55	+ 0.021 + 0.002	0 -0.015	0.002 - 0.036	—	
5	Interference between roller and bearing	80	0 -0.013	-0.021 -0.051	0.009 - 0.059	—	
6	Side clearance of roller	Standard clearance			Clearance limit		
		0.01 - 0.24			—		

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TRACK ROLLER

PC200-6, PC200LC-6
PC210LC-6, PC220LC-6



X14BR010

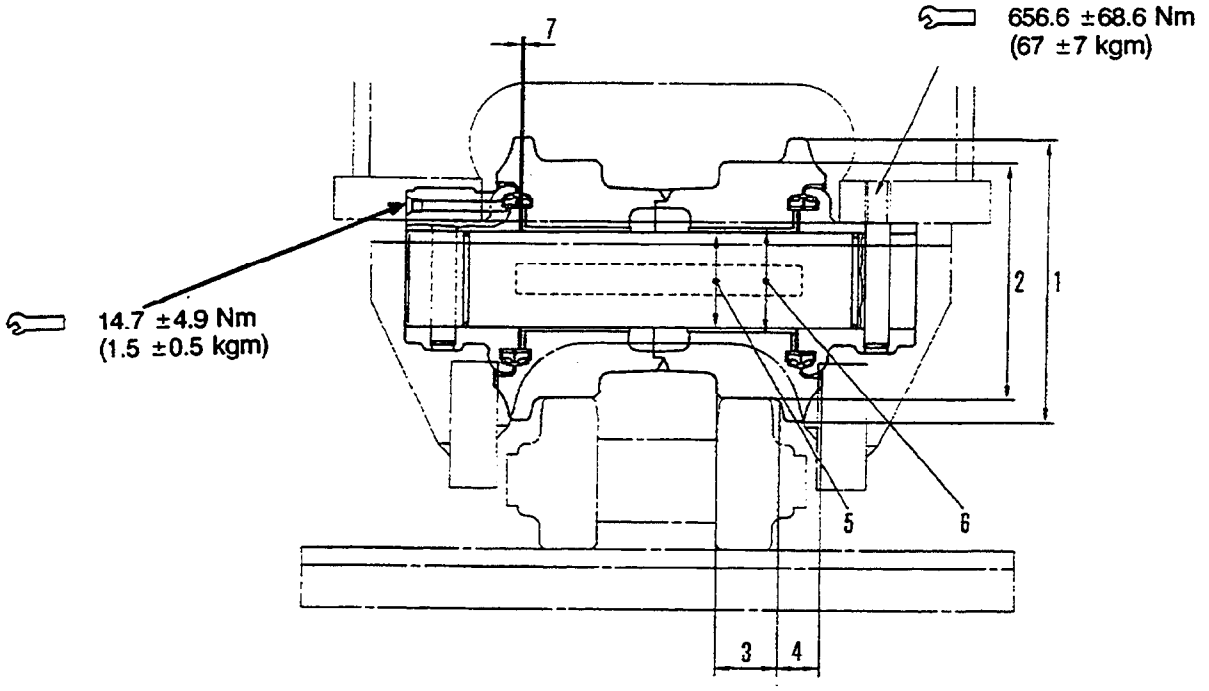
Unit: mm

No.	Check item	Criteria					Remedy
1	Outside diameter of flange (outside)	Standard size			Repair limit		Rebuild or replace
		186			—		
2	Outside diameter of tread	154			142		
3	Width of tread	44.5			52		
4	Width of flange	24.5			—		
5	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		60	- 0.215 - 0.315	+ 0.195 0	0.215 - 0.510	1.5	
6	Interference between roller and bushing	Standard size	Tolerance		Standard interference	Interference limit	
			Shaft	Hole			
		67	+ 0.153 + 0.053	+ 0.030 0	0.023 - 0.153	—	
7	Side clearance of roller	Standard clearance			Clearance limit		Replace
		0.41 - 0.95			1.5		

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TRACK ROLLER

PC250LC-6



X14BR011

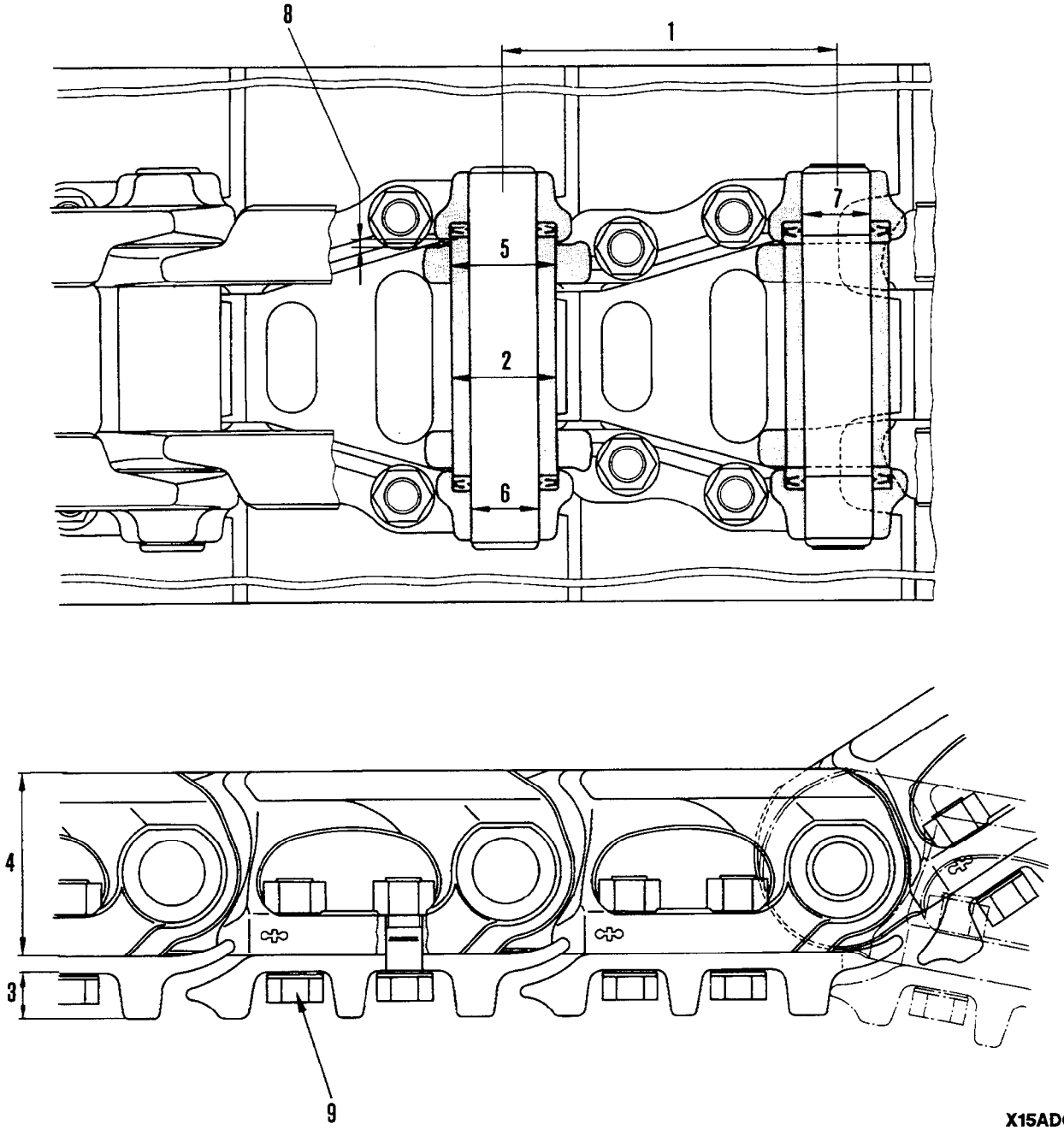
Unit: mm

No.	Check item	Criteria					Remedy
1	Outside diameter of flange (outside)	Standard size			Repair limit		Rebuild or replace
		216			—		
2	Outside diameter of tread	180			168		
3	Width of tread	49			55		
4	Width of flange	27			—		
5	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		65	- 0.215 - 0.315	+ 0.186 - 0.064	0.151 - 0.501	1.5	
6	Interference between roller and bushing	Standard size	Tolerance		Standard interference	Interference limit	
			Shaft	Hole			
		72	+ 0.108 + 0.008	- 0.006 - 0.036	0.014 - 0.144	—	
7	Side clearance of roller	Standard clearance			Clearance limit		Replace
		0.41 - 0.95			1.5		

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TRACK SHOE

PC200-6, PC200LC-6
PC210LC-6, PC220LC-6



X15AD006

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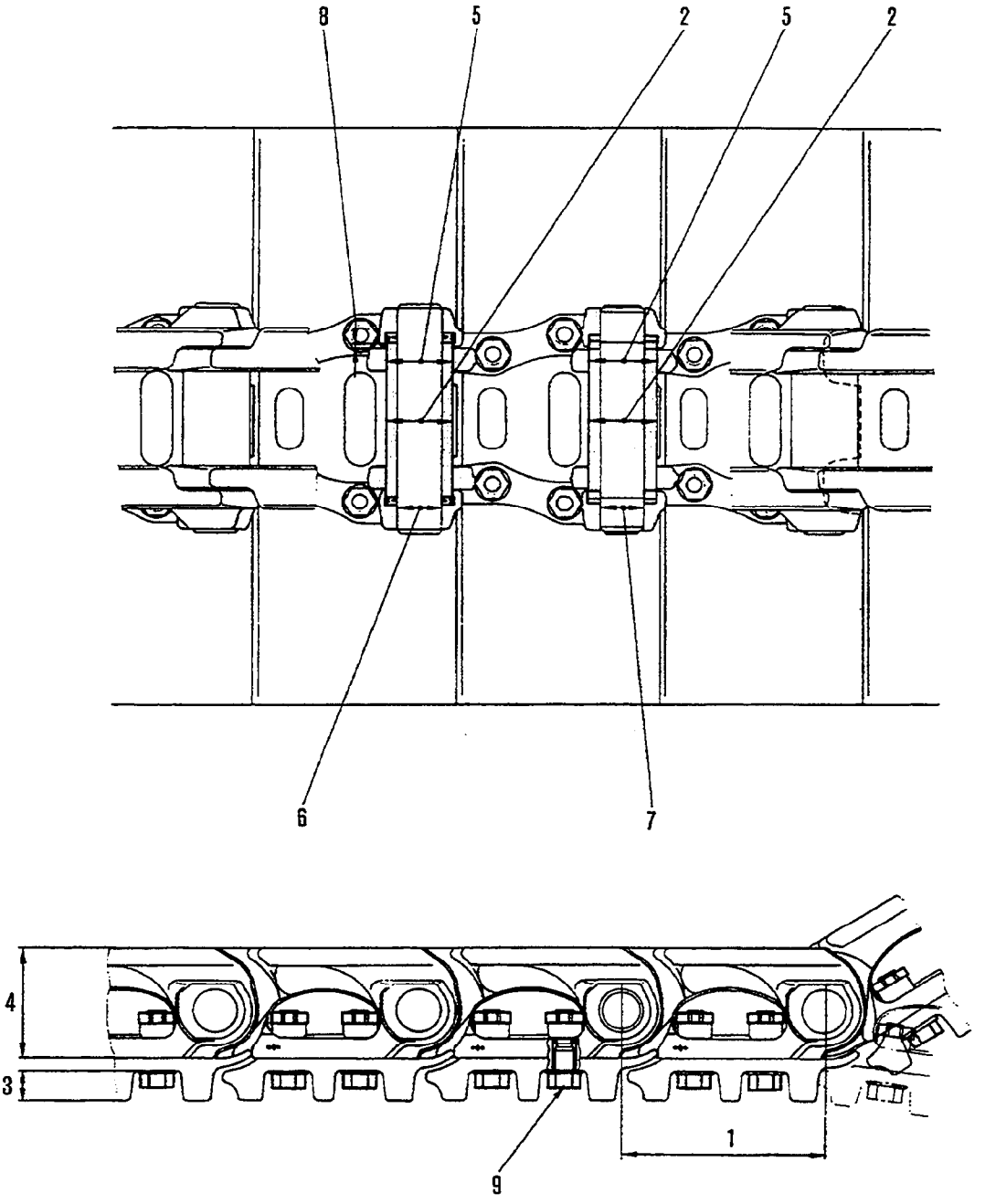
Unit: mm

No.	Check item		Criteria					Remedy
1	Link pitch		Standard size		Repair limit			Turn or replace
			190.25		194.25			
2	Outside diameter of bushing		59.3		54.3			
3	Height of grouser	Triple	26		16			Lug welding, rebuild or replace
		Swamp	102.5		90.5			
4	Height of link		105		97			
5	Interference between bushing and link		Standard size	Tolerance		Standard interference	Interference limit	Replace with over size
				Shaft	Hole			
			59	+0.304 +0.264	+0.074 0	0.190 - 0.304	0.100	
6	Interference between regular pin and link		38	+0.222 +0.072	-0.138 -0.200	0.210 - 0.422	0.140	
7	Interference between master pin and link		37.8	+0.230 +0.200	+0.062 0	0.138 - 0.230	0.130	
8	Protrusion of bushing		4.85					Adjust
9	Tightening torque of shoe bolt		Initial tightening torque: 392 ± 39.2 Nm (40 ± 4 kgm) Additional tightening angle: 120° ± 10°					Tighten

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TRACK SHOE

PC250LC-6



X15AD007

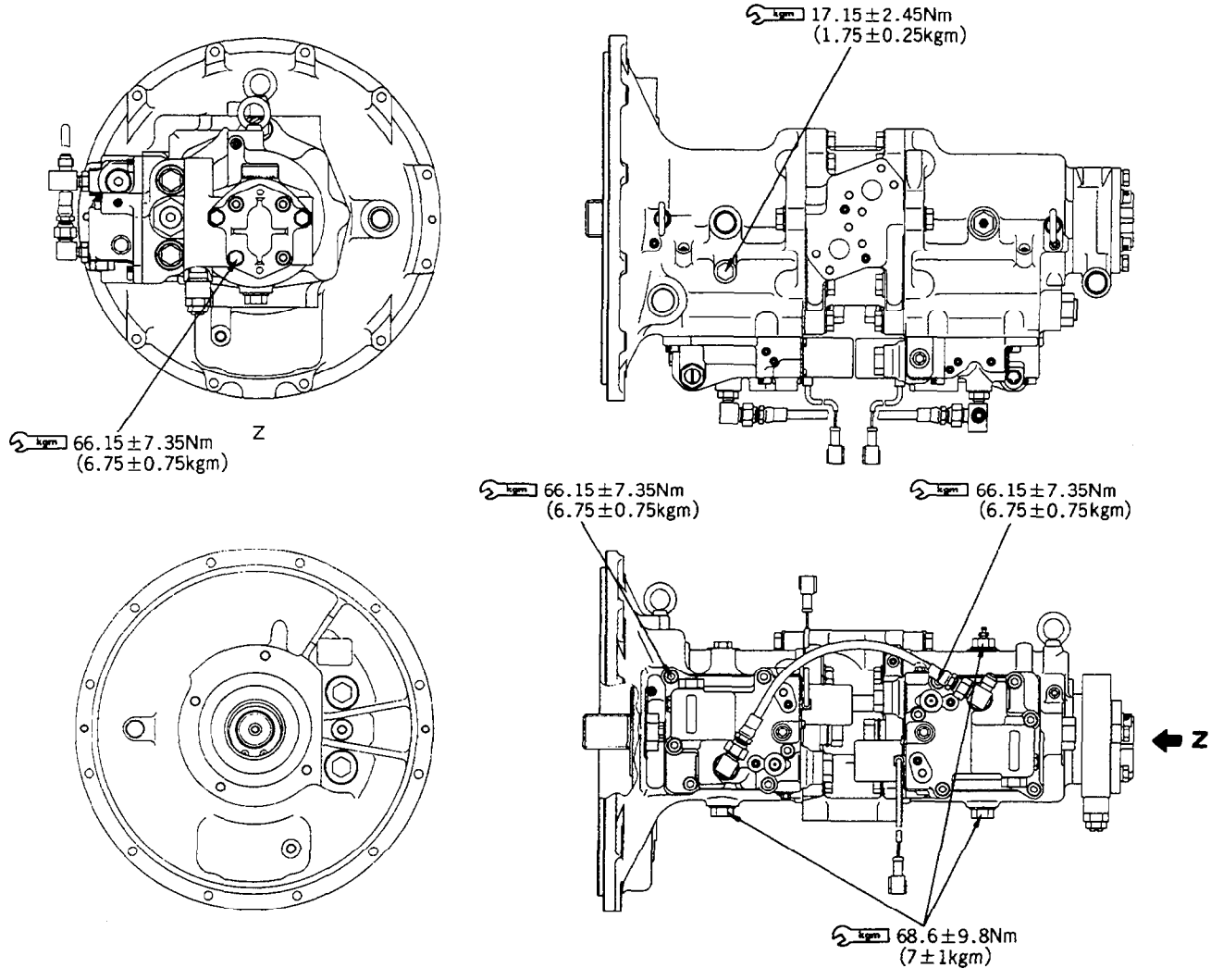
https://truckmanualshub.com/

Unit: mm

No.	Check item	Criteria				Remedy
1	Link pitch	Standard size		Repair limit		Turn or replace
		203.45		207.45		
2	Outside diameter of bushing	66.9		61.9		
3	Height of grouser	31		19		Lug welding, rebuild or replace
4	Height of link	116		107		Rebuild or replace
5	Interference between bushing and link	Standard size	Tolerance		Standard interference	Interference limit	Replace
			Shaft	Hole			
		66.5	+0.464 +0.424	+0.074 0	0.350 - 0.464	0.100	
6	Interference between regular pin and link	44.6 (Shaft) 44.35 (Hole)	+0.235 +0.085	+0.062 0	0.273 - 0.485	0.140	
7	Interference between master pin and link	44.4 (Shaft) 44.35 (Hole)	+0.230 +0.200	+0.062 0	0.188 - 0.280	0.080	Replace with over size
8	Protrusion of bushing	5.25 ± 0.3					Adjust
9	Tightening torque of shoe bolt	Initial tightening torque: 390 ± 49 Nm (40 ± 5 kgm) Additional tightening angle: 120° ± 10°					Tighten

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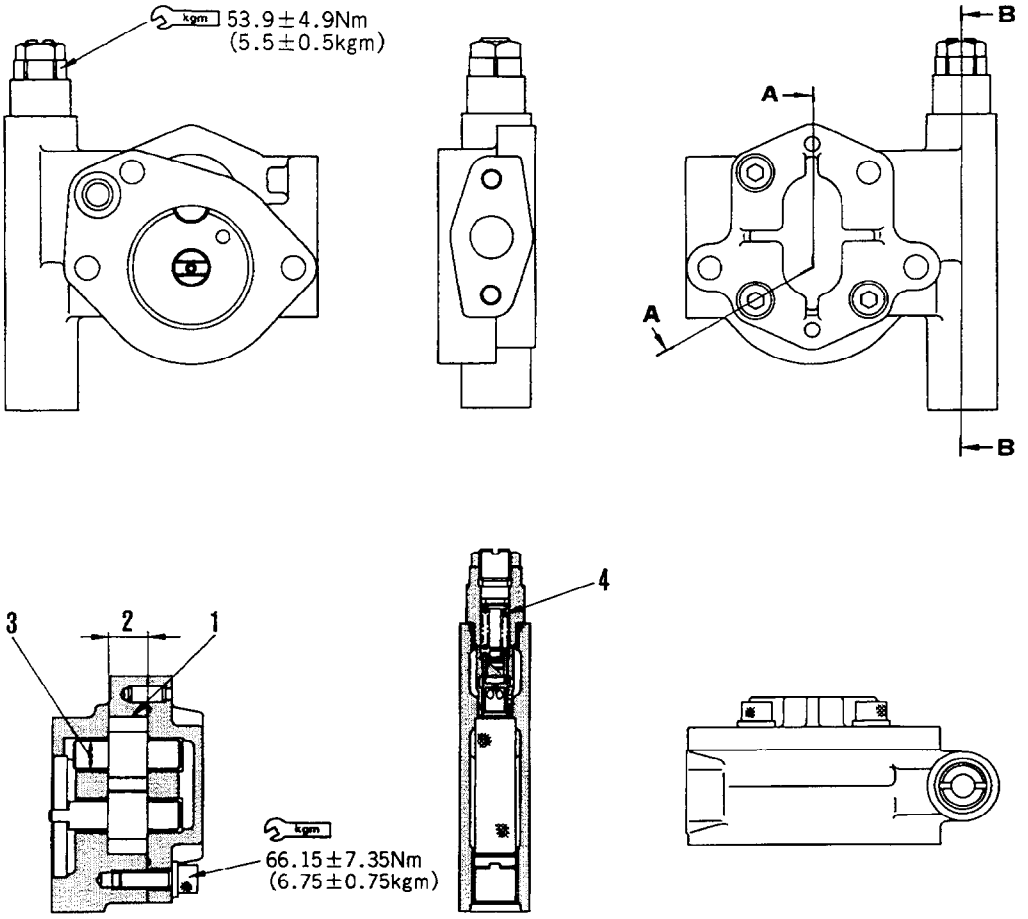
HYDRAULIC PUMP



X10AV269

https://truckmanualshub.com/

CONTROL PUMP, RELIEF VALVE



X10AV270

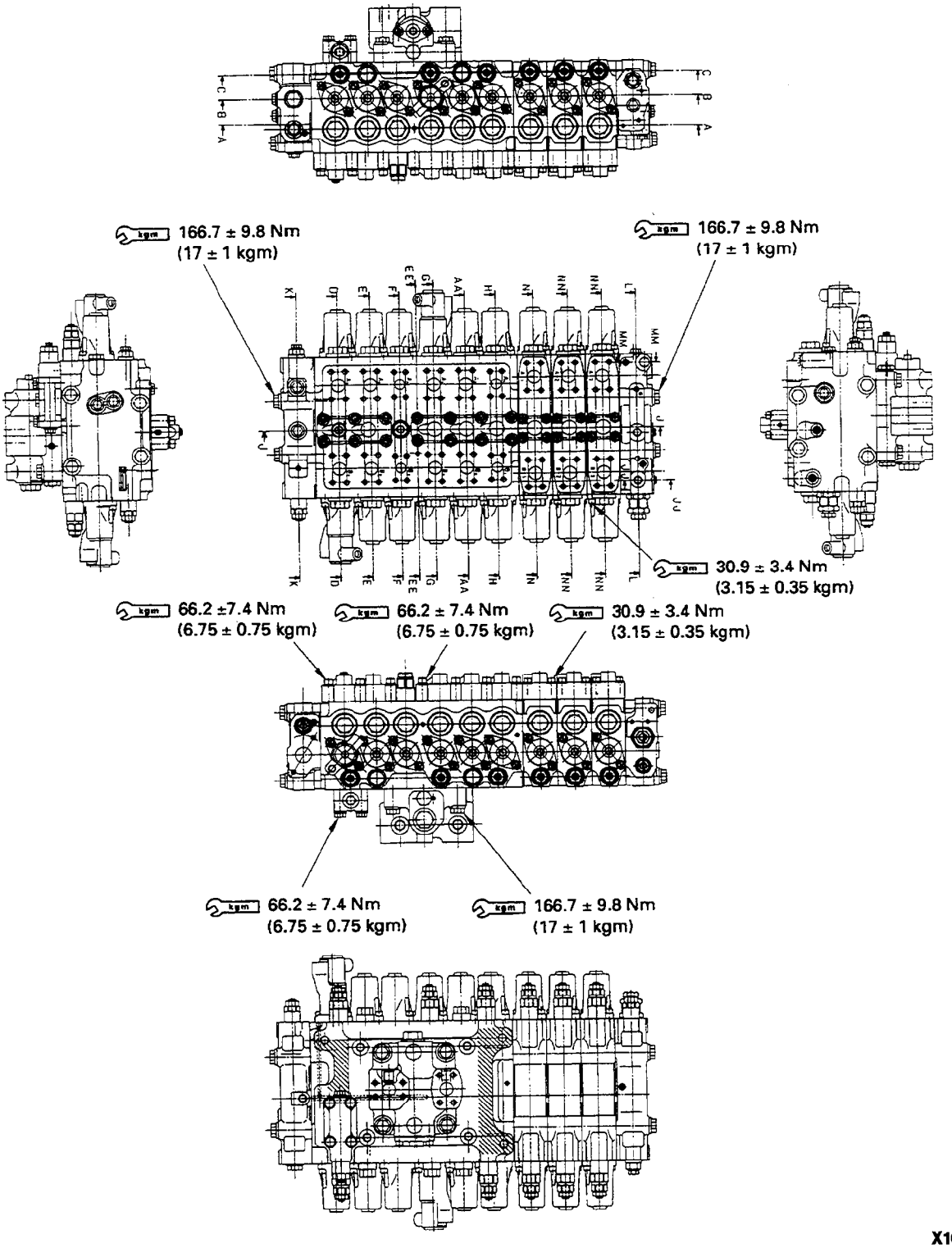
Unit: mm

No.	Check item	Criteria					Remedy
1	Radical clearance between gear and gear case	Standard clearance			Clearance limit		Replace
		0.085 - 0.125			0.145		
2	Axial clearance between gear and gear case	0.040 - 0.050			0.105		
3	Clearance between gear shaft and bushing	0.045 - 0.098			0.13		
4	Control relief valve spring	Standard size			Repair limit		Replace spring if any damages or deformations are found.
		Free length X O.D.	Installed length	Installed load	Free length	Installed load	
		32.3 X 13	25.0	177.4 N (18.1 kg)	–	159.7 N (16.3 kg)	
–	Delivery [Engine oil: SAE 30, Oil temperature: 45 - 55°C, Oil pressure: 2.94 MPa (30 kg/cm²)]	Standard value			Repair limit		Replace
		Revolution speed (rpm)	Delivery (ℓ/min)		Revolution speed (rpm)	Delivery (ℓ/min)	
		3,200	46		3,200	43	

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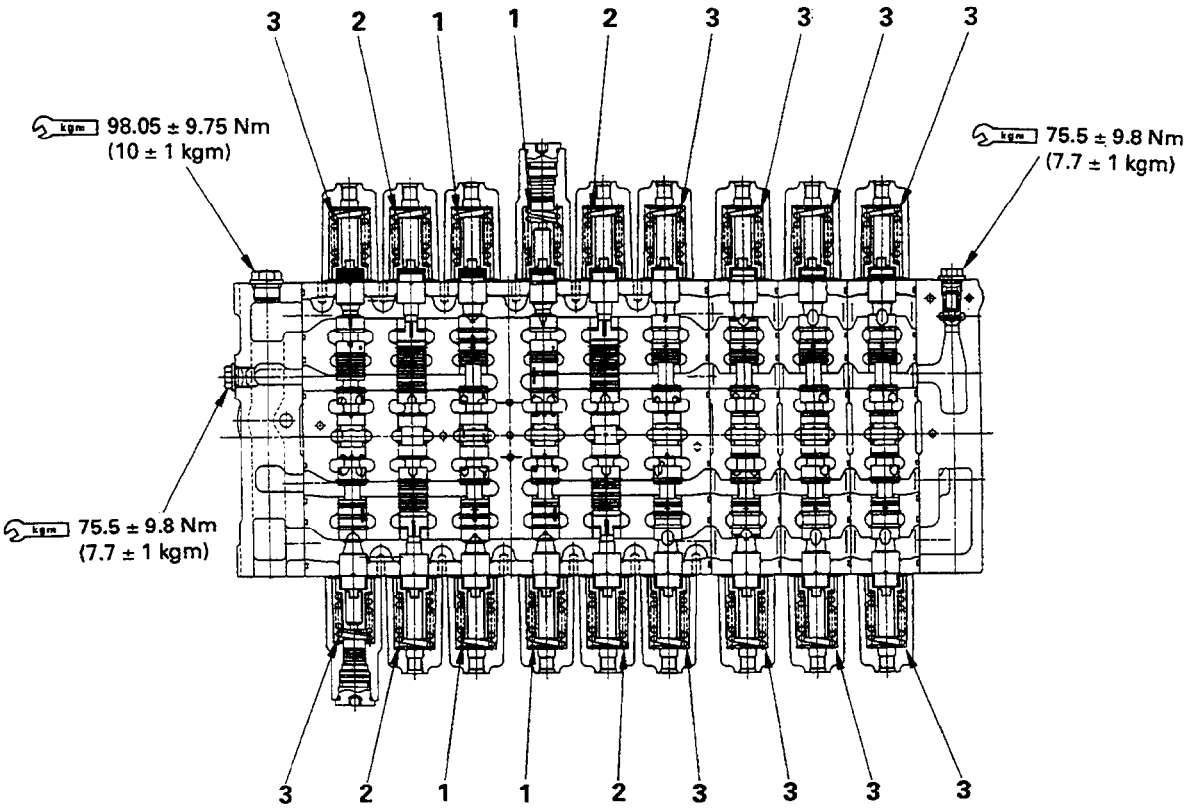
CONTROL VALVE

★ Figure shows 9-spool control valve (with 3 service valve).
9-spool control valve includes 6-spool, 7-spool and 8-spool control valves.



X10BH176

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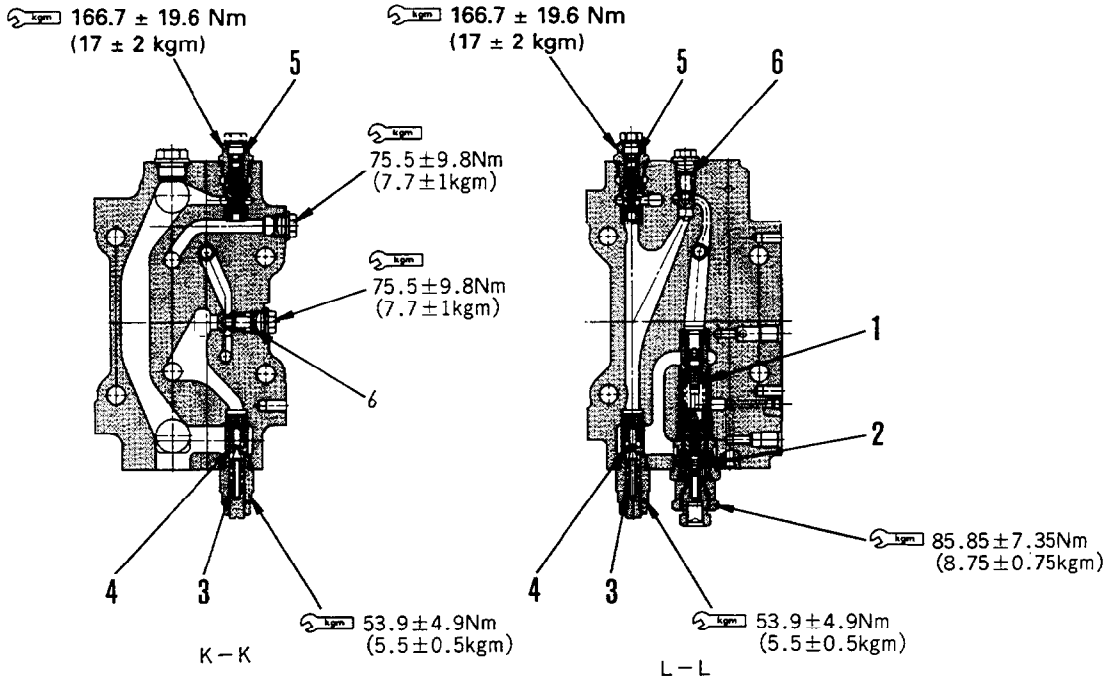


X10BH177

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 deformations are found.
		54.2 X 34.8	51.2	416.5 N (42.5 kg)	–	333.2 N (34 kg)	
2	Spool return spring	54.2 X 34.8	51.2	420.4 N (42.9 kg)	–	336.1 N (34.3 kg)	
3	Spool return spring	54.2 X 34.8	51.2	393.0 N (40.1 kg)	–	314.6 N (32.1 kg)	

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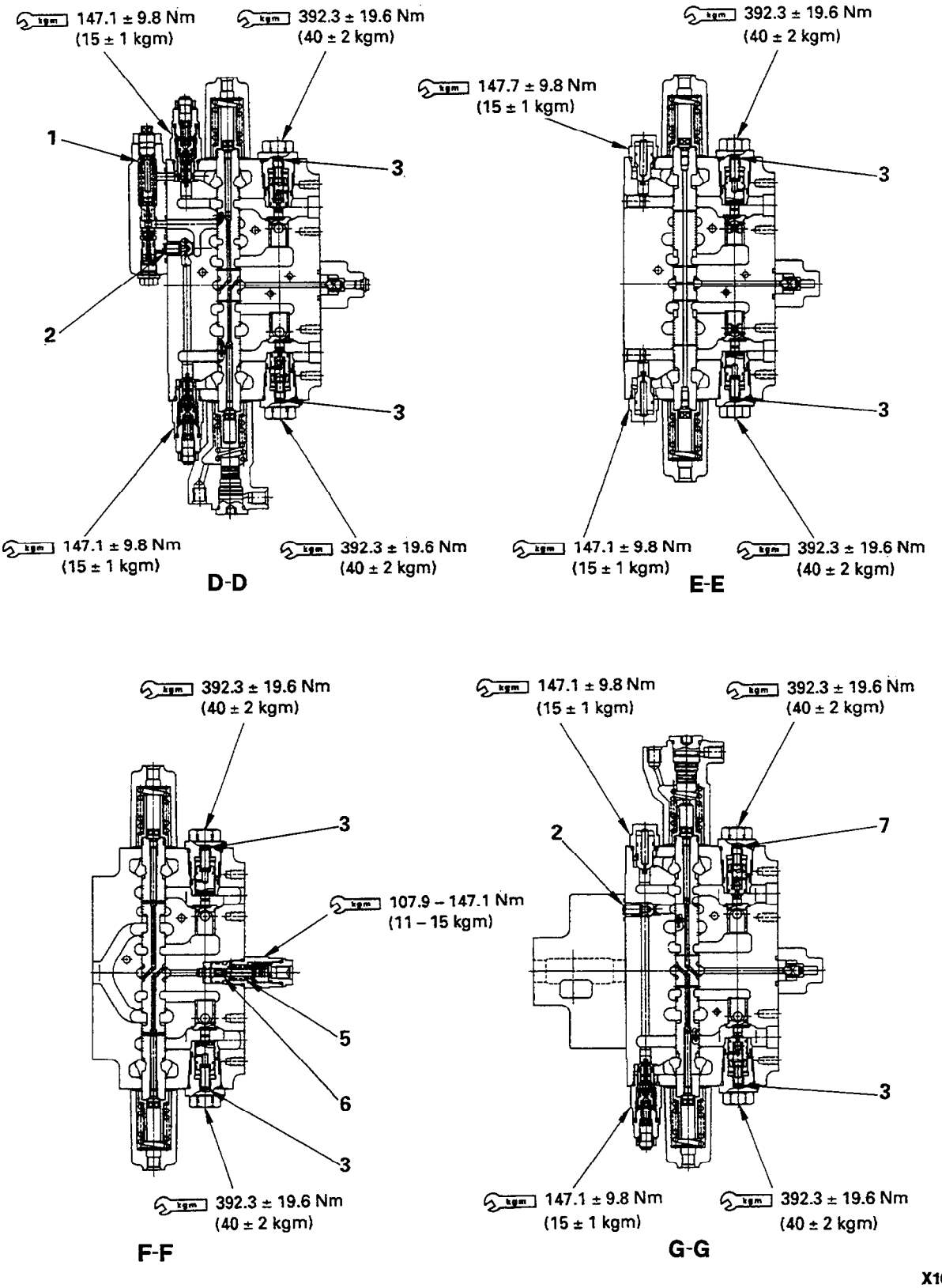


X10BH178

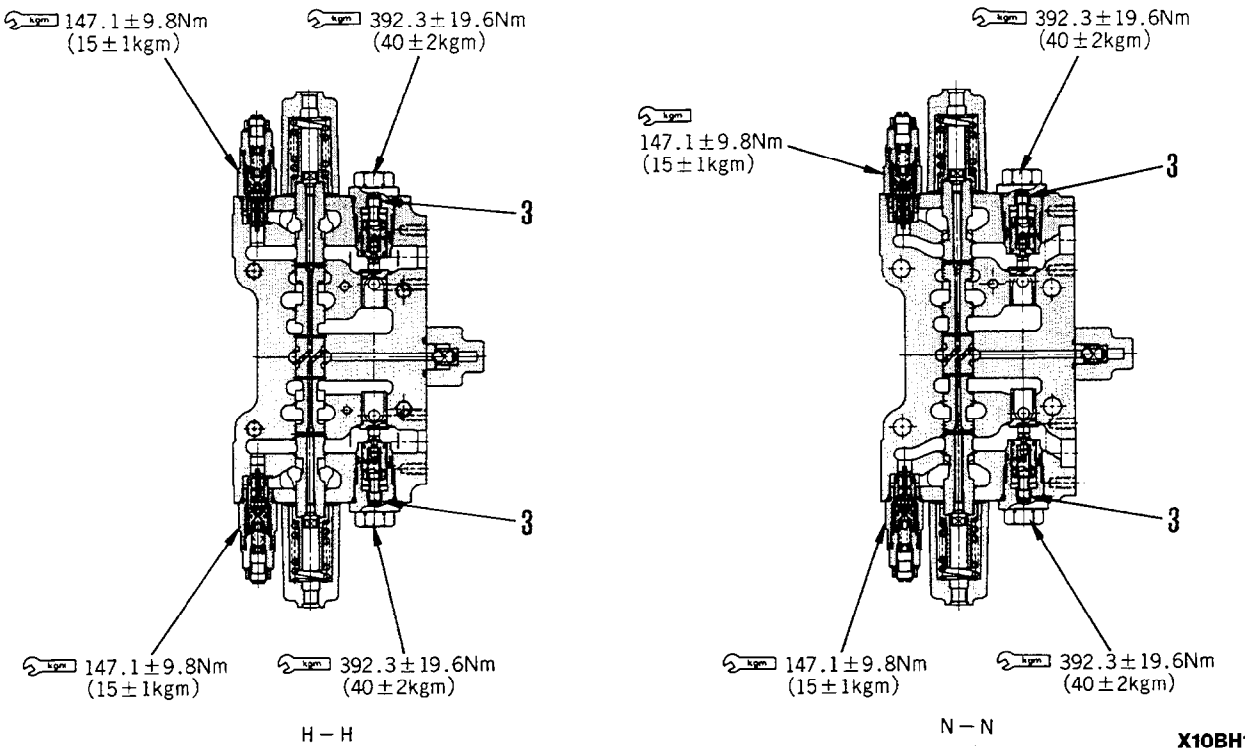
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Main unload spring	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformations are found.
		43 X 19.4	32	260.7 N (26.6 kg)	—	208.7 N (21.3 kg)	
2	LS relief spring	20.9 X 17.2	18	431.2 N (44.0 kg)	—	345.0 N (35.2 kg)	
3	Valve spring	23.2 X 7.2	19	41.2 N (4.2 kg)	—	33.3 N (3.4 kg)	
4	Relief spring	30.7 X 9.6	26.3	369.5 N (37.7 kg)	—	296.0 N (30.2 kg)	
5	Unload spring	35 X 10.4	26	138.2 N (14.1 kg)	—	110.7 N (11.3 kg)	
6	Check valve spring	31.5 X 10.3	19.5	103.9 N (10.6 kg)	—	4.4 N (0.45 kg)	

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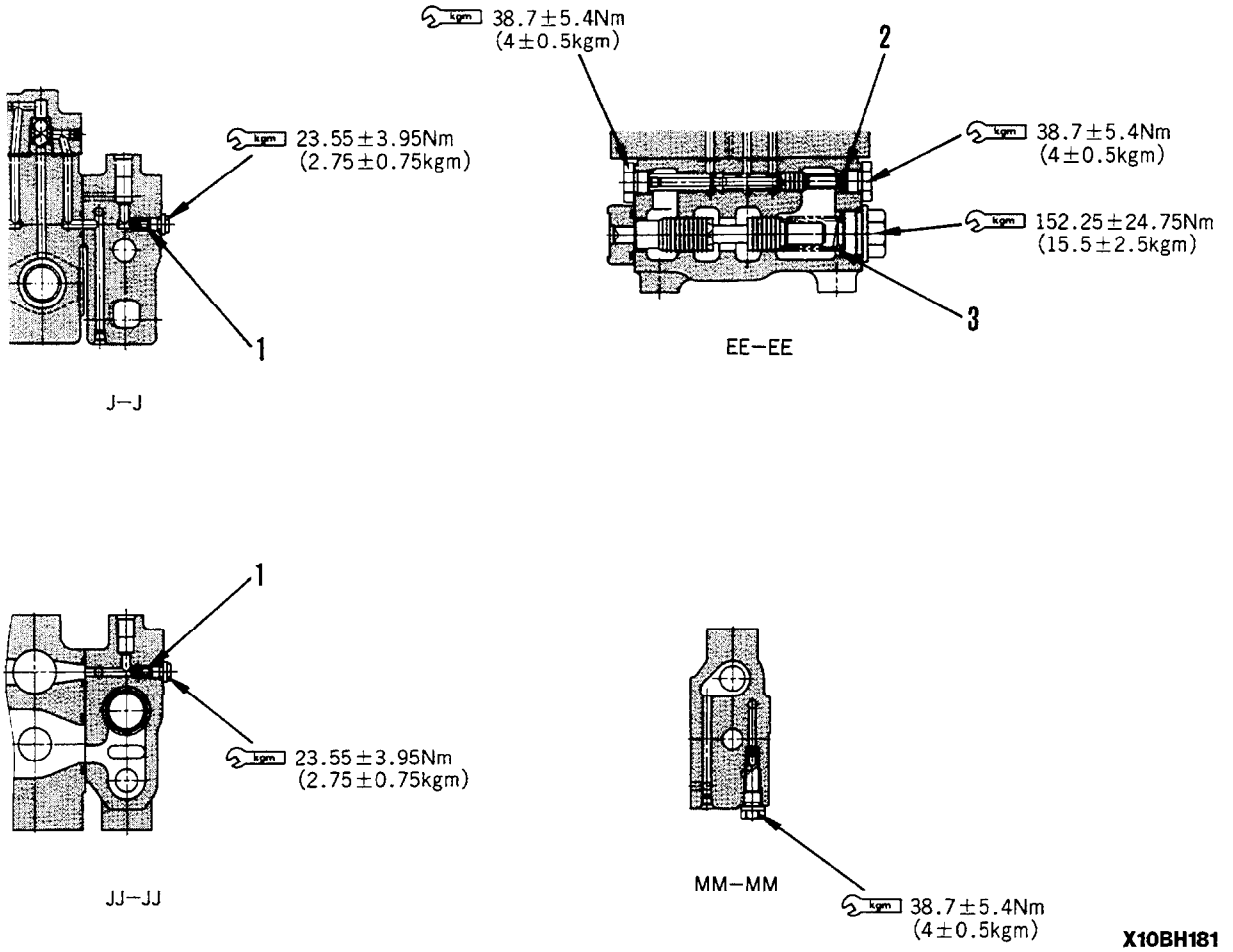


X10BH180

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Arm counterbalance valve spring	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformations are found.
		70.8 X 16.1	55	192.1 N (19.6 kg)	–	153.9 N (15.7 kg)	
2	Regeneration valve spring	31.5 X 10.3	19.5	5.9 N (0.6 kg)	–	4.4 N (0.45 kg)	
3	Piston return spring	48.1 X 10.8	30	15.7 N (1.6 kg)	–	12.7 N (1.3 kg)	
4	Check valve spring	13.0 X 6.5	9.5	2.0 N (0.2 kg)	–	1.5 N (0.15 kg)	
5	Load spring	30.4 X 16.7	27	428.3 N (43.7 kg)	–	343 N (35.0 kg)	
6	Check valve spring	13.6 X 5.5	10	2.0 N (0.2 kg)	–	1.5 N (0.15 kg)	
7	Piston return spring	36.9 X 11.1	28	29.4 N (3 kg)	–	23.5 N (2.4 kg)	

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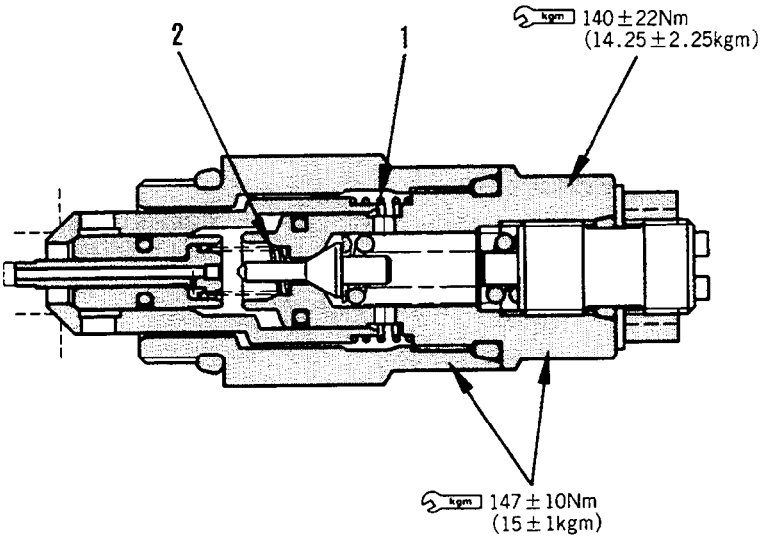
X10BH181

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 deformations are found.
		11.5 X 4.6	8.5	1.5 N (0.15 kg)	–	1.2 N (0.12 kg)	
2	Spool return spring	65.6 X 27.2	50	167.6 N (17.1 kg)	–	134.3 N (13.7 kg)	
3	Spool return spring	13.6 X 5.5	10	2.0 N (0.2 kg)	–	1.5 N (0.15 kg)	

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SAFETY-SUCTION VALVE FOR SERVICE VALVE



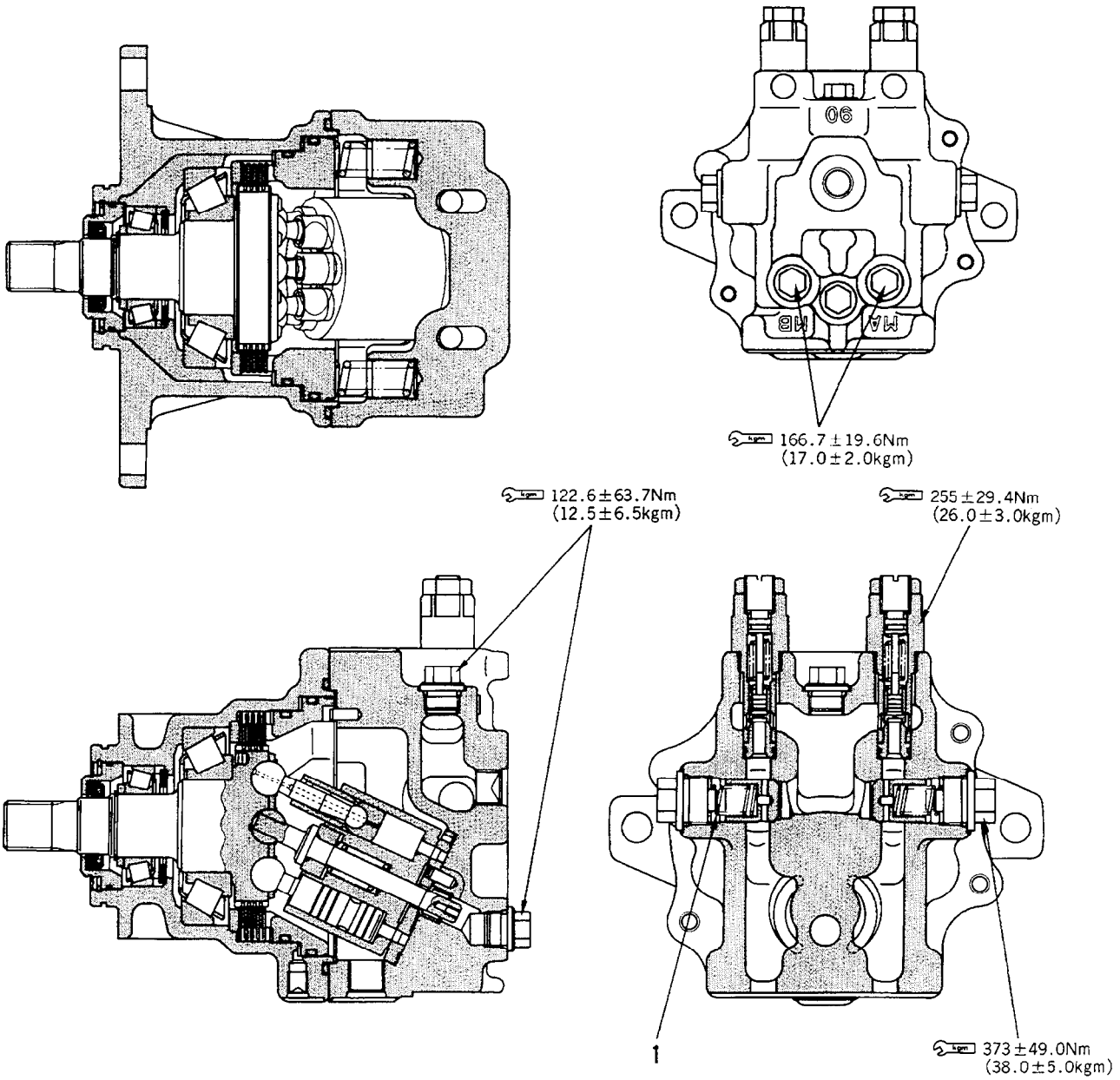
X10BH182

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Suction valve spring	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformations are found.
		16.3 X 21.3	1.5	2.1 N (0.21 kg)	—	1.6 N (0.16 kg)	
2	Piston spring	20 X 7	14	2.1 N (0.21 kg)	—	1.6 N (0.16 kg)	

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SWING MOTOR



X09DH033

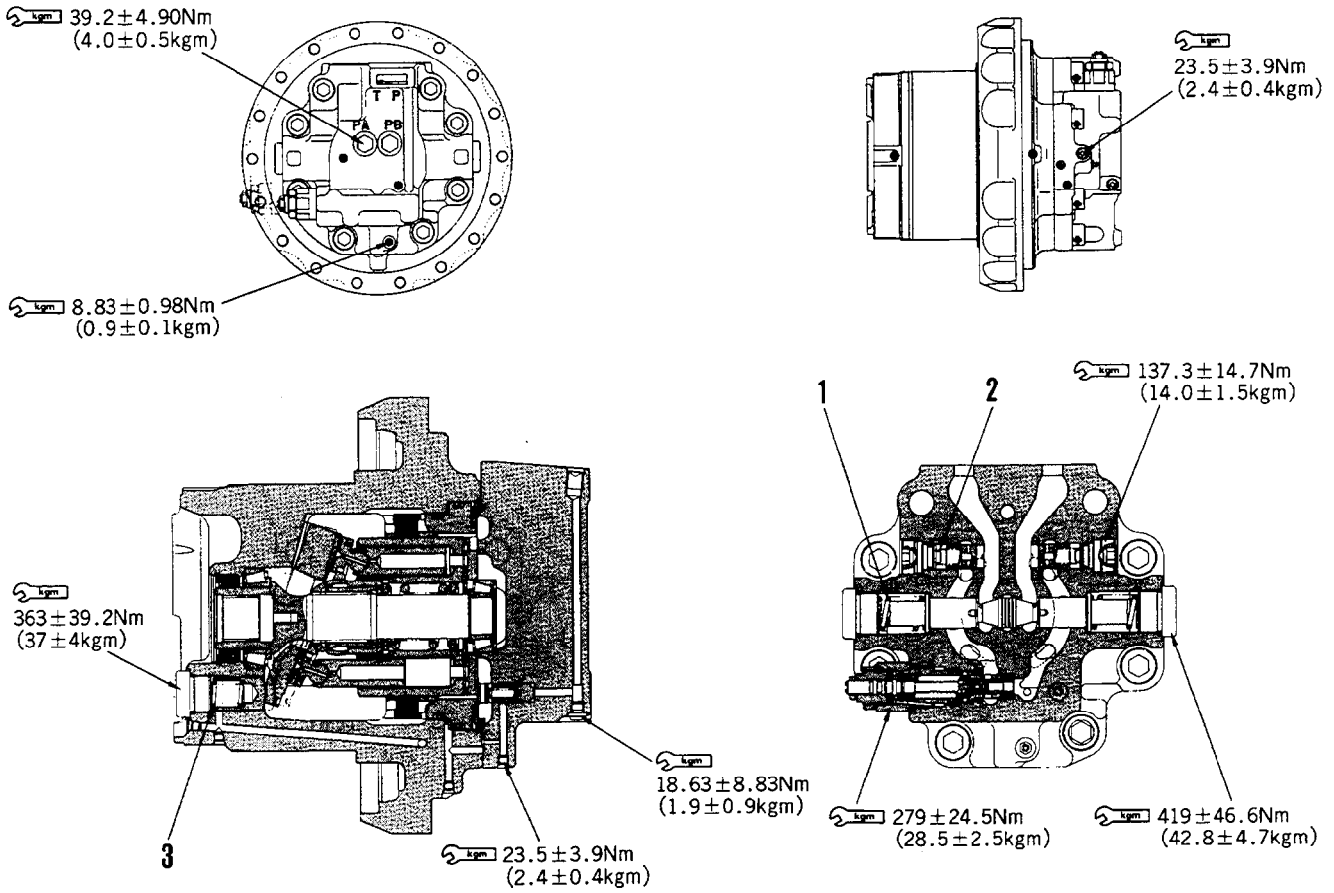
Unit: mm

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 deformations are found.
		62.5 X 20.0	35.0	3.5 N (0.36 kg)	–	2.8 N (0.29 kg)	

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TRAVEL MOTOR

PC200-6, PC200LC-6
PC210LC-6, PC220LC-6



X07HH032

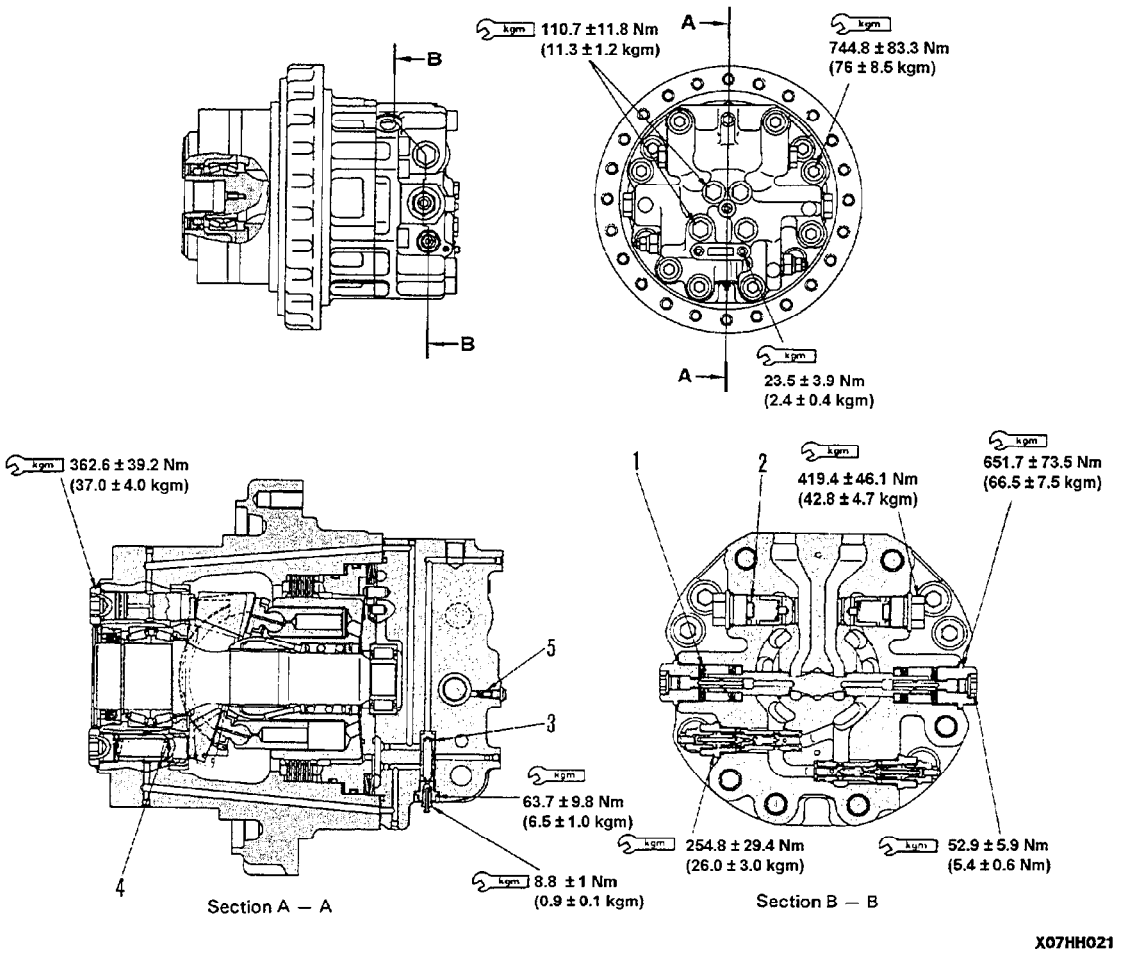
Unit: mm

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 deformations are found.
		58.43 X 30.0	42.0	426.3 N (43.5 kg)	—	341.0 N (34.8 kg)	
2	Check valve spring	33.0 X 13.8	23.0	1.3 N (0.13 kg)	—	1.0 N (0.10 kg)	
3	Regulator piston spring	61.1 X 23.2	30.0	398.9 N (40.7 kg)	—	319.5 N (32.6 kg)	

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TRAVEL MOTOR

PC250LC-6

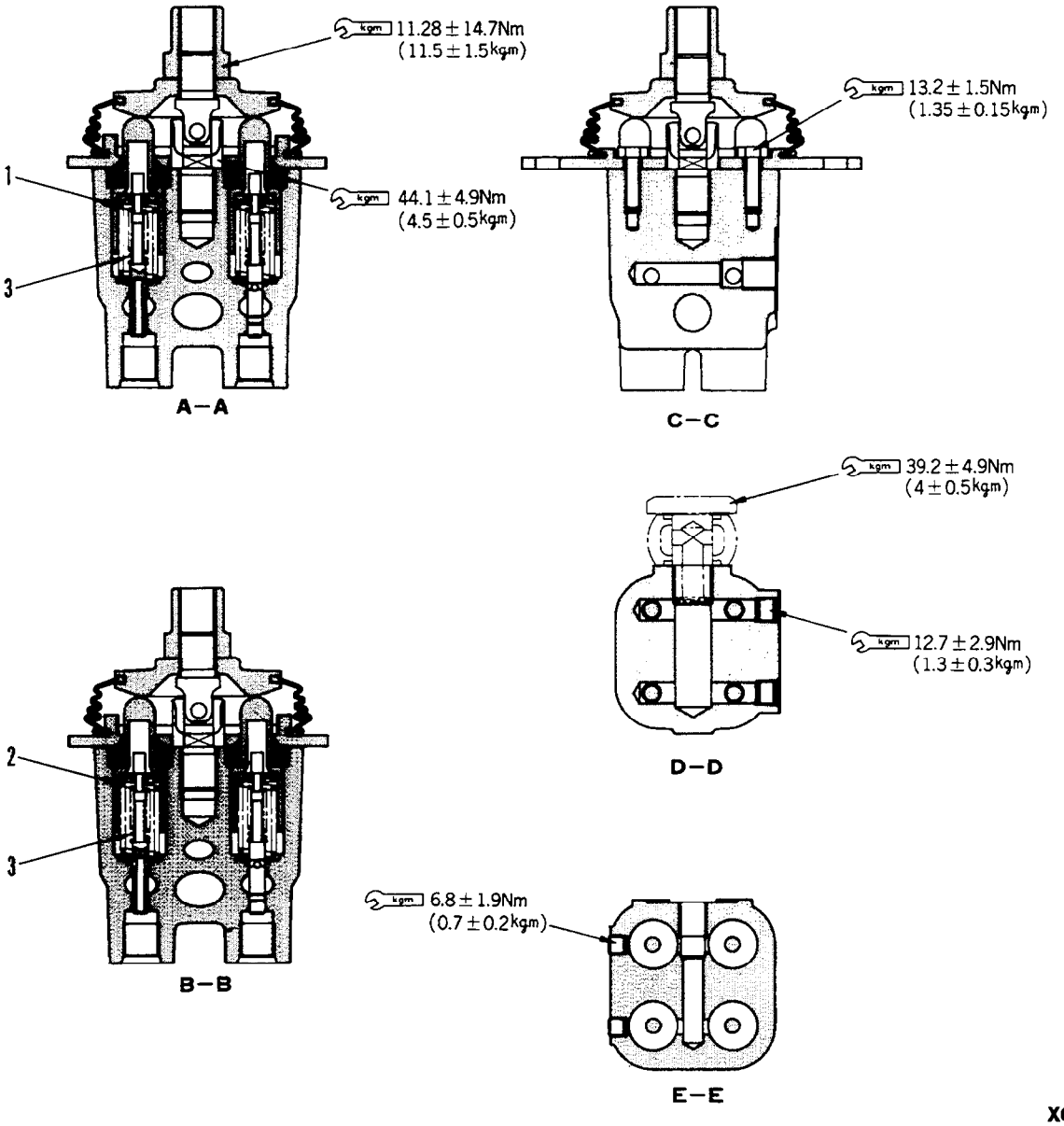


Unit: mm

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	
		42.5 X 40	41	370.4 N (37.8 kg)	—	259.7 N (26.5 kg)	
2	Check valve spring	52.7 X 22.4	37	4.9 N (0.5 kg)	—	3.9 N (0.4 kg)	Replace spring if any damages or deformations are found.
3	Regulator piston spring	55 X 9	50	98 N (10 kg)	—	78.4 N (8.0 kg)	
4	Pilot piston spring	82.7 X 19.4	60.5	624.3 N (63.7 kg)	—	499.8 N (51.0 kg)	
5	Check valve spring	9.4 X 4.6	7.75	0.5 N (0.05 kg)	—	0.4 N (0.04 kg)	

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WORK EQUIPMENT, SWING PPC VALVE



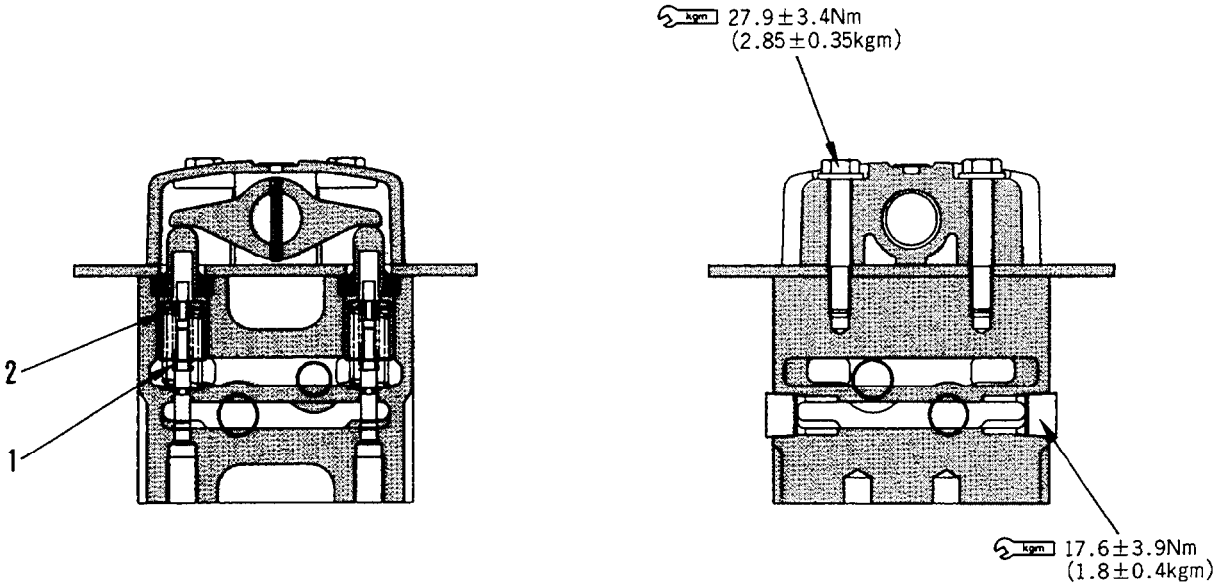
X07HH033

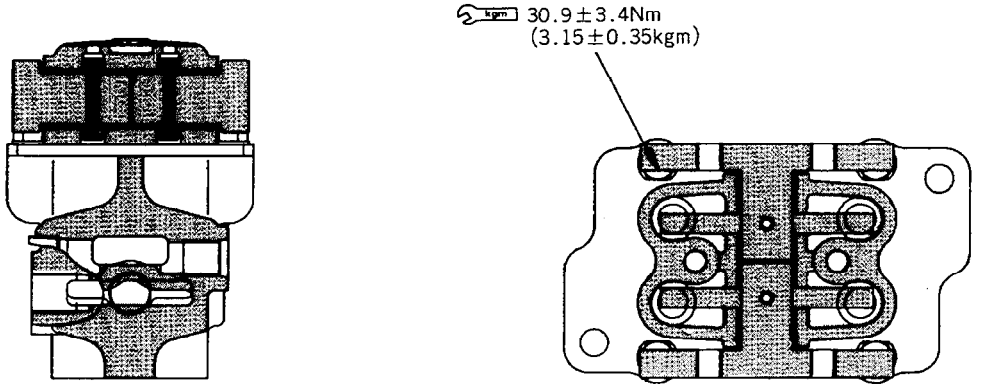
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Centering spring (for P3, P4)	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformations are found.
		42.4 X 15.5	34	17.6 N (1.8 kg)	–	13.7 N (1.4 kg)	
2	Centering spring (for P1, P2)	44.4 X 15.5	34	29.4 N (3.0 kg)	–	23.5 N (2.4 kg)	
3	Metering spring	26.5 X 8.2	24.9	16.7 N (1.7 kg)	–	13.7 N (1.4 kg)	

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TRAVEL PPC VALVE





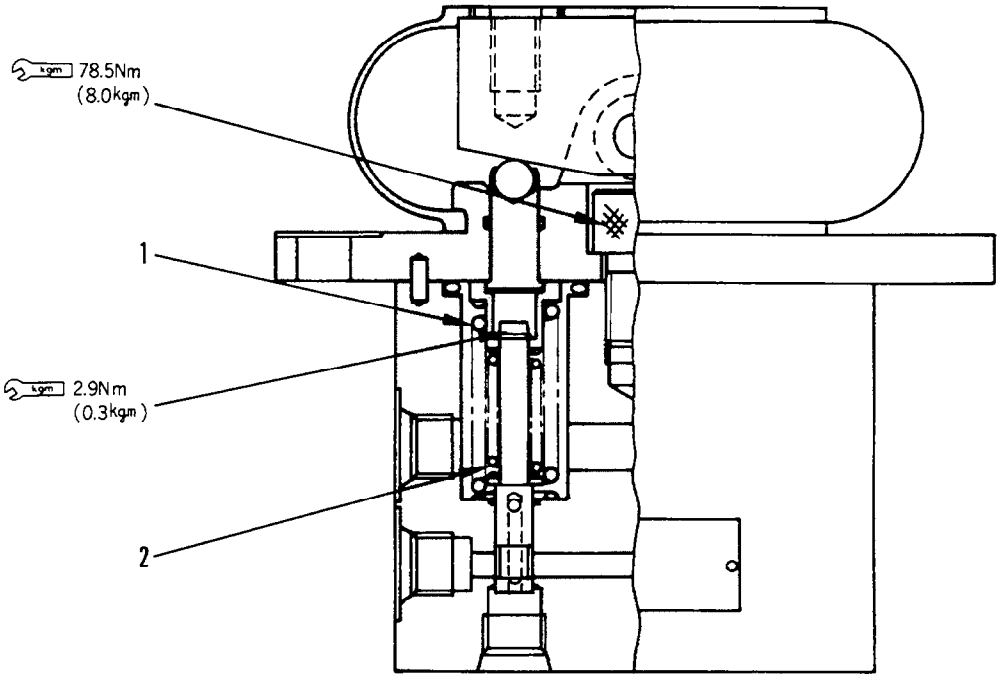
X10BH183

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.
		26.5 X 8.15	24.7	16.7 N (1.7 kg)	–	13.7 N (1.4 kg)	
2	Centering spring	48.1 X 15.5	32.5	107.8 N (11 kg)	–	86.2 N (8.8 kg)	

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SERVICE PPC VALVE



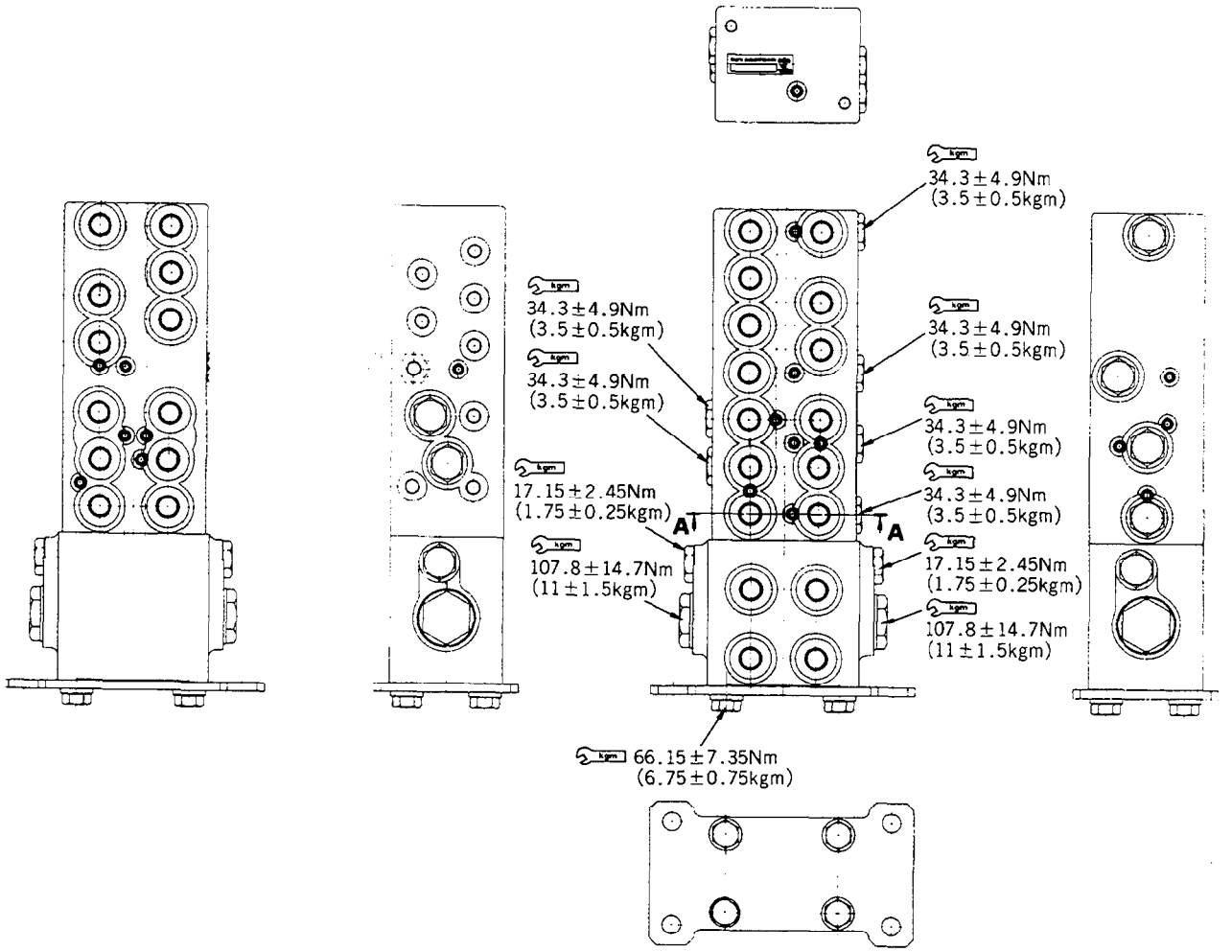
X10BH184

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 deformation are found.
		64.8 X 16.6	40.5	46.1 N (4.7 kg)	—	44.1 N (4.5 kg)	
2	Metering spring	26.0 X 10.5	25.0	25.5 N (2.6 kg)	—	24.5 N (2.5 kg)	

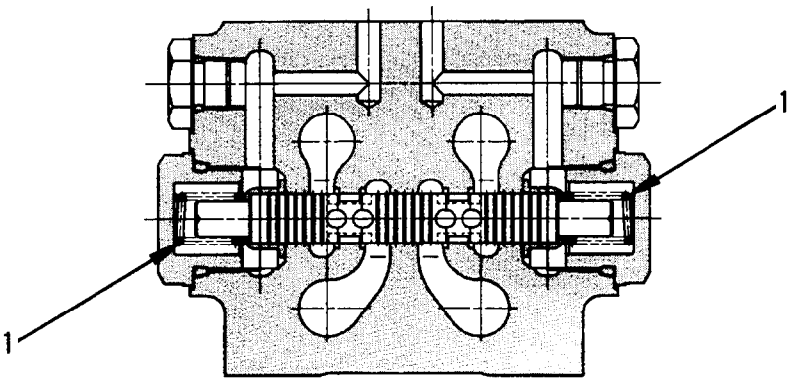
https://truckmanualshub.com/

PPC SHUTTLE, TRAVEL JUNCTION VALVE



X10BH185

https://truckmanualshub.com/



A – A

X10BH186

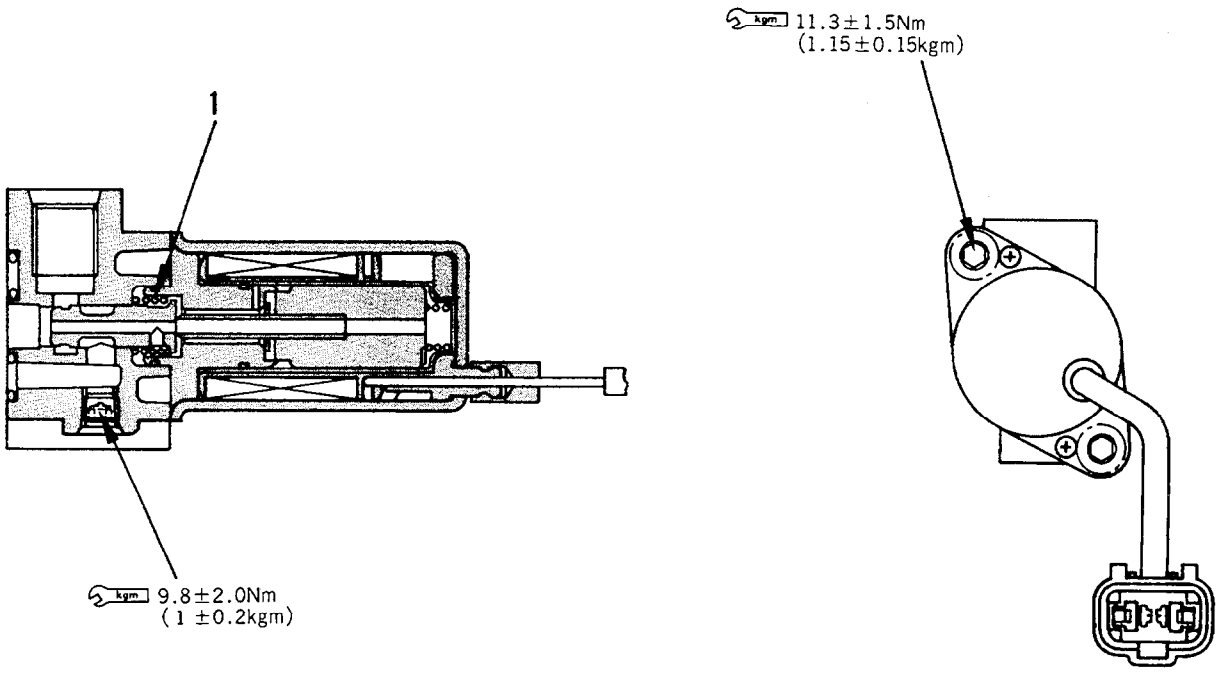
Unit: mm

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 deformations are found.
		23.6 X 13.3	20	14.7 N (1.5 kg)	–	11.8 N (1.2 kg)	

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EPC, SOLENOID VALVE

LS CONTROL EPC VALVE



X10BH187

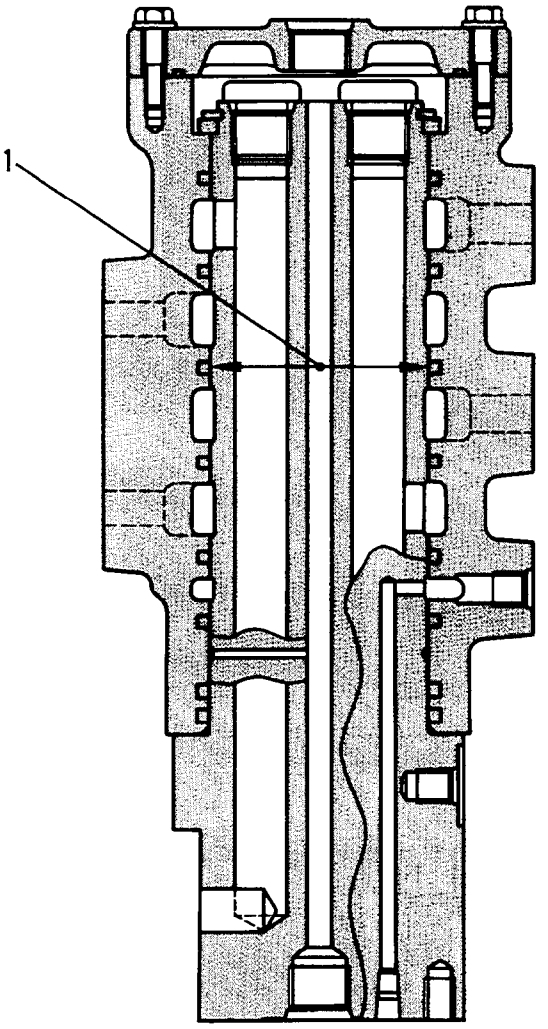
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Return spring	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace EPC valve assembly if any damages or deformations are found.
		9.0 X 11.4	7.9	3.1 N (0.32 kg)	–	–	

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CENTER SWIVEL JOINT

4 PORT SWIVEL JOINT



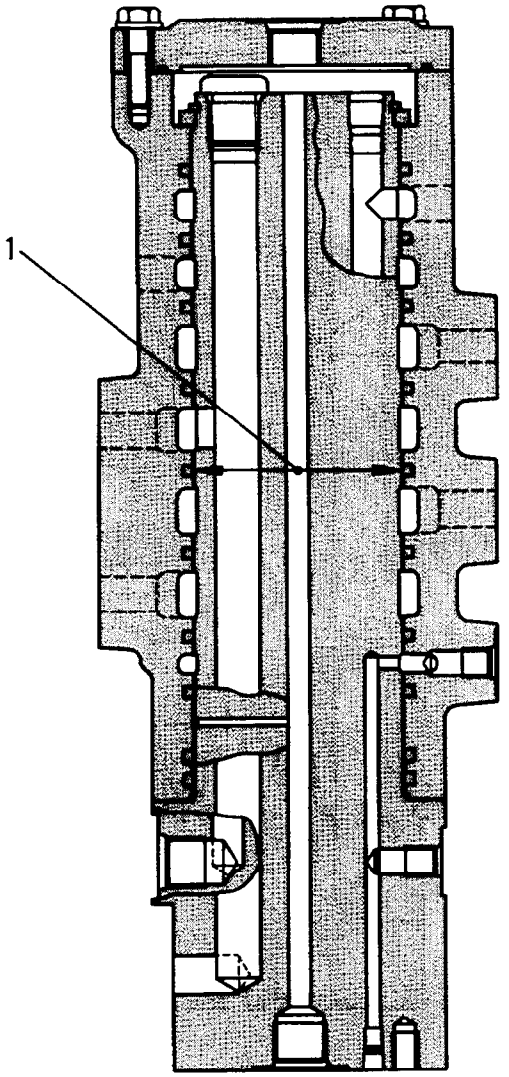
X10ZZ021

Unit: mm

No.	Check item	Criteria			Remedy
1	Clearance between rotor and shaft	Standard size	Standard clearance	Clearance limit	Replace
		90	0.056 - 0.105	0.111	

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6 PORT SWIVEL JOINT



X10ZZ022

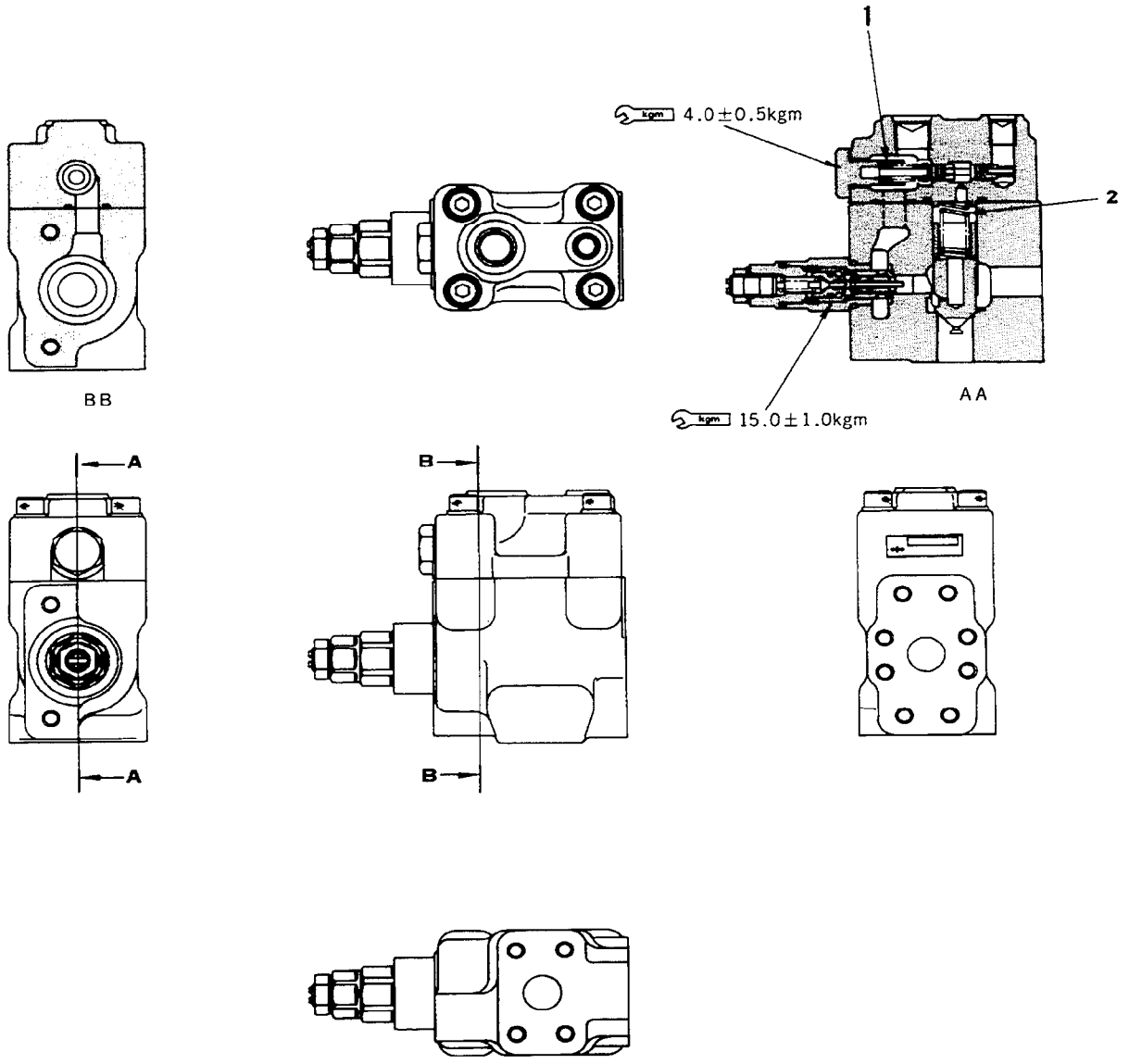
Unit: mm

No.	Check item	Criteria			Remedy
		Standard size	Standard clearance	Clearance limit	
1	Clearance between rotor and shaft	100	0.056 - 0.105	0.111	Replace

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BOOM HOLDING VALVE

★ For machines equipped with arm holding valve, the Maintenance Standard of the arm holding valve is the same as this valve.



X10BH188

Unit: mm

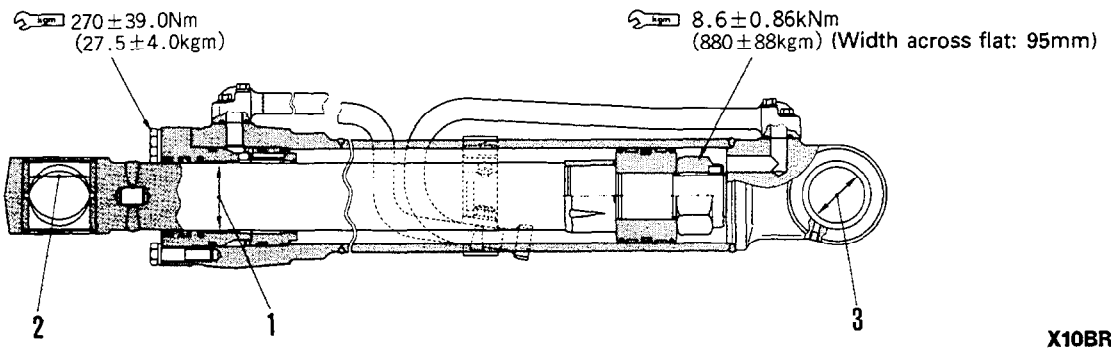
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Pilot valve spring	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformations are found.
		26.5 X 11.2	25.0	4.7 N (0.48 kg)	—	3.7 N (0.38 kg)	
2	Check valve spring	37.2 X 16.2	30.0	35.3 N (3.6 kg)	—	28.4 N (2.9 kg)	

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HYDRAULIC CYLINDER

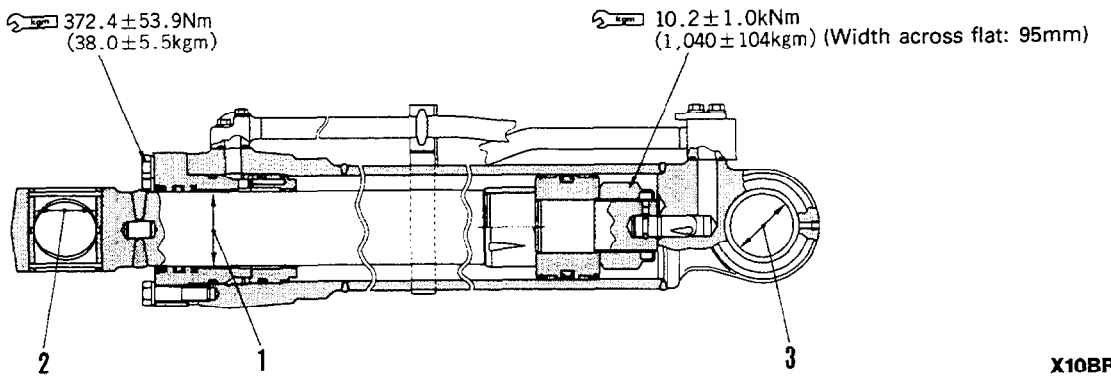
PC200-6, PC200LC-6
PC210LC-6

BOOM CYLINDER



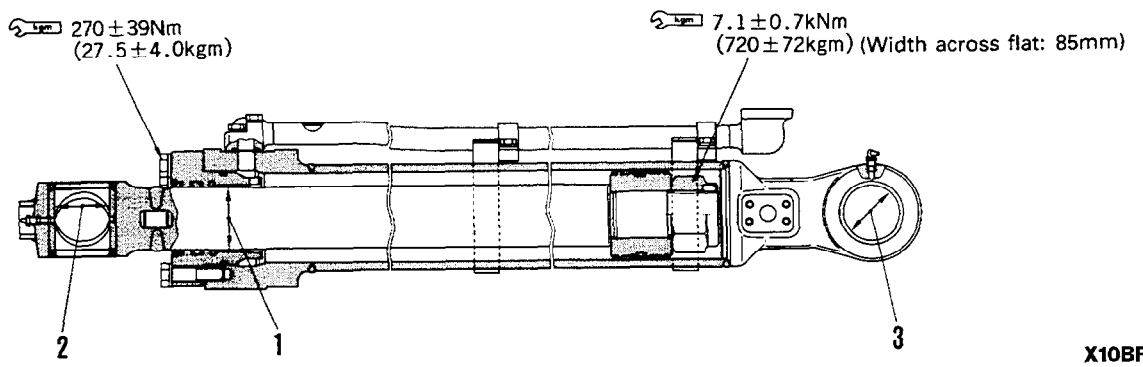
X10BR042

ARM CYLINDER



X10BR043

BUCKET CYLINDER



X10BR044

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Unit: mm

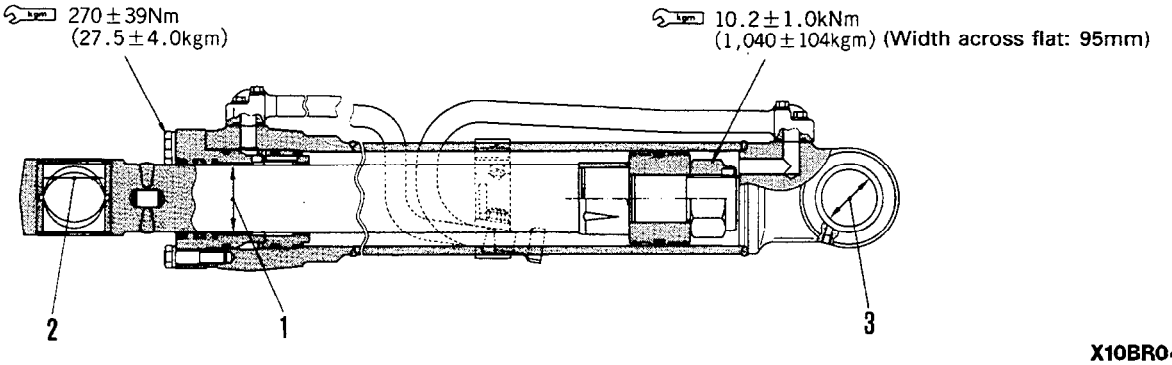
No.	Check item	Cylinder	Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Boom	90	-0.036 -0.090	+0.257 +0.048	0.083 - 0.312	0.447	Replace bushing
		Arm	95	-0.036 -0.090	+0.222 +0.047	0.083 - 0.312	0.412	
		Bucket	80	-0.030 -0.076	+0.258 +0.048	0.078 - 0.334	0.434	
2	Clearance between piston rod support pin and bushing	Boom	80	-0.030 -0.060	+0.457 +0.370	0.400 - 0.517	1.0	Replace pin or bushing
		Arm	80	-0.030 -0.076	+0.457 +0.370	0.400 - 0.533	1.0	
		Bucket	70	-0.030 -0.076	+0.424 +0.350	0.380 - 0.500	1.0	
3	Clearance between cylinder bottom support pin and bushing	Boom	80	-0.030 -0.076	+0.211 +0.124	0.400 - 0.533	1.0	
		Arm	80	-0.030 -0.076	+0.457 +0.370	0.400 - 0.523	1.0	
		Bucket	70	-0.030 -0.076	+0.424 +0.350	0.380 - 0.500	1.0	

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HYDRAULIC CYLINDER

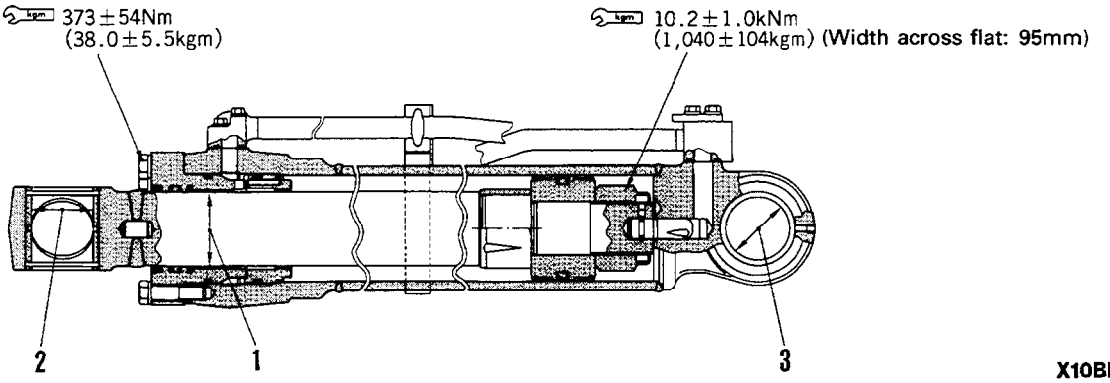
PC220LC-6, PC250LC-6

BOOM CYLINDER



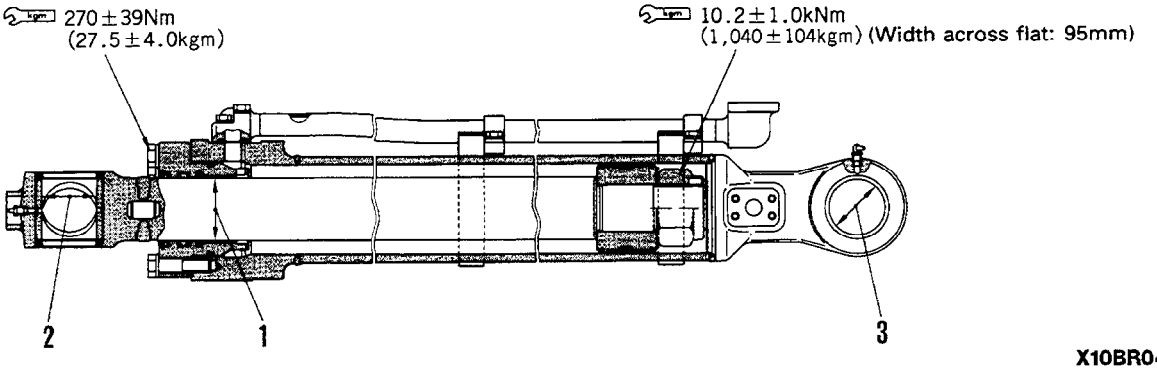
X10BR045

ARM CYLINDER



X10BR046

BUCKET CYLINDER



X10BR047

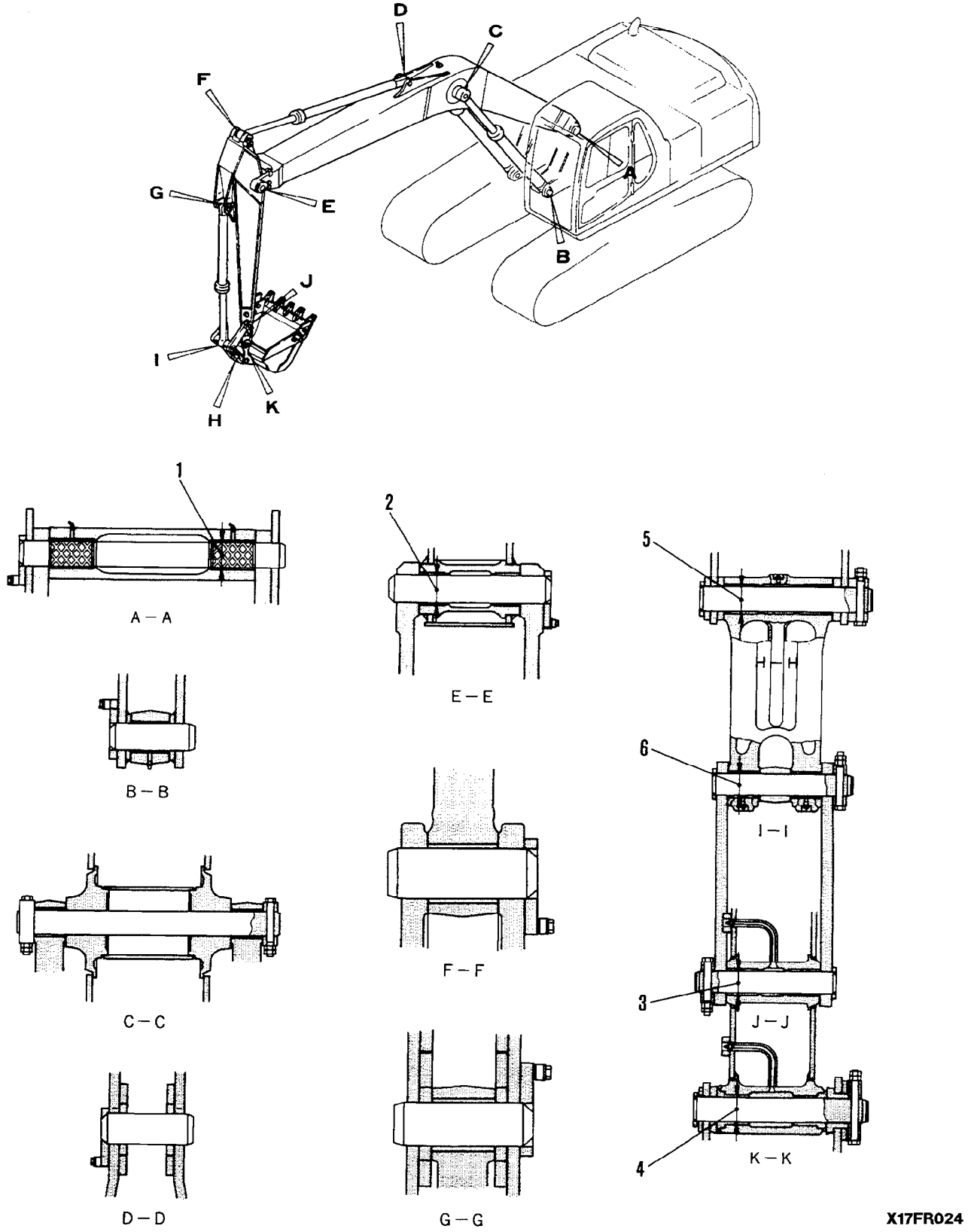
https://truckmanualshub.com/

Unit: mm

No.	Check item		Criteria					Remedy
		Cylinder	Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Boom	95	-0.036 -0.090	+0.222 +0.047	0.083 - 0.312	0.447	Replace bushing
		Arm	100	-0.036 -0.090	+0.257 +0.047	0.083 - 0.347	0.447	
		Bucket	90	-0.030 -0.090	+0.257 +0.048	0.084 - 0.347	0.447	
2	Clearance between piston rod support pin and bushing	Boom	80	-0.030 -0.060	+0.457 +0.370	0.400 - 0.517	1.0	Replace pin or bushing
		Arm	80	-0.030 -0.076	+0.457 +0.370	0.400 - 0.533	1.0	
		Bucket	80	-0.030 -0.076	+0.457 +0.370	0.400 - 0.533	1.0	
3	Clearance between cylinder bottom support pin and bushing	Boom	80	-0.030 -0.076	+0.211 +0.124	0.400 - 0.533	1.0	
		Arm	80	-0.030 -0.076	+0.457 +0.370	0.400 - 0.533	1.0	
		Bucket	80	-0.030 -0.076	+0.457 +0.370	0.400 - 0.533	1.0	

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WORK EQUIPMENT



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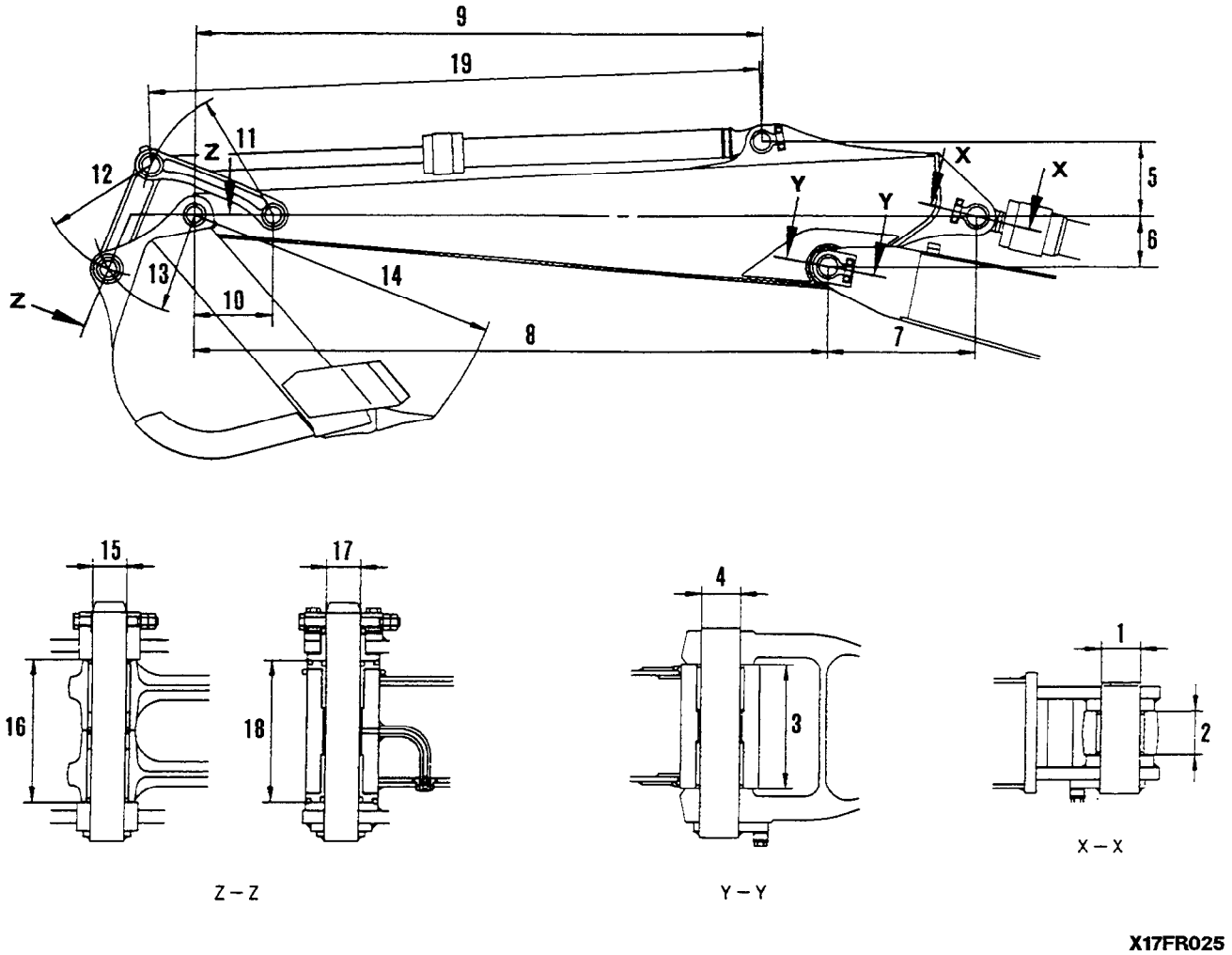
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between connecting pin and bushing of revolving frame and boom	90	-0.036 -0.071	+0.342 +0.269	0.305 - 0.412	1.0	Replace
2	Clearance between connecting pin and bushing of boom and arm	90	-0.036 -0.071	+0.153 +0.097	0.133 - 0.224	1.0	
3	Clearance between connecting pin and bushing of arm and link	70 (PC200) (PC210) 80 (PC220) (PC250)	-0.030 -0.076	+0.335 +0.275	0.305 - 0.411	1.0	
4	Clearance between connecting pin and bushing of arm and bucket	80	-0.030 -0.076	+0.337 +0.273	0.303 - 0.413	1.0	
5	Clearance between connecting pin and bushing of link and bucket	80	-0.030 -0.076	+0.337 +0.273	0.303 - 0.413	1.0	
6	Clearance between connecting pin and bushing of link and link	70 (PC200) (PC210) 80 (PC220) (PC250)	-0.030 -0.076	+0.335 +0.275	0.303 - 0.411	1.0	

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DIMENSION OF WORK EQUIPMENT

1. ARM PORTION



X17FR025

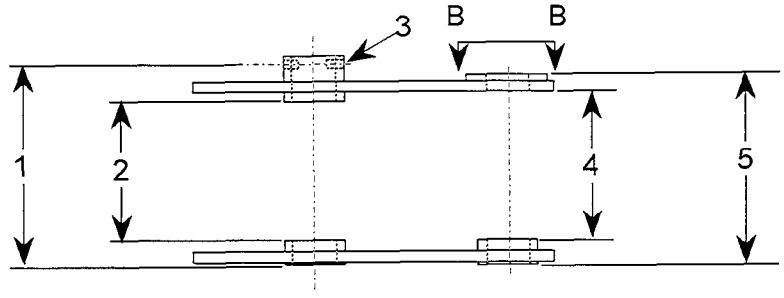
https://truckmanualshub.com/

Unit: mm

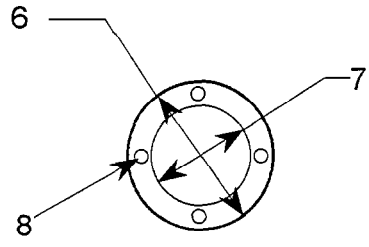
Applicable machine / No.		PC200-6	PC210-6	PC220-6 PC250-6
1		$\varnothing 80\ ^{+0.1}_{0}$	$\varnothing 80\ ^{+0.1}_{0}$	$\varnothing 80\ ^{+0.1}_{0}$
2		$107.3\ ^{+1.5}_{0}$	$107.3\ ^{+1.5}_{0}$	$107.3\ ^{+1.5}_{0}$
3		$310\ ^{+0.5}_{0}$	$310\ ^{+0.5}_{0}$	$310\ ^{+0.5}_{0}$
4		$\varnothing 90\ ^{-0.036}_{-0.071}$	$\varnothing 90\ ^{-0.036}_{-0.071}$	$\varnothing 90\ ^{-0.036}_{-0.071}$
5		361.7 ± 1	361.7 ± 1	403.9 ± 1
6		187.2 ± 0.5	187.2 ± 0.5	200 ± 0.5
7		829.1 ± 1	829.1 ± 1	920 ± 1
8		2,919	2,919	3,038
9		2,631.3 ± 1	2,631.3 ± 1	2,563.2 ± 1
10		410 ± 1	410 ± 1	465 ± 1
11		640 ± 0.2	640 ± 0.2	585 ± 0.2
12		600 ± 0.5	600 ± 0.5	600 ± 0.5
13		458.1	458.1	446.3
14		1,486	1,498.3	1,551.7
15		Ø80	Ø80	Ø80
16		326.5 ± 1	326.5 ± 1	326.5 ± 1
17		Ø80	Ø80	Ø80
18	Arm width	$311\ ^{0}_{-0.5}$	$311\ ^{0}_{-0.5}$	$311\ ^{0}_{-0.5}$
	Bushing installed	325	325	325
19	Min.	1,680	1,680	1,605
	Max.	2,800	2,800	2,625

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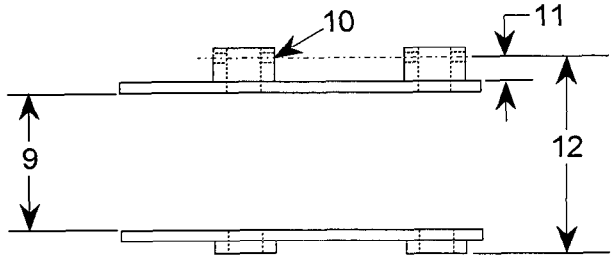
2. BUCKET PORTION



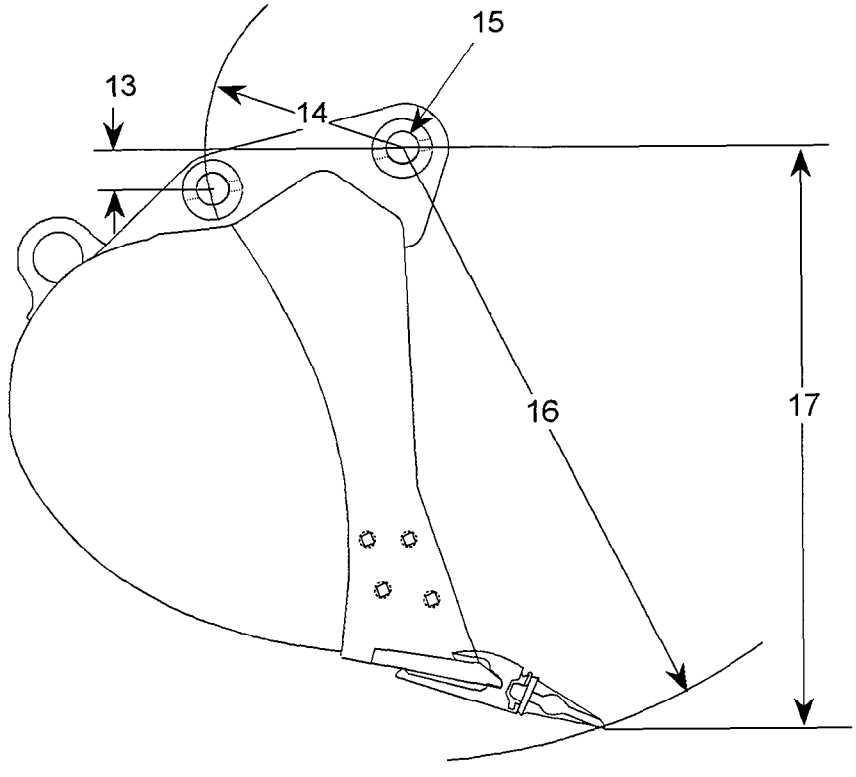
Adjustable Device Configuration



View B -B



Standard Configuration



X17FZ047

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Unit: mm

Applicable model / No.	PC200-6 PC210-6	PC220-6	PC250-6
1	469.39 - 470.41	469.39 - 470.41	469.39 - 470.41
2	326.14 - 327.66	326.14 - 327.66	326.14 - 327.66
3	Ø22.35 Thru Ø38.10 Spotface (after lineboring)	Ø22.35 Thru Ø38.10 Spotface (after lineboring)	Ø22.35 Thru Ø38.10 Spotface (after lineboring)
4	349.25 - 350.77	349.25 - 350.77	349.25 - 350.77
5	442.98 - 444.50	442.98 - 444.50	442.98 - 444.50
6	190.50 diameter	190.50 diameter	190.50 diameter
7	Ø110.01 - 110.21 Linebore Rt. front only	Ø110.01 - 110.21 Linebore Rt. front only	Ø110.01 - 110.21 Linebore Rt. front only
8	M20 X 2.5mm thru, 4 holes equally spaced on 150.11 diameter between centers	M20 X 2.5mm thru, 4 holes equally spaced on 150.11 diameter between centers	M20 X 2.5mm thru, 4 holes equally spaced on 150.11 diameter between centers
9	326.14 - 327.66	326.14 - 327.66	326.14 - 327.66
10	Ø22.35 Thru Ø38.10 Spotface (after lineboring)	Ø22.35 Thru Ø38.10 Spotface (after lineboring)	Ø22.35 Thru Ø38.10 Spotface (after lineboring)
11	59.18	59.18	59.18
12	469.36 - 470.41	469.36 - 470.41	469.36 - 470.41
13	96.27	33.27	25.40
14	457.20 - 458.72	445.52 - 447.04	445.52 - 447.04
15	Ø80.01 - 80.21 Typ.	Ø80.01 - 80.21 Typ.	Ø80.01 - 80.21 Typ.
16	1449.58	1549.91	1590.80
17	1370.08	1468.63	1516.13

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PROPOSAL FOR MANUAL REVISION

FOR INTERNAL USE ONLY -- No. PMR

PROPOSER		
	NAME OF COMPANY:	LOCATION:
		PHONE NO:
	DEPARTMENT:	DATE:
	NAME:	

MANUAL NAME:

MANUAL NO:

MACHINE MODEL:
S/N IF APPLICABLE:

PAGE NO:

PROBLEM:

Attach photo or sketch.
If more space is needed, use another sheet.

FOR INTERNAL USE ONLY

CORRECTIVE ACTION: