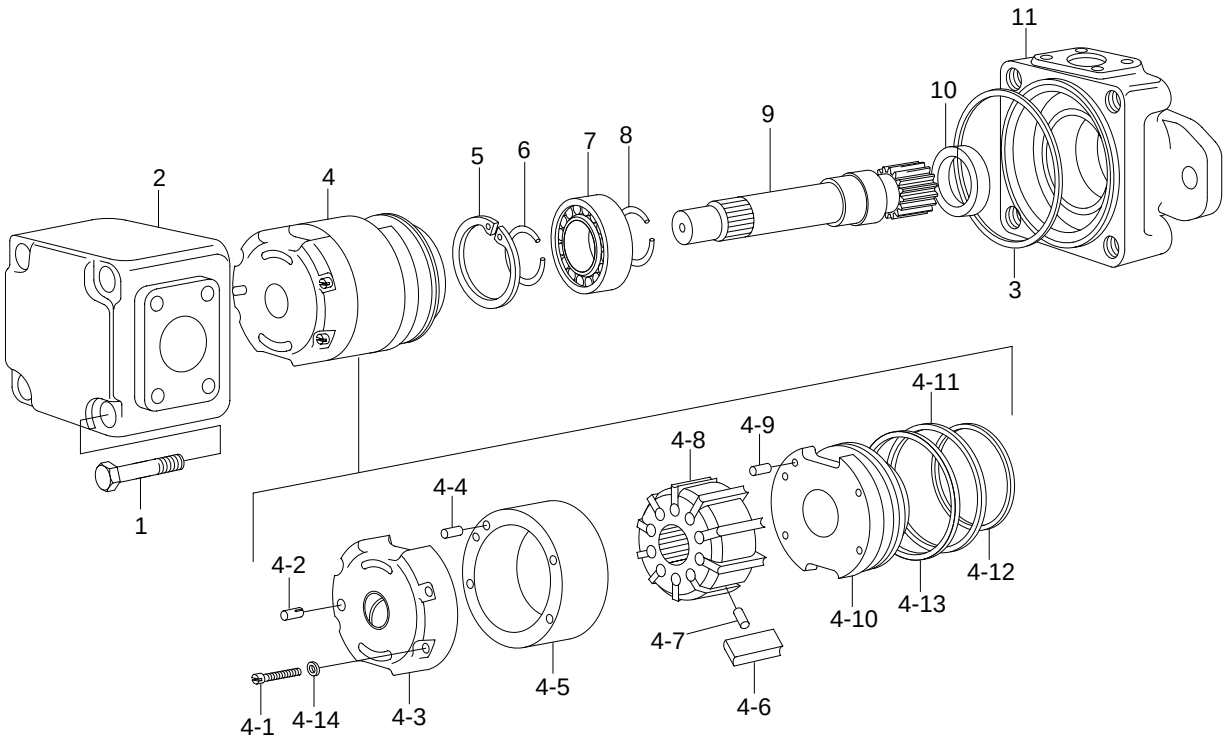
## GROUP 4 DISASSEMBLY AND ASSEMBLY

### 1. STEERING PUMP

#### 1) STRUCTURE




| | | | | | |
|---|---|---|---|---|---|
| 1 | Cap screw | 4-5 | Cam ring | 4-13 | Back up ring |
| 2 | End cap | 4-6 | vane | 5 | Internal snap ring |
| 3 | Seal | 4-7 | Vane holdout pin | 6 | External snap ring |
| 4 | Cartridge | 4-8 | Rotor assy | 7 | Ball bearing |
| 4-1 | Screw | 4-9 | Dowel pin | 8 | External snap ring |
| 4-2 | Lock pin | 4-10 | Pressure plate | 9 | Splined shaft |
| 4-3 | Port plate | 4-11 | Seal | 10 | Shaft seal |
| 4-4 | Dowel pin | 4-12 | Seal | 11 | Mounting cap |

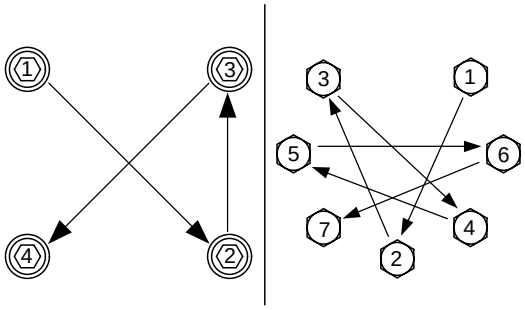
## 2) GENERAL INSTRUCTION

### (1) Preliminary

※ Any servicing work done on main pump is to be done in a clean environment to prevent potential contamination by foreign particles.

※ Appropriate tools and equipment are required in order to insure proper disassembly and reassembly in suitable conditions. In case of repetitive service, a specific working bench is recommended.

※ To prevent oil leakage and body tilting during assembly, housing bolts are to be tightened as per the following pattern.




### (2) Parts

※ Parts must be kept clean at all time. If cleaning is needed, solvent is to be used. It is needed to check and oil the inner parts before assembly.

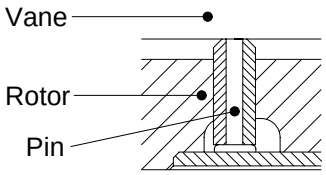
※ In case of replacement of parts with mulitiple numbers, such as vanes and holdout pins, all the parts are to be changed.

① **Vanes**

The faces and edges should be free of scratch from contamination. Vanes should move smoothly in the rotor slots, without excessive clearance. Edges may be stoned with a fine lndia stone to remove burrs.

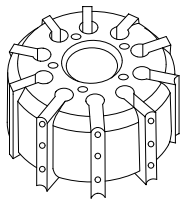
② **Vane holdout pins :**

Holdout pins should have no matting marks.



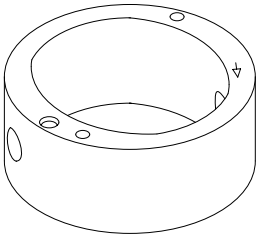

③ **Rotor :**

Side surfaces and vane slots should be free of scratches. Side feeds, vane slots and holdout pin orifices should be free of any contamination. Serration(driving splines) should not be deformed by the shaft.



④ **Camring :**

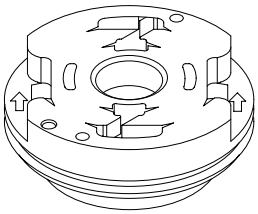
No scratches or vane shock marks(waves) should be seen. Visual axial waves on new camring are from grinding process and therefore normal.



⑤ **Port plates :**

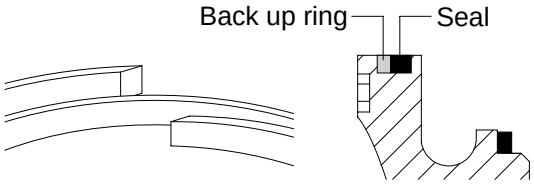
Faces should not be scratched. No cavitation/aeration/fretting corrosion marks should be seen. When there, the bronze bushing should be clean, with no abnormal wear sign.

※ Bi-directional cartridges use same port plates for CW and CCW rotation. **Unit-directional** cartridges require different port plates.



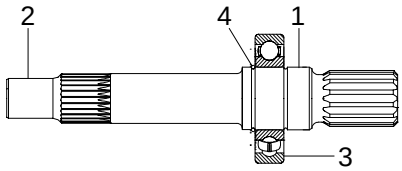
⑥ **Seals :**

- All oil seals must be cleaned, with no wear or cutting mark. When servicing a pump from field operation, it is highly recommended to change all seals. All seals are to be greased lightly before assembly.
- Use seal driver tool to install shaft seal, and protective cone to install shaft assembly.
- Backup rings(1) on pressure plates are to be replaced, anytime a cartridge is taken out of a pump. Backup rings are to be installed as follow, behind the square seal :




⑦ **Shaft :**

- Key-way should be clean and not worn on the sides by excessive torque. No fretting corrosion due to poor coupling should be visible. On spline shaft, splines should not be deformed.
- No axial scratch should be on the sealing area(1). The shaft seal lip contact line may be visible, but should not be a groove. Bronze-bushing contact area(2) should be clean and cylindrical, without scratch marks.




· Ball bearing(3) should turn freely and snap ring(4) should be in place. Some shaft assemblies have 2 snap rings, before and after the ball bearing.

※ **Never insert a snap ring from shaft seal side, to avoid scratching the sealing surface.**

※ Use protective cone to install shaft assembly. If not available, make sure not to damaged the shaft seal lips.

**(3) Pre start check and priming.**

① Before operating the pump again, the following points are to be checked :

· Pump rotation is as per electric motor or engine.
· All fittings are properly connected and tight. No oil-leak and/or air intake being allowed.
· If any, valve on suction line is to be fully opened.

② When electric motor or engine is started up, the pump should prime immediately. However, depending on installation and amount of air in the discharge lines, priming may take a few seconds.

③ In case priming does not occur within 15 seconds, equipment should be switched off at once. Then :

· Manually fill the pump housing with fluid.
· Bleed off air that may be trapped in the pump.
· Check air bleed-off valves.
· Start rotation in a jogging manner until a prime is picked up.

### 3) DISASSEMBLY

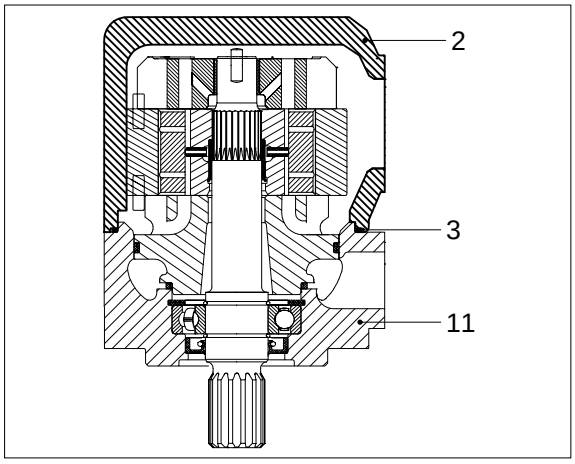
#### (1) Pump

① Securely hold the pump in a vise or similar equipment, at front cap(11) level.

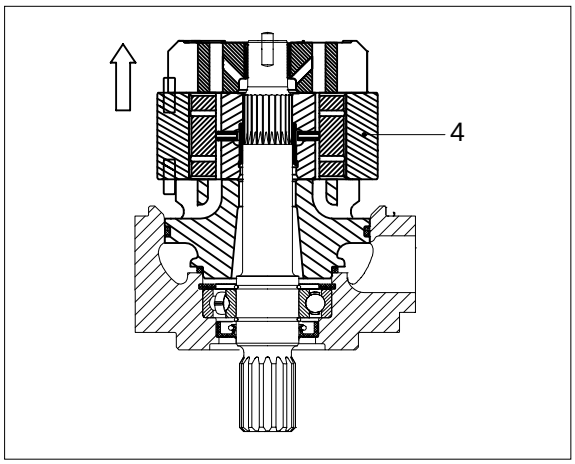
② Unscrew the housing bolts.

③ Note the porting then remove housing(2).

④ Remove seal(3).




⑤ Extact cartridge(4) carefully by using a gear puller or by prying upward. Care must be taken not to damage the parts.




#### (2) Camring replacement, cartridge change of rotation

· **Camring change**

① Unscrew the 2 bolts(4-1) holding the cartridge together.

② Remove rear plate(4-3), save dowel pin(4-4).

③ Take out camring(4-5) carefully, save dowel pin(4-9). Leave rotor and vane in place.

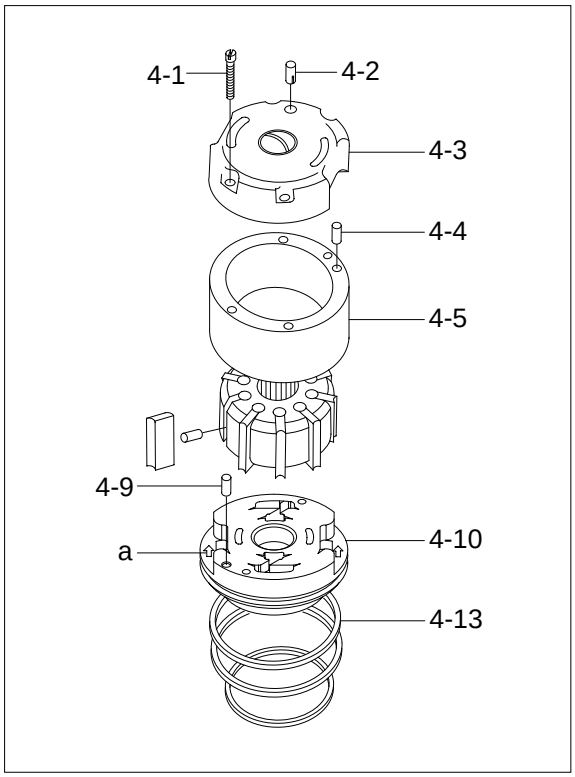
④ Install dowel pin(4-9) in pressure plate(4-10) orifice.

※ Rotation should match the arrow in the port cutout(a) closest to the dowel pin.

⑤ Install new camring(4-5).

※ Arrow on the camring size should be as per required rotation.

⑥ Install dowel pin(4-4) on camring.



⑦ Install back rear plate(4-3), then tighten the bolts(4-1). Make sure dowel pin(4-2) is in place.

⑧ Replace back up ring(4-13). Change other seals if damaged.

· **Change rotation**

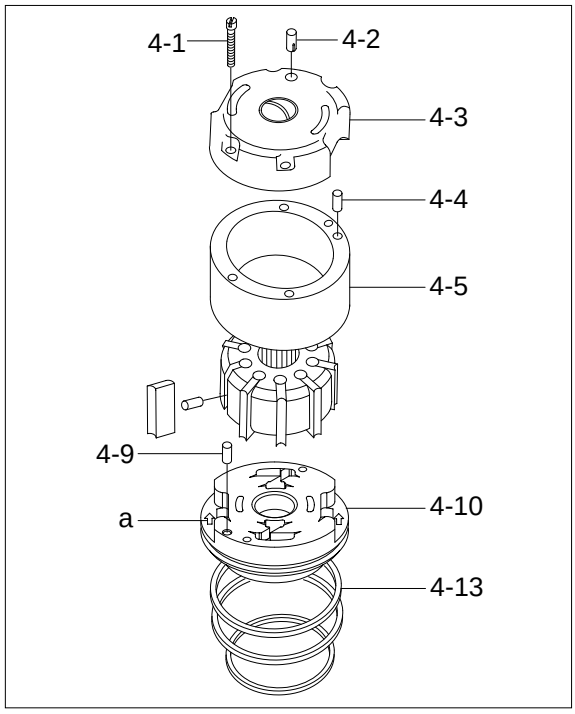
① Proceed as per above for disassembly.

② Save camring(4-5), remove rotor+vanes+pins.

※ Change of rotation requires exchange of port plates.

③ Install carefully rotor+vanes+pins on new pressure plate(4-10).

④ Flip camring from previous position. Then proceed re-assembly as per above, with new rear plate(4-3).

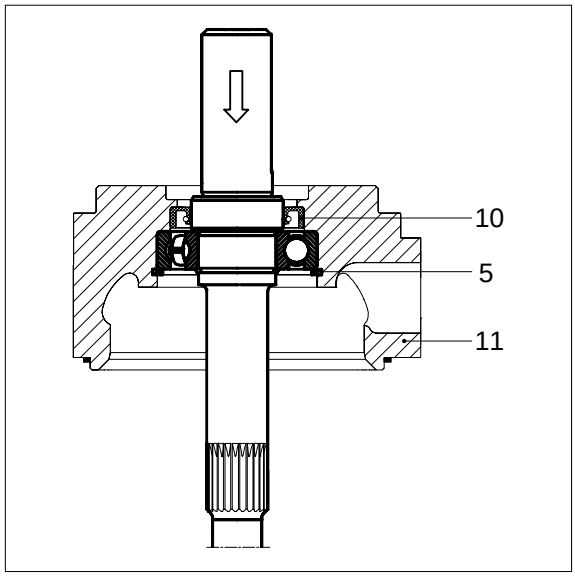



**(3) Shaft assembly replacement**

① Remove circlip (5) from front cap (11).

② Gently tap the shaft end with a plastic tipped hammer to extract the shaft assembly.

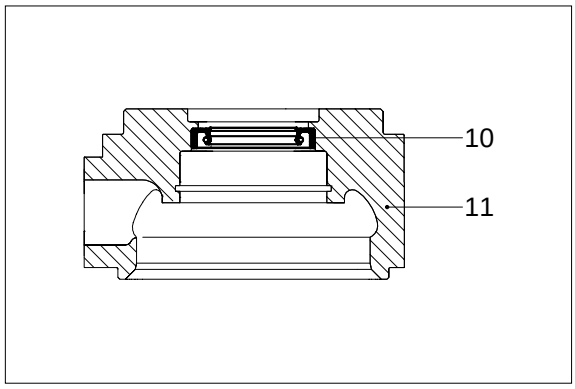
※ Unless pump is new, when changing the shaft assembly always install a new shaft seal(10).




**(4) Shaft seal**

① Remove shaft seal(10) from front cap(11).

※ Removed shaft seal should not be re-used.
It must be disposed of as per local environmental regulation.



**4) ASSEMBLY**

**(1) Pump**

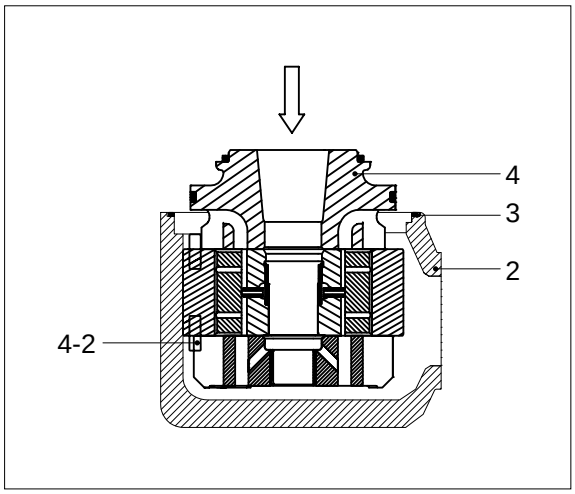
① Securely hold the pump in a vise or similar equipment, at central housing(2) level(light grip).

② Insert cartridge(4) carefully.

※ If not new, seals and backup ring are to be replaced.

※ Make sure the dowel pin(4-2) is properly inserted in the corresponding hole in the housing(2).

③ Install new seal(3) in housing(2).




④ Insert front cap+shaft assembly(A) straight and not tilted. Shaft should go through the cartridge(4) smoothly.

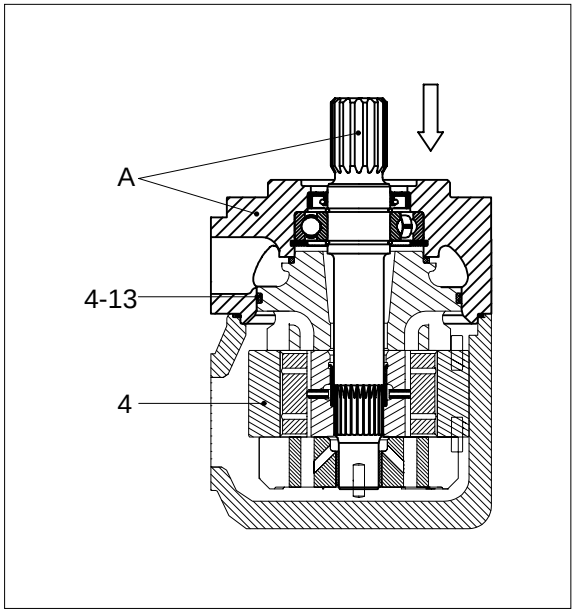
※ When inserting cartridge in frontcap, make sure the white teflon back-up ring (4-13) is not damaged and securely in place.

⑤ Insert the assembly bolts front cap side, then return the pump. Mount rear adapter (not shown).

⑥ · Tighten bolts to the indicated torque.

※ Tightening torque : 19.4kgf · m(140lbf · ft)

Shaft must rotate when turn by hand.



**(3) Shaft seal**

① Install very carefully the shaft seal(10) on the seal driver (B).

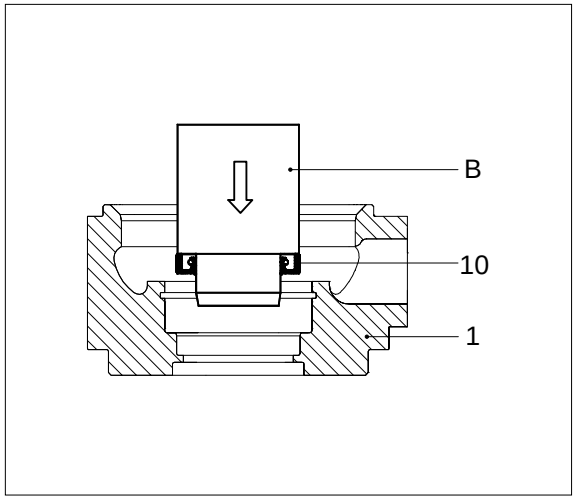
※ Grease the seal driver seal lips(10)

※ damage

② Make sure seal is mounted as per above.

③ With the shaft seal securely installed on the seal driver, insert the shaft seal(10) in the front cap(1).

※ Complete insertion using a constant press load (1020kgf · m [7376lbf · ft] Max). Do not use hammer.




**(2) Shaft assembly**

① Install the protective cone(A) on the shaft end (9). Grease the protective cone external surface.

② Apply small amount of grease on the shaft seal lip(10).

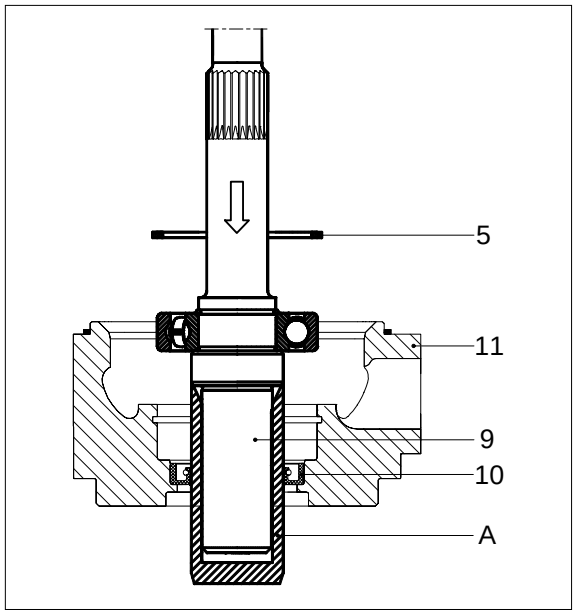
③ Insert very carefully the shaft assembly with protective cone in the front cap(11).

※ Do not damage the seal lips(10).

④ Complete insertion using a constant press load on the bearing outer ring.

※ Do not use hammer.

⑤ Install circlip(5) in front cap(11).



### 5) TROUBLESHOOTING

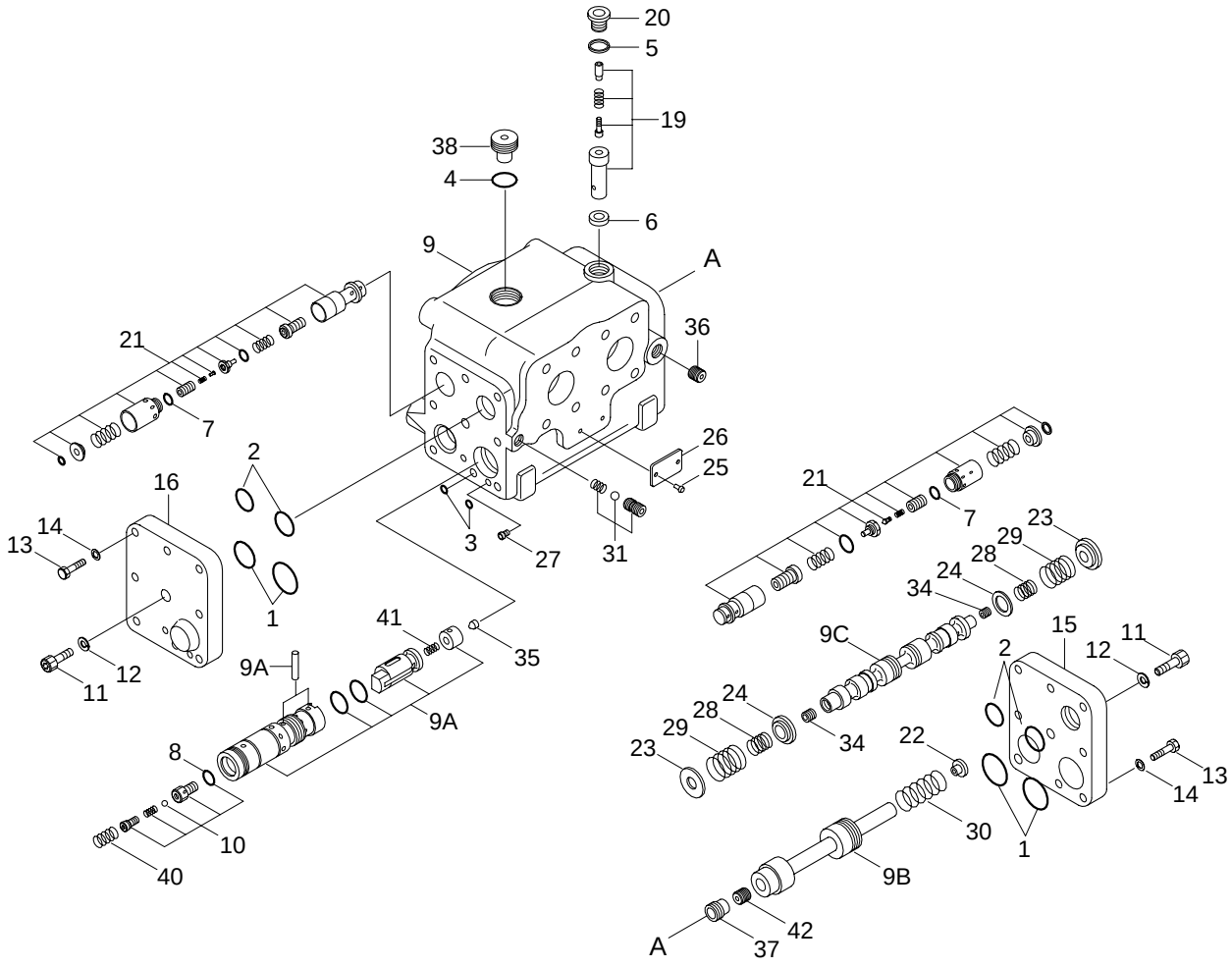
| Problem | Cause | Remedy |
|---|---|---|
| External leakage | Seal failure. | Replace seal. |
| | Porosity in casting | Replace casting. |
| | Damaged or defective seal between housing and mounting cap. | Replace seal. |
| Leakage at fittings | Cracked or damaged flange or fittings. | Replace flange or fittings. |
| | Damaged or defective flange threads. | Replace flange. |
| | Damaged or defective O-ring seal. | Replace O-ring seal. |
| | Burr on mating surfaces. | Remove burr. |
| Loss in pump RPM under load | Power source too small for pump being used. | Provide larger power source.<br>See HP requirements for pump being used. |
| Pump not delivering oil | Pump does not prime. | Bleed air from system. |
| | Wrong direction on shaft rotation. | Reverse direction of shaft.<br>Convert pump to reverse direction of rotation. (Check rotation arrows on ident. plate & cam ring). |
| | Tank fluid level too low. | Add fluid and check level to be certain suction line is submerged (minimum 100mm : 4 inch). |
| | Fluid inlet line or suction strainer clogged or undersized. | Clean strainer of all foreign material.<br>Provide proper size strainer (should have a capacity equal to 2×pump volume in GPM). |
| | Air leak in suction line. | Tighten and seal connections.<br>Replace seals. |
| | Fluid viscosity too heavy to pick up prime at low RPM. | Use lighter viscosity fluid or increase RPM. |
| | Broken pump shaft or internal parts. | Replace damaged parts per overhaul instructions. |
| Pump not developing pressure | Pump do not deliver oil (see above). | |
| | Relief valve setting too low. | Reset relief valve. |
| | Relief valve sticking open. | Check for defective or malfunctioning valve. |
| | Free recirculation of fluid to tank being allowed. | Check directional control valve for open center or neutral position.<br>Check for open for pass valve. |

| Problem | Cause | Remedy |
|---|---|---|
| Noisy or erratic operation | Air leak at pump inlet or suction lines, or at shaft seal due to misalignment. | Check for air leaks by pouring system fluid around joints and listen for change in sound level. Tighten as required. Check for shaft misalignment. |
| | Housing and mounting cap separation. | Check bolts for poor torque. |
| | Restricted or clogged inlet line or strainer. | Provide larger inlet line or strainer. Clean strainer. |
| | Excessive pump RPM (cavitation). | Provide power source that does not exceed maximum pump RPM recommendations. |
| | Aeration in the fluid. | Check for air bubbles in the tank correct this situation with return flow. |
| | Worn vanes, cam ring or port plates. | Disassemble per overhaul instructions and replace worn parts. |
| | Worn bearings. | Disassemble and replace. |
| Seal Failure | Excesive inlet pressure. | Decrease inlet pressure. Inlet pressure must not exceed 0.7 bar (14 psi)*. |

* Except for pump with S5 or HP seals. These must not exceed 7 bar [142 psi] inlet pressure.

## 2. FLOW AMPLIFIER

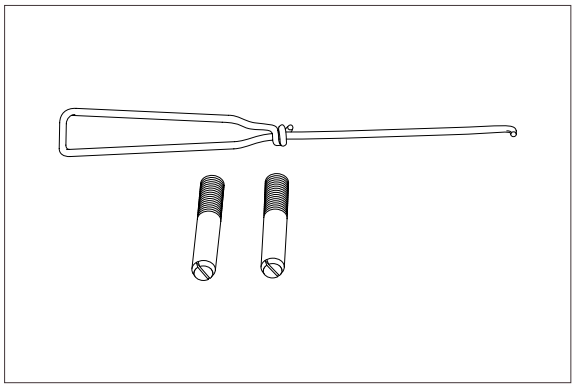
### 1) STRUCTURE



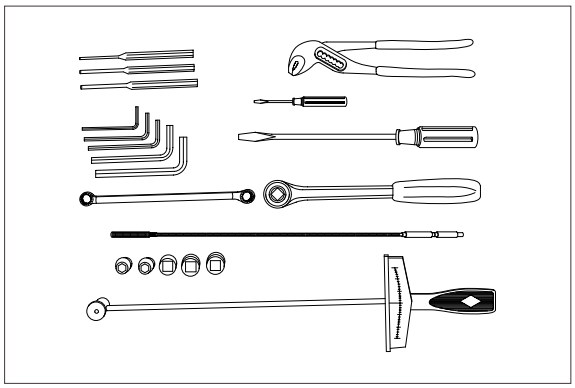

| | | | | | |
|---|---|---|---|---|---|
| 1 | O-ring | 12 | Spring washer | 28 | Spring |
| 2 | O-ring | 13 | Screw | 29 | Spring |
| 3 | O-ring | 14 | Spring washer | 30 | Spring |
| 4 | O-ring | 15 | End cover | 31 | Throttle check valve |
| 5 | Washer | 16 | End cover | 34 | Orifice |
| 6 | Washer | 19 | Relief valve | 35 | Orifice |
| 7 | O-ring | 20 | Plug | 36 | Orifice |
| 8 | O-ring | 21 | Shock, suction valve | 37 | Plug |
| 9 | Housing | 22 | Spring seat | 38 | Plug |
| 9A | Amplifier valve | 23 | Spring seat | 40 | Spring |
| 9B | Priority valve | 24 | Spring seat | 41 | Spring |
| 9C | Directional valve | 25 | Drive screw | 42 | Orifice |
| 10 | Check valve | 26 | Name plate | | |
| 11 | Screw | 27 | Orifice | | |

**2) TOOLS**

- Guide screws : M8×1.0
- Hook : Wire



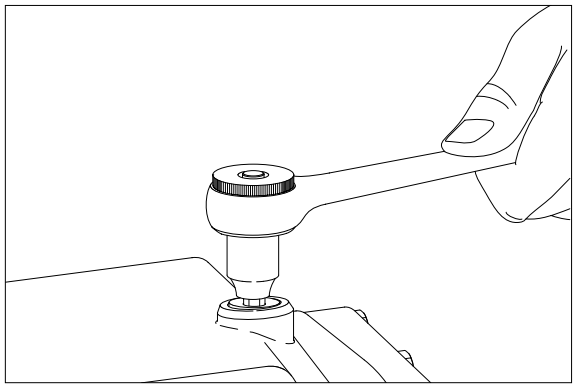
- Hexagon keys : 4, 5, 6, 8 and 10mm
- Ratchet for socket spanners
- Hex socket for external : 13, 17 & 19mm
- Hex socket for internal : 8 & 10mm
- Multigrip pliers
- Ring spanner : 13mm
- Screwdrivers : 3 and 10mm
- Steel Mandrels : 3, 5 and 8mm
- Torque wrench : 12.2kgf · m(88lbf · ft)
- Magnetic rod



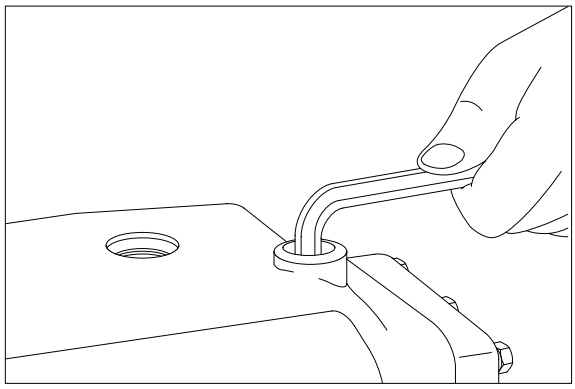
### 3) DISASSEMBLY

**(1) Removing pressure relief valve**

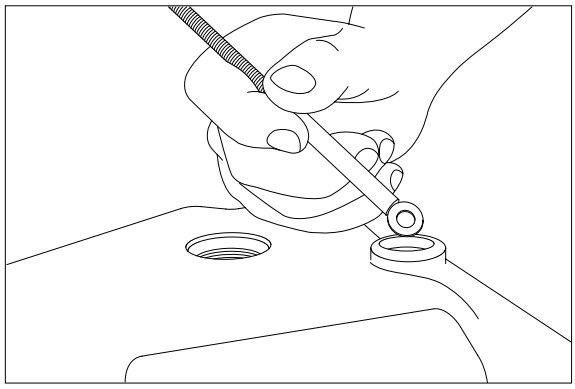
① Unscrew plug with washer (Hexagon socket for 8㎜ internal hexagon).



② Screw pressure relief valve out(10㎜ hexagon key).

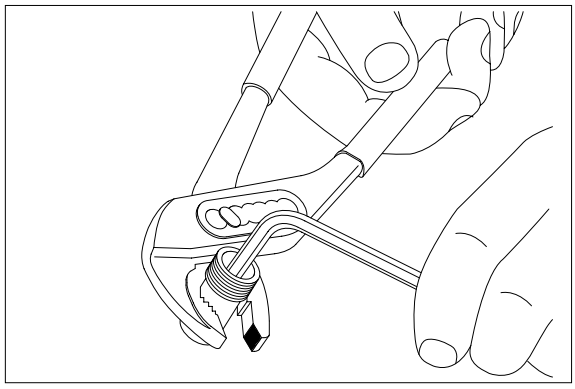


③ Take out washer(Magnetic rod).

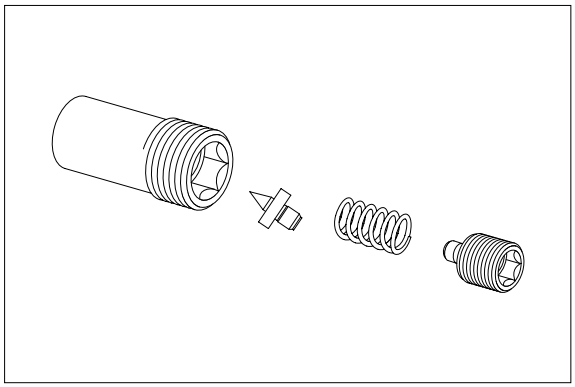


**(2) Disassembly pressure relief valve**

① Hold cartridge(Multigrip pliers) and screw the adjustment screw out(5㎜ hexagon key).

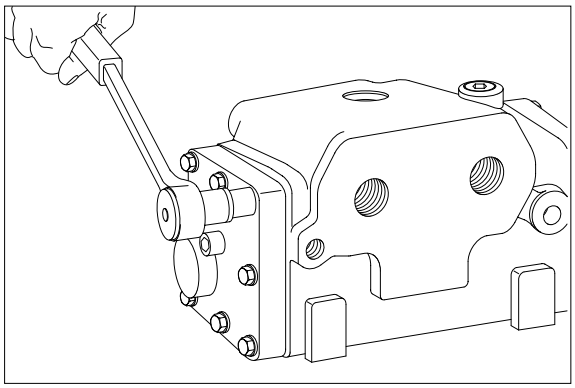


② Pressure relief valve shown disassembled.

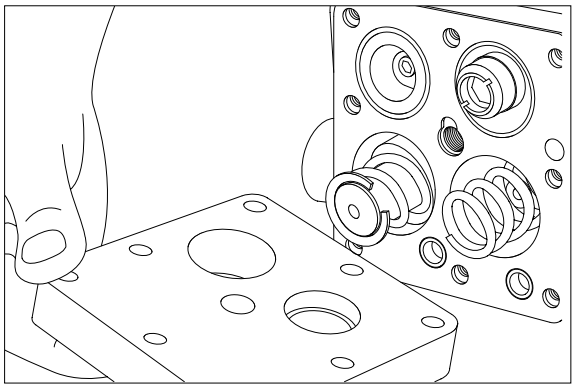


**(3) Removing end cover at PP-connection**

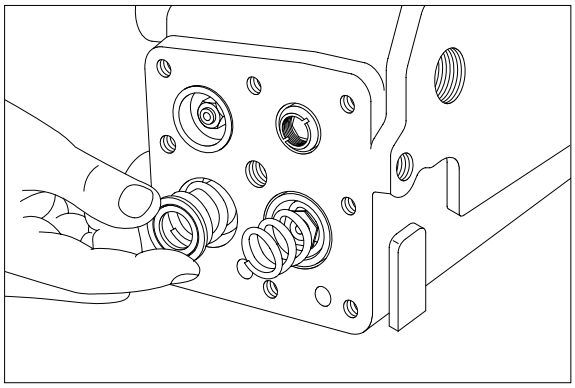
① Unscrew screws with spring washer using hexagon socket for 13㎜ external hexagon and 10㎜ internal hexagon.



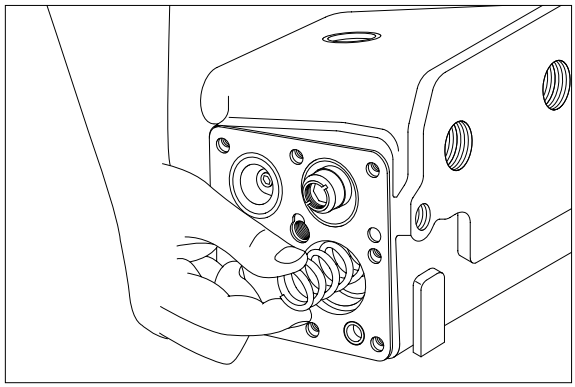
② Remove end cover.



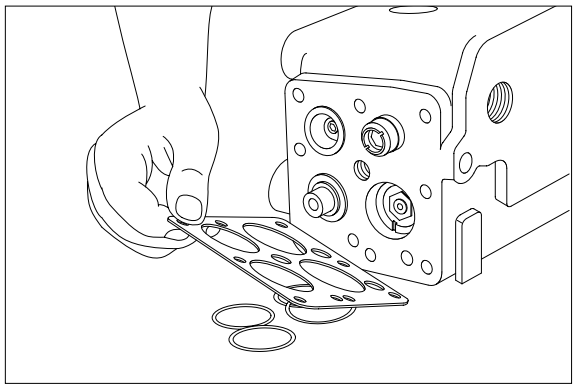
③ Remove stop and 2 springs.



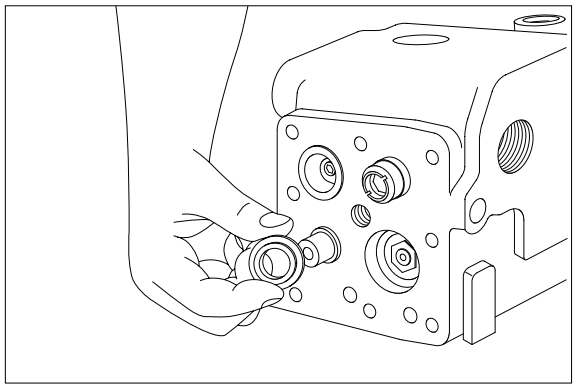
④ Remove spring.



⑤ Remove plate and 6 O-rings.

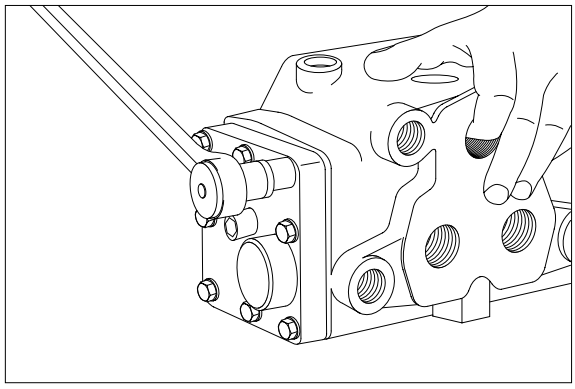


⑥ Remove spring guide.

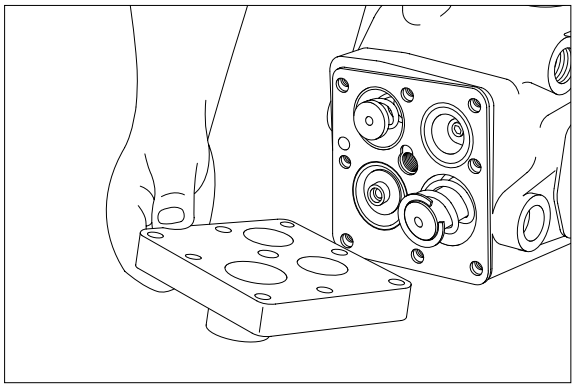


**(4) Removing end cover at LS-connection**

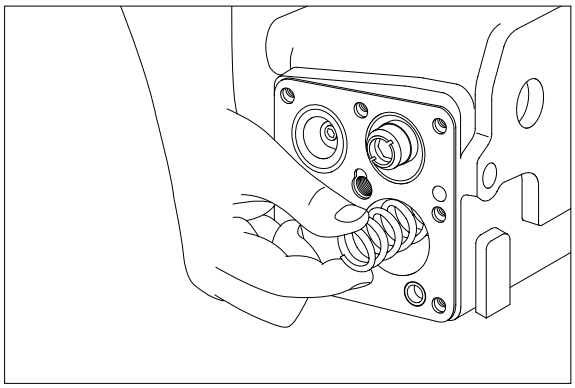
① Unscrew screws with spring washer using hexagon socket for 13㎜ external hexagon and 10㎜ internal hexagon.



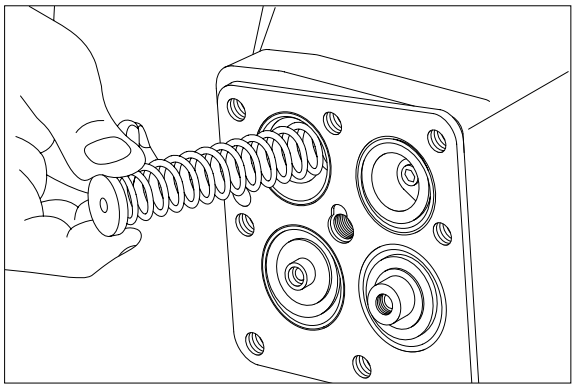
② Remove end cover.



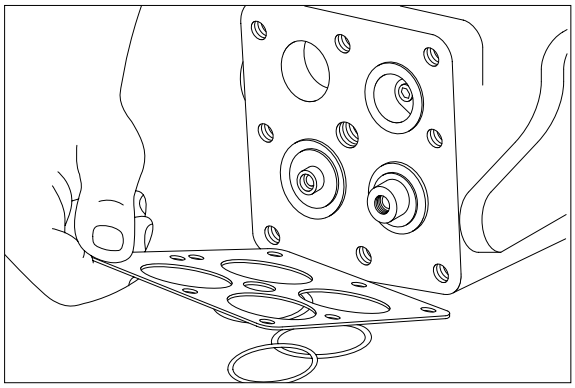
③ Remove stop and 2 springs.



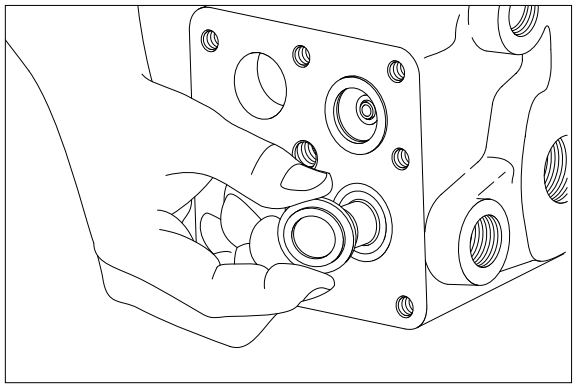
④ Remove stop and spring.



⑤ Remove plate and 4 O-rings.

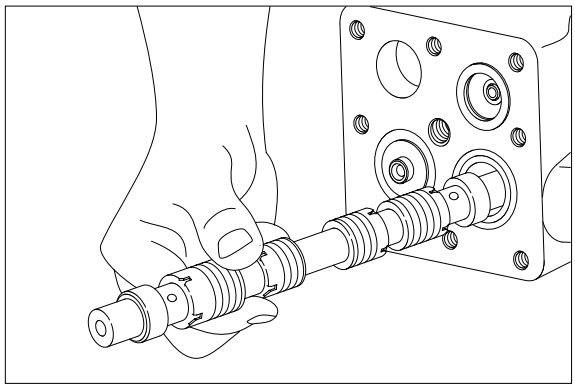


⑥ Remove spring guide.

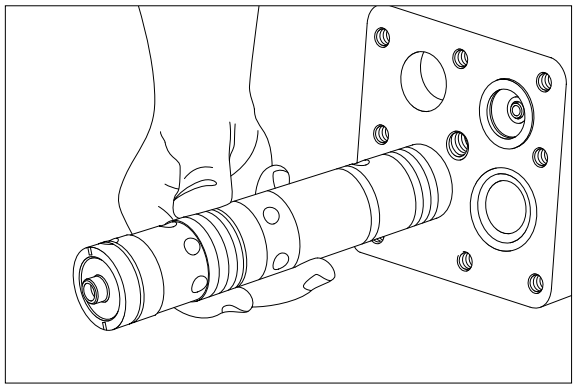


**(5) Removing spools**

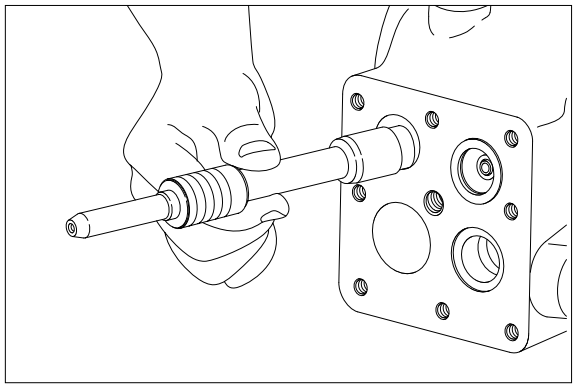
① Remove directional spool.



② Remove amplifier spool.

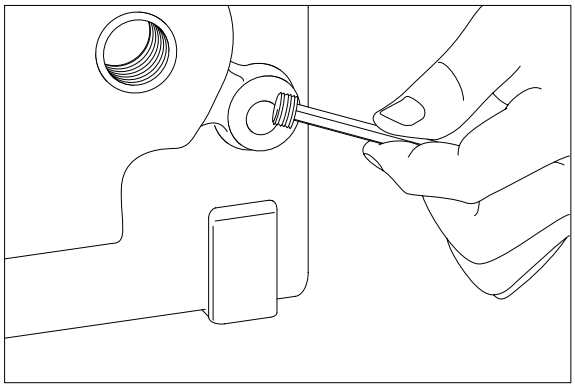


③ Remove priority valve spool.

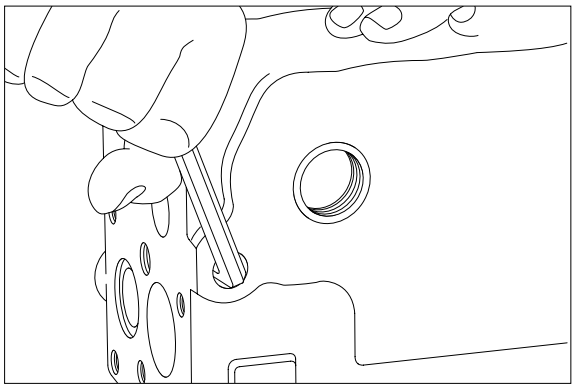


**(6) Removing orifices and throttle check valve**

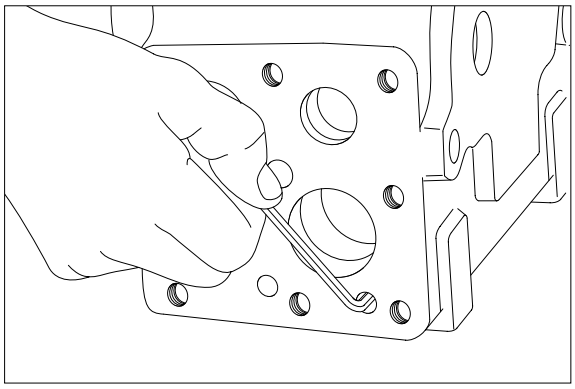
① Unscrew orifice in LS-connection with 6㎜ hexagon key.



② Unscrew throttle check valve in PP-connection with 6㎜ hexagon key.

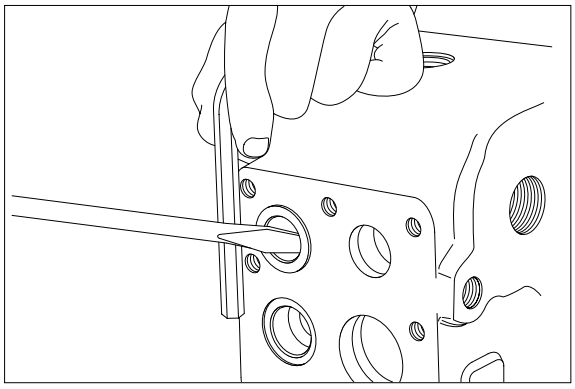


③ Unscrew orifice in housing with 4㎜ hexagon key.



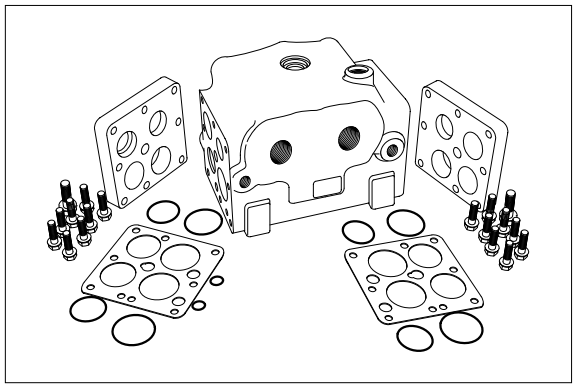
**(7) Removing shock valves**

① Remove shock valve with screwdriver and hexagon key.

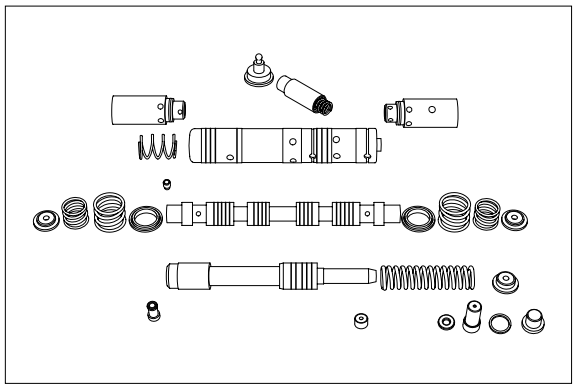


**(8) Overview of disassembled parts**

① Housing and end cover with accessories.

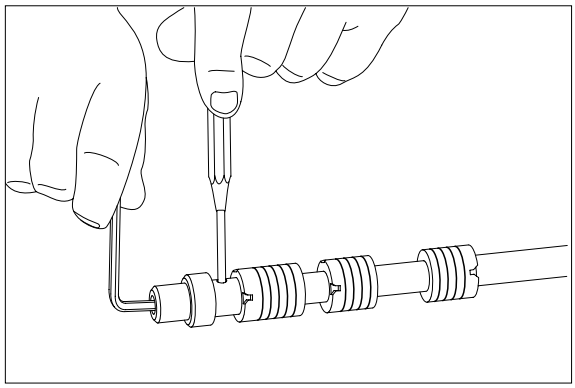


② Spool with accessories.

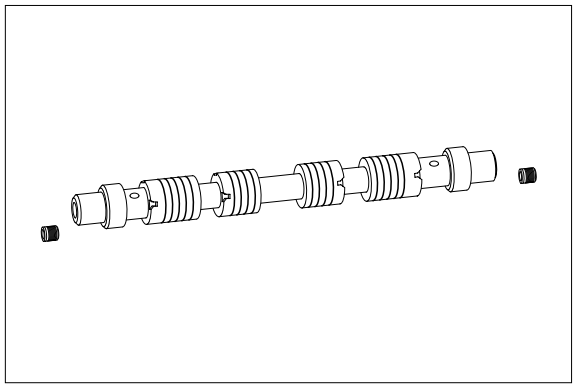


**(9) Disassembly of directional spool**

① Unscrew orifice with 4㎜ hexagon key.
Use a mandrel.

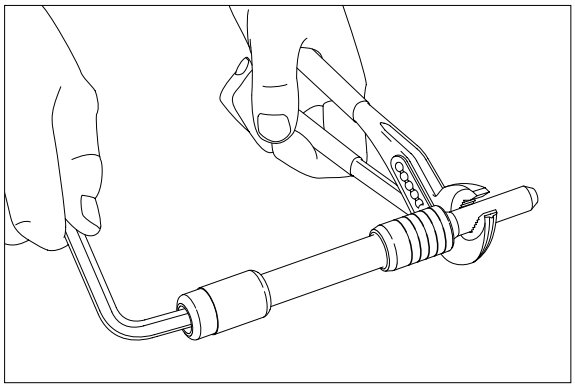


② Directional spool shown disassembled.

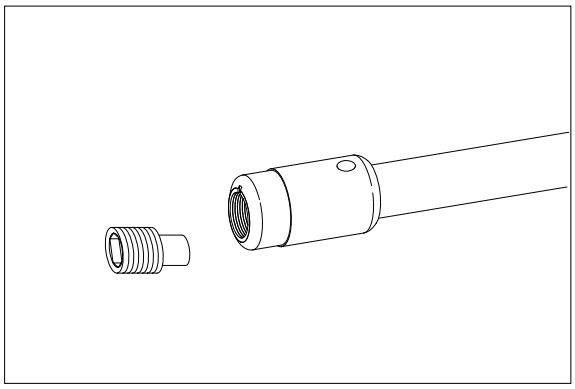


**(10) Disassembly of priority valve spool**

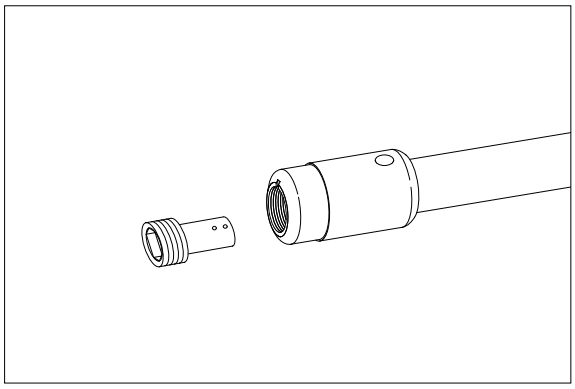
① Unscrew plug or throttle check valve with 8㎜ hexagon key.



② Priority valve spool with plug for external PP shown disassembled.



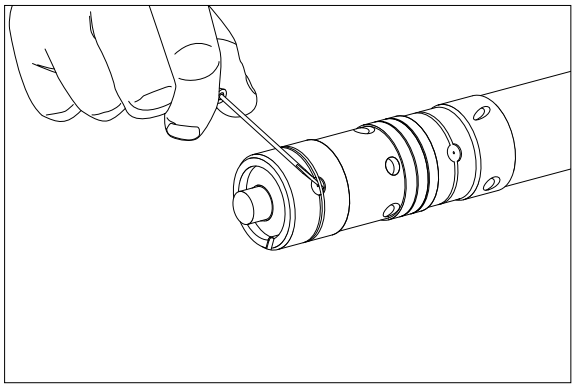
③ Priority valve spool with throttle check valve for internal PP shown disassembled.



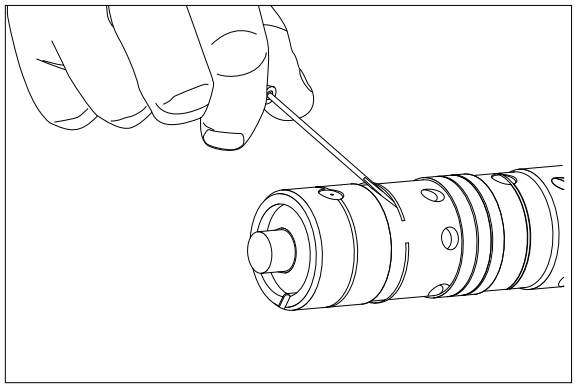
**(11) Disassembly of amplifier spool**

① Carefully remove the spring ring from the recess with 3㎜ screwdriver.

※ Avoid damage to the spring ring.

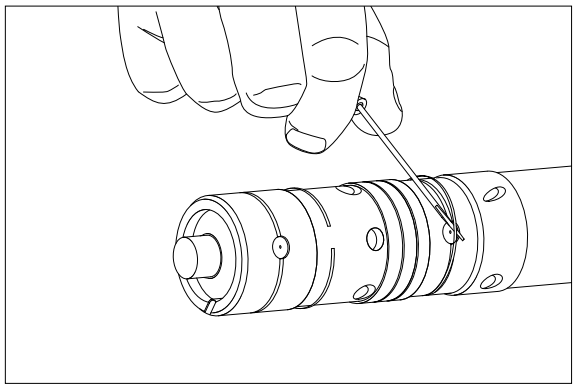


② Carefully guide the spring ring back.

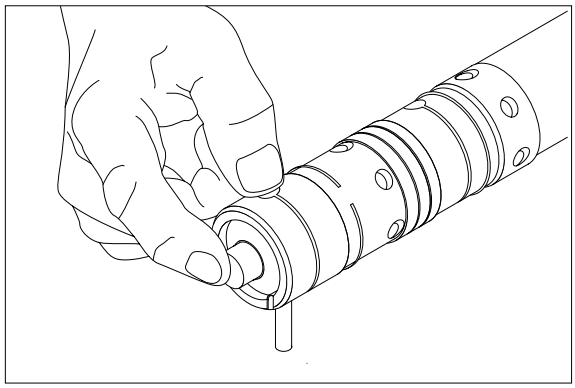


③ Carefully take the spring ring from the recess and guide it back with 3㎜ screwdriver.

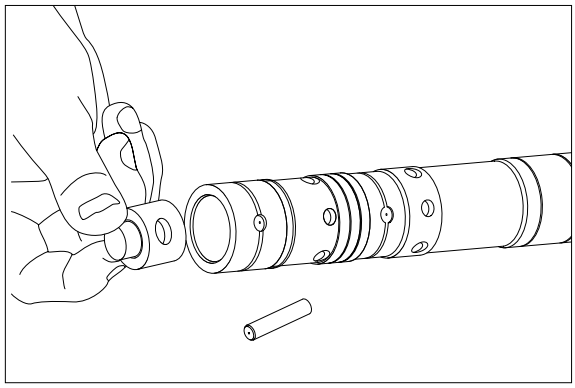
※ Avoid damage to the spring ring.



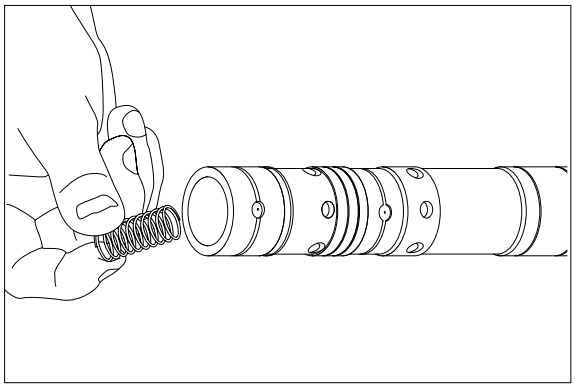
④ Press pin out gently with finger.



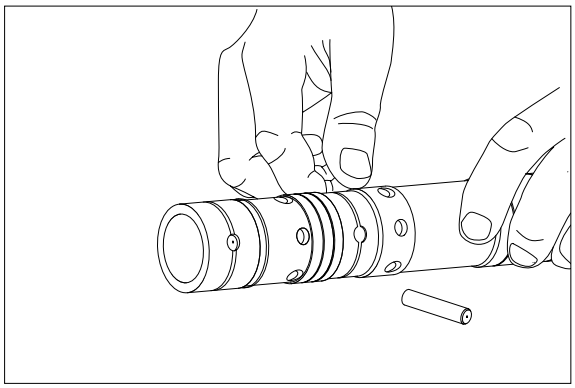
⑤ Take out plug.



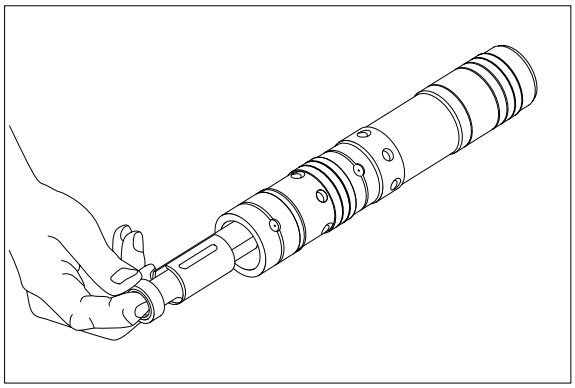
⑥ Take out spring.



⑦ Take out pin 3㎜ screwdriver.

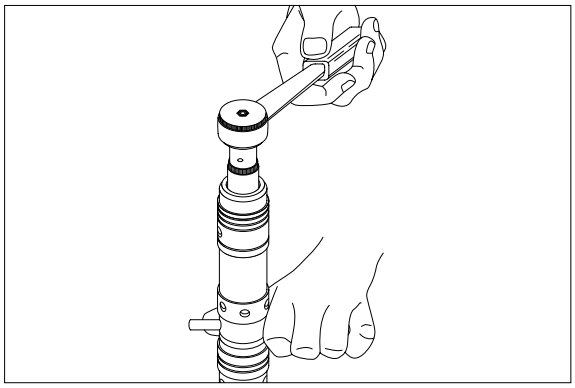


⑧ Take out inner spool.

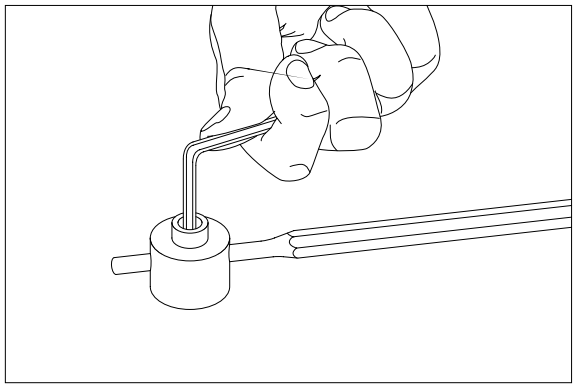


⑨ Unscrew check valve with hexagon socket for 17㎜ external hexagon and mandrel in the pin hole.

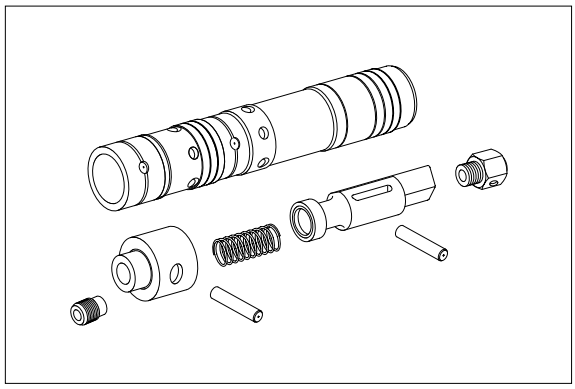
※ Avoid damaging the spool surface.



⑩ Unscrew orifice out of plug with 4mm hexagon key. Use a mandrel.

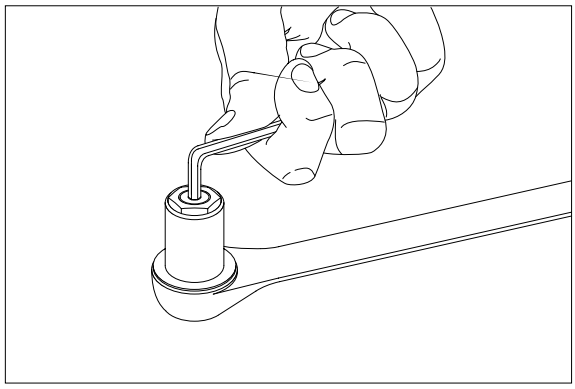


⑪ Amplifier spool shown disassembled.

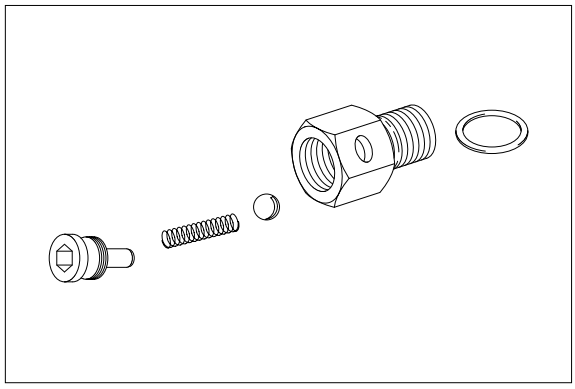


**(12) Disassembly of check valve**

① Unscrew plug with 4mm hexagon key and hexagon socket for 17mm external hexagon.



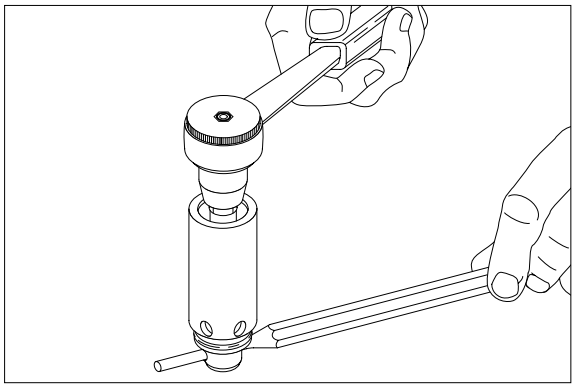
② Check valve shown disassembled.



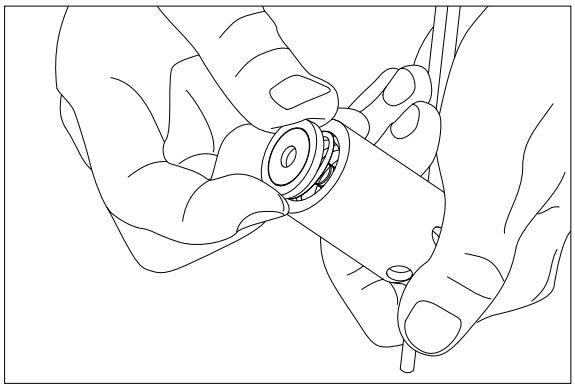
**(13) Disassembly of shock valve / suction valve**

① Unscrew locknut with hexagon socket for 13㎜ external hexagon. Use a mandrel.

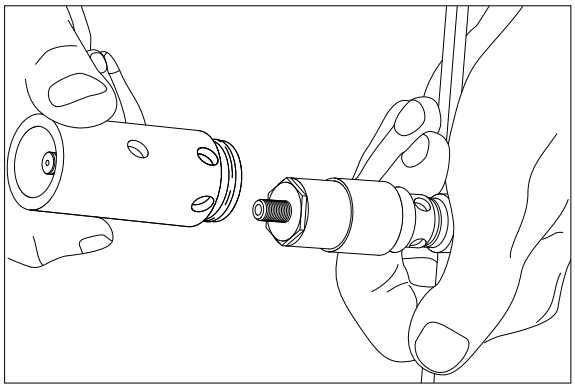
※ When readjusting shock valve hold locknut with 13㎜ ring spanner.



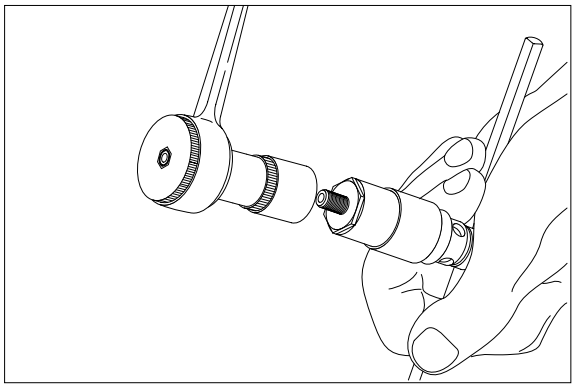
② Take out disc and spring.



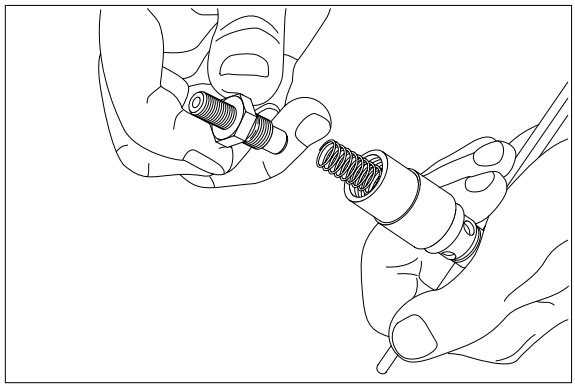
③ Take off housing.



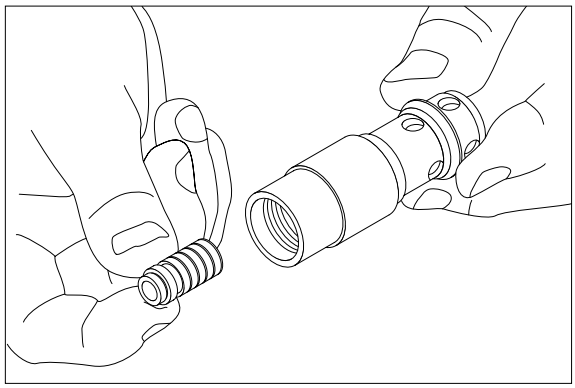
④ Unscrew pilot valve with hexagon socket for 19㎜ external hexagon. Use a mandrel.



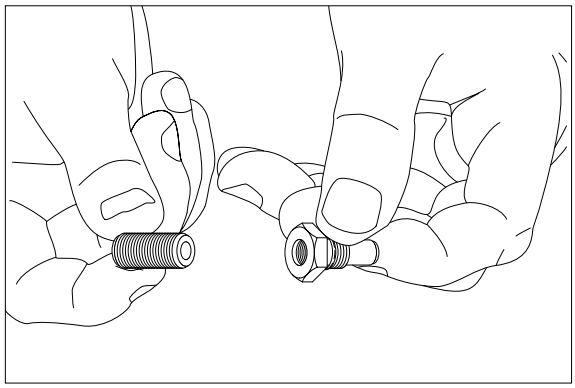
⑤ Take out pilot valve and spring.



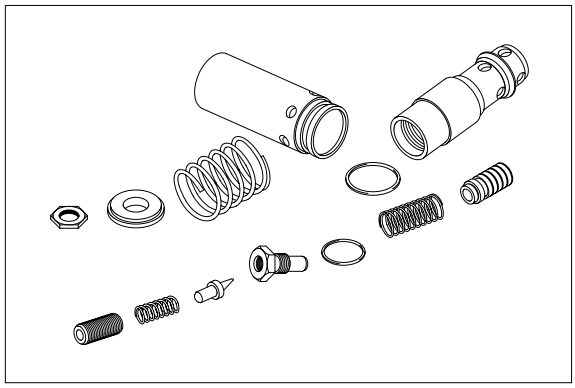
⑥ Take out spool.



⑦ Unscrew adjustment screw and take out spring and ball.



⑧ Shock valve/suction valve shown disassembled.



※ **Cleaning**

Clean all parts carefully with low aromatic kerosene.

※ **Inspection and replacement**

Replace all gaskets and sealing washers. Check all other parts carefully and replace if necessary.

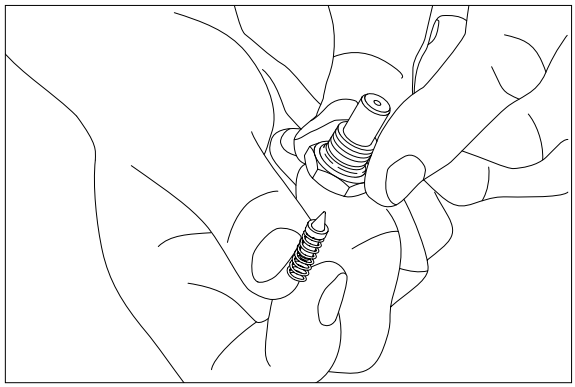
※ **Lubrication**

Before assembly, lubricate all parts with hydraulic oil.

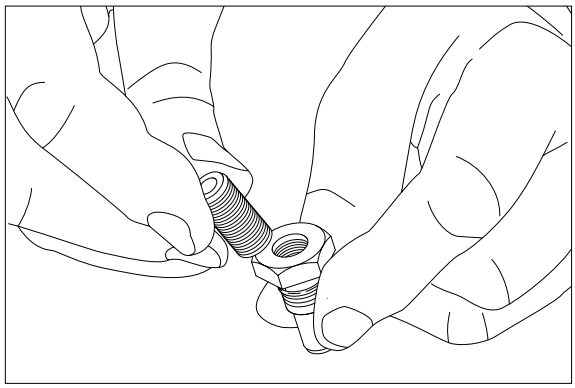
**4) ASSEMBLY**

**(1) Assembly of shock valve / suction valve**

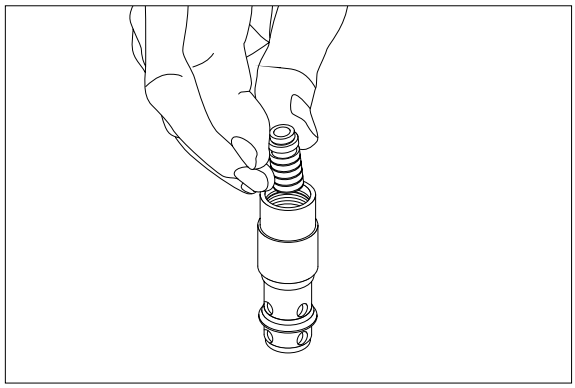
① Guide spring with cone into housing.



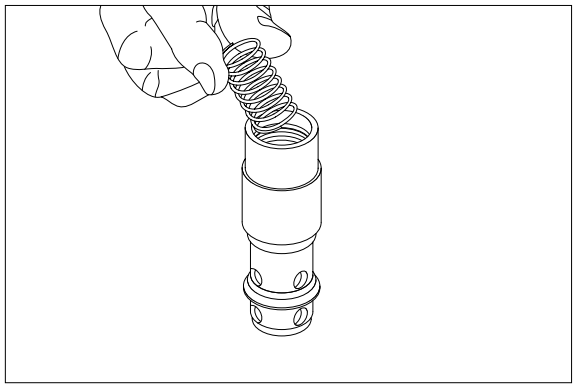
② Fit adjustment screw.



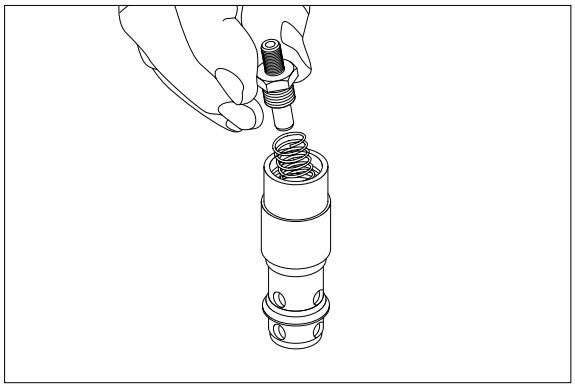
③ Fit spool.



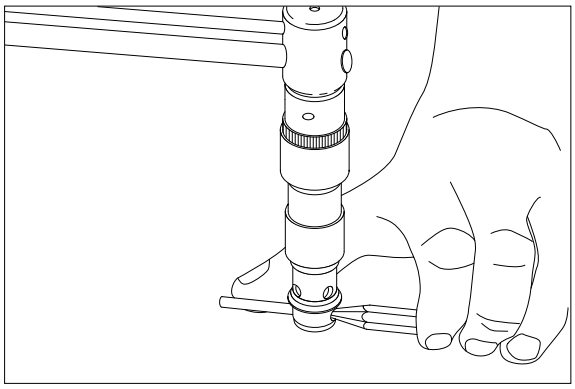
④ Fit spring.



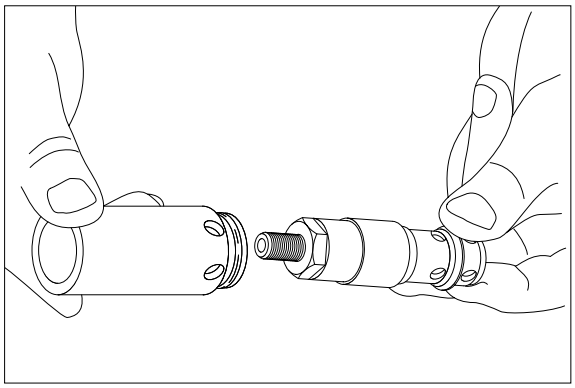
⑤ Fit pilot valve.
Remember O-ring.



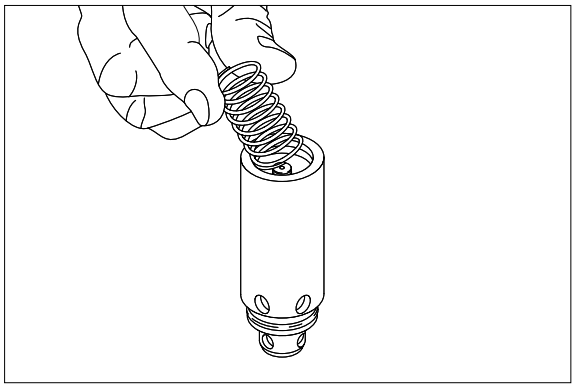
⑥ Tighten with torque wrench for 19㎜ external hexagon. Use a mandrel.
· Tightening torque : 2 ± 0.5kgf · m
(14.5 ± 3.6lbf · ft)



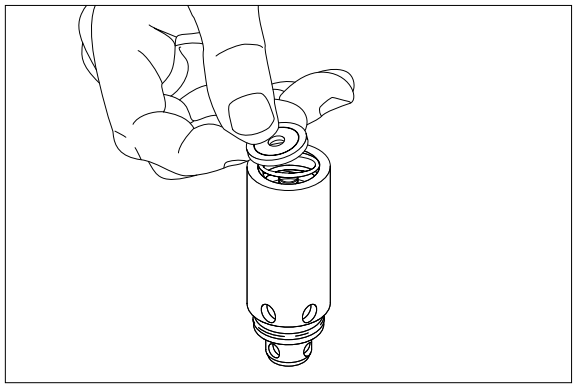
⑦ Fit housing.



⑧ Fit spring.

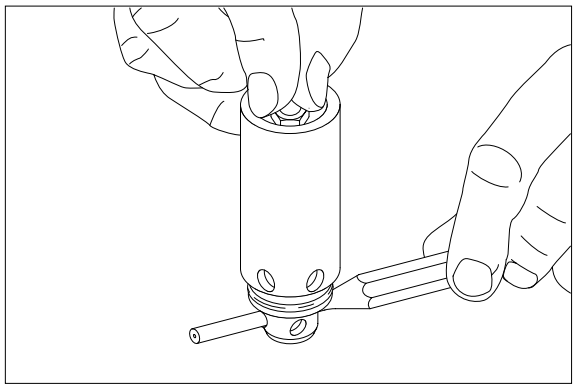


⑨ Fit disc.



⑩ Fit locknut.

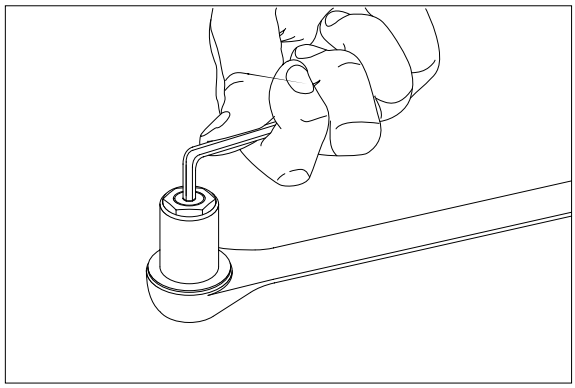
· Tightening torque : 1.5 ± 0.2kgf · m
(10.8 ± 1.4lbf · ft)



**(2) Assembly of check valve**

① Fit ball, spring and plug.

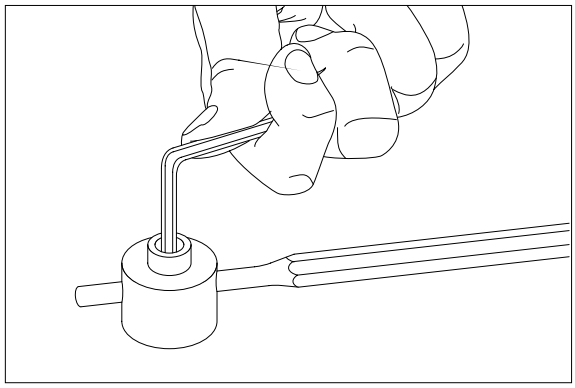
· Tightening torque : 0.5 ± 0.1kgf · m
(3.6 ± 0.7lbf · ft)



**(3) Assembly of amplifier spool**

① Fit orifice in plug.

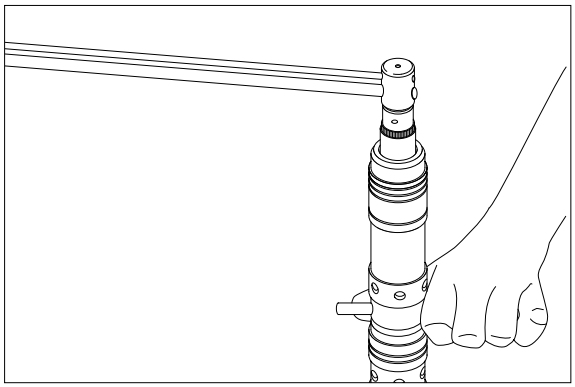
· Tightening torque : 0.5 ± 0.1kgf · m
(3.6 ± 0.7lbf · ft)



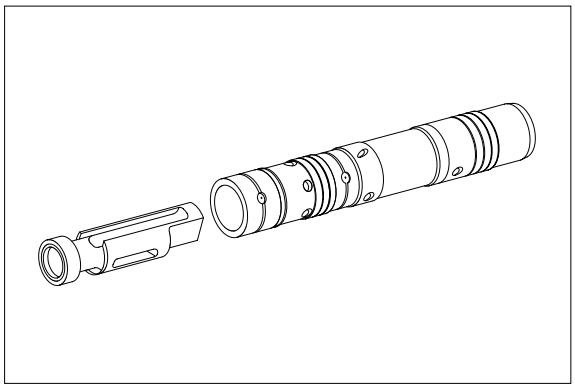
② Fit check valve.

· Tightening torque : 2 ± 0.3kgf · m
(14.5 ± 2.2lbf · ft)

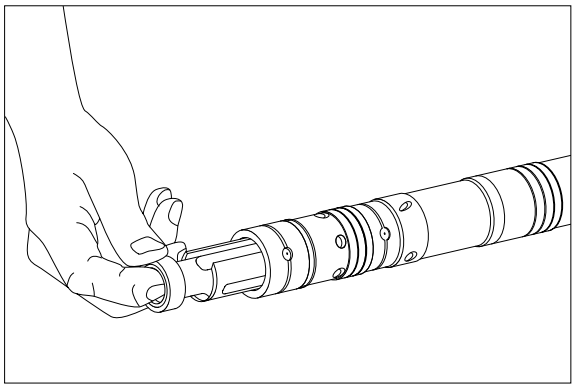
※ Avoid damaging spool surface.
Remember O-ring.



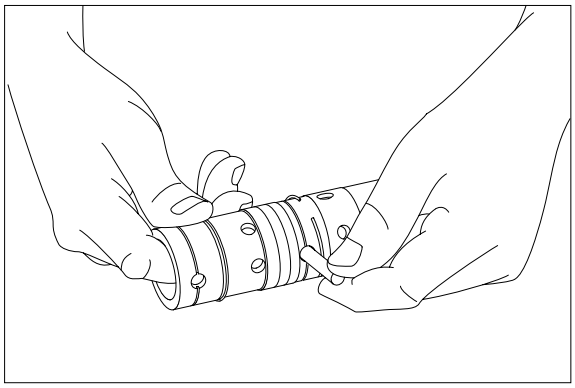
③ Place inner spool in the correct position.



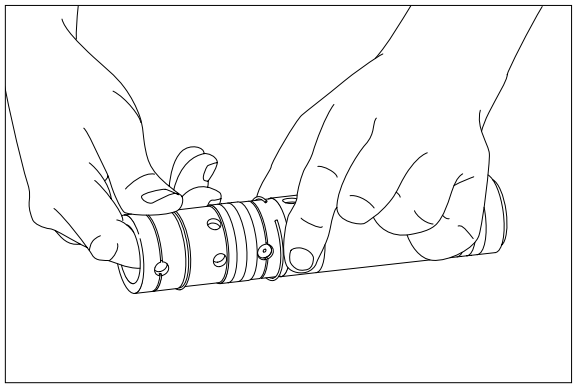
④ Guide inner spool in.



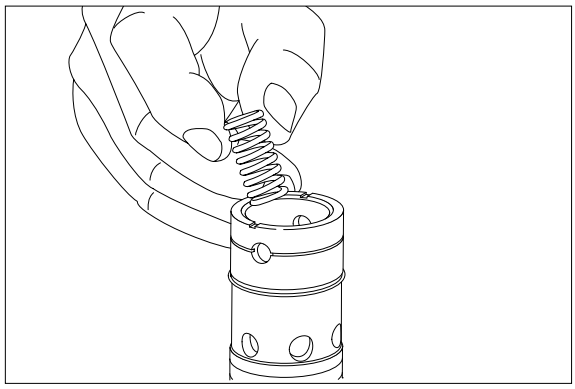
⑤ Fit pin.



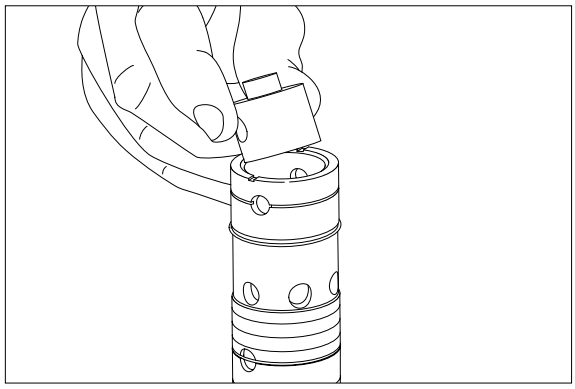
⑥ Push spring ring into position. Place spring ring into the recess with ends facing away from pin holes.



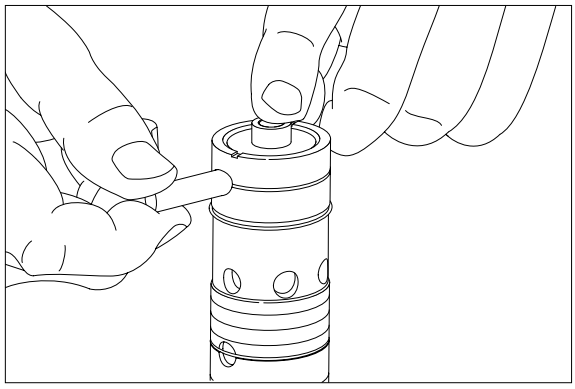
⑦ Fit spring.



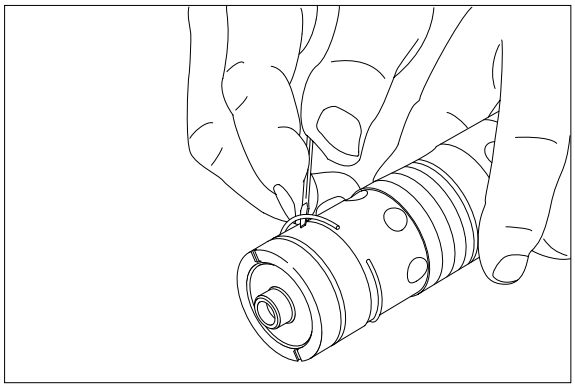
⑧ Fit plug.



⑨ Fit pin.



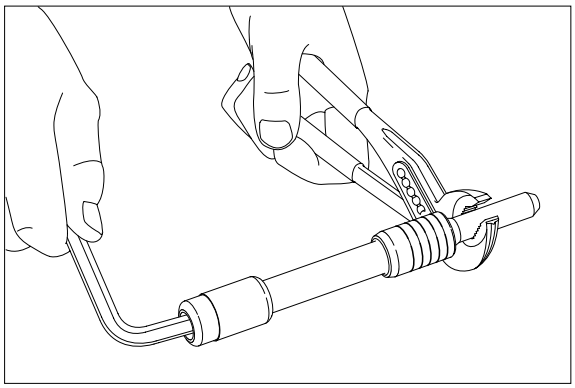
⑩ Push spring ring into position. Place spring ring into the recess with ends facing away from pin holes.



**(4) Assembly of priority valve spool**

① Fit plug or throttle check valve.
External PP : Plug.
Internal PP : Throttle check valve.

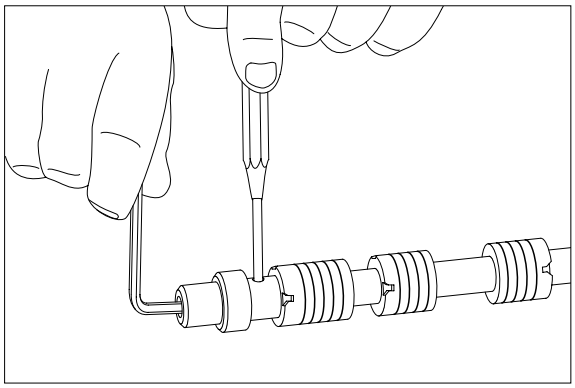
· Tightening torque : 1 ± 0.3kgf · m
(7.2 ± 2.2lbf · ft)



**(5) Assembly of directional spool**

① Screw in orifice.

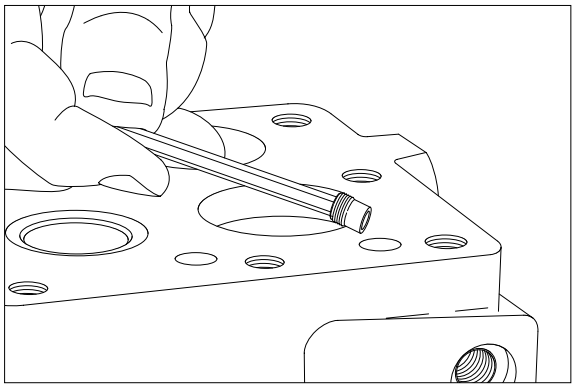
· Tightening torque : 0.5 ± 0.1kgf · m
(3.6 ± 0.7lbf · ft)



**(6) Installation of orifice and throttle check valve**

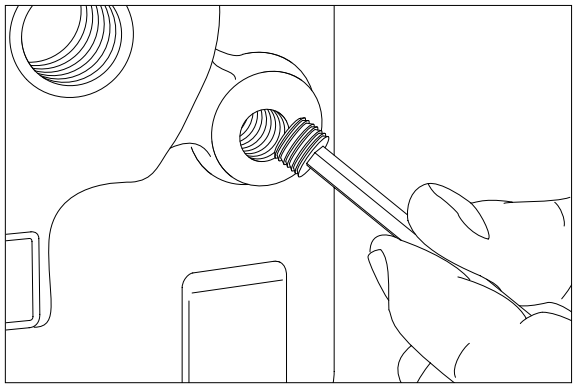
① Fit orifice in housing.

· Tightening torque : 0.5 ± 0.1kgf · m
(3.6 ± 0.7lbf · ft)



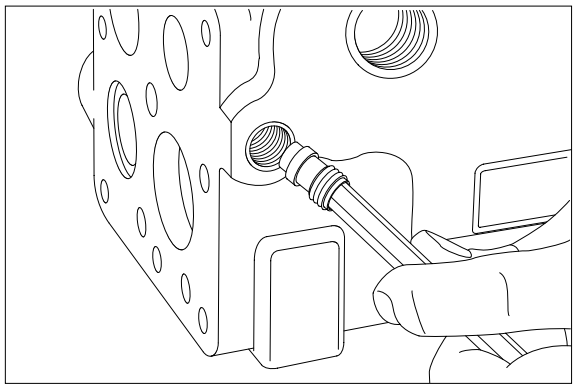
② Fit orifice in LS - connection.

· Tightening torque : 1 ± 0.3kgf · m
(7.2 ± 2.2lbf · ft)



③ Fit throttle check valve in PP - connection.

· Tightening torque : 1 ± 0.3kgf · m
(7.2 ± 2.2lbf · ft)



※ Comments on flow amplifiers with internal PP :

1. 1/4 BSP. F in PP - connection.
Fit washer and plug.

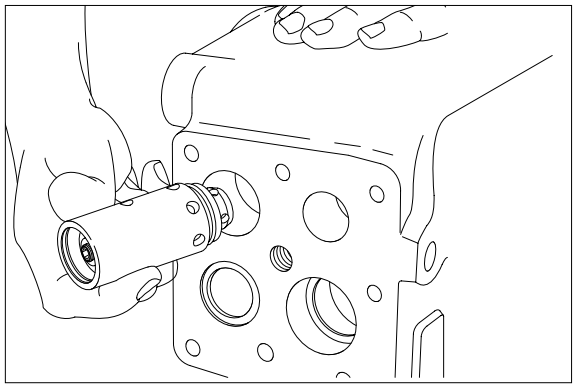
· Tightening torque : 4.1 ± 0.3kgf · m
(29.7 ± 2.2lbf · ft)

2. 7/16 - 20 UNF in PP - connection.
Fit O-ring and plug.

· Tightening torque : 1.5 ± 0.5kgf · m
(10.8 ± 3.6lbf · ft)

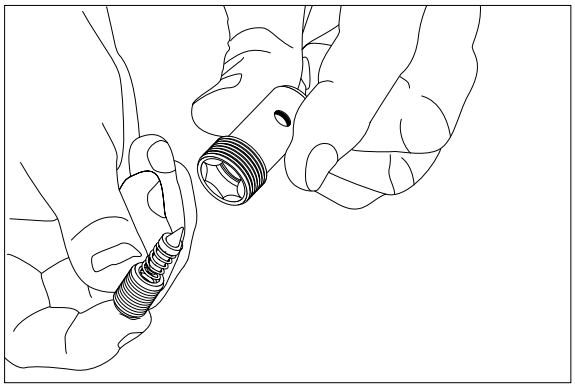
**(7) Installation of shock valves**

① Guide shock valve in and secure it by hand.
Remember O-ring.

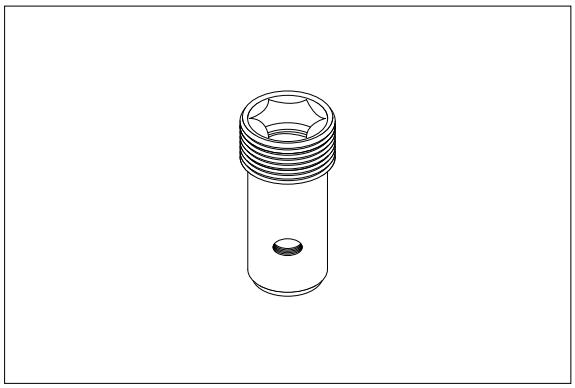


**(8) Assembly of pressure relief valve**

① Guide adjustment screw, spring and cone up into the cartridge.

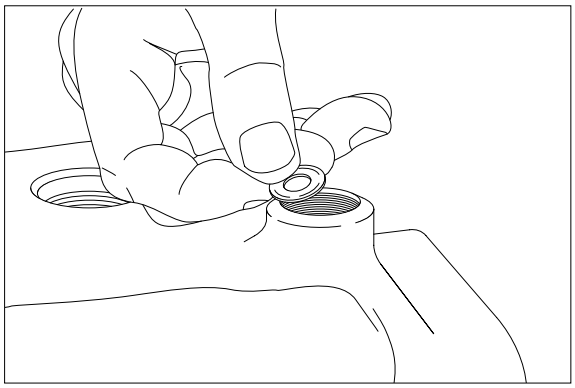


② Screw the adjustment screw so far in that the 10㎜ hexagon key fully engages.



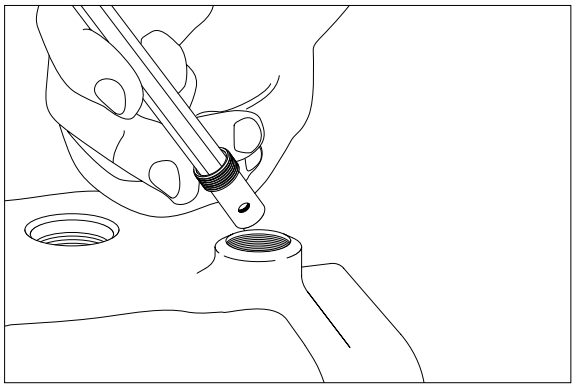
**(9) Installation of pressure relief valve**

① Let the washer drop into the hole.



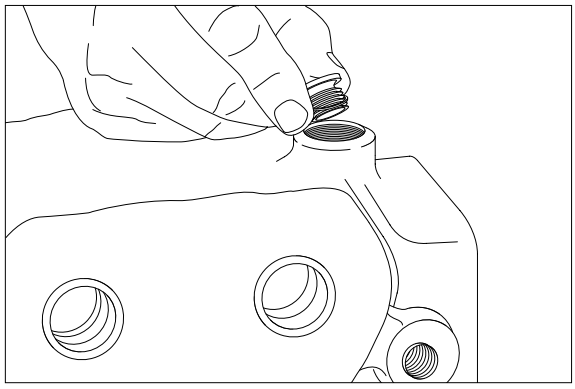
② Fit pressure relief valve.

· Tightening torque : 3.1 ± 0.3kgf · m
(22.4 ± 2.2lbf · ft)



③ Fit plug with washer.

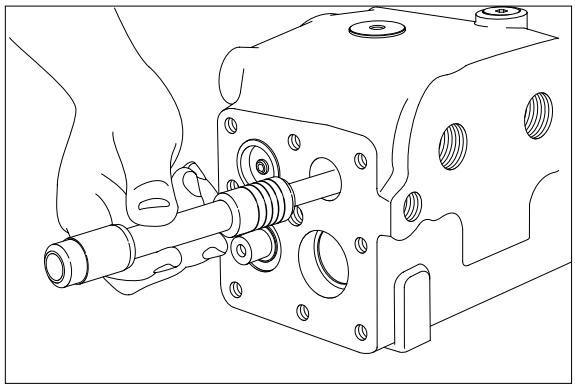
· Tightening torque : 6 ± 0.5kgf · m
(44.1 ± 3.6lbf · ft)



**(10)Installation of spools**

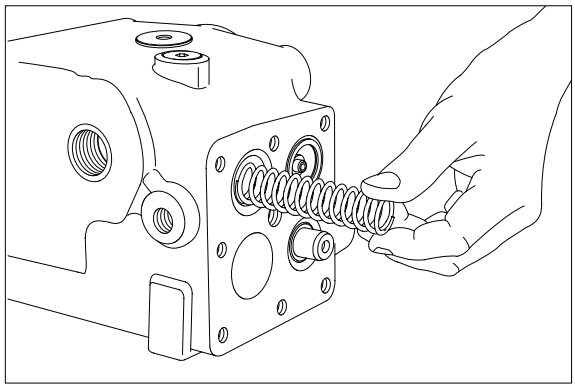
① Fit directional spool.
Fit priority valve spool.

※ Spring control must be placed in correct position against LS - connection.



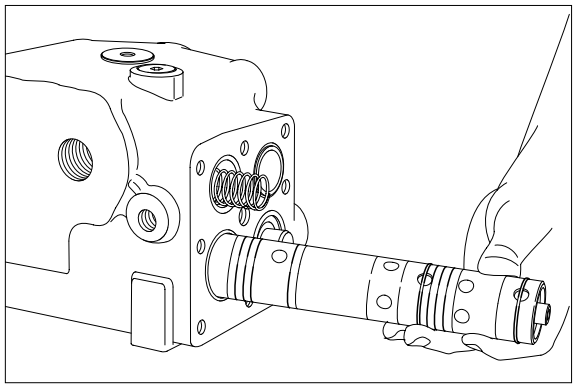
② Fit spring.

※ Spring must be by the LS - connection.



③ Fit amplifier spool.

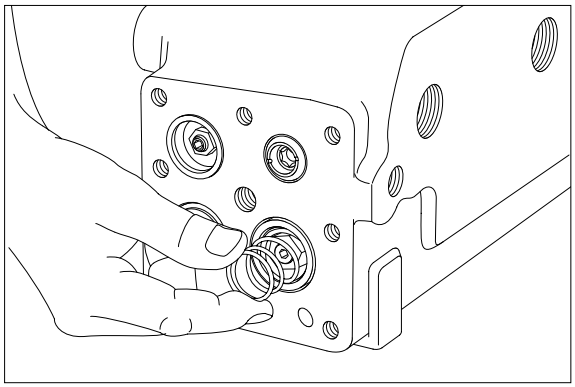
※ The orifice must be placed in correct position against LS - connection.



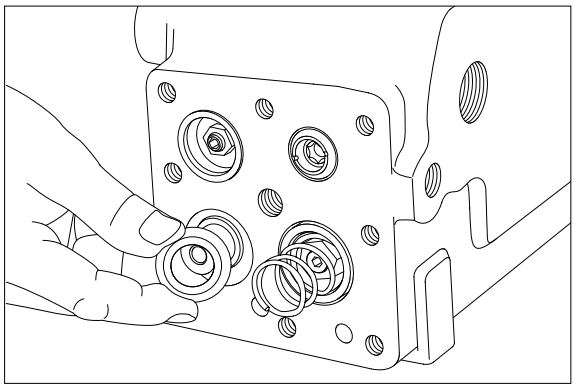
**(11) Installation of end cover at PP - connection**

① Fit spring with vaseline on amplifier spool.

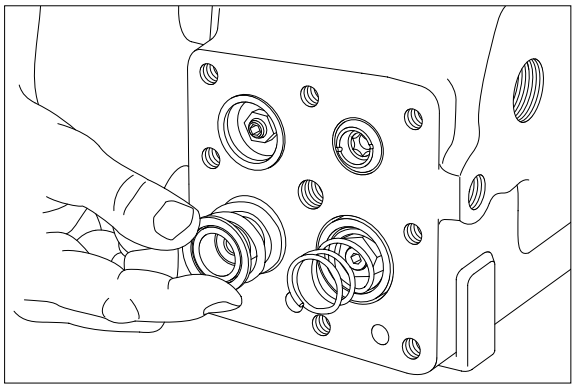
※ The spring must be fitted at the PP - connection.



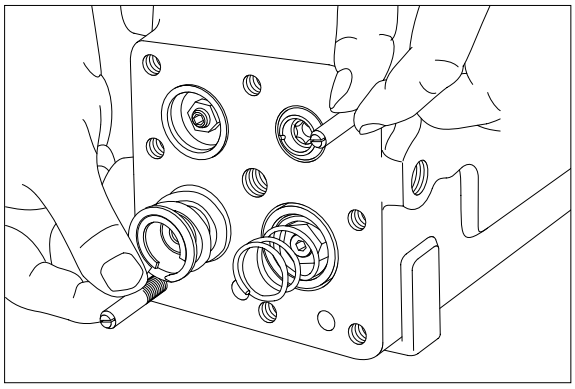
② Fit spring guide with vaseline.



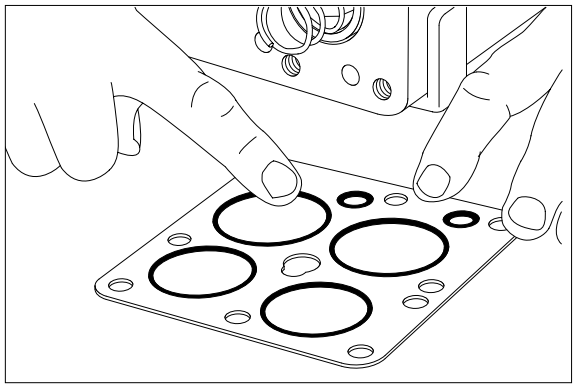
③ Fit large and small springs with vaseline.



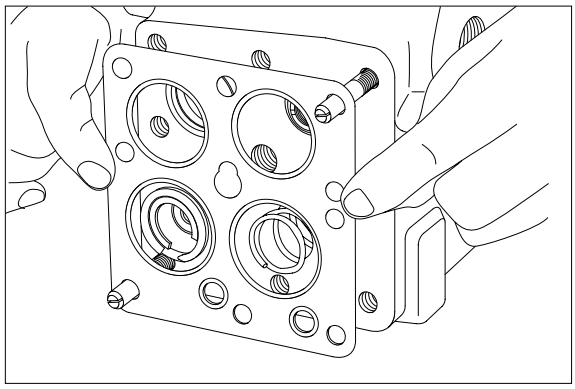
④ Fit guide screws.



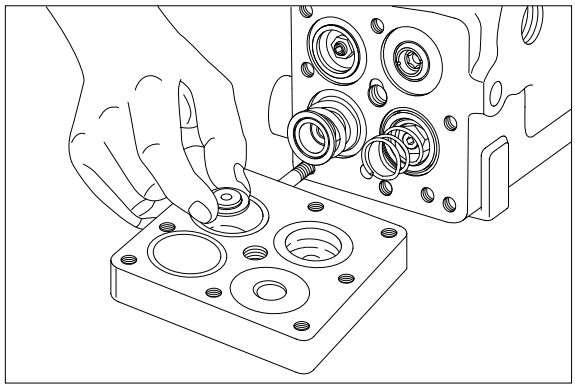
⑤ Fit 4 large and 2 small O-rings.



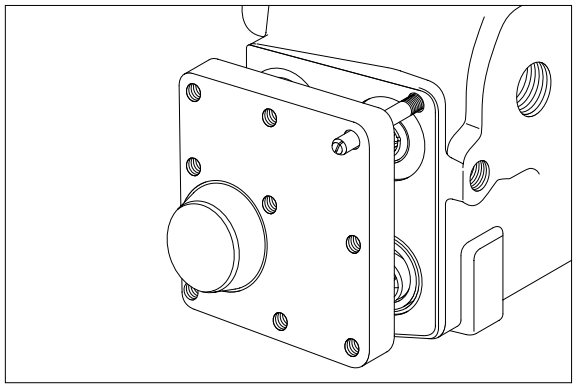
⑥ Guide plate in.



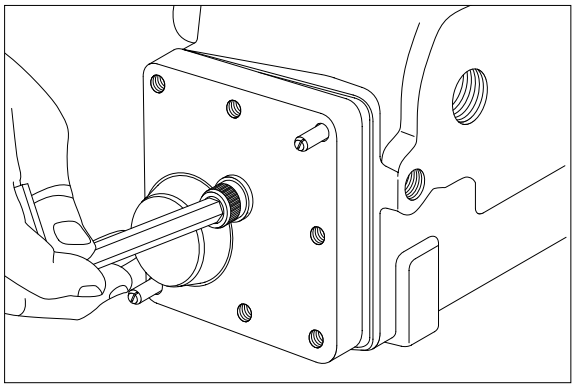
⑦ Fit stop(Thickness : 5㎜) in end cover with vaseline.



⑧ Guide end cover in.



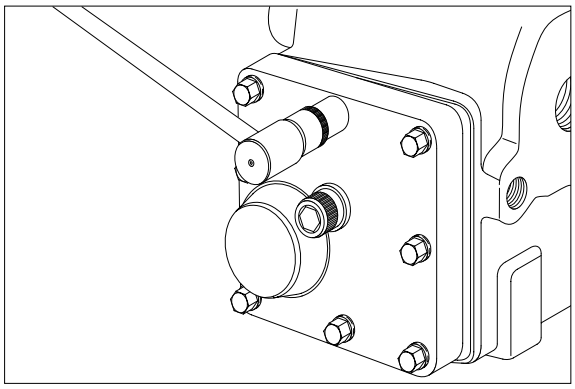
⑨ Fit screw with spring washer.



⑩ Fit screws with spring washer.

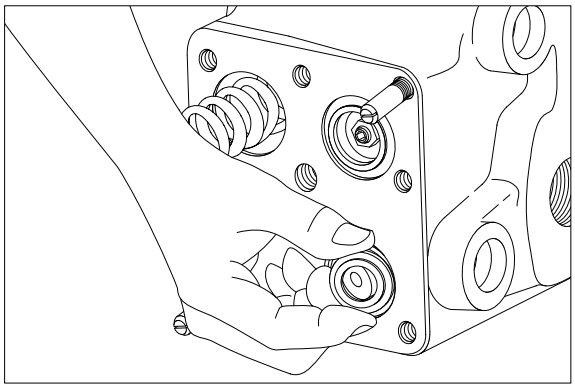
· Tightening torque : 2.6 ± 0.5kgf · m
(18.8 ± 3.6lbf · ft)

· Tightening torque : 8.2 ± 1kgf · m
for large screw (59.3 ± 7.2lbf · ft)

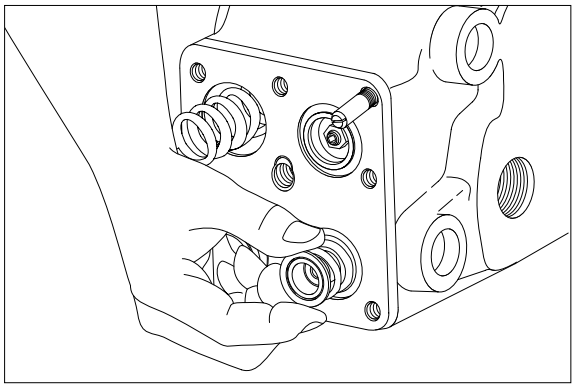


**(12) Installation of end cover at LS - connection**

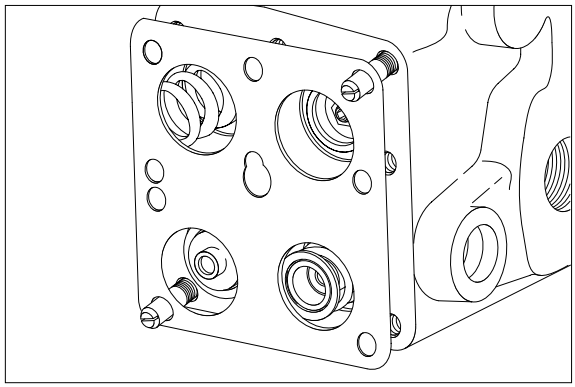
① Fit guide screws.
Fit remote control with vaseline.



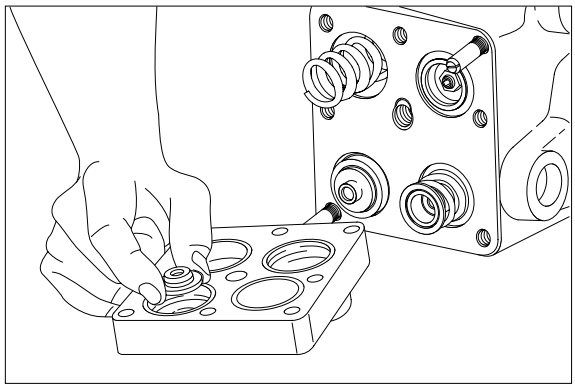
② Fit large and small springs with vaseline.



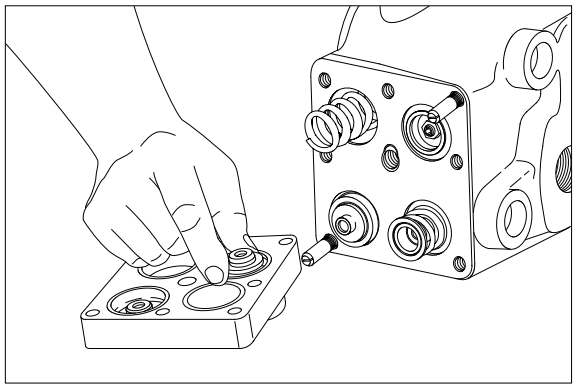
③ Guide in plate with 4 O-rings.



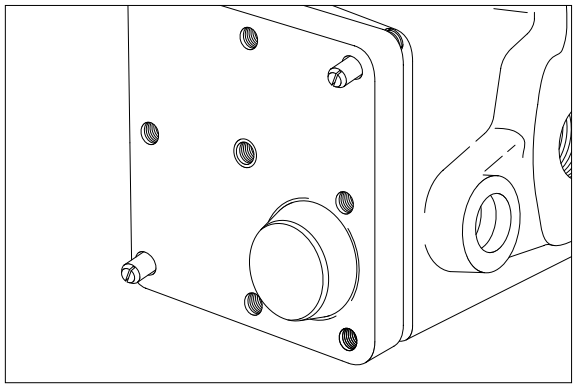
④ Fit stop for priority valve spool (Thickness : 8㎜) with vaseline.



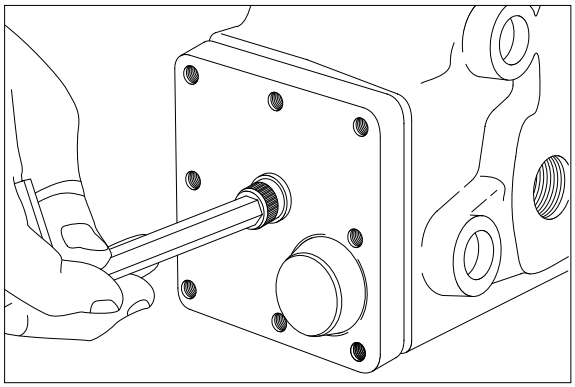
⑤ Fit stop for directional spool (Thickness : 5㎜) with vaseline.



⑥ Guide in end cover.



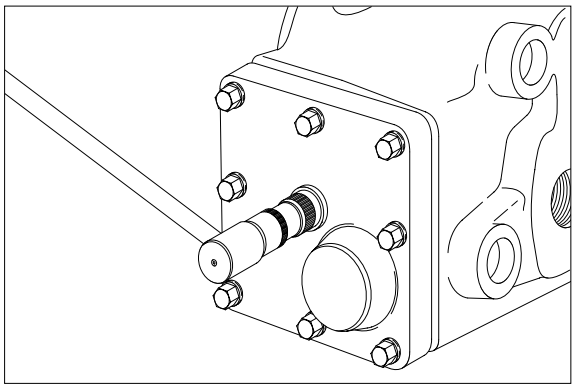
⑦ Fit large screw with spring washer.



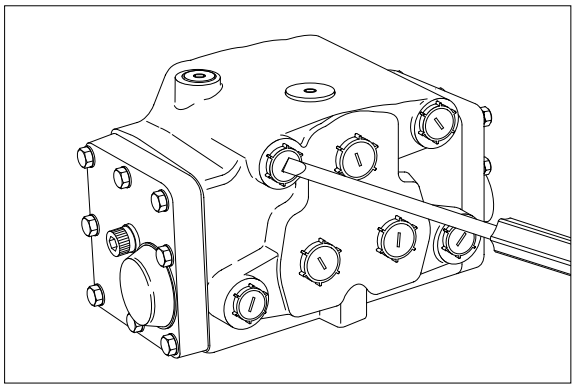
⑧ Fit screws with spring washers.

· Tightening torque : 2.6 ± 0.5kgf · m
(18.8 ± 3.6lbf · ft)

· Tightening torque : 8.2 ± 1kgf · m
for large screw (59.3 ± 7.2lbf · ft)



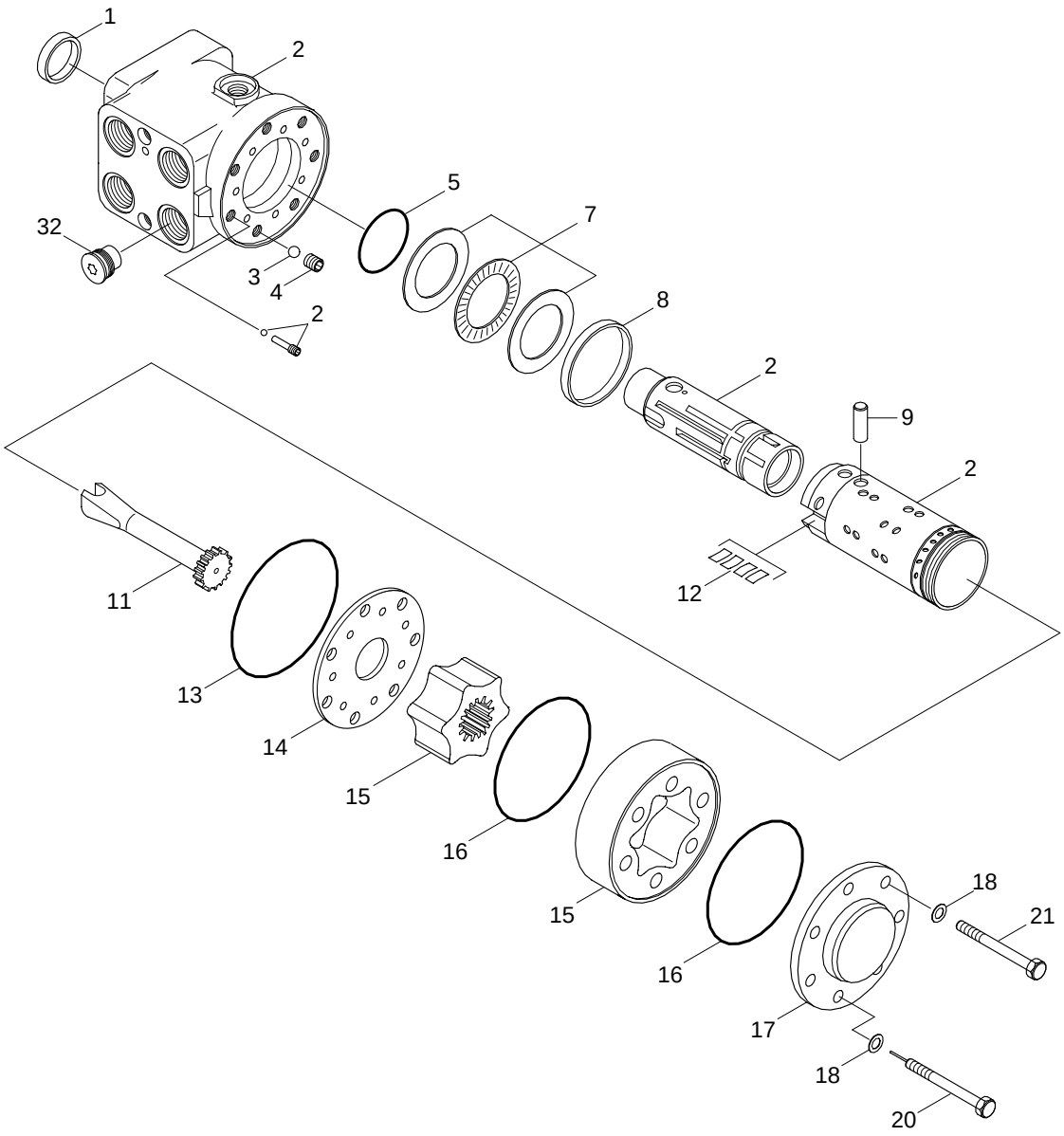
⑨ Fit plastic plugs.



This completes assembly.

## 3. STEERING UNIT

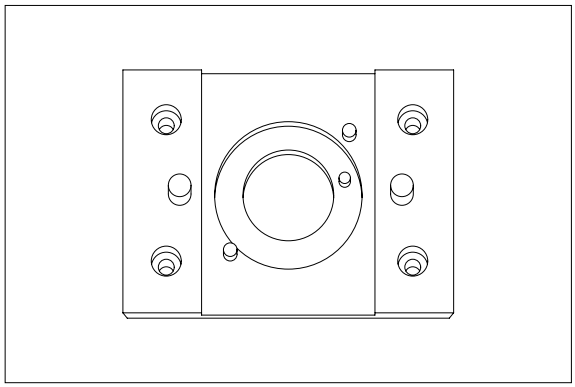
### 1) STRUCTURE



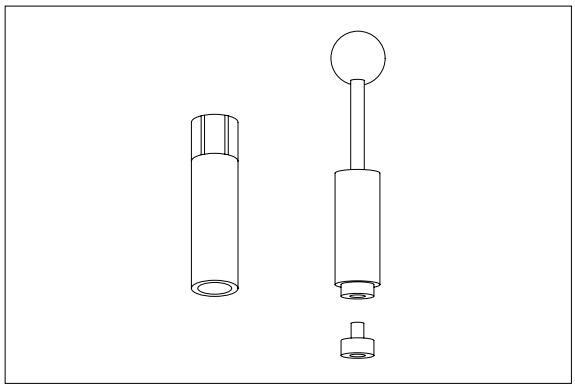

| | | | | | |
|---|---|---|---|---|---|
| 1 | Dust seal ring | 9 | Cross pin | 17 | End cover |
| 2 | Housing, Spool, Sleeve | 11 | Shaft | 18 | Washer |
| 3 | Ball | 12 | Spring set | 20 | Pin screw |
| 4 | Bushing | 13 | O-ring | 21 | Screw |
| 5 | O-ring/Roto glyd ring | 14 | Distributor plate | 32 | Check valve |
| 7 | Bearing assy | 15 | Gearwheel set | | |
| 8 | Ring | 16 | O-ring | | |

**2) TOOLS**

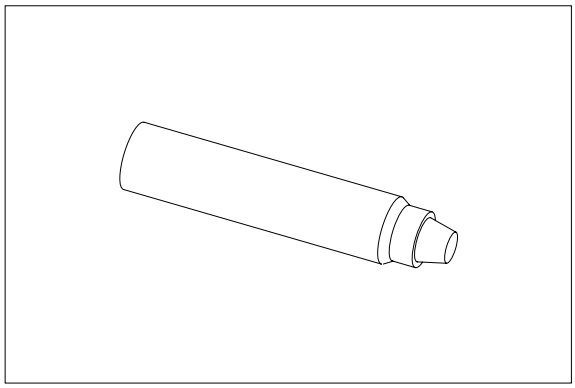
(1) Holding tool.



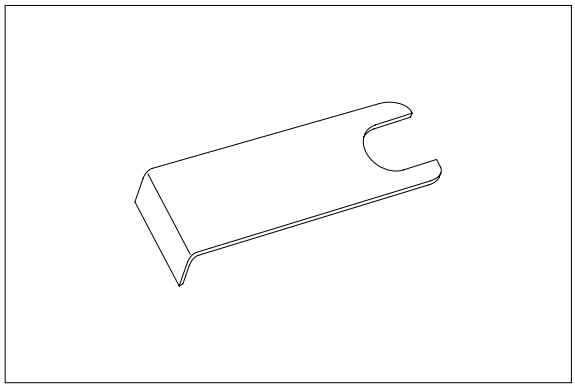
(2) Assembly tool for O-ring and kin-ring.



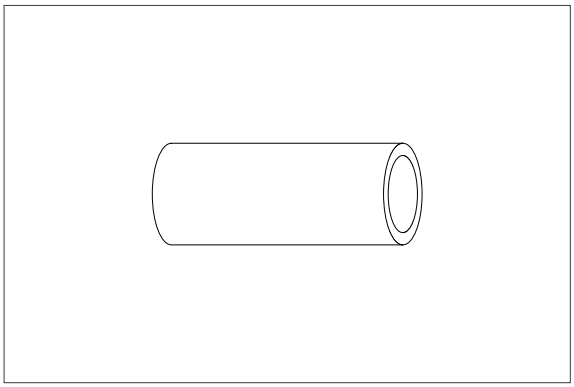
(3) Assembly tool for lip seal.



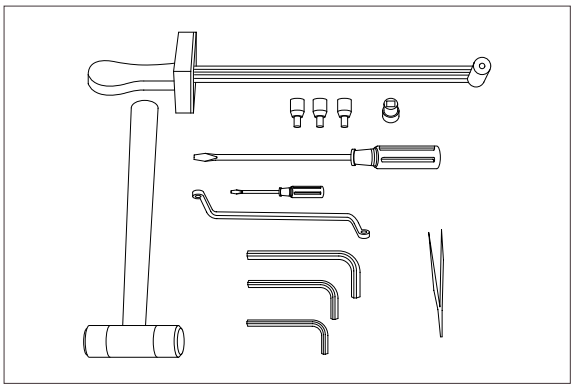
(4) Assembly tool for cardan shaft.



(5) Assembly tool for dust seal.

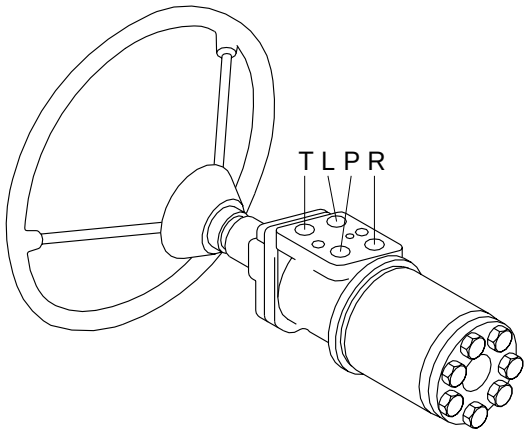


(6) Torque wrench 0~7.1kgf · m
(0~54.4lbf · ft)
13mm socket spanner
6, 8mm and 12mm hexagon sockets
12mm screwdriver
2mm screwdriver
13mm ring spanner
6, 8 and 12mm hexagon socket spanners
Plastic hammer
Tweezers



### 3) TIGHTENING TORQUE AND HYDRAULIC CONNECTIONS

#### (1) Hydraulic connections



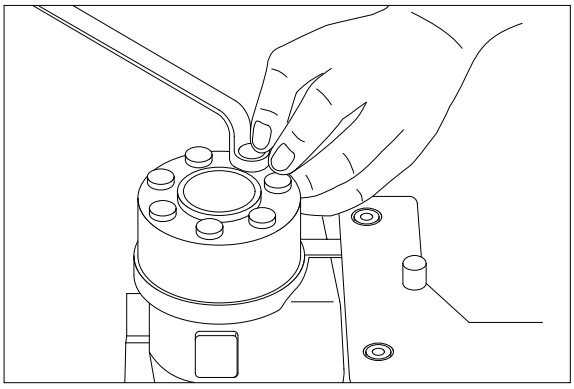

L : Left port
R : Right port
T : Tank
P : Pump

#### (2) Tightening torque

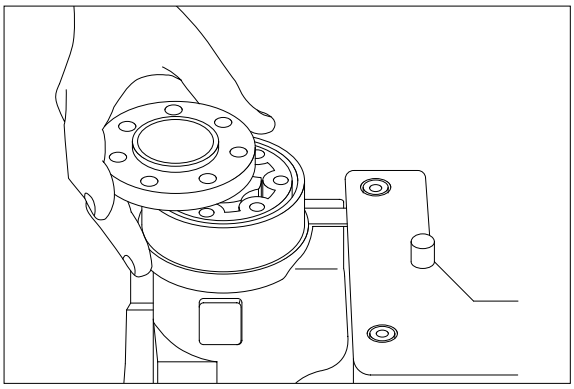
| Screwed connection | Max. tightening torque [ kgf · m(lbf · ft) ] | | | |
|---|---|---|---|---|
| | With cutting edge | With copper washer | With aluminum washer | With O - ring |
| 1/4 BSP.F | 4.1(29.7) | 2.0(14.5) | 3.1(22.4) | - |
| 3/8 BSP.F | 6.1(44.1) | 2.0(14.5) | 5.1(36.9) | - |
| 1/2 BSP.F | 10.2(73.8) | 3.1(22.4) | 8.2(59.3) | - |
| 7/16-20 UNF | - | - | - | 2.0(14.5) |
| 3/4-16 UNF | - | - | - | 6.1(44.1) |
| M 12×1.5 | 4.1(29.7) | 2.0(14.5) | 3.1(22.4) | 2.0(14.5) |
| M 18×1.5 | 7.1(51.4) | 2.0(14.5) | 5.1(36.9) | 5.1(36.9) |
| M 22×1.5 | 10.2(73.8) | 3.1(22.4) | 8.2(59.3) | 7.1(51.4) |

**4) DISASSEMBLY**

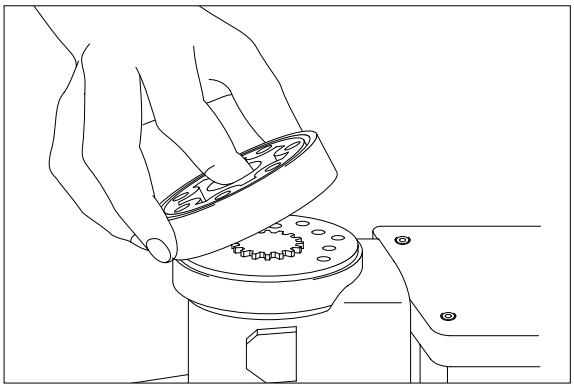
(1) Disassemble steering column from steering unit and place the steering unit in the holding tool.
Screw out the screws in the end cover(6-off plus one special screw).



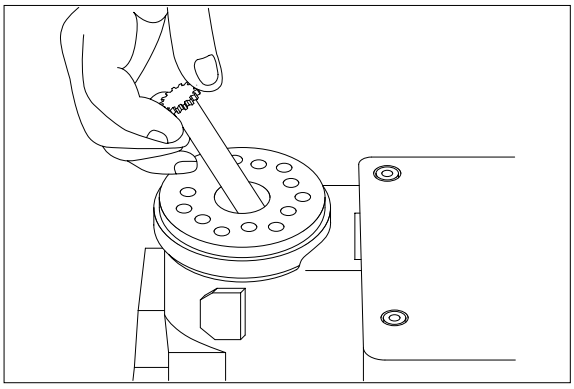
(2) Remove the end cover, sideways.



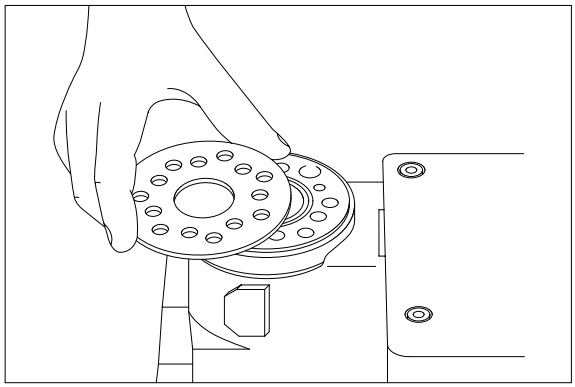
(3) Lift the gearwheel set (With spacer if fitted) off the unit.
Take out the two O-rings.



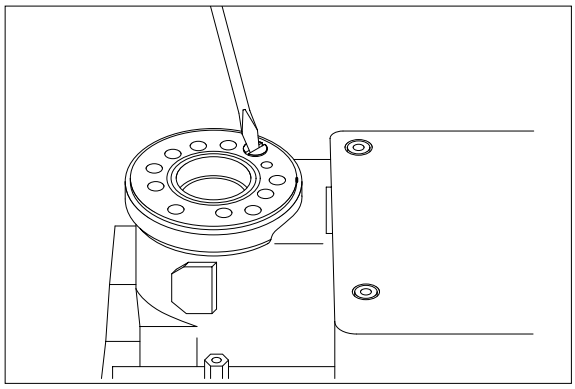
(4) Remove cardan shaft.



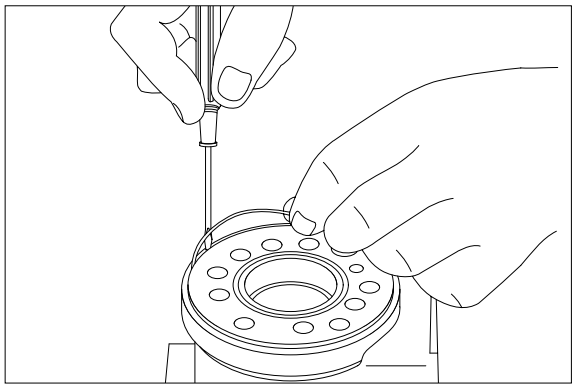
(5) Remove distributor plate.



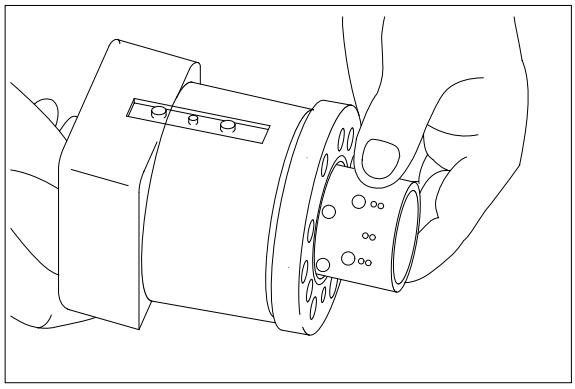
(6) Screw out the threaded bush over the check valve.



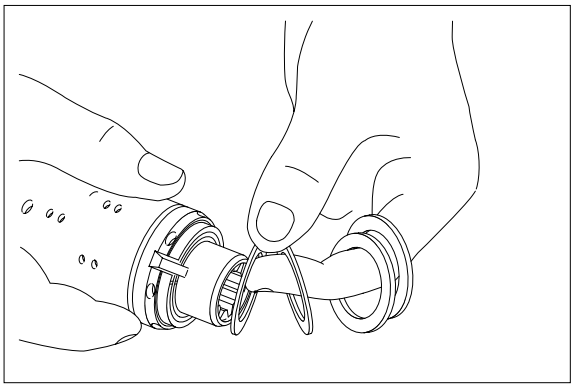
(7) Remove O-ring.



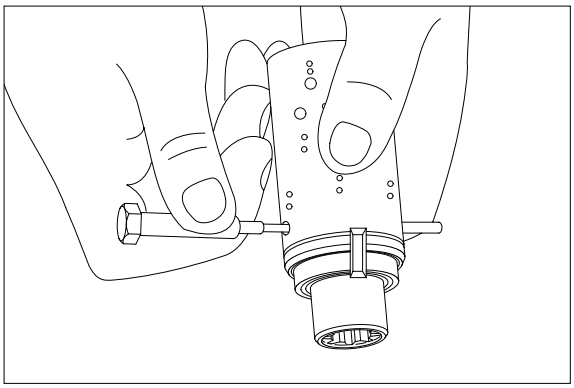
(8) Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and needle bearing will be pushed out of the housing together.



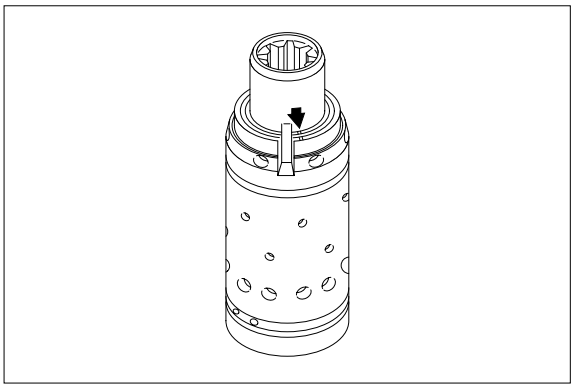
(9) Take ring, bearing races and needle bearing from sleeve and spool. The outer (Thin) bearing race can sometimes "stick" in the housing, therefore check that it has come out.



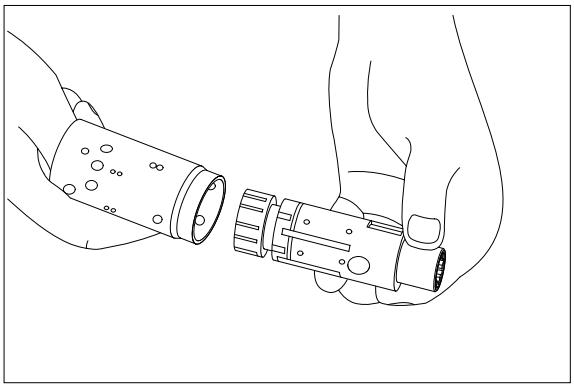
(10) Press out the cross pin. Use the special screw from the end cover.



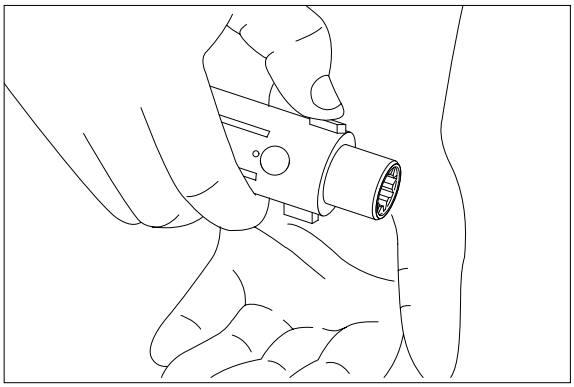
※ A small mark has been made with a pumice stone on both spool and sleeve close to one of the slots for the neutral position springs (See drawing).
If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are disassembled.



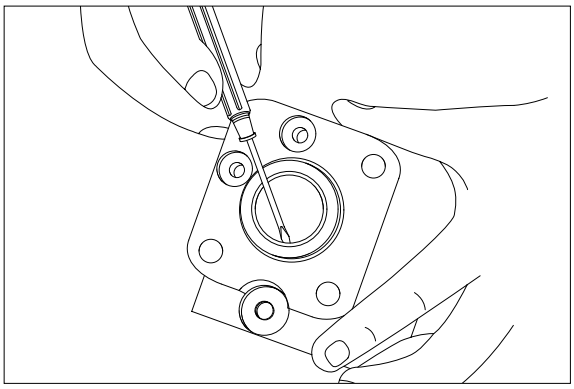
(11) Carefully press the spool out of the sleeve.



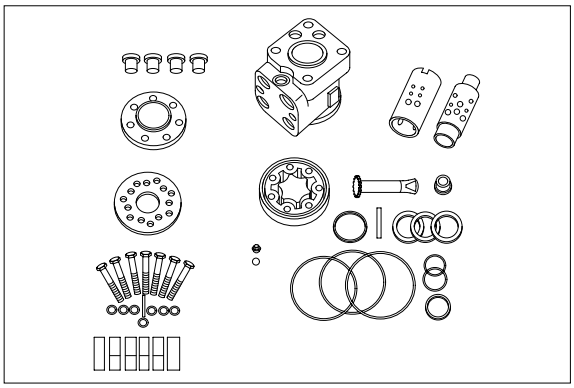
(12) Press the neutral position springs out of their slots in the spool.



(13) Remove dust seal and O-ring.



(14) The steering unit is now completely disassembled.



※ **Cleaning**
Clean all parts carefully in Shellsol K or the like.

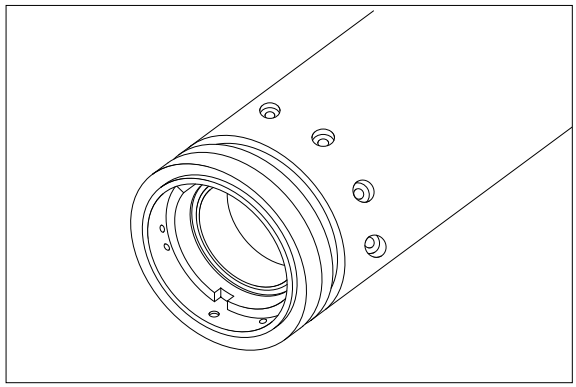
※ **Inspection and replacement**
Replace all seals and washers. Check all parts carefully and make any replacements necessary.

※ **Lubrication**
Before assembly, lubricate all parts with hydraulic oil.

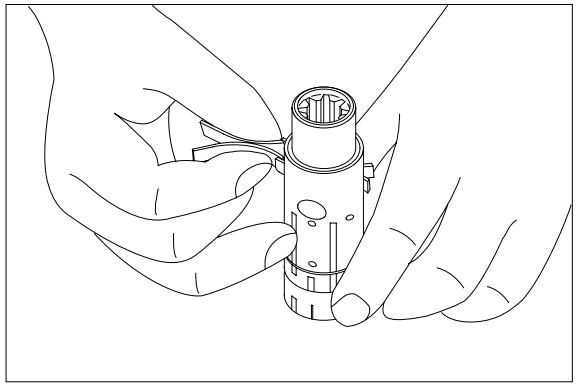
**5) ASSEMBLY**

(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.



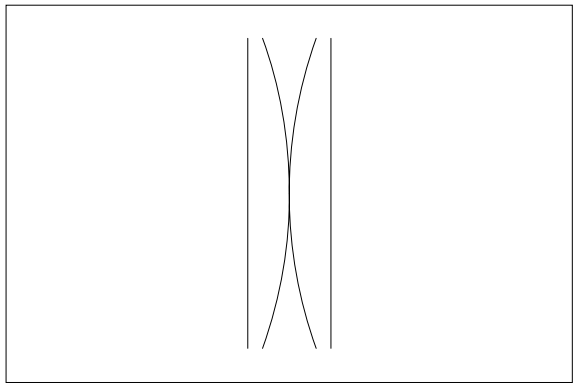
(2) Place the two flat neutral position springs in the slot.
Place the curved springs between the flat ones and press them into place (See assembly pattern).



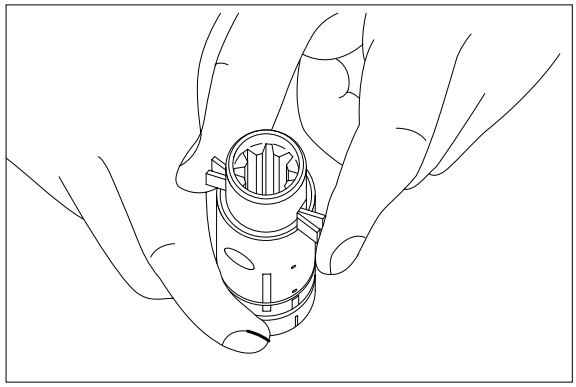
※ Assembly pattern

· Weak springs (Blue)
2 - off flat, blue : Part no. 150-0748
2 - off curved, blue : Part no. 150-0749

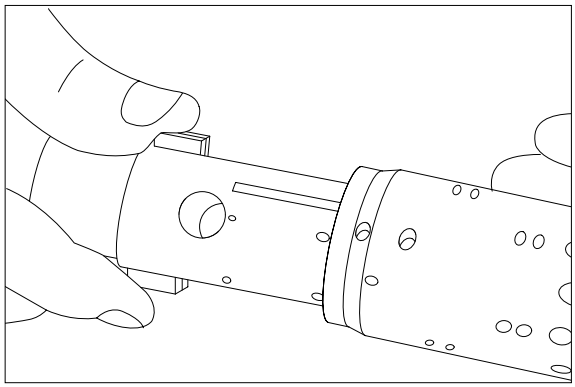
· Blue set
Spare set : Part no. 150-4265



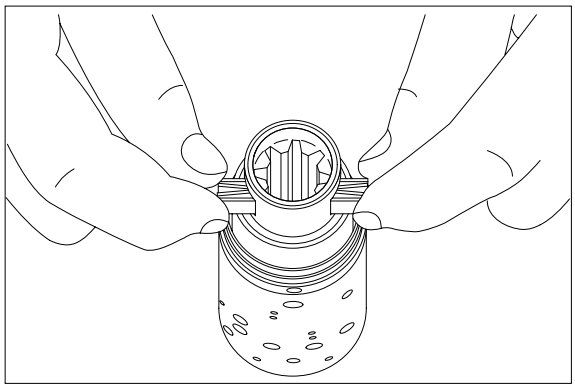
(3) Line up the spring set.



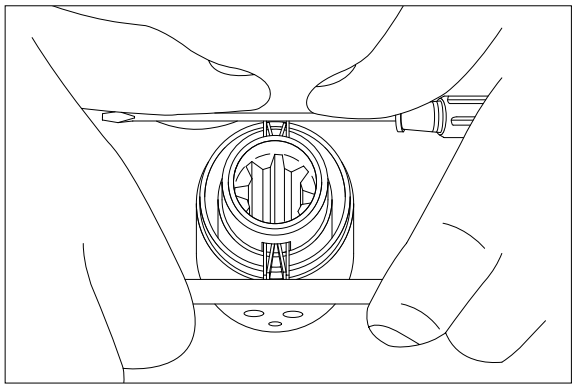
(4) Guide the spool into the sleeve. Make sure that spool and sleeve are placed correctly in relation to each other (See page 5-83, No.(1)).



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

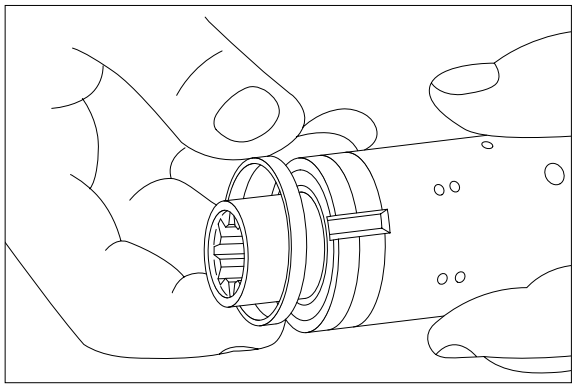


(6) Line up the springs and center them.

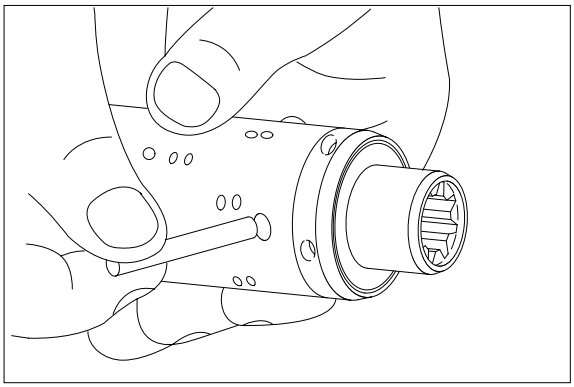


(7) Guide the ring down over the sleeve.

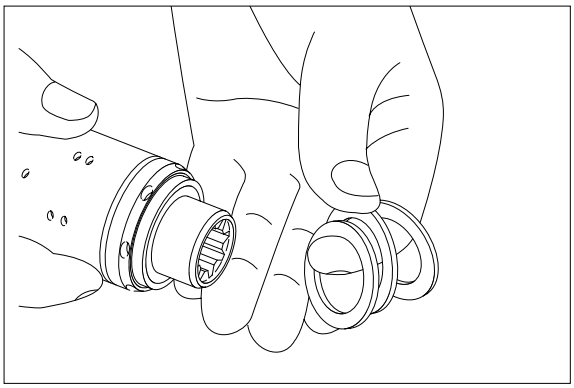
※ The ring should be able to rotate free of the springs.



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

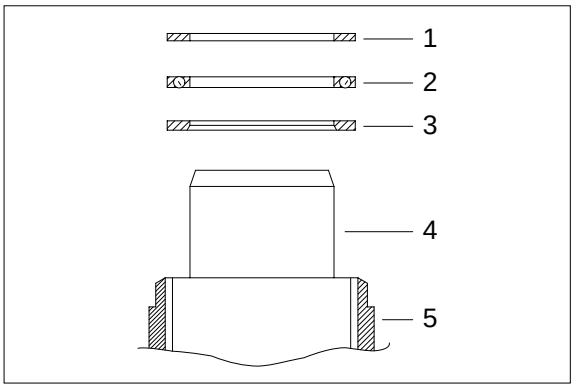


(9) Fit bearing races and needle bearing as shown on below drawing.



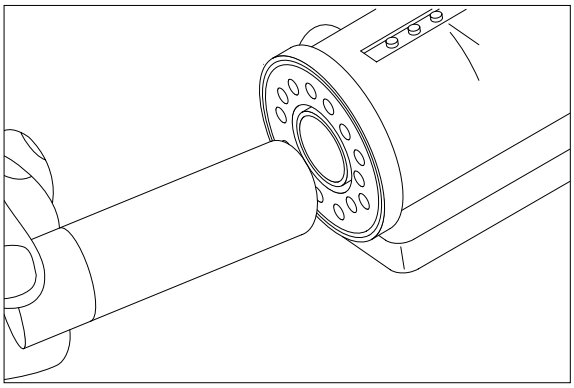
※ **Assembly pattern for standard bearings**

1 Outer bearing race
2 Needle bearing
3 Inner bearing race
4 Spool
5 Sleeve

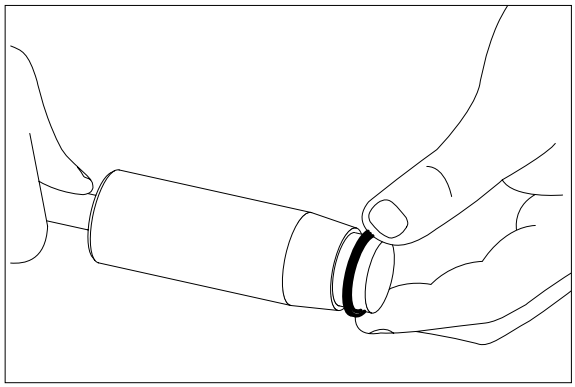


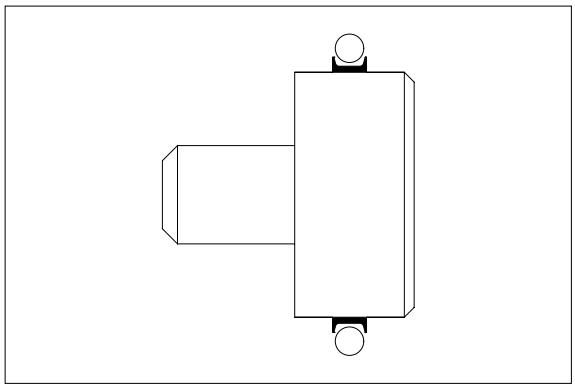

**Installation instruction for O-ring**

(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.

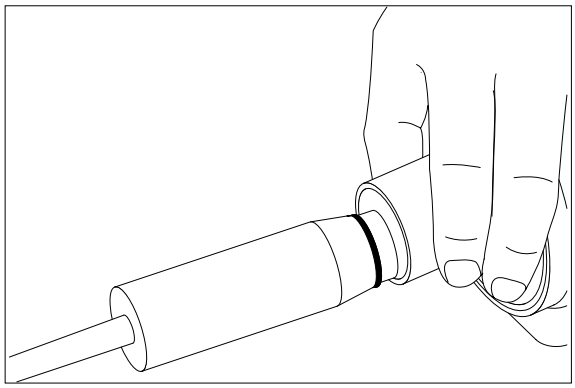


(11) Grease O-ring with hydraulic oil and place them on the tool.

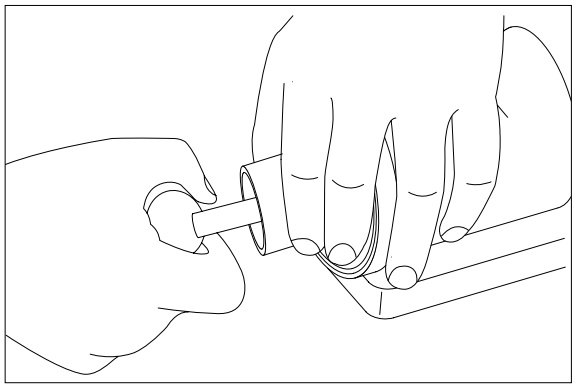




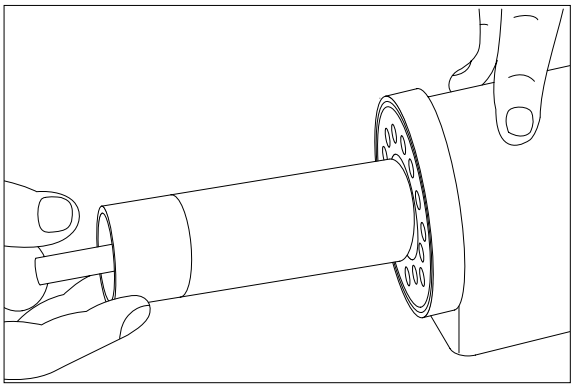
(12) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.



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

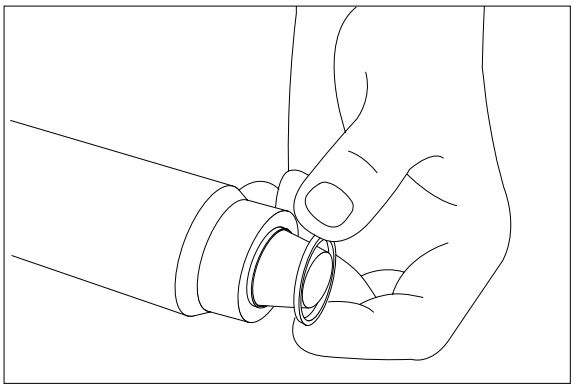


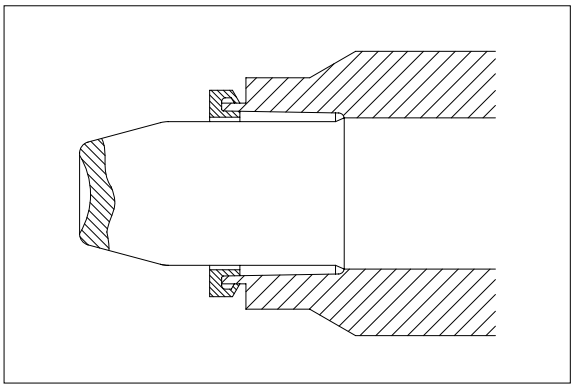
(14) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



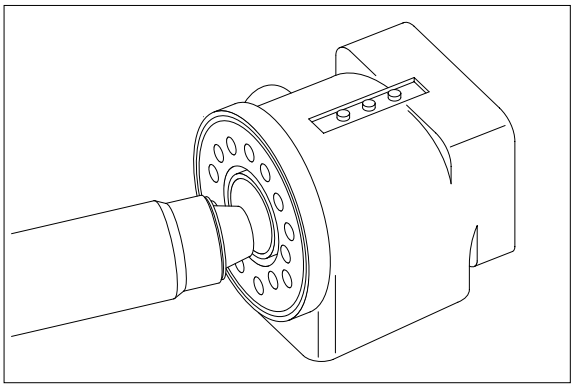
**Installation instructions for lip seal**

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

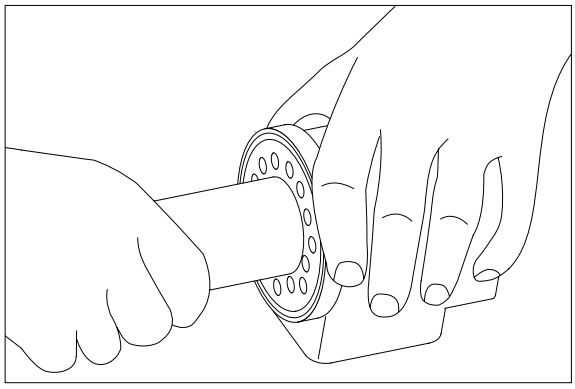




(16) Guide the assembly tool right to the bottom.

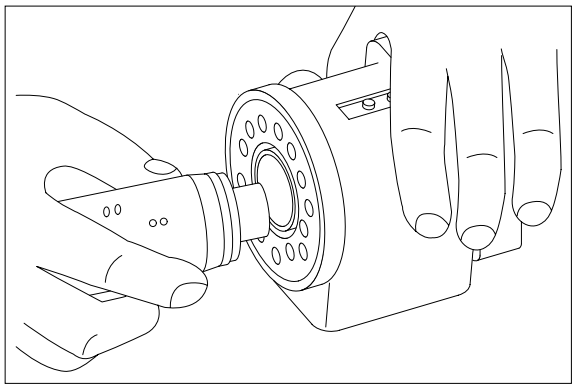


(17) Press and turn the lip seal into place in the housing.

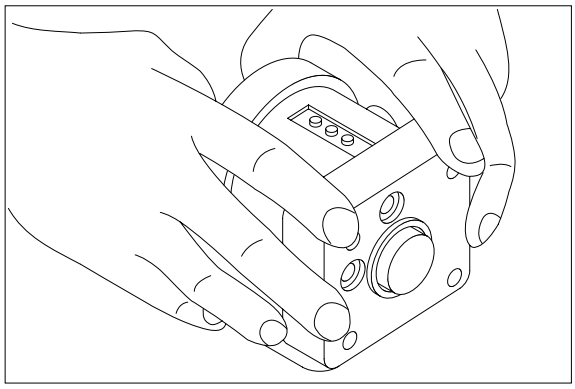


(18) With a light turning movement, guide the spool and sleeve into the bore.

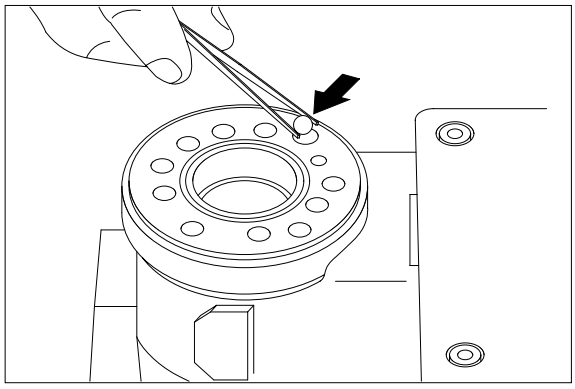
※ Fit the spool set holding the cross pin horizontal.



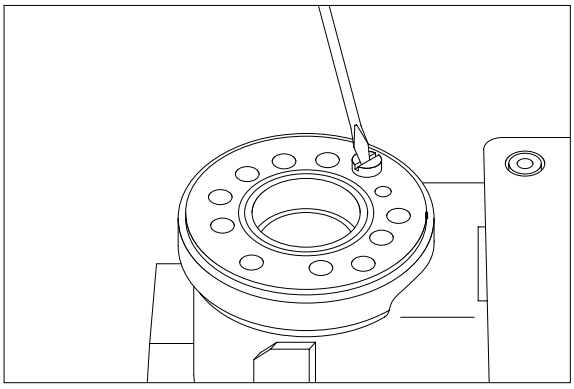
(19) The spool set will push out the assembly tool guide. The O-ring are now in position.



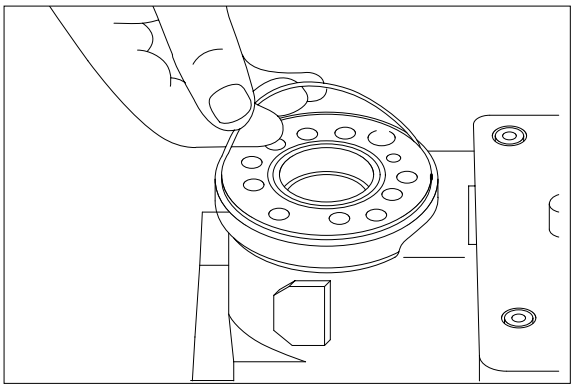
(20) Turn the steering unit until the bore is vertical again. Put the check valve ball into the hole indicated by the arrow.



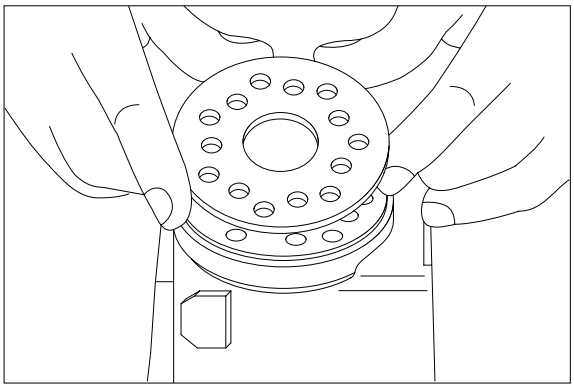
(21) Screw the threaded bush lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.



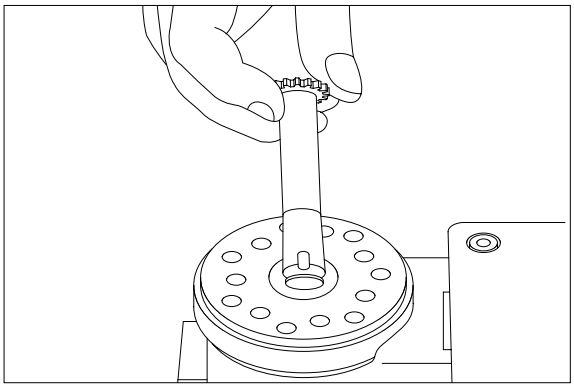
(22) Grease the O-ring with mineral oil approx. viscosity 500 cSt at 20 ℃.



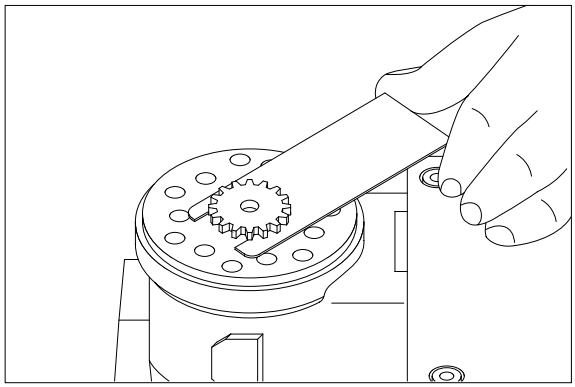
(23) Place the distributor plate so that the channel holes match the holes in the housing.



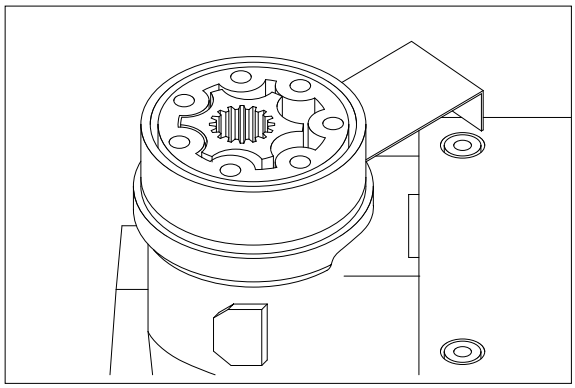
(24) Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.



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



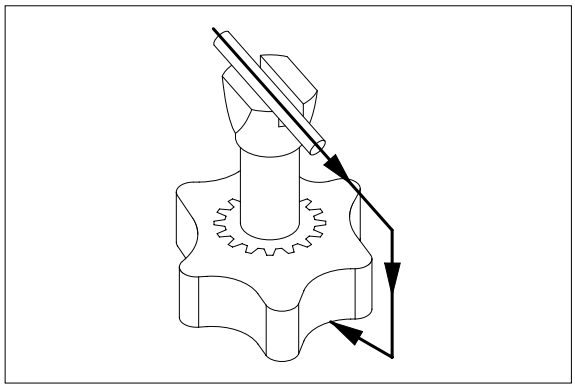
(26) Grease the two O-rings with mineral oil approx. viscosity 500 cSt at 20℃ and place them in the two grooves in the gear rim. Fit the gearwheel and rim on the cardan shaft.



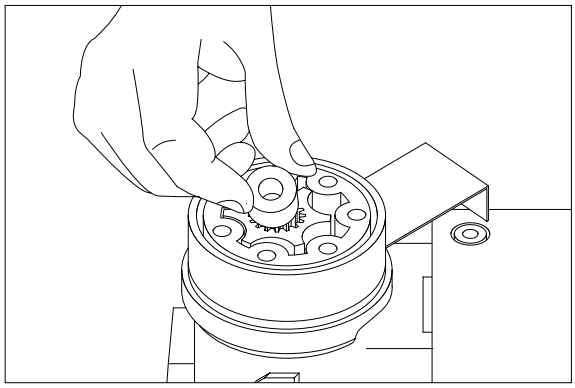
**(27) Important**

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.

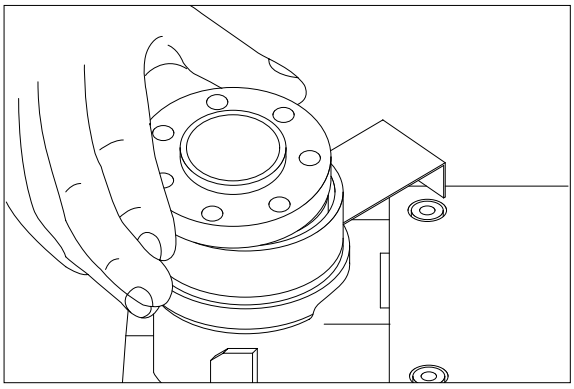
Turn the gear rim so that the seven through holes match the holes in the housing.



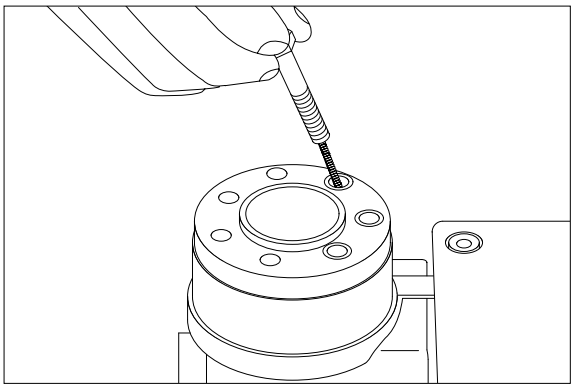
(28) Fit the spacer, if any.



(29) Place the end cover in position.

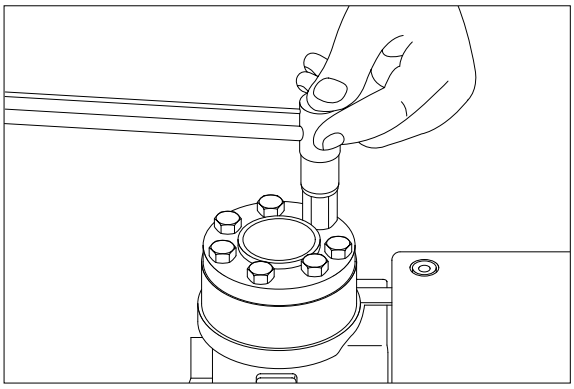


(30) Fit the special screw with washer and place it in the hole shown.

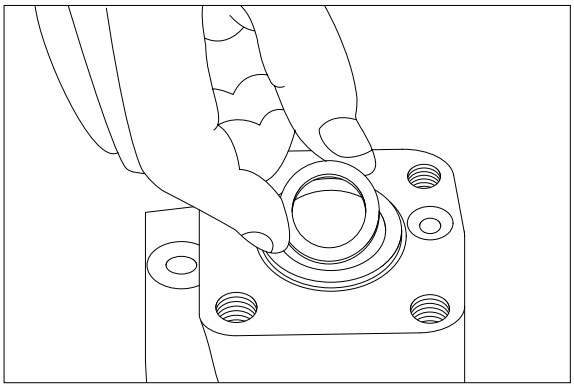


(31) Fit the six screws with washers and insert them. Cross-tighten all the screws and the rolled pin.

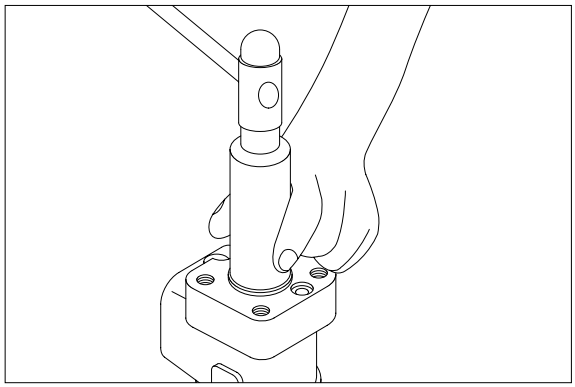
· Tightening torque : 3.1 ± 0.6kgf · m
(22.4 ± 4.3lbf · ft)



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

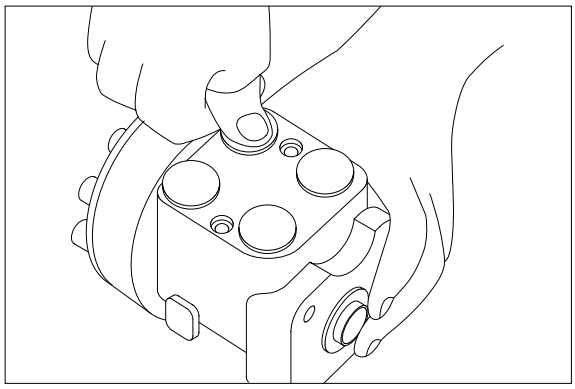


(33) Fit the dust seal ring in the housing.



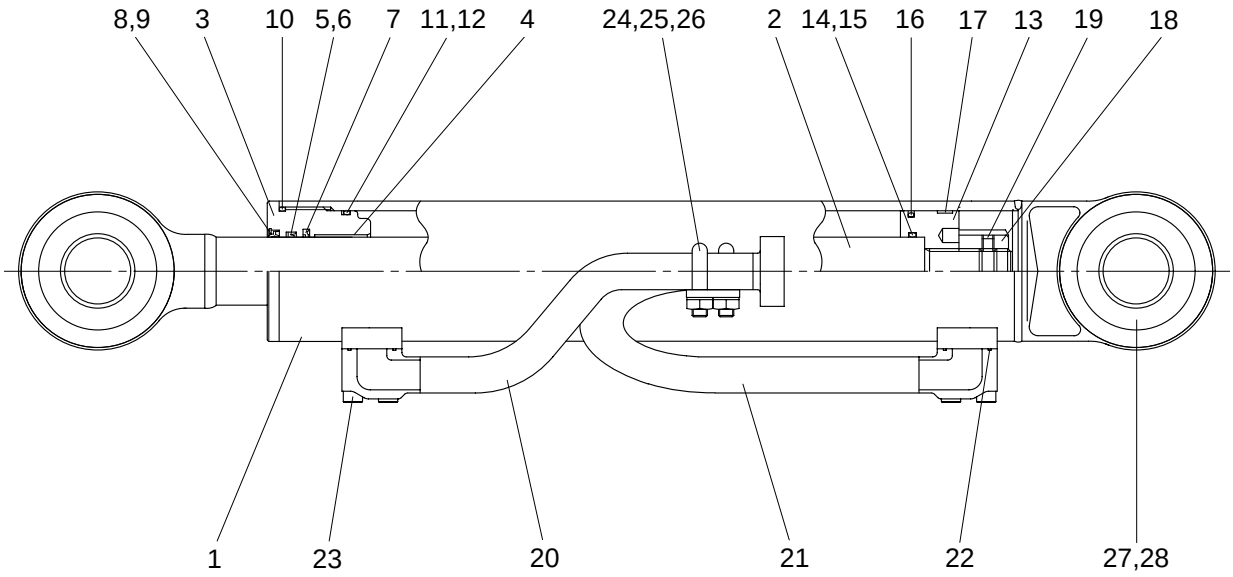
(34) Press the plastic plugs into the connection ports.

※ Do not use a hammer!



## 5. STEERING CYLINDER

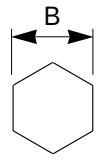
### 1) STRUCTURE




| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 11 | O-ring | 21 | Pipe assy |
| 2 | Rod assy | 12 | Back up ring | 22 | O-ring |
| 3 | Gland | 13 | Piston | 23 | Bolt |
| 4 | Bushing | 14 | O-ring | 24 | U-bolt |
| 5 | Rod seal | 15 | Back up ring | 25 | Nut |
| 6 | Back up ring | 16 | Piston seal | 26 | Spring washer |
| 7 | Buffer ring | 17 | Wear ring | 27 | Spherical bearing |
| 8 | Dust wiper | 18 | Piston nut | 28 | Retaining ring |
| 9 | Snap ring | 19 | Screw | | |
| 10 | O-ring | 20 | Pipe assy | | |

## 2) TOOLS AND TIGHTENING TORQUE

### (1) Tools

| Tool name | B | Remark |
|---|---|---|
| L-wrench | 5 |   |
| Spanner | 17 | |
| | 70 | |
| 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 | M115×3 | 60±10 | 434±72 |
| Piston | 13 | M 45×2 | 75±8 | 542±58 |
| Piston nut | 18 | M 45×2 | 100±10 | 723±72 |
| Set screw | 19 | M 10×1.5 | 5.4±0.5 | 39±3.6 |
| Bolt | 23 | M 10×1.5 | 5.4±0.5 | 39±3.6 |
| Nut | 25 | M 10×1.5 | 3.2×0.3 | 23±2.2 |

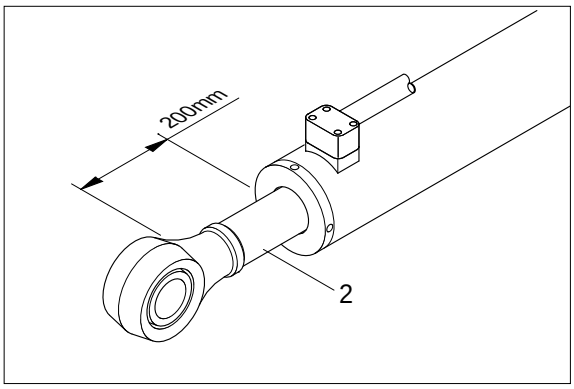
### 3) DISASSEMBLY

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

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

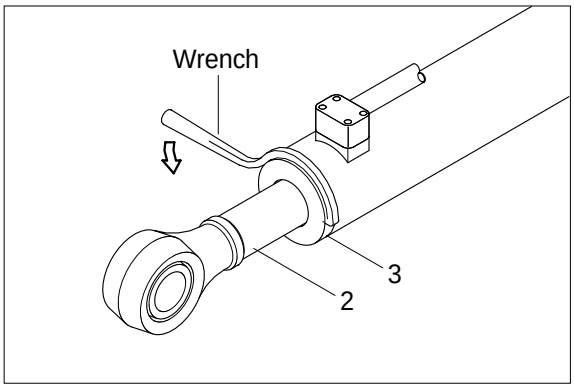
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out piston rod(2) about 200mm (7.8in). Because the piston rod is rather heavy, finish extending it with air pressure after the oil draining operation.



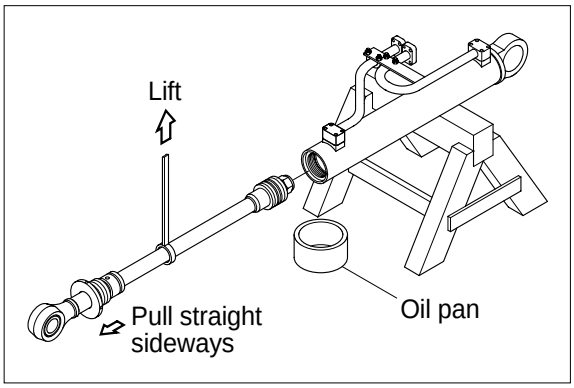

③ Loosen and remove the gland(3).

※ 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).

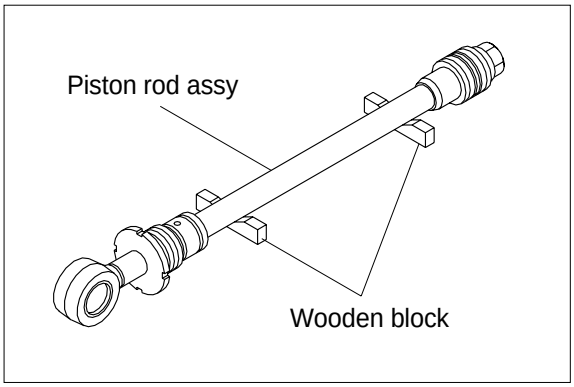
※ Since the piston rod assembly is heavy in this case, lift the tip of the piston rod(2) with a crane or some means and draw it out. However, when piston rod(2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



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.

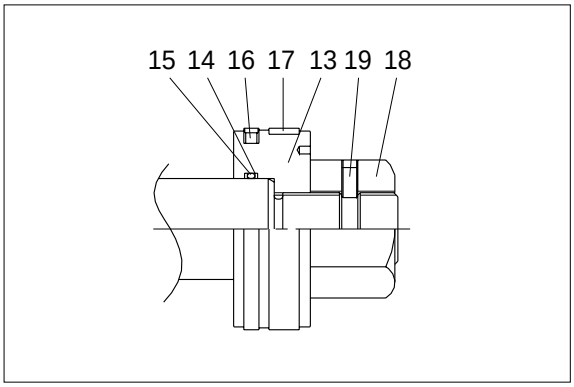



**(2) Remove piston and gland assembly**

① Remove the set screw(19).

② Remove the piston nut(18).

③ Remove piston assembly(13), back up ring(15) and O-ring(14).

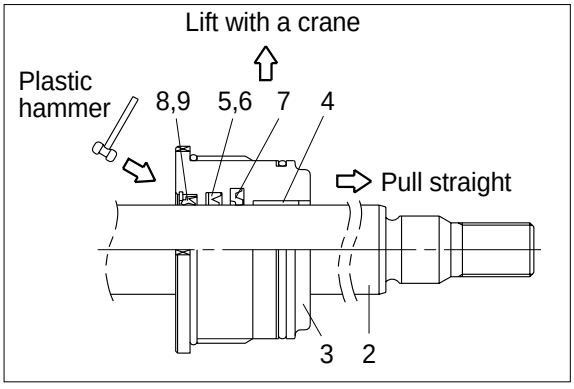



③ Remove the gland(3) assembly from piston rod(2).

※ 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 gland assembly lifted with a crane.

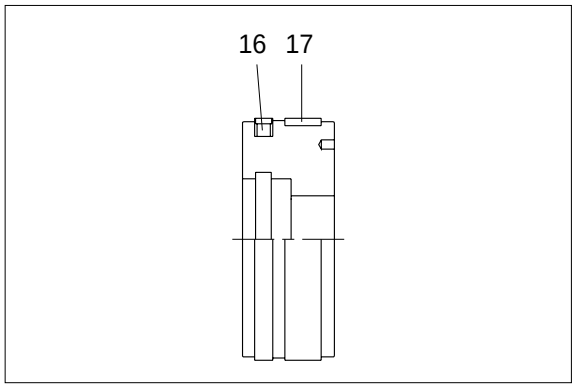
Exercise care so as not to damage the lip of rod bushing(4) and packing(5,6,7,8,9) by the threads of piston rod(2).



**(3) Disassemble the piston assembly**

① Remove wear ring(17).
Remove and piston seal(16).

※ Exercise care in this operation not to damage the grooves.




**(4) Disassemble gland assembly**

① Remove back up ring(12), and O-ring (11).

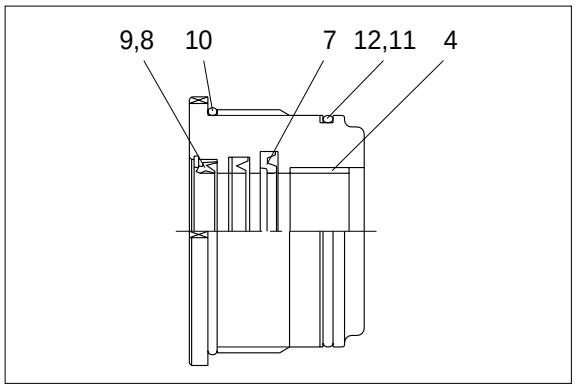
② Remove O-ring (10).

③ Remove snap ring(9) and dust wiper(8).

④ Remove back up ring(6), rod seal(5) and buffer ring(7).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

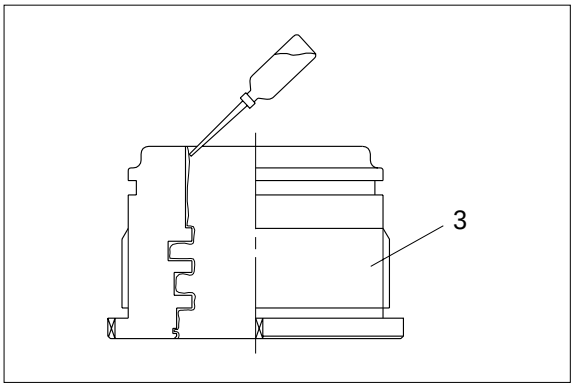


**4) ASSEMBLY**

**(1) Assemble gland assembly**

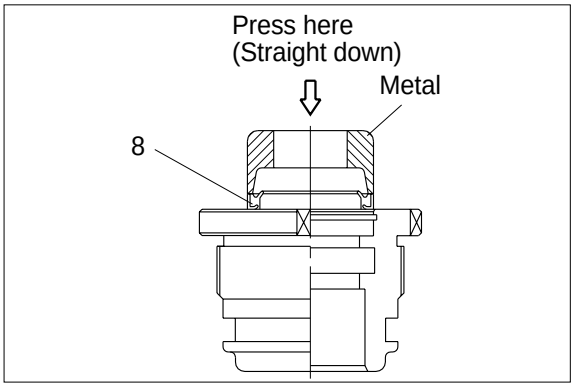
※ Check for scratches or rough surfaces if found smooth with an oil stone.

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




② Coat dust wiper(8) with grease and fit dust wiper(8) to the bottom of the hole of dust wiper.
At this time, press a pad metal to the metal ring of dust seal.

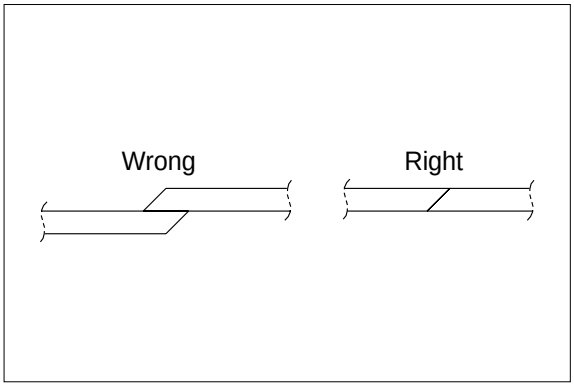
③ Fit snap ring(9) to the stop face.




④ Fit back up ring(6) and rod seal(5), and buffer ring(7) to corresponding grooves, in that order.

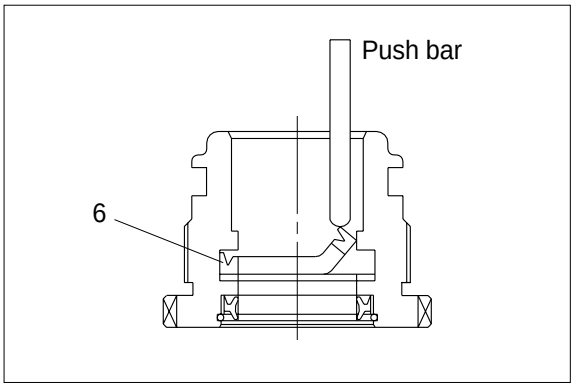
※ Coat each packing with hydraulic oil before fitting it.

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




※ Rod seal(5) has its own fitting direction. Therefore, confirm it before fitting them.

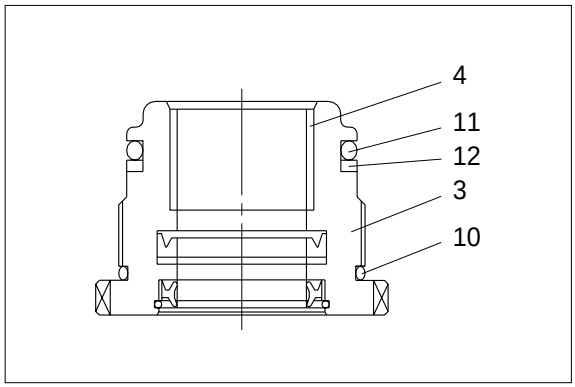
※ Fitting rod seal(5) up side down may damage its lip. Therefore check the correct direction that is shown in fig.



⑤ Fit back up ring(12) to gland (3).

※ Put the backup ring in the warm water of 30~50℃.

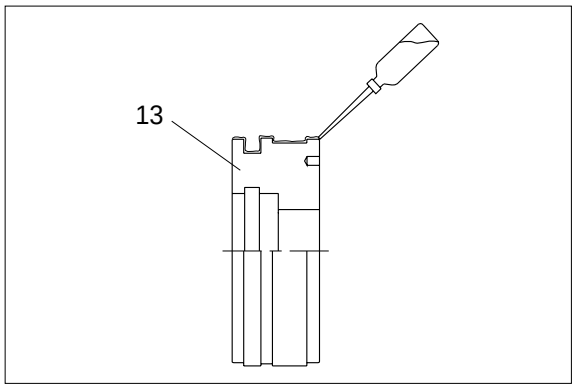
⑥ Fit O-ring(11) to gland(3).




**(2) Assemble piston assembly**

※ Check for scratches or rough surfaces.

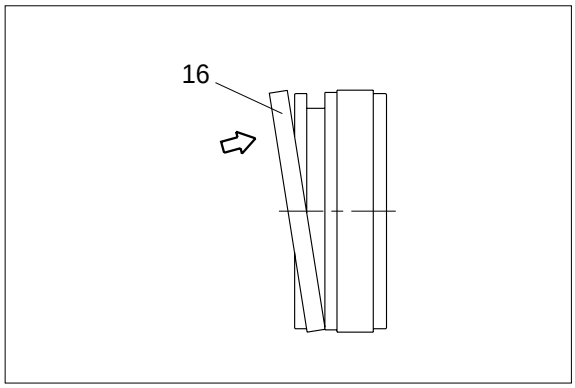
① If found smooth with an oil stone.
Coat the outer face of piston(13) with hydraulic oil.




② Fit piston seal(16) to piston

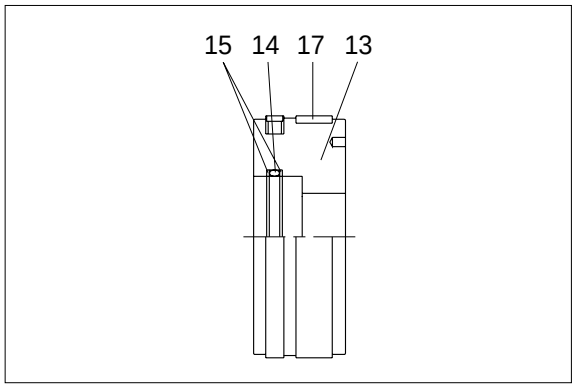
※ Put the piston seal in the warm water of 60~100℃ for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.




③ Fit wear ring(17) to piston(13).

④ Fit back up ring(15) and O-ring(14) to piston(13).

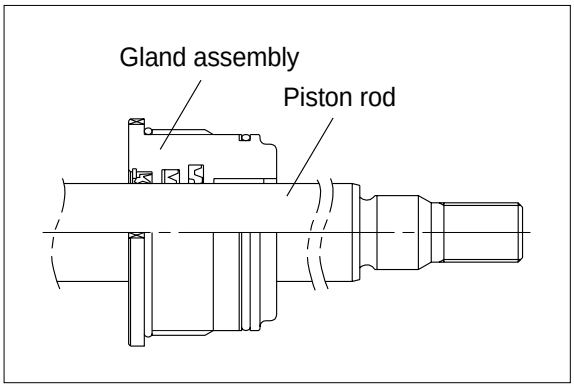


**(3) Install piston and gland assembly**

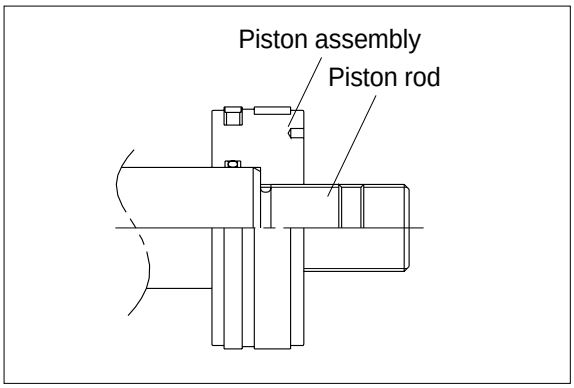
① Fix the piston rod assembly to the work bench.

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.

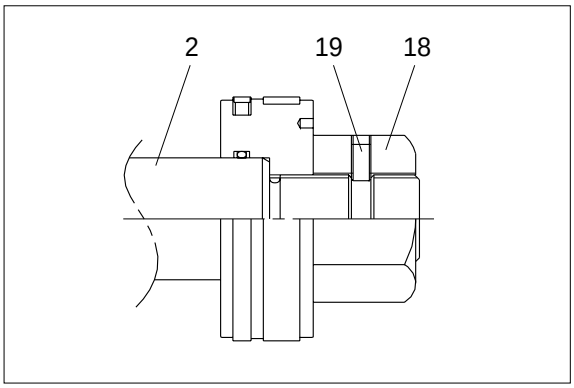



⑤ Tighten piston nut(18) to piston rod(2).

· Tightening torque : 100±10kgf · m
(723±72lbf · ft)

Tighten set screw(19) to piston nut(18).

· Tightening torque : 5.4±0.5kgf · m
(39±3.6lbf · ft)



**(4) Overall assemble**

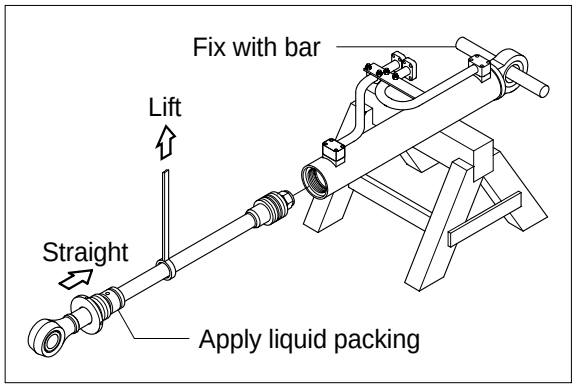
① Place a V-block on a rigid work bench. Mount the cylinder tube assembly on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

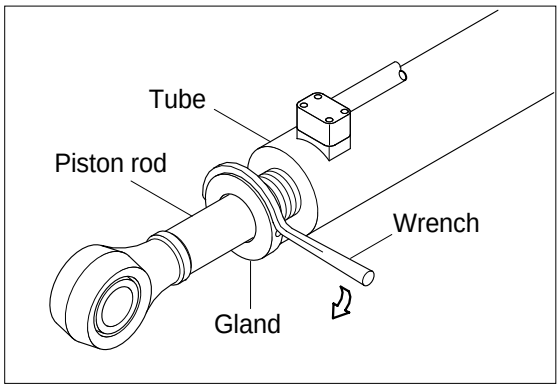
② Insert the piston rod assembly in to the cylinder tube assembly, while lifting and moving the piston rod assembly with a crane.

※ 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.

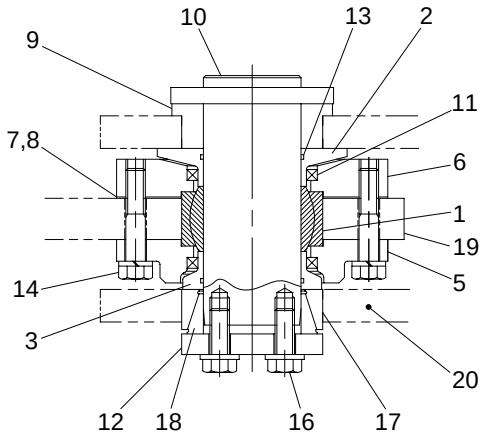


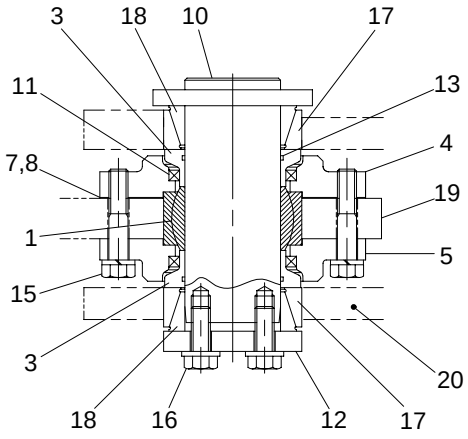
## 6. CENTER PIVOT PIN

### 1) CONSTRUCTION

Figure shows the construction of the center pivot pin assembly. This assembly serves to connect the front frame with the rear frame; two sets of assemblies are provided, one each for the upper and lower parts.




UPPER




LOWER

| | | | | | |
|---|---|---|---|---|---|
| 1 | Bearing | 8 | Shim | 15 | Hexagon bolt |
| 2 | Collar | 9 | Bushing | 16 | Hexagon bolt |
| 3 | Collar | 10 | Pin | 17 | Collar |
| 4 | Cover | 11 | Dust seal | 18 | Collar |
| 5 | Cover | 12 | Plate | 19 | Front frame |
| 6 | Cover | 13 | O-ring | 20 | Rear frame |
| 7 | Shim | 14 | Hexagon bolt | | |

**2) DISASSEMBLY**

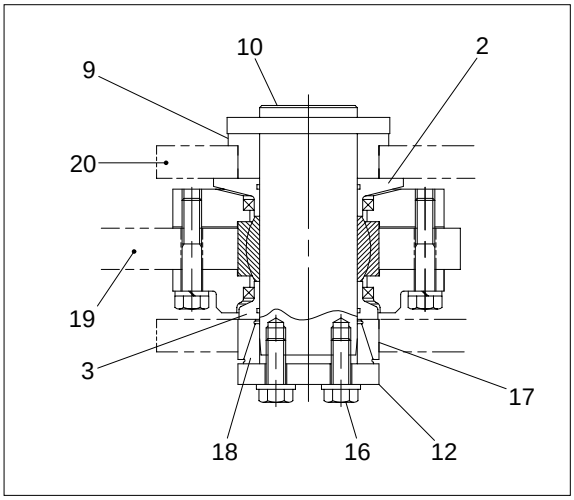
After supporting the front frame and the rear frame as horizontally as possible using wood blocks and jacks, disassemble as follows: In order to facilitate the disassembly/assembly of the center pivot pins, remove the drive shaft, hydraulic line and steering cylinder first.

(1) Maintain the horizontal level of front frame(19) and rear frame(20), and then remove hexagon bolt(16) and plate(12).

(2) Remove collar(18) and take out pin(10) to the upside using a metal punch.

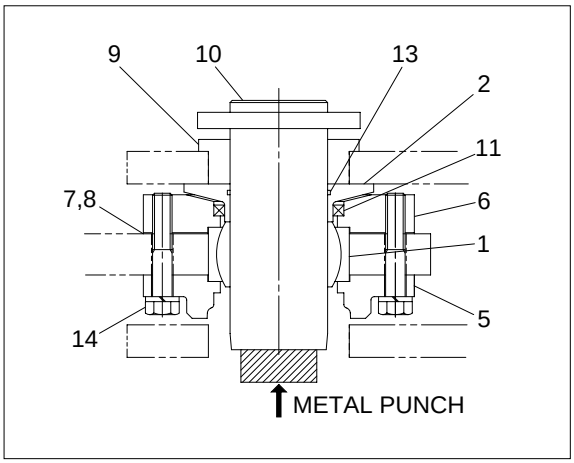
(3) Remove collar(17) and keep collar(17, 18) as a set.

(4) Put mating marks on collar(2, 3) fitting positions and pull down collar(3) to remove.




(5) Lift the frame by passing the slinging wire rope at four positions of front frame(19), in order to separate it from the rear frame(20).

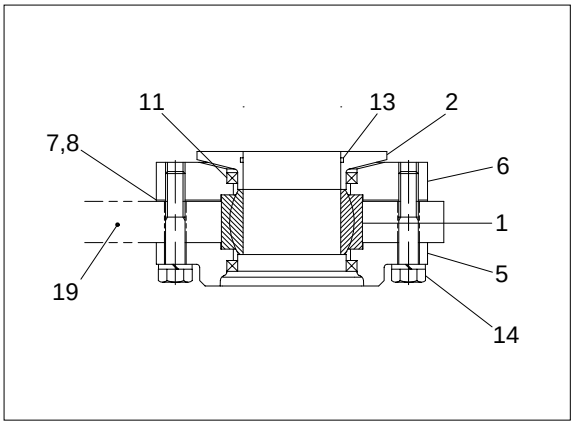
(6) Support the front frame safely.




(7) Take out hexagon bolt(14) and then remove covers(5, 6), shims(7, 8) and collar(2) and keep them as a set after putting marks on shim(7, 8) fitting position.

(8) Remove the spherical bearing(1) from the front frame.

(9) Pull dust seal(11) out of cover(5, 6).



**3) INSPECTION**

(1) Check the bearing sliding surface for excessive wear, scorching or scratches; replace if necessary.

(2) Replace all dust seals(11) and O-ring(13) with new ones.

(3) Grind any pins(10) dented with an oilstone or replace any pins abrasive excessively.

(4) Check inside cover(4, 5, 6) and collar(2, 3) for dents or scratches; if any damage is found, correct with a grinder or replace.

(5) The serviceable limit of pins and bushings is shown in the table below.

Unit : mm

| Item No. | Name | Std dimension | Serviceable limit | | | Remedy |
|---|---|---|---|---|---|---|
| | | | Outer dia | Inner dia | Clearance | |
| 10 | Pin | 100 | 99 | - | 1 | Replace |
| 1 | Spherical bearing | | - | 100.5 | | |
| 2, 3 | Collar | 100.2 | - | 100.6 | 1 | Replace |
| 17, 18 | Dust seal | When removed | | | | Replace |
| 13 | O-ring | | | | | |

**4) ASSEMBLY**

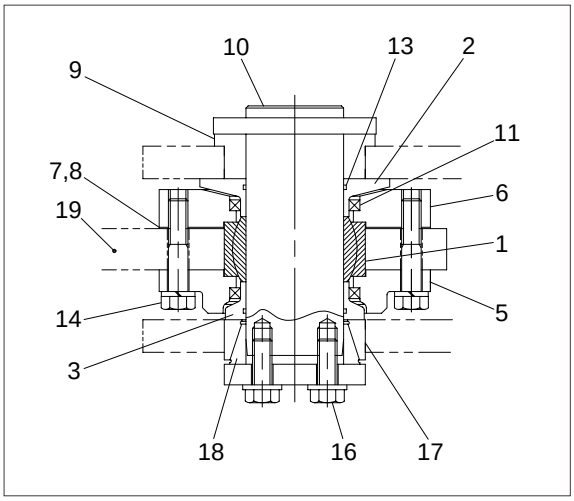
Assemble the center pivot group by reversing the order of disassembly while paying close attention to the following.

(1) Put the dust seal(11) into cover(4, 5, 6).

※ Apply grease to the lip of the dust seal. Insert the dust seal so that the dust seal lip faces out and punch four places on the outer circumference of the seal to lock it.

(2) Apply grease to the inside of spherical bearing(1) and install it to front frame(19).

(3) Assemble cover(4, 5, 6). At this time, adjust shims(7, 8) to press shoulder of the bearing(1) against cover(5, 6).(Shim thickness 0.1㎜, 0.5㎜)




(4) After setting the bearing so that its upper surface is horizontal, tighten the bolt(14). After tightening, confirm that spherical bearing(1) moves lightly; if does not move smoothly, add shims(7, 8).

· Tightening torque : 39±4kgf · m(282±29lbf · ft)

※ Apply locktite #242.

(5) Apply grease to upper collar(2) and insert it to the upper of spherical bearing(1). At this time, insert pin(10) and confirm that match collar(2), spherical bearing(1) and cover (4, 5, 6) at the center.

(6) Insert bushing(9) to the upper of the upper side rear frame and insert collar (17, 18) to the upper of the lower side rear frame.

(7) Move the front frame and join it to the rear frame so that match the pin hole at the center.

(8) Apply grease to pin(10) and insert it into spherical bearing(1).

(9) Set plate(12) after inserting collar(3, 17, 18) through the lower side of the pin; tighten hexagon bolt (16).

· Tightening torque : 35~38kgf · m(253~275lbf · ft)

※ Apply locktite #242.

(10) Connect the piping, pins, electrical wiring, links, etc. and remove the wooden block supporting the frame.

(11) Check the pin function at low revolution; and apply grease if no irregularity is found.

### 5) TROUBLESHOOTING

| Trouble | Probable cause | Remedy |
|---|---|---|
| Shock is felt when steering | Capscrew for fixing steering valve is loose | Retighten |
| | Faulty center pivot pin mounting bolts | Retighten |
| | Center pivot pins have worn out | Readjust or replace |
| | Faulty hydraulic system | See hydraulic system |
| Shock is felt when moving backward or forward | Fault fixing of connecting capscrews | Retighten |
| | Center pins have worn out | Readjust or replace |
| | Bearings of support unit have worn out | Retighten |
| | Drive shaft damaged | See drive system |
| | Faulty transmission | See transmission system |