TCM®

TCM WHEEL LOADER
SHOP MANUAL

MODEL 815-2
820-2

TOYO UMPANKI CO., LTD.

Digging Depth (bucket at 10° dump)	(edge) 185 mm
Towing Device Height	650 mm

Weight

Weight of Machine	4550 kg

Engine

Model	4BC2 diesel engine
Type	4-cycle, water-cooled overhead valve, in-line, direct combustion chamber type
Batteries	12 V, 52 Ah (at rate of 5 hours), 2 pcs.
Air Cleaner	Paper filter type (cyclopac)

Power Train

Torque Converter	
Type	3-element, single-stage, single-phase
Transmission	
Type	Full power shift constant mesh type
Reduction Gear & Differential	
Type	Ordinary type, 2-stage reduction

Axles and Wheels

Driving Method	4-wheel drive
Front Axle	Frame-fixed, semi-floating
Rear Axle	Cradle-pin pivoted, semi-floating
Tires (front and rear)	17.5/65 - 20 - 10PR, L - 2, tubeless
Rims (front and rear)	W14L x 20

Brake System

Service Brake	
Type	Front-rear wheel separate braking, wet disc, full-power brake
Number of fluid lines	2
Parking Brake	
Type	Transmission idler shaft braking, disc brake with spring cylinder

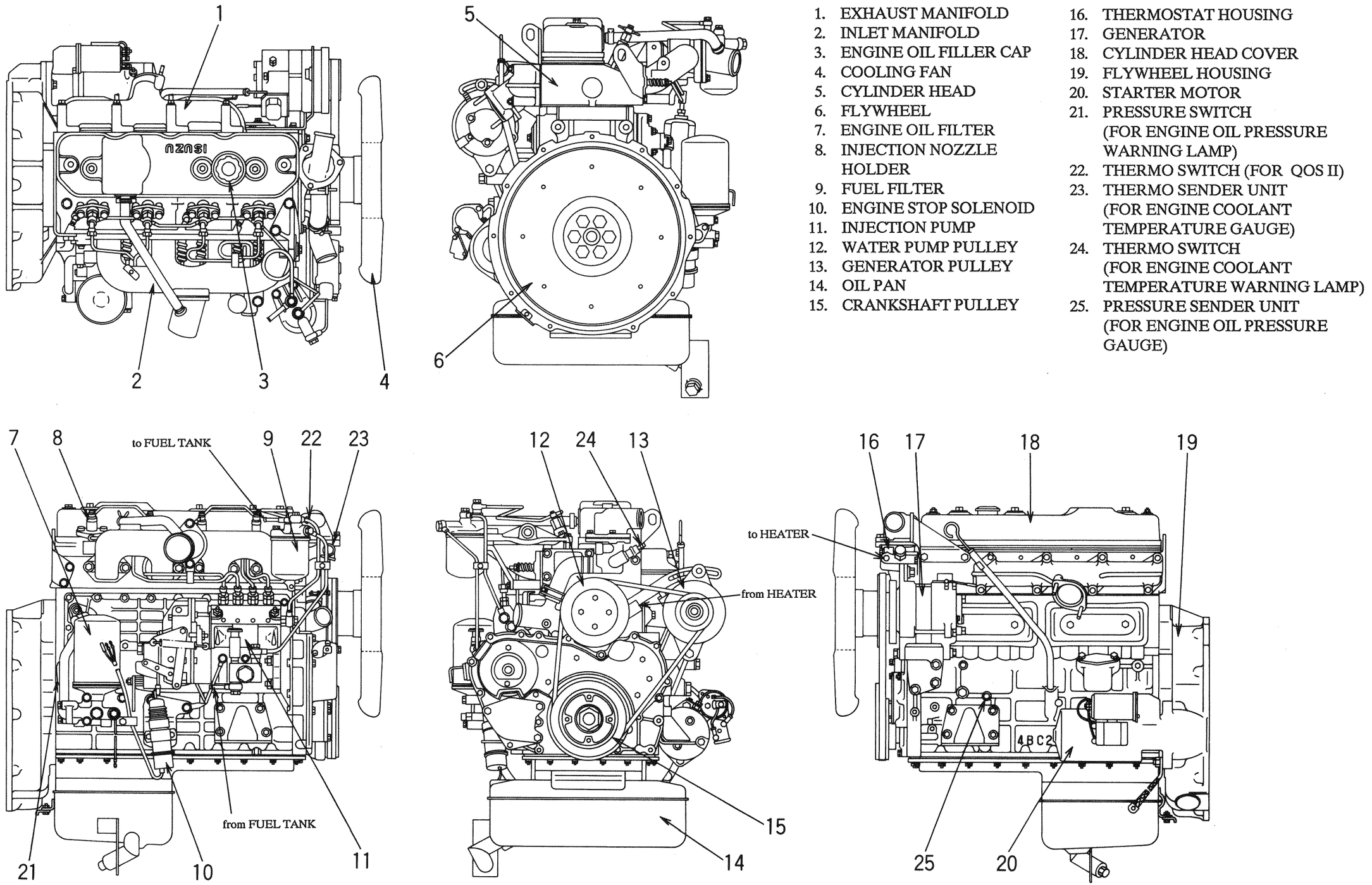
Steering System

Type	Frame articulation
Steering Cylinder	Double-acting piston type, 1 unit

Unit: ft-lbs

STANDARD BOLT TIGHTENING TORQUE LIST								
Division by strength			4.6		6.8		8.8	
Tightening condition / Thread size (millimeters)			Class A	Class B	Class A	Class B	Class A	Class B
Coarse	M6	pitch 1.00	2.6	2.9	5.2	5.7	6.9	7.6
	M8	1.25	6.4	7.0	12.7	14.0	16.9	18.6
	M10	1.50	12.7	13.9	25.3	27.8	33.7	37.0
	M12	1.75	22.1	24.3	44.3	48.7	59.1	65.1
	M14	2.00	35.5	39.0	71.1	78.1	94.8	104
	M16	2.00	56.0	61.8	112	124	150	165
	M18	2.50	76.7	83.9	153	169	204	224
	M20	2.50	109	121	219	242	292	322
Fine	M10	1.25	13.7	15.0	27.3	30.2	36.5	40.2
	M12	1.25	25.1	27.8	50.3	55.7	67.0	74.5
	M14	1.5	39.6	43.8	79.6	87.5	106	117
	M16	1.5	61.5	68.2	123	137	164	182
	M18	1.5	90.4	101	180	200	240	268
	M20	1.5	127	141	253	282	338	376
	M22	1.5	172	192	344	383	459	511
	M24	2	214	238	427	475	570	634
	M27	2	312	348	626	696	832	926
	M30	2	438	488	875	976	1160	1300
	M33	2	592	661	1190	1320	1580	1760
	M36	3	721	803	1440	1610	1920	2140

2. Outer View



1. EXHAUST MANIFOLD
2. INLET MANIFOLD
3. ENGINE OIL FILLER CAP
4. COOLING FAN
5. CYLINDER HEAD
6. FLYWHEEL
7. ENGINE OIL FILTER
8. INJECTION NOZZLE HOLDER
9. FUEL FILTER
10. ENGINE STOP SOLENOID
11. INJECTION PUMP
12. WATER PUMP PULLEY
13. GENERATOR PULLEY
14. OIL PAN
15. CRANKSHAFT PULLEY
16. THERMOSTAT HOUSING
17. GENERATOR
18. CYLINDER HEAD COVER
19. FLYWHEEL HOUSING
20. STARTER MOTOR
21. PRESSURE SWITCH (FOR ENGINE OIL PRESSURE WARNING LAMP)
22. THERMO SWITCH (FOR QOS II)
23. THERMO SENDER UNIT (FOR ENGINE COOLANT TEMPERATURE GAUGE)
24. THERMO SWITCH (FOR ENGINE COOLANT TEMPERATURE WARNING LAMP)
25. PRESSURE SENDER UNIT (FOR ENGINE OIL PRESSURE GAUGE)

Fig. 11.1 Outer View of Engine

11.4 DISMOUNTING AND MOUNTING OF ENGINE

1. Park the machine on the horizontal place, and fit the safety link to the frame.
2. Apply the parking brake, lower the bucket down to the ground, and stop the engine.
3. Block the wheels. Disconnect the negative terminal of battery.

Just after the engine is stopped, the muffler and exhaust manifold are hot. Be careful to prevent burn.

11.4.1 REMOVAL

Note: Remove the awning and ROPS canopy, if any, in advance.

(1) Removal of Bonnet

① Tentatively hang the bonnet, and remove the seat support side hinge pin fitting bolts (left and right, 2 pcs. each).

Bonnet : 27 kg

② Remove the clevis pin of gas spring from the bonnet.

③ Remove the bonnet from the machine.

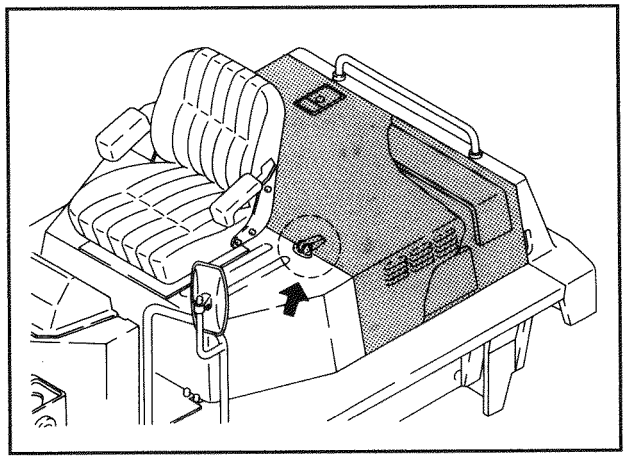


Fig. 11.14

(2) Removal of Radiator

① Open the engine and radiator drain cock (plug) to discharge the cooling water.

Cooling water: 16 liters

② Remove the transmission drain plug to discharge the torque converter oil.

Torque converter oil: 13 liters

③ Remove the radiator reserve tank and hose.

④ Disconnect the radiator hoses (upper and lower).

⑤ Disconnect the oil cooler hoses (left and right).

⑥ Remove the radiator upper part set bolts (left and right, one pc. each), pass wire rope through the bolt hole, and hang the radiator.

Radiator: 18 kg

⑦ Remove the radiator lower part fitting bolts (left and right, one pc. each).

⑧ Lift the radiator to remove it from the machine.

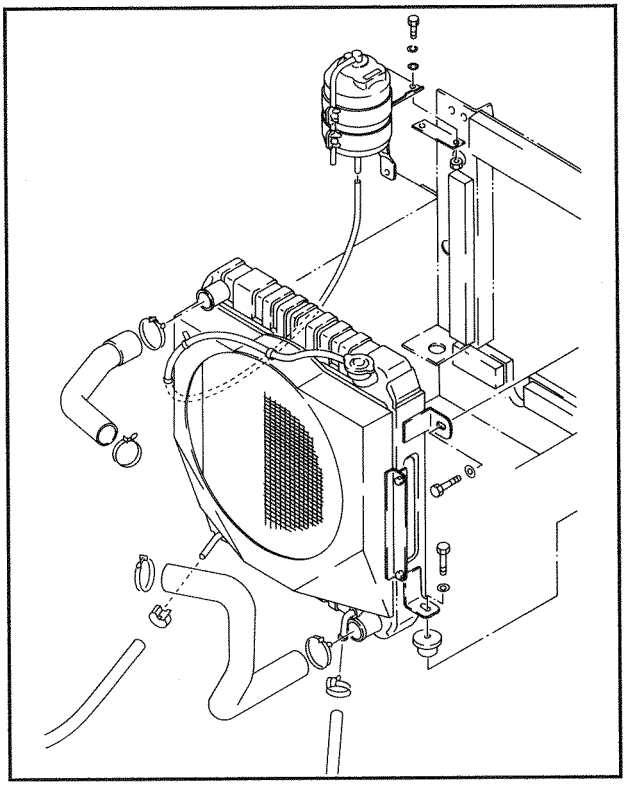
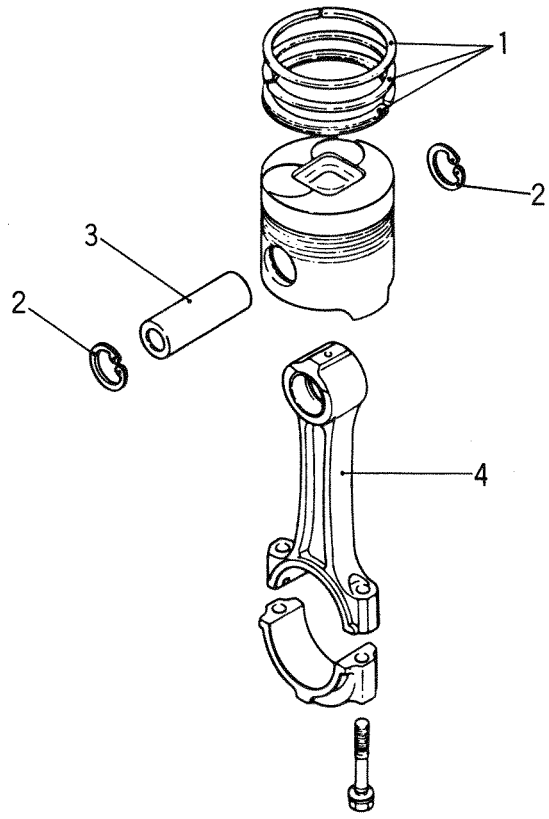


Fig. 11.15

4. Disassembling of Piston and Connecting Rod



Disassembling Procedure

1. PISTON RING
2. SNAP RING
3. PISTON PIN
4. CONNECTING ROD

Fig. 11.34 Disassembling of Piston and Connecting Rod

① Using the piston ring expander, remove the piston rings (3 pcs.).

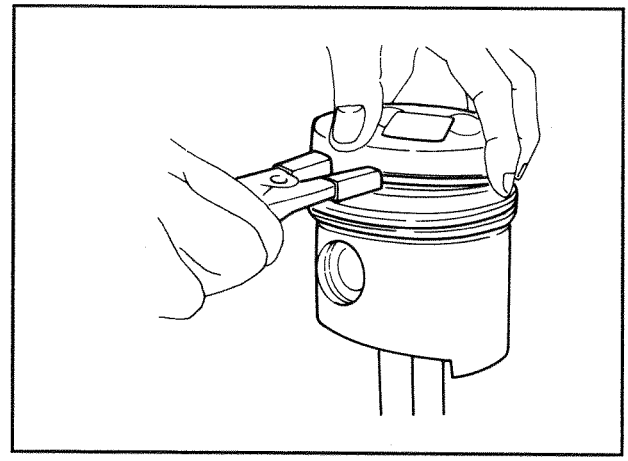


Fig. 11.35

④ Measure ID of camshaft bearing fitted into the cylinder body. If the clearance between camshaft journal and bearing exceeds the limit, replace the camshaft bearing.

Item	Maintenance standard (mm)	Limit (mm)
Clearance between Journal and Bearing	0.03 - 0.09	0.15

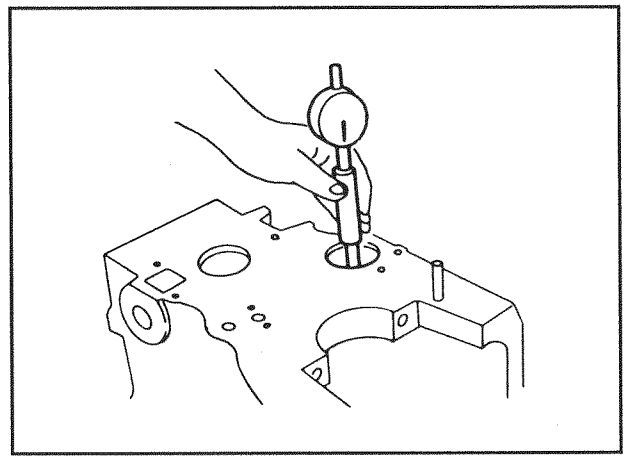


Fig. 11.60

(4) Replacement of Camshaft Bearing

To replace the bearing, use the special tool (camshaft bearing replacer set).

Note: When fitting the bearing, match the position of lubrication oil port.

8. Idler Gear and Shaft

① Measure OD of idler gear shaft to check for ununiform wear.
If the ununiform wear exceeds the limit, replace the idler gear shaft.

Item	Nominal size (mm)	Limit (mm)
Ununiform War of Idler Gear Shaft	ϕ45	0.1

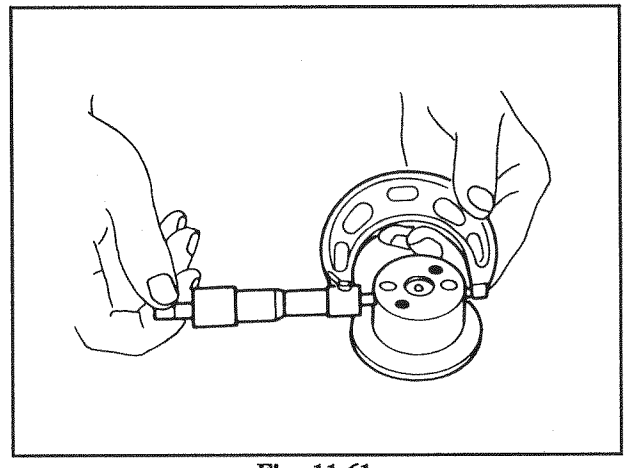


Fig. 11.61

② Measure ID of idler gear bushing, and check the clearance between bushing and shaft.
If the clearance exceeds the limit, replace the bushing.

Item	Maintenance standard (mm)	Limit (mm)
Clearance between Shaft and Bushing	0.009 - 0.060	0.2

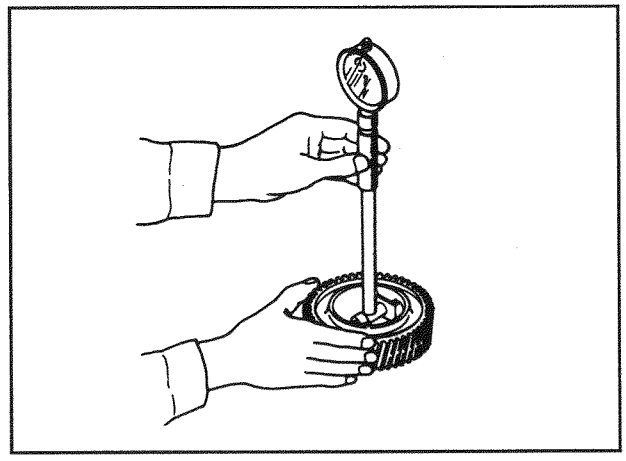


Fig. 11.62

(3) Replacement of Pilot Bearing

① Using a special tool (pilot bearing puller), remove the pilot bearing from the rear end of crankshaft.

Note: Apply the same method as that stated above, when replacing the pilot bearing without removing the flywheel.

② Attach a brass rod to the pilot bearing, and drive it in with a hammer.

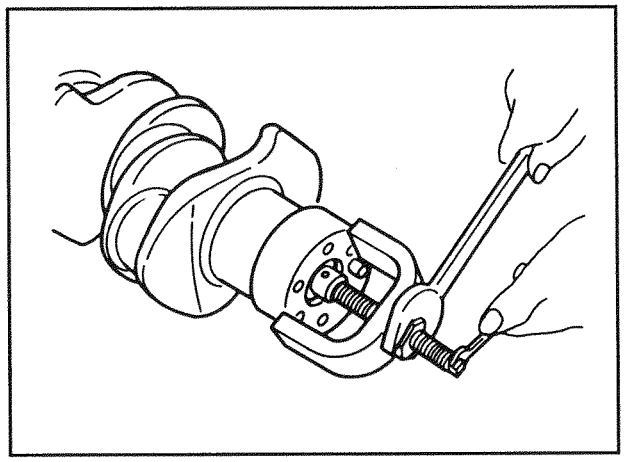


Fig. 11.84

13. Flywheel and Housing

(1) Replacement of Ring Gear

① Attach a brass rod to the end face of ring gear, and force it out with a hammer.

② To install the ring gear, heat the ring gear with gas burner to expand it, and shrink-fit it to the flywheel.

Since the ring gear is hot, take due care to prevent burn when working after heating.

Notes 1: The ring gear has chamfer at both sides. If its one side has worn out, mount it inversely so as to use it again.

2: After shrink-fitting the ring gear gently hit the ring gear with a hammer to check its tight fitting after it has cooled.

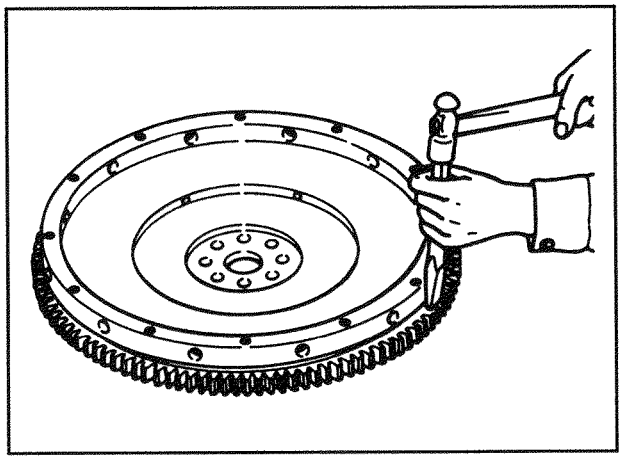


Fig. 11.85 Removing

(2) Replacement of Crankshaft Rear Oil Seal

① Remove the oil seal from the oil seal retainer.

② Using a special tool (setting tool), fit the oil seal to the oil seal retainer.

Oil seal lip: Engine oil

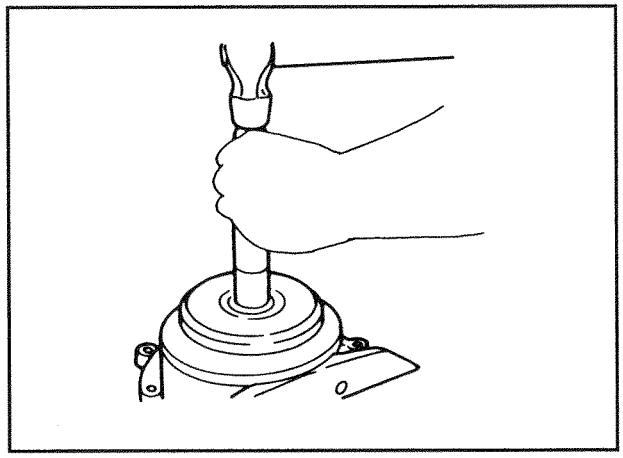


Fig. 11.86 Fitting

(12) Mounting of Cylinder Head

① Ascertain that the dowels have been fitted at the right external side of No. 1 and No. 4 cylinders on the upper surface of cylinder body.

② Fit the cylinder head gasket.

Note: The "TOP" mark of gasket must be upward and at the cylinder body front side.

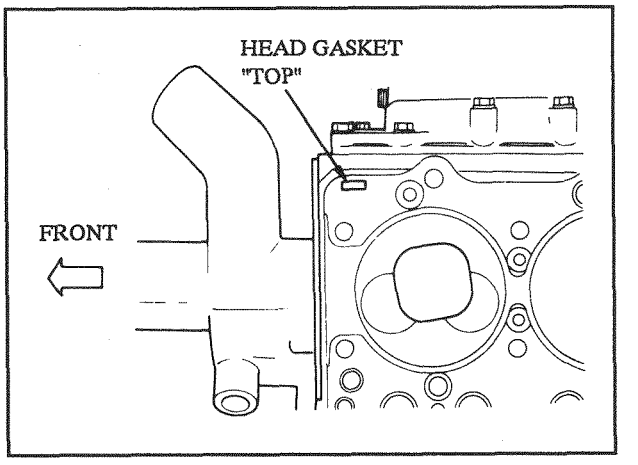


Fig. 11.109

③ Put the cylinder head on the cylinder body.

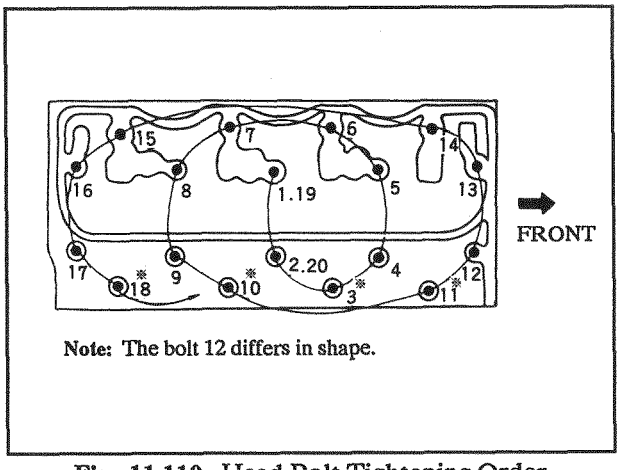
④ Tighten the cylinder head bolts in specified order in two steps.

Note: There are two types of head bolt which differ in length.

The nozzle side head bolts (4 pcs., *-marked bolts in the figure), 102 mm in length, are shorter than other bolts by 13 mm.

(1st tightening) 7.0 kg-m (51 ft-lbs)
(2nd tightening) Reused bolt: 11.5 kg-m (83.2 ft-lbs)
New bolt: 10.0 kg-m (72.3 ft-lbs)

Threads: Engine oil



Note: The bolt 12 differs in shape.

Fig. 11.110 Head Bolt Tightening Order

(13) Mounting of Rocker Arm Shaft

① Mount the push rods (8 pcs.).

Note: Direct the front round end of push rod toward the tappet.

② Mount the rocker arm shaft assembly on the cylinder head, and assemble the rocker arm adjusting screw with the push rod.
Tighten the bracket set bolts in the specified order.

Bracket set bolt: 2.5 kg-m (18 ft-lbs)

Note: The front bracket set bolt serves as lubricating oil guide. Therefore the tension bolt is used. Be careful so as not to misarrange.

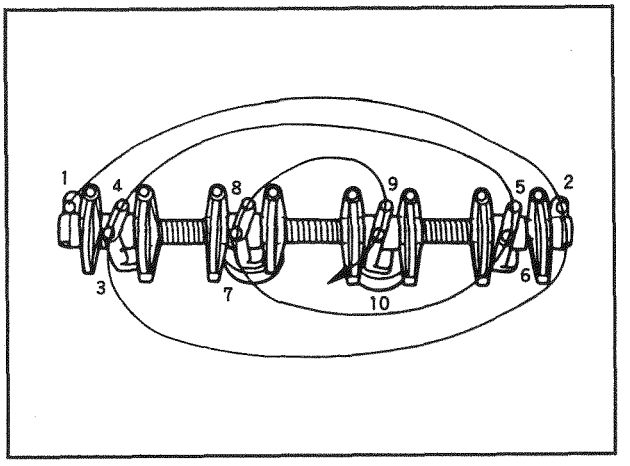


Fig. 11.111 Bolt Tightening Order

(14) Adjustment of Valve Clearance

Refer to 11.3.2 "CHECK AND ADJUSTMENT OF VALVE CLEARANCE".

③ Using a press remove the fan center from the body.
④ Then, remove the dust cover and snap ring.

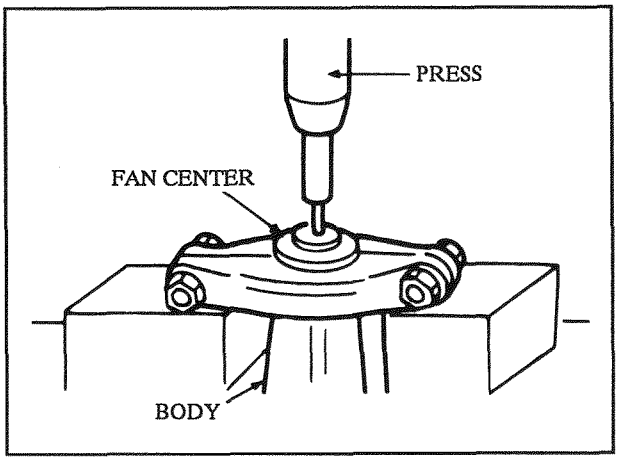


Fig. 11.125

⑤ Using a press remove the shaft and bearings as an assembly from the body.
⑥ Remove the two bearings and spacer from the shaft.
⑦ Remove the seal and seal unit from the body.

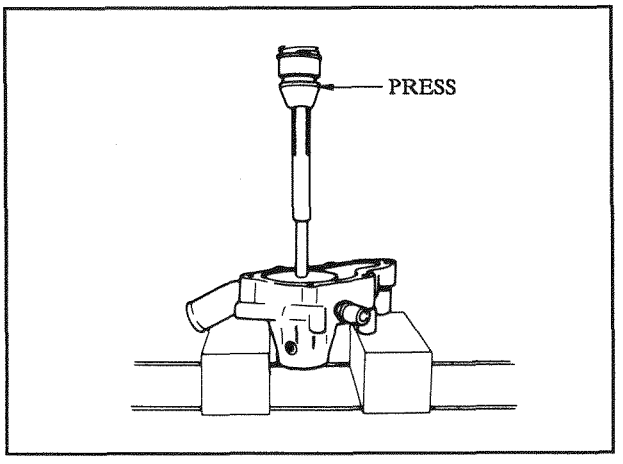


Fig. 11.126

2. Check

① If play of bearing exceeds the limit, replace.

Item	Limit (mm)
Play of Ball Bearing (radial direction)	0.2

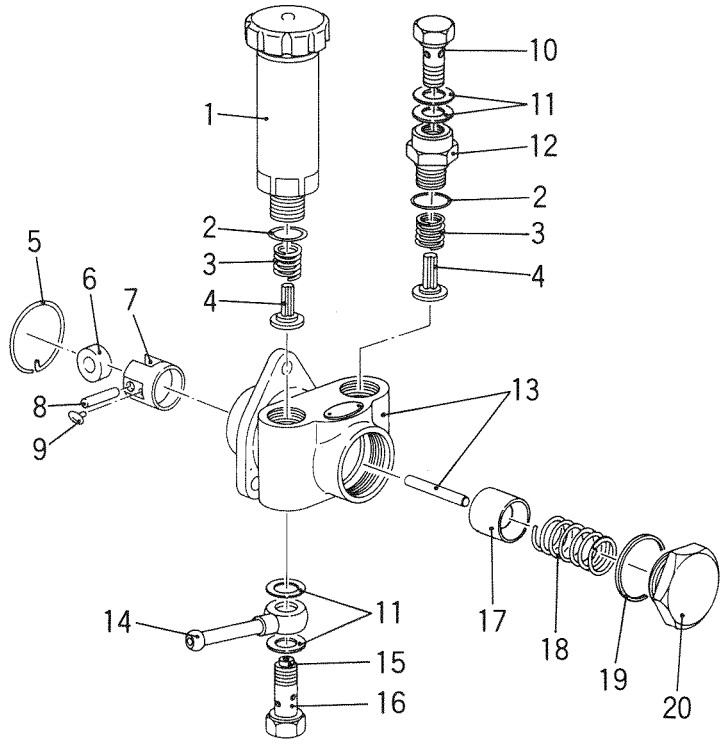
② Measure outer diameter of shaft, inner diameter of fan center and impeller. If interference is less than the maintenance standard, replace.

Item	Maintenance standard (mm)
Fan Center and Shaft Interference	0.07 - 0.11
Shaft and Impeller Interference	0.020 - 0.062

③ Measure outer diameter of fan center and inner diameter of pulley. If clearance exceeds the maintenance standard, replace.

Item	Maintenance standard (mm)
Clearance between Pulley and Fan Center	Less than 0.14

11.8.3 FEED PUMP



1. PRIMING PUMP
2. "O"-RING
3. CHECK VALVE SPRING
4. CHECK VALVE
5. SNAP RING
6. ROLLER
7. TAPPET
8. ROLLER PIN
9. TAPPET GUIDE
10. JOINT BOLT
11. PACKING
12. NIPPLE
13. HOUSING
14. HOSE JOINT
15. GAUZE FILTER
16. JOINT BOLT
17. PISTON
18. PISTON SPRING
19. GASKET
20. PLUG

Fig. 11.141 Components of Feed Pump

1. Check before Disassembling

(1) Piston Operation Check

Press the tappet with a thumb as shown in the figure. If depression is felt to be incomplete, this indicates seizure or sticking of piston or push rod.

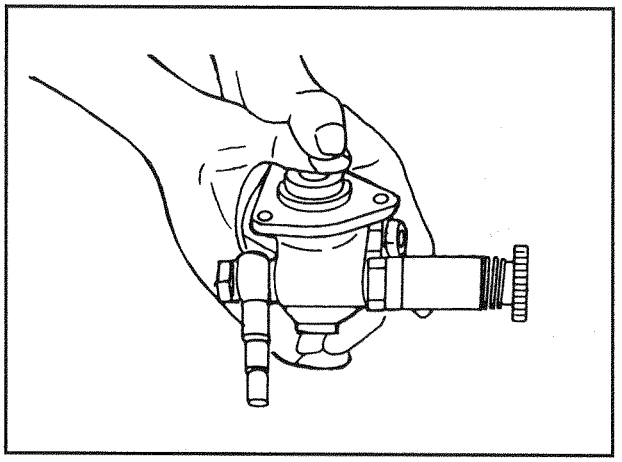


Fig. 11.142 Check

2. Check of Electrolyte Level

Make sure that the level of electrolyte is at a height of 10 to 13 mm above from the plates. When the electrolyte is lacking, add distilled water.

If the electrolyte level excessively lowers in a short period of time, check the charging system.

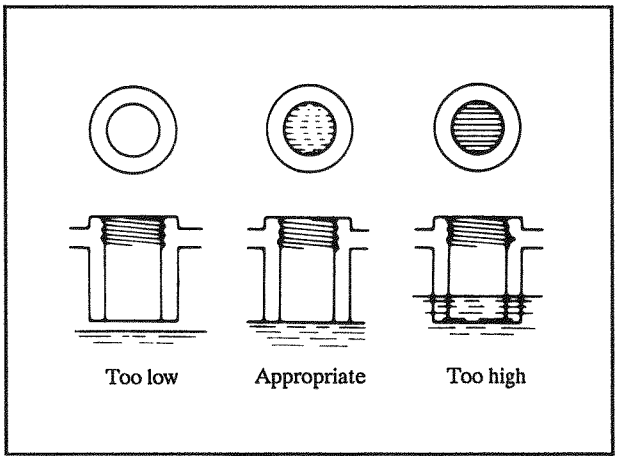


Fig. 11.153

3. Check of Charging and Discharging

(1) Check by Measuring Specific Gravity of Electrolyte

Since the specific gravity of the battery electrolyte decreases in proportion to discharge, you can determine battery charge by measuring the specific gravity of electrolyte in the battery.

① Using a suction hydrometer, such up the electrolyte, and read the graduation Ⓐ shown in Fig. 11.154.

② Measure the temperature (°C) of electrolyte.

③ Convert the measured specific gravity into one at the standard-temperature (20°C), using the following formula:

$$S20 = St + 0.0007\ (t - 20)$$

where,

S20: Specific gravity of electrolyte at standard temperature (20°C)

St: Specific gravity at t°C

t: Temperature (°C) of electrolyte when measured

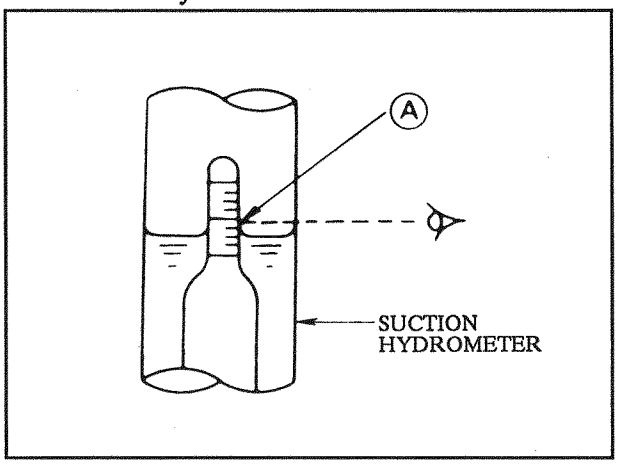


Fig. 11.154 Check

④ Make a judgement according to the table below.

Specific gravity (at 20°C)	Condition	Correction
Over 1.280	Too high	Adjust while charging.
1.250 - 1.270	Proper	① If the difference of specific gravity is less than 0.015 from one cell to another, no correction is needed. ② If more than 0.015, perform the high rate discharge test and if satisfactory, charge and adjust.
1.200 - 1.240	Attention required	① Charge if the temperature is low. If the specific gravity varies from one cell to another, adjust while charging. ② Check the charging circuit (generator and regulator) for operation, short-circuit, loose wires or corrosion.

(5) Check of Glow Plug

① Remove the glow plug from the engine.
② Check continuity of glow plug.

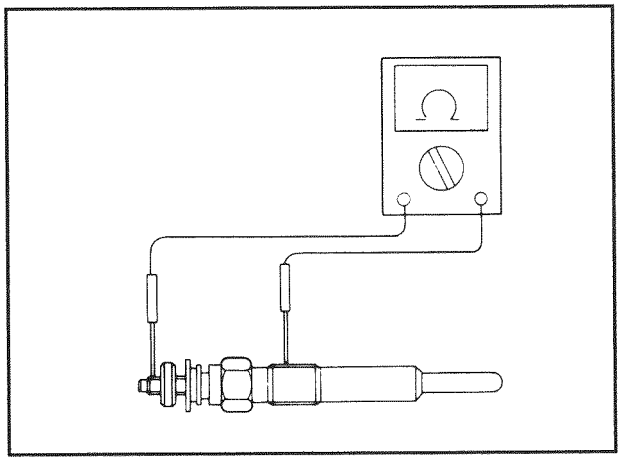
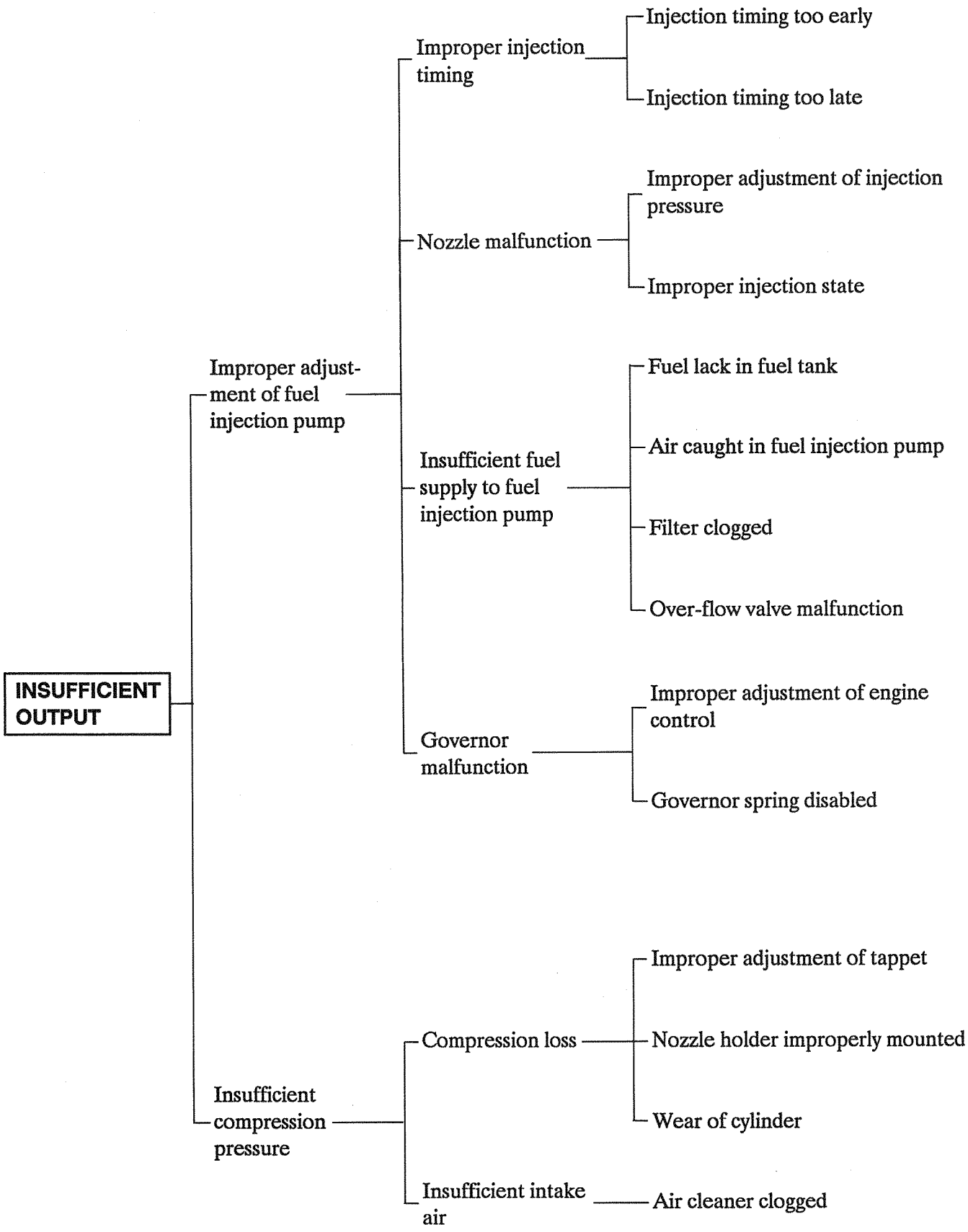


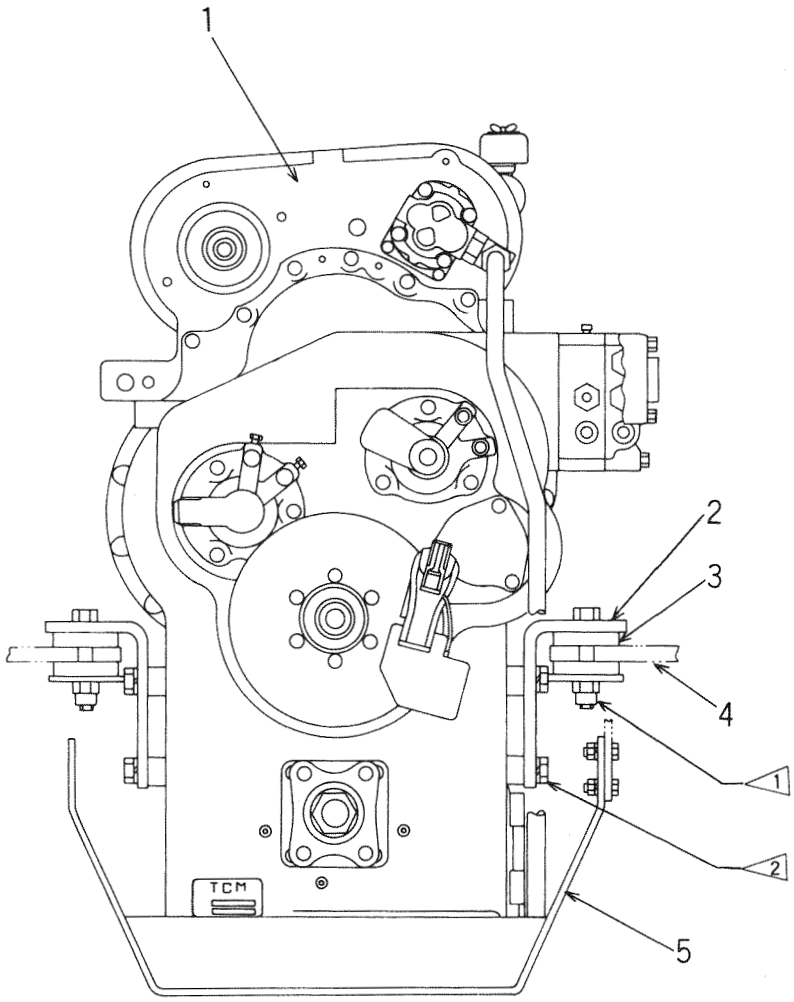
Fig. 11.166 Measurement of Resistance

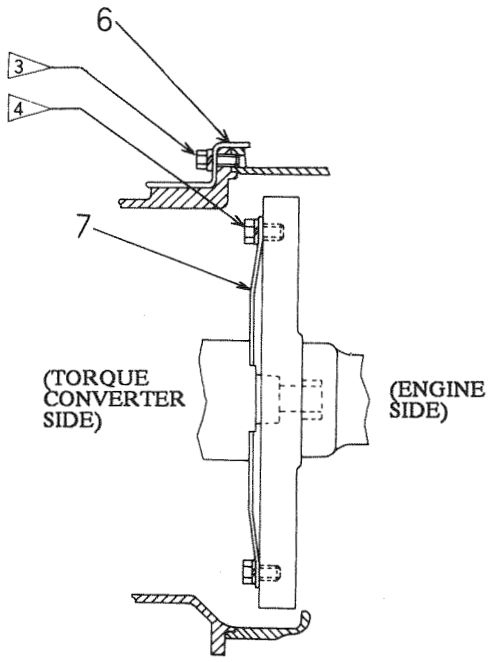
Item	Maintenance standard (ohm)	Remarks
Glow Plug Resistance (for reference)	Approx. 0.4	Normal

③ Fit the glow plug to the engine, and connect the connector.

Classification	Item	Nominal size (mm)	Assembly standard (mm)	Limit (mm)	Repair	Remarks
Final inspection	Cylinder compression pressure (kg/cm^2)	30	More than 25	Less than 22	Repair	Engine: 200 rpm Water temperature 20°C
	Difference in cylinder compression pressure		±3% with respect to average			
	Pressure of lubrication oil (kg/cm^2)		4.5	2.0	Adjust	


INSUFFICIENT OUTPUT
Improper adjustment of fuel injection pump
Improper injection timing
Injection timing too early
Injection timing too late
Nozzle malfunction
Improper adjustment of injection pressure
Improper injection state
Insufficient fuel supply to fuel injection pump
Fuel lack in fuel tank
Air caught in fuel injection pump
Filter clogged
Over-flow valve malfunction
Governor malfunction
Improper adjustment of engine control
Governor spring disabled
Insufficient compression pressure
Compression loss
Improper adjustment of tappet
Nozzle holder improperly mounted
Wear of cylinder
Insufficient intake air
Air cleaner clogged





Engine Connection Diagram

Notes: 1 At first tighten the nut so that the collars of upper and lower mount rubbers contact each other, tighten with torque of 6.1 kg-m (44 ft-lbs). Then tighten double nut (outer side) with torque of 20.5 kg-m (148 ft-lbs).

2 20.5 kg-m (148 ft-lbs), Thread: LOCTITE #262

3 5.1 kg-m (37 ft-lbs)

4 5.1 kg-m (37 ft-lbs), Thread: LOCTITE #262

1. DRIVE UNIT
2. BRACKET
3. MOUNT RUBBERS
4. (REAR FRAME)
5. GUARD
6. COVER
7. INPUT PLATE

Fig. 21.4 Mounting of Drive Unit

Item		Maintenance standard (rpm)	Use limit (rpm)
Stalling and Relief Speed	815-2	1260	1110 - 1410
	820-2	1180	1030 - 1330

21.3.2 JUDGEMENT BASED ON STALLING SPEED

The stalling (and relief) speed differs remarkably depending on drive unit oil temperature and oil level, as well as deviation of torque converter and engine.

Therefore, when making a judgement based on the stalling (and relief) speed, it is necessary to compare the currently obtained values with the previous data (obtained on acceptance) in order to compensate for the deviation.

1. Low Stalling Speed

Generally, the low stalling speed indicates that a problem exists in the engine. First, check the engine before checking the torque converter and the transmission, or the hydraulic circuit.

When the stalling speed is lower than the use limit, check the following.

- Clogging of air cleaner
- Malfunction of injection pump or nozzle
- Improper adjustment of engine control linkage
- Improper adjustment of fuel injection.
- Contamination of fuel filter
- Compression pressure drop
- Clogging of exhaust system
- Machine placed at a high place (high altitude)

2. High Stalling Speed

Generally, the high stalling speed indicates that a problem exists in the torque converter or transmission circuit.

When the stalling speed is high, check the following.

- Cavitation of torque converter
- Sliding of transmission clutch

⑥ Remove the drive gear and driven gear from the gear plate.

Note: Matchmark the gear's shaft end to ensure the same gear teeth engagement in reassembly.

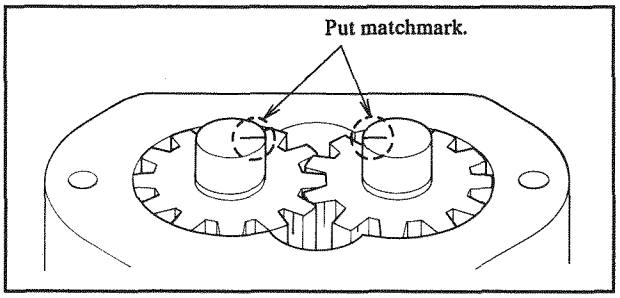


Fig. 22.16

⑦ Remove the side plate (A) from the gear plate.

Note: Be careful not to incline the side plate. If it is inclined and cannot be removed, fit the drive gear into the gear plate, gently force in the protruding part of side plate so that the side plate is placed back in initial position, and then redo side plate removal.

⑧ Remove the gasket (A), gasket (B) and balance seal from the flange.

Note: Insert the front end of screw driver into the hole of balance seal, and gently prize to remove.

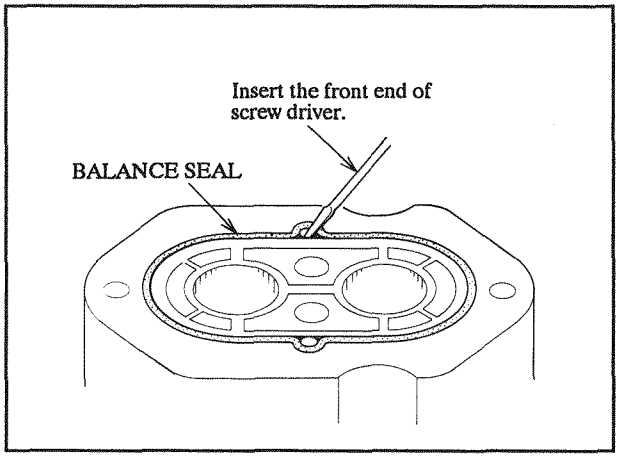


Fig. 22.17

⑨ When replacing the oil seal, release the flange from the vice, remove the snap ring and then remove the oil seal.

22.3.2 CHECK

(1) Gear Plate

Check for gear contact flaw on the suction side inner surface of gear plate. The length of contact flaw must be less than 1/2 of inside periphery of gear bore, and the depth (A) of contact flaw must be less than 0.1 mm.

If the depth (A) of contact flaw exceeds the use limit, replace the part.

Item	Use limit (mm)
Depth of Gear Plate Contact Flaw	0.15

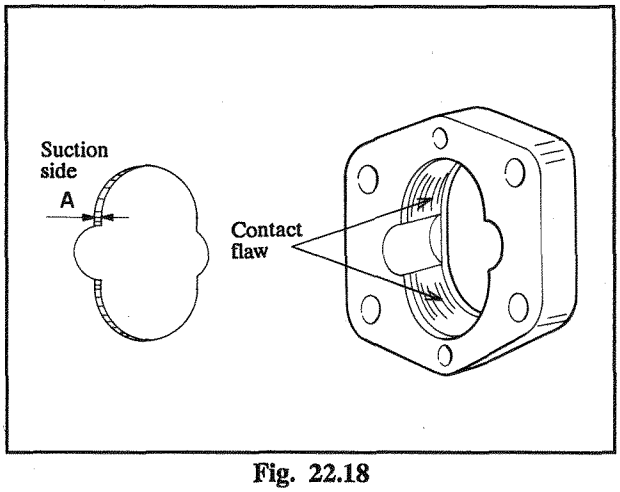
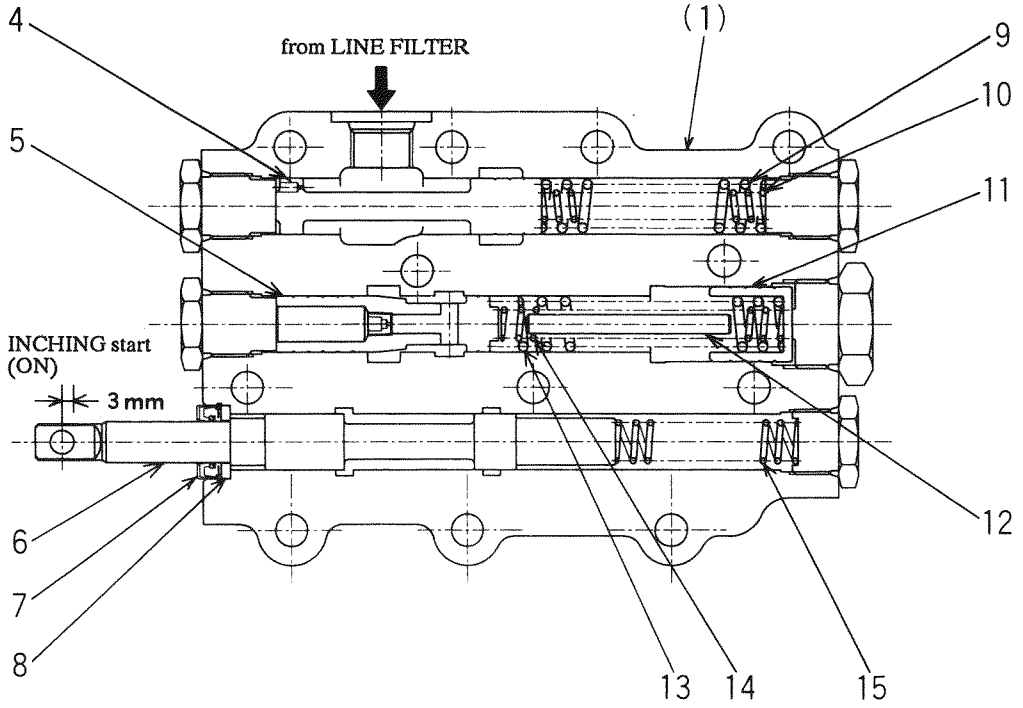
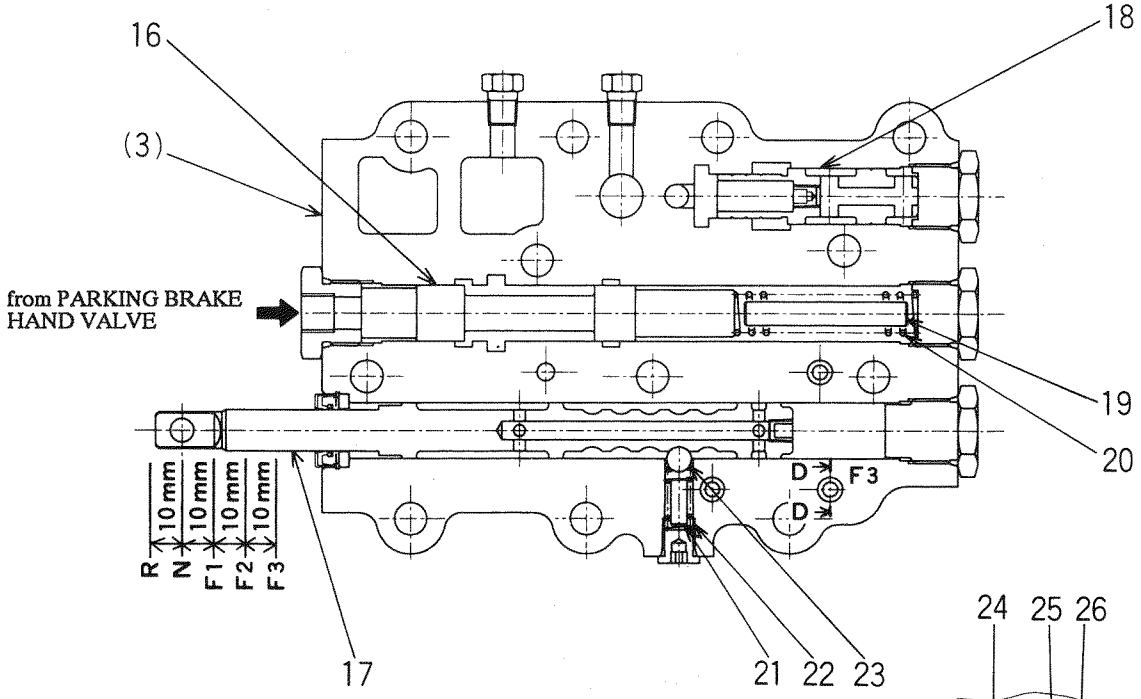


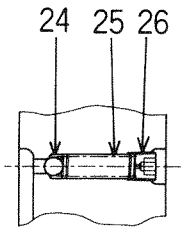
Fig. 22.18



A-A Cross Sectional View



B-B Cross Sectional View



D-D Cross Sectional View

Note: For the names of the parts, see the preceding page.

Fig. 23.6 Control Valve (2/2)

2. Forward Second Speed

The forward 2nd-speed clutch (F2) is engaged.

Power from the engine is transmitted through the torque converter as follows: turbine shaft gear → front gear of forward 1st- and 2nd-speed shaft → forward 1st- and 2nd-speed shaft → forward 2nd-speed clutch → forward 2nd-speed hub gear → idler gear (59T) → idler shaft → idler gear (30T) → output shaft gear → output shaft.

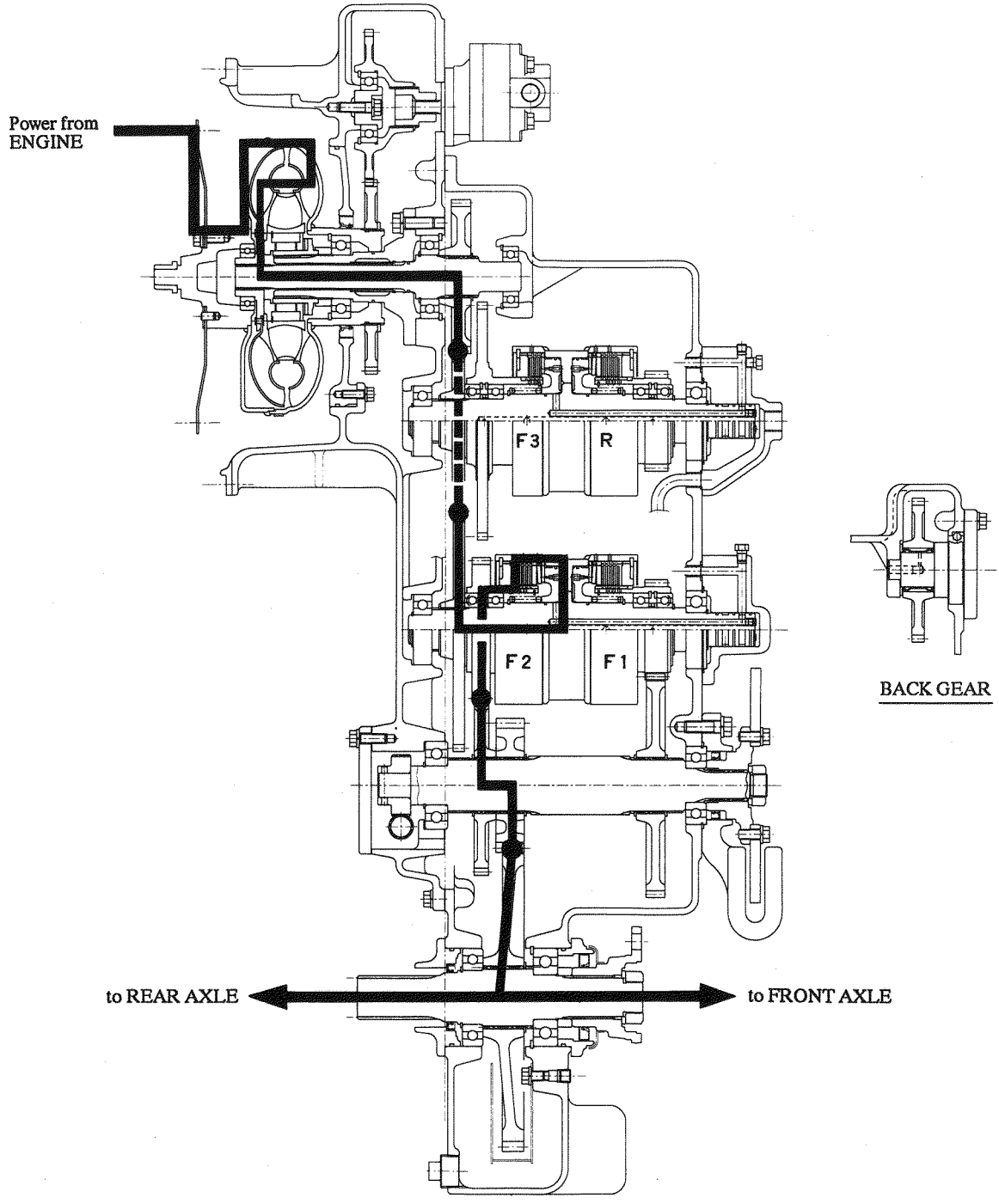


Fig. 23.16 Power Transmission Route (Forward Second Speed)

9. Installation of Control Valve

① Fit the bracket, bell cranks, links, etc. to the control valve. (See Fig. 23.56.)

② Fit the "O"-ring to the transmission control valve mounting surface.

③ Fit the control valve to the transmission together with the gasket.

Control valve and bracket: 20 kg

Notes 1: Use the long bolts (2 pcs.) to tighten the bracket and control valve.

2: Tighten the set bolts (12 pcs.) successively, beginning with the center bolt, with the specified torque.

Control valve set bolt: 5.1 kg-m (37 ft-lbs)

④ Temporarily fit the limit switches (back lamp switch and neutral switch) to the bracket, and adjust the position. (The mounting position is shown in Fig. 23.56.)

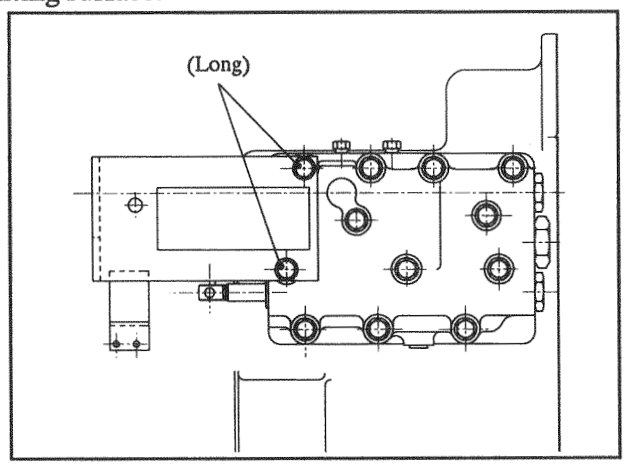


Fig. 23.36

⑤ Fit the checker to the back lamp switch. Adjust the position of the switch so that the checker LED lights when the speed change spool is in the outermost position (reverse position).

⑥ Adjust the position of neutral switch by the same procedure.
The position where the speed change spool is retracted 10 mm from the outermost position is the neutral position.

Note: Adjust the position of neutral switch so that the neutral switch does not operate at the forward 1st-speed.

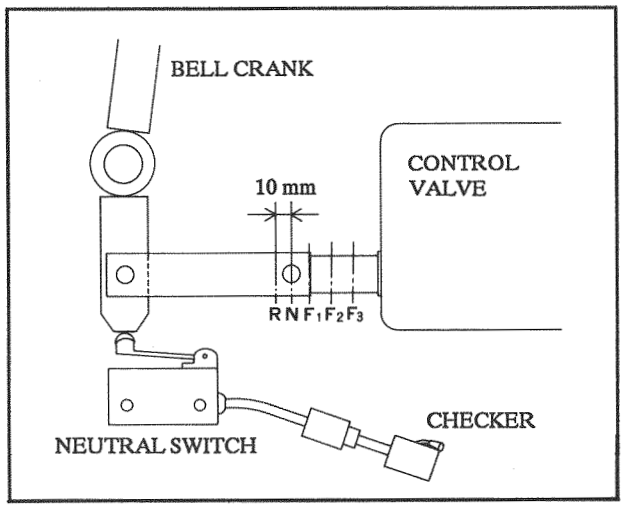


Fig. 23.37

23.4.3 CHECK

Item		Maintenance standard (mm)	Use limit (mm)
Inching Spring (hydraulic)	Free height	70.7	67.9
	Tension (measurement length = 60 mm) kg	6.0	5.4
Inching Spring (mechanical)	Free height	70.7	67.9
	Tension (measurement length = 60 mm) kg	6.0	5.4
Modulate Spring (inner)	Free height	96	92.2
	Tension (measurement length = 77 mm) kg	10.74	9.7
Modulate Spring (outer)	Free height	93	89.3
	Tension (measurement length = 80 mm) kg	20.03	18.0
Regulate Spring (inner)	Free height	82.5	79.2
	Tension (measurement length = 73 mm) kg	13.9	12.5
Regulate Spring (outer)	Free height	95	92.1
	Tension (measurement length = 73 mm) kg	37.5	33.8

23.4.4 ASSEMBLING

Assemble the control valve in the reverse order of disassembly.

 Plug without "O"-ring: LOCTITE #572

Notes 1: Since the spool is selectively fitted, replace it as assembly.

2: Do not use the seal tape for assembly. (Otherwise, clogging may occur.)

24.3 CHECK OF OIL FLOW CIRCUIT AND OIL PRESSURE

Torque converter, transmission, transmission control valve and other individual hydraulic systems are included in one same major hydraulic system and are therefore connected with one another in their operations. For that reason, when checking one individual local hydraulic system function, the entire system must be taken into consideration.

24.3.1 FLUSHING OF OIL FLOW CIRCUIT

The entire oil circuit must be flushed thoroughly if the pump is seized, if torque converter, transmission and any other parts inside the system are unusually worn or damaged, or if the torque converter or transmission is overhauled or serviced.

Flushing Procedures:

① Thoroughly drain the oil from the sump tank and the oil circuit consisting of the transmission, the torque converter, the oil filter, etc.

Converter oil: 13 liters

② Remove and clean as many tubes and hoses as possible, and blow compressed air to the oil cooler in the direction opposite to the oil flow direction so as to remove foreign material.

③ Clean or replace the oil filter element.

④ Remove and clean the transmission magnet strainer. Then remove metallic particles from the magnet.

⑤ Replace the charging pump with a spare pump used for flushing. If a spare pump is not available. Use a new pump.

⑥ Supply clean converter oil through a 10 μ-mesh paper filter till it reaches the "FULL (Hi)" mark of the oil gauge.

Converter oil: 13 liters

⑦ Operate the charging pump at the speed ranging from 1,500 to 2,000 rpm for about 20 minutes to circulate the oil, which then cleans the oil circuit.

⑧ Remove the drain plug of the transmission to drain the oil. After draining the oil, replace the charging pump and the filter element.

Converter oil: 13 liters

⑨ Fill the system with new converter oil up to the "FULL (Hi)" mark of the oil gauge. Run the engine for a while in order to remove air and to fill the piping with oil at the suction side.

Converter oil: 13 liters

26. DRIVING AXLES (FRONT AND REAR)

Driving system	4-wheel drive
Front axle	Frame-fixed, semi-floating
Rear axle	Cradle pin pivotted, semi-floating
Reduction gear and differential	
Model	TCM632-30
Type	Ordinary, 2-stage reduction
Differential gear box	Banjo type
Oil q'ty (Front/Rear)	16 liters each
Weight	
Front axle	298 kg
Rear axle	298 kg

26.1 OUTLINE

Each driving axle consists of a differential, axle shafts, and wet disc brakes.

Power from the drive unit is transmitted to the front and rear axles by the propeller shafts. After reaching the axle, power then rotates the differential case through the drive pinion and the ring gear. It is transmitted therefrom to the right and left side gears which in turn rotate the axles shafts, and consequently rotates the wheels.

For the wet disc brake operation, see 31.5 of 3. "BRAKE SYSTEM".

26.3.1 DISASSEMBLING

1. Removal of Axle Tube

① Remove the drain plug to discharge the gear oil.

Gear oil: 16 liters

② Hanging the axle tube, remove the axle tube set bolts (12 pcs.).

Axle tube and shaft: 67 kg

③ Pull out the axle tube to remove it from the differential unit.

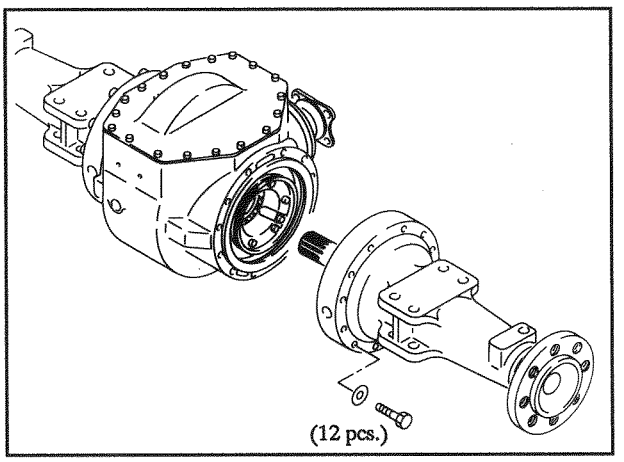


Fig. 26.12

2. Removal of Disc Brake

① Remove the brake rings (3 pcs.), brake discs (2 pcs.), and pins (8 pcs.) from the axle tube.

② Straighten the tab of lock washer of disc hub, and remove the lock nut.

Note: Some models employ double nuts.
(815-2: Machine No. 153 and later; 820-2: Machine No. 5267 and later)

③ Remove the disc hub from the axle shaft.

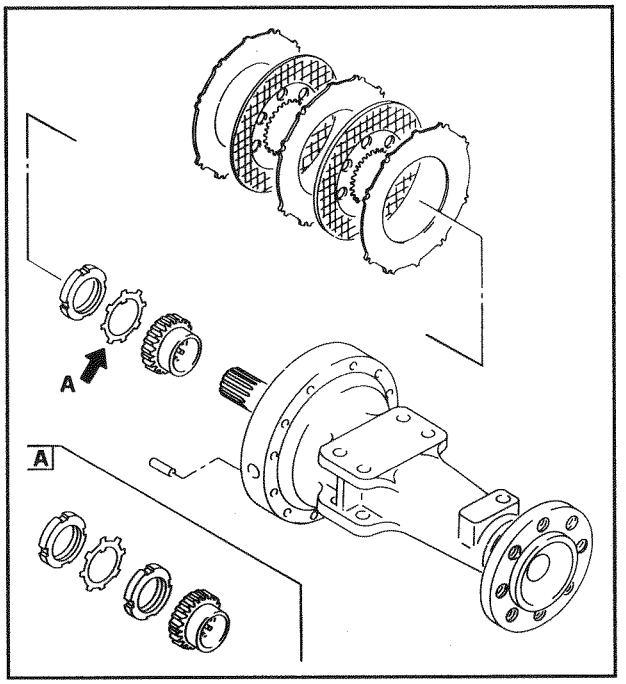


Fig. 26.13

④ Remove the brake piston from the differential unit.

Note: Insert the puller bolts into the threaded holes (M6) of piston, and pull out the piston.

⑤ Remove the "O"-rings (2 pcs.) of the brake piston.

⑥ Remove the axle tube and disc brake at the opposite side of the machine by the same procedure.

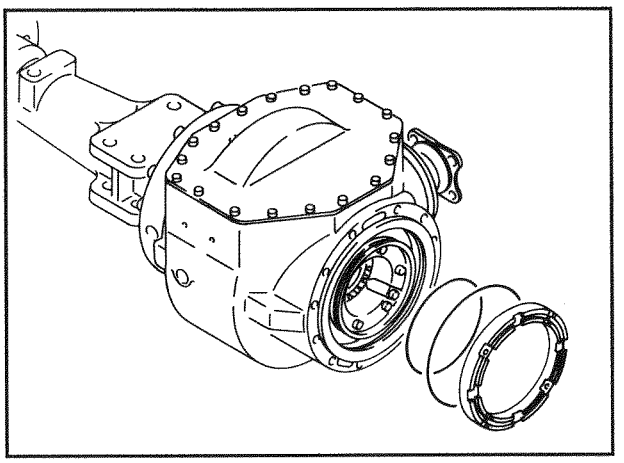


Fig. 26.14

② Fit the oil seal sleeve to the axle shaft.

③ Set upright the axle shaft, and fit the axle tube from above.
Next, tap the axle tube to press-fit the tentatively fitted bearing corn to the axle shaft.

Axle tube: 35 kg

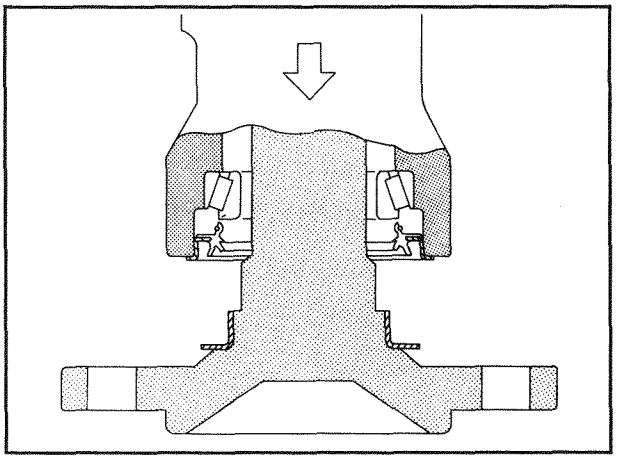


Fig. 26.41

④ Drive the axle shaft inner bearing cup into the axle tube, and fit the corn to the axle shaft.

Bearing: Grease

⑤ Fit the disc hub to the axle shaft, and mount the lock washer and lock nut.

Note: When the double nuts are used, mount nut, washer, and nut in this sequence.

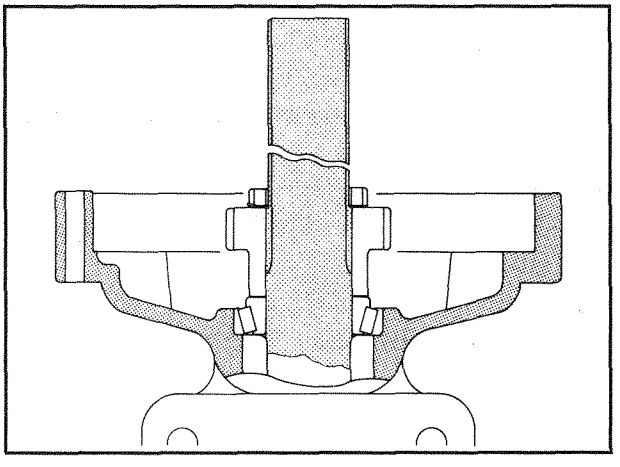


Fig. 26.42

⑥ Measure the rotation resisting torque of axle shaft bearing, and make sure it is within the standard range.
If the measured value is out of the standard range, tighten or loosen the lock nut to adjust it.

Item	Maintenance standard
Rotation Resisting Torque of Axle Shaft Bearings (Indication of spring scale: kg)	6.0 - 7.0

(Reference)
Rotation resisting torque of axle shaft bearings = 0.87 to 1.02 kg-m

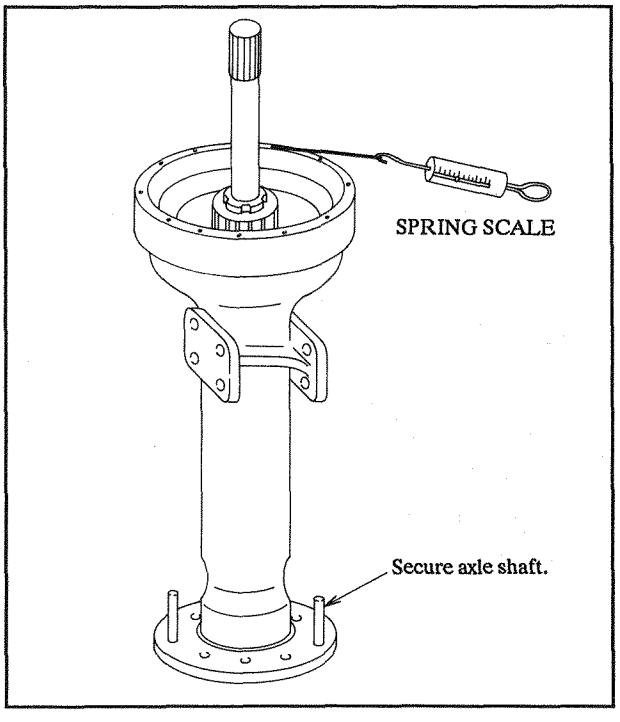


Fig. 26.43

⑦ Bend the lock washer of axle shaft to secure the lock nut.

⑧ Assemble the other axle tube by the same procedure.

③ Install a tire lifting jig on the wheel and lift it a little. Remove the wheel bolts (8 pcs.), and remove the tire.

Tire with rim (815-2): 92 kg
(820-2): 107 kg

When disassembling or assembling the tire, contact the tire supplier.

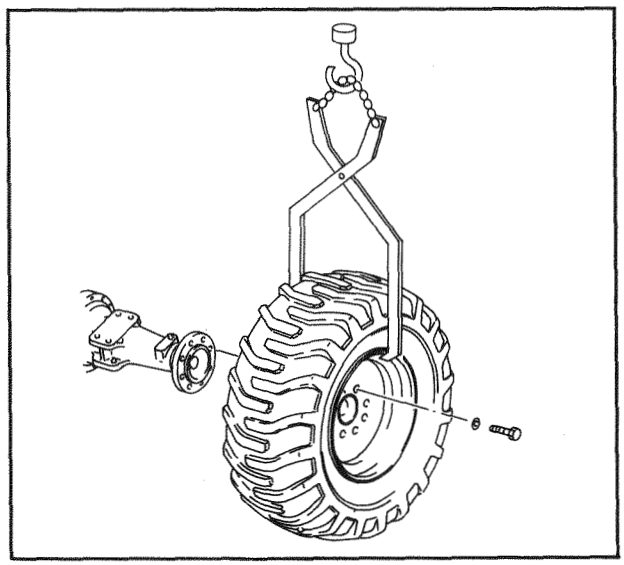


Fig. 27.7

2. Installation

Install the wheel in the reverse order of removal.

Wheel bolt: 84 - 92 kg-m (610 - 670 ft-lbs)

1. When inflating a tire, use the air check. During inflation, stand as away from the tire as possible, or behind the tread.

2. Fit the pressure regulating valve to the compressor, and adjust the air pressure before using the compressor.

4. Releasing the Brake Pedal (Fig. 31.6)

Stepping off the brake pedal (1) brings the brake pedal and the brake valve (5) back into their neutral positions.

Brake oil that has been operating on the disc brakes (11 and 12) then flows back to the brake tank (9) through the safety cylinder (10) and the brake valve, so that the disc brakes are disengaged.

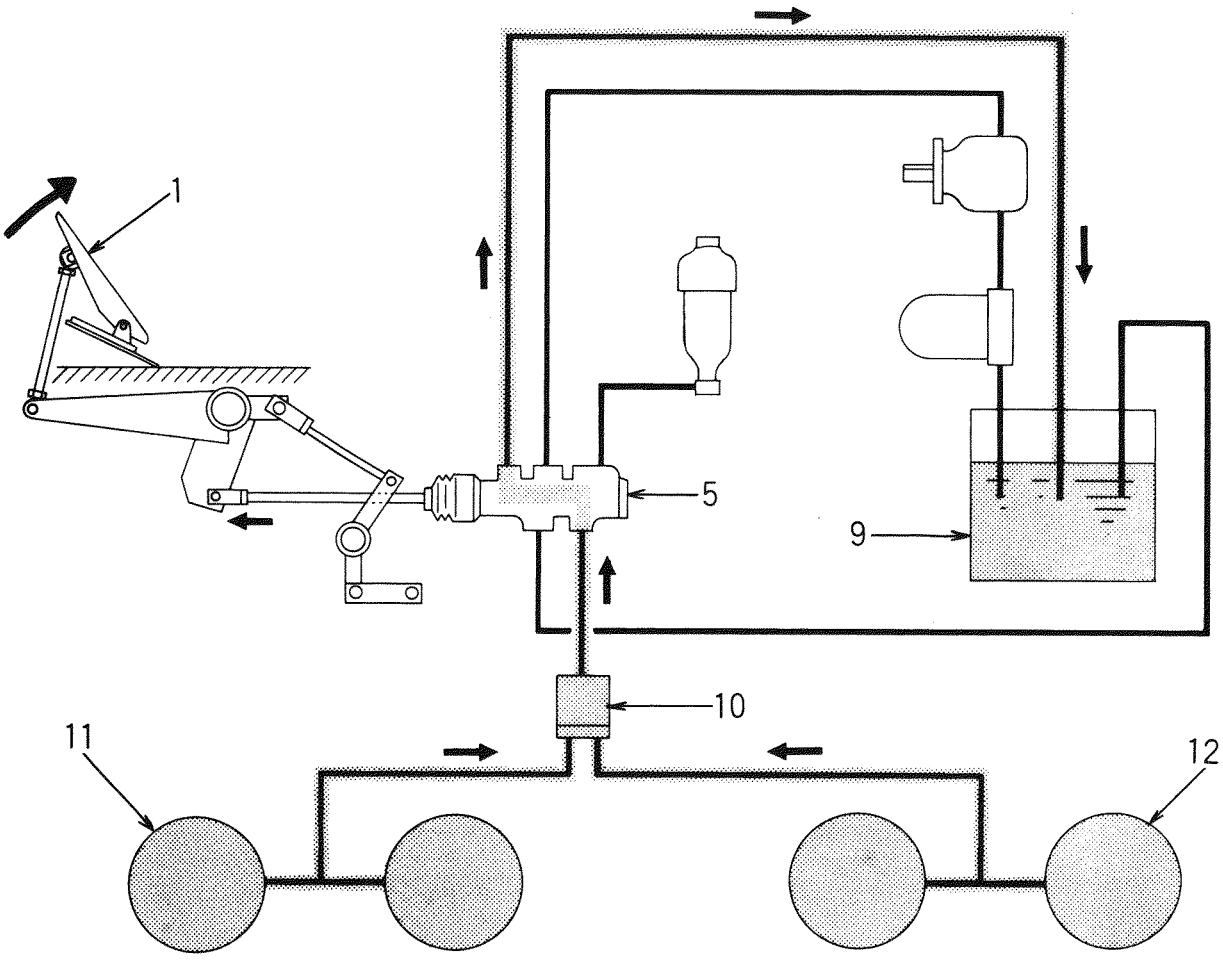


Fig. 31.6 Releasing Brake Pedal

5. Pressure Accumulation in Accumulator

When the brake pedal is depressed, as explained in Operation (A), the hydraulic pressure in the hydraulic pressure control chamber (6) is increased, and the disc brakes are actuated. If the hydraulic pressure in the accumulator port is lower than the hydraulic pressure in the hydraulic pressure control chamber (6), the ball (10) moves to open the valve (d). Therefore, the brake oil in the hydraulic pressure control chamber (6) passes through the valve (d) and is accumulated in the accumulator.

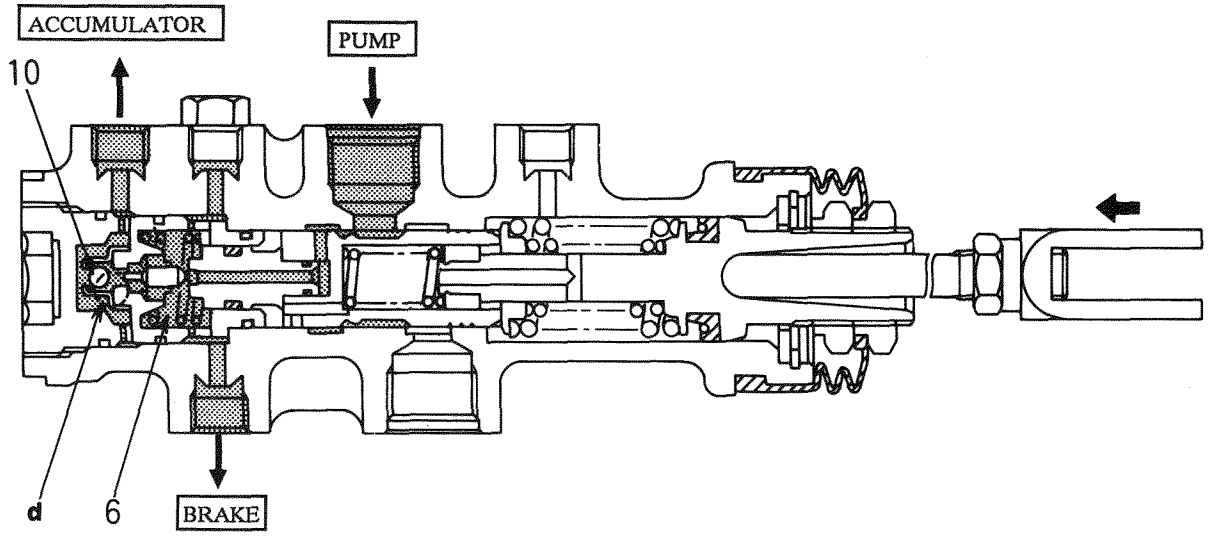


Fig. 31.24 Pressure Accumulation in Accumulator

6. Emergency Brake Operation

When the brake pedal is depressed while the brake pump is at rest, the spool (1) and the reaction piston (5) move, as in case of Operation (A), but no hydraulic pressure is generated in the hydraulic pressure control chamber (6).

If the brake pedal is further depressed, the front end of the reaction piston (5) contacts the valve rod (11), so that the valve (e) is closed. Then, the ball (10) is pushed by the valve rod (11) to open the valve (d).

Oil accumulated in the accumulator is sent from the hydraulic pressure control chamber (6) to the disc brakes through the valve (d).

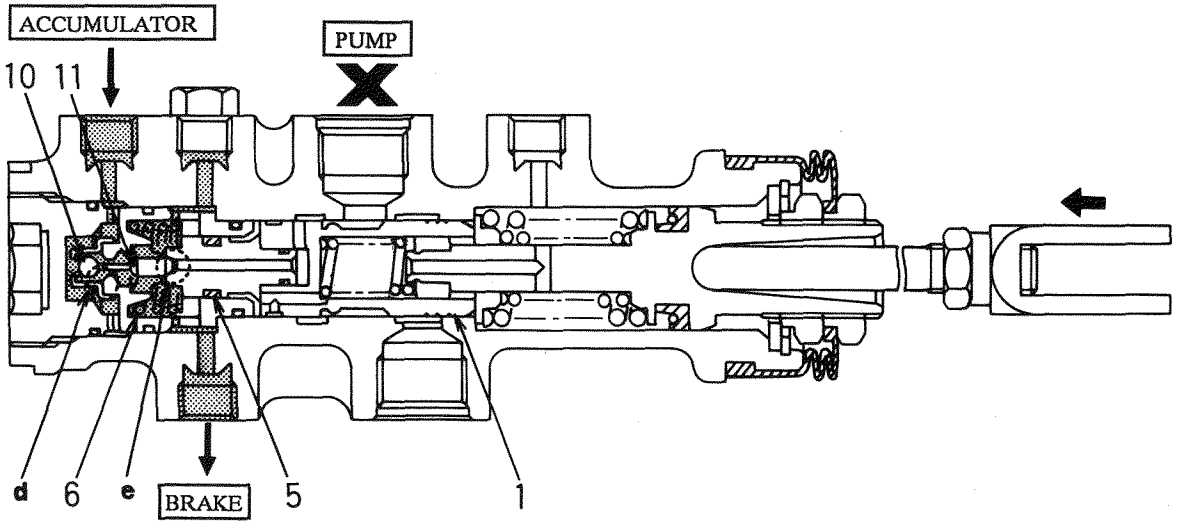


Fig. 31.25 Emergency Brake Operation

3. Adjustment after Installation

① Completely loosen the check valve.

When the check valve is not loosened, the brake oil line led to the disc brake is kept shut off, and therefore the disc brake is not actuated even if the brake pedal is depressed.

② Completely loosen the bleeding valve to bleed the brake oil line.

③ Bleed the brake oil line. (Refer to item 31.8.1 "AIR BLEEDING FROM HYDRAULIC LINE".)

④ After completion of bleeding tighten the bleeding valve.

1.4 kg-m (10 ft-lbs)

31.8 CHECK OF BRAKE LINE

31.8.1 AIR BLEEDING FROM HYDRAULIC LINE

Park the machine on the horizontal place, lower the bucket down to the ground, and stop the engine. Apply the parking brake, and block the wheels.

① Remove the cap of bleeder screw fitted to the differential body, and insert one end of vinyl hose, and put its other end in a vessel.

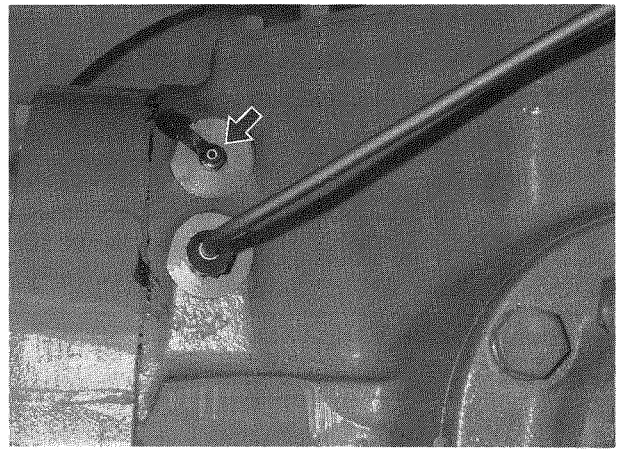


Fig. 31.56 Bleeder Screw

② Loosen the bleed valves (2 pcs.) of safety cylinder.

Note: This facilitates air bleeding. Be sure to loosen both the front and rear valves.

③ Start the engine.

④ Depress the brake pedal, and loosen the bleeder screw to bleed air.
Be sure to tighten the bleeder screw before releasing the brake pedal.

⑤ Supply the brake oil to the brake tank when necessary.

⑥ Repeat this procedure until air bubbles in oil disappear in the vinyl hose (air bleeding completes).
While the brake oil is flowing out, tighten the bleeder screw, and then release the brake pedal.

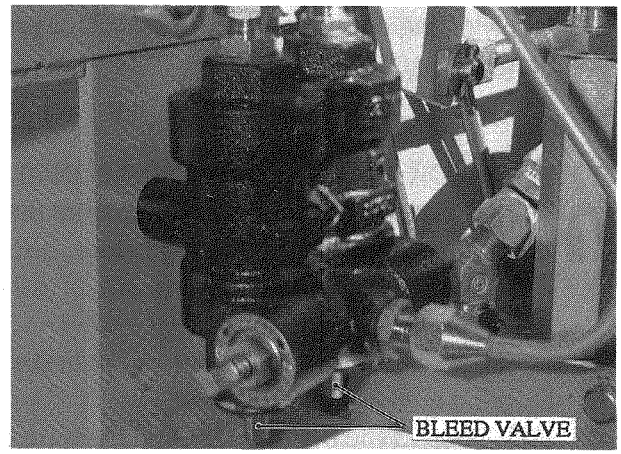


Fig. 31.57 Safety Cylinder

⑦ Bleed air from other three brake hydraulic lines by the same procedure.

⑧ Tighten the bleed valves (2 pcs.) of safety cylinder.

Bleed valve: 1.4 kg-m (10 ft-lbs)

⑨ Check the oil level in brake oil tank.

32.2 HAND VALVE

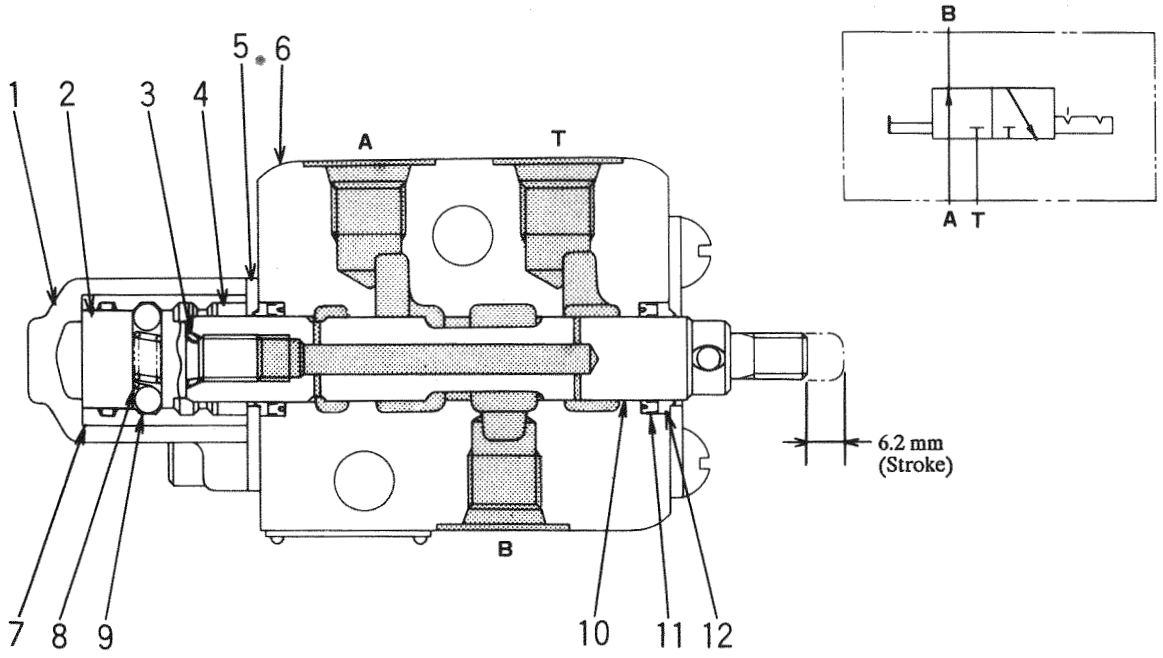
32.2.1 OUTLINE

The hand valve is used for parking brake control and is located on the instrument panel at the operator seat. Pulling the hand valve knob applies the parking brake. Be sure to push it back when running the machine.

Operation

Pressing in the hand valve knob causes the hydraulic oil coming from the charging pump to flow through the hand valve from the port A to the port B into the spring chamber.

When the hand valve knob is pulled, the hydraulic oil flow from the charging pump is blocked by the spool. The oil that has flowed into the spring chamber runs into the hand valve through the port B and flows out of it through the port T, then it goes into the torque converter.



Note: Ports A, B, and T: 3.5 to 4 kg-m (25 to 29 ft-lbs)

Set bolt: 4 to 5.3 kg-m (29 to 38 ft-lbs)
(Do not tighten them excessively. Or, the spool malfunction may occur.)

A: From CHARGING PUMP
B: To SPRING CHAMBER
T: To TORQUE CONVERTER (DRAIN PORT)

1. CAP
2. PIN
3. "O"-RING
4. COLLAR
5. SEAL PLATE
6. HOUSING
7. SLEEVE
8. SPRING
9. BALL
10. SPOOL
11. SEAL
12. WIPER

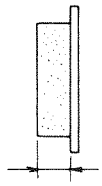
Fig. 32.5 Hand Valve

32.5 CHECK AND ADJUSTMENT

32.5.1 CHECK OF PAD WEAR

Periodically remove the pads and measure their thickness. When a pad has worn out to its use limit, replace a pair of pads with new one.

Note: The pad removal and replacement procedure is described in 32.4.2 "DISASSEMBLING AND ASSEMBLING".)

Item	Maintenance standard (mm)	Use limit (mm)
Thickness of Pad 	10.5	3.8

32.5.2 CHECK AND ADJUSTMENT OF PAD CLEARANCE

The stroke of brake caliper lever changes if the pad has worn out. Adjust the pad clearance depending on wear of pad.

1. Check

Fit the safety link to the frame, and block the wheels to stabilize the machine.

① Start the engine.
② Press in the hand valve knob to release the parking brake.
③ Make sure that the brake caliper lever is loose and the disc brake has been released.
If the brake caliper lever is not loose, adjust the pull cable length. (Refer to 32.5.3 "ADJUSTMENT OF PULL CABLE".)
④ Insert a thickness gauge between the brake disc and pad to measure the clearance. If the measured clearance is larger or smaller than the maintenance standard, adjust the clearance.

Note: Measure the clearance at both sides of brake disc.

Item	Maintenance standard (mm)
Clearance between Brake Disc and Pad	(At one side) 0.15; (Total of both sides) 0.3

④ Stop the engine.

2. Adjustment

① Start the engine.
② Press in the hand valve knob to release the parking brake.
③ Disconnect the brake caliper lever link from the pull cable clevis.

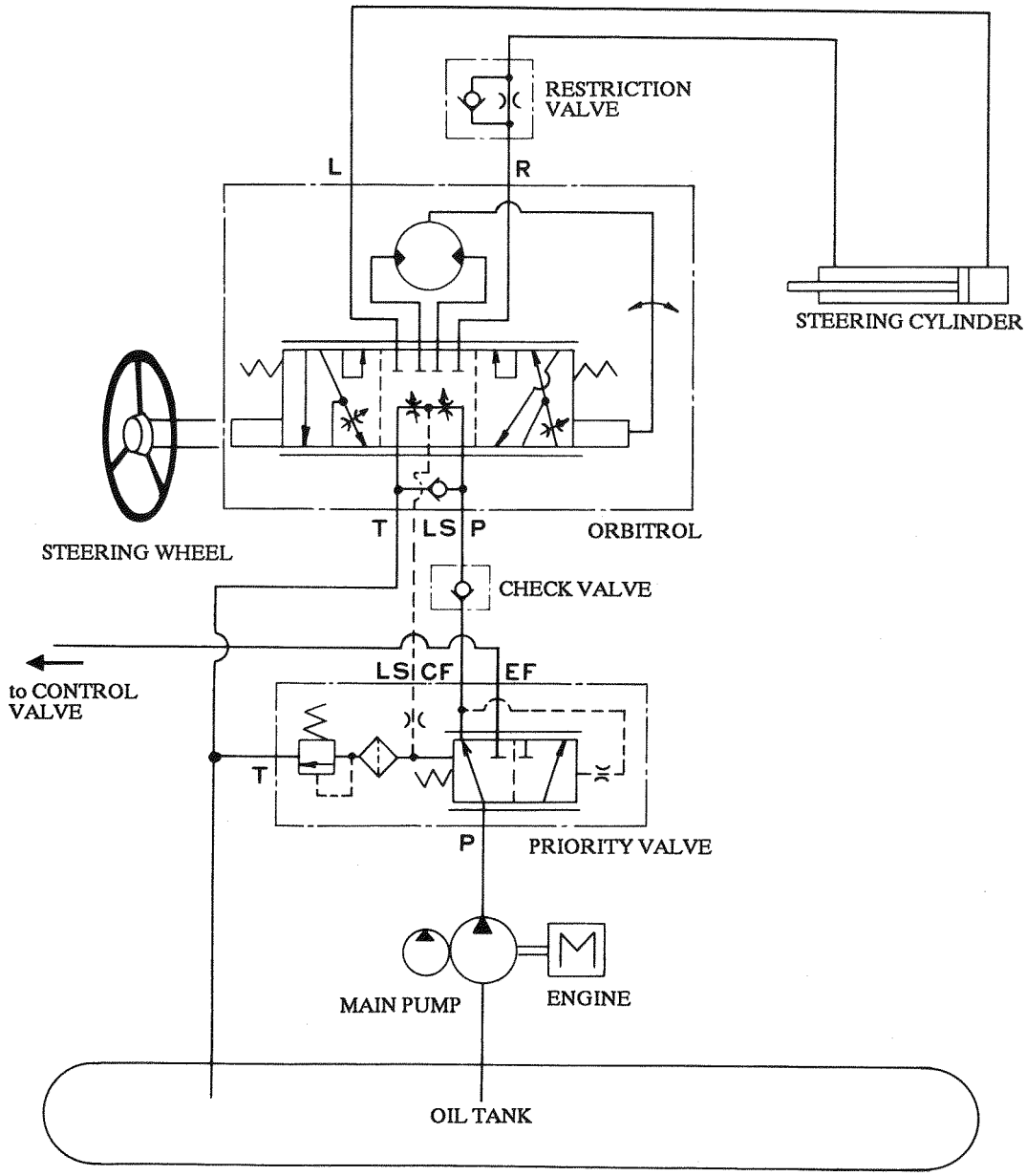


Fig. 41.3 Hydraulic Circuit Diagram

2. Parts for Piping

(1) Check Valve Connector

A check valve is provided in the P port nipple of the Orbitrol. This check valve functions as follows. When the steering wheel is turned clockwise, and the steering cylinder reaches its stroke end, the pressure at the R port side of the Orbitrol is increased to the relief setting pressure. If in this state, the steering wheel is released, the whole system restores the neutral state. But high pressure oil may remain in the R port, since the cylinder port side is blocked.

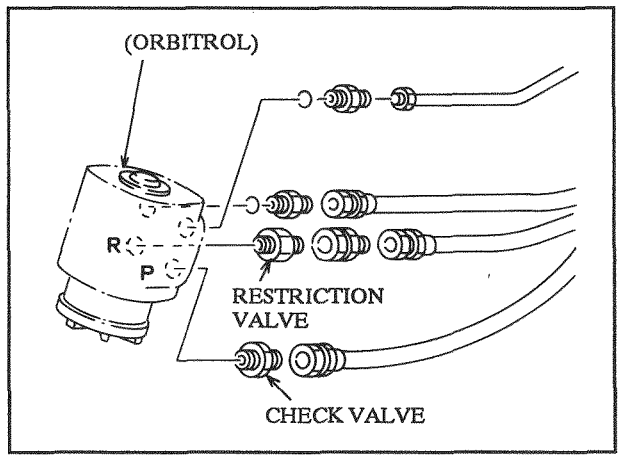
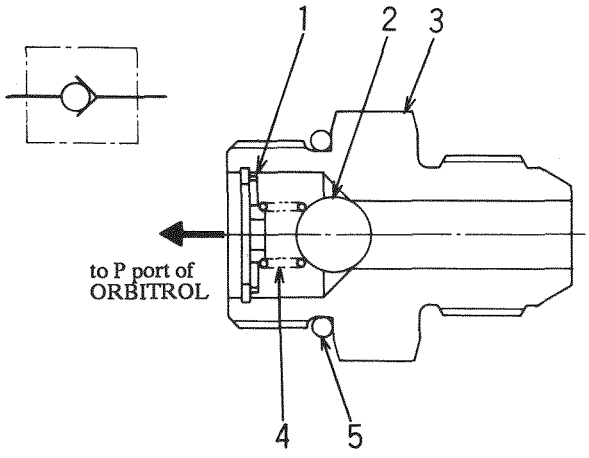


Fig. 41.20

Next, when the steering wheel is slowly turned clockwise, namely in the same direction as that mentioned above, the R port of Orbitrol is connected to the P port through the rotor. The rotor is immediately rotated by residual pressure in the P port, so that oil flows back to the P port.

As the rotor is mechanically connected to the steering wheel through the internal parts of the Orbitrol the steering wheel tends to be rotated in reverse direction (counterclockwise), opposite to steering direction (clockwise). The check valve is provided in the P port of the Orbitrol to prevent such a reverse turn.



1. SPRING PLATE
2. BALL
3. BODY
4. SPRING
5. "O"-RING

Fig. 41.21 Check Valve Connector

Operation of Load Sensing System

The load sensing system is designed to feed to the Orbitrol only the oil (supplied from the main pump) required for steering, but it sends unnecessary oil to the hydraulic system (control valve).

If the steering wheel is in neutral position, the oil discharged from the main pump is mostly sent to the control valve and is used to operate the working equipment. Therefore, the discharged oil from the main pump is effectively used, thereby ensuring energy saving in the whole hydraulic system of the machine.

1. Steering Wheel in Neutral (Engine Stopped)

When the engine is at rest, the spool (1) of the priority valve is pushed to the left by the control spring (2), so that the CF port is opened fully and the EF port is closed completely.

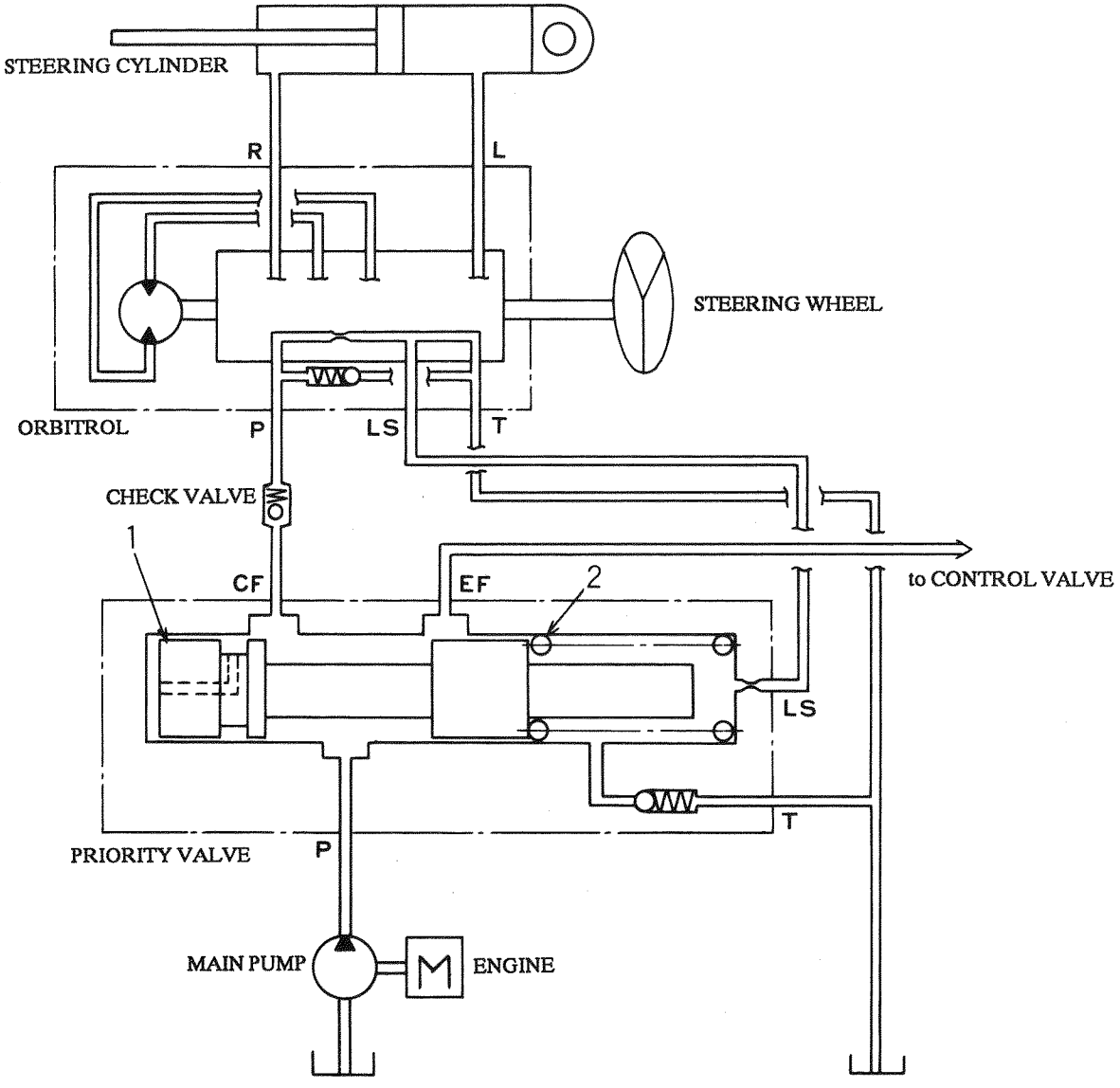


Fig. 41.42 Steering Wheel in Neutral (Engine Stopped)

3. Assembling

(1) Installation of Pin Bushing

① Press-fit the pin bushing into the boss center of cylinder tube (piston rod).

② Fit the dust seal to the upper and lower parts of bushing.

Note: The dust seal lip must be outward.

(2) Assembling of Cylinder Head

① Fit the back-up ring and "O"-rings (2 pcs.) into the grooves at the outer periphery of cylinder head.

Note: When the "O"-ring and back-up ring are as a pair, fit the "O"-ring at the pressurized side.

"O"-ring: Grease

② Press-fit the bushing into the cylinder head, and secure it with snap ring.

③ Press-fit the dust seal to the inner periphery of cylinder head.

④ Fit the back-up ring and U-ring into the U-ring groove in this order.

⑤ Fit the lock washer to the outer periphery of cylinder head.

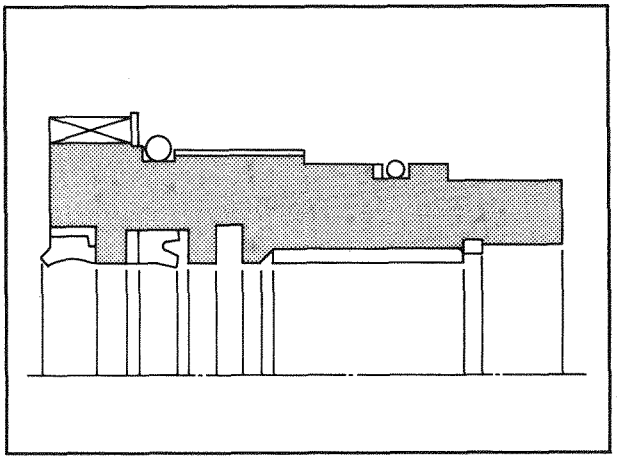


Fig. 41.57

(3) Assembling of Piston

① Fit the seal ring assembly ("O"-ring and seal ring) to the piston.

Note: When fitting, take care not to damage the seal ring.

② Fit the slide rings (2 pcs.) to the piston.

(4) Assembling of Piston Rod

① Fit the piston rod to the hydraulic cylinder repair stand, and insert the cylinder head.

Note: Take care so that the seals fitted to the inner periphery of cylinder head are not caught by the stepped section of piston rod.

② Fit the piston to the piston rod, and tighten the U-nut.

U-nut: 33 kg-m (240 ft-lbs)

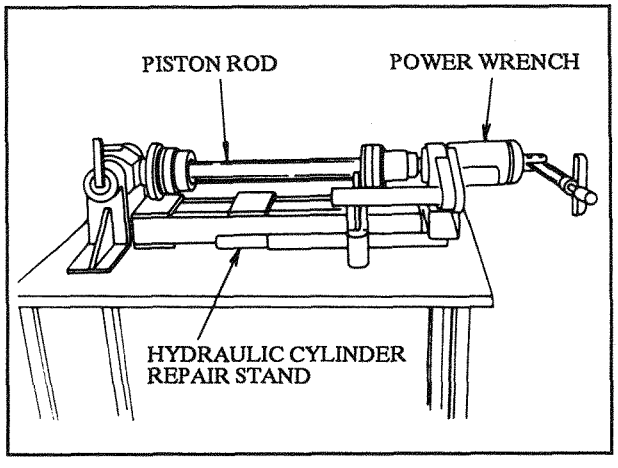


Fig. 41.58

The cylinder head slides freely on the piston rod. Therefore, when handling the assembled piston rod, take care so that your finger is not injured.

④ Remove the lower hinge pin set bolts, and remove the set plates (1 in Fig. 51.6).
⑤ Remove the lower hinge pin snap ring (2).
⑥ Remove downward the lower hinge pin (3).

When removing the pin, make sure the front and rear frames have been firmly secured, and take care not to disturb the balance.

⑦ Remove the thrust washer (4), seal, and shim (5).

Take care not to pinch your finger in the machine. Use a rod or the like for removal.

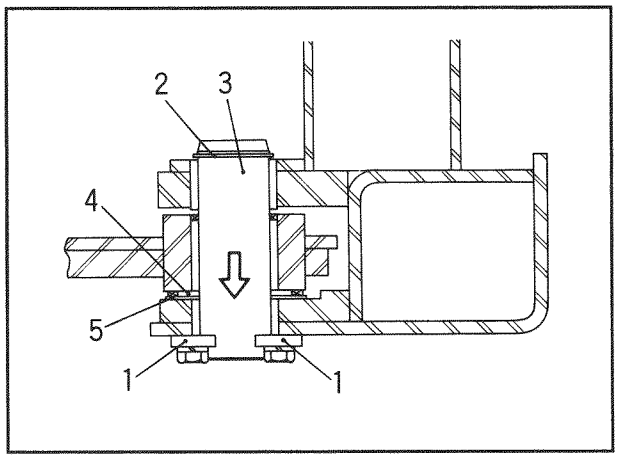


Fig. 51.6 Lower Hinge

(2) Removal of Bushing

① After having removed the upper and lower hinge pins, move the front frame to remove the bushings.
② Remove the bushings and dust seals from the front frame upper and lower hinges.

When removing the bushings, take due care not to disturb the balance of the machine.

③ Remove the bushings from the rear frame upper and lower hinges.

3. Assembling

(1) Fitting of Bushing

① Press-fit the bushings (4 pcs.) into the rear frame upper and lower hinges.

Notes 1: There are two types of bushings. For the lower hinge (lower), use the bushing 26.5 mm long. For the other parts, use the bushings 34.5 mm long.

2: Make sure the bushing does not extend to the thrust washer (or shim) fitting face. Press-fit the bushing flush with the boss.

② Press-fit the bushings (2 pcs.) and dust seals (2 pcs.) into the front frame upper and lower hinges.

Notes 1: Make sure the bushing does not extend to the thrust washer fitting face. Press-fit the bushing flush with the boss.

2: Mount the dust seals at the side opposite to the thrust washer. Direct the seal lip outward (toward the direction opposite to the bushing).

③ Apply grease to the inner surface of all the bushings.

Inner surface of bushing: Grease

(2) Fitting of Hinge Pin

① Move the front frame to align the rear frame with the upper and lower hinge pin holes.

When aligning the frame with the pin holes, do not insert your finger into the holes. Use a rod or the like.

② Insert tentatively a proper dummy pin (thinner than regular one) into the upper hinge pin hole.
③ Fit the thrust washer, seal, and shim (1 mm in thickness) to the lower hinge.

Note: Fit them in the correct positions (see Fig. 51.2).

Take care not to pinch your finger.

3. Adjustment

First stop the engine before adjusting the oil pressure.

① Loosen the lock nut of main relief valve.
② Turn the adjust screw to adjust the relief pressure.

Note: If the pressure is lower than the specified value, turn the adjust screw clockwise; if higher, turn it counter-clockwise.

③ After adjustment, tighten the lock nut to lock the adjust screw.
④ Check the adjusted pressure. If the pressure is improper, adjust it again.

Note: Since the relief valve is highly sensitive, be sure to check the adjusted pressure.

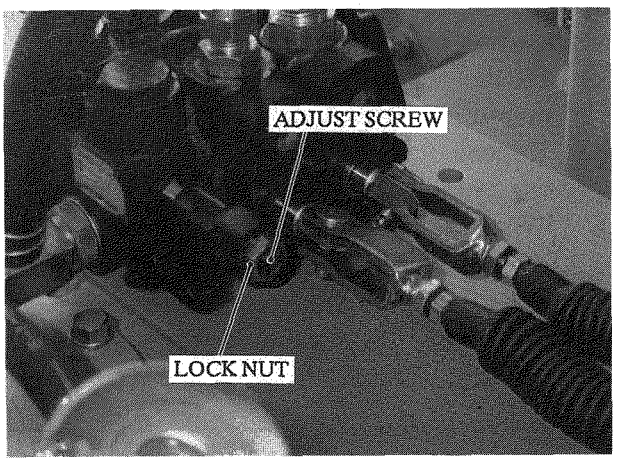


Fig. 61.5 Main Relief Valve

61.2.2 CHECK AND ADJUSTMENT OF PORT RELIEF PRESSURE (OVERLOAD RELIEF PRESSURE)

1. Check

1. Park the machine on the horizontal place, lower the bucket down to the ground, and stop the engine.

2. Loosen the cap of oil tank to release the internal pressure, and operate the loading/unloading lever forward and backward, to the right and left, several times to release the residual pressure of piping. Block the wheels.

① Remove the front frame front cover.
② Remove the port relief valve from the control valve.

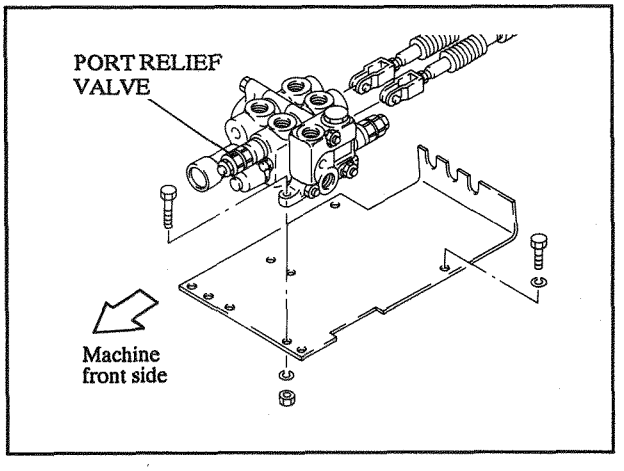


Fig. 61.6

④ Fit the plate seal and back-up ring to the pressure plate groove to prevent them from protruding above the outer periphery.

Note: Fit the back-up ring in the proper direction.

⑤ Fit the pressure plate to the bottom of gear plate, with its copper-alloy side upward.

Note: Fit the pressure plate, correctly arranging its inlet and outlet sides (see Fig. 62.2).

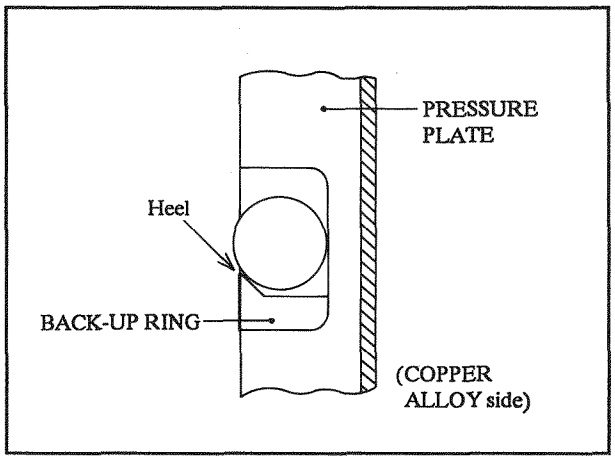


Fig. 62.13

⑥ Fit the drive gear and driven gear, mating the match-mark put on them when they are disassembled. After fitting the gears, pour approximately 5 cc of the hydraulic oil into the tooth groove.

⑦ Mount the pressure plate with the copper-alloy side downward, correctly arranging its inlet and outlet sides (see Fig. 62.2).

⑧ Fit the plate seal and back-up ring into the groove of pressure plate.

⑨ Fit the "O"-ring into the groove of gear plate.

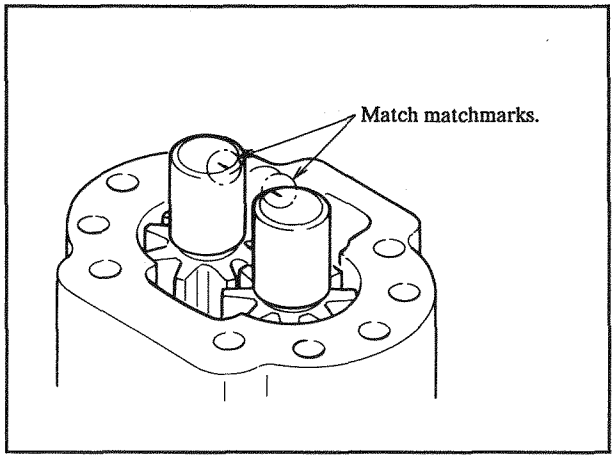


Fig. 62.14

⑩ Put the cover plate on the gear plate.

Note: If the cover plate cannot be pressed in completely, with 3 mm or so being left outside, this implies that the seal or "O"-ring has not been fitted in the correct position. In this case, once disassemble, and then assemble again.

⑪ Tighten the cover plate set bolts (4 pcs.).

Cover plate set bolt: 15 kg-m (108 ft-lbs)

Thread: Machine oil

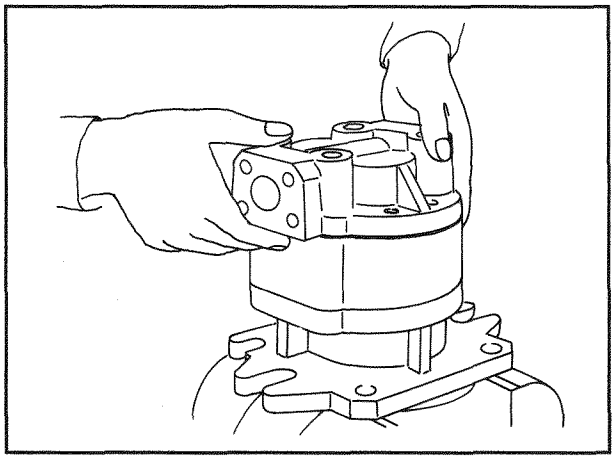


Fig. 62.15

3. Boom Spool Operation

(1) Raise and Down

The oil passage in the boom spool section is identical with that in the bucket spool section. Therefore, the boom raising operation is identical with bucket roll-back operation whereas the boom lowering operation is identical with bucket dump operation. For details of boom spool operation, see the pertinent sections of the bucket spool operation.

Note: Hydraulic oil is not supplied to the boom spool section unless the bucket spool is in neutral since the passage in the control valve is tandem circuit. (The boom cylinder is not actuated.)

(2) Float

When the control lever is further pushed down from the "Down" position to the "Float" position, the boom spool is moved as indicated by arrow in illustration. Due to this motion the neutral passage is opened. Hydraulic oil flows as in neutral position. The cylinder ports (A2) and (B2) are connected to the low pressure oil passage. As a result, the booms float over the ground surface according to its irregularities, oil discharged from the boom cylinder rod side is sent to the tail side and the oil forced out from its tail side is sent to rod side respectively through the low pressure oil passage in the control valve.

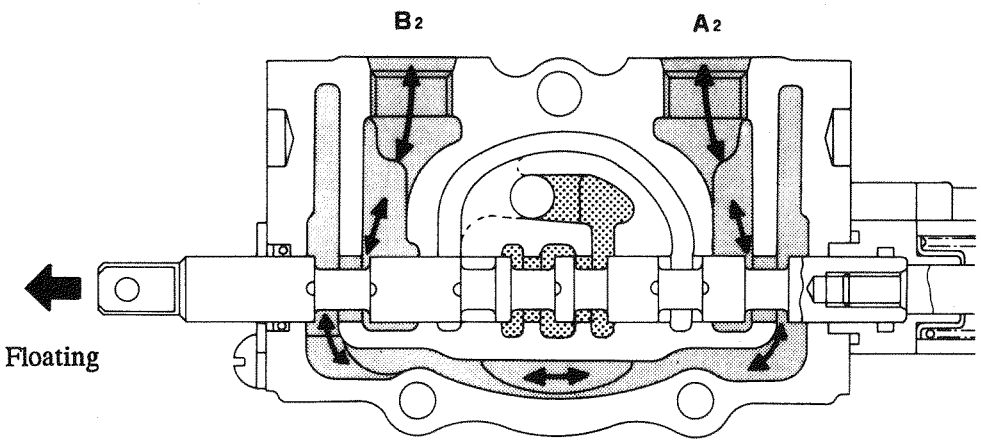


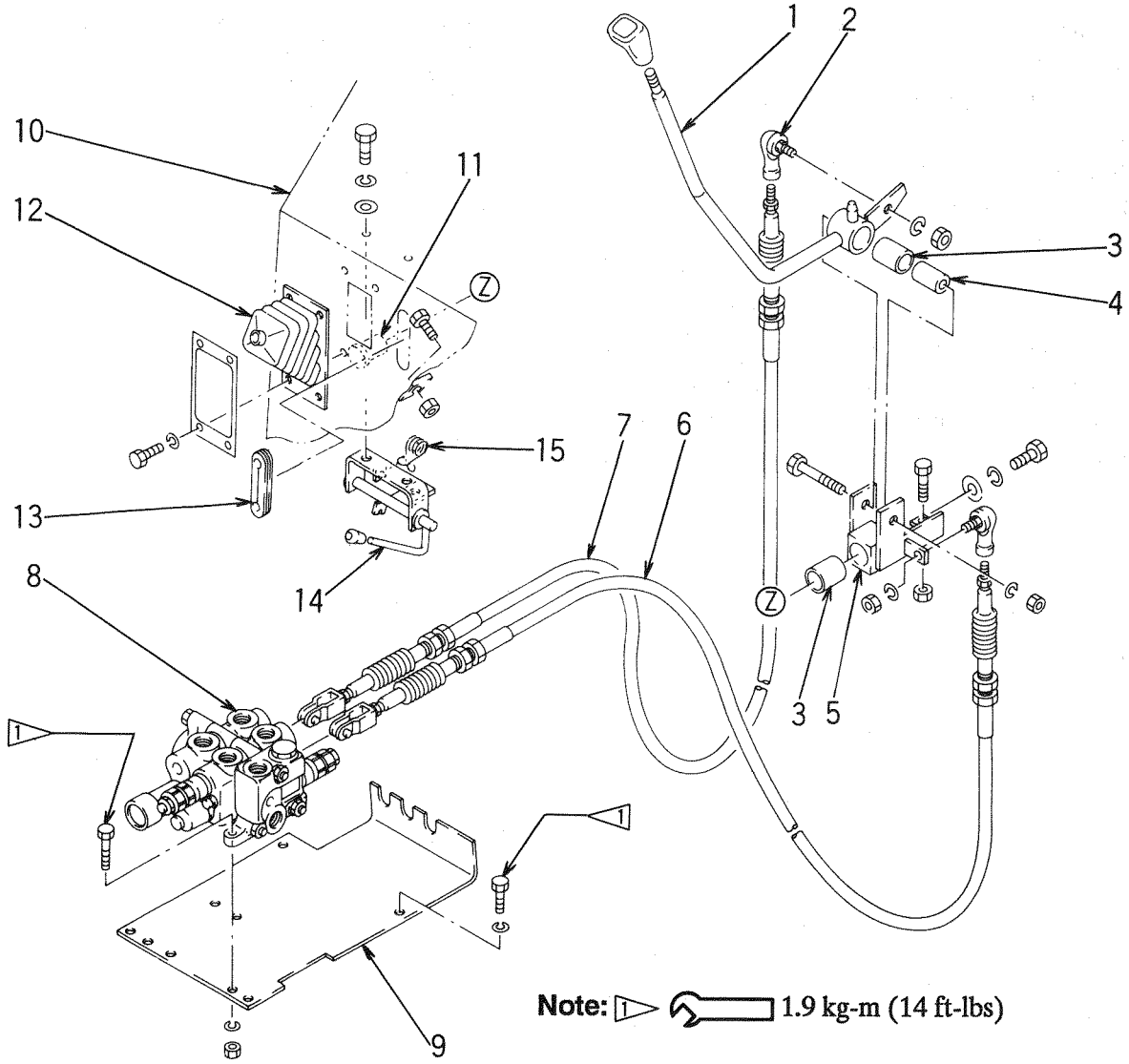
Fig. 63.7 Boom in Floating

63.5 VALVE OPERATION SYSTEM

63.5.1 OUTLINE

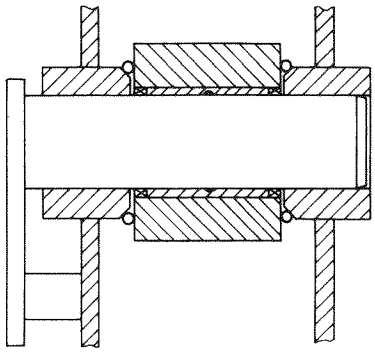
The valve operation system uses a single lever (i.e. control lever). When the control lever is operated, that operating force causes the spool in the control valve to slide by way of the cable: Operating the control lever back or forth brings the boom spool into motion and operating it right or left bring the bucket spool into action.

⚠ The stopper link is provided as a safety device for valve operation. When the machine is not used for load handling operation, be sure to operate the stopper link to fix the control lever in neutral position.

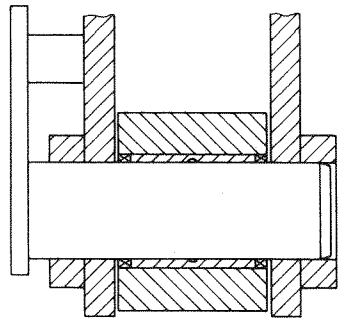


1. CONTROL LEVER
2. BALL JOINT
3. BUSHING
4. PIN
5. BOSS
6. CONTROL CABLE (for bucket)
7. CONTROL CABLE (for boom)
8. CONTROL VALVE
9. BRACKET
10. (SEAT SUPPORT)
11. (PIN)
12. BOOTS
13. COVER
14. STOPPER LINK
15. SPRING

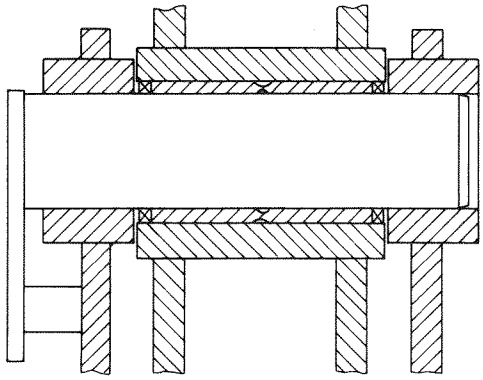
Fig. 63.23 Valve Operation System



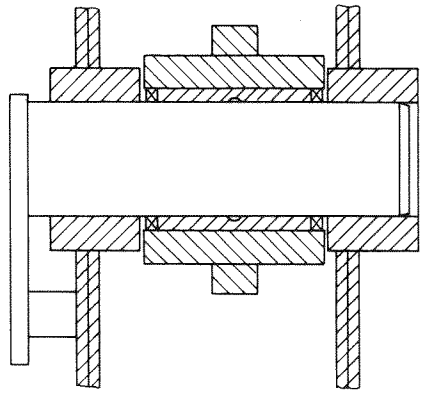
Structure of Part A



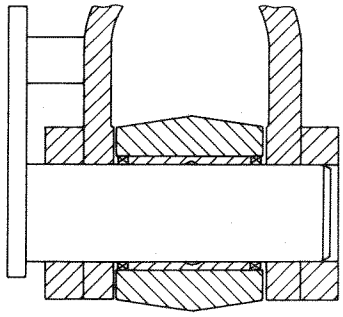
Structure of Part B



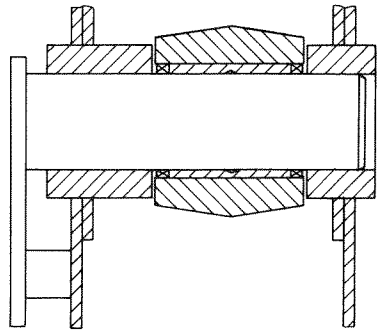
Structure of Part C



Structure of Part D



Structure of Part E



Structure of Part F

Fig. 71.3 Boom, Bucket and Push Rod (2/2)

71.5.2 LOADING SPEED OF LOADING SYSTEM

1. Boom Rising Time

① Check the oil level in the oil tank, and maintain the hydraulic oil temperature at 55 to 65°C.

② Charge the bucket with a working load, like sand, stop the machine on the horizontal place, and apply the parking brake.

③ Tilt the bucket fully backward, and hold the engine at high-idling speed.

④ Raise the boom by operating the loading/unloading lever to measure the time required to raise the bucket from its lowest position to the highest position.

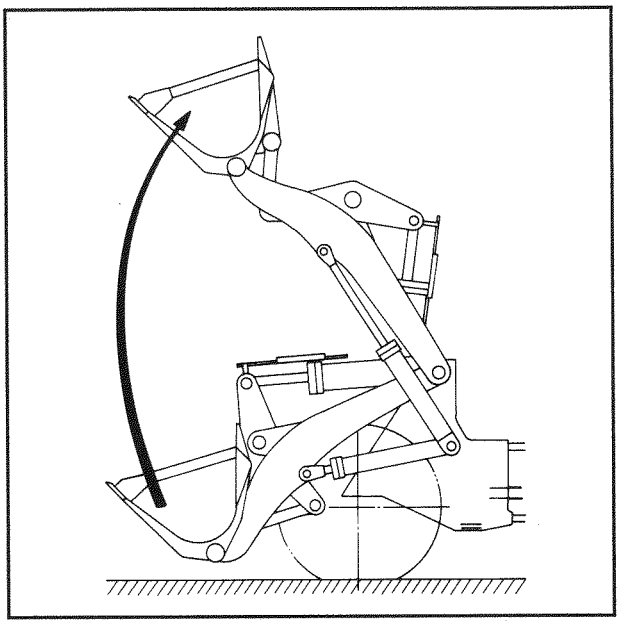


Fig. 71.20

Item		Maintenance standard (s)	Use limit (s)	Remarks
Boom Rising Time (loaded)	815-2	5.4	6.6	Load 815-2: 980 kg 820-2: 1300 kg
	820-2	5.4	6.6	

⑤ If the measured boom rising time is longer than the use limit, failure exists in the hydraulic circuit. Check for oil leak from the hydraulic hoses and pipings, check main relief pressure of control valve, check for oil leak from the boom cylinder, check discharge of main pump, and check the priority valve. If any abnormality is found, repair or replace the defective part.

2. Bucket Forward Tilting Time

① Check the oil level in the oil tank, and maintain the hydraulic oil temperature at 55 to 65°C.

② Stop the machine on the horizontal place, and apply the parking brake.

③ Unload the bucket, raise the boom up to the maximum lift height, and tilt the bucket fully backward.

④ Hold the engine at high-idling speed.

⑤ Operating the loading/unloading lever, measure the time required to move the bucket from the most backward position to the most forward position.

Item		Maintenance standard (s)	Use limit (s)
Bucket forward Tilting Time (unloaded)	815-2	1.0	1.2
	820-2	1.0	1.2

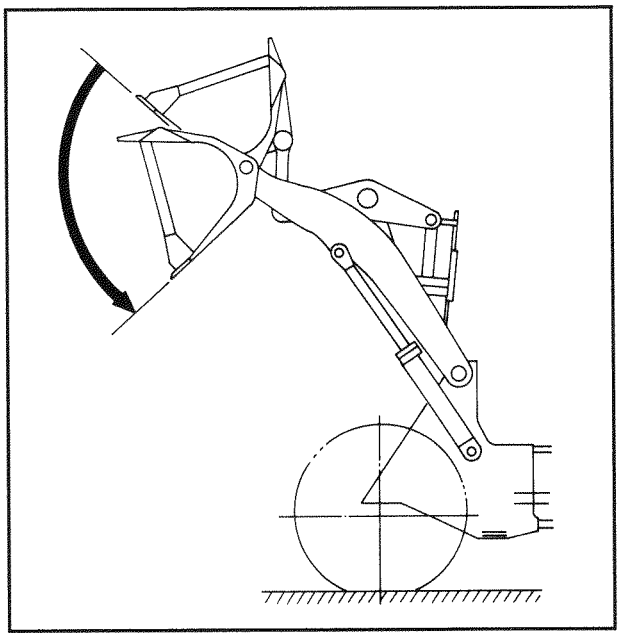


Fig. 71.21

⑥ Disconnect the hydraulic hoses (2 pcs.) led to the boom cylinder.
⑦ Contract the boom cylinder piston rod, and secure it with a wire.
⑧ Remove the boom cylinder tail connecting pin.

When pulling out the pin, do not insert your finger into the pin hole. Use a rod or the like.

⑨ Hang the boom cylinder to remove it from the machine.

Boom cylinder: 35 kg

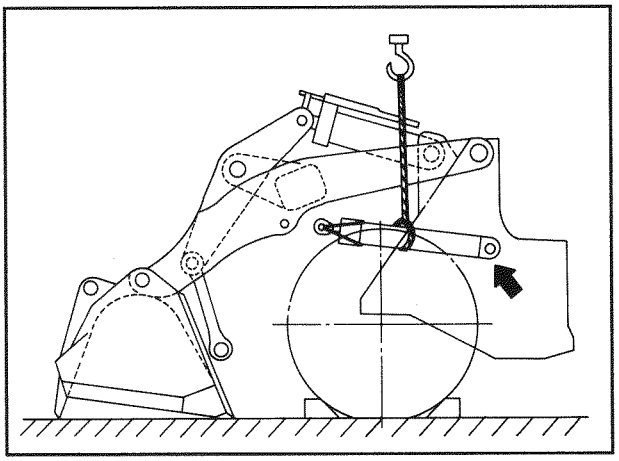


Fig. 72.5

2. Installation

Mount the boom cylinder in the reverse order of removal.

When aligning the pin holes of parts, do not insert your finger into the pin hole. Use a rod or the like.

Connecting pin and boss: Grease

72.2.2 BUCKET CYLINDER

1. Park the machine on the horizontal place, and fit the safety link to the frame.
2. Apply the parking brake, and lower the bucket down to the ground, and stop the engine.
3. Loosen the cap of oil tank to release the internal pressure, and operate the loading/unloading lever forward and backward, to the right and left, several times to release the residual pressure of pipings. Block the wheels.

1. Removal

① Sling the bucket cylinder with a belt to tentatively hang it with a hoist.
② Disconnect the hydraulic hoses (2 pcs.) led to the bucket cylinder.
③ Remove the bucket cylinder rod connecting pin.

When pulling out the pin, do not insert your finger into the pin hole. Use a rod or the like.

④ Contract the bucket cylinder piston rod, and secure it with a wire.

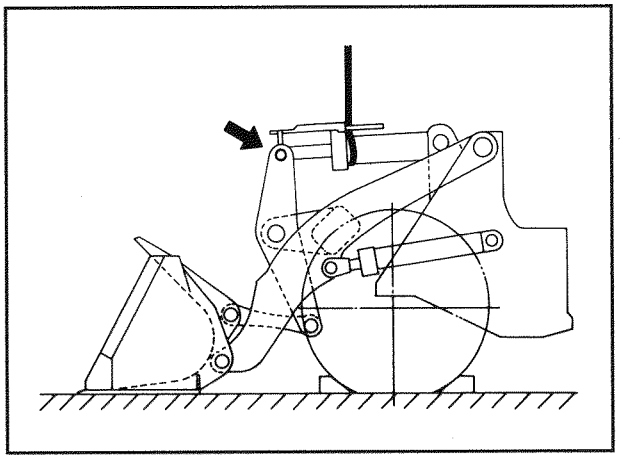


Fig. 72.6

Problem	Possible cause	Service required	Remedy
Boom rise is accompanied by jerking or shaking	Hydraulic oil lack	Check oil level in oil tank	Replenish oil up to specified level
	Cavitation in main pump	Check negative pressure valve of oil tank cap	Replace cap
	Aeration of main pump	Check for bubbling in oil tank	Check and repair suction piping
	Piston rod of boom cylinder is bent	Check for bend of piston rod	Replace
	Boom distorted	Measure deformation at both sides of boom	Repair or replace
Boom lowering is accompanied by jerking or shaking	Resonance of valve lever and spool	Check for play of linkage	Adjust, or replace pin and bushing
Spontaneous drop of boom or bucket	Internal leak in control valve	Measure cylinder drift	Replace assembly
	Oil leak from piston packing of boom cylinder	Measure cylinder drift	Replace parts
	Oil leak from piston packing of bucket cylinder		
Noise: From main pump	Cavitation in main pump	Check negative pressure valve of oil tank cap	Replace cap
	Aeration in main pump	Check for bubbling in oil tank	Check and repair suction piping
	Internal damage in main pump	Check aurally	Replace
	Main pump sleeve worn	Check aurally	Replace sleeve
From relief valve	Too high setting pressure of relief valve of control valve	Measure relief pressure	Adjust
Due to vibration of piping	Pipe line is loose	Check tightness	Retighten
	Aeration in piping of hydraulic line	Sounding check, check for bubbling in oil tank	Check and repair suction piping
	Cavitation in piping of hydraulic line	Sounding check, check negative pressure valve of oil tank cap	Replace cap

81.3 ELECTRIC CIRCUIT DIAGRAM

Notes:

1. Cord sizes
   Example: "AV 1.25" indicates a low voltage wire for automobiles (AV) and a nominal sectional area of 1.25 mm^2.

2. Colors of cords
   The colors of cords are represented by the abbreviations. The first letter of the combination color code indicates the ground color, whereas the second letter indicates the marking color.

B : Black	BW : Black & White	BY : Black & Yellow	BR : Black & Red	BG : Black & Green	BL : Black & Blue
W : White	WR : White & Red	WB : White & Black	WL : White & Blue	WY : White & Yellow	WG : White & Green
R : Red	RW : Red & White	RB : Red & Black	RY : Red & Yellow	RG : Red & Green	RL : Red & Blue
G : Green	GW : Green & White	GR : Green & Red	GY : Green & Yellow	GB : Green & Black	GL : Green & Blue
Y : Yellow	YR : Yellow & Red	YB : Yellow & Black	YG : Yellow & Green	YL : Yellow & Blue	YW : Yellow & White
Br : Brown	BrW : Brown & White	BrR : Brown & Red	BrY : Brown & Yellow	BrB : Brown & Black	
L : Blue	LW : Blue & White	LR : Blue & Red	LY : Blue & Yellow	LB : Blue & Black	LG : Blue & Green
Lg : Light Green	LgR : Light green & Red	LgB : Light green & Black	LgW : Light green & White		
P : Pink					
O : Orange					
Gr : Gray					

⚠ Before servicing the electrical system or replacing the electrical parts, be sure to remove the battery terminals. For the removal of the battery terminals, remove the negative terminal at ground in order not to allow electric current to flow. Then remove the other terminal.