

# SECTION 5 STEERING SYSTEM



Group 1 Structure and Function ..... 5-1

Group 2 Operational Checks and Troubleshooting ..... 5-11

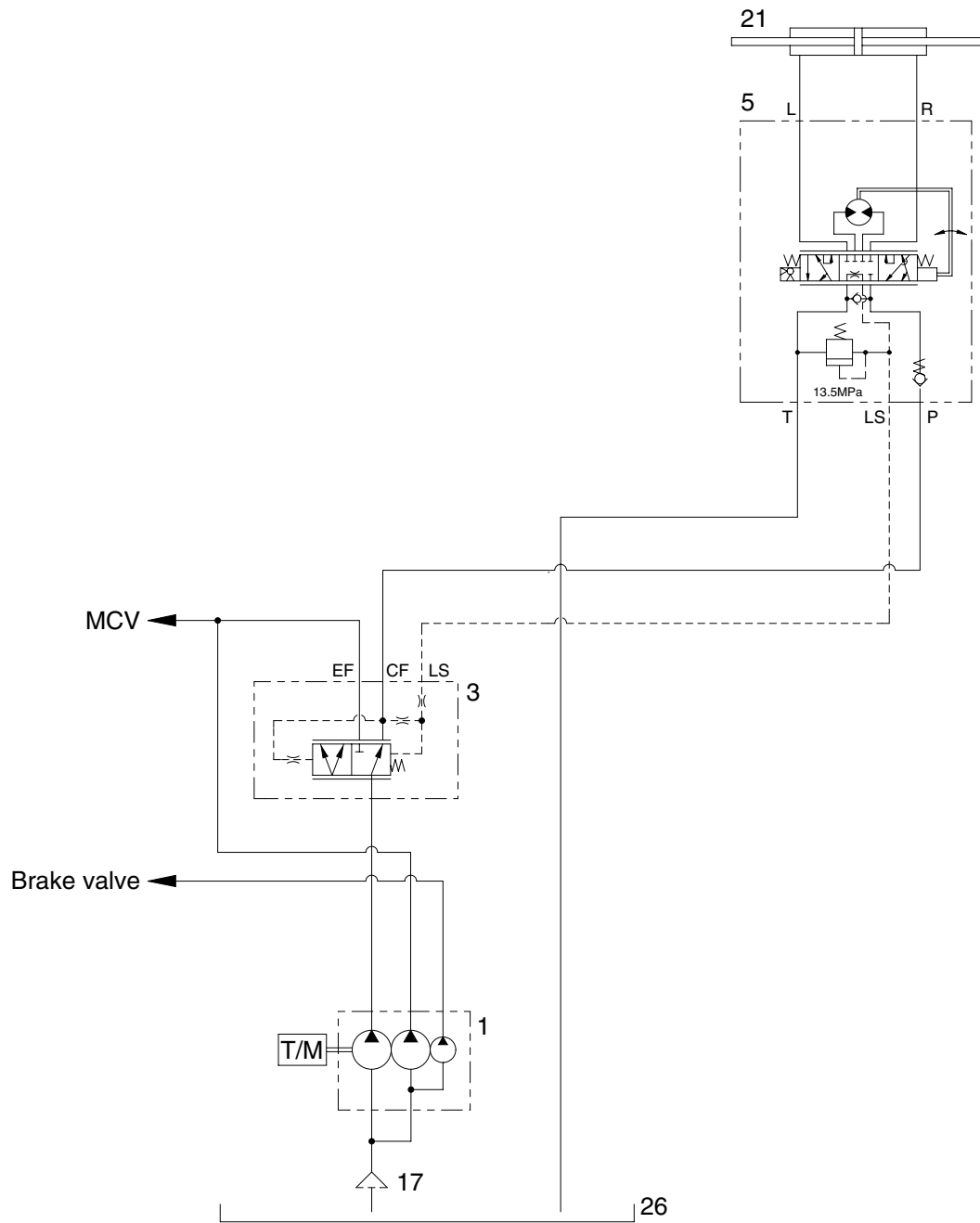
Group 3 Disassembly and Assembly ..... 5-13

## GROUP 1 STRUCTURE AND FUNCTION

1 Hydraulic gear pump  
2 Priority valve  
3 Steering unit  
4 Steering cylinder  
5 Steering wheel

The steering system for this machine is composed of steering wheel assembly, steering unit, steering cylinder, trail axle and piping. The steering force given to the steering wheel enters the steering unit through the steering column. The required oil flow is sensed by the function of the control section of the unit, and pressurized oil delivered from the hydraulic pump is fed to the steering cylinder. The force produced by the steering cylinder moves the knuckle of steering tires through the intermediate link. The axle body is unit structure having steering knuckles installed to its both ends by means of kingpins. Hub and wheel are mounted through bearing to spindle of knuckle.

## 2. HYDRAULIC CIRCUIT (50D-9 : -#0088, 70D-9 : -#1001, 80D-9 : -#0541)

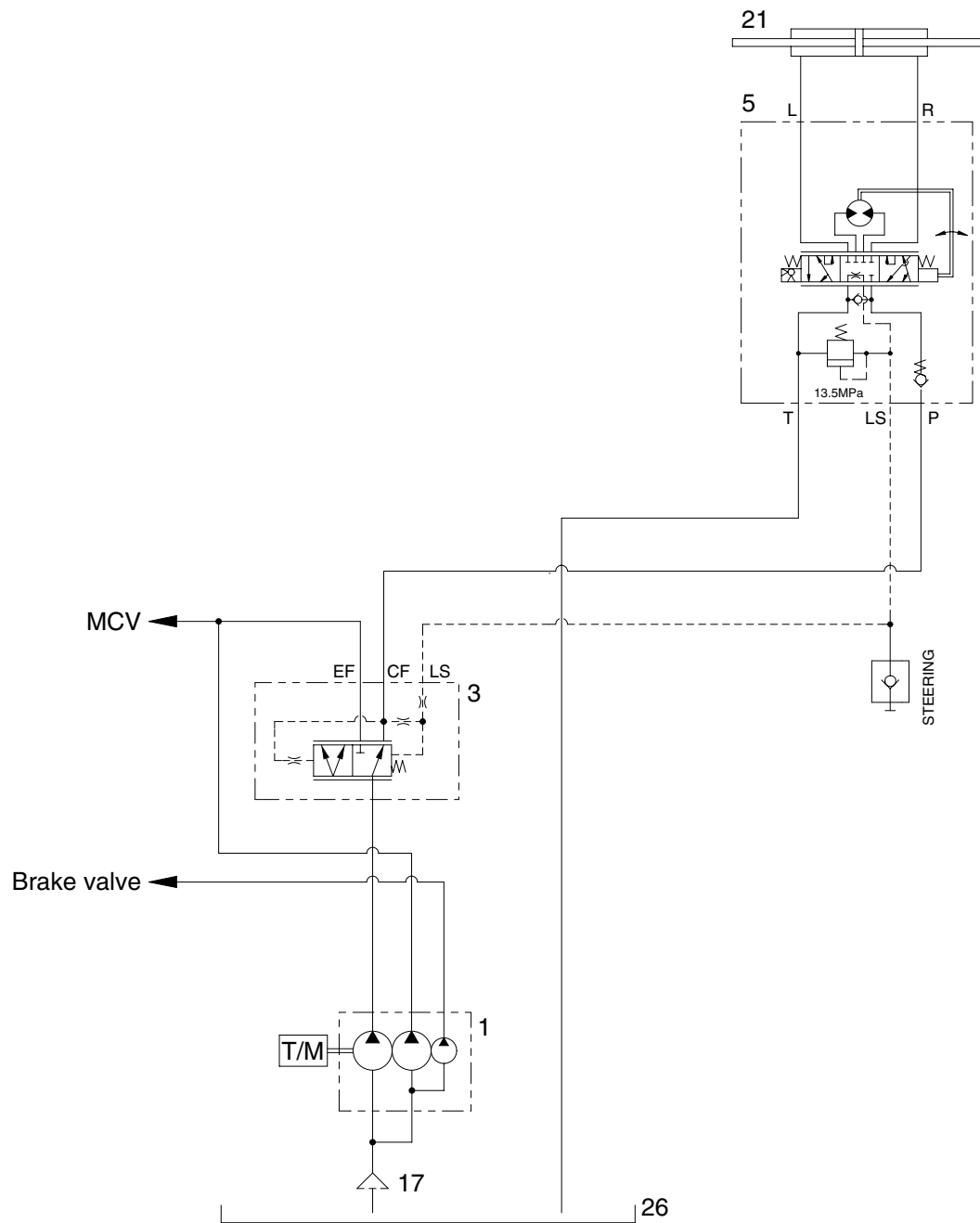


50D9SE01

- 1 Main pump
- 3 Priority valve
- 5 Steering unit

- 17 Suction strainer
- 21 Steering cylinder
- 26 Hydraulic oil tank

# HYDRAULIC CIRCUIT (50D-9 : #0089-, 70D-9 : #1002-, 80D-9 : #0542-)

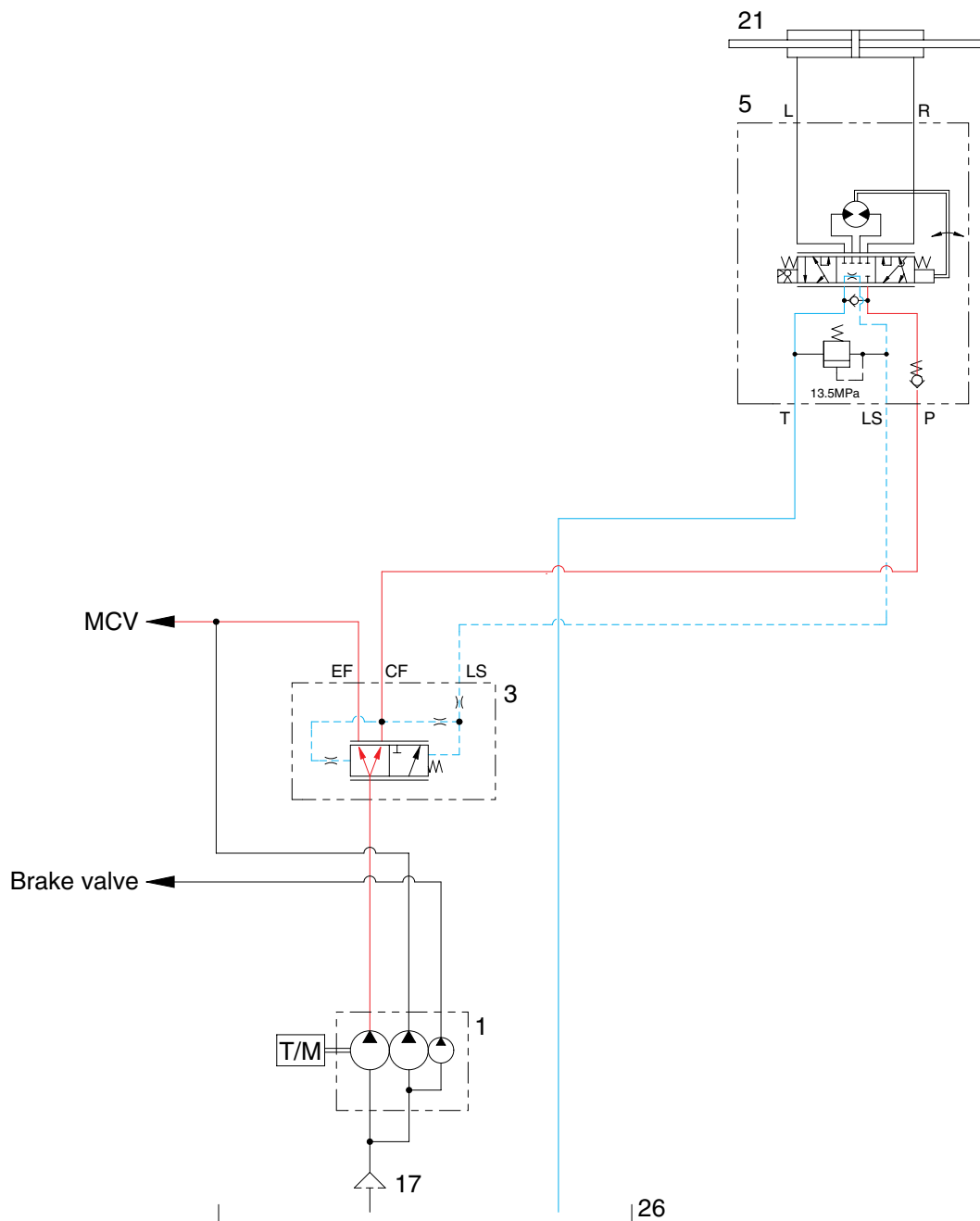


50D9SE01-01

- 1 Main pump
- 3 Priority valve
- 5 Steering unit

- 17 Suction strainer
- 21 Steering cylinder
- 26 Hydraulic oil tank

## 1) NEUTRAL



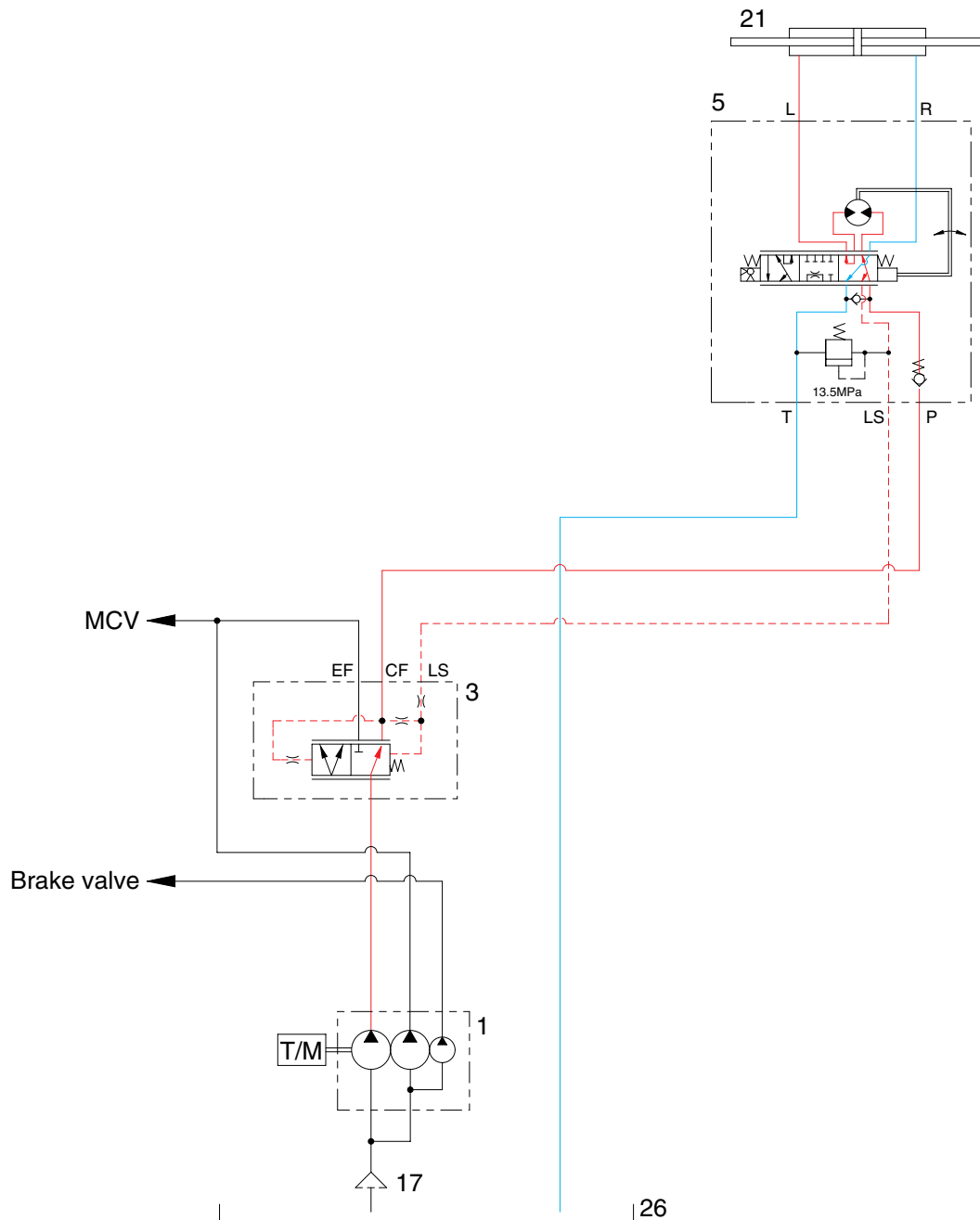
50D9SE02

The steering wheel is not being operated, so control spool (G) does not move.

The oil from hydraulic gear pump (1) enters the port P of priority valve (3) and the inlet pressure oil moves the spool (D) to the left.

Oil flow into LS port to the hydraulic oil tank (26), so the pump flow is routed to the main control valve through the EF port.

## 2) LEFT TURN



50D9SE03

When the steering wheel is turned to the left, the spool (G) within the steering unit (5) connected with steering column turns in left hand direction.

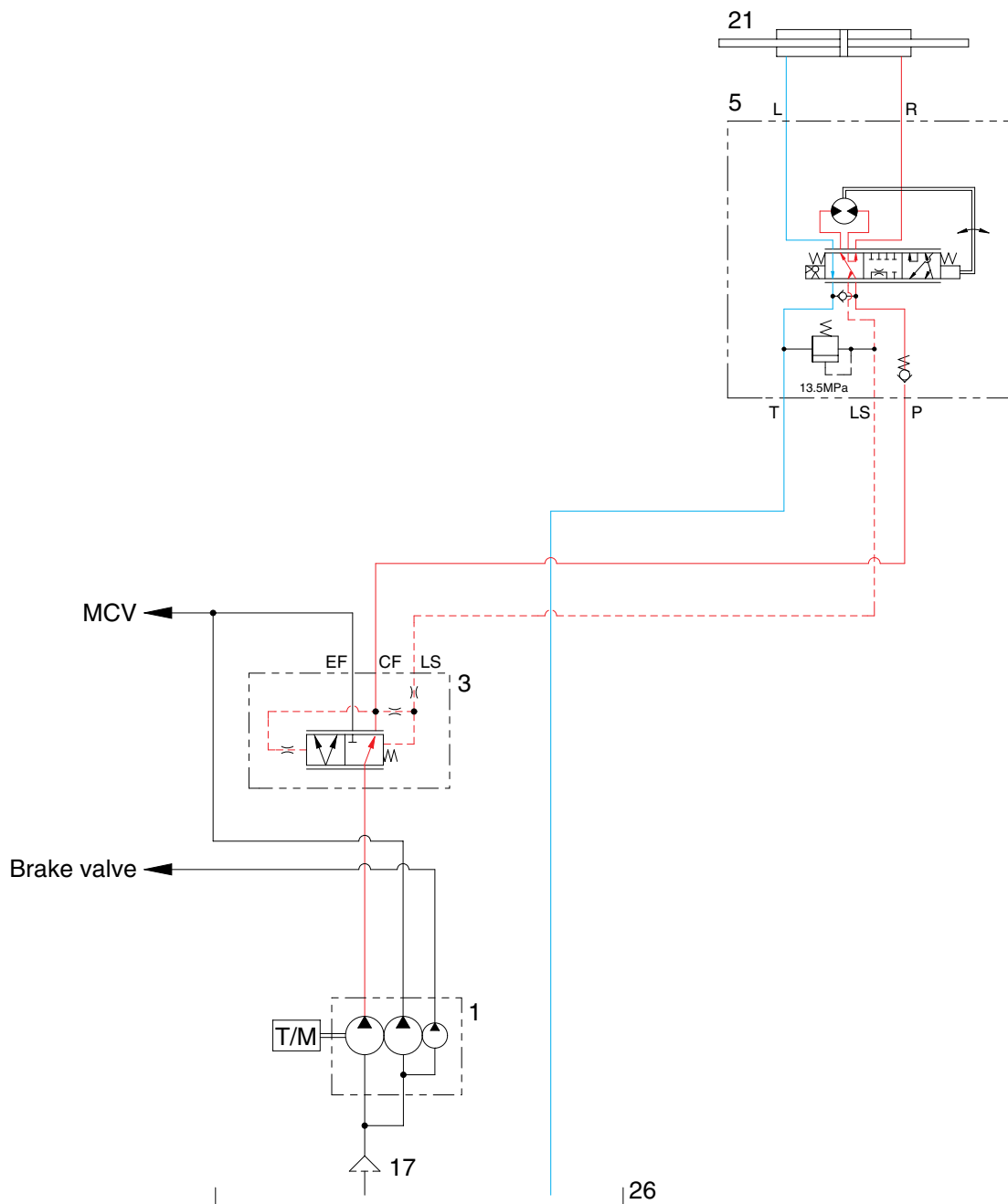
At this time, the oil discharged from the pump flows into the spool (G) the steering unit through the spool (D) of priority valve and flows the gerotor (H).

Oil flow from the gerotor flows back into the spool (G) where it is directed out the left work port (L).

Oil returned from cylinder returns to hydraulic oil tank (26).

When the above operation is completed, the machine turns to the left.

### 3) RIGHT TURN



50D9SE04

When the steering wheel is turned to the right, the spool (G) within the steering unit (5) connected with steering column turns in right hand direction.

At this time, the oil discharged from the pump flows into the spool (G) the steering unit through the spool (D) of priority valve and flows the gerotor (H).

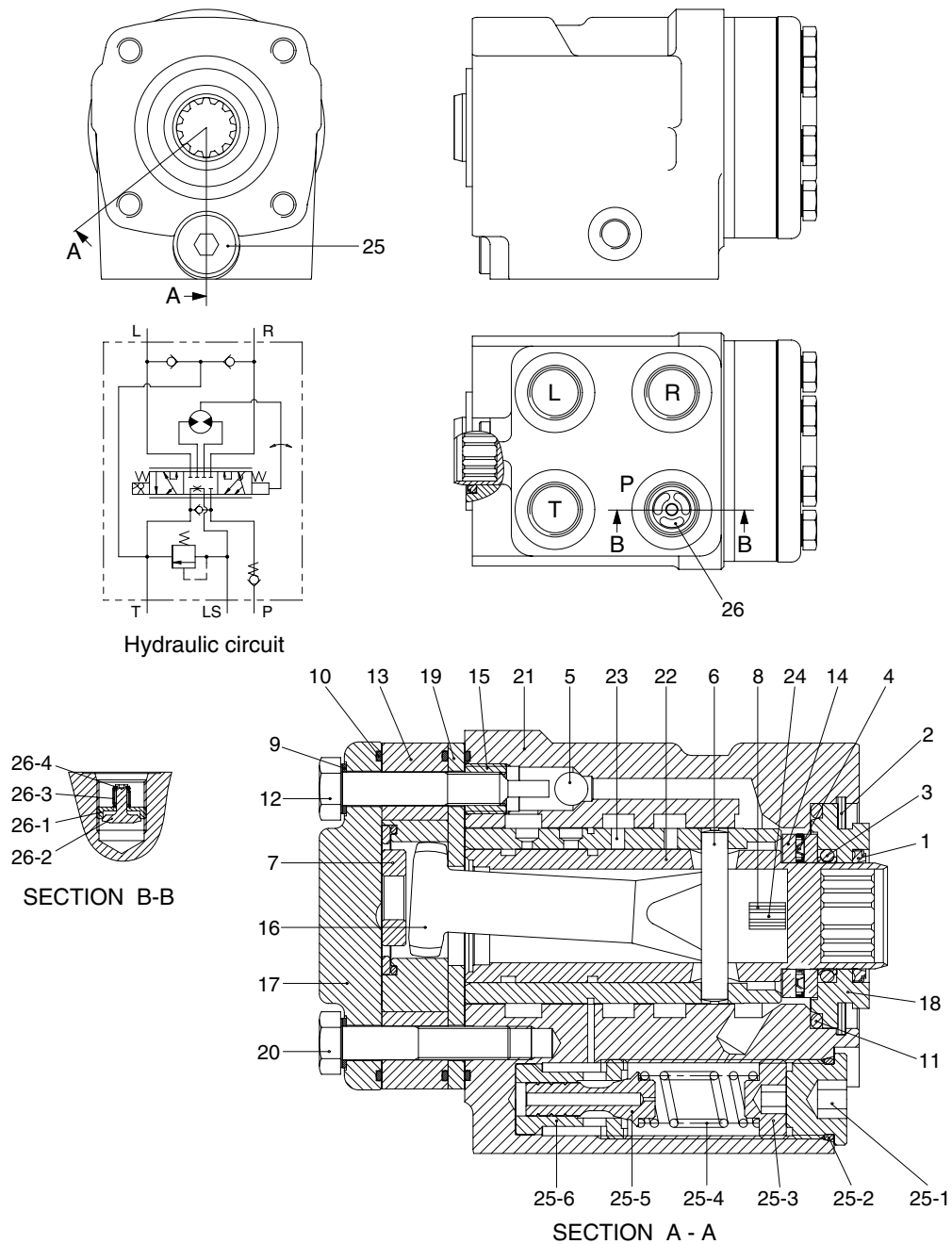
Oil flow from the gerotor flows back into the spool (G) where it is directed out the right work port (R).

Oil returned from cylinder returns to hydraulic oil tank (26).

When the above operation is completed, the machine turns to the right.

### 3. STEERING UNIT

#### 1) STRUCTURE



D507SE32

1 Dust seal	10 O-ring	19 Plate	25-3 Spring seat
2 Retaining ring	11 O-ring	20 Cap screw	25-4 Spring
3 Cap seal	12 Rolled screw	21 Housing	25-5 Spool
4 Thrust bearing	13 Gerotor set	22 Spool	25-6 Bushing
5 Ball	14 Bearing race	23 Sleeve	26 Check valve
6 Pin	15 Bore screw	24 Plate spring	26-1 Guide
7 Spacer	16 Drive shaft	25 Relief valve	26-2 Shim
8 Center spring	17 End cap	25-1 Plug	26-3 Spring
9 Washer	18 Bushing	25-2 O-ring	26-4 Washer



## 2) OPERATION

The steering unit is composed of the control valve (rotary valve) and the metering device. The control valve controls the flow of oil from the pump in the interior of the unit depending on the condition of the steering wheel. The metering device is a kind of hydraulic motor composed of a stator and a rotor. It meters the required oil volume, feeds the metered oil to the power cylinder and detects cylinder's motion value, that is, cylinder's motion rate.

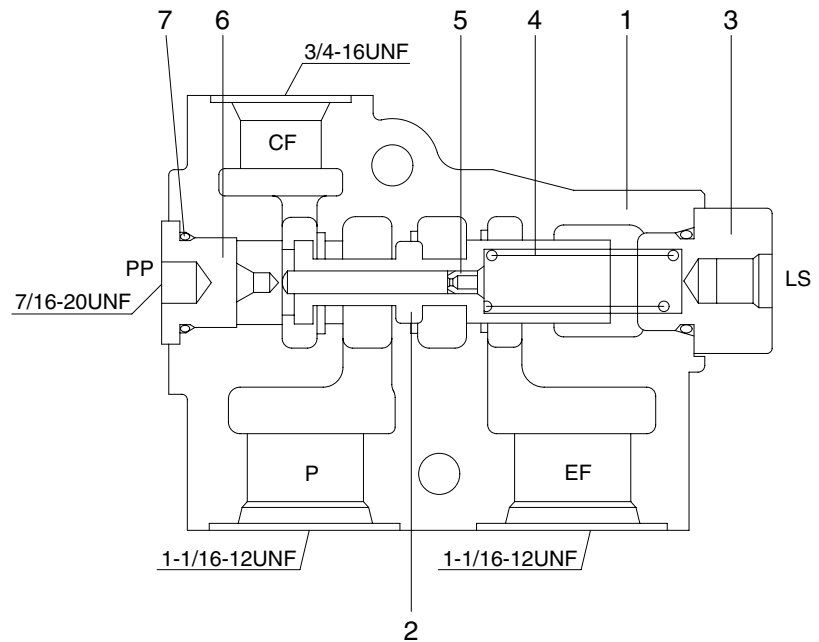
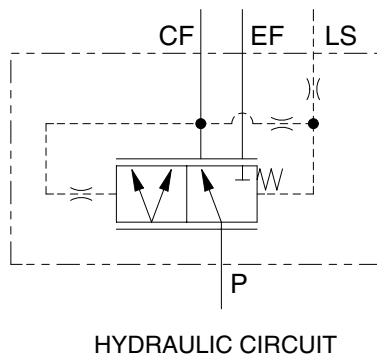
When the steering wheel is turned, the spool turns, the oil path is switched and the oil is fed into the metering device. As a result, the rotor is caused to run by oil pressure, and the sleeve is caused to run through the drive shaft and cross pin. Therefore, when the spool is turned, the spool turns by the same value in such a manner that it follows the motion of the spool. Steering motion can be accomplished when this operation is performed in a continuous state.

**▲ If the hoses of the steering system are incorrectly connected, the steering wheel can turn very rapidly when the engine is started. Keep clear of the steering wheel when starting the engine.**

The centering spring for the spool and sleeve is provided to cause the valve to return to the neutral position. It is therefore possible to obtain a constant steering feeling, which is transmitted to the hands of the driver. Return to the center position occurs when the steering wheel is released.

## 4. PRIORITY VALVE

### 1) STRUCTURE



50D9SE06

- |               |            |          |
|---------------|------------|----------|
| 1 Body        | 4 Spring   | 7 O-ring |
| 2 Spool       | 5 Orifice  |          |
| 3 Spring plug | 6 End plug |          |

### 2) OPERATION

The oil from the hydraulic gear pump flows to the priority valve.

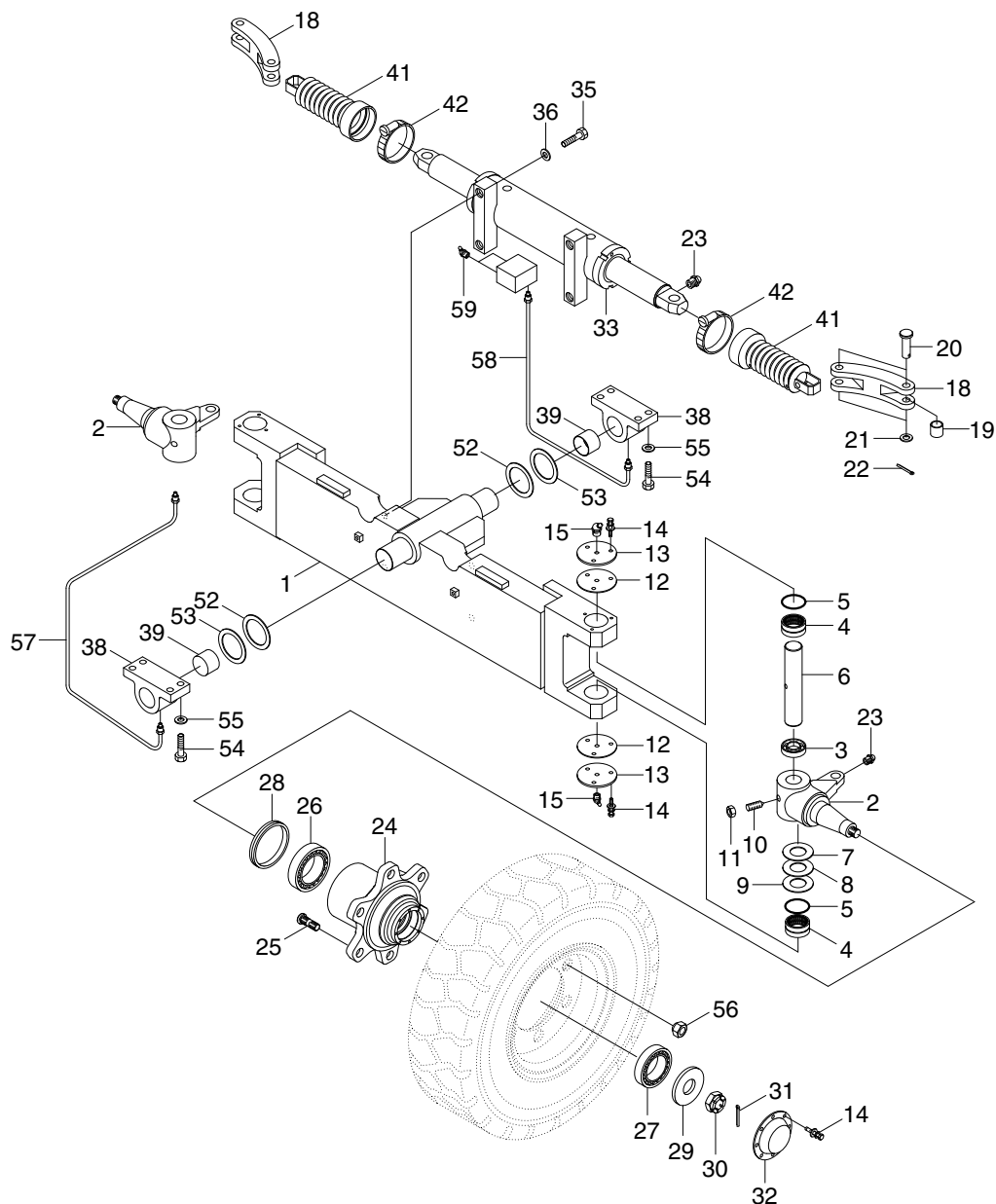
The priority valve supplies a flow of oil to the steering system and lift, tilt system.

The steering flow is controlled by the steering unit to operate the steering cylinder.

The remainder of the oil flow from the pump flows to the main control valve.

## 5. STEERING AXLE

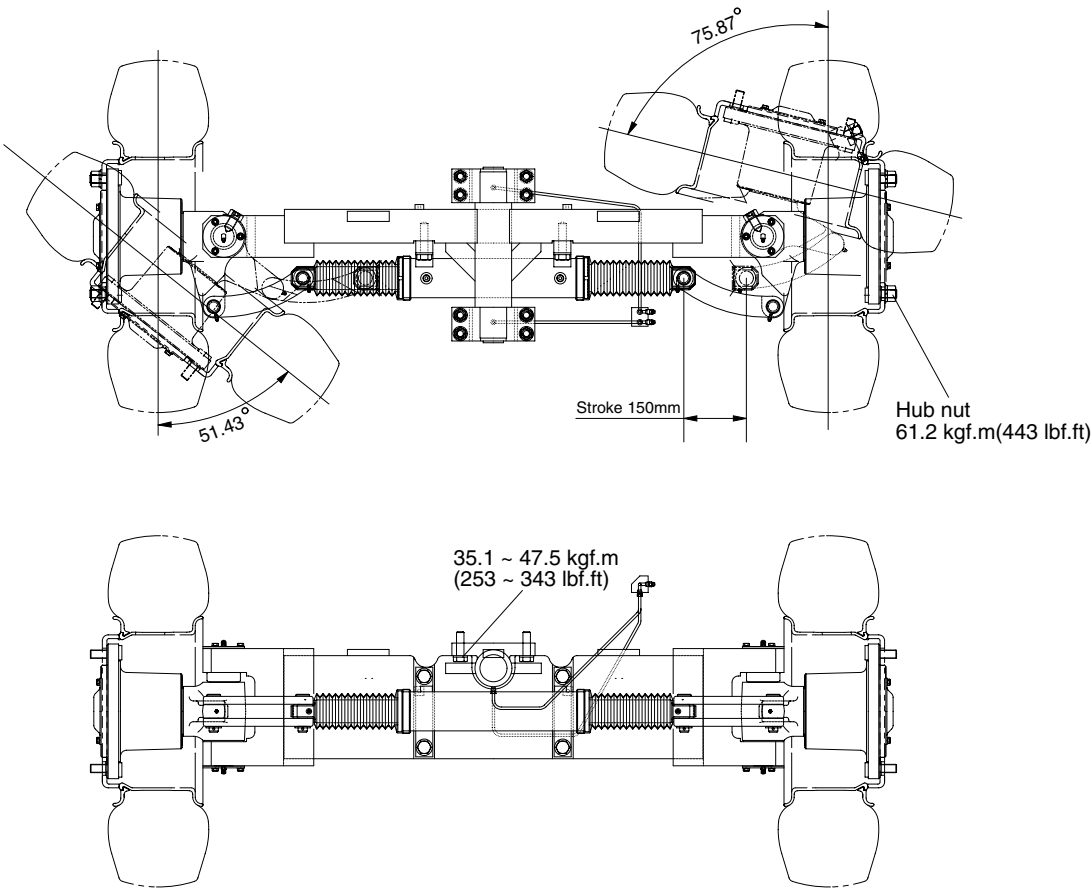
### 1) STRUCTURE



50D9SE24

1	Steering axle	13	Cover	25	Hub bolt	39	Bushing
2	Knuckle	14	Bolt w/washer	26	Taper roller bearing	41	Steering cylinder boot
3	Thrust bearing	15	Grease nipple	27	Taper roller bearing	42	Clamp
4	Needle bearing	16	Hexagon bolt	28	Oil seal	52	Shim (1.0 t)
5	Oil seal	17	Hexagon nut	29	Special washer	53	Shim (0.5 t)
6	King pin	18	Link	30	Slotted nut	54	Hexagon bolt
7	Thrust washer	19	Bushing	31	Split pin	55	Hardened washer
8	Shim washer (0.1 t)	20	Link pin	32	Hub cap	56	Hub nut
9	Shim washer (0.2 t)	21	Special washer	33	Steering cylinder	57	Front pipe assy
10	Set screw	22	Split pin	35	Hexagon bolt	58	Rear pipe assy
11	Hexagon nut	23	Grease nipple	36	Hardened washer	59	Grease nipple
12	Gasket	24	Hub	38	Support		

2) TIGHTENING TORQUE AND SPECIFICATION

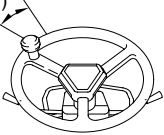


50D9SE07

Type	Unit	Center pin support single shaft
Structure of knuckle	-	Elliott type
Toe-in	degree	0
Camber	degree	0
Caster	degree	0
King pin angle	degree	0
Max steering angle of wheels(Inside/Outside)	degree	75.87/ 51.43
Tread	mm (in)	1604 (63.1)

## GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

### 1. OPERATIONAL CHECKS

Check item	Checking procedure								
<b>Steering wheel</b> 30-60mm (1.2-2.4 in) 	<ul style="list-style-type: none"> <li>Set rear wheels facing straight forward, then turn steering wheel to left and right. Measure range of steering wheel movement before rear wheel starts to move. Range should be 30~60 mm at rim of steering wheel. If play is too large, adjust at gear box.</li> <li>Test steering wheel play with engine at idling.</li> </ul>								
<b>Knuckle</b>	<ul style="list-style-type: none"> <li>Check knuckle visually or use crack detection method. If the knuckle is bent, the tire wear is uneven, so check tire wear.</li> </ul>								
<b>Steering axle</b>	<ul style="list-style-type: none"> <li>Put camber gauge in contact with hub and measure camber. If camber is not within <math>0 \pm 0.5^\circ</math>; rear axle is bent.</li> <li>Ask assistant to drive machine at minimum turning radius.</li> <li>Fit bar and a piece of chalk at outside edge of counterweight to mark line of turning radius.</li> <li>If minimum turning radius is not within <math>\pm 100</math> mm (<math>\pm 4</math> in) of specified value, adjust turning angle stopper bolt.</li> </ul> <p>Min turning radius (Outside)</p> <table border="1"> <tbody> <tr> <td>50D-9</td><td>3314 mm (10' 10")</td></tr> <tr> <td>60D-9</td><td>3374 mm (11' 1")</td></tr> <tr> <td>70D-9</td><td>3436 mm (11' 3")</td></tr> <tr> <td>80D-9</td><td>3700 mm (12' 2")</td></tr> </tbody> </table>	50D-9	3314 mm (10' 10")	60D-9	3374 mm (11' 1")	70D-9	3436 mm (11' 3")	80D-9	3700 mm (12' 2")
50D-9	3314 mm (10' 10")								
60D-9	3374 mm (11' 1")								
70D-9	3436 mm (11' 3")								
80D-9	3700 mm (12' 2")								
<b>Hydraulic pressure of power steering</b>	<p>Remove plug from outlet port of flow divider and install oil pressure gauge. Turn steering wheel fully and check oil pressure.</p> <p>※ Oil pressure : 135 ~ 140 kgf/cm<sup>2</sup> (132 ~ 137 bar)</p>								

### 2. TROUBLESHOOTING

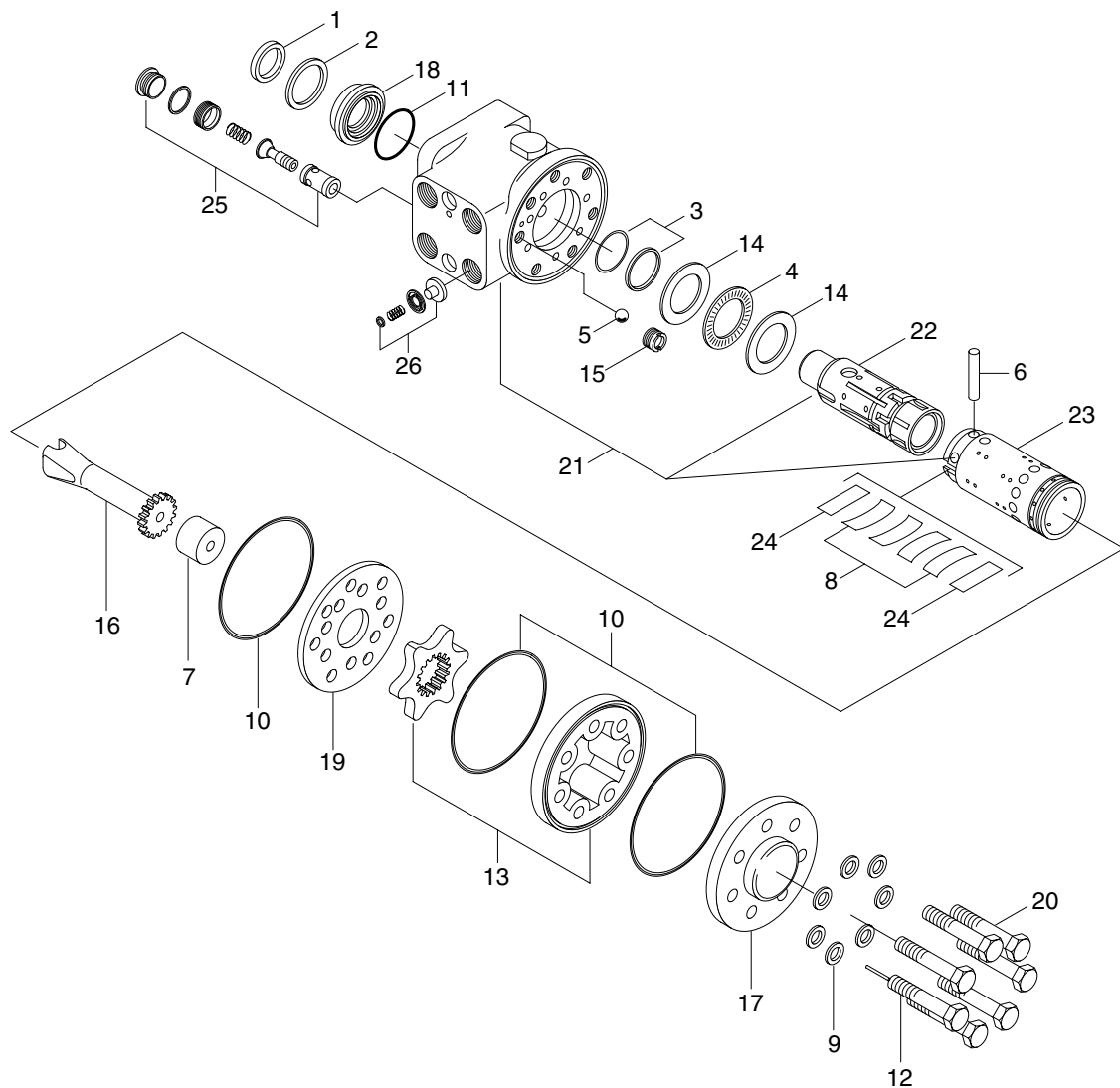
Problem	cause	Remedy
Steering wheel drags.	<ul style="list-style-type: none"> <li>Low oil pressure.</li> <li>Bearing faulty.</li> <li>Spring spool faulty.</li> <li>Reaction plunger faulty.</li> <li>Ball-and-screw assembly faulty.</li> <li>Sector shaft adjusting screw excessively tight.</li> <li>Gears poorly meshing.</li> <li>Flow divider coil spring fatigued.</li> </ul>	<ul style="list-style-type: none"> <li>Check lockout. Repair.</li> <li>Clean or replace.</li> <li>Clean or replace.</li> <li>Replace.</li> <li>Clean or replace.</li> <li>Adjust.</li> <li>Check and correct meshing.</li> <li>Replace.</li> </ul>
Steering wheel fails to return smoothly.	<ul style="list-style-type: none"> <li>Bearing faulty.</li> <li>Reaction plunger faulty.</li> <li>Ball-and-screw assy faulty</li> <li>Gears poorly meshing.</li> </ul>	<ul style="list-style-type: none"> <li>Clean or replace.</li> <li>Replace.</li> <li>Clean or replace.</li> <li>Check and correct meshing.</li> </ul>

Problem	cause	Remedy
Steering wheel turns unsteadily. Steering system makes abnormal sound or vibration.	<ul style="list-style-type: none"> <li>· Lockout loosening.</li> <li>· Metal spring deteriorated.</li> <li>· Gear backlash out of adjustment.</li> <li>· Lockout loosening.</li> <li>· Air in oil circuit.</li> </ul>	<ul style="list-style-type: none"> <li>· Retighten.</li> <li>· Replace.</li> <li>· Adjust.</li> <li>· Retighten.</li> <li>· Bleed air.</li> </ul>
Abnormal sound heard when steering wheel is turned fully	Valve <ul style="list-style-type: none"> <li>· Faulty. (Valve fails to open.)</li> </ul> Piping <ul style="list-style-type: none"> <li>· Pipe (from pump to power steering cylinder) dented or clogged.</li> </ul>	<ul style="list-style-type: none"> <li>· Adjust valve set pressure and check for specified oil pressure.</li> <li>· Repair or replace.</li> </ul>
Piping makes abnormal sounds.	Oil pump <ul style="list-style-type: none"> <li>· Lack of oil.</li> <li>· Oil inlet pipe sucks air.</li> <li>· Insufficient air bleeding.</li> </ul>	<ul style="list-style-type: none"> <li>· Add oil.</li> <li>· Repair.</li> <li>· Bleed air completely.</li> </ul>
Valve or valve unit makes abnormal sounds.	Oil pump <ul style="list-style-type: none"> <li>· Oil inlet pipe sucks air.</li> </ul> Valve <ul style="list-style-type: none"> <li>· Faulty. (Unbalance oil pressure)</li> </ul> Piping <ul style="list-style-type: none"> <li>· Pipe (from pump to power steering) dented or clogged.</li> <li>· Insufficient air bleeding.</li> </ul>	<ul style="list-style-type: none"> <li>· Repair or replace.</li> <li>· Adjust valve set pressure and check specified oil pressure.</li> <li>· Repair or replace.</li> <li>· Bleed air completely.</li> </ul>
Insufficient or variable oil flow.	<ul style="list-style-type: none"> <li>· Flow control valve orifice clogged.</li> </ul>	<ul style="list-style-type: none"> <li>· Clean</li> </ul>
Insufficient or variable discharge pressure.	Piping <ul style="list-style-type: none"> <li>· Pipe (from tank to pipe) dented or clogged.</li> </ul>	<ul style="list-style-type: none"> <li>· Repair or replace.</li> </ul>
Steering cylinder head leakage (Piston rod)	<ul style="list-style-type: none"> <li>· Packing foreign material.</li> <li>· Piston rod damage.</li> <li>· Rod seal damage and distortion.</li> <li>· Chrome gilding damage.</li> </ul>	<ul style="list-style-type: none"> <li>· Replace</li> <li>· Grind surface with oil stone.</li> <li>· Replace</li> <li>· Grind</li> </ul>
Steering cylinder head thread (A little bit leak is no problem)	<ul style="list-style-type: none"> <li>· O-ring damage.</li> </ul>	<ul style="list-style-type: none"> <li>· Replace</li> </ul>
Welding leakage	<ul style="list-style-type: none"> <li>· Cylinder tube damage.</li> </ul>	<ul style="list-style-type: none"> <li>· Tube replace.</li> </ul>
Rod	<ul style="list-style-type: none"> <li>· Tube inside damage.</li> <li>· Piston seal damage and distortion</li> </ul>	<ul style="list-style-type: none"> <li>· Grind surface with oil store.</li> <li>· Replace</li> </ul>
Piston rod bushing inner diameter excessive gap	<ul style="list-style-type: none"> <li>· Bushing wear.</li> </ul>	<ul style="list-style-type: none"> <li>· Replace</li> </ul>

## GROUP 3 DISASSEMBLY AND ASSEMBLY

### 1. STEERING UNIT

#### 1) STRUCTURE

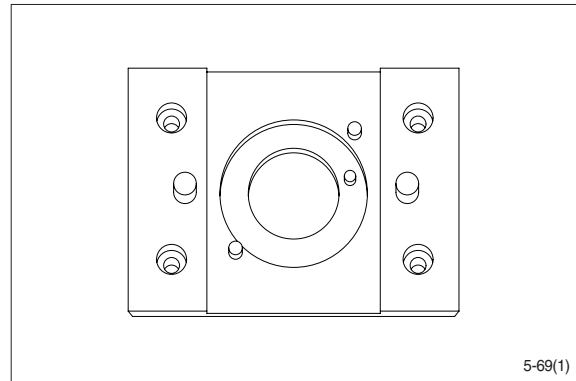


50DS7ESE05

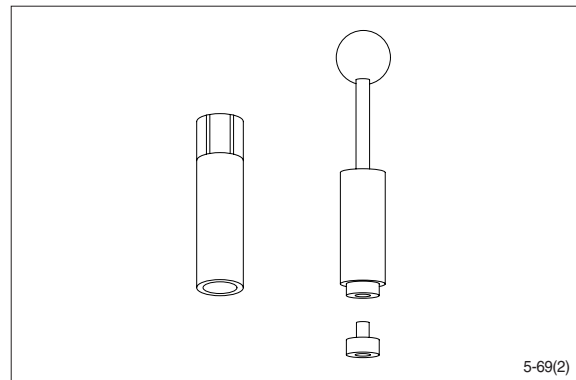
- |                  |                 |                 |
|------------------|-----------------|-----------------|
| 1 Dust seal      | 10 O-ring       | 19 Plate        |
| 2 Retaining ring | 11 O-ring       | 20 Cap screw    |
| 3 Cap seal       | 12 Rolled screw | 21 Housing      |
| 4 Thrust bearing | 13 Gerotor set  | 22 Spool        |
| 5 Ball           | 14 Bearing race | 23 Sleeve       |
| 6 Pin            | 15 Bore screw   | 24 Plate spring |
| 7 Spacer         | 16 Drive shaft  | 25 Relief valve |
| 8 Center spring  | 17 End cap      | 26 Check valve  |
| 9 Washer         | 18 Bushing      |                 |

## 2) TOOLS

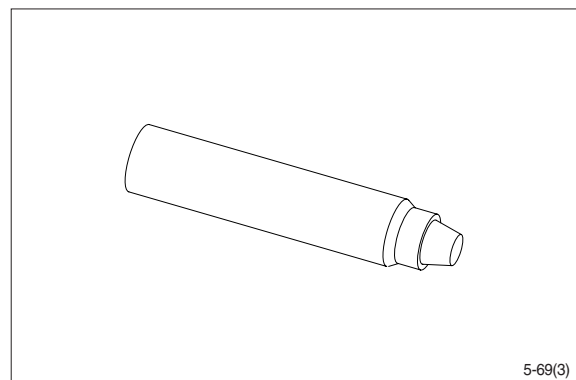
(1) Holding tool.



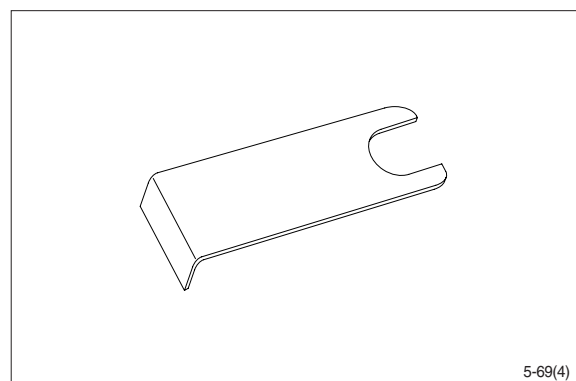
(2) Assembly tool for O-ring and kin-ring.



(3) Assembly tool for lip seal.

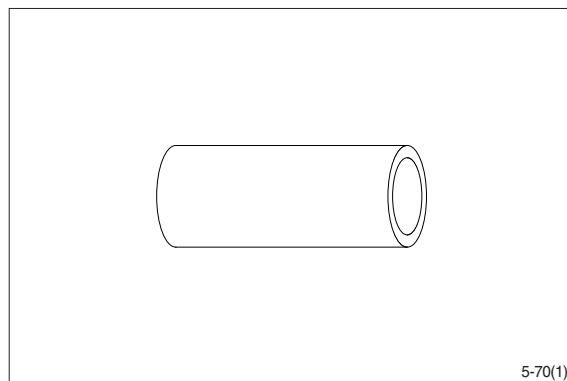


(4) Assembly tool for cardan shaft.



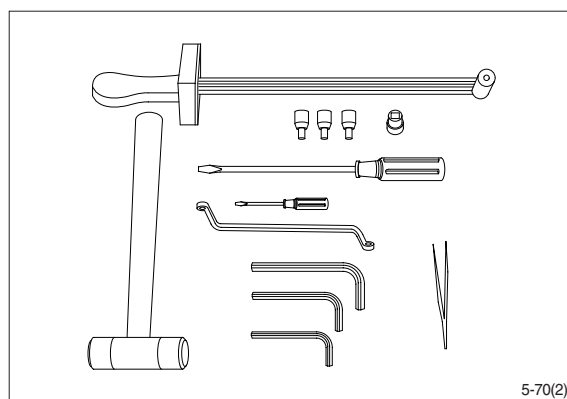


(5) Assembly tool for dust seal.



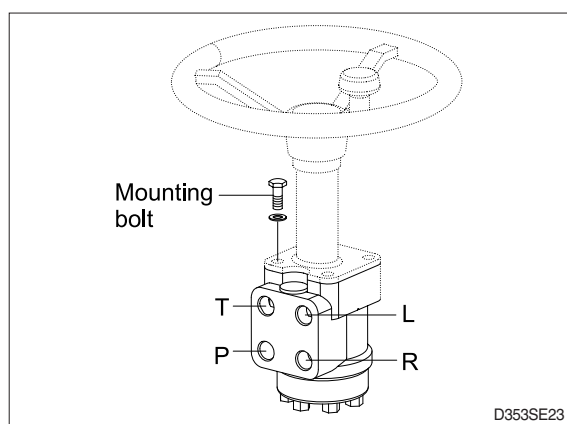
(6) Torque wrench 0~7.1 kgf·m  
(0~54.4 lbf·ft)

13 mm socket spanner  
6, 8 mm and 12 mm hexagon sockets  
12 mm screwdriver  
2 mm screwdriver  
13 mm ring spanner  
6, 8 and 12 mm hexagon socket spanners  
Plastic hammer  
Tweezers



### 3) TIGHTENING TORQUE

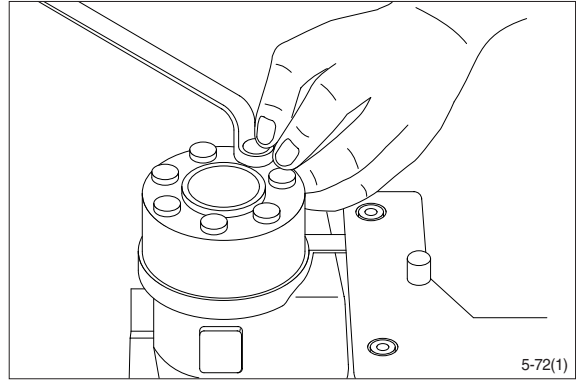
L : Left port  
R : Right port  
T : Tank  
P : Pump



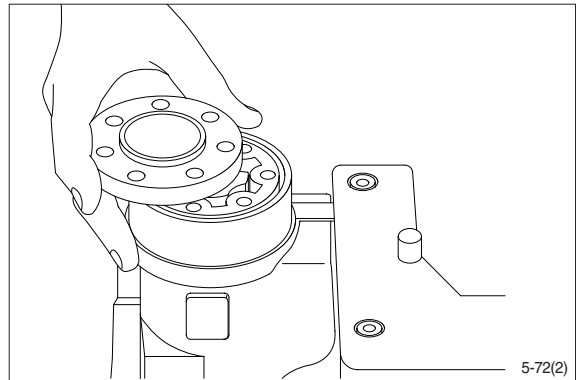
Port	Size	Torque [kgf·m (lbf·ft)]
L	3/4 UNF - 16	6.1±0.6 (44.1±4.3)
R	3/4 UNF - 16	6.1±0.6 (44.1±4.3)
T	3/4 UNF - 16	6.1±0.6 (44.1±4.3)
P	3/4 UNF - 16	6.1±0.6 (44.1±4.3)
Mounting bolt	M10×1.5	4.0 ±0.5 (29±3.6)

#### 4) DISASSEMBLY

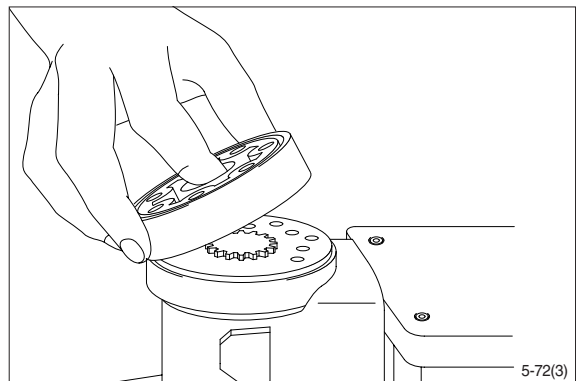
- (1) Disassemble steering column from steering unit and place the steering unit in the holding tool.  
Screw out the screws in the end cover (6-off plus one special screw).



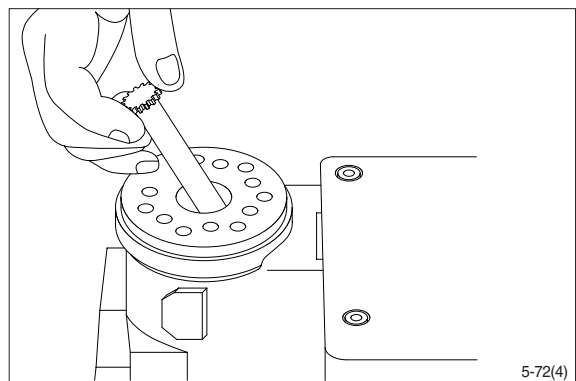
- (2) Remove the end cover, sideways.



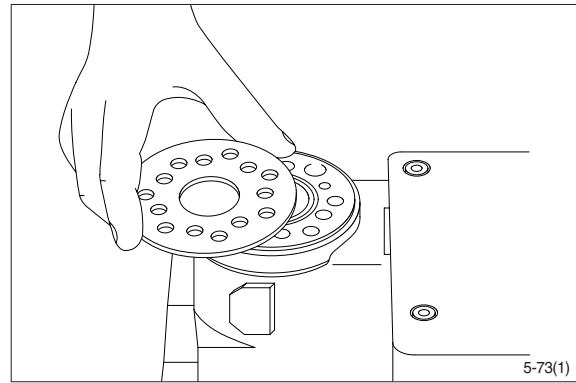
- (3) Lift the gearwheel set (With spacer if fitted) off the unit.  
Take out the two O-rings.



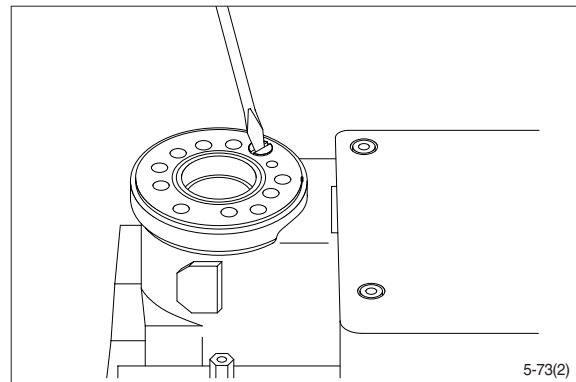
- (4) Remove cardan shaft.



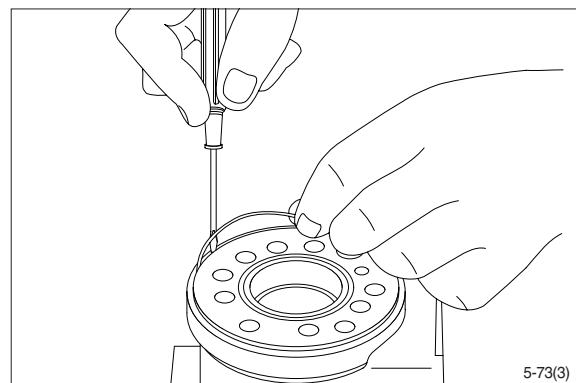
(5) Remove distributor plate.



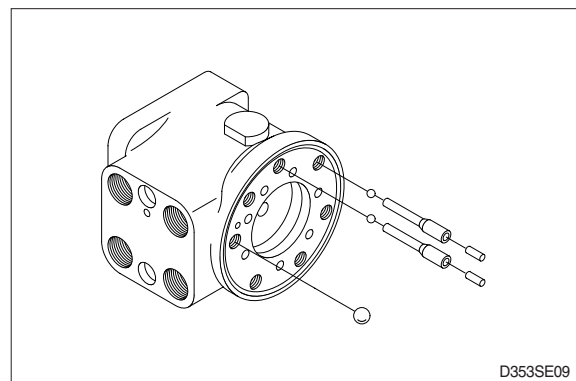
(6) Screw out the threaded bush over the check valve.



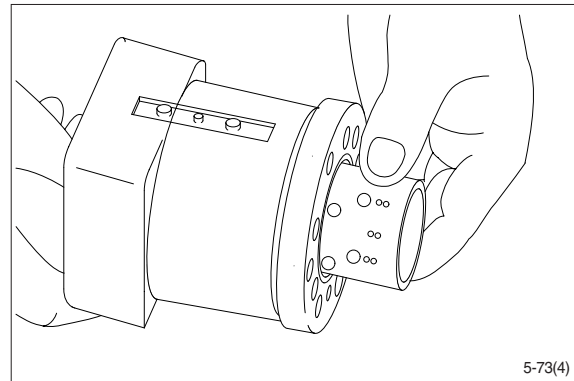
(7) Remove O-ring.



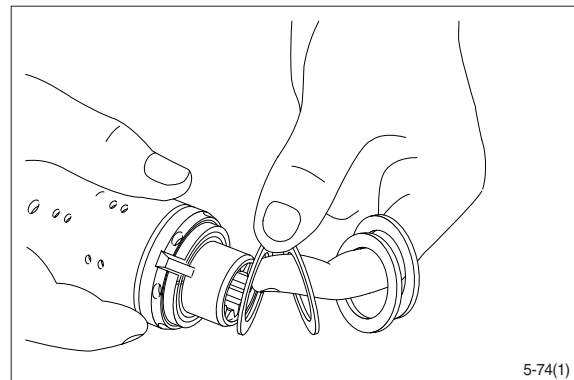
(8) Shake out the check valve ball and suction valve pins and balls.



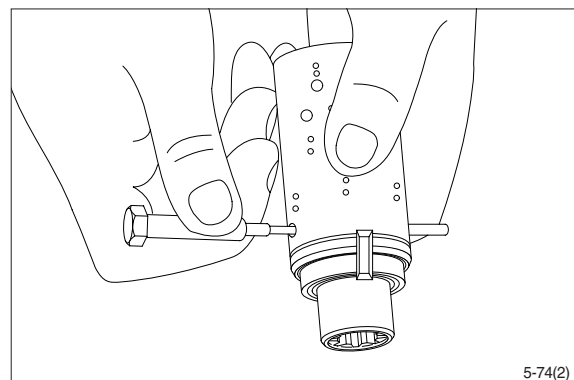
- (9) Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and thrust bearing will be pushed out of the housing together.



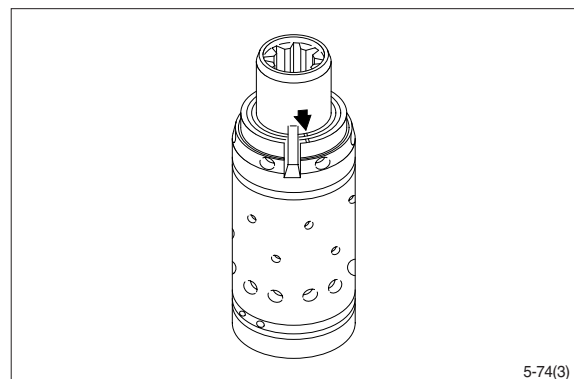
- (10) Take ring, bearing races and thrust bearing from sleeve and spool. The outer (Thin) bearing race can sometimes "stick" in the housing, therefore check that it has come out.



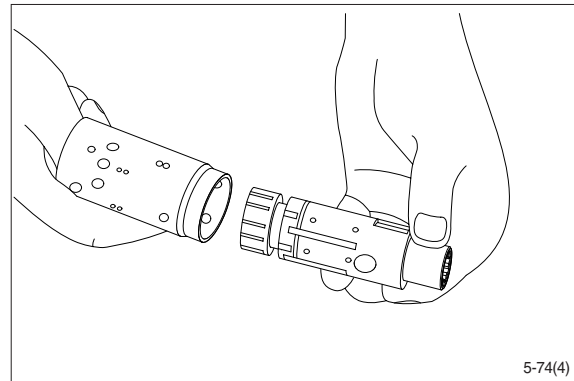
- (11) Press out the cross pin. Use the special screw from the end cover.



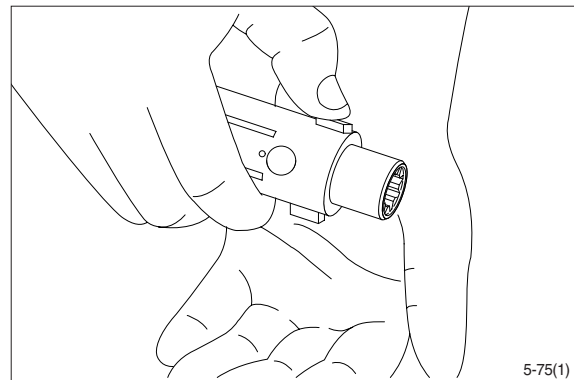
- ※ A small mark has been made with a pumice stone on both spool and sleeve close to one of the slots for the neutral position springs (See drawing). If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are disassembled.



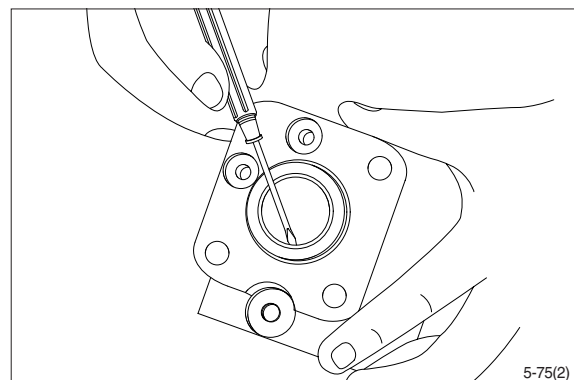
(12) Carefully press the spool out of the sleeve.



(13) Press the neutral position springs out of their slots in the spool.

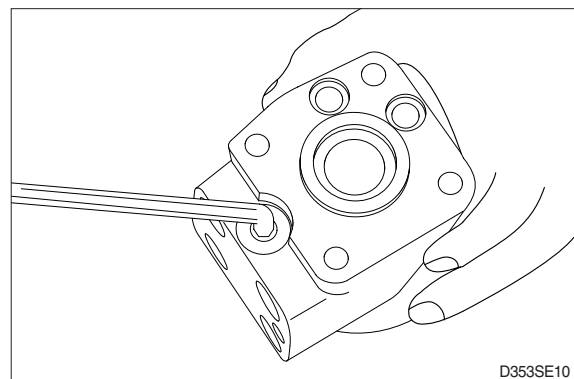


(14) Remove dust seal and O-ring.

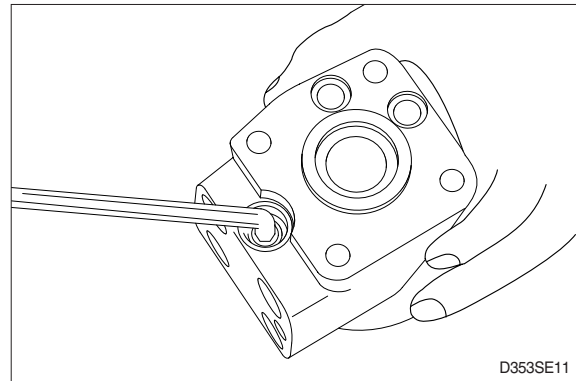


### Disassembling the pressure relief valve

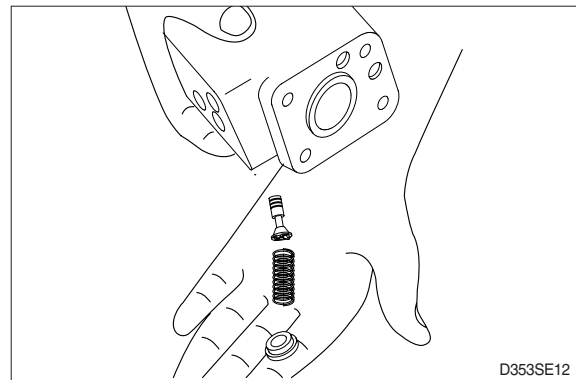
(15) Screw out the plug using an 8mm hexagon socket spanner.  
Remove seal washers.



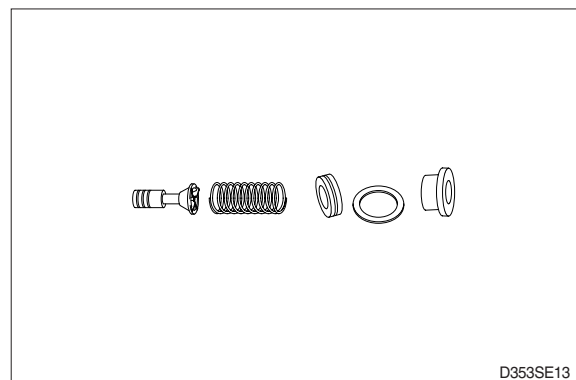
- (16) Unscrew the setting screw using an 8mm hexagon socket spanner.



- (17) Shake out spring and piston. The valve seat is bonded into the housing and cannot be removed.



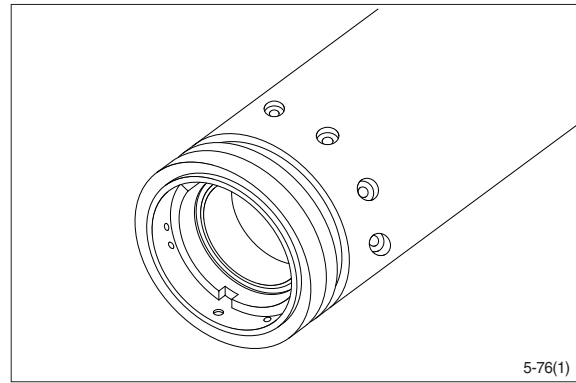
- (18) The pressure relief valve is now disassembled.



## 5) ASSEMBLY

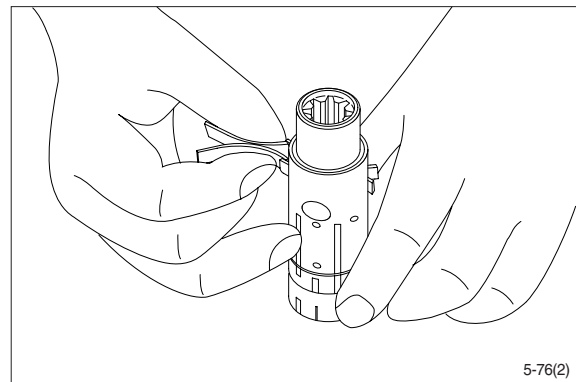
(1) Assemble spool and sleeve.

※ When assembling spool and sleeve only one of two possible ways of positioning the spring slots is correct. There are three slots in the spool and three holes in the sleeve in the end of the spool / sleeve opposite to the end with spring slots. Place the slots and holes opposite each other so that parts of the holes in the sleeve are visible through the slots in the spool.

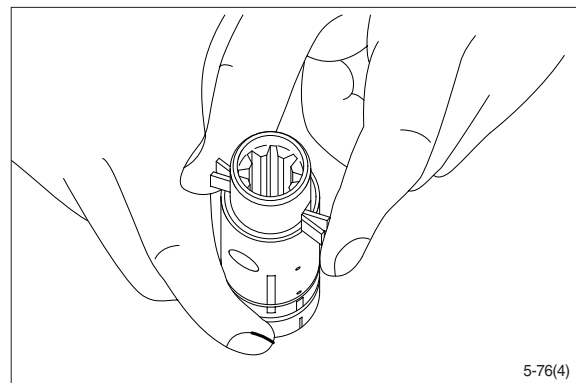


(2) Place the two flat neutral position springs in the slot.

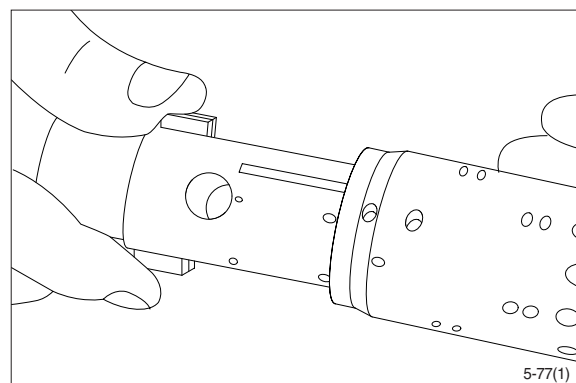
Place the curved springs between the flat ones and press them into place (see assembly pattern).



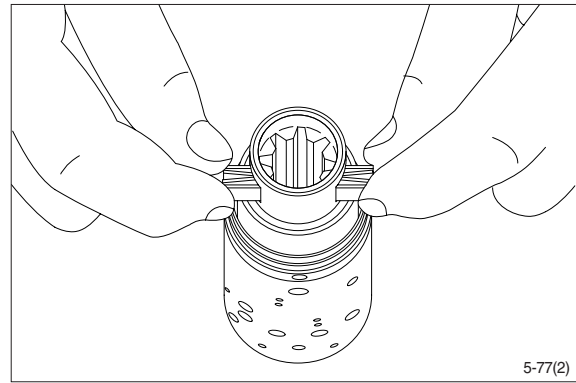
(3) Line up the spring set.



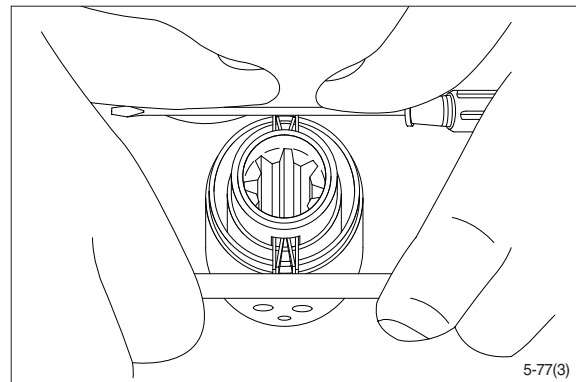
(4) Guide the spool into the sleeve. Make sure that spool and sleeve are placed correctly in relation to each other.



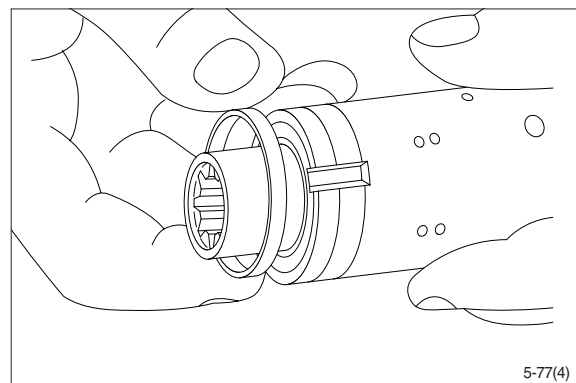
- (5) Press the springs together and push the neutral position springs into place in the sleeve.



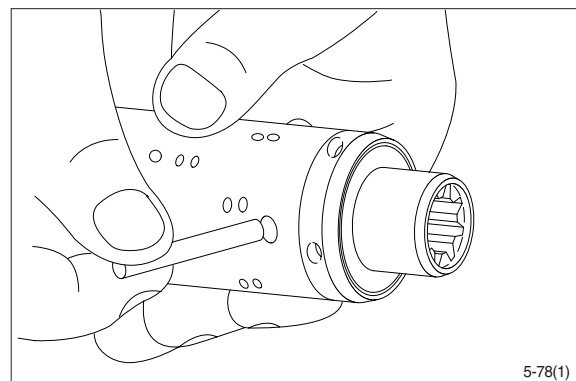
- (6) Line up the springs and center them.



- (7) Guide the ring down over the sleeve.  
※ The ring should be able to rotate free of the springs.

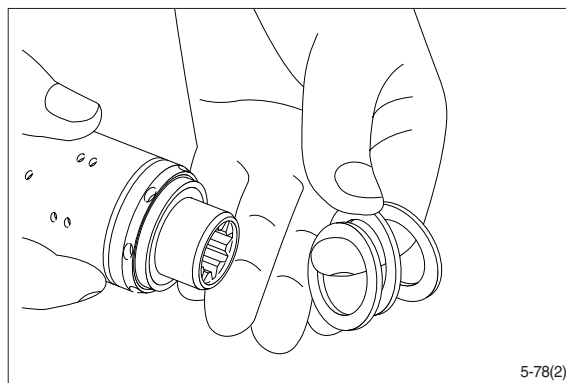


- (8) Fit the cross pin into the spool / sleeve.



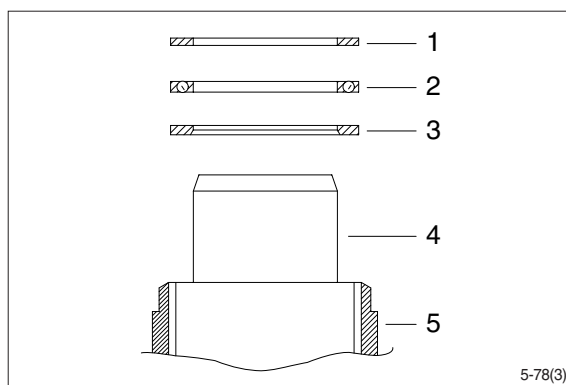


- (9) Fit bearing races and needle bearing as shown on below drawing.



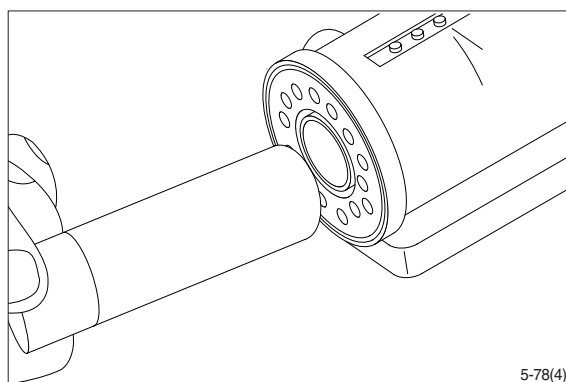
※ **Assembly pattern for standard bearings**

- 1 Outer bearing race
- 2 Thrust bearing
- 3 Inner bearing race
- 4 Spool
- 5 Sleeve

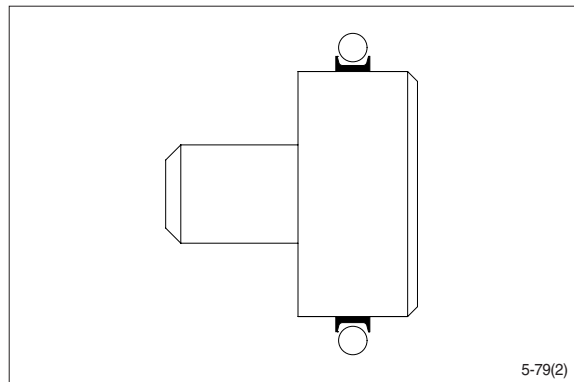
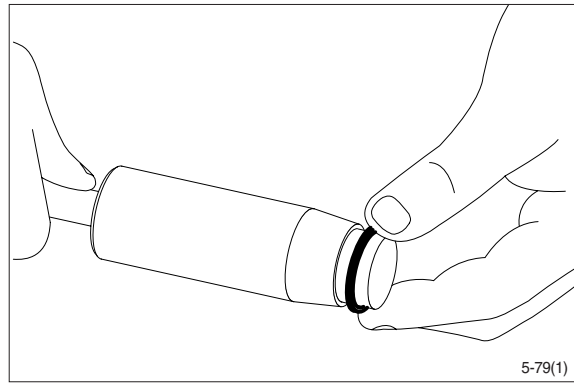


**Installation instruction for O-ring**

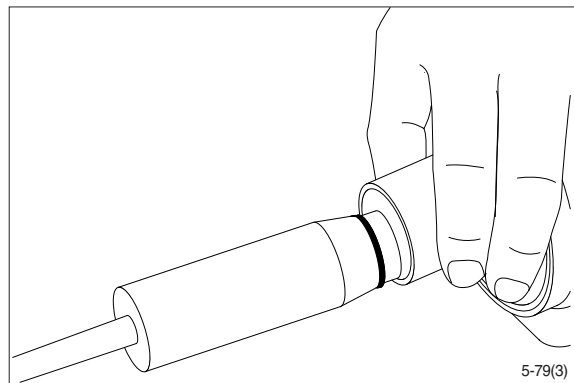
- (10) Turn the steering unit until the bore is horizontal. Guide the outer part of the assembly tool into the bore for the spool / sleeve.



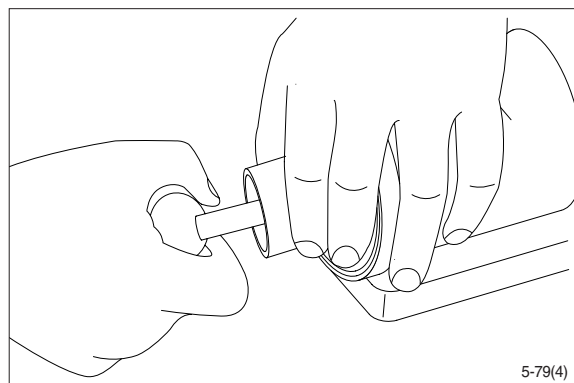
- (11) Grease O-ring with hydraulic oil and place them on the tool.



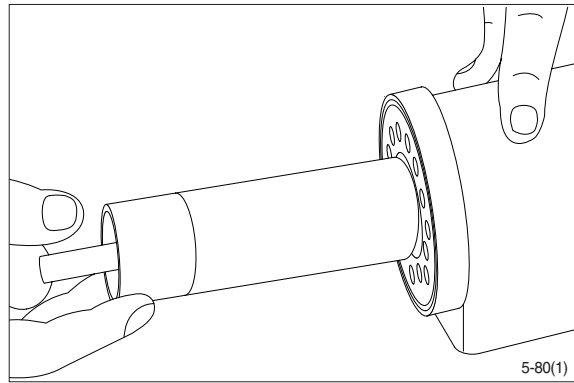
- (12) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.



- (13) Press and turn the O-ring into position in the housing.

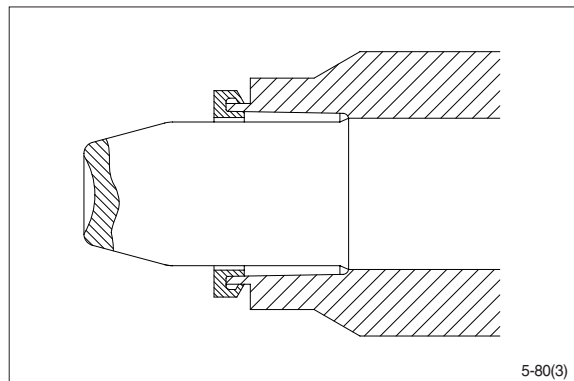
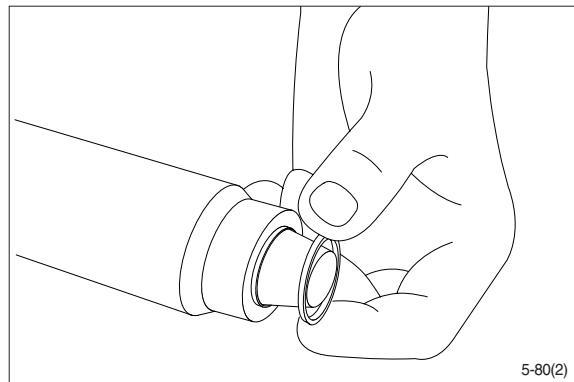


- (14) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.

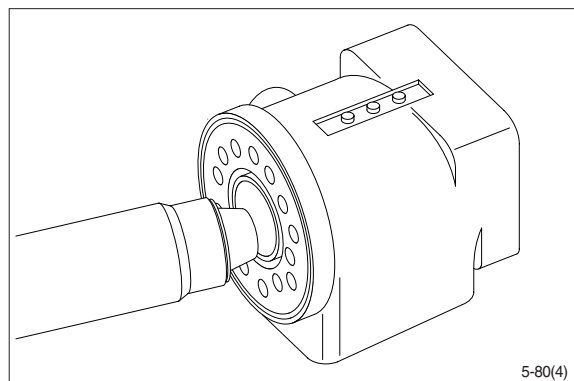


#### Installation instructions for lip seal

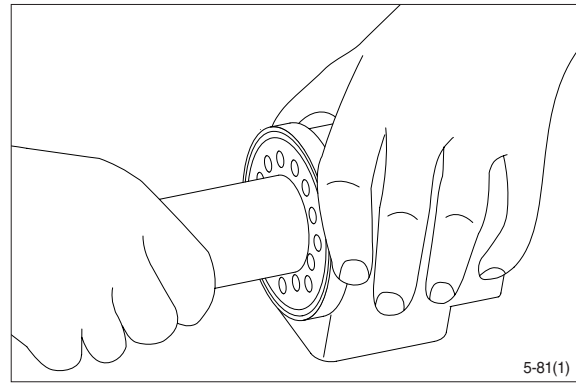
- (15) Lubricate the lip seal with hydraulic oil and place it on the assembly tool.



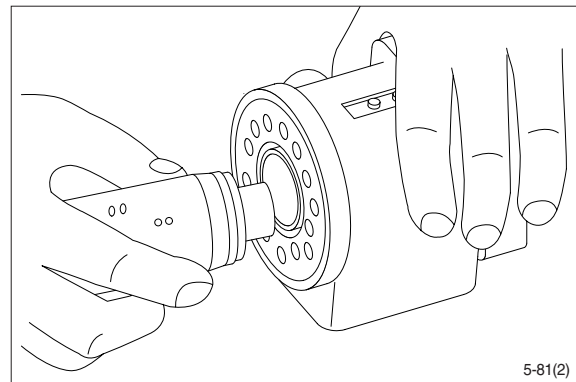
- (16) Guide the assembly tool right to the bottom.



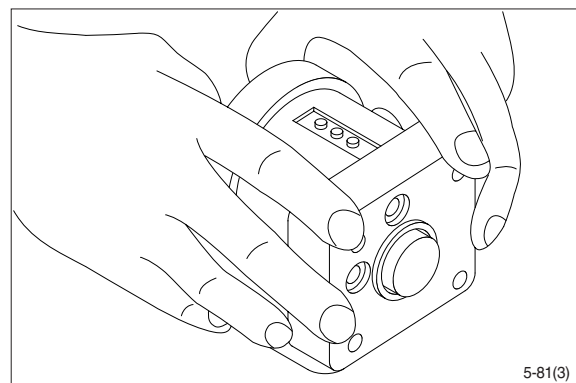
- (17) Press and turn the lip seal into place in the housing.



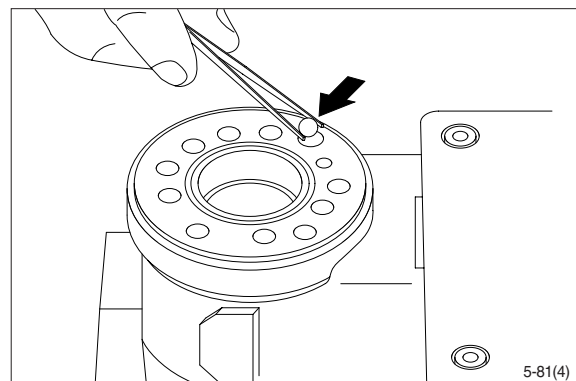
- (18) With a light turning movement, guide the spool and sleeve into the bore.  
※ Fit the spool set holding the cross pin horizontal.



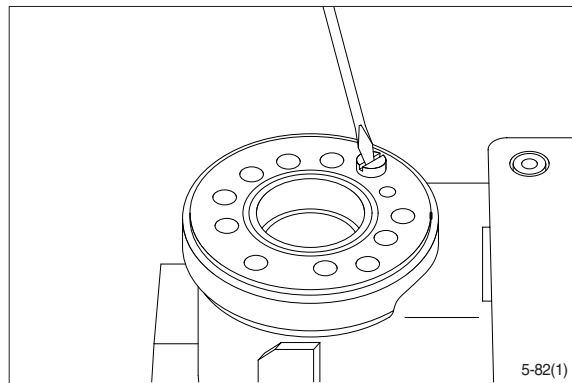
- (19) The spool set will push out the assembly tool guide. The O-ring are now in position.



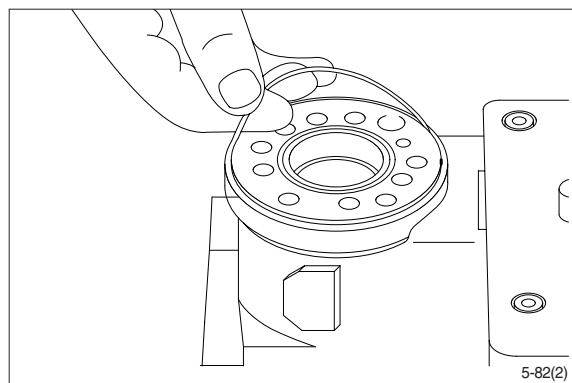
- (20) Turn the steering unit until the bore is vertical again. Put the check valve ball into the hole indicated by the arrow.



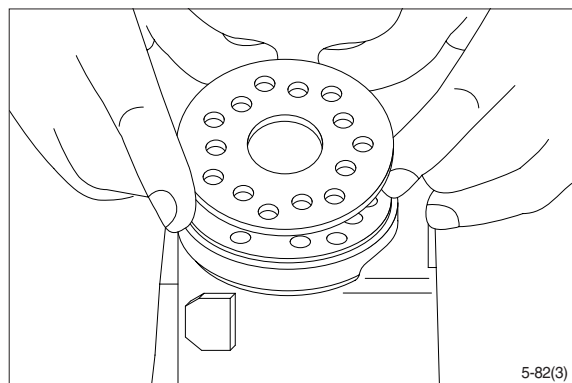
- (21) Screw the threaded bush lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.



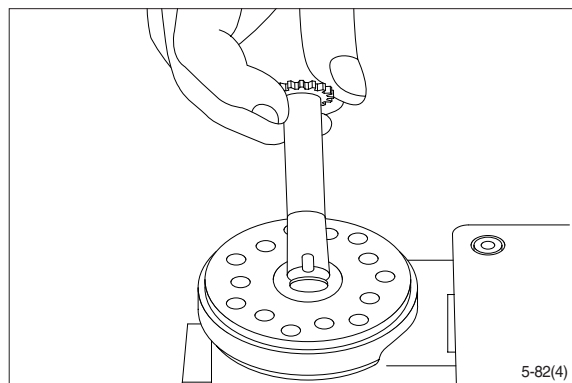
- (22) Grease the O-ring with mineral oil approx. viscosity 500 cSt at 20°C.



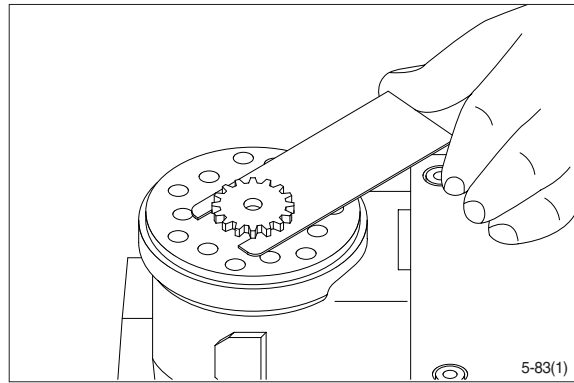
- (23) Place the distributor plate so that the channel holes match the holes in the housing.



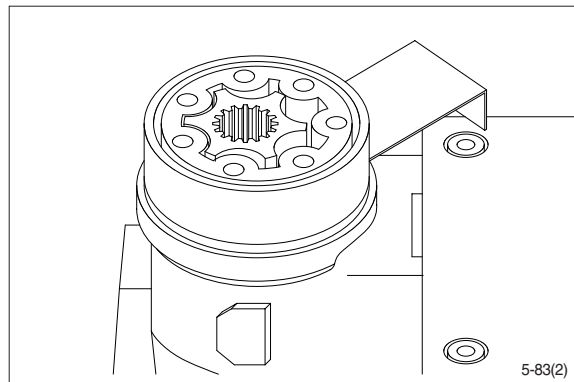
- (24) Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.



- (25) Place the cardan shaft as shown - so that it is held in position by the mounting fork.



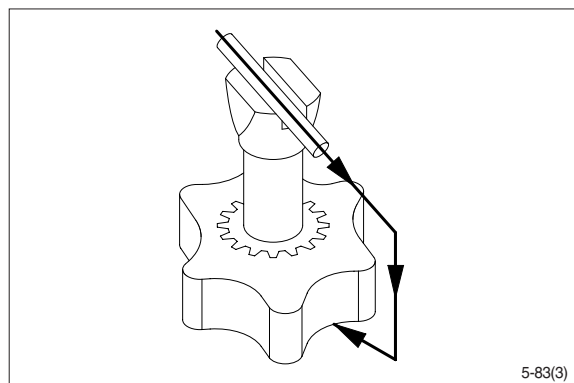
- (26) Grease the two O-rings with mineral oil approx. viscosity 500 cSt at 20°C and place them in the two grooves in the gear rim. Fit the gearwheel and rim on the cardan shaft.



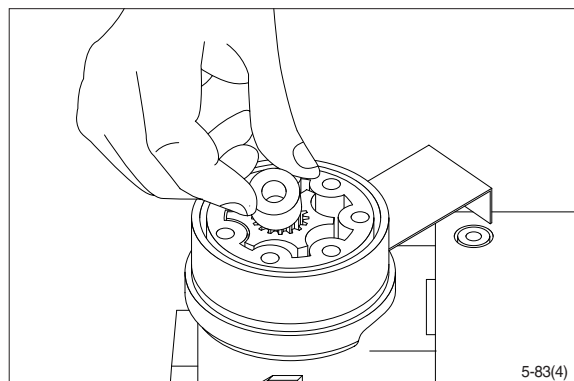
**(27) Important**

Fit the gearwheel (Rotor) and cardan shaft so that a tooth base in the rotor is positioned in relation to the shaft slot as shown.

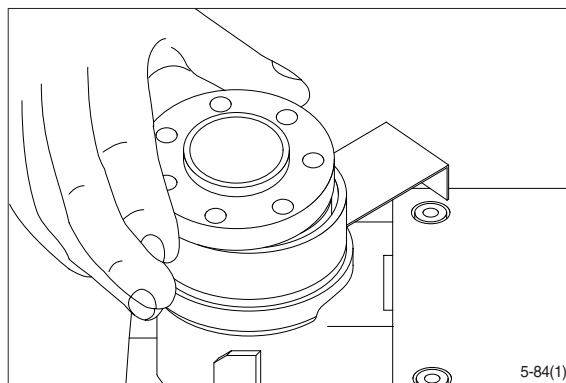
Turn the gear rim so that the seven through holes match the holes in the housing.



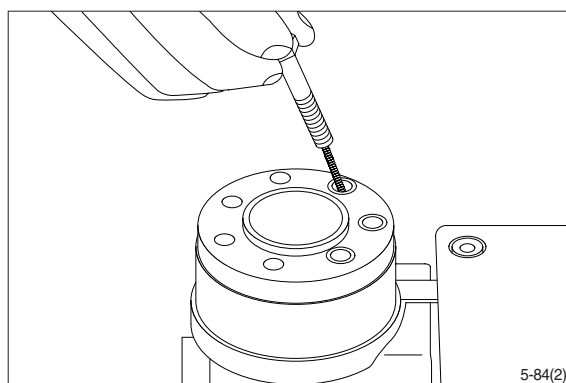
- (28) Fit the spacer, if any.



(29) Place the end cover in position.

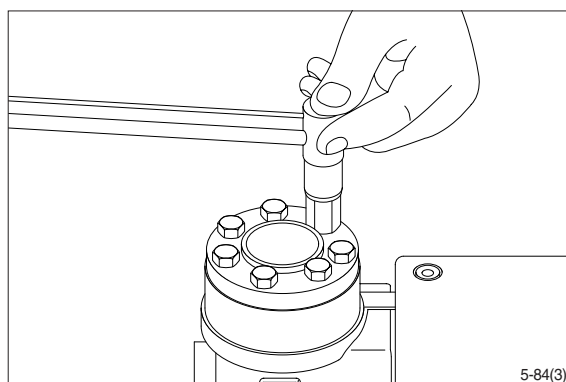


(30) Fit the special screw with washer and place it in the hole shown.

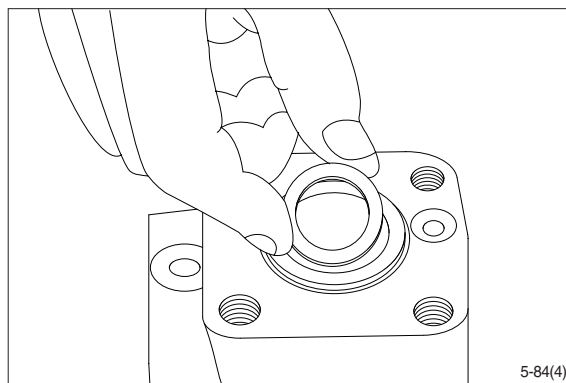


(31) Fit the six screws with washers and insert them. Cross-tighten all the screws and the rolled pin.

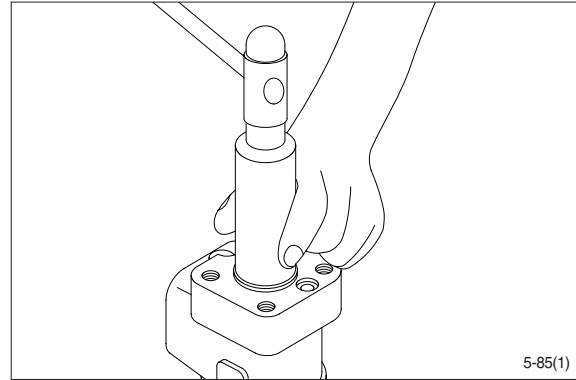
- Tightening torque :  $4.0 \pm 0.5$  kgf·m  
( $28.9 \pm 3.6$  lbf·ft)



(32) Place the dust seal ring in the housing.

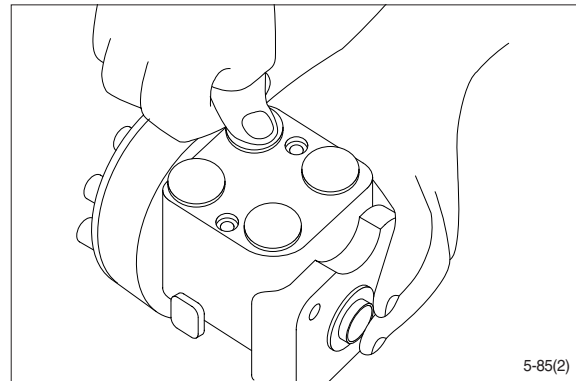


(33) Fit the dust seal ring in the housing.



(34) Press the plastic plugs into the connection ports.

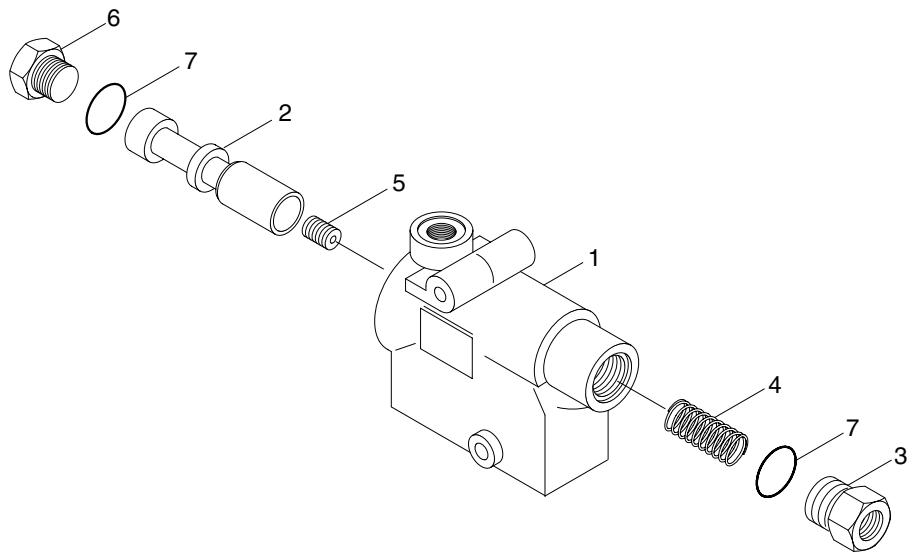
※ Do not use a hammer!





## 2. PRIORITY VALVE

### 1) STRUCTURE



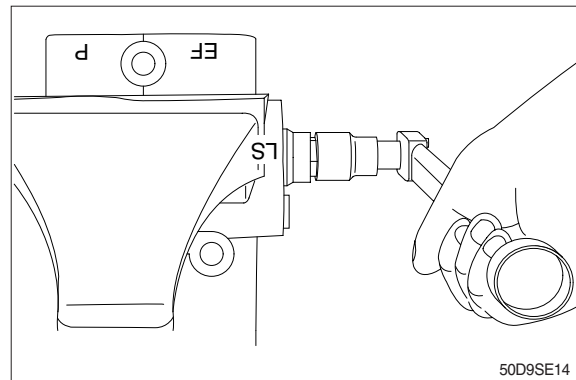
50D9SE08

- |   |             |   |          |   |        |
|---|-------------|---|----------|---|--------|
| 1 | Body        | 4 | Spring   | 7 | O-ring |
| 2 | Spool       | 5 | Orifice  |   |        |
| 3 | Spring plug | 6 | End plug |   |        |

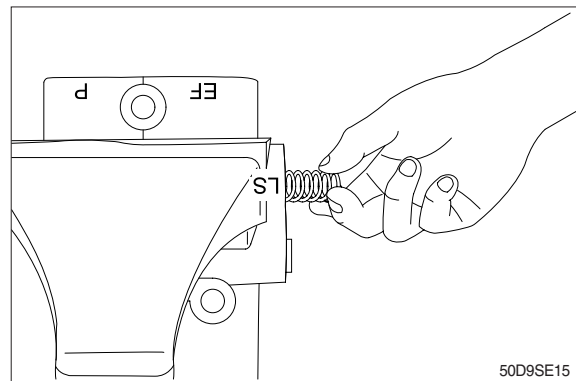
## 2) DISASSEMBLY

- ※ Cleanliness is the primary means of assuring satisfactory the priority valve life.  
Select clean place.  
Before removing the piping, clean the surrounding area of valve ports.

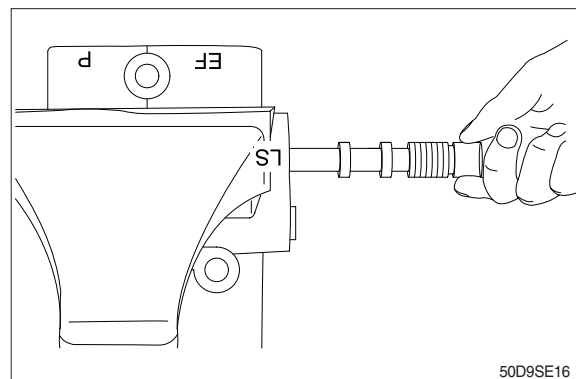
- (1) Fix the body (1) in a vise with copper or lead sheets.  
Do not over tighten jaws.
- (2) Loosen plug (3) for LS port.



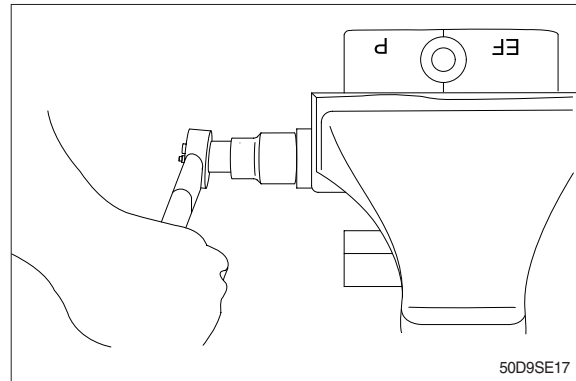
- (3) Remove spring (4).



- (4) Remove spool assy (2).
- ※ Can't remove the orifice (5) from spool (2), because the orifices were locked at the spool.



- (5) Remove plug (6) and separate O-ring (7) and plug (3, 6) individually.



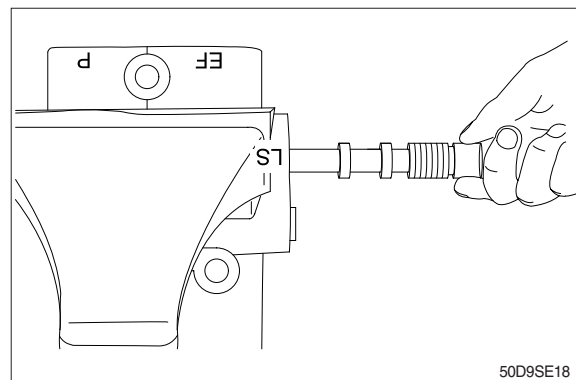
### 3) ASSEMBLY

- ※ Clean all metal parts in clean solvent and blow dry with air and correct any damage, burrs and rust.
- ※ Do not wipe dry with cloth or paper towel.
- ※ Replace seals such as O-ring with new ones as a rule and coat with grease.

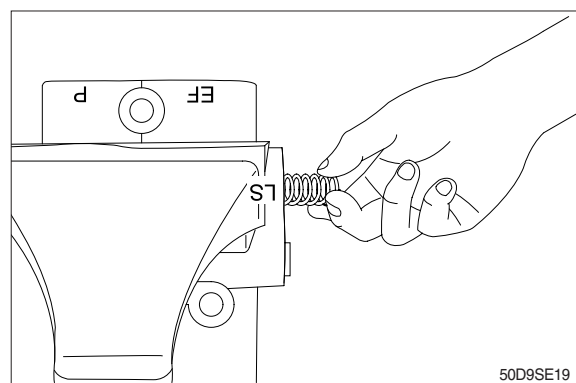
(1) Fix the body (1) in a vise.

(2) Insert the spool (2).

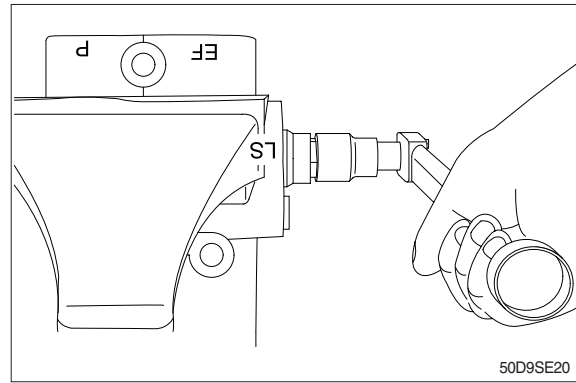
- ※ Secure the spool (2) remain in their correct direction.
- ※ Secure the spool (2) to move smoothly by finger.



(3) Insert the spring (4) into the body (1).

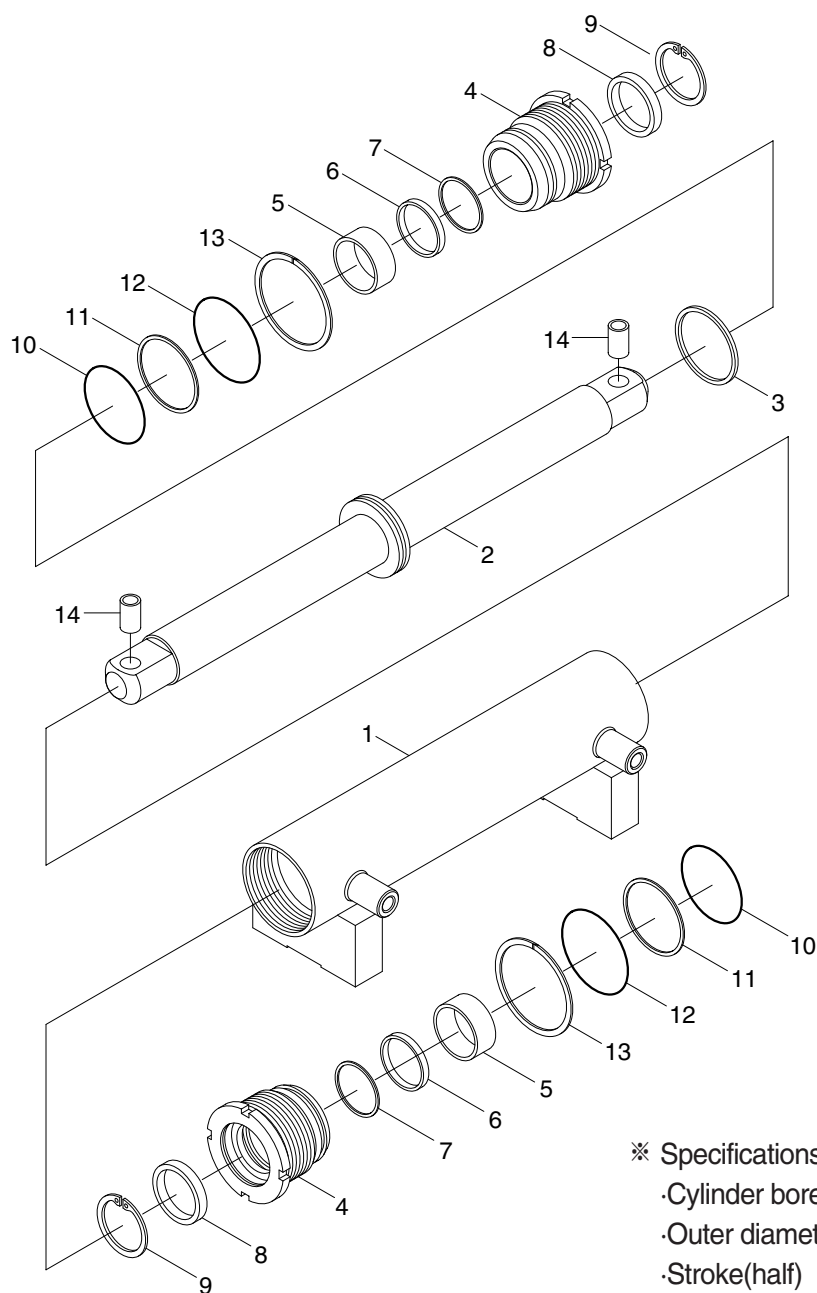


- (4) Install the O-ring (7) onto plug (3, 6) and install the plug (3, 6) into the body (1).
- Tighten torque : 4.5 kgf·m (32.5 lbf·ft)



### 3. STEERING CYLINDER

#### 1) STRUCTURE



#### ※ Specifications

- Cylinder bore : 80 mm (3.1 in)
- Outer diameter : 94 mm (3.7 in)
- Stroke(half) : 150 mm (2.9 in)
- Rod diameter : 55 mm (2.2 in)

50D9SE21

- |               |                |                 |
|---------------|----------------|-----------------|
| 1 Tube assy   | 6 Rod seal     | 11 Back up ring |
| 2 Rod assy    | 7 Back up ring | 12 O-ring       |
| 3 Piston seal | 8 Dust wiper   | 13 Lock washer  |
| 4 Gland       | 9 Snap ring    | 14 Pin bushing  |
| 5 DU bushing  | 10 O-ring      |                 |

## 2) DISASSEMBLY

※ Before disassembling steering cylinder, release oil in the cylinder first.

- (1) Put wooden blocks against the cylinder tube, then hold in & vice.
- (2) Remove the cover by hook a wrench in the notch of cylinder head and turn counter-clockwise.
- (3) Remove the cylinder rod and piston from the tube.
- (4) Check wear condition of the sealing parts (O-ring, oil seal, dust seal, U-packing, bush). If there are some damage, replace with new parts.

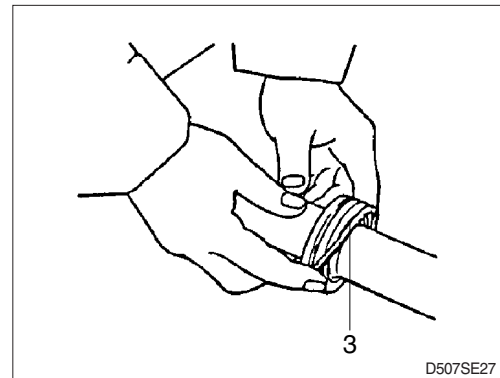
## 3) CHECK AND INSPECTION

mm (in)

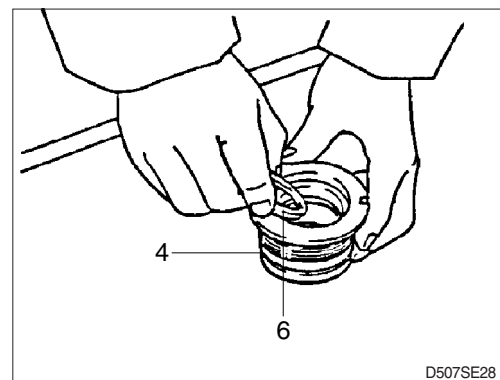
Check item	Criteria		Remedy
	Standard size	Repair limit	
Clearance between piston & cylinder tube	0.05~0.25 (0.002~0.01)	0.4 (0.02)	Replace piston seal
Clearance between cylinder rod & bushing	0.05~0.18 (0.002~0.007)	0.3 (0.01)	Replace bushing
Seals, O-ring	Damage		Replace
Cylinder rod	Dents		Replace
Cylinder tube	Biting		Replace

## 4) ASSEMBLY

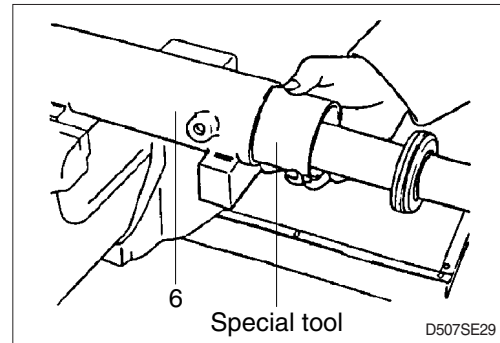
- (1) Install a new piston seal (3) around the groove on the piston.
- ※ Be careful not to scratch the seal too much during installation or it could not be seated properly.



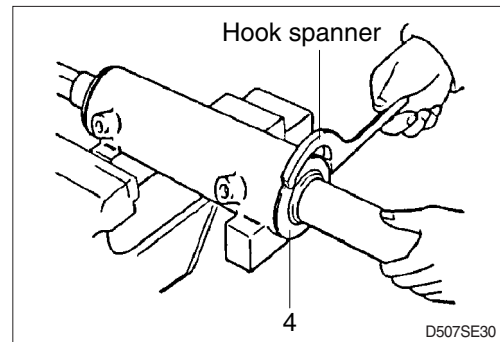
- (2) Install the rod seal (6) to the position in the gland(4) applying a slight coat with grease prior to install.



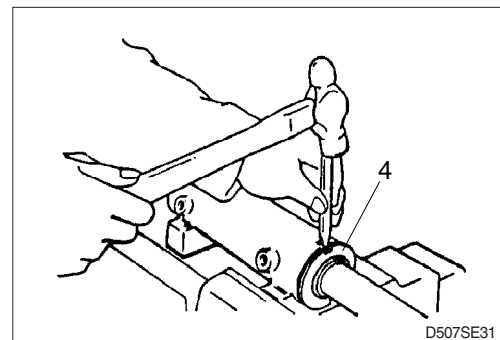
- (3) Install the dust wiper (8) to the gland (4) using a special installing tool. Coat the dust wiper with grease slightly before installing.
- (4) Using a special tool, install gland assembly into the cylinder tube (1).



- (5) Using a hook spanner, install the gland (4) assembly, and tighten it with torque  $60 \pm 6$  kgf·m ( $434 \pm 43$  lbf·ft).



- (6) After the gland (4) assembly was installed to the cylinder tube (1), calk at the tube end into the groove on the gland to prevent screw loosening.
- ※ If it is needed to calk again, never calk on the same place.

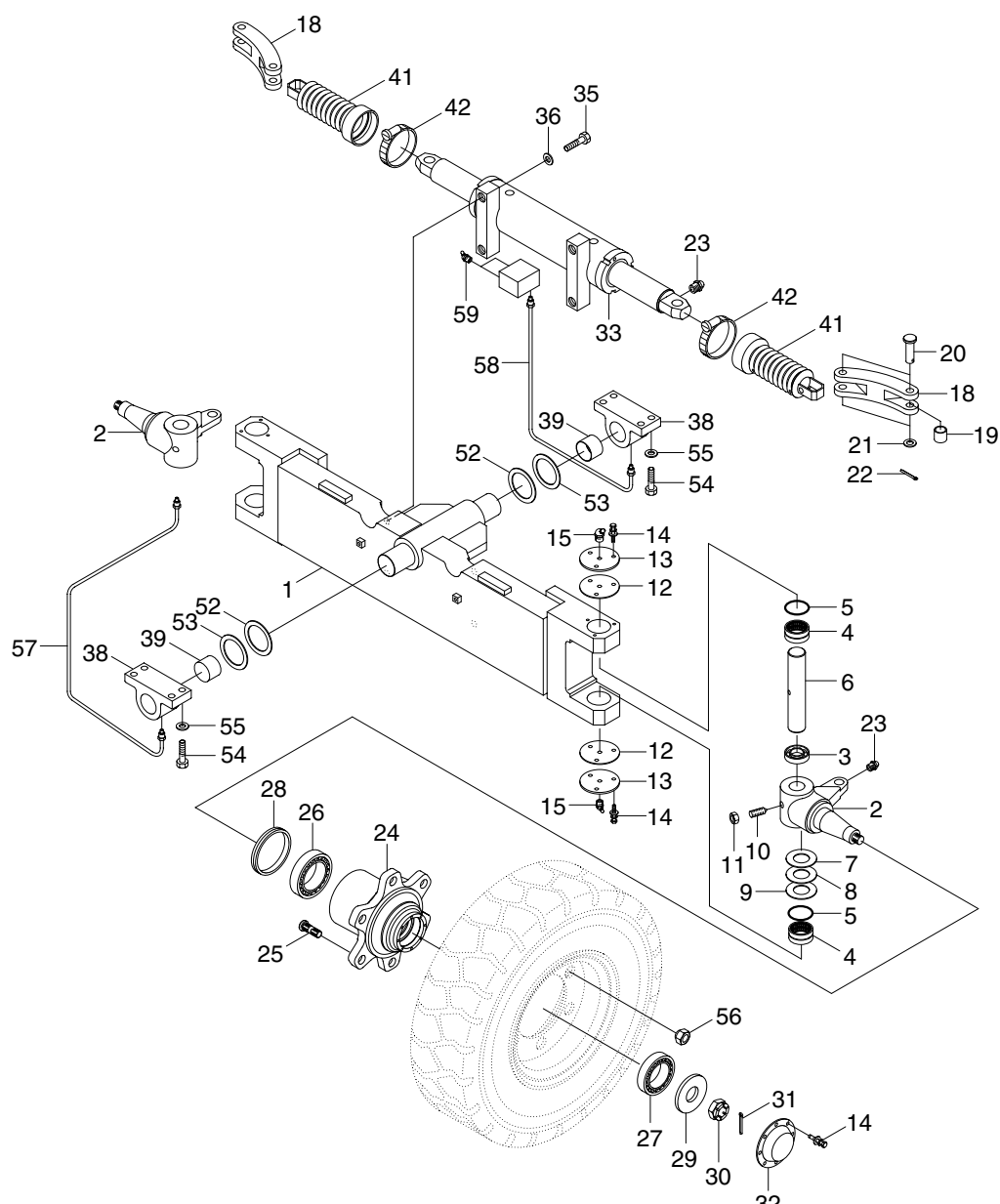


- (7) Move the piston rod back and forth several times for the full distance of its stroke. This helps to seat the ring and seals before applying full hydraulic pressure to the cylinder.
  - (8) Install cylinder into trail axle.
  - (9) While idling the engine with the rear wheels off the ground, operate the steering wheel left and right alternately.
- ※ Then, repeat the above operation at gradually increasing engine rpm. This releases air from the system and completes preparation for operation.
- (10) Stop the engine, lower the floating rear wheels, and check pump joints for oil leaks and looseness and retighten, them as required.

## 4. STEERING AXLE

### 1) STRUCTURE

※ Do not remove the stopper bolt unless necessary.

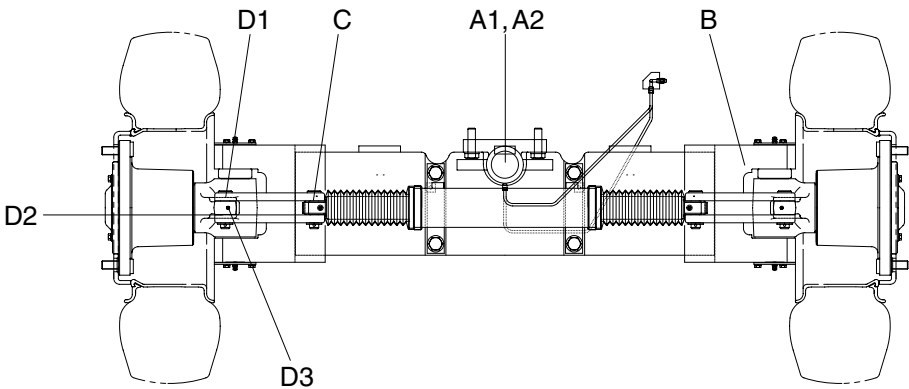


50D9SE24

1	Steering axle	13	Cover	25	Hub bolt	39	Bushing
2	Knuckle	14	Bolt w/washer	26	Taper roller bearing	41	Steering cylinder boot
3	Thrust bearing	15	Grease nipple	27	Taper roller bearing	42	Clamp
4	Needle bearing	16	Hexagon bolt	28	Oil seal	52	Shim (1.0 t)
5	Oil seal	17	Hexagon nut	29	Special washer	53	Shim (0.5 t)
6	King pin	18	Link	30	Slotted nut	54	Hexagon bolt
7	Thrust washer	19	Bushing	31	Split pin	55	Hardened washer
8	Shim washer (0.1 t)	20	Link pin	32	Hub cap	56	Hub nut
9	Shim washer (0.2 t)	21	Special washer	33	Steering cylinder	57	Front pipe assy
10	Set screw	22	Split pin	35	Hexagon bolt	58	Rear pipe assy
11	Hexagon nut	23	Grease nipple	36	Hardened washer	59	Grease nipple
12	Gasket	24	Hub	38	Support		



2) CHECK AND INSPECTION



50D9SE25

unit : mm (in)

No.	Check item			Criteria		Remedy
				Standard size	Repair limit	
A	Shaft	A1	OD of shaft	60(2.4)	59.5(2.3)	Replace
		A2	ID of bushing	60(2.4)	59.5(2.3)	
B	OD of king pin			50(2.0)	49.8(2.0)	
C	OD of steering cylinder pin			22(0.9)	21.9(0.9)	
D	Knuckle	D1	OD of pin	22(0.9)	21.9(0.9)	Adjust shim
		D2	Vertical play	-	0.2(0.008)	
		D3	ID of bushing	22(0.9)	22.5(0.9)	Replace

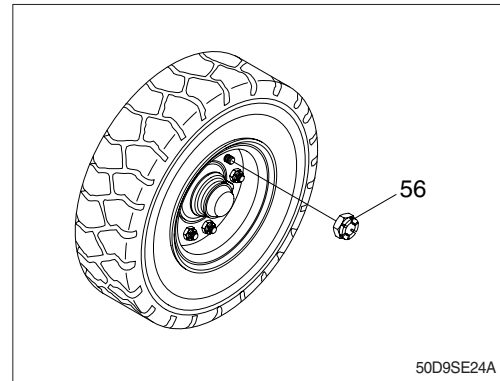
·OD : Outer diameter

·ID : Inner diameter

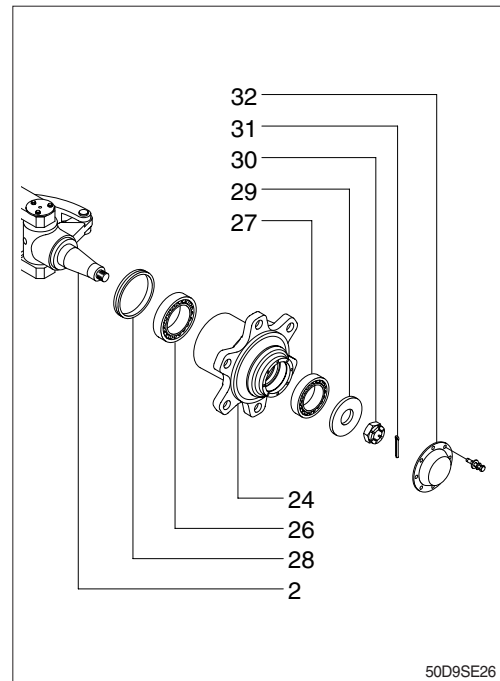
### 3) DISASSEMBLY

※ Servicing work on the knuckle part can be carried out without removing the axle assy from chassis.  
The work can be done by jacking up the balance weight part of the truck.

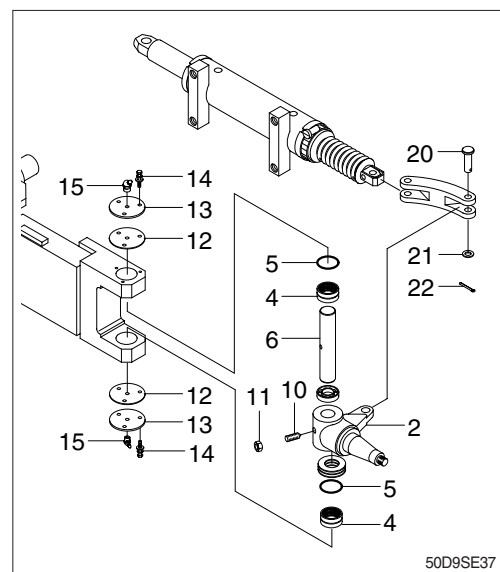
- (1) Loosen the hub nut (56) and take off the steering wheel tire.



- (2) Remove Hub cap (32).
- (3) Pull out split pin (31) and remove slotted nut (30), washer (29).
- (4) Using the puller, take off the hub (24) together with the taper roller bearing (26, 27).  
※ Be very careful because just before the hub comes off, tapered roller bearing will fall out.
- (5) After hub (24) is removed take off the inner race of taper roller bearing (26, 27).
- (6) Pull out oil seal (28).
- ※ Don't use same oil seal twice.
- (7) Repeat the same procedure for the other side.  
Moreover, when disassembling is completed, part the slotted nut in the knuckle to protect the threaded portion.



- (8) Loosen set screw (10) and nut (11).
- (9) Loosen with washer bolt (14) and remove cover (13), gasket (12). Remove grease nipple (15).
- (10) Push out the king pin (6) without damaging the knuckle arm (2).
- (11) At the same time the king pin is removed, pull out the oil seal (5).
- (12) If defect is observed in needle bearing (4), pull it out by using extractor.
- (13) Remove split pin (22), special washer (21) and link pin (20).



#### 4) ASSEMBLY

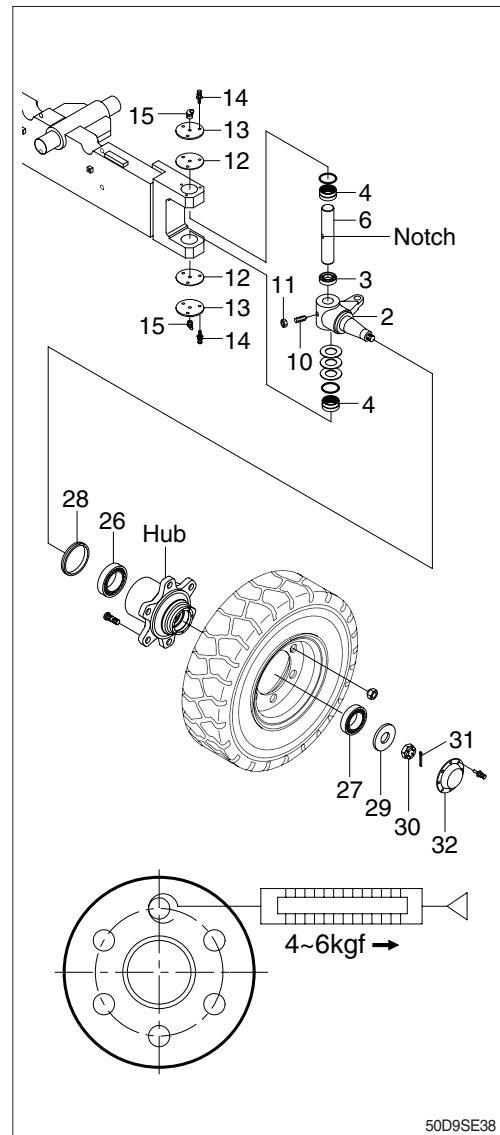
※ In reassembling, have all parts washed, grease applied to lubricating parts, and all expendable items such as oil seal and spring washers replaced by new ones.

Perform the disassembly in reverse order.

- (1) Tighten the set screw (10) of king pin (6).
- (2) There is a notch in the middle of the king pin (6), make sure that this notch is on the set screw side.
- (3) Do not hammer to drive in needle bearing(4) because it will break.  
Always use drive-in tool. In assembling the thrust bearing (3), be sure that the fixed ring of the bearing is placed in position facing the knuckle (2).

#### (4) Hub

- ※ Mount oil seal (28) and inner race of taper roller bearing (26) on the knuckle. The bearing should be well greased before assembling.
- ※ Install the outer race of the bearing (27) in the wheel center and assemble to the knuckle.
- ※ Put washer (29) in place, tighten with nut (30) and locked with split pin (31). In locking with split pin, locate the hole for the split pin by turning the nut back 1/6 of a turn. Adjust the preload of bearing.
- ※ Mount the hub cap (32).  
Bearing should be well greased before assembling.



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