

SHOP

MANUAL

KOMATSU

PW170ES-6K

MACHINE MODEL

PW170ES-6K

SERIAL NUMBER

K32001 and up
K34001 and up

- This shop manual may contain attachments and optional equipment that are not available in your area. Please consult your local Komatsu distributor for those items you may require. Materials and specifications are subject to change without notice.

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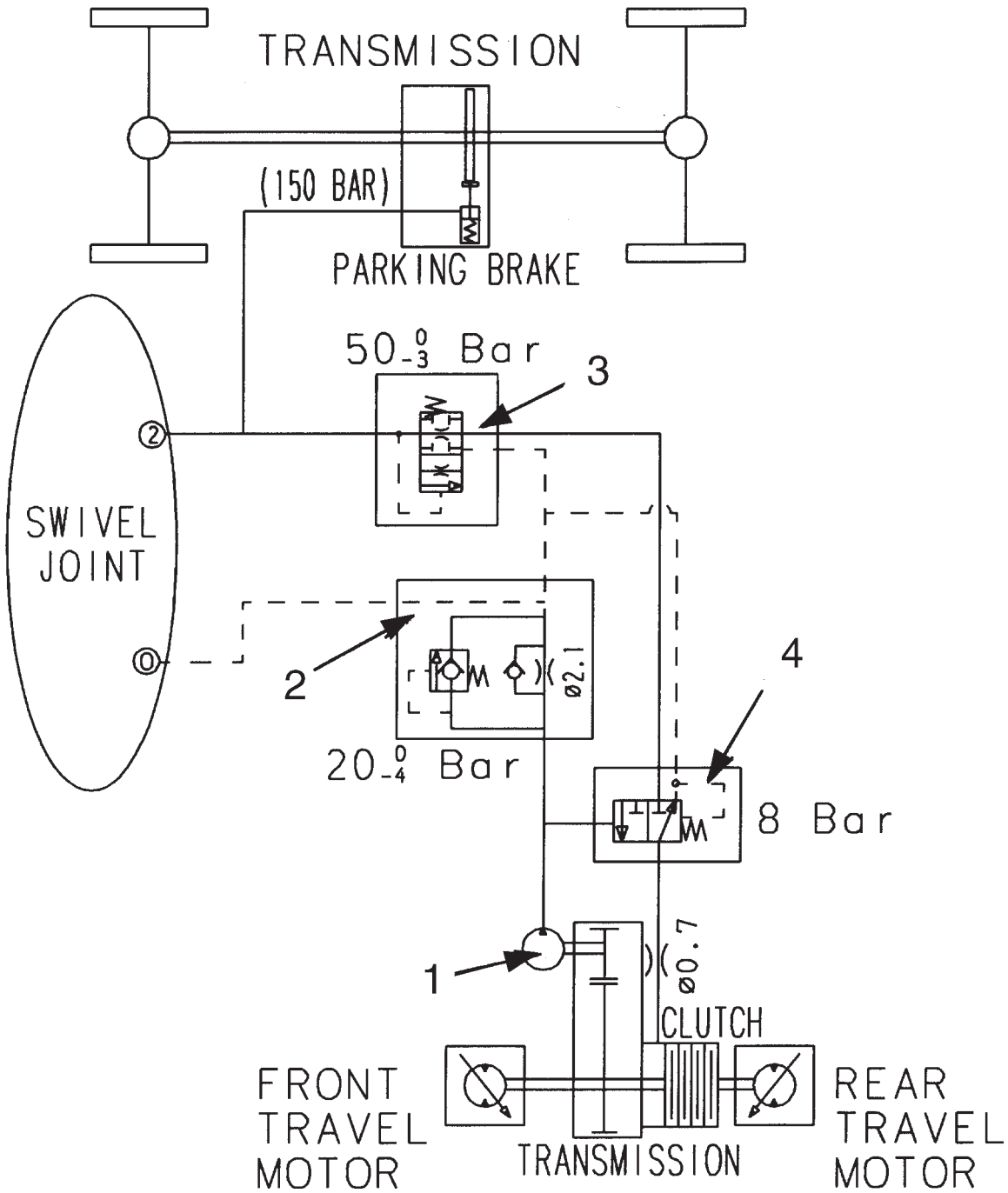
COATING MATERIALS

The recommended coating materials prescribed in Komatsu Shop Manuals are listed below.

Category	Komatsu code	Part No.	Q'ty	Container	Main applications, features
Adhesive	LT-1A	790-129-9030	150 g	Tube	<ul style="list-style-type: none"> Used to prevent rubber gaskets, rubber cushions, and cork plugs from coming out
	LT-1B	790-129-9050	20 g (x2)	Plastic container	<ul style="list-style-type: none"> Used in places requiring an immediately effective, strong adhesive. Used for plastics (except polyethylene, polypropylene, tetrafluoroethylene and vinyl chloride), rubber, metal, and non-metal.
	LT-2	09940-00030	50 g	Plastic container	<ul style="list-style-type: none"> Features: resistance to heat, chemicals Used for anti-loosening and sealant purposes for bolts and plugs
	LT-3	790-129-9060 (Set of adhesive and hardening agent)	Adhesive : 1 kg Hardening agent : 500 g	Can	<ul style="list-style-type: none"> Used as adhesive or sealant for metal, glass, plastic
	LT-4		250 g	Plastic container	<ul style="list-style-type: none"> Used as sealant for machined holes
	(Loctite 648-50)	790-129-9040	50 cc	-	<ul style="list-style-type: none"> Features: Resistance to heat, chemicals Used at joint portions subject to high temperature
Gasket sealant	LG-1	79A-129-9110	200 g	Tube	<ul style="list-style-type: none"> Used as adhesive or sealant for gaskets and packings of power train case, etc.
	LG-3	790-129-9070	1kg	Can	<ul style="list-style-type: none"> Features: Resistance to heat Used as sealant for flange surfaces and bolts at high temperature locations, used to prevent seizure Used as sealant for heat resistant gasket for high temperature locations such as engine precombustion chamber, exhaust pipe
	LG-4	790-120-9020	200 g	Tube	<ul style="list-style-type: none"> Features: Resistance to water, oil Used as sealant for flange surface, thread Also possible to use as sealant for flanges with large clearance Used as sealant for mating surfaces of final drive case, transmission case.
	LG-5	790-129-9080	1 kg	Plastic container	<ul style="list-style-type: none"> Used as sealant for various threads, pipe joints, flanges Used as sealant for tapered plugs, elbows, nipples of hydraulic piping
	LG-6	09940-00011	250 g	Tube	<ul style="list-style-type: none"> Features: Silicon based, resistance to heat, cold Used as sealant for flange surface, thread Used as sealant for oil pan, final drive case, etc.
	LG-7	09920-00150	150 g	Tube	<ul style="list-style-type: none"> Features: Silicon based, quick hardening type Used as sealant for flywheel housing, intake manifold, oil pan, thermostat housing, etc.
	Rust prevention lubricant	-	09940-00051	60 g	Can
Molybdenum disulphide lubricant	-	09940-00040	200 g	Tube	<ul style="list-style-type: none"> Used to prevent seizure or scuffing of the thread when press fitting or shrink fitting Used as lubricant for linkage, bearings, etc.
Lithium grease	G2-LI	SYG350LI SYG-400LI SYG-400LI-A SYG-160LI SYGA-160CNLI	Various	Various	<ul style="list-style-type: none"> General purpose type
Calcium grease	G2-CA	SSG2-400CA SYG2-350CA SYG2-400CA-A SYG2-160CA SYGA-16NCA	Various	Various	<ul style="list-style-type: none"> Used for normal temperature, light load bearing at places in contact with water or steam
Molybdenum disulphide grease	-	SYG2-400M	400 g (10 per case)	Bellows type	<ul style="list-style-type: none"> Used for places with heavy load

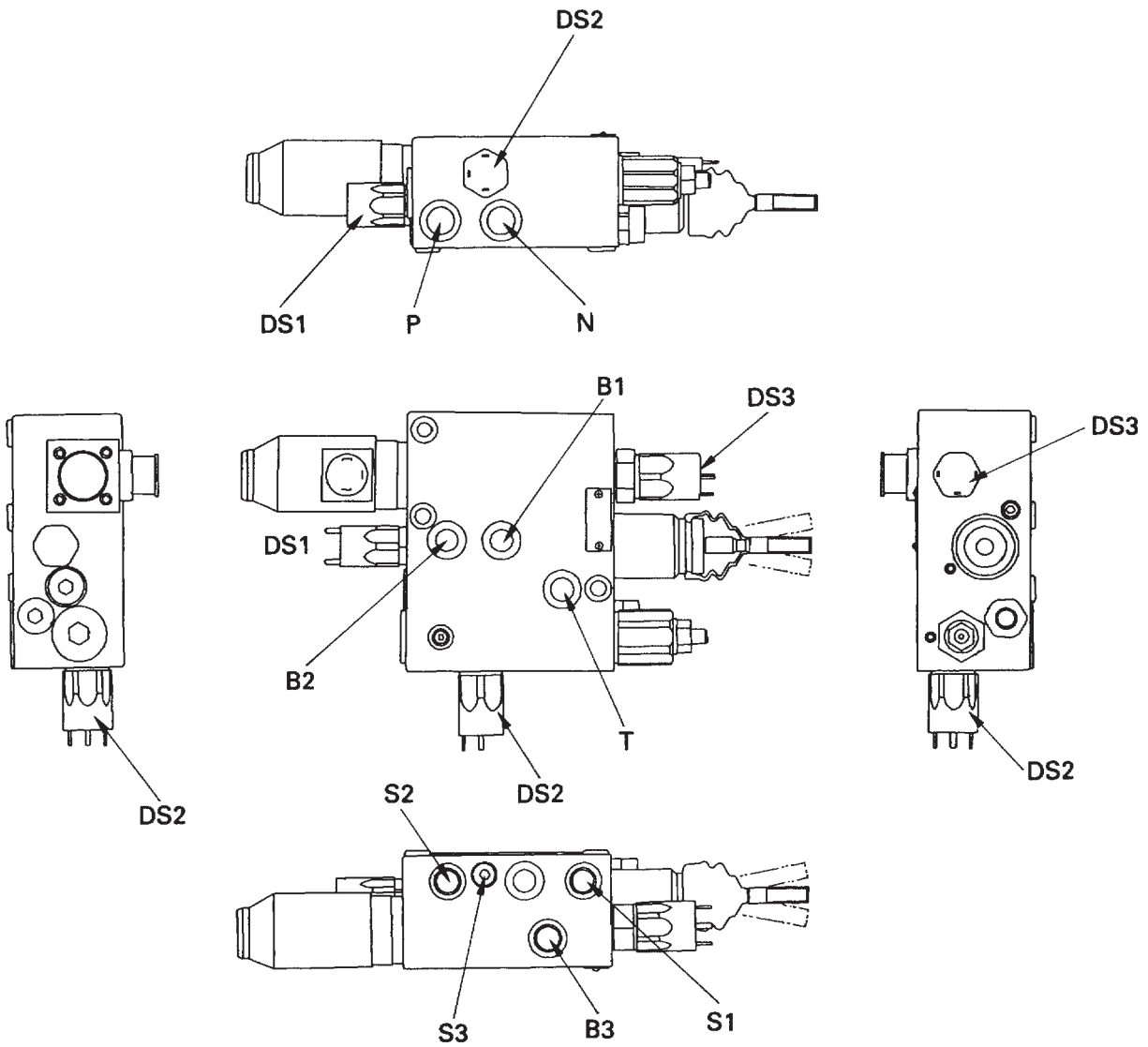
CLUTCH CONTROL CIRCUIT

STRUCTURE



1. Clutch control pump
2. Pressure relief valve ass'y
3. Pressure reducing valve
4. Clutch control valve

BRAKE VALVE

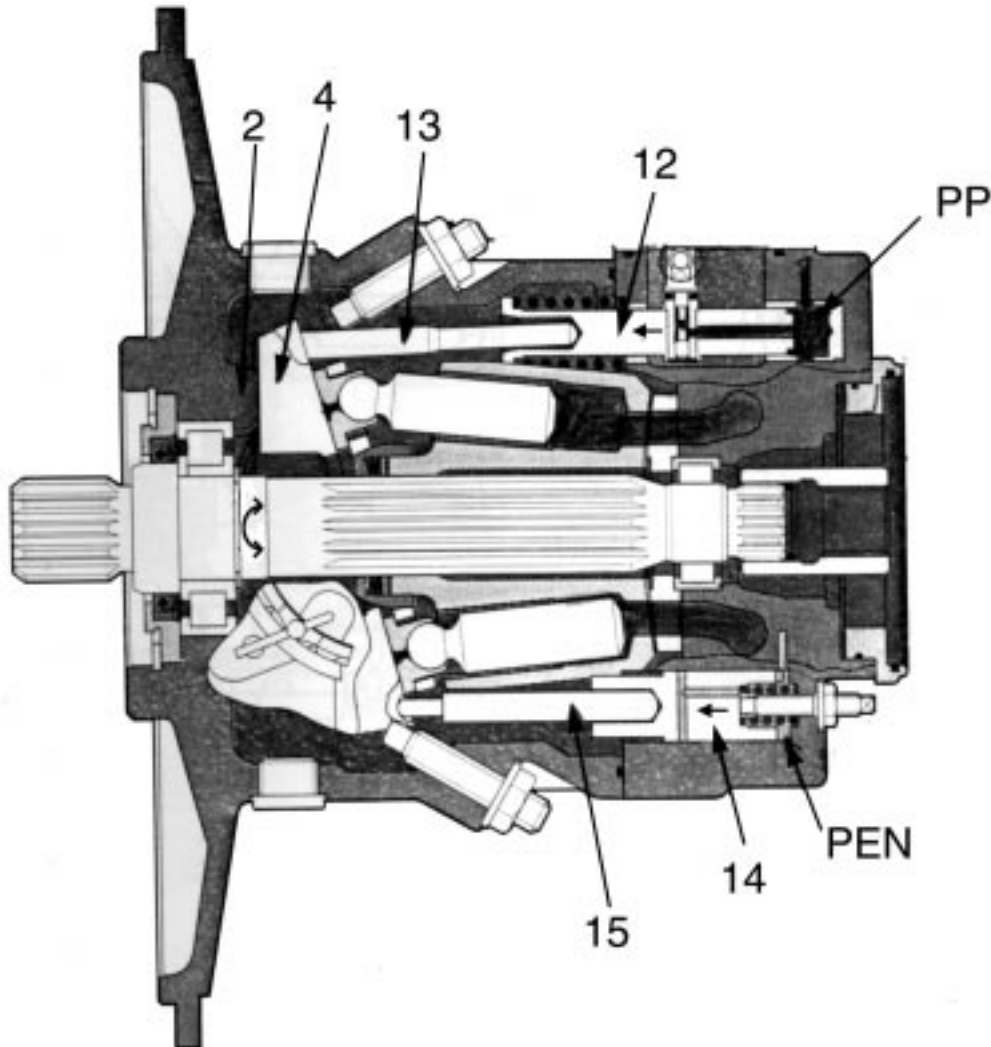


KW130P6013

P = Pump
 N = Secondary circuit
 T = Tank
 B1 = Service brake
 B2 = Service brake
 B3 = Parking brake

S1 = Accumulator service brake
 S2 = Accumulator service brake
 S3 = Accumulator parking brake
 DS1 = Pressure switch stop light
 DS2 = Pressure switch accumulator-pressure
 DS3 = Pressure switch parking brake

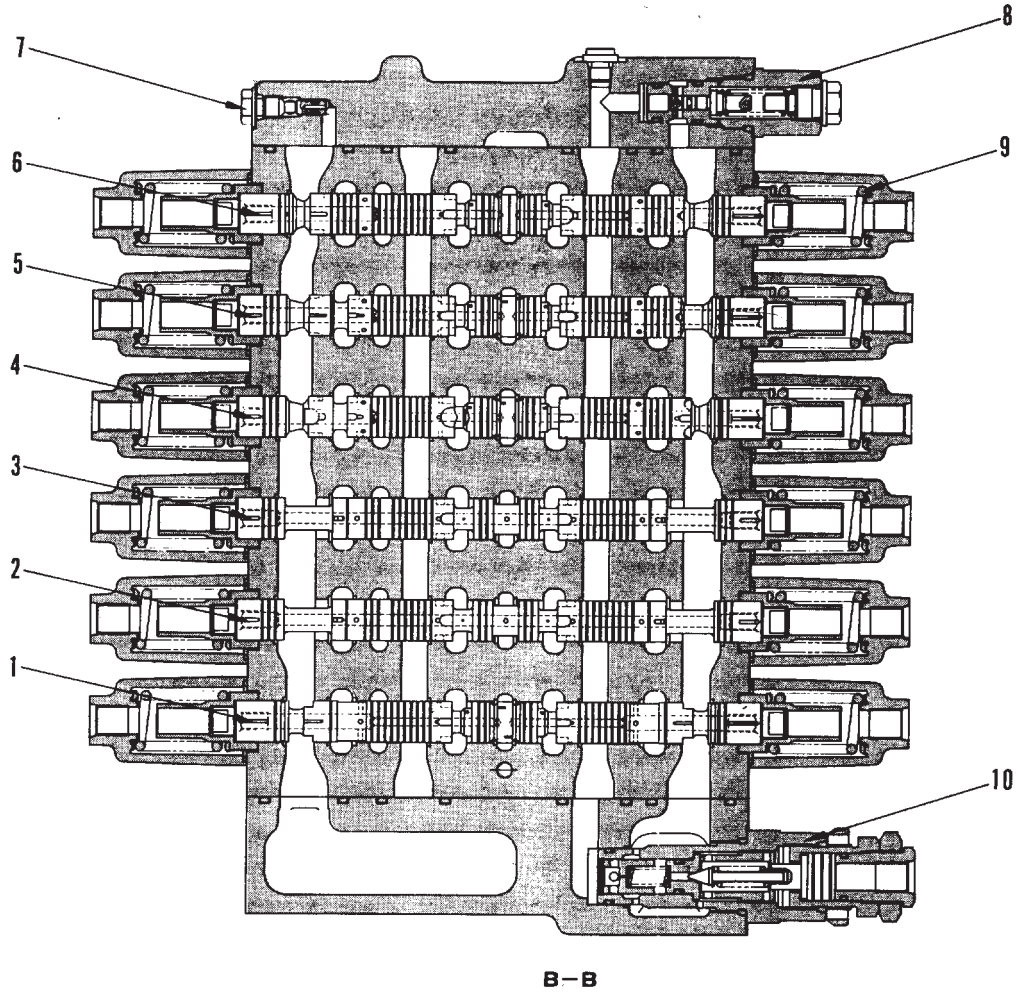
2. CONTROL OF DISCHARGE AMOUNT



- If swash plate angle α becomes larger, the difference in volumes **E** and **F** becomes larger and discharge volume **Q** increases.
- Swash plate angle α is changed by positioning piston (12) and return piston (14).
- Servo piston (12) moves in a reciprocal movement (\longleftrightarrow) according to the spring force and pump output pressure.
- This straight line movement is transmitted through rod (13) and (15) to rocker cam (4), and rocker cam (4), which is supported by the cylindrical surface to cradle (2), moves in a swinging movement on the cylindrical surface in (direction).
- Piston (14) moves in a reciprocal movement (\longleftrightarrow) according to the command from the TVC•LS valve and the spring force.
- Main pump discharge pressure (self-pressure) **PP** is always connected to the chamber receiving the pressure on piston (12) end. (the self-pressure is brought in).
- Output pressure **PEN** of the LS valve is brought to the chamber receiving the pressure at piston (14) end.
- The relationship between piston (12) and piston (14) controls swash plate (4) angle.

(2) Movement of spring

- The spring load of springs (3) and (4) in the TVC valve is determined by the swash plate position.
- When servo piston (9) moves, cam (7), which is connected to rod (8), also moves. When this happens, Lever (6) is rotated by the angle of cam (7), and piston (5) moves to the right and left.
- If piston (5) moves to the right, spring (3) is compressed, and if it moves further to the right, spring (4) contacts seat (10), so both spring (3) and spring (4) function. In other words, the spring load is changed by piston (5) extending or contracting springs (3) and (4).
- If the command current input to solenoid (1) changes further, the force pushing solenoid push pin (11) changes, and the spring load of springs (3) and (4) also changes according to the value of the solenoid command current.
- Port **c** of the TVC valve is connected to port **e** of the LS valve (see 1. LS valve). Self pressure **P_p** enters port **b**, the small piston diameter end of servo piston (9), and port **a**.
- When pump pressure **P_p** is small, piston (2) is on the right. At this point, port **c** and port **d** are connected, and the pressure entering the LS valve becomes drain pressure **P_t**. If port **h** and port **e** of the LS valve are connected (see 1. LS valve), the pressure entering the large piston diameter end from port **f** becomes drain pressure **P_t**, and servo piston (9) moves to the right. In this way, the pump discharge amount moves in the direction of the increase.
- As servo piston (9) moves further, piston (5) is moved to the left by rod (8), cam (7), and lever (6). Springs (3) and (4) expand and the spring force becomes weaker. When the spring force becomes weaker, piston (2) moves to the left, so the connection between port **c** and port **d** is cut, and the pump discharge pressure is connected to port **b**. As a result, the pressure at port **c** rises, and the pressure at the large piston diameter end also rises, so the movement of piston (9) to the right is stopped. In other words, the stop position for piston (9) (= pump discharge amount) is decided at the point where for the force of springs (3) and (4) and the pushing force from the solenoid and the pushing force created by pressure **P_p** acting on piston (2) are in balance.

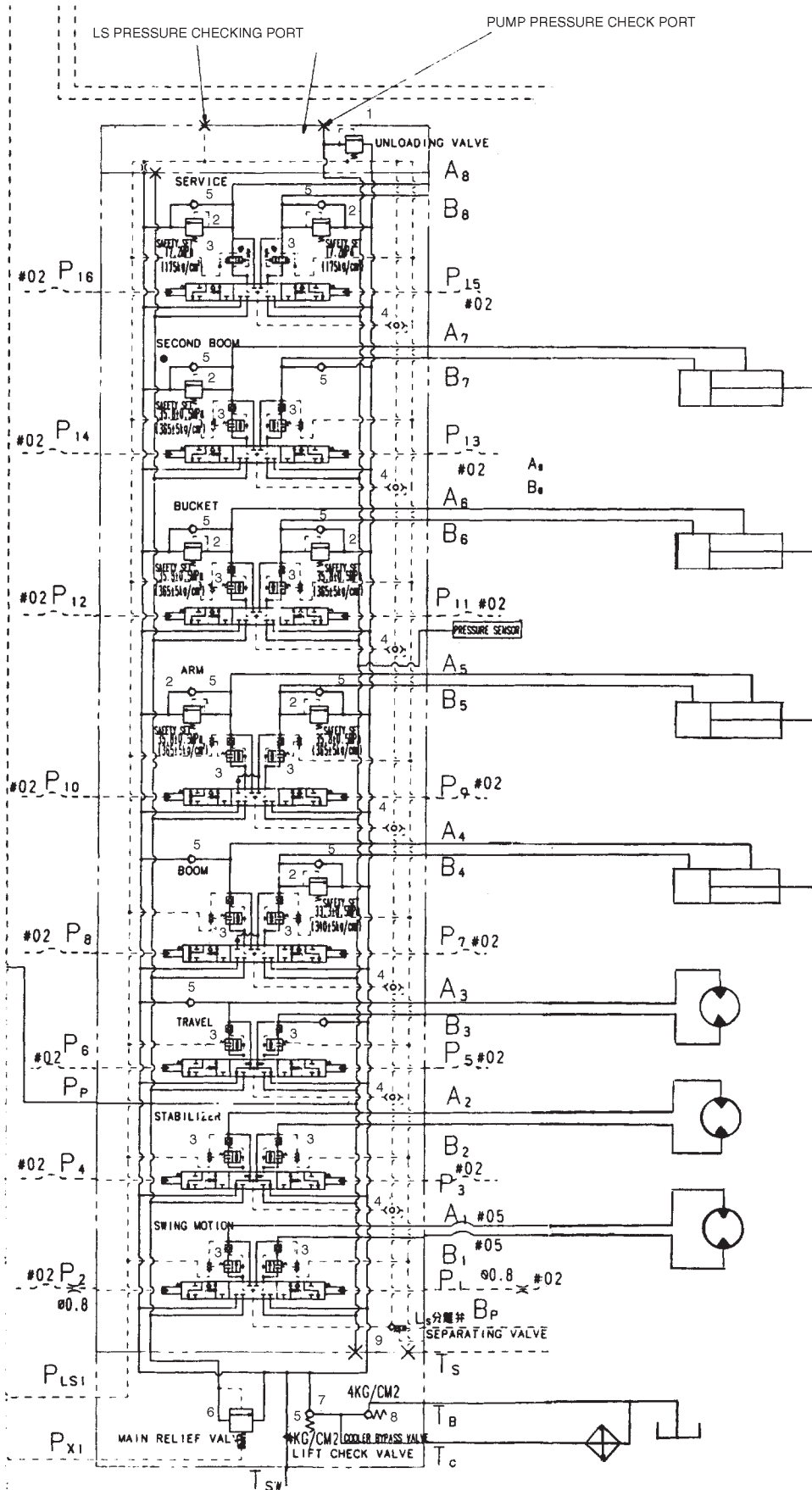


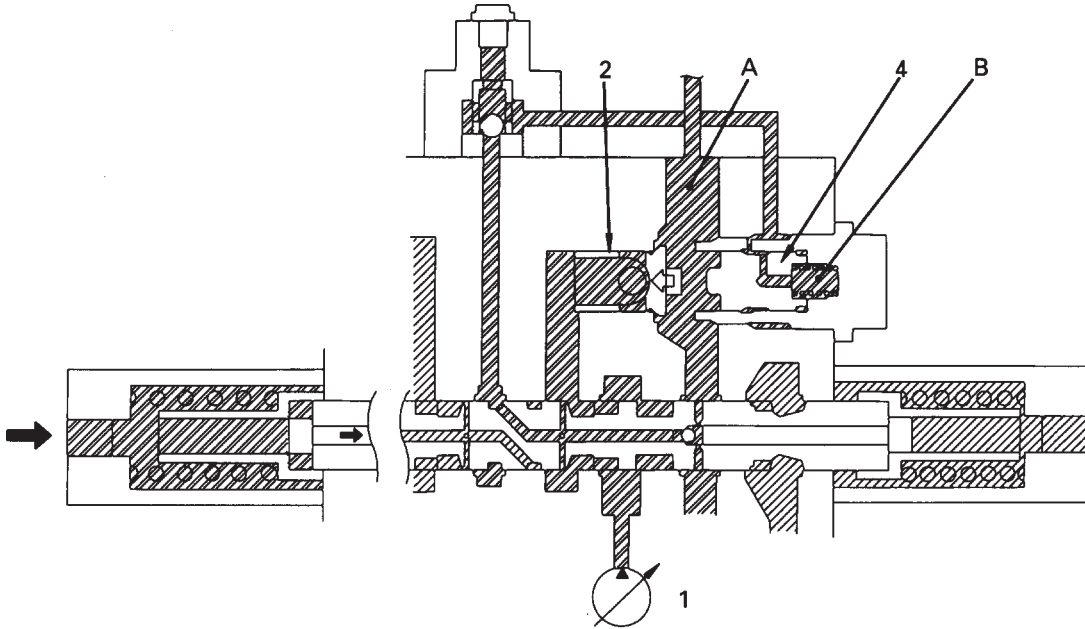
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- | | |
|---|--|
| <ul style="list-style-type: none"> 1. Spool (swing) 2. Spool (stabilizer) 3. spool (travel) 4. Spool (boom) 5. Spool (arm) | <ul style="list-style-type: none"> 6. Spool (bucket) 7. LS bypass plug 8. Unload valve 9. Spool return spring 10. Main relief valve |
|---|--|

OPERATION FOR EACH FUNCTION OF CLSS

Hydraulic circuit diagram for system

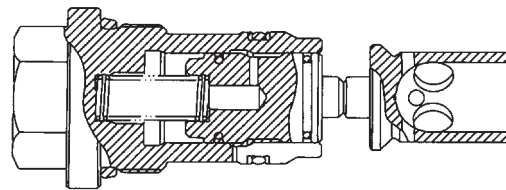




SLP00215

<For travel>

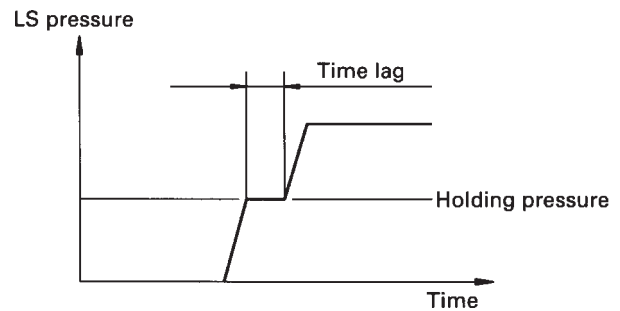
- No holding pressure is generated at port A in the travel circuit, so a pressure compensation valve without a shuttle valve is used.



SBP00216

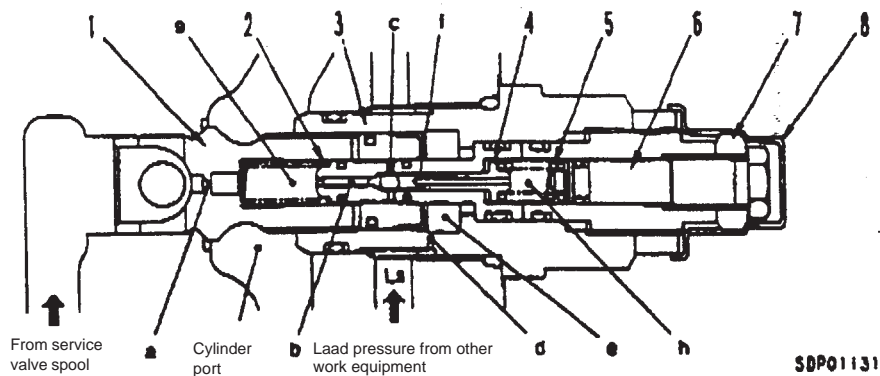
Reference: When there is no shuttle valve

- If there is no shuttle valve, piston (4) and valve (2) will separate. In this condition, if another actuator is opened, the piston acts as an accumulator, so there is a time lag.



SAP00217

12) Variable type pressure compensation valve (for service valve)



1. Valve
2. Spring
3. Sleeve
4. Poppet
5. Spring
6. Screw
7. Locknut
8. Plastic cap

Function

- It is possible to adjust the division of the oil flow to the service valve when the service valve (for attachment) is operated together with the main control valve (boom RAISE, etc.). (Variable in proportion to surface area).
- The pump pressure leaving the service valve spool acts on the left end of valve (1), and at the same time passes through throttle a and enters chamber g.

The maximum LS pressure passes through throttle d and enters chamber e. At the same time, the cylinder port pressure passes through passage c and throttle f, and goes to chamber h.

In addition, the force of spring (2) acts on valve (1), and the force spring (5) acts on poppet (4). The force of spring (5) can be adjusted with screw (6).

5) When circuit is relieved at end of boom stroke

- When boom cylinder (20) reaches the end of its stroke, main relief valve (15) opens and pump discharge amount **Q** is relieved to tank (1).
- When pump discharge pressure **P_p** comes close to the relief pressure, the pump controller sends a signal to the solenoid of TVC valve (3) to carry out the cut-off function to make pump discharge amount **Q** the minimum.
- The cylinder is at the end of its stroke, so no oil flows to the upstream or downstream side of boom spool (9A). Pump discharge pressure **P_p** and LS pressure **P_{ls}** are the same pressure, and Ls differential pressure ΔP_{ls} becomes 0.
- LS differential pressure ΔP_{ls} is lower than the LS set pressure of LS valve (4), so LS valve (4) acts to make the pump swash plate angle the maximum. However, because of the mechanism, the operation of TVC valve (3) is given priority over the operation of LS valve (4), so the pump is kept at the minimum swash plate angle by the cut-off function of TVC valve (3).

1. Hydraulic tank

Hydraulic Pump

2. Main pump
3. TVC valve
4. LS valve

Control valve

5. LS bypass plug
6. Unload valve
7. Bucket valve
 - 7A. Spool
 - 7B. Pressure compensation valve (DUMP)
 - 7C. Pressure compensation valve (CURL)
 - 7D. LS shuttle valve
8. Arm valve
 - 8A. Spool
 - 8B. Pressure compensation valve (OUT)
 - 8C. Pressure compensation valve (IN)
 - 8D. LS shuttle valve
9. Boom valve
 - 9A. Spool
 - 9B. Pressure compensation valve (RAISE)
 - 9C. Pressure compensation valve (LOWER)
 - 9D. LS shuttle valve
 - 9E. Check valve
10. Travel valve
 - 10A. Spool
 - 10B. Pressure compensation valve (FORWARD)
 - 10C. Pressure compensation valve (REVERSE)
 - 10D. LS shuttle valve
11. Stabilizer valve
 - 11A. Spool
 - 11B. Pressure compensation valve (EXTRACT)
 - 11C. Pressure compensation valve (RETRACT)
 - 11D. LS shuttle valve
12. Swing valve
 - 12A. Spool
 - 12B. Pressure compensation valve (LEFT)
 - 12C. Pressure compensation valve (RIGHT)
13. LS select valve
14. LS bypass plug
15. Main relief valve
16. Cooler bypass valve
17. Lift check valve

Actuator

18. Bucket cylinder
19. Arm cylinder
20. Boom cylinder
21. Travel motor
22. Dozer cylinder
23. Swing motor

★ The arm counterbalance valve, safety-suction valve, and suction valve are not shown.

OPERATION

1. At neutral

Ports **A** and **B** of the control valve and ports **P1** and **P2** of the PPC valve are connected to drain chamber **D** through fine control hole "f" in spool (1). (Fig 1)

2. During fine control (neutral fine control)

When piston (4) starts to be pushed by disc (5), retainer (9) is pushed; spool (1) is also pushed by metering spring (2) and moves down.

When this happens, fine control hole "f" is shut off from drain chamber **D**, and at almost the same time it is connected to pump pressure chamber **Pp**, so pilot pressure oil from the control pump passes through fine control hole "f" and goes from port **P1** to port **A**.

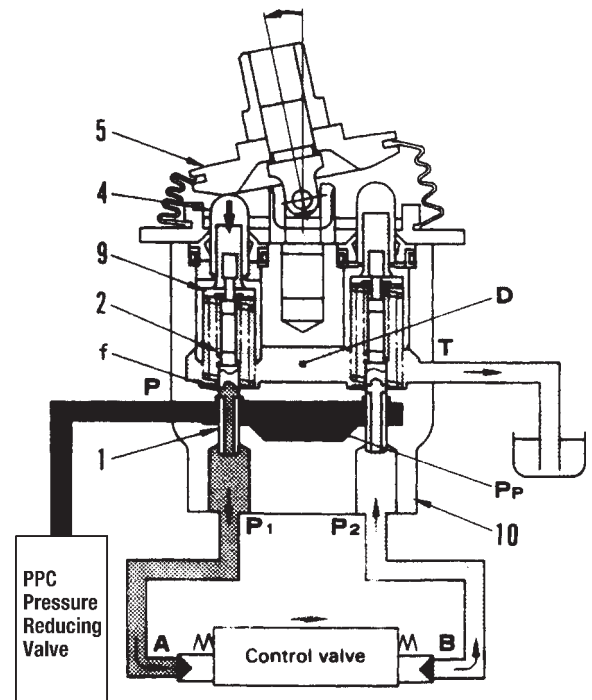
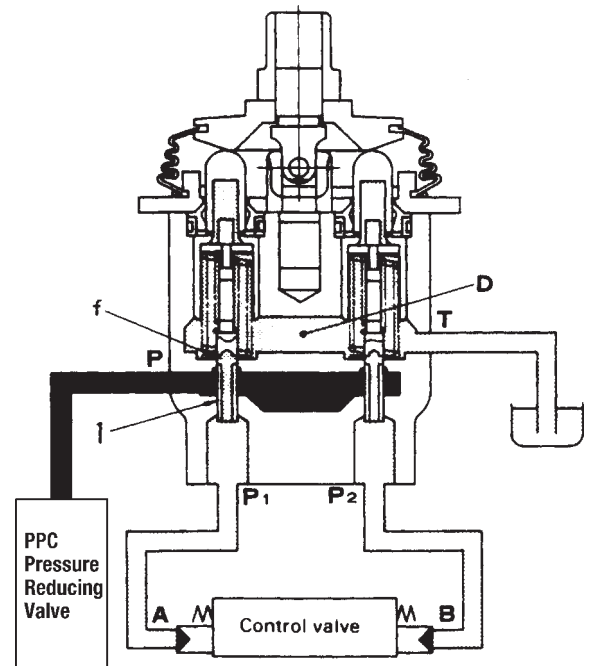
When the pressure at port **P1** becomes higher, spool (1) is pushed back and fine control hole "f" is shut off from pump pressure chamber **Pp**.

At almost the same time, it is connected to drain chamber **D** to release the pressure at port **P1**.

When this happens, spool (1) moves up or down so that the force of metering spring (2) is balanced with the pressure at port **P1**. The relationship in the position of spool (1) and body (10) (fine control hole "f" is at a point midway between drain hole **D** and pump pressure chamber **Pp**) does not change until retainer (9) contacts spool (1).

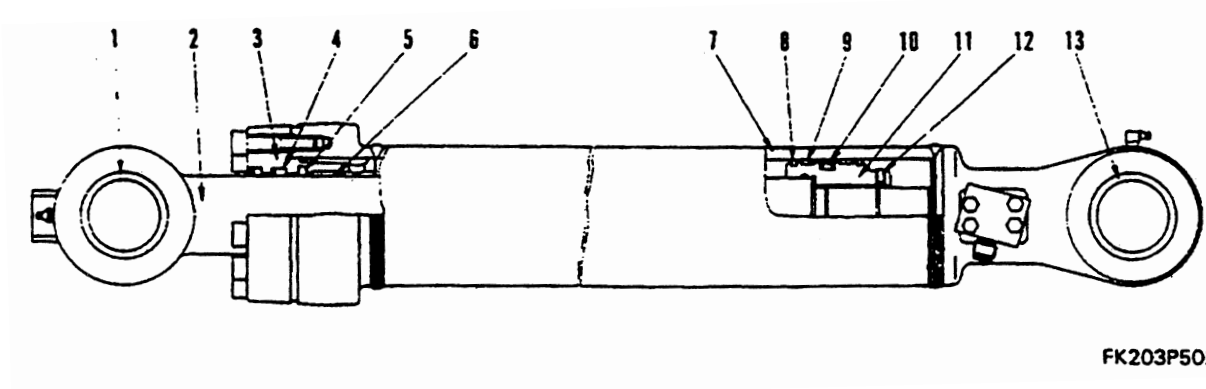
Therefore, metering spring (2) is compressed proportionally to the amount of movement of the control lever, so the pressure at port **P1** also rises in proportion to the travel of the control lever.

In this way, the control valve spool moves to a position where the pressure in chamber **A** (the same as the pressure at port **P1**) and the force of the control valve spool return spring are balanced. (Fig. 2)



MEMO

BOOM ADJUST CYLINDER



FK203P5021

- | | | |
|---------------------|-----------------|-------------------------|
| 1. Rod side bushing | 6. Wear ring | 11. Piston |
| 2. Piston rod | 7. Cylinder | 12. Set screw |
| 3. Cylinder head | 8. Casting ring | 13. Bottom side bushing |
| 4. Rod packing | 9. Wear ring | |
| 5. Buffer ring | 10. Piston ring | |

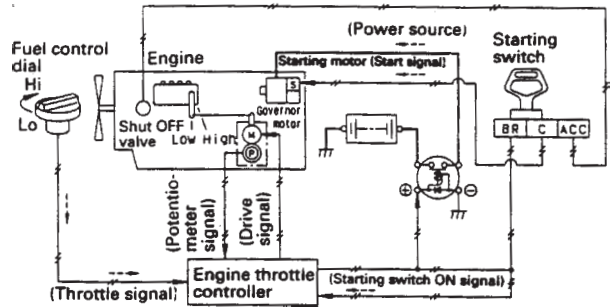
Specifications

Cylinder	1 P/B		2 P/B		Unit: mm
	Boom lift		Arm	Bucket	
Inside diameter of cylinder	110	120	120	110	160
Outside diameter of piston rod	75	85	85	75	100
Stroke	1170	996	1352	1013	687
Max. stroke	2805	2523	3285	2560	1962
Min. stroke	1635	1527	1933	1547	1275

1. OPERATION OF SYSTEM

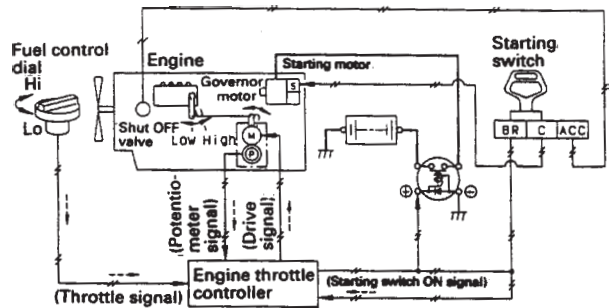
Starting engine

- When the starting switch is turned to the START position, the starting signal flows to the starting motor, and the starting motor turns to start the engine. When this happens, the engine throttle controller checks the signal from the fuel control dial and sets the engine speed to the speed set by the fuel control dial.



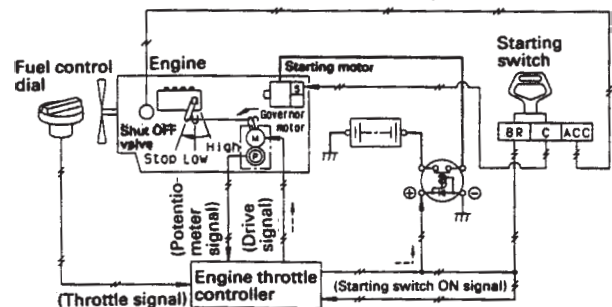
Engine speed control

- The fuel control dial sends a signal to the engine throttle controller according to the position of the dial. The engine throttle controller calculates the angle of the governor motor according to this signal, and sends a signal to move the governor motor so that it is at that angle. When this happens, the operating angle of the governor motor is detected by the potentiometer, and feedback is sent to the engine throttle controller, so that it can observe the operation of the governor motor.



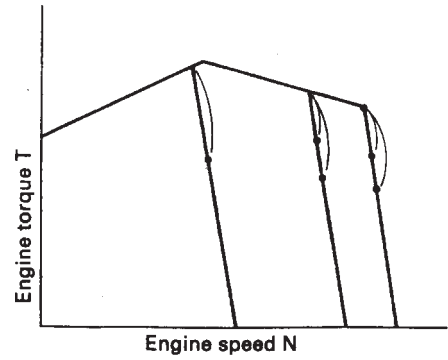
Stopping engine

- When the starting switch is placed at the OFF position, the shut off valve is closed so the supply of fuel to the engine is shut off and the engine stops.

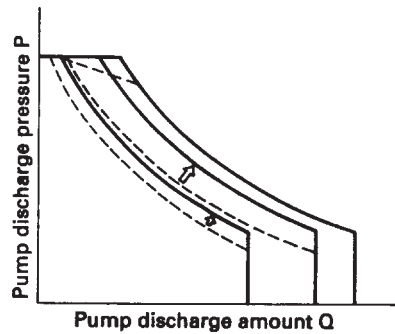


2. Pump control function when travelling

- If the travel is operated in any working mode other than the heavy-duty operation (H/O) mode, the working mode and engine speed are kept as they are, and the pump absorption torque is increased to the maximum horsepower at that speed.



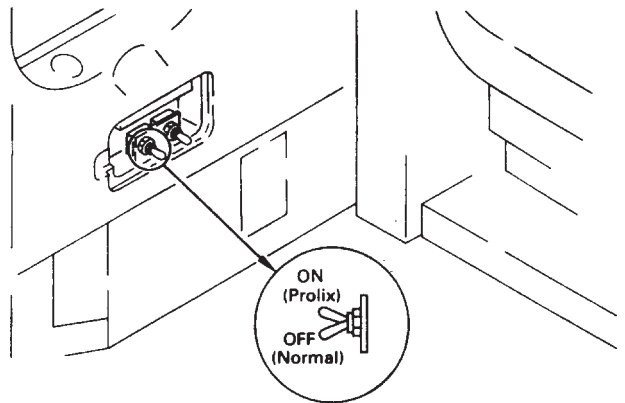
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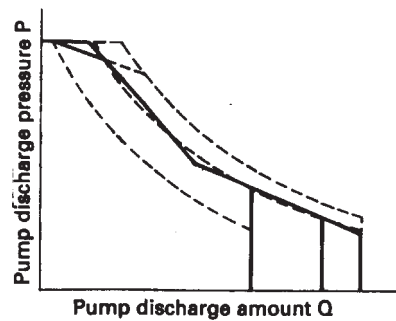
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3. control function TVC prolix switch is ON

- Even if any abnormality should occur in the controller or sensor, the TVC prolix switch can be turned ON to provide an absorption torque more or less equivalent to the general operation (G/O) mode, thereby allowing the machine to maintain its functions.
- In this case, it is designed to allow a constant current to flow from the battery to the TVC valve, so oil pressure sensing is carried out only by the TVC valve.



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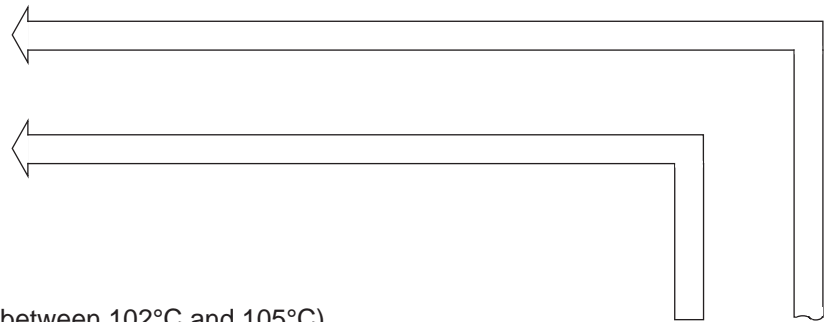
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2. Engine overheat prevention function

- This function protects the engine by lowering the pump load and engine speed to prevent overheating when the engine coolant temperature has risen too far.
- This system is actuated in two stages. The first stage is when the coolant temperature is between 102°C and 105°C, and the second stage is when the coolant temperature is 105°C and above.

Normal operation
(coolant temperature below 102°C)

Actuation condition	
Normal operation	Coolant temperature: Below 102°C
	(Coolant temperature gauge: Green range)

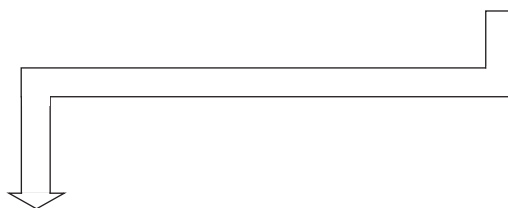


1st stage (Coolant temperature between 102°C and 105°C)

Actuation condition	
1st stage	Coolant temperature: Between 102°C and 105 c
	(Coolant temperature gauge: Red range)

Actuation, remedy	
Working mode	PC180/PC160K
Heavy-duty General Finishing Breaker	Mode kept as it is output reduced
Lifting	Lifting operation kept as it is

Cancel condition	
2nd stage	Coolant temperature: Below 102°C
	When the above condition is met, the system returns to the condition before the overheat prevention function was actuated (automatic reset).



2nd stage (coolant temperature 105°C and above)

Actuation condition	
2nd stage	Coolant temperature: 105°C and above
	(Coolant temperature gauge: Red range)

Actuation, remedy	
Working mode	In any mode
Engine speed	Low idling
Monitor caution lamp	Lights up
Caution buzzer	Sounds

Cancel condition	
2nd stage	Coolant temperature: Below 102°C
	Fuel control dial: Return temporarily to low idling position
When the above conditions are met, the system returns to the condition before the overheat prevention function was actuated (manual reset).	

TABLE OF JUDGEMENT STANDARD VALUE

• FOR ENGINE

Machine model			PW170-6k		
Engine			SA4DI02E		
Item	Measurement conditions		Unit	Standard value	Permissible value
Engine speed	High idling	Travel	rpm	2545	2545 ± 50
		Working		2340	2340 ± 20
	Low idling		rpm	900 ± 50	900 ± 50
	Rated speed		rpm	2200	2200 ± 100

STANDARD VALUE TABLE FOR ELECTRICAL PARTS

System	Name of component	Connector No.	Inspection method	Judgement table	Measurement conditions										
Control system	Fuel control dial	E06 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal <table border="1"> <tr> <td>Between (1) - (2)</td> <td>0.25 - 7 kΩ</td> </tr> <tr> <td>Between (2) - (3)</td> <td>0.25 - 7 kΩ</td> </tr> <tr> <td>Between (1) - (3)</td> <td>4 - 6 kΩ</td> </tr> </table>	Between (1) - (2)	0.25 - 7 kΩ	Between (2) - (3)	0.25 - 7 kΩ	Between (1) - (3)	4 - 6 kΩ	1) Turn starting switch OFF. 2) Disconnect connector.				
	Between (1) - (2)	0.25 - 7 kΩ													
	Between (2) - (3)	0.25 - 7 kΩ													
	Between (1) - (3)	4 - 6 kΩ													
	Governor motor	Potentiometer	E04 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal <table border="1"> <tr> <td>Between (1) - (2)</td> <td>0.25 - 7 kΩ</td> </tr> <tr> <td>Between (2) - (3)</td> <td>0.25 - 7 kΩ</td> </tr> <tr> <td>Between (1) - (3)</td> <td>4 - 6 kΩ</td> </tr> </table>	Between (1) - (2)	0.25 - 7 kΩ	Between (2) - (3)	0.25 - 7 kΩ	Between (1) - (3)	4 - 6 kΩ	1) Turn starting switch OFF. 2) Disconnect connector.			
		Between (1) - (2)	0.25 - 7 kΩ												
		Between (2) - (3)	0.25 - 7 kΩ												
	Between (1) - (3)	4 - 6 kΩ													
	Motor	E05 (male)	Measure resistance	If the condition is as shown in the table below, it is normal <table border="1"> <tr> <td>Between (1) - (2)</td> <td>2.5 - 7.5 Ω</td> </tr> <tr> <td>Between (3) - (4)</td> <td>2.5 - 7.5 Ω</td> </tr> <tr> <td>Between (1) - (3)</td> <td>No continuity</td> </tr> <tr> <td>Between (1) - chassis</td> <td>No continuity</td> </tr> <tr> <td>Between (3) - chassis</td> <td>No continuity</td> </tr> </table>	Between (1) - (2)	2.5 - 7.5 Ω	Between (3) - (4)	2.5 - 7.5 Ω	Between (1) - (3)	No continuity	Between (1) - chassis	No continuity	Between (3) - chassis	No continuity	1) Turn starting switch OFF. 2) Disconnect connector.
	Between (1) - (2)	2.5 - 7.5 Ω													
Between (3) - (4)	2.5 - 7.5 Ω														
Between (1) - (3)	No continuity														
Between (1) - chassis	No continuity														
Between (3) - chassis	No continuity														
Engine speed sensor		E07	Measure resistance	If the condition is within the range shown in the table below, it is normal <table border="1"> <tr> <td>Between(male) (1) - (2)</td> <td>500 - 1,000 Ω</td> </tr> <tr> <td>Between(male) (2) - chassis</td> <td>Min. 1 MΩ</td> </tr> </table>	Between(male) (1) - (2)	500 - 1,000 Ω	Between(male) (2) - chassis	Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector.						
			Between(male) (1) - (2)	500 - 1,000 Ω											
			Between(male) (2) - chassis	Min. 1 MΩ											
Measure voltage	Measure with AC range <table border="1"> <tr> <td>Between (1) - (2)</td> <td>0.5 - 3.0 V</td> </tr> </table>	Between (1) - (2)	0.5 - 3.0 V	1) Start engine. 2) Insert T-adaptor.											
Between (1) - (2)	0.5 - 3.0 V														
Adjust	1) Screw in rotation sensor until it contacts ring gear, then turn back $1 \pm 1/6$ turns. 2) It must work normally when adjusted as above.														
PPC oil pressure switch	Travel (Auto/decel) G75 Travel (Park brake buzzer) G156 Travel (Auto' susp' lock) G132 2 piece boom/stabiliser G68 Service S09 Service G72 boom RAISE S02 arm OUT S03 boom LOWER S04 arm IN S05 bucket CURL S06 bucket DUMP S07 swing S08	Measure resistance	If the condition is as shown in the table below, it is normal When boom, arm, and bucket levers are operated <table border="1"> <tr> <td rowspan="2">Between (male) (1) - (2)</td> <td>All levers at neutral</td> <td>Min 1 MΩ</td> </tr> <tr> <td>Levers operated</td> <td>Max. 1 Ω</td> </tr> <tr> <td colspan="2">Between (male) (1), (2) - chassis</td> <td>Min. 1MΩ</td> </tr> </table>	Between (male) (1) - (2)	All levers at neutral	Min 1 MΩ	Levers operated	Max. 1 Ω	Between (male) (1), (2) - chassis		Min. 1MΩ	1) Start engine (or with engine stopped and accumulator charged) 2) Disconnect connectors S01 - S08			
Between (male) (1) - (2)	All levers at neutral	Min 1 MΩ													
	Levers operated	Max. 1 Ω													
Between (male) (1), (2) - chassis		Min. 1MΩ													
Fuel shut-off valve	E09 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal <table border="1"> <tr> <td>Between (A) - (C)</td> <td>46.5 - 56.9 kΩ</td> </tr> <tr> <td>Between (B) - (C)</td> <td>0.87 - 1.07 kΩ</td> </tr> </table>	Between (A) - (C)	46.5 - 56.9 kΩ	Between (B) - (C)	0.87 - 1.07 kΩ	1) Turn starting switch OFF 2) Disconnect connector							
Between (A) - (C)	46.5 - 56.9 kΩ														
Between (B) - (C)	0.87 - 1.07 kΩ														

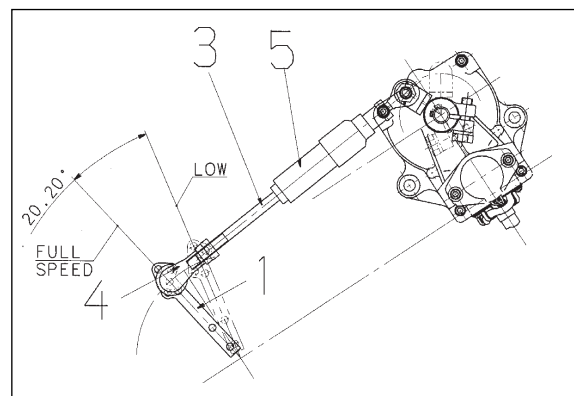
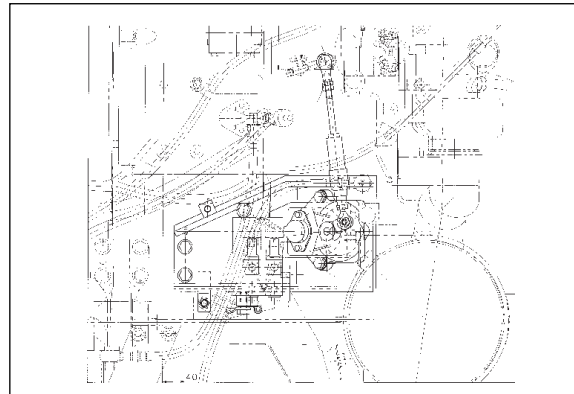
TESTING AND ADJUSTING GOVERNOR MOTOR LEVER STROKE

TESTING

1. Check engine speed at high idling in H/O work mode (ref: 20.2). If outside tolerance adjust as below
2. Check engine speed in H/O travelmode (lightly depress travel pedal until engine speed rises without machine moving) and at low idling.
3. If within tolerance check is OK (ref 20.2)

ADJUSTMENT

Set engine speed at high idling in H/O work mode to standard value by adjusting linkage (ref: 20.2)



ADJUSTING

1. Adjusting LS valve

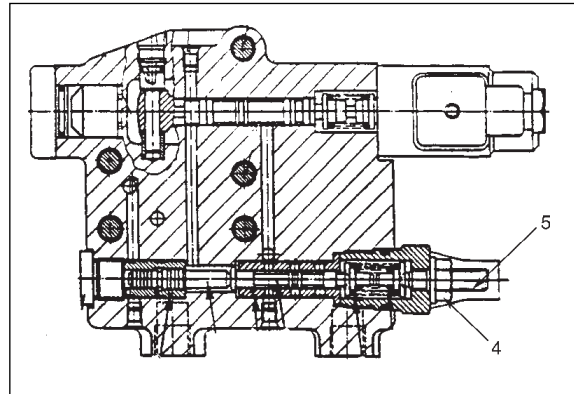
When the differential pressure is measured under the conditions above, and the results show that the differential pressure is not within the standard value, adjust as follows.

1) Loosen locknut (4) and turn screw (5) to adjust the differential pressure.

★ Turn the screw to adjust the differential pressure as follows.

- To INCREASE pressure, turn CLOCKWISE
- To DECREASE pressure, turn COUNTER-CLOCKWISE

2) After adjusting, tighten locknut (4)



 Locknut:

$29.4 \pm 4.9 \text{ Nm}$ ($3.0 \pm 0.5 \text{ kgm}$)

Note: Always measure the differential pressure while adjusting. While adjusting as the wheels are rotating, care should be taken when leaning into the pump compartment. No loose clothing.

MEASURING OIL LEAKAGE

★ Hydraulic oil temperature when measuring:
45 - 55°C

1. Work equipment cylinder

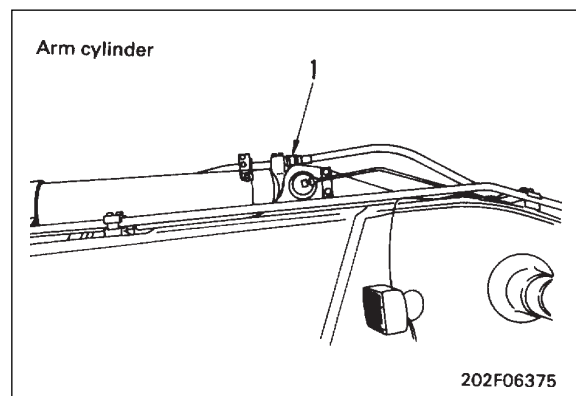
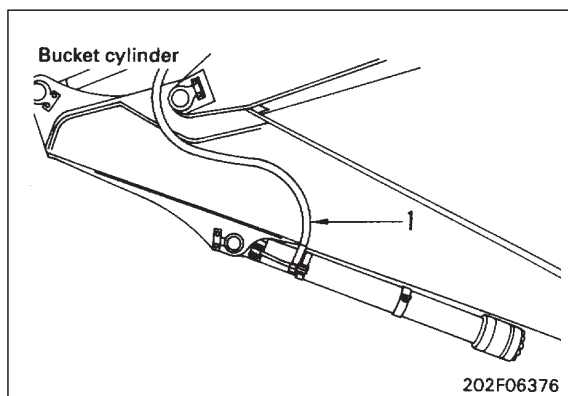
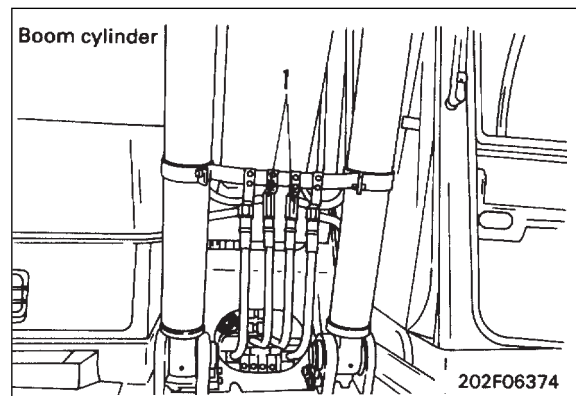
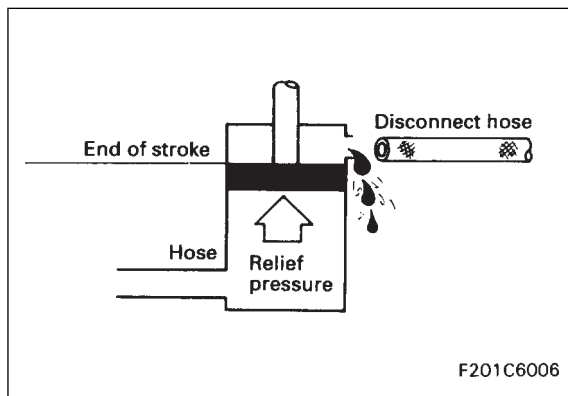
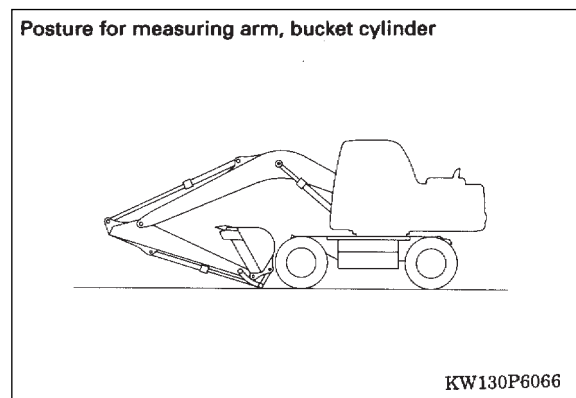
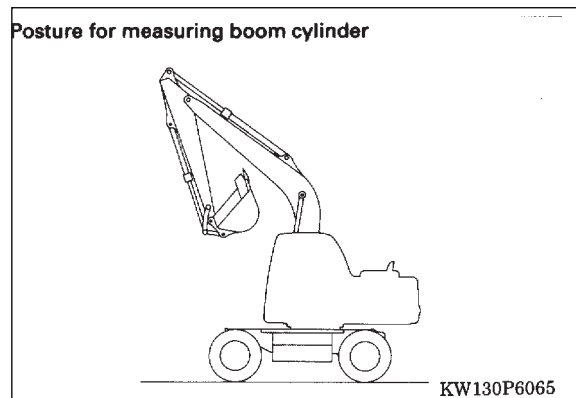
★ If the hydraulic drift of the work equipment is outside the standard value, measure the leakage inside the cylinder as follows, and judge if the cause of the hydraulic drift is in the cylinder or in the control valve.

- If the leakage is within the standard value, the problem is in the control valve.
- If the leakage is greater than the standard value, the problem is in the cylinder.

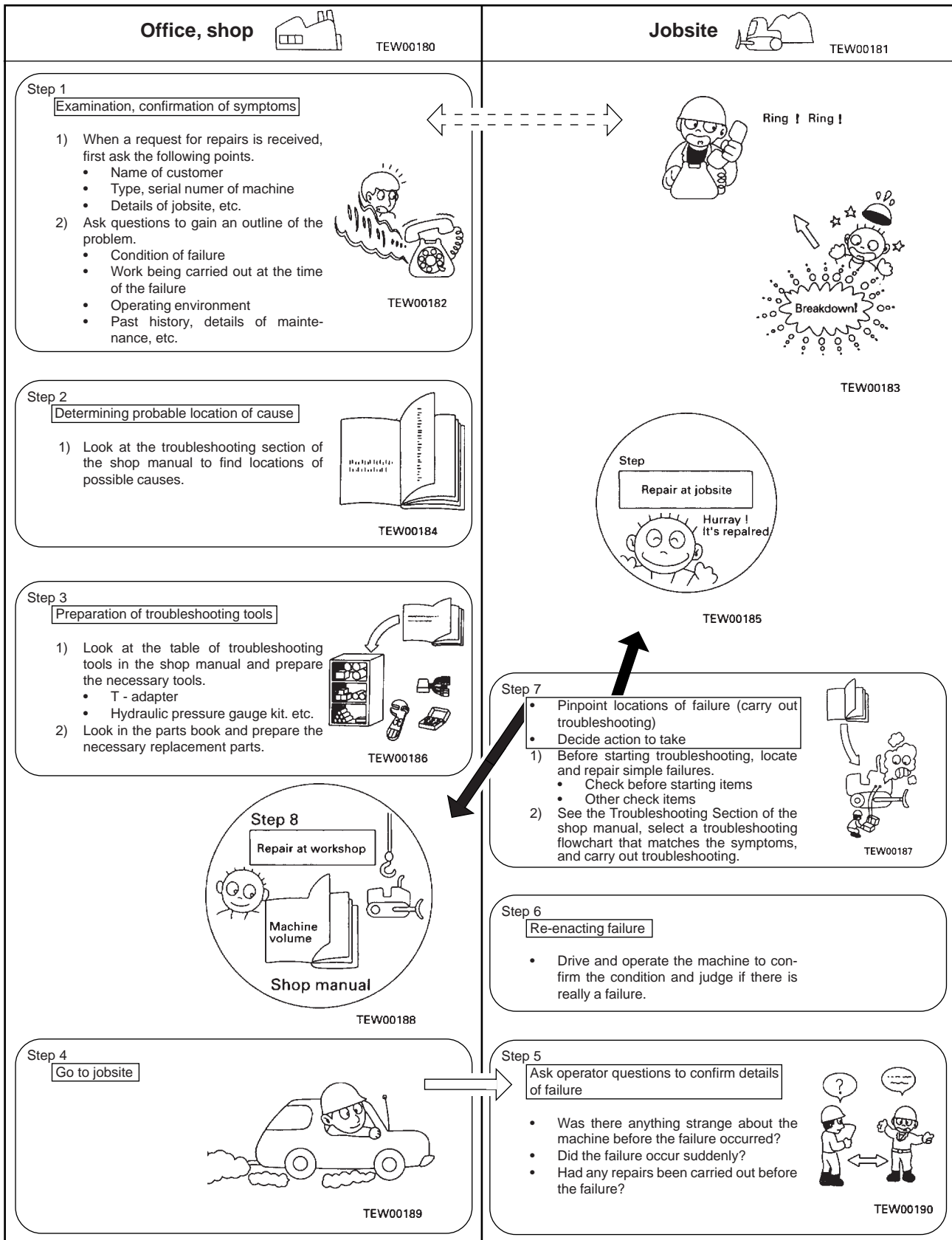
- 1) Fully extend the rod of the cylinder to be measured, then stop the engine.
- 2) Disconnect piping (1) at the head end, then block the piping at the chassis end with a blind plug.

⚠ Be careful not to disconnect piping at the bottom end.

- 3) Start engine and apply relief pressure to the bottom end of the cylinder with the engine at high idling.
- 4) Continue this condition for 30 seconds, then measure the oil leakage for the next one minute.

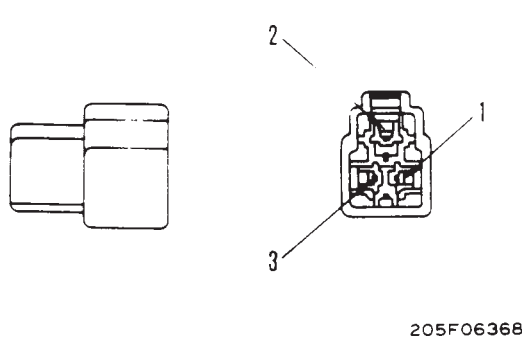
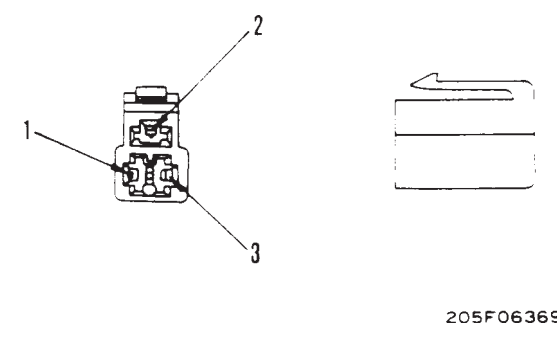


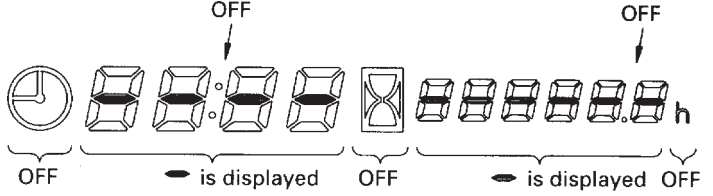
SEQUENCE OF EVENTS IN TROUBLESHOOTING



Connector No.	Type	No. of pins	Mounting location	Address
G137	LUCAS	5	Undercarriage control relay	J2
G138	LUCAS	5	Neutral start relay	J2
G139	M	2	Undercarriage control	J2
G150		2	Power outlet socket	K4
G152	LUCAS	5	Undercarriage control diode	J1
G154		2	Outrigger warning	T1
G155	M	1	Park brake buzzer	U8
G157		2	Indicator buzzer	S2
G160	<small>SIMPLE CONNECTOR</small>	1	Suspension lock switch	F9
G163	<small>SIMPLE CONNECTOR</small>	1	Washer tank	E7
G164	X	3	Overload caution sensor	F2
H12	S	16	Intermediate connector	X9
H13	S	16	Intermediate connector	Z8
H14	M	6	Intermediate connector	Z9
H15	L	2	Intermediate connector	W9
M02	X	2	Safety relay	H9
M06	M	4	Heater switch	S9
M11	KES1	2	Fusible link	L6
M12	L	3	Heater	Z1
M14		2	Fusible link	L6
M16	M	1	Horn (high sound)	G2
M17	<small>SIMPLE CONNECTOR</small>	1	Horn	F2
M18		4	Wiper, washer switch	P8
M20	PA		Cigarette lighter	P7
M21	M	9	Radio	P8
M23	M	4	R.H.stand switches	Y1
M24	M	4	LH wrist	Z1
M26	X	6	Heater	Z2
M28		2	Window washer motor	F2
M30		1	Work lights (option)	H3
M34	M	1	Electromagnetic clutch for aircon compressor	K1
M38	M	3	Light switch	P9
M40	M	1	Right working light	E9
M41	M	1	Left working light	D9
M42	KES1	2	Rear working light	I9
M45	40	3	Network bus	P1
M46	M	3	Check	S1
M54	<small>SIMPLE CONNECTOR</small>	1	Boom lamp (LH)	D7
M55	M	2	Beacon switch	R9
M56	M	2	Heated seat switch	T9
M71	<small>SIMPLE CONNECTOR</small>	1	Cab light	R1
M99	M	2	Safety lock switch	X2

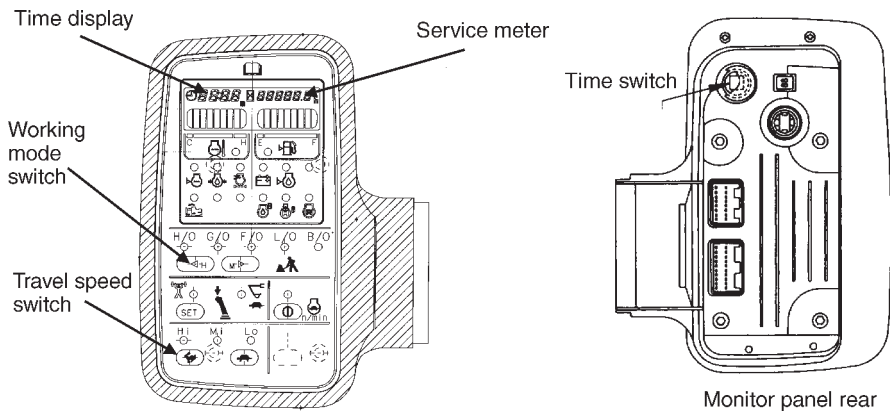
Connector No.	Type	No. of pins	Mounting location	Address
P01	40	20	Monitor panel	P5
P02	M	16	Monitor panel	P5
P03	M	2	Buzzer cancel switch	Q9
P04	X	2	Alarm buzzer	P6
P05	X	1	Engine oil level sensor	L1
P06	X	1	Fuel level sensor	D9
P07	X	2	Coolant temperature sensor	K4
P08	X	2	Coolant level sensor	L7
P11		1	Air cleaner clogging sensor	K8
P12		1	Air cleaner clogging sensor	K8
R04	SHINIGAWA	5	Light relay	P4
RO5	SHINIGAWA	5	Light relay	P2
S02	X	2	Boom raise oil pressure switch	M6
S03	X	2	Arm out oil pressure switch	M7
S04	X	2	Boom lower oil pressure switch	M7
S05	X	2	Arm in oil pressure switch	L7
S06	X	2	Bucket curl oil pressure switch	L8
S07	X	2	Bucket dump oil pressure switch	M8
S08	X	5	Swing oil pressure switch	M8
S09	X	S	Swing oil pressure switch	M6
S10	X	2	Swing RH switch	L8
S11	X	2	2PB retract switch	L7
S12	X	2	2PB extend switch	M7
S13	X	2	STabiliser down switch	L6
S14	X	2	Stabiliser up switch	L6
S15	X	2	Travel reverse switch	L7
SW01			Swing redundancy switch	Q1
SW02			Pump redundancy switch	Q1
T02			Grd	
T03			GRD (revo frame)	
T05			Grd	
V04	X	2	Swing brake solenoid valve	F9
V05	X	2	2-stage relief solenoid valve	G9
V06	X	2	Travel speed solenoid valve	F9
V07	X	2	Solenoid valve safety	F9
W04	X	6	Wiper motor	P3
W08	M	18	Wiper motor controller	S1
W10	70	4	Rear limit switch	R1
W16	KES0	4	Wiper, indicator switch	R9
X01	MIC	21	Intermediate connector	U9
X05	M	4	Swing lock switch	P8
X07	MIC	17	Intermediate connector	U9

No. of pins	AMP250 type connector	
	Male (female housing)	Female (male housing)
3	 <p>205F06368</p>	 <p>205F06369</p>

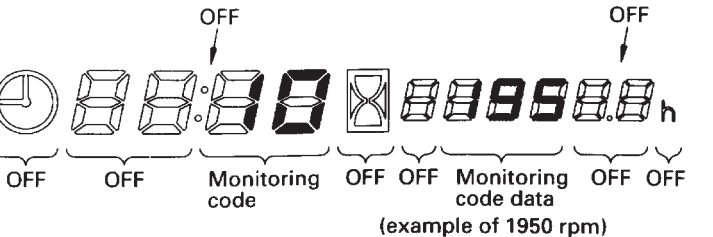
Operation	Display
<p>4. To finish with the trouble data display mode, keep the TIME switch + L.H. travel speed switch pressed for 2.5 seconds.</p> <p>5. To erase the memory, keep the time switch pressed, turn the starting switch from OFF to ON, and keep the time switch pressed for 5 seconds.</p>	<p>4. If there is no abnormality code in memory</p>  <p style="text-align: right;">BKP00081</p>

3. Machine data monitoring function

The input signals from the sensors and the output signals to drive the solenoid are displayed on the time display and service meter display.



1) Method of displaying monitoring code

Operation	Display
<p>1. To set the machine data monitoring mode, do as follows. Keep the time switch + knob button function switch pressed for 2.5 seconds. Note: this is possible at the following times.</p> <ol style="list-style-type: none"> 1) During the normal code 2) During the user code display 3) During the time adjustment mode 4) During the trouble data display mode 	<p>1. On the time display and service meter display, the monitoring code and data are displayed.</p> <ul style="list-style-type: none"> • Example of display 1) When engine speed is monitoring (monitoring code 10)  <p style="text-align: right;">BKP00083</p>

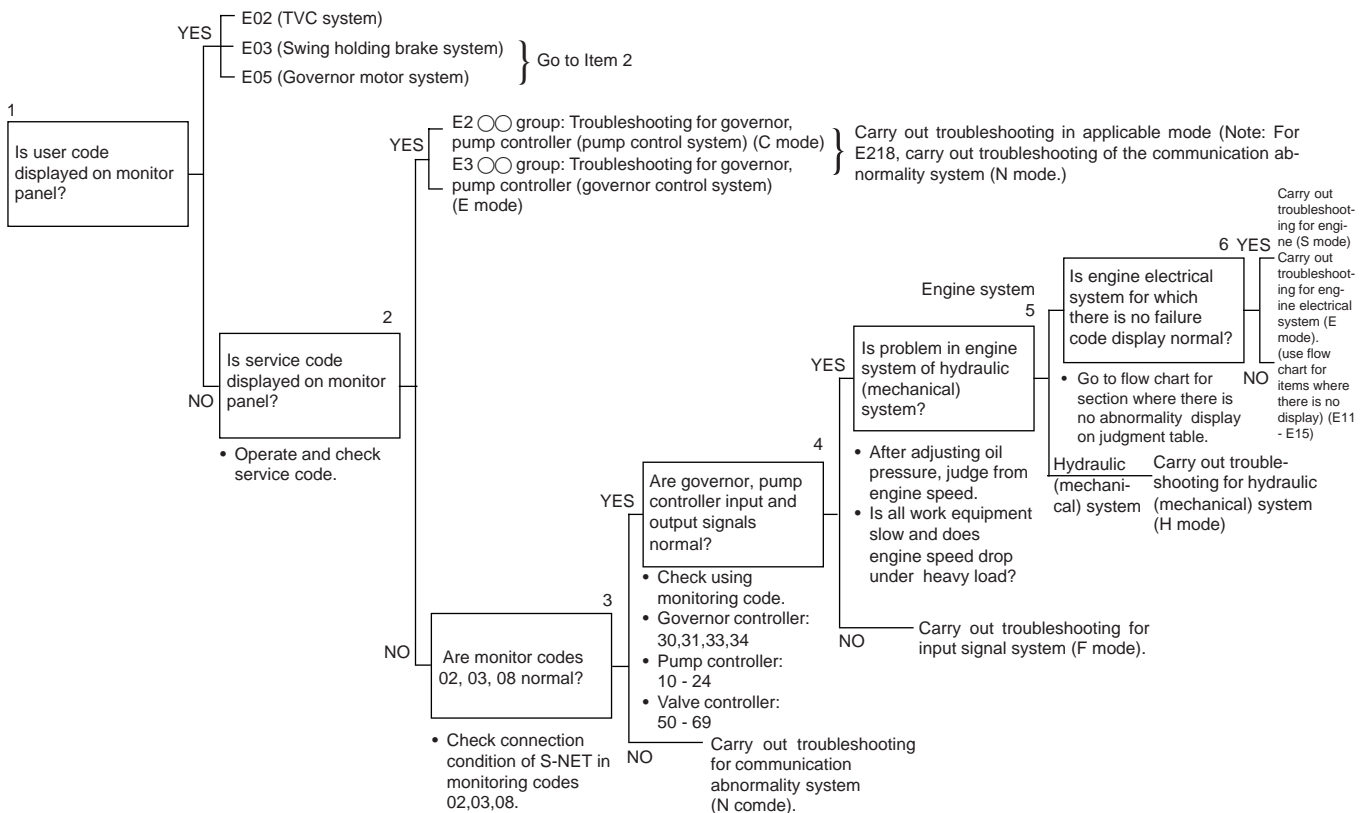
DETAILS OF TROUBLESHOOTING AND TROUBLESHOOTING PROCEDURE

If any abnormality should occur, it is necessary to go to the correct troubleshooting chart in accordance with the judgement table for that type of failure (governor, pump controller (governor control system) and governor, pump controller (pump control system). For details of the troubleshooting and troubleshooting procedure, refer to this flow chart.

When carrying out troubleshooting, ask the operator as much as possible about the condition of the machine, and check the following items before starting.

- (1) Condition of controller connection (check with monitoring codes 02 - 03)
- (2) Blown fuses
- (3) Battery voltage (monitoring mode 32)
- (4) Electricity generation (charge input) voltage (monitoring code 43)

The procedure for carrying out check items No. 3 and 4 in the flow chart below is given on the following pages.



★ For details, see governor, pump controller (governor control system) (pump control system) in the JUDGEMENT TABLE.

TROUBLESHOOTING OF GOVERNOR, PUMP CONTROLLER (GOVERNOR CONTROL SYSTEM) (E MODE)

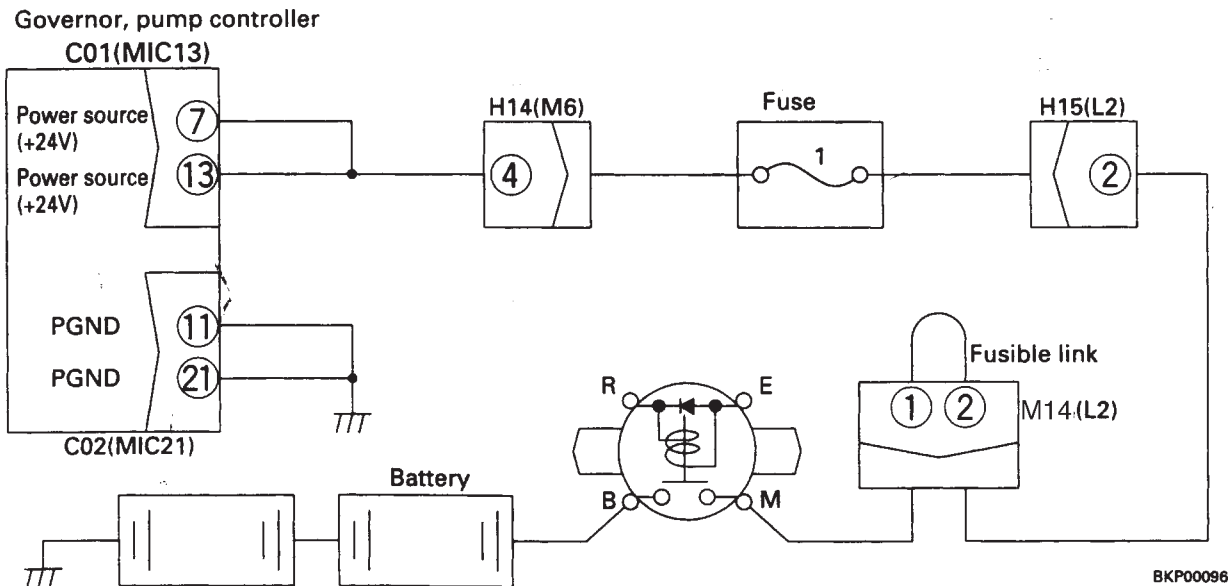
Points to remember when carrying out troubleshooting of governor, pump controller system	20-101
Action taken by controller and condition of machine when abnormality occurs	20-102
Judgement table for governor, pump controller (governor control system) and engine related parts	20-106
Electrical circuit diagram of governor, pump controller (governor control system)	20-108
E- 1 Abnormality in governor, pump controller power source (controller LED is OFF)	20-110
E-2 [E308] Abnormality in fuel control dial input value is displayed....	20-111
E-3 [E317] Abnormality (disconnection) in governor motor drive system is displayed....	20-112
E-4 [E318] Abnormality (short circuit) in governor motor drive system is displayed....	20-113
E-5 [E306] Abnormality in feedback potentiometer system is displayed....	20-114
E-6 [E315] Abnormality (short circuit) in battery relay output system is displayed....	20-115
E-7 [E316] Abnormality (step-out) in motor is displayed....	20-116
E-8 Engine does not start....	20-118
E-9 Engine speed is irregular....	20-120
a) Idling speed is irregular.....	20-120
b) There is hunting.....	20-122
E-10 Lack of output (engine high idling speed is too low)....	20-124
E-11 Engine does not stop....	20-126
E-12 Defective operation of battery relay system (engine does not stop)....	20-128

E-1 Abnormality in governor, pump controller power source (controller LED is OFF)

- ★ This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adaptor, or when removing the T-adaptor and returning the connector to its original position, if the service code E is not displayed, the problem has been removed.
- ★ Check that fuse 1 is not blown.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When the starting motor rotates correctly. (If the starting motor also does not rotate, go to E-8.)

	Cause	Remedy
<div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;"> <p>1</p> <p>Is voltage between C01 (7) (13) and C02 (11) (21) normal?</p> <ul style="list-style-type: none"> • Turn starting switch ON. • 20 - 30 V </div> <div style="margin-right: 20px;"> <p>YES</p> </div> <div style="margin-right: 20px;"> <p>NO</p> </div> </div> <div style="margin-right: 20px;"> <p>2</p> <p>Is voltage between fuse 1 and chassis normal?</p> <ul style="list-style-type: none"> • Turn starting switch ON. • 20 - 30 V </div> <div style="margin-right: 20px;"> <p>YES</p> </div> <div> <p>NO</p> </div>	Defective governor, pump controller	Replace
	Defective contact, or disconnection in wiring harness between fuse 1 and C01 (female) (7) (13)	Repair or replace
	Defective contact, or disconnection in wiring harness between fuse 1- H15 (2)-M14 (2) (1)-battery relay M	Repair or replace

E-1 Related electric circuit diagram



E-9 Engine speed is irregular

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

a) Idling speed is irregular

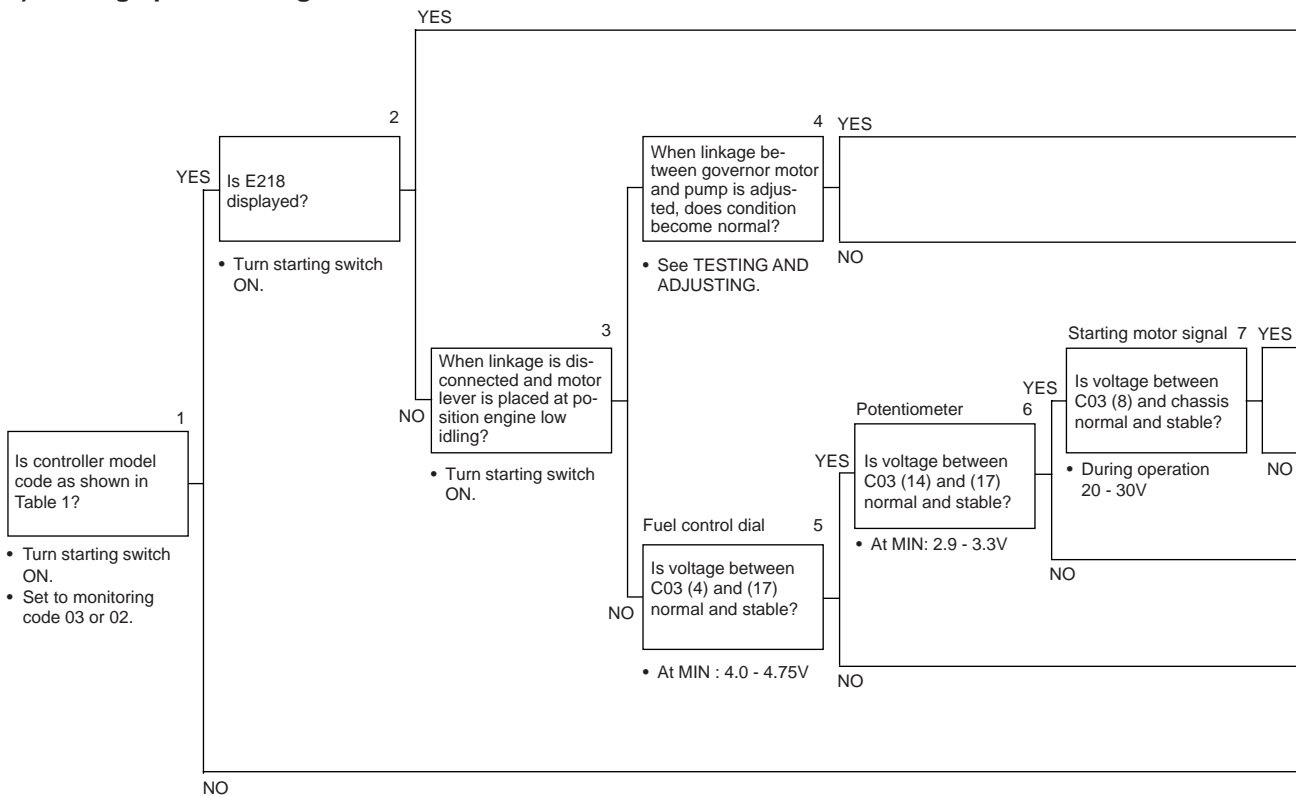


Table 1

Controller model code	
03	170

- ★ The diagram shows monitoring code 03.

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METHOD OF USING TROUBLESHOOTING CHARTS

This troubleshooting chart is divided into three sections: **questions, check items, and troubleshooting**. The questions and check items are used to pinpoint high probability causes that can be located from the failure symptoms or simple inspection without using troubleshooting tools.

Next, troubleshooting tools or direct inspection are used to check the high probability causes to make final confirmation.

[Questions]

Sections **Ⓐ** + **Ⓑ** in the chart on the right corresponds to the items where answers can be obtained from the user. The items in **Ⓑ** are items that can be obtained from the user, depending on the user's level.

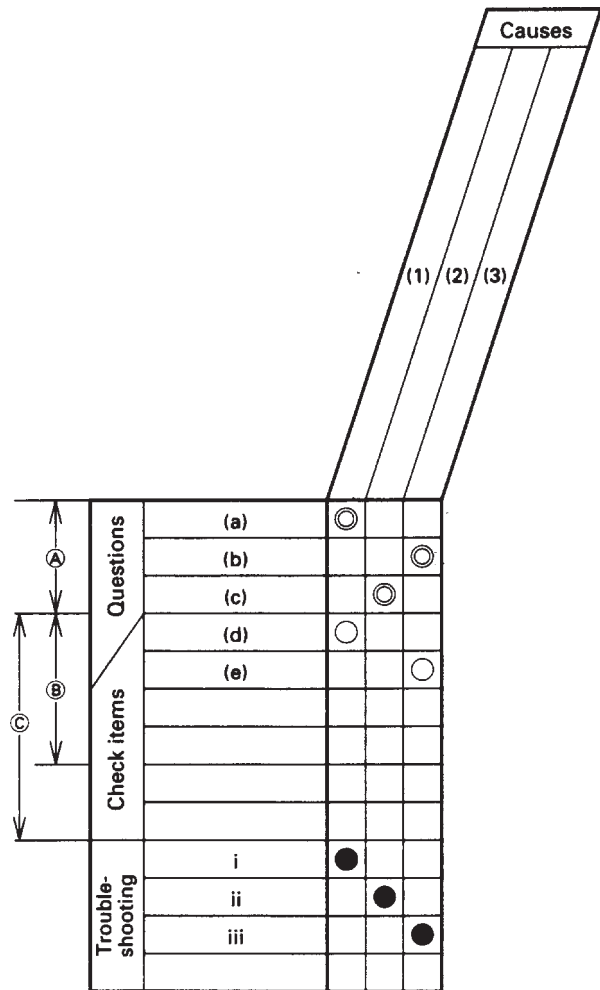
[Check items]

The serviceman carries out simple inspection to narrow down the causes. The items under **Ⓒ** in the chart on the right correspond to this.

The serviceman narrows down the causes from information **Ⓐ** that he has obtained from the user and the results of **Ⓒ** that he has obtained from his own inspection.

[Troubleshooting]

Troubleshooting is carried out in the order of probability, starting with the causes that have been marked as having the highest probability from information gained from **[Questions]** and **[Check items]**.



S-5 Engine does not rotate smoothly (hunting)

★ Check that the monitor panel does not display any abnormality in the governor control system.

General causes why engine does not rotate smoothly

- Air in fuel system
- Defective governor mechanism
- Defective electric governor mechanism
- ★ If hunting does not occur when the rod between the governor motor and the injection pump is disconnected, troubleshoot by using the electrical system troubleshooting (E mode).

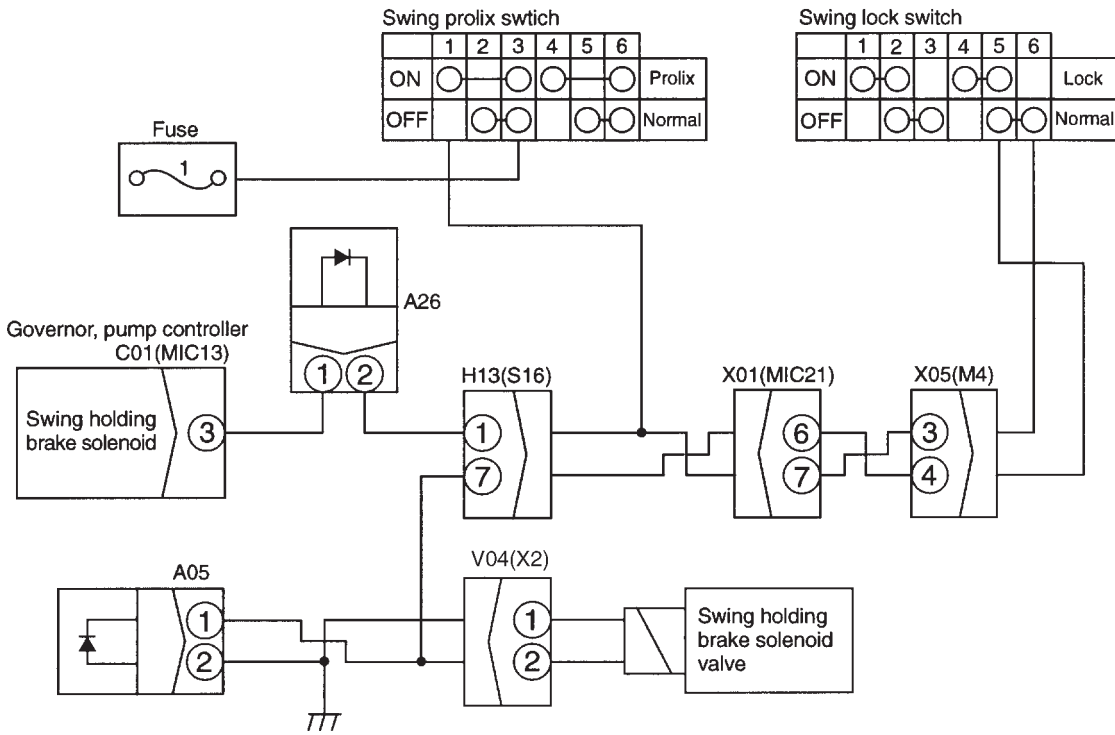
		Causes								
		Defective operation of governor	Defective adjustment of governor	Defective operation of governor	Low idling speed is too low	Clogged feed pump strainer	Clogged fuel filter, strainer	Clogged, air in circuit between fuel tank and feed pump	Clogged, air in circuit between feed pump and nozzle	
Questions	Confirm recent repair history									
	Degree of use of machine									
		Operated for long period				△	△			
	Condition of hunting	Occurs at a certain speed range	○	○	○	○				
		Occurs at low idling	○			○	○	○	○	
		Occurs even when speed is raised	○	○	○					○
	Replacement of filters has not been carried out according to Operation Manual						○	○		
	Rust, water are found when fuel tank is drained						○	○		
	Leakage from fuel piping								○	○
	Check items	When feed pump is operated,								
1) No response, light, return is quick							○	○		
2) No response, light, return is normal							○			
Engine speed sometimes rises too far		○	○							
Engine is sometimes difficult to stop		○		○						
Seal on injection pump has come off			○		○					
Troubleshooting	When governor lever is moved it is found to be stiff		●		●					
	When injection pump is tested, governor is found to be improperly adjusted			●						
	When control rack is pushed, it is found to be heavy, or does not return				●					
	When fuel cap is inspected directly, it is found to be clogged						●			●
	When feed pump strainer is inspected directly, it is found to be clogged						●			
	When fuel filter, strainer are inspected directly, they are found to be clogged							●		
Remedy		Adjust	Adjust	Adjust	Adjust	Clean	Clean	Correct	Correct	Clean

JUDGEMENT TABLE FOR GOVERNOR, PUMP CONTROLLER (PUMP CONTROL SYSTEM) AND HYDRAULIC RELATED PARTS

Failure mode		Governor, pump controller (E2:XX system)													
		Self-diagnostic display													
		User code		LED		E02		E03		E04		E05		E06	
Service code		OFF	232	233	201	211	203	213	205	215	206	216	217	222	223
All work equipment travel, swing	Speeds of all work equipment, swing, travel are slow or lack power														
	There is excessive drop in engine speed, or engine stalls														
	No work equipment, travel, swing move														
	Abnormal noise generated (around pump)														
	Auto-deceleration does not work														
Work equipment	Fine control ability is poor or response is poor														
	Boom is slow or lacks power														
	Arm is slow or lacks power														
	Bucket is slow or lacks power														
	Boom does not move														
	Arm does not move														
	Bucket does not move														
	Excessive hydraulic drift														
	Excessive time lag (engine at low idling)														
	Other equipment moves when single circuit is relieved														
	In L/O, F/O modes, work equipment speed is faster than specified speed														
Compound operations	Lack of power when pressure rises														
	In compound operations, work equipment with larger load is slow														
	In swing + boom (RAISE), boom is slow														
	In work equipment (BOOM RAISE) + travel travel speed drops excessively														
Travel system	In swing + travel, travel speed drops excessively														
	Travel speed is slow														
Swing system	Travel speed does not switch or is faster than specified speed														
	Does not swing	Both left and right													
		One direction only													
	Swing acceleration is poor or swing speed is slow	Both left and right													
		One direction only													
	Excessive overrun when stopping swing	Both left and right													
		One direction only													
	Excessive shock when stopping swing (one direction only)														
	Excessive abnormal noise when stopping swing														
	Excessive hydraulic drift of swing	When holding brake is released													
When holding brake is applied															
Swing speed is faster than specified swing speed															
Troubleshooting code when service code is displayed		C-1	C-2	C-3	C-6	C-7	C-8	C-9	C-10	C-11	C-12	C-13	C-14	C-15	C-16
Troubleshooting code when there is abnormality in monitoring check		-	-	-	-	-	-	-	-	-	-	-	-	-	-

● :This shows applicable item for service code
 * :This shows item that needs only checking with monitoring
 ○ : This shows item to check with monitoring or machine monitor

C-8 Related electric circuit diagram

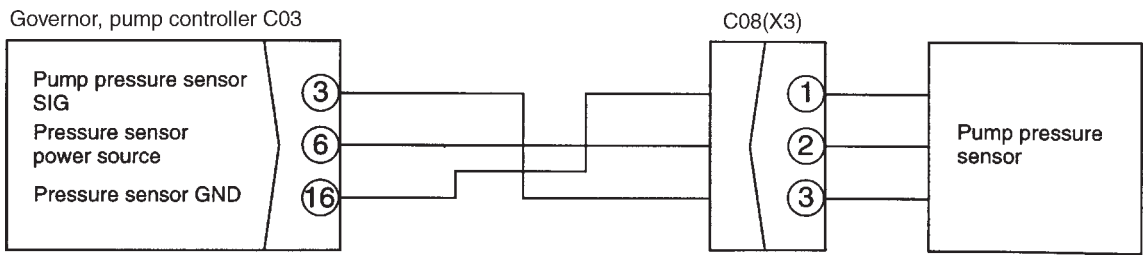


C-17 [E224] Abnormality in pump pressure sensor system is displayed

- ★ This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.
- ★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

		Cause	Remedy
<p>Is voltage between C08 (2) and (1) normal?</p> <p>1</p> <p>• Turn starting switch ON.</p> <p>• 18 - 28 V</p>	YES	<p>2</p> <p>Is voltage between C03 (3) and (16) normal?</p> <p>• Engine at high idling</p> <p>• Operate repeatedly arm IN relief ←→ lever NEUTRAL</p> <p>• 0.5 - 4.5 V</p>	<p>YES</p> <p>Defective governor, pump controller</p> <p>Replace</p>
	NO	<p>3</p> <p>Is voltage between C08 (2) and chassis normal?</p> <p>• Disconnect C08.</p> <p>• Turn starting switch ON.</p> <p>• 18 - 28 V</p>	<p>YES</p> <p>Short circuit with power source, defective contact, or disconnection in wiring harness between C03 (female) (3) - C08 (female) (3)</p> <p>Repair or replace</p>
	NO		<p>NO</p> <p>Short circuit with ground, defective contact, or disconnection in wiring harness between C03 (female) (6) and C08 (female) (1)</p> <p>Repair or replace</p>
	NO		<p>NO</p> <p>Short circuit with ground, defective contact, or disconnection in wiring harness between C03 (female) (6) and C08 (female) (2)</p> <p>Repair or replace</p>

C-17 Related electric circuit diagram



F-5 Bit pattern 20-(5) Arm IN oil pressure switch does not light up

★ This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the monitor code display returns to normal, the problem has been removed.

⚠ When measuring with the engine running, operate the lever slightly and make sure that the work equipment does not move.

(When measuring with the engine stopped, charge the accumulator first.)

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

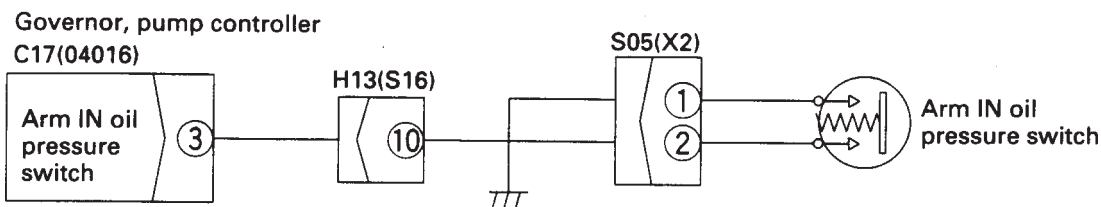
★ Always connect any disconnected connectors before going on the next step.

		Cause	Remedy		
<p>1</p> <p>Is voltage between C17 (3) and chassis normal?</p> <ul style="list-style-type: none"> Start engine. Arm lever at neutral: 20 - 30V Arm lever operated to IN : Max. 1 V 	YES	Defective governor, pump controller	Replace		
	NO	2	<p>Is resistance between S05 (male) (1) and (2) normal, and is circuit insulated from chassis?</p> <ul style="list-style-type: none"> Disconnect S05. Start engine. Arm lever at neutral : Min. 1 MΩ Arm lever operated to IN: Max. 1 Ω See Note 1. 	<p>Defective contact, or disconnection in wiring harness between S05 (female) (1) and chassis ground</p> <p>Defective contact, short circuit with ground, or disconnection in wiring harness between C17 (female) (3) - H13 (10) - S05 (female) (2)</p>	<p>Repair or replace</p> <p>Repair or replace</p>
	YES	3			

Note 1: It is also possible to fit a short connectotr and judge the condition. In this case, check the voltage between C17 (3) and the chassis.

- If it is 20 - 30V: Go to YES
- If it is less than 1V: Go to NO

F-5 Related electric circuit diagram



BKP00261

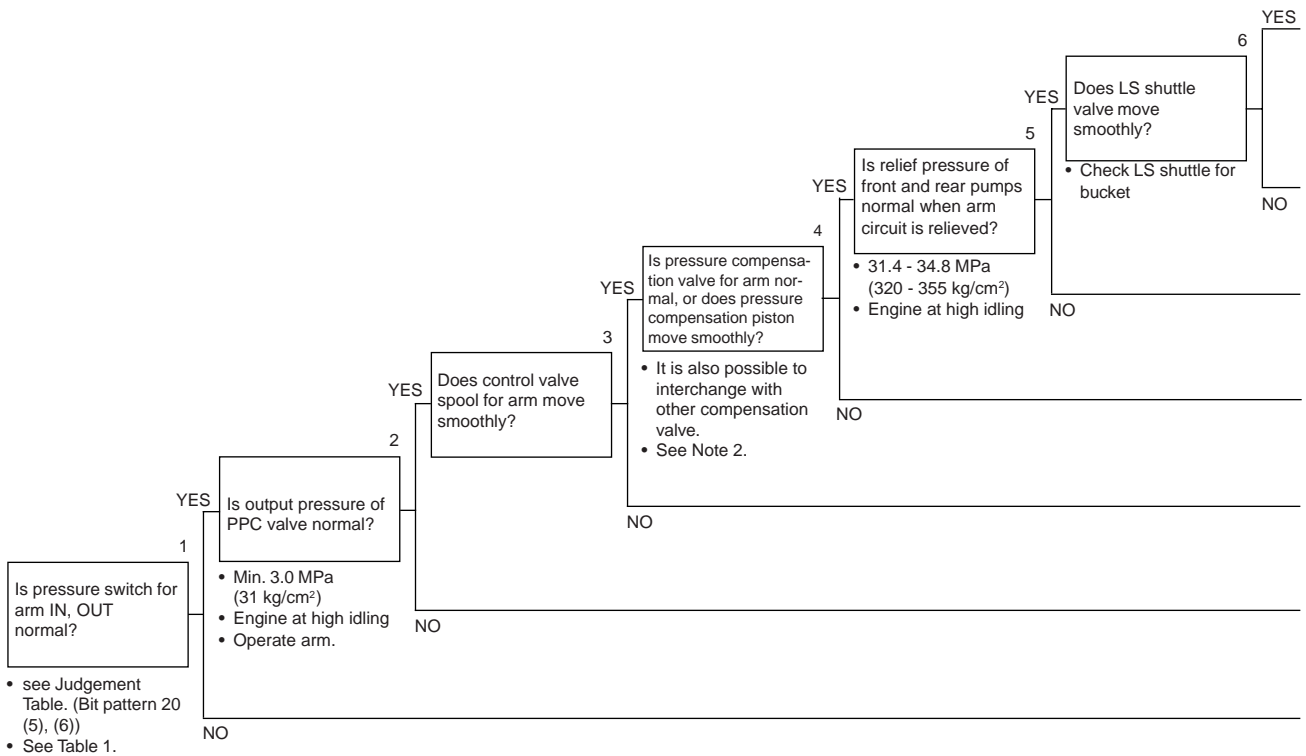
TABLE OF FAILURE MODES AND CAUSES (2/2)

Failure mode	Parts causing failure		Solenoid valve				Swing motor	
			LS-EPC	2-stage relief	Swing holding brake	Travel speed selector	Safety-suction valve	Leakage, breakage inside body
All work equipment, travel, swing	Speeds of all work equipment, swing, travel are slow or lack power		○	○				
	There is excessive drop in engine speed, or engine stalls							
	No work equipment, travel, swing move							
	Abnormal noise generated (around pump)							
	Auto-deceleration does not work							
	Fine control ability is poor or response is poor							
Work equipment	Boom is slow or lacks power							
	Arm is slow or lacks power							
	Bucket os slow or lacks power							
	Boom does not move							
	Arm does not move							
	Bucket does not move							
	Excessive hydraulic drift							
	Escessive time lag (engine at low idling)			○				
	Other equipment moves when single circuit is relieved							
	In F/O modes, work equipment speed is faster than specified speed			○				
	Lack of power when pressure rises				○			
Compound operations	In compound operations, work equipment with larger load is slow							
	In swing + boom (RAISE), boom is slow							
	In swing + travel. Travel speed drops excessively							
	In work equipment boom raise + travel, travel speed drops excessively							
Travel system	Travel speed is slow			○				
	Travel speed does not switch or is faster than specified speed			○		○		
Swing system	Does not swing	Both left and right						○
		One direction only					○	
	Swing acceleration is poor or swing speed is slow	Both left and right						○
		One direction only					○	
	Excessive overrun when stopping swing	Both left and right						○
		One direction only					○	
	Excessive shock when stopping swing(one direction only)							
	Excessive abnormal noise when stopping swing						○	
Excessive hydraulic drift of swing	When brake ON			○				
	When brake OFF					○	○	
Swing speed is faster than specified swing speed			○					

★ In the failure modes, modes for compound operations are used when independ

H-8 Arm is slow or lacks power

- ★ When travel and swing speeds are normal.
- ★ Carry out troubleshooting in the H/O mode.



Note 1: If the auto-decleration is canceled when arm IN or arm OUT is operated, the system is normal.

Note 2: After inspection, do not forget to return the interchanged valves to the original position.

H-23 Travel speed does not switch or is faster than specified speed

★ Carry out troubleshooting in the H/O mode.

		Cause	Remedy
<p>Is travel pressure switch normal?</p> <p>1</p> <p>YES</p> <p>• See Judgement Table. (Bit pattern 20 (2))</p> <p>• If autodeceleration is canceled when travel is operated, system is normal.</p> <p>NO</p>	<p>Is output pressure of LS-EPC solenoid valve normal?</p> <p>2</p> <p>• See Table 1.</p>	<p>Defective operation of travel speed selector servo piston in travel motor</p>	Replace
	<p>Is output pressure of travel speed selector solenoid valve normal?</p> <p>3</p> <p>• Min. 3.0 MPa (31 kg/cm²)</p> <p>• Travel speed selector switch: Mi, Hi</p> <p>• Turn travel switch ON.</p>	<p>Defective operation of travel speed selector solenoid valve</p>	Correct or replace
		<p>Defective operation of LS-EPC solenoid valve</p>	Correct or replace
		<p>Defective travel pressure switch</p>	Replace

Table 1. Output pressure of LS-EPC solenoid

Unit: MPa (kg/cm²)

Travel speed	Lo	Mi	Hi
LS-EPC output pressure	2.0 ± 0.2 (20.0 ± 2.0)	2.2 ± 0.2 (22.7 ± 2.0)	0.2 ± 0.2 (2.0 ± 2.0)
Remarks	<ul style="list-style-type: none"> • Engine at high idling • Operate travel lever slightly (auto-deceleration cancel position) 		

H-24 Travel does not move (one side only)

		Cause	Remedy
<p>Is any foreign material found in oil drained from final drive?</p> <p>1</p> <p>YES</p> <p>NO</p> <p>Is drain amount of travel motor normal?</p> <p>2</p> <p>• Max. : 30 /min</p> <p>• Engine at high idling</p> <p>• At travel relief</p>	<p>Does condition become normal when left and right suction valves of control valve are interchanged?</p> <p>3</p>	<p>Defective final drive</p>	Repair or replace
		<p>Defective operation of suction valve of control valve</p>	Replace
		<p>Defective operation of counterbalance valve or travel motor safety valve</p>	Replace
		<p>Defective travel motor</p>	Replace

ACTION TAKEN BY MONITOR PANEL WHEN ABNORMALITY OCCURS AND PROBLEMS ON MACHINE

User code	Service code	Abnormal system	Nature of abnormality
-	E101	Abnormality in error data	<ol style="list-style-type: none"> 1. Abnormality in internal memory 2. Excess voltage (more than 36V) has occurred 3. Low voltage (less than 12V) has occurred 4. Connector has separated
-	E102	Abnormality in clock data	<ol style="list-style-type: none"> 1. Abnormality in internal clock function 2. Excess voltage (more than 36V) has occurred 3. Low voltage (less than 12V) has occurred 4. Connector has separated
-	E103	Short circuit in buzzer output system	<ol style="list-style-type: none"> 1. Short circuit inside buzzer 2. Power line in contact with wiring harness between monitor (P01 (7) pin) and buzzer 3. Abnormality in monitor panel
-	E104	Air cleaner clogging detected is displayed	<ol style="list-style-type: none"> 1. Air cleaner clogging sensor has detected clogging
-	E106	Drop in engine oil Hi pressure detected is displayed	<ol style="list-style-type: none"> 1. Engine oil pressure Hi sensor has detected drop in oil pressure
-	E108	Engine water temperature 105°C detected is displayed	<ol style="list-style-type: none"> 1. Coolant temperature gauge has detected water temperature of 105°C

M-7 When starting switch is turned ON, monitor panel lamps all stay lighted up and do not go out

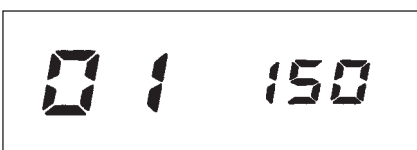
	Cause	Remedy
<div style="border: 1px solid black; width: 400px; height: 100px; margin-left: 100px;"></div>	Defective monitor panel	Replace

M-8 When starting switch is turned ON, items lighted up on monitor panel are different from actual machine (model)

★ Immediately after replacing the monitor panel, turn the starting switch OFF, then turn it On again

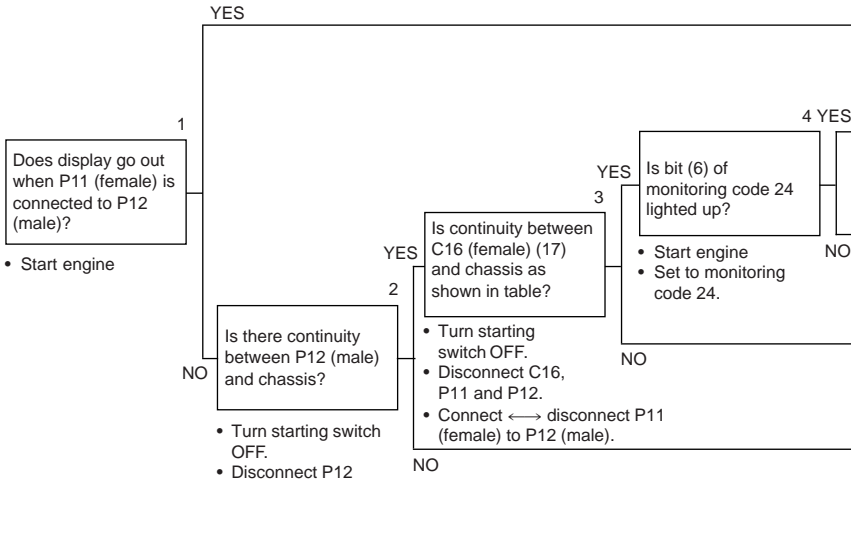
	Cause	Remedy
<div style="border: 1px solid black; padding: 5px; width: 100px;"> Is display of monitoring code 01 as shown in table? </div> <div style="margin-left: 10px;"> 1 YES <hr style="width: 400px;"/> NO </div>	Defective monitor panel	Replace
<ul style="list-style-type: none"> • Turn starting switch ON. • Set to monitoring code 01. 	Go to troubleshooting for C mode (See C-14)	-

Table



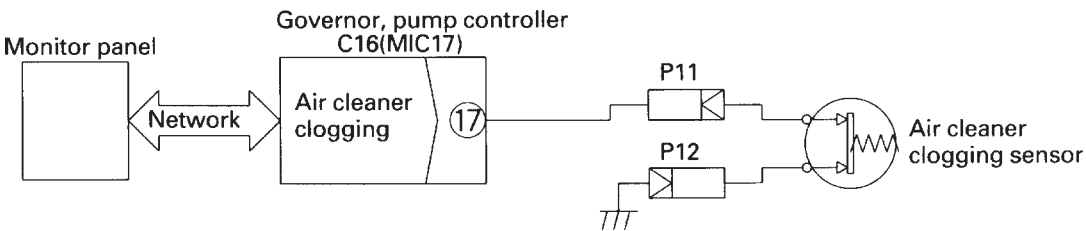
f)  (air cleaner clogging) flashes

★ Check that the air cleaner is not clogged before carrying out troubleshooting



Cause	Remedy
Defective air cleaner clogging sensor	Replace
Defective governor, pump controller	Replace
Defective monitor panel	Replace
Defective contact or disconnection in wiring harness between C16 (female) (17) and P11 (female)	Repair or replace
Defective contact or disconnection in wiring harness between P12 (male) and chassis ground	Repair or replace

M-13 f) Related electric circuit diagram



BKP00286

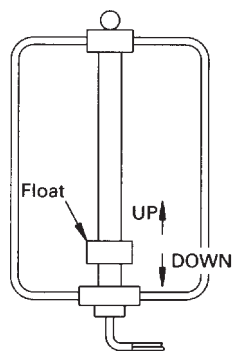
M-28 Defective coolant level sensor system

★ Remove the coolant level sensor when carrying out troubleshooting.

		Cause	Remedy
<p>When float is moved up and down, is resistance between connector (1) and (2) as shown in Table 1?</p> <p>1</p> <p>YES</p> <p>Is any foreign material (dirt) stuck to moving part of float?</p> <p>2</p> <p>NO</p> <p>Is there any large crack, chip or damage to float?</p> <p>3</p> <p>YES</p> <p>NO</p> <p>NO</p> <p>4</p> <p>YES</p> <p>Check wiring harness visually. Is it broken?</p> <p>NO</p> <p>NO</p>	Defective movement of float due to dirt	Clean	
	Resonance of mount (See Note 2)	Replace sensor (See Note 4)	
	Defective contact of connector (See Note 2)	Clean connector or replace	
	Disconnection in wiring harness (See Note 3) (defective clamp) (external force applied)	Replace sensor	
	Defective sensor	Replace	

Table

Float UP	Max. 1 Ω
Float DOWN	Min. 1 MΩ



BLP00293

- Note 1: Variations in coolant level. The coolant level may change according to the angle of the machine, or the swaying of the machine, so if there is any display, check the coolant level again with the machine at a horizontal place.
- Note 2: If the problem occurs again, the connector (female) at the chassis end is probably defective, so check the connector and wiring harness at the chassis end.
- Note 3: Check for vibration at the connector mount. If there is excessive vibration, take the appropriate action.
- Note 4: Defective installation is a possible cause, so be careful when installing. If the problem occurs again, check for vibration at the connector mount, and if there is excessive vibration, take the appropriate action.

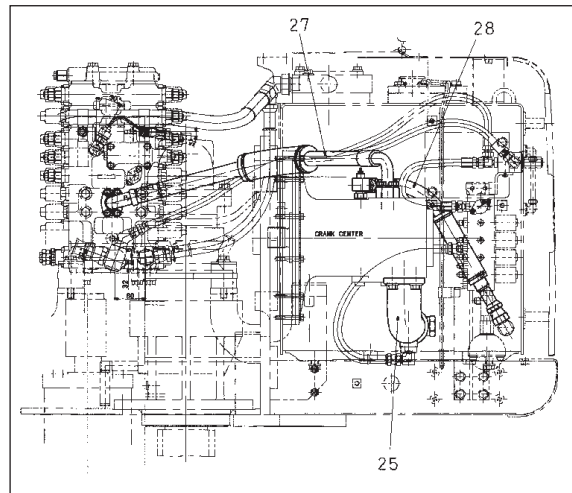
2. Precautions when carrying out installation work

- Tighten all bolts and nuts (sleeve nuts) to the specified (KES) torque.
 - Install the hoses without twisting or interference.
 - Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
 - Bend the cotter pins and lock plates securely.
 - When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2 - 3 drops of adhesive.
 - When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
 - Clean all parts, and correct any damage, dents, burrs, or rust.
 - Coat rotating parts and sliding parts with engine oil.
 - When press fitting parts, coat the surface with anti-friction compound (LM-P).
 - After fitting snap rings, check that the snap ring is fitted securely in the ring groove.
 - When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
 - When using eyebolts, check that there is no deformation or deterioration, screw them in fully, and align the direction of the hook.
 - When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.
- ★ When operating the hydraulic cylinders for the first time after reassembling cylinders, pumps and other hydraulic equipment removed for repair, always bleed the air as follows:
1. Start the engine and run at low idling.
 2. Operate the work equipment control lever to operate the hydraulic cylinder 4 - 5 times, stopping the cylinder 100 mm from the end of its stroke.
 3. Next, operate the hydraulic cylinder 3 - 4 times to the end of its stroke.
 4. After doing this, run the engine at normal speed.
- ★ When using the machine for the first time after repair or long storage, follow the same procedure.

3 Precautions when completing the operation

- If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the water level again.
- If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- If the piping or hydraulic equipment have been removed, always bleed the air from the system after reassembling the parts.
 - ★ For details, see TESTING AND ADJUSTING, Bleeding air.
- Add the specified amount of grease (molybdenum disulphide grease) to the work equipment parts.

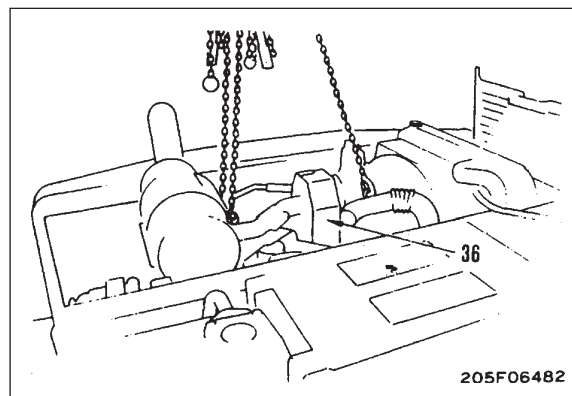
23. Disconnect main pump suction tube (25).
25. Disconnect main pump outlet hose (27).
26. Disconnect main pump drain hose (28).
27. Disconnect TVC • LS valve inlet hoses at side of main pump.
28. Disconnect engine speed wiring connector.
29. Disconnect earth wiring.



31. Remove mount bolt, then lift off engine and hydraulic pump assembly (36) slowly. * 3
 - ★ When removing the engine and hydraulic pump assembly, check that all wiring and piping has been disconnected, and be careful not to hit any part when removing.

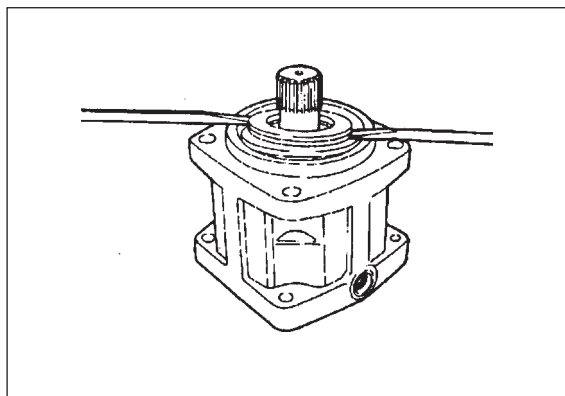


Engine • hydraulic pump assembly: 600 kg

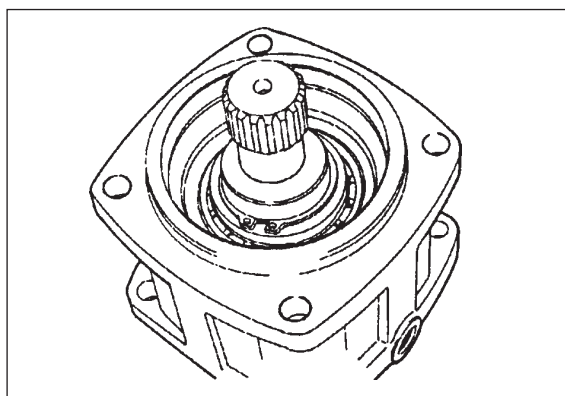


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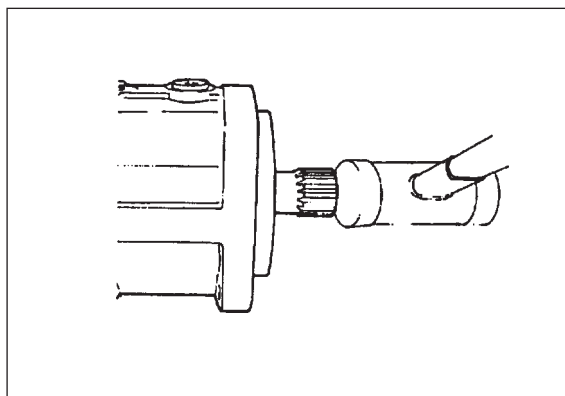
Loosen the seal carrier using two screwdrivers.



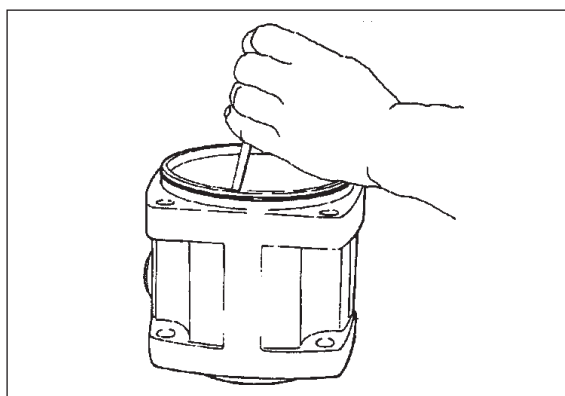
Loosen the retaining ring holding the bearing and bearing play adjustment washers.



Push out the shaft with a press or a plastic mallet.



If it is necessary to remove the bearing races, use a drift or a press.



REMOVAL OF HYDRAULIC TANK ASSEMBLY

1. Drain oil from hydraulic tank.



Hydraulic tank: Approx. 120 /

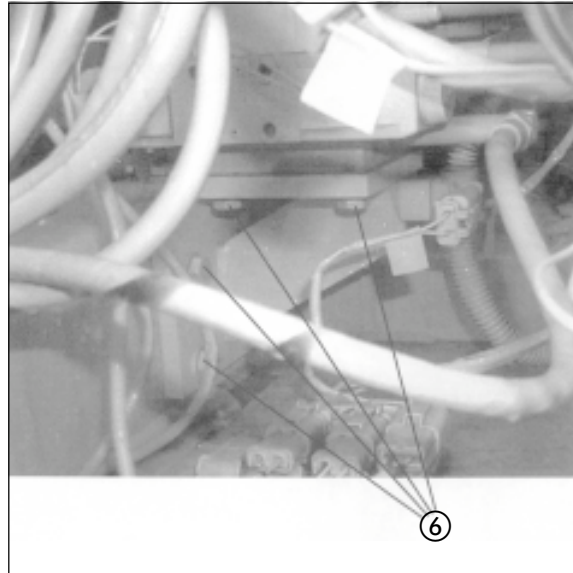
2. Open engine hood, and remove covers (1), (2), (3), and (4).



3. Remove engine room partition plate (5), then remove partition plate (6).

4. Remove frame (7).

5. Disconnect hydraulic filter inlet hoses (8), (9), (10), and (11).

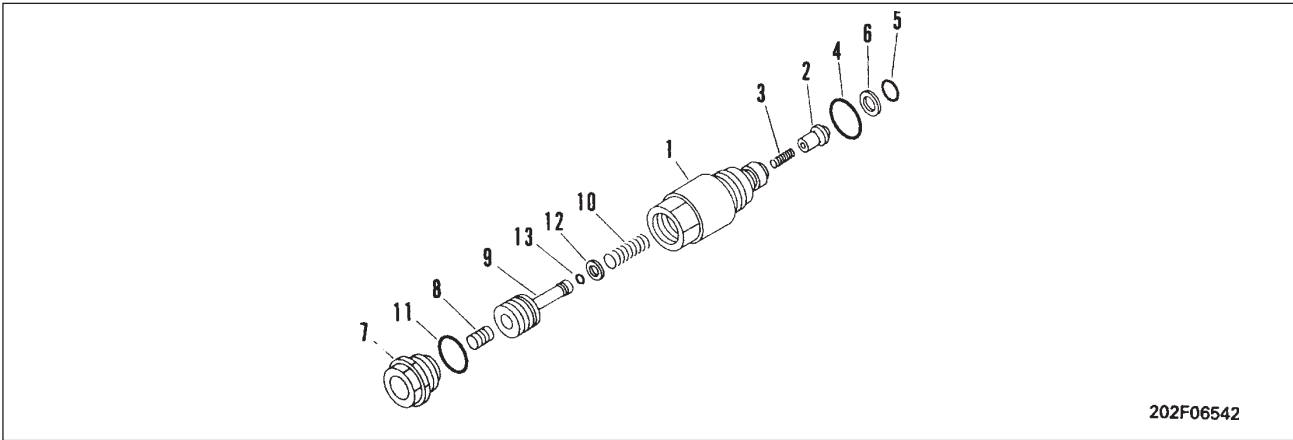


6. Remove pressure sensor wiring clamps (12).

7. Remove solenoid valve wiring clamp (13).


9. Remove wiring connector bracket (15).

DISASSEMBLY OF LS SELECT VALVE

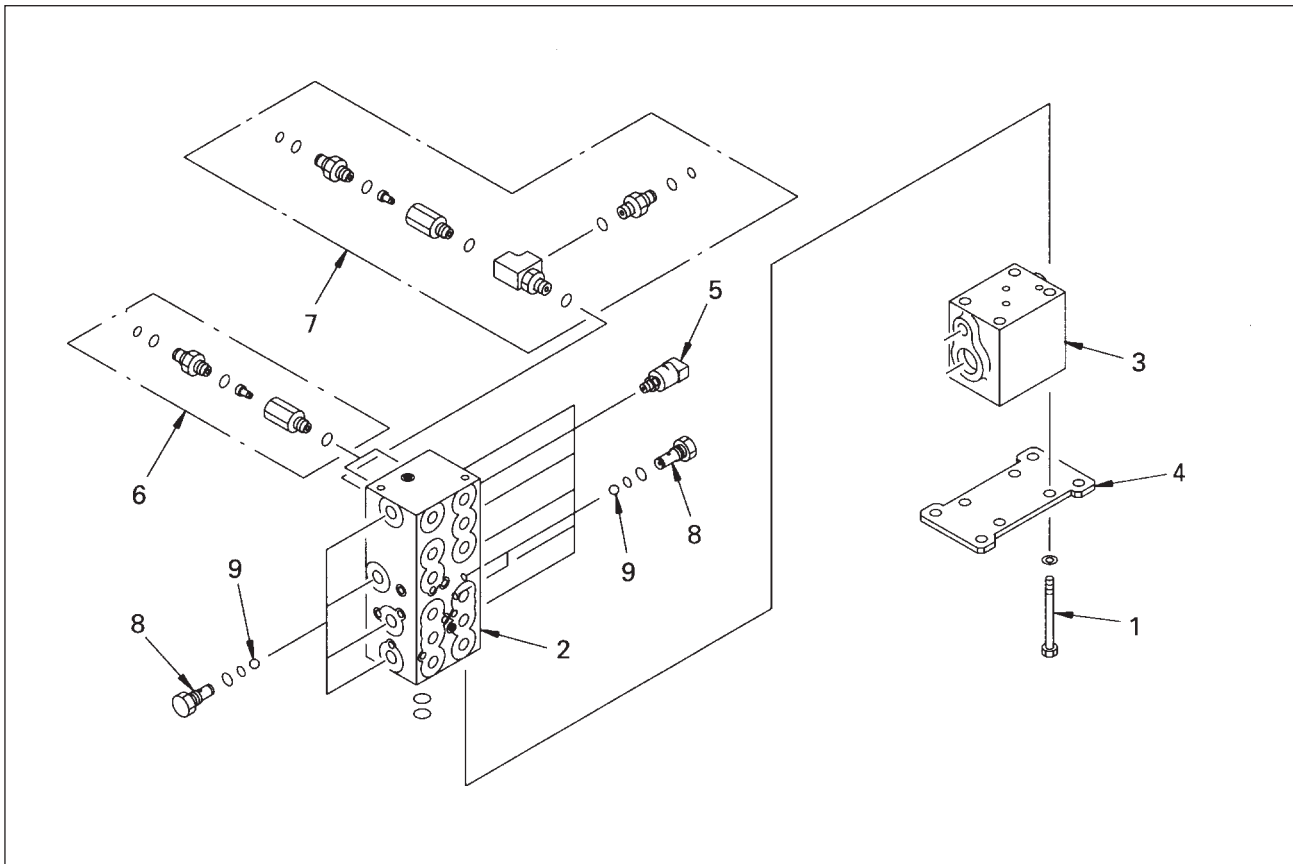


1. Remove sleeve (2) and spring (3) from sleeve (1).
2. Remove O-rings (4) and (5), and seal (6) from sleeve (1).
3. Remove plug (7), then remove pistons (8) and (9), and spring (10).
4. Remove O-ring (11) from plug (7), then remove seal (12) and O-ring (13) from piston (9).
 - ★ After disassembling, if there is any abnormality in any part except O-rings (4), (5), (11), or seal (6), replace the whole LS select valve assembly.

ASSEMBLY OF LS SELECT VALVE

- Before assembling coat the sliding surface with engine oil.
1. Install O-ring (13) and seal (12) to piston (9), then assemble piston (8) and spring (10), and install in sleeve (1).
 2. Assemble O-ring (11) to plug (7) and install to sleeve (1).
 -  Plug: 68.6±9.9 Nm (7±1 kgm)
 3. Assemble spring (3) to sleeve (2), and install to sleeve (1).
 4. Install O-rings (4) and (5), and seal (6) to sleeve (1).

DISASSEMBLY OF PPC SHUTTLE VALVE ASSEMBLY

**1. Disconnection of valve**

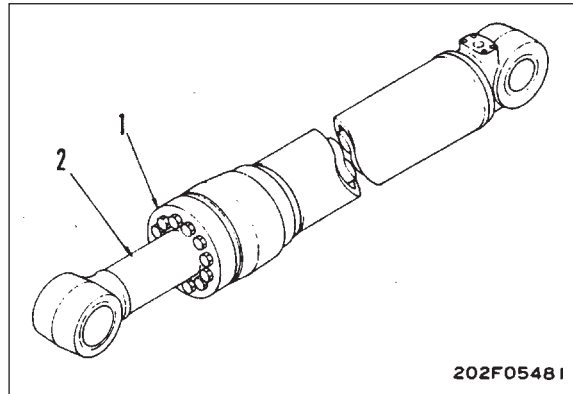
Remove mounting bolts (1), and disconnect shuttle valve assembly (2), EPC/clamshell sol. valve and plate (4).

2. Disassembly of shuttle valve assembly

- 1) Remove 8 oil pressure switches (5).
- 2) Remove 2 slow return valves (6).
- 3) Remove shuttle valve (7).
- 4) Remove plugs (8), then remove balls (9).
 - ★ There are 6 plugs and 6 balls.

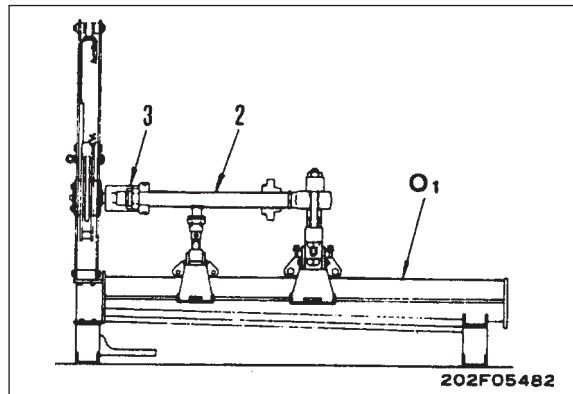
DISASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

1. Piston rod assembly
 - 1) Remove piping from cylinder assembly.
 - 2) Remove mounting bolts, and disconnect head assembly (1).
 - 3) Pull out piston rod assembly (2).
 - ★ Place a container to catch the oil under the cylinder.
 - 4) Disassemble piston rod assembly as follows.
 - i) Set piston rod assembly (2) in tool **O₁**.
 - ii) Using tool **O₂**, remove nut (3).
 - ★ Width across flats of nut

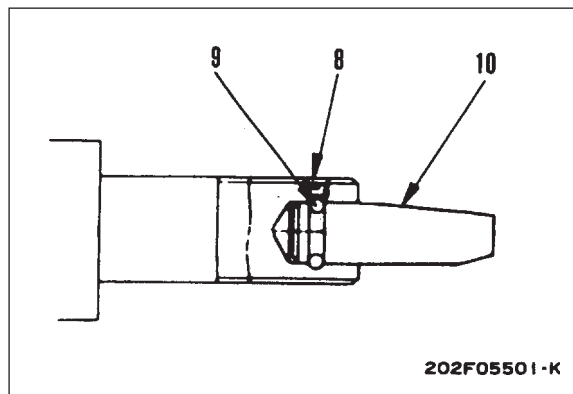
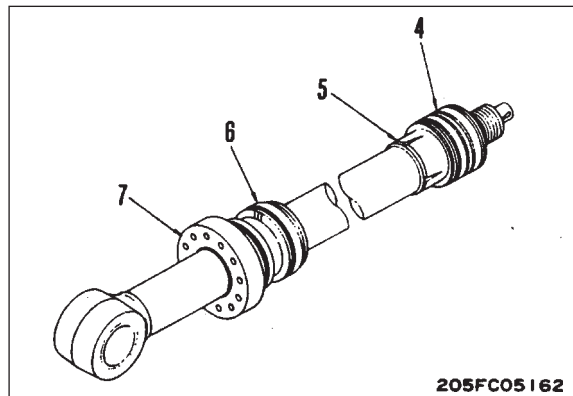


Unit: mm

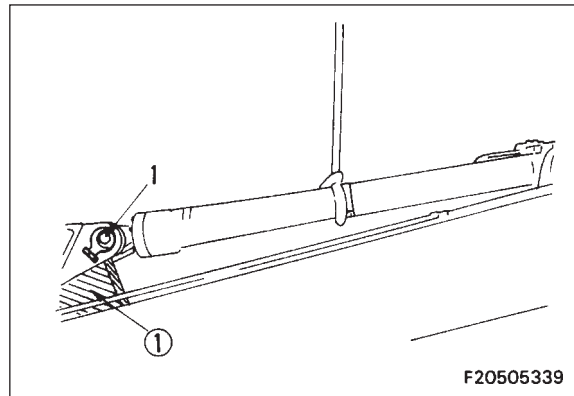
Model	Cylinder		
	1p Boom	Arm	Bucket
PW170-6	75	85	75



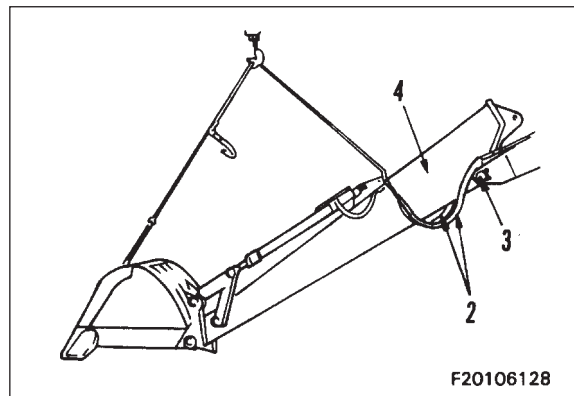
- iii) Remove piston assembly (4).
- iv) Remove plunger (5).
 - Boom and arm cylinder only
- v) Remove collar (6).
 - Boom and arm cylinder only
- vi) Remove head assembly (7).
- vii) Remove cap (8), and pull out 12 balls (9), then remove plunger (10)
 - Arm cylinder only



F1



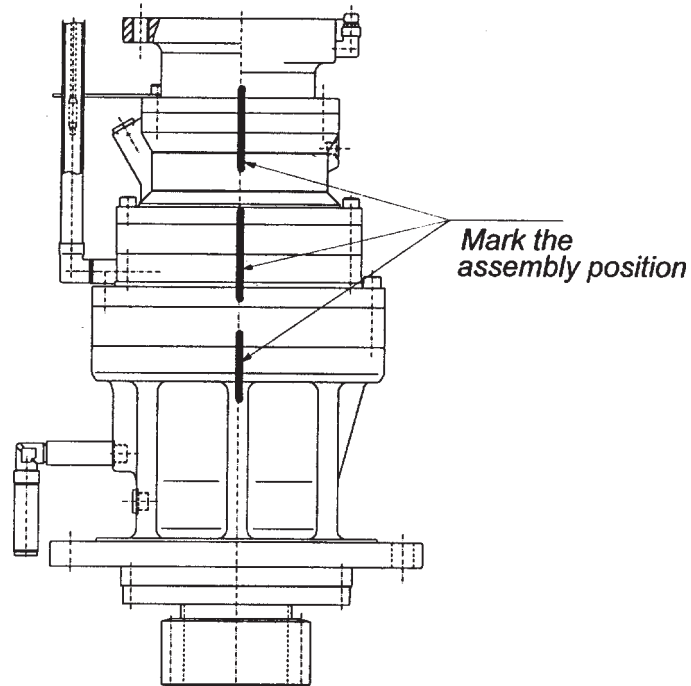
F2



DISASSEMBLY OF SWING MACHINERY ASSEMBLY

3. DISASSEMBLING

Initial inspection of the gears and the hydraulic motor, can be made without dismantling the slew drive from the machine.



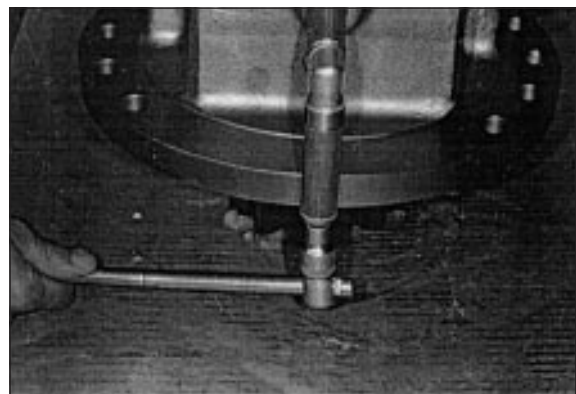
Note

Before starting the gearbox disassembly, it is better to mark the assembly position of: motor adaptor (pos. 50), brake housing (pos. 32), toothed rings (pos. 25-18), cover (pos. 21) and gearbox housing (pos. 7) in order to obtain an exact reference of position at reassembly.

Unscrew and remove the 2 screws M16x40 (pos. 49), grade 8.8, and remove the hydraulic motor and the O-ring (pos. 51).

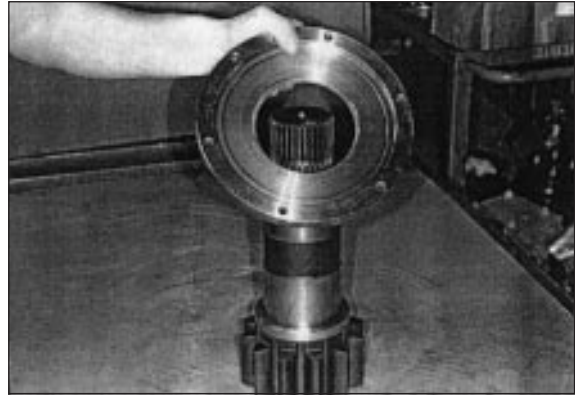
STEP 1

Unscrew the draining plug M18x1,5 (pos. 9) and its washer (pos. 8) from the gearbox housing (pos. 7) and drain the oil from the gearbox.

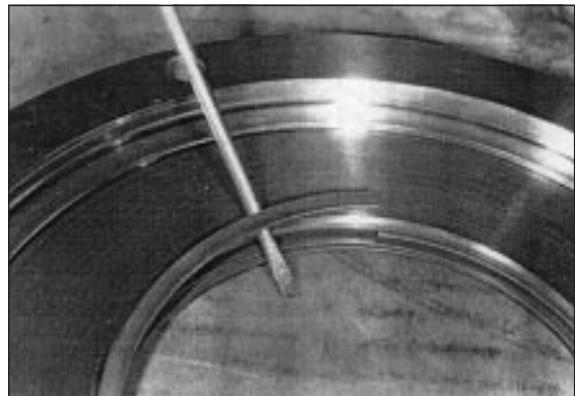


DISASSEMBLING**STEP 28**

Remove the front cover (pos. 5).

**STEP 29**

Use a screwdriver to remove the ringseals (pos. 3) from their groove in the front cover (pos. 5)

**STEP 30**

Use a rubber hammer and a metal stopper to remove the bearing (pos. 14) from the gearbox housing (pos. 7).



ASSEMBLING**STEP 56**

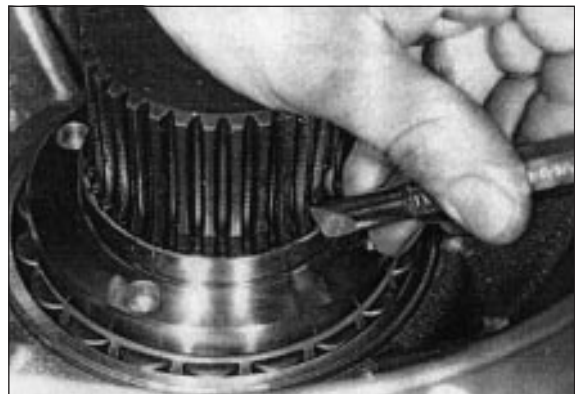
Place a new ring nut (pos. 15) on the pinion shaft (pos. 1). Never use the nut disassembled because already deformed.

**STEP 57**

Use the tool AT709C06 to tighten the ring nut M75x2 (pos. 15), by a torque wrench, at a torque of 110-120 daNm.

**STEP 58**

Caulk the ring nut (pos. 13) next to 3 spaces placed at 120° of the pinion shaft spline (pos. 1).



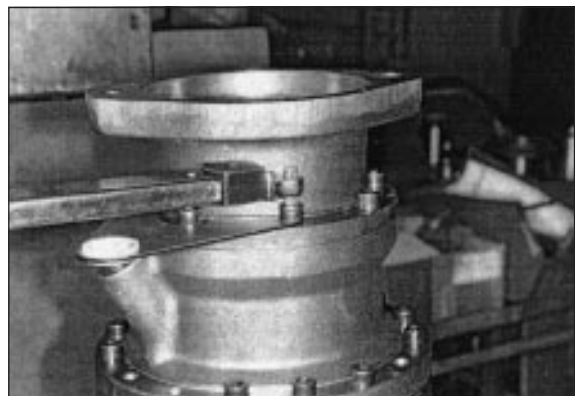
ASSEMBLING**STEP 86**

Place the motor flange (pos. 50) on the brake housing (pos. 32) and insert the 8 socket head screws M10x30 (pos. 48) grade 8.8.

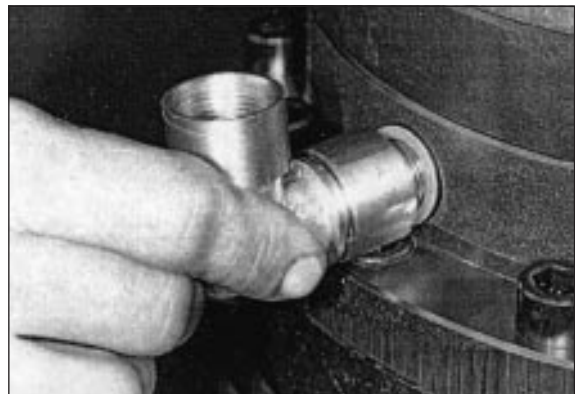
Contemporary assemble the flask of the filling and oil level kit (pos. 52).

**STEP 87**

Tighten the 8 socket head screws M10x30 (pos. 48), grade 8.8, by a torque wrench at 5 daNm torque.

**STEP 88**

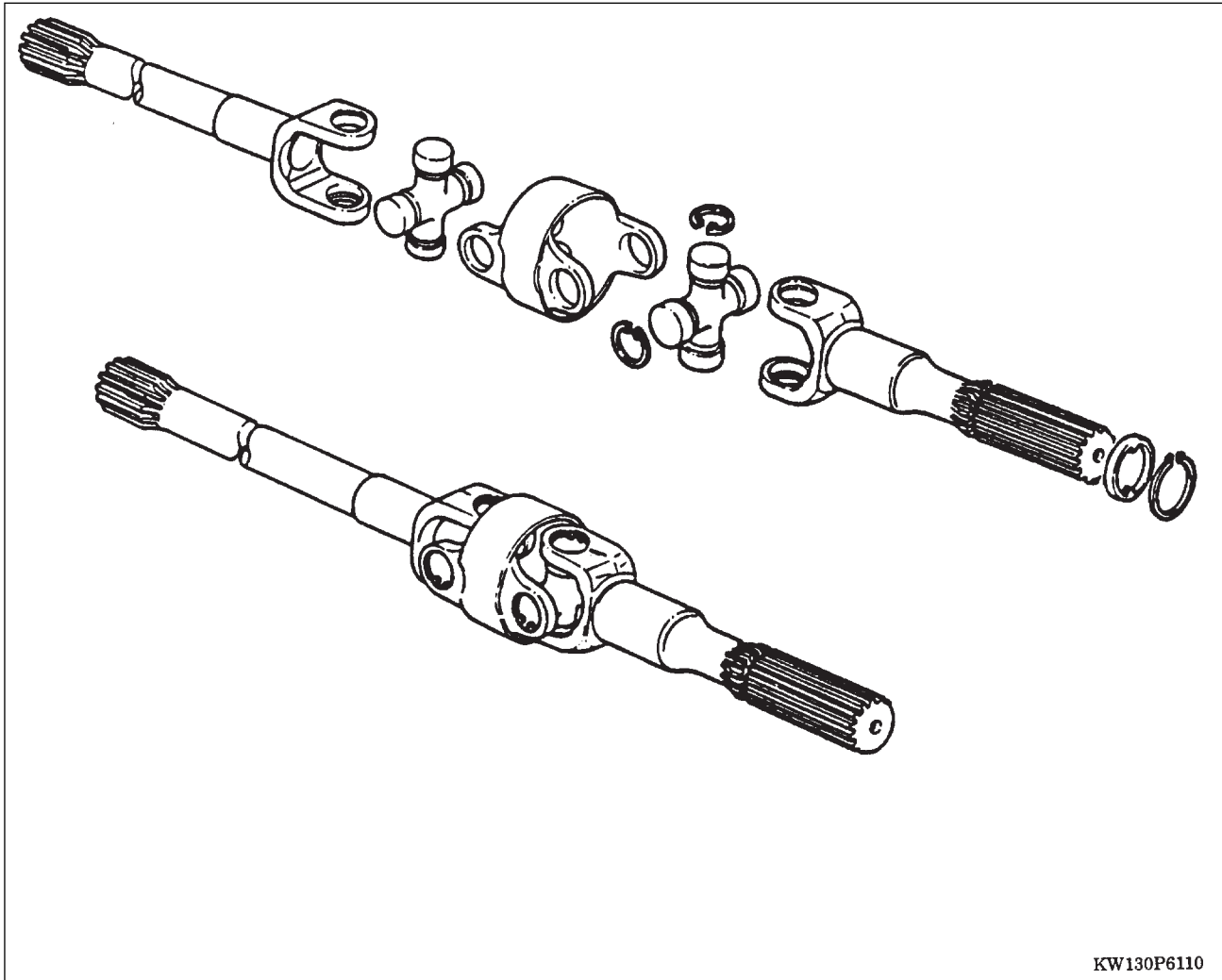
Using pliers, screw the washer (pos. 8), the elbow and the extension of the filling and oil level kit (pos. 52) in the cover (pos. 21).



GEAR AND CONTROL BOX

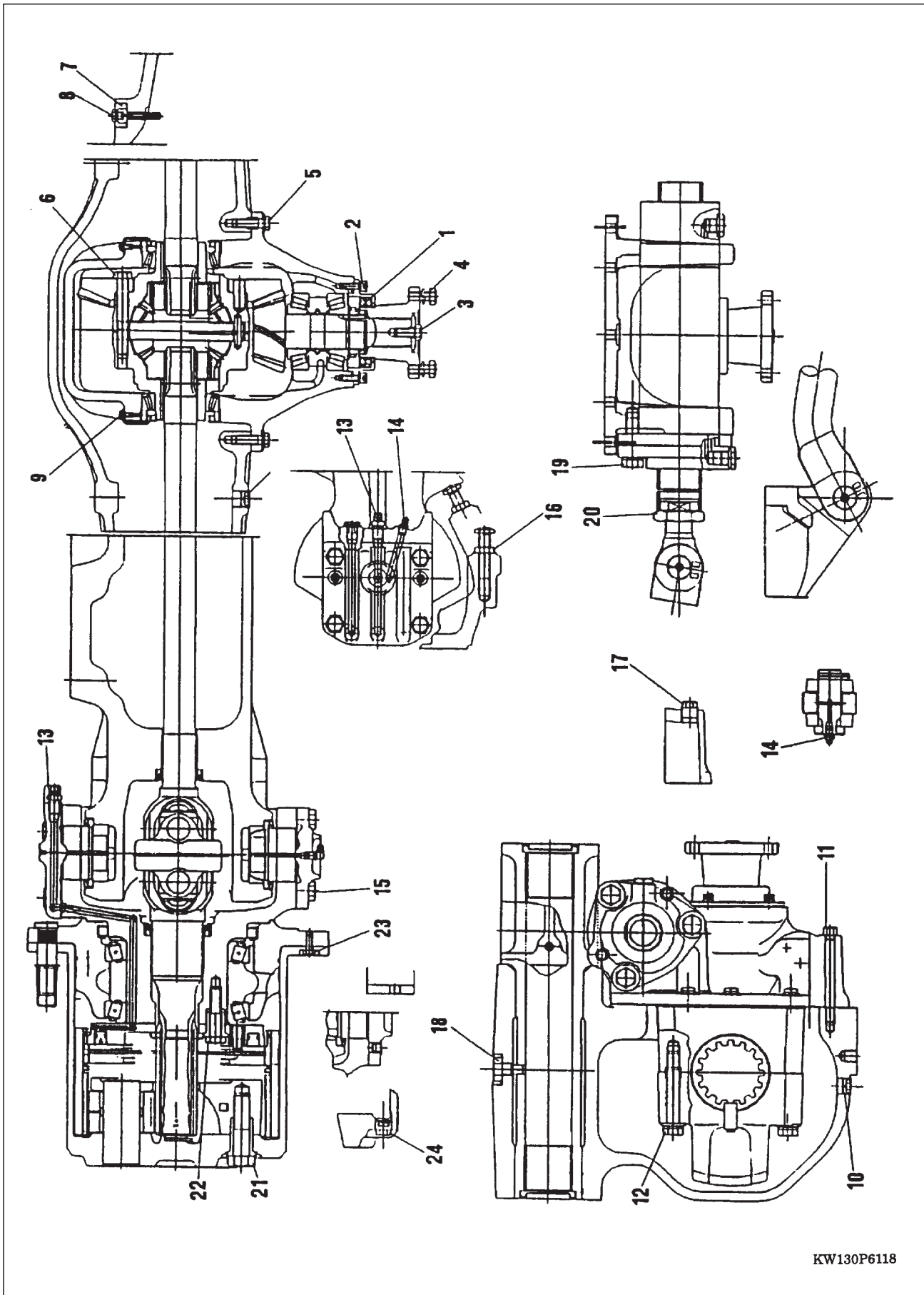
(Refer to page 30-51)

- Remove the emergency brake group as shown previously.
- Unscrew the screw (1), remove the washer (2), the thickness (3) and the flange (4).
- Unscrew the screws (20) and remove the cover (21).
- Check the seal ring condition (16); replace, if necessary. Lubricate and use a suitable coupling tool to avoid any damage during the assembly.
- Extract output shaft (5) and recover the washers (22).
- Unscrew the lever locking screw (7).
- Set the lever to "DISENGAGED" in order to reach the fork locking screw (6).
- Unscrew the screw (6) and extract the fork control lever (8).
- Remove the stop ring (13), then extract the fork (9), shaft (15) and sleeve (11) group.
- Separate this group and check pad and sleeve groove wear; replace, if necessary.
- Replace O-rings (17), (18) and (19).
- In the event of gears (14) and (23) replacement, unscrew the screws (12) and separate the half-housing. At re-assembly, clean and degrease the union surfaces of the half-housing and use Loctite 510.
- Check for bearing condition and replace, if necessary.
- Check oil drain condition, clean and replace, if necessary.

DRIVE SHAFTS

KW130P6110

- Inspect the splines on the drive shafts for wear or damage.
- Replace the spider if worn or damaged.



KW130P6118

BEVEL PINION-GEAR TEETH BACKLASH

The backlash has to be 0.21 to 0.28 mm. The adjustment is carried out operating on the side adjustment ring nuts. The ring nuts, pressing on the bearings, bring the crown towards or away from the pinion.

Operate in the following manner;

- Turn the ring nut, crown side, clockwise till getting a contact between the crown and the pinion; at the same time use a plastic hammer in order to settle the bearing.
- Turn the other ring nut clockwise, and at the same time use a plastic hammer in order to eliminate any bearing backlash. You can get such a condition when the ring nut rotation becomes difficult.
- Position the dial gauge so that the probe is in contact with it, and at 90° to a tooth of the pinion.
- Measure the backlash between pinion and bevel gear.
- Repeat the operation on two or more points (teeth) turning the pinion and remarking the backlash value.
- If the amount of backlash is different, put the probe on the tooth that has the smallest backlash.
- Bring the crown towards or away the pinion turning each ring nut in the same way, until the specified backlash is achieved.

DIFFERENTIAL BEARINGS PRE-LOAD

To carry out the adjustment operate as follows:

- With the crown engaged to the pinion, and having obtained the correct backlash between pinion and bevel gear, turn the pinion by using a dynamometer with the string wrapped around the queue of the pinion itself. Measure the value of the stress necessary to rotate both the pinion and the differential simultaneously.
- Turn each ring nut to the same extent (tighten or loosen) in order to maintain the same backlash value.

The total pre-load (T) of the bearings (pinion + differential) measured on the queue of the pinion must be the following:

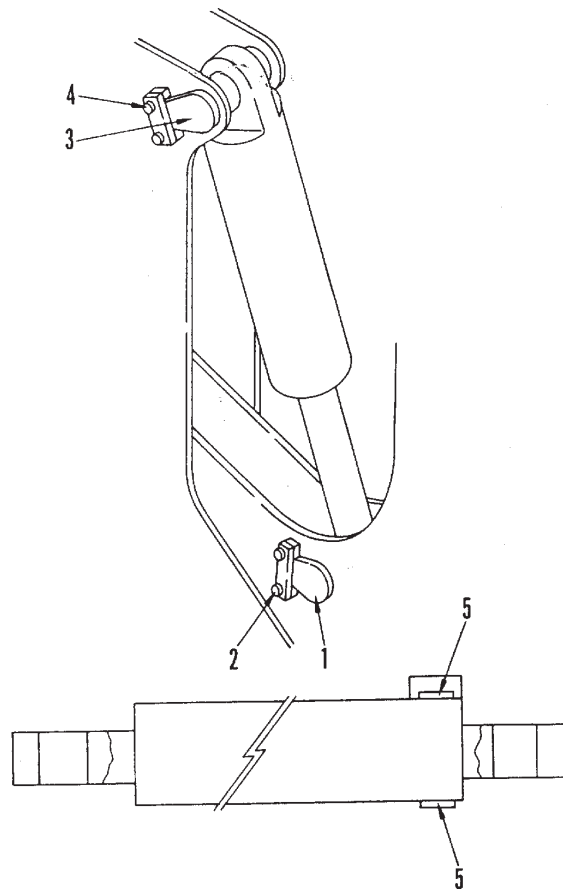
$$T = (P+29) \text{ to } (P+44) \text{ N}$$

where P is the actual pre-load measured on the pinion.

BLADE CYLINDER

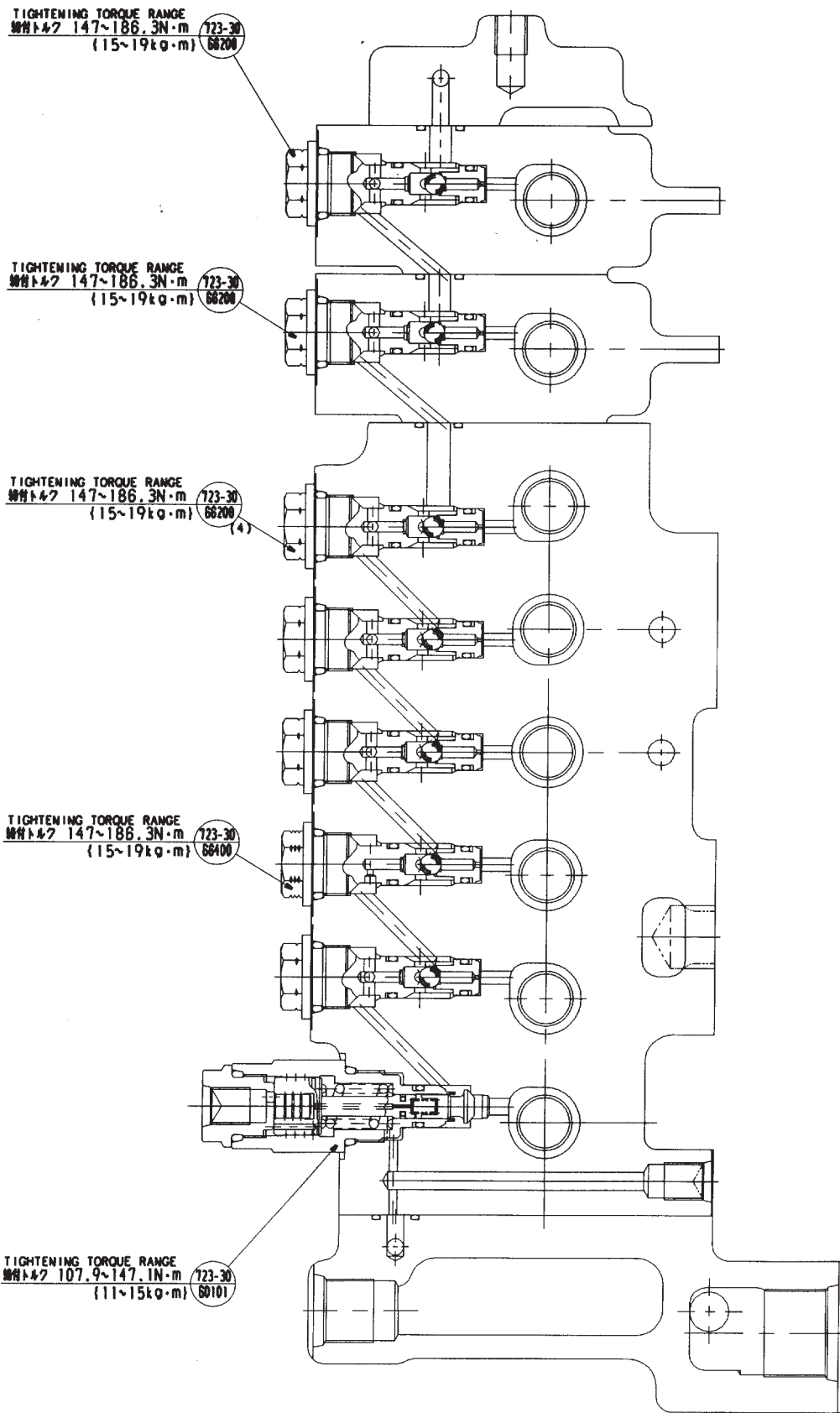
REMOVAL OF BLADE CYLINDER

- 1) Lower the blade until it just touches the ground. Do not take any of the weight of the machine on the blade.
- 2) Turn off the engine.
- 3) Depressurize the blade hydraulic circuit.
- 3) Disconnect the hydraulic lines from the cylinder.
- 4) Attach lifting tackle.
- 5) Remove bolts (2) and pin (1).
- 6) Remove bolts (4) and pin (3).
- 7) Remove cylinder.
- 8) **Important:** Depressurize cylinder before opening it. To depressurize, loosen the plugs (6) by approx. 2 turns using an Allen key and wait until all pressure has escaped. To be absolutely sure, remove the plugs completely after pressure has dropped.



INSTALLATION OF BLADE CYLINDER

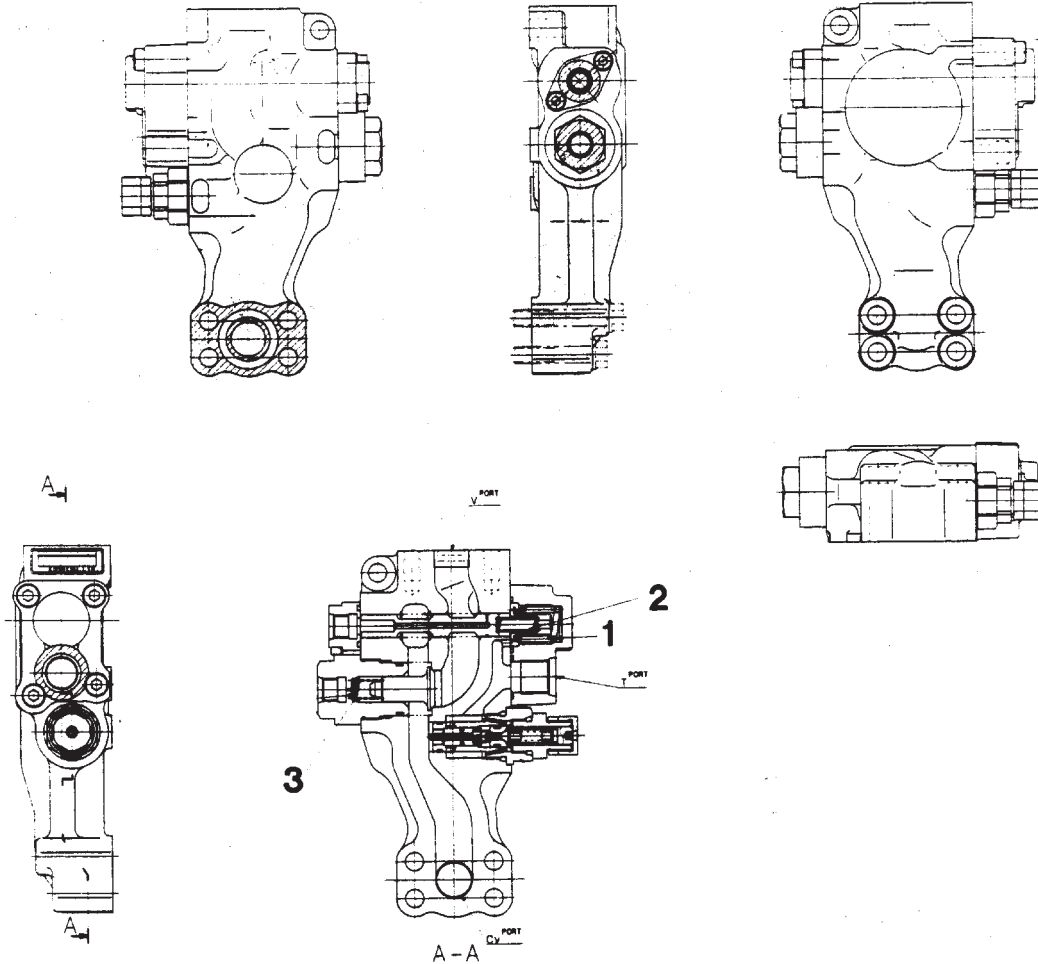
- 1) Fit the cylinder by following the reverse of the above procedure.
- 2) Grease pins (1) and (3) before fitting. Grease bearing points after assembly.
- 3) Bleed air from cylinders by raising and lowering the blade several times.



D-D

ARM, BOOM SAFETY VALVE

★ For machine equipped with arm safety valve, the Maintenance Standard of arm safety valve is the same as this valve.



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
1	Pilot valve spring. N01 (Boom safety valve)	30.9 mm	29.0	69.6 N (7.1 kg)	-	55.9 N (5.7 kg)	Replace spring if any damages or deformations are found
	Pilot valve spring N01 (Arm safety valve)	32.5 mm	29	85.3 N (8.7 kg)	-	68.6 N (7.0 kg)	
2	Pilot valve spring N02 (Boom and arm safety valve)	31.8 mm	25	29.4 N (3.0 kg)	-	23.5 N (2.4 kg)	
3	Check valve spring. (Boom and arm safety valve)	24.5 mm	18	4.9 N (0.5 kg)	-	3.9 N (0.4 kg)	

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