

Z45/450Z

Form No.
50940111
Revision A
Oct. 2012

Compact Excavator



Service Manual

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GENERAL CAUTIONS FOR MAINTENANCE WORK

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1. GENERAL CAUTIONS FOR MAINTENANCE WORK

(2) Special Parts

| Description | Hose | P | 2 | 06 | AB | 075 | W | _ |
|-------------------|------|---|---|----|----|-----|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

1 Part name

2 Hose material

- Rubber hose G
- Wear-resistant high pressure rubber hose H
- Plastic hose P
- Wear-resistant plastic hose..... F

3 Recommended working pressure PSI(Mpa)

Over 2986 (20.6) 1

2489 to 2986 (17.2 to 20.6) 2

1991 to 2489 (13.7 to 17.2) 3

1564 to 1991 (10.8 to 13.7) 4

995 to 1564 (6.9 to 10.8) 5

427 to 995 (2.9 to 6.9) 6

213 to 427 (1.5 to 2.9) 7

Below 213 (1.5) 8

4 Nominal dia. (inch)

1 / 8" 02

3 / 16" 03

1 / 4" 04

3 / 8" 06


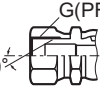
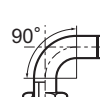
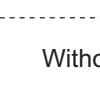
1 / 2" 08

5 / 8" 10

3 / 4" 12

1" 16

5 Combination of fitting

| Fitting type | Code |
|--|------|
|  <p>R(PT) Taper pipe thread R (PT)</p> | A |
|  <p>G(PF) Straight pipe thread G (PF) with male 30 degrees seat</p> | B |
|  <p>90° bent type. Straight pipe thread G (PF) with male 30 degrees seat</p> | C |
|  <p>Without fitting</p> | Y |

* For the combination of fitting, refer to the list on the following page.

6 Total length (Unit : cm)

7 Hose protector

- Coil spring W
- Coil tube S
- Wire braid B
- Tube (Rubber) R
- Tube (Vinyl) V
- Sponge rubber P
- Hose cover K
- No protection Blank

8 Other accessories

- No accessories...Blank
- O-ring 1

The example hose, P 2 06 AB 075 W stands for :

2 3 4 5 6 7

- 2 Material : Plastic
- 3 Working pressure : 2489 to 2986 PSI (17.2 to 20.6 MPa)
- 4 Nominal dia. : 3 / 8"
- 5 Fitting type : Taper pipe thread R (PT) and straight pipe thread G (PF) with male 30 degrees seat.
- 6 Length : 29.5 in. (75 cm)
- 7 Hose protector : Coil spring

List of pipe threads

| Symbol | Name |
|---------|--------------------------|
| G (PF) | Straight pipe thread |
| R (PT) | Male taper pipe thread |
| Rc (PT) | Female taper pipe thread |

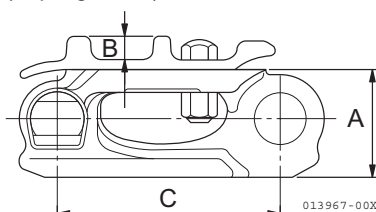
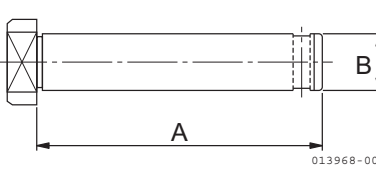
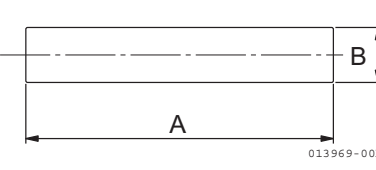
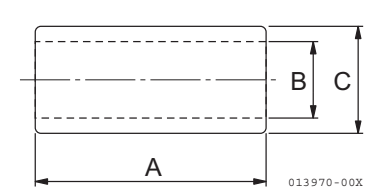
2. TECHNICAL DATA

| Item | Unit | Z45 - 450Z | | |
|--|---------------------------|--|----------|-----------------------------------|
| Engine | | | | |
| Main specifications | | | | |
| Engine model | | 4TNV88-BXBV | | |
| Type | | Vertical type series water-cooled 4 cycle diesel engine | | |
| Combustion system | | Direct injection | | |
| Number of cylinders - Bore×Stroke | pcs. - in.×in. (mm×mm) | 4 - 3.46×3.54 (88×90) | | |
| Total displacement | cu.in. (cu.cm) | 133.5 (2189) | | |
| Rated output / engine speed | HP/rpm (KW/rpm) | 38.7/2400 (28.8/2400) | | |
| Maximum torque / engine speed | ft•lbf/rpm (N•m/rpm) | 99.4 to 108.2/1200 134.8 to 146.7/1200 | | |
| Specific fuel consumption | lbs./HP•h (g/kW•h) | 0.406 (247) | | |
| Maximum idling speed | rpm | 2575 to 2625 | | |
| Minimum idling speed (engine unit) | rpm | 1125 to 1175 | | |
| Engine dry mass (excluding air cleaner and silencer) | lbs. (kg) | 375 (170) | | |
| Lubricating method | | Forced lubrication by trochoid pump | | |
| Specific lubricating oil consumption | lbs./HP•h (g/kW•h) | 0.0009 or less (0.544 or less) | | |
| Compression pressure | PSI (MPa) | 497.7 (3.4) at 250 rpm | | |
| Cylinder head | | | | |
| Intake valve | Open | bTDC | degrees | 10 to 20 |
| | Close | aBDC | degrees | 40 to 50 |
| Exhaust valve | Open | bBDC | degrees | 51 to 61 |
| | Close | aTDC | degrees | 13 to 23 |
| Intake valve clearance (Cold engine) | | | in. (mm) | 0.0059 to 0.0098 (0.15 to 0.25) |
| Exhaust valve clearance (Cold engine) | | | in. (mm) | 0.0059 to 0.0098 (0.15 to 0.25) |
| Intake valve seat angle | | | degrees | 120 |
| Exhaust valve seat angle | | | degrees | 90 |
| Piston | | | | |
| First compression ring | Ring shape | | | Barrel face (chrome-plated) |
| | Ring quantity | | pcs. | 4 |
| Second compression ring | Ring shape | | | Taper face (inner cut) |
| | Ring quantity | | pcs. | 4 |
| Oil-ring | Ring shape | | | Bevel cutter (with coil expander) |
| | Ring quantity | | pcs. | 4 |
| Governor | | | | |
| Name | | | | Mechanical all speed type |
| Type | | | | Centrifugal type |

3. SERVICING STANDARDS

3-3-2 Steel Track Specifications

[Unit : in. (mm)]

| Applicable model | | | |
|---|--------------------|----------------|----------------|
| Part | Measuring position | Standard | Wear limit |
| Steel track specifications | | | |
| (1) Track link (Triple grouser)  Note : For the link pitch, measure 5 links at three places and obtain the | A | 2.64 (67) | 2.52 (64) |
| | B | 0.55 (14.0) | 0.35 (9.0) |
| | C | 5.32 (135.0) | 5.37 (136.5) |
| (2) Master pin  | A | 4.49 (114) | – |
| | B | Ø0.87 (Ø22.16) | Ø0.77 (Ø19.63) |
| (3) Pin  | A | 4.73 (120.2) | – |
| | B | Ø0.88 (Ø22.3) | Ø0.79 (Ø20.1) |
| (4) Bush & master bush  | A | 2.89 (73.5) | – |
| | B | Ø0.89 (Ø22.5) | Ø0.95 (Ø24.1) |
| | C | Ø1.38 (Ø35) | Ø1.31 (Ø33.2) |

CHAPTER 4

ENGINE

| | | | |
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4-2 Troubleshooting

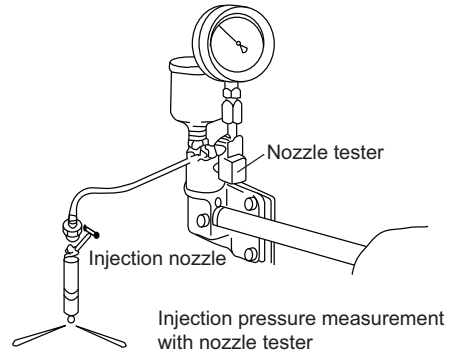
4-2-1 Quick Reference Table for Troubleshooting

The following table summarizes the general trouble symptoms and their causes. If any trouble symptom occurs, take corrective action before it develops into a serious problem so as not to shorten the engine service life.

| Cause | Trouble symptom | Starting failure | | | Insufficient engine output | | | Poor exhaust color | | High knocking sound during combustion | Abnormal engine sound | Uneven combustion sound | Hunting | | | Difficulty in returning to low speed | Excessive fuel consumption | Lubricating oil | | | | Much blow-by gas | Cooling water | | Air intake | | Exhaust temperature rise | Corrective action | |
|---------------|---|--------------------------|------------------------------|--------|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|---------------------------------------|--------------------------|-------------------------|--------------------------|--------------------------|--------------------------|--------------------------------------|----------------------------|--------------------------|--------------------------|--------------------|--------------------------|--------------------------|--------------------------|--------------------------|-----------------------------|--|--------------------------|-------------------|-------|
| | | Engine does not start | Engine starts but stops soon | | | Exhaust color | | | During work | | | | During idling | During work | Large engine vibration | | | Excessive consumption | Dilution by fuel oil | Mixture with water | Low L.O. pressure | | Overheat | Low water temperature | Pressure drop | Pressure rise | | | |
| | | | None | Little | Much | Ordinary | White | Black | White | | | | | | | | | | | | | | | | | | | | Black |
| Engine system | Improper clearance of intake/exhaust valve | <input type="checkbox"/> | <input type="checkbox"/> | | <input type="checkbox"/> | | | | | <input type="checkbox"/> | | | | | | | | | | | | <input type="checkbox"/> | <input type="checkbox"/> | | Adjust the valve clearance. | | | | |
| | Compression leakage from valve seat | | | | <input type="checkbox"/> | | <input type="checkbox"/> | | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | <input type="checkbox"/> | | | | | | <input type="checkbox"/> | <input type="checkbox"/> | | Lap the valve seat. | | | | |
| | Seizure of intake/exhaust valve | <input type="checkbox"/> | | | <input type="checkbox"/> | | <input type="checkbox"/> | | <input type="checkbox"/> | | <input type="checkbox"/> | | <input type="checkbox"/> | <input type="checkbox"/> | | | <input type="checkbox"/> | | | | | <input type="checkbox"/> | | | | Correct or replace. | | | |
| | Blowout from cylinder head gasket | | | | <input type="checkbox"/> | | | | | | | | | | | | | | <input type="checkbox"/> | | <input type="checkbox"/> | | | | | Replace the gasket. | | | |
| | Seized or broken piston ring | <input type="checkbox"/> | | | <input type="checkbox"/> | | <input type="checkbox"/> | | <input type="checkbox"/> | | <input type="checkbox"/> | | <input type="checkbox"/> | <input type="checkbox"/> | | | <input type="checkbox"/> | <input type="checkbox"/> | | | <input type="checkbox"/> | <input type="checkbox"/> | | <input type="checkbox"/> | | Replace the piston ring. | | | |
| | Worn piston ring, piston or cylinder | <input type="checkbox"/> | | | <input type="checkbox"/> | | <input type="checkbox"/> | | | | | | | | | | <input type="checkbox"/> | <input type="checkbox"/> | | | <input type="checkbox"/> | | | | | Perform honing and use oversize parts. | | | |
| | Seized crankpin metal or bearing | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | <input type="checkbox"/> | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | <input type="checkbox"/> | | | | | Repair the replace. | | | |
| | Improper arrangement of piston ring joints | | <input type="checkbox"/> | | | | <input type="checkbox"/> | | | | | | | | | | <input type="checkbox"/> | | | | <input type="checkbox"/> | | | | | Correct the ring joint positions. | | | |
| | Reverse assembly of piston rings | | | | | | <input type="checkbox"/> | | <input type="checkbox"/> | | | | | | | | <input type="checkbox"/> | | | | <input type="checkbox"/> | | | | | Reassemble correctly. | | | |
| | Worn crankpin and journal bearing | | | | | <input type="checkbox"/> | | | | | <input type="checkbox"/> | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | <input type="checkbox"/> | | | | | Measure and replace. | | | |
| | Loosened connecting rod bolt | | | | | | | | | | <input type="checkbox"/> | | | <input type="checkbox"/> | | | | | | | <input type="checkbox"/> | | | | | Tighten to the specified torque. | | | |
| | Foreign matter trapped in combustion chamber | <input type="checkbox"/> | | | | | | | | | <input type="checkbox"/> | | | | | | <input type="checkbox"/> | | | | <input type="checkbox"/> | | | | | Disassemble and repair. | | | |
| | Excessive gear backlash | | | | | | | | | | <input type="checkbox"/> | | | | | | | | | | | | | | | Adjust gear meshing. | | | |
| | Worn intake/exhaust valve guide | | | | | | <input type="checkbox"/> | | | | | | | | | | <input type="checkbox"/> | | | | <input type="checkbox"/> | | | | | Measure and replace. | | | |
| | Defective governor | | <input type="checkbox"/> | | | | | | | | | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | Make adjustment. | | | |
| | Improper open/close timing of intake/exhaust valves | <input type="checkbox"/> | | | | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | Adjust the valve clearance. | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

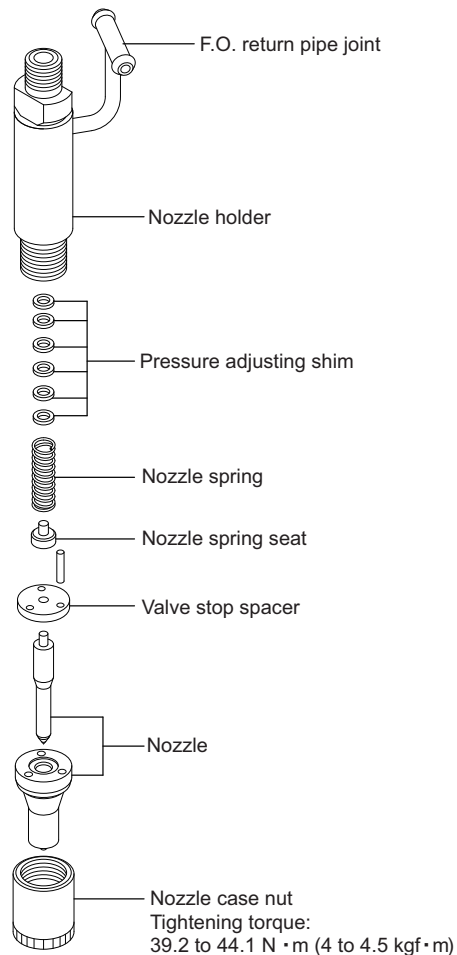
4. ENGINE

- [1] Connect the fuel injection valve to the high pressure pipe of the nozzle tester.
- [2] Operate the nozzle tester lever slowly and read the pressure at the moment when the fuel injection from the nozzle starts.
- [3] If the measured injection pressure is lower than the standard level, replace the pressure adjusting shim with a thicker one.



| Type of pressure adjusting shim thickness in. (mm) | Injection pressure adjustment |
|--|---|
| 0.0051 (0.13) 0.0059 (0.15) 0.0071 (0.18) 0.0157 (0.4) 0.0197 (0.5) 0.0315 (0.8) | The injection pressure is increased by approx. 270 PSI (1863 kPa) when the adjusting shim thickness is increased by 0.0039 in. (0.1 mm) |

[Reference : Fuel injection valve structure]



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4. ENGINE

4-3-11 Long Storage

Observe the following instructions when the engine is to be stored for a long period without operation:

- (1) Always drain cooling water in a cold season or before a long storage. (This is unnecessary when antifreeze is used.)

Notice :

Negligence of water draining will cause the cooling water remaining inside the engine to be frozen and expanded to damage the engine parts.

Water draining procedure

- [1] Remove the radiator cap.
 - [2] Loosen the water draining cock under the radiator to drain water from the inside.
 - [3] Loosen the drain cock on the side surface of the cylinder to drain water from the inside.
 - [4] After draining water, tighten the radiator cap and drain plug and cocks.
- (2) Remove the mud, dust and oil deposit and clean the outside.
 - (3) Perform the nearest periodic inspection before the storage.
 - (4) Drain or fill the fuel oil fully to prevent condensation in the fuel tank.
 - (5) Disconnect the battery cable from the battery negative (-) terminal.
 - (6) Cover the silencer, air cleaner and electric parts with PVC cover to prevent water and dust from depositing or entrance.
 - (7) Select a well-ventilated location without moisture and dust for storage.
 - (8) Perform recharging once a month during storage to compensate for self-discharge.

4. ENGINE

6) Valve Seat Correction

Notice :

Always check the oil clearance between the valve and valve guide before correcting the valve seat. If it exceeds the limit, replace the valve or valve guide first to make the clearance satisfy the standard. After correction, wash the valve and the cylinder head sufficiently with diesel oil to remove all grinding power or compound.

[1] If the seat surface is slightly roughened : perform [A] and [B] below.

[2] If the seat is heavily roughened but the width is almost normal, correct with a seat grinder or seat cutter first. Then perform lapping [A] and [B] below.

degrees

| | | |
|-------------------|--------|---------|
| Seat cutter angle | Intake | Exhaust |
| | 120 | 90 |

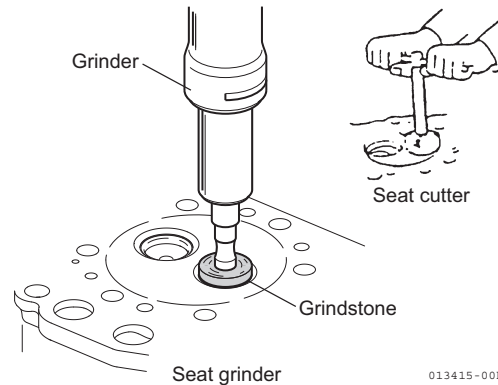
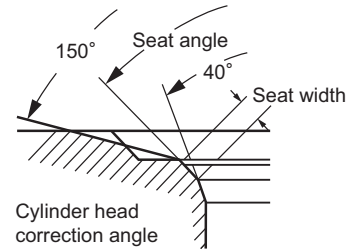
[3] If the seat is heavily roughened and the width is much enlarged, grind the seat inner surface with a seat grinder whose center angle is 40 degrees, then grind the seat outer surface with a grinder whose center angle is 150 degrees to make the seat width match the standard. Then perform seat correction as described in [2], and then carry out lapping [A] and [B] below.

degrees

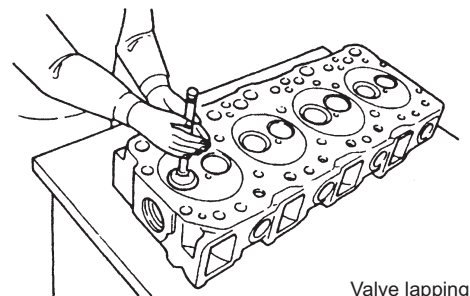
| | | |
|----------------------|------------|------------|
| Grinding wheel angle | θ_1 | θ_2 |
| | 40 | 150 |

[A] : Lap the valve and seat with a mixture of valve compound and engine oil.

[B] : Lap with engine oil only.



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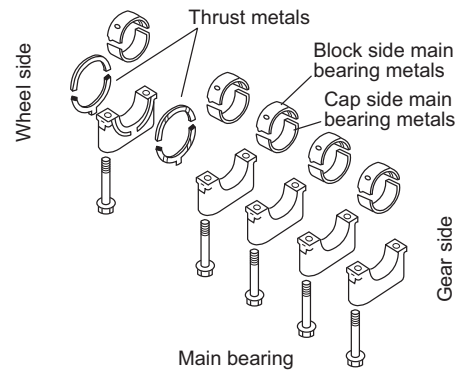


4. ENGINE

Disassemble :

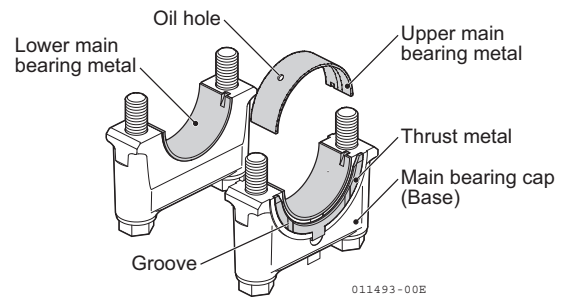
- Remove the bearing caps, cap side bearings, and thrust metals. Place each thrust metal with identification of the position and direction.

The position number of reassembling is punched on a metal cap (except for both ends) and a cylinder block.



Reassemble :

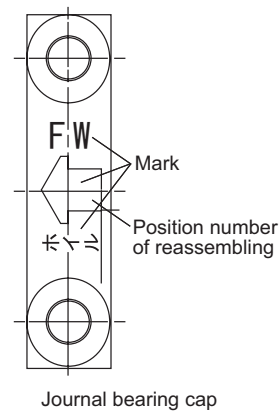
- Carefully install each thrust metal so that the grooved one is positioned away from the cap.
- Do not confuse the upper and lower main bearing metals. The upper main bearing metal (block side) has an oil hole, and the lower one does not. The "arrow" marks on the cap shall face the flywheel. Tighten main bearing cap bolts.



Main bearing cap bolt tightening torque
(apply lube oil)

ft•lbs (N•m)

| Standard |
|-----------------------------|
| 69.0 to 76.0 (93.2 to 98.1) |



Point 5 Crankshaft

Disassemble :

- Remove the crankshaft. Remove each main bearing metal upper (block side) and pair it with the metal cap side lower metal.

! CAUTION

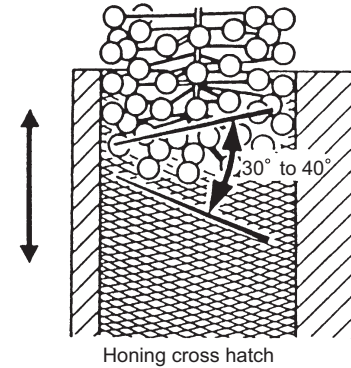
Carefully prevent damage to the bearing or finger injury when removing the crankshaft because it is heavy.

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- [3] Apply the honing fluid to the Flex-Hone and turn the electric drill at 300 to 1200 RPM. Then insert the Flex-Hone into the cylinder bore while turning it, and move it up and down for about 30 sec. to obtain a honing mark with a cross hatch angle of 30 to 40 degrees.

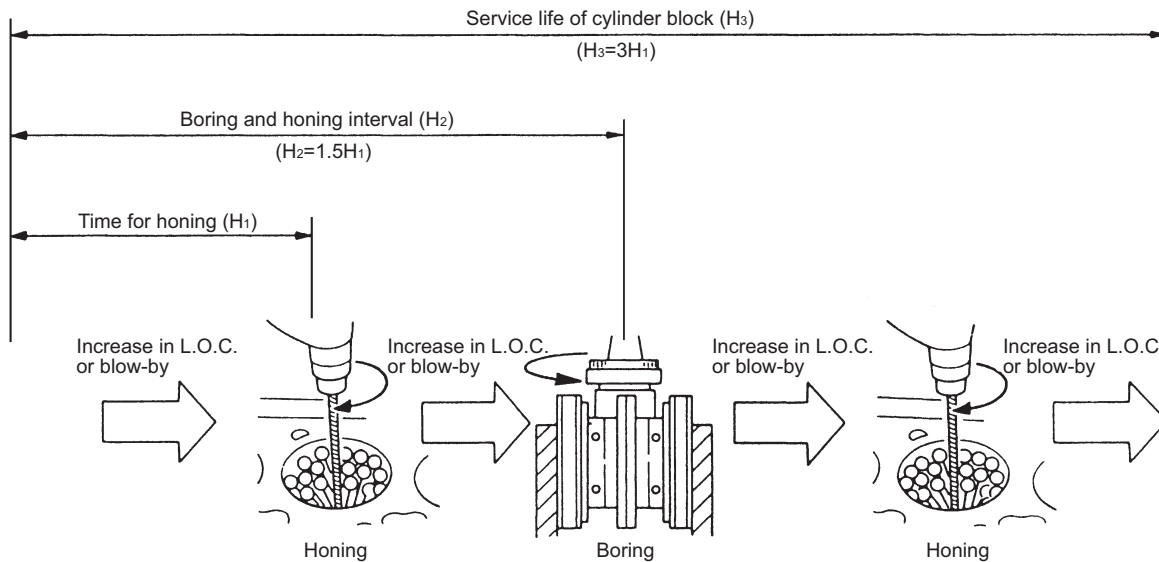
in. (mm)

| | |
|--|-------------------------------------|
| Cylinder bore after re-boring and honing | 3.4744 to 3.4756 (88.250 to 88.280) |
| Surface roughness | Rmax 0.04 to 0.14 S (1.0 to 3.5 S) |
| Roundness (Cylindricity) | 0.0004 (0.01) or less |



Notice :

- Avoid faster revolution than 1200 RPM since it may cause breakdown.
- Do not insert or extract the Flex-hone in stopped state because the cylinder will be damaged.
- Cylinder overhaul (reference)



Study if an oversized piston or piston ring is usable

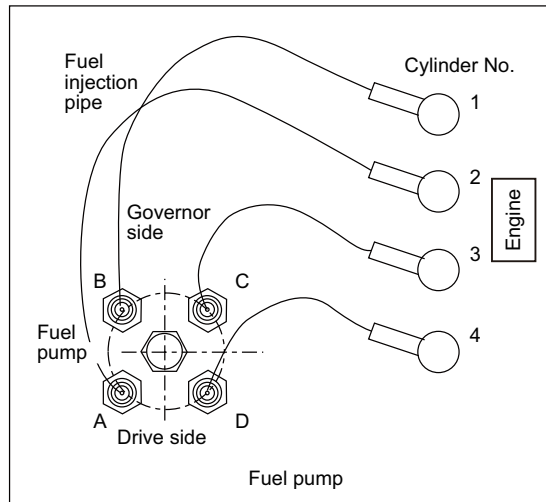
(7) Piston pin bushing replacement

Replace bushing by using the special service tool.

(8) Oil seal replacement

- [1] Replace oil seal, when mounting flange is removed. Extract the used oil seal.
- [2] Insert a new oil seal with the oil seal insertion tool.
- [3] Apply lithium grease.

4. ENGINE



4) Assembly Procedure

Reverse the disassembly procedure and adjust the fuel injection timing finally. See (4) of 4-3-7.

5) Servicing Points

Point 1

Disassemble :

- Block an entrance with the tape so that trash may not enter the fuel injection pipe and the fuel injection pump.

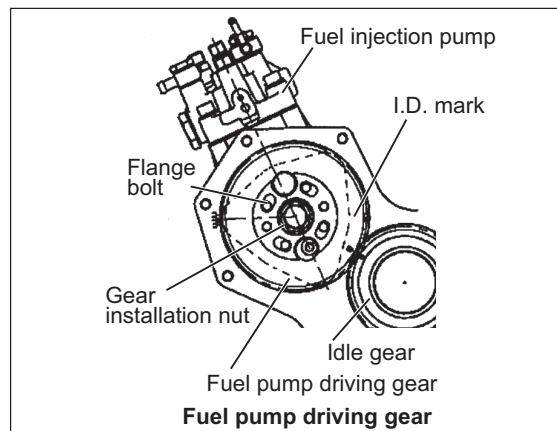
Point 2

Disassemble :

- After putting the I.D. marks on the gearing part of the pump drive gear and the idle gear with paint and so on, remove the gear installation nut.

Notice :

Don't remove four flange bolts.



Reassemble :

- Reassemble the pump driving gear while checking the I.D. marks on the driving gear and idle gear.

Tightening torque of the gear installation nut

| ft•lbf (N•m) | Lubricating oil application (thread portion, and seat surface) |
|---------------------|---|
| 58 to 65 (78 to 88) | Not applied |

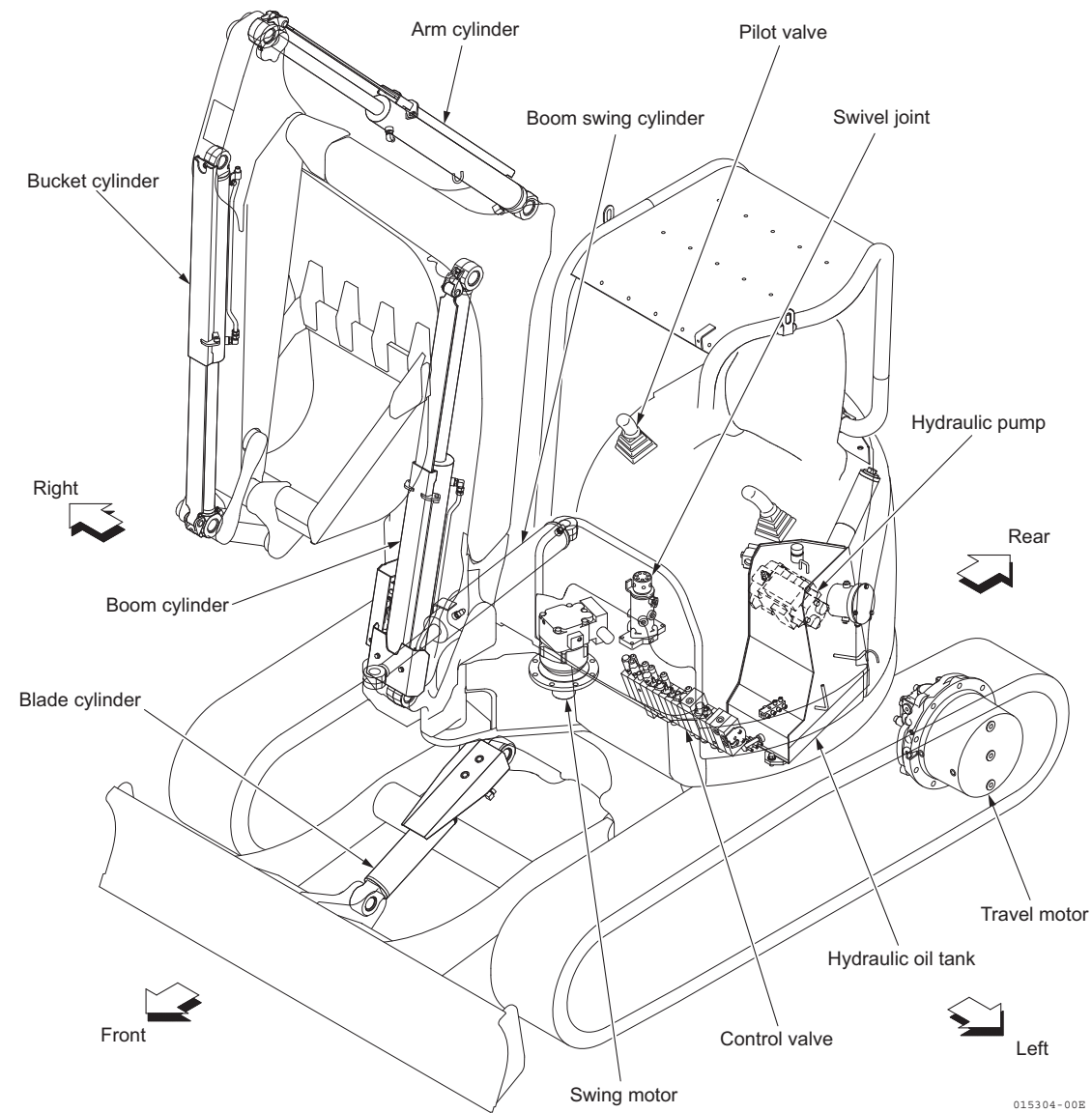
5. HYDRAULIC SYSTEM

5. Hydraulic System

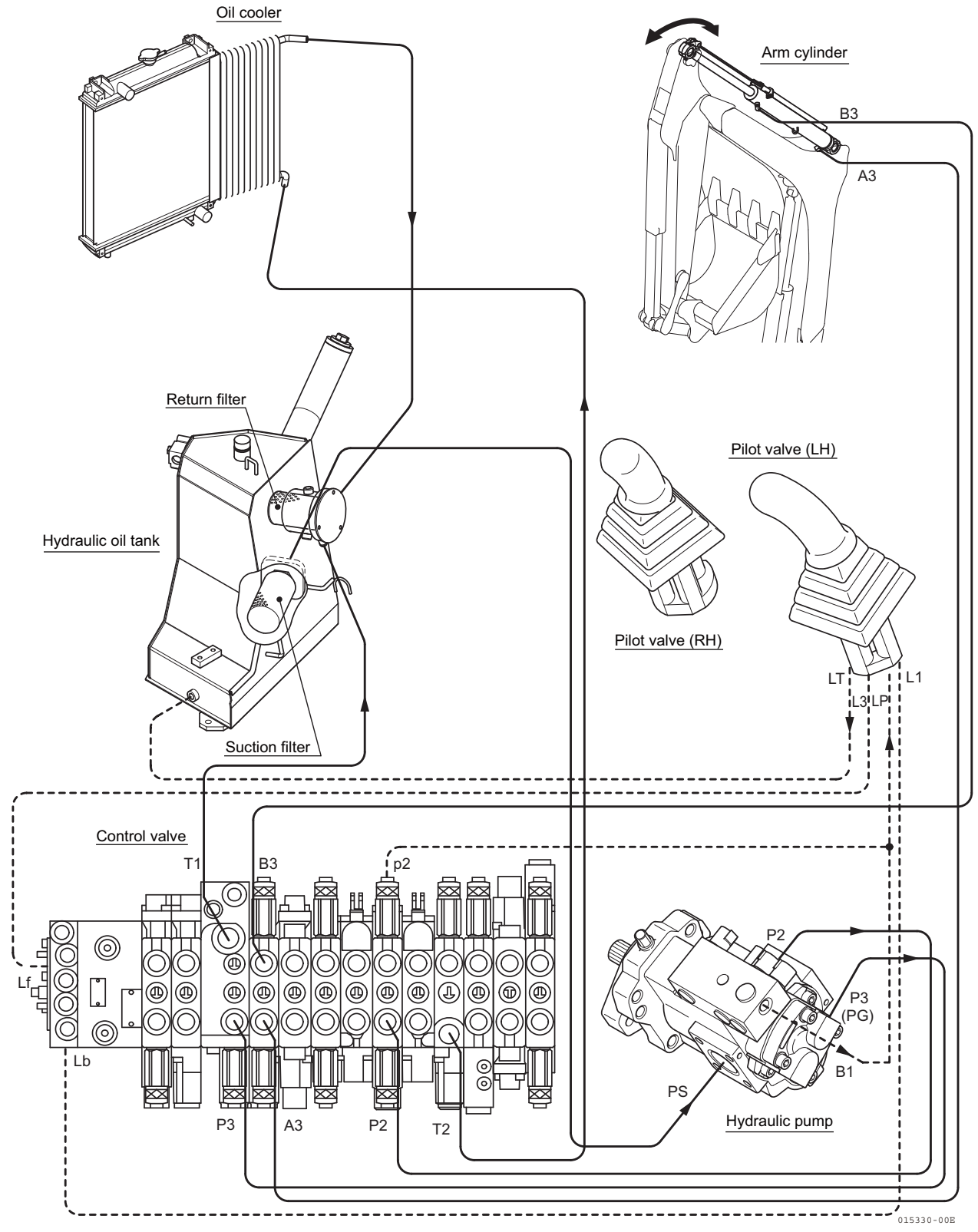
5-1 Outline

The hydraulic system consists of an engine, variable displacement piston pumps, a gear pump, a control valve, a boom cylinder, an arm cylinder, a bucket cylinder, a boom swing cylinder, a blade cylinder, a swing motor, a swivel joint, two travel motors, 2 way valve and a hydraulic oil tank. The oil discharged from the variable displacement piston pumps and that from the gear pump flow to the actuators through the control valve.

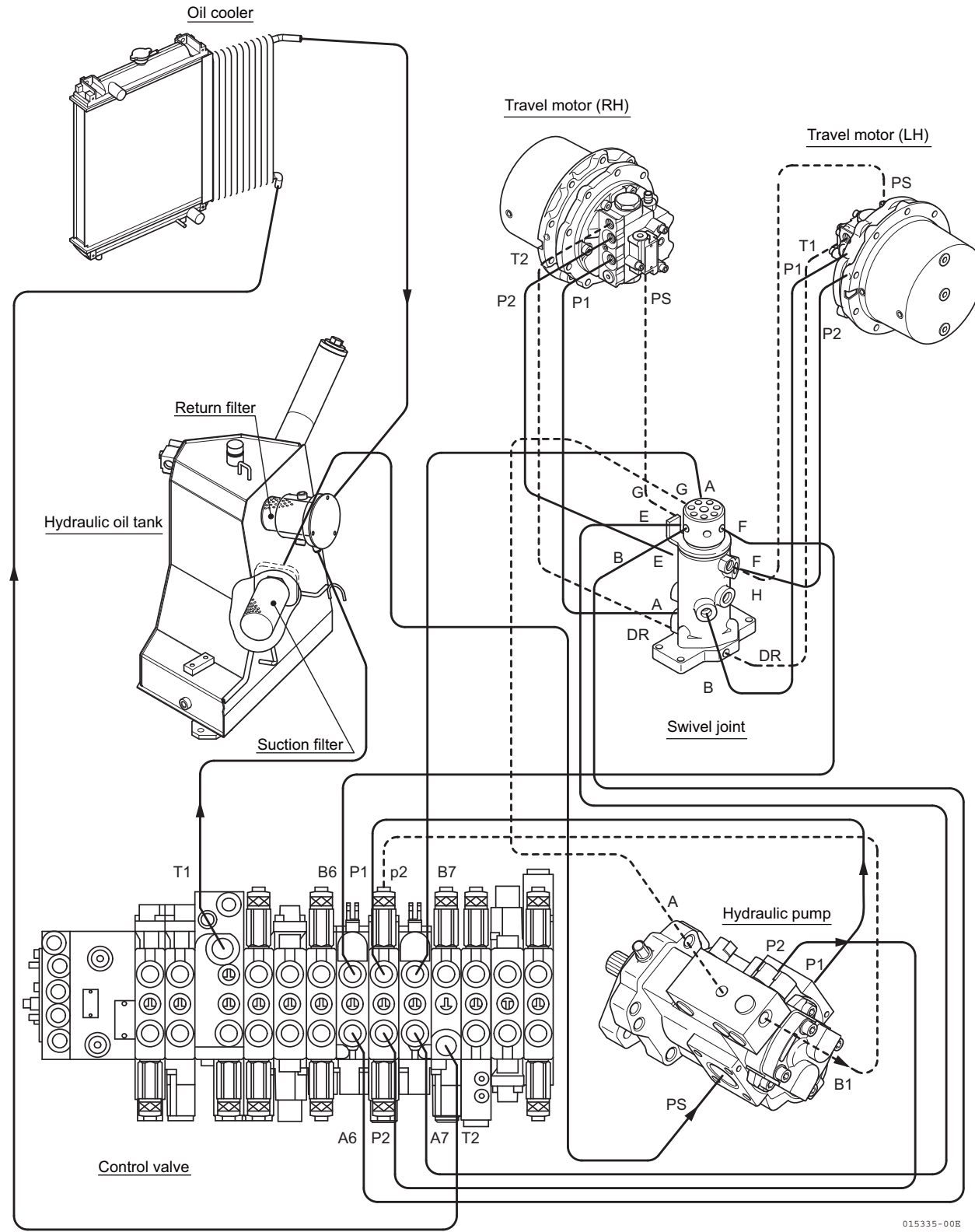
The hydraulic pilot control system comprises a pilot pump, a cut-off valve mounted on the hydraulic pump and two pilot valves. The oil discharged from the pilot pump flows into the pilot ports of the control valve through the cut-off valve, the pilot valves and 2 way valve to control the valve spool movement in proportion to the pressure at the port.



5. HYDRAULIC SYSTEM

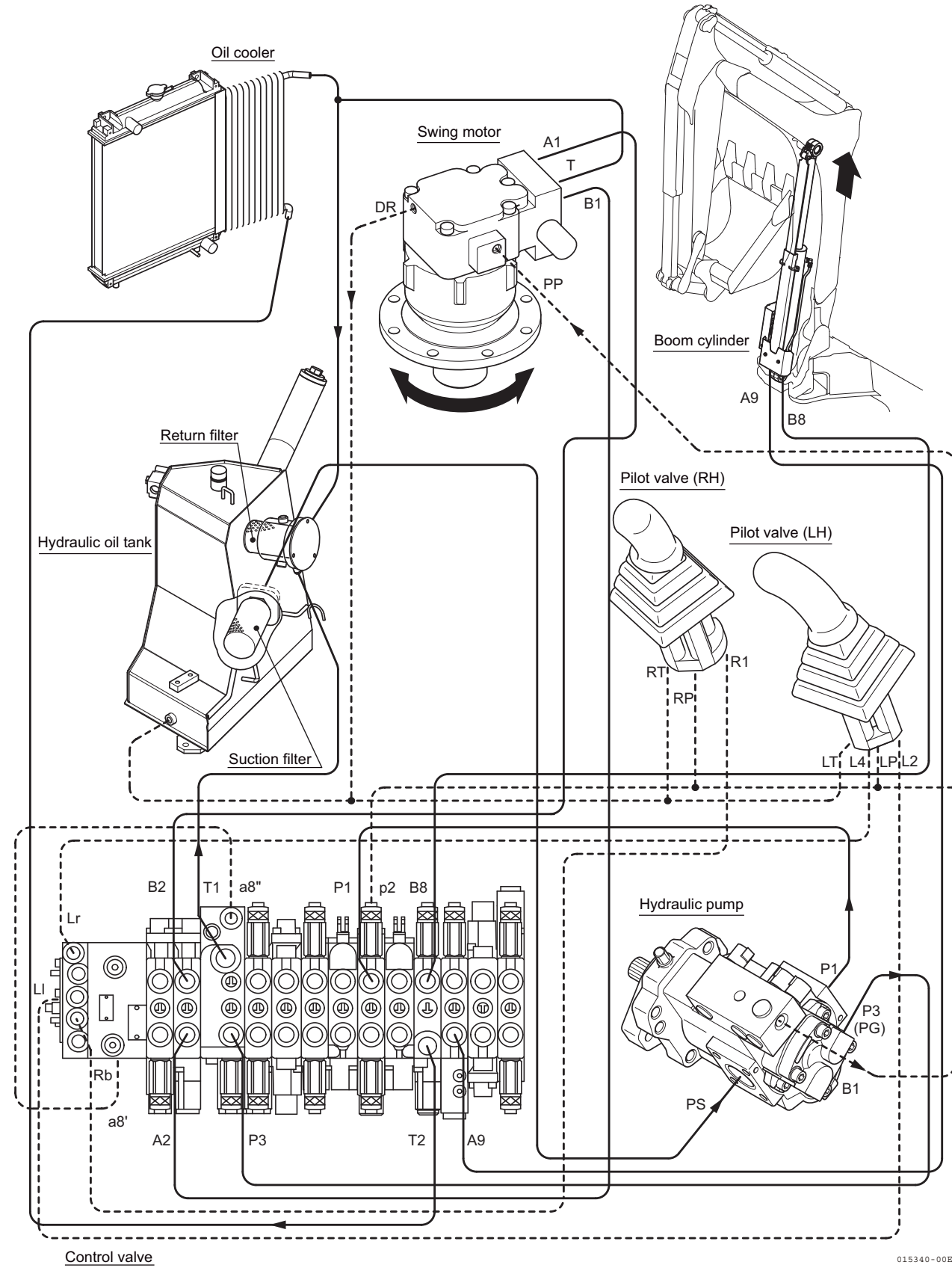


5. HYDRAULIC SYSTEM



015335-00E

5. HYDRAULIC SYSTEM



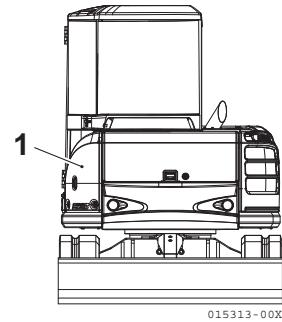
015340-00B

5. HYDRAULIC SYSTEM

5-4-2 Swing Brake Valve

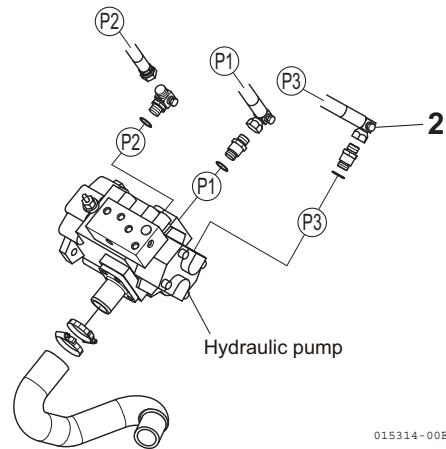
1) Conditions

- (1) Engine : rated speed
- (2) Hydraulic oil temperature : 122 to 140 °F (50 to 60 °C)
- (3) Pressure gauge capacity : 5000 to 6000 PSI (35 to 40 MPa)
- (4) Set pressure : 3130 (21.6 MPa)



2) Measuring Procedure

- (1) Open the bonnet L 1.
- (2) Remove the plug (BSPT 1/8) 2 to install the pressure gauge.
- (3) Fix the upper structure and move the swing lever to the right and the left, hold the lever with relief pressure applied and read the gauge.



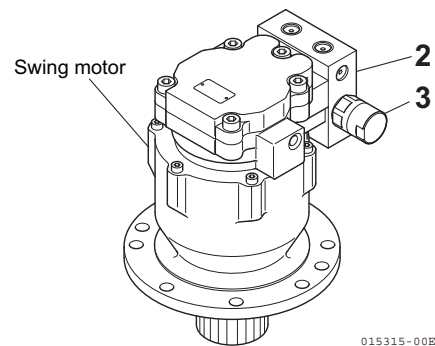
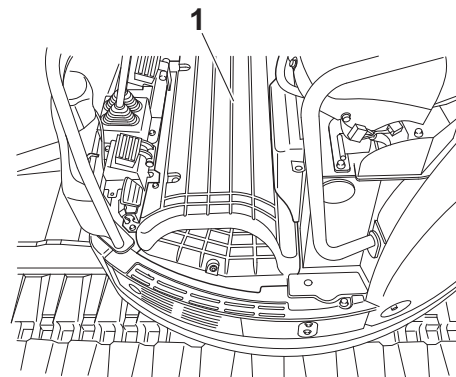
3) Adjustment Procedure

(Relief Valve Replacement Procedure)

Since the relief valve is a fixed-pressure type, replace the relief valve assembly with a new one if the relief pressure needs to be adjusted.

- (1) Remove the step 1.
- (2) Remove the relief valve assembly 4 from the brake valve 3.

| |
|---|
| Tightening torque for relief valve |
| 95.0 to 123.0 ft·lbf (127.5 to 166.7 N·m) |

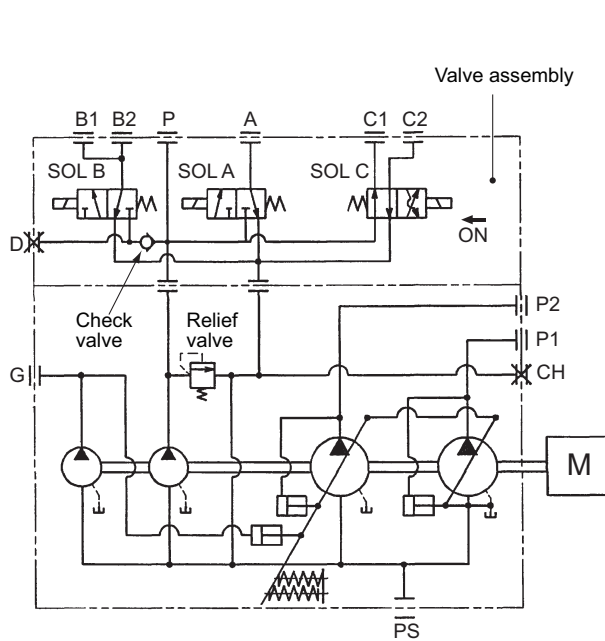


6. HYDRAULIC EQUIPMENT

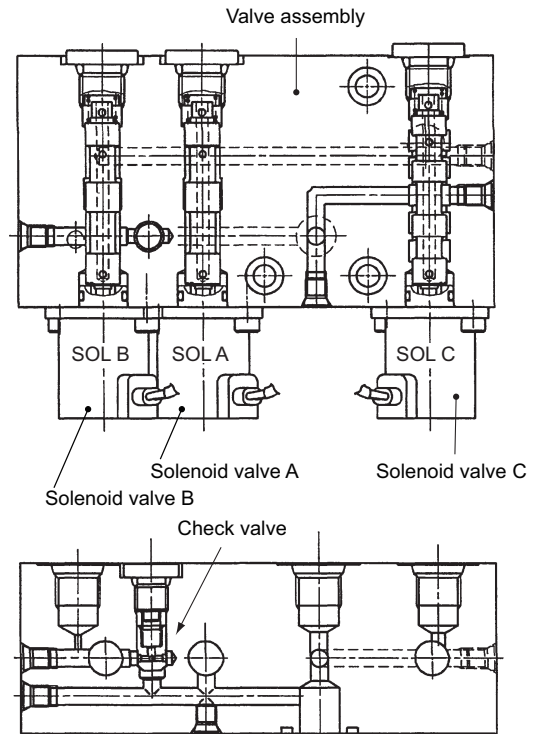
5) Function of Valve Assembly

This pump has a valve assembly, which switches the directions of the pressure oil flow from the pilot pump. Some solenoid and check valves are installed in the valve block assembly.

- [1] The solenoid valve A supplies pressure oil to the port A when the solenoid is turned on. When the solenoid is turned off, the solenoid valve A blocks the pilot oil pressure and allows the oil in the port A to escape to the intake port through the housing of the piston pump.
 - [2] The pressure oil is supplied to the solenoid valve B through the check valve. The oil flowing from the check valve toward the solenoid valve B is divided into two directions. One flows to the solenoid valve B and the other flows to the port D through the orifice.
 - [3] The solenoid valve B supplies the pilot pressure oil to the ports B1 and B2 when the solenoid is turned on. When the solenoid is turned off and no pilot oil is supplied from the pilot pump for some reason, the check valve works to keep the pressure decrease of the ports B1 and B2 at a minimum.
- When the solenoid is turned off, the solenoid valve B blocks the pilot pressure oil and allows the oil in the ports B1 and B2 to escape to the intake port through the housing of the piston pump.
- [4] When the solenoid is turned on, the solenoid valve C supplies the pilot pressure oil to the port C2 and allows the oil in the port C1 to escape to the intake port through the housing of the piston pump. When the solenoid is turned off, the solenoid valve C supplies the pilot pressure oil to the port C1 and allows the oil in the port C2 to escape to the intake port through the housing of the piston pump.

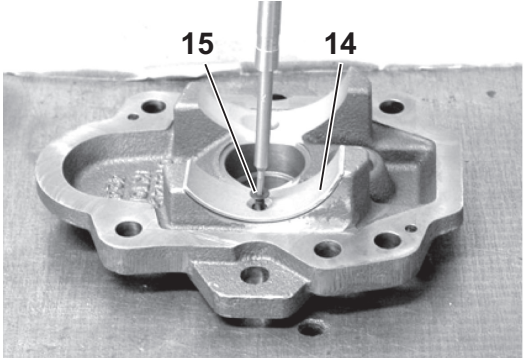
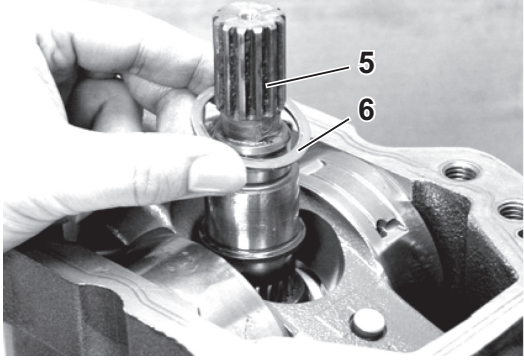
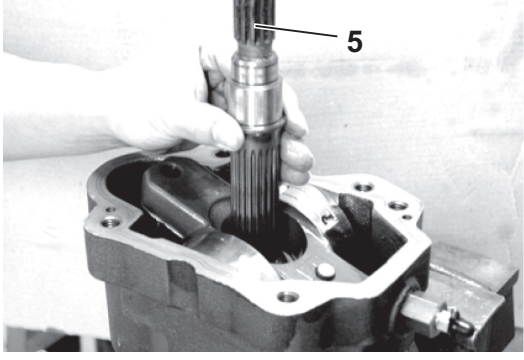
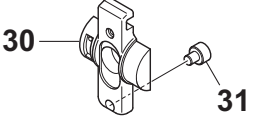
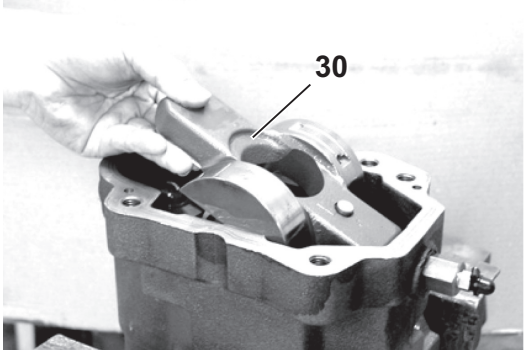


Hydraulic circuit schematic of three series solenoid valve

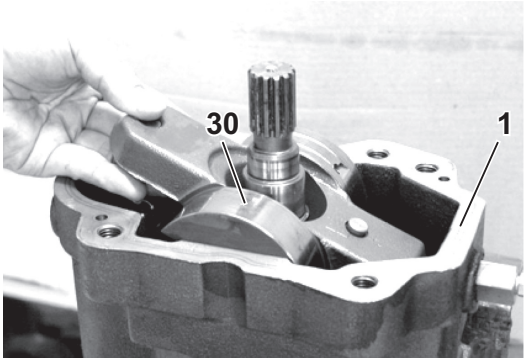
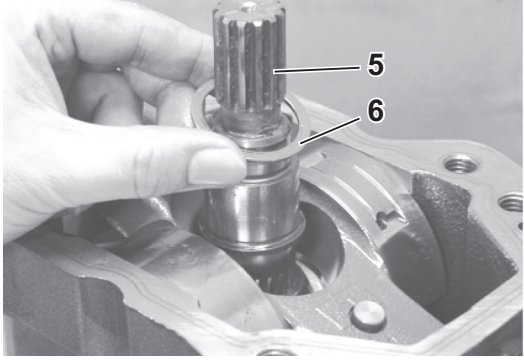
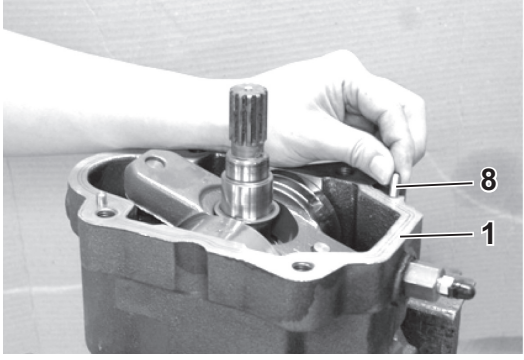
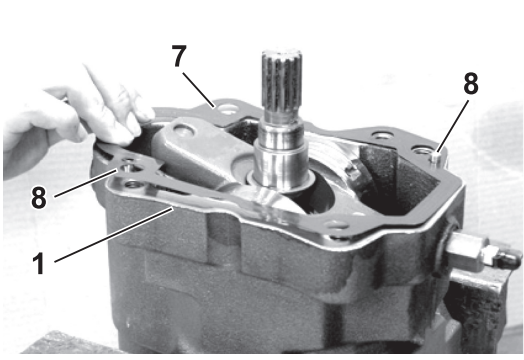


Structural drawing of three series solenoid valve
015184-00B

6. HYDRAULIC EQUIPMENT

| | |
|---|--|
| <p>Procedure</p> <p>(13) Remove the screws 15 to remove the bushes 14.</p> |  |
| <p>(14) Remove the thrust washer 6 from the shaft 5.</p> |  |
| <p>(15) Remove the shaft 5.</p> |  |
| <p>(16) Remove the swash plate 30 and the holder 31.</p> <p>Note : When removing the swash plate, take care not to drop the holder. It may damage the internal parts, such as pistons.</p>  |  |

6. HYDRAULIC EQUIPMENT

| | |
|---|---|
| <p>Procedure</p> <p>(21) Install the swash plate 30 into housing 1.</p> <p>Note : <i>Take care not to drop the holder when installing it. This can damage the internal parts, such as pistons.</i></p> |  A close-up photograph showing a hand placing a curved metal swash plate, labeled '30', into a housing, labeled '1'. A central shaft is visible through the housing. |
| <p>(22) Install the thrust washer 6 onto the shaft 5.</p> |  A close-up photograph showing a hand sliding a thrust washer, labeled '6', onto a shaft, labeled '5'. The shaft is partially inserted into the housing. |
| <p>(23) Install the pins 8 into the housing 1.</p> |  A close-up photograph showing a hand inserting a pin, labeled '8', into a hole in the housing, labeled '1'. The swash plate and shaft are already in place. |
| <p>(24) Install the gasket 7 into the housing 1 aligning with the pins 8.</p> |  A close-up photograph showing a hand placing a gasket, labeled '7', into the housing, labeled '1'. The gasket is being aligned with the pins, labeled '8', which are already installed in the housing. |

6. HYDRAULIC EQUIPMENT

2) Neutral State (Port Pp2 with Pilot Oil Supplied)

(1) Oil flow discharged from the pump P1

When the pilot oil is supplied to the port Pp2, it moves the piston to press the spool. Therefore, the line to the return passage is blocked and that to the right travel section is open, so that the oil from port P1 flows to the right travel spool section through the inlet spool land. In the neutral state of the spools, the by-pass passage is not blocked by any spool, so that the oil flows from the right travel spool section to the hydraulic oil tank through the by-pass passage of the right travel, boom and P.T.O. 2 and the by-pass passage of the bucket spool.

(2) Oil flow discharged from the pump P2

When the pilot oil is supplied to the port Pp2, it moves the piston to press the spool. Therefore, the line to the return passage is blocked and that to the left travel section is open, so that the oil from port P2 flows to the left travel spool section through the inlet spool land. In the neutral state of the spools, the by-pass passage is not blocked by any spool, so that the oil flows from the left travel spool section to the hydraulic oil tank through the by-pass passage of the left travel, boom swing and P.T.O. 1 and the by-pass passage of the arm spool.

(3) Oil flow discharged from the pump P3

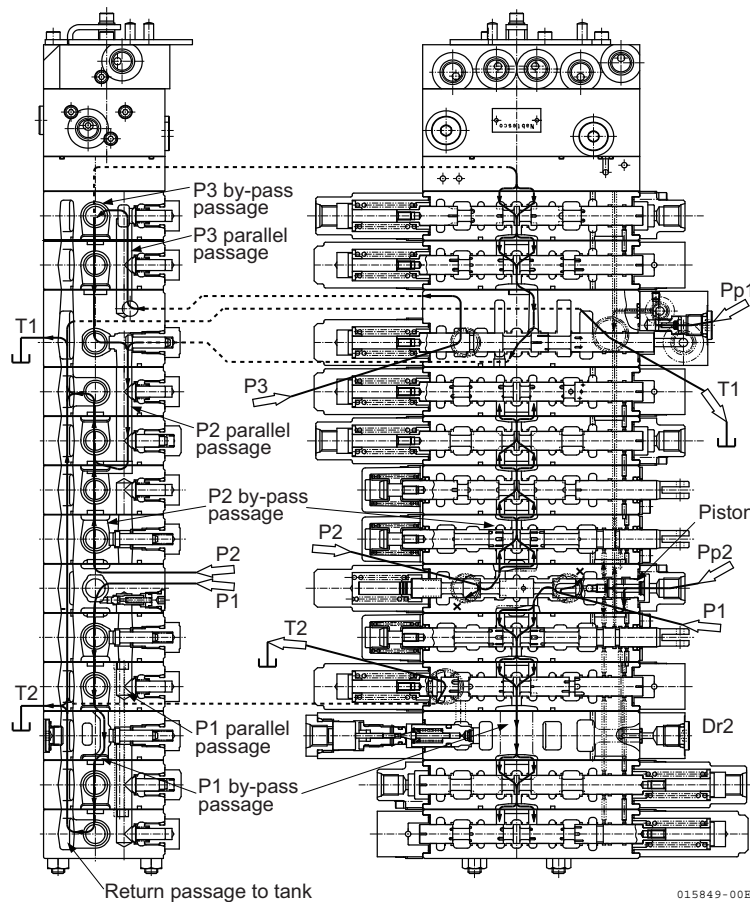
The oil discharged from the hydraulic pump P3 flows into the control valve through the port P3 and flows to the parallel passage of the swing and blade sections.

In the neutral state of the spools, the by-pass passage is not blocked by any spool, so that the oil from the parallel passage flows to the hydraulic oil tank through the by-pass passage of the blade and swing spools, the check valve in the P3 inlet section, the P2 parallel passage, the by-pass passage of the P.T.O. 1 spool and the by-pass passage of the arm section spool.

(4) 2-way valve

When oil is supplied to the port Pp2, all pilot oil ports are connected to respective circuit passages.

Operation in neutral state



6. HYDRAULIC EQUIPMENT

(2) Bucket curl operation

When the bucket control lever is moved to the right to dump the bucket, the oil from the pilot valve flows to the port PR1 to move the spool of the bucket section.

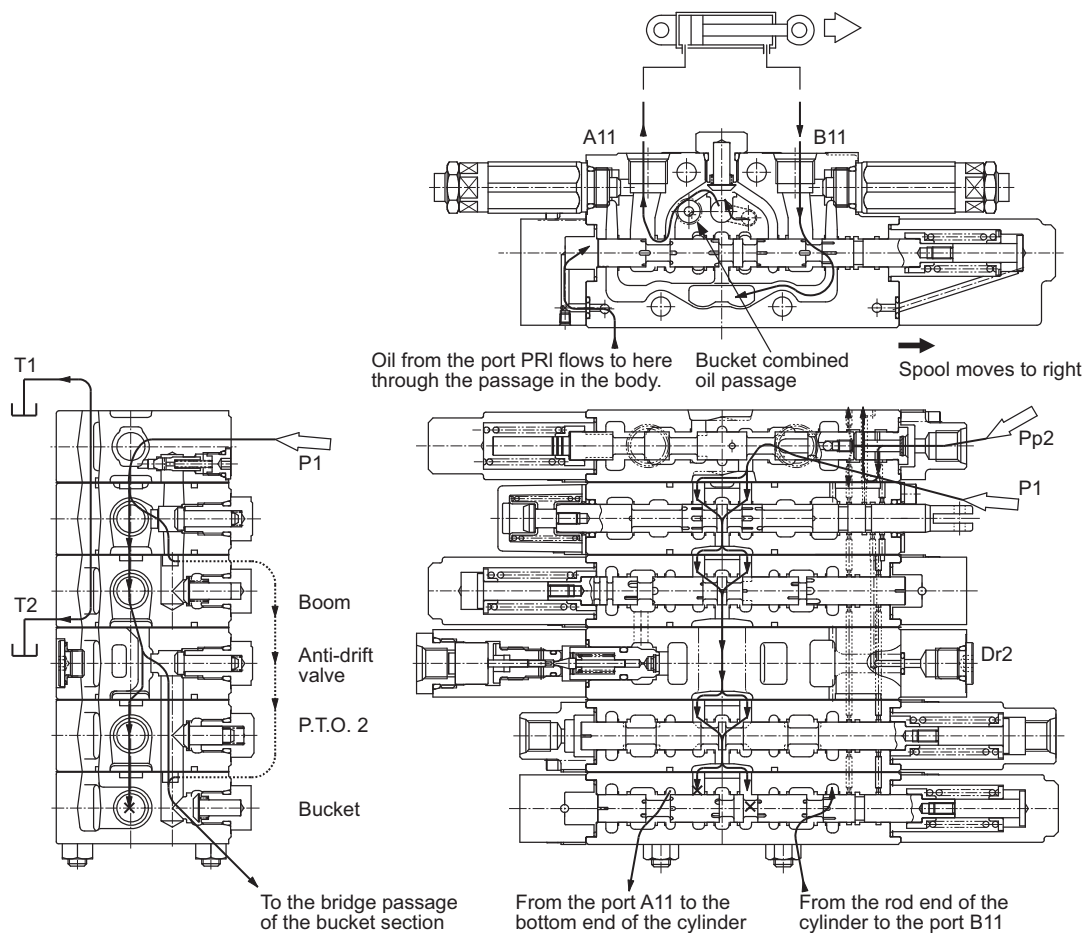
The P1 by-pass passage is blocked by the bucket spool as the spool has been moved, so that the oil from the port P1 flows through the check valve above the by-pass passage in the travel section and the check valve on the by-pass valve of the anti-drift valve to the parallel passage in the section.

The passage between the port A11 and the bridge passage is opened as the bucket spool has been moved, so that the oil flowed to the parallel passage flows through the load check valve in the bucket section and the bridge passage to the port A11, and is fed to the bottom end of the bucket cylinder.

Meanwhile, the return oil from the rod end of the bucket cylinder flows through the port B11 to the return oil passage, which is opened by the notches on the bucket spool as it has been moved.

Thus, the bucket cylinder is extended to curl the bucket.

The oil from the port Pp2 flows to the TSP (travel signal pilot) passage through the orifice of the piston. Though the return oil passage is blocked by a bucket spool movement, the spool receives no pressure to be moved because the TSP passage is connected with the return oil passage by the lands on the right and left travel section spools as long as no travel section spools are moved.

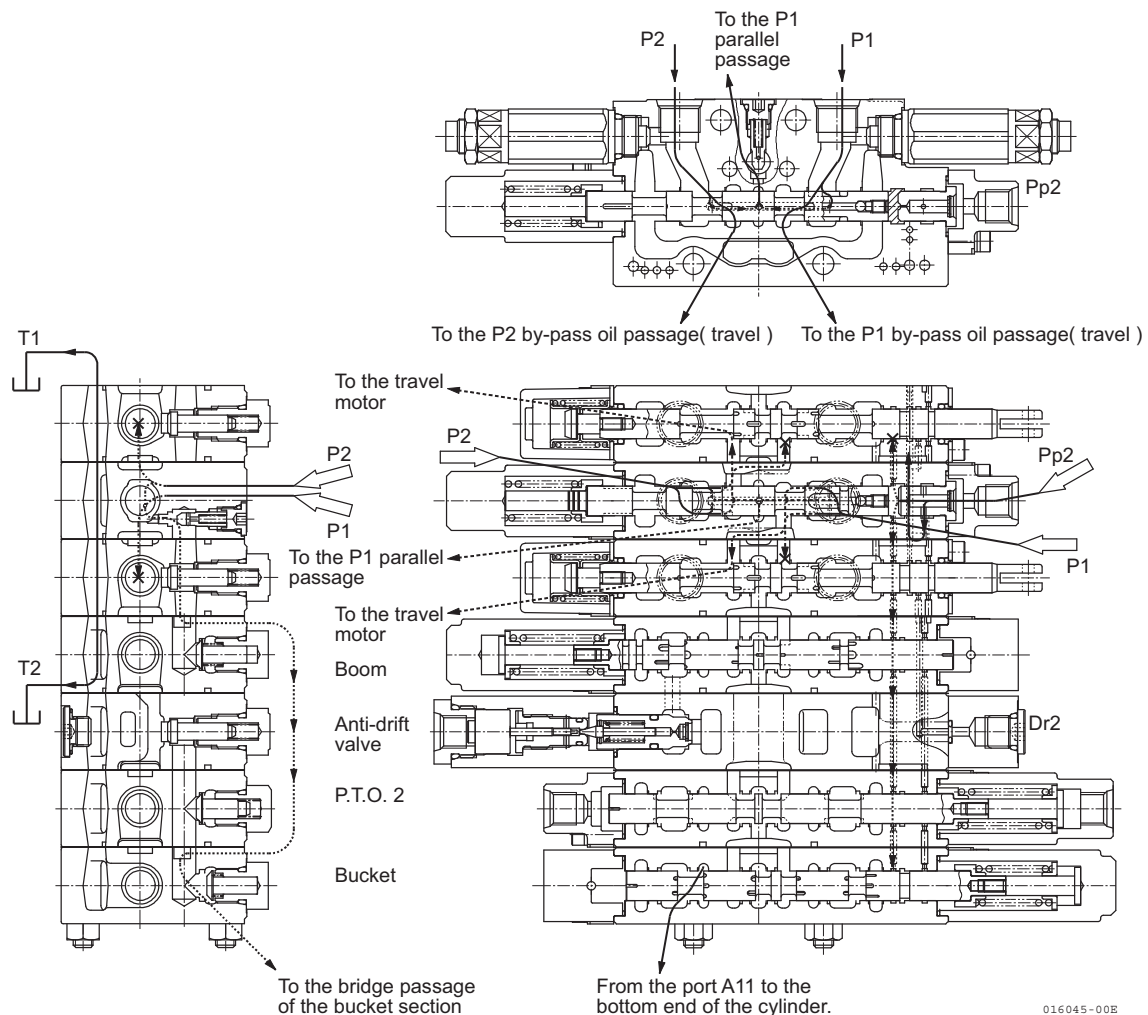


6. HYDRAULIC EQUIPMENT

(2) Traveling and bucket

When the bucket is operated while traveling, the oil from the port Pp2 flows into the TSP (traveling signal pilot) passage through the orifice in the piston but the spools of the right and left travel sections and the bucket section move to block their return oil passages. Therefore, the pressure in the TSP passage equals to that at the port Pp2, the spool of the P1, P2 inlet section is moved, the P1, P2 by-pass passages are narrowed and the P1 and P2 circuits are connected by another passage, and connected to the P1 parallel passage through the check valve. That is how the oil is supplied to the bucket section even while traveling, and simultaneous operation becomes possible.

In addition, as there are orifices in the passages to the right and left travel sections and bucket section, high pressure oil is supplied to each section even if pressure differences develop among those circuits, bucket operation while traveling is available.



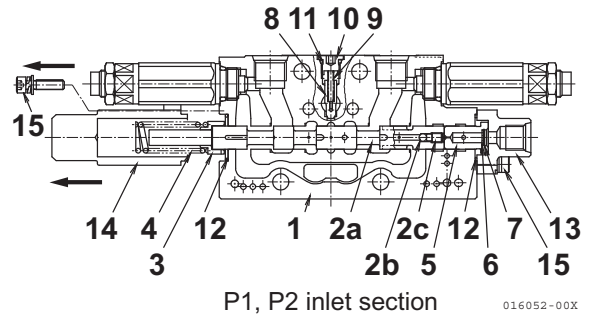
6. HYDRAULIC EQUIPMENT

(4) P1, P2 inlet

- [1] Remove the two hexagon socket head bolt and SWP washer assemblies **15** with a hexagon bar wrench (4 mm).
- [2] Remove the pilot oil chamber case A1 **14**.
- [3] Remove the return spring **4** and the return spring retainer.
- [4] Slowly pull the spool assembly **2** out of the valve holding it by its end in the level direction with the spool bore.

Note :

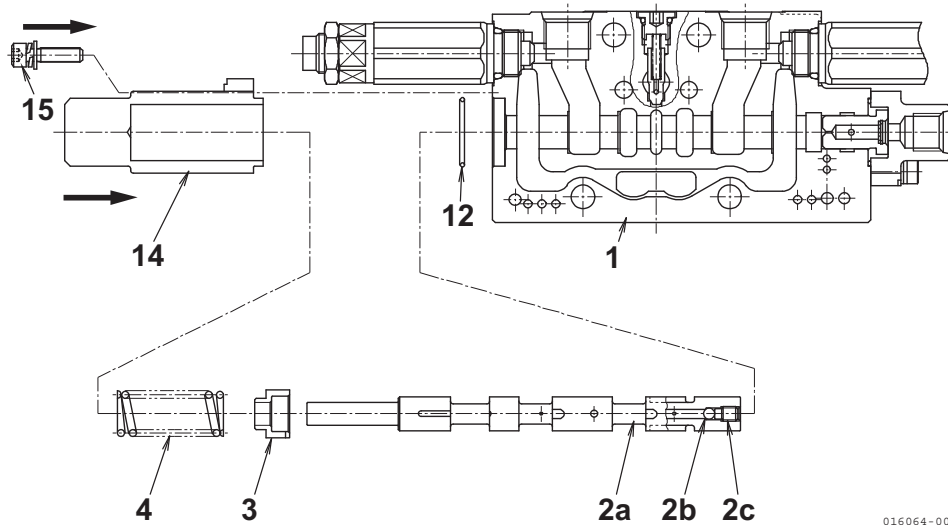
*At this time, check the O-ring **12** is installed at the bottom of the flange for pilot case on the body side.*



| No. | Part |
|-----|--|
| 1 | Body (symbol AB) |
| 2 | P1, P2 inlet spool assembly |
| a | Spool (P1, P2 inlet) |
| 3 | Return spring retainer |
| 4 | Return spring |
| 5 | Piston |
| 6 | Filter |
| 7 | Internal snap ring |
| 8 | Check valve |
| 9 | Check valve spring |
| 9 | Check valve spring |
| 10 | Plug |
| 11 | O-ring 1B P8 |
| 12 | O-ring 1B S22 |
| 13 | Pilot oil chamber case B5 |
| 14 | Pilot oil chamber case A2 |
| 15 | Hexagon socket head bolt M5×20 flows washer assembly |

6. HYDRAULIC EQUIPMENT

(4) P1, P2 inlet section



016064-00X

- [1] Make sure that there is no dust or the like in the inlet spool and the spool bore in the inlet section body and that the O-ring **12** is securely installed in the bottom of the flange on the front and rear sides of P1 and P2 inlet section body. Then, install the inlet spool assembly into the spool bore in the inlet section body taking care not to install it in a wrong direction.

Note :

Apply a little hydraulic oil to the spool before installing it.

- [2] Install the return spring holder **3** and the return spring **4**.
- [3] Securely install the pilot case **14** to the flange of the inlet section body and tighten the hexagon socket head bolt and washer assembly **15** with a hexagon bar wrench (4 mm) at the specified torque.

| |
|---|
| Tightening torque : 4.3 to 5.1 ft·lbf (5.9 to 6.9 N·m) |
|---|

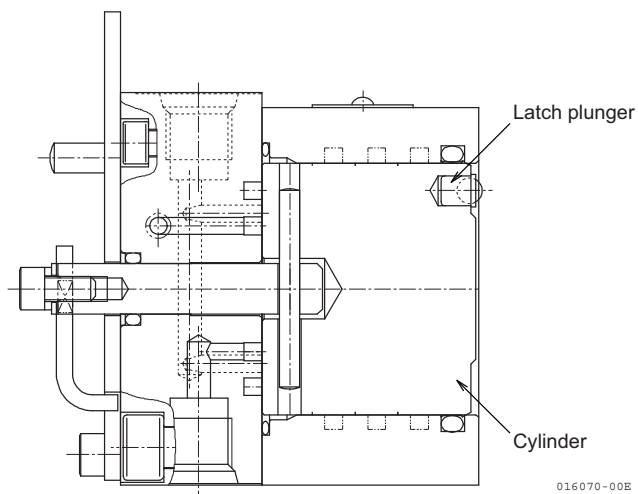
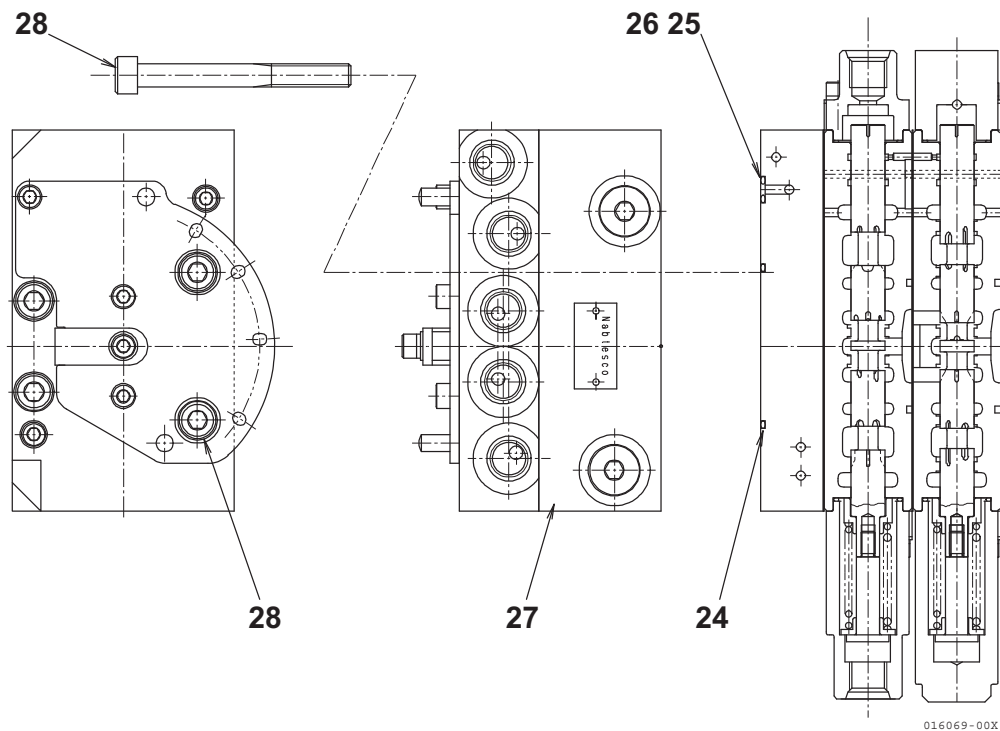
| No. | Part |
|-----|--|
| 1 | Body (symbol AB) |
| 2 | P1, P2 inlet spool assembly |
| a | Spool (P1, P2 inlet) |
| 3 | Return spring retainer |
| 4 | Return spring |
| 5 | Piston |
| 6 | Filter |
| 7 | Internal snap ring |
| 8 | Check valve |
| 9 | Check valve spring |
| 9 | Check valve spring |
| 10 | Plug |
| 11 | O-ring 1B P8 |
| 12 | O-ring 1B S22 |
| 13 | Pilot oil chamber case B5 |
| 14 | Pilot case A2 |
| 15 | Hexagon socket head bolt M5×20 flows washer assembly |

6. HYDRAULIC EQUIPMENT

(3) Removing the 2-way valve from the control valve assembly

Loosen four hexagon socket head cap screws **28** with a hex bar wrench (6 mm) to remove the 2-way valve assembly **27**.

- Make sure the O-rings **24**, **25**, **26** are in the grooves.
- Check the latch plunger for coming off from the cylinder end surface.

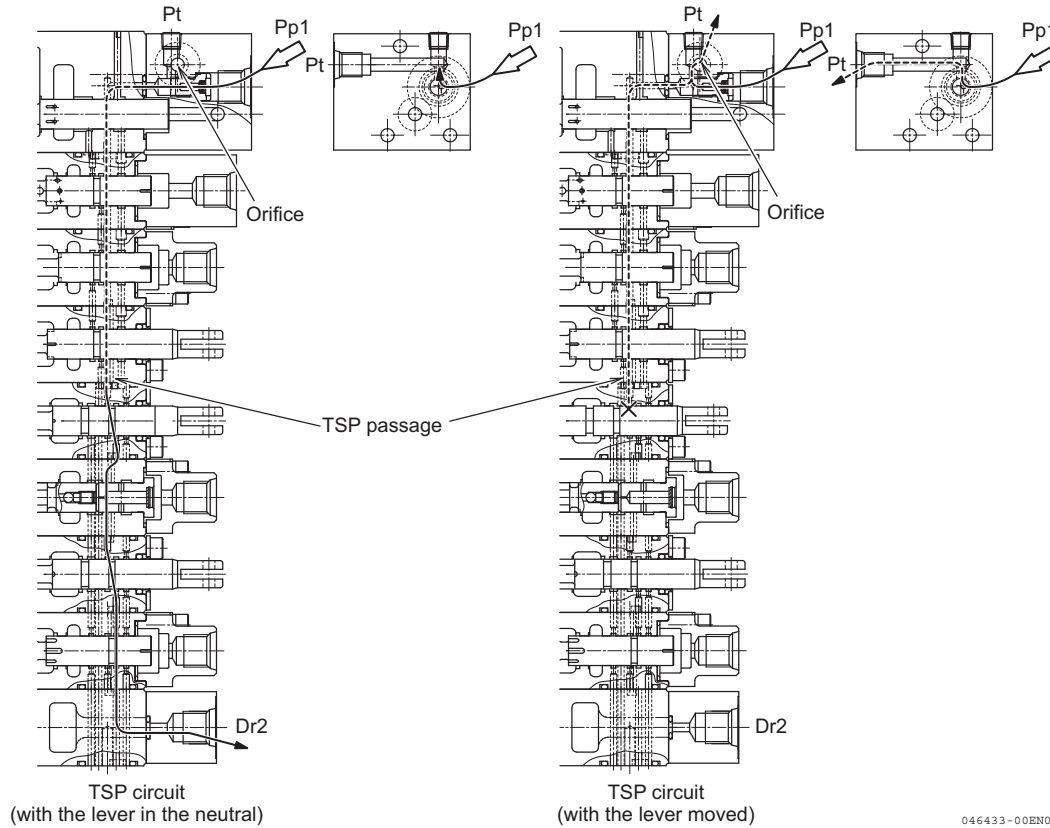


6. HYDRAULIC EQUIPMENT

When the TSP (travel signal pilot) circuit is used

The oil from the port Pp1 flows to the TSP passage through the orifice in the P3 inlet section. When the travel lever is not moved, the oil in the TSP passage flows to the port Dr2 and its pressure equals at down stream passage of the orifice to that at the port Pt (TSP port) connected to upstream oil passage of the travel section.

When right or left travel lever is moved, TSP passage is blocked in the travel section operated, so that the pressure at the port Pt goes up to that at the port Pp1.



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6. HYDRAULIC EQUIPMENT

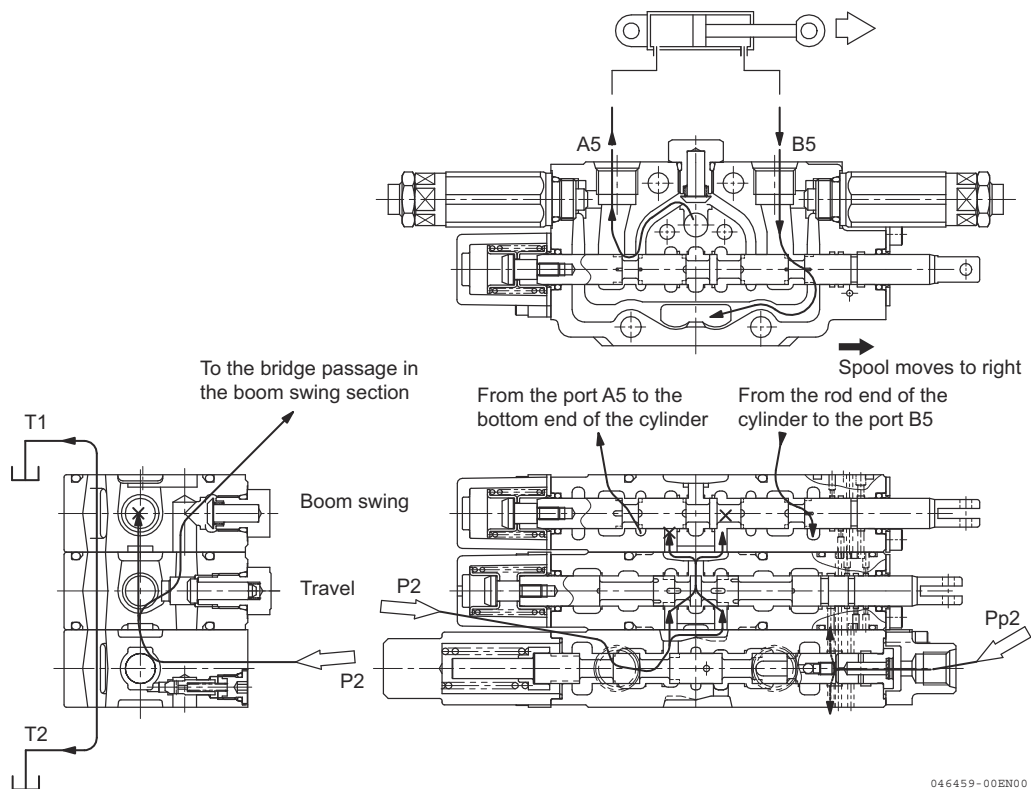
(2) Left boom swing operation

When the boom swing pedal is moved on the left, the spool of the boom swing section is pulled up. The P2 by-pass passage is blocked by the boom swing spool as the spool has been moved, so that the oil from the port P2 flows to the parallel passage of the boom swing section through the check valve installed at the upper part of the by-pass passage of the left travel spool.

The passage between the port A5 and the bridge passage is opened as the boom swing spool has been moved, so that the oil flowed to the parallel passage flows through the load check valve in the boom swing section and the bridge passage to the port A5 and is fed to the bottom end of the boom swing cylinder.

Meanwhile, the return oil from the rod end of the boom swing cylinder flows to the return oil passage, which is opened to the tank passage as the spool has been moved through the port B5 and the notch in the boom swing spool.

Thus, the boom swing cylinder is extended to swing the boom to the left.



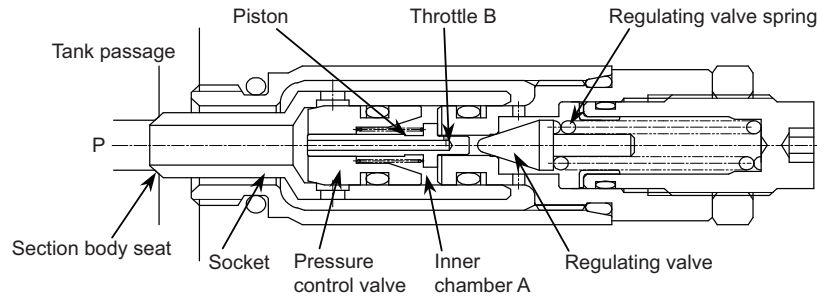
6. HYDRAULIC EQUIPMENT

13) Circuit Relief Valves

The circuit relief valve is installed in the rod and bottom sides of the bucket, boom and arm cylinders and the rod side of the boom swing and blade cylinders.

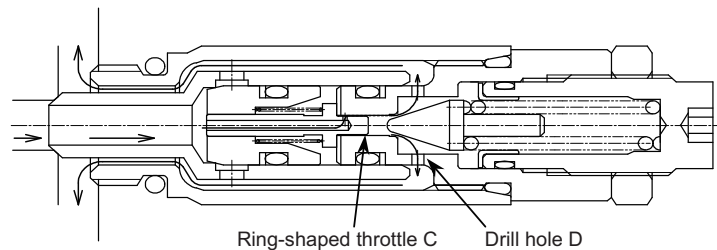
(1) Relief operation

- [1] Pressure oil flows through the inside of the piston installed in the pressure control valve (the parent valve) and the throttle B to the inner chamber A, so that it is filled with oil. The pressure control valve and the socket are securely seated, and so are the socket and the section body seat.

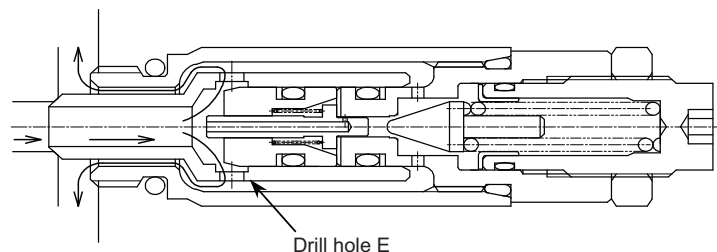


- [2] When the oil pressure in the port P reaches the set pressure of the regulating valve spring, the pressure oil flows to the regulating valve to open it.

At this time, the pressure oil passes through the inside of the piston, the throttle B, the inner chamber A, the ring-shaped throttle C and the drill hole D in sequence, and flows outside the socket to the tank passage.



- [3] When the regulating valve opens, the pressure in the inner chamber A is lowered, and consequently, the pressure control valve is opened and the pressure oil in the port P flows directly to the tank passage through the drill hole E.



- [4] When the pressure in the port P lowers to less than the set pressure of the regulating valve spring, the regulating valve is pressed on the seat with the force of the regulating valve spring and the pressure in the inner chamber A becomes equal to that in the port P. Therefore, the pressure control valve is also pressed on the seat portion of the socket and returned to the original state ([1]).

6. HYDRAULIC EQUIPMENT

3)-3. Disassembly of anti-drift valve

When the anti-drift valve malfunctions, replace it as an anti-drift valve assembly. For reference, the disassembly procedure for examination is shown below.

- [1] Remove the two hexagon socket head bolts **A** with a hexagon bar wrench (5 mm).
- [2] Remove the anti-drift valve case **B**.
- [3] Take care not to drop the two dowel pins **C** on the anti-drift valve body side.

Note :

Take care not to lose and damage the pins.

- [4] Remove the anti-drift valve **1** and the needle valve **9**.

Notes :

- *Remove the needle valve **9** first and keep it as it is easily removed.*
- *The anti-drift valve should not be disassembled but it should be kept as an anti-drift valve assembly (**1-7, 10**).*

- [5] Hold the anti-drift valve case with a vice and remove the bush **17** with a wrench or socket wrench (26 mm).

Note :

Set the vice on any side face other than the port side to hold the anti-drift valve.

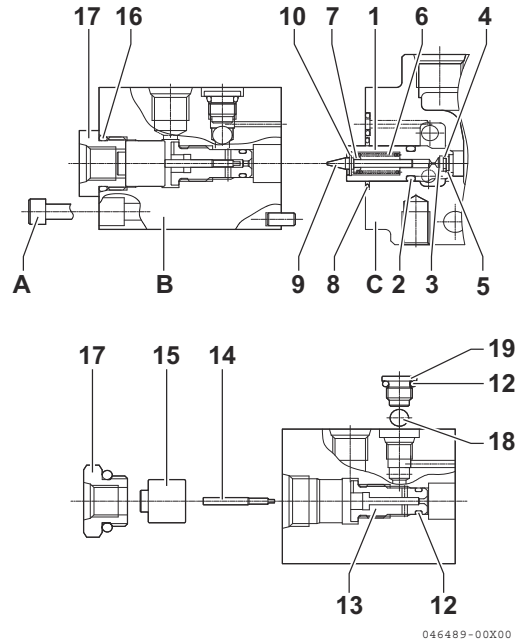
- [6] Remove the piston **B 15** and piston **A1 14** in the bore, which the bush has been removed from, with tweezers or a magnet.

Notes :

- *Make marks on the piston **B** and the piston **A1** so that they can be reassembled in the same direction as it was before.*
- *The piston guide **13** should not be disassembled, but it should be kept together with the anti-drift valve case **B**.*

- [7] Remove the ball retainer **19** with a hexagon bar wrench (4 mm).

- [8] Remove the steel ball **18** of $\varnothing 0.28$ in. (7 mm) from the bore, which the ball retainer has been removed from, using a magnet.



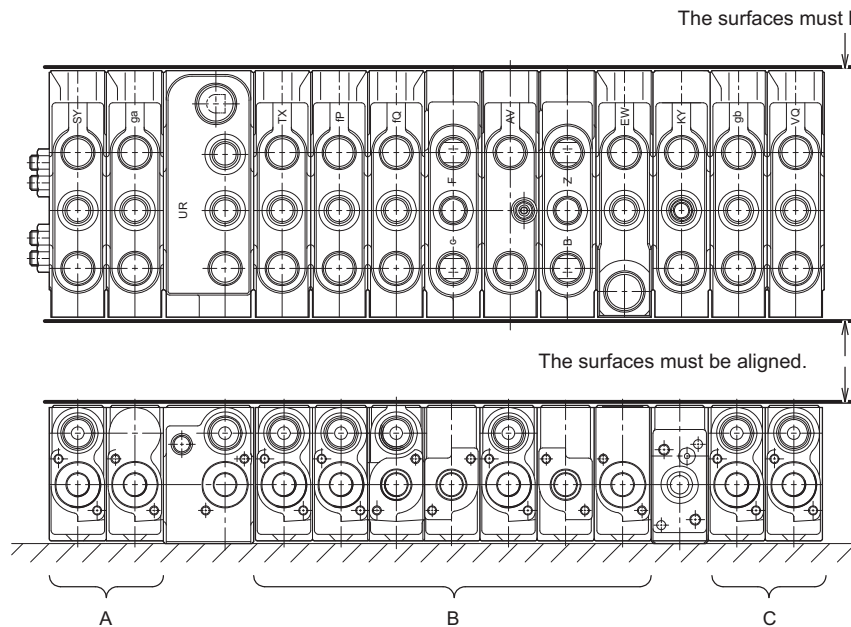
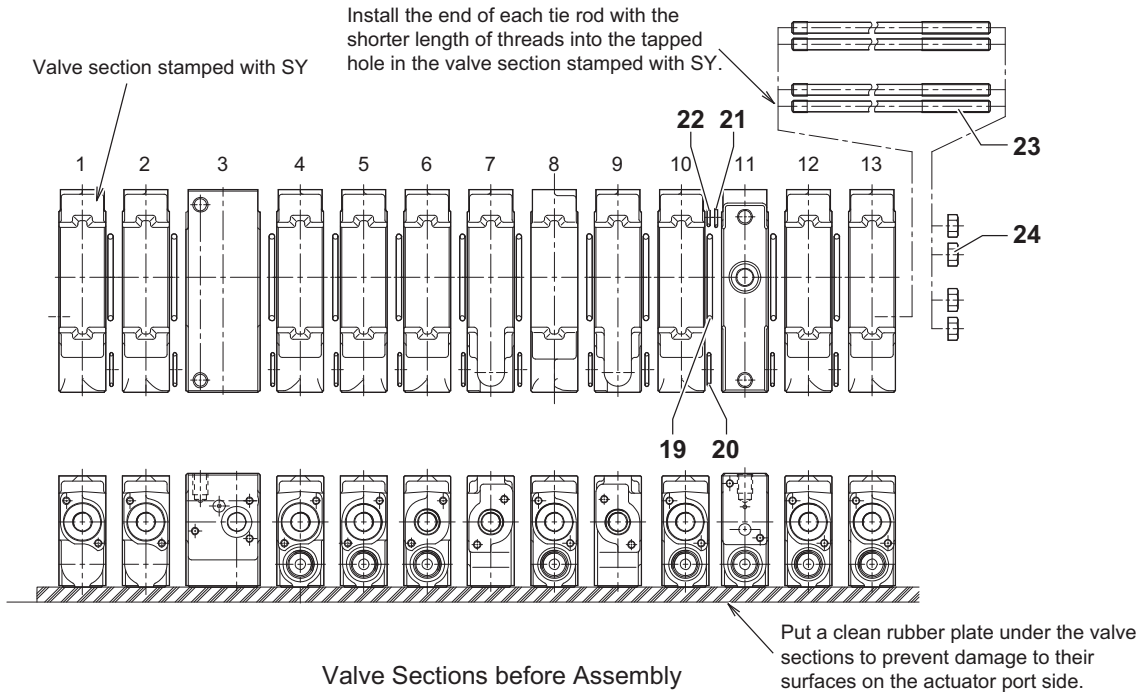
| No. | Part |
|-----|--|
| 1 | Anti-drift valve |
| 2 | Cap seal 1 BE10 |
| 3 | Filter |
| 4 | Spacer |
| 5 | Snap ring AR7 |
| 6 | Anti-drift valve spring A |
| 7 | Spring holder |
| 8 | O-ring AS 1B17 |
| 9 | Needle valve |
| 10 | Internal snap ring 9 |
| 11 | O-ring 1A P6 |
| 12 | O-ring 1B P8 |
| 13 | Piston guide |
| 14 | Piston A1 |
| 15 | Piston B |
| 16 | O-ring 1B P18 |
| 17 | Bush PF1/2×1/4 |
| 18 | Steel ball $\varnothing 0.28$ in. (7 mm) |
| 19 | Ball retainer |

6. HYDRAULIC EQUIPMENT

Order of Assembly of Valve Sections

| No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|-----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Identification Symbol | SY | ga | UR | TX | fP | fQ | cF | AV | BZ | EW | KY | gb | VQ |

Note: Identification symbols are stamped on the top surfaces (on the actuator port side) of the valve sections.

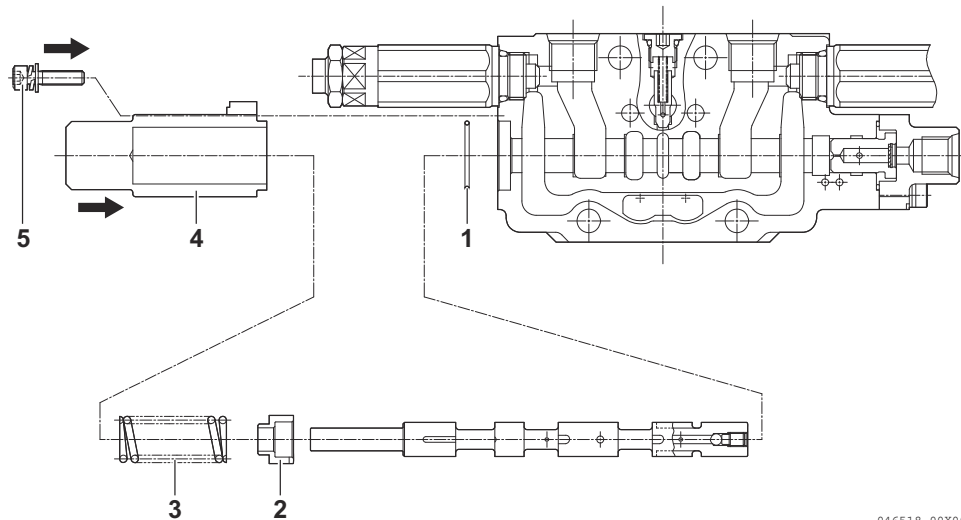


Note: When the control valve assembly is placed with the actuator port side up, there is a clearance of 1.5 mm between the end faces of the valve sections marked with A, B and C in the figure above and the contact surface of the control valve assembly with the surface plate.

046538-00EN00

6. HYDRAULIC EQUIPMENT

(3) P1/P2 inlet section (straight travel valve section)



Straight travel valve section

- [1] Check that no dirt or any other foreign matter is attached to the spool assembly or around the spool bore of the valve body and that O-ring **1** is securely installed on the flanged bottom of the valve body. Then insert the spool assembly into the spool bore of the valve body in the correct position and direction.

Note:

Before inserting the spool assembly, apply a small amount of hydraulic oil to the spool.

CAUTION:

Carefully insert the spool assembly horizontally into the bore.

If the spool assembly is not inserted easily, do not force it into the bore. Doing so may cause dents inside the bore or on the spool, resulting in malfunction of the machine.

If the spool assembly is not installed into the bore smoothly, do not forcibly insert it. Remove it and check it for dirt, flaws and burrs.

If there are any flaws or burrs, be sure to replace the spool assembly together with the valve body to avoid malfunctions.

Note:

Even if the spool assembly is inserted smoothly, take it in and out several times to check again that it moves smoothly.

- [2] Install return spring retainer **2** and return spring **3** in this order onto the portion of the spool assembly protruding from the valve body.
- [3] Install pilot oil chamber case **4** so that it fits securely onto the flange portion of the valve body from which the spring installed on the spool assembly is protruding. Then install and tighten hexagon socket head bolts (w/ washer) **5** to the specified torque with a hexagon bar wrench (4 mm).

6. HYDRAULIC EQUIPMENT

3. Fundamental Rules

1) General Information Concerning Pilot Control Unit Connection

When removing the pilot control unit, all openings must be plugged immediately to prevent any contamination of the hydraulic system.

When replacing the pilot control unit, remove the plastic plugs from the openings and lines just before making the connections.

Do not tighten connectors to a torque greater than that specified in the assembly instructions.

Check the hydraulic installation's oil quality and filtration capacity during all servicing/maintenance operations.

The use of teflon tape, hemp and joint filler is prohibited.

Hydraulic lines and connections must not be under any strain whatsoever.

4. Removal / Installation of the Pilot Control Unit Connection

1) General Recommendations

CAUTION :

Before removing the pilot control unit from the machine, the block and its surroundings must be thoroughly cleaned with a high-pressure cleaner.

No impurities must enter the hydraulic system. Plastic plugs are to be fitted on lines and orifices immediately following their removal.



Wear protective clothing and use suitable equipment to prevent accidents, particularly concerning the hydraulic fluid.

Set all actuators connected to the machine in neutral position (on the ground, at lower limit...) to avoid accidents which could result from uncontrolled movements of the equipment when the hydraulic system is disconnected.

With the machine off, release the pressure remaining in the system by manipulating all of the distribution spools. This is performed by moving the handle in all directions.

2) Pilot Control Unit Removal

Immediately after disconnecting the lines from the control device, fit the sealing plugs. Make sure to collect any possible oil leakage in a suitable receptacle.

Unscrew the mounting screws and remove the control device.

3) Installation of the Hydraulic Pilot Control Unit

Contact faces must be perfectly clean.

Check the evenness of the support area on the machine (tolerance : 0.5 mm).

Check the condition of the line connector seals.

Clean the pilot control unit if it has been in storage for a long period of time.

Correctly place and secure the pilot control unit onto the machine with the mounting screw (maxi torque : 10 N·m).

Connect the lines to the control unit as per the connecting diagram and tighten to the torque specification (maxi torque : 30 N·m).

Ensure that the hoses are not twisted or rubbed.

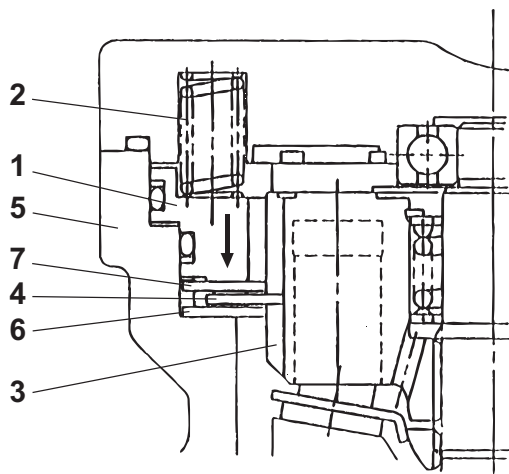
Once correctly installed, the unit can be placed into operation.

6. HYDRAULIC EQUIPMENT

2) Mechanical Brake

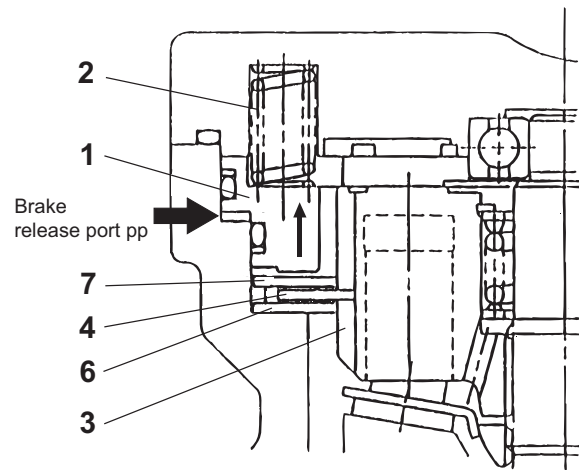
The mechanical brake serves to mechanically lock the output shaft of the swing motor while the motor is stopped. When the brake release pressure is in the OFF state, the brake piston 1 is kept pressed by the spring 2 in the arrowed direction in Fig. A. In this state, the disc plate 4 fixed to the cylinder barrel 3 by the semicircular groove is put between the steel plates 6 and 7 fixed to the body S 5 in the same way as the disc plate. Consequently, the frictional force between the disc plate 4 and the steel plates 6 and 7 disables the rotation of the cylinder barrel 3, and therefore, the output shaft of the swing motor is locked. (See Fig. A.)

When the brake release pressure is turned ON, the hydraulic oil is led to the brake release port and the oil pressure which exceeds the force of the spring 2 moves the brake piston 1 in the arrowed direction in Fig. B. Consequently, the disc plate 4 and the steel plates 6 and 7 are disengaged and the frictional force between them is lost, and therefore, the cylinder barrel 3 can be rotated. (See Fig. B.)



Brake release pressure : OFF

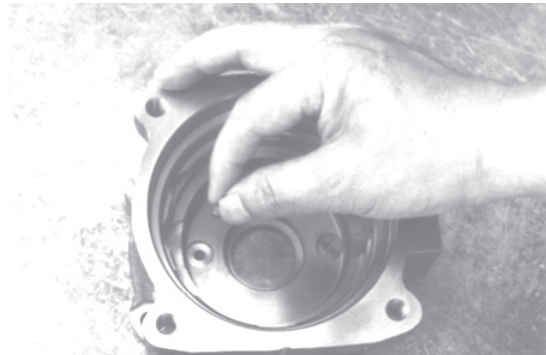
(Fig. A)



Brake release pressure : ON

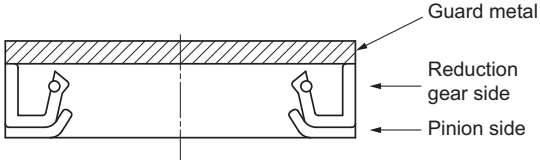
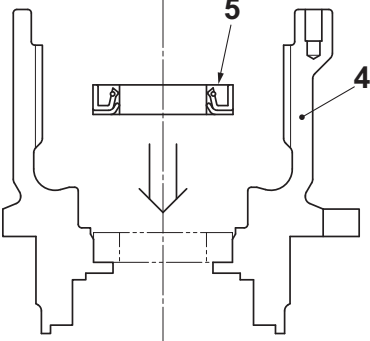
(Fig. B)


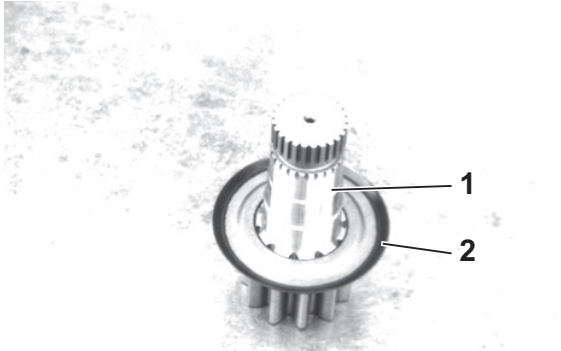
6. HYDRAULIC EQUIPMENT

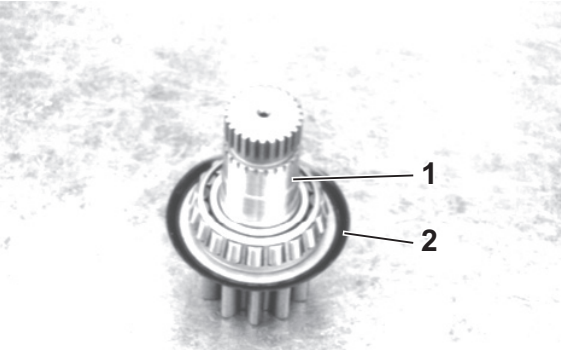
| Procedure | |
|---|---|
| (13) Remove two filters 33 and dowel pin 62 . |  A black and white photograph showing a person's hand reaching into a circular hydraulic component. The hand is positioned to remove a filter element from the center of the component. The component has a flange with four mounting holes around its perimeter. |

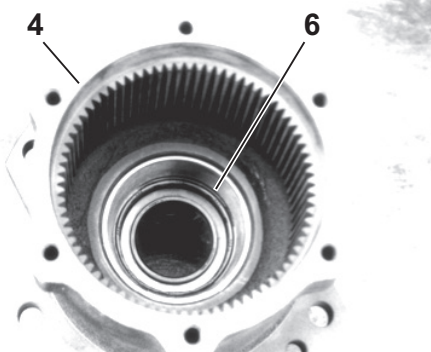
6. HYDRAULIC EQUIPMENT

2. Reduction Gear [(25) - (48)]

| Procedure | |
|--|--|
| <p>(25) Press-fit oil seal 5 into main body 4.</p> <p>Note : Install oil seal in the correct direction and by using guard metal to prevent oil seal from slanting. (Outer diameter of guard metal : $\text{Ø}2.93$ in. ($\text{Ø}74.5$ mm))</p>  |  |

| | |
|---|---|
| <p>(26) Install ring 2 onto pinion shaft 1.</p> <p>Note : The installing direction of ring is shown below.</p>  |  |
|---|---|

| | |
|---|--|
| <p>(27) Press-fit inner race of taper-roller bearing 3 onto pinion shaft 1.</p> <p>Note : After press-fitting, apply grease to surfaces of rollers of bearing and rotate rollers to spread grease on whole areas of rollers.</p> |  |
|---|--|

| | |
|--|--|
| <p>(28) Press-fit outer race of taper-roller bearing 6 into main body 4.</p> |  |
|--|--|

6. HYDRAULIC EQUIPMENT

2. Theory of Operation

1) Motor

When the travel section of the control valve is switched to "Travel", the hydraulic oil flows through the counter balance valve to the port A of the valve plate **46**.

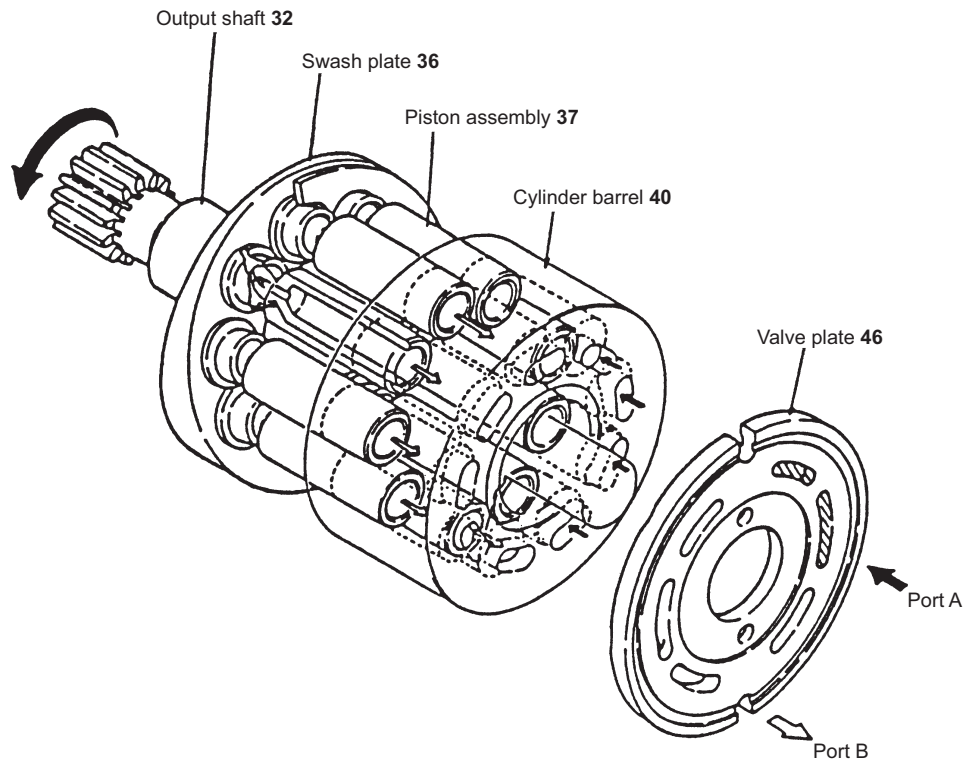
When the pressure at the port A rises, the hydraulic oil flows into the bores corresponding to the port A in the cylinder barrel **40**.

When the hydraulic oil flows into the bores, the pistons are pressed against the sliding surface of the swash plate **36**, and the shoes fitted on the pistons slide on the sliding surface of the swash plate **36** towards the circumference. That motion of more than one piston on the high pressure side is converted into the rotational motion of the cylinder barrel **40**.

The output shaft splined to this cylinder barrel **40** also starts to rotate together with the rotation of the cylinder barrel **40**.

When the pistons move to the low pressure side, the pistons are pushed into the bores and discharge hydraulic oil from them. The hydraulic oil discharged from the cylinder barrel **40** flows through the port B of the valve plate **46** to the return passage.

When the travel section of the control valve is switched to the opposite side, the pressure at the port B becomes high and the pressure at the port A becomes low, so that the rotation of the output shaft is reversed.

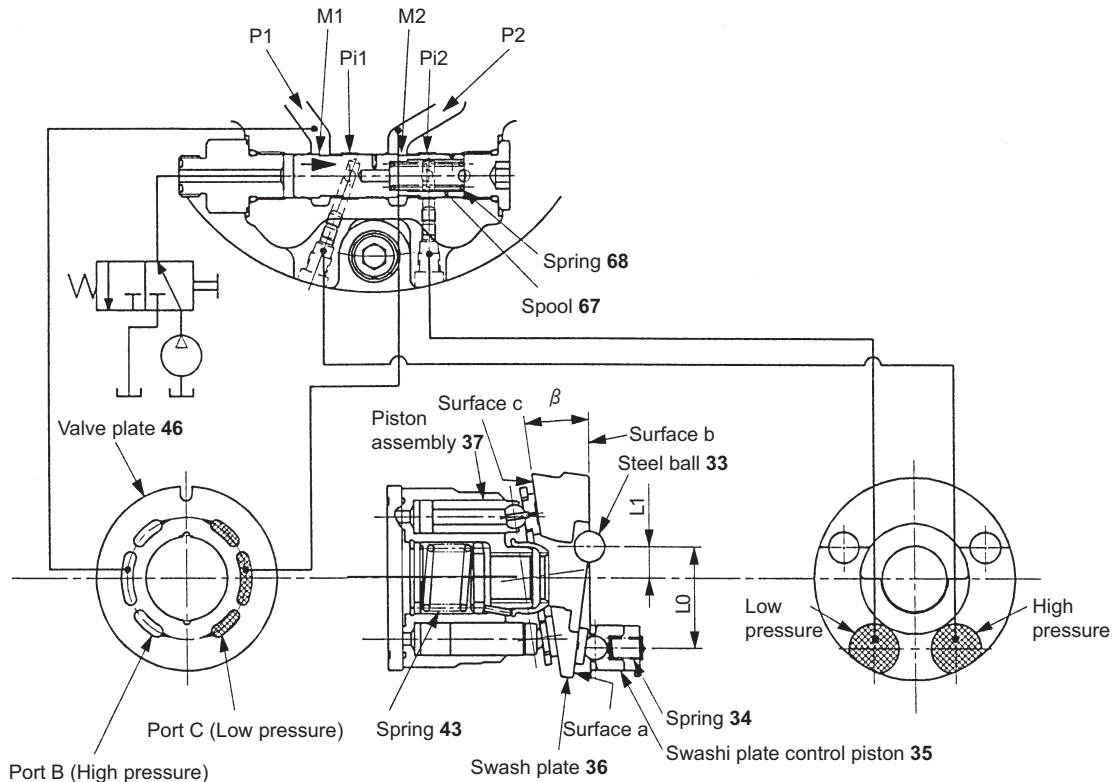


6. HYDRAULIC EQUIPMENT

(2) 2nd speed (high speed)

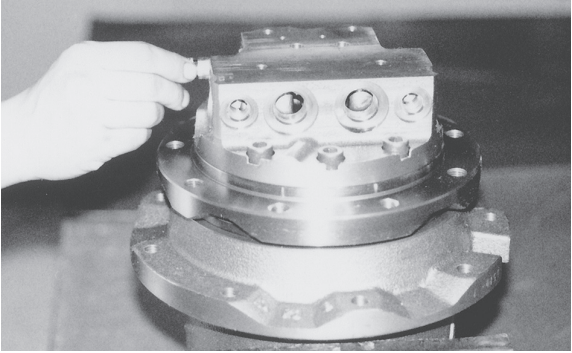
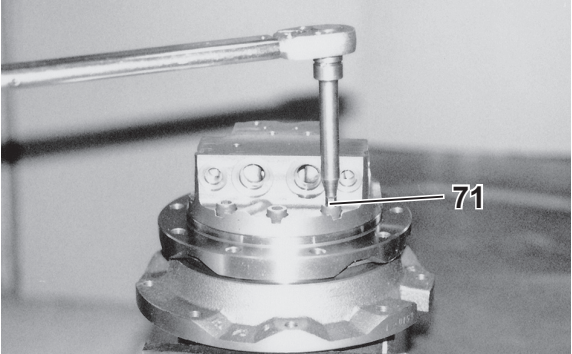
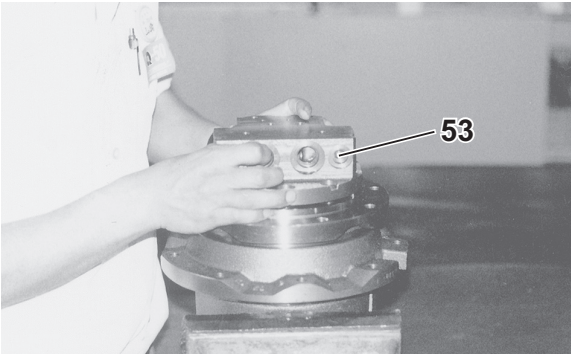
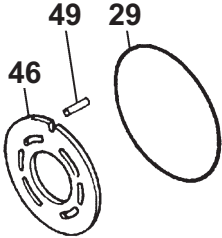
When the control valve is switched to the 2nd speed position, the pressure oil from the pump is led to the end face of the spool **67** and the spool is shifted to the position as shown in the figure below. This causes the ports M1 and M2 to open and the hydraulic oil from the port A (high pressure) in the valve plate **46** of the motor is supplied to the swash plate control piston **35** through the valve port M1. This pressure oil pushes up the swash plate control piston **35**, which overcomes the motor thrust force and the spring force, and the surface a of the swash plate **36** is detached from the vertical surface with the steel balls as the inclination axis to cause the surface b to be contacted with the vertical surface tightly. When the surface b contacts with the vertical surface, the inclination angle of the surface c, which is the sliding surface of the swash plate **36**, is reduced to " β ". Accordingly, the stroke of the piston **37** is reduced to lower the motor displacement. The motor with smaller displacement rotates faster (2nd speed). When the motor revolves in reverse, the same action as the above occurs, except that the high and low pressure ports are reversed.

When the engine is stopped, since no pumps work, no pressure oil is supplied to the end face of the spool **67** and the spool **67** returns to the 1st speed position by the spring **43** force. Accordingly, no force is applied to the swash plate control piston **35** to press the swash plate **36**, and the swash plate **36** maintains its 1st speed inclination angle " α " through the spring force. Thus, the 1st speed condition is always maintained at starting.

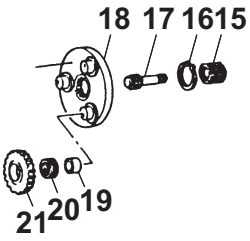
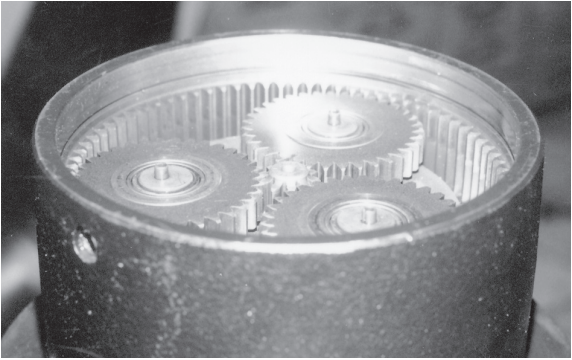
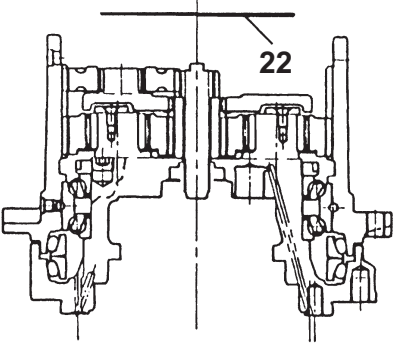
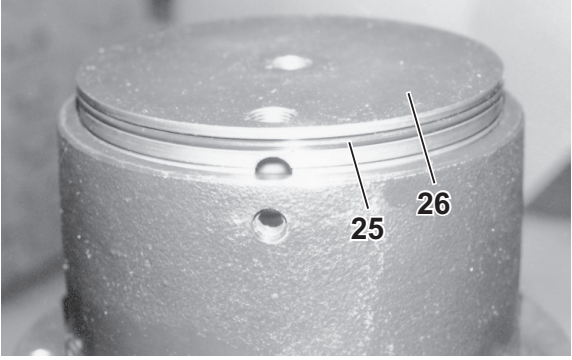
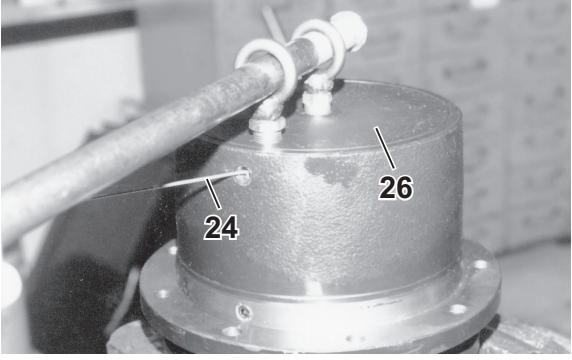


2nd speed (High speed)

6. HYDRAULIC EQUIPMENT

| Procedure | |
|--|---|
| <p>(9) Remove spring 68 and spool 67.</p> <p>Note : <i>Take care not to damage or dent the outside of the spool.</i></p> |  |
| <p>(10) Remove six hexagon socket head bolts 71.</p> <p>Tool :</p> <ul style="list-style-type: none">• Torque wrench (3)• Hexagon bit (10) |  |
| <p>(11) Remove base plate 53.</p> <p>Notes :</p> <ul style="list-style-type: none">• <i>When the base plate cannot be removed easily, tap it in the pulling-out direction with a plastic hammer. If it is still not removed, pry it up lightly with a screwdriver.</i>• <i>Take care that the cylinder barrel is not pulled out.</i> <p>Tools :</p> <ul style="list-style-type: none">• Plastic hammer (17)• Screwdriver (15) |  |
| <p>(12) Remove valve plate 46, O-ring 29 and pin 49.</p> |  |

6. HYDRAULIC EQUIPMENT

| Procedure | |
|---|--|
| <p>(12) Install sun gear 15 fitted with external snap ring 16, inner races 19, holder 18, planetary gears A 21, cage & rollers 20, and drive gear 17.</p>  |  |
| <p>(13) Install thrust plate 22.</p> |  |
| <p>(14) Apply grease to O-ring 25 and install it to cover 26. Install the cover on housing 6 with the U-groove aligned with the tapped hole for plug 8 in housing 6.</p> <p>Tool :</p> <ul style="list-style-type: none"> • Plastic hammer (17) |  |
| <p>(15) Bend the end of wire 24 by about 0.24 in. (6 mm) at an angle of 90 degrees and insert it into the tapped hole in housing 6. Turn cover 26 to draw in wire 24.</p> <p>Tools :</p> <ul style="list-style-type: none"> • Eye bolt (S-1) • Round rod (S-15) <p>(16) Wind a seal tape around plug 8 and tighten it.</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <p>Tightening torque : 50.6 to 88.3 ft·lbf (7 to 9 N·m)</p> </div> <p>Tools :</p> <ul style="list-style-type: none"> • Torque wrench (1) • Hexagon bit (7) |  |

6. HYDRAULIC EQUIPMENT

7. Troubleshooting

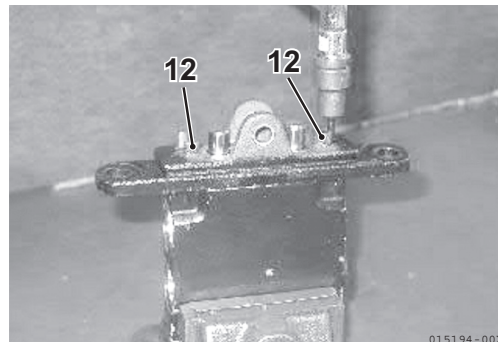
1) Motor

| Trouble | Cause | Measure |
|---|--|--|
| 1. Motor does not rotate. | 1) Malfunction of equipment other than motor, counter balance valve and reduction gear. | Check whether the specified volume of hydraulic oil is fed to the motor suction side. Then, check and repair each part. |
| | 2) Escape of pressure oil due to excessive wear of motor's sliding parts. | Replace any excessively worn parts. Repair any flaws or burrs on the surfaces, clean all the parts and reassemble them. |
| | 3) Malfunction due to breakage of motor's sliding parts. (In this case, motor makes an abnormal sound). | Disassemble the motor and replace any broken parts. Clean all the parts and reassemble them. |
| | 4) Relief valve operates due to too much load applied to motor. | Check the load and regulate it to the value corresponding to the set relief pressure. |
| 2. Motor speed is low. | 1) Specified volume of oil is not being supplied to motor due to failure of hydraulic pump, system relief valve, etc. | Check whether the specified volume of hydraulic oil is fed to the motor suction side. Then, check and repair each part. |
| | 2) Specified speed is not obtained due to drop of motor's displacement. | After disassembling the motor, check them for excessive wear of the sliding parts. Repair or replace any worn parts. |
| 3. Large fluctuation in motor revolutions | 1) A large volume of high pressure oil leaks and flows out from drain port due to wear of motor's parts, causing a large drop and fluctuation in motor revolutions. The fluctuation is also caused by worn bearing. | After disassembling the motor, check the parts and replace any worn parts. Clean all the parts and reassemble them. |
| 4. Oil leak | 1) Breakage of oil seals or O-rings. | Replace any broken oil seals and O-rings. Take care not to damage the lip of the oil seal. Apply a small amount of grease to O-rings before assembly. |

6. HYDRAULIC EQUIPMENT

Procedure

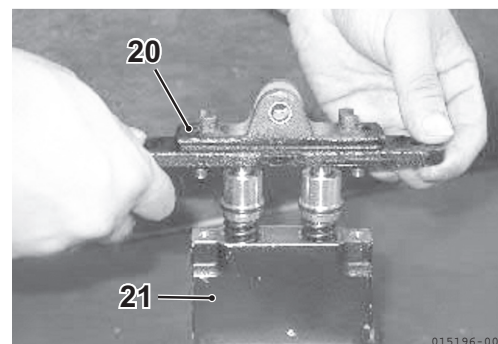
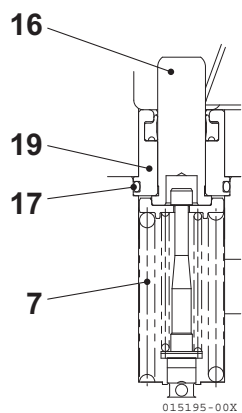
(7) Remove two allen head cap screws **12**.



(8) Remove cover **20**.

Note :

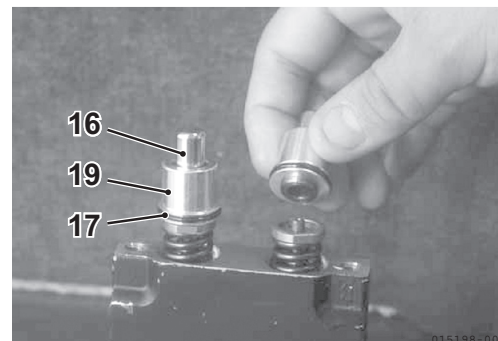
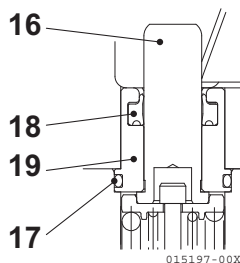
- Put marks on casing **21** and cover **20** to reassemble them as they were.
- When removing, take care of push rod **16** and plug **19** for popping out by spring **7** (plug **19** may remain in casing **21** but it must be temporary due to friction of O-ring **17**).



(9) Remove plug **19** with push rod **16**, gasket **18** and O-ring **17**.

Note :

Put marks on plug **19** and casing **21** to reassemble them as they were.

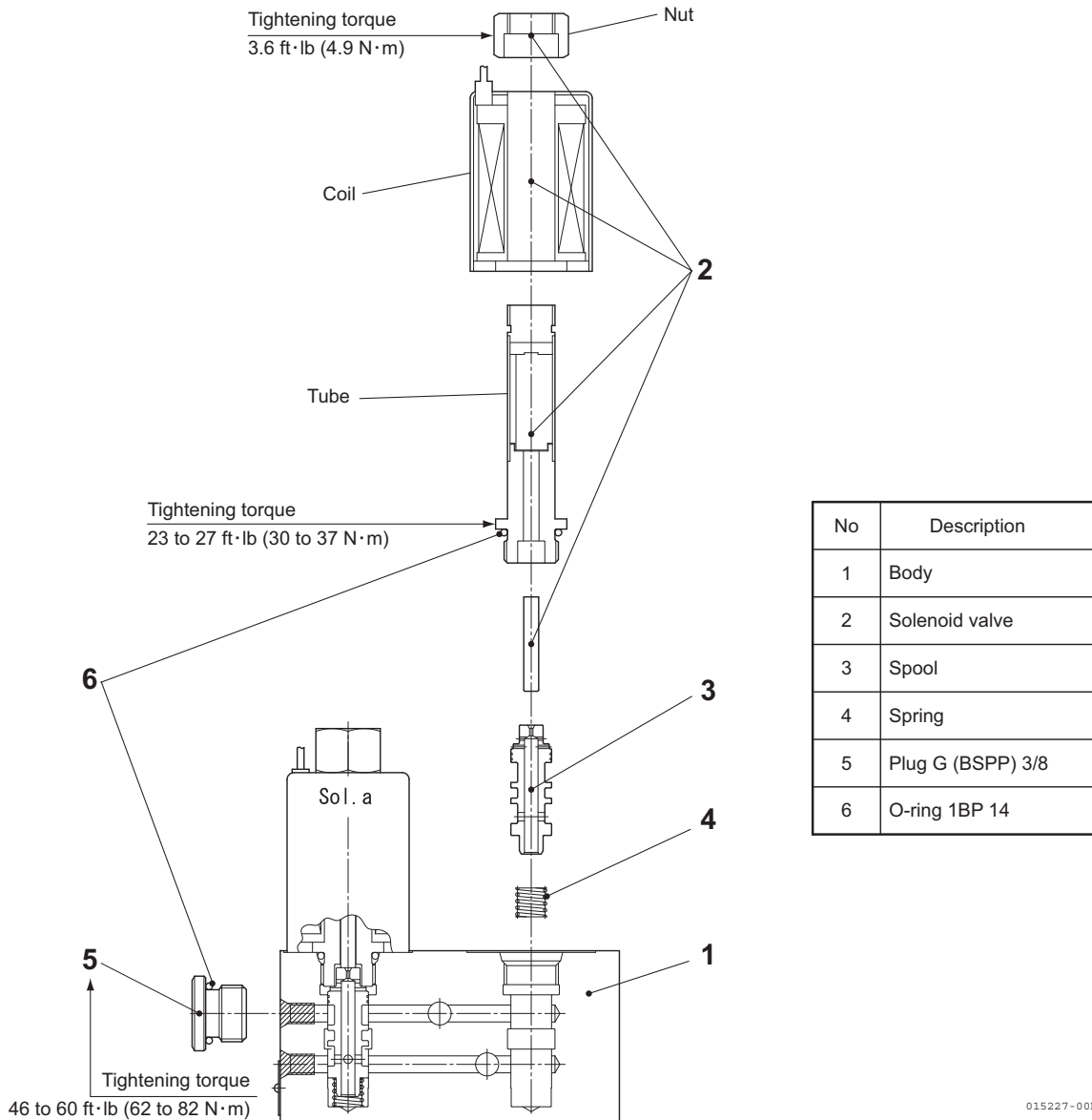


6. HYDRAULIC EQUIPMENT

3. Disassembly and Reassembly

1) Precautions

- (1) Take care not to damage O-rings and inner parts when disassembling and storing.
- (2) Damaged O-rings and inner parts must be replaced with new ones.
- (3) Take care of direction of parts installing and of reinstalling all removed parts.
- (4) Reassemble all parts in reverse order of disassembling and take care for dust or foreign materials.



2) Disassembly/Reassembly of Solenoid Valve

- (1) Loosen nut to remove coil. (Wrench: Hex 19 mm)
- (2) Loosen tube to remove it. (Wrench: Hex 21 mm)
- (3) Remove spool **3** and spring **4**.
- (4) Reassemble all parts in reverse order. Take care not to damage Hex part of tube.

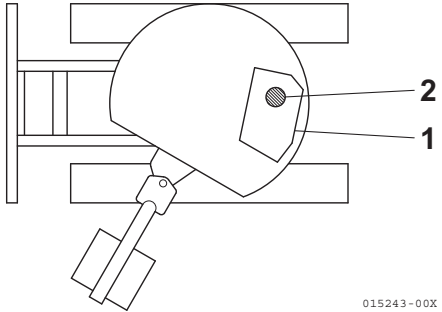
ADJUSTMENT AND REPAIR

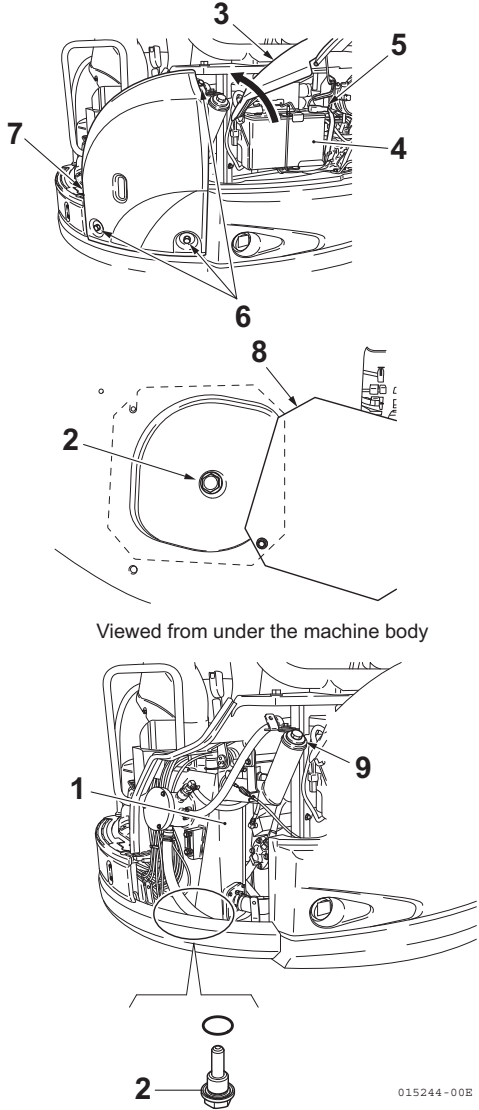
| | |
|---|--------|
| 7-1 Electric Equipment of Machine | 7-1-1 |
| 7-1-1 Parts Layout of Electrical Equipment | 7-1-1 |
| 7-1-2 Monitor and Alarm Systems | 7-1-4 |
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| 7-2-10 Drawings of Jigs | 7-2-13 |
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| 7-3 Controls | 7-3-1 |
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| 7-3-2 Mechanical Control Linkage | 7-3-2 |
| 7-3-3 Adjustment of Travel Levers | 7-3-4 |
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| 7-5-1 Removal and Reinstallation of Hydraulic Pump | 7-5-1 |
| 7-5-2 Removal and Reinstallation of Control Valve | 7-5-3 |
| 7-5-3 Removal and Reinstallation of Swing Motor | 7-5-6 |
| 7-5-4 Removal and Reinstallation of Swivel Joint | 7-5-9 |
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| 7-6 Work Implements | 7-6-1 |
| 7-6-1 Removal and Reinstallation of Work Implements | 7-6-1 |
| 7-6-2 Quick Coupler | 7-6-10 |
| 7-7 Cabin | 7-7-1 |
| 7-7-1 Cabin | 7-7-1 |

7. ADJUSTMENT AND REPAIR

7-1-5 Removal and Reinstallation of Engine

1) Removal

| Procedure | |
|--|--|
| <p>(1) Swing the upperstructure so that the drain plug 2 of hydraulic oil reservoir 1 can position in the middle of the tracks. Then lower the bucket to the ground and stop the engine.</p> |  <p>015243-00X</p> |

| | |
|--|---|
| <p>(2) Open the engine hood rear cover 3 and remove it.</p> <p>(3) Disconnect the battery negative cable 5 from the battery 4.</p> <p>(4) Loosen three cap screws 6 to remove the side cover 7.</p> <p>(5) Remove the bottom cover 8 and put an oil container under the drain plug 2 of the hydraulic oil reservoir.</p> <p>(6) Remove the drain plug 2 to drain hydraulic oil.</p> <p>(Q'ty: 10 Gal(38L))</p> <p>At this time, loosening or removing the filler cap 9 make oil draining easier.</p> |  <p>015244-00E</p> |
|--|---|

7. ADJUSTMENT AND REPAIR

7-1-7 Removal and Reassembly of Drive Belts for Generator and Compressor

1) Removal

| Procedure | |
|---|-------------------|
| <p>(1) Open the bonnet B1.</p> <p>(2) Loosen the hold bolts 3 of the generator 2 to loosen tension of the belt 4.</p> <p>(3) For the machine with the air conditioner, open the engine hood rear cover, loosen the cap screw 5 and adjuster screw 6, to loosen tension of the belt 7.</p> <p>(4) Remove the belts 4, 7.</p> | <p>015230-00E</p> |

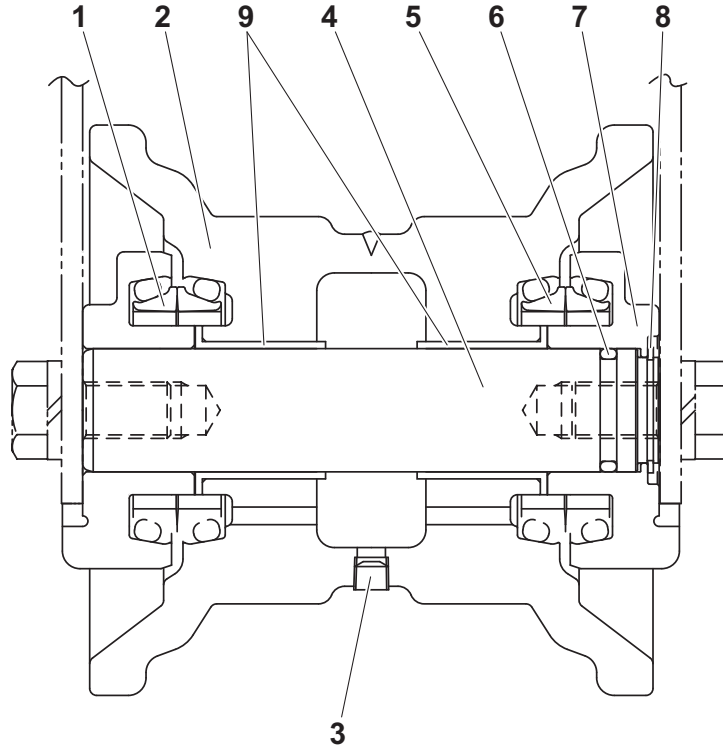
2) Reinstallation

Install the starter motor in the reverse order of the removal procedure.

7. ADJUSTMENT AND REPAIR

7-2-8 Disassembly and Reassembly of Track Roller

1) Structural Drawing and Component Part



| No. | Part | Q'ty | No. | Part | Q'ty |
|-----|-------------------------|------|-----|---------------------------|------|
| 1 | Floating seal | 1 | 6 | O-ring 1B P29 | 1 |
| 2 | Roller | 1 | 7 | Seal cover B | 1 |
| 3 | Plug PT1/8 | 1 | 8 | External snap ring C (30) | 1 |
| 4 | Shaft (with seal cover) | 1 | 9 | Bush | 2 |
| 5 | Floating seal | 1 | | | |

2) Disassembly

| Procedure | |
|---|--|
| <p>(1) Remove the track roller assembly 2 from the track frame. Installation bolt (M16)</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Adhesive Apply Three Bond 1324 or its equivalent.</p> </div> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Tightening torque : 152 to 181 ft·lbf (206 to 245 N·m)</p> </div> | |

7. ADJUSTMENT AND REPAIR

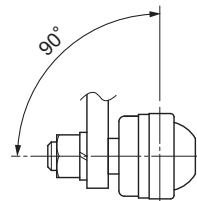
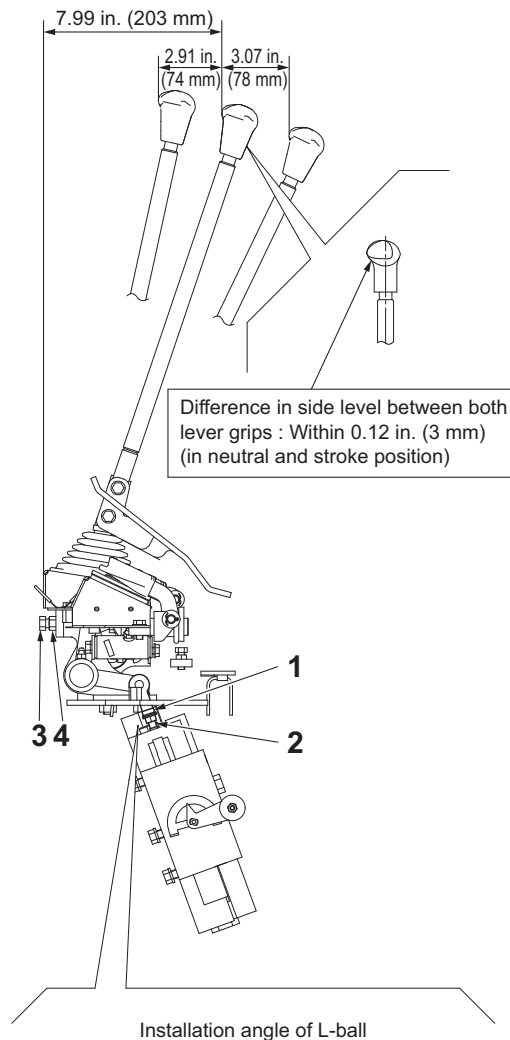
7-3-3 Adjustment of Travel Levers

1) Position of Travel Lever Grips

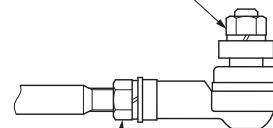
- (1) The difference in side level between the right and left lever grips : Within 0.12 in. (3 mm)
- (2) Adjustment
 - [1] Difference in side level
 - Loosen the nut **1** of the L-ball and rotate the rod **2** to adjust the positions of the lever grips to 7.99 in. (203 mm) from the frame front end.
 - After adjusting the difference in side level between the both levers to within 0.12 in. (3 mm), tighten the nut **1**.

2) Adjustment of Stopper Bolts (Forward and Reverse Travel)

- (1) Loosen the lock nuts **4** of the stopper bolts **3**.
- (2) Screw in stopper bolts **3** until they have no contact with travel lever.
- (3) Move the travel lever to its stroke ends, and loosen stopper bolts **3** until they contact with the travel lever.
- (4) Move the travel lever to the neutral position, loosen the stopper bolts **3** half a turn further and tighten lock nuts **4** to fix them.



Tightening torque :
9.40 to 12.3 ft·lbf (12.7 to 16.7 N·m)

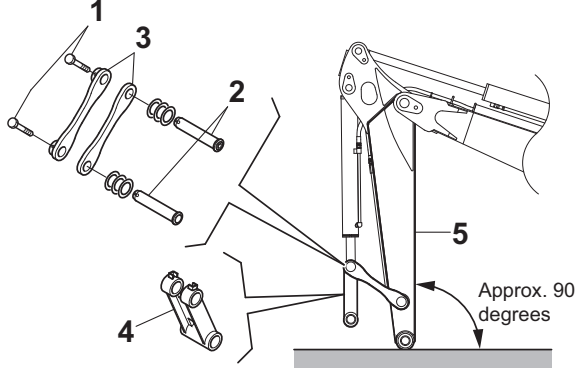
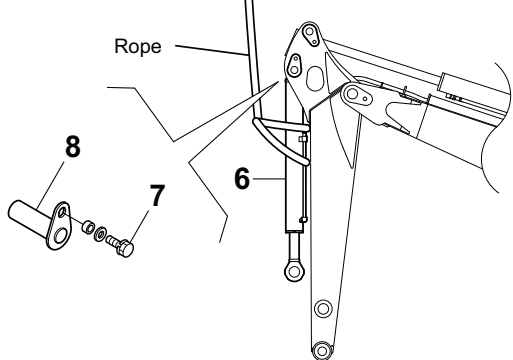
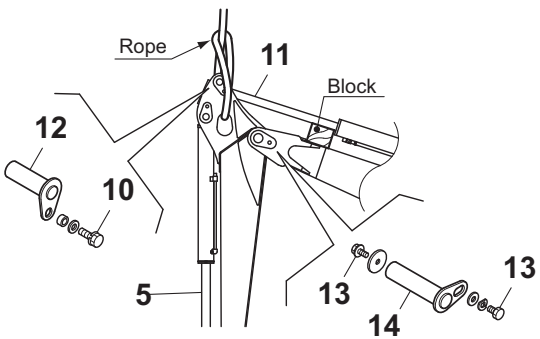


Tightening torque :
5.79 to 7.23 ft·lbf (7.8 to 9.8 N·m)

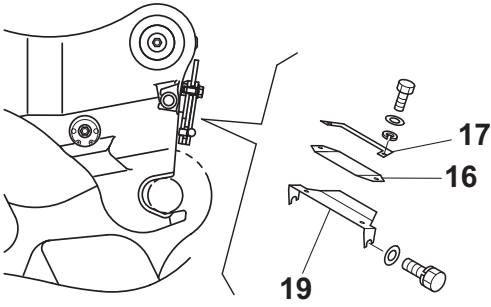
015237-00B

7. ADJUSTMENT AND REPAIR

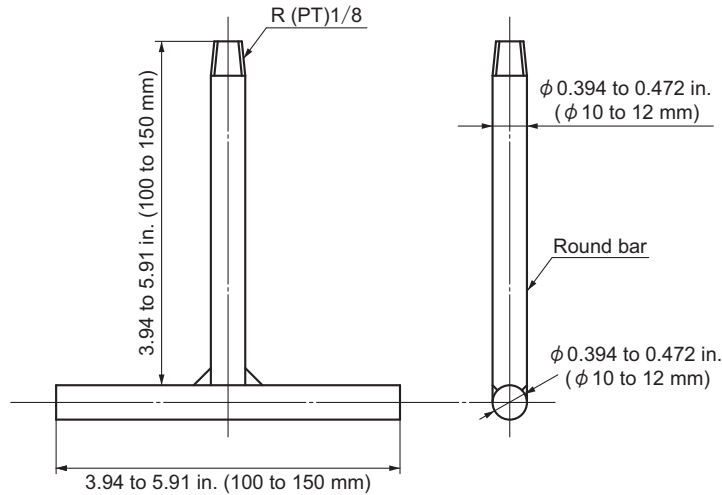
2) Removal of Arm

| Procedure | |
|--|--|
| <p>(1) Remove the bucket.</p> <p>(2) Remove the bolt 1 (M10) and pull out the pin 2 to remove the bucket link 3 and the bucket arm 4.</p> <p>(3) Lightly place the top end of the arm 5 on the ground perpendicularly to the ground.</p> |  |
| <p>(4) Remove the hydraulic hose from the bucket cylinder 6, and remove the bolt 7 (M10) to pull out the pin 8. Then remove the bucket cylinder 6.</p> <p>Note : <i>Put rope round the bucket cylinder to remove it using a lifting device.</i></p> |  |
| <p>(5) After putting rope onto the arm 5, remove the bolt 10 (M10) and pull out the pin 12 from the arm cylinder 11 on the rod side.</p> <p>Note : <i>Put a block under the arm cylinder.</i></p> <p>(6) Remove the bolts 13 (M12 and M14) to pull out the arm pin 14 and remove the arm 5.</p> |  |

7. ADJUSTMENT AND REPAIR

| Procedure | |
|---|--|
| (8) Remove the guard 19 , the rubber plate 16 and the plate 17 . |  |

3) Pin Puller Jig



4) Reassembly

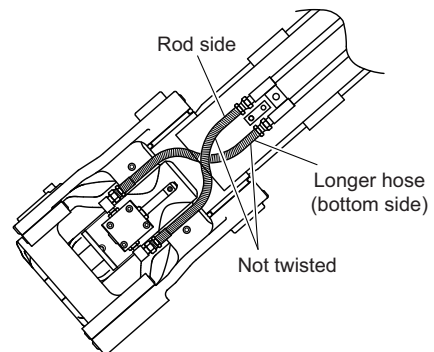
Reassemble the quick coupler in the reverse order of the disassembly procedure.

Notes :

- Install the hydraulic hoses in the way the longer one with a red identification mark is under the other one.
- After installing the hydraulic hoses, operate the quick coupler to check whether the hydraulic hoses are not twisted or caught.
- Apply multipurpose grease to O-ring (27.6 × 5.7).

Tightening torque

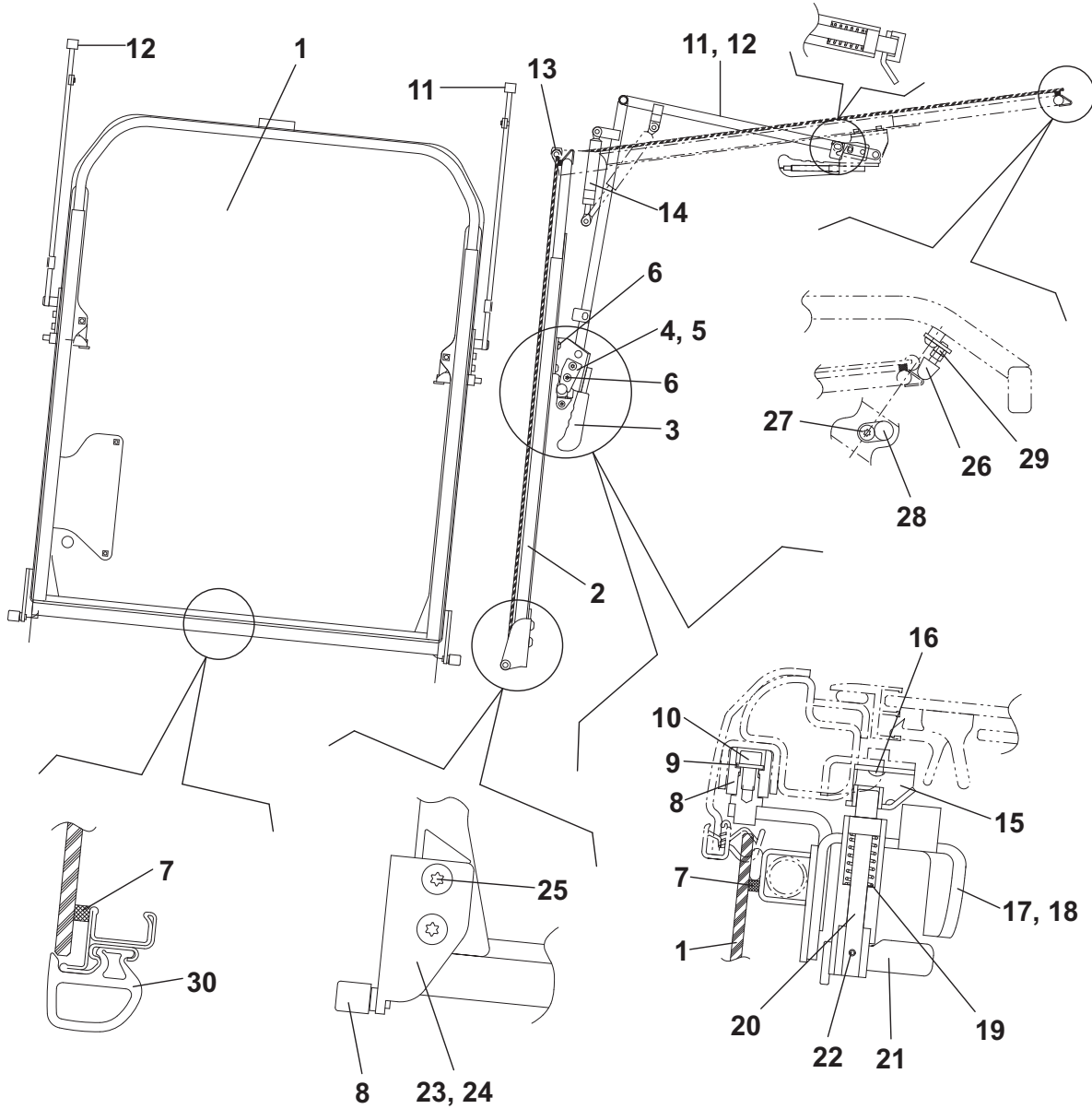
| Bolt size | Tightening torque | Adhesive |
|-----------------------------------|---|--------------------------------------|
| M12 | 57.9 to 72.3 ft-lbf (78.5 to 98.1 N·m) | Three bond 1324 or its equivalent |
| Hexagon socket head bolt M8 | 7.23 to 8.68 ft-lbf (9.81 to 11.8 N·m) | ↑ |



7. ADJUSTMENT AND REPAIR

4. Removal and Reinstallation of Front Window

1) Structure and Component Parts



| No. | Part | Q'ty | No. | Part | Q'ty | No. | Part | Q'ty |
|-----|---------------------------------|------|-----|----------------|------|-----|-----------------------|------|
| 1 | Windshield UP (front W) | 1 | 11 | Link L CMP | 1 | 21 | Lever CMP (F/W) | 2 |
| 2 | Frame CMP (front W) | 1 | 12 | Link R CMP | 1 | 22 | Spring pin 3.0A × 12 | 2 |
| 3 | Grip | 2 | 13 | Stopper rubber | 2 | 23 | Roller shaft L CMP | 1 |
| 4 | Latch L CMP | 1 | 14 | Gas damper | 2 | 24 | Roller shaft R CMP | 1 |
| 5 | Latch R CMP | 1 | 15 | F/W holder | 2 | 25 | Torques M10×20 | 4 |
| 6 | Bolt 8×16 | 8 | 16 | Torques | 4 | 26 | Stopper rubber (door) | 1 |
| 7 | Dam seal 750 (F/W) | 3 | 17 | Handle R CMP | 1 | 27 | Torques M10×20 | 1 |
| 8 | Roller 19.5×18 | 2 | 18 | Handle L CMP | 1 | 28 | Plate CMP | 1 |
| 9 | Polished washer 6 | 2 | 19 | Spring | 2 | 29 | Nut 10 | 1 |
| 10 | Hexagon socket head bolt (6×10) | 2 | 20 | Latch pin | 2 | 30 | Seal rubber (F/W) | 1 |

8. PERIODIC INSPECTION AND SERVICING

◇ : Check ○ : Supply ● : Replace □ : Adjust (clean) ■ : Oil & grease

| Check & service items | | Daily | Every 50 | Every 100 | Every 250 | Every 500 | Every 1000 | Every 2000 hrs |
|-----------------------------|---|-------|---------------|-----------|-----------|-----------|------------|-------------------|
| Fuel oil | Check & supply of oil to the tank | ◇ | | | | | | |
| | Drain the fuel tank | | □ | | | | | |
| | Clean the oil/water separator | | | □ | | | | |
| | Replace the fuel filter element | | | | | ● | | |
| Lube oil | Check the quantity of engine oil | ◇ | | | | | | |
| | Replace the engine oil | | ● 1st time | | | ● | | |
| | Replace the engine oil filter element | | ● 1st time | | | ● | | |
| Cooling water | Check & supply of cooling water | ◇ | | | | | | |
| | Clean radiator fins | | | | □ | | | |
| | Check the fan-belt tension | ◇ (□) | | | | | | |
| | Replace the cooling water | | | | | | ● | |
| | Clean & check the cooling water system | | | | | | | ● within two year |
| Rubber hose | Check & replace fuel oil pipe, cooling water pipe | | | | | | | ● |
| Operation system | Check & adjust governor lever, accelerator | ◇ | | | □ | | | |
| Intake system | Clean air cleaner & replace element | | | | □ | ● | | |
| | *Check turbocharger, adjust | | | | | | □ | |
| Cylinder head | Adjust the intake and exhaust valve clearance | | | | | | □ | |
| | Lapping the intake and exhaust valve | | | | | | | □ |
| | Retightening the cylinder head bolts | | | | | | □ | |
| Fuel pump & injection valve | Check fuel valve nozzle, clean | | | | | | □ | |
| | Check & adjustment of fuel injection pressure & atomizing condition | | | | | | □ | |
| | Check fuel pump, adjust | | | | | | | □ |

*Applicable to models with the relevant equipment

Note :

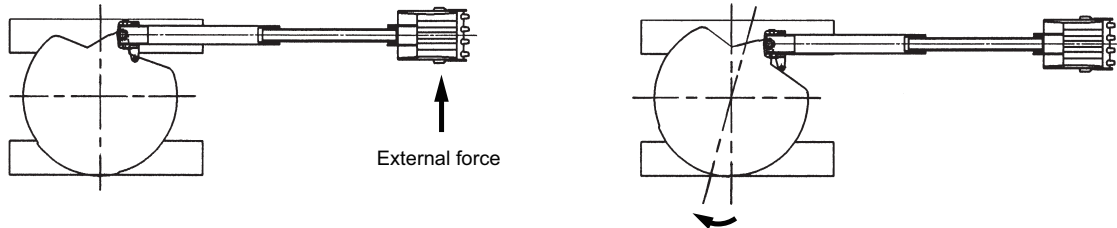
- When machine is used at dusty worksites clean and replace filter element twice or more frequently than specified in the table.
- Execution of periodic inspection and servicing is indispensable to conform the EPA emission control regulations. Keep a record of the results.

10. TROUBLESHOOTING

10-1-5 Elongation of Boom Swing Cylinder on 70 degrees Swing

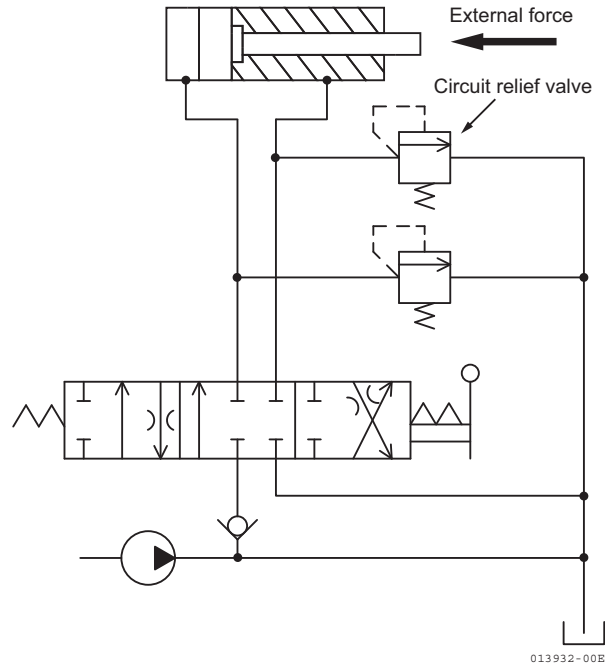
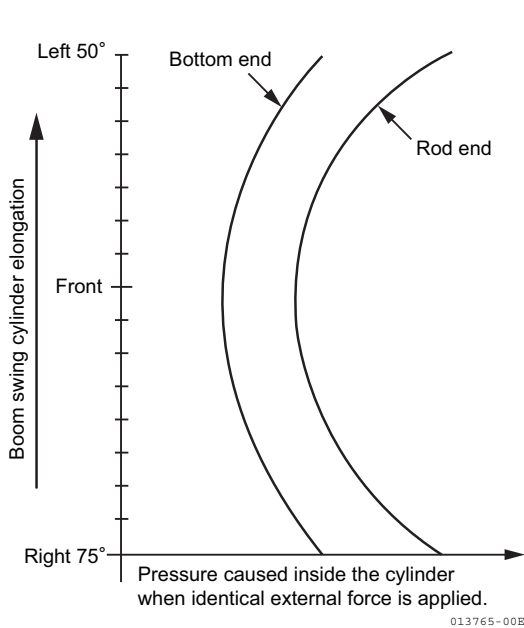
Phenomenon

The boom swing cylinder elongates in digging operation at a 70 degrees swing.

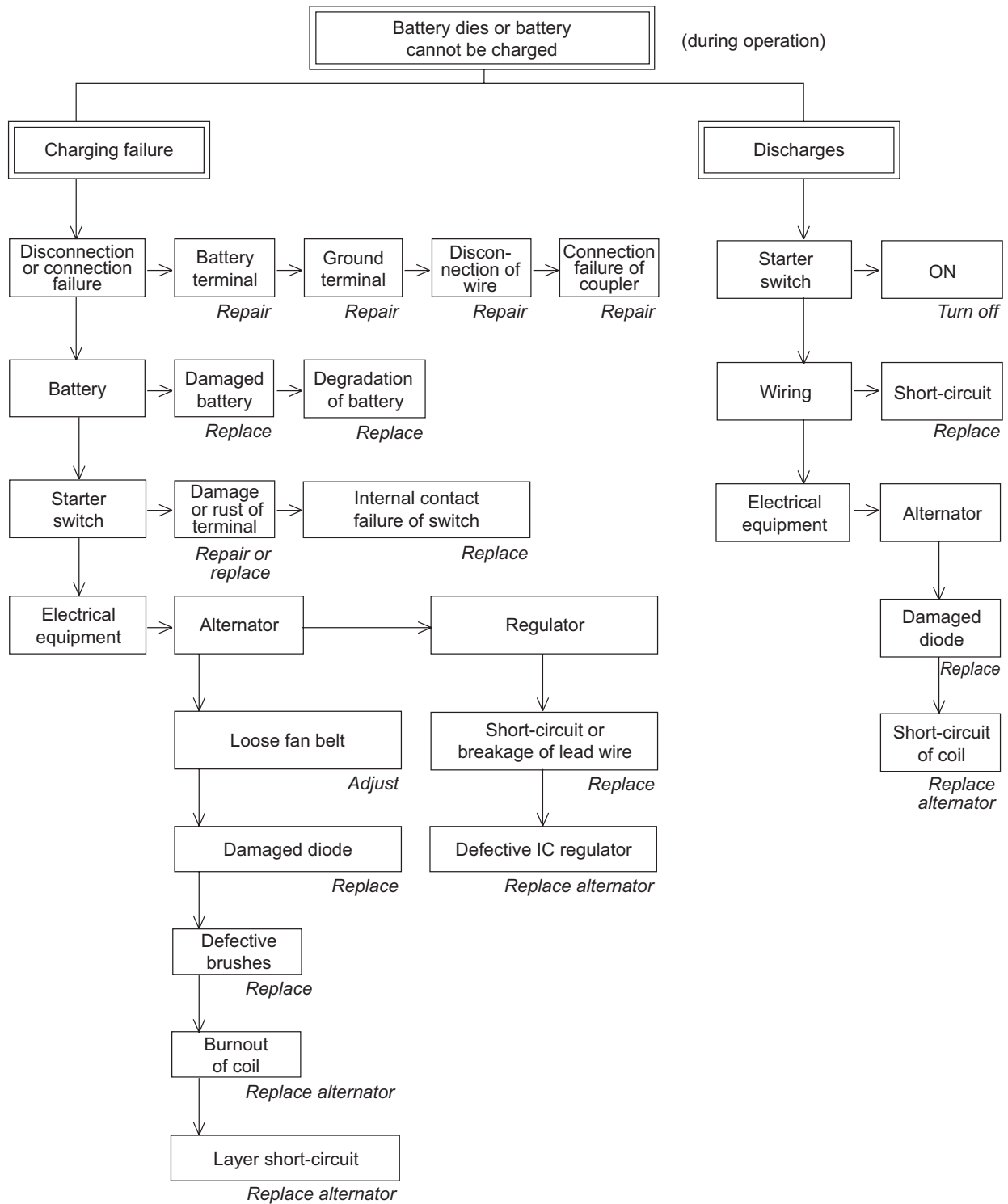


Reason

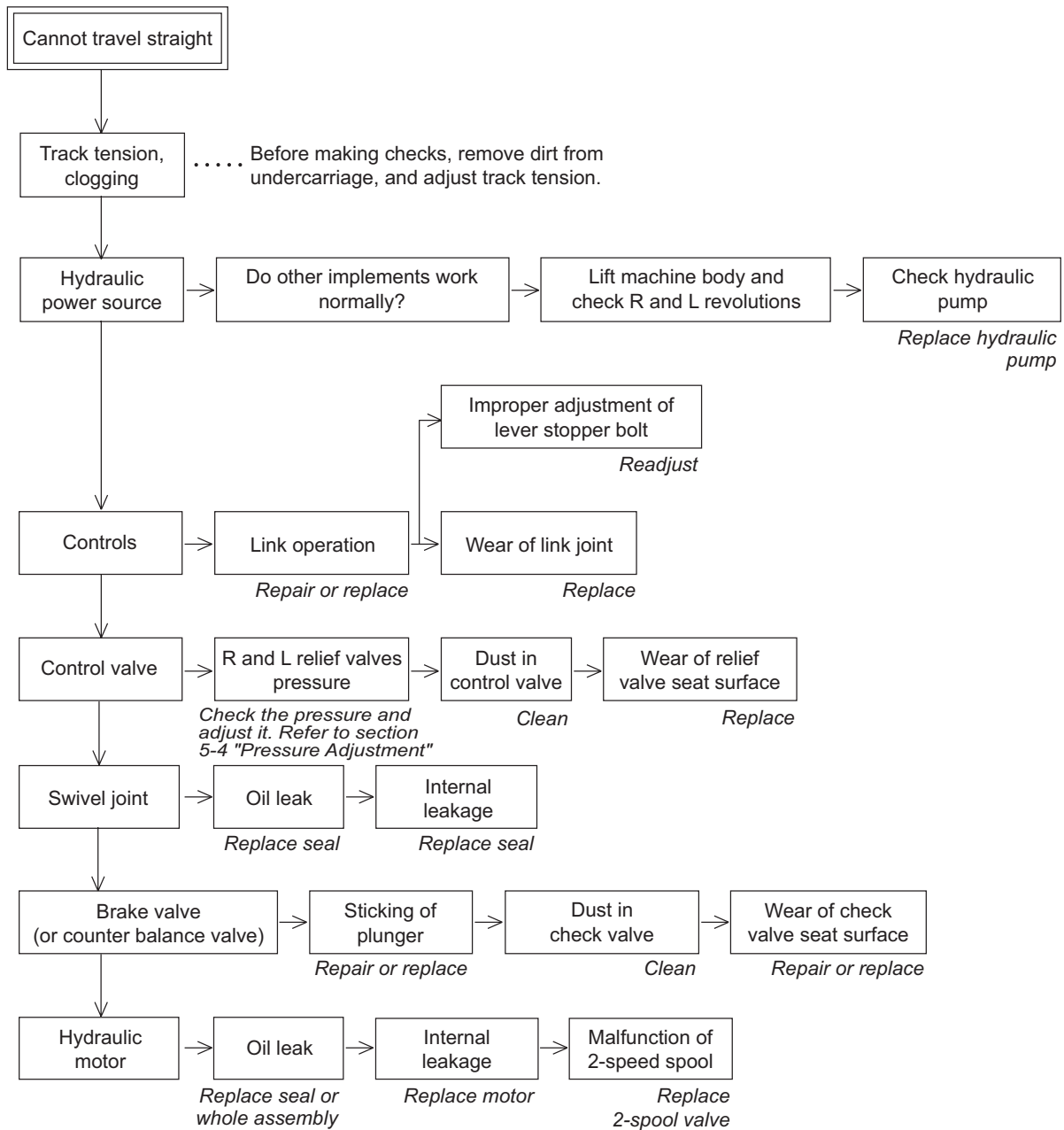
When an outside sideways force is applied to the bucket, the force extends (retracts) the boom swing cylinder. At the 70 degrees swing position, however, the cylinder's internal pressure is higher than in other positions due to the link ratio. This activates the circuit relief valve and elongates the boom swing cylinder.



10. TROUBLESHOOTING

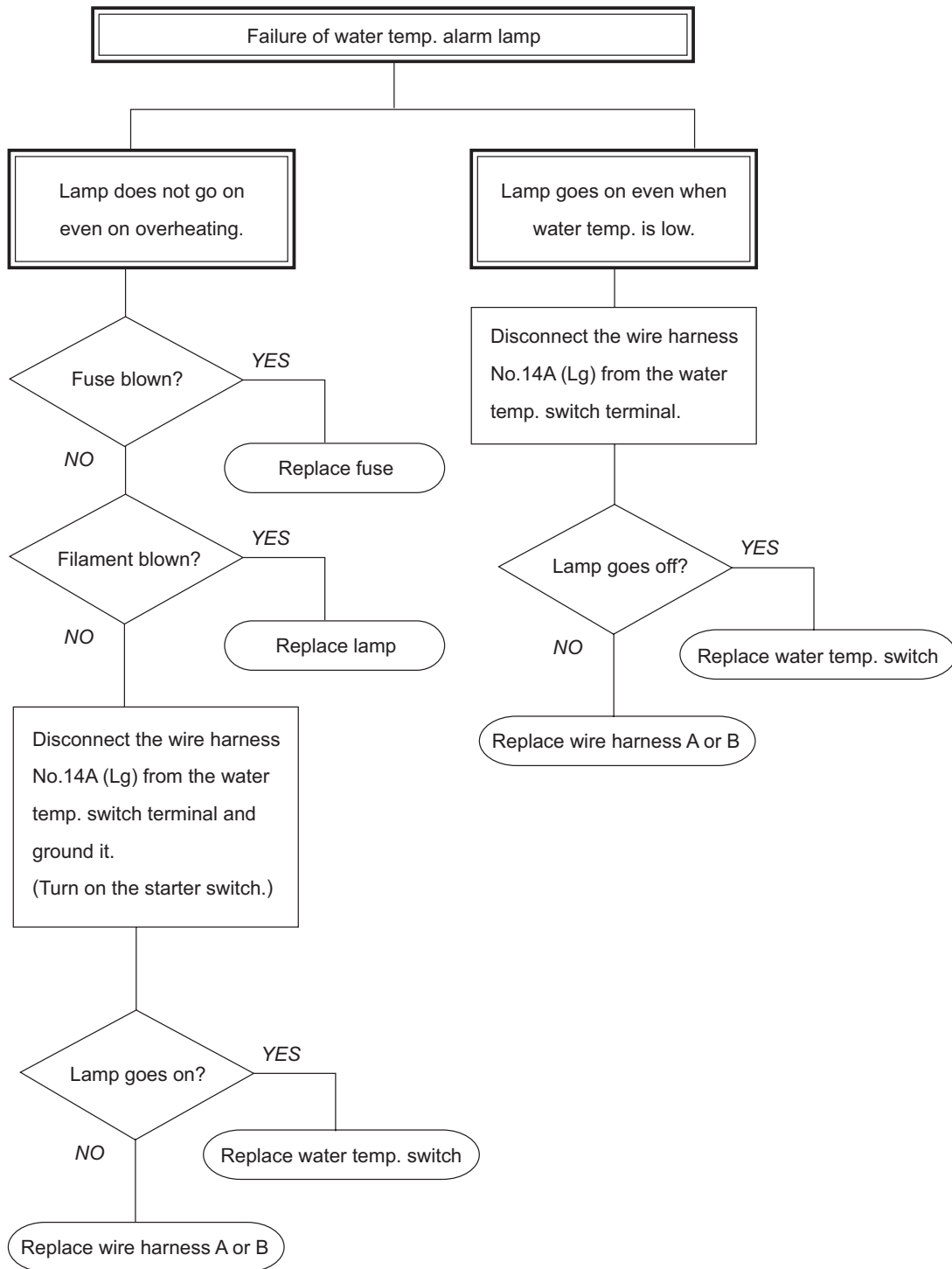


10. TROUBLESHOOTING



10. TROUBLESHOOTING

Water Temp. Alarm Lamp



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