SHOP MANUAL

KOMATSU

PC60-5
PC60L-5
PC60U-5

MACHINE MODEL	SERIAL No.
PC60-5	**20501 and up**
PC60L-5	**7501 and up**
PC60U-5	**4501 and up**

- This shop manual may contain attachments and optional equipment that are not available in your area. Please consult your local Komatsu distributor for those items you may require. Materials and specifications are subject to change without notice.

- PC60, 60L and 60U mount the 4D95L-1 engine.
  For details of the engine, see the 95 series engine Shop Manual.

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Pages having no marks are those previously revised or made additions.

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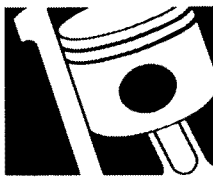
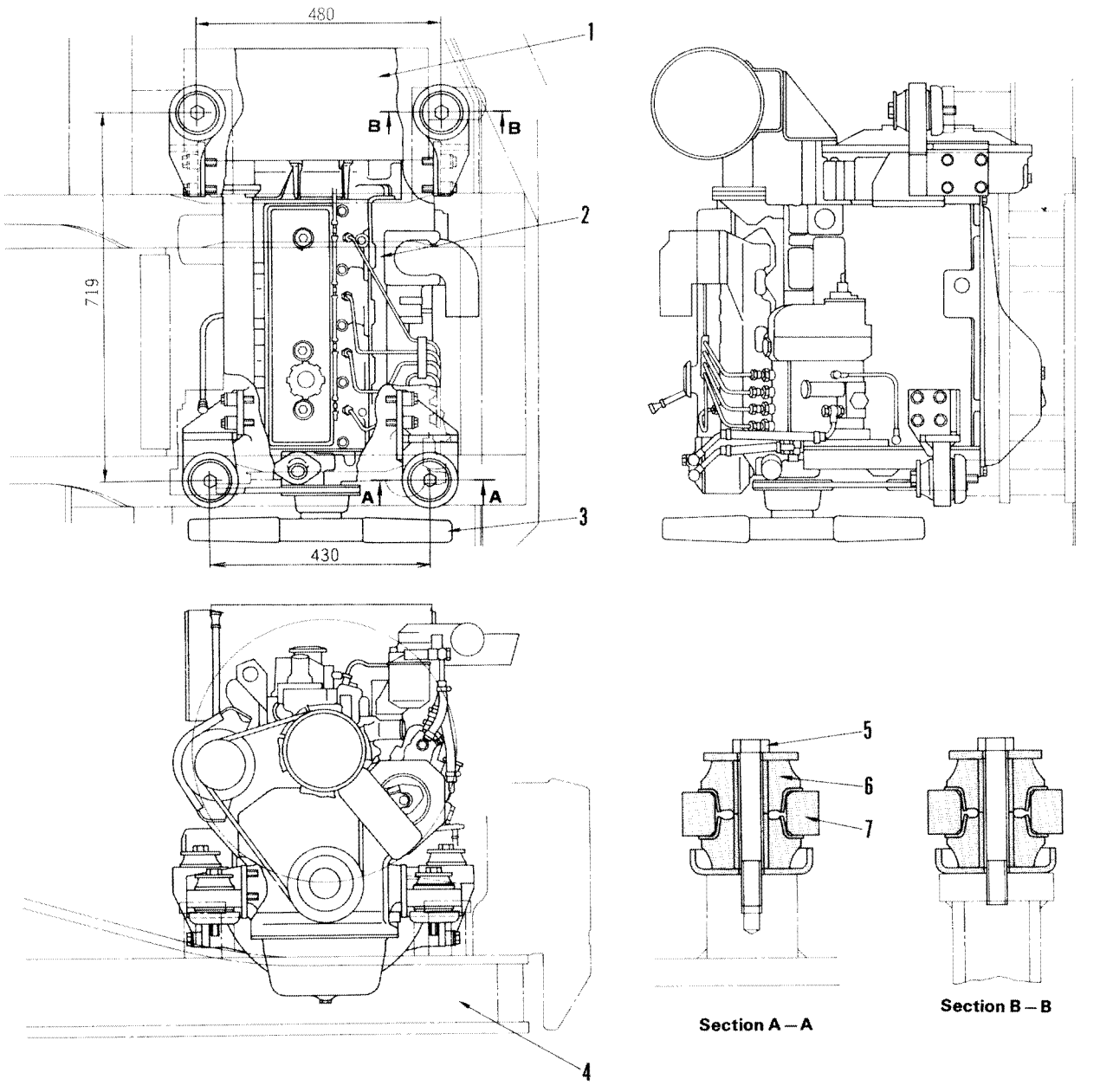
ENGINE

11 STRUCTURE AND FUNCTION



ENGINE MOUNT

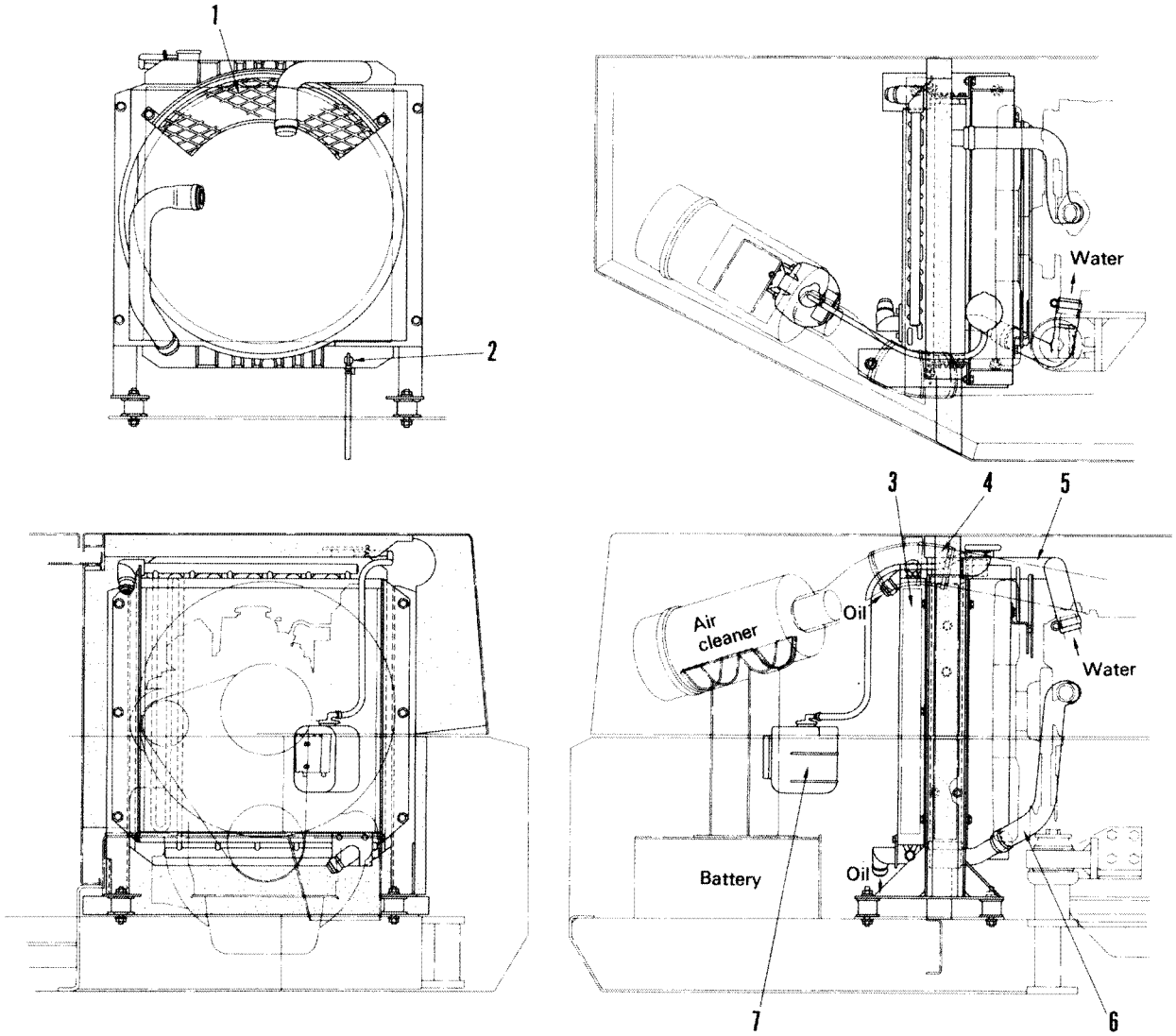


201F5008

- The engine is mounted crosswise at the rear of the upper structure. The front and rear mounts are supported by rubber pads which absorb shock.

1. Muffler
2. Engine
3. Radiator fan
4. Revolving frame
5. Mounting bolt
6. Rubber pads
7. Engine support

RADIATOR

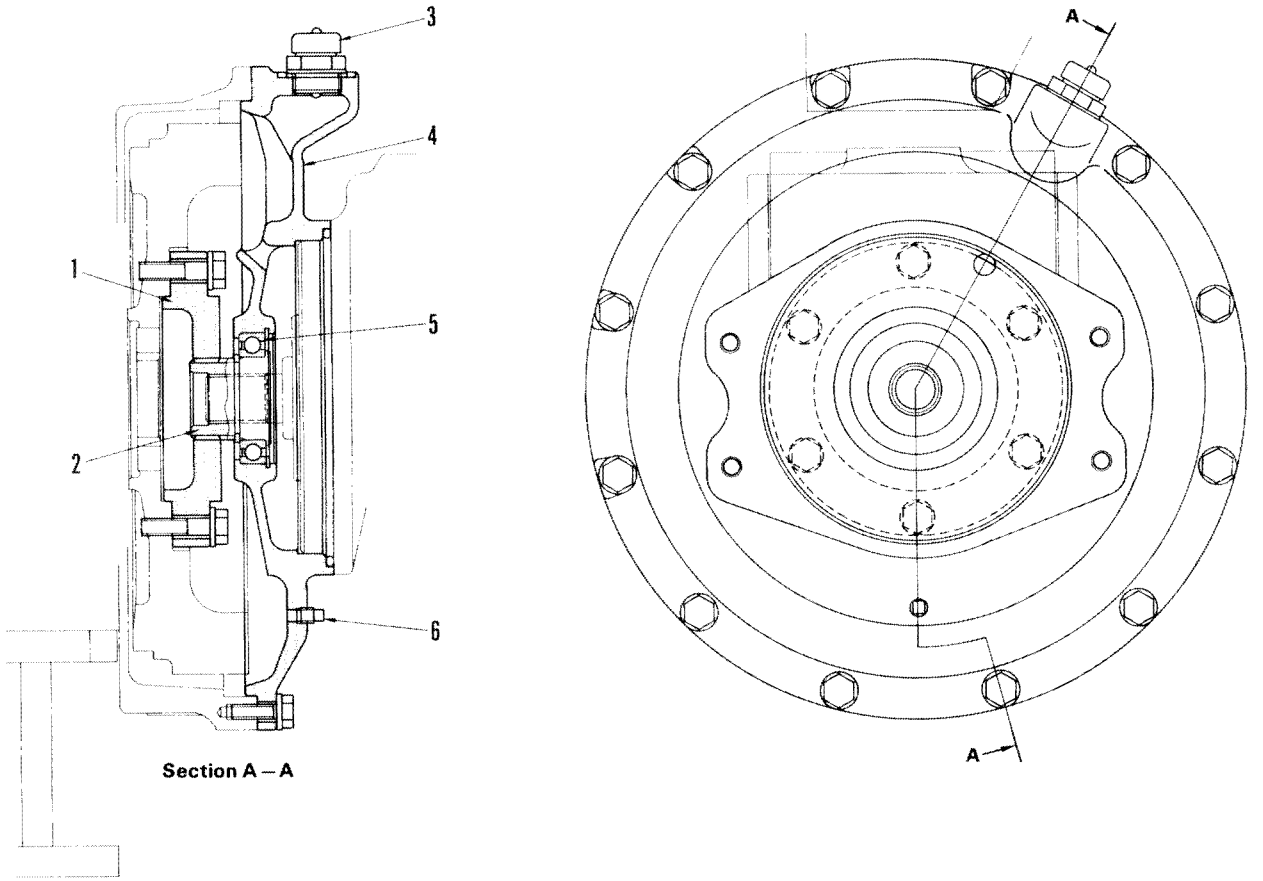


201F5009

- A model CD-3 corrugated fin type radiator core and the suction type of fan are used.
- The water level in the radiator can be visually checked through the sub-tank which is in front of the radiator.

1. Fan guard
2. Drain valve
3. Oil cooler
4. Radiator core
5. Inlet hose
6. Outlet hose
7. Sub-tank

PTO



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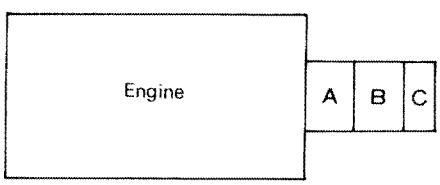
- The pumps are installed to the PTO case through the coupling at the rear of the flywheel housing of the engine.
- The pumps shown in the figure at right have the following functions.
  Pomp A (Front main pump): Used for L.H. travel, arm low speed, swinging, boom high speed and service spool.
  Pump B (Rear main pump): Used for R.H. travel, bucket, boom low speed and arm high speed.
  Pump C (Charging pump): Used for driving the auto-deceleration cylinder (if equipped), assisting the hydraulic pressure of the control valves and controlling the main pumps.



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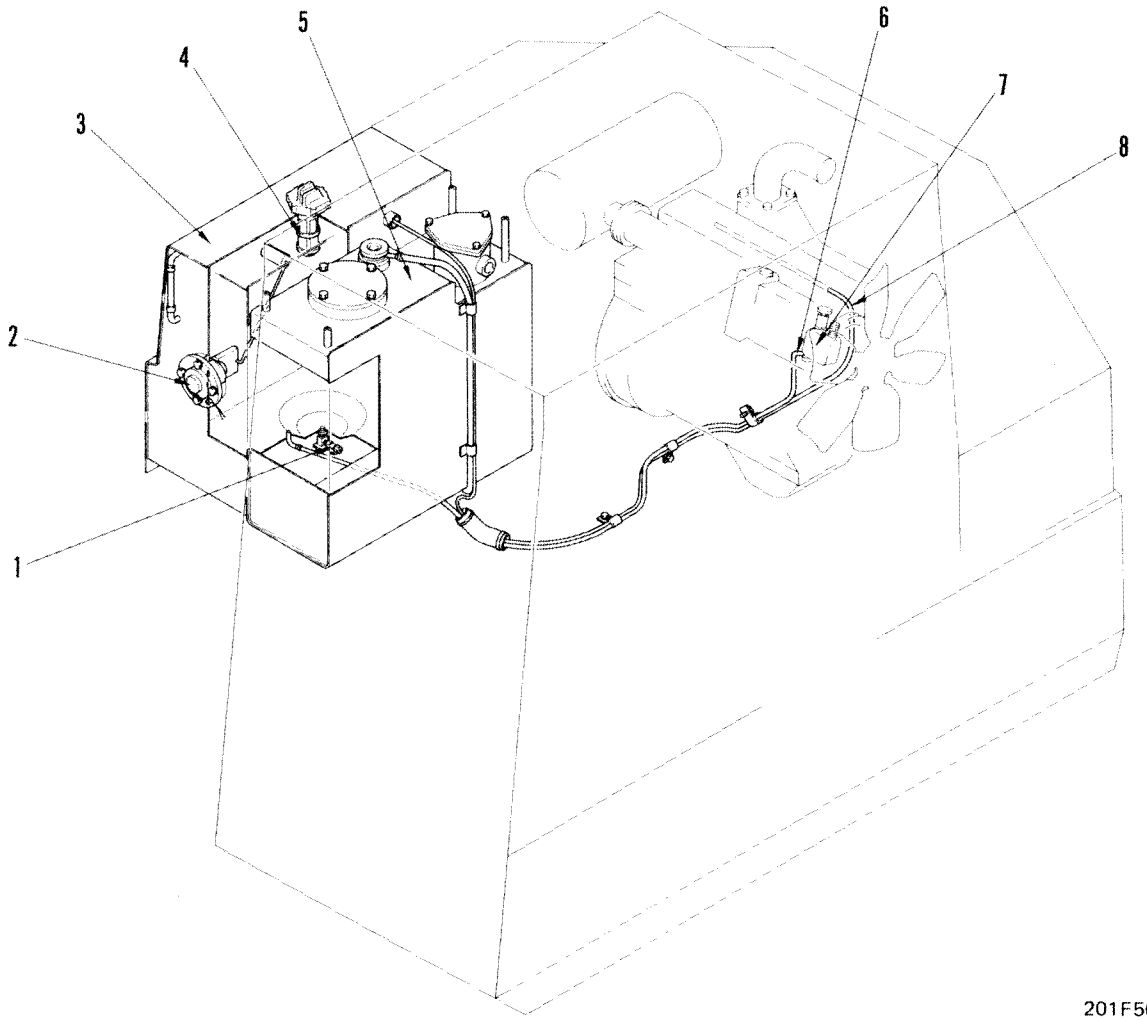
1. Coupling
2. Shaft
3. Breather
4. Case
5. Bearing
6. Oil level plug

FUEL TANK AND PIPING

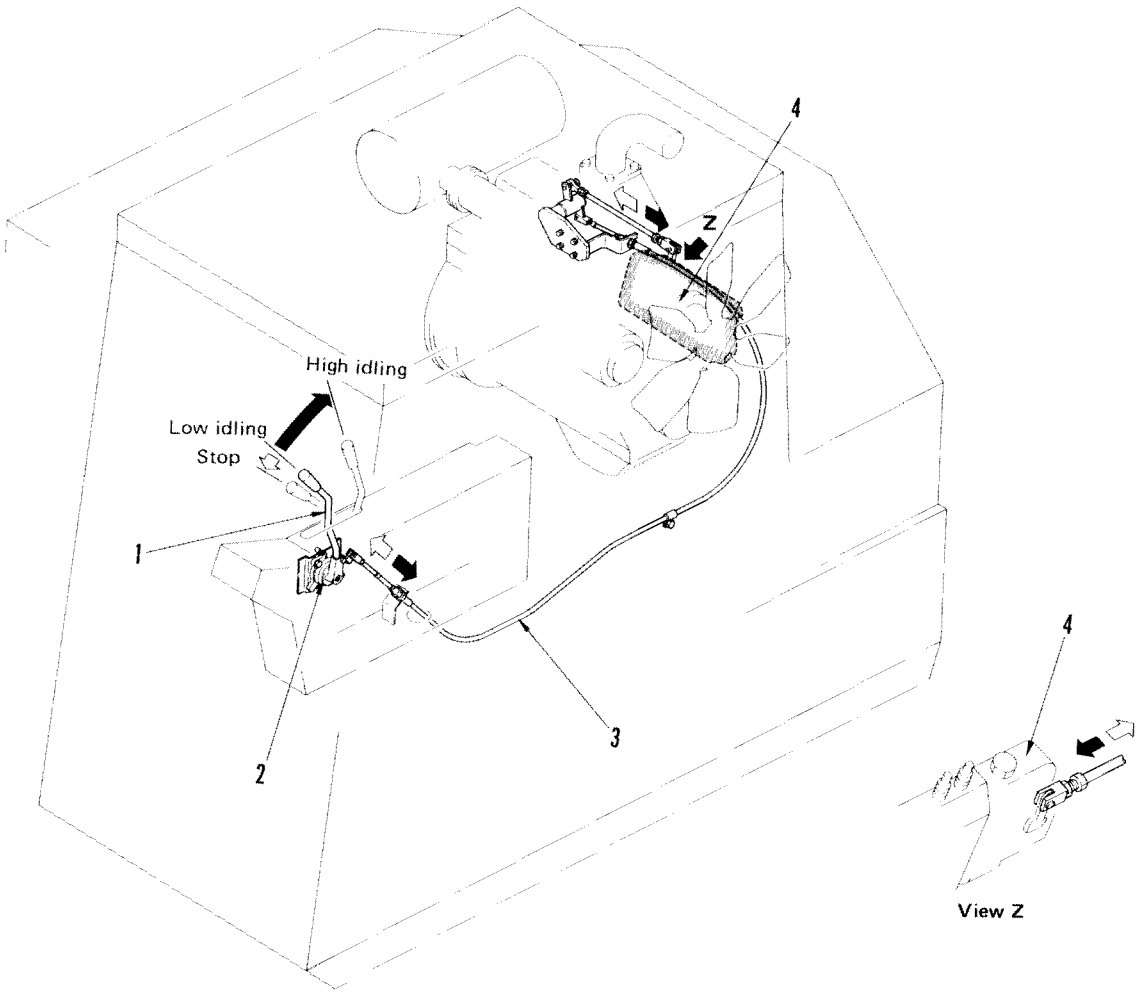


201F5011

- The fuel tank is installed together with the hydraulic tank as a unit.

1. Drain valve
2. Fuel level sensor
3. Fuel tank
4. Strainer
5. Hydraulic tank
6. Fuel supply hose
7. Fuel injection pump
8. Fuel return hose

ENGINE CONTROL



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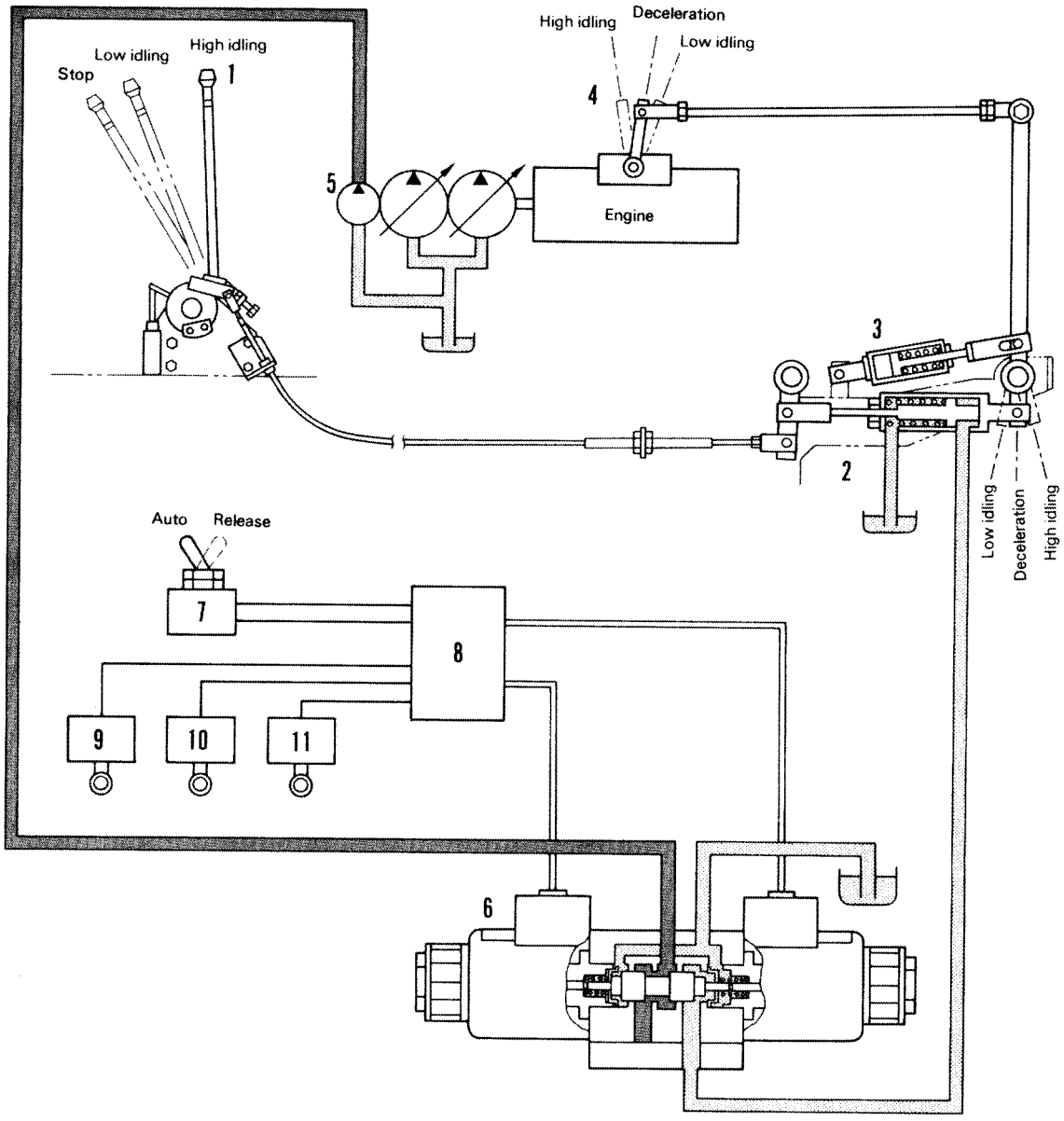
1. Engine control lever
2. Stopper
3. Cable
4. Fuel injection pump

AUTO-DECELERATION SYSTEM (If equipped)



201F5013

1. Fuel control lever
2. Deceleration cylinder
3. Loose spring
4. Engine governor control lever
5. Charging pump
6. Solenoid valve
7. Auto-deceleration switch
8. Controller
9. Limit switch (work equipment)
10. Limit switch (swing)
11. Limit switch (travel)

OPERATION (Auto-deceleration selector switch at AUTO)

1. Engine running, control levers at NEUTRAL

1) If fuel control lever (1) is set to the high idling position and the control levers are set at NEUTRAL, limit switches (9), (10) and (11), set on the linkage between the control levers and control valves, are switched OFF.
Because of this, an electric signal flows to controller (8), and controller (8) sends out a signal to switch deceleration solenoid valve (6).
When deceleration solenoid valve (6) is switched, the flow of pressure oil from charging pump (5) to the rod end of deceleration cylinder (2) is shut off. At the same time, the oil at the rod end of deceleration cylinder (2) is drained from deceleration solenoid valve (6) back to the tank. The force of the loose spring and the spring inside deceleration cylinder (2) retracts the deceleration cylinder, and engine governor lever (4) which is connected by a linkage is pulled back. (See Fig. 1) When this happens, loose spring (3) is compressed, so fuel control lever (1) is not returned.

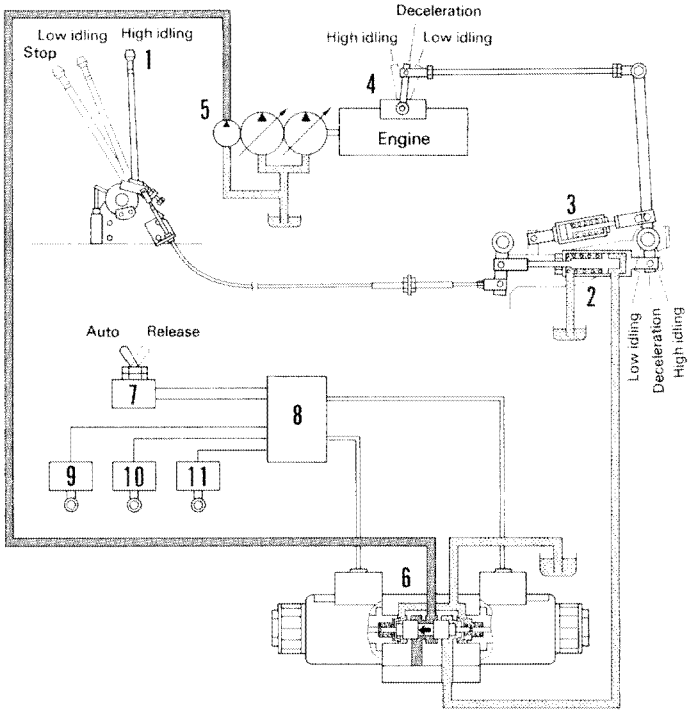


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Fig. 1

2) About 0.2 seconds after the lever is placed in neutral, the electric signal from controller (8) is cut, and deceleration solenoid valve (6) is switched. When deceleration solenoid valve (6) is switched, the flow of oil draining to the tank from the rod end of deceleration cylinder (2) is shut off by deceleration solenoid valve (6).
When this happens, deceleration cylinder (2) which was starting to retract in step 1), stops after about 0.2 seconds. At the same time, engine governor lever (4) also stops. (No.1 deceleration position)
The engine speed at this point is 1900 – 2100 rpm (No.1 deceleration speed). It is held at this position (No.1 deceleration position) for about 4.0 seconds. (See Fig. 2)

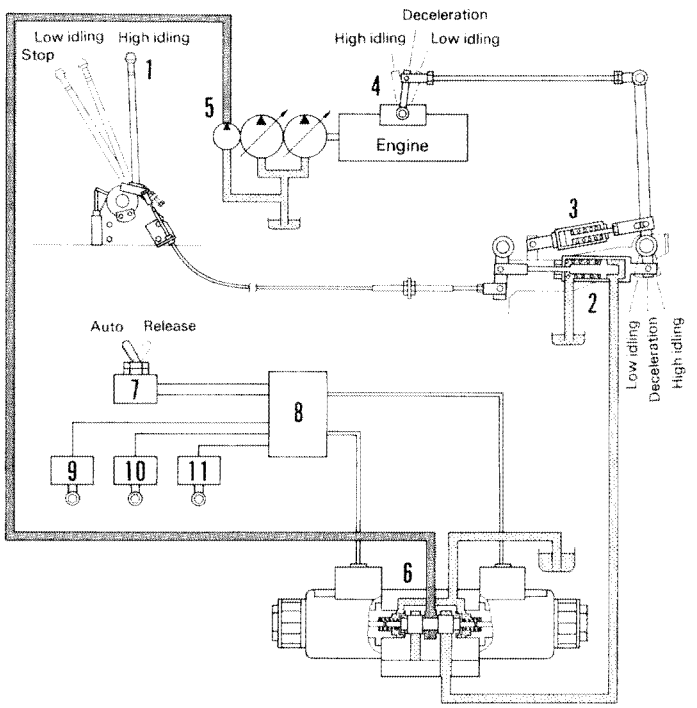

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Fig. 2

3) About 4.5 seconds after the lever is moved to neutral, controller (8) again sends out an electric signal and switches deceleration solenoid valve (6).
When deceleration solenoid valve (6) is switched, the oil at the rod end of deceleration cylinder (2) is again drained. Deceleration cylinder (2) is retracted and engine governor lever (4) is pulled back to the half open (deceleration) position. (See Fig. 3)
When this happens, loose spring (3) is compressed and fuel control lever (1) is not returned. The engine speed at this point is 1500 – 1700 rpm (deceleration speed).

★ When the engine is running at full throttle, and the control levers are set to neutral, steps 1) – 3) are carried out over a period of about 4.5 seconds, and the engine speed drops from full throttle to the deceleration speed.

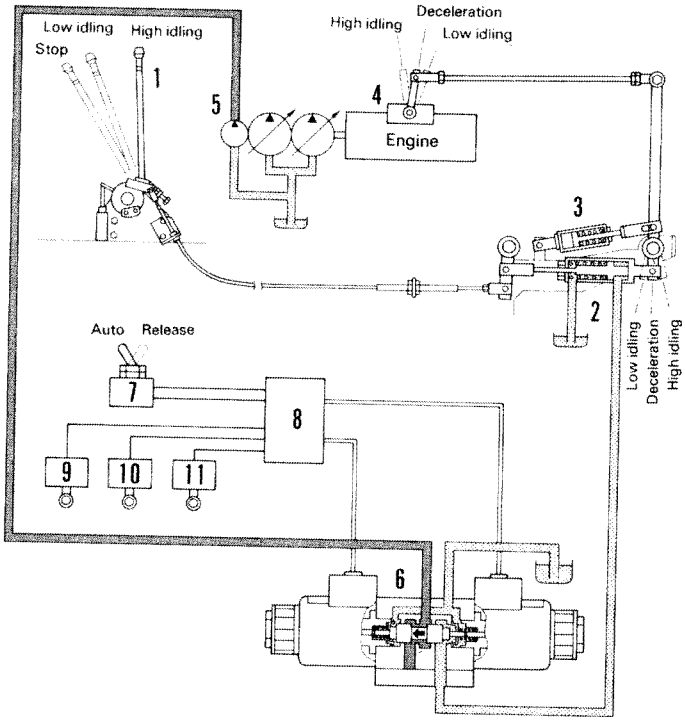

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Fig. 3

2. **Engine running, control levers operated**
If the control lever are operated with fuel control lever (1) at the high idling position, limit switches (9), (10) and (11) are turned ON. When this happens, an electric signal flows to controller (8), and controller (8) sends out a signal to switch deceleration solenoid valve (6). When deceleration solenoid valve (6) is switched, pressurized oil from charging pump (5) enters the rod end of deceleration cylinder (2). Deceleration cylinder (2) extends and pushes back engine governor lever (4) to the high idling position.
When this happens, the engine speed rises from the deceleration speed to full throttle. (See Fig. 4)

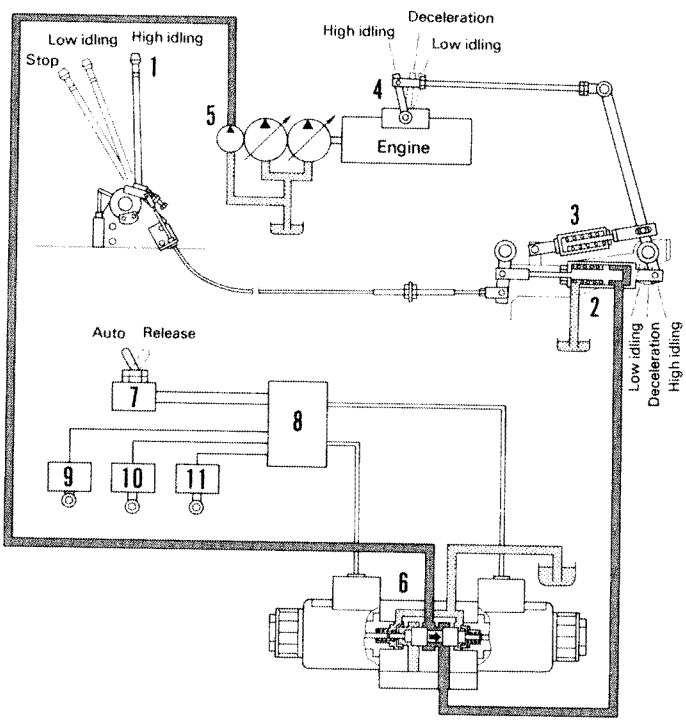

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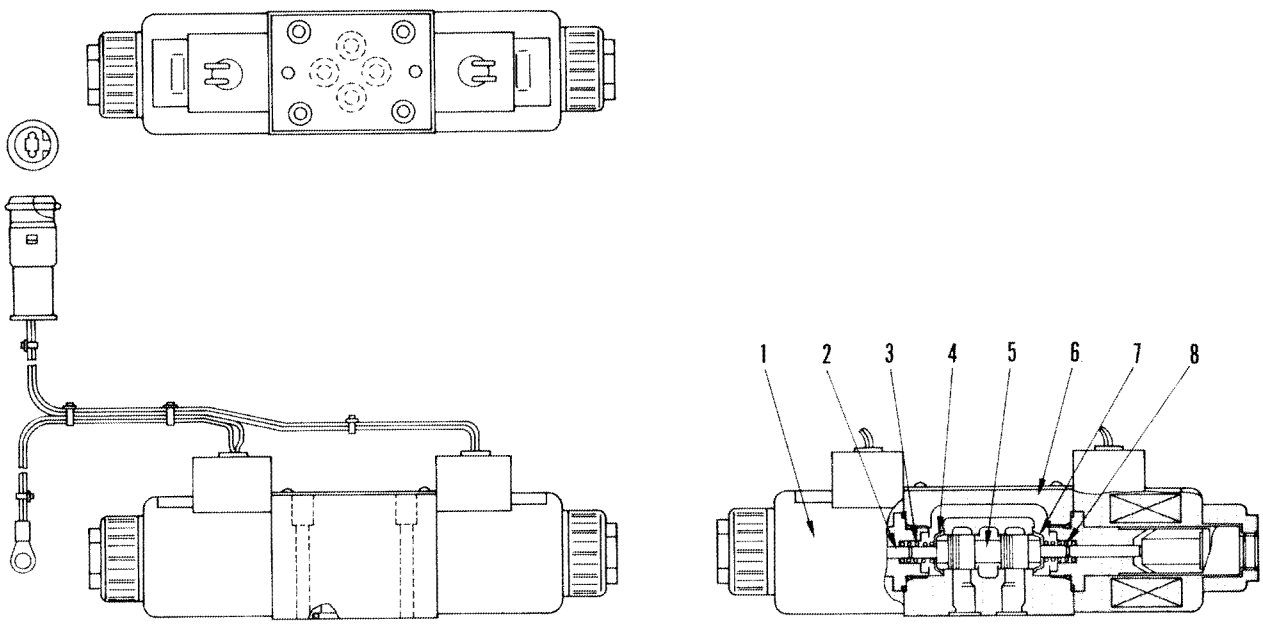
Fig. 4

★ FOR MACHINES EQUIPPED WITH AUTO-DECELERATION SYSTEM

1. SOLENOID VALVE



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FUNCTION

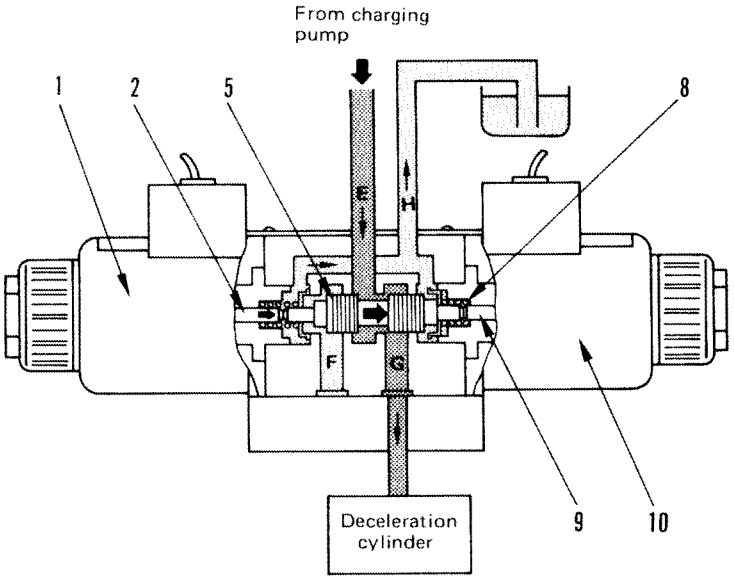
- The solenoid valve is operated by an electric signal sent from the limit switch (which is interlocked with the travel control lever) and release the oil flow from the charging pump.

1. Solenoid assembly
2. Push-pin
3. Spring
4. Spring retainer
5. Spool
6. Valve body
7. Spring retainer
8 Spring

OPERATION

1. **Work equipment, travel, and swing control levers in OPERATION**

   If the control levers are set to OPERATION the limit switch which interlocks with them will be operated to excite solenoid (1), then pushpin (2) will push spool (5) in the direction of the arrow (➡) to close ports **E** and **F** and open ports **F** and **H**, **E** and **G**. As a result, the oil from the charging pump flows from port **E** to **G** to operate the deceleration cylinder.



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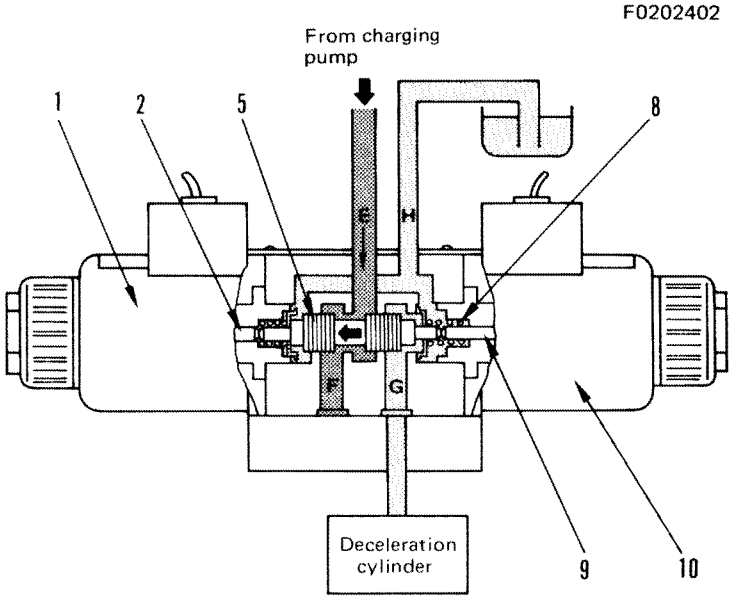
2. **Work equipment, travel, and swing control levers at NEUTRAL**

   If the control lever is set to the neutral position, the limit switch will turn off to turn off solenoid valve (1) and energize solenoid valve (10). As a result, spool (5) is pushed by push pin (9) in the direction of the arrow (⬅) and ports **H** and **G** are opened to drain some of the oil in the deceleration cylinder. (At this time, the engine speed is lowered to the first deceleration speed.)

   At the same time, ports **E** and **F** are opened, and the oil from the charging pump flows into port **F** through port **E** and stops at the block. After 0.2 seconds, the controller operates solenoid valves (1) and (10) to push back spool (5) in the direction of the arrow (➡), and each port is closed. The deceleration cylinder is stopped at a midway position. After four seconds, the controller operates solenoid valves (1) and (10) again to push spool (5) in the direction of the arrow (⬅) to open ports **H** and **G**. As a result, the oil in the deceleration cylinder is drained and the engine speed goes down to the second deceleration speed.



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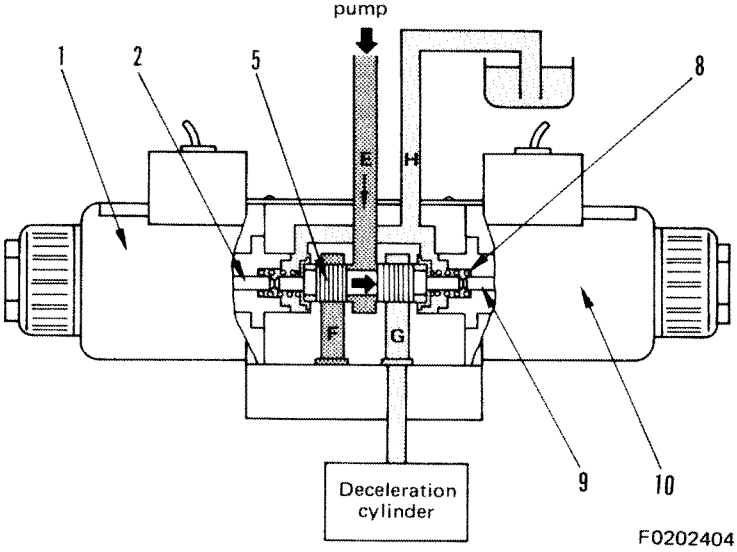

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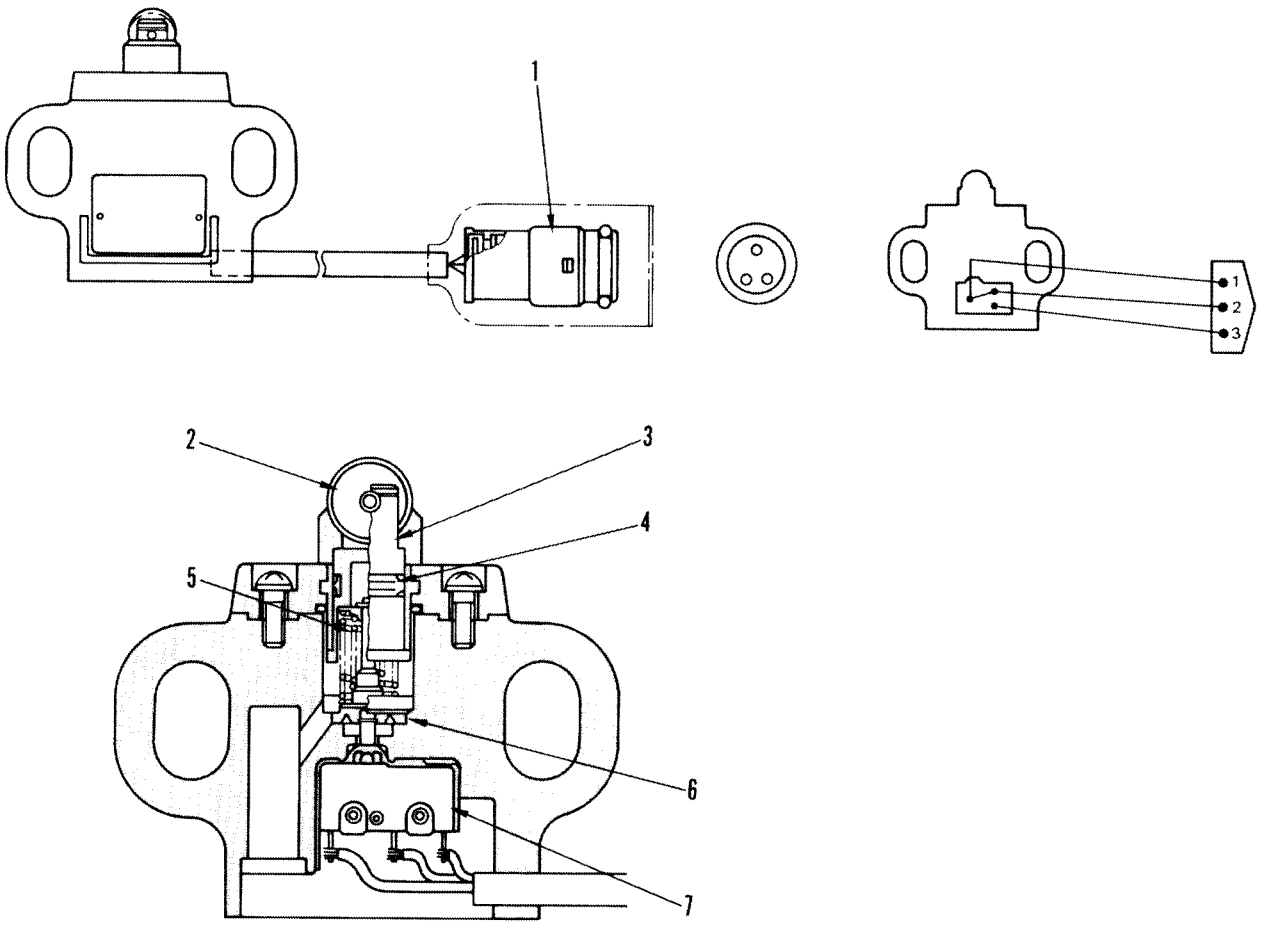
★ FOR MACHINES EQUIPPED WITH AUTO-DECELERATION SYSTEM

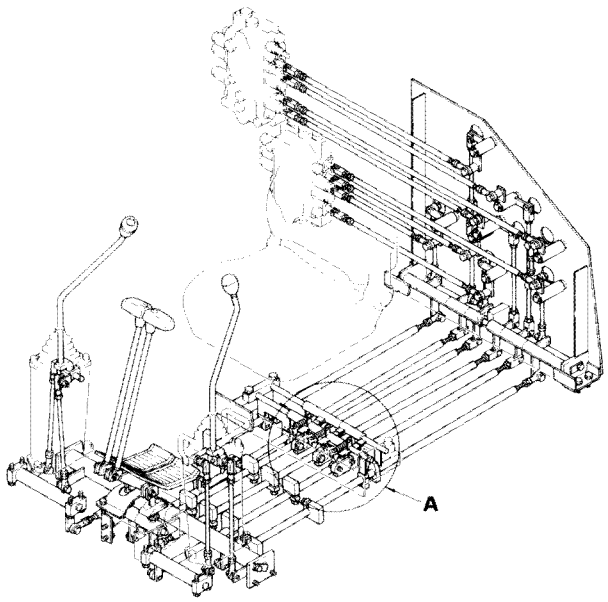
2. LIMIT SWITCH



F0202023

1. Connector
2. Roller
3. Shaft
4. Dust seal
5. Spring
6. Seal
7. Limit switch

- A limit switches which energizes the solenoid for straight travel, swing mechanical brake and swing priority control are set in the control lever linkage.
- When the control lever is operated, the motion of the linkage rod will cause lever (11) to turn when pushed by bosses (12) and (13). This will, in turn, actuate limit switch (2), (9) and (10) to make contact (ON). When the control lever is moved back to the neutral position, rod will move back to its original position. Lever (11) will be moved back by spring (1), causing limit switch (2), (9),and (10) to break contact (OFF).
- Thus, the limit switch energizes the solenoid valve when the contact is made (ON), thereby controlling the pilot circuit.



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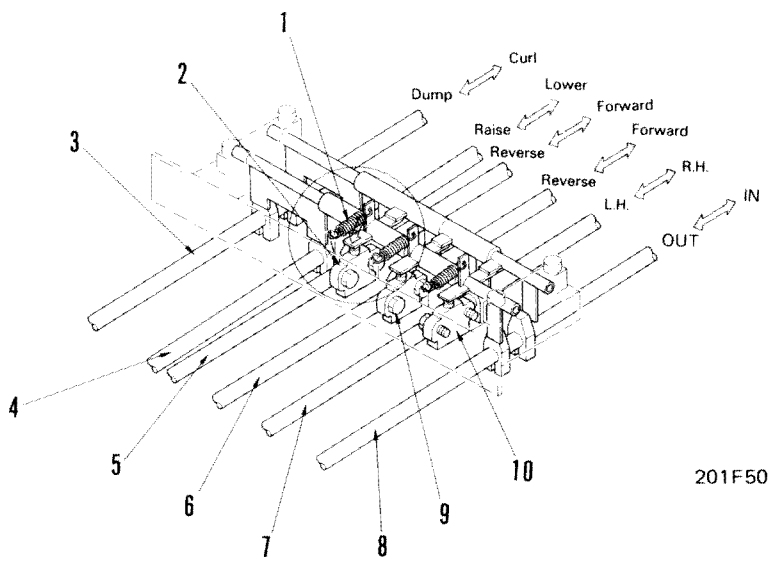

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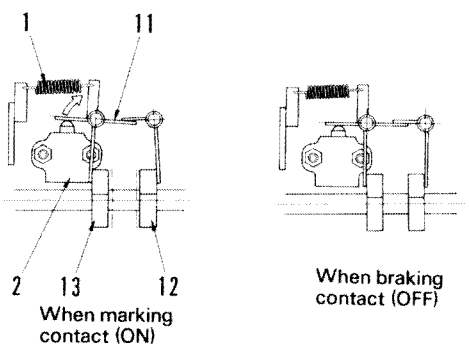
Detail A

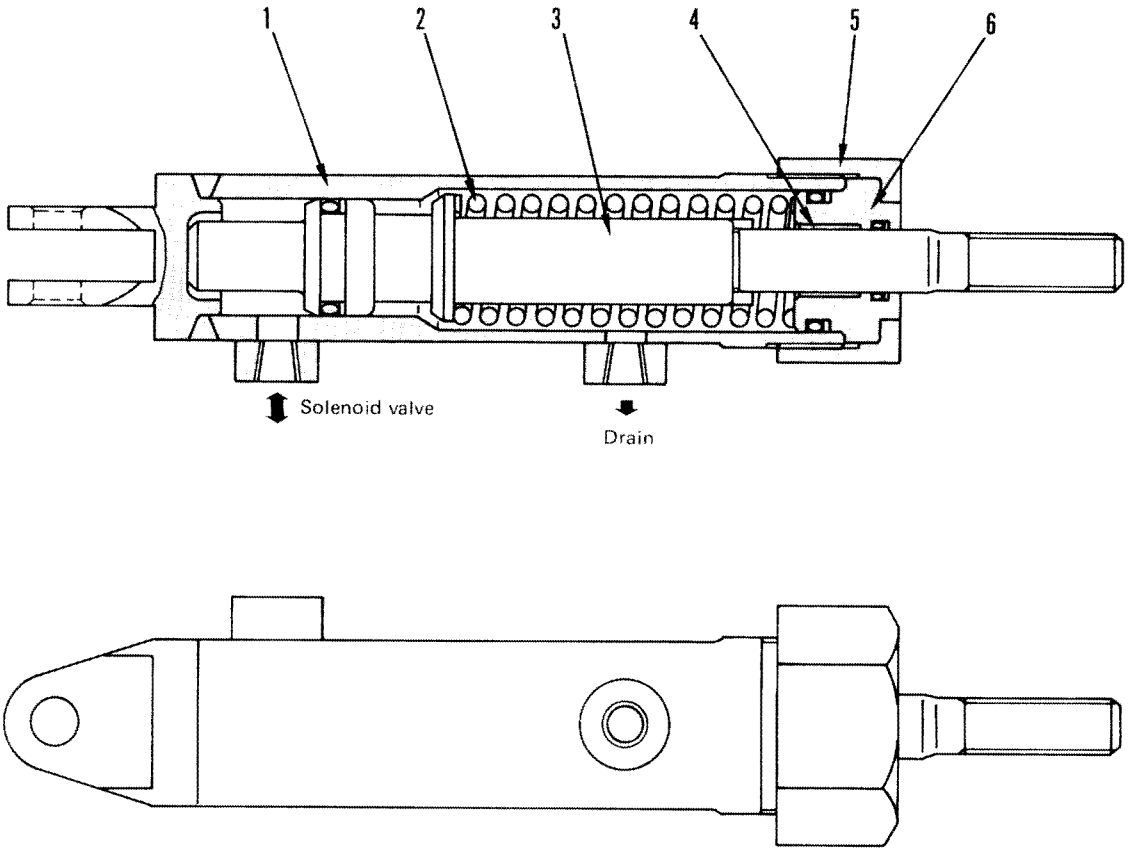


201F5020

1. Spring
2. Limit switch (work equipment)
3. Bucket control rod
4. Boom control rod
5. R.H. control rod
6. L.H. control rod
7. Swing control rod
8. Arm control rod
9. Limit switch (travel)
10. Limit switch (swing)
11. Lever
12. Boss
13. Boss

★ FOR MACHINES EQUIPPED WITH AUTO-DECELERATION SYSTEM

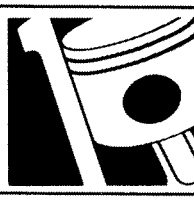
3. DECELERATOR CYLINDER



F0202016

1. Cylinder
2. Return spring
3. Piston
4. Bushing
5. Nut
6. Stopper

ENGINE
12 TESTING AND ADJUSTING



⚠ When carrying out testing, adjusting or troubleshooting, stop the machine on level ground, apply the lock levers and block the tracks.

⚠ When working in groups, use agreed signals and do not allow unauthorized persons near the machine.

⚠ When checking the water level in the radiator wait for the water to cool. Do not remove the radiator cap while the water is hot. Boiling water may spurt out.

⚠ Be careful not to get caught in rotating parts.

TESTING AND ADJUSTING DATA

Applicable machine model				PC60, 60L, 60U-5	
Engine model				4D95L-1	
	Item	Condition	Unit	Standard value	Permissible value
	Engine speed	High idling speed Low idling speed Rated speed	rpm	2250 – 2350 850 – 900 2100	
	Exhaust gas color	Quick acceleration At high idling	Bosch scale	4.5 —	5.5 —
	Valve clearance (at cold)	Intake valve Exhaust valve	mm	0.35 0.50	
	Compression pressure (SAE30 oil)	Oil temperature: 40 – 60°C (Engine speed)	kg/cm^2 (rpm)	30 (320 – 360)	21 (320 – 360)
	Blow-by pressure (SAE30 oil)	Water temperature: Inside operating range At high idling	mmH_2O	50	100
	Oil pressure (Water temperature: Inside operating range)	At high idling At low idling (SAE30) At low idling (SAE10W)	kg/cm^2	3.0 – 6.0 1.0 0.8	2.1 0.7 0.7
	Oil temperature	All speed (oil in oil pan)	°C	80 – 110	120
	Fuel injection timing	B.T.D.C.	degree	16	16
	Fan belt tension (Alternator side)	Deflection when pushed with a force of 6 kg	mm	8	6 – 8

TOOL LIST FOR TESTING AND ADJUSTING

No.	Testing and measuring item	Fault finding tool	Part No.	Remarks
1	Engine speed	Multi-tachometer	799-203-8000	Digital reading: 60 – 2,000 rpm (L range) 60–20,000 rpm (H range)
2	Water temperature, oil temperature	Digital temperature gauge or thermistor temperature gauge	799-101-6000 790-500-1300	–50 – 1,200°C
3	Lubrication oil pressure	Hydraulic tester	799-101-5000	0 – 20 kg/cm^2
4	Compression pressure	Compression gauge	795-502-1590	0 – 70 kg/cm^2
		Adapter	795-414-1110	
5	Blow-by pressure	Blow-by checker	799-201-1503	0 – 500 mmH_2O
6	Valve clearance	Feeler gauge	795-125-1370	0.35, 0.50 mm
7	Exhaust gas color	Handy smoke checker	799-201-9000	Dirtiness 0 – 70% with standard color (Dirtiness % x 1/10 ≒ Bosch scale)
		Smoke meter	Commercially available	

ADJUSTING VALVE CLEARANCE

Special tool

	Part Number	Part Name	Q'ty
A	795-125-1370	Feeler gauge	1

★ Adjust clearance between valve stem and rocker arm as follows.

Unit: mm

	Intake valve	Exhaust valve
At cold	0.35	0.5

1. Remove the cylinder head cover.

2. Rotate the crankshaft in the normal direction. While watching the movement of the intake valve of the No.4 cylinder, bring the No.1 cylinder into the top dead center position of the compression stroke and align the "1.4 TOP" mark on crankshaft pulley (1) with pointer (2).

3. When No.1 cylinder is top dead center of compression stroke, adjust the valve clearance for valves marked ● in the valve arrangement chart.

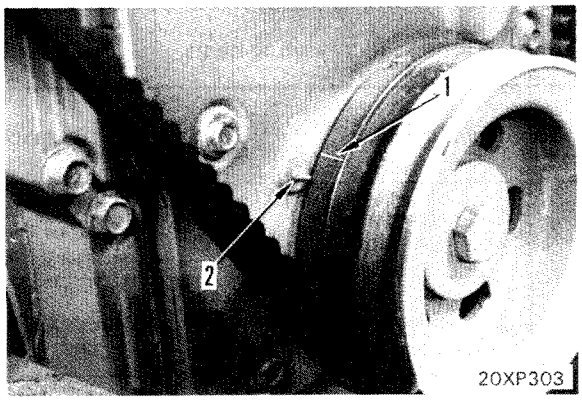
4. To adjust the valve clearance, loosen locknut (6) on adjustment screw (5), insert feeler gauge **A** corresponding to the specified clearance between valve stem (4) and rocker arm (3), and adjust the clearance with the adjustment screw until the thickness gauge can slide lightly.

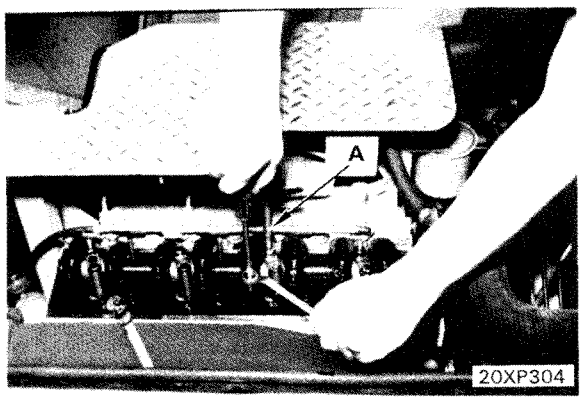
5. Rotate the crankshaft in the normal direction by one revolution and adjust the valve clearance for the remaining valves marked ○.

6. After the clearance is properly adjusted, tighten the locknut to secure the adjustment screw.

   kgm Locknut: 3.15 ± 0.35 kgm

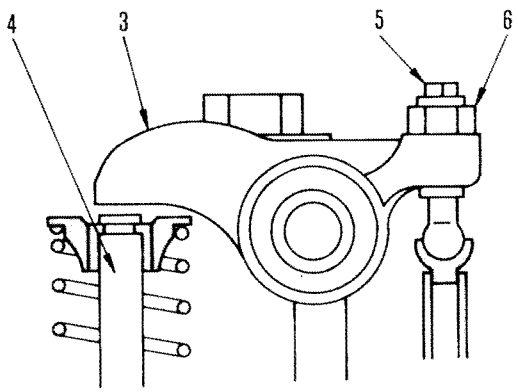
   ★ Intake and exhaust valve clearances may be adjusted for each cylinder in the firing order by rotating the crankshaft 180° at a time in the normal direction.
   ★ Firing order is 1—2—4—3.
   ★ After tightening locknut, check valve clearance again.





Front

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



21KF101

MEASURING EXHAUST GAS COLOR

⚠ When measuring the exhaust gas color, be careful not to touch the exhaust pipe.

★ Measure the exhaust gas color while engine is warm. (Oil temperature: 60°C)

1. Insert probe A_1 in outlet of exhaust pipe (1) and secure to exhaust pipe with clip.

2. Connect probe hose, connector for accelerator switch and air hose to smoke meter **A**.
   ★ The pressure of air supply should be less than 15 kg/cm^2.

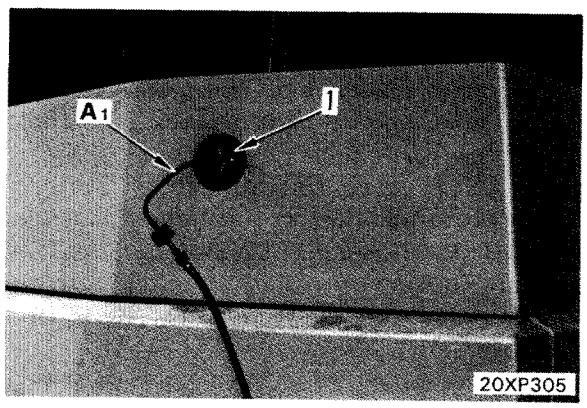
3. Connect power cable to power source.
   ★ Check that the power switch is OFF before connecting the code.

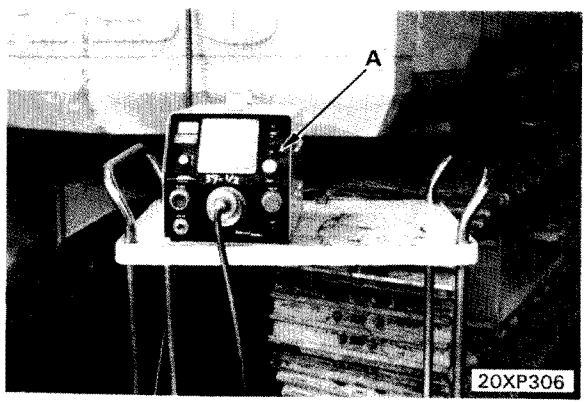
4. Loosen cap nut of suction pump and insert filter paper.

5. Turn power switch ON.

6. Accelerate engine suddenly. At the same time, depress accelerator pedal, operate relief valve and catch exhaust gas color on filter paper.

7. Lay filter paper used to catch exhaust gas color on top of unused filter papers (10 sheet or more) inside filter paper holder, and read indicated value.





MEASURING COMPRESSION PRESSURE

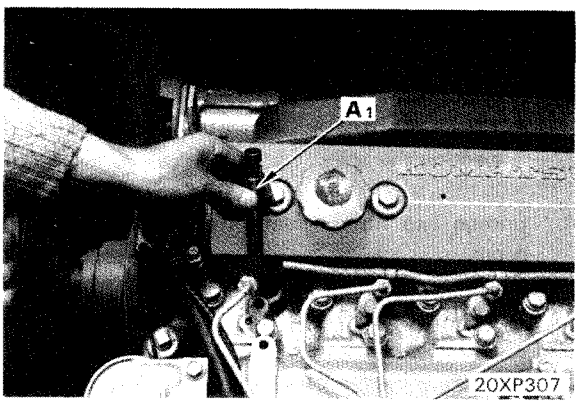
Special tools

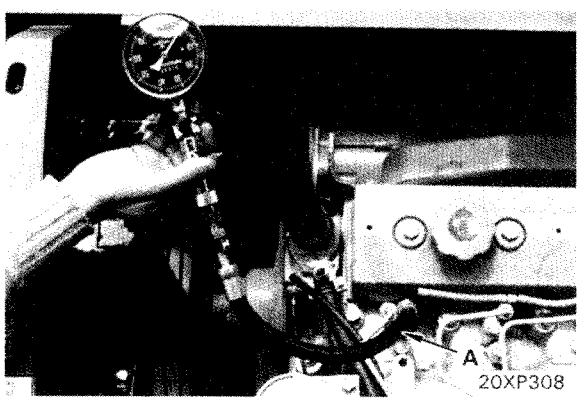
	Part Number	Part Name	Q'ty
A	795-502-1203	Compression gauge	1
A_1	795-414-1110	Adapter	1
B	799-203-8000	Tachometer	1

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

1. Adjust the valve clearance properly. For details, see ADJUSTING VALVE CLEARANCE.
2. Warm up engine. (Oil temperature: 40–60°C)
3. Remove nozzle holder assembly to be measured. For details, see REMOVAL OF NOZZLE HOLDER ASSEMBLY.
4. Install adapter A_1 to the nozzle holder mount.
5. Connect compression gauge A to the adapter A_1.
6. Place the fuel control lever in NO INJECTION position, crank the engine with the starting motor, and measure compression pressure.
   - ★ Read compression gauge when the pointer is stabilized.
   - ★ When measuring the compression pressure, measure the engine speed to confirm that it is within the specified range.

★ After measuring the compression pressure, install nozzle holder assembly. For details, see INSTALLATION OF NOZZLE HOLDER ASSEMBLY.





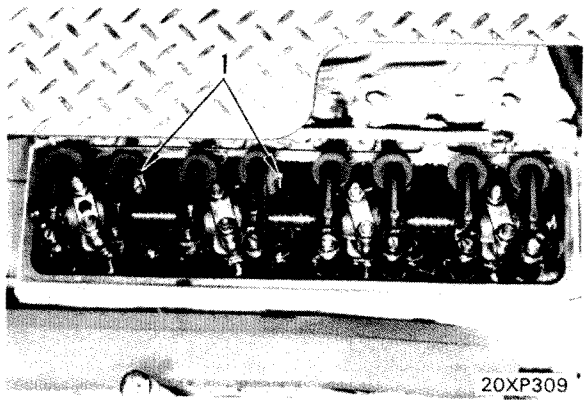
MEASURING BLOW-BY PRESSURE

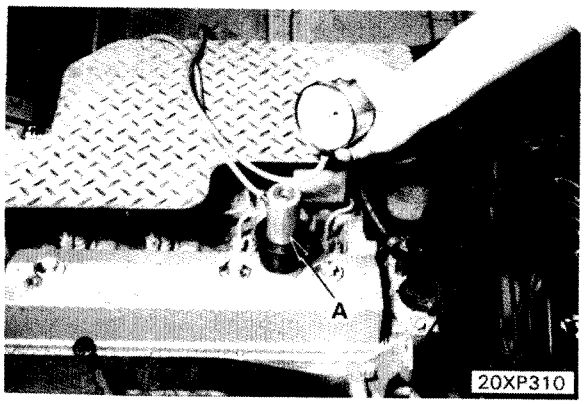
Special tool

	Part Number	Part Name	Q'ty
A	799-201-1503	Blow-by checker	1

⚠ When measuring the blow-by pressure, be careful not to touch the exhaust manifold or muffler, or to get caught in rotating parts.

1. Warm up engine. (Water temperature is inside operating range.)
2. Remove head cover, install plug on blow-by suction tube (1), then install head cover.
3. Install tool **A** on oil filler.
4. Run engine at high idling speed, then measure blow-by pressure.





ADJUSTING FUEL INJECTION TIMING

1. Align the "1.4" injection timing stamp line on crankshaft pulley (1) with pointer (2) by slowly rotating the crankshaft in the normal direction.

2. Disconnect fuel injection pipe (3) for the No.1 cylinder.

3. Remove delivery valve holder (4), remove spring (6) and delivery valve (5) from delivery valve holder, and reassemble delivery valve holder (4).

4. Place the fuel control lever in FULL position.

5. Loosen nuts (7) on injection pump mounting flange slot, and loosen injection pump mounting bolts (8).

6. Turn injection pump outward, operating priming pump, slowly turn injection pump to cylinder block end, stop injection pump in the position where fuel flow out from delivery valve holder stops.
   - ★ If fuel flow out does not stop when turn injection pump either directions, rotate crankshaft one more turn.
   - ★ If turn injection pump outward, injection timing is retard. If turn injection pump cylinder block end, injection timing is advanced.

7. Tighten injection pump mounting bolts (8) in turn.

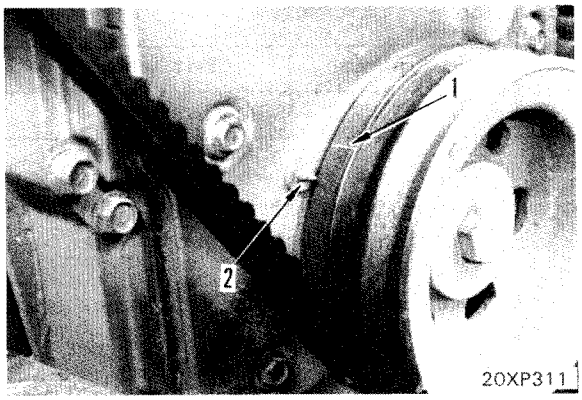
8. Tighten nuts (7) on injection pump mounting flange slot.

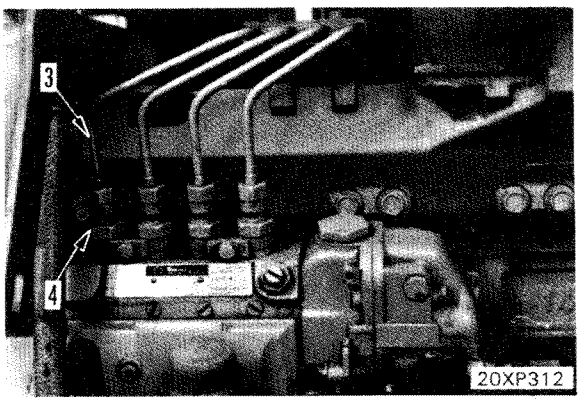
9. Remove delivery valve holder (4), assemble delivery valve (5) and spring (6), install delivery valve holder (4) again.

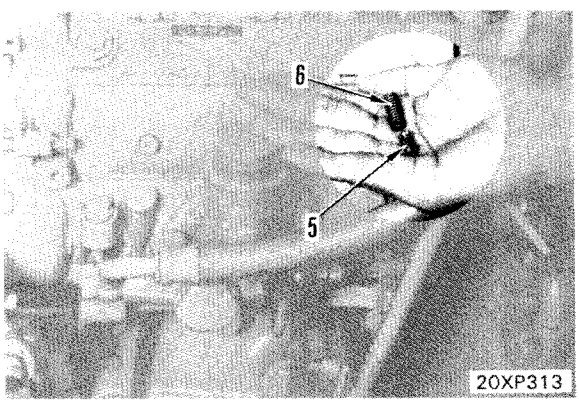
   kgm Delivery valve holder: 3.3 ± 0.2 kgm

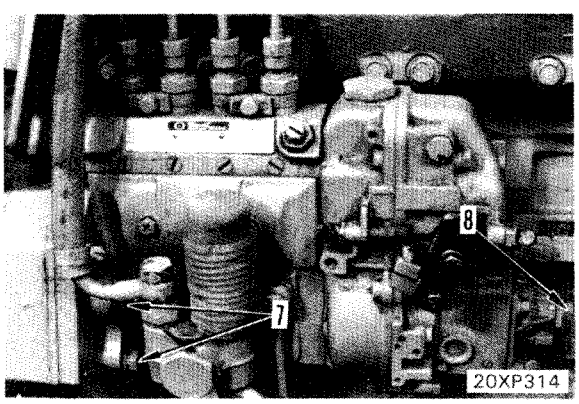
10. Connect fuel injection pipe (3).

    Sleeve nut: 2.4 ± 0.1 kgm





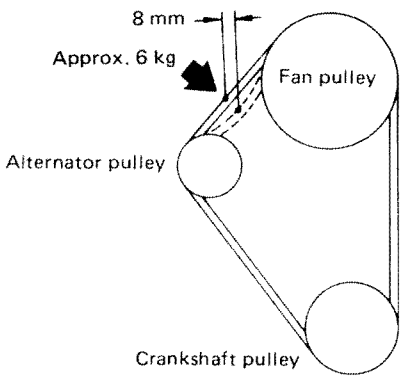




TESTING AND ADJUSTING FAN BELT TENSION

TESTING FAN BELT TENSION

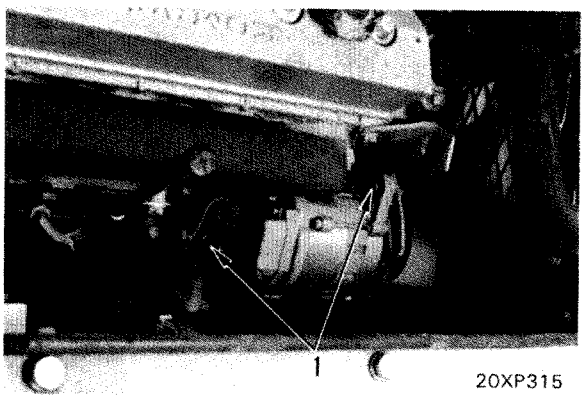
Check the amount the fan belt deflects when pushed with a force of 6 kg at a point midway between the fan pulley and the alternator pulley.



21KF102

ADJUSTING FAN BELT TENSION

1) Loosen mounting bolt of alternator assembly and belt tension adjustment bolt (1).
2) Using a bar, raise alternator and adjust fan belt tension. Tighten adjustment bolt (1), then tighten mounting bolt.



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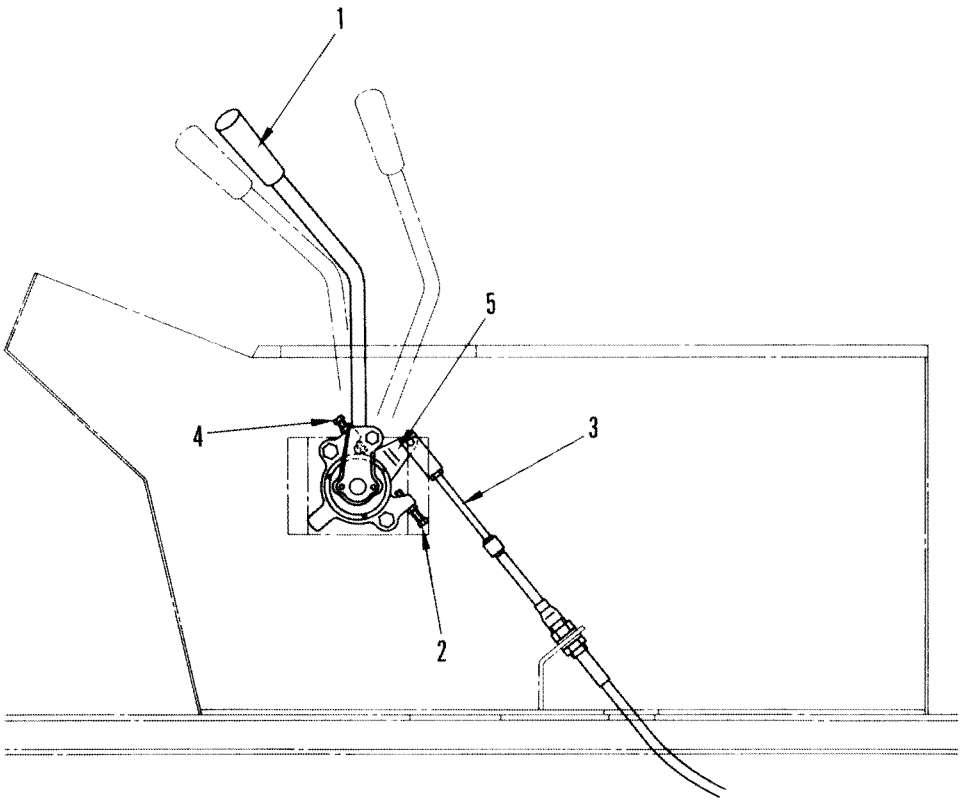
ADJUSTING FUEL CONTROL LEVER

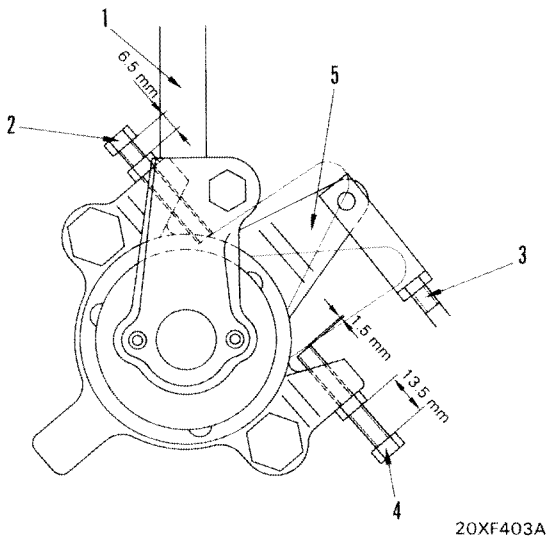


20XF402

1. After setting fuel control lever (1) in notch part, set engine governor lever in idling position, then connect cable (3).
   ★ Judge notch part with clicking sound and feeling difference in operating force.

2. Operating fuel control lever, set engine governor lever in high idling position, then adjust stopper bolt (4) so that clearance between stopper bolt (4) and fuel lever (5) is 1.5 mm.

3. Set engine governor lever in stop position, then adjust stopper bolt (2) so that clearance between stopper bolt (2) and fuel lever (5) is 1.5 mm.
   ★ If return stopper bolt 1.5 turns, clearance is approx. 1.5 mm.



20XF403A

ADJUSTING AUTO-DECELERATION SYSTEM (If equipped)

1. Set fuel control lever (1) in the notch part, set the engine governor lever at the idling position, then connect cable (3).
   ★ There is a sound of entering a detent, and there is a difference in operating force when the lever enters the notch.

2. Adjust governor lever connecting rod (6) to 515 mm, then connect.
   ★ The auto-deceleration cylinder is not extended, so the governor lever does not contact the stopper on the FULL side. Therefore, extend the rod to adjust.

3. Operate the fuel control lever and set the engine governor lever at the FULL position, then adjust so that the clearance between stopper bolt (4) and fuel lever (5) is 1.5 mm.

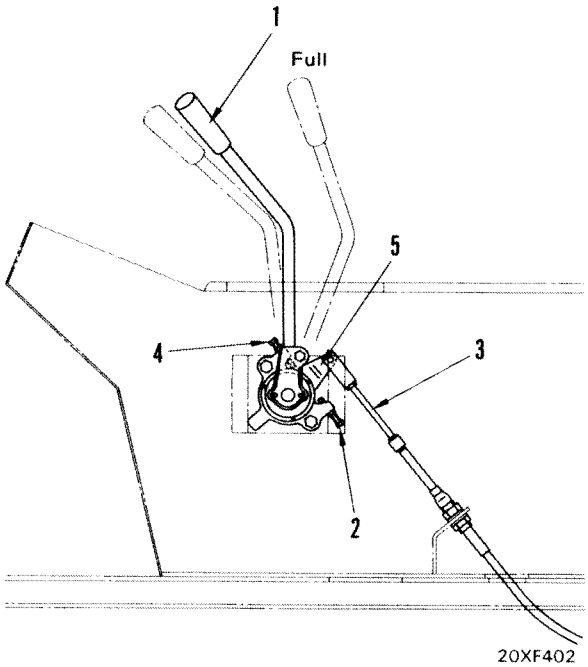
4. Next, set the engine governor lever at the STOP position and adjust the stopper bolt so that the clearance between stopper bolt (2) and fuel lever (5) is 1.5 mm.
   ★ If the stopper bolt is turned back 1.5 turns, the clearance will be approx. 1.5 mm.

5. Adjust rod (6) extended in Step 2, then connect.
   ★ Rod adjustment length: 491.6 mm

6. Adjust auto-deceleration cylinder (7).
   ★ Cylinder length: 267 mm

7. Adjust loose spring (8), then connect.
   ★ Loose spring length: 218 mm

8. Set the tachometer in position, start the engine and measure the deceleration speed.
   ★ Adjust the deceleration speed by turning yoke (9) of spring (8).
   (1/2 turn adjusts by approx. 70 rpm)



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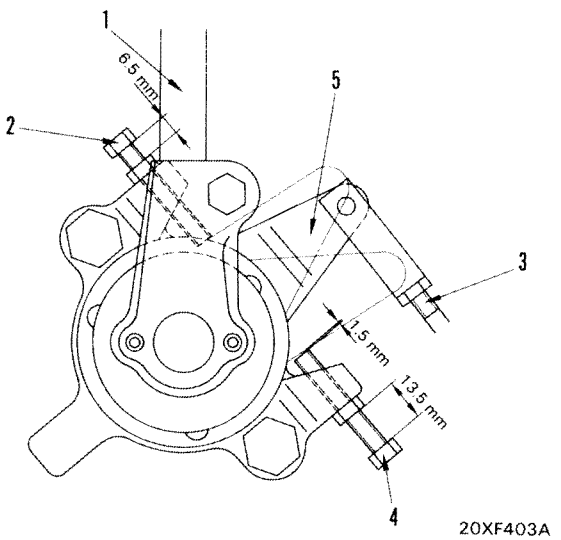

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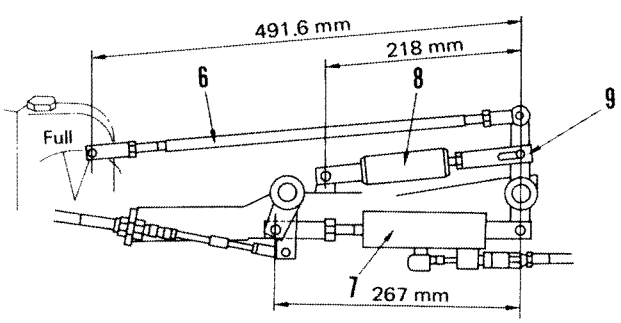

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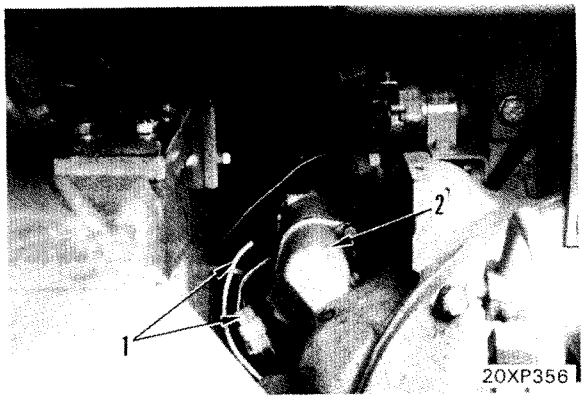
ENGINE

13 DISASSEMBLY AND ASSEMBLY

REMOVAL OF STARTING MOTOR ASSEMBLY

⚠ Open the battery cover and disconnect the lead from the negative (–) terminal of battery.

1. Open hood.
2. Disconnect wires (1) of starting motor.
3. Remove starting motor assembly (2).
   ★ Remove starting motor assembly mounting bolt (lower side) from bottom of machine cab.



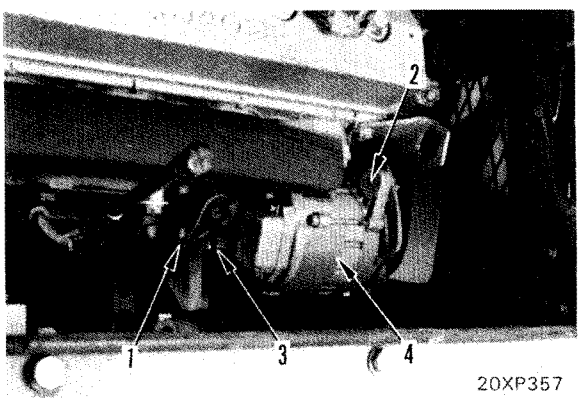
INSTALLATION OF STARTING MOTOR ASSEMBLY

1. Fit O-ring and install starting motor assembly (2).
2. Connect wires (1) of starting motor.
3. Close hood.
4. Connect lead to negative (–) terminal of battery.

REMOVAL OF ALTERNATOR ASSEMBLY

⚠ Open the battery cover and disconnect the lead from the negative (–) terminal of battery.

1. Remove engine side cover.
2. Disconnect alternator wires (1).
3. Remove fan belt tension adjusting slide bolt and nuts on mounting bolts (2), then remove cover (3).
4. Push down alternator assembly inside, then remove fan belt.
5. Remove mounting bolts, then remove alternator assembly (4).



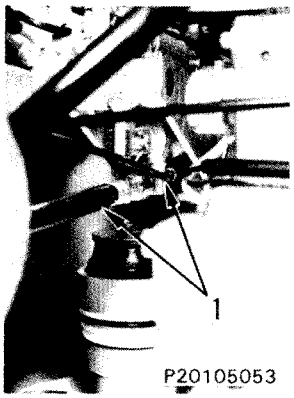
INSTALLATION OF ALTERNATOR ASSEMBLY

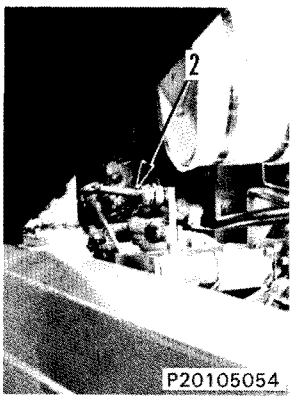
1. Install bracket, position alternator assembly (4), and install mounting bolts (2).
   Install cover (3) and temporarily tighten the nuts on the mounting bolts and fan belt tension adjusting slide bolt.
   ★ For details of adjusting the fan belt tension, see 12 TESTING AND ADJUSTING FAN BELT TENSION.
2. Connect alternator wires (1).
3. Connect lead to negative (–) terminal of battery.

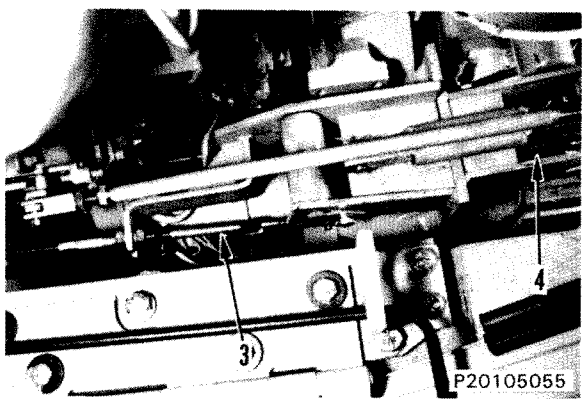
REMOVAL OF AUTO-DECELERATION CYLINDER ASSEMBLY (If equipped)

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. Disconnect hose (1) and rod (2).
2. Loosen nut, then pull out pin, and disconnect fuel control wire (3).
3. Remove 3 mounting bolts, then remove auto-deceleration cylinder assembly (4) together with bracket.
4. Pull out 2 pins, and disconnect auto-deceleration cylinder assembly (4) from bracket.

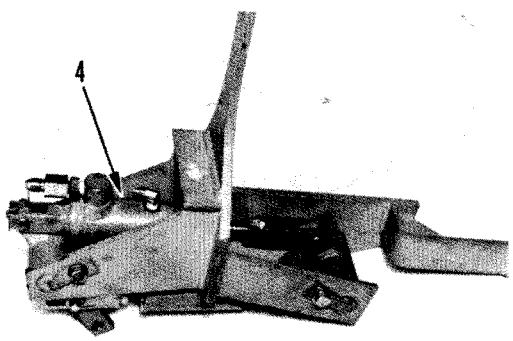






INSTALLATION OF AUTO-DECELERATION CYLINDER ASSEMBLY (If equipped)

1. Install auto-deceleration cylinder assembly (4) to bracket.
   ★ Bend the cotter pin securely.
2. Install auto-deceleration cylinder assembly (4) together with bracket.
3. Connect fuel control wire (3) with pin and nut.
   ★ Bend the cotter pin securely.
4. Connect rod (2) and hose (1).



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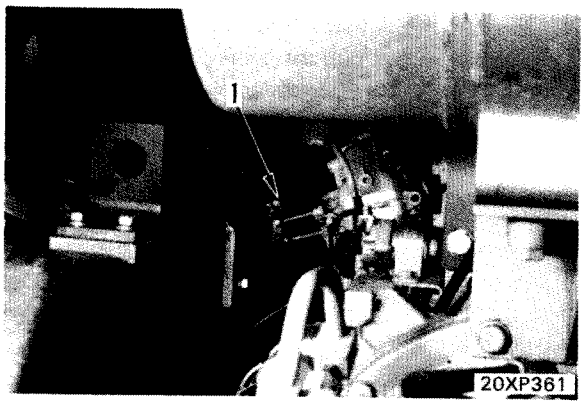
REMOVAL OF FUEL INJECTION ASSEMBLY

1. Disconnect fuel control rod (1).
2. Disconnect fuel hose (2).
3. Disconnect fuel hose pipe (3).
4. Remove lubrication tube (4).
5. Remove the six installation bolts, then remove fuel injection pump assembly (5).



INSTALLATION OF FUEL INJECTION ASSEMBLY

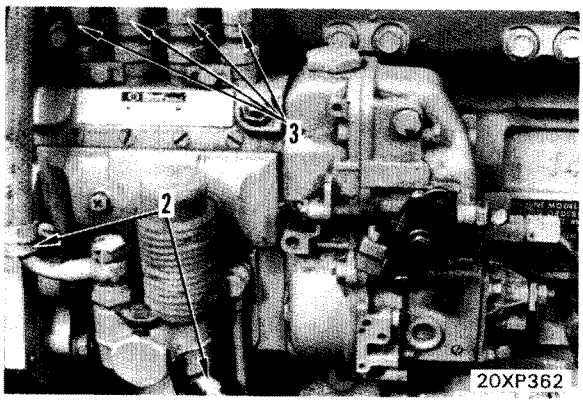
★ Turn the crankshaft in the normal direction and align the "1.4" mark on the crankshaft with the pointer. At this time, if there is no match mark on the pump drive gear, turn the crankshaft one more revolution.

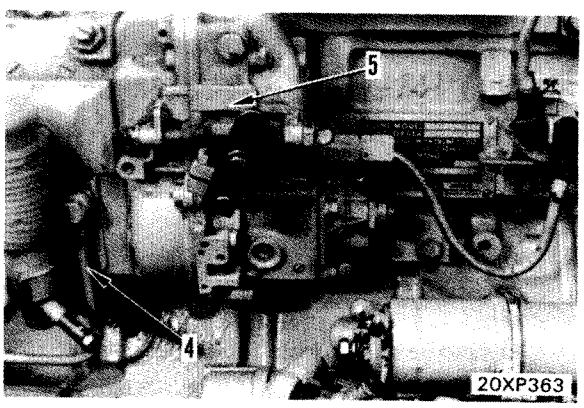
1. Fix the drive gear with a bolt (d = 8 mm, P = 1.0, ℓ = 35 mm).
2. Fit an O-ring, then install fuel injection pump assembly (5).
   ★ Insert a 45-mm-diameter pin into the hole for confirming the fuel injection timing, and confirm that the pin fits smoothly into the nail plate hole.
3. Fit a gasket and connect lubrication tube (4).
4. Connect fuel injection pipe (3).

   Sleeve nut: 2.4 ± 0.1 kgm

5. Fit a gasket and connect fuel hose (2).
6. Connect fuel control rod (1).
   ★ Bend the cotter pin securely.

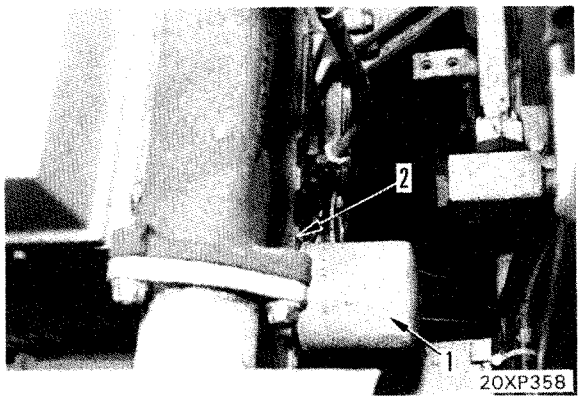
★ Refer to TESTING AND ADJUSTMENT and confirm the fuel injection timing.





REMOVAL OF ENGINE OIL COOLER ASSEMBLY

1. Loosen the radiator drain valve and the oil cooler drain valve to drain the cooling water.
   ★ If the coolant contains antifreeze, dispose of it carefully.
2. Using a filter wrench, remove oil filter (1).
3. Remove oil cooler assembly (2).



INSTALLATION OF ENGINE OIL COOLER ASSEMBLY

1. Apply liquid gasket, then install oil cooler assembly (2).

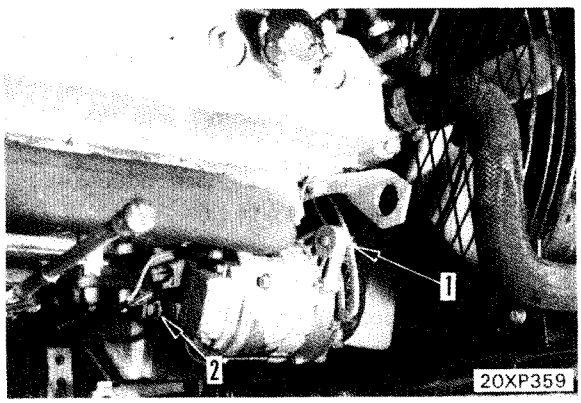
   Oil cooler installation face: Liquid gasket (LG-7)

2. Install oil filter (1).

   Oil filter seal face: Grease G2-LI)

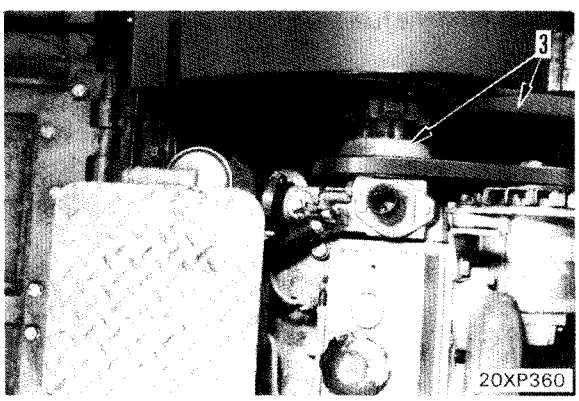
REMOVAL OF FAN AND FAN PULLEY ASSEMBLY

1. Disconnect the radiator inlet hose on the engine side.
2. Remove the fan guard.
3. Loosen installation bolt (1), the mount bolt, and nut (2) of the adjustment plate, then remove the fan belt.
4. Remove the installation bolt, then remove fan and fan pulley (3).



INSTALLATION OF FAN AND FAN PULLEY ASSEMBLY

1. Install fan and fan pulley (3) with bolts.
2. Hook the fan belt into the pulley groove.
   ★ See TESTING AND ADJUSTING for the procedure for adjusting the belt tension.
3. Install the fan guard.
4. Connect the radiator inlet hose on the engine side.



REMOVAL OF WATER PUMP ASSEMBLY

1. **Draining water**
   Loosen drain valve (1) and drain the cooling water.
   ★ Be careful not to loosen the drain valve too much. Otherwise, the drain valve will get out of place.
   ★ If the coolant contains antifreeze, dispose of it carefully.

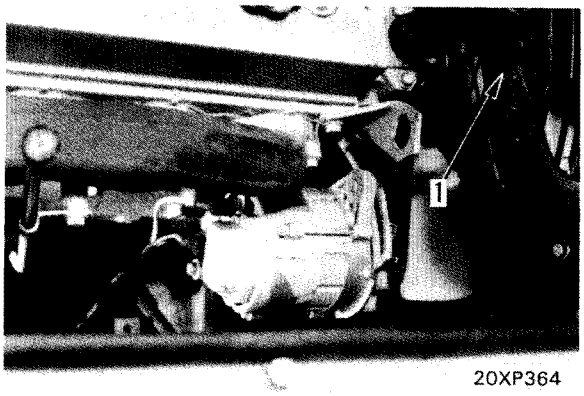
2. **Radiator inlet hose**
   Disconnect radiator inlet hose (1).

3. **Fan**
   Remove fan and fan puley, for see REMOVE FAN AND FAN PULLY.

4. **Water temperature gauge wiring and heater hose**
   1) Disconnect water temperature gauge wiring (2).
   2) Disconnect heater hose (4).

5. **Radiator outlet hose**
   Disconnect radiator outlet hose (5).

6. **Water pump assembly**
   Remove water pump assembly (6).



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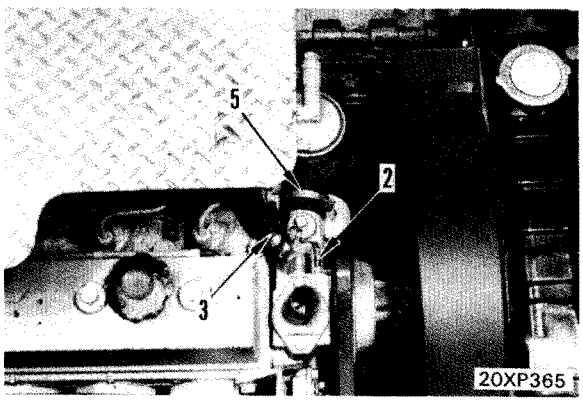

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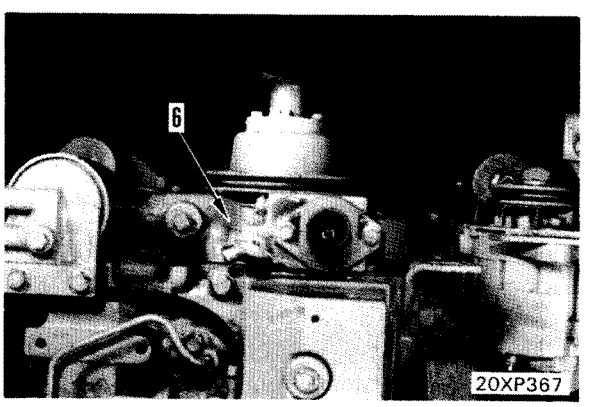
INSTALLATION OF WATER PUMP ASSEMBLY

1. Fit a gasket and O-ring, set water pump assembly (6) in its installation position, then tighten the bolts.
2. Connect radiator outlet hose (5).
3. Connect heater hoses (4) and (3), then connect water temperature sensor wiring (2).
4. Install the fan and fan pulley. For details, see the section on INSTALLATION OF FAN AND FAN PULLEY.
5. Install radiator inlet hose (1).
6. Tighten the radiator drain valve, then add water through the filler to the specified level.
   ★ Start the engine to circulate the water through the piping, then check the water level again.

20XP366



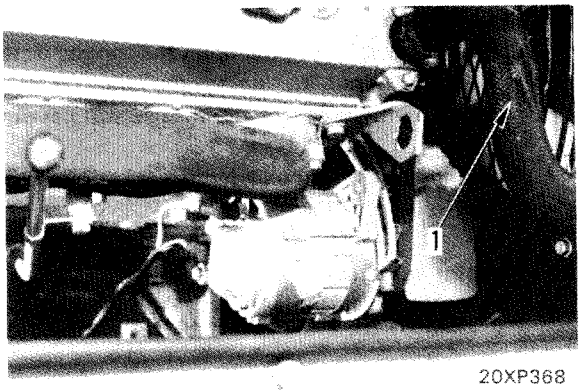
20XP367

REMOVAL OF THERMOSTAT ASSEMBLY

1. Loosen the radiator drain valve and drain the cooling water.
   ★ If the coolant contains antifreeze, dispose of it carefully.

2. Disconnect hose (1), then remove water sensor wiring (2).

3. Remove thermostat (3).



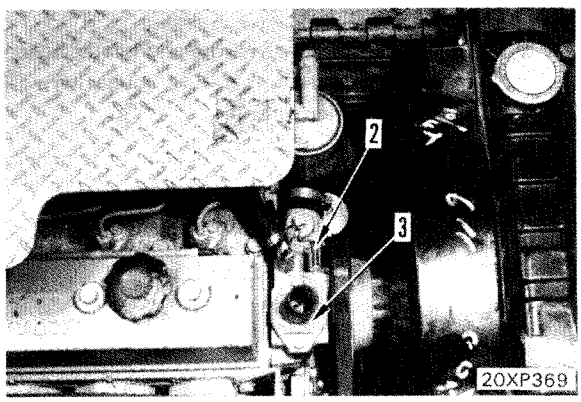
20XP368

INSTALLATION OF THERMOSTAT ASSEMBLY

1. Set thermostat (3) in its installation position.

2. Fit a gasket, install water temperature sensor (2), then connect hose (1).

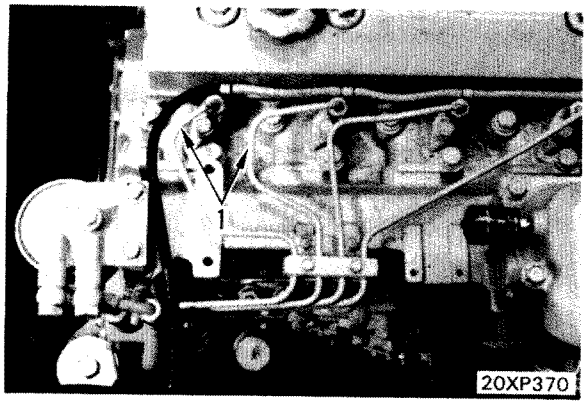
3. Tighten the radiator valve, then add water through the filler to the specified level.
   ★ Start the engine to circulate the water through the piping, the check the water level again.



20XP369

REMOVAL OF NOZZLE HOLDER ASSEMBLY

1. Disconnect fuel injection tube (1) from nozzle holder assembly.
2. Disconnect spill hose, then remove clamp (2).
3. Remove nozzle holder assembly (3).
   ★ After removing the nozzle holder, put a blind plug into the holder mounting hole to prevent the entry of foreign matter.



INSTALLATION OF NOZZLE HOLDER ASSEMBLY

★ Make sure that there is no dust or foreign matter on the nozzle holder assembly mounting surface.

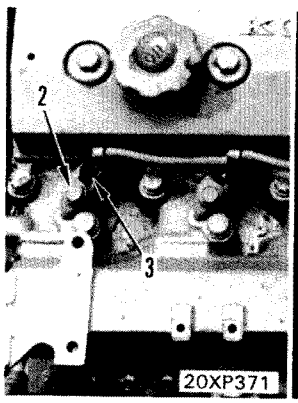
1. Fit gasket and install nozzle holder assembly (3), then install clamp (2).

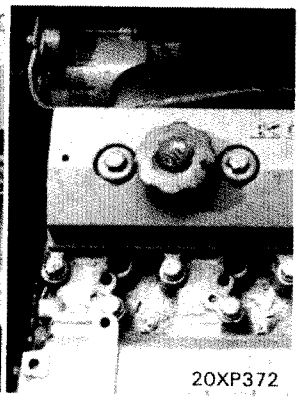
   kgm Clamp mounting bolt: 4.5 ± 0.5 kgm

2. Connect fuel injection tube (1).

   kgm Sleeve nut: 2.3 ± 0.2 kgm

3. Connect spill hose.





REMOVAL OF CYLINDER HEAD ASSEMBLY

1. **Water pump assembly**
   Remove water pump assembly.
   For details, see 13 REMOVAL OF WATER PUMP ASSEMBLY.

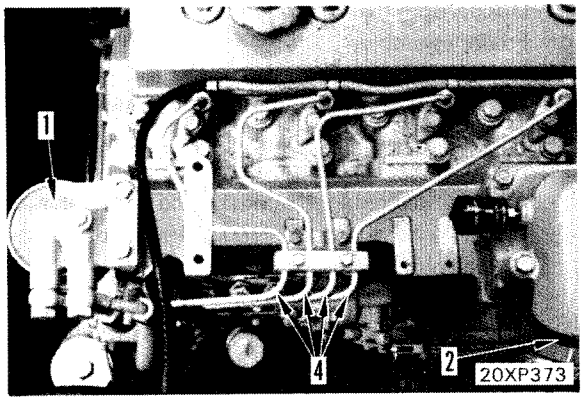
2. **Fuel filter assembly**
   Remove fuel filter assembly (1) from cylinder head.

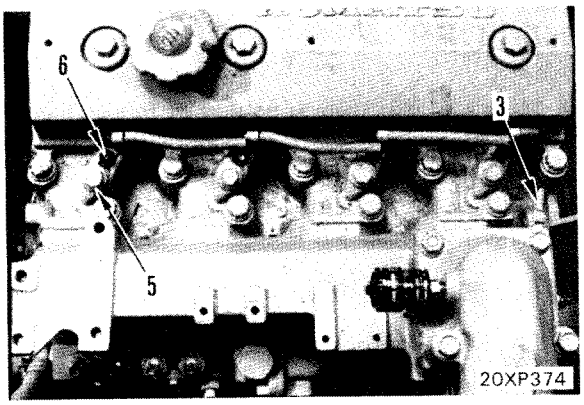
3. **Air cleaner hose and wiring**
   1) Disconnect air cleaner hose (2).
   2) Disconnect electrical intake air heater wiring (3).

4. **Fuel injection tube**
   Disconnect fuel injection tube (4).

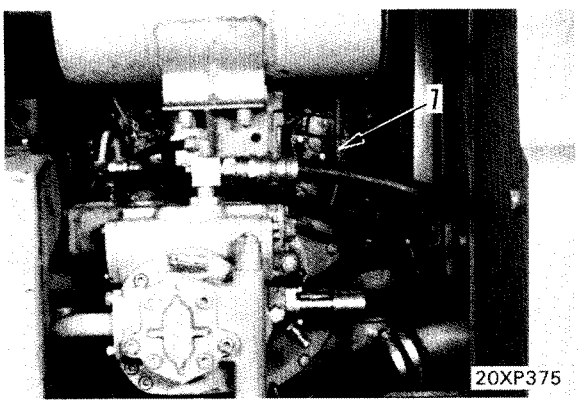
5. **Spill hose**
   Disconnect spill hose.

6. **Nozzle holder assembly**
   Remove clamp (5), then remove nozzle holder assembly (6).



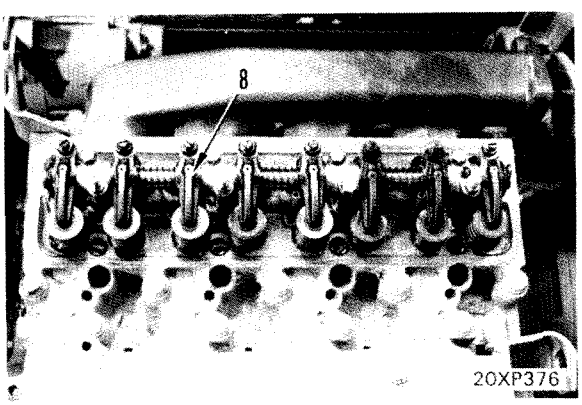


7. **Muffler assembly**
   1) Disconnect drain tube (7).
   2) Remove muffler assembly from exhaust manifold.



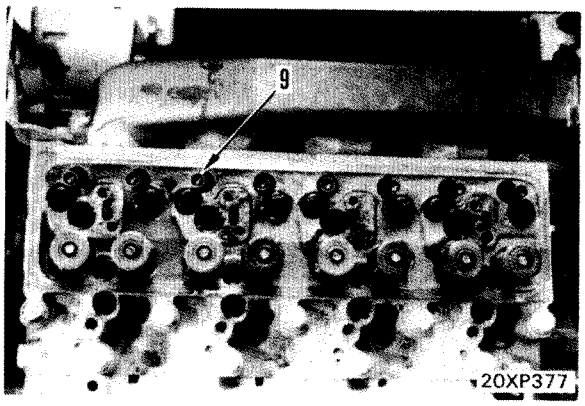
8. **Cylinder head cover**
   Remove cylinder head cover.

9. **Rocker arm assembly**
   1) Loosen locknut, then turn back adjustment screw 2 or 3 turns.
   2) Remove rocker arm assembly (8).



10. Push rod

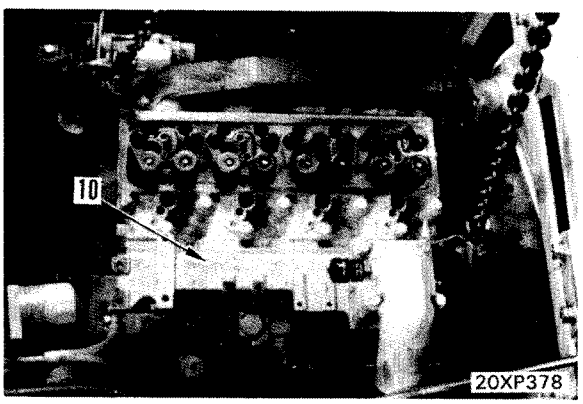
Remove push rod (9).



11. Cylinder head assembly

Remove cylinder head mounting bolts, then lift off cylinder head assembly (10).

kg Cylinder head assembly: 30 kg

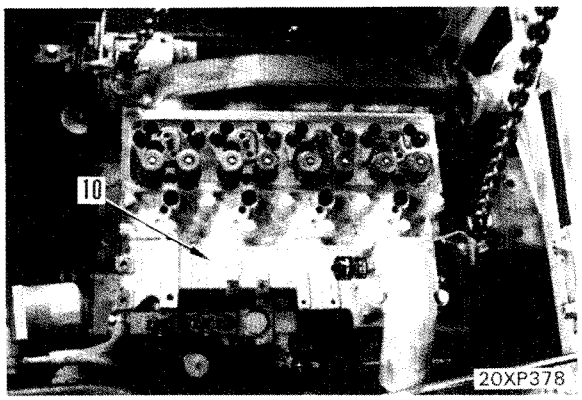


INSTALLATION OF CYLINDER HEAD ASSEMBLY

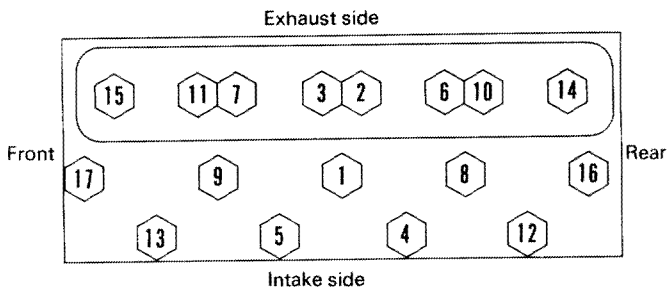
Special tools required

No.	Part No.	Part Name	Q'ty
A	795-100-1370	Feeler gauge	1

1. **Cylinder head assembly**
   1) Check that cylinder head mounting surface and inside of cylinder are free from dust.
      Install head gasket on cylinder head.
      ★ Install gasket with TOP mark facing up.
   2) Raise cylinder head assembly (10), align with dowel pin, and install.



2. **Tighten cylinder head mounting bolts on the following tightening torques and in the order given.**

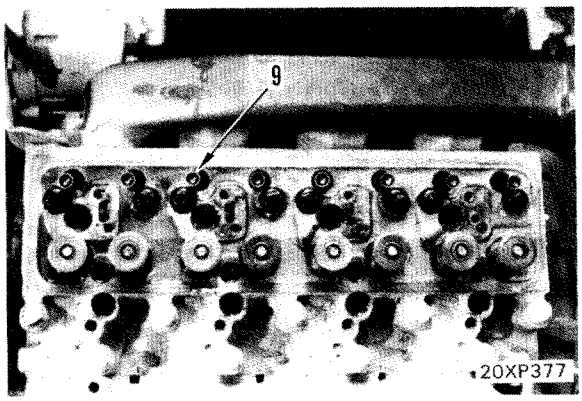


Mounting bolt:
Anti-friction compound (LM-P)

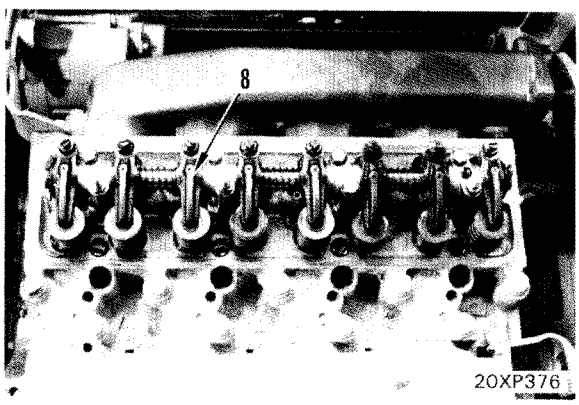
Cylinder head mounting bolt:

kgm

Order	Torque
1st step	8 ± 1.0
2nd step	13 ± 1.0
3rd step	17.5 ± 0.5



3. **Push rod**
   Install push rod (9).



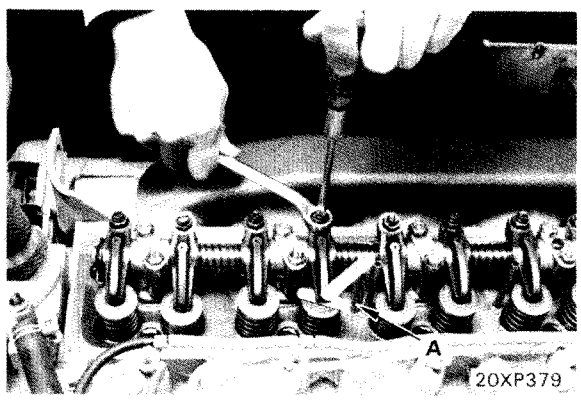
4. **Rocker arm assembly**
   1) Align rocker arm assembly (8) with stud bolt and position.
   2) Check that ball of adjustment screw is fitted in push rod, then tighten nuts and bolts.

5. **Adjustment of valve clearance**

★ Adjust the clearance between the valve and rocker arm to the following values using tool A.

Intake valve	Exhaust valve
0.35 mm	0.50 mm

: When cold

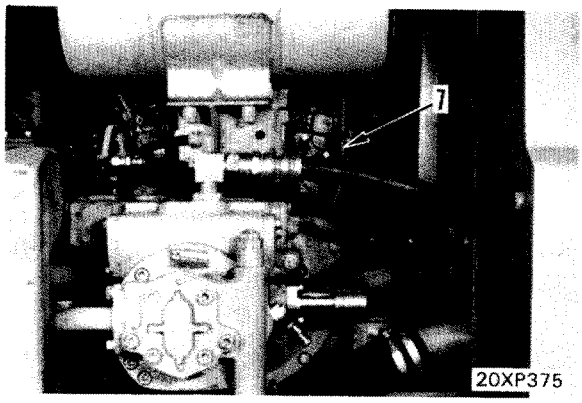


★ For details of adjusting valve clearance, see 12 TESTING AND ADJUSTING VALVE CLEARANCE.

6. **Cylinder head cover**
   Fit O-ring on cylinder head cover, then position on cylinder block.

   kgm Mounting nut: 1.05 ± 0.15 kgm

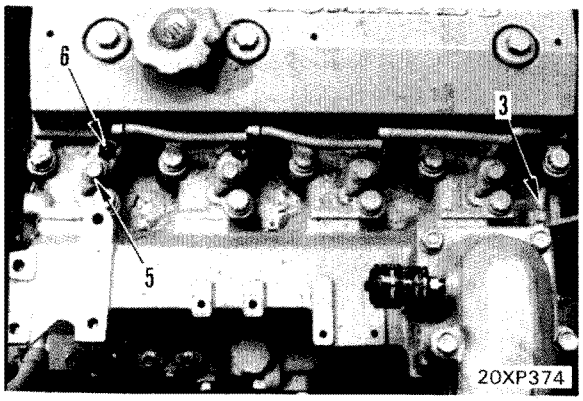
7. **Muffler assembly**
   1) Fit gasket and install muffler assembly to the exhaust manifold.
   2) Connect drain tube (7).



8. **Nozzle holder assembly**
   ★ Make sure that there is no dust or foreign matter on nozzle holder assembly mounting surface.

   Fit gasket and install nozzle holder assembly (6), then install clamp (5).

   kgm Clamp mounting bolt: 4.5 ± 0.5 kgm



9. **Spill hose**
   Connect spill hose.

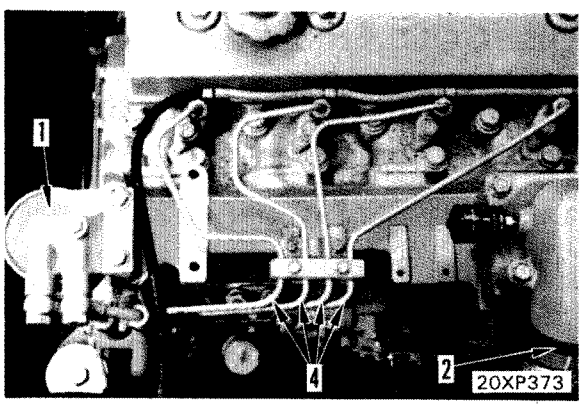
10. **Fuel injection tube**
    Connect fuel injection tube (4).

    kgm Sleeve nut: 2.3 ± 0.2 kgm

11. **Air cleaner hose**
    1) Connect electrical intake air heater wiring (3).
    2) Connect air cleaner hose (2).

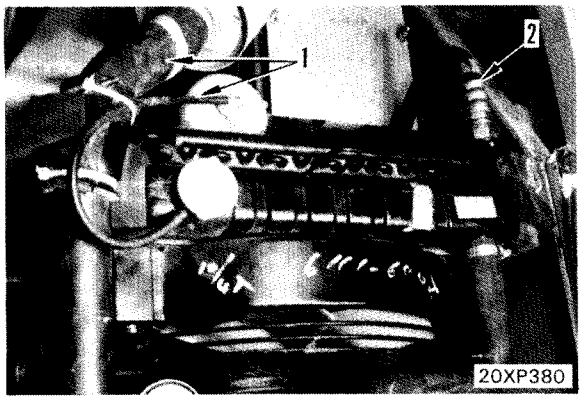
12. **Fuel filter assembly**
    Install fuel filter assembly (1) to cylinder head.

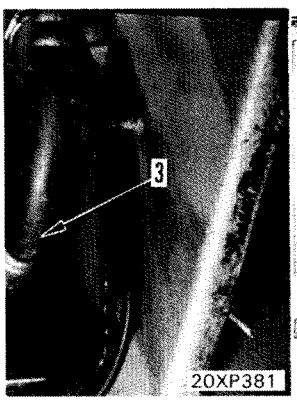
13. **Water pump assembly**
    Install water pump assembly.
    For details, see 13 INSTALLATION OF WATER PUMP ASSEMBLY.



REMOVAL OF HYDRAULIC OIL COOLER ASSEMBLY

1. Disconnect the air suction hose and overflow hose (1) on the air cleaner side.
2. Disconnect hydraulic oil inlet hose (2).
3. Disconnect hydraulic oil outlet hose (3).
4. Remove the installation bolts, then remove hydraulic oil cooler assembly (4).





INSTALLATION OF HYDRAULIC OIL COOLER ASSEMBLY

1. Set hydraulic oil cooler assembly (4) on the radiator assembly, then tighten the installation bolts.
2. Connect hydraulic oil outlet hose (3).
3. Connect hydraulic oil inlet hose (2).
4. Connect the overflow hose and air suction hose (1).

REMOVAL OF RADIATOR AND HYDRAULIC OIL COOLER ASSEMBLY

1. Loosen the radiator drain valve and drain the coolant.
   ★ If the coolant contains antifreeze, dispose of it carefully.

2. Disconnect the heater hose and radiator outlet hose (1) at the radiator side.

3. Disconnect hydraulic oil outlet hose (2) from the hydraulic oil cooler side.

4. Remove the nuts from installation bolts (3) at the lower side of the radiator assembly.

5. Disconnect hose (4) at the air cleaner side and radiator side.

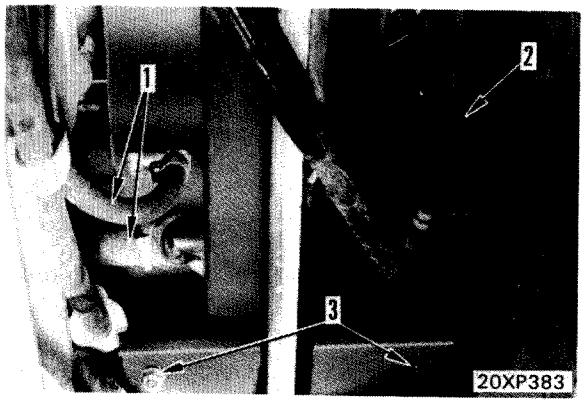
6. Disconnect radiator inlet hose (5) at the radiator side.

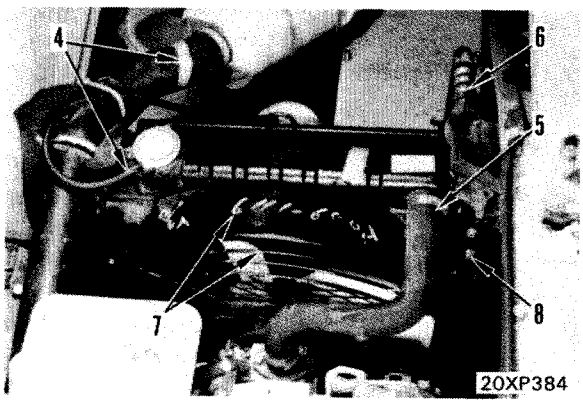
7. Disconnect hydraulic inlet hose (6) from the cooler side.

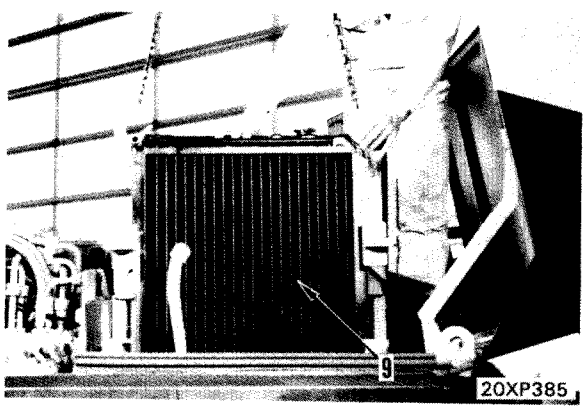
8. Disconnect the shroud and guard assembly (7) from the radiator and move them to the engine side.

9. Remove installation bolts (8) at the top of the radiator and hydraulic oil cooler assembly, then remove the radiator and hydraulic oil cooler assembly (9).

   kg Radiator and hydraulic cooler assembly: 33 kg

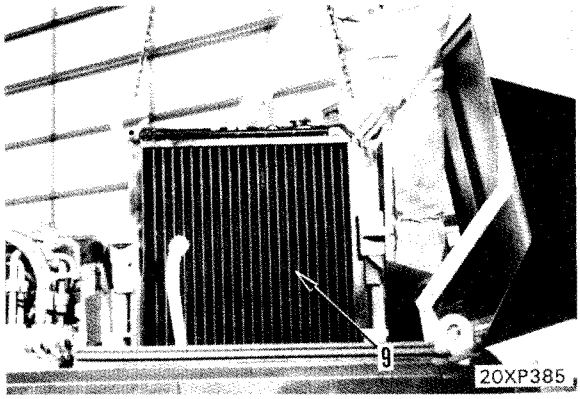


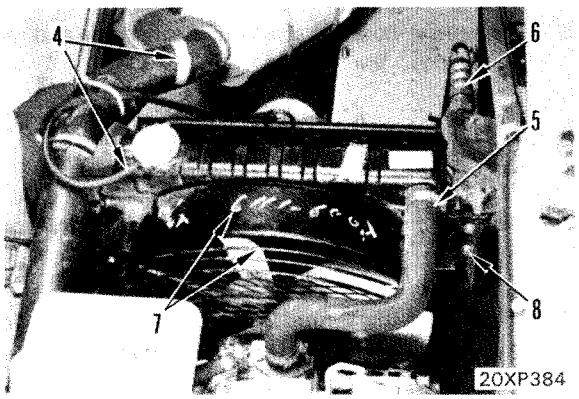


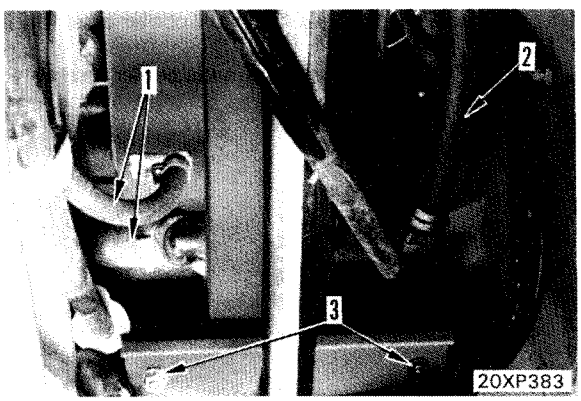


INSTALLATION OF RADIATOR AND HYDRAULIC OIL COOLER ASSEMBLY

1. Set the radiator and hydraulic oil cooler assembly (9), then temporarily tighten installation bolts (8) at top.
2. Tighten the nuts of mounting bolts (3) at the lower side of the radiator.
3. Firmly tighten loosely tightened installation bolts (8) at the top.
4. Install the shroud and guard assembly (7) to the radiator.
5. Connect hydraulic oil inlet hose (6) to the cooler.
6. Connect radiator inlet hose (5) to the radiator.
7. Connect hose (4) to the radiator and air cleaner.
8. Connect hydraulic oil inlet hose (2) to the cooler.
9. Connect radiator outlet hose (1) to the radiator.
10. Tighten the radiator drain valve, then add water through the filler to the specified level.
    - ★ Start the engine to circulate the water through the piping, then check the water level again.
    - ★ Check the hydraulic oil level at the same time.







REMOVAL OF ENGINE ASSEMBLY

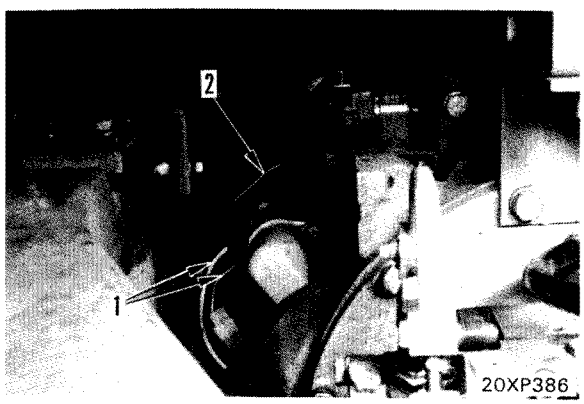
Lower work equipment to the ground. After stopping engine, operate work equipment control lever 2 or 3 times to remove the pressure remaining in piping. Then; slowly loosen hydraulic tank filler cap to relieve the internal pressure from hydraulic tank.

1. **Draining water**
   1) Loosen drain valve and drain the cooling water.
      ★ Be careful not to loosen the drain valve too much. Otherwise, the drain valve will get out of place.
      ★ If the coolant contains antifreeze, dispose of it carefully.

2. **Main pump side cover**
   Remove the cover.

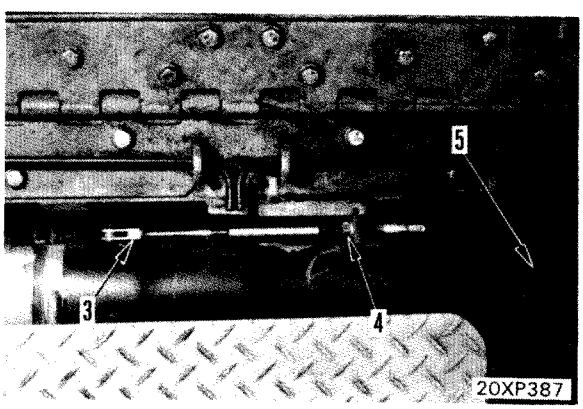
3. **Hydraulic oil drain**
   Remove the drain plug to drain the oil from the tank.
   Hydraulic oil: approx. 80ℓ

4. **Starter, ribbon heater wiring**
   Disconnect wiring (1) from the starting motor assembly and wiring (2) from the ribbon heater.

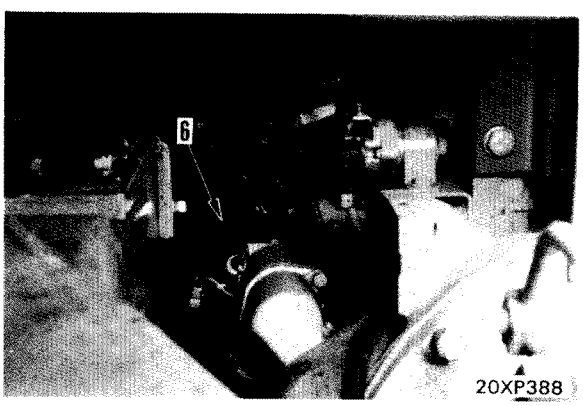


5. **Fuel control cable**
   Pull out the pin, disconnect cable (3), loosen nut (4), then remove the bracket.

6. **Air cleaner hose**
   Disconnect hose (5) from the engine side.

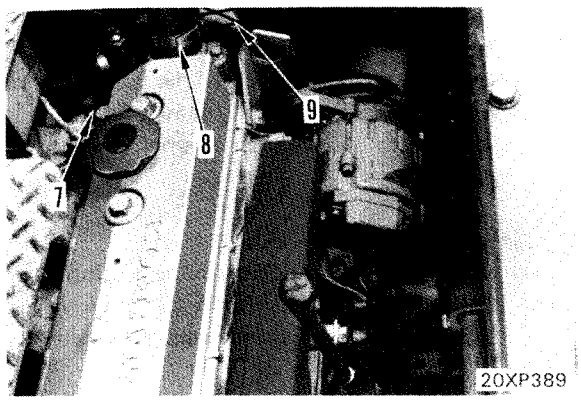


7. **Fuel injection hose**
   Disconnect hose (6) from the pump side.
   ★ Fit a blind pluf because the fuel will gush out.



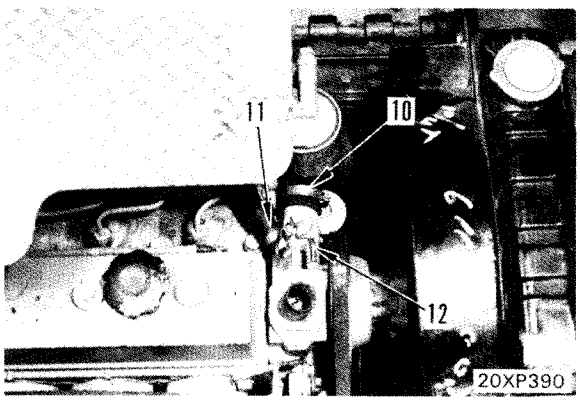
8. **Spill hose, water hose**
   1) Disconnect spill hose (7) from the engine side.
   2) Disconnect hose (8) from the pump side.

9. **Guard, fan**
   Remove guard (9), remove the fan, and place the on the radiator assembly side.



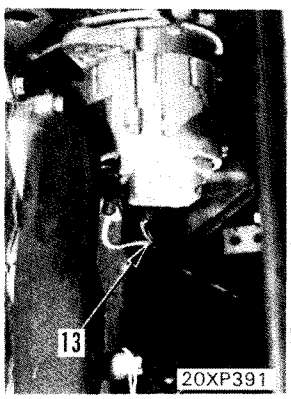
10. **Water pump hose, heater hose**
    Disconnect hoses (10) and (11) from the pump side.

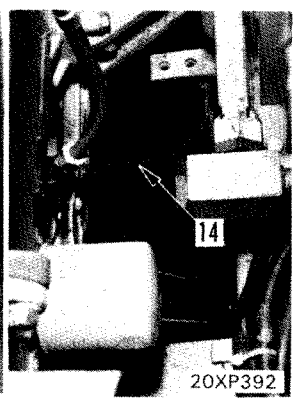
11. **Water temperature sensing wiring**
    Disconnect wiring (12).



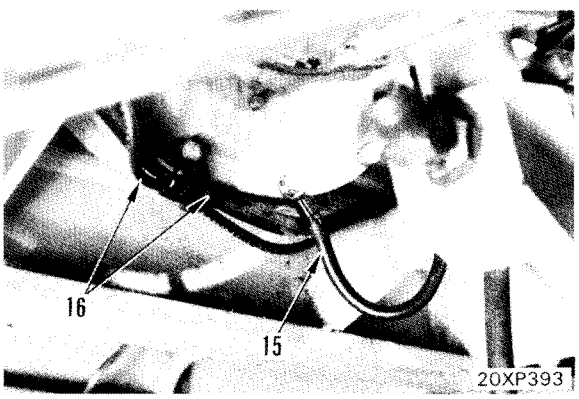
12. **Alternator, oil pressure sensor wiring**
    1) Disconnect wiring (13).
    2) Disconnect wiring (14).

13. **Pump piping**
    Disconnect the pump piping and hose from the pump assembly. For details, see REMOVAL OF MAIN PUMP ASSEMBLY.



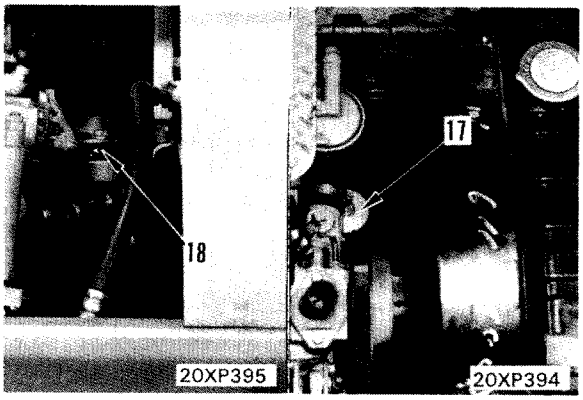


14. **Engine ground**
    Disconnect ground wiring (15), remove the clamp, and remove wiring (16) from the engine side.



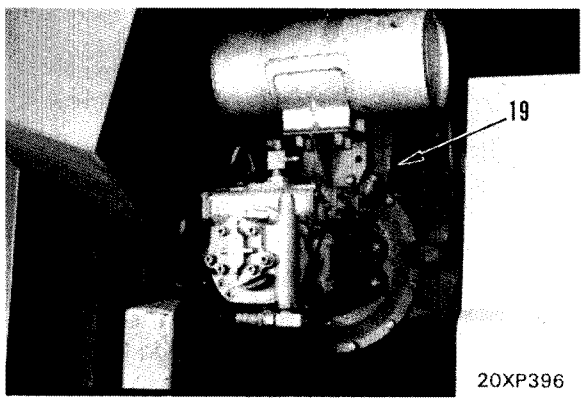
15. Engine assembly

1) Remove front and rear mounting bolts (17) and (18).



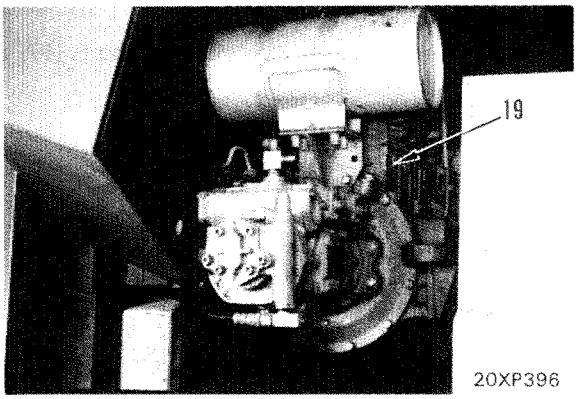
2) Sling engine assembly (19) horizontally and dismount it by gradually lifting it.

kg Engine assembly: 450 kg



INSTALLATION OF ENGINE ASSEMBLY

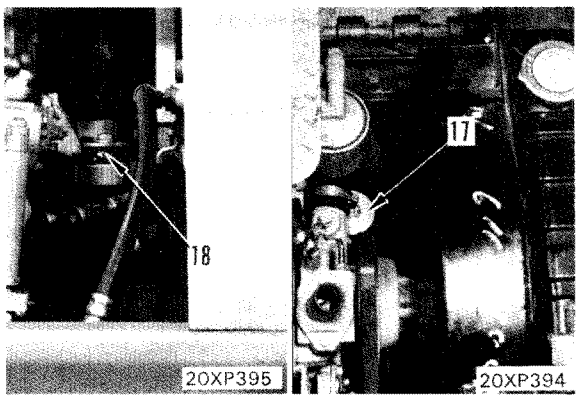
1. **Engine assembly**
   1) Sling engine assembly (19) into position, attach a cushion, align with the mounting bolts, then lower the engine.
      ★ Be careful about the shroud and fan while lowering the engine.



   2) Tighten front and Rear mounting bolts (17) and (18).

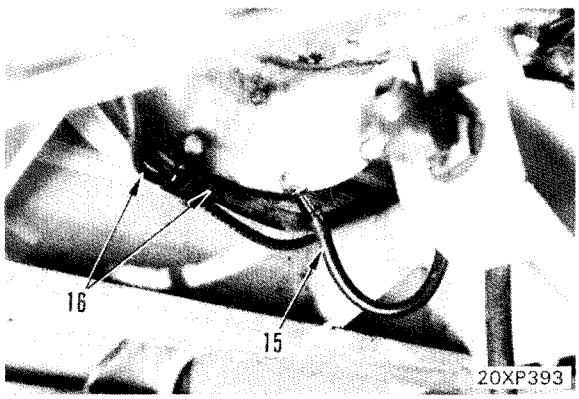
      Mounting bolt: Thread tightener (LT-2)

      Mounting bolt: 28.5 ± 3.0 kgm

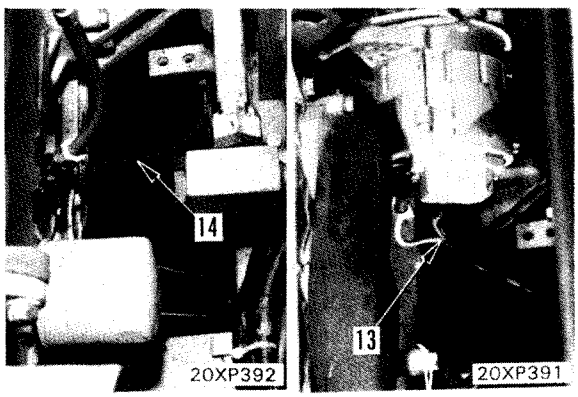


2. **Engine ground**
   Connect the clamp of wiring (16) to the engine, install the ground wiring (15).

3. **Pump piping**
   Connect the pump piping to the pump assembly. For details, see INSTALLATION OF MAIN PUMP ASSEMBLY.

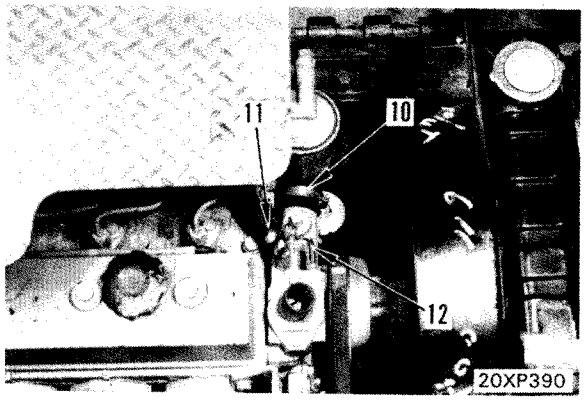


4. **Alternator, oil pressure sensor wiring**
   1) Connect wiring (14).
   2) Connect wiring (13).



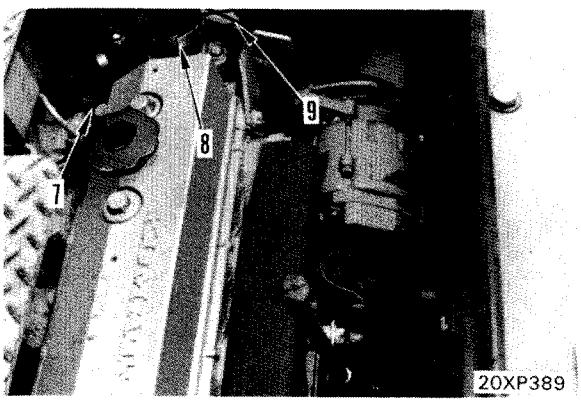
5. **Water temperature sensor wiring**
   Connect wiring (12).

6. **Water pump hose, heater hose**
   Connect hoses (11) and (10) to the pump.

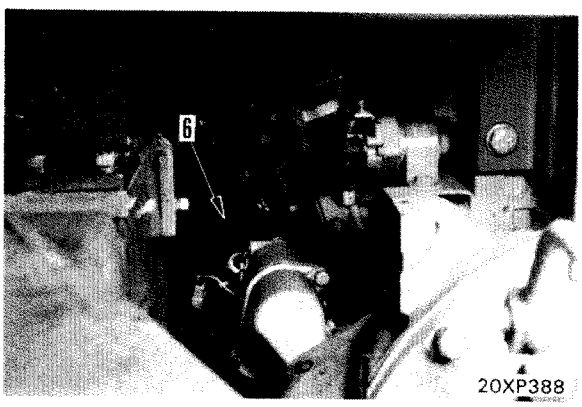


7. **Fan guard**
   Install the fan and guard.

8. **Water pump hose, spill hose**
   1) Connect hose (8) to the pump.
   2) Connect spill hose (7) to the engine side.

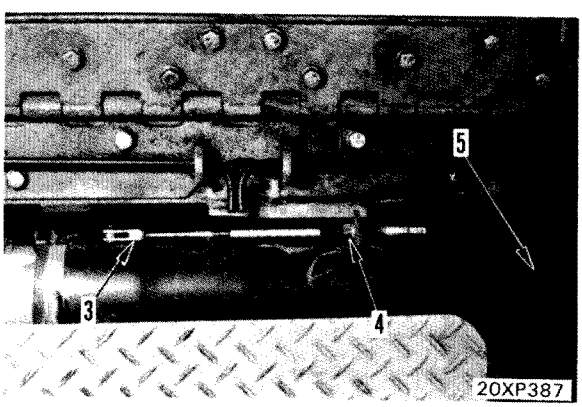


9. **Fuel inlet hose**
   Connect hose (6) to the pump.

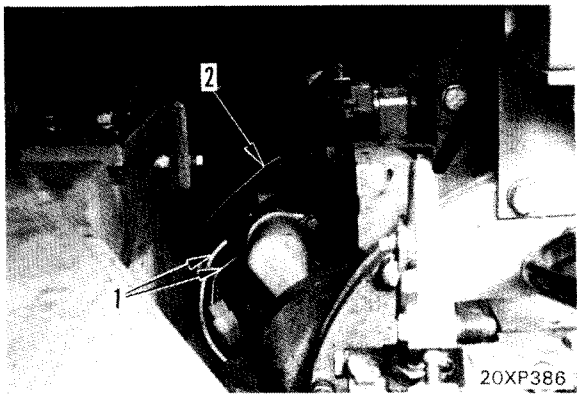


10. **Fuel control cable**
    Connect cable (3) and fix with nut (4).
    ★ Be sure to bend the cotter pin securely.

11. **Air cleaner hose**
    Connect hose (5) to the engine side.



12. **Starting motor, ribbon heater wiring**
Connect wiring (1) to the starting motor assembly and wiring (2) to the ribbon heater.



13. **Add oil**
Tighten the tank drain plug and add oil through the filler.

Hydraulic oil tank: 88 ℓ

14. **Add oil**
Tighten the radiator drain valve and add water through filler to the specified level.
★ Start the engine to circulate the cooling water and oil through the piping, then check the levels again.

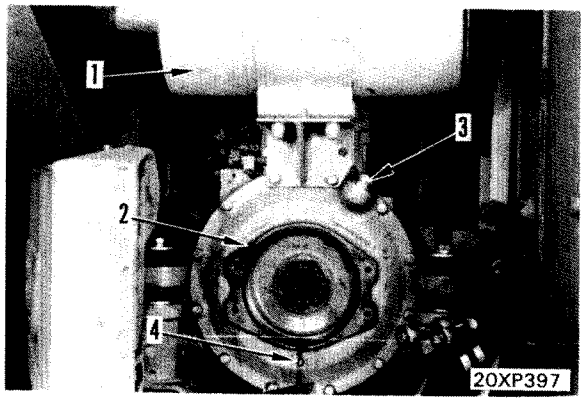
REMOVAL OF PTO ASSEMBLY

1. Remove the main pump assembly. For details, see REMOVAL OF MAIN PUMP ASSEMBLY.

2. Remove muffler assembly (1) together with the bracket.

3. Remove the ground wiring and wiring clamp.

4. Screw and eyebolt (D = 14 mm, P = 2.0) into the main pump installation hole and remove PTO assembly (2).
   ★ When removing the PTO assembly, use an oil pan because the oil in the case will flow out.



INSTALLATION OF PTO ASSEMBLY

1. Apply liquid gasket and, using an eyebolt (D = 14 mm, P = 2.0), install PTO assembly (2).

   PTO case installation face:
   Liquid gasket (LG-6)

2. Add engine oil through oil filler (3) of the PTO case, remove level plug (4), and add oil until oil flows out of the level hole.

   PTO case: approx. 0.9 ℓ

3. Fit a gasket and install muffler assembly (1) together with the bracket.

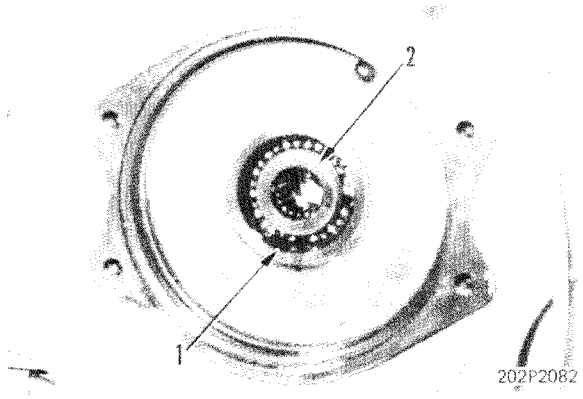
4. Install the ground wiring and wiring clamp.

5. Install the main pump assembly. For details, see INSTALLING THE MAIN PUMP ASSEMBLY.
   ★ Before checking the oil level, park the machine on flat ground and idle the engine for 3 minutes. Wait 15 minutes, remove level plug (4), the conform that the oil comes up to the installation hole.

DISASSEMBLY OF PTO ASSEMBLY

1. Remove snap ring (1), then remove shaft and bearing assembly (2).

2. Remove snap ring (3), receive the inner race of bearing (4), then push out shaft (5) with a press.

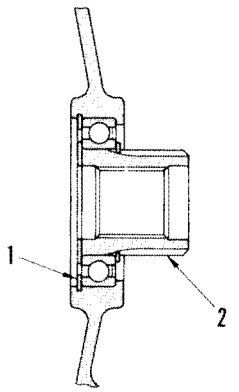


202P2082

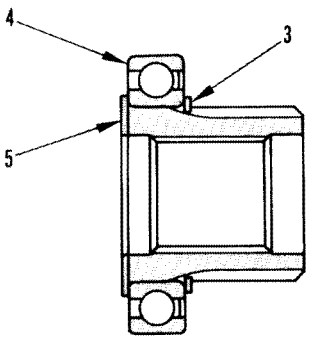
ASSEMBLY OF PTO ASSEMBLY

1. Press fit bearing (4) into shaft (5), the install snap ring (3).
   ★ Install the bearing seal so that the seals faces the engine. (So that it faces the opposite)

2. Assemble shaft-bearing assembly (2) to case (6), then install snap ring (1).

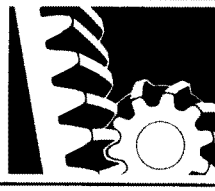


202F2010

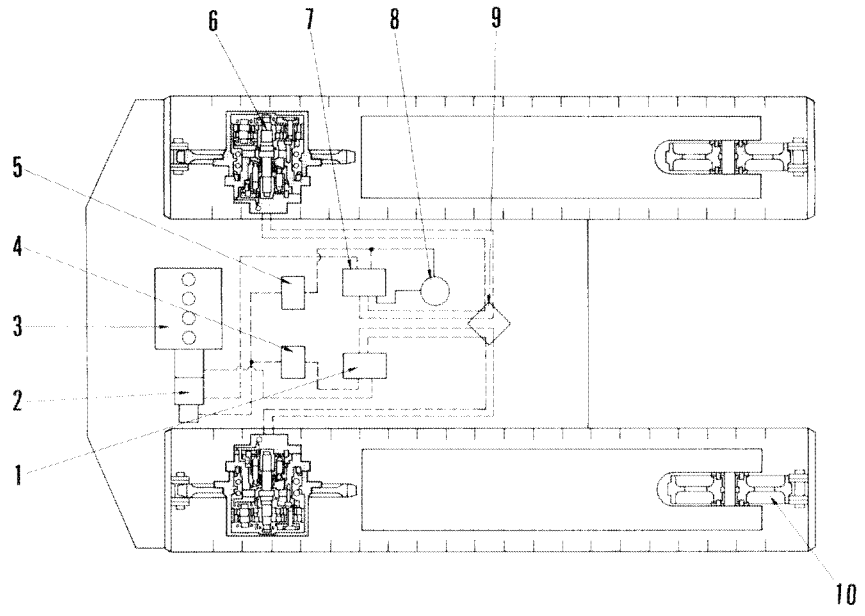


202F2011

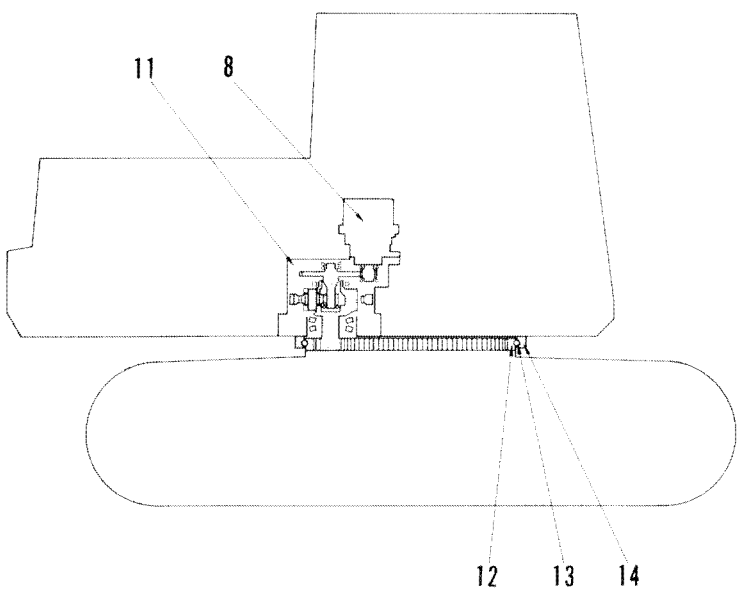
POWER TRAIN
21 STRUCTURE AND FUNCTION



POWER TRAIN



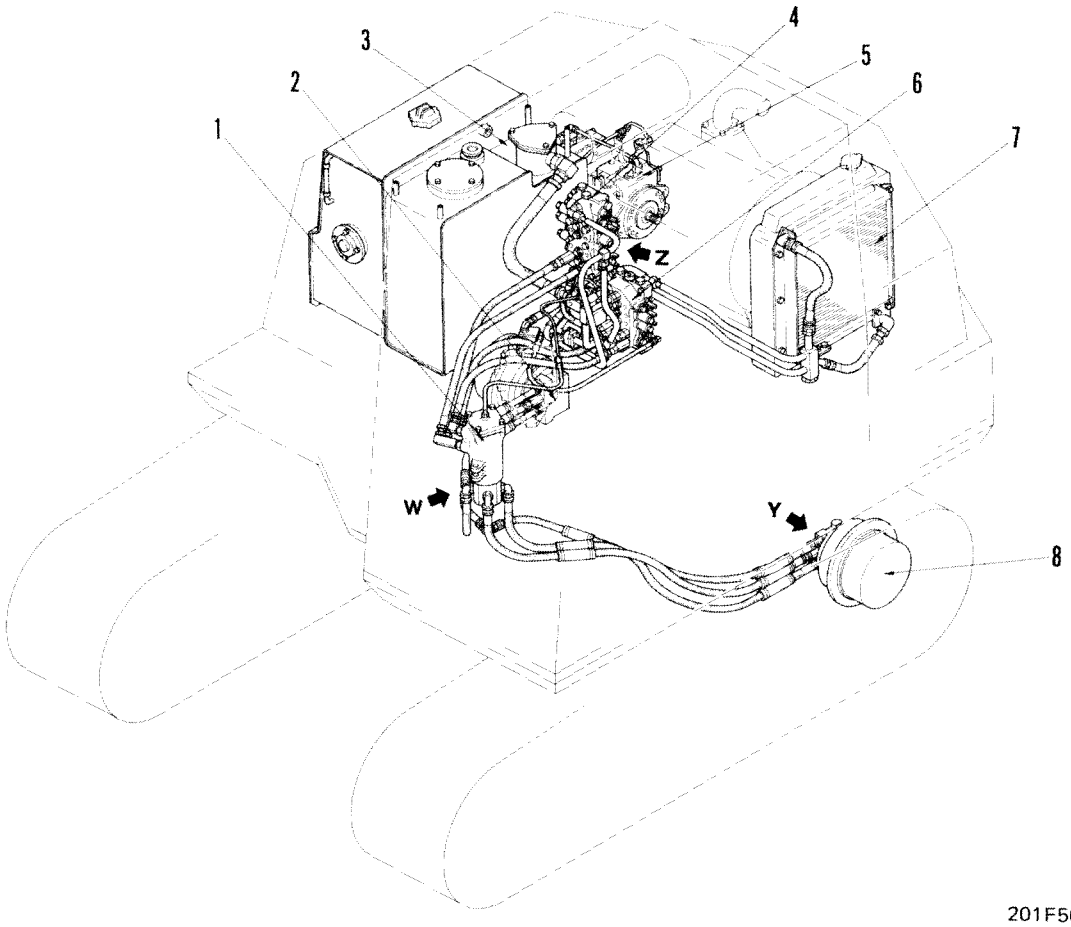
1. R.H. 5-spool control valve
2. Hydraulic pump
3. Engine
4. Solenoid valve
5. Solenoid valve
6. Travel motor (with reduction gear)
7. L.H. 6-spool control valve
8. Swing motor
9. Center swivel joint
10. Idler
11. Swing machinery
12. Swing circle inner race
13. Swing circle bearing
14. Swing circle outer race



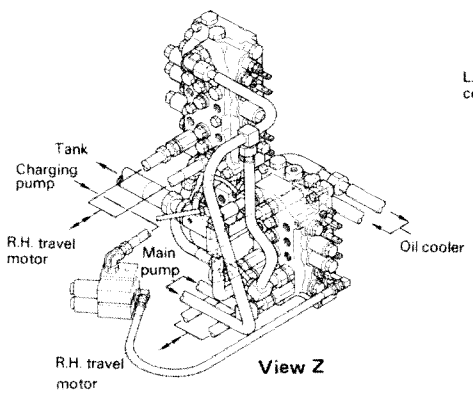
201F5021-1

The mechanical power from engine (3) is converted into the hydraulic power by hydraulic pumps. This hydraulic power is distributed through 2 control valves (1) and (7) for various functional purposes, and converted again into the mechanical power through hydraulic motors (6) and (8) as well as hydraulic cylinders for the machine traveling, swinging, and excavating performance.

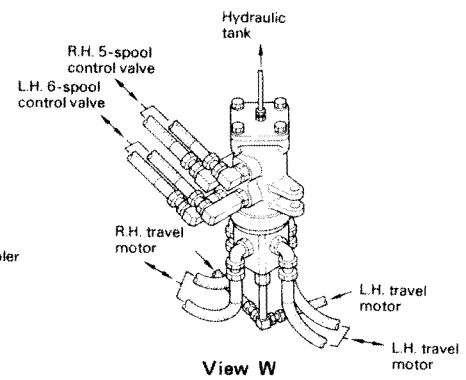
TRAVEL SYSTEM



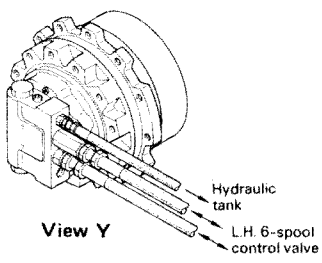
201F5022



201F5023



201F5024

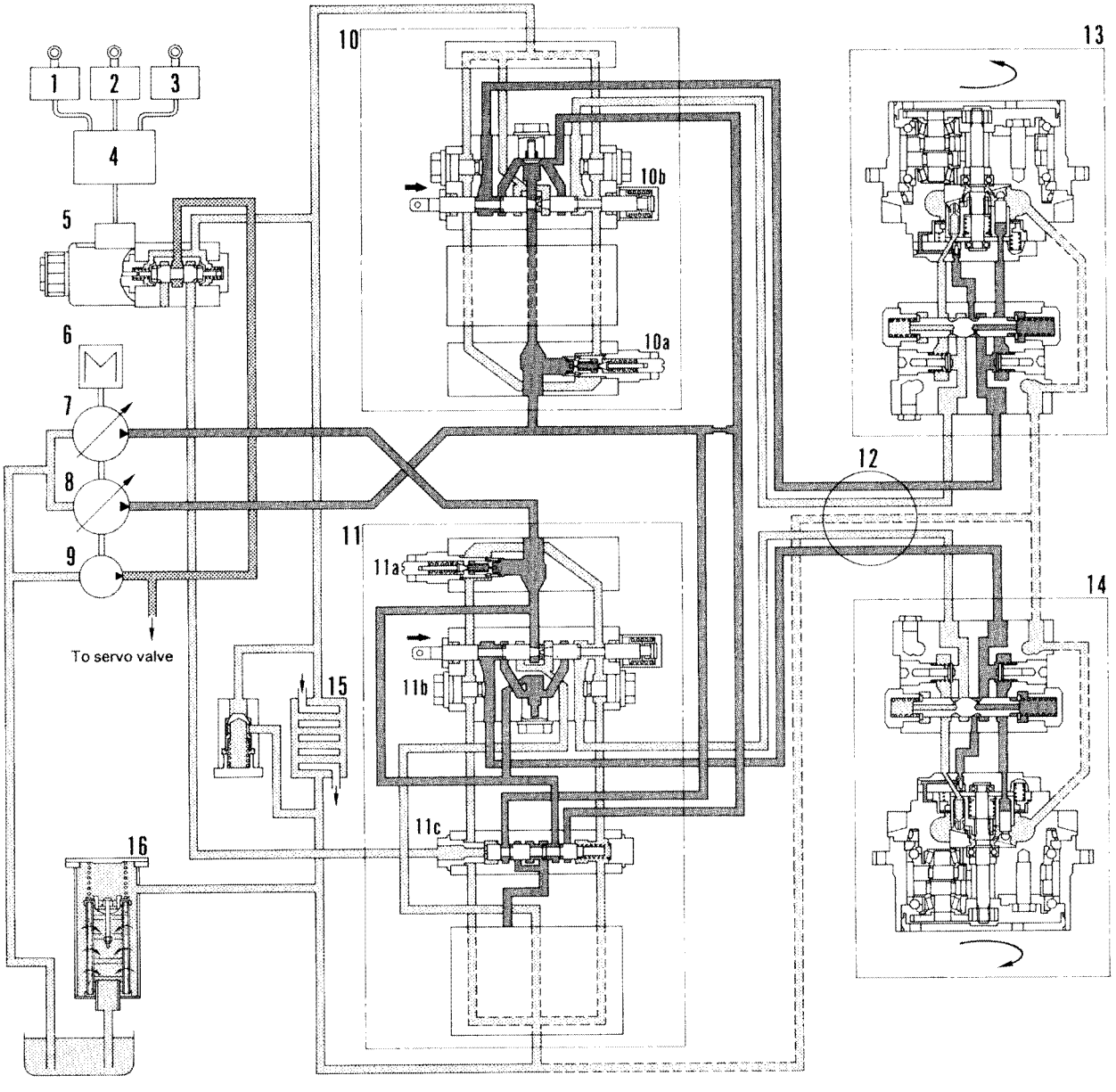


201F5025

The pressurized oil from the main pump is used by the left and right control valves to control the left and right travel motors independently.
When the machine is traveling in a straight line, even if the swing or work equipment are operated, the straight travel circuit ensures that the machine does not deviate.

1. Center swivel joint
2. R.H. travel motor
3. Hydraulic tank
4. L.H. 6-spool control valve
5. Main pump
6. R.H. 5-spool control valve
7. Oil cooler
8. L.H. travel motor

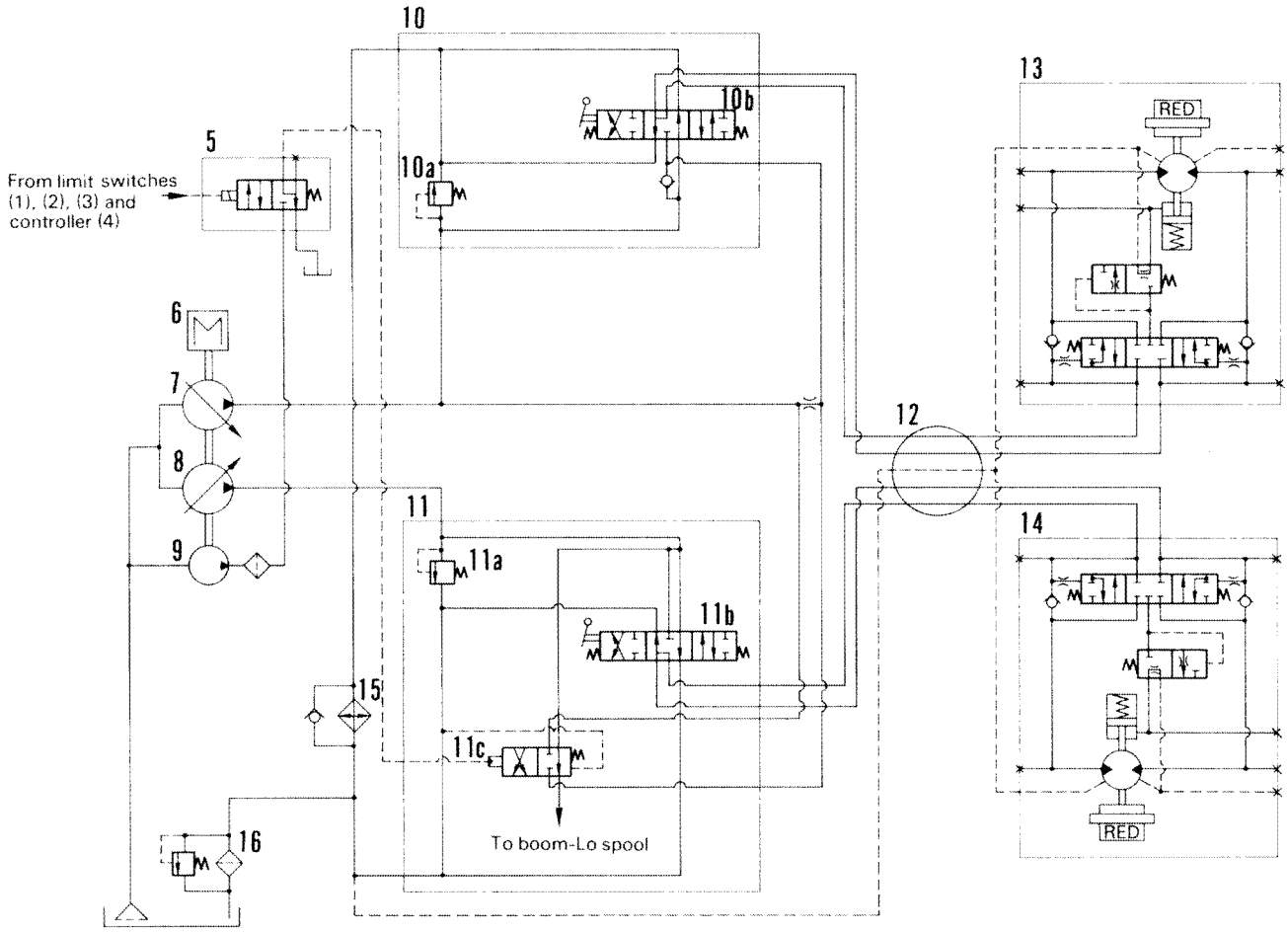
TRAVEL CONTROL CIRCUIT SCHEMATICS



201F5026-1

1. Limit switch (for swing)
2. Limit switch (for travel)
3. Limit switch (for work equipment)
4. Controller
5. Solenoid valve for straight travel
6. Engine
7. Front main pump
8. Rear main pump
9. Charging pump
10. L.H. 6-spool control valve
10a. Main relief valve
10b. L.H. travel control valve
11. R.H. 5-spool control valve
11a. Main relief valve
11b. R.H. travel control valve
11c. Straight travel valve
12. Center swivel joint
13. L.H. travel motor
14. R.H. travel motor
15. Oil cooler
16. Hydraulic filter

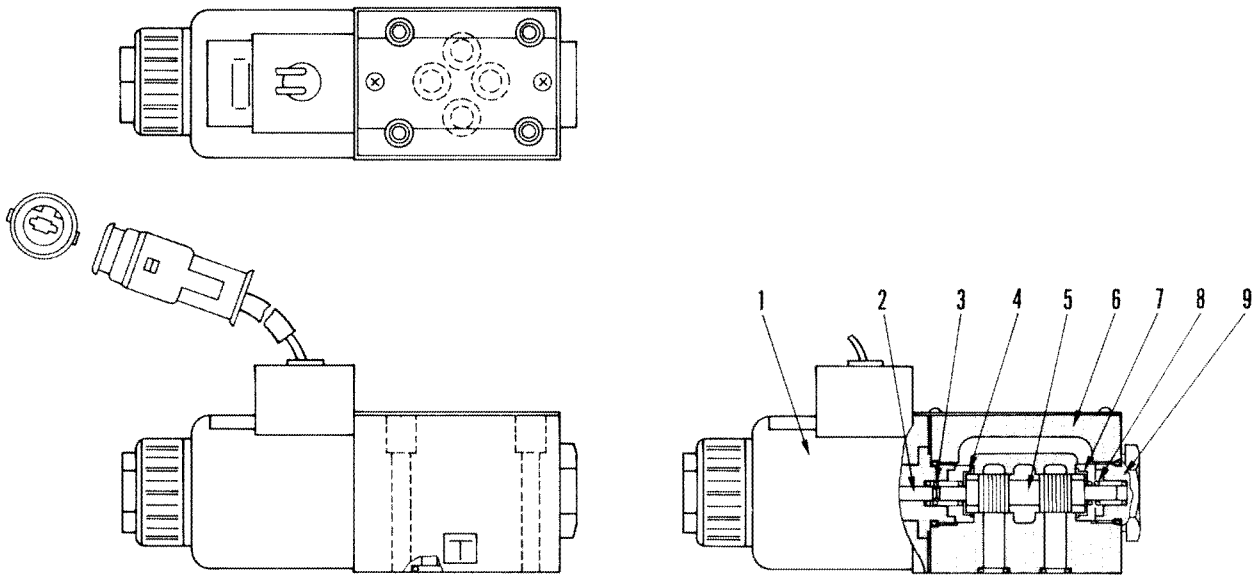
TRAVEL CONTROL CIRCUIT



F20105001

1. Limit switch (for swing)
2. Limit switch (for travel)
3. Limit switch (for work equipment)
4. Controller
5. Solenoid valve for straight travel
6. Engine
7. Front main pump
8. Rear main pump
9. Charging pump
10. L.H. 6-spool control valve
10a. Main relief valve
10b. L.H. travel control valve
11. R.H. 5-spool control valve
11a. Main relief valve
11b. R.H. travel control valve
11c. Straight travel valve
12. Center swivel joint
13. L.H. travel motor
14. R.H. travel motor
15. Oil cooler
16. Hydraulic filter

SOLENOID VALVE



F0202017

FUNCTION

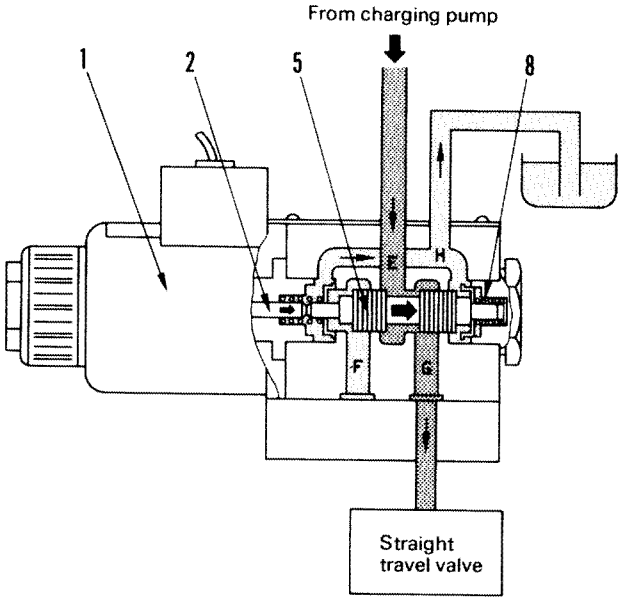
- The solenoid valve is operated by an electric signal sent from the limit switch (which is interlocked with the travel control lever) and release the oil flow from the charging pump.
- This solenoid valve is also used for the swing mechanical brake circuit, and swing priority circuit.

1. Solenoid assembly
2. Push-pin
3. Spring
4. Spring retainer
5. Spool
6. Valve body
7. Spring retainer
8. Spring
9. Plug

OPERATION

1. Travel control lever in OPERATION

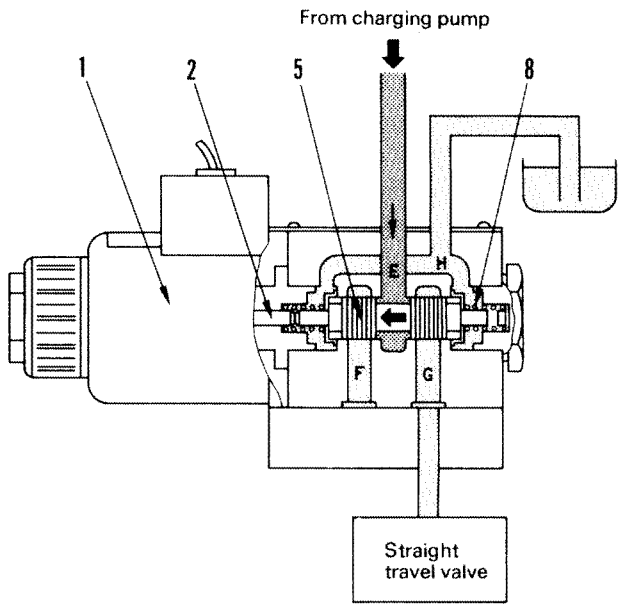
If the control levers are set to OPERATION the limit switch which interlocks with them will be operated to excite solenoid (1), then push-pin (2) will push spool (5) in the direction of the arrow (➡) to close ports **H** and **G** and open ports **E** and **G**. As a result, the oil from the charging pump flows from port **E** to **G** to operate the straight-travel valve.



F0202018

2. Travel control lever at NEUTRAL

If the control levers are set to the NEUTRAL the limit switch will turn off and solenoid (1) will be released. Then spring (8) will force spool (5) to return in the direction of the arrow (⬅) to close ports **E** and **G** and open ports **G** and **H**. As a result, the oil from port **G**, that is, the oil from the straight-travel valve is drained through port **H**.



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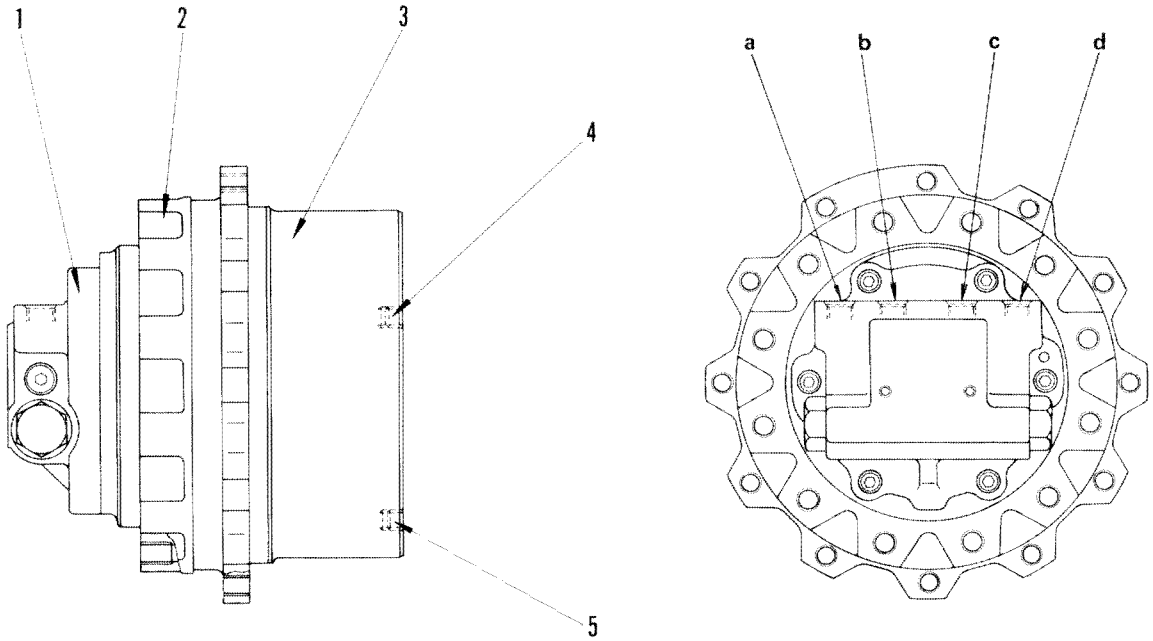
TRAVEL MOTOR (with reduction gear and parking brake)



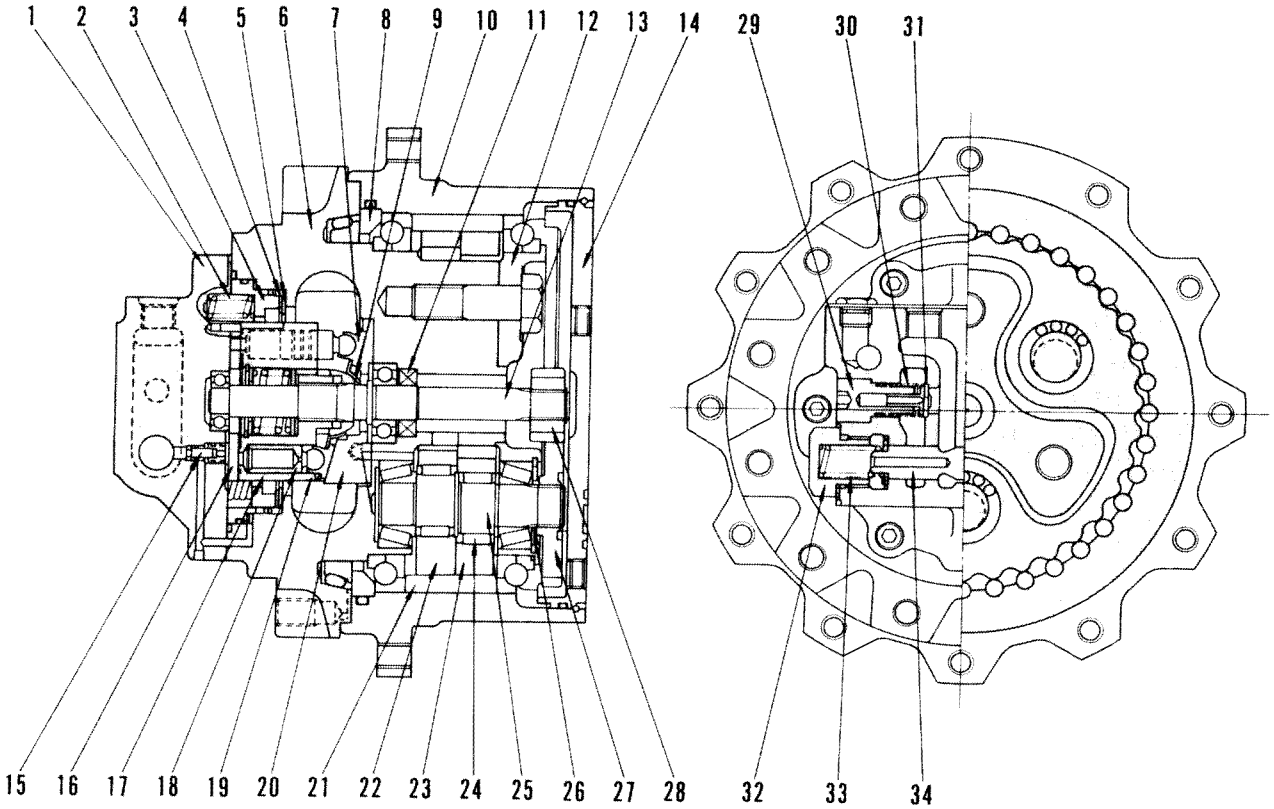
201F1027A

1. Brake valve
2. Spindle
3. Hub (case)
4. Oil filler plug
5. Drain plug

a. To tank (C_1 port)
b. From travel valve (A port)
c. From travel valve (B port)
d. To tank (C_2 port)

SPECIFICATIONS

Machine model		PC60-5	PC60L-5	PC60U-5
Type		GM08LII	GM09LII	GM08LII
Stroke capacity	(cc/rev)	34.8	34.8	34.8
Max. operating pressure	(kg/cm^2)	320	320	320
Reduction ratio		64.3	72	72
Parking brake cracking pressure	(kg/cm^2)	9	9	9



201F1028

1. Rear flange
2. Spring
3. Piston
4. Plate
5. Disk
6. Spindle
7. Shoe
8. Distance piece
9. Thrust ball
10. Hub (case)
11. Oil seal
12. Hold flange
13. Output shaft
14. Cover
15. Valve
16. Timing plate
17. Cylinder block
18. Piston
19. Retainer plate
20. Swash plate
21. Pin gear
22. RV gear
23. RV gear
24. Needle bearing
25. Crankshaft
26. Distance piece
27. Spur gear
28. Input gear
29. Plug
30. Check valve spring
31. Check valve
32. Plug
33. Spool selector spring
34. Counterbalance valve spool

REDUCTION GEAR

1. Function

The travel speed reduction section consists of a spur gearing in the No. 1 reduction unit and a differential gearing in the No. 2 reduction unit. High speed rotary motion from the hydraulic motor is decelerated and converted into a low-speed large torque which causes the hub (case) to rotate.

2. Operation

• No. 1 reduction

The rotary motion from the hydraulic motor is transmitted from input gear (28) in the No. 1 reduction unit to three spur gears (27) to slow down the travel speed.

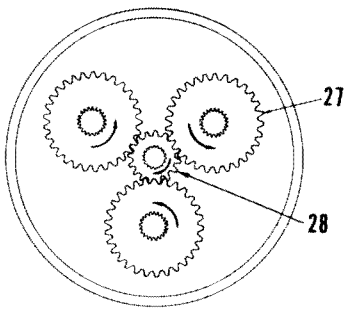
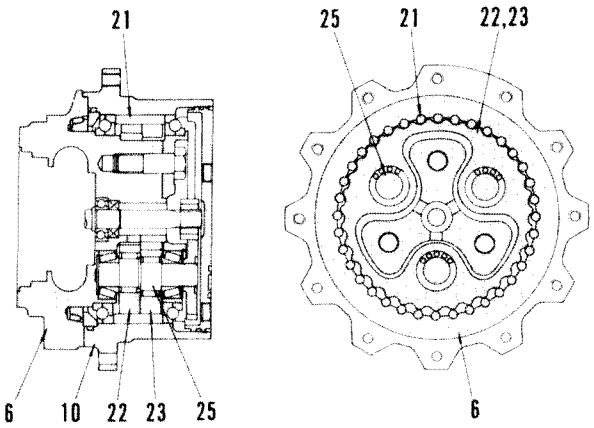


Fig. 1 20XF048A

• No. 2 reduction

The spur gears (27) are connected to their respective crankshafts (25), forming the input of the No. 2 reduction unit.
RV gears (22) and (23) are installed in bearings on the eccentric portions of the crankshafts. For this reason, the RV gears revolve in accordance with the crankshaft rotation and along pin gears (21) on the internal circumference of hub (10). At this time, the RV will try to rotate around the center while rotating on their own axes. However, they cannot revolve on their own axes because the crankshafts are supported on both ends with spindles (6). Thus, hub (10) rotates at a relatively slower speed.



201F1029

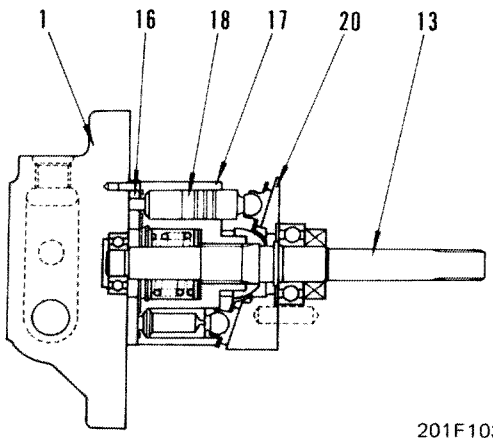
HYDRAULIC MOTOR

1. Function

This is a swash plate type axial piston hydraulic motor which converts the force of the pressurized oil delivered from a hydraulic pump into rotary motion.

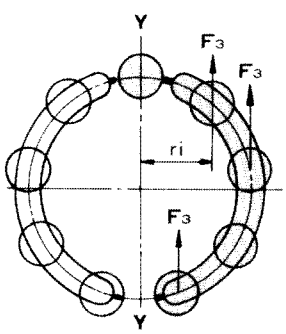
2. Principle of operation

The oil delivered from the hydraulic pump flows from timing plate (16) into the cylinder through brake valve (1).



201F1030

This oil is led into only one side of the Y–Y axis connecting the top and bottom dead centers in the stroke of piston (18). The pressurized oil flowing onto one side in cylinder block (17) pushes the respective pistons (18) (four or five pistons), generating force F_1 (F_1 kg = P kg/cm^2 x A cm^2).
This force acts on swash plate (20). However, the force is divided into components F_2 and F_3, because the swash plate is held stationary at angle (α°) to the output shaft (13).
Of these components, the radial component (F_3) generates torque ($T = F_3 \times ri$) with respect to the Y–Y axis connecting the top and bottom dead centers. The resultant force [$T = \Sigma(F_3 \times ri)$] rotates cylinder block (17) through the piston as the turning torque.
This cylinder block (17) is splined to the output shaft, and thus causes the output shaft to rotate. The output shaft, in turn, transmits the torque.



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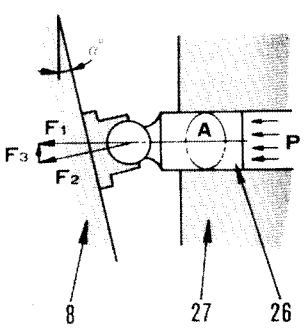
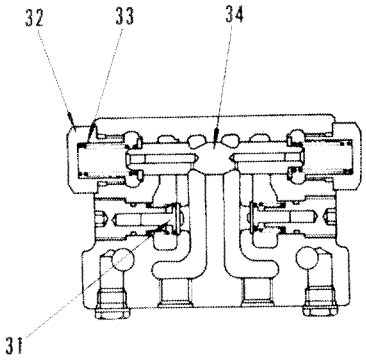


20XF053A

BRAKE VALVE

1. Function

1) When stopping the hydraulic motor, this valve controls the inertia force of the motor to continue rotation due to the inertia of the motor body. Thereby, the motor is smoothly braked until it stops.
2) Functions as a check valve to prevent caviation in the hydraulic motor.
3) Brake valves open ports to release parking brake while hydraulic motor is operating or close ports when stopping motor.



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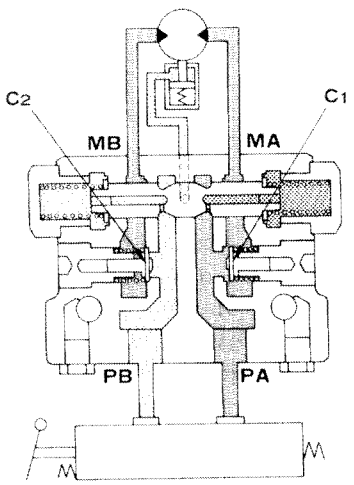
31. Check valve
32. Plug
33. Spool selector spring
34. Counterbalance valve spool

2. Operation

1) When starting to travel

- The oil from the pump is supplied to port **PA** through the control valve forcing check valve C_1 to open. Then, check valve C_1 allows the oil to flow from motor inlet port **MA** to motor outlet port **MB**.
  However, the motor outlet is closed with check valve C_2, causing the pressure in the oil supply section to go up.



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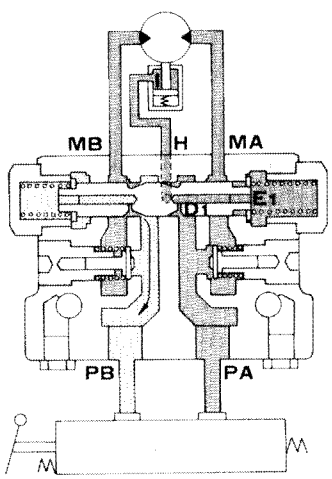
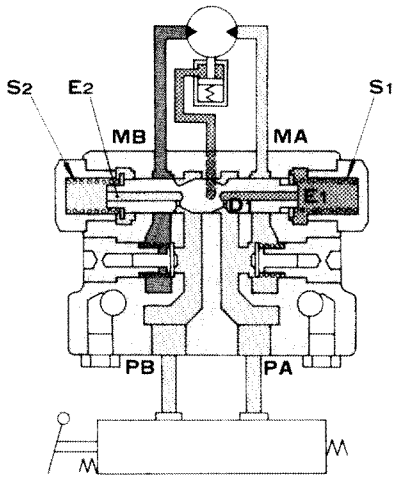
- The supplied oil also flows into chamber E_1 through the spool from throttle D_1, of the spool. When the oil pressure in chamber E_1 exceeds the spool switching pressure, the spool is pushed to the left, causing ports **MB** and **PB** to open to each other. Thus, the circuit for the motor output is opened.
  This, in turn, opens the motor output circuit. Since the spool is pushed to the left, outlet and inlet port **H** of the parking brake is also opened. Then, the oil flows into chamber **I** of the parking brake cylinder, pushing the piston to release the parking brake. Thus, the motor runs.



201F1034

2) Operating the brakes when traveling downhill

- If the machine is about to overrun while traveling downhill, the motor will rotate idly, reducing the oil pressure at the motor inlet, and, in turn, reducing the pressure in chamber E_1 through flow throttle D_1.
  If the differential pressure between chambers E_1 and E_2 is less than the spool switching spring force, the spool will return to the right by the force of spring S_2, and port **MB** for the output will be throttled. When throttled, the pressure at the outlet port will increase, generating resistance to the rotation of the motor. In this way, the overrunning of the machine is prevented.
- As described above, the motor regulates the travel speed in response to the delivery of the pump.
- When the machine stops traveling, the motor tries to continue rotation due to inertia and tries to suck in oil by pumping action. However, the oil circuit is closed, so it is impossible to supply oil. As a result, cavitation will occur, causing damage to the motor. Consequently, check valves C_1 and C_2 are set to work under even the smallest negative pressure, thereby preventing cavitation in the motor.



201F1035

PARKING BRAKE

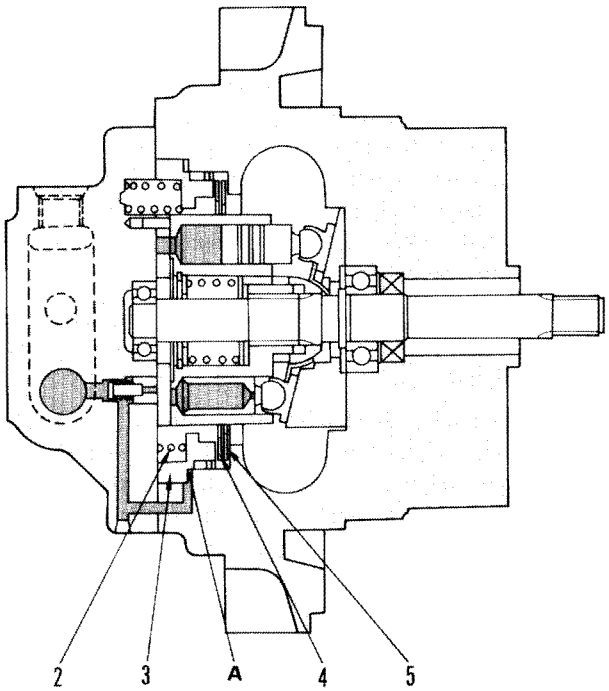
1. Function

A friction plate brake is used to prevent the machine from running away or slipping when parked or stopped on a slope.

2. Operation

1) Starting to travel

When the travel levers are put in the travel position, the oil from the pump flows to the motor. At the same time, it acts on the spool of the brake valve, and opens the circuits to the parking brake. It also flows to chamber **A** in the cylinder which is formed by the inside face of the spindle of the reduction gear and piston (3). When the pressure in chamber **A** goes above 9 kg/cm^2, it pushes back spring (2) and moves piston (3). When the piston moves, the force pushing plates (4) and disc (5) is removed. As a result, discs (5) which are fitted inside the cylinder of the motor are free to move and the brake is released.



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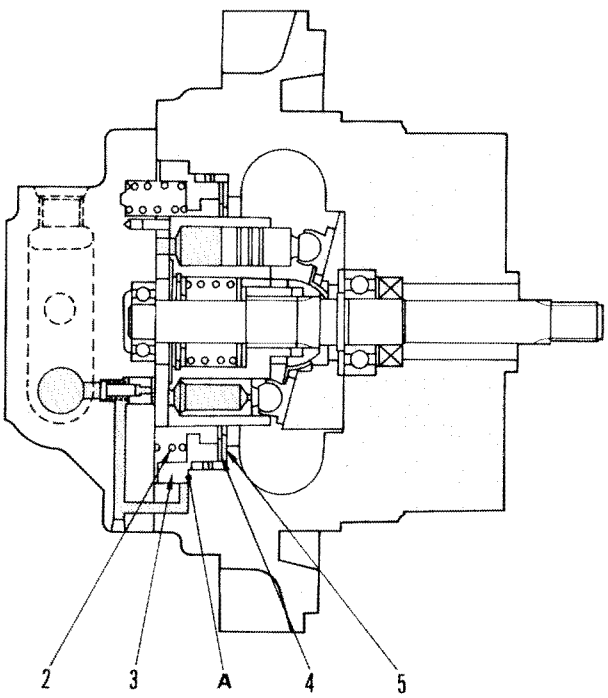
2) Stopping

When the travel levers are returned to neutral, the flow of oil to the brake valve and motor is shut off. When the pressure in chamber **A** in the cylinder drops below 9 kg/cm^2, the force of spring (2) pushes back piston (3).

Because of the force of the spring pushing piston (3), plates (4) and discs (5) can no longer move freely, and are pushed against the spindle of the reduction gear.

The friction generated when the discs are pushed against the spindle stops the rotation of the cylinder and applies a braking torque (7.8 kgm) to the shaft of the motor.



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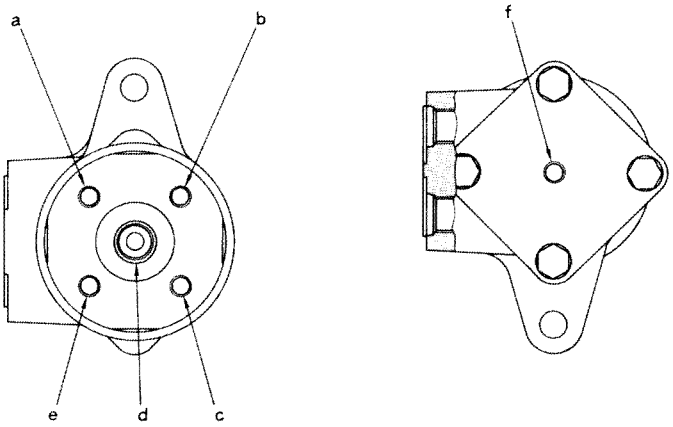
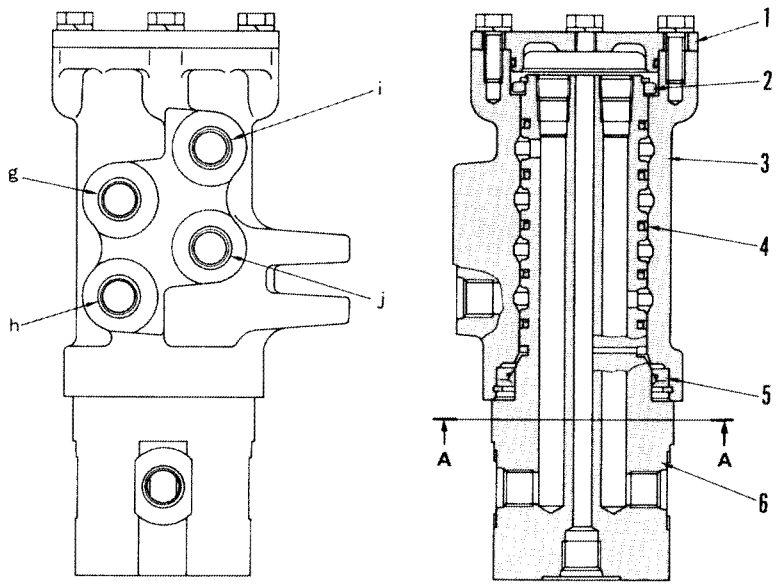
CENTER SWIVEL JOINT



Section A – A

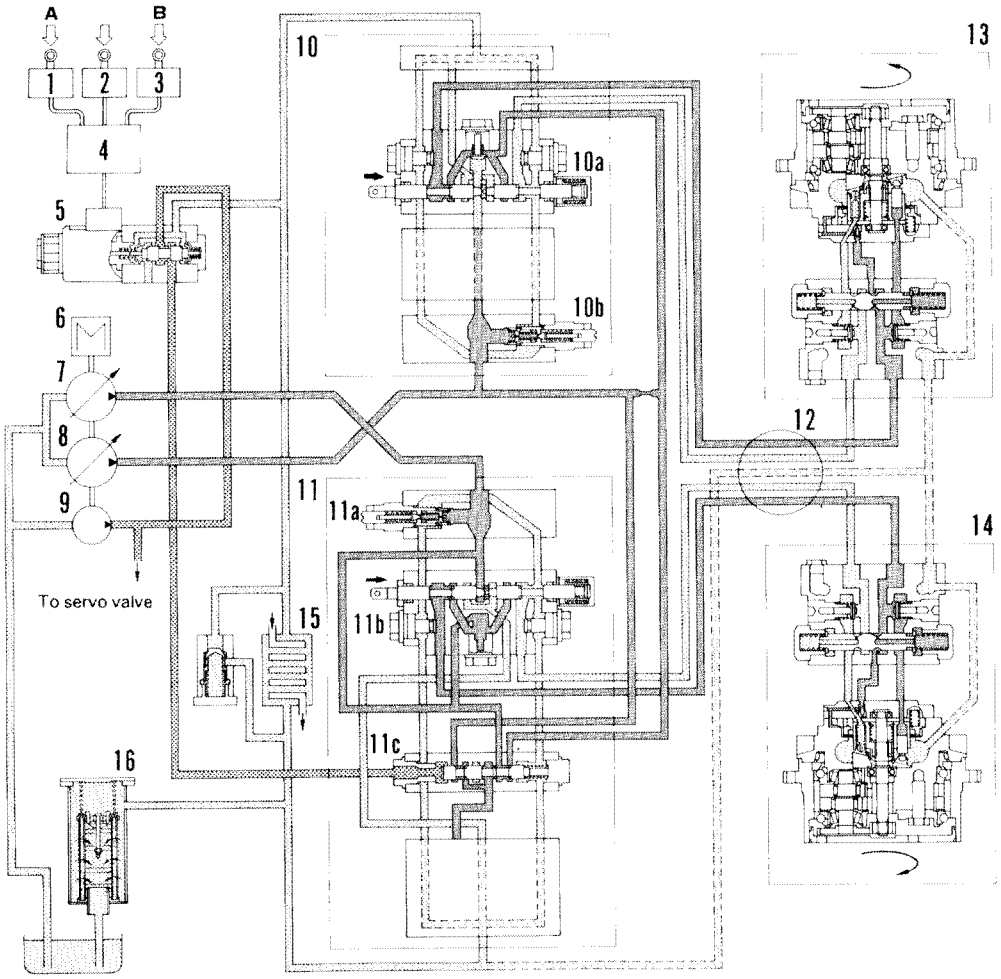


201F5030

1. Cover
2. Plate
3. Body
4. Slipper seal
5. Dust seal
6. Shaft

a. To R.H. travel motor A port (D port)
b. To R.H. travel motor B port (C port)
c. To L.H. travel motor A port (A port)
d. From L.H. and R.H. travel motor drain
e. To L.H. travel motor B port (B port)
f. To hydraulic tank
g. From R.H. travel valve B_1 port (C port)
h. From L.H. travel valve B_6 port (A port)
i. From R.H. travel valve A_1 port (D port)
j. From L.H. travel valve A_6 port (B port)

STRAIGHT TRAVEL SYSTEM



201F5031-1

When the machine is taveling, if the swing, boom, arm or bucket are operated, they actuate limit switches (1) and (3), which are set on the linkage between the control lever and the control valve.

The electric signal from limit switches (1) and (3) sends an electric current from the controller to solenoid valve (5), and solenoid valve (5) is switched.

When this happens, the pressurized oil passing through solenoid valve (5) from charging pump (9) acts on straight travel valve (11c).

When straight travel valve (11c) is switched, the independent left and right travel circuits are interconnected, and the oil supplied to left and right travel motors (13) and (14) is made equal.

As a result, the rotation speed of left and right travel motors (13) and (14) is the same, and the machine is kept traveling in a straight line.

1. Limit switch (for swing)
2. Limit switch (for travel)
3. Limit switch (for work equipment)
4. Controller
5. Solenoid valve for straight travel
6. Engine
7. Front main pump
8. Rear main pump
9. Charging pump
10. L.H. 6-spool control valve

10a. Main relief valve

10b. L.H. travel control valve

11. R.H. 5-spool control valve

11a. Main relief valve

11b. R.H. travel control valve

11c. Straight travel valve

12. Center swivel joint
13. L.H. travel motor
14. R.H. travel motor
15. Oil cooler
16. Hydraulic filter

A. From swing control lever

B. From work equipment control lever

STRAIGHT TRAVEL VALVE

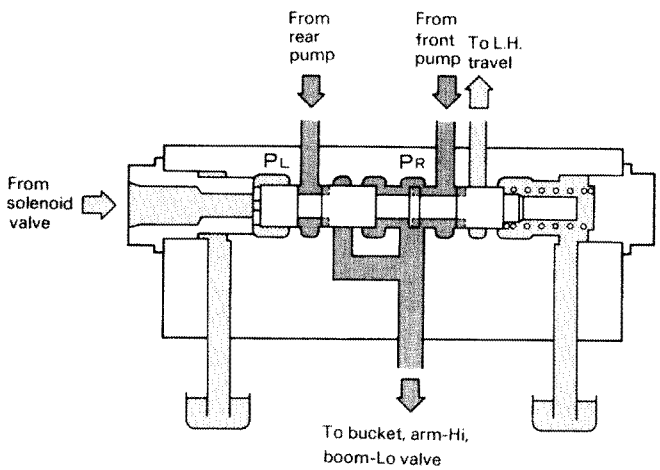
FUNCTION

- When traveling while operating the swing, boom, arm, or bucket, the hydraulic oil flowing to the R.H. and L.H. travel circuits branches into the swing, boom, arm, or bucket circuit.
  Since the supply of hydraulic oil in a branched travel circuit is less than that in the circuit before the branch, the motor naturally slows down, resulting in a turn.
- This undesired turning, therefore, is prevented by equalizing the supply of hydraulic oil to the R.H. and L.H. travel motors so that they rotate at the same speed. At the same time, the straight travel valve is switched over to establish continuity between the R.H. and L.H. travel circuits.

OPERATION

When traveling only:

- Since no signal current flows from the limit switch through the controller, no pilot hydraulic oil flows from the solenoid valve to the straight travel valve.
- Therefore, the circuit between port P_R (R.H. travel circuit) and port P_L (L.H. travel circuit) remains closed and both circuits remain independent.



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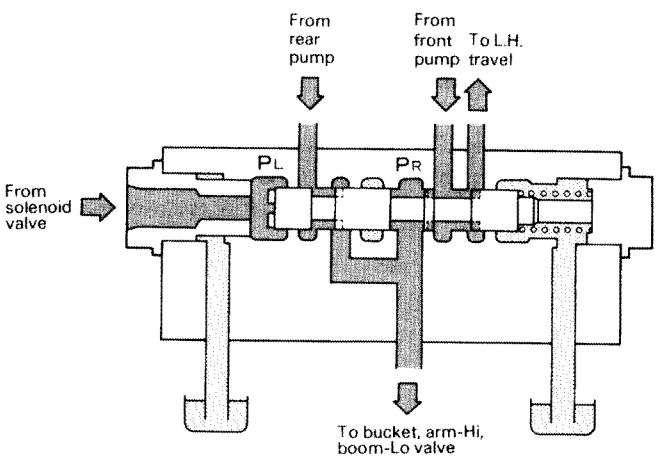
When performing simultaneous operation:

- When operating the swing, boom, arm, or bucket while traveling, the pilot hydraulic oil flows from the solenoid valve into the spool end in the straight travel valve, pushing the spool to the right.
- Port P_R and port P_L then become connected to each other and an equal amount of hydraulic oil is supplied to the R.H. and L.H. travel motors, allowing both motors to rotate at the same speed. A deviation in travel is thus prevented.



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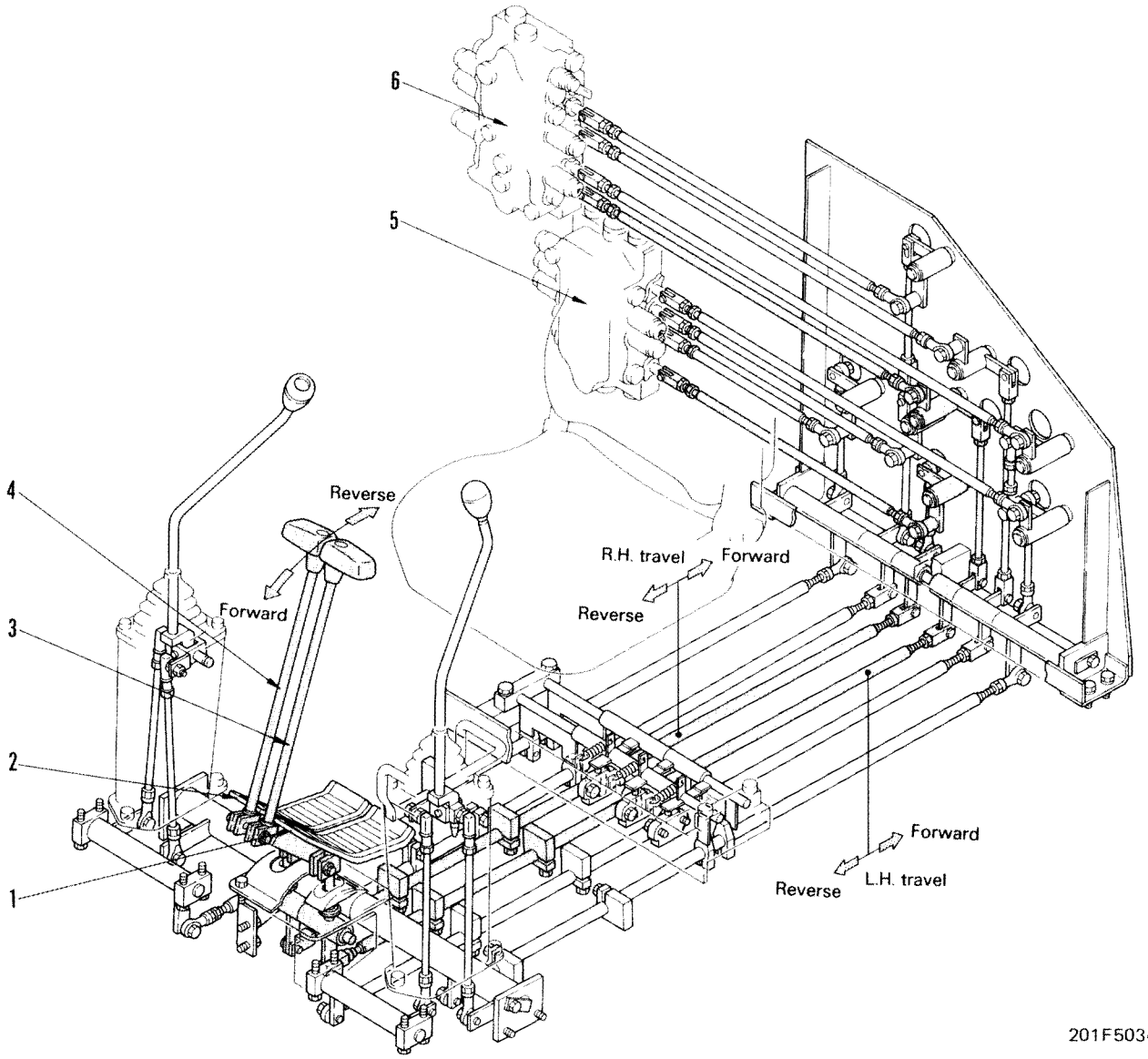
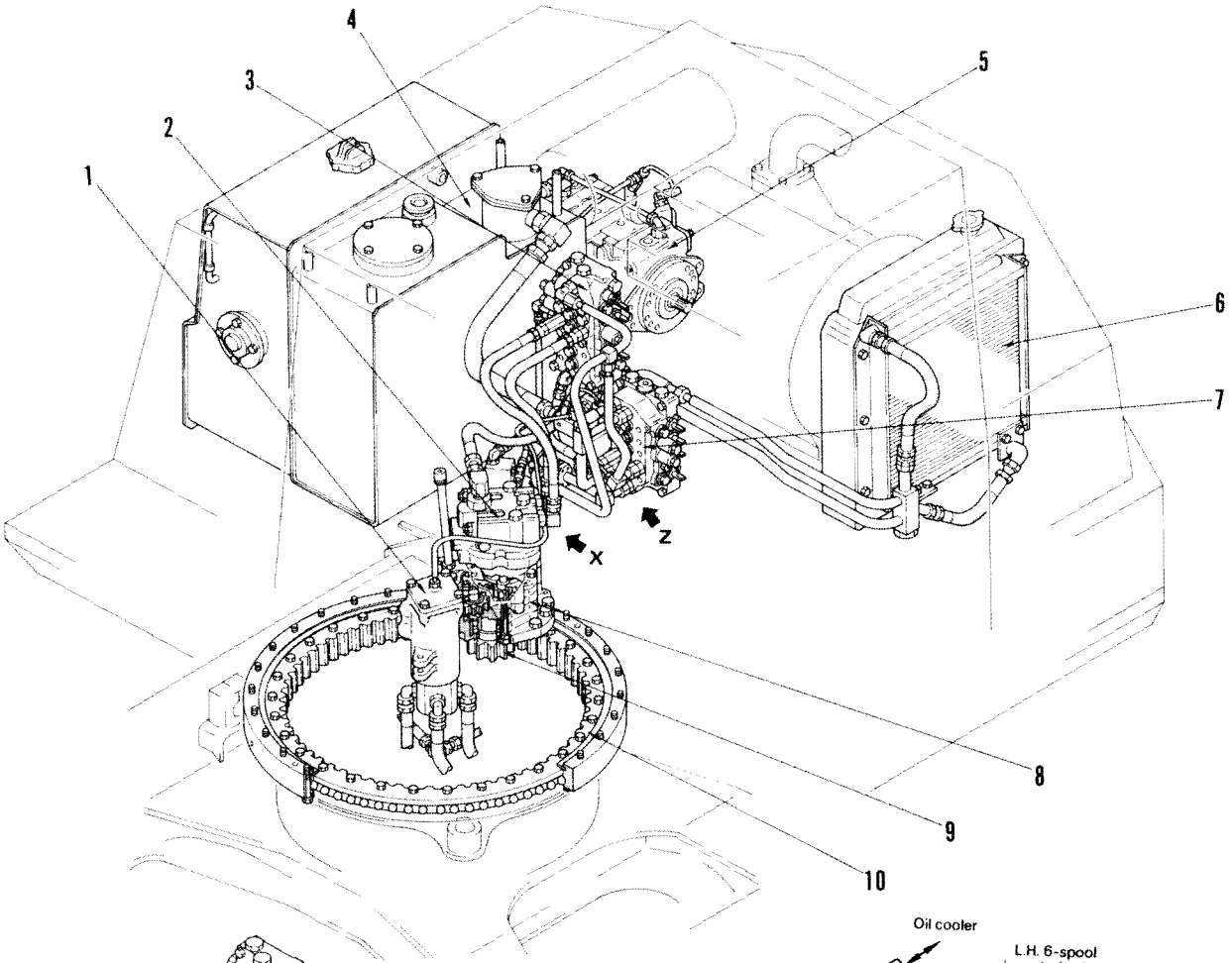
TRAVEL CONTROL

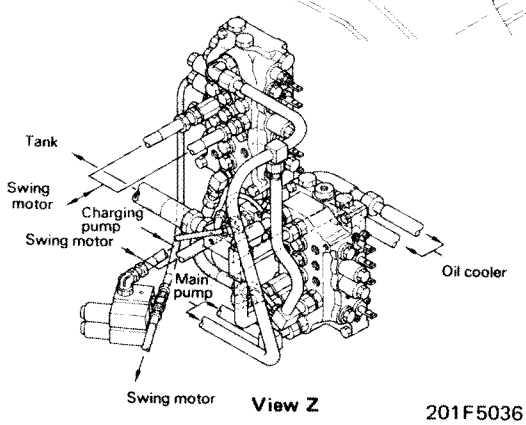


- The machine is equipped with travel control levers and travel pedals. The travel control levers are inserted in the boss of the travel pedals, and can be removed easily. The travel pedals are also inserted into a pin which protrudes from the bottom of the floor plate, so the travel pedals can also be removed easily.

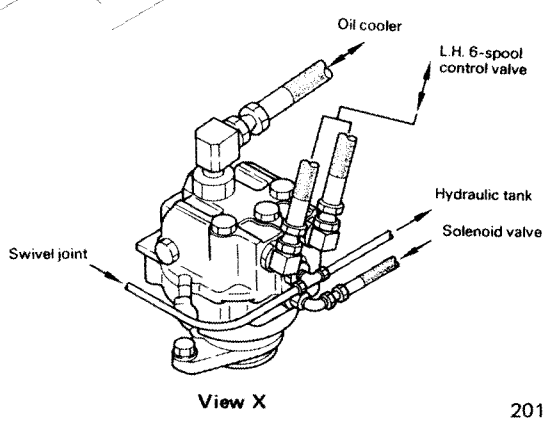
1. L.H. travel pedal
2. R.H. travel pedal
3. L.H. travel control lever
4. R.H. travel control lever
5. R.H. 5-spool control valve
6. L.H. 6-spool control valve

SWING SYSTEM





View Z 201F5036

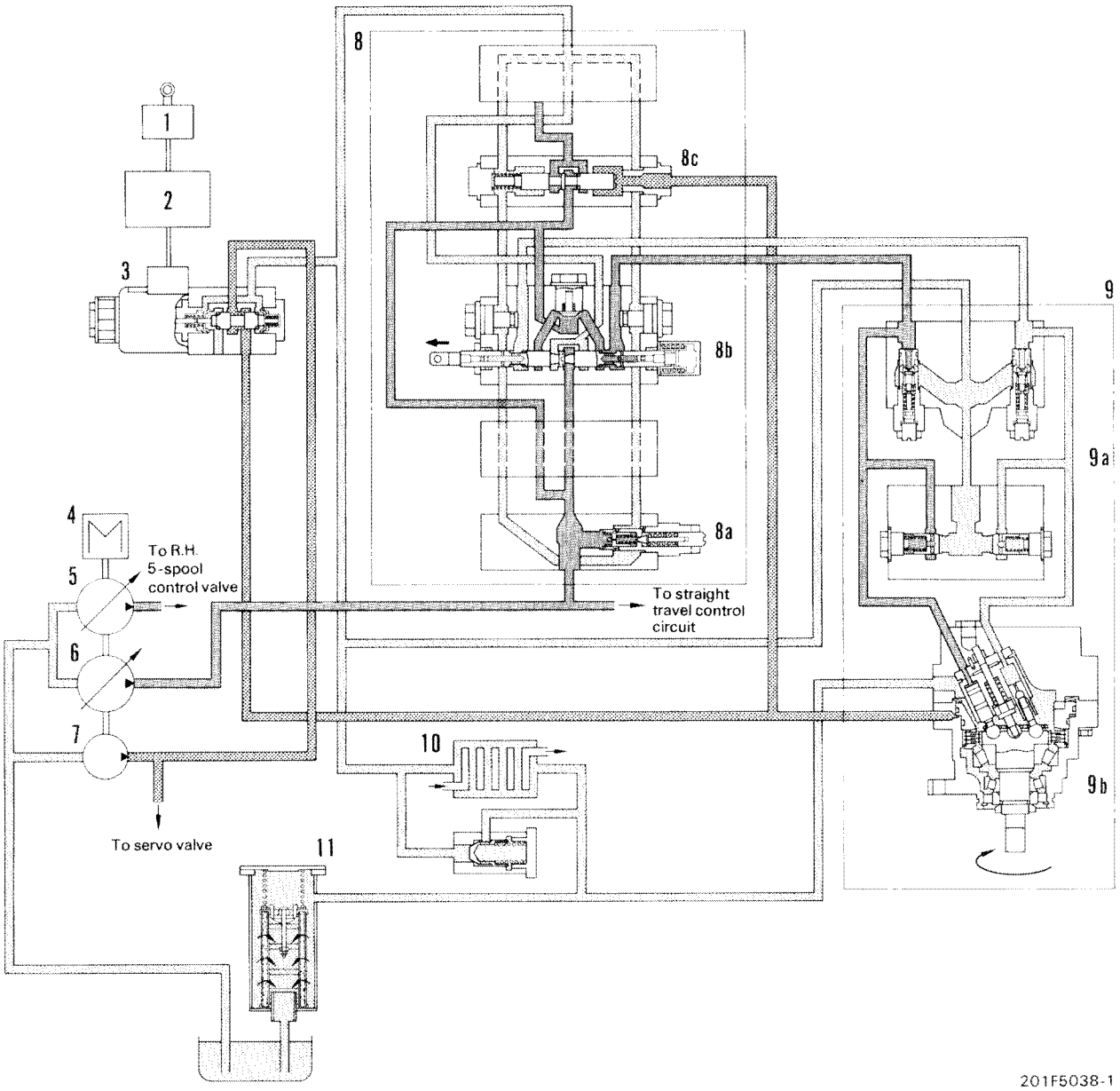


View X 201F5037

- The excavator has a swing mechanism which allows the work equipment to swing 360 degrees. Thus digging work and loading of dump trucks can be done without moving the machine.
  The swing mechanism consists of swing motor (2) which rotates the upper structure, reduction gears (swing machinery) (8), swing circle (10), and center swivel joint (1) through which the hydraulic oil is delivered from the revolving upper structure to the undercarriage.

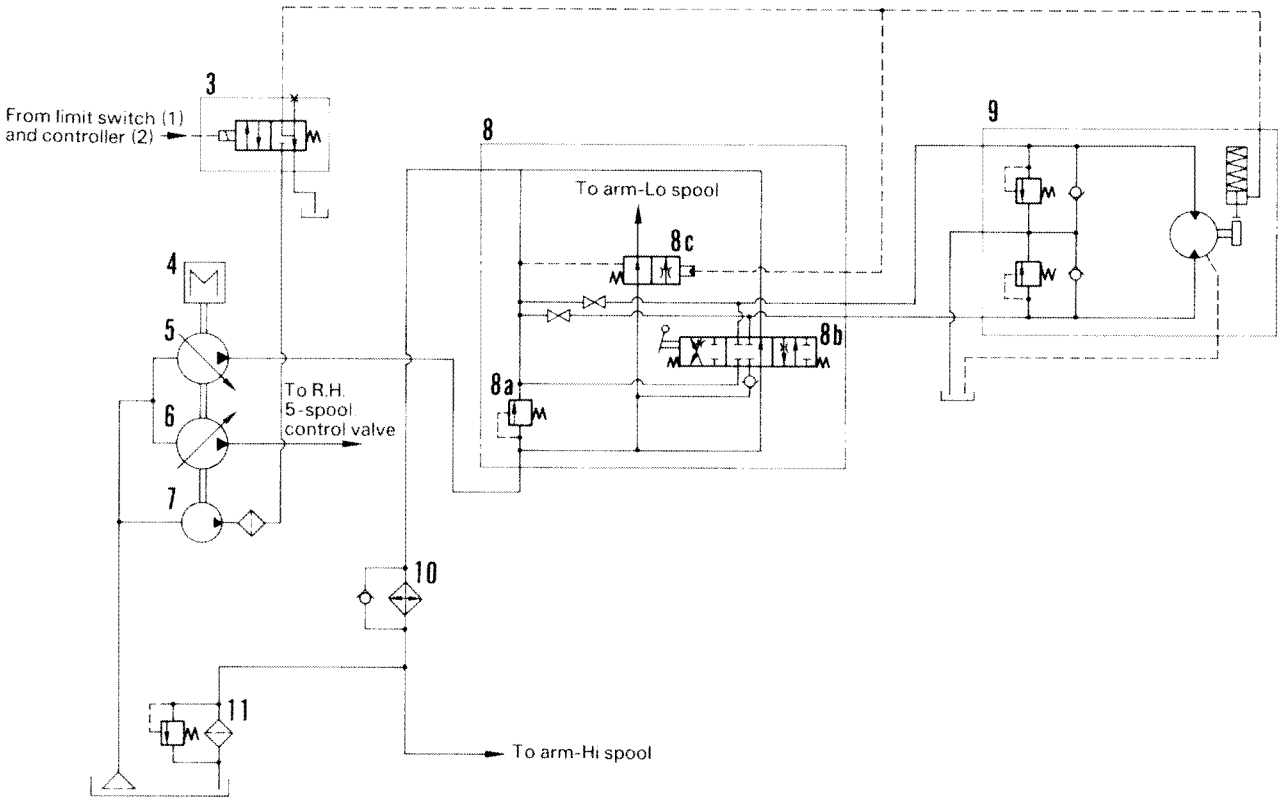
1. Center swivel joint
2. Swing motor
3. L.H. 6-spool control valve
4. Hydraulic tank
5. Main pump
6. Oil cooler
7. R.H. 5-spool control valve
8. Swing machinery
9. Swing pinion
10. Swing circle

SWING CONTROL CIRCUIT SCHEMATICS



1. Limit switch (for swing)
2. Controller
3. Solenoid valve for swing mechanical brake
4. Engine
5. Front main pump
6. Rear main pump
7. Charging pump
8. L.H. 6-spool control valve
8a. Main relief valve
8b. Swing control valve
8c. Swing priority valve
9. Swing motor assembly
9a. Brake valve
9b. Swing motor
10. Oil cooler
11. Hydraulic filter

SWING CONTROL CIRCUIT



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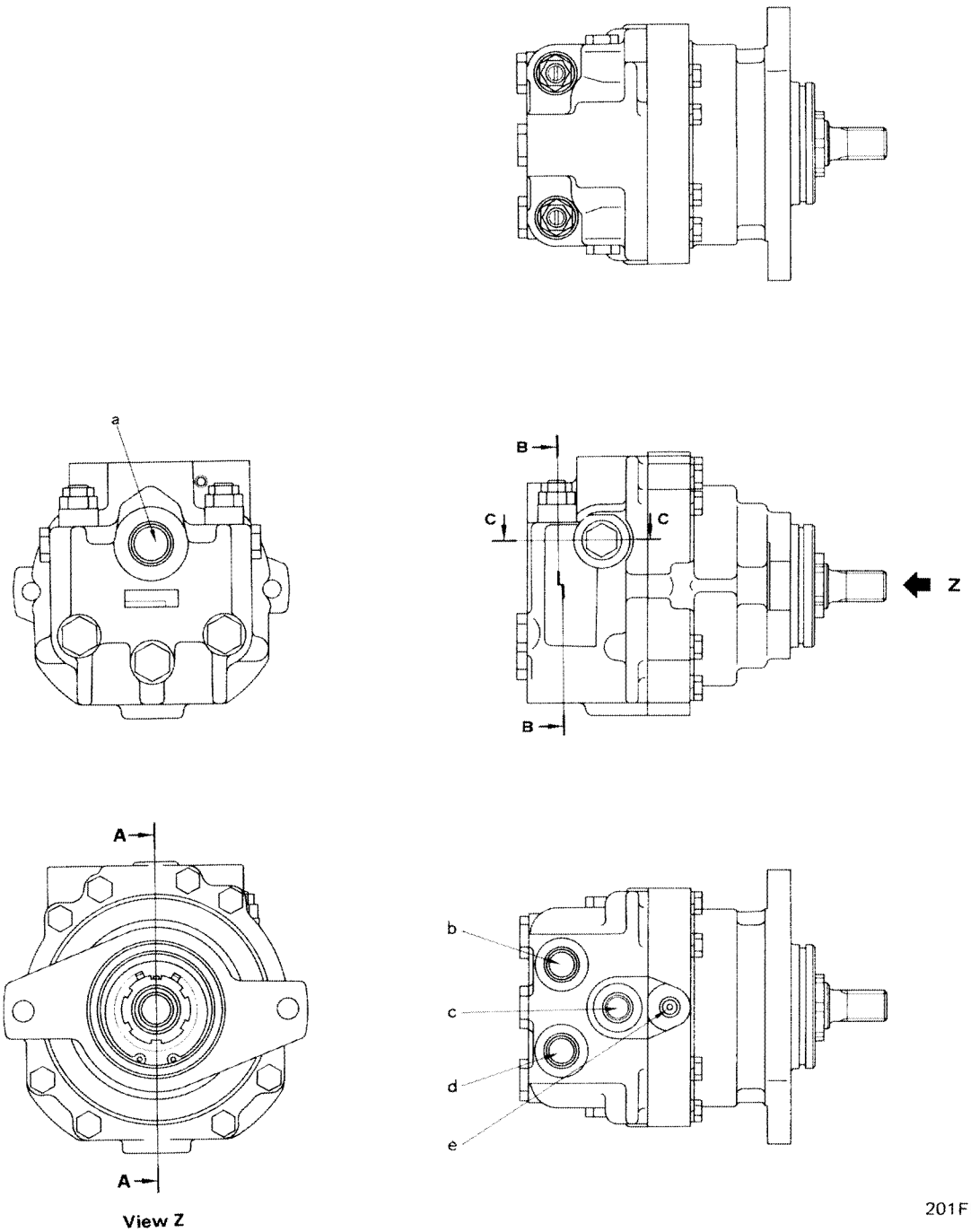
1. Limit switch (for swing)
2. Controller
3. Solenoid valve for swing mechanical brake
4. Engine
5. Front main pump
6. Rear main pump
7. Charging pump
8. L.H. 6-spool control valve
8a. Main relief valve
8b. Swing control valve
8c. Swing priority valve
9. Swing motor assembly
9a. Brake valve
9b. Swing motor
10. Oil cooler
11. Hydraulic filter

SWING MOTOR AND BRAKE VALVE



View Z

201F5039

SPECIFICATIONS

- Type: KMF40DL
- Stroke capacity: 40.2 cc/rev
- Max. operating pressure: 230 kg/cm^2
- Parking brake cracking pressure: 13 kg/cm^2

a. To hydraulic tank (S port)

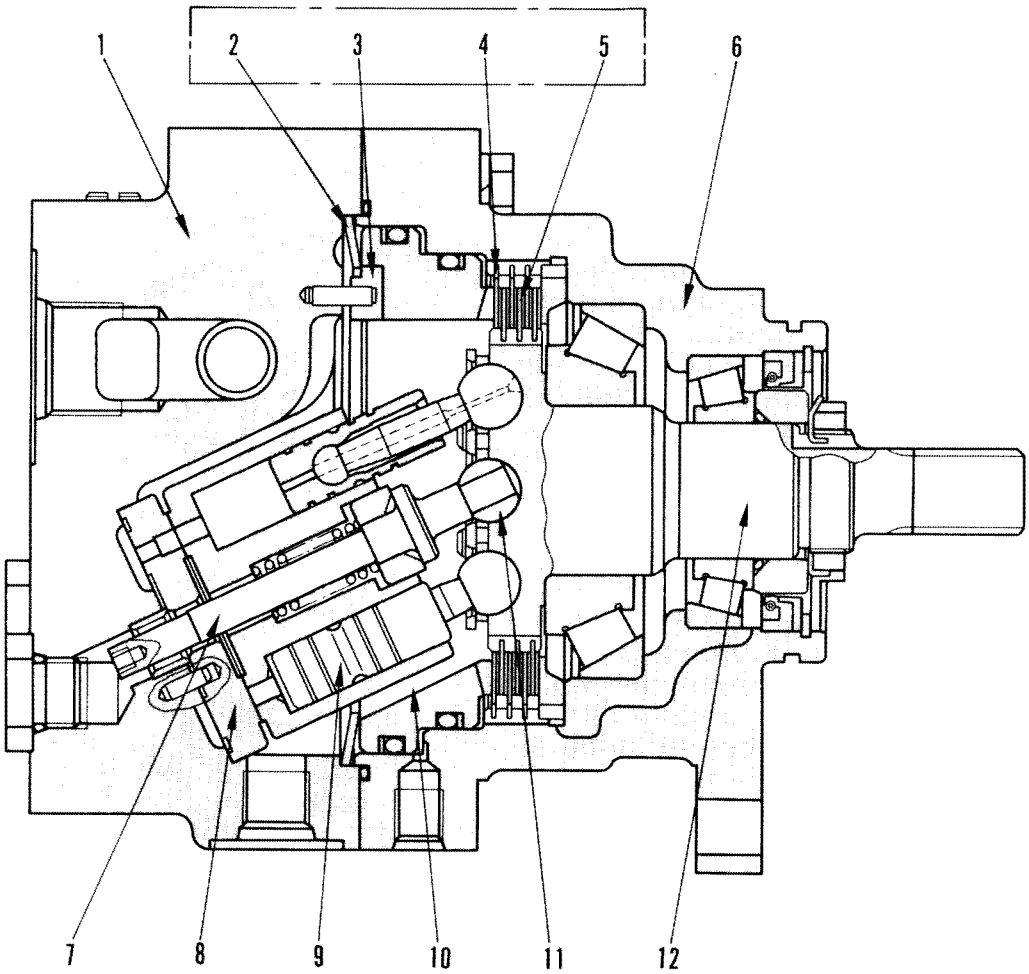
b. From swing valve A_3 port (MA port)

c. From swing valve B_3 port (MB port)

d. To hydraulic tank (T port)

e. From swing mechanical brake solenoid valve A port

1. SWING MOTOR



Section A—A

201F5040

1. Housing
2. Brake spring (belleville spring)
3. Brake piston
4. Plate
5. Disk
6. Brake case
7. Center shaft
8. Valve plate
9. Piston
10. Cylinder block
11. Center ball
12. Output shaft

Note:

⬚: Parts No. 2, 3, 4, and 5 are for machines equipped with swing mechanical brake and plug is installed in port **e**.

Operating principle

In Fig. 1, a disc shaft is carried on bearings so that the disc is free to rotate. If force F is applied diagonally to this disc, the force F is divided into the components of force, F_1 (force perpendicular to the disc) and F_2 (circumferential force of the disc). F_1 pushes the disc in its axial direction and F_2 rotates the disc clockwise. If force F' is applied to the disc, the force F' is similarly divided into the components, F'_1 and F'_2, F'_2 rotates the disc counterclockwise.

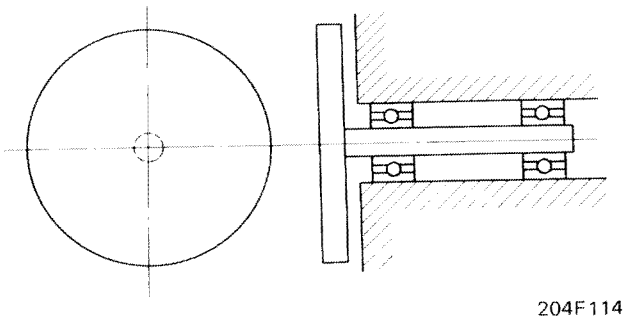


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Fig. 1

Outline of construction

The construction of the swing piston motor is shown on the preceding page. In Fig. 3, seven pistons are installed on disc-like spherical joints. The pistons are fitted in a cylinder block, and keep set angles to the output shaft. The cylinder block and valve plate are guided by a center rod. The cylinder block is free to rotate on the center rod shaft and the valve plate is secured to the base plate with a pin.

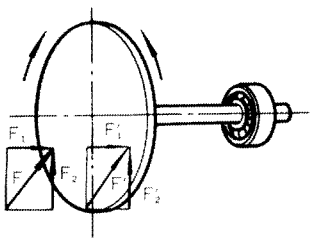
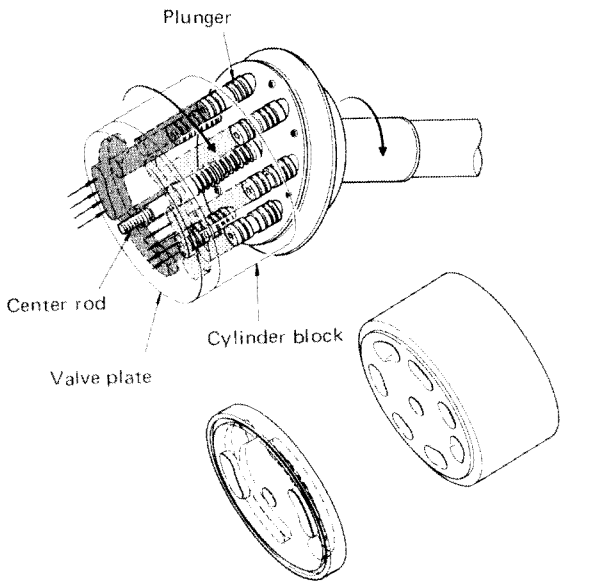


Fig. 2

204F115

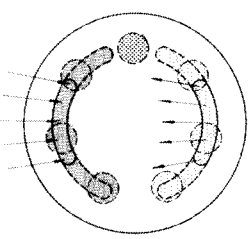
Function

Refer to Fig. 4. When oil flows into the L.H. ports and out of the R.H. ports in the valve plate, the oil pressure is applied to the rear sides of the pistons leading to the L.H. ports, causing the output shaft to rotate clockwise as described in the paragraph concerning the operating principle. In this case, the pistons rotate clockwise together with the cylinder block at the same speed as the output shaft, while sliding through the cylinder block. Then, the pistons reach the ports on the outlet side in the valve plate, passing the uppermost point of the output shaft. When the pistons reach the outlet ports', the pressure on the pistons back sides is relieved, eliminating the force on the output shaft. Then the pistons are rotated by the output shaft and allowed to slide through the cylinder block. The oil on the pistons backsides is drained to the tank. The above mentioned movements are followed by all seven pistons and the output shaft rotates clockwise. If the oil inlet and outlet ports are used in the reverse way, the above movements are made oppositely, causing the output shaft to rotate counterclockwose.



204F116

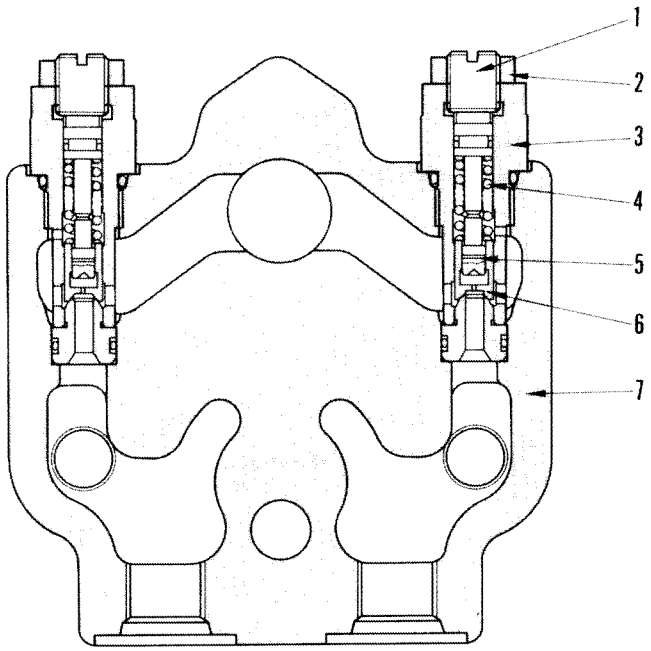
Fig. 3



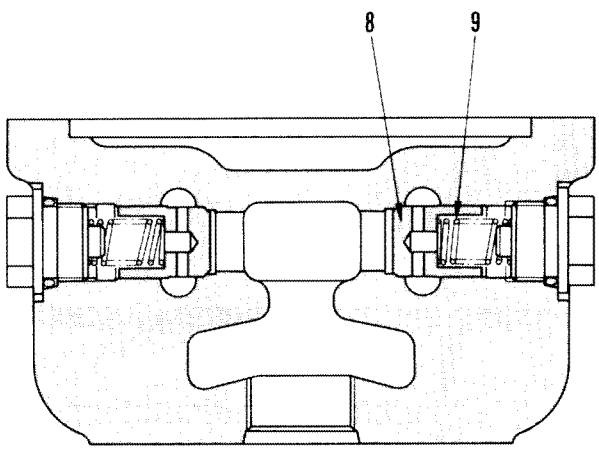
204F117

Fig. 4

2. SAFETY VALVE



Section B – B



Section C – C

201F5041

Safety valves consists of check valve and safety valve.

- Setting pressure: 230 kg/cm^2 (at 60 ℓ/min.)

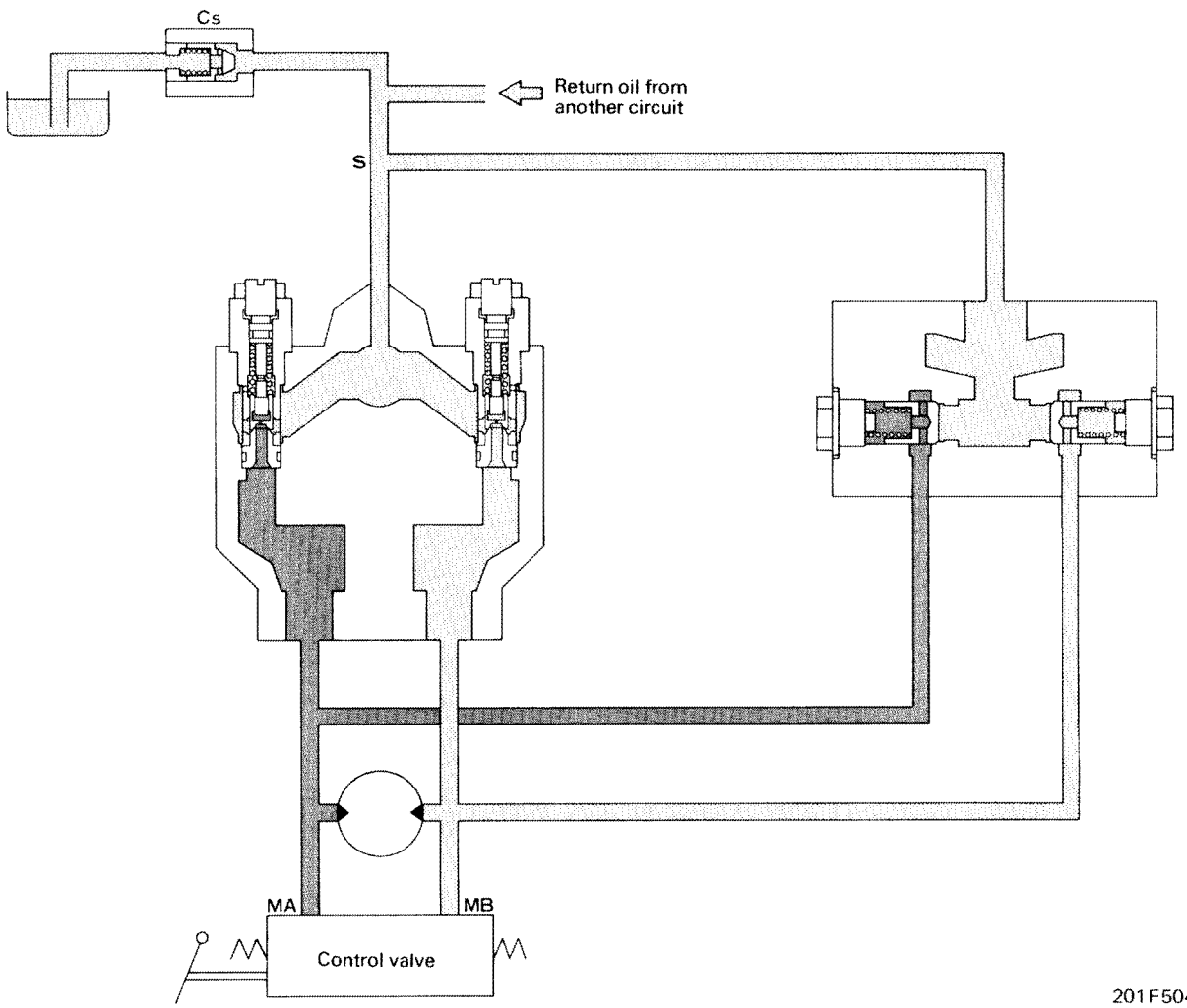
1. Adjustment screw
2. Lock nut
3. Sleeve
4. Safety valve poppet spring
5. Pilot piston
6. Safety valve poppet
7. Housing
8. Check valve
9. Check valve spring

FUNCTION

- When swing operation is stopped, the outlet circuit of the swing motor is closed by the swing control valve. However, the swing motor keep running by the force of inertia, causing the pressure in the swing motor outlet circuit to go too high. This causes damage to the swing motor. To prevent such damage, this excessively high pressure oil of the motor outlet side must be relieved to the motor inlet side (low pressure side).
- Compared with a counterbalance valve type (equipped to traveling circuit), the safety valve type does not allow the pressure to be trapped in the outlet circuit when swinging is slowed down.
  Consequently, no rattle occurs during deceleration, resulting in improved control of swinging.

OPERATION

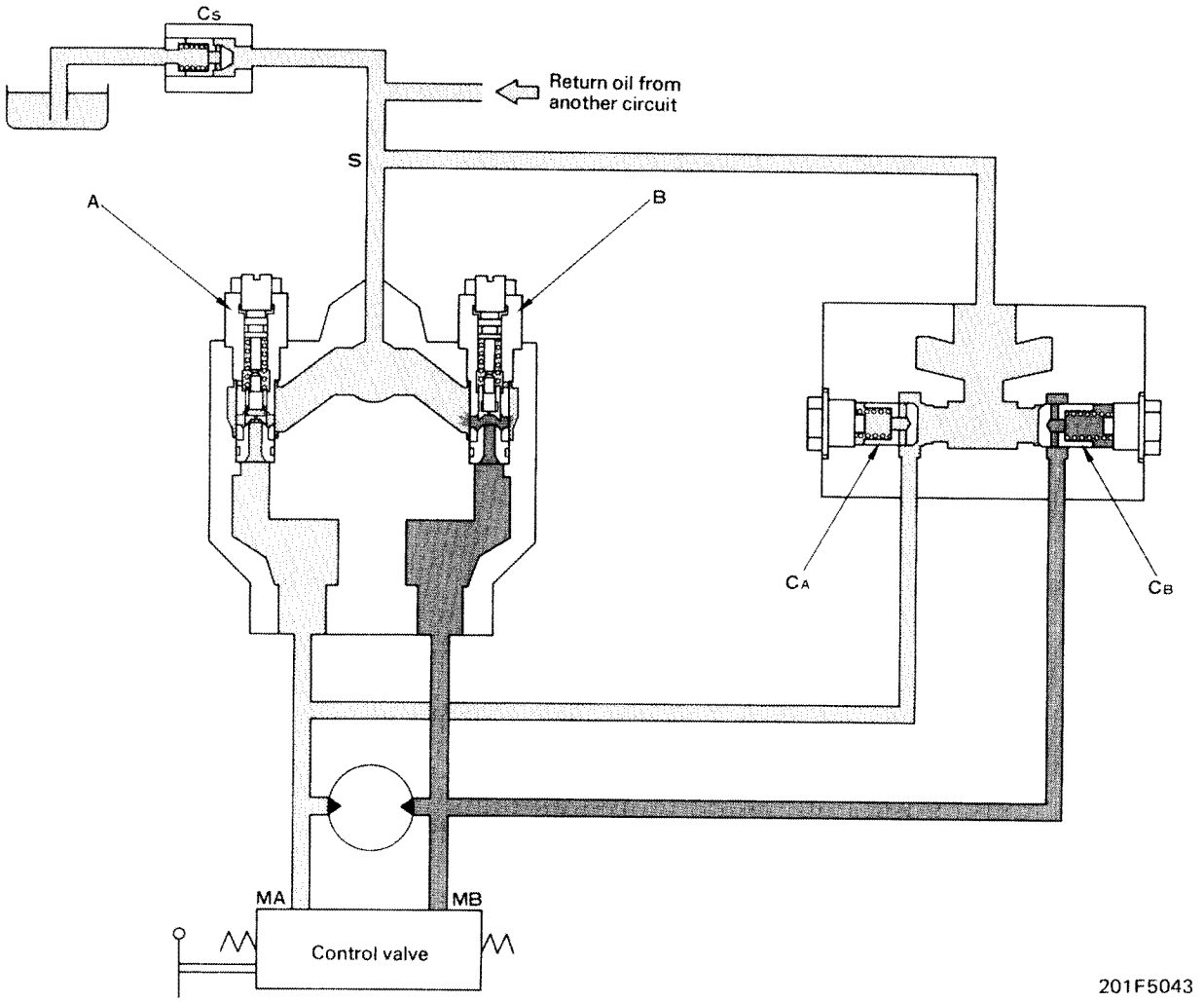
1. When starting to swing



201F5042

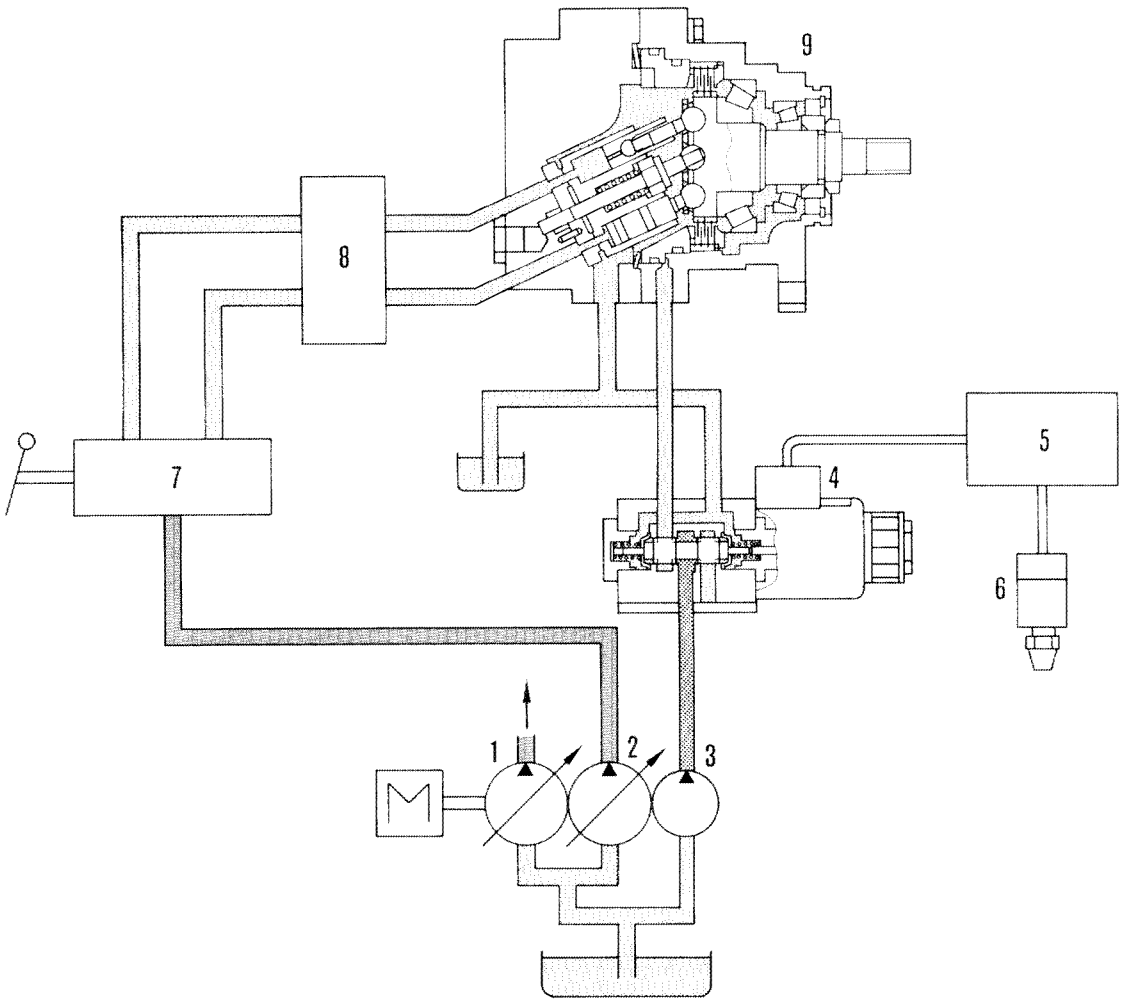
- When the swing control lever is placed in "SWING RIGHT", position the pressurized oil from the front main pump flows to port **MA** through the swing control valve.
- Thereby, the pressure at port **MA** goes up and driving torque is generated in the motor, causing the motor to start running.
- The oil from the motor outlet flows from port **MB** back to the tank through the control valve.

2. **When stopping to swing**



- When the swing control lever is returned in "NEUTRAL" position, the pressurized oil from the front main pump does not flow to port **MA**.
- Since the motor outlet drain circuit to the tank is closed by the control valve, the oil pressure at port **MB** in the motor outlet goes up, and produced rotational resistance against the motor. This starts to apply the brake.
- The oil pressure at port **MB** goes up to the set pressure of safety valve **B** and the high brake torque acts on the motor, causing the motor to stop.
- While safety valve **B** is functioning, the relief oil from safety valve **B** and the oil from port **S** are supplied through check valve C_A to port **MA**.
- At this time, the pressure of the return oil from the other circuit is kept constant (low pressure) by check valve C_S. Thus, the suction performance of check valve C_A is insured, preventing the occurrence of cavitation in port **MA**.

SWING MECHANICAL BRAKE (If equipped)



OUTLINE

- When the swing mechanical brake is installed, there is no problem of the work equipment swinging to the side under its own weight when the machine is stopped on a slope with the swing lever at neutral.
- When the swing lever is placed in neutral, the mechanical brake is applied 5 seconds later; when the lever is operated, the mechanical brake is released immediately.

1. Front main pump
2. Rear main pump
3. Charging pump
4. Solenoid valve
5. Controller (Timer)
6. Limit switch (For swing)
7. Swing control valve
8. Safety valve
9. Swing motor

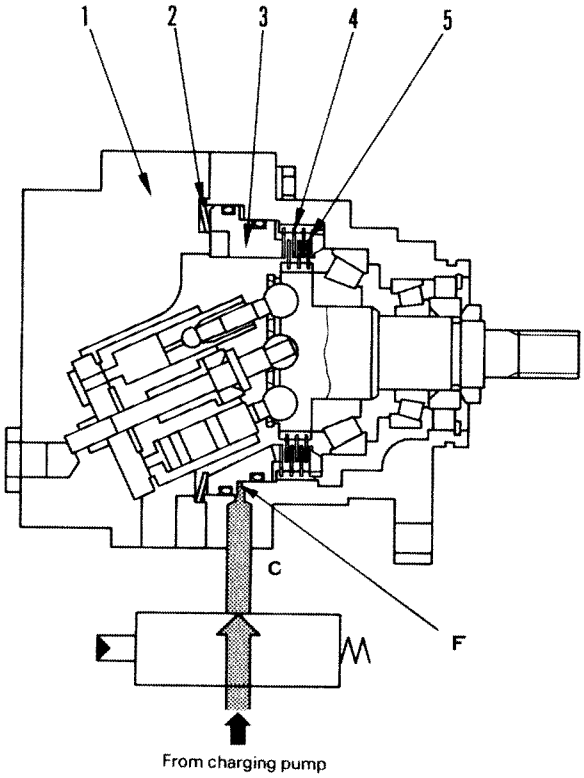
OPERATION

- **When operating swing control lever**

  When the swing control lever is operated, the limit switch installed in the link system is actuated, sends an electric signal to the controller, and electric current flows to the solenoid valve.

  When this happens, the solenoid valve is switched, and the pressurized oil from the charging pump passes through the solenoid valve, enters port **C**, and flows into swing brake pressure chamber **F**. The oil entering chamber **F** overcomes the force of brake spring (2) and pushes brake piston (3).

  When this happens, the swing brake is released, and the motor starts to turn.



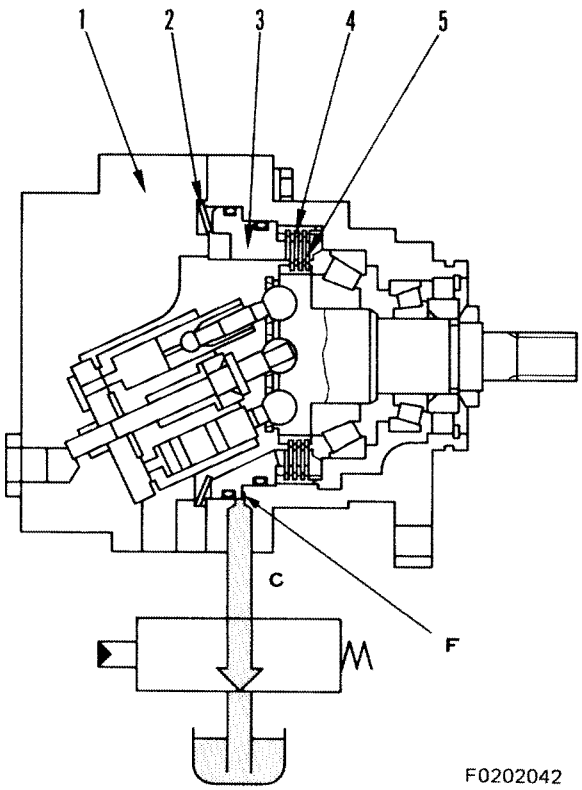
F0202041

- **Swing control lever at neutral**

  When the swing control lever is returned to neutral, the limit switch returns to its original position (OFF). 5 seconds after the limit switch goes OFF, the timer inside the controller also goes off, and the solenoid valve is switched.

  When this happens, no more pressurized oil comes from the charging pump to port **C**, and port **C** is connected to the tank.

  As a result, the pressure inside swing brake pressure chamber **F** drops, brake piston (3) is pushed back by brake spring (2), and plate (4) and disc (5) are pushed together to apply the brake.



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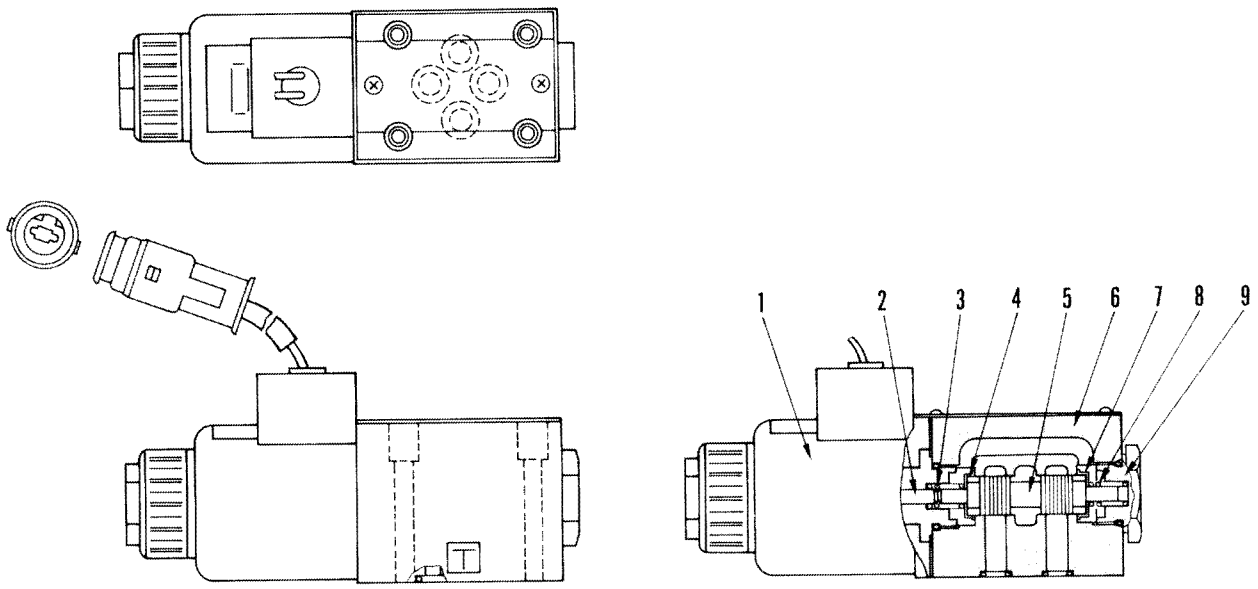
SOLENOID VALVE



F0202017

FUNCTION

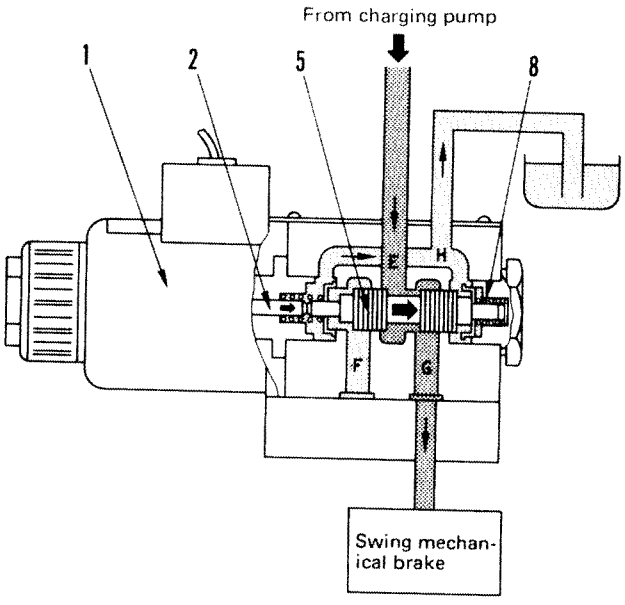
- The solenoid valve is operated by an electric signal sent from the limit switch (which is interlocked with the swing control lever) and release the oil flow from the charging pump for swing control valve.

1. Solenoid assembly
2. Push-pin
3. Spring
4. Spring retainer
5. Spool
6. Valve body
7. Spring retainer
8. Spring
9. Plug

OPERATION

1. Swing control lever in OPERATION

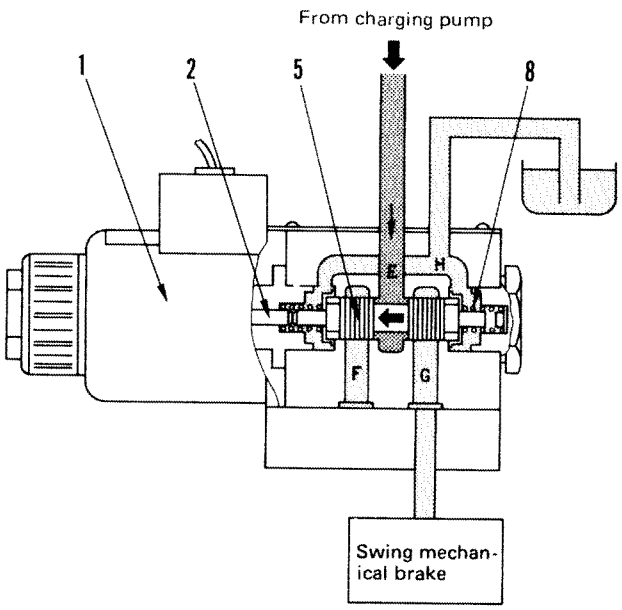
If the control levers are set to OPERATION the limit switch which interlocks with them will be operated to excite solenoid (1), then push-pin (2) will push spool (5) in the direction of the arrow (➡) to close ports **E** and **F** and open ports **F**, **H**, **E**, and **G**. As a result, the oil from the charging pump flows from port **E** to **G** to release the swing mechanical brake.



F0202018

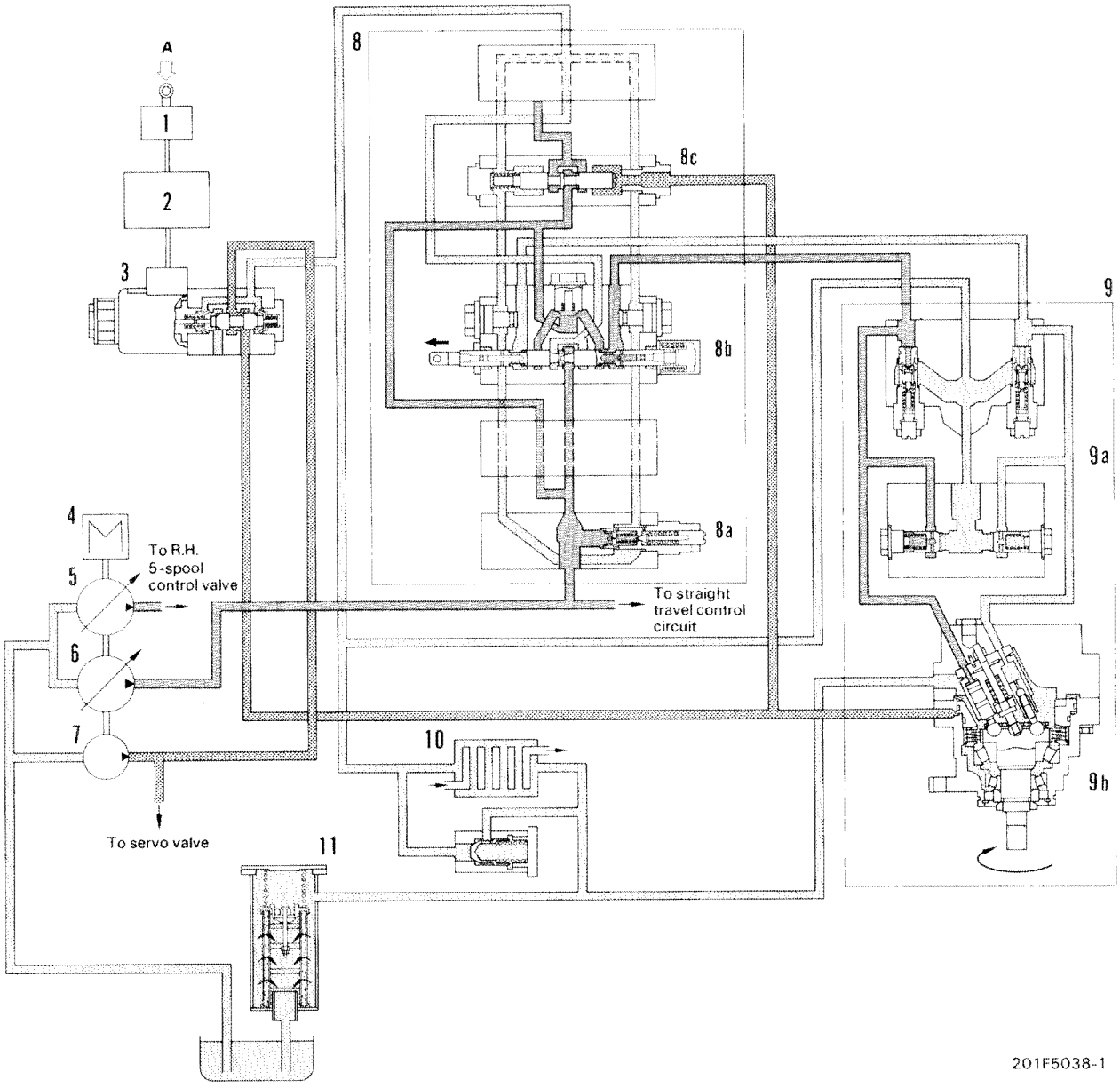
2. Swing control lever at NEUTRAL

If the control levers are set to the NEUTRAL the limit switch will turn off and solenoid (1) will be released. Then spring (8) will force spool (5) to return in the direction of the arrow (⬅) to close ports **E** and **G** and open ports **E**, **F**, **G**, and **H**. As a result, the oil from the charging pump flows from port **E** to **F** and stops at the block. The oil from port **G**, that is, the oil from the swing mechanical brake, is drained through port **H**.



F0202019

SWING PRIORITY CIRCUIT



- When the swing and arm are operated at the same time, a large amount of pressurized oil flows to the arm circuit, where the load is smaller. Only a small amount of pressurized oil flows to the swing circuit, so the arm speed is too high compared to the swing speed, and it becomes difficult to carry out simultaneous operations.
  To prevent this problem and to make it easy to carry out simultaneous operations, the swing priority circuit is used. This system gives priority to the swing and restricts the flow of pressurized oil to the arm low control valve, thereby restricting the arm speed.

1. Limit switch (for swing)
2. Controller
3. Solenoid valve for swing mechanical brake
4. Engine
5. Front main pump
6. Rear main pump
7. Charging pump
8. L.H. 6-spool control valve

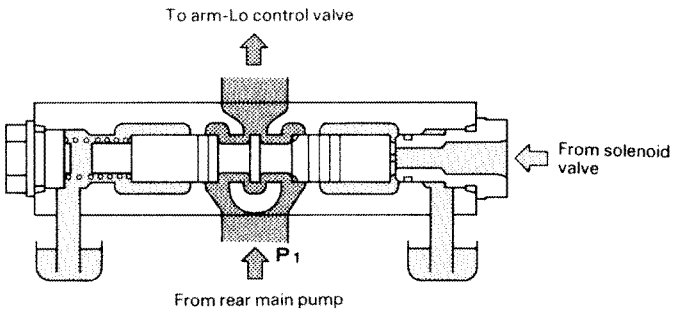
8a. Main relief valve
8b. Swing control valve
8c. Swing priority valve
9. Swing motor ass'y
9a. Brake valve
9b. Swing motor
10. Oil cooler
11. Hydraulic filter
A. From swing control lever

SWING PRIORITY VALVE

OPERATION

Swing at neutral

- When the swing is at neutral, no pilot pressure oil flows from the solenoid valve. The swing priority valve is not actuated, so the pressurized oil from the front main pump passes through port P_1 and flows to the arm-Lo control valve.

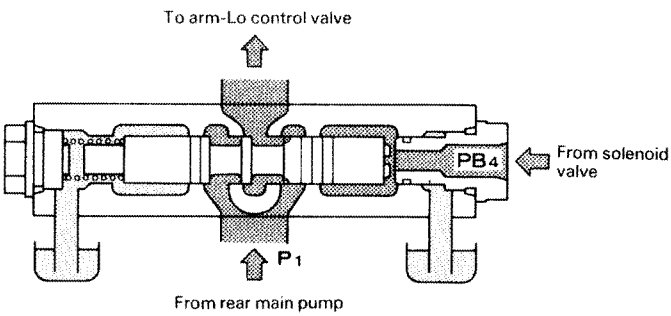


F0202167A

When operating swing

When the swing is operated, the limit switch on the linkage is actuated. This actuates the solenoid valve, and pilot pressure acts on port PB_4 of the swing priority valve, and pushes the spool to the left.

When this happens, the pressurized oil flowing from the front main pump to the arm low control valve is restricted by the swing priority valve. The arm speed is controlled, so simultaneous operations are made easier.



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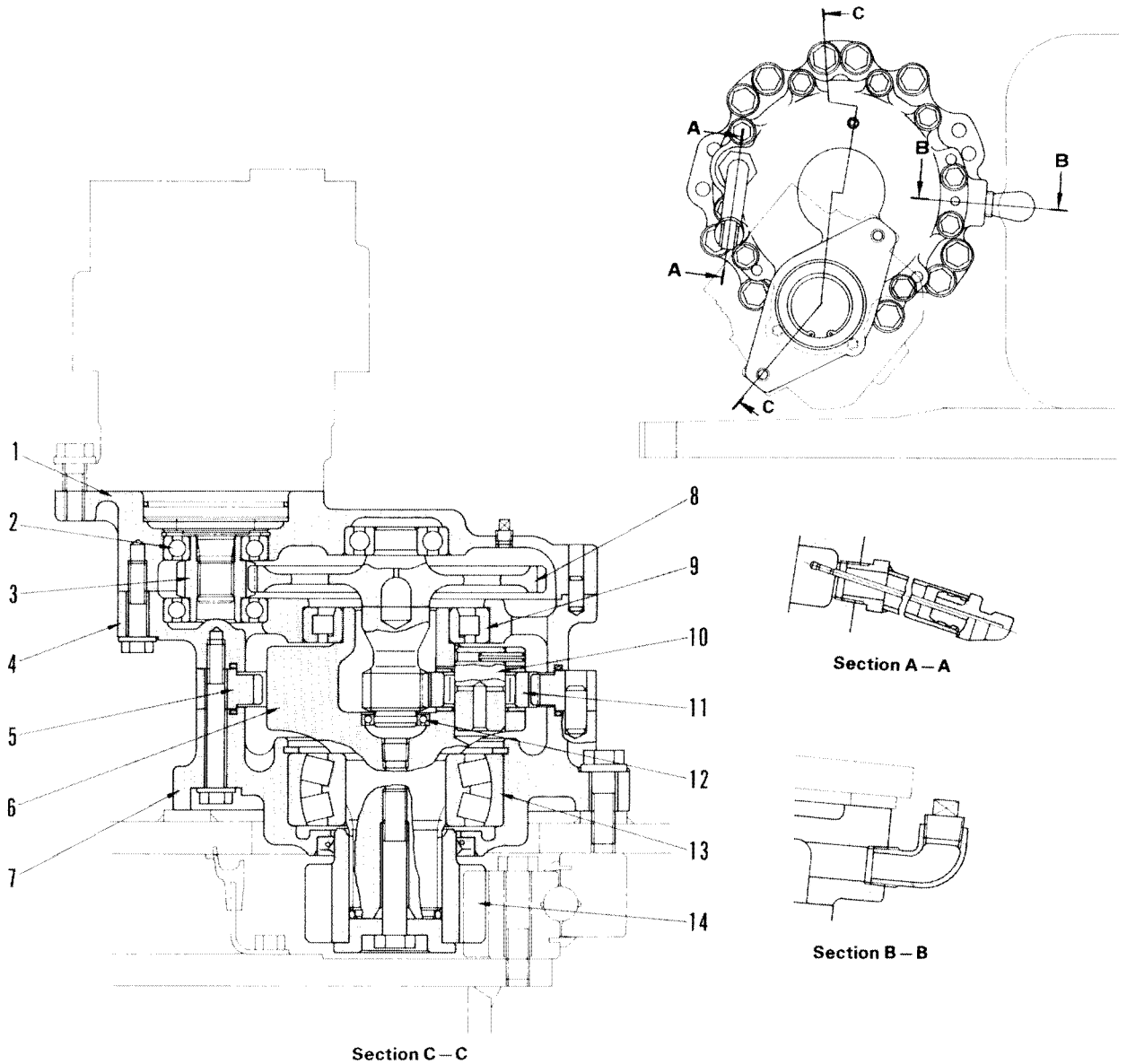
SWING MACHINERY



201F5045

The swing machinery is of the spur gear single reduction and planetary gear (with ring gear fixed) single reduction type, and is lubricated in an oil bath.

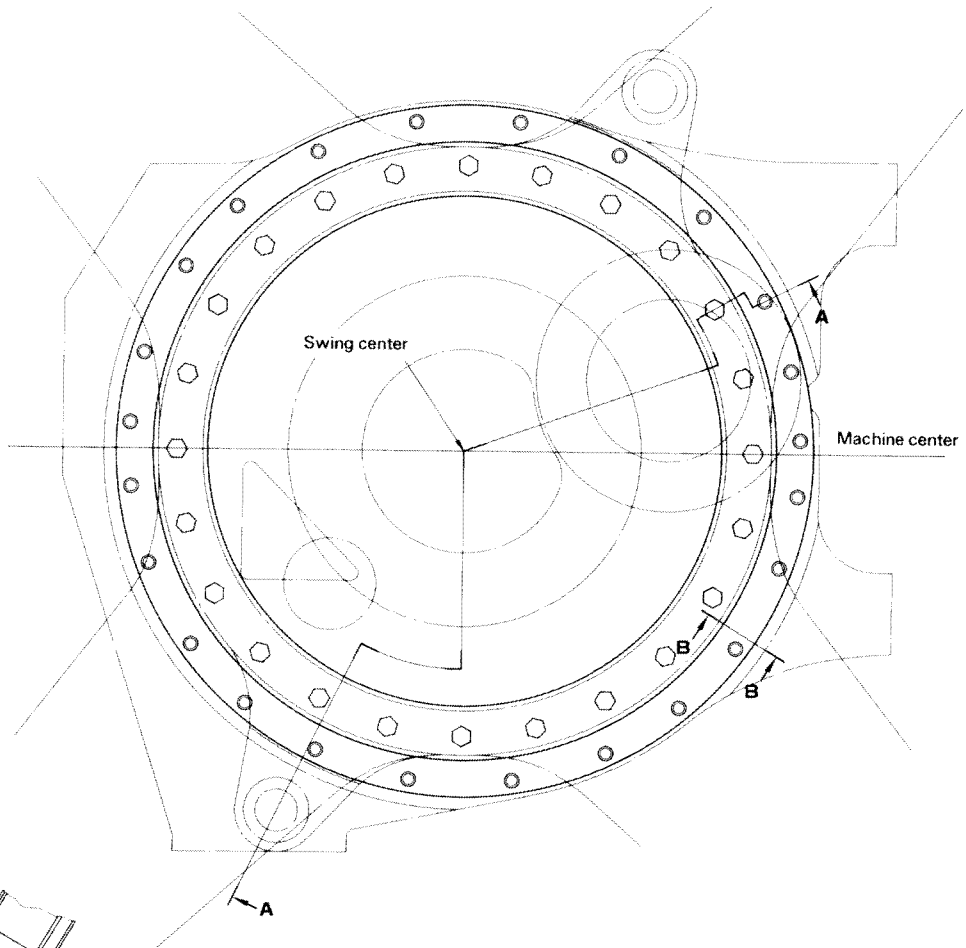
Reduction ratio = 119.75

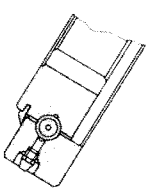
Continued swing speed: 14.0 rpm

Lubricate oil capacity: 2.2 ℓ

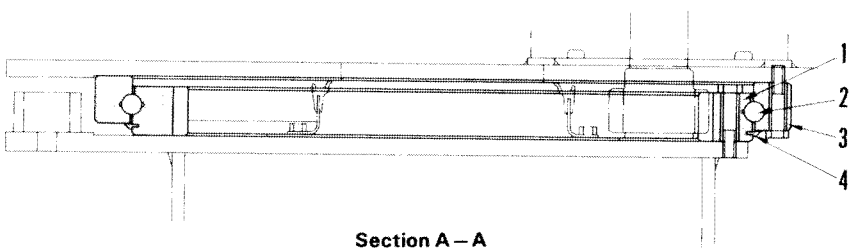
1. Cover
2. Ball bearing
3. 1st pinion
4. Case
5. Ring gear
6. Carrier
7. Cage
8. 1st gear and 2nd pinion
9. Roller bearing
10. Pinion shaft
11. Planetary pinion
12. Ball bearing
13. Roller bearing (self-aligning)
14. Swing pinion

SWING CIRCLE





Section B – B



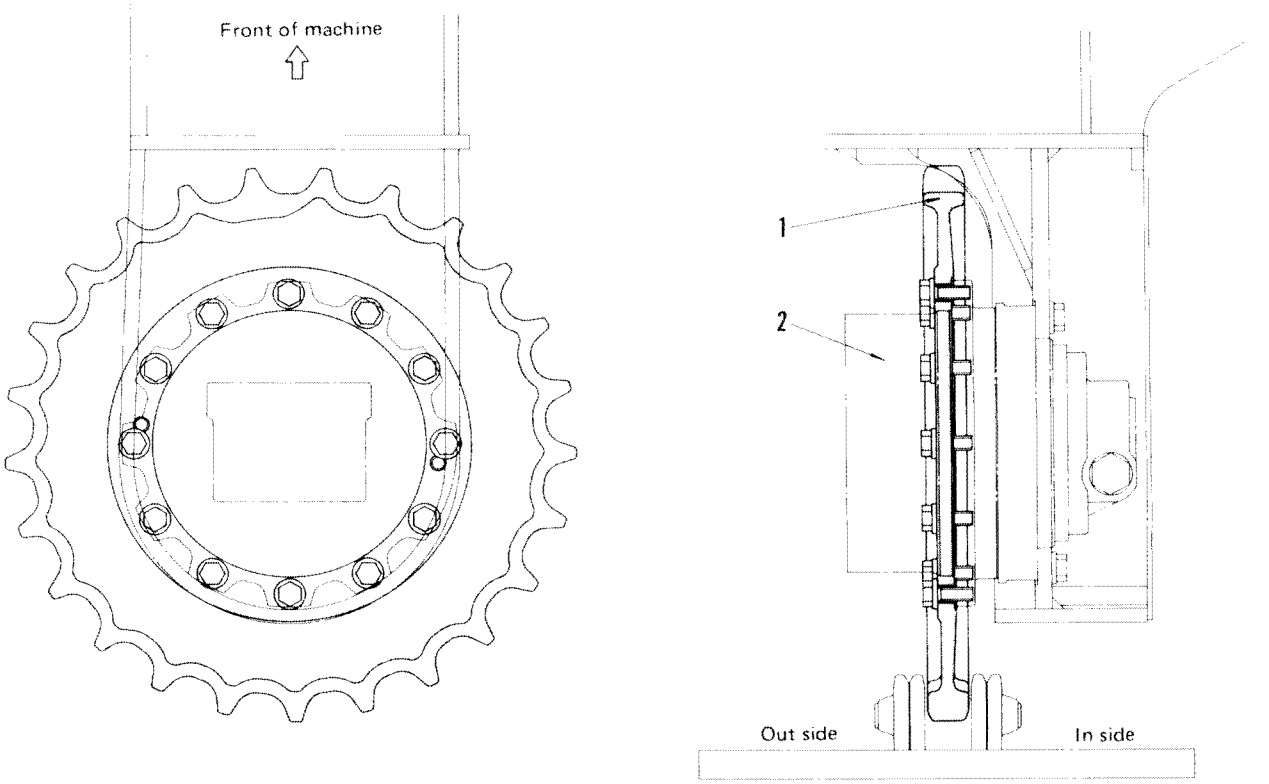
Section A – A

201F5046

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

• Grease capacity: 5 ℓ

SPROCKET

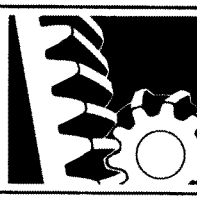


201F1007

1. Sprocket
2. Travel motor

Teeth number
PC60, 60U-5: 23
PC60L-5: 25

POWER TRAIN
23 DISASSEMBLY AND ASSEMBLY

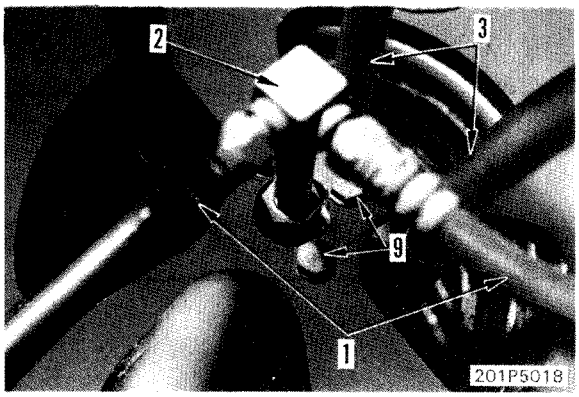


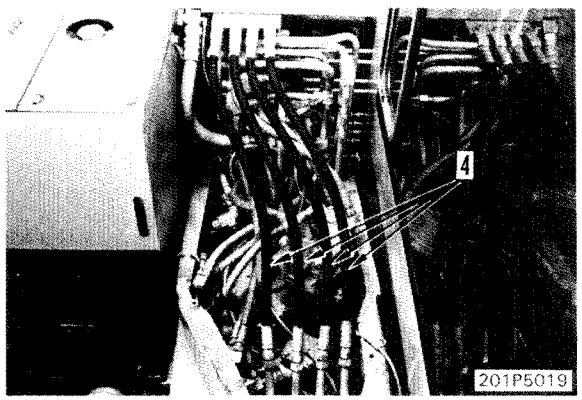
REMOVAL OF CENTER SWIVEL JOINT ASSEMBLY

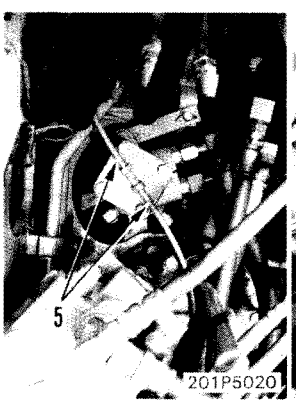
Lower the work equipment completely to the ground and stop the engine. Operate the control lever several times to release the remaining hydraulic pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the remaing oil pressure in the hydraulic tank.

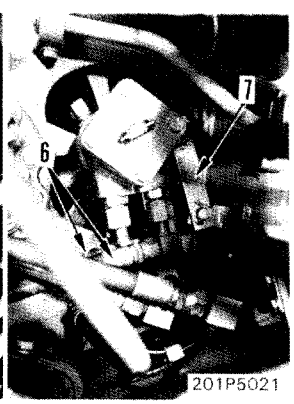
1. Disconnect drain hose (1) and remove nipple (2).
   ★ Loosen nipple (2) with a nut, then turn the whole nipple to remove it.
2. Disconnect the lower hose.
   ★ Pull the lower hose from the bottom and the upper hose from the top.
3. Disconnect work equipment hose (4) at the valve side, then place it on the boom side.
4. Disconnect drain hose (5) and hose (6).
5. Remove the nipple and, using eyebolt (1) (D = 12 mm, P = 1.5), temporarily sling swivel joint assembly (8).
6. Remove installation bolts (9) of the swivel joint and remove center swivel joint assembly (8).

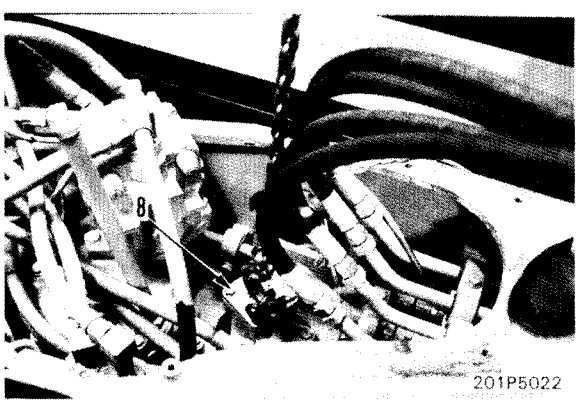
   kg Center swivel joint assembly: 30 kg







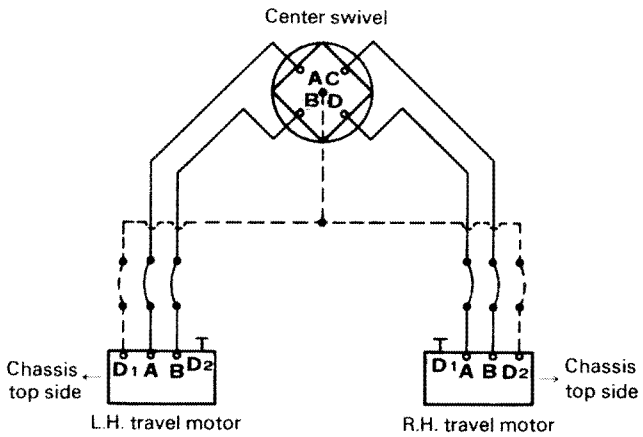




INSTALLATION OF CENTER SWIVEL JOINT ASSEMBLY

1. Using eyebolt ① (D = 12 mm, P = 1.5), set center swivel joint assembly (8) in the installation position.
   ★ Install with mark "**A**" on the swivel joint facing left and mark "**C**" facing right, as shown in the drawing at right.
2. Fix with joint assembly installation bolts (9).
3. Fix link (7) with a pin, the secure with a cotter pin.
   ★ Be sure to bend the cotter pin securely.
4. Fit an O-ring, then connect hose (6) and drain hose (5).
5. Connect work equipment hose (4).
6. Fit an O-ring and connect hose (3).
7. Fit an O-ring, install nipple (2), and connect hose (1).

★ Start the engine to circulate the oil through the piping, the add more oil to the specified level.



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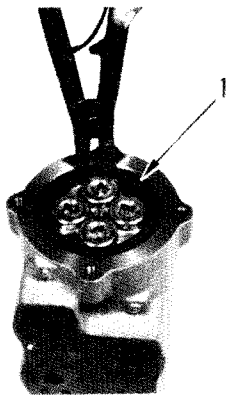
DISASSEMBLY OF CENTER SWIVEL JOINT ASSEMBLY

1. Remove the cover, remove snap ring (1), then remove ring (2).
2. Using bushing puller (1), pull swivel rotor (3) out of swivel shaft (4).
3. Remove snap ring (5), then remove oil seal (6) and slipper seal (7) from the swivel rotor.

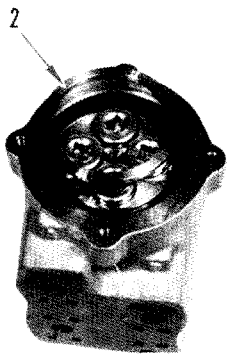


20XP402

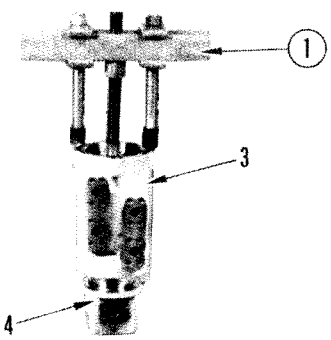
ASSEMBLY OF CENTER SWIVEL JOINT ASSEMBLY

1. Install slipper seal (7) and oil seal (6) to the swivel rotor, and fix with snap ring (5).
   ★ Apply engine oil to the slipper seal.
2. Install swivel shaft (4) to sivel rotor (3).

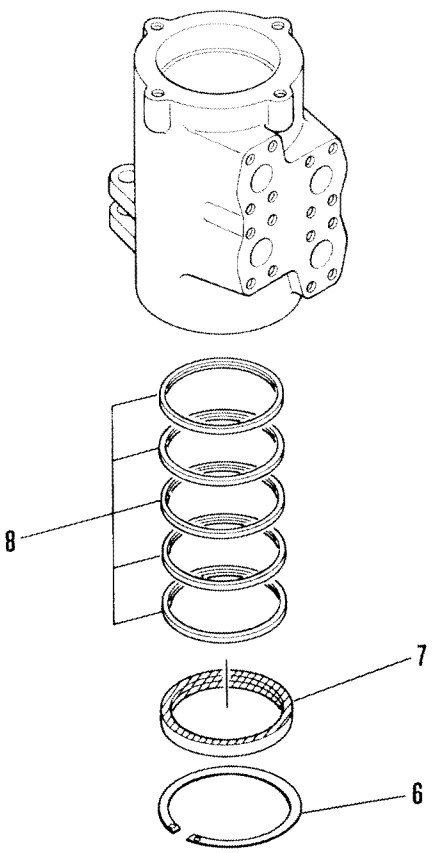
★ The swivel joint assembly for the work equipment is disassembled and assembled in the same way.



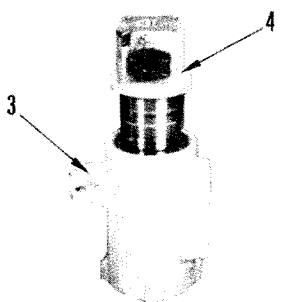
20XP403



20XP404



206F240



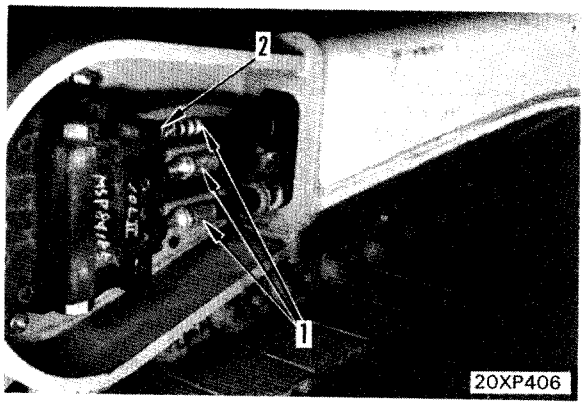
20XP405

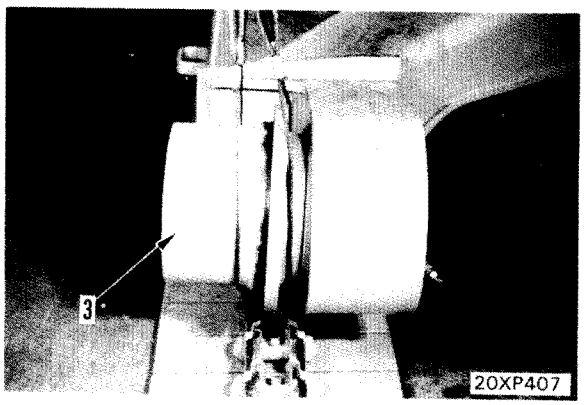
REMOVAL OF TRAVEL MOTOR ASSEMBLY

Lower the work equipment to the ground and slowly remove the oil cap filler of the hydraulic oil tank to release the pressure from inside the tank.

1. Remove the sprocket. For details, see REMOVAL OF SPROCKET.
2. Remove the cover, disconnect hose (1), and remove nipple (2).
3. Temporarily sling travel motor assembly (3), remove the installation bolts, and remove the travel motor assembly.

   kg Travel motor assembly: 85 kg





INSTALLATION OF TRAVEL MOTOR ASSEMBLY

1 Set travel motor assembly (3) on the frame and tighten the installation bolts.

   kgm Installation bolts: 22.5 ± 2.5 kgm

2. Fit an O-ring, install nipple (2), connect tube (1), and install the cover.

   kgm Sleeve nuts: 8 ± 2 kgm
   (width across flats: 24 mm)

3. Install th sprocket. For details, see INSTALLATION OF SPROCKET.

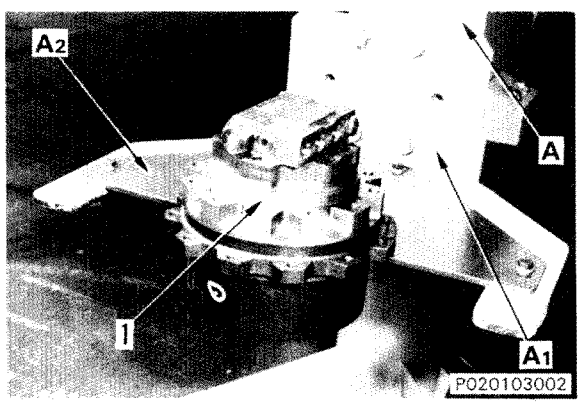
DISASSEMBLY OF TRAVEL MOTOR ASSEMBLY (GM08L-II for PC60) (GM09L-II for PC60L)

Special tools required

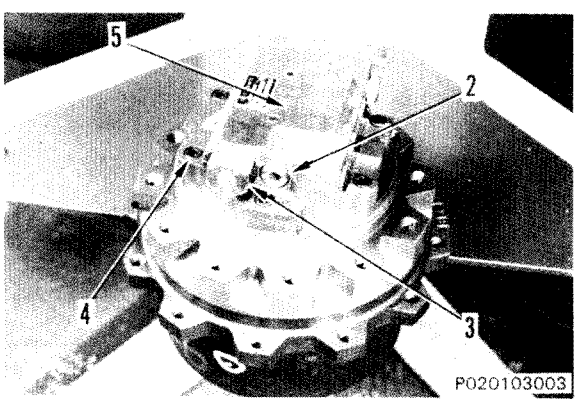
No.	Part No.	Part Name	Q'ty
A	790-501-5000 or 790-501-2000	Unit repair stand or Engine repair stand	1
A_1	790-901-2110	Bracket	1
A_2	790-901-4171	Plate	1
B	799-301-1600	Oil leak tester	1
C	796-720-5100	Fixture	2

- **Preparation**
  Set travel motor assembly (1) on tools A, A_1 and A_2.

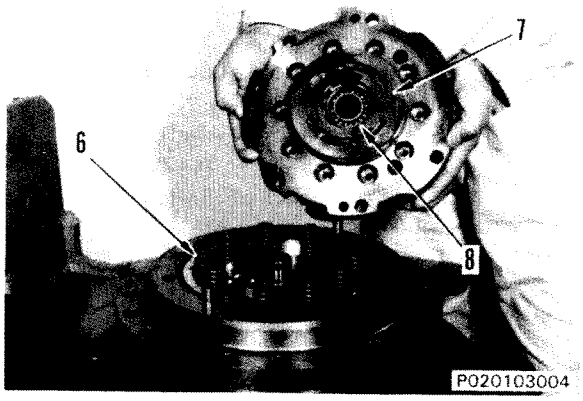
  kg Travel motor assembly: PC60: 73.5 kg
  PC60L: 77.5 kg



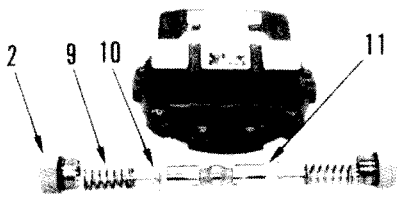
1. **Rear flange assembly**
   ★ Loosen L.H. and R.H. plugs (2) and (3).
   1) Remove hexagon-headed bolt (4) and take rear flange (5) out of place.
      ★ Since the spring may fall out of place when removing the flange, be careful.



2) Remove spring (6).
3) Remove timing plate (7).
4) Remove bearing (8).

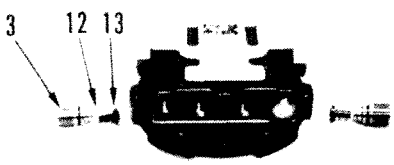


★ Disassemble the shuttle valve in the following manner.
i) Remove plug (2). Then, remove spring (9) and stopper (10).
ii) Remove shuttle spool (11).



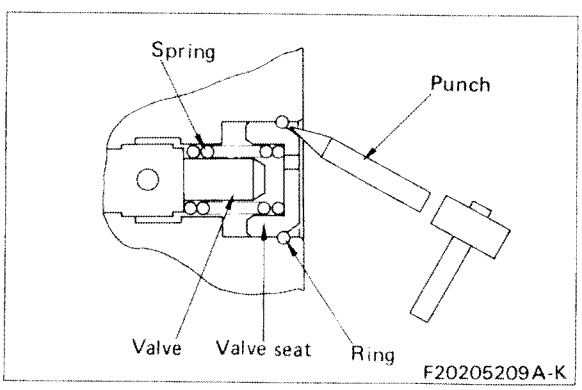
P020103005

★ Disassemble the check valve in the following manner.
Remove plug (3). Then, remove spring (12) and valve (13).



P020103006

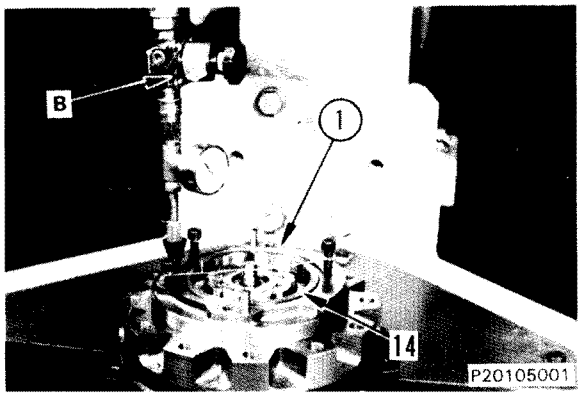
★ Disassemble the parking brake valve in the following manner.
i) Put punch in contact with ring notch, tap with a hammer and remove ring.
★ When the ring is removed, the hole is damaged, so repair the hole after removing the ring.
ii) Block valve seat hole, then blow in compressed air from hole of passage for parking brake, and remove valve seat.
iii) Remove spring and valve.



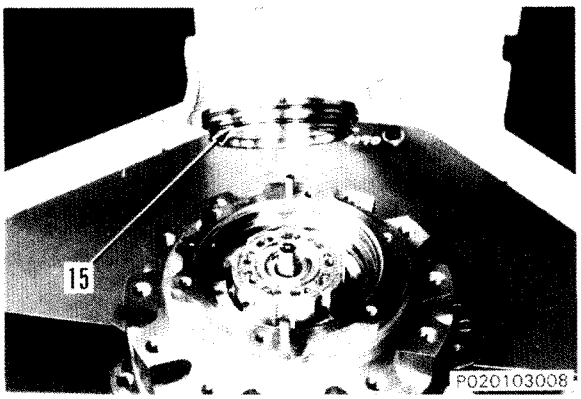
2. **Piston**

⚠ If air is let into the parking brake port, the piston will suddenly fly out of place. To prevent this, apply wire (1) to the piston.

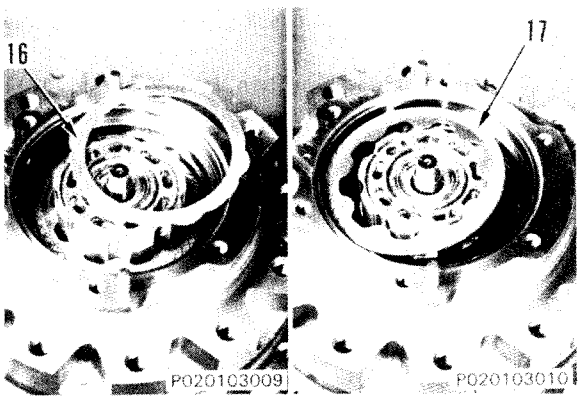
1) Using tool **B**, remove piston (14) by inhaling the air through the brake port.
   ★ Air pressure: 3 to 5 kg/cm^2



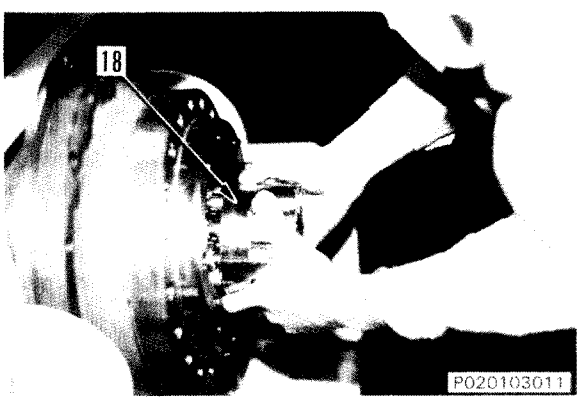
2) Remove O-ring (15) from the piston.



3. **Cylinder block, piston assembly**
   1) Remove plate (16) and disc (17).
      ★ Plate: 2 pieces
      ★ Disc: 2 pieces



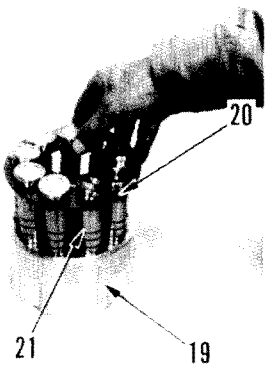
2) Turn the travel motor on its side by using the repair stand, and remove cylinder block-piston assembly (18).



★ Disassemble the cylinder block-piston assembly in the following manner.

i) Remove retainer plate (20) and piston (21) from cylinder block (19).

ii) Remove thrust bowl (22).



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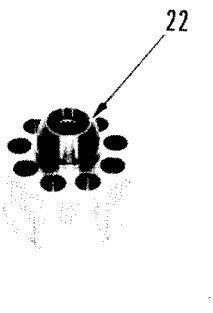
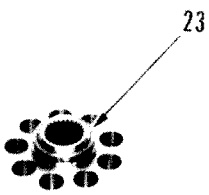


P020103013

iii) Remove washer (23).

iv) Remove parallel pin (24).



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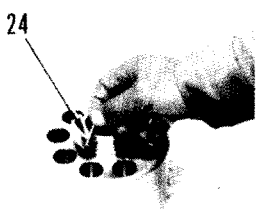
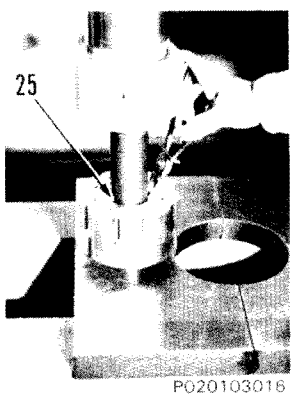


P020103015

v) Set the cylinder block on a press and take snap ring (25) out of place by compressing the spring.

★ Spring tension: 37 kg

vi) Decompress the spring and remove washers (26) and spring (27).



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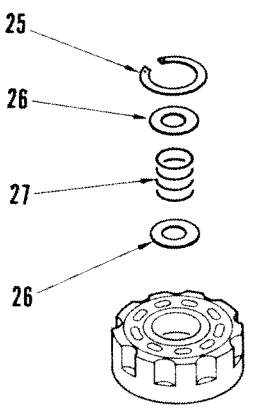

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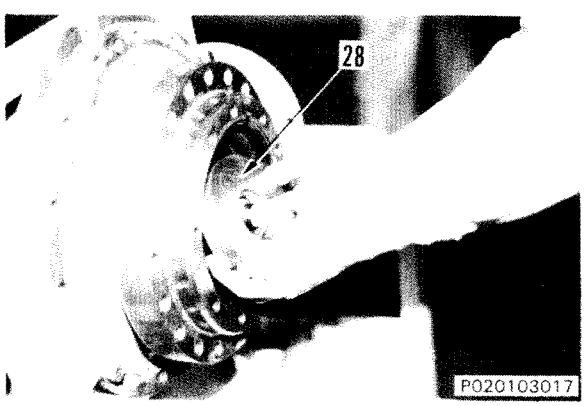
3) Take swash plate (28) out of the spindle.



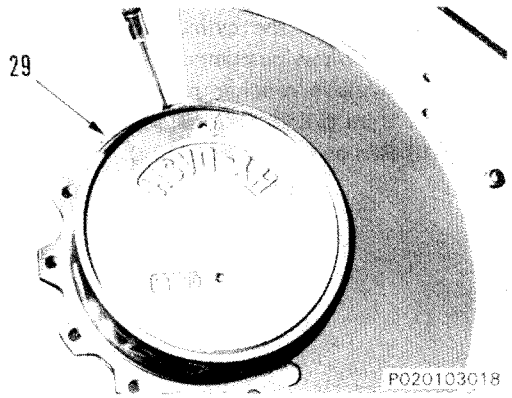
P020103017

4. **Cover**

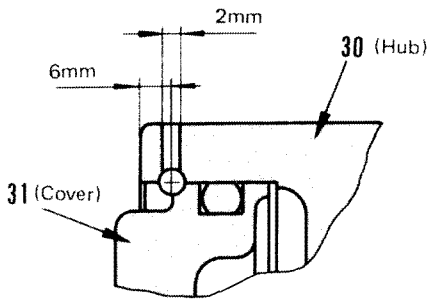
1) Remove the plug from the cover and drain the oil from the case.

Oil in the case: Approx. 2 ℓ (PC60)
Approx. 2.4 ℓ (PC60L)

2) Remove ring (29) out of place with a screwdriver.



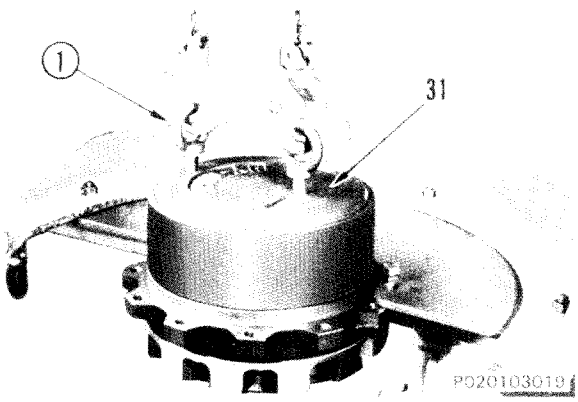
★ If the ring cannot be removed because of dirt, dust or rust, make a hole in the circumference of hub (30) (the contacting side of the ring) and remove the ring by pushing it out with a thin round bar.



F0201002A

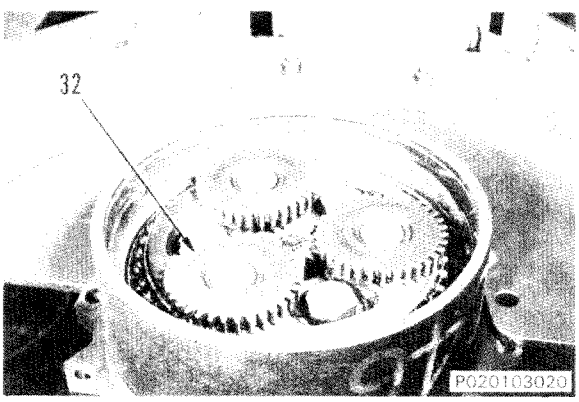
3) Remove cover (31) by lifting it with eyebolt ① (PT 3/8).

★ Lift the cover evenly because the O-ring is hard and locks flexibility against external force.



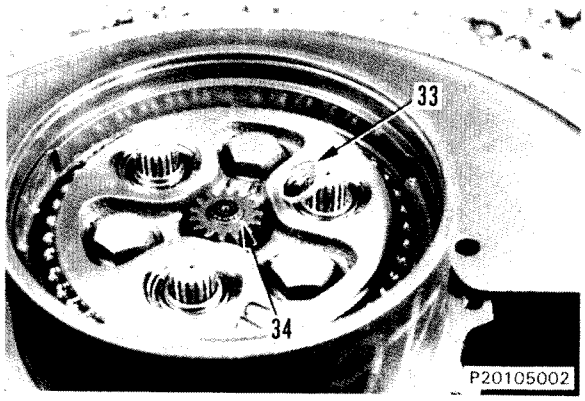
5. **Spur gear and collar**

1) Remove the snap ring and spur gear (32).
2) Remove collar (33).

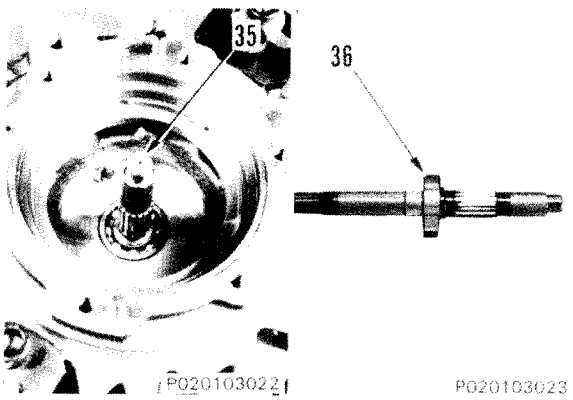


6. **Input gear and shaft**

1) Remove the snap ring and input gear (34).



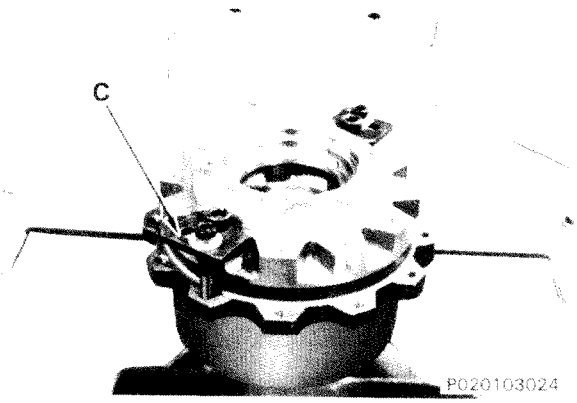
2) Turn over motor.
3) Remove shaft (35) out of spindle.
4) Remove bearing (36) from the shaft.
5) Remove oil seal.



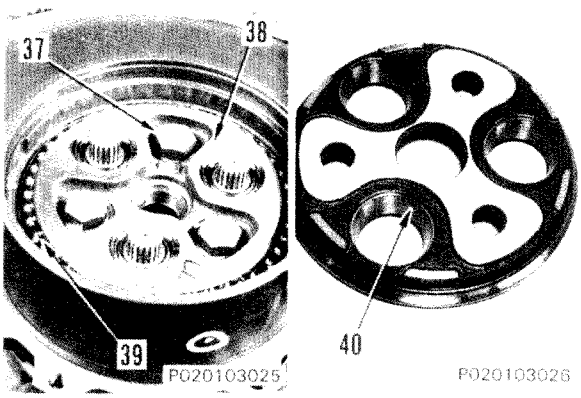
7. **Hold flange**

1) Fix the hub and spindle together, using tool **C**.

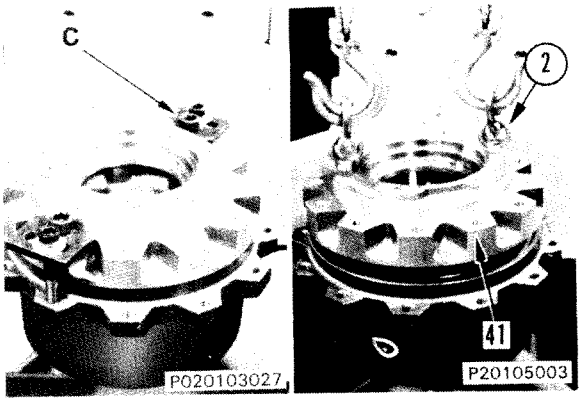
⚠ Firmly tighten tool **C** because the spindle runs out of place when the reamer bolt is removed.



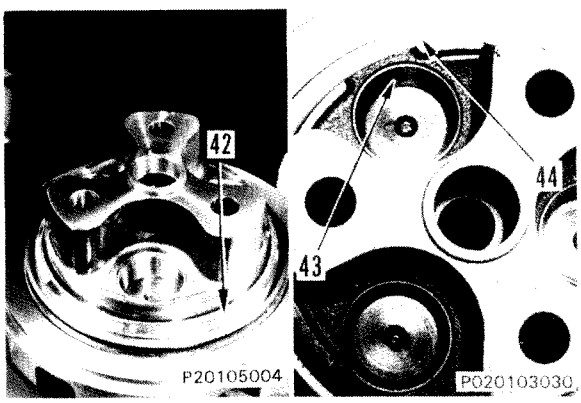
2) Turn over motor.
3) Remove 3 snap rings.
   - ★ Make match marks on the snap ring and the hold flange, then remove.
4) Remove 3 reamer bolts (37) and hold flange (38).
   - ★ Make match marks on the hold flange and the spindle.
   - ★ When the hold flange is removed, 46 bearings (39) will fall out of place. Prepare a pan to catch them so that they don't get lost.
5) Remove inner races (40) from the hold flange.



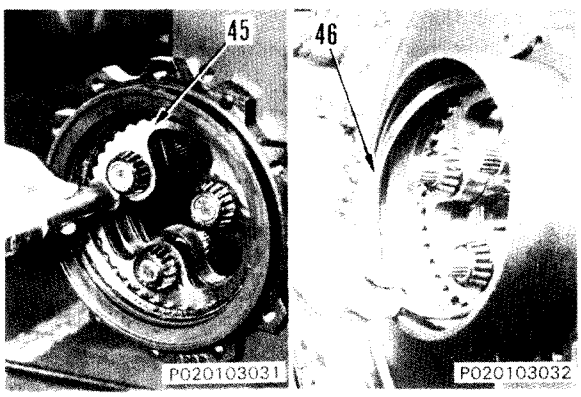
8. **Spindle**
   1) Remove tool **C**.
   2) Remove spindle (41), using eyebolt ② (D = 10 mm, P = 1.5).
      ★ When the spindle is removed, 46 bearings will fall out of place. Prepare a pan to catch them so that they don't get lost.



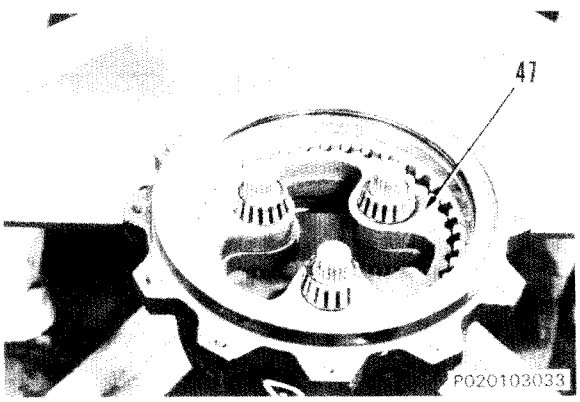
   3) Remove bearing races (42) and (43).
   4) Remove floating seal (44).



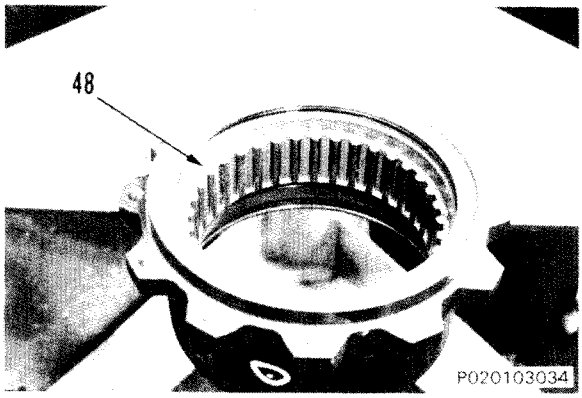
9. **RV gear**
   1) While turning RV gear (45), remove outer race (46) by hitting it with a copper hammer.



   2) Remove RV gear (47).
      ★ If necessary, replace the RV gear as an assembly.

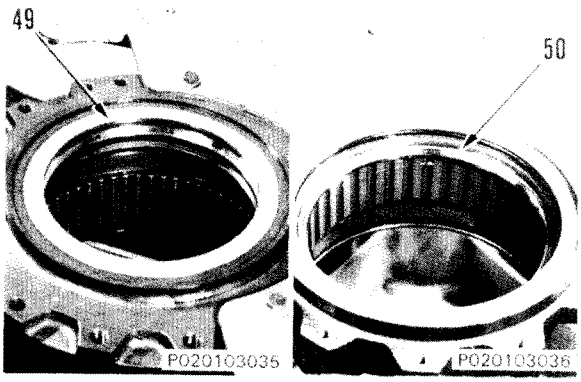


10. **Pins**
Remove 36 pins (48).



11. **Distance piece**
Remove distance piece (49).

12. **Bearing race**
Remove bearing race (50) by hitting them lightly on the rear side.



ASSEMBLY OF TRAVEL MOTOR ASSEMBLY (GM08L-II for PC60) (GM09L-II for PC60L)

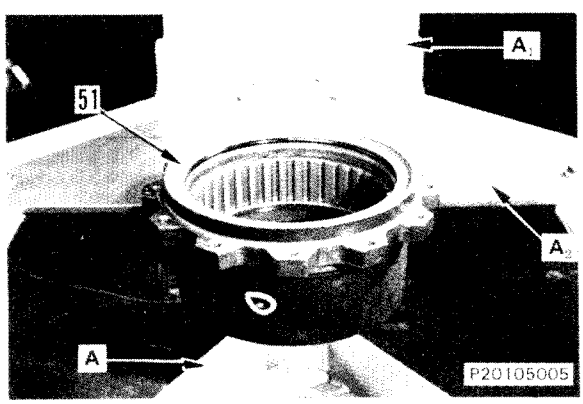
Special tools required

No.	Part No.	Part name	Q'ty
A	790-501-5000 or 790-501-2000	Unit repair stand or Engine repair stand	1
A_1	790-901-2110	Bracket	1
A_2	790-901-4171	Plate	1
C	796-720-5100	Fixture	2
D	796-720-4450	Stand	1
E	796-720-2600	Base	1

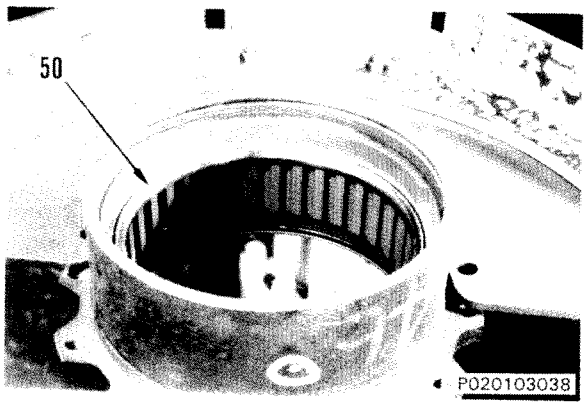
- **Preparation**
  Wash each part thoroughly in flushing oil, and recondition any sharp edges.

- **Precautions**
  1) Be sure to replace the O-rings and oil seals with new ones.
  2) Tighten the mounting bolts and plugs to the specified torques with a torque wrench.
  3) Coat the sliding or running portions of the parts with clean engine oil and assemble them into the travel motor.
  4) If any of the hub, spindle, hold flange, or bearing have been replaced, carry out adjustment. For details, see ADJUSTING PRELOAD OF BEARING.

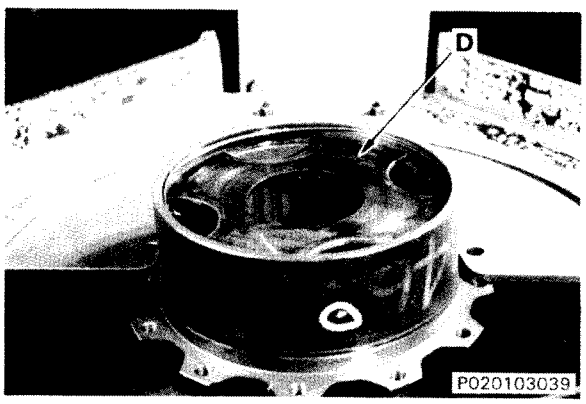
1. Hub
   1) Set hub (51) on tools A, A_1 and A_2.



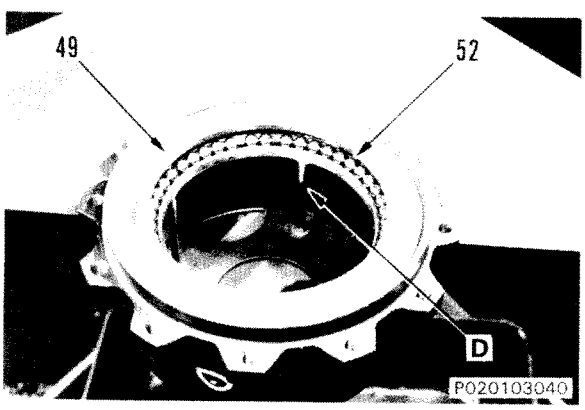
2) Install bearing outer race (50) in the hub by striking them lightly with a wooden bar.
3) Install O-ring.



4) Attach tool **D** to the hub and fix it with a ring.

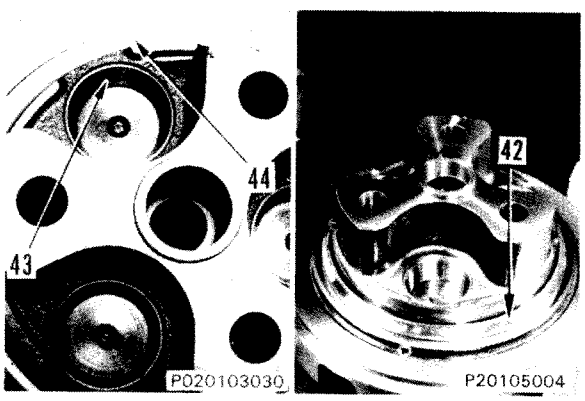


5) Operate the repair stand, turn the hub, align bearings (52) with tool **D**, and install them.
6) Install distance piece (49).

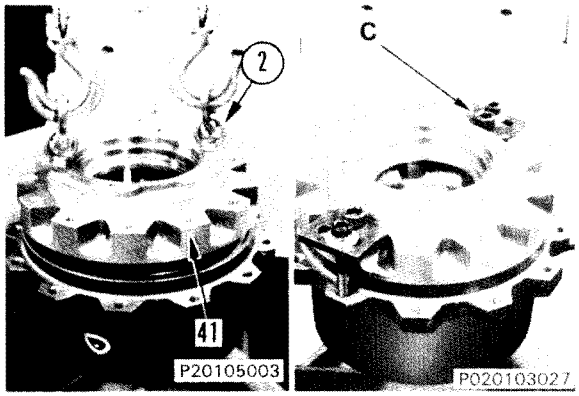


2. Spindle

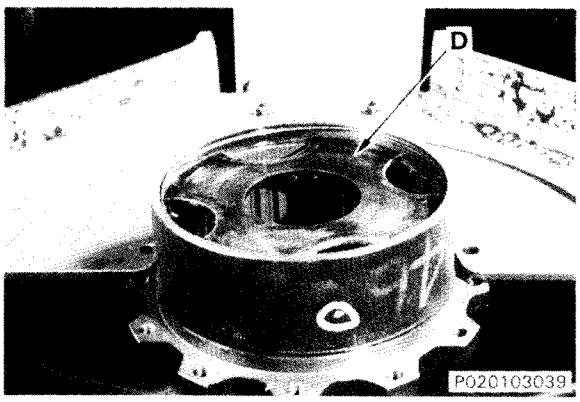
1) Install floating seal (44).
2) Install bearing races (43) and (42).



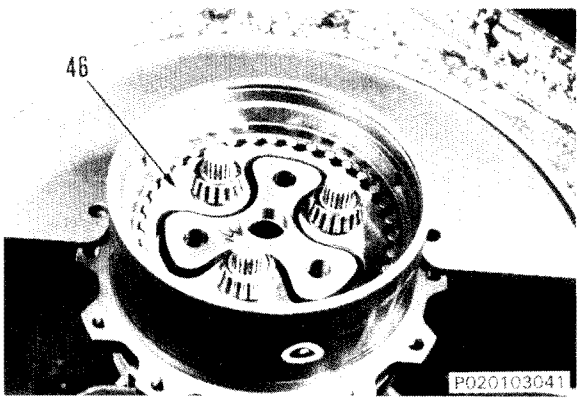
3) Install spindle (41) in the hub, using eyebolts ②
(D = 10 mm, P = 1.5).
4) Fix the hub and the spindle together, using tool **C**.



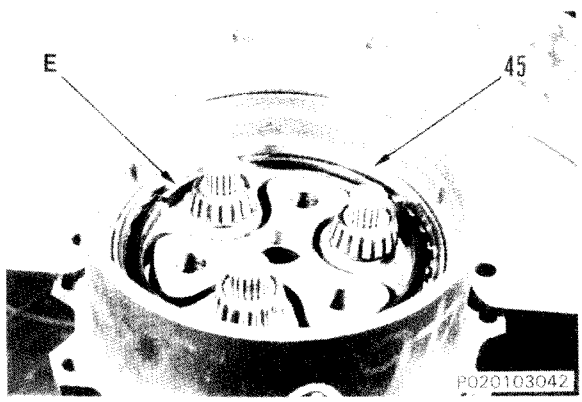
5) Turn over motor.
6) Remove the ring and tool **D** from the hub.



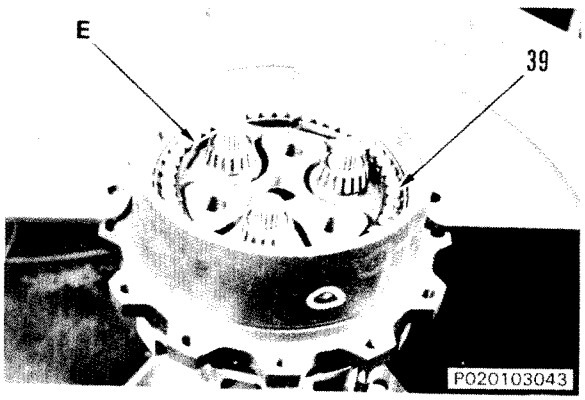
3. **RV gear**
1) Install RV gear (46) in reference to the spindle.
2) Install 36 pins.



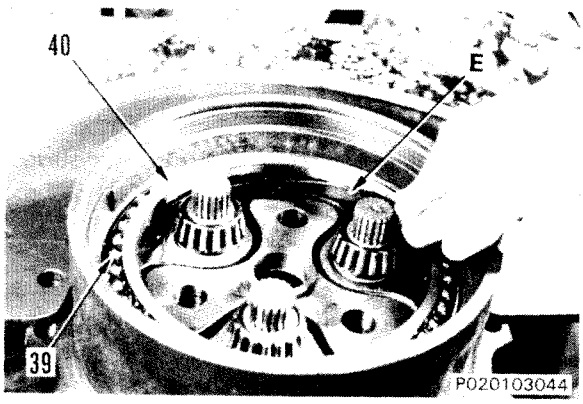
3) Install outer race (45) on the internal face of the hub.
4) Set tool **E** on the upper face of the RV gear.



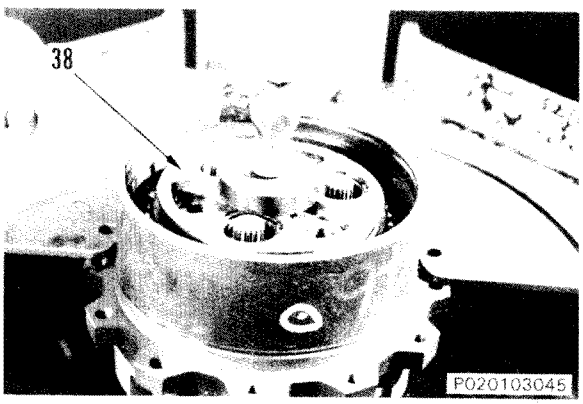
5) Install 46 bearings (39) between the outer race and tool **E**.



6) Retain bearings (39) with inner race (40) and remove tool **E**.



4. **Hold flange**
   1) Install hold flange (38) in reference to the inner race.
      ★ Align with the match marks on the spindle and install the hold flange.
      ★ When installing the hold flange, be careful not to let the bearings fall out of place.



   2) Tighten reamer bolts (37).

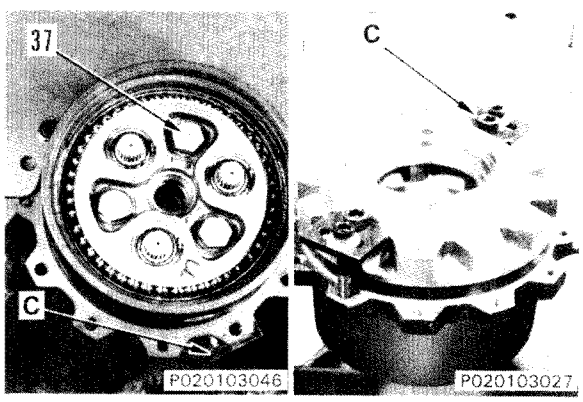
      Reamer bolt: 37.6 kgm

      Reamer bolt: Antifriction compound (Reamer portion) (LM-P)

      Reamer bolt: Thread tightner (Thread portion) (Loctite #638)

      ★ Use new reamer bolts.

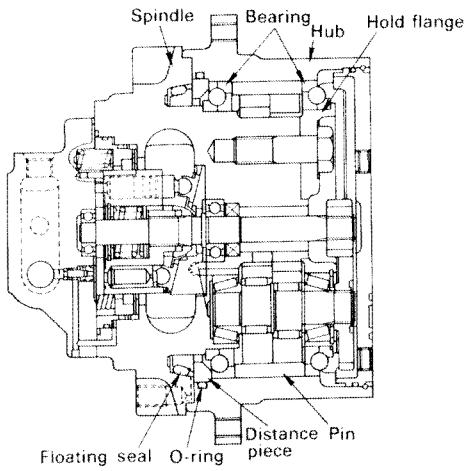
   3) Turn over motor, then remove tool **C**.



ADJUSTING PRE-LOAD OF BEARING

★ If any of the hub, spindle, hold flange, or bearing have been replaced, adjust as follows.

★ Carry out measurement before installing the floating seal, distance piece, O-ring, or pin.



F20105111

Attach spring balance ① to the outer surface of the hub and measure the driving force.

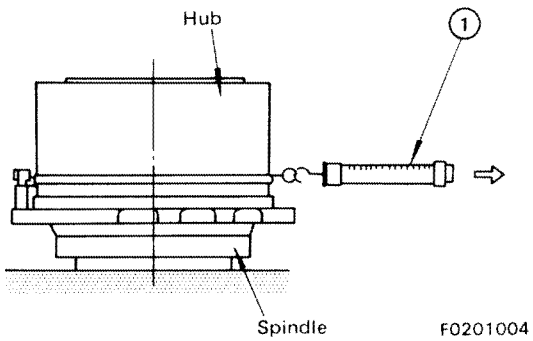
★ Driving force: 2 to 9 kg

★ The driving force is equal to the specified value: Adjustment is not needed.

★ The driving force is below the specified value: Replace the spindle, hold flange, and bearing with new parts, then carry out adjustment again.

★ The driving force exceeds the specified value: Shave the adjustment tolerance of the hold flange on a lathe to bring the driving force into the appropriate range.

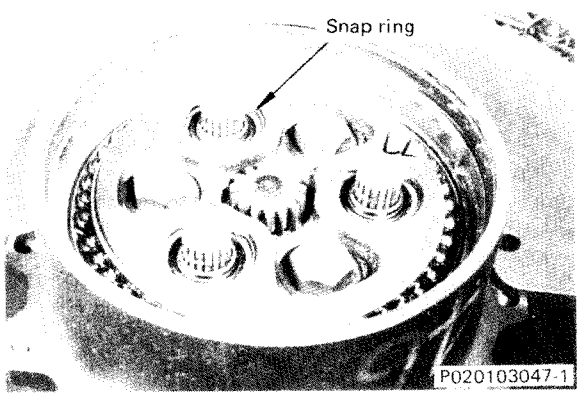
★ Shave an adjustment tolerance of 0.05 mm and make the driving force less than 2 kg.



F0201004

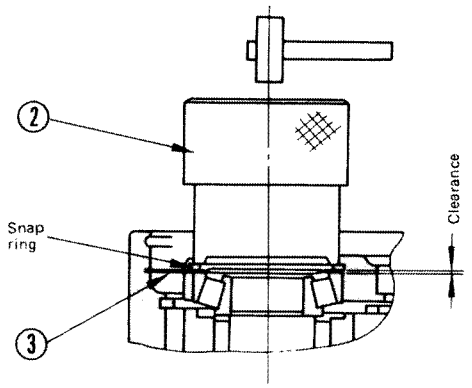
5. **Snap ring**
   1) Install 3 snap rings.
   ★ Align with the match marks on the hold flang and install the snap rings.

   ★ If any of the hub, spindle, hold flange, bearing, or RV gear assembly have been replaced, select the snap ring as follows.



P020103047-1

i) Attach driving tool ② to the bearing outer ring and set the RV gear firmly in place by lightly lifting the tool with a hammer.
ii) Install the thinnest snap ring (of classification code **A**).
★ Confirm that the snap ring has been set securely in the ring groove.
iii) In this condition, insert thickness gauge ③ between the snap ring and bearing and measure the clearance.

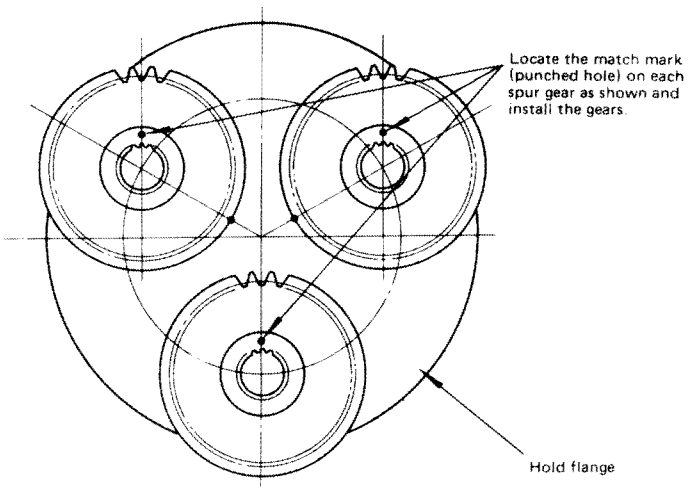


F0201006

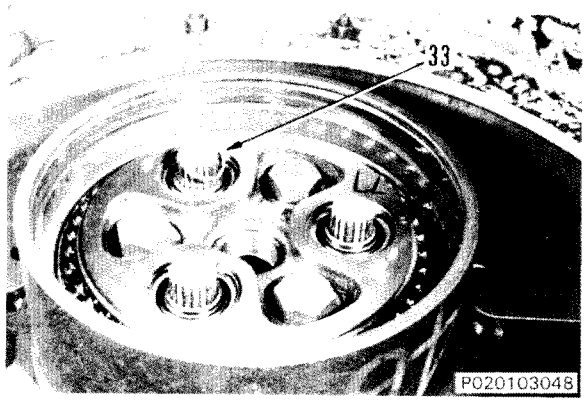
★ Proper dimension of the thickness:
Thickness gauge + thickness of the present snap ring.
★ Select a snap ring of the proper thickness from among those having the classification codes **A** through **L**.

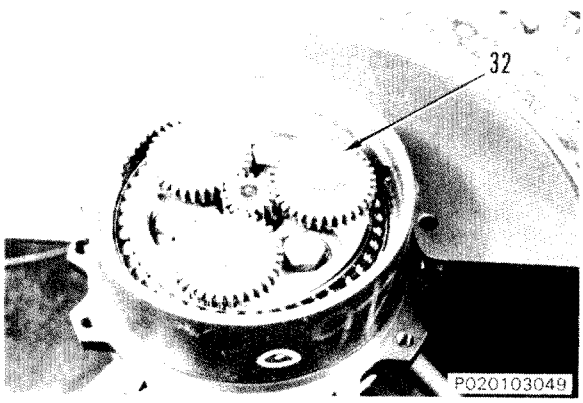
Classification code	Dimension t
A	More than 1.90, but equal to or less than 1.95.
B	More than 1.95, but equal to or less than 2.00.
C	More than 2.00, but equal to or less than 2.05.
D	More than 2.05, but equal to or less than 2.10.
E	More than 2.10, but equal to or less than 2.15.
F	More than 2.15, but equal to or less than 2.20.
G	More than 2.20, but equal to or less than 2.25.
H	More than 2.25, but equal to or less than 2.30.
I	More than 2.30, but equal to or less than 2.35.
J	More than 2.35, but equal to or less than 2.40.
K	More than 2.40, but equal to or less than 2.45.
L	More than 2.45, but equal to or less than 2.50.

6. Spur gear
1) Install collars (33).
2) Install spur gears (32) in the positions shown below and fix them firmly with snap rings.
★ Positions of match marks on spur gears.



F0201007

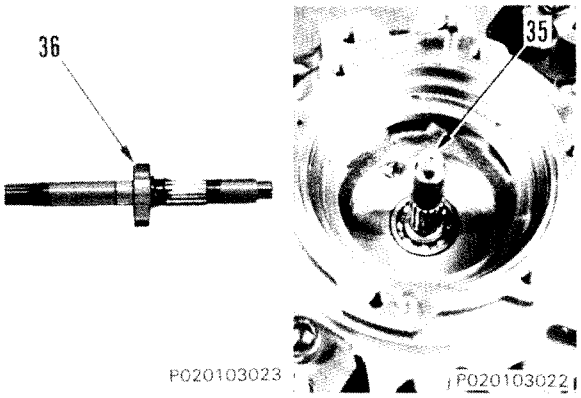




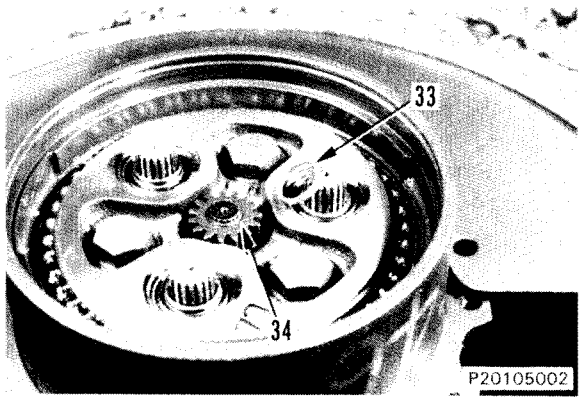
7. **Shaft**
   1) Turn over motor.
   2) Install oil seal.

      Lip of oil seal: Grease (G2-LI)

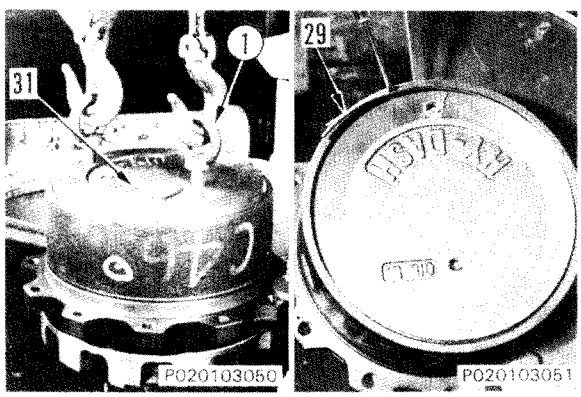
   3) Shrink fit bearing (36) to shaft.
      - Shrink-fitting temperature: 100 ± 10°C (10 min)
   4) Install shaft (35) to spindle.



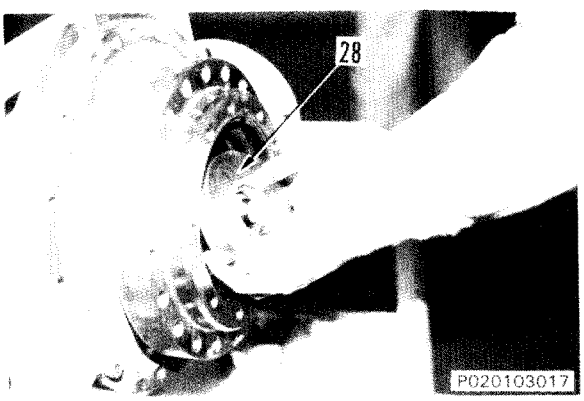
8. **Input gear**
   1) Turn over motor.
   2) Install input gear (34) in reference to the spur gears and fix it with the snap ring.



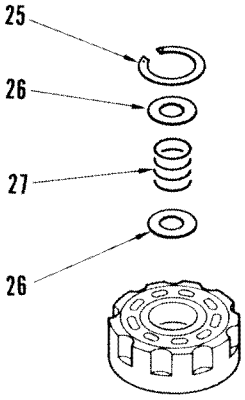
9. **Cover**
   1) Install cover (31), making use of eyebolt ① (PT 3/8).
   2) Secure the cover in place by installing ring (29).



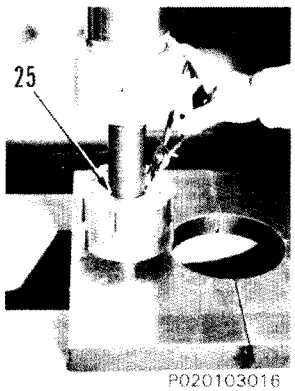
10. **Cylinder block**
    1) Install swash plate (28) in reference to the dowel pin.



2) Assembly the cylinder block-piston assembly in the following manner.
   i) Set washers (26) and spring (27) in the cylinder block.
   ii) Set the cylinder block on a press and install snap ring (25) by compressing the spring.



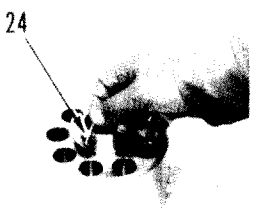
F0201001



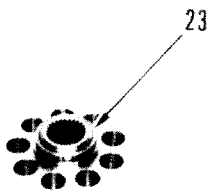
P020103016

3) Install parallel pin (24).
4) Install washer (23).

★ If any of the hub, spindle, hold flange, bearing, swash plate, cylinder block, retainer plate, or thrust bowl have been replaced, select washer (23) as follows.



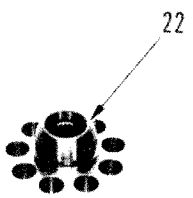
P020103015



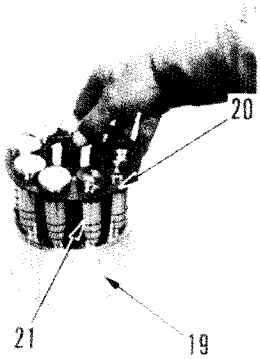
P020103014

Procedure for selection of washer thickness

i) Check that spring is not inside cylinder block.
ii) Set washer (23) with chamfered side of inside diameter on cylinder block side, then set thrust bowl (22).
   ★ Do not install the pin to the cylinder block.
iii) Assembly piston (21) and retainer plate (20) to cylinder block (19), then install spindle.



P020103013

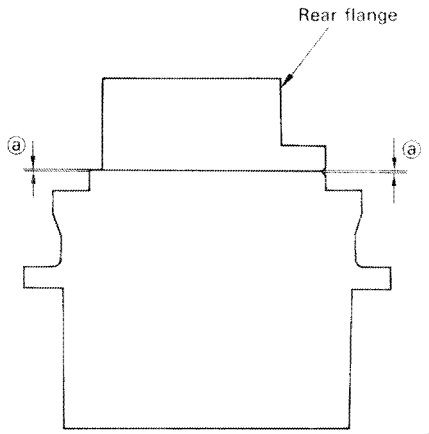


P020103012

iv) Fit a timing plate to the rear flange, and rest the rear flange on the spindle.

v) Temporarily tighten the rear flange with thickness gauges inserted at two places and measure clearances (a).

★ Use minimum 4 mounting bolts.



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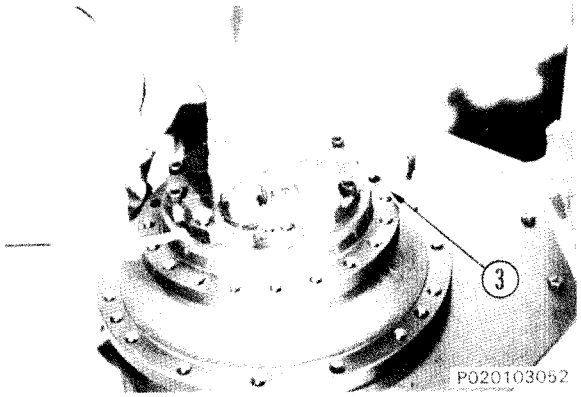


P020103052

★ First, set the thickness of each thickness gauge (3) to 0.08 mm and adjust the thickness by manually rotating the hydraulic motor shaft until it feels a little heavy.

★ Select a washer of the proper thickness from among those having classification codes **X** through **K** (GM08LII), **U** through **K** (GM09LII).

★ Dimension of the proper thickness:
The thickness of the present washer − the thickness set by the thickness gauge + 0.08 mm.

★ After the proper thickness is selected, remove the rear flange and set the hydraulic motor in its regular position.

• GM08LII

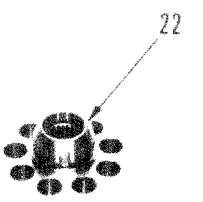
Classification code	Dimension t (mm)
X	4.65
Y	4.70
Z	4.75
A	4.80
B	4.85
C	4.90
D	4.95
E	5.00
F	5.05
G	5.10
H	5.15
I	5.20
J	5.25
K	5.30

• GM09LII

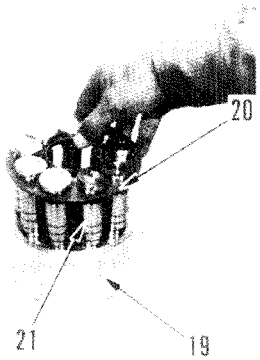
Classification code	Dimension t (mm)
U	4.50
V	4.55
W	4.60
X	4.65
Y	4.70
Z	4.75
A	4.80
B	4.85
C	4.90
D	4.95
E	5.00
F	5.05
G	5.10
H	5.15
I	5.20
J	5.25
K	5.30

5) Install thrust bowl (22).

6) Set piston (21) in retainer plate (20) and install cylinder block (19).

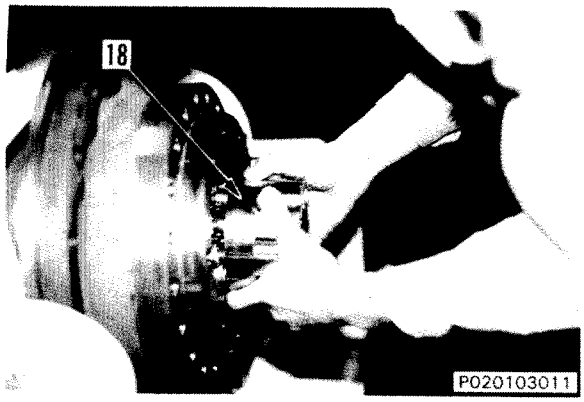


P020103013

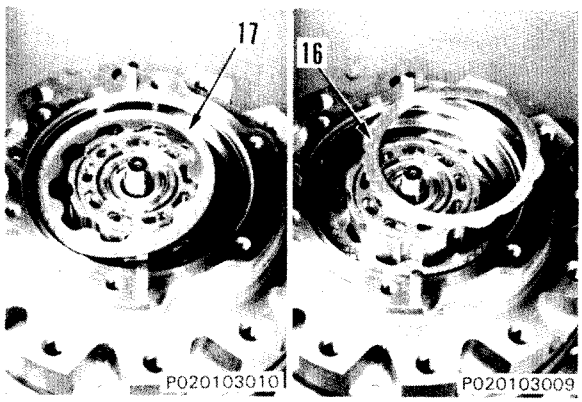


P020103012

7) Turn the travel motor on its side by operating the repair stand and install cylinder block piston assembly (18) in reference to the shaft spline.

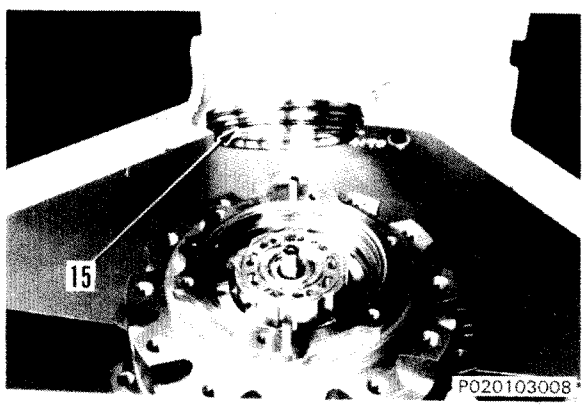


8) Install disc (17) and plate (16).

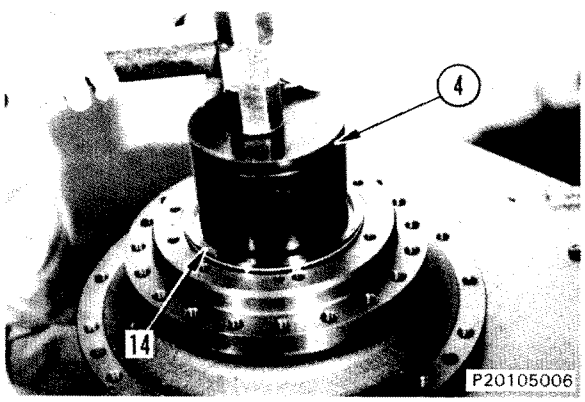


10. Piston

1) Install O-ring (15) in the piston.



2) Install piston (14), using press-fitting kit ④.

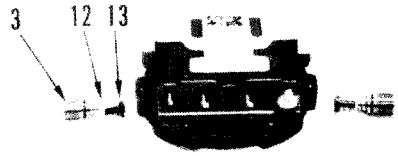


11. **Rear flange**

★ Assemble the check valve in the following manner. Set valve (13) and spring (12) in the rear flange, fit an O-ring, and tighten plug (3).

kgm Plug: 8 kgm

★ After installing the rear flange to the spindle, tighten the plug to the specified torque.



P020103006

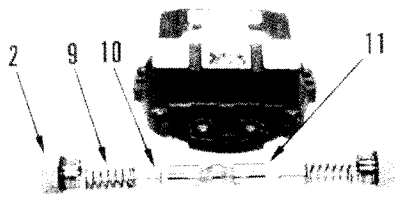
★ Assemble the shuttle valve in the following manner.

i) Set shuttle spool (11) in the rear flange.

ii) Set stopper (10) and spring (9), fit an O-ring, and tighten plug (2).

kgm Plug: 15 kgm

★ After installing the rear flange to the spindle, tighten the plug to the specified torque.



P020103005

★ Assemble the parking blake valve in the following manner.

i) Install O-ring to valve seat.

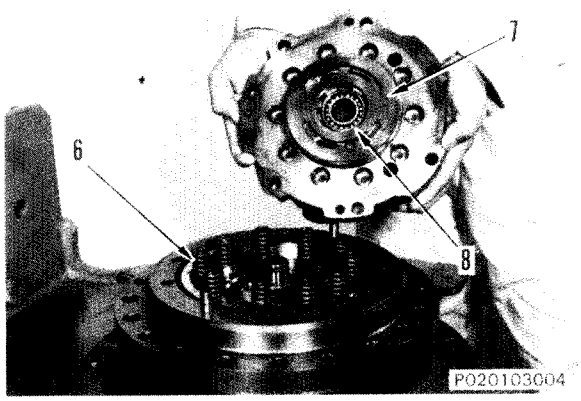
ii) Install valve, spring, and valve seal to rear flange.

iii) Bend ring slightly, and install to ring groove of rear flange.

★ Use new ring.

1) Install bearing (8) in the rear flange.
2) Install timing plate (7) in reference to the dowel pin.
3) Install 10 springs (6).

★ Coat springs with grease (G2-LI) to prevent them from falling out of place.

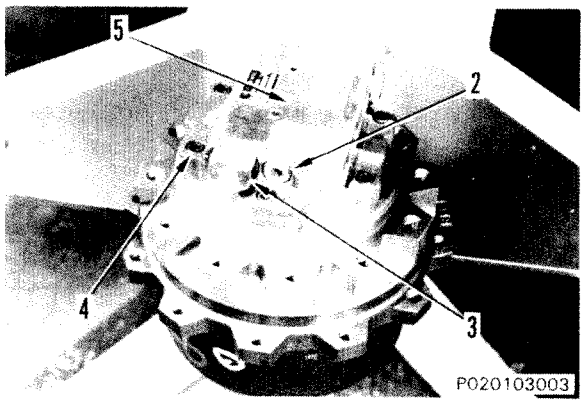


P020103004

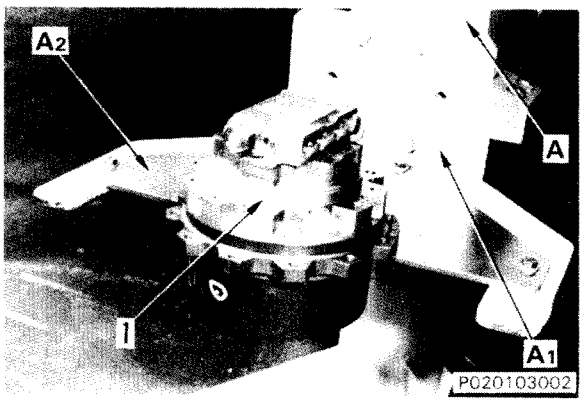
4) Fit O-ring, then install rear flange (5). Then, tighten hexagonal bolts (4).

kgm Hexagonal bolt: 5.9 kgm

★ Positively tighten plugs (3) and plugs (2) to the specified torque.



★ Sling travel motor assembly (1) and remove it from tool **A**[2].



CHECKING PERFORMANCE OF TRAVEL MOTOR

★ After completing the assembly, carry out tests to check the performance in the order given below.

1. Special tools required

	Part Name	Q'ty
1	Pressure gauge (35 kg/cm^2)	2
2	Measuring cylinder (5,000 cc)	1
3	Stop watch	1

2. Test procedure

Prucedure: 1. Motor mount, piping

1) Install the motor to the chassis.
   ★ When installing, do not hit with a hammer. Use the bolt holes and install slowly.
2) Piping
   ★ When fitting the piping, make sure that it is possible to install the pressure gauge (main circuit) and measure the drainage from the motor.

Prucedure: 2. Breaking in operation of motor

• Carry out this as follows.

	Rotating speed of GM motor	Pressure	Direction of rotation	Operating time
1	10 r.p.m.	No load	Left, right	For at least 1 minute each
2	20 r.p.m.			

Prucedure: 3. Checking performance

1) Carry out warming-up operation until the temperature is as follows.

Hydraulic oil temperature	45 — 55°C
Temperature at outside of final drive hub	40 — 80°C

2) Measure the following items.

Test item	Standard value
Drive pressure under no load	Max. 15 kg/cm^2 at 10 rpm
Drain amount	Max. 0.5 ℓ/min. at 10 rpm Operated under no load

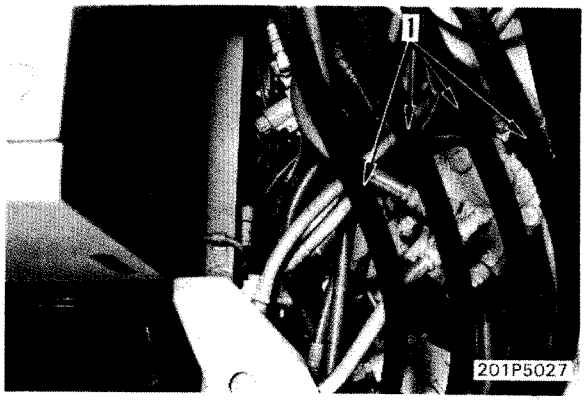
★ If the result is not within the standard value, dissassemble again and adjust.

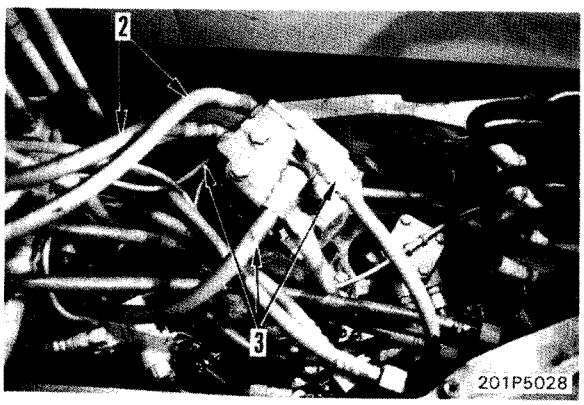
REMOVAL OF SWING MOTOR ASSEMBLY

Lower the work equipment to the ground and slowly remove the cap of the hydraulic oil tank to release the air from the tank.

1. Disconnect work equipment hose (1) on the valve side.
2. Disconnect motor hose (2).
3. Disconnect drain hose and brake hose (3).
4. Remove motor installation bolts (4), the remove the motor assembly (5).

   kg Swing motor assembly: 25 kg



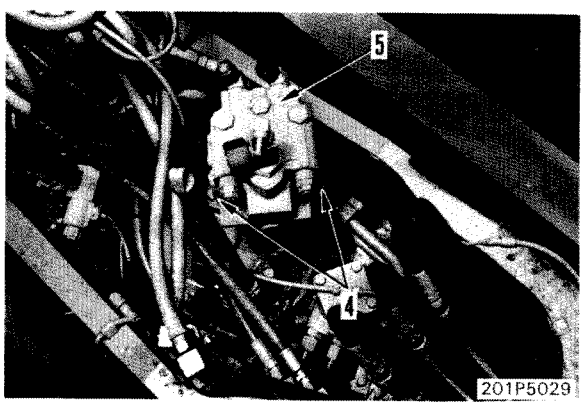


INSTALLATION OF SWING MOTOR ASSEMBLY

1. Fit an O-ring, set swing motor assembly (5), then install bolts (4).
2. Connect drain hose and brake hose (3).

   kgm Sleeve nuts: 2.5 ± 0.5 kgm

3. Connect hose (2).
4. Connect work equipment hose (1) to the valve.



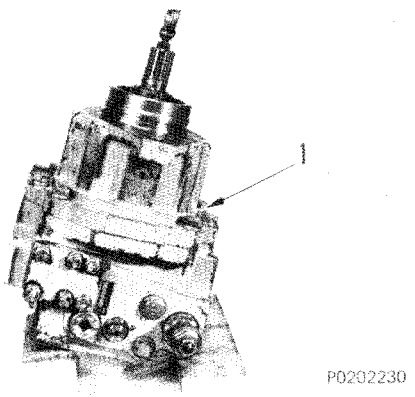
DISASSEMBLY OF SWING MOTOR ASSEMBLY

Special tools required

No.	Part No.	Part Name	Q'ty
A	790-501-5000	Unit repair stand	1
A_1	790-901-2230	Plate	1
B	795-630-1803	Torque wrench set	1
B_1	796-720-2220	Socket	1
B_2	796-730-2120	Screwdriver	1
C	796-730-2000	Wrench	1
D	796-751-2900	Holder (Travel motor)	1

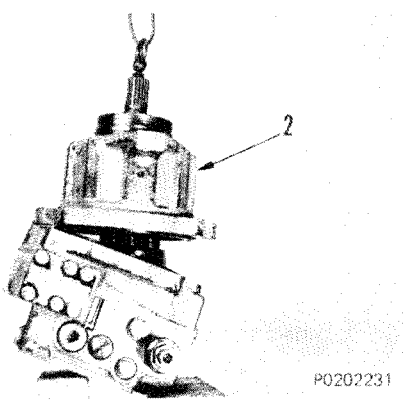
Preparatory work

- Using a block, set the swing motor assembly (1) at an angle of 25°.



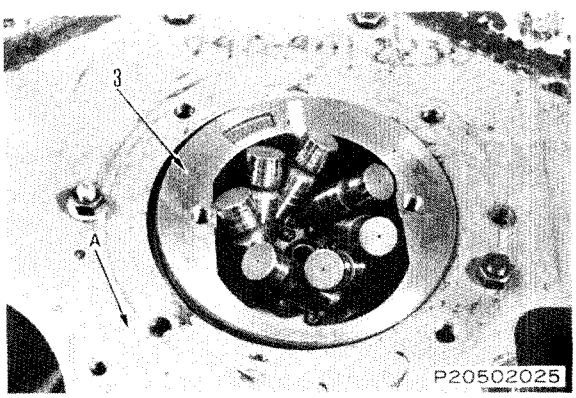
1. Brake case assembly

Using eyebolt (D = 10 mm, P = 1.5), lift off brake case assembly (2).

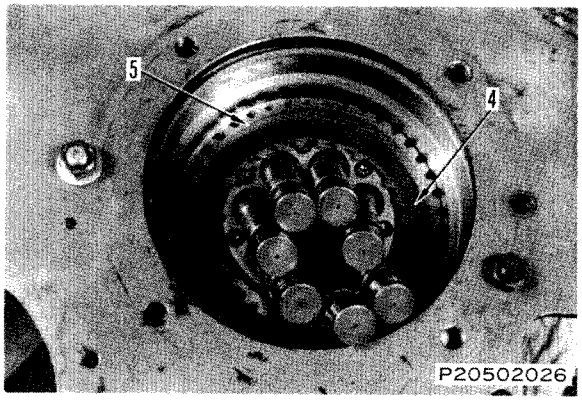


2. Brake piston

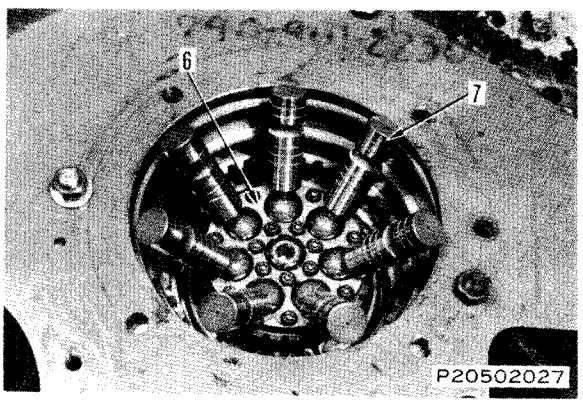
Set brake case assembly on tool **A**, then remove brake piston (3).



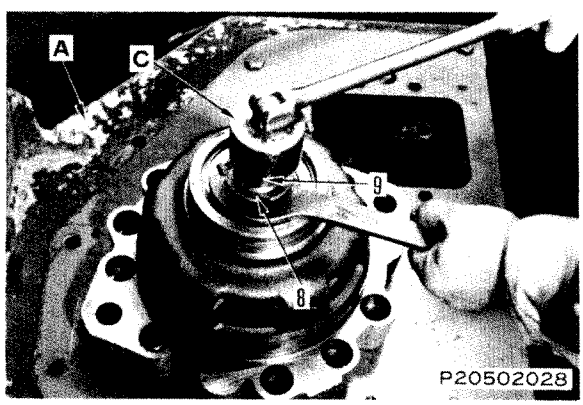
3. **Disc, plate**
Remove disc (4) and plate (5).



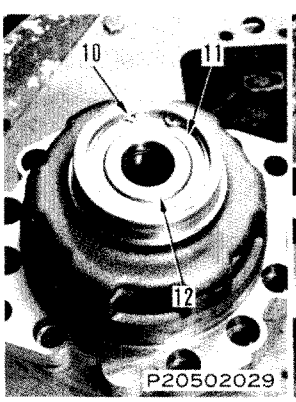
4. **Piston assembly**
1) Using tool **B**, B_1 and B_2, remove screw, then remove retainer (6).
2) Remove both piston assembly (7) and holder.

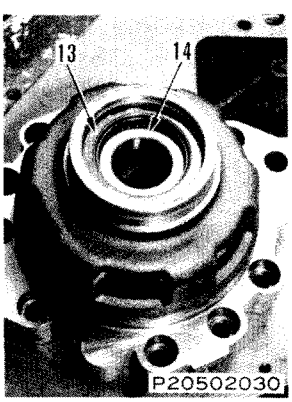


5. **Output shaft**
Turn over brake case assembly, remove nut (8) with tool **C**, then remove output shaft (9).

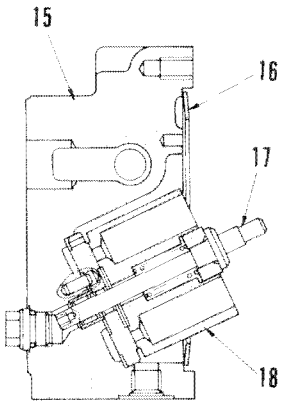


6. **Bearing**
1) Remove snap ring (10), then remove spacer (11) and ring (12).
2) Remove oil seal (13) and bearing (14).





7. **Cylinder block**
   Remove spring (16) from housing (15), then remove center shaft (17) and cylinder blocks (18).



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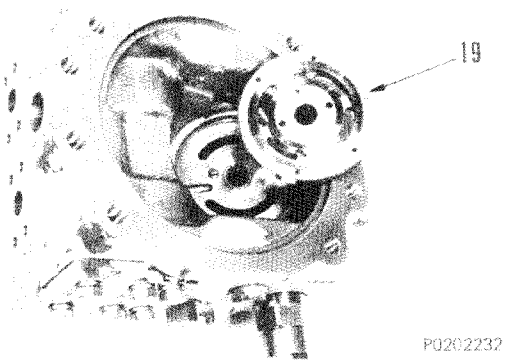
8. **Plate**
   Remove plate (19).



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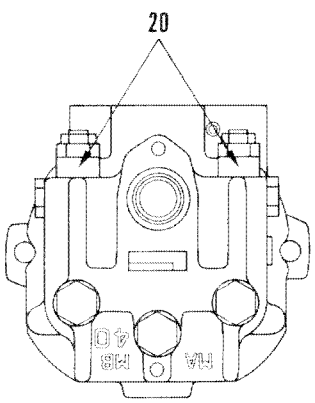
9. **Safety valve**
   Remove safety valve (20).



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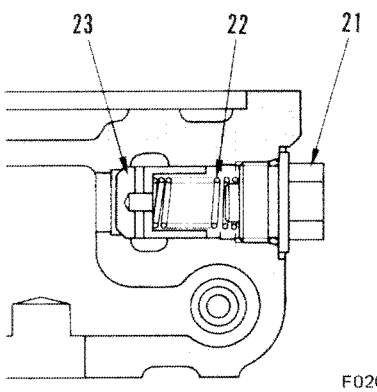
10. **Check valve**
    Remove plug (21), then remove spring (22) and valve (23).



F0202227

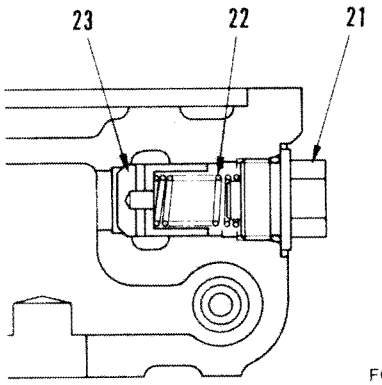
ASSEMBLY OF SWING MOTOR ASSEMBLY

Special tools required

No.	Part No.	Part Name	Q'ty
A	790-501-5000	Unit repair stand	1
A_1	790-901-2230	Plate	1
B	795-630-1803	Torque wrench set	1
B_1	796-720-2220	Socket	1
B_2	796-730-2120	Screwdriver	1
C	796-730-2000	Wrench	1
D	796-751-2900	Holder (Travel motor)	1

1. **Check valve**
   Assemble valve (23) and spring (22), then fit O-ring and install plug (21).

   kgm Plug: 7 ± 1 kgm



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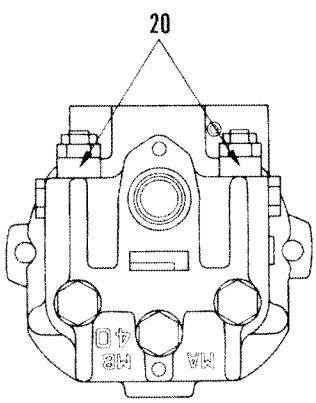
2. **Safety valve**
   Fit O-ring, and install safety valve (20).

   kgm Safety valve: 13 ± 1.5 kgm



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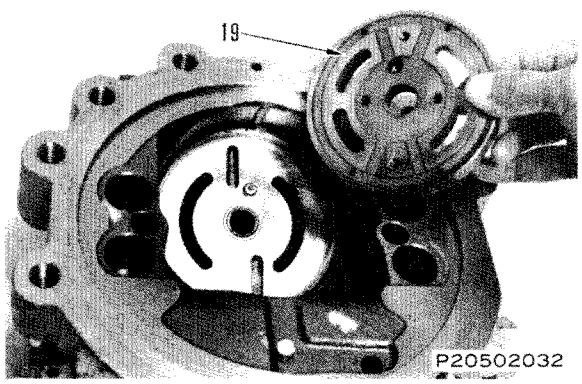
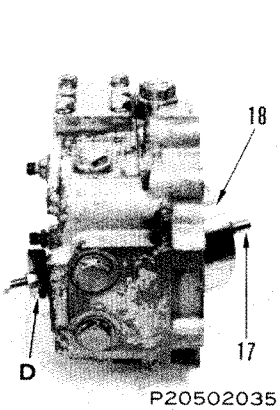
3. **Valve plate**
   Turn over housing, align dowel, then install valve plate (19).



P20502032

4. **Cylinder block**
   1) Install cylinder block (18), assemble center shaft (17), then use tool **D** to secure center shaft.
      ★ Coat end face of cylinder block with engine oil.
   2) Install springs (16) in housing (15).



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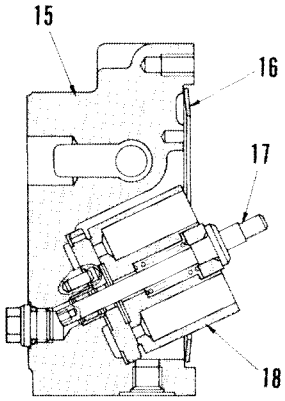

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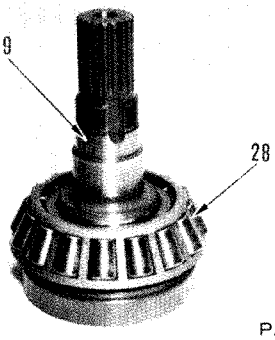
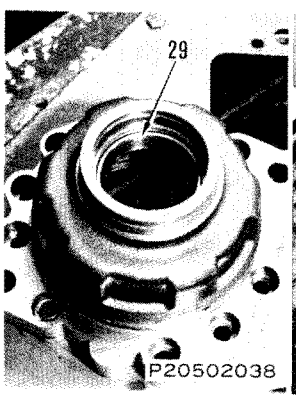
5. **Bearing**
   1) Press fit bearing (28) on shaft (9).

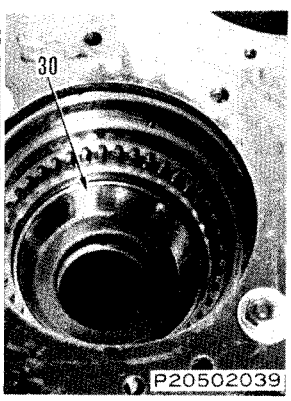


P20502037

   2) Press fit outer races (29) and (30) in brake case.



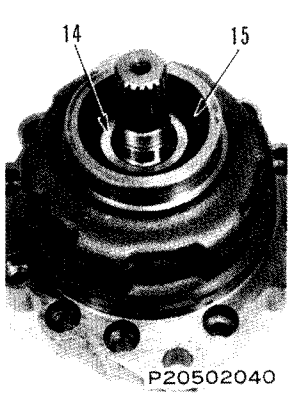
P20502038



P20502039

   3) Assemble output shaft (9) in brake case, then press fit bearing (14) and oil seal (13).
   4) Fit spacer (11), then install snap ring (10).
   5) Fit O-ring and ring(12), then partially tighten nut (8).

   Oil seal face: Grease (G2-LI)



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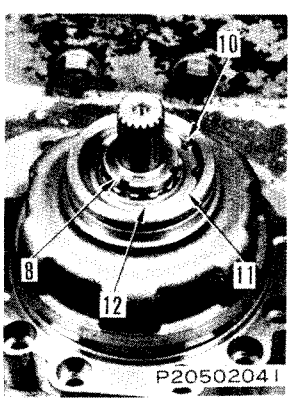
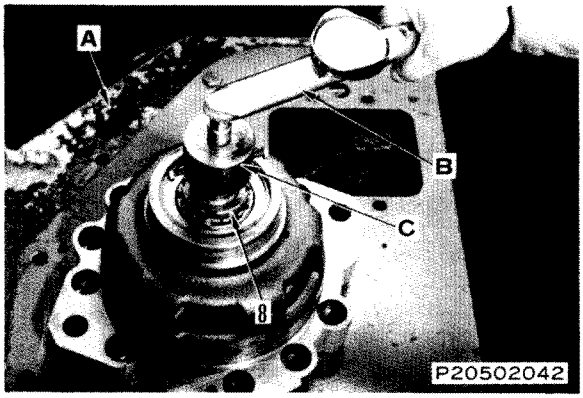


P20502041

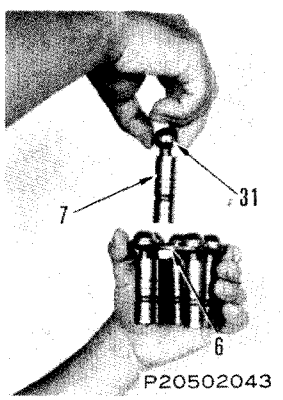
6. **Preload adjustment of output shaft**
   1) Install brake case to tool **A**.
   2) Tighten up the nut (8) using tool **B** and **C**.

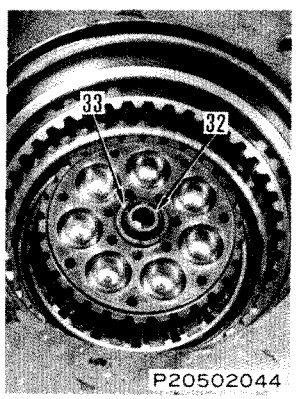
      kgm Rotational torque of shaft:
      0.15 – 0.25 kgm

      ★ Rotate the shaft at the rate of about one revolution every five seconds.
      ★ If the rotational torque becomes higher than the specified value, slacken off the nut completely to make the rotational torque zero, then retighten the nut.
      ★ After adjusting the rotational torque, bend the lock plate.
      ★ If the lock does not line up with the groove in the nut, either tighten up the nut within the range of the specified rotational torque or slacken it.

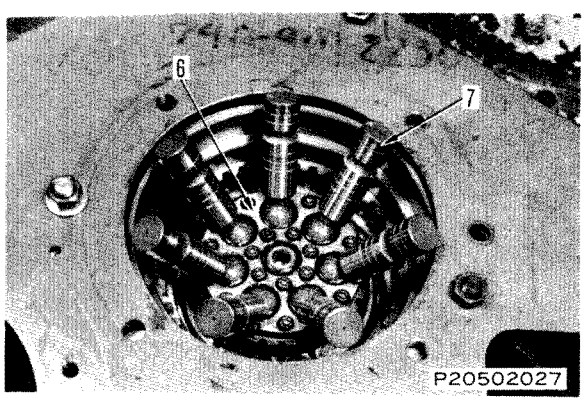


7. **Piston assembly**
   1) Install holder (31) on piston (7) and set assembly on retainer (6).
   2) Install center ball (32) and holder (33) on shaft.
      ★ Clean the spherical face of the shaft and coat lightly with engine oil.



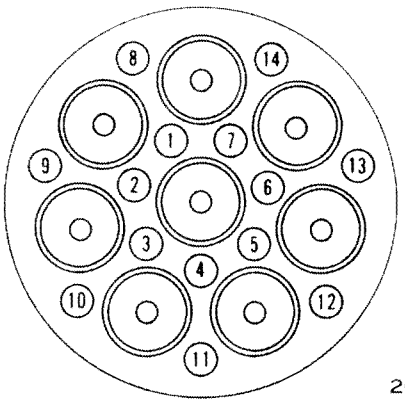


   3) Assemble piston to retainer, align with holder and set on shaft..
      ★ Coat the hole in the retainer for the mounting bolt with adhesive (LT-2), then completely remove any adhesive or oil from the side of the retainer.



4) Following the order in 206F255, tighten retainer mounting bolts with wrench **B**, $\mathbf{B_1}$ and $\mathbf{B_2}$, to the following tightening torque.

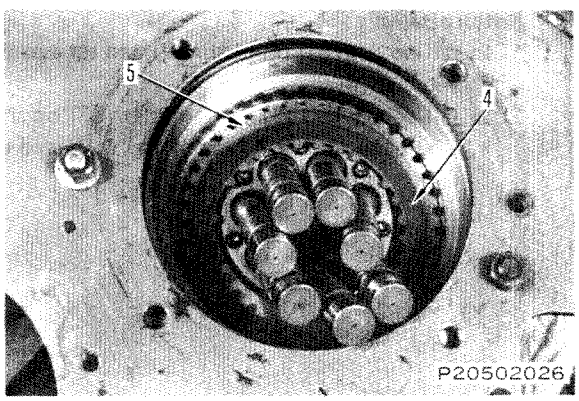
Retainer mounting bolt	Kgm
1st time	Max. 0.1 (temporary tightening)
2nd time	0.5 ± 0.1
3rd time	1.0 ± 0.1



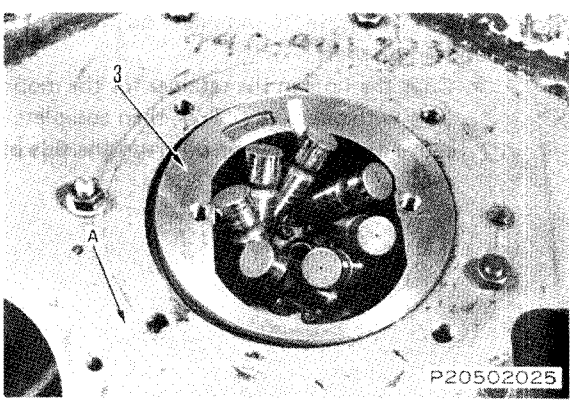
206F255

★ Completely remove all oil or grease from the mounting bolts before installing.
★ No thread tightener should come out after the bolts are tightened.
★ After tightening the mounting bolts, check that the piston moves freely and falls under its own weight.
★ If the piston does not move smoothly, loosen the mounting bolts, then tighten and check again.

8. Disc, plate
Install plates (5) and disc (4).



9. Brake piston
Fit O-ring and install brake piston (3).



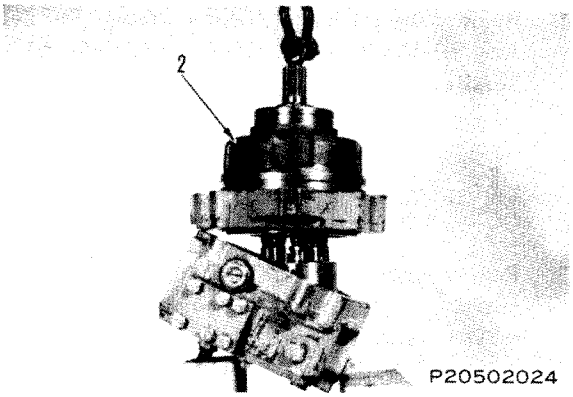
10. Brake case assembly

Fit O-ring, then using eye bolt (D = 10 mm, P = 1.5), lift brake case assembly (2).

Align piston assembly with cylinder block and install.

★ Set housing at about 25°.

★ Remove tool **D** after installing the brake case assembly.



REMOVAL OF SWING CIRCLE ASSEMBLY

1. Remove the work equipment assembly. For details, see REMOVAL OF WORK EQUIPMENT ASSEMBLY.

2. Disconnect the upper piping and links of the swivel joint. For details, see REMOVAL OF SWIVEL JOINT ASSEMBLY.

3. Remove installation bolts (1), then pull swing motor assembly (2) out of the swing machinery assembly.
   ★ The revolving frame can not swing because the brake is built into the swing motor, therefore it is necessary to remove the swing motor assembly.

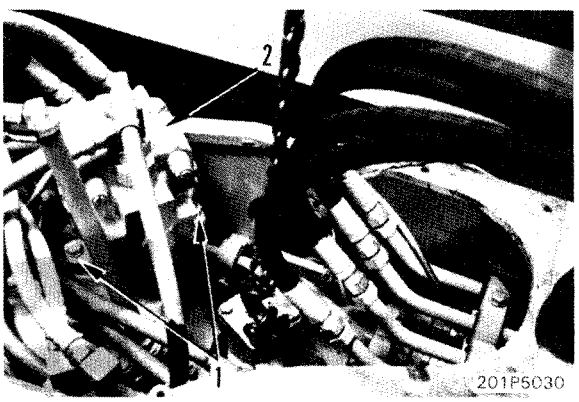
4. Remove the counterweight assembly.
   kg Counterweight assembly: 1,000 kg

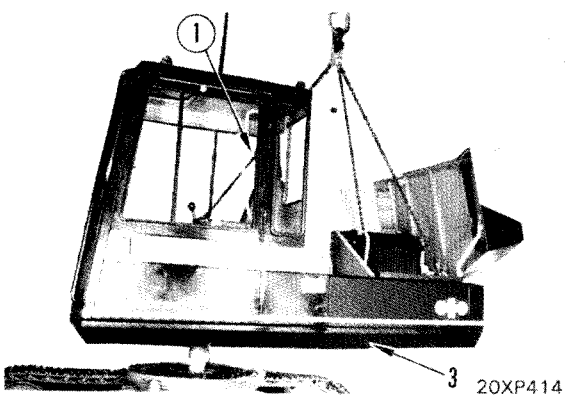
5. Remove the installation bolts for the revolving frame, leaving about two each installed at front and rear.
   ★ Remove the installation bolts while swinging the revolving frame.

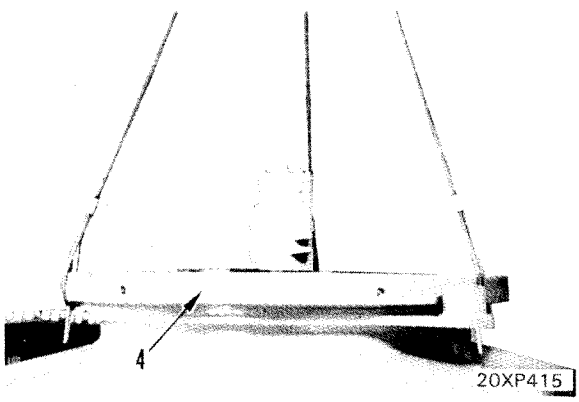
6. Hook a hanging tool at the counterweight installation portion and on the boom foot, then temporarily sling revolving frame assembly (3).

7. Using lever block (1), adjust the balance at front and rear, remove the remaining installation bolts, then remove the revolving frame assembly.
   kg Revolving frame assembly: 2,100 kg

8. Remove the installation bolts for the swing circle, then remove swing circle assembly (4).
   kg Swing circle assembly: 110 kg







INSTALLATION OF SWING CIRCLE ASSEMBLY

1. Set swing circle assembly (4) in the mounting position, then tighten the mounting bolts.
   ★ To install, turn the "S" mark on the circle to face the LH side of the frame.

   Installation bolts: Adhesive (LT-2)

   Installation bolts: 28.5 ± 3.5 kgm

2. Inject grease (G2-LI) into the swing circle to grease the inner gear.
   ★ Injection amount: approx. 5 ℓ

3. Hook a hanging tool to the counterweight and boom foot, sling revolving frame assembly (3), then adjust the balance in front and rear with lever block ①.

4. Set the revolving frame assembly in alignment with the dowel pin of the swing circle, then tighten the installation bolts.

   Installation bolts: Adhesive (LT-2)

   Installation bolts: 28.5 ± 3.5 kgm

   ★ Tighten the installation while turning the revolving frame.

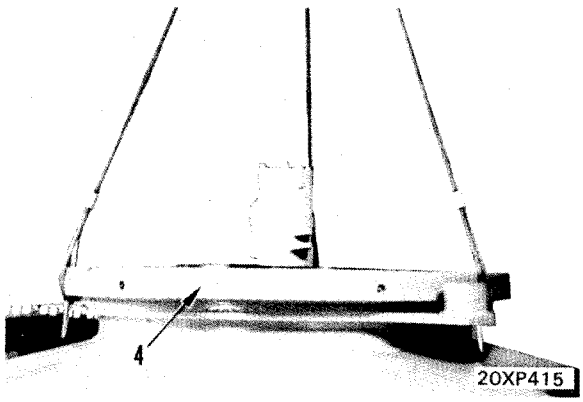
5. Fit an O-ring and install swing motor (2) to the swing machinery assembly with installation bolts (1).

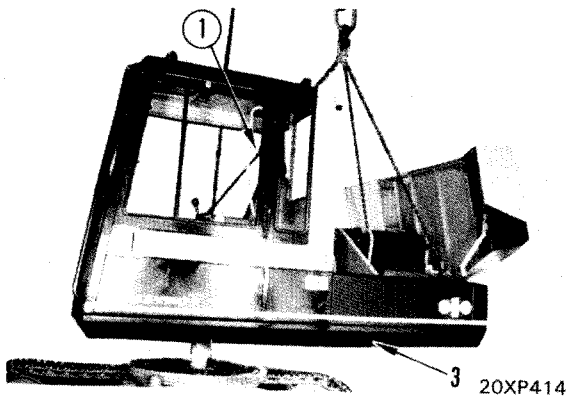
6. Connect the upper piping and links to the swivel joint. For details, see INSTALLATION OF SWIVEL JOINT ASSEMBLY.
   ★ Be sure to bend the cotter pin securely.

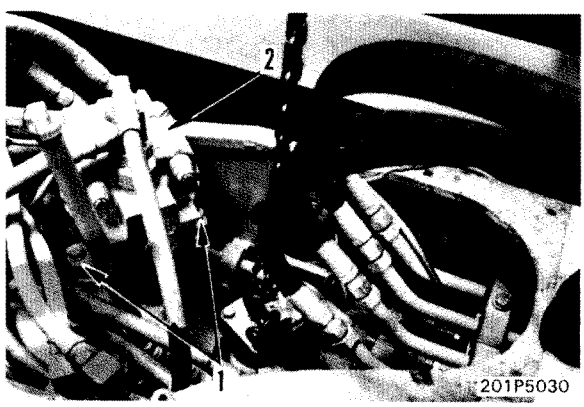
7. Install the counterweight assembly.

   Counterweight installation bolts: 56 ± 6 kgm

8. Install the work equipment. For details, see INSTALLATION OF WORK EQUIPMENT ASSEBMBLY.





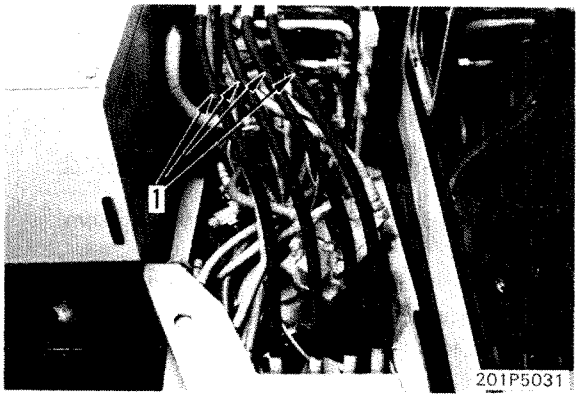


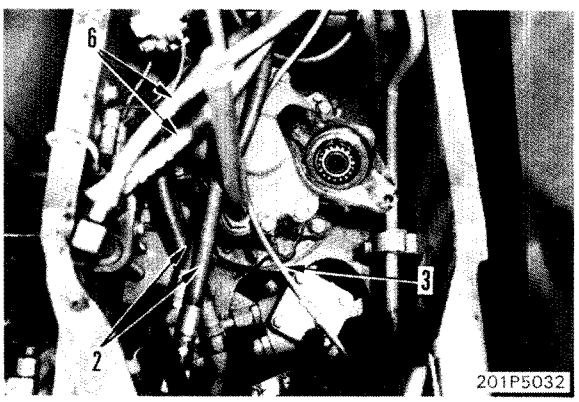
REMOVAL OF SWING MACHINERY ASSEMBLY

Lower work equipment completely to ground and stop engine. Operate control lever several times to release remaining oil pressure in hydraulic piping. Then remove oil filler cap slowly to release remaining oil pressure in hydraulic tank.

1. Disconnect work equipment hose (1) at the valve.
2. Remove the motor. For details, see REMOVING THE SWING MOTOR ASSEMBLY.
3. Disconnect swivel hose (2) and drain hose (3).
4. Remove installation bolts (5) and use eyebolt ① (D = 14 mm, P = 2.0) to remove swing machinery assembly (6).

   kg Swing machinery assembly: 65 kg





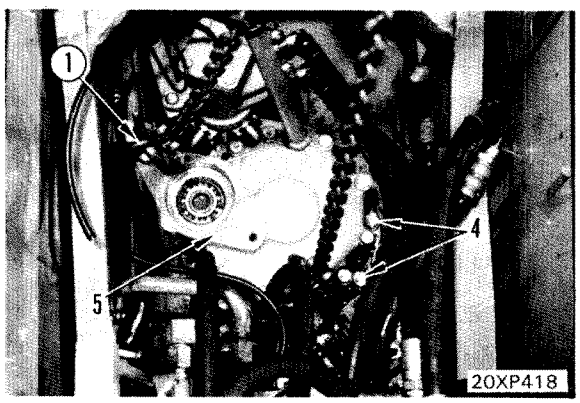
INSTALLATION OF SWING MACHINERY ASSEMBLY

★ Check the grease (G2-LI) in the circle gear chamber and add more if necessary.

1. Using eyebolt ① (D = 14 mm, P = 2.0) to install swing machinery (6), then tighten bolts (3).

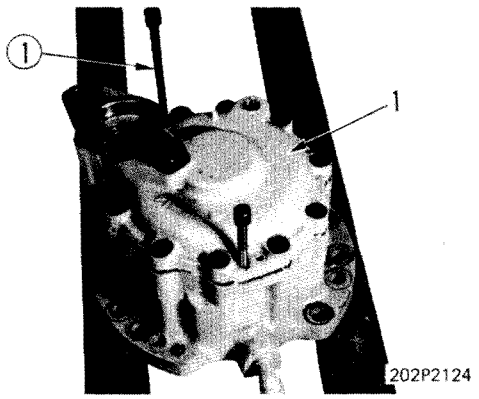
   kgm Installation bolts: 56 ± 6 kgm

2. Connect valve hose (3) and swivel hose (2).
3. Install the motor. For details, see INSTALLATION OF SWING MOTOR ASSEMBLY.
4. Connect work equipment hose (1).
5. Add engine oil through the filler to the specified level.
6. Start the engine to circulate the oil through the piping, then add oil to the specified level in the machinery case and hydraulic oil tank.



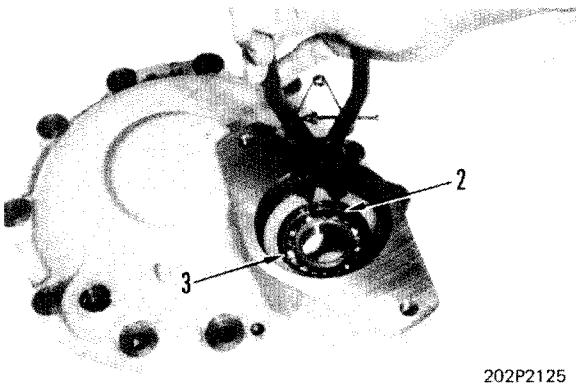
DISASSEMBLY OF SWING MACHINERY ASSEMBLY

1. **Cover**
   1) Remove the installation bolts.
      ★ Two bolts are installed on the lower side of the swing motor installation side.
   2) Using three extraction bolts ① (D = 12 mm, P = 1.75), remove cover (1).
      ★ Pull out the driven gear at the same time.



202P2124

   3) Disassemble the cover as follows.
      i) Remove snap ring (2) and remove bearing (3).



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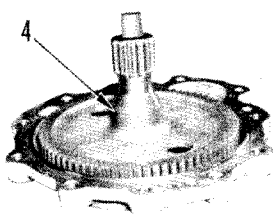
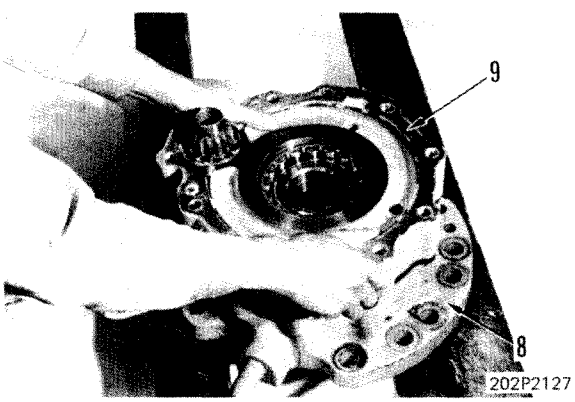
      ii) Remove gear (4).
      ★ Punch out the gear from the side from which the bearing was removed.



202P2126

2. **Case, small pinion gear**
   1) Remove the installation bolts.
      ★ One bolt is installed from the bottom.
   2) Prying between case (8) and case (9), remove case (9).
      ★ Be careful not to scratch the cases.



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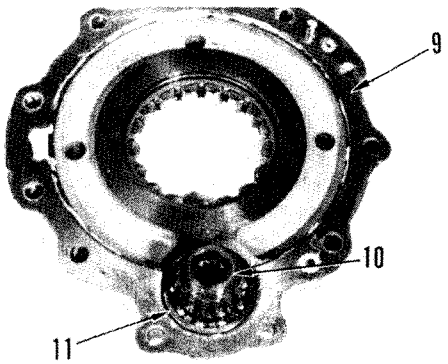
3) Remove small pinion gear (10) and bearing (11) from case (9).



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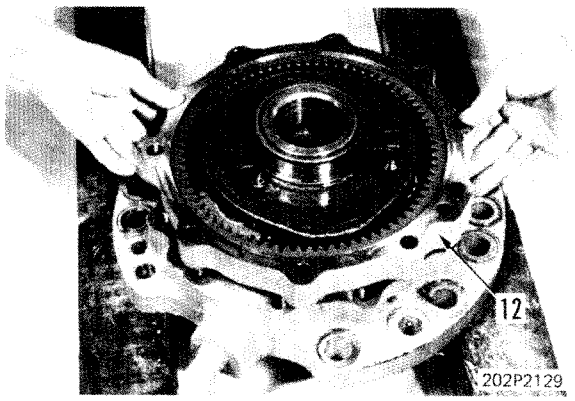
3. Ring gear

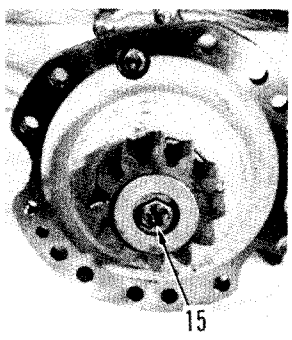
Remove ring gear (12).



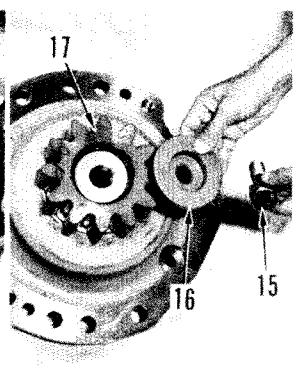
202P2129

4. Large pinion gear

1) Remove bolts (15), then remove holder (16).
2) Remove large pinion gear (17).



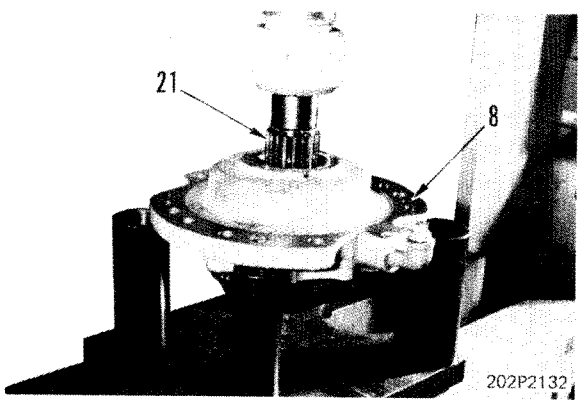
202P2130



202P2131

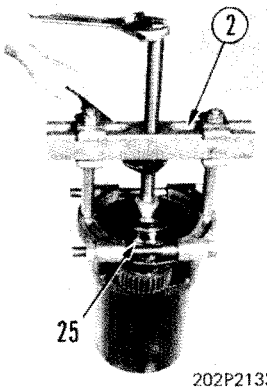
5. Carrier assembly

1) Receiving on case (8), use a press to push out carrier assembly (21).
   - ★ Pull out on the bearing inner race side.
   - ★ Extraction force for carrier assembly: Approx. 15 tons

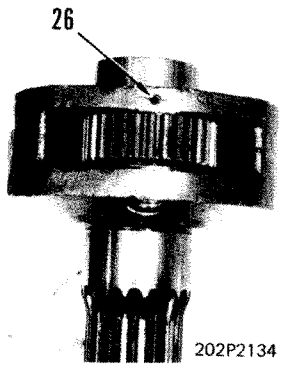


202P2132

2) Disassemble the carrier assembly as follows.
   i) Using puller ②, remove inner race (25).
   ii) Drive spring pin (26) into the shaft.

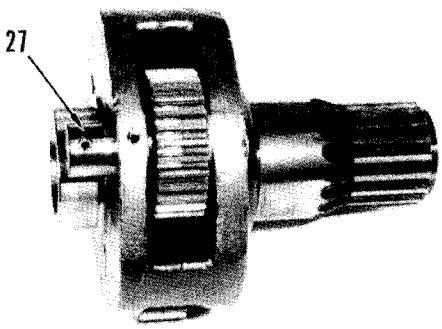


202P2133



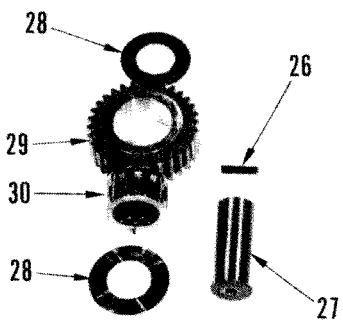
202P2134

iii) Pull out shaft (27) and remove it.



202P2135

iv) Remove thrust washer (28), gear (29), bearing (30), and spring pin (26).

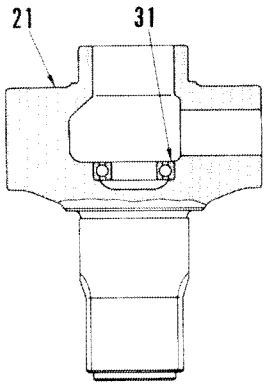


202P2136

ASSEMBLY OF SWING MACHINERY ASSEMBLY

Preparatory work

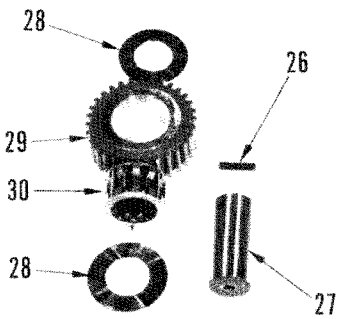
- Clean each part and correct any burrs.
- Apply engine oil to the bearings and sliding portions before assembling.



202F2016

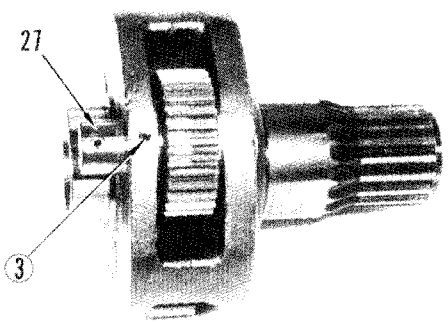
1. Carrier assembly

1) Assemble the carrier assembly as follows.
   i) Install bearing (31) (O.D.: 47 mm) to carrier (21).
   ii) Assemble bearing (30) to gear (29), put thrust washers (28) on both sides, then set carrier (21) in place.
   ★ Be sure to align the shaft holes.



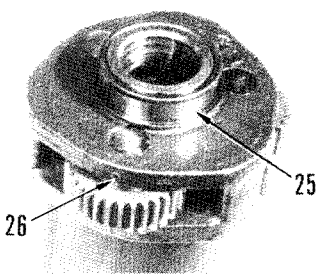
202P2136

iii) Align the pin holes, then install shaft (27).



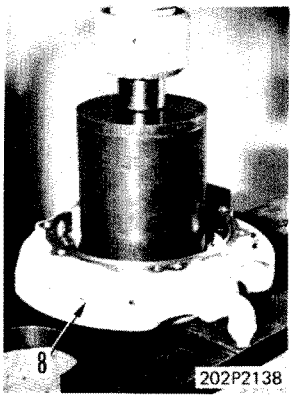
202P2135

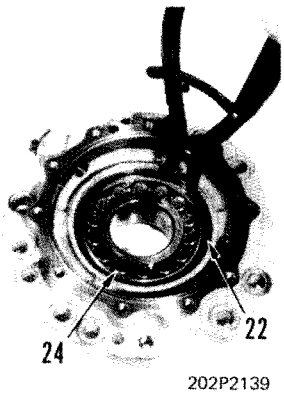
iv) Install spring pin (26).
v) Install inner race (25) by shrink fitting.
   ★ Shrink fitting temperature:
   100°C for approx 30 min.



202P2137

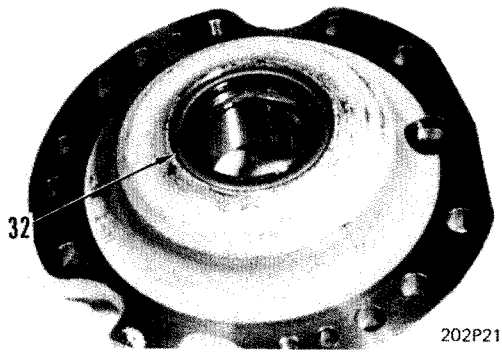
2) Install the following parts to the case.
   i) Press fit bearing (24) (O.D.: 150 mm) into case (8), the install snap ring (22).



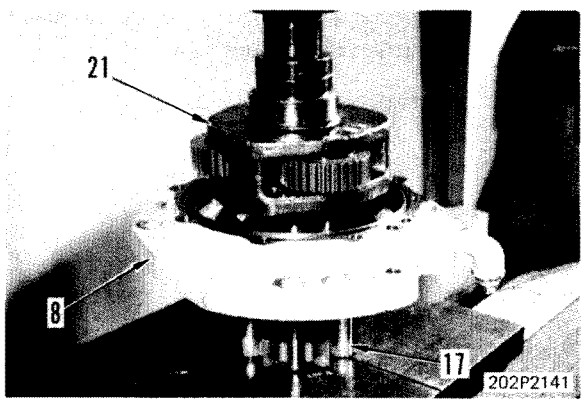


   ii) Install oil seal (32) (O.D.: 110 mm).

   Oil seal lip: Grease G2-LI

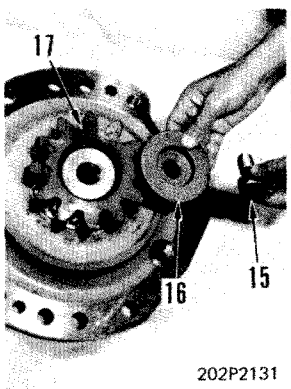


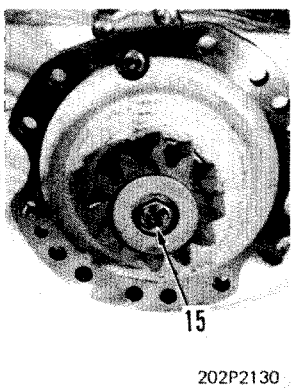
3) Assemble the carrier assembly as follows.
   i) Support the inner race of the bearing installed to case (8) with large pinion gear (17).
   ii) Set the spline of carrier assembly (21) in alignment with the pinion gear, then press fit into position.



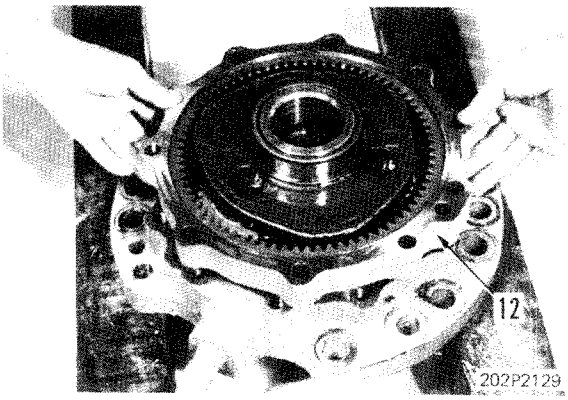
2. Large pinion gear
1) Install large pinion gear (17), an O-ring, and holder (16).
2) Tighten bolt (15).

   kgm Bolt: 28.2 ± 3.2 kgm

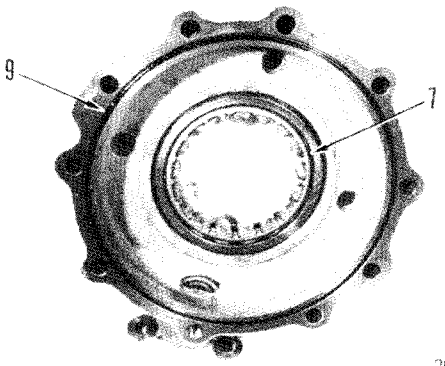




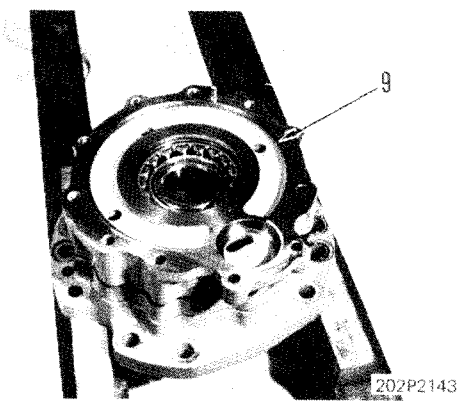
3. **Ring gear**
   Fit an O-ring and install ring gear (12).



4. **Case**
   1) Install bearing (7) (O.D.: 130 mm) to case (9).

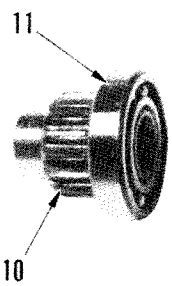


   2) Fit an O-ring, align a bearing with the inner race of the carrier, then install case (9).

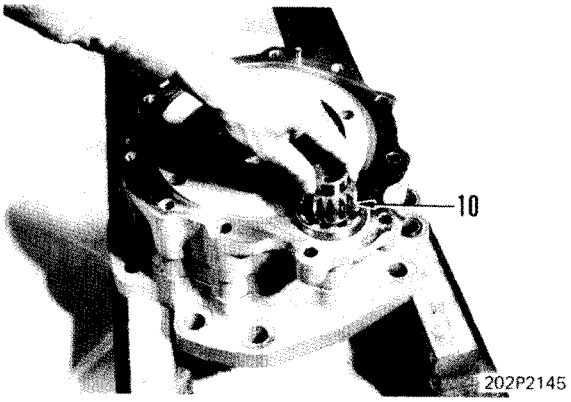


5. **Pinion gear**
   1) Install bearing (11) (I.D.: 35 mm) to small pinion gear (10).

   Bearing: Grease (G2-LI)

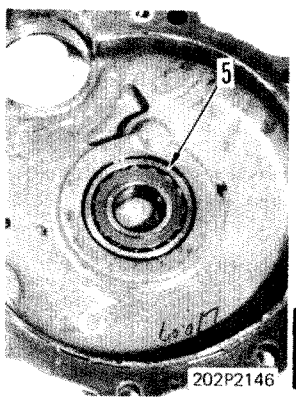


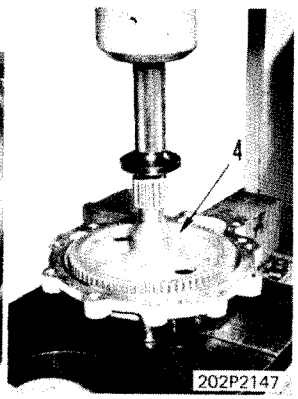
2) Install small pinion gear (10).



6. Cover

1) Install the following parts to the cover.
   i) Install bearing (5) (O.D.: 72 mm)
   ii) Install driven gear (4).



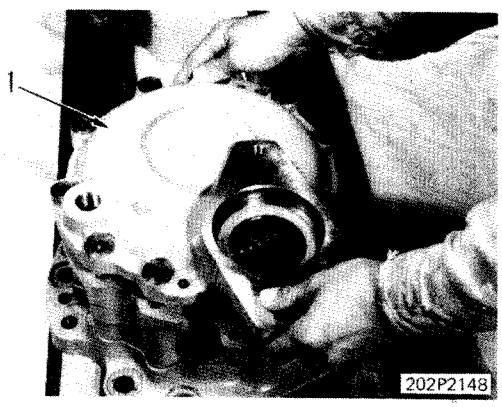


2) Apply liquid gasket, align the gear with the bearing inner race of the carrier, then install cover (1).

   Case: Liquid gasket (LG-6)

3) Tighten the installation bolts.
   ★ Three bolts are installed from below.

   kgm Installation bolts (12 mm):
   11.5 ± 1 kgm

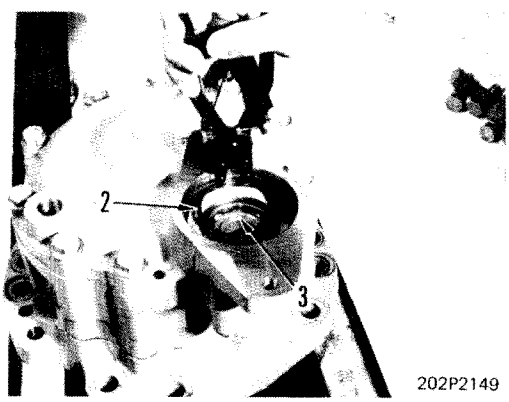


7 Bearing

1) Align bearing (3) with the small pinion gear and install it.

   Bearing: Grease (G2-LI)

2) Install snap ring (2).



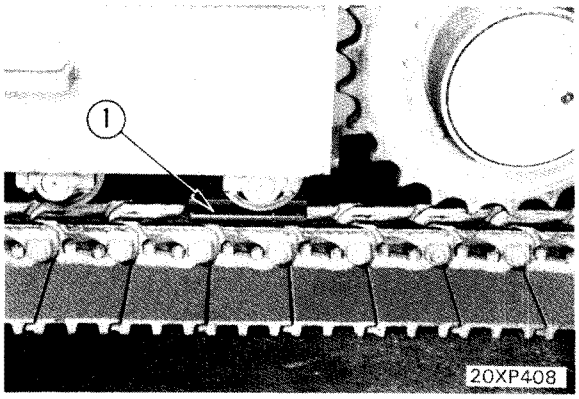
REMOVAL OF SPROCKET ASSEMBLY

1. Spread the track shoe assembly.
   For details, see SPREADING THE TRACK SHOE ASSEMBLY.

2. Swing the work equipment 90°, raise the machine, fit block (1) under the track roller, and float the sprocket tooth from the link.

3. Remove the installation bolts, then remove sprocket (1).

   kg Sprocket: 30 kg

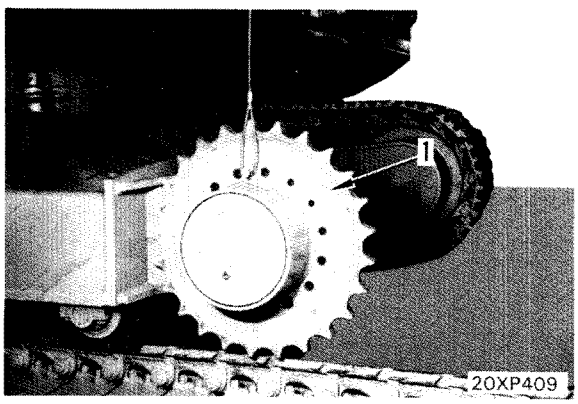


INSTALLATION OF SPROCKET ASSEMBLY

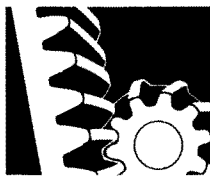
1. Set sprocket (1) on the motor, then tighten the installation bolts.

2. Raise the machine with the work equipment, remove block (1), then lower the machine.

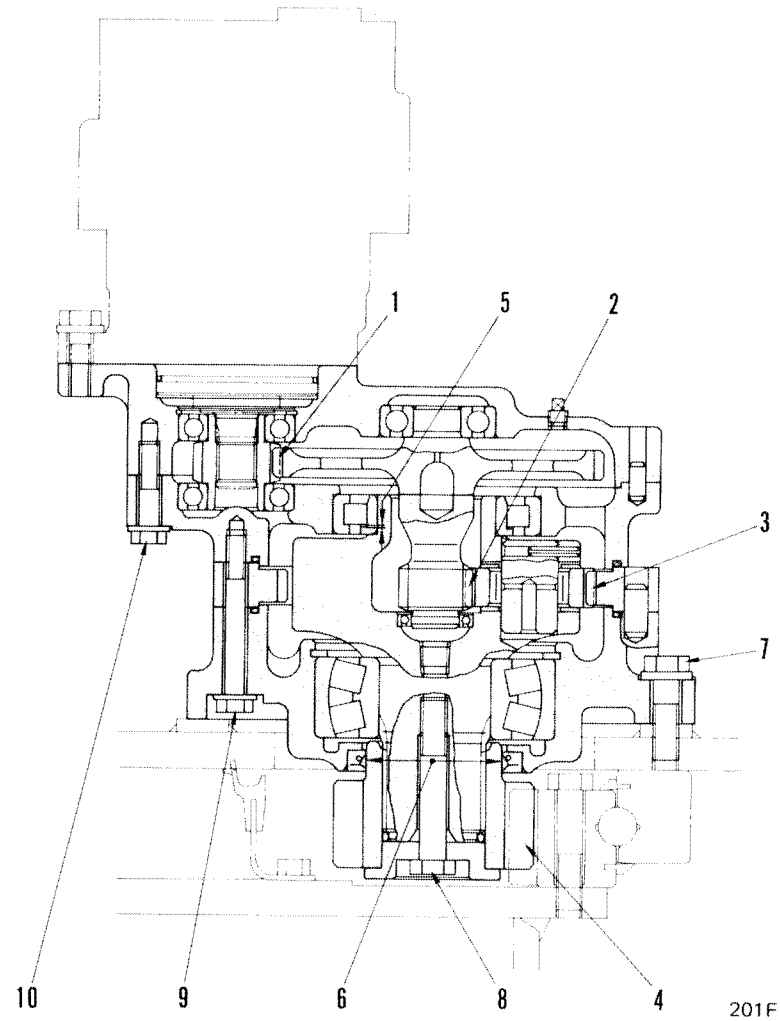
3. Install the track shoe assembly.
   For details, see INSTALLATION OF TRACK SHOE ASSEMBLY.



POWER TRAIN
24 MAINTENANCE STANDARD



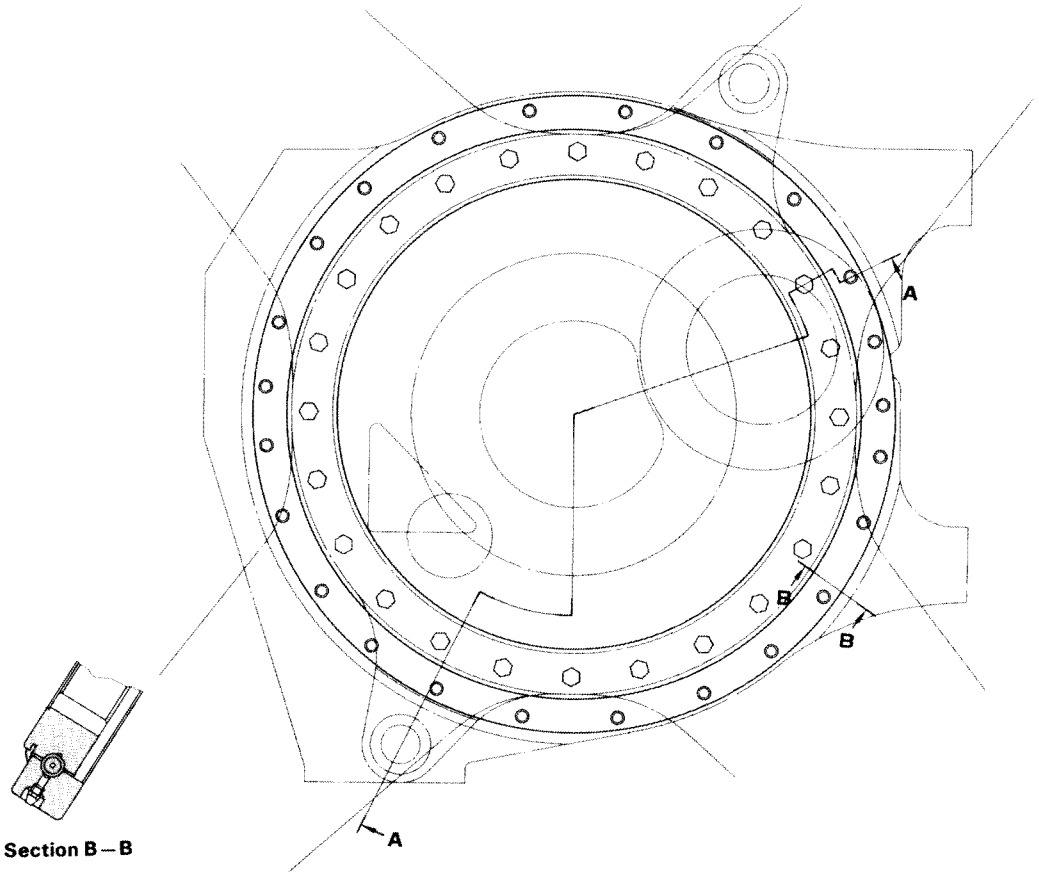
SWING MACHINERY



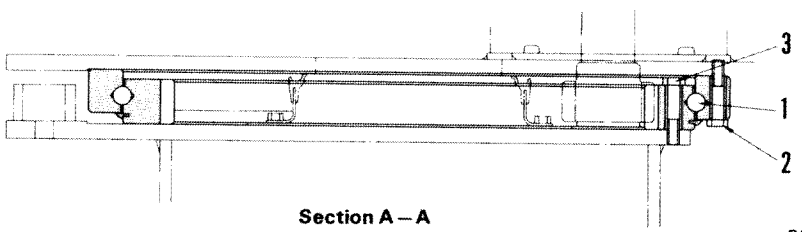
201F5118 Unit: mm

No.	Check item	Criteria		Remedy
1	Backlash between 1st pinion and 1st gear	Standard clearance	Clearance limit	Replace
		0.14 – 0.44	0.7	
2	Backlash between 2nd pinion and planet pinion	0.12 – 0.27	0.6	
3	Backlash between planet pinion and ring gear	0.16 – 0.46	0.8	
4	Backlash between output shaft and swing circle	0.31 – 0.96	2.0	
5	Swing pinion axial play	0.25 – 0.75	–	Adjust
6	Wear of output shaft collar surface contacting with oil seal	Standard size	Repair limit	Apply hard-chrome plating, recondition or replace
		$\phi 85^{0}_{-0.087}$	99.8	
7	Tightening torque of swing machinery mounting bolt	28.5 ± 3 kgm (Width across flats: 24)		Tighten
8	Tightening torque of swing pinion mounting bolt	28.5 ± 3 kgm		
9	Tightening torque of cage mounting bolt	11.5 ± 1 kgm		
10	Tightening torque of case mounting bolt	11.5 ± 1 kgm		

SWING CIRCLE



Section B—B



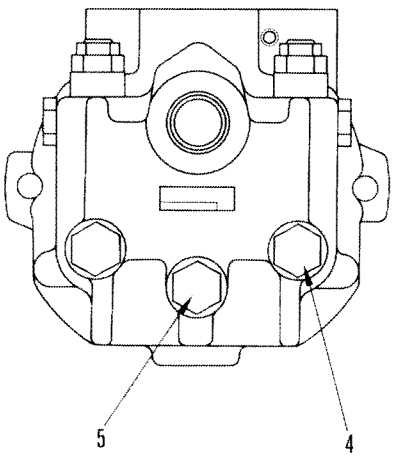
Section A—A

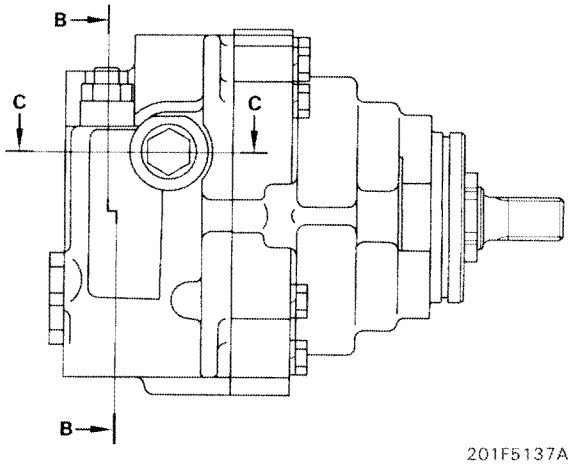
201F5119

Unit: mm

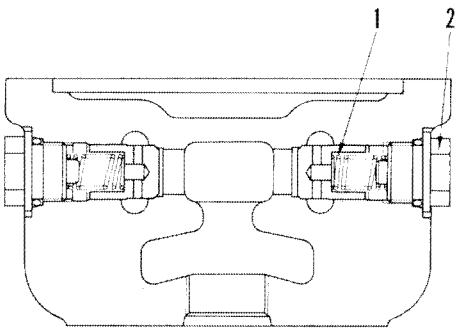
No.	Check item	Criteria		Remedy
1	Bearing axial clearance	Standard clearance	Clearance limit	Replace
		0.04 – 0.20	0.5	
2	Tightening torque for outer race bolt	28.5 ± 3 kgm		Tighten
3	Tightening torque for inner race bolt	28.5 ± 3 kgm		
4	Grease	Grease must not be badly contaminated or fouled in white. (grease capacity: 5.0 ℓ)		Replace

SWING MOTOR

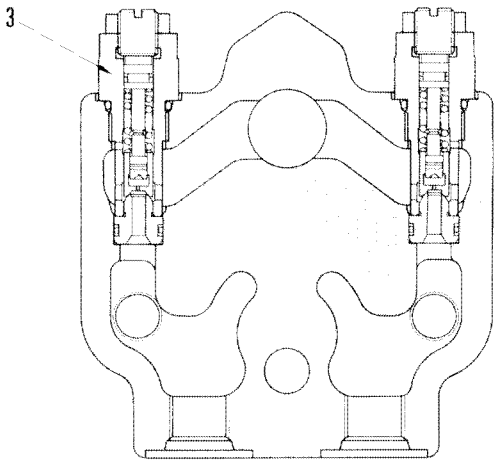




201F5137A



Section C – C



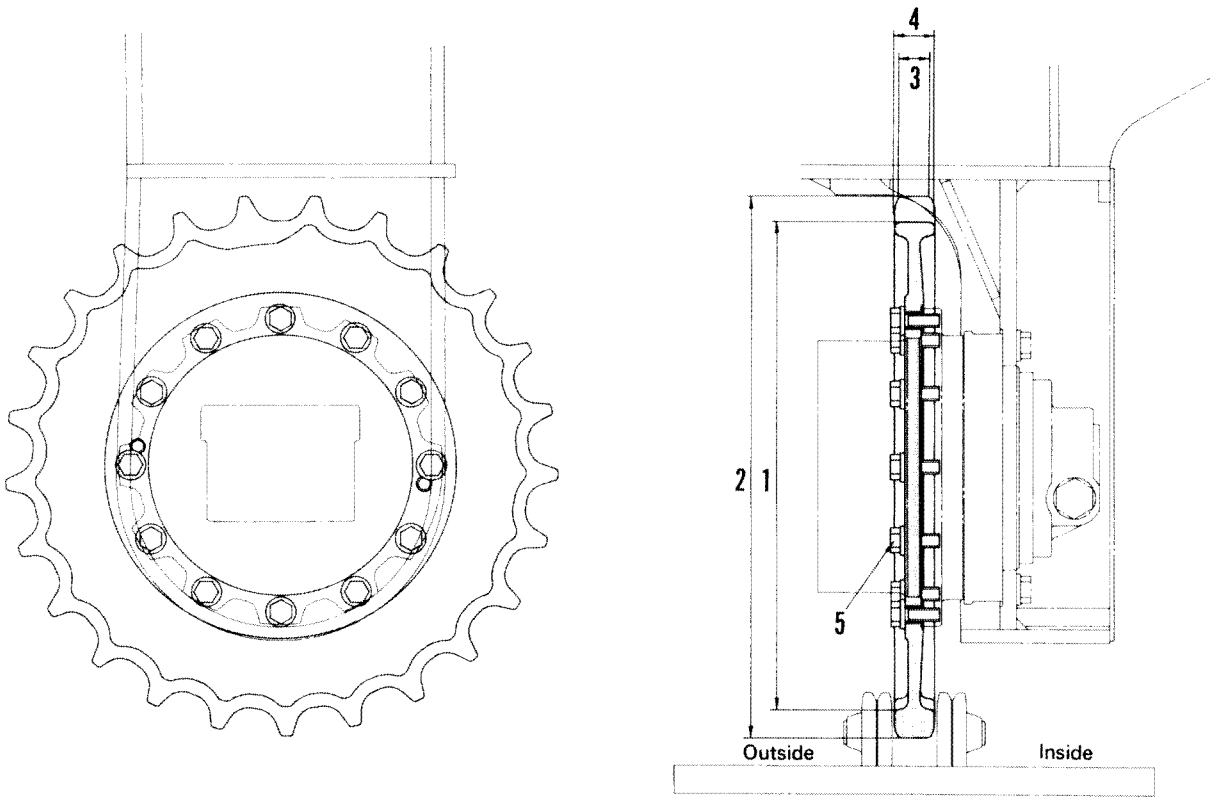
Section B – B

201F5121

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 if any damage or deformation is found.
		33.0 x 13.8	23	0.13 kg	30.7	0.10 kg	
2	Tightening torque of safety valve	13 ± 1.5 kgm					Tighten
3	Tightening torque of plug	13 ± 1.5 kgm					
4	Tightening torque of plug	8 ± 1.0 kgm					
5	Tightening torque of plug	5 ± 0.5 kgm					

SPROCKET



201F1051

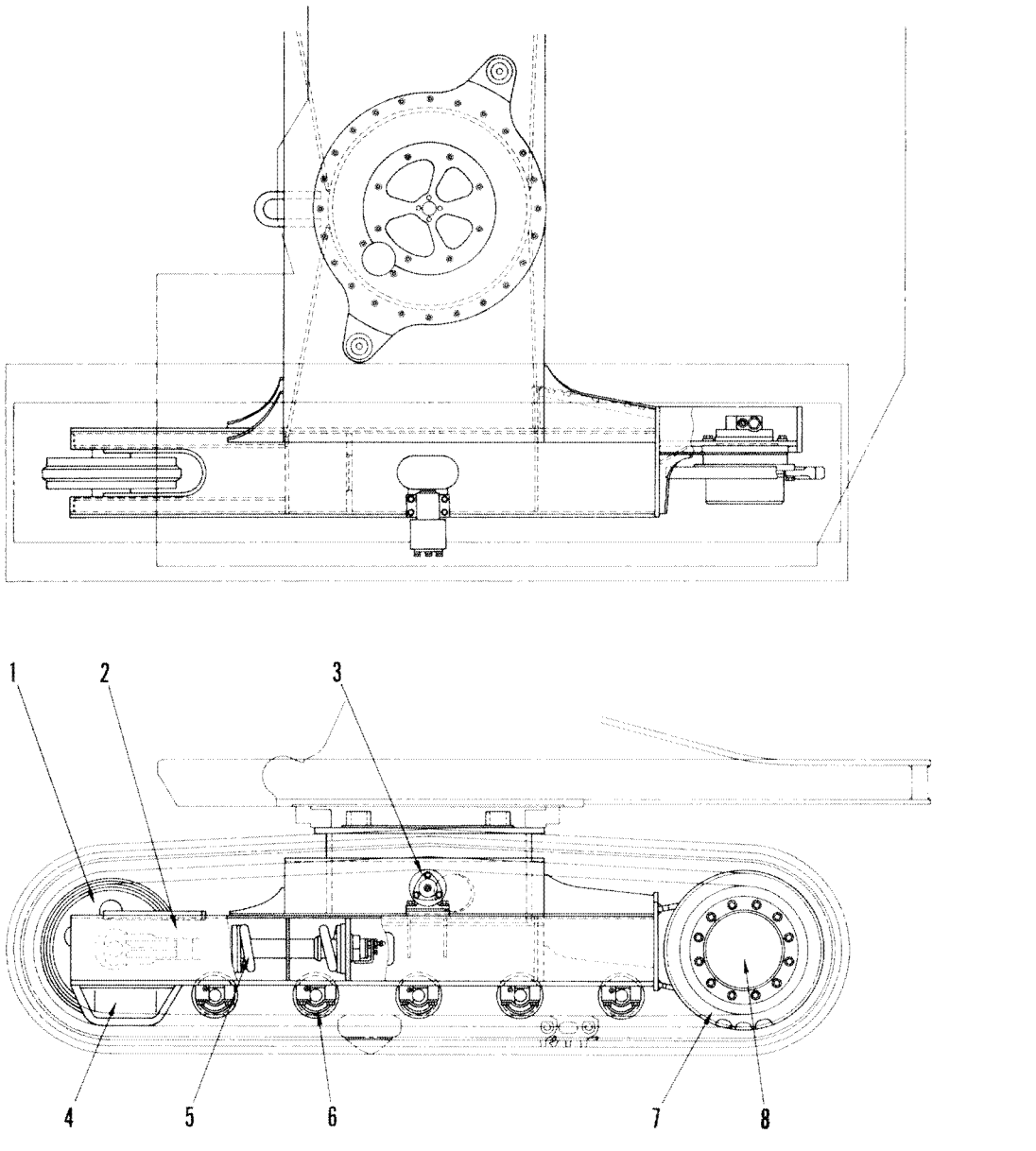
Unit: mm

No.	Check item	Criteria			Remedy
1	Wear in diameter of sprocket tooth root	Standard size	Tolerance	Repair limit	Repair by build-up welding or replace
		459.097	0 −3	453.1	
2	Wear in diameter of sprocket tooth top	513	±2	501	
3	Wear in width of sprocket tooth top	30	—	25	
4	Wear in width of sprocket tooth root	40	—	35	
5	Tightening torque of sprocket mounting bolt	18 ± 2 kgm			Tighten

UNDERCARRIAGE
31 STRUCTURE AND FUNCTION

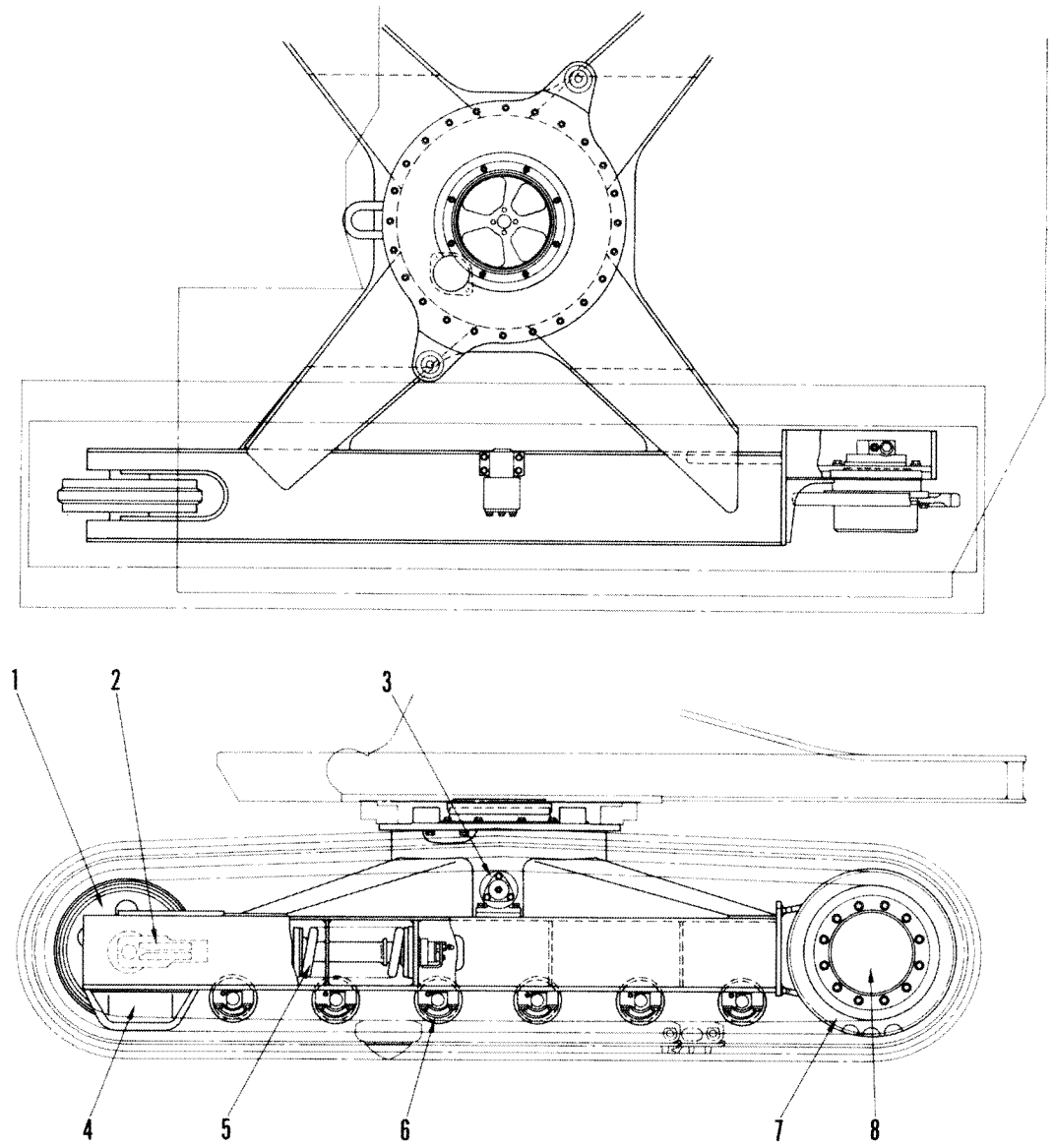
TRACK FRAME

PC60, 60U-5



201F5047

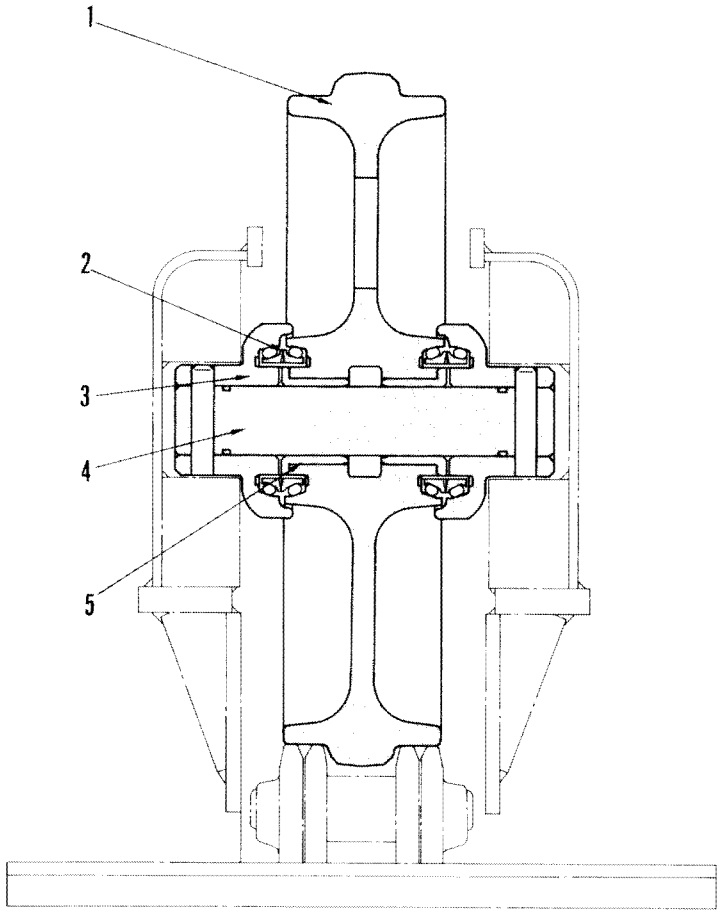
1. Idler
2. Track frame
3. Carrier roller
4. Front guard
5. Recoil spring
6. Track roller
7. Sprocket
8. Travel motor



201F5048

1. Idler
2. Track frame
3. Carrier roller
4. Front guard
5. Recoil spring
6. Track roller
7. Sprocket
8. Travel motor

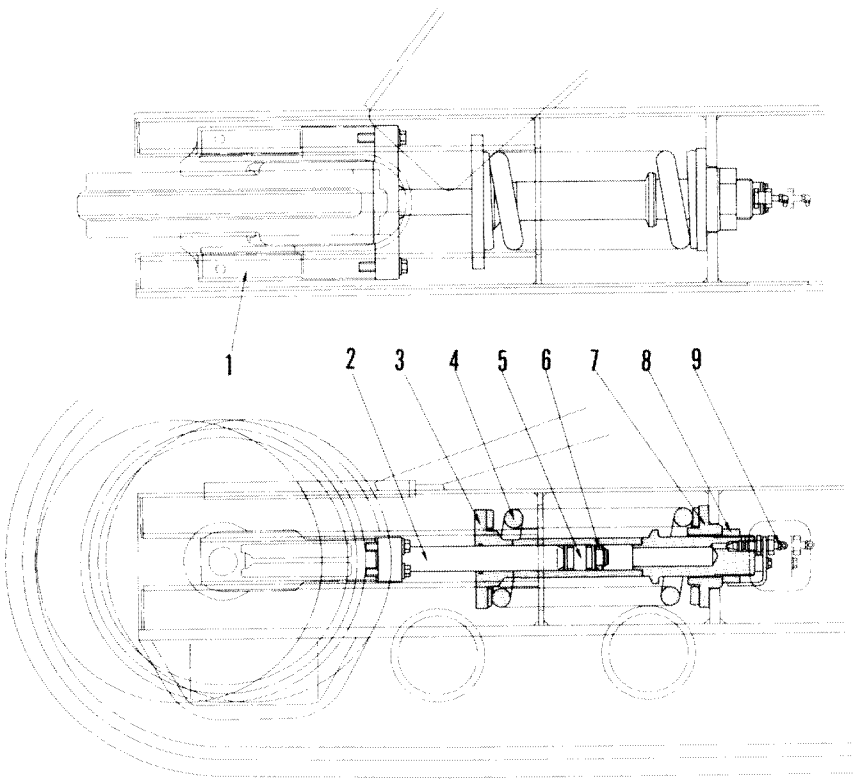
IDLER

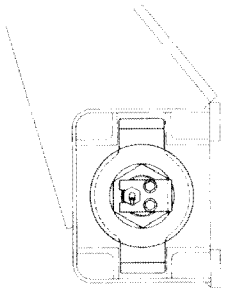


1. Idler
2. Floating seal
3. Bearing support
4. Idler shaft
5. Bushing

201F5049

RECOIL SPRING

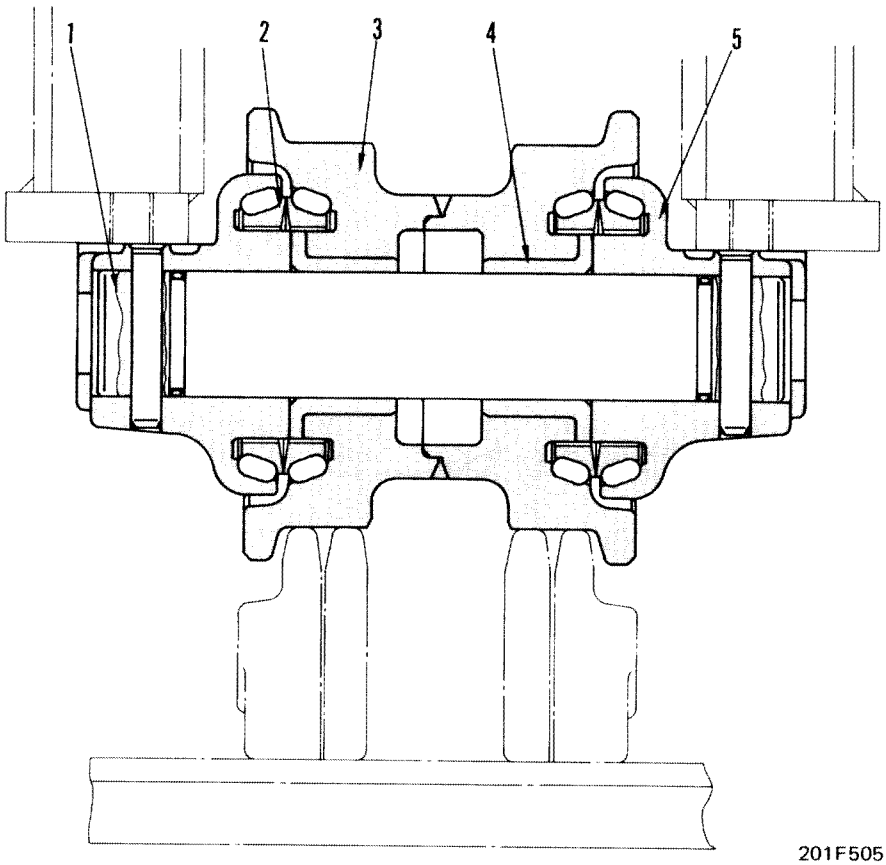




201F5050

1. Yoke
2. Rod
3. Front support
4. Recoil spring
5. Wear ring
6. Packing
7. Rear support
8. Nut
9. Lubricator

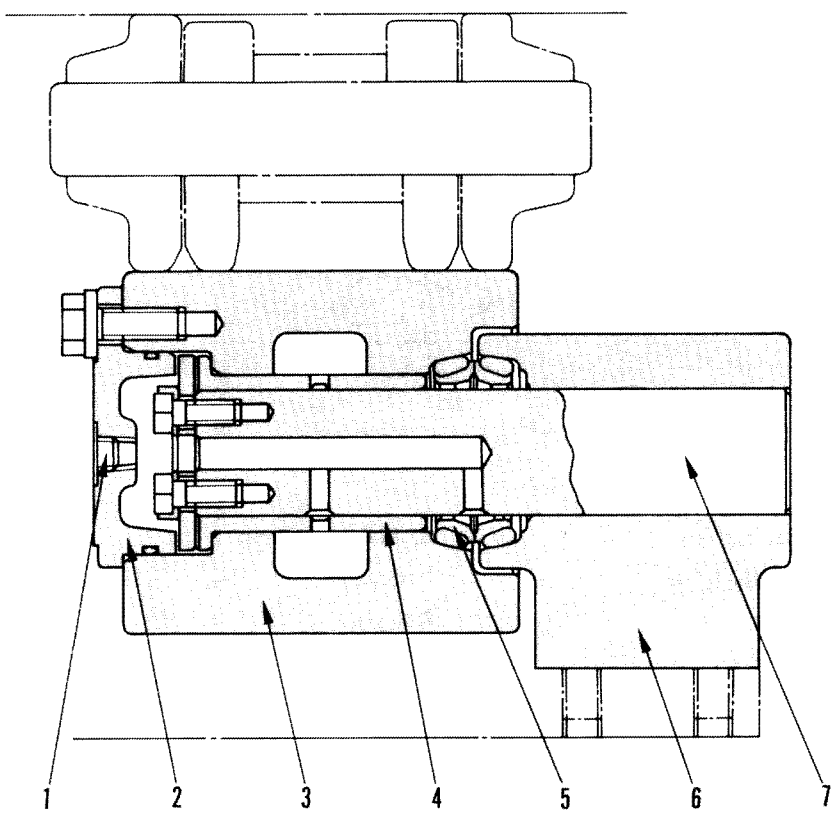
TRACK ROLLER



201F5051

1. Shaft
2. Floating seal
3. Track roller
4. Bushing
5. Collar

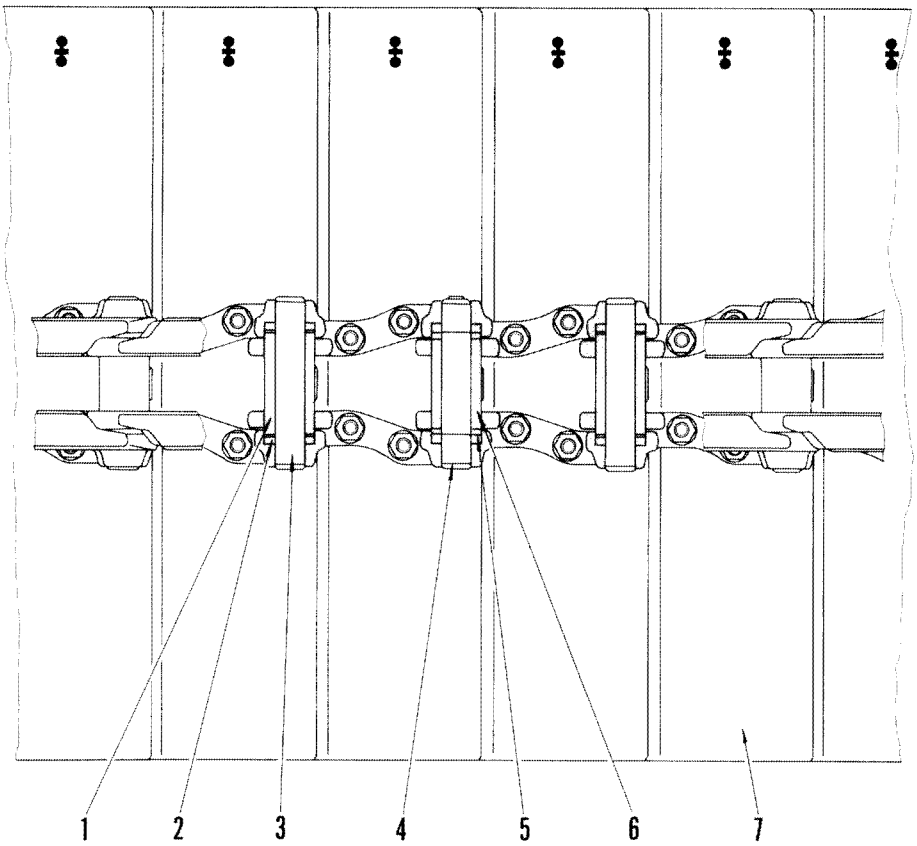
CARRIER ROLLER

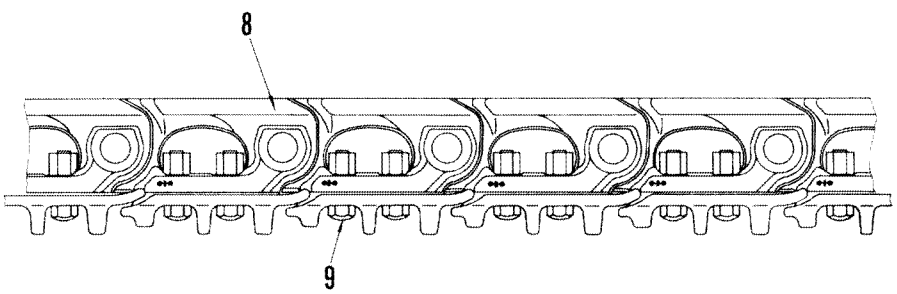


F0202053A

1. Cover
2. Carrier roller
3. Bushing
4. Floating seal
5. Collar
6. Shaft
7. Lubricating plug

TRACK SHOE





201F028

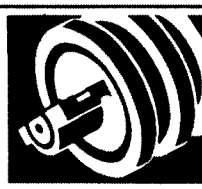
1. Regular bushing
2. Regular dust seal
3. Regular pin
4. Master pin
5. Master dust seal
6. Master bushing
7. Shoe
8. Link
9. Shoe bolt

TRACK SHOE

Model	Shoe type	Shoe width (mm)	Ground pressure (kg/cm^2)	Application
PC60-5	Triple-grouser	450 (Standard)	0.31	For general ground
		610	0.24	
	Swamp	510	0.28	For muddy ground
		700	0.20	For extremely muddy ground
	Flat	480	0.29	For pavement, etc.
PC60L-5	Triple-grouser	610 (Standard)	0.22	For general ground
		710	0.19	
	Swamp	510	0.26	For muddy ground
		700	0.19	For extremely muddy ground
PC60U-5	Triple-grouser	450 (Standard)	0.35	For general ground
	Swamp	510	0.31	For muddy ground
	Flat	480	0.32	For pavement, etc.

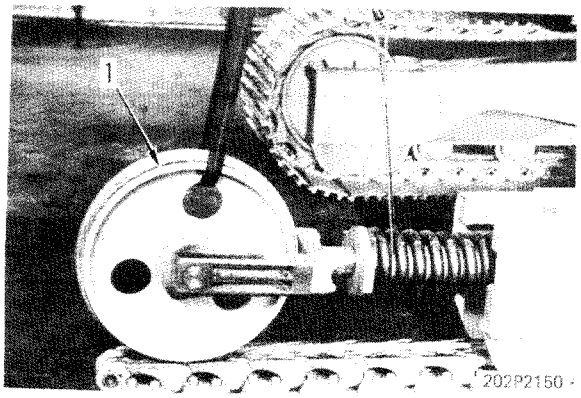
UNDERCARRIAGE

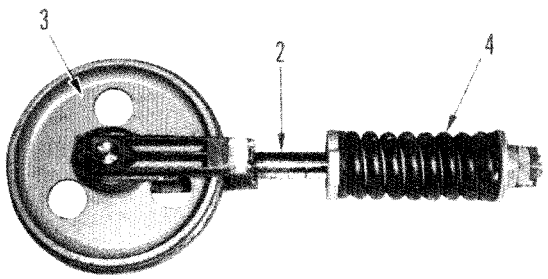
33 DISASSEMBLY AND ASSEMBLY



REMOVAL OF RECOIL SPRING ASSEMBLY

1. Remove track shoe assembly.
   For details, see 33 REMOVAL OF TRACK SHOE ASSEMBLY.
2. Remove idler assembly.
   For details, see 33 REMOVAL OF IDLER ASSEMBLY.
3. Raise recoil spring assembly (1) and remove to front.
   kg Recoil spring assembly: 95 kg
4. Remove recoil spring assembly (1) and idler (3).

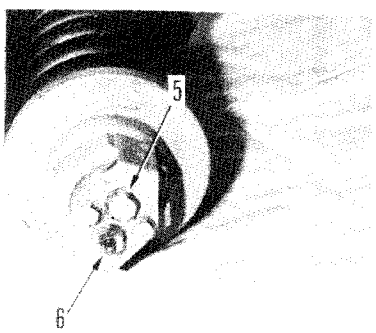




202P2151

INSTALLATION OF RECOIL SPRING ASSEMBLY

1. Remove cap (5) or lubricator (6), push in shaft assembly (2) and idler (3), then connect to recoil spring assembly (4).
2. Install cap (5) or lubricator (6), then set idler-recoil spring assembly (1) into the installation position on the frame.
3. Align pilot (7) of recoil spring assembly (4) with the installation position on the frame, then push it in.
4. Install the track shoe assembly. For details, see INSTALLATION OF TRACK SHOE ASSEMBLY.



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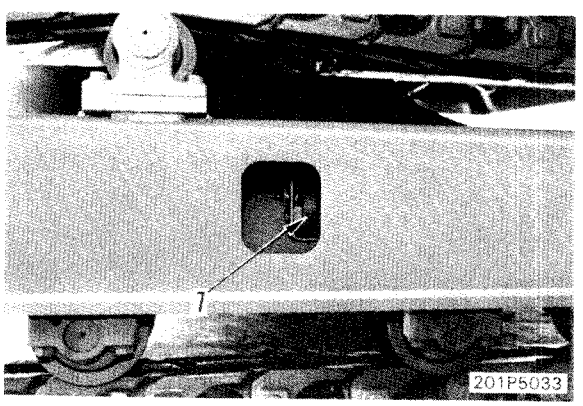
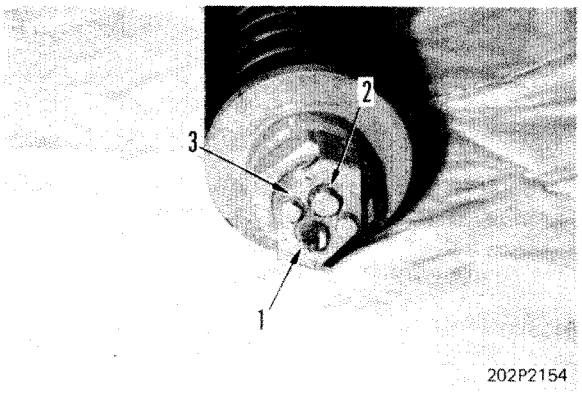


DISASSEMBLY OF RECOIL SPRING ASSEMBLY

Tools required

	Part No.	Part Name	Q'ty
A	791-685-8003	Compressor kit	1
B	790-101-1600	Cylinder assembly (70 ton)	1
C	790-101-1102	Pump assembly	1

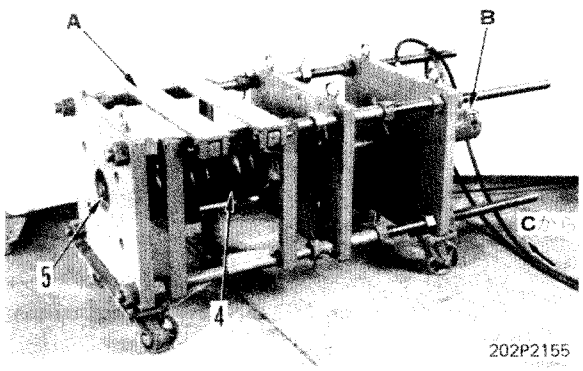


202P2154

1. Remove lubricator (1), cap (2) and plate (3).
2. Set recoil spring assembly (4) onto tool A.
3. Slowly apply hydraulic pressure, tighten the spring, and remove nut (5).

   The installation load of the spring is large and could create a hazard, so apply the hydraulic pressure gradually.

   ★ Spring installation load: 4,350 kg

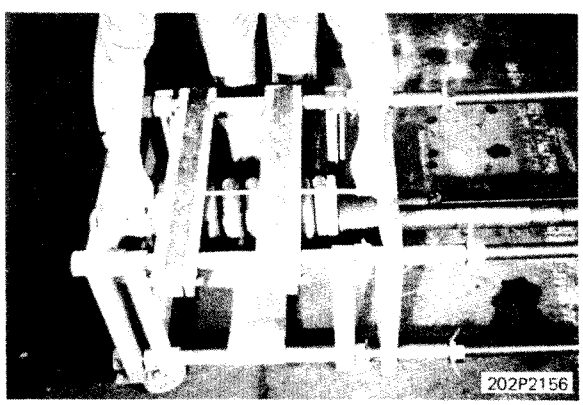


202P2155

4. Gradually release the hydraulic pressure to release the spring tension, then disassemble into shaft (6), spring (7), pilot (8), and piston (9).

ASSEMBLY OF RECOIL SPRING ASSEMBLY

1. Install piston (9) to shaft (6), then set spring (7) and pilot (8) on tool A.
   ★ Install wear ring (10), packing (11), and snap ring (12) to piston (9).
2. Gradually apply hydraulic pressure to compress the spring, install nut (5), then fix the plate.
   ★ Installed length of spring: 332 mm
3. Install cap (2), lubricator (1), and plate (3).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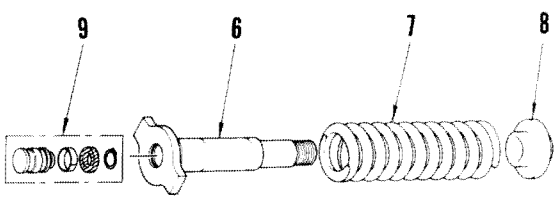

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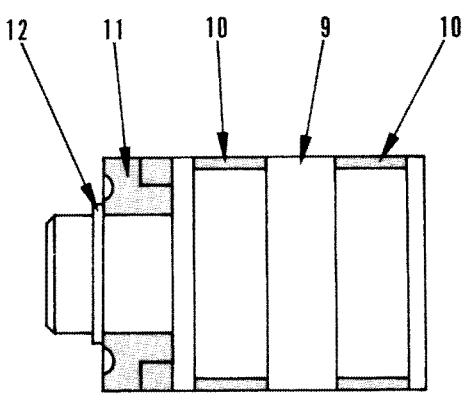

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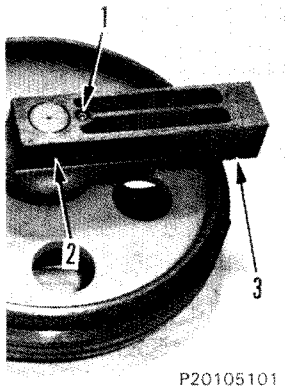
DISASSEMBLY OF IDLER ASSEMBLY

1. Remove plug (1).
2. Remove dowel pin (2).
3. Remove support (3), then remove floating seal.
4. Remove idler (4) from shaft (5), then remove top and bottom floating seals.
5. Remove top and bottom bushings (6) from idler (4).
6. Remove floating seal from support, top out dowel pin (7), then remove shaft (5) from support (8).



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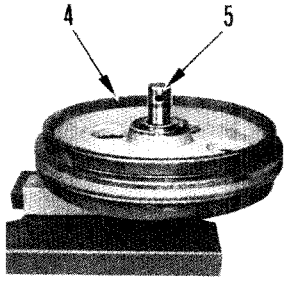

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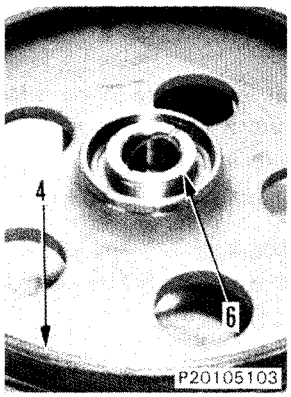
ASSEMBLY OF IDLER ASSEMBLY

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil (EO30-CD) before installing.

1. Fit O-ring to shaft (5), push in support (8), and knock in dowel pin (7), then install floating seal to support.
2. Using push tool ① , press fit top and bottom bushings (6) to idler (4).
3. Assemble top and bottom floating seals to idler (4), and install to shaft (5).
4. Assemble floating seal in support (3), then fit O-ring and push in shaft.
5. Using push tool ② , compress support and knock in dowel pin (2).
   ★ Compress the support enough to fit the dowel pin. Do not compress it any further.
6. Pour in oil through plug hole, then install plug (1).

Oil: 60 cc (EO30-R)



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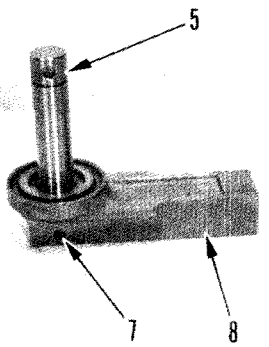

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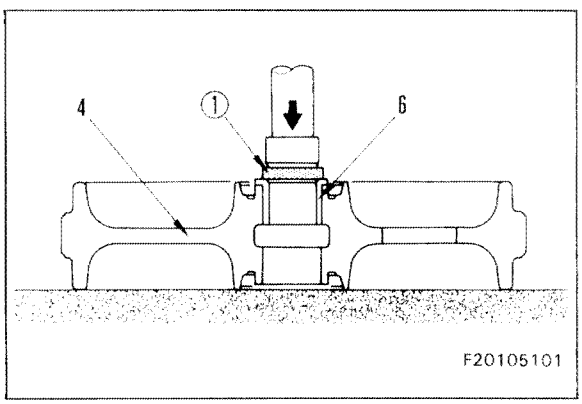

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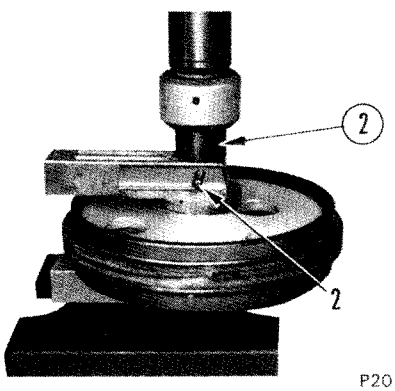


P20105105

REMOVAL OF TRACK ROLLER ASSEMBLY

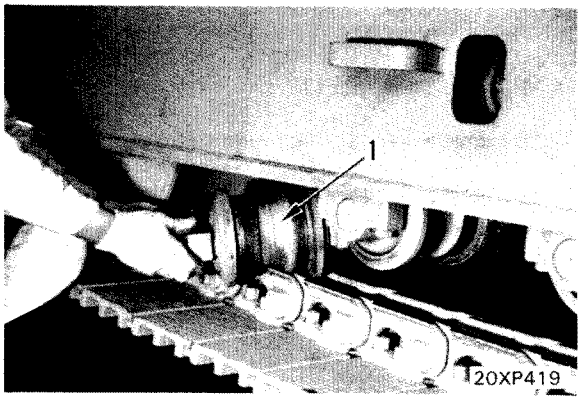
1. Lower work equipment completely to ground, then loosen lubricator one turn to relieve track tension.

   The adjustment cylinder is under extremely high pressure. Never loosen the lubricator more than one turn.

   ★ If the track tension is not relieved, move the machine backwards and forwards.

2. Remove four track roller mounting bolts.

3. Using work equipment, raise machine and remove track roller assembly (1).



INSTALLATION OF TRACK ROLLER ASSEMBLY

1. Install plate on inner flange part, face oil filler plug outwards and set track roller assembly (1) on track link.

2. Lower machine carefully to ground and temporarily tighten track roller mounting bolts.

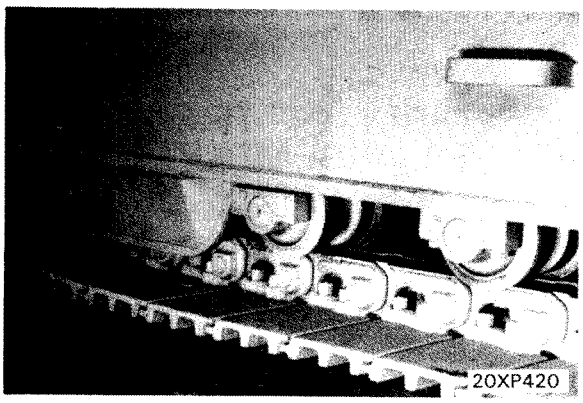
   Bolt: Thread tightener (LT-2)

3. Lower machine completely to ground and tighten track roller mounting bolts fully.

   Mounting bolt: 17.5 ± 2.5 kgm

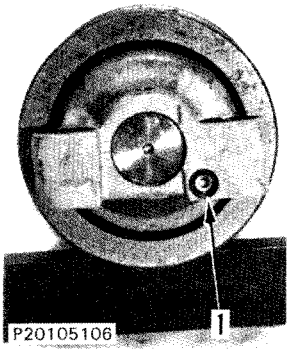
4. Tighten lubricator, then pump in grease (G2-LI) to adjust track tension.

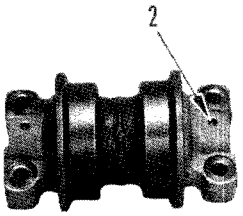
   ★ For details, see 33 INSTALLATION OF TRACK SHOE ASSEMBLY.



DISASSEMBLY OF TRACK ROLLER ASSEMBLY

1. Remove plug (1).
2. Remove dowel pin (2).
3. Remove collar (3), then remove floating seal (4).
4. Remove roller (5) from shaft (6), then remove floating seal under roller.
5. Remove top and bottom bushings (7) from roller (5).
6. Remove dowel pin (8), then remove collar (9) from shaft (6).



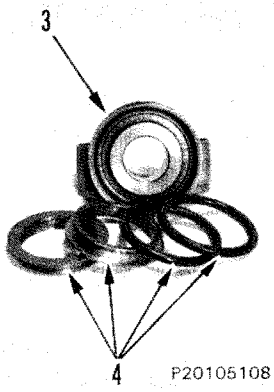


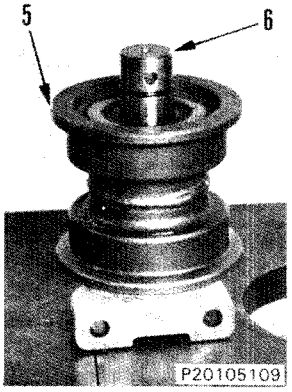
ASSEMBLY OF TRACK ROLLER ASSEMBLY

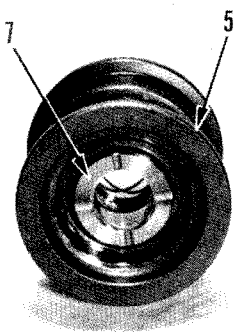
★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil (EO30-CD) before installing.

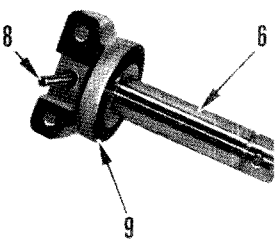
1. Assemble O-ring to shaft (6), install collar (9), then knock in dowel pin (8).
2. Using push tool (1), press fit top and bottom bushings (7) to roller (5).
3. Assemble floating seal, and install roller (5) to shaft (6).
4. Fit O-ring to shaft (6) and assemble floating seal (4), then install collar (3).
5. Put push-pull tool (2) in contact with collar, compress with a press, and knock in dowel pin (2).
   ★ Compress the support enough to align the collar and shaft hole. Do not compress it any further.
6. Pour in oil through plug hole, then install plug (1).

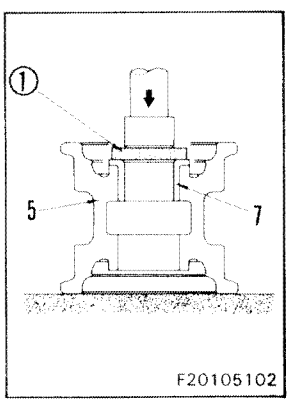
Oil: 80 cc (EO30-R)

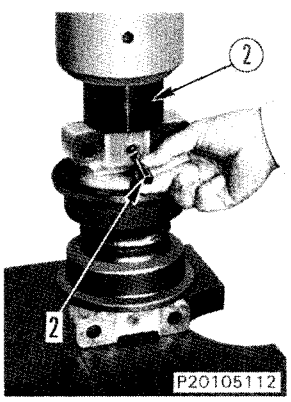






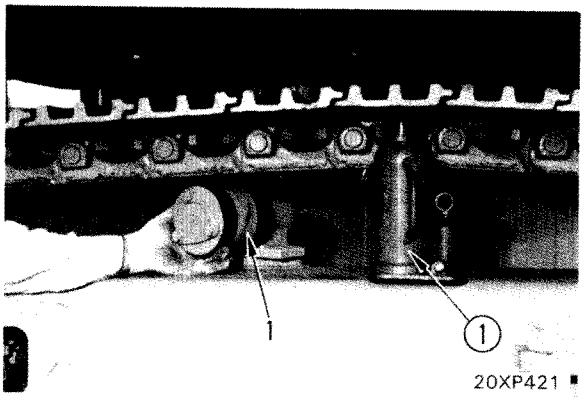






REMOVAL OF CARRIER ROLLER ASSEMBLY

1. Using hydraulic jack ① (10 ton), raise track shoe assembly.
2. Remove carrier roller assembly (1).



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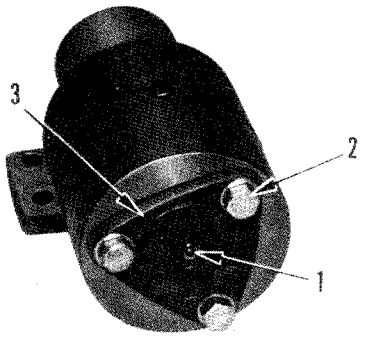
INSTALLATION OF CRRIER ROLLER ASSEMBLY

1. Using hydraulic jack ① (10 ton), raise track shoe.
2. Install carrier roller assembly (1).
3. Lower hydraulic jack ① slowly and return track shoe assembly to original position.
4. Tighten carrier roller bolts mounting bolts.

Bolt: Adhesive compound (LT-2)

DISASSMBLY OF CARRIER ROLLER ASSEMBLY

1. Remove plug (1) and bolt (2), then remove cover (3).
2. Remove bolt (4) and plate (5), then remove roller (6).
3. Remove floating seal under roller, then remove bushing (7) from roller.
4. Remove floating seal (8).
5. Remove shaft (9) from collar (10).



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ASSEMBLY OF CARRIER ROLLER ASSEMBLY

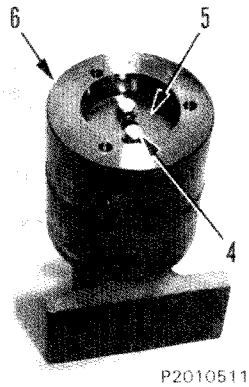
★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil (EO30-CD) before installing.

1. Coat shaft (9) with grease, and press fit in collar (10).
   ★ Fit so that the shaft hole faces down when the roller assembly is installed to the chassis, and press fit until the end faces of the roller and shaft are level.

   Grease: LM-P

2. Install floating seal (8) in collar (10).
3. Using push tool (1), press fit bushing (7) to roller (6), then install floating seal.
4. Assemble roller (6) to shaft, fit plate (5), then tighten bolt (4).
5. Fit O-ring to cover (3) and assemble in roller, then tighten bolt (2).
6. Pour in oil through plug hole, then install plug (1).

   Oil: 100 cc (EO30-R)



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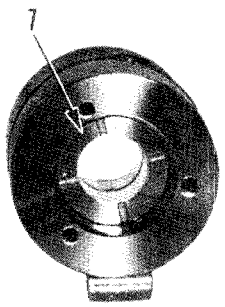

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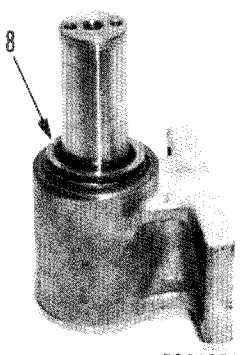

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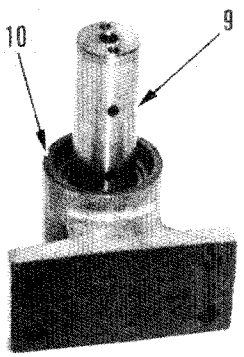

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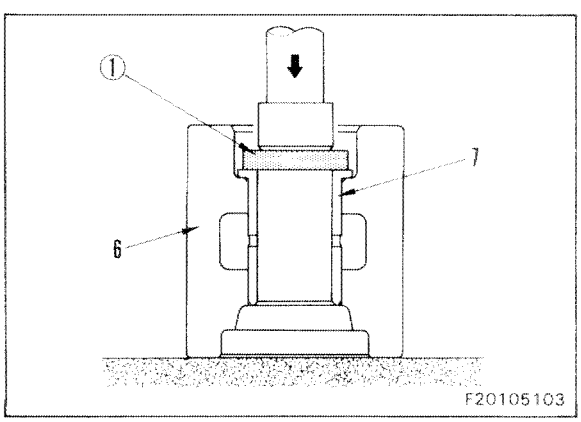
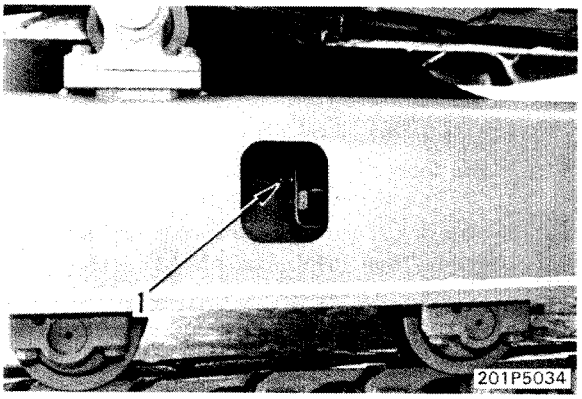


P20105103

REMOVAL OF TRACK SHOE ASSEMBLY

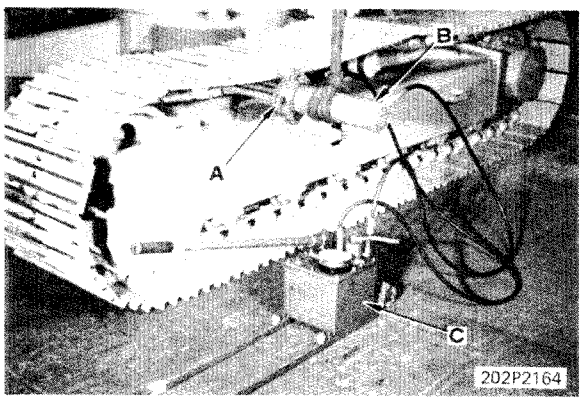
Special tools required

No.	Part No.	Part Name	Q'ty
A	791-620-7000 791-630-3000	Remover & installer	1
B	790-105-1100	Cylinder assembly (30 ton)	1
C	790-101-1102	Dump assembly	1

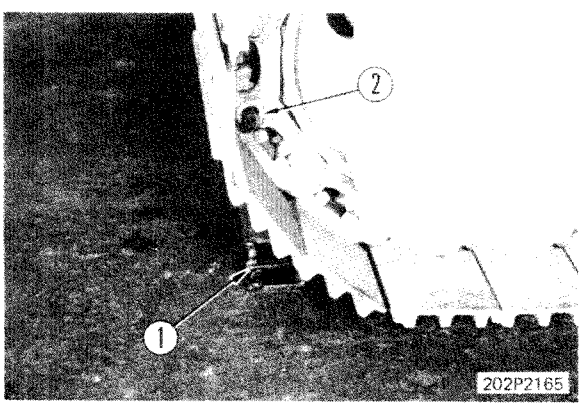


1. Stop machine in a place where track shoe assemblies can be spread front and back with master pin at the midpoint between idler and carrier roller.
2. Lower work equipment to the ground and loosen lubricator (1) to slacken track shoe assembly.

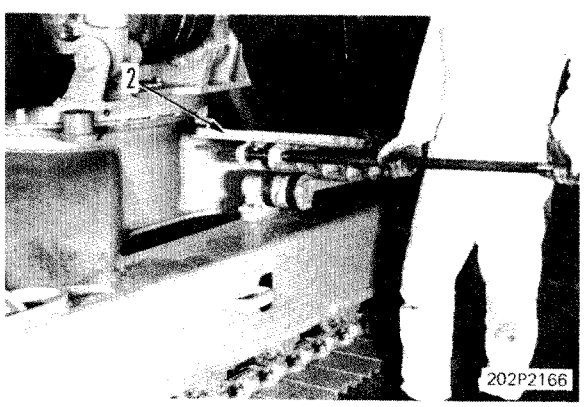
   ⚠ Since the internal pressure in adjusting cylinder is very high, loosen lubricator less than one rotation. If grease does not come out easily, move the machine back and forth.



3. Remove master pin, using tool A.
4. Remove tool A and advance machine so that temporary pin (2) is located in front of idler. Then, set block (1) in place.



5. Remove temporary pin (2) and spread each track shoe assembly (2) while moving machine backward.



INSTALLATION OF TRACK SHOE ASSEMBLY

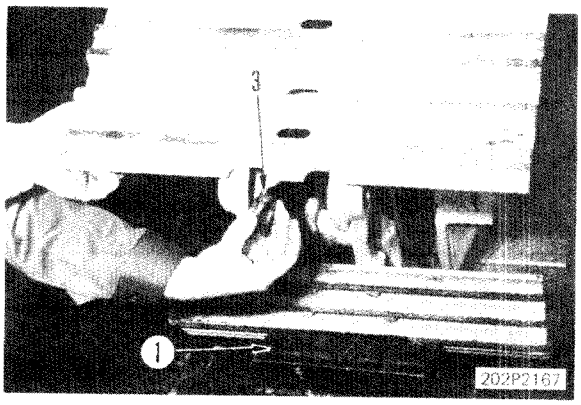
1. Position track shoe under frame and mesh link bushings with sprocket. Then, slowly move machine forward to wind track shoe assembly (2) around frame.
   ★ Link bushings should be in front of their respective shoes.

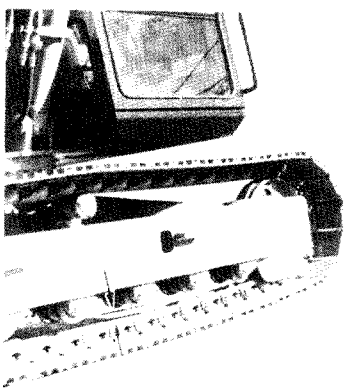
2. Set block (1) and put dust seals (3) in track link assembly. Insert temporary pin (3) as shown.

3. Move machine back until temporary pin is at the midpoint between carrier roller and idler.

4. Force master pins into link track assembly using tool A.

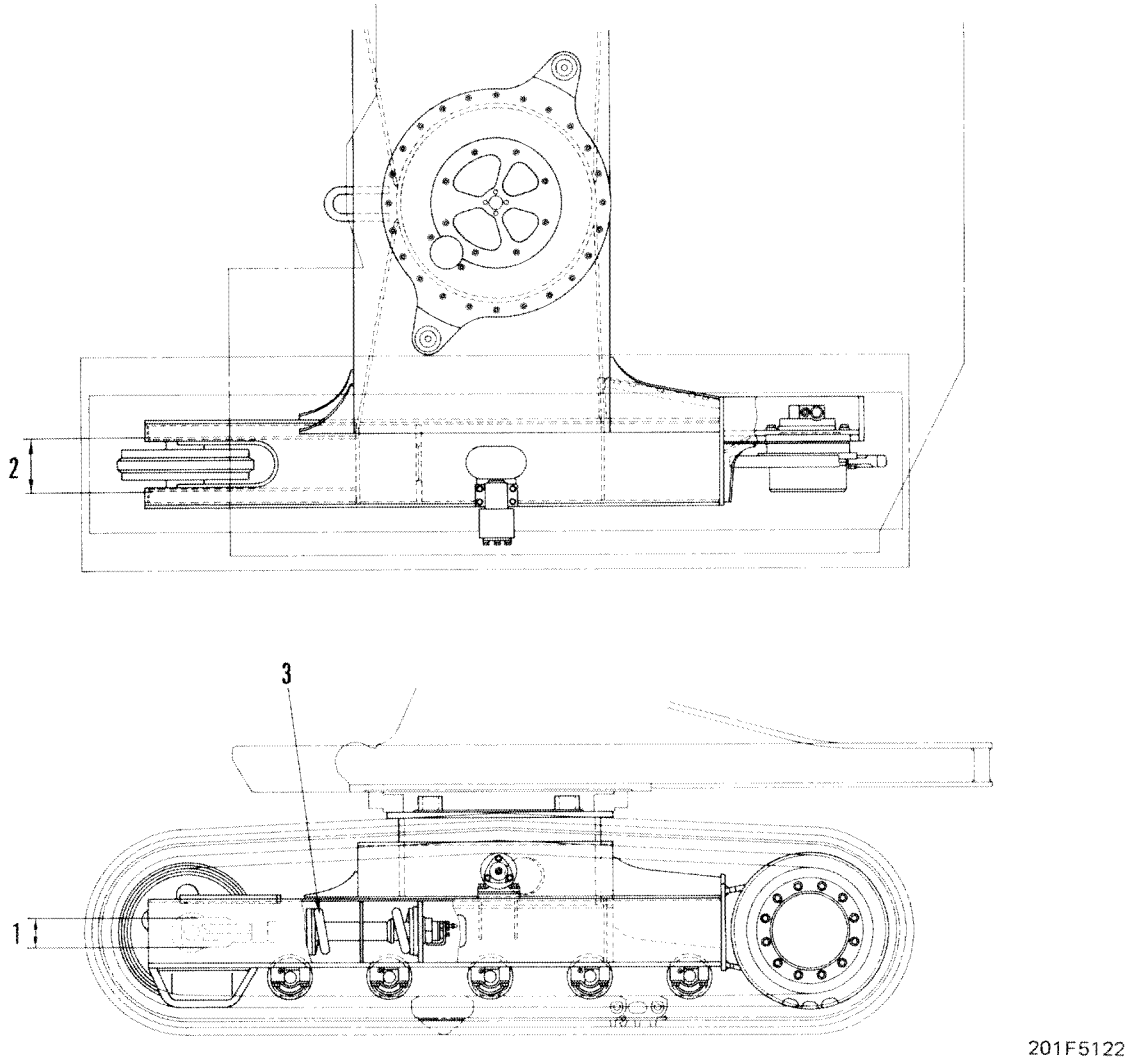
5. Tighten lubricator (1), add grease and adjust track shoe tension.
   ★ When adjusting track shoe tension, raise machine with work equipment and check the clearance between the tread of 3rd track roller counted from sprocket and roller rolling surface of track link.
   ★ Standard clearance: 60 to 100 mm




202P2168

UNDERCARRIAGE
34 MAINTENANCE STANDARD

TRACK FRAME AND RECOIL SPRING



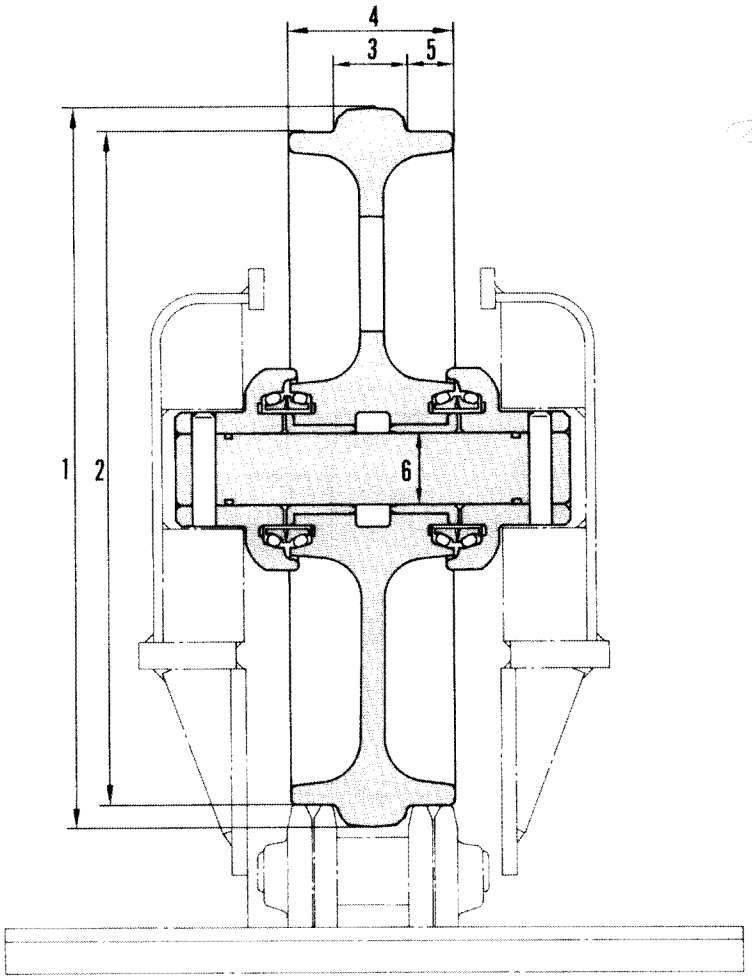
201F5122

Unit: mm

No.	Check item		Criteria			Remedy
			Standard size	Tolerance	Repair limit	
1	Vertical width of idler guide	Track frame	74	+2 0	78	Rebuild or replace
		Idler support	73	0 −0.5	69	
2	Horizontal width of idler guide	Track frame	158	—	162	Rebuild or replace
		Idler support	156	—	152	

No.	Check item	Standard size			Repair limit		Remedy
		Free length	Installed length	Installed load	Free length	Installed load	
3	Recoil spring	402	332	4,350 kg	393	3,960 kg	Replace

IDLER

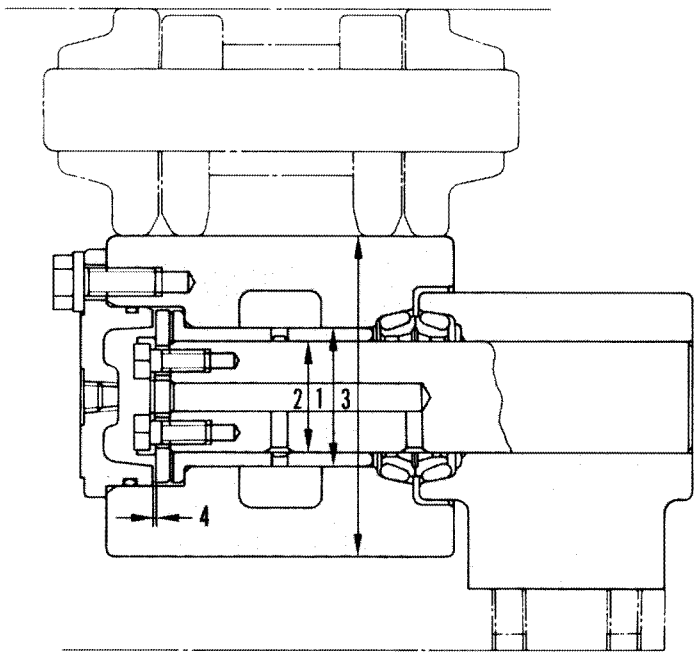


201F5123

Unit: mm

No.	Check item	Criteria				Remedy
1	Outer dia. of protrusion	Standard size: 443		Repair limit: 435		Rebuild or replace
2	Outer dia. of tread	415		407		
3	Width of protrusion	43		37		
4	Total width	100		92		
5	Width of tread	28.5		32		
6	Clearance between shaft and bushing	Standard size	Tolerance: Shaft	Tolerance: Hole	Standard clearance	Clearance limit	Replace bushing
		44	−0.250 −0.290	+0.062 0	0.250 – 0.352	1.5	
7	Idler shaft axial play	Repair limit: 1.5				Adjust

CARRIER ROLLER

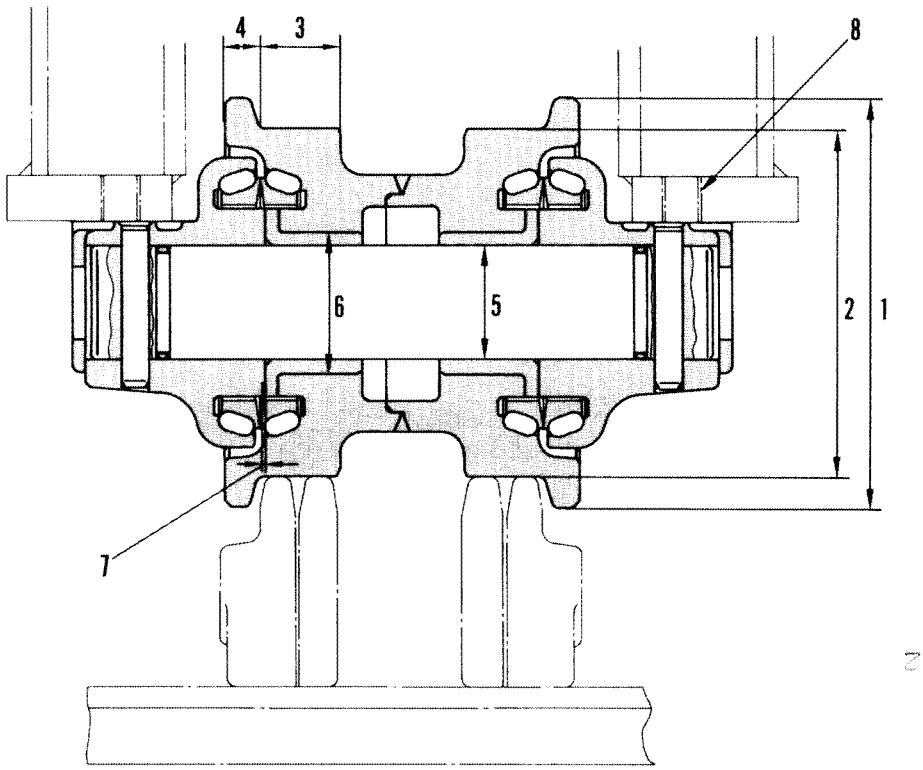


F0202057

Unit: mm

No.	Check item	Criteria				Remedy
1	Outer dia. of tread	Standard size		Repair limit		Rebuild or replace
		116		106		
2	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole		
		40	–0.025 –0.064	+0.062 0	0.025 – 0.126	1.0
3	Interference between roller and bushing	Standard size	Tolerance		Standard interference	Interference limit	
			Shaft	Hole		
		50	+0.062 +0.032	+0.025 0	0.007 – 0.062	—
4	Axial play of roller shaft	Standard clearance		Clearance limit		Replace
		0.402 – 0.576		1.5		

TRACK ROLLER

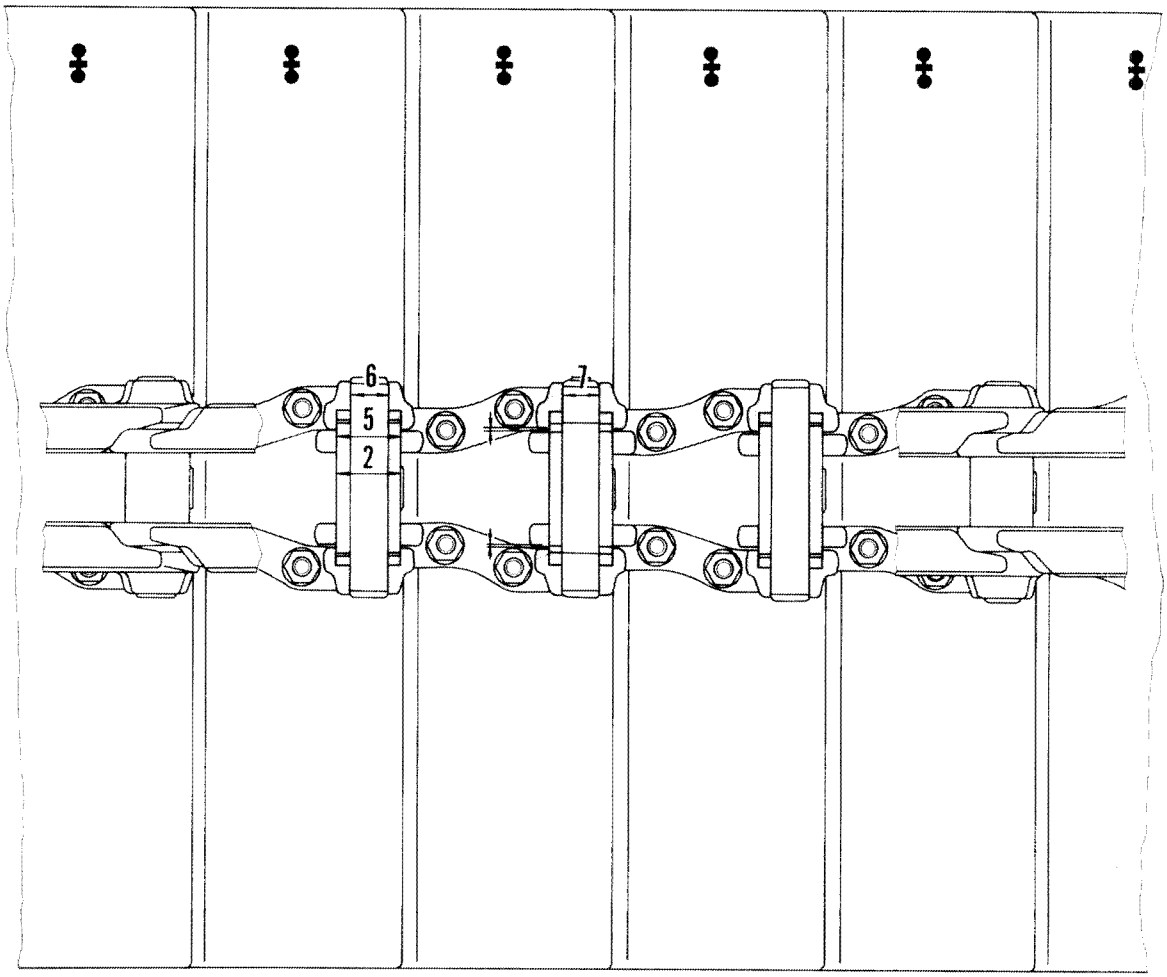


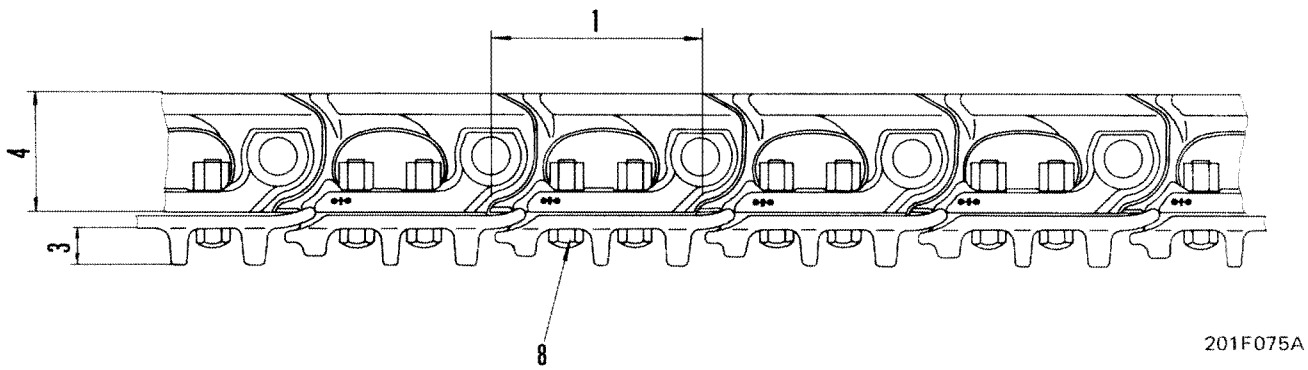
201F5124

Unit: mm

No.	Check item	Criteria					Remedy
1	Outer dia. of flange (outside)	Standard size			Repair limit		Rebuild or replace
		147			140		
2	Outer dia. of tread	125			118		
3	Width of tread	30			33.5		
4	Width of flange	12			7		
5	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		41	−0.250 −0.300	+0.062 0	0.250 – 0.362	1.5	
6	Interference between roller and bushing	Standard size	Tolerance		Standard interference	Interference limit	
			Shaft	Hole			
		51	+0.117 +0.087	+0.030 0	0.057 – 0.117	–	
7	Side clearance of roller	Standard clearance			Clearance limit		Replace
		0.145 – 0.433			3.0		
8	Tightening torque of mounting bolt	18 ± 2 kgm					Tighten

TRACK SHOE



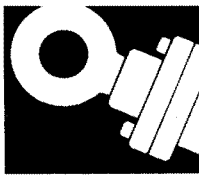


201F075A

Unit: mm

No.	Check item	Criteria				Remedy
1	Link pitch	Standard size: 135.25		Repair limit: 138.25		Turn or replace
2	Bushing outer dia.	41.2		38.2		
3	Grouser height	20		10		Rebuild or replace
4	Link height	75		68		
5	Interference between bushing and link	Standard size: 41	Tolerance: Shaft +0.215 +0.174 / Hole +0.062 0	Standard interference: 0.112 – 0.215	Interference limit: 0.100	Replace
6	Interference between regular pin and link	24	+0.150 0	−0.148 −0.200	0.148 – 0.350	0.140
7	Interference between master pin and link	24	−0.030 −0.070	−0.148 −0.200	0.078 – 0.170	0.078
8	Tightening torque for shoe bolt	14 ± 2 kgm				Tighten

HYDRAULIC SYSTEM
61 STRUCTURE AND FUNCTION

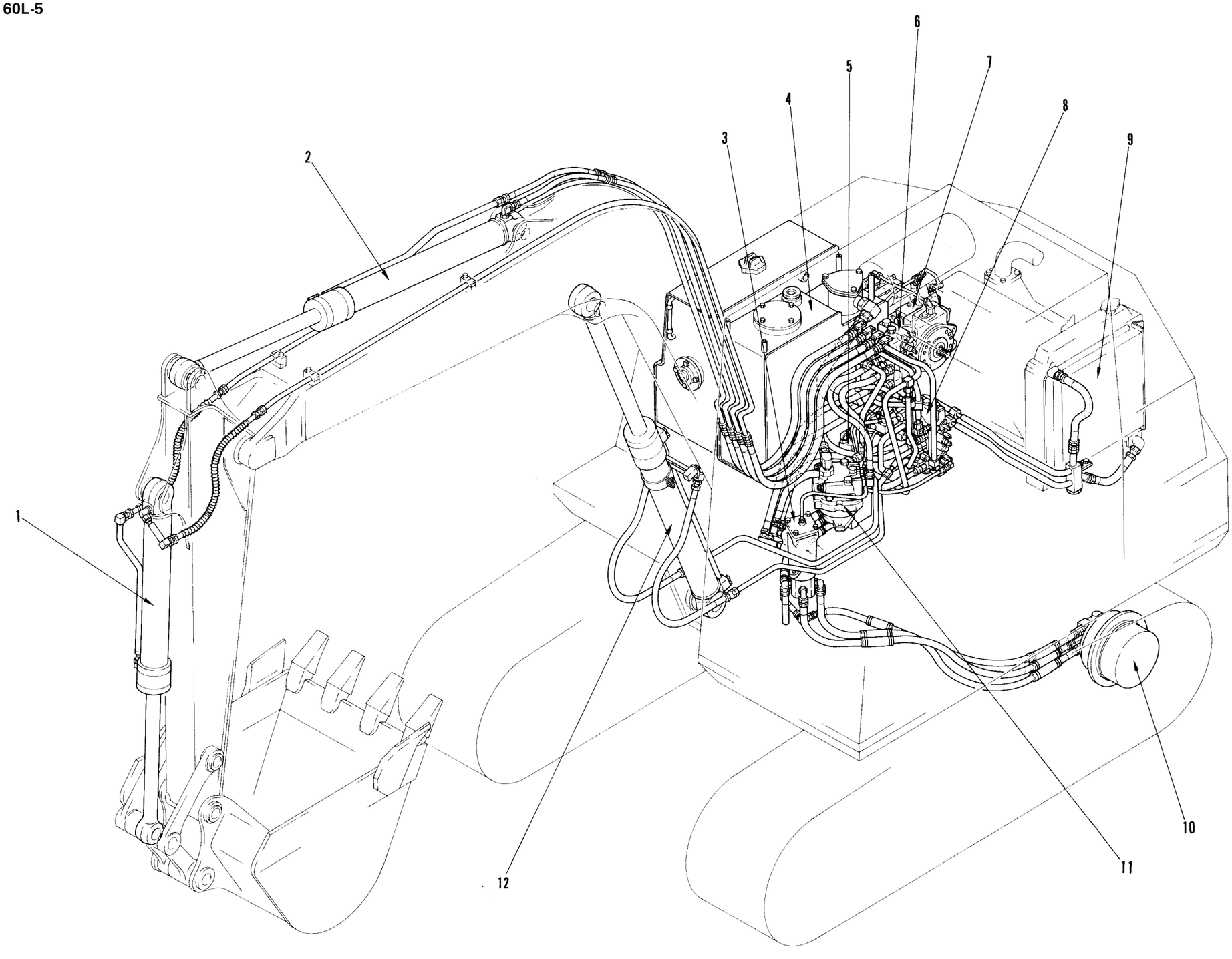


OUTLINE

- Hydraulic pumps driven by the engine are comprised of two main pumps (variable displacement pumps) and one charging pump (gear pump). The main pumps deliver the oil from the hydraulic tank to the control valve, while the charging pump delivers the oil to the solenoid valve.
- When the PC control system is used the main pumps help save energy.
- The travel, swing, and work equipment operations are all hydraulically controlled by operating the corresponding hydraulic motor and hydraulic cylinder, which in turn are operated by switching over the control valve circuit with the control lever in the operator's cab.
- Each control valve incorporates a main relief valve, a safety valve, and a suction valve.
- The main relief valve is in the circuit between the hydraulic pump and the control valve. It keeps the pressure of the oil delivered from the hydraulic pump at the setting value.
- The safety valve, located in the circuit between the control valve and the actuators (hydraulic motor, hydraulic cylinder, etc.), protects the hydraulic equipment from external over-loading when the control valve is in NEUTRAL, and ensures operational safety.
- The suction valve prevents the occurrence of negative pressure in the circuit.
- In addition, an oil cooler is provided in the hydraulic circuit to prevent the oil from getting too hot and to minimize the degradation of the oil.
- The oil flows in the circuit in one direction. All of the oil is passes through a filter in the tank in order to protect the hydraulic equipment.
- The boom and arm circuits form a two-pump merged circuit. When the arm and the swing operations are performed concurrently, the arm circuit from one of the pumps is restricted so that the swing circuit is given priority.
- The straight-travel valve is in the travel circuit. This valve makes it possible to operate the work equipment or swing while the machine is traveling straight.
  When operating the travel lever, the oil flows from two main pumps to the R.H. and L.H. travel control valves running through each separate circuit.
  When both the R.H. and L.H. travel levers are simultaneously operated, with swing, boom, arm or bucket lever the independent R.H. and L.H. travel circuits merge, equalizing the supply of hydraulic oil to the R.H. and L.H. travel motors. As a result, both motors rotate at the same speed.
- The auto-deceleration system (If equipped), helps save energy by automatically decelerating the engine while the control levers are in neutral.

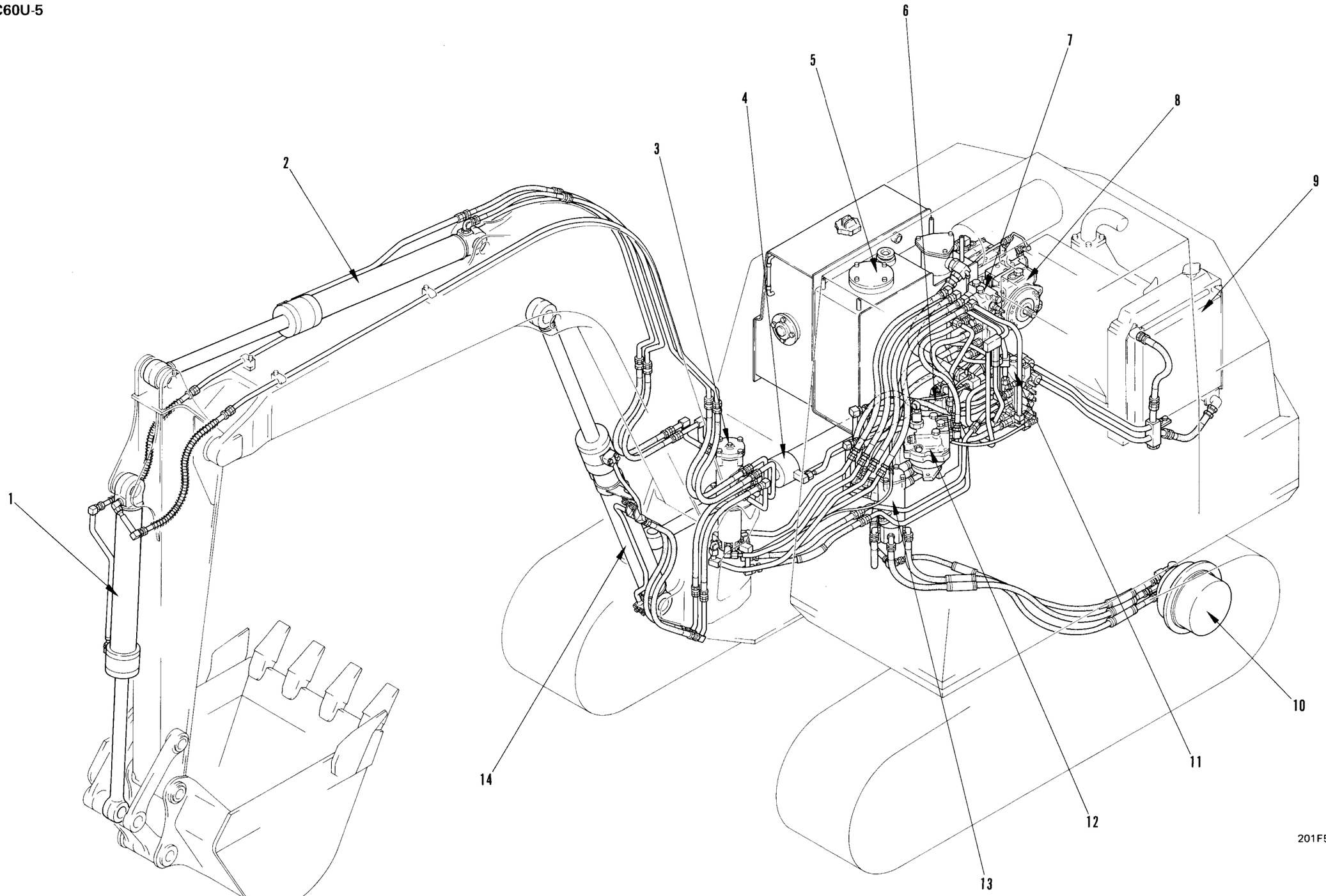
HYDRAULIC PIPING

PC60, 60L-5



1. Bucket cylinder
2. Arm cylinder
3. Center swivel joint
4. Hydraulic tank
5. Solenoid valve
6. L.H. 6-spool control valve
7. Main pump
8. R.H. 5-spool control valve
9. Oil cooler
10. Travel motor
11. Swing motor
12. Boom cylinder

201F5052



1. Bucket cylinder
2. Arm cylinder
3. Work equipment swivel joint
4. Swing cylinder
5. Hydraulic tank
6. Solenoid valve
7. L.H. 6-spool control valve
8. Main pump
9. Oil cooler
10. Travel motor
11. R.H. 6-spool control valve
12. Swing motor
13. Center swivel joint
14. Boom cylinder

201F5053

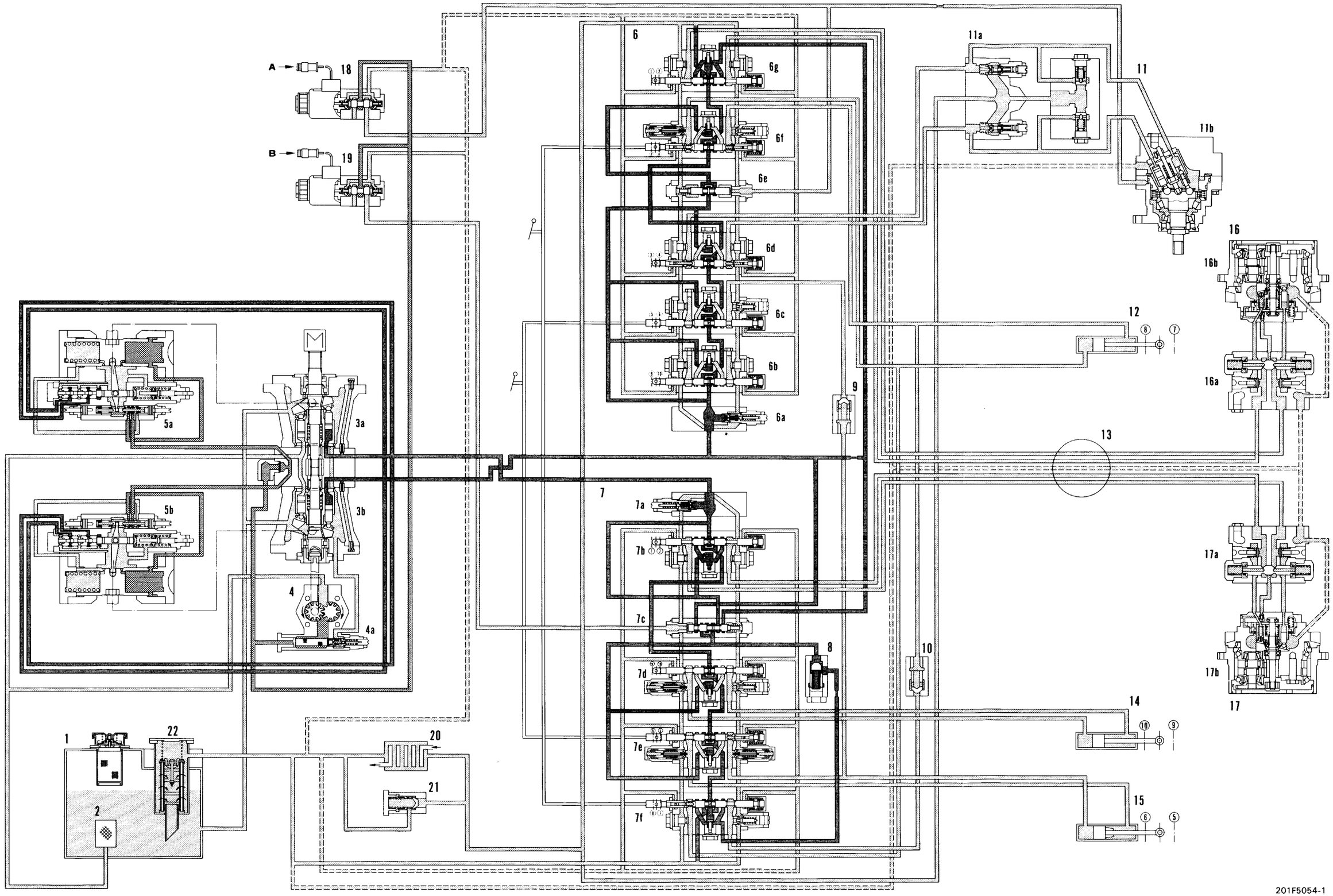
HYDRAULIC SCHEMATICS

PC60, 60L-5

1. Hydraulic tank
2. Strainer
3a. Front main pump
3b. Rear main pump
4. Charging pump
4a. Relief valve
5a. Front servo valve
5b. Rear servo valve
6. L.H. 6-spool control valve
6a. Main relief valve
6b. Service valve
6c. Boom-Hi spool
6d. Swing spool
6e. Swing priority valve
6f. Arm-Lo spool
6g. L.H. travel spool
7. R.H. 5-spool control valve
7a. Main relief valve
7b. R.H. travel spool
7c. Straight travel valve
7d. Bucket spool
7e. Boom-Lo spool
7f. Arm-Hi spool
8. Check valve
9. Check valve
10. Check valve
11. Swing motor ass'y
11a. Brake valve
11b. Swing motor
12. Arm cylinder
13. Center swivel joint
14. Bucket cylinder
15. Boom cylinder
16. L.H. travel motor ass'y
16a. Brake valve
16b. Travel motor
17. R.H. travel motor ass'y
17a. Brake valve
17b. Travel motor
18. Solenoid valve for swing mechanical brake
19. Solenoid valve for straight travel
20. Oil cooler
21. Check valve
22. Hydraulic filter

① Forward
② Reverse
③ R.H. swing
④ L.H. swing
⑤ Boom raise
⑥ Boom lower
⑦ Arm IN
⑧ Arm OUT
⑨ Bucket curl
⑩ Bucket dump

A. From controller
B. From controller


A
18
B
19
6
6g
6f
6e
6d
6c
6b
6a
11a
11
11b
16
16b
16a
12
9
13
5a
3a
5b
3b
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4a
7
7a
7b
7c
7d
7e
7f
8
10
17a
17b
17
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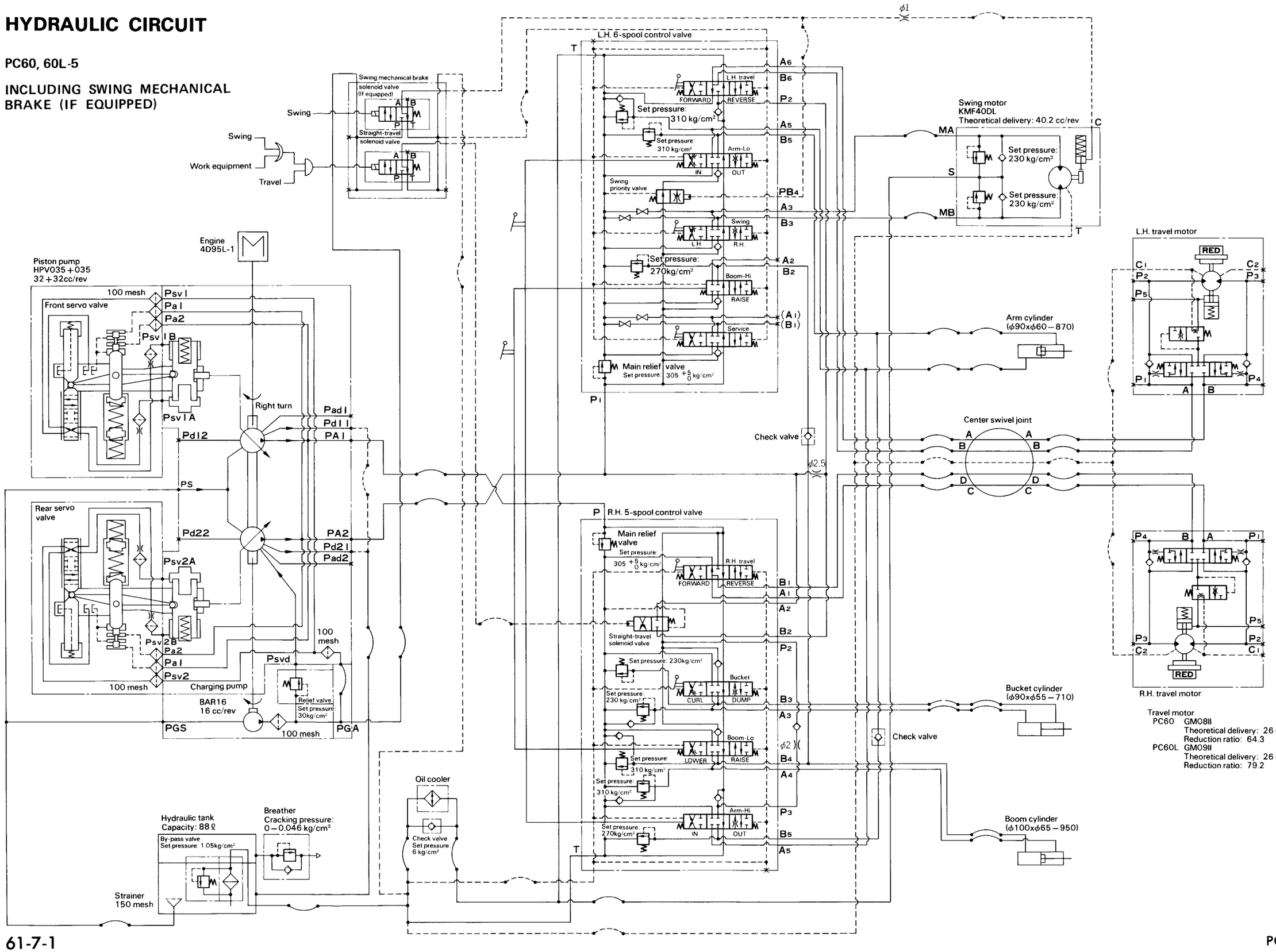
201F5054-1

HYDRAULIC CIRCUIT

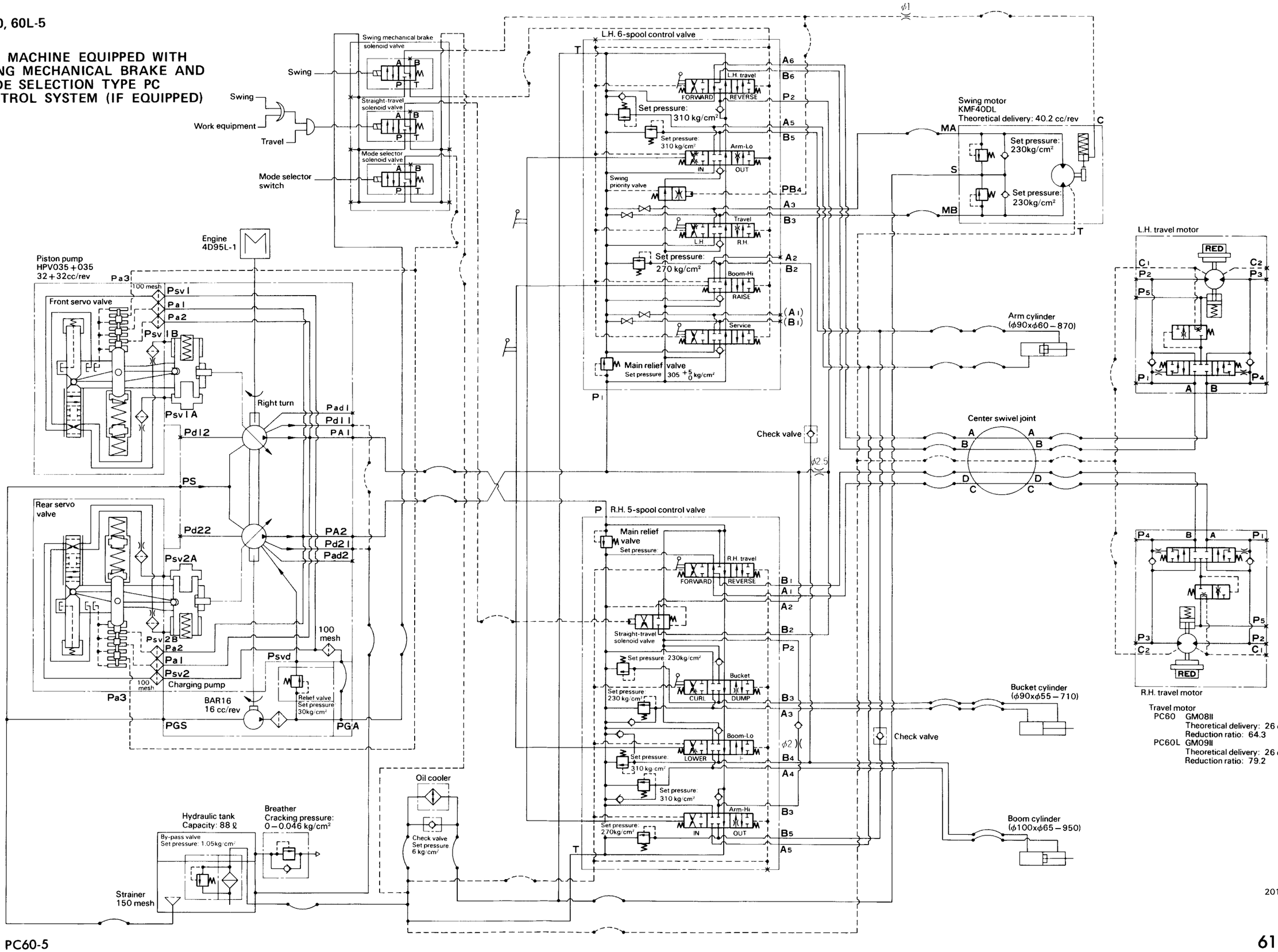
PC60, 60L-5

INCLUDING SWING MECHANICAL BRAKE (IF EQUIPPED)



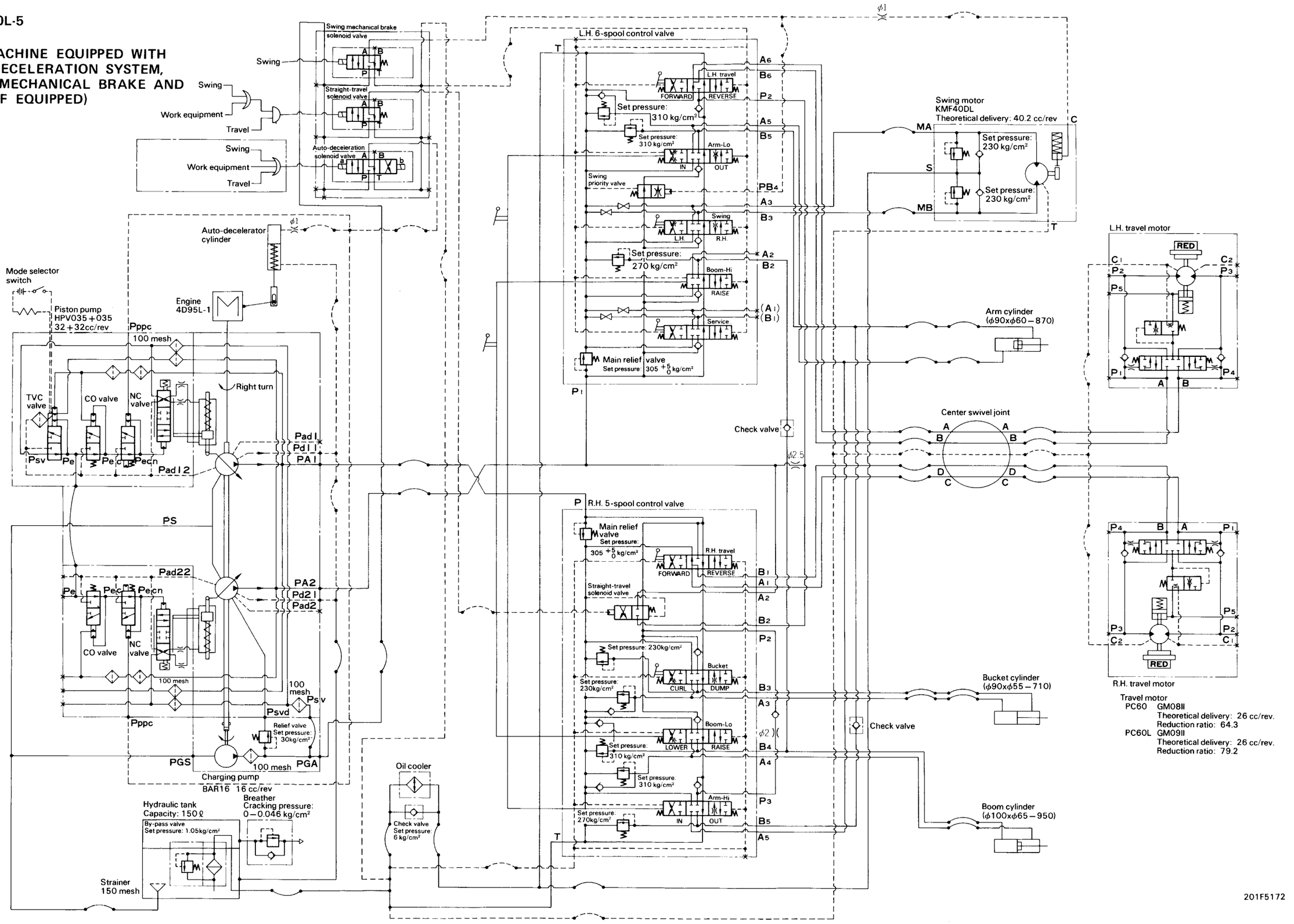
201F5056-1

FOR MACHINE EQUIPPED WITH SWING MECHANICAL BRAKE AND MODE SELECTION TYPE PC CONTROL SYSTEM (IF EQUIPPED)



PC60, 60L-5

FOR MACHINE EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHANICAL BRAKE AND OLSS (IF EQUIPPED)



201F5172

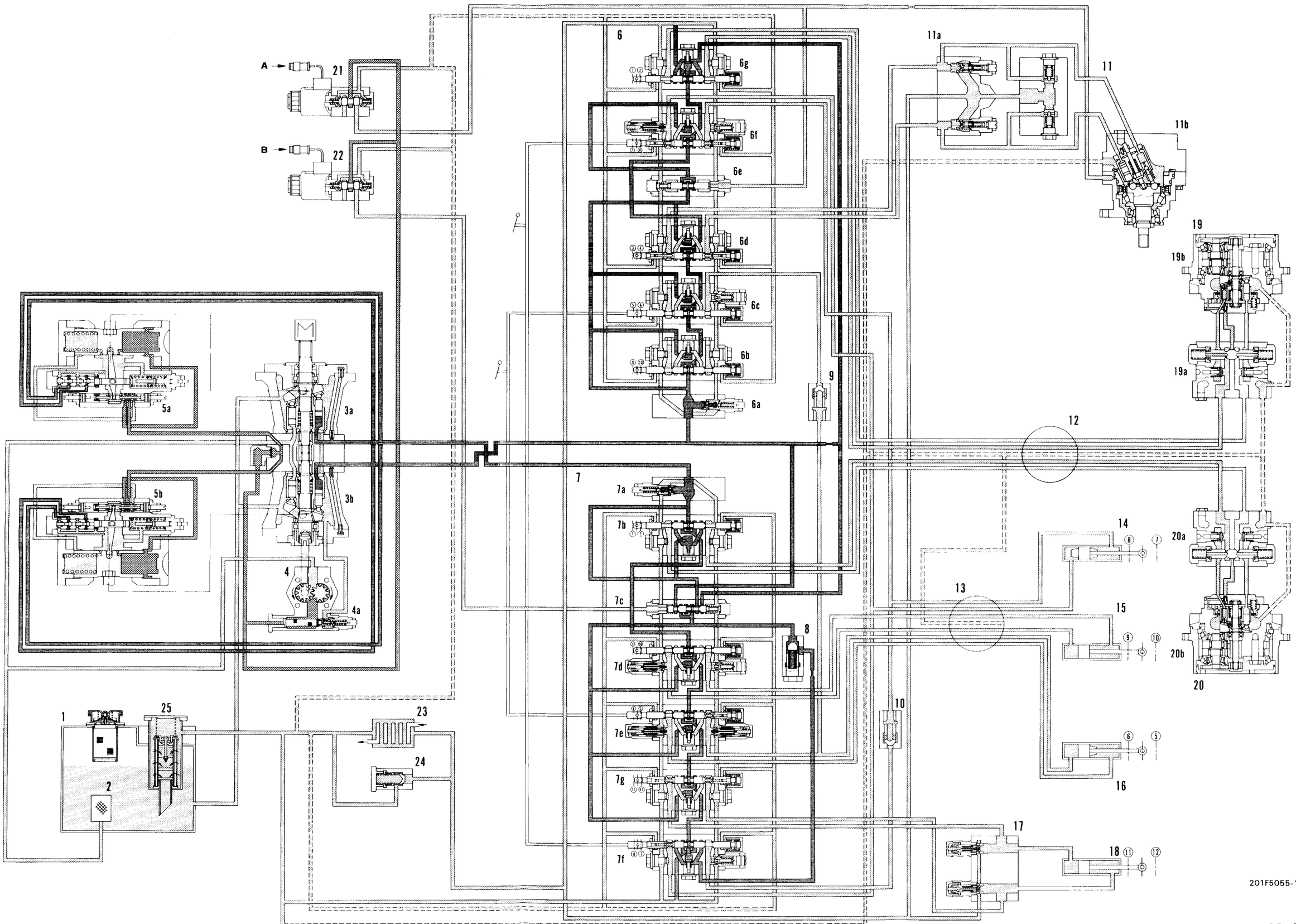
HYDRAULIC SCHEMATICS

PC60U-5

1. Hydraulic tank
2. Strainer
3a. Front main pump
3b. Rear main pump
4. Charging pump
4a. Relief valve
5a. Front servo valve
5b. Rear servo valve
6. L.H. 6-spool control valve
6a. Main relief valve
6b. Service valve
6c. Boom-Hi spool
6d. Swing spool
6e. Swing priority valve
6f. Arm-Lo spool
6g. L.H. travel spool
7. R.H. 6-spool control valve
7a. Main relief valve
7b. R.H. travel spool
7c. Straight travel valve
7d. Bucket spool
7e. Boom-Lo spool
7f. Swing spool
7g. Arm-Hi spool
8. Check valve
9. Check valve
10. Check valve
11. Swing motor ass'y
11a. Brake valve
11b. Swing motor
12. Center swivel joint
13. Work equipment swivel joint
14. Arm cylinder
15. Bucket cylinder
16. Boom cylinder
17. Safety suction valve
18. Swing cylinder
19. L.H. travel motor ass'y
19a. Brake valve
19b. Travel motor
20. R.H. travel motor ass'y
20a. Brake valve
20b. Travel motor
21. Solenoid valve for swing mechanical brake
22. Solenoid valve for straight travel
23. Oil cooler
24. Check valve
25. Hydraulic filter

① Forward
② Reverse
③ R.H. swing
④ L.H. swing
⑤ Boom raise
⑥ Boom lower
⑦ Arm IN
⑧ Arm OUT
⑨ Bucket curl
⑩ Bucket dump
⑪ R H. swing
⑫ L.H. swing

A. From controller
B. From controller


A
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B
22
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6g
6f
6e
6d
6c
6b
6a
11a
11
11b
19
19b
19a
9
12
5a
3a
5b
3b
4
4a
7
7a
7b
7c
7d
7e
7g
7f
8
14
20a
13
15
20b
20
10
16
17
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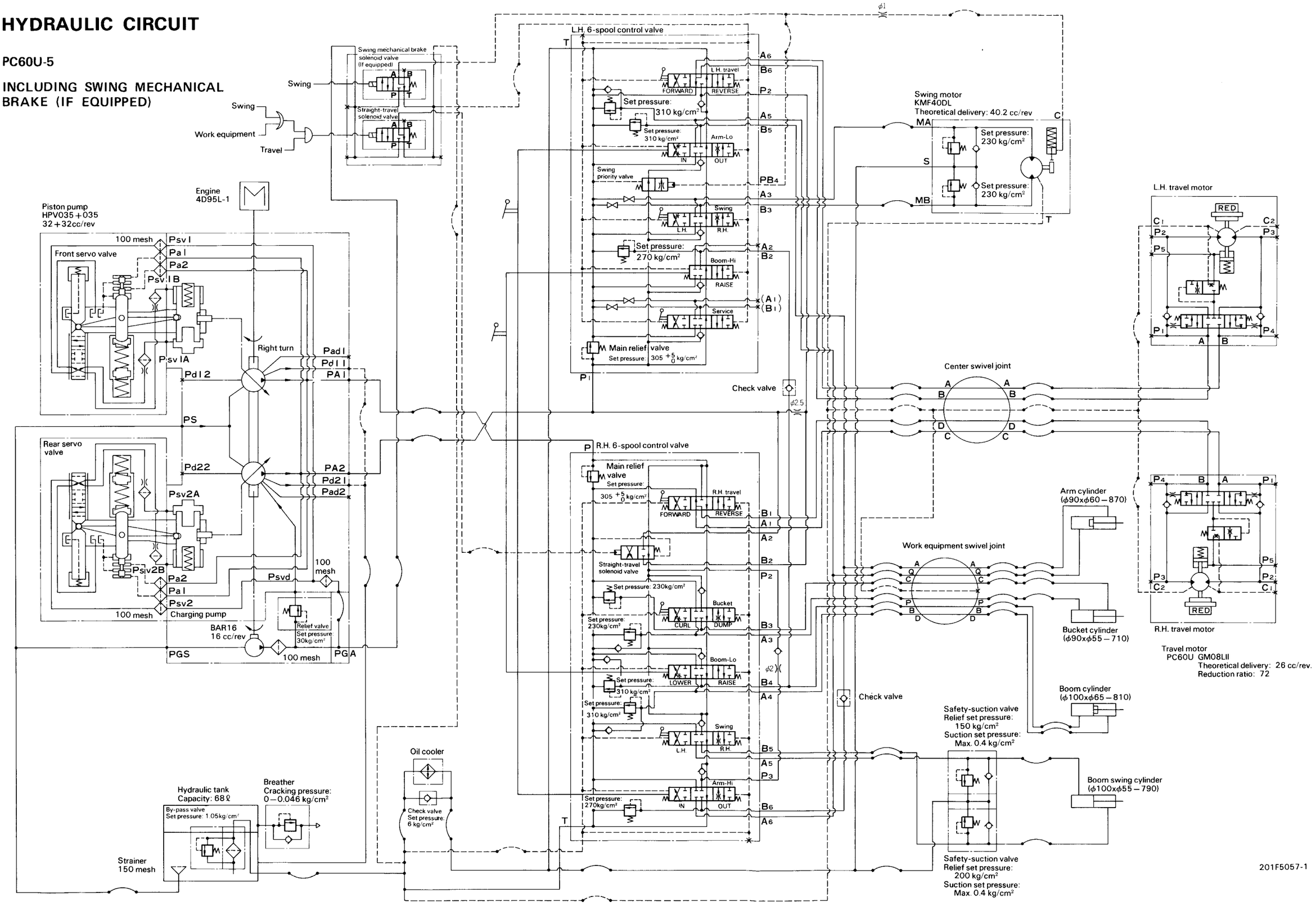
201F5055-1

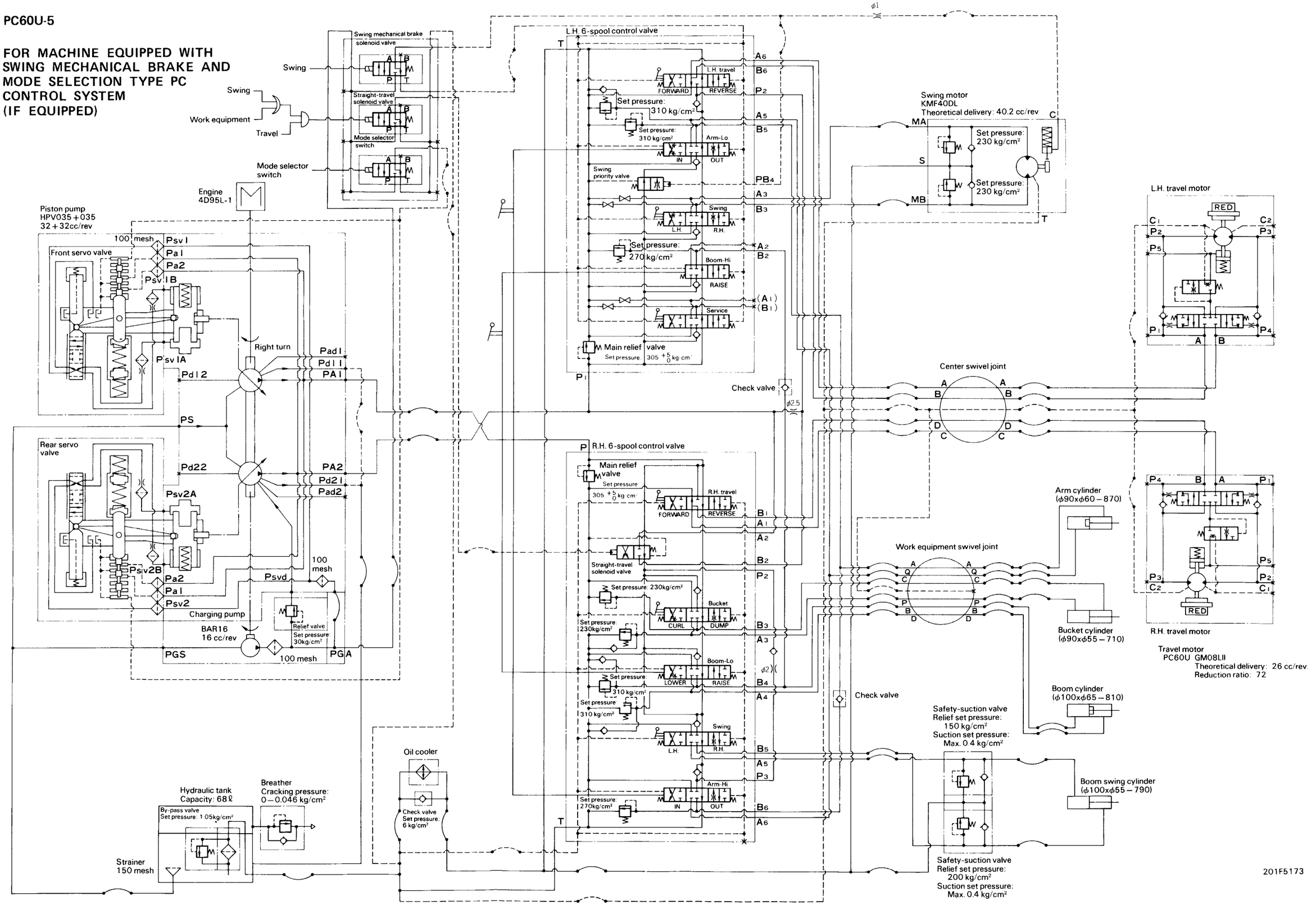
HYDRAULIC CIRCUIT

PC60U-5

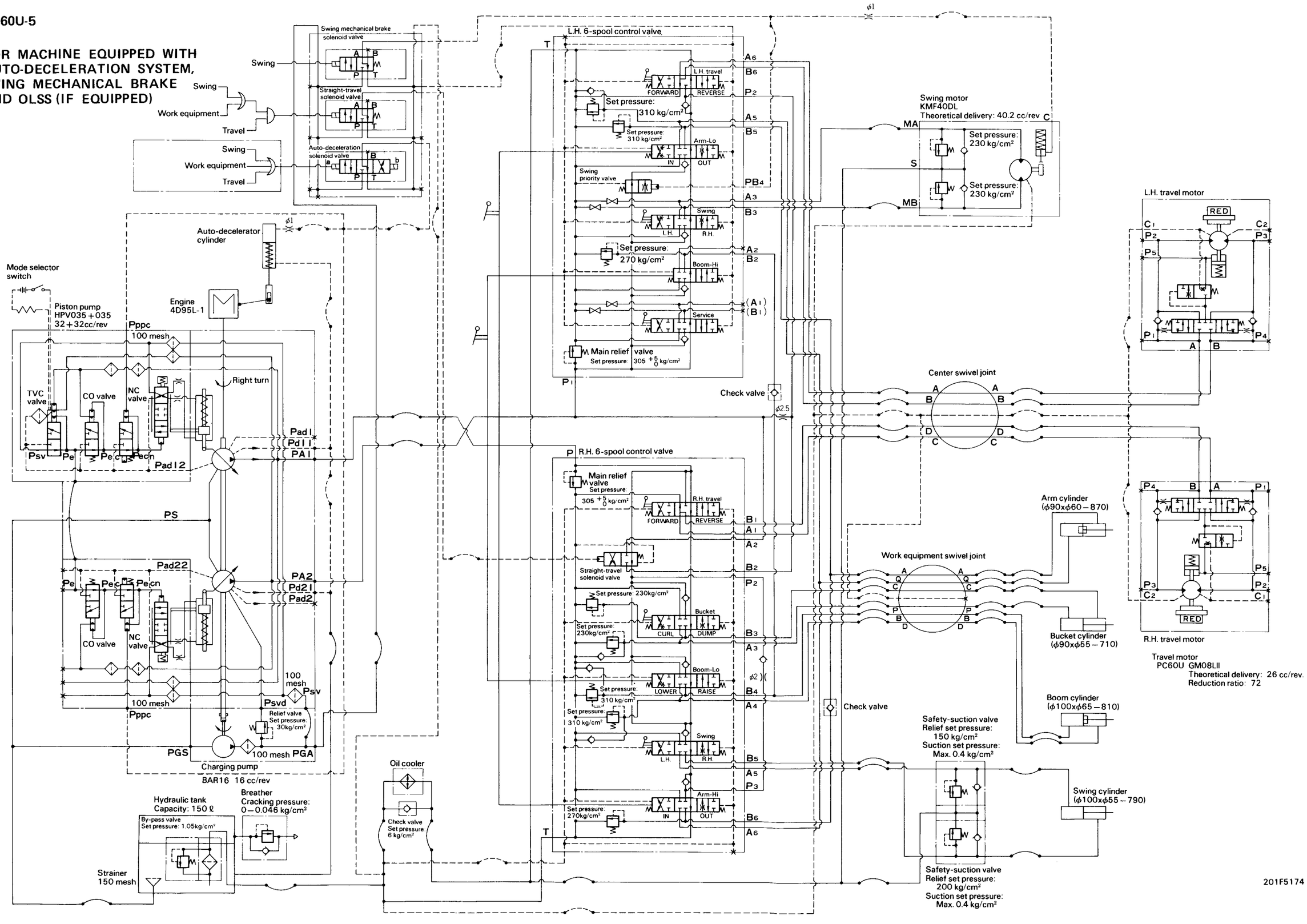
INCLUDING SWING MECHANICAL BRAKE (IF EQUIPPED)



FOR MACHINE EQUIPPED WITH SWING MECHANICAL BRAKE AND MODE SELECTION TYPE PC CONTROL SYSTEM (IF EQUIPPED)

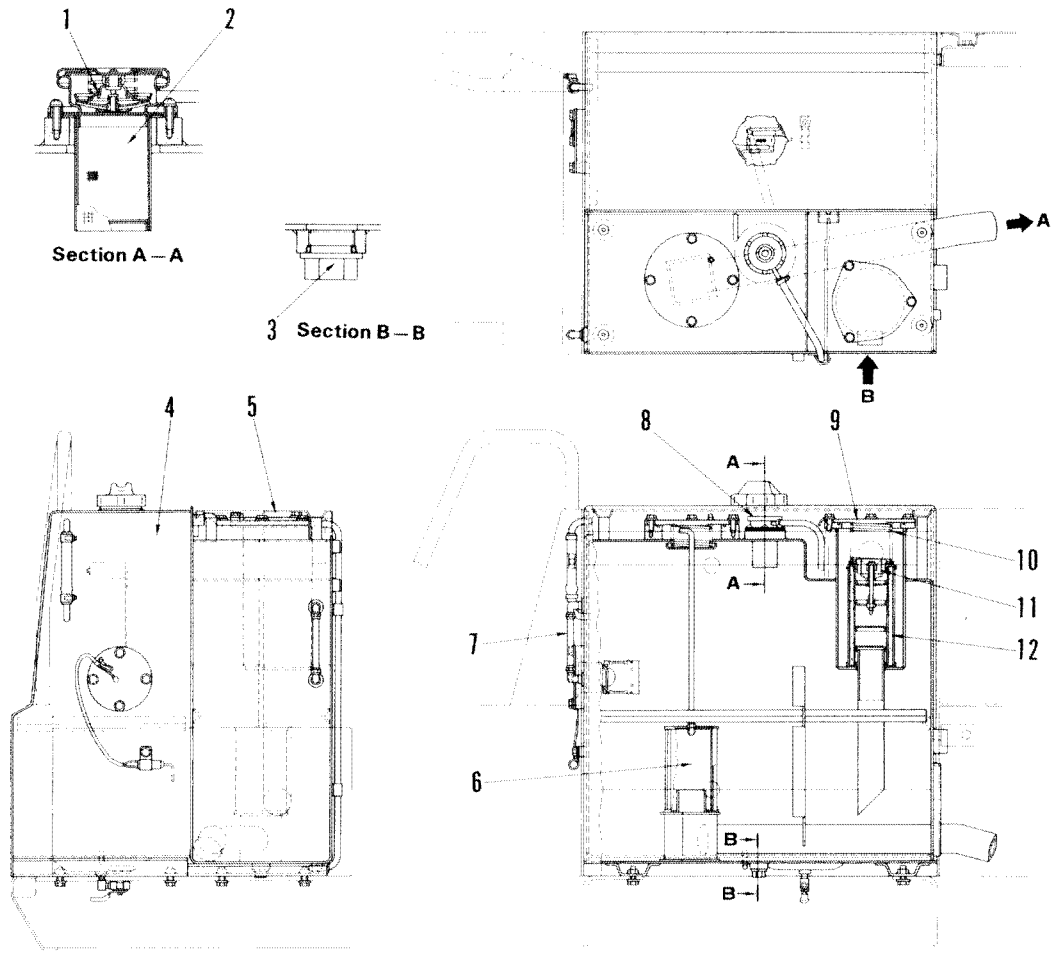


FOR MACHINE EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHANICAL BRAKE AND OLSS (IF EQUIPPED)



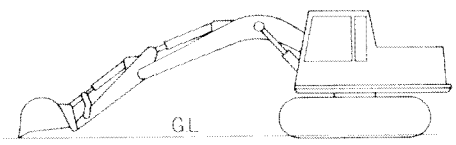
201F5174

HYDRAULIC TANK (with fuel tank)



201F5058

- The hydraulic oil tank and the fuel tank from a single unit.
- Oil capacity: 88 ℓ
  - ★ When checking the oil level, fully retract the arm and bucket cylinder, lower the bucket to the ground as shown in the drawing, and stop the engine.

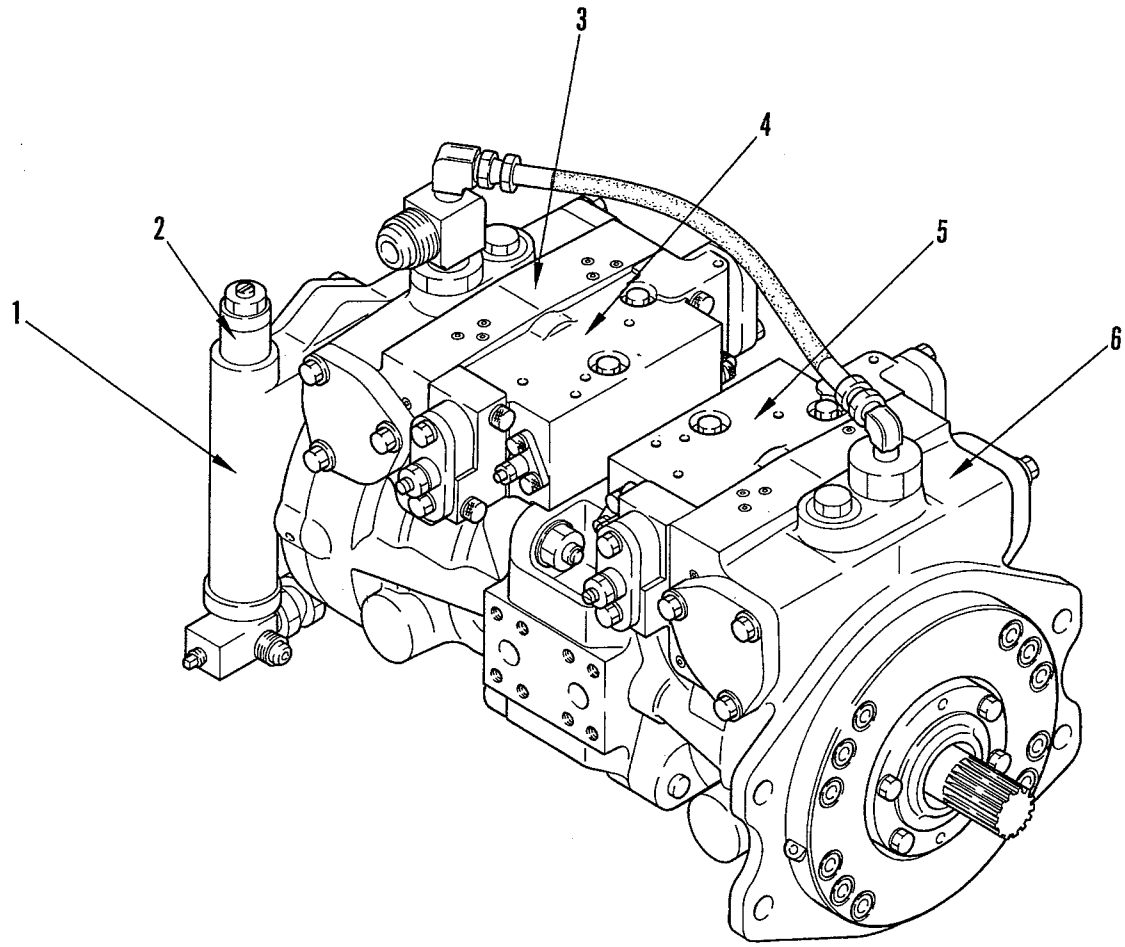


- Cracking pressure on hydraulic oil filter bypass valve: 1.05 ± 0.2 kg/cm^2
- Cracking pressure on pressure valve: 0.39 ± 0.15 kg/cm^2
- Cracking pressure on vacuum valve: 0 to 0.046 kg/cm^2

1. Pressure valve
2. Strainer
3. Drain plug
4. Fuel tank
5. Hydraulic tank
6. Strainer
7. Sight gauge
8. Oil filler
9. Hydraulic oil filter
10. Element retaining spring
11. Bypass valve
12. Hydraulic oil filter element

A. To main pump
B. From oil cooler

HYDRAULIC PUMP

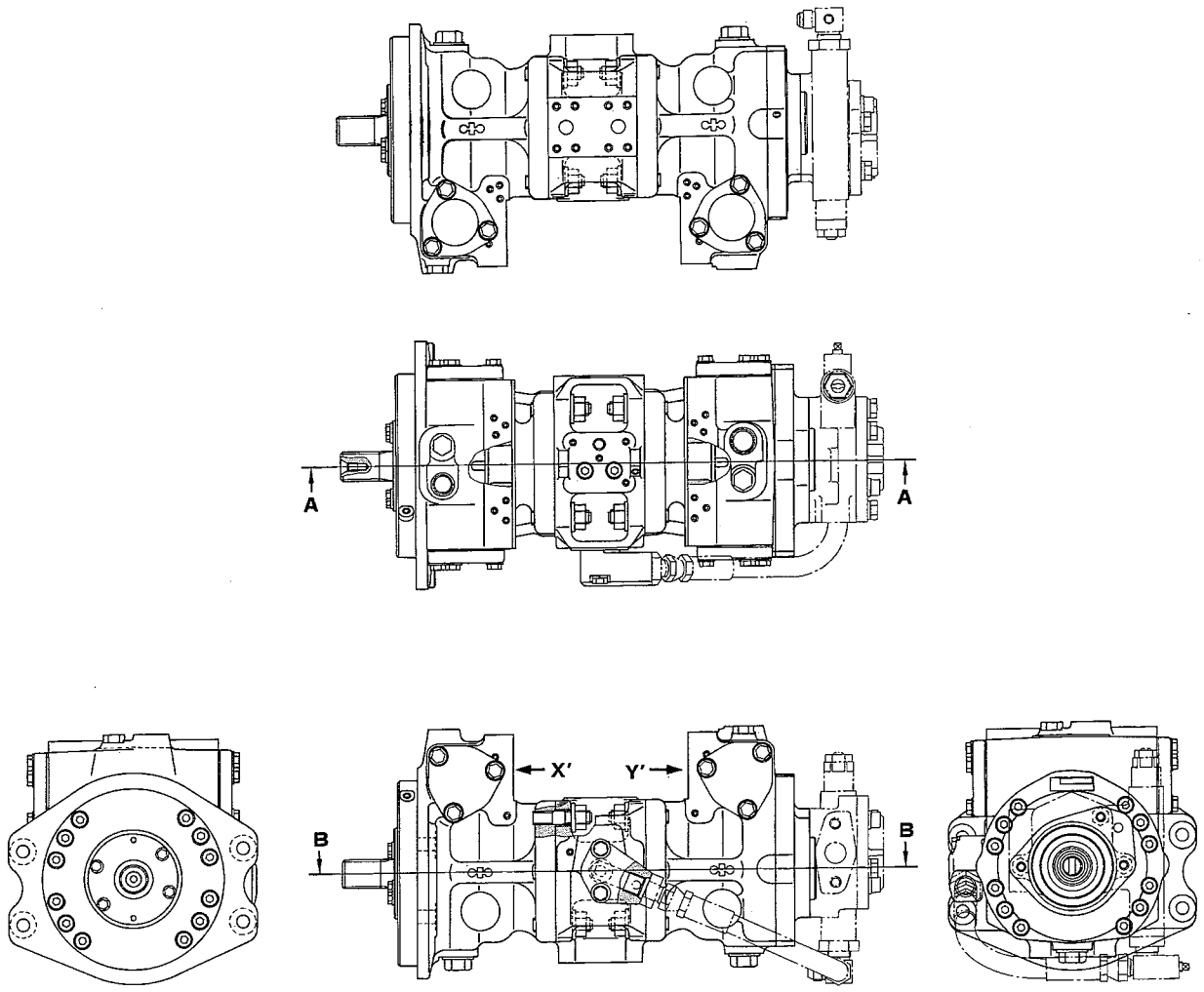


201F5059-1

- Hydraulic pumps are installed to the PTO case, and are comprised of two main pumps and a charging pump.
  Each main pump has a servo valve.
- The front main pump serves the R.H. travel, bucket, boom, and arm speed acceleration operations.
- The rear main pump serves the L.H. travel, arm, swing, and boom speed acceleration operations.
- The charging pump serves to operate the auto-deceleration cylinder (if equipped), and control the main pump.

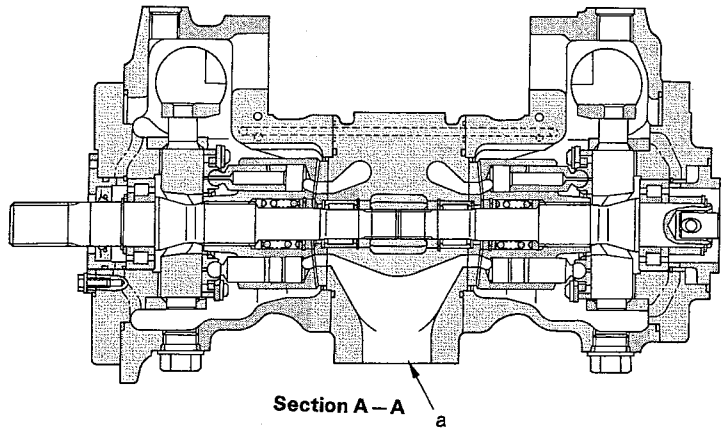
1. Charging pump
2. Relief valve
3. Rear main pump
4. Rear servo valve
5. Front servo valve
6. Front main pump

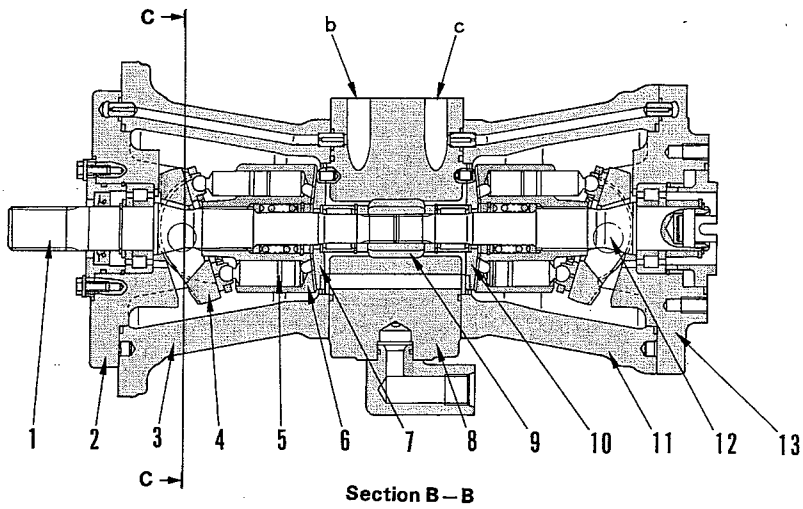
1. PISTON PUMP (HPV035+035)

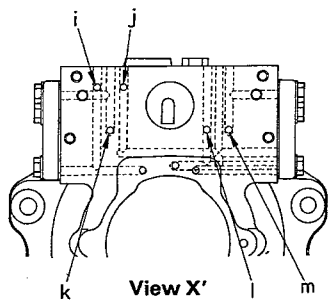


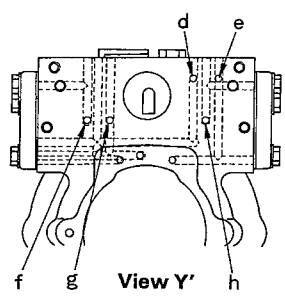
201F5060

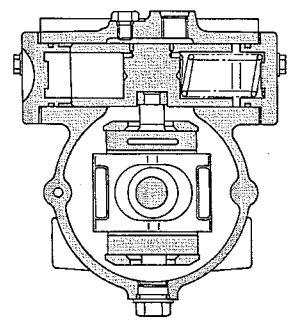
1. Front drive shaft
2. Front cradle
3. Front pump case
4. Rocker cam
5. Piston
6. Cylinder block
7. Front valve plate
8. End cap
9. Coupling
10. Rear valve plate
11. Rear pump case
12. Rear drive shaft
13. Rear cradle











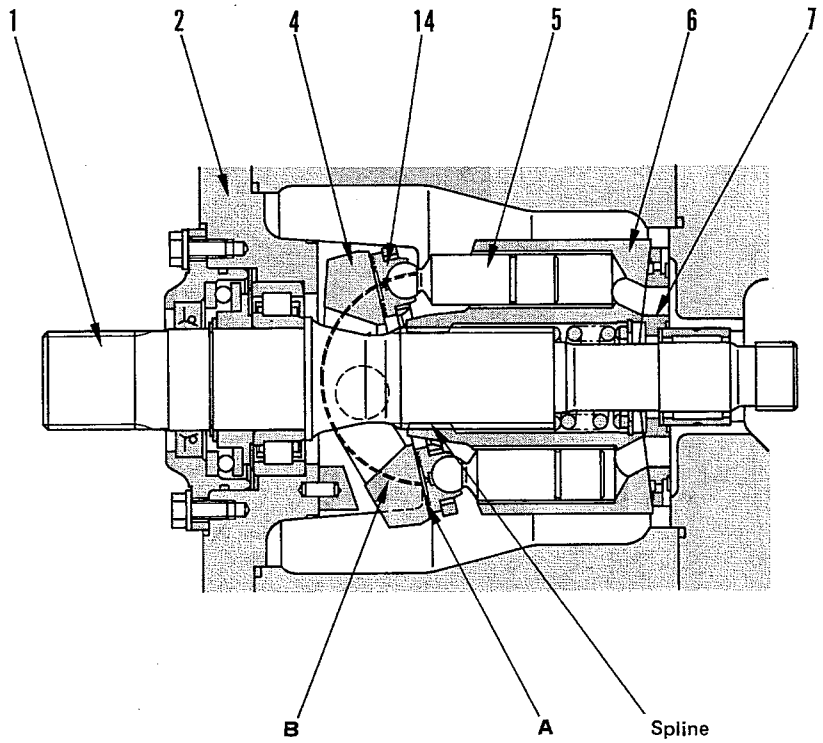
201F5061

a. Suction port
b. Front pump discharge port
c. Rear pump discharge port
d. Rear pump discharge pressure port (Pa_2 port)
e. Front pump discharge pressure port (Pa_1 port)
f. Servo valve output port (P_{SV2A} port)
g. Servo valve actuator port (P_{SV2} port)
h. Servo valve output port (P_{SV2B} port)
i. Rear pump output pressure port (Pa_2 port)
j. Front pump output pressure port (Pa_1 port)
k. Servo valve output port (P_{SV1B} port)
l. Servo valve actuator port (P_{SV1} port)
m. Servo valve output port (P_{SV1A} port)

FUNCTION

- The delivery from the pump is varied by the conversion of the turning torque transmitted to the pump shaft as the input into hydraulic energy and by the changing, according to the load, of the angle of the rocker cam discharging the pressure oil.

STRUCTURE



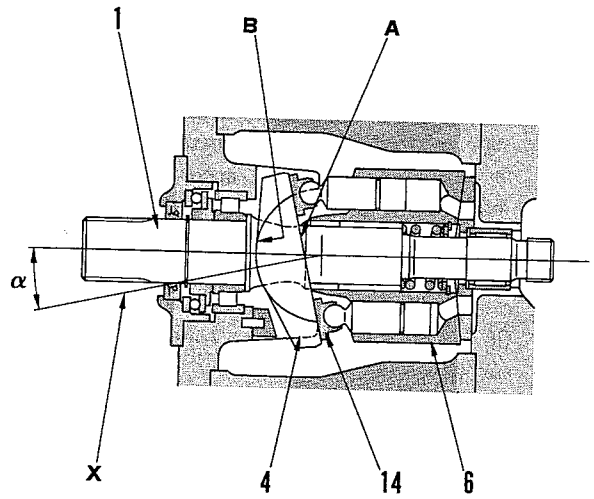
021KF030A

- Cylinder block (6) is splined onto shaft (1). Shaft (1) is carried on front and rear bearings.
- The tip of piston (5) is spherical. Shoe (4) is calked around the ball at the piston to form a single unit with the piston. Piston (5) and shoe (4) form a spherical bearing.
- Rocker cam (4) has flat surface **A**. Shoe (4) slides in a circle on surface **A** while maintaining the proper clearance between itself and surface **A**. Rocker cam (4) slides on concave face **B** of cradle (2) which is fixed to the case, and high pressure oil is conducted to the sliding concave faces to produce the static pressure bearing.
- Pistons (5) move in an axial direction inside each cylinder in cylinder block (6).
- The cylinder block rotates relative to valve plate (7), sealing the pressure oil against the valve plate. This spherical surface is provided to maintain a proper oil pressure balance, and the oil in each cylinder chamber in cylinder block (6) is drawn in or discharged through valve plate (7).

OPERATION

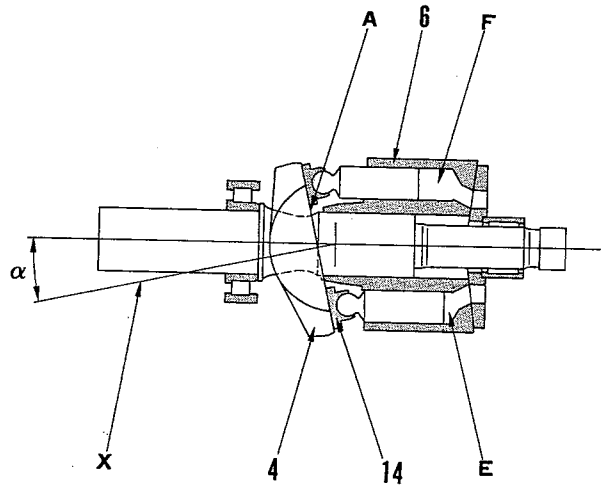
1. Pump operation

- Cylinder block (6) rotates with shaft (1) and shoe(14) slides on plane **A**. At this time, rocker cam (4) moves along cylindrical surface **B**, which varies inclination α of the center line **X** of rocker cam (4) in the axial direction of cylinder block (6). α is called the rocker cam angle.
- Rocker cam angle α is a maximum of ±14°40′.



021KF031A

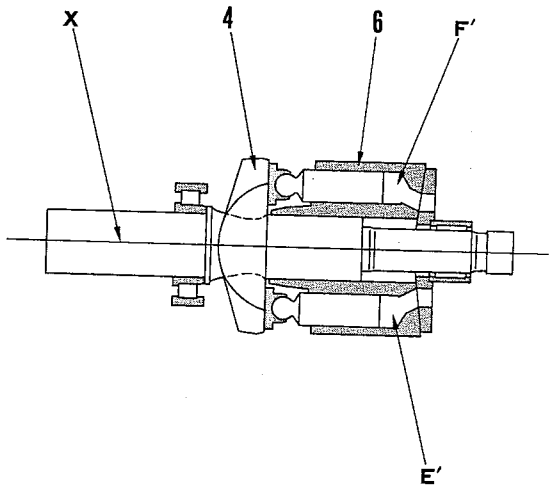
i) When the center line **X** of rocker cam (4) forms rocker cam angle α to the axial direction of cylinder block (6), plane **A** works like a cam for shoe(14). Thereby, piston (5) makes a sliding motion in the cylinder block. As a result, a difference between volumes **E** and **F** occurs, and the pressure oil is drawn in or discharged by the difference, **F**—**E**. In other words, the oil is discharged while volume **F** is gradually made smaller, approaching volume **E**. The oil is drawn in while volume **F** is returning to its original condition, passing the condition of volume **E**.



021KF032A

ii) When the center line **X** of rocker cam (4) is in line with the axial direction (when the rocker cam angle = 0), there is no difference between volumes **E′** and **F′** in cylinder block (6). Consequently, no oil comes in or out, and the pump stays out of operation.

iii) A charging pump for the control circuit also makes the same rotation as the main pump, delivering the pressure oil into the control circuit.

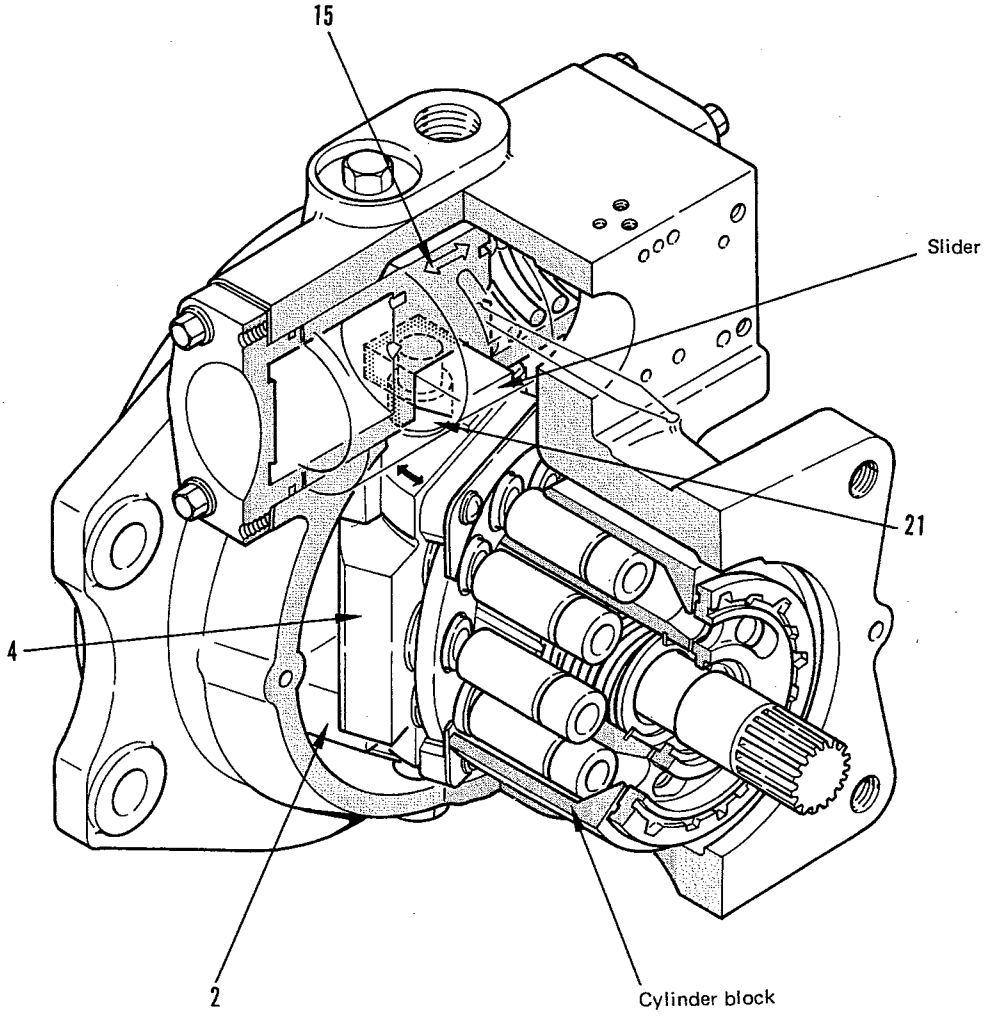


021KF033A

2. Control of the delivery

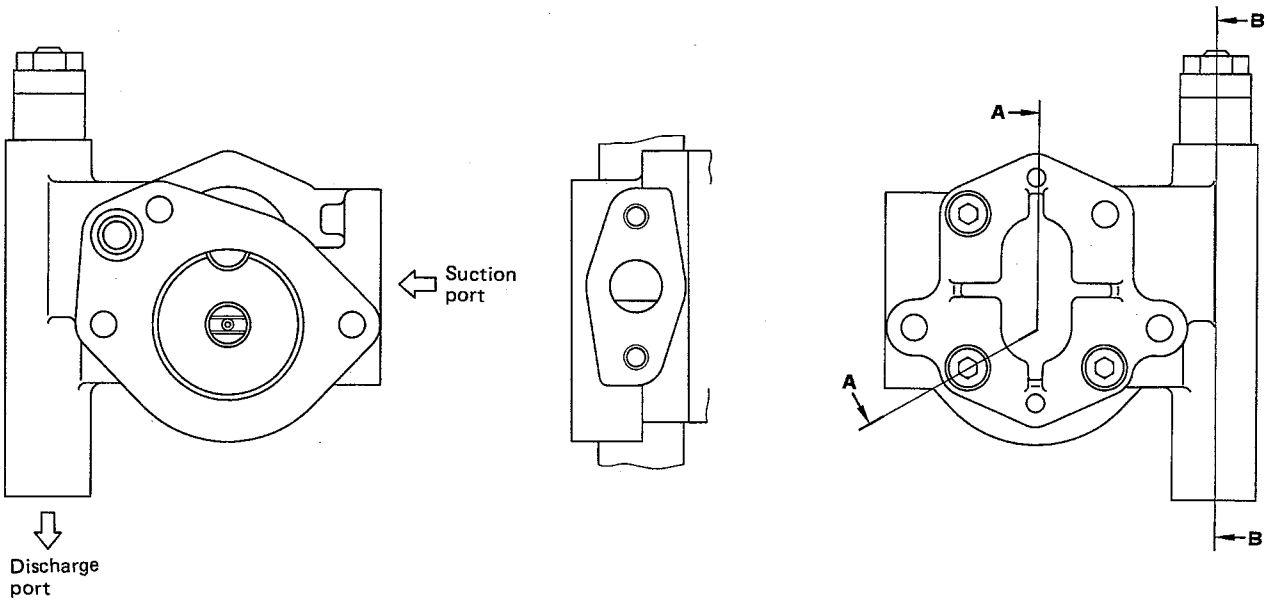
As the rocker cam angle increases, the difference between volumes **F** and **E** also gets larger, resulting in more delivery.

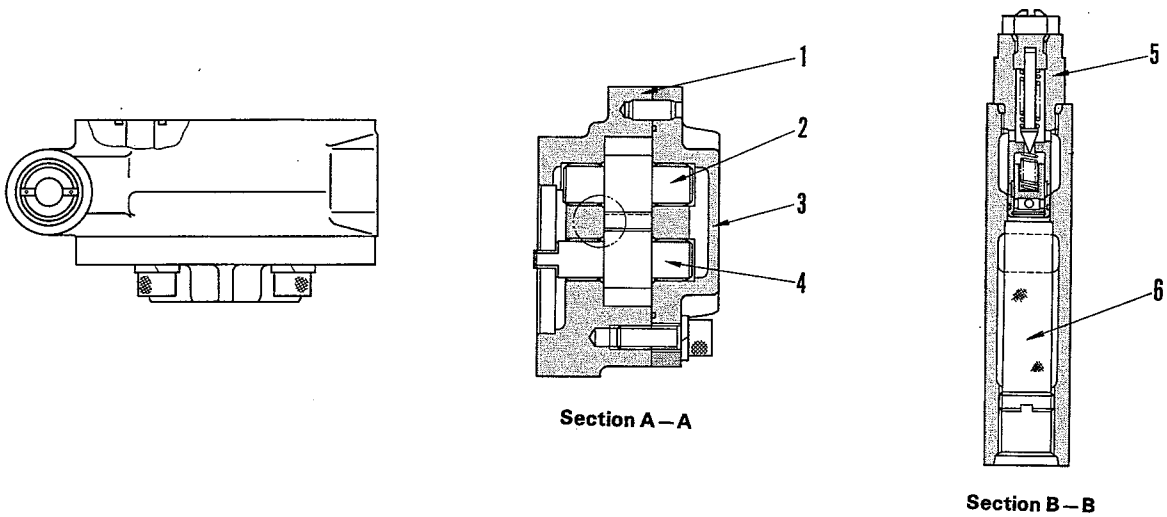
The thing that changes the rocker cam angle α is servo piston (15). Servo piston (15) reciprocates in the linear direction according to the commands from the servo valve. This linear motion is transmitted to rocker cam (4) through the rocker cam rod (21). Rocker cam (4), supported on the cylindrical surface in cradle (2), oscillates (in the directions of ↙ ↗) along the cylindrical surface.



F0202C010

2. CHARGING PUMP (BAR16)





Section A—A

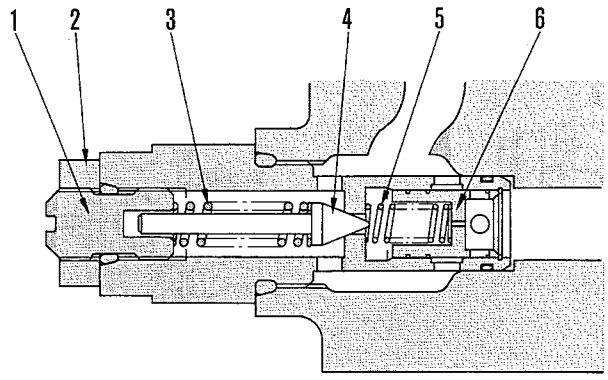
Section B—B

201F5062

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

- Theoretical delivery: 16 cc/rev.
- Max. delivery pressure: 30 kg/cm^2

RELIEF VALVE



205F2081

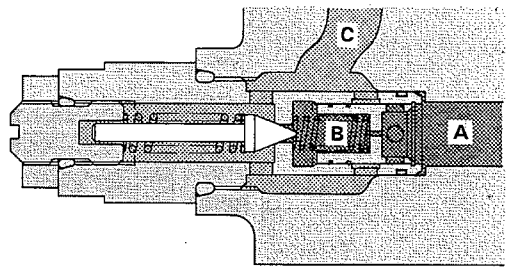
1. Adjustment screw
2. Lock nut
3. Pilot valve spring
4. Pilot valve
5. Main valve spring
6. Main valve

Function

The relief valve is built in the body of charging. It relieves the oil delivered from the pump when the control lever is placed in Neutral.

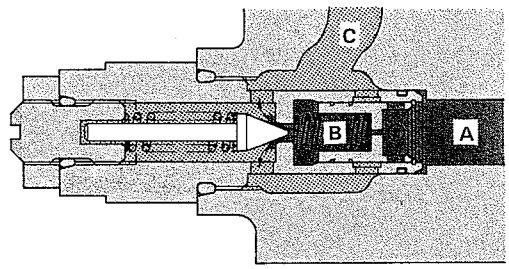
Flow of the oil

- Chamber **A** forms a pump circuit and chamber **C** forms a tank drain circuit. The oil flows into chamber **B** through the main relief valve orifice to keep the chamber filled.
  Pilot valve is set in the valve seat.



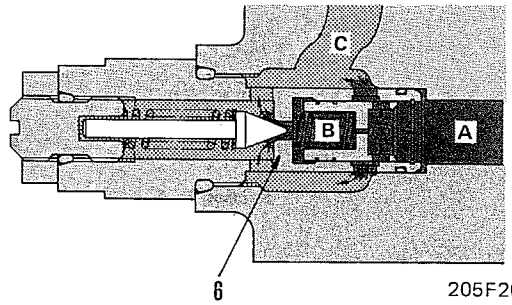
205F2082

- If the pressure in chamber **B** reaches the pilot valve spring force (set pressure), the pilot valve moves, allowing the oil in chamber **B** to flow into chamber **C**. In addition, the oil flows from chamber **A** to **B** through orifices.



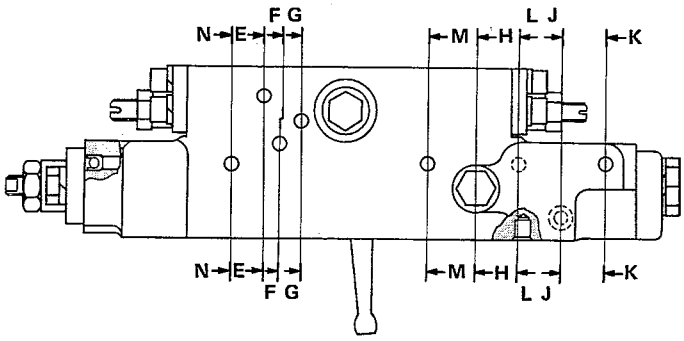
205F2083

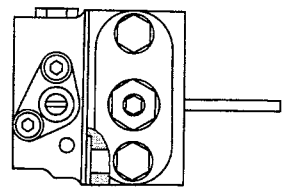
- If the oil flows through the orifice of valve (6), a differential pressure occurs between the chambers **A** and **B**, moving valve (6) to the right. This allows the oil in chamber **A** to flow into chamber **C**.



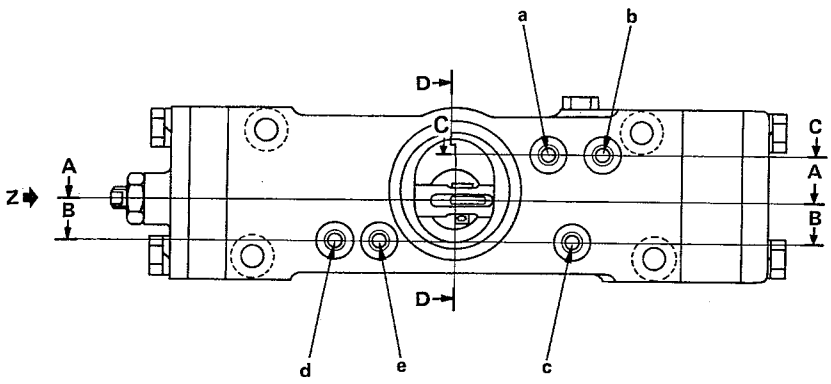
205F2084

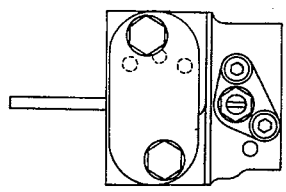
3. SERVO VALVE

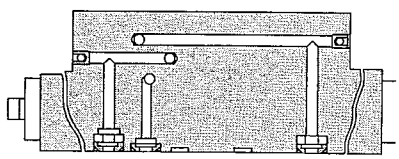




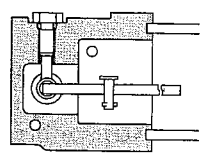
View Z





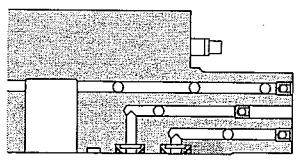


Section B – B



Section D – D

F0202C011



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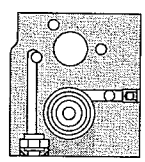
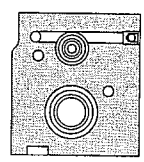
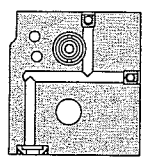


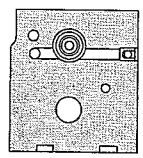
Section N – N



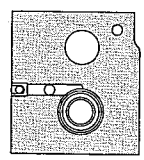
Section E – E



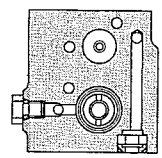
Section F – F



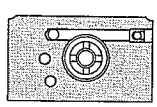
Section G – G



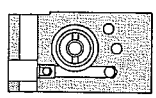
Section M – M



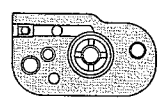
Section H – H



Section L – L



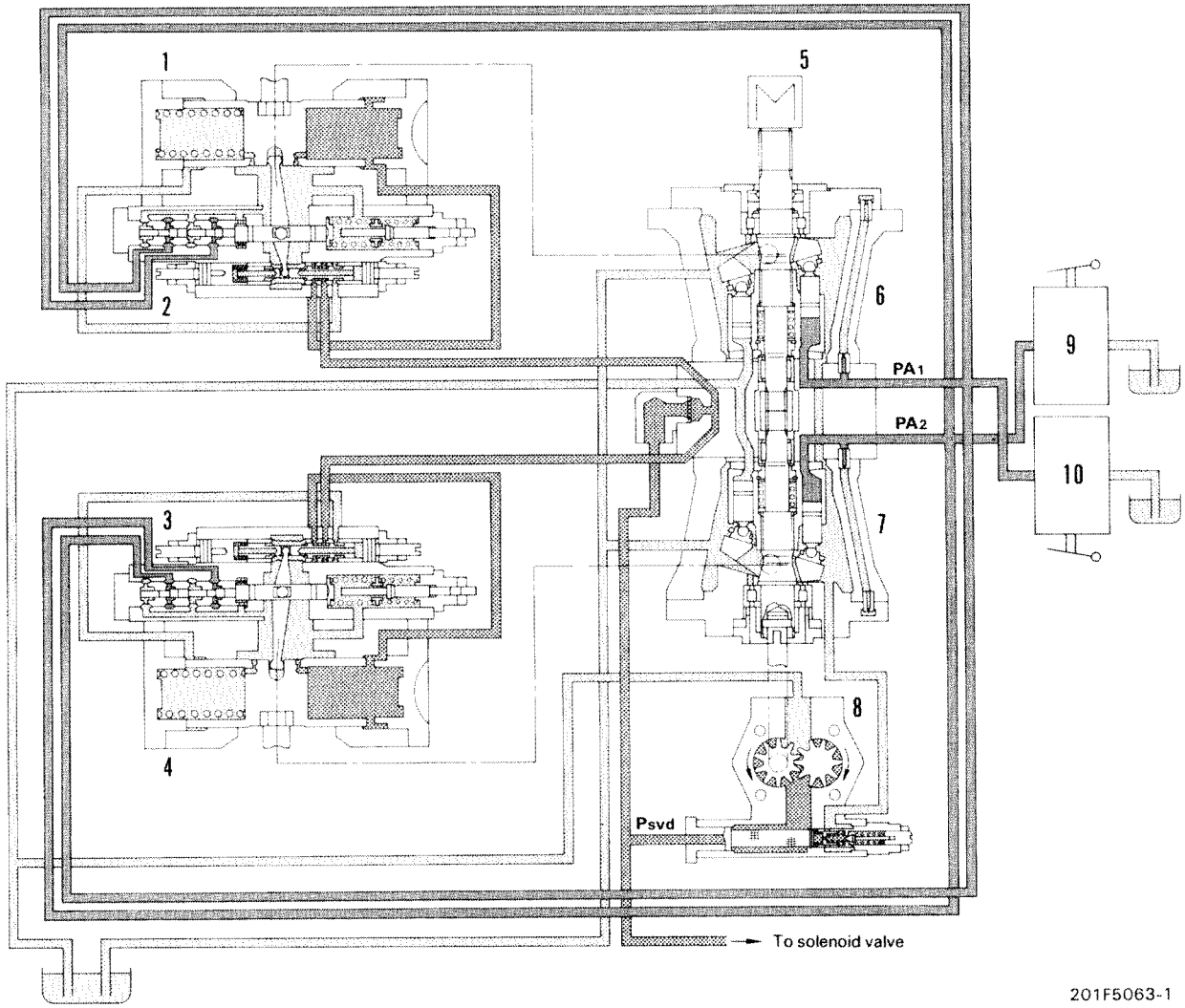
Section J – J



Section K – K

F21KC3018

PC CONTROL SYSTEM

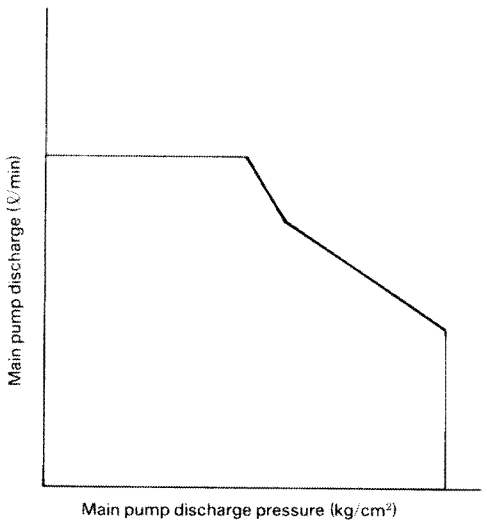


201F5063-1

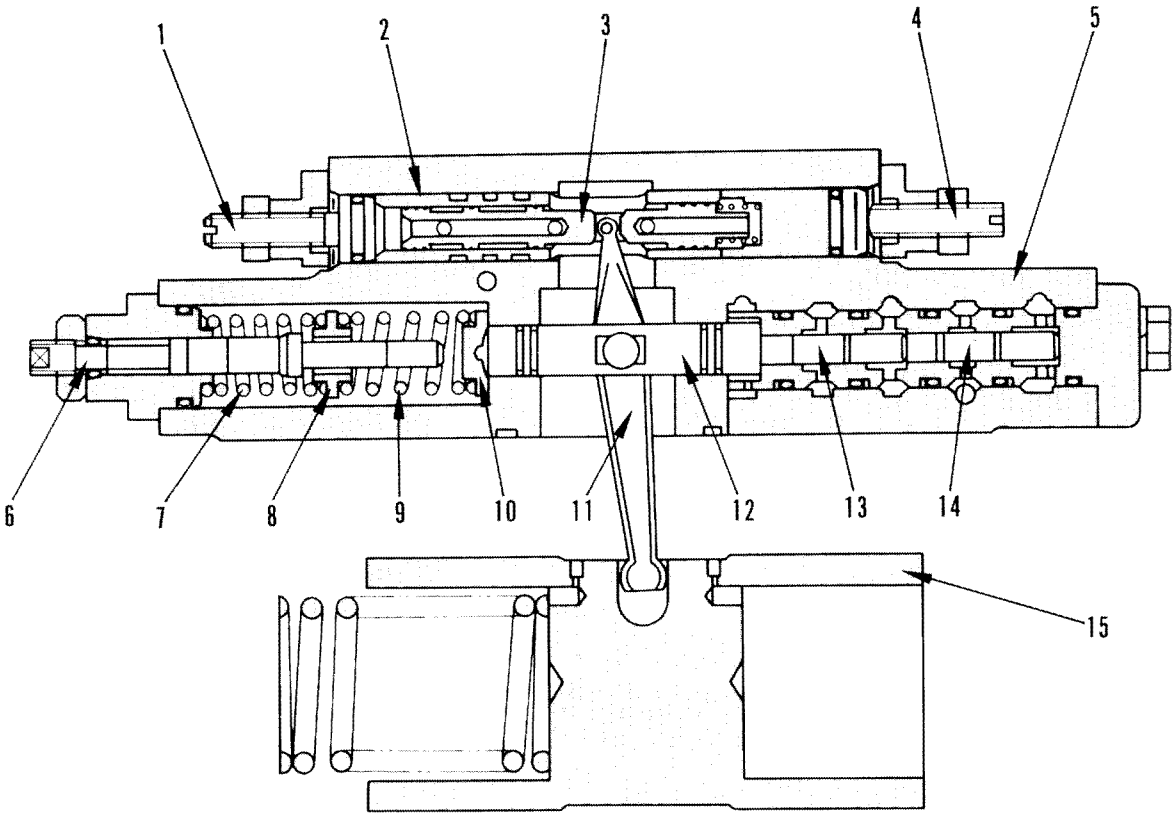
1. Front servo piston
2. Front servo valve
3. Rear servo valve
4. Rear servo piston
5. Engine
6. Front main pump
7. Rear main pump
8. Charging pump
9. L.H. 6-spool control valve
10. R.H. 5-spool control valve

OUTLINE

- With the PC control system, as shown in the diagram on the right, when the load pressure increases,the delivery amount is automatically reduced; when the load is reduced, the delivery amount increases. In other words, it acts like an automatic transmission and keeps the load on the engine constant.
  With the PC control system, a small engine can be used for a wide range of loads (pressure) with the engine always used at 100% of its output. This system is ideal for hydraulic excavators, which have a comparatively wide variation in load (pressure).



201F5064



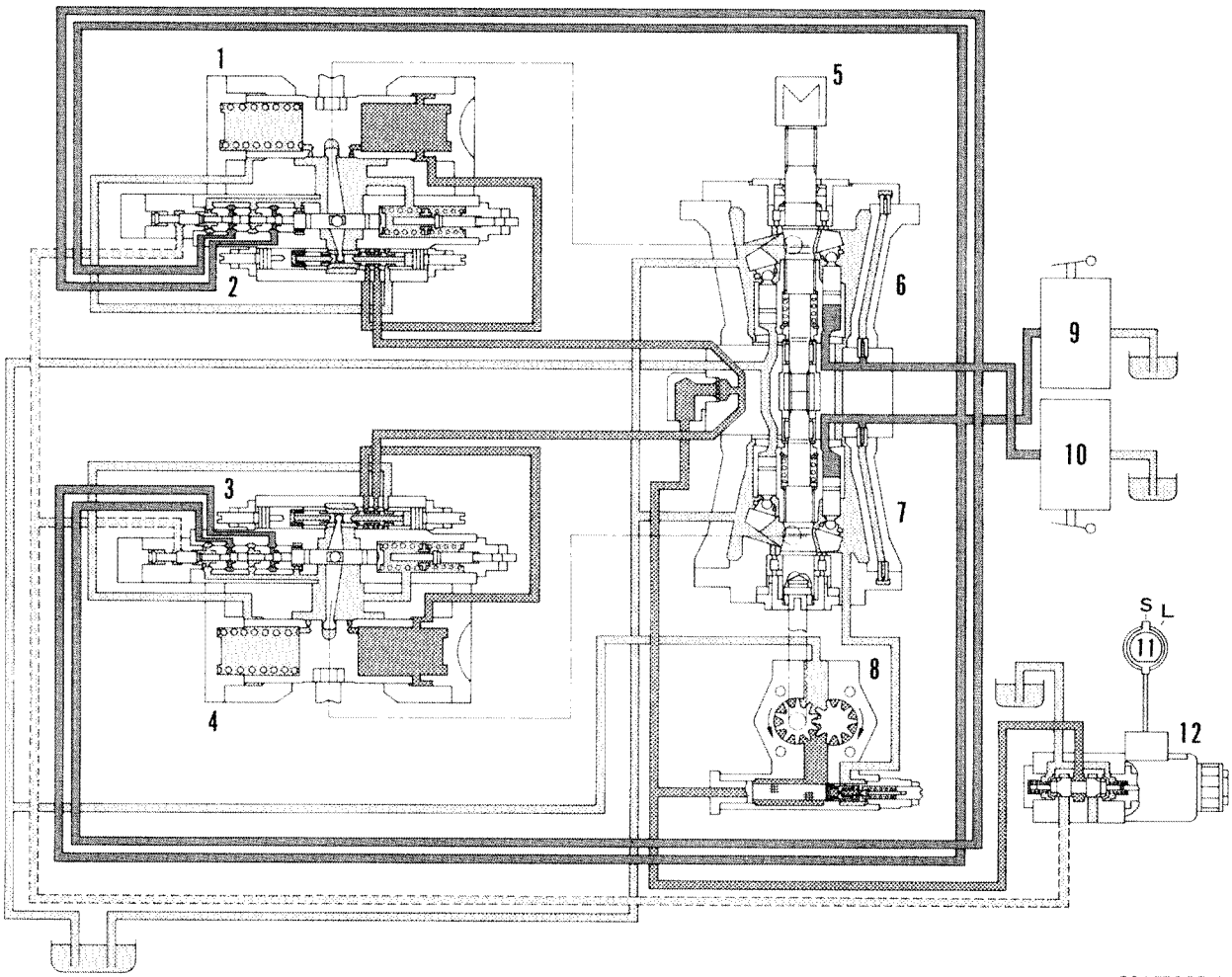
Section A–A

F21KC3019

1. Screw
2. Sleeve
3. Spool
4. Screw
5. Valve body
6. Rod
7. Spring
8. Seat
9. Spring
10. Seat
11. Arm
12. Piston
13. Piston
14. Piston
15. Servo piston

a. Front pump discharge pressure input port (Pa_2 port)
b. Rear pump discharge pressure input port (Pa_2 port)
c. Servo valve output port (P_{SV2A} port)
d. Servo valve actuator input port (P_{SV2} port)
e. Servo valve output port (P_{SV2B} port)

MODE SELECTION TYPE PC CONTROL SYSTEM (If equipped)

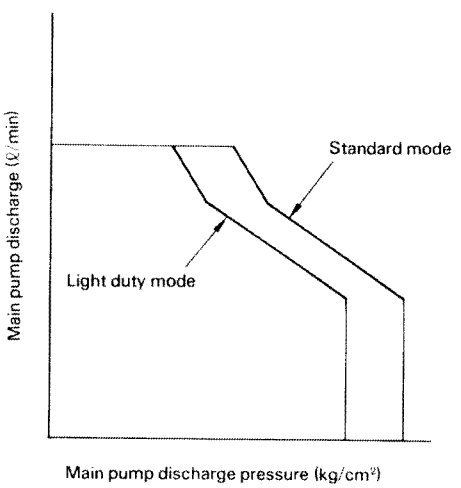


201F5068-1

1. Front servo piston
2. Front servo valve
3. Rear servo valve
4. Rear servo piston
5. Engine
6. Front main pump
7. Rear main pump
8. Charging pump
9. L.H. 6-spool control valve
10. R.H. 5-spool control valve
11. Mode selector switch
12. Mode selector solenoid valve

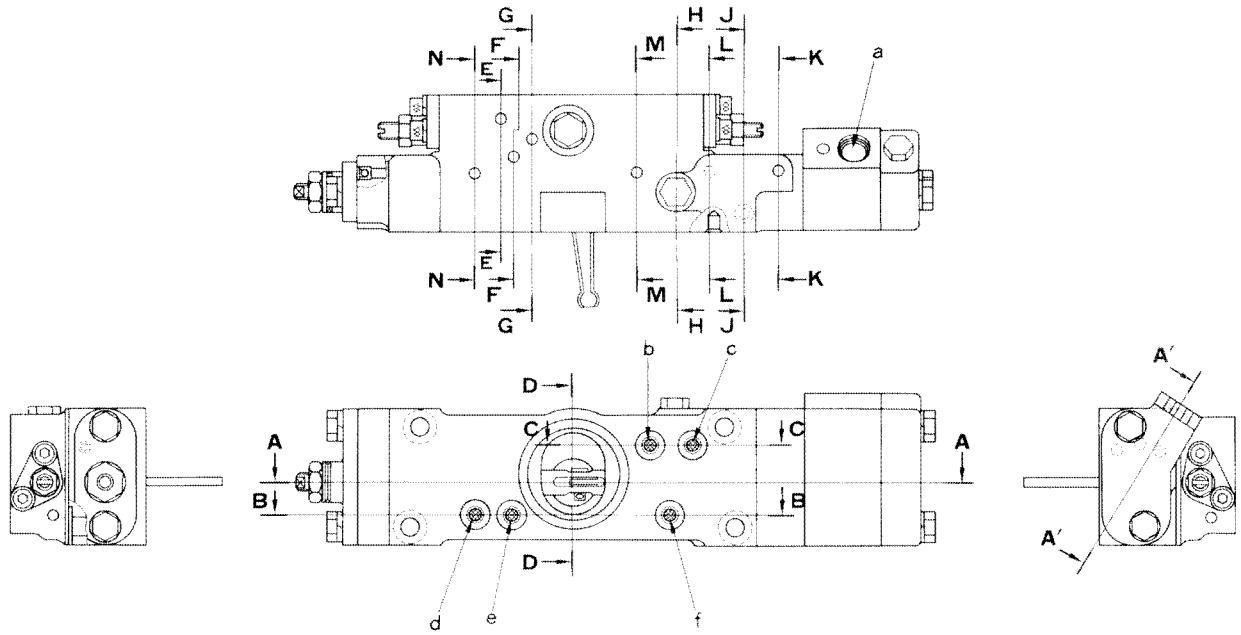
OUTLINE

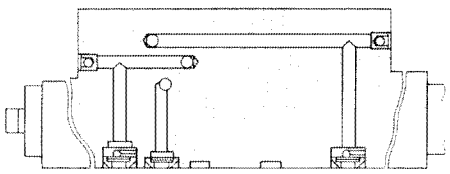
- The mode selection type PC control system uses a mode selector switch to select one of two levels: S mode (for normal operations), and L mode (for light load operations).
  In this way, the absorption torque of the pump can be made to suit the nature of the operation, so fuel consumption can be further reduced.
- The performance of the pump for each mode is as shown in the figure on the right.



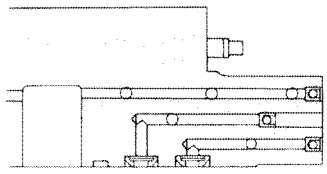
201F5069

SERVO VALVE

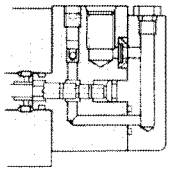




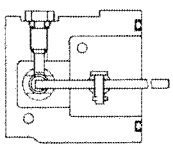
Section B—B



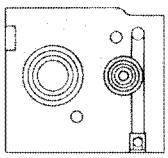
Section C—C



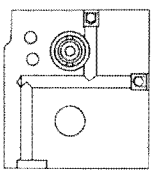
Section A′—A′



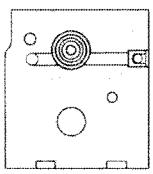
Section D—D



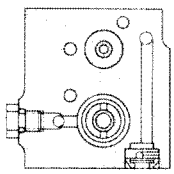
Section E—E



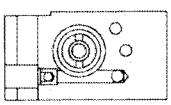
Section F—F



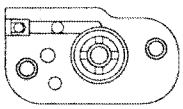
Section G—G



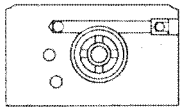
Section H—H



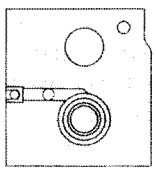
Section J—J



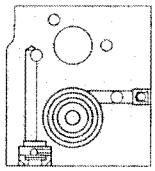
Section K—K



Section L—L

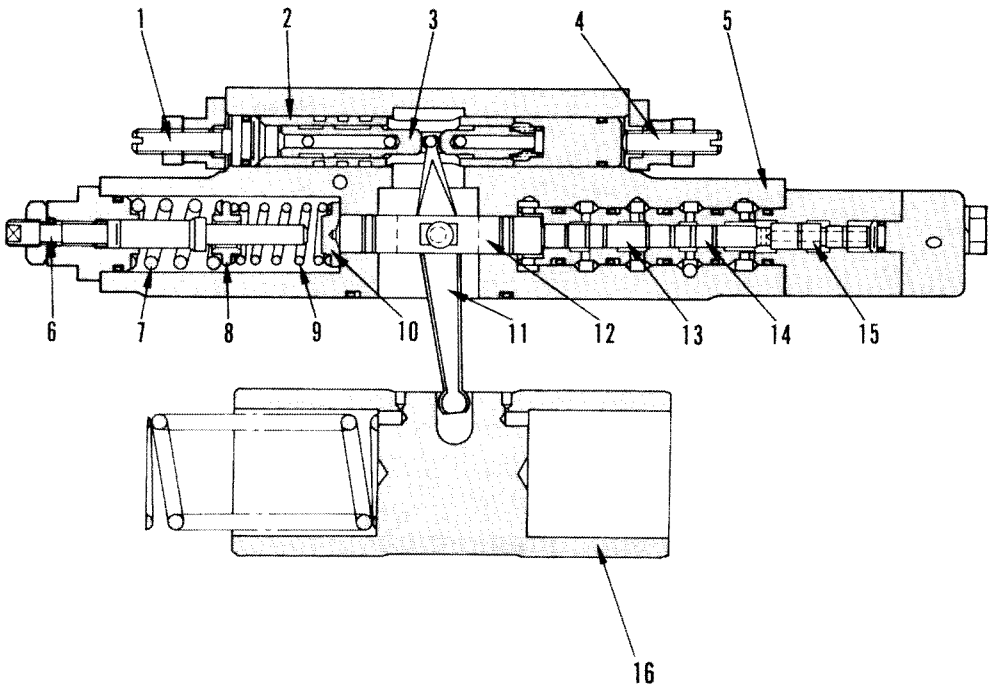


Section M—M



Section N—N

201F5070



Section A – A

201F5071

1. Screw
2. Sleeve
3. Spool
4. Screw
5. Valve body
6. Rod
7. Spring
8. Seat
9. Spring
10. Seat
11. Arm
12. Piston
13. Piston
14. Piston
15. Piston
16. Servo piston

a. Mode selector signal pressure port (Pa_3 port)
b. Front pump discharge pressure input port (Pa_1 port)
c. Rear pump discharge pressure input port (Pa_2 port)
d. Servo valve output port (P_{SV2A} port)
e. Servo valve actuator input port (P_{SV2} port)
f. Servo valve output port (P_{SV2B} port)

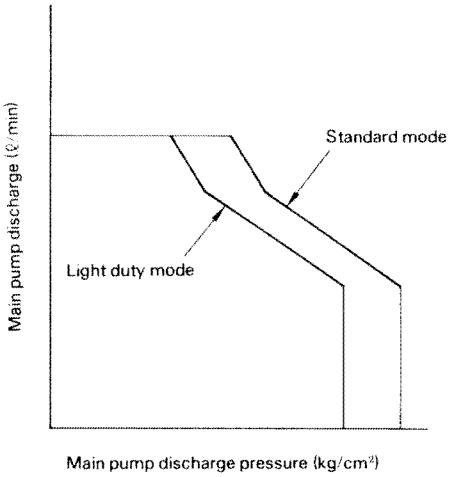
OPERATION

1. S mode (for normal operations)

For normal operations, set the mode selector switch to S mode.

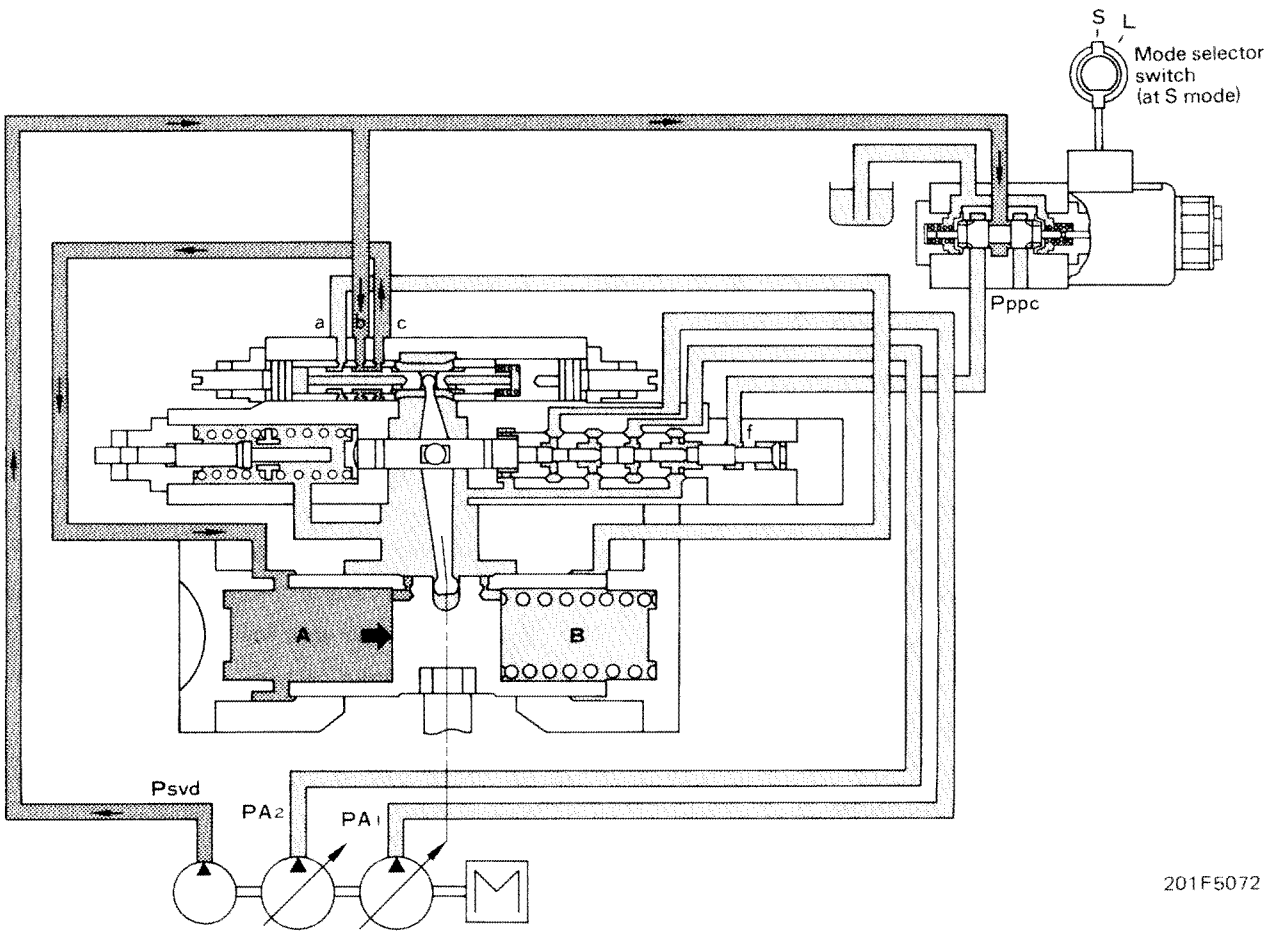
When this is done, signal pressure P_{PPC} from the mode selector valve does not enter port f of the servo valve, so the main pump is controlled as shown in the S mode graph in Fig. 1.

★ The main pump control in S mode (pump characteristics) is the same as the PC control for machines with no mode selector.



201F5069

Fig. 1



201F5072

2. **L mode (for light load operations)**

For operations with a light load, set the mode selector switch to L mode.

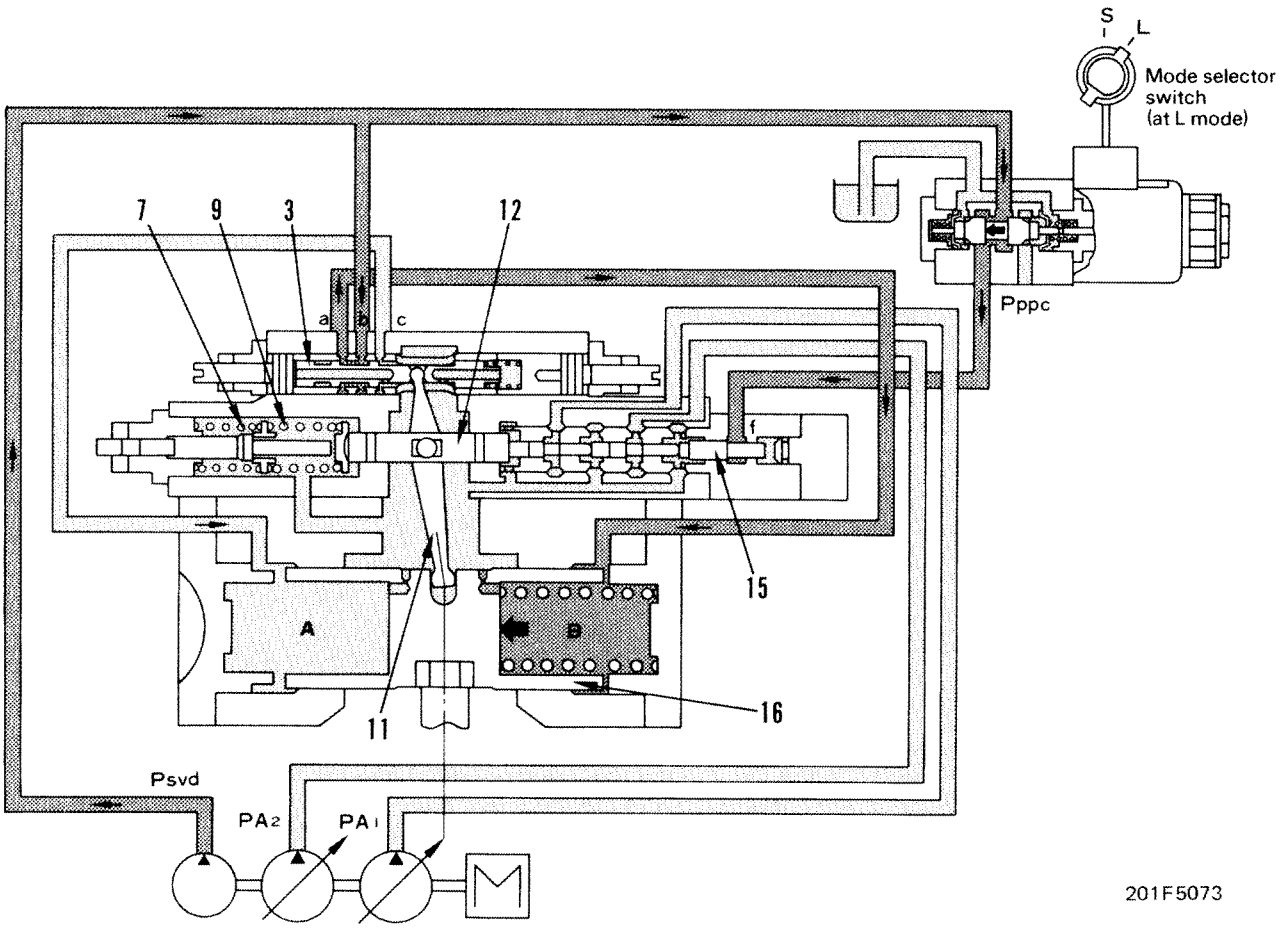
When this is done, the mode selector solenoid valve is switched, and signal pressure P_{PPC} enters port **f** and pushes piston (15) to the left.

As a result, piston (12) is pushed to the left, and arm (11) uses servo piston (16) as a fulcrum to push spool (3) to the left.

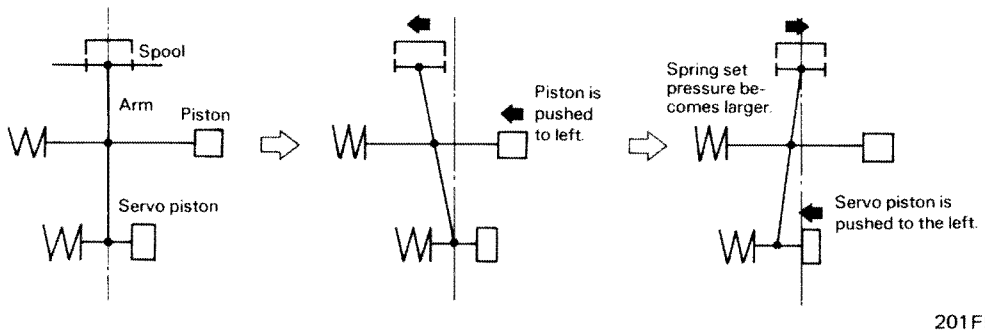
When spool (3) is pushed to the left, port **b** and port **a** are connected, and pressurized oil **Psvd** from the charging pump enters chamber **B** of servo piston (16), and pushes servo piston (16) to the left.

Arm (11) uses piston (12) as a fulcrum and moves spool (3) to the right. Servo piston (16) stops at the position where the connection between port **a** and port **b** of spool (3) is cut.

As a result, springs (7) and (9) are compressed, and the set pressure becomes larger, so the main pump is controlled as shown in the graph for the L mode in Fig. 1.

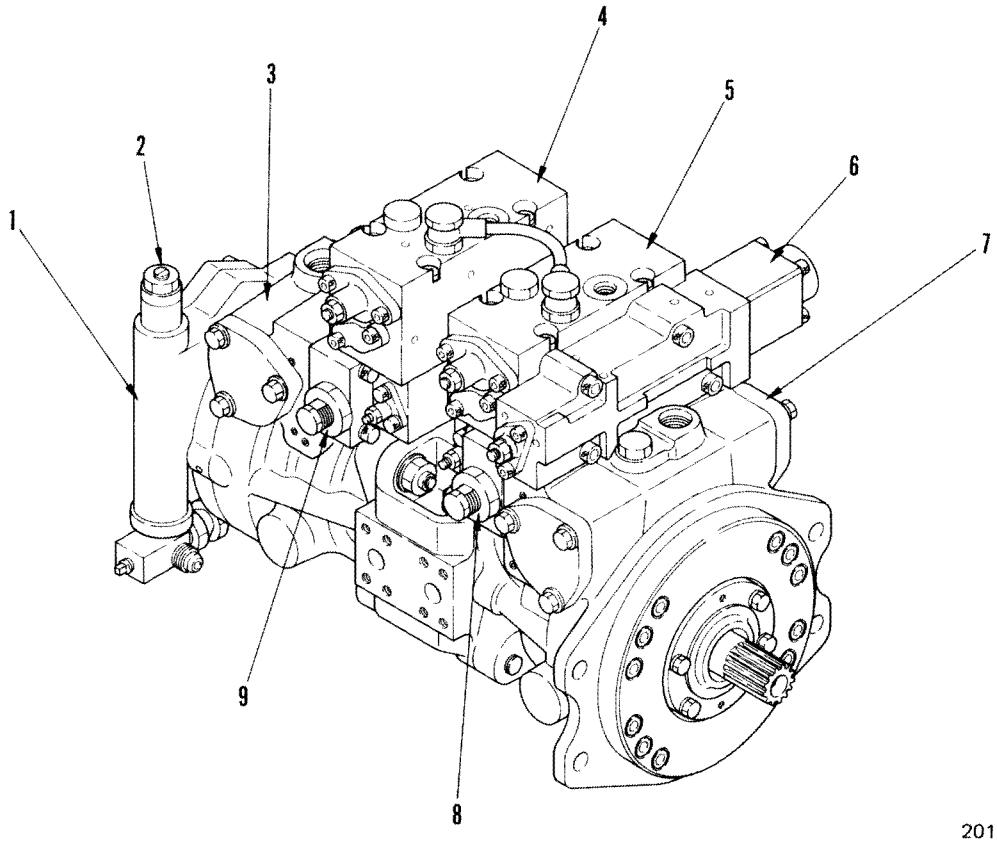


- Movement of spool, arm, piston and servo piston when switched to L mode



OLSS SYSTEM (If equipped)

1. OUTLINE



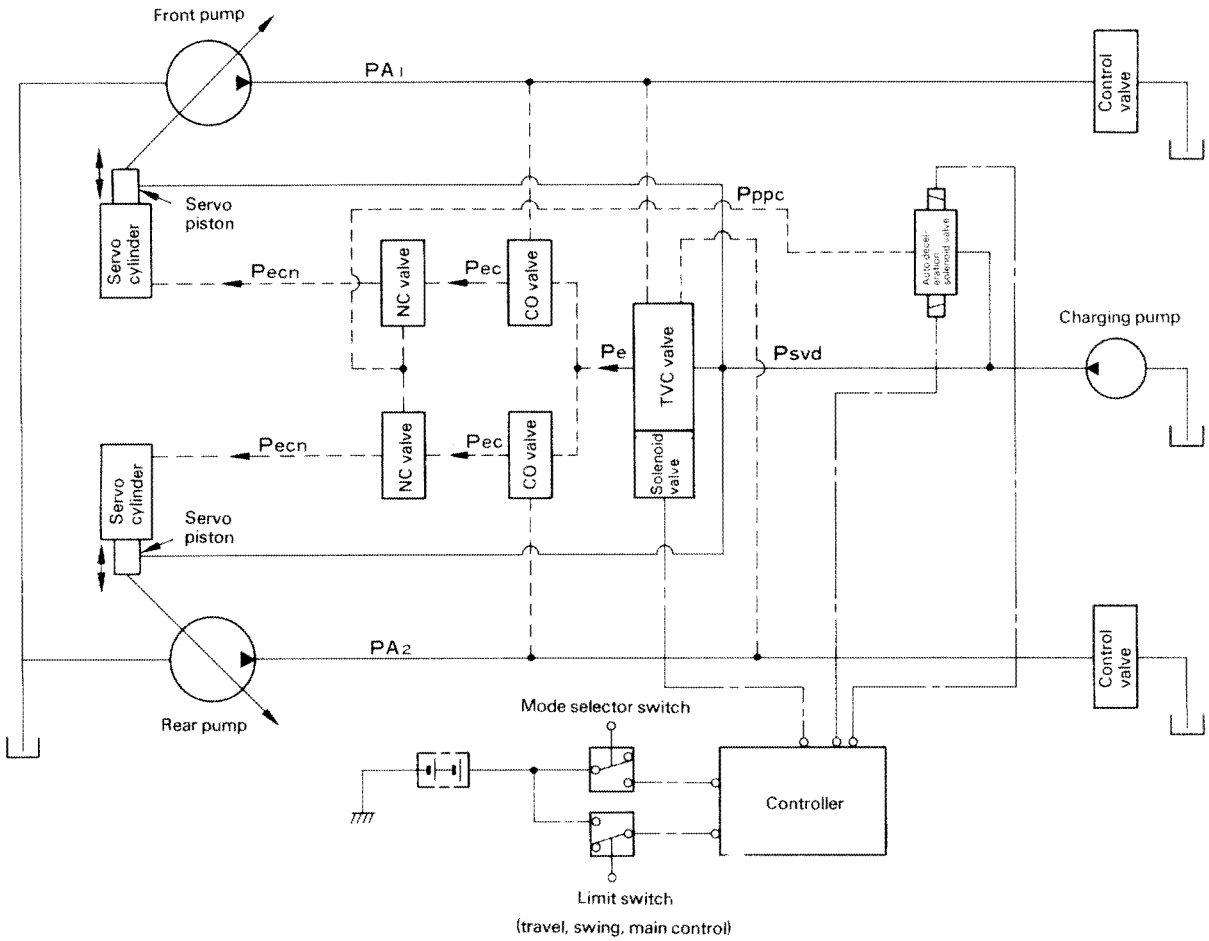
201F5074

1. Charging pump
2. Relief valve
3. Rear main pump
4. Rear CO, NC valve
5. Front CO, NC valve
6. TVC valve
7. Front main pump
8. Front servo valve
9. Rear servo valve

OLSS (Open center Load Sensing System) is a hydraulic system which controls the variable displacement piston pump for the purposes of increased energy saving and easy fine control operation.
In addition, the maximum delivery of the pump can be set in two steps, namely, the STANDARD mode and the LIGHT DUTY mode. The fuel cost can be reduced by selecting the LIGHT DUTY mode in a light-duty operation.

Note:
These parts are installed only on machine equipped with auto-deceleration system and swing mechanical brake.

2. BASIC CIRCUIT OF OLSS

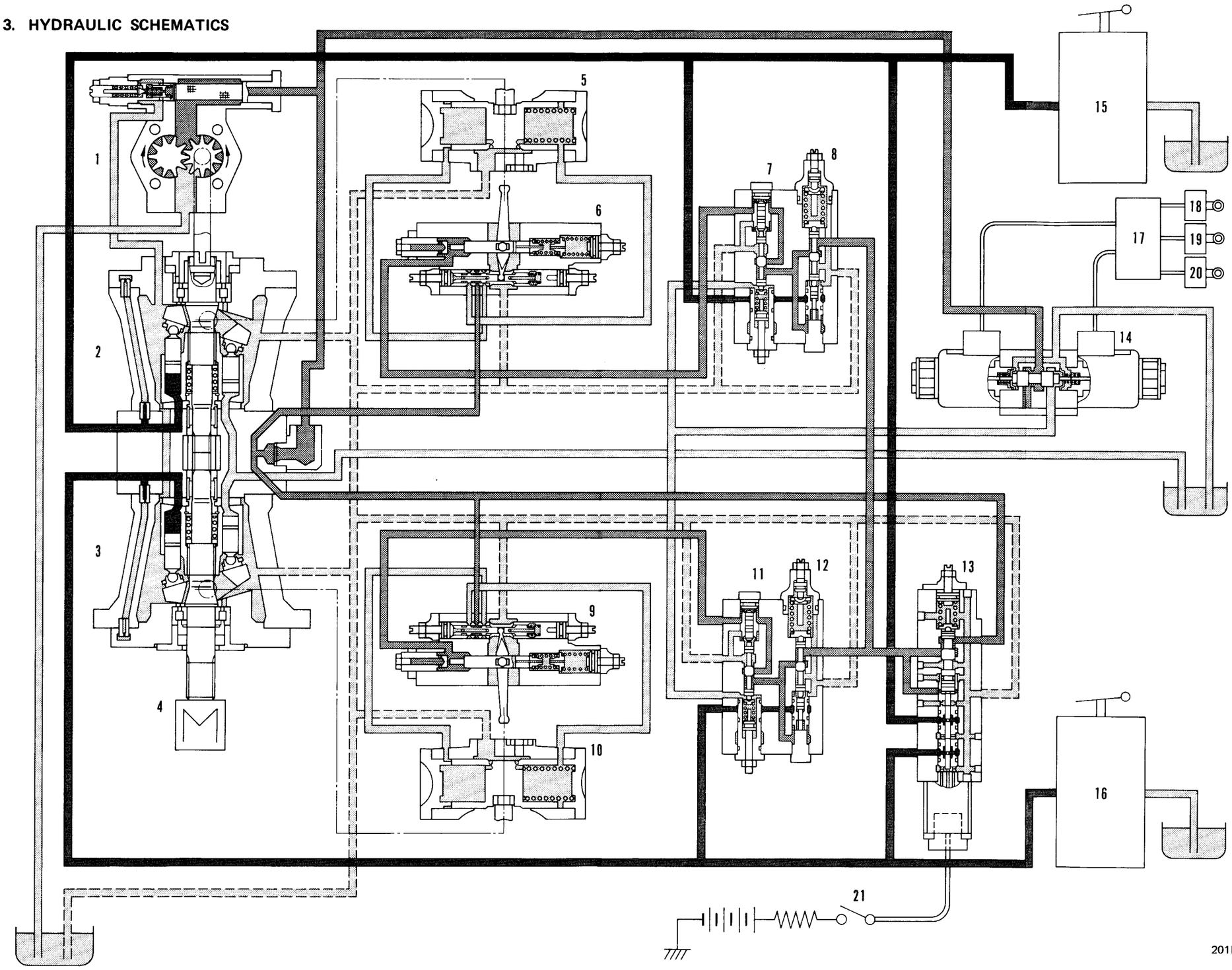


201F5075

NC valve: Negative control valve
TVC valve: Torque constant variable control valve
CO valve: Cut-off valve

★ FOR MACHINE EQUIPPED WITH OLSS

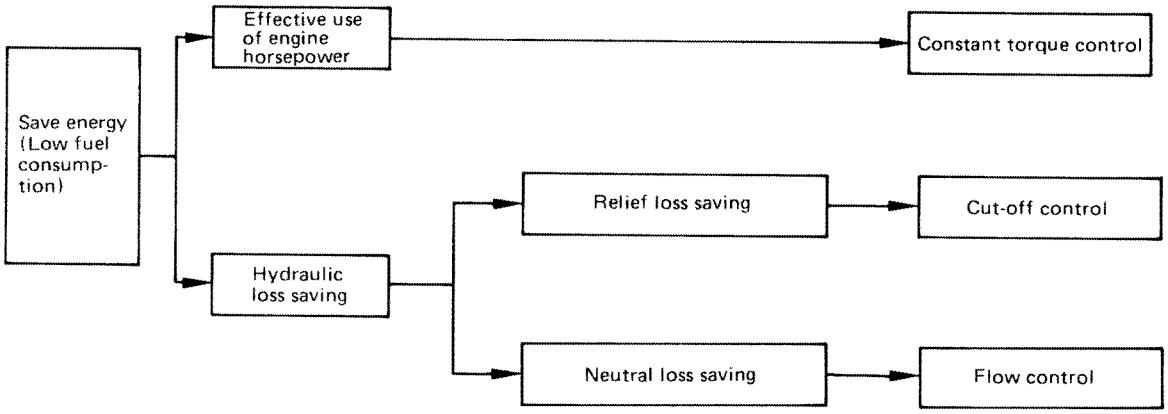
3. HYDRAULIC SCHEMATICS



201F5076

1. Charging pump
2. Rear main pump
3. Front main pump
4. Engine
5. Rear servo piston
6. Rear servo valve
7. Rear NC valve
8. Rear CO valve
9. Front servo valve
10. Front servo piston
11. Front NC valve
12. Front CO valve
13. TVC valve
14. Auto deceleration solenoid valve
15. L.H. 6-spool control valve
16. R.H. 5-spool control valve
17. Controller
18. Limit switch (for swing)
19. Limit switch (for travel)
20. Limit switch (for work equipment)
21. Mode selector switch

4. FUNCTION OF OLSS



20DF1103

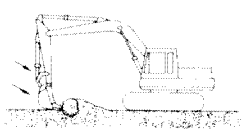
1) Effective use of engine horsepower

In order to use the engine horsepower effectively, the delivery of the pumps automatically decreases as the load pressure on the pumps goes up and increases as the load pressure goes down. That is, the constant torque control function is applied to keep the load imposed on the engine constant by means of the automatic speed change action.

2) Hydraulic loss saving

Relief loss

When bucket hits something hard during digging operations, a large quantity of oil is uselessly drained to the hydraulic tank to protect hydraulic equipment from damage.



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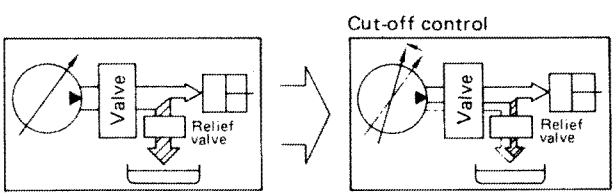

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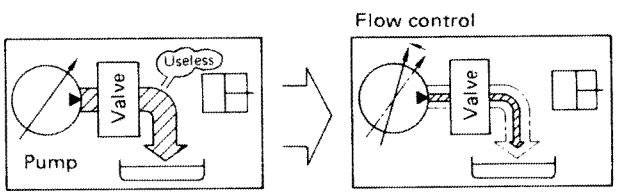
Neutral loss

Unused hydraulic oil is drained to the hydraulic tank when waiting for successive dumps and control levers are positioned in neutral.



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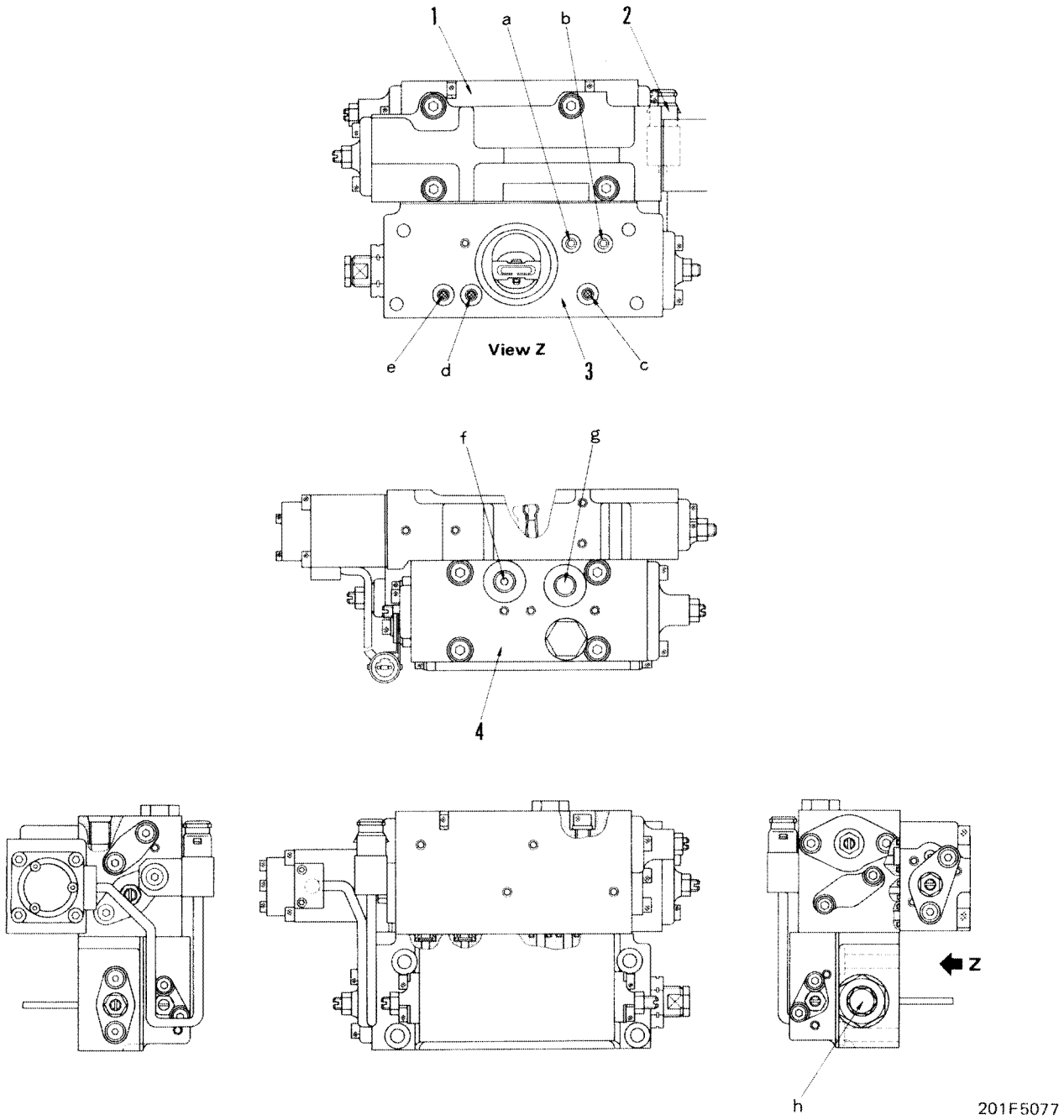
5. SERVO VALVE UNIT

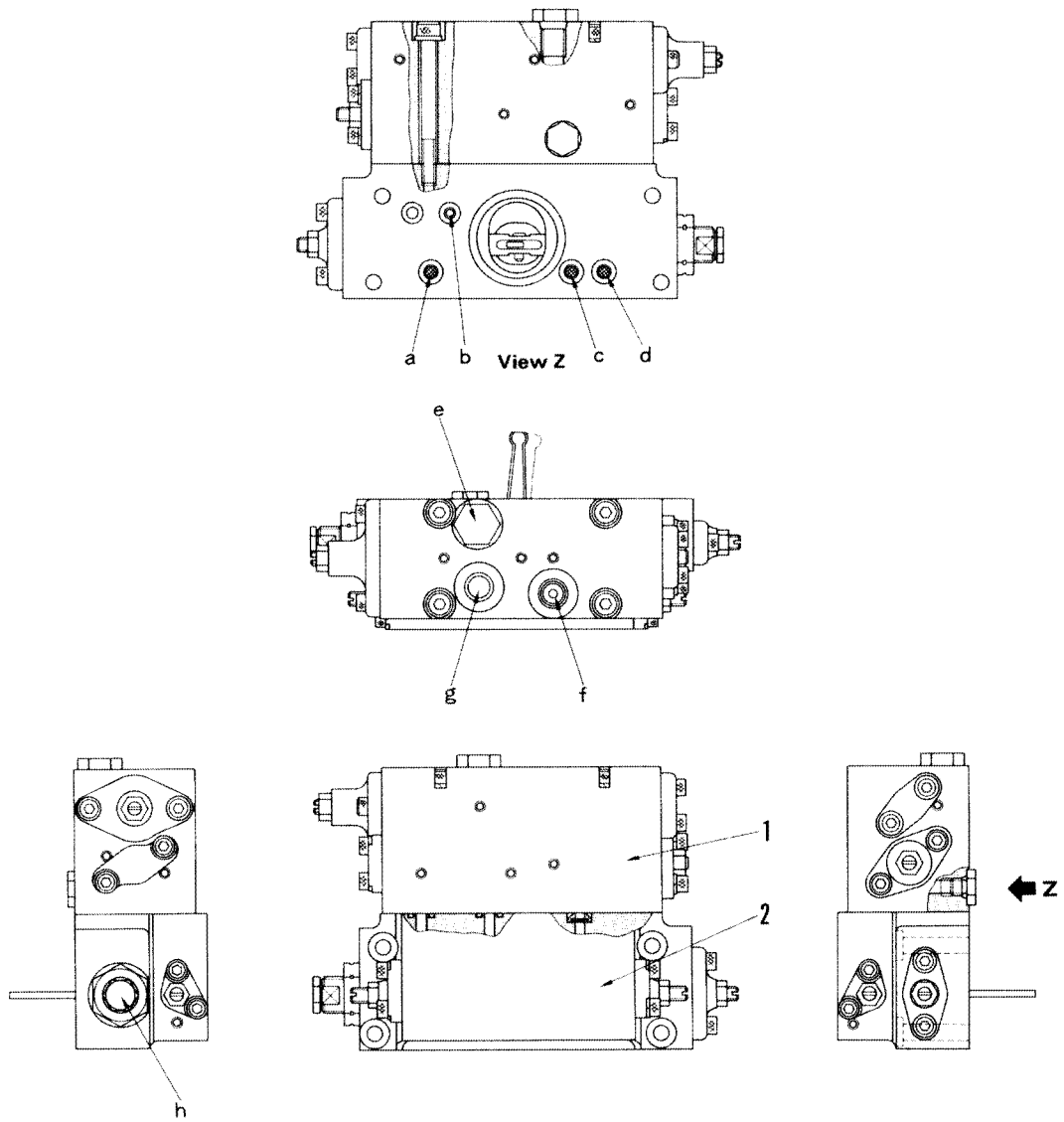
· SERVO VALVE UNIT FOR FRONT MAIN PUMP



1. TVC valve
2. Connector
3. Servo valve
4. CO·NC valve assembly

a. From front main pump discharge port
b. From rear main pump discharge port
c. To servo piston
d. From charging pump
e. To servo piston
f. From auto-deceleration solenoid valve
g. To rear CO valve
h. CO·NC valve output pressure pickup port

· SERVO VALVE UNIT FOR REAR MAIN PUMP

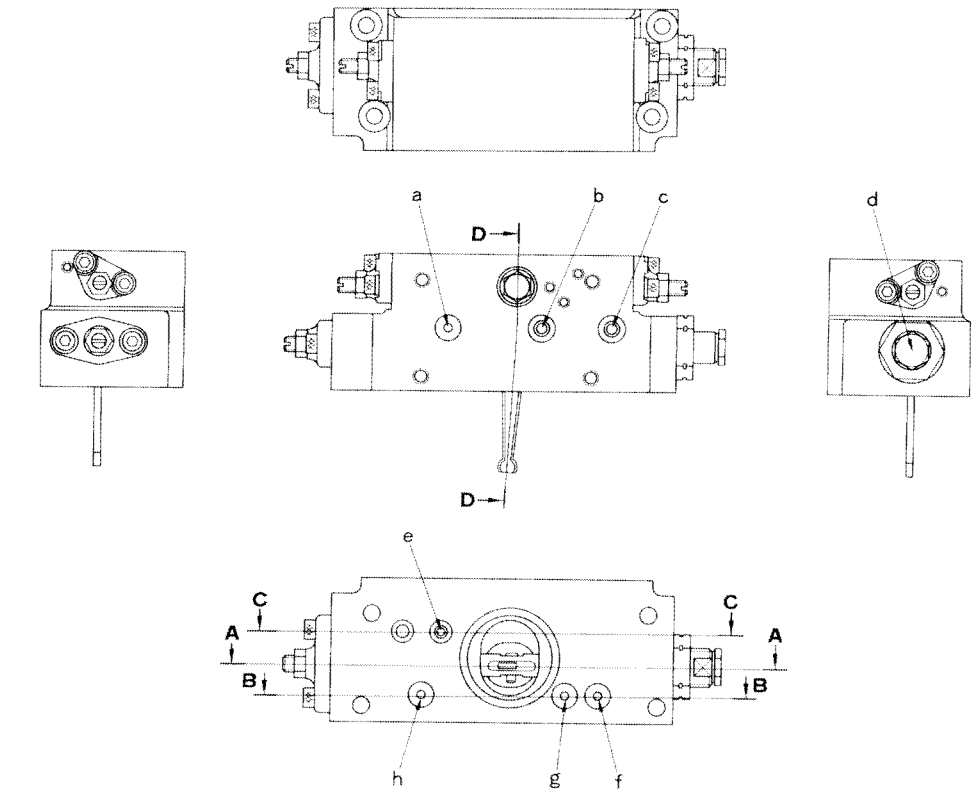


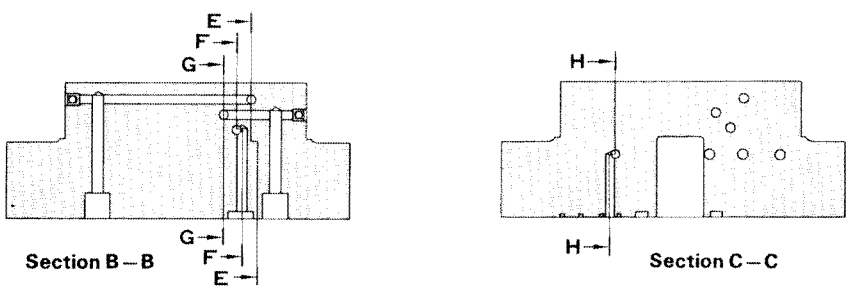
201F5078

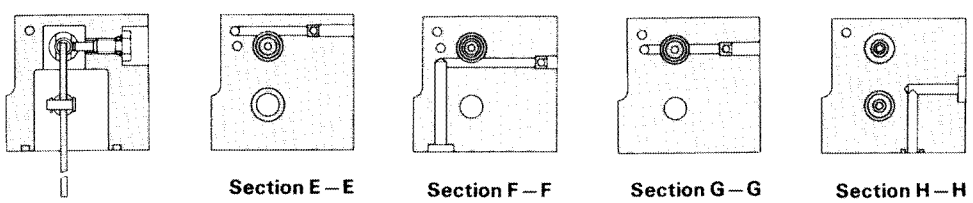
1. CO·NC valve assembly
2. Servo valve

a. To servo piston
b. From rear main pump discharge port
c. From charging pump
d. To servo piston
e. TVC valve output pressure pickup port
f. From auto-deceleration solenoid valve
g. From TVC valve
h. CO·NC valve output pressure pick-up port

1) SERVO VALVE

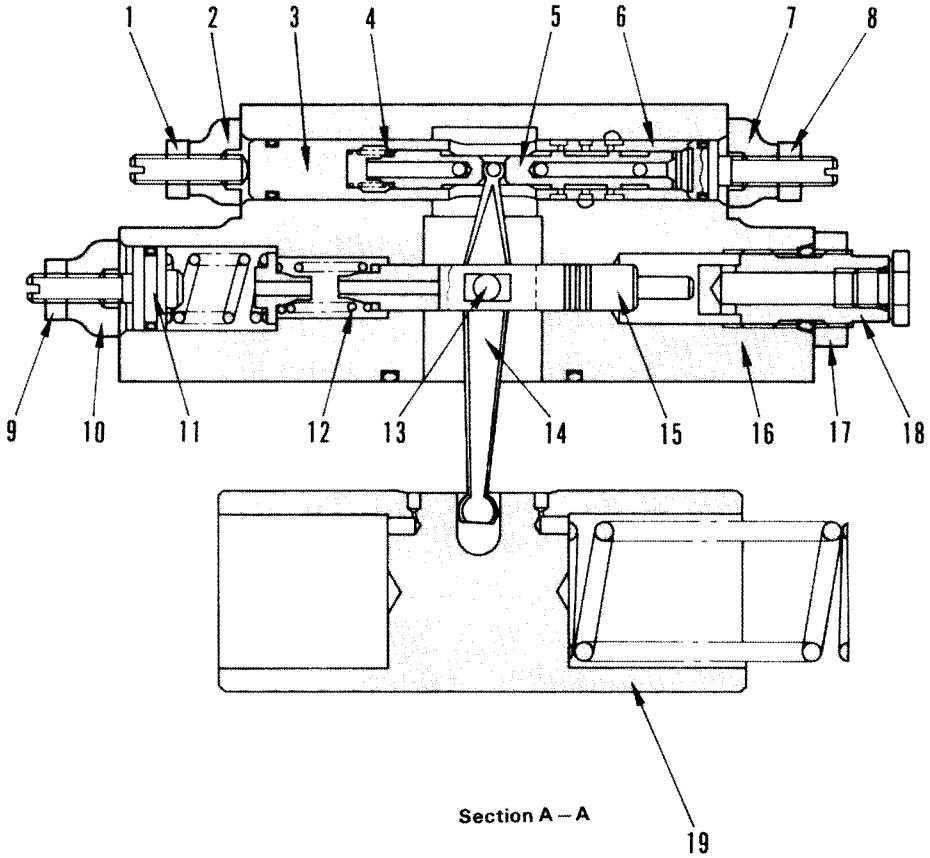






201F5079

a. To CO·NC valve
b. From CO·NC valve
c. From CO·NC valve
d. CO·NC valve output pressure pickup port
e. From rear main pump discharge port
f. To servo piston
g. From charging pump
h. To servo piston



Section A – A

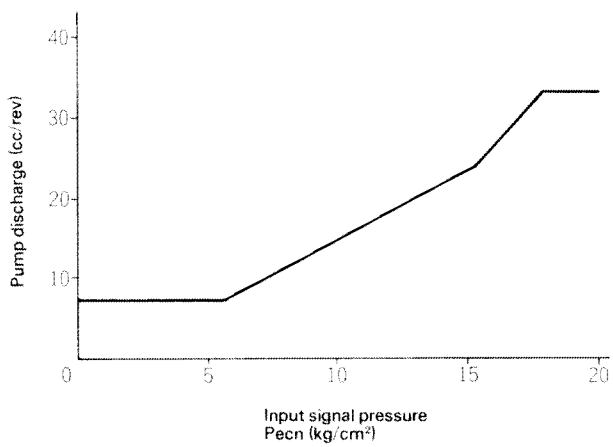
201F5080

1. Locknut
2. Cover
3. Spacer
4. Spring
5. Guide spool
6. Sleeve
7. Cover
8. Locknut
9. Locknut
10. Cover
11. Plug
12. Piston spring
13. Pin
14. Arm
15. Control piston
16. Spacer
17. Locknut
18. Plug
19. Servo piston

FUNCTION

Each discharge main piston pumps is individually controlled by each servo valve.

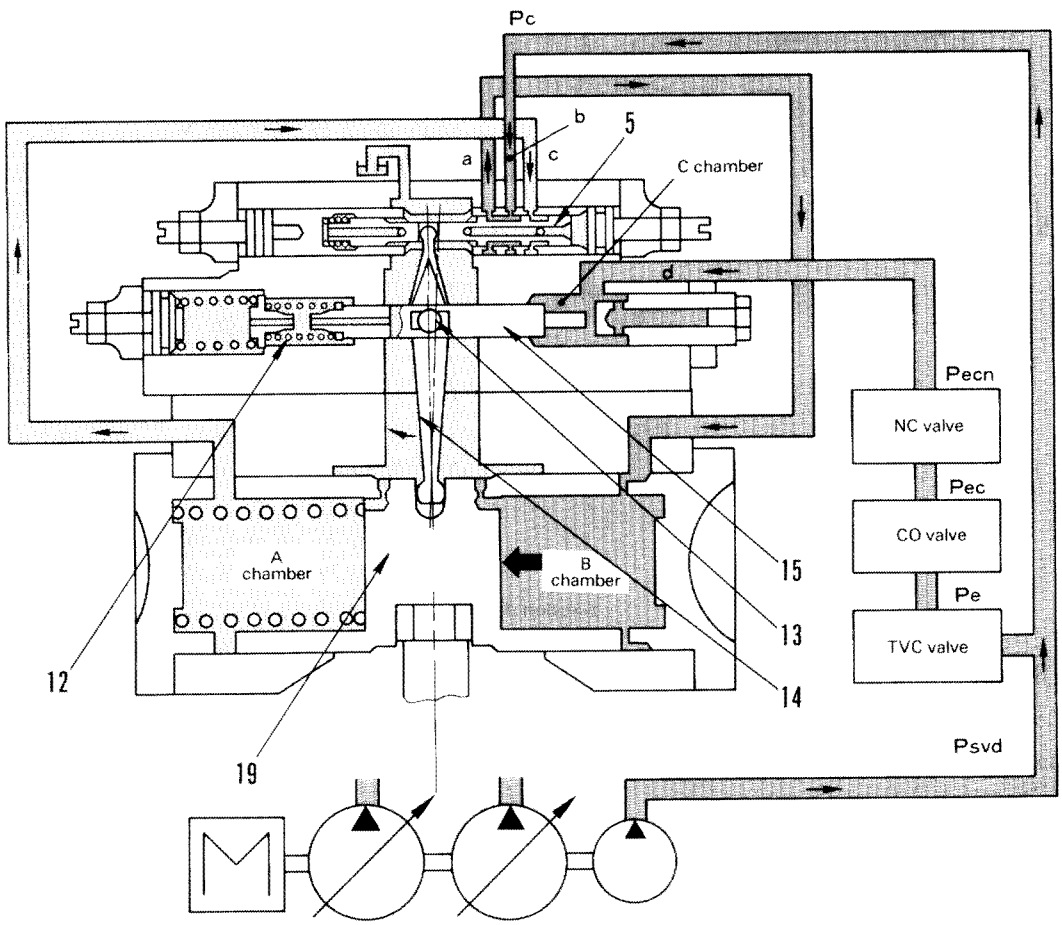
The relationship between pump discharges **qF** or **qR** and input signal pressure **Pecn** (output pressure of NC valve) to the servo valve is shown in the graph.



201F5081

OPERATION

1. Operation for increasing pump discharges



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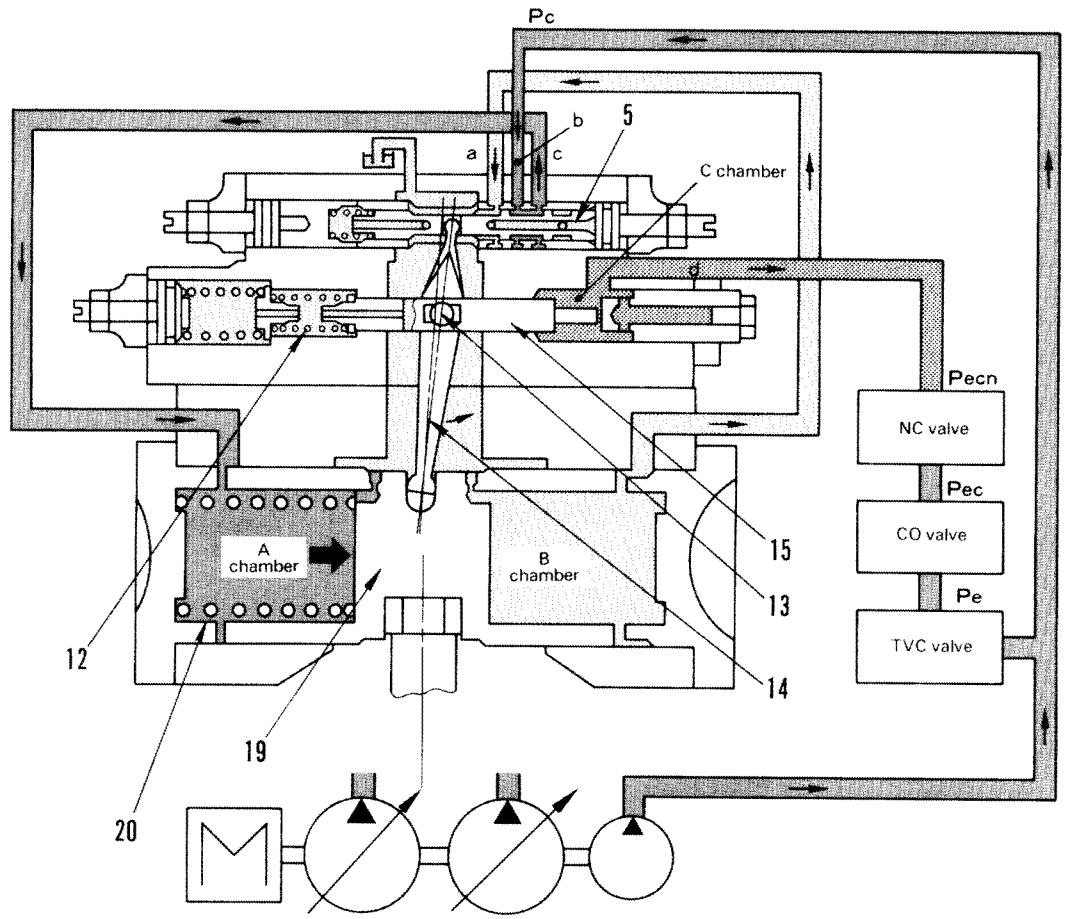
- Input signal pressure **Pecn** acts on chamber **C** in the control piston from port **d**. Pressure **Pc** in the charging pump is guided into port **b**.
- If input signal pressure **Pecn** is raised a little, the oil pressure acting on chamber **C** will increase accordingly. Control piston (15) therefore moves to a position (leftward) where the force of spring (12) is in balance with the oil pressure in chamber **C**, thus allowing arm (14) to swing leftward with servo piston (19) serving as the supporting point. As a result, guide spool (5) moves to the left.
- With the movement of guide spool (5), port **b** and port **a** connect to each other, allowing oil pressure **Psvd**, in the control pump to act on chamber **B** in servo piston (19). Servo piston (19) is then pushed leftward, increasing the swash plate angle of the main piston pump. Thus, the pump discharge is increased.
- Since arm (14) turns clockwise on pin (13) guide spool (5) moves rightward, causing port **b**, port **a**, port **c** and drain port to close. The pump discharge, therefore, increases with the change in input signal pressure **Pecn**.

2. Operation for decreasing pump discharge



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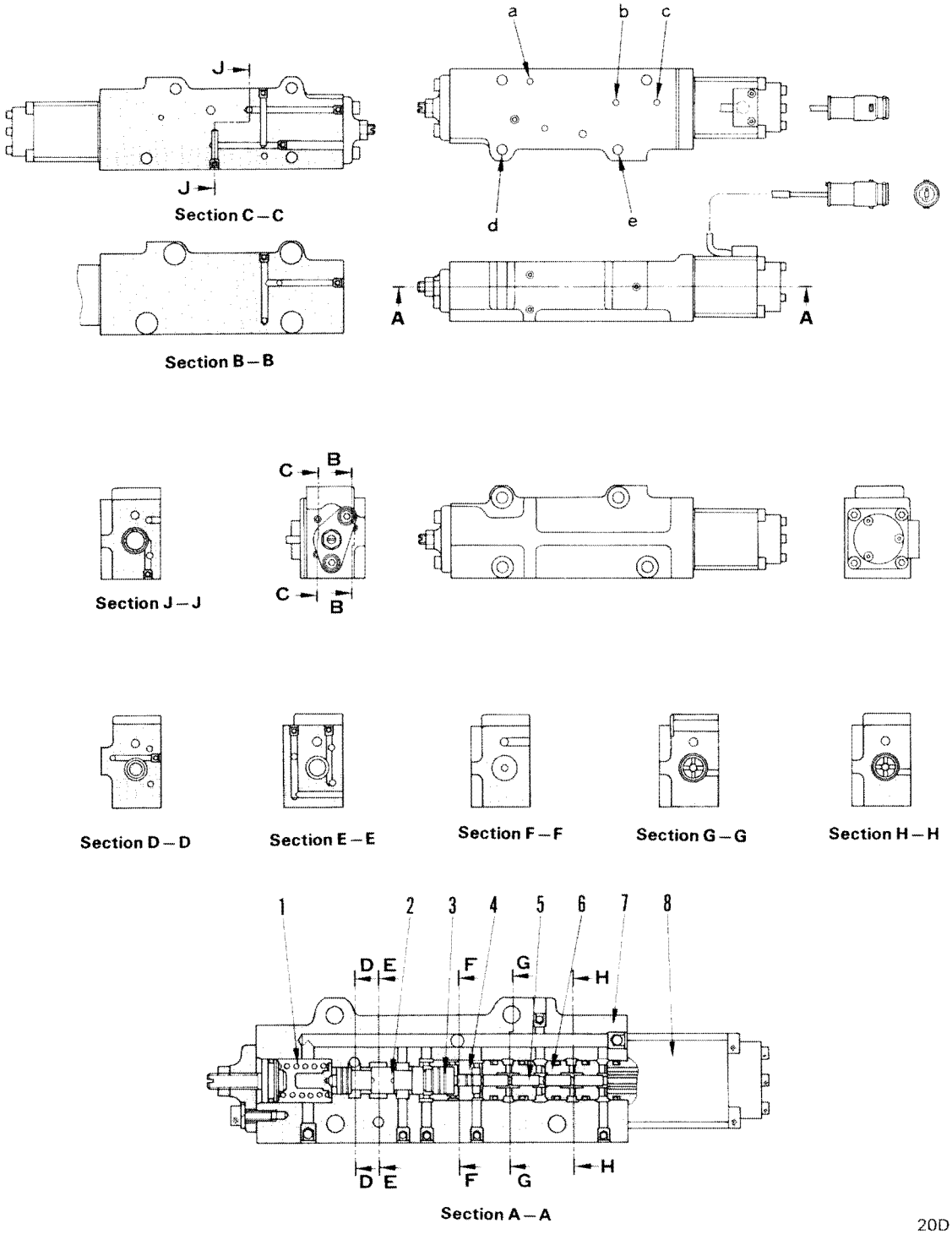
- Next, let's examine the case where control piston (15) is moved rightward. Assume that the servo piston is in a balanced position at a certain location. If **Pecn** is decreased, control piston (15) moves to a position where the oil pressure in chamber **C** balances with the force of spring (12). Then, arm (14) swings rightward, using servo piston (19) as a support point, and cause, guide spool (5) to move rightward.
- With the movement of guide spool (5), port **b** and port **a** are shut off and port **a** becomes open to the drain.

On the other hand, port **b** and port **c** are connected to each other, allowing the oil to flow into chamber **A** in the servo cylinder. Servo piston (19) is then pushed rightward by the force of spring (20), decreasing the swash plate angle of the main piston pump. Thus, the pump discharge is decreased.

- Since arm (14) rotates counterclockwise on pin (13), guide spool (5) moves leftward, shutting off port **b**, port **c** port **a**, and drain port. The pump discharge, therefore, decreases with the change in input signal pressure **Pecn**.

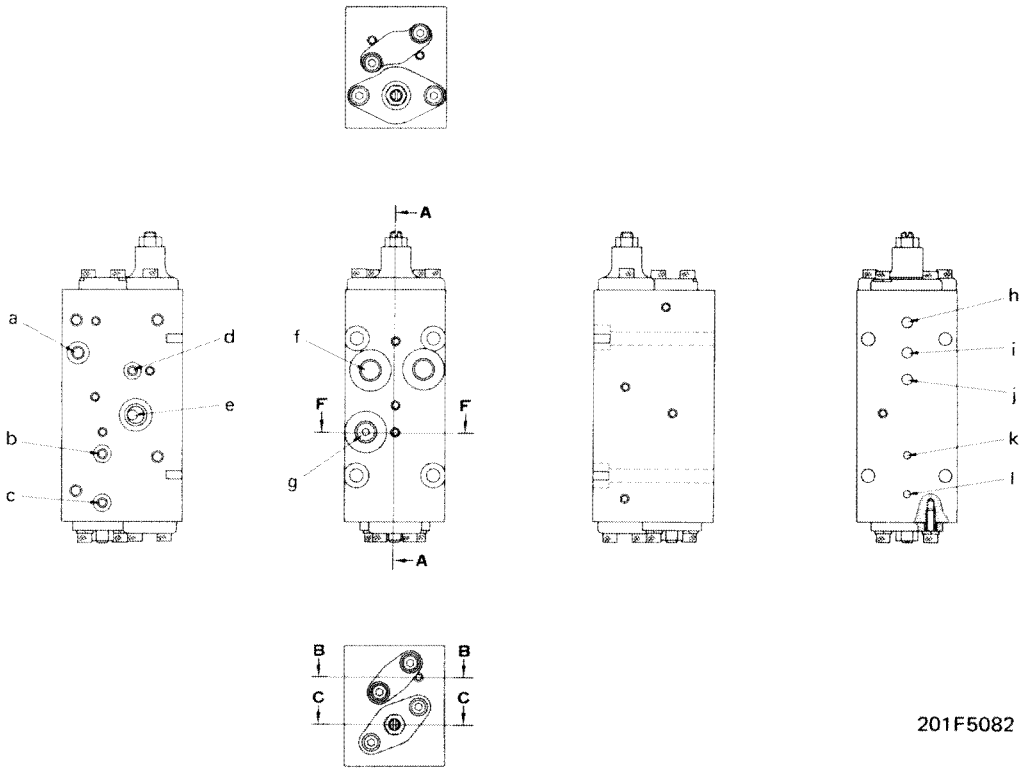
2) TVC VALVE



1. Spring
2. Spool
3. Piston
4. Sleeve
5. Piston
6. Sleeve
7. Valve body
8. Solenoid

a. From charging pump
b. From rear main pump
c. From front main pump
d. To CO valve
e. To front pump suction port

3) CO·NC VALVE



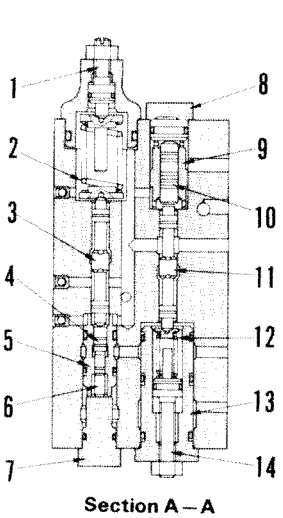
201F5082

CO valve

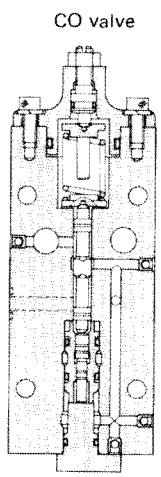
1. Adjustment screw
2. Spring
3. Spool
4. Piston
5. Sleeve
6. Piston
7. Plug

NC valve

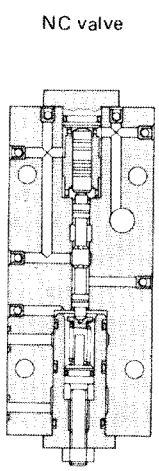
8. Plug
9. Sleeve
10. Piston
11. Spool
12. Spring
13. Plug
14. Adjustment screw



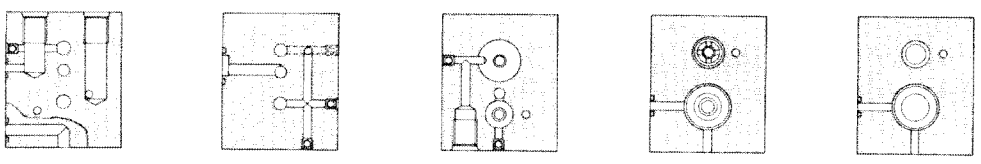
Section A—A



Section B—B



Section C—C

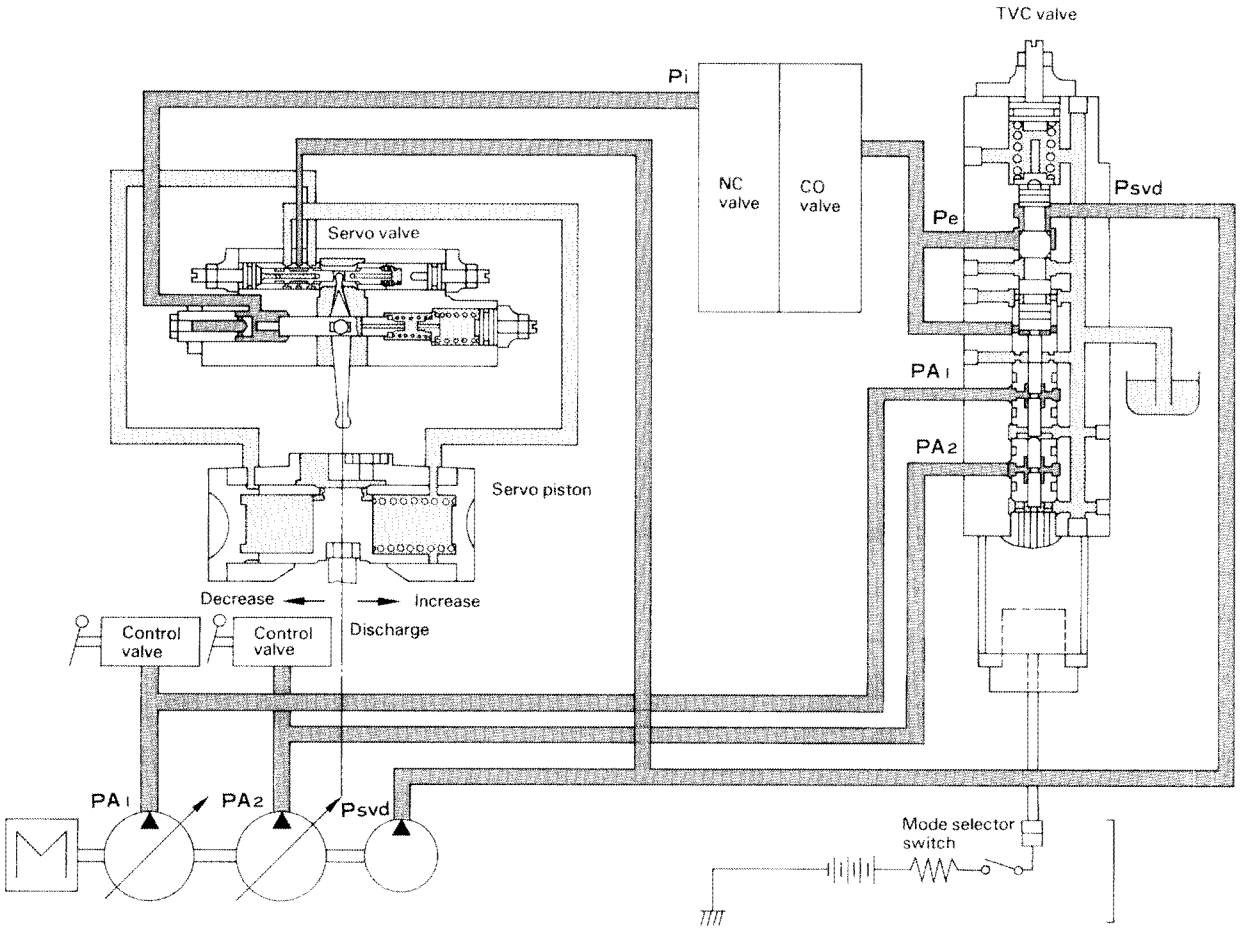


Section D—D | Section E—E | Section F—F | Section G—G | Section H—H

201F5083

a. To TVC valve
b. To TVC valve
c. To TVC valve
d. From TVC valve
e. From TVC valve
f. To rear CO·NC valve
g. From auto-deceleration solenoid valve
h. From servo valve
i. From charging pump
j. To main pump suction port
k. From front main pump discharge port
l. From rear main pump discharge port

4) CONSTANT TORQUE CONTROL



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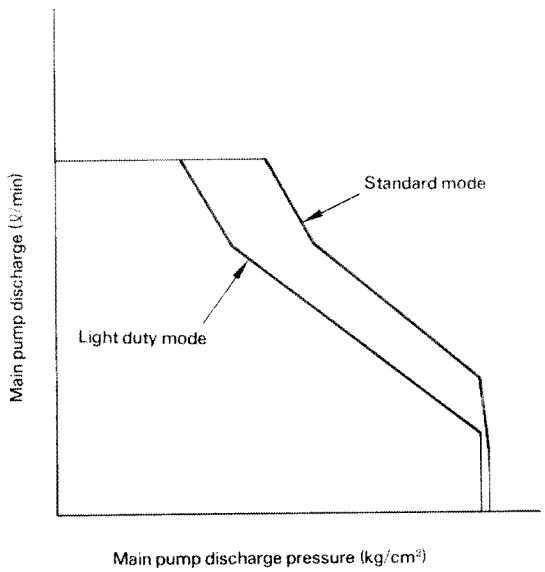
- Constant torque control is achieved by controlling the engine load at a constant level by decreasing the pump discharge when the pump pressure increases because of an increase in operating load and by increasing the pump discharge when the operating load is reduced.
- The suction horsepower of a pump (the horsepower which a pump can take out an engine) can be changed over to one of two different modes with the mode selector switch.
- In the LIGHT DUTY mode, the discharge pressure is set at a lower level than that in STANDARD mode, with the maximum discharge maintained at the same level in both modes.
- With an increase in discharge pressure PA_1 (or PA_2) of the main pump, output pressure **Pe** of the TVC valve is reduced. The servo valve then operates in such a way that the main pump discharge is reduced.

If main pump discharge pressure PA_1 (or PA_2) decreases, TVC valve output pressure **Pe** increases. Then, the servo valve will operate to increase the main pump discharge.



201F5085

Fig. 1

Operation

The TVC valve is controlled by balancing the sum of main pump discharge pressure PA_1 and PA_2 and TVC valve output pressure **Pe** against the force of spring (1).

1) When the main pumps are in operation without load (when the mode selector switch is turned to STANDARD), spool (2) is pressed downward by spring (1) because of the low discharge pressure PA_1 and PA_2 of the main pumps.
   As a result, charging pump discharge pressure **Psvd** is made equal to TVC valve output pressure **Pe** . Since TVC valve output pressure **Pe** reaches the maximum value at this stage and the servo valve will increase in the main pump swash plate angle through the servo valve operation, the main pump discharge is also increased. That is to say, the pump discharge increases as the stroke of the increase angle of the main pump, the main pump discharge is raised to the maximum. (Fig. 2)

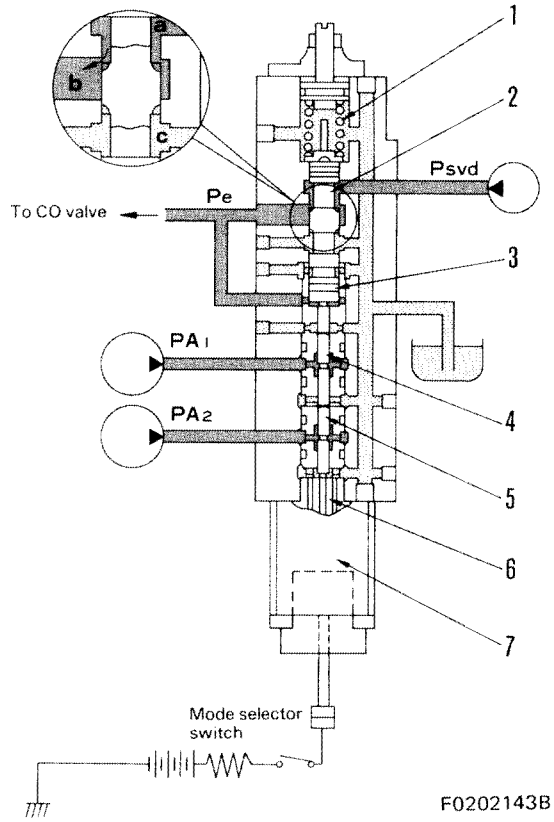


Fig. 2

2) When the main pumps are in operation under load (when the mode selector switch is turned to STANDARD), an increase in main pump discharge pressure PA_1 (or PA_2) will cause piston (4) to be pressed and spool (2) to move upward.
   As a result, the oil flow from port **a** to port **b** is restricted by the spool land, while the openings of port **b** and port **c** (drain port) are made larger. As the lowered TVC valve output pressure **Pe** reduces the main pump swash plate angle through the operation of the servo valve, the discharge of the main pump is also reduced. (Fig. 3)

3) When the mode selector switch is turned to LIGHT DUTY or when the machine is switched to the LIGHT-DUTY mode by the action of the remote switch when the fuel control lever is put in the LOW IDLING position, piston (5) is pushed upward by shaft (6) on solenoid valve (7).
   As a result, the setting pressure of spring (1) is made higher and the control is effected as shown in Fig. 1.

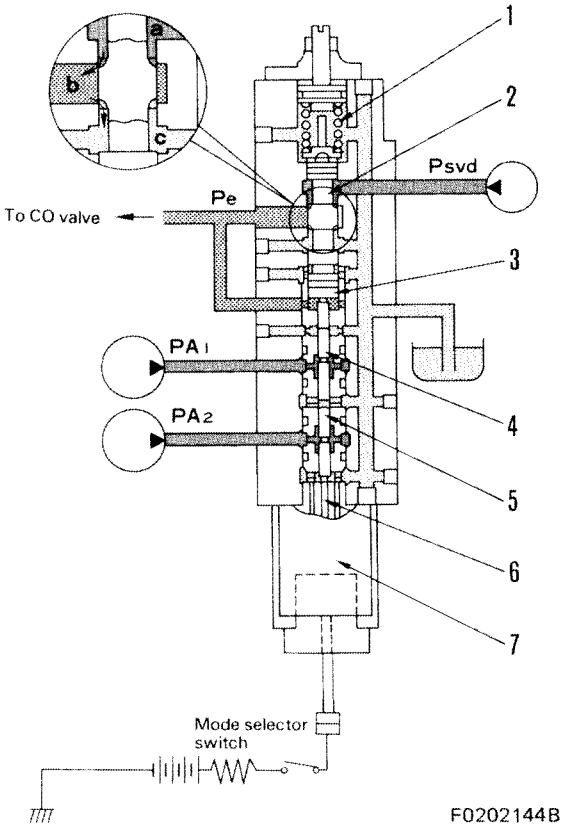
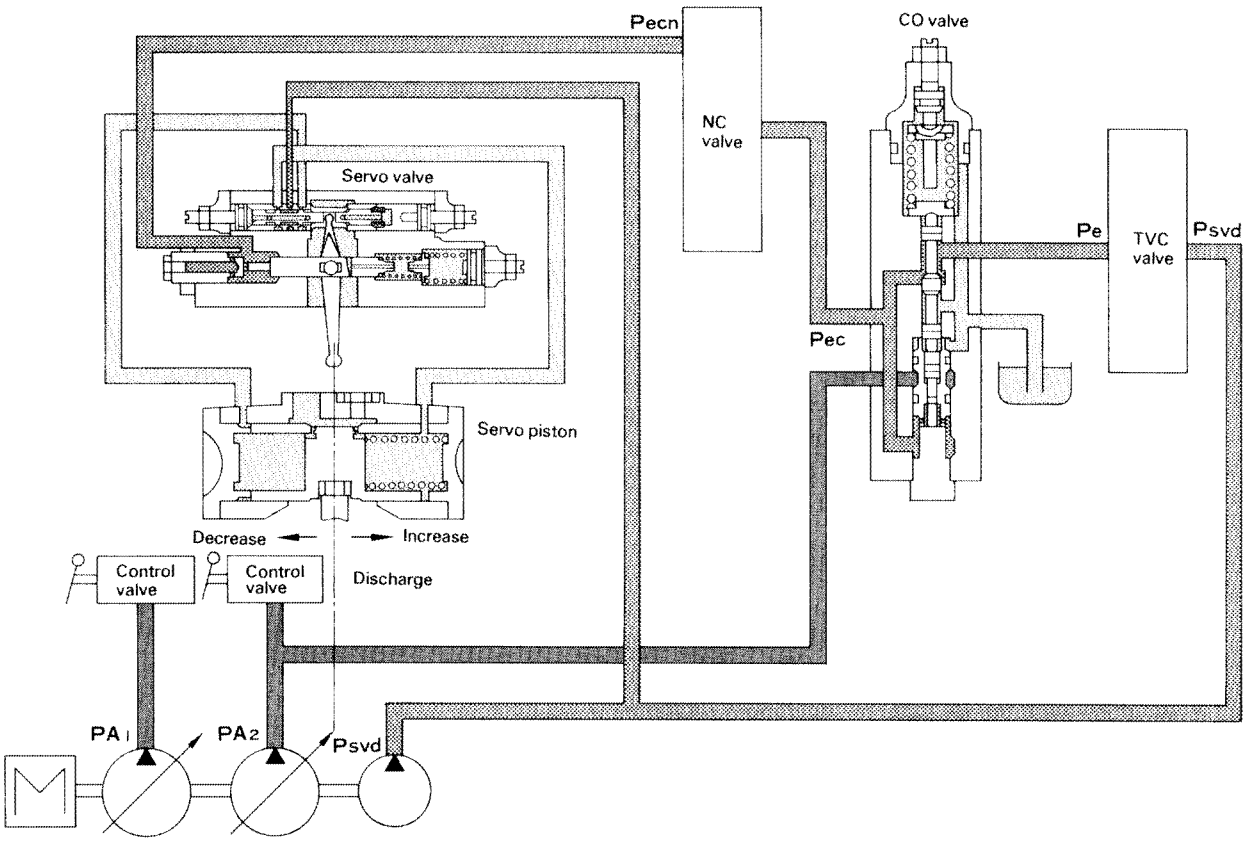


Fig. 3

5) CUT-OFF CONTROL



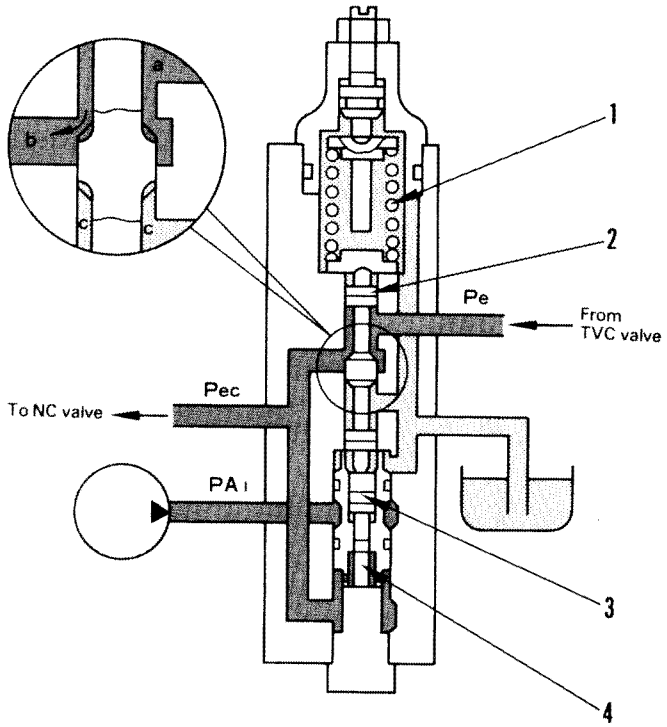
201F5088

- Cut-off control is a function which minimizes the relief loss by reducing the pump discharge through the operation of the CO valve when the main pump discharge pressure comes near the relief pressure.
- The CO valve is controlled by balancing the sum of main pump discharge pressure **PA** and CO valve output pressure **Pec** against the force of the spring.

Operation

1) When the main pump discharge pressure is lower than the relief pressure:

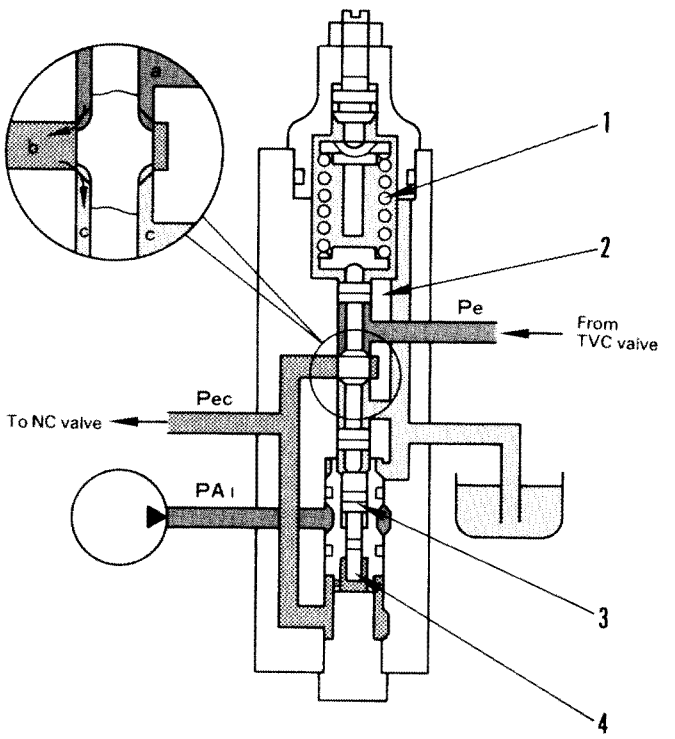
   Since spool (2) is pushed downward by the force of spring (1), port **a** and port **b** are open to each other and TVC valve output pressure **Pe** is equal to the CO valve output pressure. CO valve output pressure **Pec** is then maximized and the main pump discharge is also increased to the maximum with the swash plate angle maximized by the operation of the servo valve.



201F5089

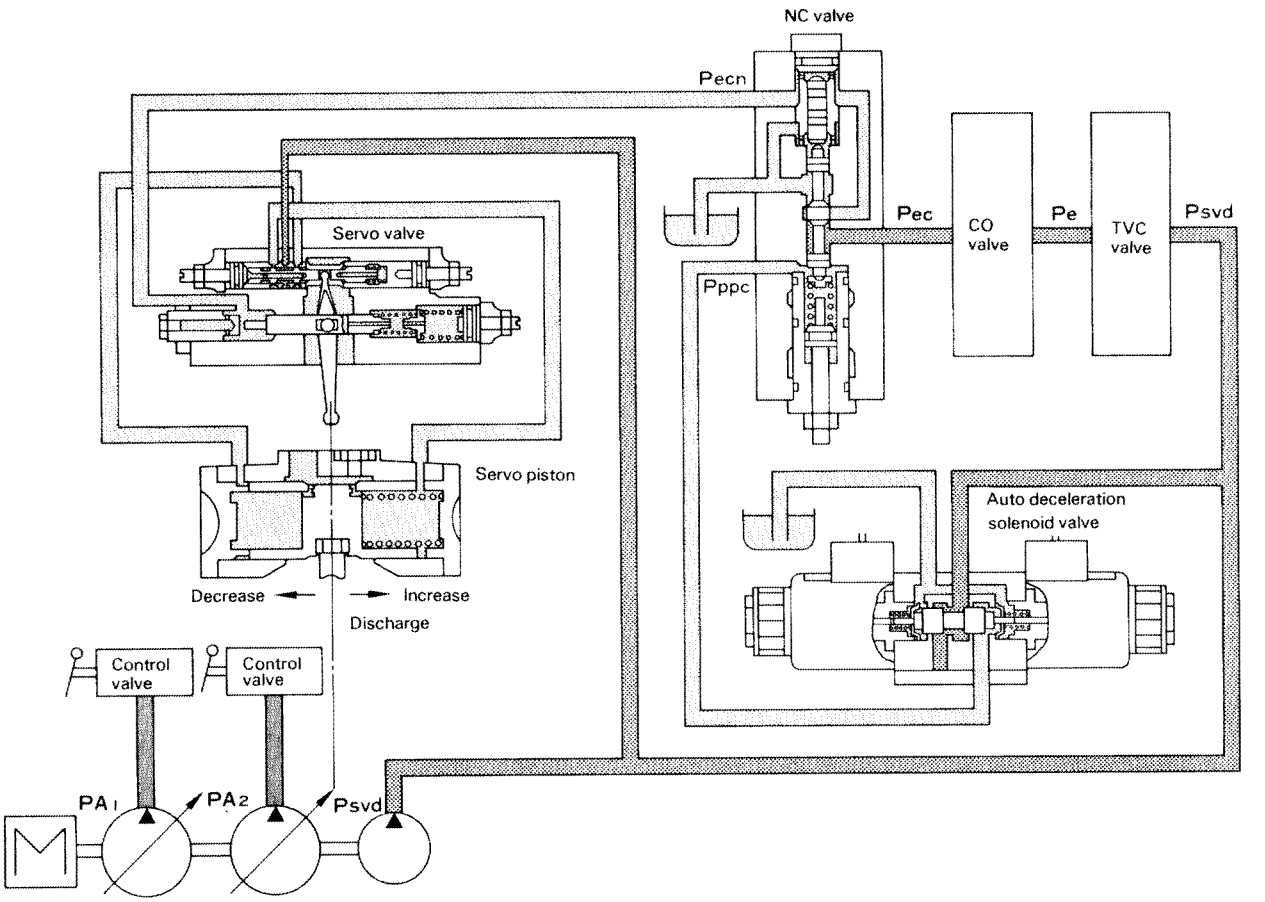
2) When the main pump discharge is higher than the relief pressure:

   When main pump discharge pressure PA_1 comes close to the relief pressure owing to an increase in the load, piston (3) is pushed by main pump discharge pressure PA_1 and at the same time piston (4) is pushed by CO valve output pressure **Pec**. When the force of spring (1) is overcome by the pressing force of the pistons, spool (2) moves upward.
   As a result, the spool land restricts the oil flow from port **a** to port **b** and at the same time the opening areas of port **b** and port **c** (drain port) are made larger.
   With reduced CO valve output pressure **Pec** and with the swash plate angle reduced by the operation of the servo valve, the main pump discharge is reduced.



201F5090

6) FLOW CONTROL



201F5091

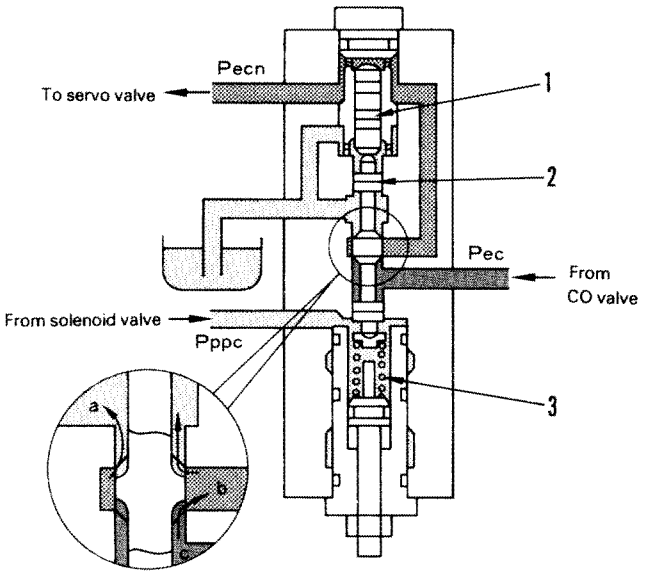
- Flow control is the function to reduce the unnecessary oil flow which occurs when the control valves are in neutral. It controls the pump delivery amount to the minimum by using the NC valve and auto deceleration solenoid valve when the control levers are at neutral.

OPERATION

1. Control levers at neutral

The auto deceleration solenoid valve signal pressure P_{PPC} drops, so the pressure **Pec** from the CO valve pushing piston (1) becomes larger than the total force of spring (3) and signal pressure P_{PPC} pushing the bottom end of spool (2).

As a result, spool (2) is pushed down, so the flow at port **c** and port **b** is restricted, and the area of the opening of port **b** and port **a** (drain port) becomes larger. Because of this, NC valve output pressure **Pecn** becomes the minimum, and the servo valve moves the main pump swash plate to the minimum angle, so the delivery amount of the main pump is at the minimum.

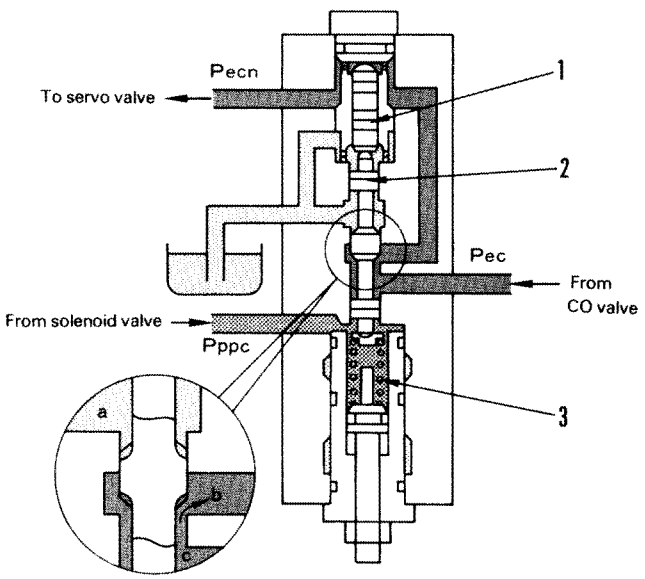


201F5092

2. Control lever operated

When the control levers are operated, the auto deceleration solenoid valve is switched, and signal pressure P_{PPC} enters the NC valve.

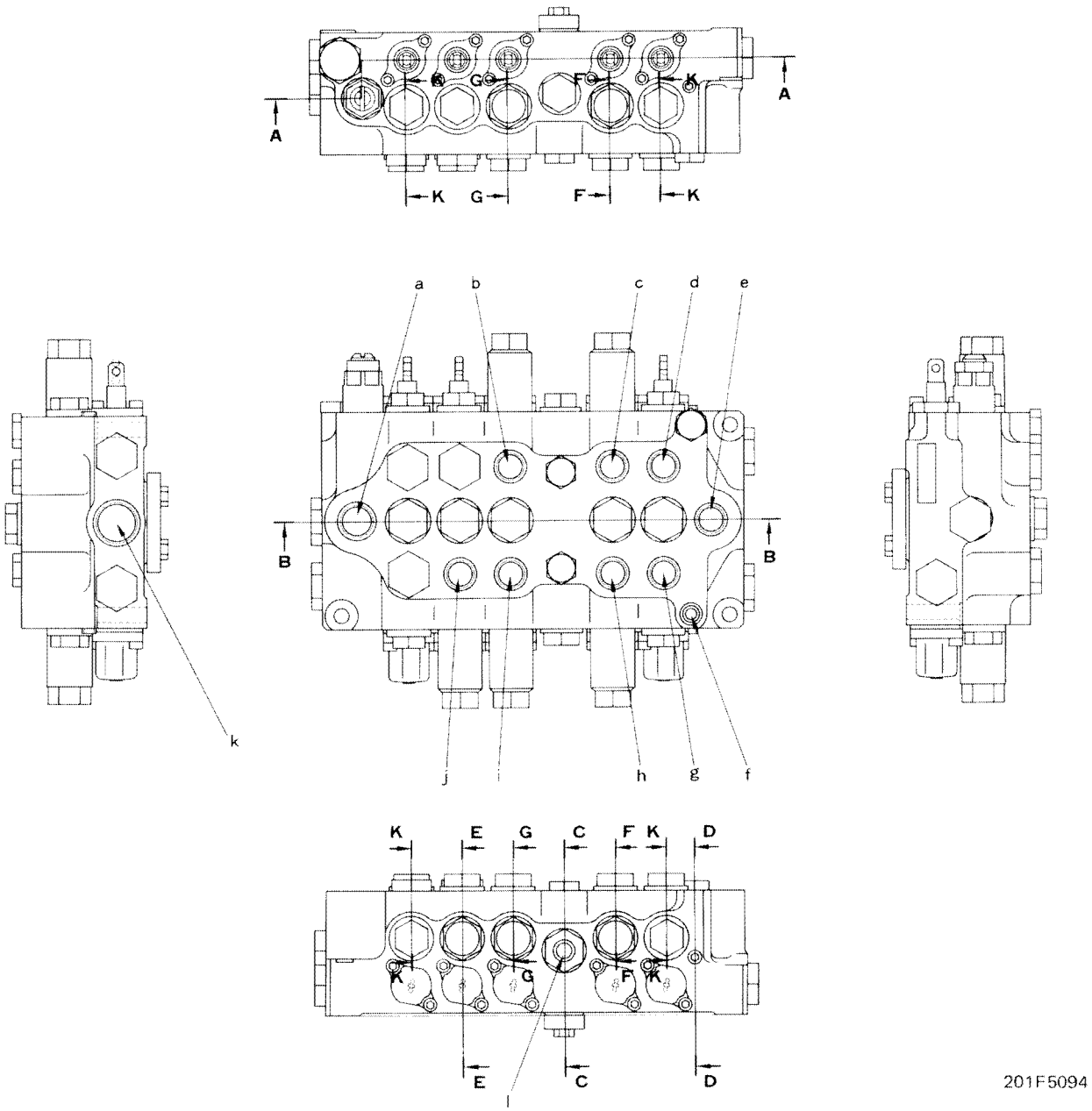
When this happens, spool (2) is pushed up, and the area of the opening of port **c** and port **b** becomes larger. As a result, NC valve output pressure **Pecn** increases and the servo valve moves to make the main pump swash plate angle larger, so the main pump delivery amount increases.



201F5093

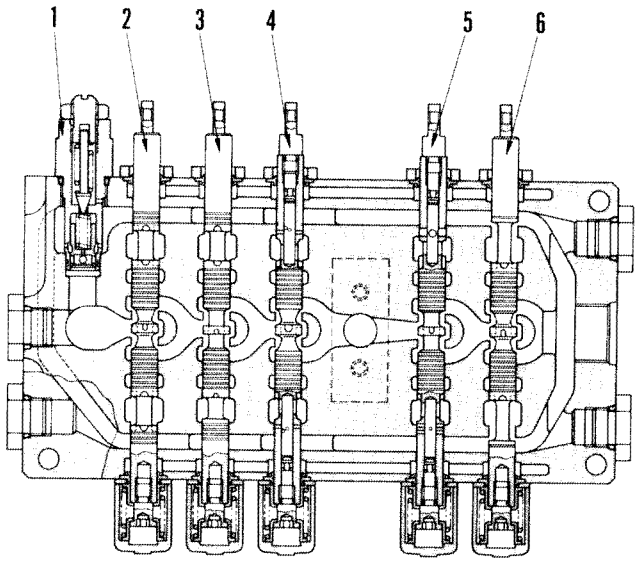
CONTROL VALVE

1. L.H. 6-SPOOL CONTROL VALVE

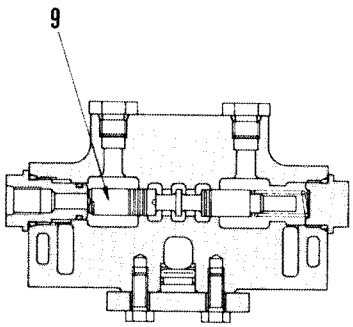


201F5094

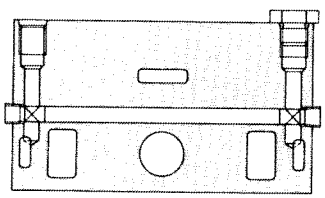
a. From rear main pump (P_2 port)
b. To swing motor (MA) (A_3 port)
c. To arm cylinder bottom side (A_5 port)
d. To L.H. and R.H. travel motor (B) (A_6 port)
e. From straight travel valve (P_2 port)
f. To hydraulic tank (Ts port)
g. To L.H. travel motor (A) (B_6 port)
h. To arm cylinder head side (B_5 port)
i. To swing motor (MA) (B_3 port)
j. To boom cylinder bottom side (B_2 port)
k. To hydraulic tank (T port)
l. From swing mechanical brake solenoid valve (P_{B4} port)



Section A – A



Section C – C



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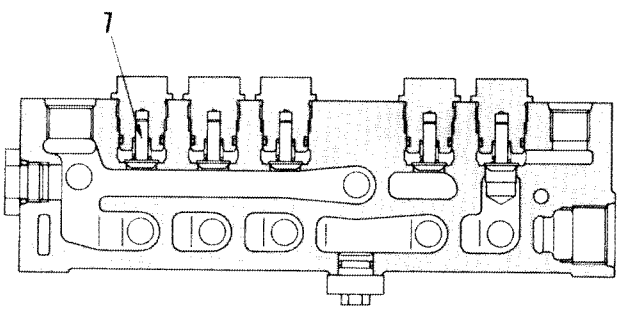
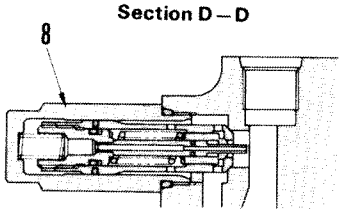


Section B – B



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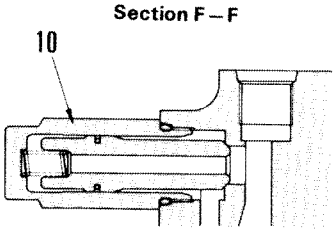
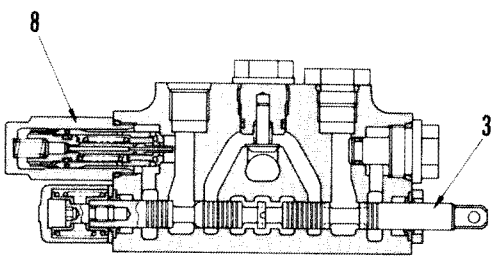


Section G – G



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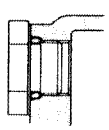

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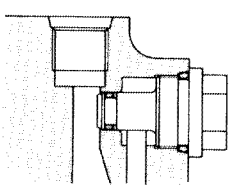


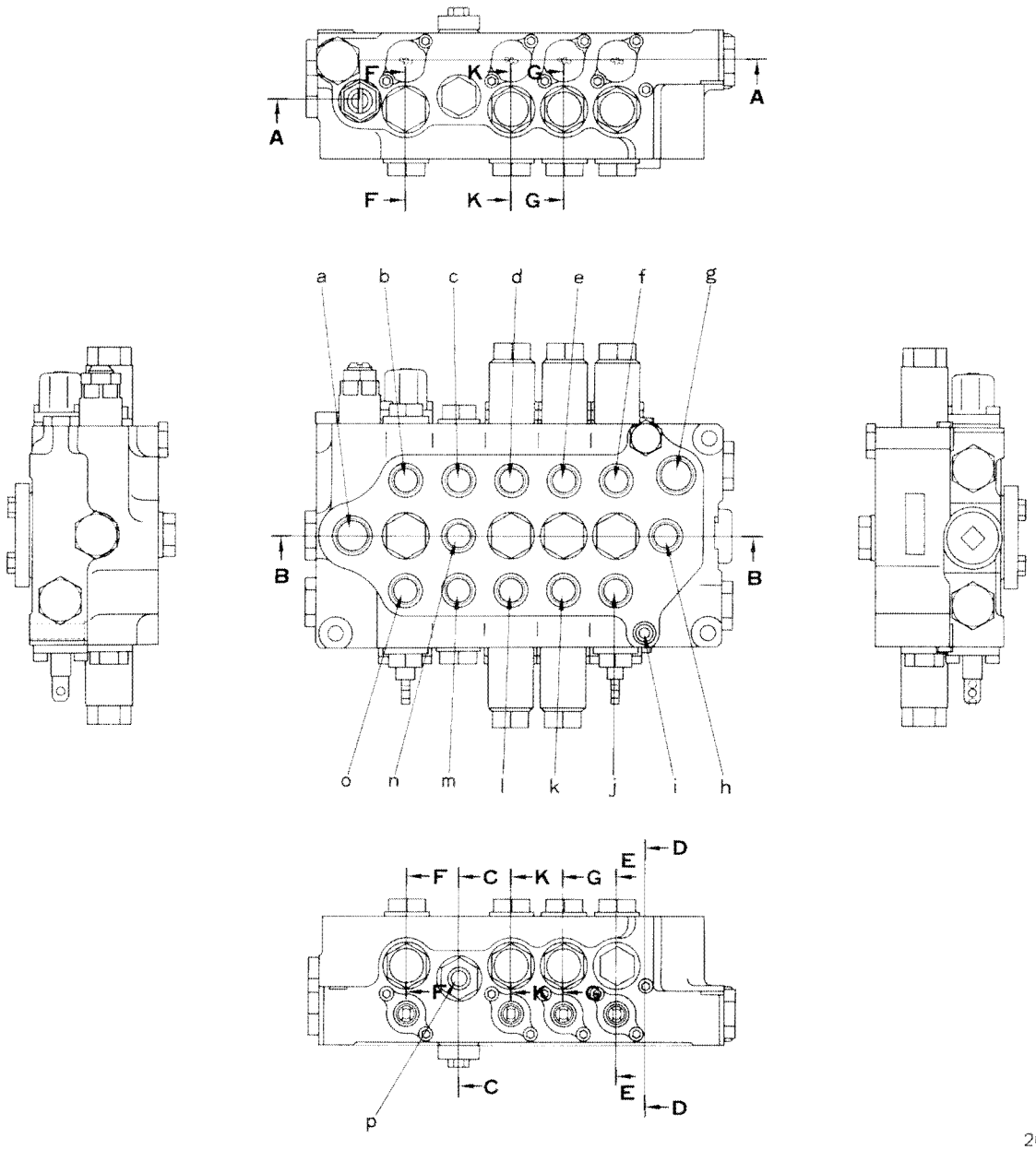
Section K – K

201F5095

1. Main relief valve
2. Spool (service)
3. Spool (boom-High)
4. Spool (swing)
5. Spool (arm-Low)
6. Spool (L.H. travel)
7. Check valve
8. Safety valve (with suction valve)
9. Spool (swing priority)
10. Suction valve

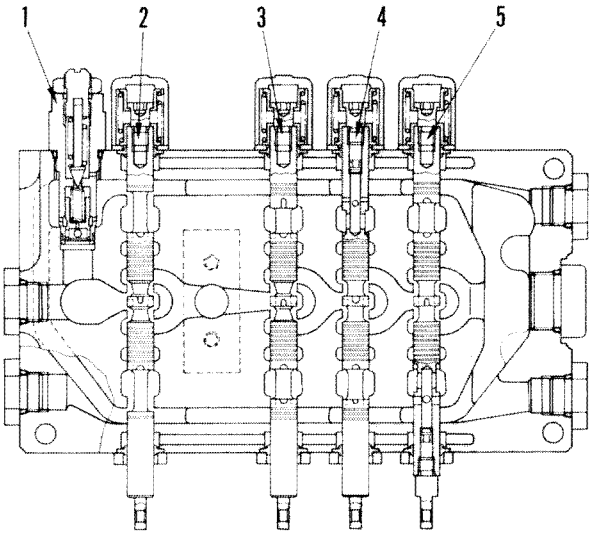
2. R.H. 5-SPOOL CONTROL VALVE

PC60, 60L-5

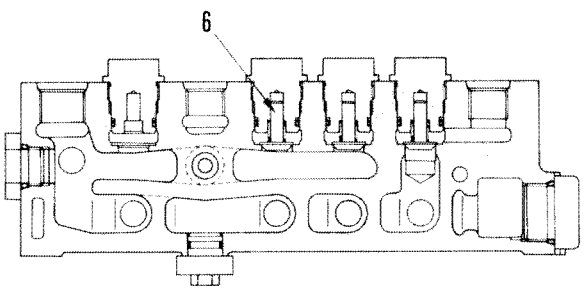


201F5096

a. From front main pump (P port)
b. To R.H. travel motor (B) (B_1 port)
c. To L.H. travel control valve (B_2 port)
d. To bucket cylinder head side (B_3 port)
e. To boom cylinder bottom side (B_4 port)
f. To arm cylinder head side (B_5 port)
g. To hydraulic tank (T port)
h. From straight travel valve (P_3 port)
i. To hydraulic tank (T_3 port)
j. To arm cylinder bottom side (A_5 port)
k. To boom cylinder head side (A_4 port)
l. To bucket cylinder bottom side (A_3 port)
m. From main pump (A_2 port)
n. To arm-Hi control valve (P_2 port)
o. To R.H. travel motor (A) (A_1 port)
p. From straight travel solenoid valve (P_{B2} port)



Section A—A



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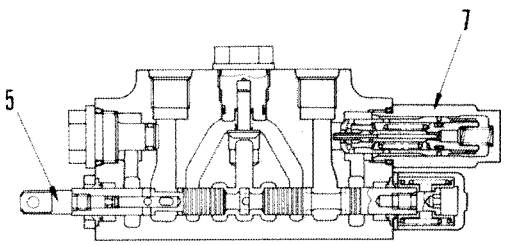

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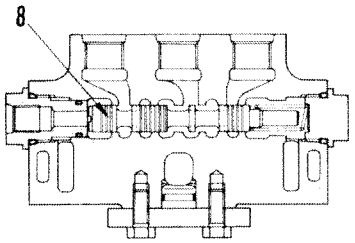

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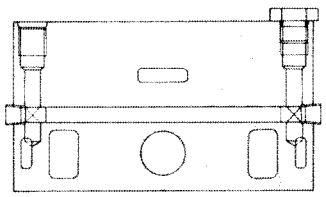

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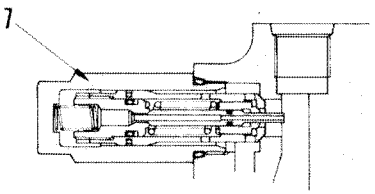
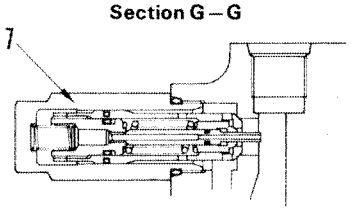
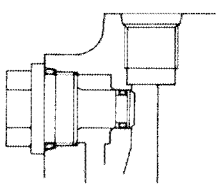


Section G—G



Section K—K



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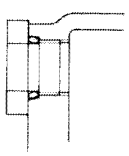


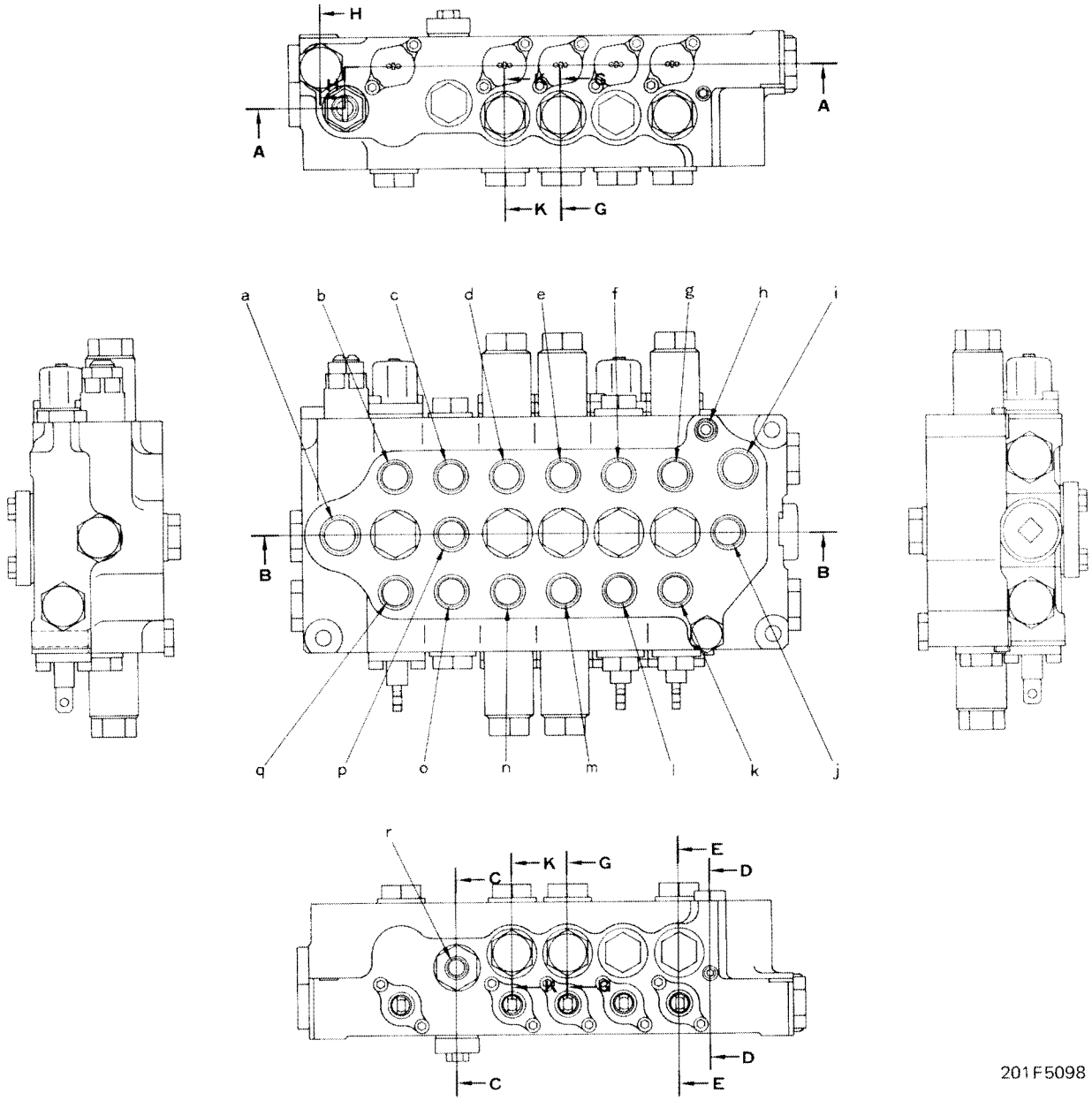
Section H—H

201F5097

1. Main relief valve
2. Spool (R.H. travel)
3. Spool (bucket)
4. Spool (boom-Lo)
5. Spool (arm-Hi)
6. Check valve
7. Safety valve (with suction valve)
8. Spool (straight travel)

3. R.H. 6-SPOOL CONTROL VALVE

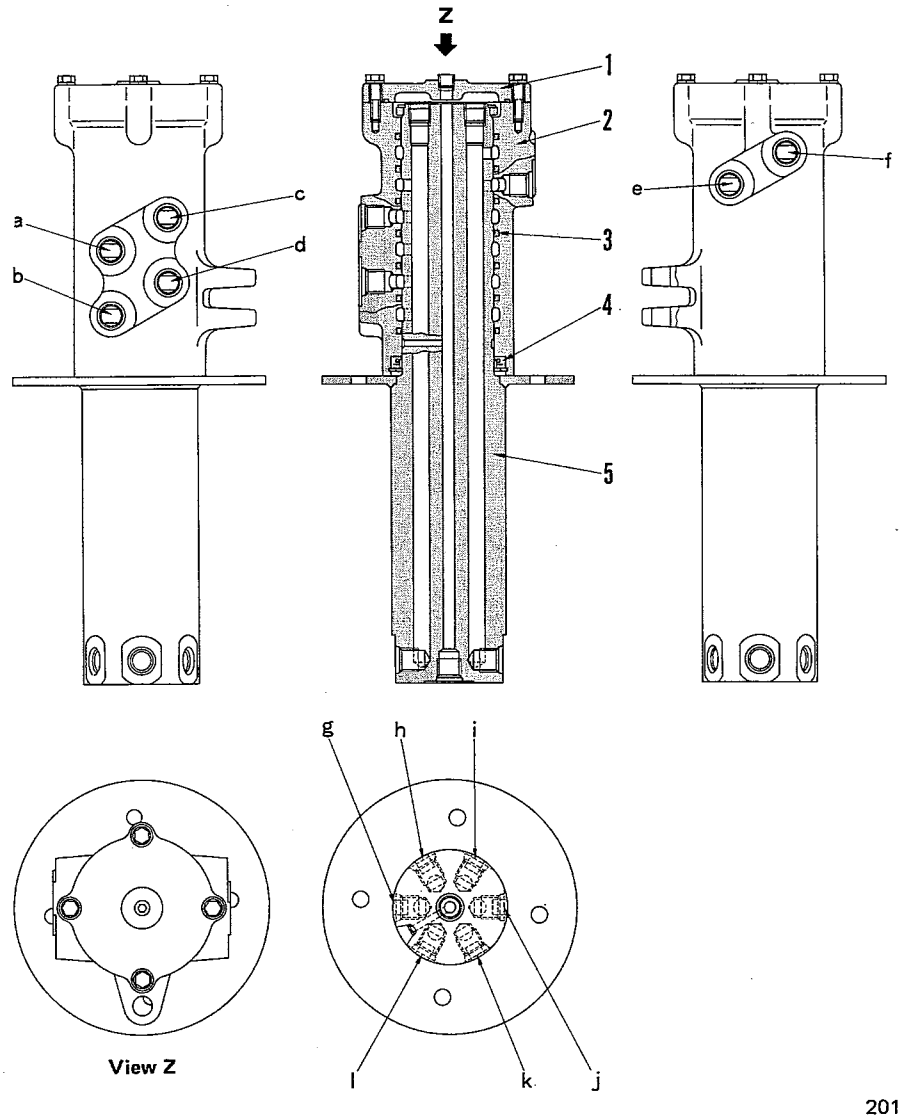
PC60U-5



a. From front main pump (P port)
b. To R.H. travel motor (B) (B_1 port)
c. To L.H. travel control valve (B_2 port)
d. To bucket cylinder head side (B_3 port)
e. To boom cylinder bottom side (B_4 port)
f. To swing cylinder head side (B_5 port)
g. To arm cylinder head side (B_6 port)
h. To hydraulic tank (Ts port)
i. To hydraulic tank (T port)
j. From straight travel valve (P_3 port)
k. To arm cylinder bottom side (A_6 port)
l. To swing cylinder bottom side (A_5 port)
m. To boom cylinder head side (A_4 port)
n. To bucket cylinder bottom side (A_3 port)
o. From front main pump (A_2 port)
p. To arm-Hi valve (P_2 port)
q. To R.H. travel motor (A_1 port)
r. From straight travel solenoid valve (PA_2 port)

WORK EQUIPMENT SWIVEL JOINT

PC60U-5



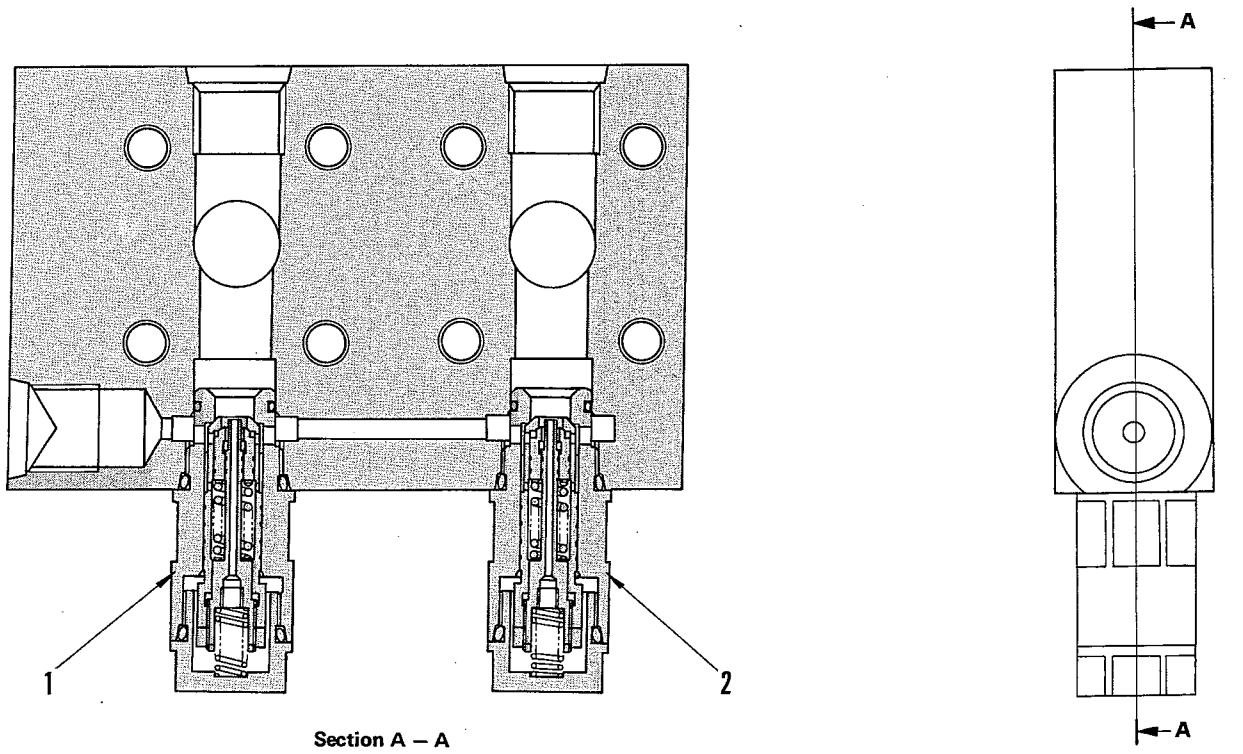
201F5106

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

a. From boom-Lo, Hi control valves
b. From boom-Lo, control valve
c. From arm-Lo, Hi control valves
d. From bucket control valve
e. From arm-Lo, Hi control valves
f. From bucket control valve
g. To arm cylinder bottom side
h. To boom cylinder bottom side
i. To boom cylinder head side
j. To bucket cylinder bottom side
k. To bucket cylinder head side
l. To arm cylinder head side

SAFETY SUCTION VALVE (For boom swing)

PC60U-5



Section A – A

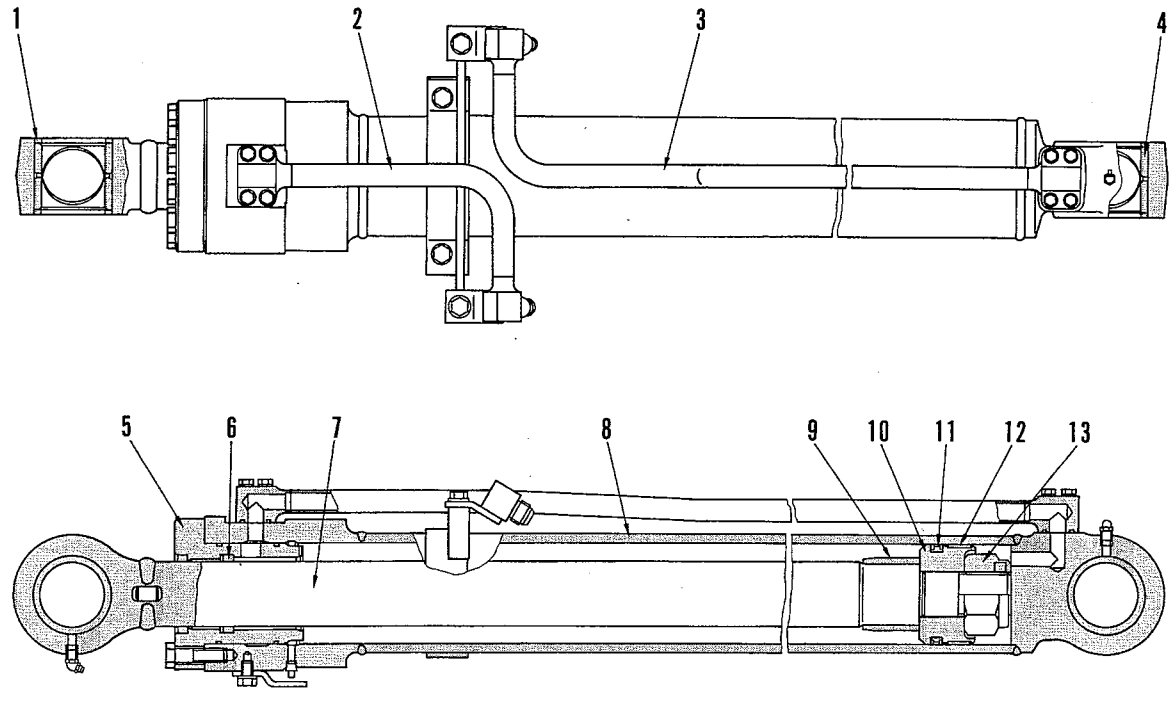
201F1037

1. Safety suction valve (bottom side)
2. Safety suction valve (head side)

HYDRAULIC CYLINDER

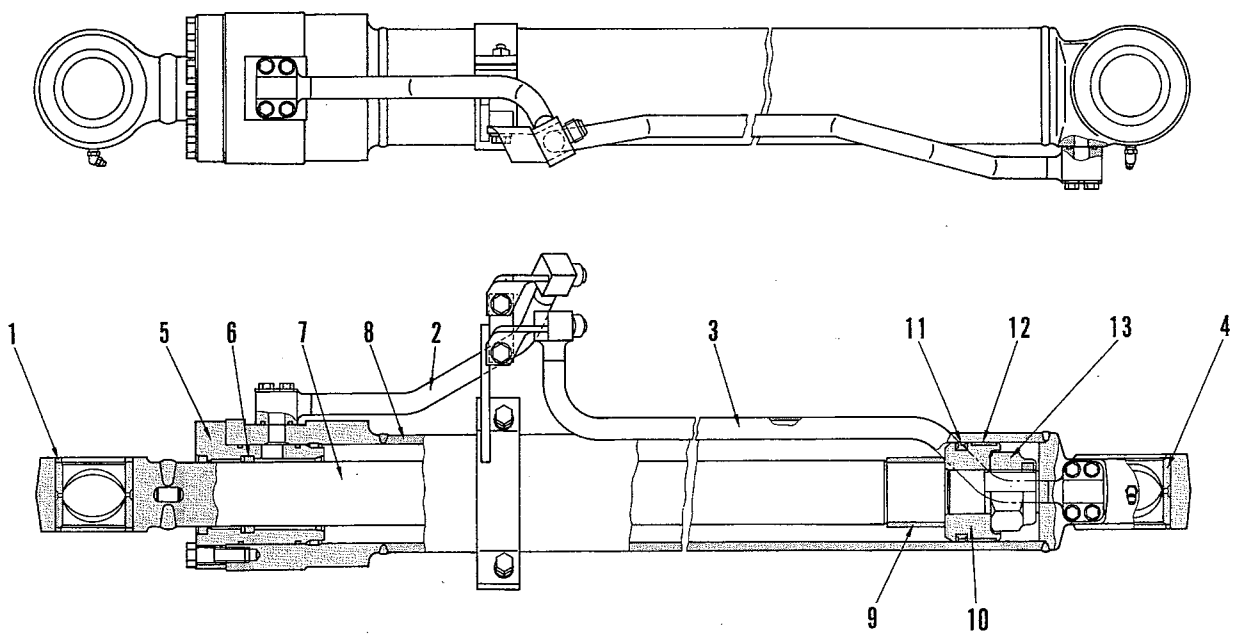
1. BOOM CYLINDER

PC60, 60L-5



201F5107

PC60U-5



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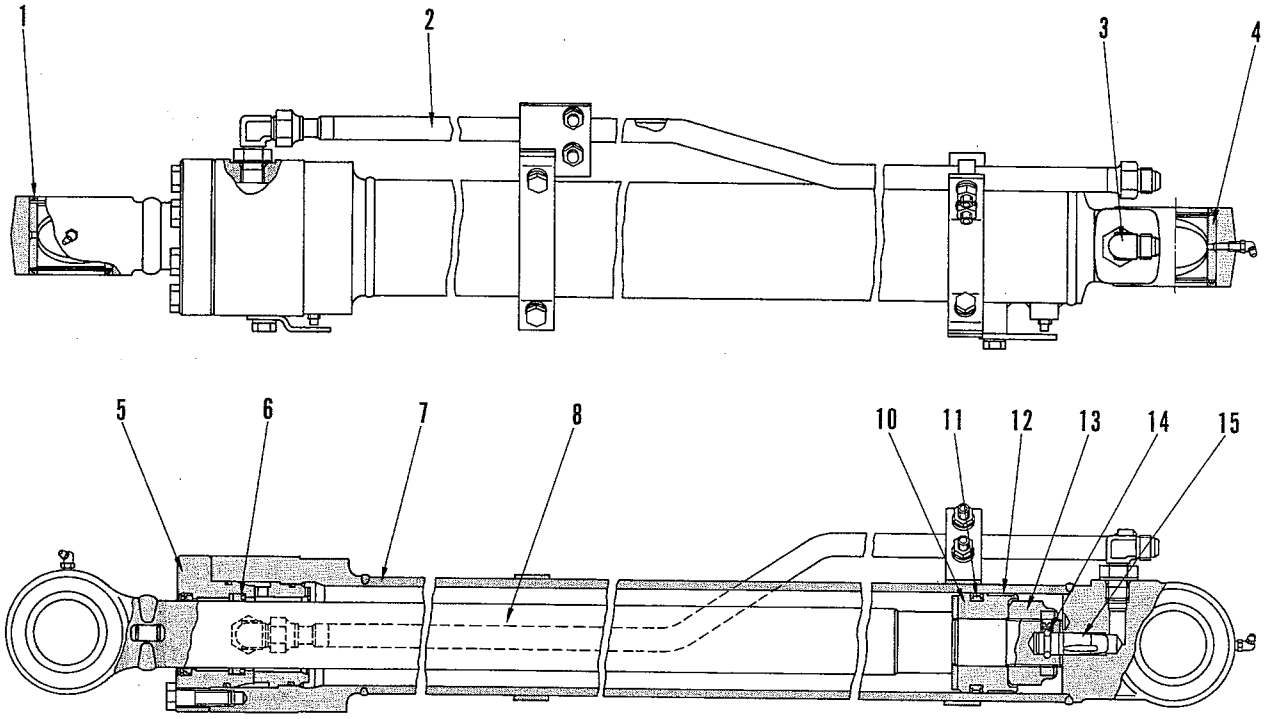
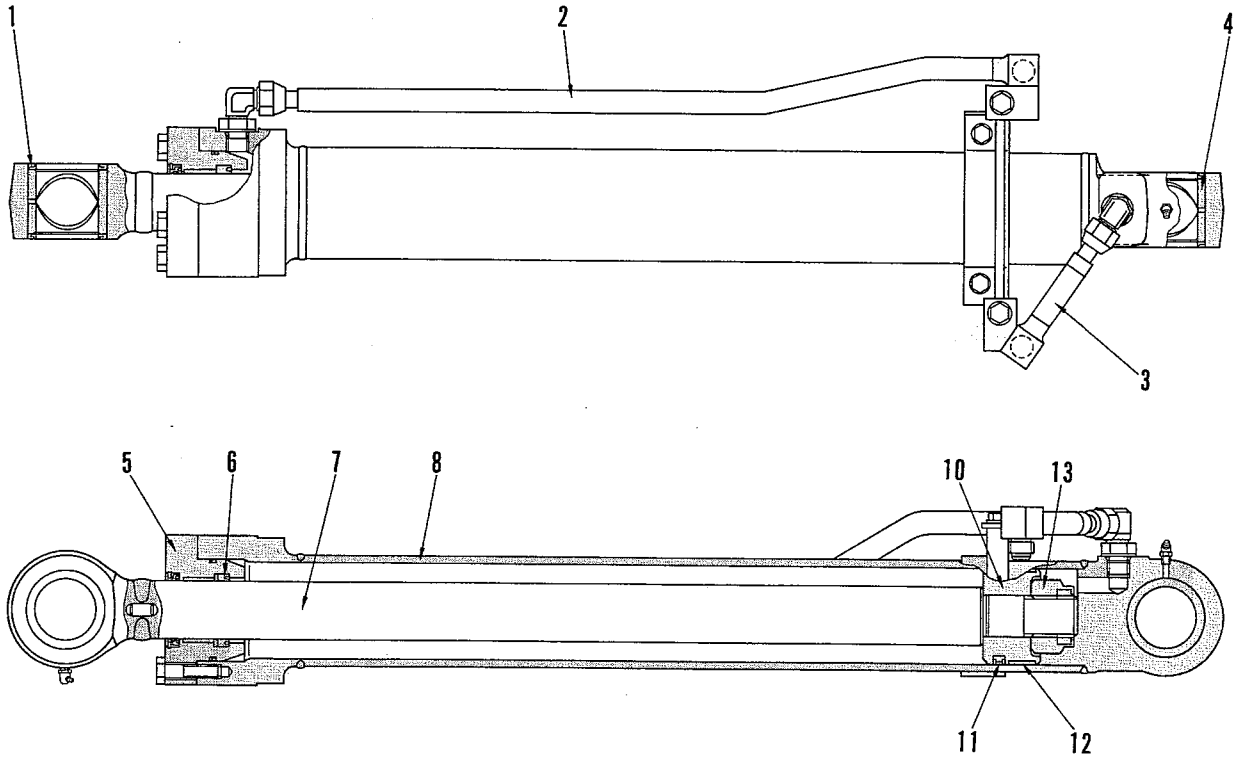
2. ARM CYLINDER



201F5109

3. BUCKET CYLINDER



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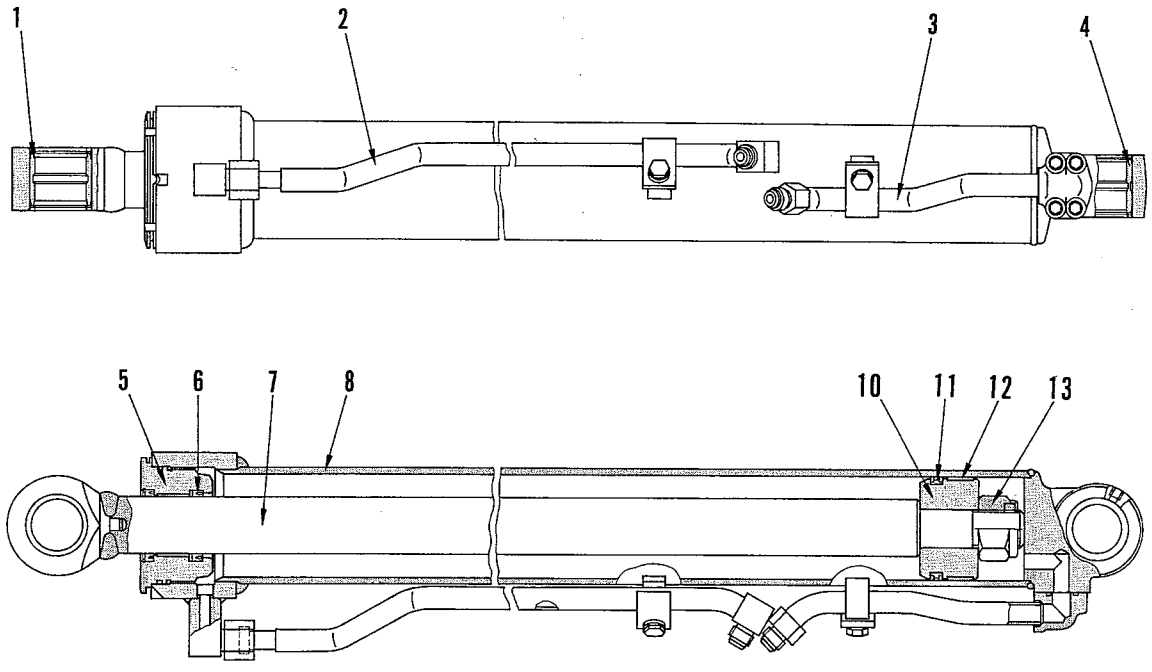
4. SWING CYLINDER

PC60U-5



201F5111

1. Bushing
2. Head side tube
3. Bottom side tube
4. Bushing
5. Cylinder head
6. Rod packing
7. Piston rod
8. Cylinder
9. Cushion plunger
10. Piston
11. Piston ring
12. Wear ring
13. Piston nut
14. Bolt
15. Cushion cylinder

SPECIFICATIONS

Unit: mm

Item \ Cylinder	Boom		Arm	Bucket	Swing
	PC60-5 PC60L-5	PC60U-5			PC60U-5
Piston rod O.D.	65	65	60	55	55
Cylinder I.D.	100	100	90	90	100
Stroke	910	850	870	710	790
Max. stroke	2,245	2,125	2,160	1,765	1,905
Min. stroke	1,335	1,275	1,290	1,055	1,115
Width across flats of piston nut	70	70	65	60	55

5. CUSHION CYLINDER (ARM CYLINDER HEAD, BOTTOM SIDE)

1. PURPOSE

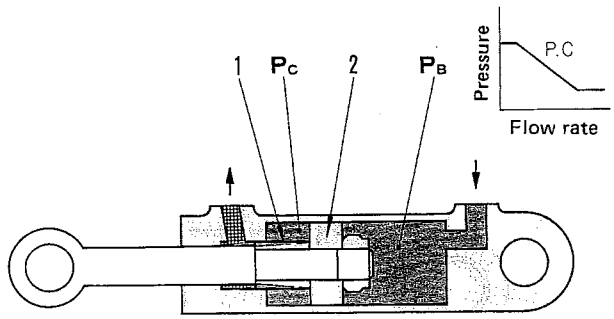
- Reducing the piston striking speed at the stroke ends alleviates the shock loads on the chassis, contributing to improved productivity and performance reliability.
- The piston striking sound is reduced.
- Durability of cylinders and their piping is improved, resulting in high operational safety and reliability.

2. FEATURES

- The construction is simple, yet a large decelerating effect is ensured.
- There is a cylinder aligning effect resulting in high durability and performance reliability of cylinders.

3. Operating principle

- If piston (2) approaches the stroke end, causing a cushion plunger (1) to throttle oil, the cushion pressure Pc goes up.
  Consequently, P_B also goes up. In a variable displacement pump, the flow rate is decreased along a PC curve, causing the piston speed to slow down.
  Further, if P_B continues going up, exceeding the main relief pressure setting, the cylinder speed is reduced more, resulting in a sufficient cushioning (shock absorbing) effect.



206F110

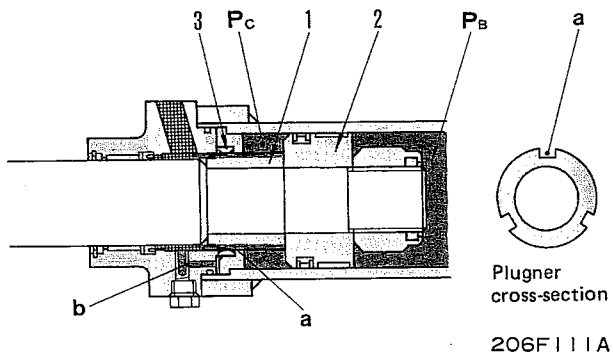
4. OPERATION

In boom cylinder head

- When the piston (2) approaches its stroke end, the plunger (1) enters the cushion ring (3), causing oil to be confined in chamber Pc. Then, the oil in chamber Pc flows from the cylinder head section through slits a (3 slits) around the plunger and restrictor b. This cushioning effect plus a reduced delivery from a variable displacement pump responding to the pressure variation in chamber P_B ensures a thorough shock absorbing effect for the boom cylinder.

In arm cylinder bottom

- Similarly in the boom cylinder head, the oil in chamber P_B is confined and the shock absorbing effect is available through slits C (3 slits) around the plunger. Steel balls (4) aid the plunger in its self-alignment.



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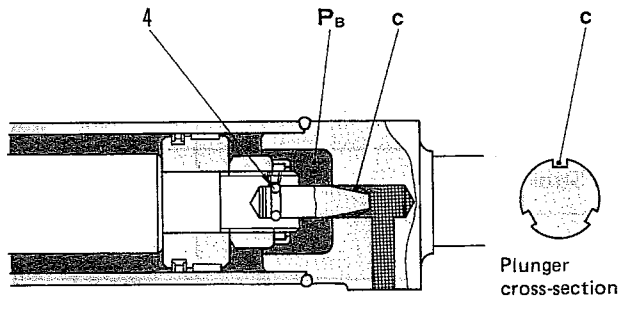
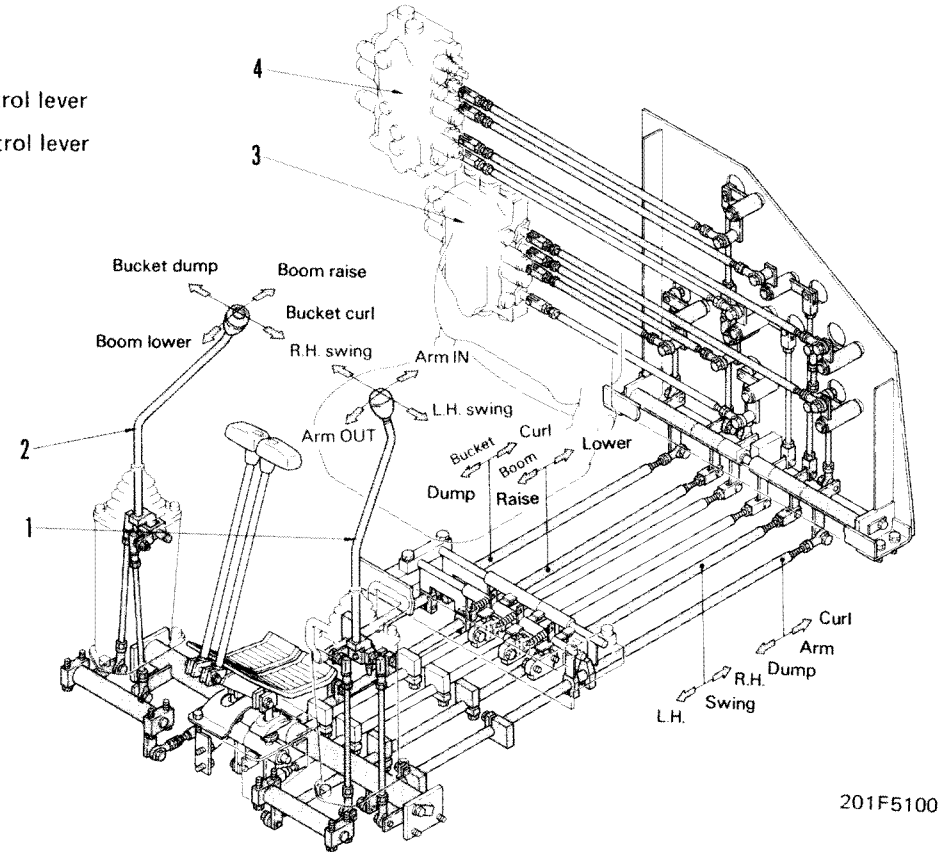


206F112

WORK EQUIPMENT CONTROL

PC60, 60L-5

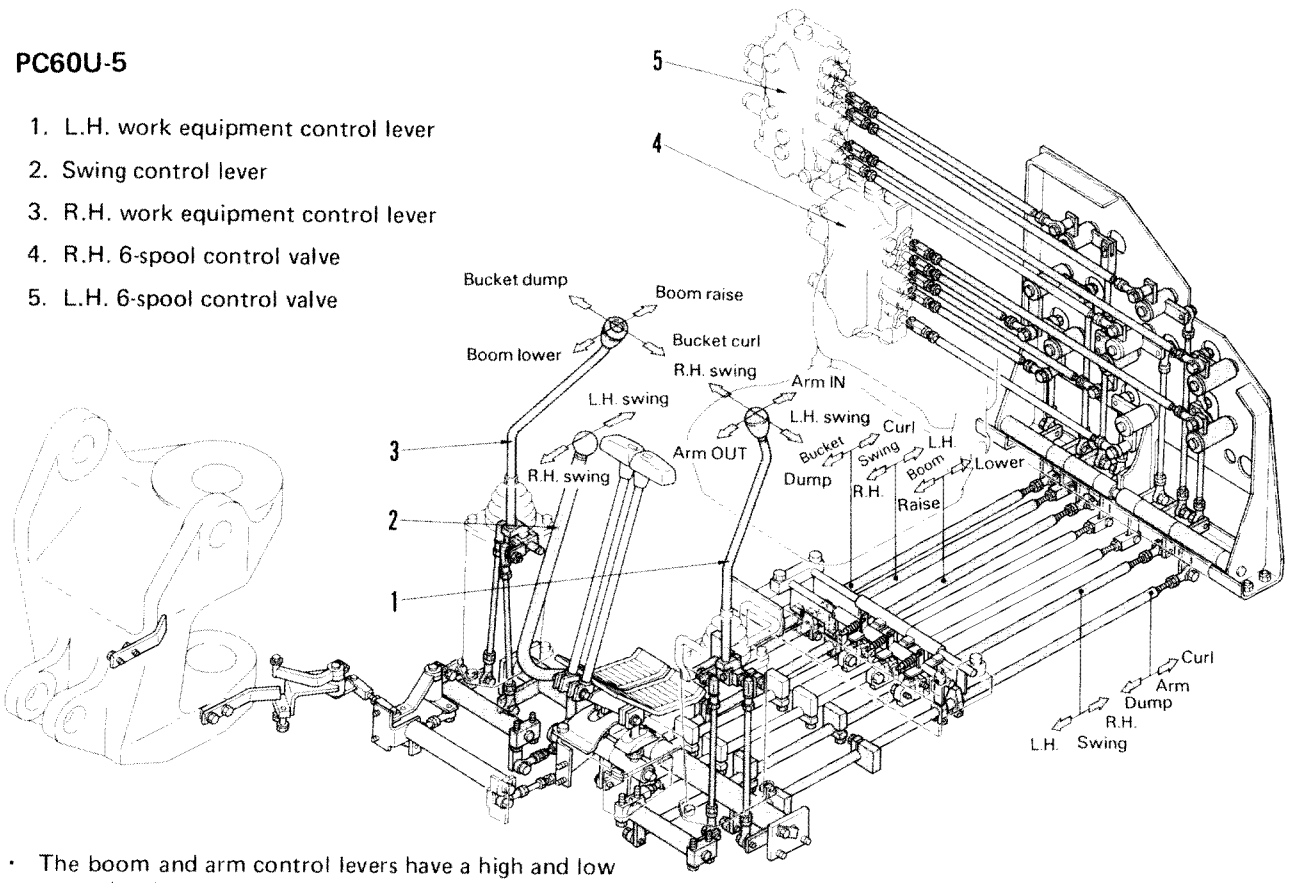
1. L.H. work equipment control lever
2. R.H. work equipment control lever
3. R.H. 5-spool control valve
4. L.H. 6-spool control valve



201F5100

PC60U-5

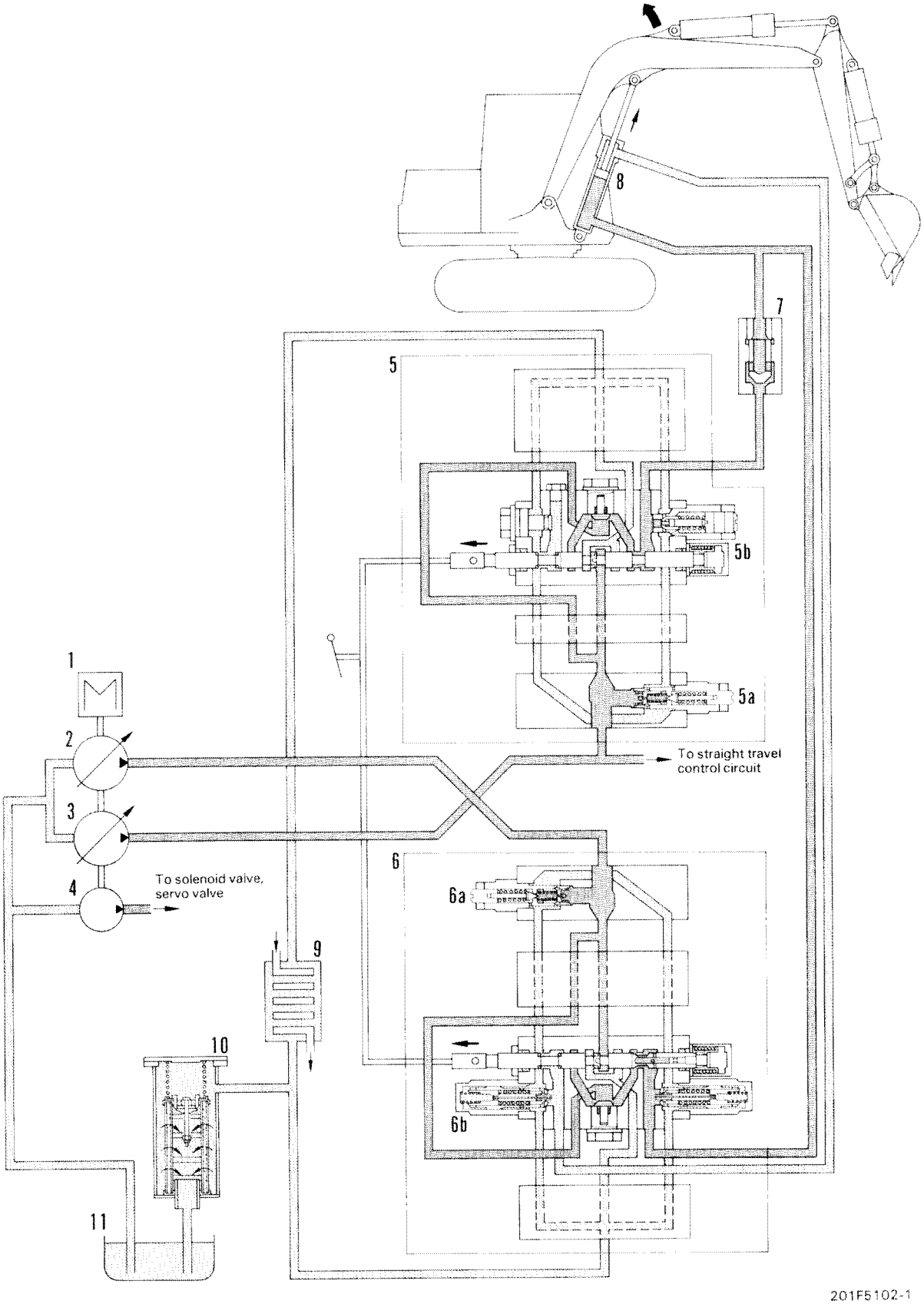
1. L.H. work equipment control lever
2. Swing control lever
3. R.H. work equipment control lever
4. R.H. 6-spool control valve
5. L.H. 6-spool control valve



201F5101

- The boom and arm control levers have a high and low control valve, so the rod changes from one system and is divided to two systems along the linkage.

1. BOOM CONTROL



201F5102-1

1. Engine
2. Front main pump
3. Rear main pump
4. Charging pump
5. L.H. 6-spool control valve
5a. Main relief valve
5b. Boom high control valve
6. R.H. 5-spool control valve
6a. Main relief valve
6b. Boom low control valve
7. Check valve
8. Boom cylinder
9. Oil cooler
10. Hydraulic oil filter
11. Hydraulic tank

OPERATION

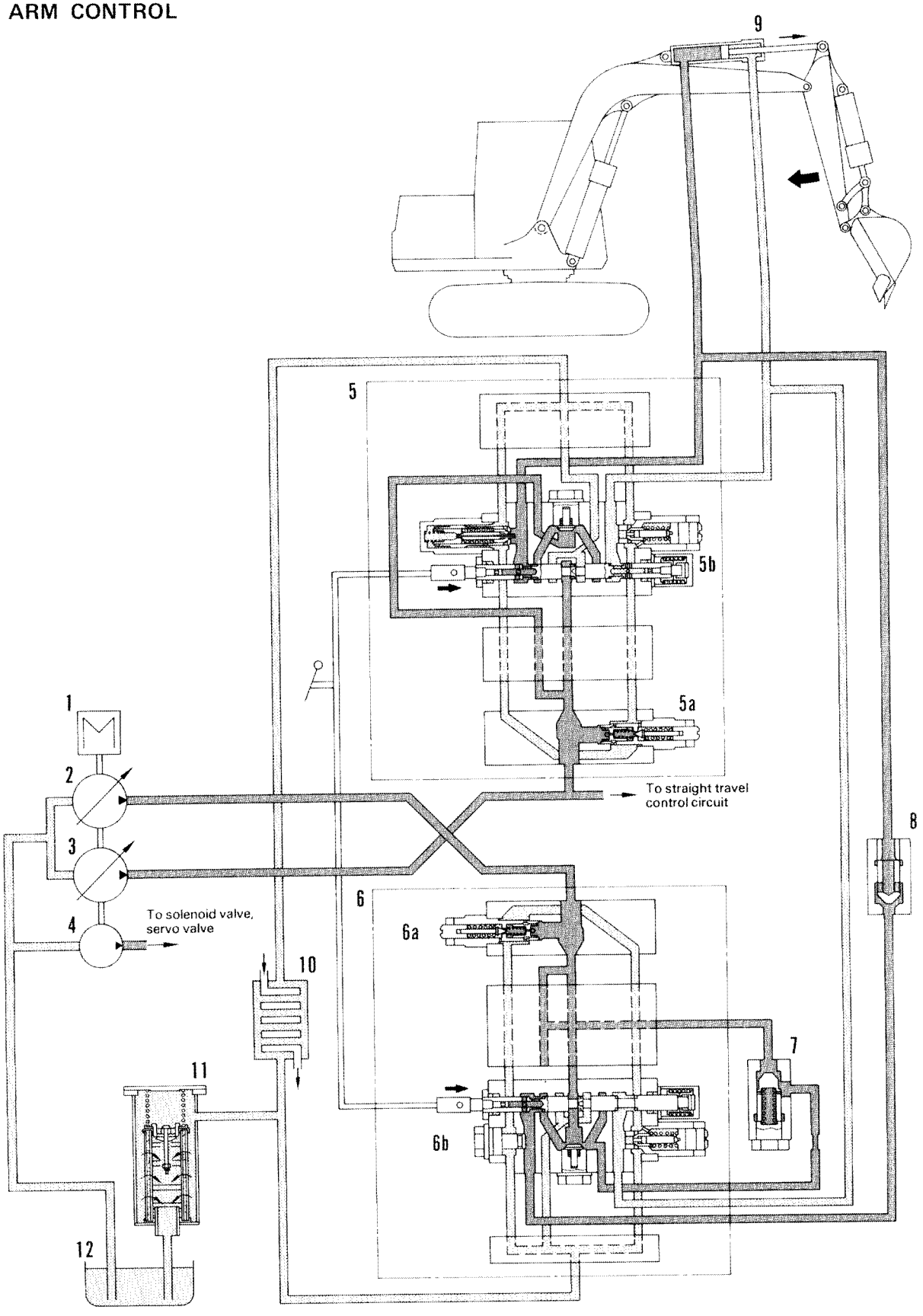
1. Boom RAISE

- When the boom control lever is moved to the RAISE position, it moves the link and actuates the spool of the boom low control valve and boom high control valve, which are joined together.
- The pressurized oil from the front pump passes through the boom low control valve and goes to the bottom end of the boom cylinder.
  At the same time, pressurized oil from the rear pump passes through the boom high control valve and merges at the bottom end of the boom cylinder.
- The return oil from the boom cylinder head passes through the boom low control valve, and then is drained back to the hydraulic tank through the hydraulic filter.
- For machines equipped with the auto deceleration system, when the boom control lever is operated, a limit switch along the link is switched ON, and the auto deceleration system is actuated to increase the engine speed.

2. Boom LOWER

- When the boom control lever is moved to the LOWER position, it moves the link and actuates the spool of the boom low control valve and boom high control valve, which are joined together.
- The pressurized oil from the front pump passes through the boom low control valve and goes to the head end of the boom cylinder.
  At the same time, pressurized oil from the front pump passes through the boom high control valve and merges at the head end of the boom cylinder.
- The return oil from the boom cylinder bottom passes through the boom low control valve, and then is drained back to the hydraulic tank through the hydraulic filter.
- For machines equipped with the auto deceleration system, when the boom control lever is operated, a limit switch along the link is switched ON, and the auto deceleration system is actuated to increase the engine speed.

2. ARM CONTROL



201F5103-1

1. Engine
2. Front main pump
3. Rear main pump
4. Charging pump
5. L.H. 6-spool control valve
5a. Main relief valve
5b. Arm-Lo control valve
6. R.H. 5-spool control valve
6a. Main relief valve
5b. Arm-Hi control valve
7. Check valve
8. Check valve
9. Arm cylinder
10. Oil cooler
11. Hydraulic oil filter
12. Hydraulic tank

OPERATION

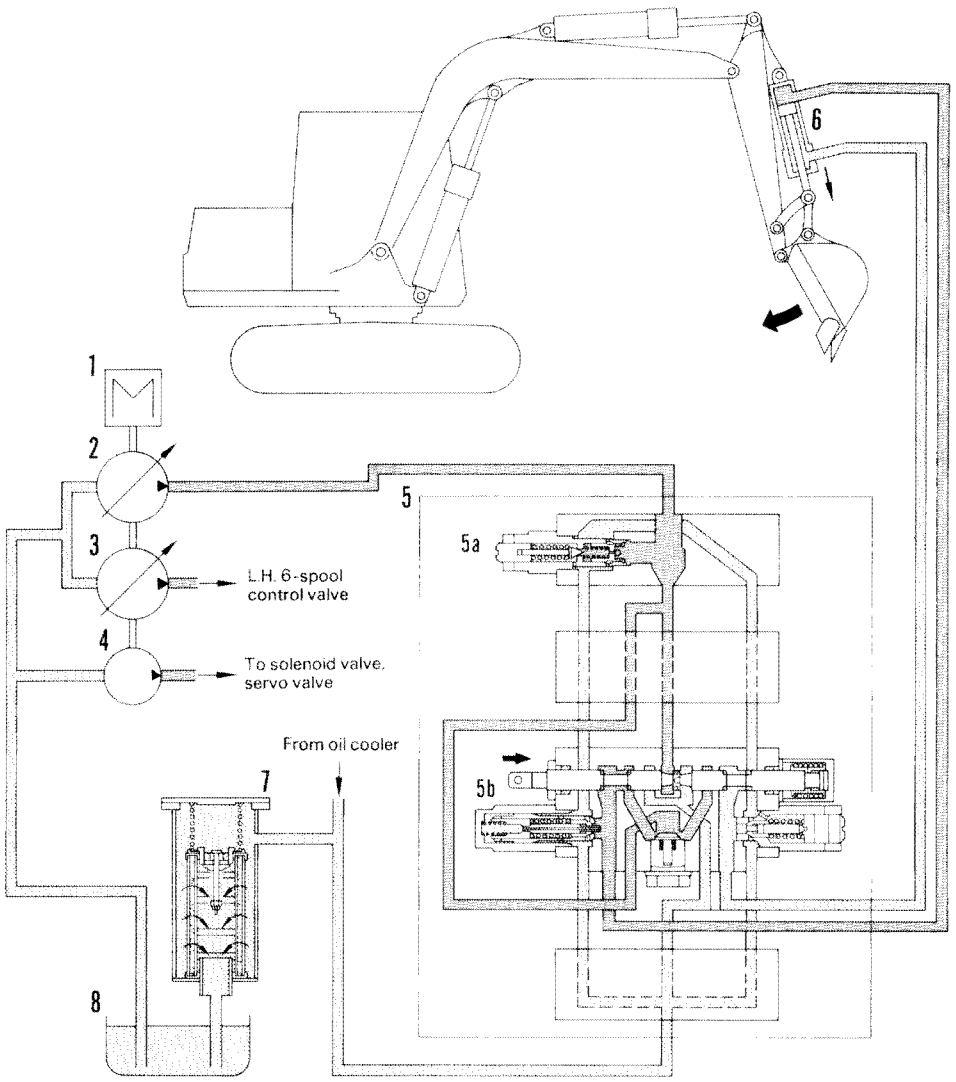
1. Arm IN

- When the arm control lever is moved to the IN position, it moves the link and actuates the spool of the arm-Hi control valve and arm-Lo control valve, which are joined together.
- The pressurized oil from the rear pump passes through the arm-Lo control valve and goes to the bottom end of the arm cylinder.
  At the same time, pressurized oil from the front pump passes through the arm-Hi control valve and merges at the bottom end of the cylinder.
- The return oil from the arm cylinder head passes through the arm-Lo control valve and arm-Hi control valve, and then is drained back to the hydraulic tank through the hydraulic filter.
- For machines equipped with the auto deceleration system, when the arm control lever is operated, a limit switch along the link is switched ON, and the auto deceleration system is actuated to increase the engine speed.

2. Arm OUT

- When the arm control lever is moved to the OUT position, it moves the link and actuates the spool of the arm-Hi control valve and arm-Lo control valve, which are joined together.
- The pressurized oil from the rear pump passes through the arm-Lo control valve and goes to the head end of the arm cylinder, causing the arm cylinder to retract.
  At the same time, the oil from the front pump flows together after passing through the arm control valve.
- The return oil from the arm cylinder bottom passes through the arm-Lo control valve, and then is drained back to the hydraulic tank through the hydraulic filter.
- At this stage, an orifice (machined in the spool) in the return circuit functions to control the lowering speed of the work equipment and to prevent the occurrence of negative pressure in the arm cylinder head.
- For machines equipped with the auto deceleration system, when the arm control lever is operated, a limit switch along the link is switched ON, and the auto deceleration system is actuated to increase the engine speed.

3. BUCKET CONTROL



201F5104-1

1. Engine
2. Front main pump
3. Rear main pump
4. Charging pump
5. R.H. 5-spool control valve

5a. Main relief valve

5b. Bucket control valve

6. Bucket cylinder
7. Hydraulic oil filter
8. Hydraulic tank

OPERATION

1. Bucket CURL

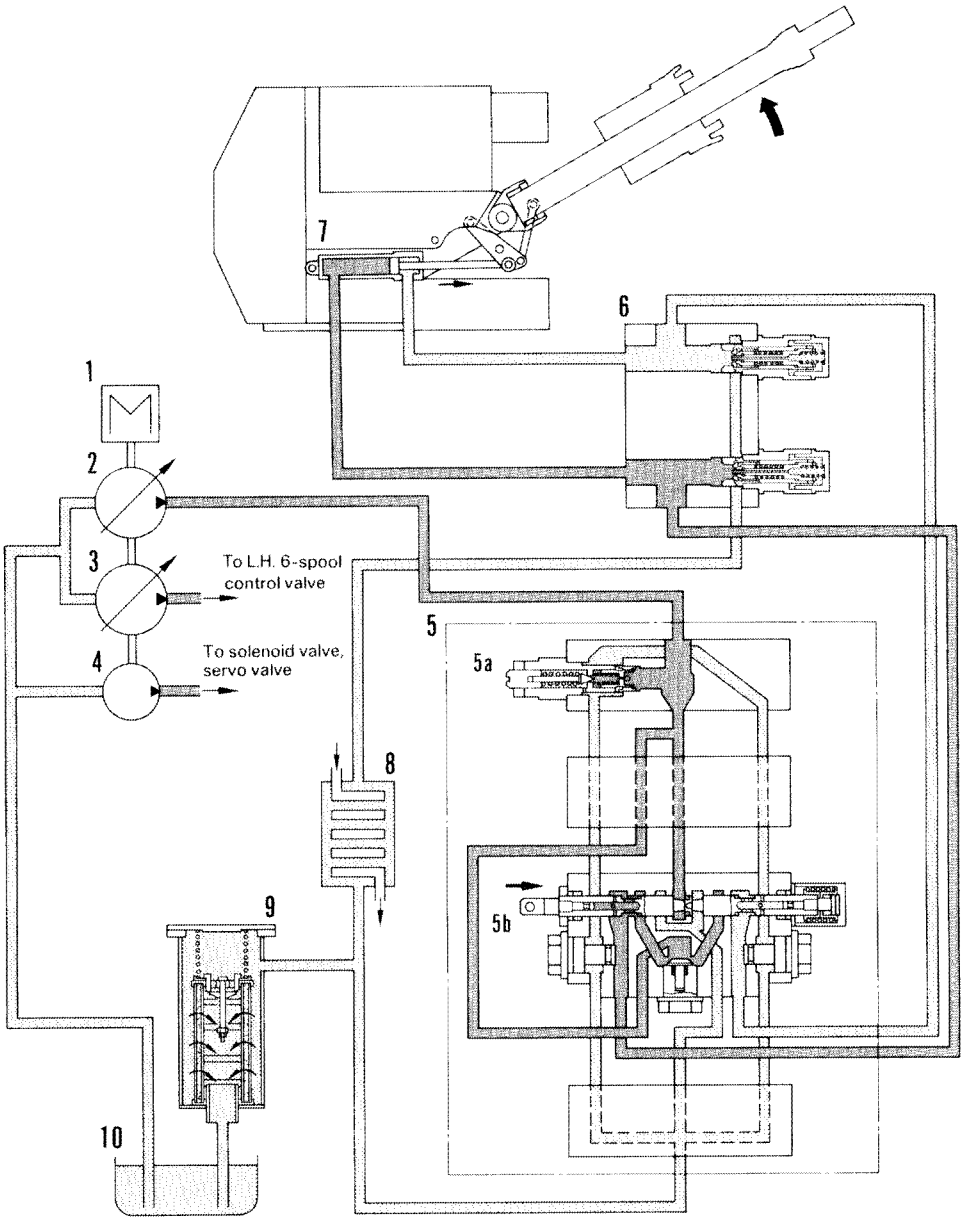
- When the bucket control lever is moved to the CURL position, it moves the link and actuates the bucket control valve which are joined together.
- The pressurized oil from the front pump passes through the bucket control valve and goes to the bottom end of the bucket cylinder.
- When the bucket CURL operation is performed under no-load, negative pressure is built up in the bottom section of the cylinder under the bucket's own weight, resulting in a time lag in the bucket movement. This causes the bucket to wobble. To prevent this, an orifice (a machined spool) is provided in the return circuit of the bucket control valve.
- The return oil from the bucket cylinder head passes through the bucket control valve, and then is drained back to the hydraulic tank through the hydraulic filter.
- For machines equipped with the auto deceleration system, when the bucket control lever is operated, a limit switch along the link is switched ON, and the auto deceleration system is actuated to increase the engine speed.

2. Bucket DUMP

- When the bucket control lever is moved to the DUMP position, it moves the link and actuates the bucket control valve, which are joined together.
- The pressurized oil from the front pump passes through the bucket control valve and goes to the head end of the bucket cylinder, causing the bucket cylinder to retract.
- The return oil from the bucket cylinder bottom passes through the bucket control valve, and then is drained back to the hydraulic tank through the hydraulic filter.
- For machines equipped with the auto deceleration system, when the bucket control lever is operated, a limit switch along the link is switched ON, and the auto deceleration system is actuated to increase the engine speed.

4. SWING CONTROL (Swing LEFT)

PC60U-5



201F5105-1

1. Engine
2. Front main pump
3. Rear main pump
4. Charging pump
5. R.H. 6-spool control valve
5a. Main relief valve
5b. Swing spool
6. Safety suction valve
7. Swing cylinder
8. Oil cooler
9. Hydraulic filter
10. Hydraulic tank

OPERATION

1. Swing LEFT

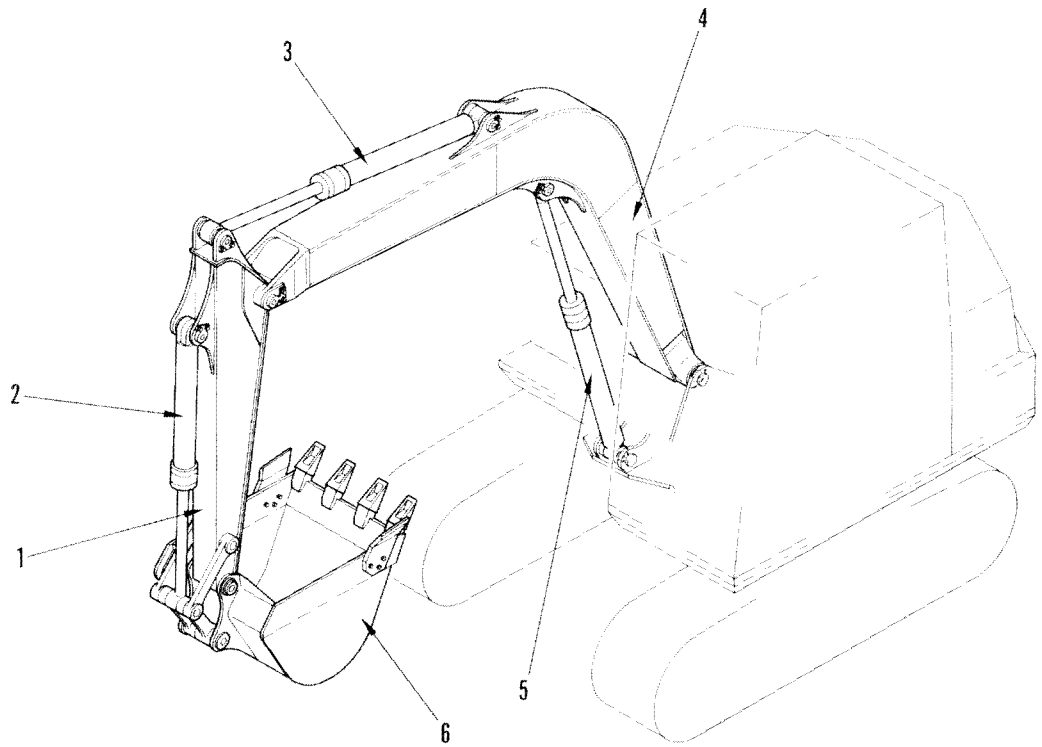
- When the swing control lever is moved to the swing LEFT position, it moves the link and actuates the spool of the swing control valve.
- The pressurized oil from the front pump passes through the swing control valve and goes to the bottom end of the swing cylinder.
- The return oil from the swing cylinder head passes through the swing control valve, and then is drained back to the hydraulic tank through the hydraulic filter.

2. Swing RIGHT

- When the swing control lever is moved to the swing RIGHT position, it moves the link and actuates the spool of the swing control valve.
- The pressurized oil from the front pump passes through the swing control valve and goes to the head end of the swing cylinder.
- The return oil from the swing cylinder bottom passes through the swing control valve, and then is drained back to the hydraulic tank through the hydraulic filter.

WORK EQUIPMENT

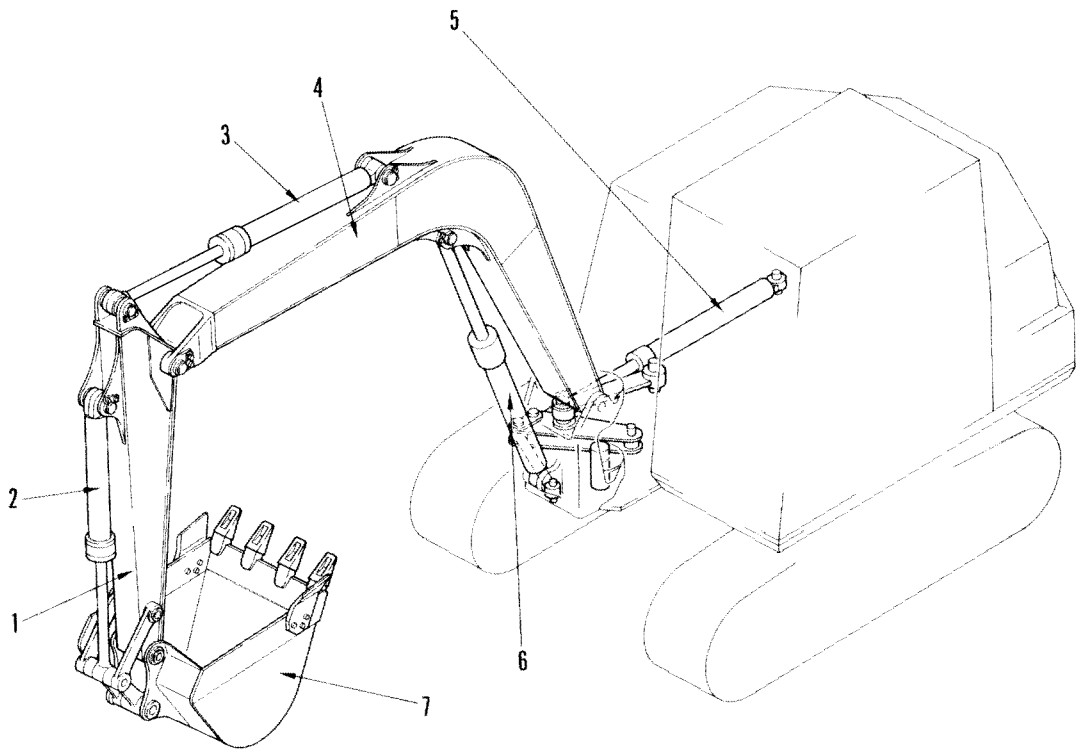
PC60, 60L-5



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

201F5112

PC60U-5



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

201F5113

HYDRAULIC SYSTEM
62 TESTING AND ADJUSTING

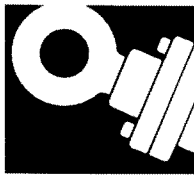
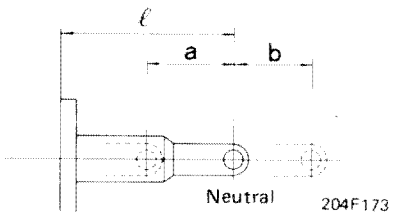
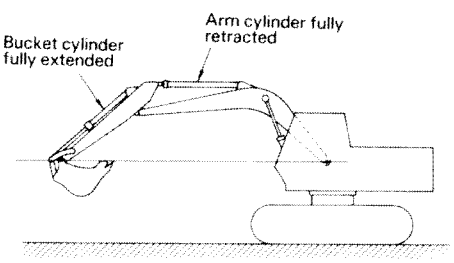
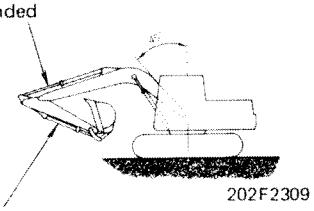


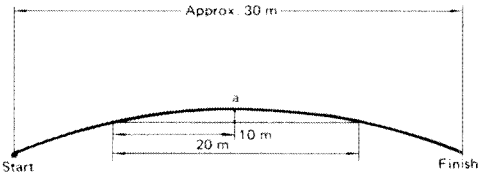
TABLE OF JUDGEMENT STANDARD VALUE

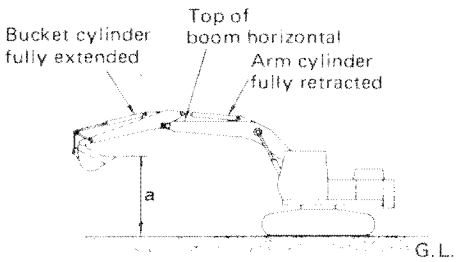
	Item	Condition		Standard value (New machine)			Permissible value		
Engine	Engine low idling speed	• Engine oil pressure: Inside operating range • Engine coolant temperature: Inside operating range		850 – 900 rpm					
	Engine high idling speed			2250 – 2350 rpm					
	Engine speed when one main pump circuit oil is relieved.	• Hydraulic oil temperature: 45 – 55°C • Engine oil pressure: Inside operating range • Engine coolant temperature: Inside operating range • At one pump relief: Bucket circuit relief • At two pump relief: Bucket and arm circuits relief		2100 rpm			2100 rpm		
	Engine speed when two main pump circuit oil is relieved.			2100 rpm			2100 rpm		
Spool travel				ℓ	a	b	ℓ	a	b
	Boom Lo control valve			33 mm	6.5±0.5 mm	6.5±0.5 mm	33 mm	6.5±0.5 mm	6.5±0.5 mm
	Boom Hi control valve								
	Arm Lo control valve								
	Arm Hi control valve								
	Bucket control valve								
	Boom swing control valve								
	Swing control valve								
	L.H. travel control valve								
	R.H. travel control valve								
	Service valve								
Control lever and pedal travel (mm)	Boom control lever	• At center of lever knob	Neutral → Raise or Lower	160 ± 40			160 ± 40		
	Arm control lever	• Measure maximum valve in traveling	Neutral → Arm in or out	130 ± 30			130 ± 30		
	Bucket control lever	• Engine stopped	Neutral → Curl or Dump	110 ± 27			110 ± 27		
	Swing control lever		Neutral → Swing right or swing left	120 ± 30			120 ± 30		
	Boom swing control lever		Neutral → Swing right or swing left						
	Travel control lever		N → Forward or Reverse (L.H., R.H.)	100 ± 25			100 ± 25		
	Fuel control lever		Stop ⟷ Low idling	41 ± 12			41 ± 12		
			Low idling ⟷ High idling	138 ± 20			138 ± 20		

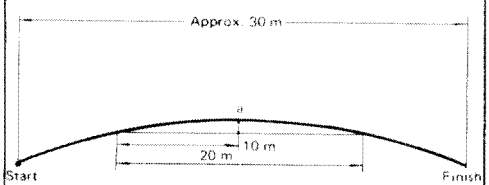
	Item	Condition		Standard value (New machine)	Permissible value
Control lever operating force (kg)	Boom control lever	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Hook push-pull scale on center of control lever knob to measure · Measure maximum value in traveling	Neutral → Raise	1.8 – 2.2	2.4
			Neutral → Lower	1.3 – 1.7	1.9
	Arm control lever		Neutral → Curl or dump	1.8 – 2.2	2.4
	Bucket control lever			1.4 – 1.8	2.0
	Swing control lever		Neutral → Swing right or swing left	1.7 – 2.1	2.3
	Boom swing control lever		Neutral → Swing right or swing left	1.9 – 2.3	2.5
	Travel control lever		Lever: Forward / Reverse	1.4 – 1.8	2.0
			Pedal: Forward	3.7 – 4.7	5.9
			Pedal: Reverse	4.1 – 5.1	6.4
Hydraulic pressure	Boom	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · 1 pump relieved, other pump no load		$300\ ^{+10}_{0}$ kg/cm²	$320\ ^{+20}_{-30}$ kg/cm²
	Arm				
	Travel				
	Bucket			$230\ ^{+10}_{0}$ kg/cm²	$250\ ^{+20}_{0}$ kg/cm²
	Swing			$230\ ^{+20}_{0}$ kg/cm²	$260\ ^{+20}_{0}$ kg/cm²
	Charging pump			$30\ ^{+1}_{0}$ kg/cm²	30 ± 3 kg/cm²
	Lowered hydraulic pressure	· Hydraulic oil temperature: 45 – 55°C · Difference oil relief pressure between at engine full speed and at engine a half speed. (Measure pressure when one pump circuit oil is relieved.)		Max. 30 kg/cm²	Max. 30 kg/cm²
Swing	Movement when stopping swing (Swing brake angle)	 (Fig. 1) 203F419 · Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Bucket unloaded · Write 2 match marks on outside of upper and lower swing circles · Stop the normal swing at 2 match marks fitted · Measure difference between 2 match marks ( ): Swing brake angle		Max. 409 mm (Max. 55°)	Max. 483 mm (Max. 60°)

	Item	Condition		Standard value (New machine)	Permissible value
Swing	Time taken to start swing	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Bucket unloaded · Measure time taken for 90° – 180° swing from starting point with work equipment in posture in Fig. 1	90°	1.9 ± 0.3 sec.	Max. 2.5 sec.
			180°	2.9 ± 0.3 sec.	Max. 3.5 sec.
	Time taken to swing	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Bucket unloaded · Work equipment in posture in Fig. 1 · Measure time taken to swing for 5 turns, after swinging one turn as an approach swing		21.4 ± 1.1 sec.	Max. 25 sec.
	Hydraulic drift of swing	· Engine speed: Stopped · Hydraulic oil temperature: 45 – 55°C · Work equipment in posture in Fig. 1 · Bucket unloaded · Swing lock switch is in ON. (With swing lock brake system) · Stop the machine on 15° slope and set boom at 90° angle across the slope · Measure distance moved by outside of swing circle in 5 min.		Max. 400 mm	Max. 400 mm
	Leakage from swing motor	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Relieve swing circuit · Measure leakage from swing motor with measuring cylinder		Max. 1.5 ℓ/min.	2.5 ℓ/min.

	Item	Condition	Standard value (New machine)			Permissible value		
			PC60	PC60L	PC60U	PC60	PC60L	PC60U
Travel	Travel speed (1)	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Raise track on one side, then measure time taken to rotate for 5 turns after rotating one turn as an approach travel · Repeat same way with track on other side	26.9±2 sec.	37.3±2 sec.	30±2 sec.	Max.31 sec.	Max.41 sec.	Max.34 sec.
	Travel speed (2)	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Machine is on level ground · Measure time taken to travel for 20 m after traveling 10 m as an approach travel · Work equipment posture: Arm cylinder fully extended  202F2309 Bucket cylinder fully extended	18.9± 0.9sec.	24 ± 1.2sec.	21.2± 1.1sec.	$18.9^{+2.9}_{-0.9}$ sec.	$24^{+3.7}_{-1.2}$ sec.	$21.2^{+3.3}_{-1.1}$ sec.

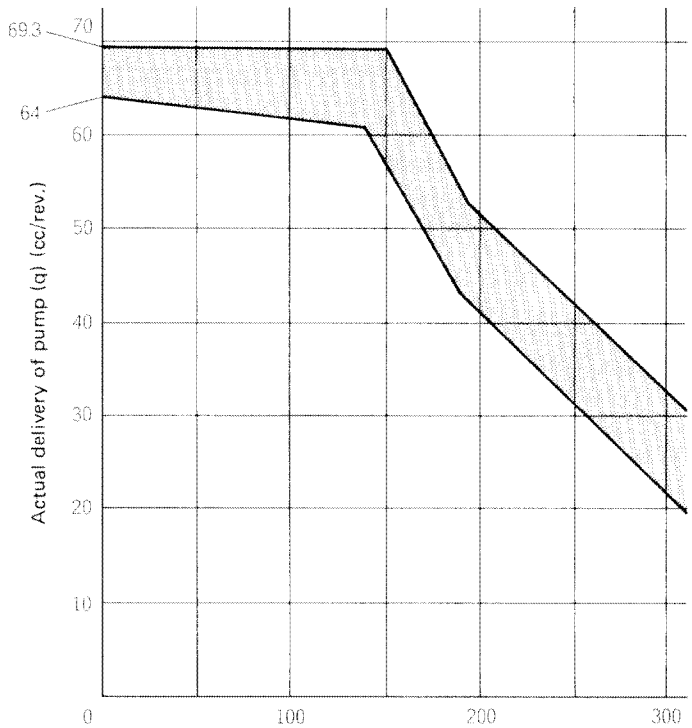
Item			Condition	Standard value (New machine)	Permissible value
Travel	Travel deviation		 · Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Run the machine for about 30 m on firm and level ground. · Lay out a 20 m string from a point 5 to 6 m from the start, and measure the deviation (a) of the machine at the midway point (10 m mark).	Max. 200 mm	Max. 220 mm
	Hydraulic drift of travel		· Engine speed: Stopped · Hydraulic oil temperature: 45 – 55°C · Stop the machine on 12° slope with setting sprocket on uphill · Measure distance moved by machine in 5 minutes.	0 mm	0 mm
	Leakage from travel motor		· Engine speed: High idling · Hydraulic oil pressure: 45 – 55°C · Block track to relieve circuit · Measure leakage from travel motor with measuring cylinder	Max. 0.520 ℓ/min.	Max. 1 ℓ/min.
Work equipment	Work equipment speed	Boom	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Bucket unloaded · Arm and bucket cylinder fully retracted · Measure time taken from bucket tooth touching the ground to boom cylinder fully extended (RAISE) · Measure time taken from boom cylinder fully extended to bucket tooth touching the ground (LOWER)	RAISE 2.5 ± 0.3 sec. LOWER 2.3 ± 0.2 sec.	Max. 3.1 sec. Max. 2.8 sec.
		Arm	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Bucket unloaded · Top of boom is in horizontal, and bucket cylinder fully retracted · Measure time taken from arm cylinder fully retracted position to cylinder fully extended position (IN) · Measure time taken cylinder fully extended position to cylinder fully retracted position (OUT)	IN 3.2 ± 0.3 sec. OUT 2.5 ± 0.3 sec.	Max. 3.9 sec. Max. 3.1 sec.
		Bucket	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Bucket unloaded · Top of boom is in horizontal, and arm cylinder fully retracted · Measure time taken from cylinder fully retracted position to cylinder fully extended position (CURL) · Measure time taken from cylinder fully extended position to cylinder fully retracted position (DUMP)	CURL 4.2 ± 0.4 sec. DUMP 2.8 ± 0.3 sec.	Max. 5.1 sec. Max. 3.4 sec.

Item			Condition	Standard value (New machine)	Permissible value
Work equipment	Hydraulic drift	Total work equipment	 (Fig. 2) 205F575 · Engine speed: Stopped · Hydraulic oil temperature: 45 — 55°C · Bucket loaded · Work equipment in posture in Fig. 2 · Measure amount bucket tooth moved down (distance "a") in 15 min. · Measure immediately after setting	Max. 550 mm	Max. 825 mm
		Boom	· Engine speed: Stopped · Hydraulic oil temperature: 45 — 55°C · Bucket rated loaded · Work equipment in posture in Fig. 2 · Measure amount boom cylinder retracted in 15 min.	Max. 39 mm	Max. 59 mm
		Arm	· Engine speed: Stopped · Hydraulic oil temperature: 45 — 55°C · Bucket rated loaded · Work equipment in posture in Fig. 2 · Measure amount arm cylinder extended in 15 min.	Max. 39 mm	Max. 59 mm
		Bucket	· Engine speed: Stopped · Hydraulic oil temperature: 45 — 55°C · Bucket rated loaded · Work equipment in posture in Fig. 1 · Measure amount bucket cylinder retracted in 15 min.	Max. 10 mm	Max. 15 mm
	Internal leakage	Each cylinder	· Hydraulic oil temperature: 45 — 55°C · Operating pressure: 300^{+5}_{0} kg/cm²	Max. 1.5 cc/min.	Max. 7.5 cc/min.
		Center swivel joint		Max. 10 cc/min.	Max. 50 cc/min.
		Work equipment swivel joint		Max. 10 cc/min.	Max. 50 cc/min.

Item			Condition	Standard value (New machine)	Permissible value
Work equipment	Time lag	Boom	• Engine speed: Low idling • Hydraulic oil temperature: 45 – 55°C • Bucket unloaded • Arm and bucket cylinder fully retracted • Measure time taken from bucket tooth touching the ground to the machine raised	Max. 3.0 sec.	Max. 3.6 sec.
		Arm	• Engine speed: Low idling • Hydraulic oil temperature: 45 – 55°C • Bucket unloaded • Top of boom is in horizontal, arm cylinder fully retracted • Measure time taken from arm stopped when arm came into vertical to arm moved again	Max. 3.0 sec.	Max. 3.6 sec.
		Bucket	• Engine speed: Low idling • Hydraulic oil temperature: 45 – 55°C • Bucket unloaded • Arm is in vertical. • Measure time taken from bucket stopped when bucket tooth came in bottom to bucket moved again	Max. 5.0 sec.	Max. 6.0 sec.
Compound operation performance	Deviation during compound operation. (work equipment + travel)		 • Engine speed: High idling • Hydraulic oil temperature: 45 – 55°C • Run the machine for about 30 m on firm and level ground. Lay out a 20 m string from a point 5 to 6 m from the start, and measure the deviation (a) of the machine at the midway point (10 m mark)	Max. 200 mm	Max. 220 mm
Hydraulic pump performance	Delivery	Charging pump	• Hydraulic oil temperature: 45 – 55°C • Engine speed: rated speed • Delivery pressure: 30 kg/cm²	Min. 23.5 ℓ/min. (at 2,100 rpm)	Min. 21 ℓ/min.
		Main pump	See next page	See next page	

Item	Condition	Standard value (New machine)	Permissible value

Checking performance of hydraulic pump



201F5152

★ Q (ℓ/min.) = N (rpm) x q (cc/rev.) x 10^{-3}
N: Engine speed

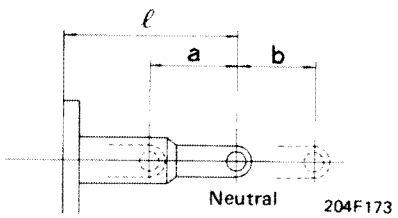
Check point	Delivery pressure of tester pump (kg/cm²)	Delivery pressure of other pump (kg/cm²)	Ave. pressure (kg/cm²)	Standard value for delivery Q(ℓ/min.) Median ± 10	Permissible value Q(ℓ/min.) Lower limit
(1)	P_1	P_2	$\frac{P_1 + P_2}{2}$	Refer to graph	Refer to graph
(2)	305	305	305	27.5 ± 5	22.5
(3)	135	305	220	42.5 ± 5.5	37
(4)	305	0 – 20	160	59.5 ± 6.5	53
(5)	0 – 20	0 – 20	0 – 20	$67^{+2.3}_{-3}$	64

Note: If install oil pressure gauge (600 kg/cm²) on pump circuit which does not install flow meter, average pressure are measured accurately.

★ FOR MACHINE EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHANICAL BRAKE AND OLSS

TABLE OF JUDGEMENT STANDARD VALUE

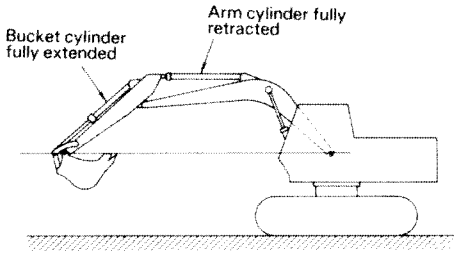
★ Standard value and permisslbe value in following table are the value when mode selector switch is at S position.

	Item	Condition		Standard value (New machine)	Permissible value
Engine	Engine low idling speed	• Engine oil pressure: Inside operating range • Engine coolant temperature: Inside operating range		850 – 900 rpm	
	Engine high idling speed			2250 – 2350 rpm	
	Engine speed when one main pump circuit oil is relieved.	• Hydraulic oil temperature: 45 – 55°C • Engine oil pressure: Inside operating range • Engine coolant temperature: Inside operating range • At one pump relief: Bucket circuit relief • At two pump relief: Bucket and arm circuits relief		2100 rpm	2100 rpm
	Engine speed when two main pump circuit oil is relieved.			2100 rpm	2100 rpm
	Engine speed when auto-deceleration acts. (if equipped)	• Fuel control lever at "High idling" • Work equipment control lever at "Hold"		1250 – 1450 rpm	1250 – 1450 rpm
Spool travel	Boom Lo control valve			ℓ: 33 mm a: 6.5±0.5 mm b: 6.5±0.5 mm	ℓ: 33 mm a: 6.5±0.5 mm b: 6.5±0.5 mm
	Boom Hi control valve				
	Arm Lo control valve				
	Arm Hi control valve				
	Bucket control valve				
	Boom swing control valve				
	Swing control valve				
	L.H. travel control valve				
	R.H. travel control valve				
	Service valve				
Control lever and pedal travel (mm)	Boom control lever	• At center of lever knob	Neutral → Raise or Lower	150 ± 30	150 ± 30
	Arm control lever	• Measure maximum valve in traveling	Neutral → Arm in or out	157 ± 30	157 ± 30
	Bucket control lever	• Engine stopped	Neutral → Curl or Dump	105 ± 25	105 ± 25
	Swing control lever		Neutral → Swing right or swing left	105 ± 25	105 ± 25
	Boom swing control lever		Neutral → Swing right or swing left		
	Travel control lever		N → Forward or Reverse (L.H., R.H.)	100 ± 25	100 ± 25
	Fuel control lever		Stop ⟷ Low idling	41 ± 12	41 ± 12
			Low idling ⟷ High idling	138 ± 20	138 ± 20

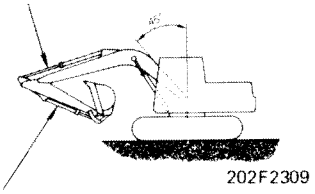
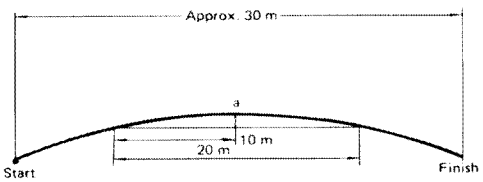
★ FOR MACHINE EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHANICAL BRAKE AND OLSS

	Item	Condition		Standard value (New machine)	Permissible value
Control lever operating force (kg)	Boom control lever	• Engine speed: High idling • Hydraulic oil temperature: 45 – 55°C • Hook push-pull scale on center of control lever knob to measure • Measure maximum value in traveling	Neutral → Raise	1.8 – 2.2	2.4
			Neutral → Lower	1.8 – 2.2	2.4
	Arm control lever		Neutral → Curl or dump	1.6 – 2.0	2.2
	Bucket control lever			1.4 – 1.8	2.0
	Swing control lever		Neutral → Swing right or swing left	1.8 – 2.2	2.4
	Boom swing control lever		Neutral → Swing right or swing left	1.9 – 2.3	2.5
	Travel control lever		Lever: Forward / Reverse	1.4 – 1.8	2.0
			Pedal: Forward	3.7 – 4.7	5.9
			Pedal: Reverse	4.1 – 5.1	6.4
Hydraulic pressure	Boom	• Engine speed: High idling • Hydraulic oil temperature: 45 – 55°C • 1 pump relieved, other pump no load		$300\ ^{+10}_{0}$ kg/cm²	$320\ ^{+20}_{-30}$ kg/cm²
	Arm				
	Travel				
	Bucket			$230\ ^{+10}_{0}$ kg/cm²	$250\ ^{+20}_{0}$ kg/cm²
	Swing			$230\ ^{+20}_{0}$ kg/cm²	$260\ ^{+20}_{0}$ kg/cm²
	Charging pump			$30\ ^{+1}_{0}$ kg/cm²	30 ± 3 kg/cm²
	TVC valve output pressure	• Engine speed: High idling • Hydraulic oil temperature: 45 – 55°C	Control levers at NEUTRAL	23.5 kg/cm²	18 kg/cm²
			One pump relief (Ave. delivery pressure $\frac{P_1 + P_2}{2}$ = 145 – 155 kg/cm²)	17 ± 1 kg/cm²	16.5 ± 1.5 kg/cm²
	Pressure when NC valve is actuated	• Engine speed: High idling • Hydraulic oil temperature: 45 – 55°C	Control levers at NEUTRAL	5.5 ± 1 kg/cm²	7 kg/cm²
			Travel control lever at full travel with track raised from ground and rotated	21 ± 1 kg/cm²	18 kg/cm²
	Lowered hydraulic pressure	• Hydraulic oil temperature: 45 – 55°C • Difference oil relief pressure between at engine full speed and at engine a half speed. (Measure pressure when one pump circuit oil is relieved.)		Max. 30 kg/cm²	Max. 30 kg/cm²

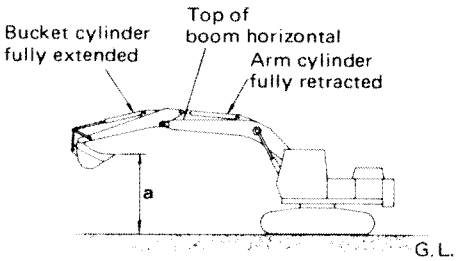
★ FOR MACHINE EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHANICAL BRAKE AND OLSS

	Item	Condition		Standard value (New machine)	Permissible value
Swing	Movement when stopping swing (Swing brake angle)	 (Fig. 1) 203F419 · Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Bucket unloaded · Write 2 match marks on outside of upper and lower swing circles · Stop the normal swing at 2 match marks fitted · Measure difference between 2 match marks ( ): Swing brake angle		Max. 409 mm (Max. 55°)	Max. 483 mm (Max. 60°)
	Time taken to start swing	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Bucket unloaded · Measure time taken for 90° – 180° swing from starting point with work equipment in posture in Fig. 1 · ( ): Bucket loaded Rated load: 450 kg	90°	1.9 ± 0.3 sec. (2.5 ± 0.3 sec.)	Max. 2.5 sec. (Max. 3.1 sec.)
			180°	2.9 ± 0.3 sec. (3.6 ± 0.4 sec.)	Max. 3.5 sec. (Max. 4.3 sec.)
	Time taken to swing	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Bucket unloaded · Work equipment in posture in Fig. 1 · Measure time taken to swing for 5 turns, after swinging one turn as an approach swing		21.4 ± 1.1 sec.	Max. 25 sec.
	Hydraulic drift of swing	· Engine speed: Stopped · Hydraulic oil temperature: 45 – 55°C · Work equipment in posture in Fig. 1 · Bucket unloaded · Swing lock switch is in ON. (With swing lock brake system) · Stop the machine on 15° slope and set boom at 90° angle across the slope · Measure distance moved by outside of swing circle in 5 min.		0 mm	0 mm
	Leakage from swing motor	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Relieve swing circuit · Measure leakage from swing motor with measuring cylinder		Max. 1.5 ℓ/min.	2.5 ℓ/min.
Travel	Travel speed (1)	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Raise track on one side, then measure time taken to rotate for 5 turns after rotating one turn as an approach travel · Repeat same way with track on other side		PC60: 26.9±2 sec. PC60L: 37.3±2 sec. PC60U: 30±2 sec.	PC60: Max.31 sec. PC60L: Max.41 sec. PC60U: Max.34 sec.

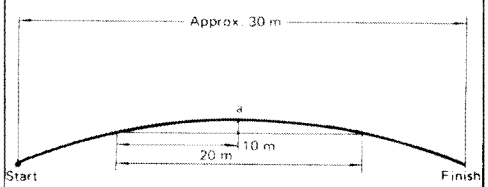
★ FOR MACHINE EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHANICAL BRAKE AND OLSS

	Item		Condition	Standard value (New machine)			Permissible value		
Travel	Travel speed (2)		· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Machine is on level ground · Measure time taken to travel for 20 m after traveling 10 m as an approach travel · Work equipment posture: Arm cylinder fully extended  202F2309 Bucket cylinder fully extended	18.9± 0.9sec.	24 ± 1.2sec.	21.2± 1.1sec.	$18.9^{+2.9}_{-0.9}$ sec.	$24^{+3.7}_{-1.2}$ sec.	$21.2^{+3.3}_{-1.1}$ sec.
	Travel deviation		 · Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Run the machine for about 30 m on firm and level ground. · Lay out a 20 m string from a point 5 to 6 m from the start, and measure the deviation (a) of the machine at the midway point (10 m mark).	Max. 200 mm			Max. 220 mm		
	Hydraulic drift of travel		· Engine speed: Stopped · Hydraulic oil temperature: 45 – 55°C · Stop the machine on 12° slope with setting sprocket on uphill · Measure distance moved by machine in 5 minutes.	0 mm			0 mm		
	Leakage from travel motor		· Engine speed: High idling · Hydraulic oil pressure: 45 – 55°C · Block track to relieve circuit · Measure leakage from travel motor with measuring cylinder	Max. 0.520 ℓ/min.			Max. 1 ℓ/min.		
Work equipment	Work equipment speed	Boom	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Bucket unloaded · Arm and bucket cylinder fully retracted · Measure time taken from bucket tooth touching the ground to boom cylinder fully extended (RAISE) · Measure time taken from boom cylinder fully extended to bucket tooth touching the ground (LOWER)	RAISE 2.5 ± 0.3 sec. LOWER 2.3 ± 0.2 sec.			Max. 3.1 sec. Max. 2.8 sec.		
		Arm	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Bucket unloaded · Top of boom is in horizontal, and bucket cylinder fully retracted · Measure time taken from arm cylinder fully retracted position to cylinder fully extended position (IN) · Measure time taken cylinder fully extended position to cylinder fully retracted position (OUT)	IN 3.2 ± 0.3 sec. OUT 2.5 ± 0.3 sec.			Max. 3.9 sec. Max. 3.1 sec.		

★ FOR MACHINE EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHANICAL BRAKE AND OLSS

Item			Condition	Standard value (New machine)	Permissible value
Work equipment	Work equipment speed	Bucket	· Engine speed: High idling · Hydraulic oil temperature: 45 – 55°C · Bucket unloaded · Top of boom is in horizontal, and arm cylinder fully retracted · Measure time taken from cylinder fully retracted position to cylinder fully extended position (CURL) · Measure time taken from cylinder fully extended position to cylinder fully retracted position (DUMP)	CURL 4.2 ± 0.4 sec. DUMP 2.8 ± 0.3 sec.	Max. 5.1 sec. Max. 3.4 sec.
	Hydraulic drift	Total work equipment	 (Fig. 2) 205F575 · Engine speed: Stopped · Hydraulic oil temperature: 45 – 55°C · Bucket loaded Rated load: 450 kg · Work equipment in posture in Fig. 2 · Measure amount bucket tooth moved down (distance "a") in 15 min. · Measure immediately after setting · ( ): Bucket unloaded	Max. 550 mm (Max. 320 mm)	Max. 825 mm (Max. 500 mm)
		Boom	· Engine speed: Stopped · Hydraulic oil temperature: 45 – 55°C · Bucket rated loaded · Work equipment in posture in Fig. 2 · Measure amount boom cylinder retracted in 15 min.	Max. 39 mm	Max. 59 mm
		Arm	· Engine speed: Stopped · Hydraulic oil temperature: 45 – 55°C · Bucket rated loaded · Work equipment in posture in Fig. 2 · Measure amount arm cylinder extended in 15 min.	Max. 39 mm	Max. 59 mm
		Bucket	· Engine speed: Stopped · Hydraulic oil temperature: 45 – 55°C · Bucket rated loaded · Work equipment in posture in Fig. 1 · Measure amount bucket cylinder retracted in 15 min.	Max. 10 mm	Max. 15 mm
	Internal leakage	Each cylinder	· Hydraulic oil temperature: 45 – 55°C · Operating pressure: 300^{+5}_{0} kg/cm²	Max. 1.5 cc/min.	Max. 7.5 cc/min.
		Center swivel joint		Max. 10 cc/min.	Max. 50 cc/min.
		Work equipment swivel joint		Max. 10 cc/min.	Max. 50 cc/min.

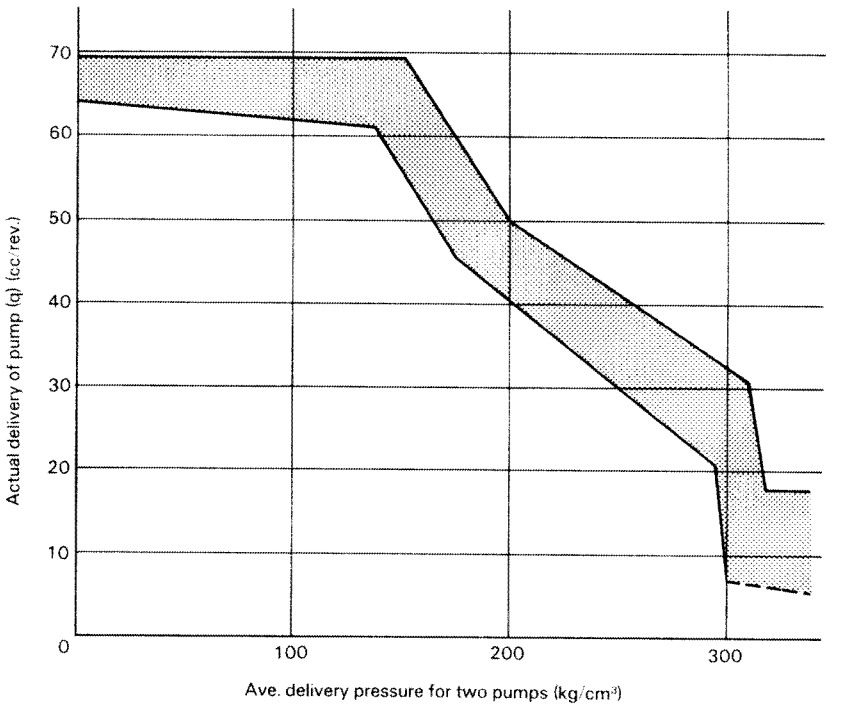
★ FOR MACHINE EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHANICAL BRAKE AND OLSS

Item			Condition	Standard value (New machine)	Permissible value
Work equipment	Time lag	Boom	• Engine speed: Low idling • Hydraulic oil temperature: 45 – 55°C • Bucket unloaded • Arm and bucket cylinder fully retracted • Measure time taken from bucket tooth touching the ground to the machine raised	Max. 3.0 sec.	Max. 3.6 sec.
		Arm	• Engine speed: Low idling • Hydraulic oil temperature: 45 – 55°C • Bucket unloaded • Top of boom is in horizontal, arm cylinder fully retracted • Measure time taken from arm stopped when arm came into vertical to arm moved again	Max. 3.0 sec.	Max. 3.6 sec.
		Bucket	• Engine speed: Low idling • Hydraulic oil temperature: 45 – 55°C • Bucket unloaded • Arm is in vertical. • Measure time taken from bucket stopped when bucket tooth came in bottom to bucket moved again	Max. 5.0 sec.	Max. 6.0 sec.
Compound operation performance	Deviation during compound operation. (work equipment + travel)		 • Engine speed: High idling • Hydraulic oil temperature: 45 – 55°C • Run the machine for about 30 m on firm and level ground. Lay out a 20 m string from a point 5 to 6 m from the start, and measure the deviation (a) of the machine at the midway point (10 m mark)	Max. 200 mm	Max. 220 mm
Hydraulic pump performance	Delivery	Charging pump	• Hydraulic oil temperature: 45 – 55°C • Engine speed: rated speed • Delivery pressure: 30 kg/cm²	Min. 23.5 ℓ/min. (at 2,100 rpm)	Min. 21 ℓ/min.
		Main pump	See next page	See next page	

Item	Condition	Standard value (New machine)	Permissible value

Checking performance of hydraulic pump

When mode selector switch is S position



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★ Q (ℓ/min.) = N (rpm) x q (cc/rev.) x 10^{-3}
N: Engine speed

Check point	Delivery pressure of tester pump (kg/cm^2)	Delivery pressure of other pump (kg/cm^2)	Ave. pressure (kg/cm^2)	Standard value for delivery Q(ℓ/min.) Median ± 10	Permissible value Q(ℓ/min.) Lower limit
(1)	P_1	P_2	$\frac{P_1 + P_2}{2}$	Refer to graph	Refer to graph
(2)	305	0 — 20	—	11 ± 6	4.5
(3)	135	305	220	42.5 ± 5.5	37
(4)	70	230	160	59.5 ± 6.5	53
(5)	0 — 20	0 — 20	0 — 20	$67^{+2.3}_{-3}$	64

Note: If install oil pressure gauge (600 kg/cm^2) on pump circuit which does not install flow meter, average pressure are measured accurately.

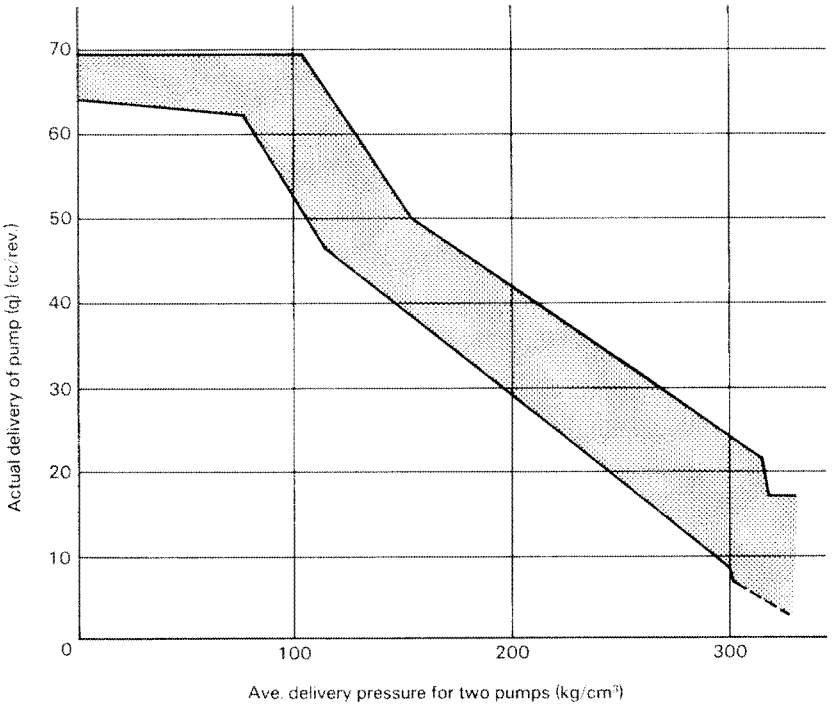
Note: The CO valve is working, so the average pressure is unnecessary.

★ FOR MACHINE EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHANICAL BRAKE AND OLSS

Item	Condition	Standard value (New machine)	Permissible value

Checking performance of hydraulic pump

When mode selector switch is L position



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★ Q (ℓ/min.) = N (rpm) x q (cc/rev.) x 10^{-3}
N: Engine speed

Check point	Delivery pressure of tester pump (kg/cm^2)	Delivery pressure of other pump (kg/cm^2)	Ave. pressure (kg/cm^2)	Standard value for delivery Q(ℓ/min.) Median ± 10	Permissible value Q(ℓ/min.) Lower limit
(1)	P_1	P_2	$\frac{P_1 + P_2}{2}$	Refer to graph	Refer to graph
(2)	305	0 – 20	–	10 ± 5.5	2.5
(3)	135	305	220	31 ± 6.5	24.5
(4)	260 – 240	0 – 20	130	50.5 ± 8	42.5
(5)	0 – 20	0 – 20	0 – 20	$67^{+2.3}_{-3}$	64

Note: If install oil pressure gauge (600 kg/cm^2) on pump circuit which does not install flow meter, average pressure are measured accurately.

Note: The CO valve is working, so the average pressure is unnecessary.

TROUBLESHOOTING TOOLS

No.	Troubleshooting tools	Troubleshooting chart No. H															
		-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-16
	Diagnostic tools																
1	Hydraulic tester	○	○	○	○	○	○	○		○		○	○		○		
2	Stop watch	○					○					○	○		○		○
3	Thermistor kit	○	○	○	○	○	○	○		○		○	○		○		○
4	Measuring cylinder	○					○					○	○		○		
5	Push pull scale				○												
6	Scale	○					○					○			○		
7	Multi-purpose tachometer						○										
	Replacement parts																
8	Servo valve	○		○	○		○	○									
9	Travel shuttle valve			○				○						○			
10	Swing safety valve													○			
11	Relief valve in control valve	○		○	○		○										
12	Main relief valve · suction valve																○
13	Swing check valve													○			
	KES parts																
14	Cap plug (07376-50315) 3 pieces	○															
15	Sleeve nut (07221-20210,20315,20422)	○		○	○	○	○	○		○		○	○				
16	Plug (07222-00210, 00312, 00414)	○		○	○	○	○	○		○		○	○				
17	Flange (07379-00500, 00600)	○															

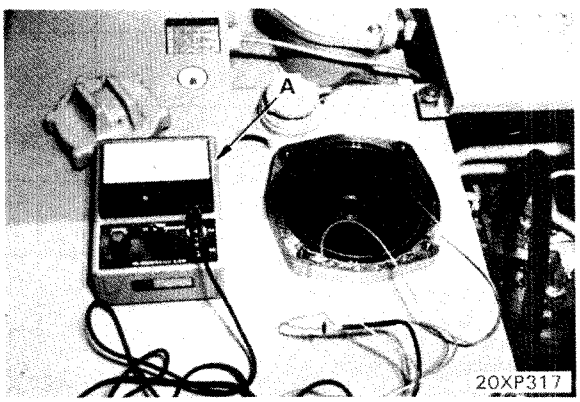
MEASURING HYDRAULIC OIL TEMPERATURE

Special tool

	Part Number	Part Name	Q'ty
A	790-500-1300	Thermistor temperature gauge	1

Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the remaining oil pressure in the hydraulic tank.

- Remove cover, then measure the oil temperature using thermistor **A**.
- When hydraulic oil temperature is lower than 45°C, raise the oil temperature as follows.
- Start the engine and warm up running. Operate the swing and bucket control lever fully to relieve oil from main relief valve and swing motor safety valve so that oil temperature is raised.
  - ★ Continued operation in above is within 30 seconds.



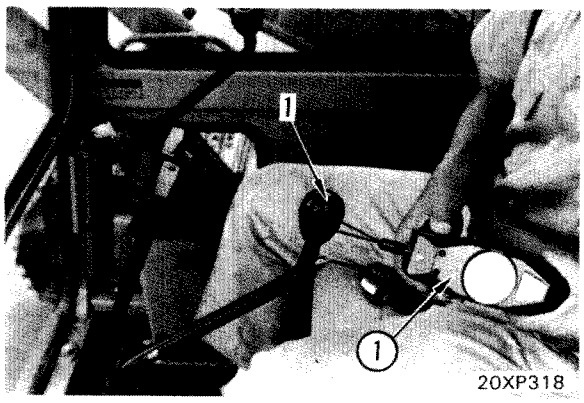
TESTING OPERATNG FORCE OF CONTROL LEVERS

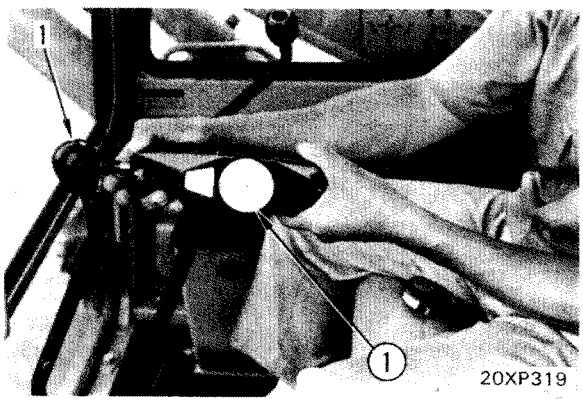
★ When measuring, engine is high idling speed and hydraulic oil temperature is 45 to 55°C.

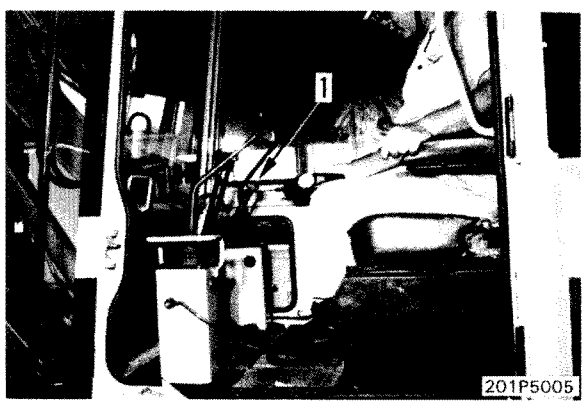
⚠ When testing operating force, be careful safety of surrounding.

Measuring operating force

Hook push-pull scale (1) on the center of knob (1) of the control lever, and measure the force needed to move the lever to each position.

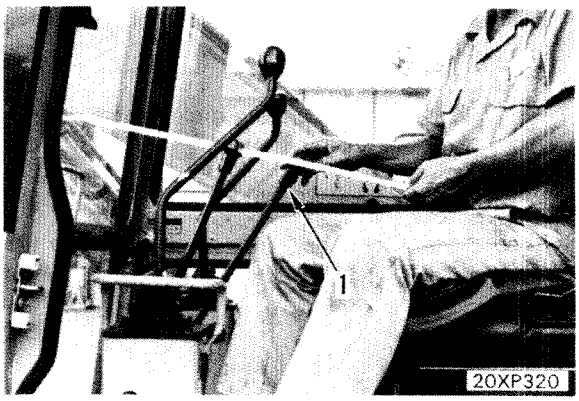




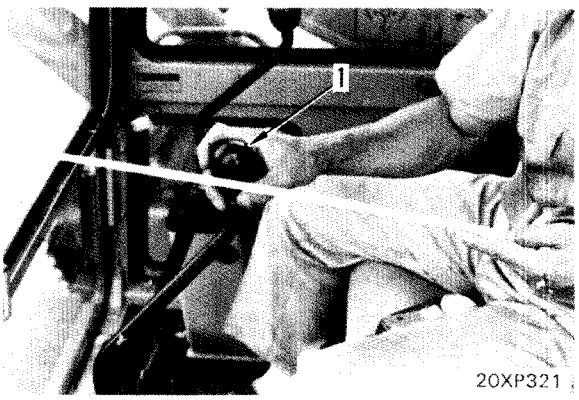


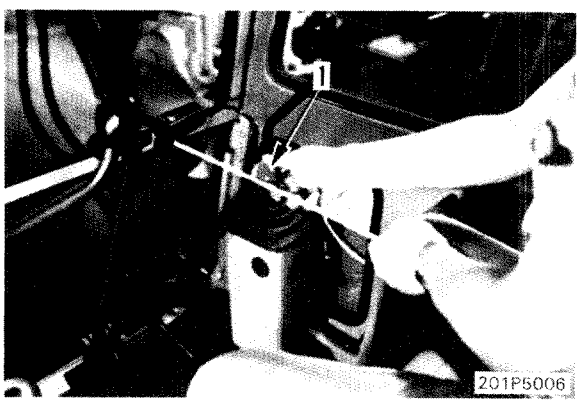
TESTING TRAVEL OF CONTROL LEVERS

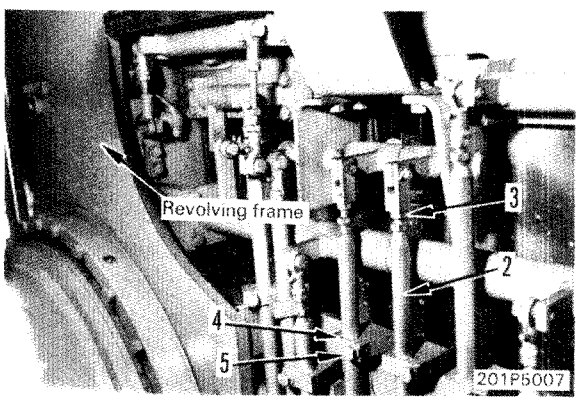
1. **Measuring travel**
   Contact steel tape on the center of knob (1) of the control lever, and measure the travel need to move the lever to each position.
   ★ If the result of the measurement shows that the travel is not within the standard value, check as follows.
   Lever travel is the same as valve spool travel. If there is no abnormality in the rod, check the travel of control valve spool.



2. **Checking the neutral position of the control levers**
   If the control levers are not aligned when they are in neutral or if they hit a wall of the operator's cab when they are operated, loosen nut (3) at each end of rod (2) and adjust the lever by turning rod (2).
   1) Check the rod for any abnormalities (bending, distortion, excessive wear, etc.).
   2) Adjust the lever stopper in the following manner.
      i) Place the lever in neutral.
      ii) Loosen lock bolts (5) on stopper (4).
      iii) Adjust each clearance between the revolving frame and the stopper as follows.
      ★ Boom: 10.8 mm
      Arm: 11.8 mm
      Bucket: 10.8 mm
      Boom swing: 4.7 mm (lever end)
      6.5 mm (valve end)
      Swing: 9.2 mm
      Travel: 12.8 mm
      iv) Tighten the lock bolt.





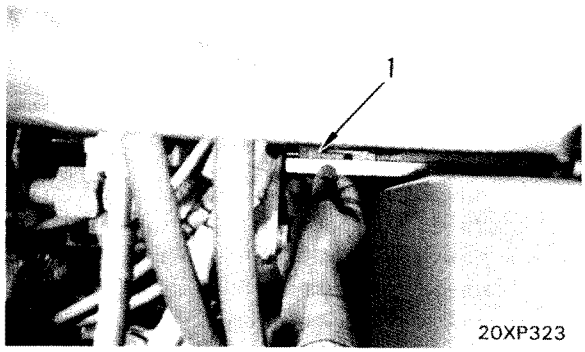


TESTING TRAVEL OF CONTROL VALVE SPOOLS

Measuring travel

Set the scale to the spool (1) to be measured and measure the travel when operating the control lever.

★ When measuring by one person, pull the control lever by a cord or disconnect the linkage (rod) from spool and pull the spool directly.



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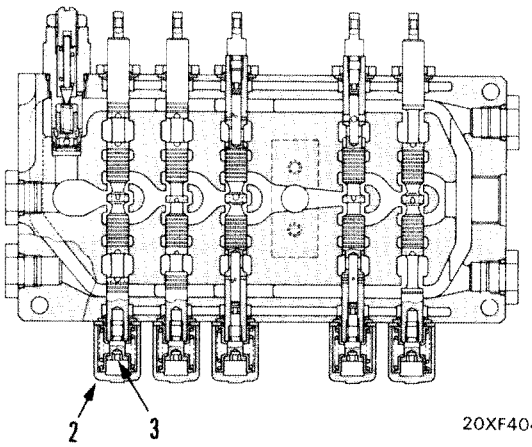
★ If the result of the measurement shows that the travel is not within the standard value, check as follows.

1) Remove cover (2). Check looseness of the bolts (3). If there is no abnormality, disassemble control valve and check.



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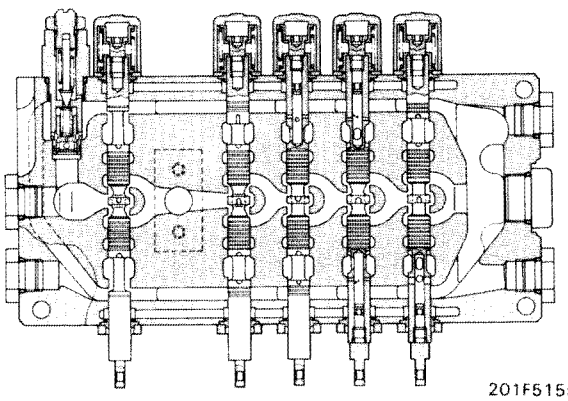
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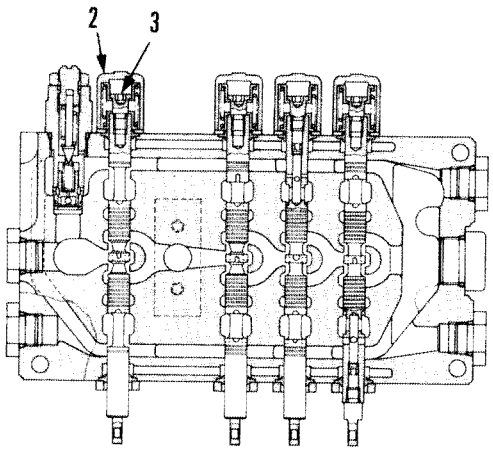

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TESTING AND ADJUSTING MAIN RELIEF VALVE

Special tool

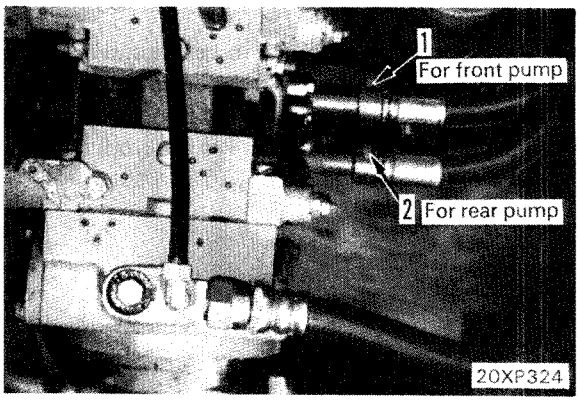
	Part Number	Part Name	Q'ty
A	799-101-5000	Hydraulic tester	1

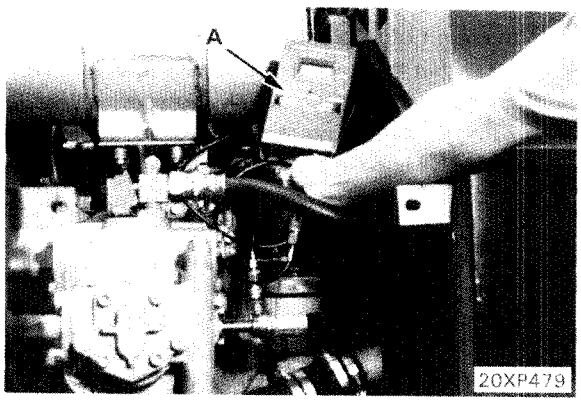
★ Oil temperature at time of measurement: 45 – 55°C

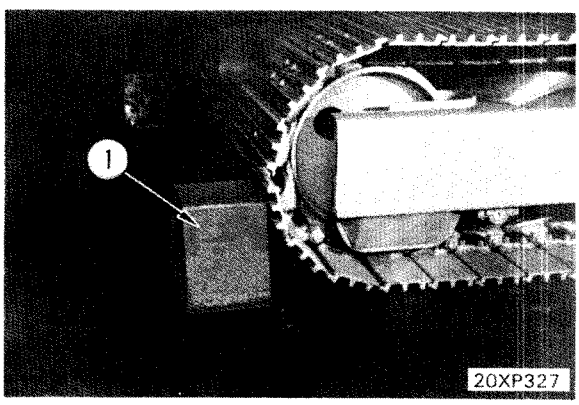
Lower the work equipment on the ground, stop the engine, operate the control levers several times to release the pressure in the piping, then slowly loosen the oil filler cap of the hydraulic tank to release the pressure in the tank.

1. **Measuring the main relief oil pressure**
   1) Remove pressure measuring plug (1) or (2) (PT 1/8) of the circuit to be tested and install pressure gauge **A** (600 kg/cm^2).
   2) Start the engine, operate the circuit to be tested, and measure the main relief pressure with the engine speed at high idling.
   3) Set the actuator to be tested as follows:
      i) Set cylinders to the stroke end.
      ii) Lock upper structure with swing lock pin.
      iii) Block track shoe with block (1), or insert block (1) between sprocket and frame.
      ★ The combinations of the pumps and actuators are shown below.

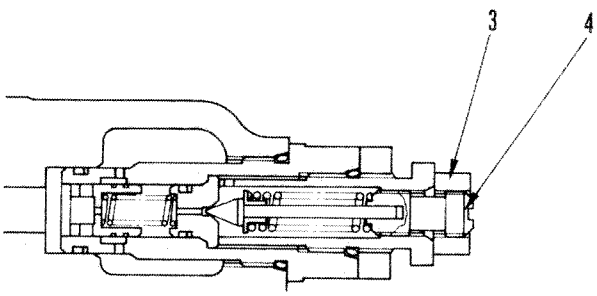
Pump	Control actuator	
Front pump	· Arm cylinder (Hi) · Bucket cylinder	· Boom cylinder · R.H. travel motor
Rear pump	· Arm cylinder · Swing motor	· Boom cylinder (Hi) · L.H. travel motor







2. **Adjusting the main relief pressure**
   Adjust the main relief pressure valve as follows.
   Loosen locknut (3) and turn adjustment screw (4) to adjust the relief pressure.
   ★ The pressure can be
      · increased by turning the screw clockwise.
      · decreased by turning it counterclockwise.
   ★ After adjusting the main relief pressure, confirm it again according to Step 1.



202F2314

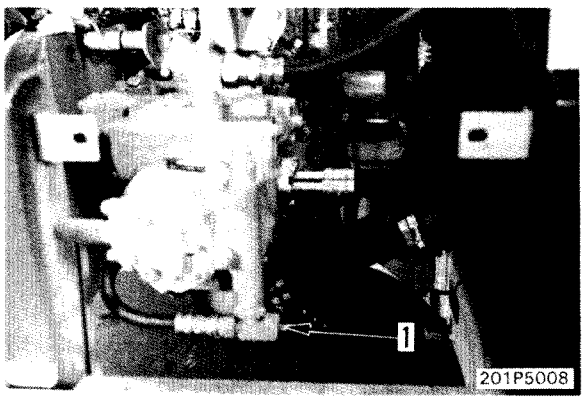
TESTING AND ADJUSTING CHARGING PUMP RELIEF VALVE

Special tool

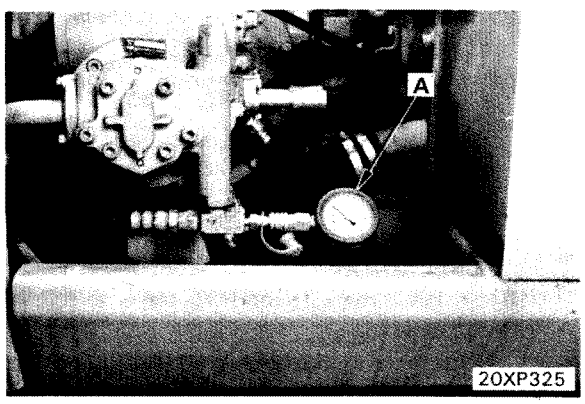
	Part Number	Part Name	Q'ty
A	799-101-5000	Hydraulic tester	1

★ Oil temperature at time of measurement: 45 – 55°C

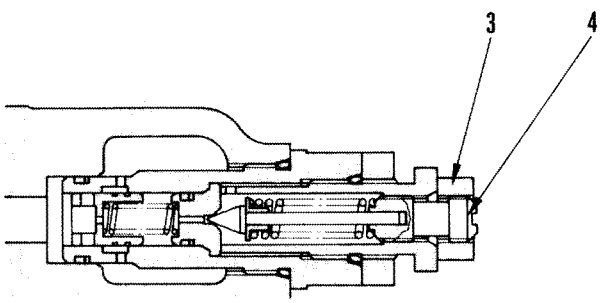
Lower the work equipment on the ground, stop the engine, operate the control levers several times to release the pressure in the piping, then slowly loosen the oil filler cap of the hydraulic tank to release the pressure in the tank.



1. **Measuring the relief pressure**
   1) Remove pressure measuring plug (PT 1/8) (1).
   2) Install pressure gauge **A** (60 kg/cm^2).
   3) Start the engine and measure the relief pressure at engine speed high idling.



2. **Adjusting charging pump relief pressure**
   Loosen locknut (3), and turn adjustment screw (4) to adjust relief pressure.
   ★ The pressure can be
   - increased by turning the adjustment screw clockwise.
   - decreased by turning the adjustment screw counterclockwise.



TESTING CONTROL CIRCUIT PRESSURE

Special tool

	Part No.	Part Name	Q'ty
A	799-101-5000	Hydraulic tester	1

★ Oil temperature when measuring: 45 – 55°C

1. Output pressure of TVC valve

When using adapter ①

★ There is no space to install the normal adapter, so use the following adapter.
Part No. : 790-261-1230

1) Remove plug (1).
2) Fit adapter ① , then install hydraulic tester A (60 kg/cm^2).
3) Measure the hydraulic pressure at the following two points.
   i) Hydraulic pressure when control lever is at neutral.
      ★ Turn the auto-deceleration switch OFF.
   ii) Hydraulic pressure when one pump is relieved
      Lock the L.H. or R.H. travel to relieve the circuit.

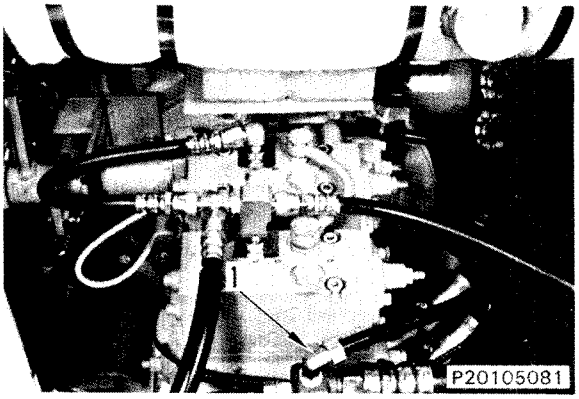
   Measure with the engine at high idling in each case.

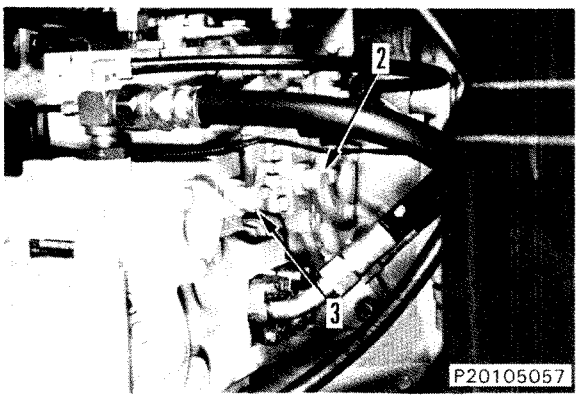
When not using adapter ①

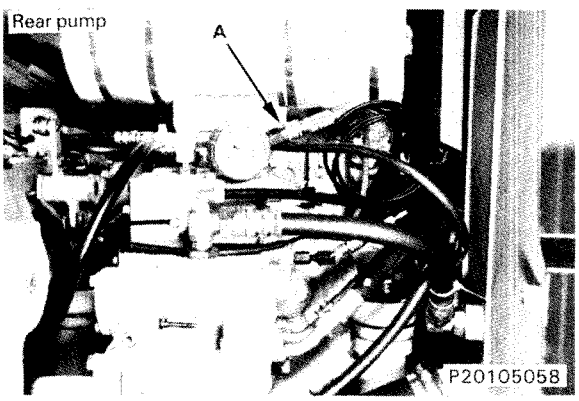
★ There is no space to install the adapter in the hydraulic tester kit, so measure as follows.

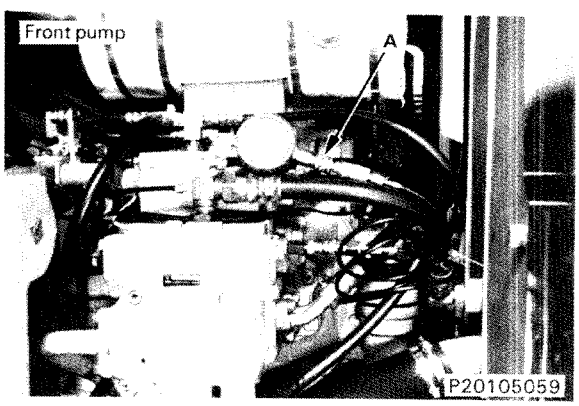
1) Remove NC valve output pressure measuring plug (2) or plug (3) (Thread dia. = 10 mm, Pitch = 1.25 mm).
2) Install hydraulic tester A (60 kg/cm^2).
3) Measure the hydraulic pressure at the following two points.
   i) Hydraulic pressure when control lever is at neutral
      ★ Turn the auto-deceleration switch OFF.
   ii) Hydraulic pressure when one pump is relieved
      Lock the L.H. or R.H. travel to relieve the circuit.
      ★ When the circuit is relieved, the CO valve is actuated, so when relieving the L.H. travel circuit, install the pressure gauge to the front pump; when relieving the R.H. travel circuit, install the pressure gauge to the rear pump.

   Carry out the both the above measurements with the engine at high idling.









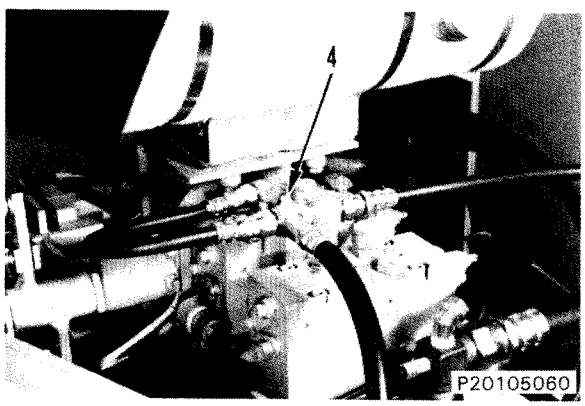
2. **Output pressure of NC valve**
   - ★ For details of installing the pressure gauge, see the procedure for measuring the output pressure of the TVC valve.
   - ★ Front pump: (2)
     Rear pump: (3)

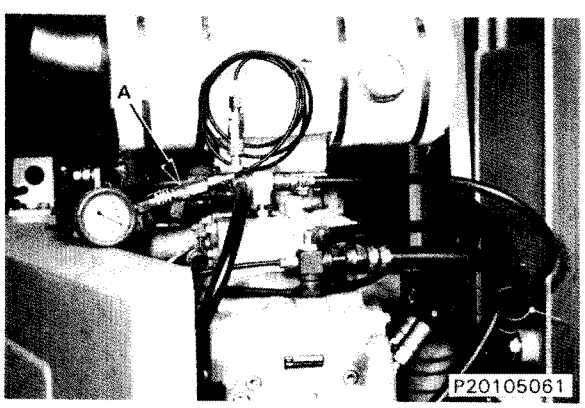
   1) Measure the hydraulic pressure at the following two points.
      i) Hydraulic pressure when control lever is at neutral
      ii) Hydraulic pressure when track on one side is rotating under no load.
         - ★ Using the work equipment, raise the track on one side off the ground.
         - ★ NC valve for front pump:
           R.H. travel motor
           NC valve for rear pump:
           L.H. travle motor

         Carry out both the above measurements with the engine at full throttle.

3. **Measuring auto-deceleration control pressure**
   1) Remove oil pressure measuring plug (4) (PT 1/8).
   2) Install hydraulic tester A (60 kg/cm^2).
   3) Set the fuel control lever at the FULL position, and measure the hydraulic pressure when the control lever is at neutral and when it is operated.
      - ★ Always turn the auto-deceleration switch ON.

   Reference:
   When the auto-deceleration is operated, the NC valve is actuated at the same time.





MEASURING SWING AND BUCKET RELIEF PRESSURE

1. **Swing relief pressure**
   - ★ The preparatory work is the same as for measuring the main relief pressure. Install hydraulic tester A (600 kg/cm^2) to the outlet hose of the rear pump and front pump.
   1) Lock the upper structure with the swing lock pin.
   2) Start the engine, relieve the swing circuit, and measure with the engine at high idling.
      - ★ The set pressure of the safety valve is 230 kg/cm^2, so this is relieved before the main relief valve.

2. **Bucket relief pressure**
   - ★ The preparatory work is the same as for measuring the main relief pressure. Install hydraulic tester A (600 kg/cm^2) to the outlet hose of the front pump.
   1) Start the engine, relieve the bucket cylinder, and measure with the engine at high idling.
      - ★ The set pressure of the safety valve is 230 kg/cm^2, so this is relieved before the main relief valve.

3. **Measuring arm and boom relief pressure**
   1) For the arm cylinder, install hydraulic tester A (600 kg/cm^2) to the rear pump.
   2) For the boom cylinder, install hydraulic tester A to the front pump.

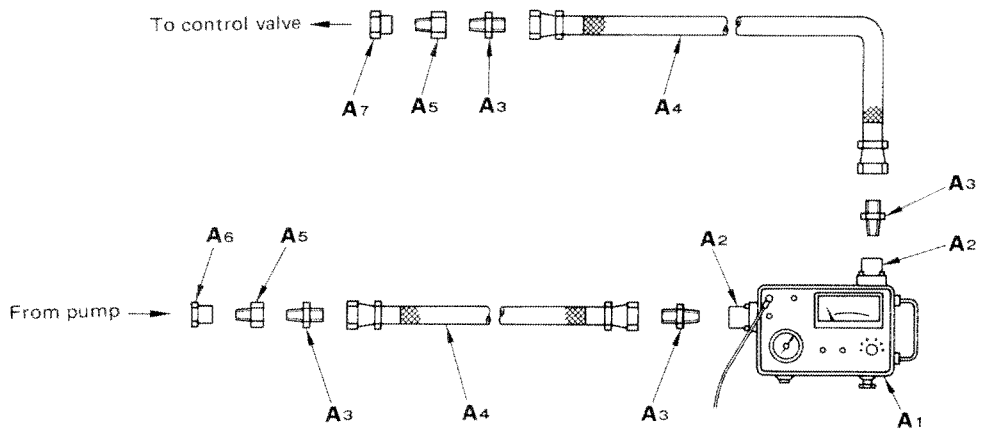
   Reference:

   There are safety valves installed to the acceleration valve at the head end of the arm cylinder and the bottom end of the boom cylinder. The set pressure of these is 270 kg/cm^2, so if the pressure is measured at the acceleration end (front pump for arm, rear pump for boom), the safety valve mentioned above will be relieved before the main relief valve.

MEASURING DELIVERY OF PISTON PUMP

Special tools

	Part Number	Part Name	Q'ty
A	790-303-1001	Flowmeter kit	1
A_1	790-303-1010	. Flowmeter	1
A_2	790-303-1030	. Flange	2
A_3	790-303-1440	. Nipple	4
A_4	790-303-1050	. Hose	2
A_5	790-303-1410	. Nipple	2
A_6	790-303-1071	. Adapter (flange)	1
A_7	790-303-1061	. Adapter (flange)	1
B	795-502-1001	Tachometer	1
C	799-101-5000	Hydraulic tester	1



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METHOD OF MEASURING DELIVERY

1. **Preparation**
   1) Set flowmeter kit A and tachometer in position.
   2) Raise the oil temperature to 45 – 55°C.

2. **Procedure for measuring**
   1) Turn the auto-deceleration switch OFF. (Only for machines equipped with auto-deceleration)
   2) Set the engine speed to the rated speed, and measure the delivery at the pressures in the table of judgement standard value.

CHECKING PERFORMANCE OF WORK EQUIPMENT

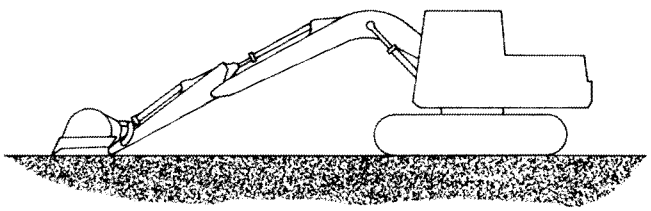
1. Measuring the work equipment speed

★ Oil temperature at time of measurements:
45 – 55°C

★ Stop the machine on level ground.

1) Measuring the rising speed of the boom
   i) Set the work equipment to the maximum reach (fully retract the arm and bucket cylinder rods) and lower the work equipment to the ground.
   ii) With the engine running at full throttle, measure the time it takes to raise the work equipment to its upper limit.
      ★ Move the control lever to the end of its stroke in a single motion.

Posture when measuring the boom speed



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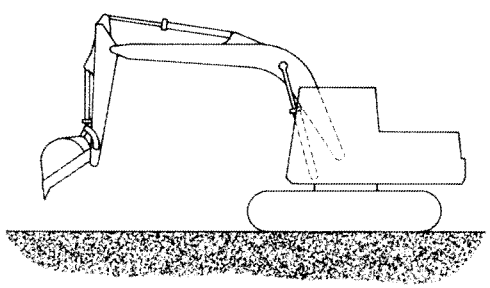
2) Measuring the arm speed
   i) Set the upper surface of the boom horizontally and fully retract the bucket cylinder.
      ★ Confirm that the bucket does not contact the ground when the arm is set vertically.
   ii) With the engine running at full throttle, measure the time required to move the arm cylinder rod from its fully extended position to its fully retracted position.

Posture when measuring the arm speed



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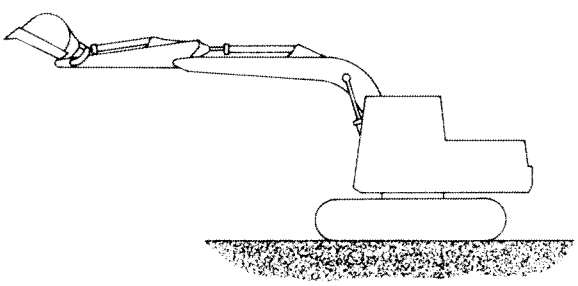
3) Measuring the bucket speed
   i) Set the upper surface of the boom horizontally, and fully retract the arm cylinder rod.
   ii) With the engine running at full throttle, measure the time required to move the bucket cylinder rod from its fully extended position to its fully retracted position.

Posture when measuring the bucket speed



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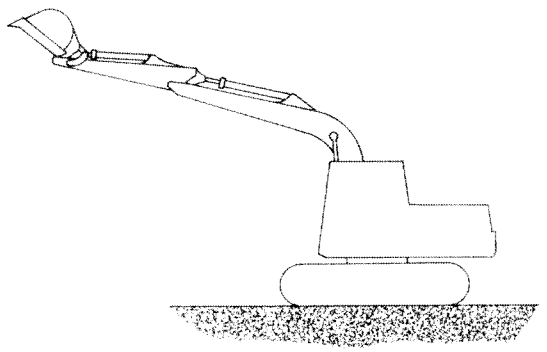
2. Measuring the time lag

★ Oil temperature at time of measurements:
45 – 55°C

1) Measuring the time lag of the boom
   i) Fully retract the arm and bucket cylinders, then raise the boom to its upper limit.
   ii) Run the engine at a slow speed and lower the boom. Measure the time required to start to lift the machine after the bucket comes into contact with the ground.
      ★ Perform this test on soft (clayey) ground.
      ★ Move the control lever to the end of its stroke in a single motion.

Posture when measuring the time lag of the boom



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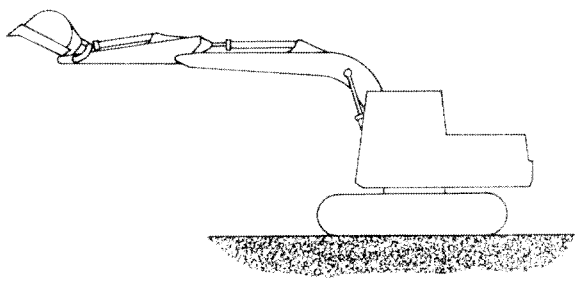
2) Measuring the time lag of the arm
   i) Set the upper surface of the boom horizontally and fully retract the bucket cylinder.
   ii) With the engine running at slow speed, start to extend the arm cylinder from its fully retracted position. Measure the time required to start the arm again after it stops at the lowest point.
      ★ Move the control lever to the end of its stroke in a single motion.

Posture when measuring the time lag of the arm and bucket



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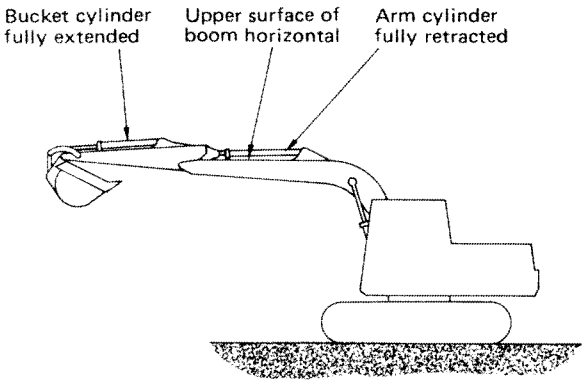
3) Measuring the time lag of the bucket
   i) Set the upper surface of the boom horizontally and fully retract the arm cylinder.
   ii) With the engine running at slow speed, start to extend the bucket cylinder from its fully retracted position. Measure the time required to start the bucket again after it stops at the lowest point.
      ★ Move the control lever to the end of its stroke in a single motion.

3. Measuring the hydraulic drift of the work equipment

★ Oil temperature at time of measurement: 45 – 55°C

1) Stop the machine on level ground, set the upper surface of the boom horizontally, fully retract the arm cylinder rod, and fully extend the bucket cylinder rod.



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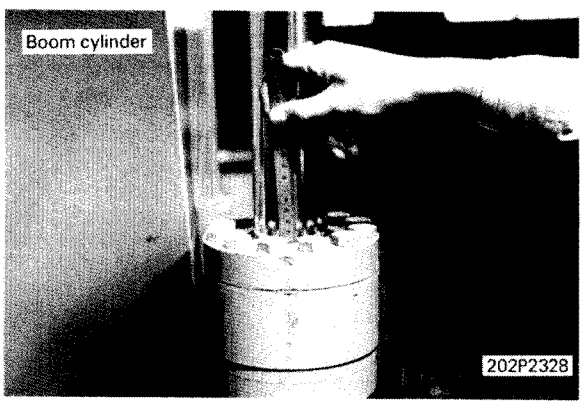
2) As soon as you stop the engine, start measuring the amount of extension of the arm cylinder and the amount of retraction of the boom and bucket cylinders caused by hydraulic drift. Stop measuring after 15 minutes.

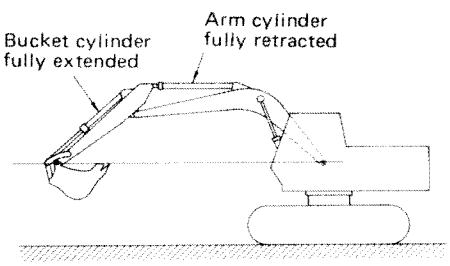


4. Measuring hydraulic drift of boom swing cylinder (PC60U-5)

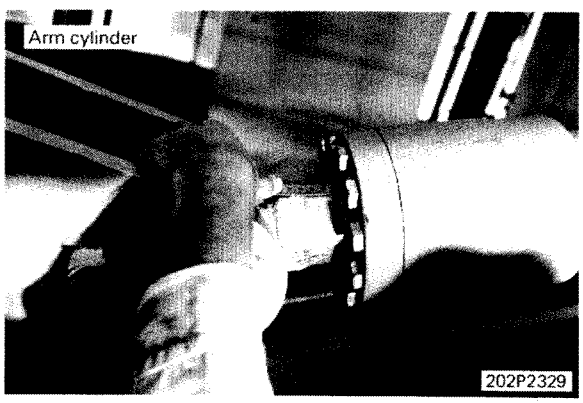
★ Oil temperature at the time of measurement: 40 – 55°C

1) Stop machine on 15° slope and set boom at above 45°.

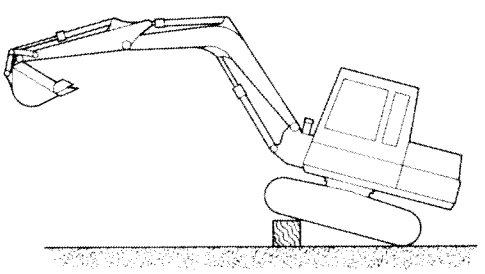
★ Work equipment posture
Bucket load: 720 kg



(Fig. 1) 203F419



2) Measure retraction (expansion) of rod in 15 min.



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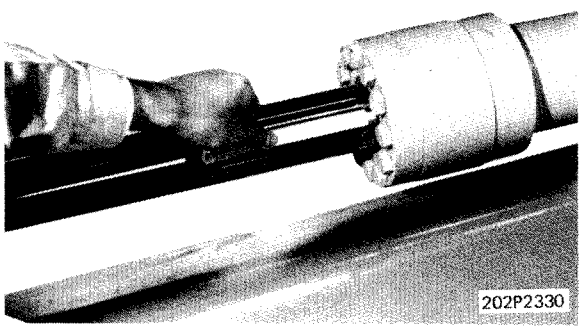
Bucket cylinder



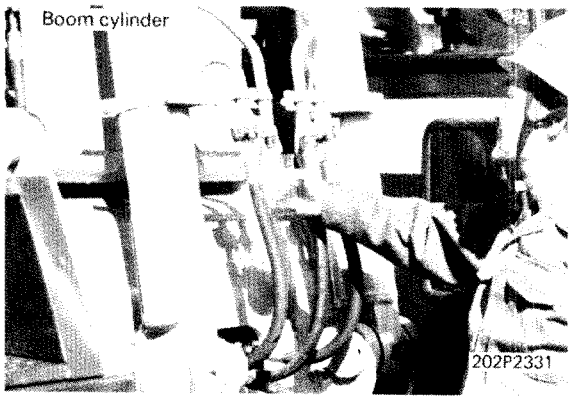
5. **Measuring the internal leakage of the cylinders**

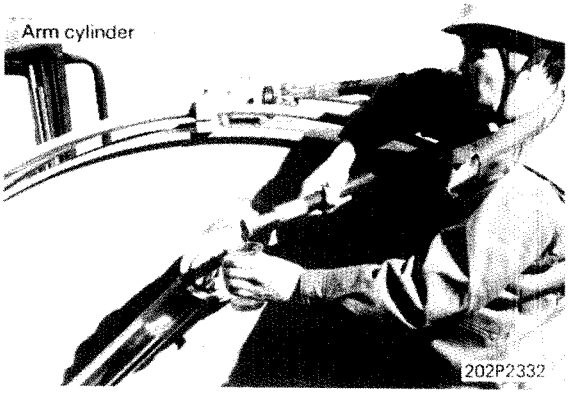
- If the hydraulic drift of any cylinder exceeds standard value, see the cause of the hydraulic drift is in the cylinder or in the control valve by performing the following.
  - ★ Oil temperature at time of measurement:
    45 – 55°C

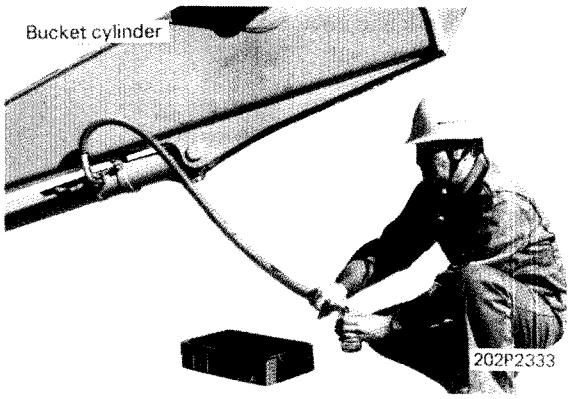
1) Fully extend the rod of the cylinder to be tested and stop the engine.
2) Disconnect the piping on the head side, and plug the piping on the machine body side with a plate.

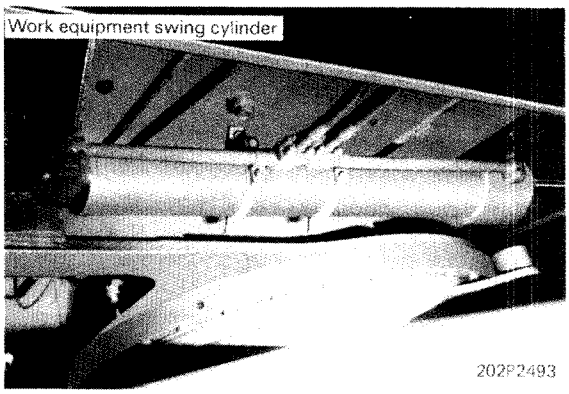
   ⚠ Do not disconnect the piping on the bottom side.

3) Start the engine and run it at full throttle to apply the relief pressure to the bottom side.
4) After 30 seconds, measure the leakage during one minute.









AIR BLEEDING

1. **Bleeding air from hydraulic cylinder**

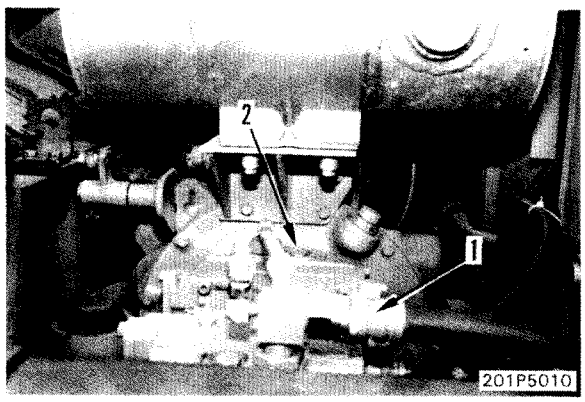
★ When removing hydraulic cylinder or disconnecting piping, bleed air in hydraulic cylinder as follows.

1) Start the engine and run at low idling for 5 minutes.
2) Raise and lower the boom 5 times repeated air low engine speed.
   ★ When operating, stop the piston rod 100 mm before the stroke end, and never relieve oil.
3) Repeat 2) at engine full speed.
4) Operate boom control lever fully to relieve oil.
5) For arm and bucket cylinders, follows the same procedure as above 2), 3) and 4).

2. **Bleeding air from main pump**

★ When replacing or dismounting the main pump, bleed air in main pump as follows to prevent pump inner parts seizing.

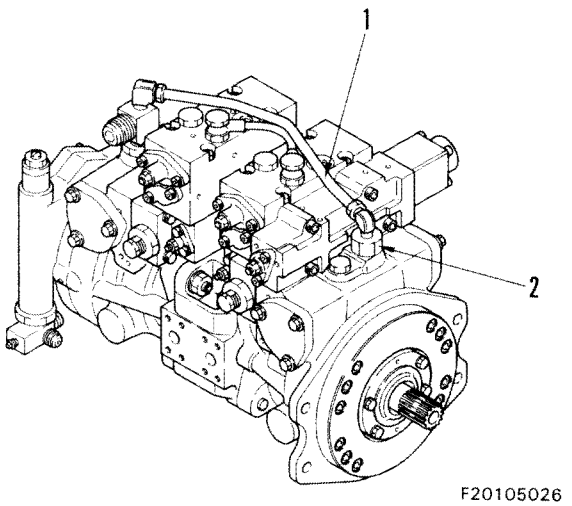
1) Disconnect drain hose (1).
2) Remove plug (2).
3) Add oil from drain plug hole to full.
4) Connect drain hose (1).
5) Attach O-ring and tighten plug (2).



★ FOR MACHINE EQUIPPED WITH OLSS

★ When changing the oil in the hydraulic tank, or when replacing the main pump, or when the pump suction piping or gear pump have been removed, bleed the air as follows after completing the operation.

1) Disconnect drain hose (1).
2) Loosen plug (2).
   ★ Use a wrench on the right side of the pump.
3) When no more bubbles come out with the oil, tighten the plug.
4) Connect hose (1).
   ★ If the oil flow is slow, remove plug (2) and add oil until oil flows out normally from the plug hole.



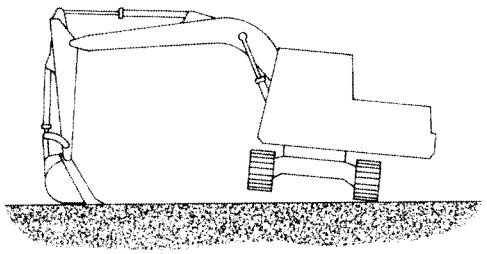
CHECKING TRAVEL MOTOR PERFORMANCE

1. Measuring travel deviation

Preparatory work

★ Oil temperature at time of measurement:
45 – 55°C

- Adjust the track shoe assembly tension as follows.
  i) Raise track frame with boom or arm, and measure the clearance between tread of third track roller from sprocket and that of track link.
     ★ Standard clearance: 60 – 100 mm



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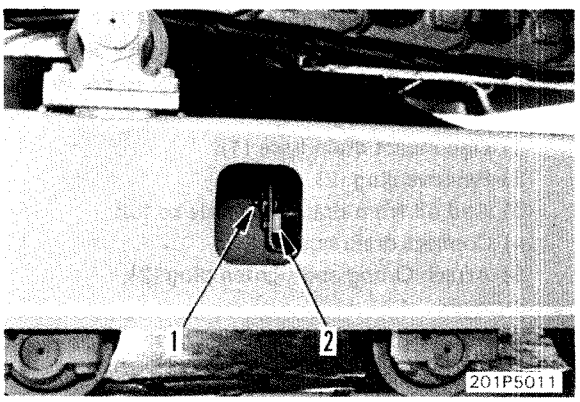
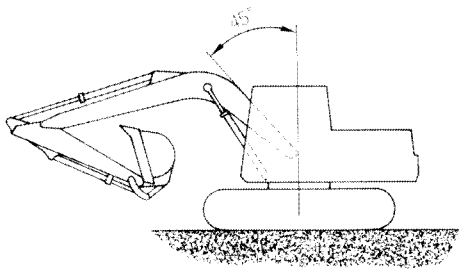
  ii) To increase the tension, add grease through lubricator (1). To reduce the tension, loosen cap (2) to discharge grease.



⚠ Do not loosen lubricator more than one turn. Otherwise grease will gush out of lubricator. If grease does not come out easily, move machine slightly back and forth.

1) Measuring by turning track shoe assembly 5 rotations.
   i) Raise track frame on the side of track shoe assembly to be measured with boom or arm.
   ii) Run engine at high idling. After track has made one rotation, measure the time it takes for track shoe assembly to make five rotations. Repeat this measurement for reverse movement.
      ★ Make the above measurements several times and average the measured values.
2) Measuring by traveling
   i) After traveling 10 m on a hard, flat road, travel another 20 m. Measure the deviation of the "Track prints".
      ★ In the travel posture, fully extend bucket and arm cylinder rods and keep boom angle 45°.



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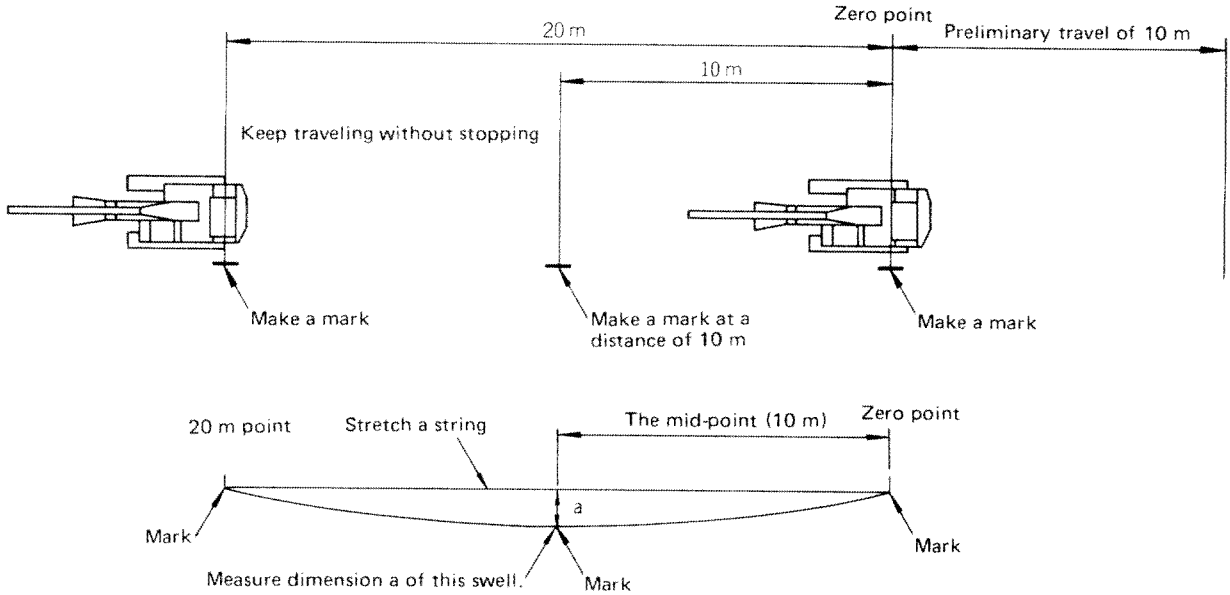

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★ When making the measurement, clearly state the direction of curve together with the dimensions of the curve.

2. Measuring the travel speed

1) Adjust the track shoe tension.
   ★ See MEASURING THE TRAVEL DEVIATION .

2) After traveling a distance of 10 m on hard, flat ground, travel another 20 m under the same conditions as above. Measure the time it takes to travel 20 m.
   ★ Use the same travel posture as when measuring the travel deviation.

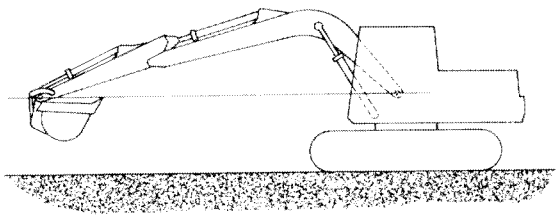
CHECKING PERFORMANCE OF SWING MOTORS

★ Oil temperature at time of measurement: 45 – 55°C
★ Stop the machine on level ground.

1. Time taken to start swinging

1) Fully retract the arm cylinder, fully extend the bucket cylinder, then set the work equipment so that the line connecting the center of the arm top pin and the center of the boom foot pin will be horizontal.
2) Run the engine at high idling, and measure the time required to swing 90° and 180° to the right or left from the stationary position.
   ★ Do not stop the swing 90° and 180°, but swing it continuously and measure the time at which the work equipment passes those points.
   ★ Move the control lever to its stroke end in a single motion. To simplify the measurement make a mark in front of the work equipment.

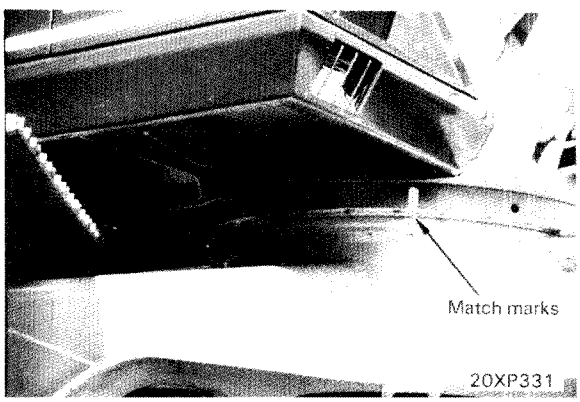
Posture when measuring



202F2323

2. Time taken to swing

Run the engine at full throttle and measure the time required to swing the upper structure five turns after swinging it one turn.



20XP331

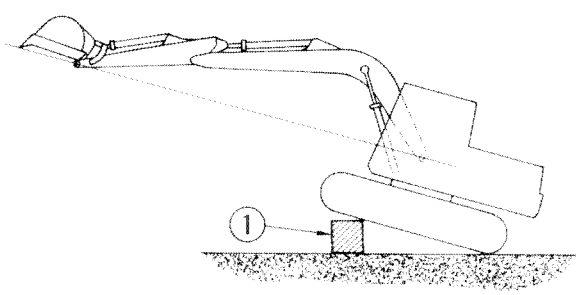
3. Braking distance after swinging

1) Make match marks on the outer race of the swing circle and the track frame.
2) Run the engine at high idling, swing the upper structure one turn and stop it. Measure the distance between the match marks.
   ★ When making the match marks on the outer race and track frame, place something as a mark at the arm end to simplify the measurement.

4. Measuring the hydraulic drift of the swing

1) Fully retract the arm cylinder rod, fully extend the bucket cylinder rod, and set the work equipment so that the line connecting the center of the arm top pin and the center of the boom foot pin will be horizontal.
2) Stop the machine on a slope of 15°, or place block (1) under the tracks so that the machine will tilt 15°.
3) Set the upper structure crosswise to the track shoe.
4) Make match marks on the outer race of the swing circle and the track frame, then measure the distance between the match marks after five minutes.

Posture when measuring the hydraulic drift of swing



202F2324

MEASURING OIL LEAKAGE FROM SWING AND TRAVEL MOTORS

★ Oil temperature at time of measurement: 45 – 55°C
★ Lower the work equipment on the ground and stop the engine.

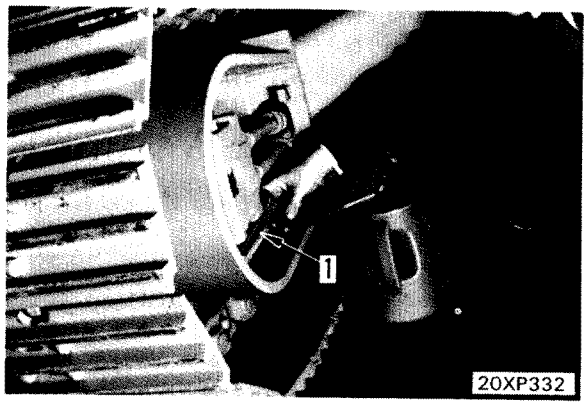
Slowly loosen the oil filler cap to release the pressure in the hydraulic tank.

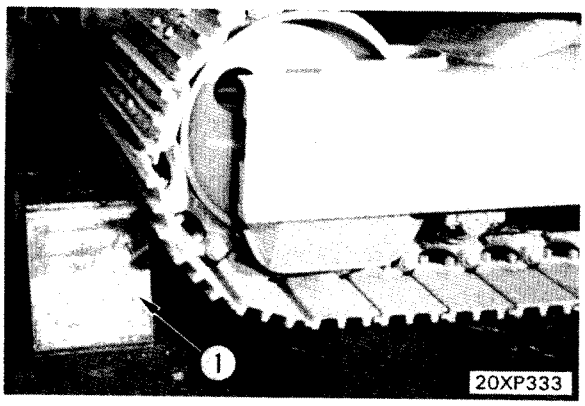
1. **Measuring the leakage from travel motor**
   1) Disconnect motor drain hose (1), then install plug on hose.
      ★ Part No. of plug: 07376-50422
   2) Block track shoe assembly to be measured with block (1) or insert block between frame and sprocket.
   3) Start engine, and relieve travel motor to be measured.
   4) Run engine at high idling, and catch the oil flowing from travel motor with measuring cylinder to measure the oil which leaks when the travel motor is relieved for one minute.

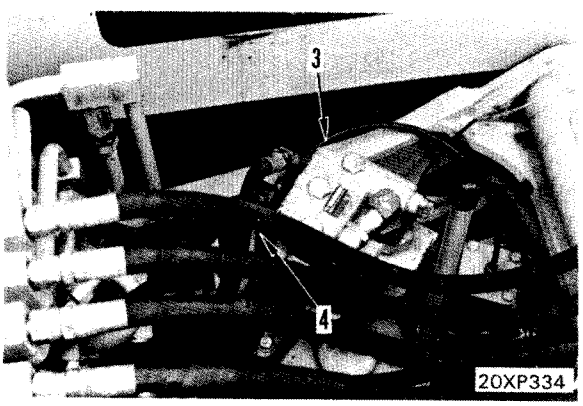
      If the lever is moved wrongly while measuring the oil leakage from the travel motors, an accident may occur. Be sure to exchange signals and make confirmations with other workers.

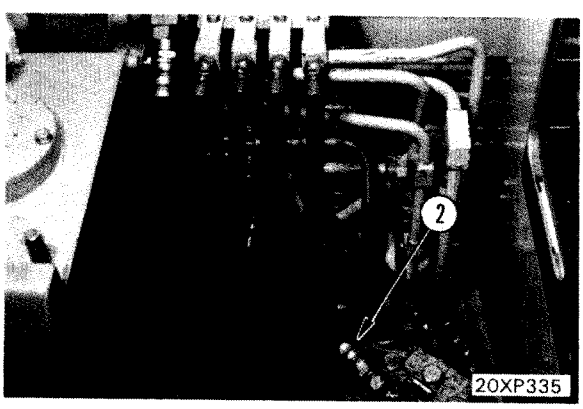
   Note: Measure the leakage several times by moving the motor a little (deviate the valve plate from the cylinder, and the cylinder from the piston).

2. **Measuring the leakage from swing motor**
   1) Disconnect motor drain hoses (3) and (4), and install plugs (2) on swivel joint end and return tube end.
      ★ To avoid influence of travel motor, disconnect swivel joint end hose.
      ★ Disconnect drain hose from swing motor at control valve end.
   2) Lock upper structure with swing lock pin.
   3) Start engine, and relieve swing motor.
   4) Run engine at high idling, and catch the oil flowing from swing motor with measuring cylinder to measure the oil which leaks when the swing motor relieved for one minute.









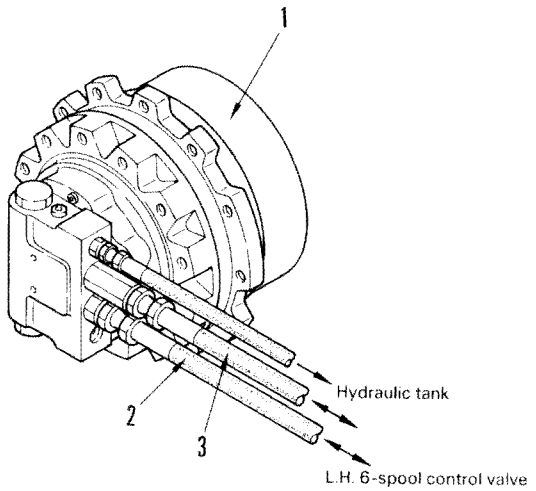
CHECKING FOR OIL LEAKAGE FROM SWIVEL JOINT

- If there is no abnormality in the hydraulic pump or control valve, but there is abnormality in travel (deviation, lack of travel speed), carry out the following check.
  - ★ Oil temperature when measuring: 45 – 55°C

1. Disconnect left and right hoses (2) and (3) of travel motor (1).

2. Pull out hoses to swivel joint end.

3. Reverse the left and right hoses (the left motor hose to the right, and the right motor hose to the left), pass under the center frame and connect to the motor.
   - ★ Connect the hoses as shown in the diagram on the right.



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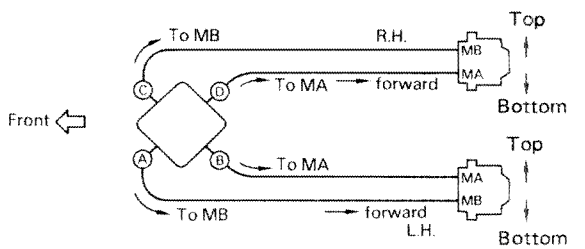
Inspection

- If there is no change in the problem, the travel motor is defective. If the problem is reversed, there is leakage inside the swivel joint.

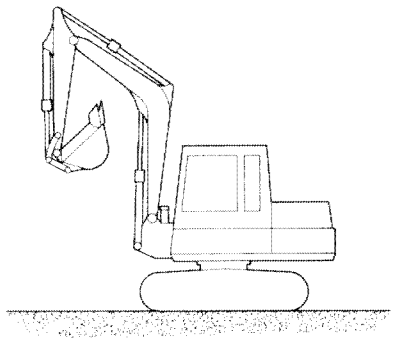
Normal connection



F20105028

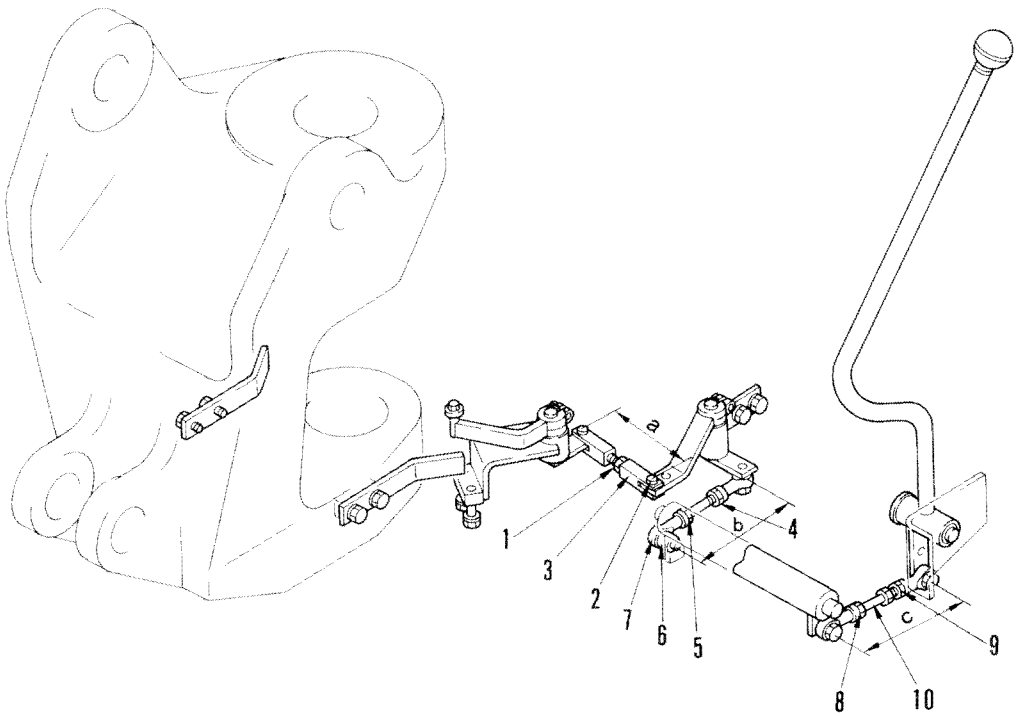
ADJUSTING BOOM SWING KICKOUT (On PC60U-5)

1. Adjust boom swing kickout so that when work equipment is kept at minimum turning radius and is swung to left or right, swing bracket will stop just before it comes into contact with stopper on revolving frame.



201F5153

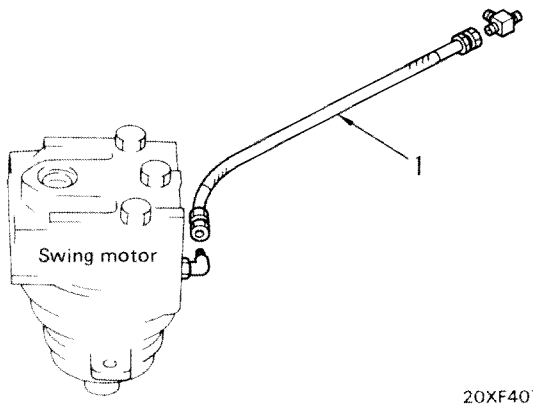
2. **Adjustment**
   1) Loosen locknut (1), remove pin (2), then adjust dimension "a" between pins with yoke (3).
      ★ Standard dimension "a": 76 mm
   2) Loosen locknuts (4) and (5), remove pin (6), then adjust dimension "b" between pins with yoke (7).
      ★ Standard dimension "b": 138 mm
   3) Loosen locknuts (8) and (9), then adjust dimension "c" between yokes with rod (10).
      ★ Standard dimension "c": 205 mm



201F5154

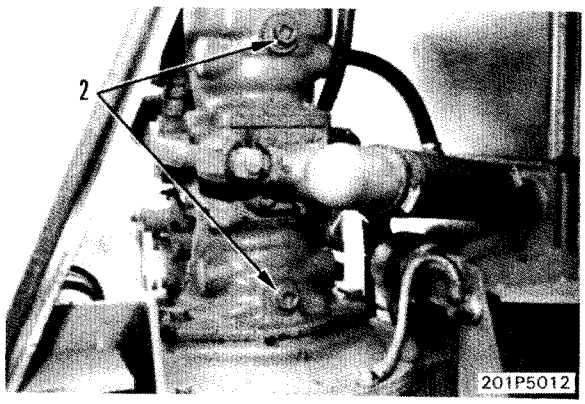
CHECKING VISUALLY OR BY "FEEL"

1. **Checking the operating pressure of the swing mechanical brake**
   Run the engine at low idle speed. Hold inlet hose (1) of the swing mechanical brake by hand, and see if the vibration transfers through the hose when the swing mechanical brake switch is changed.

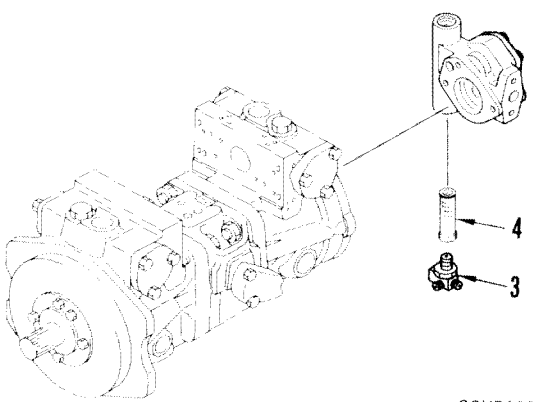


20XF407

2. **Main pump drain plug**
   Remove plug (2), check that metal power or foreign matter adheres abnormally on magnet part.

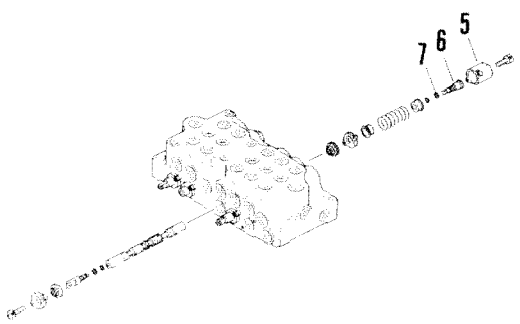


3. **Charging pump outlet filter**
   Remove lower block (3), then pull out filter (4). Check for clogging, clogged material or deflection of filter.



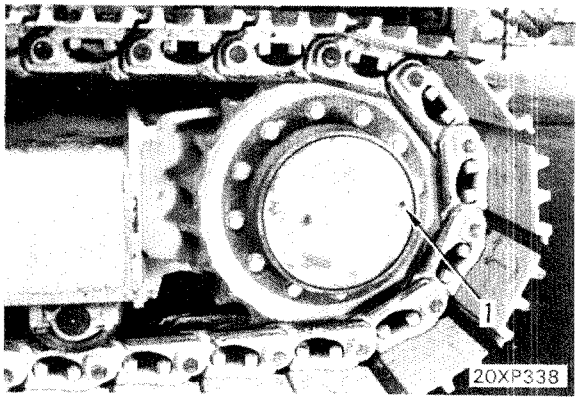
20XF408

4. **Checking the O-ring after removing the spool plug of the control valve**
   Remove spool cover (5) from the faulty spool, and check plug (6) for looseness and O-ring (7) for breakage.

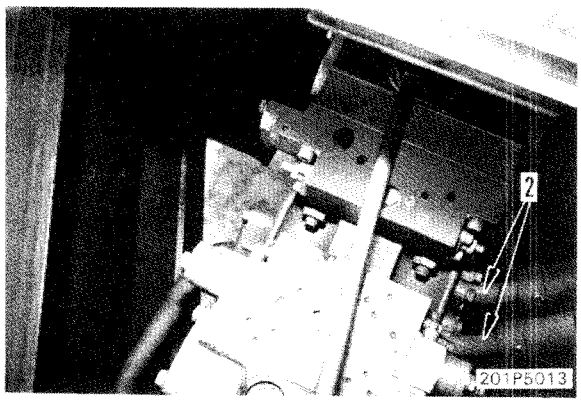


20XF409

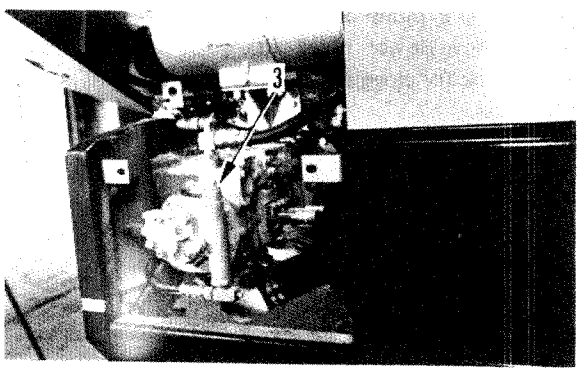
5. **Each position of testing and adjusting**
   1) Final drive drain plug (1)



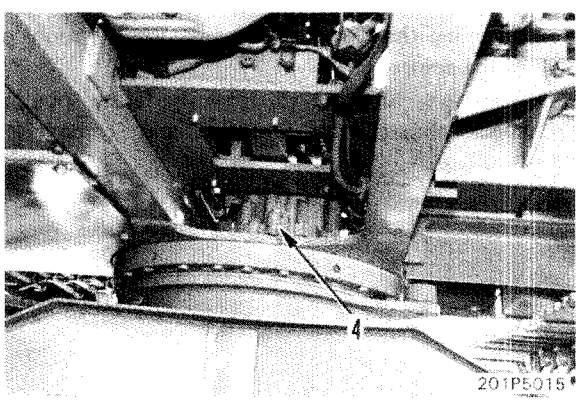
   2) Main pump outlet hoses (2)



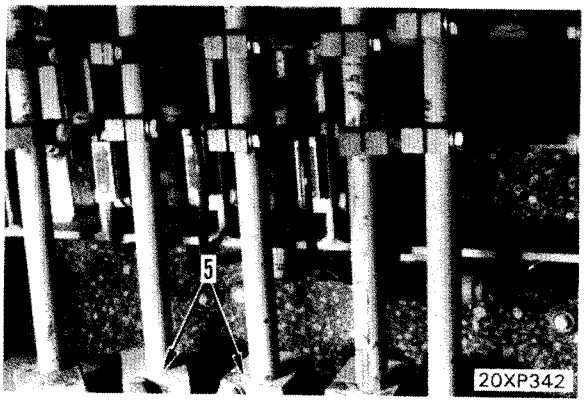
   3) Charging pump relief valve (3)



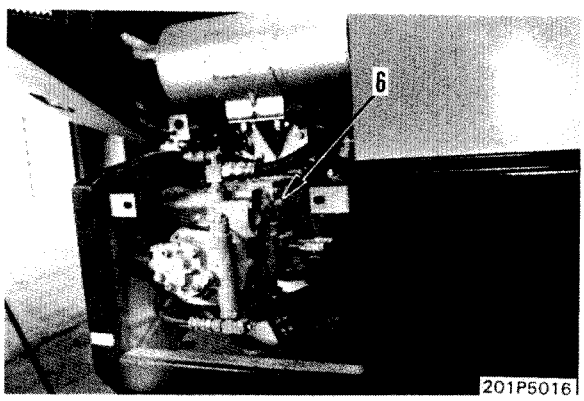
   4) Swing machinery drain plug (4)



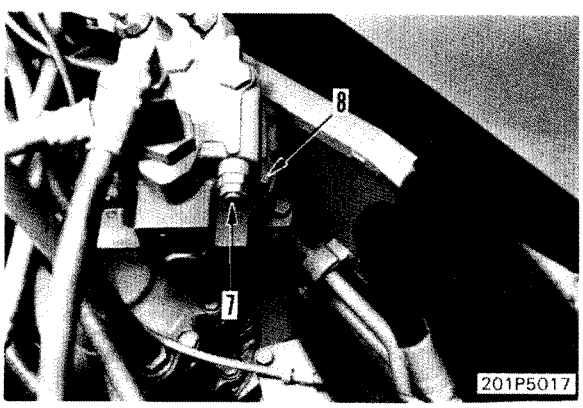
5) Each control lever linkage stopper (5)



6) Servo valve (6)



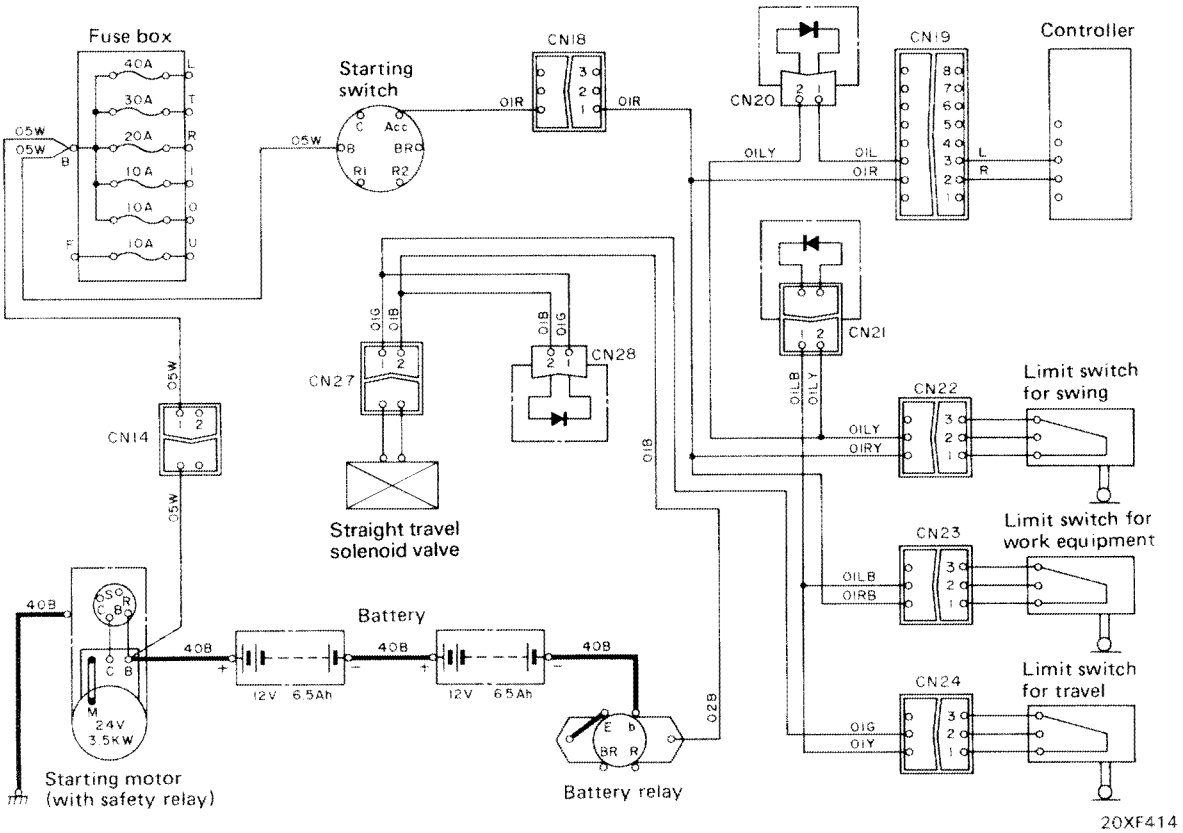
7) Swing motor safety valve (7), check valve (8)



TROUBLESHOOTING

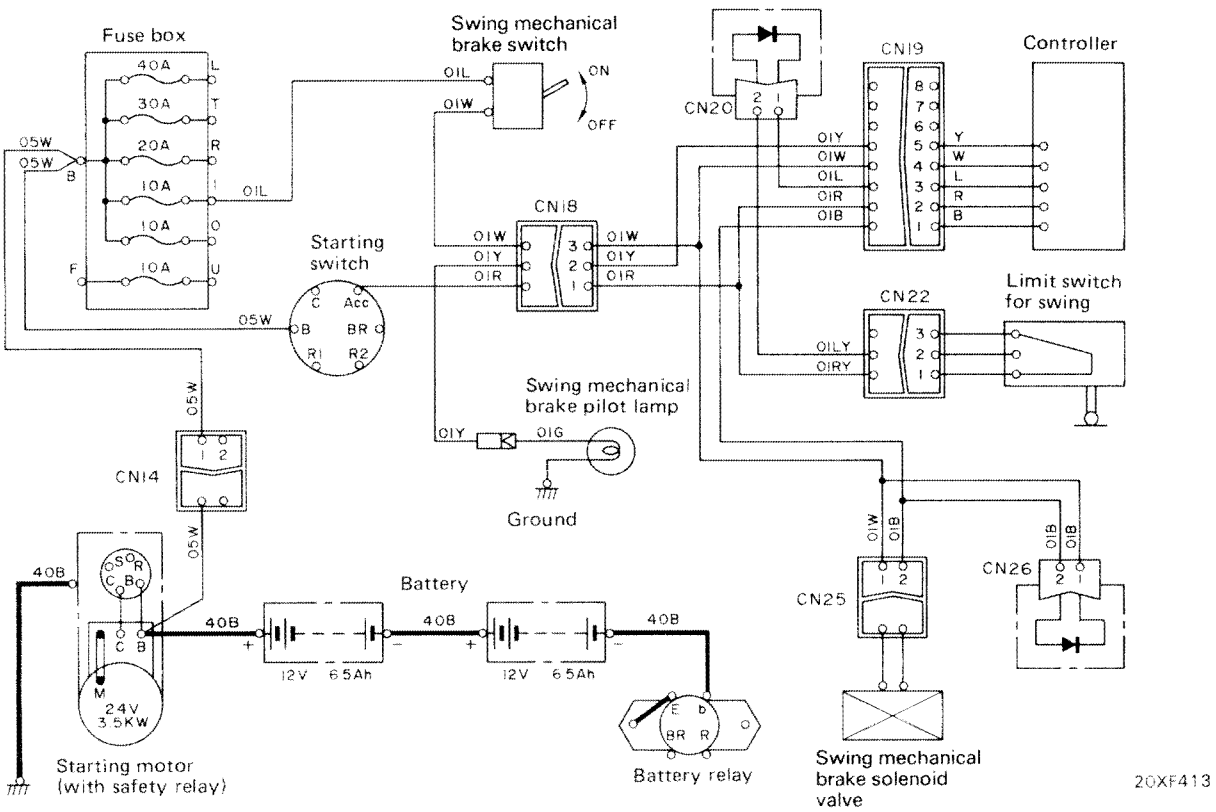
ELECTRICAL CIRCUIT

STRAIGHT-TRAVEL CIRCUIT



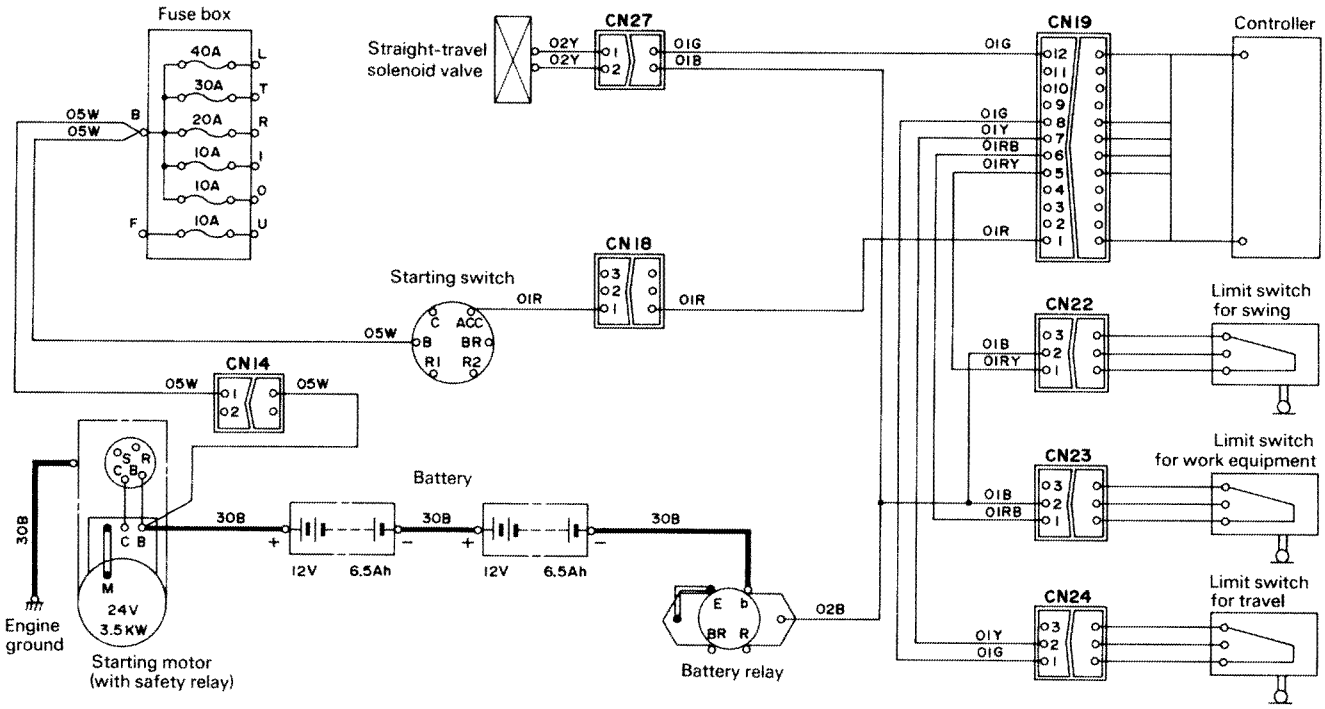
★ FOR MACHINE EQUIPPED WITH SWING MECHANICAL BRAKE

SWING MECHANICAL BRAKE CIRCUIT



★ FOR MACHINE EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHANICAL BRAKE AND OLSS

STRAIGHT-TRAVEL CIRCUIT



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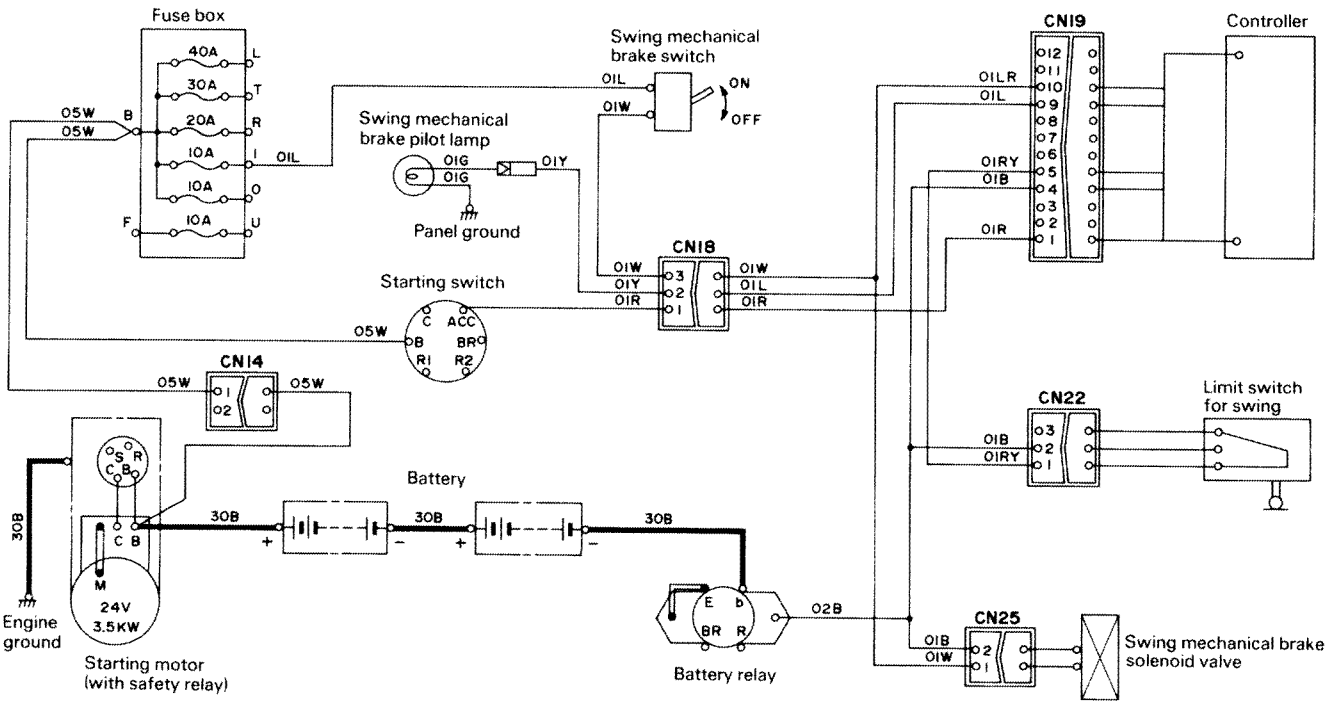
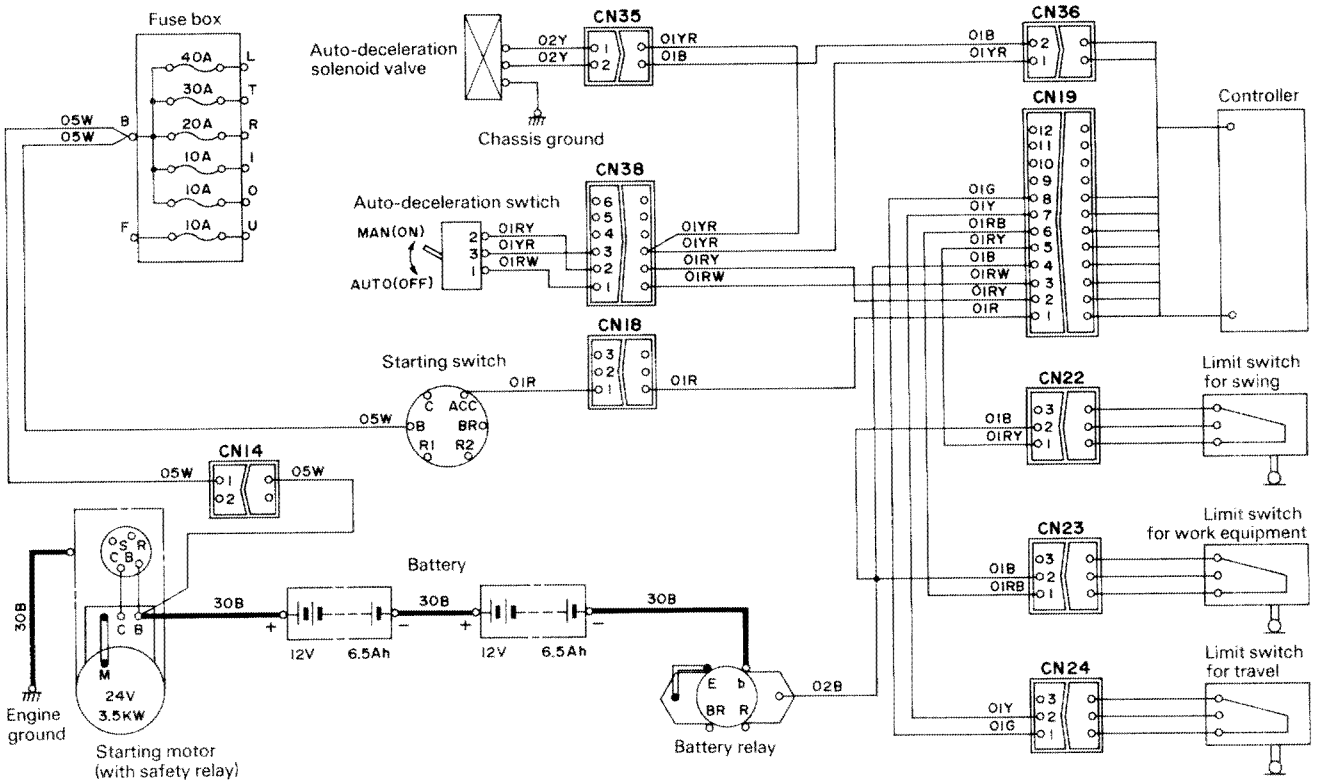
SWING MECHANICAL BRAKE CIRCUIT



F20105030

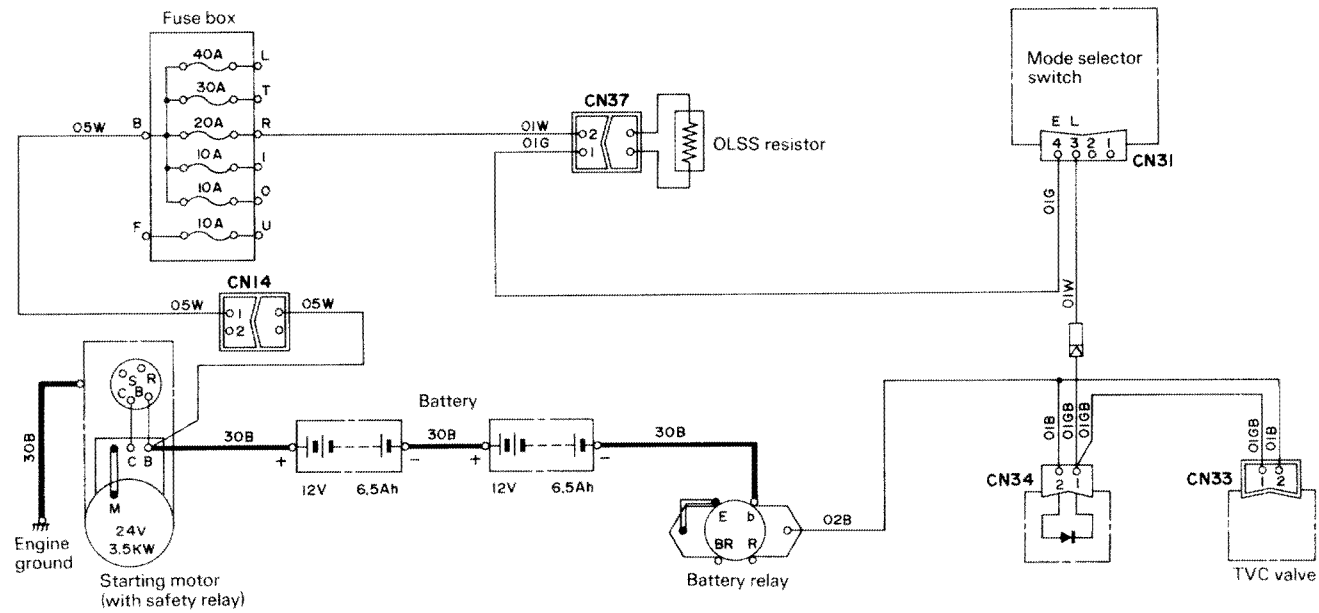
★ FOR MACHINE EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHANICAL BRAKE AND OLSS

AUTO-DECELERATION CIRCUIT



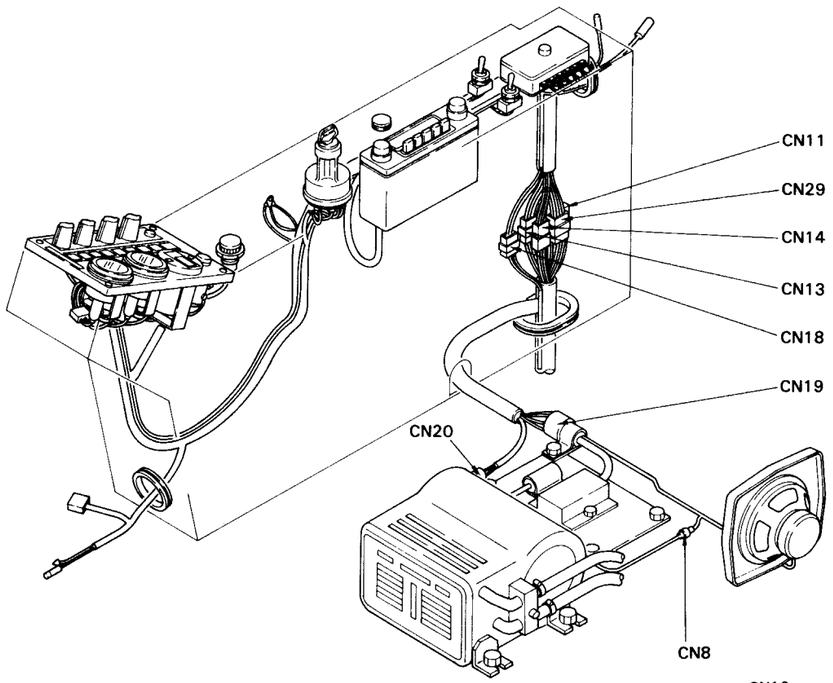
F20105031

OLSS CIRCUIT

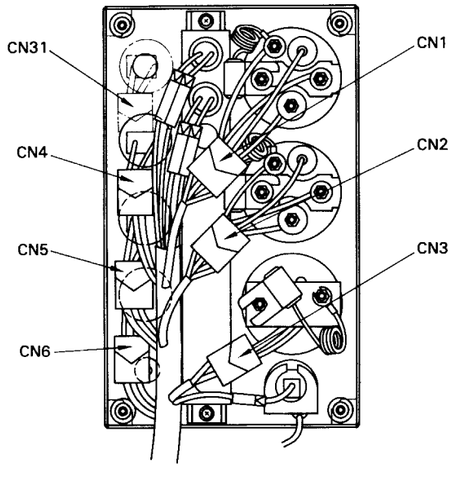


F20105032

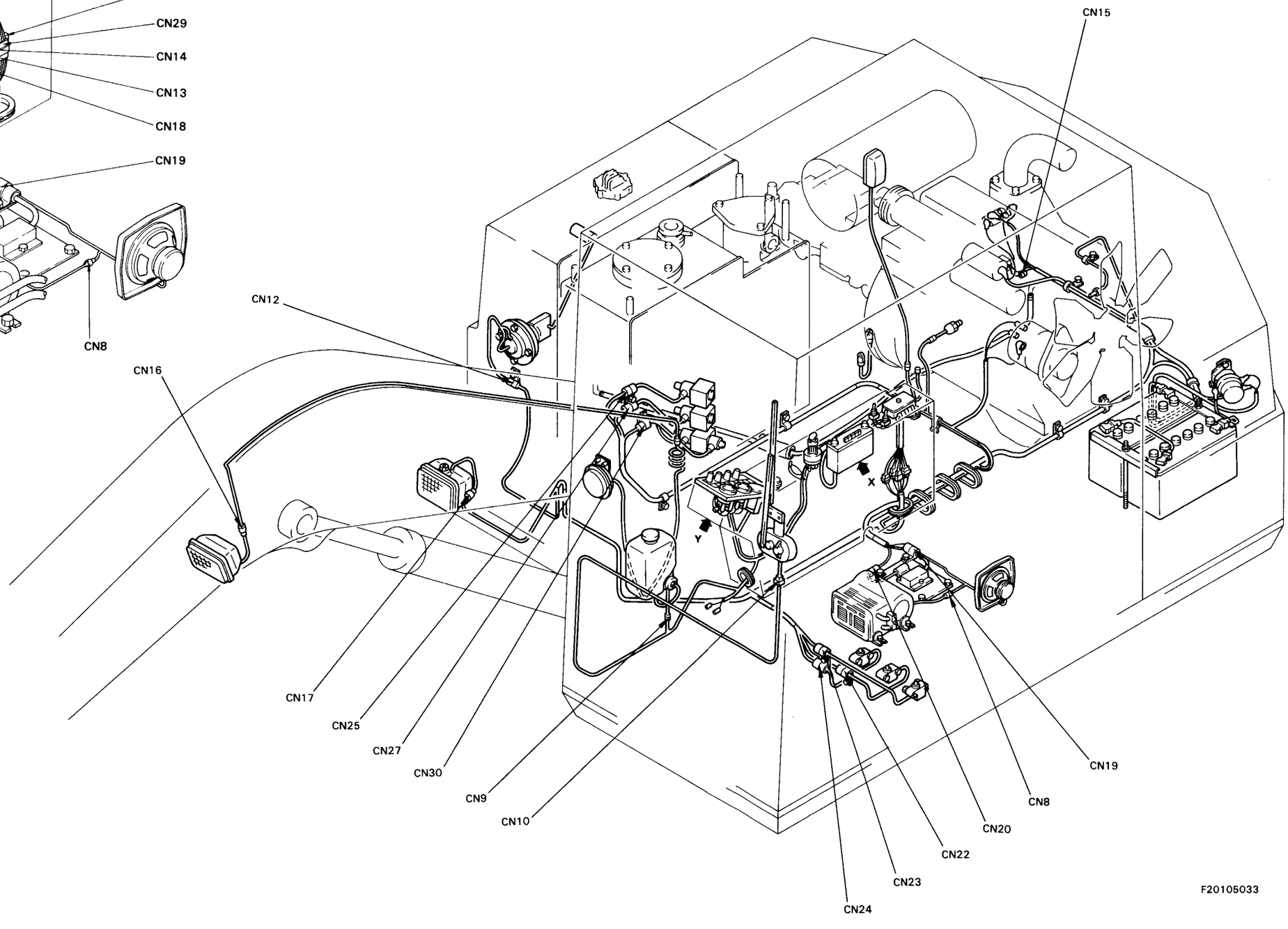
PISTON OF CONNECTORS FOR TROUBLESHOOTING



View X

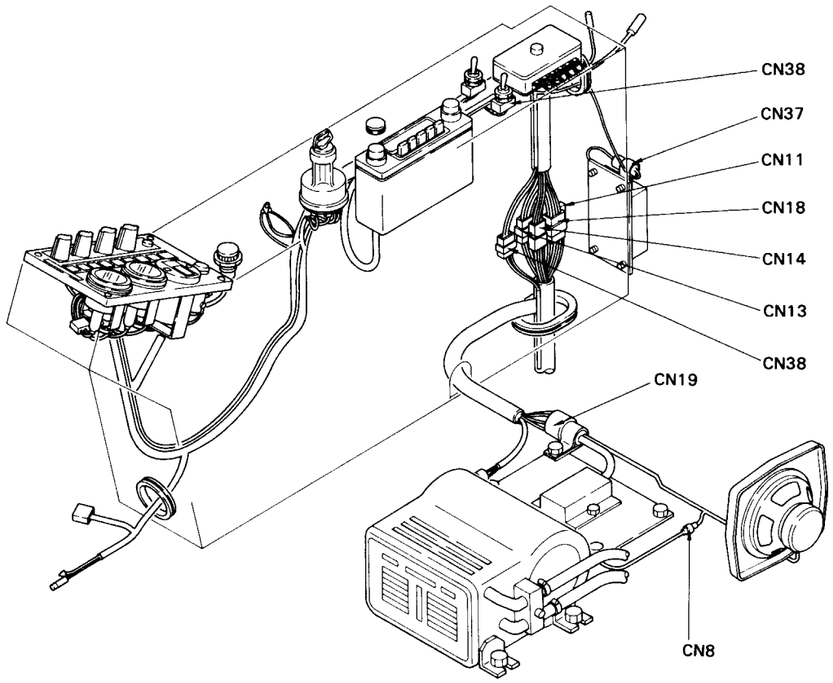


View Y

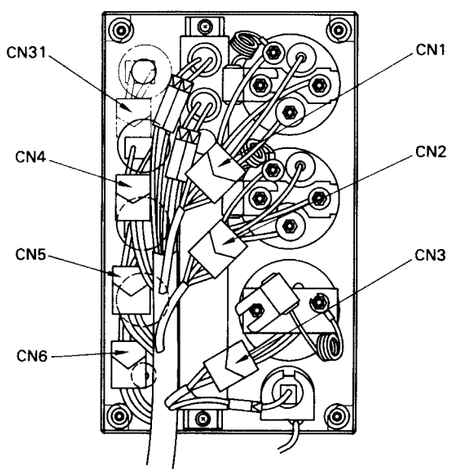


F20105033

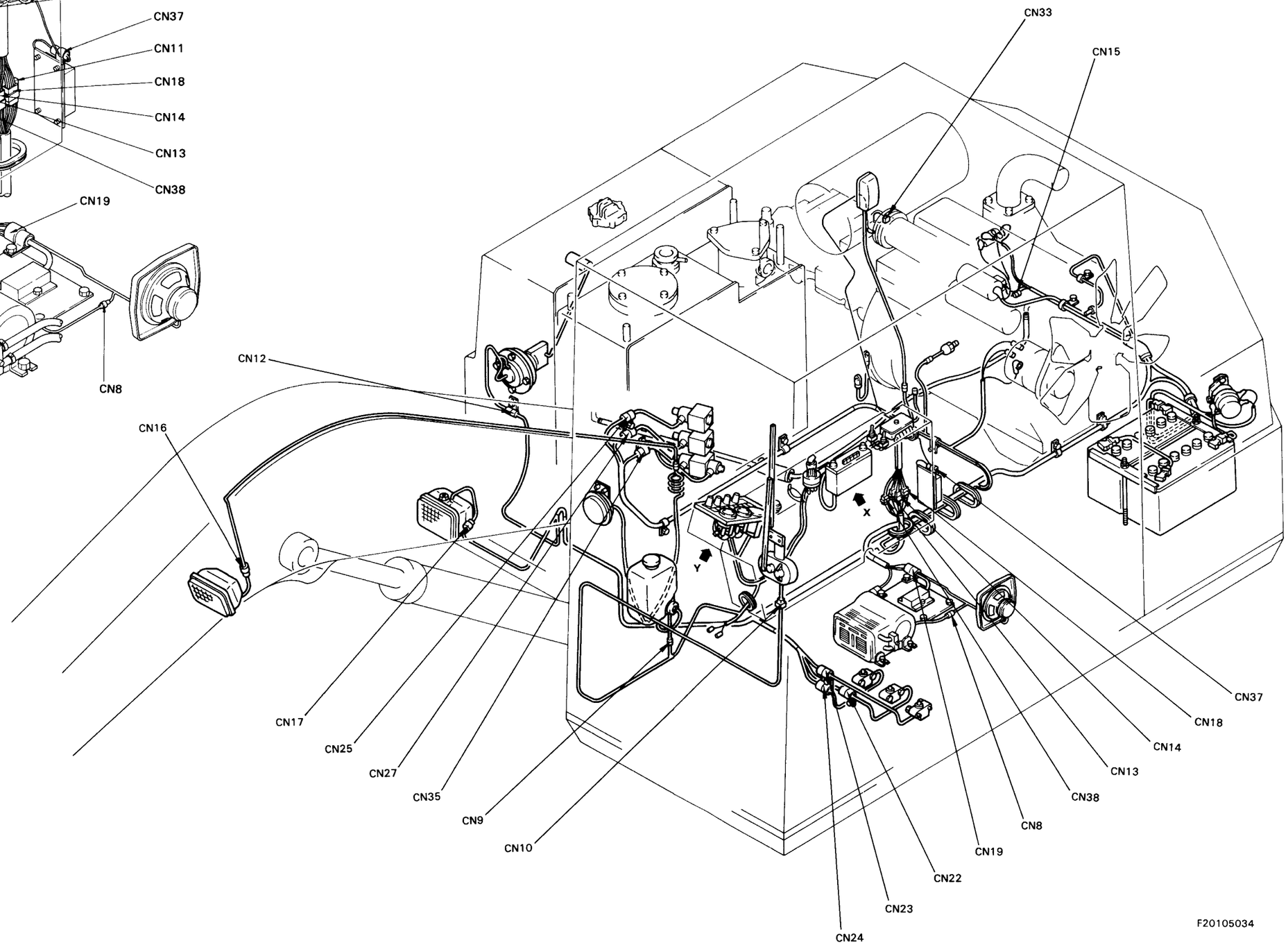
★ FOR MACHINE EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHANICAL BRAKE AND OLSS



View X

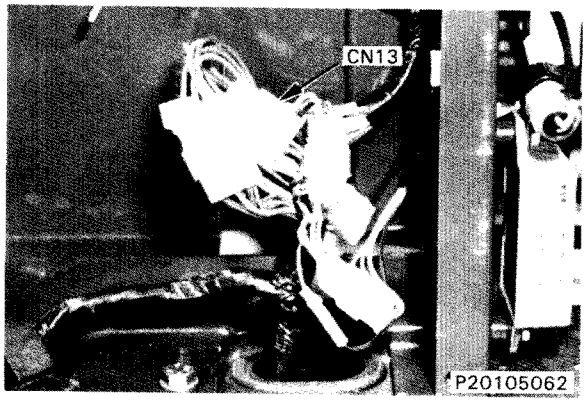


View Y

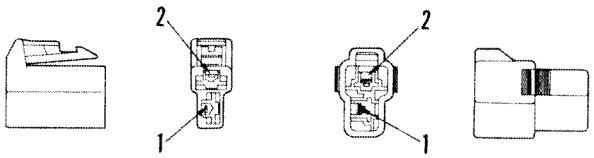


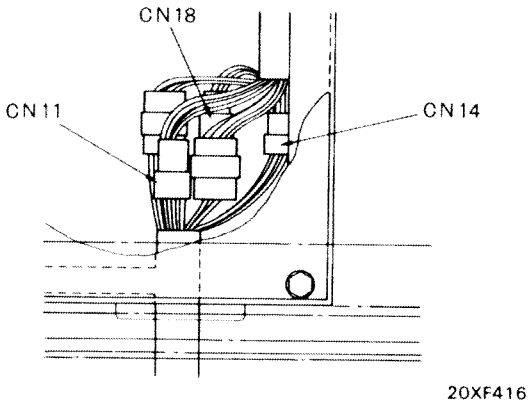
F20105034

CN13
N-SLC connector 9 pins

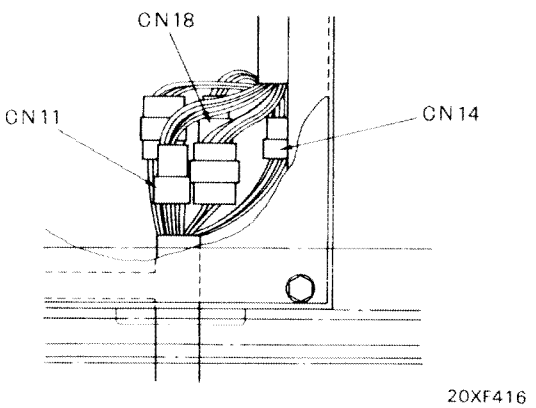


CN14
N-SLC connector 2 pins

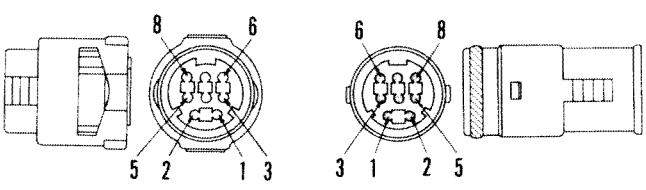


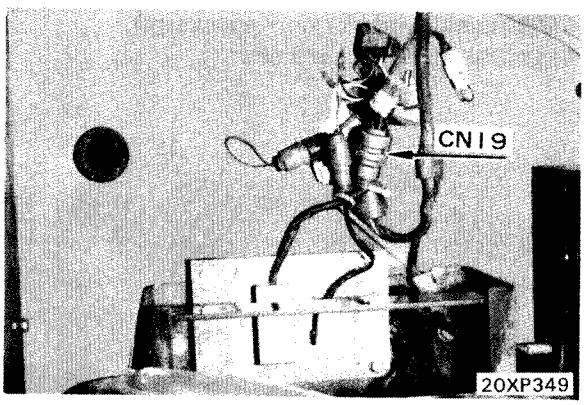


CN18
N-SLC connector 3 pins

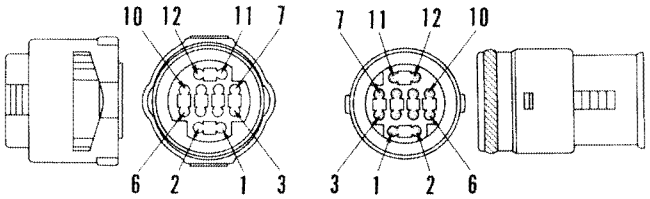


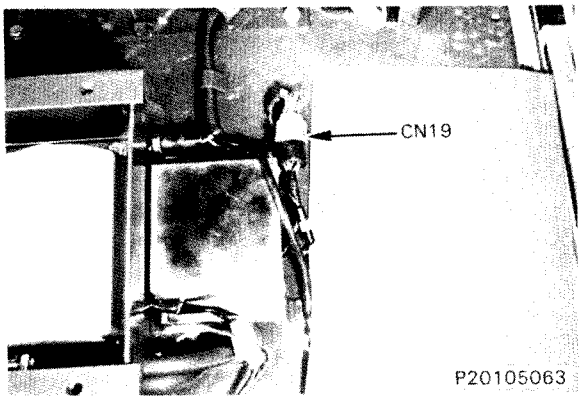
CN19 (Controller)
(For machine equipped with swing mechanical brake)
ECONOSEAL connector 8 pins



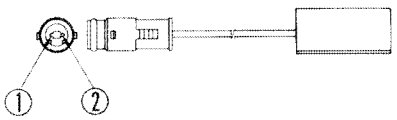


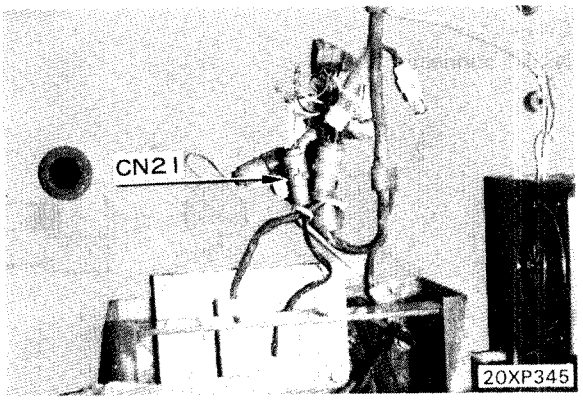
CN19 (Controller)
(For machine equipped with auto-deceleration and OLSS)
ECONOSEAL connector 12 pins



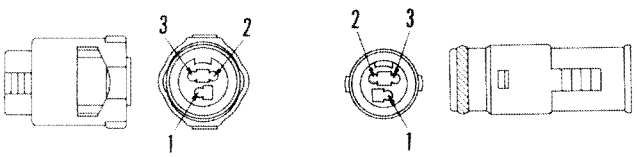


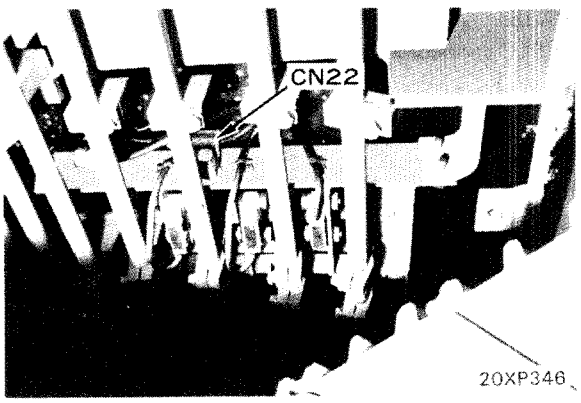
CN21 (Diode)
ECONOSEAL connector 2 pins



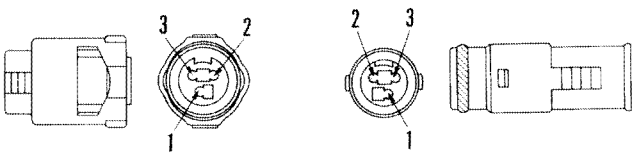


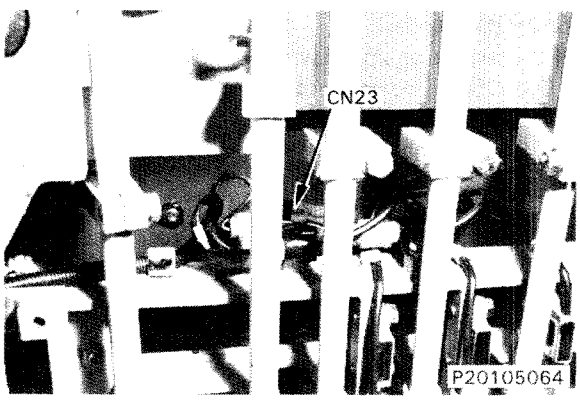
CN22 (Limit switch for swing)
ECONOSEAL connector 3 pins



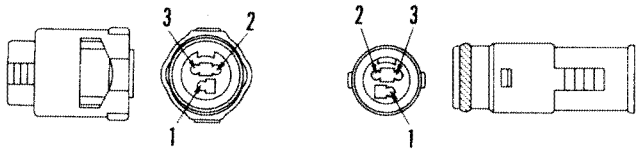


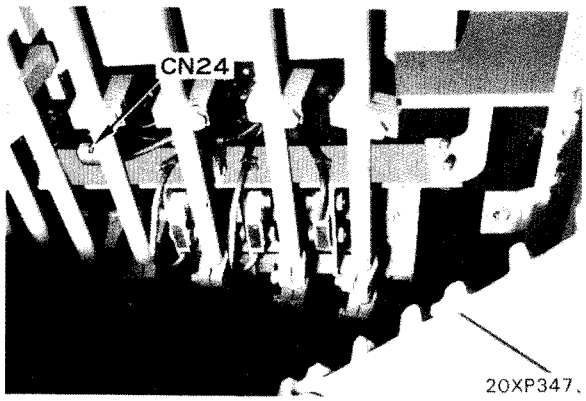
CN23 (Limit switch for work equipment)
ECONOSEAL connector 3 pins



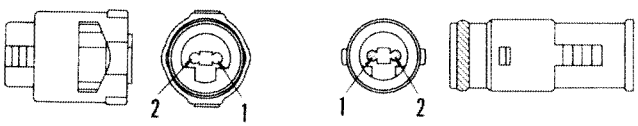


CN24 (Limit switch for travel)
ECONOSEAL connector 3 pins

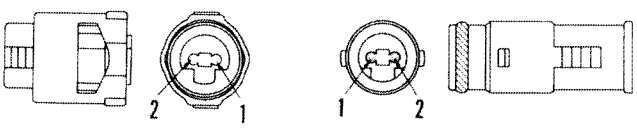




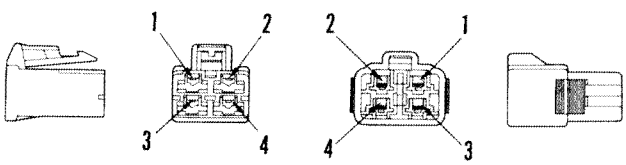
CN25 (Swing mechanical brake solenoid valve)
(For machine equipped with swing mechanical brake)
ECONOSEAL connector 2 pins

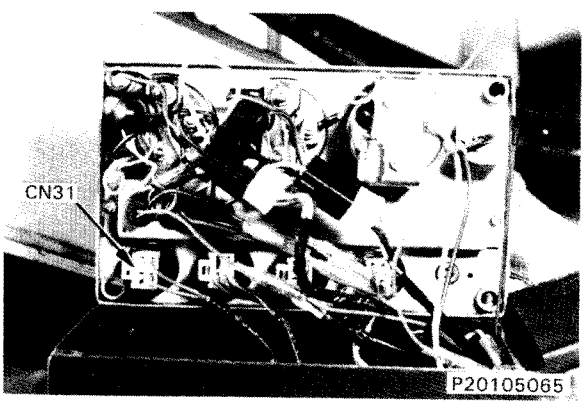


CN27 (Straight-travel solenoid valve)
ECONOSEAL connector 2 pins

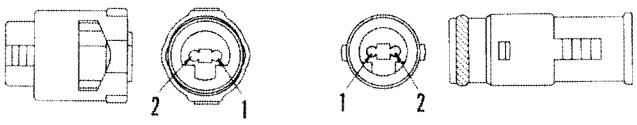


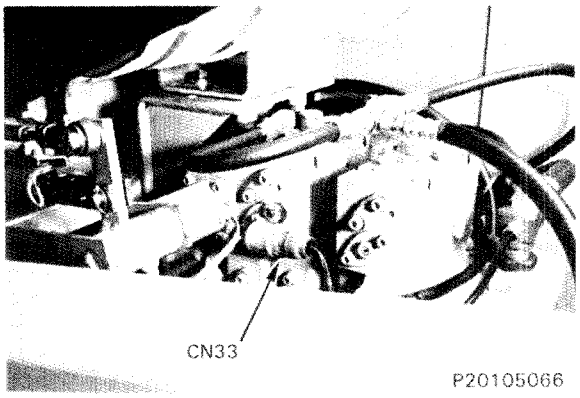
CN31 (Mode selector switch)
(For machine equipped with auto-deceleration)
N-SLC connector 4 pins



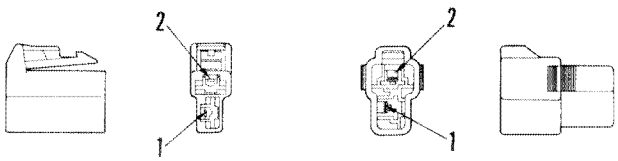


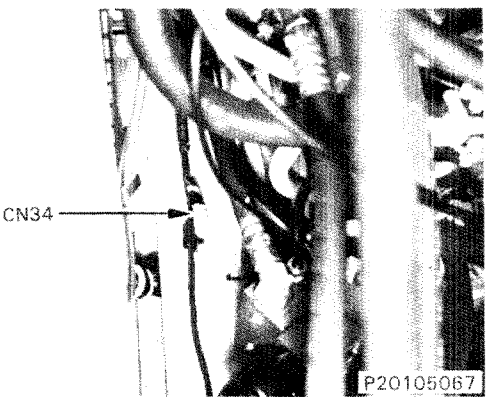
CN33 (TVC valve solenoid)
(For machine equipped with OLSS)
ECONOSEAL connector 2 pins



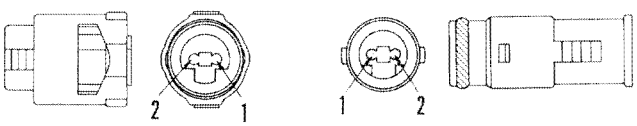


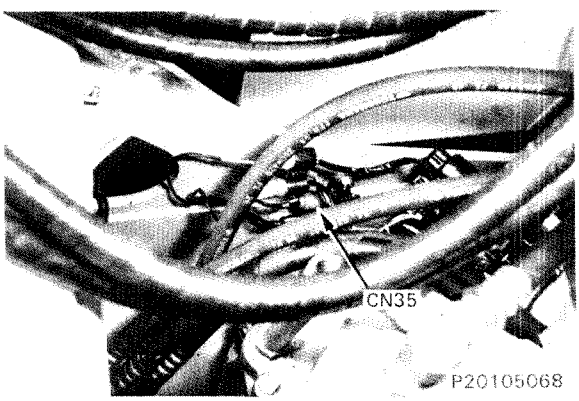
CN34 (Diode)
N-SLC connector 2 pins



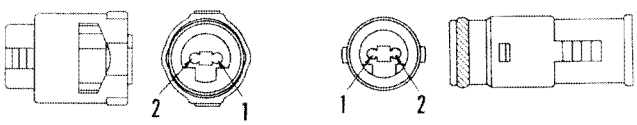


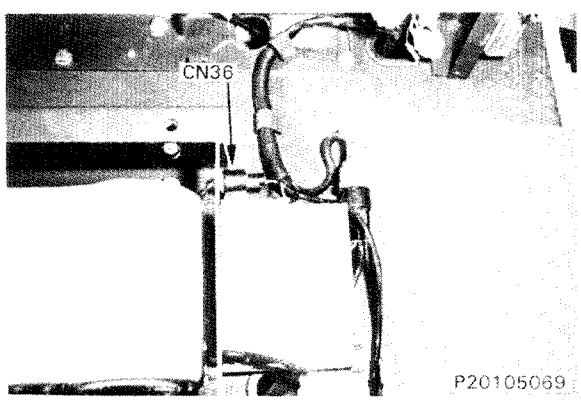
CN35 (Auto-deceleration solenoid valve)
(For machine equipped with auto-deceleration)
ECONOSEAL connector 2 pins



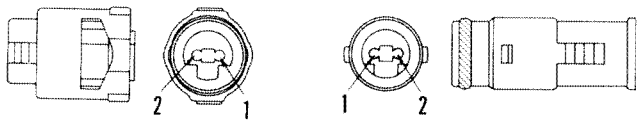


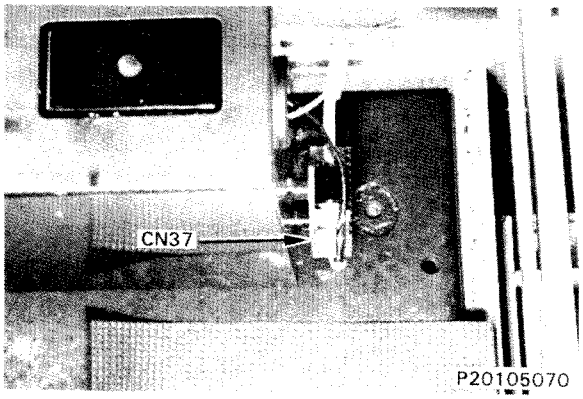
CN36 (Controller)
(For machine equipped with auto-deceleration and OLSS)
ECONOSEAL connector 2 pins



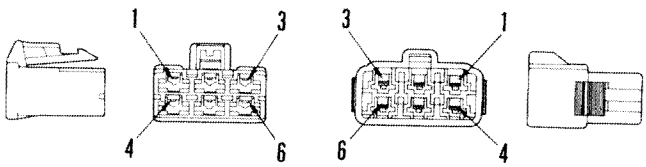


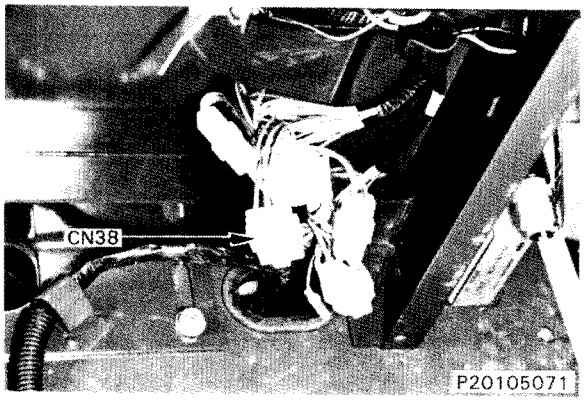
CN37 (OLSS resistor)
(For machine equipped with OLSS)
ECONOSEAL connector 2 pins



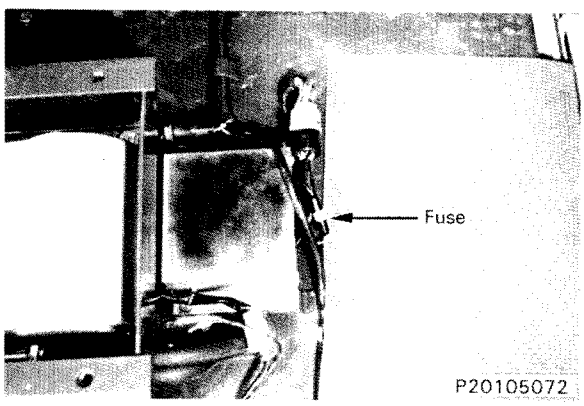


CN38 (Auto-deceleration switch)
(For machine equipped with auto-deceleration)
N-SLC connector 6 pins

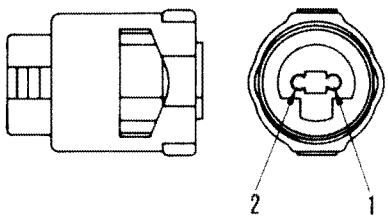
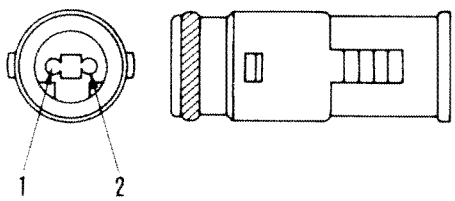
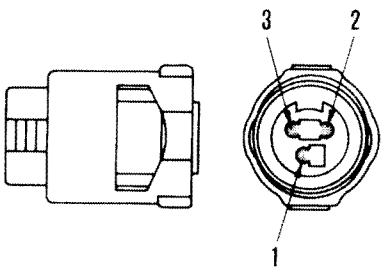
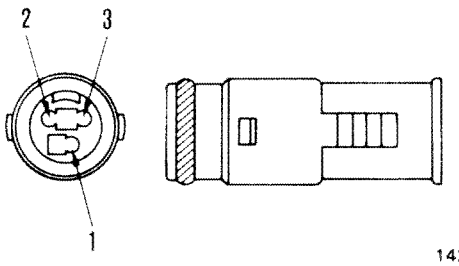
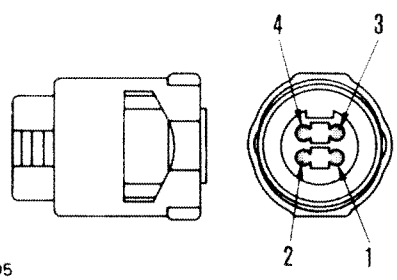
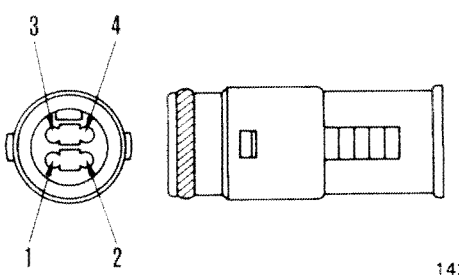
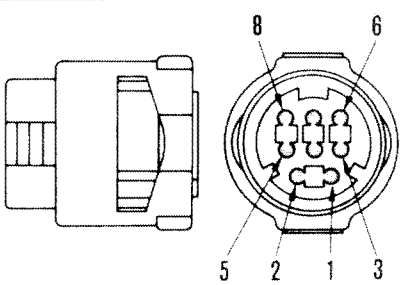
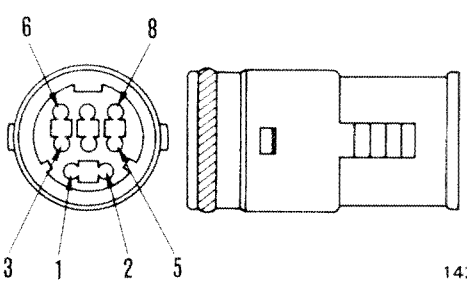
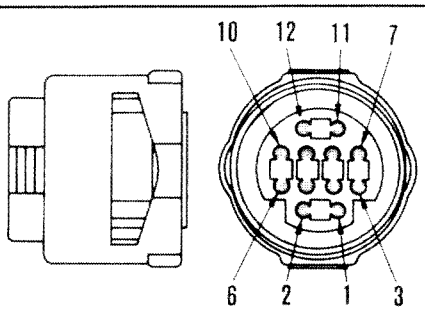
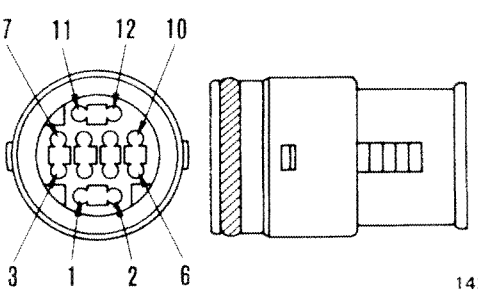


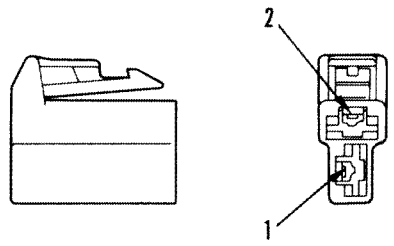
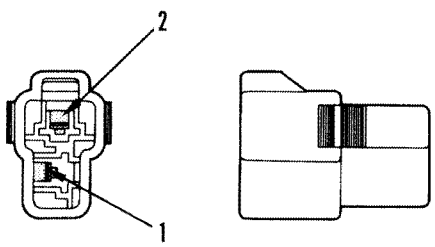
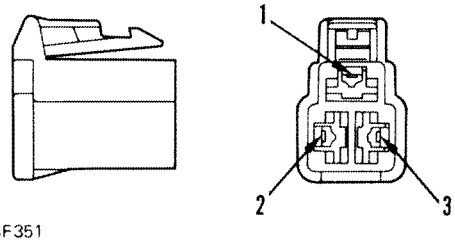
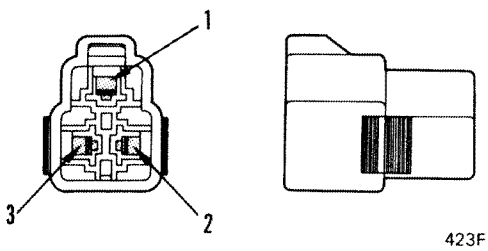
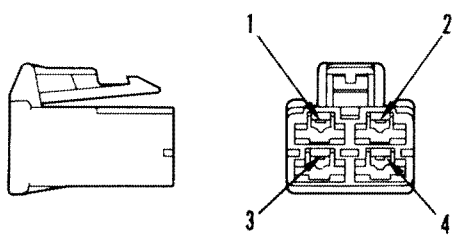
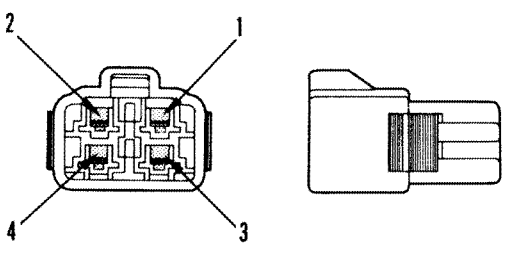
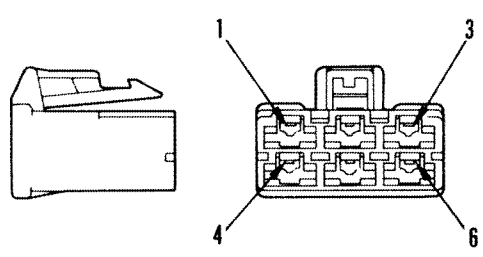
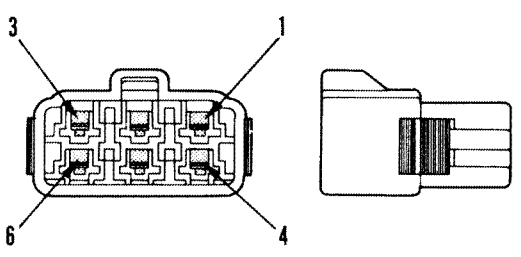
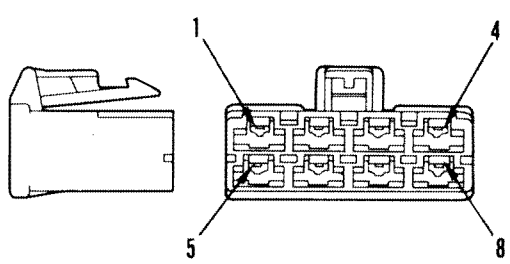
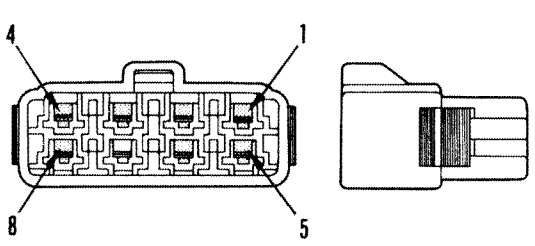


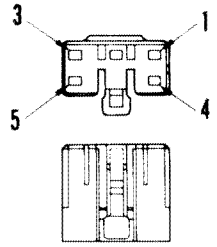
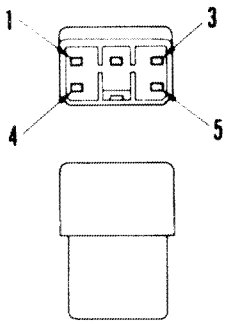
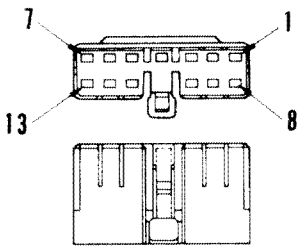
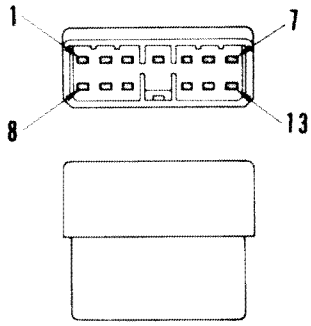
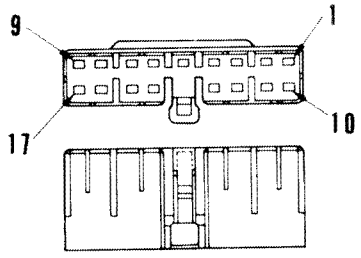
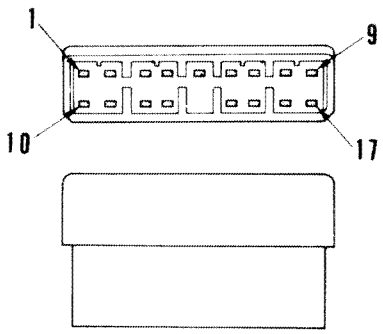
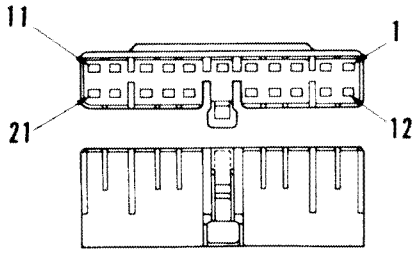
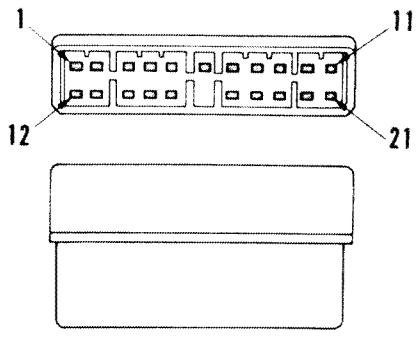
Fuse (5A)
(For machine equipped with auto-deceleration and OLSS)

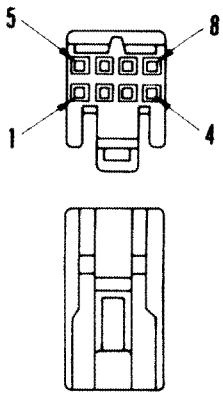
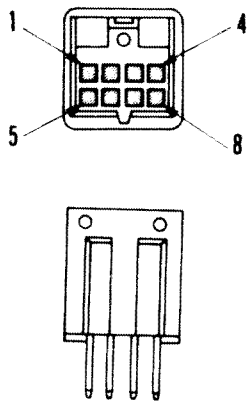
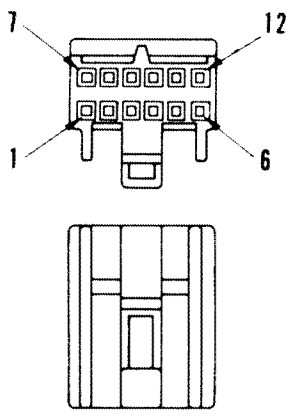
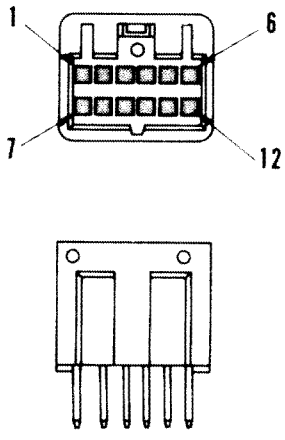
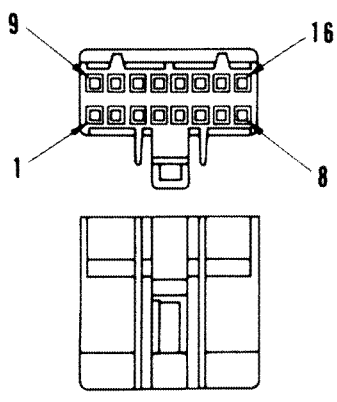
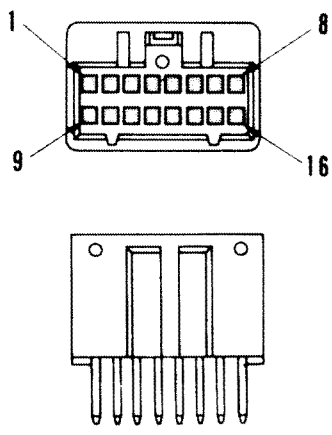


CONNECTION TABLE FOR CONNECTOR PINS

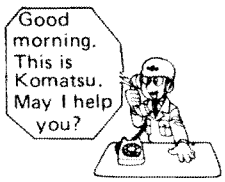
No. of pins (Connector)	ECONOSEAL CONNECTORS	
	Female connector (socket)	Male connector (pin)
2	 142F401	 142F400
3	 142F403	 142F402
4	 142F405	 142F404
8	 142F407	 142F406
12	 142F409	 142F408

No. of pins (Connector)	N-SLC CONNECTORS	
	Female connector (socket)	Male connector (pin)
2	 423F349	 423F350
3	 423F351	 423F352
4	 423F353	 423F354
6	 423F355	 423F356
8	 423F357	 423F358

No. of pins (Connector)	MIC CONNECTORS	
	Female connector (socket)	Male connector (pin)
5	 142F410	 142F411
13	 142F412	 142F413
17	 142F414	 142F415
21	 142F416	 142F417

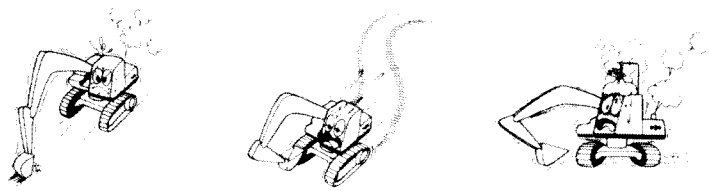
No. of pins (Connector)	DLI CONNECTOR (Monitor panel of machine)	
	Female connector (socket)	Male connector (pin)
8	 142F418	 142F419
12	 142F420	 142F421
16	 142F422	 142F423

TROUBLESHOOTING PROCEDURE



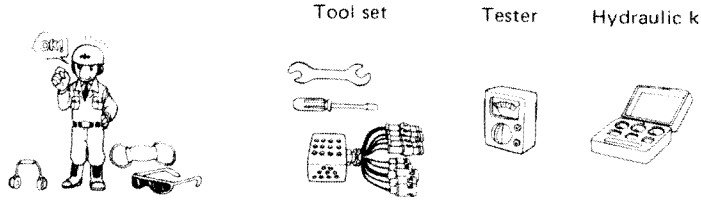
1. When a request comes in for repairs, first ask the following points.
   - Name of customer.
   - Type as Serial No. of machine.
   - Jobsite.

Lack of digging power? Does machine deviate when traveling? Is swing defective?

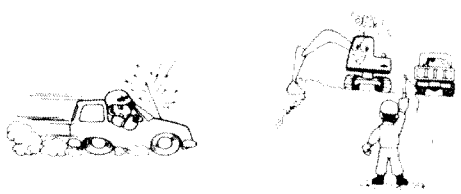


2. Get an outline of the problem. Ask the following points.
   - Symptoms of failure.
   - What was machine doing when it broke down?
   - Operating environment.
   - Details of past repairs and maintenance.

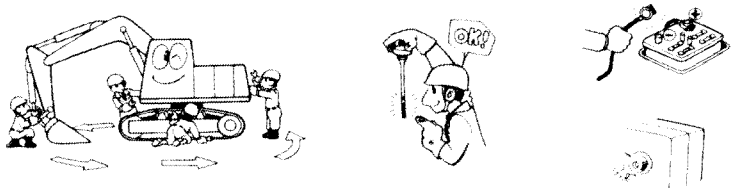
Tool set Tester Hydraulic kit



3. Look at the table of troubleshooting tools and decide what tools are needed.
   ★ Do not forget circuit tester and socket for troubleshooting.



4. Re-enact failure.
   - Operate the travel and work equipment, and check the symptoms.



Self testing display

5. Look at the Checks before troubleshooting, locate and repair simple problems first.
   - Checks before starting.
   - Other checks items.

1) In case of OLSS, auto-decelerator, swing brake, or straight-travel

Depending on the judgement ("good" or "not good") about the voltage at the solenoid valve inlet marked ○ (depending on the failure mode) in the judgement table, decide which troubleshooting should be carried out, that is, whether the troubleshooting should be made in the electrical system (E-ΔΔ) or the hydraulic-mechanical system. (H-ΔΔ).

★ If there are failures in diagnosis Nos. 4, 5, 7, 10, 11, 14, 15, and 16, the electrical system need not be subjected to troubleshooting. Troubleshoot the hydraulic and mechanical systems to correct the problem.

2) In case of a machine monitor

→ proceed to Troubleshooting Chart No. M-1 — M-3

6. TROUBLESHOOTING (Regular diagnosis)

1) In case of OLSS, auto-decelerator, or swing brake, or straight-travel

(1) Use the judgement table to determine if the failure is in the electrical system or hydraulic-mechanical system.

(2) Make the diagnosis by referring to the diagnostic flow chart indicated in the judgement table.

2) In case of a vehicle monitor

(1) Make the diagnosis after selecting the diagnostic flow chart which corresponds to the symptom.

CHECKS BEFORE TROUBLESHOOTING

(1. Checks before starting, 2. Other check items)

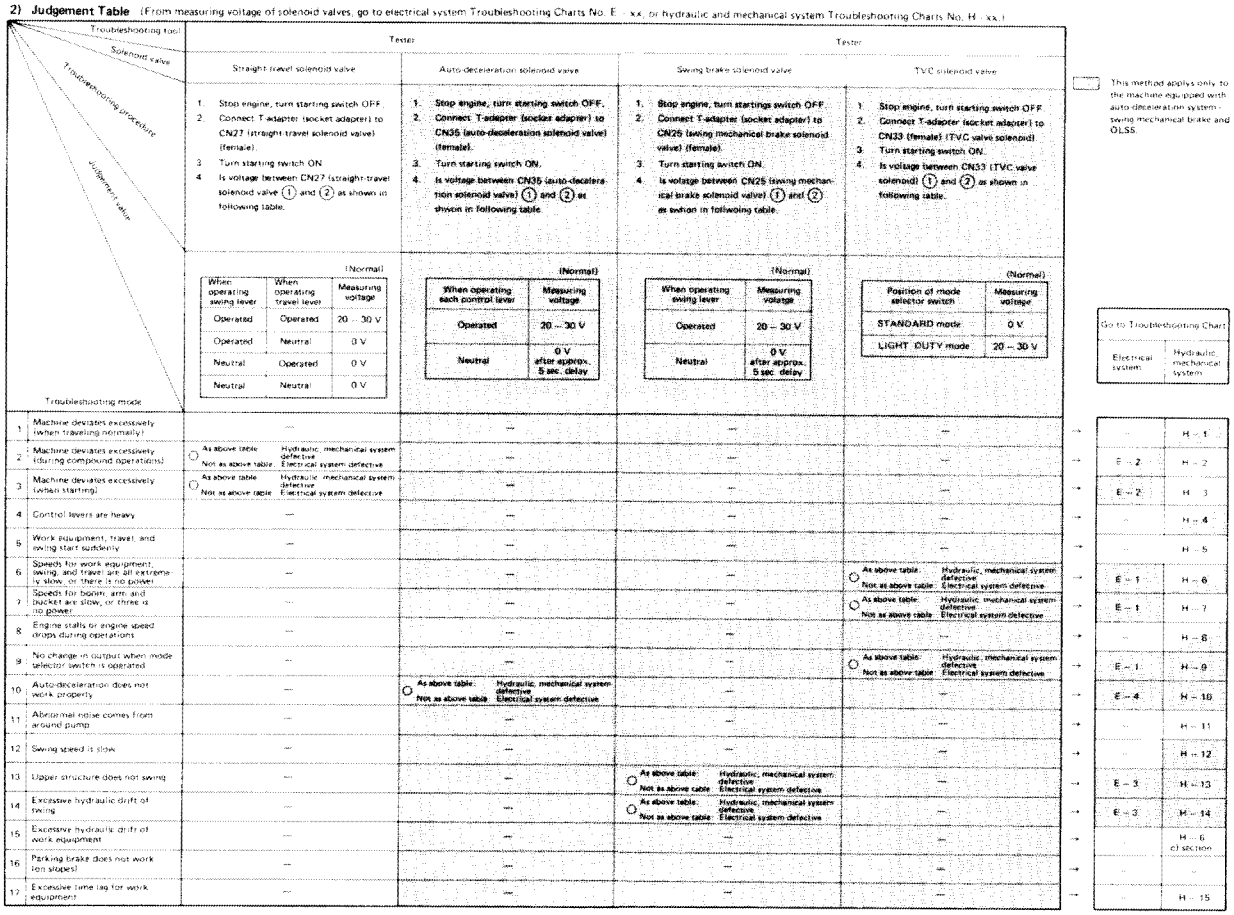
		Item	Judgement standard	Remedy
Checks before starting	Lubricating oil, cooling water	1. Check fuel level	—	Add fuel
		2. Check for dirt or water in fuel	—	Clean, drain
		3. Check hydraulic oil level	—	Add oil
		4. Check hydraulic oil strainer	—	Clean, drain
		5. Check swing machinery oil level	—	Add oil
		6. Check engine oil level (Level of oil in oil pan)	—	Add oil
		7. Check cooling water level	—	Add water
		8. Check condition of dust indicator	—	Clean or replace
Item	Electrical components	9. Check for loose or corroded battery terminals	—	Tighten or replace
		10. Check for loose or corroded alternator terminals	—	Tighten or replace
		11. Check for loose or corroded starting motor terminals	—	Tighten or replace
Other check items	Hydraulic, mechanical components	12. Check for abnormal noise or smell	—	Repair
		13. Check for oil leakage	—	Repair
		14. Bleed air from system	—	Bleed air
	Electrical components	15. Check battery voltage (engine stopped)	23 – 26 V	Replace
		16. Check level of battery electrolyte	—	Add or replace
		17. Check for discolored, burnt, or bare wiring	—	Replace
		18. Check for missing wiring clamps, hanging wires	—	Repair
		19. Checks for water leaking onto wiring (check carefully water leakage at connectors and terminals)	—	Disconnect connector and dry connection
		20. Check for broken or corroded fuses	—	Replace
		21. Check alternator voltage (engine running at over half throttle)	27.5 – 29.5 V	Replace
		22. Noise when battery relay is operated (switch starting switch from on to off)	—	Replace

JUDGEMENT TABLE

1) HOW TO USE THE JUDGEMENT TABLE

Troubleshooting for Travel, Work Equipment, and Swing System. (OLSS, auto-decelerator, swing mechanical brake)

2) **Judgement Table** (From measuring voltage of solenoid valves, go to electrical system Troubleshooting Charts No. E - xx, or hydraulic and mechanical system Troubleshooting Charts No. H - xx.)



Step 1 **Search for the troubleshooting mode**

After using indirect diagnosis and reproducing the failure (to confirm that a faulty symptom actually exists on the machine), find the applicable faulty symptom from among failure modes no. 1 through no. 16 in Judgement table.

Step 2 **Decide whether the failure is in the electrical or the hydraulic-mechanical system**

1) Connect a T-adapter or a socket adapter between the connector for a solenoid valve marked ○ and the wiring harness, and measure the voltages when operated according to the diagnostic procedure. Then, see if the measured voltage values are in the normal range.

2) See if the measured voltage is equal to the normal value in the table.

If the measured voltage is same as the normal value given in the table →
Failure in the hydraulic-mechanical system
Procced to the applicable regular diagnosis (H - ΔΔ)

If the measured voltage is different from the normal value given in the table →
Failure in the electrical system
Proceed to the applicable regular diagnosis (E - ΔΔ)

Step 3 Proceed to the applicable regular diagnosis (Yes or No diagnosis).

2) Judgement Table (From measuring voltage of solenoid valves, go to electrical system Troubleshooting Charts No. E

Troubleshooting mode	Troubleshooting tool / Solenoid valve / Troubleshooting procedure / Judgement value	Tester: Straight-travel solenoid valve	Tester: Auto-deceleration solenoid valve
		1. Stop engine, turn starting switch OFF. 2. Connect T-adapter (socket adapter) to CN27 (straight-travel solenoid valve) (female). 3. Turn starting switch ON. 4. Is voltage between CN27 (straight-travel solenoid valve (1) and (2) as shown in following table.	1. Stop engine, turn starting switch OFF. 2. Connect T-adapter (socket adapter) to CN35 (auto-deceleration solenoid valve) (female). 3. Turn starting switch ON. 4. Is voltage between CN35 (auto-deceleration solenoid valve) (1) and (2) as shwon in following table.
		(Normal) When operating swing lever: Operated / Neutral / Operated / Neutral When operating travel lever: Operated / Operated / Neutral / Neutral Measuring voltage: 20 – 30 V / 0 V / 0 V / 0 V	(Normal) When operating each control lever: Operated / Neutral Measuring voltage: 20 – 30 V / 0 V after approx. 5 sec. delay
1	Machine deviates excessively (when traveling normally)	—	—
2	Machine deviates excessively (during compound operations)	○ As above table: Hydraulic, mechanical system defective Not as above table: Electrical system defective	—
3	Machine deviates excessively (when starting)	○ As above table: Hydraulic, mechanical system defective Not as above table: Electrical system defective	—
4	Control levers are heavy	—	—
5	Work equipment, travel, and swing start suddenly	—	—
6	Speeds for work equipment, swing, and travel are all extremely slow, or there is no power	—	—
7	Speeds for boom, arm and bucket are slow, or three is no power	—	—
8	Engine stalls or engine speed drops during operations	—	—
9	No change in output when mode selector switch is operated	—	—
10	Auto-deceleration does not work properly	—	○ As above table: Hydraulic, mechanical system defective Not as above table: Electrical system defective
11	Abnormal noise comes from around pump	—	—
12	Swing speed is slow	—	—
13	Upper structure does not swing	—	—
14	Excessive hydraulic drift of swing	—	—
15	Excessive hydraulic drift of work equipment	—	—
16	Parking brake does not work (on slopes)	—	—
17	Excessive time lag for work equipment	—	—

- xx, or hydraulic and mechanical system Troubleshooting Charts No. H - xx.)

Tester			Go to Troubleshooting Chart	
Swing brake solenoid valve	TVC solenoid valve		Electrical system	Hydraulic, mechanical system
1. Stop engine, turn startings switch OFF. 2. Connect T-adapter (socket adapter) to CN25 (swing mechanical brake solenoid valve) (female). 3. Turn starting switch ON. 4. Is volatge between CN25 (swing mechanical brake solenoid valve) ① and ② as swhon in follwoing table.	1. Stop engine, turn starting switch OFF. 2. Connect T-adapter (socket adapter) to CN33 (female) (TVC valve solenoid). 3. Turn starting switch ON. 4. Is voltage between CN33 (TVC valve solenoid) ① and ② as shown in following table.			
(Normal) When operating swing lever: Operated → Measuring volatge: 20 – 30 V When operating swing lever: Neutral → Measuring volatge: 0 V after approx. 5 sec. delay	(Normal) Position of mode selector switch: STANDARD mode → Measuring voltage: 0 V Position of mode selector switch: LIGHT DUTY mode → Measuring voltage: 20 – 30 V			
—	—	→	—	H – 1
—	—	→	E – 2	H – 2
—	—	→	E – 2	H – 3
—	—	→	—	H – 4
—	—	→	—	H – 5
—	○ As above table: Hydraulic, mechanical system defective Not as above table: Electrical system defective	→	E – 1	H – 6
—	○ As above table: Hydraulic, mechanical system defective Not as above table: Electrical system defective	→	E – 1	H – 7
—	—	→	—	H – 8
—	○ As above table: Hydraulic, mechanical system defective Not as above table: Electrical system defective	→	E – 1	H – 9
—	—	→	E – 4	H – 10
—	—	→	—	H – 11
—	—	→	—	H – 12
○ As above table: Hydraulic, mechanical system defective Not as above table: Electrical system defective	—	→	E – 3	H – 13
○ As above table: Hydraulic, mechanical system defective Not as above table: Electrical system defective	—	→	E – 3	H – 14
—	—	→	—	H – 6 c) section
—	—	→	—	—
—	—	→	—	H – 15

: This method applys only to the machine equipped with auto-deceleration system, swing mechanical brake and OLSS.

3) METHOD OF USING THE TROUBLESHOOTING CHART (See "Example 1")

1 Problem number and symptoms

The problem number and symptoms are written at the top left of the toubleshooting chart.

Problem No.	Location of failure
E–ΔΔ	Electrical system of OLSS, auto-deceleration, swing mechanical brake, and straight-travel
H–XX	Hydraulic or mechanical system of OLSS, auto-deceleration, swing mechanical brakes, and straight-travel

2. Troubleshooting tools

Prepare the tools listed under "Troubleshooting tools" at the bottom left or right before starting troubleshooting.

3. Categories for same symptom

Even though the symptom is the same, if the machine model or component is different, the method of using the troubleshooting chart may be different. In such cases, the symptom is divided into sections a), b), etc. Select the appropriate section and start toubleshooting from that point. If there are no sections, start troubleshooting from the beginning.

4. Following the troubleshooting chart

- Carry out the check or measurement inside the box. If the result is "YES", follow the YES arrow; if the result is "NO", follow the NO arrow.
- If the YES or NO arrow leads direcly to the Cause column, take the action given in the Remedy column; if the arrow leads to another box, carry out the check listed in the box.
  (Note: The number at the top right corner of each box is only a list number; it does not necessarily indicate the order for troubleshooting.)
- Any instructions given below the box are work to be carried out before making the check listed in the box. These instructions include preparatory work, operations to be carried out, and judgement values. If the preparatory work is not carried out, or the operations are carried out wrongly, mistakes will be made in judgement, or the machine may be damaged. Therefore, before making the check or measurement in the box, read these instructions carefully and carry them out in the order listed. Then go on to the check or measurement.

5. General precautions

In the troubleshooting chart some precautions apply to the whole troubleshooting procedure for that symptom. Such symptoms are marked ★, and are listed below the symptom.
The precautions marked ★ are not usually repeated in the instructions under each box, but they apply in each case and must not be forgotten.

6. The page following the Troubleshooting Chart (See Example 2) gives the places to be checked or measured, and the connector pin numbers.

- Photograph showing location of connector, fuse or plug for measuring
- Diagram showing location of connector pin number

< Example 1 >

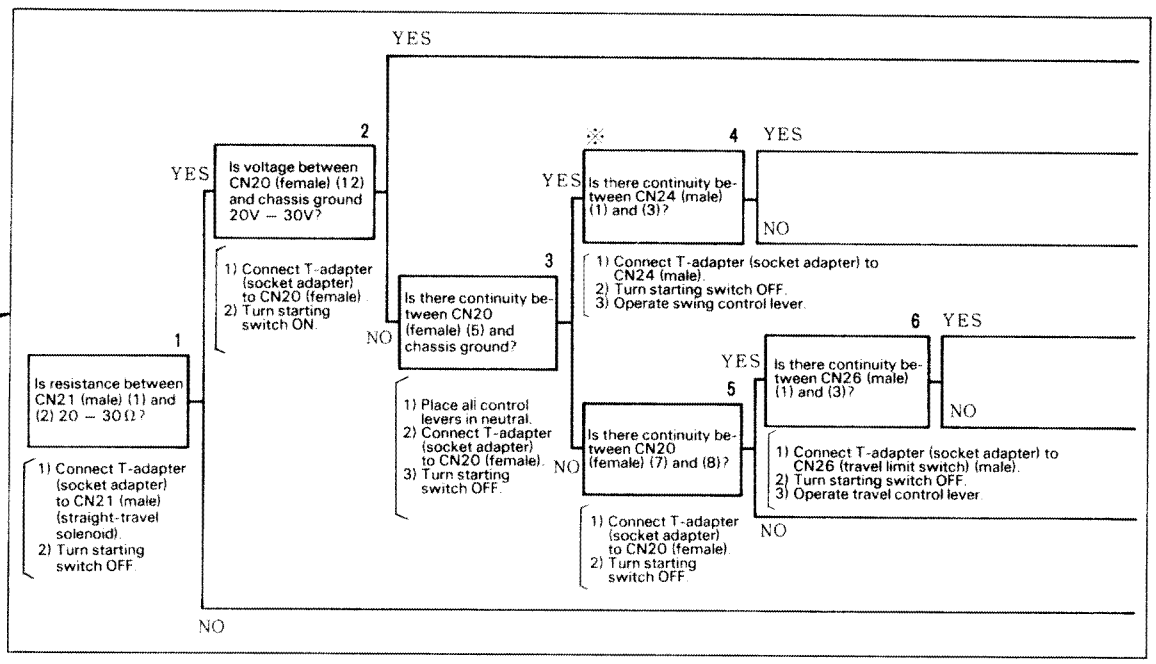
① **TROUBLESHOOTING CHART NO. E-2**

Failure mode: Machine deviates excessively (during compound operations).
Machine deviates excessively (when starting).

⑤
★ Turn the starting switch OFF before removing the connector, and connect the T-adapter (or socket adapter).
★ Connect the male and female of the T-adapter respectively; for the socket adapter, connect as shown in ( ).
※ When checking wrist control type, run the engine for about 10 seconds, then stop the engine.

③ **a) Compound operations**

④



② Trouble-shooting tools

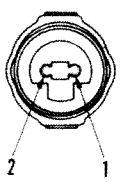
	Tester	T-adapter or socket adapter (for MIC)
	T-adapter or socket adapter (for Econosela)	T-adapter or socket adapter (for DLI)

< Example 2 >

⑥

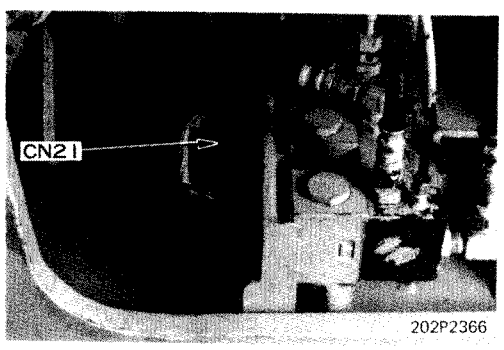
E-2

(a), (b)-1 Measure the resistance between CN21 (male) ① and ② .



(female)

142F400



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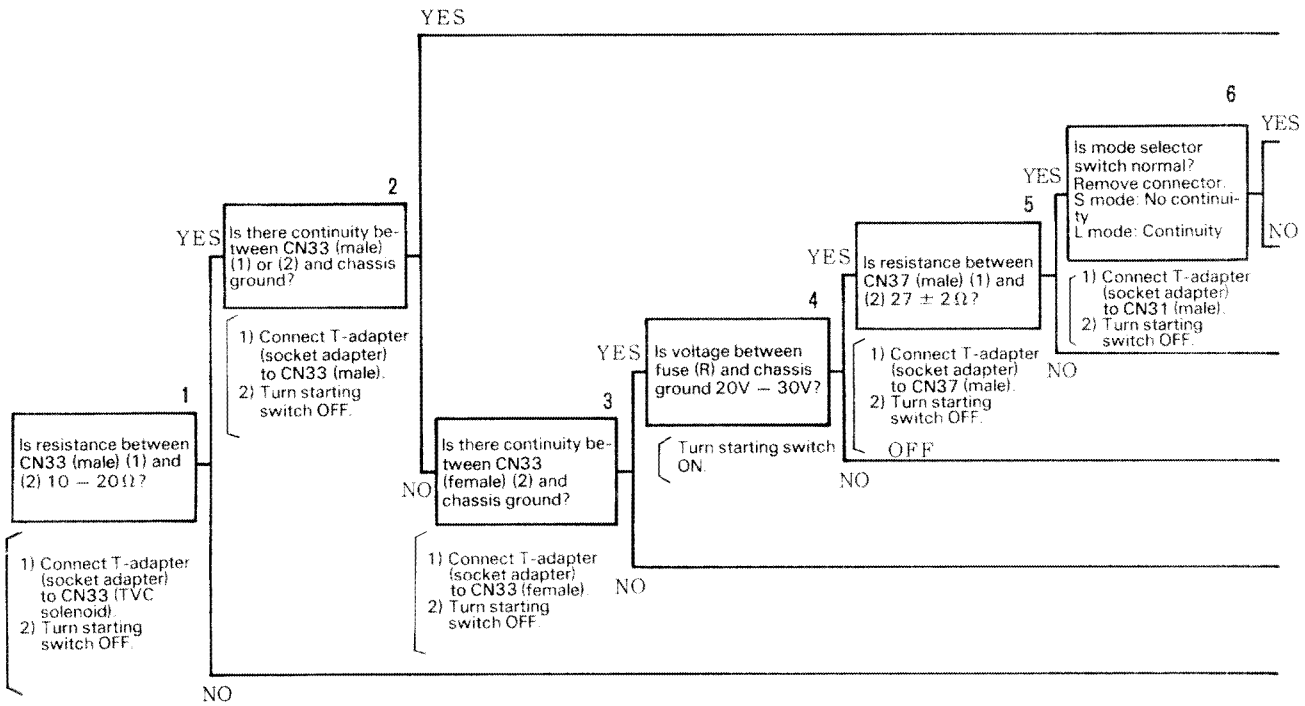
TROUBLESHOOTING CHART NO. E-1

Work equipment, swing, travel speeds extremely slow, or lack of power.
No change in output when mode selector switch is operated.

★ Turn the starting switch OFF before removing the connector, and connect the T-adapter (or socket adapter).
★ Connect the male and female of the T-adapter respectively; for the socket adapter, connect as shown in ( ).
★ After disconnecting the connectors and checking, connect again immediately.



Trouble-shooting tools		
	Tester	T-adapter or socket adapter (for MIC)
	T-adapter or socket adapter (for Econosela)	T-adapter or socket adapter (for DLI)

★ FOR MACHINE EQUIPPED AUTO-DECELERATION SYSTEM AND OLSS

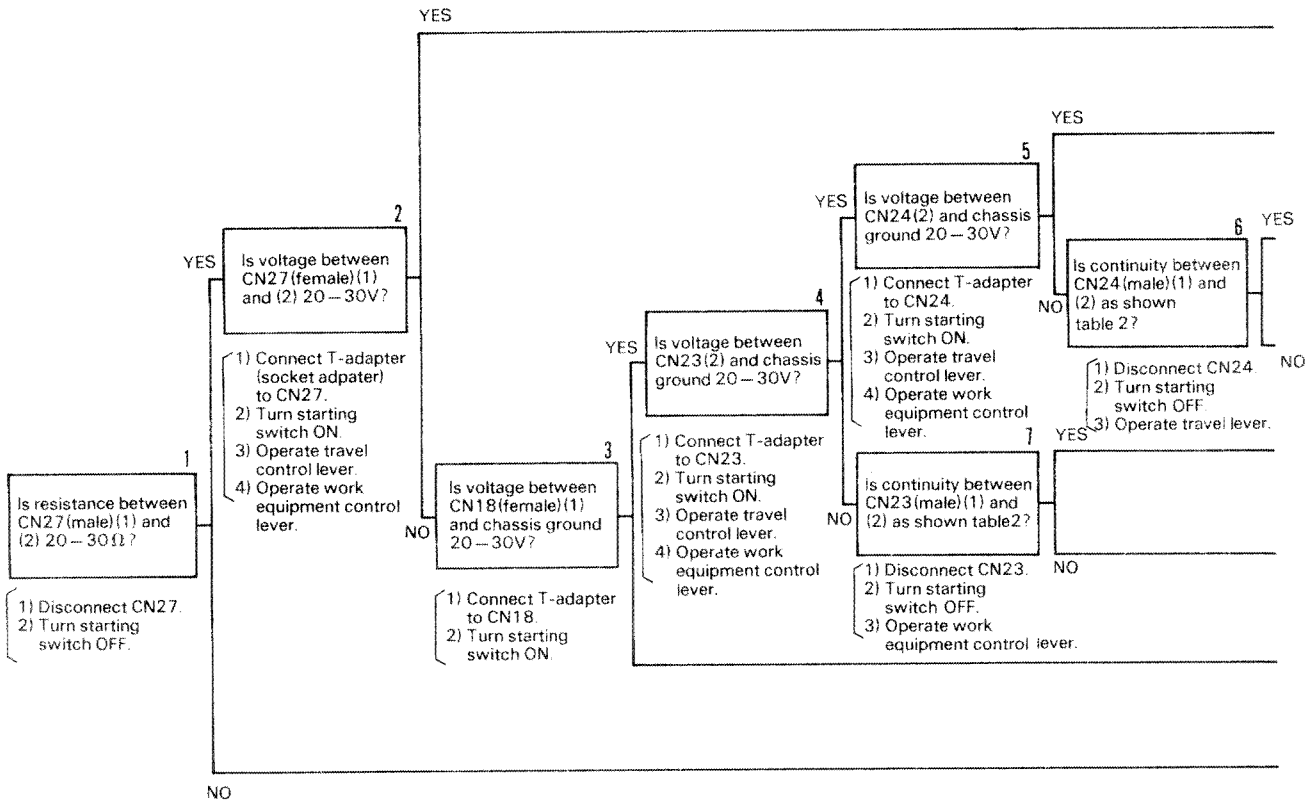
Cause	Remedy
TVC solenoid defective	Replace
Defective contact or disconnection in wiring harness between CN37 (female) (1) – CN31 (female) (4), or CN31 (female) (3) – CN33 (female) (1).	Clean (defective contact) or replace
Mode selector switch defective.	Replace
OLSS resistor assembly defective.	Replace
Disconnection in wiring harness between fuse R – CN14 (1) – battery, or fuse R – starting switch (B), (BR) – battery relay.	Replace
Disconnection in wiring harness between CN33 (female) (2) and ground connection	Replace
TVC solenoid defective.	Replace

TROUBLESHOOTING CHART NO. E-2

Failure mode: Machine deviates excessively (during compound operations)

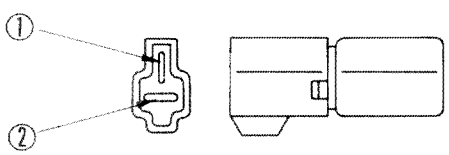
★ Turn the starting switch OFF before removing the connector, and connect the T-adapter (or socket adapter).
★ Connect the male and female of the T-adapter respectively; for the socket adapter, connect as shown in ( ).
★ After checking the connectors, connect again immediately.

a) Operate work equipment control lever during traveling



Note: Check that CN21 and CN28 (diode assemblies) are in normal.

CN28
Diode assembly



CN21
Diode assembly

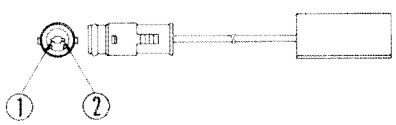


Table 1

Tester pin		Continuity
Red	Black	
①	②	No
②	①	Yes

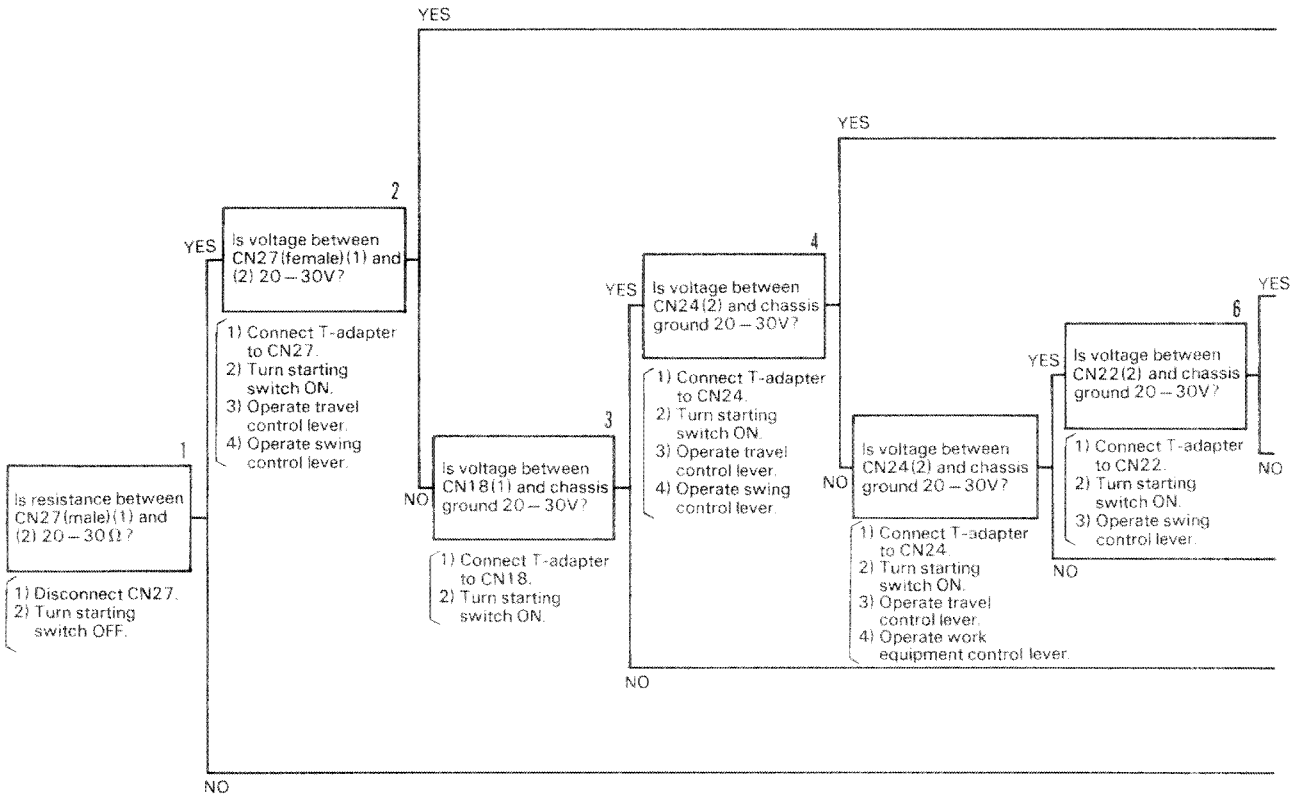
Table 2

Lever	Continuity
Operated	No
Neutral	Yes

Troubleshooting tools	Tester
	T-adapter or socket (For econoseal)

Cause	Remedy
Defective straight-travel solenoid	Replace.
Disconnection in wiring harness of defective contact between CN24 (2) and CN27 (1).	Clean or replace.
Disconnection in wiring harness or defective contact between CN23 (2) and CN24 (1).	Clean or replace.
Defective travel limit switch.	Replace.
Disconnection in wiring harness or defective contact between CN18 (1) and CN23 (1).	Clean or replace.
Defective work equipment limit switch.	Replace.
Disconnection in wiring harness or defective contact between starting switch terminal ACC and CN18 (1).	Clean or replace.
Defective straight-travel solenoid.	Replace

b) Operate swing control lever during traveling



Troubleshooting tools	Tester
	T-adapter or socket (For econoseal)

Cause	Remedy
Defective straight-travel solenoid.	Replace.
Disconnection in wiring harness or defective contact between CN24 (2) and CN27 (1).	Clean or replace.
Disconnection in wiring harness or defective contact between CN21 (1) and CN24 (1).	Clean or replace.
Defective diode (CN21).	Replace.
Defective swing limit switch.	Replace.
Disconnection in wiring harness or defective contact between CN18 (1) — CN22 (1), CN23 (1).	Clean or replace.
Disconnection in wiring harness or defective contact between starting switch terminal ACC and CN18 (1).	Clean or replace.
Defective straight-travel solenoid.	Replace.

Is voltage between CN21 (1) and chassis ground 20 – 30V?

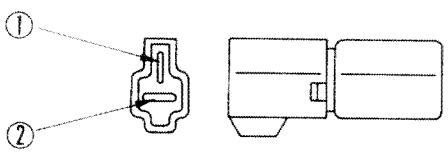
YES

NO

1) Connect T-adapter to CN21.
2) Turn starting switch ON.
3) Operate swing control lever.

Note: Check that CN21 and CN28 (diode assemblies) are in normal.

CN28
Diode assembly



CN21
Diode assembly

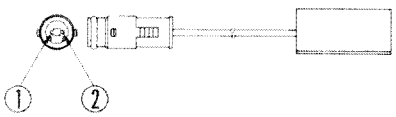


Table 1

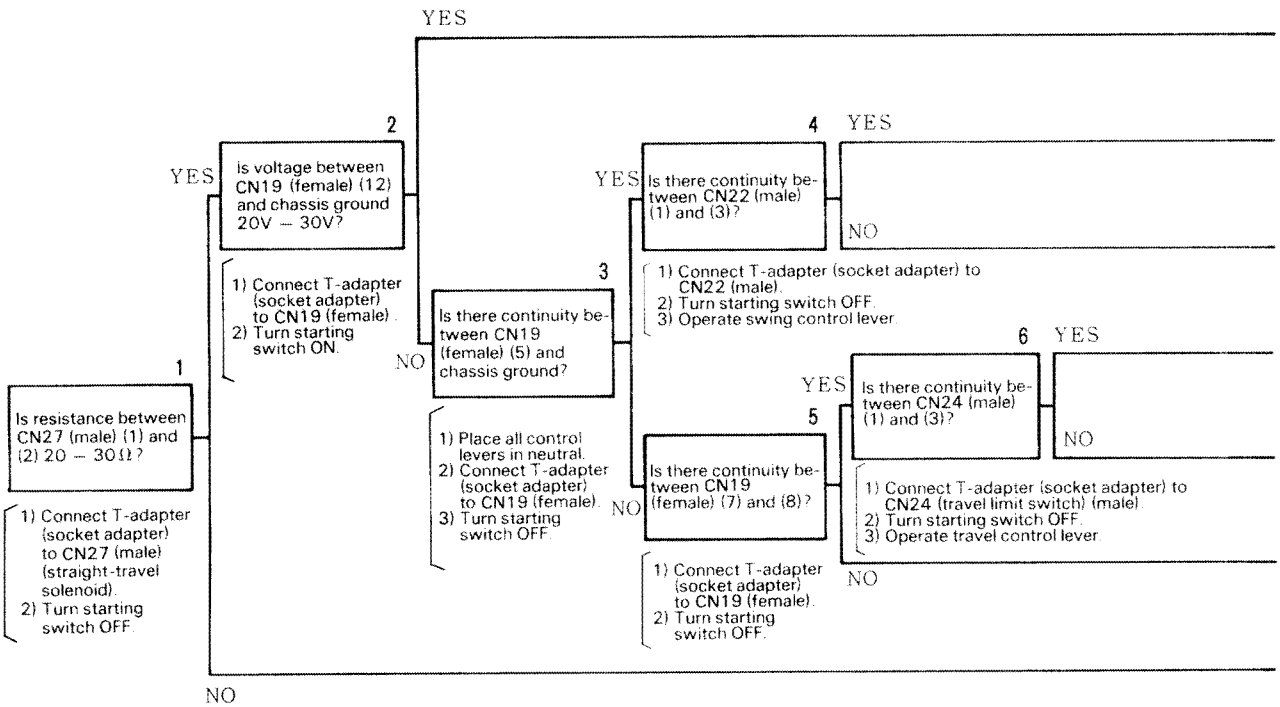
Tester pin		Continuity
Red	Black	
①	②	No
②	①	Yes

TROUBLESHOOTING CHART NO. E-2

Failure mode: Machine deviates excessively (during compound operations).
Machine deviates excessively (when starting).

★ Turn the starting switch OFF before removing the connector, and connect the T-adapter (or socket adapter).
★ Connect the male and female of the T-adapter respectively; for the socket adapter, connect as shown in ( ).
★ After disconnecting the connectors and checking, connect again immediately.

a) Compound operations



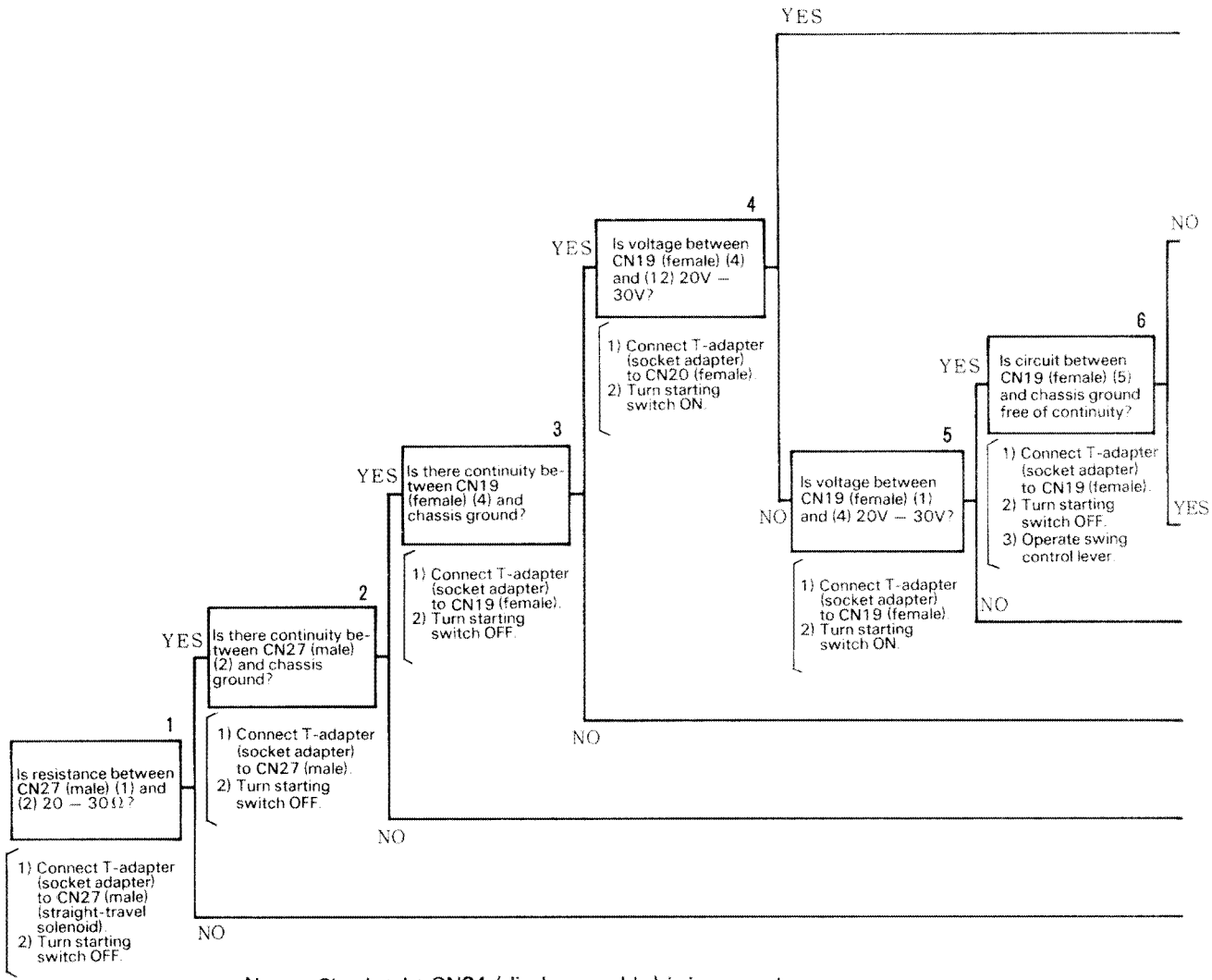
Trouble-shooting tools		
	Tester	T-adapter or socket adapter (for MIC)
	T-adapter or socket adapter (for Econosela)	T-adapter or socket adapter (for DLI)

★ FOR MACHINE EQUIPPED AUTO-DECELERATION SYSTEM AND OLSS

Cause	Remedy
Contact between CN27 (female) (1) – CN19 (female) (12) and CN19 (1) or (10).	Repair or replace
Contact between CN22 (female) (1) – CN19 (female) (5) and chassis ground.	Repair or replace
Swing limit switch defective.	Replace
Defective contact, disconnection in wiring harness between CN24 (female) (1) – CN19 (female) (7) and CN24 (female) (2) – CN19 (female) (8).	Clean (defective contact) or replace
Travel limit switch defective	Replace
Controller defective	Replace
Straight-travel solenoid defective	Replace

b) When starting

(Even when the swing and travel lever are operated at the same time, the voltage between CN27 (female) (1) and (2) of straight-travel solenoid valve connector is not over 20V.)



Note: Check taht CN34 (diode assembly) is in normal.

CN34

Diode assembly

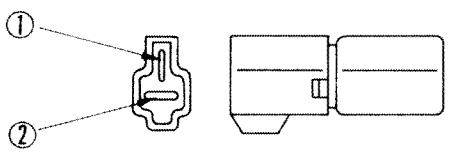
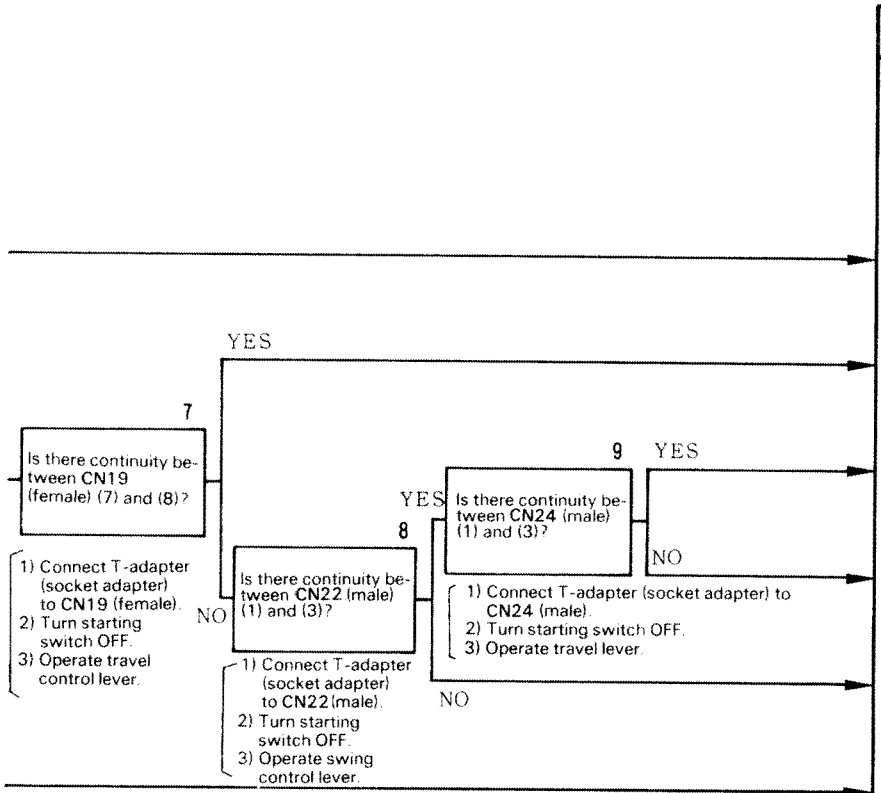


Table 1

Tester pin		Continuity
Red	Black	
①	②	No
②	①	Yes

Trouble-shooting tools	Tester	T-adapter or socket adapter (for MIC)
	T-adapter or socket adapter (for Econosela)	T-adapter or socket adapter (for DLI)

★ FOR MACHINE EQUIPPED AUTO-DECELERATION SYSTEM AND OLSS



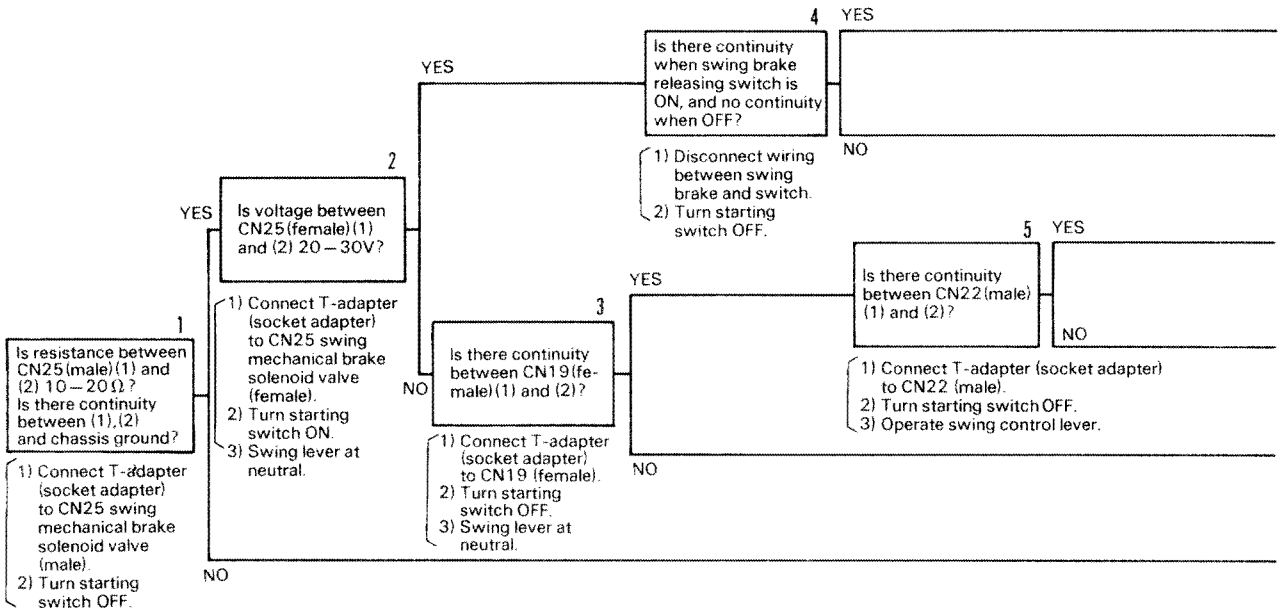
Cause	Remedy
Defective contact or disconnection in wiring harness between CN19 (female) (12) and CN27 (female) (1).	Clean (defective contact) or replace
Controller defective	Replace
Defective contact or disconnection in wiring harness between one of the following. CN19 (female) (7) – CN24 (female) (1) CN19 (female) (8) – CN24 (female) (2). CN19 (female) (5) – CN22 (female) (1) CN22 (female) (2) – chassis ground	Clean (defective contact) or replace
Travel limit switch defective	Replace
Swing limit switch defective.	Replace
Defective contact or disconnection in wiring harness between starting switch terminal ACC – CN18 (1) – CN19 (female) (1).	Replace
Defective contact or disconnection in wiring harness between fuse – CN13 (1) – CN19 (female) (1).	Clean (defective contact) or replace
Defective contact or disconnection in wiring harness between CN19 (female) (4) – CN34 (1), (2) - chassis ground.	Clean (defective contact) or replace
Defective contact or disconnection in wiring harness between CN27 (female) (2) and chassis ground.	Clean (defective contact) or replace
Straight-travel solenoid valve defective	Replace

TROUBLESHOOTING CHART NO. E-3

Failure mode: Hydraulic drift of swing is excessive, or upper structure does not swing.

★ Turn the starting switch OFF before removing the connector, and connect the T-adapter (or socket adapter).
★ Connect the male and female of the T-adapter respectively; for the socket adapter, connect as shown in ( ).
★ After checking the connectors, connect again immediately.

a) When swing lever is at neutral, there is electric current to swing mechanical brake solenoid valve, hydraulic drift of swing is excessive.



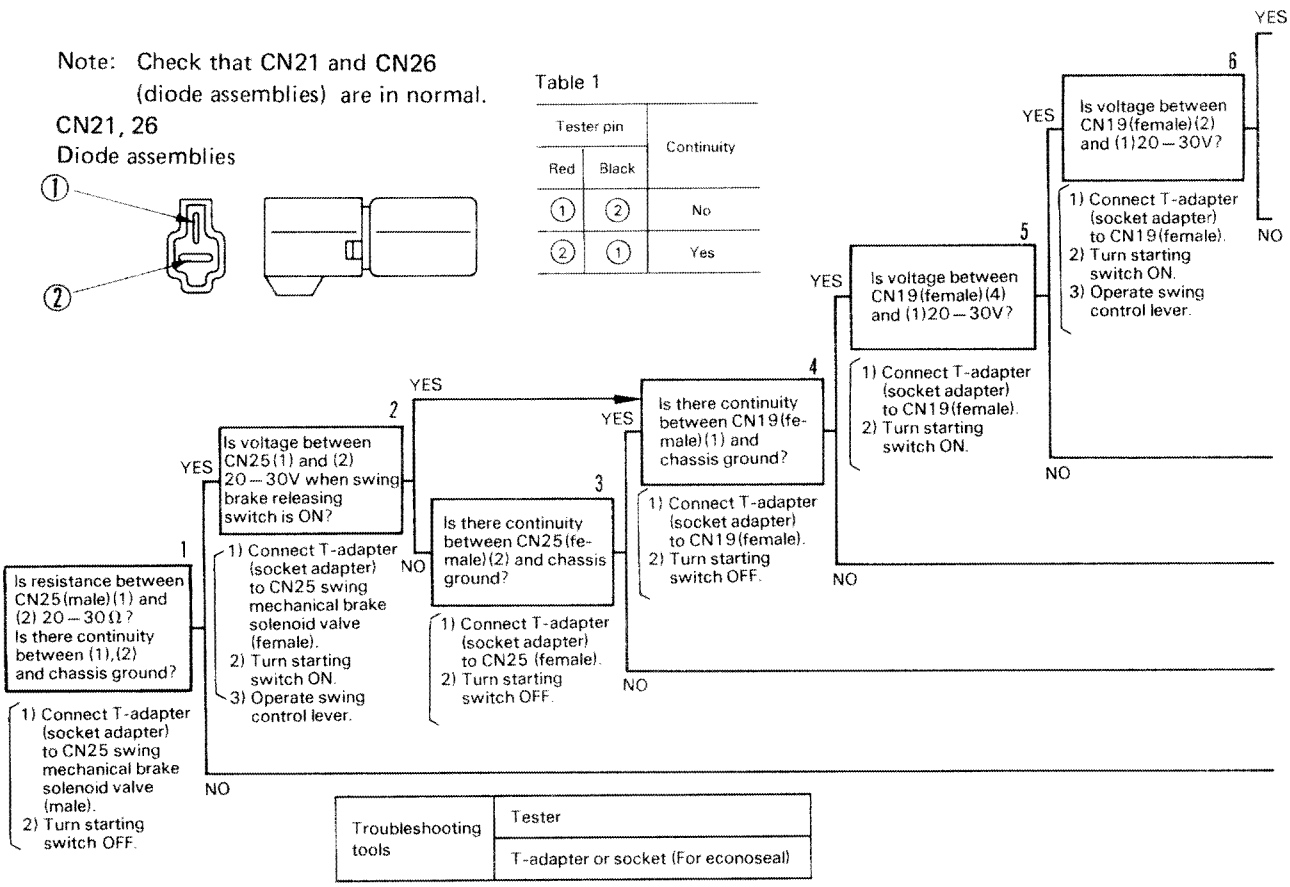
b) When swing lever is operated, there is no electric current to swing mechanical brake solenoid valve, upper structure does not swing.

Note: Check that CN21 and CN26 (diode assemblies) are in normal.

CN21, 26
Diode assemblies

Table 1

Tester pin		Continuity
Red	Black	
①	②	No
②	①	Yes



Troubleshooting tools	Tester
	T-adapter or socket (For econoseal)

Cause	Remedy
Abnormal contact between CN19 (4) – CN25 (1) with +24V.	Repair or replace.
Defective swing brake releasing switch.	Replace.
Contact between chassis ground and CN19 (4) – CN22 (1).	Repair or replace.
Defective swing limit switch.	Replace.
Defective timer.	Replace.
Defective swing brake solenoid.	Replace.

Table 2

Swing control lever	Continuity
Operated	No
Neutral	Yes

7 Is there continuity between CN19 (female) (2) and (1)?

1) Connect T-adapter (socket adapter) to CN19 (female).
2) Turn starting switch OFF.
3) Operate swing control lever.

YES

NO

8 Is there continuity between CN22 (male) (1) and (2) as shown in Table 2?

YES

NO

1) Connect T-adapter (socket adapter) to CN22 swing mechanical brake solenoid valve (male).
2) Turn starting switch OFF.
3) Move swing lever between neutral and operating position.

Cause	Remedy
Defective contact or disconnection in wiring harness between CN19 (female) (4) and CN25 (female) (1).	Clean (defective contact) or replace.
Defective timer.	Replace.
Defective contact or disconnection in wiring harness between CN19 (female) (2) and CN22 (female) (1) or CN22 (female) (2) and chassis ground.	Clean (defective contact) or replace.
Defective swing limit switch.	Replace.
Defective contact or disconnection in wiring harness between starting switch terminal ACC – CN18 (1) – CN19 (female) (4).	Clean (defective contact) or replace.
Defective contact or disconnection in wiring harness between CN19 (female) (1) and chassis ground.	Clean (defective contact) or replace.
Defective contact or disconnection in wiring harness between CN25 (female) (2) and chassis ground.	Clean (defective contact) or replace.
Defective swing mechanical brake solenoid valve.	Replace.

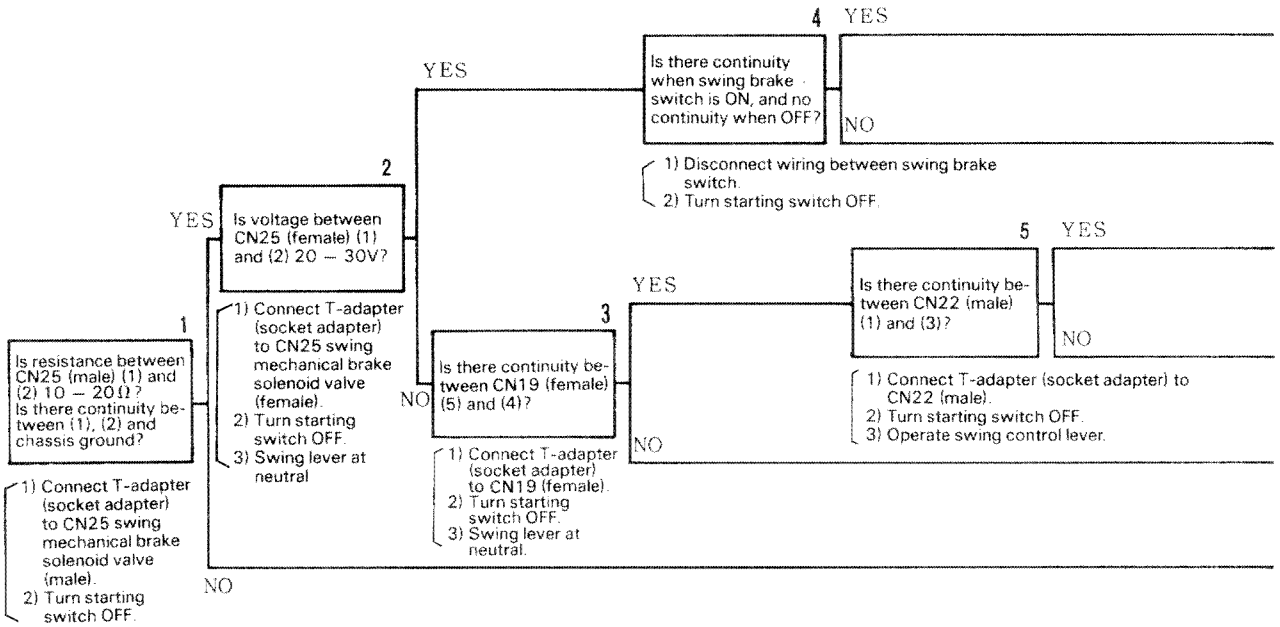
★ FOR MACHINES EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHKANICAL BRAKE AND OLSS

TROUBLESHOOTING CHART NO. E-3

Failure mode: Hydraulic drift of swing is excessive, or upper structure does not swing.

★ Turn the starting switch OFF before removing the connector, and connect the T-adapter (or socket adapter).
★ Connect the male and female of the T-adapter respectively; for the socket adapter, connect as shown in ( ).
★ After disconnecting the connectors and checking, connect again immediately.

a) When swing lever is at neutral, there is no electric current to swing mechanical brake solenoid valve hydraulic drift of swing excessive.



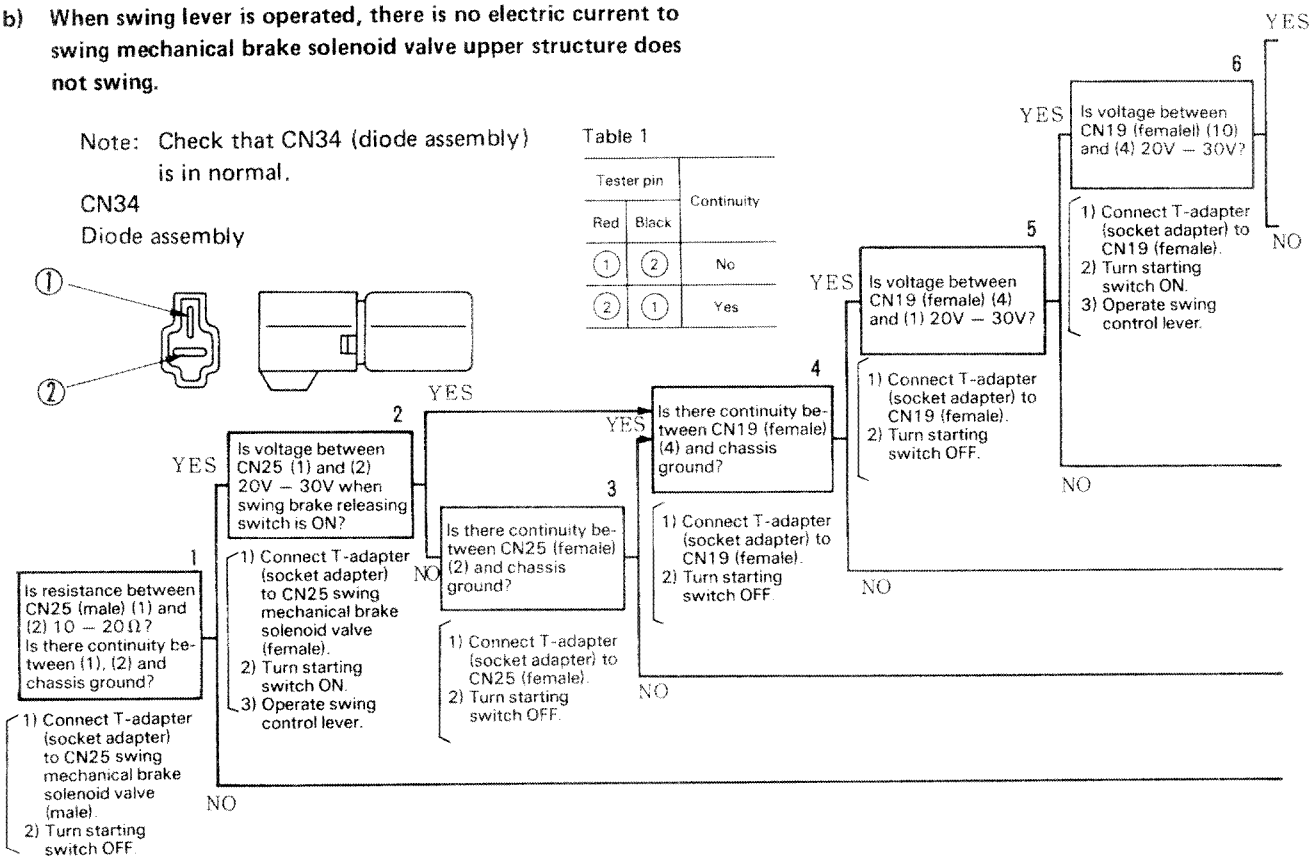
b) When swing lever is operated, there is no electric current to swing mechanical brake solenoid valve upper structure does not swing.

Note: Check that CN34 (diode assembly) is in normal.

CN34
Diode assembly

Table 1

Tester pin		Continuity
Red	Black	
①	②	No
②	①	Yes



★ FOR MACHINES EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHKANICAL BRAKE AND OLSS

Trouble-shooting tools		
	Tester	T-adapter or socket adapter (for MIC)
	T-adapter or socket adapter (for Econosela)	T-adapter or socket adapter (for DLI)

Cause	Remedy
Abnormal contact between CN19 (10) and CN25 (1) with CN19 (1) (+24V).	Repair or replace
Swing brake switch defective.	Replace
Contact between chassis ground and CN19 (5) — CN22 (1).	Repair or replace
Swing limit switch defective.	Replace
Controller defective	Replace
Swing brake solenoid valve defective	Replace
Defective contact or disconnection in wiring harness between CN19 (female) (10) and CN25 (female) (1).	Clean (defective contact) or replace.
Controller defective	Replace
Defective contact or disconnection in wiring harness between CN19 (female) (5) and CN22 (female) (1) or CN22 (female) (2) and chassis ground.	Clean (defective contact) or replace.
Swing limit switch defective.	Replace
Defective contact or disconnection in wiring harness between starting switch terminal ACC — CN18 (1) — CN19 (female) (1).	Clean (defective contact) or replace.
Defective contact or disconnection in wiring harness between CN19 (female) (4) — CN34 (1), (2) — chassis ground.	Clean (defective contact) or replace.
Defective contact or disconnection in wiring harness between CN25 (female) (2) and chassis ground.	Clean (defective contact) or replace.
Swing mechanical brake solenoid valve defective	Replace

7 Is there continuity between CN19 (female) (4) and (5)?

YES

NO

1) Connect T-adapter (socket adapter) to CN19 (female).
2) Turn starting switch OFF.
3) Operate swing control lever.

8 Is there continuity between CN22 (male) (1) and (3) as shown in table?

YES

NO

Swing control lever	Continuity
Operated	No
Neutral	Yes

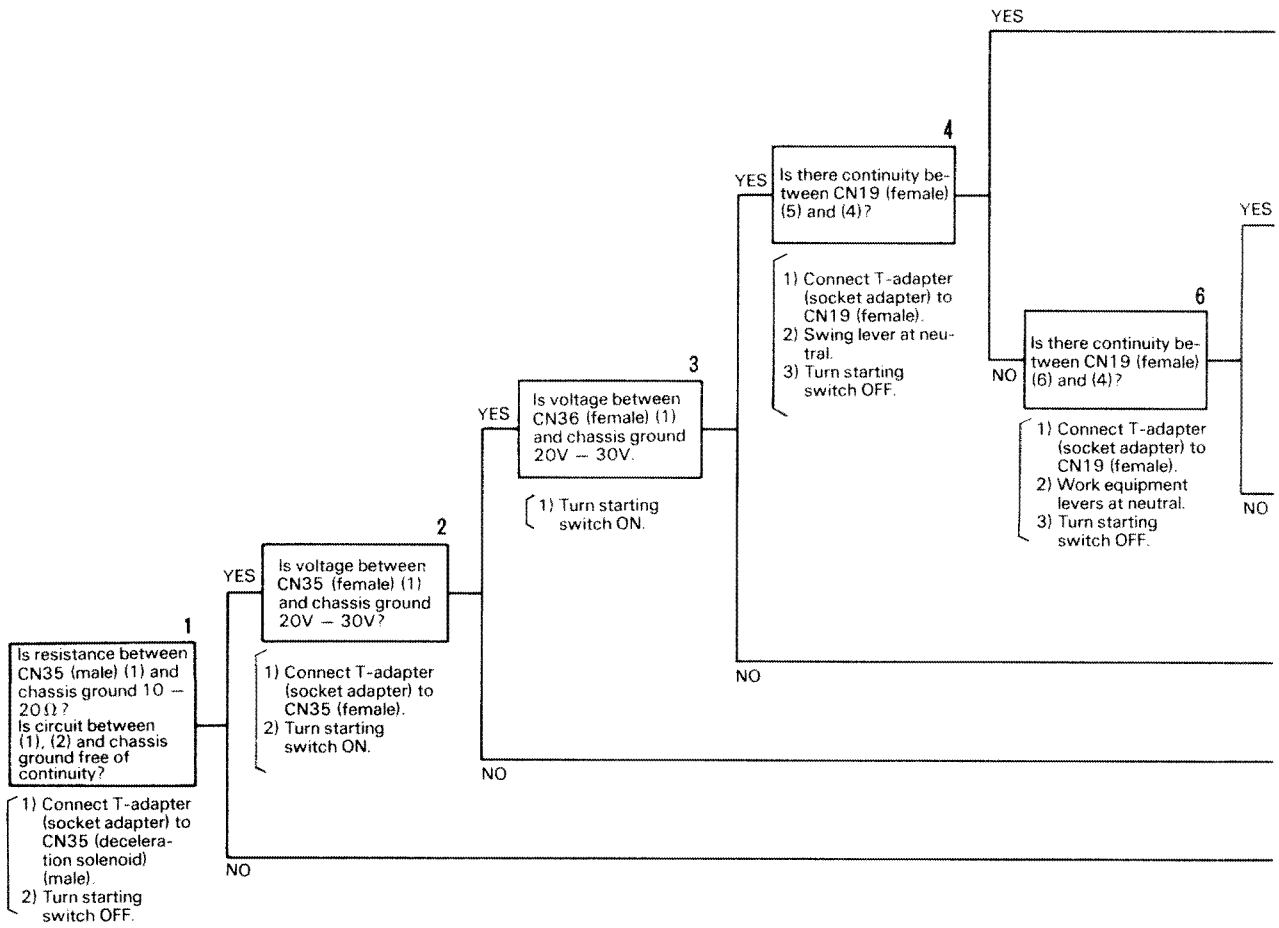
1) Connect T-adapter (socket adapter) to CN22 swing mechanical brake solenoid valve (male).
2) Turn starting switch OFF.
3) Move swing lever between neutral and operating position.

TROUBLESHOOTING CHART NO. E-4

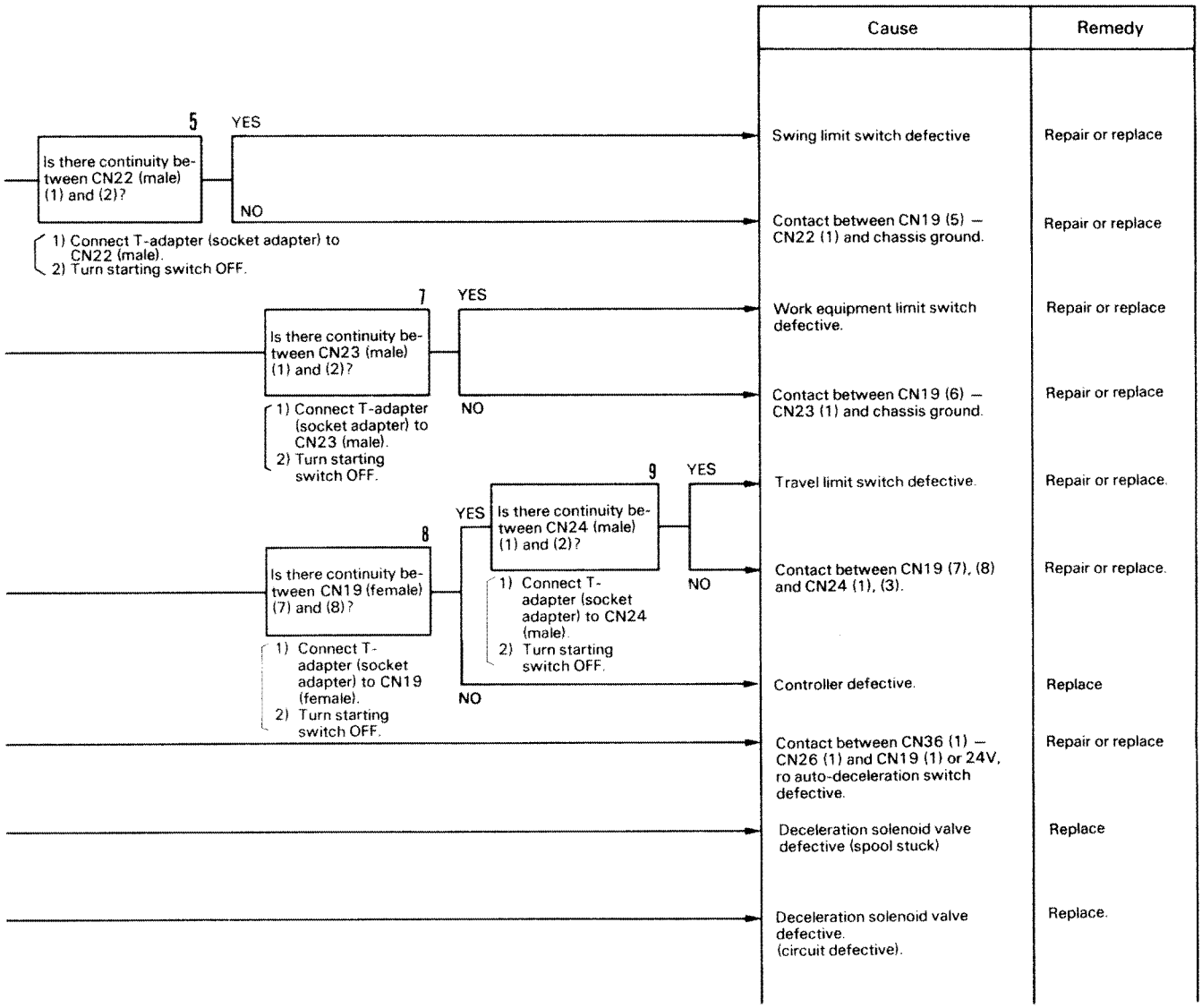
Failure mode: Auto-deceleration does not work.

★ Turn the starting switch OFF before removing the connector, and connect the T-adapter (or socket adapter).
★ Connect the male and female of the T-adapter respectively; for the socket adapter, connect as shown in ( ).
★ After disconnecting the connectors and checking, connect again immediately.

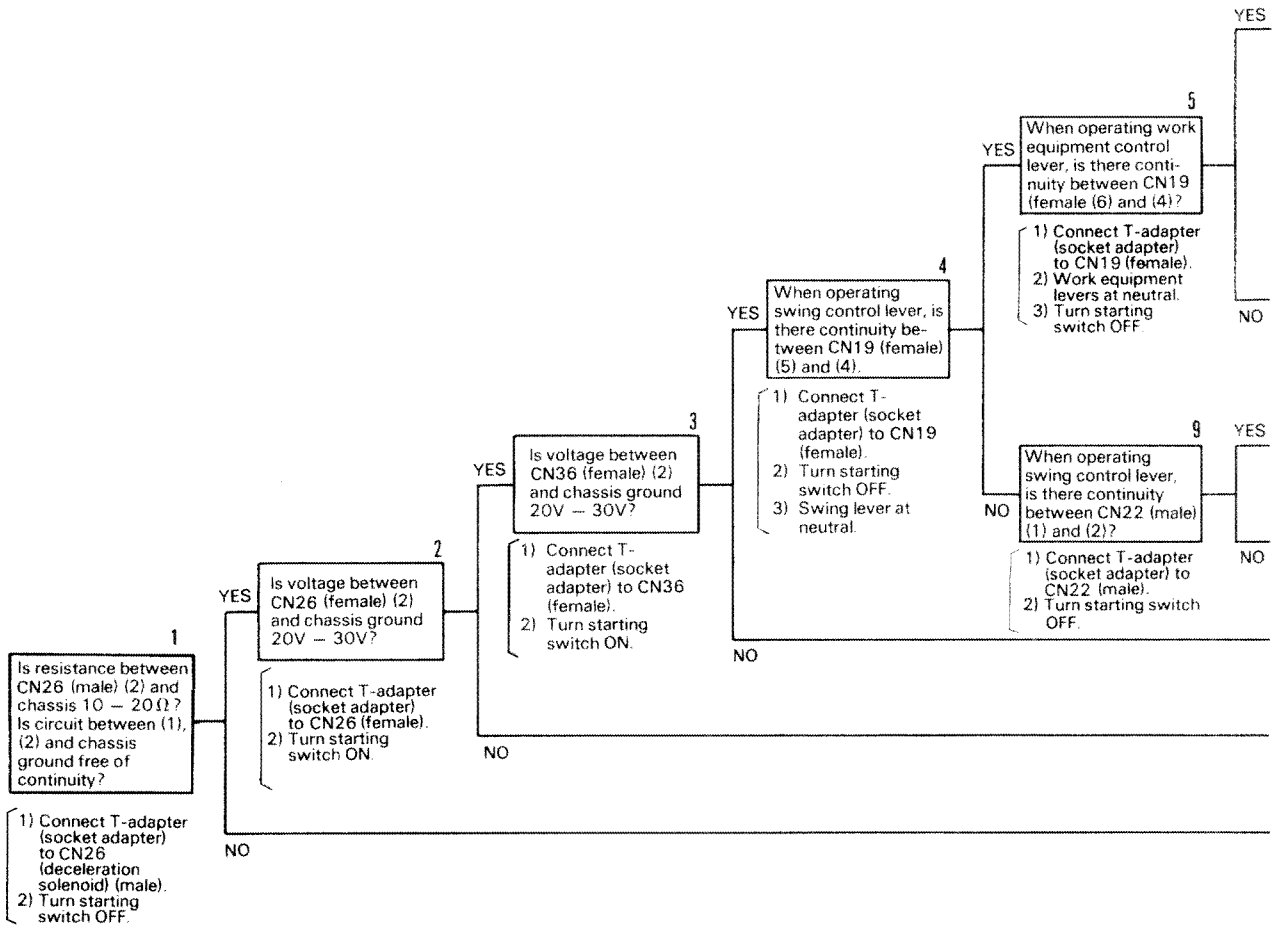
a) No deceleration when control levers (work equipment, swing) are at neutral.

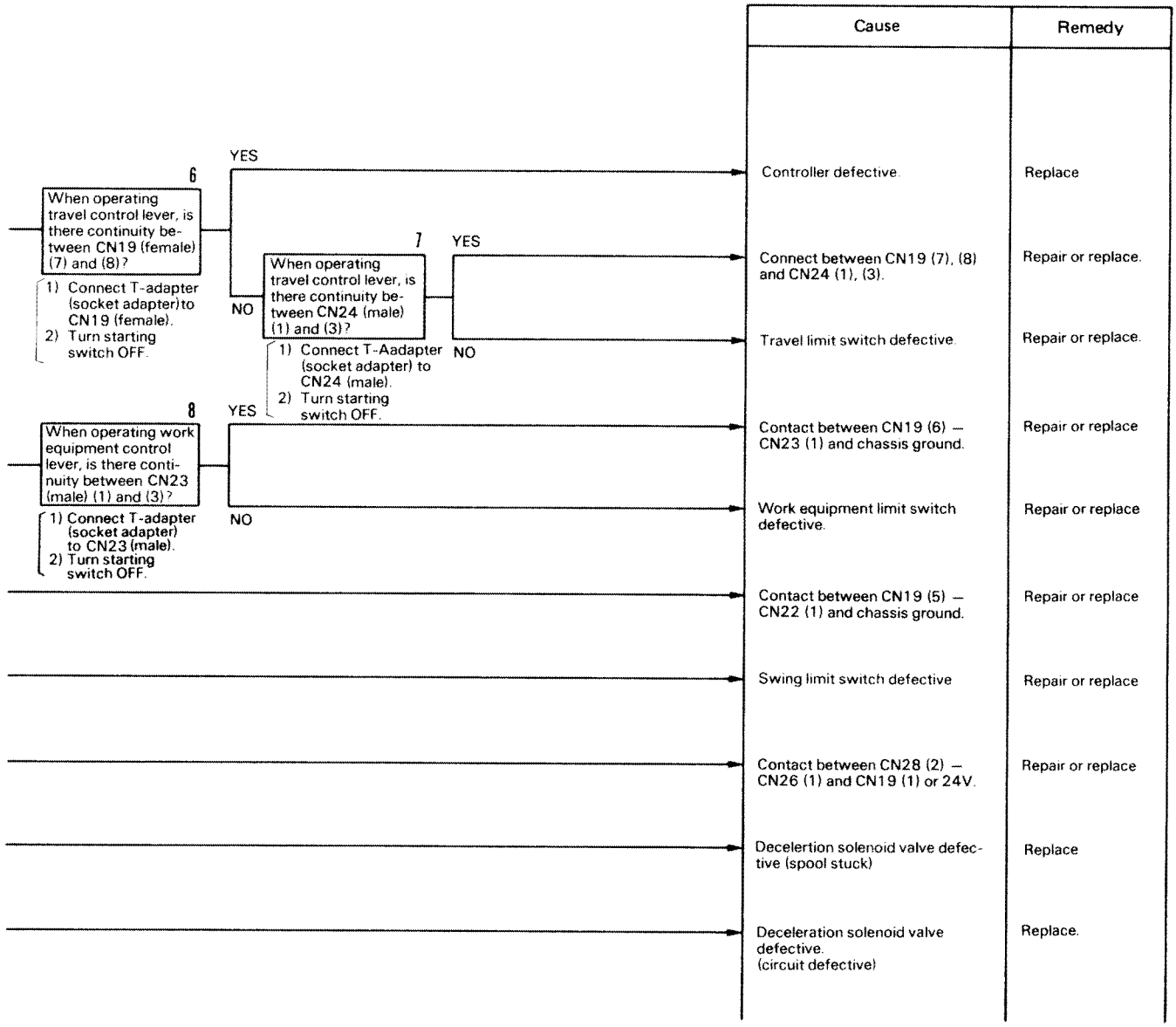


Trouble-shooting tools		
	Tester	T-adapter or socket adapter (for MIC)
	T-adapter or socket adapter (for Econosela)	T-adapter or socket adapter (for DLI)


Cause
Remedy
5
YES
Is there continuity between CN22 (male) (1) and (2)?
NO
1) Connect T-adapter (socket adapter) to CN22 (male).
2) Turn starting switch OFF.
Swing limit switch defective
Repair or replace
Contact between CN19 (5) — CN22 (1) and chassis ground.
Repair or replace
7
YES
Is there continuity between CN23 (male) (1) and (2)?
NO
1) Connect T-adapter (socket adapter) to CN23 (male).
2) Turn starting switch OFF.
Work equipment limit switch defective.
Repair or replace
Contact between CN19 (6) — CN23 (1) and chassis ground.
Repair or replace
9
YES
Is there continuity between CN24 (male) (1) and (2)?
NO
1) Connect T-adapter (socket adapter) to CN24 (male).
2) Turn starting switch OFF.
Travel limit switch defective.
Repair or replace.
8
YES
Is there continuity between CN19 (female) (7) and (8)?
NO
1) Connect T-adapter (socket adapter) to CN19 (female).
2) Turn starting switch OFF.
Contact between CN19 (7), (8) and CN24 (1), (3).
Repair or replace.
Controller defective.
Replace
Contact between CN36 (1) — CN26 (1) and CN19 (1) or 24V, ro auto-deceleration switch defective.
Repair or replace
Deceleration solenoid valve defective (spool stuck)
Replace
Deceleration solenoid valve defective. (circuit defective).
Replace.

b) Deceleration continues even when control levers (work equipment, swing and travel) are operated.

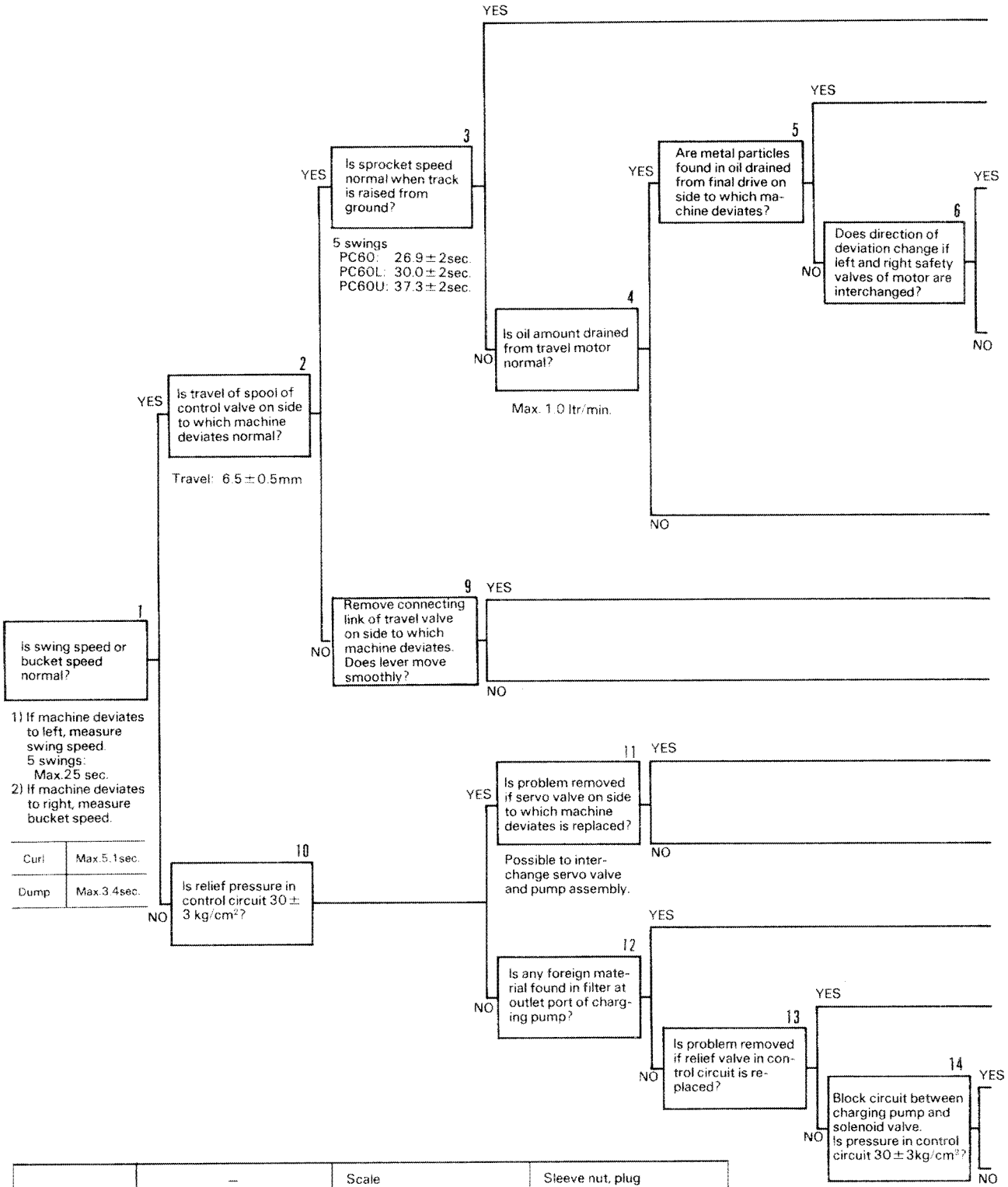



Cause
Remedy
6
When operating travel control lever, is there continuity between CN19 (female) (7) and (8)?
1) Connect T-adapter (socket adapter) to CN19 (female).
2) Turn starting switch OFF.
YES
NO
7
When operating travel control lever, is there continuity between CN24 (male) (1) and (3)?
1) Connect T-Aadapter (socket adapter) to CN24 (male).
2) Turn starting switch OFF.
YES
NO
8
When operating work equipment control lever, is there continuity between CN23 (male) (1) and (3)?
1) Connect T-adapter (socket adapter) to CN23 (male).
2) Turn starting switch OFF.
YES
NO
Controller defective.
Replace
Connect between CN19 (7), (8) and CN24 (1), (3).
Repair or replace.
Travel limit switch defective.
Repair or replace.
Contact between CN19 (6) — CN23 (1) and chassis ground.
Repair or replace
Work equipment limit switch defective.
Repair or replace
Contact between CN19 (5) — CN22 (1) and chassis ground.
Repair or replace
Swing limit switch defective
Repair or replace
Contact between CN28 (2) — CN26 (1) and CN19 (1) or 24V.
Repair or replace
Decelertion solenoid valve defective (spool stuck)
Replace
Deceleration solenoid valve defective. (circuit defective)
Replace.

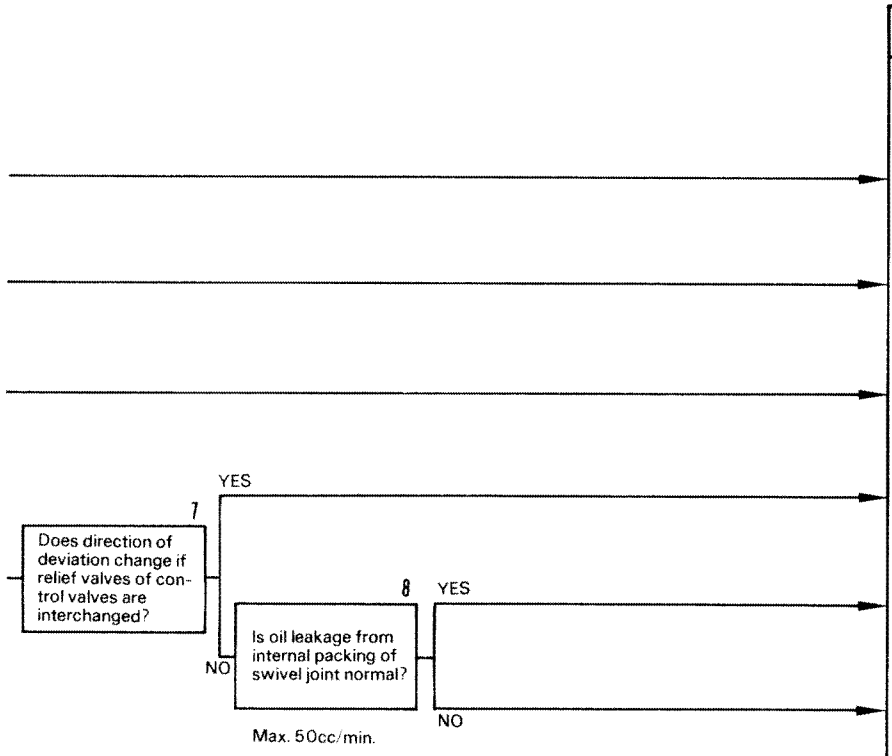
TROUBLESHOOTING CHART NO. H-1

Failure mode: Machine deviates excessively (deviates more than standard when only travel system is used, travel lever is pulled fully).

★ For details of measuring deviation, see TESTING AND ADJUSITNG.



Troubleshooting tools	—	Scale	Sleeve nut, plug
	Thermistor temperature gauge	Stop watch	Measuring cylinder
	Oil pressure gauge (60 kg/cm²)	Servo valve (Limited supply)	Control relief valve

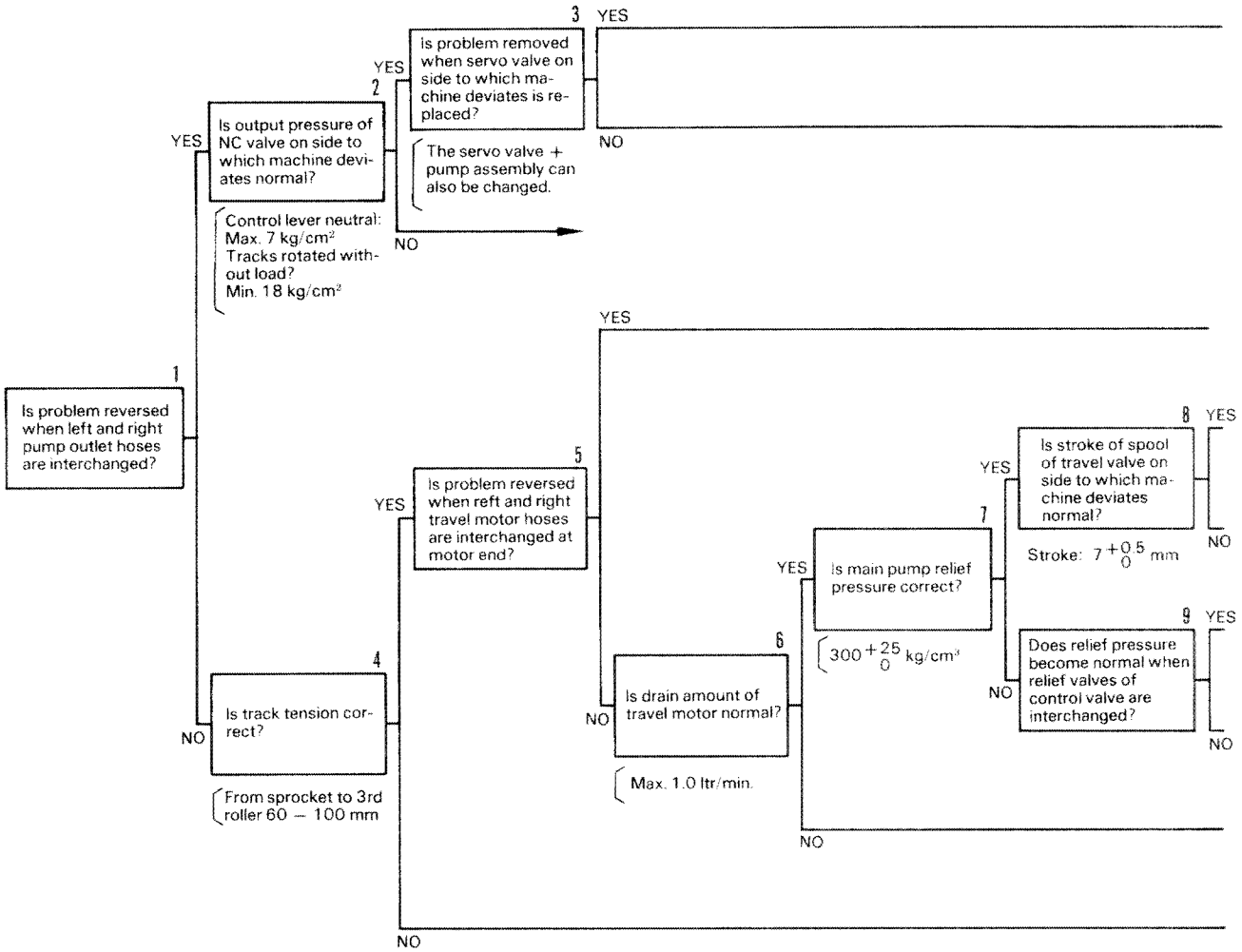


Cause	Remedy
Track tension defective.	Adjust.
Final drive defective.	Disassemble and replace damaged parts.
Excessive leakage from safety valve of motor.	Clean or replace.
Main relief valve defective.	Clean or replace.
Travel motor defective.	Replace.
Swivel shaft seal defective.	Replace shaft seal, or replace swivel assembly.
Drop in efficiency of motor.	Replace motor assembly.
Defective spool or seize.	Replace.
Lever linkage defective.	Adjust or replace.
Failure inside servo valve.	Replace servo valve.
F or R pump defective.	Replace F-R pump.
Charging pump defective.	Replace.
Control circuit relief valve defective.	Replace.
Internal leakage of solenoid valve.	Replace.
Internal leakage of servo valve.	Replace.

TROUBLESHOOTING CHART NO. H-1

Failure mode: Machine deviates excessively (deviates more than standard when only travel system is used, travel lever at full travel).

★ For details of measuring deviation, see Testing and adjusting.
★ Following measured value is at S position of mode selector switch.

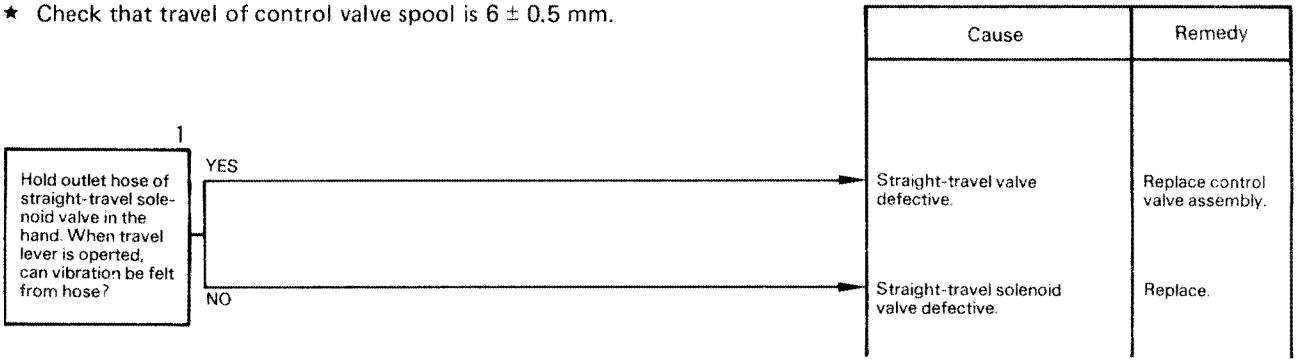


Cause	Remedy
Operation of servo valve defective.	Replace servo valve assembly
Defective servo piston or pump.	Replace
Defective swivel shaft seal.	Replace shaft seal or replace swivel assembly
Operation of spool defective or internal leakage from spool.	Repair or replace
Scuffing of lever or link.	Repair
Defective relief valve.	Adjust or replace
Defective pump.	Replace F, R pump sub assembly.
Defective travel motor.	Replace motor assembly
Defective track tension.	Adjust

TROUBLESHOOTING CHART NO. H-2

Failure mode: Machine deviates excessively during compound operation.

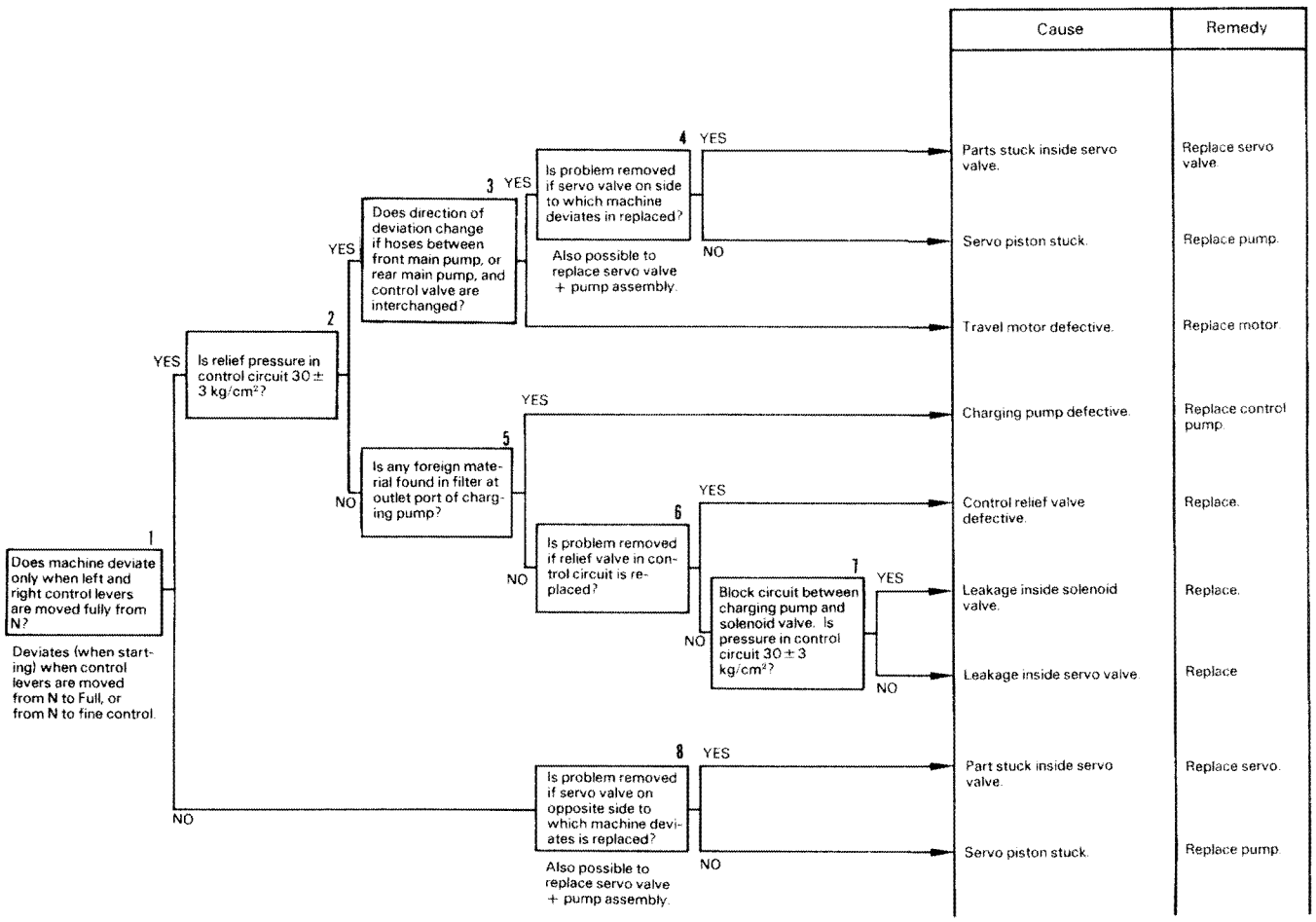
★ Check that travel of control valve spool is 6 ± 0.5 mm.



TROUBLESHOOTING CHART NO. H-3

Failure mode: Machine deviates excessively when starting.

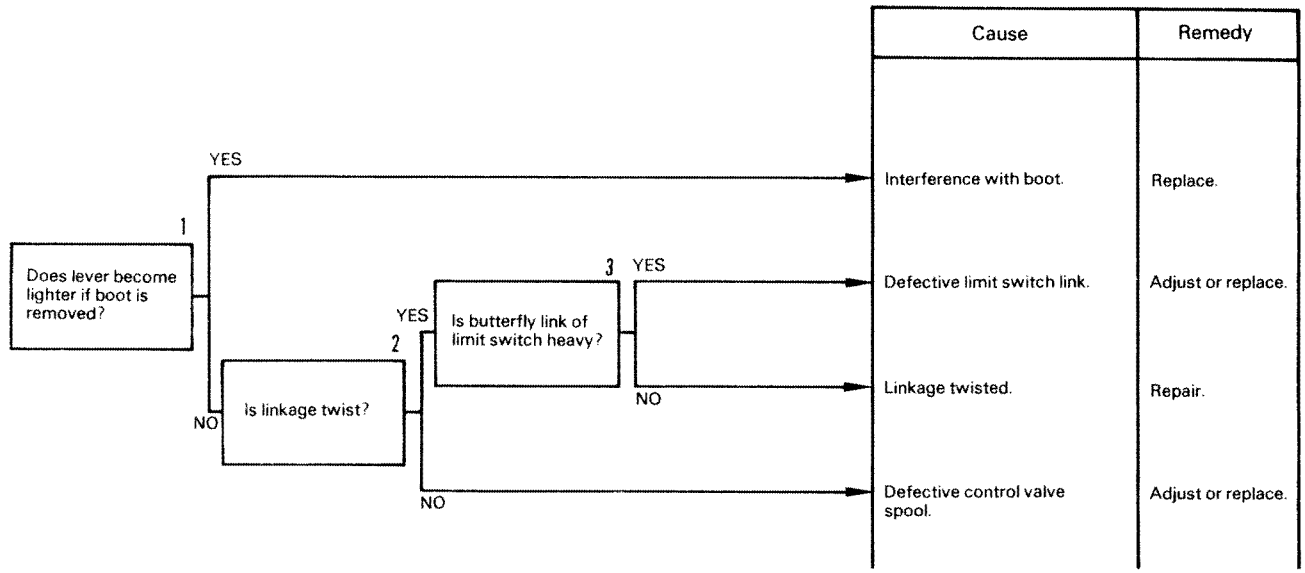
★ If the machine also deviates during normal travel, go to H-1 "Machine deviates excessively."
★ If the machine deviates when the work equipment is operated, go to H-2 "Machine deviates excessively during compound operations."
★ Air must be bled from the circuits.
★ Check that travel of control valve spool is 6 ± 0.5 mm.



Troubleshooting tools	Oil pressure gauge (60 kg/cm²)	Servo valve	Control relief valve
	Sleeve nut, plug	Thermistor temperature gauge	—

TROUBLESHOOTING CHART NO. H-4

Failure mode: Control levers are extremely heavy.



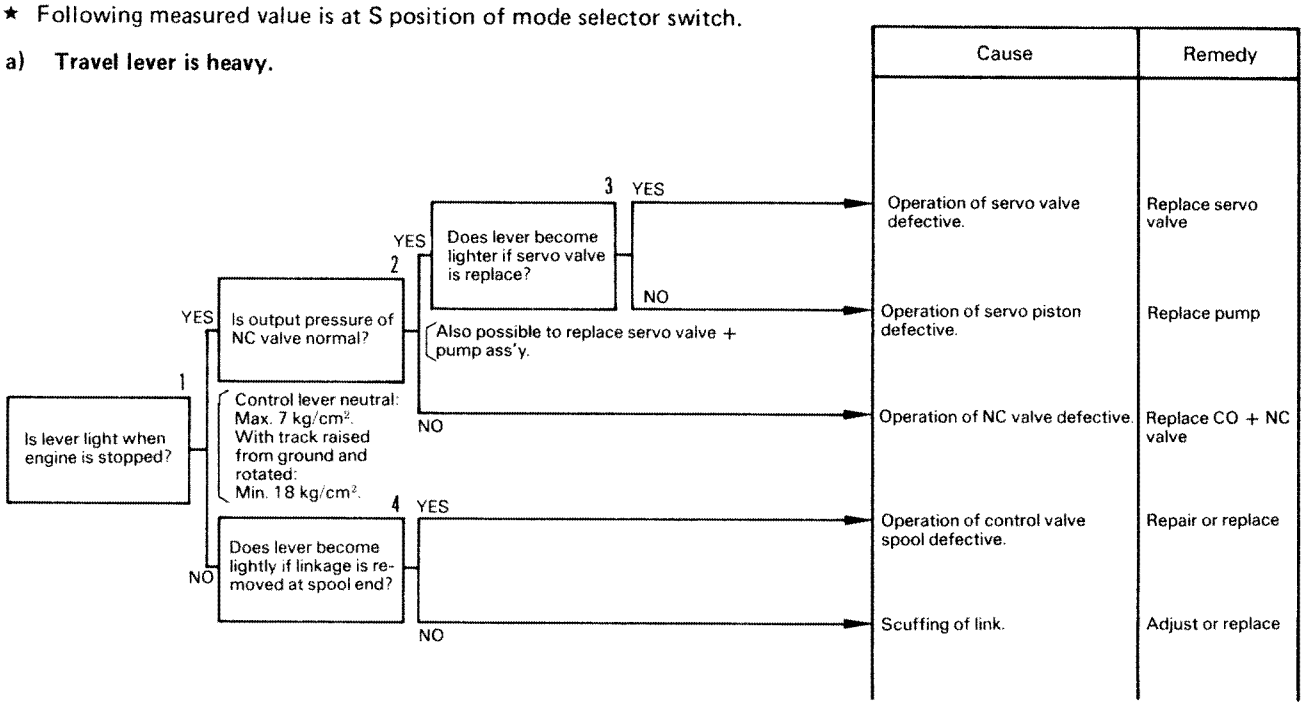
★ FOR MACHINE EQUIPPED WITH OLSS

TROUBLESHOOTING CHART NO. H-4

Failure mode: Control levers are extremely heavy.

★ Following measured value is at S position of mode selector switch.

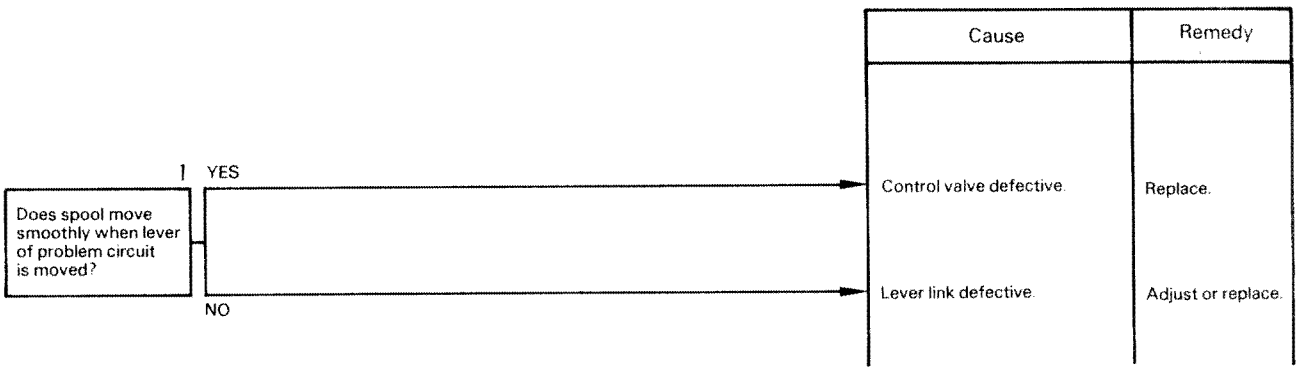
a) Travel lever is heavy.



Trouble-shooting tools	Oil pressure gauge (60 kg/cm²)	Servo valve	Push pull scale
	Thermistor kit	Jet sensor relief valve	

TROUBLESHOOTING CHART NO. H-5

Failure mode: Work equipment, travel and swing start suddenly during fine control operations.

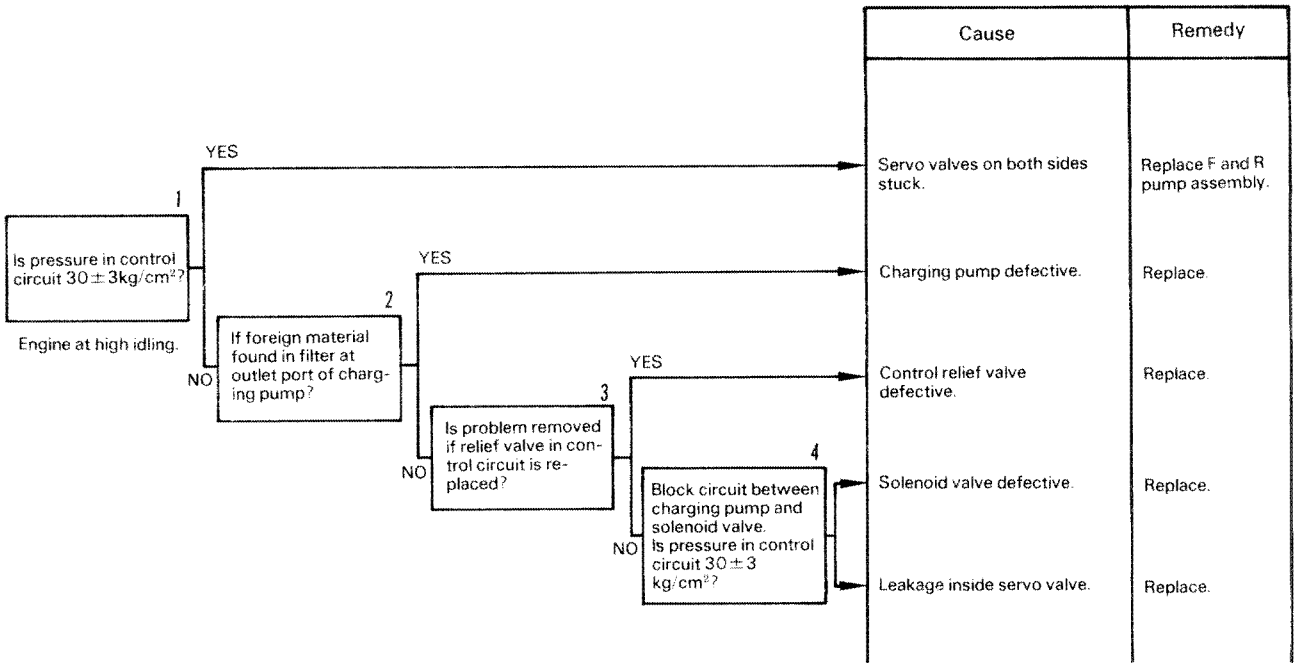


TROUBLESHOOTING CHART NO. H-6

Failure mode: Speeds for work equipment, swing, and travel are all extremely slow, or there is no power.

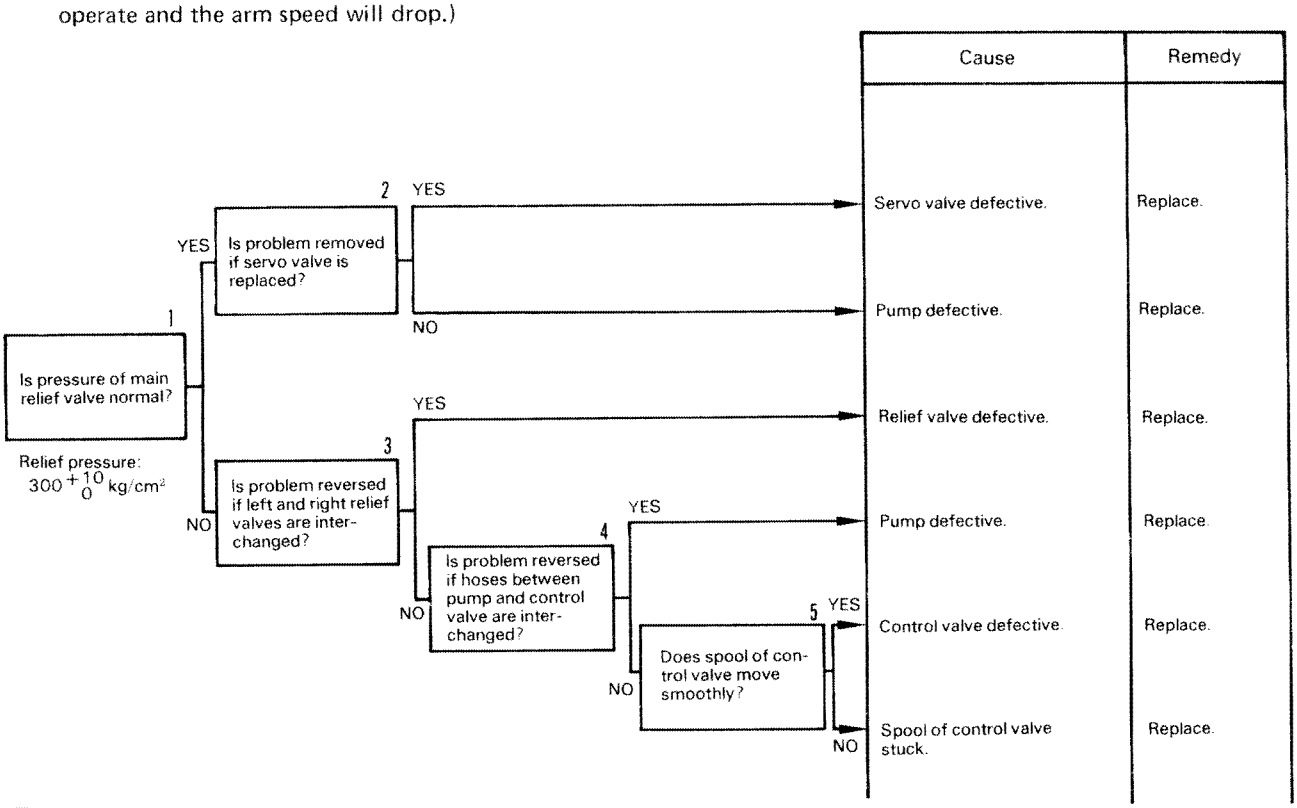
★ If there is any symptom (black exhaust smoke, etc.) that indicates that the engine output is low, go to troubleshooting for engine "Lack of power."

a) Machine hardly move. (Work equipment does not move. Upper structure does not swing. Machine does not travel.)



b) Abnormality is some part (abnormality on one side).

- Swing speed and left travel are slow, or bucket and right travel are slow.
- Boom, arm move at half speed. (If the swing brake releasing switch is RELEASE, the swing priority valve will operate and the arm speed will drop.)

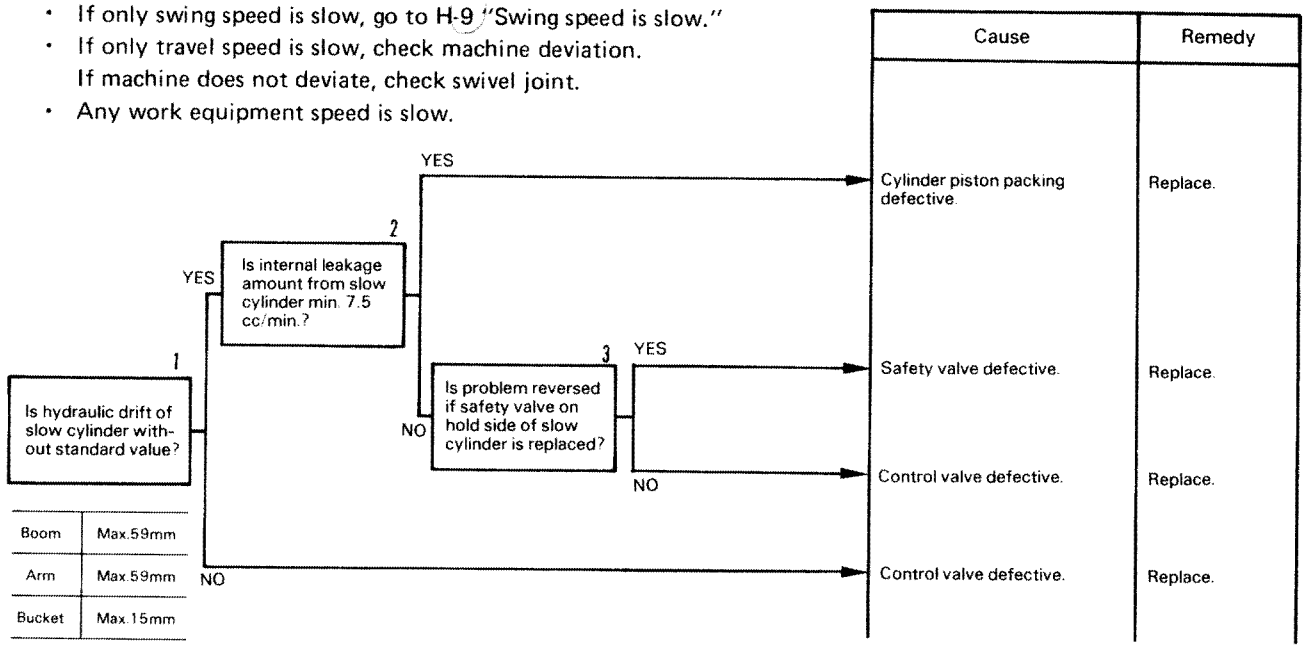


Troubleshooting tools	Oil pressure gauge (60, 450 kg/cm²)	Relief valve in control circuit	Servo valve
	Thermistor kit	Sleeve nut, plug	—

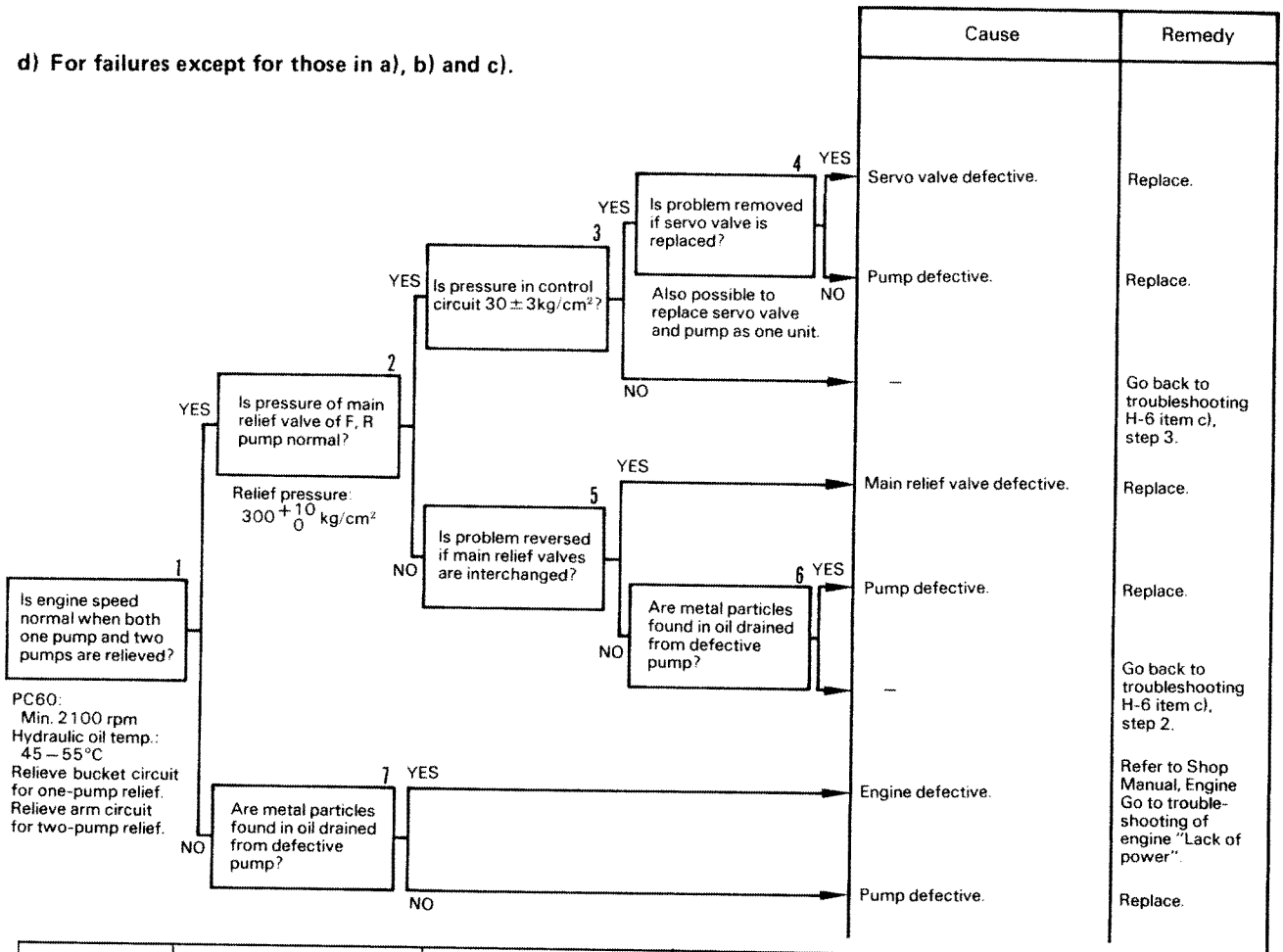
★ If the swing brake switch is RELEASE, the swing priority valve will operate and the arm speed will drop.

c) Individual symptoms

- If only swing speed is slow, go to H-9 "Swing speed is slow."
- If only travel speed is slow, check machine deviation.
  If machine does not deviate, check swivel joint.
- Any work equipment speed is slow.



d) For failures except for those in a), b) and c).



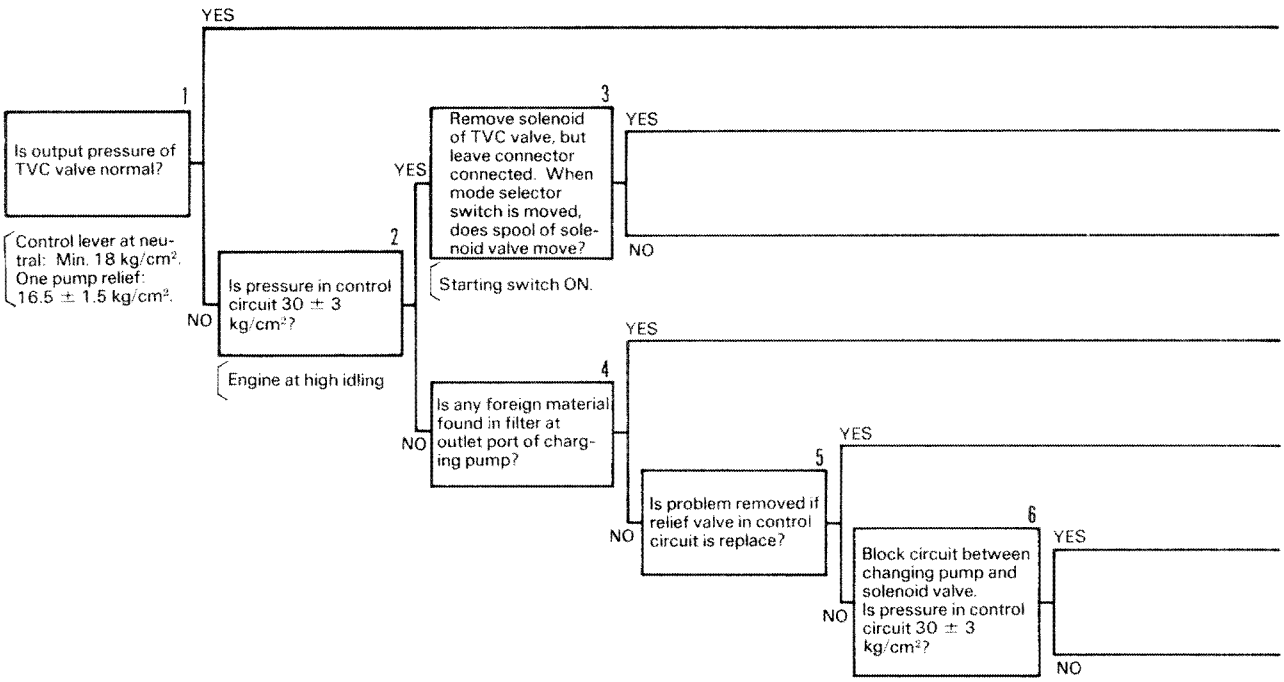
Troubleshooting tools	Stop watch	Multi-purpose tachometer	Measuring cylinder	Scale
	Servo valve	Hydraulic tester	Sleeve nut, plug	–

TROUBLESHOOTING CHART NO. H-6

Failure mode: Speeds for work equipment, swing, and travel are all extremely slow, or there is no power (no abnormality in auto-deceleration

★ Check that there is no abnormality in the auto-deceleration system. If there is any abnormality, go to H-10 "Auto-deceleration does not work".
★ If there is any symptom (black exhaust smoke, etc.) that indicates that the engine output is low, go to troubleshooting for engine "Lack of power".
★ Following measured value is at S position of mode selector switch.

a) Machine hardly move (Work equipment does not move. Upper structure does not swing. Machine does not travel.)



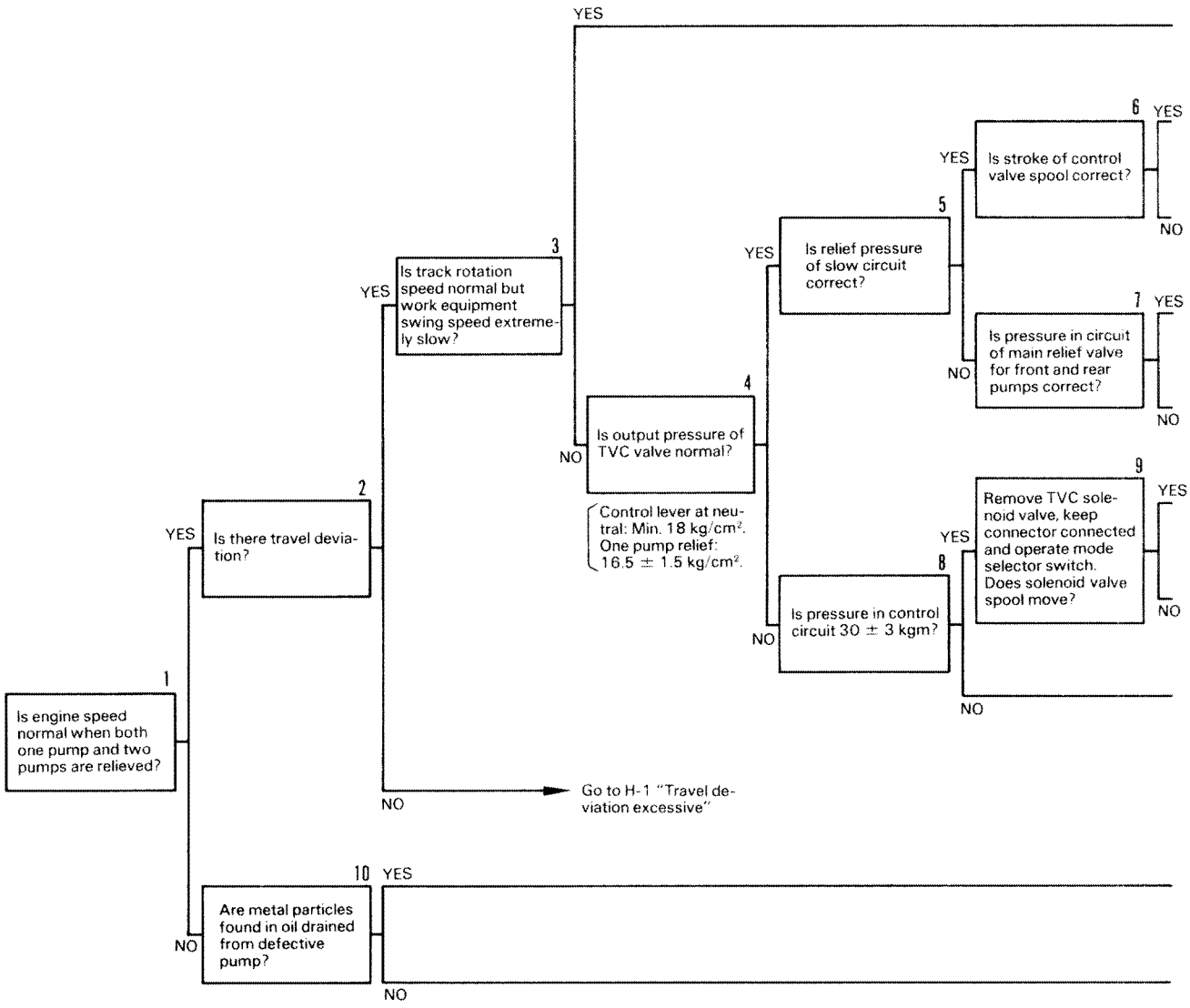
Troubleshooting tools	Oil pressure gauge (60 kg/cm²)	Relief valve in control circuit
	Thermiustor kit	Sleeve nut, plug

★ FOR MACHINE EQUIPPED WITH AUTO-DECELERATON SYSTEM AND OLSS

Cause	Remedy
Servo valves on both sides stuck.	Replace F and R pump ass'y
TVC valve stuck.	Replace
Solenoid valve seized.	Replace
Charging pump defective.	Replace
Control relief valve defectrive.	Replace
Leakage inside servo valve.	Replace
Solenoid valve defective.	Replace

b) Abnormality is some part (abnormality on one side).

- Swing speed and left travel are slow, or bucket and right travel are slow.
- Boom, arm move at half speed.
  (If the swing brake switch (If equipped) is RELEASE, the swing priority valve will operated and the arm speed will drop.)



Trouble-shooting tools		
	Stop watch	Multi-purpose tachometer
	Scale	Hydraulic tester

Control valve	Control circuit	Main relief set pressure (kg/cm²)	Safety valve set pressure (kg/cm²)
L.H. control valve	Arm (Lo)	305	310
	Boom (Hi)		Bottom 270
	Swing		230
	L.H. travel		—
R.H. control valve	Boom (Lo)	305	Bottom 310
			Head 310
	Arm (Hi)		Head 270
	Bucket		230
	R.H. travel		—

Cause	Remedy
Defective travel shuttle valve.	Replace
Defective adjustment of linkage.	Adjust
Excessive leakage from spool.	Replace
Defective safety valve.	Replace
Defective main relief valve.	Adjust or replace
Defective operation of TVC valve spool.	Replace
Defectie TVC valve solenoid.	Replace
→ Go to H-6 (a) Step 2	
Defective pump.	Replace
Drop in engine output.	See Engine Shop Manual

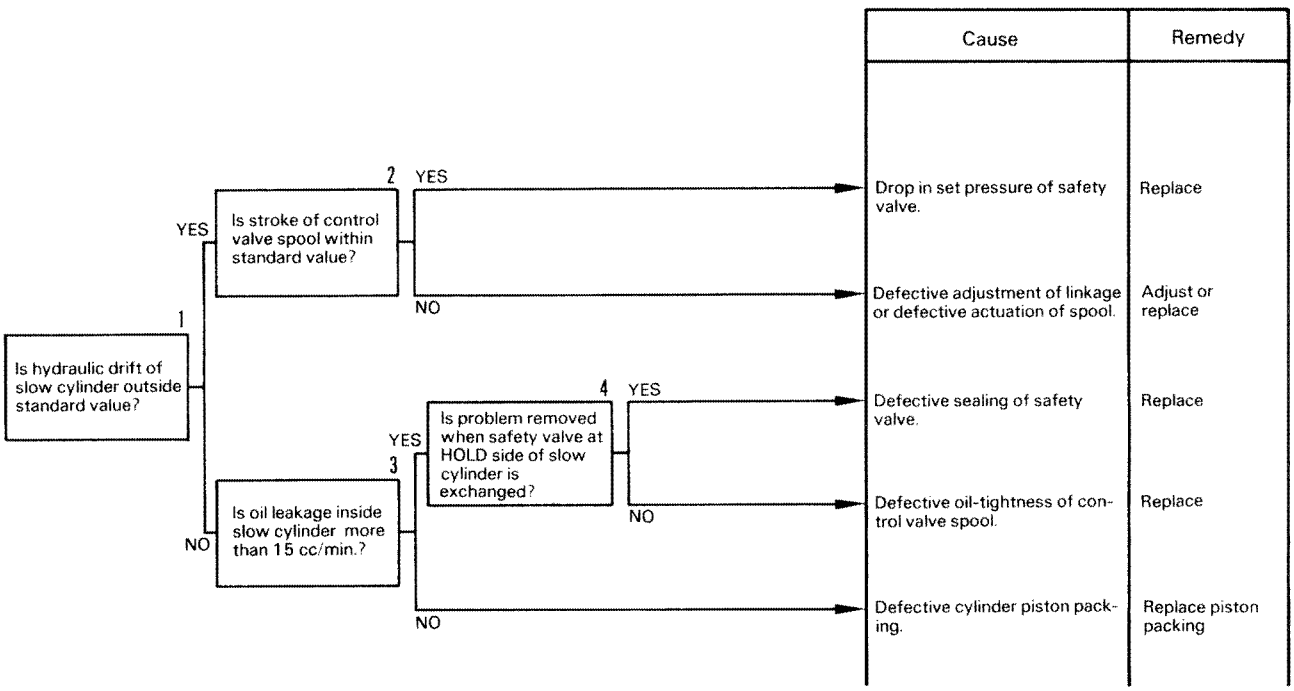
TROUBLESHOOTING CHART NO. H-7

Failure mode: Speeds for boom, arm and bucket are slow, or there is no power (no abnormality in auto-deceleration)

★ Following measured value is at S position of mode selector switch.
★ If the swing brake switch (If equipped) is RELEASE, the swing priority valve will operated and the arm speed will drop.

Individual symptoms

- If only swing speed is slow, go to H-12 "Swing speed is slow."
- If only travel speed is slow, check machine deviates.
  If machine does not deviate, check swivel joint.
- Any work equipment speed is slow.

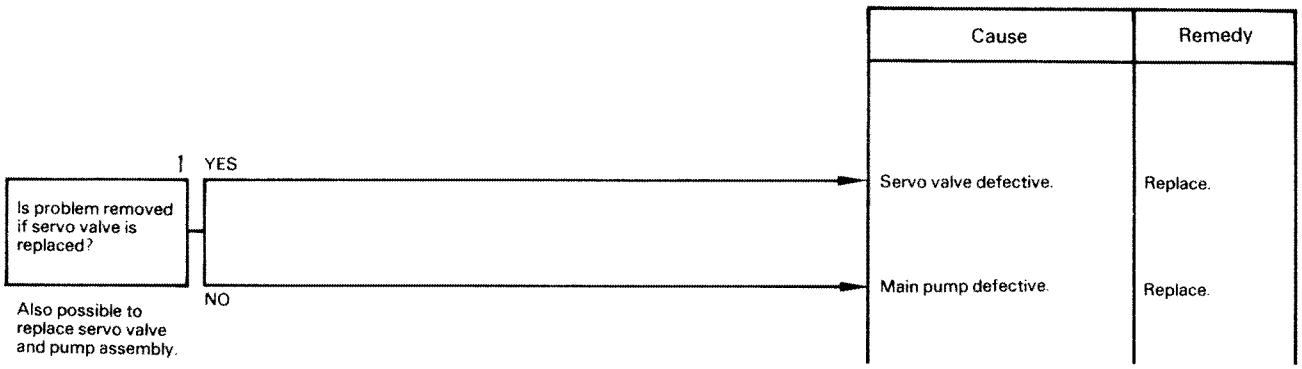


Trouble-shooting tools			
	Scale	Measuring sylinder	Stop watch
	Oil pressure gauge (60 kg/cm²)	Sleeve nut, plug	———

TROUBLESHOOTING CHART NO. H-8

Failure mode: Engine stalls or engine speed drops during operations.

★ Engine output is normal.
★ If work equipment speed is slow, or it does not move, go to H-6 a).

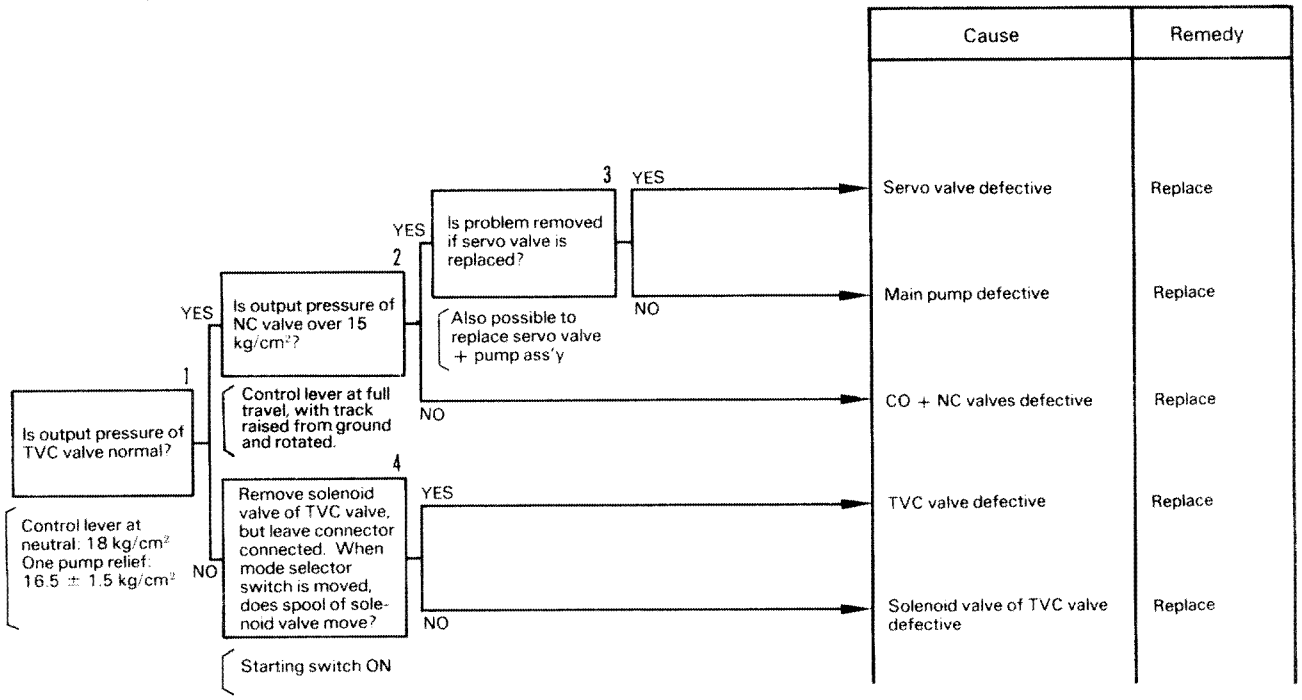


Troubleshooting tools	Oil pressure gauge (60 kg/cm²)	Servo valve
	Thermistor temperature gauge	Sleeve nut, plug

TROUBLESHOOTING CHART NO. H-8

Failure mode: Engine stalls or engine speed drops during operations.

★ Engine output taken as normal.
★ If the work equipment speed is slow, or it does not move, go to H-6 a).
★ Following measured value is at S position of mode selector switch.

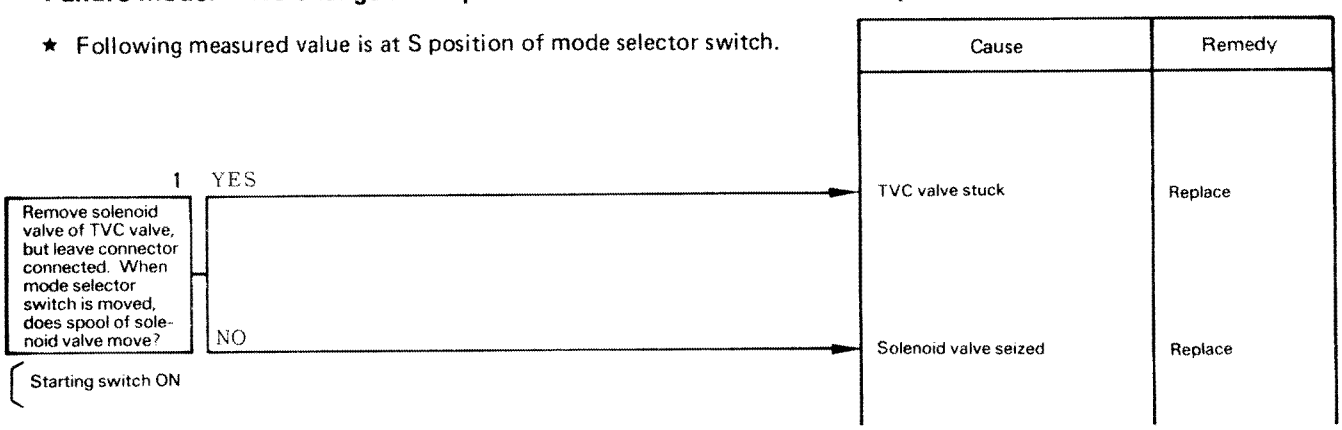


Trouble-shooting tools			
	Hydraulic tester	Servo valve	Jet sensor relief valve
	Thermistor kit	Sleeve nut, plug	———

TROUBLESHOOTING CHART NO. H-9

Failure mode: No change in output when mode selector switch is operated.

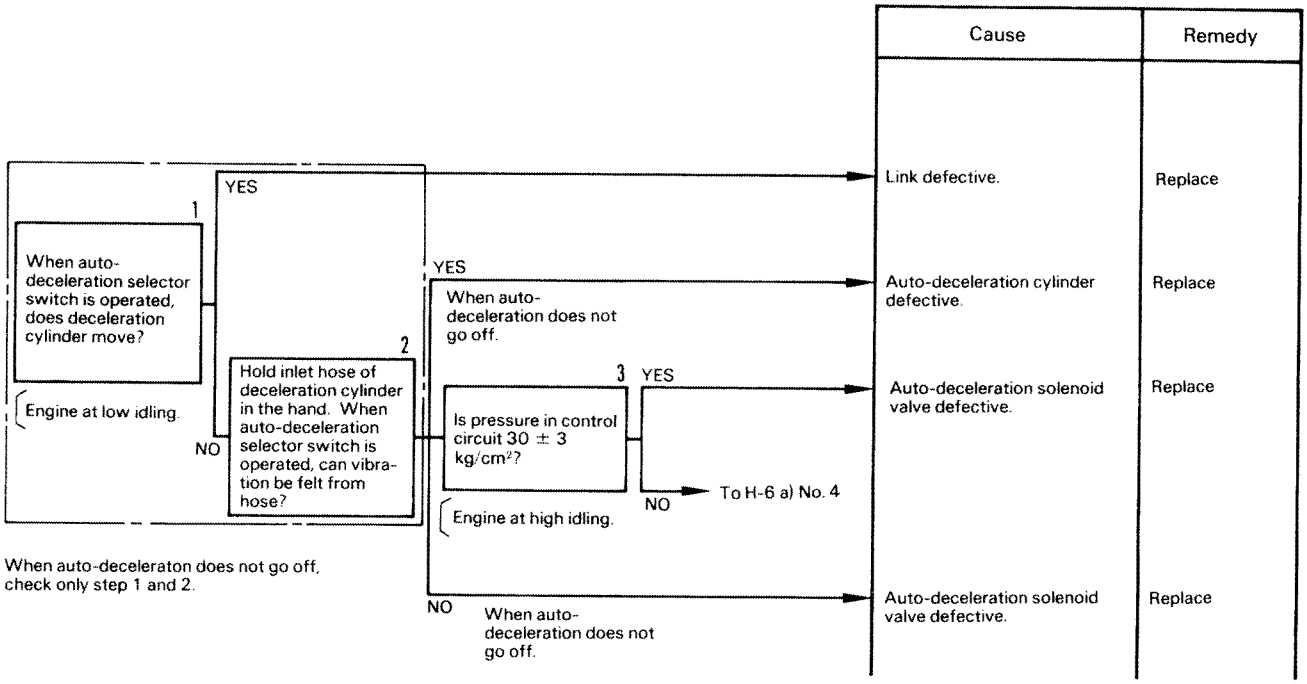
★ Following measured value is at S position of mode selector switch.



TROUBLESHOOTING CHART NO. H-10

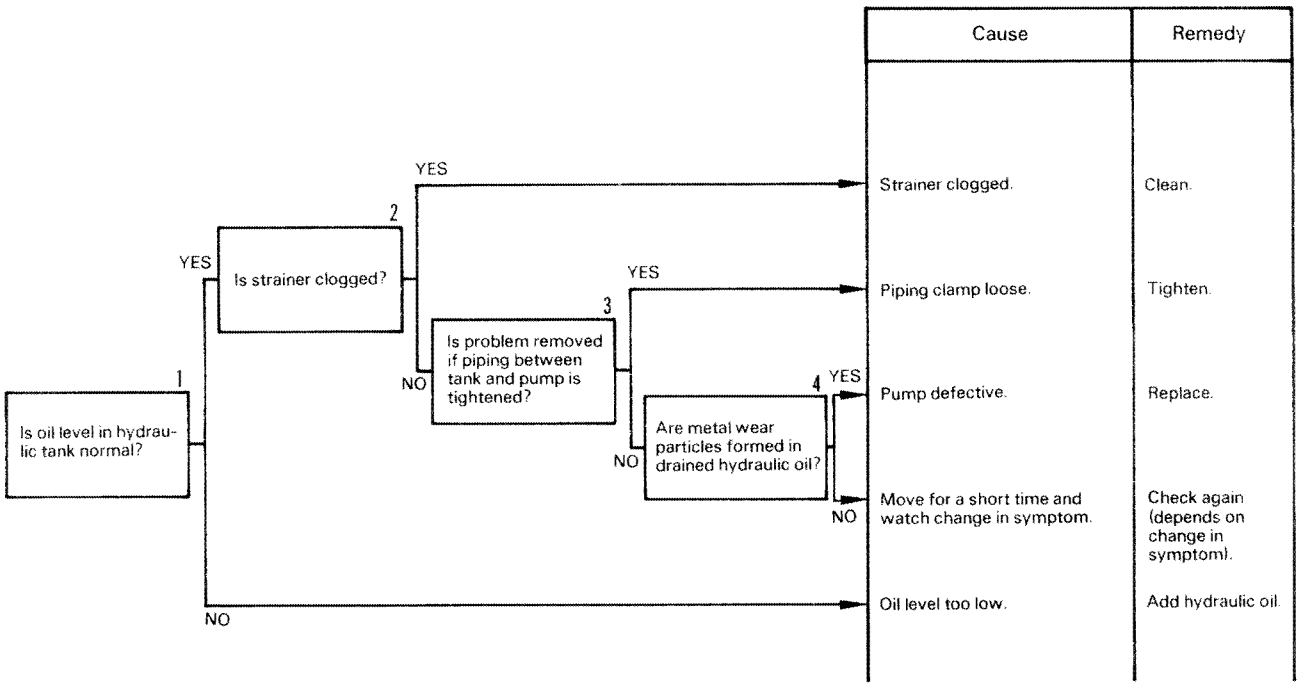
Failure mode: Auto-deceleration does not come on, or does not go off.

★ **This troubleshooting chart is for cases where the auto-deceleration system does not work automatically or when the auto-deceleration switch is operated.**
★ If the work equipment speed is slow, or it does not move, go to H-6 a).
★ Following measured value is at S position of mode selector switch.



TROUBLESHOOTING CHART NO. H-11

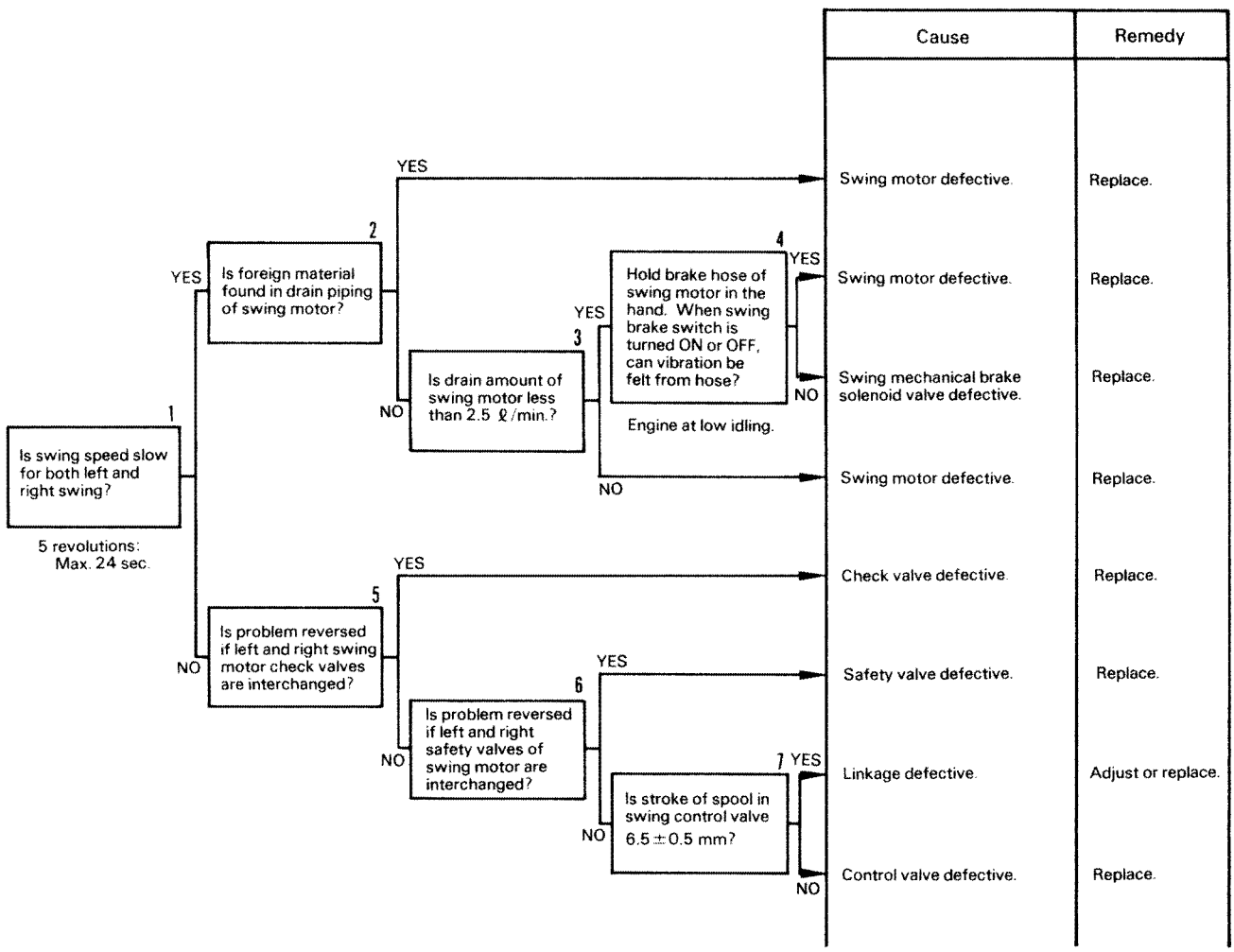
Failure mode: Abnormal noise comes from around pump.



TROUBLESHOOTING CHART NO. H-12

Failure mode: Swing speed is slow, or overrun when stopping swing is excessive.

★ If swing speed is slow when arm and swing are operated together, swing priority valve is defective.
★ If other work equipment speed apart from arm is slow, go to H-6 "Speeds for work equipment, swing, and travel are all extremely slow, or there is no power."

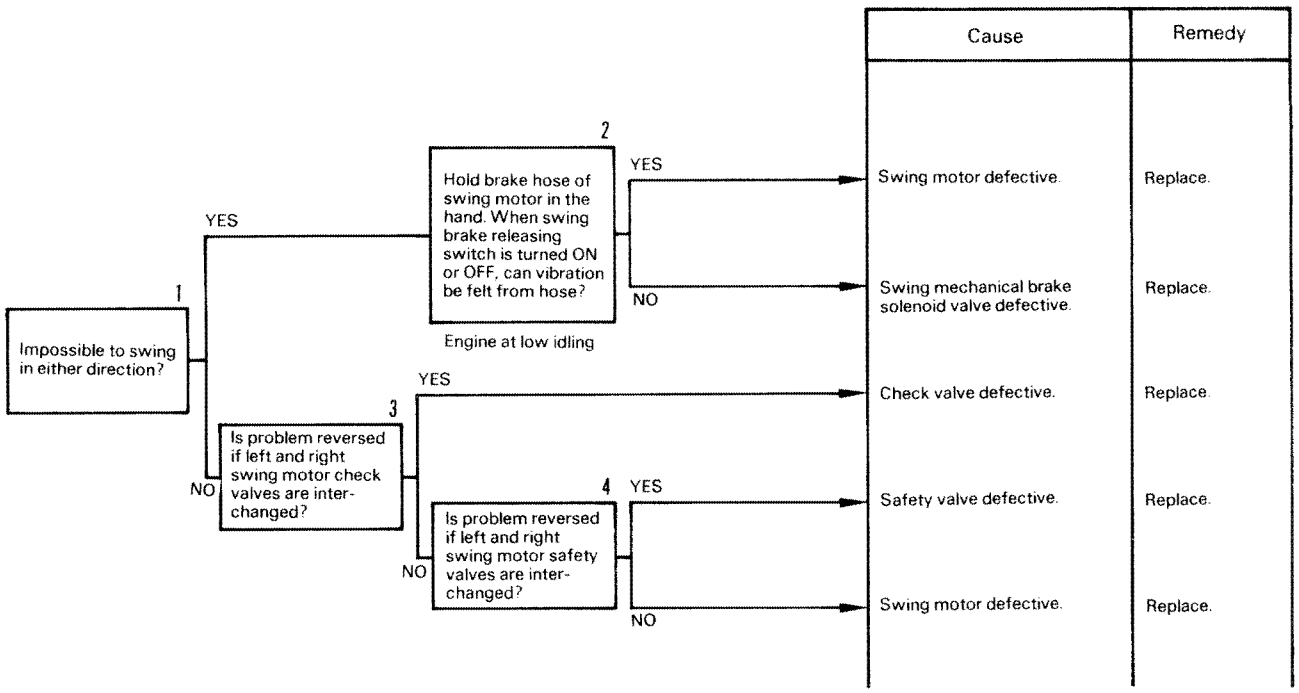


Troubleshooting tools	Measuring cylinder	Stop watch	Hydraulic tester
	Scale	Sleeve nut, plug	Thermistor kit

TROUBLESHOOTING CHART NO. H-13

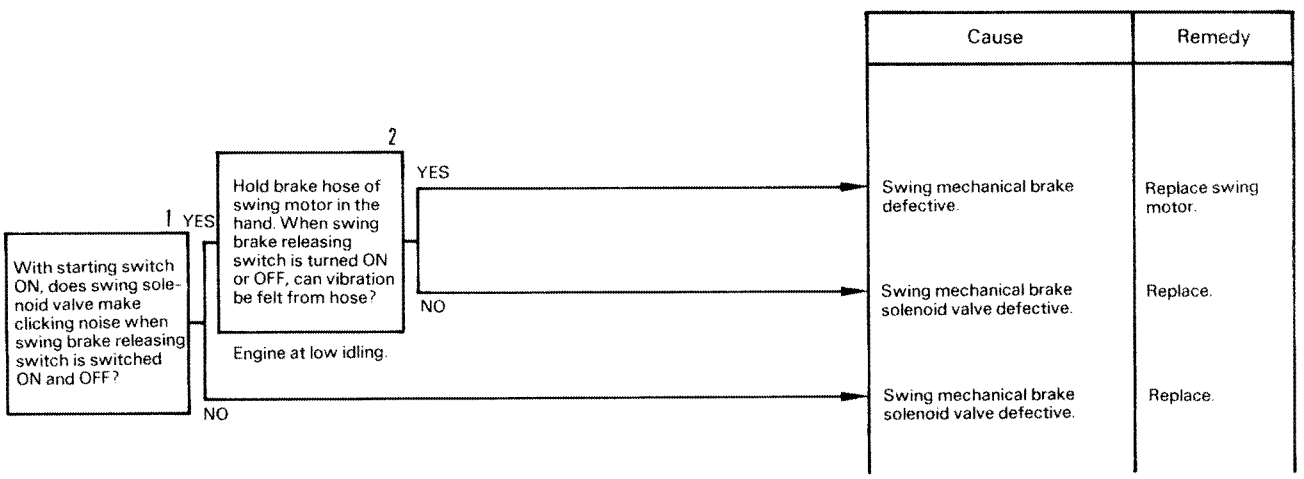
Failure mode: Upper structure does not swing.

★ Check that the swing brake switch is at RELEASE.
★ Run the engine at half throttle and put the left and right travel levers in FORWARD. If either of the sprockets does not move, go to H-1 "Machine deviates excessively."



TROUBLESHOOTING CHART NO. H-14

Failure mode: Excessive hydraulic drift of swing



Troubleshooting tools	Hydraulic tester	Measuring cylinder	Stop watch
	Sleeve nut, plug	Thermistor kit	–

TROUBLESHOOTING CHART NO. H-15

Failure mode: Excessive hydraulic drift of work equipment

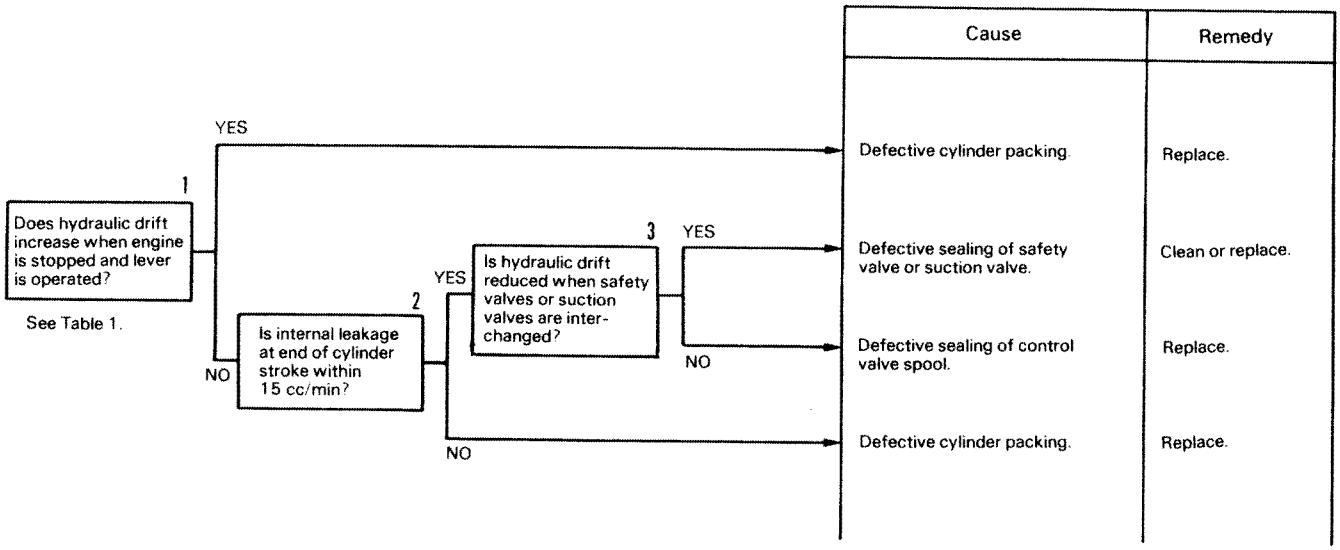


Table 1 Position of work equipment when checking

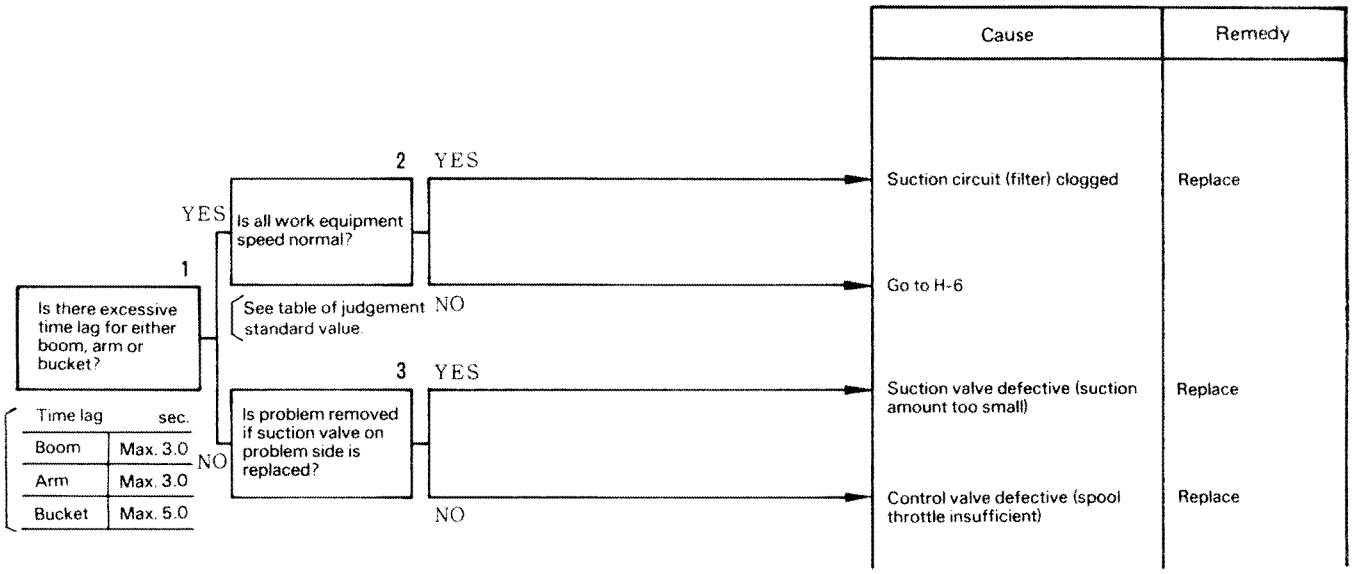
Cylinder name	Position of work equipment	Direction of lever operation	Remarks
Boom cylinder	· Maximum reach	· RAISE	Bucket should be loaded if hydraulic drift is small.
Arm cylinder	· Arm cylinder fully extended · Bucket cylinder fully retracted	· ARM IN	
Bucket cylinder	· Boom, arm horizontal · Bucket cylinder fully extended	· CURL	

★ A PPC valve is installed, so operate the lever quickly.
★ Always check with the engine stopped.

TROUBLESHOOTING CHART NO. H-16

Failure mode: Excessive time lag for work equipment

★ Following measured value is at S position of mode selector switch.



Trouble-shooting tools	Stop watch
	Thermistor kit

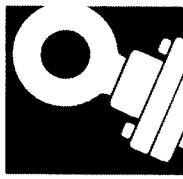
FAILURE MODE AND COMPONENTS

	Failure mode \ Component causing failure	Electrical system															Hydraulic system																												Mechanical system	
					Solenoid					Limit switch		Control switch					Pump control				Charg-ing pump		Control system						Swing motor			Travel motor															
		Power supply line	Wiring harness (including connectors)	Control box	TVC solenoid	Auto-deceleration (If equipped)	Swing brake (If equipped)	Straight-travel	Travel lever	Work equipment lever	Swing lever	Mode selector	Auto-deceleration (If equipped)	Swing brake (If equipped)	Main pump	Servo valve	NC valve (If equipped)	CO valve (If equipped)	TVC valve (If equipped)	(TVC solenoid valve) (If equipped)	Pump	Relief valve	Suction valve	Safety valve	Spool (including spring case)	Straight-travel valve	Swing priority valve	Travel shuttle valve	Auto-deceleration solenoid (If equipped)	Motor	Safety valve	Check valve	Solenoid valve (If equipped)	Motor	Counterbalance valve	Straight-travel solenoid valve	Center swivel	Hydraulic cylinder	Hydraulic tank (including oil)	Strainer, filter	Engine	Swing machinery, reduction gear	Linkage	Final drive
1	Machine deviates excessively (normal travel)											○			○	○	○	○							○								○	○	○	○	○							○	○
2	Machine deviates excessively (compound operations)	○	○	○				○	○		○															○		○																	
3	Machine deviates excessively (when starting)	○	○	○				○	○		○				○	○	○	○																											
4	Control levers are heavy														○	○	○				○	○			○				○															○	
5	Work equipment, travel, and swing start suddenly															○	○								○																			○	
6	Speeds for work equipment, swing, and travel are all extremely slow, or there is no power	○	○	○	○							○			○	○	○	○	○	○	○	○	○						○										○	○	○			
7	Speeds for boom, arm and bucket are slow, or there is no power																										○	○									○						
8	Engine stalls or engine speed drops during operations														○	○	○	○	○	○									○												○			
9	No change in output when mode selector switch is operated	○	○	○	○							○							○	○																								
10	Auto-deceleration does not work properly (if equipped)	○	○	○		○			○	○	○		○								○	○							○				○				*1. ○					○	
11	Abnormal noise comes from around pump														○																							○	○				
12	Swing speed is slow (auto-deceleration is normal)																				○	○			○				○	○	○	○	○	○							○	○
13	Upper structure does not swing (work equipment and travelis normal)						○						○												○					○	○	○	○									○	
14	Excessive hydraulic drift of swing	○	○	○			○						○																○									○					
15	Excessive hydraulic drift of work equipment																						○	○	○																	○		
16	Excessive time lag for work equipment																						○	○	○																			

Note: *1. For auto-deceleration cylinder

HYDRAULIC SYSTEM

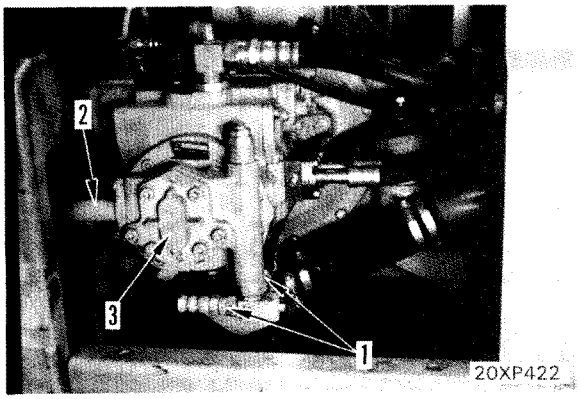
63 DISASSEMBLY AND ASSEMBLY



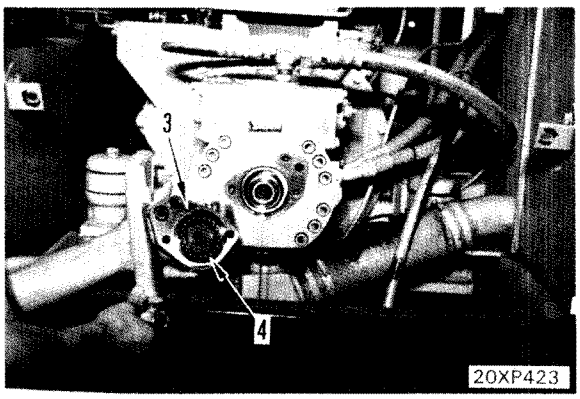
REMOVAL OF CONTROL PUMP ASSEMBLY

Lower the work equipment completely to the ground and stop the engine. Operate the control lever several times to release the remaining hydraulic pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the remaining oil pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the remaining oil pressure in the hydraulic tank.

1. Remove drain plug (1) and drain the hydraulic tank.
   Hydraulic tank: Approx. 88 ℓ
2. Disconnect outlet hoses (1).
   ★ Prepare an oil pan to catch the oil which will flow out.
3. Remove control pump assembly (3).
   ★ Remove the hex bolt which has a width across flats of 17 mm.
   ★ Be careful not to let bearing (4) fall.
4. Remove retainer (5), shims (6), and bearing outer race (7) from the guide portion of the control pump.



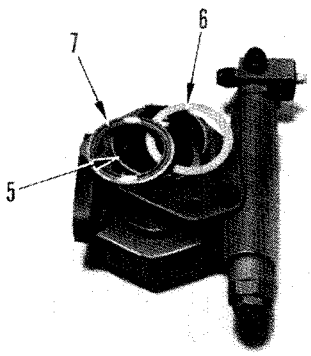
20XP422



20XP423

INSTALLATION OF CONTROL PUMP ASSEMBLY

1. Install retainer (5), shims (6) and bearing outer race (7) to the guide portion of the control pump.
   ★ Insert the retainer up to the end of the guide portion.
   ★ If the bearing has been removed, install it to the main pump side.
2. Fit O-rings to the control pump and cradle side.
3. While keeping control pump assembly (3) horizontal, insert the protruding portion of the pump into the coupling groove.



20XP424

4. Tighten two installation bolts (8) evenly, then tighten remaining installation bolts (9) and install control pump assembly (3).
   ★ Be careful not to let the O-rings come off.

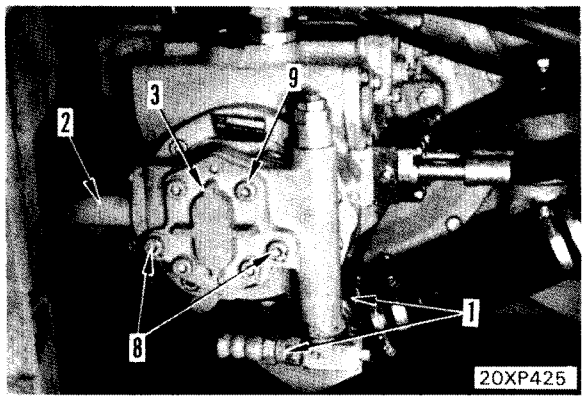
   Installation bolts: 6.8 ± 0.7 kgm

5. Fit O-rings then connect pump inlet tube (2) and pump outlet hose (1).

6. Tighten the drain plug of the hydraulic tank, then add hydraulic oil to the specified level.

   Hydraulic oil tank: 88 ℓ

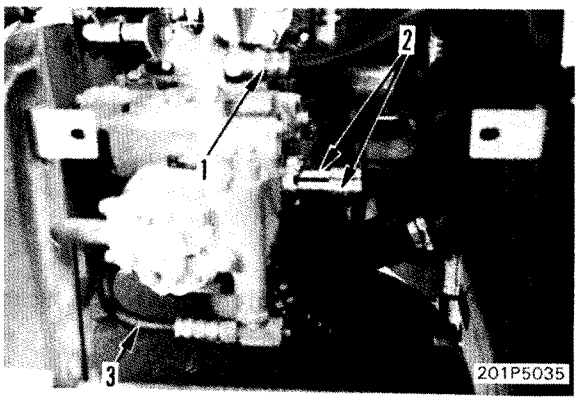
7. Bleed the air from the main pump. After all the air has been released, start the engine to circulate the oil in the piping, then add engine oil up to the specified level.
   ★ For details about bleeding the air, see Bleeding Air from the Main Pump under TESTING, ADJUSTING, AND TROUBLESHOOTING.



REMOVAL OF MAIN PUMP ASSEMBLY

Lower the work equipment to the ground and slowly remove the cap from the hydraulic tank to release the air from the tank.

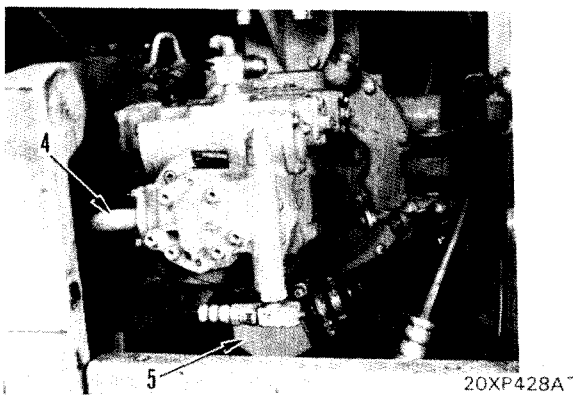
1. **Hydraulic oil drain**
   Loosen the drain plug to drain the oil from the tank,
   Hydraulic oil: 88 ℓ



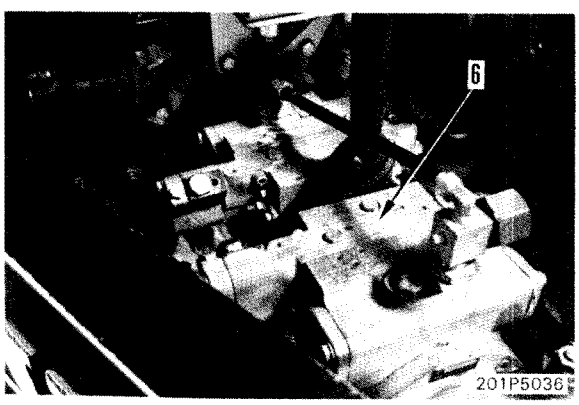
2. **Main pump drain hose**
   Disconnect hose (1).

3. **Main pump outlet hose**
   Disconnect hose (2).

4. **Control pump outlet hose**
   Disconnect hose (3).



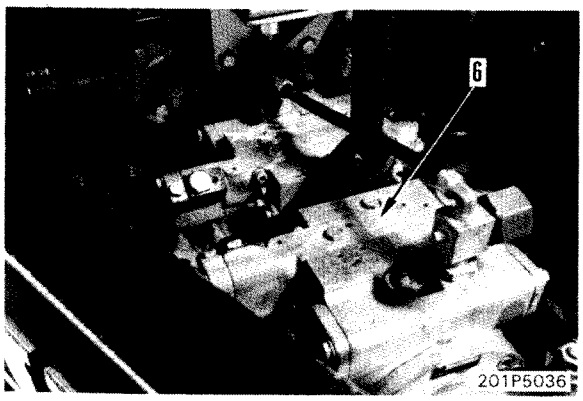
5. **Pump inlet tube**
   Remove tube (4) and disconnect tube (5) at the pump side.
   ★ Prepare an oil pan to catch the oil which will drain out.



6. **Main pump assembly**
   Remove main pump assembly (6).
   kg Main pump assembly: 75 kg

INSTALLATION OF MAIN PUMP ASSEMBLY

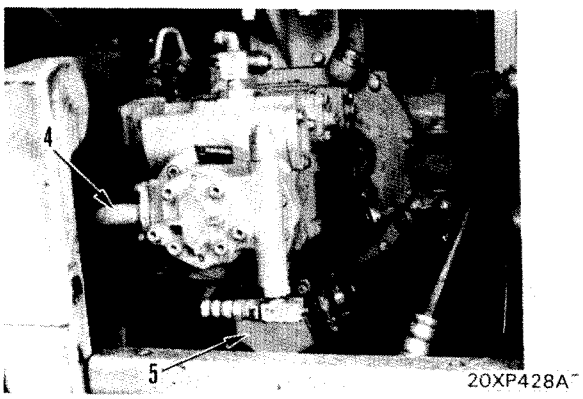
1. **Main pump assembly**
   Fit an O-ring and install main pump assembly (6).



2. **Pump inlet tube**
   Fit O-rings, then connect tube (5) to the pump assembly and install tube (4) between the pump and the tube.

3. **Control outlet pump hose**
   Connect hose (3).

   kgm Sleeve nut: 5 ± 2 kgm



4. **Main pump outlet hose**
   Fit an O-ring, then connect hose (2) to the pump assembly.

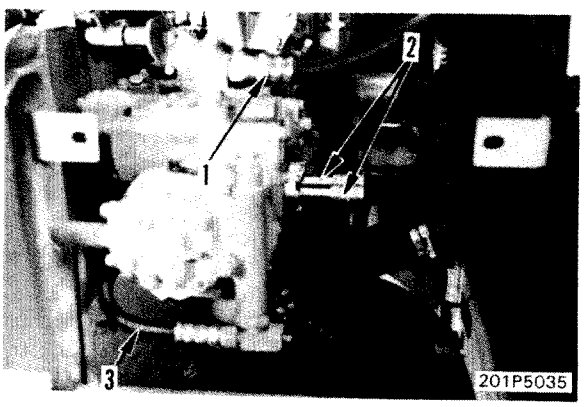
5. **Main pump drain hose**
   Disconnect hose (1).

   kgm Sleeve nut: 18 ± 3 kgm

   kgm Sleeve nut: 2.5 ± 0.5 kgm

6. **Adding oil to hydraulic oil tank**
   Tighten the drain plug of the tank, then add engine oil up to the specified level.

7. **Bleeding air from the pump**
   Bleed the air from the main pump. After all the air has been released, start the engine to circulate the oil in the piping, then add engine oil up to the specified level.
   ★ For details about bleeding the air, see Bleeding Air from the Main Pump under TESTING AND ADJUSTING.



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.

1. **Draining hydraulic oil**
   Remove drain plug and drain oil from tank.
   Hydraulic oil: Approx. 88 ℓ

2. **Main pump drain hose**
   Disconnect hose (1).

3. **Auto-deceleration hose**
   Disconnect hose (2).

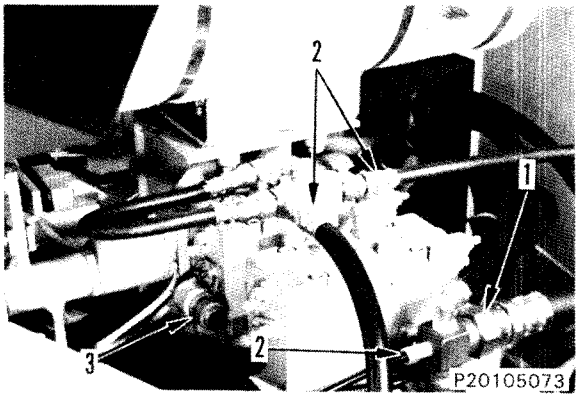
4. **TVC valve wiring**
   Disconnect wiring (3).

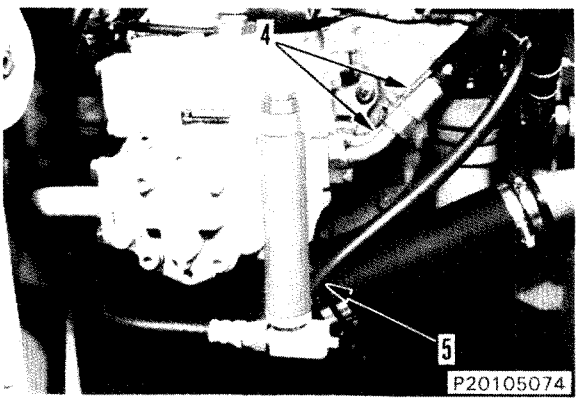
5. **Charging pump outlet hose**
   Disconnect hose (4).

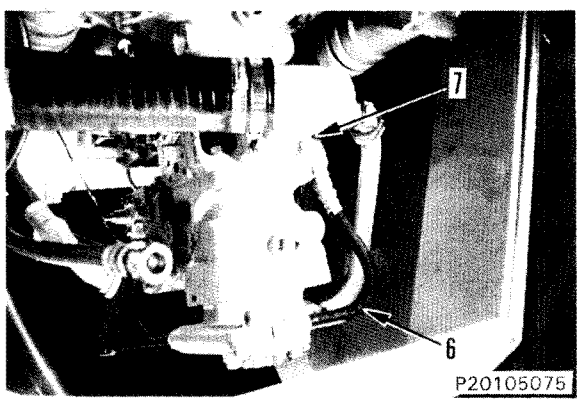
6. **Main pump outlet hose**
   Disconnect hose (5).

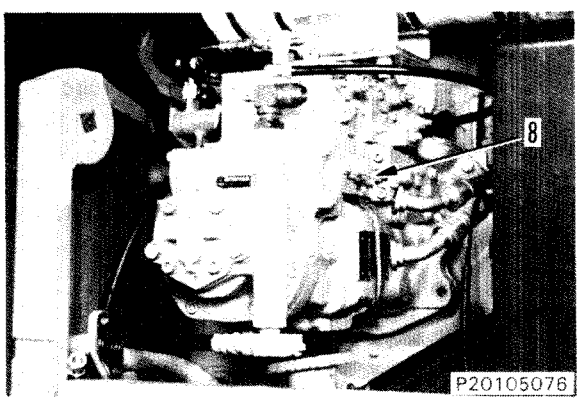
7. **Pump inlet tube**
   Disconnect tube (6) at charging pump end, then disconnect tube (7) at pump end.
   ★ The oil inside the tube will flow out, so catch it in an oil pan.

8. **Main pump assembly**
   Remove main pump assembly (8).
   kg Main pump assembly: 110 kg









INSTALLATION OF MAIN PUMP ASSEMBLY

1. **Main pump assembly**
   Fit O-ring and install main pump assembly (8).

2. **Pump inlet tubes**
   Fit O-rings and connect tube (7) to pump assembly, connect tube (6) to charging pump.

3. **Main pump outlet hose**
   Fit O-ring and connect hose (5) to pump assembly.

4. **Charging pump outlet hose**
   Connect hose (4).

   kgm Sleeve nut: 5 ± 2 kgm

5. **TVC valve wiring**
   Connect wiring (3).

6. **Auto-deceleration hose**
   Connect hose (2).

   kgm Sleeve nut (width across flats: 19 mm): 2.5 ± 0.5 kgm

7. **Main pump drain hose**
   Connect hose (1).

   kgm Sleeve nut: 18 ± 3 kgm

8. **Refilling with hydraulic oil**
   Tighten tank drain plug and add engine oil through tank oil filler to the specified level.

   Hydraulic tank: Approx. 88 ℓ

9. **Bleeding air from pump**
   After bleeding the air, run the engine to circulate the oil through the system. Then add oil to the specified level.
   For details of bleeding the air, see 62 TESTING AND ADJUSTING, BLEEDING AIR FROM MAIN PUMP.

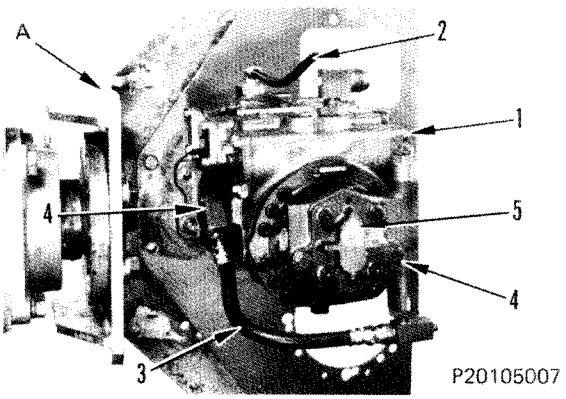
DISASSEMBLY OF MAIN PUMP ASSEMBLY (PISTON PUMP)

Special tools required

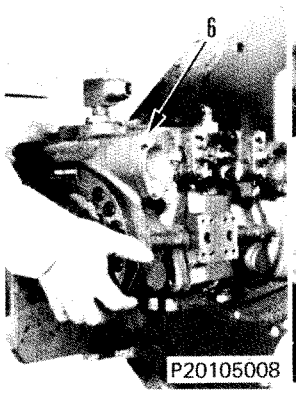
No.	Part No.	Part Name	Q'ty
A	790-501-5000	Unit repair stand	1
A_1	790-901-2110	Bracket	1
A_2	790-901-1341	Plate	1
B	790-445-2630	Push tool	1

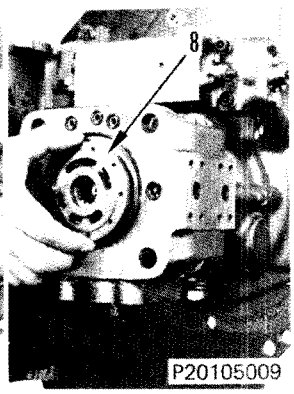
Note) The procedure for disassembly is basically the same for both front and rear pumps, so this section describes the disassembly of the front pump only. When there are differences, however, they will be noted at the appropriate place in the description.

1. Control pump
   1) Set pump assembly (1) on tool A.
   2) Remove flanges (4) from hoses (2) and (3).
   3) Remove control pump assembly (5).

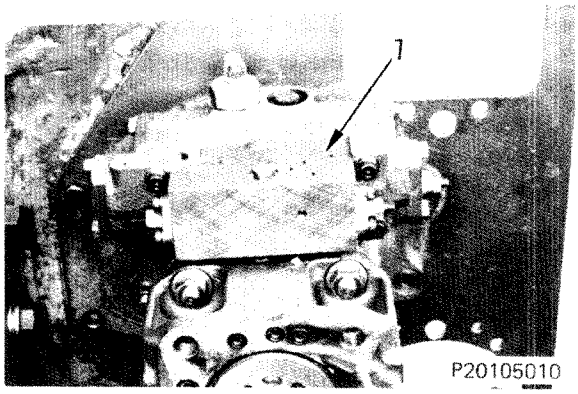


2. **Rear pump assembly**
   1) Remove rear pump assembly (6).
   2) Remove valve plate (8).
   ★ For a pump which has been operated, the valve plate will have become stuck to the cylinder block, so twist it carefully without causing scratches.
   Note) If the cylinder block and valve plate will be reused, store them as a set.

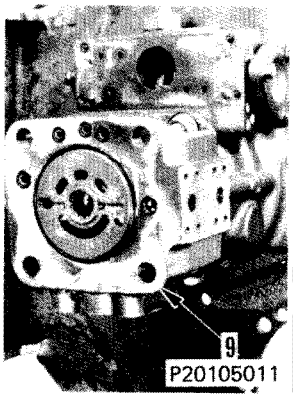


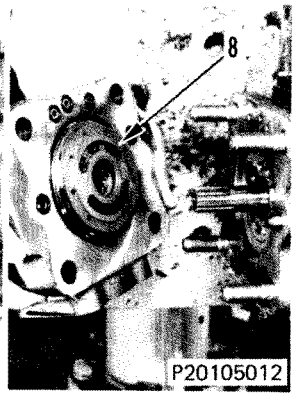


3. **Servo valve assembly**
   Remove servo valve assembly (7).

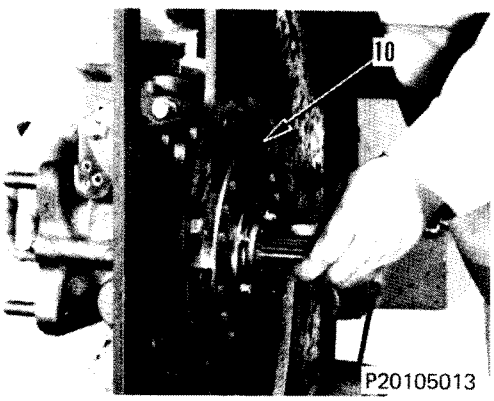


4. **End cap**
   1) Remove end cap (9).
   2) Remove valve plate (8) for the front pump.
      ★ For a pump which has been operated, the valve plate will have become stuck to the cylinder block, so twist it carefully without causing scratches.

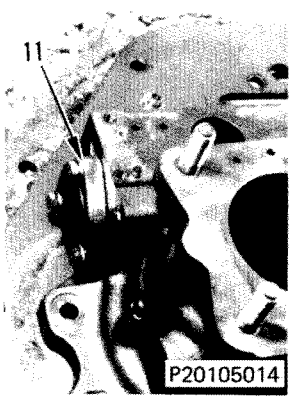


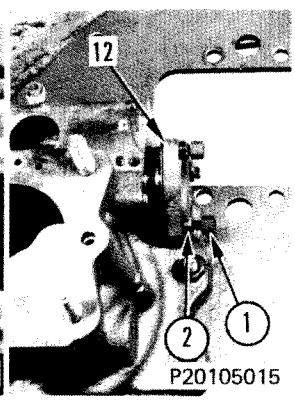


5. **Pump subassembly**
   Supporting the cylinder block and shaft, remove pump subassembly (10).
   ★ Mount the end cap side to a plate, then remove the rear pump.



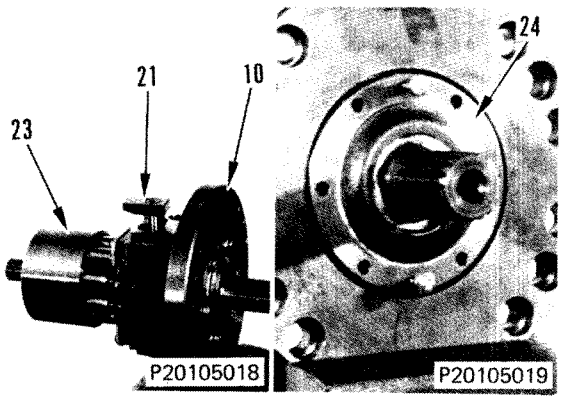
6. **Servo piston**
   1) Loosen the installation bolts on one side of cap (11) by approx. 10 mm.
   2) Remove two of the installation bolts on the other side of the cap, fit nut ② to extraction bolt ① (D = 8 mm, P = 1.25), slowly loosen nut ② and one of the installation bolts, and remove cap (12).
   3) Remove cap (11) from the side on which the installation bolts were first loosened.
      ★ Spring installed load: Approx. 60 kg
      ★ Confirm the number of shims, then record it.
   4) Remove spring (13).
      ★ Looking at the pump from the rear, the spring is on the 'LH' side.
   5) Remove servo piston (14).



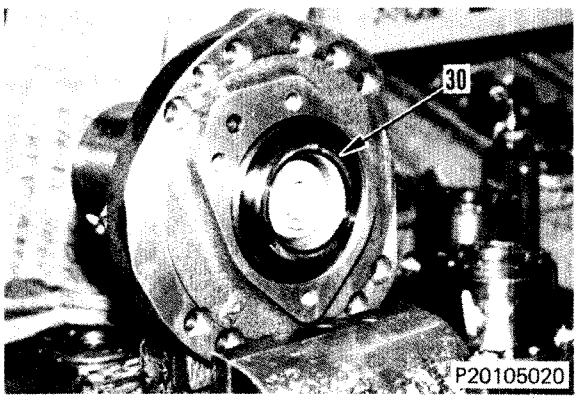


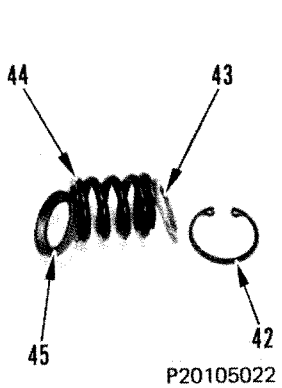
DISASSEMBLY OF PUMP SUBASSEMBLY

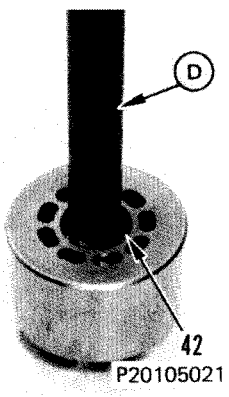
7. **Cylinder block and shaft**
   1) Set pump subassembly (10) on a vice.
   2) Remove slider (21).
   3) Remove cylinder block (23).
   4) Screw in an extraction bolt and remove housing (24).
      ★ Remove retainer (30) of the rear pump.

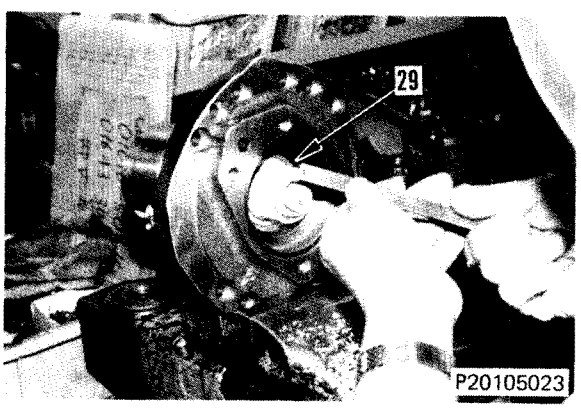


   5) When removing a spring from the cylinder block, use the following procedure.
      i) Using tool (D) , push spring (44).
         ★ Push just enough to separate washer (43) from the snap ring.
         ★ Spring installed load: approx. 100 kg
      ii) Remove snap ring (42), slowly extend spring (44), and remove the spring together with washers (43) and (45).

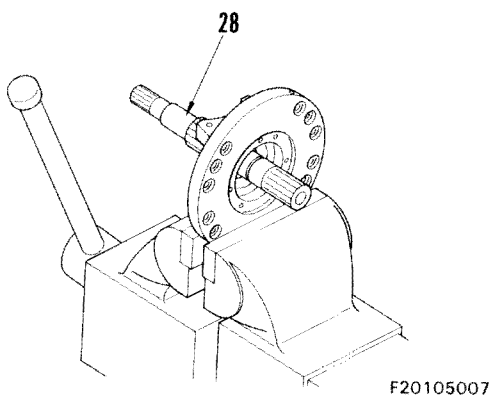




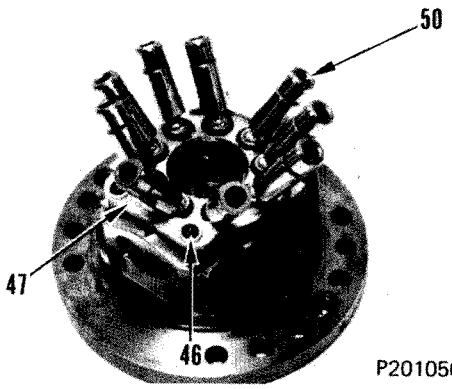




   6) Remove snap ring (29).
   7) Drive shaft assembly (28) out from the end cap side and remove it.
      ★ If the shaft will be reused, be careful not to scratch it.



8. **Piston**
   Remove four screws (46), then remove retainer bearing (47), shoe retainer (48), spacer (49), and piston (50).



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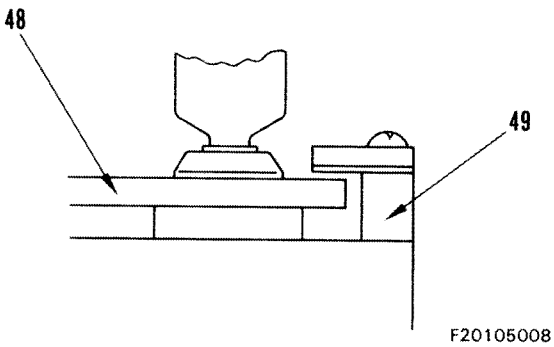
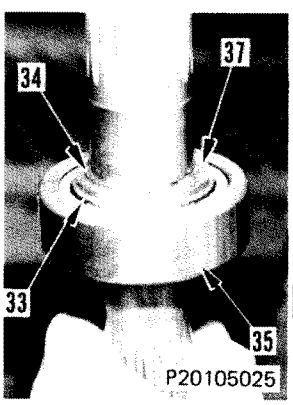


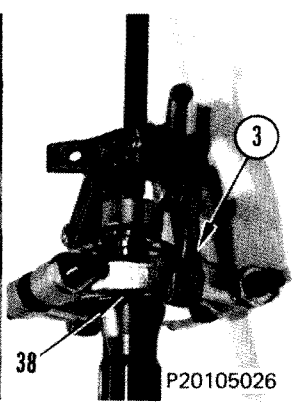
F20105008

WHEN THE PUMP DRIVE SHAFT AND END CAP WILL BE REUSED

1. **Remove the inner race from the pump drive shaft.**
   1) Remove snap ring (34).
   2) Remove washer (37), angle ring (33), and bearing (35).
   3) Using bearing race puller ③ . remove inner race (38).

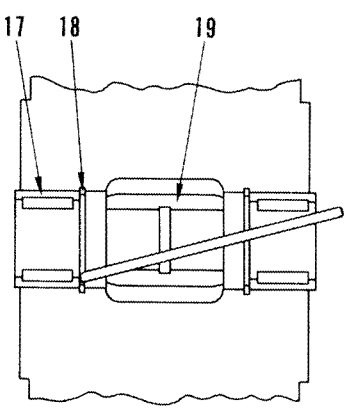


P20105025



P20105026

2. **End cap**
   1) Drive out bearing (17) from the inside of the end cap and remove it.
      ★ Hit the outer ring of the bearing from the slit in the snap ring.
   2) Remove snap ring (18).
   3) Remove coupling (19).



F20105009

ASSEMBLY OF MAIN PUMP ASSEMBLY

Special tools required

No.	Part No.	Part Name	Q'ty
A	790-501-5000	Unit repair stand	1
A_1	790-901-2111	Bracket	1
A_2	790-901-1341	Plate	1
B_1	796-720-4070	Gauge	1
B_2	796-720-4040	Gauge	1
C_1	795-630-1803	Torque wrench set	1
C_2	796-720-2250	Screwdriver	1
C_3	796-720-2220	Socket	1
C_4	796-730-2120	Screwdriver	1
D	790-445-2630	Push tool	1
E	790-445-2610	Hook	1

Precautions at time of assembly

1) Clean each part thoroughly and remove all sharp edge and rough edges.
2) Apply engine oil (EO10-CD) to the rotating and sliding parts before assemblying them.

★ Be sure to use the following parts as a set
   i) Cradle and rocker cam
   ii) Cylinder block and valve plate

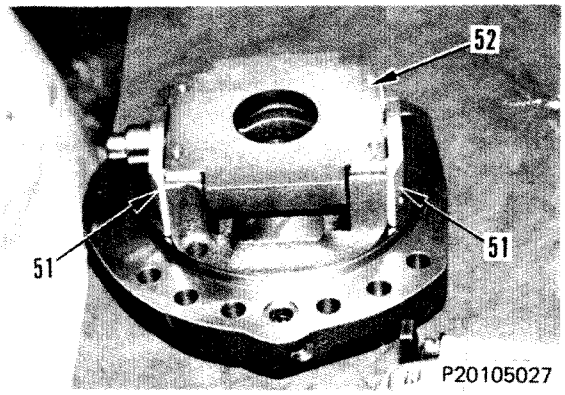
Note) The procedure for assembly is basically the same for both front and rear pumps, so this section describes the assembly of the front pump only. When there are differences, however, they will be noted at the appropriate place in the description.

4) Fit a dowel pin to the cradle, set rocker cam (52) on it, then install plate (51).
   ★ Align the side of the rocker cam which has grooves with the side of the cradle which has oil holes.

   Plate bolt: Adhesive (LT-2) (Locktite #262)

   Plate bolt: 1.35±0.15 kgm

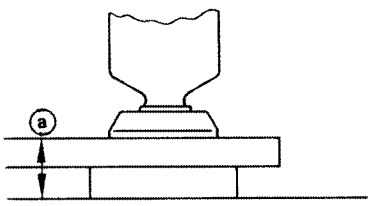
   ★ After tightening the bolts, confirm that the rocker cam can slide smoothly.



P20105027

5) Select the thickness of the spacers as follows
   i) Assemble piston (50) to shoe retainer (48), set it on the surface plate, and measure dimension (a) up to the top of the retainer.
   ii) Select spacers equal to dimension (a) 0.03 mm to 0.07 mm.

   ★ There are three sizes of spacers.



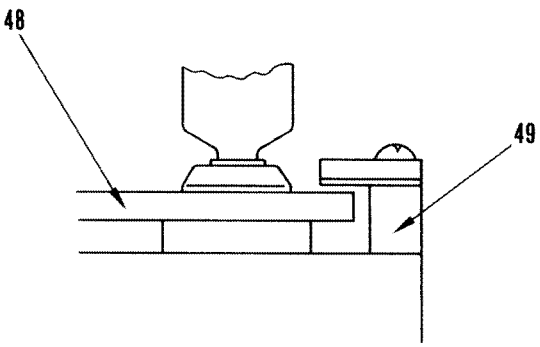
Surface plate

F20105010

6) Fit spacers (49) as calculated in Step 5)-i), ii), then install piston (50), shoe retainer (48), and retainer bearing (47) with four screws.

   Retainer bearing bolt: Adhesive (LT-2) (Locktite #262)

   Retainer bearing bolt: 1.35±0.15 kgm



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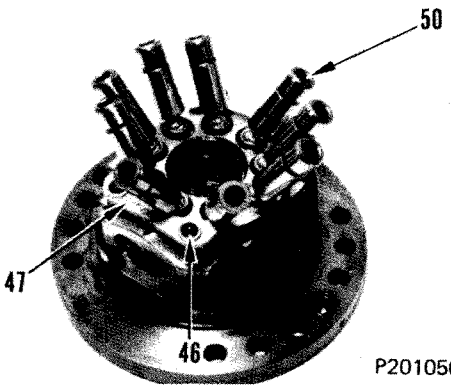
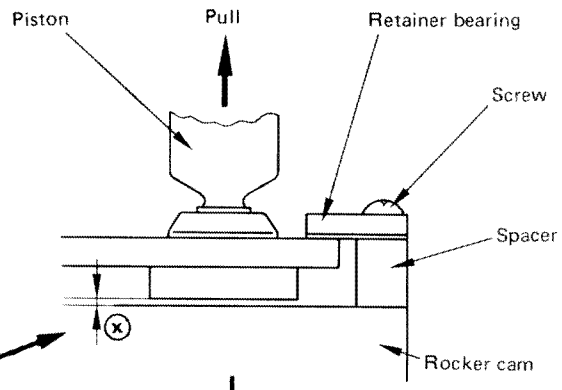


P20105024

7) Fix the rocker cam, pull piston (50) with a force of 2 – 3 kg, and measure clearance (x) between the piston shoe and the rocker cam.
   - ★ Carry out the measurement with the rocker cam in position (a) or (b) and measure for all nine pistons.
   - ★ Clearance: 0.03 – 0.07 mm
   - ★ If clearance (x) is not within the standard value, adjust the spacers again.



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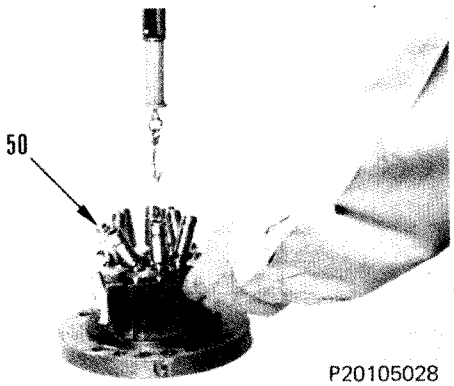

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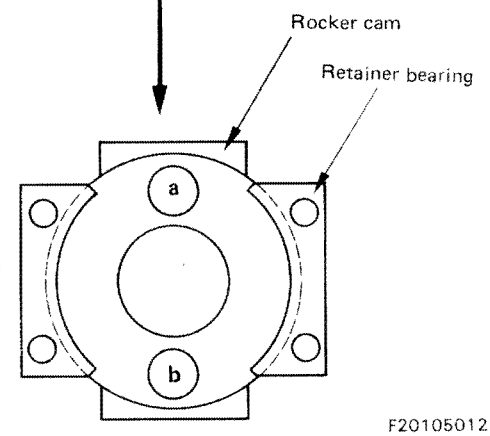
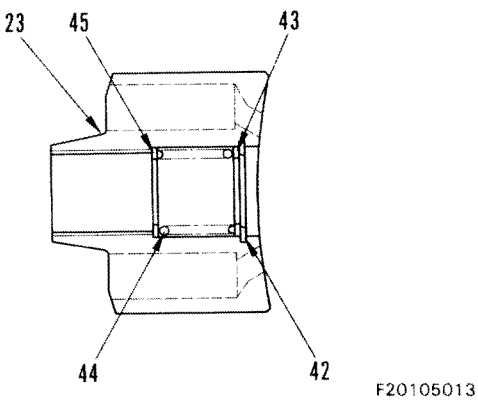


F20105012

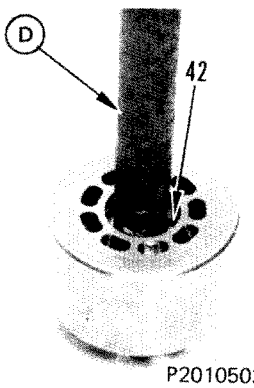
2. Cylinder block

1) Fit washer (45), spring (44), and washer (43) to cylinder block (23), use tool D to compress the spring, then install snap ring (42).
   - ★ Make sure that the installation position and direction washers (45) and (43) are correct.
   - ★ Spring installed load: Approx. 100 kg



F20105013

2) Install cylinder block (23) in alignment with the piston.
   - ★ Be sure to install the partner valve plate for the cylinder block.



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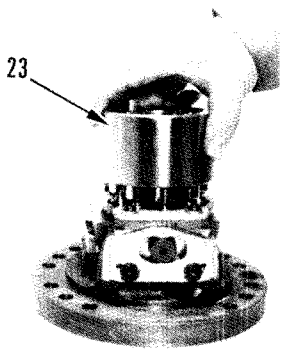
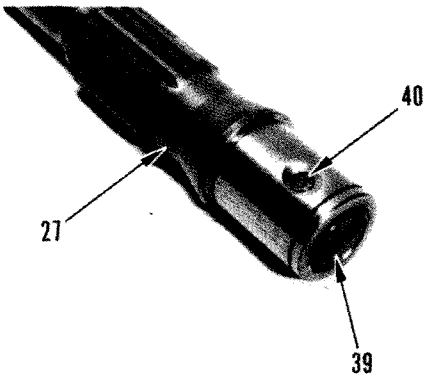


P20105030

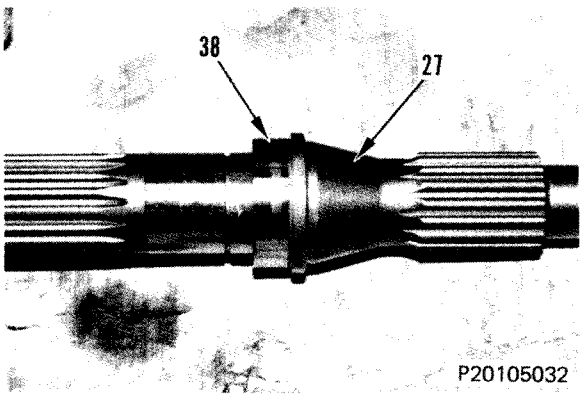
3. **Shaft assembly**

1) Assemble coupling (39) to shaft (27) and secure with pin (40).
   ★ On rear pump only.



P20105031

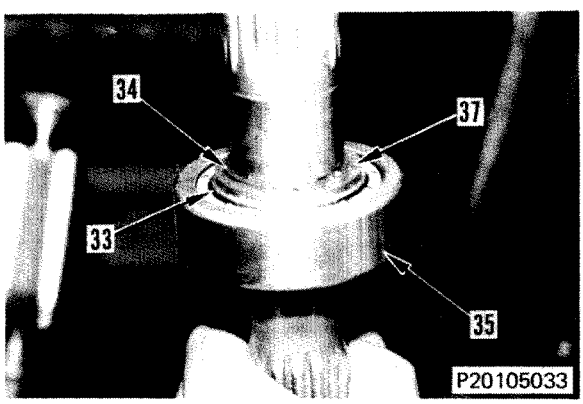
2) Press-fit inner race (38) (Inner Dia: 30 mm) to shaft (27).



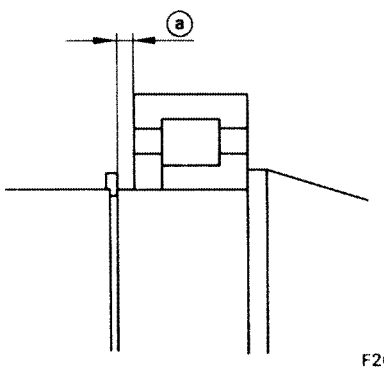
P20105032

3) Assemble bearing (35) and install angle ring (33).
4) Fit washers (37) and install spring (34).
   ★ Confirm that there is no play between the snap ring and washer.

   ★ Select the washers as follows:
      i) Install the inner race and retainer.
         ★ See 2) and 3).
      ii) Install snap ring (34).
         ★ Use a snap ring which is free of deformations and scratches. Correct any burrs in advance.
      iii) Use a thickness gauge to measure clearance (a) between snap ring (34) and angle ring (33).
         ★ Install the snap ring in the direction shown in the drawing, and firmly push it into the groove on the opposite side of the retainer.
      iv) Select and install washers equal to the measured dimension 0 – 0.1 mm.
         ★ There are four sizes of washers.

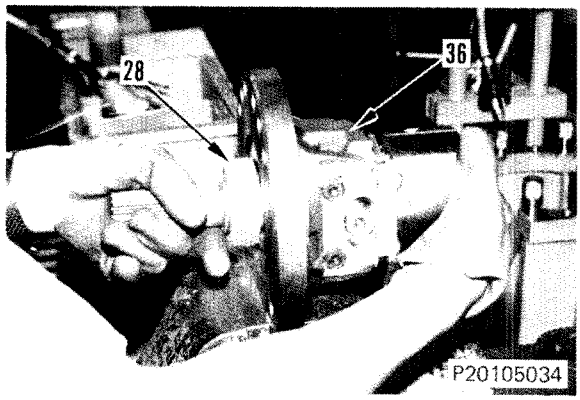


P20105033

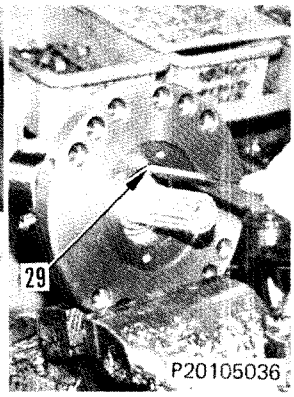


F20105014

5) Set the cradle and piston assembly (36) into a vice.
   ★ Engage the block under the cylinder block.
6) Align the splines of shaft (28) with the cylinder block and install it by expansion fitting.
   ★ Cooling temperature: 5 – 10 min. with dry ice



7) Install ring (29).



8) Install oil seal (25) (Out Dia.: 50 mm) to housing (24).

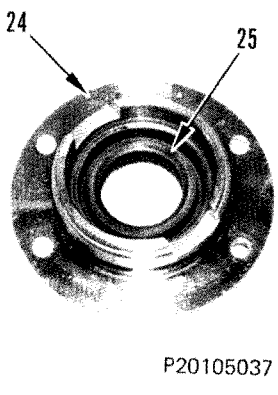
Oil seal lips: Grease (G2-LI)

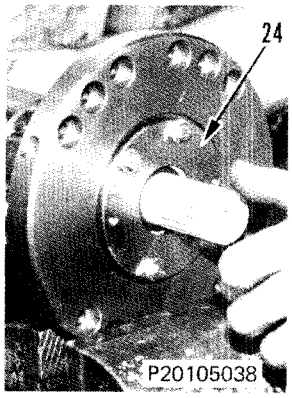
★ Be careful not to deform the oil seal.

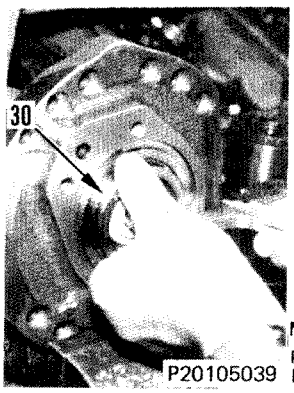
9) Install the O-ring, then install housing (24).
   ★ Be careful not to scratch the lips of oil seal.

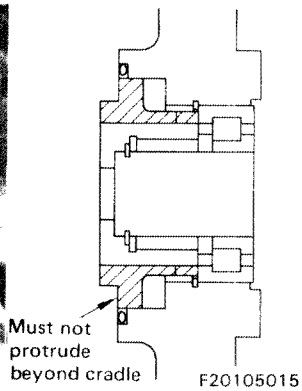
kgm Installation bolt: 1.35±0.15 kgm

★ For the rear pump, install retainer (30) and push it in by hand, then confirm that it does not protrude beyond the cradle.



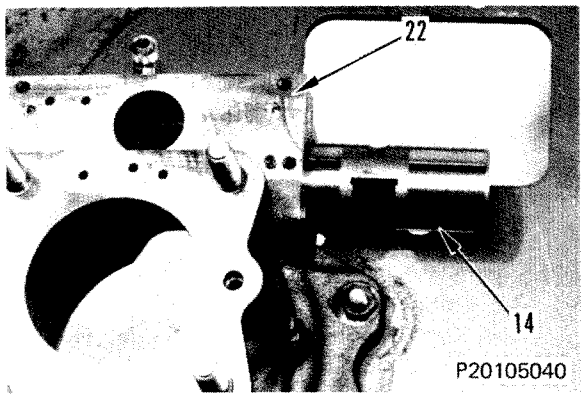




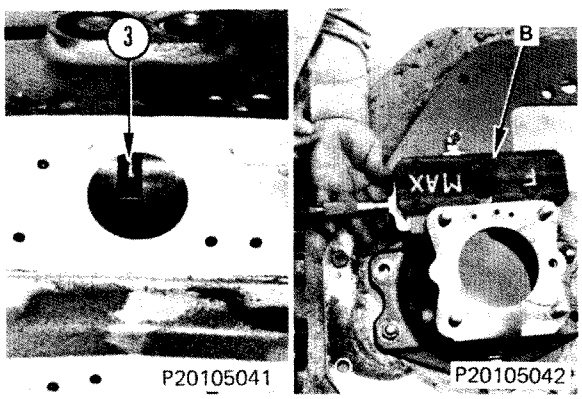


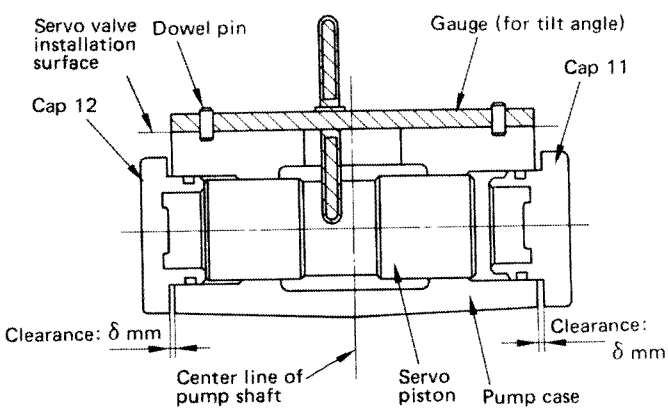
4. Servo piston

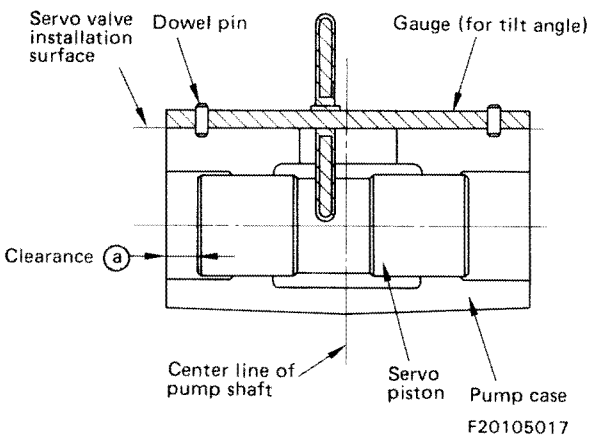
1) Install servo pistons (14) to case (22).
   ★ The front and rear servo pistons are interchangeable.



2) Adjust the stroke of the servo piston as follows.
   i) Align the dowel pin with groove (3) for the servo valve arm of the servo piston, then set tool B.
      ★ The LH side (the side in which the spring is inserted) when viewing the pump from the rear is the max. tilt angle.
      ★ For the rear pump, use the same tool in an inside-out fashion.
   ii) Measure clearance (a) between the servo piston and the case.



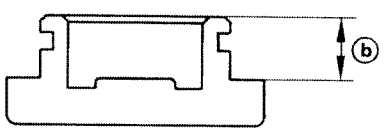




   iii) Measure dimension (b) of cap (12). (The smallest angle is cap (11))
   iv) Select shims so that the difference between dimension (a) on the servo side and dimension (b) on the cap side is less than±0.05mm.

   (b) - (a) = (c) ±0.05 : shim thickness

   ★ For the adjustment on the min. tilt angle side, change to tool B for the smallest angle, and repeat the procedure in i) through iv) above. Note, however, that the measurement direction of the case is on the opposite side of the max. tilt angle.
   ★ Tighten the adjusted shims together with the cap.



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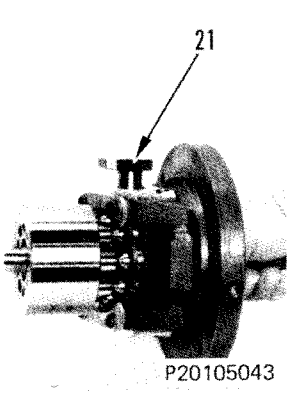
5. **Pump subassembly**
   1) Install slider (21) and O-rings.
      ★ Install O-rings at guide of the flange portion and joint portion.
   2) Install the joint to the case.
      ★ Face the small side of the hole towards the cradle.
   3) Supporting the cylinder block, align the slider with the servo piston and install pump servo assembly (10).
      ★ Take care not to let the O-rings get chewed up.

   kgm Installation bolt: 6.8±0.7 kgm



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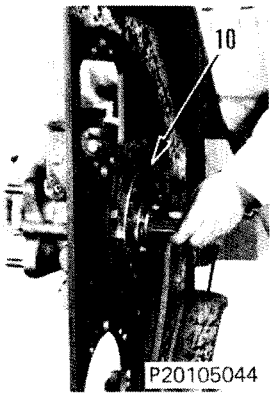
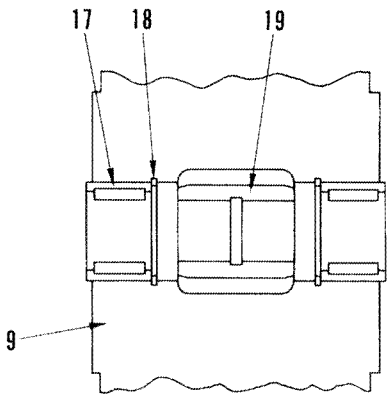


P20105044

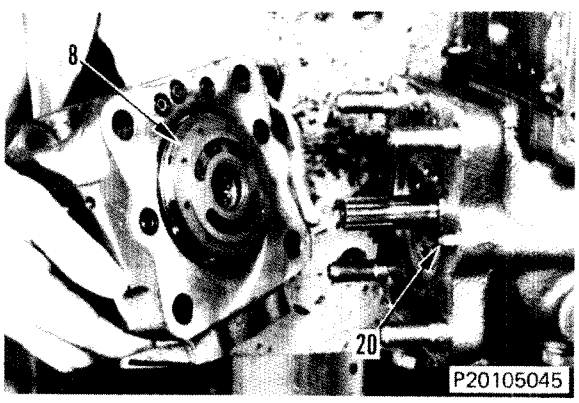
6. **End cap**
   1) Insert coupling (19) into end cap (9) and install snap ring (18).
   2) Install bearing (17) (Out Dia.: 32 mm)

   Bearing installation surface: Grease (G2-LI)



F20105019

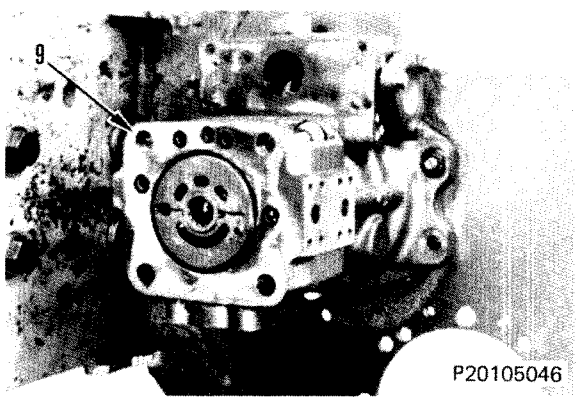
   3) Install joint (20), the pin and O-ring.
      ★ Install the joint so that the large side of the hole faces the end cap side.
   4) Apply engine oil, align the pin and bearing, and install valve plate (8).
      ★ Bring the port of the end cap and the valve plate together and ensure that there is no interference between the pin and bearing.



P20105045

   5) Align the coupling with the pump shaft and install end cap (9).

   kgm Installation nut: 16.5±1.5 kgm



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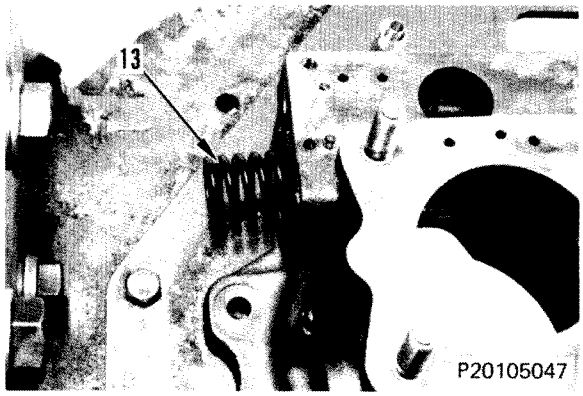
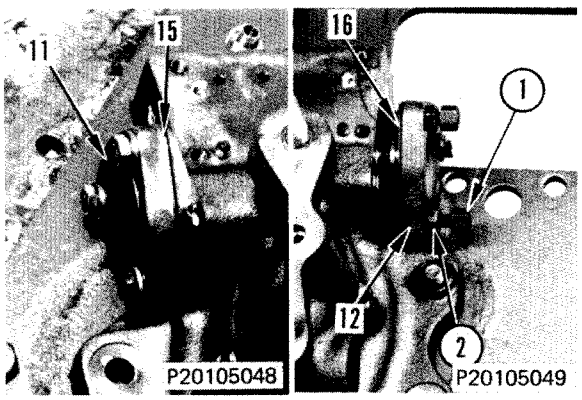
7. **Servo piston cap**
   1) Install spring (13).
      ★ Insert it on the LH side when viewing the pump from behind.



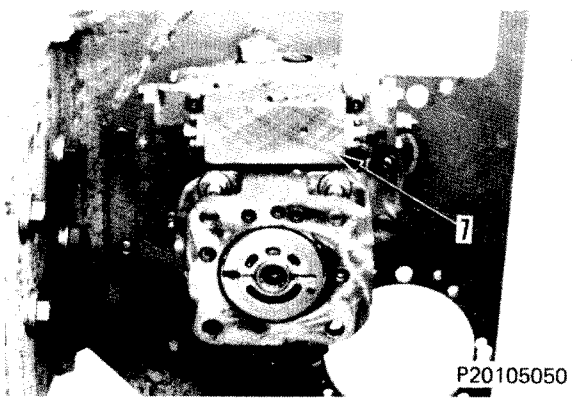
   2) Fit O-rings and shims (16) and (15) selected in Step 5)-ii), and install cap (11).
      ★ Screw in the cap installation bolts on one side by 3 - 4 turns. Using extraction bolt ① (D = 8 mm, P = 1.25) and nut ②, install cap (12) on the other side.
      ★ Spring installed load: Approx. 60 kg

      kgm Installation bolts: 3.2±0.3 kgm

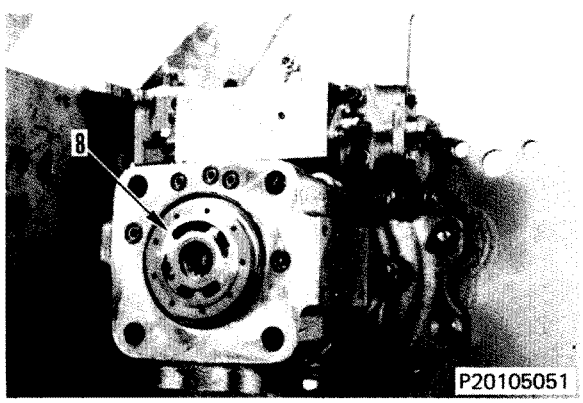


8. **Servo valve assembly**
   Fit an O-ring, align the arm with the servo piston, and install servo valve assembly (7).
   ★ The servo piston faces the minimum angle and the servo valve arm faces the maximum angle, so use a thin wire to positively fit the arm into the servo piston groove, then tighten the bolts.
   ★ Be careful not to let the O-ring fall off and tighten the installation bolts evenly in a criss-cross fashion.

   kgm Installation bolt: 3.2±0.3 kgm

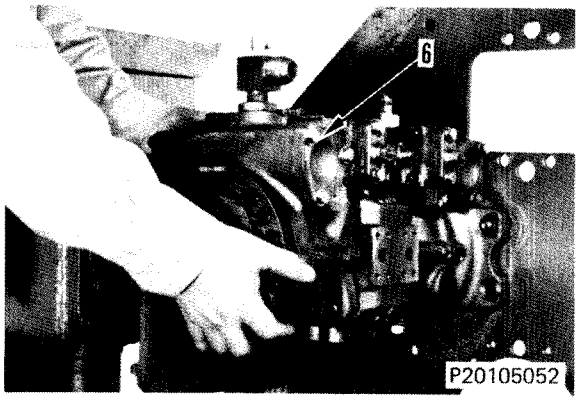


9. **Rear pump assembly**
   1) Apply engine oil, align the pin and bearing, and install valve plate (8).
      ★ Bring the port of the end cap and the valve plate together and ensure that there is no interference between the pin and bearing.
   2) Install O-rings and joints
      ★ Install the joint so that the large side of the hole faces the end cap.



3) Align the shaft with the coupling and install rear pump assembly (6).
   ★ Be careful not to let the O-rings fall off or get chewed up.

   kgm Installation nut: 16.5±1.5 kgm



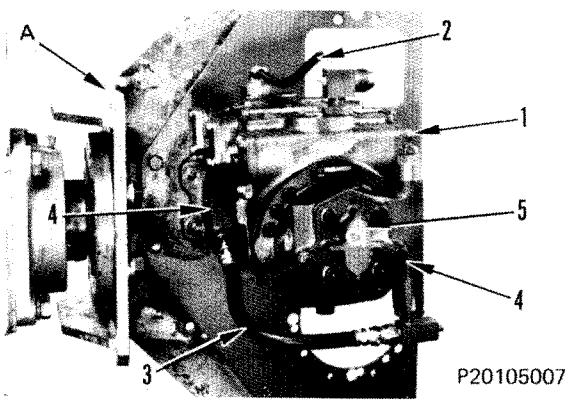
10. Measure the rotary torque of the pump assembly

Run the input shaft at a speed of about 3 - 5 revolutions per second and measure the rotary torque.
   ★ The rotary torque should be even (within a range of 0.2 kgm) and be 0.8 kgm or less.
   ★ If the rotary torque and range of unevenness are not within the standard value, disassemble the pump and assemble it again.

11. Control pump assembly

1) Fit O-rings and install control pump assembly (5).
2) Install a filter, fit an O-ring, and install flange (4).
3) Install cases (3) and (2).

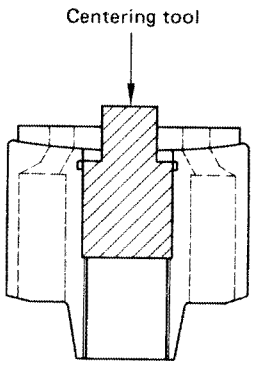
   kgm Sleeve nut hose : 5±2 kgm



CHECKING CONTACT BETWEEN THE CYLINDER BLOCK AND VALVE PLATE AND BETWEEN THE ROCKER CAM AND CRADLE

1. **Checking contact between the cylinder block and valve plate**
   1) Make a centering tool between the cylinder block and valve plate.
      ★ Use a soft material such as plastic or bakelite.
   2) Remove the grease from the parts to be inspected.
      ★ Do not wipe with a cloth.
   3) Set the tool and apply some paint for inspection purposes on the cylinder block.
      ★ Apply the paint thinly.
   4) Set the valve plate on the tool, push it in with a force of 4 — 5 kg, then rotate 2 — 3 turns.
   5) Remove the valve plate, transfer the contact face to a tape, and inspect the contact face.
      ★ The standards for the contact face are as follows.

Valve plate	Seal portion (a)	80% min.
Cylinder block	Seal portion (a)	80% min.



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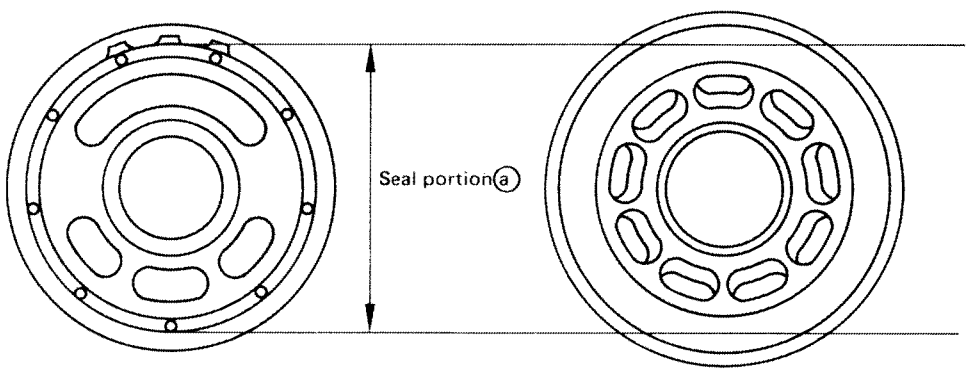

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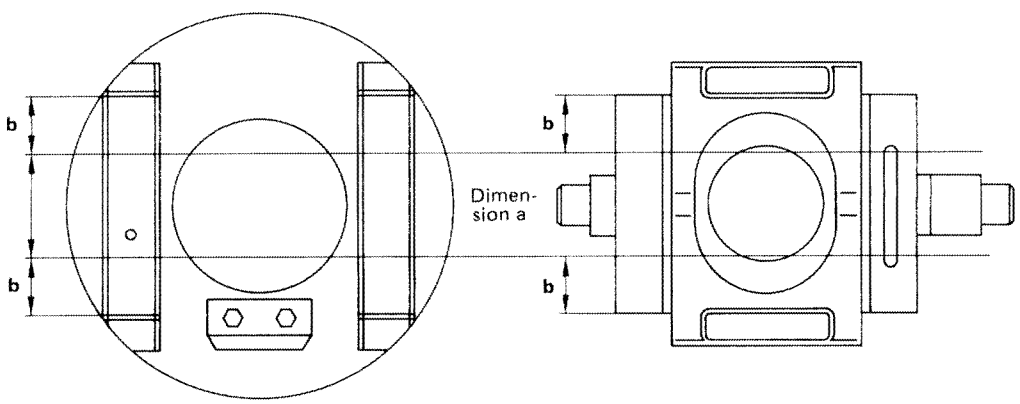
2. **Checking contact between the rocker cam and cradle**
   1) Remove grease from the parts to be inspected.
      ★ Do not wipe with a cloth.
   2) Apply paint for inspection purposes to the cradle.
      ★ Apply the paint thinly.
   3) Set the rocker cam. While applying a force of 4 – 5 kg, rotate the rocker cam 2 – 3 turns between the position in which it hits the stopper and the maximum tilt angle.
   4) Remove the rocker arm, transfer the contact face to a tape, then inspect the contact face.
      ★ The standards for the contact face are as follows.

Model	Dimension **a** (mm)	Contact face	Contact **b** from **a** to outer side
HPV 035	48	90% min.	50% min.

★ It is impossible for only the outer side to make contact without the center making contact.



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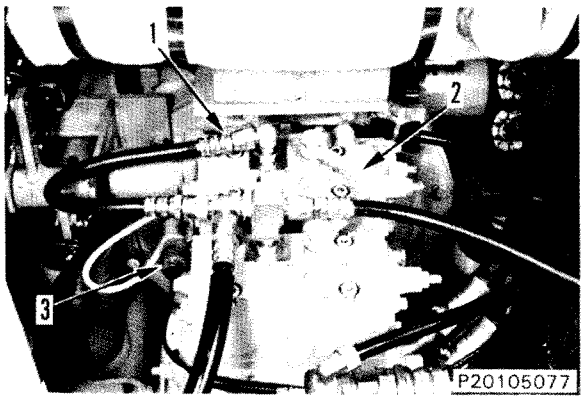
(Reference)

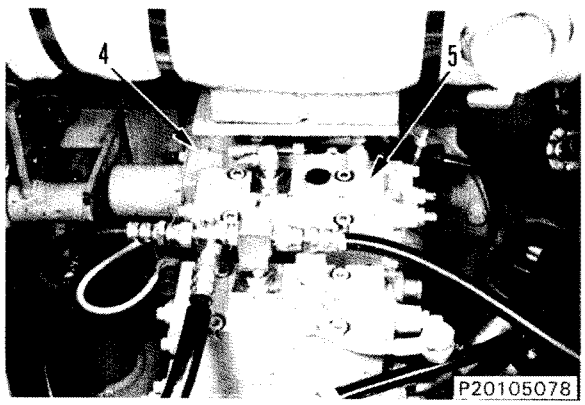
If the contact is not within the standard value, be sure to machine the parts together when carrying out lapping.

★ Parts with scratches cannot be reused.

REMOVAL OF TVC VALVE AND FRONT CO · NC VALVE ASSEMBLY (If equipped)

1. Disconnect hose (1) and tube (2).
2. Disconnect wiring (3).
3. Remove TVC valve assembly (4) and CO · NC valve assembly (5) as a set.
4. Disconnect TVC valve assembly and CO · NC valve assembly.





INSTALLATION OF TVC VALVE AND FRONT CO · NC VALVE ASSEMBLY (If equipped)

1. Fit O-ring and connect TVC valve assembly and CO · NC valve assembly.

   kgm Mounting bolt: 3.15 ± 0.35 kgm

2. Fit O-ring and install TVC valve assembly (4) and CO · NC valve assembly (5) as a set.

   kgm Mounting bolt: 3.15 ± 0.35 kgm

3. Connect wiring (3).
4. Fit O-ring and connect tube (2).

   kgm Joint bolt: 1.8 ± 0.2 kgm

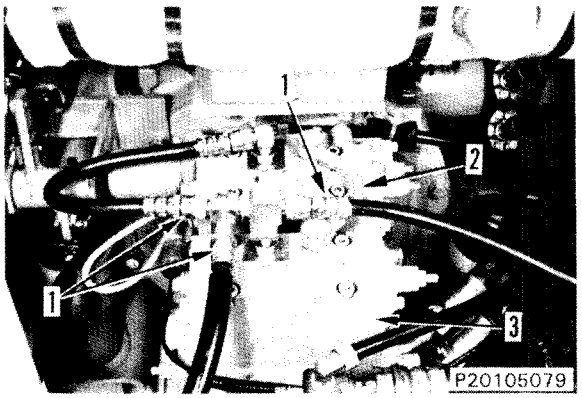
5. Connect hose (1).

   kgm Sleeve nut: 2.5 ± 0.5 kgm

★ FOR MACHINE EQUIPPED WITH OLSS

REMOVAL OF REAR CO · NC VALVE ASSEMBLY (If equipped)

1. Disconnect hose (1) and tube (2).
2. Remove CO · NC valve assembly (3).



INSTALLATION OF REAR CO · NC VALVE ASSEMBLY (If equipped)

1. Fit O-ring and install CO · NC valve assembly (3).

   kgm Mounting bolt: 3.15 ± 0.35 kgm

2. Fit O-ring and connect tube (2).

   kgm Joint bolt: 1.8 ± 0.2 kgm

3. Connect hose (1).

   kgm Sleeve nut: 2.5 ± 0.5 kgm

REMOVAL OF SERVO VALVE ASSEMBLY (If equipped)

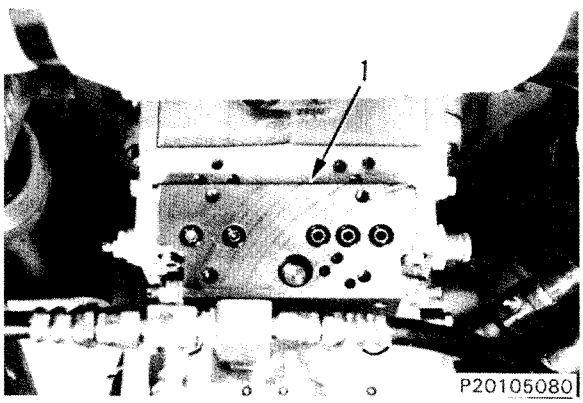
1. For front pump; remove TVC and CO • NC valve assembly.
   For rear pump; remove CO • NC valve assembly.
   ★ For details, see 63 REMOVAL OF TVC VALVE AND FRONT CO • NC VALVE ASSEMBLY, and REMOVAL OF REAR CO • NC VALVE ASSEMBLY.

2. Remove servo valve assembly (1).

INSTALLATION OF SERVO VALVE ASSEMBLY (If equipped)

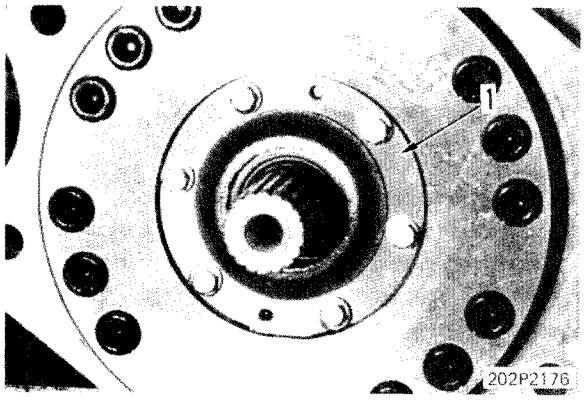
1. Fit O-ring and align lever with groove of servo piston, then install servo valve assembly (1).
   ★ Press in the servo valve assembly until it is in close contact with the mounting surface, then tighten the bolts. (If the lever is not fitted securely in the groove, it is impossible to insert by hand to the above position.)

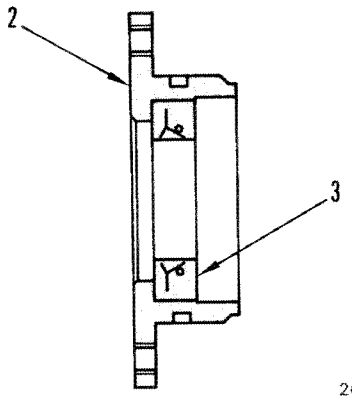
2. For rear pump; install CO • NC valve assembly.
   For front pump; install TVC and CO • NC valve assembly.
   ★ For details, see 63 INSTALLATION OF TVC VALVE AND FRONT CO • NC VALVE ASSEMBLY, and INSTALLATION OF REAR CO • NC VALVE ASSEMBLY.



REMOVAL OF MAIN PUMP INPUT SHAFT OIL SEAL ASSEMBLY

1. Remove the main pump assembly. For details, see REMOVAL OF MAIN PUMP ASSEMBLY.
2. Remove the installation bolts, then remove housing assembly (1).
3. Remove oil seal (3) from housing (2).





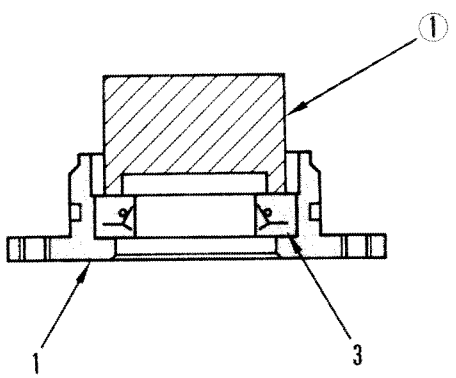
INSTALLATION OF MAIN PUMP INPUT SHAFT OIL SEAL ASSEMBLY

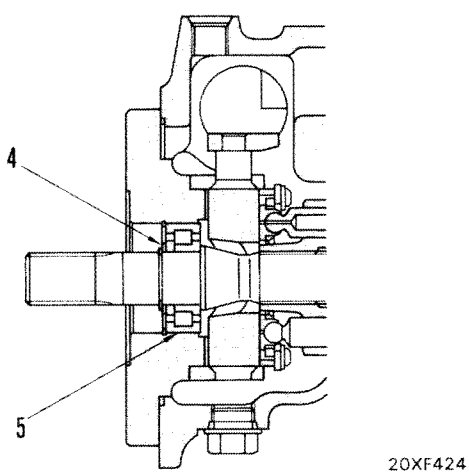
1. Using tool ① , press fit oil seal (3) (O.D.: 62 mm) to housing (2).

   Oil seal lip: Grease (G2-LI)

2. Install oil seal (3) to housing (2).
3. Confirm that snap ring (4) and bearing (5) are installed the pump side.
4. Apply grease (G2-LI) to the pump shaft, then install the shaft to housing (1).

   kgm Installation bolts: 1.35 ± 0.15 kgm



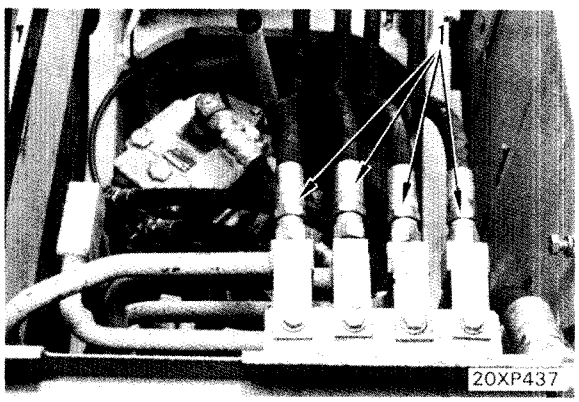


REMOVAL OF L.H. 6-SPOOL CONTROL VALVE ASSEMBLY

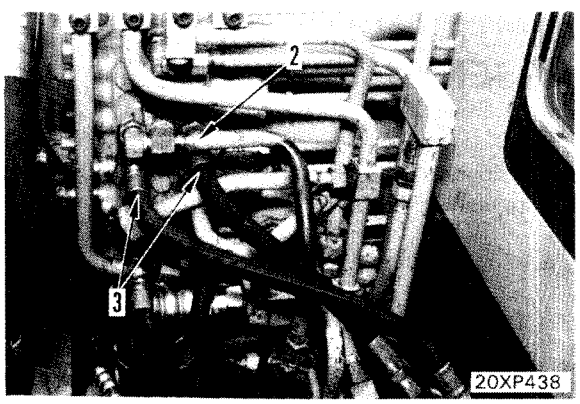
Lower the work equipment to the ground, slowly remove the cap from the hydraulic oil tank to release the air from inside the tank, then operate the control lever to remove the remaining air from the piping.

★ If an O-ring boss and O-ring nipple are installed to the control valve with a tube or hose connected to them, the tightening torque for each section will be different. Therefore, use two spanners to disconnect the hose or tube.

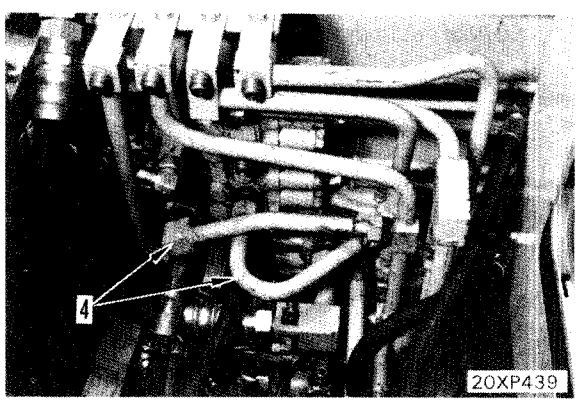
1. **Work equipment hose**
   Disconnect hose (1) and place it on the work equipment side.



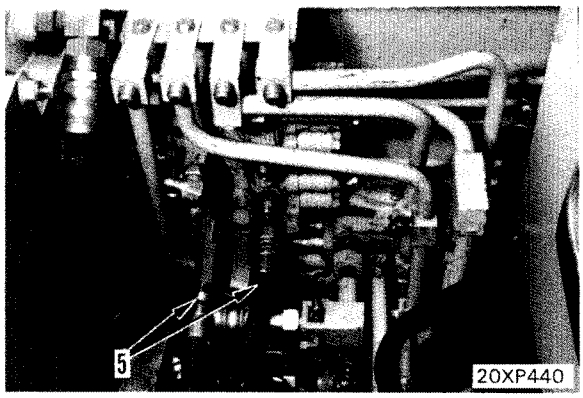
2. **Swing motor hose, tube**
   1) Remove tube (2).
   2) Remove hose (3) and place it on the cabin side.



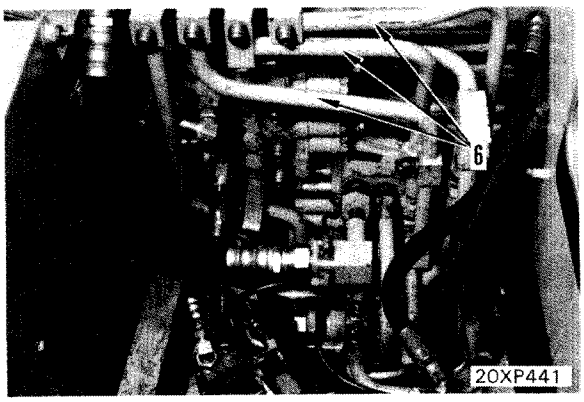
3. **Tube**
   Remove tube (4).



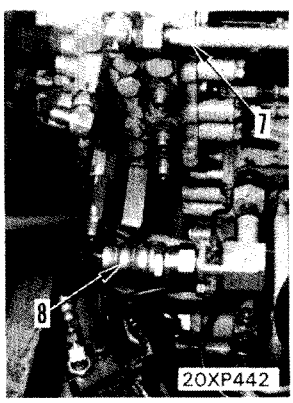
4. **Travel hose**
   Disconnect hoses (5).

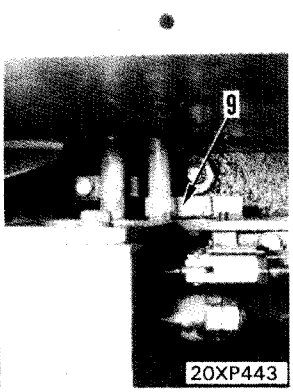


5. **Work equipment tubes**
   Remove tubes (6).

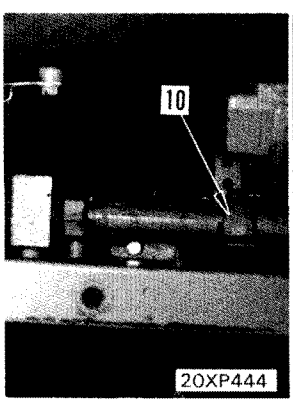


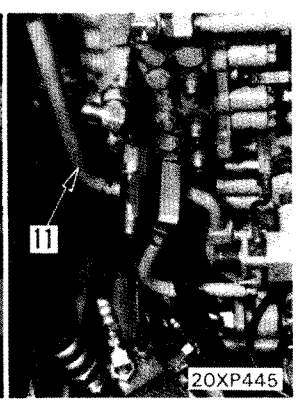
6. **Drain hose, tube**
   1) Disconnect tube (7).
   2) Disconnect hose (8).



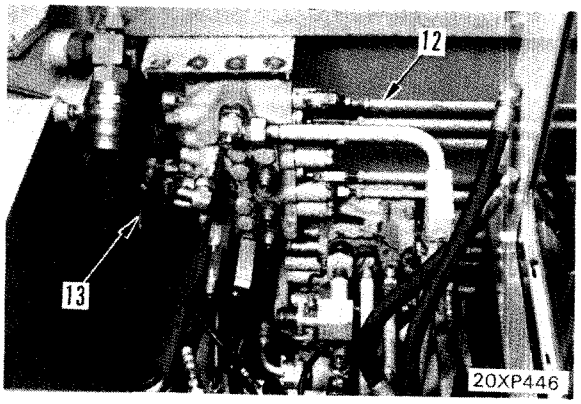


7. **LH, RH connecting tubes, work equipment tubes**
   1) Remove clamps (9) and (10) used to fix the oil cooler tube, then remove the tube.
   2) Remove tube (11).

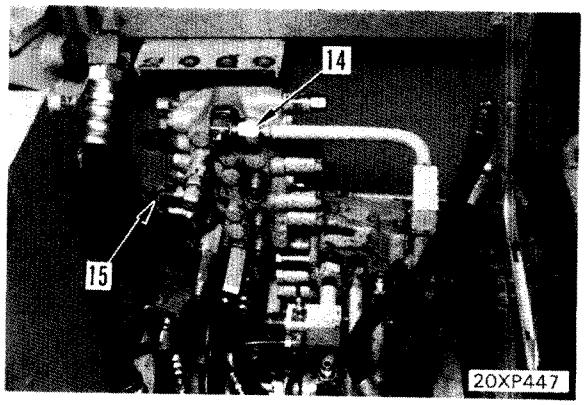




8. **Rods, hoses**
   1) Disconnect rods (12) at the valve side.
   2) Disconnect hose (13).

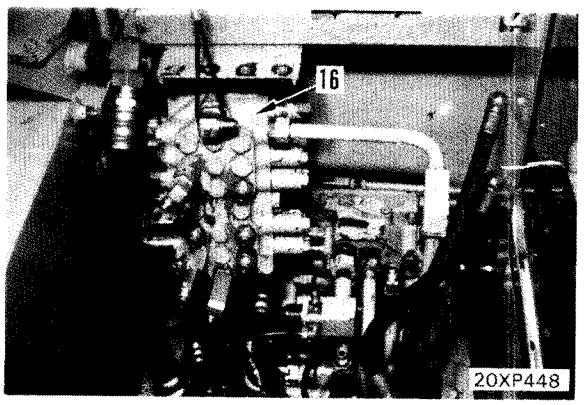


9. **Tube, drain tube**
   1) Disconnect tube (14) at the valve side.
   2) Disconnect tube (15).

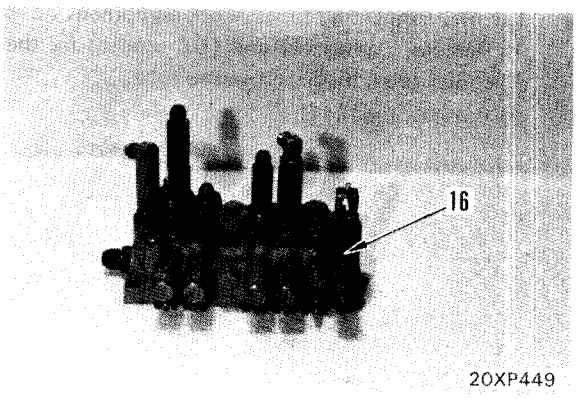


10. **LH 6-spool control valve assembly**
    Remove LH 6-spool control valve assembly (16).

    kg LH 6-spool control valve assembly: 40 kg



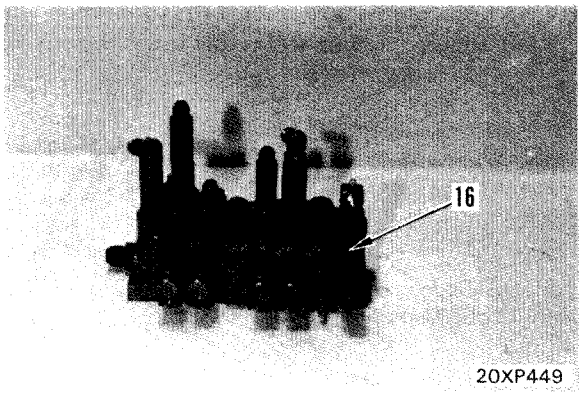
11. **Control valve subassembly**
    Remove the tubes and nipples from assembly (16).



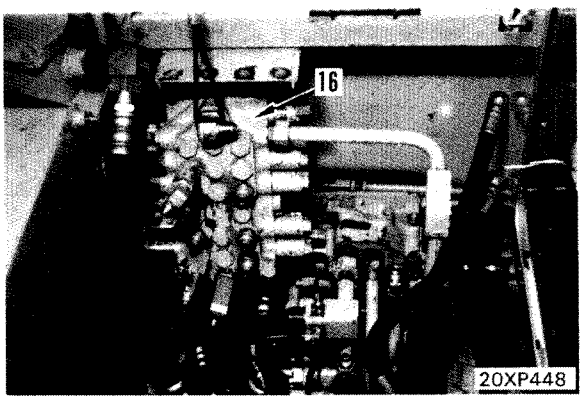
INSTALLATION OF L.H. 6-SPOOL CONTROL VALVE ASSEMBLY

★ Install an O-ring boss and O-ring nipple to the control valve assembly. When connecting tubes or hoses to that assembly, the tightening torque at each section will be different, so use two spanners to tighten the tubes or hoses.

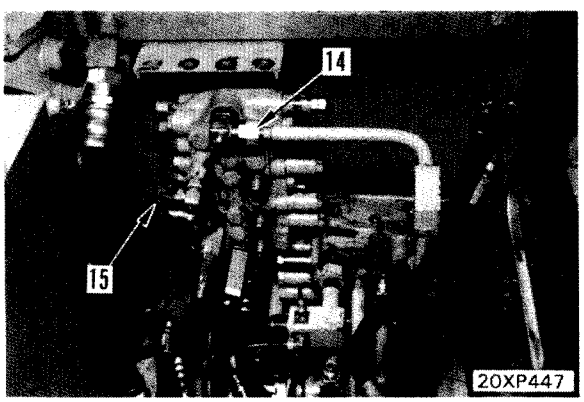
1. **Control valve subassembly.**
   Fit an O-ring then install the O-ring boss and O-ring nipple to the control valve to make assembly (16).



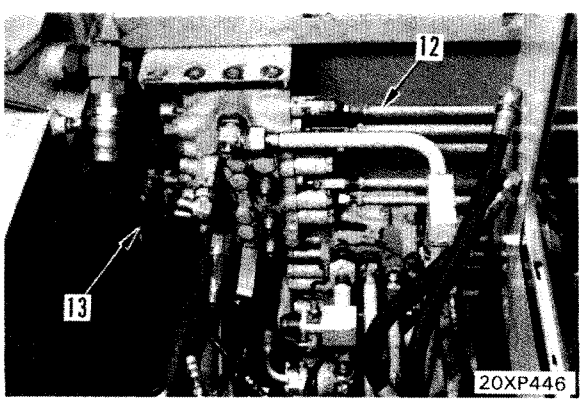
2. **LH 6-spool control valve assembly**
   Install LH 6-spool control valve assembly (16).
   ★ Tighten the installation bolts evenly.



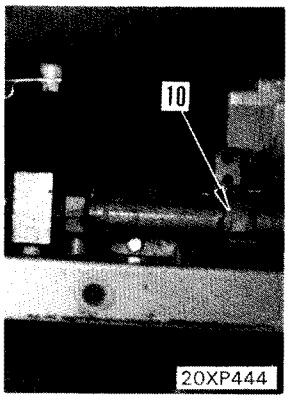
3. **Drain tube and tube**
   1) Connect tube (15).
   2) Connect tube (14).

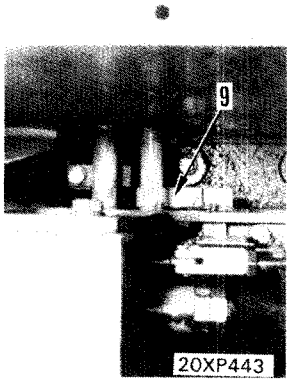


4. **Hoses and rods**
   1) Fit a tube, then install hose (13).
   2) Connect rods (12).
      ★ Be sure to bend the cotter pin securely.

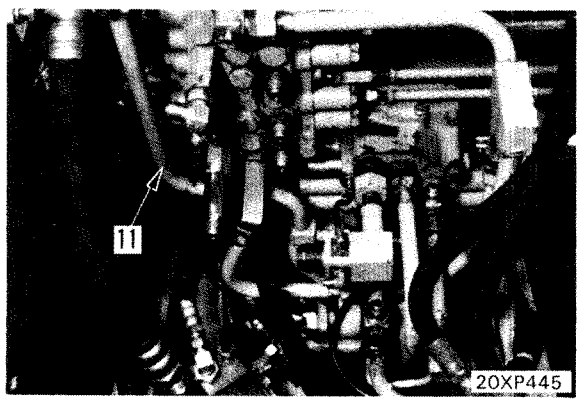


5. **Work equipment tube and LH-RH connection tube**
   1) Connect the tube to the RH valve, then fix with tube clamps (10) and (9).

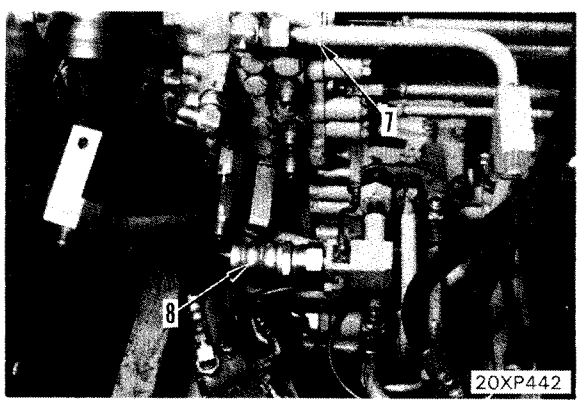




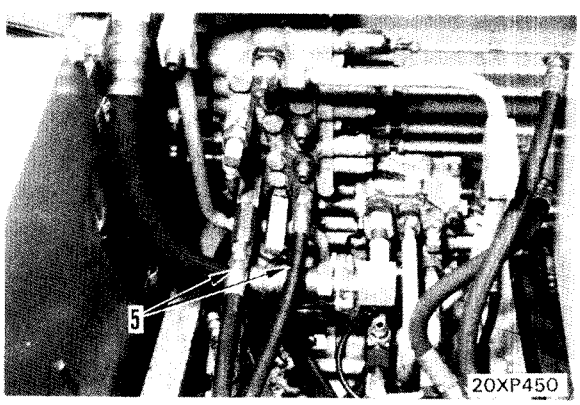
   2) Install tube (11).



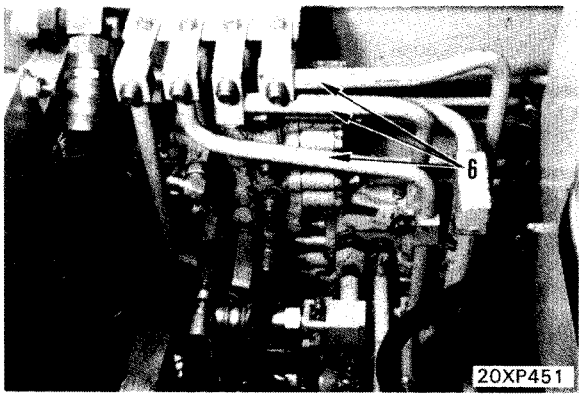
6. **Drain hose and tube**
   1) Connect hose (8).
   2) Connect tube (7).



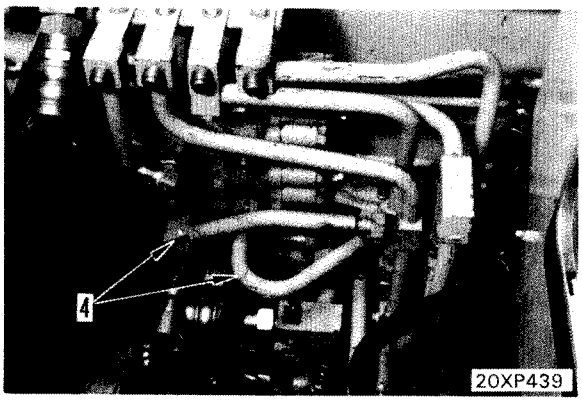
7. **Travel hose**
   Connect hose (5).



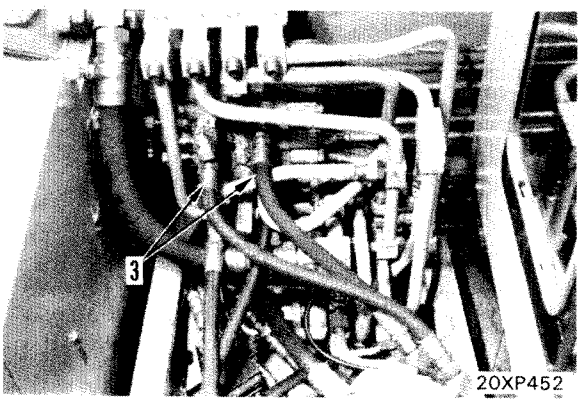
8. **Tube of work equipment**
   Install tubes (6).



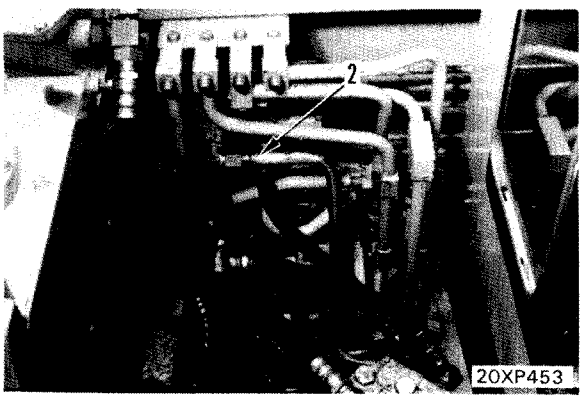
9. **Tube**
   Install tubes (4).



10. **Travel hose**
    Install hose (3).

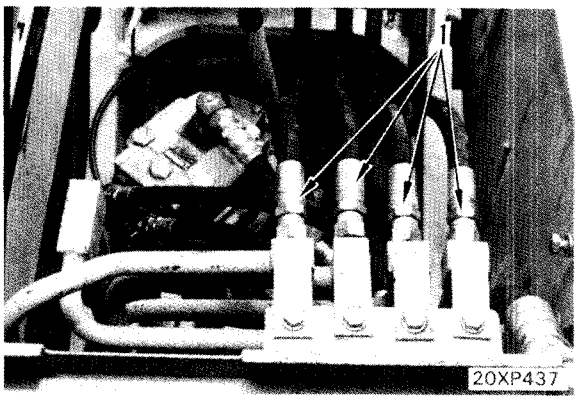


11. **Tube**
    Install tubes (2).



12. **Work equipment hose**
    Connect hose (1).

13. **Bleeding air from the cylinder, and adding oil**
    1) Bleed the air from the cylinder circuit. For details, see Bleeding the Air from Hydraulic Cylinders under TESTING AND ADJUSTING.
    2) Add engine oil through the hydraulic oil filler up to the specified level.
       ★ If the piping was removed, add oil to make up the portion which leaked out.



REMOVAL OF R.H. 5-SPOOL CONTROL VALVE ASSEMBLY

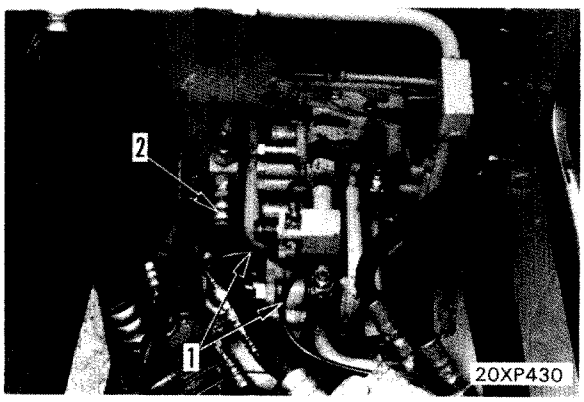
(PC60, 60L-5)

Lower the work equipment to the ground, slowly remove the oil filler cap to release the air from inside the tank, then operate the control lever to release the remaining pressure from the tank.

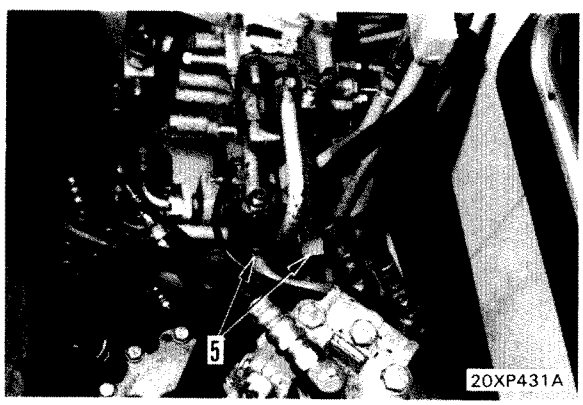
★ If hoses or tubes are connected to a control valve assembly to which O-ring bosses and O-ring nipples are installed, the tightening torque at different sections will be different at each section, so use two spanners to disconnect the tubes or hoses.

1. Remove the LH 5-spool control valve assembly. For details, see REMOVING THE LH 5-SPOOL CONTROL VALVE ASSEMBLY.

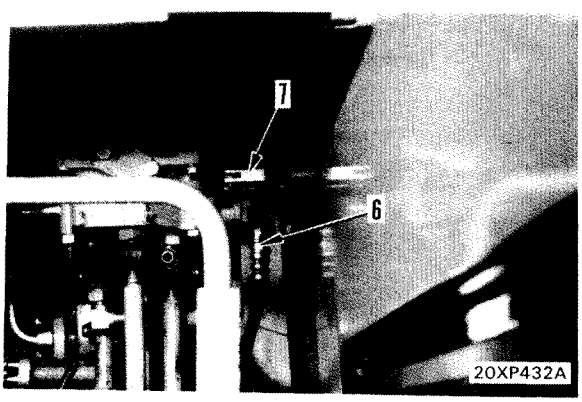
2. Disconnect the drain tube, the swing motor drain hose, tube (1), and hose (2).



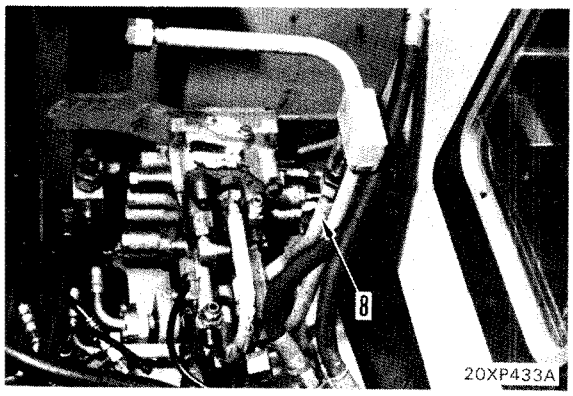
3. Boom cylinder tube
   Disconnect tube (5).
   ★ Loosen the tube clamps between the boom cylinders.



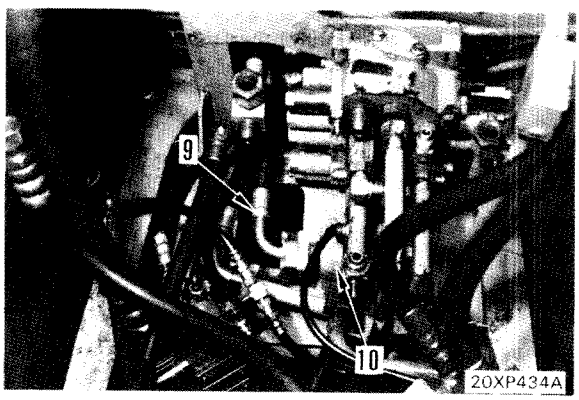
4. Connecting rod and hose
   1) Disconnect hose (6).
   2) Disconnect connecting rod (7).



5. **Inlet tube**
   Remove the clamps, then disconnect tube (8).



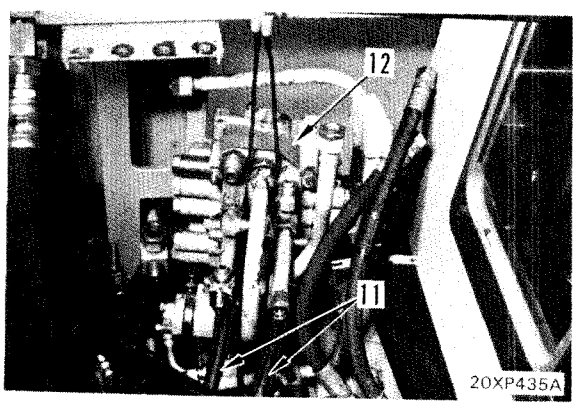
6. **Inlet hose and clamps**
   1) Remove the flange, then disconnect hose (9).
   2) Remove the bolts, then remove clamps (10).



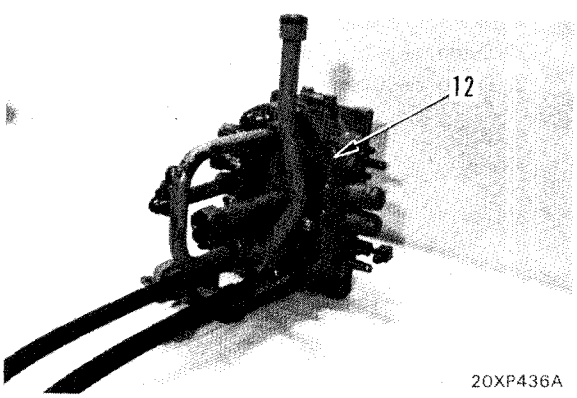
7. **Center swivel hose, RH 5-spool and RH 6-spool control valve assembly**
   1) Disconnect hose (11) from the center swivel side.
   2) Remove the installation bolts, then remove RH 5-spool and RH 6-spool control valve assembly (12).

   kg RH 5-spool control valve assembly:

   RH 6-spool control valve assembly:



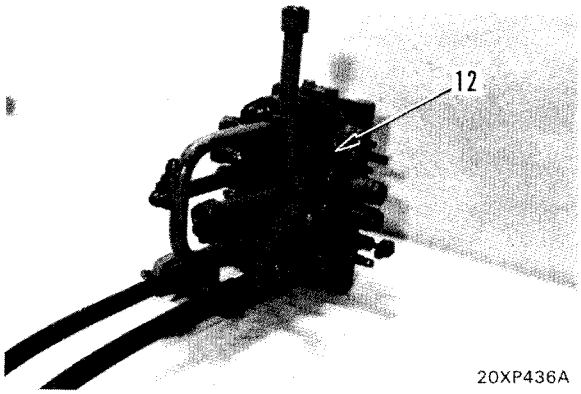
8. **Control valve subassembly**
   Remove the tubes, nipples, and hoses from assembly (12).



INSTALLATION OF R.H. 5-SPOOL CONTROL VALVE ASSEMBLY (PC60, 60L-5)

★ If hoses or tubes are connected to a control valve assembly to which O-ring bosses and O-ring nipples are installed, the tightening torque at different sections will be different, so use two spanners to tighten the hoses or tubes.

1. **Control valve subassembly**
   Fit O-rings and attach the bosses, nipples, and hoses to the control valve to make assembly (12).



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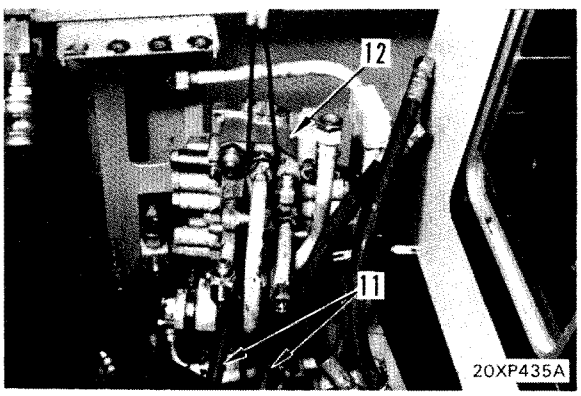
2. **RH 5-spool and 6-spool control valve assembly and center swivel hose**
   1) Install RH 5-spool/6-spool control valve assembly (12).
      ★ Tighten the installation bolts evenly.
   2) Connect hose (11) to the center swivel.



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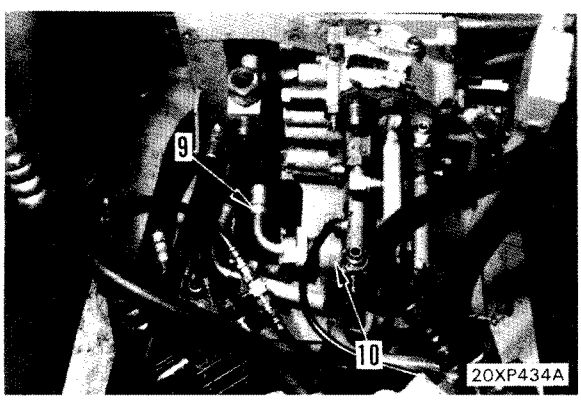
3. **Clamps and inlet hose**
   1) Set the tube, install clamps (10), then tighten the bolts.
   2) Fit an O-ring, set hose (9), then tighten the clamp.



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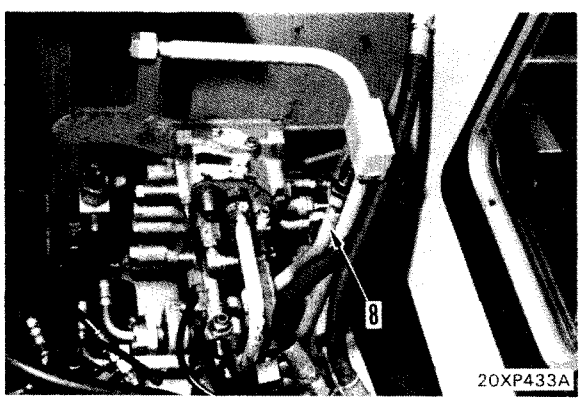
4. **Inlet tube**
   Connect tube (8) and secure with the clamp.



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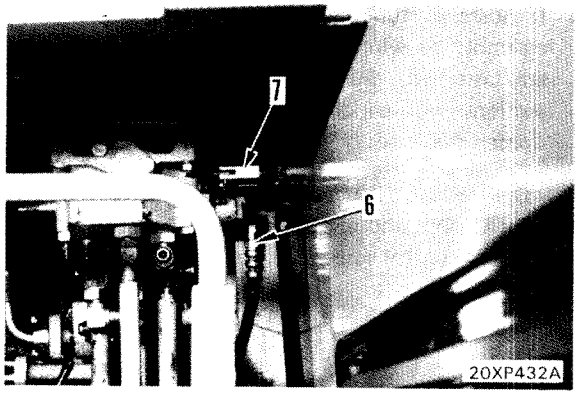
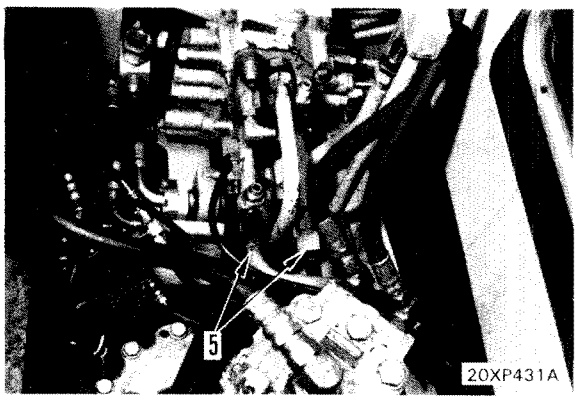
5. **Connecting rod and hose**
   1) Connect connecting rod (7).
   2) Connect hose (6).
      ★ Be sure to bend the cotter pin securely.

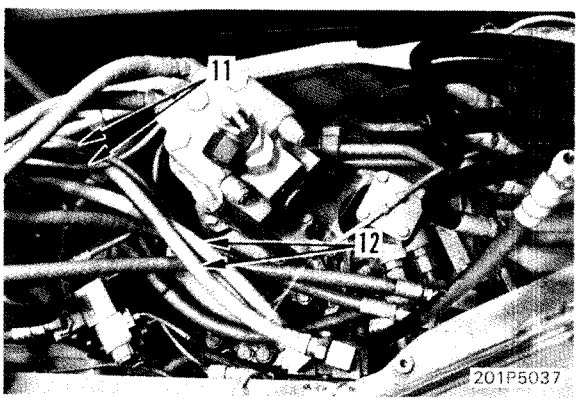


6. **Boom cylinder tube**
   Connect tube (5).
   ★ Tighten the tube clamp between the boom cylinders.

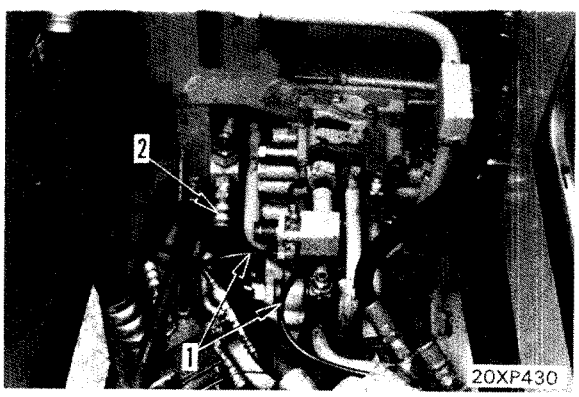


7. **Boom swing hose**
   Connect hose (4), then connect drain tube (3).

8. **Swing motor, drain hose, drain tube**
   Connect hose (2) and tube (1).



9. **LH 6-spool control valve assembly**
   Install the LH 6-spool control valve assembly, then install the tube for the RH control valve assembly. For details, see INSTALLATION OF RH 6-SPOOL CONTROL VALVE ASSEMBLY.

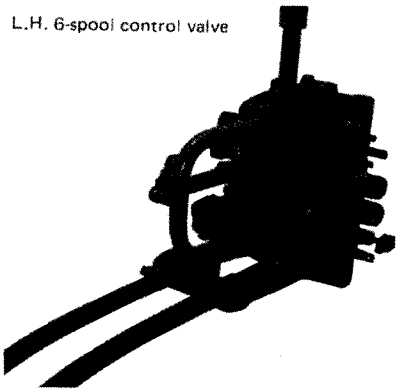


DISASSEMBLY OF CONTROL VALVE ASSEMBLY

★ Use the LH 6-spool control valve.
★ The set pressure of the safety valve can not be adjusted while the safety valve is mounted on the machine, so do not disassemble it.

1. Remove plugs (1) and (2).
2. Remove plugs (5), plugs (4), and plugs (3).
3. Remove plug (6), then remove spring (7) and check valve (8).
4. Remove safety valve assembly (9).
   ★ The set pressure for the safety valve is higher than for the main relief valve, so do not disassemble it again.
5. Remove suction valve assembly (10).
6. Remove main relief valve assembly (11).
   ★ Loosen lock nut (12) and adjust screw (13).
7. Remove the bolts from body (14), then remove cover (15).
8. Remove plug (16), retainer (17), and spring (18).
   ★ Pull out the plug with the spool assembled to the body.
9. Pull spools (19) and (20) out of the body.
   ★ Disconnect the connection portions so that the sliding surfaces of spools (19) and (20) do not get scratched.
10. Remove cover (15).
11. Remove plug (21), retainer (17), and spring (20).
12. Pull spool (22) out of the body.
13. Remove nipple (23).
14. Remove plug (24), then pull out spring (25) and spool (26).
15. Remove the body, remove plates (27) and (28), then remove seal (29).

L.H. 6-spool control valve



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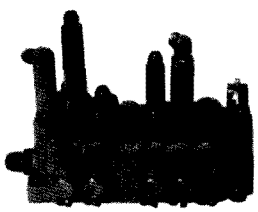
R.H. 5-spool control valve



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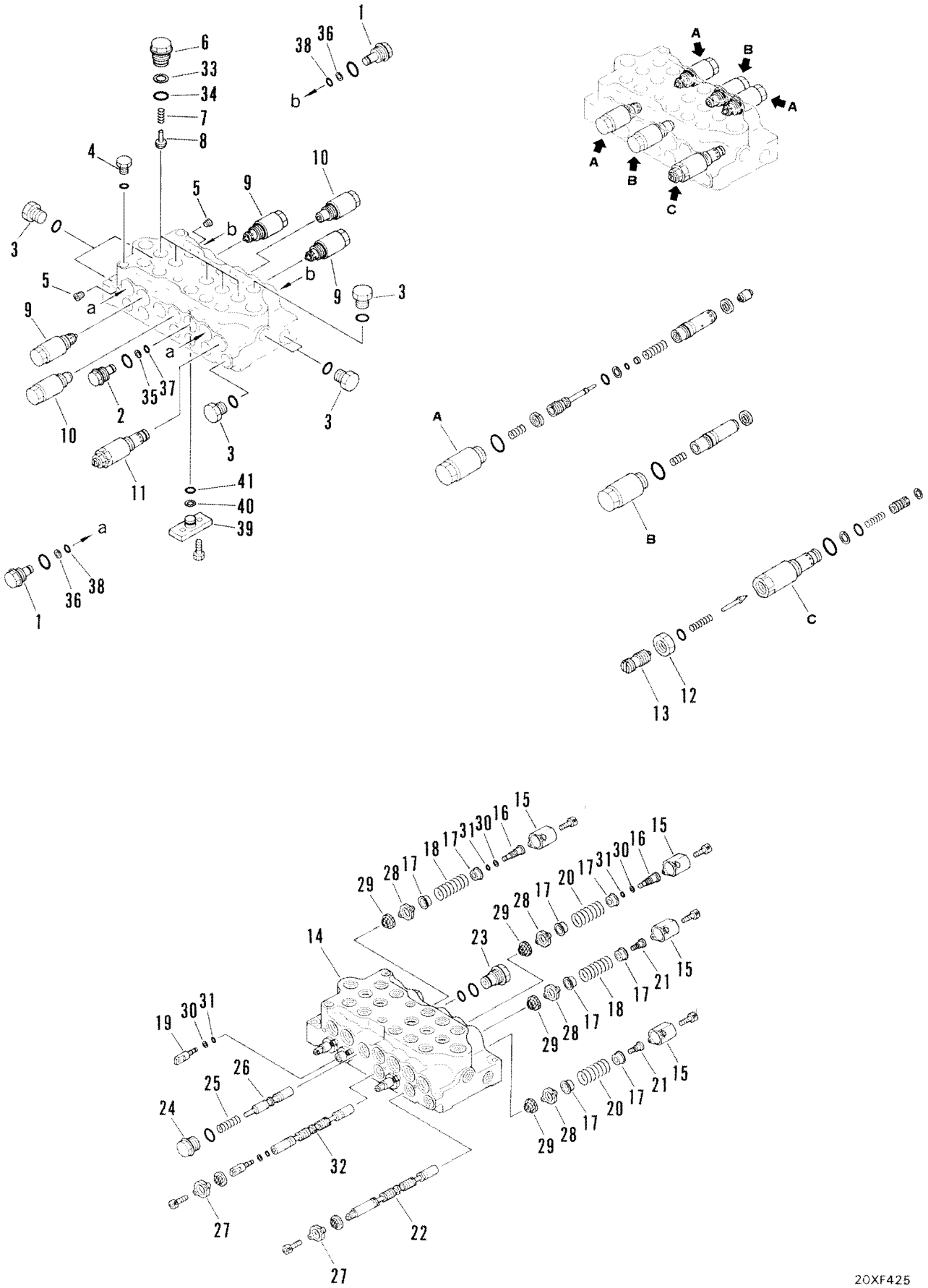
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ASSEMBLY OF CONTROL VALVE ASSEMBLY

★ Use the LH 6-spool control valve.
★ Confirm that there is no foreign matter or scratches on any of the parts and apply engine oil to the sliding surfaces before assembling the control valve assembly.

1. Confirm that there are no scratches on oil seal (29), then install it to body (14).
2. Install plate (27) to the body.
3. Fit an O-ring to spool (26), spring (25), and plug (24), the install to the body.
4. Fit an O-ring to nipple (23) and tighten it to the body.

   kgm Nipple: 7 ± 1 kgm

5. Install spool (22) to the body, and install plate (28), retainer (17), and spring (20) then install plug (21).

   kgm Plug: 1.5 ± 0.5 kgm

6. Install cover (15).
7. Fit back-up ring (30) and O-ring (31) to joint (19), connect to spool (32), then install to the body.

   kgm Joint: 1.5 ± 0.5 kgm

8. Fit back-up ring (30) and O-ring (31) to plate (28), retainer (17), and spring (20), then install the plug to spool (32).

   kgm Plug: 1.5 ± 0.5 kgm

9. Install cover (20).
10. Fit an O-ring and install safety valve assembly (9).

    kgm Safety valve assembly: 7 ± 1 kgm

11. Fit an O-ring and install suction valve assembly (10).

    kgm Suction valve assembly: 7 ± 1 kgm

12. Fit an O-ring and install main relief valve assembly (26).

    kgm Main relief valve assembly: 5.5 ± 0.5 kgm

    ★ After installing the control valve to the machine following disassembly, turn screw (28) to adjust the set pressure to 305^{+5}_{0} kg/cm^2.

13. Install check valve (8) and spring (7) to the body. Fit back-up ring (33) and O-ring (34) to plug (6), then install plug (6) to the body.

    kgm Plug: 7 ± 1 kgm

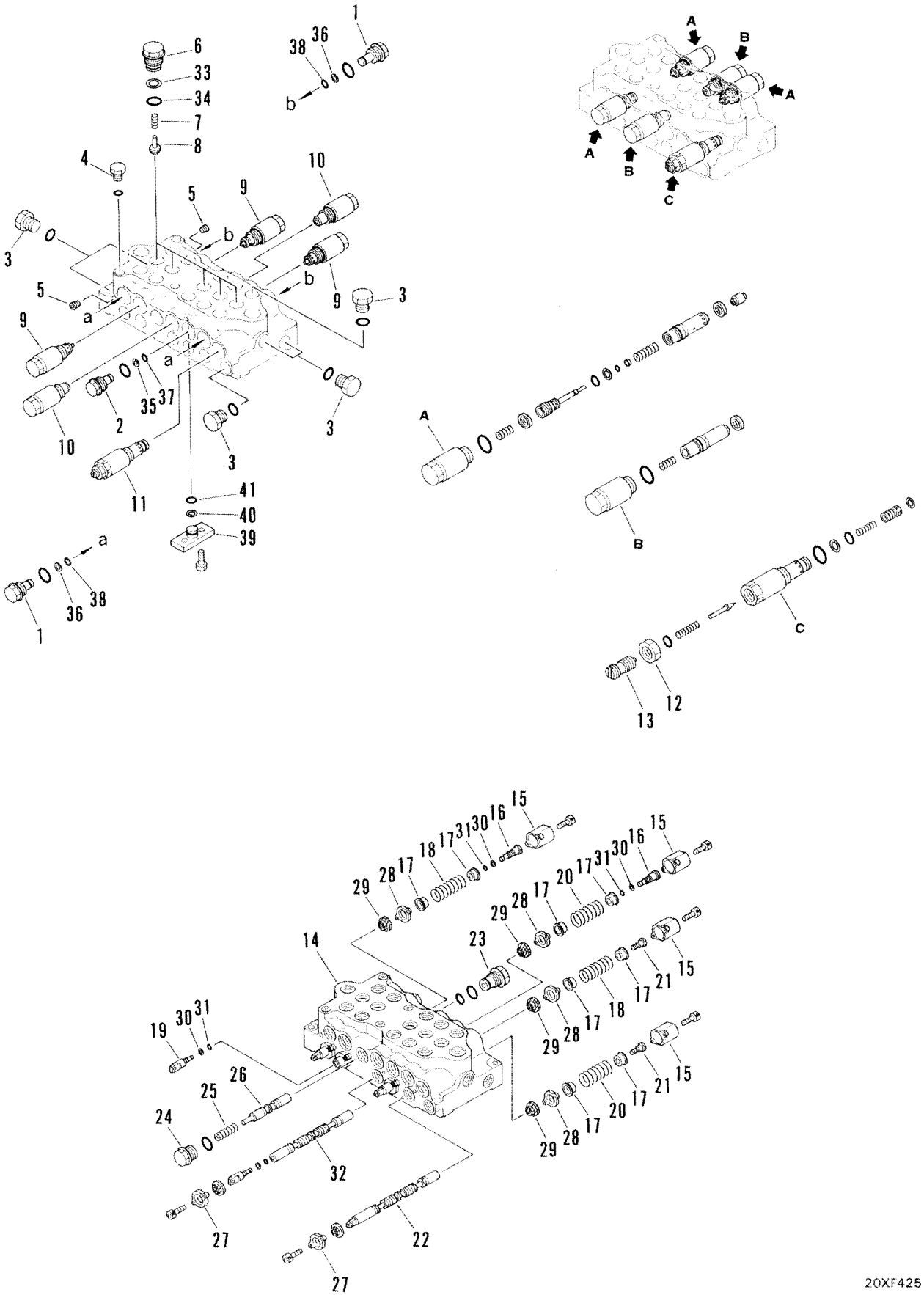
14. Fit O-rings to plugs (1) and (2), install back-up rings (35) and (36), fit O-rings (37) and (38), then install to the body.

    kgm Plug: 7 ± 1 kgm

15. Fit an O-ring to plugs (4) and (3) and install them to the body.

    kgm Plug: 5 ± 0.5 kgm

16. Fit back-up ring (40) and O-ring (41) to plate (39), then install the plate to the body.
17. Install plug (5).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REMOVAL OF BOOM CYLINDER ASSEMBLY

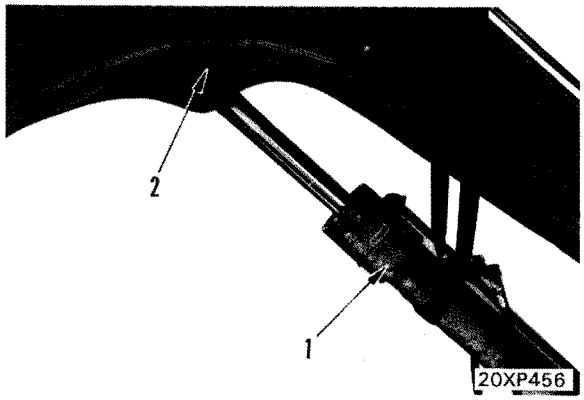
⚠ Lower the work equipment completely to the ground.

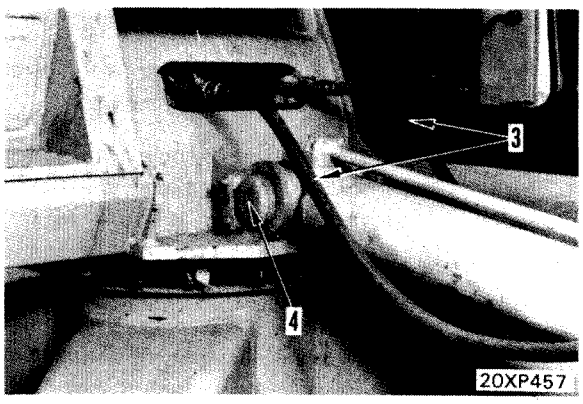
1. Sling boom cylinder assembly (1).
2. Remove the lock plate and remove mounting pin (2) on the rod.

   ⚠ After stopping the engine, operate the control lever several times to release the remaining hydraulic pressure form the piping.

3. Disconnect hoses (3) from the cylinder.
4. Remove the lock plate and remove mounting pin (4) from the bottom. Then, dismount boom cylinder assembly (1).

   kg Boom cylinder assembly: 72 kg





INSTALLATION OF BOOM CYLINDER ASSEMBLY

1. Sling boom cylinder assembly (1), position the mounting pin hole in the bottom on the revolving frame and drive mounting pin (4) into the hole. Then, install the lock plate.
2. Lower the assembly to the support (Height: Approx. 800 mm) and connect hoses (3) to the cylinder.
   ★ Install hoses without twisting or interference.

   kgm Hose: 8 ± 2 kgm

3. Start the engine, extend the piston rod, and align the pin holes in the rod with those in the boom. Then, drive mounting pin (2) into the holes. Install the plate.

★ After mounting the boom cylinder assembly start the engine to circulate the oil through the piping. Then add engine oil up to the specified level.

REMOVAL OF ARM CYLINDER ASSEMBLY

Lower the work equipment completely to the ground so that the arm is extended all the way out with block (1) (Height = Approx. 50 mm) set between the arm and the boom.

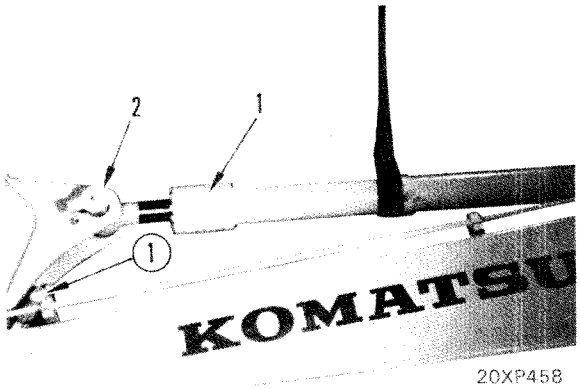
★ If block (1) is not used between the arm and the boom, the weight of the arm will be imposed on the piston rod, making it difficult to remove the mounting pin from the rod side.

1. Sling arm cylinder assembly (1).
2. Remove the block plate and remove mounting pin (2) from the rod side.
3. Start the engine and fully retract the piston rod.

   Fasten the rod in place with wire to prevent it from falling out of place.

   After stopping the engine, operate the control lever several times to release the remaining hydraulic pressure from the piping.
4. Disconnect hoses (3) from the cylinder.
5. Remove the lock plate. Remove mounting pin (4) from the bottom side and dismount arm cylinder assembly.

   kg Arm cylinder assembly: 75 kg



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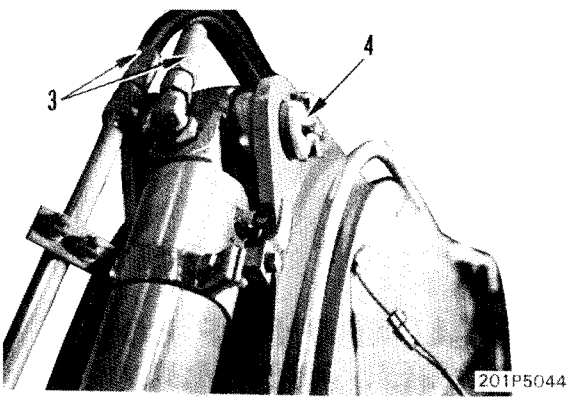

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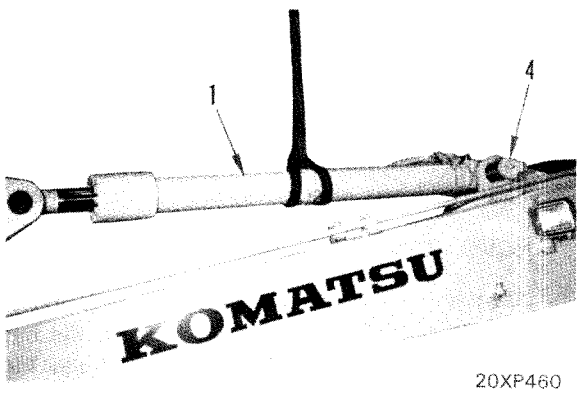
INSTALLATION OF ARM CYLINDER ASSEMBLY

1. Sling arm cylinder assembly (1), position the mounting pin hole in the bottom of the boom. Then, drive mounting pin (4) into the hole. Install the lock plate.
2. Connect hoses (3) to the cylinder.
   ★ Install hoses without twisting or interference.

   kgm Hose nut: 8 ± 2 kgm
3. Start the engine and extend the piston rod. Align the pin holes in the rod with those in the arm, then drive mounting pin (2) into the hole. Install the lock plate.
4. Remove block (1).

★ After mounting the arm cylinder assembly, start the engine to circulate the oil through the piping. Then add engine oil up to the specified level.



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REMOVAL OF BUCKET CYLINDER ASSEMBLY

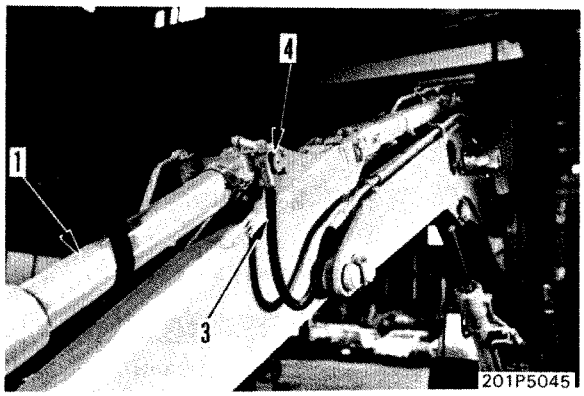
⚠ Lower the work equipment completely to the ground.

1. Sling bucket cylinder assembly (1).
2. Remove the lock bolt and remove mounting pin (2) from the rod side.
3. Start the engine and fully retract the piston rod.

   ⚠ Fasten the rod in place with wire to prevent from falling out of place.

   ⚠ After stopping the engine, operate the control levers several times to release the remaining hydraulic pressure from the piping.
4. Disconnect hoses (3) from the cylinder.
5. Remove the lock plate and remove mounting pin (4) from the bottom. Then, dismount bucket cylinder assembly (1).

   kg Bucket cylinder assembly: 55 kg



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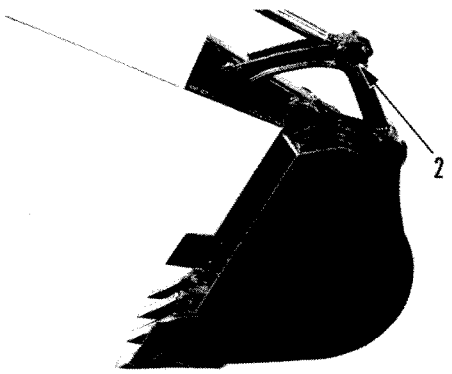


201P5046

INSTALLATION OF BUCKET CYLINDER ASSEMBLY

1. Sling bucket cylinder assembly (1), position the cylinder bottom on the arm, and drive mounting pin (4) into the hole. Install the lock plate.
2. Connect hoses (3) to the cylinder.
   ★ Install the hoses without twisting or interference.

   Pin matching surface: LM-P

   ★ Make sure adjusting shim 1.0 below to each fitting clearance.
3. Start the engine and extend the piston rod. Align the pin holes in the rod with those in the link. Drive mounting pin (2) into the holes and install the lock bolt.

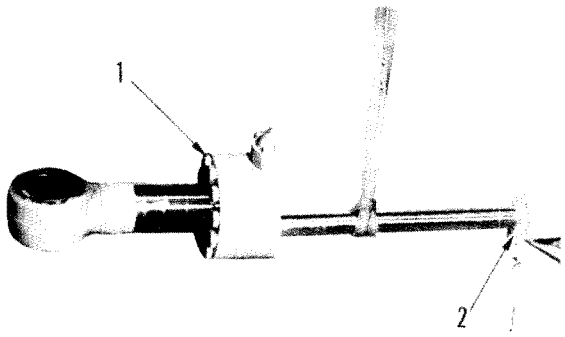
★ After mounting the bucket cylinder assembly, start the engine to circulate the oil through the piping. Then add engine oil up to the specified level.

DISASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

(For boom, arm, bucket, and boom swing cylinders)

Special tools required

	Part No.	Part Name	Q'ty
A_1	790-502-2000 or 790-502-3000	Repair stand	1
A_2	790-320-1290	Socket (60 mm, short)	1
A_3	790-102-1470	Socket (60 mm, long)	1
A_4	790-302-1340	Socket (80 mm)	1
A_5	790-101-1102	Pump	1
A_6	790-102-2310	Wrench	1



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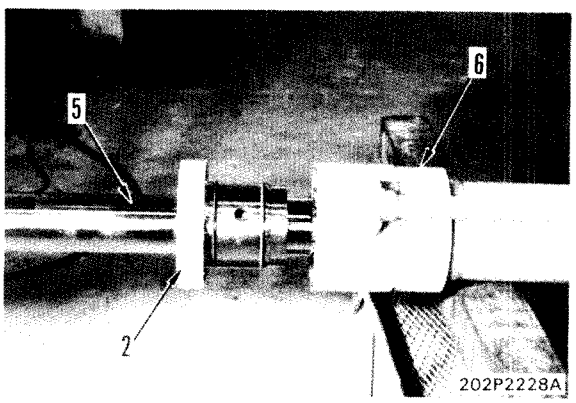
202P2227

1. Piston rod assembly

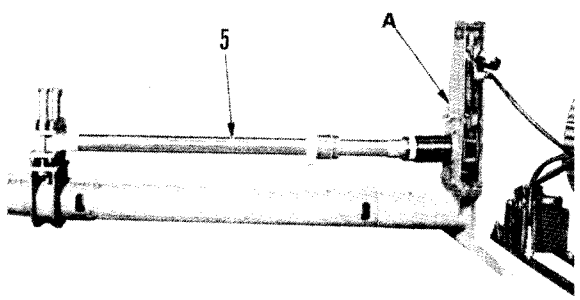
1) Head
Remove head bolt (1).

2) Sling the piston rod and pull out the piston to the stroke end.
★ Oil will come out of the tube on the head side, so catch it with an oil pan.

3) Pull out head assembly (2) and remove piston rod assembly (5) from cylinder (6).



202P2228A

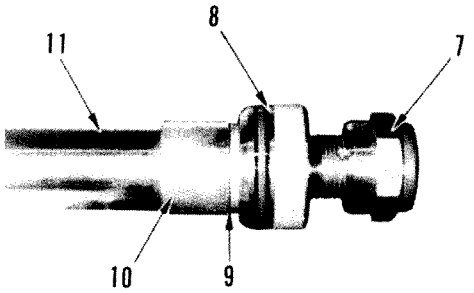


202P2229A

2. Piston assembly

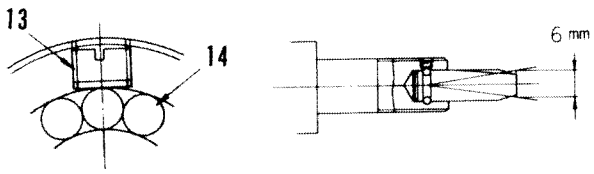
1) Set cylinder assembly (1) on tool A_1.

2) Loosen nut (7) and remove it.
   ★ Nut width across flats: 70 mm (Boom)
   65 mm (Arm)
   60 mm (Bucket)
3) Remove piston assembly (8), spacer (9), and bead side plunger (10) from rod (11).
   ★ Plunger (10) of head side (boom cylinder only.)
4) Remove head assembly (12) from rod (5).

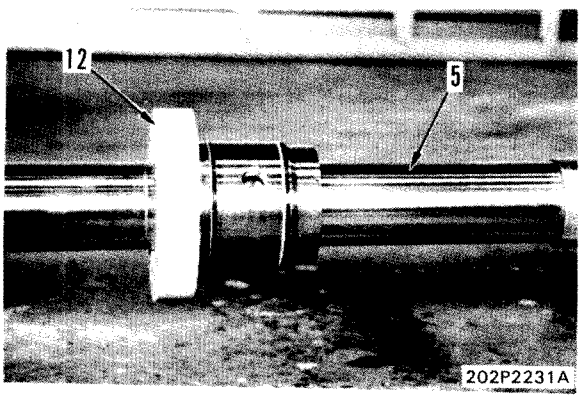


202P2230A

3. **Plunger of bottom side (arm cylinder only)**
   Remove screw (13), pull out 11 balls (14), then remove plunger (15).



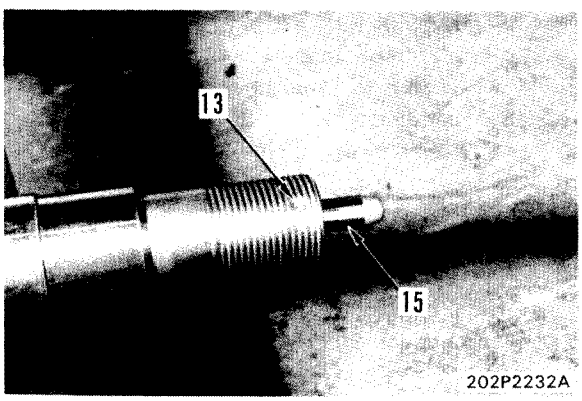
207F254C



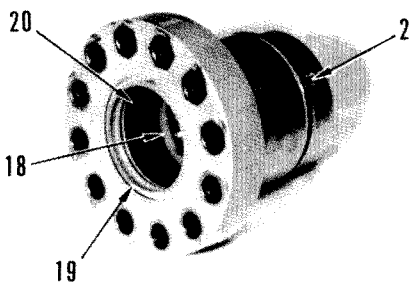
202P2231A

4. **Disassembly piston assembly**
   1) Remove wear ring (17) from piston assembly (8).
   2) Remove piston ring (16).

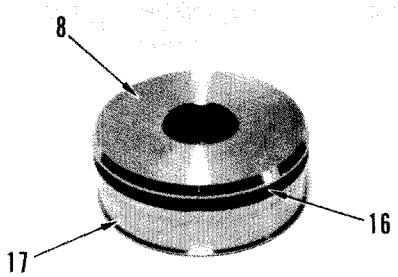
5. **Disassemble head assembly**
   Remove packing (18), dust seal (19), and bushing (20) from head assembly (2).



202P2232A



202P2234A



202P2233A

ASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

(For boom, arm, bucket, and swing cylinders)

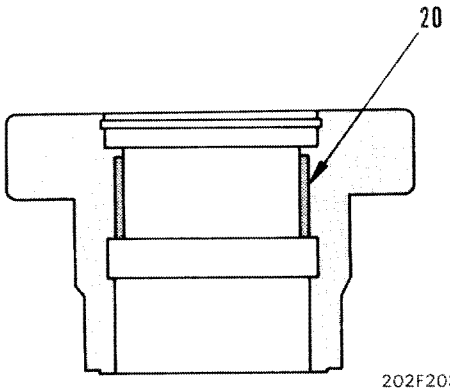
Special tools required

No.	Part No.	Part Name	Q'ty
A_1	790-502-2000 or 790-502-3000	Repair stand	1
A_2	790-302-1290	Socket (Width across flats: 60 mm)	1
A_3	790-102-1470	Socket (Width across flats: 70 mm)	1
A_4	790-302-1340	Socket (Width across flats: 80 mm)	1
A_5	790-101-1102	Pump	1
A_6	790-102-2310	Wrench	1
B	790-702-1000	Expander	1
C	790-720-1660	Ring	1

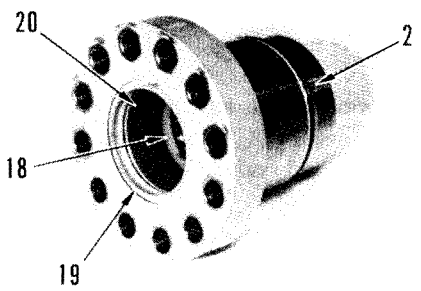
★ Before assembling the cylinder, apply engine oil to the various sliding faces.

1. Assembly of cylinder head assembly

1) Install bushing (20) into cylinder head (28), using a push tool.
   ★ Be careful not to deform the bushings when installing them.
2) Install rod packing (18).
   ★ Be sure to install the rod packing in the correct direction.
   ★ Bush out dia.: 65 mm (Boom)
   60 mm (Arm)
   55 mm (Bucket)
3) Install backup ring (18) and O-ring.
   ★ Before installing the backup ring, warm it in hot water.
4) Install dust seal (19) in cylinder head.



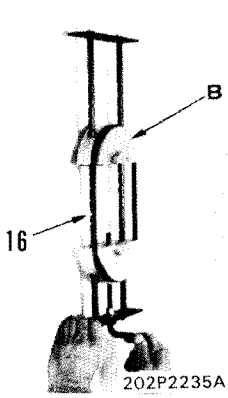
202F2032A



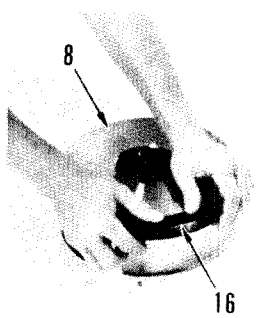
202P2234A

2. Assembly of piston assembly

1) Using tool B, extend piston ring (16).
2) Install piston ring to piston.

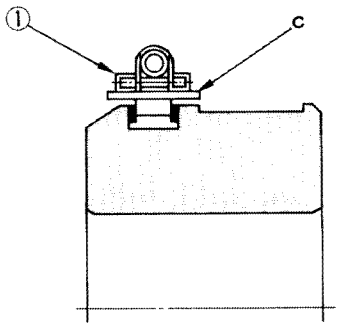


202P2235A

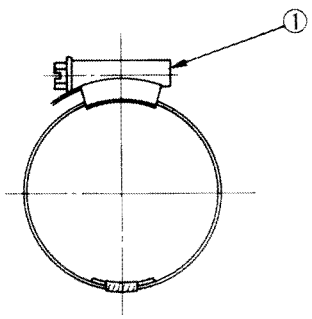


202P2236A

3) Cover with tool C, tighten clamp (1), install piston ring (16), and tighten to the specified dimensions.
   ★ Clamp Part No. 07281-01279
   (for 100 – 115 mm)



202F2033

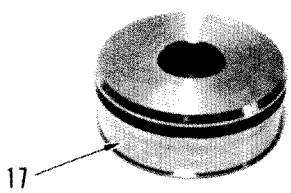


202F2034

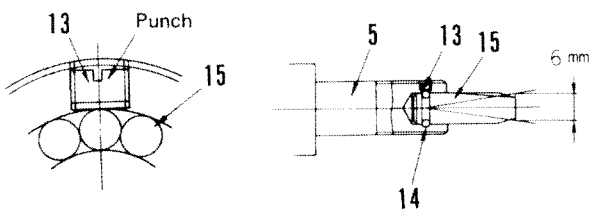
4) Install wear ring (17).

3. Plunger (arm cylinder only)

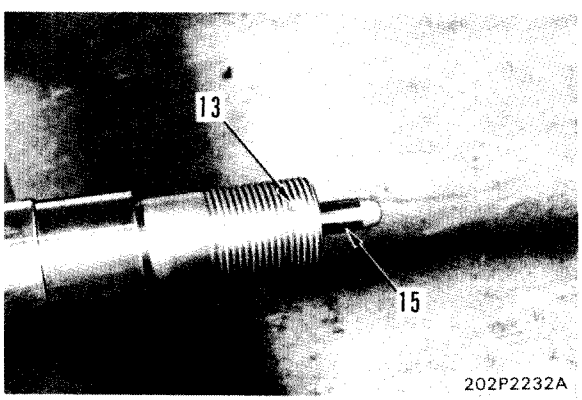
1) Assemble rod (5) to plunger (15), insert 11 balls (14), and tighten screw (13).
   ★ After the screw is completely tightened, loosen it until there is about 6 mm of play in the tip of the plunger.
2) Punch screw (13).



202P2237A



203F423B



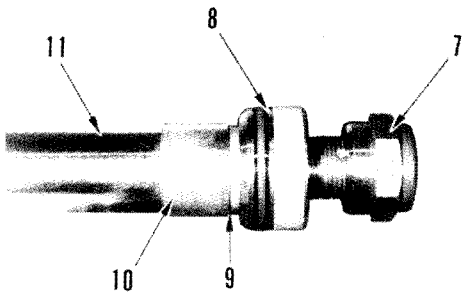
202P2232A

4. **Piston assembly**

1) Assemble plunger (10), ring (9), piston assembly (8), and nut (7) to the rod.
   ★ Plunger (10) is for the arm cylinder only.

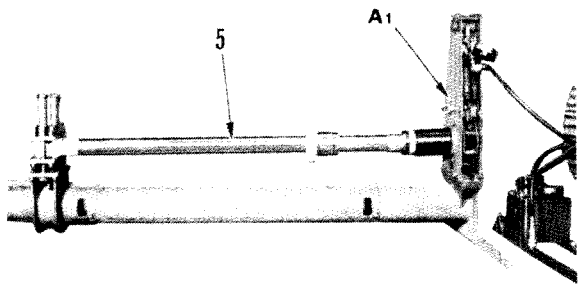
2) Set rod assembly (5) on tool A and tighten nut (7).

   kgm Nut width across flats (55 mm):
   170 ± 17 kgm
   Nut width across flats (60 mm)
   220 ± 22 kgm
   Nut width across flats (65 mm)
   270 ± 27 kgm
   Nut width across flats (70 mm)
   340 ± 34 kgm



202P2230A

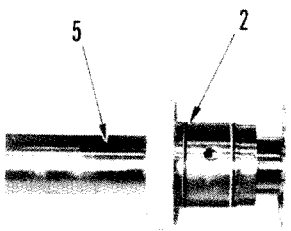
3) Remove the rod assembly from tool A.



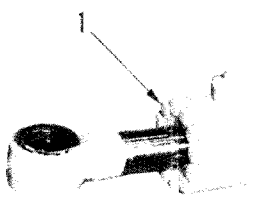
202P2229A

5. **Rod assembly**

1) Apply engine oil and assemble piston rod assembly (5) to the cylinder.
2) Install head assembly (2) to the cylinder and tighten bolt (1).
3) Push the rod in to the stroke end.

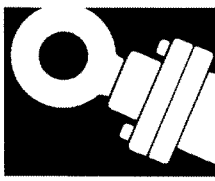


202P2238A

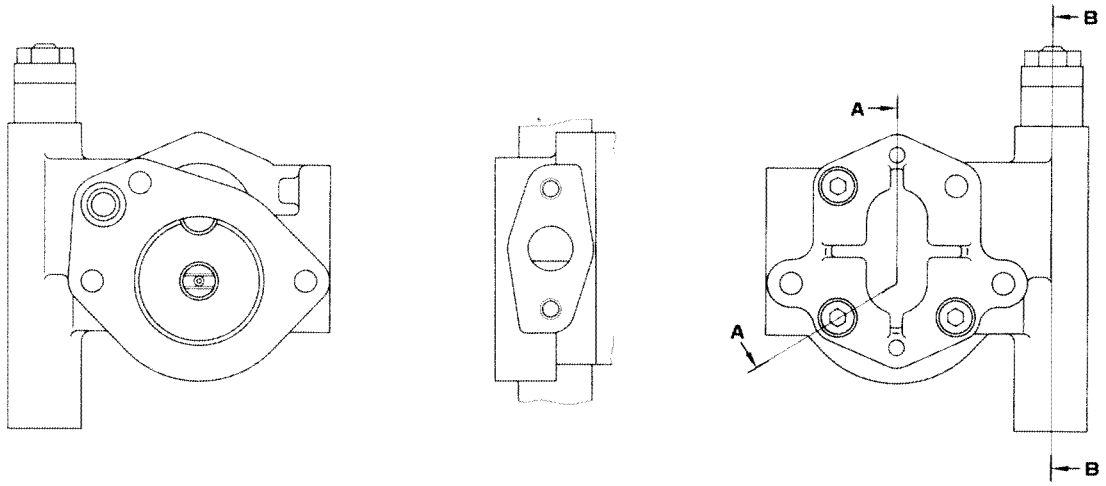


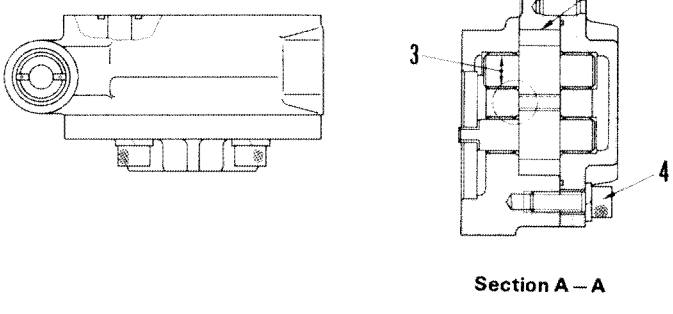
202P2239A

HYDRAULIC SYSTEM
64 MAINTENANCE STANDARD

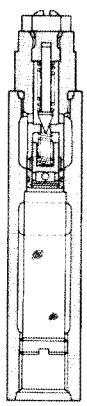


CHARGING PUMP (BAR16)





Section A – A



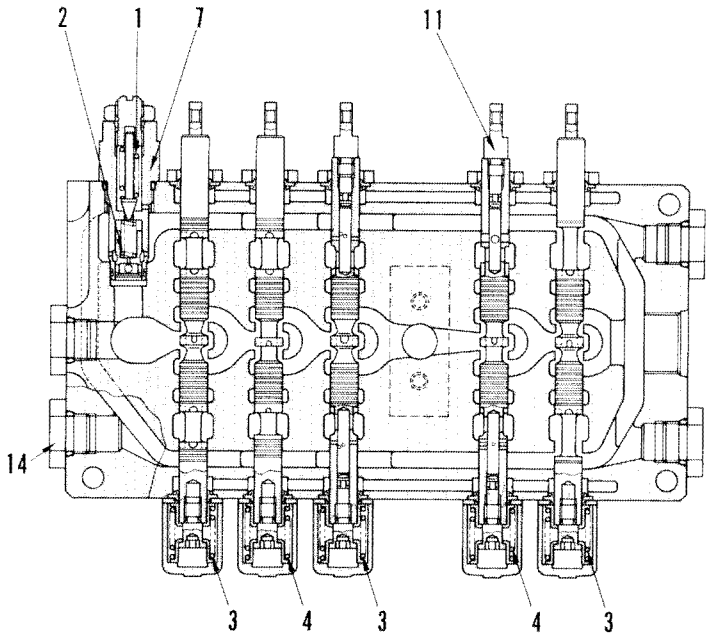
Section B – B

201F5125

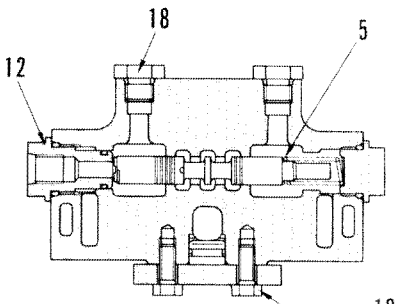
Unit: mm

No.	Check item	Criteria				Remedy
1	Radical clearance gear and gear case	Standard clearance		Clearance limit		Replace
		0.085 – 0.125		0.145		
2	Axial clearance gear and gear case	0.055 – 0.075		0.105		
3	Clearance between gear shaft and bushing	0.045 – 0.098		0.13		
4	Tightening torque for mounting bolt of housing and case	7 ± 0.5 kgm				Tighten
5	Delivery (flow rate) (SAE10W-CD at 50°C and 30 kg/cm²)	Standard value		Repair limit		Replace
		Revolutions (rpm)	Delivery (ℓ/min.)	Revolutions (rpm)	Delivery (ℓ/min.)	
		3200	46	3200	43	

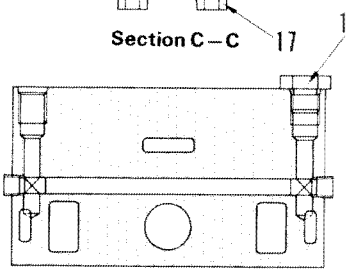
L.H. 6-SPOOL CONTROL VALVE



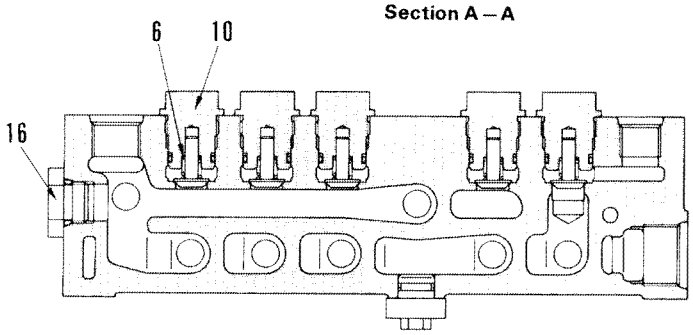
Section A – A



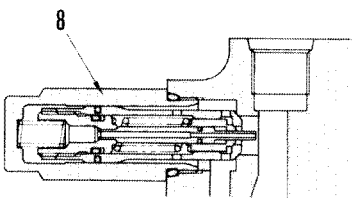
Section C – C



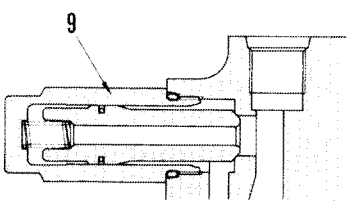
Section D – D



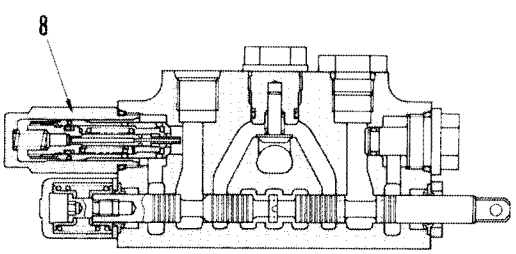
Section B – B



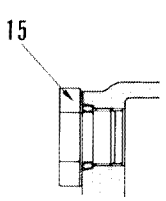
Section F – F



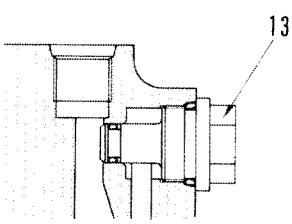
Section G – G



Section E – E



Section H – H



Section K – K

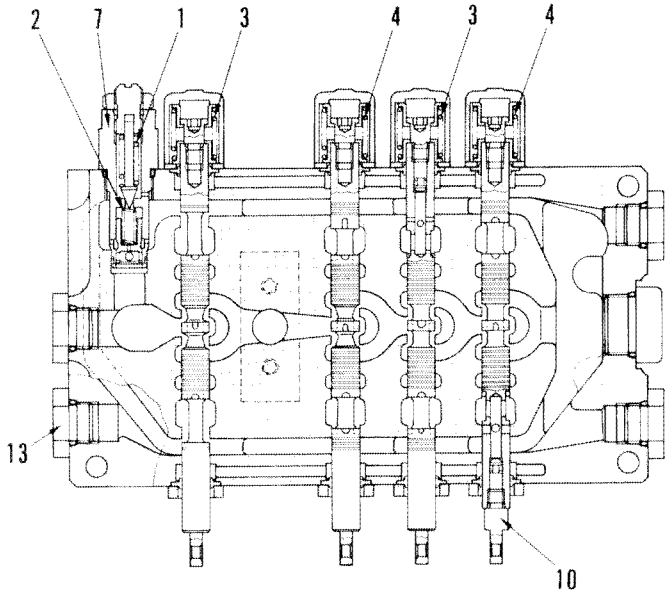
201F5126

Unit: mm

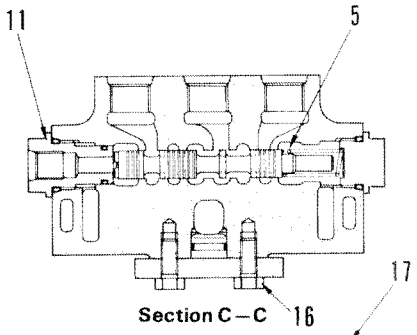
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Pilot poppet spring (for main relief valve)	Free length	Installation length	Installation load	Free length	Installation load	
		30.65 x 9.6	26.3	37.7 kg	—	30.2 kg	
2	Main valve spring (for main relief valve)	23.17 x 7.2	19	4.2 kg	—	3.4 kg	
3	Spool return spring	50.0 x 22.7	26.5	14.1 kg	—	11.3 kg	Replace
4	Spool return spring	55.7 x 22.3	26.5	10 kg	—	8 kg	
5	Spool return spring	48.6 x 13.6	31.5	5.4 kg	—	4.3 kg	
6	Check valve spring	14.6 x 8.9	11.5	1.4 kg	—	1.1 kg	
7	Tightening torque of main relief valve	5.5 ± 0.5 kgm					
8	Tightening torque of safety valve with suction valve	7 ± 1 kgm					
9	Tightening torque of suction valve	7 ± 1 kgm					
10	Tightening torque of check valve	7 ± 1 kgm					
11	Tightening torque of spool joint	1.5 ± 0.5 kgm					
12	Tightening torque of plug	7 ± 1 kgm					
13	Tightening torque of plug	7 ± 1 kgm					Tighten
14	Tightening torque of plug	5 ± 0.5 kgm					
15	Tightening torque of plug	5 ± 0.5 kgm					
16	Tightening torque of plug	5 ± 0.5 kgm					
17	Tightening torque of plug	3.2 ± 0.3 kgm					
18	Tightening torque of plug	2.25 ± 0.25 kgm					
19	Tightening torque of plug	2.25 ± 0.25 kgm					

R.H. 5-SPOOL CONTROL VALVE

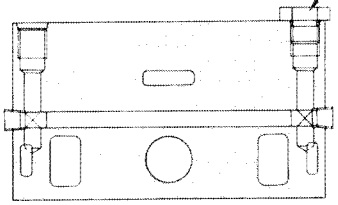
PC60, 60L-5



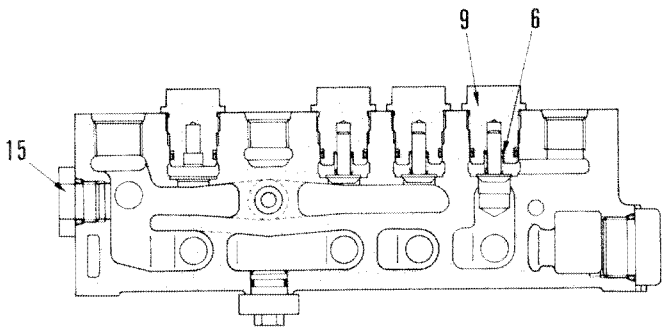
Section A – A



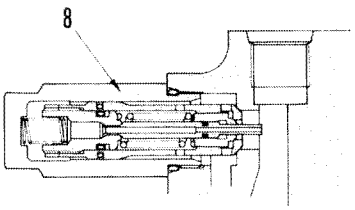
Section C – C



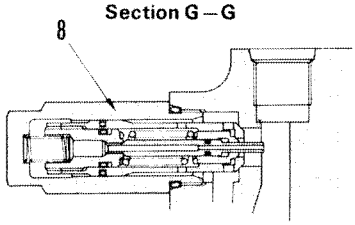
Section D – D



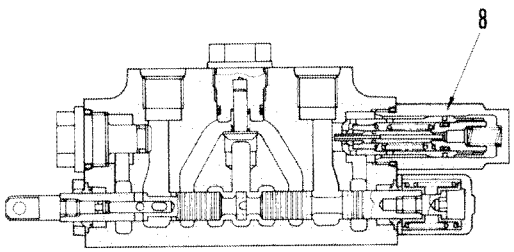
Section B – B



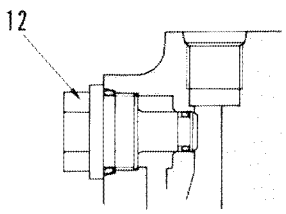
Section G – G



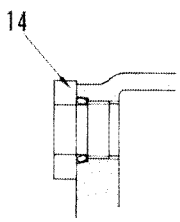
Section K – K



Section E – E



Section F – F



Section H – H

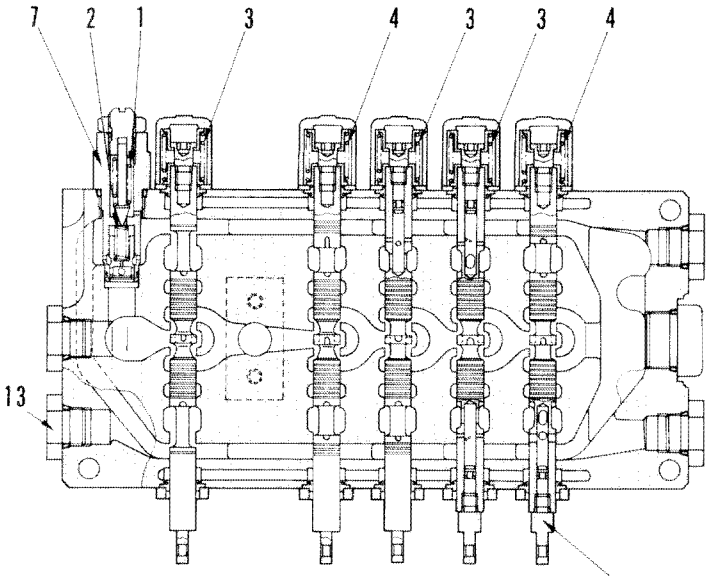
201F5127

Unit: mm

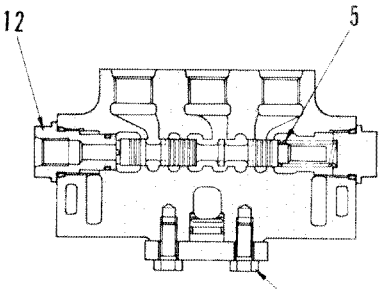
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Pilot poppet spring (for main relief valve)	Free length	Installation length	Installation load	Free length	Installation load	Replace
		30.65 x 9.6	26.3	37.7 kg	—	30.2 kg	
2	Main valve spring (for main relief valve)	23.17 x 7.2	19	4.2 kg	—	3.4 kg	
3	Spool return spring	50.0 x 22.7	26.5	14.1 kg	—	11.3 kg	
4	Spool return spring	55.7 x 22.3	26.5	10 kg	—	8 kg	
5	Spool return spring	48.6 x 13.6	31.5	5.4 kg	—	4.3 kg	
6	Check valve spring	16.4 x 8.9	11.5	1.4 kg	—	1.1 kg	
7	Tightening torque of main relief valve	5.5 ± 0.5 kgm					Tighten
8	Tightening torque of safety valve with suction valve	7 ± 1 kgm					
9	Tightening torque of check valve	7 ± 1 kgm					
10	Tightening torque of spool joint	1.5 ± 0.5 kgm					
11	Tightening torque of plug	7 ± 1 kgm					
12	Tightening torque of plug	7 ± 1 kgm					
13	Tightening torque of plug	5 ± 0.5 kgm					
14	Tightening torque of plug	5 ± 0.5 kgm					
15	Tightening torque of plug	5 ± 0.5 kgm					
16	Tightening torque of plug	3.2 ± 0.3 kgm					
17	Tightening torque of plug	2.25 ± 0.25 kgm					

R.H. 6-SPOOL CONTROL VALVE

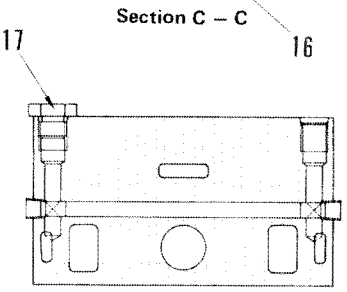
PC60U-5



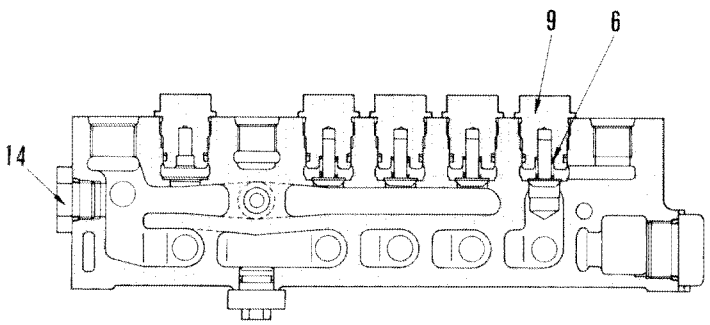
Section A – A



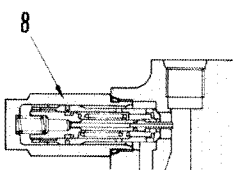
Section C – C



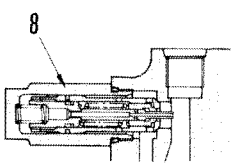
Section D – D



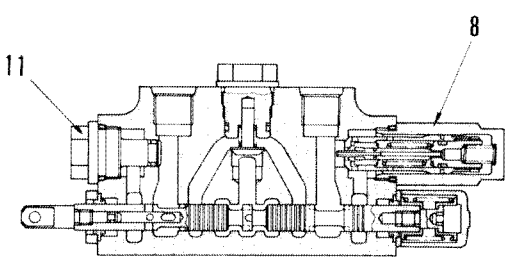
Section B – B



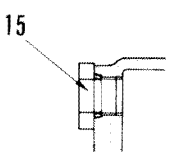
Section G – G



Section K – K



Section E – E



Section H – H

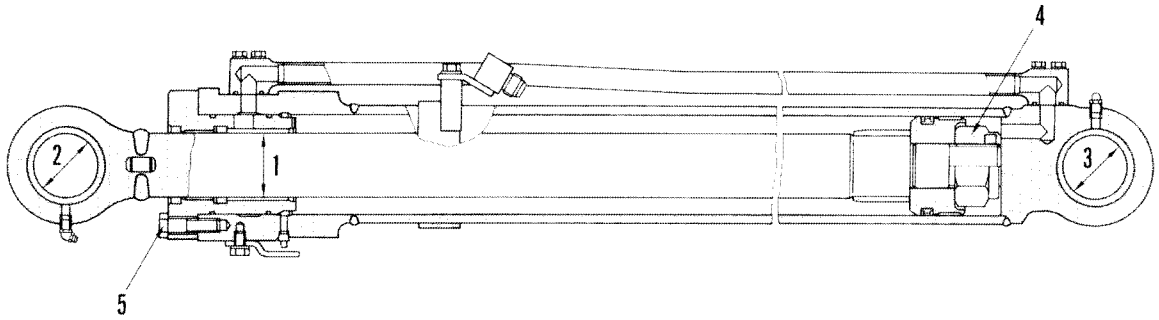
201F5128

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Pilot poppet spring (for main relief valve)	Free length	Installation length	Installation load	Free length	Installation load	Replace
		30.65 x 9.6	26.3	37.7 kg	—	30.2 kg	
2	Main valve spring (for main relief valve)	23.17 x 7.2	19	4.2 kg	—	3.4 kg	
3	Spool return spring	50.0 x 22.7	26.5	14.1 kg	—	11.3 kg	
4	Spool return spring	55.7 x 22.3	26.5	10 kg	—	8 kg	
5	Spool return spring	48.6 x 13.6	31.5	5.4 kg	—	4.3 kg	
6	Check valve spring	16.4 x 8.9	11.5	1.4 kg	—	1.1 kg	
7	Tightening torque of main relief valve	5.5 ±0.5 kgm					Tighten
8	Tightening torque of safety valve with suction valve	7 ±1 kgm					
9	Tightening torque of check valve	7 ±1 kgm					
10	Tightening torque of spool joint	1.5 ±0.5 kgm					
11	Tightening torque of plug	7 ±1 kgm					
12	Tightening torque of plug	7 ±1 kgm					
13	Tightening torque of plug	5 ±0.5 kgm					
14	Tightening torque of plug	5 ±0.5 kgm					
15	Tightening torque of plug	5 ±0.5 kgm					
16	Tightening torque of plug	3.2 ±0.3 kgm					
17	Tightening torque of plug	2.25 ±0.25 kgm					

HYDRAULIC CYLINDER

1. BOOM CYLINDER



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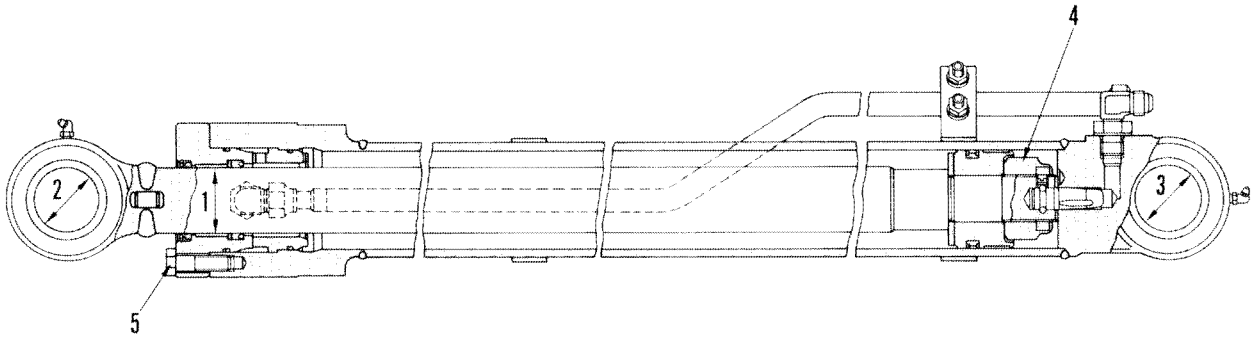
2. ARM CYLINDER



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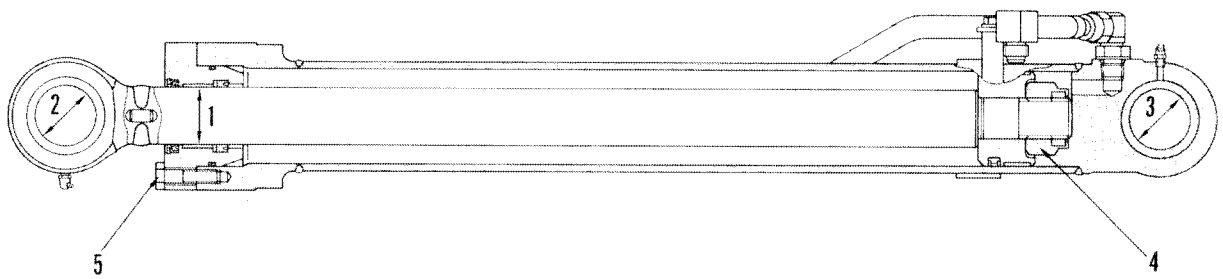
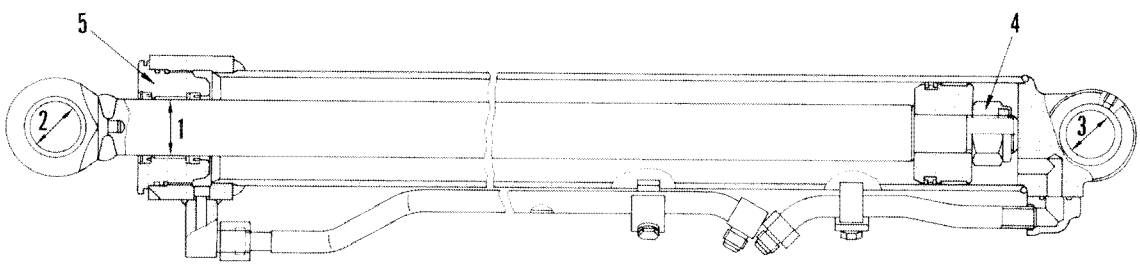
3. BUCKET CYLINDER



201F5131

4. SWING CYLINDER (PC60U-5)



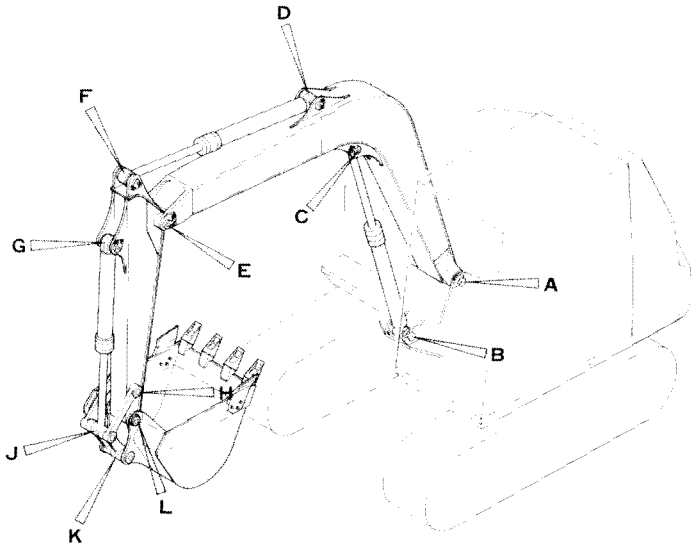
201F5132

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	65	−0.100 −0.174	+0.262 +0.067	0.167 – 0.436	0.736	Replace bushing
		Arm	60	−0.100 −0.174	+0.163 +0.006	0.106 – 0.337	0.637	
		Bucket	55	−0.100 −0.174	+0.163 +0.006	0.106 – 0.337	0.637	
		Swing	55	−0.100 −0.174	+0.163 +0.006	0.106 – 0.337	0.637	
2	• Clearance between piston rod support shaft and bushing	Boom	65	−0.030 −0.100	+0.174 +0.100	0.130 – 0.274	1.0	Replace pin and bushing
		Arm	60	−0.280 −0.350	+0.174 +0.100	0.380 – 0.524	1.0	
		Bucket	60	−0.280 −0.350	+0.174 +0.100	0.380 – 0.524	1.0	
		Swing	50	−0.025 −0.064	+0.142 +0.080	0.105 – 0.205	1.0	
3	Clearance between cylinder bottom support shaft and bushing	Boom	65	−0.030 −0.100	+0.174 +0.100	0.130 – 0.274	1.0	
		Arm	60	−0.280 −0.350	+0.174 +0.100	0.380 – 0.524	1.0	
		Bucket	60	−0.280 −0.350	+0.174 +0.100	0.380 – 0.524	1.0	
		Swing	50	−0.025 −0.064	+0.142 +0.080	0.105 – 0.205	1.0	
4	Tightening torque of piston nut	Boom	340 ± 34 kgm (Width across flats: 70)					Tighten
		Arm	270 ± 27 kgm (Width across flats: 65)					
		Bucket	220 ± 22 kgm (Width across flats: 60)					
		Swing	170 ± 17 kgm (Width across flats: 55)					
5	Tightening torque of cylinder head	Boom	18 ± 2 kgm					
		Arm	18 ± 2 kgm					
		Bucket	18 ± 2 kgm					
		Swing	80 ± 8 kgm					

WORK EQUIPMENT

PC60, 60L-5



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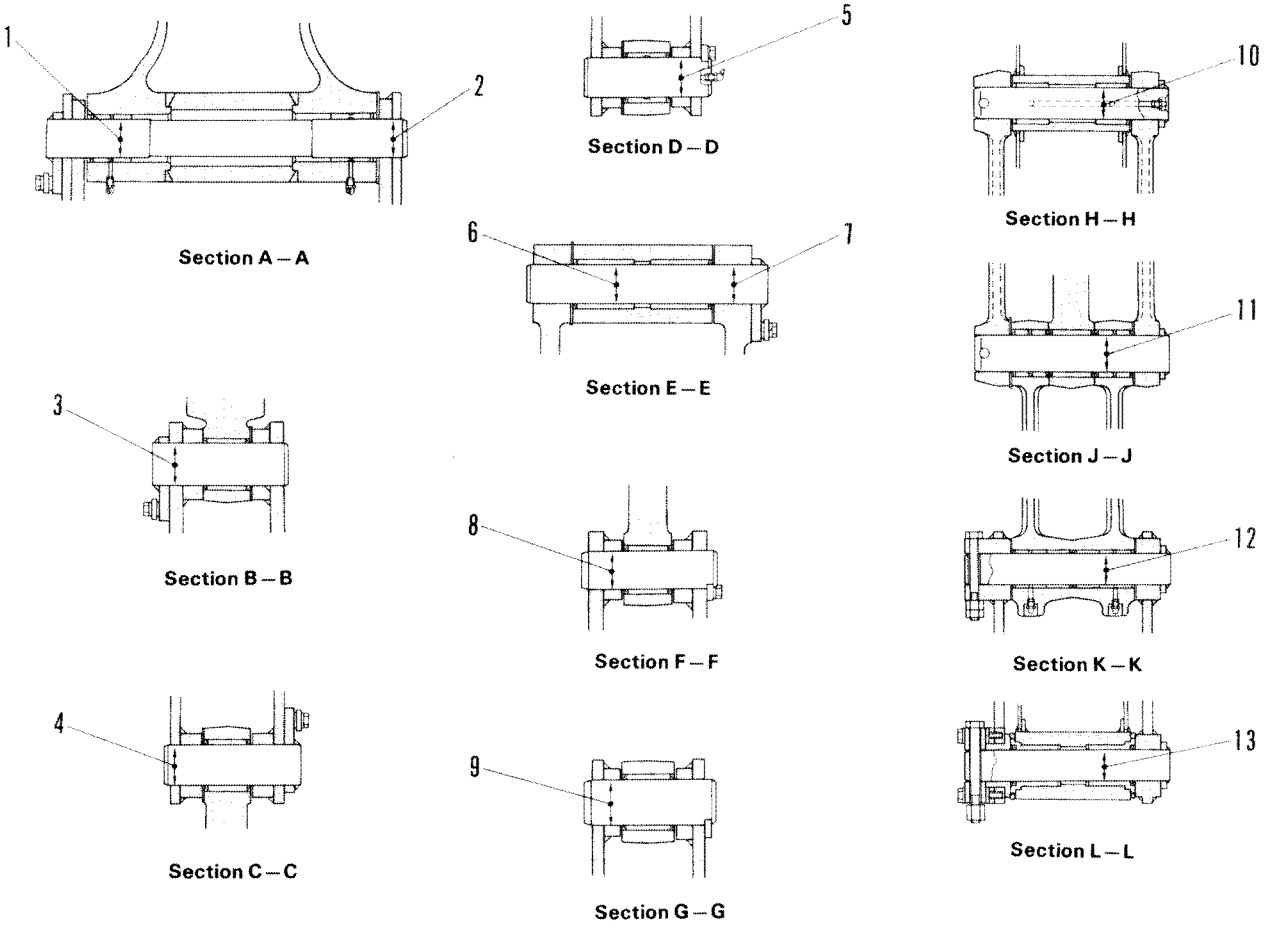
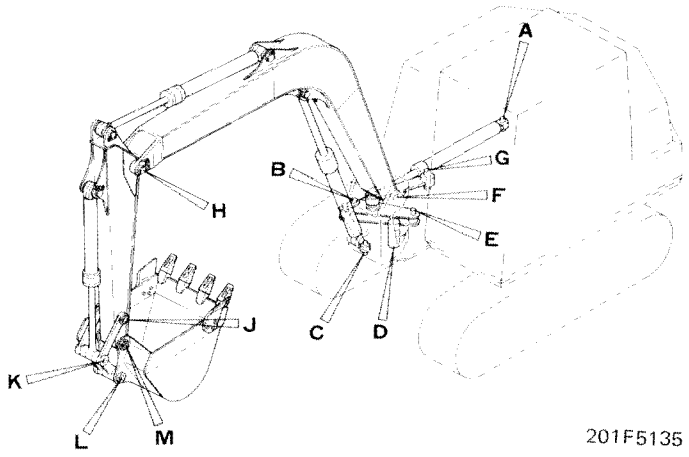


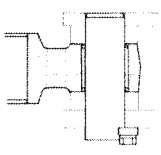
201F5134

Unit: mm

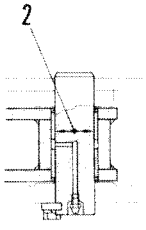
No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between boom-revolving frame mounting pin and bushing	60	−0.280 −0.326	−0.076 −0.149	0.131 – 0.250	0.8	Replace
2	Clearance between boom-revolving frame mounting pin and boss hole	60	−0.280 −0.326	−0.150 −0.250	0.030 – 0.176	0.5	
3	Clearance between boom cylinder-revolving frame mounting pin and boss hole	65	−0.030 −0.100	+0.1 0	0.030 – 0.2	0.5	
4	Clearance between boom-boom cylinder rod mounting pin and boss hole	65	−0.030 −0.100	+0.1 0	0.030 – 0.2	0.5	
5	Clearance between boom-arm cylinder mounting pin and boss hole	60	−0.280 −0.350	−0.1 −0.25	0.030 – 0.25	0.8	
6	Clearance between boom-arm mounting pin and bushing	60	−0.280 −0.350	−0.076 −0.149	0.131 – 0.274	0.8	
7	Clearance between boom-arm mounting pin and boss hole	60	−0.280 −0.350	+0.1 0	0.28 – 0.45	0.8	
8	Clearance between arm-arm cylinder mounting pin and boss hole	60	−0.280 −0.350	−0.1 −0.25	0.030 – 0.25	0.8	
9	Clearance between arm-bucket cylinder mounting pin and boss hole	60	−0.280 −0.350	−0.1 −0.25	0.030 – 0.25	0.8	
10	Clearance between arm-link mounting pin and bushing	50	−0.225 −0.262	−0.062 −0.120	0.105 – 0.2	0.5	
11	Clearance between bucket cylinder-link mounting pin and bushing	60	−0.225 −0.295	+0.174 +0.100	0.325 – 0.469	1.0	
12	Clearance between link-bucket mounting pin and bushing	50	−0.225 −0.285	+0.142 +0.080	0.305 – 0.424	1.0	
13	Clearance between arm-bucket mounting pin and bushing	50	−0.225 −0.285	−0.062 −0.120	0.105 – 0.202	0.5	



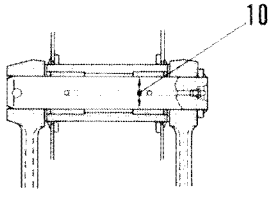
201F5135



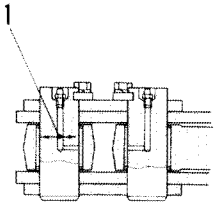
Section A – A



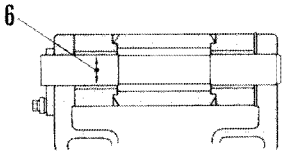
Section E – E



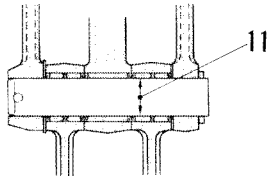
Section J – J



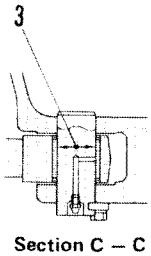
Section B – B



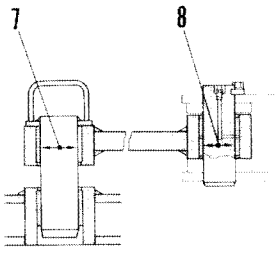
Section F – F



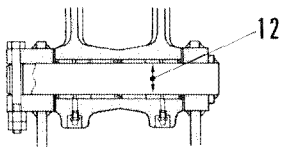
Section K – K



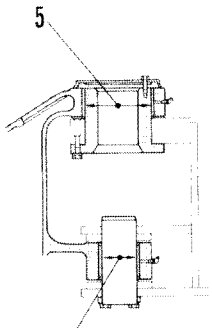
Section C – C



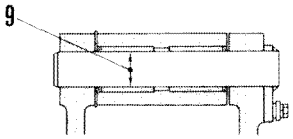
Section G – G



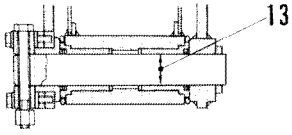
Section L – L



Section D – D



Section H – H



Section M – M

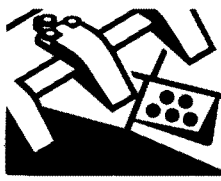
201F5136

Unit: mm

No.	Check item	Tolerance					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between boom swing link pin and bushing	50	−0.025 −0.064	+0.142 +0.080	0.105 – 0.206	0.8	Replace
2	Clearance between boom swing link-revolving frame mounting pin and bushing	50	−0.025 −0.064	+0.142 +0.080	0.105 – 0.206	0.8	
3	Clearance between boom swing link-swing bracket mounting pin and bushing	50	−0.025 −0.064	+0.142 +0.080	0.105 – 0.206	0.8	
4	Clearance between swing bracket and bushing	100	−0.036 −0.090	+0.207 +0.120	0.156 – 0.297	1.0	
5	Clearance between swing bracket-revolving frame mounting pin and bushing	185	−0.050 −0.122	+0.325 +0.253	0.303 – 0.447	1.0	
6	Clearance between swing bracket-boom mounting pin and bushing	60	−0.280 −0.326	−0.076 −0.149	0.131 – 0.250	0.8	
7	Clearance between boom swing link-rigid link mounting pin and bushing	70	−0.250 −0.400	+0.174 +0.100	0.350 – 0.547	1.5	
8	Clearance between boom swing rigid link-revolving frame mounting pin and bushing	60	−0.030 −0.076	+0.174 +0.100	0.130 – 0.250	0.5	
9	Clearance between boom-arm mounting pin and bushing	60	−0.280 −0.326	−0.076 −0.149	0.131 – 0.250	0.8	
10	Clearance between arm-link mounting pin and bushing	50	−0.225 −0.262	−0.062 −0.120	0.105 – 0.200	0.5	
11	Clearance between arm-bucket mounting pin and bushing	50	−0.225 −0.285	−0.062 −0.120	0.105 – 0.202	0.5	
12	Clearance between bucket cylinder-link mounting pin and bushing	60	−0.225 −0.295	+0.174 +0.100	0.325 – 0.469	1.0	
13	Clearance between bucket-link mounting pin and bushing	50	−0.225 −0.285	+0.142 +0.080	0.305 – 0.427	1.0	

WORK EQUIPMENT

73 DISASSEMBLY AND ASSEMBLY



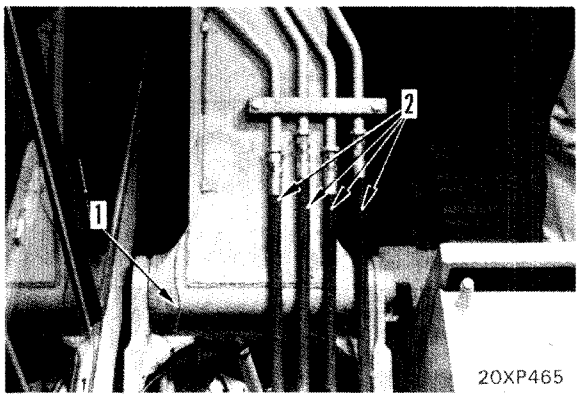
REMOVAL OF WORK EQUIPMENT ASSEMBLY

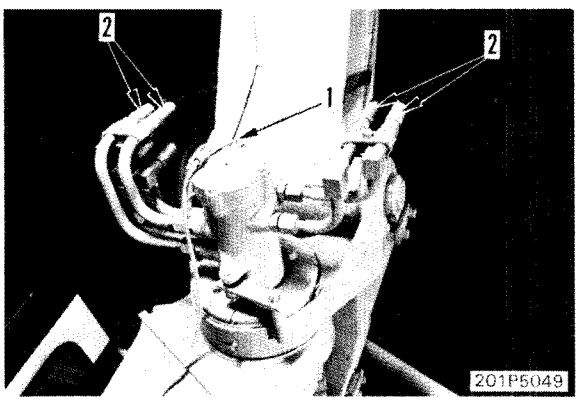
Special tools required

No.	Part No.	Part Name	Q'ty
A	792-785-1100	Remover	1
A_1	790-101-1102	Pump	1
A_2	790-101-3800	Puller (50 ton)	1

1. Disconnect the boom cylinder assembly from the boom. For detail, see REMOVING THE BOOM CYLINDER ASSEMBLY.
2. Disconnect wiring (1) for the front lamps.
3. Disconnect four hoses (2).
4. Temporarily sling work equipment assembly (3).
5. Remove the lock plate. Using tool A, pull out pin (4), then remove work equipment assembly (3).

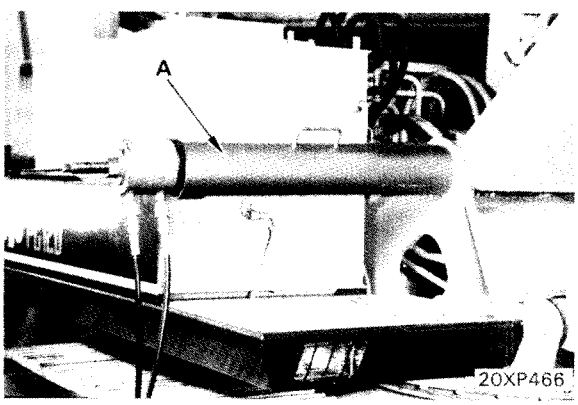
   kg Work equipment assembly: 1,200 kg

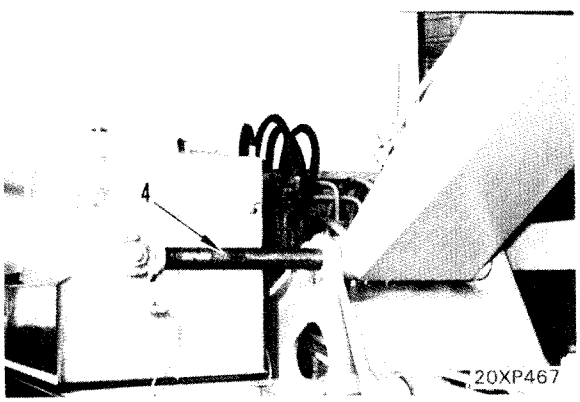


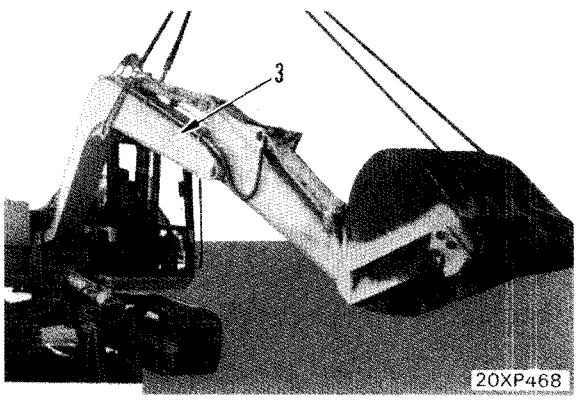


INSTALLATION OF WROK EQUIPMENT ASSEMBLY

1. Sling work equipment assembly (3), drive in pin (4), the secure with the lock plate.
2. Connect four hoses (2).
   ★ Connect the hoses without twisting or interference.
3. Connect wiring (1) for the front lamps.
4. Connect the boom cylinder assembly to the boom. For details, see INSTALLATION OF BOOM CYLINDER ASSEMBLY.





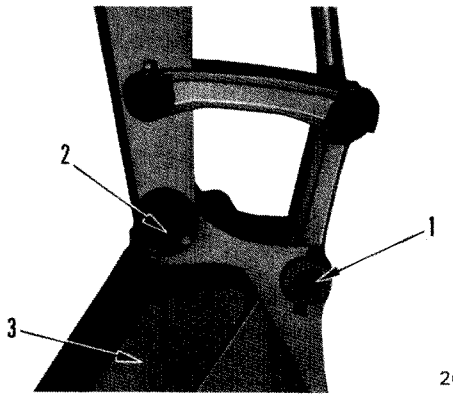


DISASSEMBLY OF BUCKET ASSEMBLY

⚠ Lower work equipment completely to the ground with bottom of bucket touching the ground.

1) Remove lock bolt, then remove connecting pin (1) of link.
2) Remove lock bolt, then remove connecting pin (2) of arm.
3) Remove bucket (3).

kg Bucket: 220 kg



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ASSEMBLY OF BUCKET ASSEMBLY

1) Sling bucket (3) and set it in its mounting position.
2) Start engine, drive mounting pin (2) into pin holes in arm and bucket. Install lock bolt.
   ★ Fit O-ring between arm and bucket.
3) Extend piston rod of bucket cylinder drive mounting pin (1) into pin holes in link and bucket. Install lock bolt.
   ★ Fit O-ring between link and bucket.

★ Lubricate each pin with grease (G2-LI).

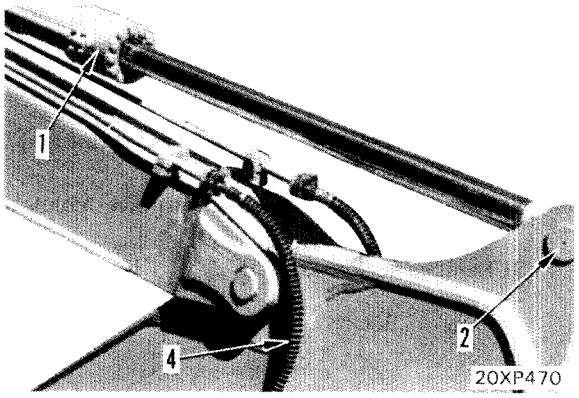
REMOVAL OF ARM ASSEMBLY (WITH BUCKET CYLINDER)

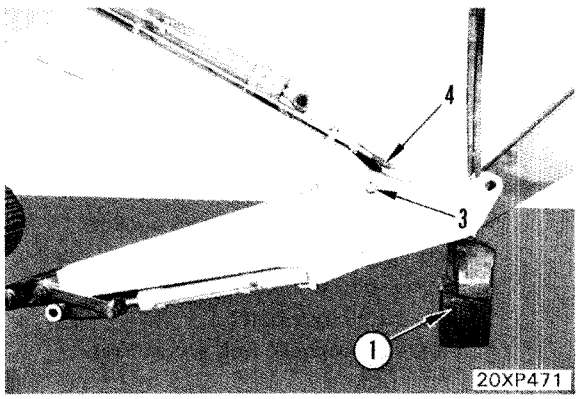
★ If the bucket cylinder assembly will be removed, follow the procedure in REMOVAL OF BUCKET CYLINDER ASSEMBLY.

1. Remove the bucket assembly. For details, see REMOVAL OF BUCKET ASSEMBLY.
2. Insert the arm and set the assembly on block ① (Height: Approx. 500 mm).
3. Temporarily sling arm cylinder assembly (1), remove the lock plate, and pull out pin (2).
4. Remove the lock plate, then pull out pin (3).
5. Disconnect bucket cylinder hose (4) from the cylinder side.
   ★ To prevent oil from bushing out, install a blind plug in the tube flange.
6. Start the engine and fully retract the piston rod.

   ⚠ Tie with wire so that the rod does not fall out.
7. Swing the work equipment and remove arm assembly (5).

   kg Arm assembly: 220 kg
   With bucket cylinder: 280 kg

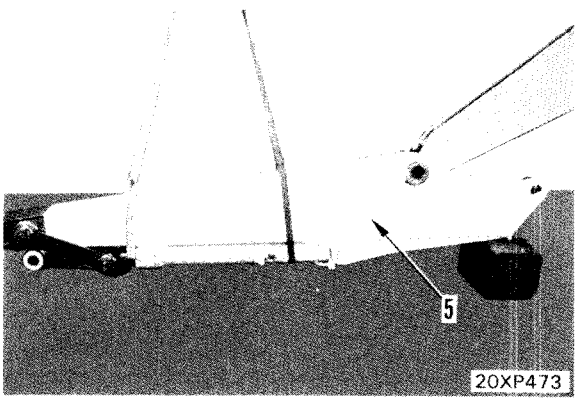


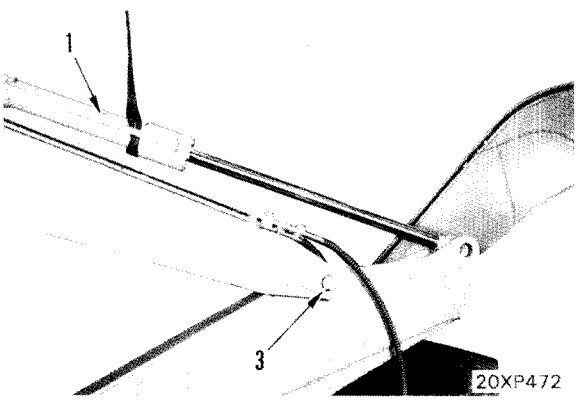


INSTALLATION OF ARM ASSEMBLY (WITH BUCKET CYLINDER)

1. Sling arm assembly (5) and set it on block ① (Height: Approx. 500 mm).
2. Swing the boom and align the arm installation position.
3. Drive in pin (3) and secure with the lock plate.
4. Temporarily sling arm cylinder assembly (1), drive in the rodside pin, then fix with the lock plate.
5. Connect bucket cylinder hose (4).
6. Install the bucket assembly. For details, see INSTALLATION OF BUCKET ASSEMBLY.

★ Bleed the air from the cylinder. For details, see Bleeding the Air from Hydraulic Cylinders under TESTING AND ADJUSTING.
★ After bleeding the air, check the oil level in the hydraulic oil tank.





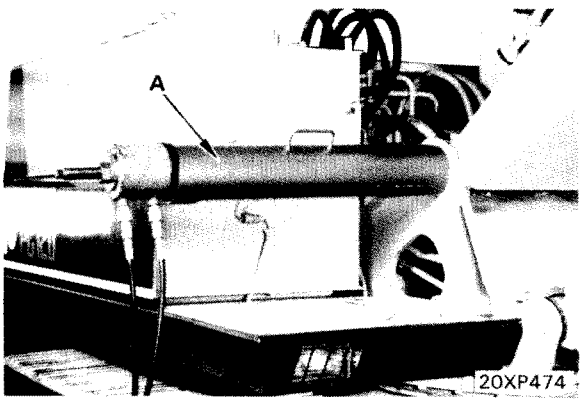
REMOVAL OF BOOM ASSEMBLY

Special tools required

No.	Part No.	Part Name	Q'ty
A	792-785-1100	Remover	1
A_1	790-101-1102	Pump	1
A_2	790-101-3800	Puller (50 ton)	1

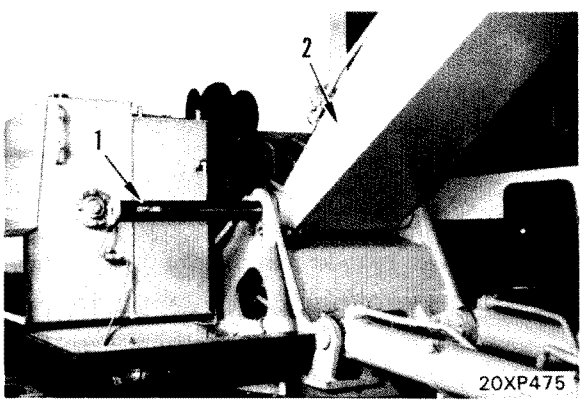
1. Disconnect the boom cylinder assembly from the boom. For details, see REMOVAL OF BOOM CYLINDER ASSEMBLY.
2. Remove the bucket assembly, bucket cylinder assembly, and arm assembly. For details, see REMOVAL OF BUCKET ASSEMBLY, BUCKET CYLINDER ASSEMBLY, AND ARM ASSEMBLY.
3. Disconnect the wiring for the front lamps and the hoses. For details, see REMOVAL OF WORK EQUIPMENT ASSEMBLY.
4. Remove the lock plate, use tool A to pull out pin (1), then remove boom assembly (2).

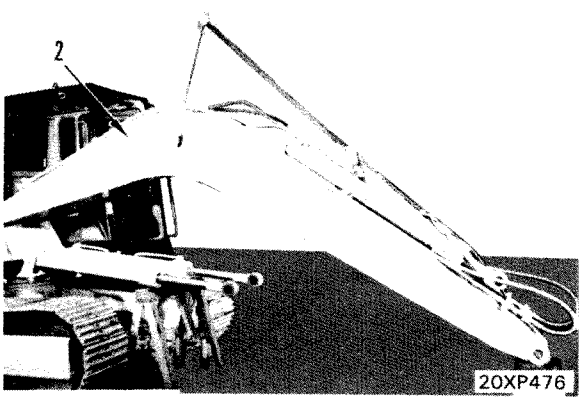
kg Boom assembly (incl. arm cylinder): 680 kg



INSTALLATION OF BOOM ASSEMBLY

1. Sling boom assembly (2), drive in pin (1), then secure with the lock plate.
2. Connect the hoses and wiring for the front lamps. For details, see INSTALLATION OF WORK EQUIPMENT ASSEMBLY.
3. Install the arm assembly, bucket cylinder assembly, and bucket assembly. For details, see INSTALLATION OF ARM ASSEMBLY, BUCKET CYLINDER ASSEMBLY, AND BUCKET ASSEMBLY.
4. Connect the boom cylinder assembly to the boom. For details, see INSTALLATION OF BOOM CYLINDER ASSEMBLY.





REMOVAL OF ARM, BUCKET ASSEMBLY

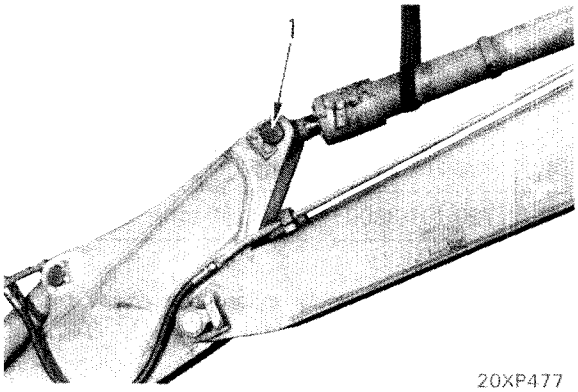
Fully extend the arm and bucket cylinders, set the work equipment on the ground, and stop the engine. Operate the control levers two or three times to release the remaining air from the piping.

1. Temporarily sling the arm cylinder assembly, remove the lock plate, and pull out pin (1).
2. Start the engine and fully retract the piston rod.

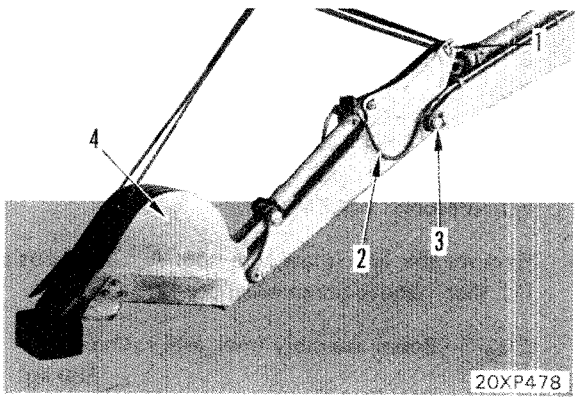
   Tie the rod with wire so that it does not fall out.

3. Temporarily install arm cylinder installation pin (1).
4. Hook a hanging tool between the installation pin and bucket, and temporarily sling the bucket assembly.
5. Disconnect bucket cylinder hose (2), remove the lock plate for the arm installation pin, pull out the pin, then remove arm, bucket assembly (4).

   kg Arm bucket assembly: 500 kg



20XP477



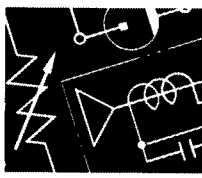
20XP478

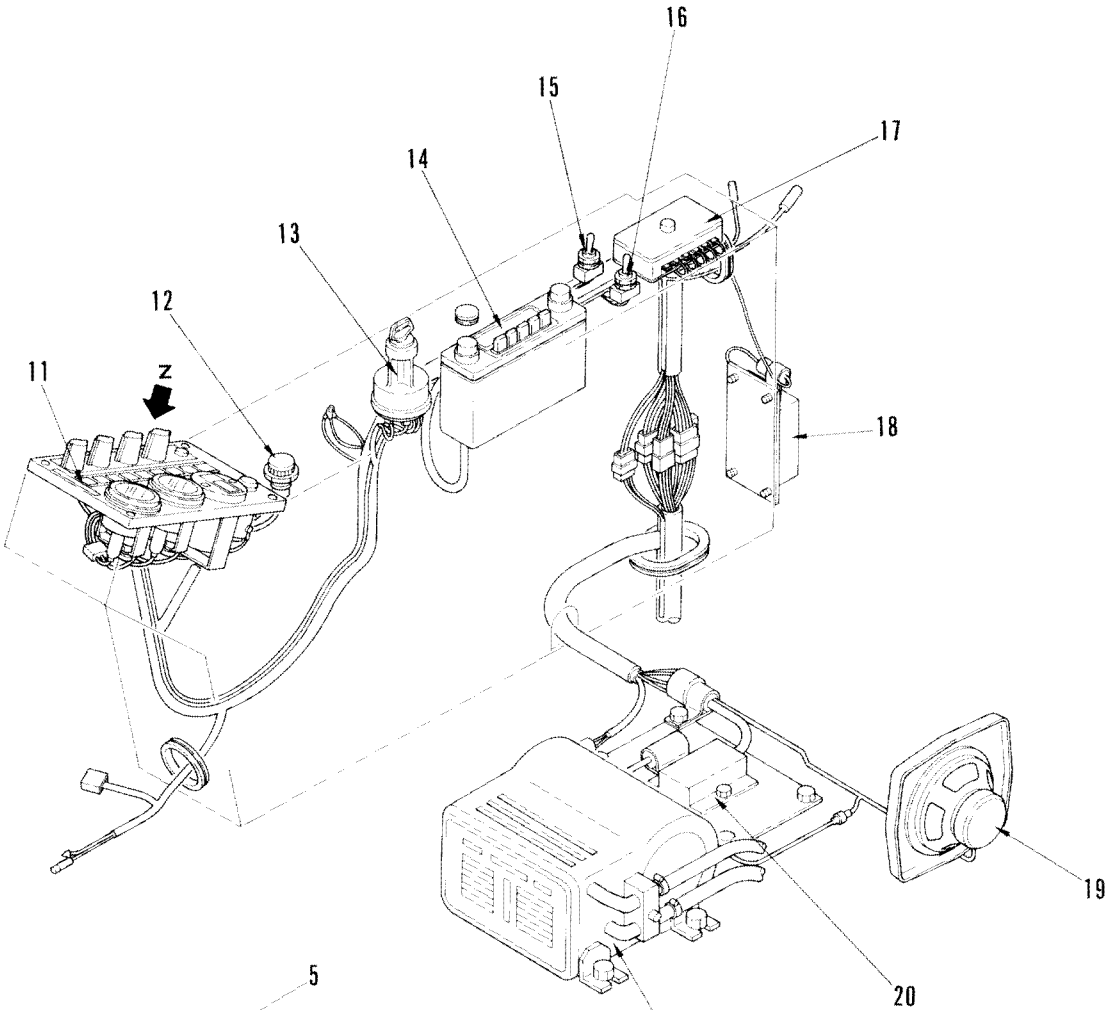
INSTALLATION OF ARM, BUCKET ASSEMBLY

1. Set arm, bucket assembly (4) on the boom installation position, drive in arm installation pin (3), then secure with a lock plate.
2. Connect bucket cylinder hose (2).
3. Set the arm cylinder assembly on the arm, drive in installation pin (1), then secure with a lock plate.

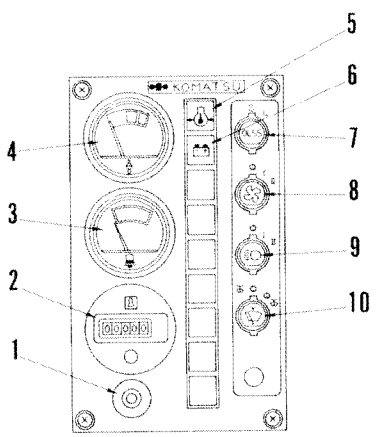
★ Bleed the air from the cylinder. For details, see Bleeding the Air from Hydraulic Cylinders under TESTING AND ADJUSTMENT.
★ After bleeding the air, check the oil level in the hydraulic oil tank.

ELECTRICAL SYSTEM
81 STRUCTURE AND FUNCTION





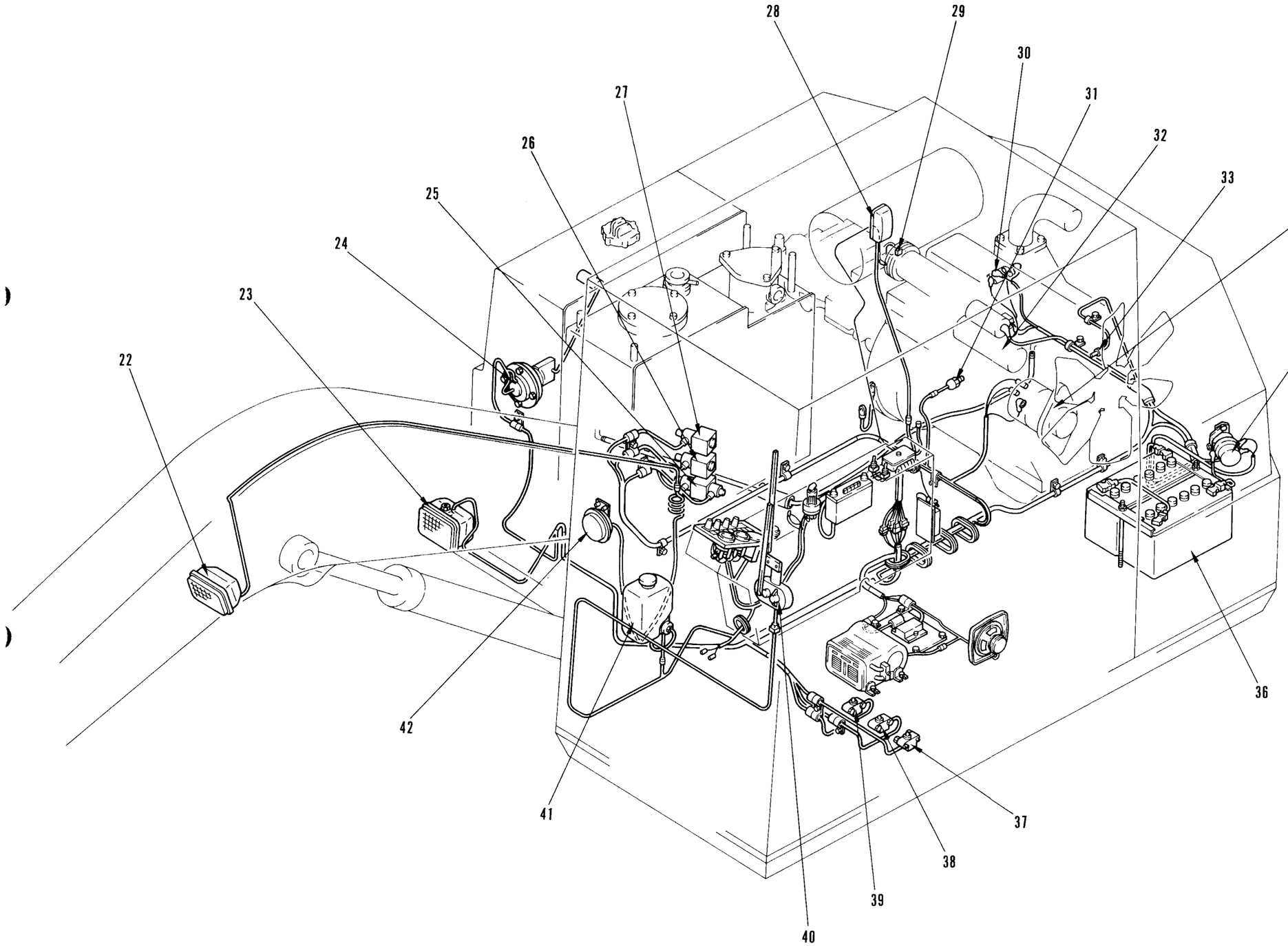
201F5114-1



View Z

201F5115-1

1. Heater signal
2. Service meter
3. Fuel gauge
4. Engine water temperature gauge
5. Engine oil pressure caution lamp
6. Charging lamp
7. Mode selector switch (if equipped)
8. Heater switch
9. Lamp switch
10. Wiper switch
11. Monitor panel
12. Swing mechanical brake pilot lamp (if equipped)
13. Starting switch
14. Radio
15. Swing mechanical brake switch (if equipped)
16. Auto-deceleration switch (if equipped)
17. Fuse box
18. OLSS resistor (if equipped)
19. Speaker
20. Swing mechanical brake timer (if equipped)
    Controller (if equipped)
21. Heater

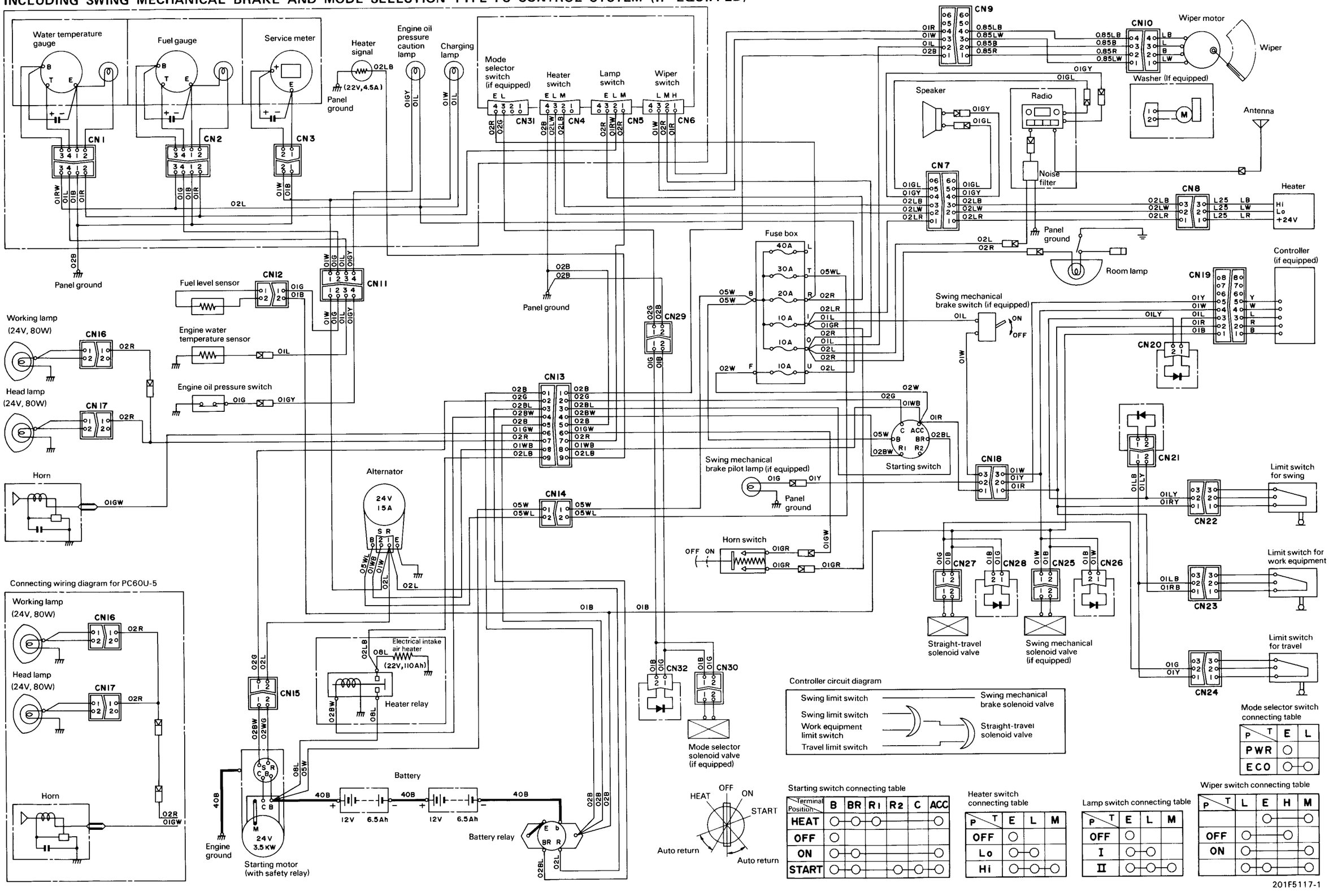


22. Working lamp
23. Head lamp
24. Fuel level sensor
25. Mode selector solenoid valve (if equipped)
    Auto-deceleration solenoid valve (if equipped)
26. Swing mechanical brake solenoid valve (if equipped)
27. Straight-travel solenoid valve
28. Room lamp
29. TVC valve (if equipped)
30. Heater relay
31. Engine oil pressure switch
32. Starting motor
33. Engine water temperature sensor
34. Alternator
35. Battery relay
36. Battery
37. Limit switch for work equipment
38. Limit switch for swing
39. Limit switch for travel
40. Wiper motor
41. Washer tank
42. Horn

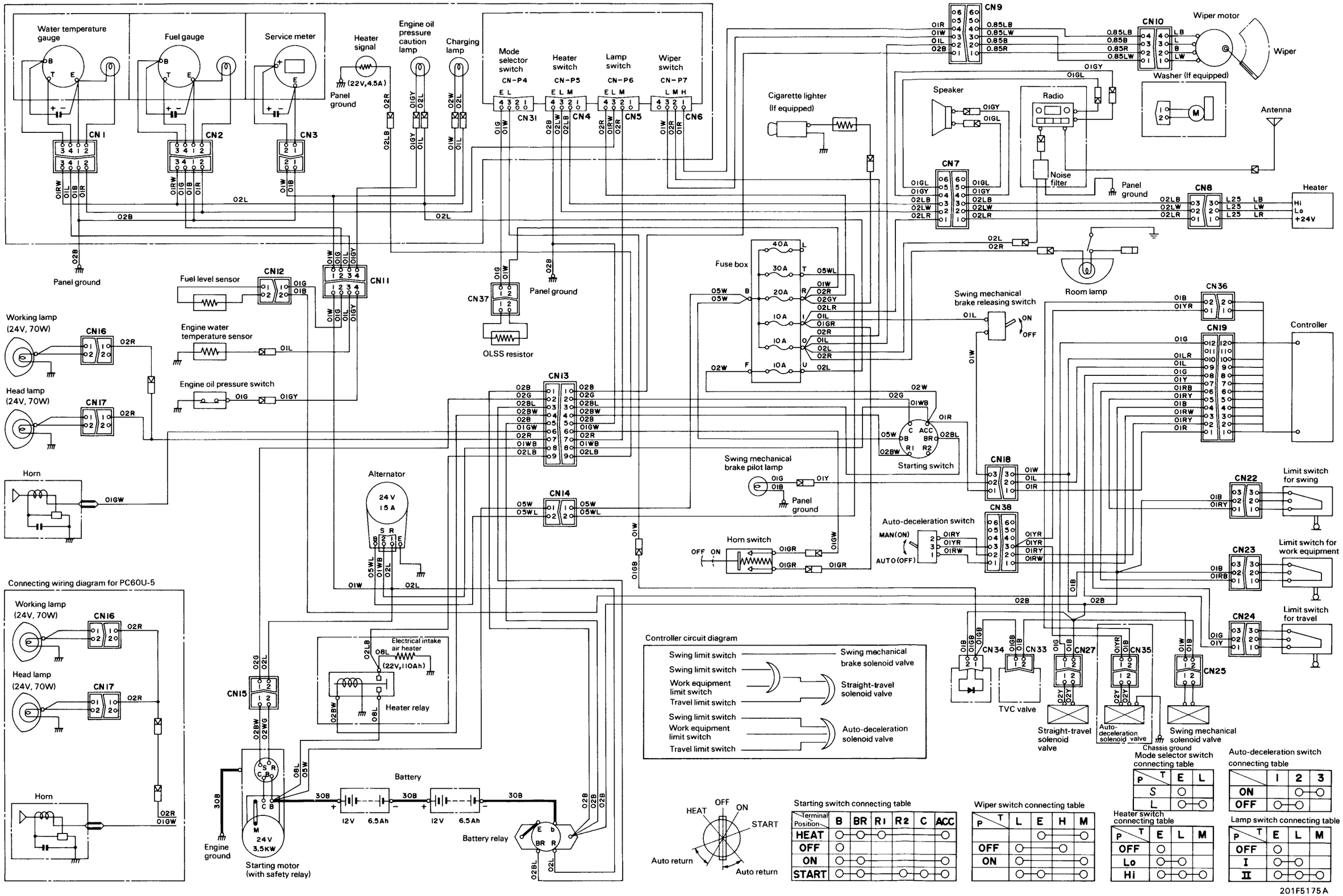
201F5116-1

ELECTRICAL CIRCUIT DIAGRAM

INCLUDING SWING MECHANICAL BRAKE AND MODE SELECTION TYPE PC CONTROL SYSTEM (IF EQUIPPED)



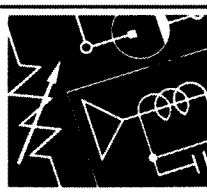
FOR MACHINE EQUIPPED WITH AUTO-DECELERATION SYSTEM, SWING MECHANICAL BRAKE AND OLSS (IF EQUIPPED)



Connecting wiring diagram for PC60U-5

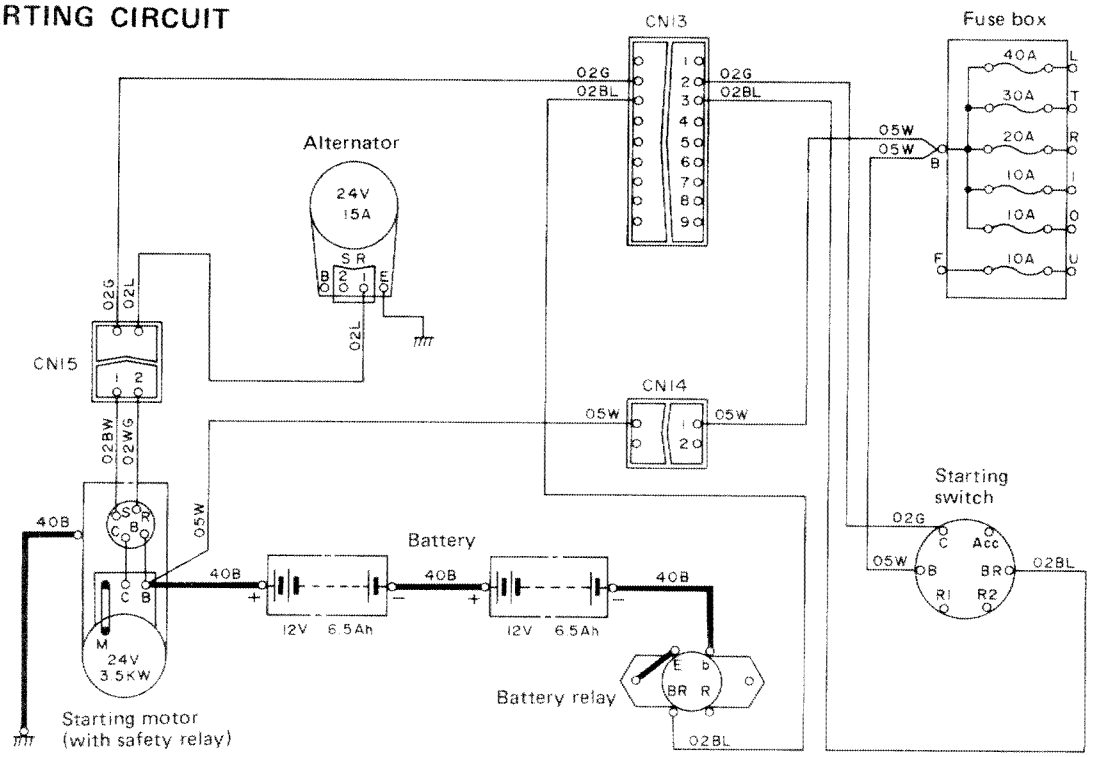
ELECTRICAL SYSTEM

82 TESTING AND ADJUSTING



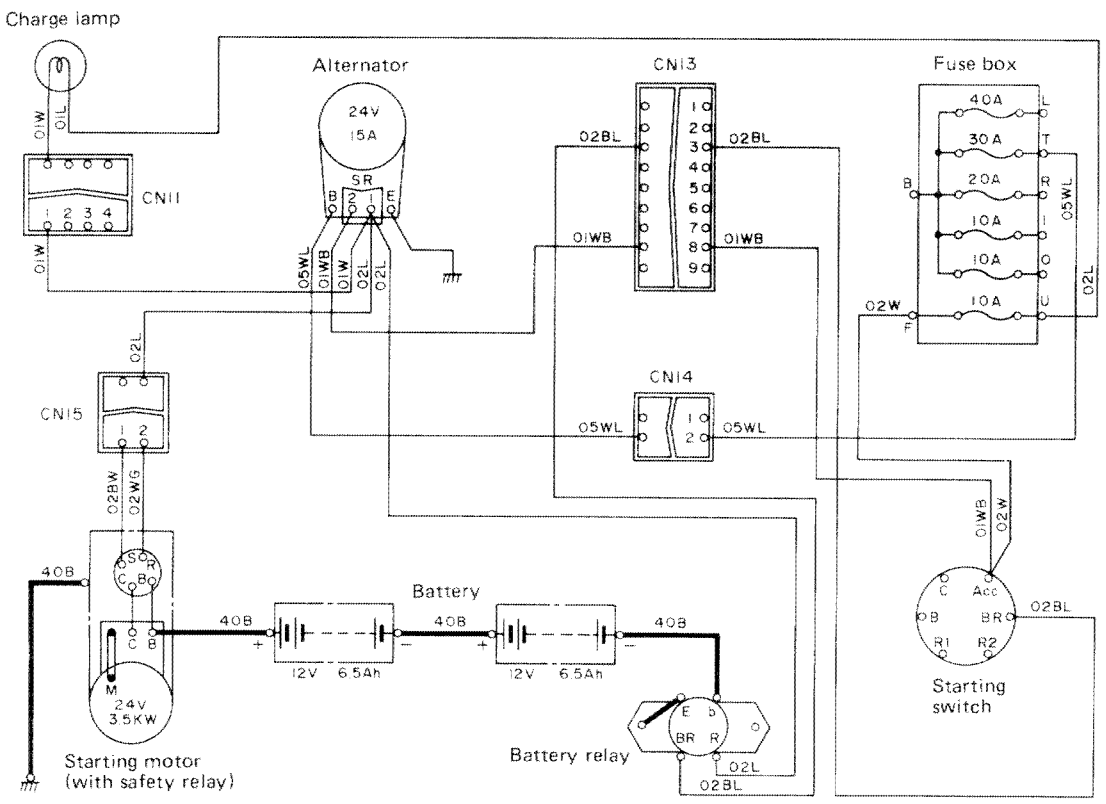
ELECTRICAL CIRCUIT

STARTING CIRCUIT



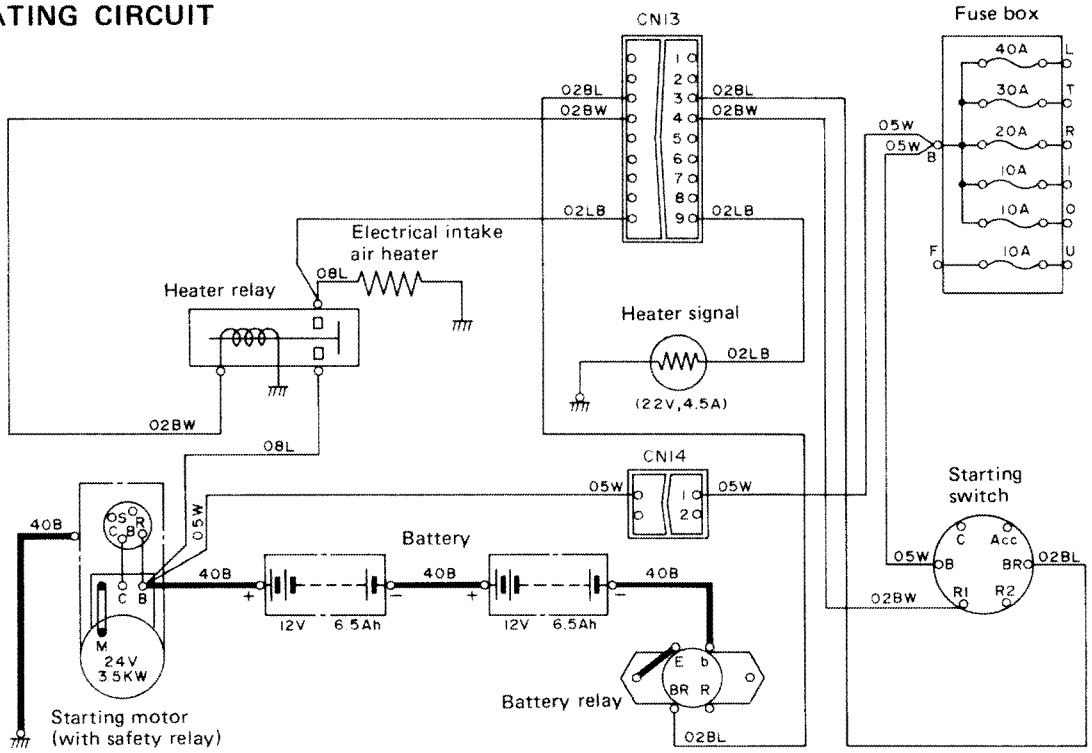
20XF410

CHARGING CIRCUIT



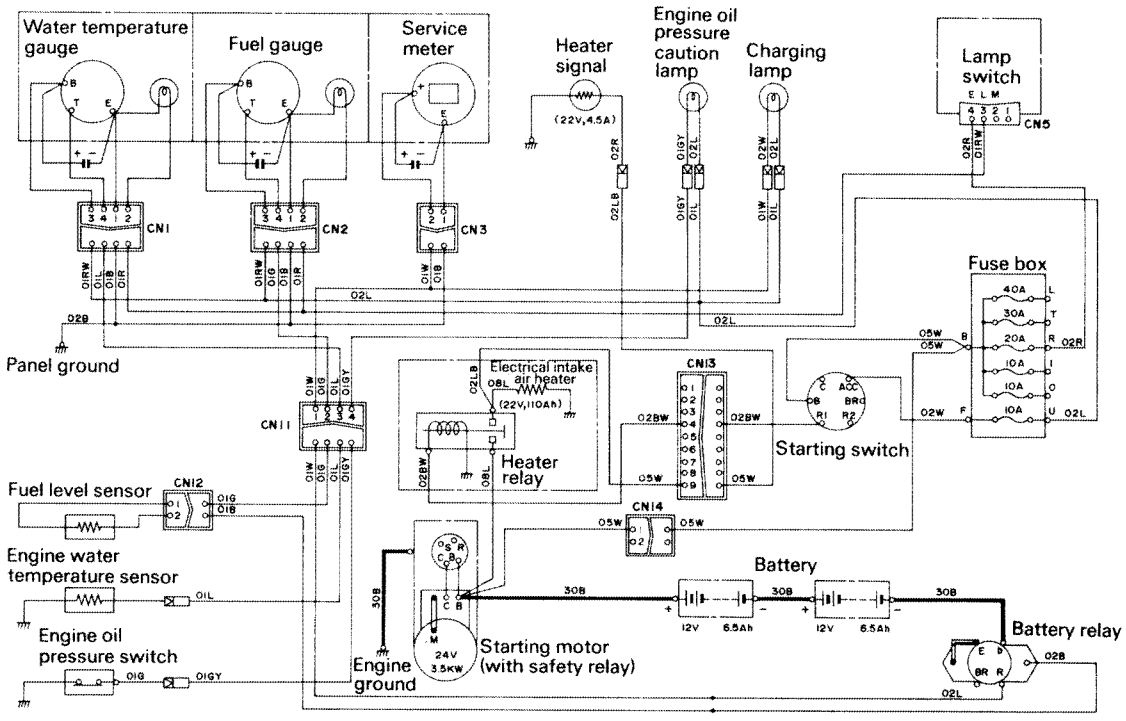
20XF411

PREHEATING CIRCUIT



20XF412

MONITOR CIRCUIT

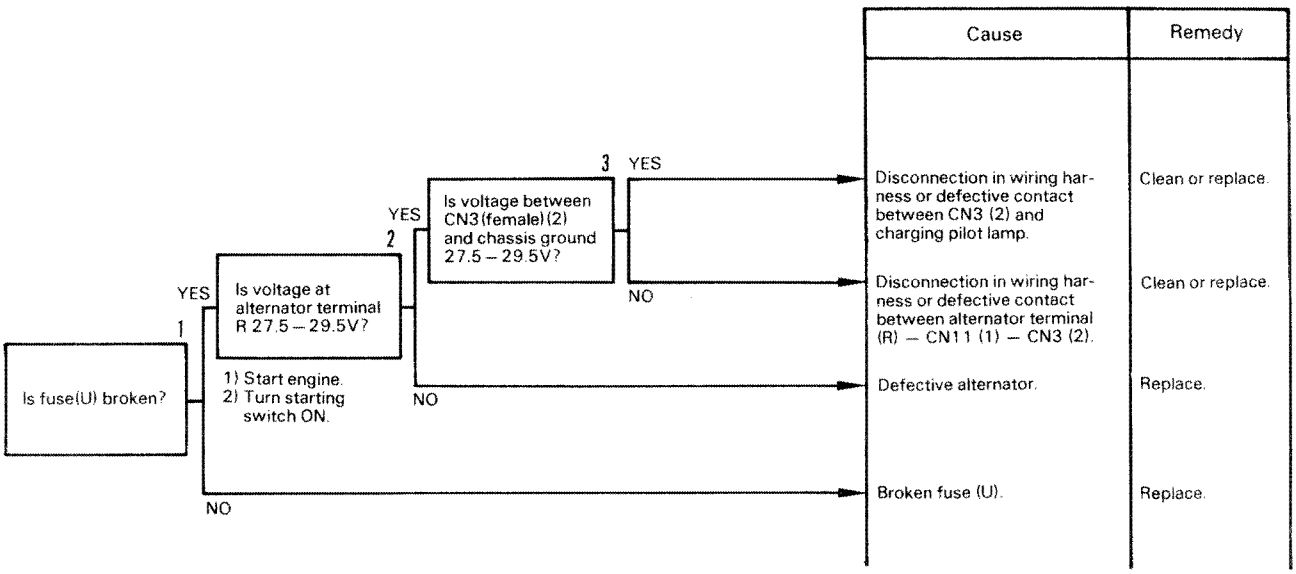


F20105035

TROUBLESHOOTING CHART NO. M-1

Failure mode: Battery charging pilot lamp does not go off.

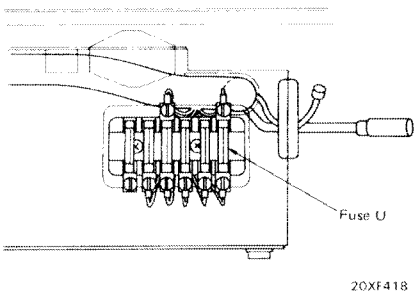
★ Turn the starting switch OFF before removing the connector, and connect the T-adapter (or socket adapter).
★ Connect the male and female of the T-adapter respectively; for the socket adapter, connect as shown in ( ).
★ After checking the connectors, connect again immediately.



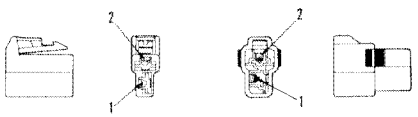
Troubleshooting tools	Tester
	T-adapter or socket (For econoseal)

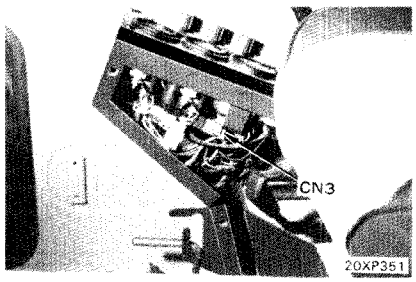
POSITION OF CONNECTOR

Fuse U

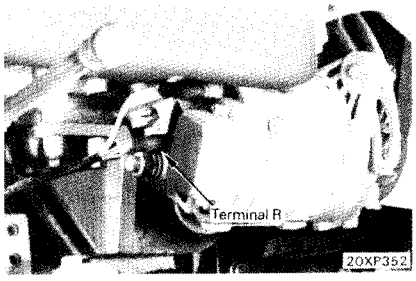


CN3

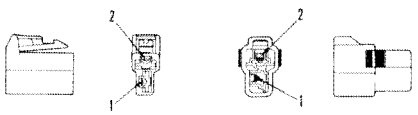




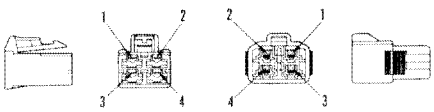
Alternator terminal R

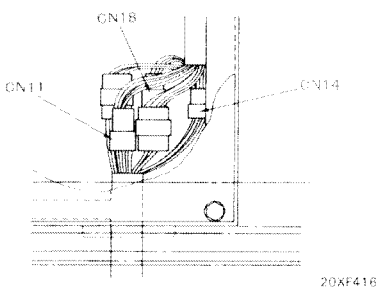


CN11



CN14



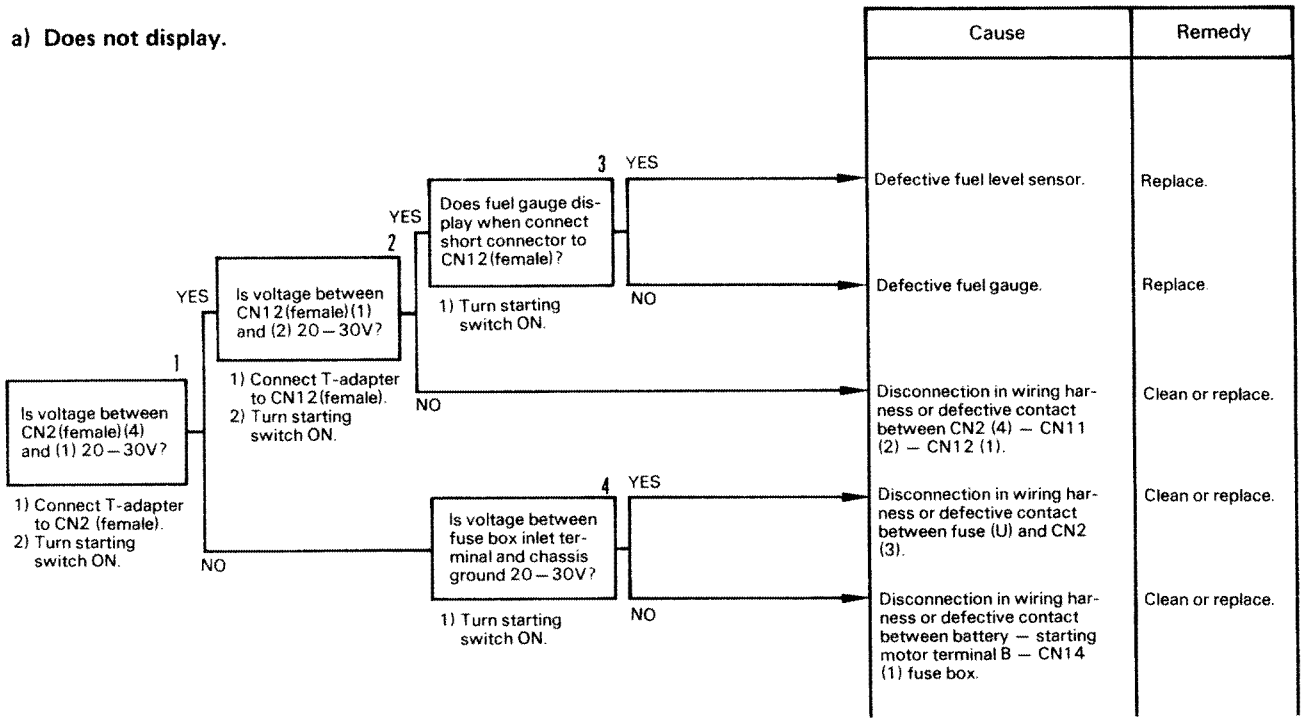


TROUBLESHOOTING CHART NO. M-2

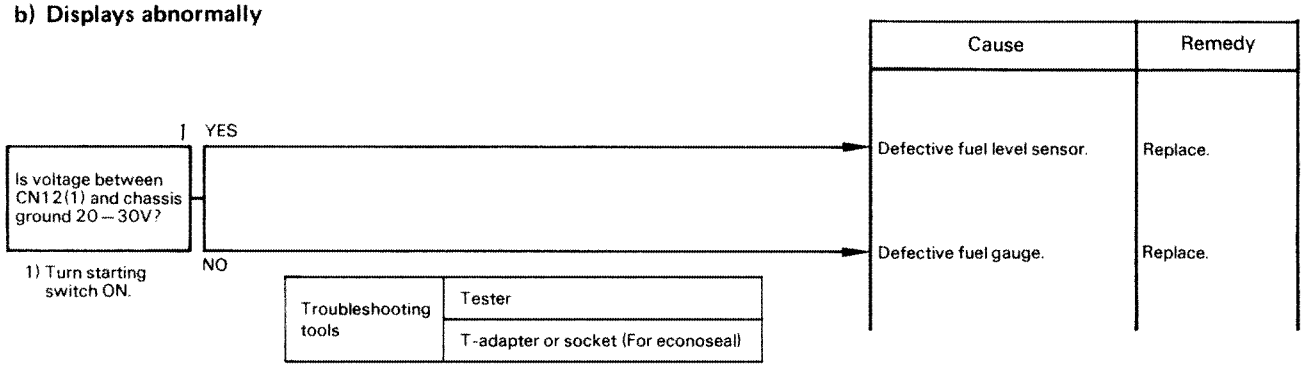
Failure mode: Fuel gauge does not display or displays abnormally.

★ Turn the starting switch OFF before removing the connector, and connect the T-adapter (or socket adapter).
★ Connect the male and female of the T-adapter respectively; for the socket adapter, connect as shown in ( ).
★ After checking the connectors, connect again immediately.

a) Does not display.



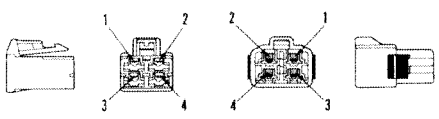
b) Displays abnormally



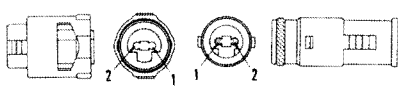
Troubleshooting tools	Tester
	T-adapter or socket (For econoseal)

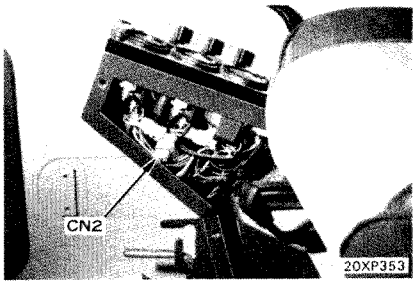
POSITION OF CONNECTOR

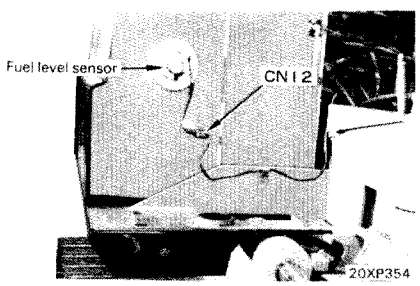
CN2



CN12







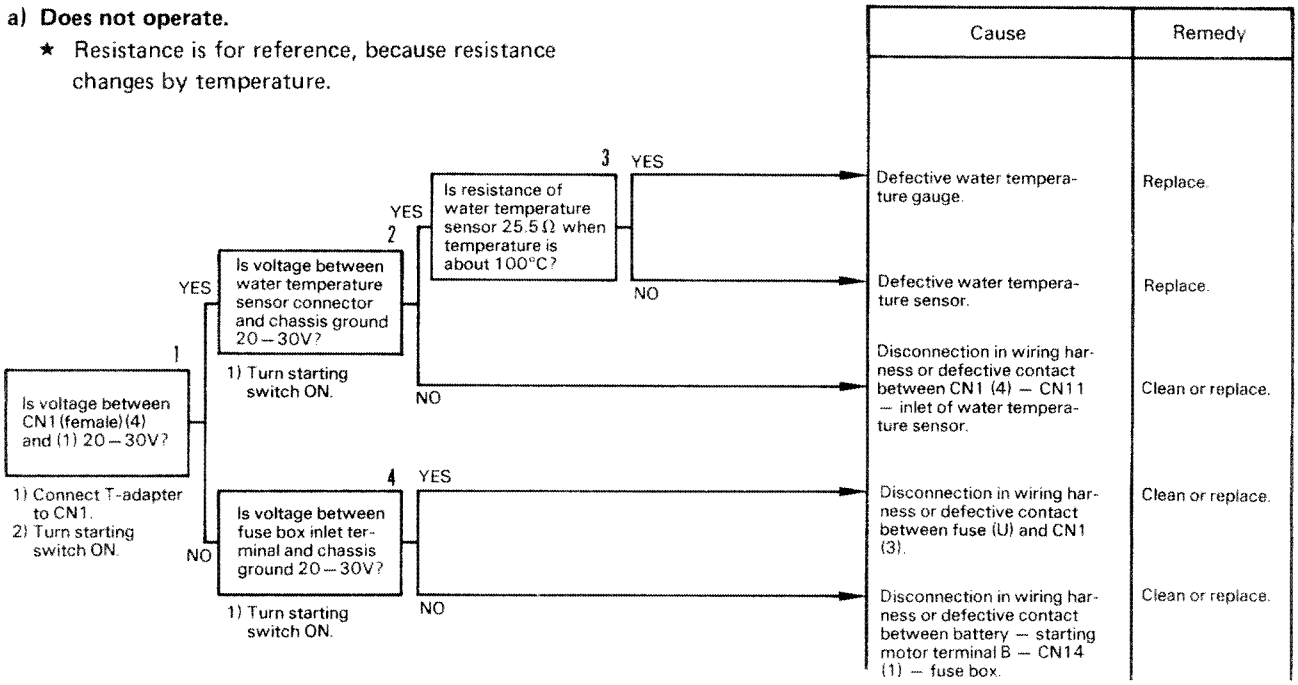
TROUBLESHOOTING CHART NO. M-3

Failure mode: Water temperature gauge does not operate or displays abnormally.

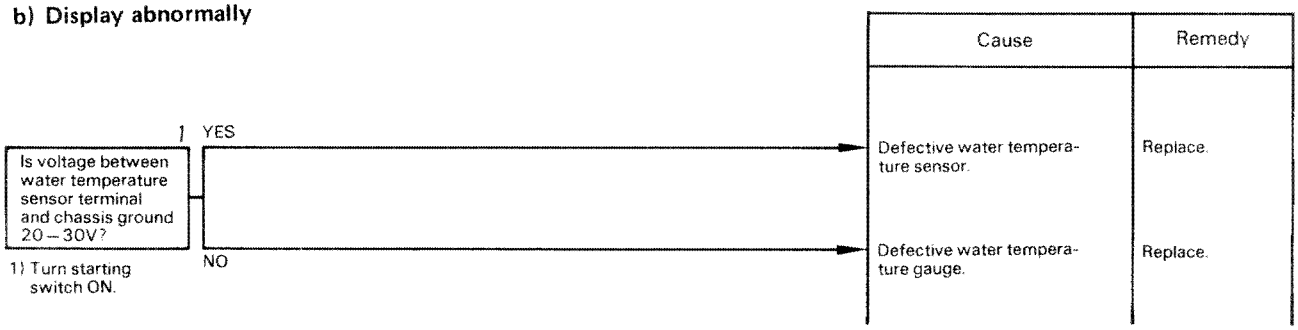
★ Turn the starting switch OFF before removing the connector, and connect the T-adapter (or socket adapter).
★ Connect the male and female of the T-adapter respectively; for the socket adapter, connect as shown in ( ).
★ After checking the connectors, connect again immediately.

a) Does not operate.

★ Resistance is for reference, because resistance changes by temperature.



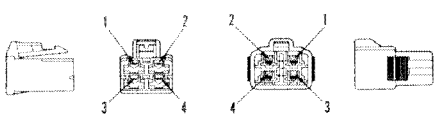
b) Display abnormally

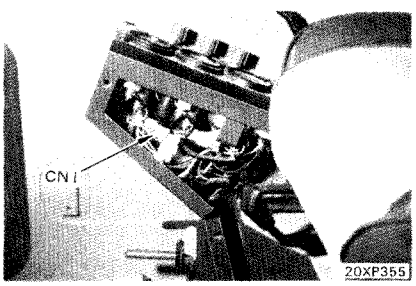


POSITION OF CONNECTOR

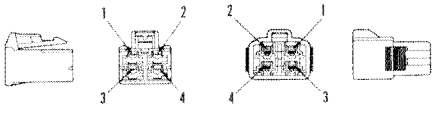
Troubleshooting tools	Tester
	T-adapter or socket (For econoseal)

CN1

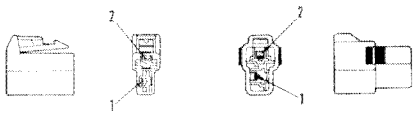


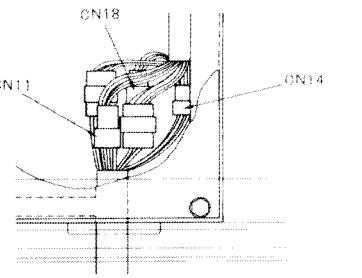


CN11



CN14





20XF416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