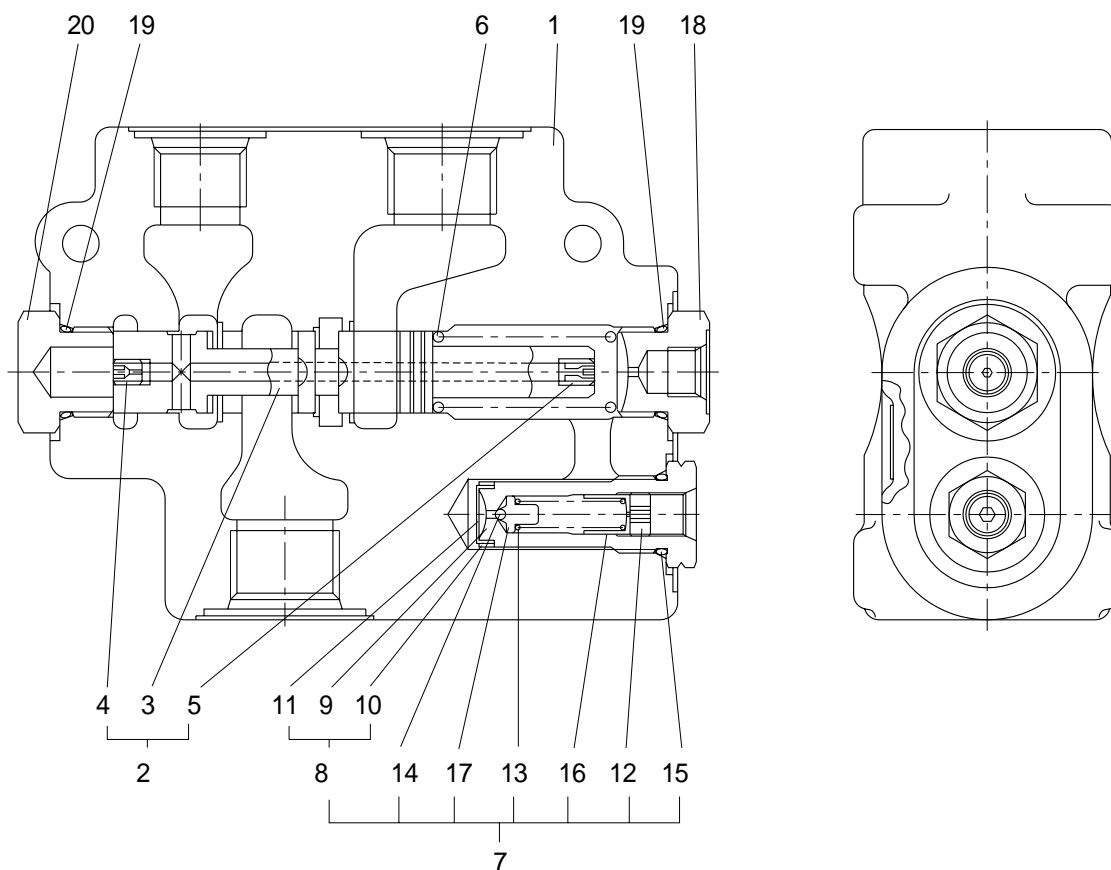


## GROUP 4 DISASSEMBLY AND ASSEMBLY

### 1. PRIORITY VALVE

#### 1) STRUCTURE



|   |                  |    |               |    |        |
|---|------------------|----|---------------|----|--------|
| 1 | Housing          | 8  | Body sub assy | 15 | O-ring |
| 2 | Spool assy       | 9  | Body          | 16 | Guide  |
| 3 | Spool            | 10 | Ring          | 17 | Holder |
| 4 | Orifice          | 11 | Screen        | 18 | Plug   |
| 5 | Orifice          | 12 | Screw         | 19 | O-ring |
| 6 | Control spring   | 13 | Spring        | 20 | Plug   |
| 7 | Relief cartridge | 14 | Ball          |    |        |

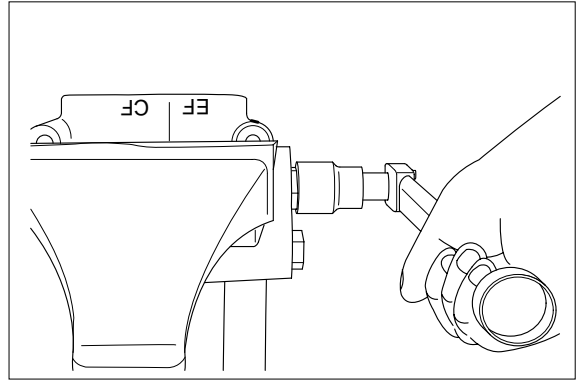
#### 2) TOOLS

- Torque wrench(5kgf · m)
- Hex socket wrench(1")
- Hex socket wrench(7/8")
- Hex wrench (7/32")
- Pincette
- Grease

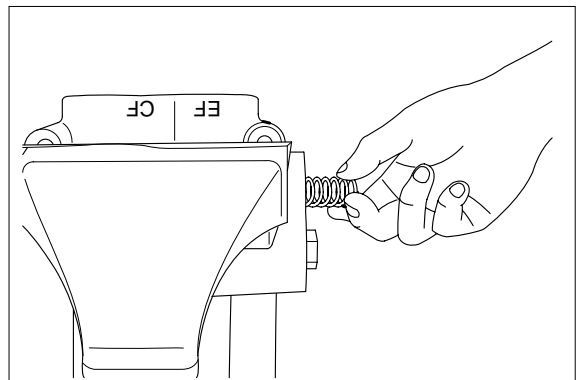
### 3) DISASSEMBLY

- ※ 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.

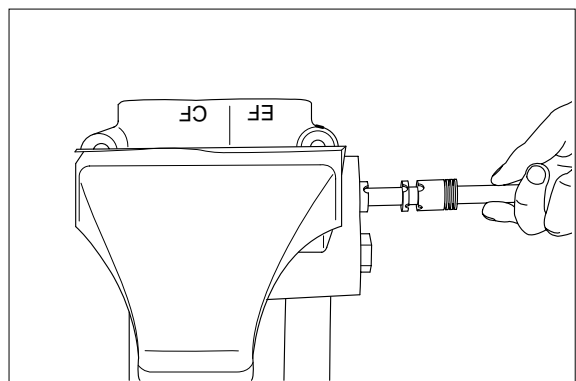
- (1) Fix the housing(1) in a vise with copper or lead sheets.  
Do not over tighten jaws.
- (2) Loosen plug(18) for LS port.



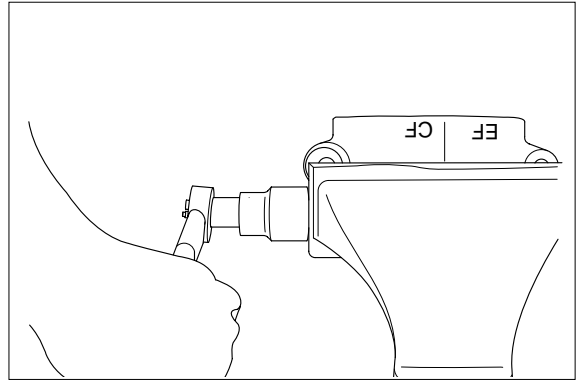
- (3) Remove spring (6).



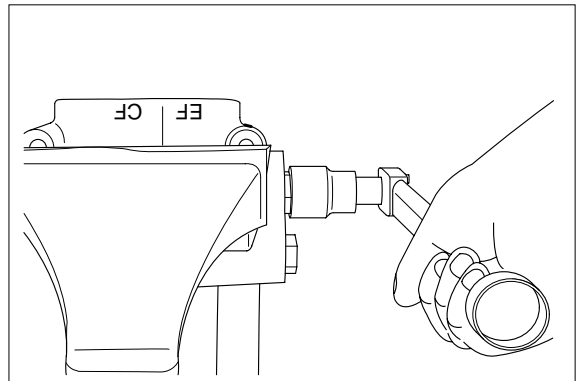
- (4) Remove spool assy(2).



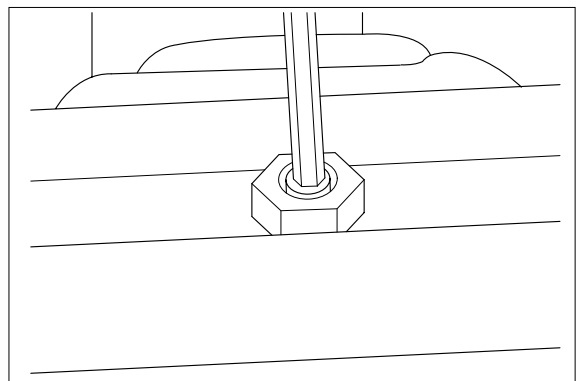
- (5) Remove plug(20) and separate O-ring (19) and plug(18, 20) individually.
- ※ Can't remove the orifice(4) and orifice(5) from spool(3), because the orifices were locked at the spool.



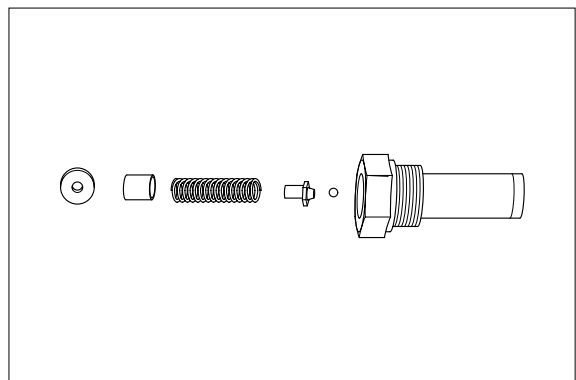
- (6) Remove the relief valve cartridge assembly(7) from the housing(1).



- (7) Secure the hexagon head of the relief in a vise and loosen the screw(12) from relief valve with hexagon wrench.



- (8) Remove the O-ring(15).
- (9) Remove the guide(16), spring(13), holder (17) and ball(14), in that order.
- (10) Do not remove the screen(11) and ring (10) because that parts were locked the relief valve.

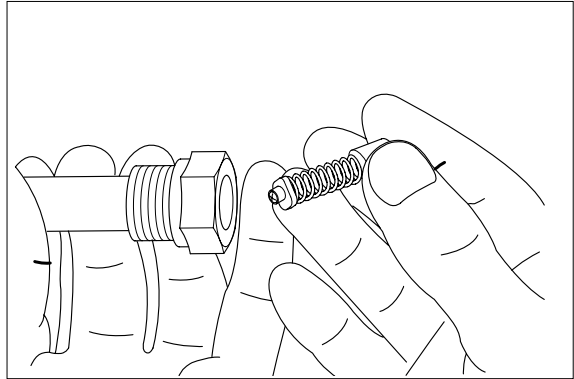


#### 4) ASSEMBLY

- ※ 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.

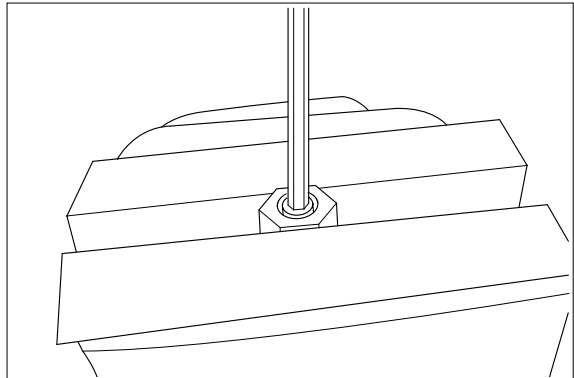
(1) Assembly the relief valve cartridge(7).

- ① Insert the O-ring(15) onto the housing(1).
- ② Assemble the guide(16), spring(13), holder(17) and ball(14) and insert this sub assembly to the housing(1).



③ Tighten the screw(12) by using hexagon wrench.

- ※ Steering valve setting pressure of priority valve is adjustable by the screw(12).
  - 1 turn  $\approx$  70kgf/cm<sup>2</sup>

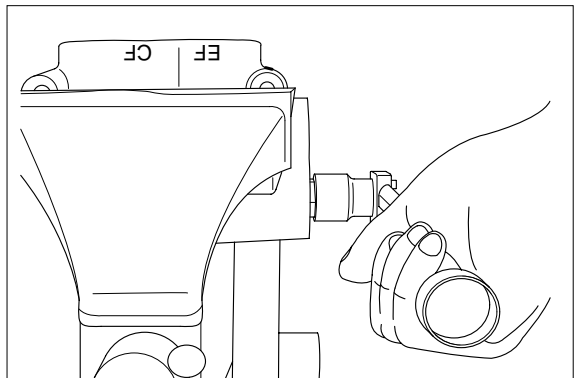


(2) Fix the housing(1) in a vise.

- ※ Do not over tighten jaws.

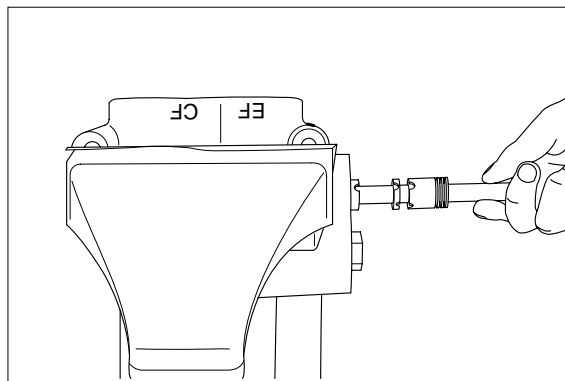
(3) Insert the relief valve cartridge(7) into the housing(1) and tighten the valve assembly.

- Tighten torque : 2.1kgf · m(15.2lb · ft)

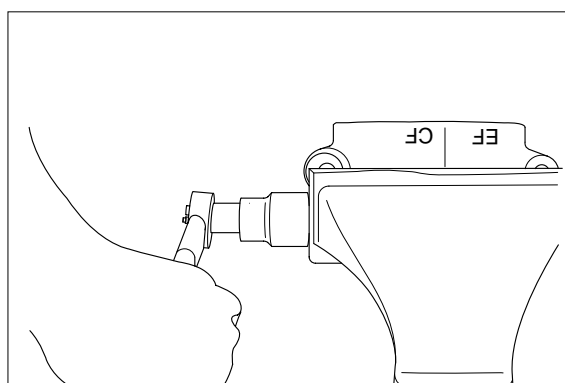


(4) Insert the spool(2) in the housing(1).

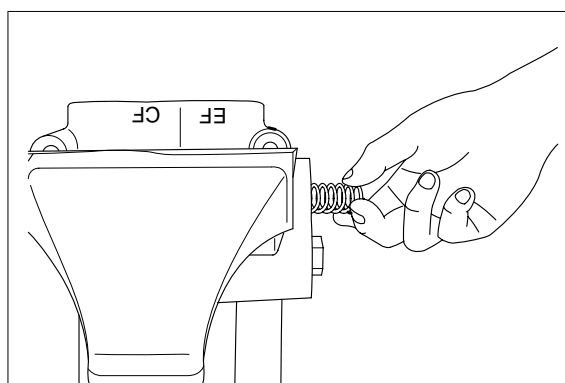
- ※ Secure the spool(2) remain in their correct direction as the illustration.



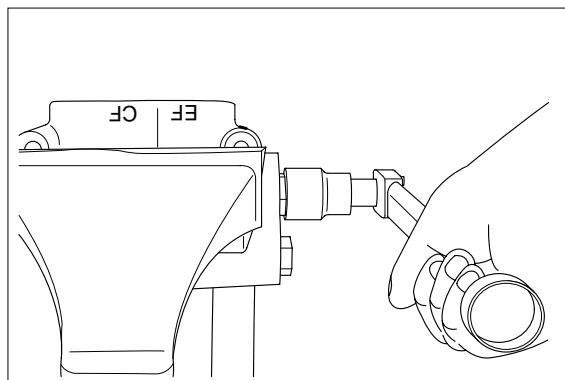
- ※ Secure the spool(2) to move smoothly by finger.



(5) Insert the spring(6) into the housing(1).



(6) Install the O-ring(19) onto plug(18, 20) and install the plug(18, 20) into the housing(1).  
• Tighten torque : 4.5kgf · m(32.5lb · ft)



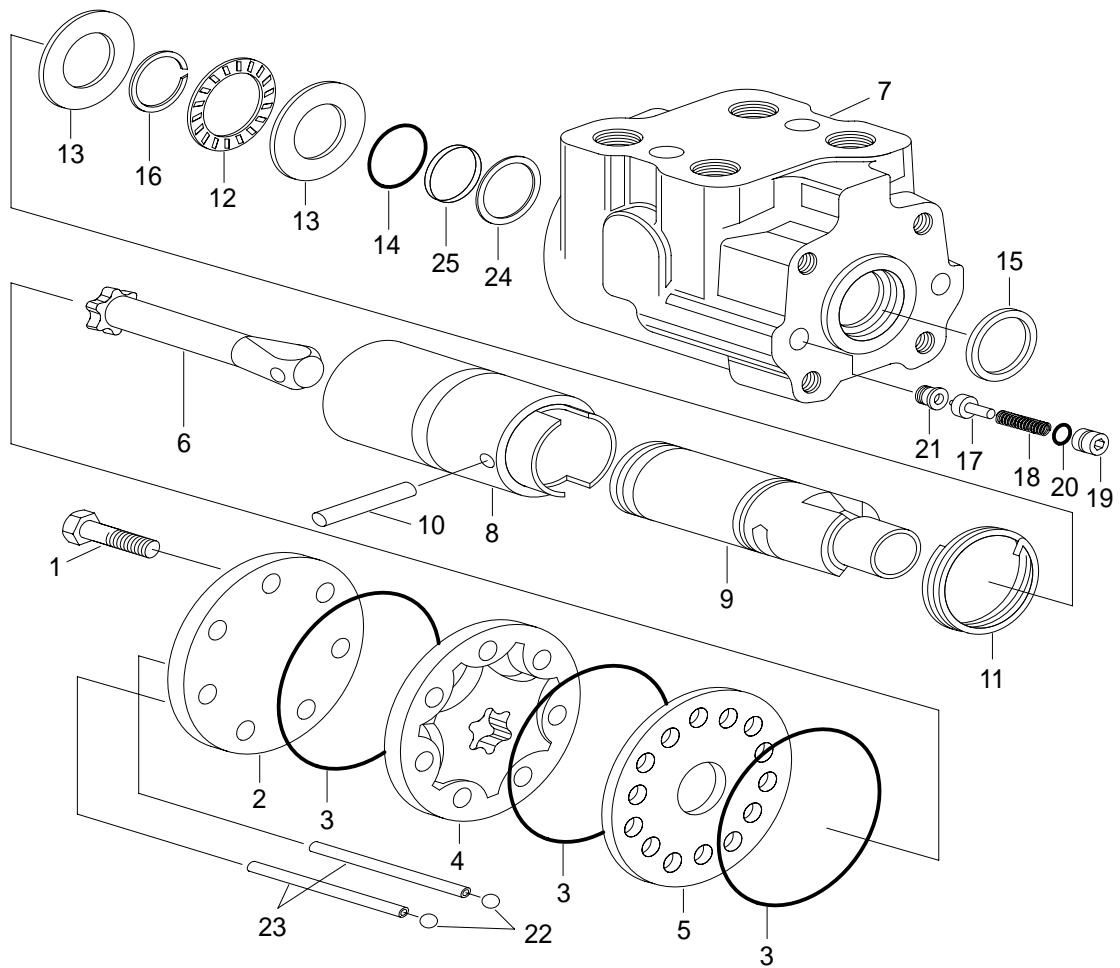
This completes assembly.

## 5) TROUBLESHOOTING

| Problem   | Cause  | Remedy  |
|---|--|---|
| Steering wheel is heavy<br><br>(Steering wheel is heavy at engine low idle)<br><br>(Steering speed is not high at engine high idle) | 1. Relief valve is clogged with dirt.<br>2. Spool is stuck.<br><br>3. Orifice of plug and spool is clogged.<br>a. Pump is faulty.<br><br>b. Control pressure is low.<br>c. Piping is faulty.<br>d. Pump is faulty. | Disassembly, clean and reassembly.<br><br>Disassembly, clean and reassembly or replace.<br><br>Disassembly, clean and reassembly.<br>Check pump.<br><br><br>Reset control pressure.<br>Replace piping.<br>Check pump. |
| Abnormal noise  | 1. Relief valve is clogged with dirt.<br>2. Spool is stuck.  | Disassembly, clean and reassembly.<br><br>Disassembly, clean and reassembly or replace.   |
| Leakage   | 1. Loosen the plug.<br>2. O-ring is damaged.   | Retighten the specified torque.<br><br>Replace.   |

## 2. STEERING VALVE

### 1) STRUCTURE



- |                |                     |                       |
|----------------|---------------------|-----------------------|
| 1 Cap screw    | 10 Pin              | 18 Compression spring |
| 2 End cap      | 11 Centering spring | 19 Plug               |
| 3 O-ring       | 12 Needle bearing   | 20 O-ring             |
| 4 Gerotor      | 13 Bearing race     | 21 Valve seat         |
| 5 Spacer plate | 14 O-ring           | 22 Ball               |
| 6 Drive        | 15 Dust seal        | 23 Roll pin           |
| 7 Housing      | 16 Retaining ring   | 24 Backing ring       |
| 8 Sleeve       | 17 Poppet           | 25 Seal               |
| 9 Spool        |                     |                       |

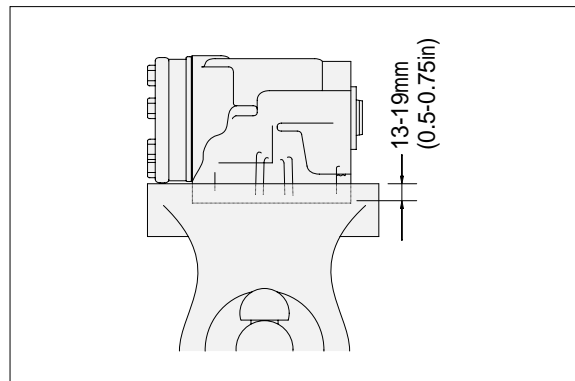
### 2) TOOLS

- 13mm Socket
- Torque wrench(4kgf · m)
- 15/16" Hexagon key
- Small blade screwdriver
- Soda straws(2EA)

### 3) DISASSEMBLY

※ Cleanliness is extremely important when repairing a hydraulic steering control unit. Work in a clean area. Before disconnecting the hydraulic lines, clean the port area of the steering control unit. Before disassembly, drain the oil, then plug the ports and thoroughly clean the exterior of the steering control unit. During repairs, always protect machined surfaces.

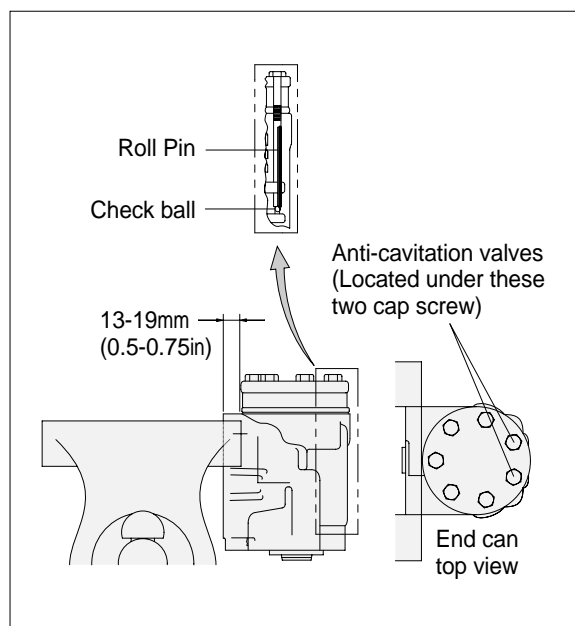
※ Mount steering control unit in vise horizontally for breaking loose seven cap screws. Use this mounting position for final torque of reassembled unit.



※ Steering control units with anti-cavitation valves require special handling in both disassembly and reassembly. Ball valves (2) can end up in a cavity in the housing where they are not supposed to be. These units must be disassembled and reassembled in the vertical position; Removal of anti-cavitation valves is outlined in step (8).

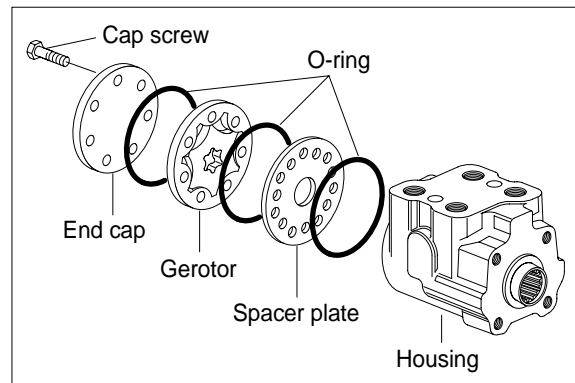
※ After cap screws have been loosened, mount steering control unit in the vise vertically for disassembly and reassembly.

※ Illustrations have been created from the exploded parts drawing, and do not relate the parts correctly as seen by the service person.

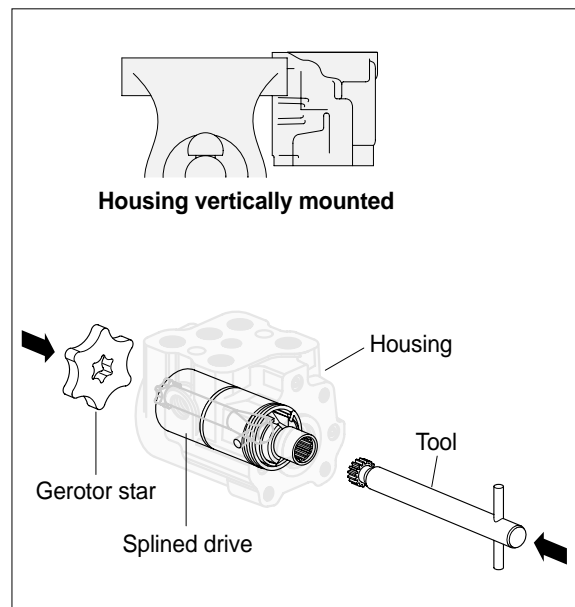




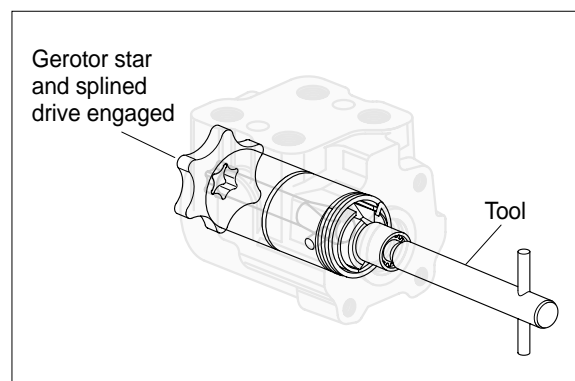
- (1) Remove the 7 cap screws(1), end cap(2), O-ring(3), gerotor(4), O-ring(3), spacer plate (5) and O-ring(3).



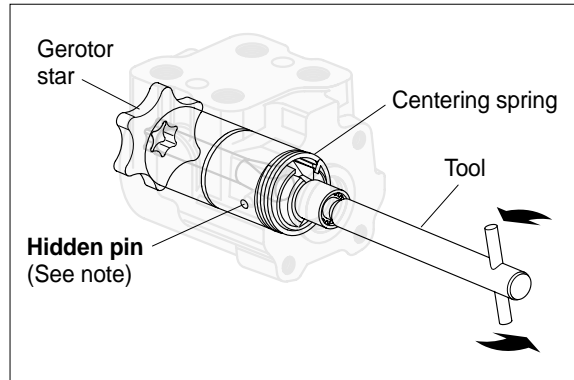
- (2) Engage tool with splined end of spool.



- (3) Protect gerotor star and hand with shop towel - Hold gerotor star and splined drive from turning.



- (4) Twist tool to compress centering spring radially CW or CCW, decreasing the coil diameter of the centering spring allowing it to be removed along with the spool and sleeve(Ball checks if applicable), drive, pin, bearing race(2), retaining ring, and needle thrust bearing.(Bearing races, retaining ring, and needle thrust bearing, not shown on drawing(Right). Centering spring shown compressed.)

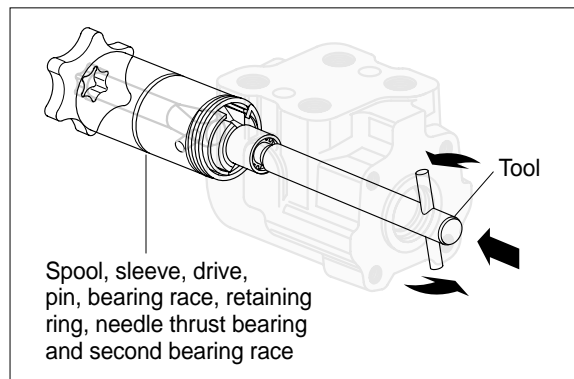


※ **Hidden pin**

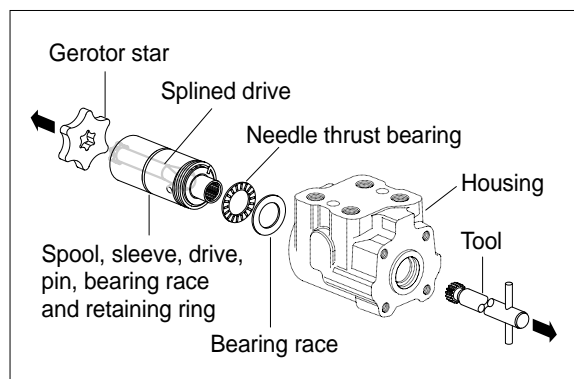
If tension on this pin is released before these parts are fully disengaged and the pin is not horizontal, the pin can drop and lockup can occur like a deadbolt.

Positioning unit vertically is a safe option and is required if the unit has anti-cavitation valves.

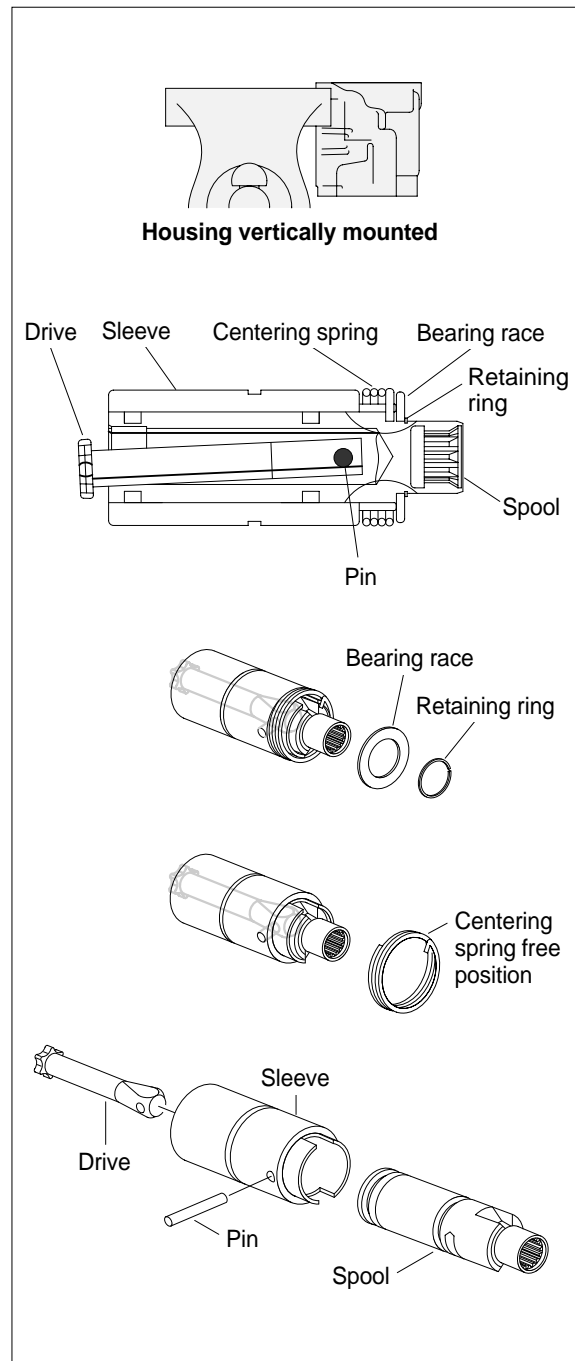
- (5) With drive held stationary and centering spring compressed, carefully push these assembled parts out of housing.



- (6) Remove the thrust bearing race and needle thrust bearing.

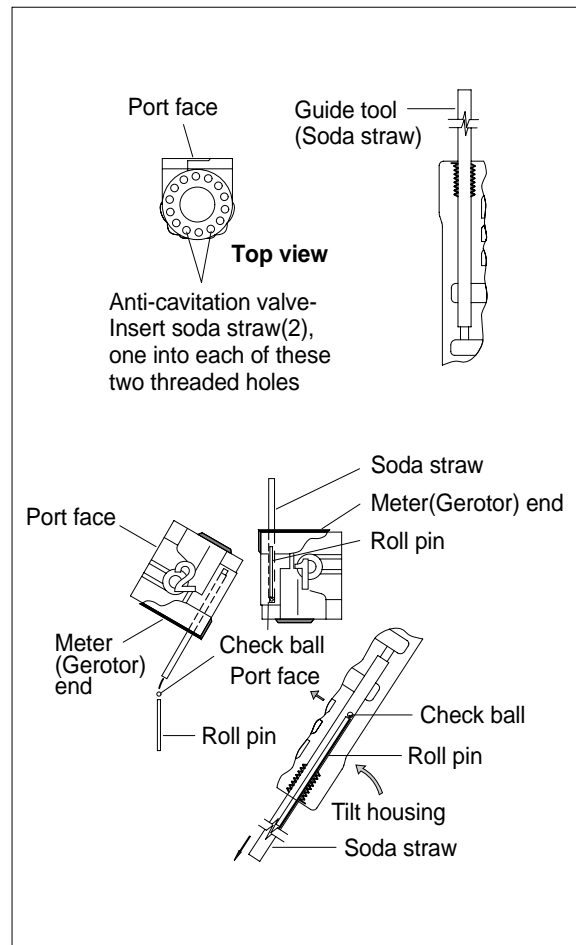


- (7) Remove the retaining ring, bearing race, centering spring, pin, drive, spool, sleeve.

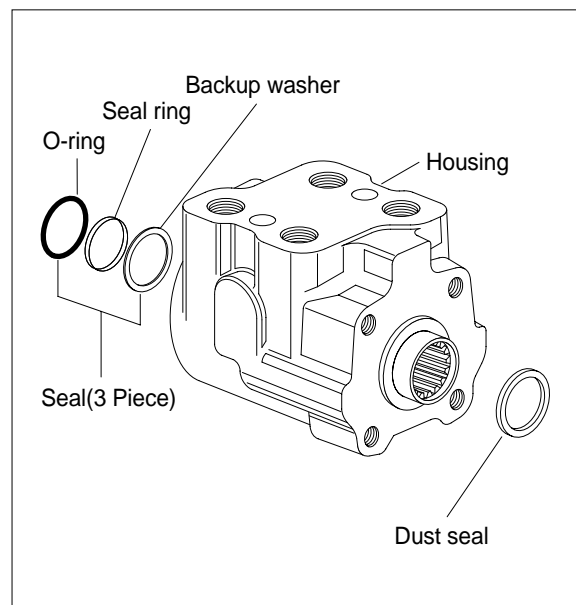


### Anti cavitation valves

- (8) Insert two soda straws, one in each of two threaded holes, as a safety measure for removal of two small ball check valves and roll pins (Correct threaded holes identified in illustration right). Remove housing from vise, tilt the housing and bring the port face upward. Continue turning the housing until the roll pins and ball checks slide through the straws from the meter (Gerotor) end of the housing.

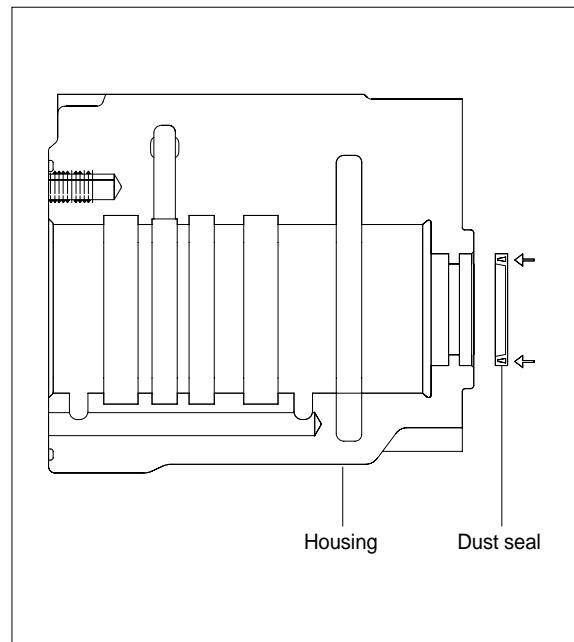


- (9) Remove the shaft seal. These three parts may or may not still be in the housing. These parts include O-ring, seal ring, and backup washer.
- (10) Using a small blade screwdriver, carefully pry the dust seal from the housing.
- ※ Do not damage the dust seal seat.



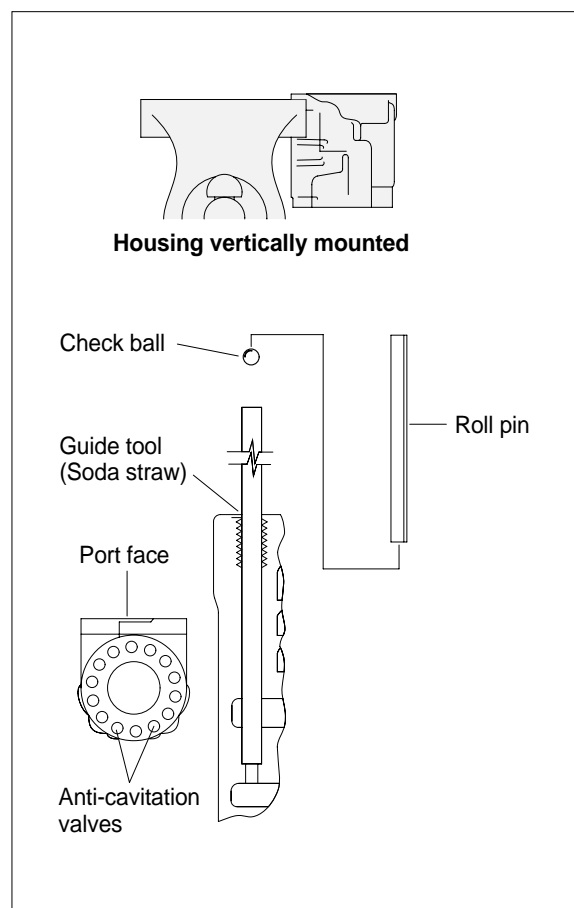
#### 4) ASSEMBLY

- ※ Check all mating surfaces. Replace any parts that have scratches or burrs to lessen the chance of leakage. Wash all metal parts in clean solvent. Blow them dry with pressurized air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage.
  - ※ Always use new seals when reassembling hydraulic steering control units.
  - ※ During reassembly lubricate the new seals with a petroleum jelly like Vaseline. Also lubricate machined surfaces with clean hydraulic fluid.
- (1) Lubricate and install the dust seal ; See drawing(Right) for correct seal orientation.

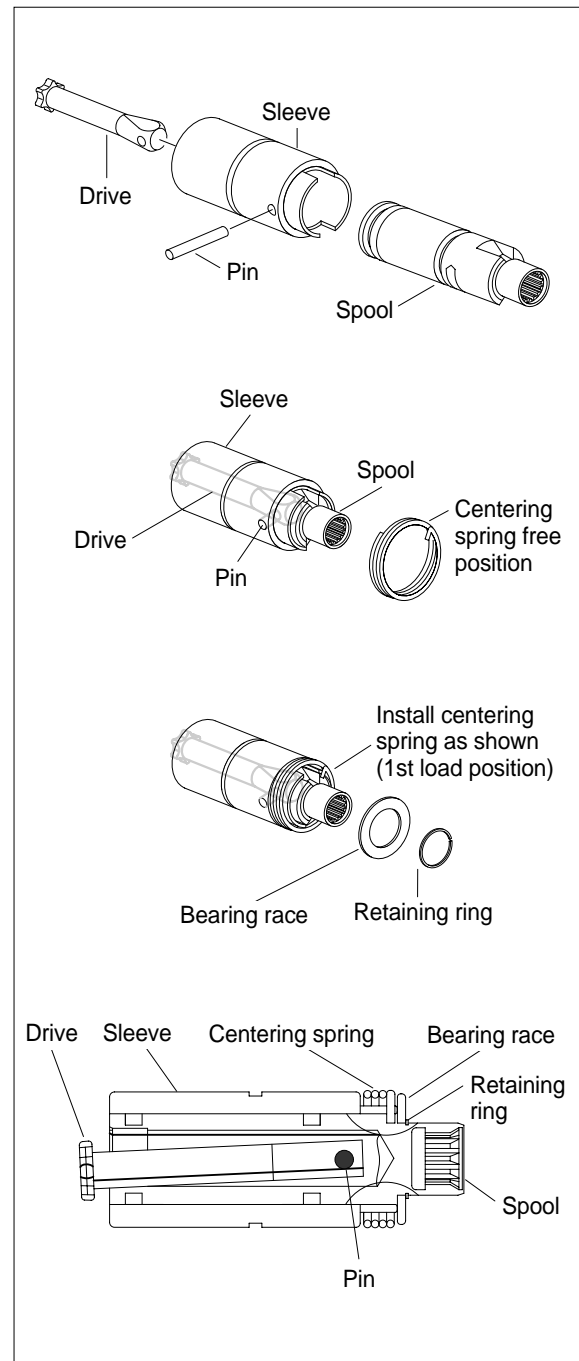


#### Anti cavitation valves

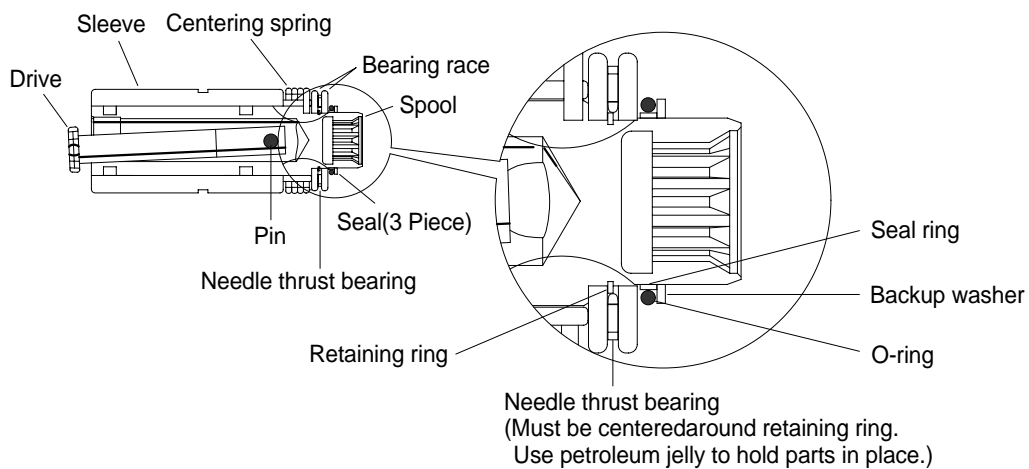
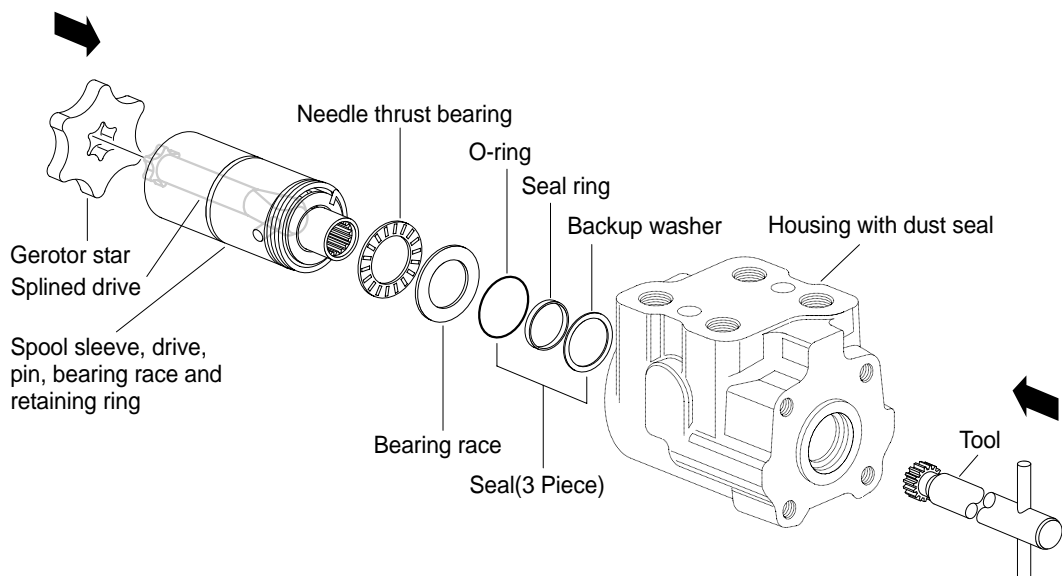
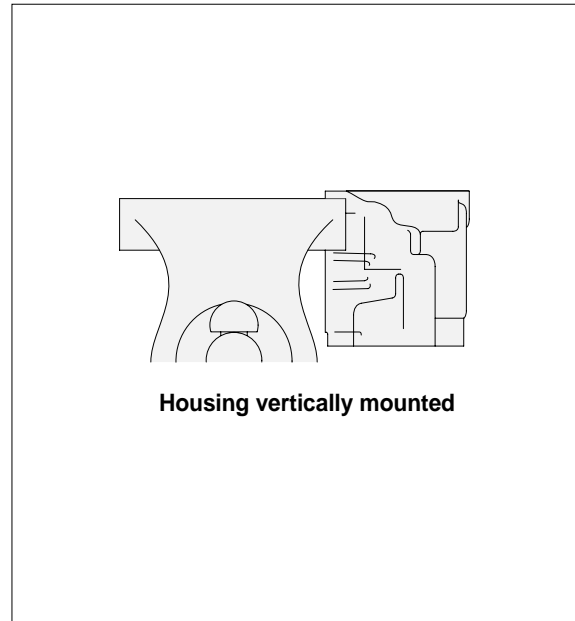
- (2) Installing the anti-cavitation ball checks seems simple enough ; However, a word of caution : Use a soda straw as a guide tool. Drop the straw into the hole to the bottom of bore, then drop ball through straw. Pull straw and use the same procedure in second ball seat. Check each bore with small light to make sure each ball is in the correct place. Add roll pin in each bore.



- (3) Apply a light coating of clean hydraulic fluid to the spool and slide it into the sleeve along with the ball checks if applicable.
- (4) Install the drive and pin.
- (5) Install the centering spring. Position one end of spring in slotted end of spool and sleeve, and compress the spring radially (CCW) to engage free end of spring.
- (6) Install the bearing race and retaining ring onto spool.



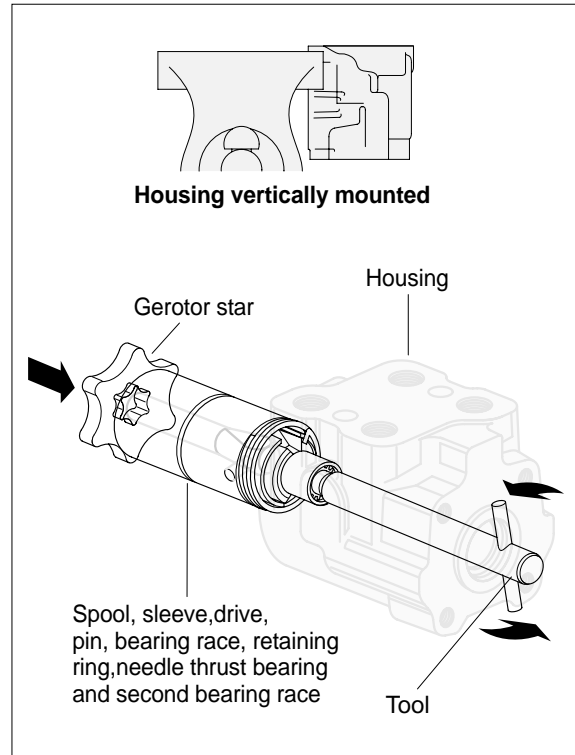
- ※ Apply a light coating of petroleum jelly to the inside diameter of the previously mounted dust seal in the housing.
- ※ Apply a light coating of petroleum jelly to the needle thrust bearing, second bearing race, and three part shaft seal. Position each part onto the spool as shown in enlarged section drawing below. The needle thrust bearing goes between the two bearing races and must be centered around retaining ring.
- ※ Apply a light coating of clean hydraulic fluid to the spool and sleeve assembly and slide it into the housing ; See steps (7)-(12).
- ※ Do not damage the dust or shaft seals.



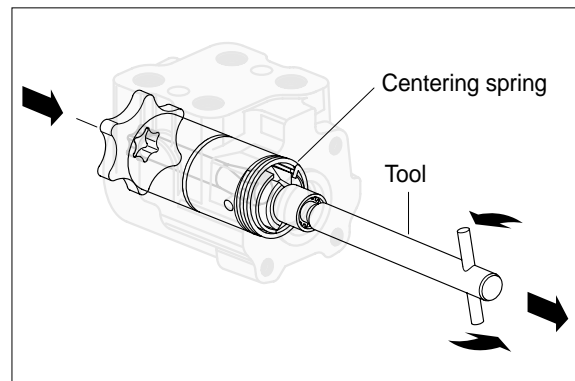
(7) Protect gerotor star and hand with shop towel - Hold gerotor star and splined end of drive to keep it from turning.

(8) Insert tool through housing ; Engage with splined end of spool assembled inside of sleeve along with ball checks(If applicable), centering spring, drive, pin, bearing race, retaining ring, needle thrust bearing, second bearing race, shaft seals and backup washer. Twist tool to compress spring coils radially CW or CCW.

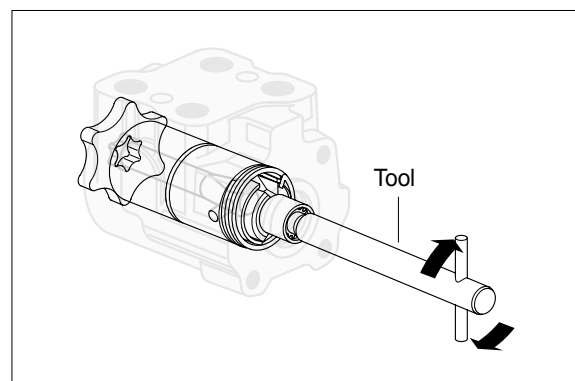
※ If by some chance this unit is in the horizontal position keep pin nearly horizontal. If tension on this pin is released before these parts are fully engaged and the pin is not horizontal, the pin can drop and lockup can occur like a deadbolt.



(9) Keep centering spring compressed, and carefully insert these assembled parts into housing. **Do not force.**(Bearing races, retaining ring, needle thrust bearing, shaft seals and backup washer not shown on drawing at right. Centering spring shown compressed.)

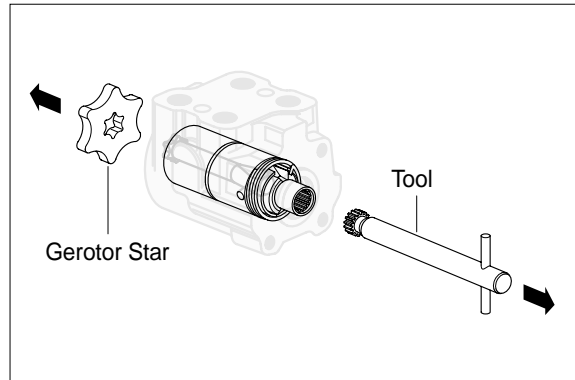


(10) Release centering spring tension.

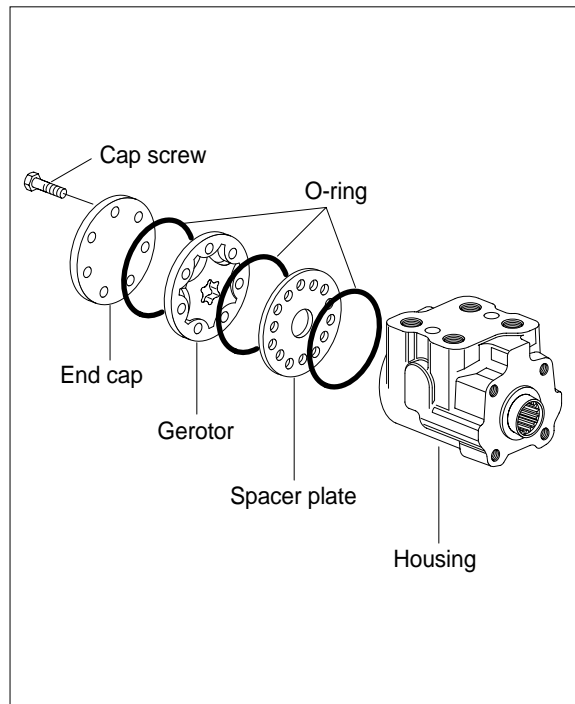




- (11) Remove gerotor star.
- (12) Remove tool.

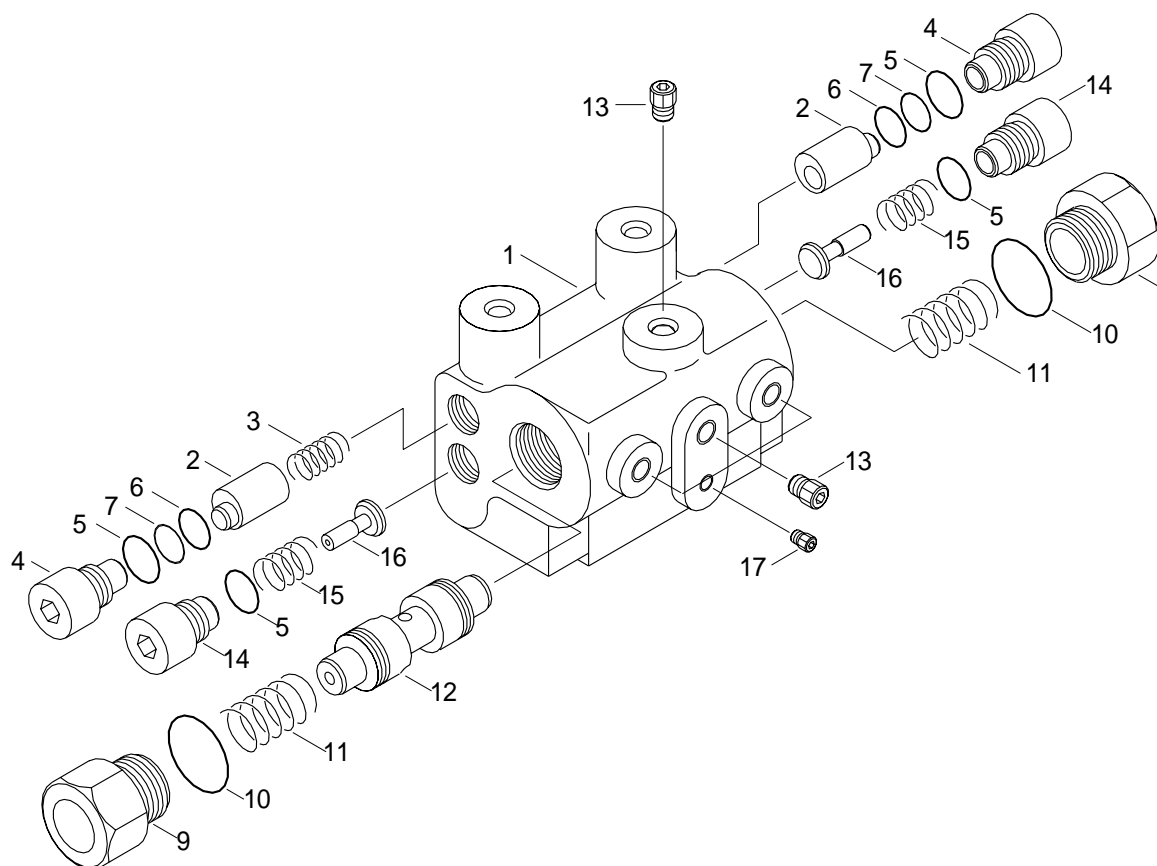


- (13) Lubricate and install a new O-ring seal in the groove in the housing.
- (14) Install the wear plate O-ring groove up and align the holes in the wear plate with threaded holes in the housing.
- (15) Lubricate and install a new O-ring seal in the groove in the wear plate.
- (16) Install the gerotor and align the screw holes.
- (17) Lubricate and install a new O-ring seal in the groove in the gerotor ring.
- (18) Install the end cap and 7 cap screws. Pretighten the cap screws, in a criss-cross pattern, to  $1.7\text{kgf} \cdot \text{m}$  ( $12.3\text{lb} \cdot \text{ft}$ ), finally in a criss-cross pattern, tighten cap screws to  $3.4\text{kgf} \cdot \text{m}$  ( $24.6\text{lb} \cdot \text{ft}$ ).



### 3. CUSHION VALVE

#### 1) STRUCTURE



- |   |            |
|---|------------|
| 1 | Housing    |
| 2 | Poppet     |
| 3 | Spring     |
| 4 | Valve seat |
| 5 | O-ring     |
| 6 | O-ring     |

- |    |              |
|----|--------------|
| 7  | Back up ring |
| 8  | Orifice      |
| 9  | Plug         |
| 10 | O-ring       |
| 11 | Spring       |
| 12 | Spool        |

- |    |        |
|----|--------|
| 13 | Plug   |
| 14 | Plug   |
| 15 | Spring |
| 16 | Poppet |
| 17 | Plug   |

#### 2) TOOLS

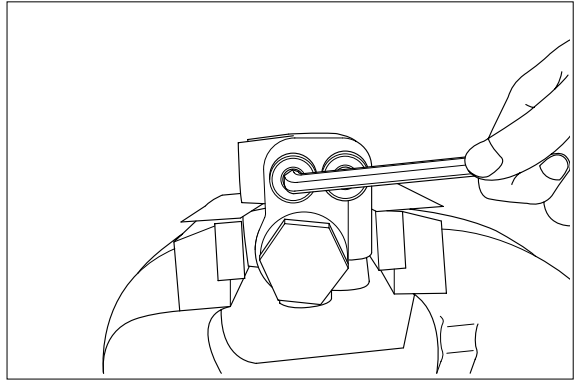
- Torque wrench(5 ~ 20kgf · m)
- Hexagon wrench(5, 6, 8mm)
- Spanner(36mm) or socket
- Pincette
- Grease and seal tape

### 3) DISASSEMBLY

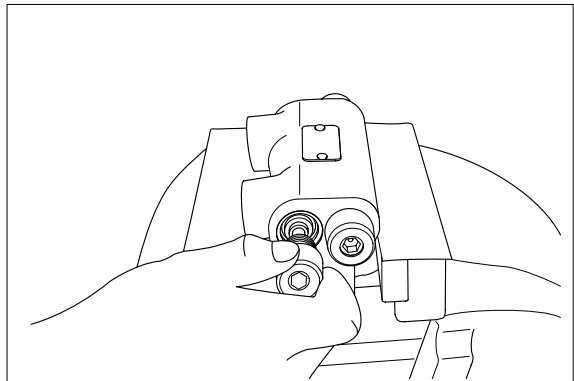
- ※ Cleanliness is extremely important when repairing a cushion valve.
- ※ Clamp valve in vise. Use protective material on vise jaws.
- ※ Do not over tighten jaws.

#### (1) Pilot valve part

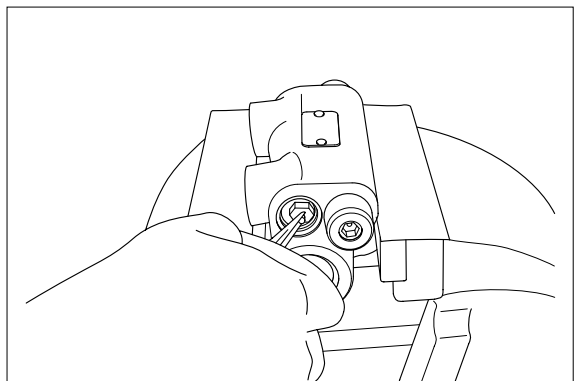
- ① Remove seat valve(4).



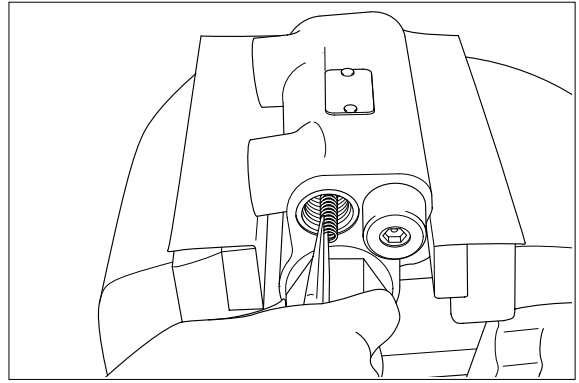
- ② Remove O-ring(5, 6) and back up ring(7) from seat valve(4).



- ③ Remove poppet(2).

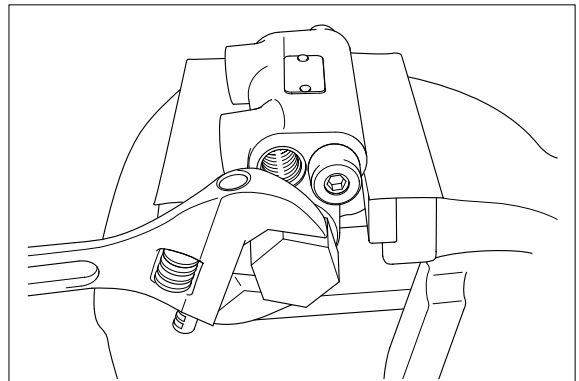


④ Remove spring(3).

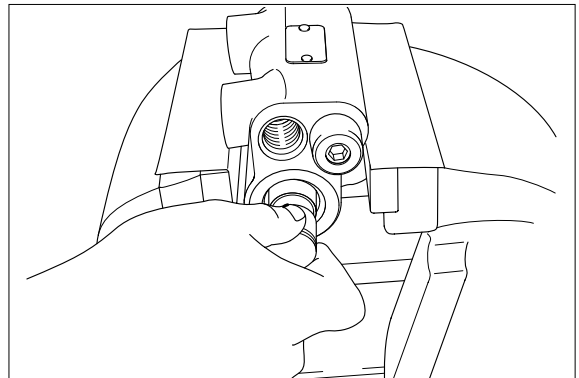


**(2) Main valve part**

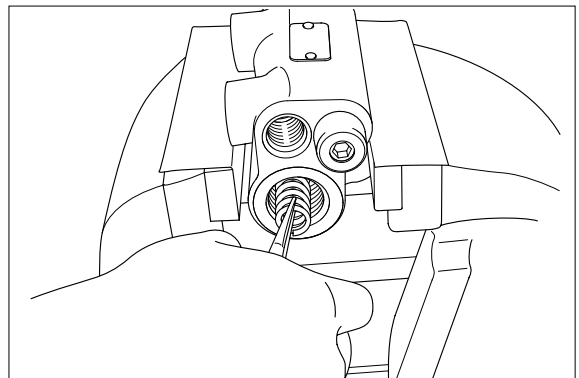
① Remove plug(9).



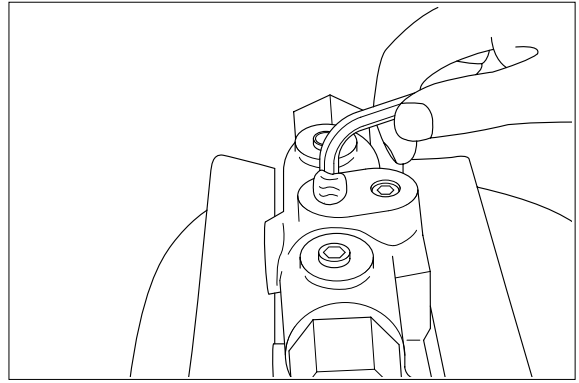
② Remove spring(11).



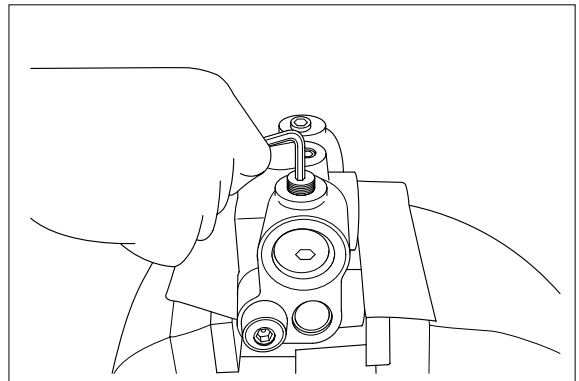
③ Remove spool(12).



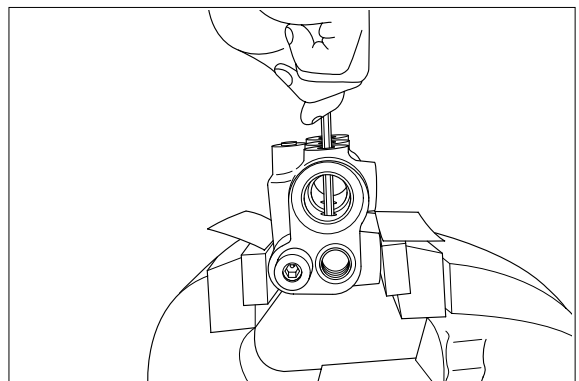
- ④ Remove O-ring(10) from plug(9).



- ⑤ Remove plug(13).

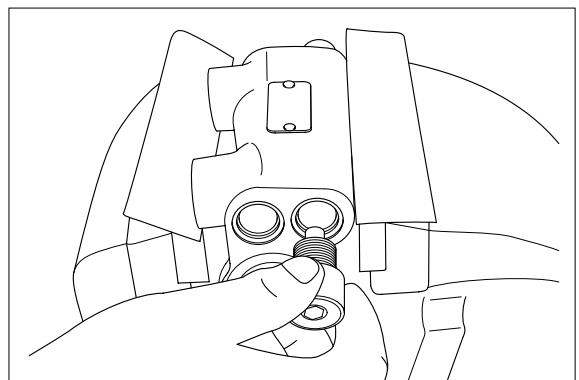


- ⑥ Remove orifice(8).

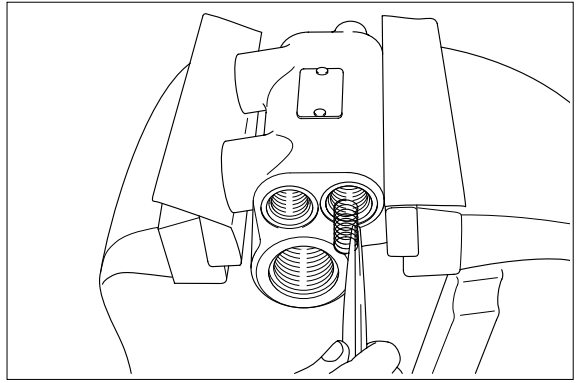


**(3) Check valve part**

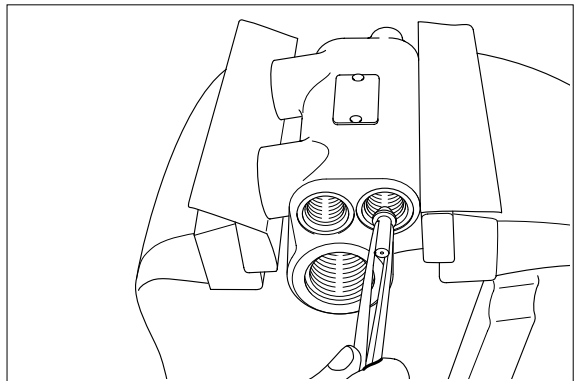
- ① Remove plug(14).



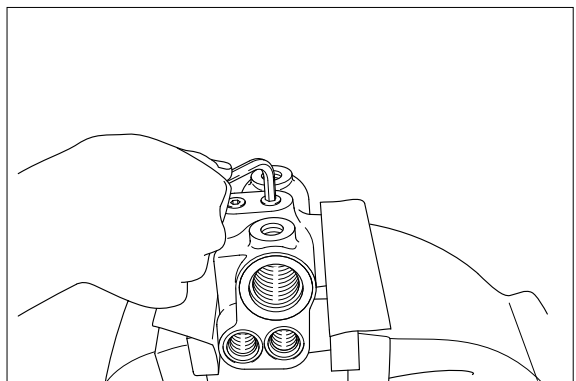
② Remove spring(15).



③ Remove poppet(16).



④ Remove plug(13, 17).

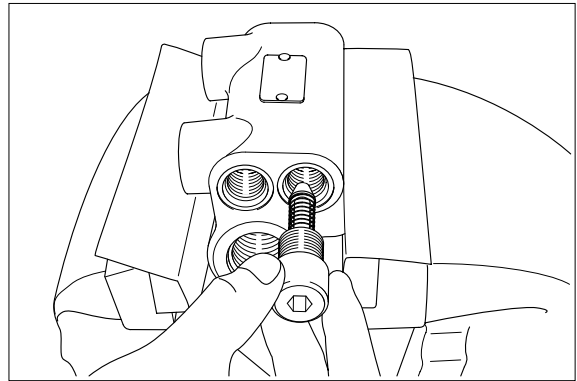


#### 4) ASSEMBLY

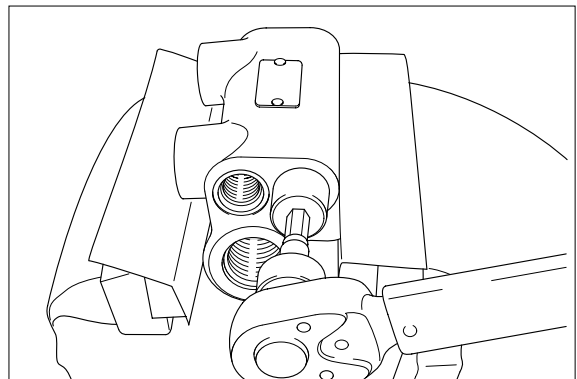
- ※ Clean all metal parts in clean solvent and blow dry with air and correct any damage, burrs and rust.
- ※ Do not wipe dry with cloth or paper towel.
- ※ Replace seal such as O-ring with new ones as a rule and coat with grease.

##### (1) Check valve part

- ① Insert poppet(16), spring(15).

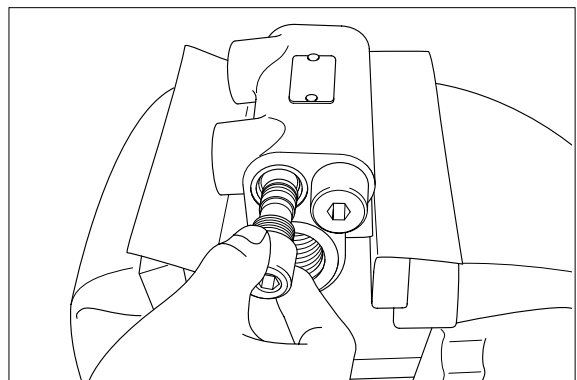


- ② Install O-ring(5) on plug(14) and install this plug assembly into housing(1).
  - Tighten torque : 6.0kgf · m(43lb · ft)

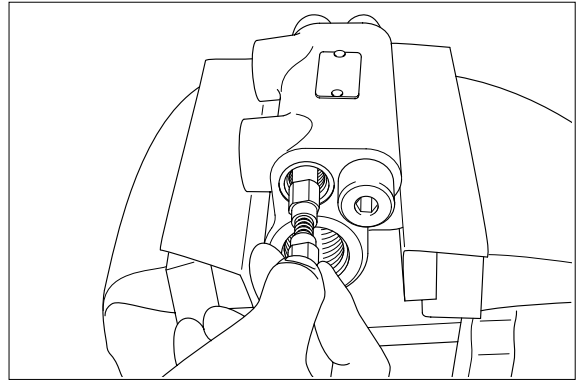


##### (2) Pilot valve part

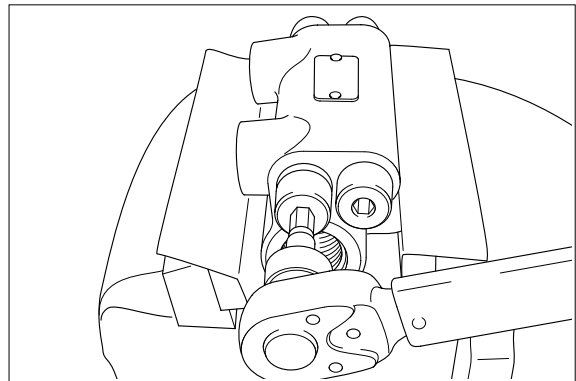
- ① Insert O-ring(5, 6), back up ring(7) into valve seat(4).



- ② Insert spring(3) and poppet(2) into housing(1).

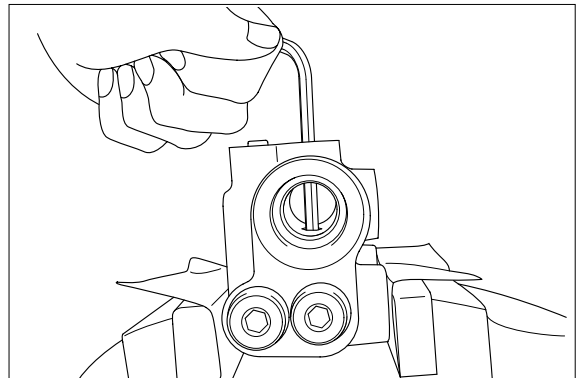


- ③ Install valve seat(4) into housing(1).  
• Tighten torque : 6.0kgf · m(43lb · ft)

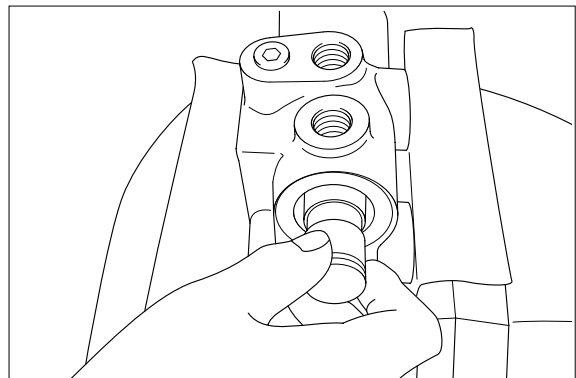


### (3) Main valve part

- ① Insert orifice(8) into housing(1).  
• Tighten torque : 2.0kgf · m(14.5lb · ft)

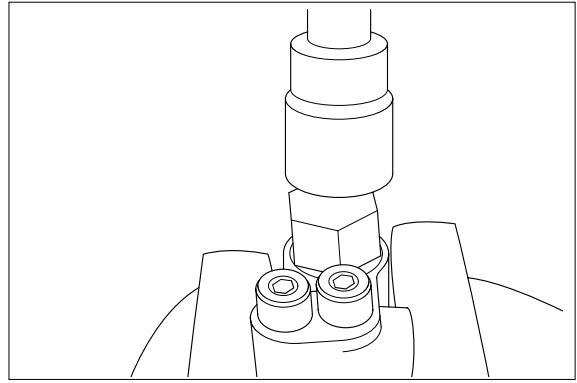


- ② Insert spool(12) into housing(1).  
Spool(12) should rotate smoothly in housing(1) with finger tip force.

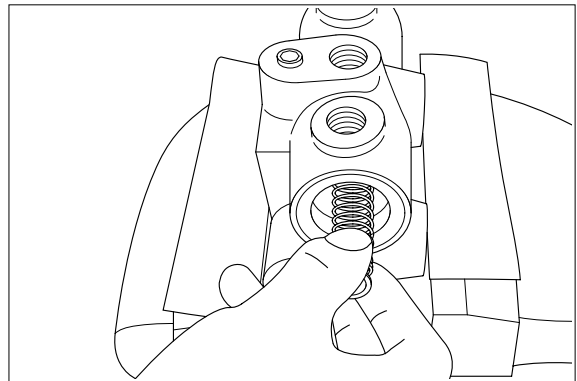




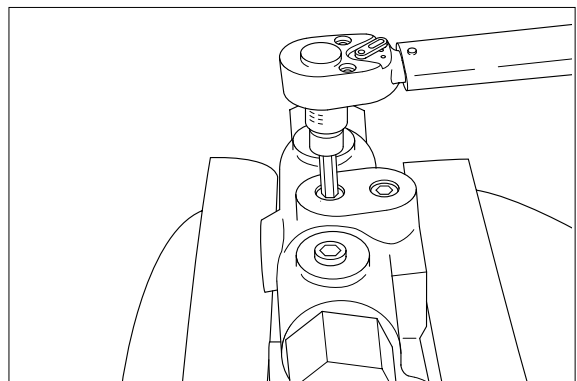
- ③ Insert O-ring(10) onto each plug(9).



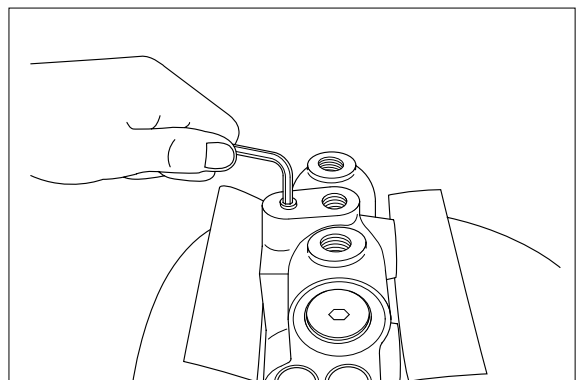
- ④ Insert spring(11), plug(9) into housing(1).  
• Tighten torque : 14kgf · m(101lb · ft)



- ⑤ Insert plug(13) into housing(1).  
• Tighten torque : 3.0kgf · m(21.7lb · ft)



- ⑥ Insert plug(17) into housing(1).  
• Tighten torque : 2.0kgf · m(14.5lb · ft)

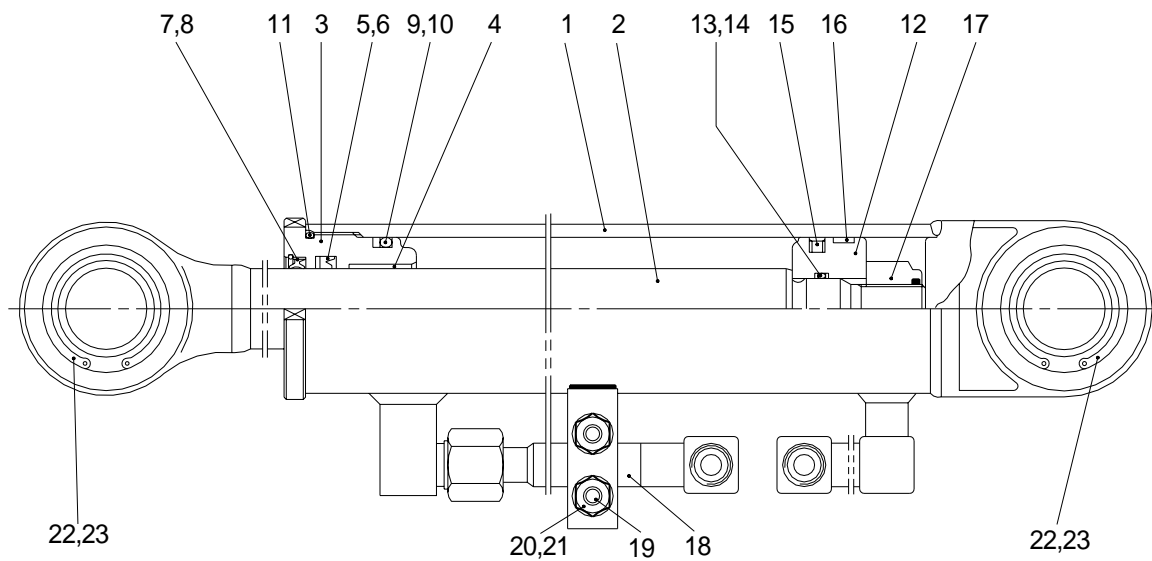


## 5) TROUBLESHOOTING

| Problem   | Cause   | Remedy   |
|---|---|--|
| Steering cylinder reaction is bad (Wheel slip is large) | 1. Check valve seat side is clogged with dirt.<br>2. Main valve spool is stuck.<br>3. Orifice is clogged with dirt. | Disassembly, clean and reassembly.<br><br>Disassembly, clean or replace.<br><br>Disassembly, clean and reassembly. |
| Non cushion effect or less                              | 1. Main valve speed is stuck.<br>2. Pilot valve poppet is stuck.  | Disassembly, clean or replace.<br><br>Disassembly, clean or replace.   |
| Leakage   | 1. Loosen the plug.<br><br>2. Damage of O-ring.   | Apply seal tape and retighten specified torque.<br><br>Replace.  |

## 4. STEERING CYLINDER

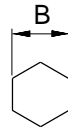
### 1) STRUCTURE



|   |              |    |              |    |                   |
|---|--------------|----|--------------|----|-------------------|
| 1 | Tube assy    | 9  | O-ring       | 17 | Nylon nut         |
| 2 | Rod assy     | 10 | Back up ring | 18 | Pipe assy         |
| 3 | Gland        | 11 | O-ring       | 19 | U-bolt            |
| 4 | Bushing      | 12 | Piston       | 20 | Nut               |
| 5 | Rod seal     | 13 | O-ring       | 21 | Spring washer     |
| 6 | Back up ring | 14 | Back up ring | 22 | Spherical bearing |
| 7 | Dust wiper   | 15 | Piston seal  | 23 | Retaining ring    |
| 8 | Snap ring    | 16 | Wear ring    |    |                   |

## 2) TOOLS AND TIGHTENING TORQUE

### (1) Tools

| Tool name     | Remark   |   |
|---------------|--|---|
| Spanner       | 17   |  |
|               | 32   |   |
|               | 36   |   |
| Wrench        | For gland  |   |
| (-) Driver    | Small and large sizes                            |   |
| Torque wrench | Capable of tightening with the specified torques |   |

### (2) Tightening torque

| Part name      | Item | Size      | Torque  |          |
|----------------|------|-----------|---------|----------|
|                |      |           | kgf · m | lbf · ft |
| Gland          | 3    | M72 × 2   | 60±10   | 434±72   |
| Nylon nut      | 17   | M24 × 2   | 75±7.5  | 542±54   |
| Nut(Pipe assy) | 18   | M22 × 1.5 | 30±3    | 217±22   |
| Nut            | 20   | M10 × 1.5 | 8±0.8   | 58±6     |

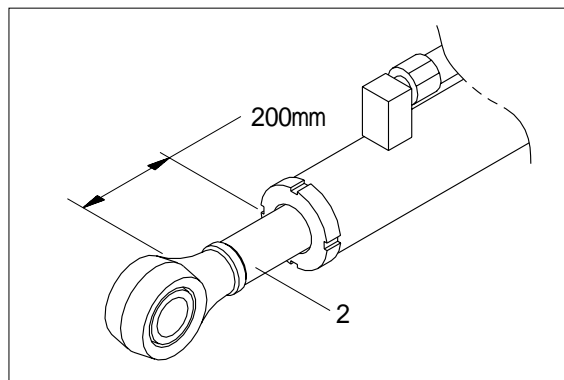
### 3) DISASSEMBLY

#### (1) Remove cylinder head and piston rod

① Hold the clevis section of the tube in a vise.

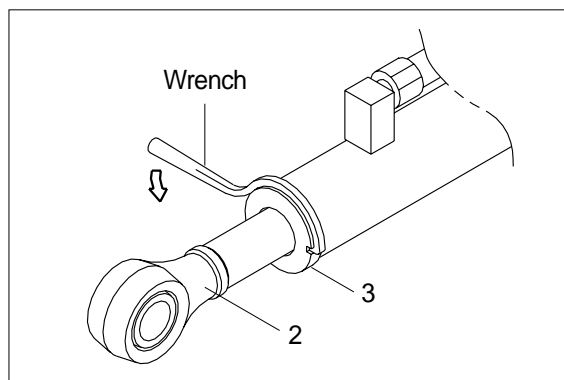
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out piston rod(2) about 200mm (7.1in). Because the piston rod is rather heavy, finish extending it with air pressure after the oil draining operation.



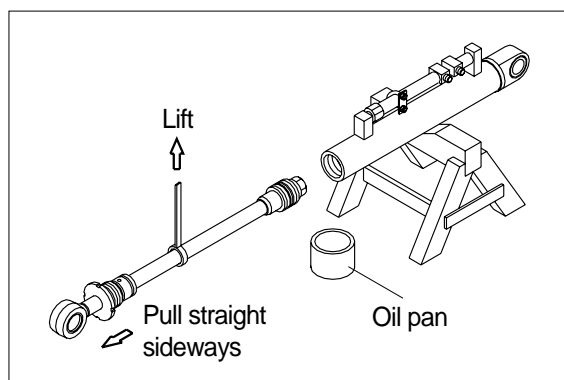
③ Loosen and remove the gland(3).

※ Cover the extracted piston rod(2) with rag to prevent it from being accidentally damaged during operation.



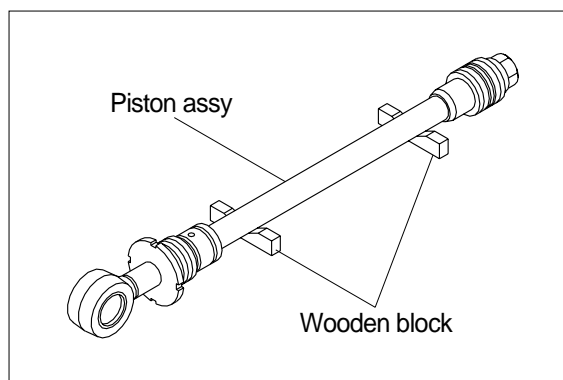
④ Draw out gland(3) and piston rod(2) assembly together from cylinder tube(1).

※ Since the piston rod assembly is heavy in this case, lift the tip of the piston rod(2) with a crane or some means and draw it out. However, when piston rod(2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



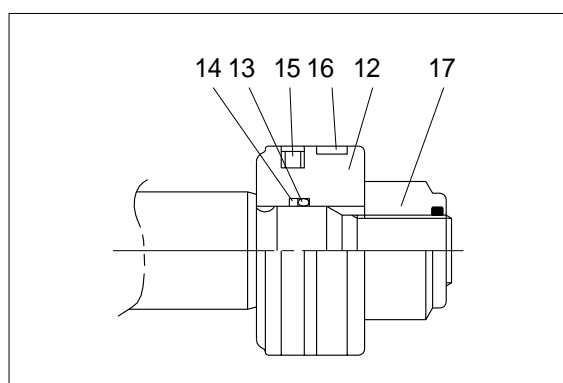
Note that the plated surface of piston rod(2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

- ⑤ Place the removed piston rod assembly on a wooden V-block that is set level.
- ※ Cover a V-block with soft rag.

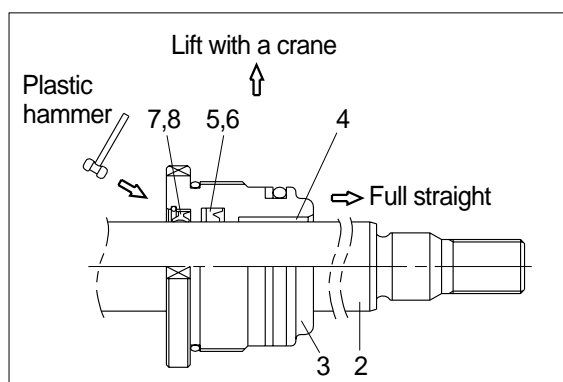


## (2) Remove piston and cylinder head

- ① Remove the piston nut(17).
- ② Remove piston assembly(12), back up ring(14) and O-ring(13).

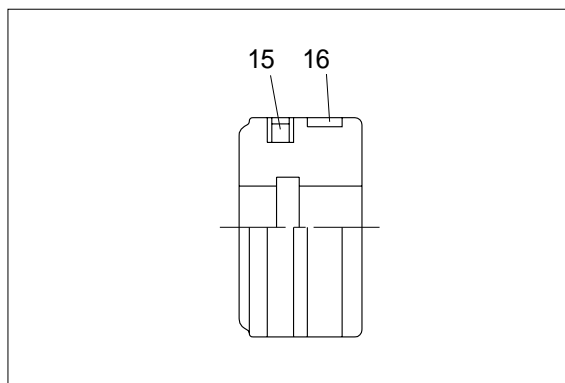


- ③ Remove the gland(3) assembly from piston rod(2).
  - ※ If it is too heavy to move, move it by striking the flanged part of gland(3) with a plastic hammer.
  - ※ Pull it straight with cylinder head assembly lifted with a crane.
- Exercise care so as not to damage the lip of rod bushing(4) and packing(5,6,7,8) by the threads of piston rod(2).



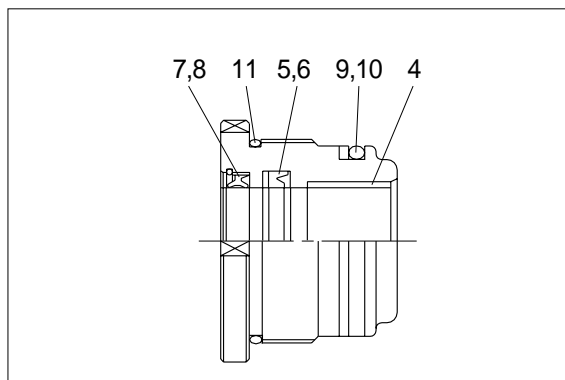
### (3) Disassemble the piston assembly

- ① Remove wear ring(16).
- Remove and piston seal(15).
- ※ Exercise care in this operation not to damage the grooves.



### (4) Disassemble gland assembly

- ① Remove back up ring(10), and O-ring(9).
- ② Remove O-ring(11).
- ③ Remove snap ring(8) and dust wiper(7).
- ④ Remove back up ring(6), rod seal(5).
- ※ Exercise care in this operation not to damage the grooves.
- ※ Do not remove seal and ring, if does not damaged.

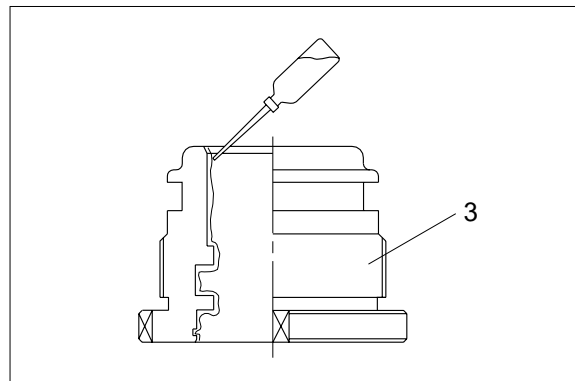


#### 4) ASSEMBLY

##### (1) Assemble gland assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

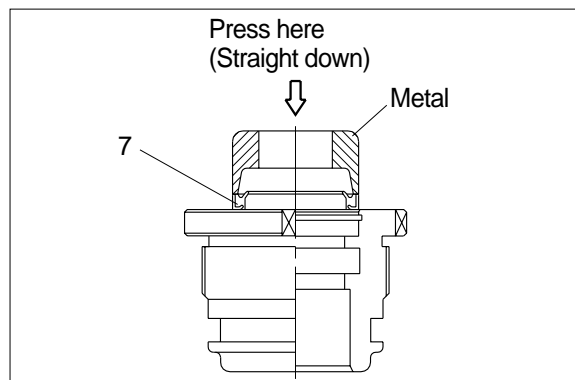
- ① Coat the inner face of gland(3) with hydraulic oil.



- ② Coat dust wiper(7) with grease and fit dust wiper(7) to the bottom of the hole of dust wiper.

At this time, press a pad metal to the metal ring of dust seal.

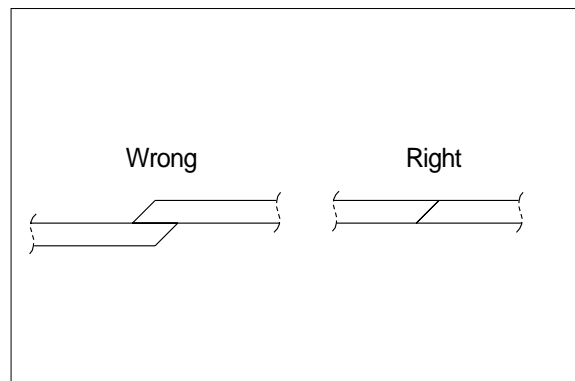
- ③ Fit snap ring(8) to the stop face.



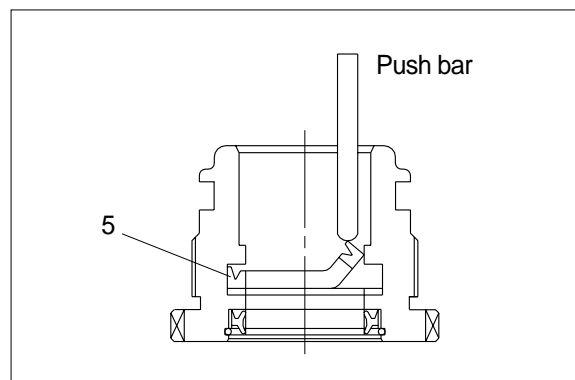
- ④ Fit back up ring(6) and rod seal(5) to corresponding grooves, in that order.

※ Coat each packing with hydraulic oil before fitting it.

※ Insert the backup ring until inside of it is inserted into groove.

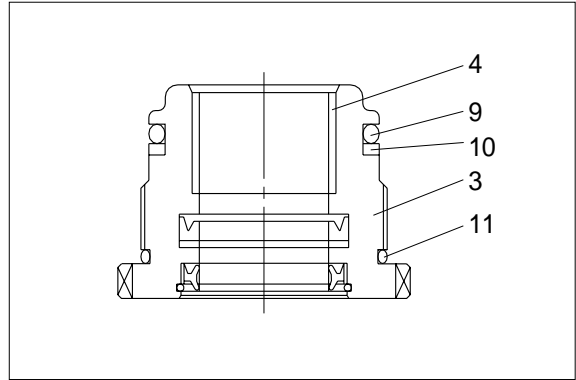


- ※ Rod seal(5) has its own fitting direction. Therefore, confirm it before fitting them.
- ※ Fitting rod seal(5) up side down may damage its lip. Therefore check the correct direction that is shown in fig.



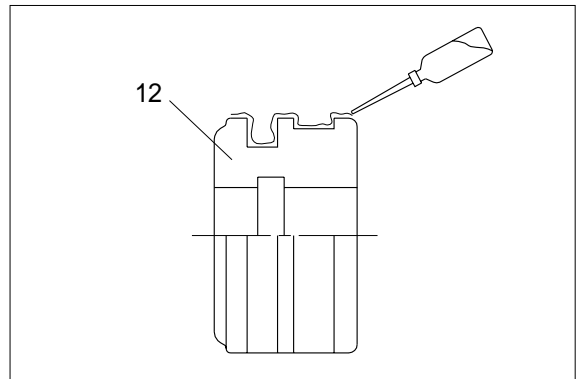


- ⑤ Fit back up ring(10) to gland (3).
- ※ Put the backup ring in the warm water of 30~50°C.
- ⑥ Fit O-ring(9) to gland(3).

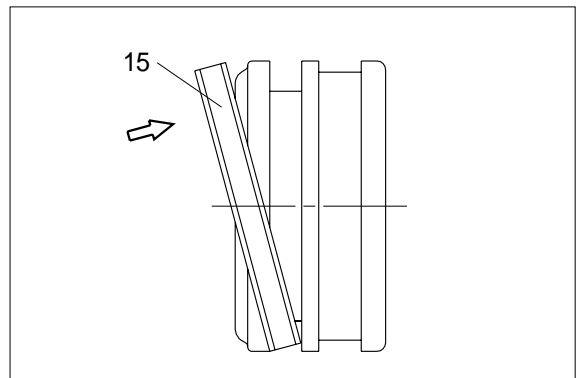


## (2) Assemble piston assembly

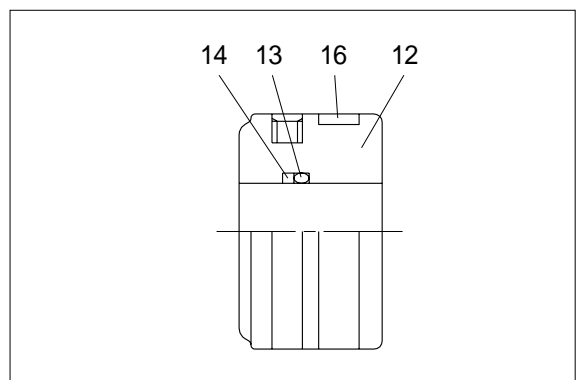
- ※ Check for scratches or rough surfaces.  
If found smooth with an oil stone.
- ① Coat the outer face of piston(12) with hydraulic oil.



- ② Fit piston seal(15) to piston
- ※ Put the piston seal in the warm water of 60~100°C for more than 5 minutes.
- ※ After assembling the piston seal, press its outer diameter to fit in.

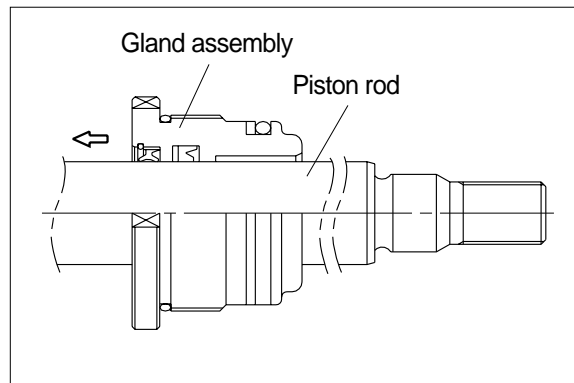


- ③ Fit wear ring(16) to piston(12).
- ④ Fit back up ring(14) and O-ring(13) to piston(12).

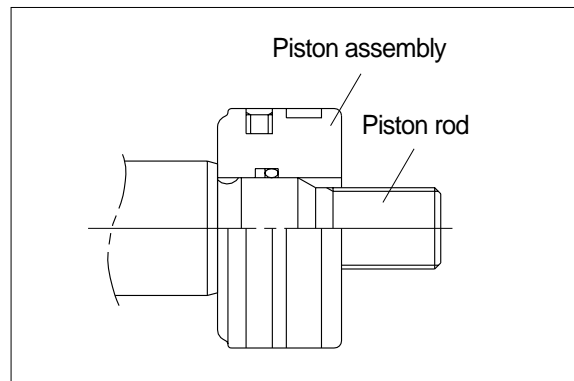


### (3) Install piston and gland

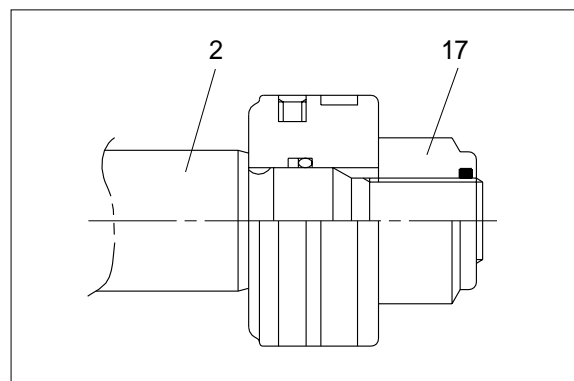
- ① Fix the piston rod assembly to the work bench.
- ② Apply hydraulic oil to the outer surface of piston rod(2), the inner surface of piston and gland.
- ③ Insert gland assembly to piston rod(2).



- ④ Fit piston assembly to piston rod.



- ⑤ Tighten piston nut(17) to piston rod(2).
  - Tightening torque :  $75 \pm 7.5 \text{ kgf} \cdot \text{m}$   
( $542 \pm 54 \text{ lbf} \cdot \text{ft}$ )



#### (4) Overall assemble

- ① Place a V-block on a rigid work bench.  
Mount the cylinder tube assembly(1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.
- ② Insert the piston rod assembly in to the cylinder tube assembly, while lifting and moving the piston rod assembly with a crane.
  - ※ Be careful not to damage piston seal by thread of cylinder tube.
- ③ Match the bolts holes in the cylinder head flange to the tapped holes in the cylinder tube assembly and tighten socket bolts to a specified torque.
  - ※ Refer to the table of tightening torque.

