Z45/450Z

Compact Excavator

Form No.
50940111
Revision A
Oct. 2012

Service Manual

CHAPTER 1

GENERAL CAUTIONS FOR MAINTENANCE WORK

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

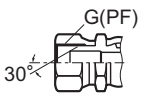
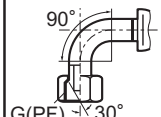
1 Part name

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
 Taper pipe thread R (PT)	A
 Straight pipe thread G (PF) with male 30 degrees seat	B
 90 degrees bent type. Straight pipe thread G (PF) with male 30 degrees seat	C
Without fitting	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

List of pipe threads

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

The example hose, P 2 06 AB 075 W stands for :
2 3 4 5 6 7

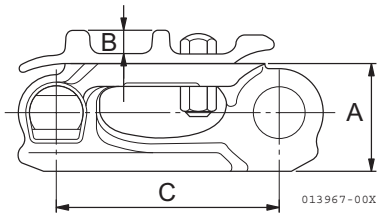
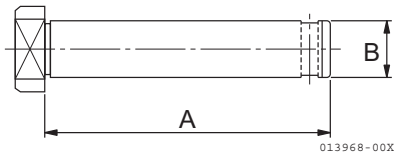
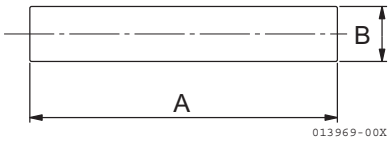
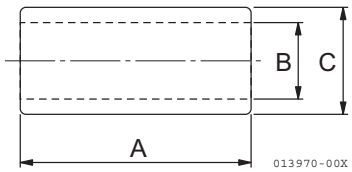
2 Material : Plastic
3 Working pressure : 2489 to 2986 PSI (17.2 to 20.6 MPa)
4 Nominal dia. : 3 / 8"
5 Fitting type : Taper pipe thread R (PT) and straight pipe thread G (PF) with male 30 degrees seat.
6 Length : 29.5 in. (75 cm)
7 Hose protector : Coil spring

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

3-3-2 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

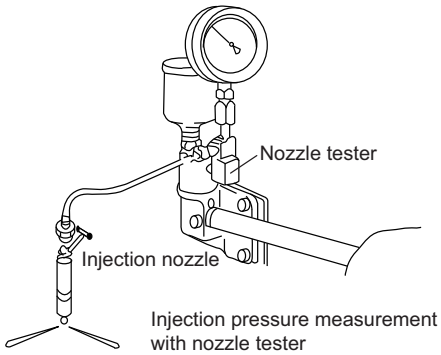
4-2 Troubleshooting

4-2-1 Quick Reference Table for Troubleshooting

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

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

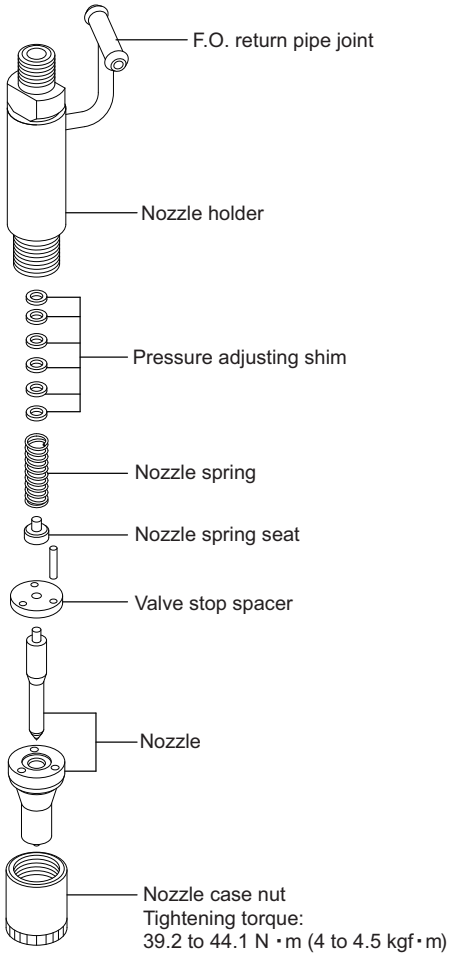
[1] Connect the fuel injection valve to the high pressure pipe of the nozzle tester.
[2] Operate the nozzle tester lever slowly and read the pressure at the moment when the fuel injection from the nozzle starts.
[3] If the measured injection pressure is lower than the standard level, replace the pressure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



Injection pressure measurement with nozzle tester

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]



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.

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

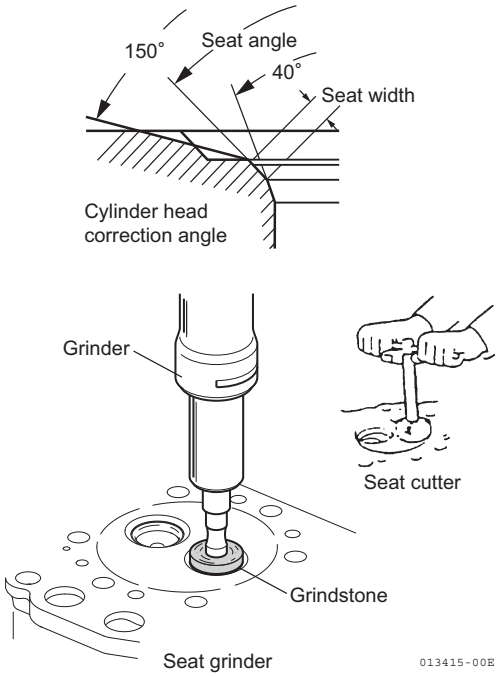
[3] If the seat is heavily roughened and the width is much enlarged, grind the seat inner surface with a seat grinder whose center angle is 40 degrees, then grind the seat outer surface with a grinder whose center angle is 150 degrees to make the seat width match the standard. Then perform seat correction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

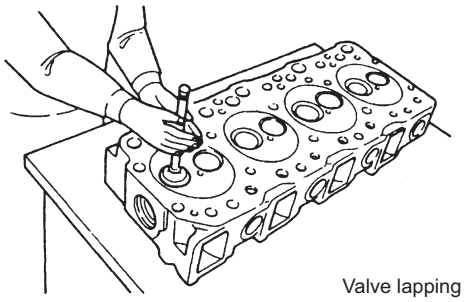
degrees

Grinding wheel angle	θ_1	θ_2
	40	150

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

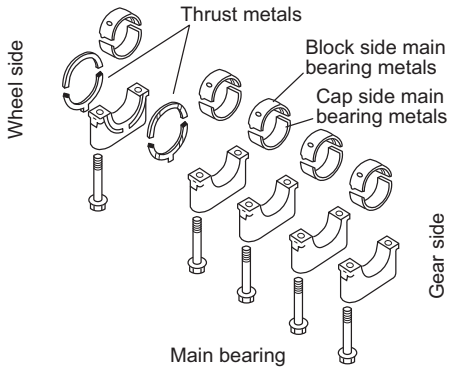
[B] : Lap with engine oil only.





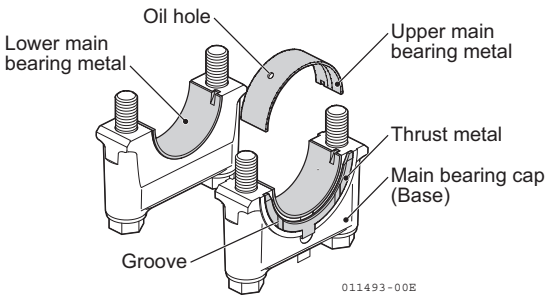
Disassemble :

- 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 :

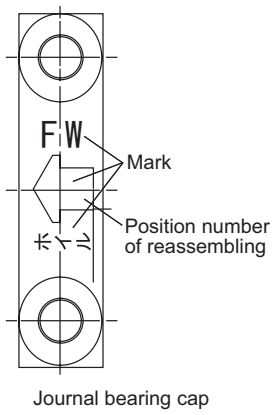
- Carefully install each thrust metal so that the grooved one is positioned away from the cap.
- Do not confuse the upper and lower main bearing metals. The upper main bearing metal (block side) has an oil hole, and the lower one does not. The “arrow” marks on the cap shall face the flywheel. Tighten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

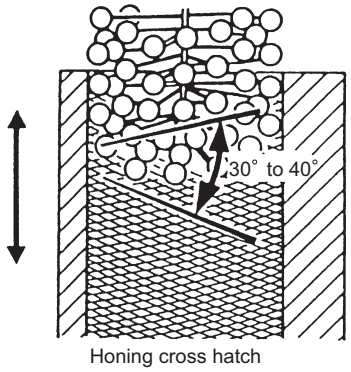
Disassemble :

- 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.

[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.



Honing cross hatch

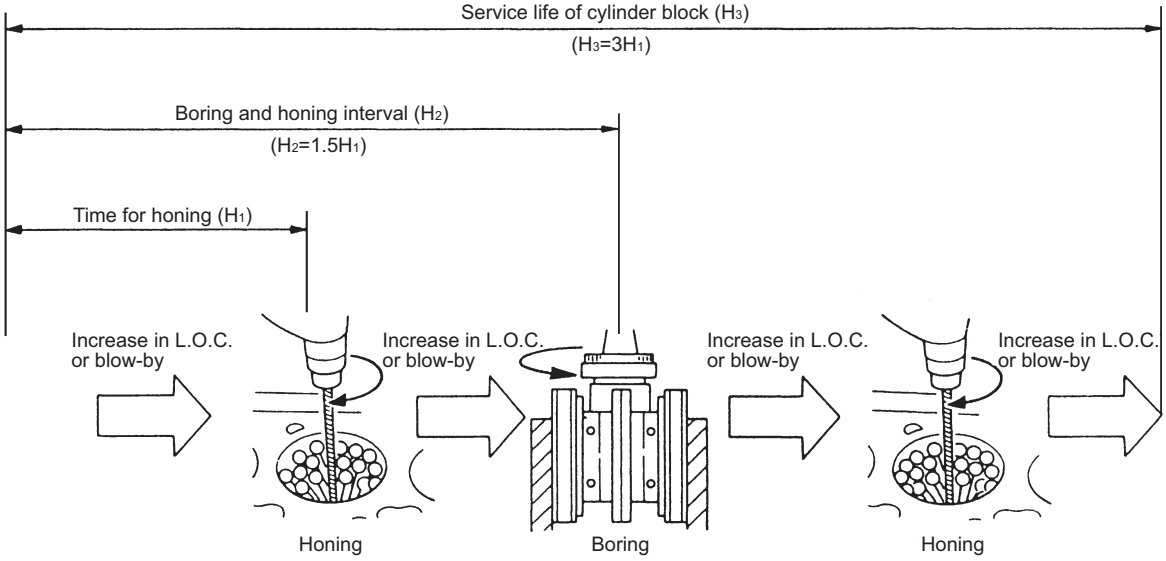
in. (mm)

Cylinder bore after re-boring and honing	3.4744 to 3.4756 (88.250 to 88.280)
Sureface roughness	Rmax 0.04 to 0.14 S (1.0 to 3.5 S)
Roundness (Cylindericity)	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

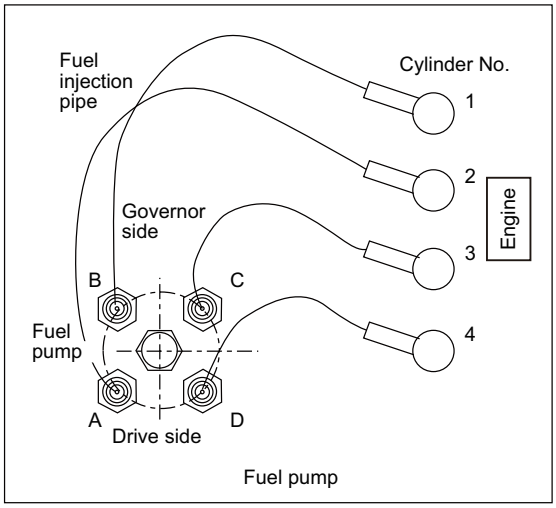
Replace bushing by using the special service tool.

(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) Assembly Procedure

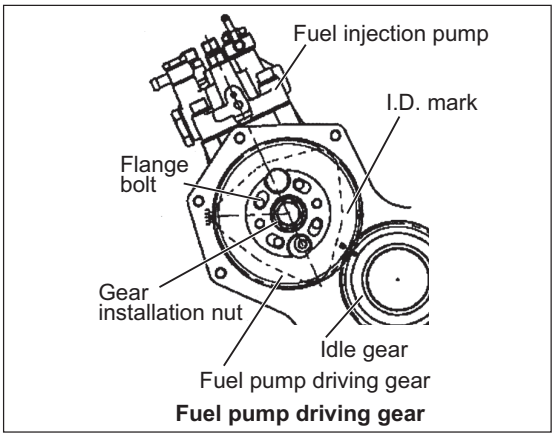
Reverse the disassembly procedure and adjust the fuel injection timing finally. See (4) of 4-3-7.

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.



Fuel pump driving gear

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

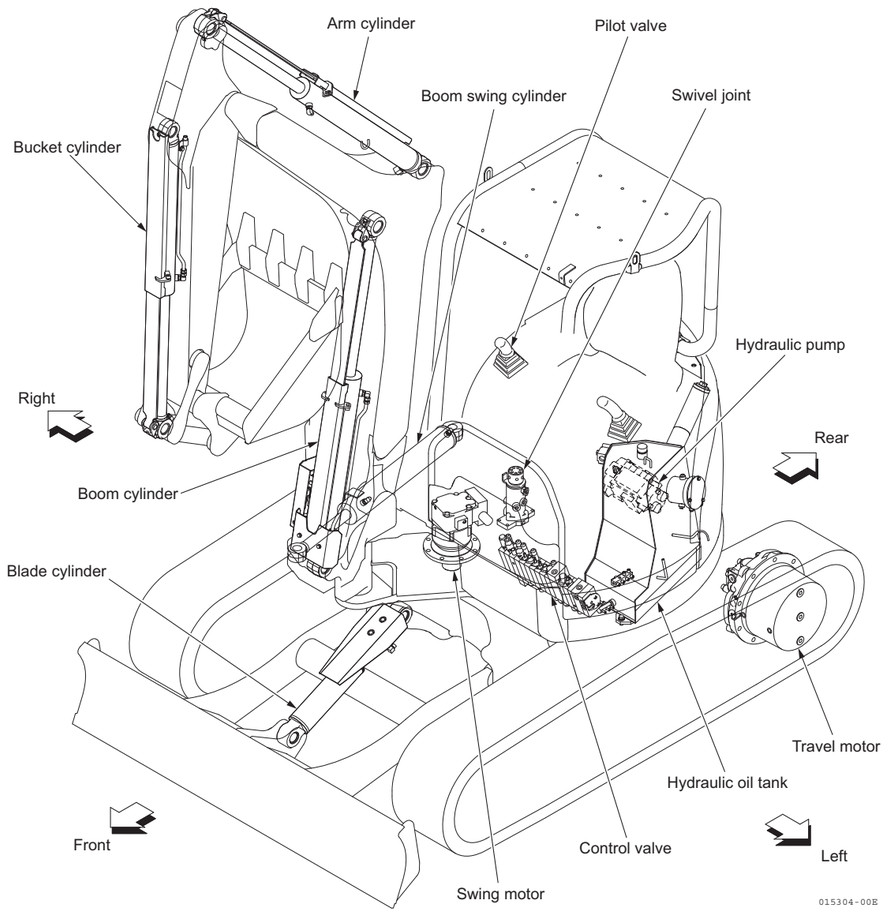
ft•lbf (N•m)	Lubricating oil application (thread portion, and seat surface)
58 to 65 (78 to 88)	Not applied

5. HYDRAULIC SYSTEM

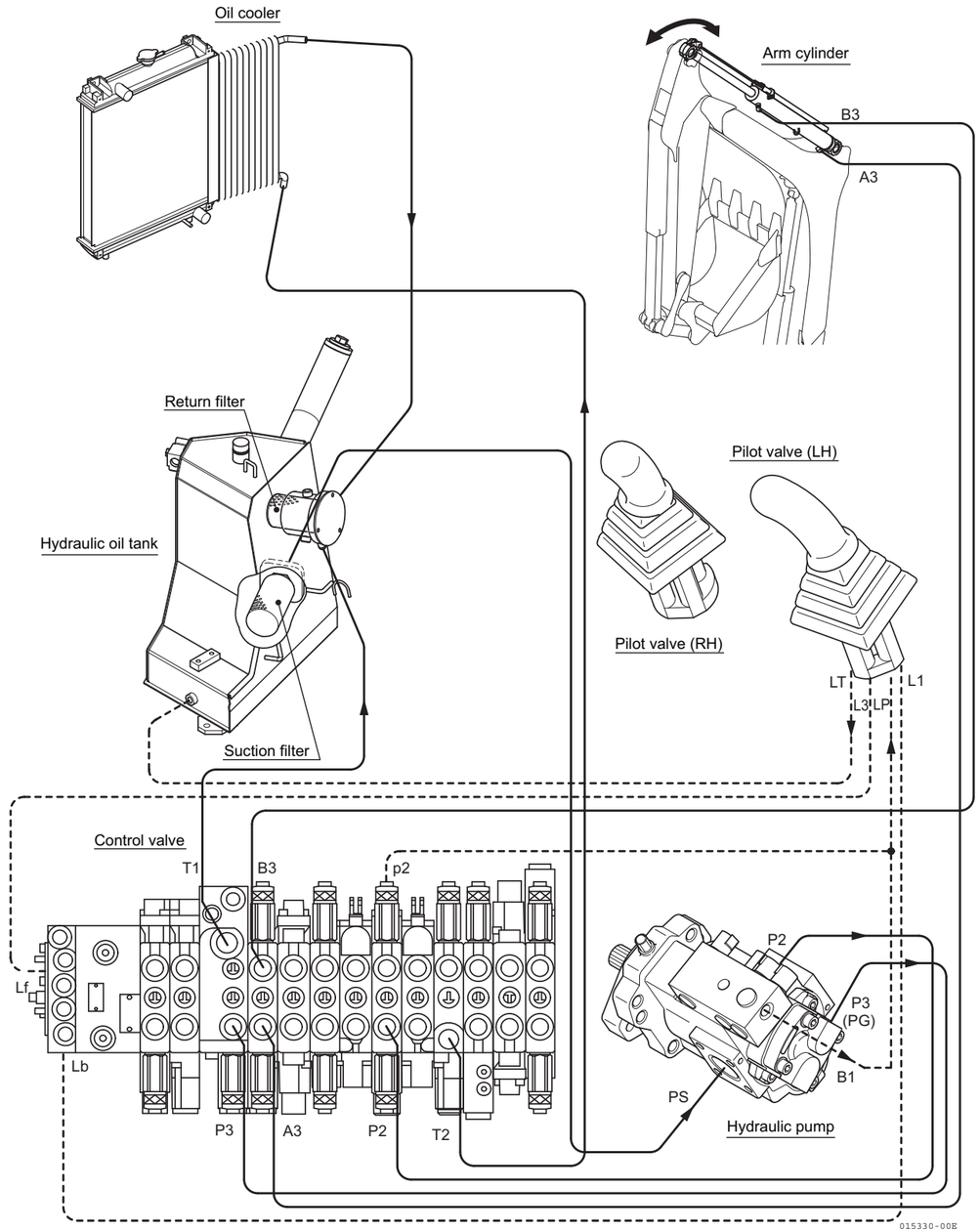
5. Hydraulic System

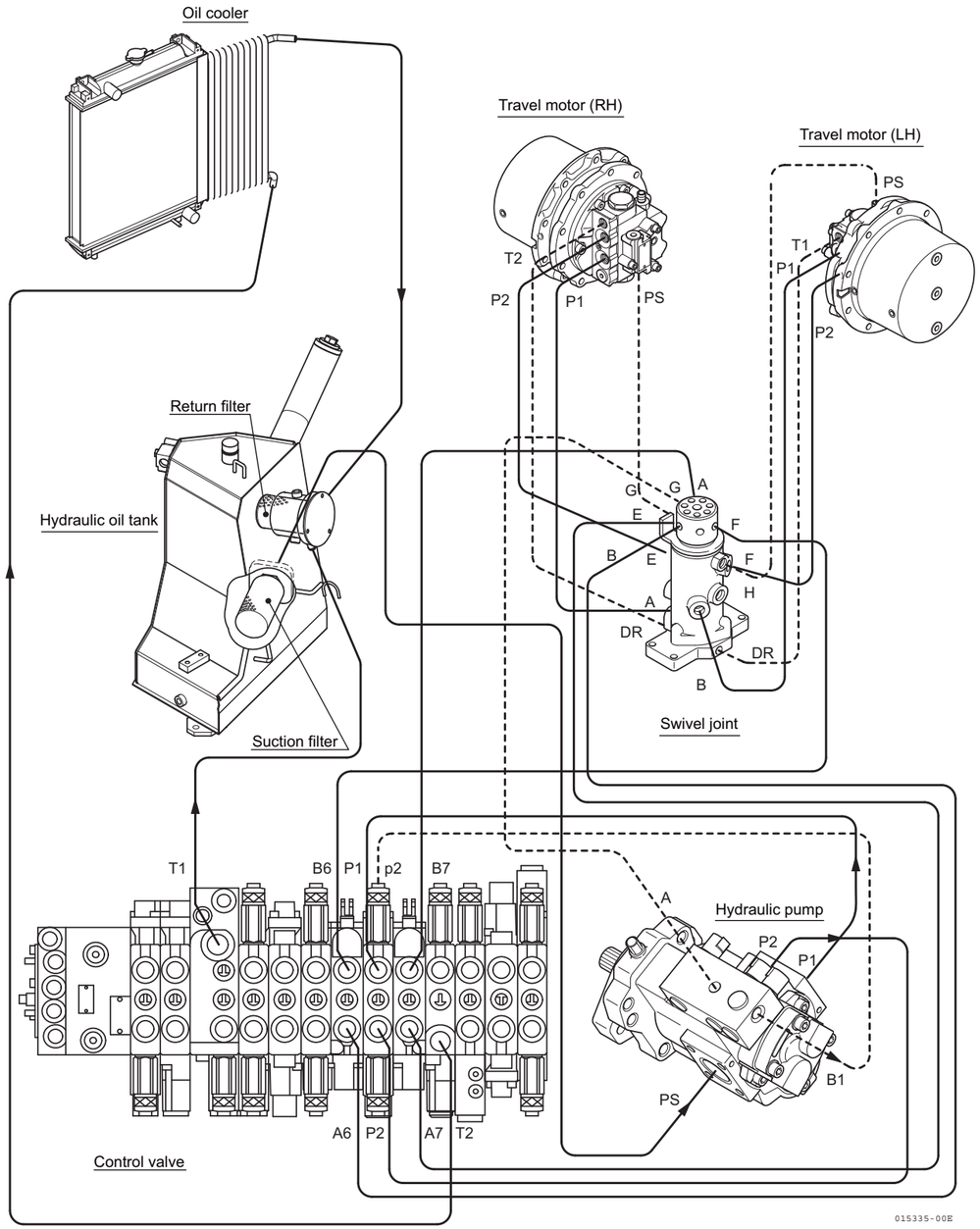
5-1 Outline

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.

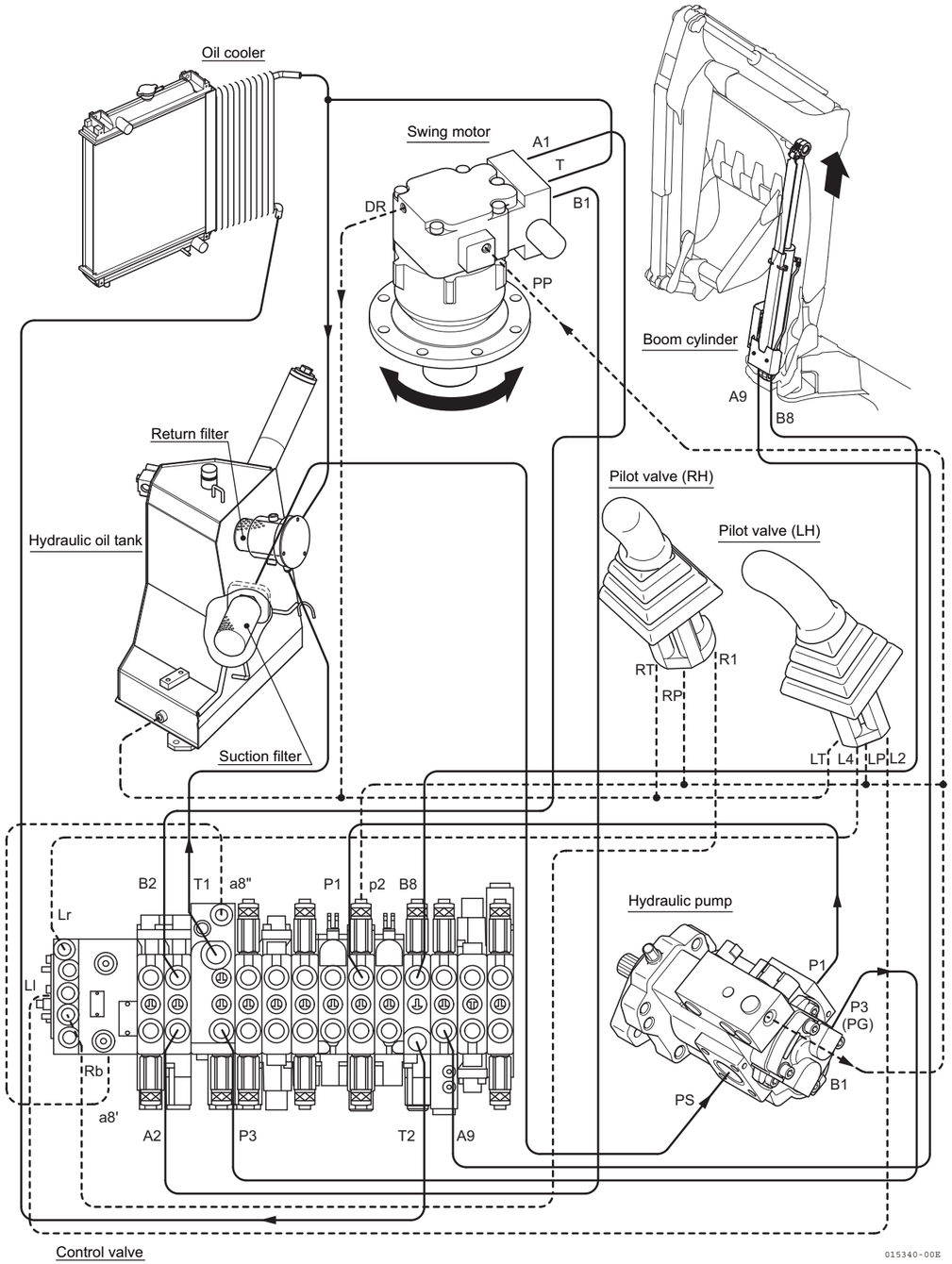


5. HYDRAULIC SYSTEM

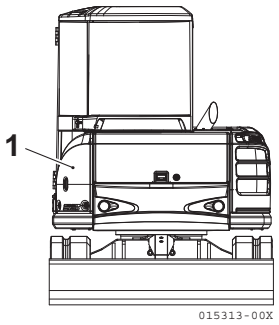



Oil cooler
Travel motor (RH)
Travel motor (LH)
T2
P2
P1
PS
PS
T1
P1
P2
Return filter
Hydraulic oil tank
G
G
A
E
F
B
E
F
H
A
DR
DR
B
Swivel joint
Suction filter
T1
B6
P1
p2
B7
A
Hydraulic pump
P2
P1
B1
PS
A6
P2
A7
T2
Control valve
015335-00E

5. HYDRAULIC SYSTEM



5-4-2 Swing Brake Valve

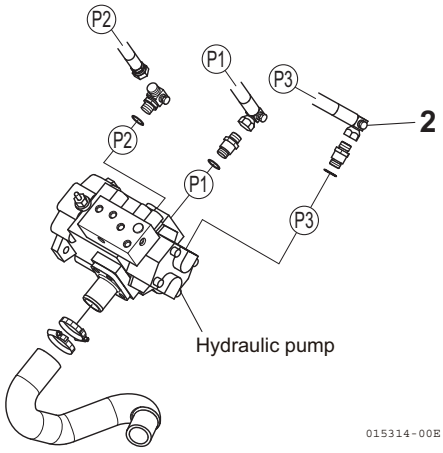


1) Conditions

(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.

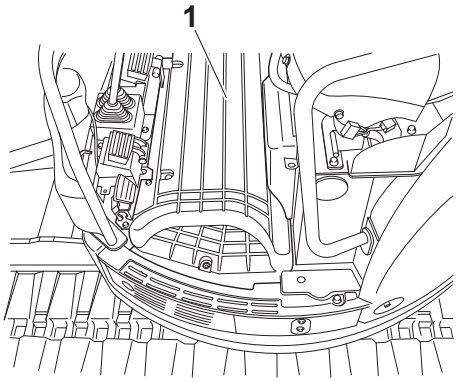


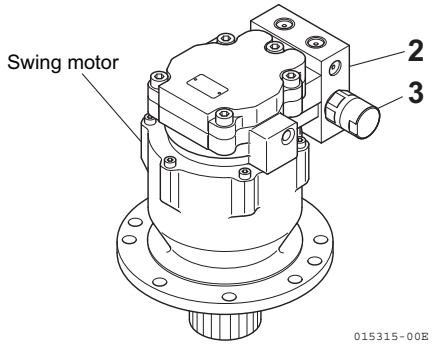
3) Adjustment Procedure
(Relief Valve Replacement Procedure)

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 to166.7 N·m)





5) Function of Valve Assembly

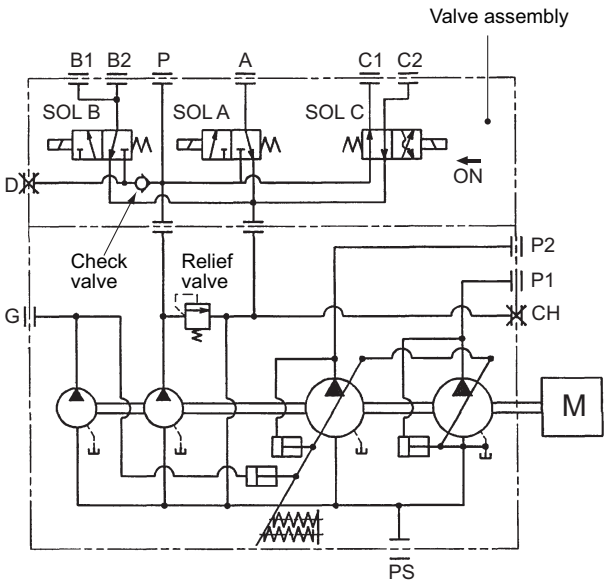
This pump has a valve assembly, which switches the directions of the pressure oil flow from the pilot pump. Some solenoid and check valves are installed in the valve block assembly.

[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.

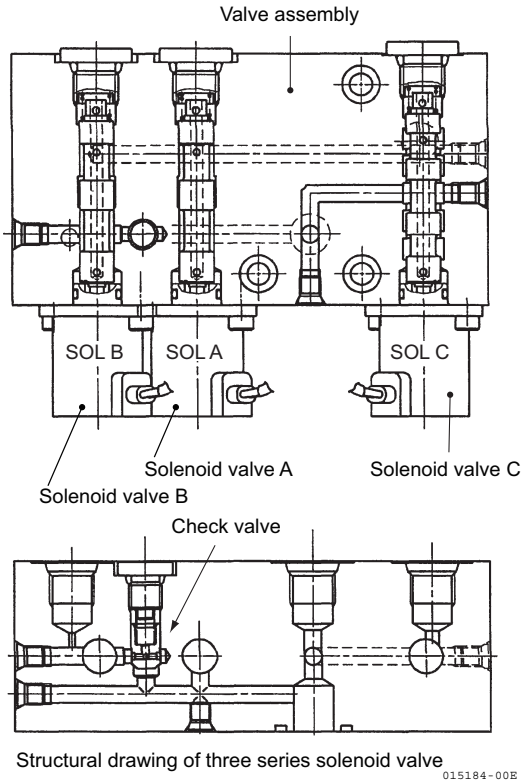
[2] The pressure oil is supplied to the solenoid valve B through the check valve. The oil flowing from the check valve toward the solenoid valve B is divided into two directions. One flows to the solenoid valve B and the other flows to the port D through the orifice.

[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.

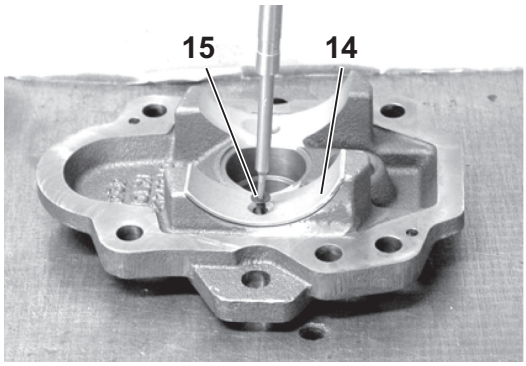
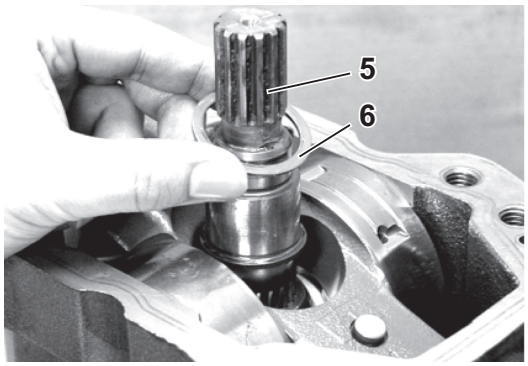
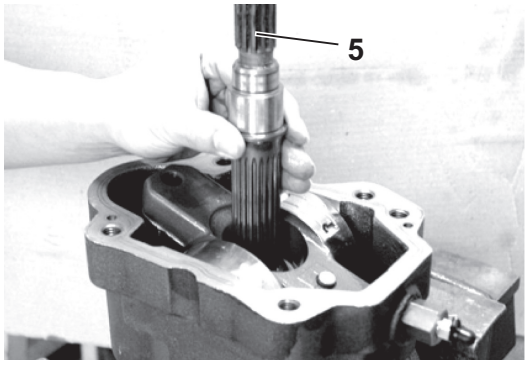
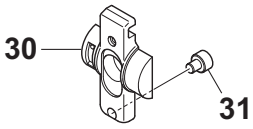
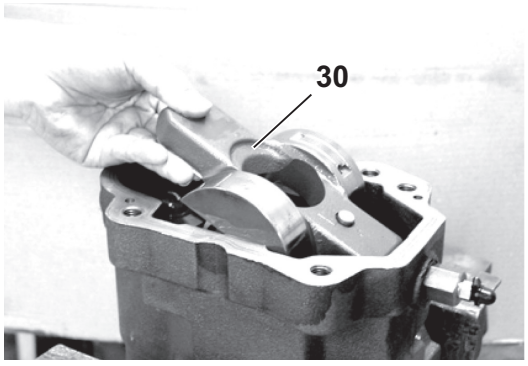


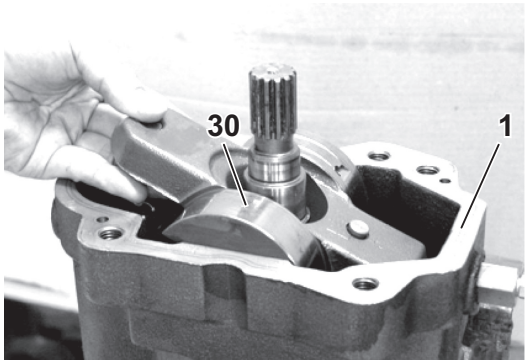
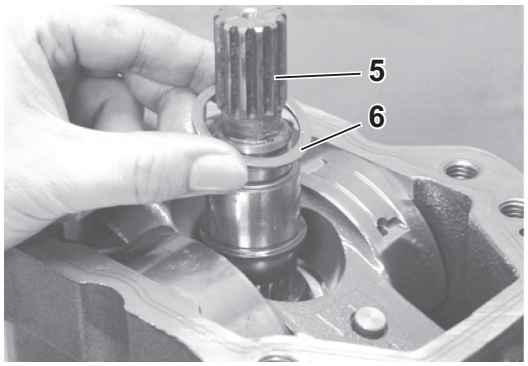
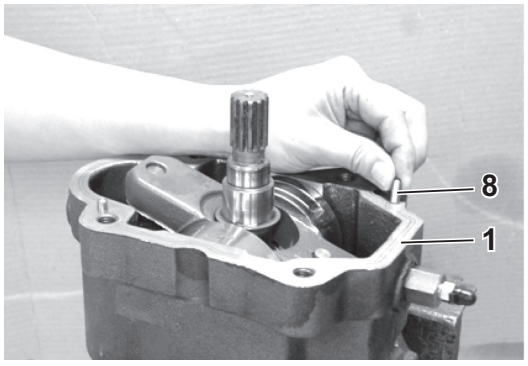
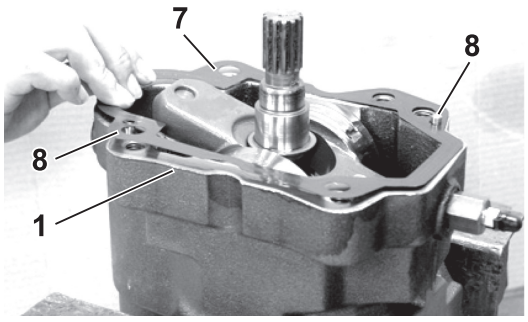
Hydraulic circuit schematic of three series solenoid valve



Structural drawing of three series solenoid valve

015184-00E

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

Procedure	
(21) Install the swash plate **30** into housing **1**. ***Note :*** *Take care not to drop the holder when installing it. This can damage the internal parts, such as pistons.*	
(22) Install the thrust washer **6** onto the shaft **5**.	
(23) Install the pins **8** into the housing **1**.	
(24) Install the gasket **7** into the housing **1** aligning with the pins **8**.	

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

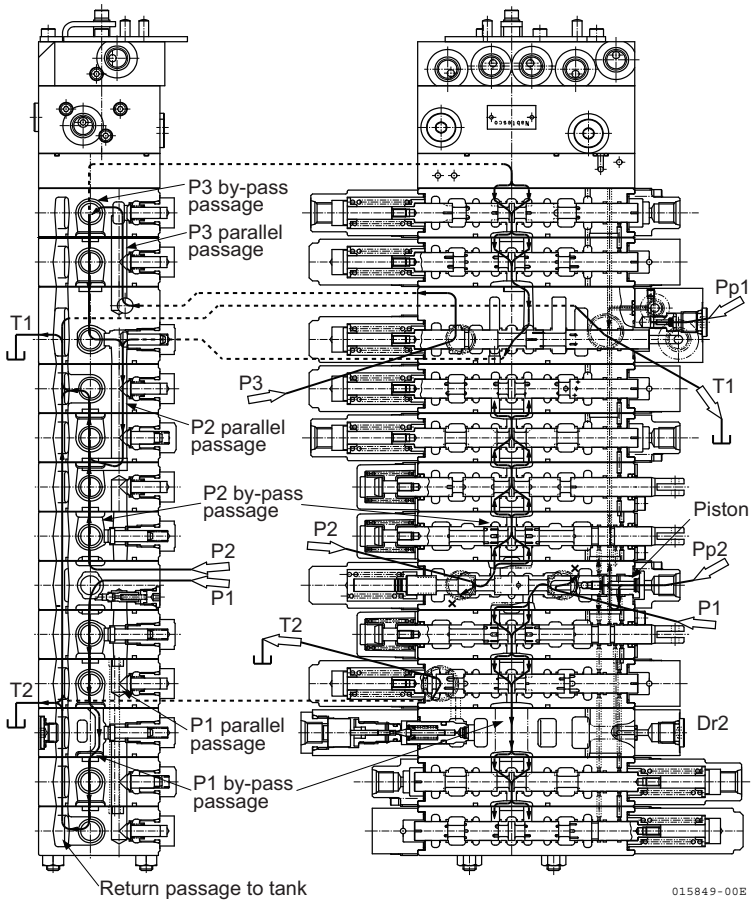
The oil discharged from the hydraulic pump P3 flows into the control valve through the port P3 and flows to the parallel passage of the swing and blade sections.

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



(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.

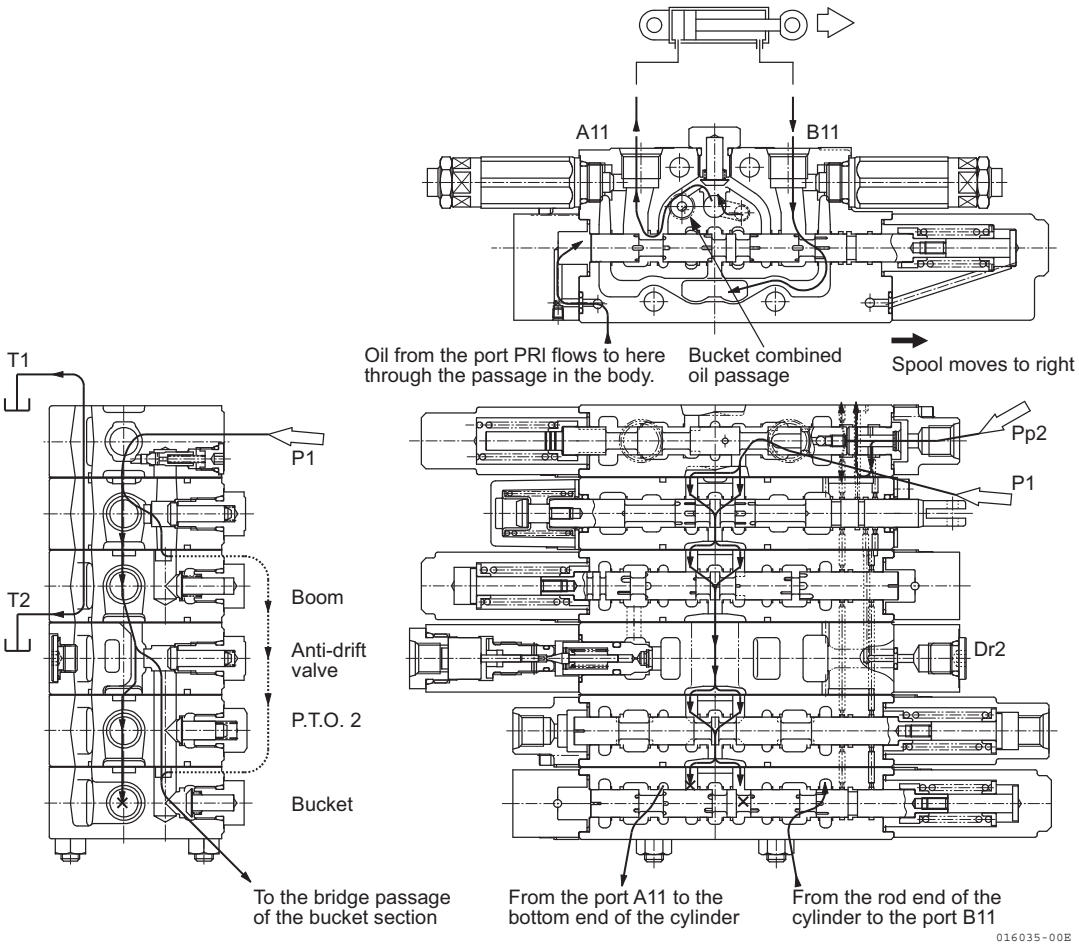
The P1 by-pass passage is blocked by the bucket spool as the spool has been moved, so that the oil from the port P1 flows through the check valve above the by-pass passage in the travel section and the check valve on the by-pass valve of the anti-drift valve to the parallel passage in the section.

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.

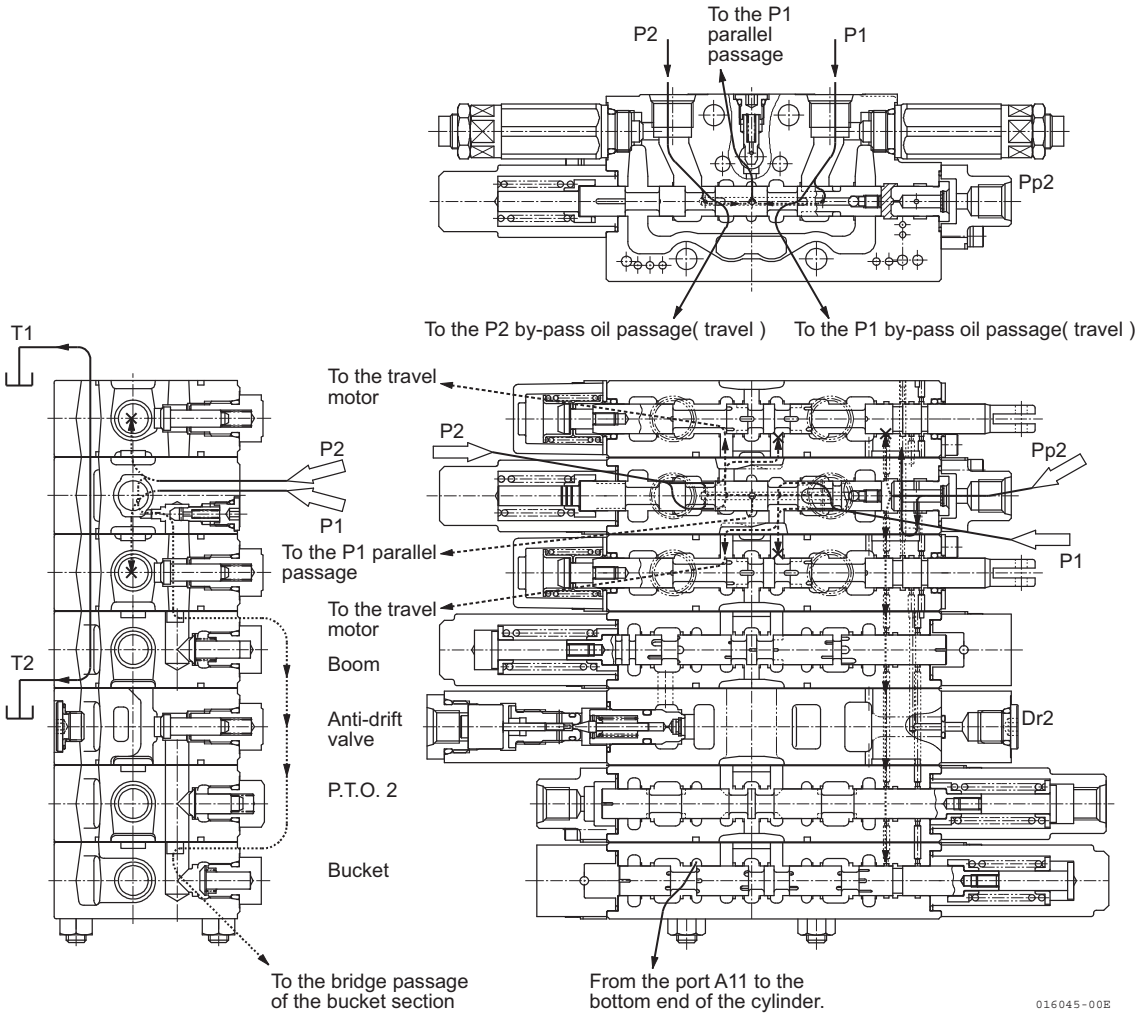


(2) Traveling and bucket

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.



(4) P1, P2 inlet

[1] Remove the two hexagon socket head bolt and SWP washer assemblies **15** with a hexagon bar wrench (4 mm).

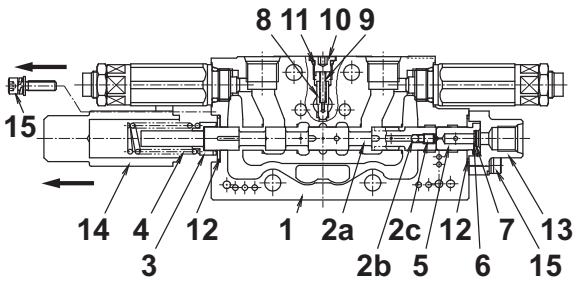
[2] Remove the pilot oil chamber case A1 **14.**

[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 :

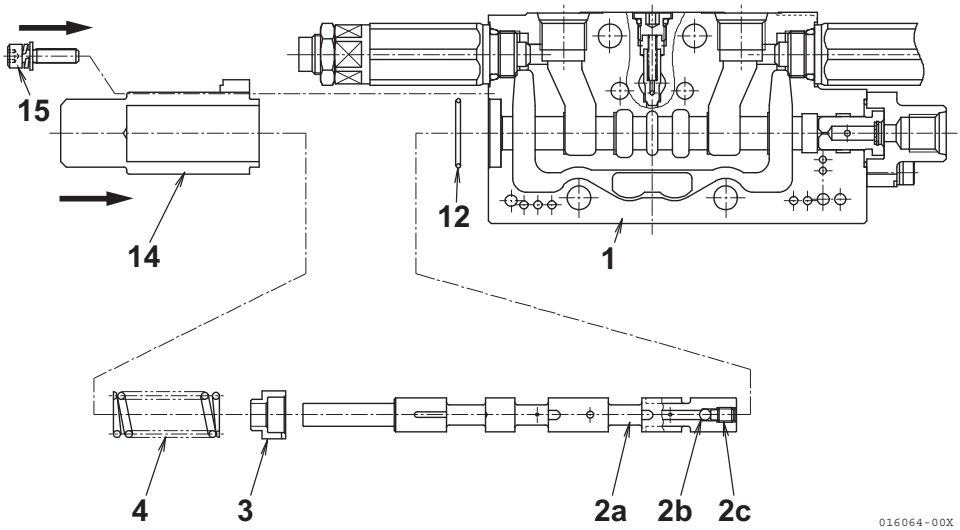
*At this time, check the O-ring **12** is installed at the bottom of the flange for pilot case on the body side.*



P1, P2 inlet section

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

(4) P1, P2 inlet section



[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.

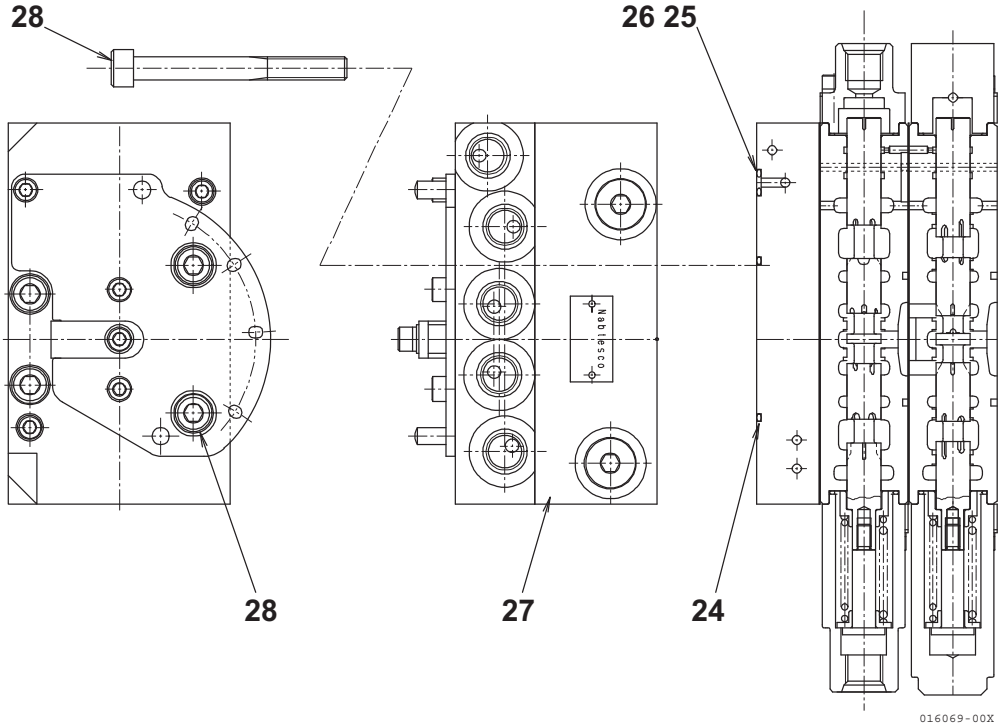
Tightening torque : 4.3 to 5.1 ft·lbf (5.9 to 6.9 N·m)

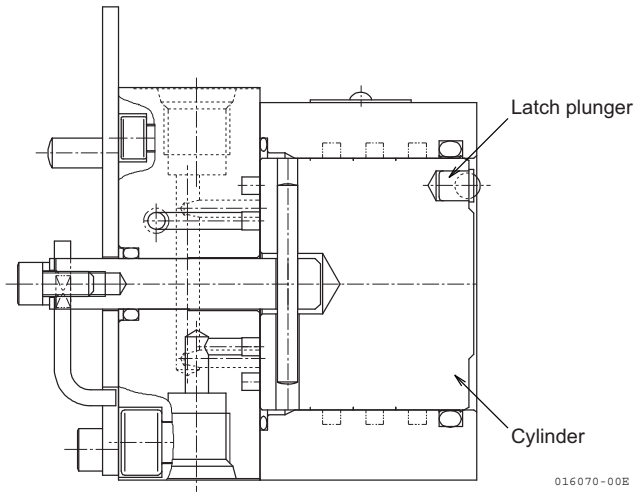
No.	Part
1	Body (symbol AB)
2	P1, P2 inlet spool assembly
a	Spool (P1, P2 inlet)
3	Return spring retainer
4	Return spring
5	Piston
6	Filter
7	Internal snap ring
8	Check valve
9	Check valve spring
9	Check valve spring
10	Plug
11	O-ring 1B P8
12	O-ring 1B S22
13	Pilot oil chamber case B5
14	Pilot case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

(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.

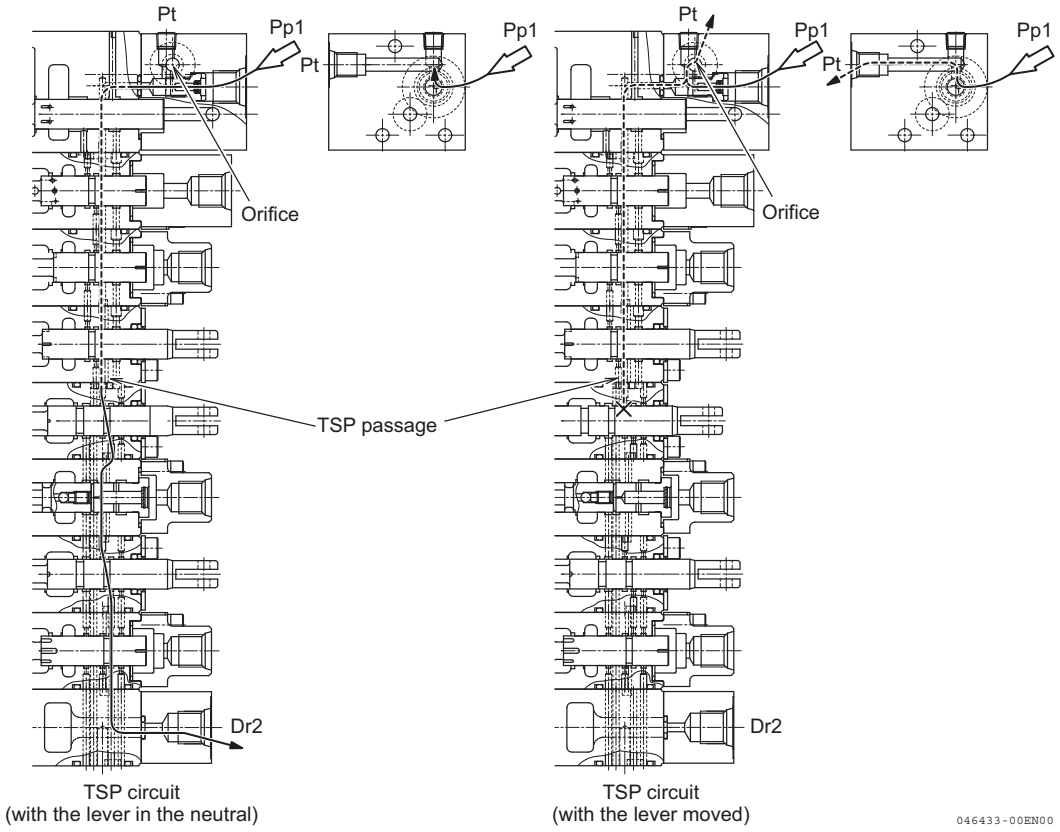




When the TSP (traveling signal pilot) circuit is used

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.



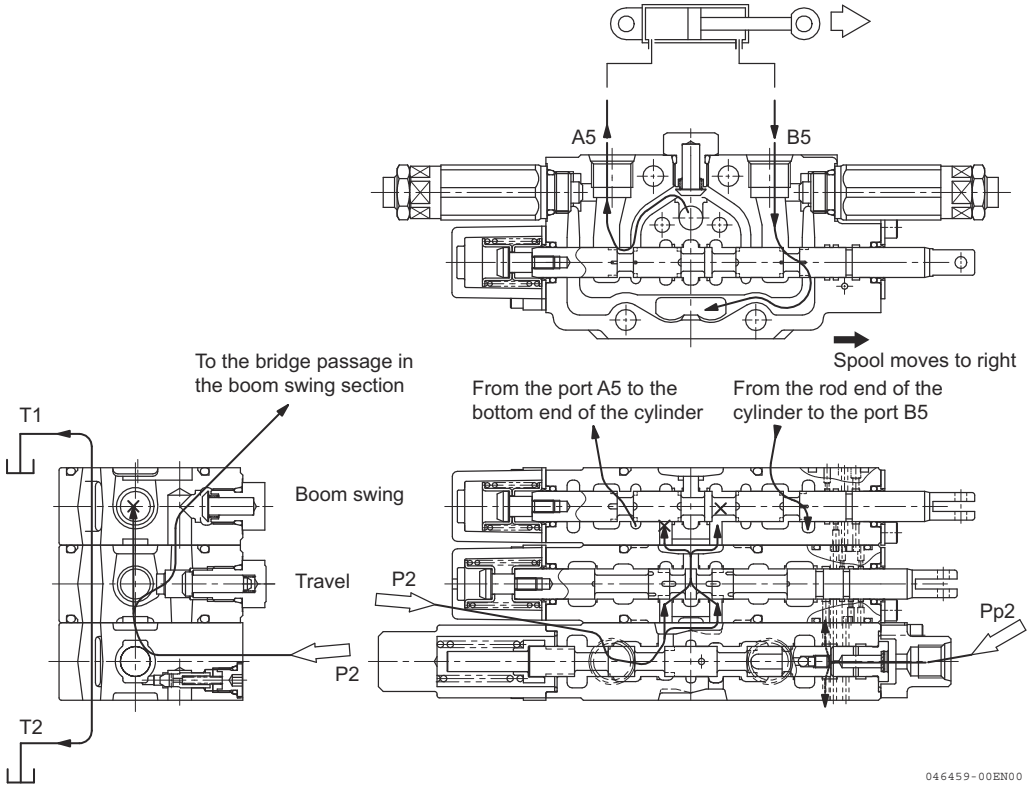
(2) Left boom swing operation

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.

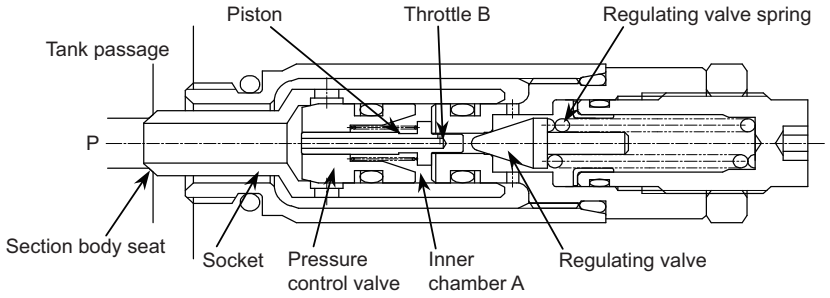


13) Circuit Relief Valves

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.

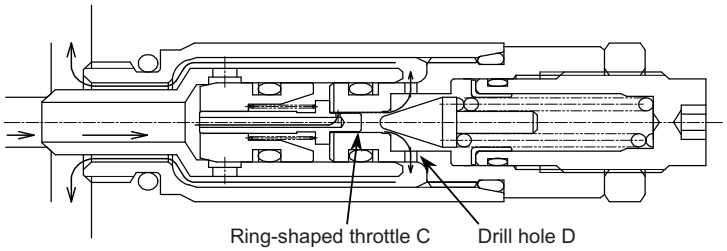
(1) Relief operation

[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.

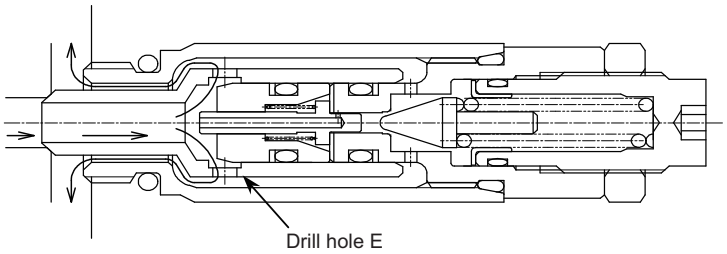


[2] When the oil pressure in the port P reaches the set pressure of the regulating valve spring, the pressure oil flows to the regulating valve to open it.

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]).

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.

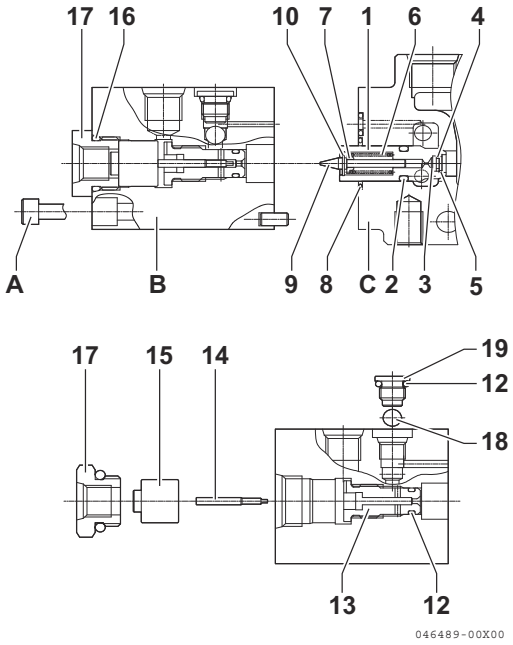
[6] Remove the piston B **15** and piston A1 **14** in the bore, which the bush has been removed from, with tweezers or a magnet.

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 Ø 0.28 in. (7 mm) from the bore, which the ball retainer has been removed from, using a magnet.

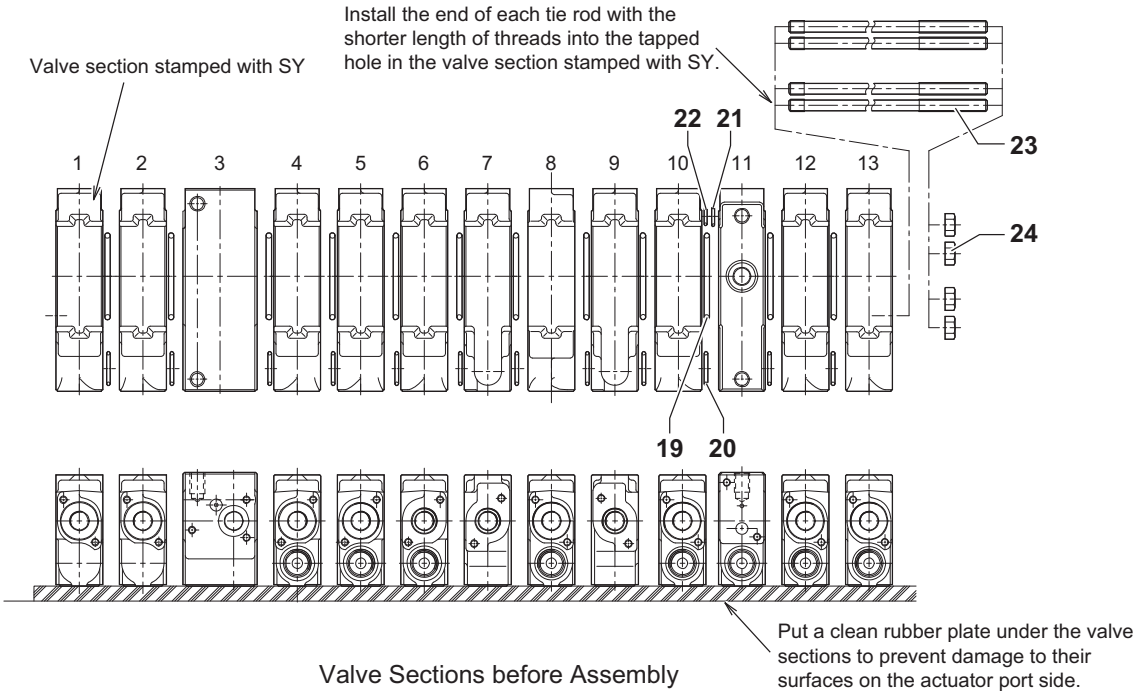


No.	Part
1	Anti-drift valve
2	Cap seal 1 BE10
3	Filter
4	Spacer
5	Snap ring AR7
6	Anti-drift valve spring A
7	Spring holder
8	O-ring AS 1B17
9	Needle valve
10	Internal snap ring 9
11	O-ring 1A P6
12	O-ring 1B P8
13	Piston guide
14	Piston A1
15	Piston B
16	O-ring 1B P18
17	Bush PF1/2×1/4
18	Steel ball Ø0.28 in. (7 mm)
19	Ball retainer

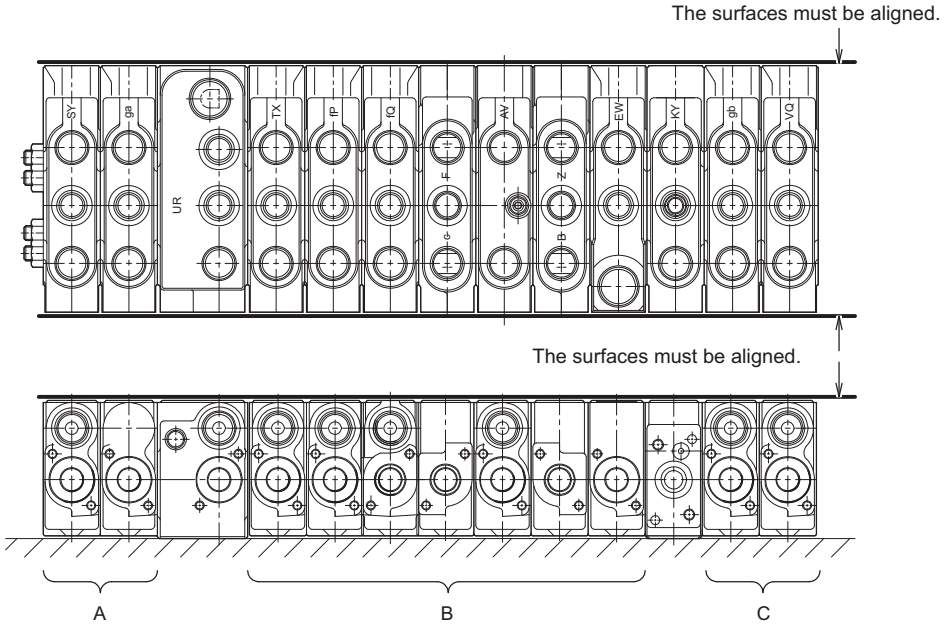
Order of Assembly of Valve Sections

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.



Valve Sections before Assembly

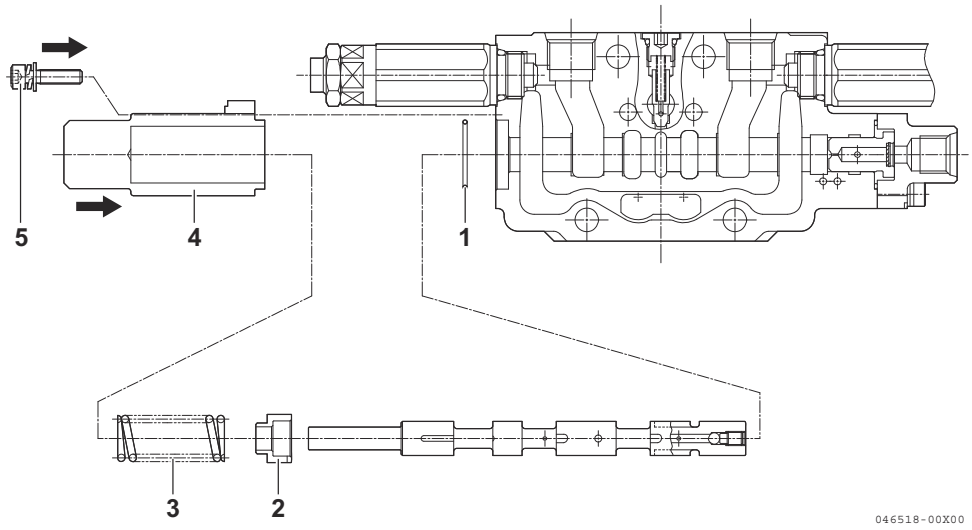


Note: When the control valve assembly is placed with the actuator port side up, there is a clearance of 1.5 mm between the end faces of the valve sections marked with A, B and C in the figure above and the contact surface of the control valve assembly with the surface plate.

046538-00EN00

Control Valve Assembly

(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).

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.

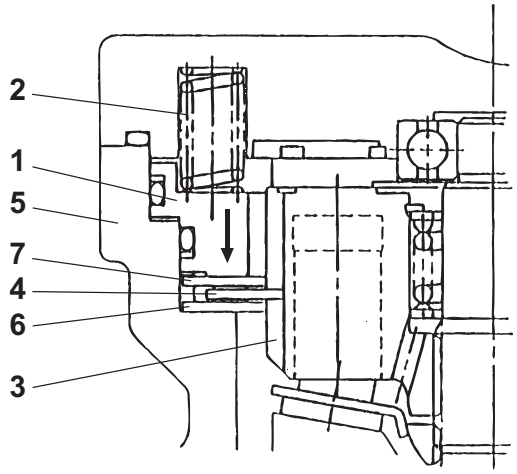
Once correctly installed, the unit can be placed into operation.

2) Mechanical Brake

The mechanical brake serves to mechanically lock the output shaft of the swing motor while the motor is stopped.

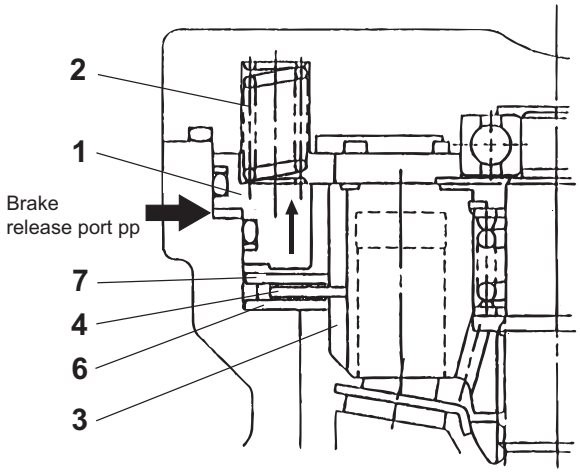
When the brake release pressure is in the OFF state, the brake piston **1** is kept pressed by the spring **2** in the arrowed direction in Fig. **A**. In this state, the disc plate **4** fixed to the cylinder barrel **3** by the semicircular groove is put between the steel plates **6** and **7** fixed 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**.)



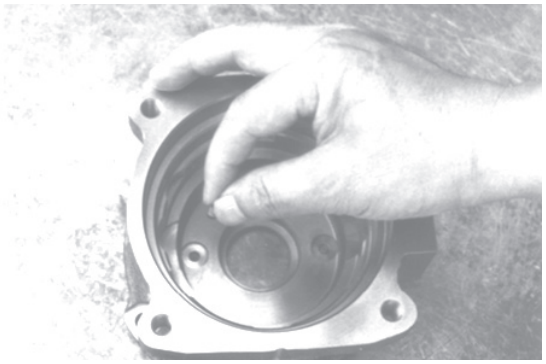
Brake release pressure : OFF

(Fig. A)

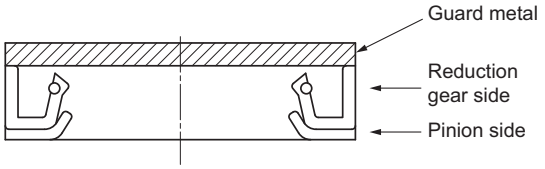
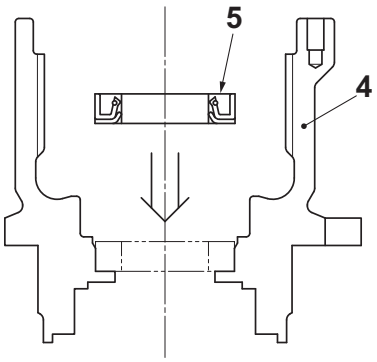
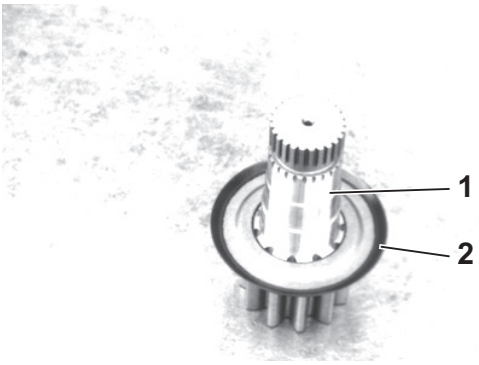
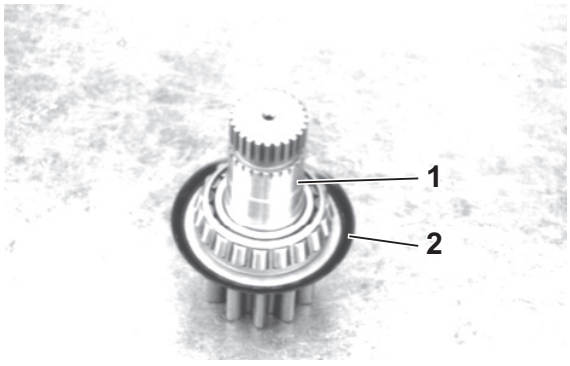
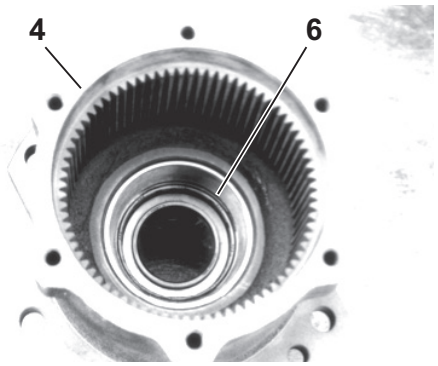


Brake release pressure : ON

(Fig. B)

Procedure	
(13) Remove two filters **33** and dowel pin **62**.	

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

Procedure	
(25) Press-fit oil seal **5** into main body **4**. ***Note :*** *Install oil seal in the correct direction and by using guard metal to prevent oil seal from slanting.* *(Outer diameter of guard metal : Ø2.93 in. (Ø74.5 mm)* 	
(26) Install ring **2** onto pinion shaft **1**. ***Note :*** *The installing direction of ring is shown below.* 	
(27) Press-fit inner race of taper-roller bearing **3** onto pinion shaft **1**. ***Note :*** *After press-fitting, apply grease to surfaces of rollers of bearing and rotate rollers to spread grease on whole areas of rollers.*	
(28) Press-fit outer race of taper-roller bearing **6** into main body **4**.	

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**.

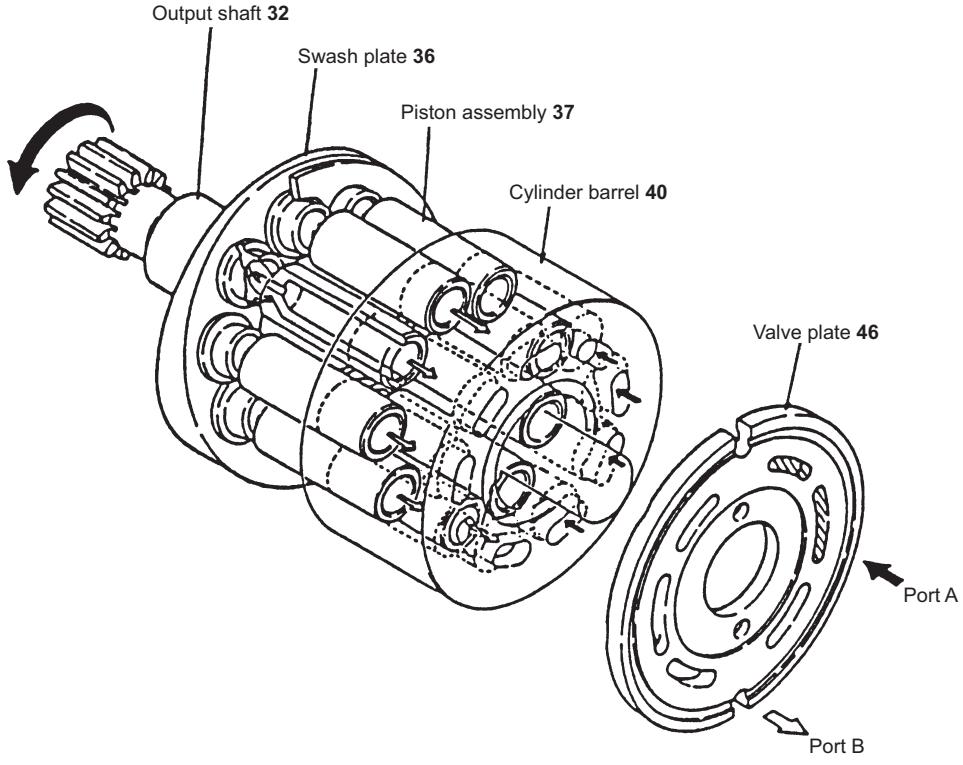
When the pressure at the port A rises, the hydraulic oil flows into the bores corresponding to the port A in the cylinder barrel **40**.

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.

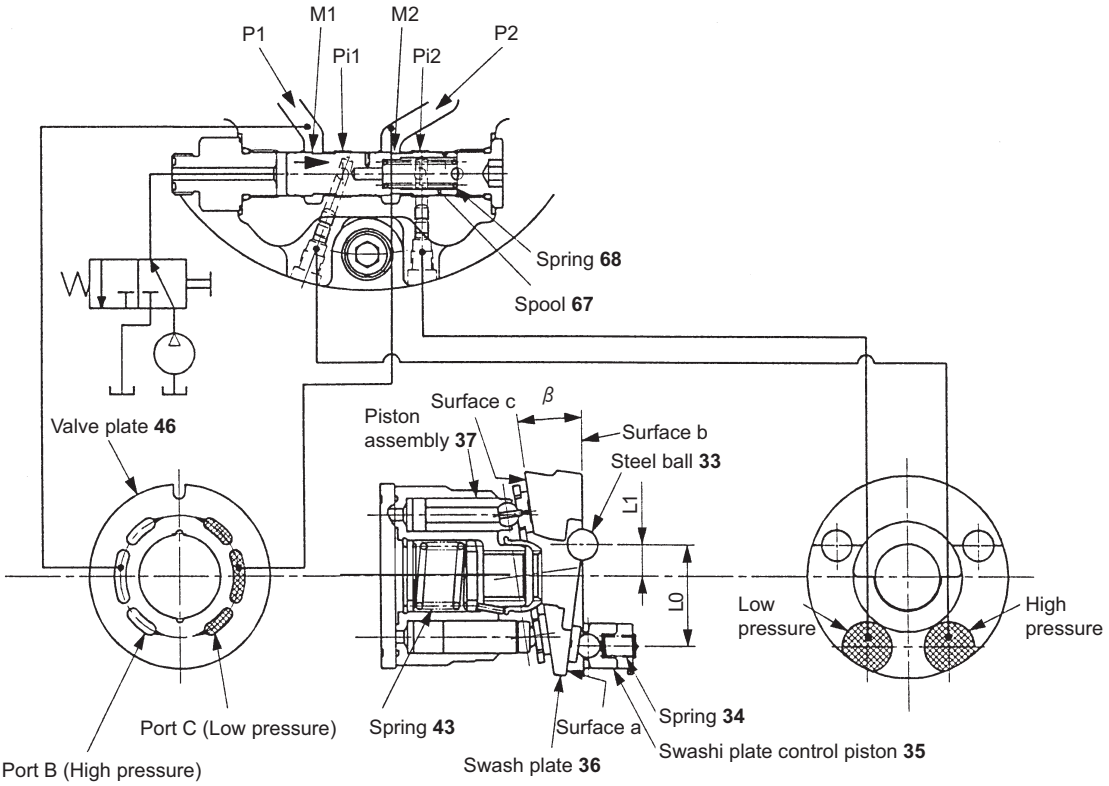


(2) 2nd speed (high speed)

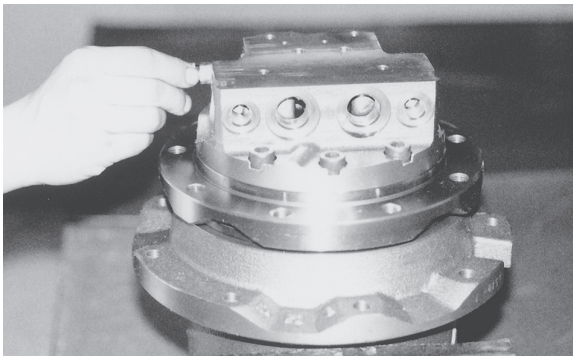
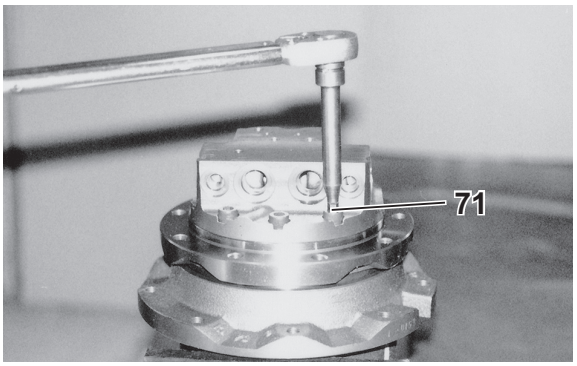
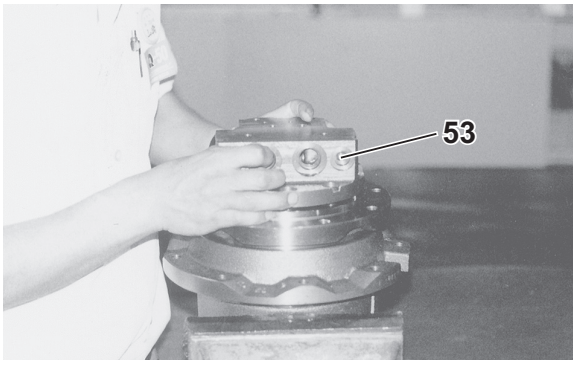
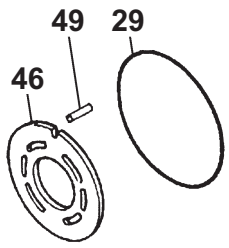
When the control valve is switched to the 2 nd speed position, the pressure oil from the pump is led to the end face of the spool **67** and the spool is shifted to the position as shown in the figure below. This causes the ports M1 and M2 to open and the hydraulic oil from the port A (high pressure) in the valve plate **46** of the motor is supplied to the swash plate control piston **35** though 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 (2 nd speed).

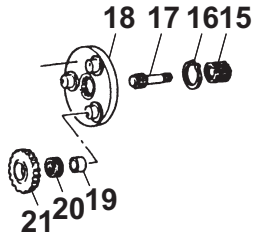
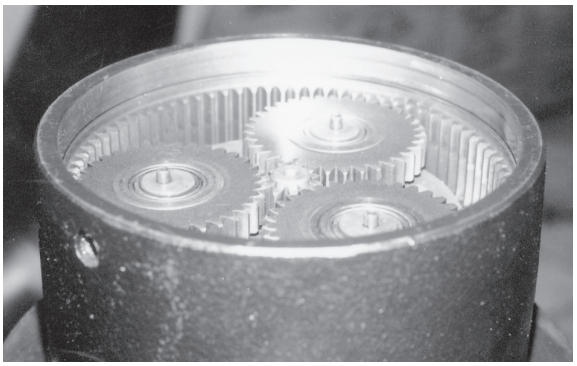
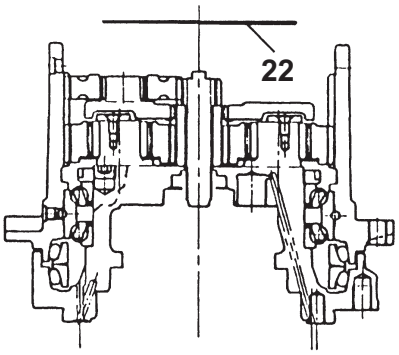
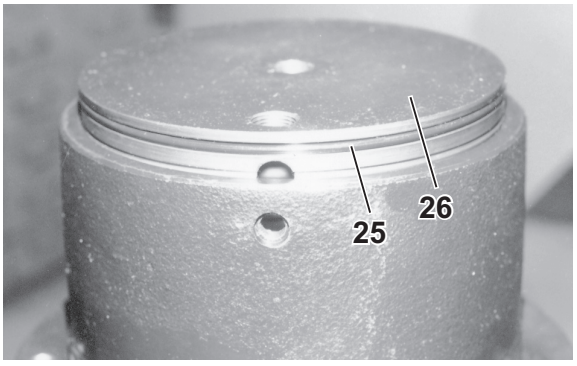
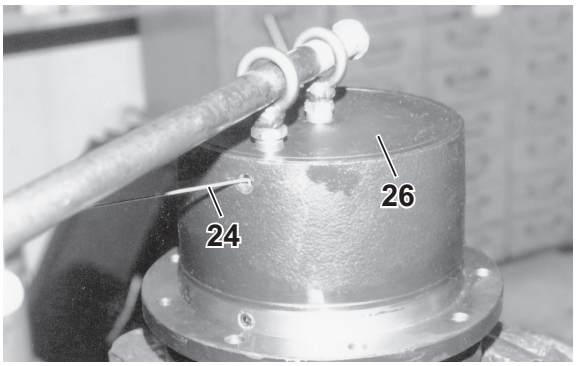
When the motor revolves in reverse, the same action as the above occurs, except that the high and low pressure ports are reversed.

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)

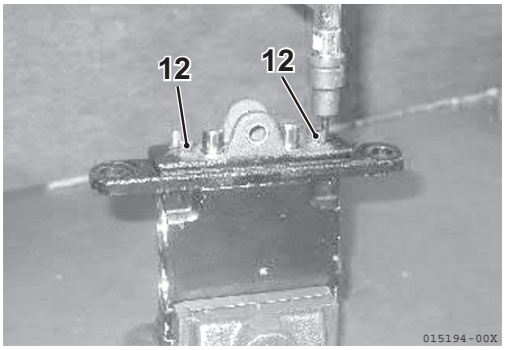
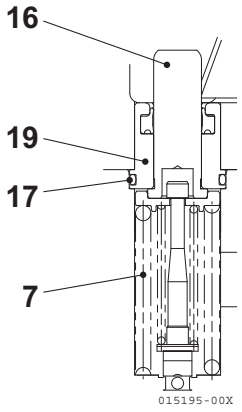
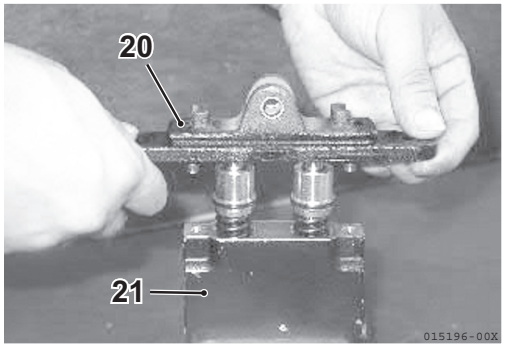
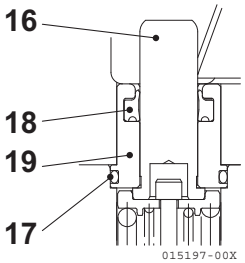
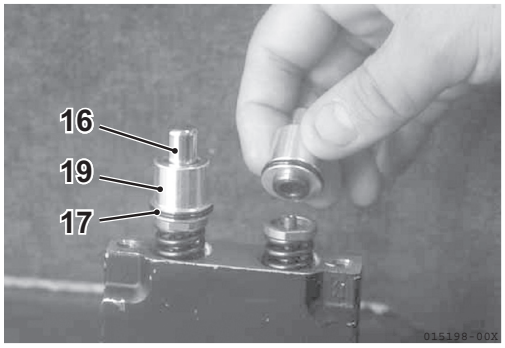
Procedure	
(9) Remove spring **68** and spool **67**. ***Note :*** *Take care not to damage or dent the outside of the spool.*	
(10) Remove six hexagon socket head bolts **71**. **Tool :** • Torque wrench (3) • Hexagon bit (10)	
(11) Remove base plate **53**. ***Notes :*** • *When the base plate cannot be removed easily, tap it in the pulling-out direction with a plastic hammer. If it is still not be removed, pry it up lightly with a screwdriver.* • *Take care that the cylinder barrel is not pulled out.* **Tools :** • Plastic hammer (17) • Screwdriver (15)	
(12) Remove valve plate **46**, O-ring **29** and pin **49**.	

Procedure	
(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**. 	
(13) Install thrust plate **22**.	
(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**. **Tool :** • Plastic hammer (17)	
(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**. **Tools :** • Eye bolt (S-1) • Round rod (S-15) (16) Wind a seal tape around plug **8** and tighten it. Tightening torque : 50.6 to 88.3 ft·lbf (7 to 9 N·m) **Tools :** • Torque wrench (1) • Hexagon bit (7)	

7. Troubleshooting

1) Motor

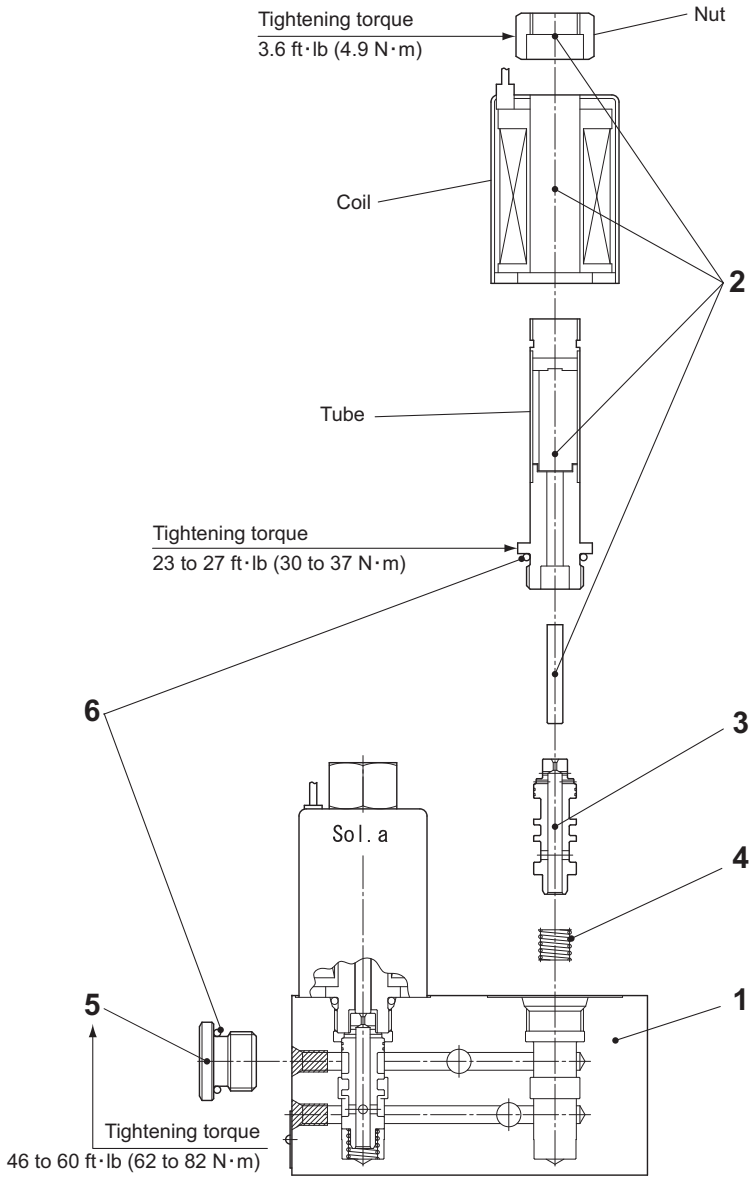
Trouble	Cause	Measure
1. Motor does not rotate.	1) Malfunction of equipment other than motor, counter balance valve and reduction gear.	Check whether the specified volume of hydraulic oil is fed to the motor suction side. Then, check and repair each part.
	2) Escape of pressure oil due to excessive wear 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.

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.* 	

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.



No	Description
1	Body
2	Solenoid valve
3	Spool
4	Spring
5	Plug G (BSPP) 3/8
6	O-ring 1BP 14

2) Disassembly/Reassembly of Solenoid Valve

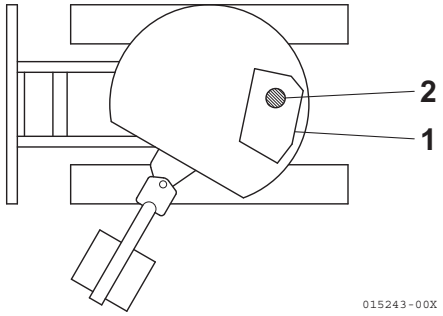
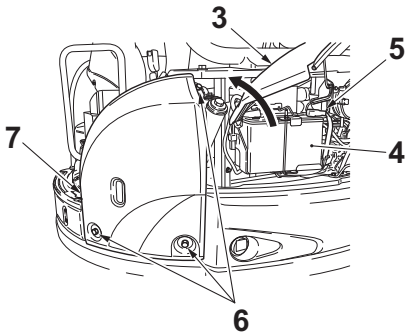
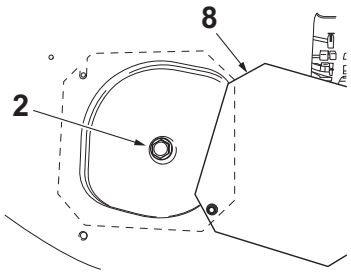
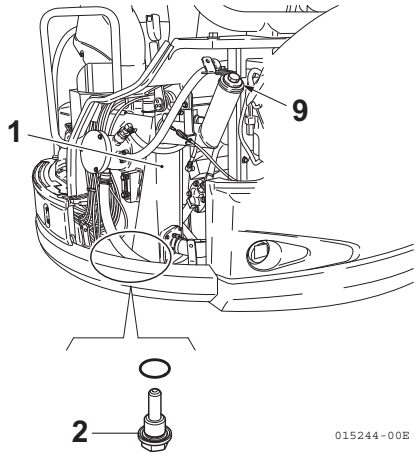
(1) Loosen nut to remove coil. (Wrench: Hex 19 mm)
(2) Loosen tube to remove it. (Wrench: Hex 21 mm)
(3) Remove spool **3** and spring **4**.
(4) Reassemble all parts in reverse order. Take care not to damage Hex part of tube.

CHAPTER 7

ADJUSTMENT AND REPAIR

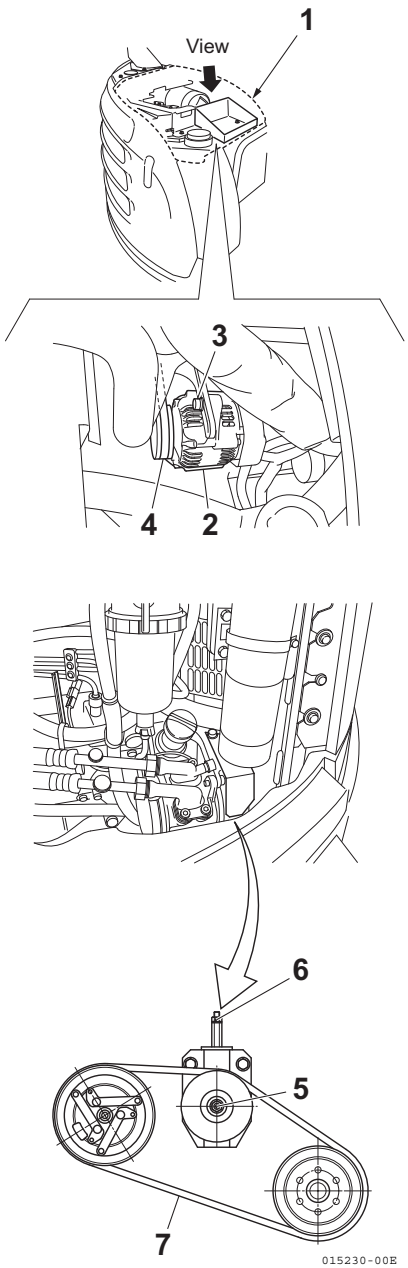
7-1-5 Removal and Reinstallation of Engine

1) Removal

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

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

1) Removal

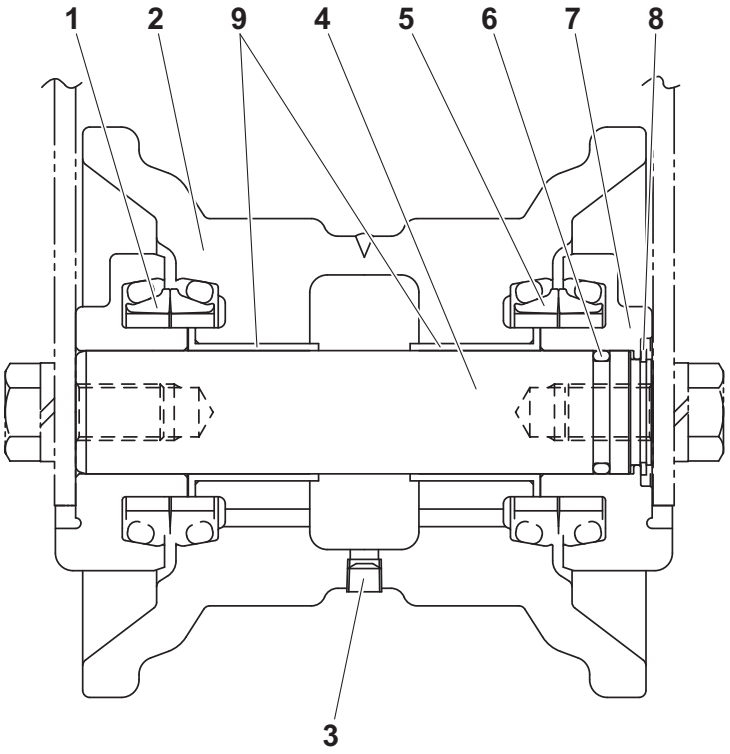
Procedure	
(1) Open the bonnet B**1**. (2) Loosen the hold bolts **3** of the generator **2** to loosen tension of the belt **4**. (3) For the machine with the air conditioner, open the engine hood rear cover, loosen the cap screw **5** and adjuster screw **6**, to loosen tension of the belt **7**. (4) Remove the belts **4**, **7**.	

2) Reinstallation

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

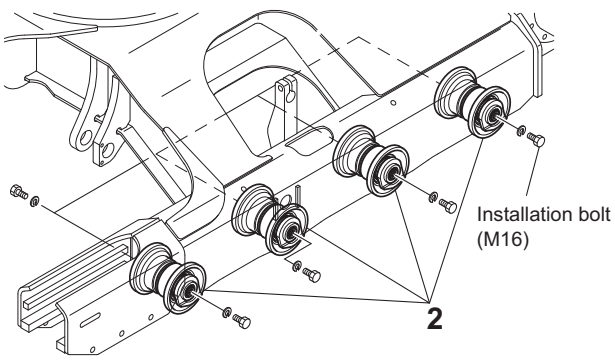
7-2-8 Disassembly and Reassembly of Track Roller

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	
(1) Remove the track roller assembly **2** from the track frame. Installation bolt (M16) Adhesive Apply Three Bond 1324 or its equivalent. Tightening torque : 152 to 181 ft·lbf (206 to 245 N·m)	

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**.

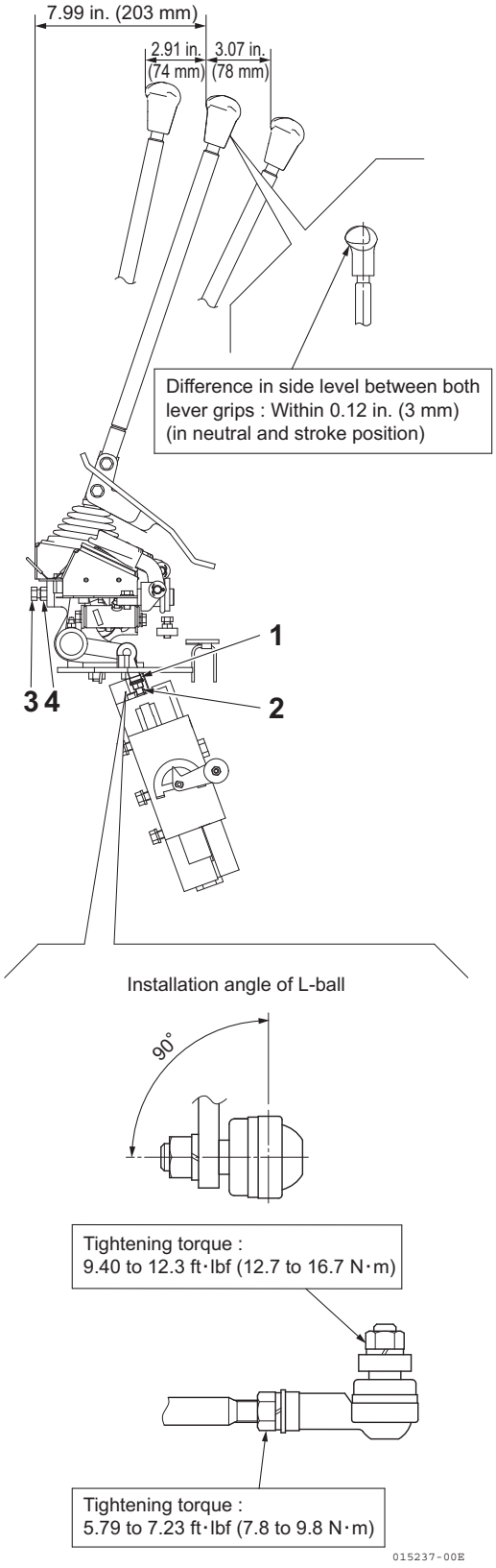
2) Adjustment of Stopper Bolts (Forward and Reverse Travel)

(1) Loosen the lock nuts **4** of the stopper bolts **3**.

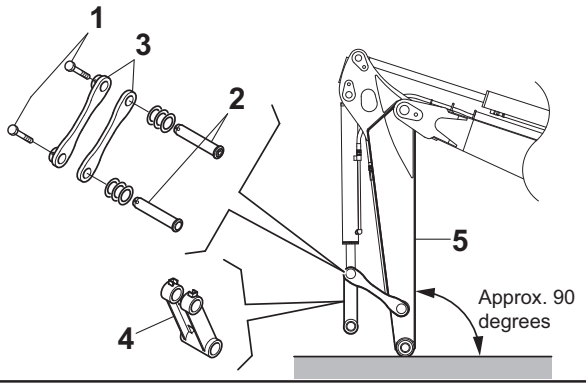
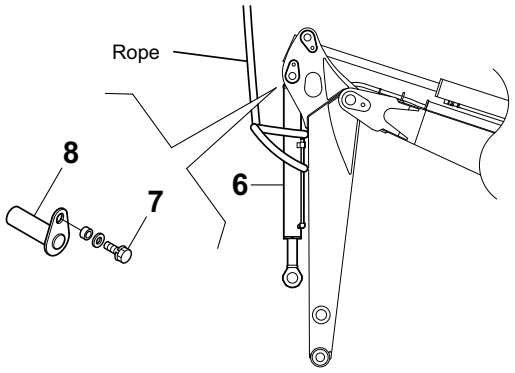
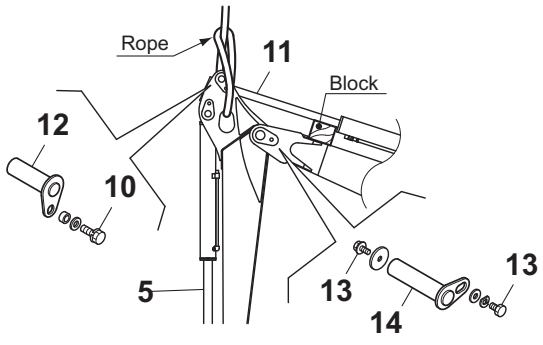
(2) Screw in stopper bolts **3** until they have no contact with travel lever.

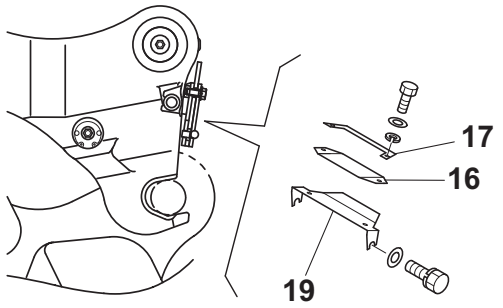
(3) Move the travel lever to its stroke ends, and loosen stopper bolts **3** until they contact with the travel lever.

(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.

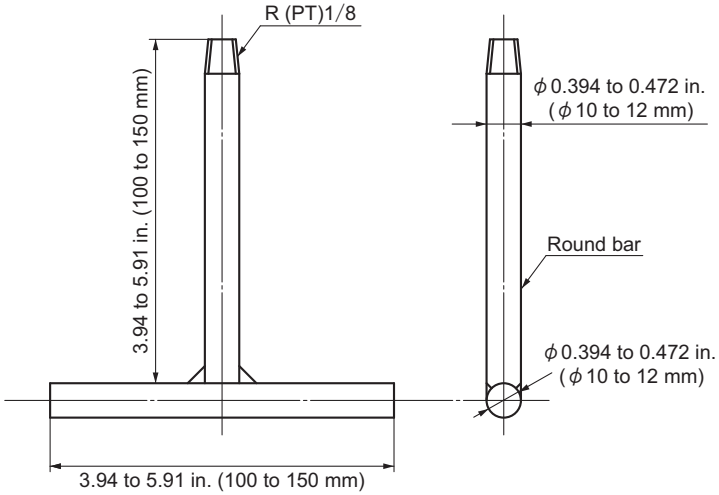


2) Removal of Arm

Procedure	
(1) Remove the bucket. (2) Remove the bolt **1** (M10) and pull out the pin **2** to remove the bucket link **3** and the bucket arm **4**. (3) Lightly place the top end of the arm **5** on the ground perpendicularly to the ground.	
(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**. ***Note :*** *Put rope round the bucket cylinder to remove it using a lifting device.*	
(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. ***Note :*** *Put a block under the arm cylinder.* (6) Remove the bolts **13** (M12 and M14) to pull out the arm pin **14** and remove the arm **5**.	

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

3) Pin Puller Jig



4) Reassembly

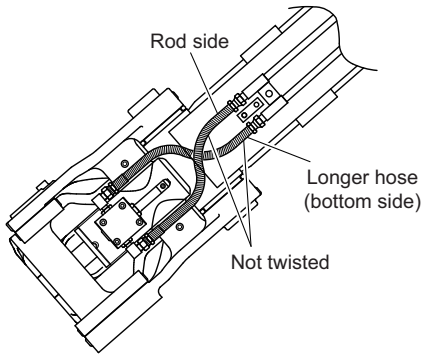
Reassemble the quick coupler in the reverse order of the disassembly procedure.

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).*

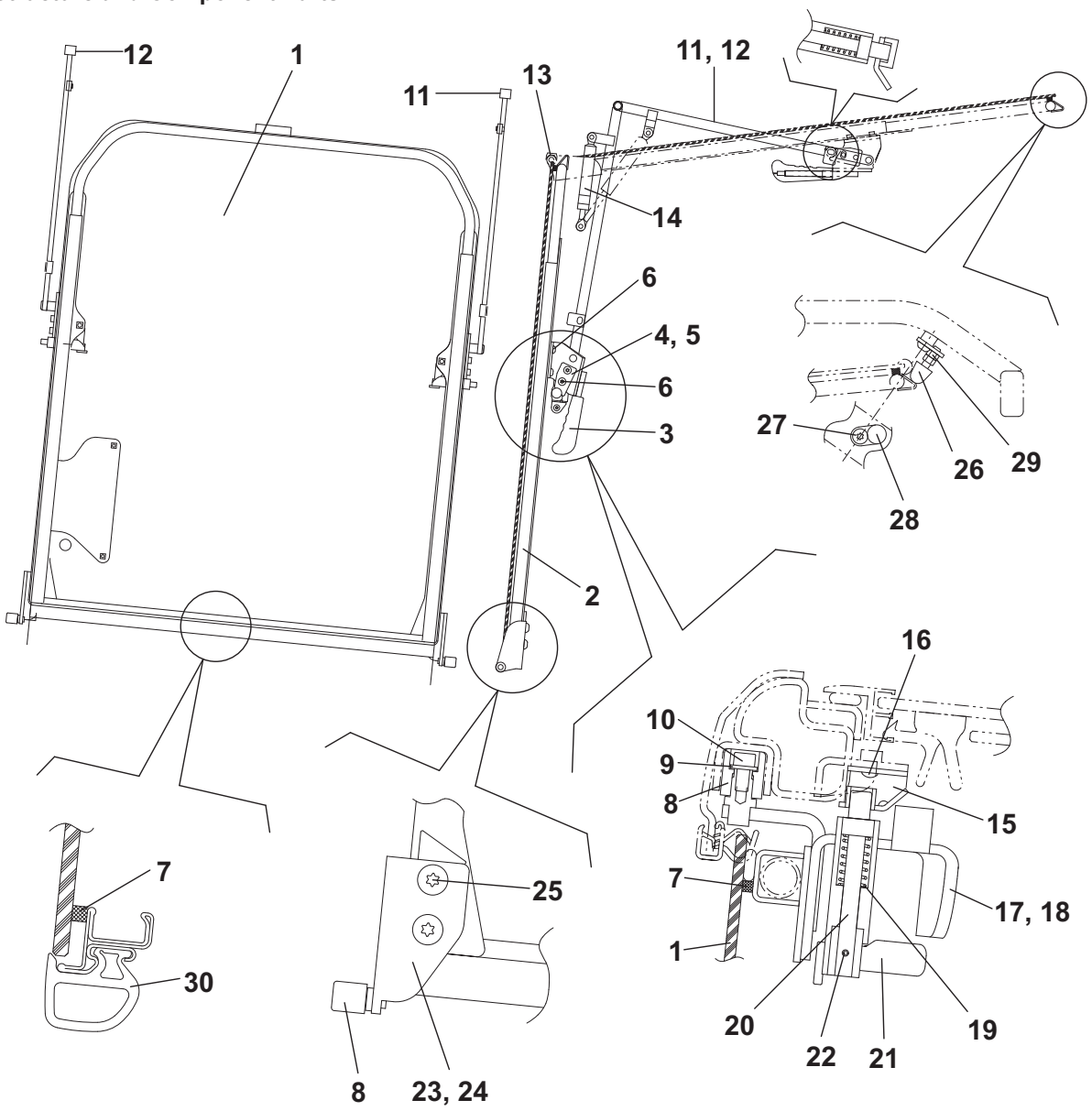
Tightening torque

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)	↑



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

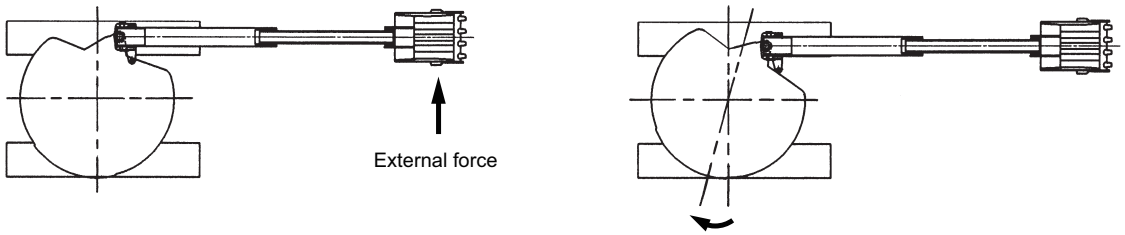
Note :

- *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.*

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

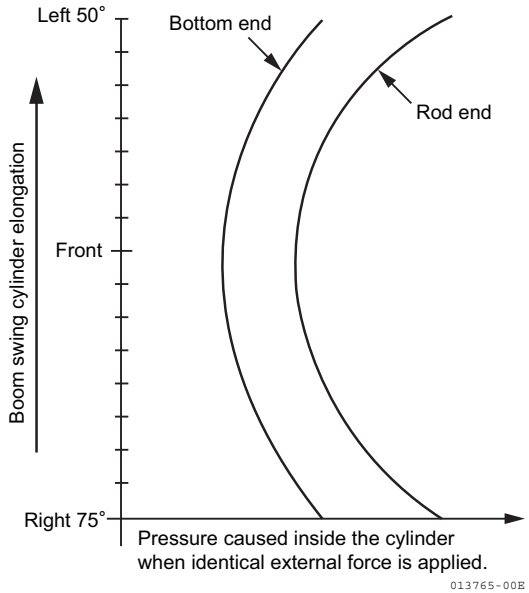
Phenomenon

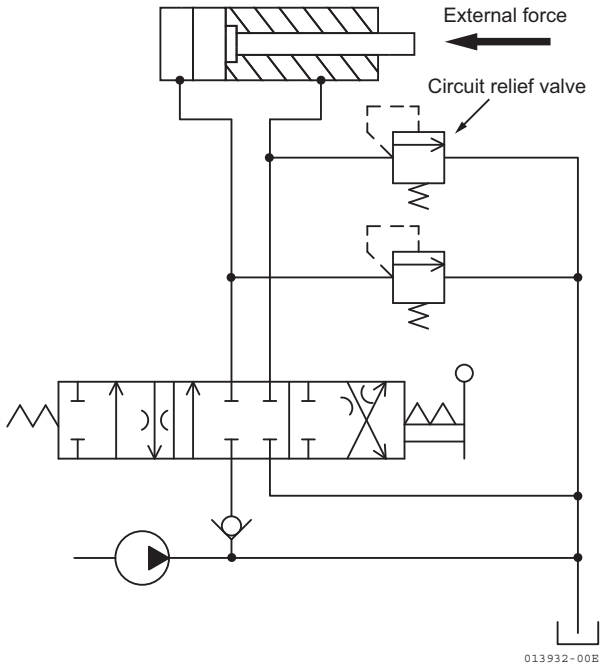
The boom swing cylinder elongates in digging operation at a 70 degrees swing.

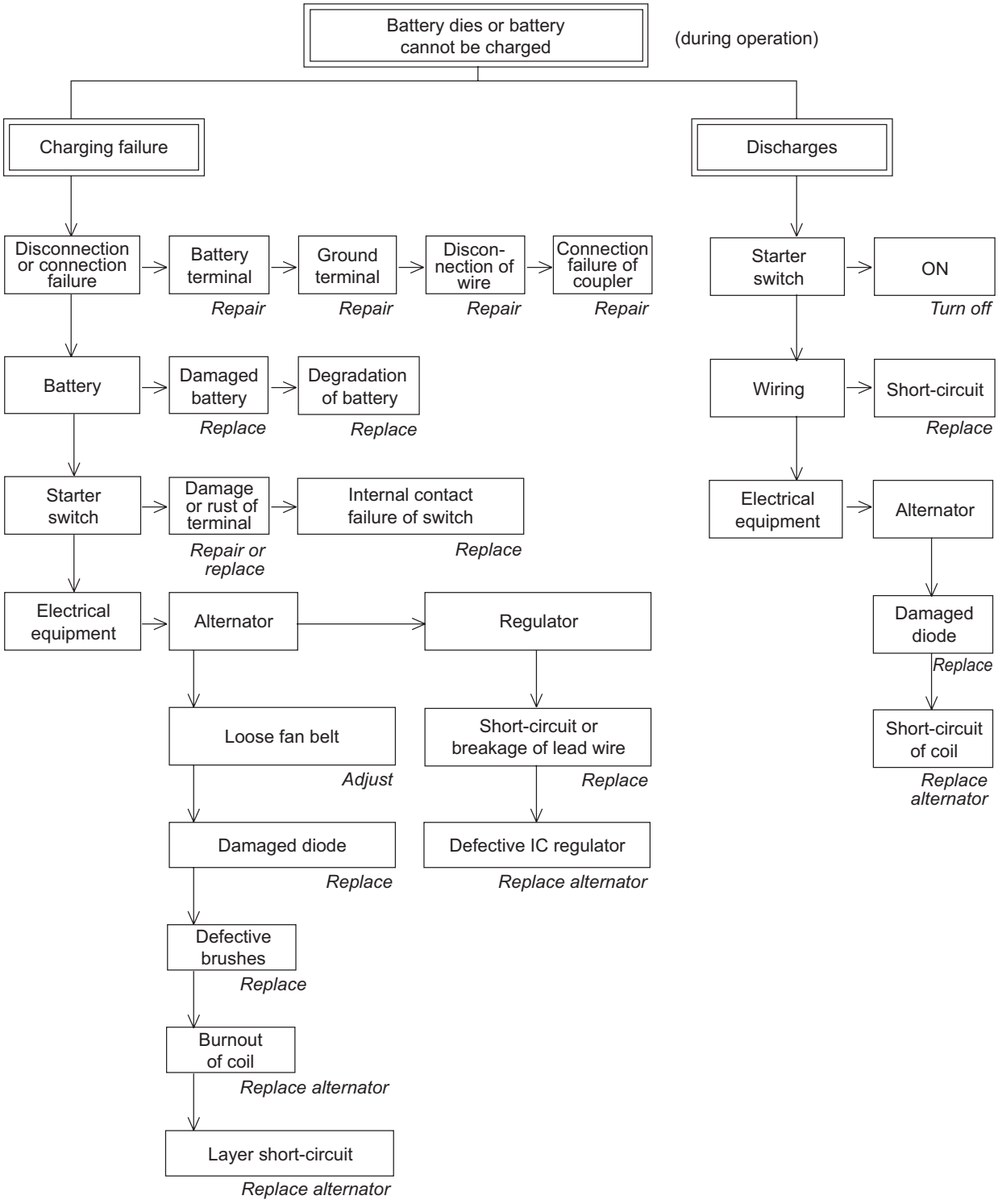


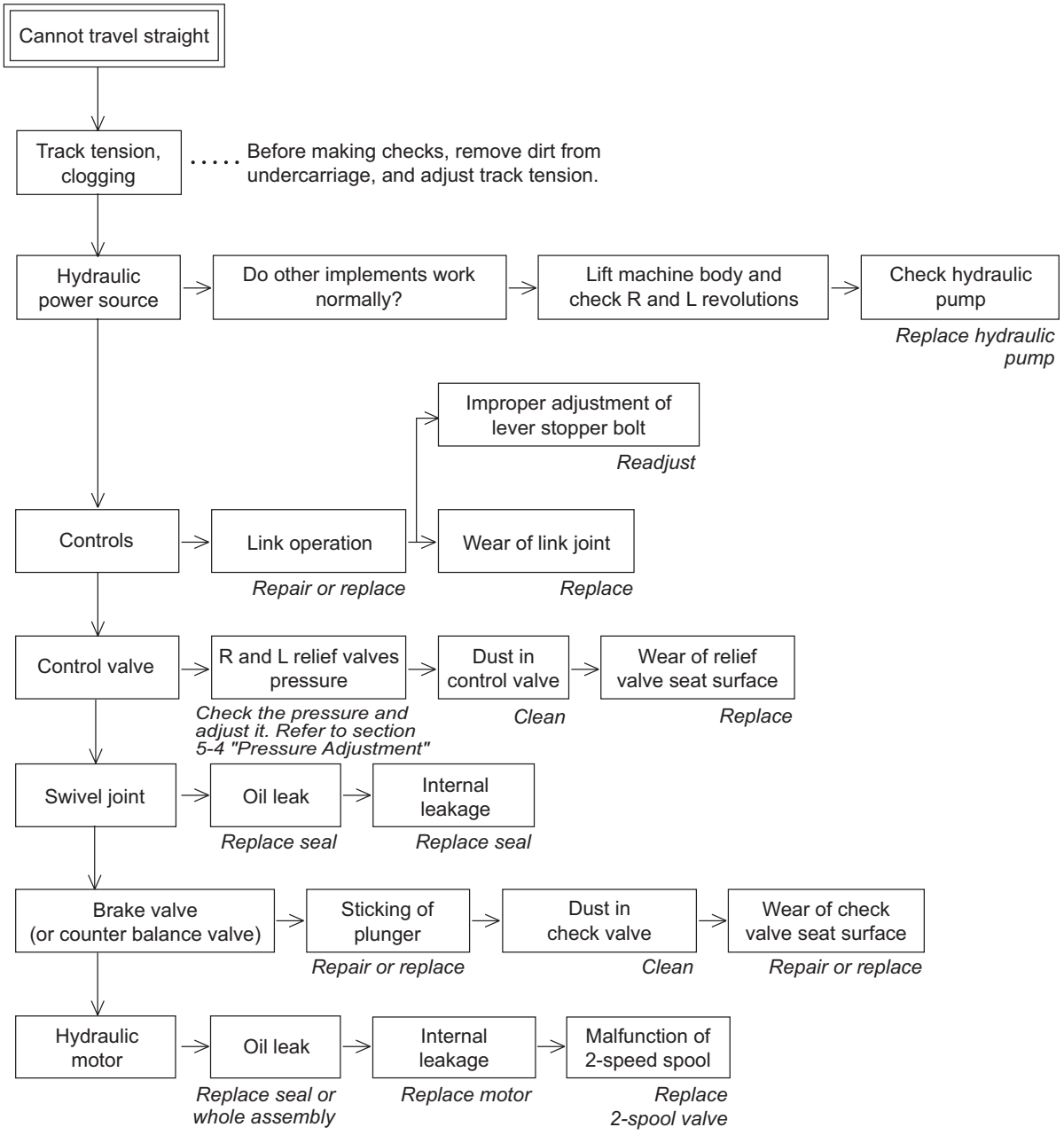
Reason

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.






Battery dies or battery cannot be charged
(during operation)
Charging failure
Discharges
Disconnection or connection failure
Battery terminal
Repair
Ground terminal
Repair
Discon-nection of wire
Repair
Connection failure of coupler
Repair
Battery
Damaged battery
Replace
Degradation of battery
Replace
Starter switch
Damage or rust of terminal
Repair or replace
Internal contact failure of switch
Replace
Electrical equipment
Alternator
Regulator
Loose fan belt
Adjust
Damaged diode
Replace
Defective brushes
Replace
Burnout of coil
Replace alternator
Layer short-circuit
Replace alternator
Short-circuit or breakage of lead wire
Replace
Defective IC regulator
Replace alternator
Starter switch
ON
Turn off
Wiring
Short-circuit
Replace
Electrical equipment
Alternator
Damaged diode
Replace
Short-circuit of coil
Replace alternator


Cannot travel straight
Track tension, clogging
Before making checks, remove dirt from undercarriage, and adjust track tension.
Hydraulic power source
Do other implements work normally?
Lift machine body and check R and L revolutions
Check hydraulic pump
Replace hydraulic pump
Improper adjustment of lever stopper bolt
Readjust
Controls
Link operation
Wear of link joint
Repair or replace
Replace
Control valve
R and L relief valves pressure
Dust in control valve
Wear of relief valve seat surface
Check the pressure and adjust it. Refer to section 5-4 "Pressure Adjustment"
Clean
Replace
Swivel joint
Oil leak
Internal leakage
Replace seal
Replace seal
Brake valve (or counter balance valve)
Sticking of plunger
Dust in check valve
Wear of check valve seat surface
Repair or replace
Clean
Repair or replace
Hydraulic motor
Oil leak
Internal leakage
Malfunction of 2-speed spool
Replace seal or whole assembly
Replace motor
Replace 2-spool valve

Water Temp. Alarm Lamp