KM051-00

UH031

UH031 SPECIFICATIONS

1. ENGINE

For Engine Service Data other than this service manual, refer to ISUZU DIESEL ENGINE WORKSHOP MANUAL.

1.1 General Specifications

Model	ISUZU 4BB1-PC
Type	4-stroke, water-cooled, in-line overhead valve, open type combustion chamber, natural aspirated diesel engine
Number of cylinders	4
Bore & stroke	102 & 110 mm
Total piston displacement	3595 cm^3
Compression ratio	17.5
Rated output	40^{+3}_{-0} kW (55^{+4}_{-0} PS) at 1950 min^{-1} (rpm)
Max. torque	216^{+15}_{-0}/1400 min^{-1} ($22^{+1.5}_{-0}$ kgfm/1400 rpm)
Fuel consumption rate	Less than 238 g/kW.hr (175 g/PS.hr) at 1950 min^{-1} (1950 rpm)
Oil consumption rate	Less than 0.7 g/kW.hr (0.5 g/PS.hr)
No load maximum rotation	2150±50 min^{-1} (2150±50 rpm)
No load minimum rotation	770±20 min^{-1} (770±20 rpm)
Dry weight	325 kg
Dimensions	Overall length; width; height 812 mm; 614.5 mm; 779.5 mm
Firing order	1-3-4-2
Rotating direction	Clockwise as viewed from fan side
Fuel system	
• Fuel injection pump	
Type	BOSCH, Type A
Plunger	Diameter 8.5 mm
• Fuel injection nozzle	
Type	Multiple holes type
Injection pressure	185 bar (185 kgf/cm^2)
• Feed pump	
Type	Plunger type
• Governor	
Model	RSV
Type	BOSCH type, mechanical, all-speed controlled

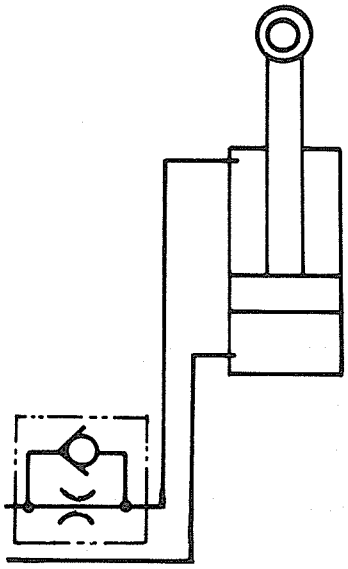
UH031 SPECIFICATIONS

18. SLOW-RETURN VALVE (BUCKET)

Model	HITACHI 9035841
Type	Fixed throttle
Flow rate	67 ℓ/min
Resistible pressure	300 bar (kgf/cm^2)
Weight	0.7 kg

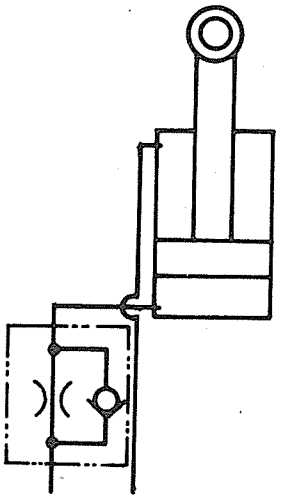
19. SLOW-RETURN VALVE (FOR ARM)

Model	HITACHI 9035828
Type	Fixed throttle
Flow rate	100 ℓ/min
Resistible pressure	300 bar (kgf/cm^2)
Weight	0.58 kg



20. SLOW-RETURN VALVE (FOR BOOM)

Model	HITACHI 9035827
Type	Fixed throttle
Flow rate	67/95 ℓ/min
Resistible pressure	300 bar (kgf/cm^2)
Weight	0.58 kg



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SWING OPERATION (Single operation)

In the single operation of swing, only oil discharged out of pump B is delivered to the swing motor. Oils discharged out of pumps A and C pass through the right control valve, and acceleration valve/left control valve respectively and return to the hydraulic tank.

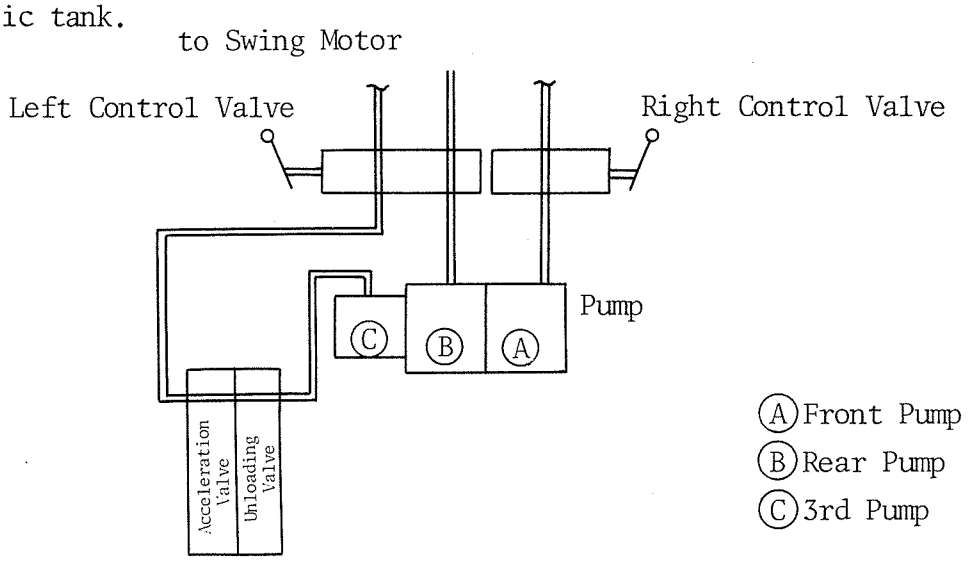


Fig. 6

Arm Operation (Single Operation)

Upon operating the arm lever in the single operation of arm, oil discharged out of pump C passes through the acceleration valve and goes into the left control valve, where it joins oil discharged out of pump B, and the oil is supplied to the arm cylinder. Thus in the single operation of arm, the arm roll-in and roll-out operations are achieved promptly.

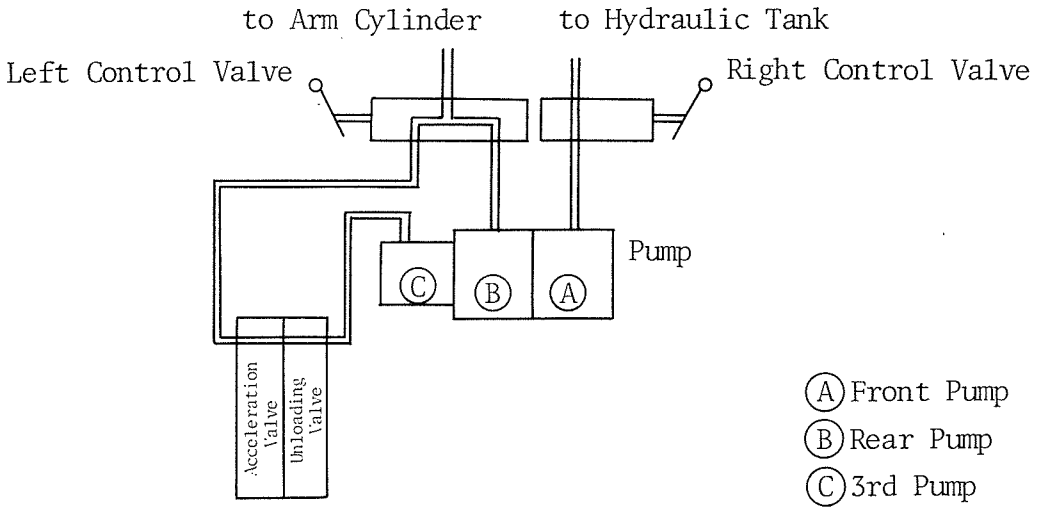


Fig. 7

BOOM LOWER OPERATION

When the boom control lever is pushed, the oil from the front pump goes through ports P_1 and BD of the right control valve to port BD of the head chamber of the boom cylinder.

The return oil expelled from the bottom chamber of boom cylinder flows into the hydraulic tank through the throttle in the slow-return valve and ports BU and T_1 of the right control valve.

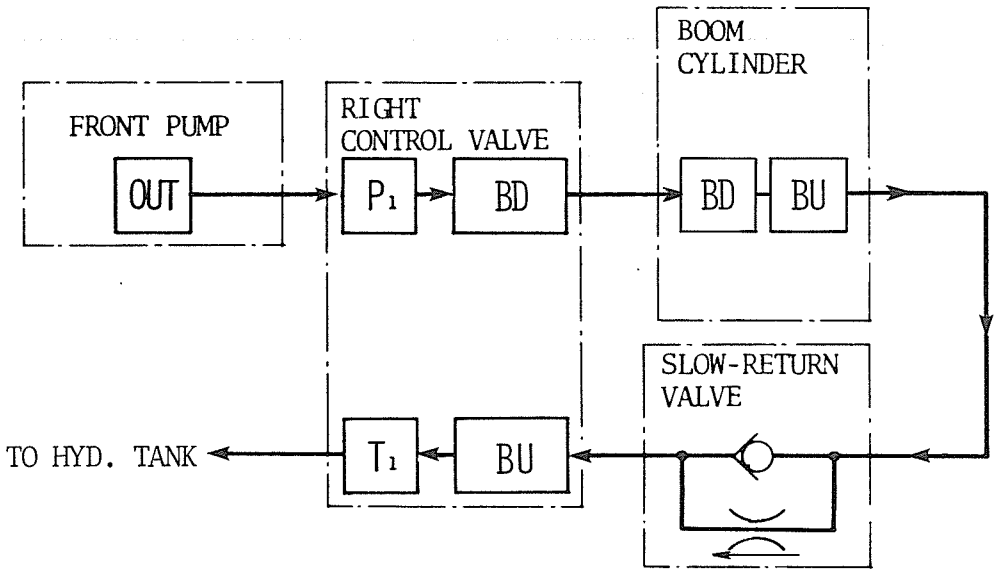


Fig. 18

The slow-return valve is provided in the boom raise circuit for preventing the boom floating phenomenon which may be happened due to a vacuum produced in the head chamber of boom cylinder in the boom lowering operation.

UH031 MAIN HYDRAULIC CIRCUIT

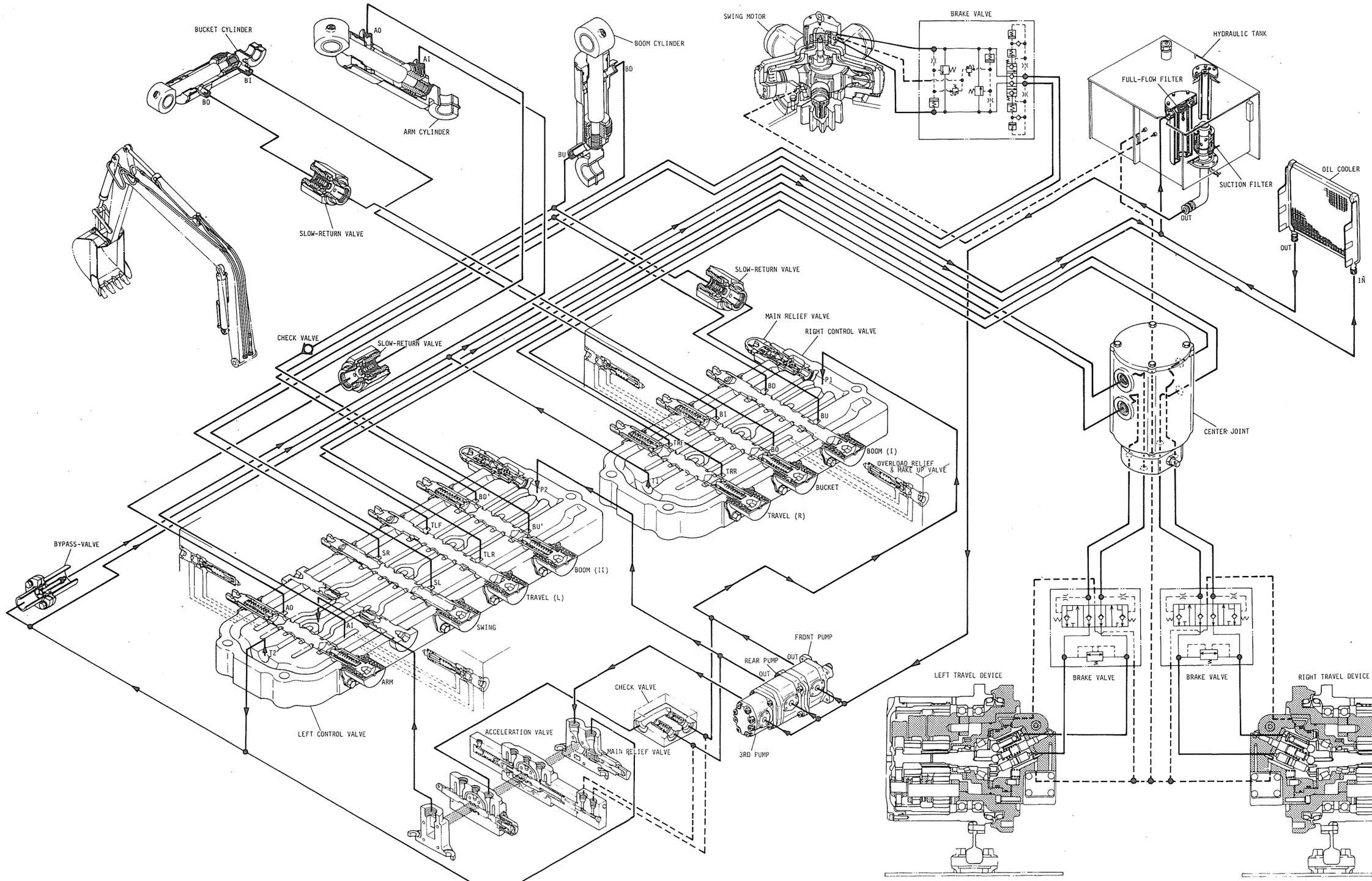
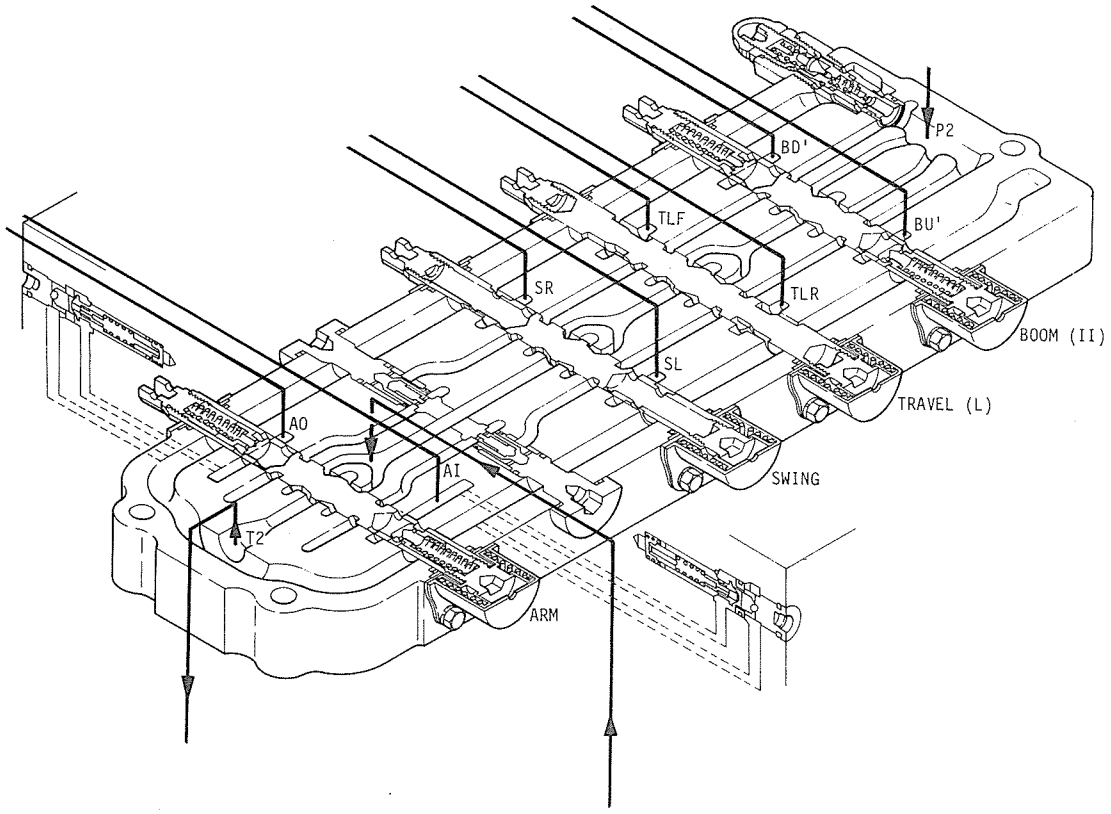


Fig. 28

MCV19 CONTROL VALVE

GENERAL

There are two types of spools in this control valve.
One is called as OPEN-CENTER spool and the other as CLOSE-CENTER spool. This control valve is of a manual operated type and all spools are connected in parallel circuit. The combination valve is installed between 3rd plunger and 4th plunger. Overload relief valve and make-up valve are provided in each actuator port of 4th plunger.



Left Control Valve

Fig. 1

SC3P-2R2V2P CONTROL VALVE

(ACCELERATION VALVE)

MRS-200X SWING MOTOR

VBR-06SR-06SG-S BRAKE VALVE

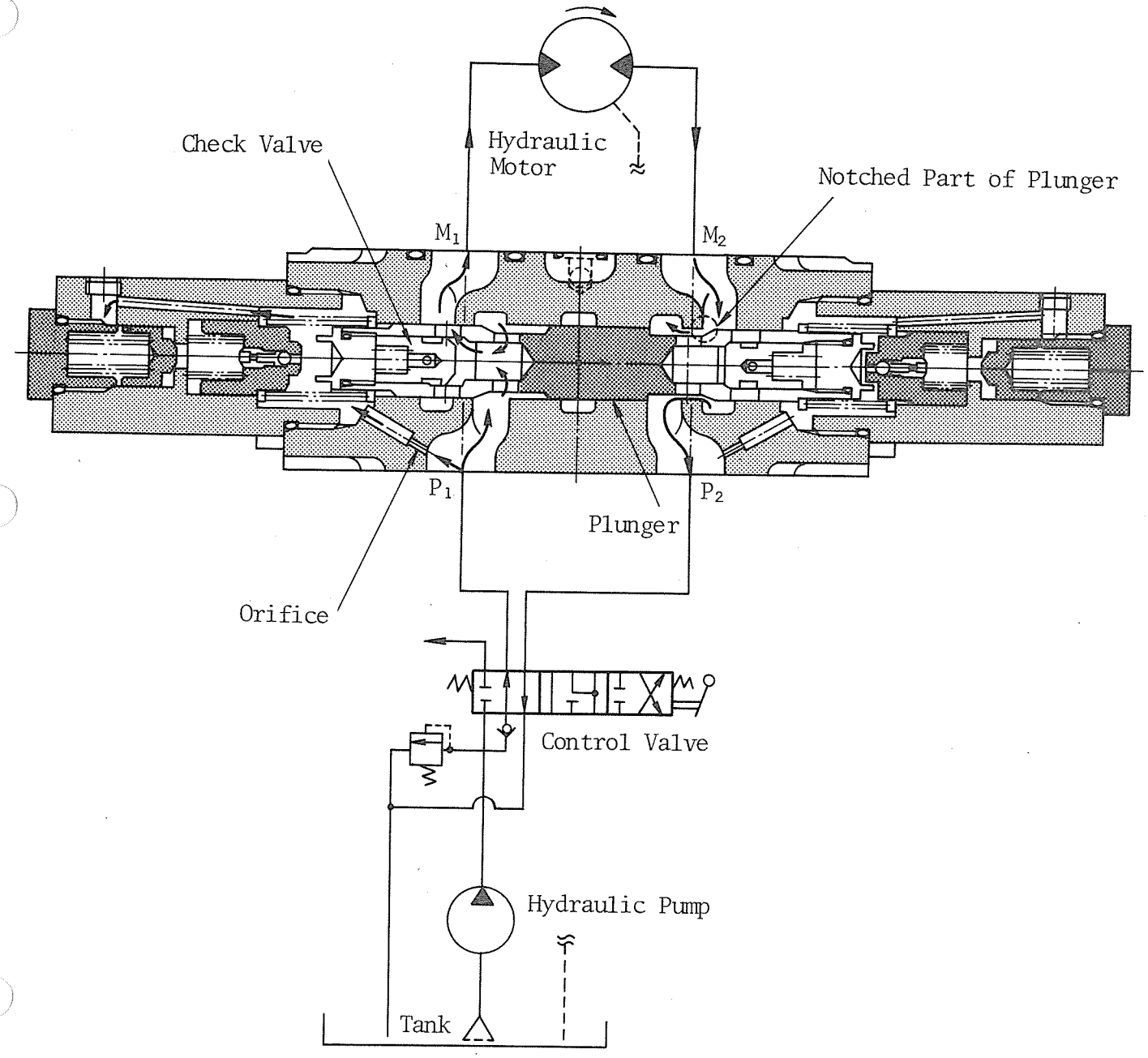


Fig. 4 Condition in driving

In this way, the throttle opening at the notched part of plunger is automatically adjusted so that the hydraulic motor can rotate at pressure at port P_1 side, i.e., at a speed corresponding to the flow rate at port P_1.

(2) In braking: See Fig. 3 and 5.

Next, when the control valve is returned to its neutral position, pressure oil fed out of the hydraulic pump is cut off, pressure levels at port P_1 and P_2 become the same and the plunger is moved back to the neutral position by a spring, whereby the notched part is closed. However, since the hydraulic motor works to still continue rotating owing to inertial energy even if the notched part is closed,

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SLOW RETURN VALVE

CONSTRUCTION

The slow return valve comprises the poppet, spring and body, as shown Fig. 1. There are the slow return valves of two types; fixed throttle and variable throttle. This valve is of a variable throttle type.

FUNCTION

If the oil displacement from the bottom end of the cylinder by retracting force of a load exceeds the charging oil into the rod end of the cylinder from the pump, a vacuum cavity will be formed in the rod end of the cylinder. The slow return valve is provided to such formation of the vacuum cavity in the cylinder when the implement is lowered by its self-weight. When the pressure oil enters into the port (A) of the slow return-valve, the oil pushes up the poppet (05) against the force of the spring (03) and goes freely out of the port (B) through the passage (C) and variable throttle (D).

On the contrary, when the oil enters into the port (B), it is led to the port (A) through a variable throttle (D), formed between body (01) and nut (02).

Here, this oil flow can be adjusted by turning the nut (02) when required.

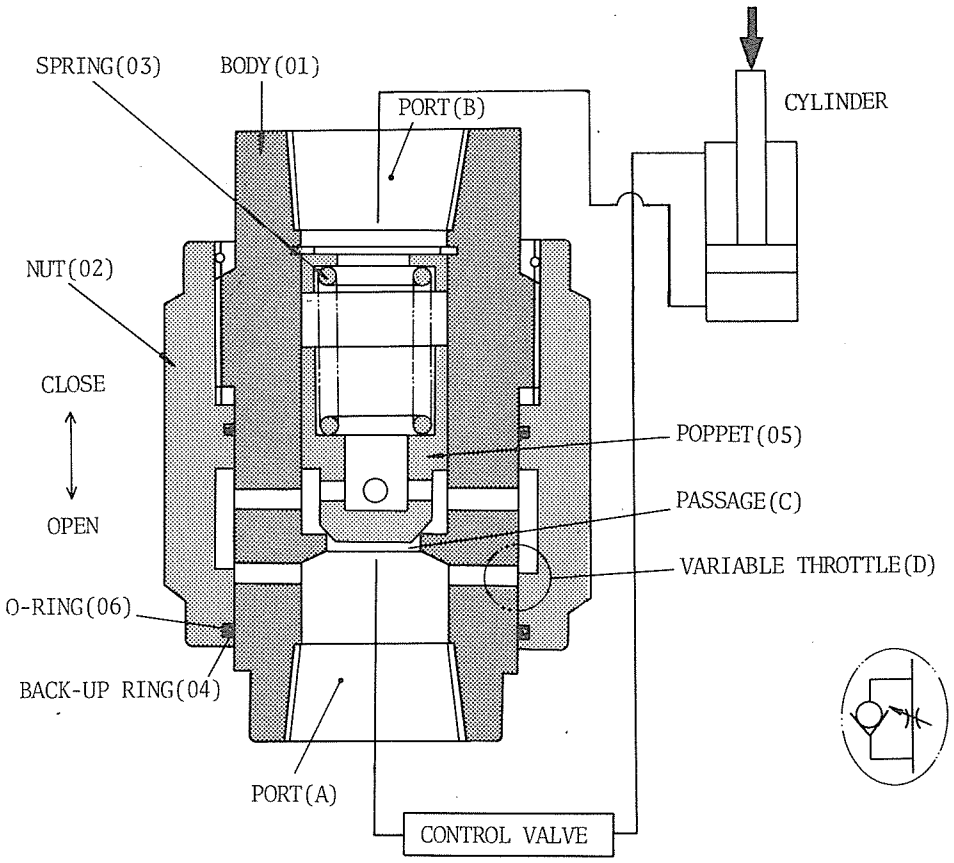


Fig.1

an orifice to set on the end face of plunger and works to move the plunger with a force corresponding to pressure against a spring at the opposite side. The pressure reaches 5.5 to 7.5kg/cm^2, the plunger starts moving and hydraulic oil at port M_2 side is throttled by a notched part provided on the outer periphery of plunger, flows to port P_2 while generating back pressure at port M_2 and returns to the tank via the control valve.

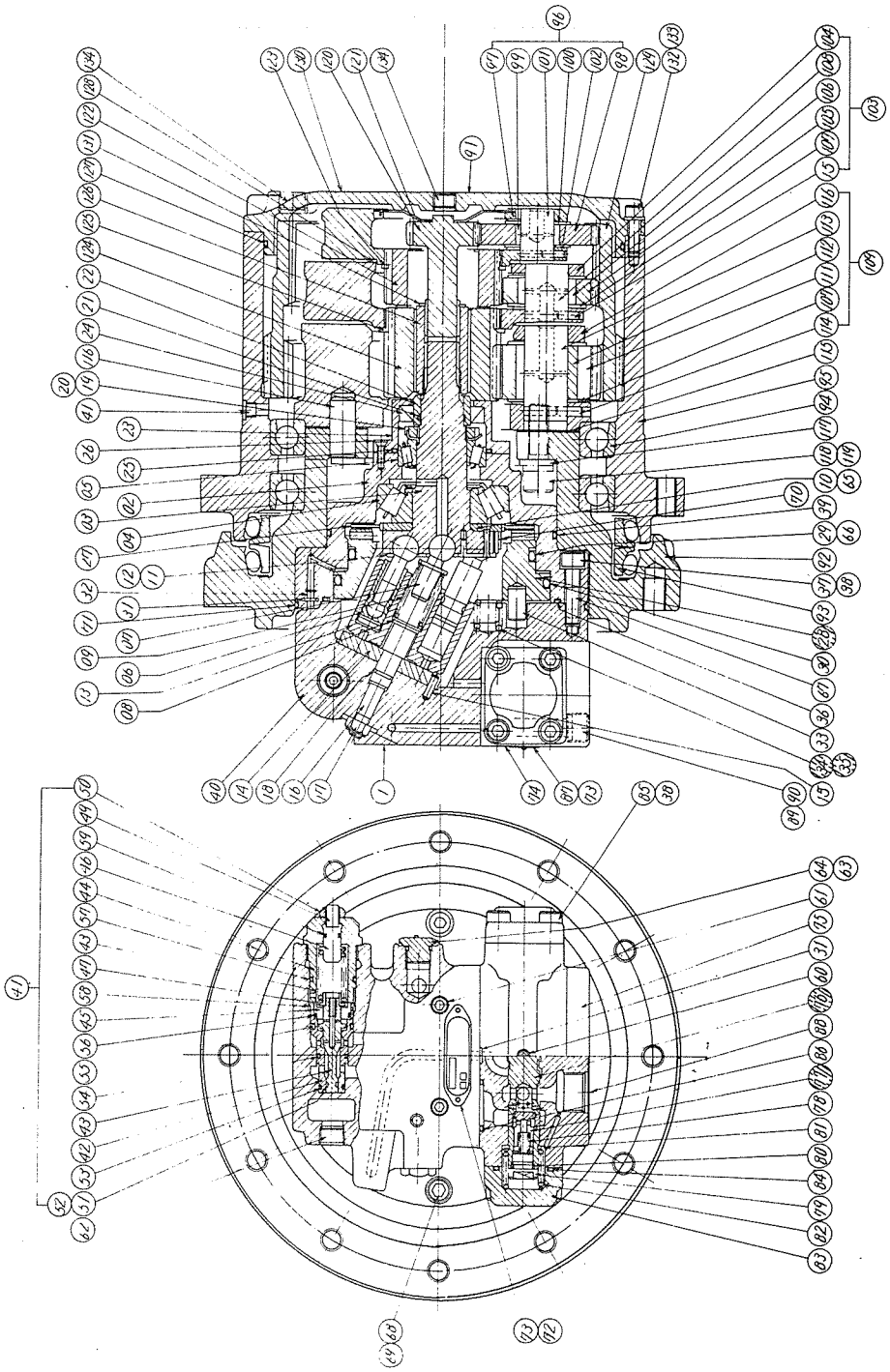


Fig. 4

PH-TYPE GEAR PUMP

3) Removing wear plate (37) at body side, as shown in Fig. 7, draw pedesrals (31) and (32) out.
Since there is burr on a face contacting the gear at the inner face of body (30), wear plate (37) and pedestals (31) and (32) cannot sometimes be drawn out in the direction where there is burr. In this case, follow the procedure below.
Removing socket bolt (41) as shown in Fig. 8, detach front cover (35) while tapping with a wooden mallet and draw pedestals (31) and (32) and wear plate (37) out in that direction.

(Note) Prior to detaching front cover (35) and rear cover (36), be sure to put match marks on them to enable reassembling both covers correctly with the initial same faces conformed to each other.
Further, be sure to mark the shaft ends properly even for drive gear (33) and driven gear (34) to enable discriminating between the front and rear.

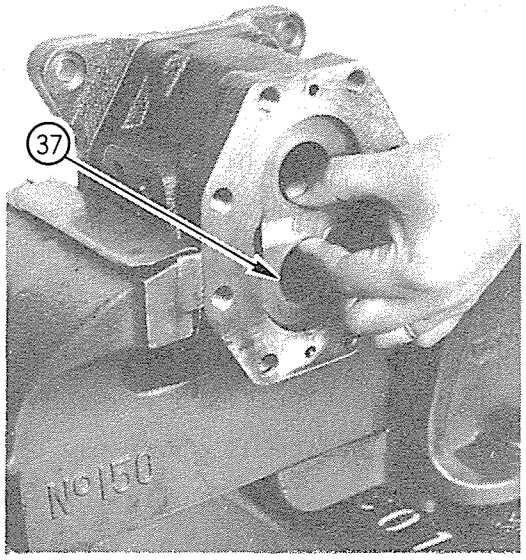


Fig. 7

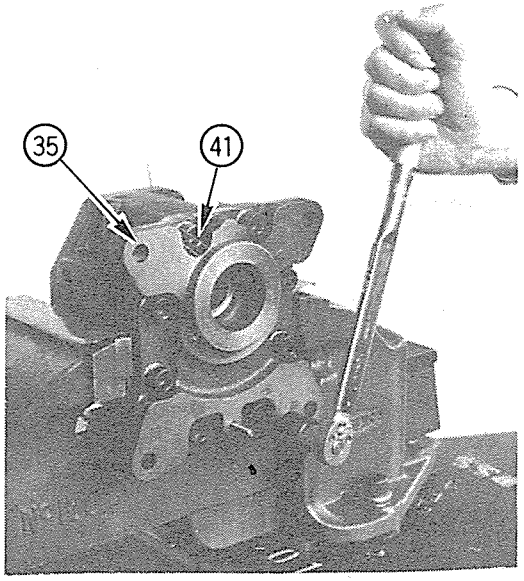


Fig. 8

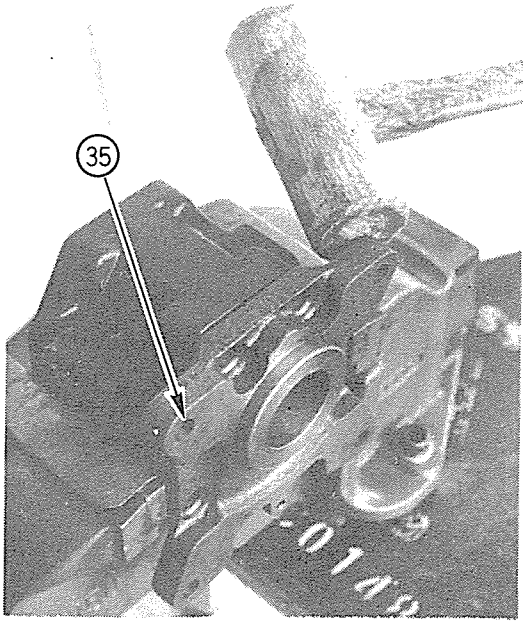
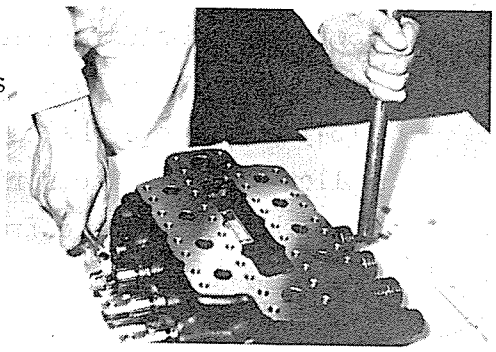


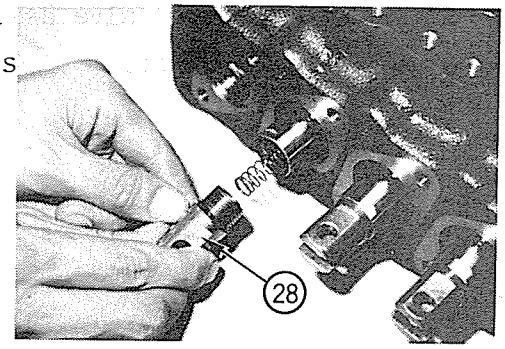
Fig. 9

MVP TYPE CONTROL VALVE

11. Loosen eye ends (28) by using an allen wrench and a spanner or tools (refer to special tools list item 2 and 3).

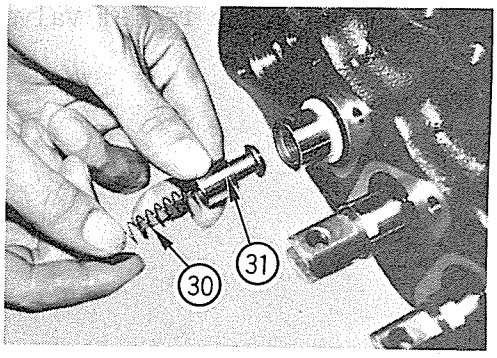


12. Remove eye ends (28) by using an allen wrench and a spanner or tools (refer to special tools list item 2 and 3).



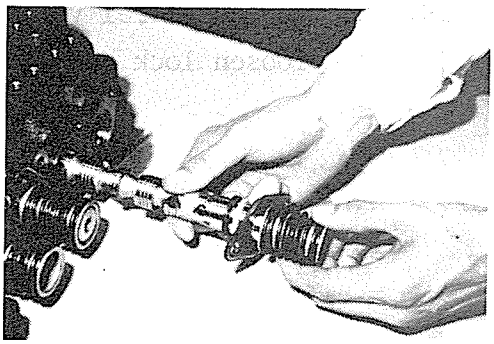
13. Remove spring (30) and check valve (31) from the close-center type plunger (32).

NOTE: PUT A TAG OR MARK TO THE CHECK VALVE (31) FOR CORRECT ASSEMBLY.

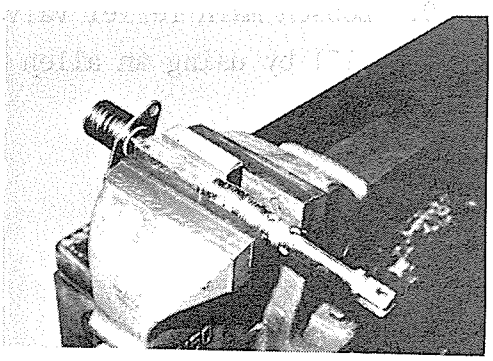


14. Pull the plunger toward the spring end out of the housing.

NOTE: PUT A TAG OR MARK TO THE PLUNGER FOR CORRECT ASSEMBLY.

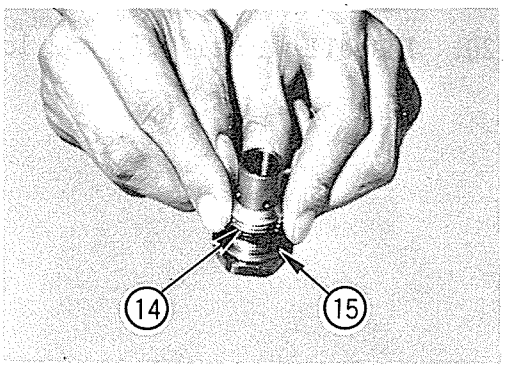


15. Secure the plunger assembly in a vice with soft liners or a tool (refer to special tools list item 4).

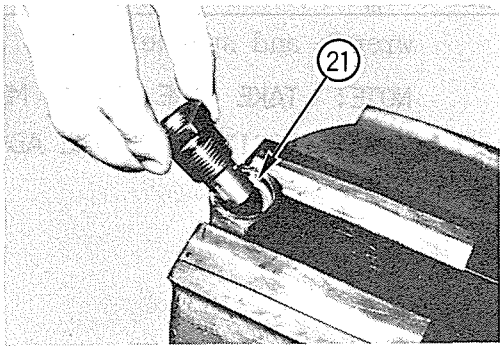


MVP TYPE CONTROL VALVE

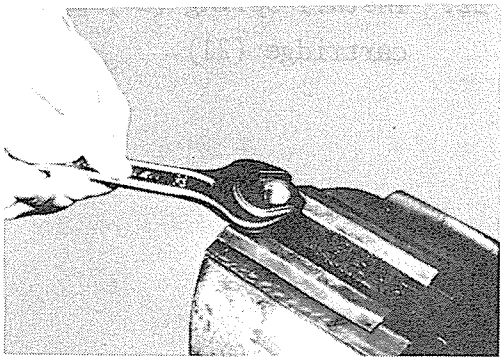
15. Install O-ring (14) into groove of plug (15).



16. Hold the cartridge (21) with a vice and then install the plug with O-ring into the cartridge.

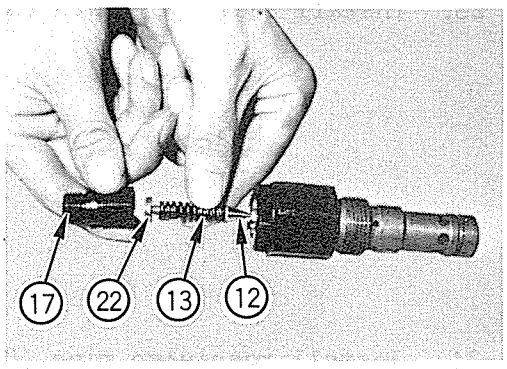


17. Tighten the plug by using a spanner.

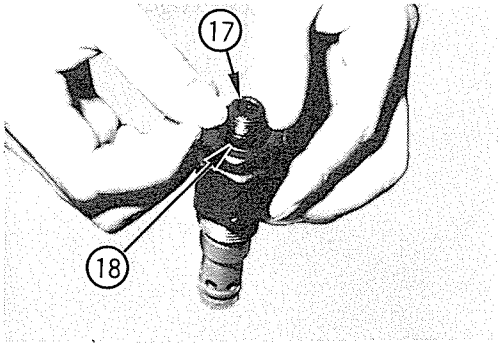


18. Install poppet (12), spring (13), spring seat (22) and adjusting screw (17) into the plug.

NOTE: SET THE ADJUSTING SCREW IN SAME POSITION AS BEFORE DISASSEMBLING.



19. Install O-ring (18) into groove of the adjusting screw (17).



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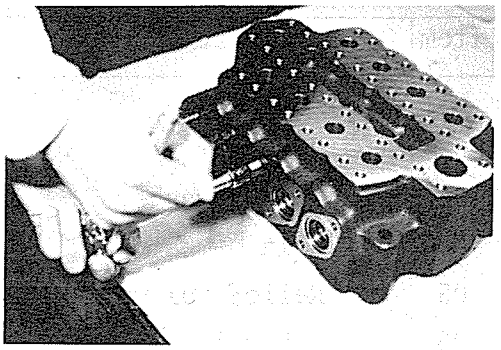
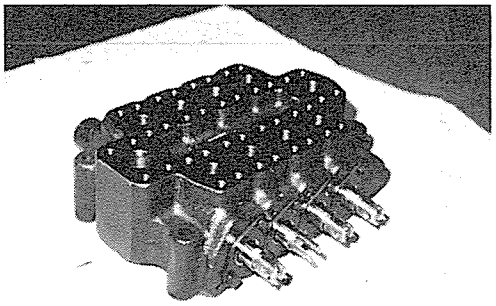
MVP TYPE CONTROL VALVE

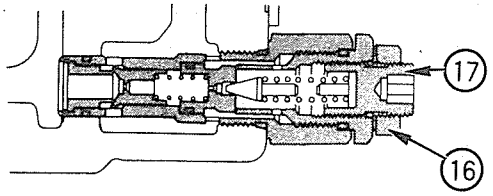
64. Tighten the bolts by using a socket wrench. Assemble the remaining plungers to the housing in the same manner as above.



65. The control valve assembling work is now completed. Apply pure hydraulic oil into the control valve and plug the ports to keep it free from dust.

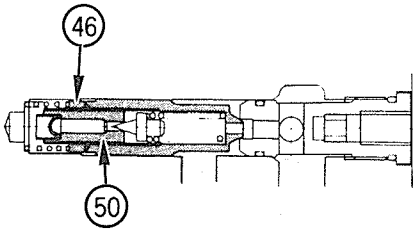


66. Adjust the main relief setting pressure to the specified degree by following method, if necessary.
Loosen lock nut (16) and turn adjusting screw (17) clockwise for increasing the setting pressure (counter-clockwise for decreasing the setting pressure) by means of an allen wrench.



NOTE: BY TURNING ADJUSTING SCREW (17) ONE FULL-TURN, THE SETTING PRESSURE WILL VARY APPROXIMATELY 154 BAR (154 KGF/CM^2).

67. Adjust the overload setting pressure by following method, if necessary. Take out the overload relief valve assembly and hold it in a vice with a soft liners and then loosen lock nut (46). By using a spanner, turn the adjusting screw (50) clockwise for increasing the setting pressure.



NOTE: BY TURNING ADJUSTING SCREW (50) ONE FULL-TURN, THE SETTING PRESSURE WILL VARY APPROXIMATELY 70 BAR (70 KGF/CM^2).

Tighten lock nut (46) securely and then install the overload relief valve assembly into the housing at correct position.

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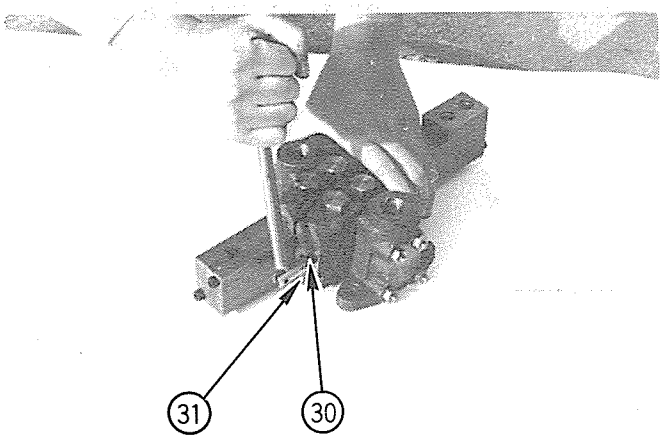
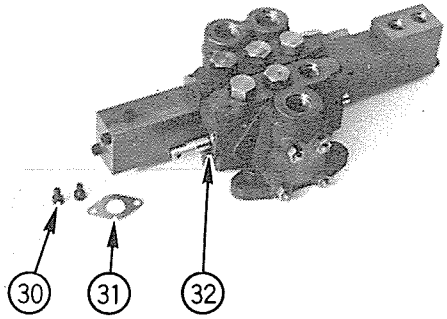
SC3P-2R2V2P CONTROL VALVE

b) Loose 2 pieces of bolts (30), and oil seal plate is removable, thus reverse side oil seal (32) can be taken off.



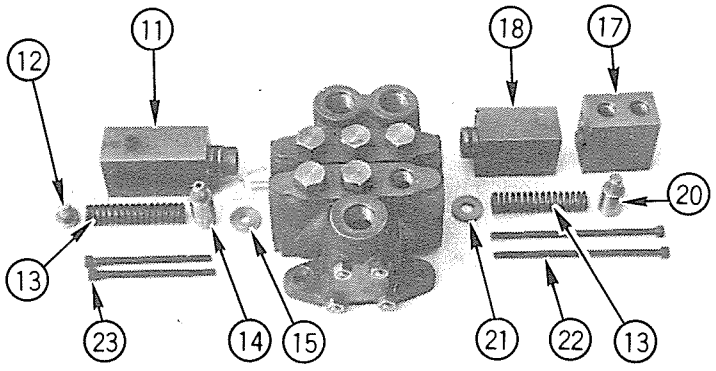


3-B) Unload valve spool section

Loose and remove each 2 pieces of fixing bolts (22) and (23), and detach the both side case (11), (18) and (17).

(As setting load of spring (13), is high, take care to loose the bolts uniformly to avoid giving strong stress to specific bolt).

After detach the case (11), (18) and (17), take off spring (13), damper (14), (20) and washer (15), (21), and then draw out spool (16).



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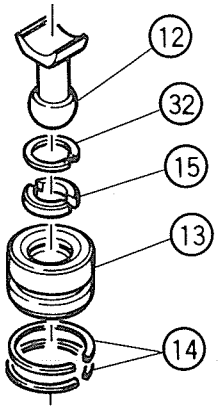
MRS-200X SWING MOTOR

5.2 Assemble piston (13) and connecting rod (12).

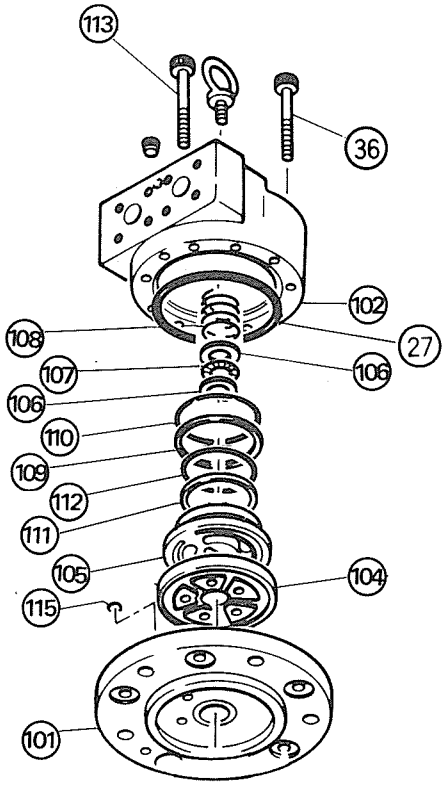


a) Put piston ring (14) on piston (13).

b) Fix piston (13), collar (15) and connecting rod (12) with snap ring (32).

Note: If piston ring expander is unavailable, piston ring can be fitted even by hand. In that case, be careful not to scratch outer periphery of piston. Pre-apply hydraulic oil to spherical part of connecting rod.

5.3 Assemble valve Ass'y



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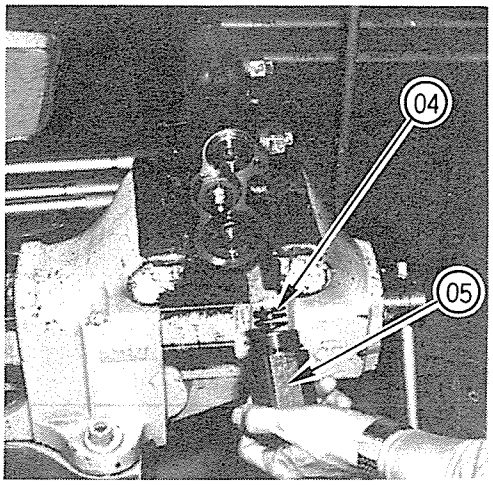
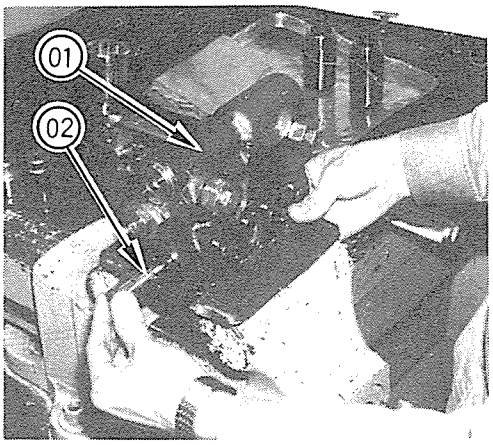
VBR-06SG-S BRAKE VALVE

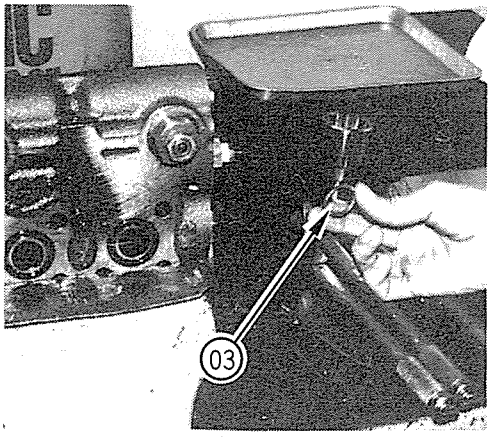
(3) Remove cap Ass'y ⑤ (at both sides). When cap ⑤ is removed, spring ④ can also be taken out together. If any abnormality is found in cap Ass'y, replace it as an assembly. Don't dismantle Ass'y unnecessarily.

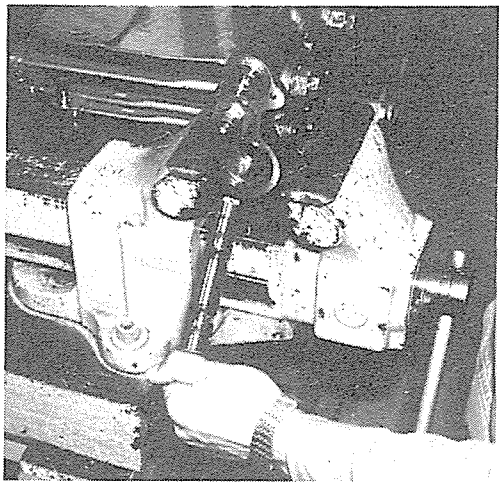


(4) Draw plunger Ass'y ② out of body ① . After removing cap ⑤ and spring ④ at both sides, push plunger Ass'y ② through hole at one side of body ① . Then, plunger Ass'y comes out of the opposite-side hole of body ① together with spring seat ③ . Extract the plunger Ass'y gently while turning little by little. If plunger Ass'y is sticking stubbornly and cannot be removed, don't draw it out forcibly.



(5) Take the remaining spring seat out.





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VBR-06SG-S BRAKE VALVE

	(3) Relief valve fails to seat properly.	Remove foreign matters thoroughly. However, if damage in seat face is too serious to repair, replace as relief valve Ass'y.
	(4) Permanent set in fatigue of relief valve spring	Replace relief valve Ass'y.
	(5) Sub-relief valve fails to seat properly.	Remove foreign matters thoroughly. However, if damage in seat face is too serious to repair, replace as relief valve Ass'y.
	(6) Permanent set in fatigue of sub-relief valve spring	Replace relief valve Ass'y.
	2.2 Abnormality in hydraulic motor	Refer to Item 6 "Trouble-shooting" of MRS-200X Swing Motor.
3 Fluctuation in rotation	3.1 Movement of brake valve plunger is unsmooth.	
	(1) Poor tightening torque of body	Tighten with normal torque.
	(2) Foreign matters left caught between body and plunger	Remove foreign matters thoroughly, repair damaged part (if any) and clean with washing oil and then, reassemble. However, if damage is serious and oil leakage is heavy, replace valve.
	(3) Foreign matters sticking to damper of cap Ass'y or sliding part of accumulator	Replace cap Ass'y.
	(4) Reduction in accumulator set pressure of cap Ass'y (resulting from permanent set in fatigue of spring)	Replace cap Ass'y.
	3.2 Abnormality in hydraulic motor	Refer to Item 6 "Trouble-shooting" of MRS-200X Swing Motor.

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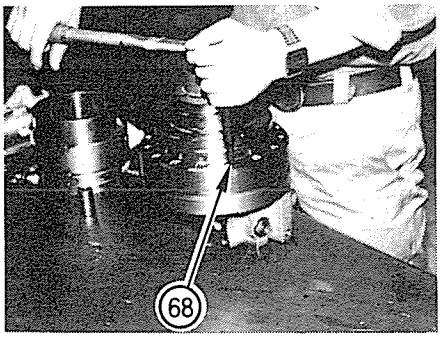
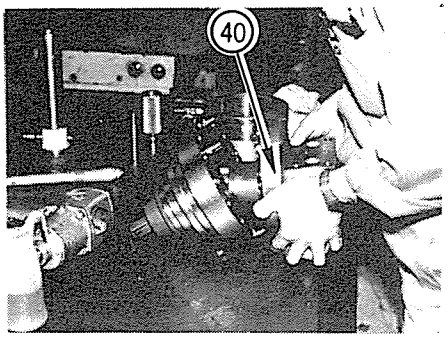
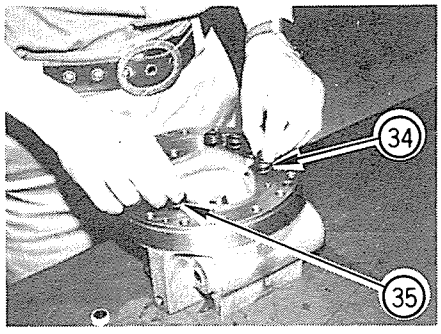
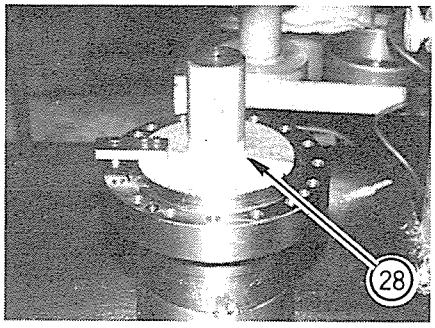
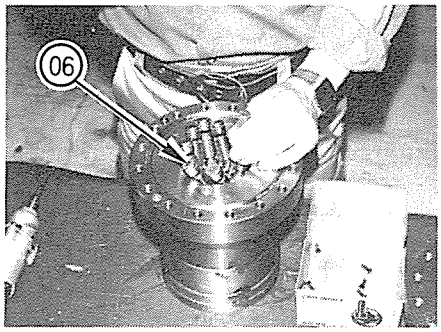
MAF-9K-3-4 AXIAL PISTON MOTOR

Disassembling instructions	Notice on disassembling
2. Disassembling of base plate Loose and take off the socket head bolt (2-M10 x 75) ⑱.	Fix the hydraulic motor by special tool or by vise.
	
Draw out base plate ⑩.	When draw out the base plate, take care not to draw out together with cylinder block ⑬. The cylinder block is easily disconnected from valve plate by pressing and wrenching the side of base plate. Carefully draw out the base plate to protect the cylinder block sliding surface which is apt to be damaged by the tip of center rod ⑯.
	
Take off springs ㉞, ㉟.	Two springs ㉟ are located in the springs ㉞ as shown on photo.
	

MAF-9K-3-4 AXIAL PISTON MOTOR

Disassembling instructions	Notice on disassembling
Press fit piston (28) to body (02) by pressing machine.  	At press fitting, take care not to incline the piston. Also care on the positional relationship between body and piston. The special tool, as shown on photo, will be much helpful for easy assembling.
4. Assembling of piston Set the piston (06) (7 pieces) and retainer ring (11) to shaft, and fasten with screw (10), (12). Then, caulk at 3 points each of screw periphery.  	Fastening torque is 0.094 ∿ 0.138 kgf-m. After fastening screw, move the pistons conically to confirm 7 pistons are movable lightly. If there would be any piston not movable lightly, then such piston to be tapped at end with plastic hammer, and secure the centering of piston and shaft. Caulking to be achieved with center punch, and let the head of screw to be covered.

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VWCB-06 COUNTERBALANCE VALVE

1. NECESSARY TOOLS FOR DISASSEMBLY AND ASSEMBLY

Items of tools & to be prepared	Application	Disas-sembling	Mainte-nance	Assem-bling	Fastening torque (kgf-m)
1. Spanner (width across flat 14mm)	Plug (79)	○		○	3±0.2
2. Hex. wrench or socket wrench (width across flat 8mm)	Socket head bolt (85)	○		○	5.5 ∿ 6.5
3. Hex. wrench or socket wrench (width across flat 10mm)	Socket head bolt (89)	○		○	6.7 ∿ 7.3
4. Torque wrench		○		○	
5. Round bar (7mm dia. × 200mm long)	Plunger (76)				
Hex. wrench (width across flat 6mm)		○			
6. Sub-plate	Body (75)	○		○	
7. Rag		○		○	
8. Cleaning oil (light oil or kerosene)		○		○	
9. Oil pan		○			
10. Grease				○	
11. Vise		○		○	

2. DISASSEMBLING INSTRUCTIONS

2.1 Notice in prior to disassembling

Clean the device with rag and cleaning oil in prior to disassembling, and prevent to get in the dust into inside of the device.

2.2 Notice on disassembling

Disassembling should be proceeded at clean place without dust.

Since every parts are precisely finished, handle them carefully not to damage caused by dropping out or giving strong impact.

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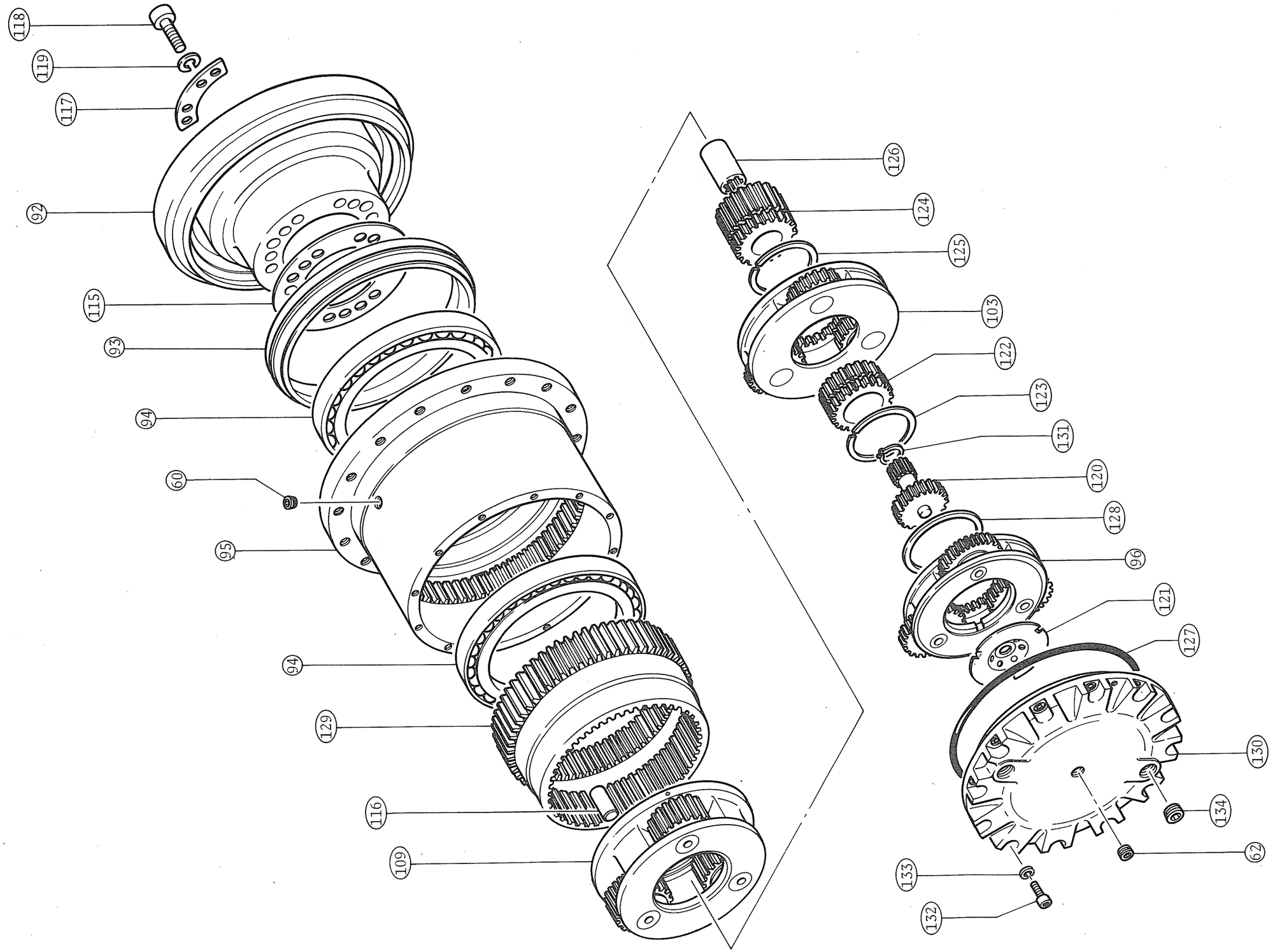
REDUCTION DEVICE (I = 1/75 209)

REDUCTION DEVICE (i = 1/75. 209)



TROUBLE SHOOTING

Trouble shooting

In case of any troubles would happen, please practice the checking and arrange the counter-measures according to following informations.

Troubles	Cause	Symptom	Remedy
1. Motor would not rotate	1. Hydraulic pump, control valve etc. other than motor is not actuated, then pressure oil does not come to motor.	Pressure oil does not come to counterbalance valve.	Operate other control valve within same pump system as hydraulic motor, and check if pressure oil is coming, also check & repair each of parts.
	2. Disorder of counterbalance valve	Pump discharging pressure raise up to relief set pressure.	
	1) Plunger can not be changed-over 1-1) Jamming of impurities		Disassemble the counterbalance valve, and remove the impurities completely. Any damaged parts should be repaired and assembled based on maintenance basis. But if damage is severe & can not be repaired, exchange it with new one.
	1-2) Bolt fastening torque is not proper.		Fasten the bolt with specified torque.
	3. Damage of the motor 1) Sliding parts roughed and hydraulic pressure unbalanced & pressure loosed.	Oil flows out from drain port.	Disassemble the motor, and lap the sliding face of valve plate & cylinder block. But if damage is severe and can not be repaied, exchange it with new one. Also check oil seal of reduction device.
	2) Unsufficient actuation due to damage of main parts	Abnormal sound from motor	Disassemble the motor, and exchange defect parts, clean all relating part by cleaning oil and then assemble. If defected parts may possibly damage other device, then practice circuit flushing and oil exchange.

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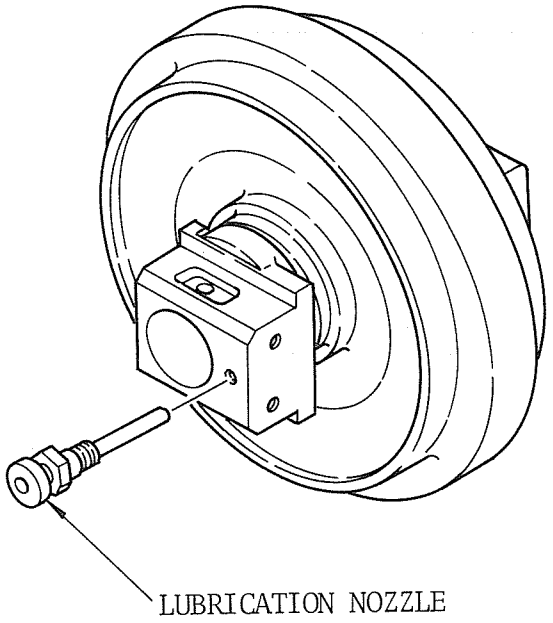
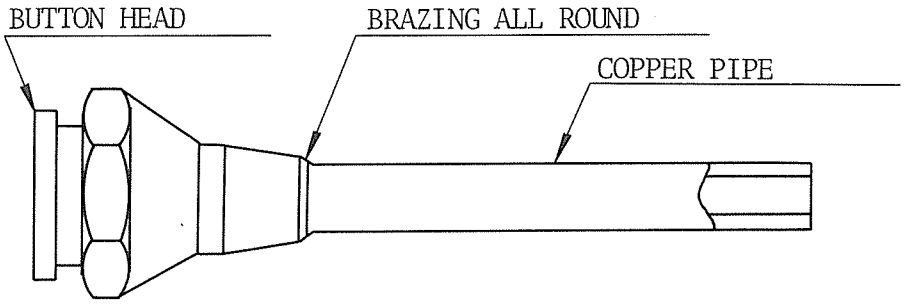
FRONT IDLER

5. Set the front idler assembly in the same posture as that of being installed to the track frame.
   Pour engine oil (SAE S-3 #30) until the oil overflows out of the opposite plug hole by using a lubrication nozzle as shown below.
   Then install plugs (06) to both ends of the bearing (03) with seal tape.



LUBRICATION NOZZLE



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LOWER ROLLER

TRACK LINK

11. Remove the pin (05) from the link as shown in Fig. 7.

NOTE: BEFORE REMOVING THE PIN, GRIND OFF SHARP EDGES AT PARTS OF "A" AS SHOWN IN FIG. 7.

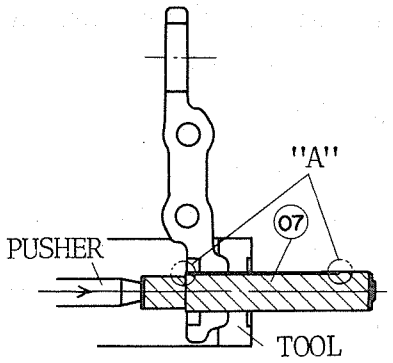

Fig. 7

12. Disassemble the remaining track links as in step 5 through 11 above.

ASSEMBLING

Precautions for Assembling Track Links

Before assembling track links, carefully observe the following points:

(1) Grind off sharp edges at both ends of each bushing by using a hand grinder or an equivalent. See Fig. 8

(2) Similarly grind off sharp edges at both ends of each master pin and pin. See Fig. 9

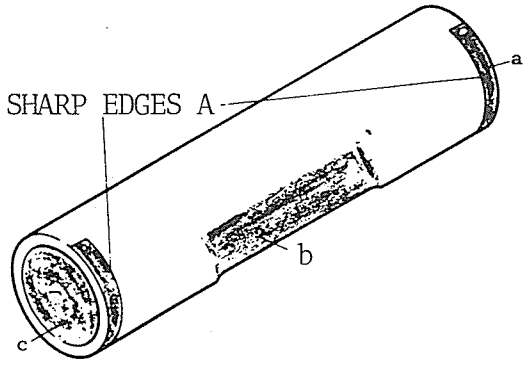

Fig. 8

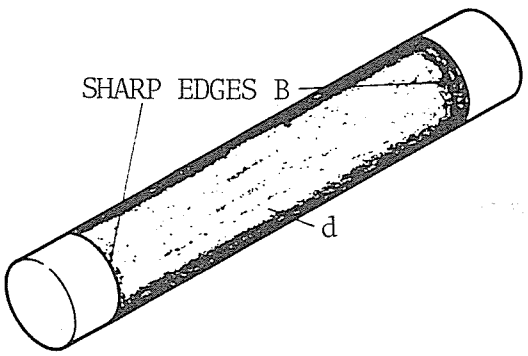

Fig. 9

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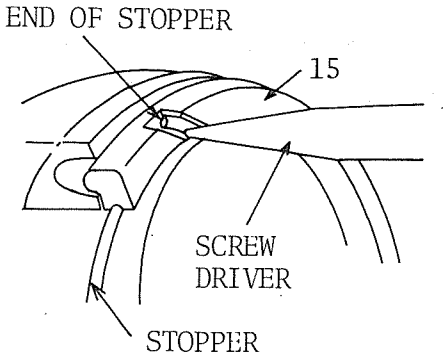
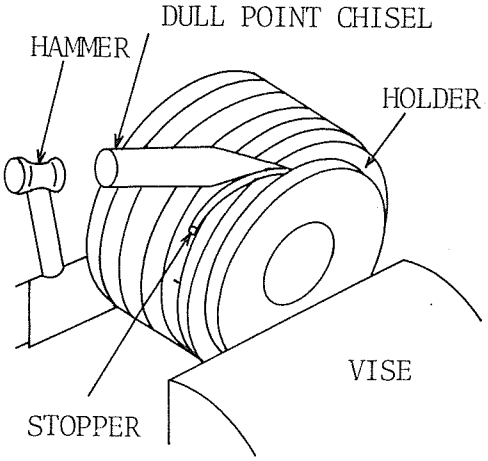
HYDRAULIC CYLINDER

12. DISASSEMBLING PISTON

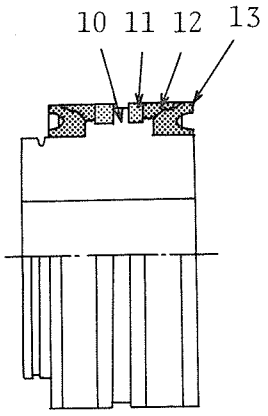
(1) Hold the piston assembly by a vise.
Turn the holder (15) until the end of the stopper (16) is found in the groove of the holder (15).
Pry up the end of the stopper (16) by using a screw driver.



(2) Remove the stopper (16) out of the holder (15) by turning the holder with a dull point chisel and a hammer so that the holder (15) is removed out of the piston (10).



(3) Remove the U-rings (13), seals (12) and piston rings (11) by using a screw driver.



MAINTENANCE STANDARD

PERFORMANCE STANDARD

I. BASIC MACHINE

1. CHECK OF AMOUNT OF OIL

1-1 Engine oil

Major procedures:

- Check the amount of oil 10 to 20 minutes after the engine has been stopped.
- Check together contamination and viscosity of oil.

(1) Measurement

1) Extract the oil level gauge (dipstick) and wipe it with clean rag.

2) Re-insert the gauge to its home position as far as it goes and draw it out again gently and then, check the position of oil sticking to the gauge.

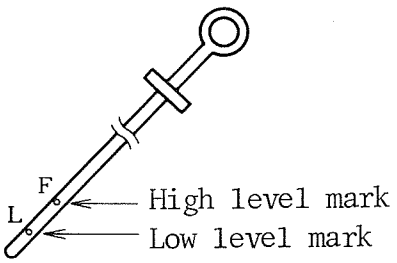
(2) Judgment

If the oil sticking position is between high level mark (F) and low level mark (L) at the gauge end, it is O.K.

(3) Note

Engine oil may be refilled through an oil filler port attached to the cylinder head cover.

The whole amount of engine oil supplied is 13ℓ.

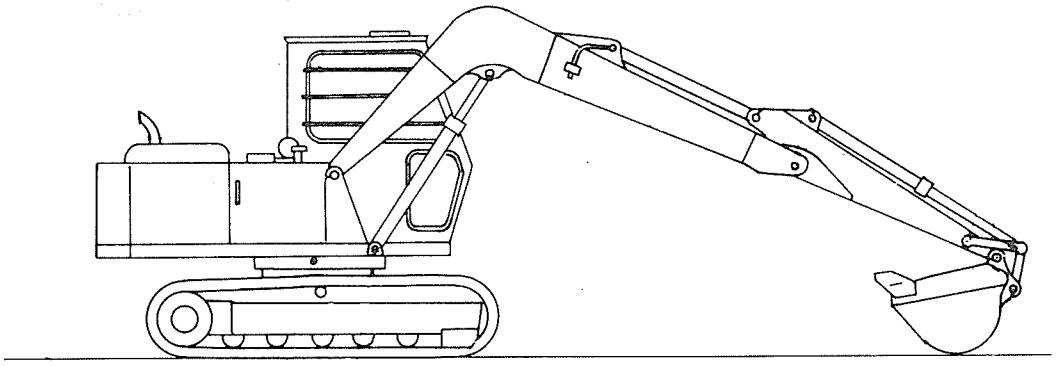


1-2 Hydraulic oil

Major procedures:

- After a cylinder has been replaced, for example, air may sometimes remain inside the cylinder. So, bleed air by working each cylinder at full stroke.
- Check the amount of oil in such a condition where there is no big difference between oil temperature and atmospheric temperature.
  When the oil temperature is relatively high, the oil level obtained through the gauge may be a little higher.

(1) Preparations for measurement



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PERFORMANCE STANDARD

4) Measure at least 3 times and take the mean value.

(3) Judgment

Model & Mfg. No.		UH031 · 0101∿		
		Standard performance	Performance suggesting maintenance	Working limit performance
Leakage in swing motor on slope	mm/5 min	Less than 120	130	140

4. PERFORMANCE STANDARD OF FRONT-END ATTACHMENTS

4-1 Operating time of hydraulic cylinders

Major procedures:

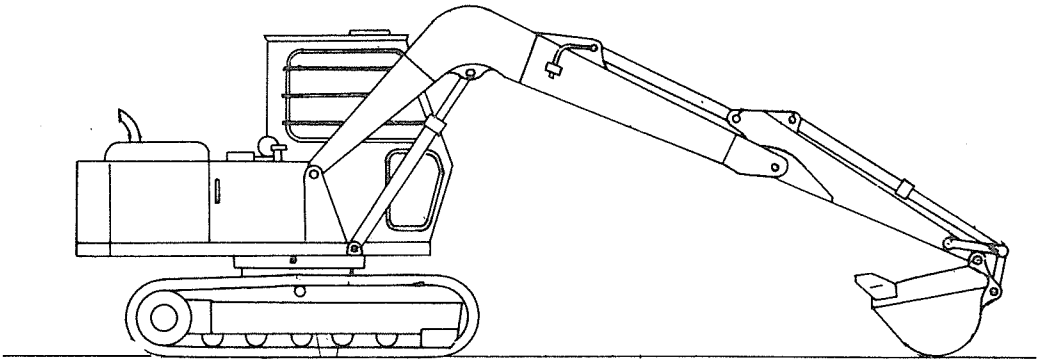
- In the standard front-end condition, measure the operating time of boom, arm and bucket cylinders.
- For the retracting operation of boom cylinder wherein a slow-return valve is incorporated and the extending operation of arm cylinder, make sure that they have been adjusted not to cause a breathing motion at the maximum engine speed.

(1) Preparations for measurement

1) The machine posture for measurement must be as follows:

* Measurement of boom cylinder operating time

Ground the bucket with the arm cylinder fully retracted and the bucket cylinder fully extended.



* Measurement of arm cylinder operating time

Keep the arm center vertical with the ground extending the bucket cylinder fully, and hold the bucket about 50 cm about the ground.

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PERFORMANCE STANDARD

ii Extend the arm cylinder to its stroke end to relieve the circuit pressure and take the reading of pressure at that time through the pressure gauge.

iii Retract the arm cylinder to its stroke end to relieve the circuit pressure and take the reading of pressure at that time through the pressure gauge.

Notes:

(1) The set pressure of main relief valve may be measured by relieving the pressure of cylinder circuits of bucket, arm, etc. and the overload relief valve is incorporated in these cylinder circuits.

(2) Therefore, when the set pressure of overload relief valve is lower than that of main relief valve, it results in the low pressure of overload relief valve being measured.

3) Main relief valve set pressure

		UH031 · 0101∿		
		Standard performance	Performance suggesting maintenance	Working limit performance
Main relief valve set pressure	kg/cm²	200 ±12	MAX 210 MIN 170	MAX 210 MIN 160

Notes:

(1) When the measured pressure of each circuit shows the same numerical value within the standard performance range of main relief valve set pressure, it denotes the set pressure of main relief valve. (If it is out of the standard performance range, adjustment is required.)

(2) If the measured pressure differs, it is suspected that the set pressure of any overload relief valve is dropping.

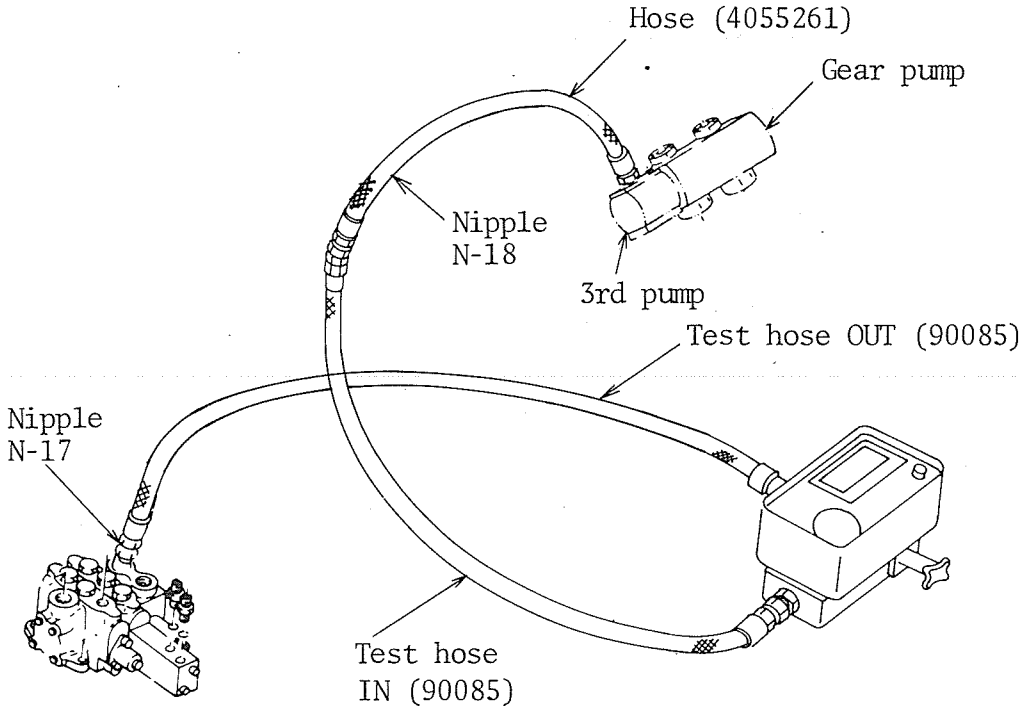
4) Overload relief valve set pressure

		UH031 · 0101∿		
		Standard performance	Performance suggesting maintenance	Working limit performance
Set pressure of boom overload relief valve	kg/cm²	230 $^{+15}_{-5}$		
Set pressure of arm overload relief valve	kg/cm²	230 $^{+15}_{-5}$		
Set pressure of bucket overload relief valve	kg/cm²	230 $^{+15}_{-5}$		

Notes:

(1) When the measured pressure of 4 circuits (including control valve (L) and

PERFORMANCE STANDARD



5) Open fully the loading valve of portable hydraulic tester.
6) Actuate the engine to pressurize the hydraulic tank and at the same time, be sure that there is no oil leak from the hose connected parts.
7) Keep the hydraulic oil temperature at 50 ±5°C.

(2) Measurement

1) Increase the engine speed to the maximum.
2) Measure flow rate, oil temperature and engine speed in no-load condition and record the measured values.
3) Closing the loading valve of portable hydraulic tester, measure flow rate, oil temperature and engine speed at the set pressure of relief valve and record the measured values.

(3) Judgement

1) Judgment by delivery at rated load pressure

i Conversion of measured value

The measured flow rate of pump may be converted to the pump delivery at rated engine speed.

Q : Measured flow rate (ℓ/min)
Q_1 : Converted flow rate (ℓ/min)
N : Engine speed in measurement (rpm)
N_1 : Rated engine speed (rpm)

$$Q_1 = \frac{Q}{N} \times N_1 \quad (\ell/\text{min})$$

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MAINTENANCE STANDARD