



HYDRAULIC PILE DRIVER  
MODEL KH193

SERVICE MANUAL

MARUZEN KOGYO CO., LTD.

# FOREWORD

The purpose of this Maruzen Hydraulic Pile Driver Model KH193 service manual is for supporting and instructing all personnel involved in repair and maintenance for KH193 Hydraulic Pile Driver. This service Manuals provides detailed information including safety alert, operating instruction and step by step repair and maintenance procedures.

All personnel involved in repair and maintenance **MUST** fully – understood and familiarize all the necessary procedures before each repair and maintenance conducted. Before conducting repair or maintenance, the person in charge must read this service manual carefully and thoroughly. Fail to follow the procedures, or repair/maintain in alternative ways from this service manual may result damages to the machines or serious personal injuries. Moreover, it may also endanger machine operator.

It is particular important that all personnel involved in repair and maintenance read “**SAFETY INFORMATION**” thoroughly. All the safety precautions **MUST** be followed strictly at all times.

## INTERNATIONAL STANDARD:

This service manual shows SI unit as following:

Examples:

Tightening Torque	200N · m (20kgf · m)
	56N · m(5.6kgf · m)
	45N · m(4.5kgf · m)
	30N · m(3.0kgf · m)

Charging Pressure of Nitrogen Gas	4MPa(40kgf/cm <sup>2</sup> )
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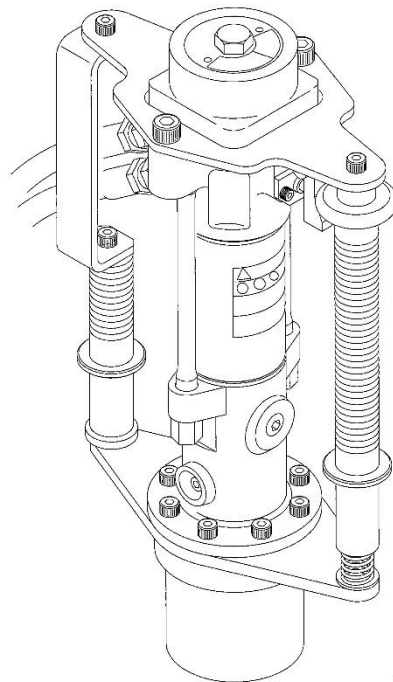
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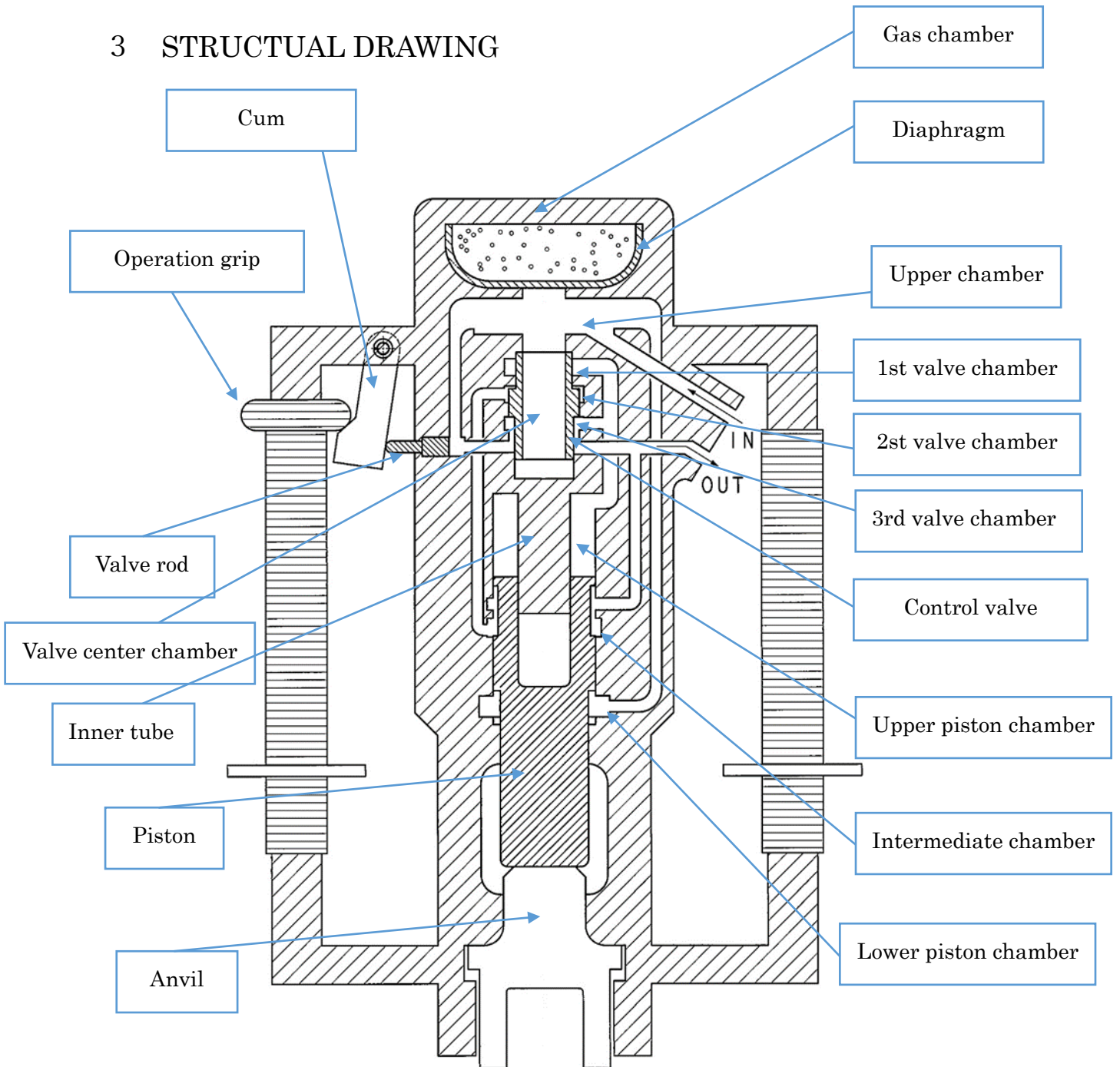
## 1 SPECIFICATIONS

Dimensions	L486 X W273 X T146
Weight	20 kg
Hydraulic Pressure	8 -11 MPa
Max Allowable Pressure	20.6 MPa
Operating Flow	20 L/min
Impact Numbers	1920 b.p.m
Connection	3/8 " Coupler
Allowable Back Pressure	2.5 MPa
Recommended Hydraulic Oil	ISO VG32/46 or Equivalent
Max Driving Diameter	Φ50mm

## 2 OUTSIDE VIEW



### 3 STRUCTUAL DRAWING



#### 4 OPERATING PRINCIPLE

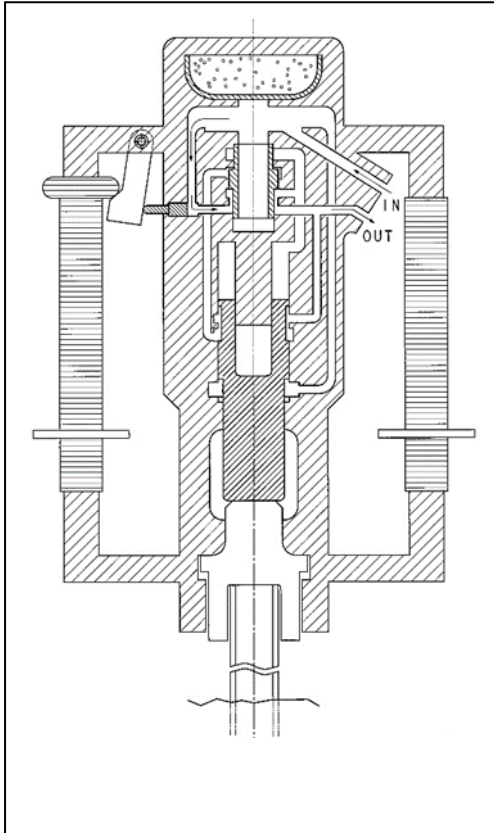


Fig.1

The hydraulic oil that has flowed in from the inlet flows out from the 3rd valve chamber to the outlet, so the pile driver does not operate.

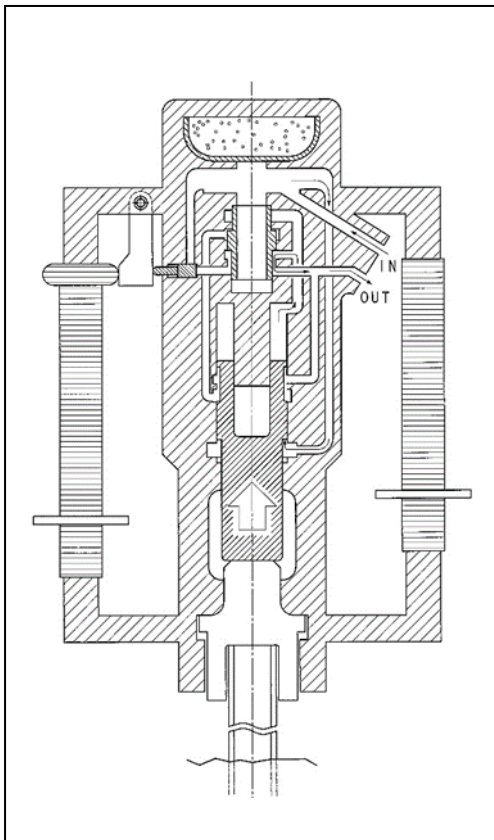


Fig.2

When the operating grip is pushed down, the cam pushes the valve rod and the circuit to the outlet is closed.

The hydraulic oil that has flowed into the upper chamber from the inlet flows into the lower piston chamber.

The piston is pushed up by the pressure in the lower piston chamber.

At this time, the hydraulic oil in the upper piston chamber is pushed out and flows out to the outlet through the 3rd valve chamber.

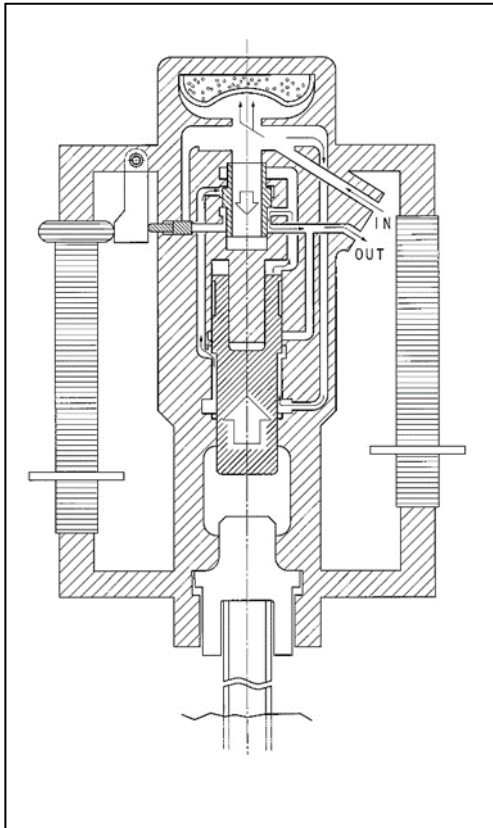


Fig.3

While the piston pushed up, some of the hydraulic oil that flows from the inlet into the upper chamber flows into the accumulator chamber. And the pressure pushes up the diaphragm and compresses the gas in the gas chamber.

When the end of the piston reaches the intermediate chamber, the high-pressure hydraulic oil in the lower piston chamber flows from the intermediate chamber into the 2nd valve chamber.

The control valve begins to be pushed down due to the pressure in the 2nd valve chamber

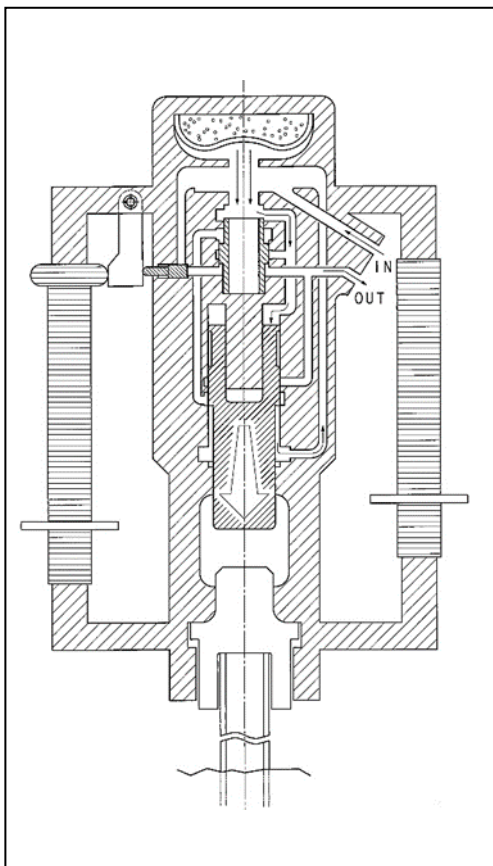


Fig.4

When the control valve is pushed down, the space between the upper chamber and the 1st valve chamber is opened, and at the same time, the space between the 3rd valve chamber and the lower port is closed.

The high-pressure hydraulic oil in the upper chamber flows from the 1st valve chamber through the passage to the upper piston chamber.

Since the area of the upper piston chamber is much larger than the area of the lower piston chamber, the piston is pushed down sharply by the pressure of the upper piston chamber. The hydraulic oil in the lower piston chamber is pushed out and flows back into the upper chamber.

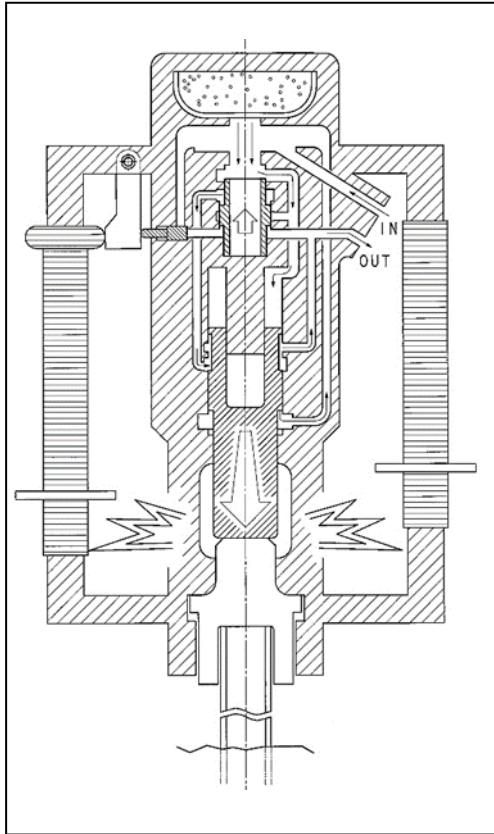


Fig.5

While the piston is being pushed down, hydraulic oil in the gas chamber is released and supplied from the 1st valve center chamber thorough passage to the upper piston chamber to increase the pressure in the circuit.

The tip of the piston hits the head of the anvil, which transfers this striking energy and hits the stake or pipe.

When the piston hits the anvil's head, the end of the piston reaches the intermediate chamber and connects between the intermediate chamber and the low-pressure port

The hydraulic oil in the 2nd valve chamber flows out to the outlet via the intermediate chamber and the low-pressure port.

It begins to push up the control valve due to the depression of the pressure in 2nd valve chamber and pressure on intermediate chamber.

The control valve is pushed up and it returns to the state as Fig.1, and the piston is pushed up again.

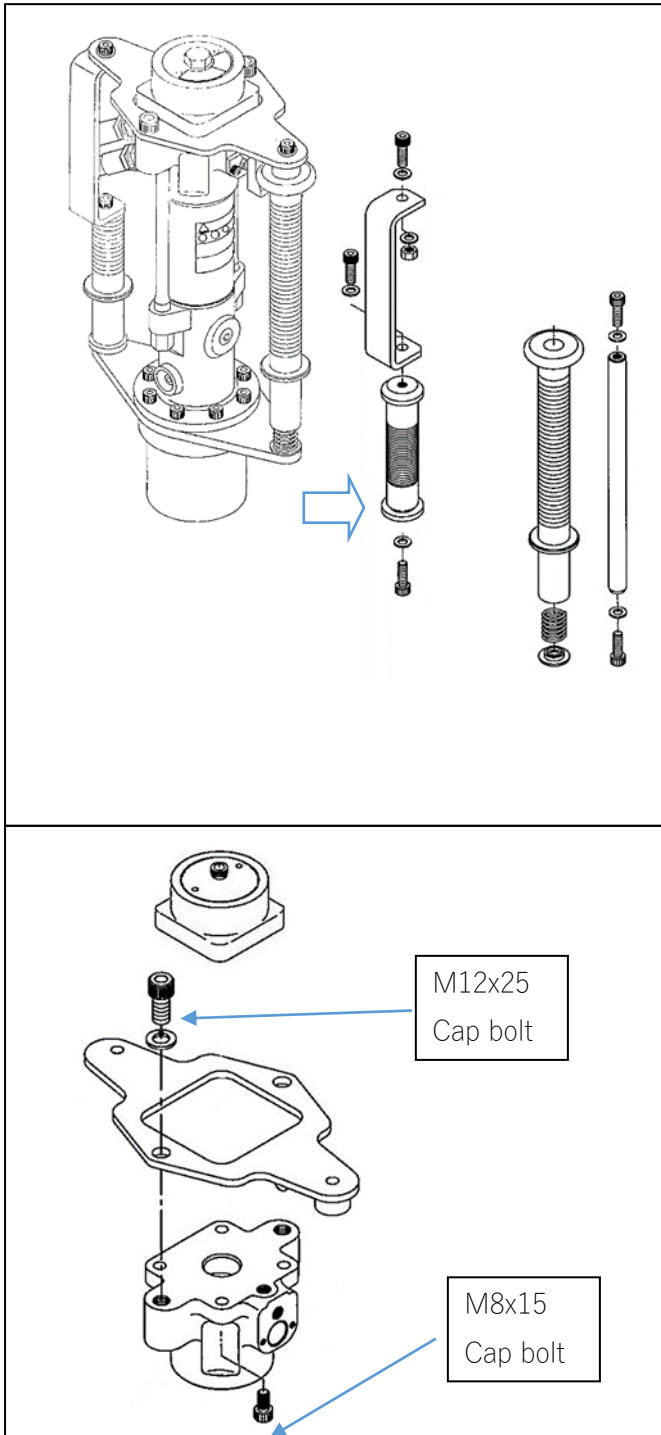
After that, by repeating the same operation, the anvil is hit continuously.



## 5 SPECIAL JIG LIST

<p>Wrench M68 M71053</p> <p>Technical drawing of Wrench M68 M71053 showing three views: side, front, and top. Dimensions include 38, 9, 40, 9, 45, and 2-M10.</p>	<p>Handle T-726</p> <p>Technical drawing of Handle T-726 showing two views: side and front. Dimensions include 400, 30, 20±0.1, 2-M10, 45±0.1, 32, 9, and 16.</p>
<p>Nut M71054</p> <p>Technical drawing of Nut M71054 showing a side view with dimensions: outer diameter 55, height 28, and inner diameter 26.</p>	<p>Bolt T-727</p> <p>Technical drawing of Bolt T-727 showing a side view with dimensions: outer diameter 55, height 28, and inner diameter 26.</p>
<p>Gas charging valve T-2411</p> <p>Technical drawing of Gas charging valve T-2411 showing a side view of the valve assembly with a gauge and handle.</p>	

## 6 DISASSEMBLY



### 6-1 Preparation before disassembling

- ① Carry out disassembling in clean place.
- ② To Prevent mis-assembling, all the disassembled main parts should be marked with white pen.
- ③ To attach the tag which is written the remarkable notices to the main parts to prevent mis-assembling.
- ④ When fixing each part with a vise, use a copper plate or the like to fix it so that it will not be scratched

### 6-2 Disassembling of handle.

- ① Remove M8x25 cap bolt by hex wrench 6mm
- ② Handle pipe, handle shaft, operating grip, spring, and spring

stay can be removed.

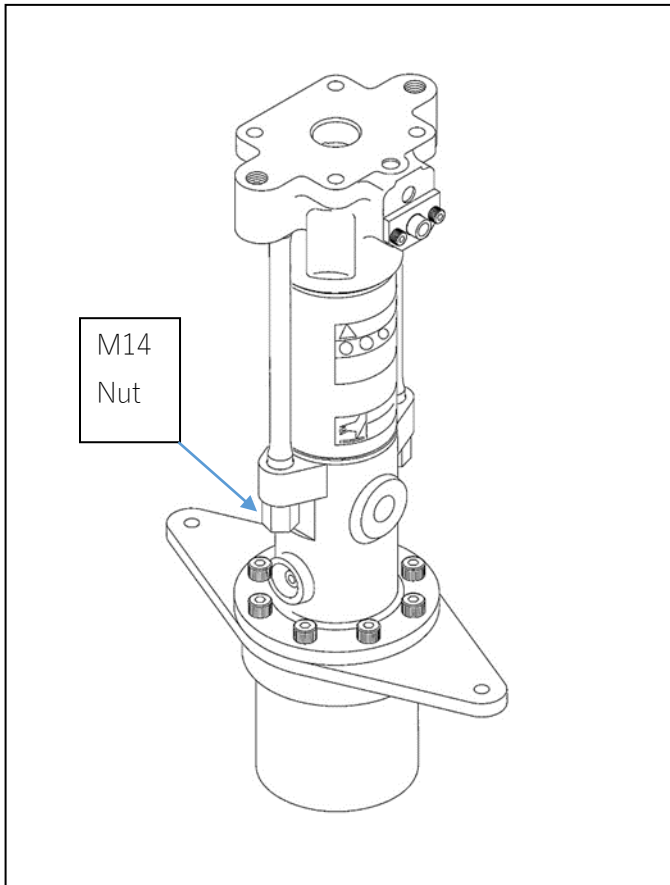
### 6-3 To remove accumulator.

- ① Remove M8x15 cap bolt by hex wrench 6mm.
- ② Take off accumulator Assy'.

\*Be careful: High-pressure gas is filled in the accumulator.

**DO NOT BURN WITH GAS TORCH.**

- ③ Remove M12x25 cap bolt by hex wrench 10mm.
- ④ Remove the top plate.

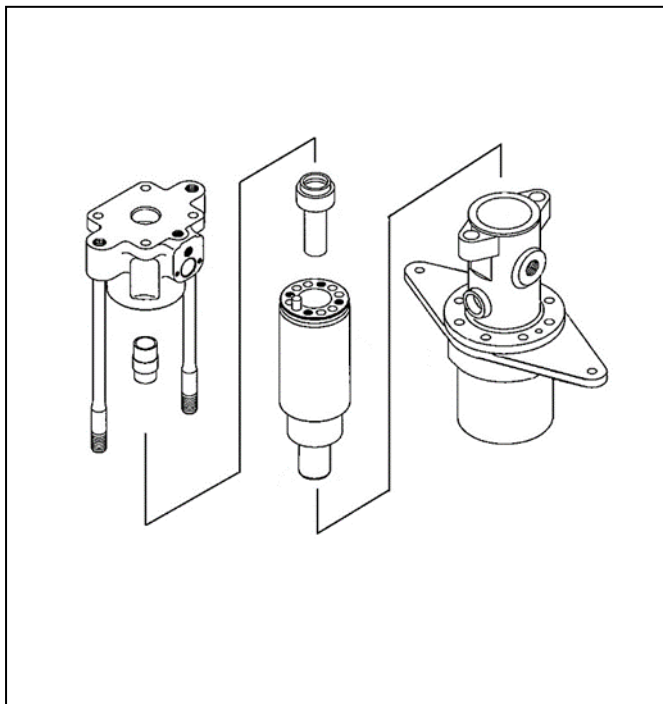


#### 6-4 Disassembling main body

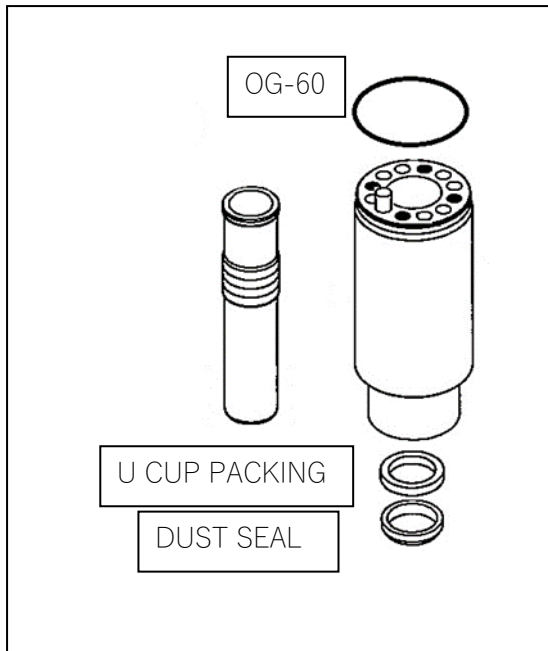
- ① Heat the M14 nut with a gas torch to burn the anaerobic adhesive. (2 parts)

\*Be careful: When heating the implant part of the draw bolt, wait until the nitrogen gas is completely released before starting work.

- ② Loosen and remove the M14 nut with a 19mm spanner.



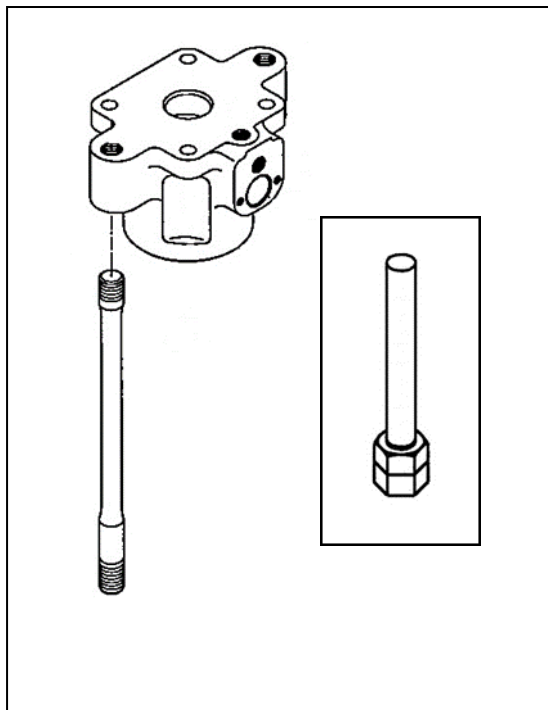
- ③ Lift up and remove the valve body.
- ④ Remove the control valve.
- ⑤ Take off the cylinder from the front end.
- ⑥ Remove inner tube.
- ⑦ Take of the piston.



#### 6-5 Taking off the oil seal.

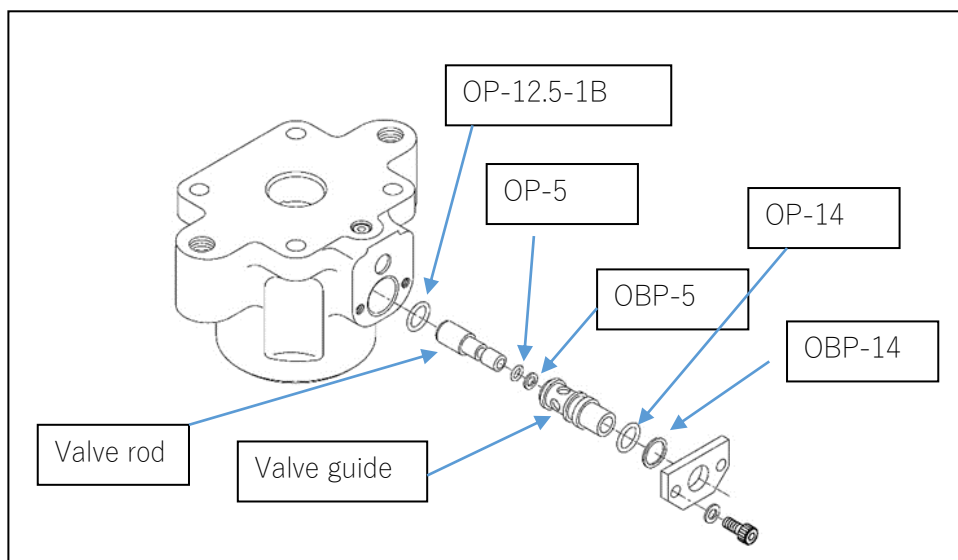
- ① Taking off O-ring (OG-60)
- ② Taking off dust seal with flat blade screw driver.
- ③ Pierce u cup packing by awl and remove it.

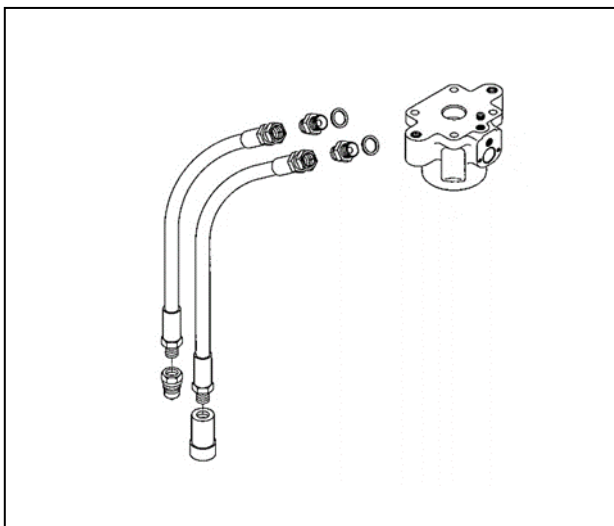
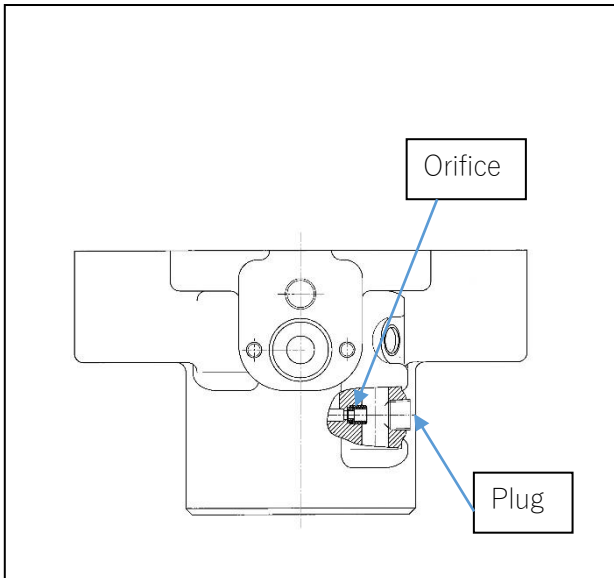
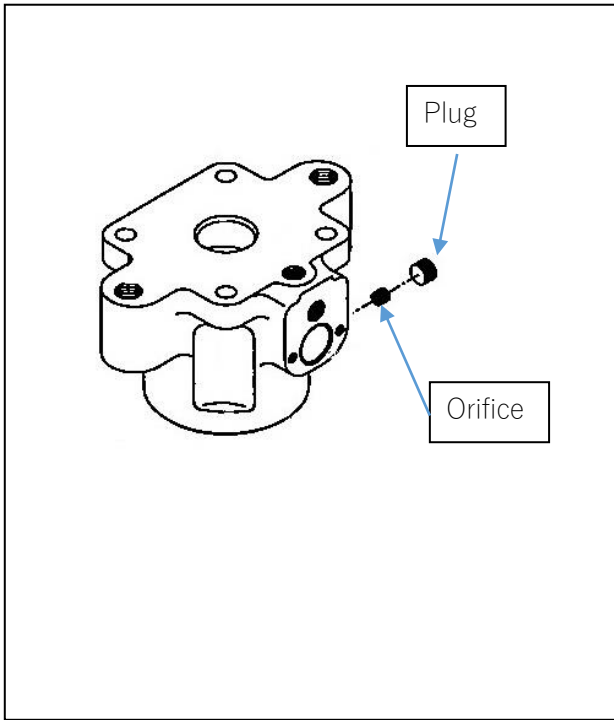
**\*DO NOT RE-USE U CUP PACKIN AND DUST SEAL.**



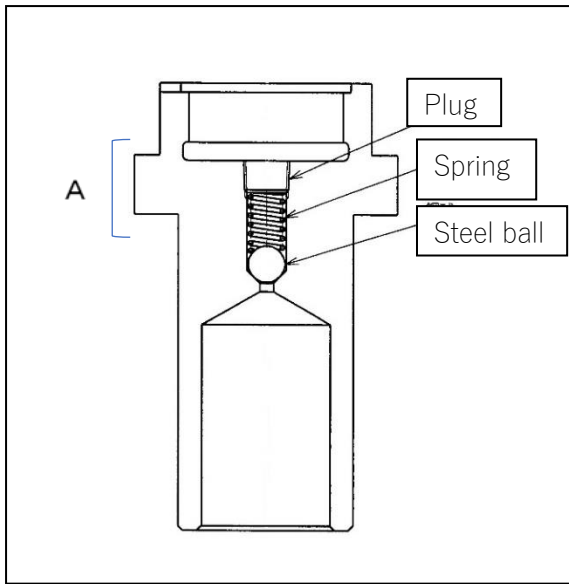
#### 6-6 Disassembling the valve body

- ① Heat the implantable part of the draw bolt with a gas torch and burn the anaerobic adhesive.
- ② Loosen the draw bolt with double nuts and remove it.
- ③ Remove M5x12 cap bolt by hex wrench 6mm.
- ④ Plate, valve guide, valve rod and each O-ring can be removed



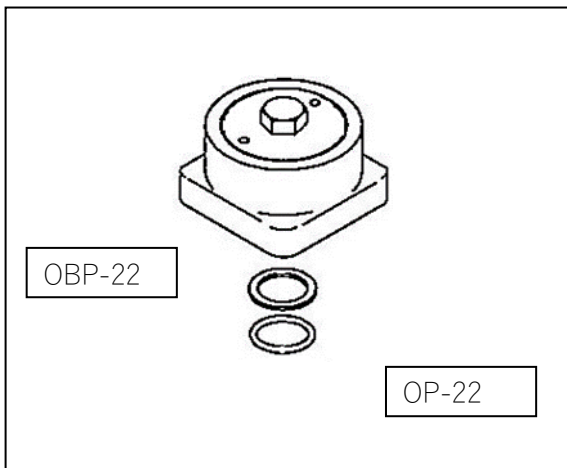


- ⑤ Heat 1/8 taper plug with a gas torch and burn the anaerobic adhesive.
- ⑥ Remove 1/8 taper plug by hex wrench 5mm.
- ⑦ Loosen orifice assembled as figure by hex wrench 3mm and remove it with pressing carefully for not to fall it.
- ⑧ Remove cap nut of the hydraulic hose by spanner 22mm.
- ⑨ Remove connector by spanner 22mm. At the same time, seal washer can be removed.
- ⑩ Fix the fitting of the hydraulic hose with spanner 19mm, and remove the coupler by spanner 24mm.



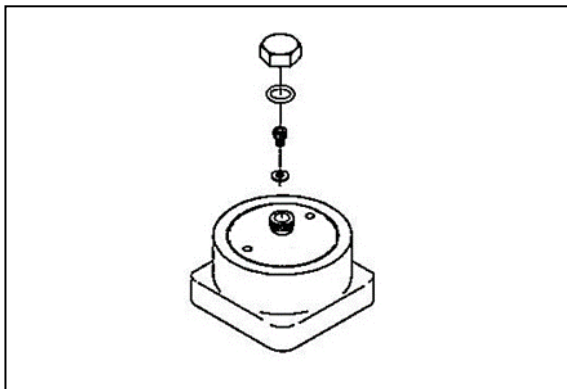
### 6-7 Disassembling inner tube

- ① Fix the A part of the inner tube by vise.
- \* When fixing each part with a vise, use a copper plate or the like to fix it so that it will not be scratched.
- ② Take off the 1/8 taper plug by hex wrench 5mm.
- ③ Take off the spring and steel ball.



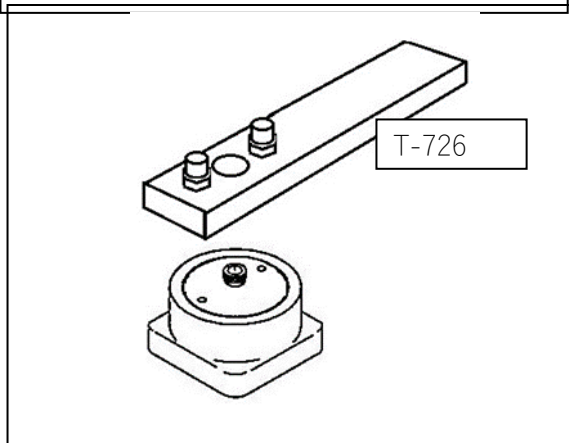
### 6-8 Disassembling accumulator.

- ① Fix the accumulator Assy' by vise.
- ② Take off the O-ring (OP-22) and back up ring (OBP-22).



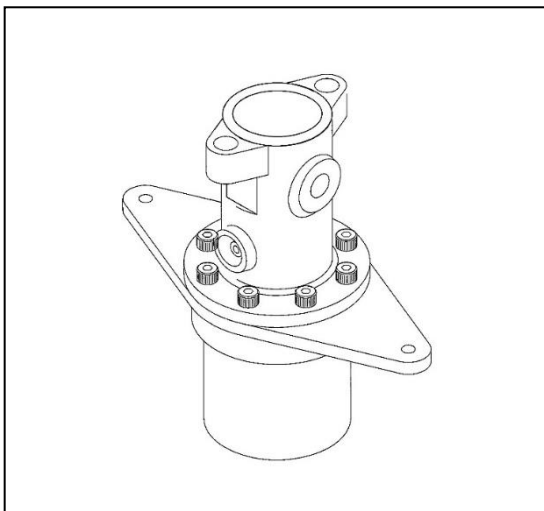
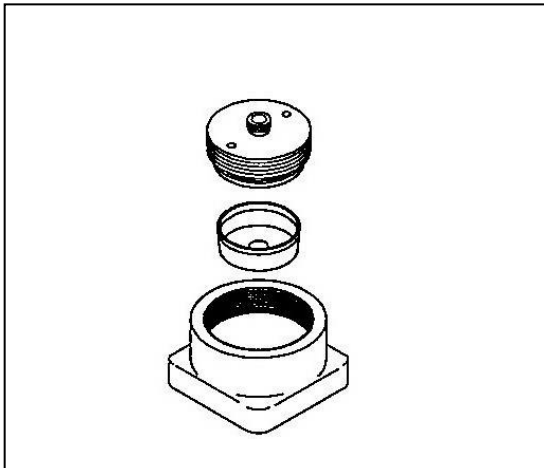
- ③ Take of the cap nut by spanner 22mm.
- ④ Take off the O-ring (OP-22.4).
- ⑤ Loosen the cap bolt slowly by hex wrench 5mm with pressing the waste rug.

And then, release enclosed Nitrogen gas.



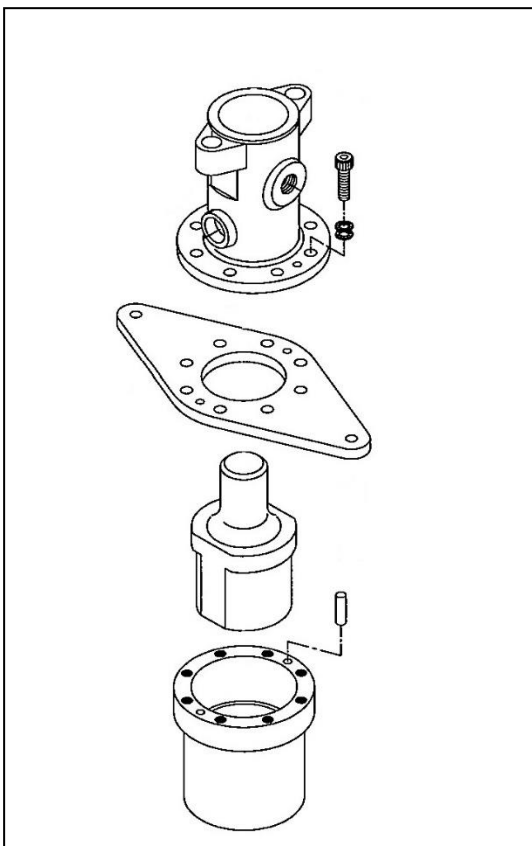
- ⑥ Attach the handle (T-726) with the rid and fix it.
- ⑦ Remove the rid of the accumulator by the handle (T-726).
- ⑧ Remove the fitted diaphragm carefully by thin flat blade screw driver.

\*Be careful not scratch the accumulator.



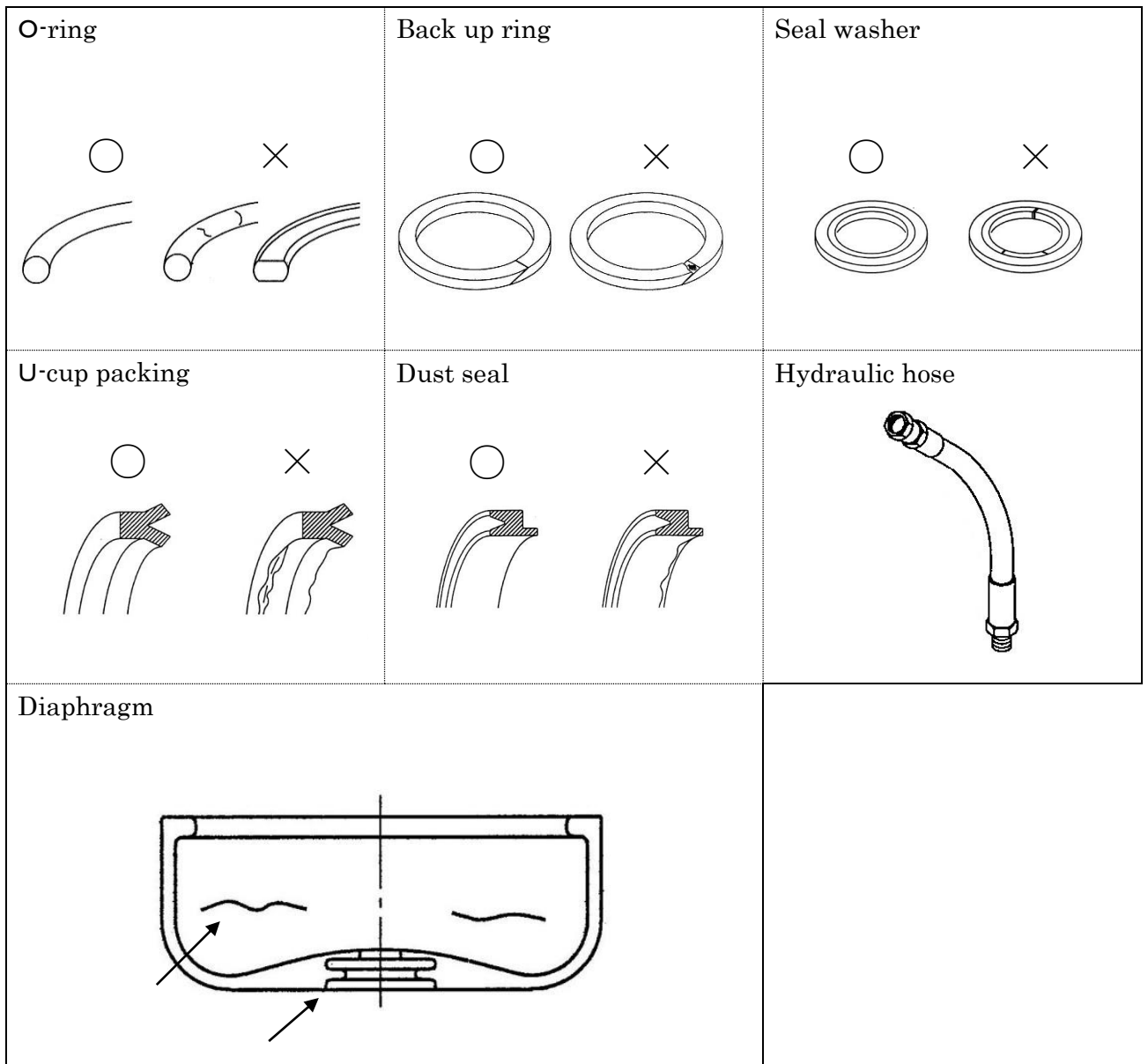
6-9 Disassembling the post cover.

- ① Fix the post cover part by vise.
- ② Take off the M8x30 cap bolt (8pcs) and NL8DP Nord lock washer (8pcs) by hex wrench 6mm.
- ③ Remove the front cap.
- ④ Remove the flange.
- ⑤ Remove the anvil.



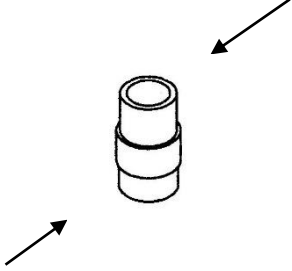
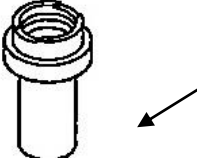
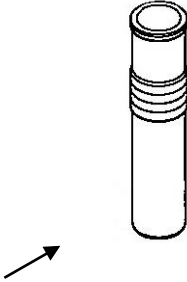
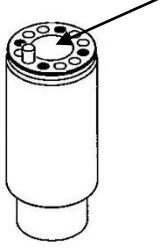
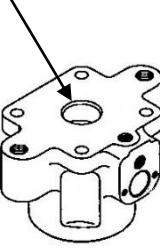
## 7. Inspection after disassembly

- ① Replace the U-cup packing and Dust seal.  
Replace O-ring which is deformed, wear, scratch or harden.
- ② Replace the diaphragm which is cracked or wear.
- ③ Make sure if there is any deformation, wear and scratch on the surface of each part.
- ④ Replace the parts with rusted or scratched sliding part.
- ⑤ Replace the valve body if the oil passage of it is eroded by cavitation.

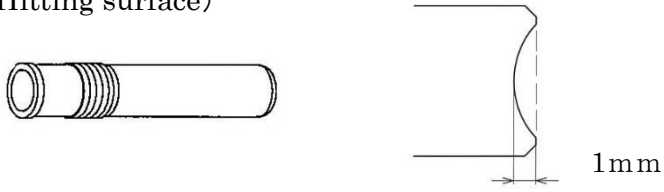
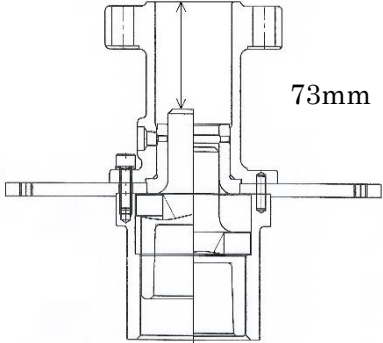
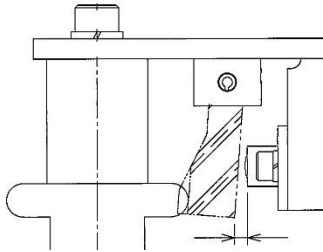




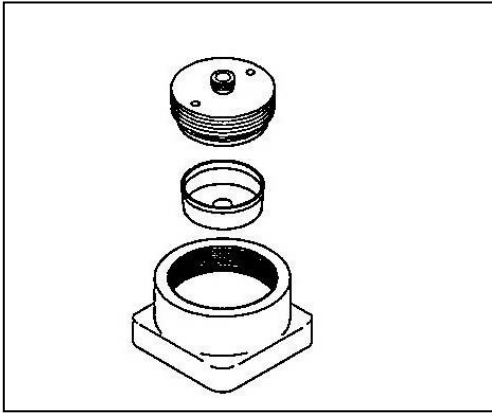
Sliding part

<p>Control valve</p>  A technical drawing of a control valve, which is a small cylindrical component with a slightly wider top section. Two arrows point towards it from the bottom-left and top-right.	<p>Inner tube</p>  A technical drawing of an inner tube, a cylindrical component with a threaded top section. An arrow points towards it from the bottom-right.	<p>Piston</p>  A technical drawing of a piston, a long cylindrical component with several rings near the top. An arrow points towards it from the bottom-left.
<p>Cylinder</p>  A technical drawing of a cylinder, a long cylindrical component with a flange at the top. An arrow points towards the top flange from the top-right.	<p>Valve body</p>  A technical drawing of a valve body, a complex cast component with a central opening and several side ports. An arrow points towards the central opening from the top-left.	

## Marginal wear

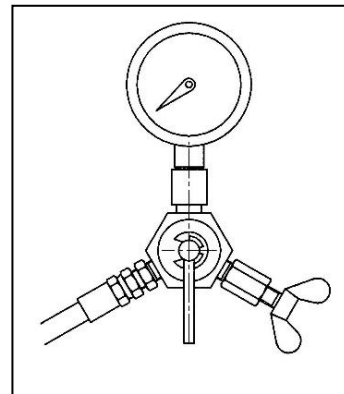
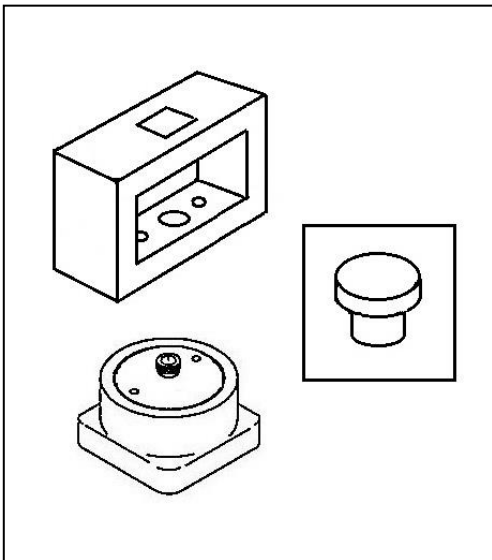
Description	Standard dimension	Limited dimension
<p>Piston (Hitting surface)</p> 	150mm	149mm
<p>Bush, Anvil (Hitting point)</p> 	73mm	71mm
<p>Cum part (Gap)</p> 	1.2mm	5.1mm

## 8. Assembling

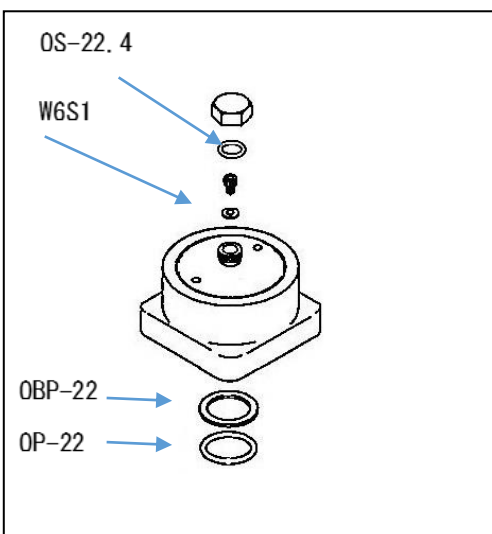


### 8-1 Assembling accumulator

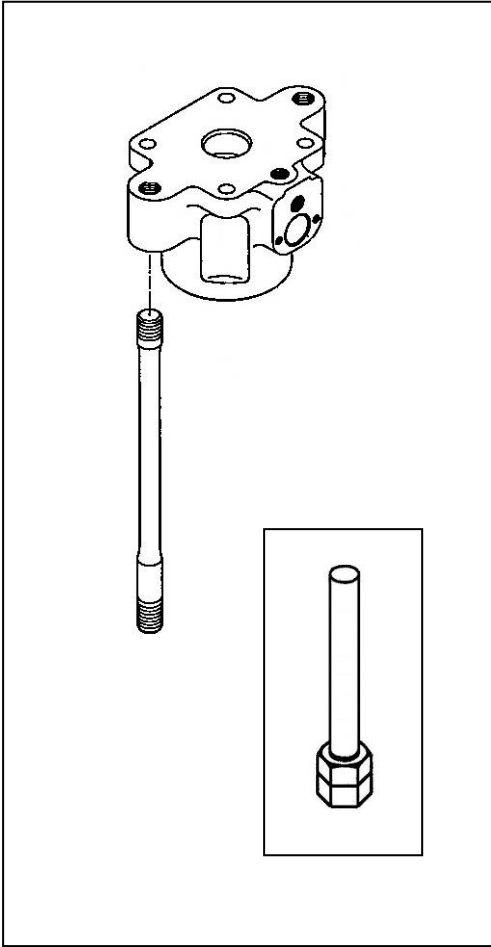
- ① Clean the inner diameter of the shell and then fix by vise.
- ② Clean the lid and fit the diaphragm into the groove.
- ③ in the groove of the lid.
- ④ Apply the hydraulic oil to inner diameter of the shell and perimeter of the diaphragm.
- ⑤ Fit the shell and lid carefully, and tighten slowly.
- ⑥ Set the jig wrench M71053 with lid and fix with jig nut M71054.
- ⑦ Tighten until the screw part of the lid Tightening torque 200 N · m



Charging valve  
external view

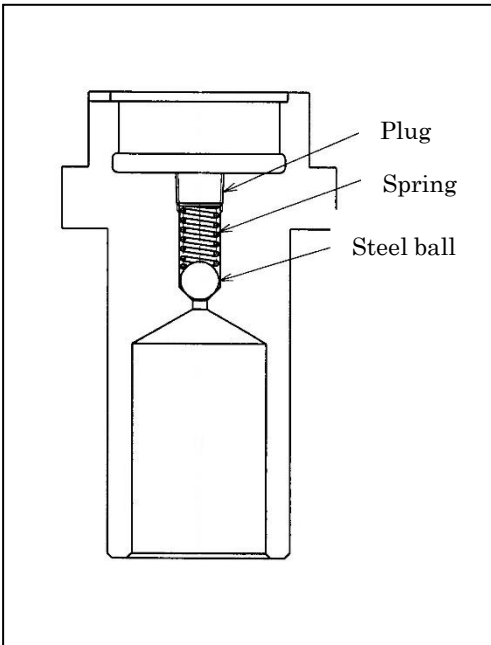


- ⑧ Fit the seal washer (W6S1) into the cap bolt and attach it to the screw part of the center of the lid.
- ⑨ Fill with nitrogen gas. 4.0 MPa
- ⑩ Apply the hydraulic oil to the O-ring (OS-22.4) and set into the groove of the cap nut.
- ⑪ Tighten the cap nut by spanner 27mm.  
Tightening torque : 60N · m
- ⑫ Apply the hydraulic oil to the O-ring (OP-22) and back up ring (OBP-22) and put into the groove.



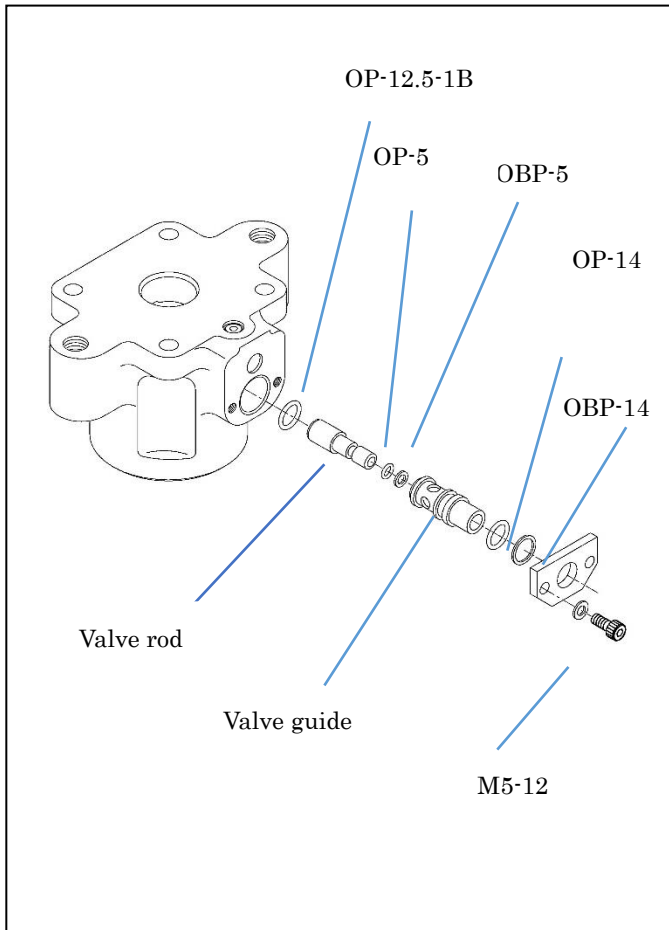
### 8-2 Attaching the draw bolt.

- ① Fix the shell part by vise.
- ② Degrease the M14 female threaded part of the valve body and the threaded part of the draw bolt.
- ③ Apply anaerobic adhesive high-strength screw lock (1305N) to the shorter thread part of the draw bolt.
- ④ Tighten the draw bolt to the threaded part of the valve body with a double nut or a draw bolt socket of a commercially available tool.
- ⑤ Tightening torque 56 N · m



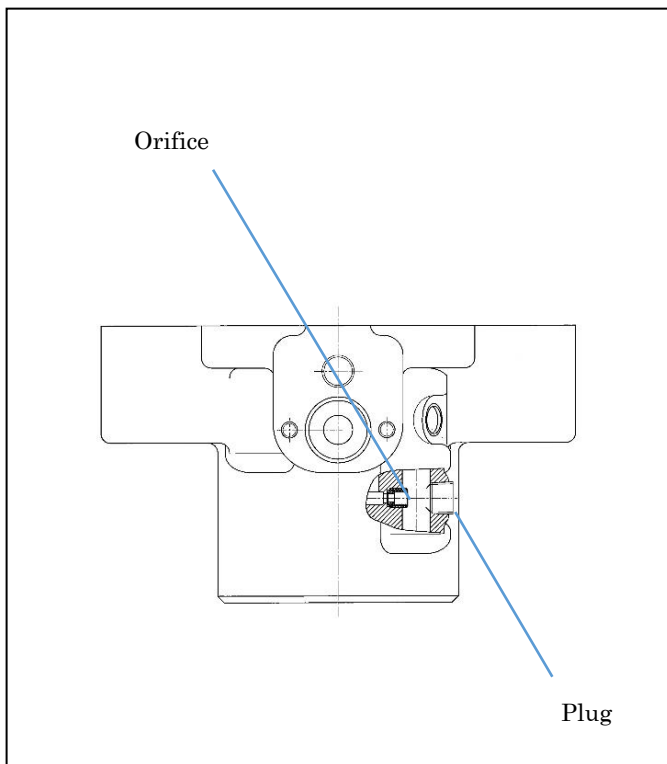
### 8-3 Assembling inner tube

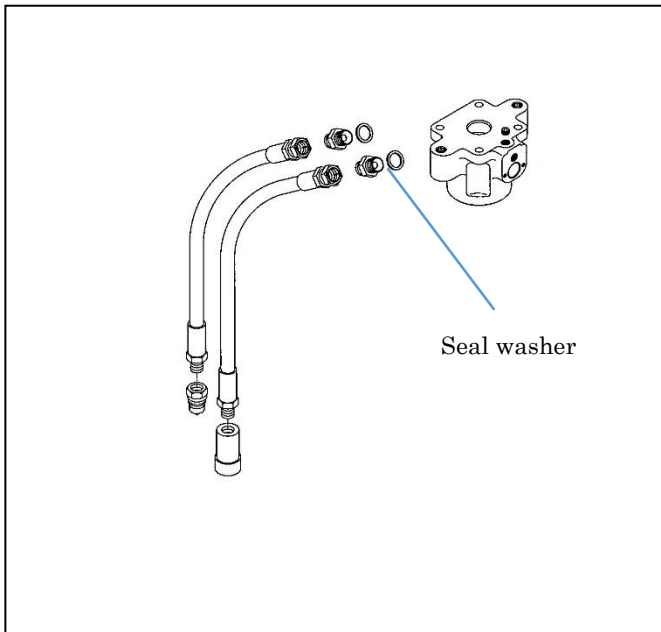
- ① Fix the inner tube by vise.
- ② Wrap sealing tape around the 1/8 taper plug.
- ③ Put the steel ball and spring into the inner tube, and then tighten the taper plug by hex wrench 5mm.
- ④ Tightening torque 25N · m



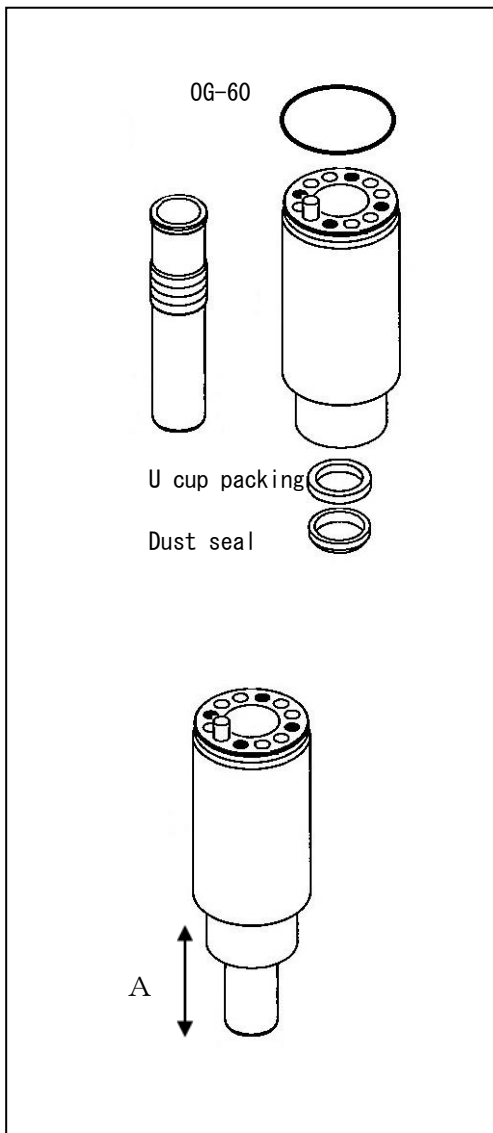
#### 8-4 Assembling valve body

- ① Apply the hydraulic oil to the O-ring (OP-5) and back up ring (OBP-5), and then attach them to the valve rod.
- ② Apply the hydraulic oil to the O-ring (OP-14, OP-12.5-1B) and back up ring (PBP14), and then attach them to the valve guide.
- ③ Push the valve rod into the valve guide.
- ④ Degreasing the cap bolt and the screw part to attach, and then apply the anaerobic adhesive low-strength screw lock (1342J).
- ⑤ Tighten the M5x12 cap bolt by Hex wrench 4mm. Tightening torque 8N.m.
- ⑥ Degreasing the orifice and screw part of the valve body.
- ⑦ Apply the anaerobic adhesive high-strength screw lock (1303B).
- ⑧ Tighten the orifice by hex wrench 3mm.  
Tightening torque: 6.5 N · m
- ⑨ Wrap the sealing tape around 1/8 plug.
- ⑩ Tighten the 1/4 taper plug by hex wrench 5mm.  
Tightening torque: 25N · m



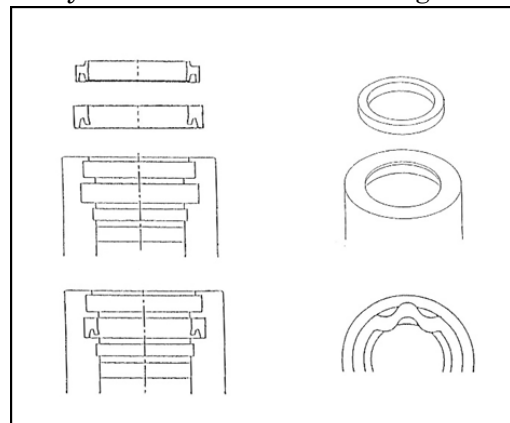


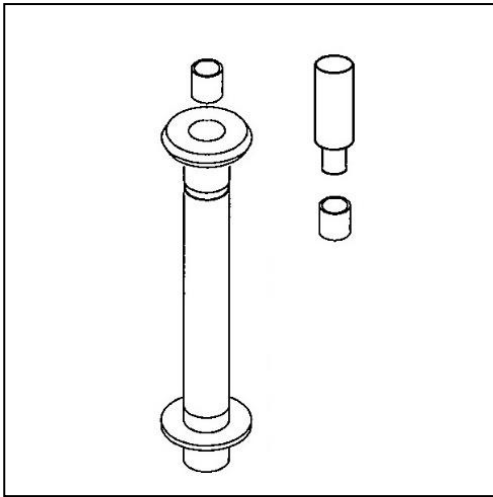
- ⑪ Wrap the sealing tape around taper screw of the hydraulic hose.
- ⑫ Attach the coupler by spanner 19mm and 24mm.  
Tightening torque: 56N · m
- ⑬ Attach the connector and seal washer (W18S1) by spanner 22mm.  
Tightening torque: 56N · m
- ⑭ Attach the hydraulic hose by spanner 22mm.  
Tightening torque: 56N · m



#### 8-5 Attaching oil seal

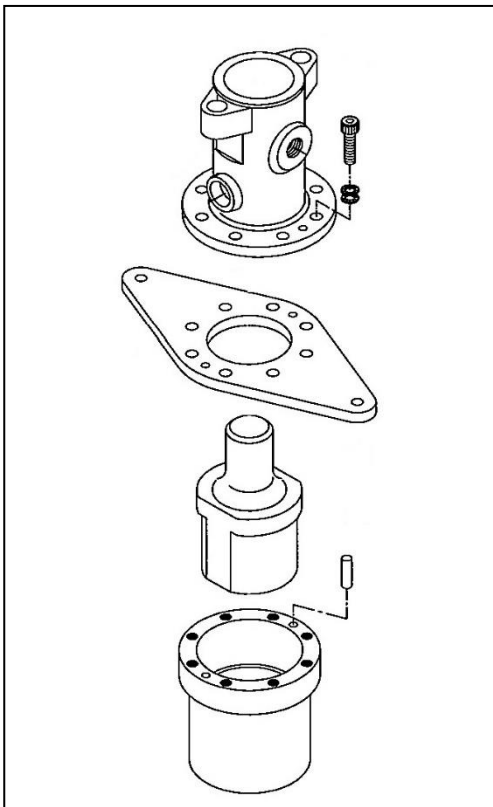
- ① Apply the hydraulic oil to the O-ring (OG-60), and fit it into the groove.
- ② Apply the hydraulic oil to the Packing fitting part of the inner diameter of the cylinder, u cup packing and dust seal.  
OG-60
- ③ Press the U-cup packing flat on the inner diameter of the cylinder with your finger and fit it into the groove
- ④ Fit dust seal into the groove as same way.
- ⑤ Apply the hydraulic oil to the sliding part of the piston, and then insert it from above of the cylinder.
- ⑥ Grab the A part of the piston, and check the sliding.
- ⑦ Wipe off the hydraulic oil with waste rug.





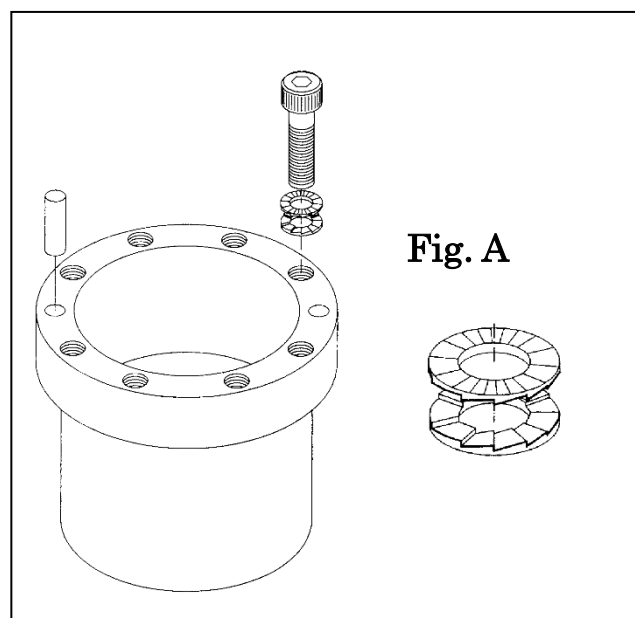
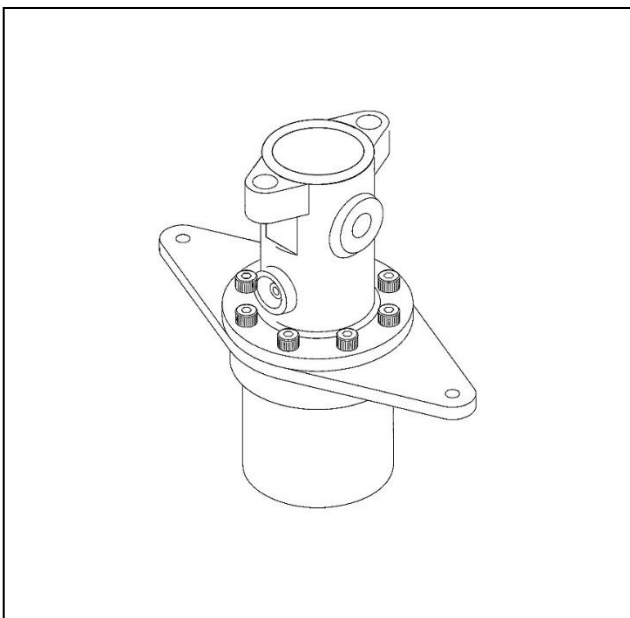
#### 8-6 Assembling the operation grip.

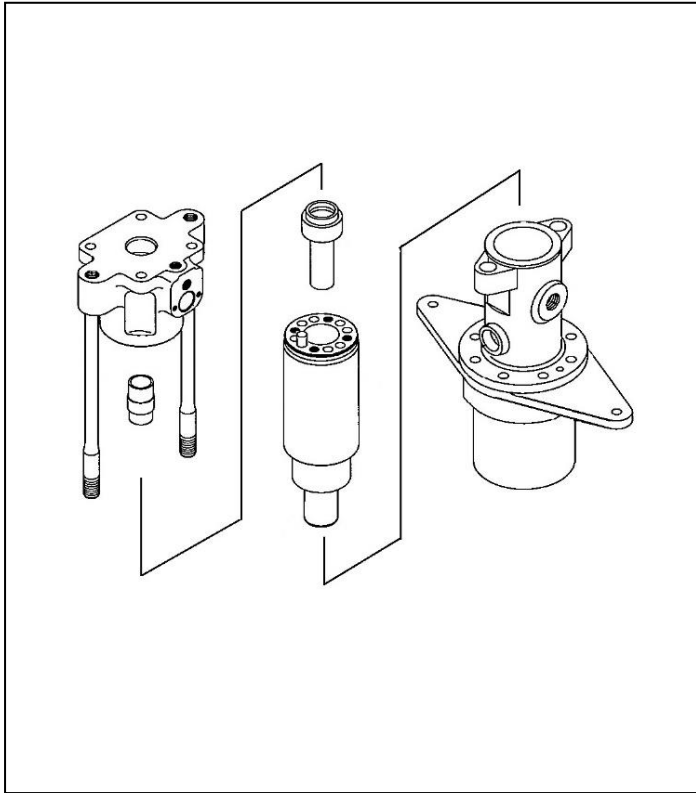
- ① Clean the inner diameter part of the operation grip.
- ② Apply the hydraulic oil to the DU bush.
- ③ Set the special jig tools, and press it by hand press machine.



#### 8-7 Assembling the post cover.

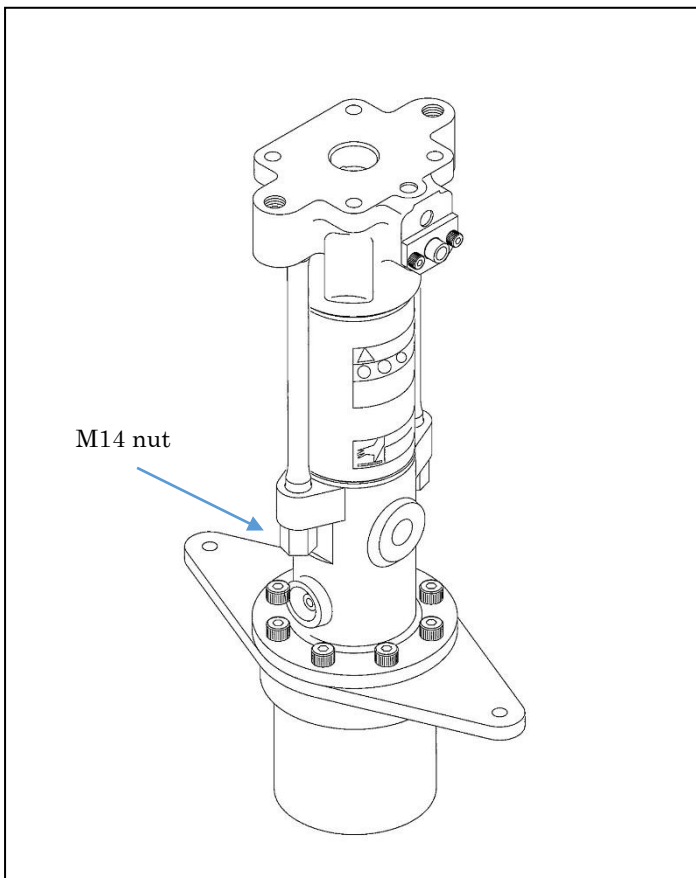
- ① Fix the post cover part by vise,
- ② Apply the hydraulic oil to the positioning pin and hit lightly by shockless hammer.
- ③ Apply the grease to the upper part of the anvil and sliding part of the front cap.
- ④ Attach the anvil into the post cover.
- ⑤ With the groove on the flange facing down, attach it according to the positioning pin
- ⑥ Attach the front cap according to the positioning pin.
- ⑦ Assemble M8x30 cap bolt with Nord lock washer. (Fig. A)
- ⑧ Tighten the M8x30 cap bolt evenly by hex wrench 6mm. (8 pcs)
- ⑨ Tightening torque 35N · m



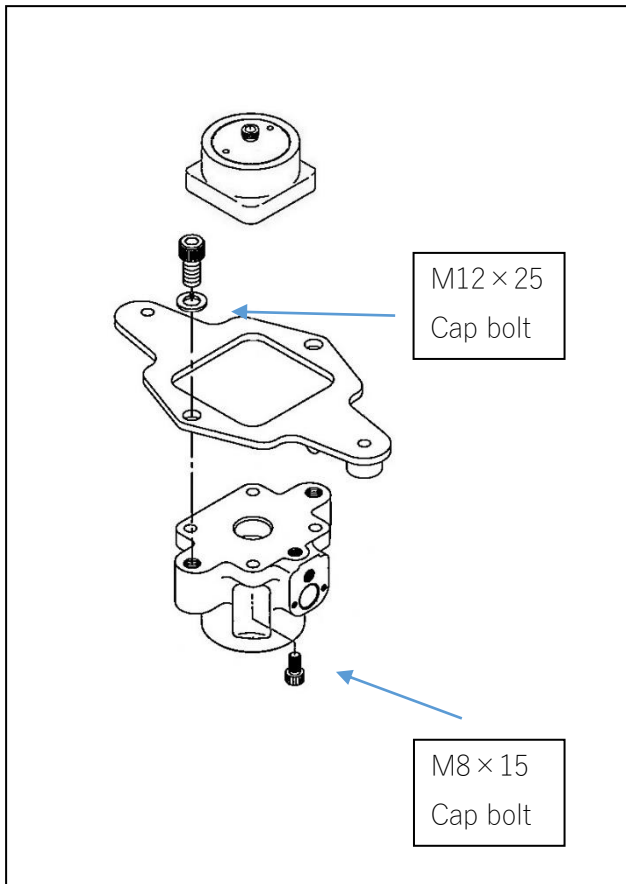


8-8 Assembling the main body.

- ① Fix the part A of post cover by vise.
- ② Insert the cylinder Assy' into the inner diameter of front cap.
- ③ Apply the hydraulic oil to the control valve and inner tube.
- ④ Insert the inner tube into the inner diameter of the piston.
- ⑤ Insert the control valve into the inner diameter of the inner tube.
- ⑥ Align the draw bolt with the hole on the front cap and push it in.
- ⑦ Degrease the screw part of the draw bolt and M14 nut, apply anaerobic adhesive high-strength screw lock (1303B).
- ⑧ Tighten the 14 nut by spanner 19mm.
- ⑨ Tightening torque:  $56\text{N} \cdot \text{m}$



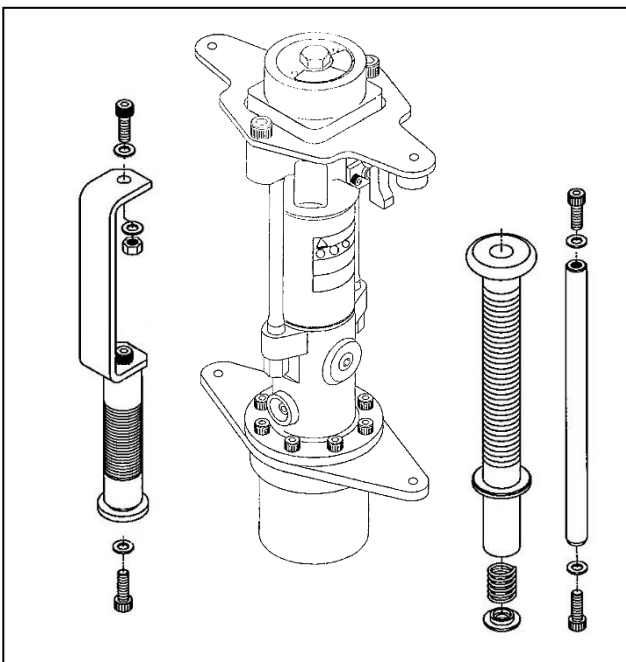




### 8-9 Assembling main body

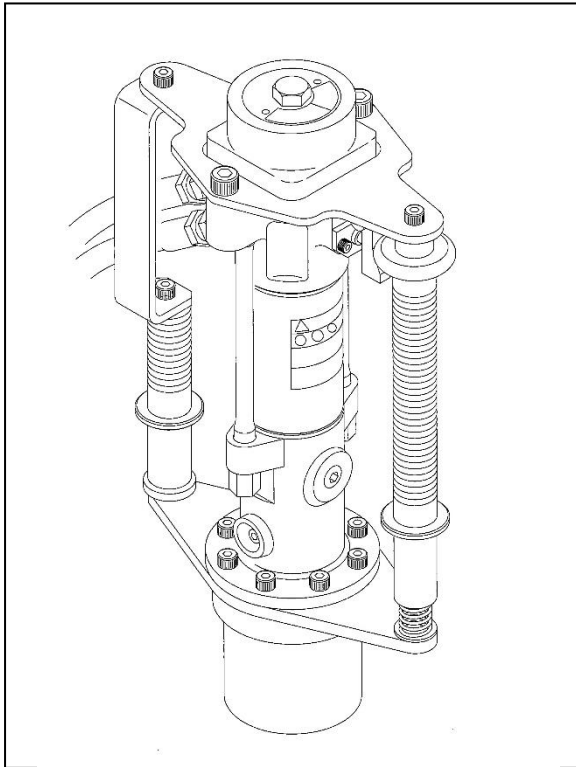
(Accumulator part.)

- ① Degrease the cap bolt M12x35 (2pcs), M8x15 (4pcs), screw part where attaching.
- ② Set the accumulator on the valve .
- ③ Apply anaerobic adhesive low-strength screw lock (1342J).
- ④ Tighten the M8x15 cap bolt by hex wrench 6mm.
- ⑤ Tightening torque: 35N · m
- ⑥ Set the top plate on the valve body, and then tighten the M12x25 cap bolt by hex wrench 10mm.
- ⑦ Tightening torque: 100N · m



### 8-10 Assembling the handle part.

- ① Degrease the M8x25 cap bolt (4 pcs) and screw part where attaching.
- ② Apply anaerobic adhesive high-strength screw lock (1305N)
- ③ Insert the handle shaft into the operation grip, and then set the spring and spring holder, and attach them to the main body.
- ④ Attach the handle pipe Assy to the main body. Adjust so that the stay does not interfere with the hydraulic hose.
- ⑤ Tighten M8c25 cap bolt by hex wrench 6mm. Tightening torque: 35N · m



Completed

## 9. About Hydraulic Oil

### 9-1 Characteristics and species

Hydraulic oil is the liquid to be used in hydraulic systems as a transmitting agent of power. It effects lubricating, anti-rust and cooling etc. To fulfill the functions of hydraulic tools, always use the suitable hydraulic oil.

Industrial Hydraulic Oil . . . ISO Viscosity Grade VG32, 46

Species . . . . . Wear Resistant Hydraulic Oil

Recommended Oil . . . . . Shell Talus 32

ISO viscosity grade shows the viscosity of hydraulic oil on 40°C. Unit: mm<sup>2</sup>/s. Each viscosity grade has a range of allowance of 10%

### 9-2 Replacement of Hydraulic Oil

Check and refill . . . every time

Replace all . . . . . every 100 hours

Hydraulic oil should be replaced in the specified period. The deterioration of hydraulic oil will be a cause of the troubles of hydraulic tools and may cause the drop down of performance, pressure decrease, unstable operation and leakage of oil by the damage of packing.

## 10 Trouble Shooting

Symptom of Trouble	Cause	Countermeasure
Impact power is weak Hoses are shaking abnormally	Less nitrogen gas pressure	Replace diaphragm Re-charge nitrogen gas
Impact power is weak	Looseness of through bolt nut	Re-tighten
Impact power is weak	Mud infiltrates the anvil	Disassemble and clean the anvil.
Impact power is weak	Rust and sticking of the anvil	Disassemble and clean the anvil.
Impact number is a few	Low output of hydraulic power unit	Check the power unit
Impact power is weak or no impact numbers	Wear of coupler	Replace coupler
Machine stops suddenly on operation	Coupler is disconnected	Check connection of coupler
Oil leaks	Rust of Piston Damage of oil seals	Replace piston Replace seals
No impact	Hydraulic hose is connected in reverse.	Connect hydraulic hose properly.

## 11 Notice on Long Storage

Connect the pile driver to the extension hose of the hydraulic unit, push the anvil from the bottom of the post cover of the pile driver, and push the piston to the upper limit.

Replace the 1/8 taper plug on the front cap with a grease nipple and grease it with a grease gun. After lubrication, return the grease nipple to the plug.

Clean the entire pile driver with an oil-moistened cloth and store it in a dry place.