



Service Manual

JS200

from machine no. 705001

JS210

from machine no. 705648

JS220

from machine no. 705001

JS240

from machine no. 708001

JS260

from machine no. 708501

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Torque Specifications JS200/JS240

Component	Nm	kgfm	lb/ft	Remarks
Traction motor Locating Bolts	266.6 - 311.6	27.2 - 31.8	196 - 229.9	Apply 262

Traction Motor

This table refers to the Traction Motor sectional drawing

Component	Nm	kgfm	lb/ft	Part No.	Remarks	Qty
Plug	118 ±5.9	12 ±0.6	86.76 ±4.3	2-14,-17	PF ¹ / ₂	1,1
Orifice	2.45 ±0.49	0.25 ±0.05	1.8 ±0.36	2-22,-23		2,2
Plug	9.8 ±1.0	1.0 ±0.1	7.23 ±0.72	2-8	NPTF ¹ / ₁₆	10
Plug	118 ±5.9	12 ±0.6	86.76 ±4.3	2-17		1
* Cap Assy	373 ±20	38 ±2	274.7 ±14.46	2-6		2
Nut	37.2 ±4.7	4.0 ±0.5	28.92 ±3.6	2-16		1
Socket Head Bolt	108 ±10	11 ±0.1	79.5 ±7.23	2-6.5		4
Plug	137 ±10	14 ±1	101.2 ±7.23	2-2.4		2
Plug	9.8 ±1.0	1.0 ±0.1	7.23 ±0.72	2-8	NPTF ¹ / ₁₆	10
Plug	29.4 ±2.9	3 ±0.3	21.6 ±2.16	2-19	PT ¹ / ₄	5
Plug	39.2 ±4.9	4 ±0.5	28.9 ±3.61	2-24	PT ³ / ₈	1
Orifice	2.45 ±0.49	0.25 ±0.05	18 ±0.36	35	M5	1
Plug	9.8 ±1.0	1.0 ±0.1	7.23 ±0.72	34	NPTF ¹ / ₁₆	5
Plug	7.8 ±1.0	0.8 ±0.1	5.78 ±0.72	28	PT ¹ / ₈	1
Plug	12.3 ±2.5	1.25 ±0.25	9.03 ±1.8	27	PT ¹ / ₄	1
Bolt socket head	191 ±15	19.5 ±1.5	140.9 ±10.8	21		16
Plug	58.8 ±4.9	6 ±0.5	43.38 ±3.6	26	PT ¹ / ₂	3
Bolt socket head	58.8 ±4.9	6 ±0.5	43.38 ±3.6	25		16
Bolt socket head	294 ±19	30 ±2	216.9 ±14.46	16		4
Bolt socket head	417 ±25	42.5 ±2.5	307.27 ±18.07	17		16
Bolt socket head	108 ±10	11 ±1	79.5 ±7.23	20		13
Relief valve	373 ±20	38 ±2	274.74 ±14.46	2-6		2

Gearbox

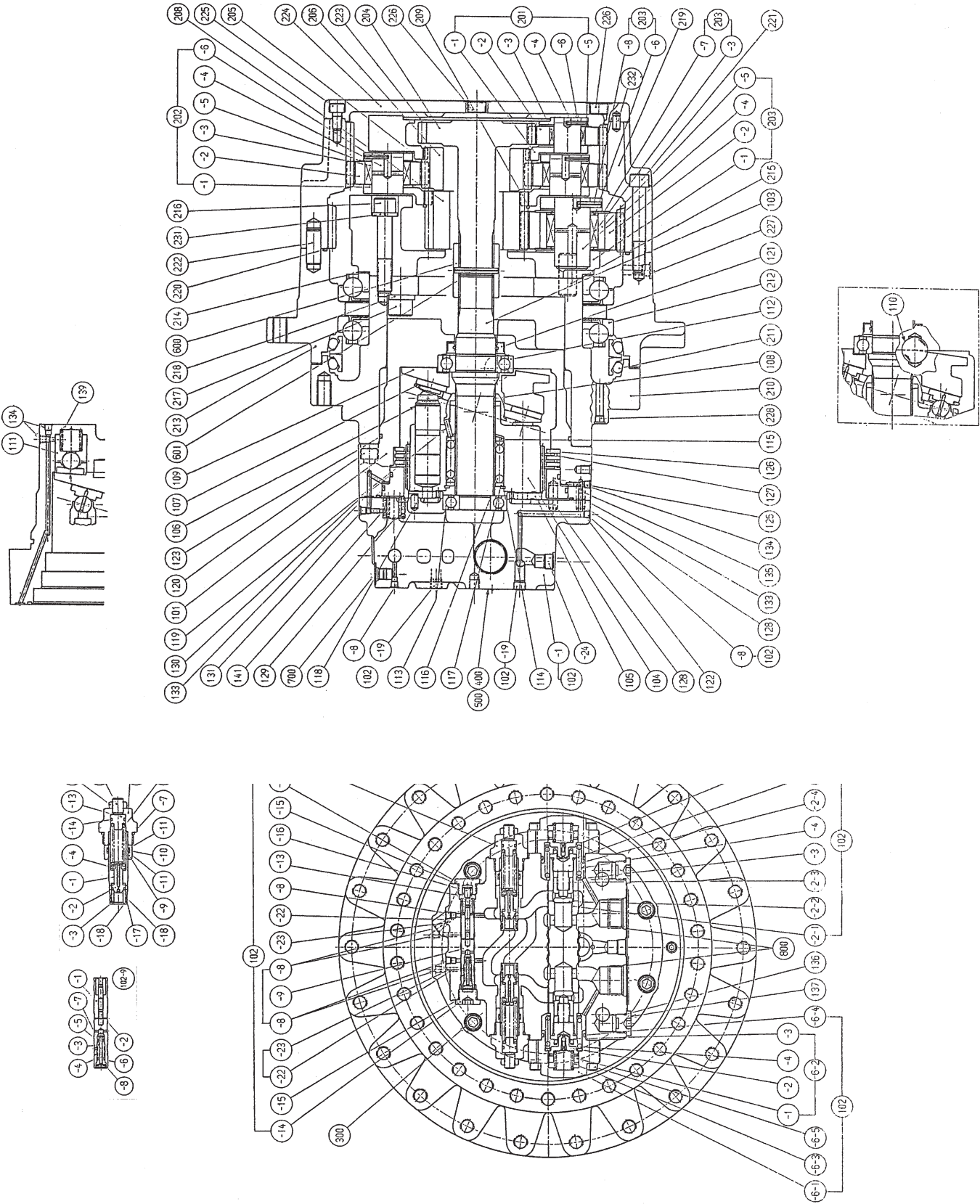
This table refers to the Gearbox sectional drawing

Item	Component	Nm	kgfm	lb/ft	Remarks	Qty
13	Ring Nut				M320 x 2	1
1	Socket head bolt				M10 x 25	10
2	Plug				M22 x 1.5	2
22	Socket head screws				M12 x 90	3

Schematics, specifications

			JS200	JS240
Displacement	Motor * cm ³ /rev	1st	157.8	164.4
		2nd	92.9	98.2
	Reduction gear, etc. value * cm ³ /rev	1st	7004	7297
		2nd	4123	4359
Cross over relief Valve	Cracking pressure MPa (kgf/cm ²)		31.1 {317} at 1.2 l/min	
	Full flow pressure MPa (kgf/cm ²)		35.3 {360} at 40 l/min	
Double counter balance valve	Plunger switch pressure MPa (kgf/cm ²)		0.6~1.3 {6~13}	
	Check valve cracking pressure MPa (kgf/cm ²)		less than 0.03 {0.3}	
2-speed switch valve	Pilot pressure for 2-speed switch MPa (kgf/cm ²)		3.9 {40}	
	1→2 MPa (kgf/cm ²)		23.2 {237}	
	2→1 MPa (kgf/cm ²)		25.3 {259}	
Reduction gear	Structure		Planetary gear 3 step reduction gear	
	Speed		1/44.384	
Parking brake	Parking brake torque KNm {kgf/cm ² }	Motionless	more than 20.94 {2135}	
		Moving	more than 16.67 {1700}	
	Release pressure MPa (kgf/cm ²)		less than 1.4 {14}	
Pressure MPa (kgf/cm ²)			34.3 {350}	
Supply flow L/min	1st speed		198.7	212.2
	2nd speed		198.7	212.2
* Output torque kNm {kgf m}	1st speed		0.862 {87.9}	0.898 {91.6}
	2nd speed		0.507 {51.7}	0.536 {54.7}
Output revolutions rpm	1st speed		1259	1291
	2nd speed		2139	2161
Drain pressure Mpa {kgf/cm ² }	Normal		less than 0.2 {2.0}	
	Maximum instant		less than 0.5 {5.0}	
Oil temperature	°C		-20 ~ +95	
Total dry weight	kg		270	

Schematics, specifications



Operation

Traction Motor Assembly

The traction motor assembly consists of a counter balance valve, cross-over relief valve, 2-speed switch mechanism, swash plate-type axial piston motor with parking brake function and the gearbox.

The piston motor converts the liquid energy of the pressurised oil sent from the hydraulic pump to mechanical energy and transmits high speed low torque power to the reduction gear. The gearbox converts this to low speed high torque power and transmits it to the crawler.

Its characteristics are:-

- a. The parking brake is self-contained and when the motor stops, the mechanical brake works.
- b. The motor is designed to be small, light-weight and compact and is contained within the gearbox.
- c. The counter balance valve and the cross-over valve make-up the braking system.
- d. The counter balance valve controls motor speed in relation to the supply amount and prevents motor runaway.
- e. The cross-over valve alleviates the shock at starting and stopping times and gives good feeling performance.
- f. It is possible to change the motor speed to high and low by the 2-speed switch valve.
- g. It is possible to automatically select the motor speed according to the motor load by the automatic 2-speed function.

When reading the operations section, refer to the schematics, specifications section in conjunction with the accompanying section illustrations.

Operation

Swash Plate Type Axial Piston Motor

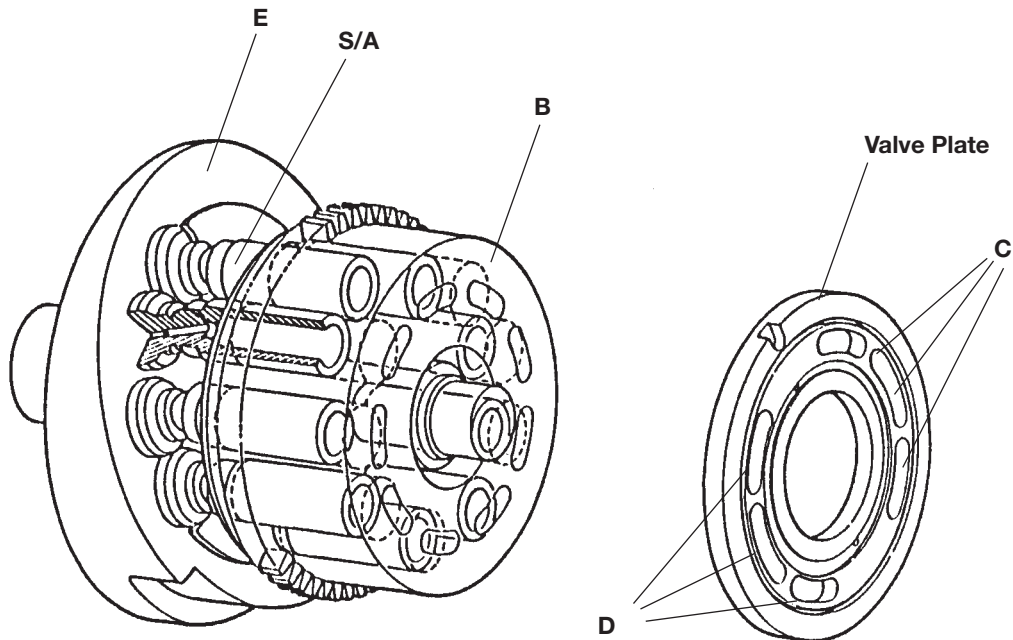


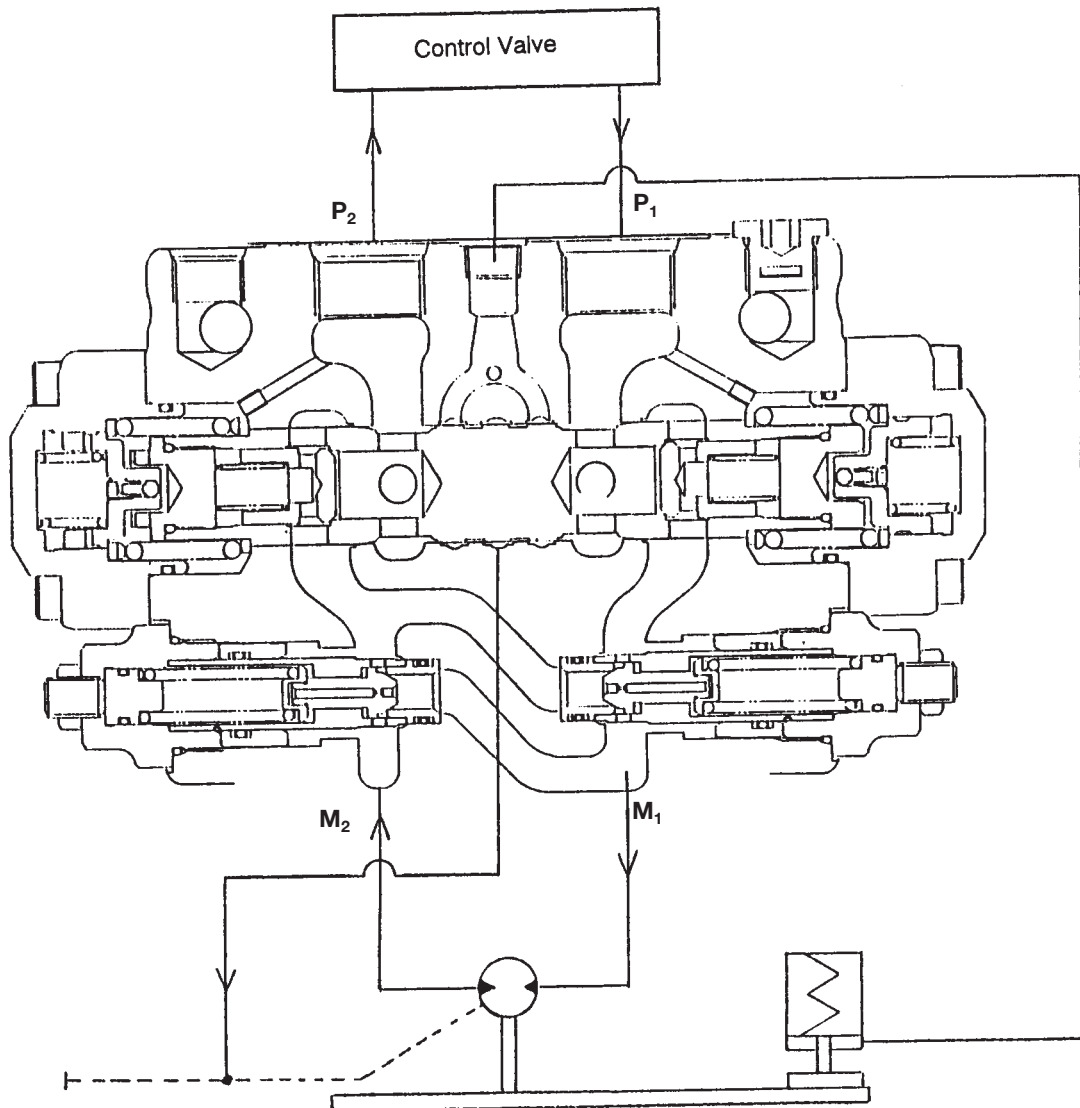
Fig.1 Swash Plate Type Axial Piston Motor

Nine pistons **S/A** are integrated in the Cylinder block **B**. The valve plate which has two sets of half-moon ports **C** and **D** (High/low pressure switching valve) is in contact with the face of the Cylinder block. When high-pressure oil (pressure **P**) is guided to port **C**, the force presses against the swash plate at the rate of force **F = P X A**, (**A**: cross-sectional area of piston) per piston sub-assembly. The corresponding reaction force works on the pistons on the high-pressure side generating rotation of the Cylinder block. Through the spline, torque is transmitted to the shaft and the shaft rotates. The piston motor's output torque and revolution speed are dependent on the pressure (**P**) and flow-in rate (**Q**), calculated as follows:

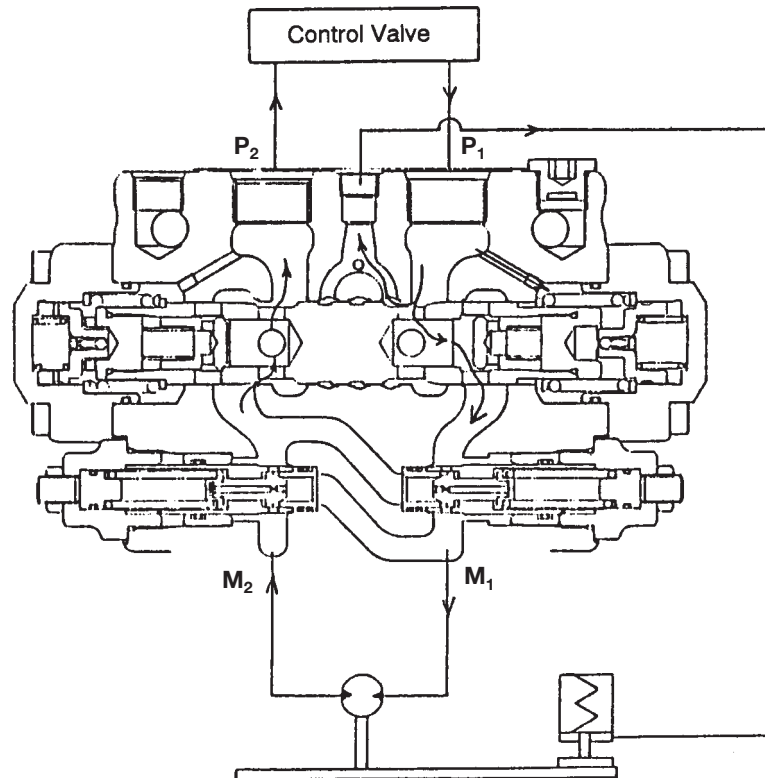
$$T = \frac{P \times D \times \eta_m}{2 \times 5 \times 10^2}$$

$$N = \frac{Q \times 10^3 \times \eta_v}{D}$$

- T: Output torque (Nm)
- N: Revolution speed (rpm)
- P: Effective drive pressure (Pa)
- Q: Flow - in rate (l/min)
- D: Displacement volume (cm³/rev)
- η_m : Machine efficiency
- η_v : Volume efficiency

Operation (continued)**Counterbalance Valve****Fig.2 Counterbalance Valve**

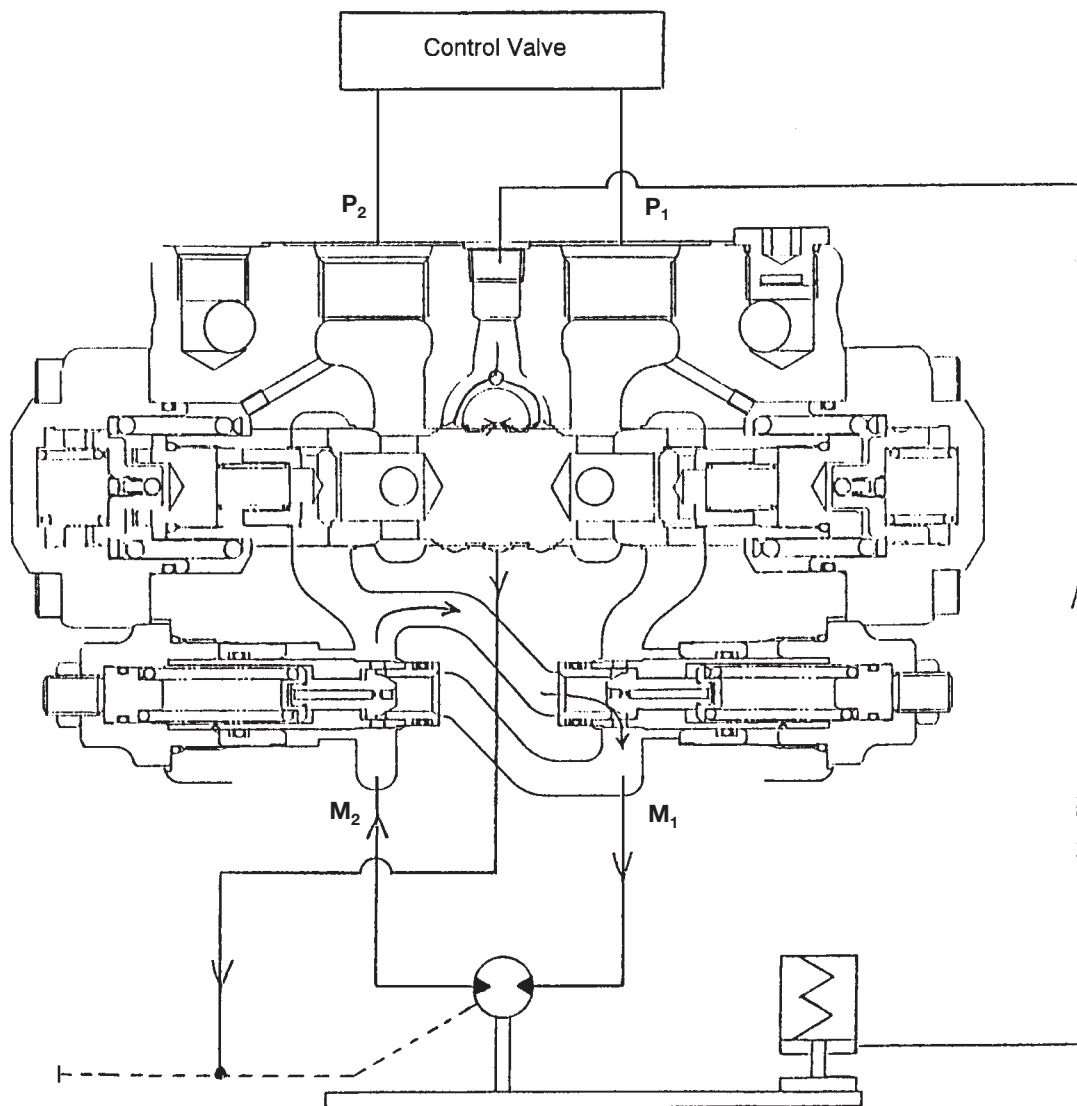
The counterbalance valve serves to prevent the sudden stoppage of the axial piston motor and control its overrun. When in neutral, the control valve's pressure is generated at ports **P1** or **P2** so ports **M1** and **M2** are blocked by the flange and check valve so the motor does not rotate.

Operation (continued)**Counterbalance Valve (continued)****Counterbalance Operation****Fig. 3 Counterbalance Valve (Counterbalance)**

When hydraulic oil delivered from the hydraulic pump is guided to **P1** port of the counterbalance valve through the control valve, the hydraulic oil goes through the check valve and flows into the piston motor from **M1** port and tries to rotate the motor.

On the other hand, the return oil from the piston motor can flow from **M2** port to the counterbalance valve, but is prevented by the check valve, so the pump delivery pressure rises. The boosted hydraulic oil at **P1** port side goes past the orifice and works on the flange face, and resisting the spring on the opposite side with a force proportional to the pressure, it tries to move the plunger to the right side.

When a certain pressure is reached, the plunger moves towards the right and the hydraulic oil of **M2** port passes through the notch of the plunger outer perimeter and generates back pressure at **M2** port while flowing to **Ps** port and returns to the tank through the control valve. When the pump delivery pressure rises, the plunger opening enlarges and the **M2** port back pressure decreases. In this way, the opening of the plunger automatically adjusts the return side passageway area so the piston motor will rotate at a speed suitable to **P1** port side pressure, that is, the **P1** port side flow rate.

Operation (continued)**Counterbalance Valve (continued)****Brake Function****Fig. 4 Counterbalance Valve (Brake)**

When the control valve is returned to neutral, the pressurised oil from the pump is blocked, and pressure at P_1 and P_2 become equal, and the plunger tries to return to neutral position by the spring. When the plunger moves, the plunger opening becomes smaller and because the piston motor continues to rotate due to inertia (motor pumping function), the pressure at M_2 port side rises and braking occurs. At this time, when the M_2 port side pressure reaches the relief valve set pressure, the relief valve works and allows oil to escape to M_1 port side, absorbing shock pressure caused by inertia of M_2 port side while also preventing M_1 port side cavitation.

Operation (continued)

Shuttle Function

The counterbalance valve has a shuttle function. When the plunger moves from the position in Fig. 5-1 to that of Fig. 5-2, the parking brake release port **P3** is opened to guide the pressurised oil to the brake releasing cylinder cavity. This releases the parking brake. When the motor stops, the counterbalance valve becomes as shown in Fig. 5-1 and **P3** port is blocked and the drain port in the motor case is opened. The pressurised oil in the brake is exhausted into the motor case to activate the brake.

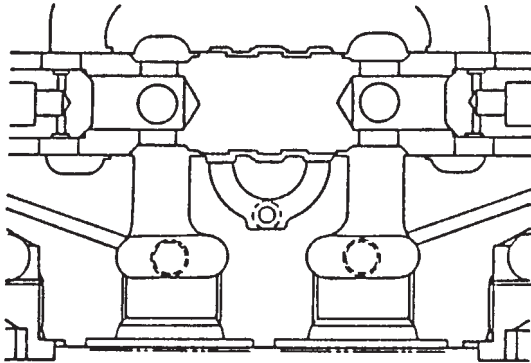


Fig 5-1. Shuttle Function

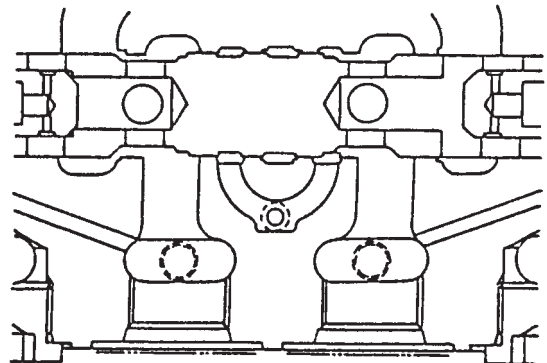


Fig 5-2. Shuttle Function

Relief Valve

The relief valve determines the drive force and brake force which controls the machine travel and is located on the cross line. This valve also provides the shockless function which reduces shock during acceleration.

The relief valve is constructed as shown in Fig. 6.

- a. Area differential type directly driven relief valve
- b. Shockless piston

With the shockless type relief valve, reduction of shock and stress on the structure is achieved.

Relation of relief valve set pressure and adjuster amount

Per one rotation approx. 8.6 Mpa {88 kgf/cm²}

Do not make adjustments unless there are problems.

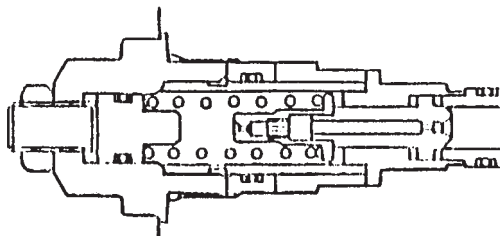


Fig 6. Relief Valve Section.

Operation (*continued*)

Relief Valve (*continued*)

The relief valve works in the following two stages.

First Stage: Refer to Fig. 6-1

When the relief valve starts operating, the shockless piston moves to keep the spring cavity at low pressure. The pressure receiving area of the poppet equals the area of the poppet seat (**S1**) and so it is considerably larger than the pressure receiving area (**S1-S2**) when the relief is normally set. Since the relief operating pressure in this state is low, it is kept at low pressure (about on third of the normally set pressure). The low pressure holding time depends on the poppet orifice diameter, the shockless piston pressure receiving area and the piston stroke.

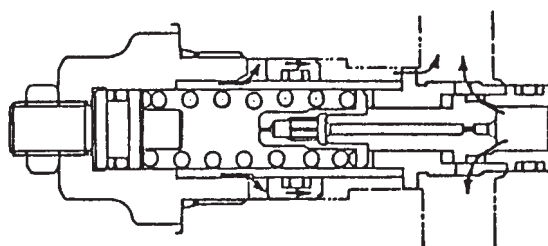


Fig. 6-1 First Stage of Relief Valve Working

Second Stage: Refer to Fig. 6-2

When the movement of the shockless piston is completed, the pressure in the spring cavity of the relief valve increases to make the pressures on both sides of the poppet equal. Accordingly, the relief valve works at the normal set pressure.

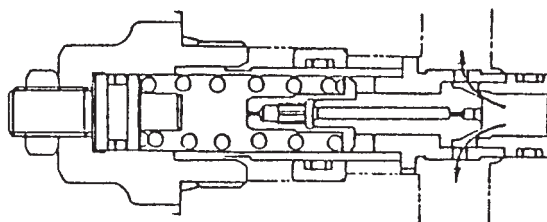
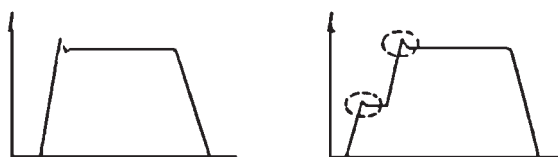


Fig. 6-2 Second Stage of Relief Valve Working

Below is a comparison of the normal type and shockless type.



Operation (continued)**2-Speed Switch Mechanism****2-Speed Switch Mechanism Assembly**

The swash plate has three surfaces, **A**, **B** and **C** as illustrated in Fig. 7, being assembled in a slantable state in the motor case with two steel balls.

The 2-speed switch valve is assembled inside the base plate.

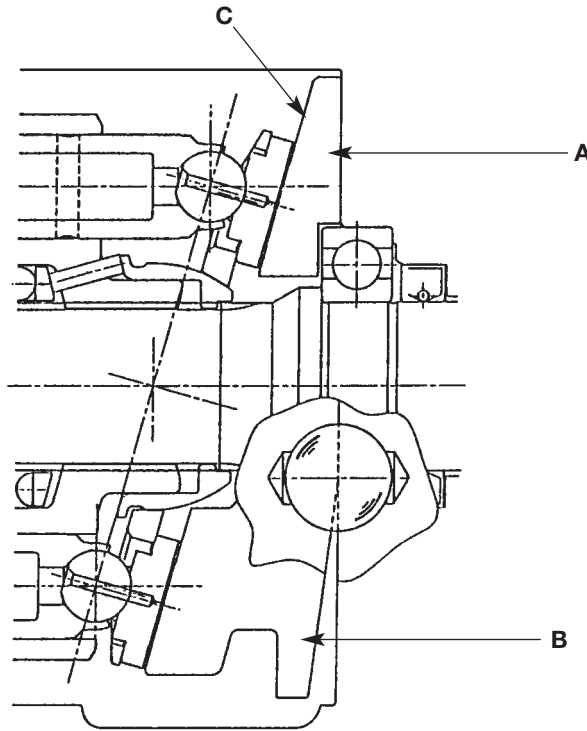


Fig. 7 2-Speed Mechanism Assembly

The following instructions refer to the illustrations following this section.

2-Speed Mechanism

Refer to Fig. 8-2

When the 2-speed mechanism is in the position as illustrated, the motor driving pressure works on the 2-speed control piston. The swash plate is slanted to the position where the resultant thrust force of the piston sub-assembly and the spring force are balanced with the thrust force of the 2-speed control piston. The swash plate settles when surface **B** comes into contact with the motor case and the motor is then in second, or high speed.

Refer to Fig. 8-1

When the 2-speed valve is in the position as illustrated, the 2-speed control piston cavity is connected to the motor case drain and the swash plate is pushed by the resultant force of the piston sub-assembly thrust force and spring force. The swash plate settles when surface **A** comes into contact with the motor case and the motor is in first or low speed.

When the engine stops, the swash plate is pressed by spring force to bring the surface **A** into contact with the motor case. The motor changes into first, or low speed.

Operation (continued)**Automatic 2-speed****Refer to Fig. 8-1**

With pilot pressure $P_s = 0$, the 2-speed valve is maintained in the position as illustrated and the motor speed is first, or low.

Refer to Fig. 8-2

During travel on level ground when the motor load pressure is below the set pressure P , if pilot pressure P_s is operated, the pressure inside cavity B of the 2-speed valve is low, ($F_2 < F_1$) and the 2-speed valve is held in the illustrated state and the motor speed changes to second or high.

Refer to Fig. 8-3

When the motor load pressure rises and reaches the set pressure P after going uphill or steering operations are done with the pilot pressure P_s operated, the pressure inside cavity B of the 2-speed valve also rises, ($F_2 > F_1$) and the 2-speed valve moves to the state shown and the motor speed changes to first or low.

When the motor drive pressure drops lower than the set pressure P , the pressure inside cavity B of the 2-speed valve also drops ($F_2 < F_1$), the 2-speed valve moves as shown in Fig. 8-2 and the motor speed changes to second, or high.

Parking Brake

The parking brake is a pressurised off type comprising a disk (wear-resistant material) as the rotary section, brake piston and spring.

Refer to Fig. 9

As explained on page F/3-6 at the shuttle function of the counterbalance valve, pressurised oil is guided to the cylinder cavity for parking brake release through port P_3 . The force corresponding to the pressure receiving area is fed to the brake piston. This force overcomes the spring force to press the brake piston upward, and this releases the parking brake. When parking or stopping the machine, the pressurised oil in the parking brake cylinder is released to the motor case drain, and the brake piston is pushed by the spring force, applying the parking brake.

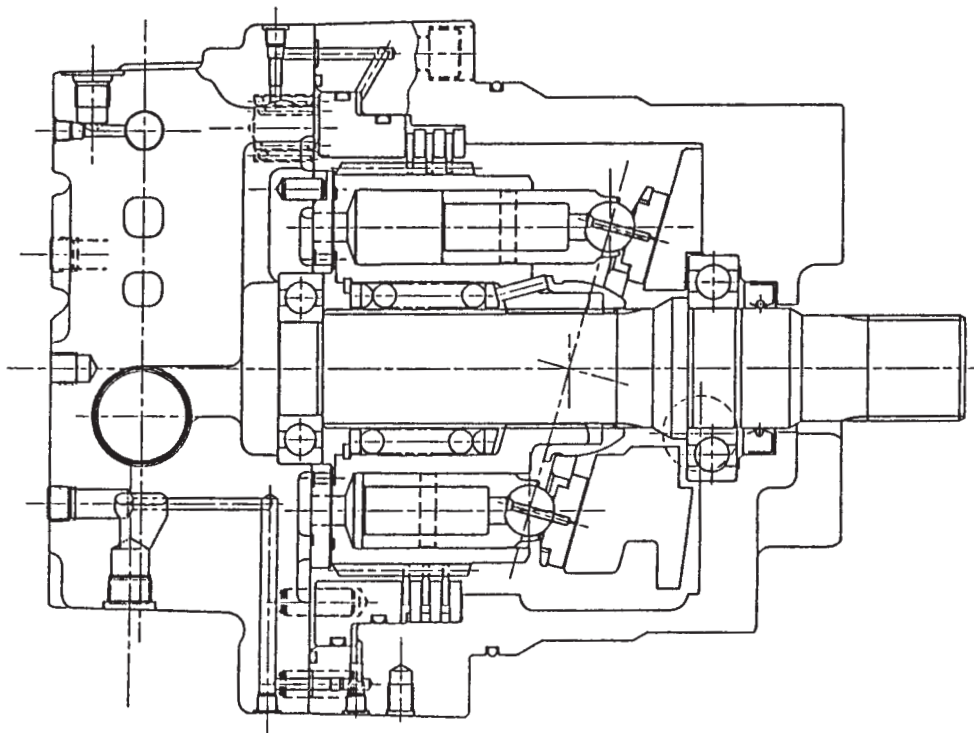


Fig. 9 Parking Brake

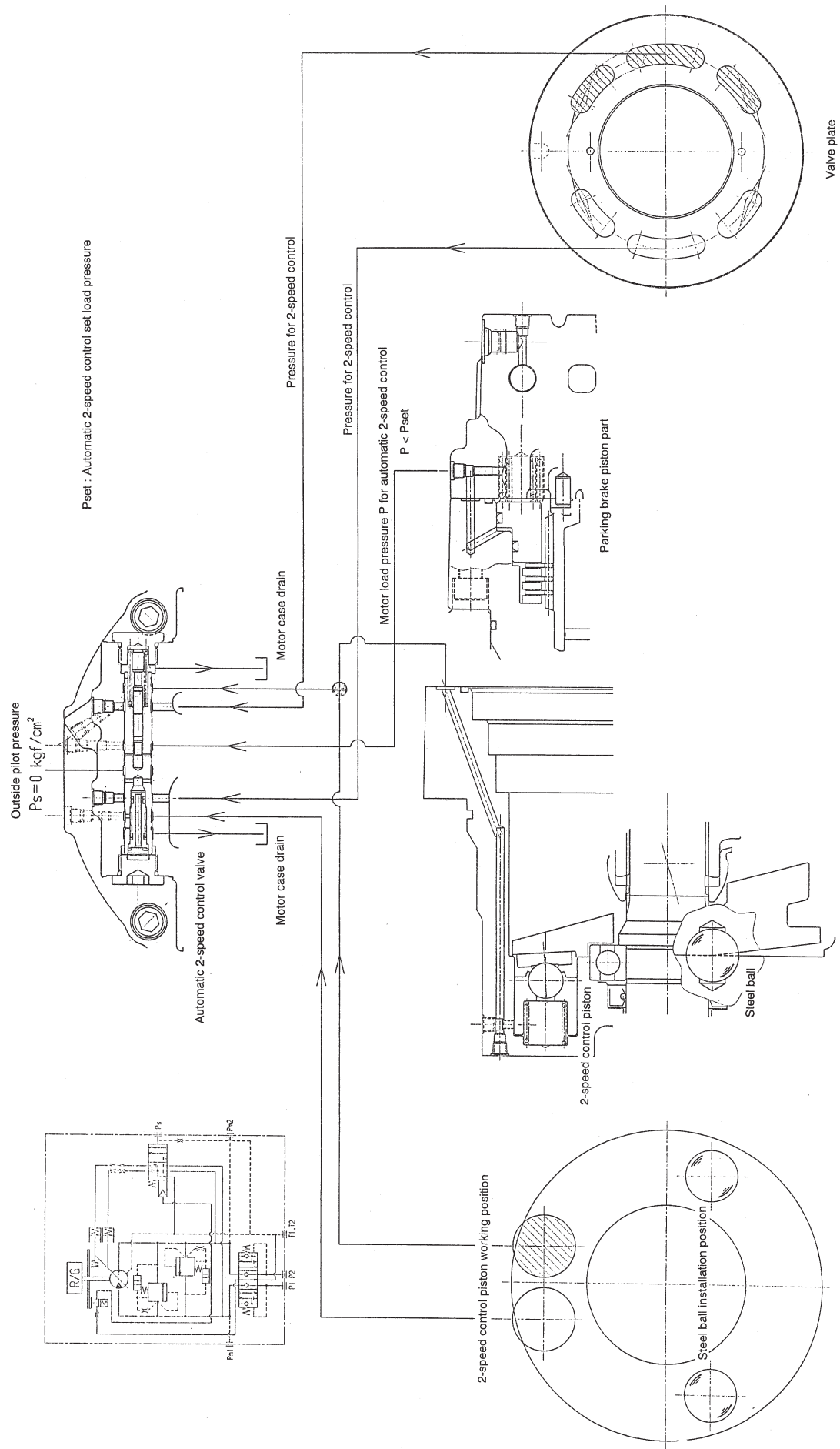


Fig. 8-1 1st Speed Fixed Mode

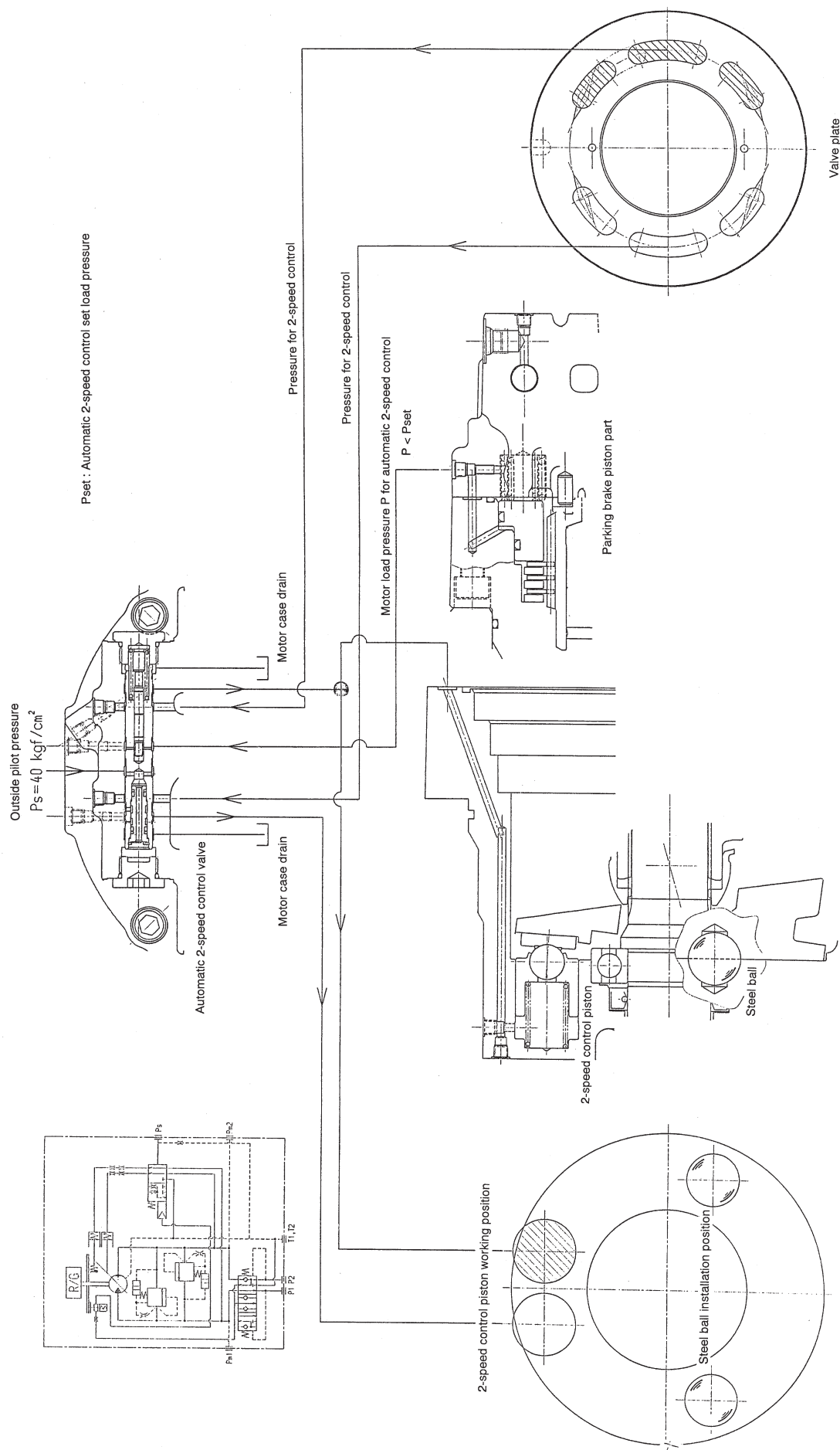


Fig. 8-2 Automatic 2-Speed Mode in 2nd Speed State

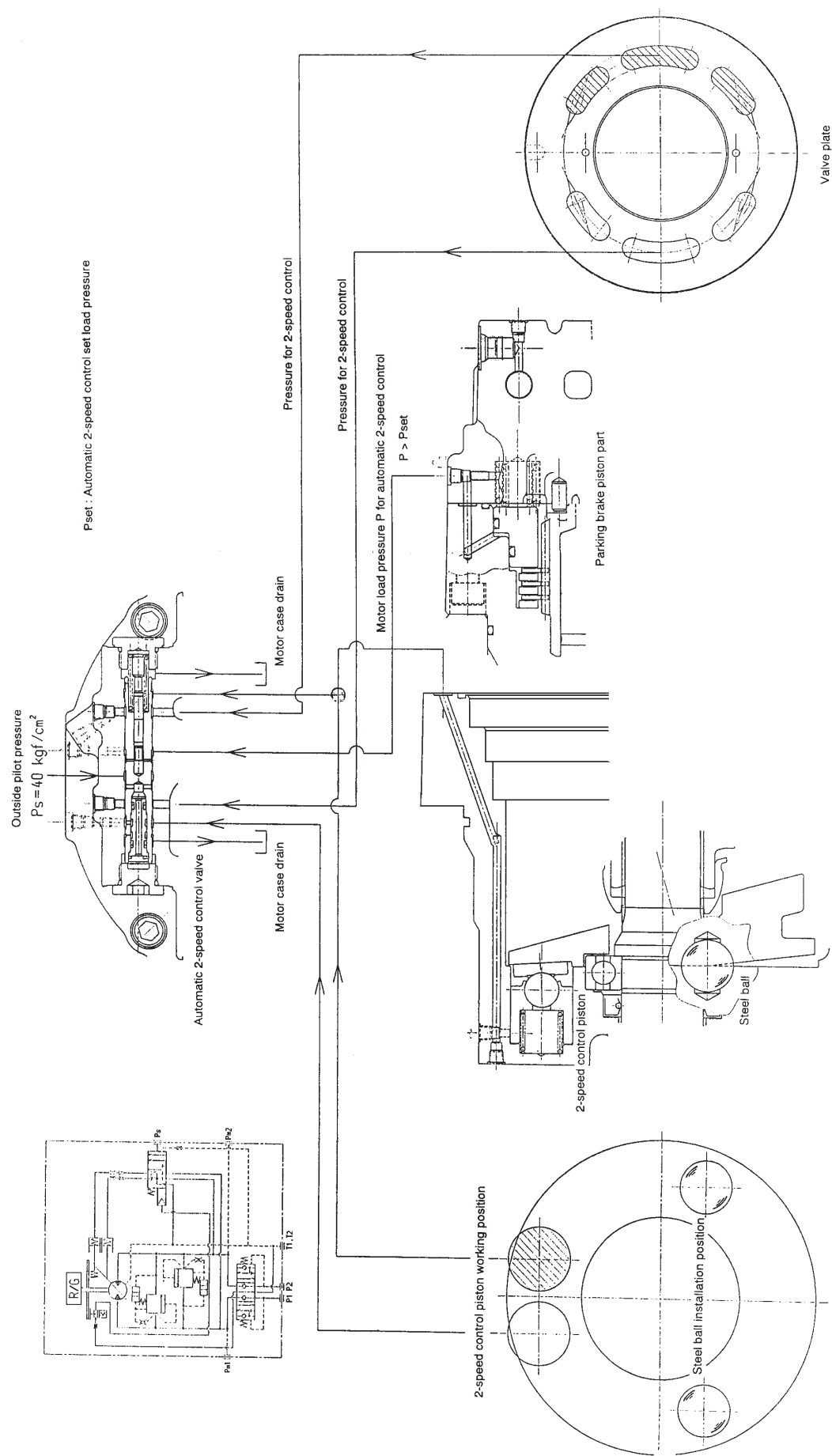


Fig. 8-3 Automatic 2-Speed Mode in 1st Speed State

Precautions during Installation

Before installation, check the overall condition of the axial piston motor, are any parts loose, are **P1**, **P2** drain ports and pilot ports completely sealed so that contaminants cannot enter the axial piston.

Rotation Direction

The relationship between the flow direction of the hydraulic oil and the rotation direction is as shown below.

Arrow	Oil input port	Oil output port	Rotation direction (viewed from output shaft end of motor)
	P1	P2	Rotation to right (clockwise)
	P2	P1	Rotation to left (counterclockwise)

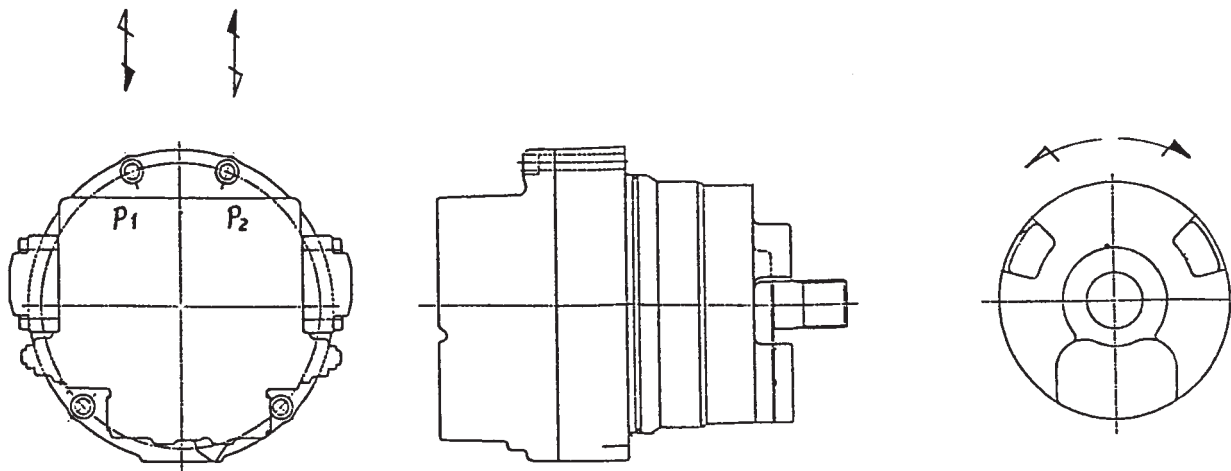


Fig 9. Rotational Direction

Precautions during Installation (*continued*)

Install the new or repaired and inspected traction motor on the machine and perform the inspection and starting preparations described below.

- a. Fully fill the piston motor case with clean hydraulic oil. Also bleed air from each part of the piping.

Fill gearbox casing to level **A**.

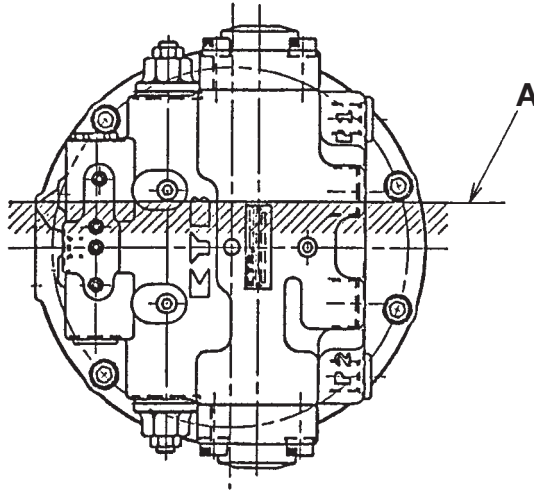


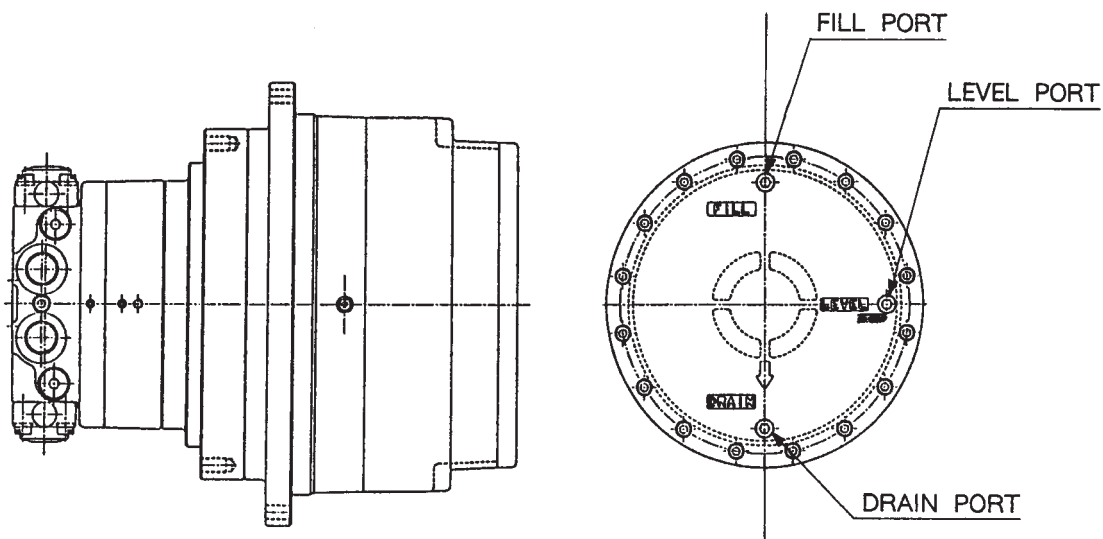
Fig 10.

Note: When using a hand pump or small capacity electric pump for filling with hydraulic oil, be careful that the inner case pressure does not exceed 0.3 MPa (3 kgf/cm²). Oil Capacity is 400 cm³.

b. Initial Operation

First run at low speed, repeating the operations. At this time, air remaining in the circuit may cause abnormal sounds in the valve, so continue running at low speed. Also check for oil leakage from the equipment.

After air bleeding and checking for oil leakage is completed, confirm that abnormal noise or vibration does not occur in the traction motor due to running with a load on the motor.



Fault Finding

Piston Motor

Fault	Possible cause	Countermeasure or remedy
1. Motor does not run	1. Device other than the piston motor or reduction gear may have malfunctioned.	Check whether or not the specified pressurised oil is delivered to the motor input side and then inspect each device and repair if necessary.
	2. Sliding area of motor is abnormally worn allowing the pressurised oil to escape.	Replace the excessively worn part. Remove scratches and burrs from the surface and completely clean all parts. Reassemble the parts.
	3. Improper operation resulting from damage of important motor part. In this case, abnormal noise is heard from the motor itself.	Disassemble and replace the damaged part. Completely clean all parts and reassemble.
	4. Relief valve is activated because the motor is excessively loaded.	Check the load state and operate the machine under a load which matches the relief pressure.
2. Motor revolution speed is insufficient	1. Oil not supplied to motor at specified rate due to problems in hydraulic pump, pressure control valve, etc.	Check whether the specified pressurised oil is delivered to the motor input side and then inspect each device and repair if necessary.
	2. Specified revolution speed cannot be achieved due to reduced volume efficiency of motor.	After disassembly, check for abnormal wear of the sliding area and repair or replace worn parts.
3. Motor revolution speed varies greatly	1. Pressurised oil escaping through the drain port due to wear on the sliding area of the motor. Also, revolution speed variation resulting from wear in the bearing.	Disassemble and replace excessively worn parts. Completely clean all parts and reassemble them.
	2. Motor load is excessive and the automatic 2-speed function is working.	Check the load state and operate the machine under a load which matches the automatic 2-speed set pressure.
4. Oil leaks	1. Oil leaks due to damage of the oil seals or 'O'-rings.	Replace a broken oil seal or 'O'-ring with a new one. When inserting the oil seal, be careful not to damage the lip. Since the safe working temperature limit of the oil seal and 'O'-ring is up to 80°C, it is necessary to take steps to prevent the hydraulic oil temperature from exceeding 80°C.

Fault Finding (continued)

Fault	Possible cause	Countermeasure or remedy
* 4. Oil Leaks (continued)	2. Motor case excessively pressurised resulting in oil leakage. Oil seal pressure resistance Ordinary 0.2 MPa {2 kgf/cm ² } Maximum 0.5 MPa {5 kgf/cm ² }	Repair the motor and replace oil seal. When inserting new oil seal, be careful not to damage the lip.
	3. Due to clogging, etc. by foreign matter in drain pipe, pressure rises causing the oil seal to leak. Oil seal pressure resistance Ordinary 0.2 MPa {2 kgf/cm ² } Maximum 0.5 MPa {5 kgf/cm ² }	Clean the clogged drain piping. There should not be more than 0.3 MPa {3 kgf/cm ² } pressure on the oil seal. Renew oil seal. When inserting new oil seal, be careful not to damage the lip.
* 5. Abnormal noise, excessive revolution variation and pressure variation due to cavitation.	1. When the motor works as a pump, when the closed circuit is used, when the boost pressure is low (standard: 0.4~0.5 MPa {4~5 kgf/cm ² }) or when the double counterbalance valve operates incorrectly, negative pressure is generated on the suction side of the motor, resulting in cavitation.	Recheck the hydraulic circuit and repair or replace the double counterbalance valve. Disassemble the motor and replace any abnormally worn or broken parts. After cleaning all parts, reassemble them.

Parking Brake

Fault	Possible cause	Countermeasure or remedy
1. Oil Leaks	1. Disk is worn.	Replace the disk. Completely remove foreign matter and repair damaged areas. After cleaning, reassemble.
	2. Disk surface has changed in quality or the contact is incorrect.	Grind and recondition the affected area. Reassemble after cleaning and replace if change in quality of the surface is excessive.
	3. Spring is deformed or damaged.	Replace the spring. Completely remove foreign matter and reassemble after cleaning.
2. Abnormal heat generated from brake drag.	1. Brake release incorrect. 1) Oil leaks due to broken 'O'-ring. 2) Orifice is clogged.	Replace the broken 'O'-ring. Reassemble after cleaning.

Fault Finding (continued)**Relief Valve**

Fault	Possible cause	Countermeasure or remedy
1. Motor does not run or rotation speed is slow.	1. Relief valve closing incorrectly. 1) Foreign matter is clogging components. 2) Spring is broken	Completely remove foreign matter, repair damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Replace the spring. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive.
	2. The cracking pressure of relief valve is low. 1) Spring is deformed 2) Poppet orifice is clogged	Replace relief valve sub assembly. After cleaning, reassemble.
2. Motor does not stop or stops slowly.	1. Relief valve closing incorrectly. 1) Foreign matter is clogging components. 2) Spring is broken.	Completely remove foreign matter, repair damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Replace the spring. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive.
	2. The cracking pressure of relief valve is low. 1) Spring is deformed. 2) Poppet orifice is clogged.	Replace relief valve sub assembly. After cleaning, reassemble.
3. Excessive shock when travel is stopped.	1. Shockless function does not work. 1) Foreign matter caught up in shockless piston section. 2) Spring is deformed. 3) Relief pressure set too high.	Completely remove foreign matter, repair damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Replace the spring. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Readjust the relief valve set pressure.

Fault Finding (continued)**Double Counterbalance Valve**

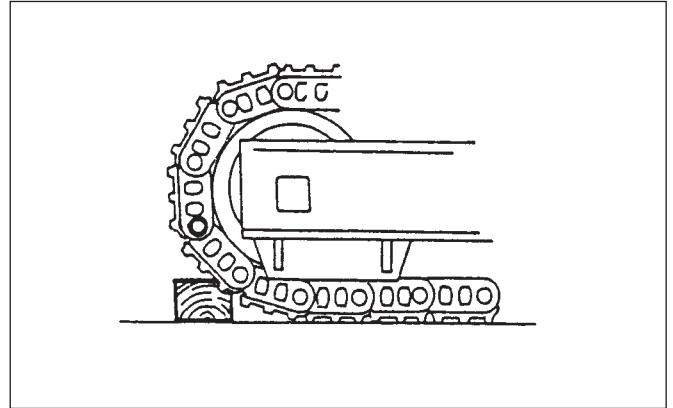
Fault	Possible cause	Countermeasure or remedy
1. Motor does not run or rotation speed is slow.	1. Plunger is not switched 1) <i>Pressurised oil from the pilot not there.</i> 2) <i>Foreign matter caught between plunger and body.</i> 3) <i>Orifice is clogged.</i> 4) <i>Foreign matter caught between dumper piston and cap.</i>	Inspect the piping for damage. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Reassemble after cleaning. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive.
2. Motor does not stop or stops slowly.	1. Plunger does not return. 1) <i>Foreign matter is caught.</i> 2) <i>Spring is broken.</i> 3) <i>Spring is not assembled correctly.</i> 4) <i>Orifice is clogged.</i>	Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Replace spring. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Assemble spring in specified position. Reassemble after cleaning.
3. Rotation varies.	1. Plunger does not return. 1) <i>Foreign matter is caught.</i> 2) <i>Orifice is clogged.</i>	Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Reassemble after cleaning.
4. Abnormal noise is heard.	1. Plunger does not return. 1) <i>Foreign matter is caught.</i> 2) <i>Spring is broken.</i> 3) <i>Orifice is clogged.</i>	Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Replace spring. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Reassemble after cleaning.
5. Travel not linear.	1. Dumper piston or cap is abnormally worn.	Replace dumper piston and cap. Completely remove foreign matter, repair the damaged part and reassemble after cleaning.

Fault Finding (continued)**2-Speed Control Function**

Fault	Possible cause	Countermeasure or remedy
1. Travel is not linear	1. Plunger is not switched 1) Foreign matter is caught between plunger and body. * 2) Spring is not assembled correctly. 3) Spring is broken. * 4) Foreign matter is trapped in spool galleries.	Completely remove foreign matter, repair the damage and reassemble after cleaning. Replace if damage or leakage is excessive. Assemble spring in specified position. * Renew spring. Completely remove foreign matter, repair the damage and reassemble after cleaning. Replace if damage or leakage is large.
	2. Pressurised oil leaks due to abnormal wear of 2-speed control piston	Replace the 2-speed control piston. Completely remove foreign matter and reassemble after cleaning.
	3. 2-speed control piston is not assembled correctly	Assemble 2-speed control piston to the specified position.
	4. Steel ball is abnormally worn.	Replace steel balls. Completely remove foreign matter and reassemble after cleaning.
	5. Set pressure is rising due to abnormal wear of spools.	Replace spool. Completely remove foreign matter and reassemble after cleaning.
	6. The orifice of the 2-speed piston cavity drain is incorrect.	Confirm orifice diameter.
	7. The orifice of the 2-speed piston cavity drain is clogged.	Reassemble after cleaning.
	8. Number of washers is different and set pressure is different on the left and right.	Reassemble using correct number of washers.
2. Will not go into 2nd.	1. Plunger is not switched 1) Foreign matter is caught between plunger and body. * 2) Foreign matter is trapped in spool galleries.	Completely remove foreign matter, repair the damage and reassemble after cleaning. Replace if damage or leakage is excessive. Completely remove foreign matter, repair the damage and reassemble after cleaning. Replace if damage or leakage is excessive.
	2. Pressurised oil leaks due to abnormal wear of 2-speed control piston.	Replace the 2-speed control piston. Completely remove foreign matter and reassemble after cleaning.
	3. 2-speed control piston is not assembled correctly.	Assemble 2-speed control piston to the specified position.
	4. The orifice of the 2-speed piston cavity drain is clogged.	Reassemble after cleaning.
3. Will not go into 1st.	1. Spring is not assembled correctly.	Assemble spring to specified position.
	2. Spring is broken.	Replace spring. Completely remove foreign matter, repair the damage and reassemble after cleaning. Replace if the damage or leakage is excessive.
	3. Set pressure is rising due to abnormal wear of spools.	Replace spool. Completely remove foreign matter, repair the damage and reassemble after cleaning. Replace if the damage or leakage is excessive.

Removal

1. Move the track link until the master pin is over the take-up roller in the position shown, place a wooden block under the track shoe as shown.



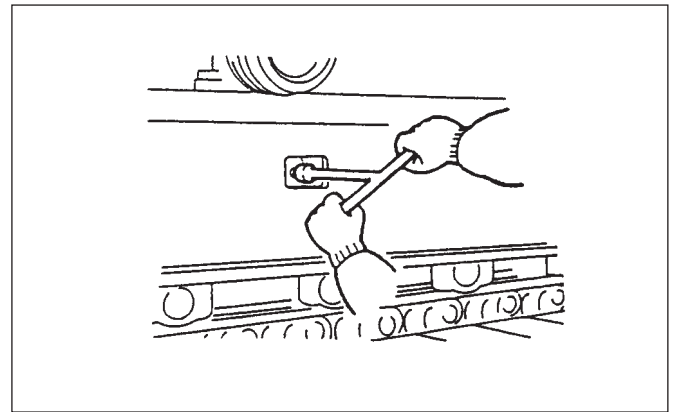
2. Slacken the check valve to bleed out the grease.



WARNING

Slacken the check valve slowly and stop when grease is released. The grease and valve are under extremely high pressure and could cause injury if suddenly released.

TRANS 6-2



- * 3. Disconnect the track link by removing the locking pin and knocking out the master pin.

- a. Remove bolts and lift off the track shoes adjacent to the master pin.
- b. Position a suitable hydraulic press so that its ram aligns with the master pin.
- c. Insert the spacer bar between the master pin and the hydraulic ram.
- d. Slowly operate the hydraulic ram and press out the master pin.

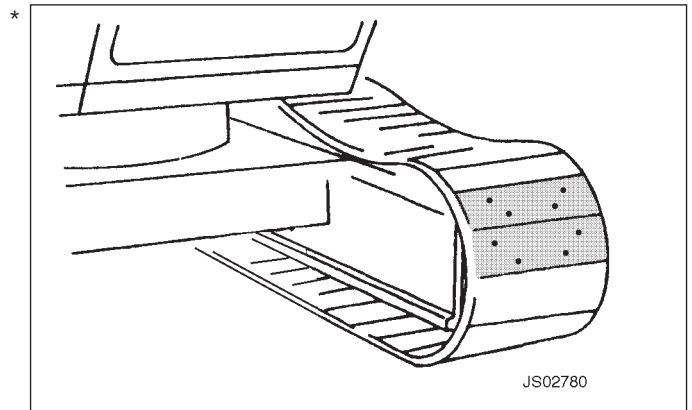


WARNING

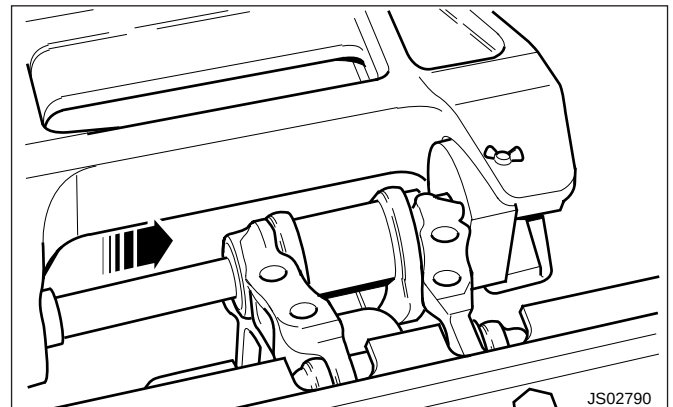
Stand clear and to one side of the track while you remove the master pin. When the master pin is removed the track could fall forward and injure you.

TRACK 1-1

- e. Remove the seal rings from each side of the chain link.



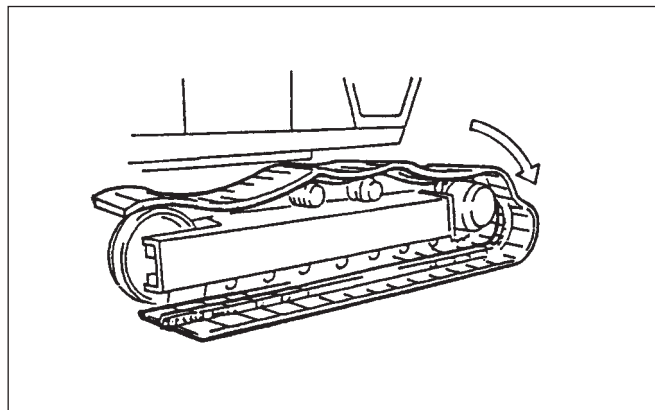
JS02780



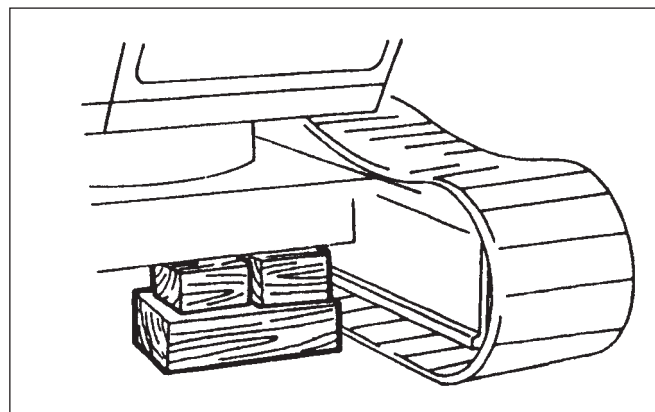
JS02790

Removal (continued)

4. Operate the traction motor to remove the track.



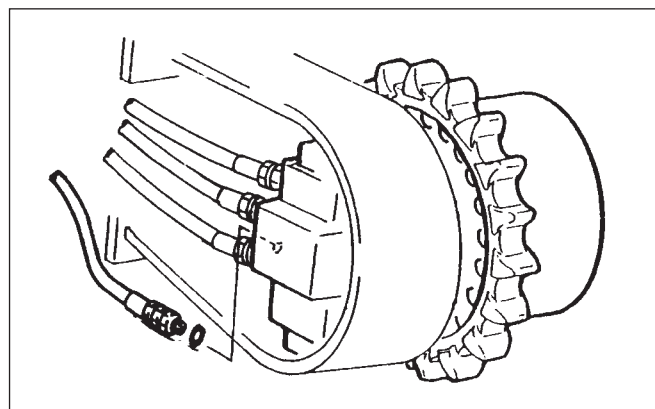
5. Lift the side of the undercarriage high enough to permit drive sprocket removal. Support with wooden blocks.



6. Stop the engine and operate the control lever to relieve pressure in the hydraulic system.

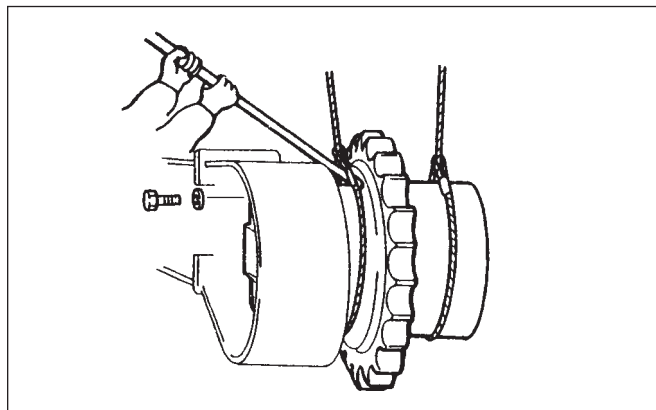
Release pressure in the hydraulic tank (See **Releasing Tank Pressure in Routine Maintenance**).

7. Remove the motor cover, attach identification tags to the motor hoses, disconnect the hoses from the motor and install plugs and caps.



Removal (continued)

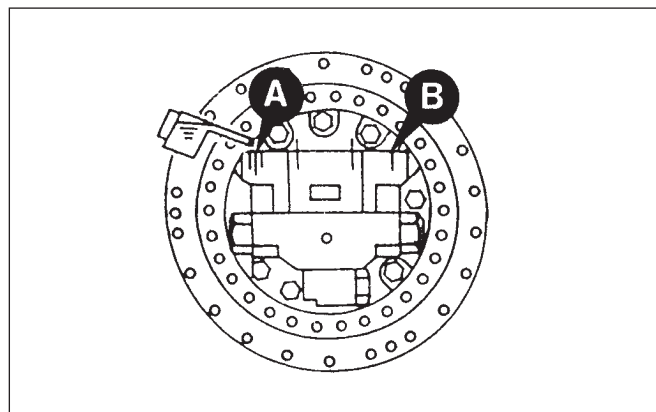
8. Support the motor so that the cables are in tension, then remove the motor installation bolts.

**Replacement**

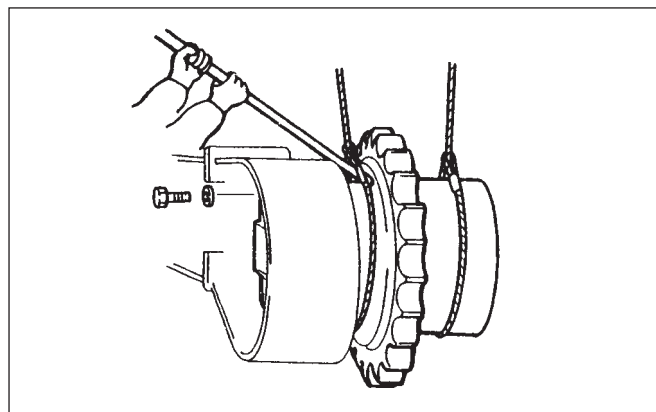
1. Before fitting, clean the gearbox and bleed air out as follows:

Turn the gearbox so that the hydraulic oil ports are facing upwards.

Remove plugs from ports **A** and **B**. Fill the motor through port **A** with the specified hydraulic oil. Fit plugs to ports **A** and **B**.

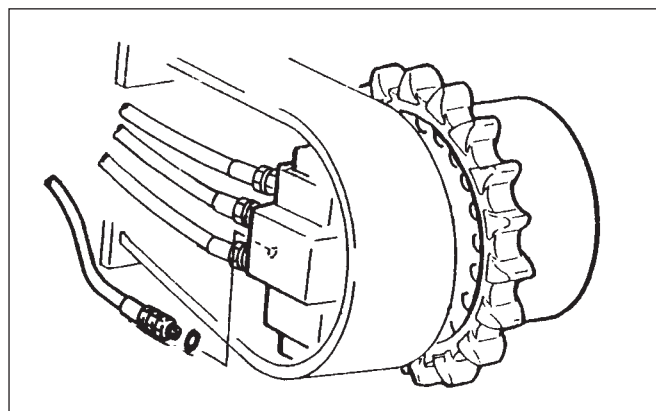


2. Lift the gearbox and position it on the undercarriage. Install the bolts and washers, using Loctite 262 on the bolt threads. Tighten the bolts in a diagonal sequence.

**Torque Settings**

267-312 Nm (196-229 lbf ft)

3. Remove plugs and install the hoses to the motor.

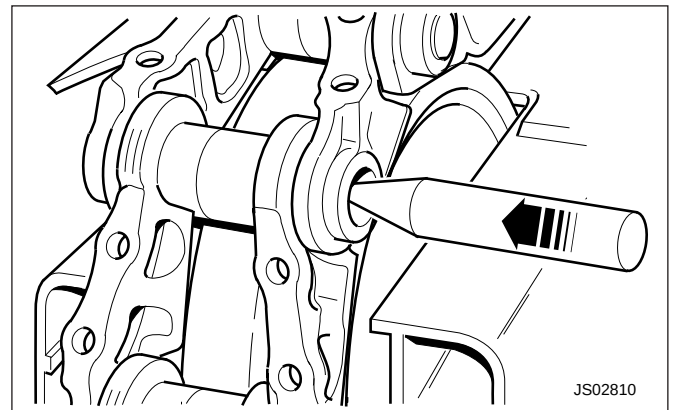
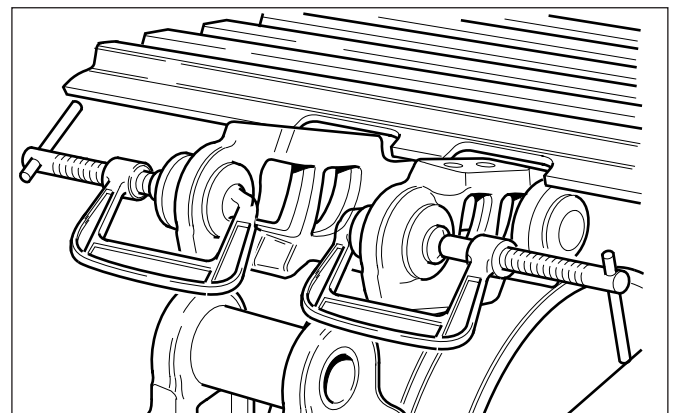
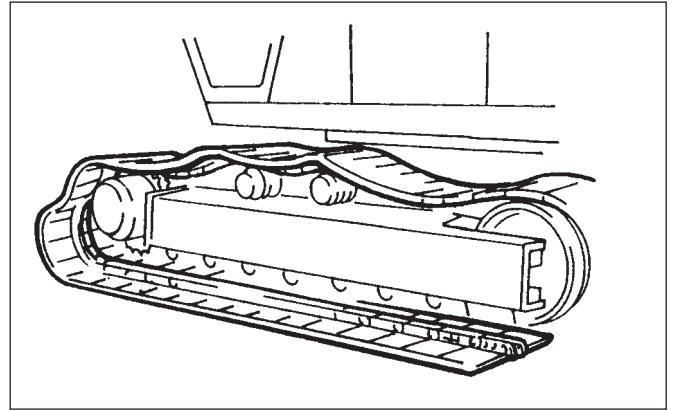


Replacement (continued)

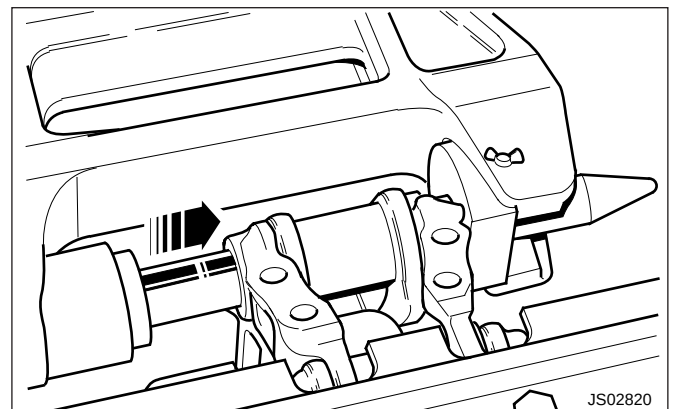
- * 4.
 - a. Install the covers over the motor.
 - b. Check the amount of oil in the gearbox.
 - c. Bleed air from the motor (see **Motor Bleeding**).
 - d. If the traction motor has been dismantled and serviced, carry out the functional tests detailed under **Testing** later in this section.
 - e. Install the drive sprocket (see **Drive Sprocket, Replacement, Section J**).
 - f. Remove the wooden blocks.
 - g. Position the lower frame on the track.
 - h. Move the track link by reversing step 1 of **Removal**.
 - i. Clean the seal ring housings in the chain link. Insert the seal rings and clamp into position.
 - j. Using a plastic hammer, tap the upper link down to align holes.

Note: As the links overlap, the seal rings will be held in position. Remove 'G' clamps.

- k. Insert the pointed guide pin from the inner face and tap through its full length.
- l. Position a suitable hydraulic press so that its ram aligns with the guide pin.
- m. Insert the master pin into its locating hole.
- n. Slowly operate the hydraulic ram and press the master pin into position.
- o. Re-locate the track shoes and tighten the bolts (see **Checking Shoe Plate, Routine Maintenance, Section 3**).



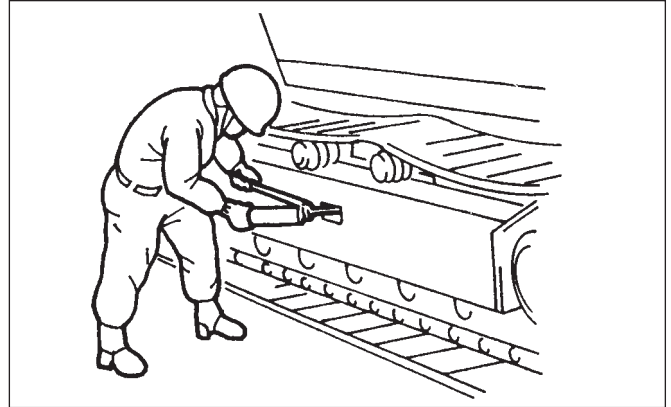
JS02810



JS02820

* Replacement (continued)

- 5 Apply grease through the check valve to adjust the track tension (see **Tracks and Running Gear, Checking/Adjusting the Track Tension, Section 3**).



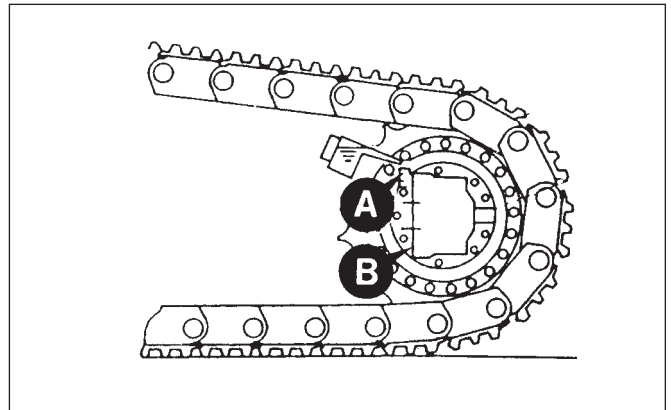
Motor Bleeding

Bleeding must be done whenever a track motor is being fitted.

Note: If a track gearbox assembly is being fitted to the machine with the motor attached, follow the procedure given under **Track Gearbox Removal and Replacement**.

When the motor is being fitted to a gearbox already fitted to the machine, bleed the air from the motor by one of the three methods detailed below.

Note: Method 1 will take considerable time as air in the motor is very difficult to purge. Methods 2 or 3 may be quicker.



Method 1

After fitting the motor but before connecting the pipework, remove plug from upper drain port **A** but make sure that a plug is fitted to lower drain port **B**.

Fill the motor with specified hydraulic oil through port **A**. Connect the pipes.

Method 2

Fit the motor and connect all pipes except the two drains. Remove plug from port **A**. Make sure that a steel plug is fitted to bottom drain port **B**.

Run the engine and operate the track control lever slightly so that the sprocket does not turn. If necessary, prevent the sprocket from turning by means of a steel bar or tube jammed in the track. Return the lever to neutral when air-free oil flows from port **A**. Connect the drain pipes.

Method 3

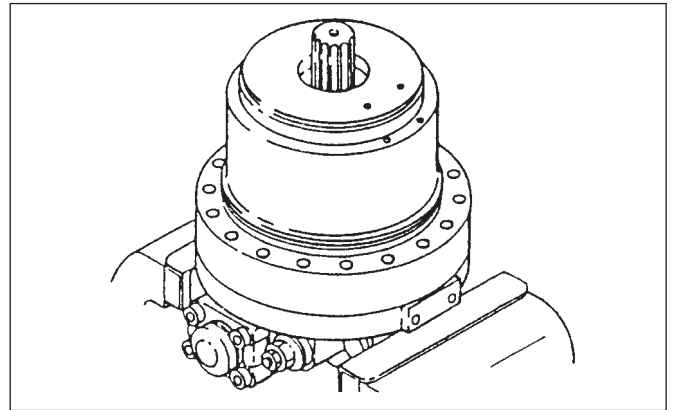
Fit the motor and connect all pipes. Prevent the sprocket from turning by means of a steel bar or tube jammed in the track. Run the engine and fully select the track control lever for about 1 minute. This will fill the motor case with oil.

Dismantling

Note: The numbers in the following section refer to the illustrations on pages F/7-15 and F/7-16.

Before starting the dismantling, drain the oil, clean all the surfaces with a suitable solvent and dry with compressed air. Discard all 'O'-rings and seals which are disturbed during dismantling.

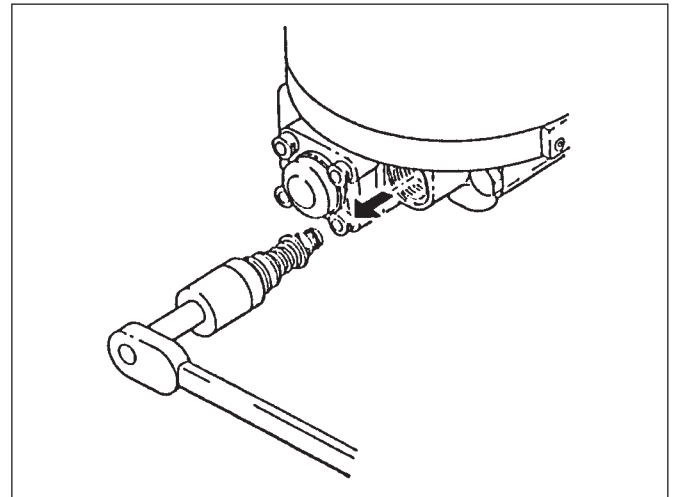
1. With the motor/gearbox assembly removed from the machine as described in the previous section. Unscrew the three socket head screw and separate the hydraulic motor from the gearbox.
 2. Remove the O ring from its groove in the motor.
-
3. Fix the motor into a suitable vice or jig with the shaft facing upwards.



4. Base plate disassembly

- a. Relief valve disassembly.
 - * Loosen the plug (2-7-6) and remove the relief valve sub-assembly (2-7).
- * b. The (2-7-6) plug and (2-7-1) relief housing are press fitted but the (2-6-2) poppet is not. Remove the (2-7-3) poppet seat from the (2-1) housing using the poppet seat removal jig.

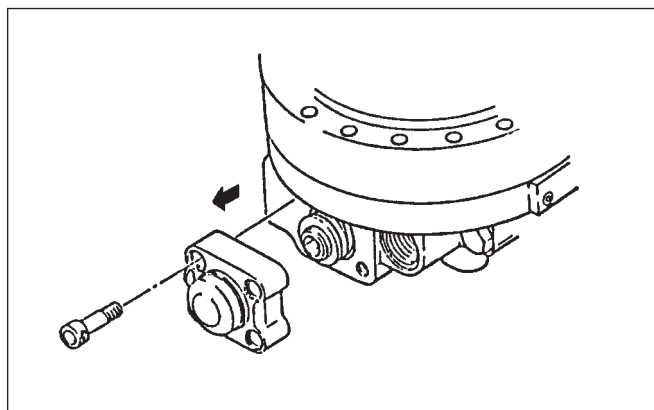
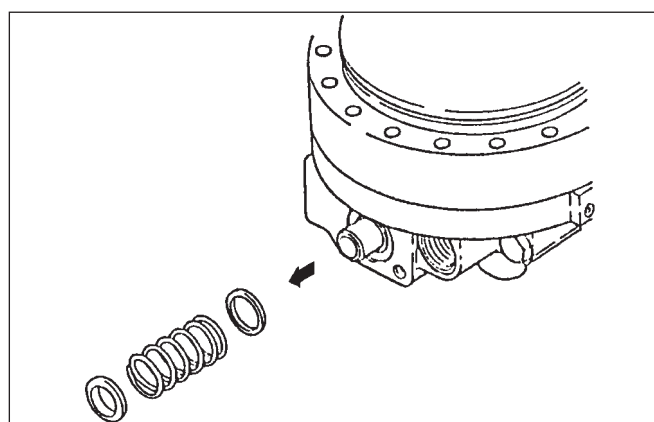
* **Note:** When removing the (2-7) relief valve sub-assembly, the relief set pressure will be lost if the (2-7-16) nut and (2-7-15) set screw are loosened, so take care not to loosen them. Do not disassemble the relief valve unless absolutely necessary.



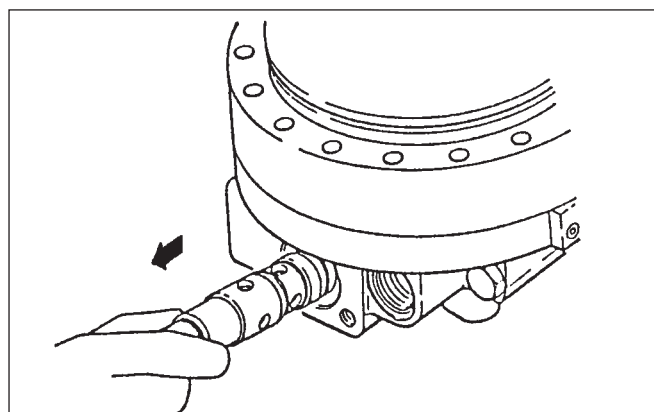
Dismantling (continued)**3. Counterbalance valve disassemble**

Loosen (2-6-5) socket head bolt and remove the (2-6) cap.

Note: Since the cap is loaded by a spring, loosen the socket head bolt halfway and while pressing the cap by hand, remove the socket head bolt.

**4. Remove (2-5) spring seat, (2-4) spring and (2-3) spring seat.****5. Pull out the (2-2) plunger assembly.**

While turning the plunger, pull it out slowly, being careful not to damage the outer circumference.

**6. 2-speed control valve disassembly**

- a. Loosen (2-14) (2-17) plugs and remove (2-9) valve assembly, (2-13) spring, (2-16) spring guide.

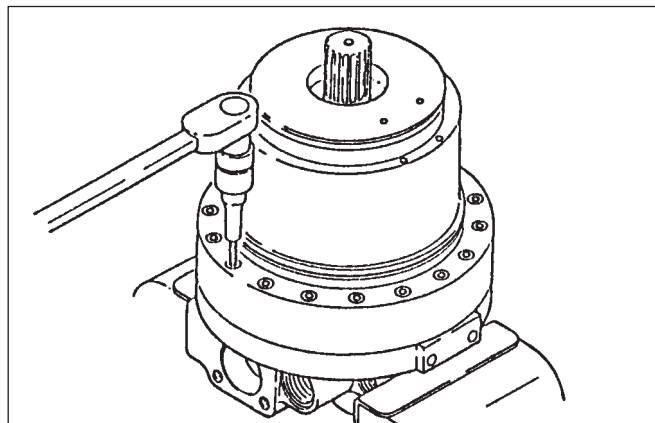
While turning the (2-9) valve assembly, pull it out slowly.

Be careful not to damage the outer circumference.

Dismantling (continued)**7. Base plate disassembly**

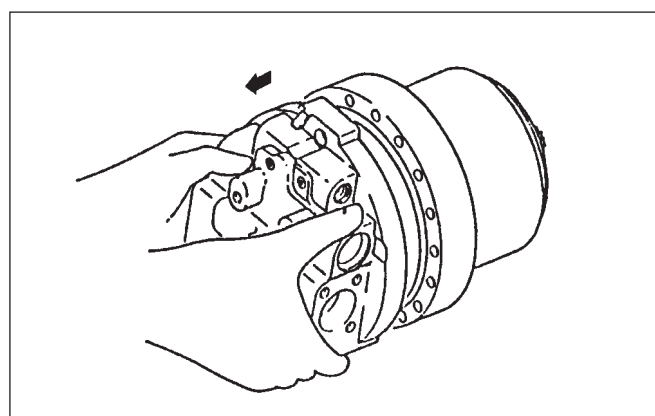
- a. Loosen (20) socket head bolt.

Note: Since the base plate is forced upwards by springs, loosen the bolts evenly.



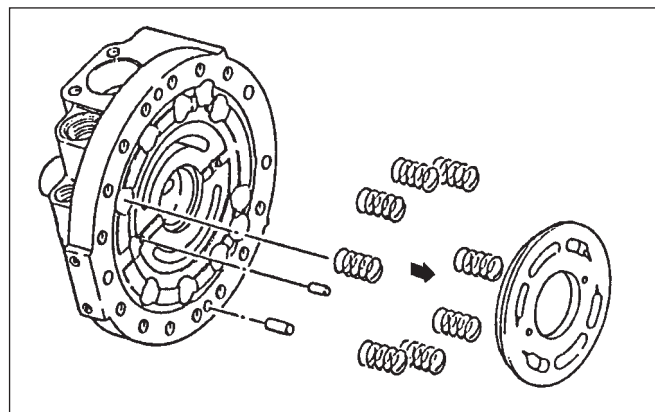
8. Remove the (20) socket head bolts and using a screwdriver, etc. remove the (2-1) base plate.

Note: Do not pry off the base forcibly as the (28) pin may stick.



9. Remove the (5) valve plate, (28) pin, (22) 'O'-ring, (33) 'O'-ring and (29) (41) springs.

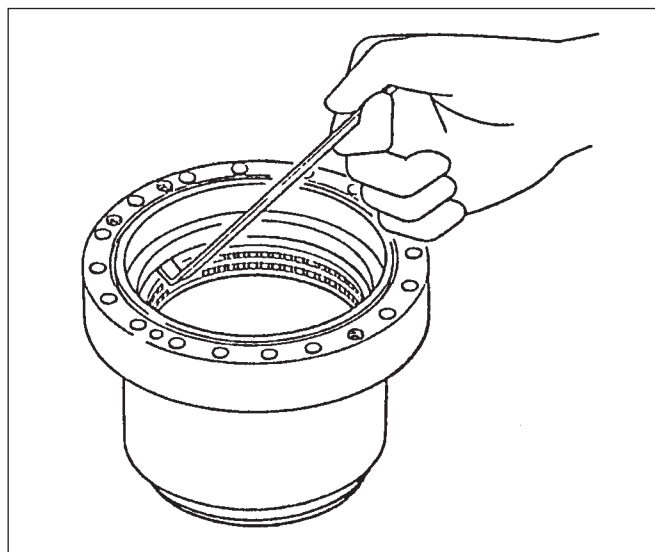
Note: When pulling out (28) pin, if using pincers, be careful not to damage the outer circumference. Be careful not to damage the sliding surface of the (5) valve plate.



Dismantling (continued)**10. Brake piston disassembly**

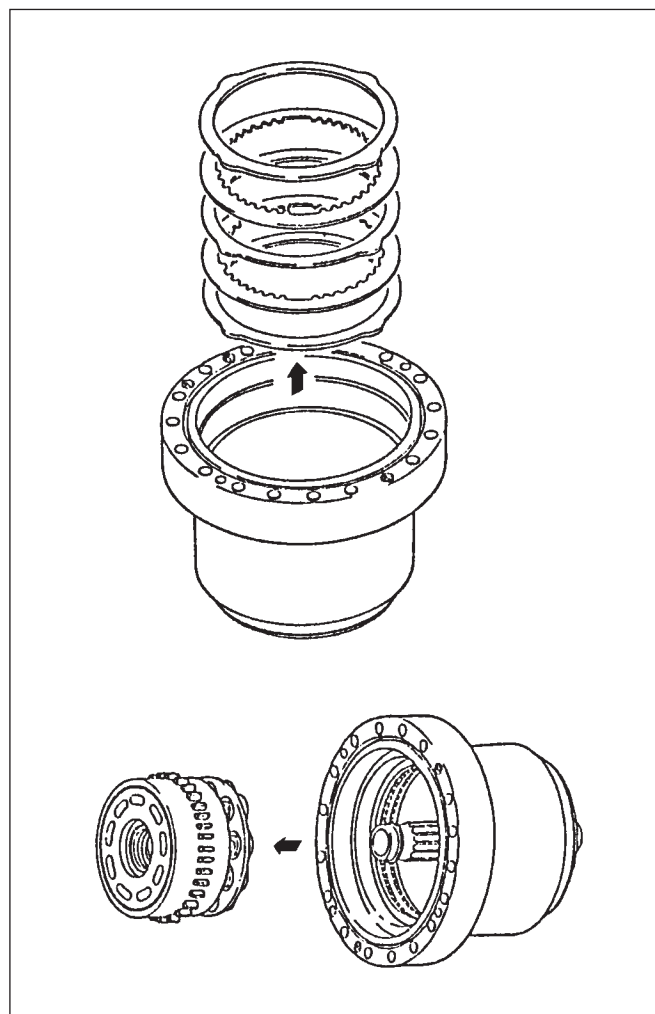
- * a. Through the (1) case (35) orifice, apply compressed air to remove the (25) brake piston from the (1) case and also remove the (26) disk and (27) friction plate.

Note: Because the brake piston may fly out due to the compressed air, take sufficient care to do the work safely. Be careful not to damage the sliding surface of the disk.

**11. Cylinder rod disassembly**

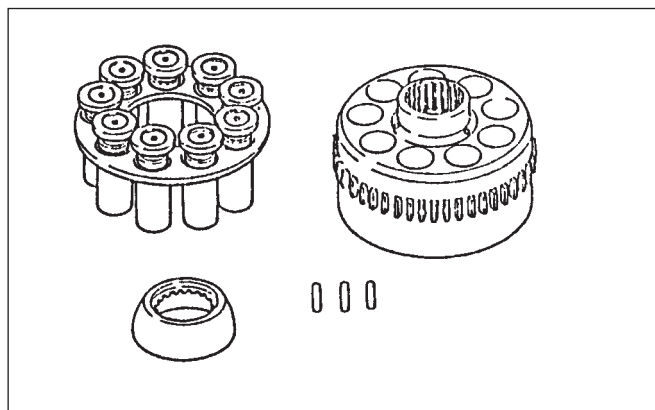
- a. Place the (1) case horizontally on the working bench and remove the (4) Cylinder block, (6) piston S/A, (7) retainer plate, (8) retainer holder, (19) pin, (14) snap ring, (15) spring seat, (16) spring and (17) spring seat from the (1) case.

Note: Be careful not to damage the sliding surface of the cylinder block, piston and swash plate.

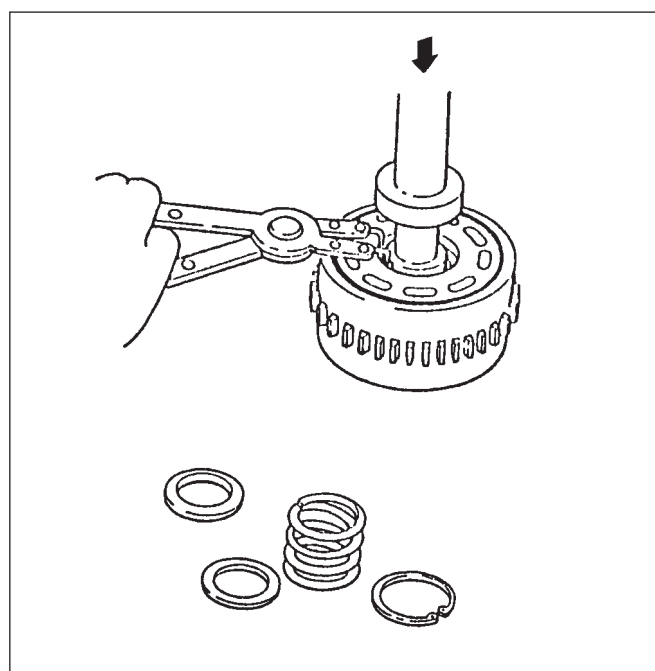


Dismantling (*continued*)

12. Remove the (6) piston, (7) retainer plate, (8) retainer holder and (19) pin from the (4) cylinder block.

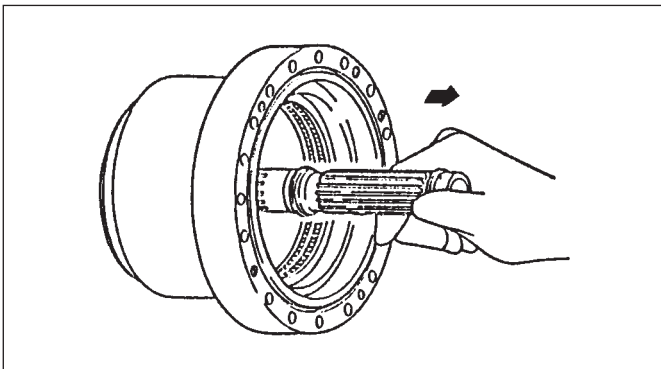


13. Remove the (14) snap ring using a jig or press and remove the (15) spring seat, (16) spring and (17) spring seat.



Dismantling (continued)

14. Remove the (3) shaft from the (1) case and remove the (9) swash plate, (11) piston, (40) spring and (10) steel ball from the (1) case.

**15. Plunger disassembly**

- * Push through a Ø10 mm bar in the (2-2) plunger Ø11 mm hole and fix with a vice then loosen the (2-2-4) plug.

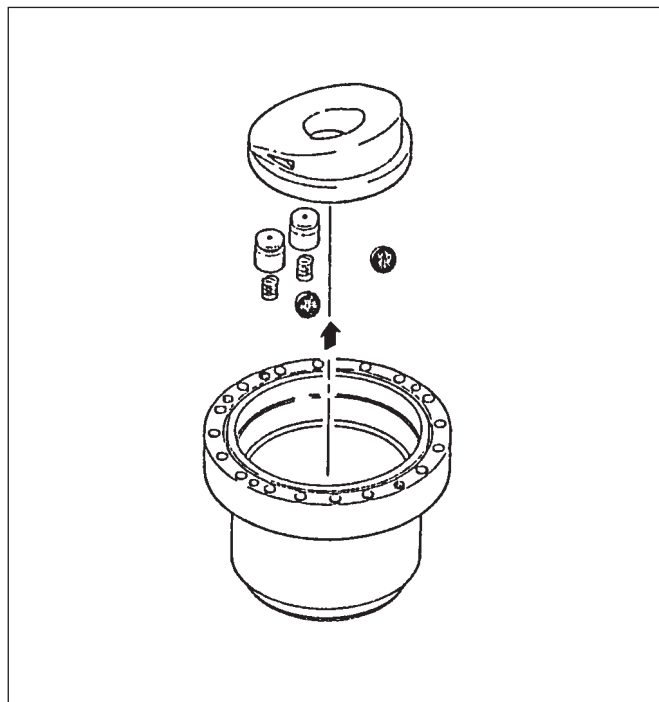
Note: Unless absolutely necessary, do not disassemble. When fixing with a vice, use a copper plate so as not to damage the plunger sliding area.

16. Remove the (2-2-3) spring and (2-2-2) check valve.

* **17. Cap disassembly**

- Remove the (2-6-2) piston and (2-6-3) spring from the (2-6-1) cap.

Note: Do not disassemble the piston unless necessary. The disassembly is now complete.



Assembly

Assembly is essentially a reverse of the dismantling procedure in the previous section.

Exchange or repair any parts not in accordance with instructions laid down in the **Maintenance Standards**.

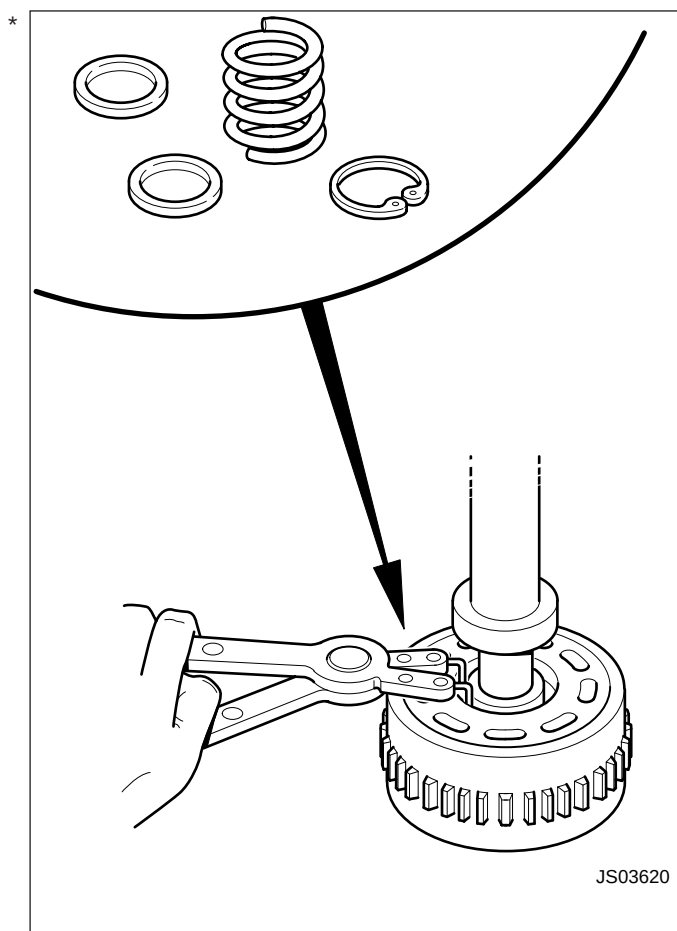
Ensure that all parts are cleaned in the appropriate solvent and dried with compressed air.

Apply a thin film of hydraulic fluid to all sliding parts, bearings and other contact surfaces before assembly.

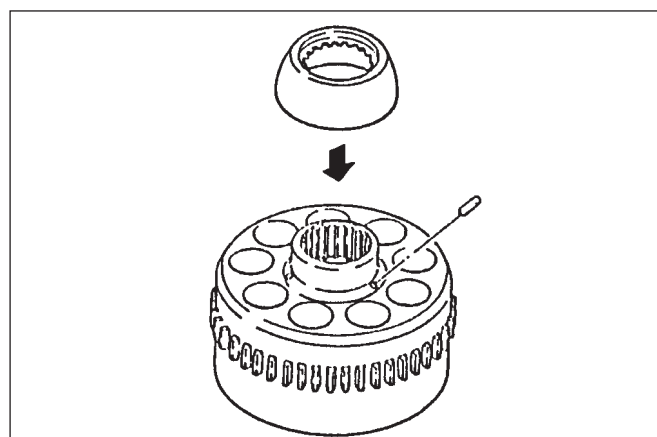
Replace all 'O'-rings and seals, where appropriate cover with petroleum jelly before fitting.

1. Cylinder block assembly

Assemble the (17) spring seat, (16) spring and (15) spring seat to the (4) cylinder block and fit the (14) snap ring.



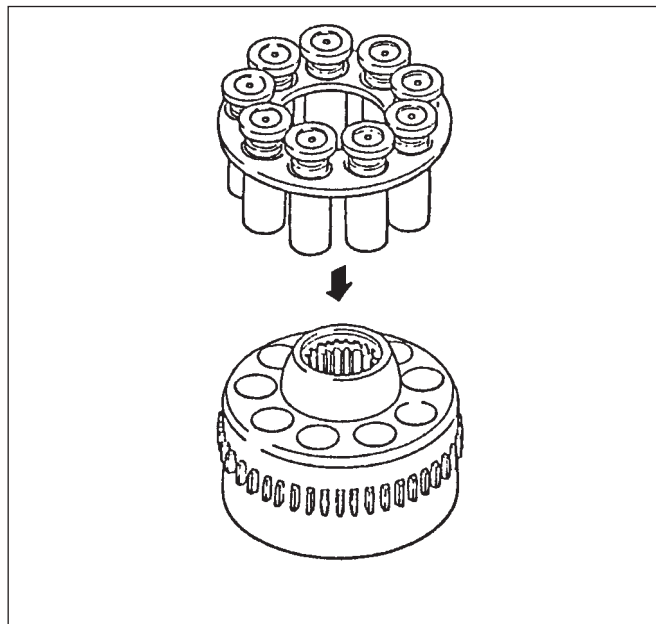
- * 2. Apply grease to the (19) pin and assemble at the three holes on the (4) cylinder block then assemble the (8) retainer holder to the (4) cylinder block.



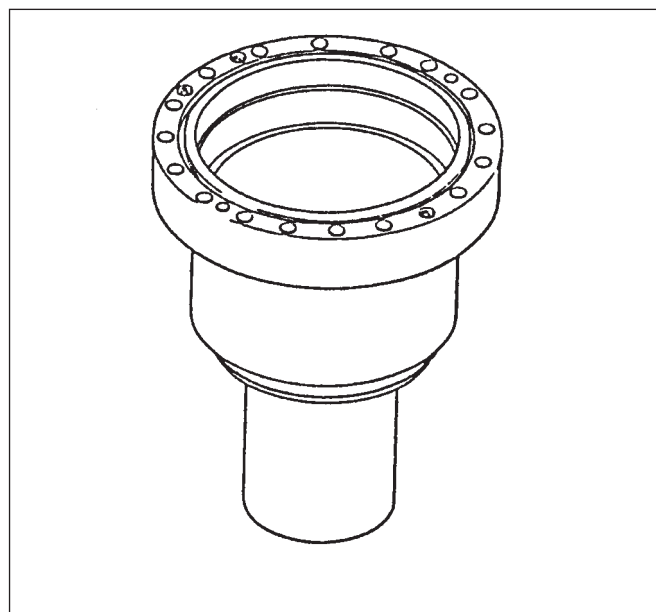
Assembly (continued)

3. Assemble the (6) piston into the (7) retainer plate and insert into the (4) cylinder block.

Note: Assemble them so that the small diameter of the inner taper of the retainer plate comes into contact with the flange of the piston shoe. Coat hydraulic oil on the piston bores of the cylinder block and then insert the piston.

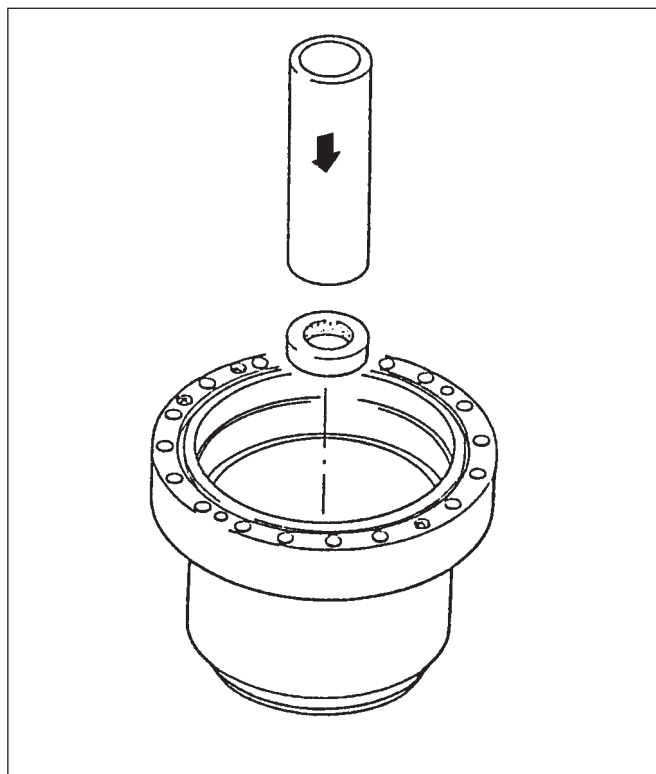


4. Fix the (1) case on the work bench.

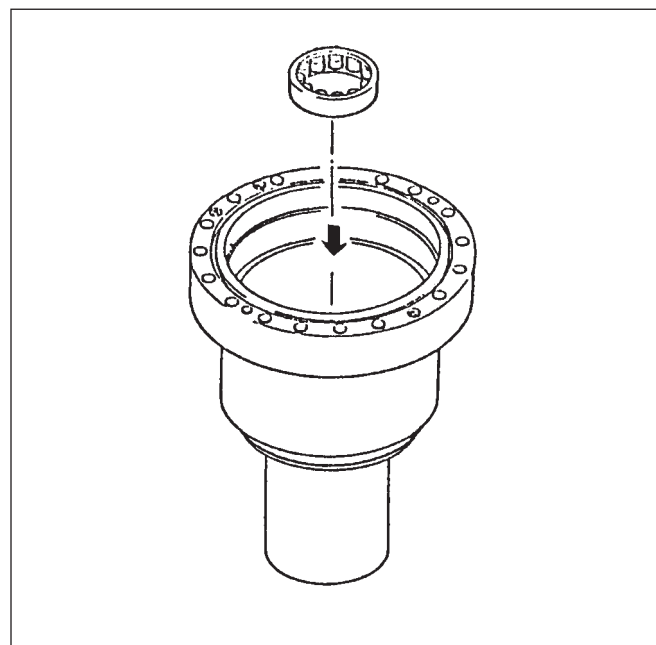


Assembly (continued)

5. Assemble the (21) oil seal to the (1) case.

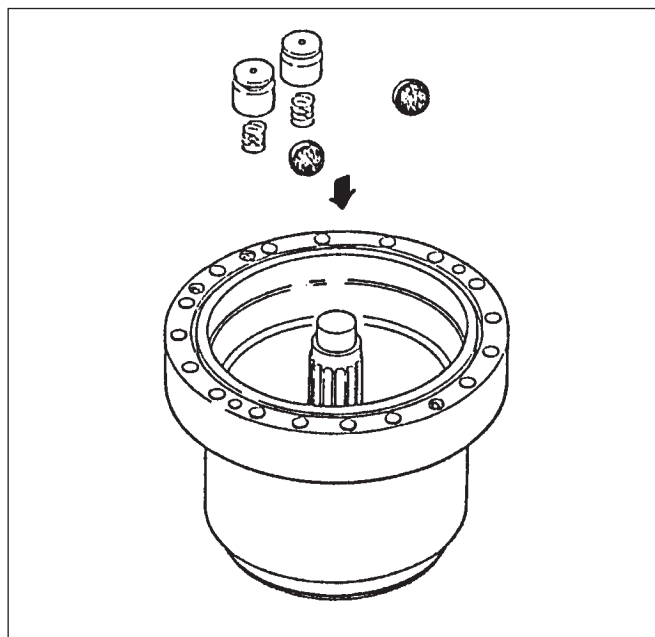


6. Assemble the (12) ball bearings into the (1) case.



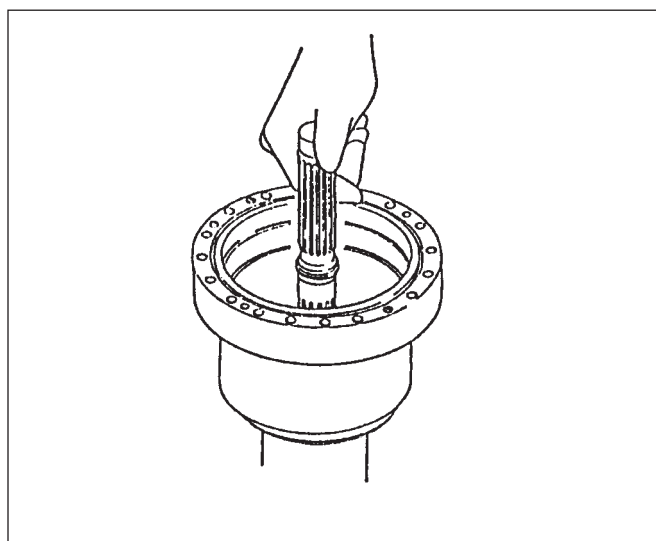
Assembly (continued)

7. Assemble the (10) steel balls, (40) spring and (11) piston into the (1) case.



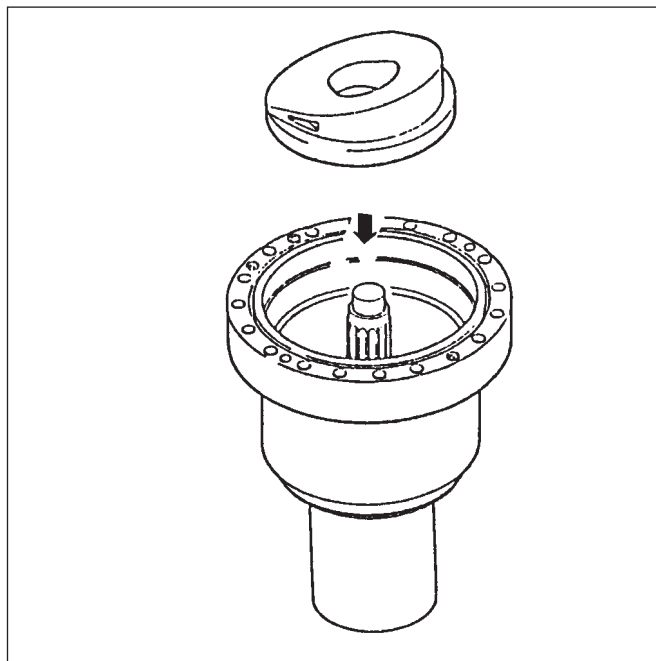
8. Install the (3) shaft into the (1) case.

Note: Be careful not to damage the oil seal lip.



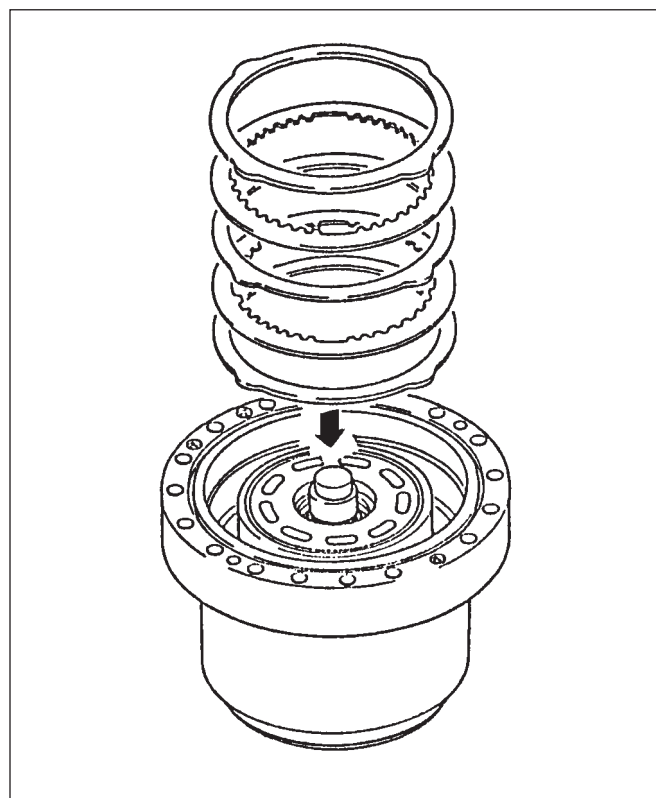
Assembly (continued)

9. Assemble the (9) swash plate to the (1) case.



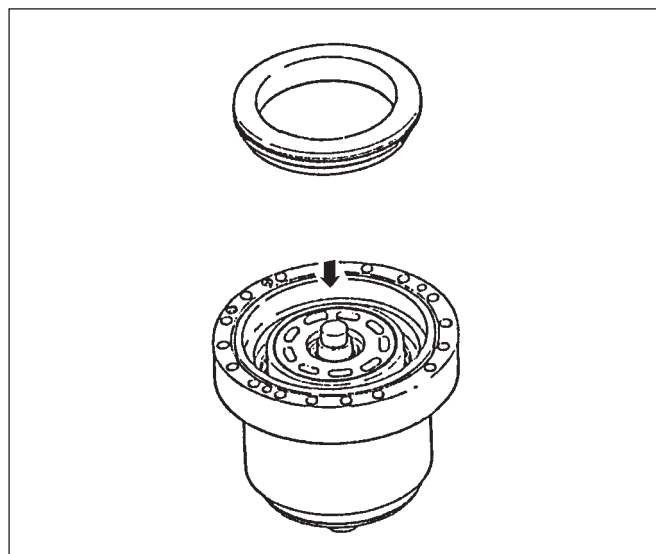
10. Place the (1) case on the work bench horizontally and insert the (4) cylinder block into the (1) case. Next, assemble the (26) disk and (27) friction plate in order.

Apply hydraulic oil to the (9) swash plate before assembling the (4) cylinder block. Check to see that the (4) cylinder block is rotating smoothly and the (6) piston is moving back and forth.



Assembly (continued)

- * 11. Assemble (30) (31) 'O'-rings which have been greased into (25) brake piston.
Assemble the (25) brake piston into the (1) case.
Align so that the two pinholes of the (25) brake piston and the two pinholes of the (1) are aligned in a straight line.



12. Place the jig for aligning the brake piston and lightly tap the head of the jig with plastic hammer evenly and insert the (25) brake piston.

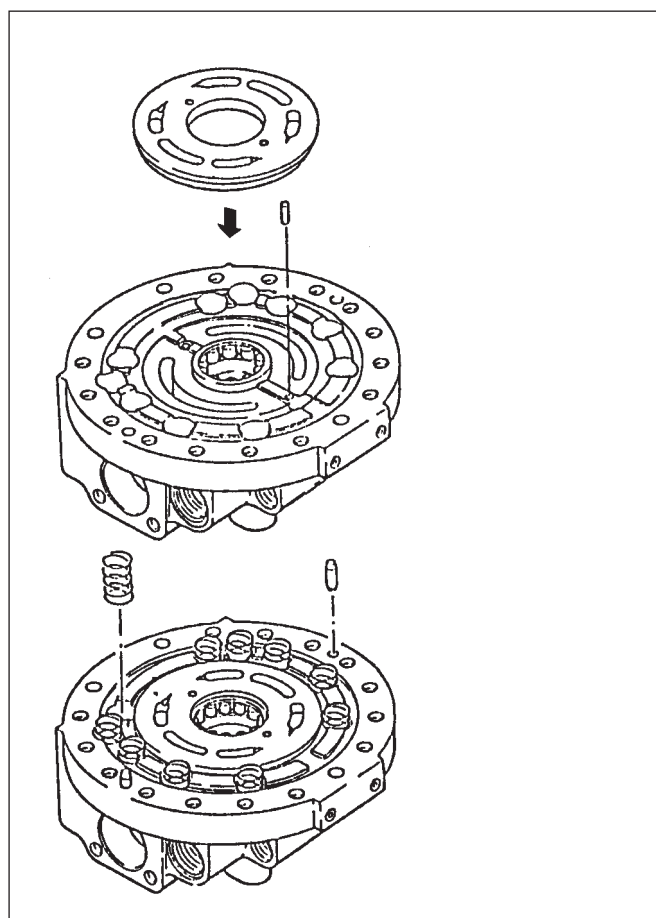
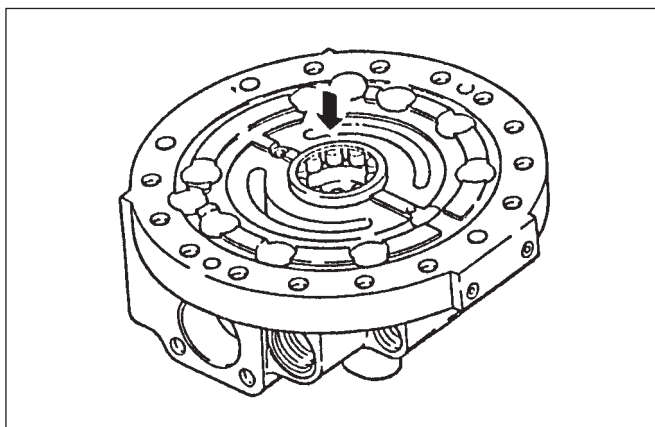
13. Assemble the (22) (33) 'O'-rings in the (1) case.

14. Fix the (2-1) base plate on the work bench and assemble the (13) ball bearing, (28) four pins, (18) pin, (5) valve plate and (29) (41) springs.

Note: Apply grease to the non-sliding areas of the valve plate and base plate.

Be careful not to damage the sliding area of the valve plate.

To prevent the springs from falling, coat them with grease.



Assembly (continued)

15. Fix the (1) case in a vice and assemble the (2-1) base plate to the (1) case and tighten with (20) socket head bolts.

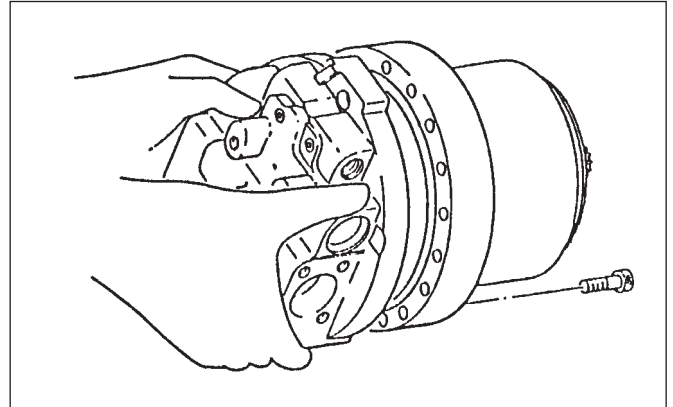
Note: Coat the sliding surfaces of (4) cylinder block and (5) valve plate with hydraulic oil.

Be careful not to drop the (5) valve plate.

Align the (28) pin and (1) case pinhole.

Tighten the socket head bolts at the specified torque.

$108 \pm 10 \text{ Nm}$ ($11 \pm 1.0 \text{ kgf/m}$, $79.5 \pm 7.2 \text{ lb/ft}$)

**16. Plunger assembly**

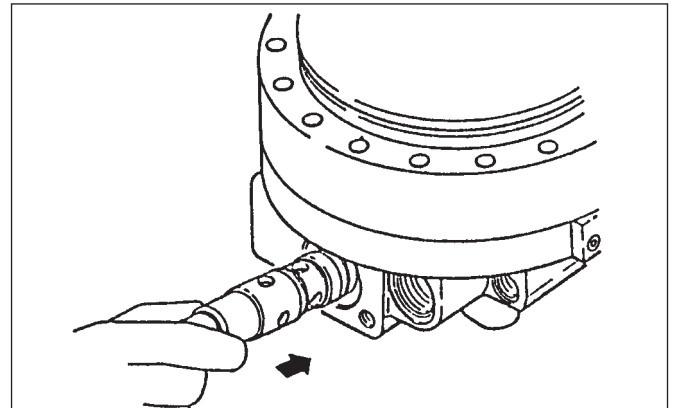
- * a. Attach $\varnothing 10$ mm bar to the $\varnothing 11$ mm hole of the (2-2-1) plunger and fix with a vice. Assemble the (2-2-2) check valve and (2-2-3) spring in order.
- b. Assemble (2-2-4) plug which has (2-2-5) 'O'-ring attached to it into the (2-2-1) plunger and tighten to the specified tightening torque. $137 \pm 10 \text{ Nm}$ ($14 \pm 1.0 \text{ kgf/m}$, $101.2 \pm 7.2 \text{ lb/ft}$)

- * 17. Assemble the (2-2-1) plunger into the (2-1) base plate.

Note: Coat the plunger sliding part with hydraulic oil and then assemble it.

Slowly turn the plunger as you assemble it.

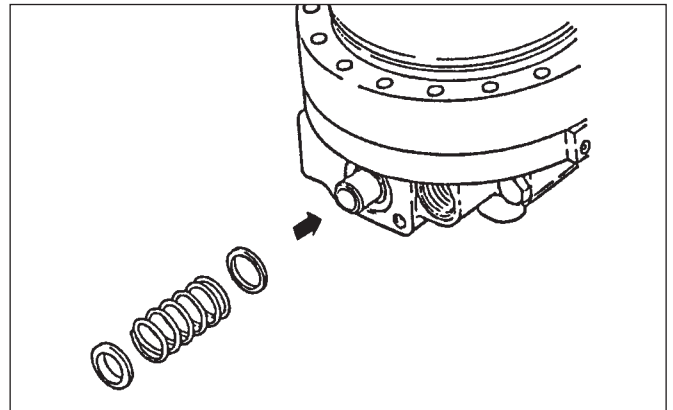
Check that the plunger moves smoothly.

**18. Cap Assembly**

Assemble the (2-6-3) spring and (2-6-2) piston in order to the (2-6-1) cap.

Assembly (continued)

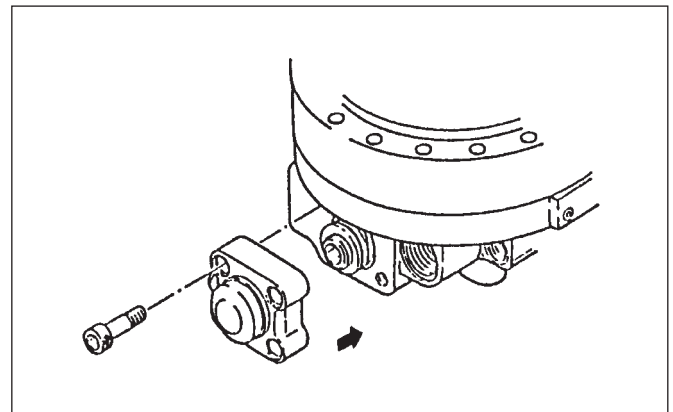
19. Assemble the (2-3) spring and (2-5) spring seat in order.



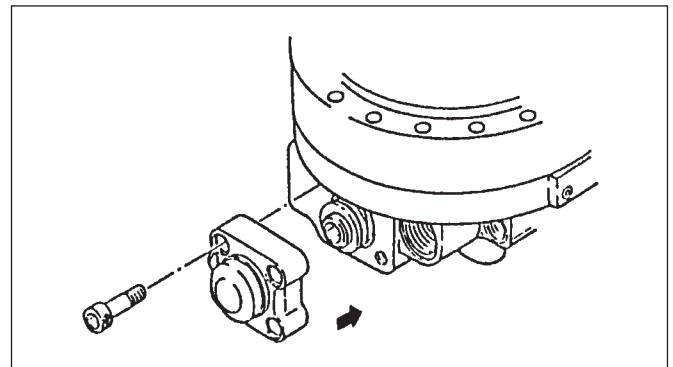
20. Assemble the (2-6-1) cap to the (2-1) base plate and fasten with (2-6-5) socket head bolts.

Note: Because it is pushed upwards by the spring, press down by hand and tighten the socket head bolts to the specified tightening torque.

* $108 \pm 20 \text{ Nm}$ ($11 \pm 2 \text{ kgf/m}$, $79.5 \pm 14.75 \text{ lb/ft}$).



21. Assemble the (2-7) relief valve (S/A) to the (2-1) base plate and tighten to the specified torque. $373 \pm 20 \text{ Nm}$ ($38 \pm 2 \text{ kgf/m}$, $274.85 \pm 14.47 \text{ lb/ft}$).



22. Assemble the (2-9) valve assembly to the (2-1) base plate.

Note: Take care to assemble the valve in the correct order. If assembled in reverse, the motor may become damaged.

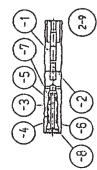
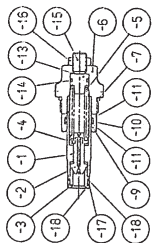
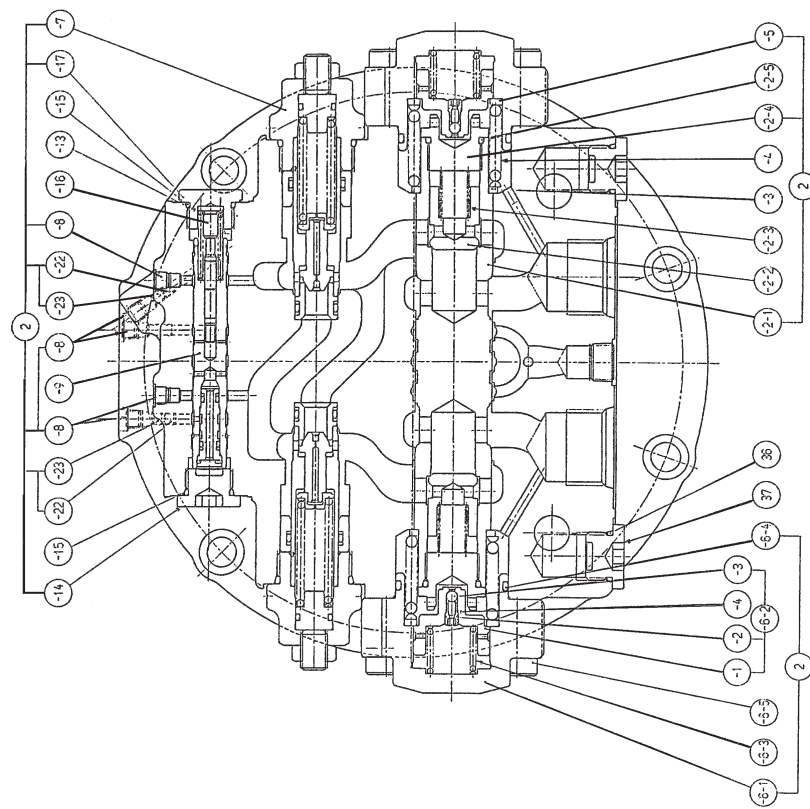
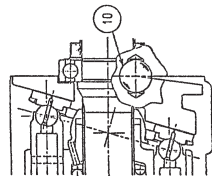
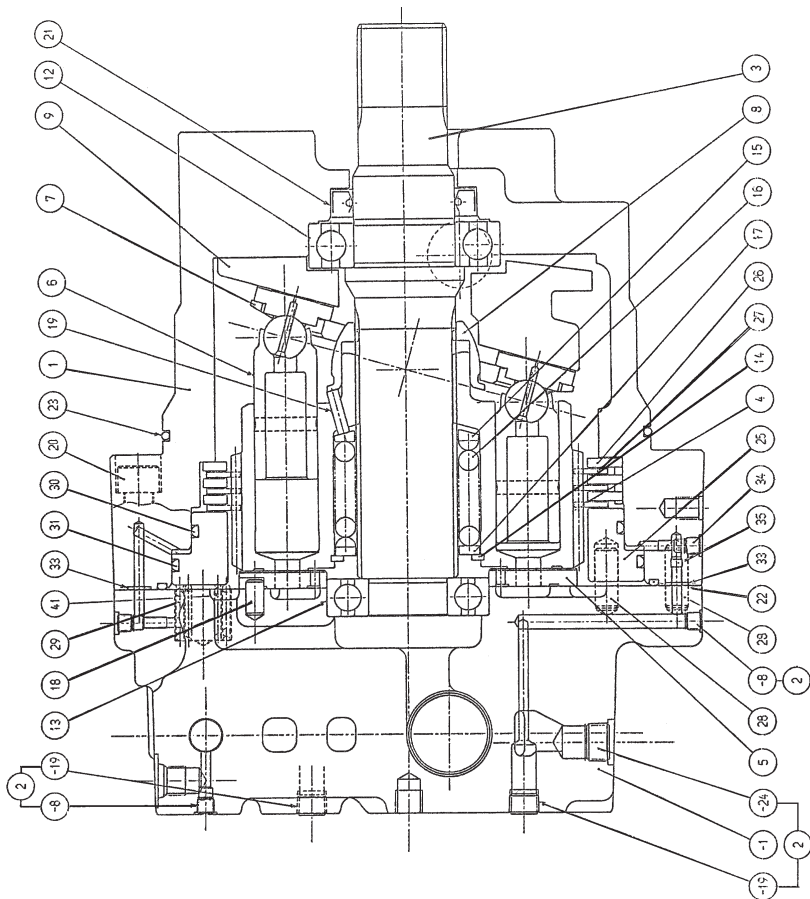
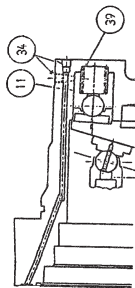
23. After assembling the (2-14) plug, tighten to the specified torque.

- a. Next, assemble the (2-16) spring guide, (2-13) spring to the (2-17) plug and then assemble it to the (2-1) base plate.

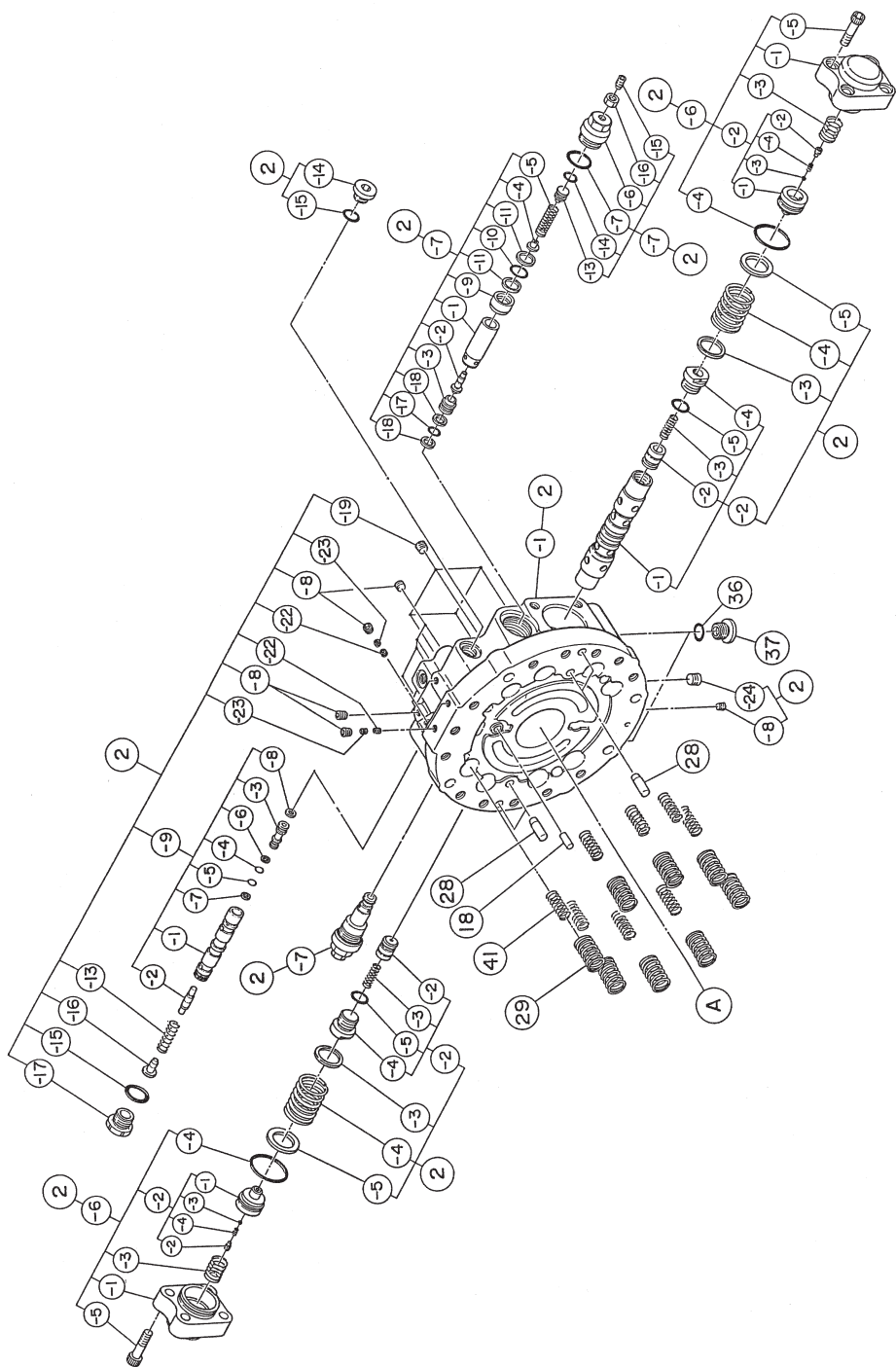
Note: Tighten (2-17) plug to the specified torque. $118 \pm 5.9 \text{ Nm}$ ($12 \pm 0.6 \text{ kgf/m}$, $86.8 \pm 4.27 \text{ lb/ft}$).

24. The motor can now be mated to the gearbox using a new 'O' ring in the groove on the motor and using the three socket head screws.

*



JS03550



Maintenance Specifications

If the seals are disassembled, replace them even though no damage is observed.

Part Name	Appearance	Standard Value	Allowable Value	Replaceable Part
(6) Piston	1. Deeply scarred or rough surface is observed on sliding area.			Cylinder block kit
	2. The clearance to the block bore is excessive.	0.030	0.060	
	3. Backlash is excessive in shoe ball section.	0.15	0.4	
(4) Cylinder Block	1. Deeply scarred or rough surface is observed on sliding area.	Roughness 0.2a	No seizure and scar deeper than 0.02mm	Cylinder block kit See note 1. When scar cannot be completely removed, replace.
	2. The inside of the bore is excessively worn.			
	3. The engaged tooth is abnormally worn or broken.			
(5) Valve Plate	1. Deeply scarred, thermally seized, unevenly worn or rough surface is observed on sliding area.	Roughness 0.2a	0.8a No seizure and scar deeper than 0.02mm	Cylinder block kit See note 1. When scar cannot be completely removed, replace.
(7) Retainer Plate (8) Retainer Holder	1. Deeply scarred, thermally seized, unevenly worn or rough surface is observed on sliding area.	Roughness 0.2a	0.8a	Retainer plate kit
(9) Swash Plate	*1. Deeply scarred, thermally seized, unevenly worn or rough surface is observed on sliding area.	Roughness 0.2a	0.8a No seizure and scar deeper than 0.02mm	* Swash plate steel ball See note 2. When scar cannot be completely removed, replace.
	*2. Deeply pitted, thermally seized on the contact area with the steel ball.	* Ball seating depth 14.3	* Ball seating depth 14.5	* Swash plate steel ball See note 2. When scar cannot be completely removed, replace.

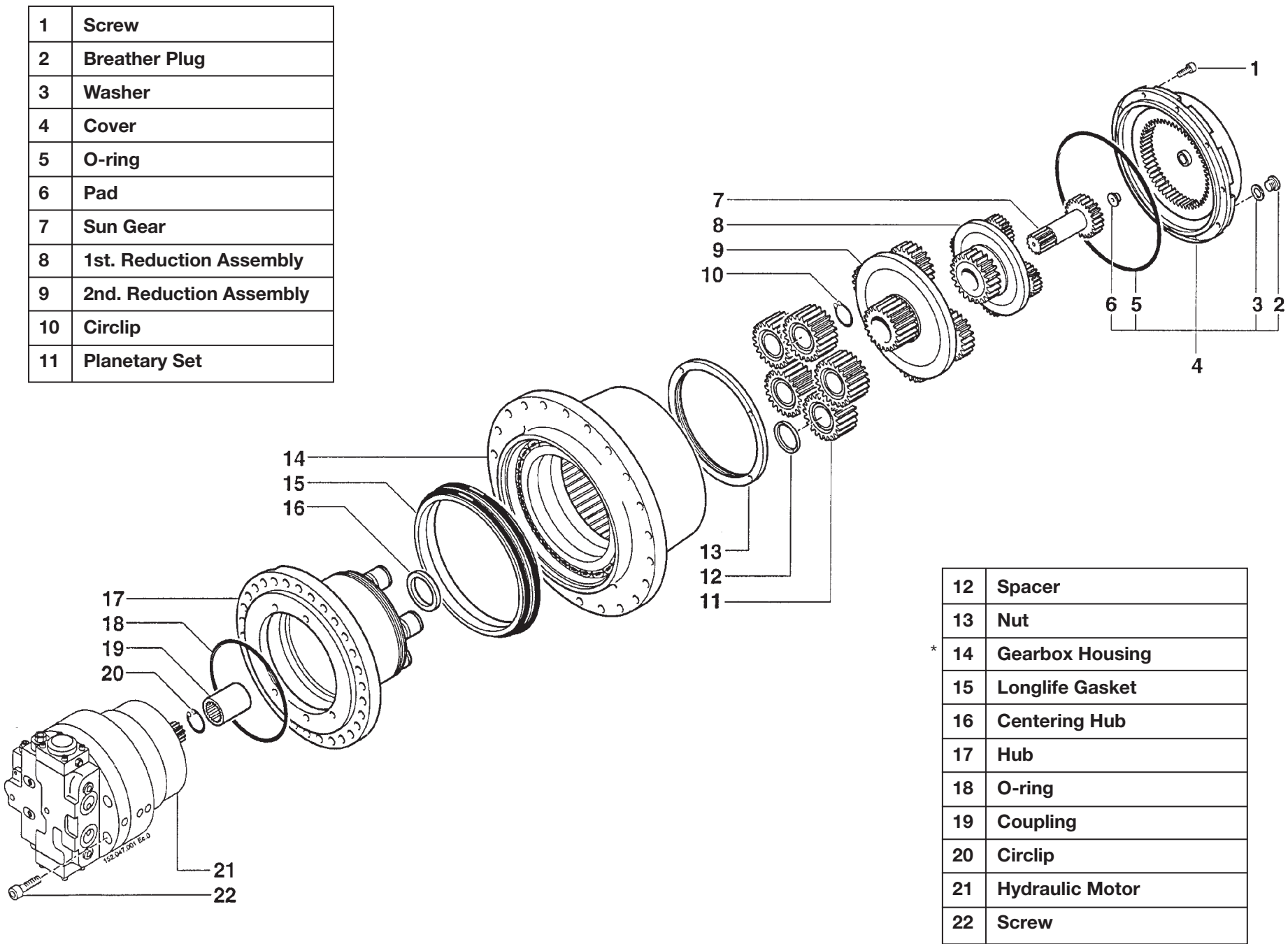
* **Note 1.** Lap, using very fine grade paste.

* **Note 2.** Use very fine grade paste and lap with a steel ball.

Maintenance Specifications (continued)

Part Name	Appearance	Standard Value	Allowable Value	Replaceable Part
(3) Shaft	1. Sliding area of the (21) oil seal is deeply scarred or rough surface is observed.			Cylinder block kit
	2. Abnormally worn or broken teeth of the engaged teeth are observed.	0.030	0.060	
(25) Brake piston	1. All sliding areas are deeply scarred or rough surface is observed.	0.15	0.4	
(27) Disk plate	1. The disk (wear-resistant material) is deeply scarred or has peeling.	Roughness 0.2a	No seizure and scar deeper than 0.02mm	Cylinder block kit
(12) Ball bearing	1. Flaking, peeling is observed on the TENSOMEN.			See note 1. When scar cannot be completely removed, replace.
(13) Ball bearing	2. Pressure mark is observed on the TENSOMEN.			
	3. Abnormal rotation (abnormal sound, roughness, etc.) is observed.	Roughness 0.2a	0.8a No seizure and scar deeper than 0.02mm	Cylinder block kit See note 1. When scar cannot be completely removed, replace.
(11) Piston	1. All sliding areas are deeply scarred or rough surface is observed.			
	2. Clearance with case is excessive.	* 0.020	* 0.040	
	3. Shoe ball backlash is excessive.	* 0.5	* 1.0	
(10) Steel ball	1. Seizure is observed on the contact area with the (9) swash plate.			Swash plate Steel ball

* **Note 1.** Lap, using very fine grade paste.

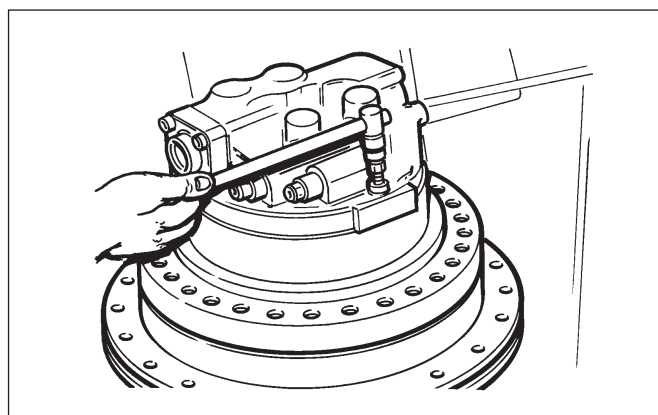


Dismantling

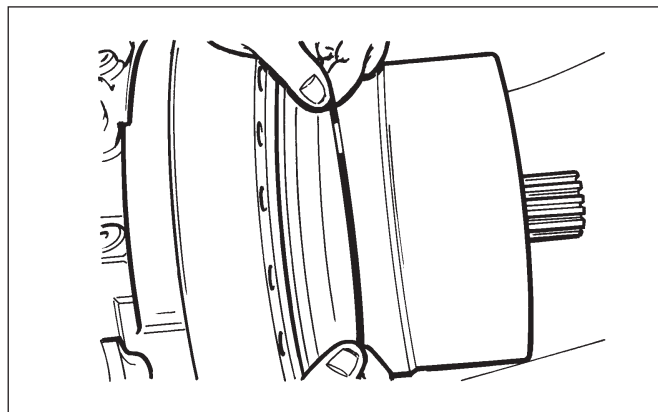
Note: The numbers in the following section refer to the illustration at the start of this Section. Before starting dismantling drain the oil. (See **Routine Maintenance**.) Clean all surfaces with a suitable solvent and dry with compressed air.

Discard all 'O'-rings and seals which are disturbed during dismantling.

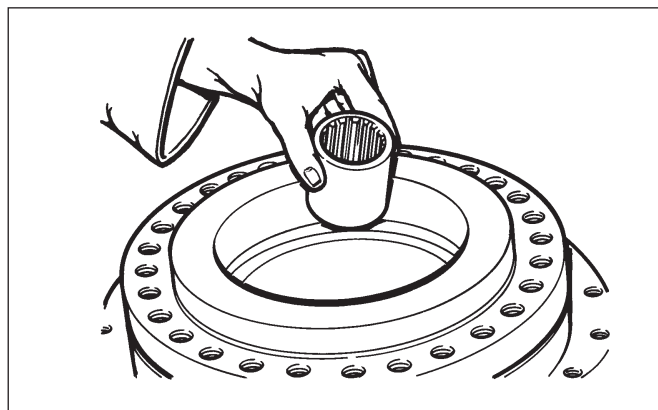
1. Remove the (22) three socket head screws, and remove the hydraulic motor from the gearbox.



2. Remove the (18) 'O'-ring, from its groove on the (21) motor.

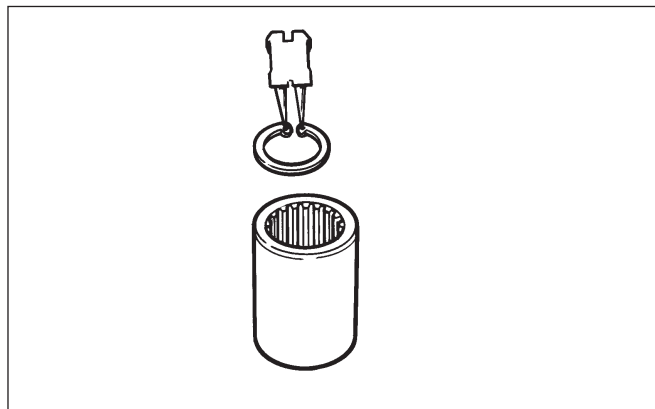


3. Remove the (19) coupling.

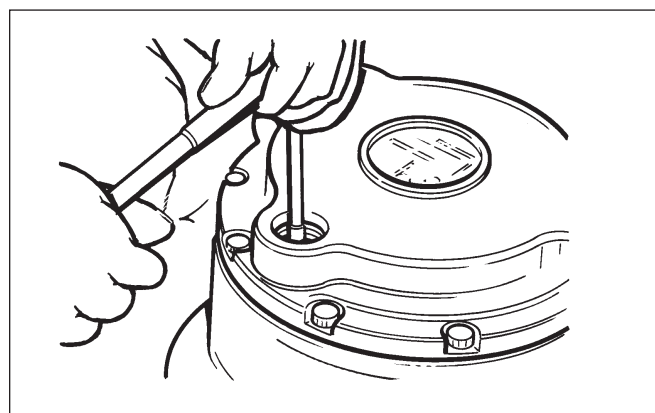


Dismantling (*continued*)

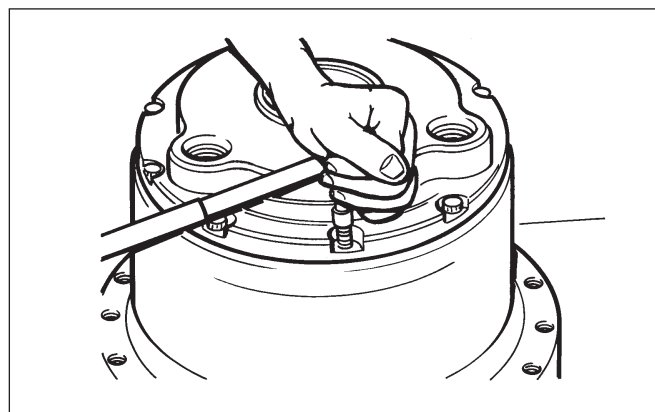
4. Using pliers remove the (20) circlip, from the (19) coupling.



5. Turn the gearbox around, unscrew and remove the (2) two plugs, from the end of the (4) cover.

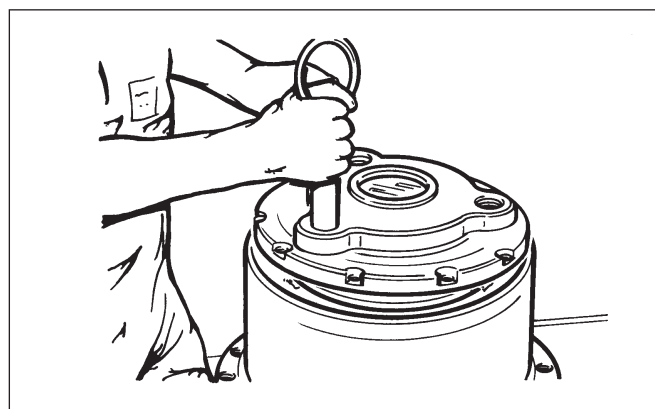


6. Remove the (1) socket head screw.



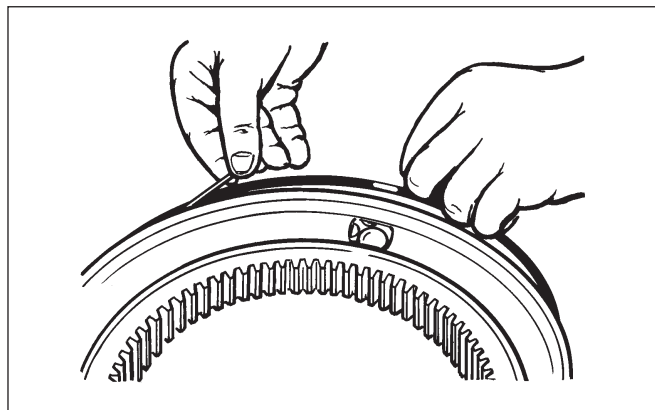
7. Remove the (4) end cover.

Note: Screws M22 x 1.5 can be inserted in the two open oil plug holes to aid the cover removal.

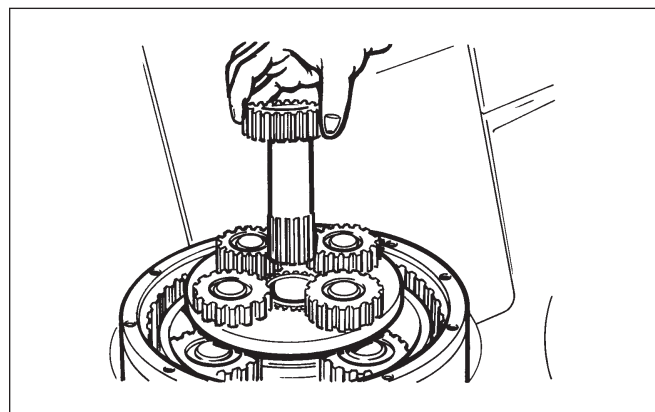


Dismantling (*continued*)

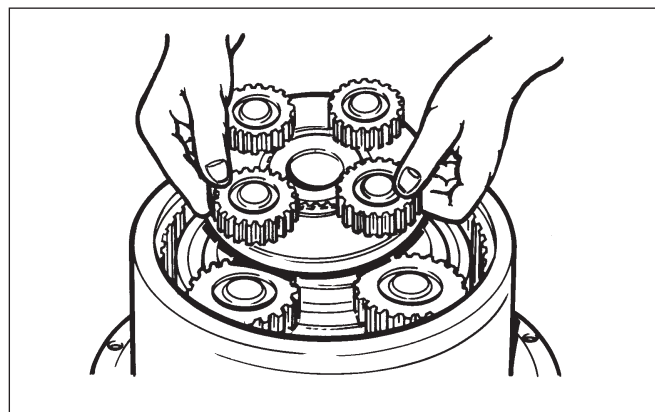
8. Remove the (5) 'O'-ring, from its groove in the (4) end cover.



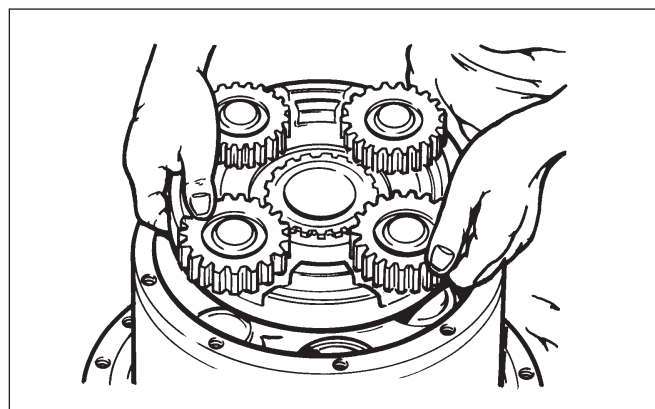
9. Remove the (7) first stage sun gear.



10. Remove the (8) first reduction assembly.

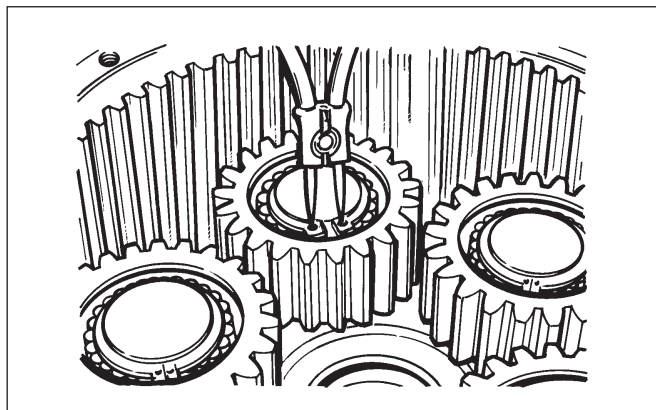


11. Remove the (9) second reduction assembly.

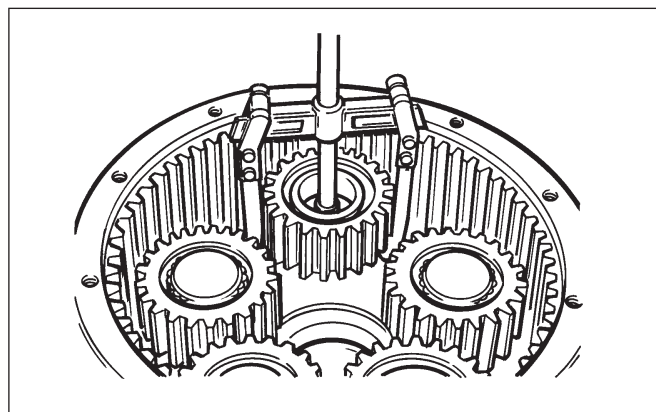


Dismantling (*continued*)

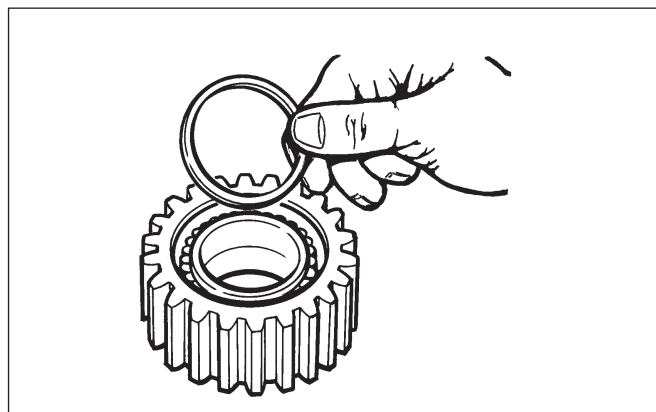
- 12.** Remove the (10) circlip, from the planet assembly of the third reduction assembly.



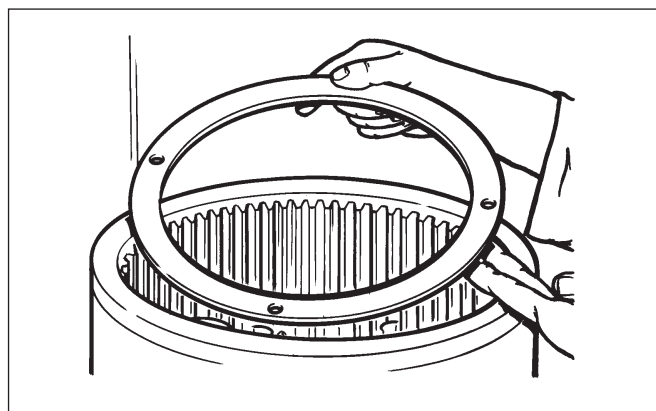
- 13.** Use a puller and remove the (11) five planet gears off the third reduction assembly.



- 14.** Remove the (12) spacers, positioned on the back of the planet gears of the third reduction assembly.



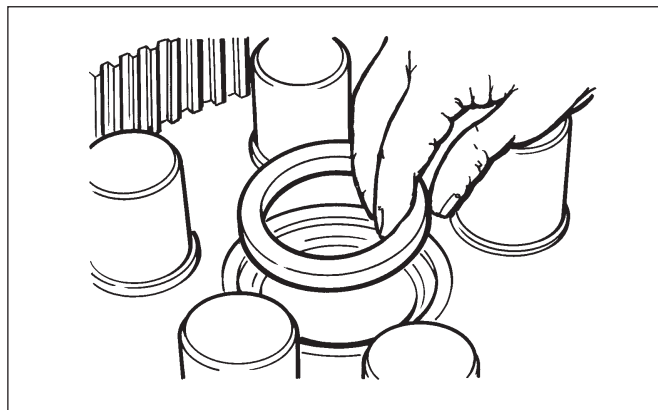
- 15.** Using a punch, remove the deformed section of the (13) ring nut. Use the special tool, unscrew the (13) ring nut.



Dismantling (continued)

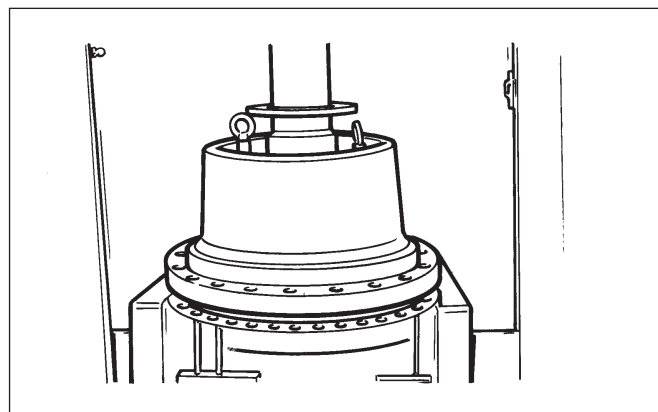
16. Remove the (16) centering ring, from the (17) flanged hub.

Note: This operation must be carried out only when the hub is to be replaced.

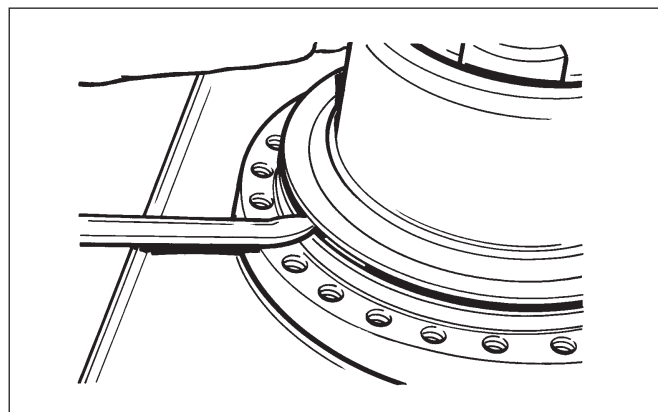


17. Using a press and a drift, remove the (17) flanged hub, from the (14) gearbox housing.

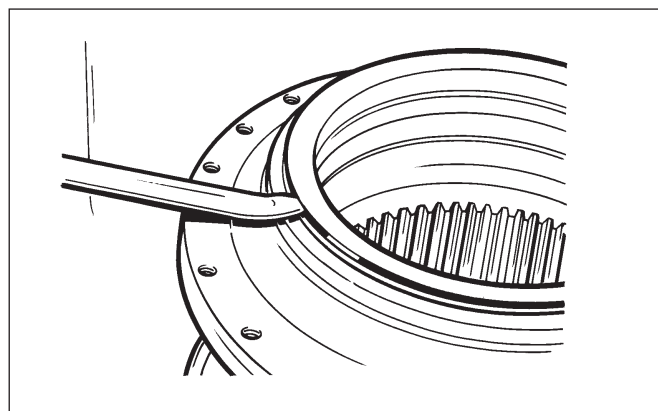
Note: To prevent oil leaks it is advisable to replace the lifetime seals, (both the metal ring and 'O'-rings) at this time. Seal replacement can only be done with the gearbox removed from the machine.



18. Remove the (15) half seal, from the (17) flanged hub.



19. Remove the (15) half seals, from the (14) gearbox housing.



Assembly

Assembly is a reversal of the Dismantling procedure.

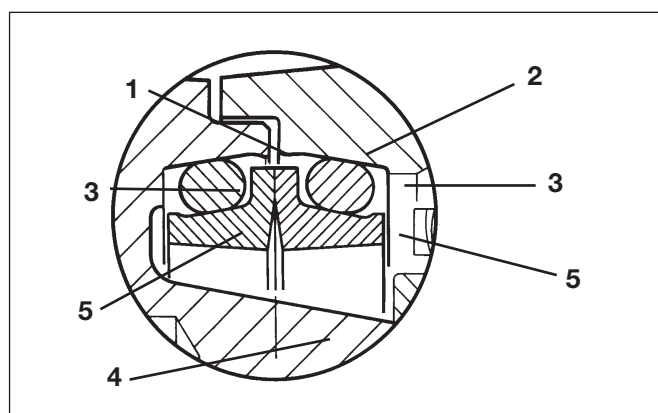
Note:

1. *Exchange or repair all parts that are found to be damaged. In the case of a damaged planet gear, do not replace the single gear but the whole reduction stage.*
2. *Ensure that all the parts are cleaned in the appropriate solvent and dried with compressed air.*
3. *Apply a thin film of hydraulic fluid to all sliding parts, bearings and other contact surfaces before assembly.*
4. *Replace all O-rings and seals and thoroughly clean the grooves that they sit in. Cover the O-rings and seals with petroleum jelly.*

Half Seal Installation

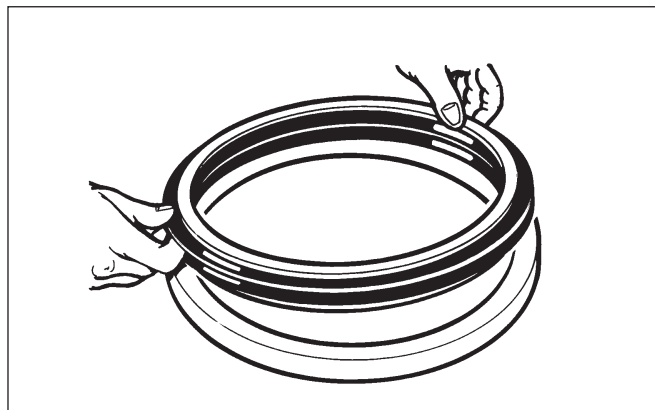
The half seals used in re-assembly require a specific technique to install. Follow the instructions detailed below.

- A. Carefully clean the seats **1** and **2** using a small wire brush or solvent. The surfaces in contact with the O-ring **3** must be perfectly clean and dry.
- B. Make sure that the sealing surfaces **4** of the metal rings are free from scratches and abrasions and foreign substances and are clean and dry.
- C. Carefully clean the contact surface of the metal rings **5** and remove dust and fingerprints. Lubricate them with a thin film of oil. Take care not to oil the other components.

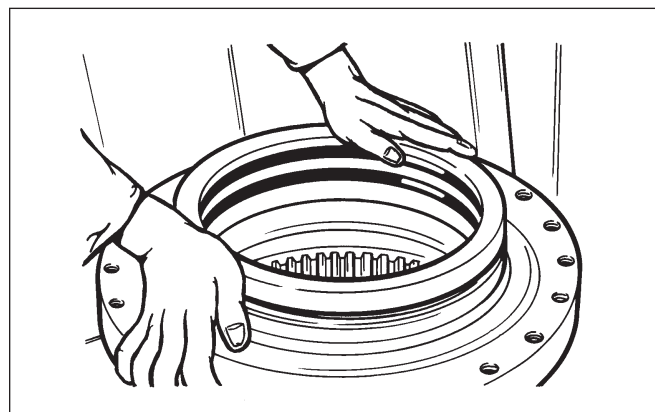


Assembly (continued)

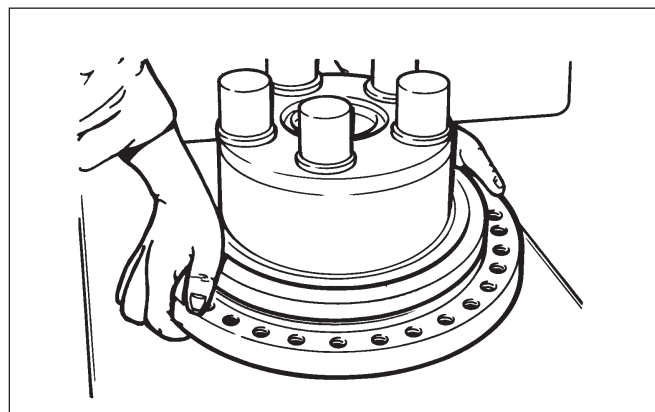
1. Fit a (15) half seal, on the tool.



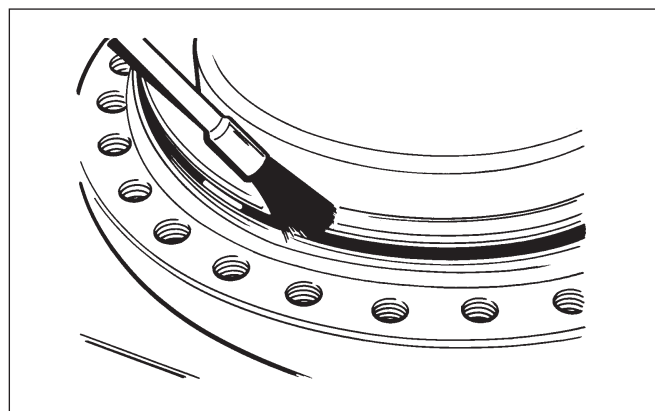
2. Fit the (15) half seal, inside the (14) gearbox housing.



3. Assemble, by using the same tool, the (15) half seal, on the (17) flanged hub.
Carefully clean the metal faces of the half seals.

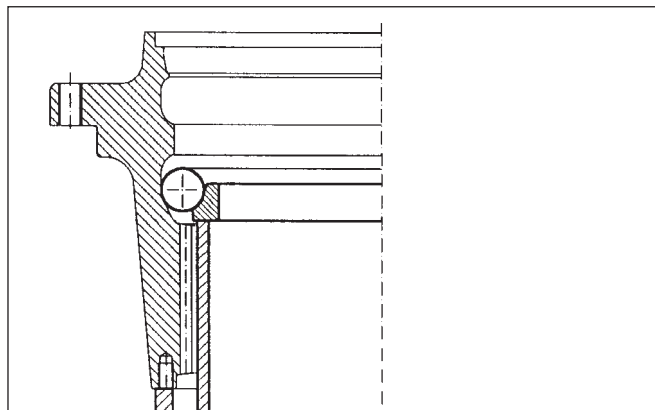


4. Lubricate the metallic face of the half seal with a thin film of oil.

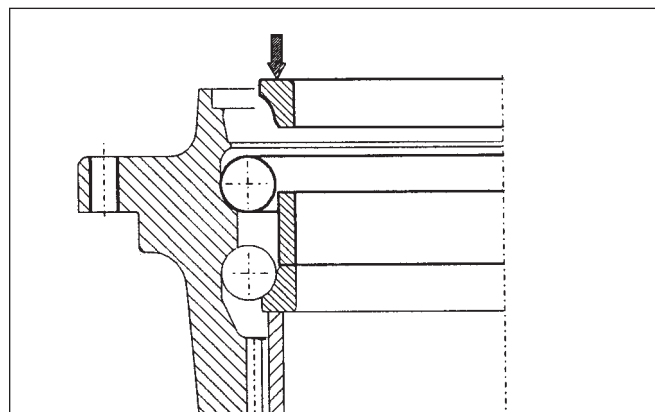


Assembly (continued)

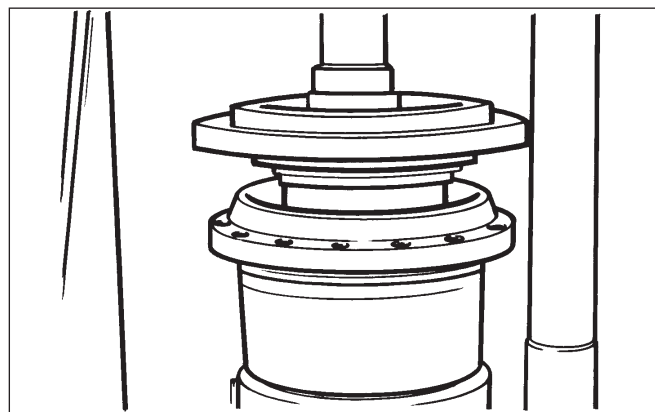
5. Fit the lower ball bearing sets in the housing, holding the inner raceway in position with the spacer tools **S1** and **S2**.



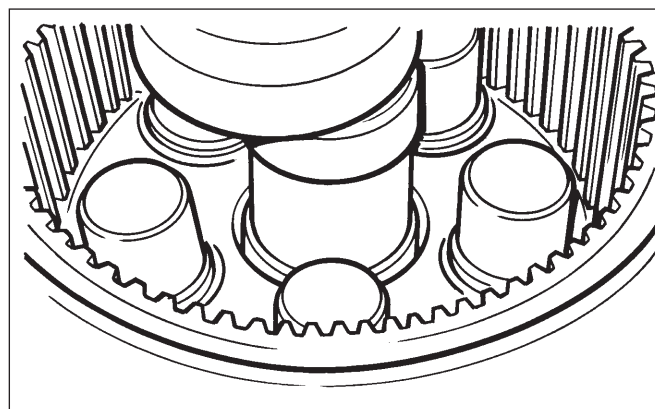
6. Place the bearing spacer into position and drop the upper ball bearing sets into position. Then fit the inner race.



7. Place the (17) flanged hub, inside the (14) gearbox housing. Using a press and a metal drift, push the (17) flanged hub, against the shoulder on the (14) gearbox housing, until it is seated.

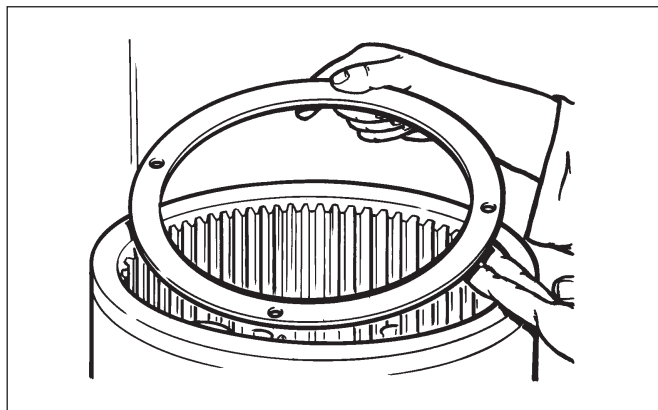


8. By using a press and a drift, assemble the (16) centering ring onto the (17) flanged hub.

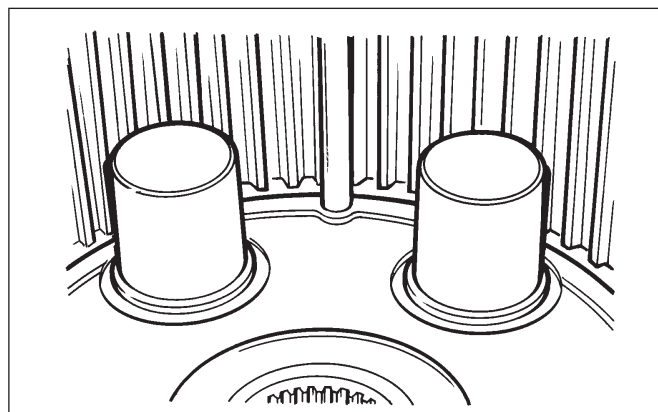


Assembly (continued)

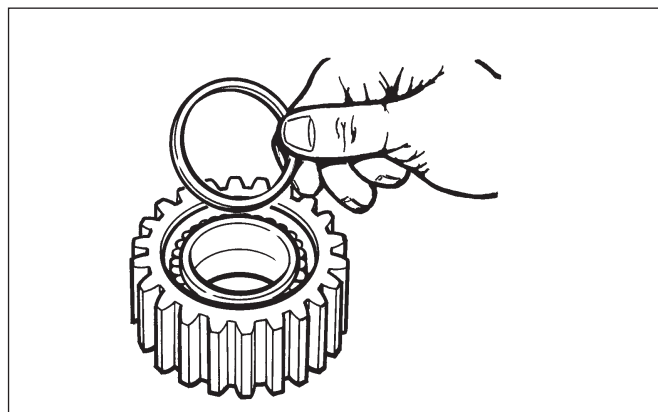
9. Using the special tool screw a new (13) ring nut.



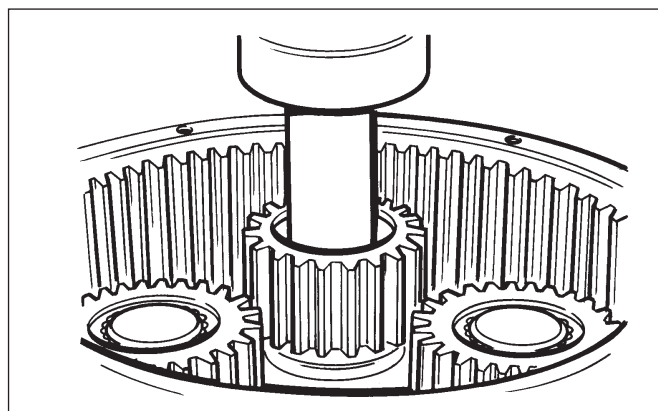
10. Deform the (13) ring nut, at a position next to a space on the (17) flanged hub.



11. Place the (12) spacers, on the back of the planet gears of the third reduction assembly.

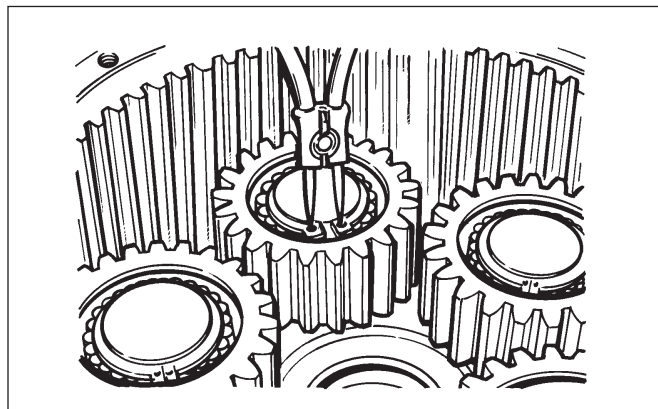


12. Place the (11) five planet gears of the third reduction assembly onto the (17) flanged hub.
Using a press, push on the special tool until assembly of the (11) five planet gears onto the (17) flanged hub is complete.

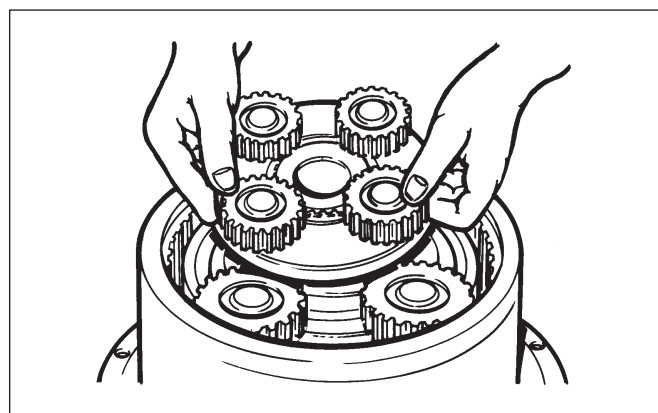


Assembly (continued)

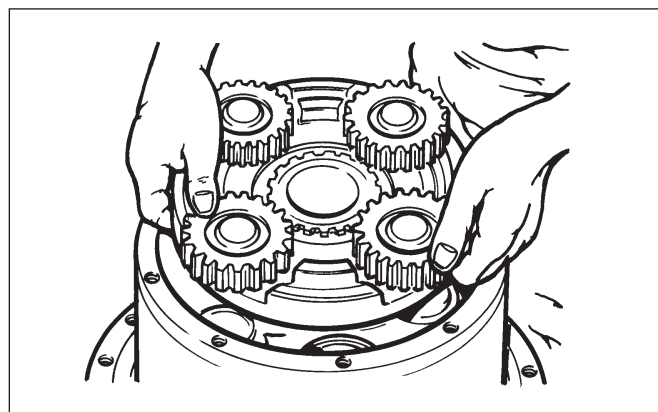
- 13.** Using circlip pliers, place the (10) circlip, into its groove.



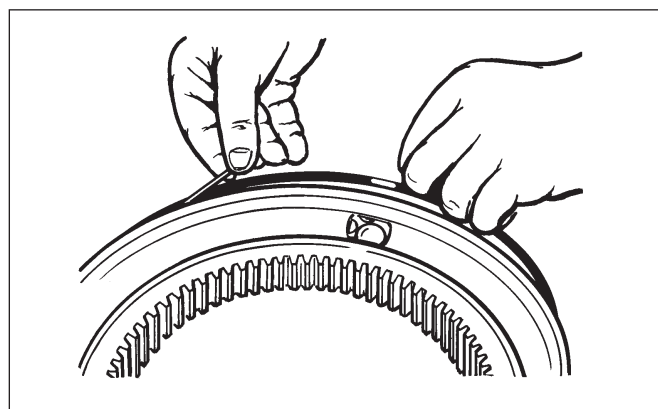
- 14.** Insert the (9) second reduction assembly.



- 15.** Insert the (8) first reduction assembly.

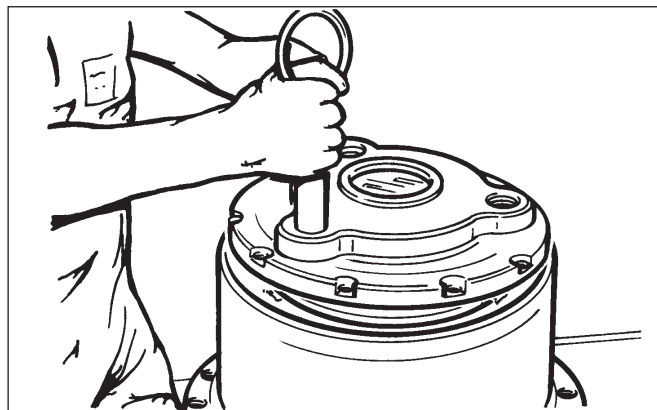


- 16.** Position the (5) O-ring, into its groove in the (4) end cover.

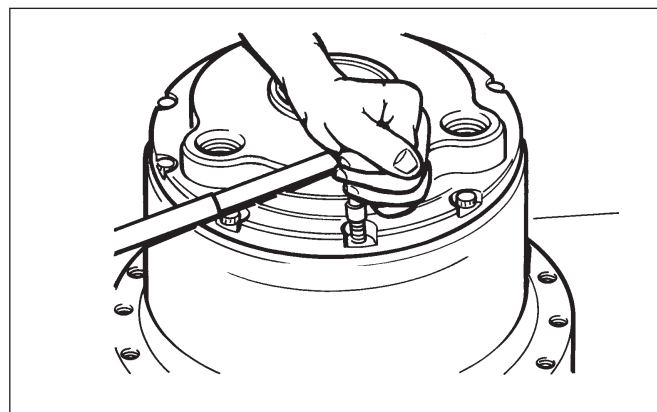


Assembly (continued)

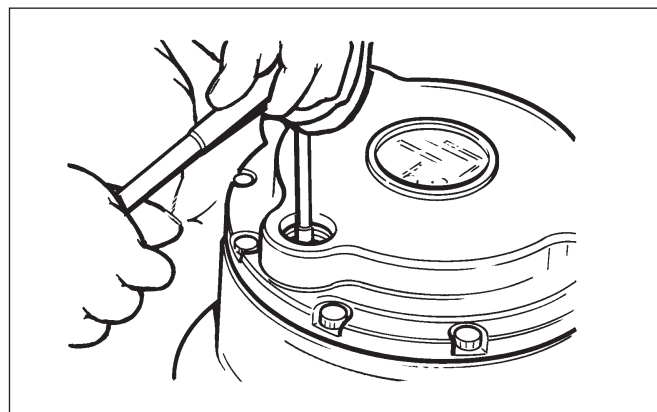
17. Fit the (4) end cover, on the (14) gearbox housing.



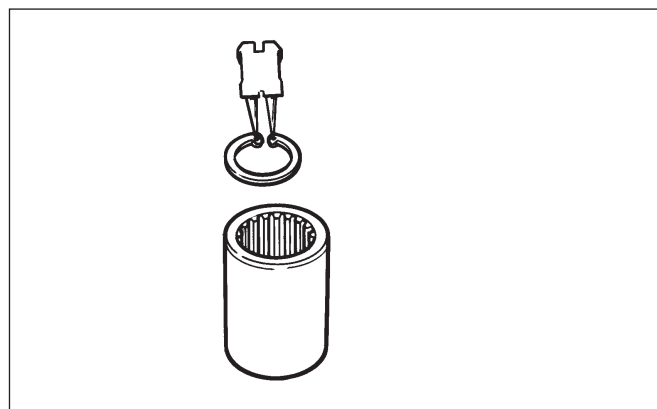
18. Fix the (4) end cover, with the (1) socket screws.



19. Tighten the two plugs, **Item 2**.

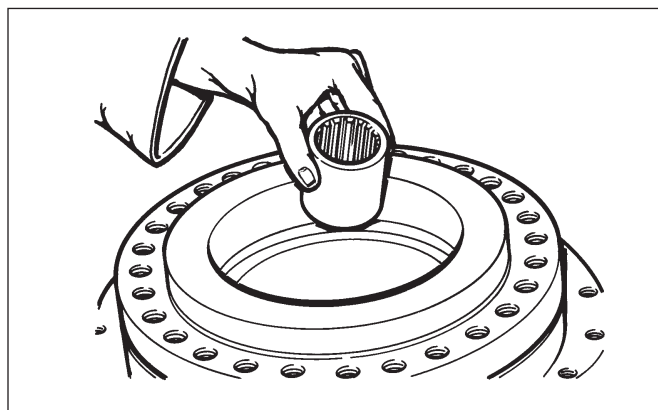


20. Rotate the gearbox and by means of circlip pliers, place the (20) circlip, into its groove inside the (19) coupling.

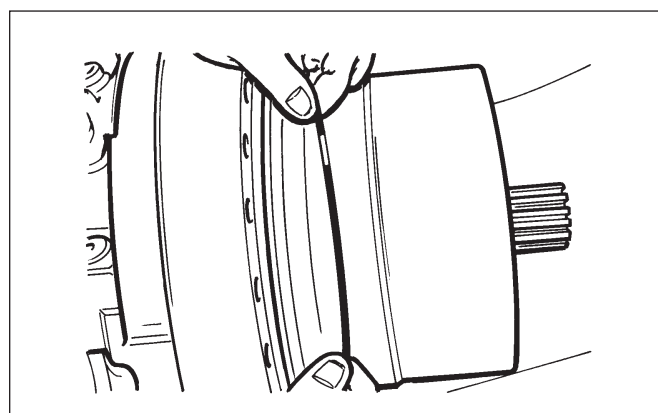


Assembly (continued)

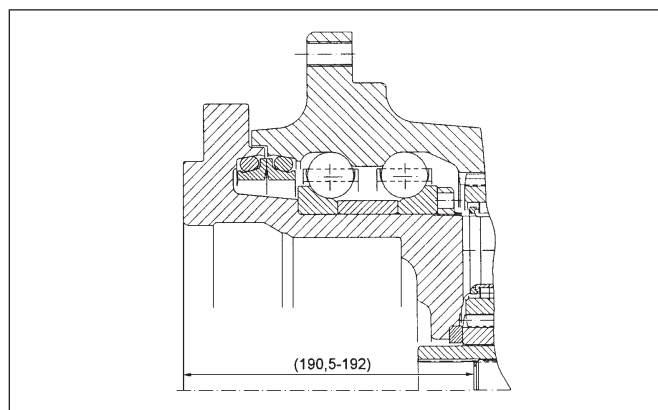
21. Insert the (19) coupling.



22. Fit the (18) O-ring into the groove on the (21) hydraulic motor.



23. After mounting the (17) hub into the (14) bearing assembly, check the axial dimension of the gearbox determined by the input side shoulder of the (17) hub, with the (20) circlip, inside the (19) coupling.



24. Position the (21) hydraulic motor into the gearbox and secure the (22) socket screws.

The gearbox should now be filled with the correct amount and grade of oil. See **Lubricants and Capacities**. The assembly is now complete.

