# WORKSHOP MANUAL

## EX 200 – Hydraulic Excavator

DS Cat/part No.

SUPPLY ORDER NO: AT No.51021 – Proc/55x Hyd Exc 20 Ton /GS 2010 -11 /DGBR / E3ES Dt 07 Mar 2011

**SUPPLIED BY:**

**TELCON**

**TELCO CONSTRUCTION EQUIPMENT CO. LTD**

**KIADB BLOCK NO.2, BELLUR INDUSTRIAL ESTATE, MUMMIGATTI, DHARWAD – 580 007**

**PUBLISHED BY:**

**BHARAT SARKAR RAKSHA MANTRALAYA**

**ENGINEERY UPASKARON KA GUNVATHA ASHVASAN NIYANTRANALAYA**

**CONTTROLLERRATE OF QUALITY ASSURANCE OF ENGINEERING EQUIPMENT**
**AUNDH CAMP - PUNE – 411 027**

**Mar 2011**

**SERVICE HOTLINE TOLL FREE NO-1800 3456 500**

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## TO THE CUSTOMER,

This manual is prepared experienced technician to provide the technical information needed to maintain and repair this machine.In this manual included the technical information needed for maintenance and repair of the m/c, tools and devices needed for maintenance and repair, maintenance standards, and removal/Installation and assemble/disassemble procedures.

Any Errors or omissions and User's Queries should be referred to :

**The Product Support Manager,**

**Telcon Service And Spares Support Centre,**

**Telcon PIP - 3, Garag Road , Mummigatti**

**Dharwad – 580007.**

**Additional References are,**

EX 200 – Operation Manual

EX200- Parts Catalogue

**(SPECIFICATIONS AND DESIGN SUBJECT TO CHANGE WITHOUT NOTICE.)**

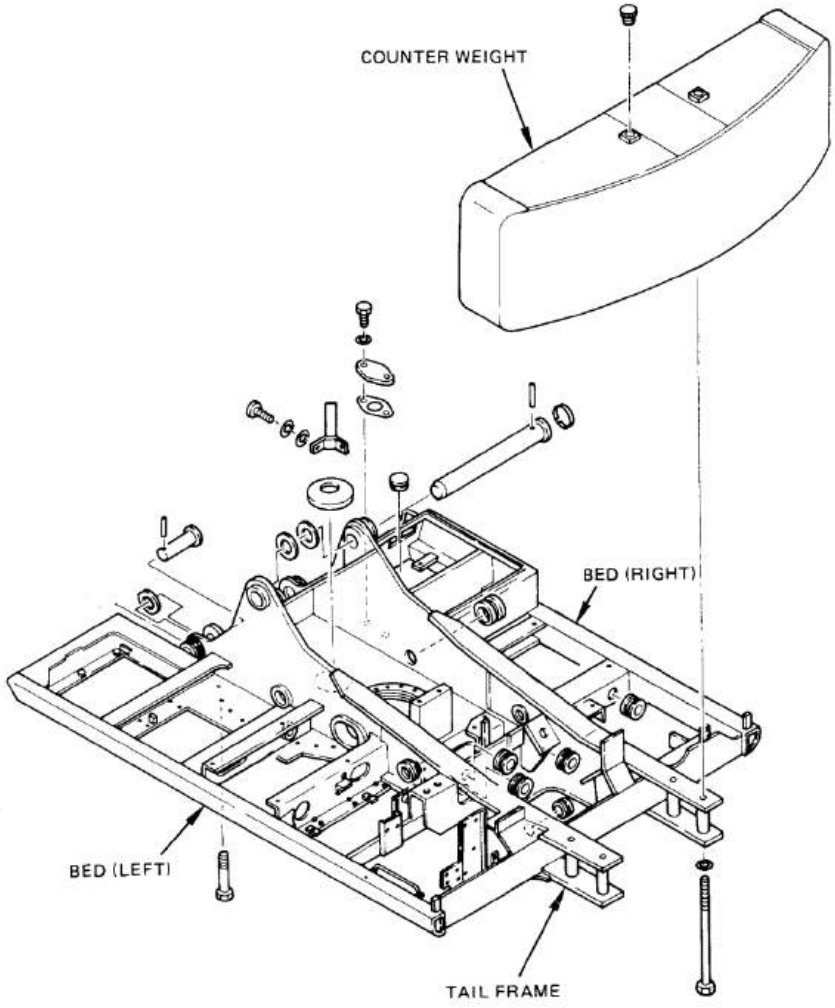
# CONTENTS

# SUPER STRUCTURE

# 1. MAIN FRAME & COUNTER WEIGHT

## 1.1 CONSTRUCTION

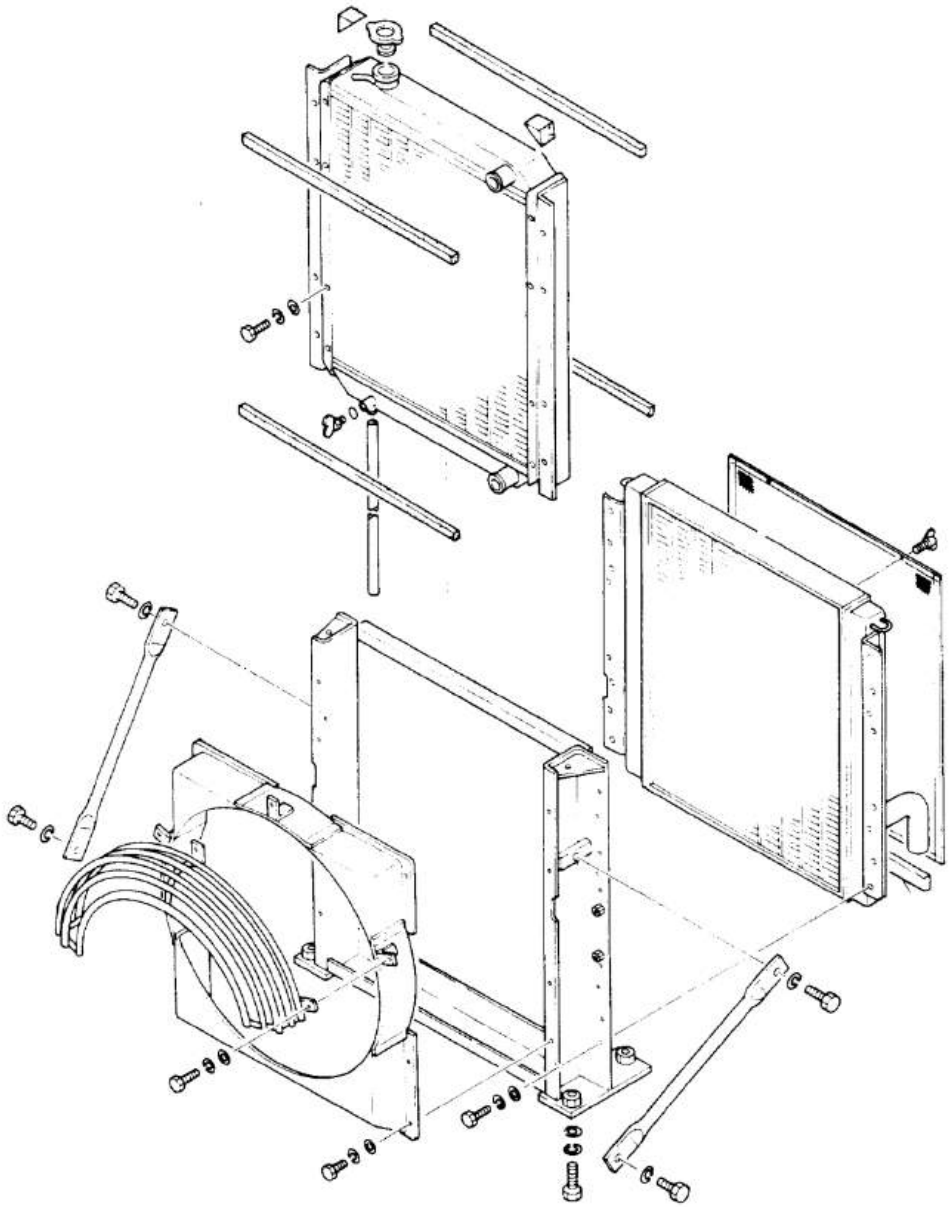
Main frame consists of center frame, bed (right, left) and tail frame.
They are welded together.
Swing device and control valve are installed to the center frame. Operator's cab and hydraulic oil tank are mounted on the left bed.
Fuel tank is mounted on the right bed.
Engine, pumps and counter weight are mounted on the tail frame.



### 2.1.2 RADIATOR

The radiator is installed in front of engine with the oil cooler, and it is cooled by engine fan.

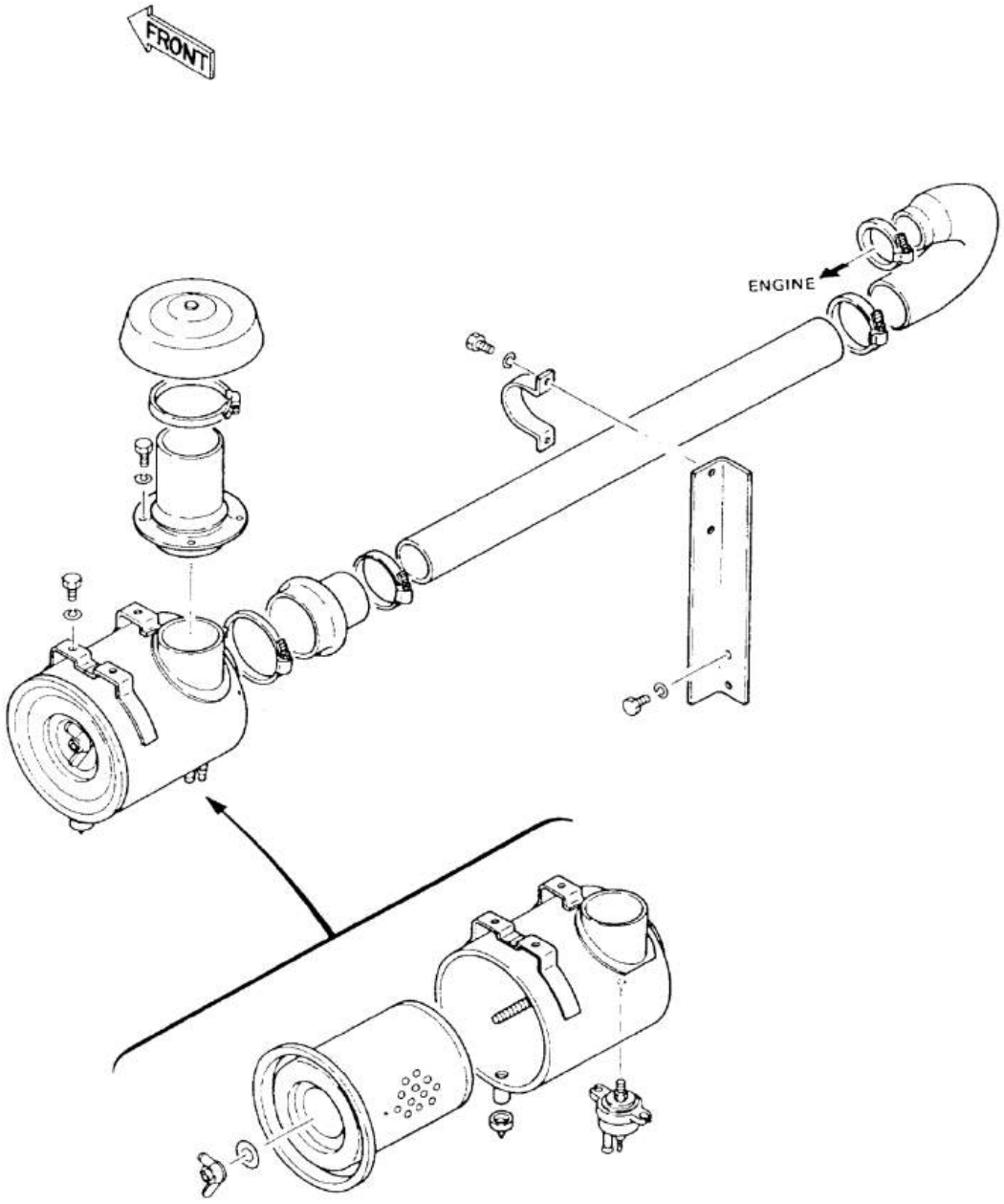
This machine is provided the water reserve tank to improve the ability and it has level switch connecting to OK monitor in the cab.



### 2.1.3 AIR CLEANER

Air cleaner consists of element, electric indicator and valve. This machine is provided with an air cleaner warning lamp which lights up in the monitor panel when the air cleaner cleaner's element becomes clogged.

Note: The additional element (for dusty condition) can be installed into the element (option).



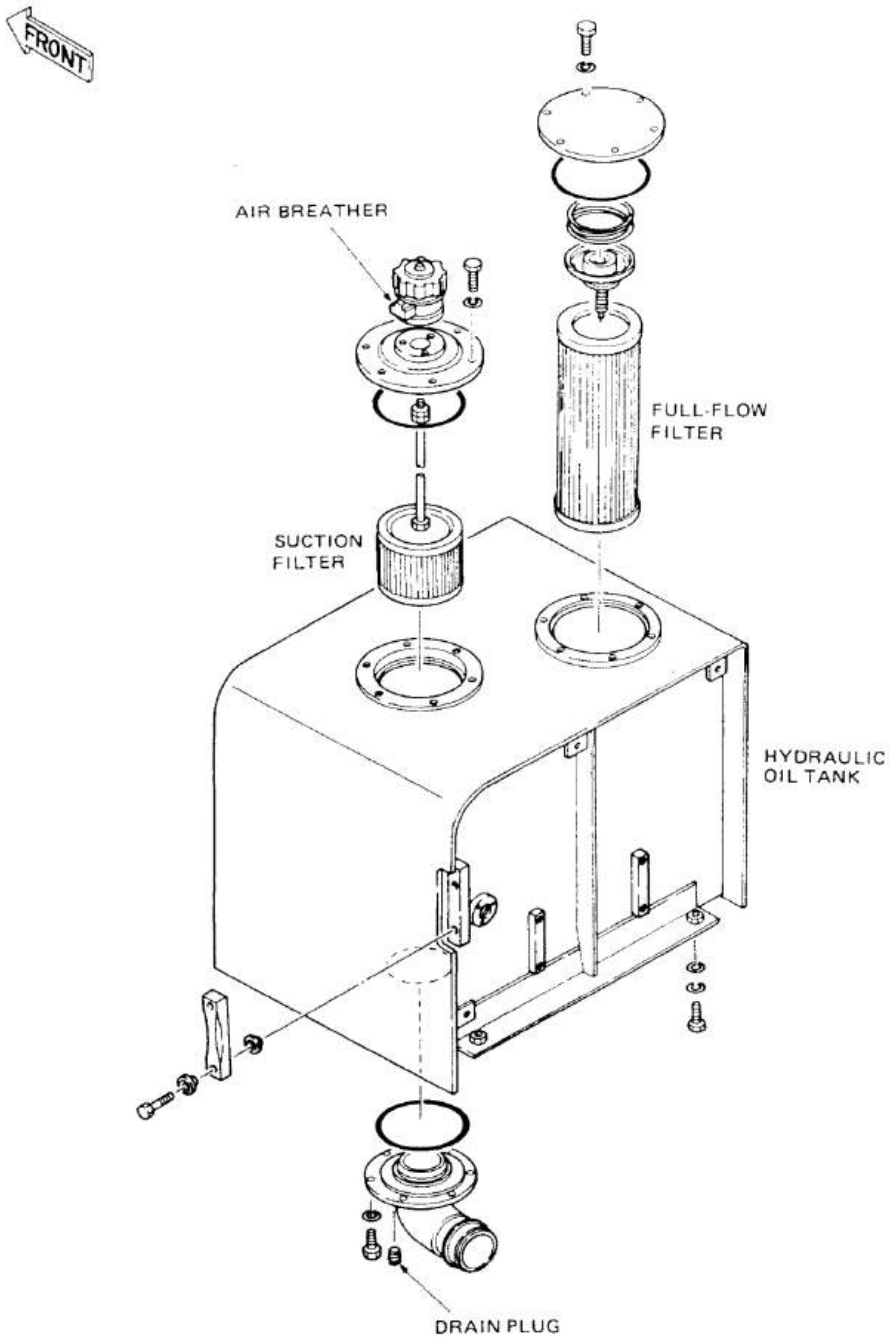
# 3. HYDRAULIC OIL TANK

## 3.1 CONSTRUCTION & FUNCTION

### 3.1.1 OIL TANK

The oil tank acts as both a reservoir and an oil conditioner. Its functions are to dissipate heat from the oil, to separate out air from the oil and remove contaminants.

A full-flow filter and a suction filter are provided in the hydraulic oil tank. They catch and remove dust and dirt particles from the oil.



### 3.1.2 FULL-FLOW FILTER

Full-flow filter means that the entire supply of oil is filtered each time the oil circulates round the hydrualic system. The full-flow filter catches and removes dust and dirt particles from the oil.
A full-flow filter is provided in the hydraulic oil tank.
As the filter element gets dirty, the pressure difference between the inside and outside of the filter element increases because of the clogged element.
Filter relief valve is provided to prevent the filter element from break out.

IMPORTANT: Immediately replace the filter element when the relief valve opens, or dirt in the oil will cause serious damage to hydrualic components.

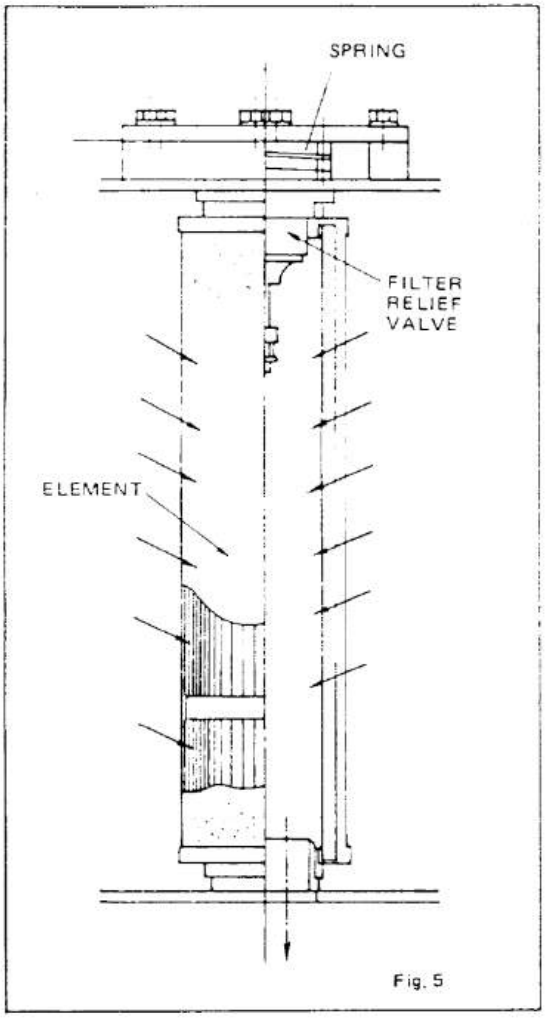
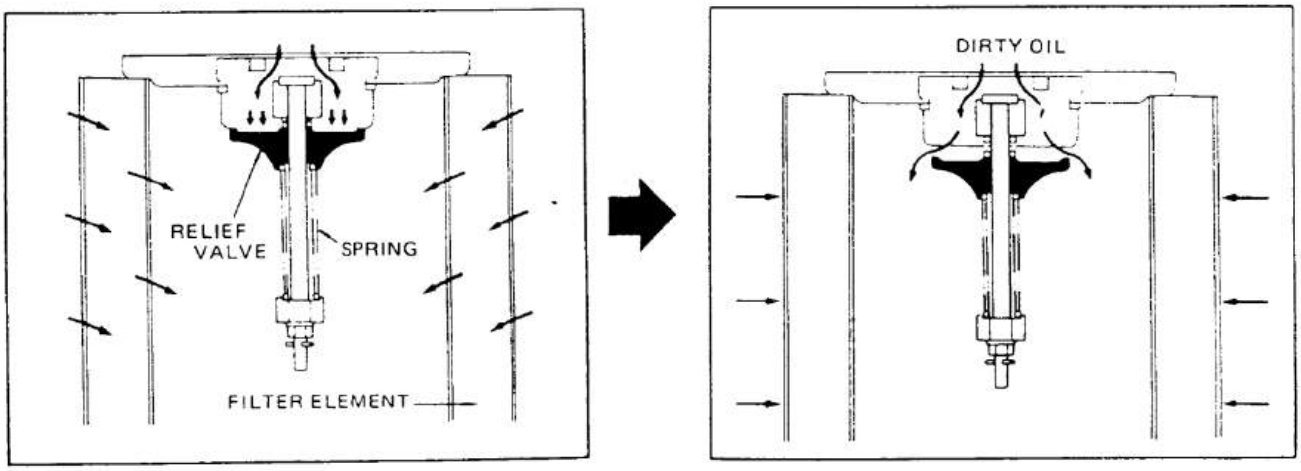


Fig. 5

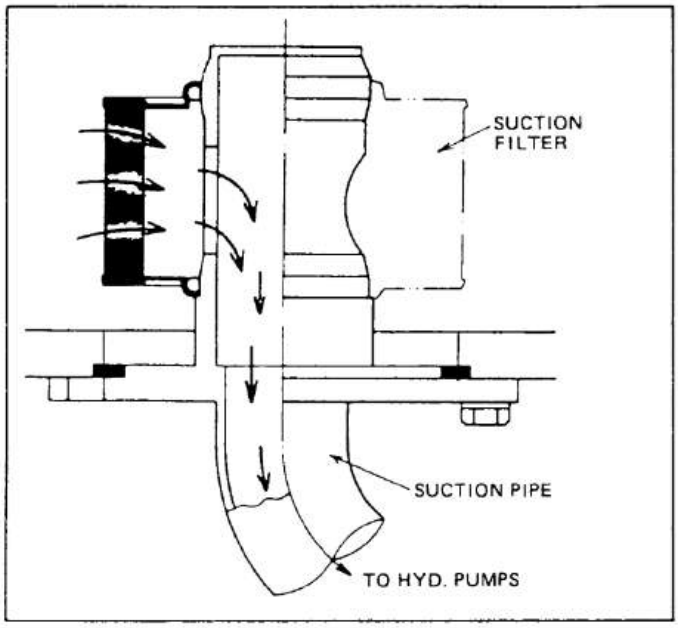
(A) Hydraulic oil is filtered.

(B) Hydraulic oil is not filtrated but released from relief vlave.



### 3.1.3 SUCTION FILTER

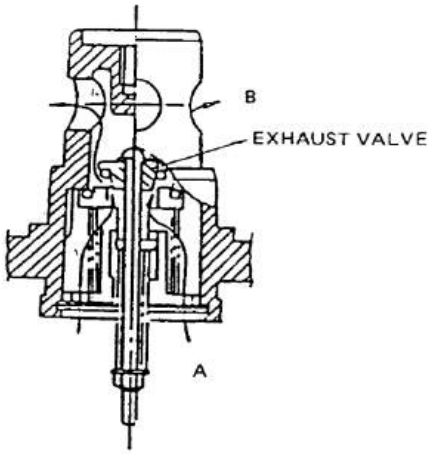
Suction filter is provided to take out foreign matter before oil enters the pump.

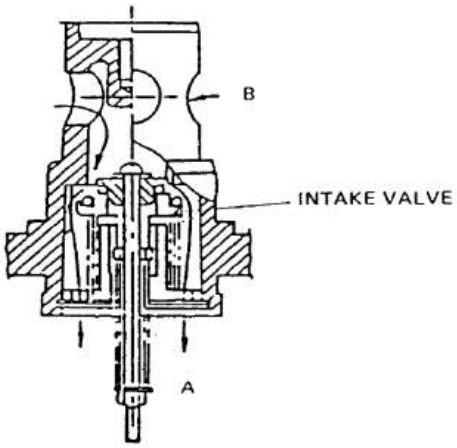



### 3.1.4 AIR BREATHER

The air breather consists of valves (intake and exhaust) and air breather cap. The intake and exhaust valves prevent destruction and pump cavitation by sucking or releasing air to the inside or outside of oil tank.

When the pressure is port A becomes higher than that of port B, the valve exhaust will open to read the pressure to port B.
If the pressure in the port B becomes higher than that of port A, the valve intake will open to read the pressure to port A.



## 3.2 MAINTENANCE STANDARD

Refer to maintenance standard of Section 3 group 2.

## 3.3 SPECIFICATIONS

### 3.3.1 OIL TANK

| | |
|---|---|
| . Weight | 149 kg |

### 3.3.2 FULL-FLOW FILTER

| | |
|---|---|
| . Type | Paper element |
| . Filtration area | 24,600 $cm^2$ |
| . Max. filtration | 10 μ |
| . Oil flow rate | 600 ℓ/min |
| . Replacement interval | 500 hrs |
| . Weight | 2 kg |

### 3.3.3 SUCTION FILTER

| | |
|---|---|
| . Filtration area | 2,120 $cm^2$ |
| . Max. filtration | 10 μ |
| . Oil flow rate | 600 ℓ/min |
| . Weight | 0.7 kg |

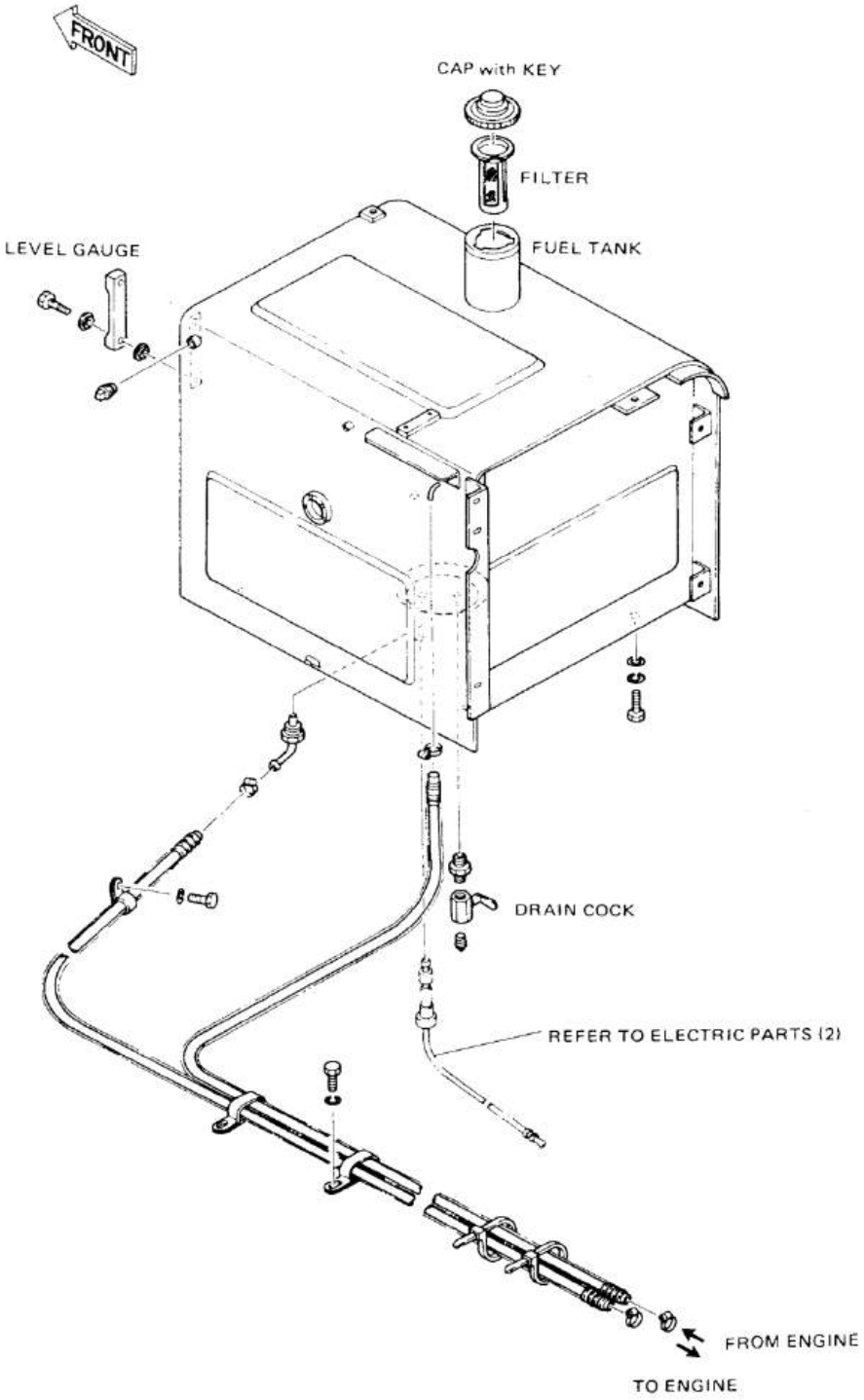
### 3.3.4 AIR BREATHER

| | |
|---|---|
| . Max. filtration | 10 μ |
| . Filtration area | 240 $cm^2$ |
| . Valve set: intak | 0.04 ±0.01 $kgf/cm^2$ at 1ℓ/min. |
| : exaust | 0.5 ±0.04 $kgf/cm^2$ at 1ℓ/min. |
| . Weight | 0.6 kg |

# 4. FUEL TANK

## 4.1 CONSTRUCTION & FUNCTION

Filter (fuel in port) and fuel level gauge are provided in the fuel tank.
Sensor of fuel gauge and fuel level warning lamp are also provided.
As to these sensors, see section 9 group 2.

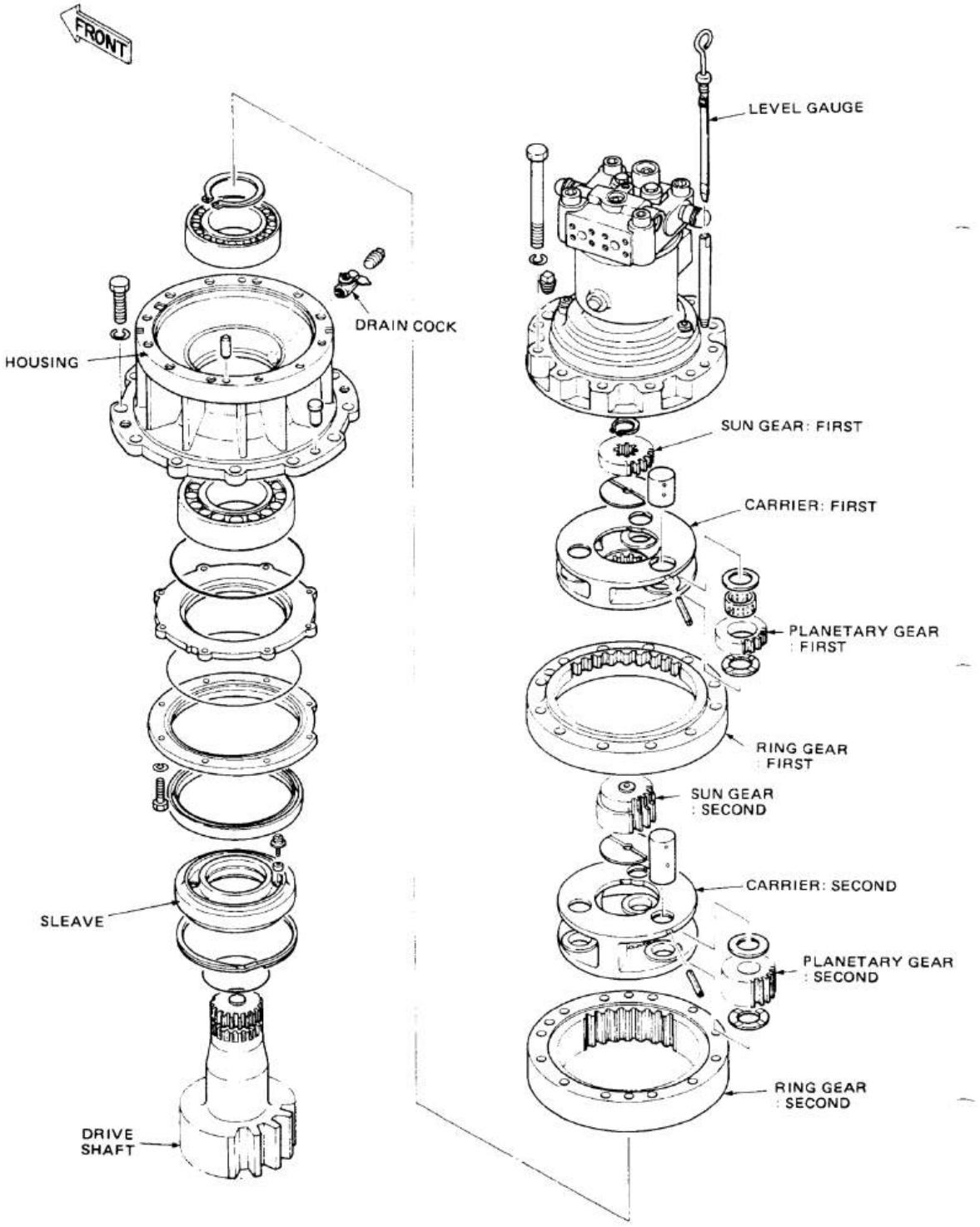


## 5. SWING DEVICE

### 5.1 CONSTRUCTION & FUNCTION

Swing device consists of one swing motor and one swing reduction device. The swing motor is axial piston motor and swing reduction device is planetary gear 2 stage type.

The swing motor and reduction device are mounted on the main frame.



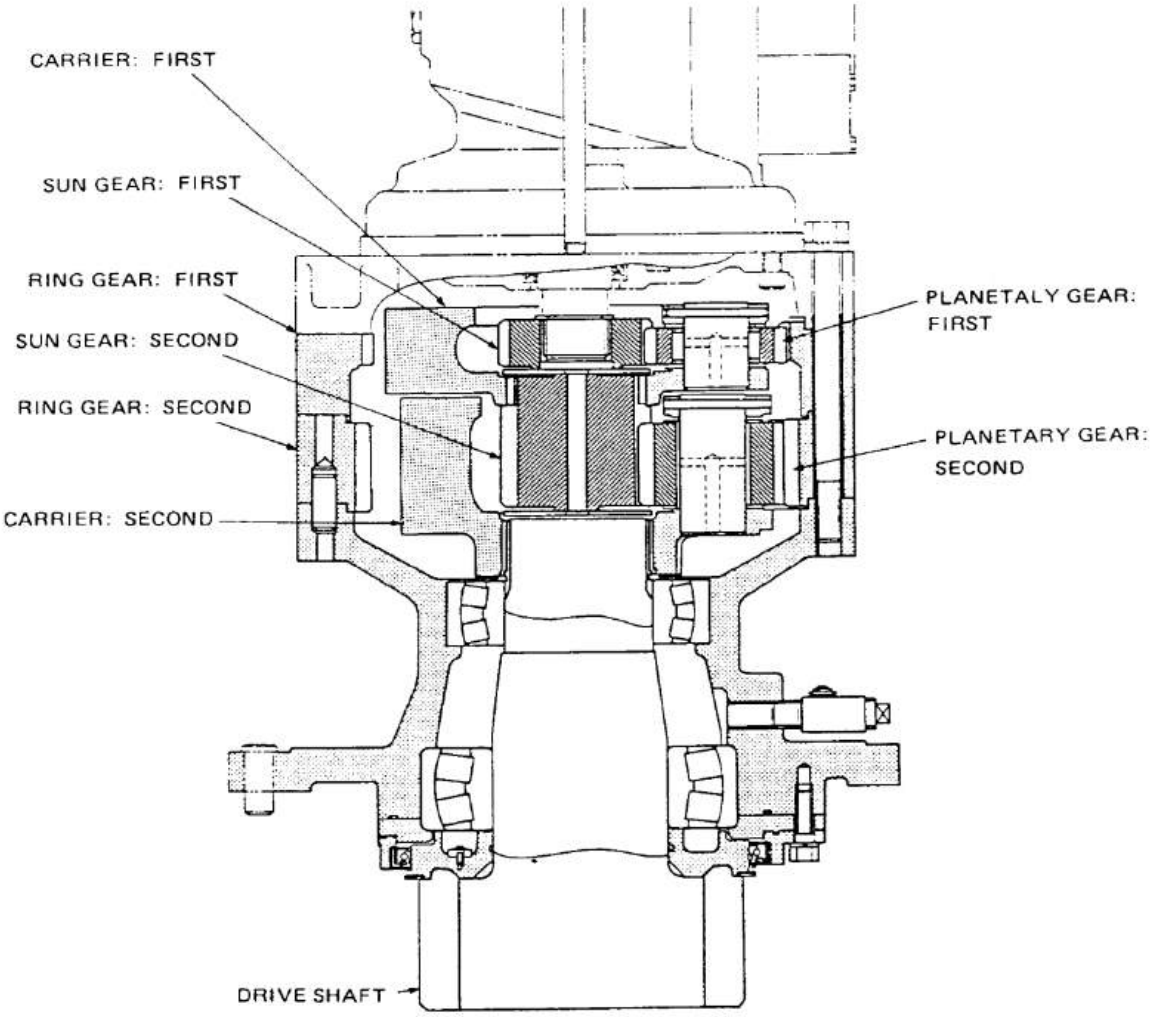
### 5.1.1 SWING REDUCTION DEVICE

The swing reduction device is two stage planetary gear type.

The three first planetary gears fixed to a first carrier are driven by the first sun gear on the output shaft of the swing motor. As the planetary gear mesh with the first ring gear, the first carrier rotates.

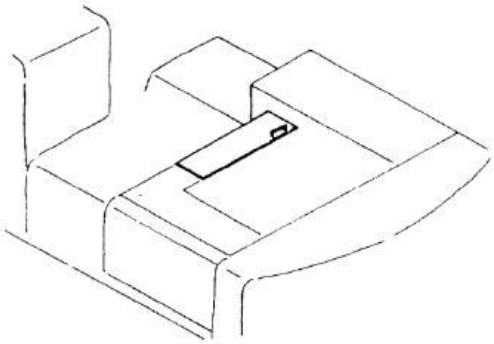
The second sun gear mesh with the first carrier and second carrier moving is same as first carrier.

The drive shaft mesh with the second carrier, which meshes with the internal gear of swing bearing. The power from the motor is transmitted to the drive shaft and thus the superstructure is rotated.



## 5.2 MAINTENANCE STANDARD

### 5.2.1 REMOVAL & INSTALLATION

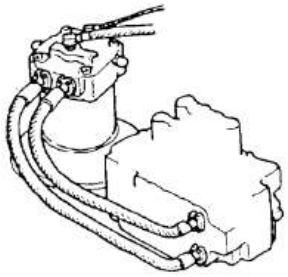


(1) REMOVE SWING DEVICE

1 Loosen the air breather cap to release the compressed air in the hydraulic oil tank.

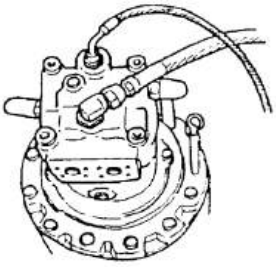
2 Remove cover.

3 Remove hoses from the swing motor.



: 8 mm

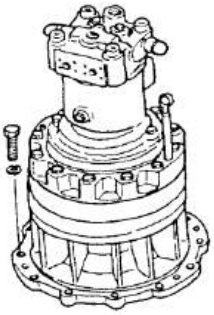
4 Remove hoses from swing motor, then, install plugs.



: 36 mm

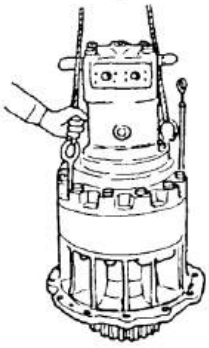
: 19 mm

5 Remove bolts.



: 32 mm

6. Remove swing device by using a eye bolts.

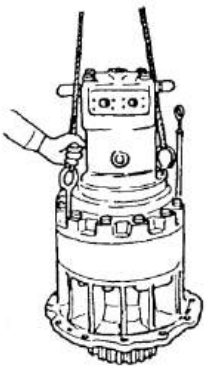


Weight: 231 kg

(2) INSTALL SWING DEVICE

Note: Before installing, clean the swing device.

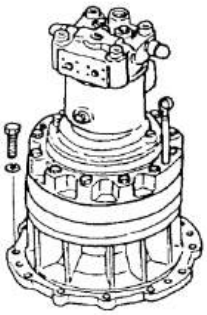
1 Install swing device to the main frame.



2 Install bolts.

Tightening torque: 75 kgf-m, 542 ft.lbs.

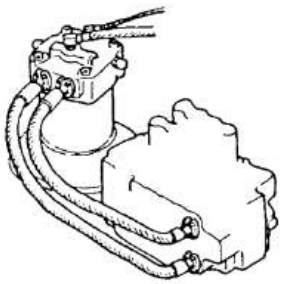
: 32 mm



3 Install hoses

Tightening torque: 6.5 kgf-m, 47 ft.lbs

: 8 mm



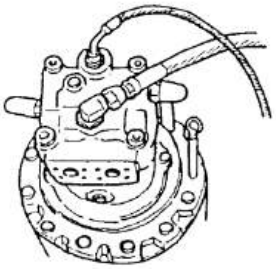
4 Install hoses (drain and make-up).

Tightening torque (drain): 5 kgf-m, 22 ft.lbs

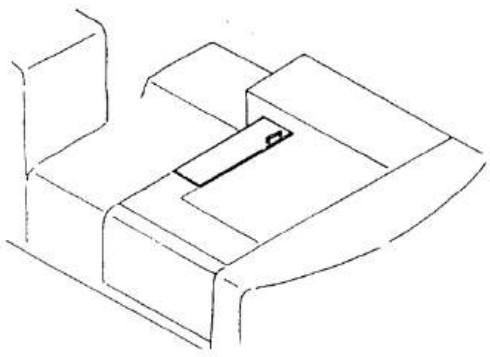
(make-up): 18 kgf-m 130 ft.lbs

: 19 mm

: 36 mm



5 Install cover and air beather cap.



# Swing - Motor

# 3. Working Principle

## 3.1 Hydraulic Motor Section

When high-pressure oil passes through the inlet port (a) of the valve plate (1) and flows into the cylinder as shown in Fig.2, the oil pressure acts upon the piston to generate the axial force "F".

This force "F" is divided into two vector forces through the shoe (2) : namely, the force "F1" vertical to the swash plate (3) and the force "F2" perpendicular to the shaft. This force "F2" is transmitted to the cylinder block (4) via the piston and generates a couple of forces that turn the output shaft.

In the cylinder block nine pistons are equally spaced, and the pistons connected to the high pressure oil inlet ports give their rotating torque to the output shaft sequentially.

When the oil inflow/outflow directions are reversed, the rotating direction of the output shaft is reversed.

The theoretical output torque "T" is given by the following formula:

$$T = \frac{P \times q}{2 \times \pi} \cdot \frac{1}{100} \quad \text{N-m}$$

where $P$ : **Effective pressure difference** MPa

$q$ : **Displacement per revolution** $cm^3$

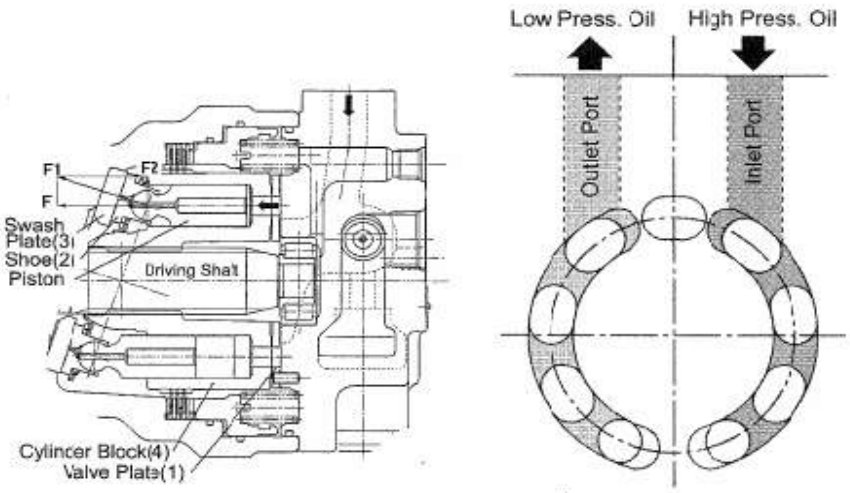



Fig.2 Operation of motor section.

## 3.2 Valve Casing Section

1) Anti-Cavitation Check Valve Section

Some systems using motors of this type have no valves of counterbalance functions, and so the motors may be turned beyond their supplied oil flows. In order to prevent cavitation due to oil shortage, check valves are fitted to suck short oil flows.

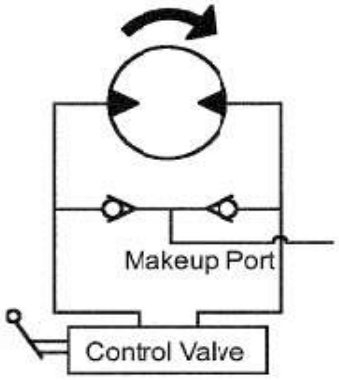



Fig. 3

2) Relief Valve

In acceleration or braking, the relief valve works and the pressure is kept at the set value. The relief valve provides a small shock less piston, and it works at the start of relief action and keeps the pressure low value for a short time. So smooth acceleration or braking with small shock is possible.

## 3.3 Brake Section

The cylinder (111) is connected to the drive shaft (101) with a gear. In addition, the separator plate (743) is restrained from circumferentially - rotating by an arc groove cut on the casing (301).

When the friction plate (742) connected with a gear to the external periphery of the cylinder is pressed to the casing (301) by the brake spring (712) via the separator plate (743) and brake piston (702), friction force is generated among the friction plate, casing, separator plate and brake piston. This friction force restrains the driving gear and the brake is applied.

On the other hand, when the release pressure is applied to the oil chamber formed between the brake piston and casing and this pressure force overcomes the spring force, the brake piston moves and the friction plate are not pushed to the casing and so the brake is released.

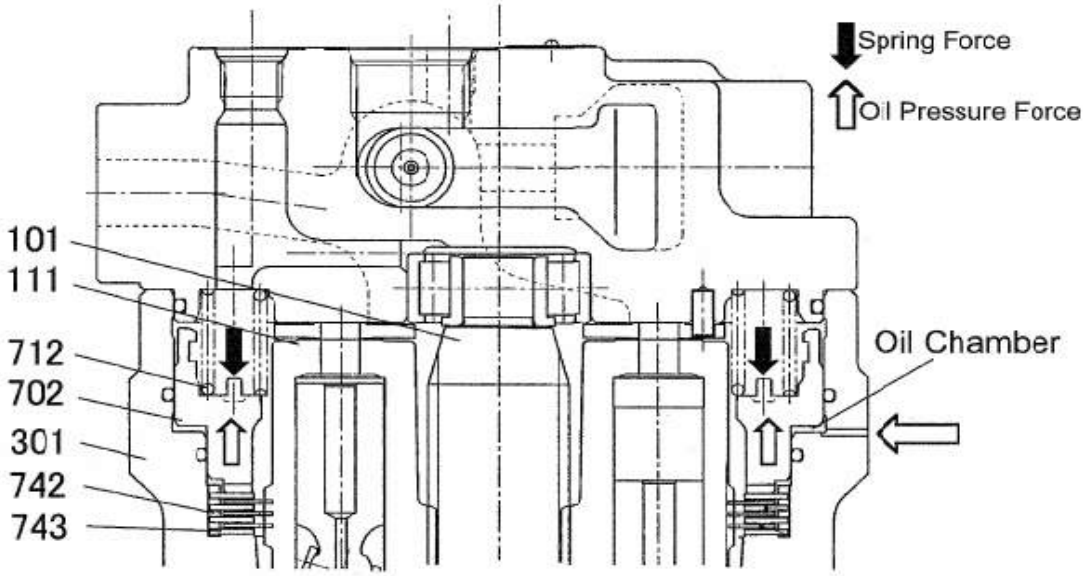



Fig.4 Operation of brake

# 4. General Handling Method

## 4.1 Inspection

Before installing a new motor, check the following items.

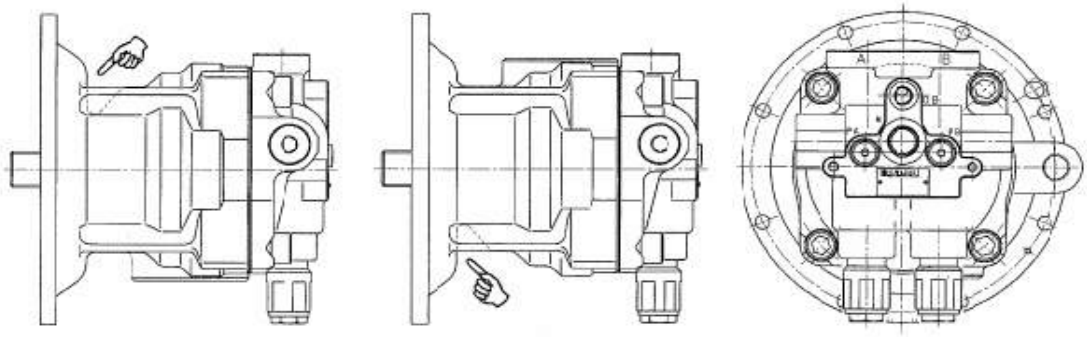
1) Check if anything has been damaged and if any part has been lost during transportation.

2) Check all tightening parts for looseness.

3) Check flange faces and drain port covers for complete tightness to prevent dust from entering into the motor.

## 4.2 Rotating Direction

The relation between the oil flow direction and shaft rotating direction is shown in Fig.5 and Table 3. The rotating direction depends on the tilting direction of the inclined plane in the casing. Since the tilting direction can be seen from the shape of the casing and the direction of the flange, pay attention to the tilting direction.



FORWARD REVERSE (Model has the letter"M"at its end)

Fig.5 Rotating Direction

Table 3

| | Inlet port | Outlet port | Shaft rotation direction viewed from shaft end. |
|---|---|---|---|
| Forward | A | B | Clockwise |
| Reverse (Letter "M" at end of Model.) | B | A | Counterclockwise |

## 4.3 External Load on Shaft End

Do not apply any external radial/thrust load in general on the motor's shaft end.

## 4.4 Hydraulic Oil and Temperature Range

### 4.4.1 Type of oil

Use generally-used mineral hydraulic oil that is added with extreme pressure additives, antifoaming agents, antioxidants, anticorrosive, and so on and has a high viscosity index.

### 4.4.2 Optimum Viscosity and Temperature of Hydraulic Oil (Fig.6)

The viscosity range of 10 to 1000 cSt is available, but the range of 10 to 200 cSt is recommended in consideration of optimum efficiency.

The temperature range is limited approximately to -25 to 100 degrees Centigrade (77 to 212 degrees Fahrenheit) by oil seals, O-rings, etc. It is recommended to use oil at a temperature lower than 60 degrees Centigrade (140 degrees Fahrenheit) as far as possible, considering deterioration of hydraulic oil, seals and so on.

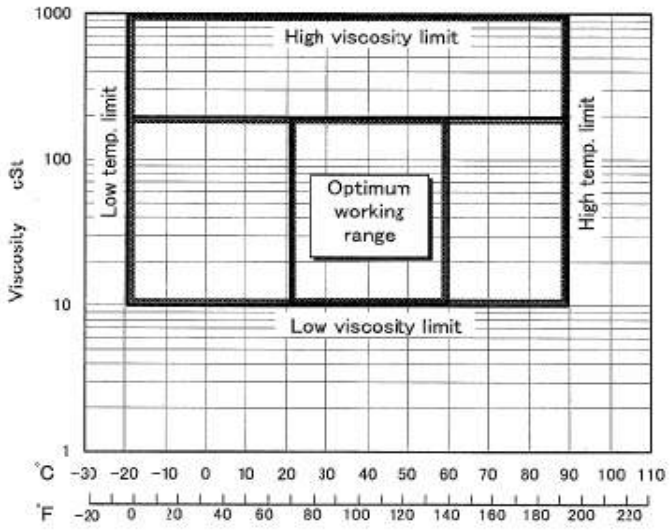



Fig.6 Appropriate viscosity/temperature range

### 4.4.3 Hydraulic Oil Other than Mineral Based Oil

When any hydraulic oil of phosphate ester, water-glycol, fatty acid ester or so on is to be used, do not fail to consult us in advance.

## 4.5 Filter

If sand or metal particles mix into oil, they may wear sliding surfaces fast and sometimes may cause sticking or seizure. Therefore, provide a filter of 10 micron in the circuit, together with prevention of dust from entering. The operation fluid should be continuously filtered to maintain the maximum permissible degree of contamination of fluid to NAS 1638 class 9 and below.

## 4.6 Installation and Piping

1) Install the motor with its shaft downward in general.
2) Carry out centering to the driven machine with full accuracy. Keep off-centeredness within 0.05 mm.
3) For the tightening torque of bolts to fit the motor to brackets, refer to the installation dimension drawing.
4) Fill always the casing inside with oil. Determine the draining position the motor so that the casing inside will be filled with oil as shown in Fig.7.

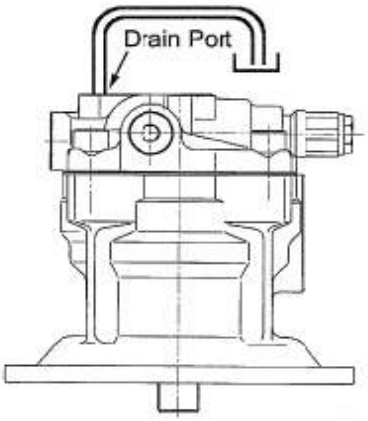



Fig.7 The draining position

5) The maximum allowable pressure of the casing inside is 0.2 MPa.
6) Carry out acid cleaning and flushing of piping fully.
7) Fit the piping without applying any unreasonable load.
8) For drain piping, use pipe equal to or larger than the port sizes of the motor, and try to shorten the piping as far as possible.

## 4.7 Oil Filling and Air Venting

1) Before starting operation, fill the casing with oil through the drain port without fail. Inside the motor there are high-speed sliding parts, such as the bearings, pistons/shoes, retainer, and so on. If not filled with oil, these parts may suffer from serious troubles, such as seizures, damages, and so on.
   Fill it with oil without fail. Amount of oil : 1 liter
2) When air is left in the circuit or motor, it may cause any poor operation or damage. Vent air completely from the circuit and motor without fail.

## 4.8 Cautions in Starting Operation

1) Check piping for being fitted completely.
2) Check that the rotating direction is correct.
3) Check all parts of the motor for oil leak.
4) During running or directional control valve operation, check the motor for heavy vibration.
5) Check the oil temperature for abnormal increase after a short time of running.
6) Check the pressure for extreme deviation from its designed value.
7) Attach the pipe and the level bar to the reduction gear and confirm that the gear oil level is kept in marked area.

# 5. Causes of Troubles and Countermeasures

## 5.1 General Precautions

This section describes countermeasures to be taken if any abnormality is detected during operation of the hydraulic motor.

General cautions are as follows :

1) Consider the situation before taking action.

   Judge the nature of the abnormality before taking action, and consider if you have experienced any similar trouble or not. Also consider if it is caused by the motor truly or not.

2) Pay attention to dust remarkably.

   Many wear troubles are resulted from dust. During disassembling, take care not to make dust enter into the motor.

3) Handling of parts

   Since the parts are finely finished, handle them carefully not to damage them.

4) During working

   Pay attention not to damage O-rings and gasket surfaces , during working. In disassembling, it is recommended to replace the O-rings with new ones.

## 5.2 Causes of Motor for Abnormalities

It is very difficult to find the cause of a failure in the hydraulic circuit. Check the following items and investigate them well to find the cause of trouble is in the motor or not.

1) Check of oil in motor casing

   Remove the drain plug and check the working oil in the motor casing. If plenty of metal particles flow out together with oil, there is quite a possibility of any trouble in internal parts of the motor.

2) Existence of abnormal noise

   Check the motor for any abnormal noise generated.

3) Pressure measurement at various points

   Do not disassemble and check the motor recklessly, but measure pressure at various points to investigate for abnormal points.

## 5.3 Causes of Troubles and Remedies

1) The hydraulic motor does not rotate.

| Phenomenon | Possible cause | Remedy |
|---|---|---|
| Pressure does not increase | 1. Safety valve in circuit is not correctly.<br>2. Relief valve does not function well.<br>a) Sticking of plunger<br>b) Clogging of plunger throttle.<br>3. Seat of plunger does not function well. | 1. Set valve at correct value.<br>2. a) Repair or replace stuck section.<br>b) Disassemble and plunger.<br>3. Check seat section Replace it, if damaged. |
| Pressure rises | 1. Overload<br>2. Seizure of moving parts.<br>3. Brake is not applied with release pressure.<br>4. Brake piston sticks.<br>5. Spool sticks.<br>6. Friction plate is seized. | 1. Remove load.<br>2. Check and repair piston/shoes, cylinder, valve plate, etc.<br>3. a) Check and repair circuit.<br>b) Check time delay valve for brake.<br>4. Disassemble and check it.<br>5. Disassemble and check it.<br>6. Disassemble and check it. Replace seized one. |

2) The motor rotates reversely.

| Phenomenon | Possible cause | Remedy |
|---|---|---|
| Motor rotates reversely. | 1. Motor is assembled to rotate reversely.<br>2. Piping is connected to inlet and outlet reversely. | 1. Confirm this, referring to Fig.6, and reassemble it.<br>2. Correct piping. |

3) The speed does not reach the set value.

| Phenomenon | Possible cause | Remedy |
|---|---|---|
| Speed does not reach set value | 1. Oil flow rate is insufficient.<br>2. Oil temp is high and oil leaks abnormally.<br>3. Sliding parts are worn or damaged. | 1. Check pump's delivery flow and circuit to motor.<br>2. Reduce oil temp.<br>3. Replace damaged parts. |

4) The braking torque is insufficient.

| Phenomenon | Possible cause | Remedy |
|---|---|---|
| Brake torque is insufficient. | 1. Friction plate is worn. | 1. Disassemble and check it. Replace it, if worn more than criterion. |
| | 2. Brake piston sticks. | 2. Disassemble and check it. |
| | 3. Brake release pressure cannot be removed. | 3. a) Check and repair circuit. b) Check time delay valve for brake. |
| | 4. Spline for friction plates is damaged. | 4. Disassemble and check it. Replace it, if damaged. |

5) The hydraulic motor slips too much.

Investigate the drain flow rate of the motor. If it is about 500 $cm^3$/min or lower, the motor is considered to be normal.

| Phenomenon | Possible cause | Remedy |
|---|---|---|
| When external driving torque is applied to motor, it slips too much. | 1. Relief valve does not function well. Same as Item 1) | 1. Replace it. Same as Item 1) |
| | 2. Seat of plunger does not function well. | 2. Replace it. |

6) Oil leakage

i ) Oil leaks from oil seal.

| Phenomenon | Possible cause | Remedy |
|---|---|---|
| Oil leaks from oil seal. | 1. Lip catches particles of dirt and is damaged. | 1. Replace oil seal. |
| | 2. Shaft is scratched or worn. | 2. Shift lip/shaft contact position or replace them. |
| | 3. Because of excessively-high casing internal press., lip of oil seal is turned up. | 3. If drain piping is clogged, clean it out. |
| | 4. Shaft is rusted. | 4. Disassemble and repair it. |

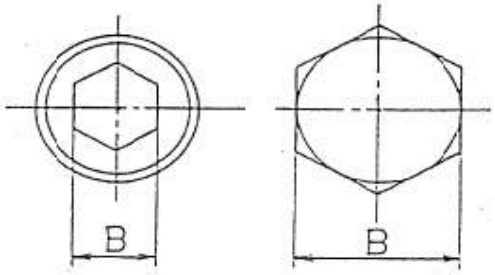
# 6. Disassembling , Reassembling

## 6.1 Necessary Tools

The tool necessary for disassembling and reassembling and their dimensions are shown in Tables 4.

Table 4

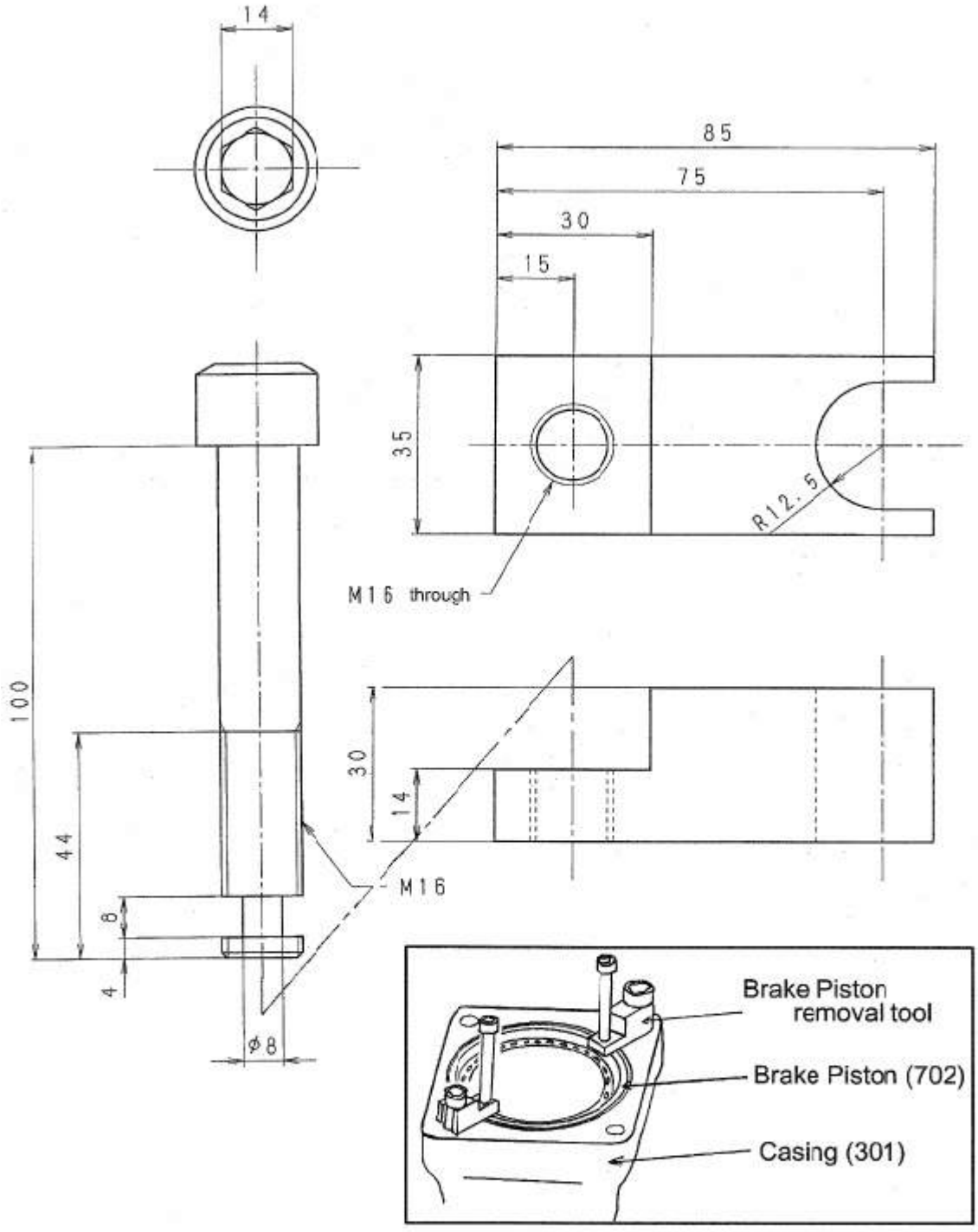
| Name of Tools | Dimension B (mm) | Name of Parts Applied and Remarks |
|---|---|---|
| Hexagon bar wrenches ( JIS B 4686 ) | 6 | ROH plug (467) |
| | 17 | ROMH plug (469) |
| | | Hexagon socket head cap screw (401) |
| Spanner , Socket wrenches | 41 | Relief valve (051) |
| Hammers Plastic hammer<br>Iron hammer | | Wooden hammer allowed.<br>Nominal 1 or so. |
| Steel rod approx. 10 x 8 x 200mm | | Bearings (443 & 444) , Pin (451) |
| Torque wrench | | 5 to 10 N-m |
| | | 10 to 45 N-m |
| | | 40 to 275 N-m |
| | | 75 to 550 N-m |
| Screw driver | | 2 pieces |
| Bearing pliers | | Bearings (443 & 444) |
| Brake piston removal tool | | Brake piston (702) |



## 6.2 Thread Size Used and Tightening Torque

Table 5

| Part Name | Part No. | Sizes | Dimensions B (mm) | Torque (N-m) |
|---|---|---|---|---|
| Hexagon socket head cap screw | 401 | M20 (ISO724) | 17 | 431 |
| ROMH plug | 469 | M36 (ISO724) | 17 | 539 |
| ROH plug | 467 | G1/4 (ISO228/1) | 6 | 36 |
| Relief valve | 051 | M33 (ISO724) | 41 | 177 |




Brake piston removal tool

## 6.3 Disassembling

Disassemble the motor , following the procedures described below.

| | Operations | Precautions | Photo No. |
|---|---|---|---|
| 1 | Ensure that the motor is clean and free from dirt and debris prior to any disassembly. | All parts are to be plugged to prevent ingress of dirt during external cleaning. | |
| 2 | Remove the oil from drain port. | | |
| 3 | Put identification marks on each parts to show its location in the motor. | Prevent damage to disassembled parts, by keeping them protected and in a clean area. | 2 |
| 4 | Remove relief valves (051) from the valve casing (303). | Be sure to replace O-rings of relief valves because they are frequently damaged during disassembly. | 3 |
| 5 | Remove R.O.M.H plugs (469) , spring (355) and plungers (351) from the valve casing (303). | Handle carefully to prevent damage to the seat on the plunger (351). | 4 |
| 6 | Remove socket head bolts (401) and remove valve casing (303) from casing (301) then remove valve plate (131). | When the bolts are loosened the valve casing is slightly lifted by the brake springs (712).<br>Valve plate may often remain on cylinder. | 5 |
| 7 | Remove springs (712) from the brake piston (702). | | 6 |
| 8 | Remove brake piston (702) from casing (301) by using special tooling. | Pull brake piston vertically by using the special tooling. | 7 |
| 9 | Put the motor on its side as shown in photo 8. Remove rotation group from the drive shaft (101). | During the removal of the rotation group from the swing motor , do not let the pistons fall cut of the cylinder. All pistons in the rotation group must be re-installed in their original locations. | 8 |

| | | | |
|---|---|---|---|
| 10 | Disassemble rotation group as follows:<br>Put identification marks on nine pistons (121), showing their location in the plate (123) and the cylinder (111). Remove nine pistons (121) and plate (123) as a unit from the cylinder. Separate the piston assemblies from the plate. | Handle carefully so as not to damage sliding face on the retainer (113) or shoes (122). | |
| 11 | Remove friction plates (742) and separator plates (743) from casing (301). | Position of friction and separator plates. | 9 |
| 12 | Turn the motor body over, and remove shaft assembly from casing (301). | | 10<br>11 |
| 13 | Remove bearing center cone (443) using press if necessary. | Be careful not to damage sliding face on the shaft.<br>If bearing center cone is removed do not use in re-assembly of motor. | |
| | Remove bearing (443) from casing (301) using rod and hammer. | When hammering be sure to use a soft metal bar to prevent damage to parts.<br>Never hit directly with iron hammer or bar.<br>Do not use in re-assembly of motor if bearing is removed. | |
| | Remove bearing (444) from the motor body using bearing pliers, only if necessary. | Do not use in re-assembly of motor if bearing is removed. | 12 |

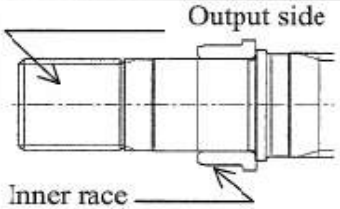
That is all of disassembling work.

## 6.4 Reassembling

Cleanliness is a primary means of insuring satisfactory motor life, on either new or repaired units. Cleaning parts by using a solvent wash and air-drying is adequate, providing clean solvent is used. As with any precision equipment, the internal mechanism and related items must be kept free of foreign materials and chemicals. Protect all exposed sealing surfaces and open cavities from damage and foreign material.

It is recommended that all oil seals and O-rings be replaced. Lightly lubricate all oil seals and O-rings with clean oil prior to assembly. Lubricate all sliding sections, bearings, and cylinders with clean oil prior to assembly.

Reassemble the motor, following the procedures described below.

| | Operations | Precautions | Photo No. |
|---|---|---|---|
| 1 | Place the motor in a vertical position with bell housing face down. | | |
| 2-1 | Heat the bearing inner race (443) to 110 degrees Centigrade (230 degrees Fahrenheit) max. and insert to the drive shaft. |  DO NOT EXCEED TEMPERATURE 110 DEGREES CENTIGRADE. | |
| 2-2 | Heat the bearing inner race (444) to 110 degrees Centigrade (230 degrees Fahrenheit) max. and insert to the drive shaft (101). | DO NOT EXCEED TEMPERATURE 110 DEGREES CENTIGRADE. | |
| 3 | Grease to seal (491) and install seal (491) to casing (301). | Be careful of direction of seal.<br>Be careful not to damage the lip of the oil seal. | 13 |

| | | | |
|---|---|---|---|
| 4 | Insert bearing (443) to casing (301). | | 14 |
| 5 | Insert shaft (101) to casing (301). | Be careful not to damage the lip of the oil seal. | 15 |
| 6 | Install shoe plate (124) into casing (301). | Shoe plate to be fitted lapped side cutwards. | 16 |
| 7 | Put set plate (123) on plate spring (114) and install piston assembly (121 & 122) into set plate (123). | | 17 |
| 8 | Insert piston assemblies into cylinder (111).<br>Install rotation group into casing (301). | | 18<br>19 |
| 9 | Place the motor in a vertical position with bell housing face down.<br><br>At first, insert a separator plate (743), and then insert a friction plate (742) and separator plate alternately. | Separator plate: 4<br>Friction plate: 3 | 20<br><br>21 |
| 10 | Install O-ring (707) and O-ring (706) into casing (301). | Ensure that the seal is lightly greased not to be cut. | 22 |
| 11 | Install brake piston (702) into casing (301) by tapping the piston into position using a plastic hammer, and then press to ensure brake piston is seated correctly. | | 23 |
| 12 | Install spring (712) into the brake piston(702). | | 24 |
| 13 | Install bearing (444) into valve casing (303) using hammer and steel rod. | Insert to hit at the periphery of bearing evenly using steel rod and hammer. | 25 |

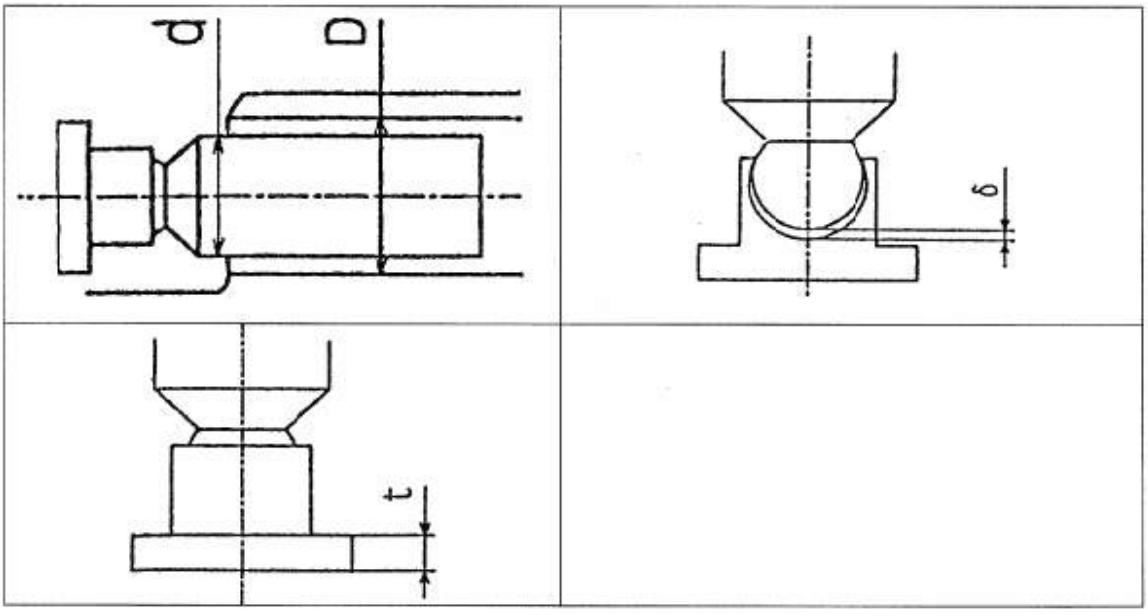
# 7. Maintenance

## 7.1 Service Limit

Replace parts in accordance with the following standards. However , if a part is damaged significantly in terms of its appearance , replace it irrespective of the standards.

Table 6 Part replacement standards

| Part name and inspection item | Standard dimension | Recommended value for replacement | Remedy |
|---|---|---|---|
| Clearance between piston & cylinder bore | D - d = 0.028 mm | D - d = 0.058 mm | Replace piston or cylinder. |
| Clearance caulked part between piston & shoe | $\delta$ = 0.0 mm | $\delta$ = 0.3 mm | Replace assembly of piston & shoe. |
| Thickness of shoe | t = 5.5 mm | t = 5.3 mm | Replace assembly of piston & shoe. |
| Thickness of friction plate | 2.0 mm | 1.6 mm | Replace friction plate |



## 7.2 Renovation Limit

If the face roughness is found to exceed the renovation limit , renovate or replace the parts.

Table 7 Renovation limit

| Parts name | Normal face roughness | Renovation limit |
|---|---|---|
| SHOE | 0.8-Z (Ra=0.2) (lapping) | 3-Z(Ra=0.8) |
| SHOE PLATE | 0.4-Z (Ra=0.1) (lapping) | 3-Z(Ra=0.8) |
| CYLINDER | 1.6-Z (Ra=0.4) (lapping) | 12.5-Z(Ra=3.2) |
| VALVE PLATE | 0.8-Z (Ra=0.2) (lapping) | 6.3-Z(Ra=1.6) |

note) 1. Renovate face of parts by lapping below normal face roughness.

2. If SET PLATE and RETAINER 's face is no good , replace those parts as an assembly.

No. 1

No. 5

No. 2

No. 6

No. 3

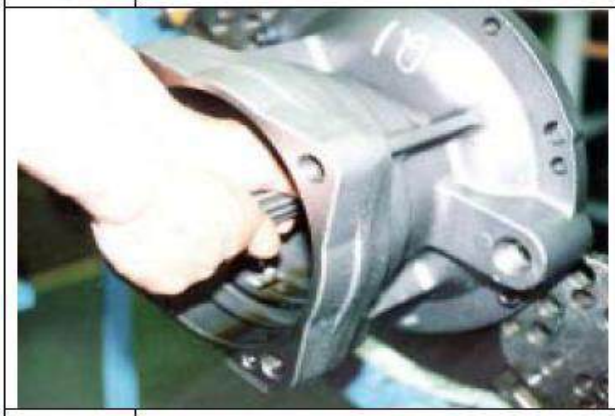
No. 7

No. 4

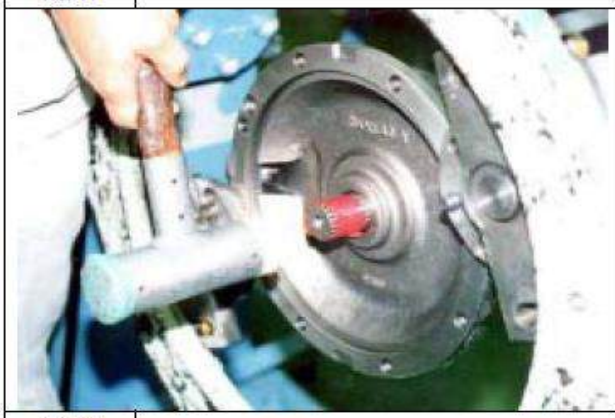
No. 8

No. 9

No. 10



No. 11



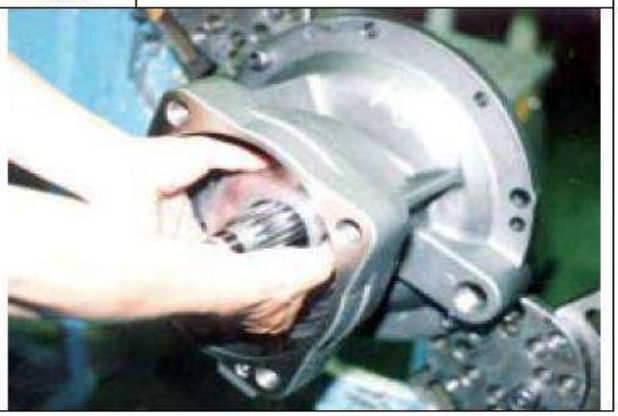
No.12

No. 13

No. 14

No. 15

No. 16



No. 17

No. 21

No. 18

No. 22

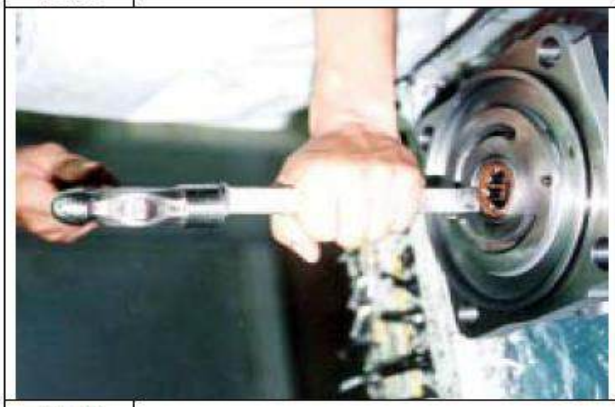
No. 19

No. 23

No. 20

No. 24

No. 25

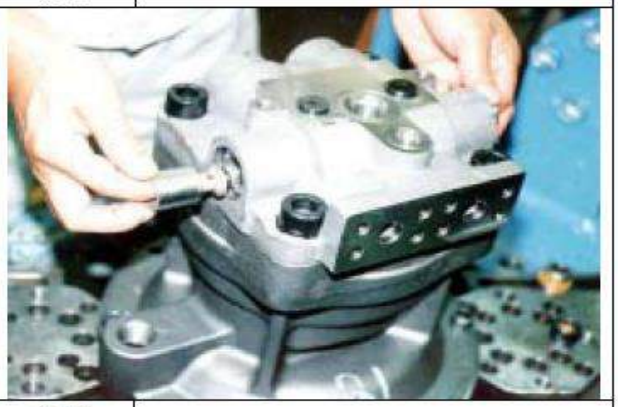


No. 26

No. 27

No. 28

No. 29

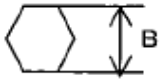


No. 30

# HYDRAULIC PUMP

# 1. DISASSEMBLING AND REASSEMBLING PROCEDURES

## 1.1 Tools




The tools necessary to disassemble / reassemble K3V pump are shown in the following list.
The size of the bolts and plugs depend on the pump type.

| Tool name and size | | ○: Necessary tool | | | Part name | | | |
|---|---|---|---|---|---|---|---|---|
| | | Pump model | | | | | | |
| Names | B | K3V63 K5V80 | K3V112 K5V140 | K3V140/180 K5V160/200 | Hexagon socket head cap screw | Pressure plug (Taper thread) | ROH plug VP plug (Parallel thread) | Hexagon socket head set screw |
| Allen wrench | 2 | | | | — | — | — | M4 |
| | 2.5 | | | | — | — | — | M5 |
| | 3 | | | | — | — | — | M6 |
| | 4 | ○ | ○ | ○ | M5 | Rc 1/16 | — | M8 |
| | 5 | ○ | ○ | ○ | M6 | Rc 1/8 | — | M10 |
| | 6 | ○ | ○ | ○ | M8 | Rc 1/4 | G 1/4 | M12 M14 |
| | 8 | ○ | ○ | ○ | M10 | Rc 3/8 | G 3/8 | M16 M18 |
| | 10 | | | | M12 | Rc 1/2 | G 1/2 | M20 |
| | 12 | | | | M14 | — | — | — |
| | 14 | ○ | ○ | | M16 M18 | Rc 3/4 | G 3/4 | — |
| | 17 | | ○ | ○ | M20 M22 | Rc 1 | G 1 | — |
| | 19 | | ○ | | M24 M27 | — | — | — |
| Double ring spanner, Socket wrench, Double (Single) open end spanner | 22 | | ○ | | — | — | G 3/8 | — |
| | 24 | | ○ | ○ | M16 | — | — | — |
| | 27 | ○ | | ○ | M18 | — | G 1/2 | — |
| | 30 | | ○ | ○ | M20 | — | — | — |
| | 36 | | ○ | ○ | — | — | G 3/4 | — |
| | 41 | | | | — | — | G 1 | — |
| | 50 | | | | — | — | G 1 1/4 | — |
| | 55 | | | | — | — | G 1 1/2 | — |
| Adjustable angle wrench | — | ○ | ○ | ○ | Medium size 1 set | | | |
| Screwdriver | — | ○ | ○ | ○ | Flat-blade screwdriver (medium size) 2 pieces | | | |
| Hammer | — | ○ | ○ | ○ | Plastic hammer 1 piece | | | |
| Plier | — | ○ | ○ | ○ | TSR-160 for stop ring (retaining ring/internal snap ring) | | | |
| Steel bar | — | ○ | ○ | ○ | Steel bar for Key 10 × 8 × 200 or similar dimensions | | | |
| Torque wrench | — | ○ | ○ | ○ | Capable of tightening with the specified torques | | | |

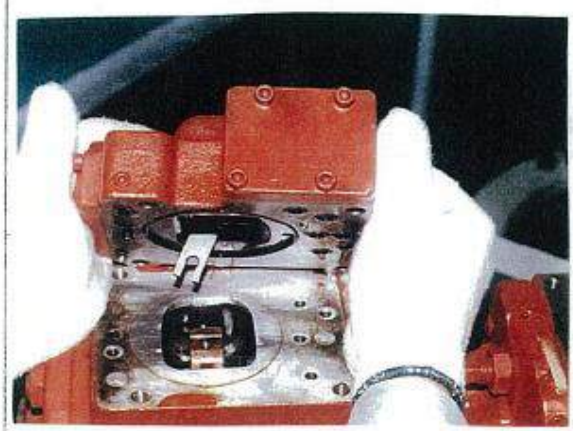
## 1-2. Disassembling Procedures

4

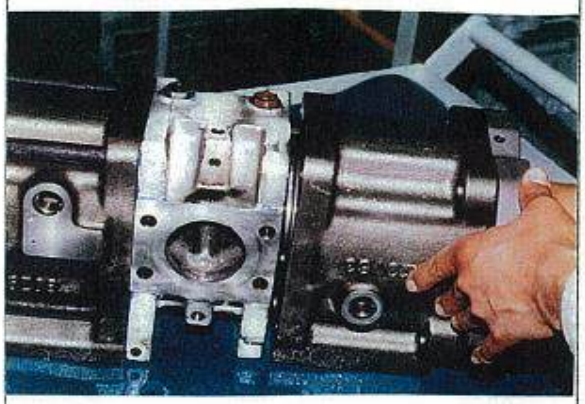
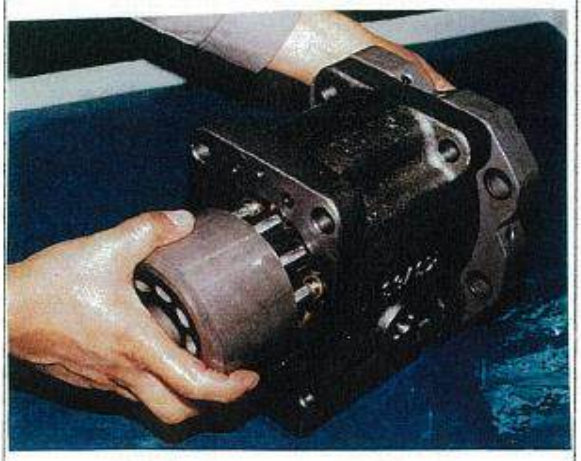
For disassembling the pump, read this section thoroughly and then disassemble it in the following sequence. The figures in parentheses after part names show the items in Attached Dwg.3,4 Construction of Pump.

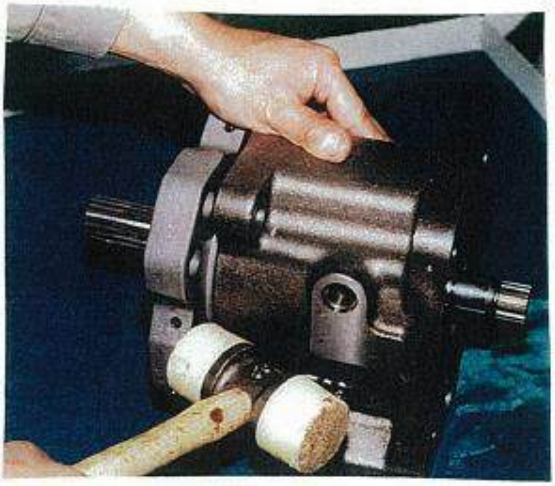
This maintenance manual describes the disassembling procedures for both the single pump and tandem type double- pump. Disassemble the pump, referring to the contents for its appropriate type.

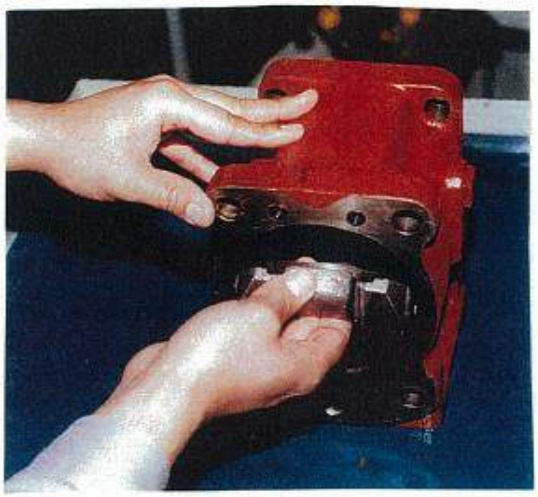
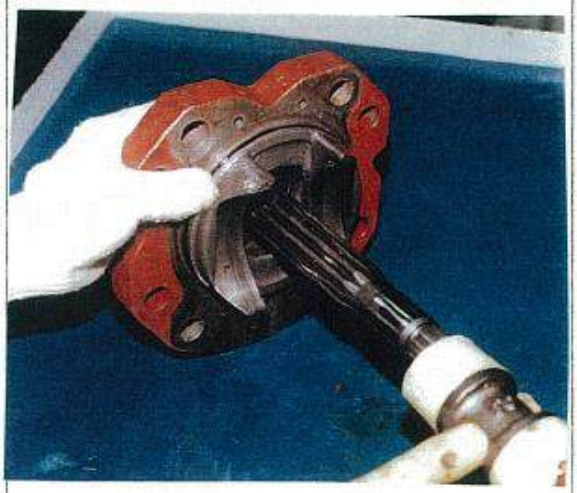
In addition, for the double- pump, take care not to mix up parts of one pump with the same ones of the other pump.

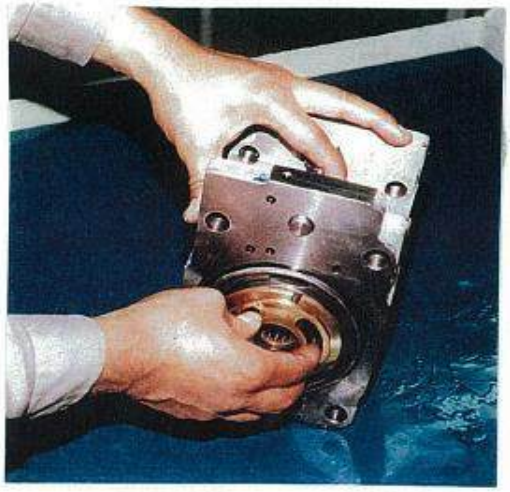
| No. | Procedure | Caution | Applied type |
|---|---|---|---|
| 1 | Select place suitable to disassembling. | (1) Select clean place.<br>(2) Spread rubber sheet, cloth or so on on overhaul workbench top to prevent parts from being damaged. | |
| 2 | Remove dust, rust, etc, from pump surfaces with cleaning oil or so on. | | |
| 3 | Remove drain port plug (468) and let oil out of pump casing. | (1) For tandem type pump, remove plugs from both front and rear pumps. | |
| 4 | Remove hexagon socket head bolts (412, 413) and remove regulator.<br>  | (1) Refer to instruction manual of regulator for its disassembling. | |
| 5 | Loosen hexagon socket head bolts (401) which tighten swash plate support (251), pump casing (271) and valve block (312). | (1) If gear pump and so on are fitted to rear face of pump, remove them before starting this work. | |

D

| No. | Procedure | Caution | Applied type |
|---|---|---|---|
| 6 | Place pump horizontally on workbench with its regulator-fitting surface down, and separate pump casing (271) from valve block (312).<br>  | (1) Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged. | |
| 7 | Pull cylinder (141) out of pump casing (271) straightly over drive shaft (111). Pull out also pistons (151), set plate (153), spherical bush (156) and cylinder springs (157) simultaneously.<br>  | (1) Take care not to damage sliding surfaces of cylinder, spherical bush, shoes, swash plate, etc. | All types |

| No. | Procedure | Caution | Applied type |
|---|---|---|---|
| 8 | Remove hexagon socket head bolts (406) and then seal cover (F) (261).<br>  | (1) Fit bolt into pulling-out tapped hole of seal cover (F), and cover can be removed easily.<br>(2) Since oil seal is fitted on seal cover (F), take care not to damage it in removing cover. | All types |
| 9 | Remove hexagon socket head bolts (406) and then seal cover (R) (262)<br>{In case fitting a gear pump, first, remove gear pump} | | |
| 10 | Tapping lightly fitting flange section of swash plate support (251) on its pump casing side, separate swash plate support from pump casing.<br>  | | |

| No. | Procedure | Caution | Applied type |
|---|---|---|---|
| 11 | Remove shoe plate (211) and swash plate (212) from pump casing (271).<br>  | | |
| 12 | Tapping lightly shaft ends of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.<br>  | | |

| No. | Procedure | Caution | Applied type |
|---|---|---|---|
| 13 | Remove valve plates (313, 314) from valve block (312).<br>  | (1) These may be removed in Work 6. | All types |
| 14 | If necessary, remove stopper (L) (534), stopper (S) (535), servo piston (532) and tilting pin (531) from pump casing (271), and needle bearing (124) and splined coupling (114) from valve block (312). | (1) In removing tilting pin, use a protector to prevent pin head from being damaged.<br>(2) Since locktight is applied to fitting areas of tilting pin and servo piston, take care not to damage servo piston.<br>(3) Do not remove needle bearing as far as possible, except when it is considered to be out of its life span.<br>(4) Do not loosen hexagon nuts of valve block and swash plate support. If loosened, flow setting will be changed. | All types |

## 1-3. Reassembling Procedures

For reassembling reverse the disassembling procedures, paying attention to the following items.

(1) Do not fail to repair the parts dadmaged during disassembling, and prepair replacement parts in advance.

(2) Clean each part fully with cleaning oil and dry it with compressed air.

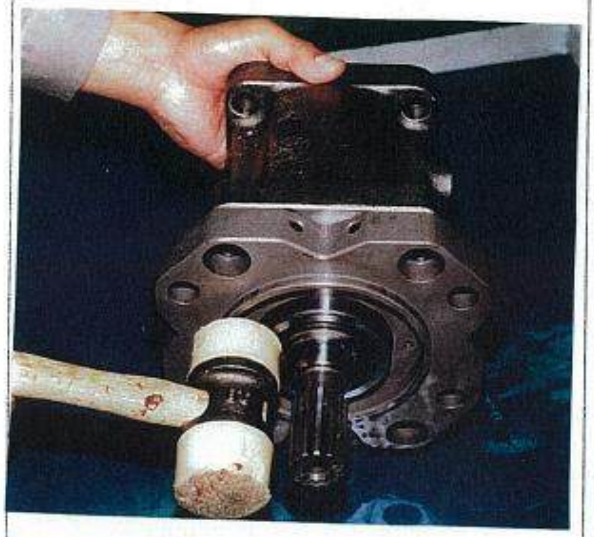
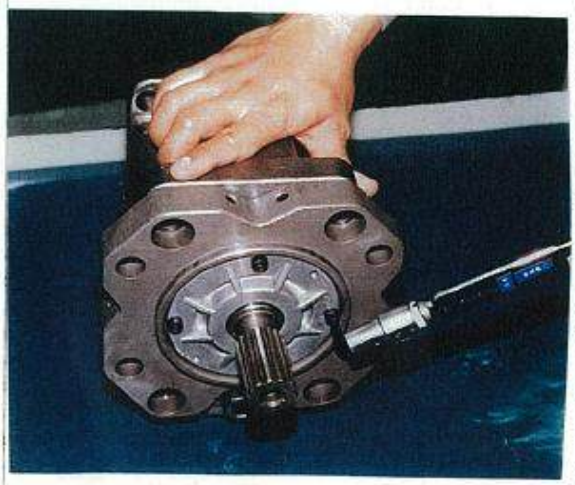
(3) Do not fail to apply clean working oil to sliding sections, bearings, etc.before assembling them.

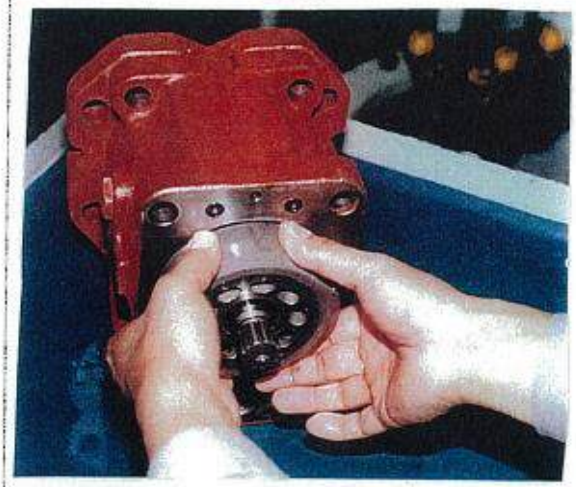
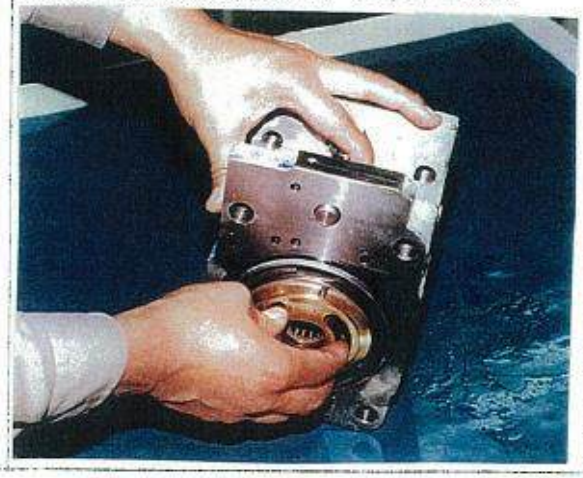
(4) In principle, replace seal parts, such as O-rings, oil seals, etc.

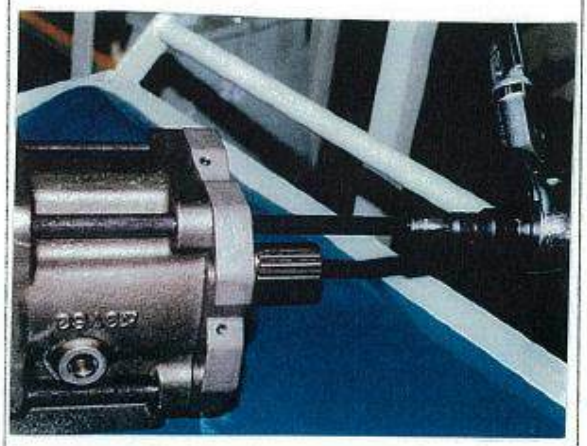
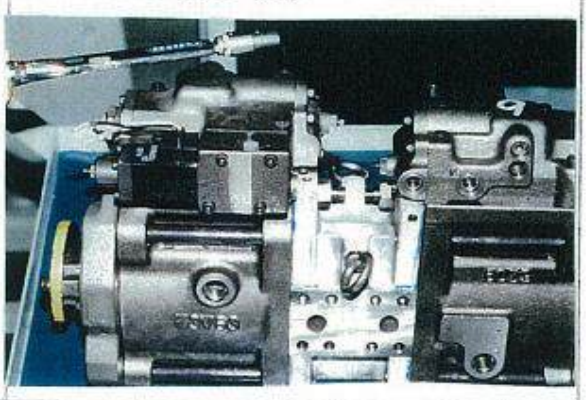
(5) For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in Section 2-3.

(6) For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

| No. | Procedure | Caution | Applied type |
|---|---|---|---|
| 1 | Fit swash plate support (251) to pump casing (271), tapping the former lightly with a hammer.<br>  | (1) After servo piston, tilting pin, stopper (L) and stopper (S) are removed, fit them soon to pump casing in advance for reassembling.<br>(2) In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply Lock-tight (medium strength) to their threaded sections. | All types |
| 2 | Place pump casing with its regulator-fitting surface down, fit tilting bush of swash plate to tilting pin (531), and fit swash plate (212) to swash plate support (251) correctly.<br>  | (1) Confirm with fingers of both hands that swash plate can be removed smoothly.<br>(2) Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily. | All types |

| No. | Procedure | Caution | Applied type |
|---|---|---|---|
| 3 | To swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (127) and snap ring (824).<br>  | (1) Do not tap drive shaft with hammer or so on.<br>(2) Assemble them into support, tapping outer race of bearing lightly with plastic hammer. Fit them fully, using steel bar or so on. | All types |
| 4 | Assemble seal cover (F) (261) to pump casing (271) and fix it with hexagon socket head bolts (406).<br>  | (1) Apply grease lightly to oil seal in seal cover (F).<br>(2) Assemble oil seal, taking full care not to damage it.<br>(3) For tandem type pump, fit rear cover (263) and seal cover (262) similarly. | All types |

| No | Procedure | Caution | Applied type |
|---|---|---|---|
| 5 | Assemble piston cylinder subassembly (cylinder (141), piston subassembly (151, 152), set plate (153), spherical bush (156) and cylinder spring (157)).<br>Fit spline phases of retainer and cylinder.<br>Then, insert piston cylinder subassembly into pump casing.<br>  | | All types |
| 6 | Fit valve plate (313) to valve block (312), entering pin in to pin hole.<br>  | (1) Take care not to mistake suction / delivery directions of valve plate. | |

| No. | Procedure | Caution | Applied type |
|---|---|---|---|
| 7 | Fit valve block (312) to pump casing (271) and tighten hexagon socket head bolts (401).<br>  | (1) At first assemble this at rear pump side, and this work will be easy.<br>(2) Take care not to mistake direction of valve block.<br>☆ [Clockwise rotation (viewed from input shaft side)] —<br>Fit block with regulator up and with delivery flange left, viewed from front side.<br>☆ [Counterclockwise rotation (viewed from input shaft side)] —<br>Fit block with regulator up and with delivery flange right, viewed from front side. | All types |
| 8 | Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts (412, 413)<br>  | (1) Take care not to mistake regulator of front pump for that of rear pump. | All types |

| No. | Procedure | Caution | Applied type |
|---|---|---|---|
| 9 | Fit drain port plug (468).<br>This is the end of ressembling procedures. | | All types |

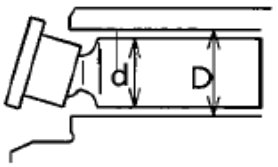
## 2. PUMP MAINTENANCE CRITERIA

### 2.1 Worn Part Replacement Criteria

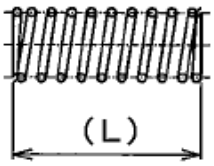
Replace a part when it exceeds any of the following criteria.

However, when a part is damaged seriously in appearance, replace it without fail.

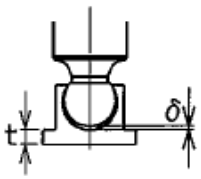
| Part name and inspection | Standard dimension/Recommended value | | | | | Countermeasures |
|---|---|---|---|---|---|---|
| | Pump model | | | | | |
| | K3V63, K5V80 | K3V112, K5V140 | K3V140 | K5V160 | K5V200, K3V180 | |
| Clearance between piston and cylinder bore (D–d) | 0.028 ／ 0.056 | 0.039 ／ 0.067 | 0.043 ／ 0.070 | 0.038 ／ 0.070 | 0.0375 ／ 0.078 | Replace piston or cylinder. |
| Play between piston and shoe–caulking section (δ) | 0 ～ 0.1 ／ 0.3 | 0 ～ 0.1 ／ 0.3 | 0 ～ 0.1 ／ 0.3 | 0 ～ 0.1 ／ 0.35 | 0 – 0.1 ／ 0.35 | Replace assembly of piston & shoe. |
| Thickness of shoe(t) | 3.9 ／ 3.7 | 4.9 ／ 4.7 | 5.4 ／ 5.0 | 5.4 ／ 5.0 | 5.4 ／ 5.0 | Replace assembly of piston & shoe. |
| Free height of cylinder spring (L) | 31.3 ／ 30.2 | 41.1 ／ 40.3 | 47.9 ／ 47.1 | 40.9 ／ 40.1 | 40.9 ／ 40.1 | Replace cylinder spring. |
| Combined height of set plate and spherical bush (H–h) | 19.0 ／ 18.2 | 23.0 ／ 22.0 | 23.8 ／ 22.8 | 23.8 ／ 22.8 | 23.8 ／ 22.8 | Replace set plate or spherical bush |
| Cylinder over pin Diameter (Cyinder internal spline) | | | 35.17(φ5)／35.57 | | | Replace of cylinder and spherical bush |



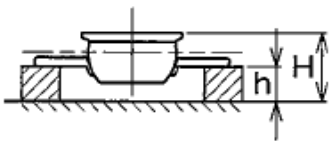

Clearance between Piston & cylinder bore (D–d)




Free height of cylinder spring : L




Play between piston & shoe : δ
Thickness of shoe : t

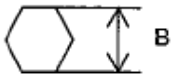



Combined height of set plate & spherical bush : H – h

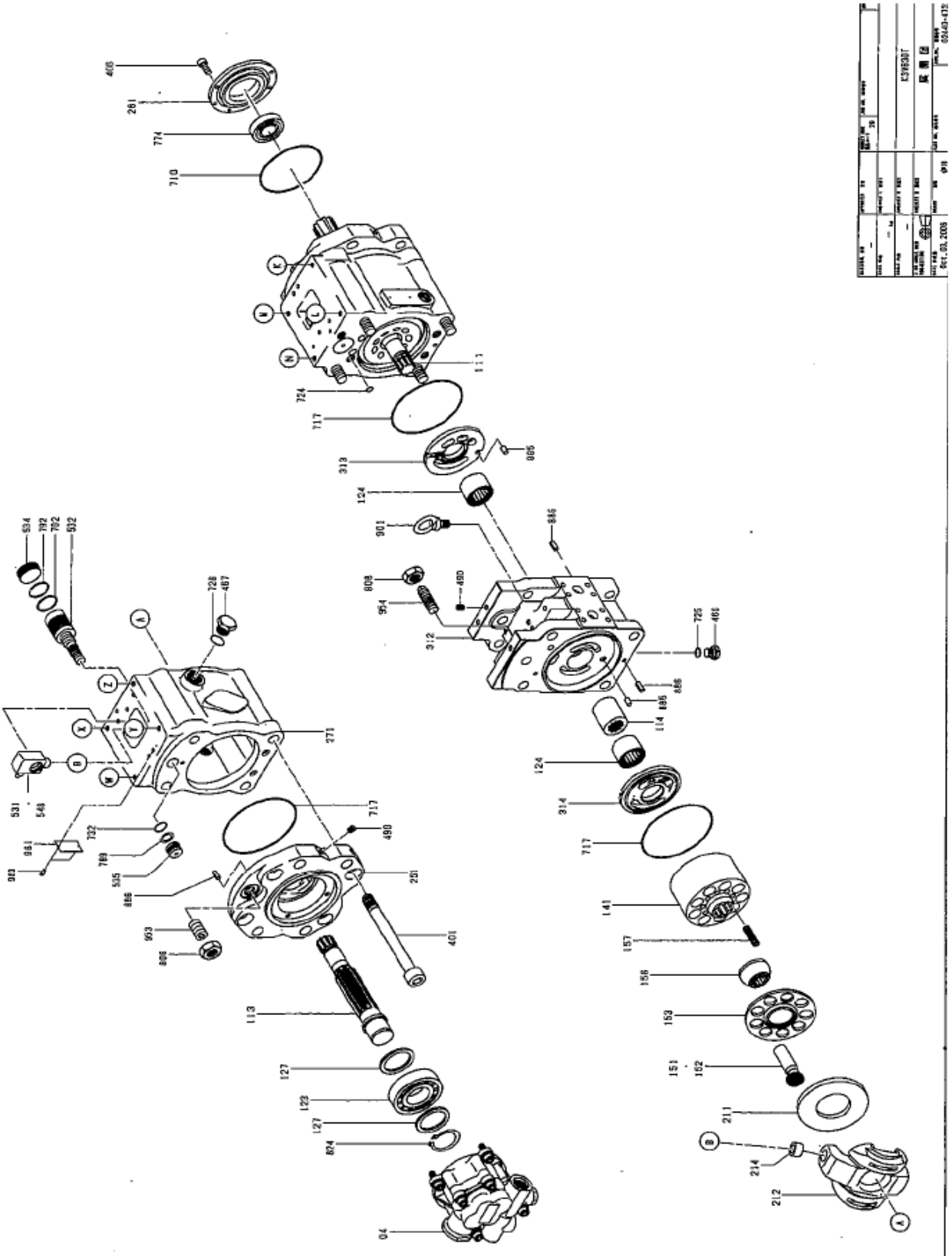
2.2 Correction Criteria for Cylinder, Valve Plate and Swash plate (Shoe plate)

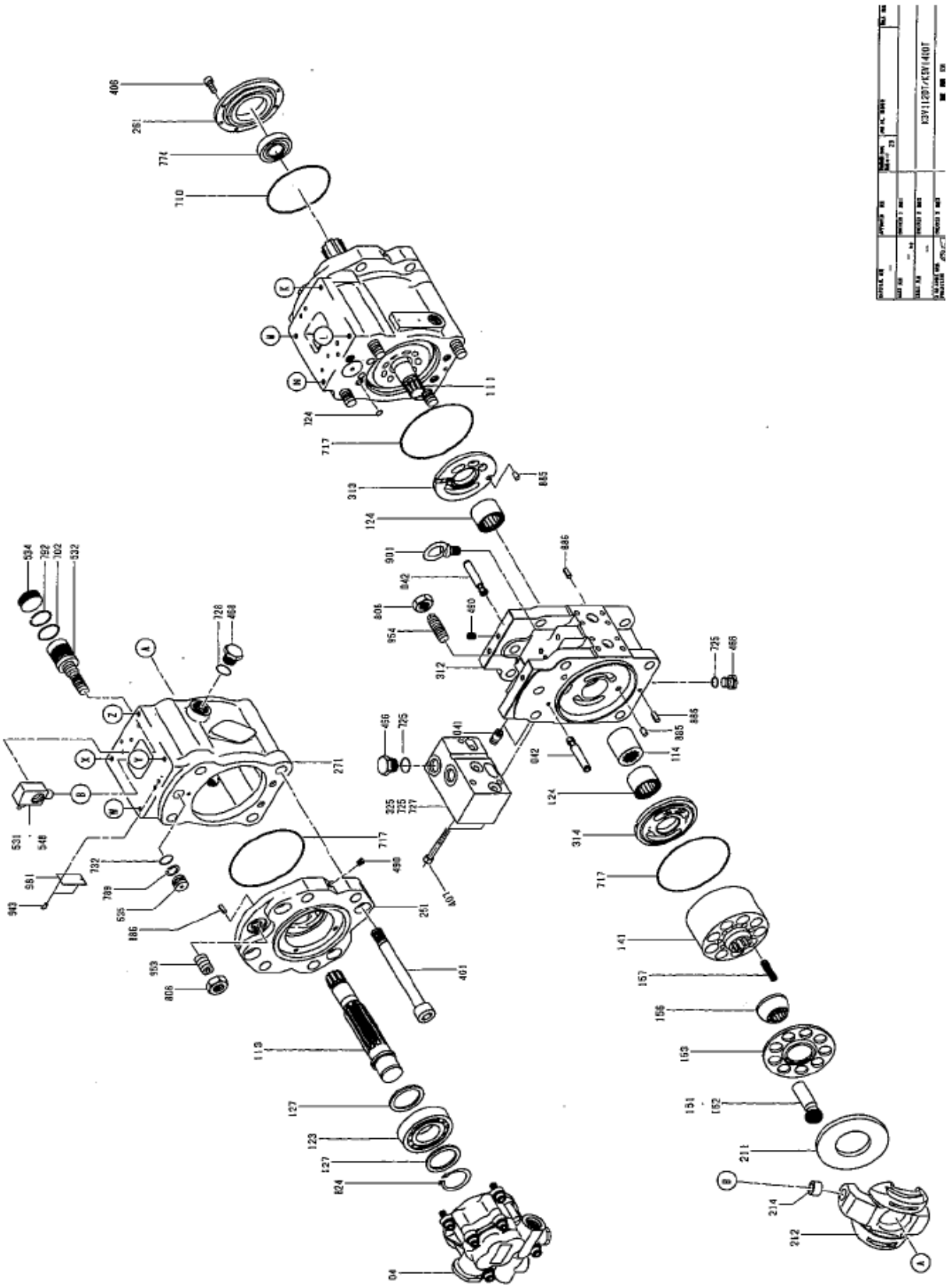
| | | |
|---|---|---|
| Surface roughness for valve plate (sliding face), swash plate (shoe plate area) & cylinder (sliding face) | Surface roughness necessary to be corrected | 3-Z |
| | Standard surface roughness (Corrected value) | 0.4-Z or lower (Lapping) |

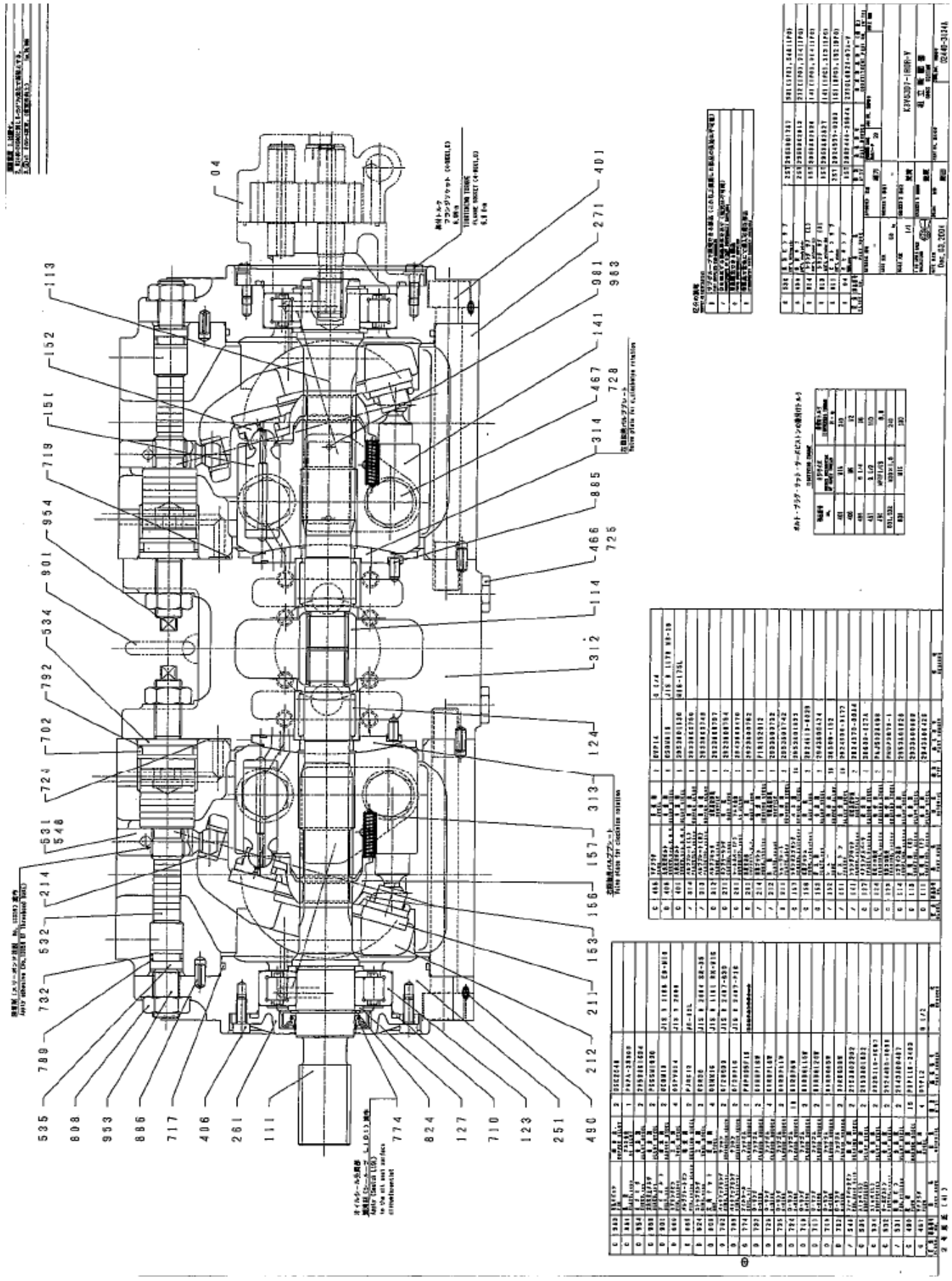
2.3 Tightening Torques




| Part name | Size | Tightening torque (N·m) | Tool name (mm) | |
|---|---|---|---|---|
| Hexagon socket head bolt (Material: SCM435). | M5 | 6.9 | B= 4 | Allen wrench |
| | M6 | 12 | 5 | |
| | M8 | 29 | 6 | |
| | M10 | 57 | 8 | |
| | M12 | 98 | 10 | |
| | M14 | 160 | 12 | |
| | M16 | 240 | 14 | |
| | M18 | 330 | 14 | |
| | M20 | 430 | 17 | |
| Taper filling plug (Material: S45C) Wind a seal tape 1.5 to 2 turns round the plug. | $R_c$1/16 | 6.9 | 4 | Do. |
| | $R_c$1/8 | 10 | 5 | |
| | $R_c$1/4 | 17 | 6 | |
| | $R_c$3/8 | 34 | 8 | |
| | $R_c$1/2 | 49 | 10 | |
| ROH plug VP plug (Material: S45C) | G1/4 | 36 | 6 | Do. |
| | G3/8 | 74 | 6 | |
| | G1/2 | 110 | 10 | |
| | G3/4 | 170 | 14 | |





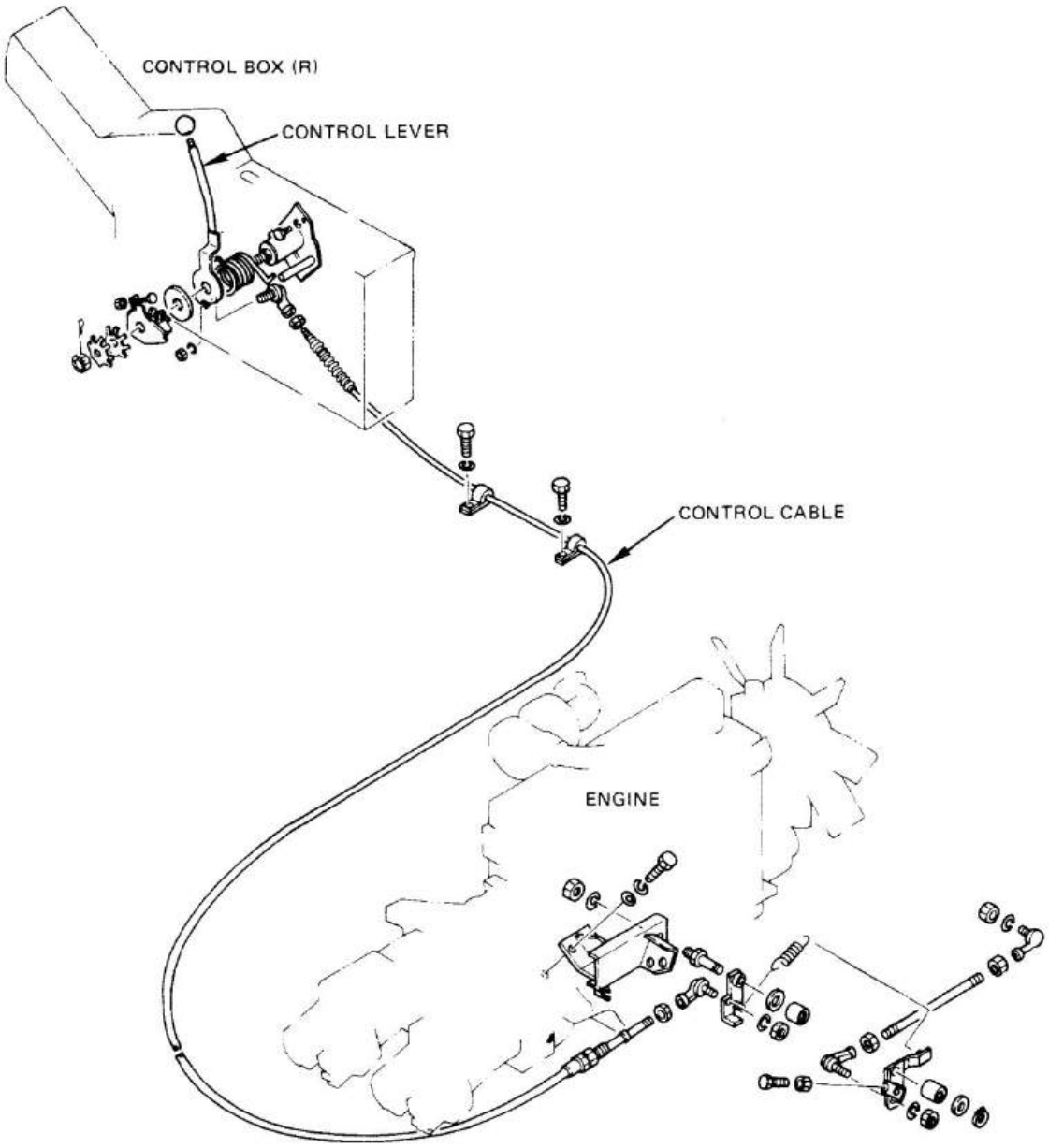


## 8. ENGINE CONTROL LEVER

### 8.1 CONSTRUCTION & FUNCTION

Engine control lever is provided in the operator's control box for controlling the engine.

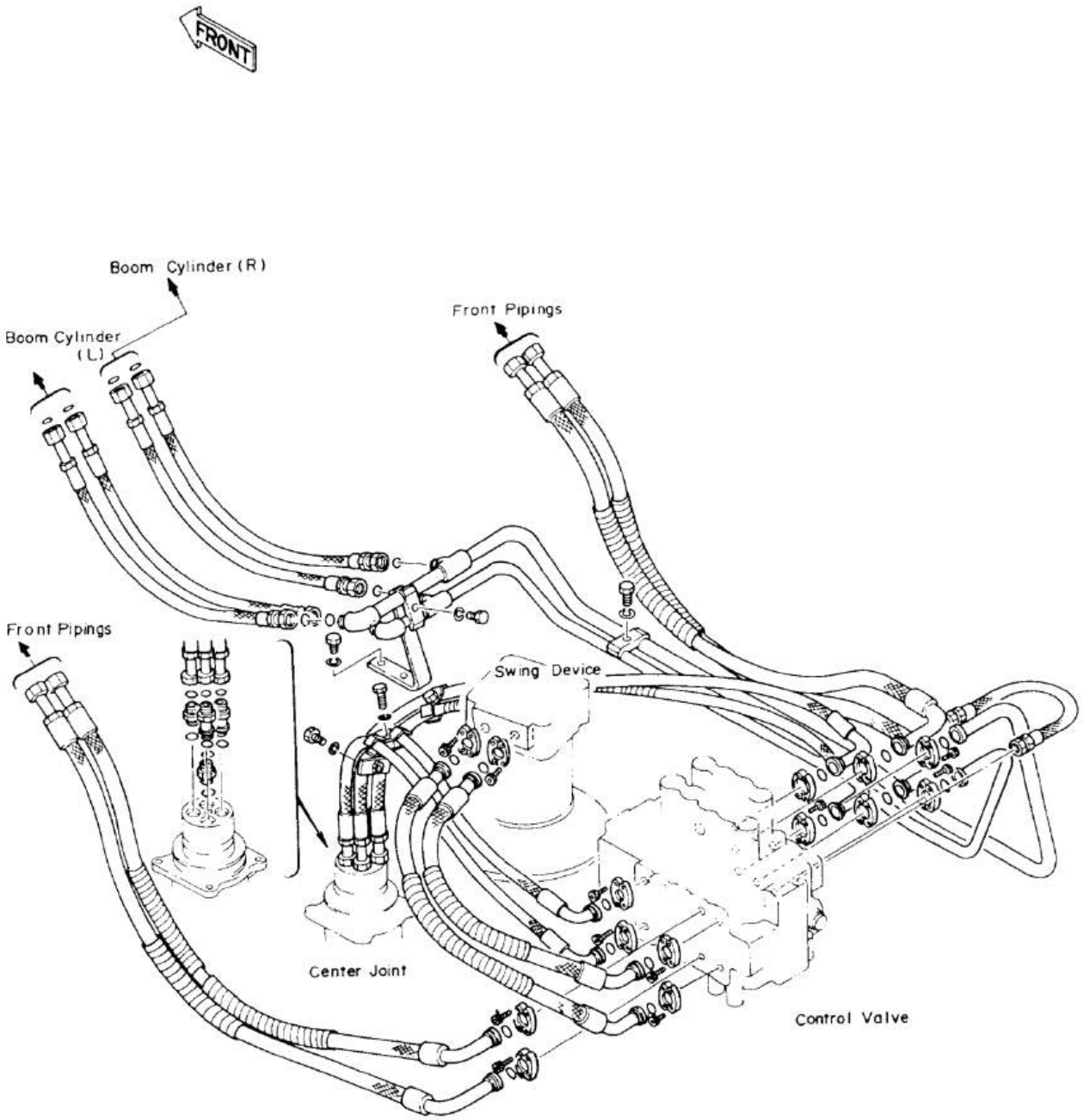
The engine control lever is connected with a engine fuel lever through a push-pull type cable.



# 9. MAIN PIPING

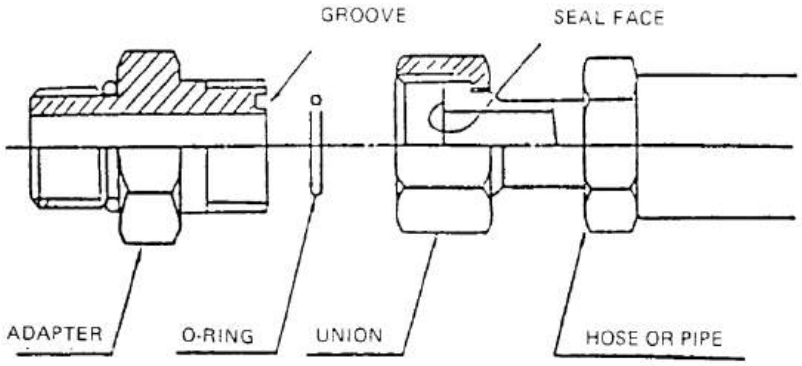
## 9.1 CONSTRUCTION

Main piping consists of boom, arm, bucket, swing and center joint pipings and foses from the control valve.



## 9.2 MAINTENANCE STANDARD

Main and suction pipings are used ORS (O-ring Seal) joint for prevent oil leak.




CAUTION

(1) When removing the joint, replace O-ring.

(2) Make sure of the O-ring position before tightening.

(3) Be careful doesn't damage to the groove of O-ring and seal face.

(4) If there oil leak from the union, replace O-ring and make sure its position before tightening.

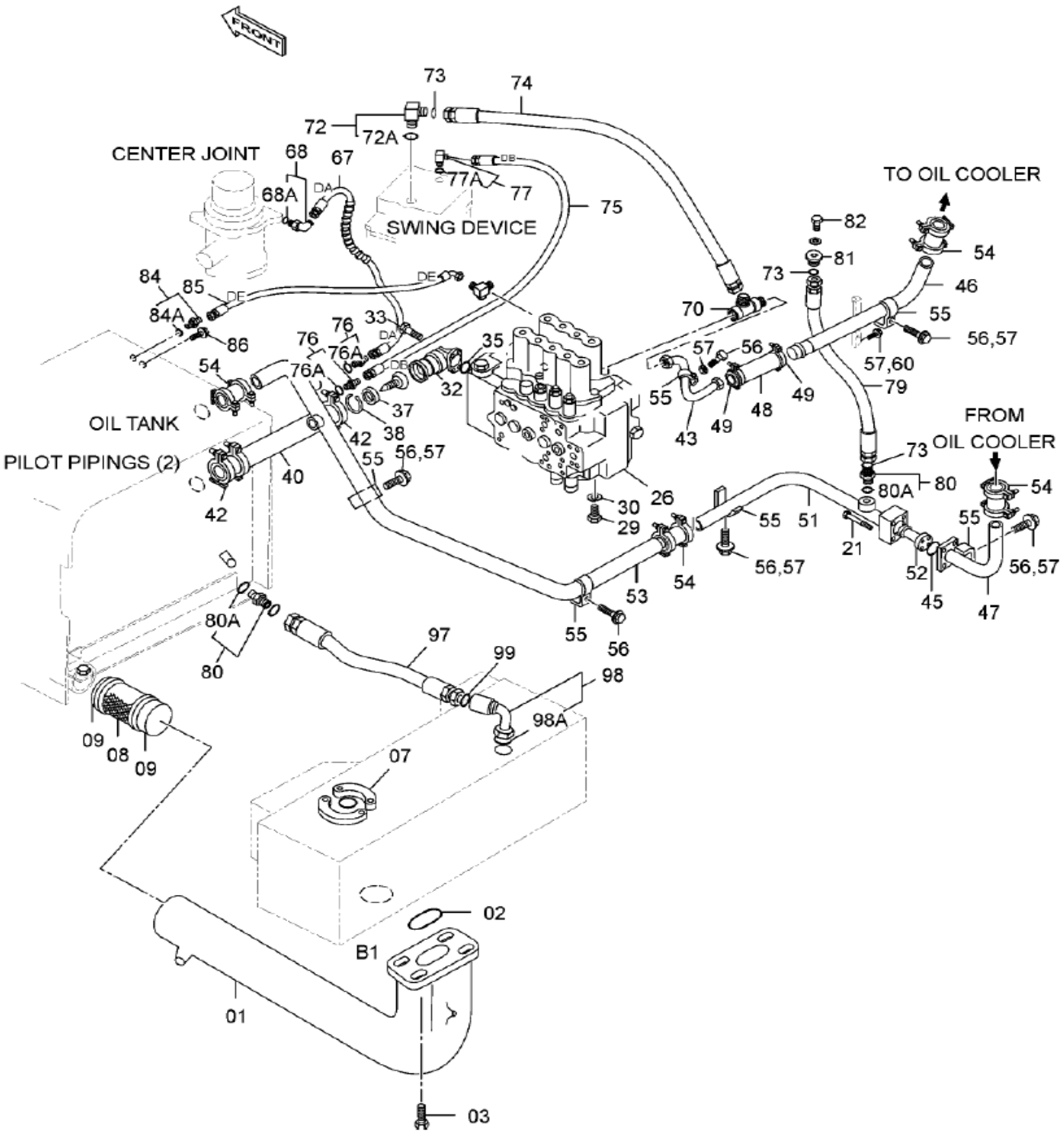
(5) Tightening torque.

| Width across flats mm | 25 | 32 | 36 | 41, 46 |
|---|---|---|---|---|
| Tightening torque kgf.m (ft.lbs) | 9.5 (195) | 14 (101) | 18 (130) | 21 (152) |

## 10. OIL COOLER PIPING

### 10.1 CONSTRUCTION

Oil cooler piping consists of pump suction line, pump delivery line, control valve return line, swing and travel motor drain line and control valve.



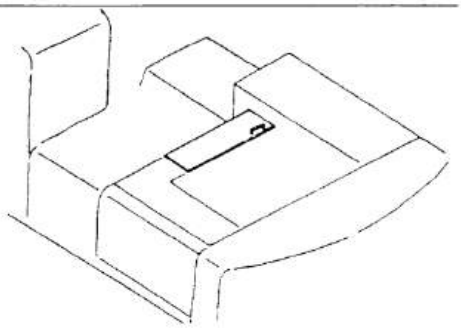
## 10.2 MAINTENANCE STANDARD

### 10.2.1 REMOVAL & INSTALLATION

(1) REMOVE CONTROL VALVE

1 Remove cover

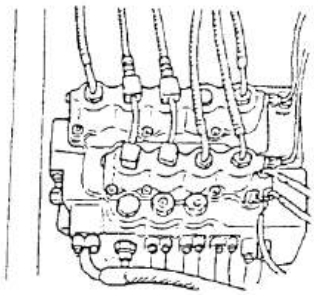
: 17 mm



2. Remove pilot hoses from the control valve.

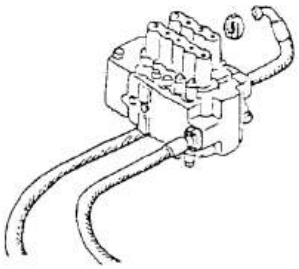
**Note:** Put matching number or tag on the hoses and control valve.

: 19 mm, 22 mm



3. Remove pump delivery hoses from the control valve.

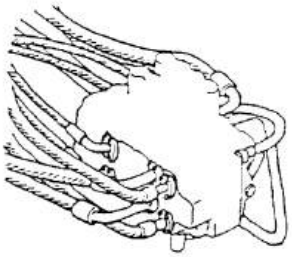
: 10 mm



4. Remove actuator's hoses from the control valve.

**Note:** Put matching number or tag on the hoses and control valve.

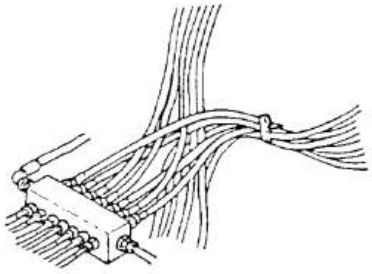
: 8 mm, 10 mm



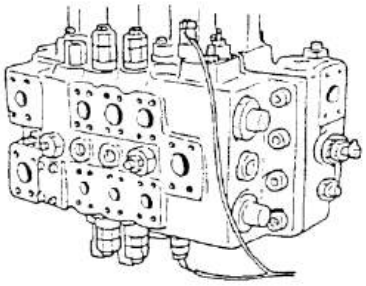
5. Remove pilot hoses of control valve bottom side from the shockless valve.

**Note:** Put matching number or tag on the hoses and shockless valve.

: 19 mm, 22 mm

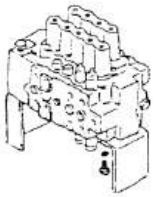


6 Remove wire from pressure switches.

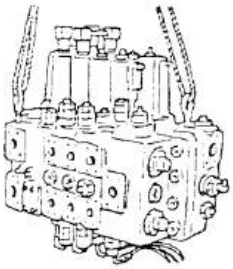


7 Remove bolts

: 24 mm

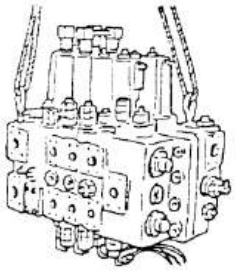


8 Remove control valve by using a eye bolts.



(2) INSTALL CONTROL VALVE

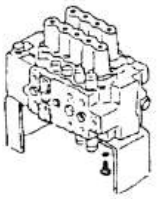
1 Install control valve to the main frame by using a eye bolts.



2 Install bolts

Tightening torque: 21 kgf-m, 174 ft.lbs

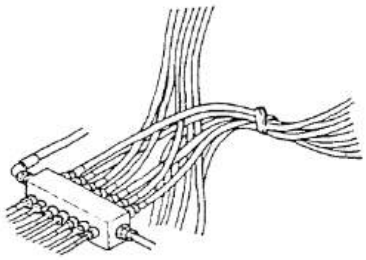
: 24 mm



3 Install pilot hoses of control valve bottom side to the shockless valve.

Tightening torque: 3 kgf-m, 22 ft.lbs
4 kgf-m, 29 ft.lbs

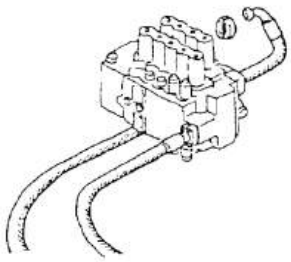
: 19 mm, 22 mm



4 Install pump delivery hoses to the control valve.

Tightening torque: 15 kgf-m, 108 ft.lbs

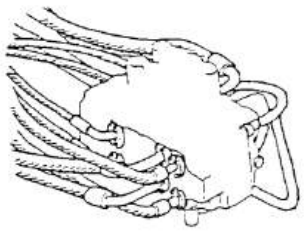
: 10 mm



5. Install actuator's hoses to the control valve.

Tightening torque: 12 kgf-m, 87 ft.lbs

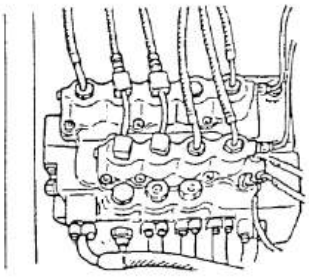
: 8 mm



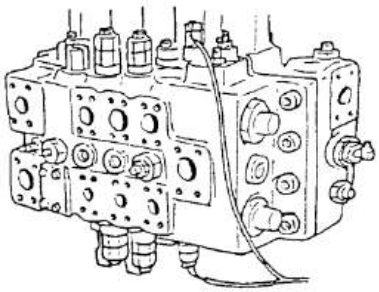
6 Install pilot hoses onto the control valve.

Tightening torque: 3 kgf-m, 22 ft.lbs
4 kgf-m, 29 ft.lbs

: 19 mm, 22 mm



7. Install wire to the pressure switches.

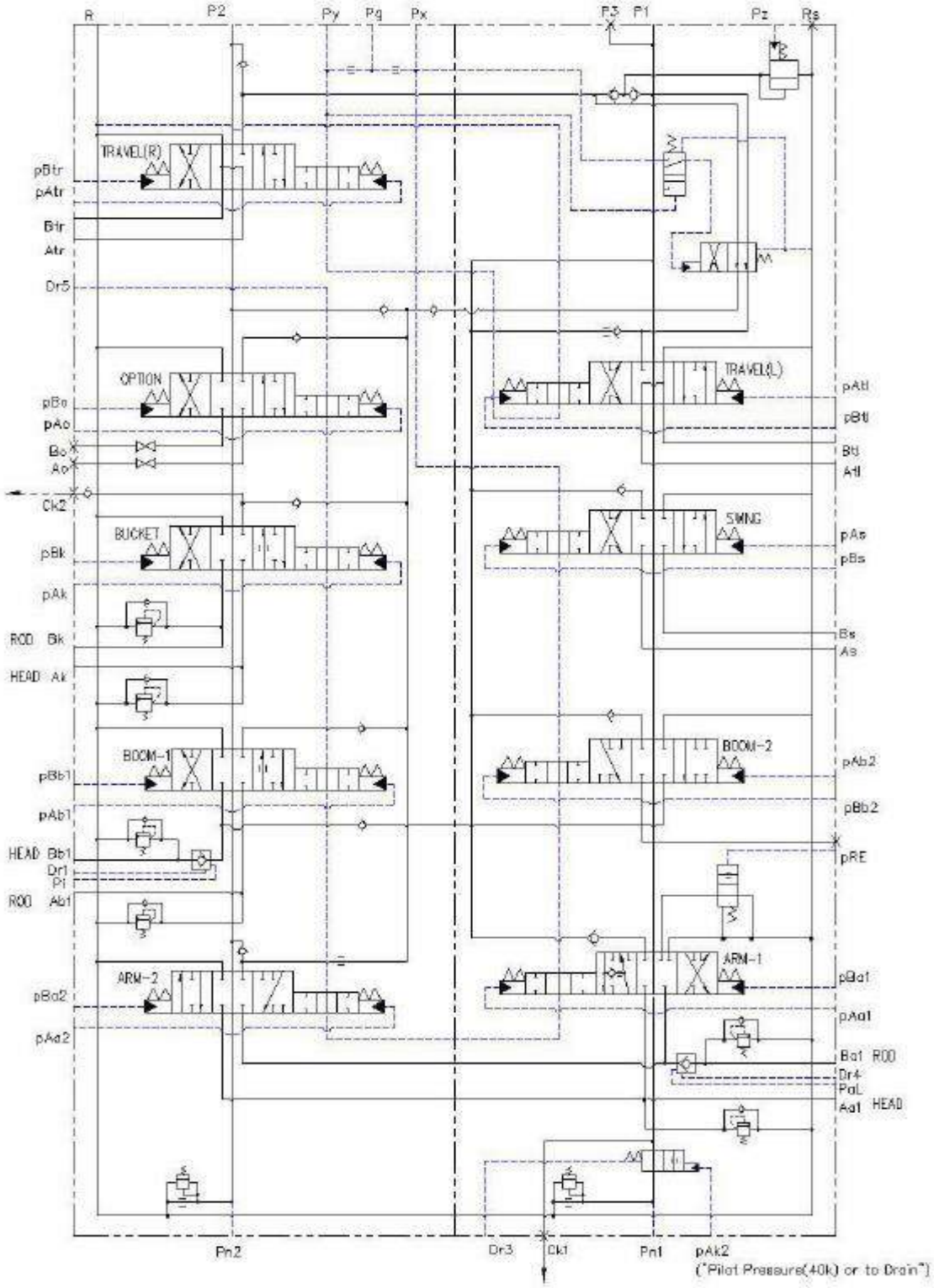


# CONTROL VALVE – AV 280

3) Main Specifications of AV-280

| | |
|---|---|
| 1. Maximum Pressure | 34.3 MPa (350 kgf/cm$^2$) |
| 2. Maximum Flow Rate | 280 L/min |
| 3. Adjustable Range of Relief Valve | 5.88 ~ 35.3 MPa (60 ~ 360 kgf/cm$^2$) |
| 4. Adjustable Range of Overload Relief Valve | 5.88 ~ 39.2 MPa (60 ~ 400 kgf/cm$^2$) |
| 5. Pilot Pressure | Max. 4.9 MPa (50 kgf/cm$^2$) |
| 6. Back Pressure | Normal 0.98 MPa (10 kgf/cm$^2$)<br>Peak 1.47 MPa (15 kgf/cm$^2$) |
| 7. Spool Stroke | 10 mm |
| 8. Leakage from Holding Valve | 3.0 cc/min in max. at 14.7 MPa (150 kgf/cm$^2$) |
| 9. Hydraulic Oil | Mineral Oil |
| 10. Temperature Range of Hydraulic Oil | -20°C ~ +90°C<br>Max. 100°C (Intermittently) |
| 11. Outside Temperature Range for Machine | -20°C ~ +80°C |
| 12. Contamination Class | To be maintained at or below the Class NAS9. |
| 13. Painting Color | Black (or as to the customer's request) |

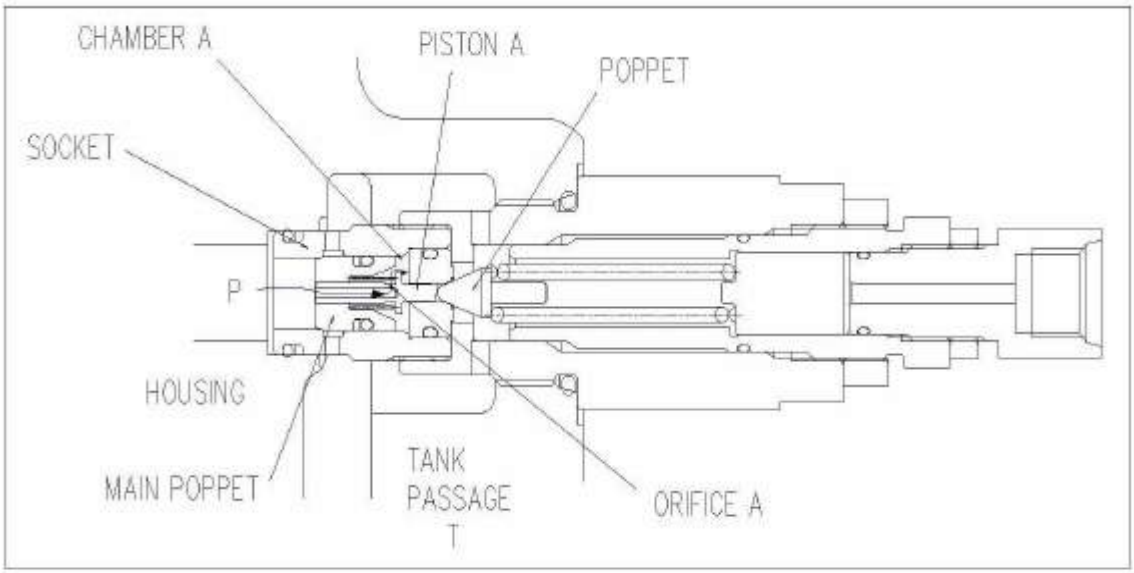
## 4) Hydraulic Circuit



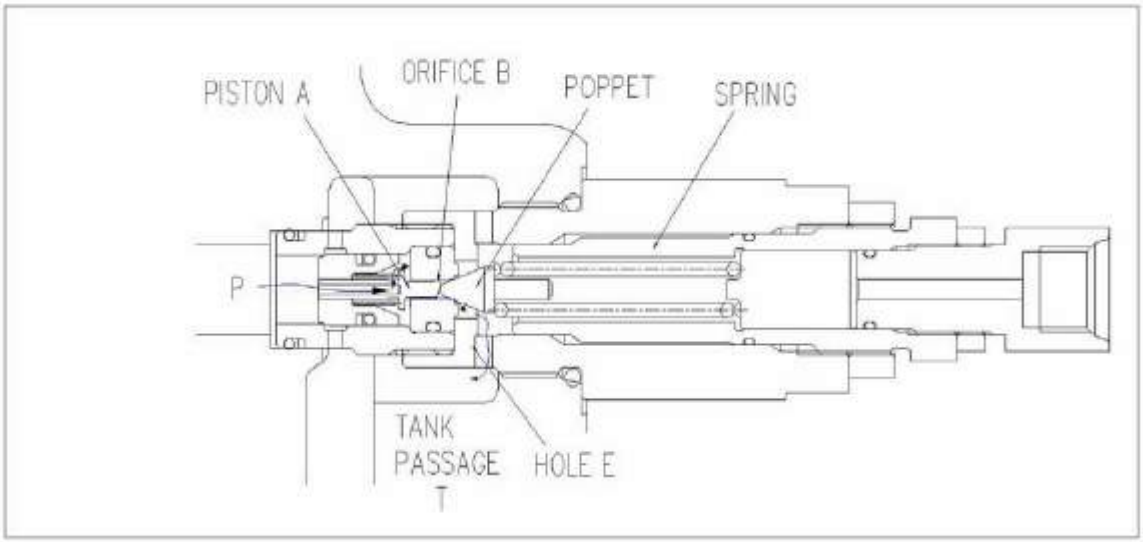
6) OPERATION OF MAIN RELIEF VALVE

The main relief valve is fitted to the straight travel valve block and function as follows:

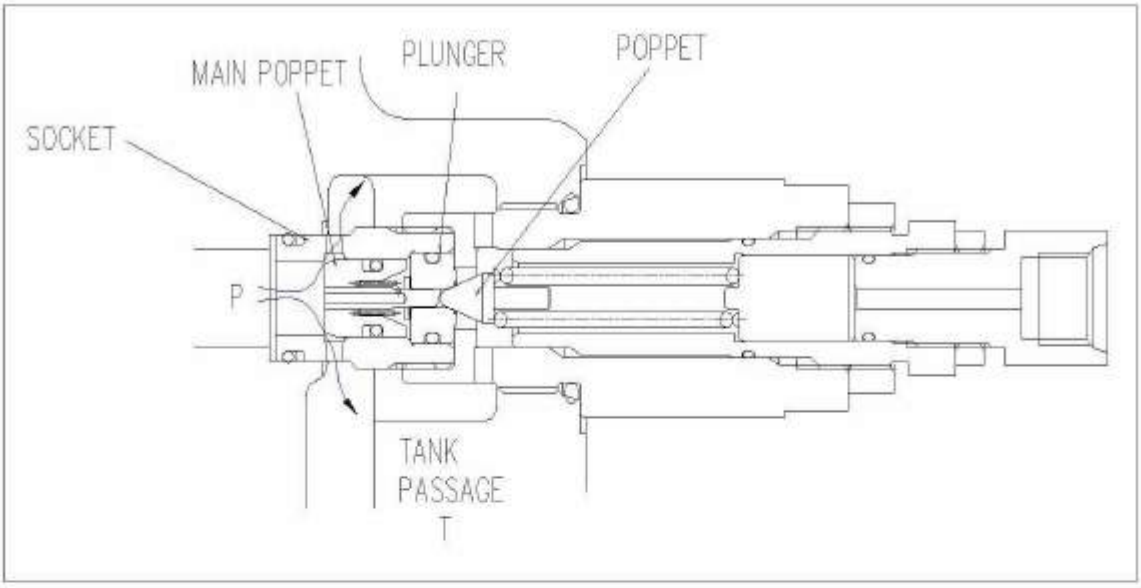
① The pressurized oil passes through the orifice (A) of the main poppet, and seats the main poppet against the housing securely.




② When the pressure of the hydraulic oil from the P port reaches the preset pressure of the spring, the hydraulic oil is applied to the poppet through the piston A to have the poppet opened. At this time, the hydraulic oil is drained out to the tank through the orifice B and the hole E.

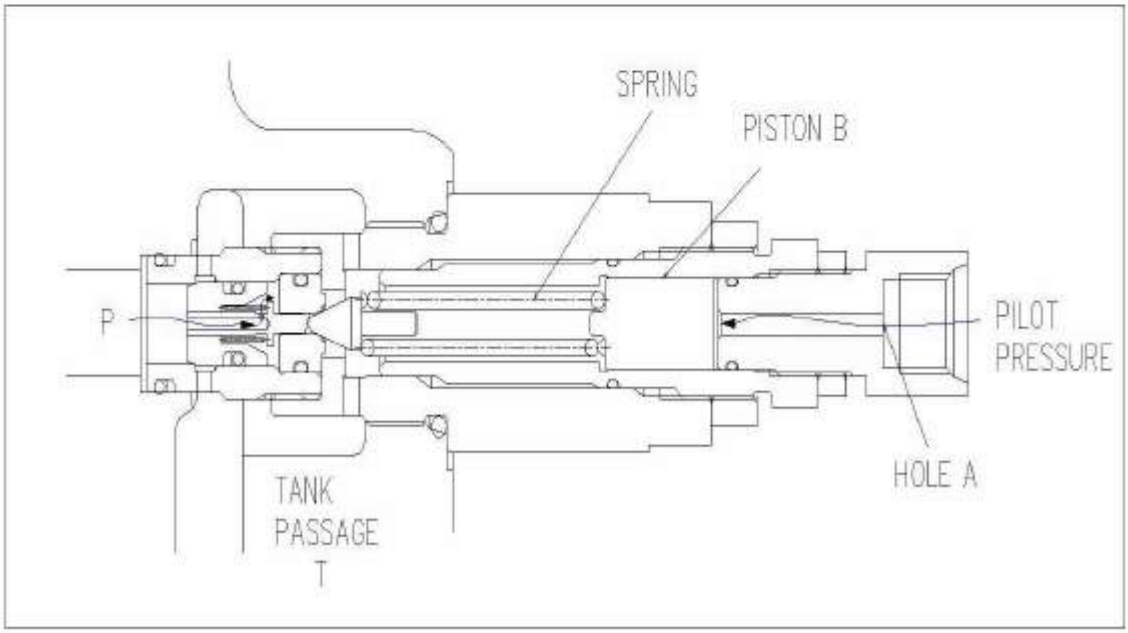


③ As the main poppet gets opened, the hydraulic oil is drained out to the tank passage through the hole on the side of the socket.




④ High pressure setting pilot signal (Pz) : ON

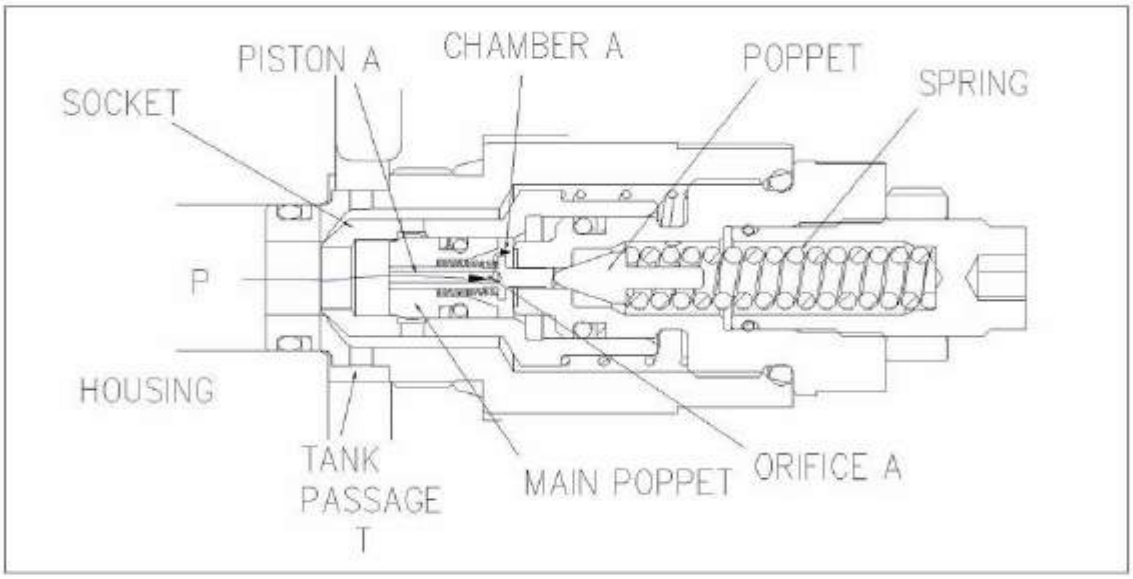
When the power boost switch is ON, the pilot pressure enters through hole A. It pushes the piston B in the left direction to increase the force of the spring and change the relief set pressure to the high pressure.



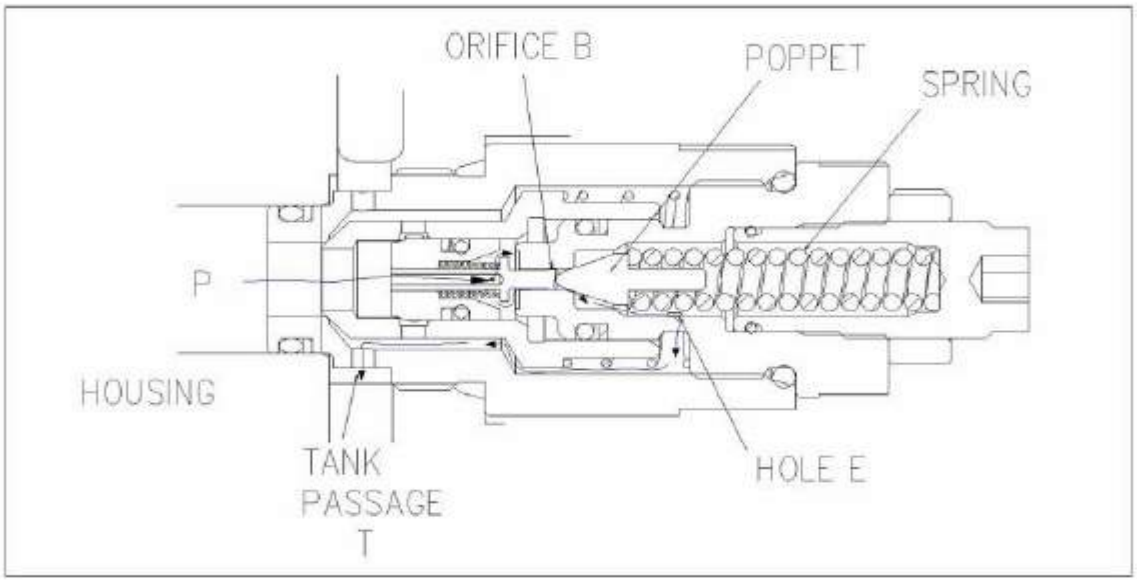
7) OPERATION OF OVERLOAD RELIEF VALVE

① Function as relief valve

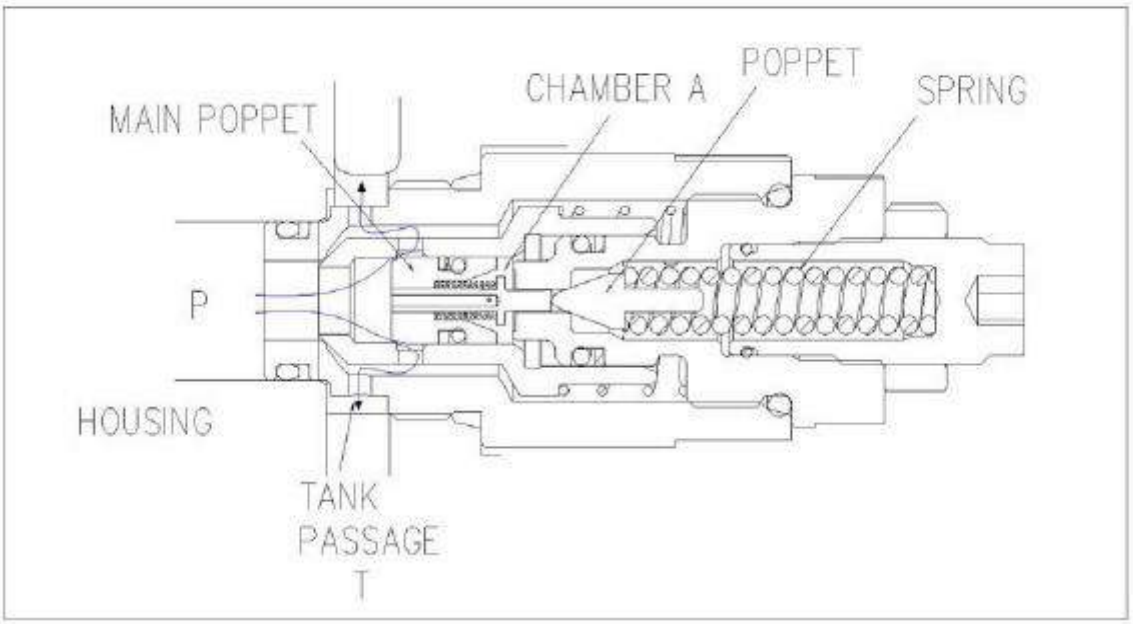
ⓐ The pressurized oil passes through the piston A and orifice is filled up in chamber A of the inside space and seat the main poppet against the socket and the socket against the housing securely.



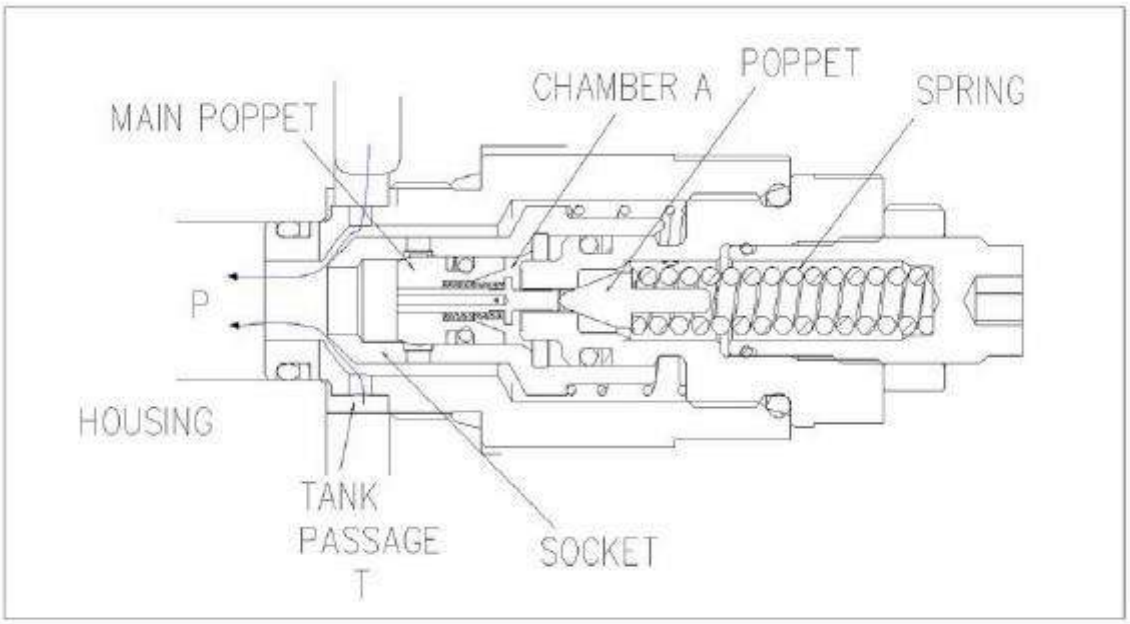

ⓑ When the pressure at port P becomes equal to the set pressure of the spring, the pressurized oil pushes open the poppet flows to tank passage (T) through hole E.



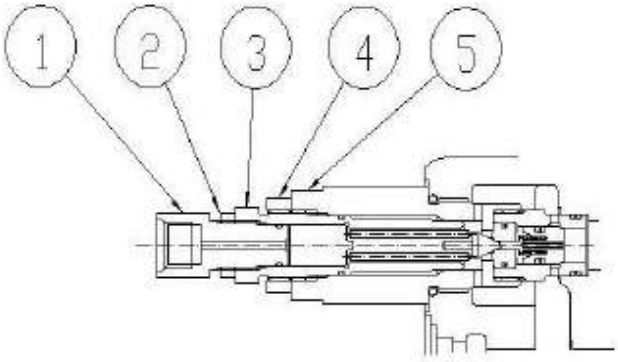
ⓒ Opening of the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T).




② Make-up function
When the pressure at P less than tank pressure (T), the socket moves in the right direction. Then, sufficient oil passes around the socket from tank passage (T) to port P and fills up the space.



**Main Relief Valve**




| Reference Number | Description |
|---|---|
| 1 | Low-Pressure Adjust Screw |
| 2 | Low-Pressure Fixing Nut |
| 3 | High-Pressure Adjust Screw |
| 4 | High-Pressure Fixing Nut |
| 5 | MRV Housing |

**Disassembly**

1. Remove the hex head nut on the cap of the main relief valve with a 32 mm spanner.

2. Be careful not to make a scratch on the sheet with the removed main relief valve.

| | |
|---|---|
| **Important** | The main relief valve and the overload relief valve are important parts for functions and safety. Thus, replace them in assembly in case there is a problem. |

**Assembly**

1. Fasten the nut at the specified torque with a 32mm torque wrench.

| | |
|---|---|
| CAP | 32mm |
| Tightening torque | 9kg·m |

**Pressure Adjustment**

**High Pressure Adjustment**

1. Install an accurate pressure gauge at the discharge outlet of the hydraulic pump.
2. Start the engine and drive hydraulic pump at normal RPM.
3. Completely stroke one of Bm-Up, AM or BKT spools and read pressure gauge.
4. Adjust pressure by turning High pressure Adjust screw ③ while monitoring pressure gauge. Each 1/4 turn changes pressure by approximately 45 kg/cm².

| | |
|---|---|
| **Important** | The relief valve is extremely sensitive and sudden extreme changes should be avoided. |

5. Tighten hexagonal nut ④ while High pressure Adjust screw ③ is secured. Recheck high side pressure.

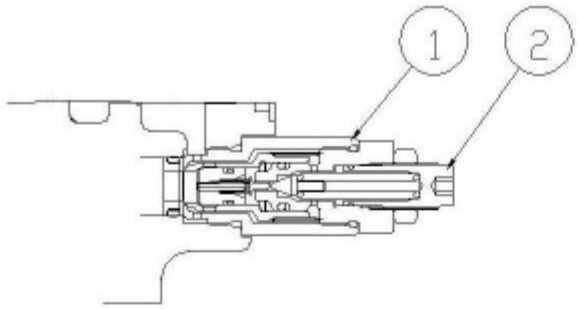
| | |
|---|---|
| High pressure fixed Nut | 27mm |
| Tightening torque | 4kg·m |

**Low Pressure Adjustment**

1. After the high pressure adjustment has been completed, low pressure adjustment can be made by turning the adjustment screw ①.
2. After the desired pressure has been adjusted, tighten hexagonal nut ② while adjustment screw ① is secured. Recheck low side pressure.

| | |
|---|---|
| Low pressure fixed Nut | 19mm |
| Tightening torque | 4kg·m |

## OVERLOAD RELIEF VALVE




| Reference Number | Description |
|---|---|
| 1 | ORV Housing |
| 2 | Pressure Adjust Element |

| | |
|---|---|
| **Important** | Do not disassemble the pressure adjustment element. The pressure is factory set and can not be correctly adjusted on the vehicle. |

### Disassembly

1. Remove the hex head nut of the overload relief valve housing with a 32 mm spanner.

| | |
|---|---|
| **Important** | When disassembling overload relief valve, tag and label each component so that all parts can be reassembled in the proper order. |

2. Be careful not to make a scratch on the sheet with the removed overload relief valve.

### Re-assembly

1. Fasten the nut at the specified torque with a 32mm torque wrench.

| | |
|---|---|
| CAP | 32mm |
| Tightening torque | 9kg·m |

| | |
|---|---|
| **Important** | Each Overload Relief Valve must be reinstalled into its original position. |

**Pressure Adjustment**

1. Install an accurate pressure gauge at the discharge outlet of the hydraulic pump.

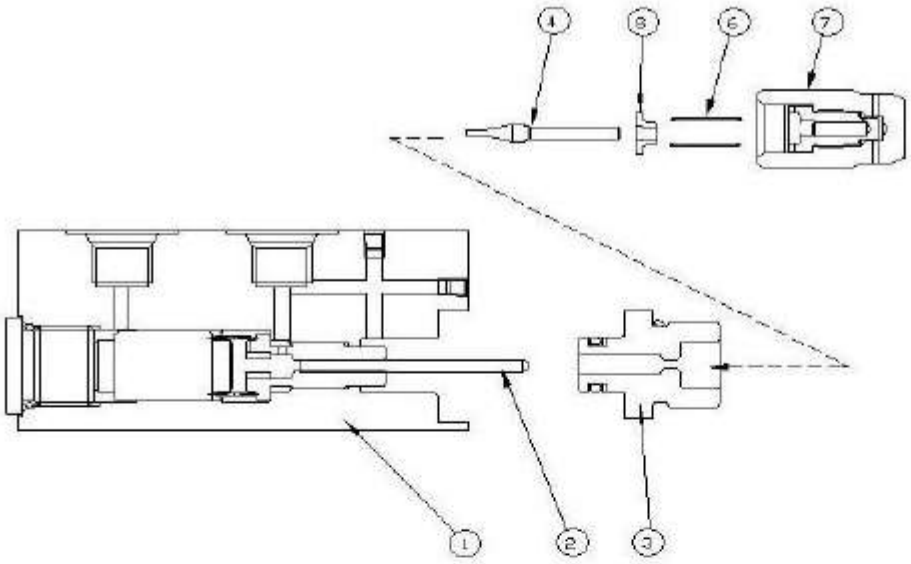
2. Start the engine and drive hydraulic pump at normal RPM.

3. Read the pressure gauge after selecting the spool that requires pressure adjustment.

4. Adjust pressure by turning High pressure Adjust screw ② while monitoring pressure gauge. Each 1/4 turn changes pressure by approximately 45 kg/cm²

| | |
|---|---|
| Allen head bolt | 6mm |
| Tightening torque | 3.5kg·m |

## HOLDING VALVE




| Reference Number | Description |
|---|---|
| 1 | Holding Body Sub Ass'y |
| 2 | Piston2 |
| 3 | Seat Poppet |
| 4 | Piston1 |
| 5 | Guide |
| 6 | Spring |
| 7 | Holding Poppet Sub Ass'y |

### Disassembly

1. After unfastening the two hex-head socket bolts for fixing the holding valve, remove the holding body sub-assembly.

| | |
|---|---|
| Allen head bolt | 6mm |
| Tightening torque | 3.5kg·m |

| | |
|---|---|
| **Important** | As the piston 2 is removed along with the holding body assembly when you remove it, be careful of deformation of the piston 2 during removal. |

2. Remove the seat poppet.

| | |
|---|---|
| Seat Poppet | 32mm |
| Tightening torque | 9kg·m |

| | |
|---|---|
| **Important** | Be careful when you remove the seat poppet as the parts ④, ⑤, ⑥ and ⑦ are removed together with it. |

3. Remove the holding poppet sub-assembly from the MCV.

| | |
|---|---|
| **Important** | Be careful not to damage the surface of the seat. |

**Re-assembly**

1. Insert the holding poppet sub-assembly to the MCV.

2. Arrange the holding valve in the order of Piston1- Guide- Spring, and place and mount it on the seat poppet.

| | |
|---|---|
| **Important** | Do not change the direction of the guide. Be careful not to have the combination of the piston1, guide and spring separated when you mount them on the seat poppet. |

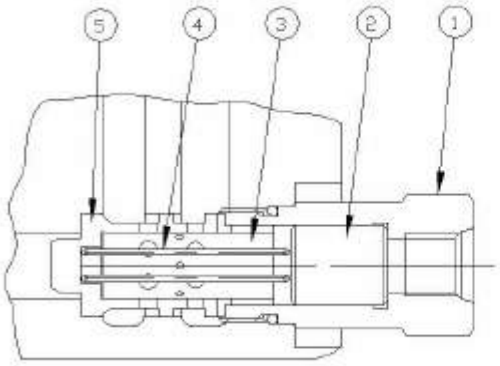
3. Tighten the seat poppet at the specified torque.

4. After mounting the piston2 on the holding body assembly, tighten the two hex-head socket bolts for fixing the holding valve at the specified torque with a 6 mm torque wrench. (Standard Torque: 3.5kg·m)

| | |
|---|---|
| **Important** | Be careful not to change the direction when you mount the piston2 on the holding body assembly. |

## Arm Regeneration Valve

| | |
|---|---|
| **Important** | When disassembling Arm Regeneration Valve, tag and label each component so that all parts can be reassembled in the proper order. |




| Reference Number | Description |
|---|---|
| 1 | Cap |
| 2 | Piston |
| 3 | Spool |
| 4 | Spring |
| 5 | Sleeve |

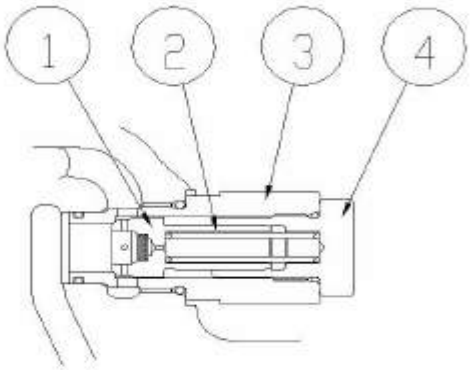
1. Loosen cap ① and remove piston ②.

| | |
|---|---|
| Cap wrench size | 27mm |
| Tightening torque | 10kg·m |

2. Remove spool ③, spring ④ and sleeve ⑤ from housing.

## NEGACON VALVE

| | |
|---|---|
| **Important** | When disassembling Negacon Valve, tag and label each component so that all parts can be reassembled in the proper order. |




| Reference Number | Description |
|---|---|
| 1 | Poppet |
| 2 | Spring |
| 3 | Body |
| 4 | Cap |

1. Loosen body ③.

| | |
|---|---|
| Body wrench size | 32mm |
| Tightening torque | 9kg·m |

2. Loosen cap ④ and remove poppet ① and spring ②.

| | |
|---|---|
| Cap wrench size | 24mm |
| Tightening torque | 6kg·m |

## 4. Maintenance Standards

### Part Test

| Part Name | Test Item | Evaluation Criteria and Troubleshooting |
|---|---|---|
| Housing | Existence of flaw, rust and corrosion | 1) Replace the part when there is a damage on the following parts.<br><br>▫ Grooves of housings, sliding areas of spools, and especially lands where pressure is applied.<br>▫ Seal pocket areas where a spool is inserted.<br>▫ Sealing areas of ports, contacting an O-ring.<br>▫ Sealing areas of the main travel port.<br>▫ Other damages which are considered to interrupt normal functions. |
| Spool | 1) Existence of flaw, rust and corrosion<br>2) Sealing areas for O-rings at both ends<br>3) After inserting the spool in the groove of the housing, perform a stroke by rotating it. | 1) Replace the spool in case there is a scratch on the outer surface of the operating parts in contact.<br><br>2) Replace the spool in case there is a damage on the sliding areas.<br><br>3) Modify or replace the spool in case the O-ring seems to become damaged or the operation of the spool is not smooth. |
| Poppet | 1) Damage on poppet or spring<br>2) Insert the poppet in the housing and operate it. | 1) Replace the poppet in case sealing is not perfect.<br>2) It is to be considered normal if it is operated smoothly without interruption. |
| Spring Related Parts | Rust, corrosion or deformation on springs, spring sheets, plugs and housing | A severe damage needs replacement. |
| Spool Seal Areas | 1) Outside leakage<br>2) Rust, corrosion or deformation on the seal plate. | 1) Modification or replacement<br>2) Modification or replacement |
| Main Relief Valve<br>Overload Relief Valve<br>Negacon Valve | 1) Rust or deformation on the outside surfaces<br>2) Contacting surfaces of the valve sheets<br>3) Contacting surfaces of the poppets<br>4) Problems with springs<br>5) O-rings, Back-up rings and seals | 1) Replacement<br>2) Replacement for a damage<br>3) Replacement for a damage<br>4) Replacement<br>5) Basically, replace all the parts. |

## 5. Causes of Troubles and Troubleshooting

1) When you find a problem with the equipment or the excavator, it is necessary to check the pilot pressure or discharging pressure, load pressure and signal pressure of the pump to find whether the problem is of the hydraulic equipment, control valves, pumps, cylinders, motors or circuit. When you need to focus on checkup of the control valves, disassembly and checkup should be carried out according to the above-mentioned instructions on disassembly and re-assembly.

2) As foreign materials are extremely harmful to hydraulic devices, pay keen attention to securing cleanliness.

3) Be careful when you handle the sliding areas of a part.

4) Be careful not to make a scratch on the gasket surface of O-rings. A scratch on the surface of these parts may cause oil leakage.

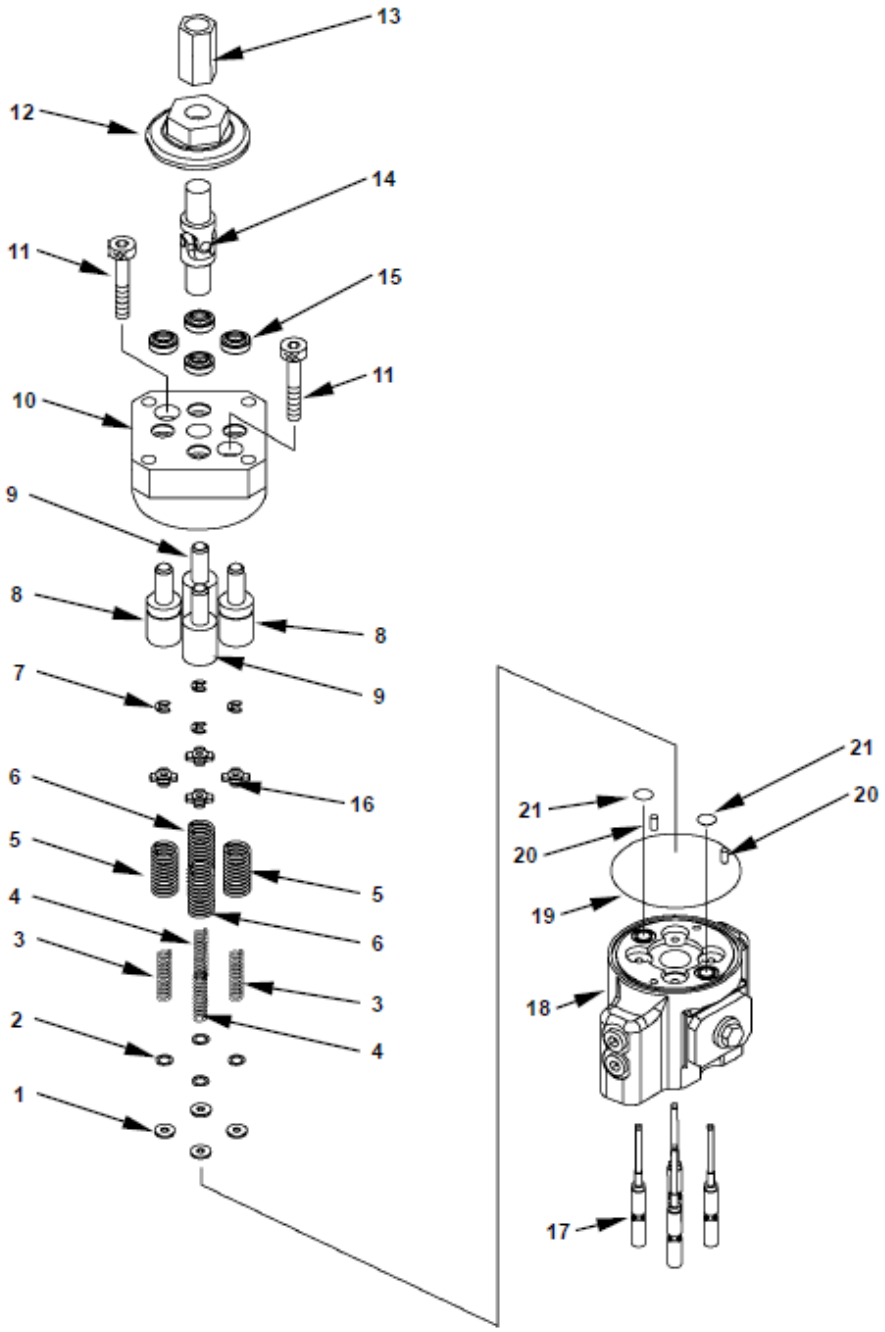
### A. Main Control Valve

| Problems | Causes | Troubleshooting |
|---|---|---|
| 1. Bad traveling operation, decreased speed of swing operation (lack of power), or delayed response | 1) Bad operation of the main relief valve<br>• Foreign materials between the main poppet and the sheet<br>• Foreign materials between the poppet and the sheet<br>• Stickage in the main poppet<br>• Breakage or deformation on springs<br>• Blockage in the orifice of the main poppet<br>• Loosened control screws<br>2) Blockage in the orifice of the pilot passage, bound for the control valve | 1) Measuring the pressure of the main relief valve and treatments<br>• Disassembly and rinsing. A severe damage needs replacement of the assembly or sub-assembly.<br>• Disassembly and rinsing. A severe damage needs replacement of the assembly or sub-assembly.<br>• Correcting the stuck area.<br>• Replacing the springs.<br>• Removing the foreign material.<br>• Readjusting the screws and tightening the lock nuts at the specified torque.<br>2) Removing the foreign material. |

| | | |
|---|---|---|
| 2. Excessive natural descent of the cylinder at the neutral position of the spool | Where there is no holding valve | |
| | 1) Excessive gap between the housing and spool | 1) Replacing the spool or the housing. |
| | 2) The spool does not completely return to the neutral position.<br>• Foreign materials or slip-stickage between the housing and spool<br>• Breakage or deformation of springs<br>• Foreign materials in the pilot passage. | 2) Measuring the second pilot pressure.<br>• Disassembly, rinsing, or correcting the stuck area.<br>• Replacing the springs.<br>• Removing the foreign materials |
| | 3) Bad operation of the main relief valve<br>▫ Refer to the clause 1.1) above. | 3) Measuring the pressure of the main relief valve.<br>- Refer to the clause 1.1) above. |
| | Where there is holding valve | |
| | 1) Damage on the check poppet<br>2) Damage on the pilot poppet or the seat<br>3) Bad pilot signal pressure<br>4) Bad sliding operation of pistons | 1) Replacing<br>2) Replacing<br>3) Measuring the pilot pressure, checking the joystick.<br>4) Replacing |
| 3. Descent of the cylinder before elevating operation of the cylinder | 1) Bad operation of the load check valve<br>• Foreign materials between the poppet and the housing.<br>• Slip-stickage in the poppet<br>• Breakage or deformation of springs | • Disassembly and rinsing. A severe damage needs replacement of the housing.<br>• Correcting the stuck area.<br>• Replacing the springs. |

| | | |
|---|---|---|
| 4. Bad operation of bucket, boom, or arm<br>• Decreased speed of operation (lack of power) and delay in response | 1) Bad operation of the main spool<br><br>• Excessive gap between the housing and the spool<br>• Foreign materials between the housing and the spool<br>• Slip-stickage in the spool<br>• Breakage or deformation of the return spring<br>• Blockage of the pilot circuit by foreign materials<br><br>2) Bad operation of the main relief valve<br>- Refer to the clause 1.1) above. | 1) Measuring the second pilot pressure.<br><br>• Replacing the spool or the housing.<br><br>• Disassembly and rinsing<br><br>• Correcting the stuck area.<br>• Replacing the spring.<br><br>• Removing the foreign materials.<br><br>2) Measuring the pressure of the main relief valve.<br>- Refer to the clause 1.1) above. |
| 5. Impossible confluence of boom and arm | 1) Bad operation of the spool for swing.<br>• Slip-stickage in the spool<br><br>• Breakage or deformation of springs<br>• Excessive gap between the housings (left and right) and the spool<br>• Blockage in the spool passage by foreign materials | 1) Measuring the pilot pressure.<br><br>• Disassembly, rinsing, or correcting the stuck area.<br>• Replacing the springs.<br><br>• Disassembly and rinsing, removing the foreign materials<br><br>• Disassembly and rinsing, replacing the filter. |
| 6. Unable to operate negacon and unable to control minimum flow rate when you operate the levers | 1) Bad operation of the negacon valve<br>• Foreign materials in the poppet sheets<br><br>• Breakage or deformation of springs<br>• Blockage in the orifice of the poppet<br>• Blockage in the filter | 1) Measuring the negacon pressure.<br><br>• Disassembly and rinsing, A severe damage requires replacement of the assembly or sub-assembly.<br>• Replacing the springs.<br><br>• Disassembly and rinsing, removing the foreign materials<br>• Disassembly and rinsing, replacing the filter. |

## DISASSEMBLE RIGHT AND LEFT PILOT VALVES




1 - Spacer (4 Used)
2 - Shim
3 - Balance Spring A (2 Used)
4 - Balance Spring B (2 Used)
5 - Return Spring A (2 Used)
6 - Return Spring B (2 Used)
7 - Retaining Ring (4 Used)
8 - Push Rod A (2 Used)
9 - Push Rod B (2 Used)
10 - Block
11 - Socket Bolt (2 Used)
12 - Cam
13 - Screw Joint
14 - Universal Joint
15 - Oil Seal (4 Used)
16 - Spring Guide (4 Used)
17 - Spool (4 Used)
18 - Housing
19 - O-Ring
20 - Knock Pin (2 Used)
21 - O-Ring (2 Used)

### Disassemble Right and Left Pilot Valves

**IMPORTANT: Block (10) and housing (18) are made of aluminium. Too strong a force can deform, or damage them. Therefore, handle with care.**

**IMPORTANT: As spool (17) has been selected to match the hole of housing (18), they must be replaced as a set. In addition, the dimensions of balance springs A (3), B (4) and return springs A (5), B (6) as well as those of push rods A (8), B (9) are different. For this reason, be sure to indicate the port number from which each is removed. Port numbers are stamped on housing (18).**

**IMPORTANT: Do not clamp housing (18) in a vise to remove the screw joint because the strong torque may act on the screw joint.**

1. Secure screw joint (13) in a vise. Then turn cam (12) with a spanner to remove the screw joint.
   : 32 mm

2. Clamp the flat surface of housing (18) in a vise slightly. Remove cam (12) from universal joint (14).
   : 32 mm

*NOTE: The universal joint has been secured on block (10) with LOCTITE. Do not remove it unless necessary.*

3. Remove socket bolt (11) to remove block (10). At this time, push rods (8) and (9) are still on the block side.
   : 6 mm

**IMPORTANT: Two kinds of push rods are used. They must be handled in order of port number after removing.**

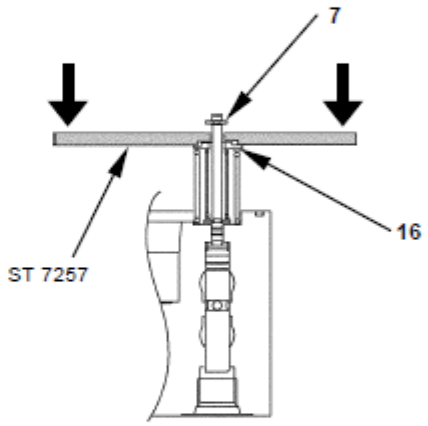
4. Pull push rods (8) and (9) out of block (10).

5. Using a bamboo spatula, remove oil seals (15) (4 used) from block (10).

*NOTE: If a metal bar is used, the mating part of oil seal may be damaged.*

**IMPORTANT: The retaining ring may come off while disassembling. Take care not to drop it.**

6. Press springs with special tool (ST 7257) from the top of spring guide (16). Retaining ring (7) will appear. Remove it with a screw driver or similar tool. (4 places)



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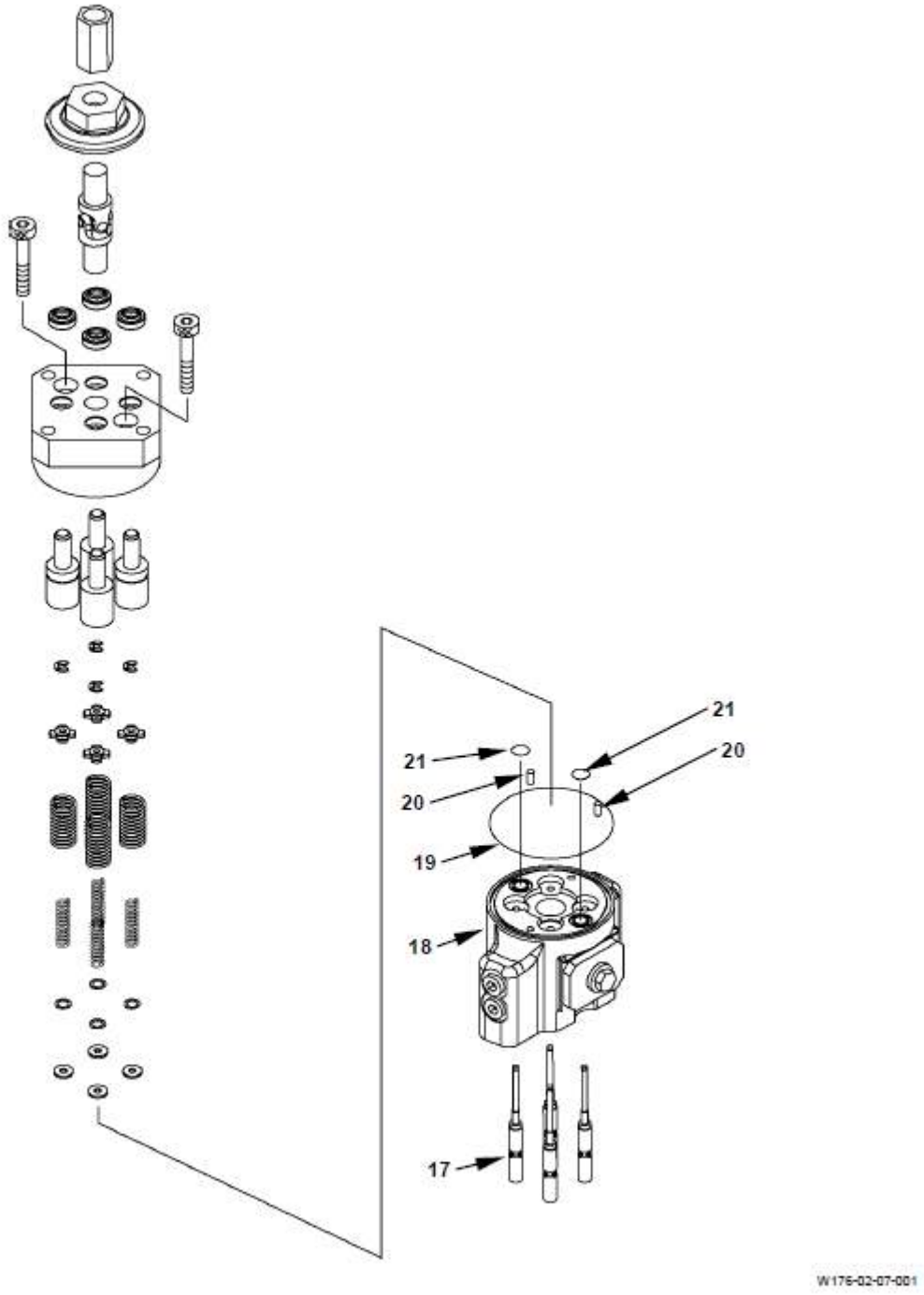
**IMPORTANT: The number of shims (2) has been determined for each port during the performance testing at the factory. Take care not to lose them. Keep them carefully so as to install them to each former port when reassembly.**

7. Remove spring guide (16), balance springs (3) and (4), return springs (5) and (6), shim (2) and spacer (1) from spool (17).


21
21
20
20
19
18
17
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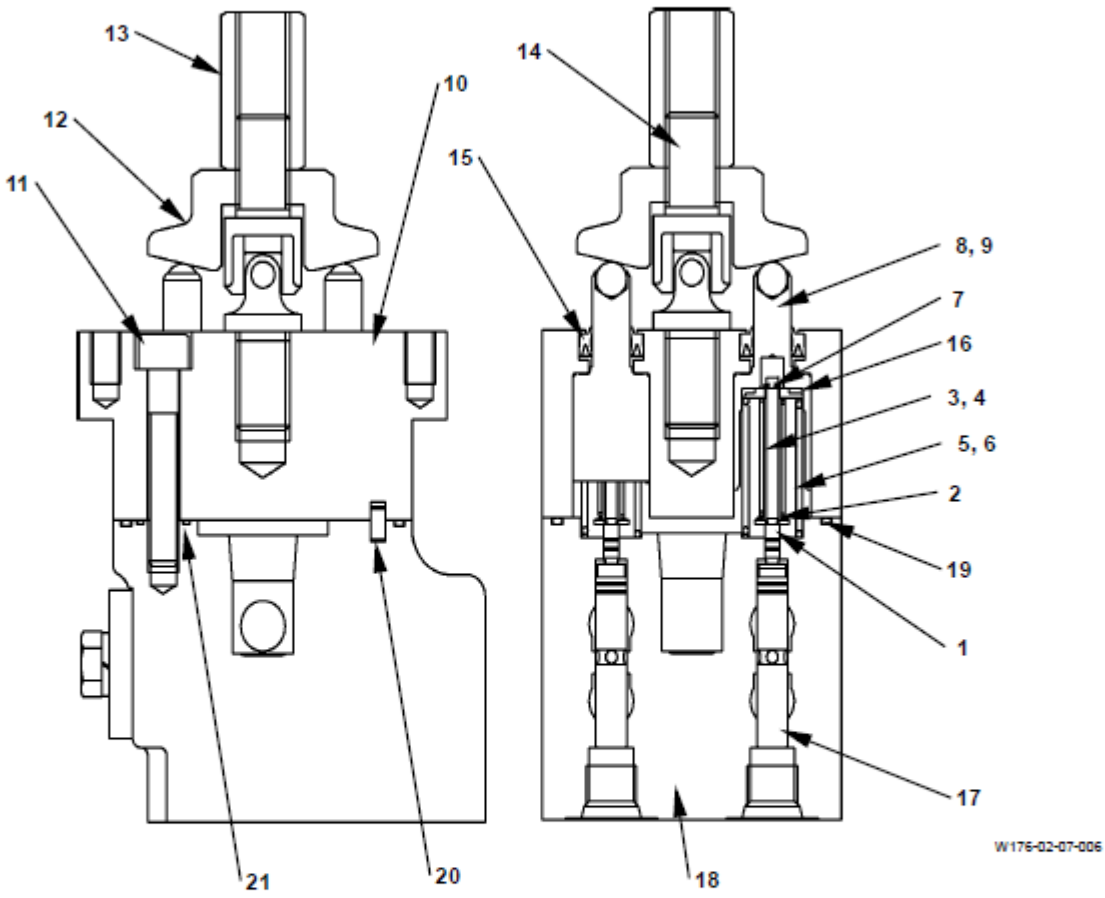
**IMPORTANT: As spool (17) has been selected to match the hole of housing (18), keep them carefully so as to install them to the former port when reassembling.**

8. Remove spool (17) from housing (18). Pulling it out while turning it slowly.

*NOTE: The spool and the housing must be replaced as an assembly.*

9. Remove O-rings (19) and (21) (2 used) from housing (18). Do not remove knock pins (20) (2 used) unless necessary.

# ASSEMBLE RIGHT AND LEFT PILOT VALVES




1 - Spacer (4 Used)
2 - Shim
3 - Balance Spring A (2 Used)
4 - Balance Spring B (2 Used)
5 - Return Spring A (2 Used)
6 - Return Spring B (2 Used)
7 - Retaining Ring (4 Used)
8 - Push Rod A (2 Used)
9 - Push Rod B (2 Used)
10 - Block
11 - Socket Bolt (2 Used)
12 - Cam
13 - Screw Joint
14 - Universal Joint
15 - Oil Seal (4 Used)
16 - Spring Guide (4 Used)
17 - Spool (4 Used)
18 - Housing
19 - O-Ring
20 - Knock Pin (2 Used)
21 - O-Ring (2 Used)

### Assemble Right and Left Pilot Valves

**IMPORTANT: The pilot valve is susceptible to contamination. Keep parts clean when assembling.**

*NOTE: Table below shows the relations between each port and the components. Take care not to confuse them when assembling.*

| Port No. | Spool (17) | Shim (2) | Push rods (8), (9) |
|---|---|---|---|
| 1 | Same to the former one | Same to the former one | with outer groove |
| 2 | | | without outer groove |
| 3 | | | with outer groove |
| 4 | | | without outer groove |

| Port No. | Return Springs (5), (6) | Blance Springs (3), (4) |
|---|---|---|
| 1 | short | short |
| 2 | long | long |
| 3 | short | short |
| 4 | long | long |

**IMPORTANT: Make sure of the port hole number and insert spool (17) to the former port.**

1. Insert the thinner end of spools (17) (4 used) to housing (18), then push the spool rotating it.

*NOTE: The spool has been selected to match the hole of the housing. The spool and housing must be replaced as an assembly.*

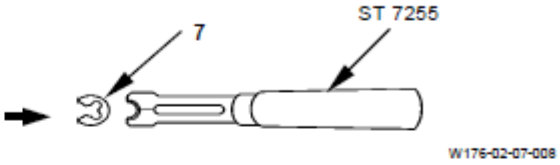
**IMPORTANT: Refer to the table above to assemble them correctly.**

2. Install spacers (1) (4 used), shim (2), balance springs (3) (2 used) or (4) (2 used), return springs (5) (2 used) or (6) (2 used) onto spools (17) (4 used) installed in housing (18).

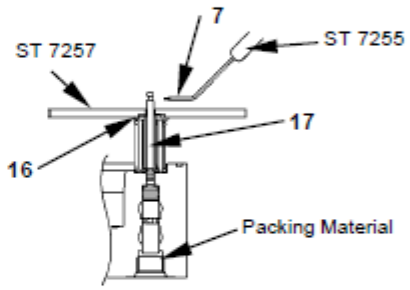
**IMPORTANT: Install spring guide (16), with the protrusion facing upward.**

3. Install spring guides (16) (4 used) onto return springs (3) (2 used) or (4) (2 used).

4. Install retaining ring (7) onto ring holder (ST 7255).



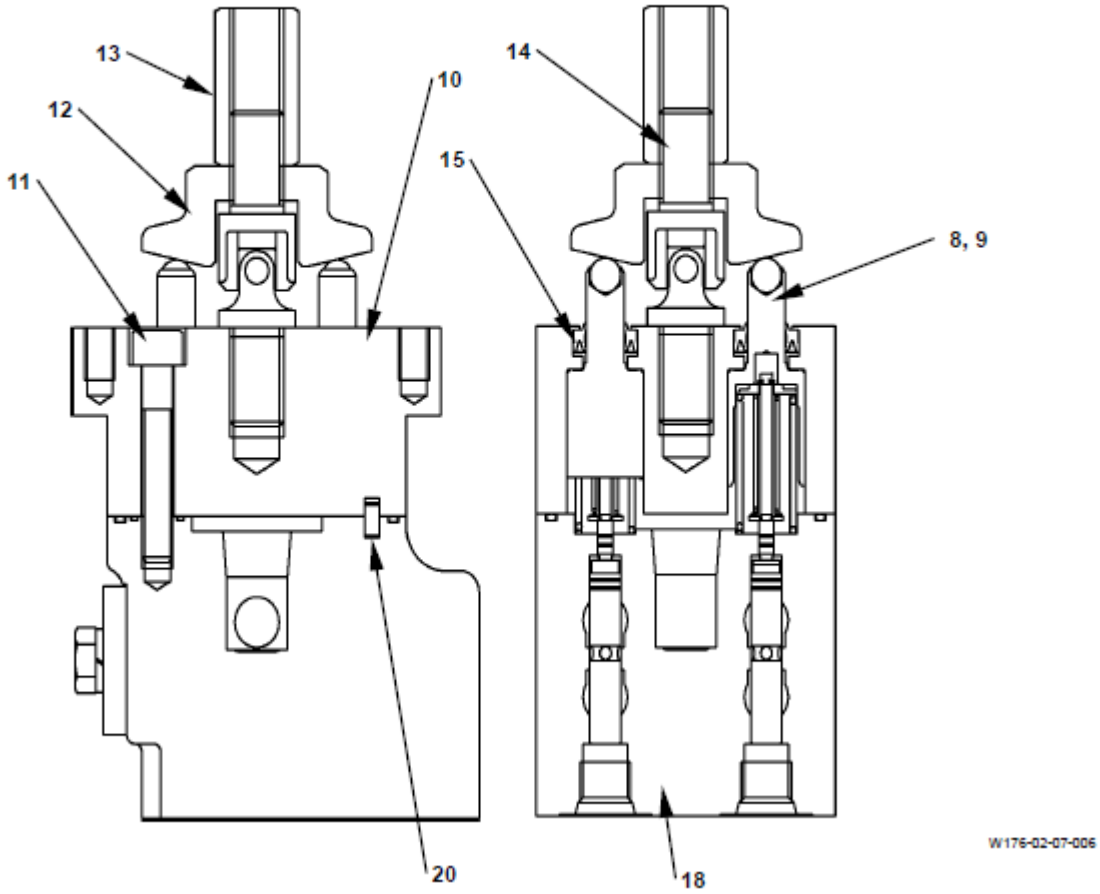

5. Insert the spool (17) head into the hole of spring special tool (ST 7257) to press the spring from the top of spring guide (16). Install retaining ring (7) with the ring holder (ST 7255) onto the head of the spool.




*NOTE: Put approx. dia. 8 mm, length 10 mm of packing material into the port hole, to not only make the work easy to do, but also prevent the spool from lowering to the bottom when compressing the spring.*

6. Assemble the remained spools (17) (3 used) into housing (18) in the same procedures as step 2 to 5.

7. Install O-rings (19) and (21) (2 used) on to housing (18).


13
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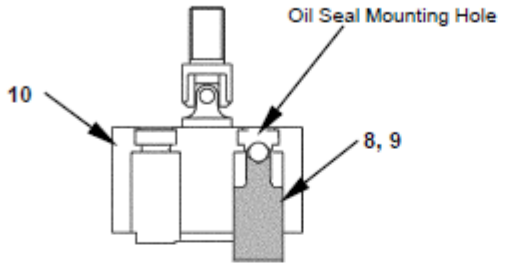
W176-02-07-006

8. Apply grease to the inner face of oil seals (15) (4 used), then install the oil seals (4 used) into block (10) with a bamboo spatula.

*NOTE: As shown bellow, inserting push rods (8) and (9) first, then installing oil seal (15). This prevents the oil seal from entering into the hole.*




W176-02-07-007

**IMPORTANT: Make sure of the position to install the push rod.**

9. Install push rods (8) (2 used) and (9) (2 used) to block (10). When installing the push rods, install the push rods with groove to ports # 1 and # 3, the ones without groove to ports # 2 and # 4, respectively.

10. Apply grease to the ball at the ends of push rods (8) (2 used) and (9) (2 used).

11. Apply grease to the joint part of universal joint (14).

12. Align the position of knock pins (20) (2 used), install the block (10) assembly to housing (18) with socket bolts (11) (2 used).
    : 6 mm
    : 20 N·m (2 kgf·m, 14.5 lbf·ft)

**IMPORTANT: Make sure of the tightness of cam.**

13. Clamp housing (18) carefully in a vise and then install cam (12) to universal joint (14).
    Tighten the universal joint so that the clearance between the cam and push rod (8) and (9) becomes 0 to 0.2 mm.
    : 32 mm

**IMPORTANT: Do not clamp housing (18) in a vise because the strong torque may act on screw joint (43).**

14. Clamp screw joint (13) in a vise to tighten universal joint (14). Tighten cam (12) with a spanner.
    : 32 mm
    : 90 N·m (9.2 kgf·m, 67 lbf·ft)

## REMOVE AND INSTALL TRAVEL PILOT VALVE

**CAUTION: Escaping fluid under pressure may penetrate the skin, causing serious injury. Avoid this hazard by relieving pressure before disconnecting hydraulic or other lines. Hydraulic oil may be hot just after operation, and may spurt, possibly causing severe burns. Be sure to wait for oil to cool before starting any repair work.**
**The hydraulic oil tank cap may fly off if removed without releasing accumulated pressure first. Push the air release valve on top of the hydraulic oil tank to release any remaining pressure.**

M104-07-021

### Preparation

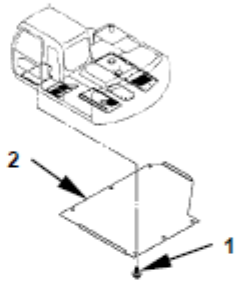
1. Park the machine on a solid level surface. Lower the bucket to the ground.

2. Stop the engine. Push the air release valve on the hydraulic oil tank to release any pressure remaining in the hydraulic tank.

### Removal

1. Loosen bolts (1) (6 used) to remove under cover (2).
   : 17 mm

ZAXIS110, 120

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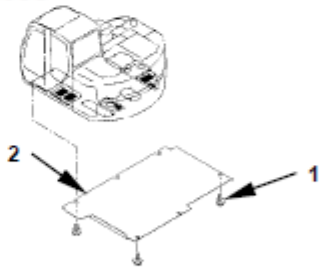
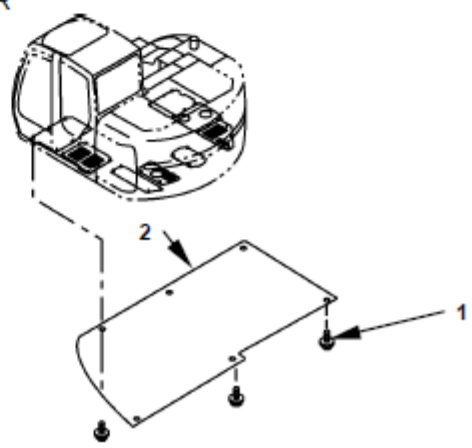
ZAXIS125US, 135US




W1SE-02-08-002

ZAXIS135UR




W187-02-07-001

2. Loosen bolt (3) to remove pedal (4), levers (15) and (16).
   : 17 mm

**IMPORTANT: Attach identification tags on all disconnected hoses for reassembly.**

3. Disconnect pipes (5 and 6) and hoses (7 to 10).
   : 19 mm

*NOTE: Attach a cap on each disconnected hose end.*

4. Remove socket bolt (13), spring washer (12) and plain washer (11) to remove pilot valve (14).
   : 8 mm

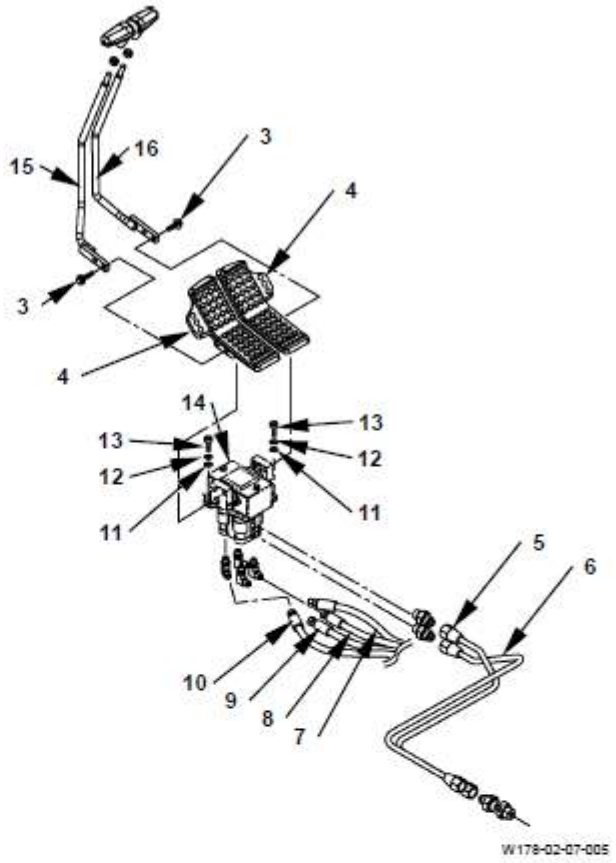
**Installation**

1. Install pilot valve (14) with socket bolt (13), spring washer (12) and plain washer (11).
   : 8 mm
   : 49 N·m (5.0 kgf·m, 36 lbf·ft)

2. Connect pipe (5 and 6), hoses (7 to 10).
   : 19 mm
   : 29.5 N·m (3.0 kgf·m, 21.5 lbf·ft)

3. Install pedal (4), lever (15) and (16) with bolt (3).
   : 17 mm
   : 49 N·m (5.0 kgf·m, 36 lbf·ft)

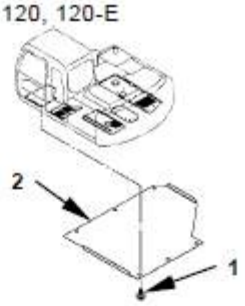
**IMPORTANT: After installation, check the oil level. Start the engine and check for oil leaks.**




5 - Pipe: (To the pilot shut-off valve)
6 - Pipe: (From the pilot shut-off valve)
7 - Hose K: (To the signal control valve port K (right travel forward))
8 - Hose L: (To the signal control valve port L (right travel reverse))
9 - Hose J: (To the signal control valve port J (left travel reverse))
10 - Hose I: (To the signal control valve port I (left travel forward))

4. Install under cover (2) with bolts (1) (6 used).
   : 17 mm
   : 49 N·m (5.0 kgf·m, 36 lbf·ft)

ZAXIS110, 110-E, 120, 120-E

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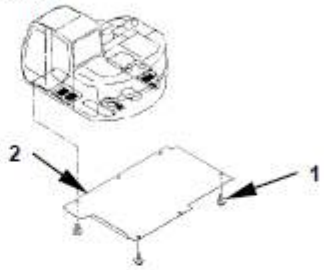
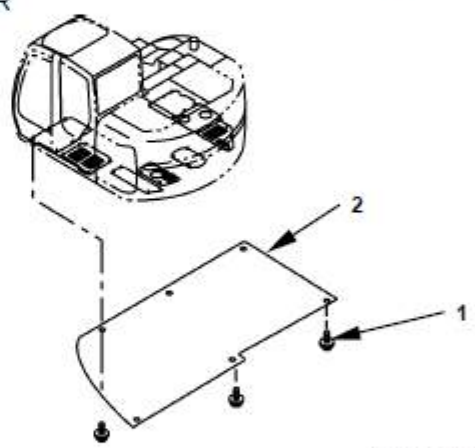
ZAXIS125US, 135US




W1SE-02-09-002

ZAXIS135UR

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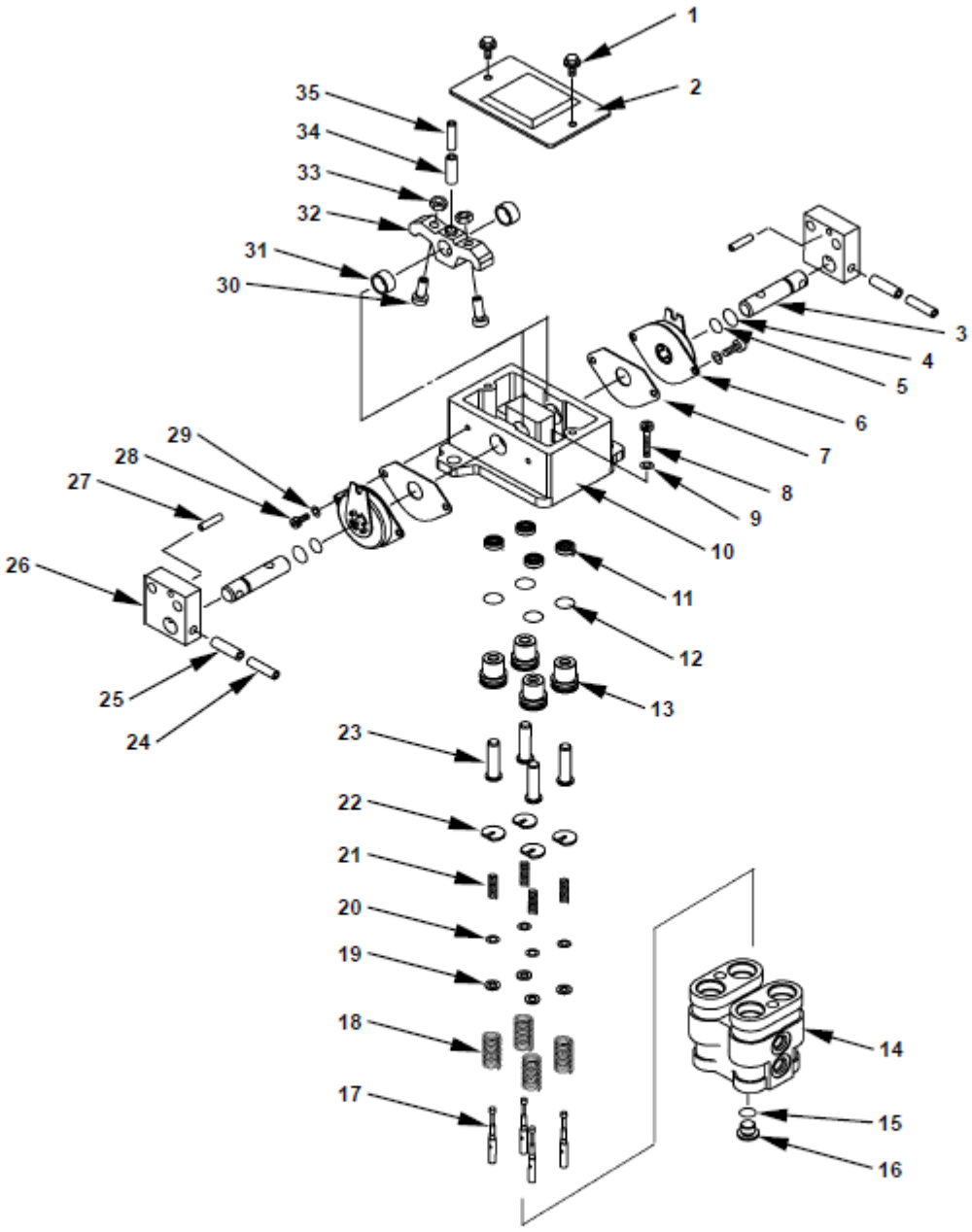
## DISASSEMBLE TRAVEL PILOT VALVE




1 - Bolt (2 Used)
2 - Cover
3 - Pin (2 Used)
4 - O-Ring (2 Used)
5 - O-Ring (2 Used)
6 - Damper (2 Used)
7 - Rubber Seat (2 Used)
8 - Socket Bolt (2 Used)
9 - Spring Washer (2 Used)
10 - Holder
11 - Oil Seal (4 Used)
12 - O-Ring (4 Used)
13 - Bushing (4 Used)
14 - Casing
15 - O-Ring
16 - Plug
17 - Spool (4 Used)
18 - Spring (4 Used)
19 - Spacer (4 Used)
20 - Shim (Several)
21 - Balance Spring (4 Used)
22 - Spring Guide (4 Used)
23 - Pusher (4 Used)
24 - Spring Pin (2 Used)
25 - Spring Pin (2 Used)
26 - Bracket (2 Used)
27 - Spring Pin (2 Used)
28 - Socket Bolt (4 Used)
29 - Spring Washer (4 Used)
30 - Adjust Bolt (4 Used)
31 - Bushing (4 Used)
32 - Cam (2 Used)
33 - Lock Nut (4 Used)
34 - Spring Pin (2 Used)
35 - Spring Pin (2 Used)

**Disassemble Travel Pilot Valve**

1. Clamp casing (14) in a vise. Remove bolts (1) (2 used) to remove cover (2) from holder (10).
   : 10 mm

2. Remove socket bolts (8) (2 places) and spring washers (9) (2 used), to remove holder (10) from casing (14).
   : 8 mm

3. Pull out pusher (23) from casing (14) (4 places). Bushing (13) and oil seal (11) are removed with the pusher.

4. Pull out pusher (23) from bushing (13), with a bamboo spatula to remove oil seal (11). (4 places)

**IMPORTANT: Make marks on spools (17) (4 used) so as to easily install them to their former position.**

5. Pull out the spool (17) assembly from casing (14) turning the spool.(4 places)
   Spring guide (22), balance spring (21), shim (20) and spacer (19) are removed with the spool.

*NOTE: The spool has been selected to match the hole of the casing. The spool and casing must be replaced as an assembly.*

**IMPORTANT: The number of shims (20) has been determined during the performance testing at the factory. They must be kept together with their spool.**

6. Compress balance spring (21). Remove spring guide (22), balance spring (21), shim (20) and spacer (19) from spool (17). (4 places)

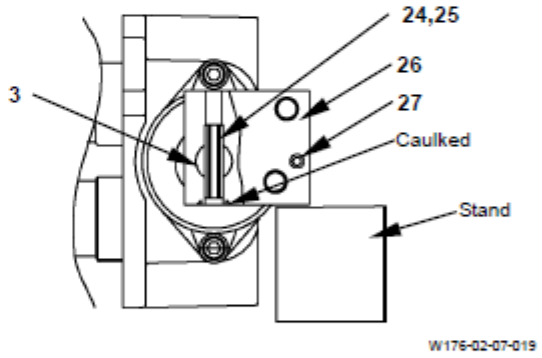
7. Remove spring (18) from casing (14). (4 places)

**IMPORTANT: Put a stand under bracket (26). If holder (10) bears the reaction force, a strong force acts on pin (3) and the pin may deform.**

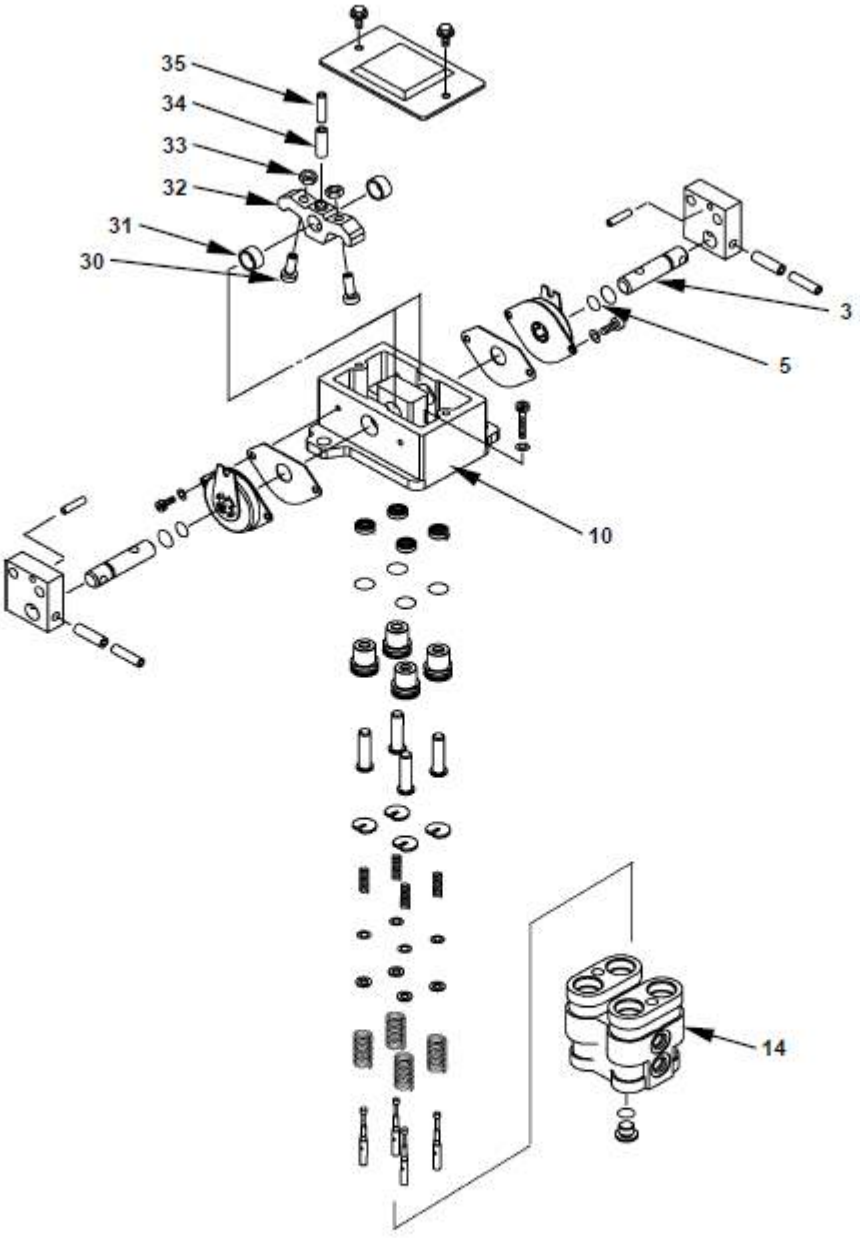
**IMPORTANT: The inside of the spring pins (24) and (25) holes in brackets (26) (2 used) is stepped-shape. Therefore, the spring pin can only be pulled out in one direction.**

8. Put a stand under bracket (26).
   Push out spring pins (24) and (25) from the bracket at the same time using special tool (ST 1237). Remove the bracket from pin (3). (2 places)
   Do not remove spring pin (27) from the bracket unless necessary.

*NOTE: The outside end of the spring pin has been caulked.*




9. Remove socket bolts (28) (2 used) to remove damper (6) and rubber seat (7) from pin (3). O-ring (4) is removed with them. (2 places)
   : 5 mm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10. Remove O-ring (5) from pin (3). (2 places)

11. Place holder (10) with the casing (14) matching surface facing upward.

**IMPORTANT: The holes for spring pins (34) and (35) of cam (32) is stepped-shape. Therefore the pins shall be removed from the bottom of the cam.**

12. Pull out spring pins (34) and (35) from cam (32) at the same time using special puller (ST 1237). (2 places)

*NOTE: The spring pin is a double-pin.*

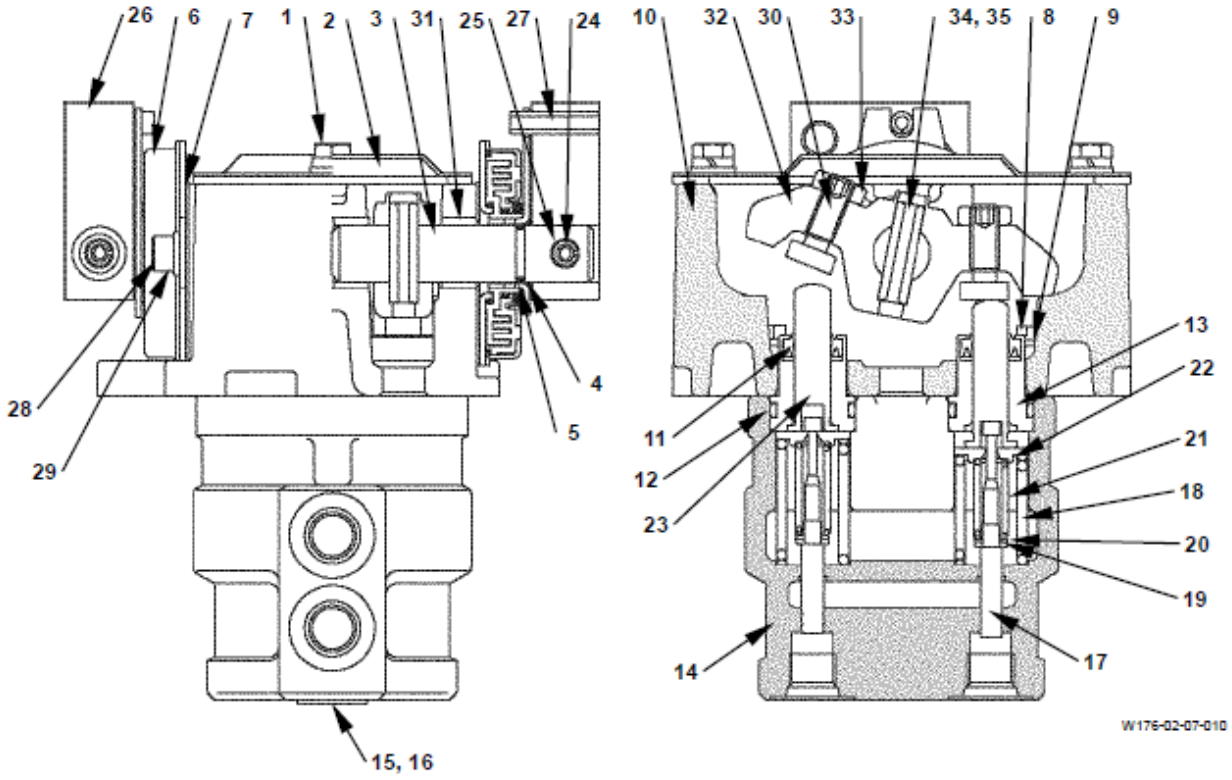
*NOTE: The spring pin is caulked in its hole, so it may feel tight when removing.*

13. Remove pin (3) with a round bar and hammer. At this time cam (32) is also removed. (2 places)

*NOTE: Do not remove bushings (31) (4 used) left on holder (10) unless necessary. When removal is necessary, the bushing special tool (ST 7256) should be used to tap it out.*

14. Remove lock nuts (33) (2 used) from cam (32) to remove adjusting bolts (30) (2 used).(2 places)
    : 13 mm
    : 4 mm

## ASSEMBLE TRAVEL PILOT VALVE




1 - Bolt (2 Used)
2 - Cover
3 - Pin (2 Used)
4 - O-Ring (2 Used)
5 - O-Ring (2 Used)
6 - Damper (2 Used)
7 - Rubber Seat (2 Used)
8 - Socket Bolt (2 Used)
9 - Spring Washer (2 Used)
10 - Holder
11 - Oil Seal (4 Used)
12 - O-Ring (4 Used)
13 - Bushing (4 Used)
14 - Casing
15 - O-Ring
16 - Plug
17 - Spool (4 Used)
18 - Spring (4 Used)
19 - Spacer (4 Used)
20 - Shim
21 - Balance Spring (4 Used)
22 - Spring Guide (4 Used)
23 - Pusher (4 Used)
24 - Spring Pin (2 Used)
25 - Spring Pin (2 Used)
26 - Bracket (2 Used)
27 - Spring Pin (2 Used)
28 - Socket Bolt (4 Used)
29 - Spring Washer (4 Used)
30 - Adjust Bolt (4 Used)
31 - Bushing (4 Used)
32 - Cam (2 Used)
33 - Lock Nut (4 Used)
34 - Spring Pin (2 Used)
35 - Spring Pin (2 Used)

### Assemble Travel Pilot Valve

**IMPORTANT: Pay attention to the mounting direction of spring guide (22).**

**IMPORTANT: Install the former number of shims (20).**

1. Assemble spool (17) into an assembly. (4 used)
   - Insert spacer (19), shim (20), balance spring (21) into the spool in order.
   - Press the balance spring by hand. Install spring guide (22) to the spool with the stepped-end facing downward.

2. Insert spring (18) to casing (14). (4 places)

**IMPORTANT: Insert the spool (17) assembly into the former port.**

3. Turn and install the spool (17) assembly into casing (14). (4 places)

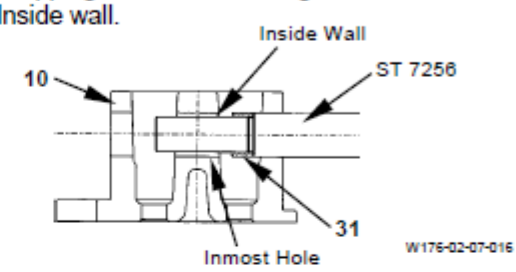
4. Assemble pusher (23) into an assembly (4 used).
   - Install oil seal (11) onto bushing (13).
   - Apply grease to the inner face of the oil seal.
   - Install O-ring (12) to the bushing.
   - Insert pusher (23) to the bushing.
   - Apply grease to the pusher head section.

5. Insert the pusher (23) assembly to holder (10). (4 places).

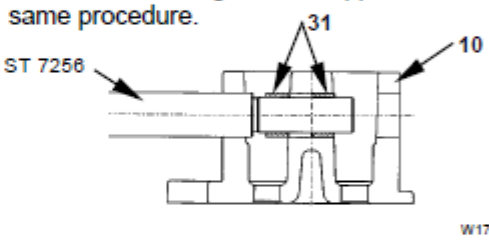
6. If bushing (31) removes from holder (10), install it on the holder using special tool (ST 7256) in the following procedures.

*NOTE: The bushings (4 used) are identical.*

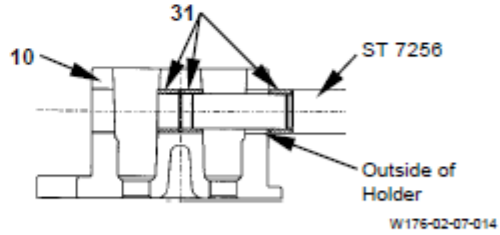
- Insert the bushing into special tool (ST 7256), then tap on the special tool (ST 7256) to install the bushing into the hole of holder.
  Stop tapping when the bushing end is flush with the Inside wall.



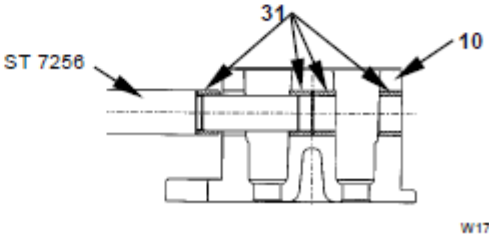

- Install the bushing on the opposite side in the same procedure.

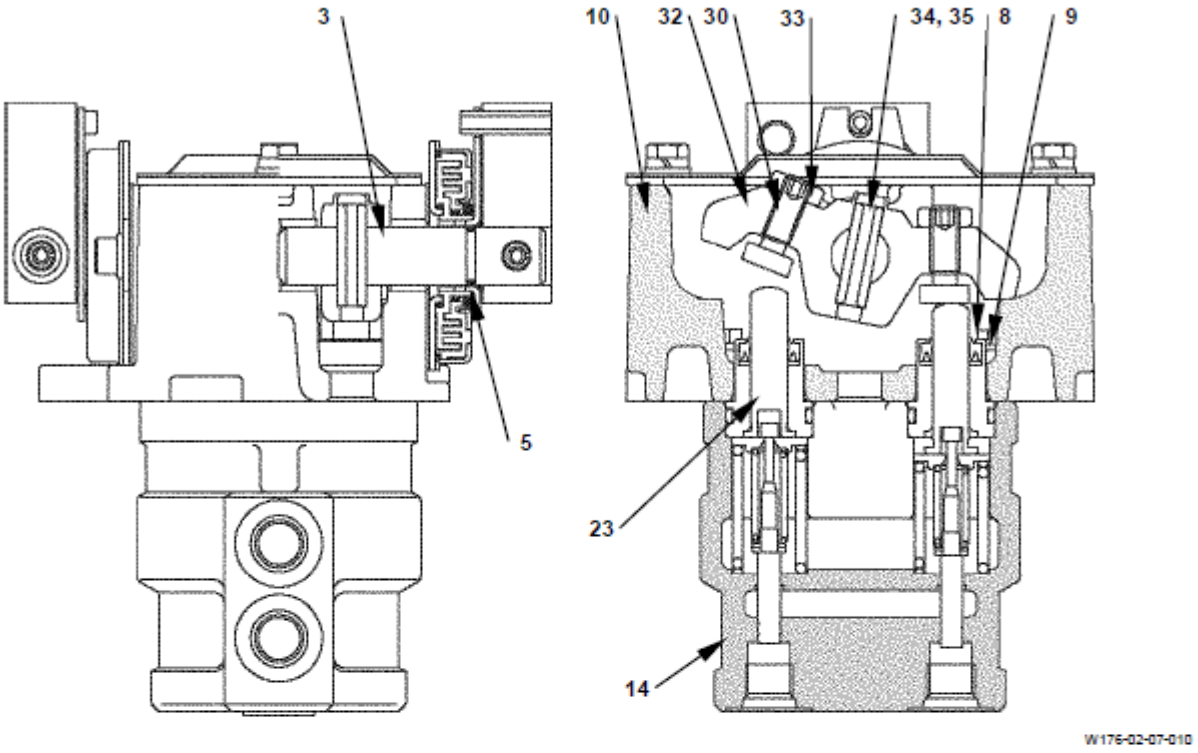



- Install the bushing in the right side as shown bellow. Stop tapping when the bushing end is flush with the outside of holder.




- Install the bushing in the left side as shown below.

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7. Insert adjust bolt (30) to cam (32). Tighten the bolt by hand, and then lightly secure it temporarily with lock nut (33). (2 places)

*NOTE: Adjust the dimensions later.*

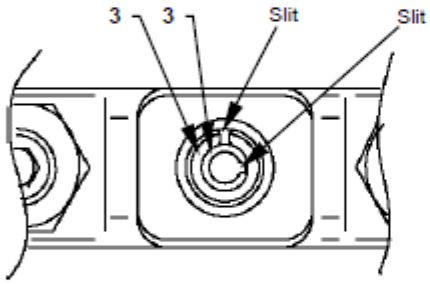
8. Apply grease on the head (matching surface for pusher (23)) of adjust bolt (30) (2 places).

9. Install O-ring (5) to pin (3), then assemble the pin to holder (10) with cam (32) (2 places).

**IMPORTANT: Take care of the inserting direction of spring pins (34, 35).**

**IMPORTANT: Tap the spring pin in until it makes contact with the stepped-shape in hole.**

10. Install spring pins (34), (35) to cam (32) using special tool (ST 1237), then secure the cam and pin (3). The spring pins shall be displaced with their slits at 90°.

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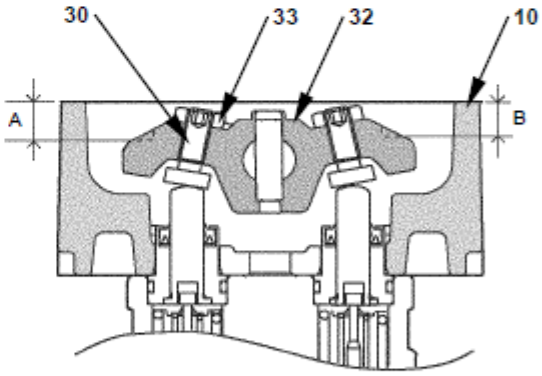
11. Caulk the hole edge of cam (32), where spring pins (34) and (35) are inserted, with a punch. (2 places)

12. Place holder (10) on the casing (14) assembly and install it with socket bolts (8) (2 used) and spring washers (9) (2 used).
: 8 mm
: 50 N·m (5.1 kgf·m, 37 lbf·ft)

**IMPORTANT: Do not adjust the adjust bolt (30) while pressing the pusher (23) head with the adjust bolt. The standard clearance between the adjust bolt and pusher must be 0 to 0.2 mm (0 to 0.008 in).**

13. Adjust bolt (30) as the following procedures. (2 places)
: 13 mm
: 4 mm

- Loosen lock nut (33).
- Move cam (32) to check whether there is play. If none, turn the adjust bolt to adjust.
- Turn both adjust bolts on the left and right alternatively to keep the cam horizontal.
- Measure dimensions A and B from both left and right caves on the cam to holder (10). Fine adjust the adjust bolt to get same distance for both left and right.
- Secure the adjust bolt by using a hexagon-head wrench. Tighten the lock nut to specified torque first, securing the adjust bolt.
- When adjustment is finished, move the cam to check that is a little play. If there is no play, the pusher may be in compressed condition, and adjustment should be carried out again.
: 10 N·m (1 kgf·m, 7.2 lbf·ft)

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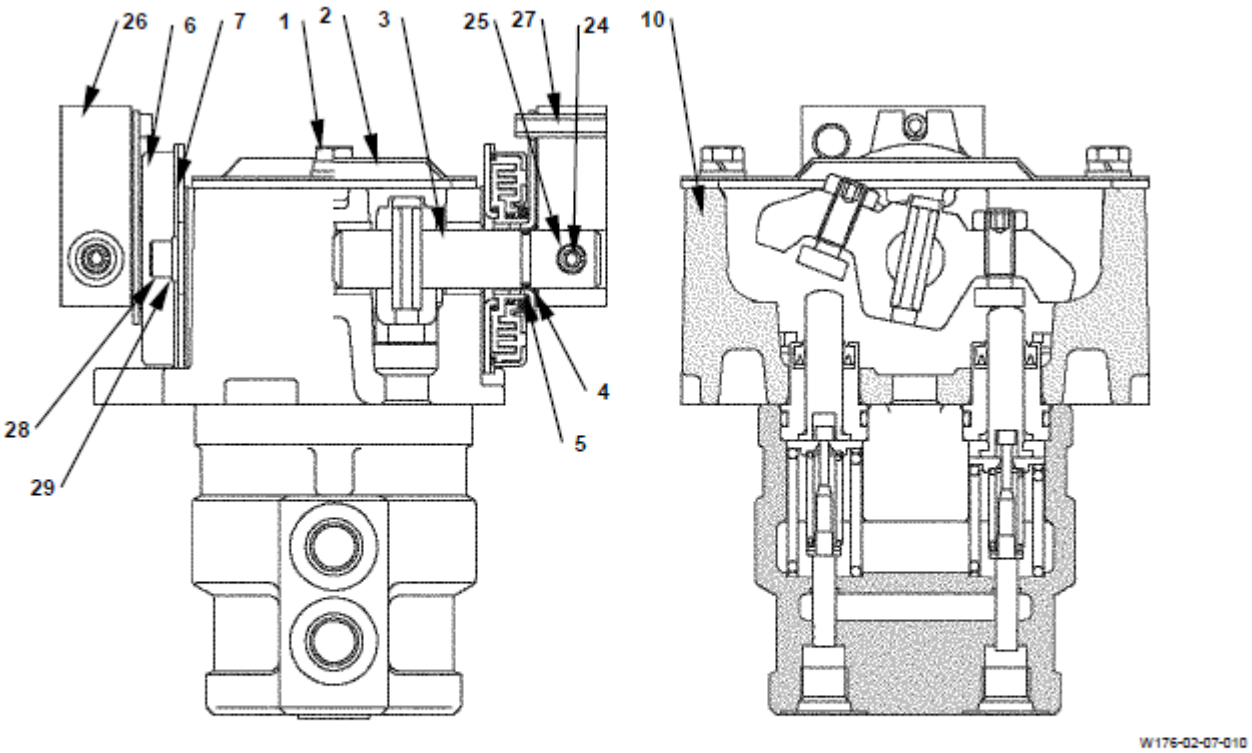
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14. Install rubber seat (7) to pin (3). (2 places)

15. Apply grease to O-ring (5). (2 places)

**IMPORTANT: Pay attention to the direction of damper (6).**

**IMPORTANT: The inner bore of damper (6) is edged-shape. If the damper is pried upward, O-ring (5) will be damaged.**

16. With the lever upward, install damper (6) to pin (3) straight without prying. (2 places)

17. Secure damper (6) to holder (10) with socket bolts (28) (2 used) and spring washers (29) (2 used). (2 places)
    : 8 mm
    : 7 N·m (0.7 kgf·m, 5.1 lbf·ft)

18. Apply grease to O-ring (4), then press it to the absolute most end of pin (3). (2 places)

**IMPORTANT: As for the direction to install bracket (26), refer to the figure in the disassemble section (W2-7-22). Take care not to misassemble it.**

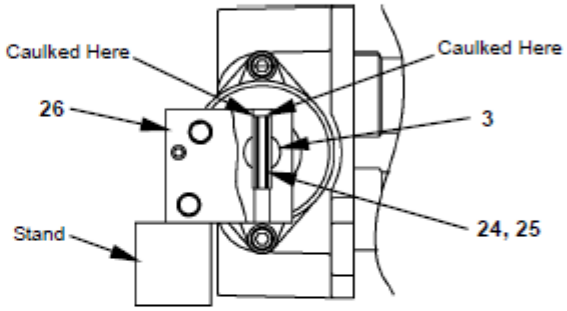
19. Install pin (3) into bracket (26), then align the inserting holes of spring pins (24) and (25) to fix pin on the bracket.

**IMPORTANT: Place a stand under bracket (26). If holder (10) bears the reaction force, strong force acts on the pin and the pin may deform.**

**IMPORTANT: The inside of the hole of spring pins (24, 25) in the bracket is stepped-shape. Make sure of the direction to insert the spring pin.**

**IMPORTANT: Make sure of the direction of the spring pin.**

20. Put a stand under bracket (26).
    Tap spring pins (24) and (25) into the bracket until the spring pin comes to the stepped end using special tool (ST 1237). The spring pins shall be displaced with their slits at 90°.




21. Caulk the hole edge of bracket (26), where spring pins (24) and (25) are inserted, with a punch. (2 places)
    (Refer to the figure above.)

22. Install pin (3) on other bracket (26) as in step 19 to 21.

23. Install cover (2) to holder (10) with bolts (1) (2 used).
    : 10 mm
    : 5 N·m (0.5 kgf·m, 3.6 lbf·ft)

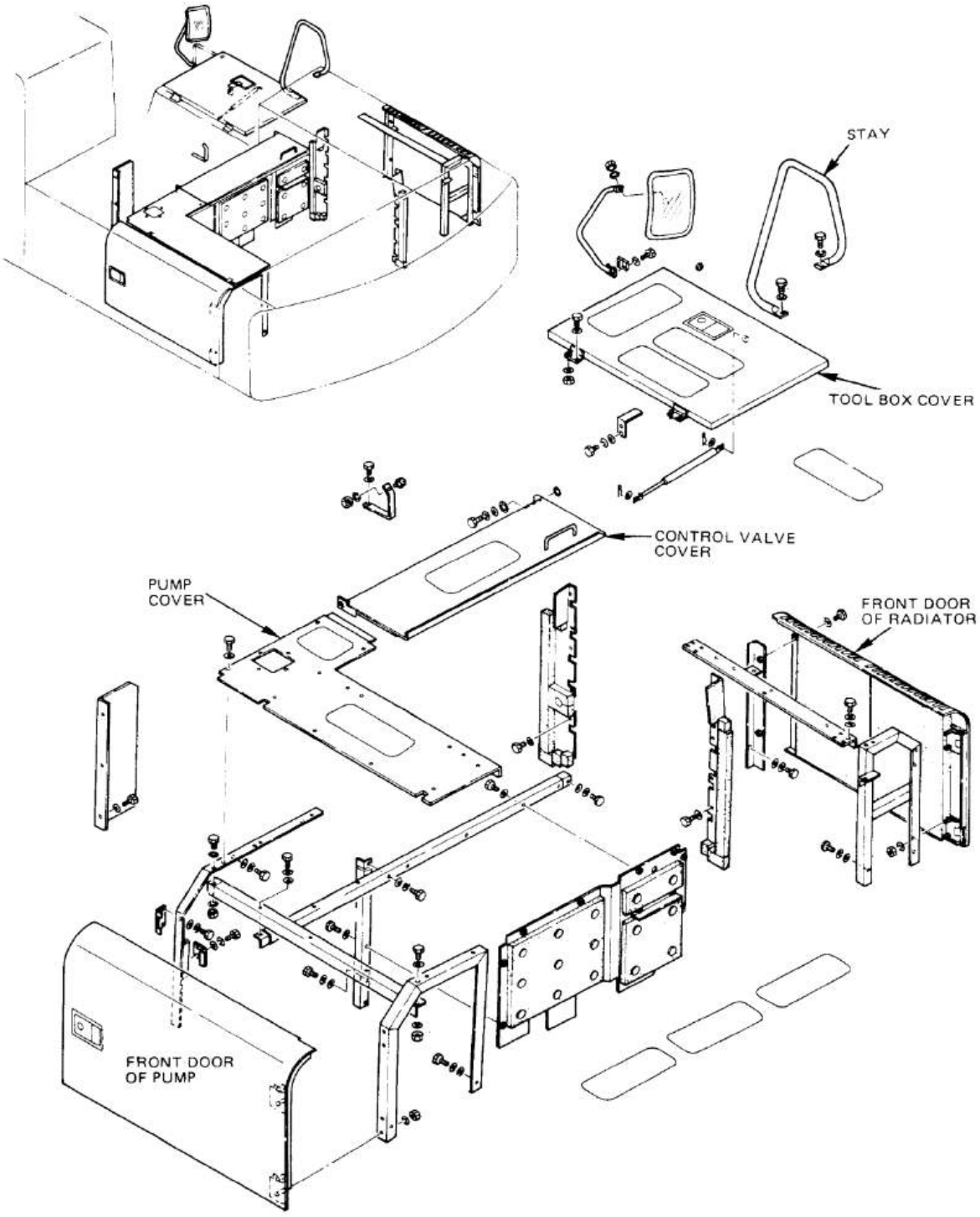
24. Apply grease to the spring pin (27) contact part of damper (6). (2 places)

## 11. COVER

### 11.1 CONSTRUCTION

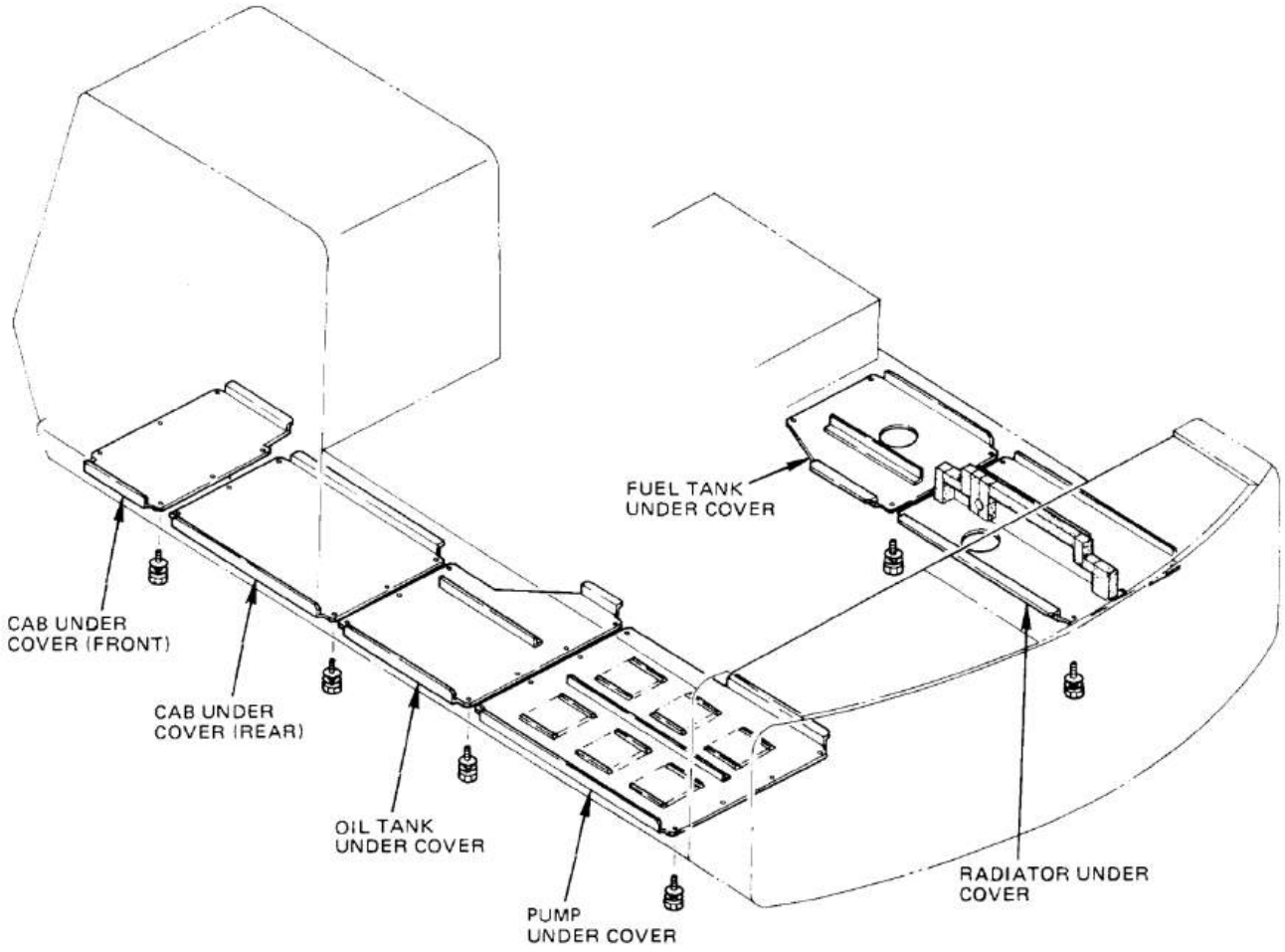
(1) COVER & ENGINE COVER

The covers are installed on the superstructure to protect rain, dust and damage from external obstruction for hydraulic components.



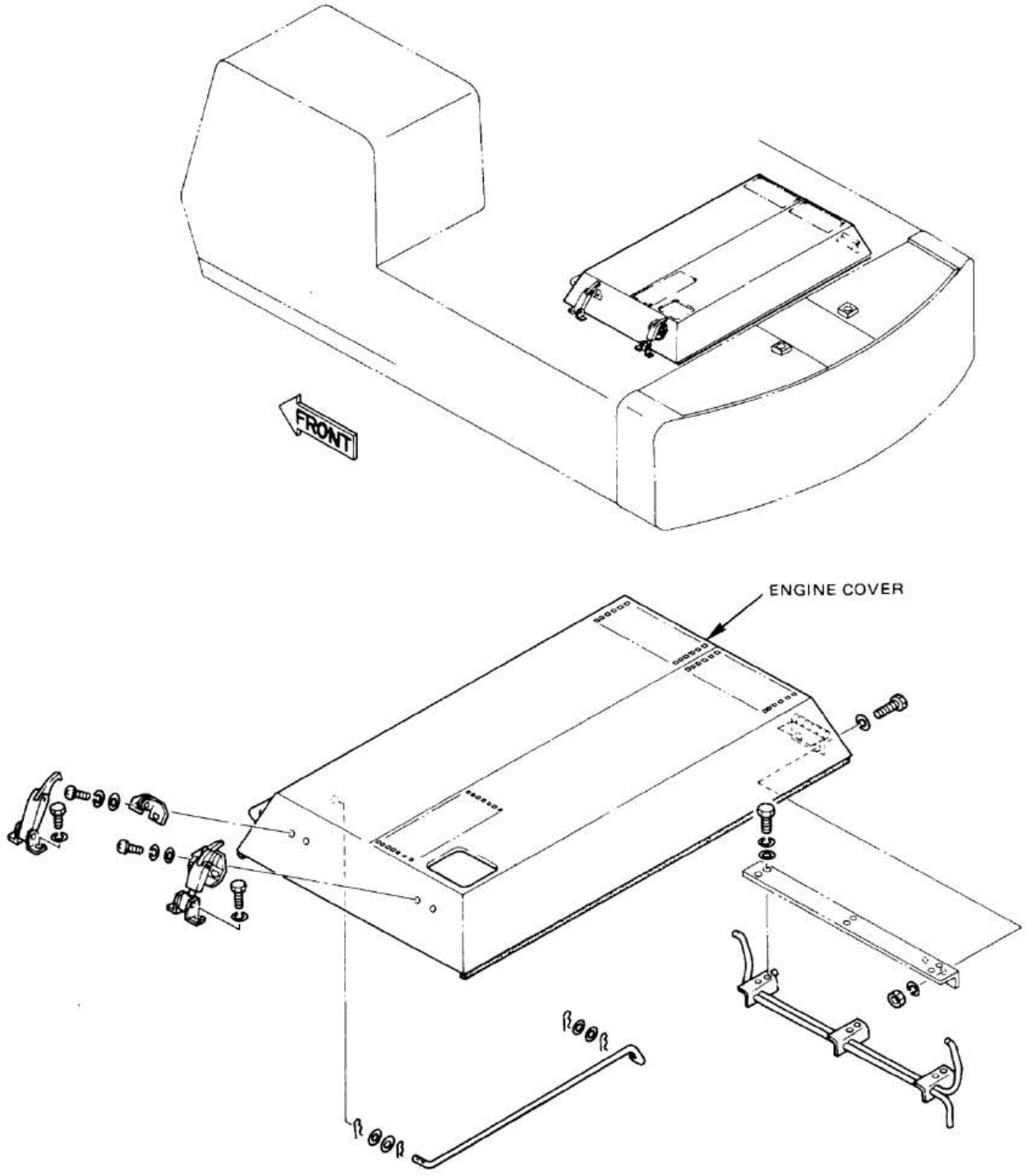
(2) UNDER COVER

The under covers are installed to protect dust and damage from external obstruction for hydraulic components.



(3) ENGINE COVER

The engine cover is installed to protect damage from external obstruction for engine.



# UNDER CARRIAGE

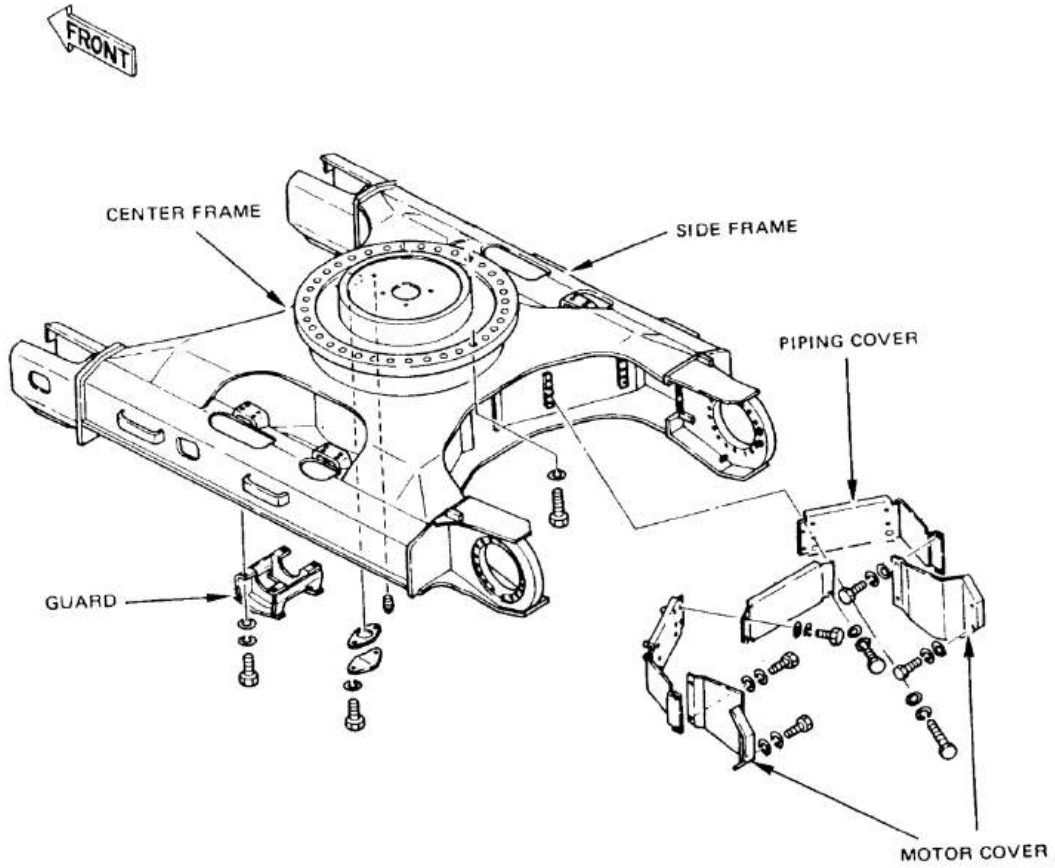
# 1. TRACK FRAME

## 1.1 CONSTRUCTION & FUNCTION

The track frame is a welded one-construction and composed of center frame, right and left side frames.

The center frame is X of shape and has a centralized hole for the pipings to improve the reliability. The side frame is convex of shape so that the mud can be easily eliminated. A hole is provided beneath the upper roller to make mud fall off easily.

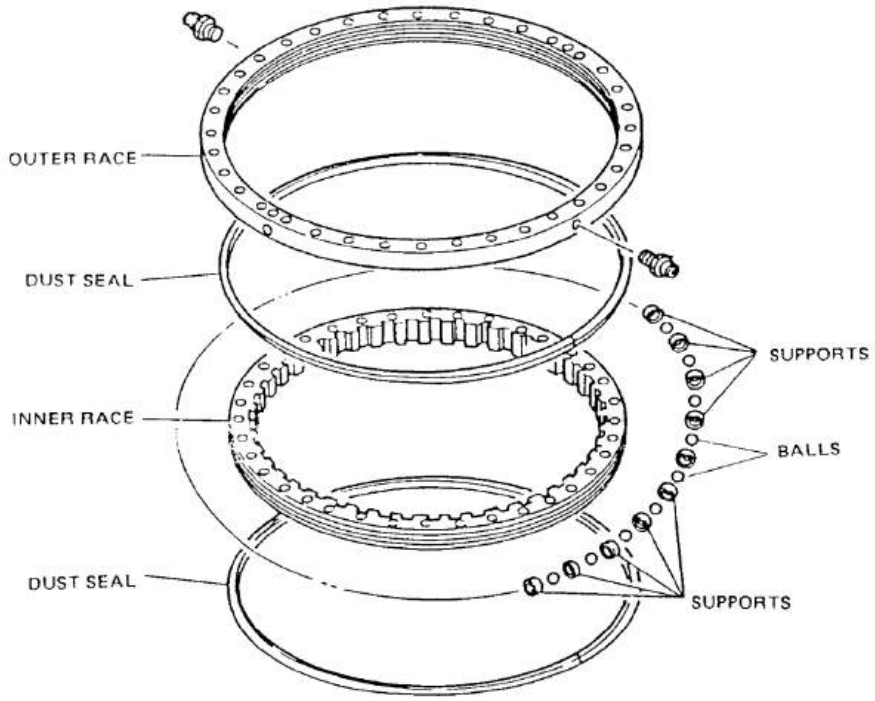
The swing bearing and the center joint are provided on the center frame, the lower rollers and the center guards are under the side frames, the upper rollers are on the side frames, the front idlers are at the front of the side frames and the travel devices are at the rear of the side frames.



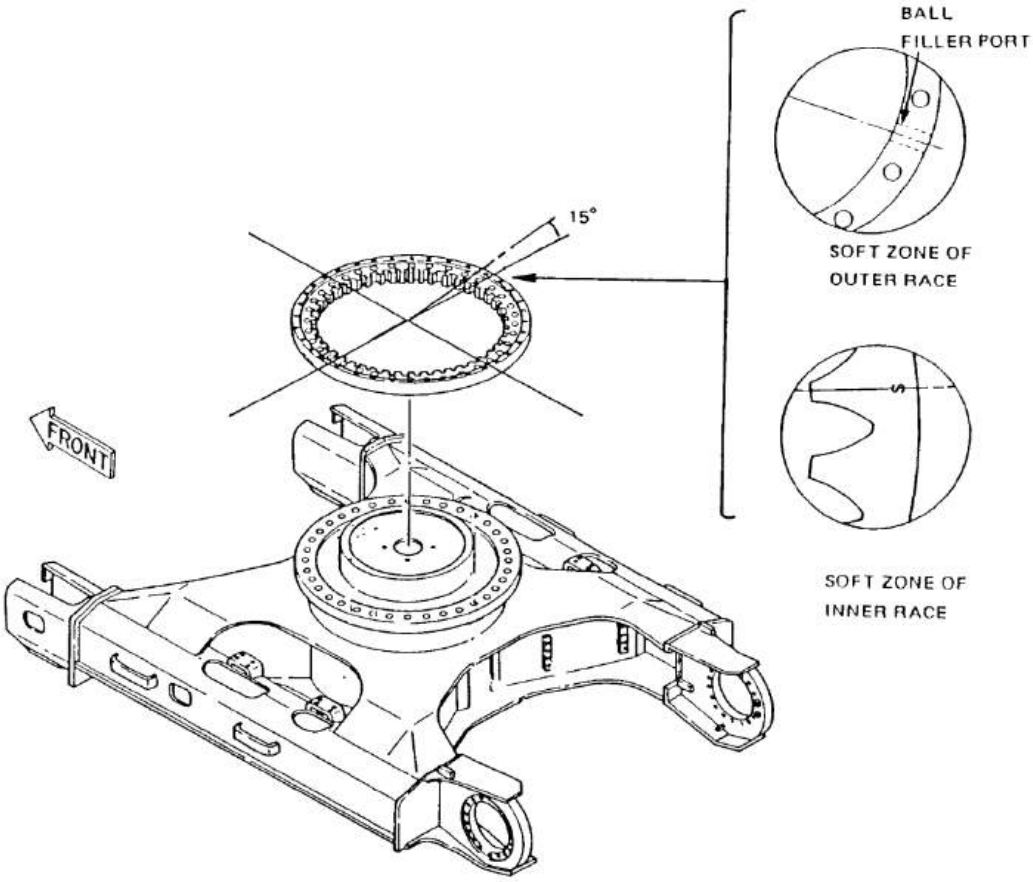
## 2. SWING BEARING

### 2.1 CONSTRUCTION & FUNCTION

The swing bearing supports the superstructure and makes rotation smooth.
This swing bearing is a single row shear type ball bearing.
The major parts of the swing bearing are the outer race, the inner race with internal gear, balls, supports and dust seals.
The outer race is bolted to the superstructure.
The inner race is bolted to the undercarriage.
The internal gear is incorporated in the inner ring and meshes with the pinion from the swing reduction device.



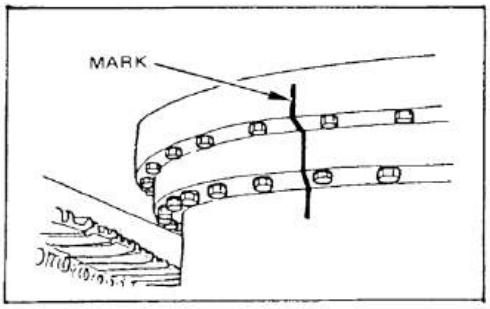
The races, on which the steel balls run, are hardened by means of flame hardening which creates a soft zone at heat starting point. On the inner race (internal gear side), the soft zone is marked with "S" as shown below. To minimize loading on the soft zone, mark "S" should be placed on the righthand side of the track frame as shown below. Also, the soft zone of outer race is placed on the righthand side as same as inner race.



2.2.2 REMOVAL & INSTALLATION

(1) REMOVAL

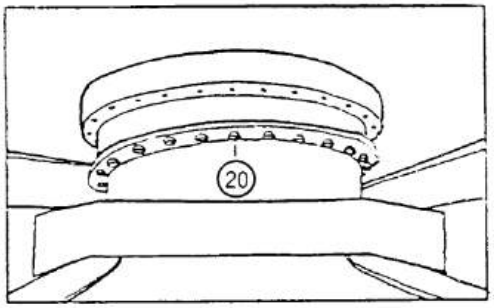
Remove the superstructure




1 Put a mating mark on swing bearing and undercarriage.

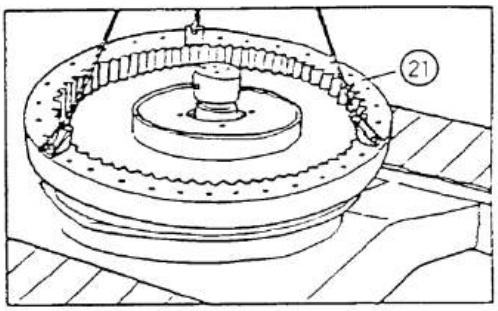
2 Remove bolts (20).

30

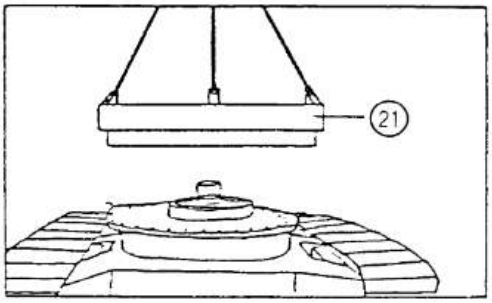



3 Hoist swing bearing (21) using special tool (ST-9050)

Weight: 227 kg



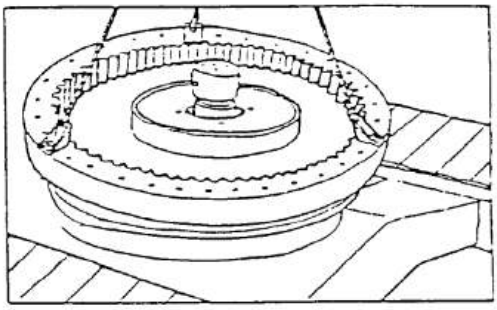

4 Remove swing bearing (21).



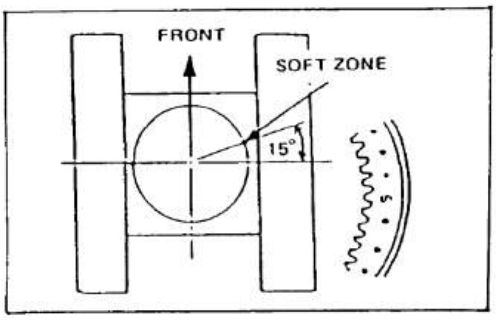

(2) INSTALLATION

1 Clean the mating faces of truck frame and swing bearing.

2 Install special tool (ST-9050) to the swing bearing.



3 Hoist the swing bearing.
Align the swing bearing with the mating mark of truck frame.
Weight: 227 kg

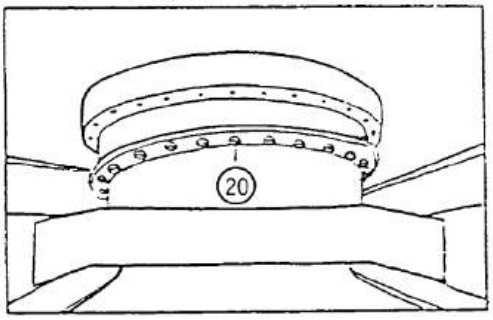



NOTE Inner race soft zone and outer race soft zone should be placed on the same position as shown.

4 Install bolts (20).

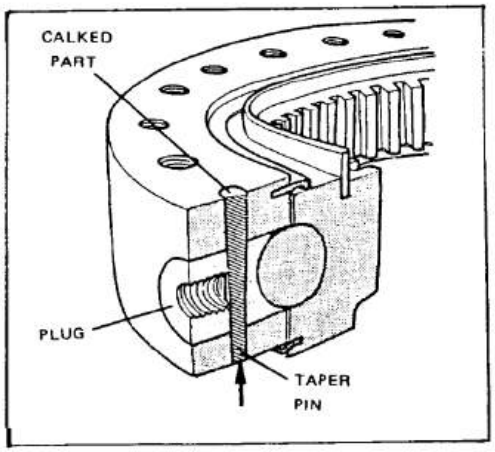
Tightening torque: 55 kgf.m
(400 ft.lbs)

30

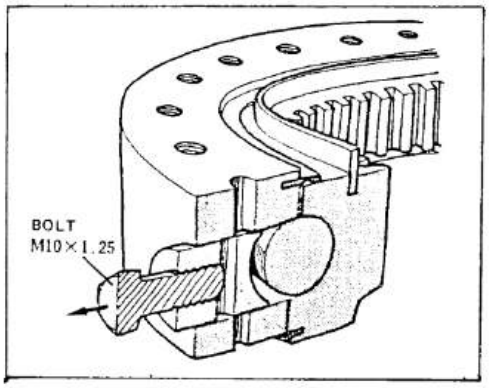



2.2.3 DISASSEMBLY

1 1 Grind off calked part of taper pin.
2 Push the pin out from lower part.

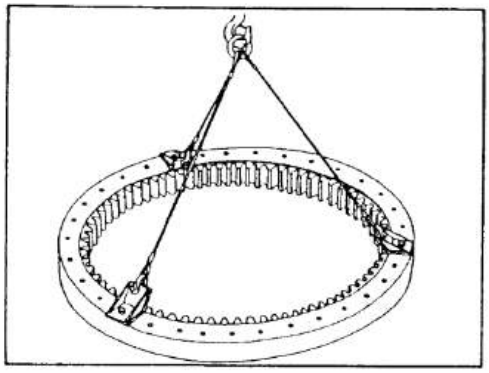


2 Remove plug using a (10 mm, Pitch 1.25 mm) bolt as shown.

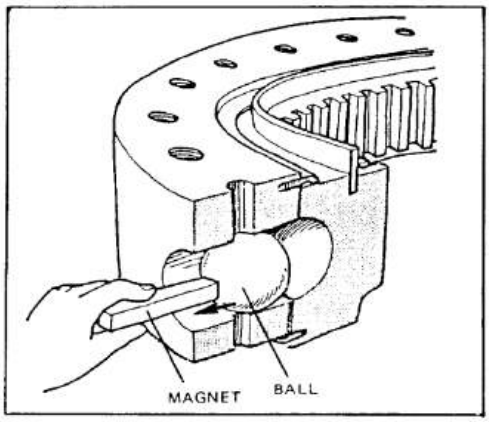



3 1 Hoist the swing bearing outer race slightly using special tool (ST-9050).
2 Inspect the rotation of the bearing.

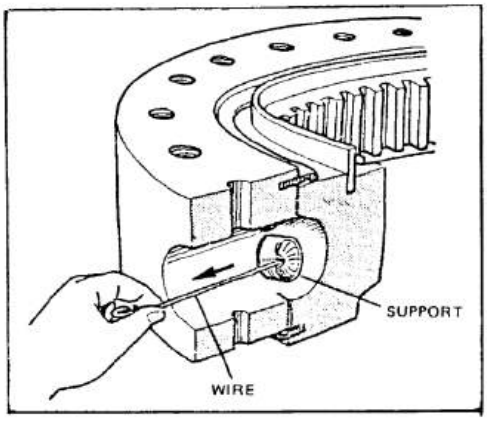
Note; If the rotation of the bearing is not smooth, remove seals.



4 Remove the steel ball using magnet as shown.



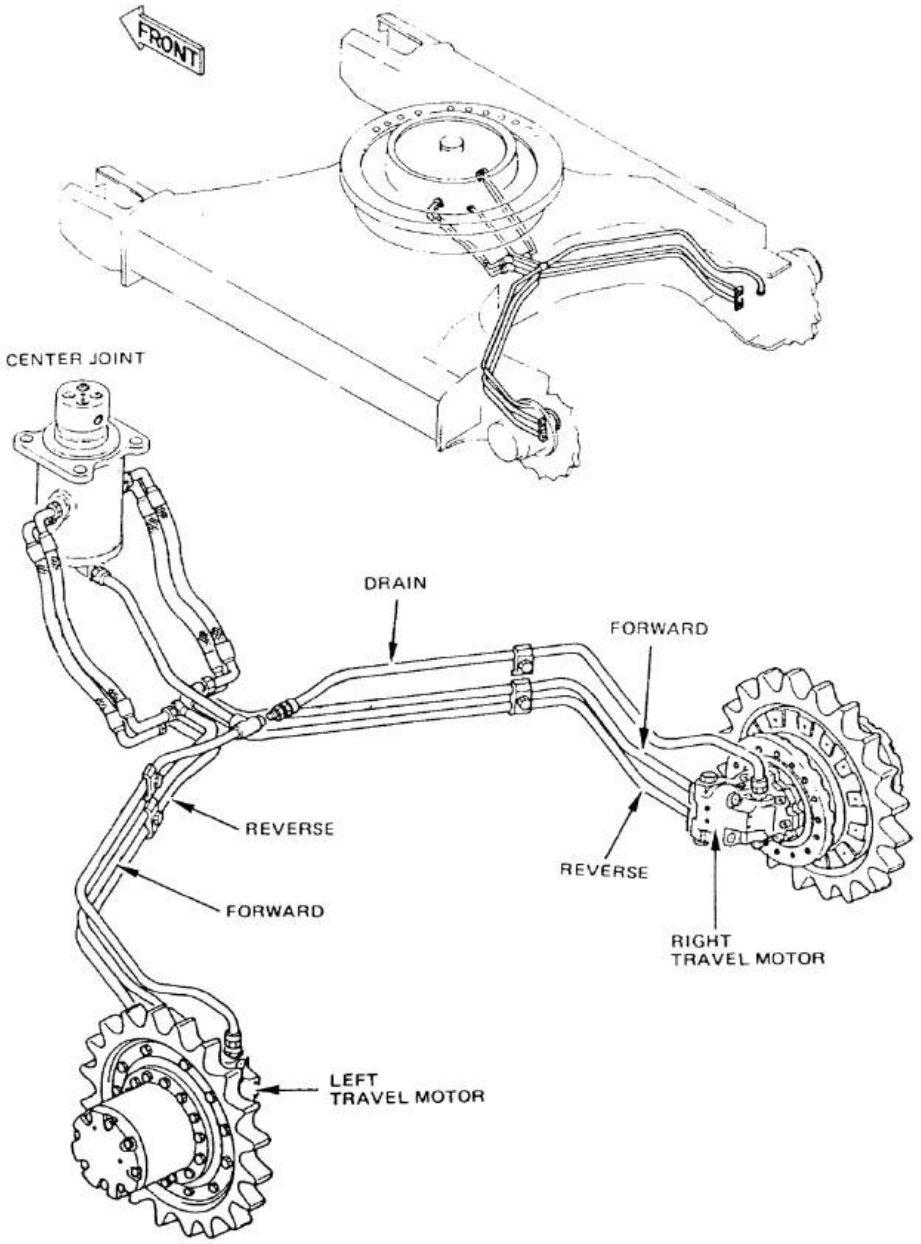

5 1 Remove the support using wire as shown.
2 While rotating the inner race, remove steel balls and supports.



## 3. TRAVEL DEVICE & PIPING

### 3.1 CONSTRUCTION & FUNCTION

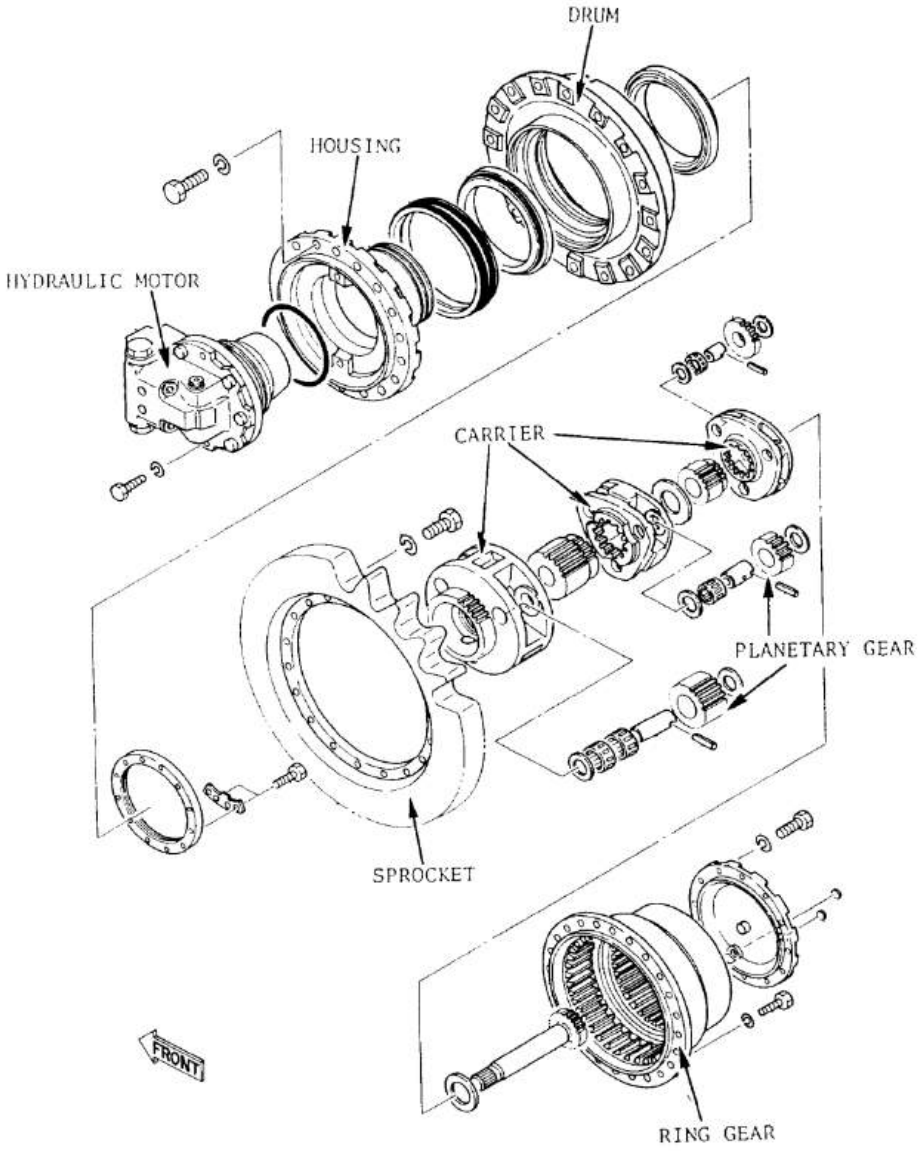
The below figure shows the piping from center joint to travel motor. This piping consists of one pipe for draining from the travel motor and four piping for actuating the travel motor. The oil for releasing the parking brake is supplied from the brake valve.



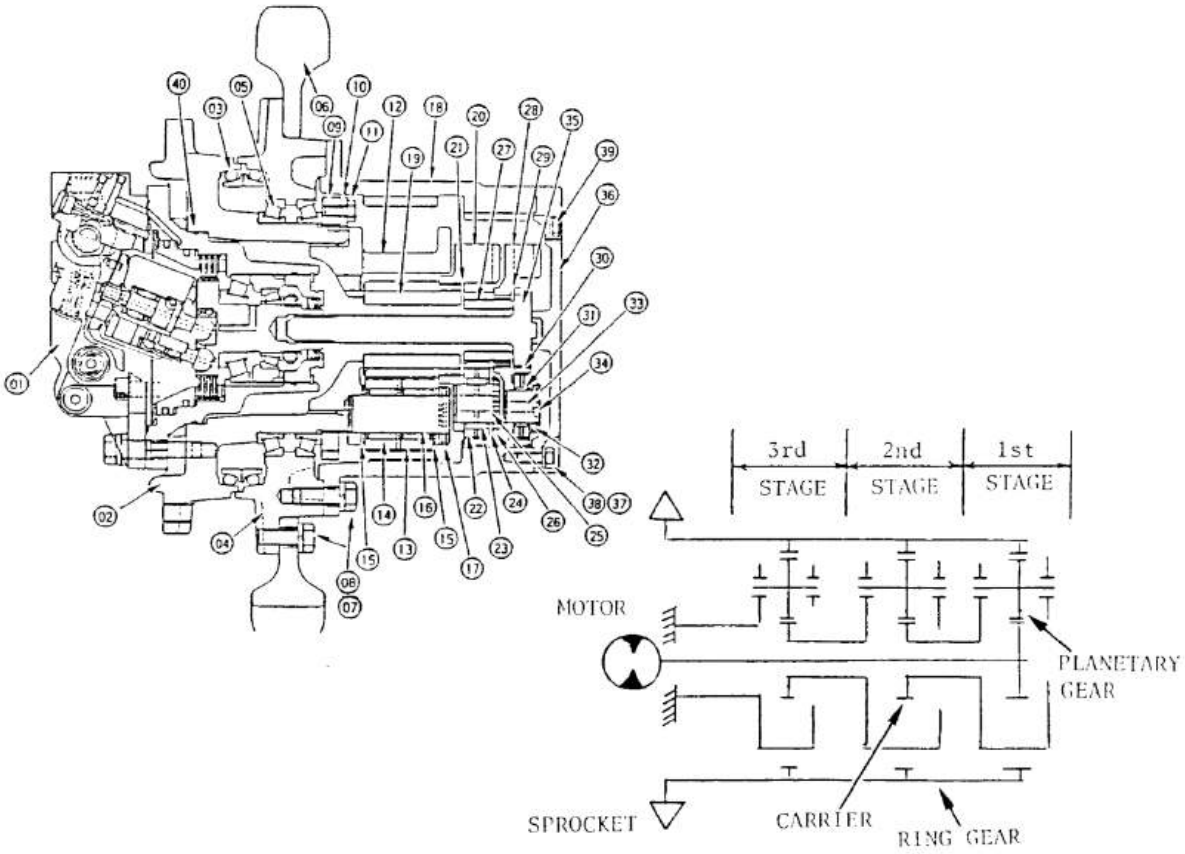
3.1.1 TRAVEL DEVICE

The travel device consists of travel motors, travel reduction device and sprocket.

The spring-set hydraulically released type disc parking brake is provided in the travel device.



3.1.2 TRAVEL DEVICE FUNCTION




The travel reduction device is three stage planetary gear type.
If the motor rotates clockwise, propel shaft (35) does the same direction.
As ring gear (18) is being fixed, planetary gear (30) rotates counterclockwise on its axis and moves around the propel shaft. This orbital motion of the planetary gears (30) rotate the carrier clockwise in the same direction of the propel shaft.
The relationship between propel shaft (35) and 2-stage carrier, and 2-stage carrier and 3-stage carrier.
The 2-stage carrier rotates the 3-stage planetary gear (13). The 3-stage carrier is fixed by the housing, so the ring gear is rotated. The ring gear is fixed to the sprocket with bolts. Consequently, the sprocket is rotated.

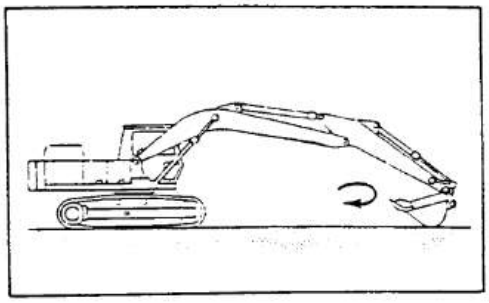
| | INPUT | FIX | OUTPUT |
|---|---|---|---|
| 1-stage | Sun gear | Ring gear | Carrier |
| 2-stage | Sun gear | Ring gear | Carrier |
| 3-stage | Sun gear | Carrier | Ring gear |

## 3.2 MAINTENANCE

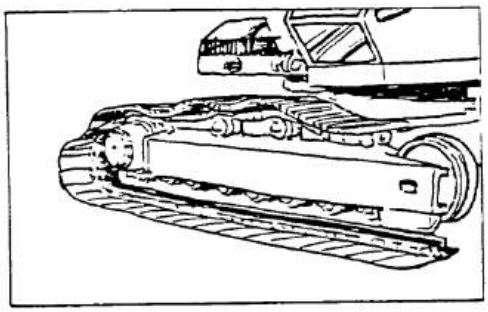
### 3.2.1 REMOVAL & INSTALLATION

REMOVAL

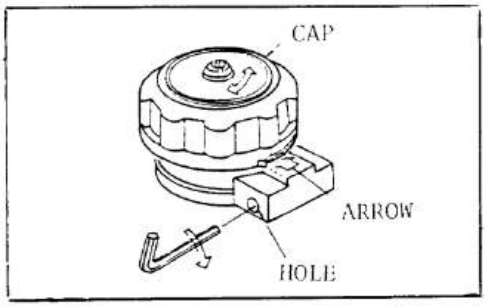
1 Place unit on level ground. Swing the superstructure so that the operator's cab side is travel device side as shown.



2 Disconnect track link.



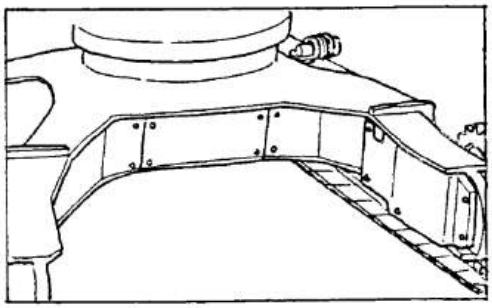
3 Stop the engine and operate the control lever for releasing pressure in the hydraulic system.
Remove the air breather cap and release the air from the hydraulic tank.




4

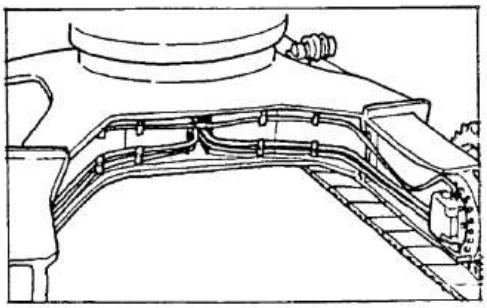
4 Remove the piping covers.

19

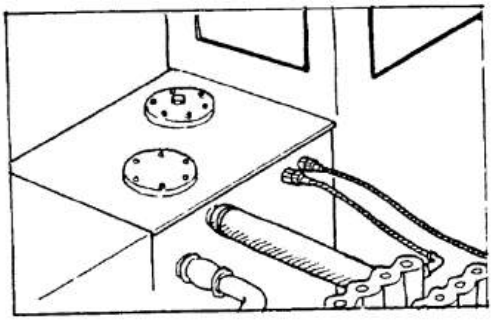


5 Remove clamps

19

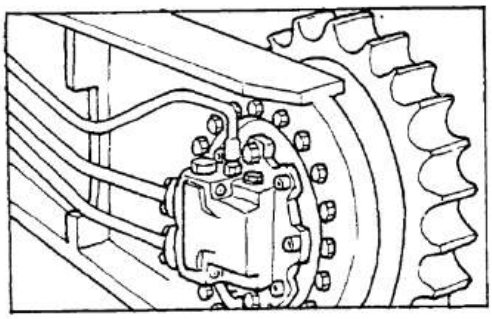


6 Disconnect the hose for releasing the air from the control valve.
Set the vaccume pump and operate it.



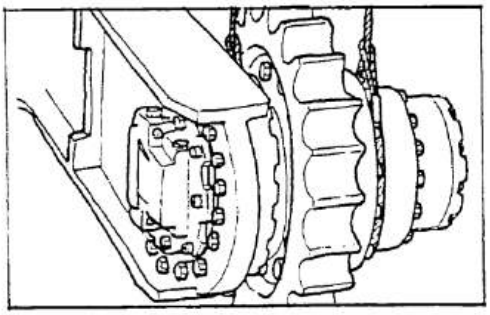
7 Disconnect travel pipings from the travel motor.

22
8



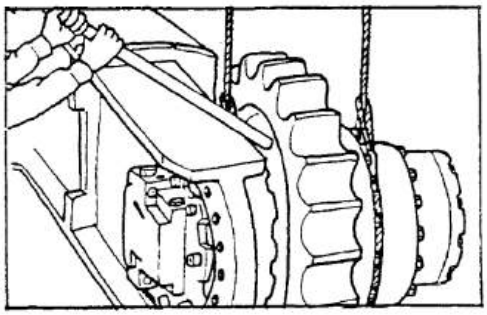
8 Lift the travel device.

Weight: 522 kg



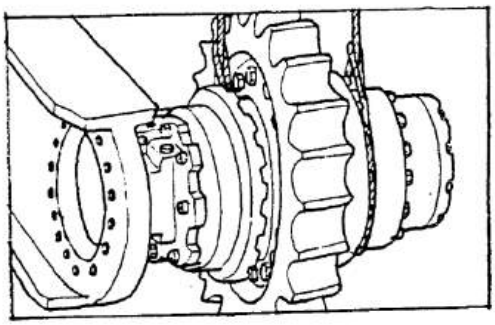
9 Remove bolts and separate the travel device from the track frame using a bar.

30



INSTALLATION

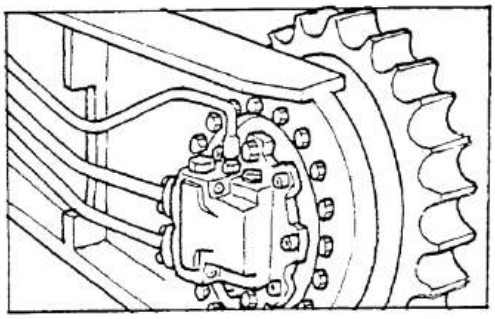
1 Lift the travel device and place it on the track frame.
Install bolts.
Tightening torque: 55 kgf.m
(400 ft.lbs)



2 Install travel pipings to the motor.

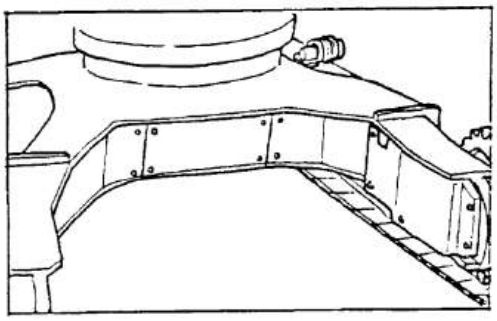
22

8

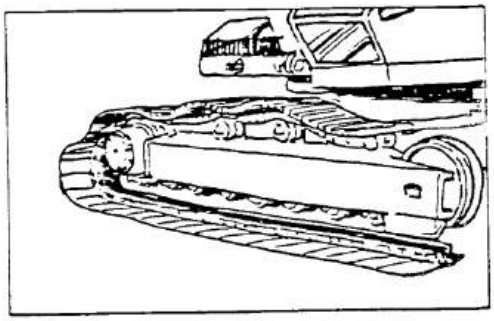


3 Install clamps and piping covers.

19



4 Connect track link

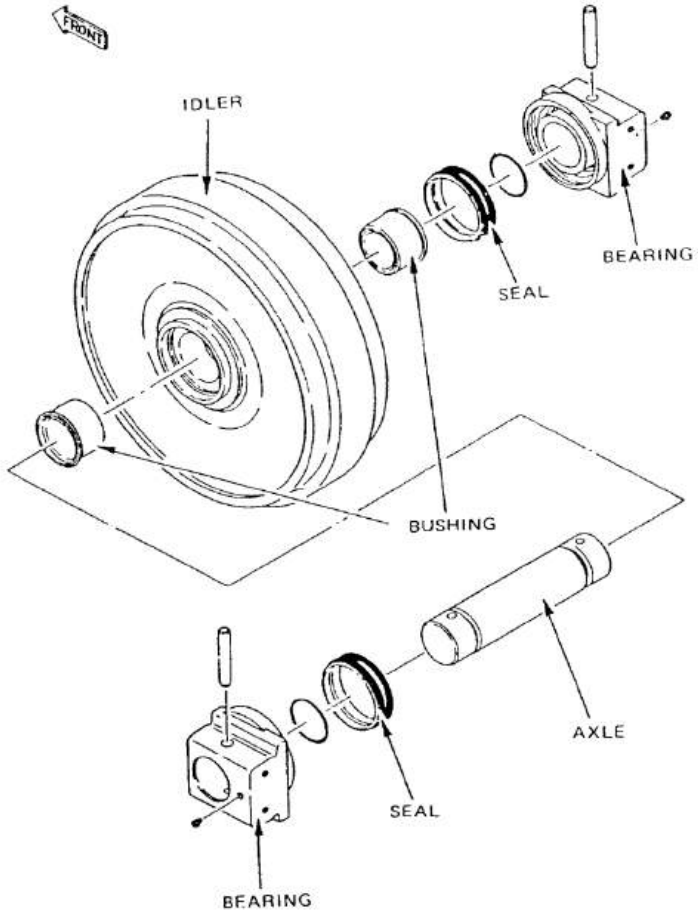


5 Check the hydraulic oil level.
Supply the hydraulic oil at the level.

## 4. FRONT IDLER

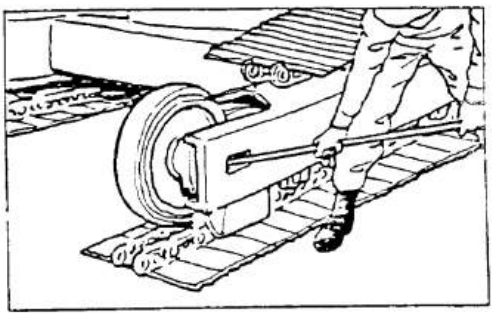
### 4.1 CONSTRUCTION

The front idler is equipped with both ends of the side frame and can be moved back and forth. The bearing in it is fitted with the yoke of track spring.

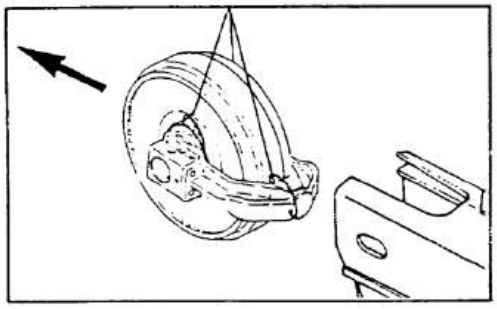


4.2.2 REMOVAL

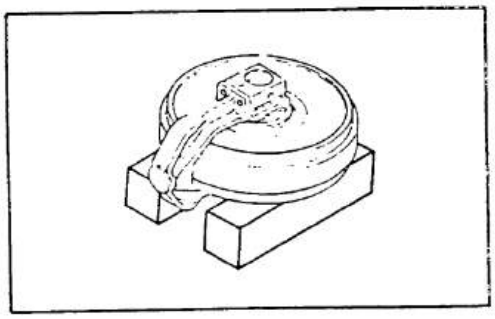
1 Disconnect track link
Move front idler and york assembly to the end of track frame with bar.



2 Fasten wire around idler wheel and york.
Remove idler and york assembly from track frame.

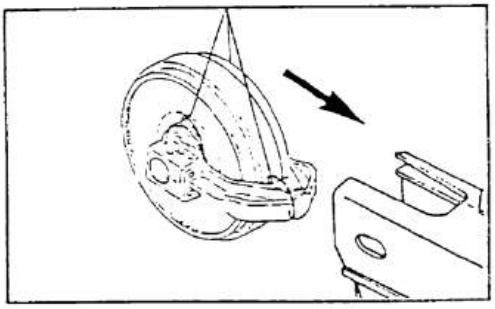


3 If keep it for a time, place it as shown.



4 Installation is the reverse order.

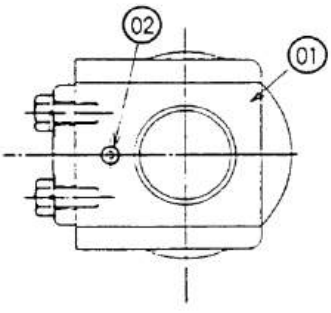
**Note** : Make sure that upward or downward of the yoke.



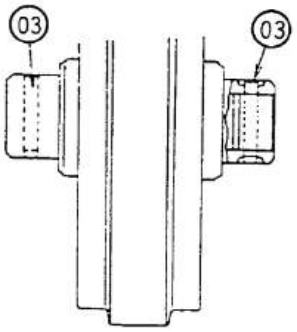
4.2.3 DISASSEMBLY & ASSEMBLY

DISASSEMBLY

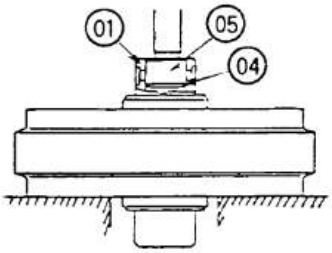
1 Remove plug (02) and drain the oil.



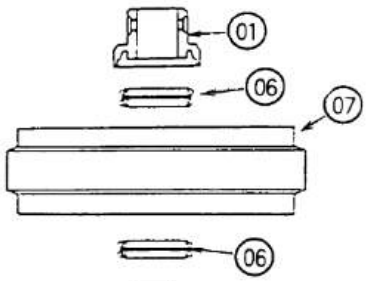
2 Remove pin (03).



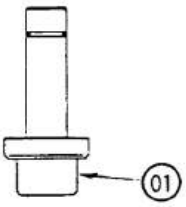

3 Press axle (05) and remove bearing (01) from the axle.




4 Remove O-ring (04) from the axle and push out the axle with the bearing.

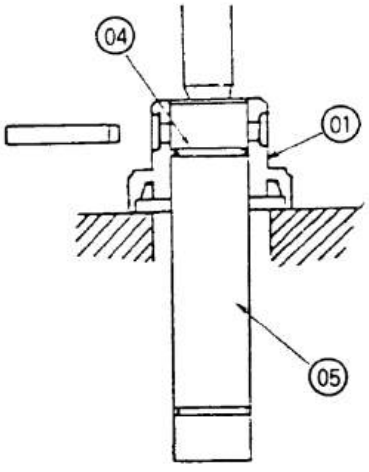



5 Remove seal groups (06) from idler (07) and bearings (01).

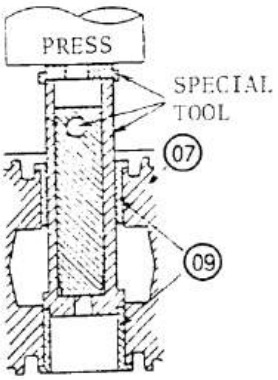



Note: The seal groups can be reused if they are not worn. Seal groups are to be kept in matched sets and to put cardbord between seals to protect the sealing face.

6 Press axle (05) and remove axle (05), O-ring (04) and bearing (01).



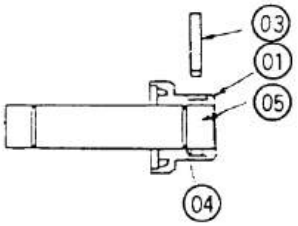
7 Press out bushing (09) using press and special tool (ST1924).



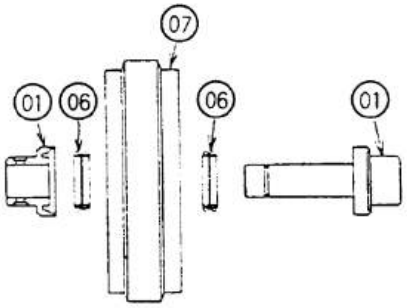

ASSEMBLY

Before assembling, clean all parts.

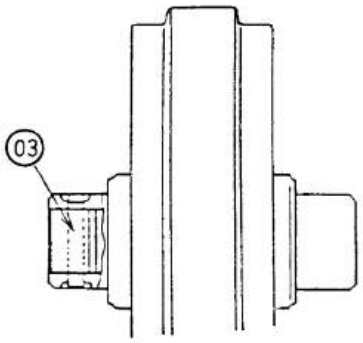
1 Press bushing (09) to idler (07).




2 Apply a grease to O-ring (04) and install it to axle (05).
Install axle (05) to bearing (01) and fix it by pin (03).




3 Install seal groups (06) to idler (07) and bearing (01).




4 Intall the axle to the idler.
Install bearing (01) and pin (03) to the axle.

5 Supply oil through plug hole.
Recommended oil

Class: API CD SAE30

Volume: 260 $cm^3$

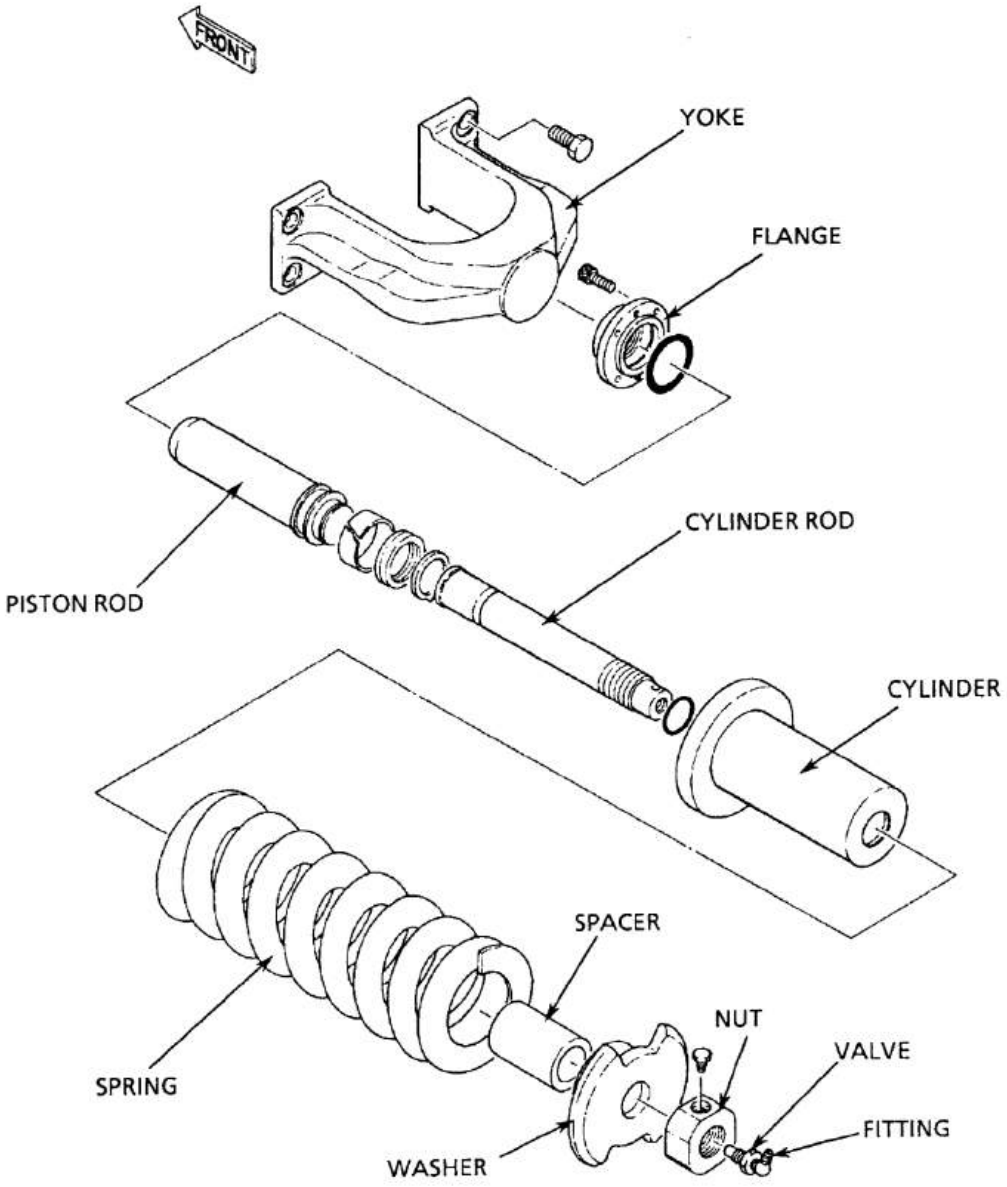
## 5. ADJUSTER

### 5.1 CONSTRUCTION

Track adjuster consists of track spring, cylinder, piston rod,cylinder rod and other small parts.

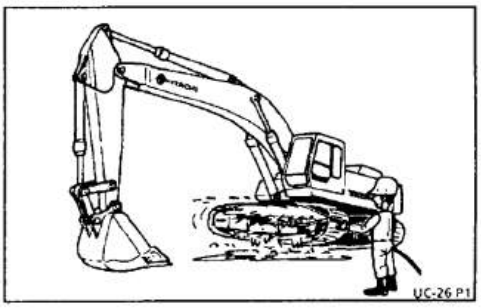
The back-end of spring is seated on washer and supported track frame structure.

The front-end of piston rod contacts with yoke.



5.2.2 REMOVAL & INSTALLATION

PREPARATION

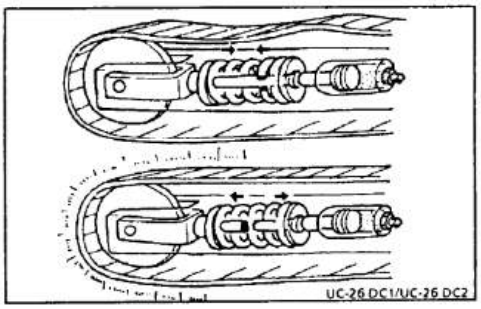



1 Clean track adjuster, then carefully check it for damage or breakage.

DAMAGE CHECK

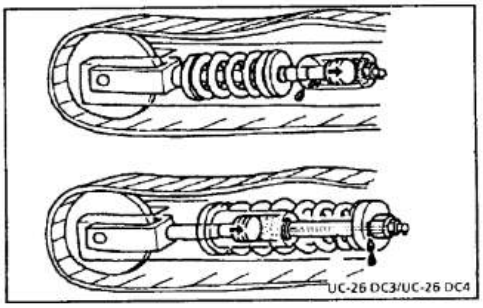
It must be noticed to be irregular if tracks are tight after releasing grease from adjuster or loose after feeding grease.

1 Check if adjuster is damaged or not.
- If spring is broken,track becomes loose.
- If rod is broken or cracked, track remains tightened even after releasing grease

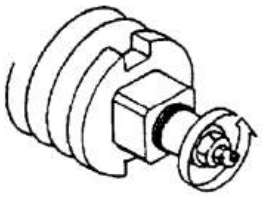



2 Add grease to adjuster and check for leakage.
- If there is any leakage, track becomes loose.

Wipe grease off and find out leaking points and causes.

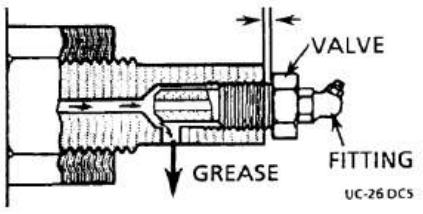



When releasing grease, gradually turn the valve one turn.
Never loosen the fitting.



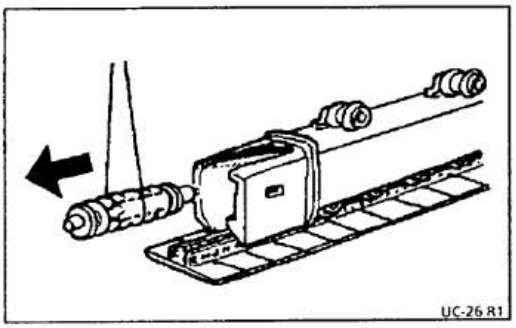
ONE TURN

**WARNING: Spring in track adjuster is preloaded heavily, and grease in cylinder is under high pressure.Improper handling of spring system and grease cylinder may cause a dangerous situation, leading to serious personal injury. Pay utmost care for handling of spring system and grease cylinder.**

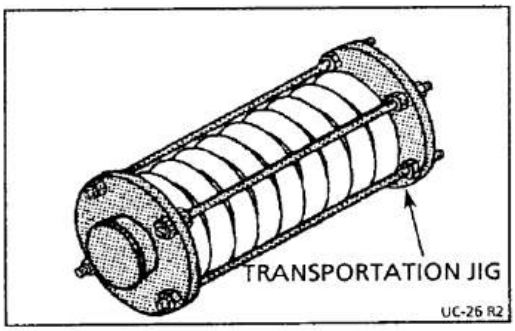


REMOVAL

1 Remove track adjuster after removing yoke with front idler.
Adjuster weight: 99 kg

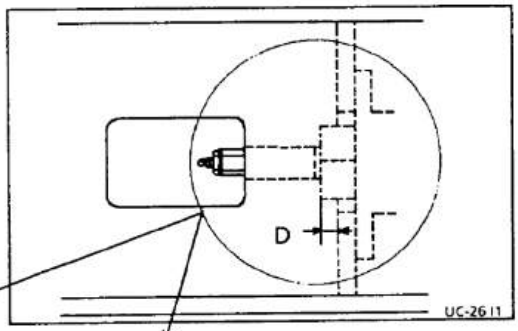


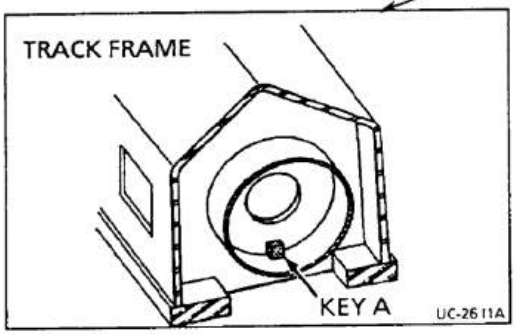

2 Lay down adjuster carefully.
Protect adjuster with transportation jig if needed for transportation.

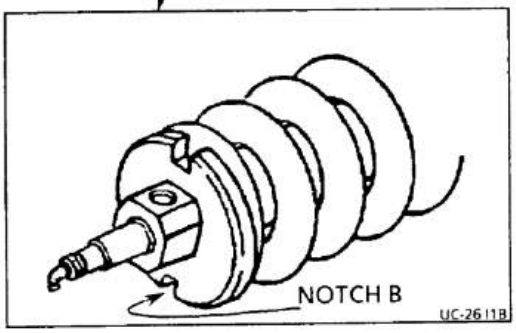



INSTALLATION

1 Instal adjuster onto track frame.
Adjuster weight: 99 kg
NOTE: Key Ⓐ in track frame must align with notch Ⓑ on washer.
Check that length Ⓓ is 15 mm.



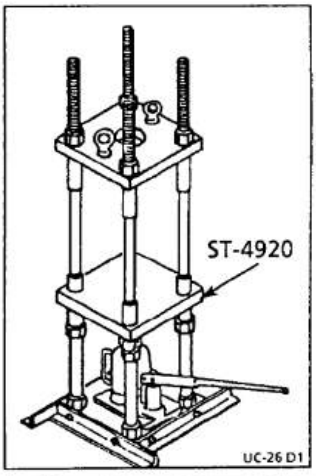



5.2.3 DISASSEMBLY & ASSEMBLY

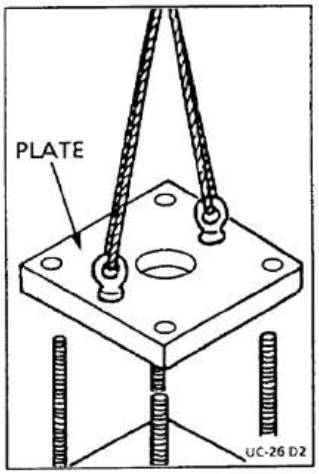
DISASSEMBLY

1 Place oil jack on bottom of the special tool (ST-4920)



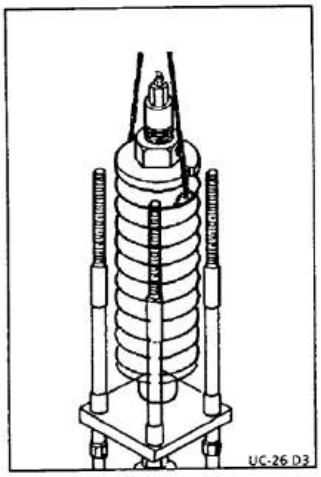

2 Remove nuts and plate.

46

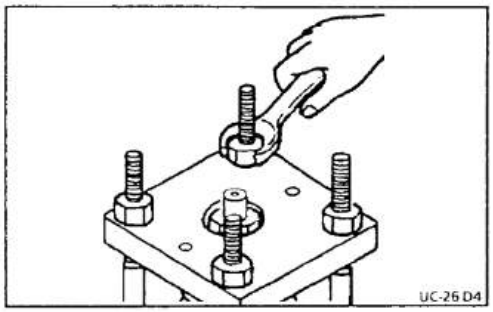



3 Lift adjuster.

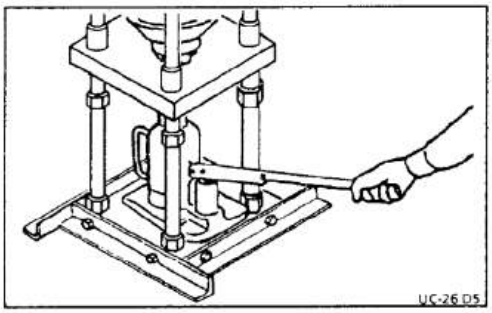
Place adjuster in the special tool.



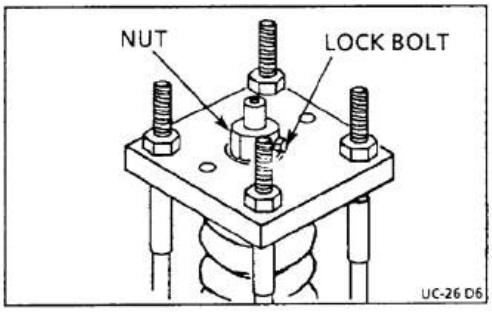
**4** Install plate.
Remove valve with fitting.
Tighten nuts to secure adjuster.
46



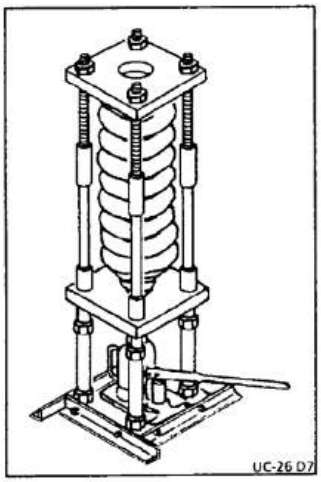

**5** Operate jack and compress spring until nut fully extends through hole in plate.



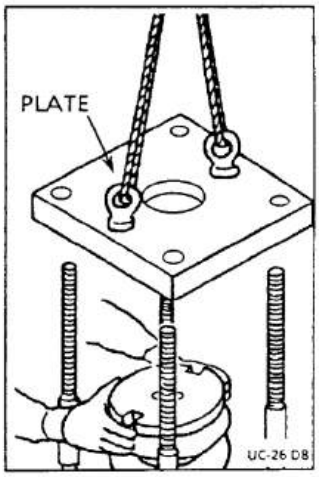

**6** Remove lock bolt and nut.
17 and 82



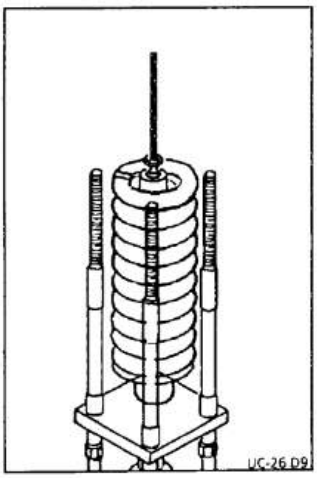

**7** Lower jack slowly.



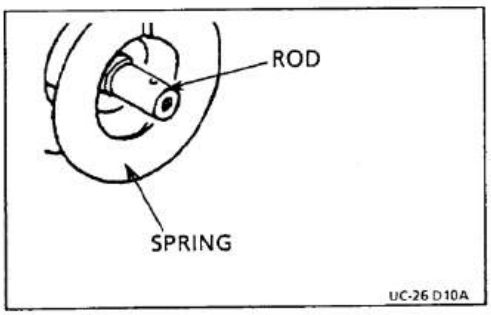
**8** Remove nuts and plate.



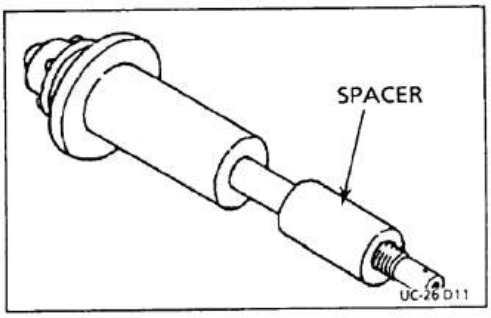

**9** Remove washer.
Install lifting tool, and remove adjuster from the special tool.




**10** Remove spring from rod.




**11** Remove spacer.

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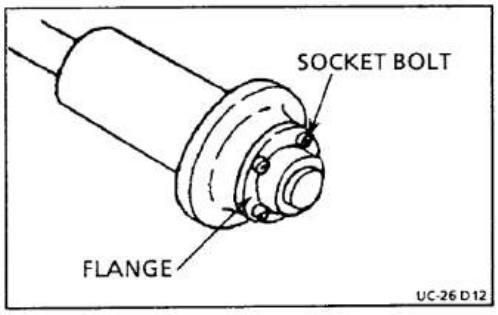
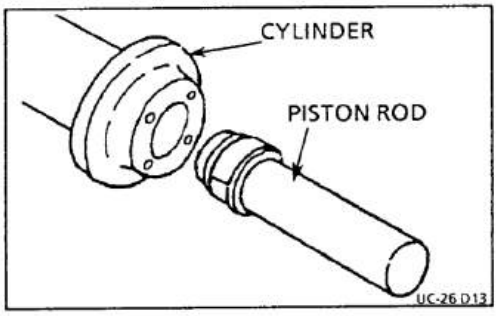
**12** Remove socket bolts and flange.

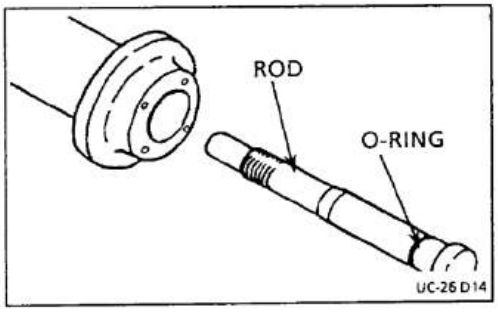
8



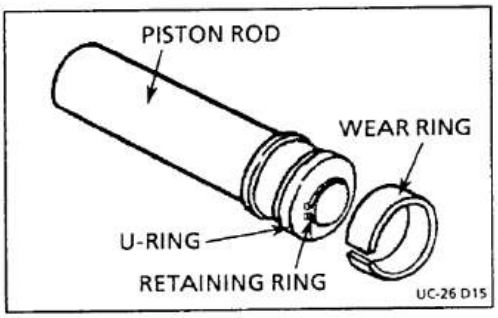

**13** Pull out piston rod from cylinder.




**14** Push out rod.
Remove O-ring.

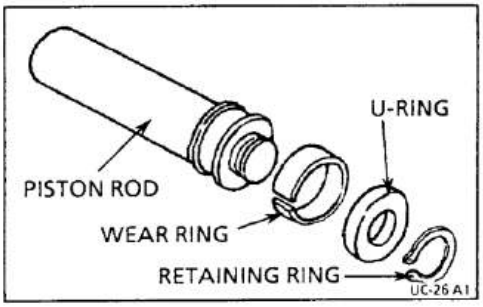



**15** Remove wear ring, retaining ring and U-ring from piston rod.

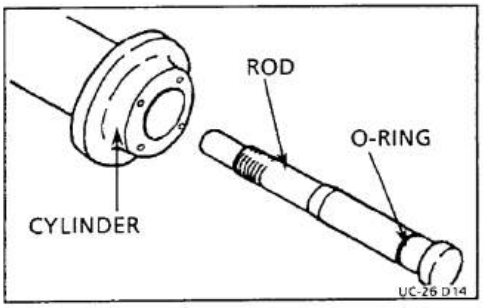


ASSEMBLY

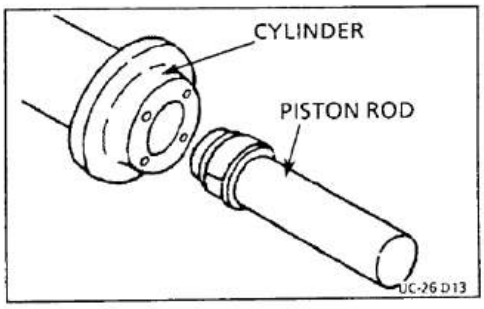
1 Clean all parts.
Install U-ring,retaining ring and wear ring.




2 Apply grease to O-ring and install it on rod.
Install rod into cylinder.
NOTE: Handle carefully not to damage O-ring.

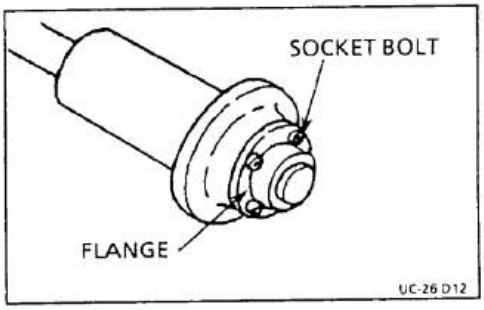



3 Apply grease to U-ring and wear ring.
Apply hydraulic oil to cylinder and piston rod.
Install piston rod into cylinder.
NOTE: When installing piston rod, apply grease (about 100 $cm^3$) onto its head.

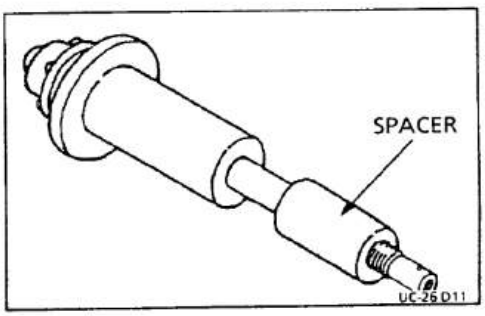




4 Fill flange inside grooves with grease.
Install flange into cylinder and tighten socket bolts.

8

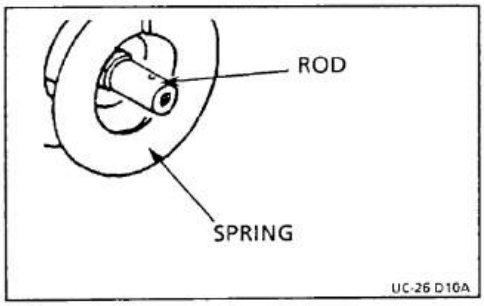




5 Install spacer on rod.

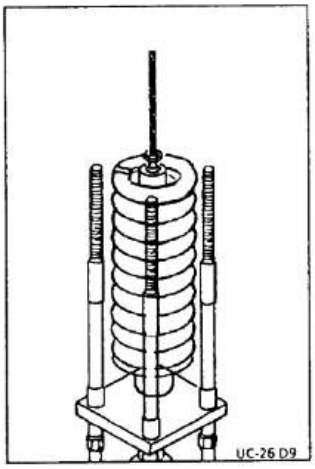



62

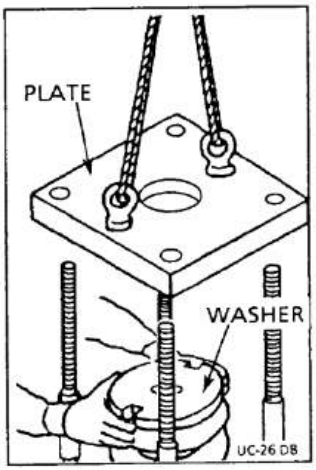
**6** Install spring on rod.



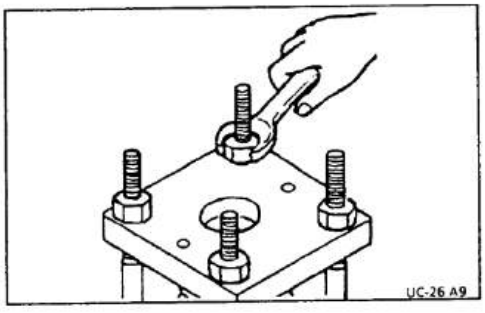

**7** Lift adjuster.
Place adjuster in the special tool.



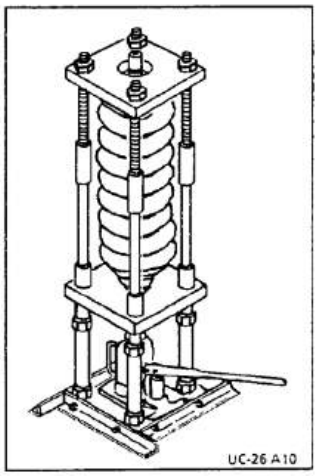

**8** Remove lifting tool.
Install washer on rod.
Install plate.




**9** Align jack and adjuster with hole in plate.
Install and tighten nuts to secure adjuster.
46

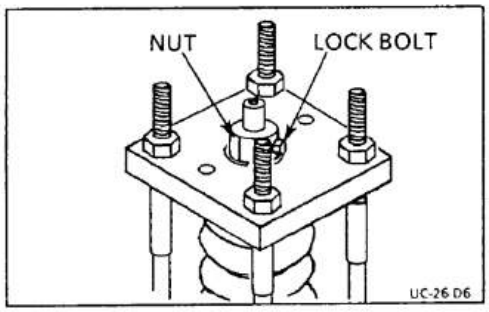


10 Operate jack and compress spring to the set length.



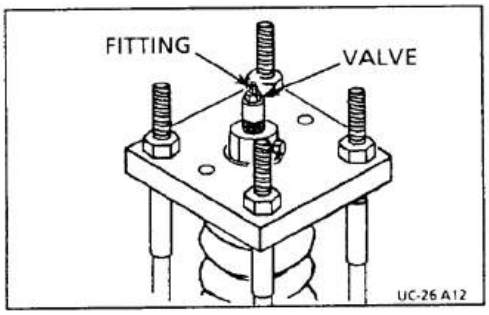

11 Install nut and lock bolt.

82 and 17

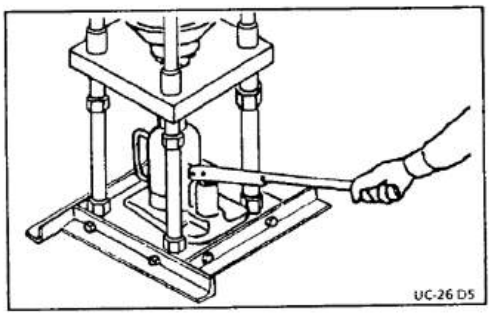



12 Install valve with fitting.

Valve tightening torque: 15 kgf·m (110 lbf·ft)

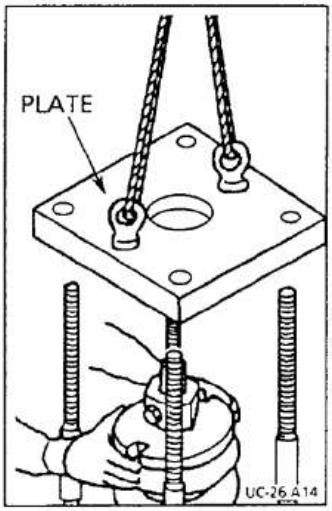



13 Lower jack.

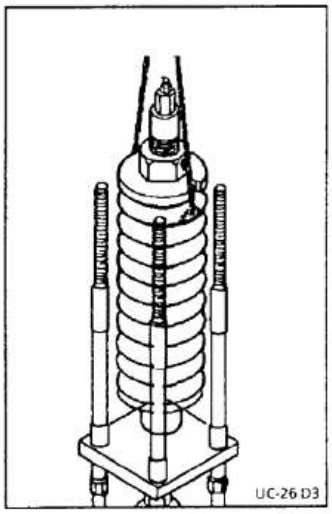


**14** Remove nuts and plate.

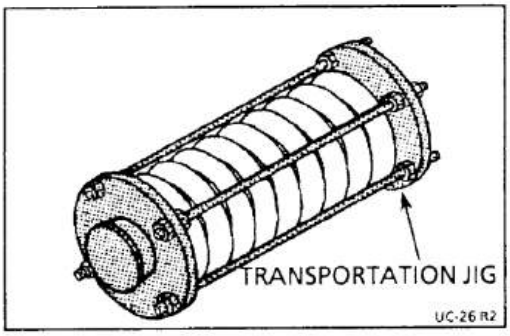
46




**15** Lift adjuster and remove it from the special tool.




**16** Lay down adjuster carefully. Protect adjuster with transportation jig if needed for transportation or storage.

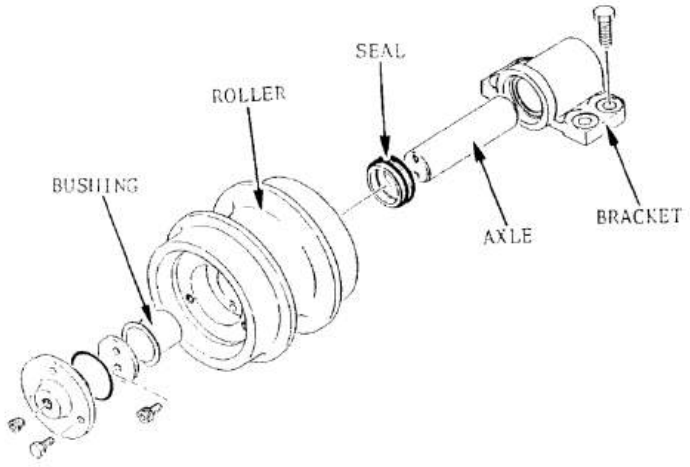


# 6. UPPER ROLLER & LOWER ROLLER

## 6.1 CONSTRUCTION

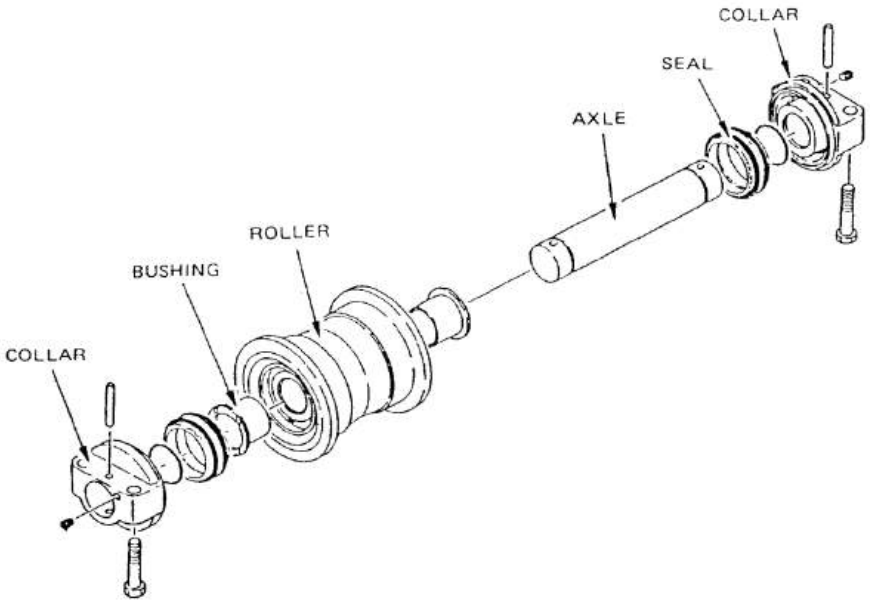
### 6.1.1 UPPER ROLLER

Two upper rollers are equipped on each side track frame to support track link. This roller is an overhang support type.




### 6.1.2 LOWER ROLLER

Seven lower rollers (EX200LC: Eight) are equipped under each side of track frame to stable rotating of track link.



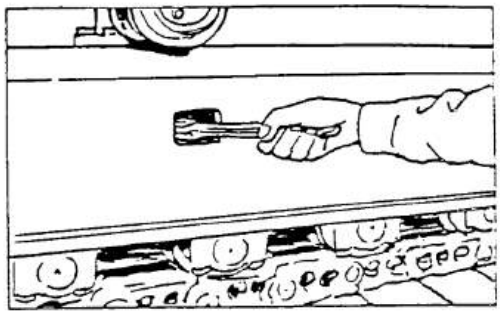
6.2.2. REMOVAL & INSTALLATION

(1) UPPER ROLLER

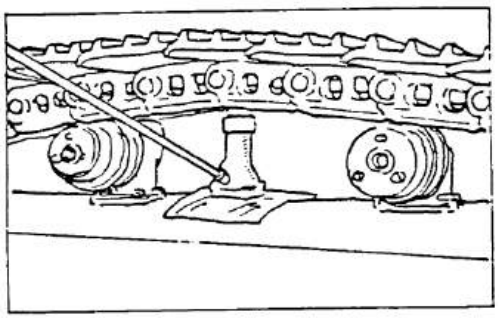
Removal

1 Open valve to drain grease

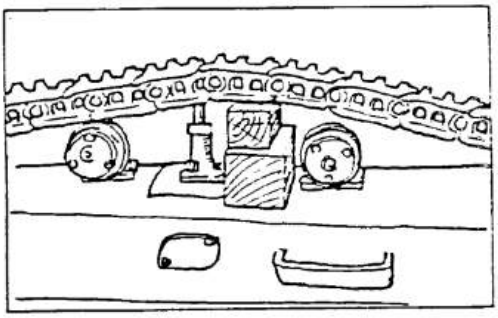
24



2 Jack up track link high enough to permit upper roller removal

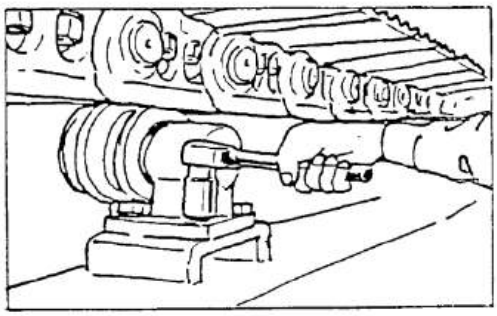


3 Put wooden blocks between track link and side frame.



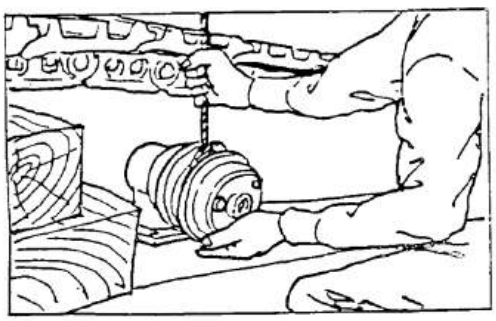
4 Remove bolts.

24



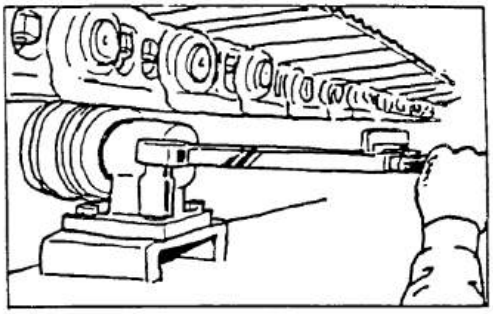
5 Remove upper roller.

Weight: 19.7 kg

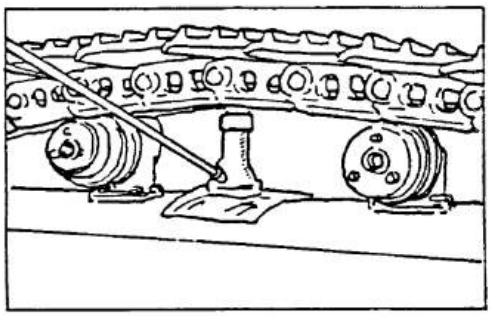


INSTALLATION

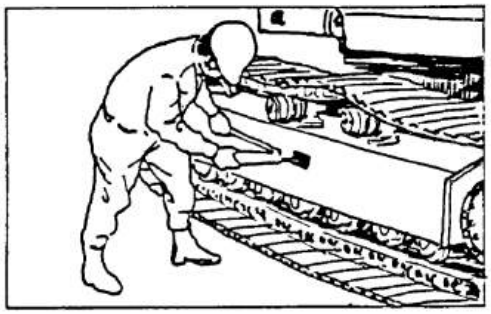
1 Install upper roller and bolts.
Tightening torque: 27 kgf.m
(200 ft.lbs)



2 Remove wooden blocks and jack.



3 Supply grease to cylinder through valve to adjust track link tension.
Track tension sag; 310 to 330 mm
(For normal ground)
370 mm
(For sandy soil)
330 to 370 mm
(For muddy ground)

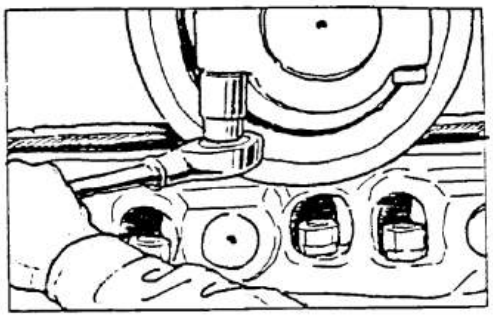


(2) LOWER ROLLER

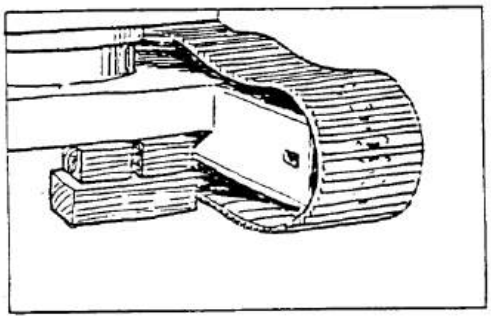
Removal

1 Remove roller guard.
Loosen bolts.

24

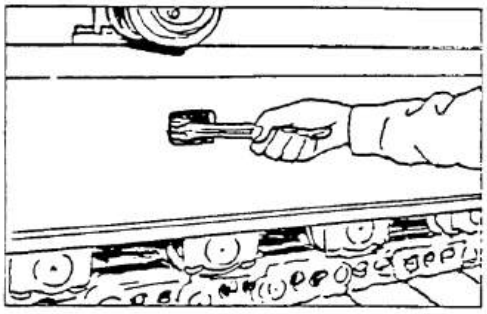


2 Lift the one side of unit high enough to remove lower roller.
Put wooden blocks under unit.



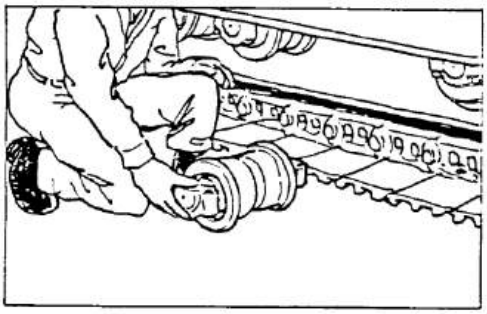
3 Open valve to bleed out grease.

24



4 Remove lower roller.

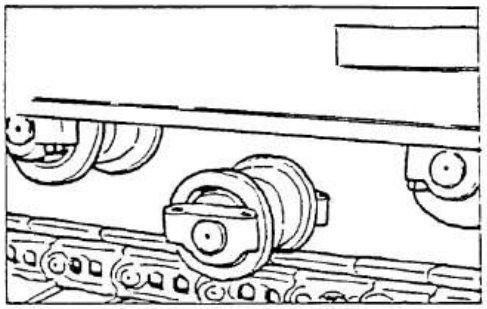
Weight: 40.4 kg



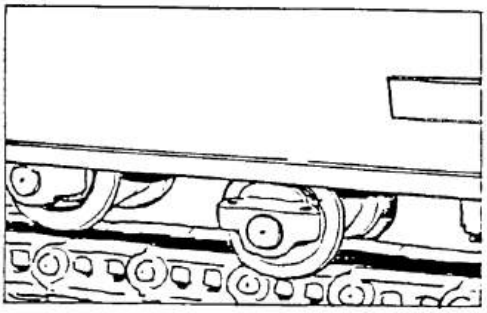
INSTALLATION

1 Put rollers on track link with flat portion of collar pointing up.

Align with tapped holes in track frame.



2 Lower unit enough to allow bolts to be installed into track frame.

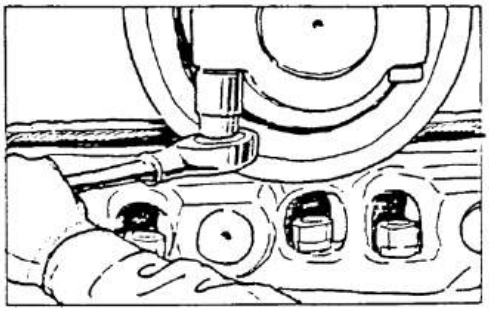


3 Install bolts.

Tightening torque: 27 kgf.m
(200 ft.lbs)

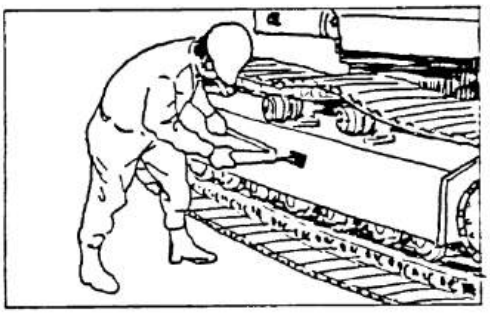
24

**Serial no.32496~ : 34 kgf·m**
**(246 ft·lbs)**



4 Supply grease to cylinder through fitting.

Track tension sag; 310 to 330 mm
(For normal ground)
370 mm
(For sandy soil)
330 to 370 mm
(For muddy ground)



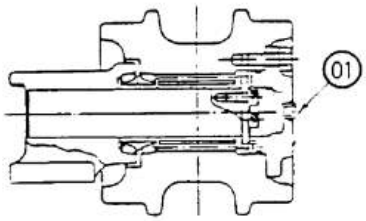
6.2.3 DISASSEMBLY & ASSEMBLY

(1) UPPER ROLLER

DISASSEMBLY

1 Remove plug (01) and drain the oil.

6

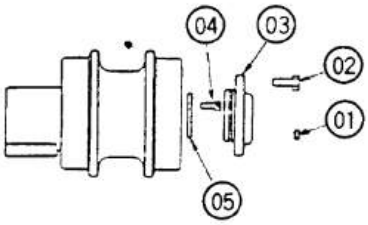



2 Remove bolts (02) and cover (03).

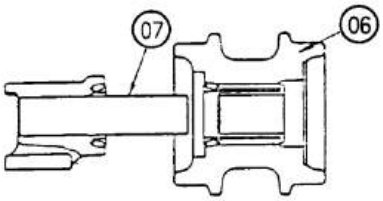
Remove bolts (04) and plate (05).

6

17

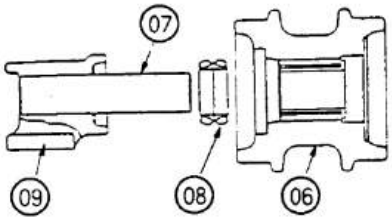



3 Pull out roller (06) from axle (07).

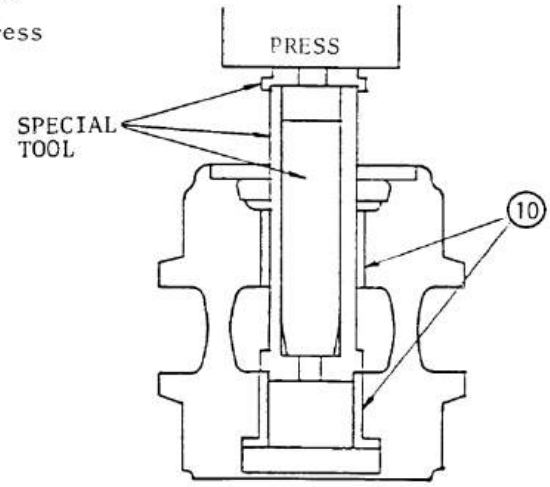



4 Remove seal group (08) from bracket (09) and roller (06).

Note: The seal group can be reused if it is not worn. Seal group is to be kept in matched set and to put cardbord between seal to protect the sealing face.



5 In case of changing bushing (10), remove the bushing from the roller by using press and special tool (ST-1925).

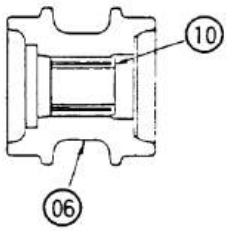



ASSEMBLY

Before assembling,

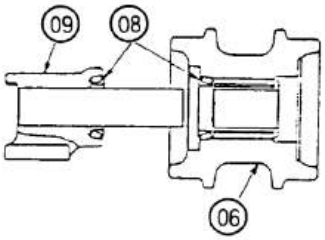
- Clean all parts.
- Polish up scratches and roughness of the parts by using oil stone.
- Replace O-ring and seal group with new as a rule.

1 Press bushing (I6) into roller (06).



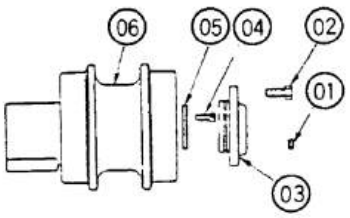

2 Install seal group (08) to roller (06) and bracket (09).

Note: • Apply grease to O-ring part of seal group.
• Apply engine oil to matching surface of seal group.

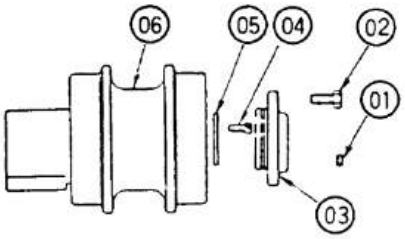



3 Install roller (06) to axle (07).
Install plate (05) and bolts (04)

6

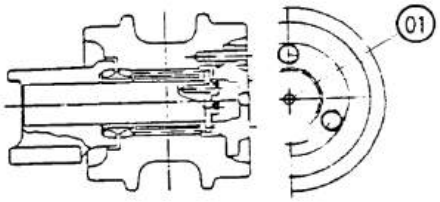


4 Apply grease to O-ring and install it to cover (03).
Install cover (03) and bolts (02) to roller (06).




5 Supply engine oil to the roller through the plug hole and tighten plugs (01).

Note: Recommended oil
Class: API-CD
SEA30
Volume: 75 $cm^3$

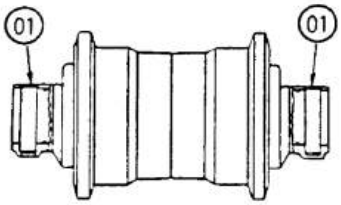



6

(2) LOWER ROLLER

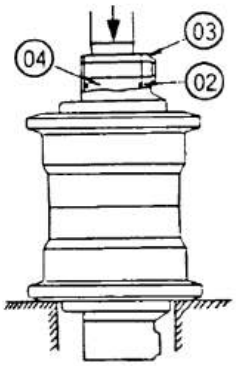
DISASSEMBLY

1 Remove plug from collar and drain the oil.

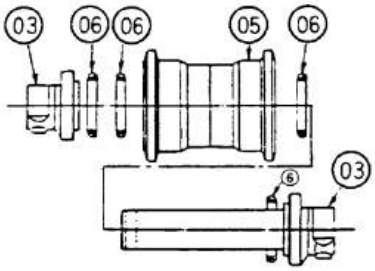



6

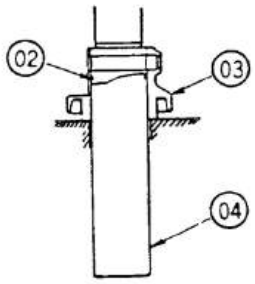
2 Remove pin (01).
Press axle (04) to end of collar (03).
Remove collar and O-ring.



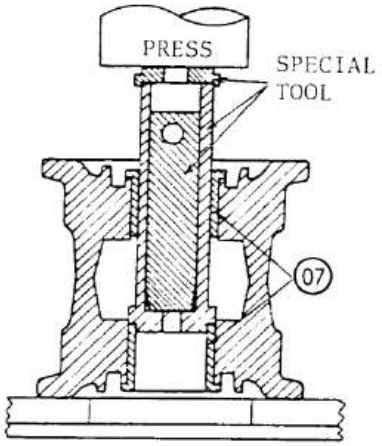

3 Remove seal groups (06) from the roller and collar (03).
The seal groups can be reused if they are not worn. Seal groups are to be kept in matched sets and to put cardbord to protect the sealing face.



4 Press axle (04) and remove collar (03) and O-ring (02) from the axle.




5 In case of changing bushings (07), remove the bushings using press and special tools (08) (ST-1955).

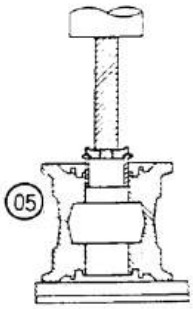



ASSEMBLY

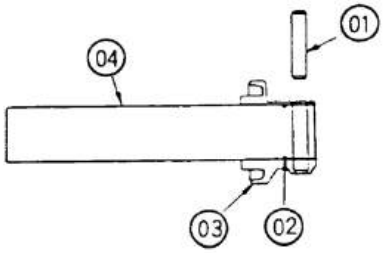
Before assembling,

- Clean all parts.
- Polish up scratches and roughness of the parts by using oil stone.
- Replace O-ring and seal group with new as a rule.

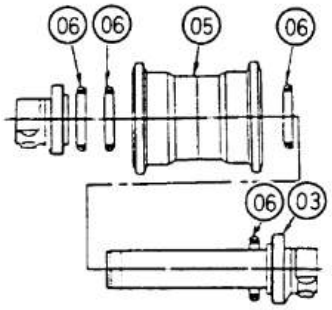
1 Press bushing (07) into roller (08) by using press and special tools (ST-1955).




2 Apply grease to O-ring (02) and install it to axle (04).
Install collar (03) to axle (04) and fix it by pin (01).

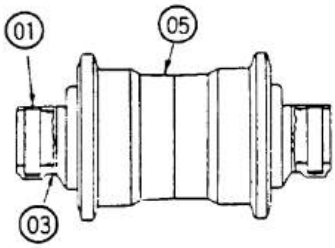


3 Install seal groups (06) into roller (05) and collar (03).

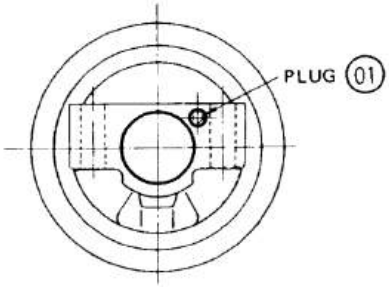



Note: Apply grease to O-ring part of seal groups.
Apply engine oil to matching surface of seal groups.

4 Install axle (04) into roller (05).
Fix another collar (03) to the axle by pin (01).



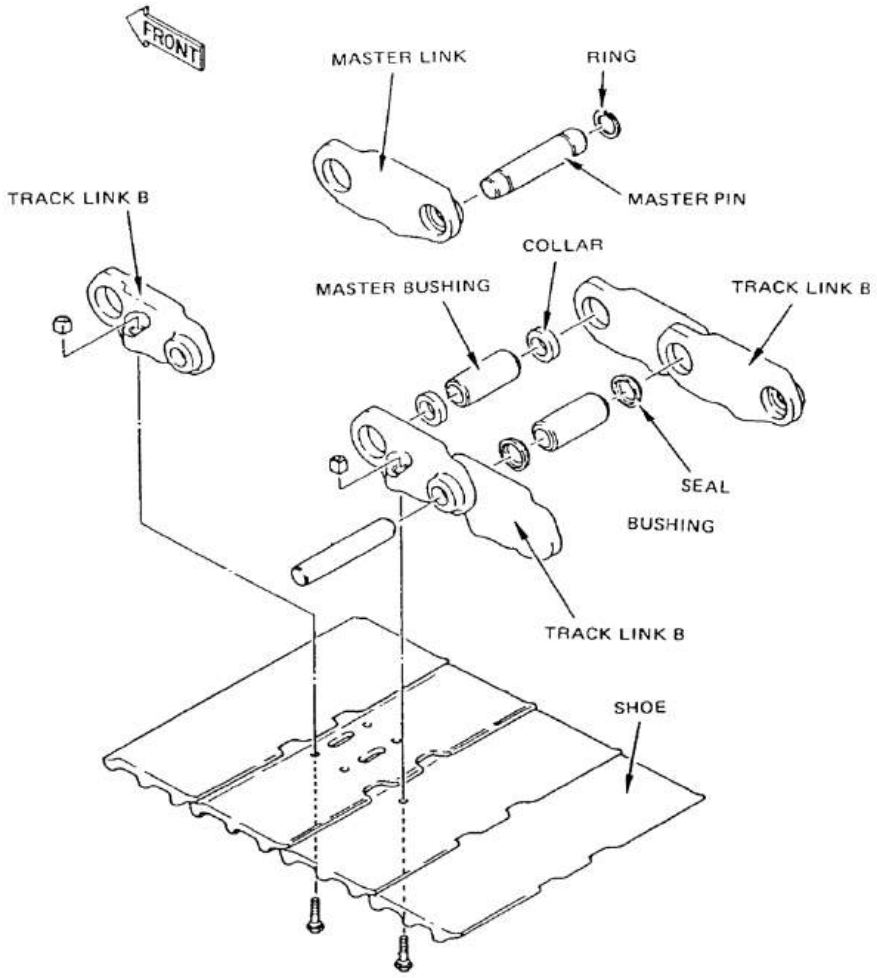

5 Supply engine oil to the roller through the plug hole.
Install plug (01) to collor (03).
Note: Recommended oil
Class: API-CD
SEA30 6
Volume: 350 $cm^3$



## 7. TRACK LINK

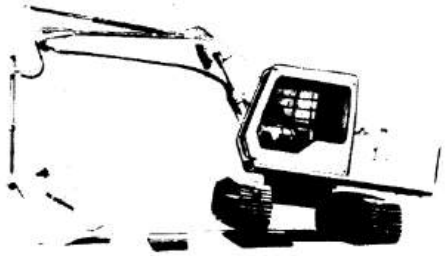
### 7.1 CONSTRUCTION

The track link is provided with a center strut for reinforcement to withstand heavy loads encountered in digging operations.

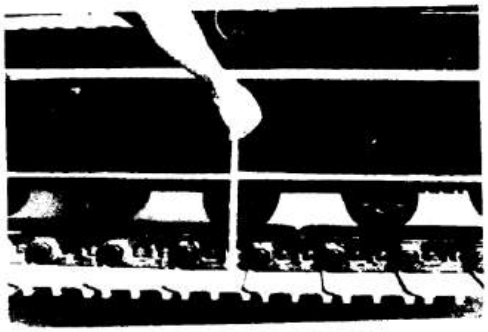


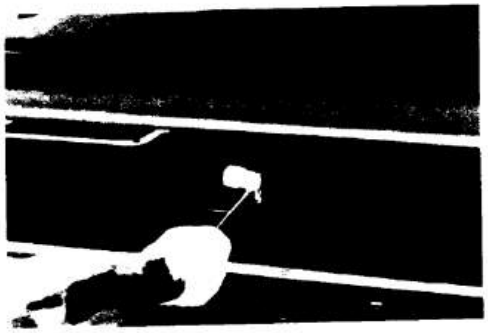
7.2.2 ADJUST TRACK LINK TENSION

The track link tension is adjusted by either adding grease to the adjustment cylinder inside the side frame through the fitting 2 or draining the grease from the valve 1 .

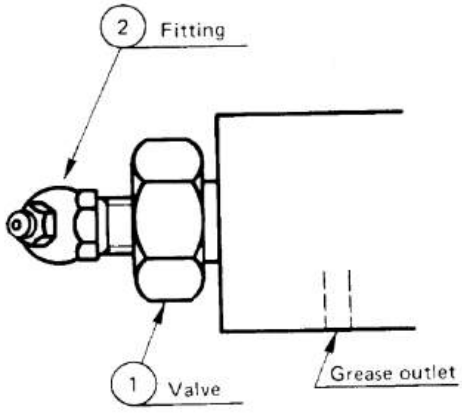


For checking the tension, jack up the machine as shown on the right, and measure the distance between the upper surface of the shoe and the lower surface of the side frame at the center of the side frame. The distance should be 310 ~ 330 mm for general ground, about 370 mm for gravel, and 330 ~ 370 mm for damp ground.





Loosening Track Link:
Apply a socket (tool: long socket 24) at the hexagonal part of the valve body 1 , and drain grease by loosening the valve little by little. The valve 1 should be loosened at most 1 ~ 1.5 turns. If the grease does not drain well, jack up the track belt to be loosened.




CAUTIONS:

(1) Do not loosen the valve 1 too much or suddenly, as it causes the high pressure grease to pour out from the adjustment cylinder. It should be loosened little by little.

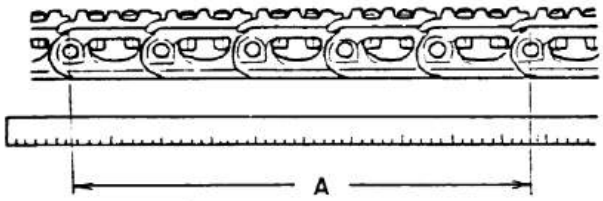
(2) Check and remove any foreign matters such as gravel caught at the sprocket.

Tightening Track Link:
Retighten the valve, and add grease from the fitting 2 .

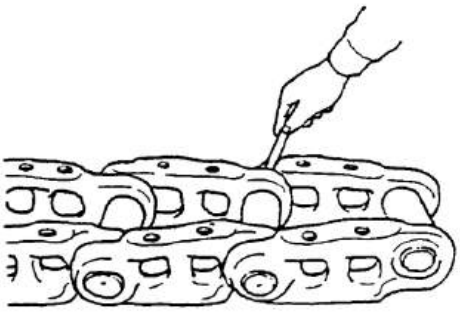
7.2.3 DETERMINATION

(1) LINK PITCH

While lifting track link assembly, measure A.



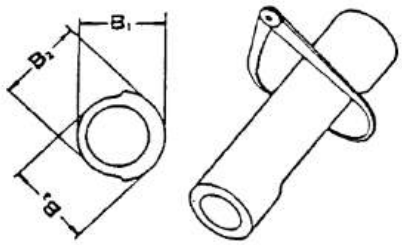

Measure gap between link sides.



(2) PIN BUSHING

Check score and crack.

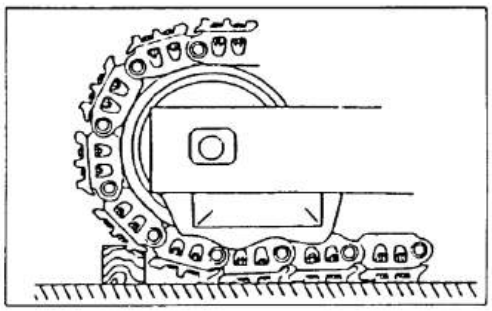
Measure pin and bushing diameter at three places.



### 7.2.4 REMOVAL & INSTALLATION

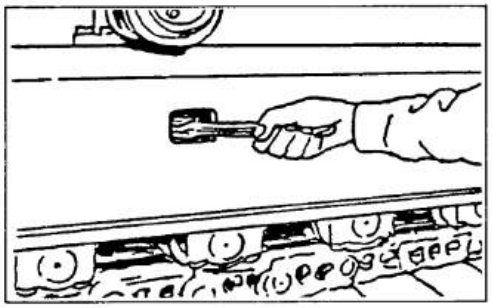
REMOVAL

1 Move track link until master pin is over front idler in the position as shown. Put wooden block.

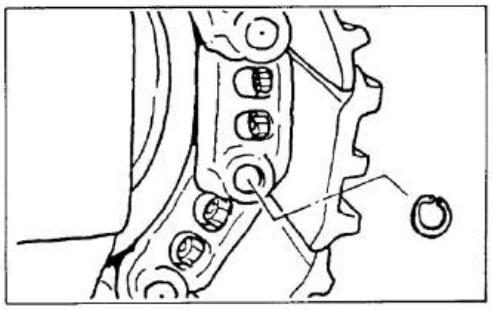


2 Open valve to bleed out grease.

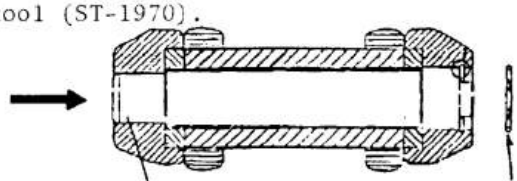
24

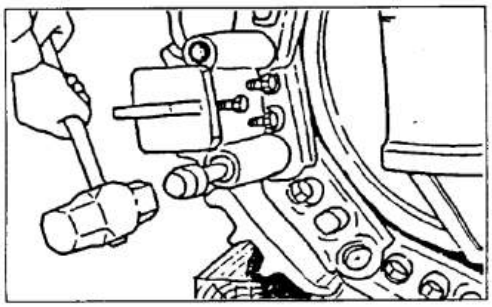


3 Remove retaining ring.

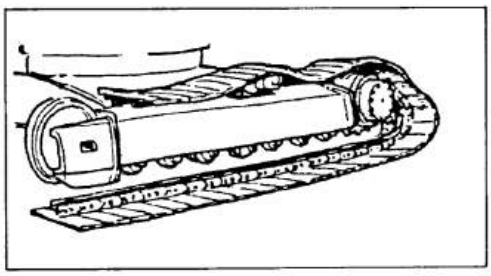


4 Pull out master pin by using a special tool (ST-1970).



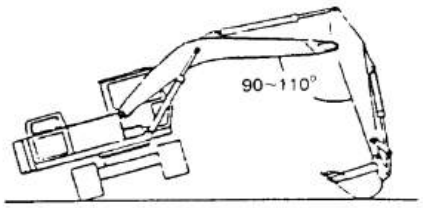



5 Operate the machine to backward.



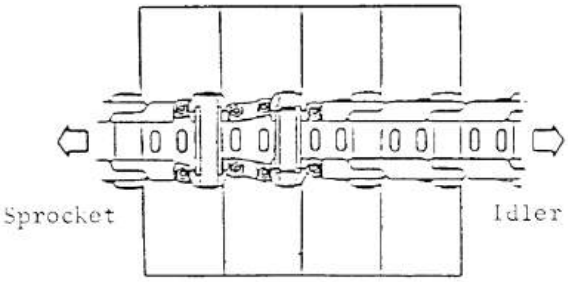
73

6 Juck up the machine as shown.
Put wooden blocks under the machine.
Pull out the track link.

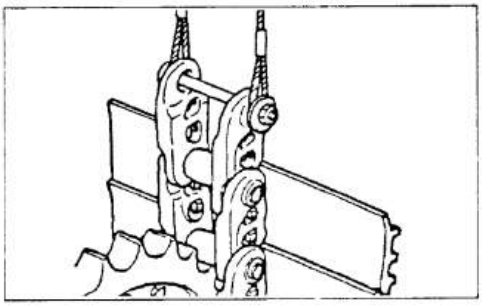



INSTALLATION

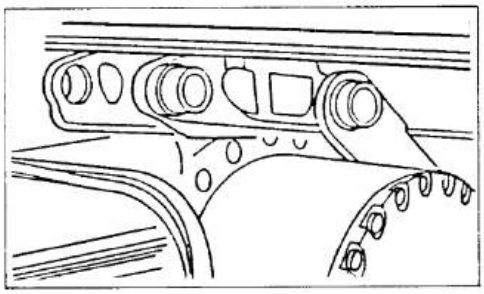
1 Juck up the machine and put the track link under the lower roller.



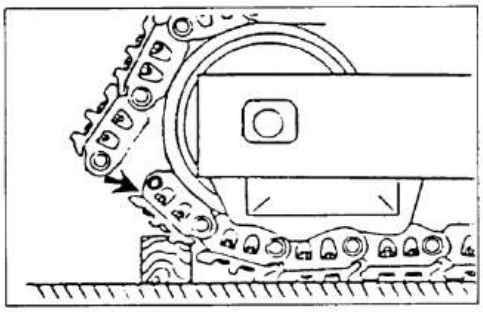

2 Lift the track link and place it on the sprocket.



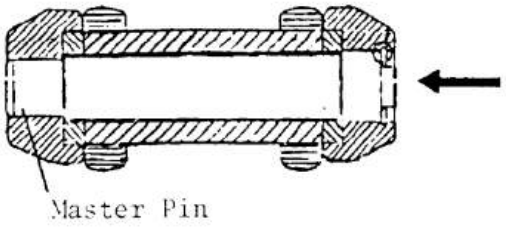
3 Slowly operate the sprocket in forward direction.

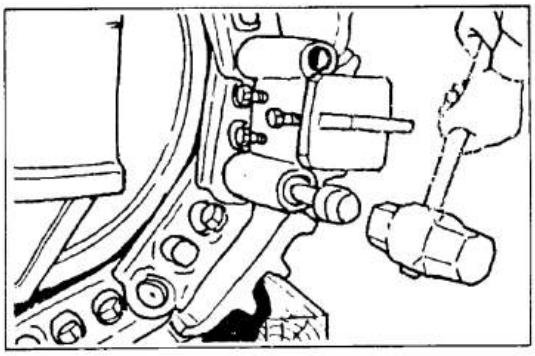


4 Keep on operating the sprocket until end of track link is over front idler.
Lower the machine.
Put wooden block as shown.

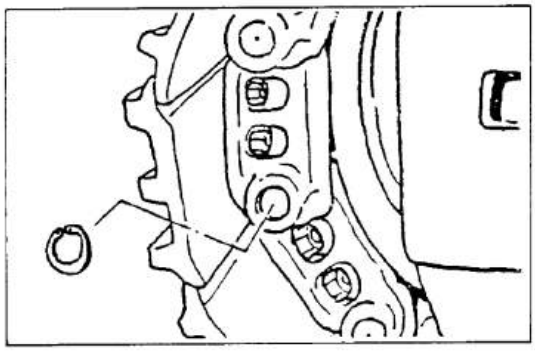


5 Install master pin using a special tool (ST-1970).



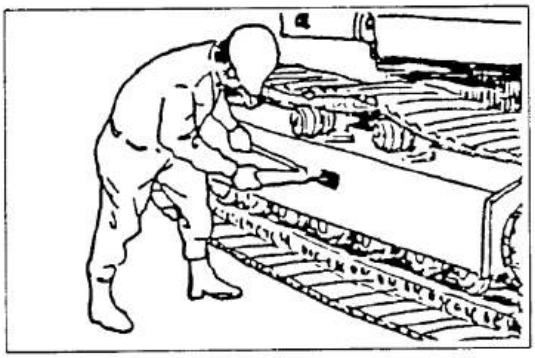



6 Install retaining ring.



7 Supply grease to the cylinder through the fitting to adjust track link tension.

24

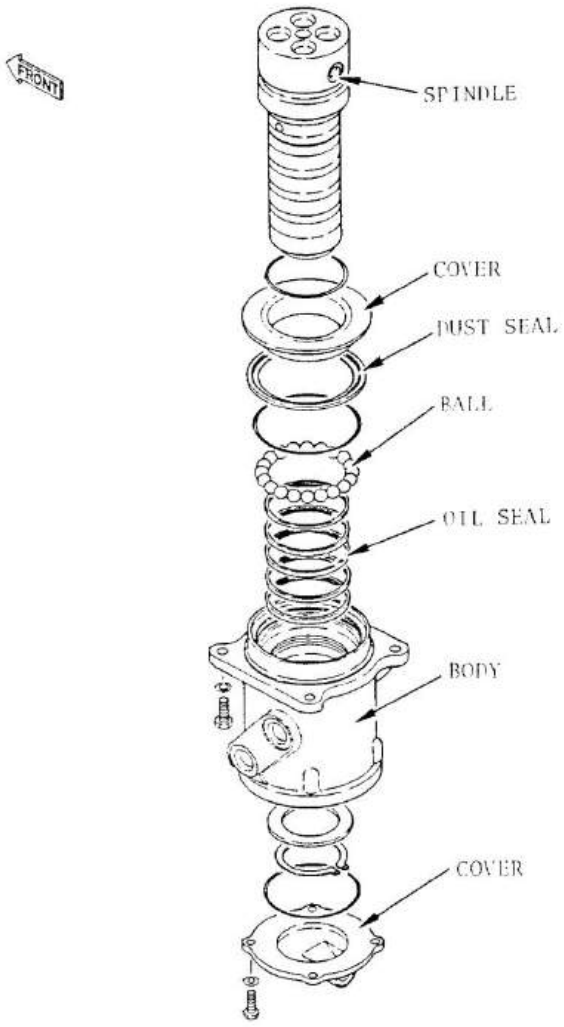


## 8. CENTER JOINT

### 8.1 CONSTRUCTION

The center joint is a kind of rotary joint. It is located at the center of the machine to connect the hydraulic lines from the superstructure to the travel device.

It comprises a spindle and a body on which seals are installed. The spindle is stationed and installed at the center of the main frame, and the body is installed in the track frame of the superstructure to rotate around the spindle.

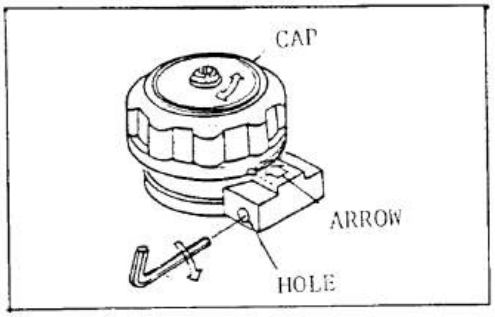


8.2.2 REMOVAL & INSTALLATION

(1) REMOVAL

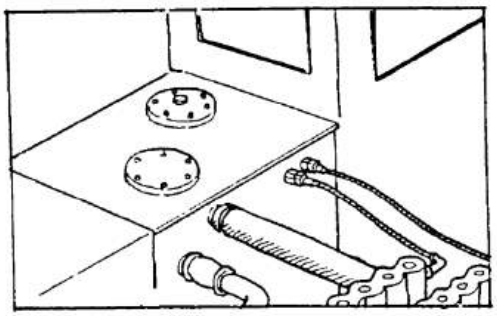
1 Release air pressure from the hydraulic tank.

4



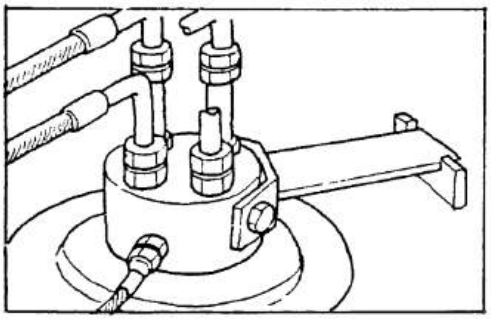

2 Remove hose for releasing air from control valve.
Set the vaccume pump and operate it.

17, 19



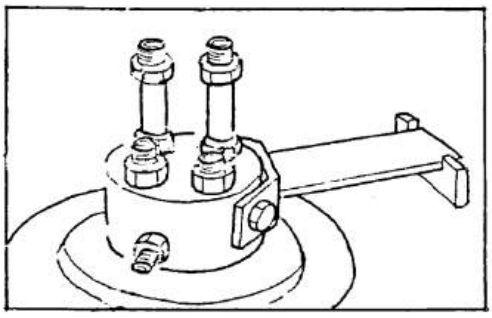
3 Remove hoses from center joint.

36, 22



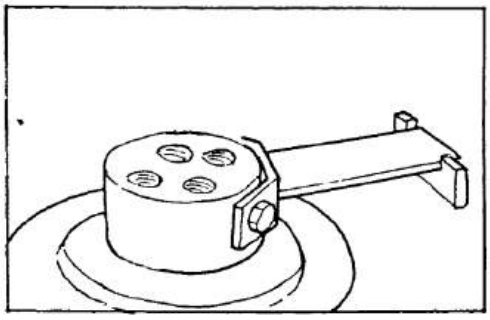
4 Remove adapters from center joint.

36, 22



5 Remove bolts (09) and stopper (11).

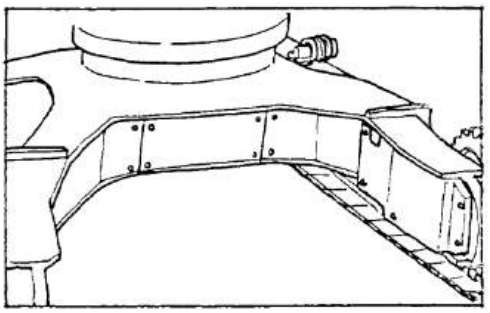
22



277

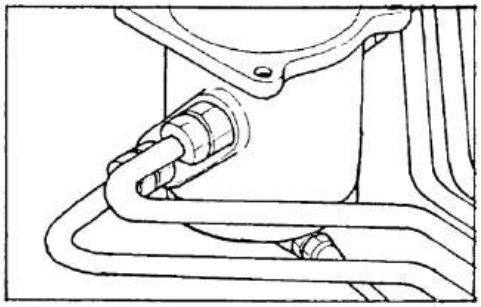
6 Remove covers (12) and (13).

19



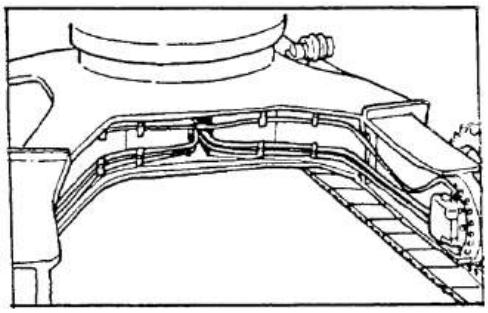
7 Remove pipes (15) and (16).

36, 22



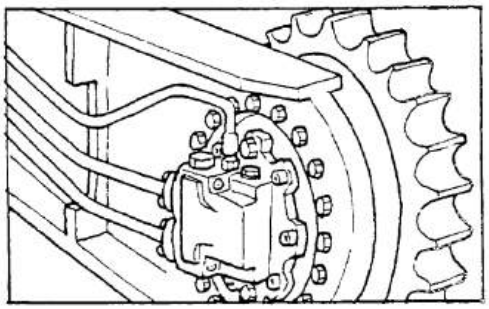
8 Remove bolts and cramps.

19

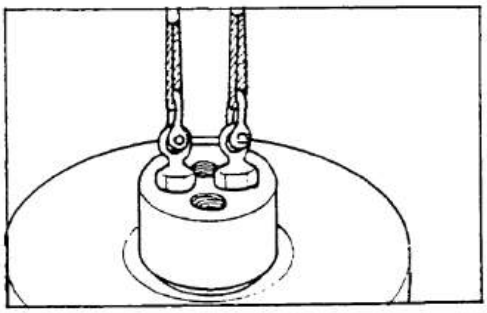


9 Remove pipes (17) and (22).

36, 22

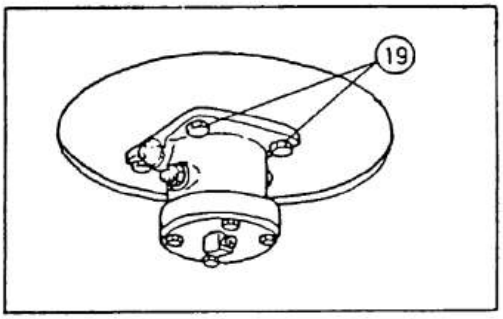


10 Install a lifting tools to center joint and hold it.
Lift center joint.
Weight: 34 kg

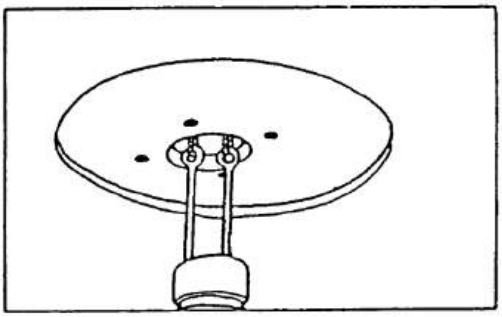


11 Remove bolts (19)

19

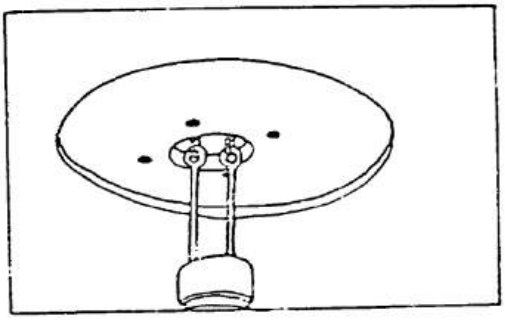



12 Remove center joint.



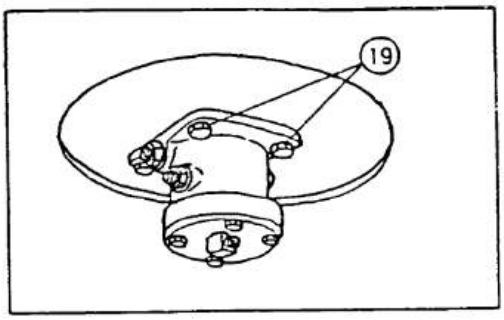
(2) INSTALLATION

1 Install lifting tools and lift center joint.

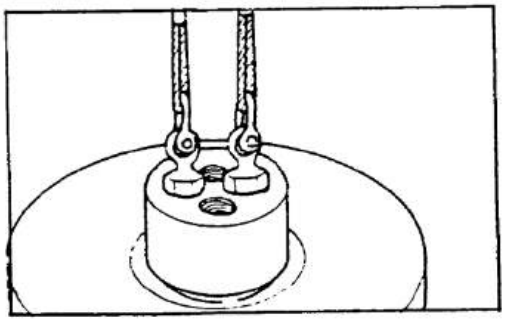


2 Install bolts (19).

19

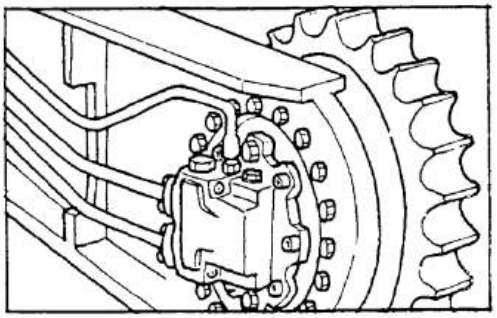



3 Remove lifting tolls and install rubber cover.

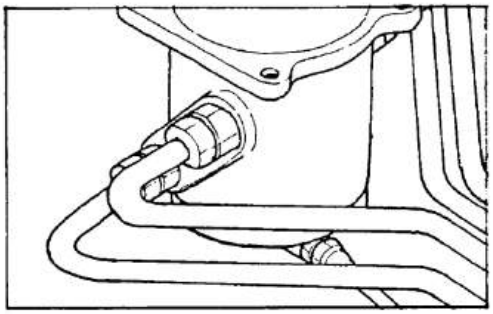


4 Install pipes (17) and (18).

36, 22

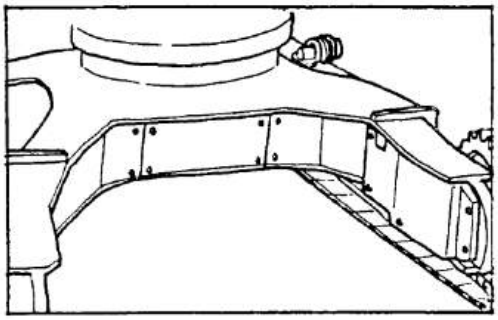


5 Install pipes (15) and (16).



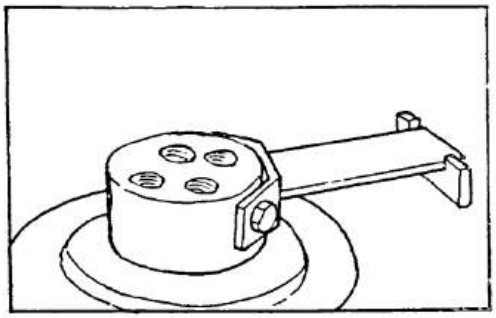
6 Install bolts, cramps and covers.

19

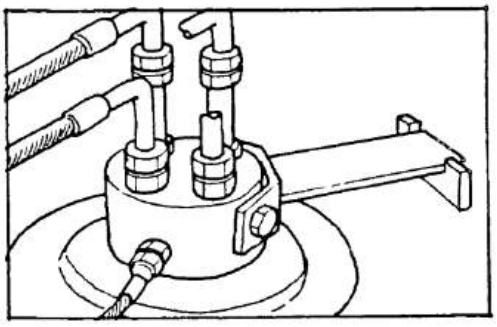


7 Install stopper (11) and bolts (09).

22



8 Install adapters to center joint and install hoses.



# TRAVEL MOTOR

# For safety

1) Follow the instructions given in this manual when disassembling of inspecting the product. If you have any questions or unclear points in this manual, please consult with the manufacturer.

2) When disassembling or assembling the product, use the special tools indicated in the manual.

3) For service or repair parts, be sure to use only those made by or specified by the manufacturer.

4) Types and meaning of signal words
4 signal words are used in this manual.
They are defined as the table below regarding to the degree of the danger (or the seriousness of the potential accident).

Understand the meaning of these signal words, and obey the corresponding instructions.

| Signal words | Meaning |
|---|---|
| ⚠ DANGER | Used in case of impending danger, which if not avoided, will result in death or serious injury. |
| ⚠ WARNING | Used in case of potential danger, which if not avoided, may result in death or severe injury. |
| ⚠ CAUTION | Used in case of potential danger, which if not avoided, may result in moderate or minor injury. |
| NOTE | Used in case of prompting cautions, emphasizing information, and in case of important procedure, which if neglected, may result in damages on parts or equipments. |

This service manual does not contain items of danger and warning.

# 1. Service outline

## 1. Tools

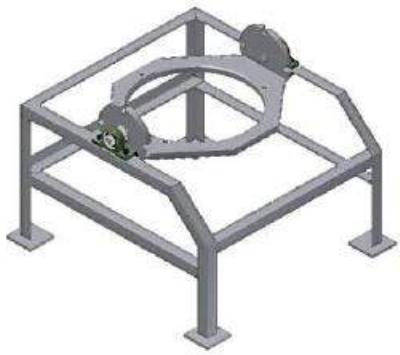
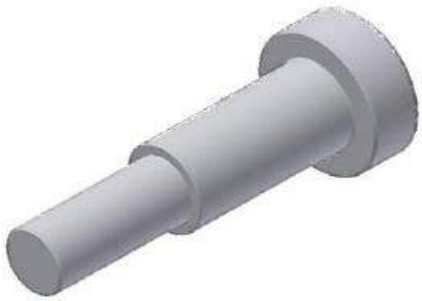
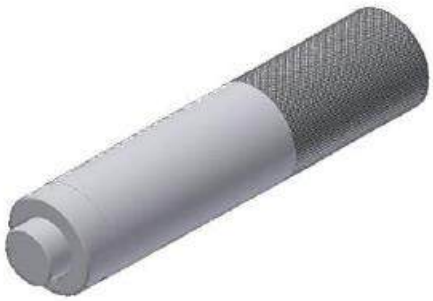
### 1-1. Standard tools

| No. | Name | Type / Dimensions | Q'ty |
|---|---|---|---|
| 1 | Hexagon socket screw keys | 6, 10, 12 [mm] | 1 each |
| 2 | Spanners | 27, 41 [mm] | 1 each |
| 3 | Torque wrench adaptors | Socket type ; 27, 41 [mm]<br>Key type ; 6, 10, 12 [mm] | 1 each |
| 4 | Torque wrench<br>(JIS B 4650) | Nominal dial type ;<br>280 [N]<br>850 [N] | 1 each |
| 5 | Extension bar<br>(JIS B 4637) | 150 [mm] | 1 |
| 6 | Hammer | Nominal designation 12 [mm] | 1 |
| 7 | Plastic hammer | Approx. L=150 [mm] | 1 |
| 8 | Snap ring pliers | For hole | 1 |

### 1-2. Equipment

| No. | Applicable parts | Name | Type / Dimensions | Q'ty |
|---|---|---|---|---|
| 1 | Parts washing | Washing tank | For rough and fine washing. | 1 |
| 2 | 104, 149 | Press bench | Max. 1960 [N] (200 [kg]) | 1 |
| 3 | 149, 150 | Heating equipment | Heating capacity: max. 100°C | 1 |
| 4 | 112, Drying and washing | Compressed air | 0.02-0.05 [MPa]<br>(2-5 [kgf/cm$^2$]) | 1 |
| 5 | Disassembly | Receptacle | Approx. 450 X 300 X 120H | 1 |
| 6 | Heating | Leather gloves | | 1 |

1-3. Special tools

| | |
|---|---|
|  | Name : Workbench<br>• Workbench for easy and safe disassembly and assembly of the travel motor. |
|  | Name : Holder ( I )<br>• For inserting spring [114], washer [110] and snap ring[145] into cylinder block [104].<br>• For removing spring [114] from cylinder block [104]. |
|  | Name : Holder ( II )<br>• For removing ball bearing [149] from or inserting it onto shaft [102]. |
|  | Name : Holder ( III )<br>• For press fitting oil seal [132] into the oil seal hole the spindle [2]. |

| | |
|---|---|
|  | Name : Press Plate( 1 )<br>· For press fitting piston [112] into the piston hole the spindle [2]. |

# 2. Disassembly

## 2-1. Preparation:

1). Workbench preparations:

- Prepare a motor workbench.
- Provide a sturdy workbench with which the internal parts of the travel motor can be disassembled, and which is wide enough to place parts so they do not move or fall of the bench while working.
- Spread a rubber or vinyl sheet on the workbench.

2). Tools and materials preparations:

- Prepare the tools and materials listed in this manual.

## 2-2. General cautions:

**⚠ CAUTION**

- **Internal parts may be coated with hydraulic fluid during disassembly and are slippery. If a parts slips out of your hand and falls, it may result injury or damage the parts. Be very careful when handling these parts.**
- **Combustibles such as kerosene are used for washing parts. These combustibles are easily ignited, and may result in fire of injury. Be very careful when handling these combustibles.**

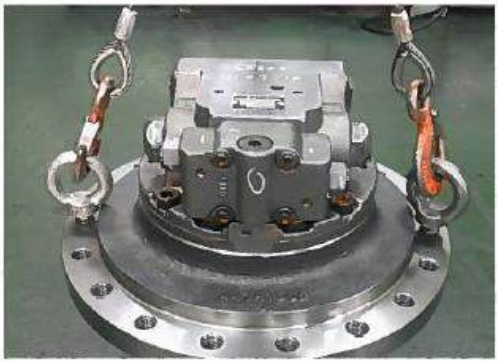
1). During the disassembly, carefully check each part for abnormalities or damage.

2). Disassembly should be carried out in a clean location according to the disassembling procedure below.

3). Arrange the detached parts to prevent them from being damaged or lost.

4). The disassembled seals must be replaced with new ones as a rule even if they are free from damage. For reassembly, therefore, prepare new seals in advance.

## 2-3. Disassembly procedure



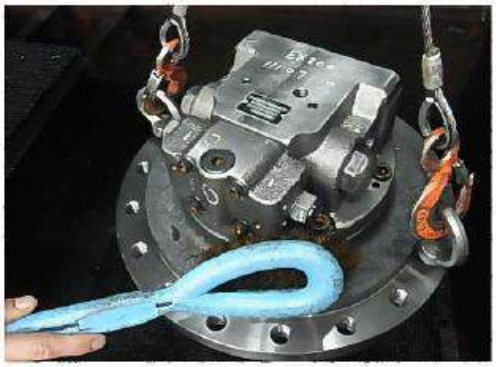
**1). Washing the travel motor;**

a. Fasten two eyebolts to the Spindle [2].

**NOTE : Two eyebolts are positioned symmetrically to the spindle.**

b. Hook the wire to the eyebolts, hoist the travel motor with a crane and carry to the washing tank.

c. Wash each part of travel motor.



**NOTE : Be sure the outside of the travel motor is thoroughly clean and free of dirt prior to disassembly.**

**2). Travel motor installation;**

a. Use a crane, carry the travel motor to the workbench.

b. Fasten the travel motor to the workbench.

**⚠ CAUTION**

**Tighten the bolts securely, may result in falling when it's inverted.**

**3). Remove the Rear flange;**

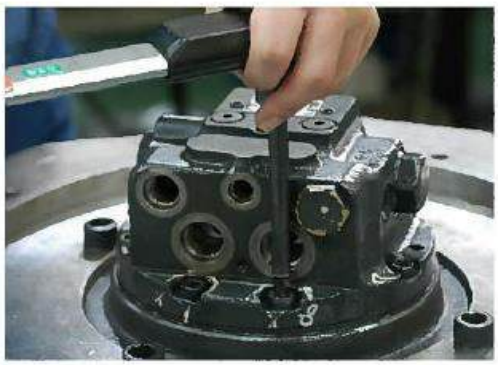
a. Temporarily loosen the Plugs [324], [326] to make the work easier later.

b. Loosen the Hex. socket head bolts [370] and remove the Body [212] from the Rear flange [301].

c. Remove the two O-rings [338] from the Rear flange [301].

d. Remove the nine Hex. socket head bolts [343].

**NOTE : Be sure loosen the last three bolts slowly and equally to avoid jamming by the Spring [113].**



e. Remove the Rear flange [301] from the Spindle [2].

f. Remove the Springs [113].

g. Remove the Parallel pins [42] and O-rings [27], [29] from the Spindle [2].

**NOTE : Do not reuse the disassembled O-rings.**

**4). Disassembly of the Rear flange inner parts;**

a. Place the Rear flange kit on the workbench. Bring the mating surface with the Spindle [2] to top.

b. Remove the Timing plate [109] and Pins [341] from the Rear flange [301].

c. Remove the Roller bearing [150] from the Rear flange [301].

**d.** Loosen the Plug[324] and remove the Spring [328] and Stopper [325].

e. Repeat the procedure on the opposite side.

f. Remove the O-rings [336] from the Plugs [324].

**NOTE : Do not reuse the disassembled O-rings.**

g. Using a finger, push the Spool [323] out from the Rear flange [301].

h. Loosen the Plug [326] and remove the Spring [330] and Valve [327].

i. Repeat the procedure on the opposite side.

j. Remove the O-ring [337] from the Plug [326].

**NOTE : Do not reuse the disassembled O-rings.**

**5). Disassembly SRV2;**

a. Loosen the Plug [214] and remove the Piston [213] from the Body [212].

b. Remove the O-ring [219] from the Plug [214].

**NOTE : Do not reuse the disassembled O-ring.**

c. Loosen the Plugs [215] and remove the Steel balls [216].

d. Remove the O-rings [220] from the Plugs [215].

**NOTE : Do not reuse the disassembled O-ring.**

e. Loosen the Sleeve [202] and take out from the Body [212].

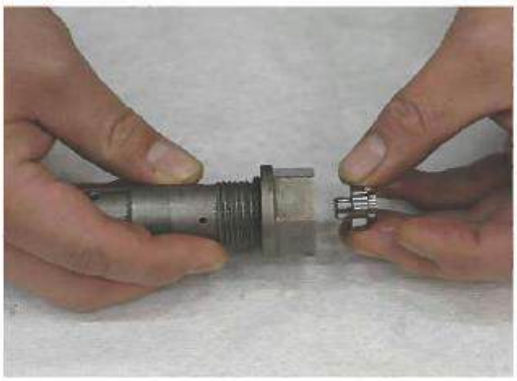
f. Remove the O-ring [208] and Back-up rings [211] from the Sleeve [202].

g. Remove the O-ring [209] and Back-up rings [217] from the Body [212].

**NOTE : Do not reuse the disassembled O-rings and Back-up rings.**

h. Loosen the Plug [204] and remove the Shim [205] and O-ring [210] from the Plug [204].

**NOTE : Do not reuse the disassembled O-ring.**



i. Remove the Spring retainer [203], Spring [206] and Valve [201] from the Sleeve [202].

j. Repeat the procedure on the opposite side.

**6). Disassembly of parking brake;**

a. Remove the piston [112] by injecting compressed air into the access hole in the Spindle [2].

**⚠ CAUTION**

**The abrupt injection compressed air could cause the piston to pop out.**
**To ensure your safety, hold a protective cover over the piston.**
**The injecting compressed air should be 0.02-0.05 [MPa] (2-5 [kgf/cm$^2$]).**

b. Remove the O-rings [135], [139] from the Piston [112].

**NOTE : Do not reuse the disassembled O-rings.**

**7). Disassembly of hydraulic motor parts;**

a. Remove the Cylinder block [104] from the Shaft [102]. At the same time the Mating plate [116], Friction plate [115] and the Mating plate [169] will come out with the Cylinder block [104].

b. Remove the Piston assembly [105], [106] and Retainer plate [107] from the Cylinder block [104].

c. Remove the Piston assembly [105], [106] from the Retainer plate [107].

d. Remove the Thrust ball [108], Washer [111] and Needle rollers [151] from the Cylinder block [104].

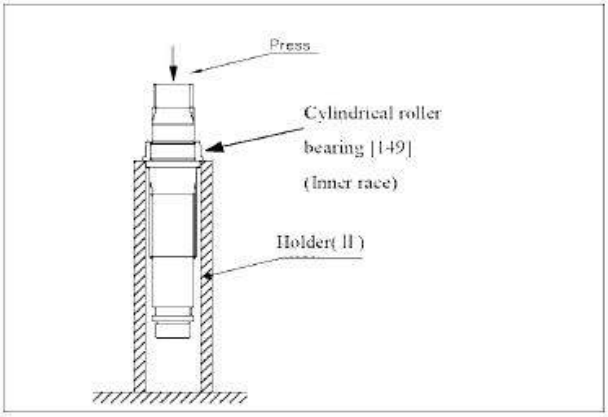
e. Remove the Swash plate [103] from the Spindle [2].

f. Remove the Pivots [167] and Parallel pins [171] from the Spindle [2].

g. Remove the Shaft [102] from the Spindle [2]. The inner ring of the Roller bearing [149] comes out with the Shaft [102].

**NOTE : Before removal of the Shaft, drain the lubrication oil of the reduction gear in advance.**

h. Remove the Roller bearing [149] and Oil seal [132] from the Spindle [2].

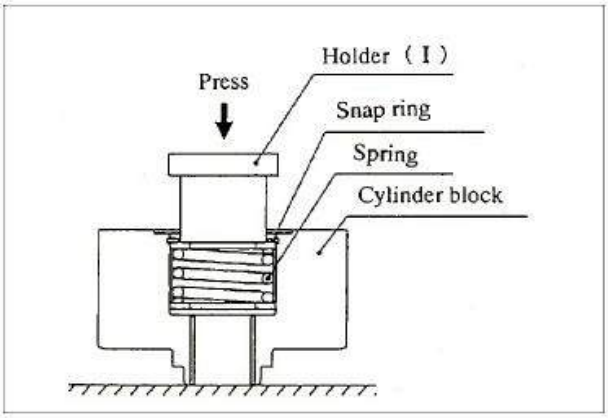



**8). Removal of inner ring of the Roller bearing [149];**

a. Place the Holder [ II ] on the press bench then insert the Shaft [102] into the Holder [ II ].

b. Press the tip of the Shaft [102].

**NOTE : Do not reuse the disassembled Roller bearing [149].**




**9). Removal of the Spring [114];**

a. Place the Cylinder block [104] on the press bench.

b. Place the Holder [ I ] on the Washer [110] and press the Holder [ I ] until the Washer's surface is free from the Snap ring [145].

c. Remove the Snap ring [145] from the Cylinder block [104].

d. Release the press slowly and remove the Spring [114] and Washer [110] from the Cylinder block [104].

**⚠ CAUTION**

**If the press released suddenly, the Spring pop out, may result injury.**
**Release the press slowly and carefully.**

# 3. Maintenance standard

**3-1. Summary:**

The EM motor should be disassembled and inspected for the purpose of maintenance in accordance with the standard given below. Note that each parts should be handled carefully not to scratch the sliding and moving surface in particular.

**3-2. Seals:**

The removed seals (O-ring, Oil seal) should be replaced with a new ones even if they are free from damage.

**3-3. Table of maintenance standard:**

1). The parts which is remarkably damaged in appearance should be replaced with a new ones.

2). Replace each parts with a new ones if it shows the following abnormality (phenomenon).

| Parts No. | Parts Name | Phenomenon | Basic Size (Standard Size) | Wear Limit (judgment) |
|---|---|---|---|---|
| 301 | Rear flange | ・Scratch mark on the sliding surface with the Spool [323].<br>・Increase the clearance of the bore between the Spool [323].<br>・Scratch mark on the seat surface with the Valve [327]. | Diametral clearance 10-20 $\mu$ | Diametral clearance 25 $\mu$ |
| 323 | Spool | ・Scratch mark on the sliding surface with the Rear flange [301].<br>・Abnormal wear on the sliding surface with the Rear flange [301]. | | |
| 327 | Valve | ・Scratch mark on the seat surface with the Rear flange [301]. | | |
| 102 | Shaft | ・Abnormal wear on the sliding surface with the Oil seal [132].<br>・Abnormal wear on the spline tooth. | | |
| 103 | Swash plate | ・Abnormal wear or scratch mark on the sliding surface with the Shoe [106].<br>・Abnormal wear or scratch mark of the contact surface with the Pivot [167] and the Spindle [2]. | | |
| 104 | Cylinder block | ・Remarkable wear of the bore for the Piston [105].<br>・Scratch mark or partial wear on the sliding surface with the Timing plate [109].<br>・Abnormal wear on the spline tooth. | Diametral clearance 25-40 $\mu$ | Diametral clearance 50 $\mu$ |

| Parts No. | Parts Name | Phenomenon | Basic Size (Standard Size) | Wear Limit (judgment) |
|---|---|---|---|---|
| 105<br>106 | Piston assembly (piston & shoe) | ・Increase the axial clearance between Piston [105] and Shoe [106].<br>・Abnormal wear on the sliding surface with the Cylinder block [104].<br>・Abnormal wear on the sliding surface with the Swash plate [103]. | Axial clearance 0.05 [mm] | Axial clearance 0.15 [mm] |
| 107 | Retainer plate | ・Abnormal wear on the contact surface with the Shoe [106].<br>・Abnormal wear on the sliding surface with the Thrust ball [108]. | | |
| 108 | Thrust ball | ・Abnormal wear on the sliding surface with the Retainer plate [107].<br>・Abnormal wear on the spline surface. | | |
| 109 | Timing plate | ・Abnormal wear and scratch mark on the sliding surface with the Cylinder block [104]. | | |
| 115<br>116 | Friction plate<br>Mating plate | ・Abnormal wear on the contact surface. | Braking torque 255 [N-m] (26 [kg-m]) or more | Braking torque 255 [N-m] (26 [kg-m]) or more |
| 149<br>150 | Roller bearing | ・Flaking on the inner ring, outer ring and roller. | | |
| 201 | Valve | ・Abnormal wear or scratch mark on the sliding surface with the Sleeve [202].<br>・Abnormal wear on the seat surface with the Sleeve [202]. | | |
| 202 | Sleeve | ・Abnormal wear or scratch mark on the sliding surface with the Valve [201].<br>・Abnormal wear on the seat surface with the Valve [201]. | | |
| 212 | Body | ・Abnormal wear on the seat surface with the Steel ball [216].<br>・Abnormal wear and scratch mark on the sliding surface with the Piston [213]. | | |
| 213 | Piston | ・Abnormal wear and scratch mark on the sliding surface with the Body [212]. | | |

# 4. Assembly

## 4-1. Preparation:

1). Workbench preparations;

- Prepare a motor workbench.
- Provide a sturdy workbench with which the internal parts of the travel motor can be assembled, and which is wide enough to place parts so they do not move or fall of the bench while working.
- Spread a rubber or vinyl sheet on the workbench.

2). Tools and materials preparations;

- Prepare the tools and materials listed in this manual.

## 4-2. General cautions:

**⚠ CAUTION**

**· Internal parts may be coated with hydraulic fluid during assembly and are slippery. If a parts slips out of your hand and falls, it may result injury or damage the parts. Be very careful when handling these parts.**

**· Combustibles such as kerosene are used for washing parts. These combustibles are easily ignited, and may result in fire of injury. Be very careful when handling these combustibles.**

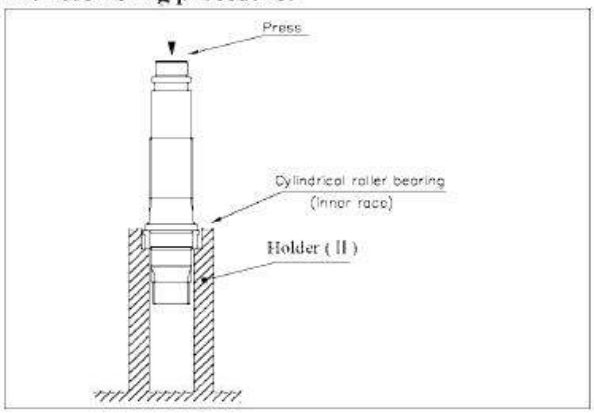
1). Before proceeding assembly, confirm the check items or in the event of abnormality, judges its nature, etc. and carefully consider the assembly sequence.

2). Assembly should be carried out in a clean location according to the assembling procedure below.

3). Arrange the detached parts to prevent them from being damage or lost.

4). The disassembled seal must be replace with new ones as a rule even if they are free from damage. For assembly, therefore, prepare new seals in advance.

**4-3. Assembling procedure:**




**1). Inner ring (for Roller bearing [149]) press fitting;**

a. Place the inner ring into the heater.

b. Heat the inner ring.

**NOTE : Heating temperature should be 100±10℃. To ensure your safety, use leather grooves.**

c. Press fit the inner ring onto the Shaft [102].

**2). Assembly of the Spring [114];**

a. Place the Cylinder block [104] on the press bench and insert the Washer [110], Spring [114], Washer [110] and Snap ring [145] in that order.

b. Place the Holder [ I ] on the Washer [110].

c. Press the Holder [ I ] and fit the Snap ring [145] in its groove.

**⚠ CAUTION**

**The Snap ring [145] pop out when release the press if the Snap ring [145] is fitted incomplete in its grove, may result injury.**
**Make sure that the Snap ring [145] fitted in its groove completely and release the press slowly.**

**3). Assembly of the Rear flange;**

a. Fit the O-ring [337] to the Plug [326] and apply hydraulic oil to the O-ring [337].

b. Insert the Valve [327] and Spring [330] into the Rear flange [301].

c. Temporarily fasten the Plug [326].

d. Repeat the procedure on the opposite side.

e. Apply hydraulic fluid to the Spool [323] and insert to the Rear flange [301].

f. Fit the O-ring [336] to the Plug [324] and apply hydraulic fluid to the O-ring [336].

g. Install the Spring [328] and Stopper [325] to the Plug [324].

h. Temporarily tighten the Plug [324].

i. Repeat the procedure on the opposite side.

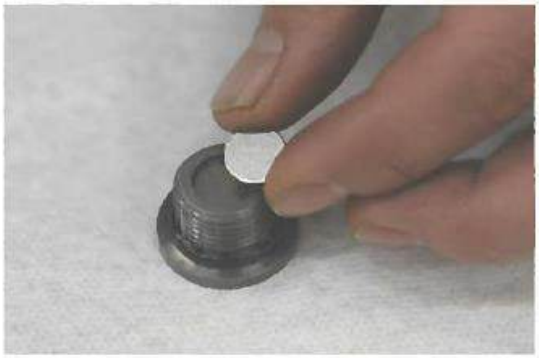
j. Fit the Roller bearing [150] to the Rear flange [301].

k. Insert the Pins [341] to the Rear flange [301].

l. Apply grease to the mating surface with the Rear flange [301] of the Timing plate [109].

**NOTE : Grease is applied to prevent the fall of the Timing plate [109].**

m. Fit the Timing plate [109] to the Rear flange [301].



**4). SRV2 assembly;**

a. Apply hydraulic fluid to the O-rings [209], [210] then fit the O-ring [209], [210] to the Sleeve [202] / Plug [204].

b. Apply hydraulic fluid to the O-rings [208] and [209] then fit the O-ring [208], [209] to the Body [212] / Sleeve [202].

c. Fit the Back-up rings [211], [217] to the Sleeve [202] and Body [212].

d. Apply hydraulic fluid to the Shim [205] and fit to the Plug [204].

**NOTE : When installing the Shim [205], the Shim [205] may fall. Hydraulic fluid applied to prevent the fall of the Shim [205]. Relief setting pressure is set according to the Shim [205], so fit the disassembled Shim [205] as is.**

e. Apply hydraulic fluid to the Valve [201] and insert it to the Sleeve [202].

f. Insert the Spring [206] and Spring retainer [203] to the Sleeve [202].

g. Fasten the Plug [204] to the Sleeve [202] with the specified torque.

**NOTE : Tightening torque**

**78.5±19.6 [N-m] (8±2 [kgf-m])**

h. Fasten the Sleeve [202] to the Body [212] with the specified torque.

**NOTE : Tightening torque**

**127±19.6 [N-m] (13±2 [kgf-m])**

i. Repeat the procedure on the opposite side.

j. Apply hydraulic fluid to the O-ring [220] and fit the O-ring [220] to the Plug [215].

k. Install the Steel ball [216] to the Body [212].

l. Fasten the Plug [215] with the specified torque.

**NOTE : Tightening torque**

**29.4 ± 4.9 [N-m] (3 ± 0.5 [kgf-m])**

m. Repeat the procedure on the opposite side.

n. Apply hydraulic fluid to the Piston[213] then insert to the Body [212].

o. Apply hydraulic fluid to the O-ring [219] and fit the O-ring [219] to the Plug [214].

p. Fasten the Plug [214] with the specified torque.

**NOTE : Tightening torque**

**98.1 ± 19.6 [N-m] (10 ± 2 [kgf-m])**

**5). Hydraulic motor assembly;**

a. Apply grease to the lip portion of the Oil seal [132].

b. Using the Holder [Ill] and hammer, fit the Oil seal [132] to the Spindle [2].

c. Fit the Roller bearing [149] to the Spindle [2].

d. Insert the Pins [171], and Pivots [167] in the Spindle [2].

e. Install the Shaft [102] to the Spindle [2].

f. Insert the Roller [151] into the Cylinder block [104] then put the Washer [111] and Thrust ball [108] on it.

g. Install the Piston assembly [105], [106] into the Retainer plate [107].

h. Apply hydraulic fluid into the piston bore of the Cylinder block [104] the fit the Piston assembly [105], [106] and Retainer plate [107] to the Cylinder block [104].

i. Apply grease to mating surface with the Spindle [2] of the Swash plate [103].

**NOTE : Grease is applied to prevent the fall of the Swash plate [103].**

j. Install the Swash plate [103] to the Spindle [2].

k. Install the Cylinder & Piston kit to the Shat [102].

**6). Parking brake assembly;**

a. Fit the O-ring [135]and [139] to the Piston [112] then apply hydraulic fluid on the surtace of the O-ring [135]and[139] surface.

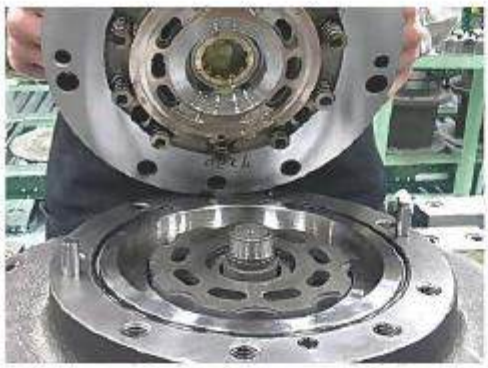
b. Install the Mating plate [169], friction plate [115] and mating plate [116] into the Spindle [2].

c. Install the Piston [112] to the Spindle [2].

d. Press plate( 1 ) to spindle [2] by tightening 2 bolts.
Press it until plrte( 1 ) comes to contact to spindle [2].

**NOTE : 2 bolts shall be tightened evenly. it not, piston [112] is possibly Interfere with spindle [2].**

e. check that piston [112] is inserted and the and sueface is located even or lower than and face to spindle[2].



**7). Rear flange kit attachment;**

a. Fit the O-rings [27], [29] and Parallel pins [42] to the Spindle [2].

b. Apply grease to the Springs [113] and fit the Spring [113] to the Rear flange [301].

**NOTE : Grease is applied in order to hold and suppert Spring [113] while assemblimg.**

c. Mount the rear flange [301] on the Spindle [2].

d. Make sure that rear flange [301] is guided by 2 paralel pins [42]

e. Fasten the first three Hex. socket head bolts [343] slowly and evenly to position the Rear flange [301], tighten all Hex. socket head bolts [343] using the specified torque.

**NOTE : Tightening torque**

**163 ± 24.5 [N-m] (16.6 ± 2.5 [kgf-m])**

e. Fasten the Plugs [324] with the specified torque.

**NOTE : Tightening torque**

**441 ± 39.2 [N-m] (45 ± 4 [kgf-m])**

f. Fasten the Plugs [326] with the specified torque.

**NOTE : Tightening torque**

**177 ± 19.6 [N-m] (18 ± 2 [kgf-m])**

**8). SRV2 mounting;**

a. Fit the O-ring [338] to the Rear flange [301].

b. Install the Body [212] to the Rear flange [301] and tighten the Hex. socket head bolts [370] with the Washer [374] with the specified torque.

**NOTE : Tightening torque**

**29.4 ± 4.9 [N-m] (3 ± 0.5 [kgf-m])**

**9). Remove the reassembled EM motor from workbench;**

a. Remove the bolts securing the EM motor to the workbench.

b. Fasten two eyebolts to spindle[2]

## 5. Performance check

After replacing the EM motor, check the performance in accordance with the following method.

5-1. Test procedure:

1). Mounting and piping:

a. Mount the EM motor to the test device.

b. Connect the piping.

**NOTE : When mounting the EM motor, do not strike with a hammer but rather mount the EM motor using the screw holes.**

**NOTE : The pressure gauges (Main circuit) can be mounted and the drain quantity can be measured when connect the pipe.**

2). Warm up operation:

a. Conditions:

- Motor speed : 500 [rpm]
- Pressure : Non-load
- Rotation of direction : Both (CW & CCW)
- Running time : 1 minute each direction
- Hydraulic fluid : ISO VG46 or equivalent
- Hydraulic fluid temp. : 45-55 [℃] (104-176 [F])

3). Performance check:

a. Conditions:

- Motor speed : 500 [rpm]
- Pressure : Non-load
- Rotation of direction : Both (CW & CCW)
- Running time : 1 minute each direction
- Hydraulic fluid : ISO VG46 or equivalent
- Hydraulic fluid temp. : 45-55 [℃] (104-176 [F])

b. Check items:

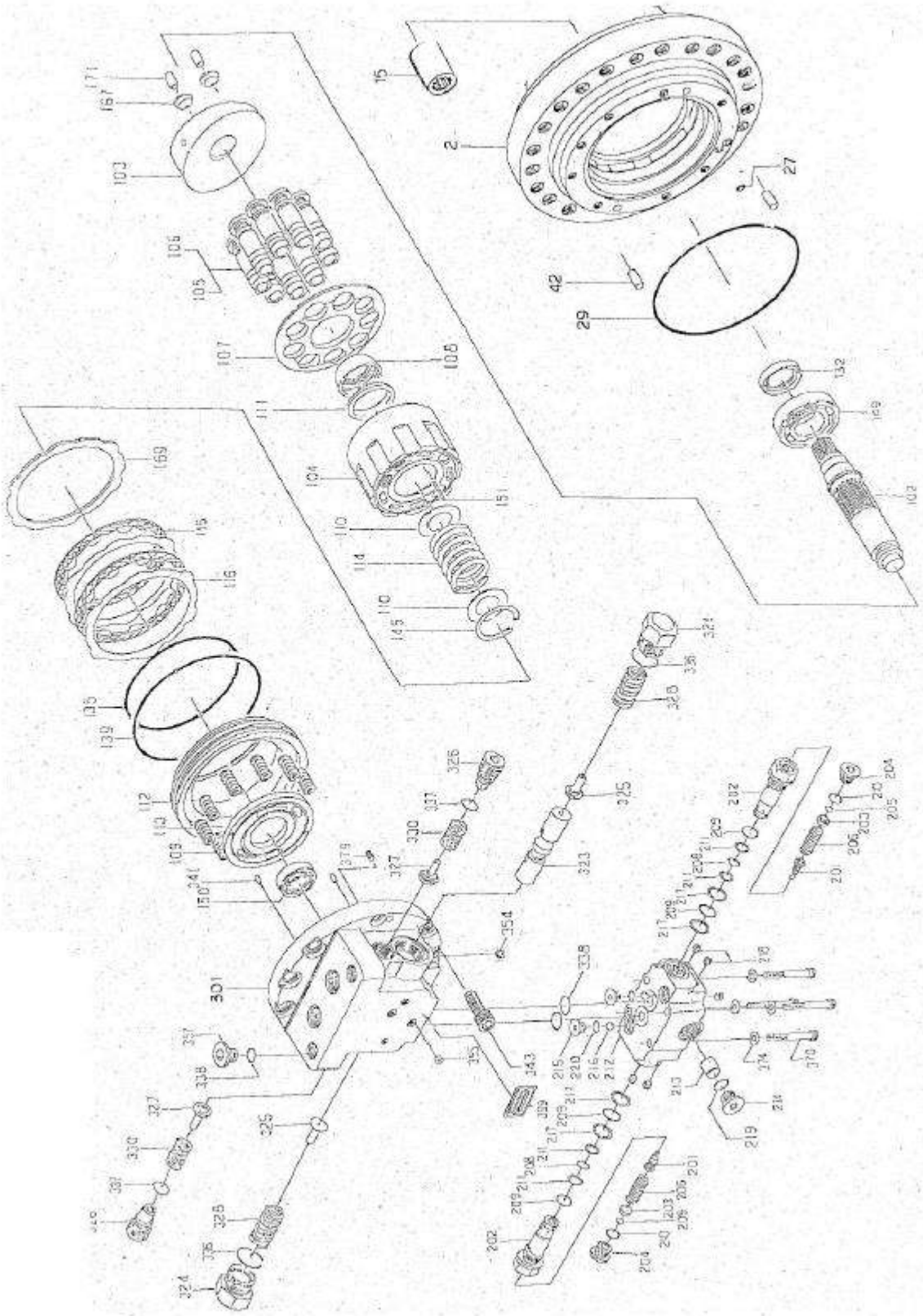
- Operating pressure
- Drain quantity

c. Judgment standard:

- Operating pressure : 1.96 [MPa] (20 [kgf/cm$^2$]) or below
- Drain quantity : 2.0 [l/min.] or below

**NOTE : In case of rejected the above judgment standards, repeat the disassembly and assembly procedure following in this manual.**

## 6. Exploded diagram of Hydraulic motor

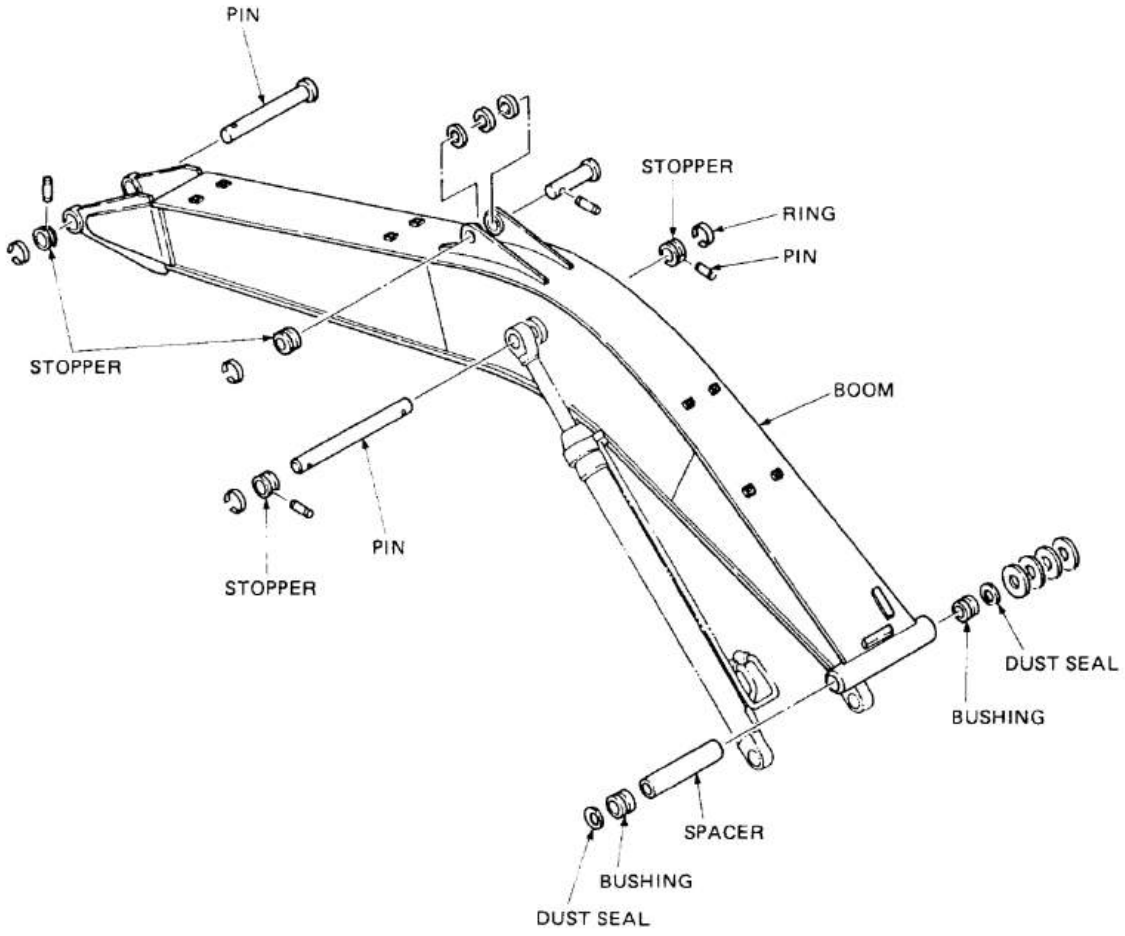


# FRONT ATTACHMENTS

# 1. BOOM ASSEMBLY

## 1.1 CONSTRUCTION

Boom assembly consists of Boom with bushings and pins for Boom cylinders and arm cylinder. The stoppers are wedded on the boom except the boom cylinder rod side.

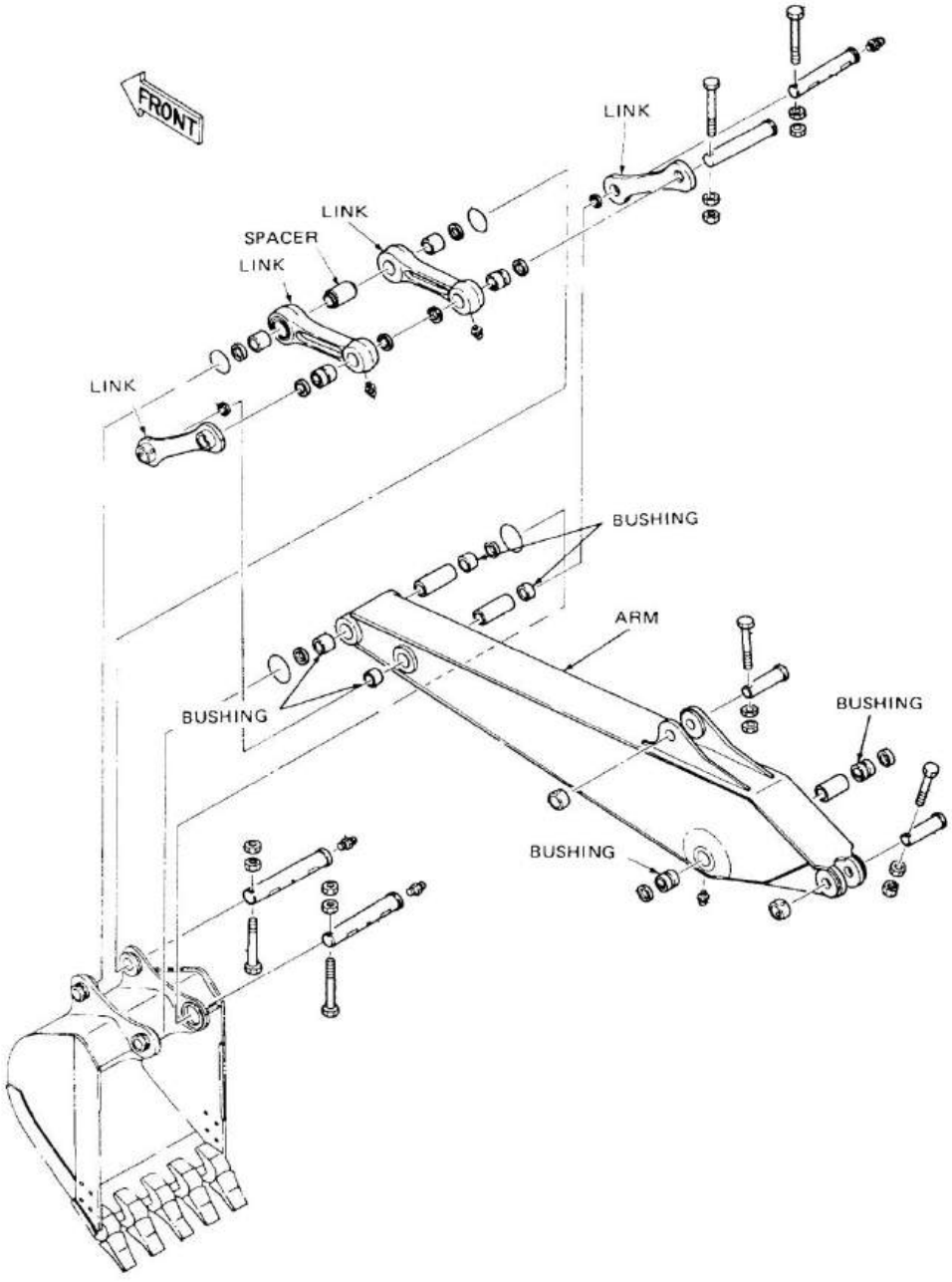


## 2. ARM ASSEMBLY

### 2.1 CONSTRUCTION

Arm assembly consists of arm with bushings, link and pins.

Variety: 2.9 m Standard
2.2 m Short
1.9 m Super short



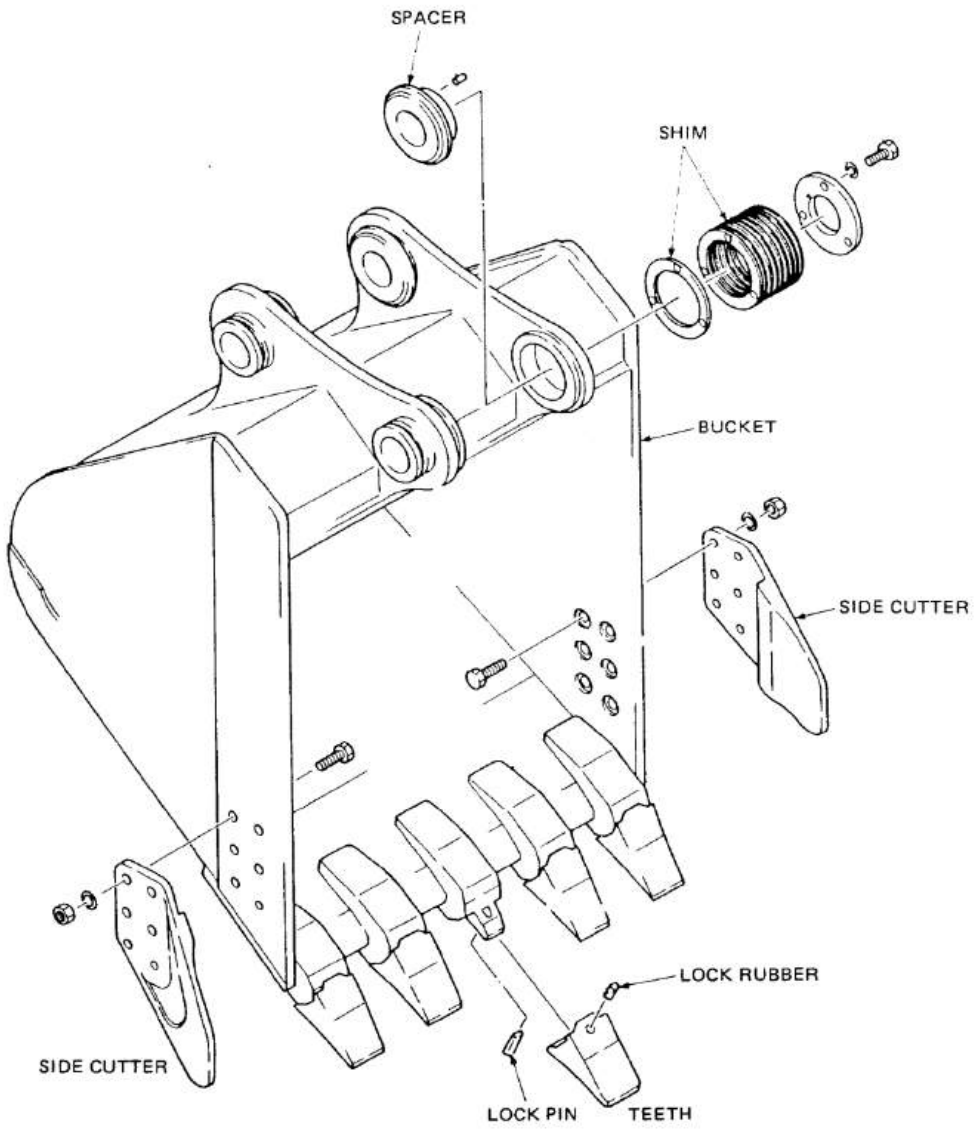
## 3. BUCKET ASSEMBLY

### 3.1 CONSTRUCTION

(1) HOE BUCKET

The hoe bucket is of all-welded, high-strength steel structure and provided teeth and side cutter.

Variety: 0.7 $m^3$, 0.45 $m^3$, 0.8 $m^3$, 0.9 $m^3$, 1.0 $m^3$
1.0 $m^3$ (with out side cutter)

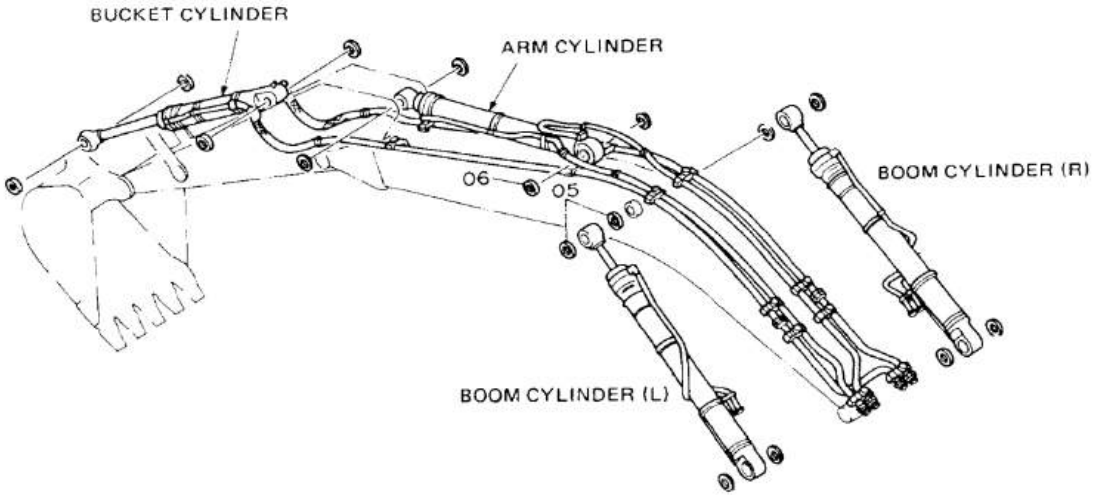


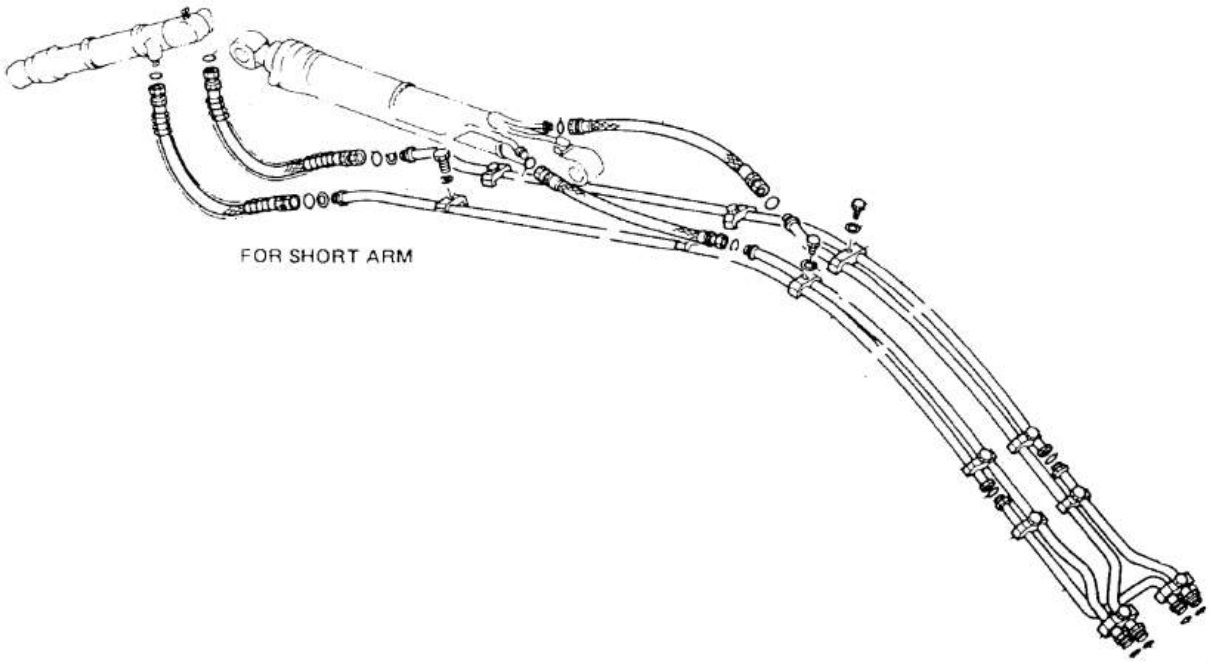
# 4. FRONT PIPINGS

## 4.1 CONSTRUCTION

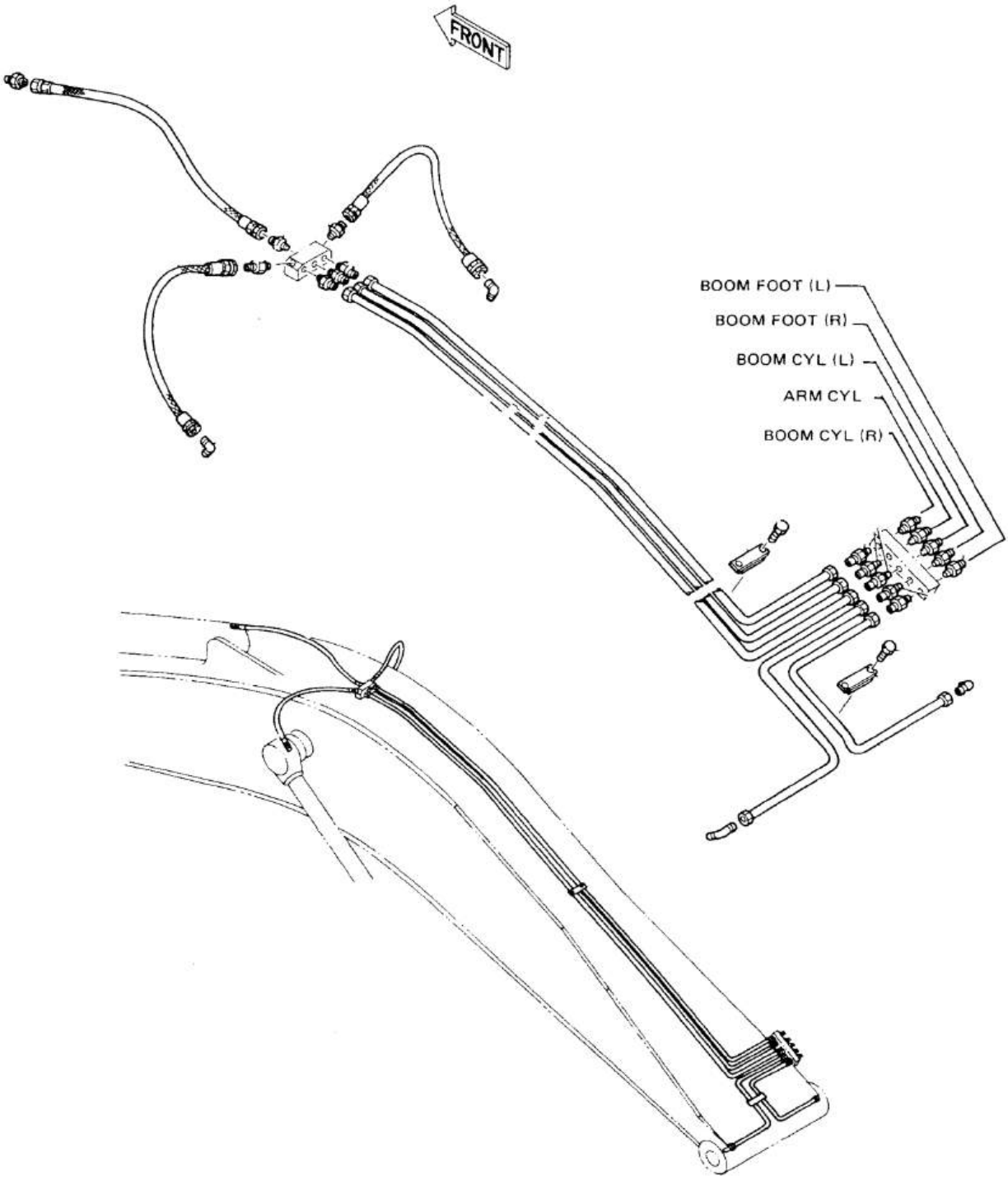
(1) GENERAL

Front pipings consist of boom cylinder pipings, arm cylinder pipings, bucket cylinder pipings and hoses.

(2) LUBRICATE PIPINGS

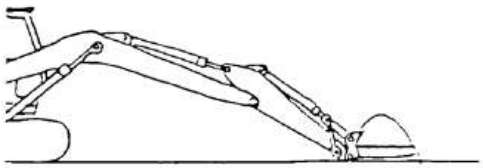


## 4.2 MAINTENANCE STANDARD

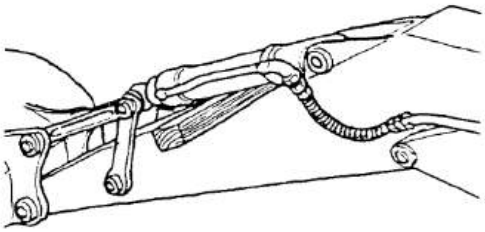
### 4.2.1 REMOVAL & INSTALLATION

(1) REMOVE BUCKET CYLINDER

1 Place the unit on level ground.

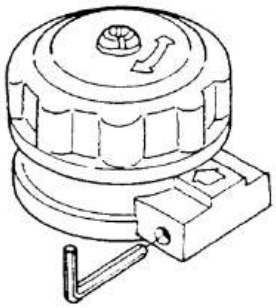


2 Put wooden block under the bucket cylinder.

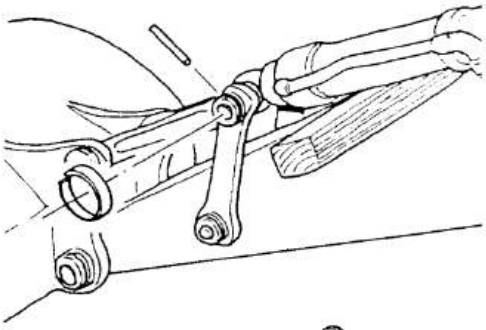


3 Stop the engine, then, loosen the air breather cap to release pressure in hydraulic tank.

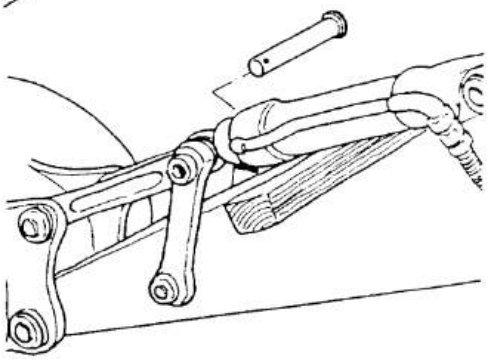
: 4 mm



4 Remove ring and stopper pin.



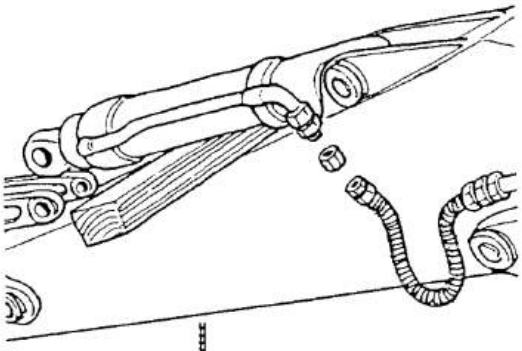
5 Push out pin with bar and hammer.



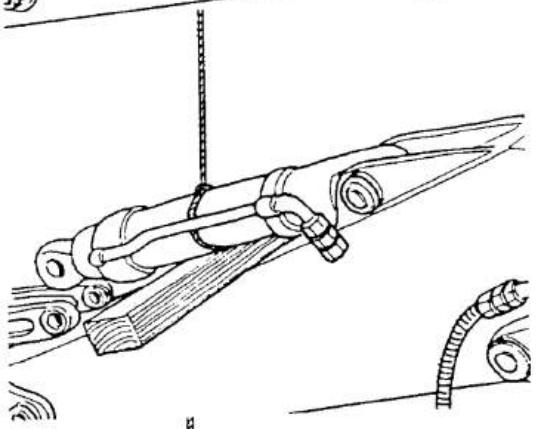
6 Fasten wire to bucket cylinder to hold cylinder rod.

7 Remove bucket cylinder hoses.
Install plugs to the bucket cylinder.

: 36 mm

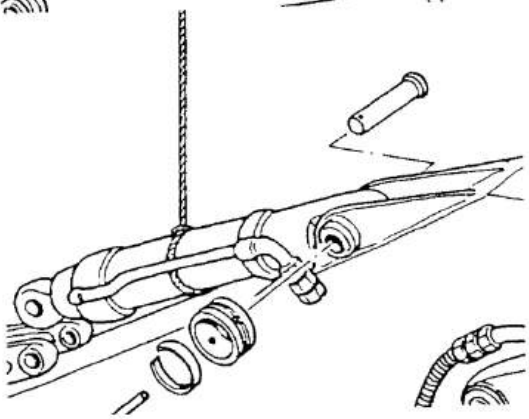


8 Hoist bucket cylinder.
Note: The approximate weight of the bucket cylinder is 153 kg.



9 Remove ring, stopper pin and pin, then, remove bucket cylinder.

: 30 mm

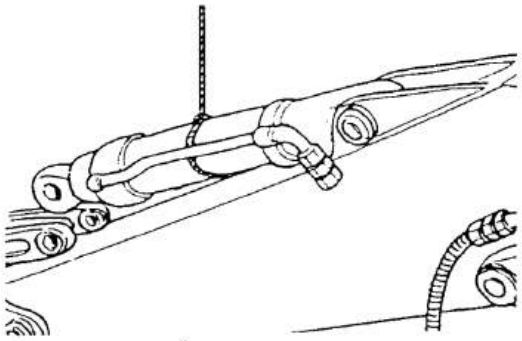


(2) INSTALL BUCKET CYLINDER

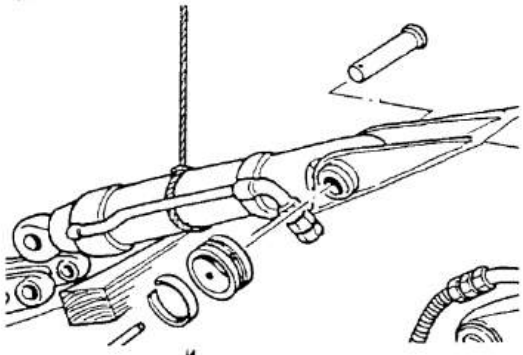
1 Install bucket cylinder to the arm.

Note: The approximate of the bucket cylinder is 153 kg.

Align bucket cylinder with arm.



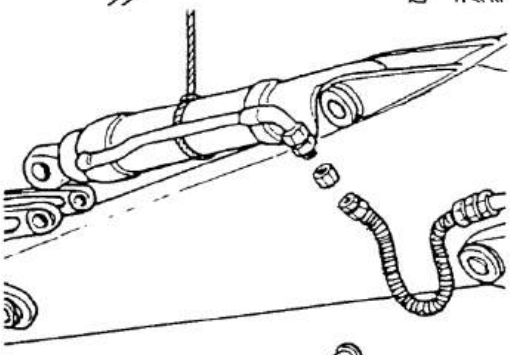
2 Install pin, stopper pin and ring.



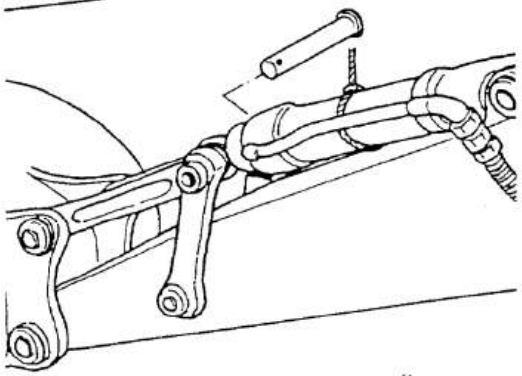
3 Install bucket cylinder hoses to the cylinder.

Tightening torque: 18 kgf.m, 130 ft.lbs

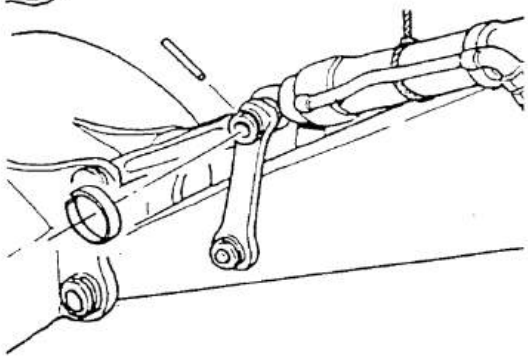
: 36 mm



4 Hoist bucket cylinder, then, align bucket cylinder rod with link.

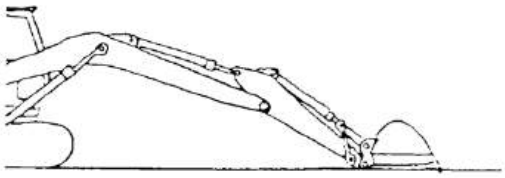


5 Install pin, stopper pin and ring.

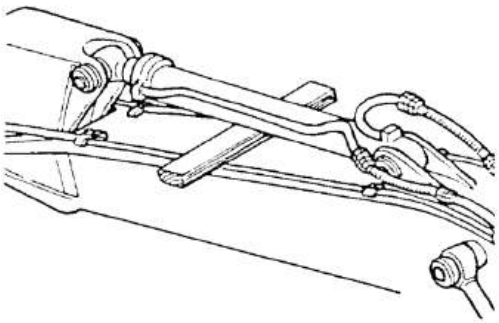


(3) REMOVE ARM CYLINDER

1 Place the unit on level ground.

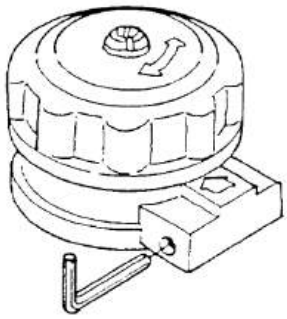


2 Put wooden block under the arm cylinder.

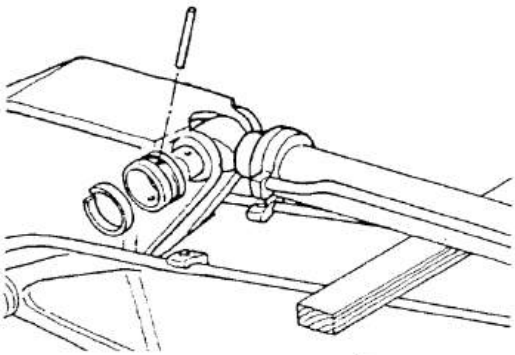


3 Stop the engine, then, loosen the air breather cap to release pressure in hydraulic tank.

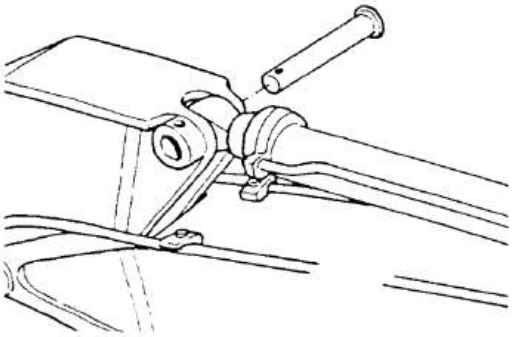
: 4 mm



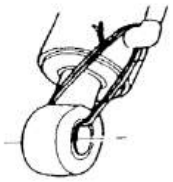
4 Remove ring and stopper pin.



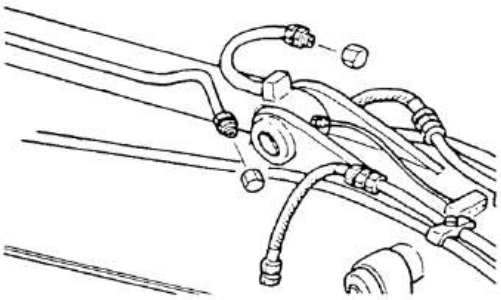
5 Push out pin with bar and hammer.



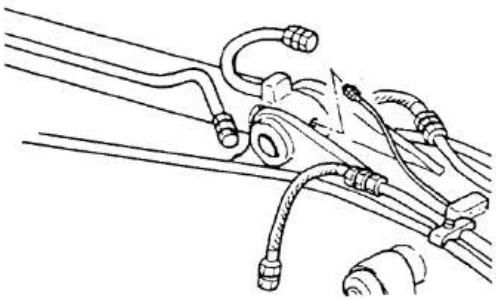
6 Fasten wire to arm cylinder to hold cylinder rod.



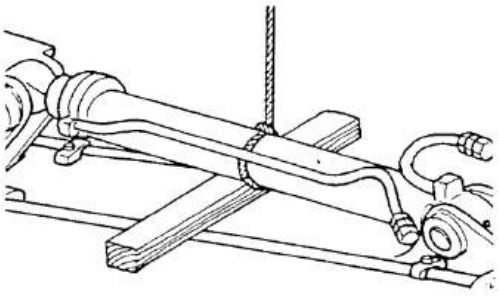
7 Remove arm cylinder hoses.
Install plugs to the arm cylinder.
: 36 mm
: 41 mm



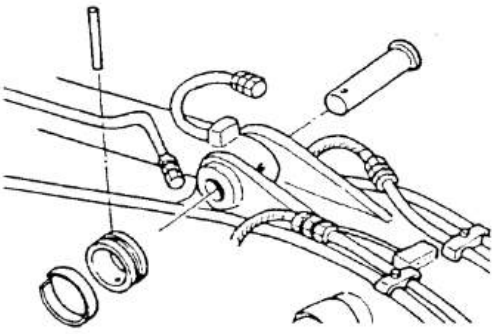
8 Remove lubricate piping from the arm cylinder.
: 19 mm



9 Hoist arm cylinder.
Note: The approximate weight of the arm cylinder is 282 kg.



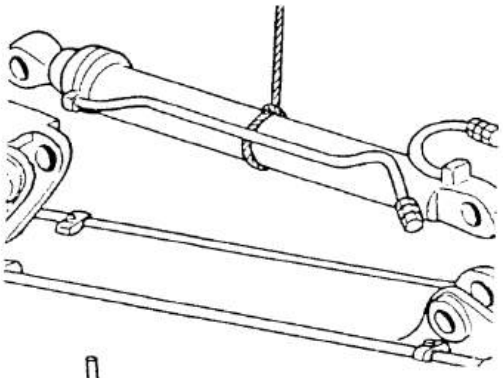
10 Remove ring, stopper pin and pin, then, remove arm cylinder.



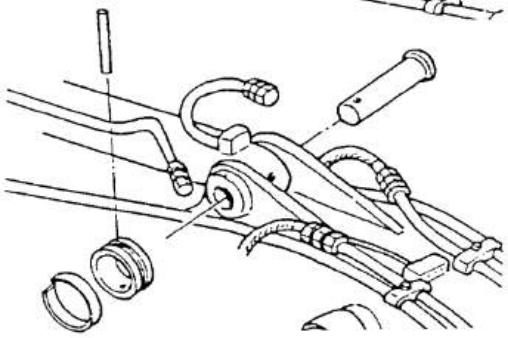
3

(4) INSTALL ARM CYLINDER

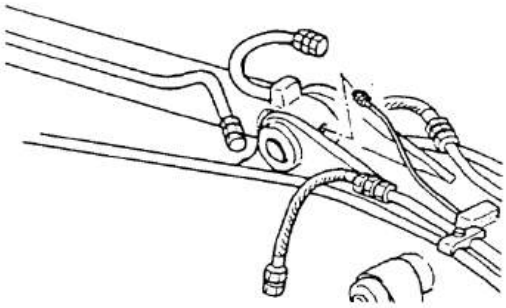
1 Install arm cylinder to the boom.
Note: The approximate of the arm cylinder is 282 kg.



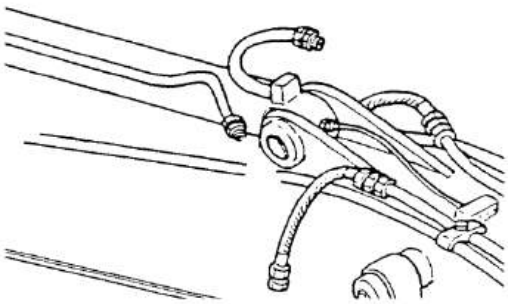
2 Install pin, and stopper pin and ring.



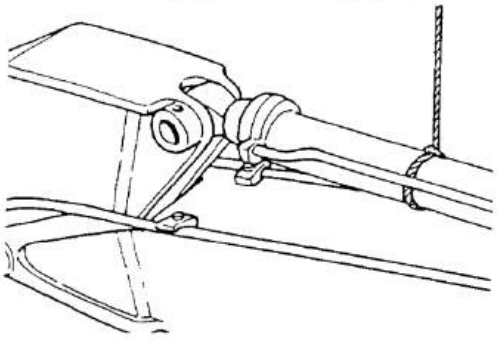
3 Install lubricate piping to the arm cylinder.
Tightening torque: 3 kgf.m, 22 ft.lbs
: 19 mm



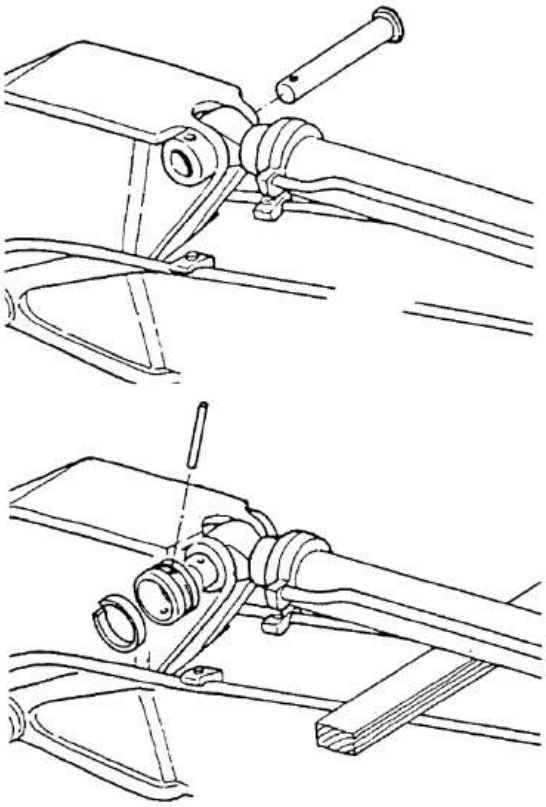
4 Install arm cylinder hoses to the cylinder.
Tightening torque: 21 kgf.m, 152 ft.lbs
: 18 kgf.m, 130 ft.lbs
: 36 mm
: 41 mm



5 Hoist arm cylinder, then, align arm cylinder rod with arm.

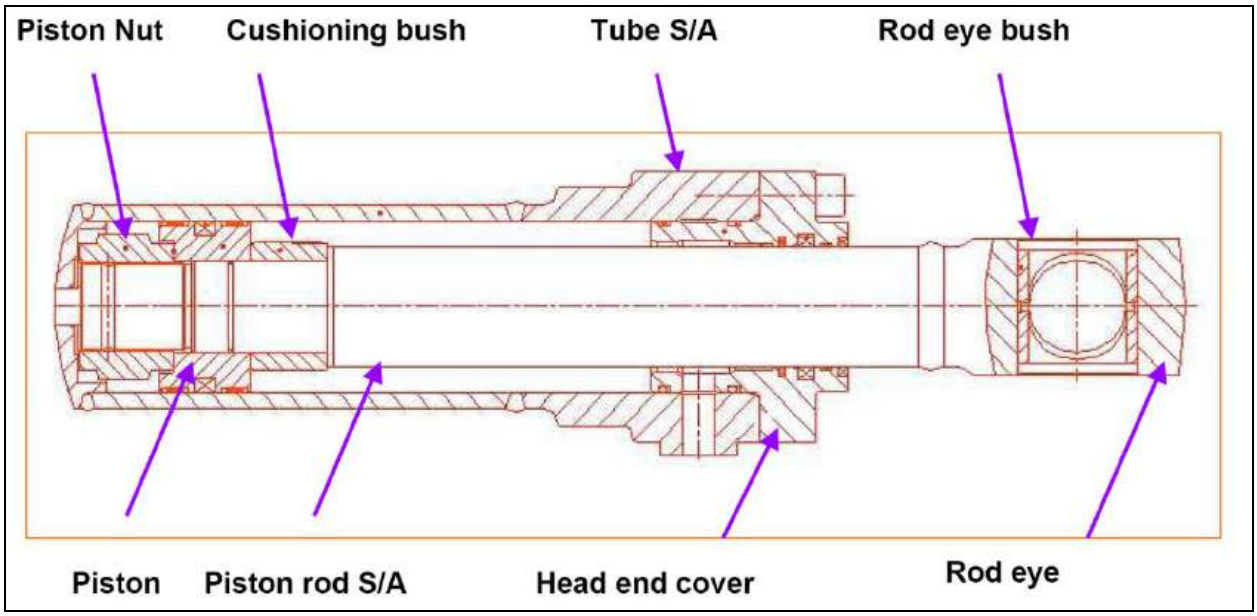


6 Install pin, stopper pin and ring.



## HOW TO DISMENTLE & ASSEMBLE WIPRO CYLINDERS

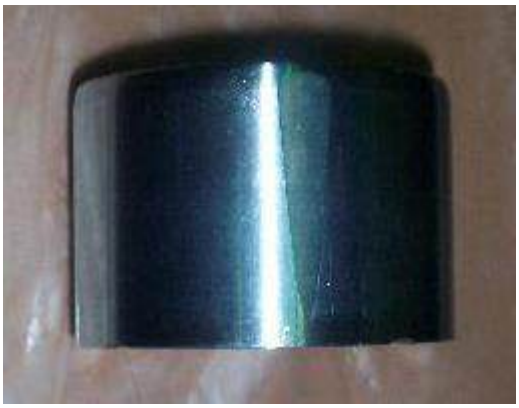
## TERMINOLOGY OF HYDRAULIC CYLINDERS




**TERMINOLOGY OF COMPONENTS IN CYLINDERS**

1. **Head End Cover**

2. **Cushioning Bush**



**3. Piston**

4.Piston Nut

5. Piston Rod(Tube S/A)

**<u>Disassembly of Cylinder from Machine</u>**

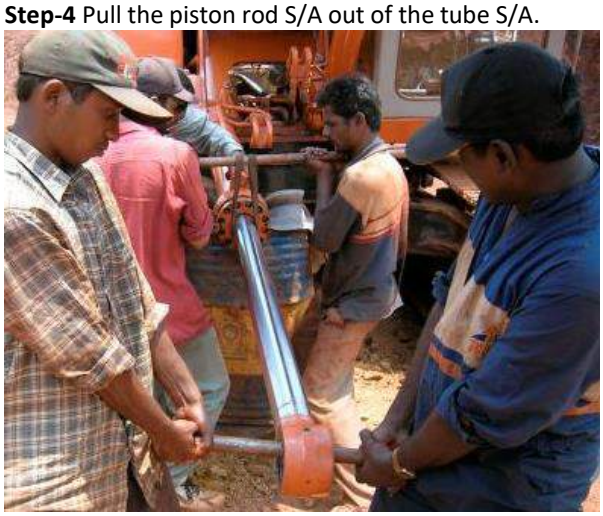
**Step - 1** Tie the boom cylinder with a rope. Ensure the rope is strong and can hold the weight of the cylinder & Remove lock pin & lock of mounting pin

**Step-2** Lower the boom cylinder slowly & Place the cylinder on a drum. Ensure the cylinder is firmly placed

**Disassembly of Cylinder**

**Step -3** Loosen the head end cover bolts. Don't use worn out socket key to open the bolts

**Step-4** Pull the piston rod S/A out of the tube S/A.

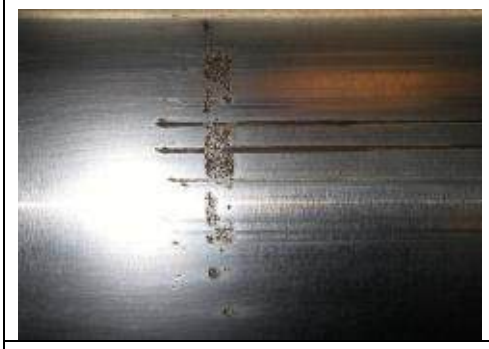
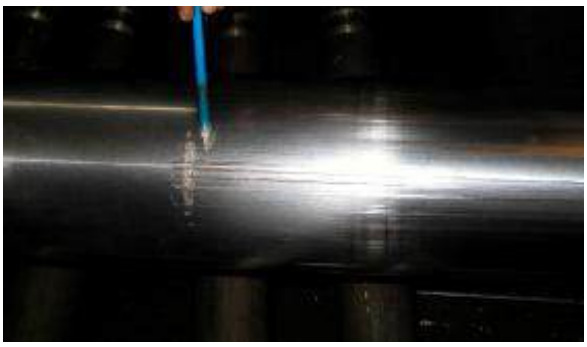


**Step - 5 Clamp the piston rod by using the linkages to ensure the piston rod is held firmly.**

**Step -6 For small size piston insert a pipe into the rod eye.**

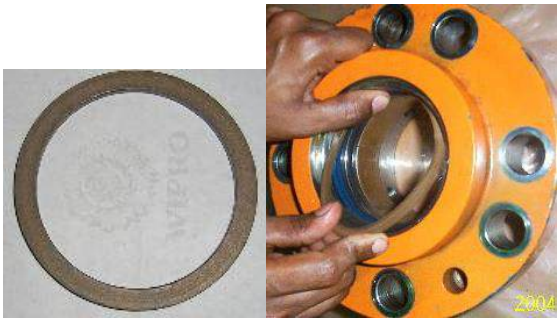
| | |
|---|---|
| **Step - 7 Loosen grub screw**<br>  | **Step- 8** Remove the steel ball<br>  |
| **Step 9** Mark the piston rod & piston nut before opening the piston nut. This will ensure the torque while retightening<br>  | **Step -10** Loosen the piston nut using spanner<br>  |
| **Step-11** Remove piston Nut<br>  | **Step-12** Remove the piston<br>  |

| | |
|---|---|
| **Step-13** Remove O-ring & cushioning bush<br>  | **Step- 14** Remove head end cover<br>  |
| **Step-15 Remove the primary seal from the groove**<br>  | **Step-16 Remove the secondary seal from the groove**<br>  |
| **Step-17 Remove the rod seal from head end cover.**<br>  | **Step-18** Remove Wiper lock & wiper from the grove<br>  |

| | |
|---|---|
| **Step - 19 Remove the Piston seal.**<br>  | **Step-20** Remove O-Ring<br>  |
| **Inspection of components** | |
| External damage<br>  | External damage<br>  |
| Welding Arching<br>  | Seal damages<br>  |

## ASSEMBLY OF SEALS

Before assembly clean all parts & assemble all parts / seals inside dust free atmosphere

| | |
|---|---|
| **Step - 1** Install the secondary seal as shown in figure. The direction of the seal is very important  | **Step - 2** Insert the back ring into the groove. Ensure the back up ring is assembled behind the secondary seal.  |
| Wrong installation of secondary seal as shown in photo  | Right installation of secondary seal as shown in photo  |

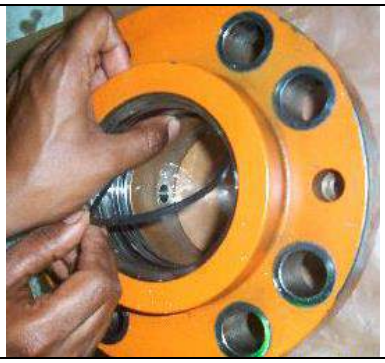
## Assembly of Rod Seals on Head End Cover

**Wrong Installation of Primary seal as shown in Photo.This will lead to rod seal leakage.**

**Right Installation of Primary seal & backup ring as shown in photo**

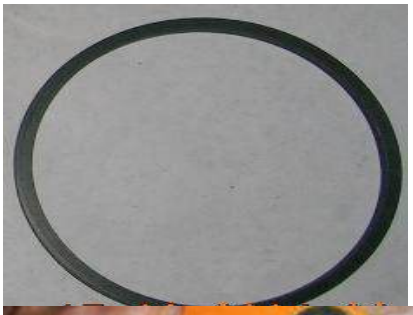
**Step - 3** Install the primary seal, the direction of the seal is very important.

Insert the primary seal in the groove ensure the slot direction



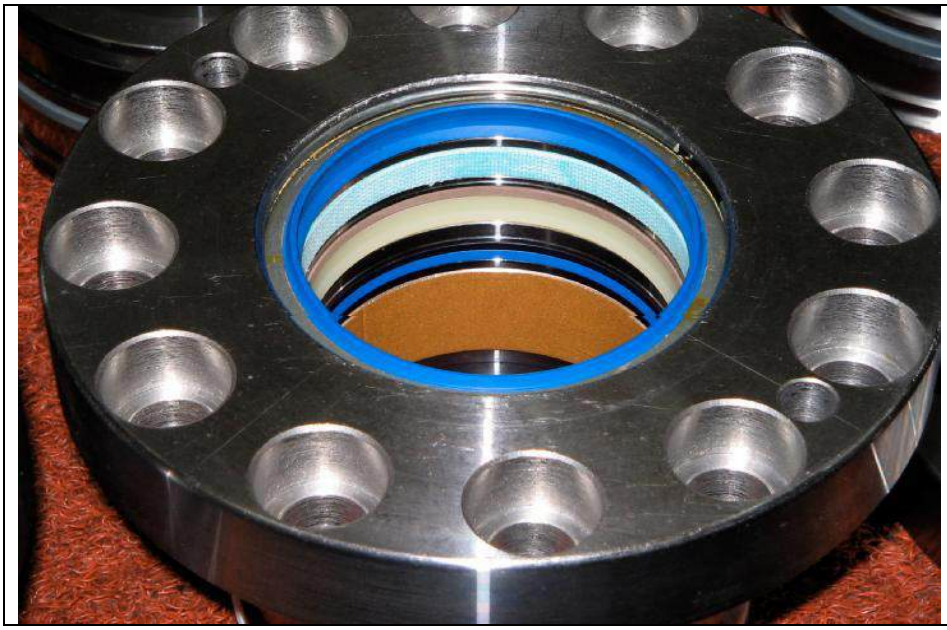
**Assembly of rod seal on EX –Series**

**Step-4 Install the Backup ring ensures the backup ring is assembled behind the seal.**



**Step-7 Install the wiper**

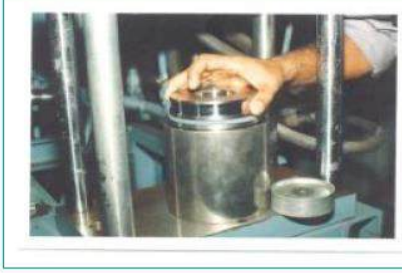
HEC assembled with Seals & BI-Metal Bush



**Assembly of Piston seal on EX-Series**

**This type of seal is used on Bucket & Boom cylinders.**

Insert Piston seal into piston seal groove.

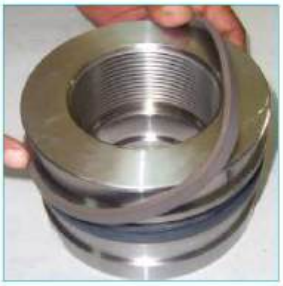


Insert Energizer in to piston seal groove.

Size piston seal.

This type of piston seal is used on mainly Arm cylinders.

Step -1 Insert Energizer in to piston seal groove.



Step -2 Insert Piston seal into piston seal groove.

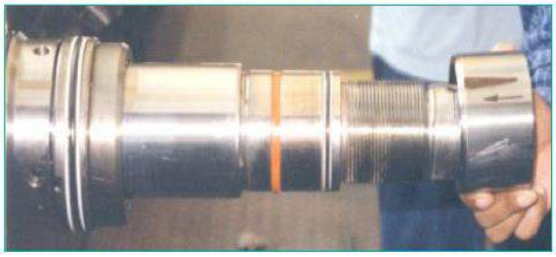
Step -3 Size piston seal.

## Assembly of piston seal

| Insert Back up ring the groove | Complete the assembly of piston seals |
|---|---|
|  |  |

**Assembly of piston rod s/a This process is suitable for EX 70,110,200**

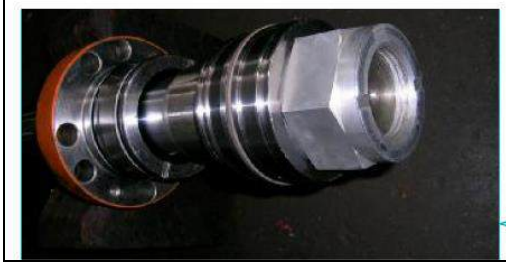
Step - 1 Insert Head end cover .



Step - 2 Insert the Cushioning bush.
Ensure the slot direction

**Assembly of piston rod s/a -This process is suitable for EX 70,110,200**

Step - 3 Assembly piston.



Step - 4 Assembly the Piston Nut.

Step - 5 Insert piston nut & tighten to the required torque.

Step - 6 Insert the ball

Step - 7 Insert Grub Screw & tighten.

Step - 8 Tighten & Caulk the Grub screw after tightening.

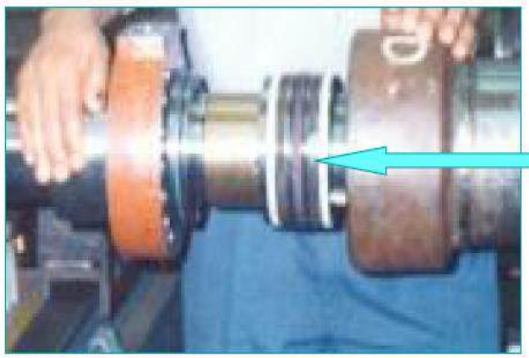
**ASSEMBLY OF CYLINDER**

Step-1 Clamp the tube S/A in the vice. Clean the tube and oil with clean hydraulic oil.

**Step-2 Install piston bearings**

**Step -3 Install the piston rod S/A into the Tube S/A**

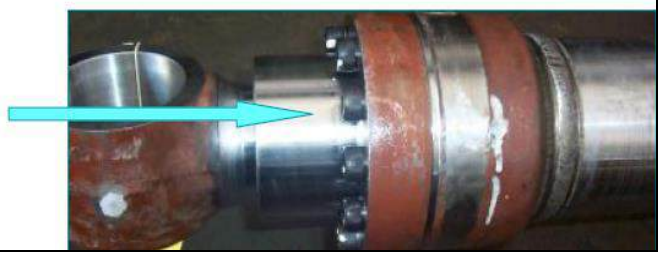
Push the piston rod into the tube S/A keeping the piston rod aligned with the tube S/A.



Apply Clean Hydraulic oil on the HEC O rings.

Gently tap the head end cover into the tube s/A.

Tighten the head end cover bolt using the specified socket head key.
Refer page - 4



**MEMO**

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“We welcome any suggestions from the our valuable readers of this manual for updating its quality & mistakes at the following

Postal address “

To,

The Product Support Manager,

Telcon Service & Spares Support Centre,

Garag Road, Mummigatti.

Dharwad-Pin 580011

Karnataka State