SHOP MANUAL

KOMATSU

PC160-6k
PC180LC, 180NLC-6k

MACHINE MODEL	SERIAL NUMBER
PC160-6k	**K30001 and up**
PC180LC, 180NLC-6k	**K30001 and up**

- This shop manual may contain attachements 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
- PC160-6k mount the SA4D102E engine;
  PC180LC-6k, PC180NLC-6k mount the SA4D102E engine.
  For details of the engine, see the 102 Service Engine Shop Manual.

Printed in Belgium 01-97

01

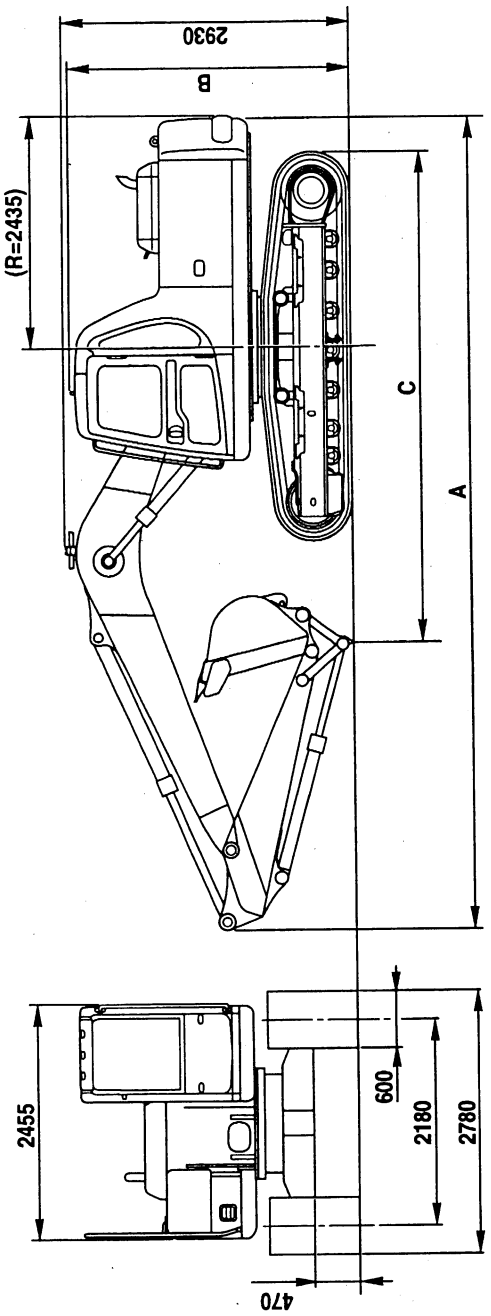
01 GENERAL

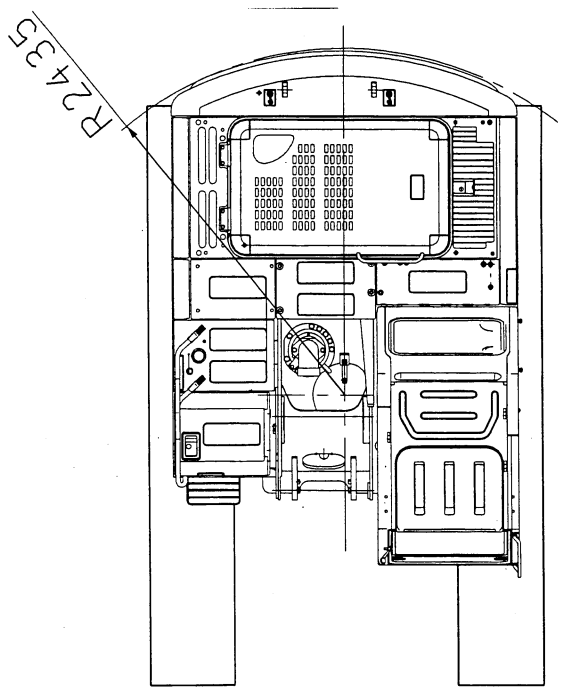
SPECIFICATIONS

				PC180LC-6K	PC160-6K
		Machine model		PC180LC-6K	PC160-6K
		Serial Number		and up	and up
		Bucket capacity	(SAE) (m^2)	0.67	0.58
		Operating weight	(kg)	17900 (with 2.25 m ARM)	16300 (with 2.25 m ARM)
Performance	Working range	Max. digging depth	(mm)	5610	5645
		Max. digging depth of cut for 8 level	(mm)	5375	5415
		Max. digging reach	(mm)	8675	8675
		Max. reach at ground level	(mm)	8510	8515
		Max. digging height	(mm)	8840	8800
		Max. dumping height	(mm)	6230	6190
	Max. digging force (using power max. function)		(kN(kg))	115 (11700)	115 (11700)
	Swing speed		(rpm)	12	12
	Swing max. slope angle		(deg.)	20	20
	Travel speed		(km/h)	Lo: 2.7 Mi: 4 Hi: 5,5	Lo: 2.7 Mi: 4 Hi: 5.5
	Gradeability		(deg.)	35	35
	Gound pressure [standard triple grouser shoe width]		(MPa(kg/cm^2)	0.041 (0.42) [600 mm]	0.051 (0.52) [500 mm]
Dimensions	Overall length (for transport)		(mm)	8560	8565
	Overall width		(mm)	2780	2490
	Overall width of track		(mm)	2780	2490
	Overall height (for transport)		(mm)	2960	2945
	Overall height to top of cab		(mm)	2930	2890
	Ground clearance of counterweight		(mm)	1030	990
	Min. ground clearance		(mm)	440	440
	Tail swing radius		(mm)	2435	2435
	Min. swing radius of work equipment		(mm)	3060	3060
	Height of work equipment at min. swing radius		(mm)	7140	7100
	Length of track on ground		(mm)	3260	2880
	Track gauge		(mm)	2180	1990
	Height of machine cab		(mm)	2010	1970

				PC180LC-6K	PC160-6k
	Machine model				
	Serial Number			and up	and up
Engine	Model			KOMATSU SA4D102E	
	Type			4-cycle, water-cooled, in-line, vertical, direct injection, with turbocharger	
	No. of cylinders - bore x stroke		(mm)	4 - 102X120	
	Piston displacement		(cc)	3920	
	Performance	Flywheel horsepower	(kW(PS)/rpm)	78 (106)	
		Max torque	(Nm(kgm)/rmp)	422 (43)/1400	
		Max. speed at no load	(rpm)	2450	
		Min. speed at no load	(rpm)	950	
		Min. fuel consumption	(g/kW.h(g/PS.h))	210 (155)	
	Starting motor			24V 4.5 KW	
	Alternator			24V 55A	
	Battery			12V 95 AhX2	
	Radiator core type			CWX-4	
Undercarriage	Carrier roller			2 on each side	1 on each side
	Track roller			7 on each side	6 on each side
	Track shoe			Assembly-type triple grouser	Assembly-type triple grouser
Hydraulic system	Hydraulic pump	Type X No.		Variable displacement piston type X gear type X 1	
		Delivery	(ℓ/min.)	Piston type: 276 X 1, gear type: 34	
		Set pressure	(MPa(kg/cm²)	Piston type 34.81(355) 31.87(325) gear type: 32.36 (33)	
	Control valve	Type X No.		6-spool + 1-spool type X 1	
		Control method		Hydraulic	
	Hydraulic motor	Travel motor		Piston type (with brake valve,)X2	
		Swing motor		Piston type (with safety valve,): X1	
	Hydraulic cylinder			Double-acting piston	
	Hydraulic tank			Box-shaped, sealed	
	Hydraulic filter			Tank return side	
	Hydraulic cooler			Air cooled	

	1.85m ARM	2.25m ARM	2.62m ARM	2.90m ARM
A	8620 mm	8560 mm	8560 mm	8570 mm
B	3125 mm	2960 mm	2965 mm	3055 mm
C	6040 mm	5135 mm	4750 mm	4555 mm

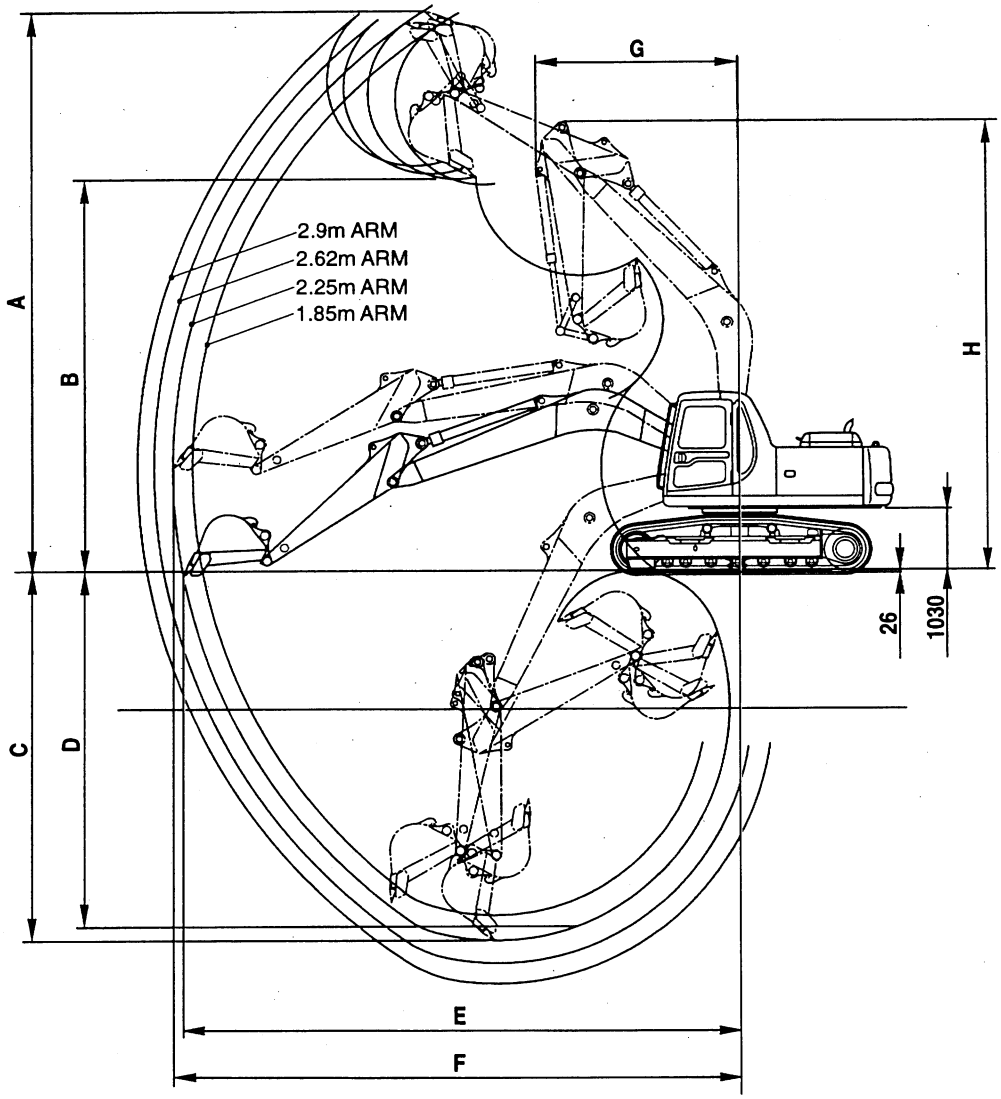




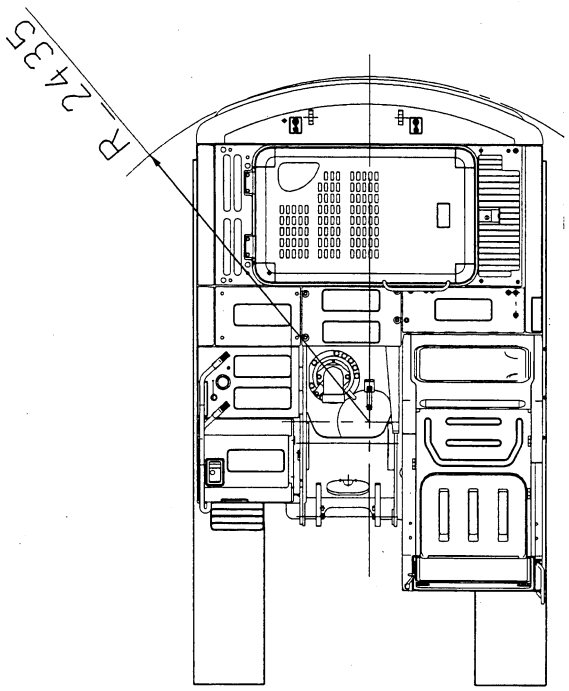
PC180 LC-6k

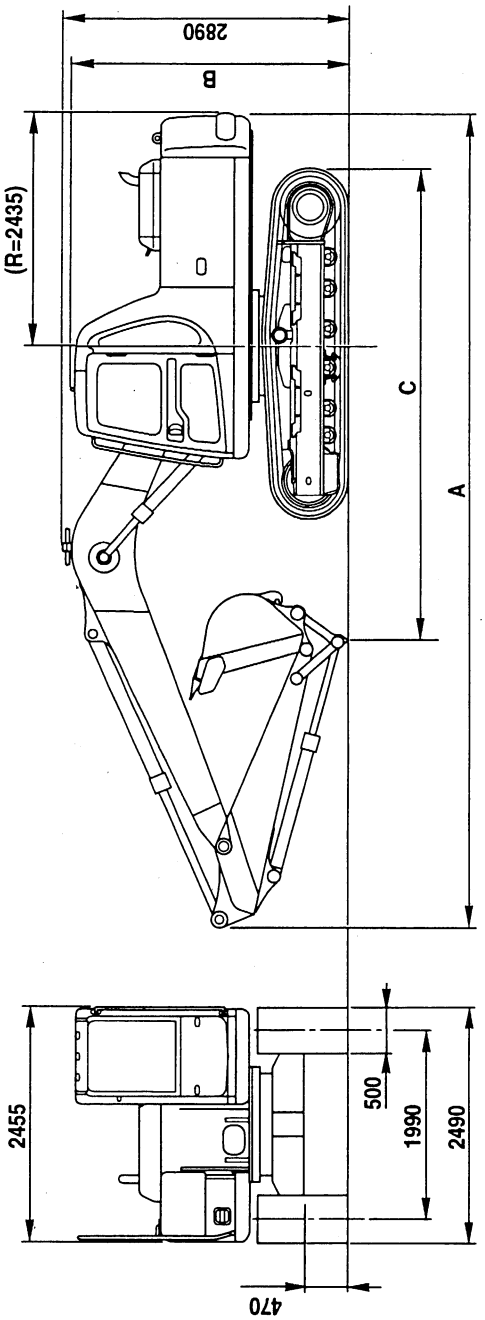
PC180LC-6k

		1.85m ARM	2.25m ARM	2.62m ARM	2.90m ARM
A	Max digging height	8775 mm	8840 mm	8900 mm	9055 mm
B	Max dumping height	6130 mm	6230 mm	6320 mm	6470 mm
C	Max digging depth	5200 mm	5610 mm	5960 mm	6250 mm
D	Max digging depth of cut for 8' level	4950 mm	5375 mm	5740 mm	6050 mm
E	Max digging reach	8355 mm	8675 mm	8960 mm	9230 mm
F	Max digging reach at ground	8180 mm	8510 mm	8800 mm	9075 mm
G	Min swing radius	3360 mm	3060 mm	3000 mm	3010 mm
H	Work equipment height of min swin radius	7210 mm	7140 mm	7120 mm	7140 mm



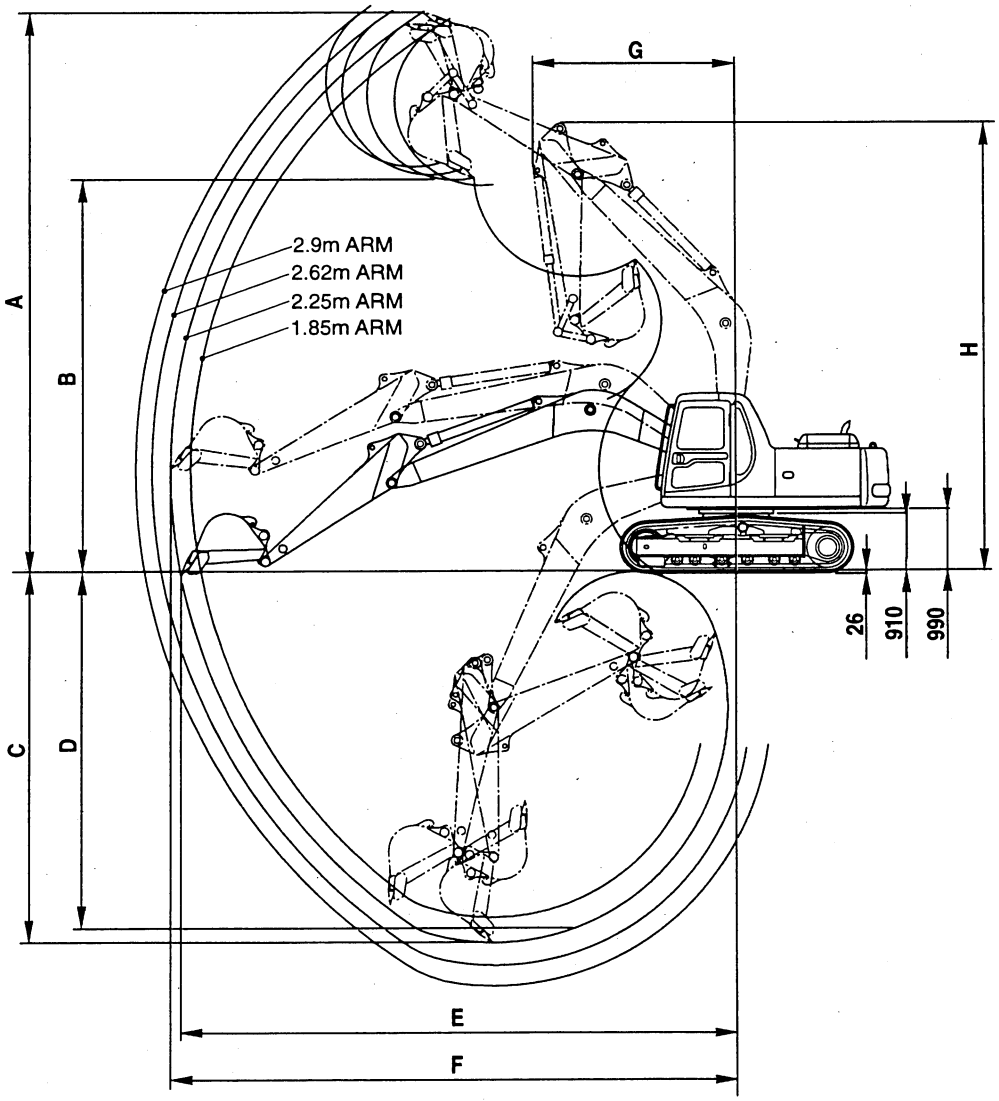
	1.85m ARM	2.25m ARM	2.62m ARM	2.90m ARM
A	8625 mm	8565 mm	8565 mm	8570 mm
B	3115 mm	2945 mm	2960 mm	3060 mm
C	5865 mm	4970 mm	4585 mm	4395 mm





PC160-6k

		1.85m ARM	2.25m ARM	2.62m ARM	2.90m ARM
A	Max digging height	8735 mm	8800 mm	8865 mm	9015 mm
B	Max dumping height	6090 mm	6190 mm	6280 mm	6430 mm
C	Max digging depth	5240 mm	5645 mm	6000 mm	6290 mm
D	Max digging depth of cut for 8' level	4990 mm	5415 mm	5780 mm	6090 mm
E	Max digging reach	8355 mm	8675 mm	8960 mm	9230 mm
F	Max digging reach at ground	8190 mm	8515 mm	8805 mm	9080 mm
G	Min swing radius	3360 mm	3060 mm	3000 mm	3010 mm
H	Work equipment height of min swin radius	7170 mm	7100 mm	7080 mm	7100 mm



WEIGHT TABLE

Units:kg

Machine model	PC180LC-6
Serial Number	
Engine assembly	600
Engine	445
Damper	15
Hydraulic pump	100
Radiator, oil cooler assembly	115
Hydraulic tank, filter assembly (excl. hydraulic oil)	125
Fuel tank (excl. fuel)	100
Revolving frame	1410
Operator's cab	290
Operator's seat	30
Counterweight	2950
Swing machinery (excl. oil)	115
Control valve (7 spools)	70
Swing motor	30
Travel motor	95 X 2
Center swivel joint	45
Under carriage assembly (excl. track shoes assembly)	4600
Track frame	2460
Swing circle	235
Idler assembly	140 x 2
Idler cushion	135 x 2
Carrier roller	20 x 2
Track roller	40 x 14
Final drive (excl. travel motor)	195 x 2

Units:kg

Machine model	PC180LC-6
Serial Number	
Track shoe assembly (shoes +link+pin)	
600mm triple grouser shoe	2620
700mm triple grouser shoe	2870
800mm triple grouser shoe	3120
Boom assembly	1030
Arm assembly	
1850 mm arm	400
2250 mm arm	450
2620 mm arm	520
2900 mm arm	600
Bucket assembly (SAE 0.67 m^3)	580
Boom cylinder assembly + Boom cylinder bottom pin	135 x 2 + 7 x 2
Arm cylinder assembly	200
Bucket cylinder assembly	130
Link assembly	160
Boom pin (boom foot pin, boom cylinder top pin, arm cylinder bottom pin, boom top pin)	30 +21 + 9 + 19
Arm pin (arm cylinder top pin, bucket cylinder bottom pin, arm top pin, arm - link joint pin)	10 + 7 + 16 + 15
Link pin (bucket cylinder top pin, link - bucket joint pin)	15 + 16

WEIGHT TABLE

Units:kg

Machine model	PC160-6k
Serial Number	
Engine assembly	600
Engine	445
Damper	15
Hydraulic pump	100
Radiator, oil cooler assembly	115
Hydraulic tank, filter assembly (excl. hydraulic oil)	125
Fuel tank (excl. fuel)	100
Revolving frame	1410
Operator's cab	290
Operator's seat	30
Counterweight	2950
Swing machinery (excl. oil)	115
Control valve (7 spools)	70
Swing motor	30
Travel motor	95 x 2
Center swivel joint	45
Under carriage assembly (excl. track shoes assembly)	4150
Track frame	2100
Swing circle	235
Idler assembly	140 x 2
Idler cushion	135 x 2
Carrier roller	20 x 2
Track roller	40 x 14
Final drive (excl. travel motor)	195 x 2

Units:kg

Machine model	PC160-6k
Serial Number	
Track shoe assembly (shoes +link+pin)	
500mm triple grouser shoe	2160
600mm triple grouser shoe	2390
700mm triple grouser shoe	2620
Boom assembly	1030
Arm assembly	
1850 mm arm	400
2250 mm arm	450
2620 mm arm	520
2900 mm arm	600
Bucket assembly (SAE 0.67 m^3)	580
Boom cylinder assembly + Boom cylinder bottom pin	135 x 2 + 7 x2
Arm cylinder assembly	200
Bucket cylinder assembly	130
Link assembly	160
Boom pin (boom foot pin, boom cylinder top pin, arm cylinder bottom pin, boom top pin)	30 + 21 + 9 + 19
Arm pin (arm cylinder top pin, bucket cylinder bottom pin, arm top pin, arm - link joint pin)	10 + 7 + 16 + 15
Link pin (bucket cylinder top pin, link - bucket joint pin)	15 + 16

FUEL, COOLANT AND LUBRICANTS

RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE -22 -4 14 32 50 68 86 104°F -30 -20 -10 0 10 20 30 40°C	CAPACITY (ℓ)	
			Specified	Refill
Engine oil pan	Engine oil	SAE 30 / SAE 10W / SAE 10W-30 / SAE 15W-40	16	16
Swing machinery case			4	4
Final drive case (each side)			4	4
		SAE 30		
Idler (1 each)			0.16	0.16
Track roller (1 each)			0.10	0.10
Carrier roller (1 each)			0.16	0.16
Hydraulic system		SAE 10W / SAE 10W-30 / SAE 15W-40	190	135
	Hydraulic oil	H046-HM (★)		
Fuel tank	Diesel fuel	ASTM DG75 No. 2 / ASTM D975A No. 1	250	-
Cooling system	Coolant	Add antifreeze	20	-

NOTE:

(1) When fuel sulphur content is less than 0.5%, change oil in the oil pan every periodic maintenance hours described in this manual.
Change oil according to the following table if fuel sulphur content is above 0.5%.

Fuel sculphur content	Change interval of oil in engine oil pan
0.5 to 1.0%	1/2 of regular interval
Above 1.0%	1/4 of regular interval

2) When starting the engine in an atmospheric temperature of lower than 0°C, be sure to use engine oil of SAE10W, SAE10W-30 and SAE15W-40, even though an atmospheric temperature goes up to 10°C more or less in the day time.
3) Use API classification CD as engine oil and if API classification CC, reduce the engine oil change interval to half.
4) There is no problem if single grade oil is mixed with multigrade oil (SAE10W-30), 15W matches the temperature in the table on the left.
5) We recommend Komatsu genuine oil which has been specifically formulated and approved for use in engine and hydraulic work equipment applications.

★ For the HO46-HM, use the oil recommentded by Komatsu.

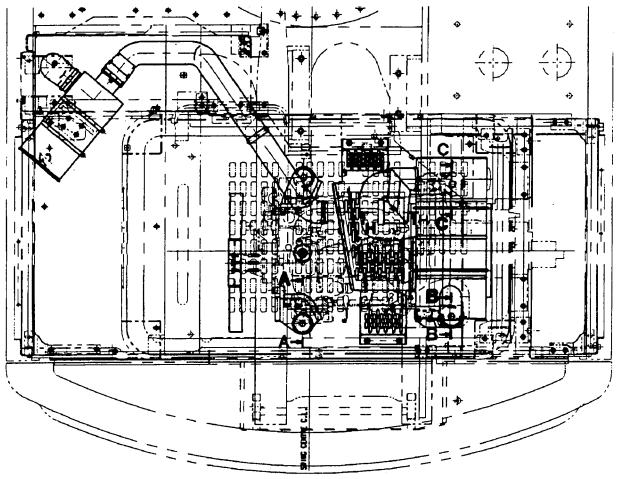
ASTM: American Society of Testing and Material
SAE: Society of Automotive Engineers
API: American Petroleum Institute

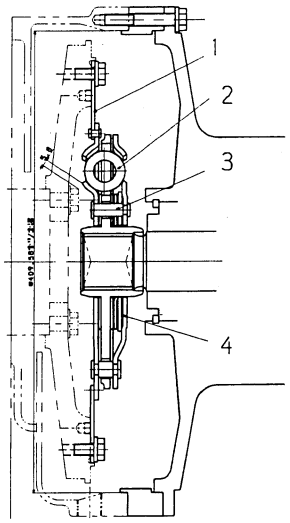
Specified capacity: Total amount of oil including oil for components and oil in piping.
Refill capacity: Amount of oil needed to refill system during normal inspection and maintenance.

10

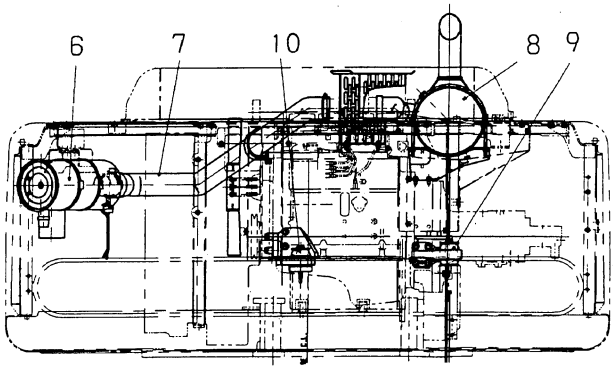
10 STRUCTURE AND FUNCTION

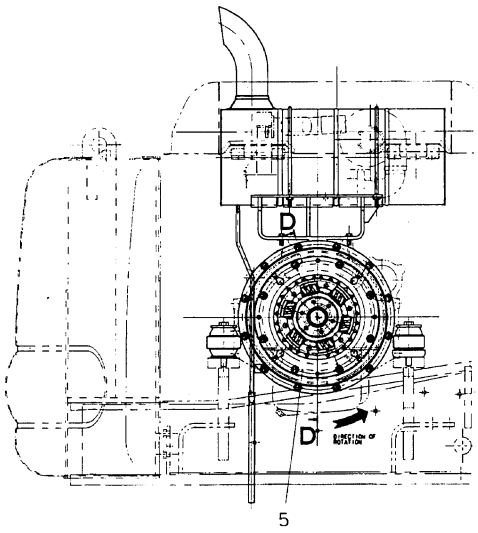
ENGINE RELATED PARTS

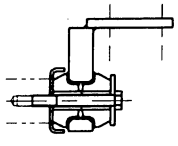




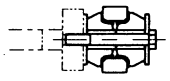
D-D



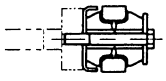




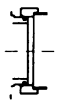
A-A



B-B



C-C



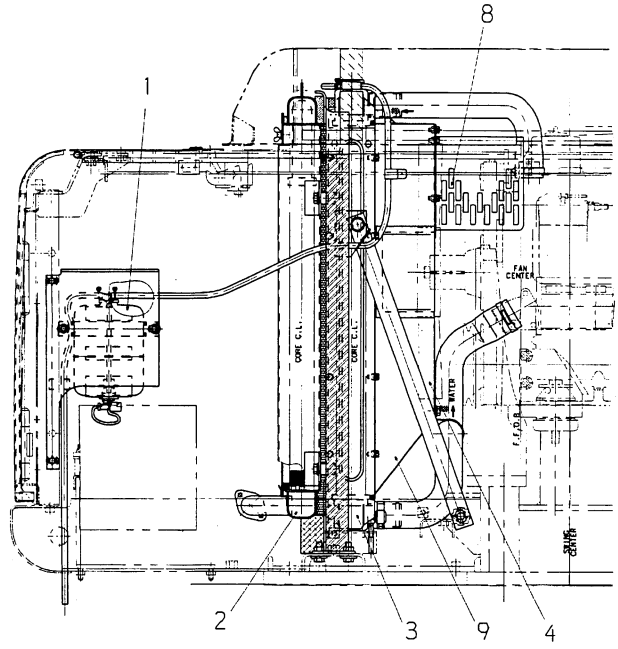
H-H

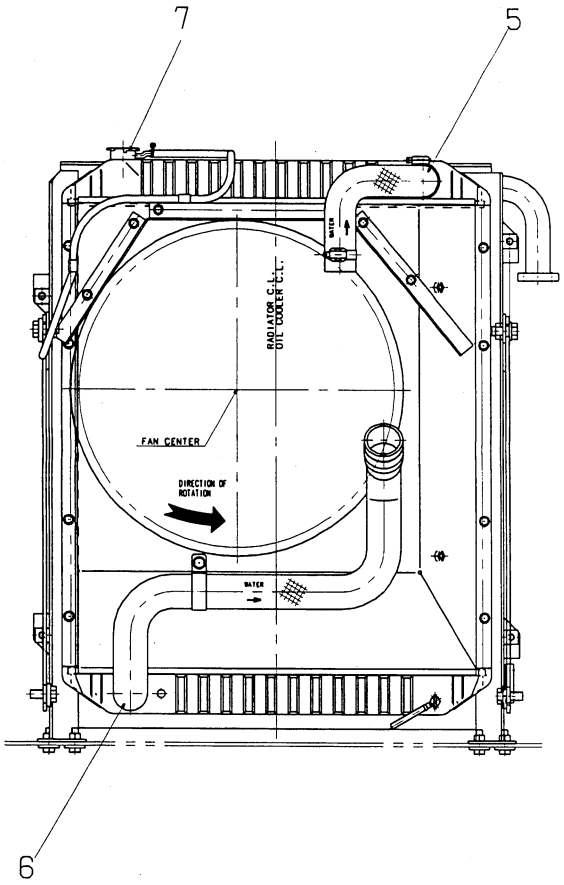
1. Drive plate
2. Torsion spring
3. Stopper pin
4. Friction plate
5. Damper assembly
6. Air cleaner
7. Intake connector
8. Muffler
9. Rear engine mount
10. Front engine mount

OUTLINE

- The damper assembly is a dry type.

RADIATOR • OIL COOLER

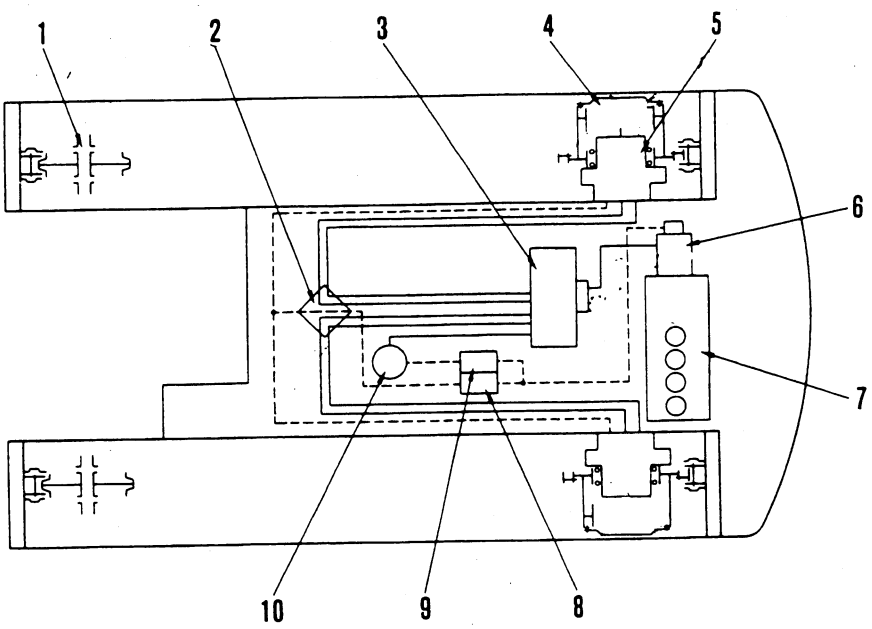


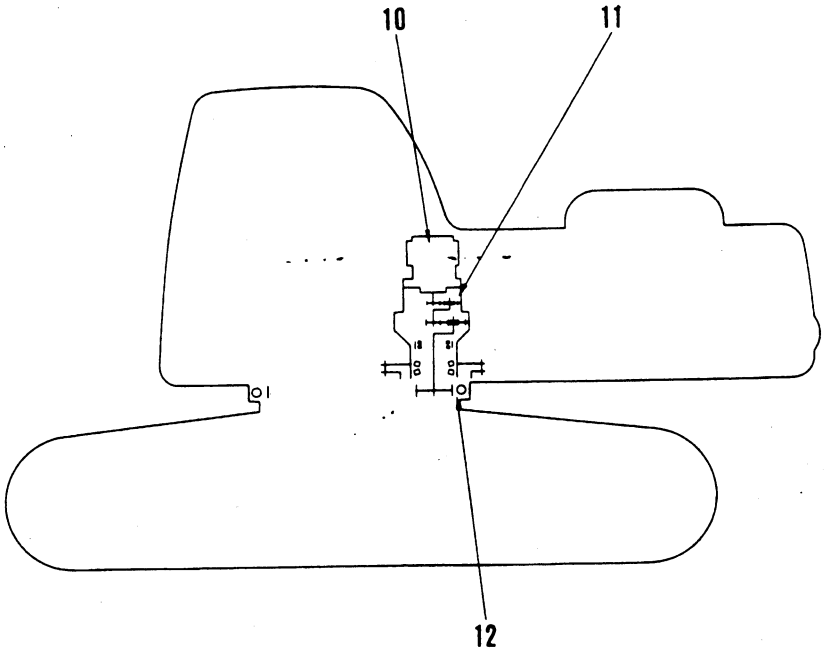


1. Reservoir tank
2. Oil cooler
3. Radiator
4. Fan
5. Radiator inlet hose
6. Radiator outlet hose
7. Radiator cap
8. Net
9. Shroud

SPECIFICATIONS
Radiator: CWX-4
Oil cooler: SF-3

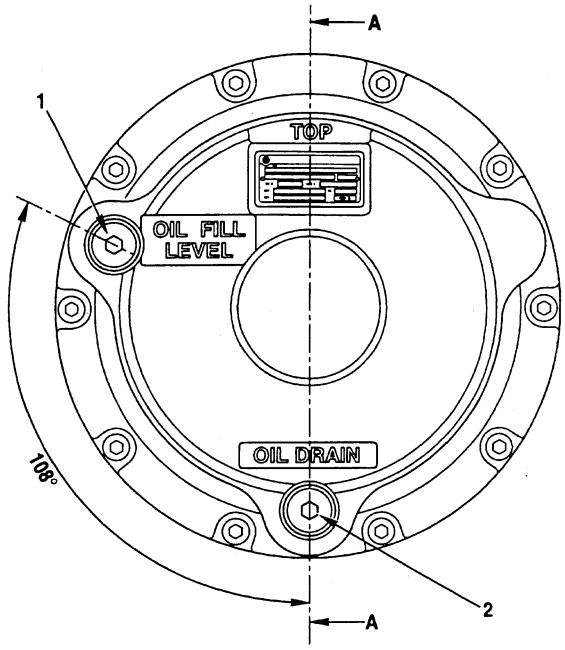
POWER TRAIN





1. Idler
2. Center swivel joint
3. Control valve
4. Final drive
5. Travel motor
6. Hydraulic pump
7. Engine
8. Travel speed solenoid valve
9. Swing brake solenoid valve
10. Swing motor
11. Swing machinery
12. Swing circle

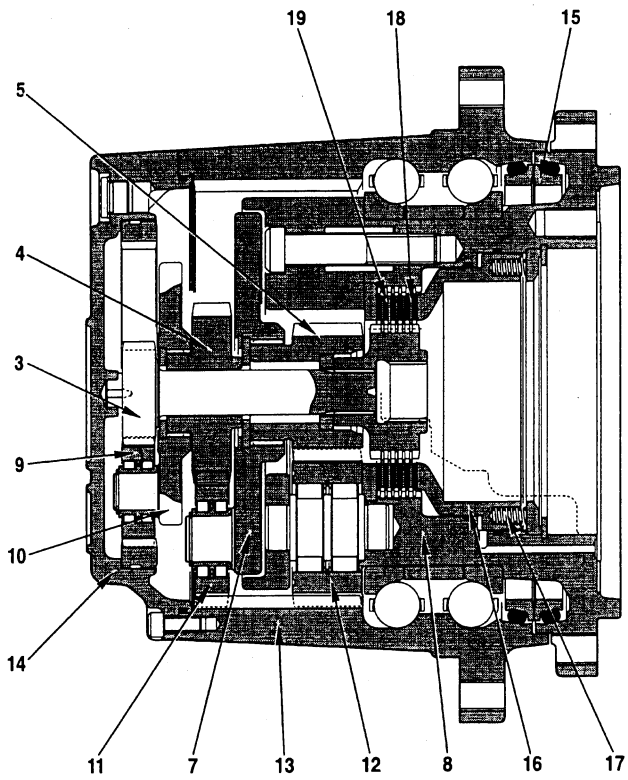
FINAL DRIVE



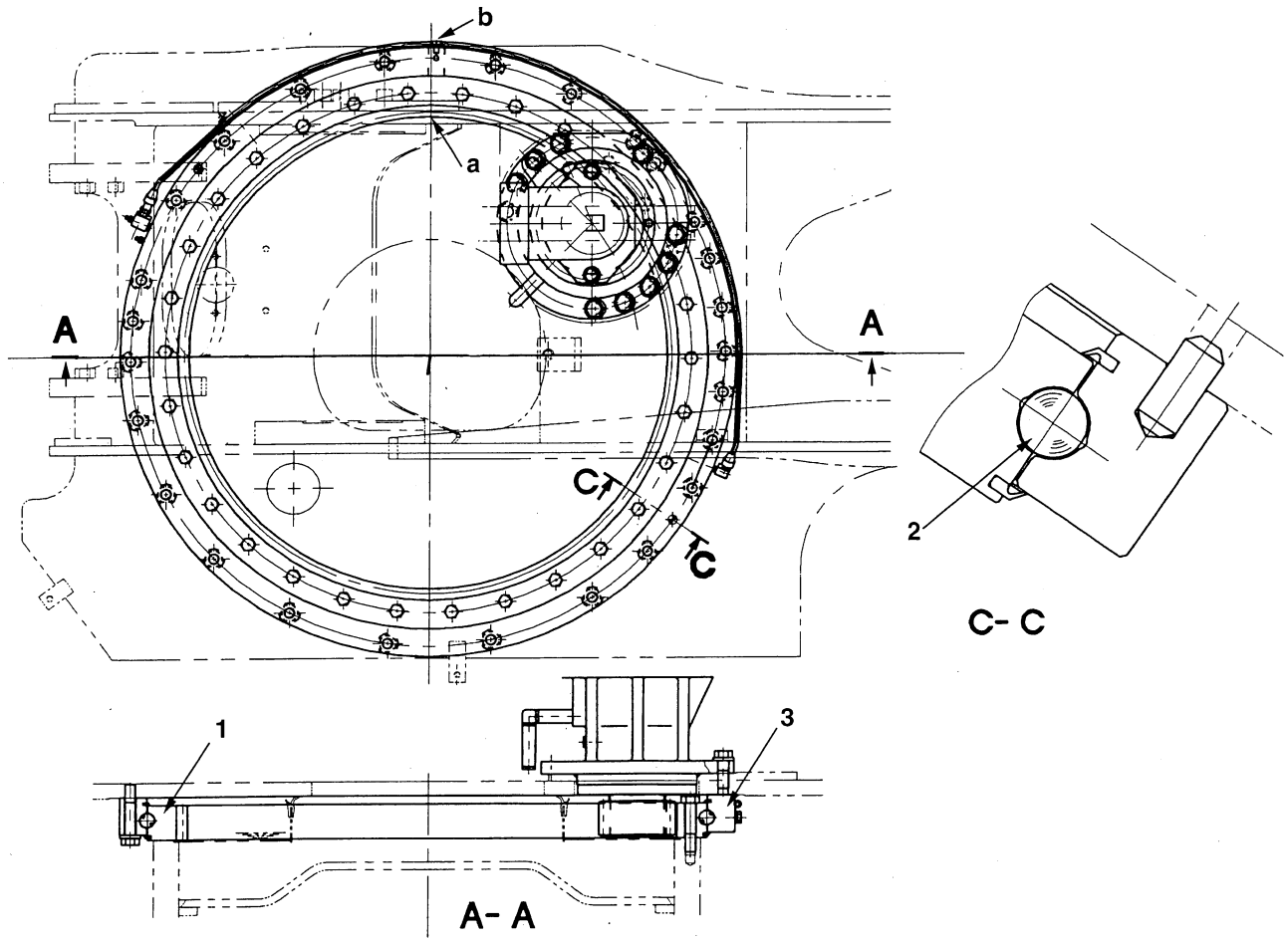
1. Level plug
2. Drain plug
3. No. 1 sun gear (No. of teeth: 24
4. No. 2 sun gear (no. of teeth: 28
5. No. 3 sun gear (No of teeth: 20)
6. No. 1 planetary carrier
7. No. 2 planetary carrier
8. No. 3 planetary carrier
9. No. 1 planetary gear (No. ot teeth: 26)
10. No. 1 ring gear (No. of teeth: 78)
11. No. 2 planetary gear (No. of teeth:20)
12. No. 3 planetary gear (No. of teeth: 23)
13. No. 2 ring gear (No. of teeth: 68)
14. Cover
15. Floating seal
16. Parking brake piston
17. Parking brake spring
18. Parking brake disc
19. Parking brake plate

Reduction ratio:

$$-\left(\frac{24+78}{24}\right) \times \left(\frac{28+68}{28}\right) \times \left(\frac{20+68}{20}\right) + 1 = 63.114$$



SWING CIRCLE



1. Swing circle inner race (No. of teeth: 94)
2. Ball
3. Swing circle outer race

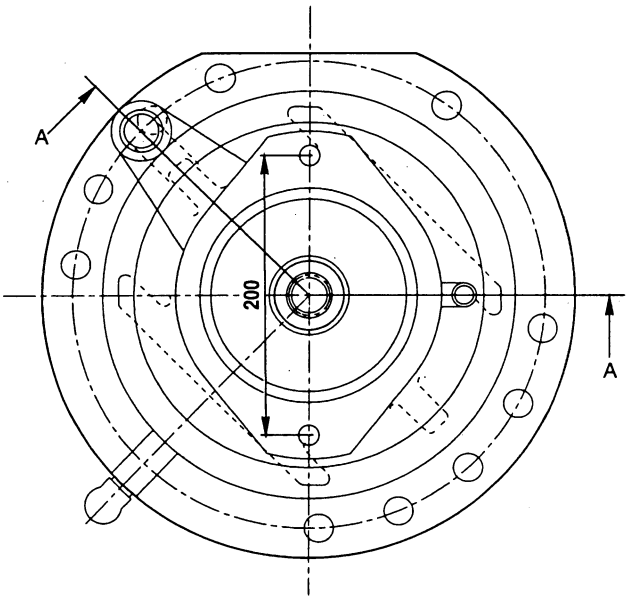
a. Innner race soft zone **S** position
b. Outer race soft zone **S** position

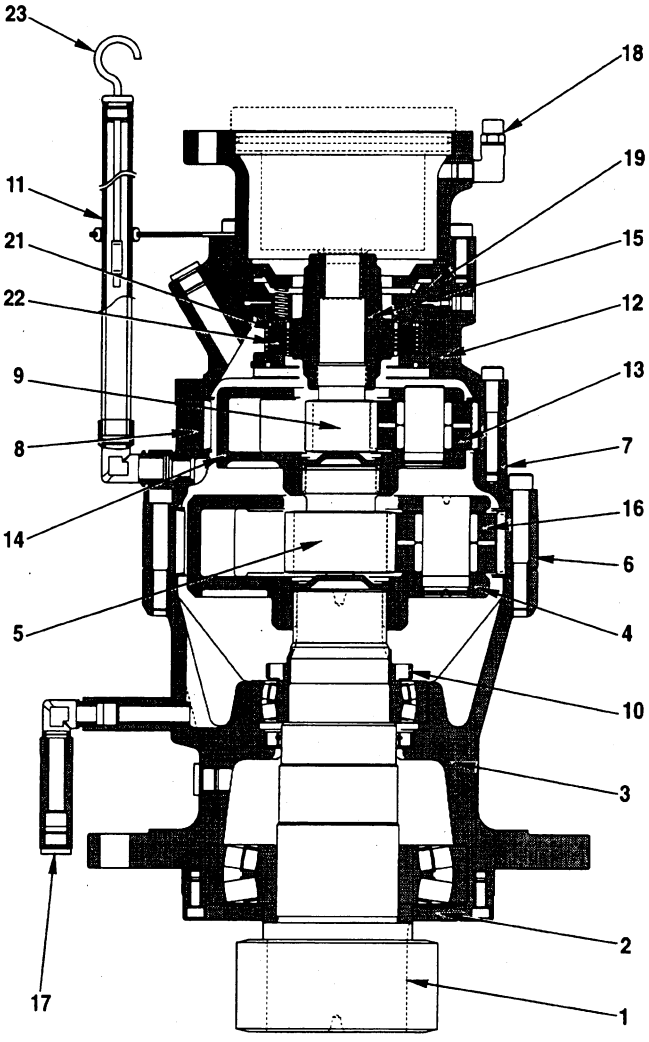
SPECIFICATIONS

Reduction ratio: $\frac{94}{12} = 7.833$

Amount of grease: 8ℓ (G2-LI)

SWING MACHINERY





1. Swing pinion (No. of teeth: 12)
2. Cover
3. Case
4. No. 2 of planetary carrier
5. No. 2 sun gear (No. of teeth: 24)
6. No. 2 ring gear (No. of teeth: 78)
7. Case
8. No. 1 ring gear (No. of teeth: 78)
9. No. 1 sun gear (No. of teeth: 18)
10. Retainer
11. Oil level gauge
12. Cover
13. No. 1 planetary gear (No. of teeth: 29)
14. No. 1 planetary carrier
15. Coupling
16. No. 2 planetary gear (No. of teeth: 26)
17. Drain plug
18. Breather
19. Parking brake piston
20. Parking brake spring
21. Parking brake disc
22. Parking brake plate.
23. Gauge rod.

SPECIFICATIONS

Reduction ratio: $\frac{24+78}{24} \times \frac{18+78}{18} = 22.667$

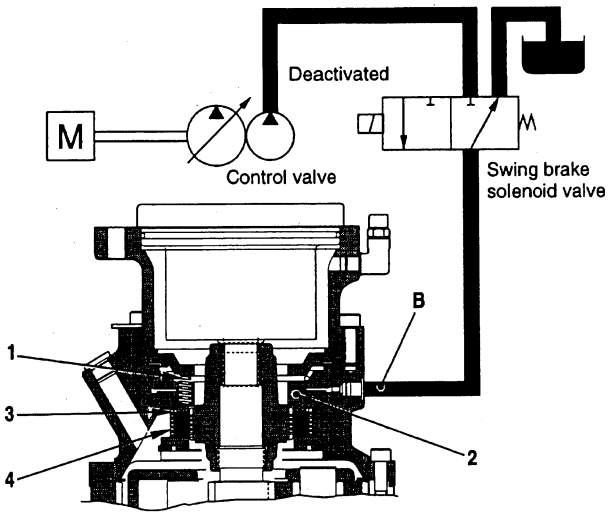
SWING HOLDING BRAKE

OPERATION

1) When swing brake solenoid valve is deactivated

When the swing brake solenoid valve is deactivated, the pressurized oil from the control pump is shut off and port **B** is connected to the tank circuit.

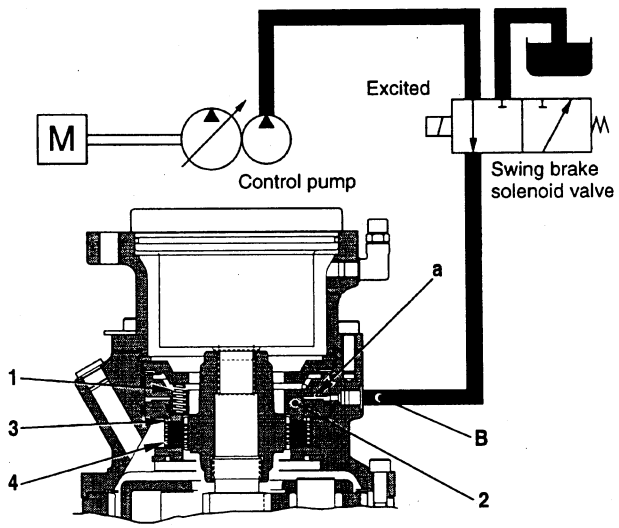
Because of this, brake piston (2) is pushed down in the direction of the arrow by brake spring (1), so disc (3) and plate (4) are pushed together and the brake is applied.



2) When swing brake solenoid valve is excited

When the swing solenoid valve is excited, the valve is switched, and the pressurized oil from the control pump enters port **B** and flows to brake chamber "**a**".

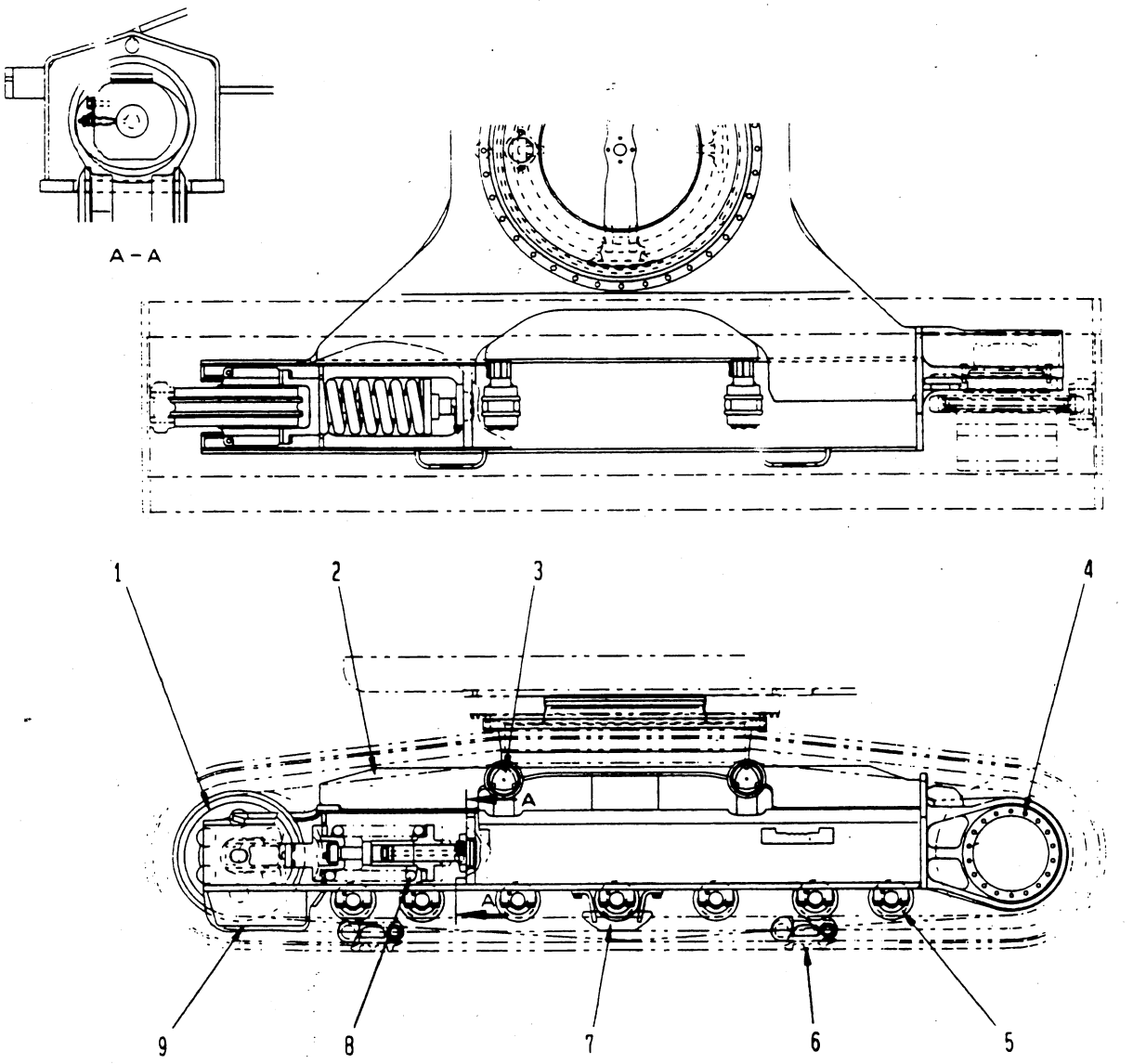
The pressurized oil entering chamber "**a**" overcomes the force of brake spring (1), and brake piston (2) is pushed up in the direction of the arrow. Because of this, disc (3) and plate (4) serparate, and the brake is released.



1. Brake spring
2. Brake piston
3. Disc
4. Plate

TRACK FRAME • RECOIL SPRING

★ The diagram shows the PC180LC-6K



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- The dimensions and number of track rollers may differ according to the model, but the basisc structure is the same.

1. Idler
2. Track frame
3. Carrier roller
4. Final drive
5. Track roller
6. Track shoe
7. Center guard
8. Recoil spring
9. Front guard

• No. of rollers (each side)

Model	No. of track rollers	No. of carrier rollers
PC180LC-6K	7	2
PC160-6K	6	1

TRACK SHOE

STANDARD SHOE

Item \ Model	PC180LC-6K	PC160-6K
Shoe width (triple shoe)	600 mm	500 mm
Link pitch	190 mm	190 mm
No. of rollers (each side)	45	41

SELECTION OF TRACK SHOE

- Select the most suitable track shoe from the following table.

Model	PC180LC-6K		PC160-6K	
	Specification	Cate-gory	Specification	Cate-gory
Standard	600mm triple	A	500 mm triple	A
Option	700 mm triple	B	600 mm triple	B
Option	800 mm triple	C	700 mm triple	C
Option	-	-	-	-
Option	-	-	-	-
Option	-	-	-	-
Option	-	-	-	-

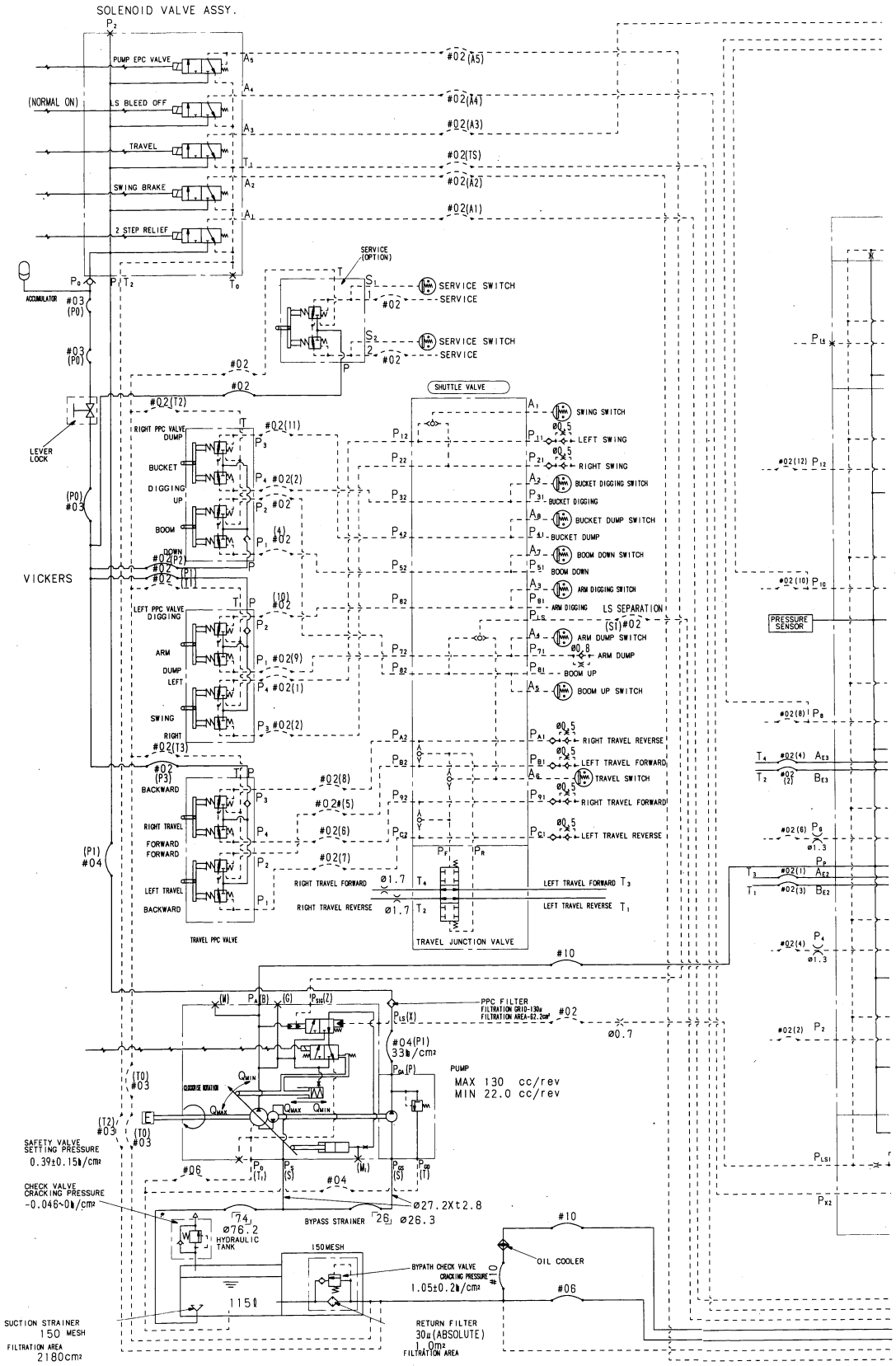
Category	Use	Precautions when using
A	Rocky ground, normal river soil	• Travel in Lo speed when traveling on rough ground with obstacles such as large boulders and fallen trees.
B	Normal soil, soft land	• Cannot be used on rough ground where there are large obstacles such as boulders and fallen trees. • Travel in Hi speed only on flat ground, and when it is impossible to avoid traveling obstacles, lower the travel speed to approx. half of Lo speed.
C	Extremely soft ground (swampy ground)	• Use only for ground where "**A**" and "**B**" sink and are impossible to use. • Cannot be used on rough ground where there are large obstacles such as boulders and fallen trees. • Travel in Hi speed only on flat ground, and when it is impossible to avoid traveling over obstacles, lower the travel speed to approx. half of Lo speed.

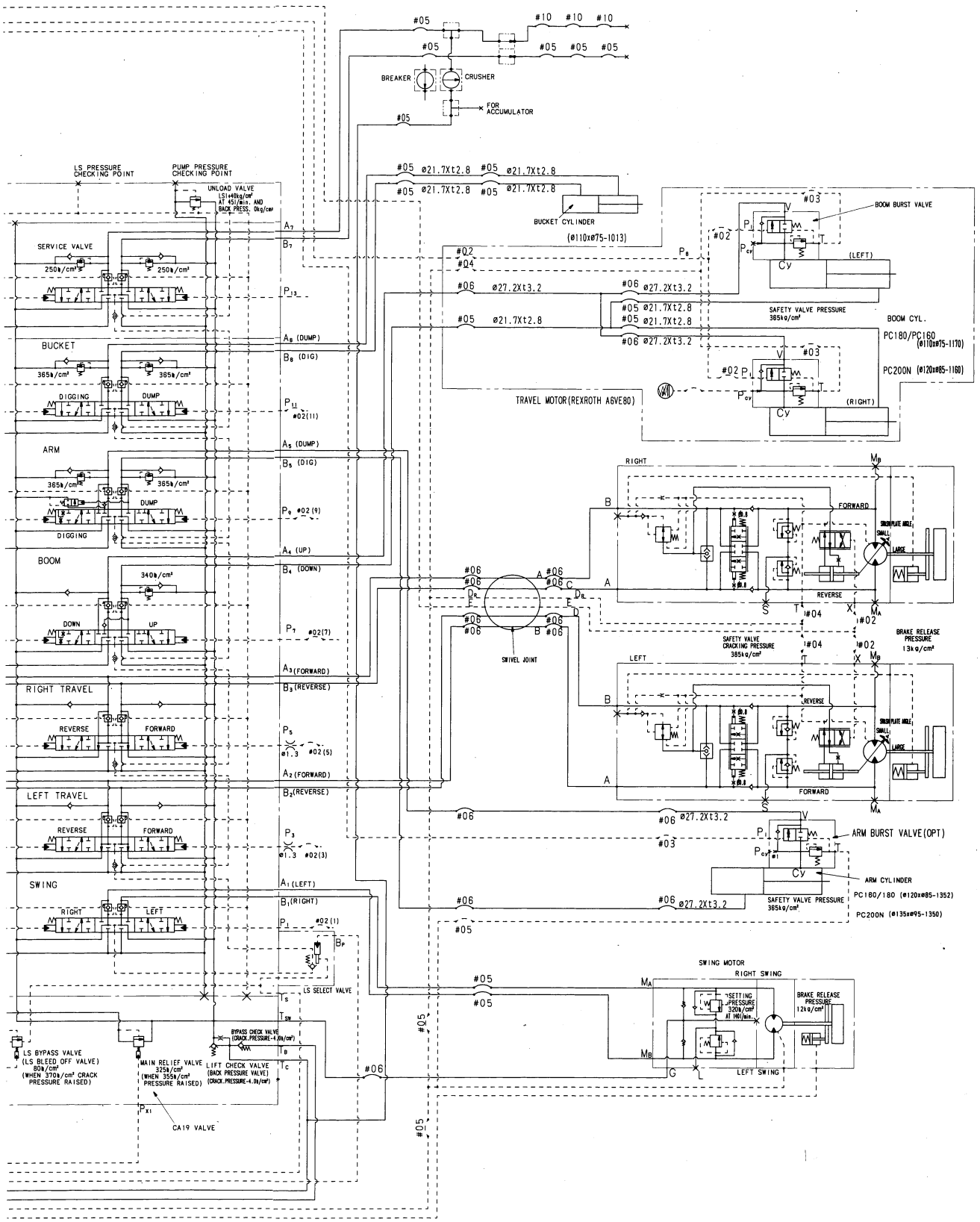
★ Categories "**B**" and "**C**" are wide shoes, so there are restrictions on their use. Therefore, before using, check the restrictions and consider carefully the conditions of use before recommending a suitable shoe width.
If necessary, given the customer guidance in their use.

★ When selecting the shoe width, select the narrowest shoe possible within the range that will give no problem with flotation and ground pressure.
If a wider shoe than necessary is used, there will be a large load on the shoe, and this may lead to bending of the shoe, cracking of the links, breakage of the pins, loosing of the shoe bolts, or other problems.

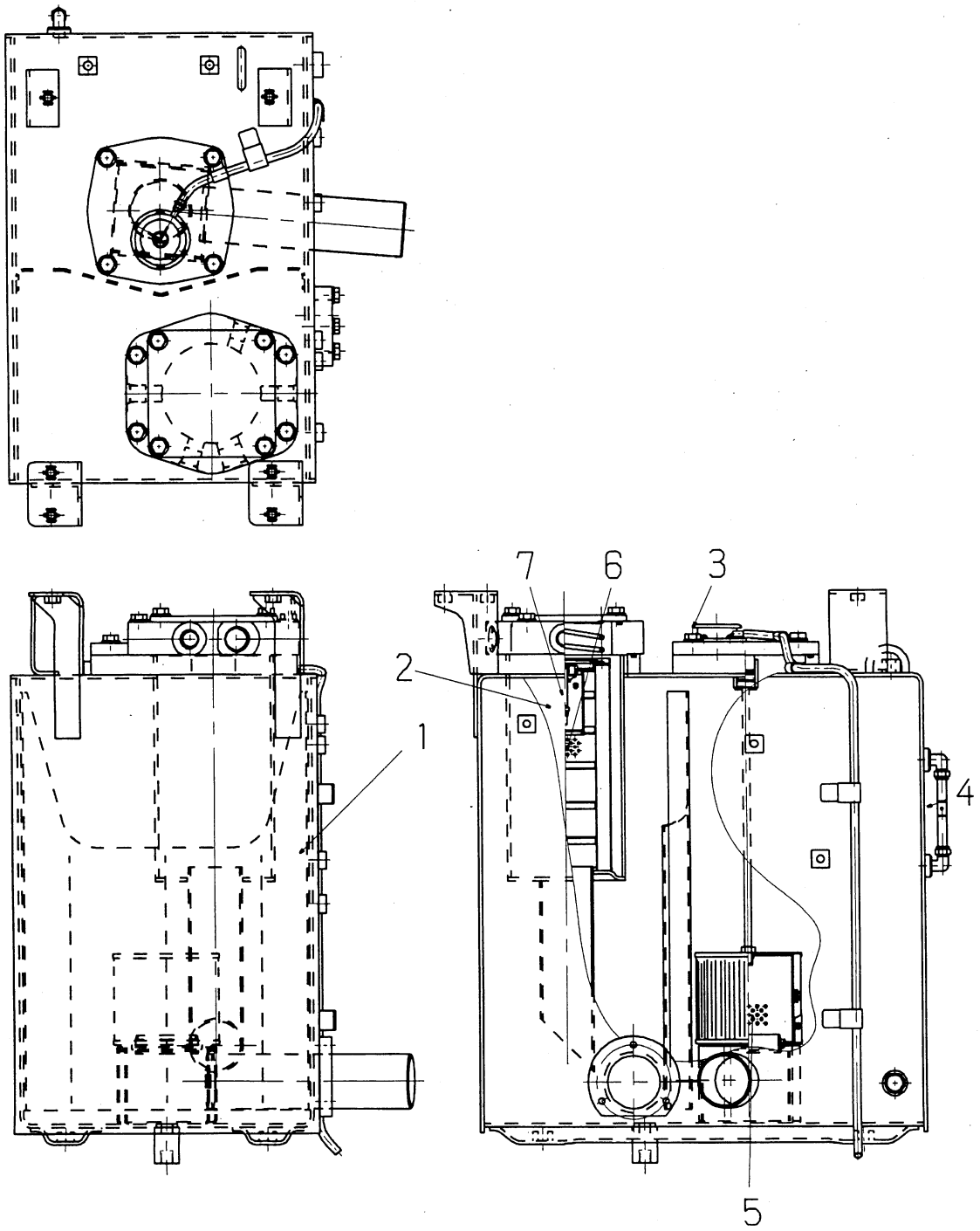
HYDRAULIC CIRCUIT DIAGRAM

PC180LC-6k
PC160-6k




#05
#10 #10 #10
#05 #05 #05
BREAKER
CRUSHER
FOR ACCUMULATOR
LS PRESSURE CHECKING POINT
PUMP PRESSURE CHECKING POINT
UNLOAD VALVE
SERVICE VALVE
250k/cm²
BUCKET
365k/cm²
DIGGING
DUMP
ARM
BOOM
340k/cm²
DOWN
UP
RIGHT TRAVEL
REVERSE
FORWARD
LEFT TRAVEL
SWING
RIGHT
LEFT
LS BYPASS VALVE
(LS BLEED OFF VALVE)
80k/cm²
(WHEN 370k/cm² CRACK PRESSURE RAISED)
MAIN RELIEF VALVE
325k/cm²
(WHEN 355k/cm² PRESSURE RAISED)
LIFT CHECK VALVE
(BACK PRESSURE VALVE)
(CRACK.PRESSURE-4.0k/cm²)
BYPASS CHECK VALVE
(CRACK.PRESSURE-4.0k/cm²)
LS SELECT VALVE
CA19 VALVE
ø21.7Xt2.8
BUCKET CYLINDER
(ø110xø75-1013)
BOOM BURST VALVE
(LEFT)
(RIGHT)
ø27.2Xt3.2
SAFETY VALVE PRESSURE
385kg/cm²
BOOM CYL.
PC180/PC160
(ø110xø75-1170)
PC200N (ø120xø85-1160)
TRAVEL MOTOR(REXROTH AGVE80)
SWIVEL JOINT
SAFETY VALVE CRACKING PRESSURE
385kg/cm²
BRAKE RELEASE PRESSURE
13kg/cm²
ARM BURST VALVE(OPT)
ARM CYLINDER
PC180/180 (ø120xø85-1352)
PC200N (ø135xø95-1350)
SWING MOTOR
RIGHT SWING
LEFT SWING
SETTING PRESSURE
320k/cm²
AT 14l/min.
BRAKE RELEASE PRESSURE
12kg/cm²

HYDRAULIC TANK

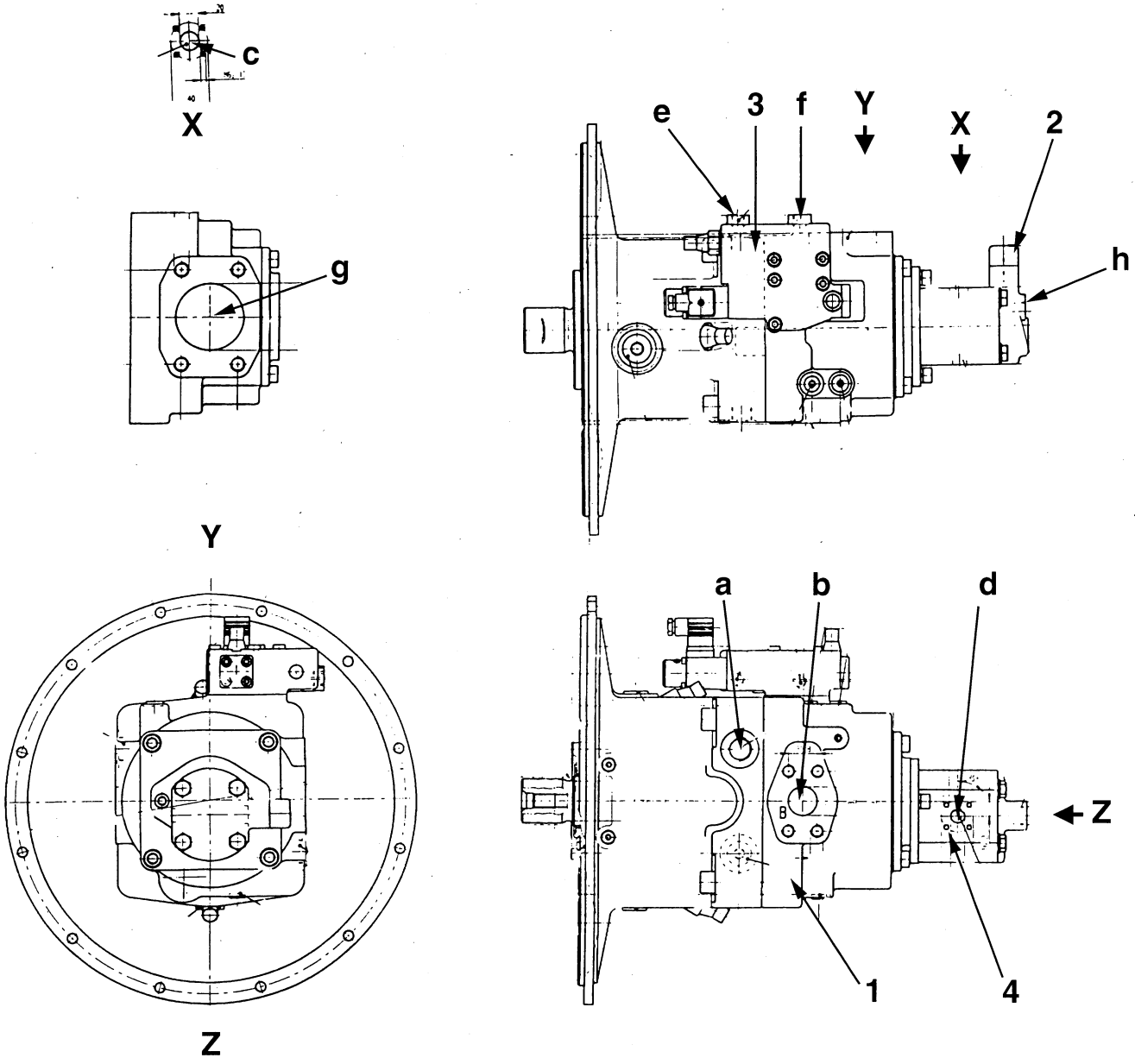


1. Hydraulic tank
2. Bypass valve
3. Oil filter cap
4. Sight gauge
5. Suction strainer
6. Filter element
7. Bypass strainer

SPECIFICATIONS

Tank capacity:	
Amount of oil inside tank:	
Pressure valve	
Relief cracking pressure:	0.038 ± 0.015 MPa (0.39 ± 0.15 kg/cm²)
Suction cracking pressure:	0 — 0.0045 MPa (0 — 0.046 kg/cm²)
Bypass valve set pressure:	0.103 ± 0.02 MPa (1.05 ± 0.2 kg/cm²)

HYDRAULIC PUMP



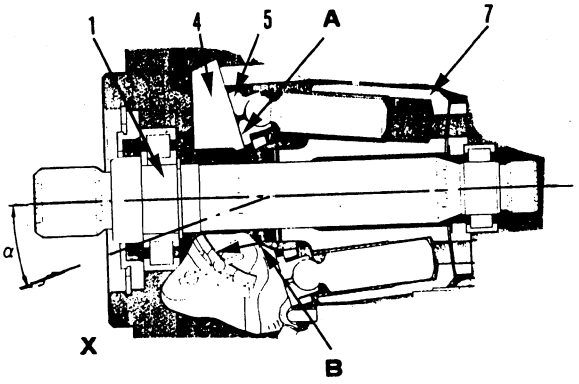
a. Pump drain port **PD**
b. Pump delivery port **PA**
c. Control pump suction port **PGS**
d. Control pump delivery port **PGA**
e. Pump LS pressure port **PLS**
f. LS control EPC pressure port **PSIG**
g. Main pump suction port **PS**
h. Control pump drain port **PGD**

1. Main pump
2. Control relief valve
3. TVC•LS valve
4. Control pump

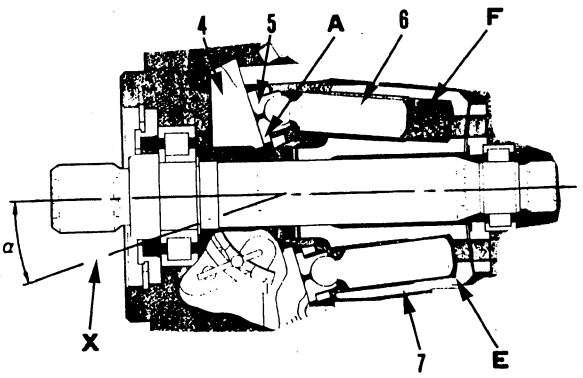
OPERATION

1. Operation of pump

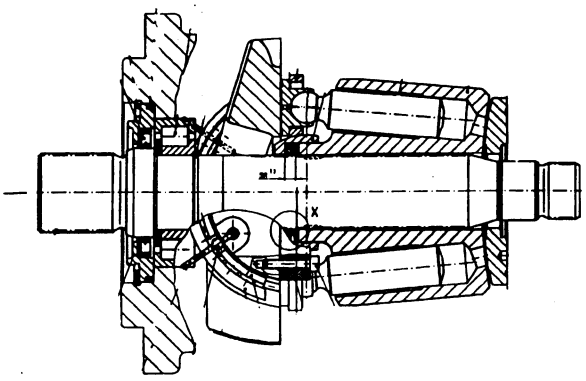
1) cylinder block (7) rotates together with shaft (1), and shoe (5) slides on flat surface **A**.
When this happens, rocker cam (4) moves along cylindrical surface **B**, so angle α between center line **X** of rocker cam (4) and the axial direction of cylinder block (7) changes. (Angle α is called the swash plate angle.)



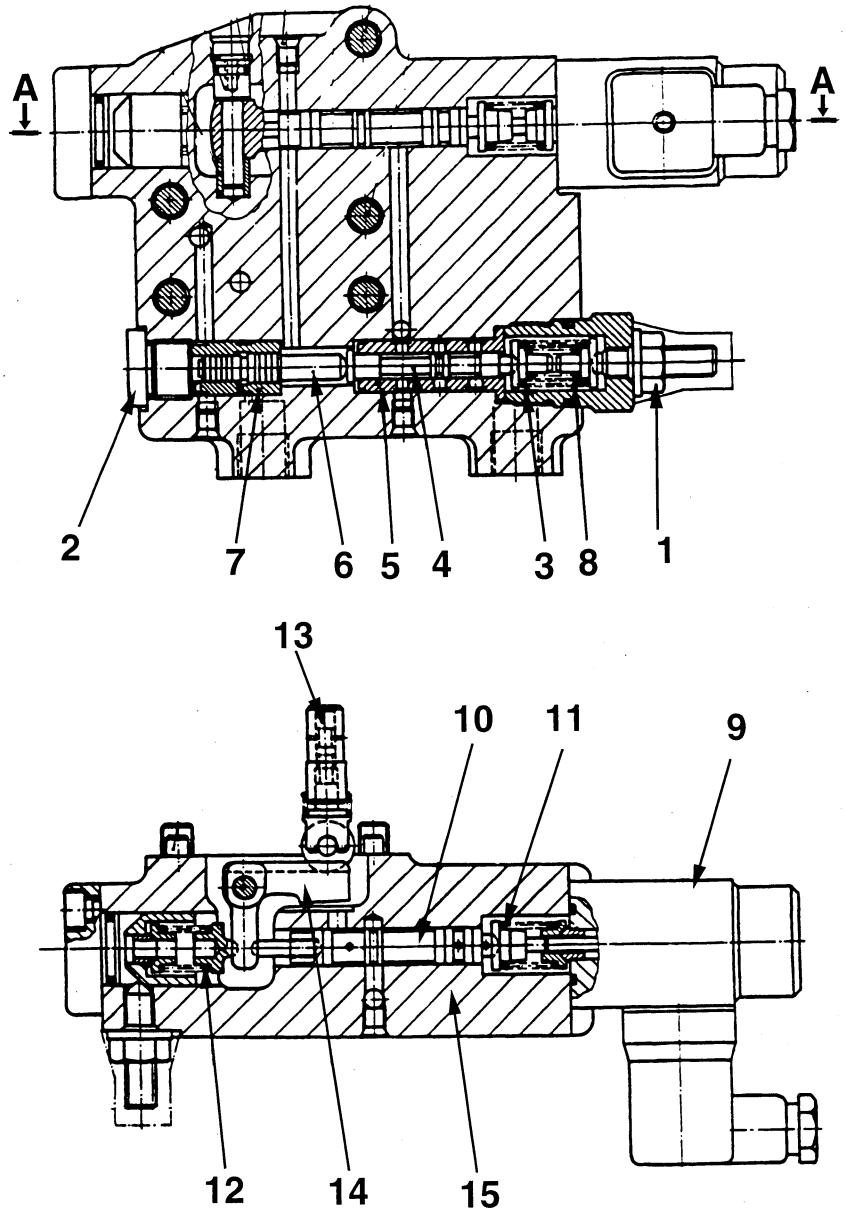
2) Center line **X** of rocker cam (4) maintains swash plate angle α in relation to the axial direction of cylinder block (7), and flat surface **A** moves as a cam in relation to shoe (5).
In this way, piston (6) slides on the inside of cylinder block (7), so a difference between volume **E** and **F** is created inside cylinder block (7). The suction and discharge is carried out by this difference **F - E**.
In other words, when cylinder block (7) rotates and the volume of chamber **E** becomes smaller, the oil is discharged during that stroke. On the other hand, the volume of chamber **F** becomes larger, and as the volume becomes bigger, the oil is sucked in.



3) If center line **X** of rocker cam (4) is in line with the axial direction of cylinder block (7) (swash plate angle = 0), the difference between volumes **E'** and **F'** inside cylinder block (7) becomes 0, so the pump does not carry out any suction or discharge of oil. (In actual fact, the swash plate angle never becomes 0.)



2. TVC. LS valve



LS VALVE

1. Locknut
2. Plug
3. Spring
4. Spool
5. Sleeve
6. Piston
7. Sleeve
8. Spring

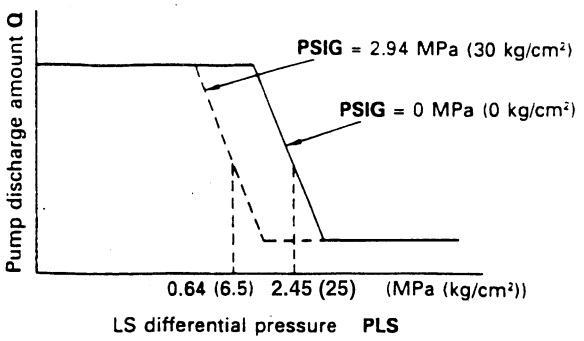
TVC VALVE

9. Solenoid
10. Piston
11. Spring
12. Spring
13. Piston
14. Lever
15. Valve body

FUNCTION

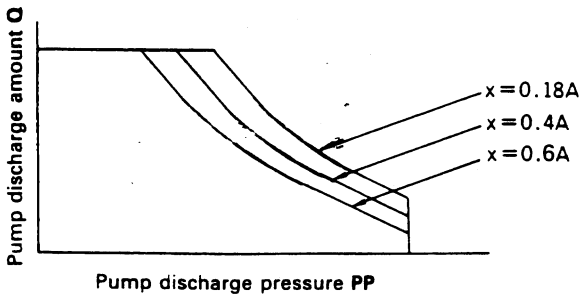
1. LS VALVE

- The **LS** valve detects the load and controls the discharge amount.
  This valve controls main pump discharge amount **Q** according to differential pressure **ΔPLS** (=**PP** - **PLS**) (the difference between main pump pressure **PP** and control valve outlet port pressure **PLS**) (called the **LS** differential pressure).
- Main pump pressure **PP**, pressure **PLS** (called the **LS** pressure) coming from the control valve output, and pressure **PSIG** (called the **LS** selection pressure) from the proportional solenoid valve enter this valve. The relationship between discharge amount **Q** and differential pressure **ΔPLS**, (the difference between main pump pressure **PP** and **LS** pressure **PLS**) (=**PP**- **PLS**) changes as shown in the diagram on the right according to **LS** selector pressure **PSIG**.
- When **PSIG** changes between 0 and 2.94 MPa (0 and 30 kg/cm²), the spool load changes according to this, and the selector point for the pump discharge amount changes at the rated central value between 0.64 and 2.45 MPa (6.5 and 25 kg/cm²).



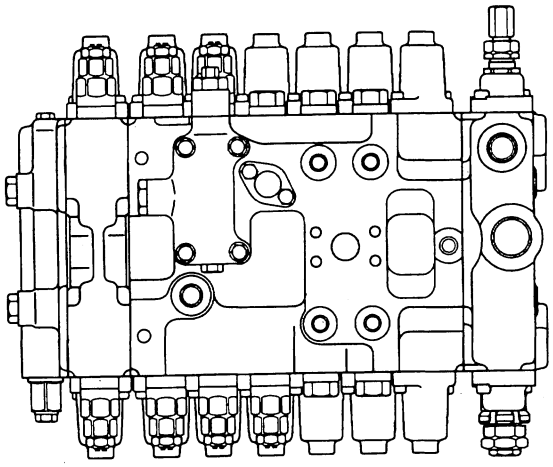
2. TVC VALVE

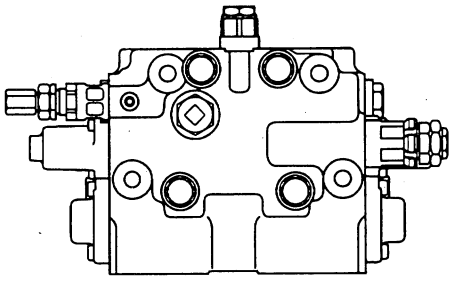
- When the pump discharge pressure **PP** (selfpressure) is high, the TVC valve controls the pump so that no more oil than the constant flow (in accordance with the discharge pressure) flows even if the stroke of the control valve becomes larger. In this way it carries out equal horsepower control so that the horsepower absorbed by the pump does not exceed the engine horsepower.
- In other words, if the load during the operation becomes larger and the pump discharge pressure rises, it reduces the discharge amount from the pump; and if the pump discharge pressure drops, it increases the discharge amount from the pump. The relationship between the average of the front and rear pump discharge pressures (**PP1** + **PP2**)/2 and pump discharge amount **Q** is shown on the right, with the current given to the TVC valve solenoid shown as a parameter. However, in the heavy-duty opreation mode, there are cases where it is given the function of sensing the actual speed of the engine, and if the speed drops because of an increase in the load, it reduces the pump discharge amount to allow the speed to recover. In other words, when the load increases and the engine drops below the set value, the command to the TVC valve solenoid from the controller increases according to the drop in the engine speed to reduce the pump swash plate angle.

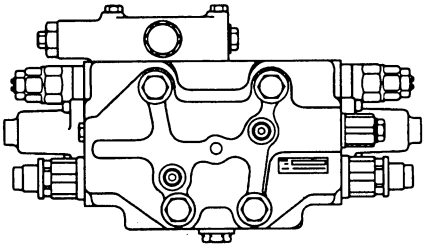


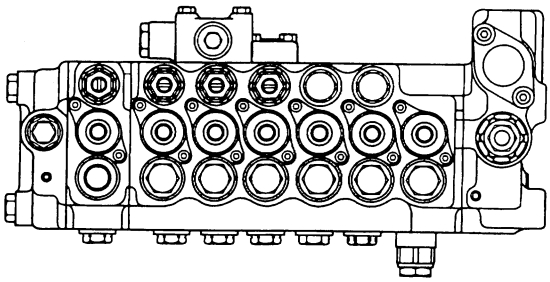
CONTROL VALVE

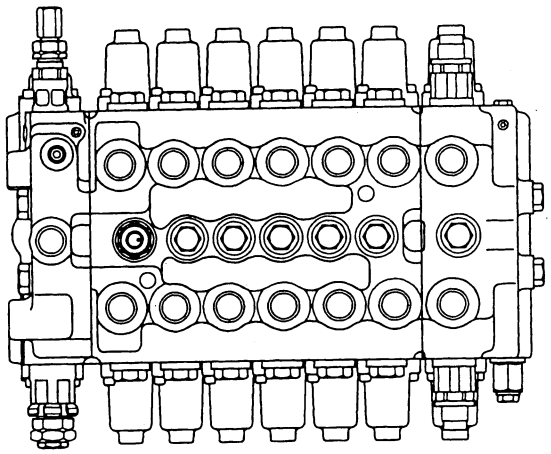
7-SPOOL VALVE (+ 1 SERVICE VALVE)

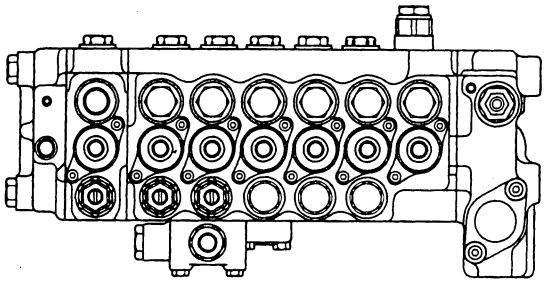












1. 7-spool valve
2. Cover 1 (main relief valve, LS bypass valve)
3. Cover 2 (Unload valve)
4. Arm counterbalance valve
5. No. 1 service valve

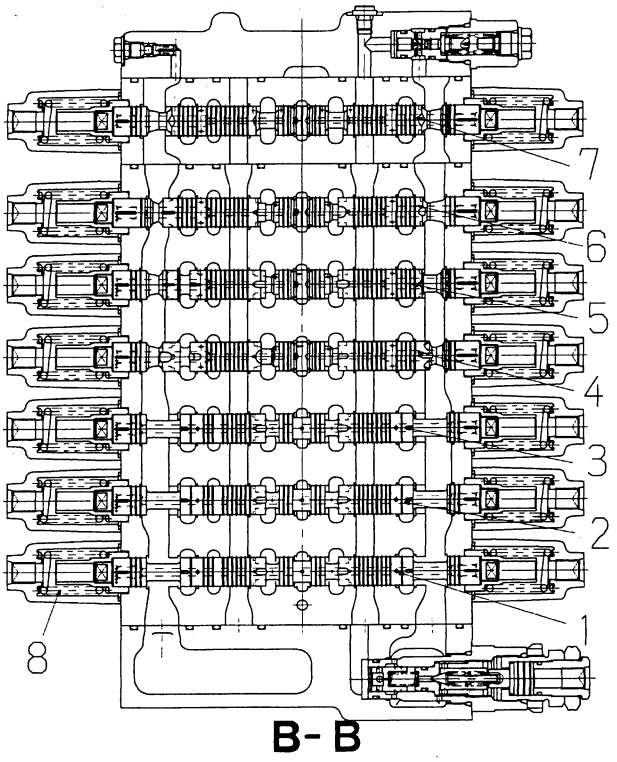
OUTLINE

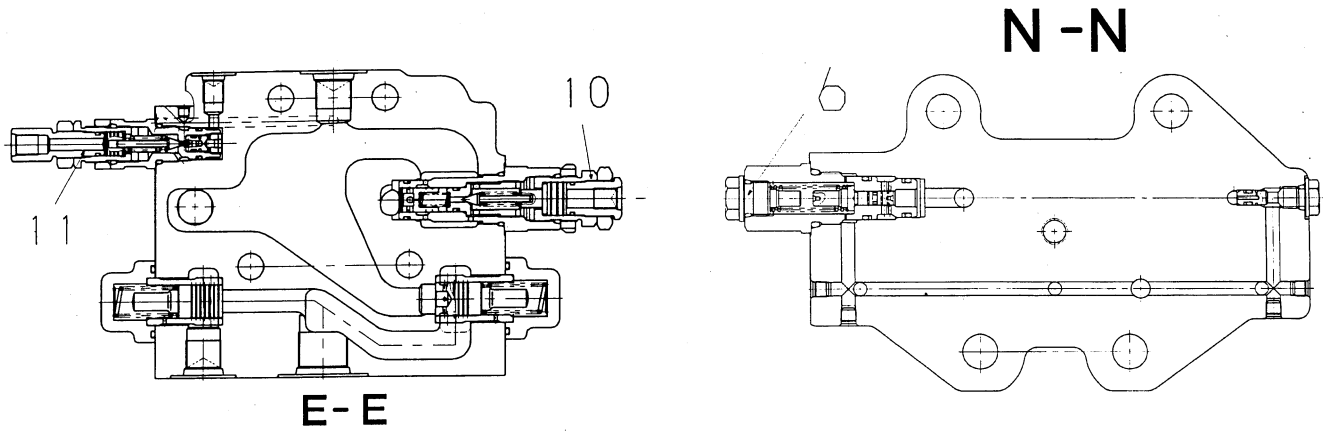
- This control valve consists of the 6-spool valve (an integrated composition) and 1 service valve. Arm counterbalance valve is installed to this.
- Each valve forms one unit with the connection bolt, and the passages are internally connected, so the structure is compact and is very easy to service.
- This control valve consists of one spool for one item of the work equipment, so it has a simple structure.

a. Port **PP** (from main pump)
b. Port **A1** (to swing motor)
c. port **B1** (to swing motor)
d. Port **A2** (to L.H. travel motor)
e. Port **B2** (to L. H. travel motor)
f. Port **A3** (to R.H. travel motor)
g. Port **B3** (to R.H. travel motor)
h. Port **A4** (to boom cylinder bottom)
i. Port **B4** (to boom cylinder head)
j. Port **A5** (to arm cylinder head)
k. Port **B5** (to arm cylinder bottom)
l. Port **A6** (to bucket cylinder head)
m. Port **B6** (to bucket cylinder bottom)
n. Port **A7** (to attachment)
o. Port **B7** (to attachment)
p. Port **TB** (to tank)
q. Port **AE2** (to travel junction valve)
r. Port **BE2** (to travel junction valve)
s. Port **AE3** (to travel junction valve)
t. Port **BE3** (to travel junction valve)
u. Port **TE** (to oil cooler)
v. Port **TSW** (to swing motor)

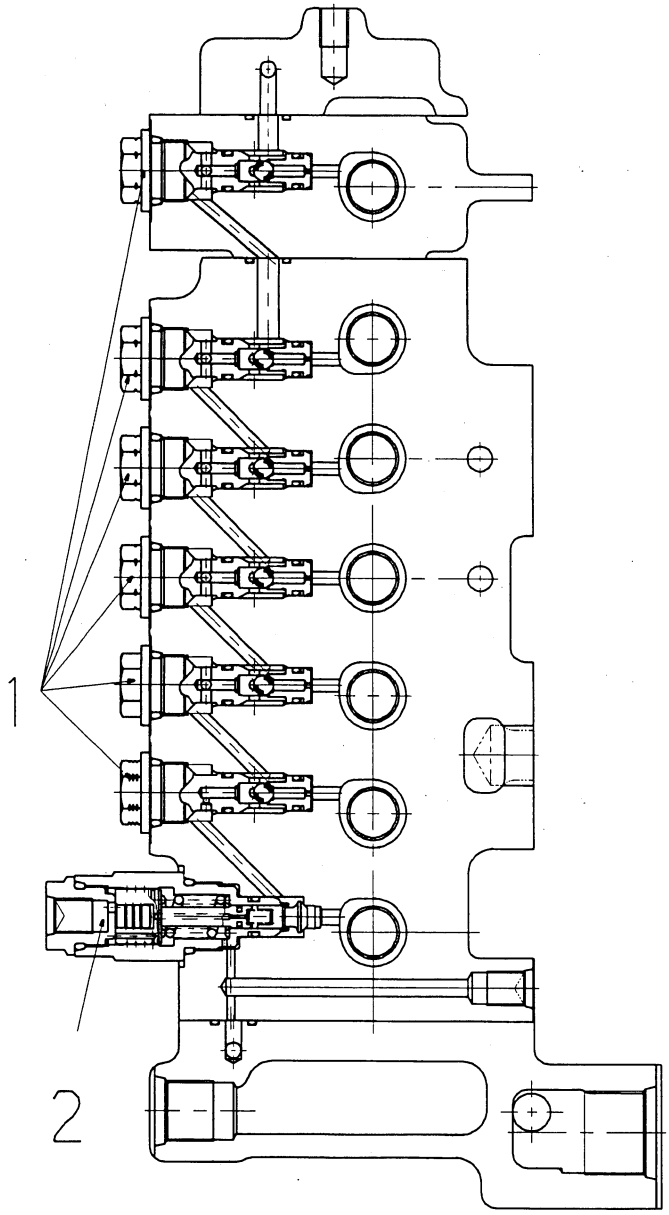
aa. Port **PLS1** (to rear pump control)
bb. Port **TS** (to tank)
cc. Port **PX1** (from solenoid valve)
dd. Port **PX2** (from solwnoid valve)
ee. Port **SA** (pressure sensor mount port)
gg. Port **BP** (from solenoid valve)
hh. Pump pressure checking port
ii. LS pressure checking port
pa. Port **P1** (from swing PPC/EPC valve)
pb. Port **P2** (from swing PPC/EPC valve)
pc. Port **P3** (from L.H. travel PPC valve)
pd. Port **P4** (from L.H. travel PPC valve)
pe. Port **P5** (from R.H. travel PPC valve)
pf. Port **P6** (from R.H. travel PPC valve)
pg. Port **P7** (from boom PPC/EPC valve)
ph. Port **P8** (from boom PPC/EPC valve)
pi. Port **P9** (from arm PPC/EPC valve)
pj. Port **P10** (from arm PPC/EPC valve)
pk. Port **P11** (from bucket PPC/EPC valve)
pl. Port **P12** (from bucket PPC/EPc valve)
pm. Port **P13** (from service PPC valve)
pn. Port **P14** (from service PPC valve)

MAIN STRUCTURE



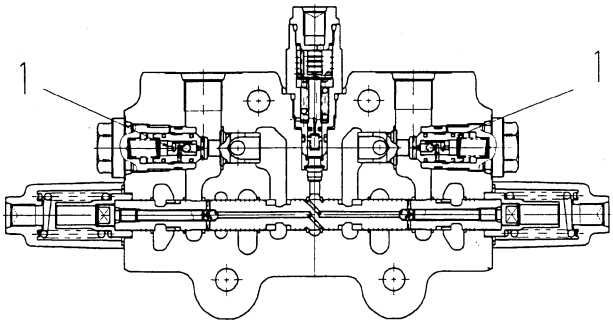


1. Spool (swing)
2. Spool (L.H. travel)
3. Spool (R.H travel)
4. Spool (boom)
5. Spool (arm)
6. Spool (bucket)
7. Spool (service 1)
8. Spool return spring
9. Unload valve
10. Main relief valve
11. LS bypass valve

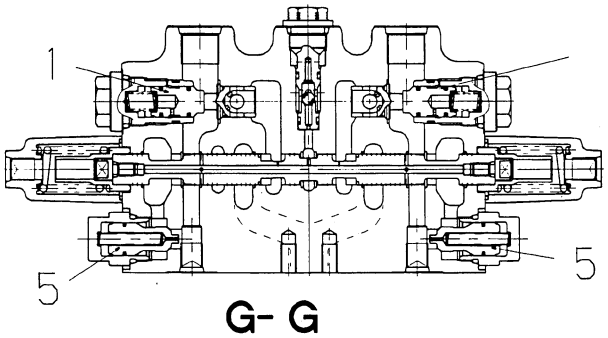


D- D

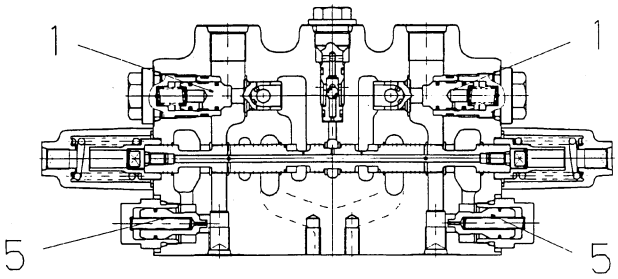
1. LS shuttle valve
2. LS select valve



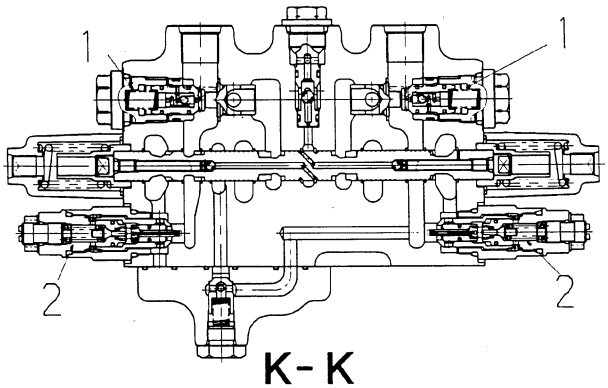
F - F



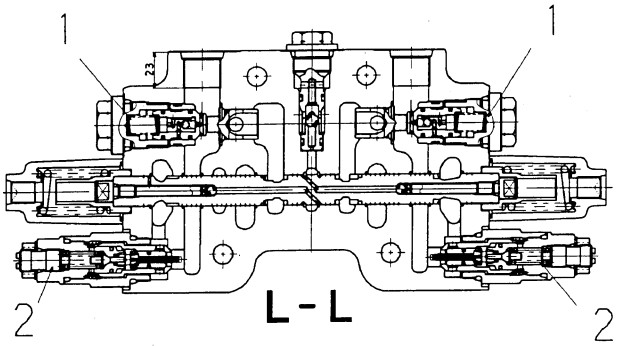
G - G



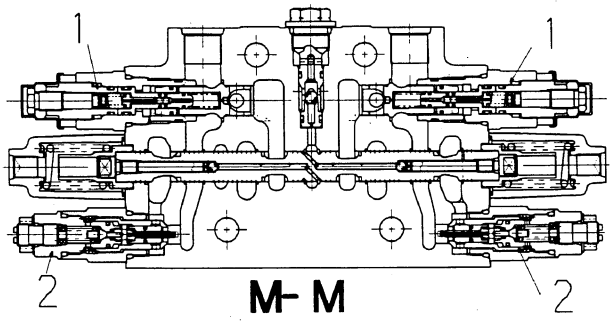
H - H



K - K



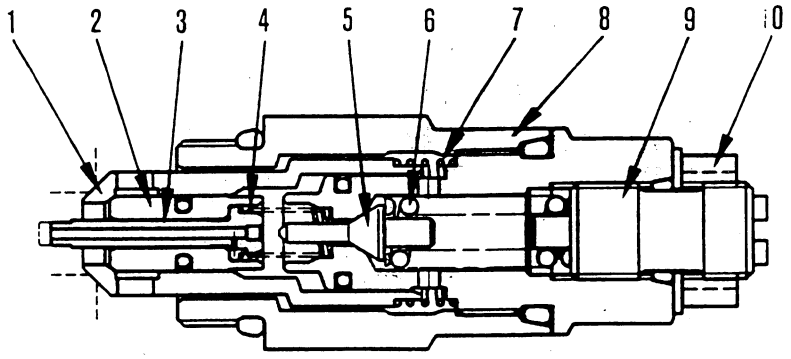
L - L



M - M

1. Pressure compensation valve
2. Safety-suction valve
5. Suction valve

SAFETY-SUCTION VALVE FOR SERVICE VALVE

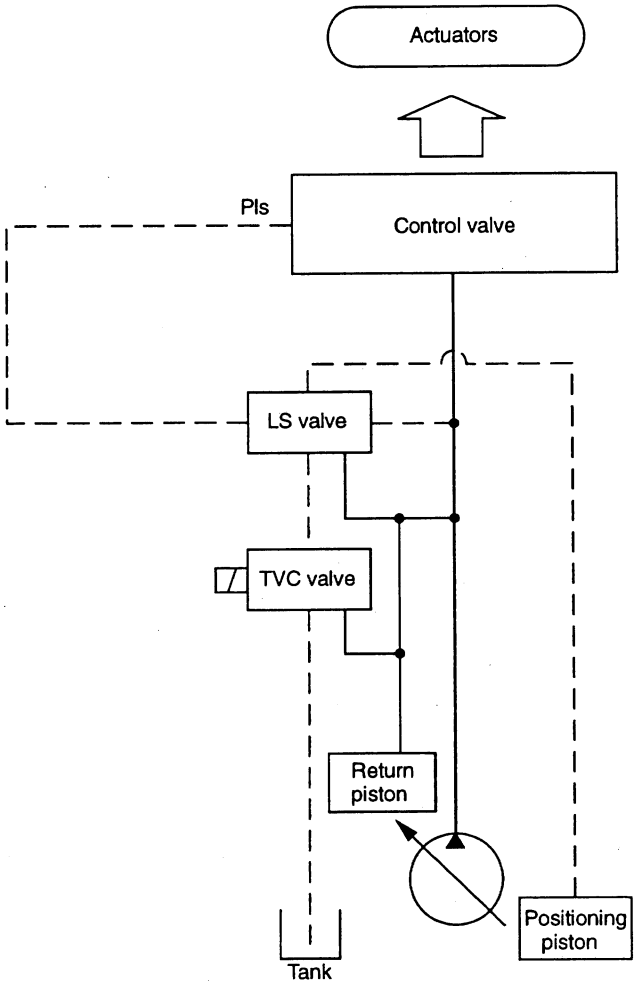


1. Suction valve
2. Main valve
3. Piston
4. Piston spring
5. Poppet
6. Poppet spring
7. Suction valve spring
8. Sleeve
9. Adjustment screw
10. Locknut

205F06038

Part No.	Set Pressure	Use
709-70-74600	24.5 MPa (250 kg/cm²) at 5ℓ/min	For crusher (Okada)

CLSS
OUTLINE OF CLSS



Features

- CLSS stands for **C**losed center **L**oad **S**ensing **S**ystem, and has the following features.

1) Fine control not influenced by load
2) Control enabling digging even with fine control
3) Ease of compound operation ensured by flow divider function using area of opening of spool during compound operations
   Energy saving using variable pump control

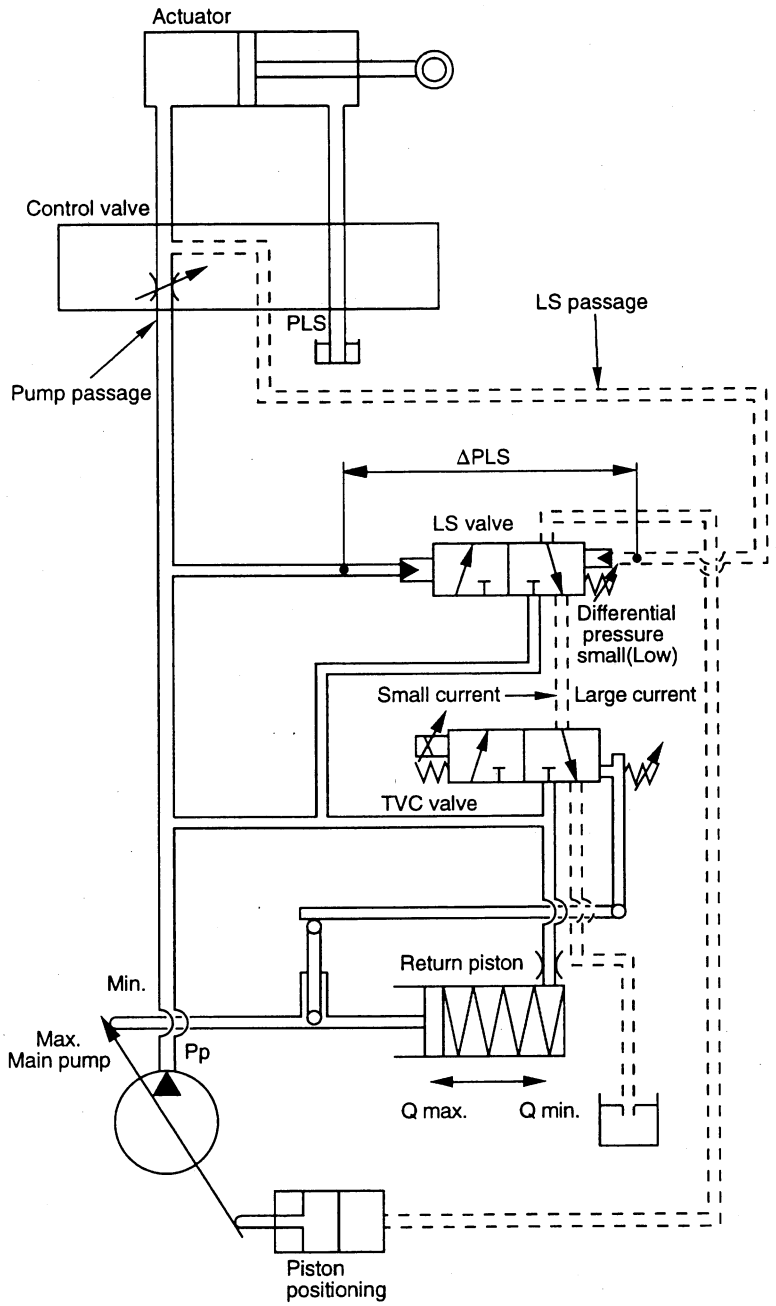
Structure

- The CLSS consists of a main pump (2 pumps), control valve, and actuators for the work equipment.
- The main pump body consists of the pump itself, the TVC valve and LS valve.

BASIC PRINCIPLE

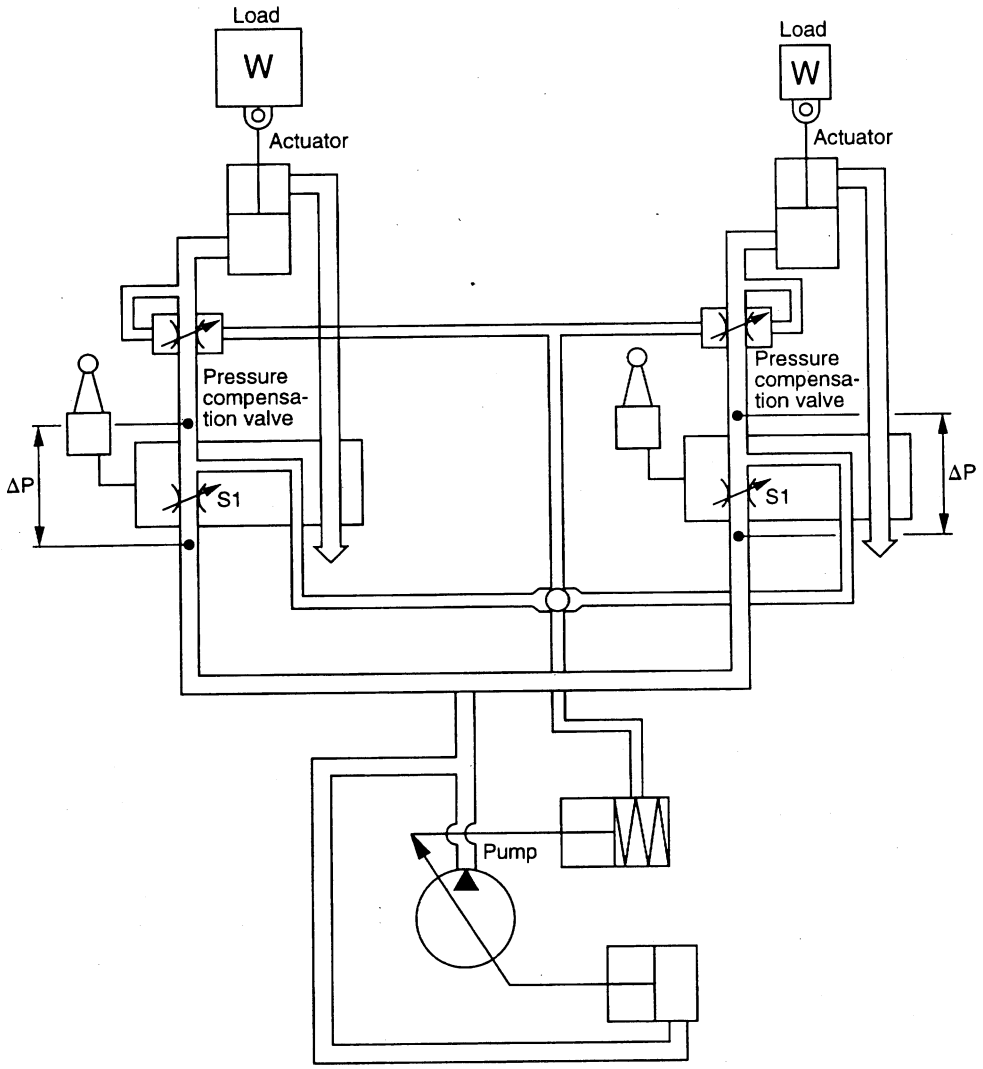
1) Control of pump swash plate angle

- The pump swash plate angle (pump discharge amount) is controlled so that LS differential pressure **ΔPLS** is constant. LS differential pressure **ΔPLS**, which is the differential pressure between pump discharge pressure **PP** and LS pressure **PLS** (actuator load pressure) at the outlet port of the control valve (LS differential pressure **ΔPLS** = Pump discharge pressure **PP** - LS pressure **PLS**)
- If LS differential pressure **ΔPLS** becomes lower than the set differential pressure of the LS valve, the pump swash plate angle becomes greater, and if it becomes higher, the pump swash plate angle becomes smaller.



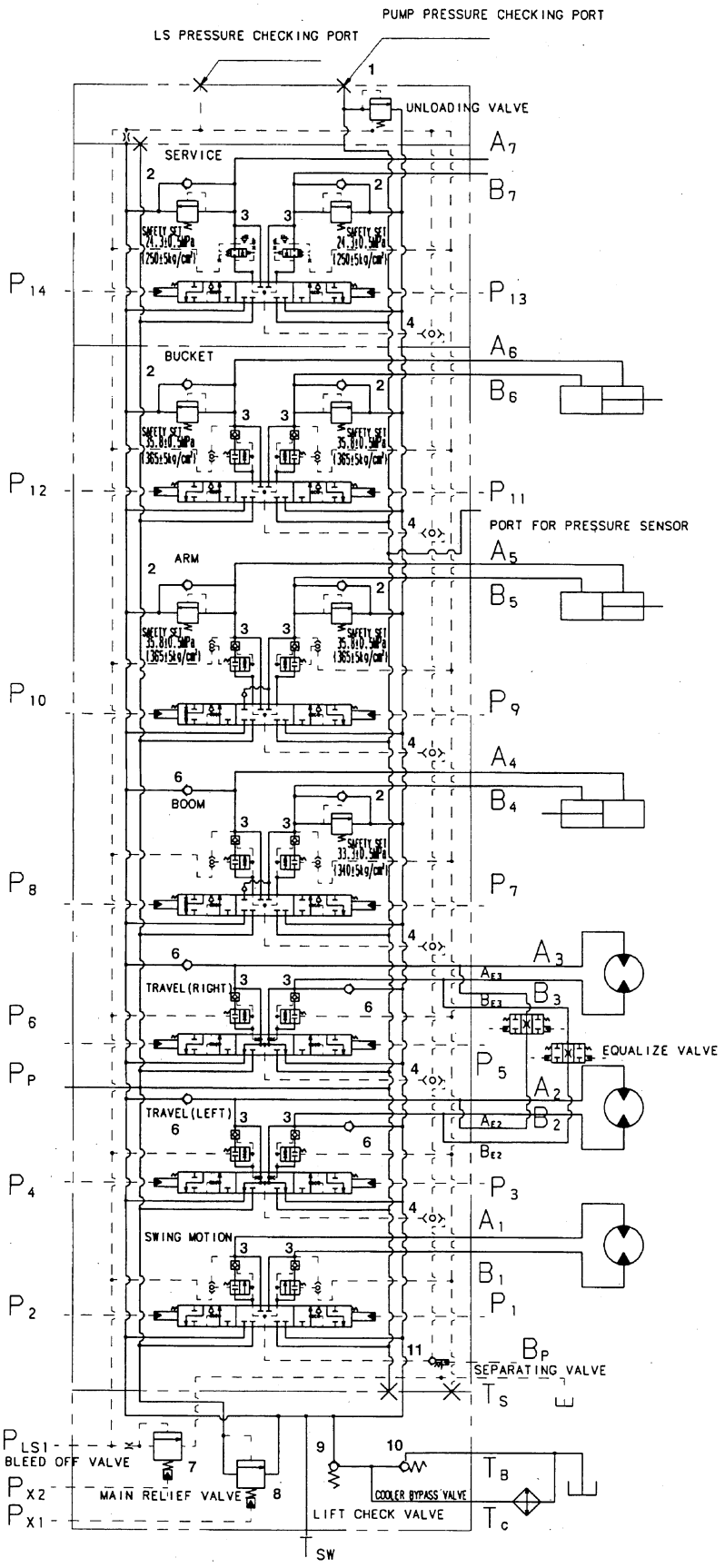
2) Pressure compensation control

- A valve (pressure compensation valve) is installed to the outlet port side of the control valve to balance the load.
  When there is compound operation of the actuators, this valve acts to make pressure difference **ΔP** constant for the upstream flow (inlet port) and downstream flow (outlet port) of the spool of each valve. In this way, the flow of oil from the pump is divided in proportion to area of opening **S1** and **S2** of each valve.



OPERATION FOR EACH FUNCTION OF CLSS

Hydraulic circuit diagram for system

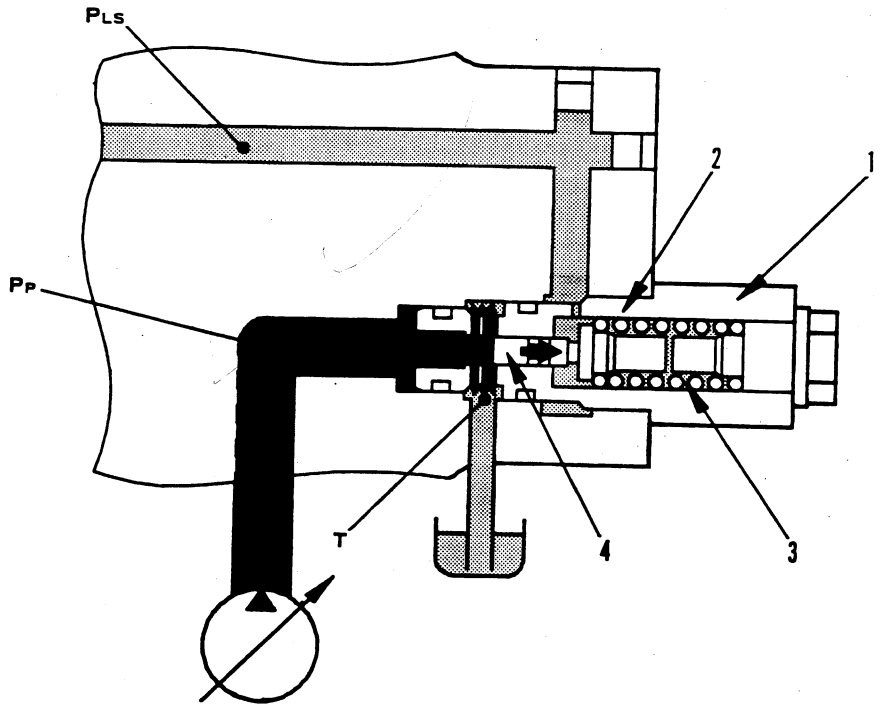


1. Unload valve
   (LS pressure + 3.92 MPa (40 kg/cm^2))
2. Safety-suction valve
   (35.77 MPa (365 kg/cm^2) - Arm, Bucket)
   (33.32 MPa (340 kg/cm^2) - Boom)
3. Pressure compensation valve
4. LS shuttle valve
5. Arm counterbalance valve
6. Suction valve
7. LS bypass valve
   (7.84MPa (80 kg/cm^2),
   when pressure rises:
   36.26MPa (370 kg/cm^2))
   (cracking pressure)
8. Main relief valve
   (normal: 31.85MPa (325 kg/cm^2),
   when pressure rises:
   34.79MPa (355 kg/cm^2))
9. Lift check valve
10. Bypass check valve
11. LS select valve

1) Unload valve

Function

1. When the control valve is at neutral, pump discharge amount **Q** discharged by the minimum swash plate angle is released to the tank circuit.
   When this happens, pump discharge pressure **Pp** is set at 3.92 MPa (40 kg/cm²) by spring (3) inside the valve. (LS pressure **PIs**: 0MPa (0 kg/cm²)



202F06063

Operation

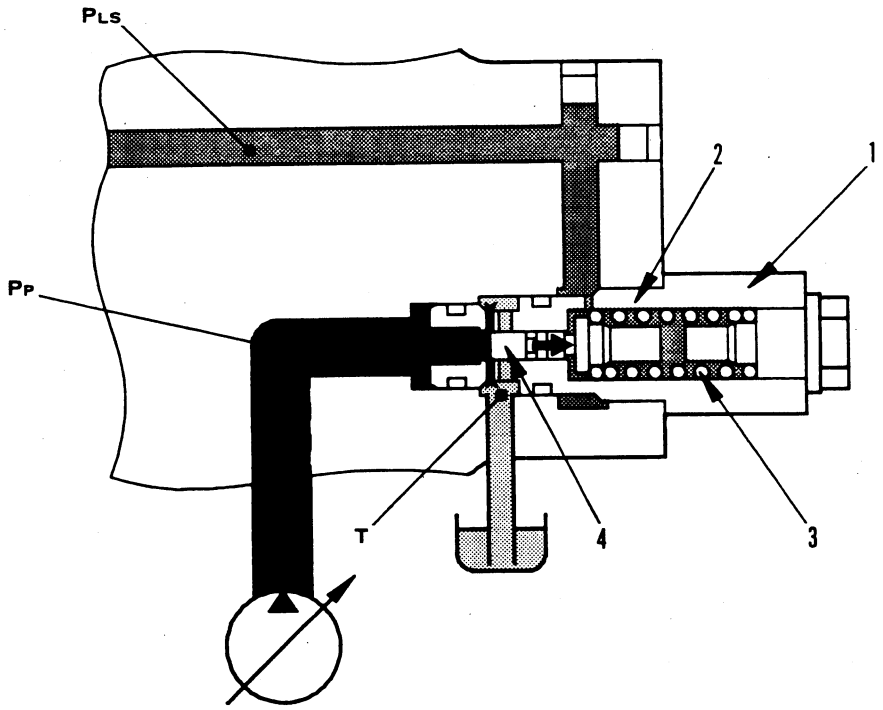
When control valve is at neutral

- Pump discharge pressure **Pp** is acting on the left end of spool (4), and LS pressure **PLS** is acting on the right end.
- When the control valve is at neutral, LS pressure **PLS** is 0, so only pump discharge pressure **Pp** has any effect, and **Pp** is set only by the load of spring (3).
- As pump discharge pressure **Pp** rises and reaches the load of spring (3) (3.92 MPa (40kg/cm²)), spool (4) is moved to the right in the direction of the arrow. Pump discharge pressure **Pp** then passes through the drill hole in sleeve (2) and is connected to tank circuit **T**.
- in this way, pump discharge pressure **Pp** is set to 3.92 MPa (40kg/cm²)

1. Unload valve
2. Sleeve
3. Spring
4. Spool

Pp: Pump circuit (pressure)
PLS: LS circuit (pressure)
T: Tank circuit (pressure)

2. During fine control of the control valve, when the demand flow for the actuator is within the amount discharged by the minimum swash plate angle of the pump, pump discharge pressure **Pp** is set to LS pressure **PLS** + 3.92MPa (40 kg/cm²).
   When the differential pressure between pump discharge pressure **Pp** and LS pressure **PLS** reaches the load of spring (3) 3.92MPa (40 kg/cm²)), the unload valve opens, so LS differential pressure **ΔPLS** becomes 3,92 MPa (40 kg/cm²)).



202F06064

Operation

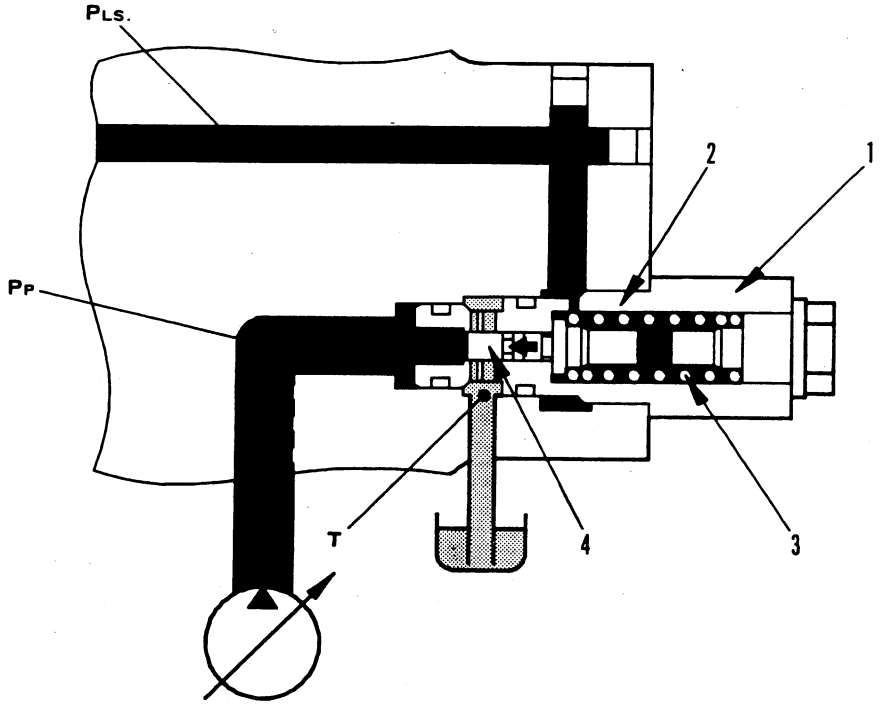
Fine control of control valve

- When fine control is carried out on the control valve, LS pressure **PLS** is generated and acts on the right end of spool (4).
  When this happens, the area of the opening of the control valve spool is small, so there is a big difference between LS pressure **PLS** and pump discharge pressure **Pp**.
- When the differential pressure between pump discharge pressure **Pp** and LS pressure **PLS** reaches the load of spring (3) 3.92 MPa (40 kg/cm²)), spool (4) moves to the right in the direction of the arrow, and pump circuit **Pp** and tank circuit **T** are connected.
- In other words, pump discharge pressure **Pp** is set to a pressure equal to the spring force 3.92 MPa (40 kg/cm²)) + LS pressure **PLS**, and LS differential pressure **PLS** becomes 3.92 MPa (40 kg/cm²)).

1. Unload valve
2. Sleeve
3. Spring
4. Spool

Pp: Pump circuit (pressure)
PLS: LS circuit (pressure)
T: Tank circuit (pressure)

3. When the control valve is being operated and the demand flow for the actuator becomes greater than the pump discharge from the minimum swash plate angle, the flow of the oil out to tank circuit **T** is cut off, and al of pump discharge **Q** flows to the actuator circuit.



202F06065

Operation

Control valve operated

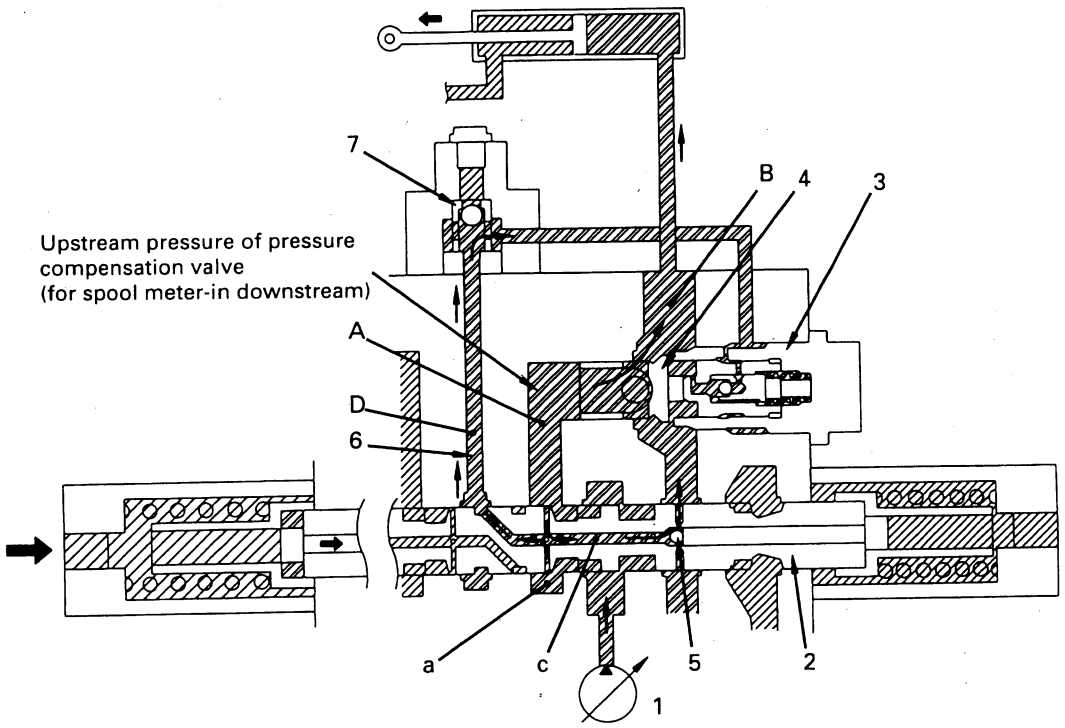
- When the control valve is operated to a bigger stroke, Ls pressure **PLS** is generated and acts on the right end of spool (4). When this happens, the area of the opening of the control valve spool is large, so the difference between LS pressure **PLS** and pump discharge pressure **Pp** is small.
- For this reason, the differential pressure between pump discharge pressure **Pp** and LS pressure **PLS** does not reach the load of spring (3) (3.92 MPa (40 kg/cm²)), so spool (4) is pushed to the left by spring (3).
- As a result, pump circuit **Pp** and tank circuit **T** are shut off, and all the pump discharge amount **Q** flows to the actuator circuit.

1. Unload valve
2. Sleeve
3. Spring
4. Spool

Pp: Pump circuit (pressure)
PLS: Ls circuit (pressure)
T: Tank circuit (pressure)

3. Introduction of LS pressure

★ The diagram shows the condition for arm IN.



SLP00210

1. Main pump
2. Main spool
3. Pressure compensation valve
4. Valve
5. Ball valve
6. LS circuit
7. LS shuttle valve

Function

- The upstream pressure (= spool meter-in downstream pressure) of pressure compensation valve (3) is introduced and goes to shuttle valve (7) as the **LS** pressure. When this happens, it is connected to port **B** of the actuator through valve (4), and LS pressure = actuator load pressure. Introduction hole **a** inside the spool has a small diameter, so it also acts as a throttle.

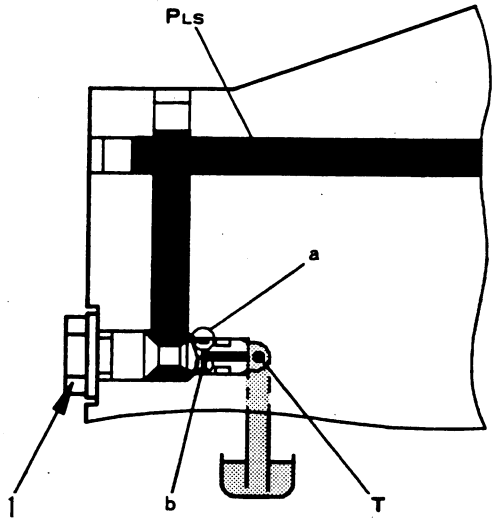
Operation

- When spool (2) is operated, the pump pressure passes through introduction hole a, enters port , and is taken to the LS circuit. When the pump pressure rises and reaches the load pressure of port **B**, ball valve (5) opens.

3) LS bypass plug

Outline

1. This releases the residual pressure of LS pressure **PLS**.
2. This makes the speed of the rise in pressure of LS pressure **PLS** more gentle.
   In addition, with this discarded throttled flow, it creates a pressure loss in the throttled amount of the spool or shuttle valve, and increases the stability by lowering the effective LS differential pressure.



202F06067

Operation

- The pressurized oil for LS circuit **PLS** passes from clearance filter **a** (formed by the clearance between LS bypass plug (1) and the valve body) through orifice **b** and flows to the tank circuit.

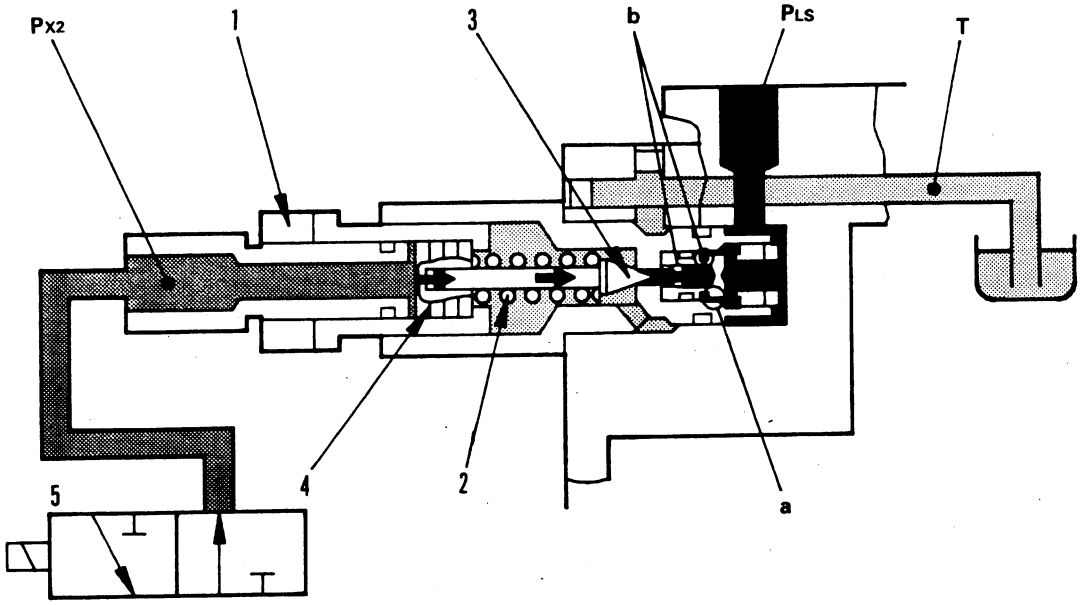
1. LS bypass plug

PLS: LS circuit (pressure)
T: Tank circuit (pressure)

4) LS bypass valve

Function

- When the travel and another actuator are operated at the same time, the LS throttle amount that is discarded is increased and the drop in the travel speed is kept small by relaxing the pressure compensation precision in the travel circuit.
- During normal operations, the pilot pressure (3.23 MPa (33 kg/cm^2)) acts on pilot circuit **Px2** from the LS bypass solenoid valve, but when the travel + another are operated at the same time, the pilot pressure does not have any effect.



F20206001

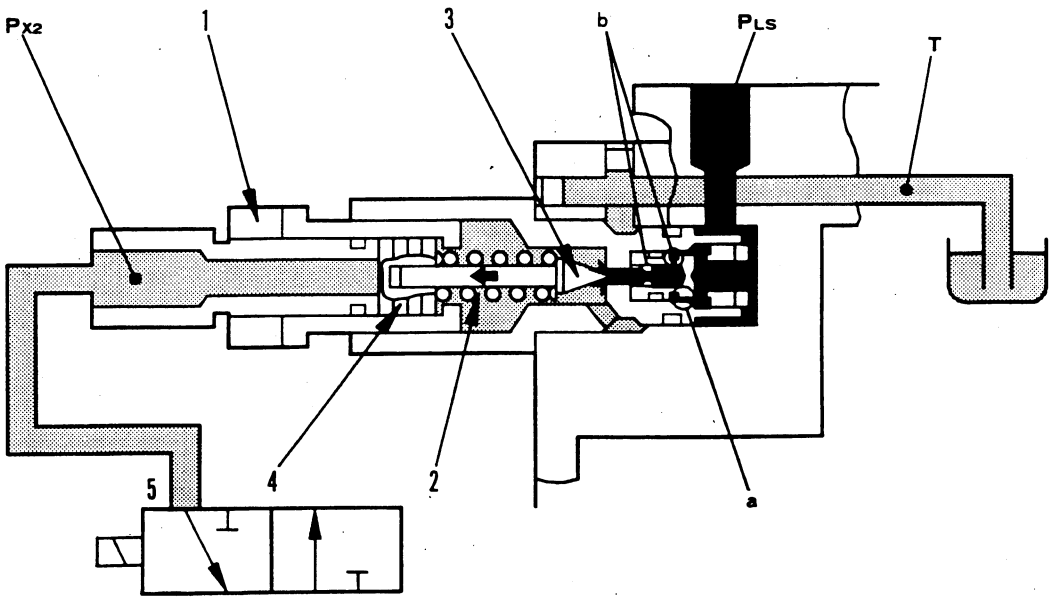
Operation

Normal operation

- LS pressure **PLS** passes through clearance filter **a** and two-stage throttle **b**, and acts on poppet (3).
- Poppet (3) is being pushed to the right in the direction of the arrow by the load of spring (2).
- In addition, during normal operation, the pressure form the LS bypass solenoid valve acts on pilot circuit **Px2**, and pushes piston (4) to the right in the direction of the arrow.
- In other words, poppet (3) is pushed to the right in the direction of the arrow by the load of spring (2) (which is set by piston (4)), so it normally does not open, and LS circuit **PLS** and tank circuit **T** are not interconnected.

1. LS bypass valve
2. Spring
3. Poppet
4. Piston
5. LS bypass solenoid valve

PLS: LS pressure
Px2: LS bypass pilot pressure
T: Tank pressure



202F06069

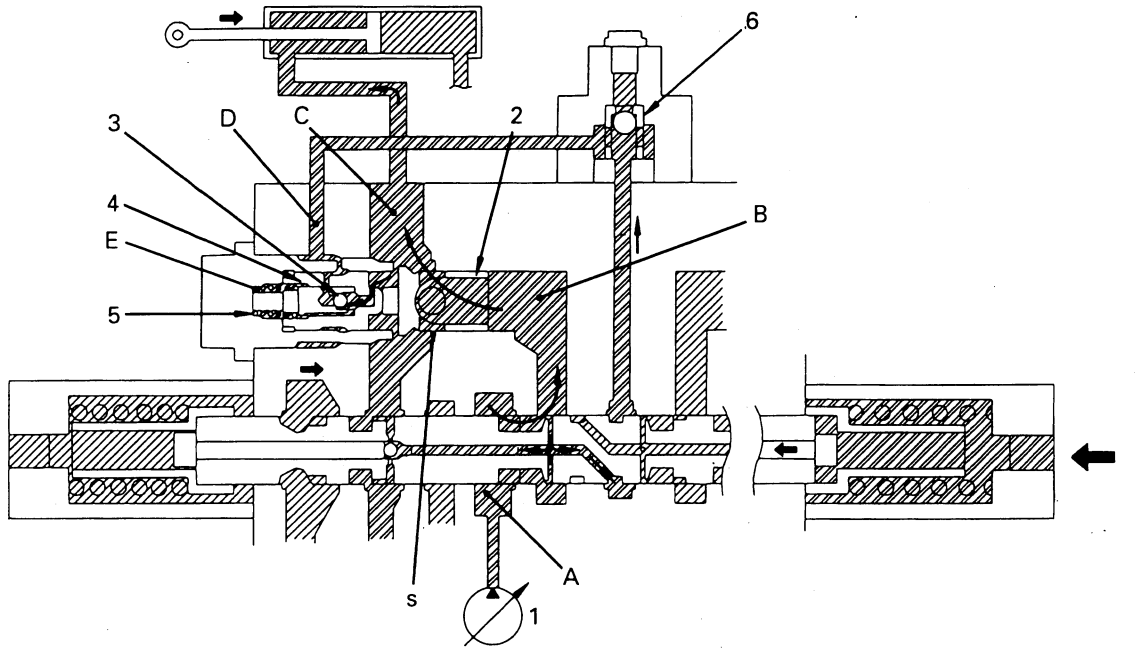
When travel and another actuator are operated together

- With the operation described above, the pilot pressure form the LS bypass solenoid valve does not act on pilot circuit **Px2**.
- For this reason, poppet (3) is pushed to the right in the direction of the arrow by the load of spring (2) (piston (4) is not acting on spring (2)).
- In this condition, if LS pressure Pls rises and reaches the load of spring (2) (7.84 MPa (approx. 80 kg/cm^2)), poppet (3) opens, LS circuit **PLS** and tank circuit **T** are interconnected, and LS pressure Pls flows out.

1. LS bypass valve
2. Spring
3. Poppet
4. Piston
5. LS bypass solenoid valve

PLS: LS pressure
Pxz: LS bypass pilot pressure
T: Tank pressure

5. Pressure compensation valve



SLP00212

1. Main pump
2. Valve
3. Shuttle valve
4. Piston
5. Spring
6. LS shuttle valve

Fuction

1) During independent operation and at maximum load pressure (during compound operations, when load pressure is highter than other work equipment)

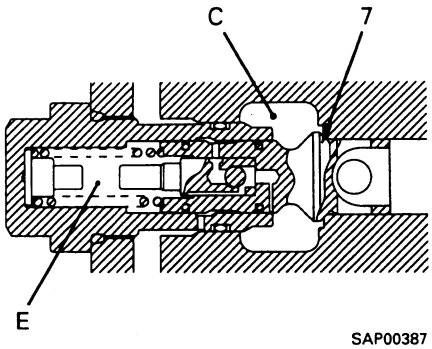
- The pressure compensation valve acts as a load check valve.

Operations

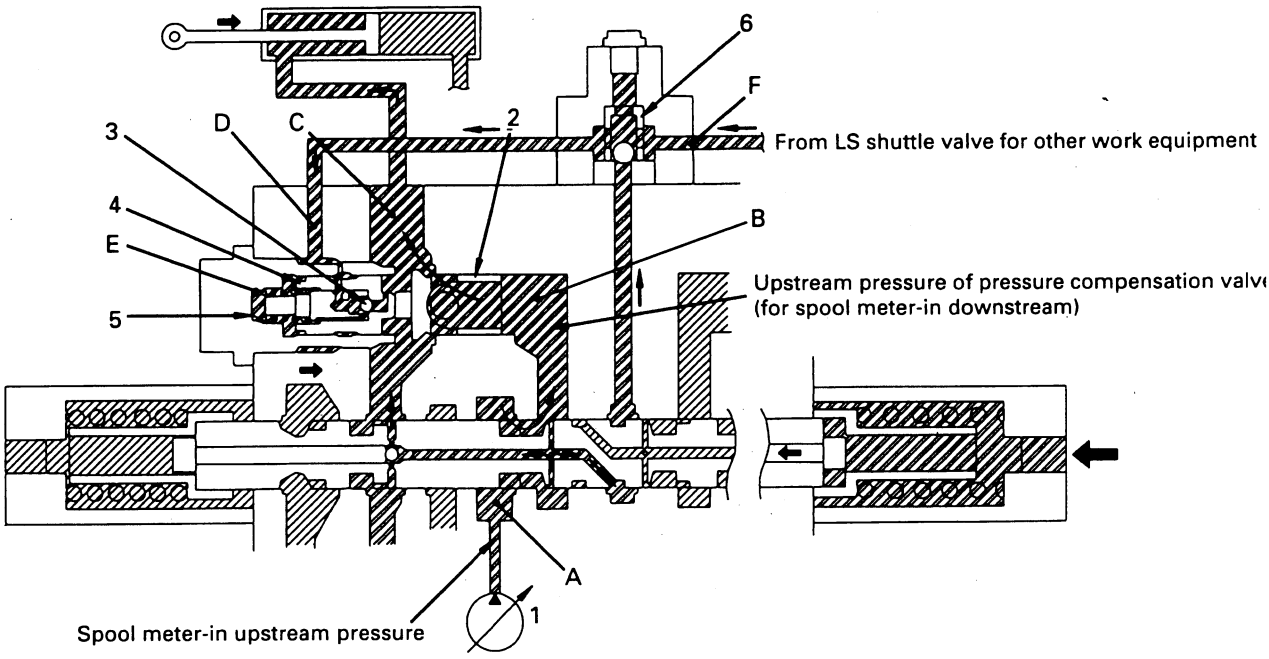
- If the pump pressure (LS pressure) is lower than the load pressure at port **C**, shuttle valve (3) inside pressure compensation valve piston (4) moves to interconnect spring chamber **E** and port **C**.
  From this condition, the force of spring (5) acts to move piston (4) and valve (2) in the direction of closing.

Reference: Intergrated pressure compensation valve

- When high peak pressure is generated in the actuator circuit or when peak pressure is generated repeatedly over a continuous period (such as when using a breaker), valve (2) may hit vavle chamber seat **s** and generate a high stress. To prevent this, an integrated pressure compensation valve combining valve (2) and piston (4) is used. On this machine, this is employed for the bucket valve (at the cylinder bottom) and service valve.
  With the integrated compensation valve, as a basic rule, port **C** and spring chamber **E** are not interconnected, so even if a high peak pressure is generated at port **C**, valve(7) does not hit the valve chamber.
  (However, the system is designed so that port **C** and spring chamber **E** are interconnected just before the bucket valve is seated.)



SAP00387



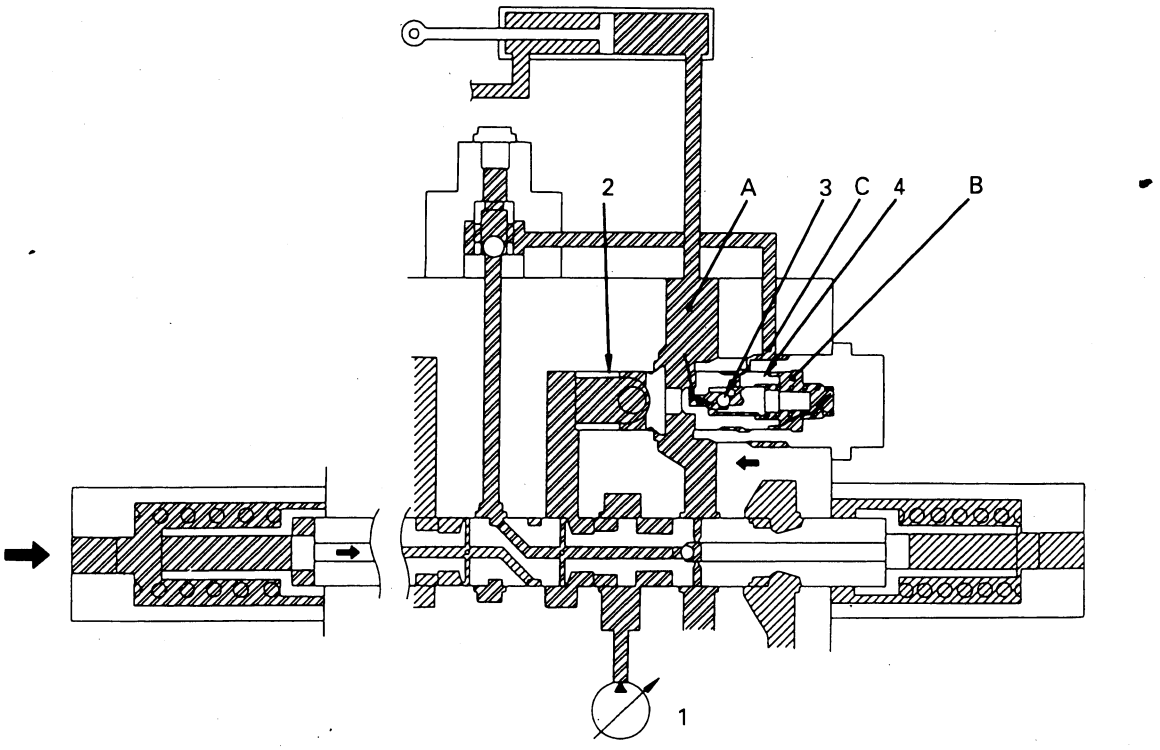
2) When receiving compensation (during compound operations, when load pressure is lower than other work equipment)

- The pressure compensation valve is closed by the LS pressure of port **D**, and the spool meter-in downstream pressure of port **B** becomes the same as the maximum pressure of the other work equipment. The spool meter-in upstream pressure of port **A** is the pump pressure, so spool meter-in differential pressure (upstream pressure (pressure of port **A**) - downstream pressure (pressure of port **B**)) becomes the same for all spools that are being operated. In this way, the pump flow is divided in proportion to the area of the meter-in opening.

Operation

- Spring chamber **E** is interconnected with port **D**. Piston (4) and valve (2) are actuated by the LS circuit pressure from the other work equipment at port **F** in the direction of closing (to the right). In other words, the valve upstream pressure of port **B** (= spool mentering downstream pressure) is controlled by the **LS** pressure.

6. Shuttle valve inside pressure compensation valve



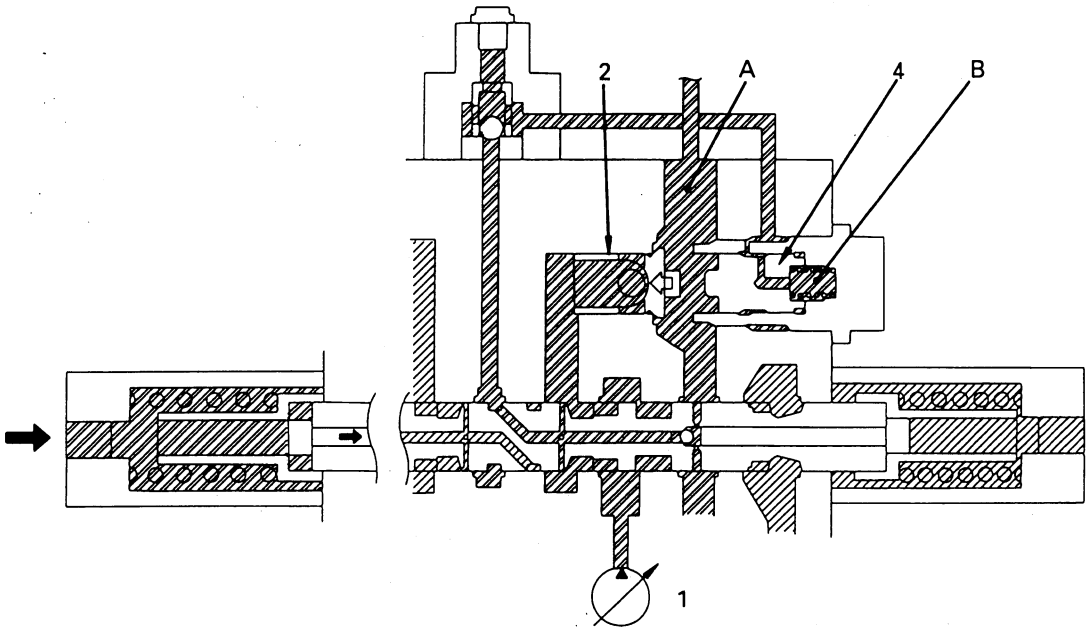
SLP00214

1. Main pump
2. Valve
3. Shuttle valve inside pressure compensation valve
4. Piston

Function

When holding pressure at port A > LS pressure in spring chamber B.

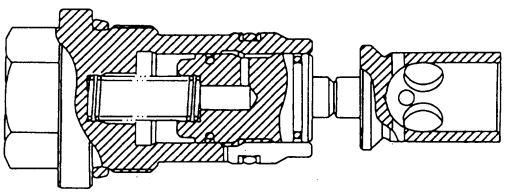
- Shuttle valve (3) is pushed to the right by the pressure of port **A**, and the circuit between ports **A** and **C** is shut off. In this condition, the holding pressure at port **A** is taken to spring chamber **B**, and pushes piston (4) to the left to prevent piston (4) and valve (2) from seperating.



SLP00215

<For travel>

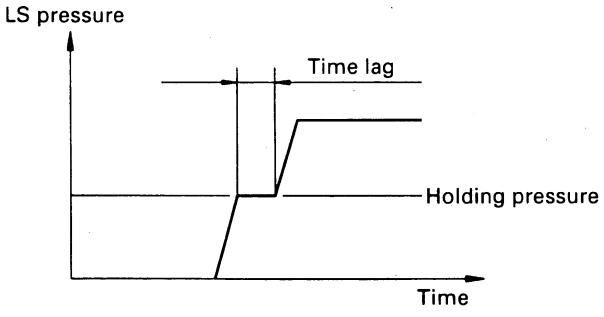
- No holding pressure is generated at port **A** in the travel circuit, so a pressure compensation valve without a shuttle valve is used.



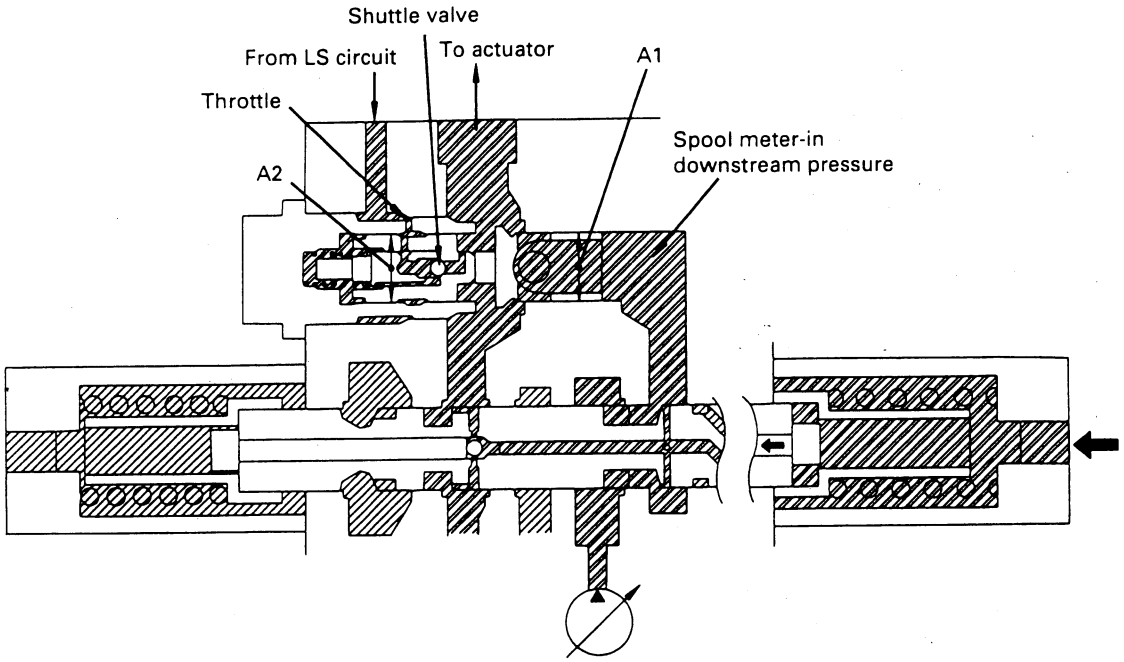
SBP00216

Reference: When there is no shuttle valve

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



SAP00217



SLP00218

<Area ratio of pressure compensation valve>
The condition of the flow division changes according to the ratio of the areas of portion **A1** and portion **A2** of the pressure compensation valve.
Area ratio = **A2/A1**

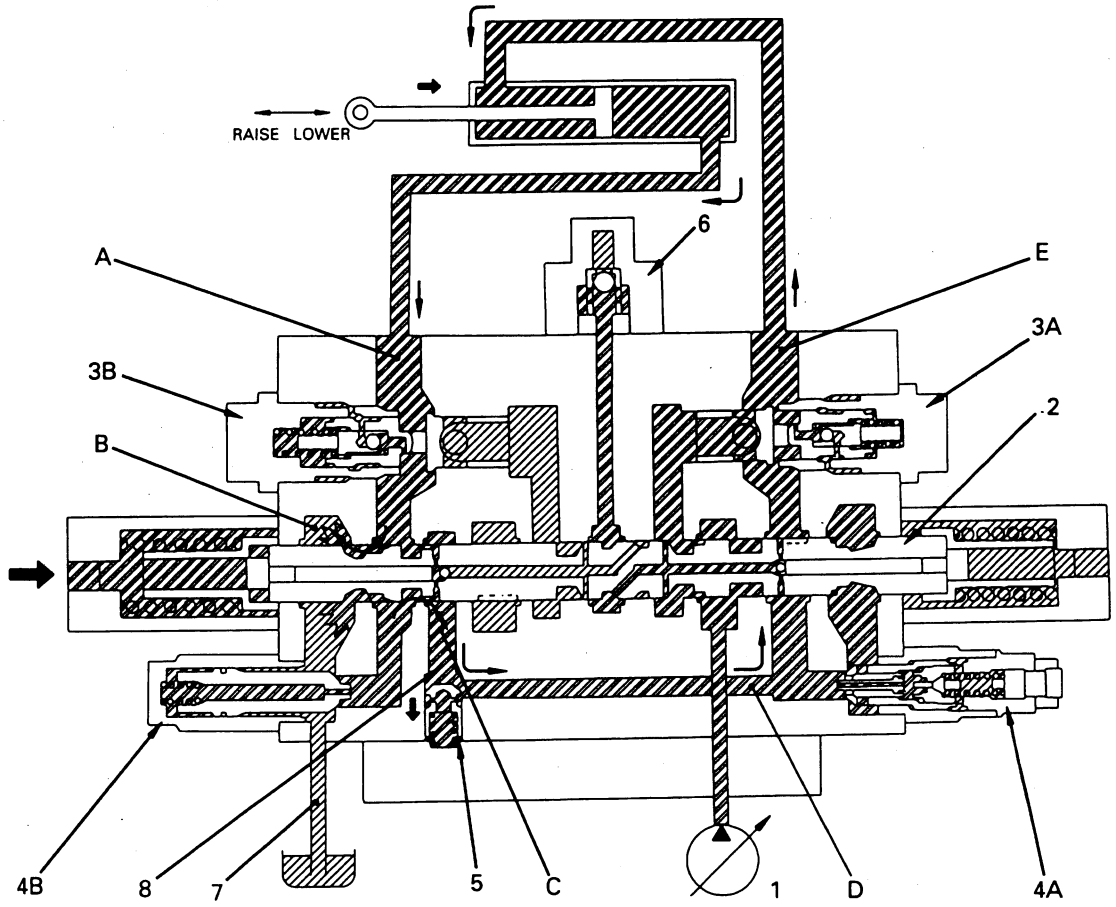
- When area ratio = 1: Spool meter- in downstream pressure = Max. load pressure, and oil flow is divided in proportion to area of opening of spool.
- When ratio is more than 1: Spool meter-in downstream pressure > Max. load pressure, and a smaller oil flow is divided than the proportion between the areas of opening of the spool.
- When ratio is less than 1: Spool meter-in downstream pressure < Max. load pressure, and a larger oil flow is divided than the proportion between the areas of opening of the spool.

Area ratio for each part of work equipment

	Port A		Port B	
	Area ratio	Throttle diameter (mm)	Area ratio	Throttle diameter (mm)
Bucket	1.0 (CURL)	-	1.0 (DUMP)	-
L.H./ R.H. travel	1.01	0.6 No Shuttle valve	1.01	0.6 NO SHUTTLE VALVE
Boom	0.96 (RAISE)	-	1.0 (LOWER)	-
Swing	0.98	0.6	0.98	0.6
Arm	0.96 (OUT)	-	1.0 (IN)	-
Service (for 2 -spool valve)				
Service (for 1-spool valve)	Vaiable	-	Variable	-

★ Integrated pressure compensation valve

7. Boom regeneration circuit



SLP00220

1. Main pump
2. Main spool
3A. Pressure compensation valve
3B. Pressure compensation valve
4A. Suction valve (with safety)
4B. Suction valve
5. Check valve
6. LS shuttle valve
7. Drain circuit
8. Regeneration circuit

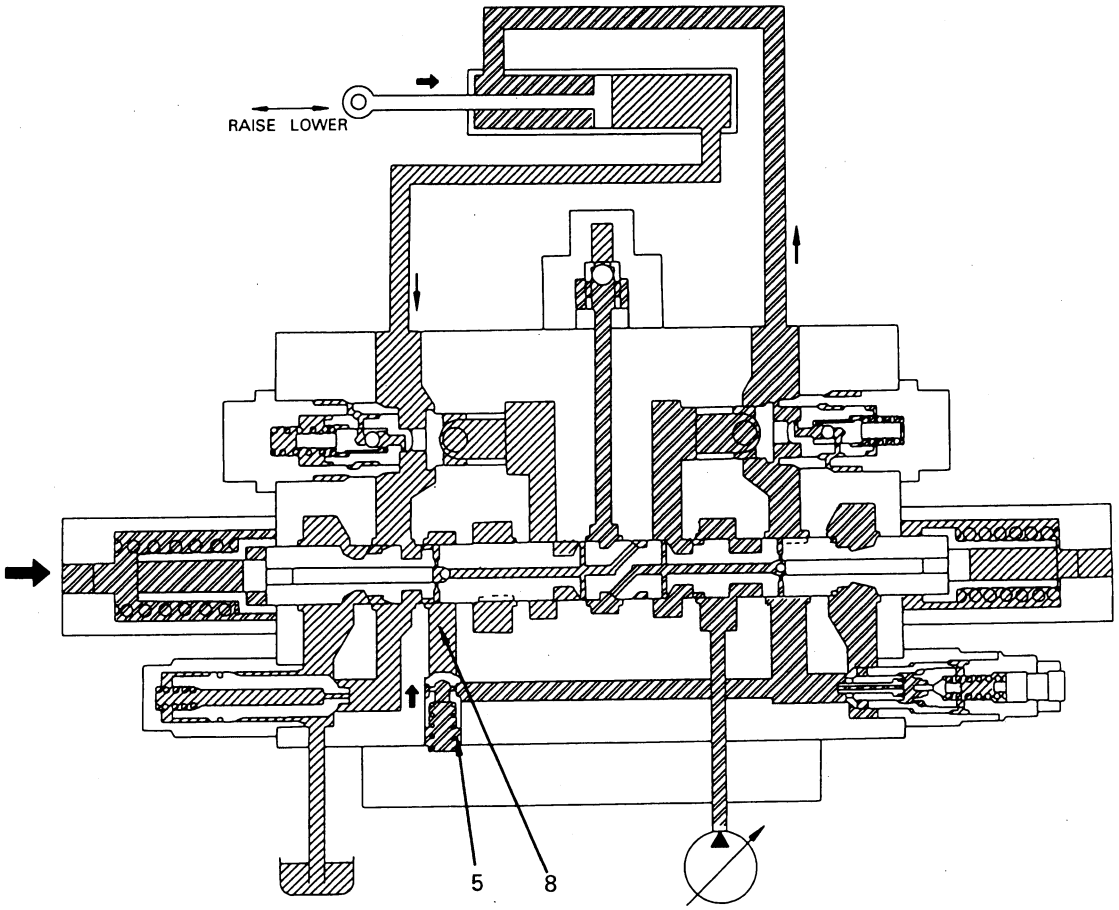
Function

1) Cylinder head pressure < cylinder bottom pressure (free fall, etc.)

- A return flow circuit is provided from the cylinder bottom to the cylinder head so that when the boom is lowered, the return flow can be used to increase the flow of oil from the pump to the cylinder bottom.

Operation

- When the cylinder head pressure < cylinder bottom pressure, part of the pressurized oil from the cylinder bottom passes through the notch in spool (2), goes through port **B**, and enters drain circuit (7). The rest of the oil goes from port **C**, enters regeneration circuit (8), opens check valve (5), and passes through ports **C** and **D** to flow back to the cylinder head.

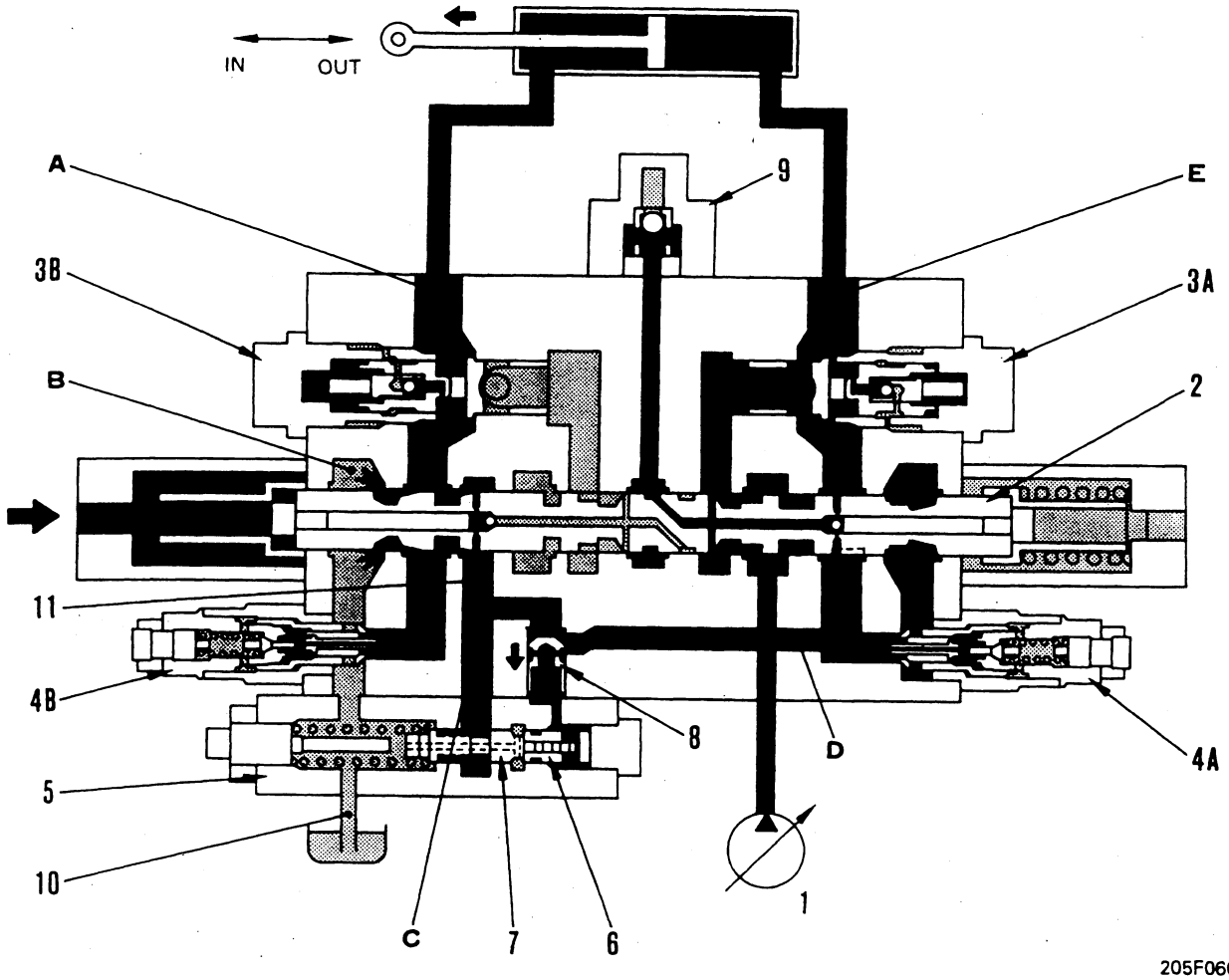


S LP00221

2) Cylinder head pressure > Cylinder bottom pressure (digging operations, etc.)

- Check valve (5) in regeneration circuit (8) acts to shut off the flow from the cylinder head to the cylinder bottom.

8. Arm regeneration circuit



1. Main pump
2. Main spool
3A. Pressure compensation valve
3B. Pressure compensation valve
4A. Safety valve
4B. Safety valve
5. Arm counterbalance valve
6. Piston
7. Spool
8. Check valve
9. LS shuttle valve
10. Drain circuit
11. Regeneration circuit

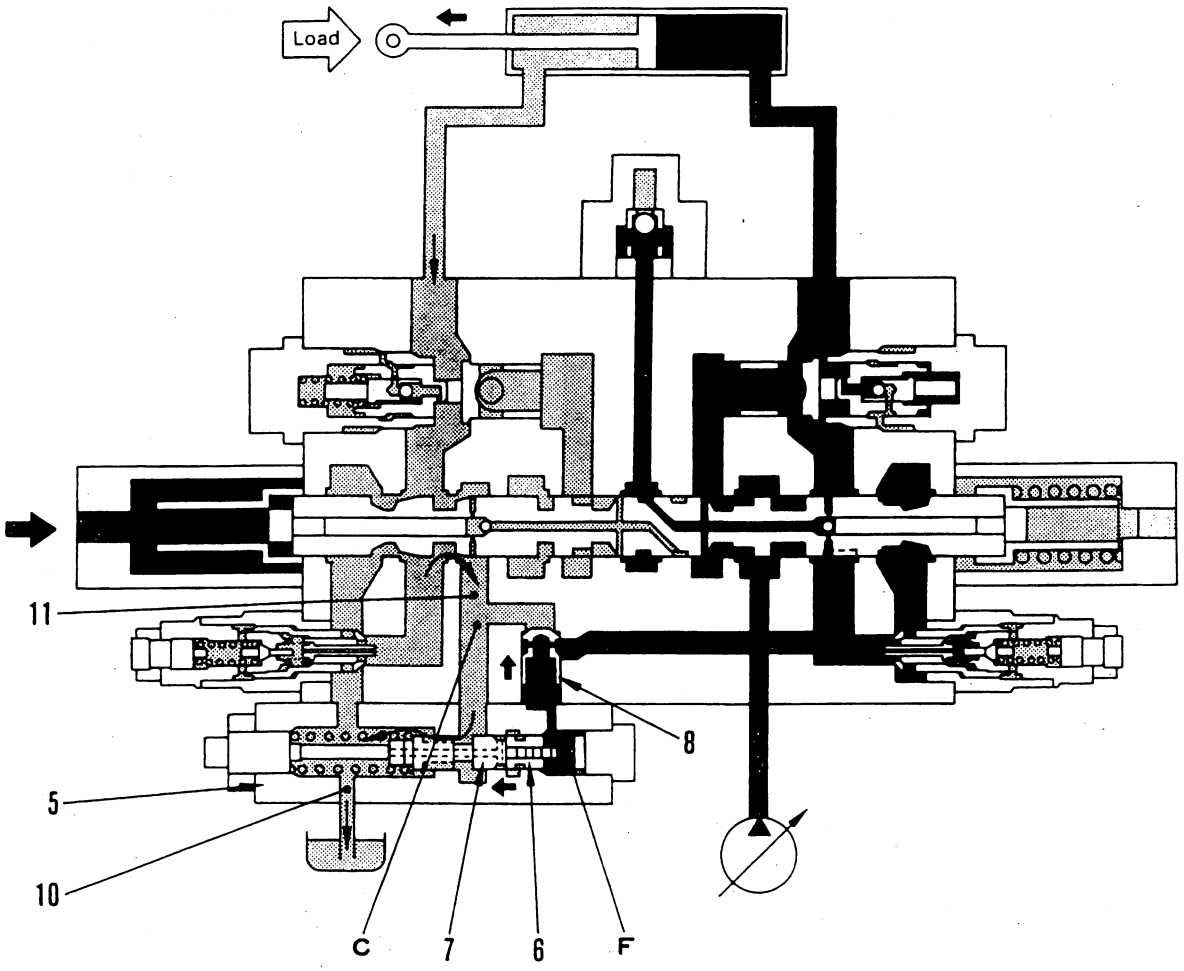
Function

1) **Cylinder head pressure > cylinder bottom pressure**

- A return flow circuit is provided from the cylinder head to the cylinder bottom so that when the arm is moved in, the flow of oil to the cylinder becomes the pump discharge amount + the return flow, and this increases the cylinder speed.

Operation

- When the cylinder head pressure > cylinder bottom pressure, the pressurized oil from the cylinder head passes through the notch in spool (2), enters port **C** and opens check valve (8), then passes through ports **D** and **E** to flow back to the cylinder bottom.



205F06061

2) When load is large

- During arm IN operations, if the load increases and the cylinder bottom pressure exceeds 16.6 MPa (170 kg/ cm^2), counterbalance valve (5) is actuated to increase the meter-out opening at the cylinder head. This reduces the pressure loss between the cylinder head and the hydraulic tank, and ensures the digging force.

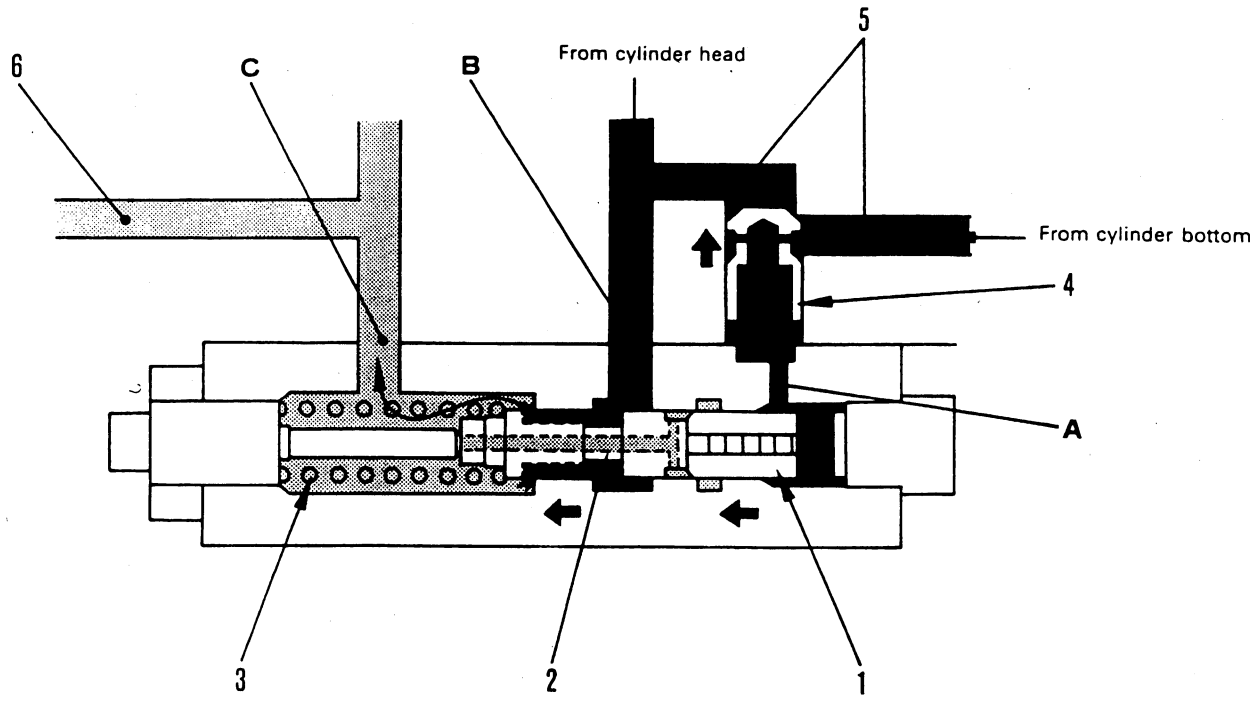
Operation

- The cylinder bottom pressure enters port **F** and pushes piston (6) to the left. Spool (7) moves fully to the left and interconnects port **C** of regeneration circuit (11) and tank drain circuit (10). As a result, the pressure loss in the drain circuit is reduced.

3) Cylinder bottom pressure > Cylinder head pressure

- When the cylinder bottom pressure > cylinder head pressure, check valve (8) is closed by the cylinder bottom pressure and prevents any oil flowing back from the cylinder bottom to the head end.

9. Arm counterbalance valve



205F06062

1. Piston
2. Spool
3. Spring
4. Check valve
5. Regeneration circuit
6. Tank drain circuit

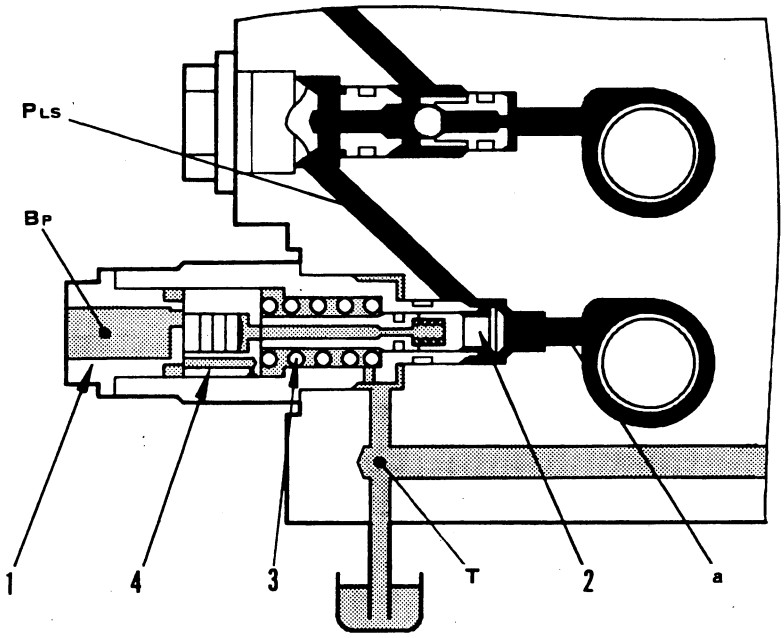
Operation

- During arm IN operations, if the actuating pressure at the arm cylinder bottom rises, the pressure at port **A** also rises. When the force received by piston (1) from the pressure at port **A** becomes greater than the force of spring (3), piston (1) moves to the left.
- Spool (2) is pushed by piston (1) and also moves to the left, so ports **B** and **C** are interconnected. When this happens, the pressurized oil from the cylinder head passes through ports **B** and **C**, and flows directly to drain circuit (6). (The pressure loss is removed when draining.)
- When this happens, check valve (4) is closed by the pressure at port **A**, so it shuts off regeneration circuit (5), and prevens the oil from flowing back from the cylinder bottom to the head end.

10) LS select valve

Function

- When the swing + boom RAISE, or swing + travel are operated together, this valve prevents the high pressure which is generated when driving the swing, and prevents swing LS pressure **a** from flowing into LS circuit **PLS**.



202F06081

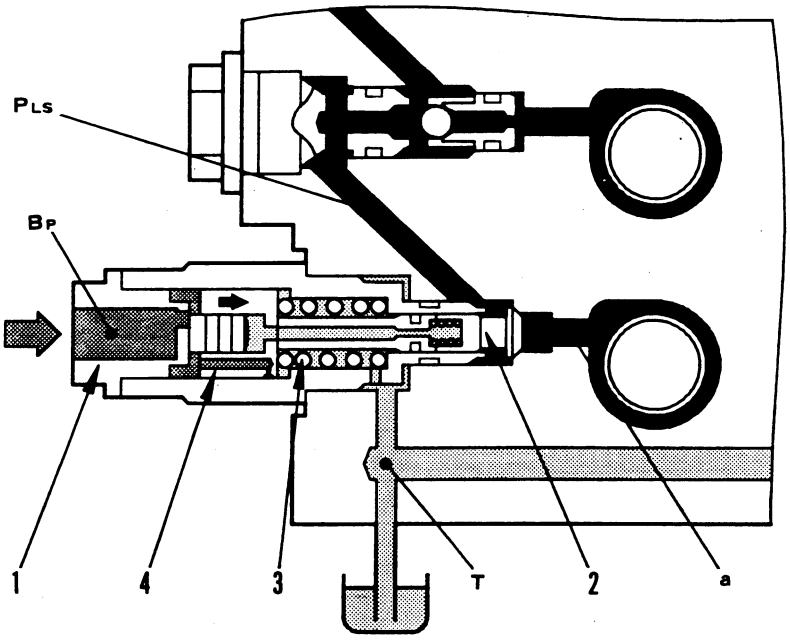
Operation

Normal operation

- Normally, when the swing is operated alone, or when it is operated together with any other movement except boom RAISE or the travel, the pilot pressure does not act on pilot port **Bp**.
- In this condition, swing LS pressure pushes valve (2) open, and flows to LS circuit **PLS**.

1. LS select valve
2. Valve
3. Spring
4. Piston

a: Swing LS circuit (pressure)
PLS: LS circuit (pressure)
Bp: PPC pilot circuit (pressure)
T: Tank circuit (pressure)



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Swing + boom RAISE, or swing + travel operated together

- When the swing + boom RAISE, or swing + travel are operated, the pilot pressure from the PPC shuttle valve flows into pilot port **Bp**.
- When pilot pressure **Bp** becomes stronger than spring (3), piston (4) is pushed to the right in the direction of the arrow, valve (2) closes, and swing LS pressure **a** does not flow into LS circuit **PLS**.
- The size of pilot pressure **Bp** is determined by the amount the control lever is operated.

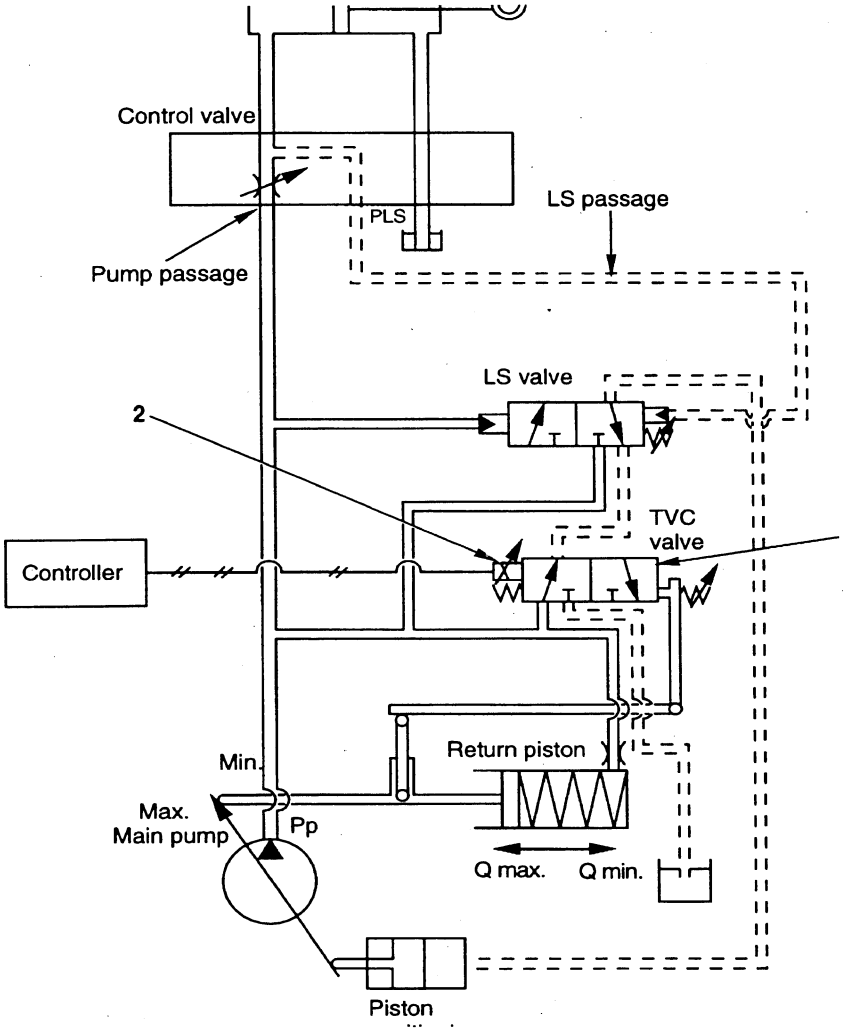
1. LS select valve
2. Valve
3. Spring
4. Piston

a: Swing LS circuit (pressure)
PLS: LS circuit (pressure)
Bp: PPC pilot circuit (pressure)
T: Tank circuit (pressure)

11) Cut-off function

Function

- This function uses the TVC valve, pump controller, and pump pressure sensor, and if pump discharge pressure **Pp** exceeds the set pressure, it makes pump discharge amount **Q** the minimum.



A: Cut off
B: Cut off cancel

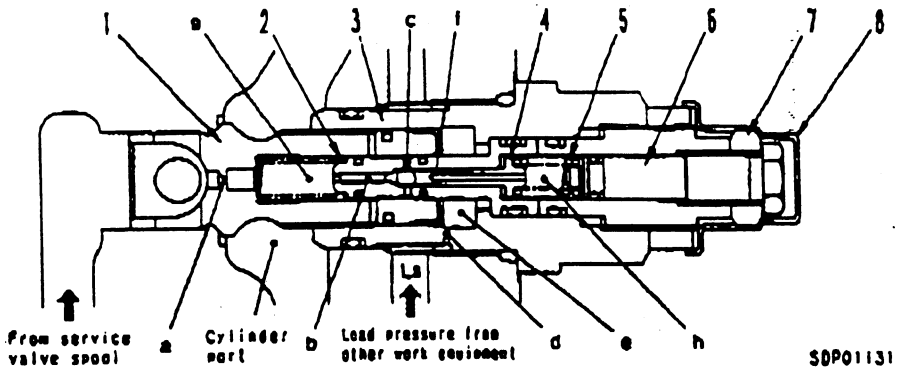
	Swing lock switch		
	On (Brake on)	Off (Brake off)	
			Power max or speed down + knob s/w on
HO	B	B	B
GO	B	A	B
FO	B	A	A
BO	B	A	A
LO	B	B	B
Travel	B	B	B

Operation

- If the pump pressure sensor detects that the pump discharge pressure **Pp** has gone above the set pressure, it sends this information to the pump controller.
- When the pump controller receives this signal, it increases the signal current to TVC valve (1), and makes the pump discharge amount (swash plate angle) **Q** the minimum.

1. TVC valve
2. Solenoid

6B. 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

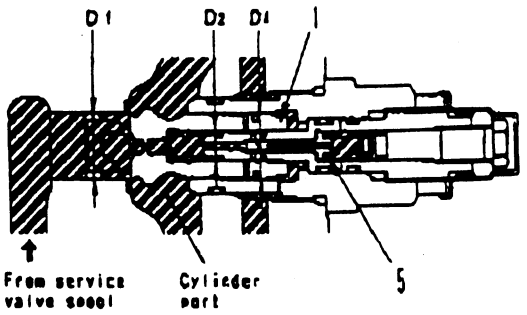
Function

- 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.).
  (Variabel in proportion to surface area)
- The pump preessure 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 sametime, the cylinder port pressue passes through passage **c** and throttle **f**, and goes to chamber **h**.
  In additon, the force of spring (2) acts on valve (1), and the force of spring (5) acts on poppet (4). The force of spring (5) can be adjusted with screw (6).

Operation

Simultaneous operation with work equipment under heavy load (boom RAISE, etc.)

1. The pump pressure and LS pressure are determined by the pressure of the other work equipment, but the cylinder port pressure becomes the actuating pressure of the attachment.
   When the difference between the pump pressure and the cylinder pressure is less than the force of spring (5), the balance of the force acting on valve (1) is as follows.
   Px A: = P x A + LS (A2 - A1) + F
   A1: Cross-sectional area of diameter D1
   A2: Cross-sectional area of diameter D2
   F : Force of spring



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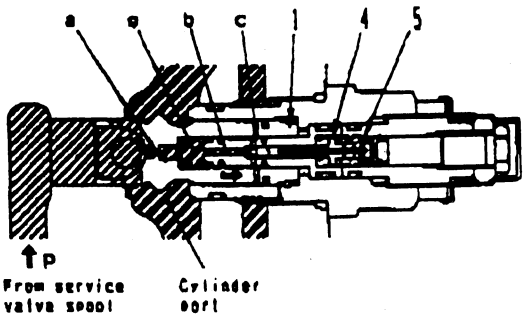
2. If the difference between pump pressure P and the cylinder pressure becomes greater than the force of spring (5), poppet (4) is pushed to the right and the passage opens, so the pump passage is connected to the cylinder port through throttle **a**, chamber **g**, and passaged **b** and **c**, and the oil flows to the cylinder port. When this happens, a differential pressure is formed between the upstream and downstream sides of throttle **a**, and the pressure in chamber **g** goes down, so the force pushing valve (1) to the left is reduced. In other words, the area ratio becomes smaller, so valve (1) moves to the right and increases the flow from the pump to the cylinder.



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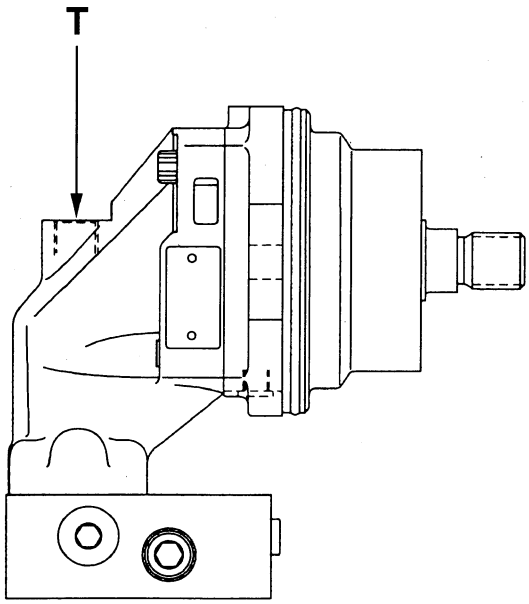
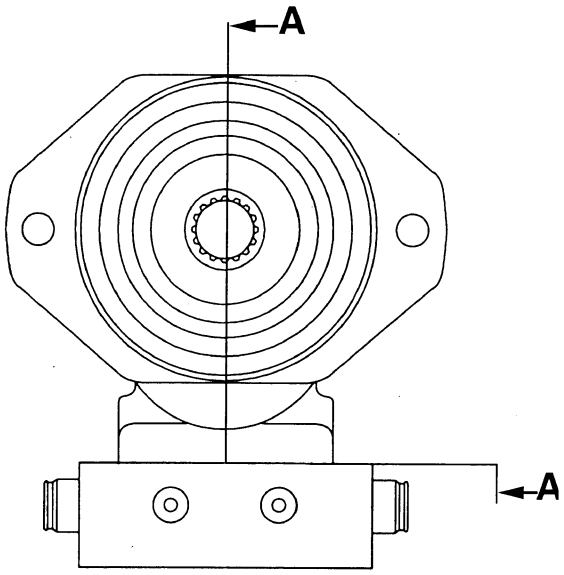
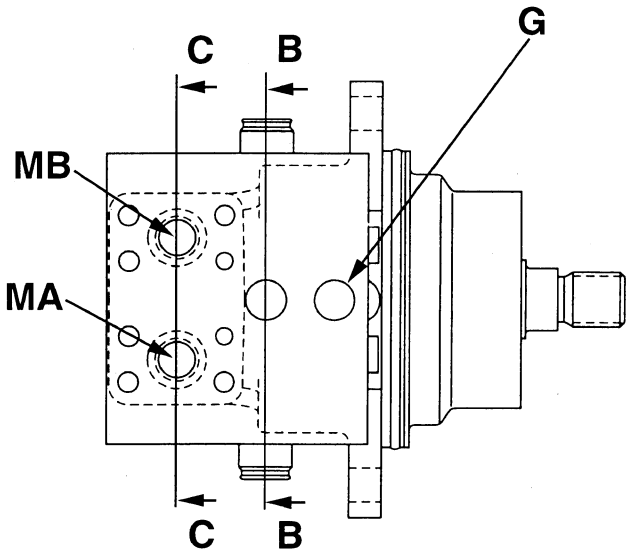
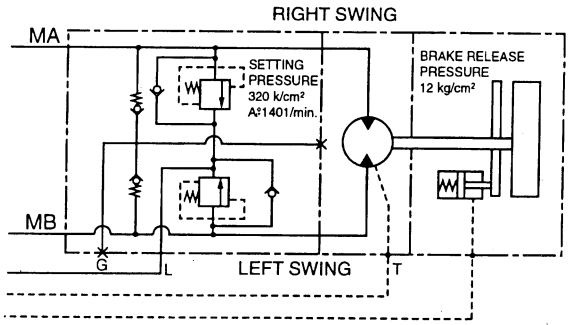
SWING MOTOR





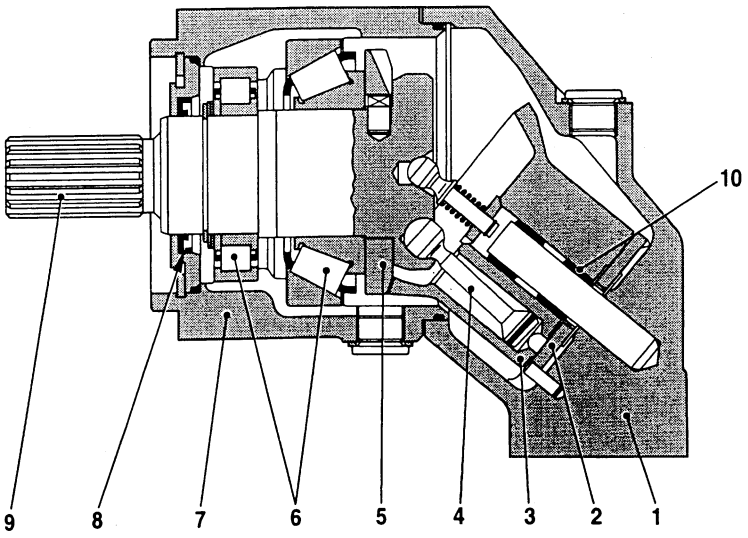




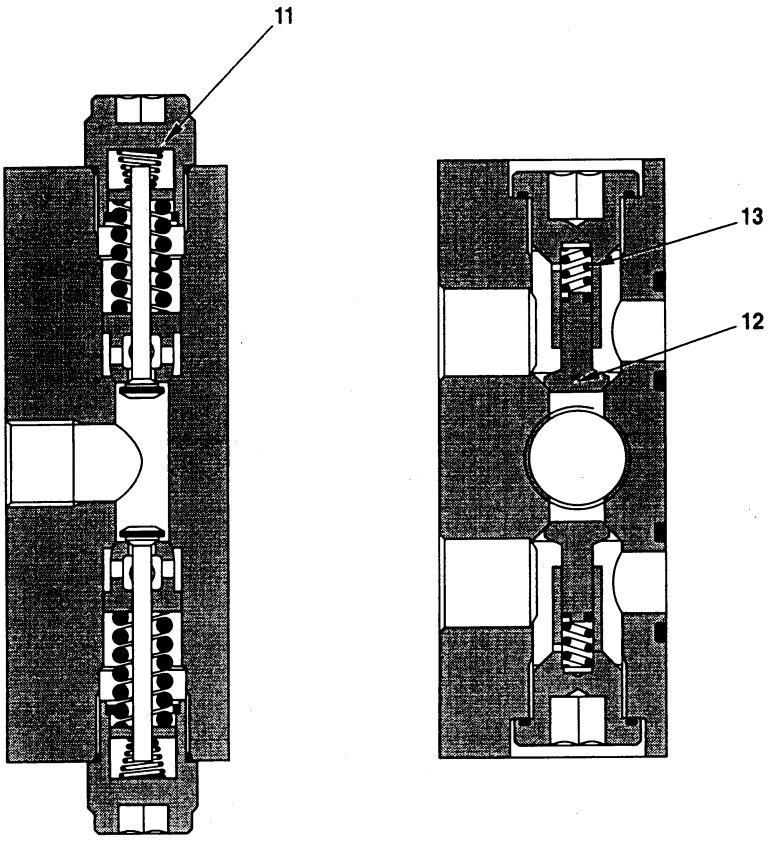
a. Port **L**. (to control valve TSW port)
b. Port **MB** (from control valve)
c. Port **MA** (from control valve)
d. Port **T** (to tank)

SPECIFICATIONS

Type	F12-060-MF-CV-C-509
Theoretical delivery	59.8 cc/rev
Safety valve set pressure	31.36 MPa (320 kg/cm²)
Rated speed	2250 rpm

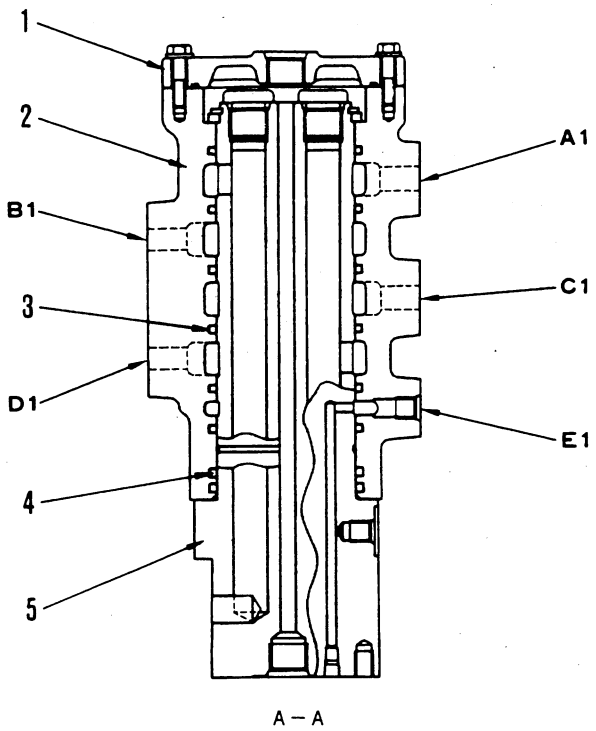


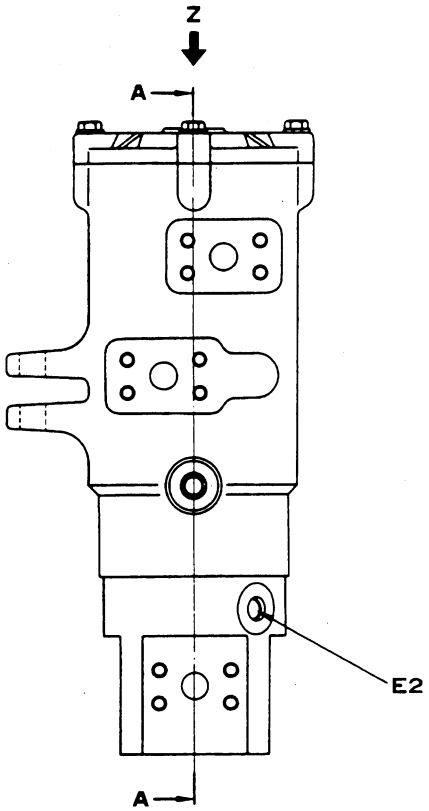
1. Barrel housing
2. Valve plate
3. Cylinder barrel
4. Piston with piston rings
5. Timing gear
6. Roller bearings
7. Bearing housing
8. Shaft seal
9. Output/input shaft
10. Needle bearings
11. Safety valve with check valve
12. Check valve
13. Check valve spring

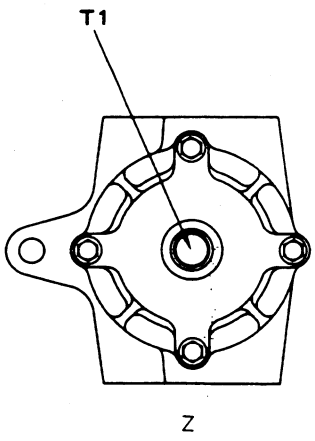


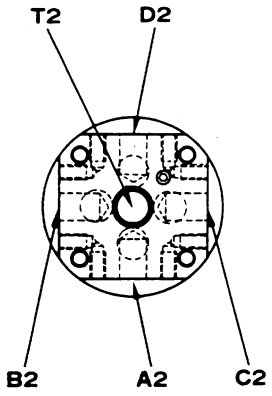
CENTER SWIVEL JOINT

4-PORT SWIVEL









1. Cover
2. Body
3. Slipper seal
4. O-ring
5. Shaft

A1. From control valve port **B2**
A2. To R.H. travel motor port **PB**
B1. From control valve port **B5**
B2. To L.H. travel motor port **PA**
C1. From control valve port **A2**
C2. To R.H. travel motor port **PA**
D1. From control valve port **A5**
D2. To L.H. travel motor port **PB**
E1. From travel speed solenoid valve
E2. To L.H. and R.H. travel motors port **P**
T1. To tank
T2. From L.H. and R.H. travel motors port **T**

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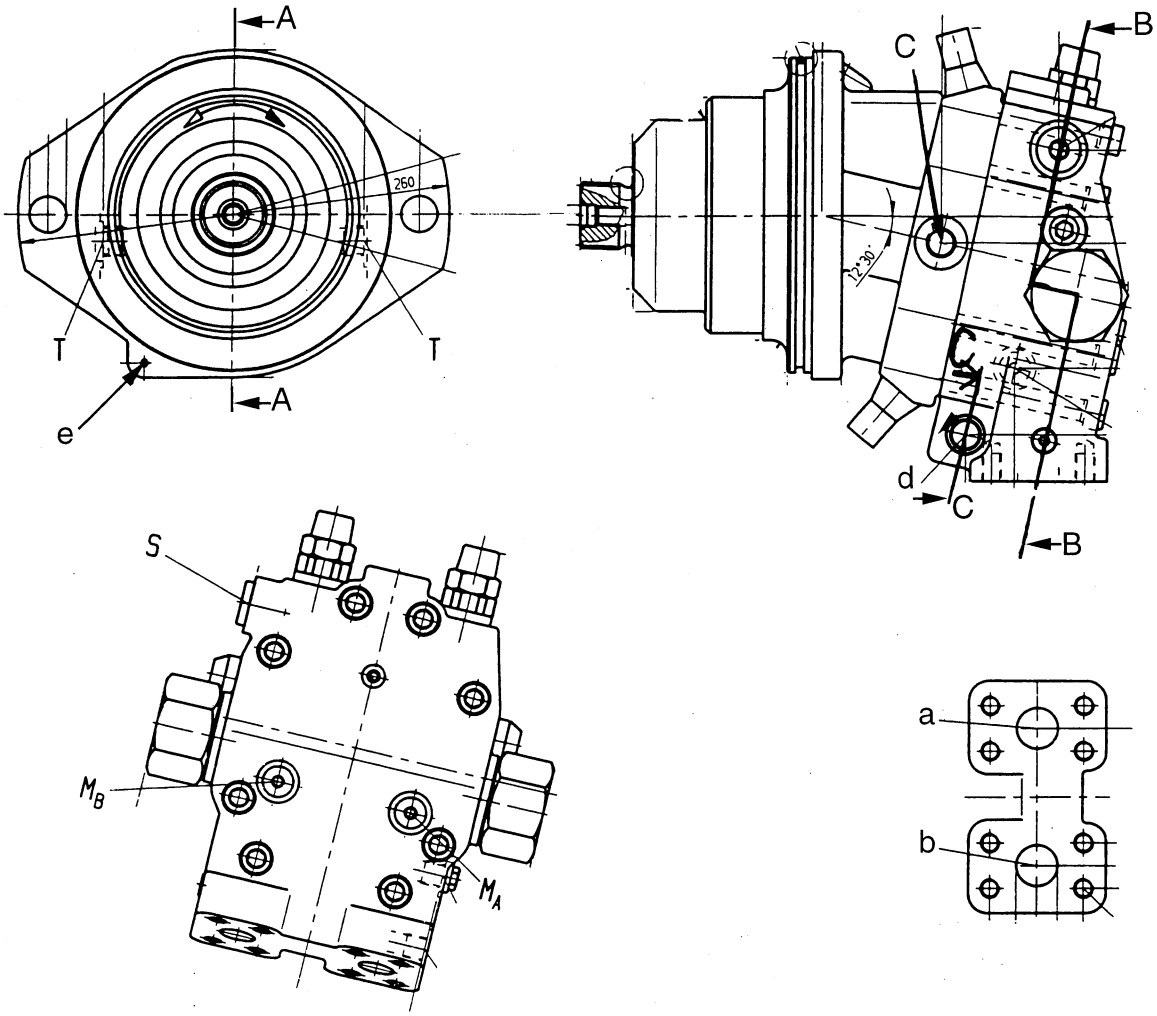
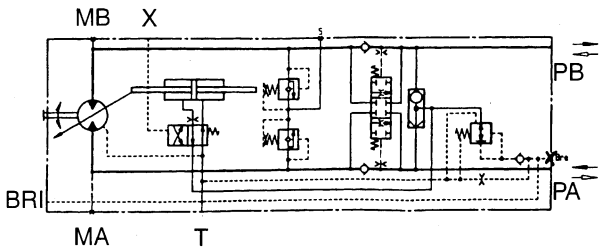
TRAVEL MOTOR

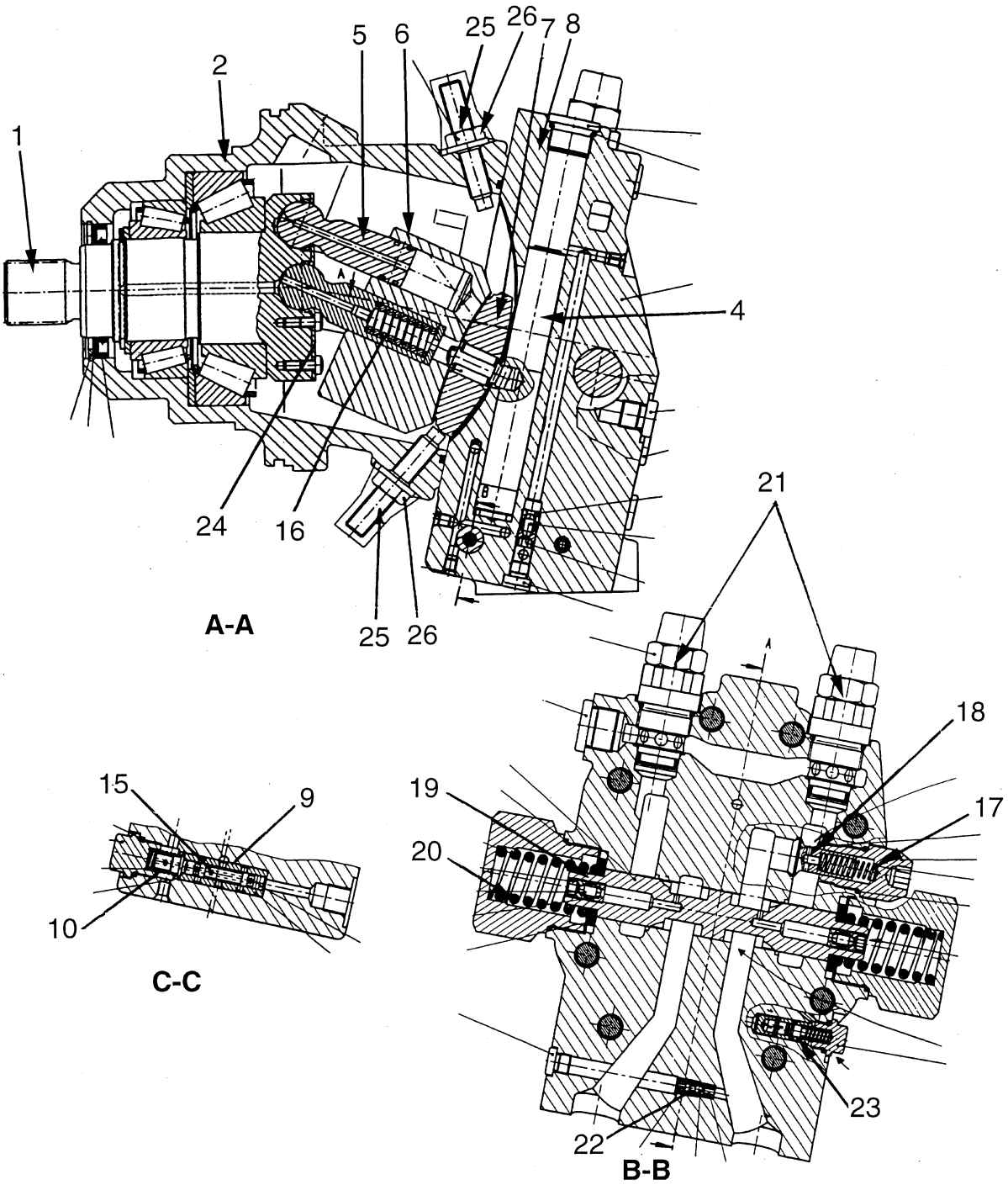


a. Port **PB** (from control valve)
b. Port **PA** (from control valve)
c. Port **T** (to tank)
d. Port **X** (from travel speed solenoid valve)
e. Port **Bri** (to parking brake release port of final drive)



SPECIFICATIONS

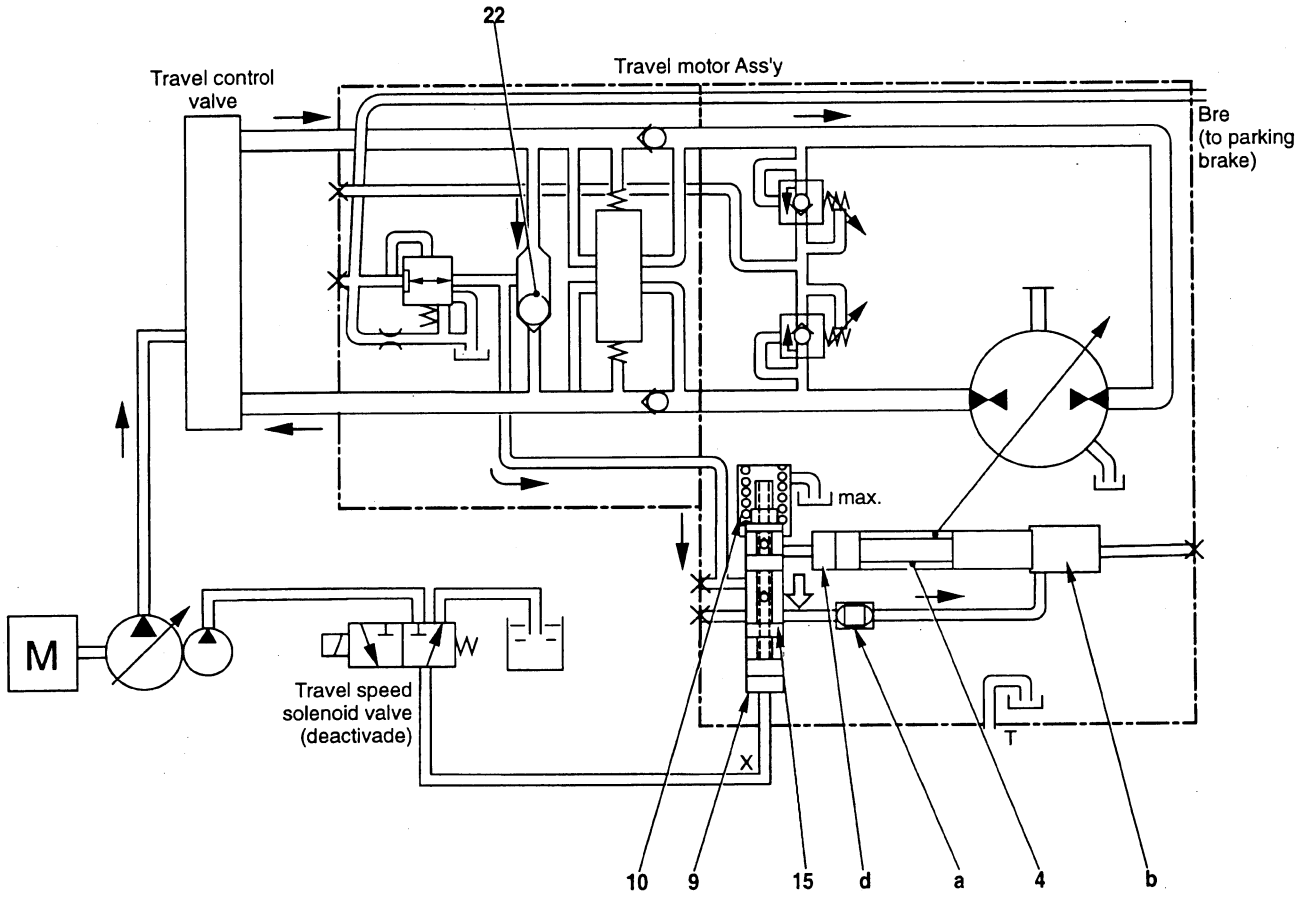
Type		A6VE80
Theoretical delivery	Min.	50 cc/rev
	Max.	80 cc/rev
Crakcing pressure of safety valve		37.73 MPa (385 kg/cm²)/ at 5ℓ/min
Rated speed	Min. capacity	2650 rpm
	Max. capacity	1650 rpm
Brake releasing pressure		1.27 MPa (13 kg/cm²)



1. Output
2. Motor case
3. Ball
4. Servo piston
5. Piston
6. Cylinder
7. Valve plate
8. End cover
9. Regulator valve
10. Spring
15. Regulator piston
16. Spring
17. Check valve spring
18. Check valve
19. Counterbalance valve
20. Spool return spring
21. Safety valve
22. Shuttle valve
23. Pressure reducing valve
24. Retainer plate
25. Stopper
26. Lock nut

OPERATION OF MOTOR

1) Motor swash plate angle (capacity) at maximum

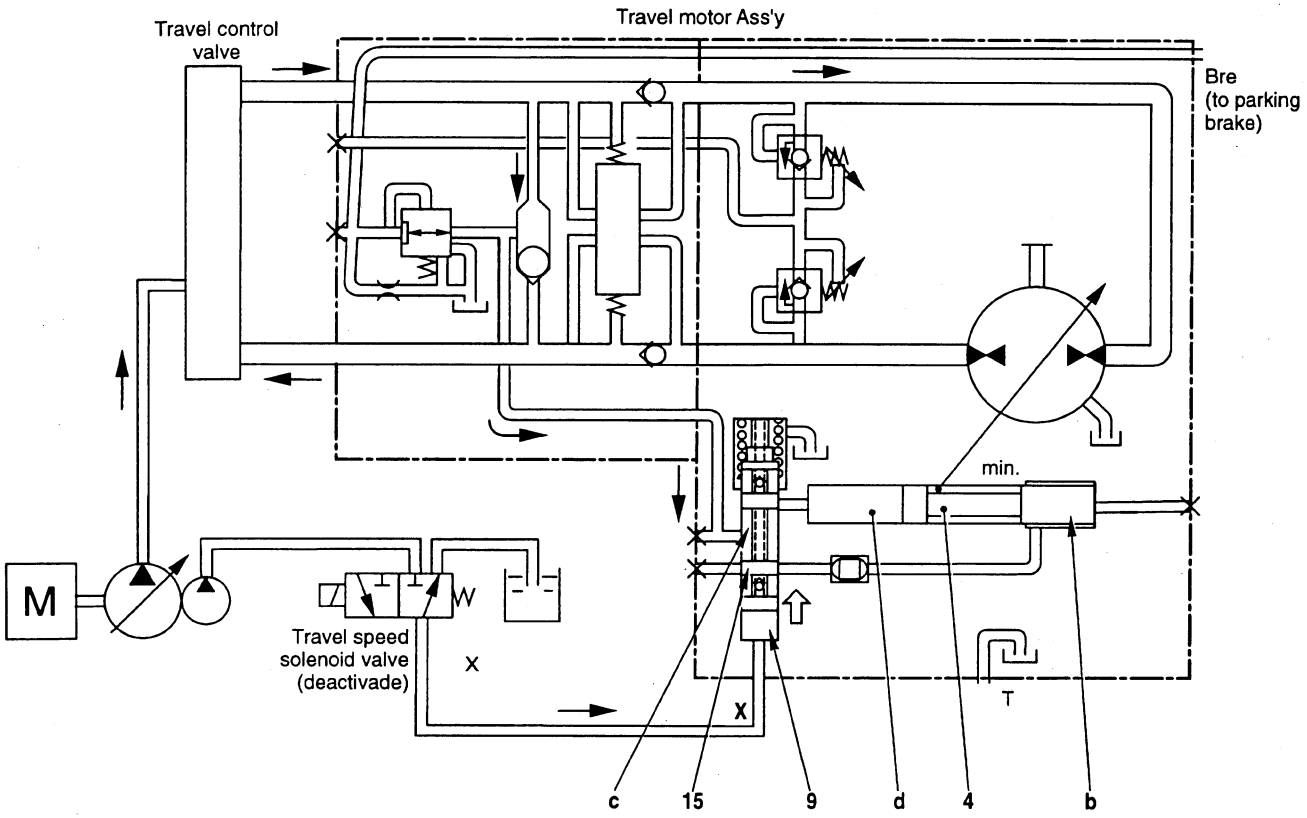


- The solenoid valve is deactivated, so the pilot pressure oil from the control pump does not flow to port **X**.
  For this reason, regulator piston (15) is pushed to the bottom in the direction of the arrow by spring (10).
- Because of this, it pushes shuttle valve (22), and the main pressure oil from the control valve goes to regulator valve (9).

- (Piston direction), the pressurized oil at regulator valve (9) passes through orifice "**a**" and goes to chamber "**b**"

- As a result, servo piston (4) moves in the maximum swash plate angle direction, the motor capacity becomes maximum.
- At the same time the oil in chamber "**d**" passes through passage in (15) and goes to drain port.

2) Motor swash plate angle (capacity) at minimum



- When the solenoid valve is excited, the pilot pressure oil from the control pump flows to port **X**, and pushes regulator piston (15) to the up in the direction of the arrow.
- Because of this, the main pressure oil from the control valve passes through passage in regulator valve (9), and goes to chamber "**d**".
- As a result, servo piston (4) moves in the minimum swash plate angle direction, the motor capacity becomes minimum.
- At the same time the oil in chamber "**b**" passes through passage in piston (15) and goes to drain port.

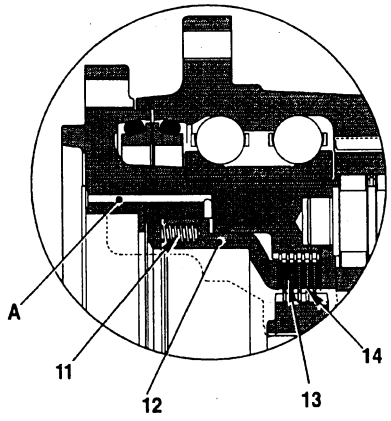
OPERATION OF PARKING BRAKE

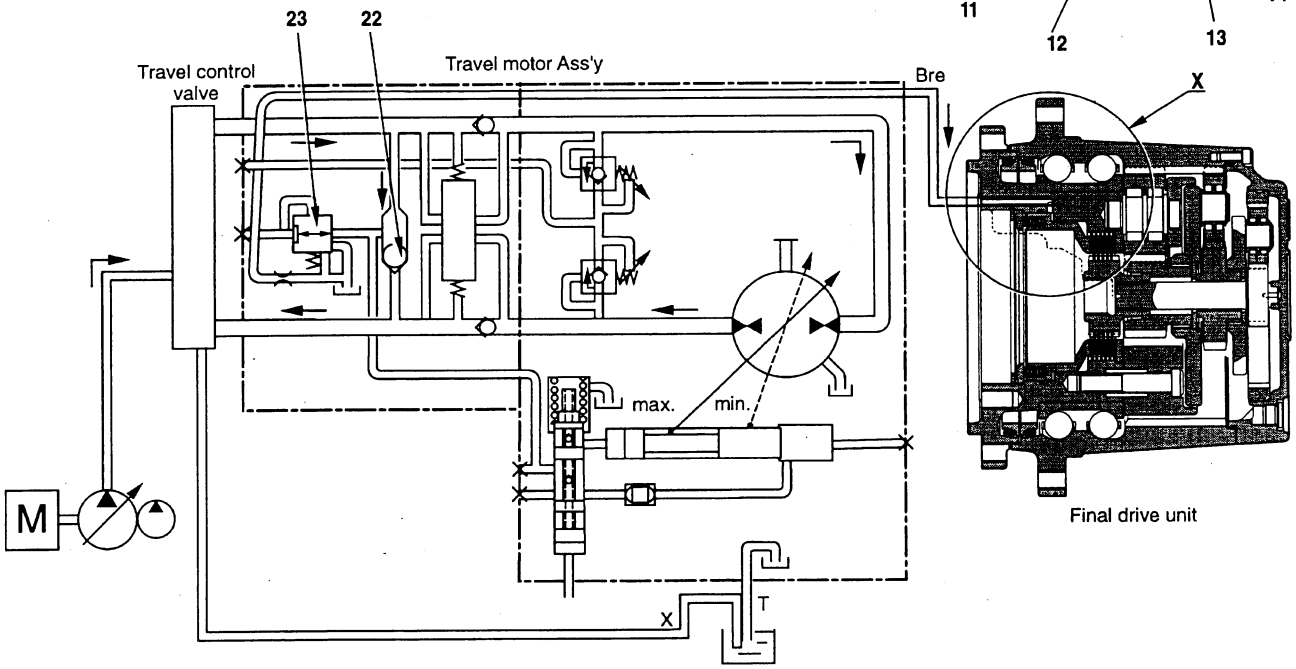
1) **When starting to travel**

When the travel lever is operated, the pressurized oil from the pump passes through shuttle valve (22) and goes to pressure reducing valve (23). The oil pressure is reduced by this valve and flows into chamber **A**. This circuit pressure is kept Max 23 bar by pressure reducing valve (23).

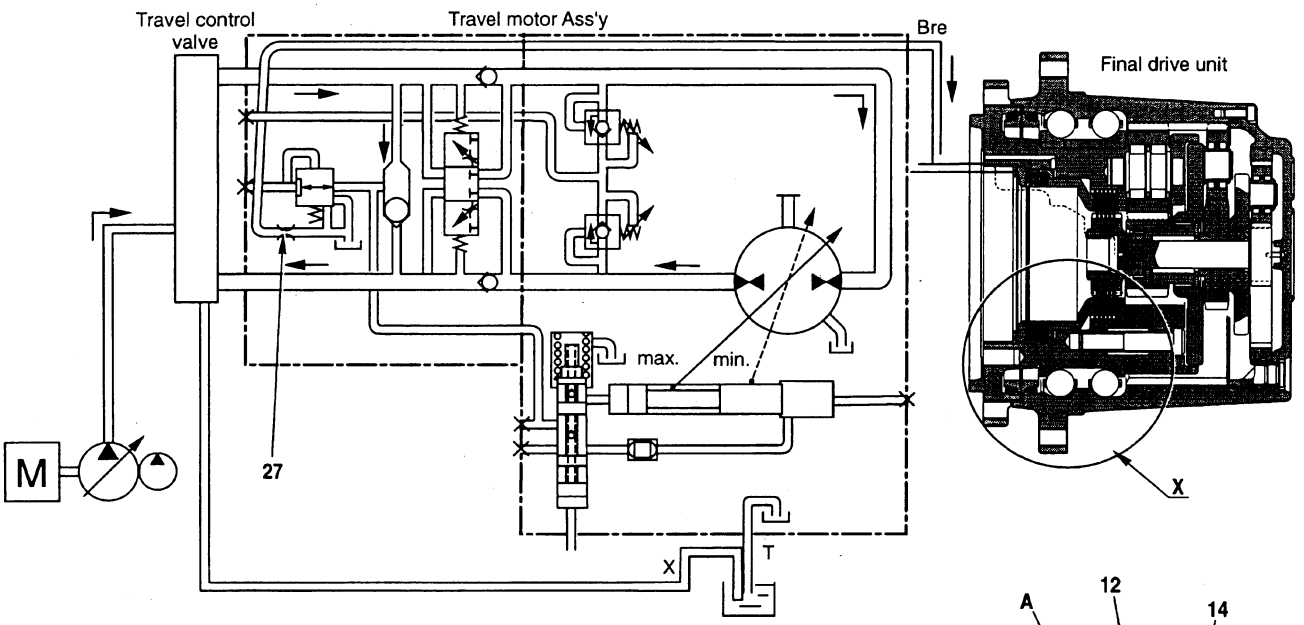
It overcomes the force of spring (11), and pushes piston (12) to the left in the direction of the arrow.

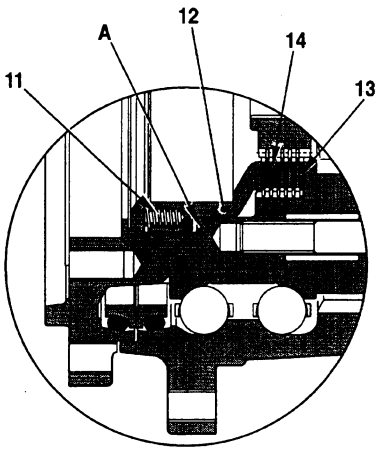
When this happens, the force pushing plate (13) and disc (14) together is lost, so plate (13) and disc (14) seperate and the brake is released





OPERATION OF PARKING BRAKE





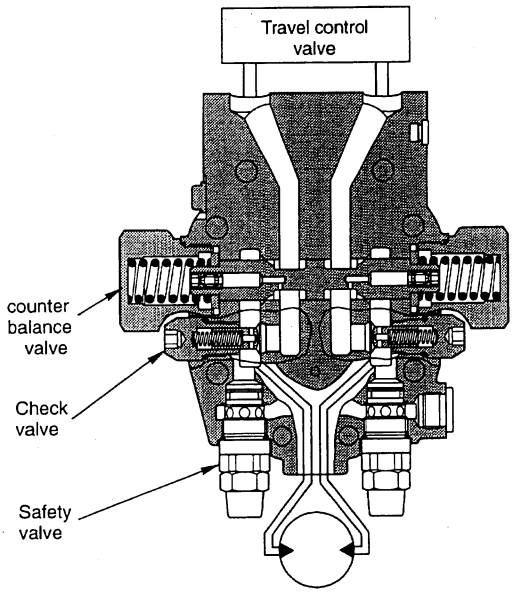
2) When stopping travel

When the travel lever is placed in neutral, Travel Contral valve returns to the neutral position.

The pressurized oil in chamber **A** of brake piston (12) is drained to the case from the orifice (27) and brake piston (12) is pushed in the drection of the arrow by spring (11).
As a result, plate (13) and disc (14) are pushed together, and the brake is applied.
A time delay is provided by having the pressurized oil pass through orifice (27) when the brake piston returns, and this ensures that the brake still effective after the machine stops.

OPERATION OF BRAKE VALVE

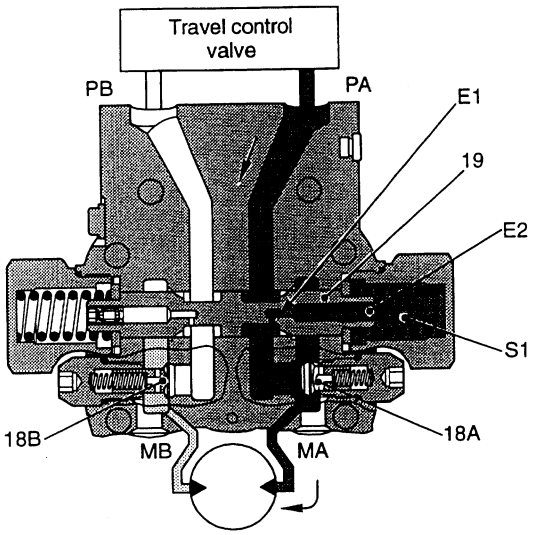
- The brake valve consist of a check valve, counterbalance valve, and safety valve in a circuit as shown in the diagram on the right. (Rig.1)
- The function and operation of each component is as given below.



1) Counterbalance valve, check valve

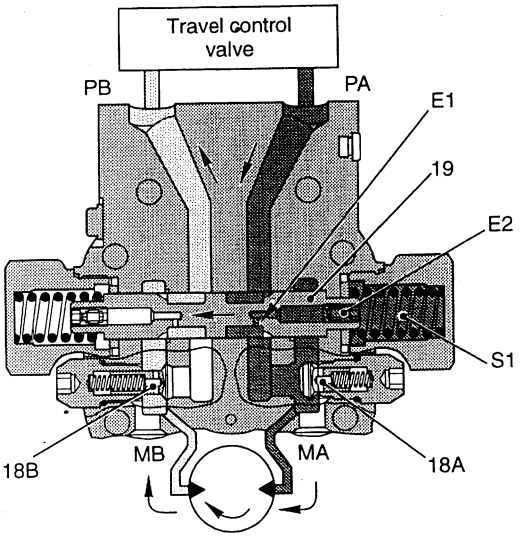
Function

- When traveling downhill, the weight of the machine makes it try to travel faster than the speed of the motor.
  As a result, if the machine travels with the engine at low speed, the motor will rotate without load and the machine will run away, which is extremely dangerous.
  To prevent this, these valves act ot make the machine travel according to the engine speed (pump discharge amount).



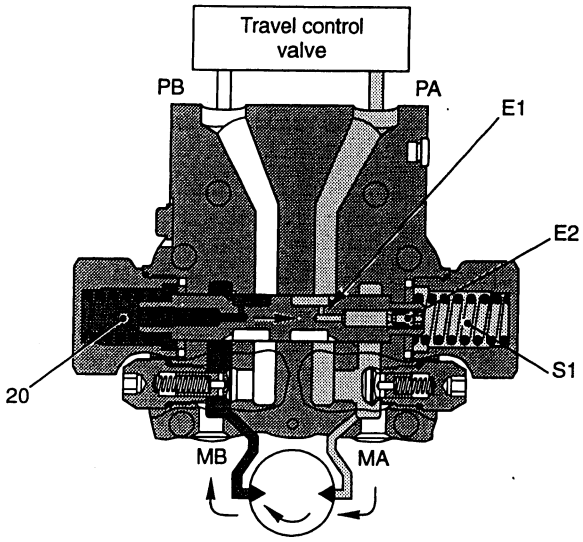
Operation when pressure oil is supplied

- When the travel lever is operated, the pressurized oil from the control valve is supplied to port **PA**. It pushes open check valve (18A) and flows from motor inlet port **MA** to motor outlet port **MB**.
  However, the motor outlet port is closed by check valve (18B) and spool (19), so the pressure at the supply side rises. (Fitg.2)
- The pressurized oil at the supply side flows from orifice **E1** in spool (19) and shuttle orifice **E2** in the piston to chamber **S1**. When the pressure in chamber **S1** goes above the spool switching pressure, spool (19) is pushed to the right in the direction of the arrow.
  As a result, port **MB** and **PB** are connected, the outlet port side of the motor is opened, and the motor starts to rotate. (Fig. 3)



Operation of brake when traveling downhill

- If the machine tries to run away when traveling downhill, the motor will turn under no load, so the pressure at the motor inlet port will drop, and the presure in chamber S1 through ofifices **E1** and **E2** will also drop.
  When the pressure in chamber **S1** drops below the spool switching pressure, spool (19) is returned to the left in the direction of the arrow by spring (20), and outlet port MB is throttled. (Fig.4)
  As a result, the pressure at the outlet port side rises, resistance is generated to the rotation of the motor, and this prevents the machine form running away.
  In other words, the spool moves to a position where the pressue at outlet port **MB** balances the pressure at the inlet port and the force generated by the weight of the machine. It throttles the outlet port circuit and controls the travel speed according to the amont of oil discharged from the pump. (Fig. 4)

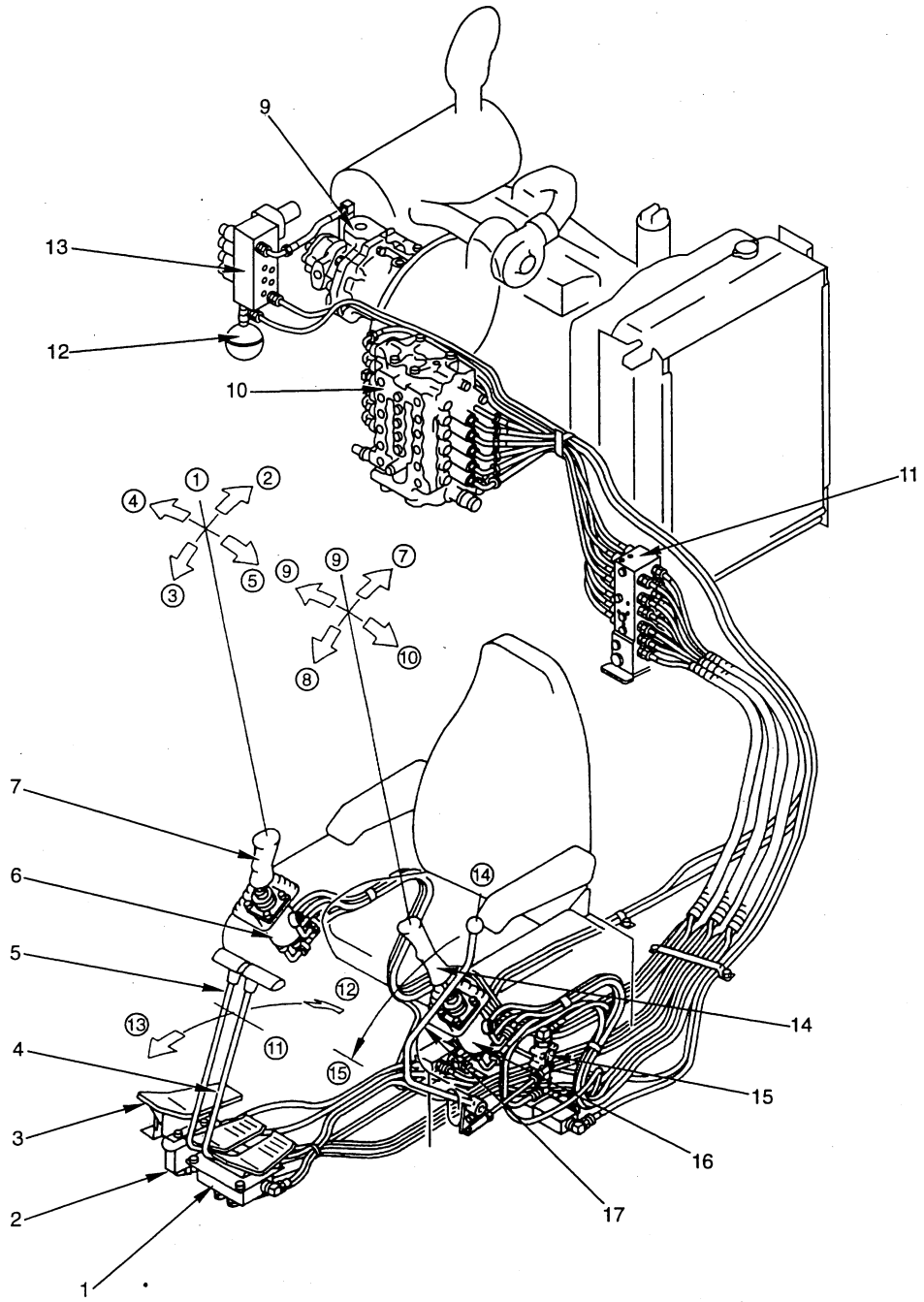


2) Safety valve

Fuction

- When travel is topped (or when traveling downhill), the circuits at the inlet and outlet ports of the motor are closed by the counterbalance valve, but the motor is rotated by inertia, so the pressure at the outlet port of the motor will become abnormally high and damage the motor or piping. The safety valve acts to release this abnormal pressure and send it to the inlet port side of the motor to prevent damage to the equipment.

VALVE CONTROL

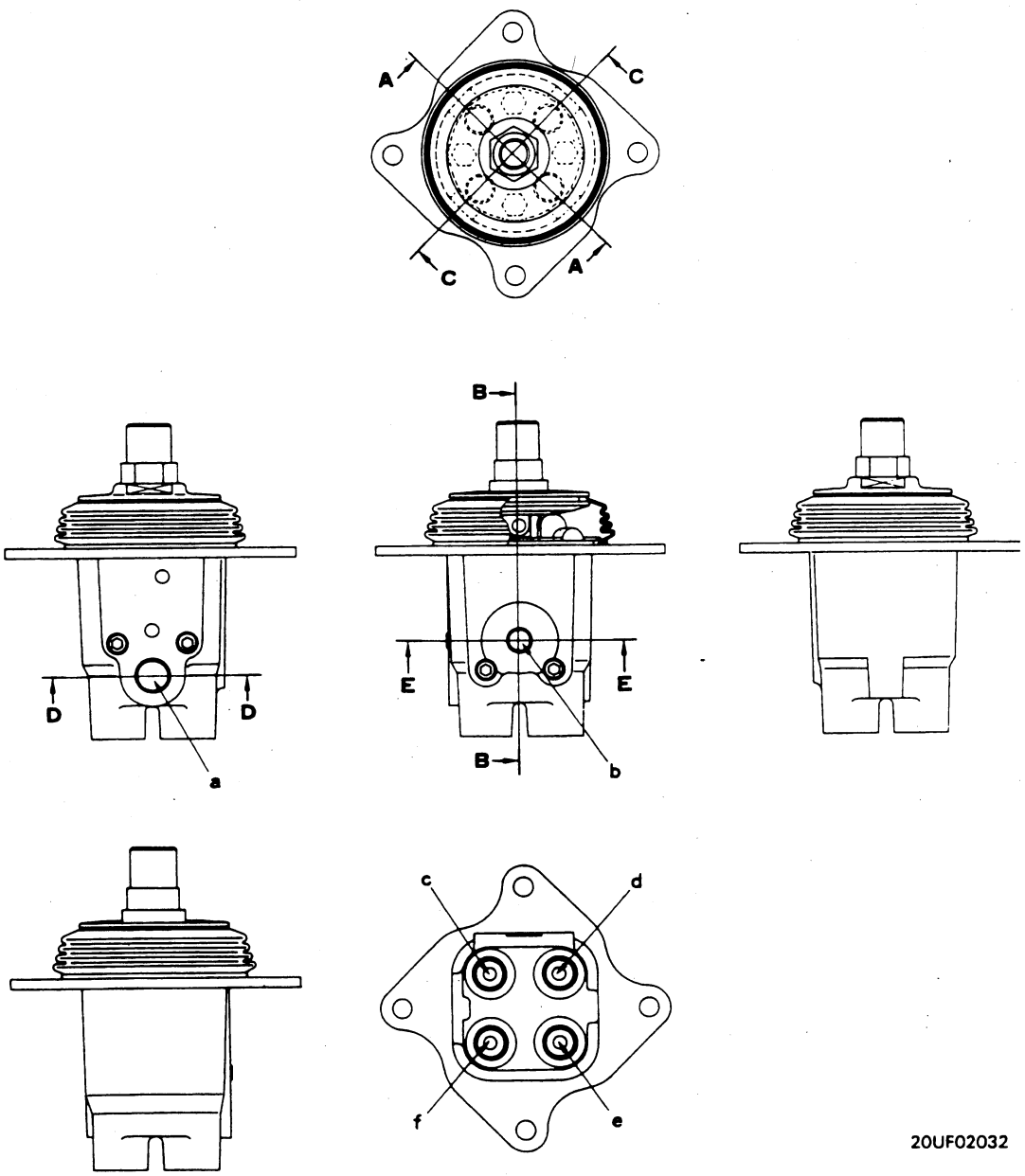


1. Travel PPC valve
2. Service PPC valve
3. Service pedal
4. L.H. travel lever
5. R.H. travel lever
6. R.H. PPC valve
7. R.H. work equipment lever
8. LS control EPC valve
9. Hydraulic pump
10. Control valve
11. PPC shuttle valve
12. Accumulator
13. Solenoid valve block
14. L.H. work equipment lever
15. Safety lock valve
16. L.H. PPC valve
17. Safety lock lever

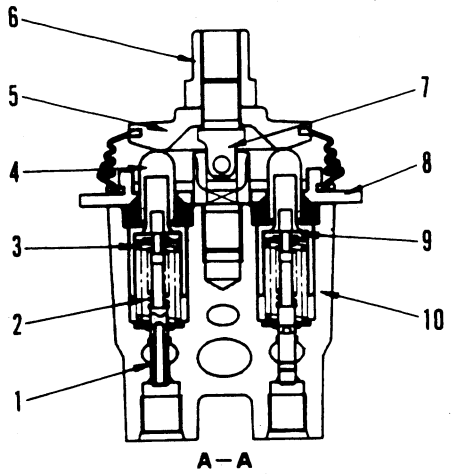
Lever positions

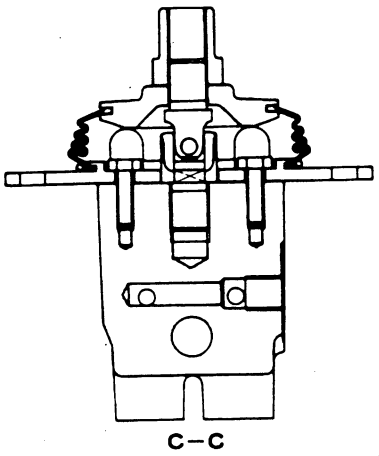
① Neutral
② Boom RAISE
③ Boom LOWER
④ Bucket DUMP
⑤ Bucket CURLL
⑥ Neutral
⑦ Arm In
⑧ Arm OUT
⑨ Swing RIGHT
⑩ Swing LEFT
⑪ Neutral
⑫ Travel REVERSE
⑬ Travel FORWARDS
⑭ LOCK
⑮ FREE

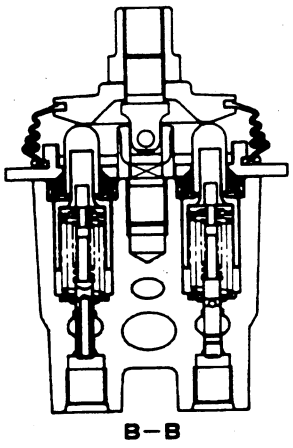
WORK EQUIPMENT • SWING PPC VALVE

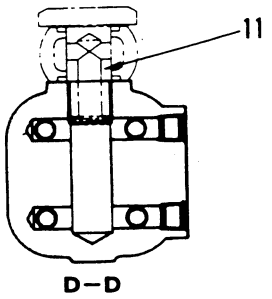


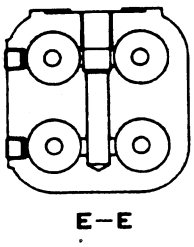
a. Port **P** (from control pump)
b. Port **T** (to tank)
c. Port **P2** (L.H. : Arm IN/ R.H.: Boom RAISE)
d. Port **P4** (L.H.: Swing LEFT/ R.H.: Bucket DUMP)
e. Port **P1** (L.H.: Arm OUT/ R.H.: Boom LOWER)
f. Port **P3** (L.H.: Swing RIGHT/ R.H.: Bucket CURL)









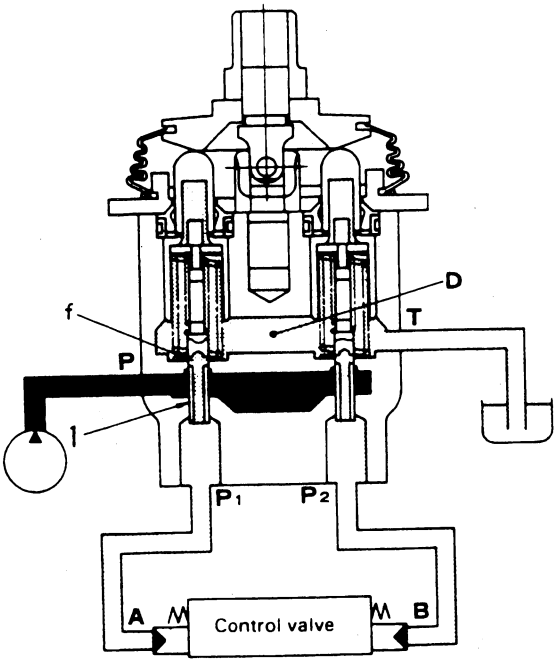


20UF02033

1. Spool
2. Metering spring
3. Centering spring
4. Piston
5. Disc
6. Nut (for connecting lever)
7. Joint
8. Plate
9. Retainer
10. Body
11. Filter

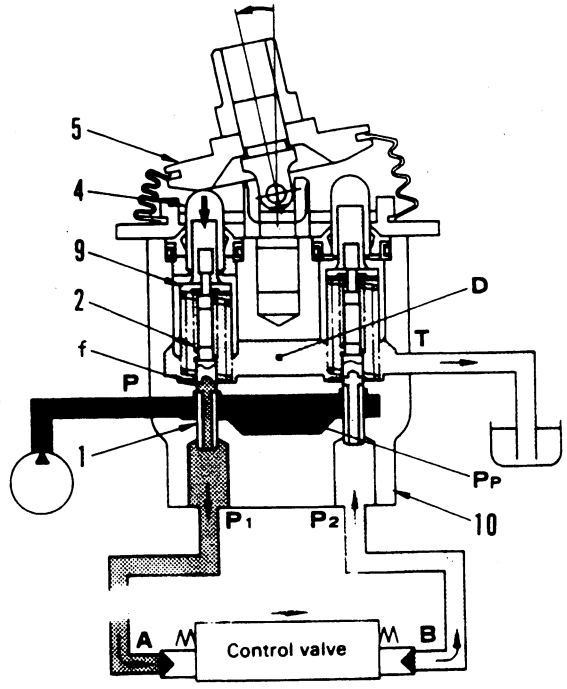
OPERATION

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)



20TF01044

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 drian hole **D** and pump pressure chamber **Pp**) does not change until retainer (9) contacts spool (1).
Therefor, metering spring (2) is compressed proportionally to the amount on 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)



20TF01045

3) **During fine control (when control lever is returned)**

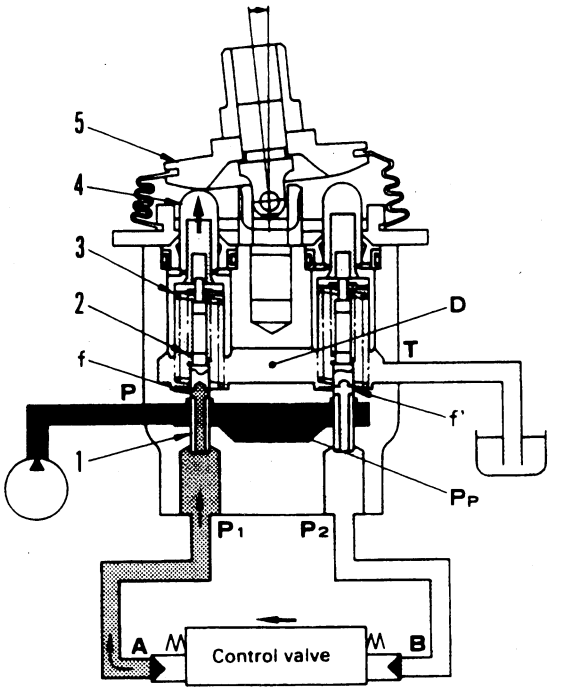
When disc (5) starts to be returned, spool (1) is pushed up by the force of centering spring (3) and the pressure at port **P1**.

When this happens, fine control hole "**f**" is connected to drain chamber **D** and the pressure oil at port **P1** is released.

If the pressure at port **P1** drops too far, spool (1) is pushed dwon by metering spring (2), and fine control hole "**f**" is shut off from drain chamber D.

At almost the same time, it is connected to pump pressure chamber **Pp**, an the pump pressure is supplied until the pressure at port **P1** recovers to a presure that corresponds to the lever position. When the spool of the control valve returns, oil in drain chamber D flows in from fine control hole "**f**" in the valve on the side that is not working.

The oil passes through port **P2** and enters chamber **B** to fill the chamber with oil. (Fig. 3)



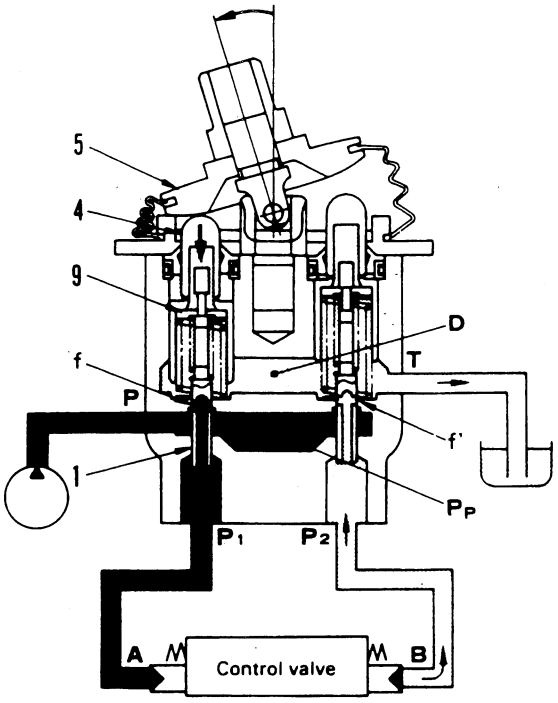
20TF01046

4) **At full stroke**

When disc (5) pushes down piston (4), and retainer (9) pushes down spool (1), fine control hole "**f**" is shut off from drain chamber **D**, and is connected with pump pressure chamber **Pp**.

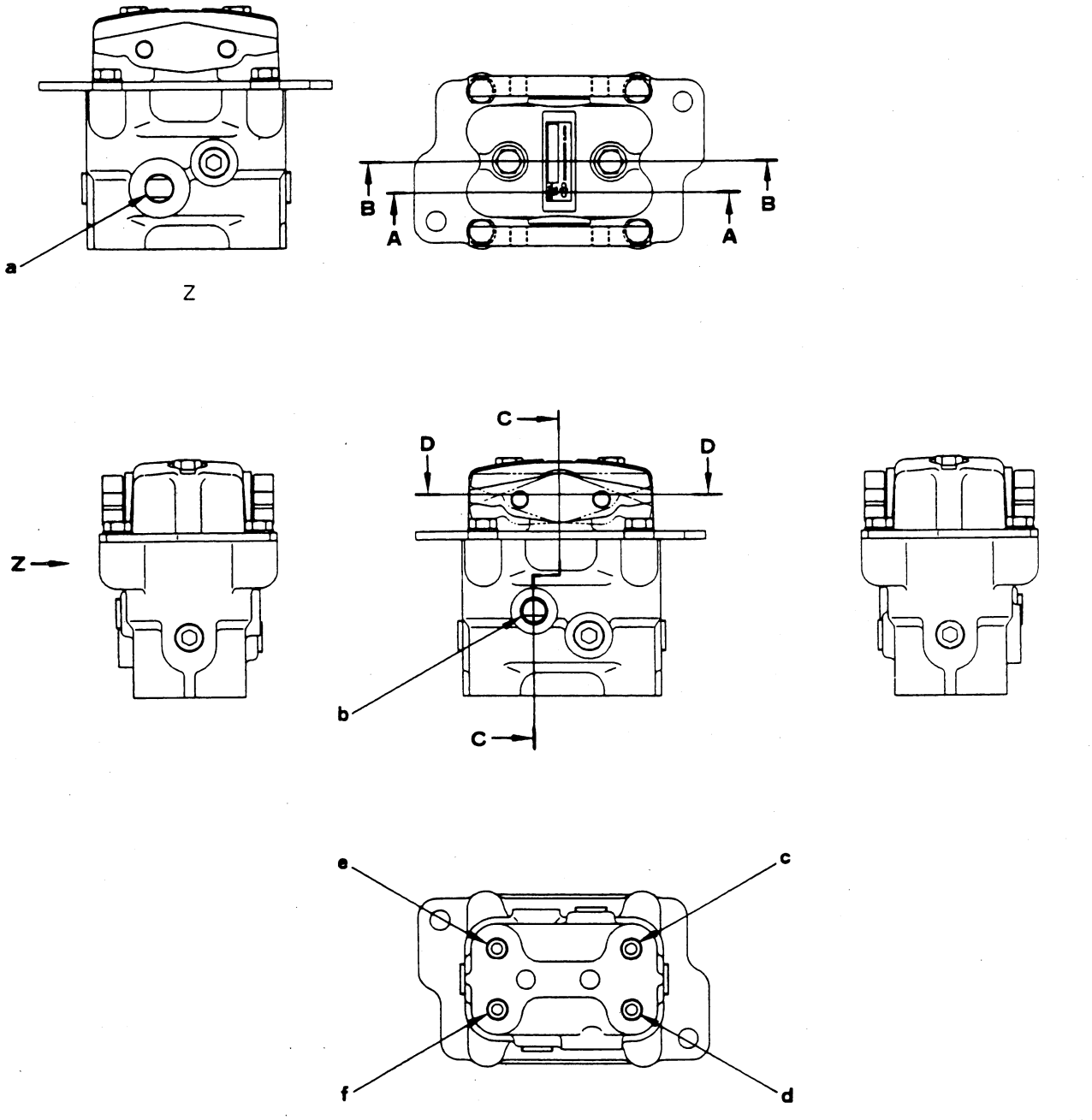
Therefore, the pilot pressure oil from the control pump passes through fine control hole "**f**" and flows to chamber **A** from port **P1**, and pushes the control valve spool.

The oil returning from chamber **B** passes from port **P2** through fine control hole "**f**" and flows to drain chamber **D**. (Fig. 4)



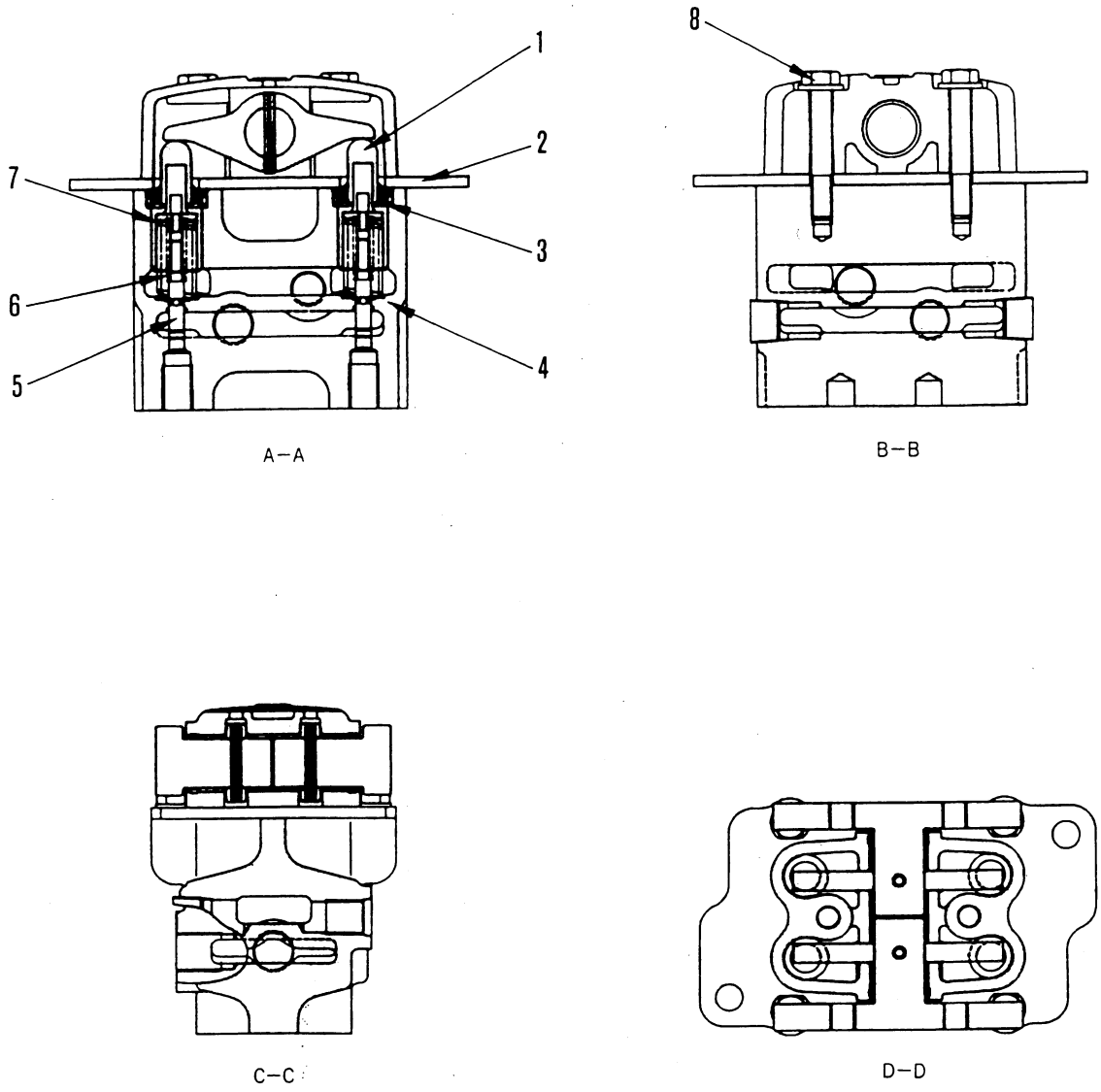
20TF01047

TRAVEL PPC VALVE



205F06102

a. Port **P** (from control pump)
b. Port **T** (to tank)
c. Port **P1** (L.H. travel REVERSE)
d. Port **P3** (R.H. travel REVERSE)
e. Port **P2** (L.H. travel FORWARD)
f. Port **P4** (R.H. travel FORWARD)

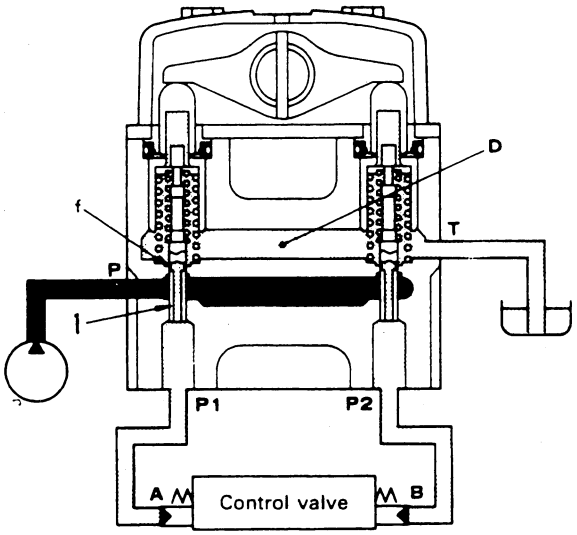


205F06103

1. Piston
2. Plate
3. Collar
4. Body
5. Valve
6. Metering spring
7. Centering spring
8. Bolt

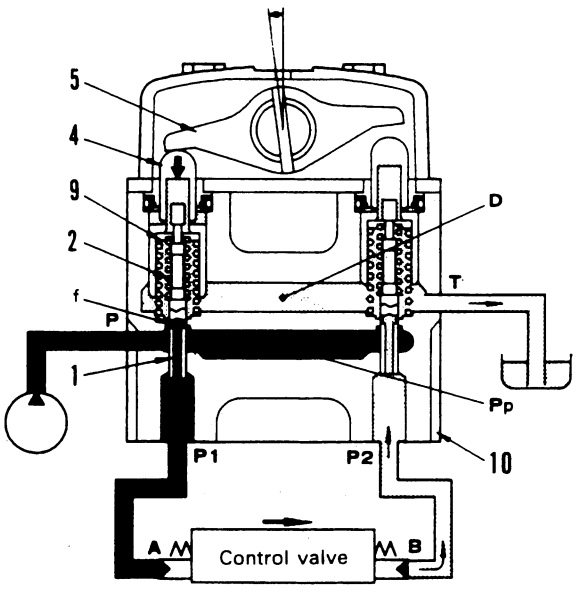
OPERATION

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)



22TF01094

2. **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**. At almost the same time, it is connected to pump pressure chamber **Pp**, and the pilot pressure of the control pump is sent from port **A** through fine control hole "**f**" to port **P1**.
   When the pressure at port **P1** rises, spool (1) is pushed back. Fine control hole "**f**" is shut off from pump pressure chamber **Pp**. At almost the same time, it is connected to drain chamber **D**, so the pressure at port **P1** escapes.
   As a result, spool (1) moves up and down until the force of metering spool (2) is balanced with the pressure of port **P1**.
   The relationship of the positions of spool (1) and body (10) (fine control hole "**f**" is in the middle between drain hole **D** and pump pressure chamber **Pp**) does not change until retainer (9) contacts spool (1).
   Therefore, metering spring (2) is compressed in proportion to the travel 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 spool of the control valve moves to a position where the pressure of chamber **A** (same as pressure at port **P1**) and the force of the return spring of the control valve spool are balanced. (Fig. 2)



22TF01095

3. Fine control (control lever returned)

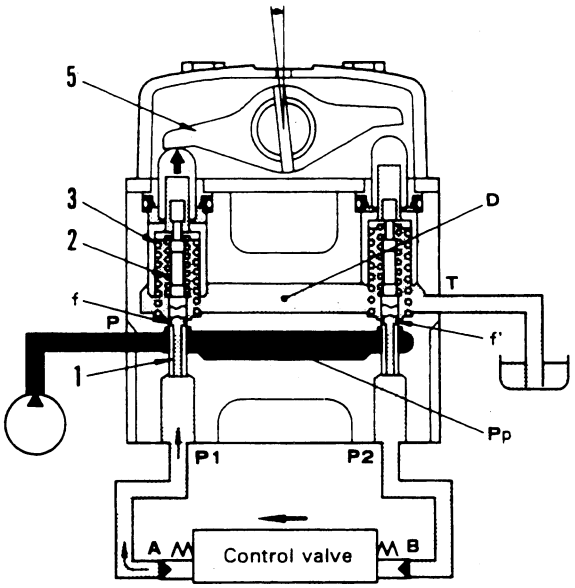
When disc (5) starts to be returned, spool (1) is pushed up by the force of centering spring (3) and the pressure at port **P1**.

Because of this, fine control hole "**f**" is connected to drain chamber **D**, and the pressurized oil at port **P1** is released.

If the pressure at port **P1** drops too much, spool (1) is pushed up by metering spring (2), so fine control hole "**f**" is shut off from drain chamber **D**.

At almost the same time, it is connected to pump pressure chamber **Pp**, so the pressure at port **P1** supplies the pump pressure until the pressure recovers to a pressure equivalent to the position of the lever.

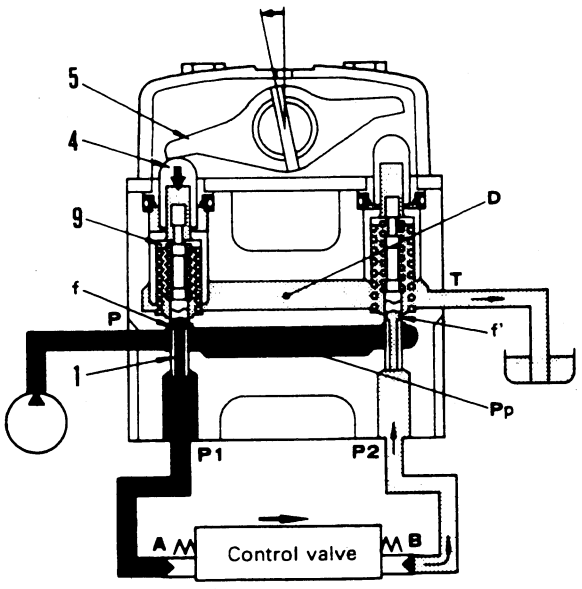
When the control valve returns, oil in drain chamber **D** flows in from fine control hole "**f**" of the valve on the side that is not moving. It passes through port **P2** and goes to chamber **B** to charge the oil. (Fig. 3)



22TF01096

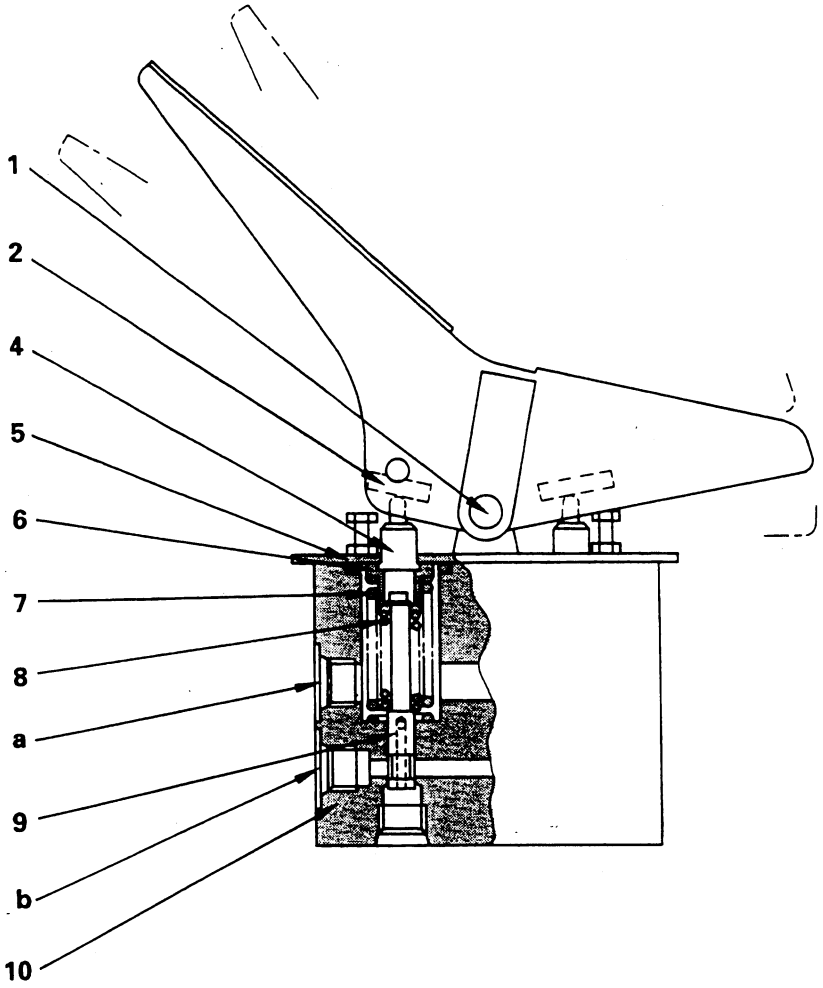
4) At full stroke

Disc (5) pushes down piston (4), and retainer (9) pushes down spool (1). Fine control hole "**f**" is shut off from drain chamber **D**, and is connected to pump pressure chamber **Pp**. Therefore, the pilot pressure oil from the control pump passes through fine control hole "**f**" and flows to chamber **A** from port **P1** to push the control valve spool. The return oil from chamber **B** passes from port **P2** through fine control hole "**f**" and flows to drain chamber **D**. (Fig. 4)



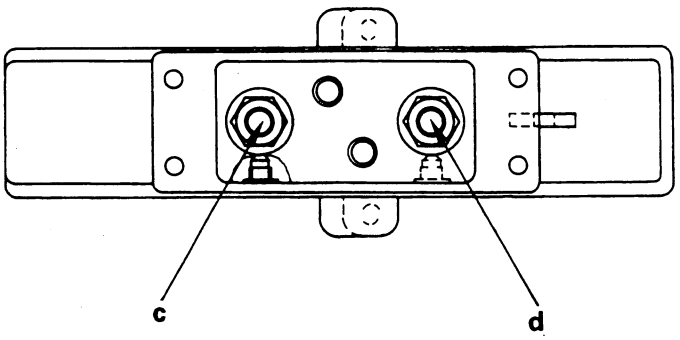
22TF01097

SERVICE PPC VALVE



1. Pin
2. Cam
3. Ball
4. Piston
5. Cover
6. Sleeve
7. Centering spring
8. Metering spring
9. Spool
10. Body

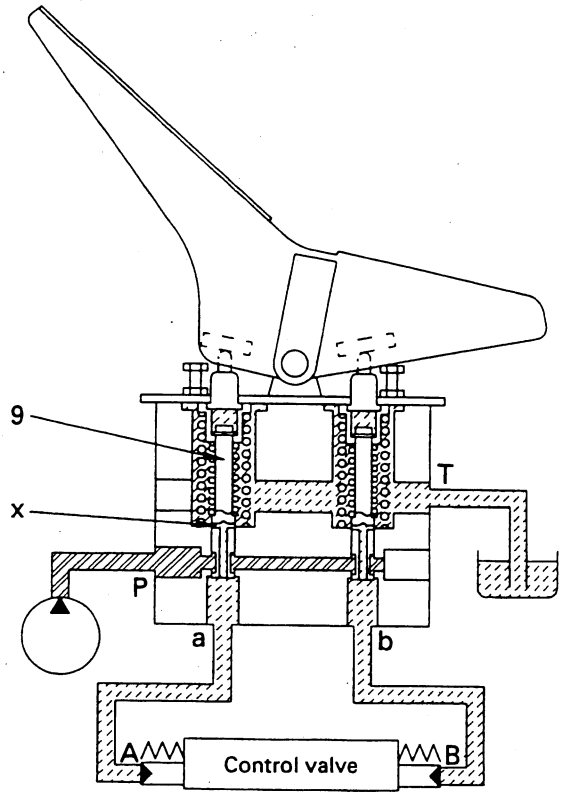
a. Port **T** (to tank)
b. Port **P** (from control pump)
c. Port **A** (to service valve **P1**)
d. Port **B** (to service valve **P2**)



OPERATION

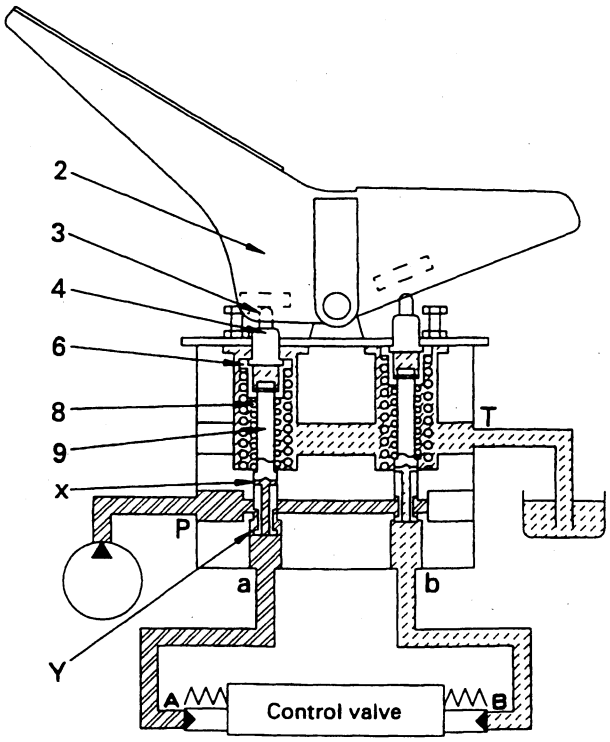
At neutral

- The pressurized oil from the control pump enters from port **P** and is blocked by spool (9).
- Port **A** and **B** of the control valve and port "**a**" and "**b**" of the PPC valve are connected to drain port **T** through fine control hole **X** of spool (9).

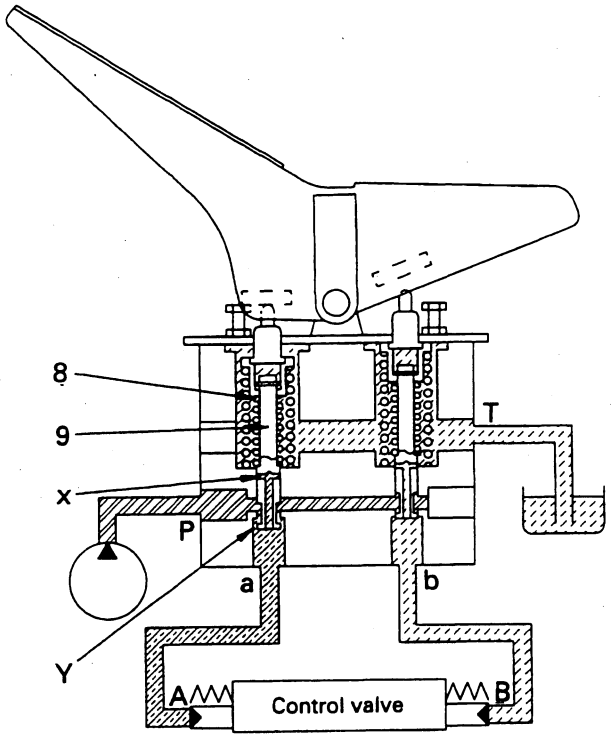


When operated

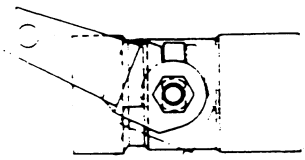
- When cam (2) is moved, metering spring (8) is pushed by ball (3), piston (4), and sleeve (6), and spool (9) is also pushed down by this.
- As a result, fine control hole **X** is shut off from the drain circuit. At almost the same time, fine control portion **Y** is connected with port "**a**", and the pressurized oil from port **P** flows from port "**a**" to port **A** of the control valve.



- When the pressure at port "**a**" becomes higher, spool (9) is pushed back by the force acting on the end of the spool. When fine control portion **Y** closes, fine control hole **X** is connected to the drian circuit at almost the same time.
- As a result, spool (9) moves up and down to balance the force at port "**a**" and the force at metering spring (8).
- Therefore, metering spring (8) is compressed in proportion to the amount the control lever is moved. The spring force becomes larger, so the pressure at port "**a**" also increases in proportion to the amount the control lever is operated.
- In this way, the control valve spool moves to a position where the pressure of port **A** (the same as the pressure at port "**a**") is balanced with the force of the return spring of the control valve spool.

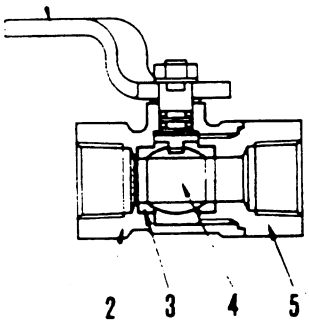


SAFETY LOCK VALVE



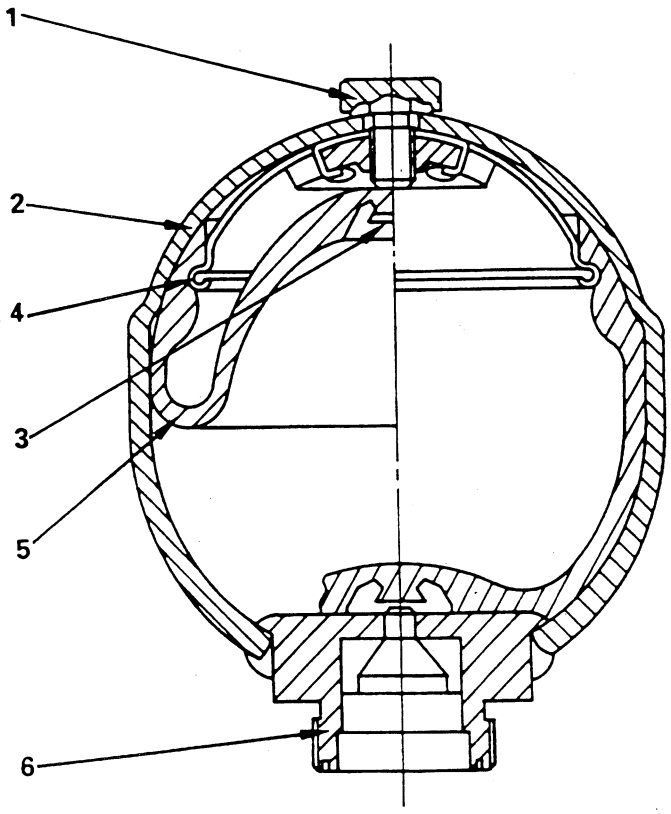
1. Lever
2. Body
3. Seat
4. Ball
5. End cap

1



F205C5018

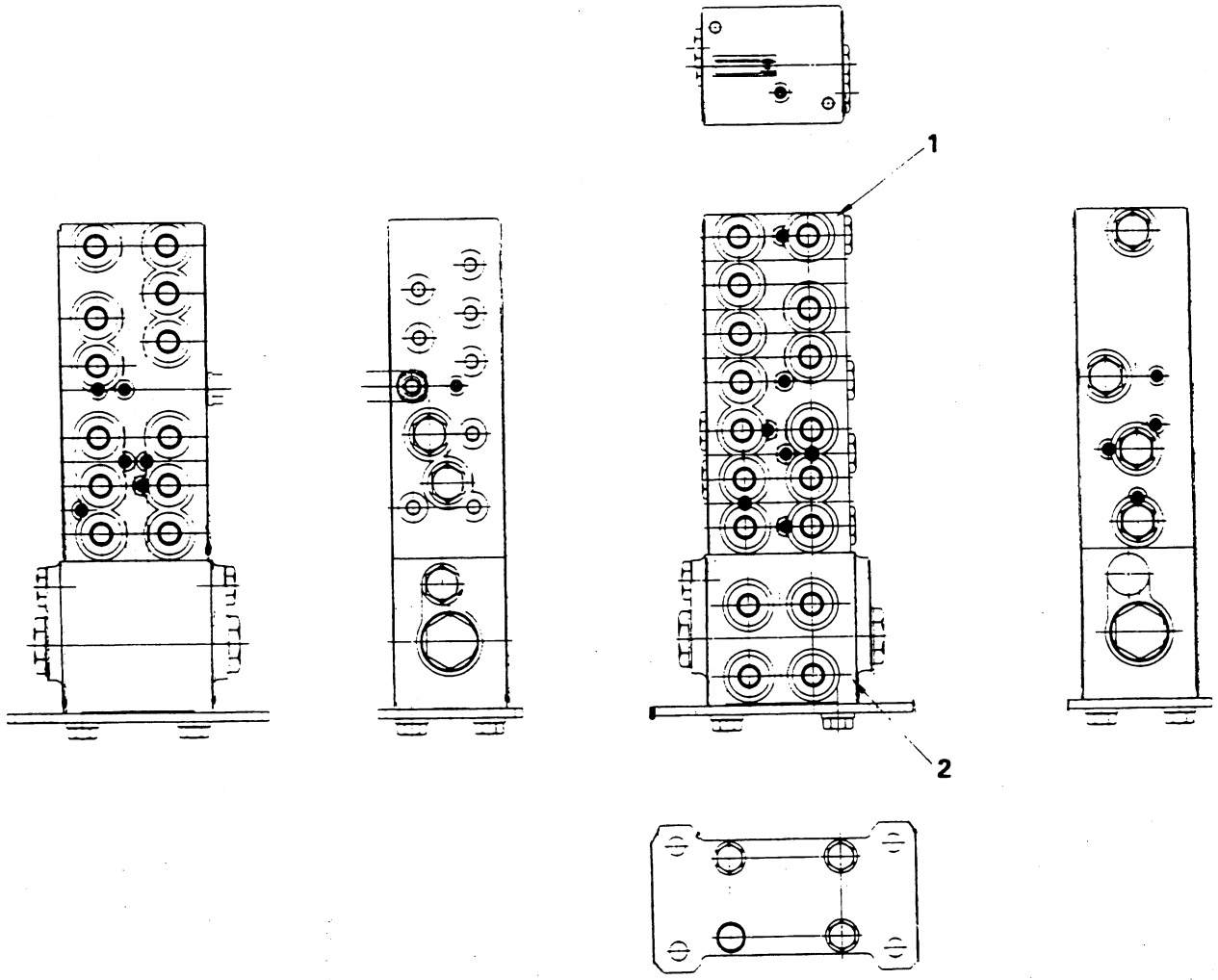
PPC ACCUMULATOR



1. Gas plug
2. Shell
3. Poppet
4. Holder
5. Bladder
6. Oil port

SPECIFICATIONS
Gas capacity: 400 cc

PPC SHUTTLE • TRAVEL JUNCTION VALVE

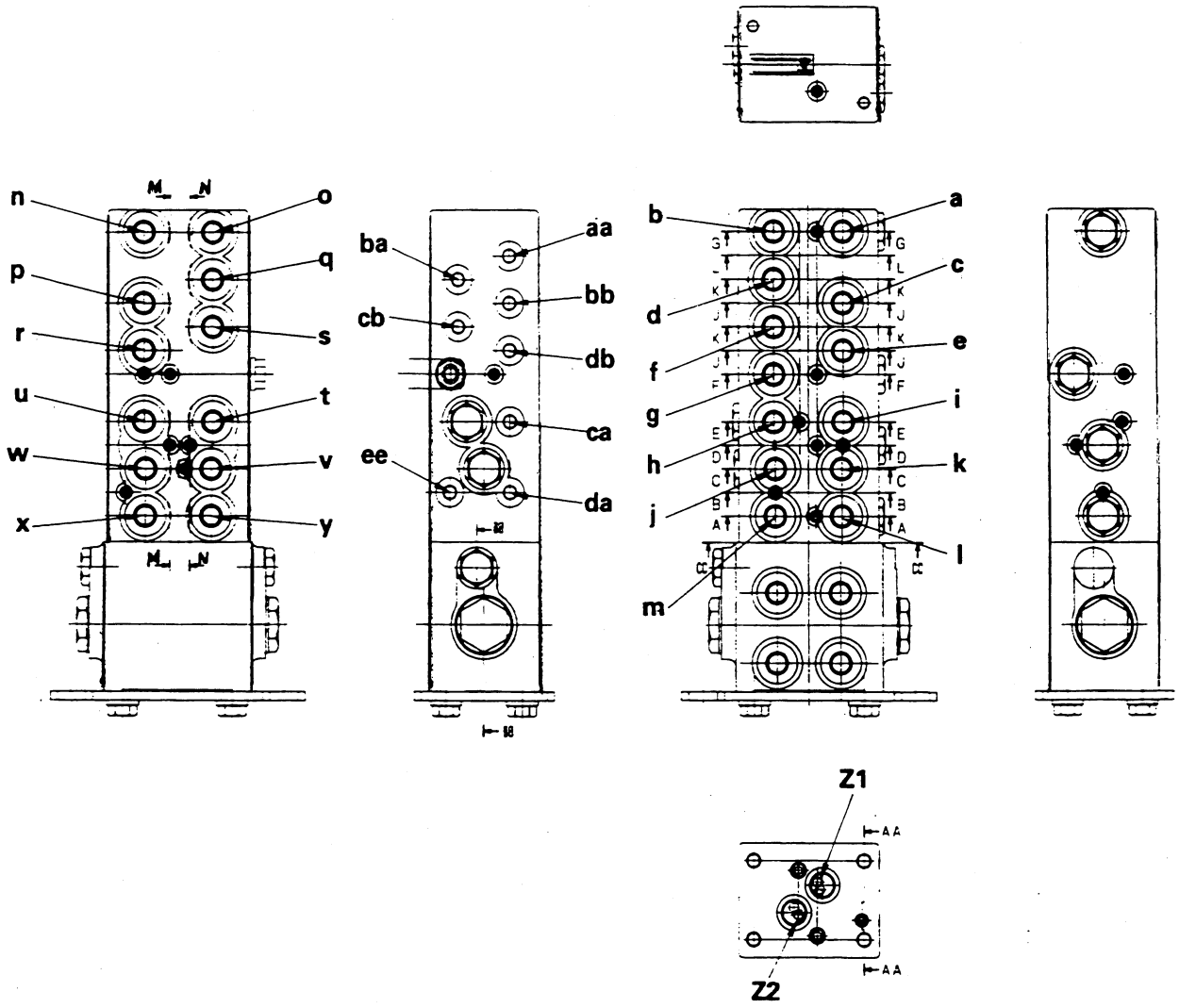


1. PPC shuttle valve
2. Travel junction valve

OUTLINE

- The PPC shuttle valve and travel junction valve form a combined structure.

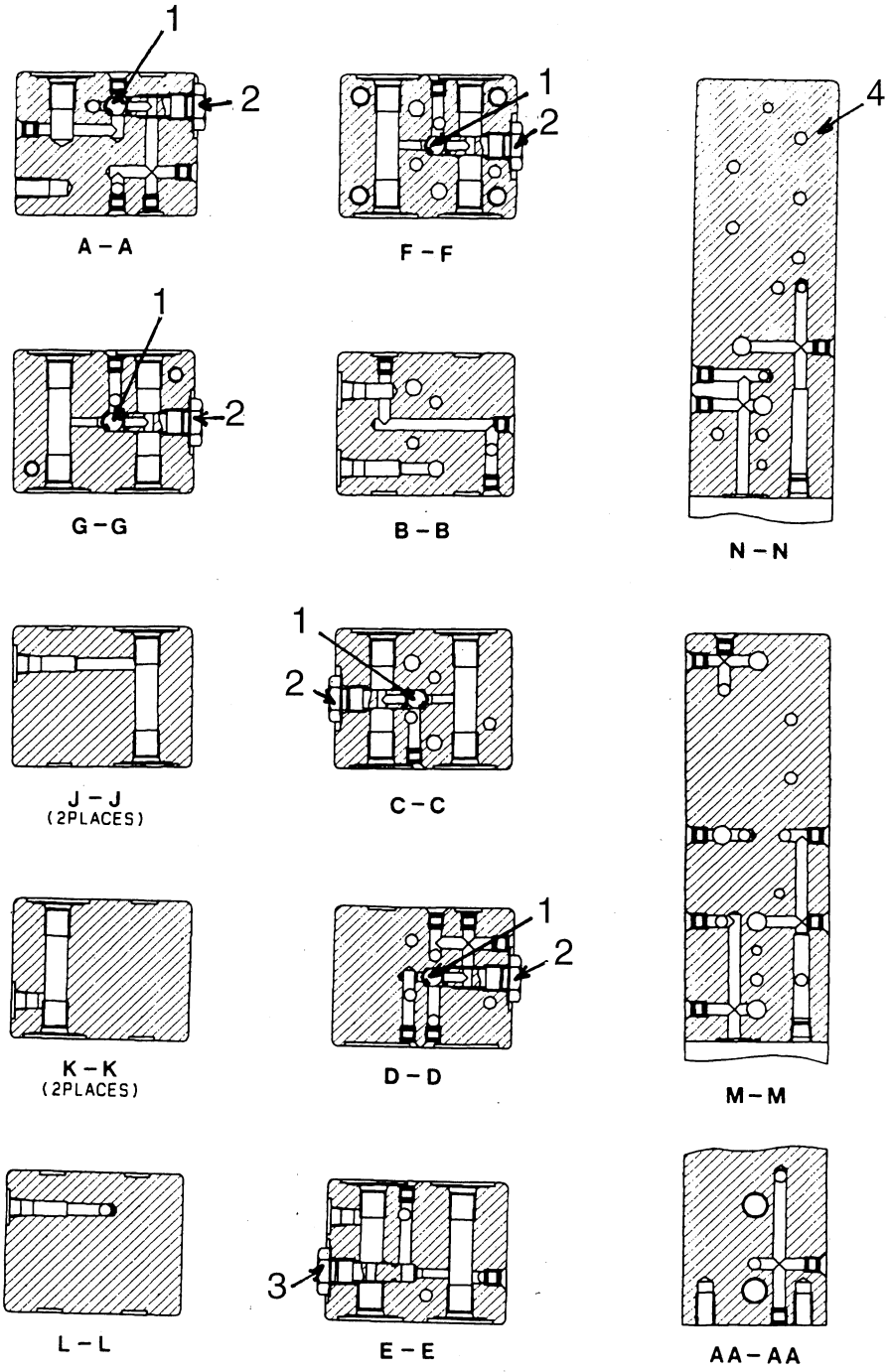
PPC SHUTTLE VALVE



FUNCTION

This sends the PPC valve output pressure or EPC valve output pressure to the control valve and travel junction valve. It is provided with a mount port for the pressure switch for detecting the pilot pressure.

a. Port **P11** (to control valve [swing)]
b. Port **P21** [to control valve (swing)]
c. Port **P31** [to control valve (bucket)]
c. Port **P41** [to control valve (bucket)]
e. Port **P51** [to control valve (boom)]
f. Port **P61** [to control valve (arm)]
g. Port **PLS** (to LS select valve)
h. Port **P71** [to control valve (arm)]
i. Port **P81** [to control valve (boom)]
j. Port **PA1** [to control valve (R.H. travel)]
k. Port **PB1** [to control valve (L.H. travel)]
l. Port **PC1** [to control valve (L.H. travel)]
m. Port **P91** [to control valve (R.H. travel)]
n. Port **P12** (from swing PPC valve)
o. Port **P22** (from swing PPC valve)
p. Port **P32** (from bucket PPC valve)
q. Port **P42** (from bucket PPC valve)
r. Port **P52** (from boom PPC valve)
s. Port **P62** (from arm PPC/EPC valve)
t. Port **P72** (from arm PPC/EPC valve)
u. Port **P82** (from boom PPC/EPC valve)
v. Port **PA2** (from R.H. travel PPC valve)
w. Port **PB2** (from L.H. travel PPC valve)
x. Port **PC2** (from L.H. travel PPC valve)
y. Port **P92** (from R.H. travel PPC valve)
z1. Port **PR** (to travel junction valve)
z2. Port **PF** (to travel junction valve)
aa. Port **A1** (mount port for swing oil pressure switch)
ba. Port **A8** (mount port for bucket DUMP oil pressure switch)
bb. Port **A2** (mount port for bucket CURL oil pressure switch)
ca. Port **A4** (mount port for arm OUT oil pressure switch)
cb. Port **A3** (mount port for arm IN oil pressure switch)
da. Port **A5** (mount port form boom RAISE oil pressure switch)
db. Port **A7** (mount port for boom LOWER oil pressure switch)
ee. Port **A6** (mount port for travel oil pressure switch)

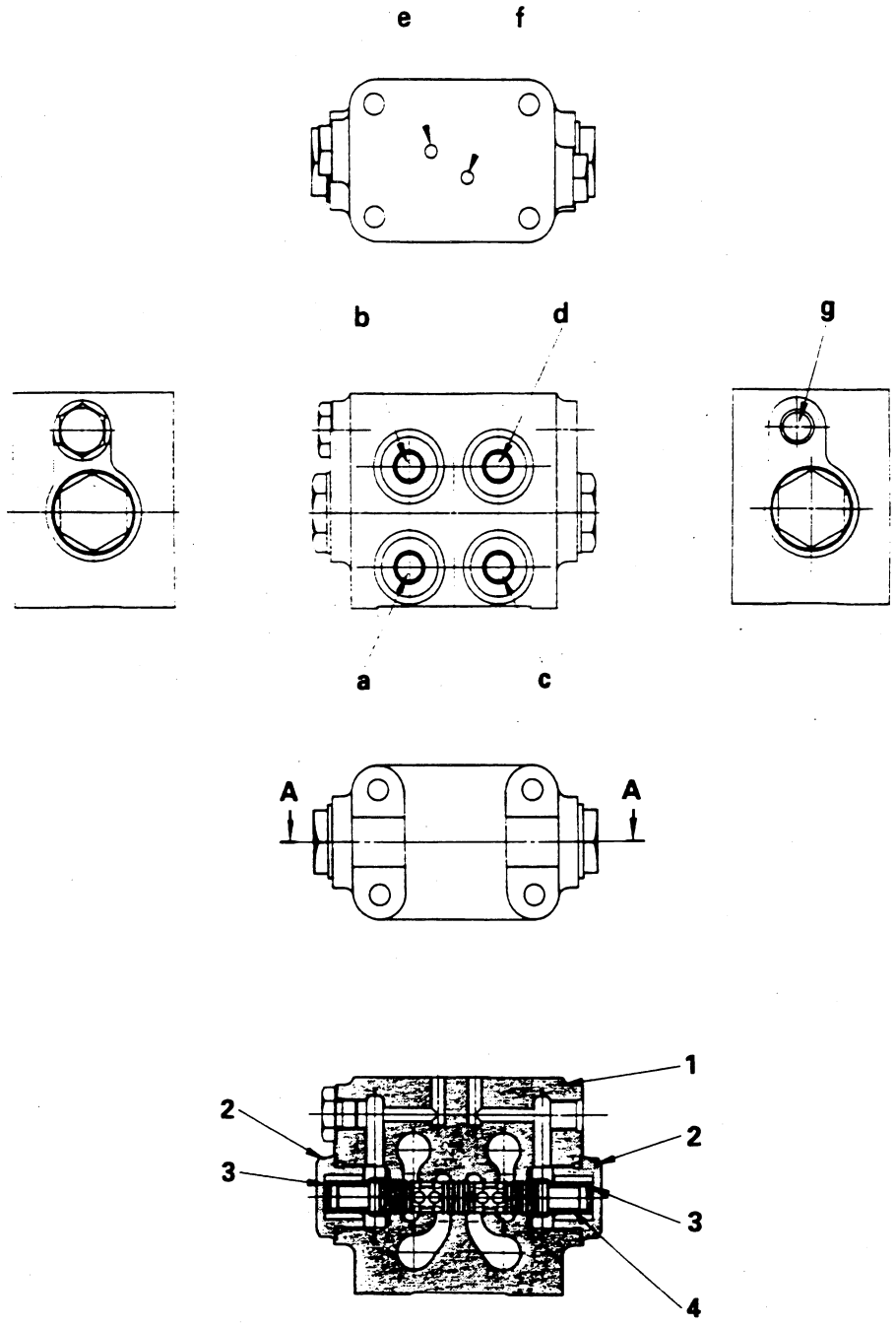


KW130P6033

PPC shuttle valve

1. Ball
2. Plug
3. Blind plug
4. Valve body

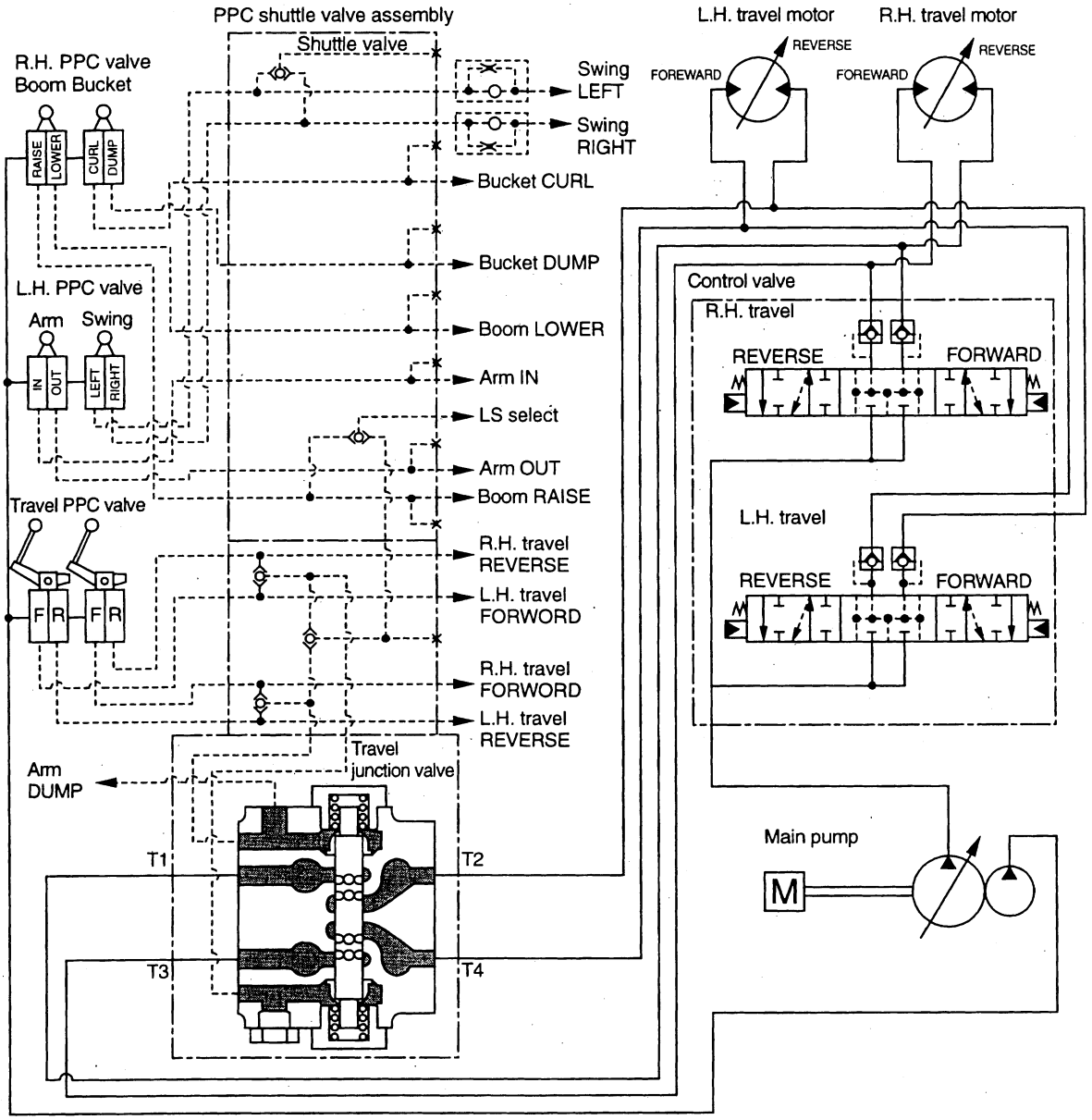
TRAVEL JUNCTION VALVE



1. Body
2. Plug
3. Spring
4. Spool

a. Port **T1** (from R.H. travel control valve)
b. Port **T2** (from L.H. travel control valve)
c. Port **T3** (from R.H. travel control valve)
d. Port **T4** (from L.H. travel control valve)
e. Port **PF** (from PPC shuttle valve)
f. Port **PR** (from PPC shuttle valve)
g. Port **PS** (to control valve (arm))

STRAIGHT-TRAVEL SYSTEM



FUNCTION

- A travel junction valve is installed between the travel valve and travel motor to compensate for any difference in the oil flow to the left and right travel circuits when traveling in a straight line.
- Because of this, the flow of oil to the left and right travel motors when traveling in a straight line is almost the same, so there is no travel deviation.
- The travel junction valve interconnects the travel circuit when the straight-travel is operated independently or when the straight travel + another actuator are operated simultaneously.
- When steering, if the difference in the movement of the travel levers is more than approx. 10 mm, the travel junction valve is switched, and the left and right travel circuits are shut off.

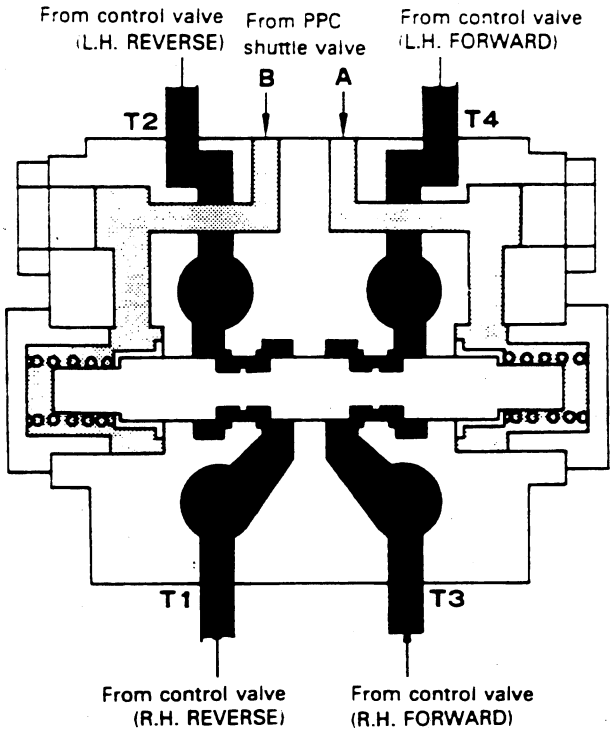
OPERATION

A: PPC output pressure (R.H. travel REVERSE or L.H. travel FORWARD)

B: PPC output pressure (R.H. travel FORWARD or L.H. travel REVERSE)

WHen traveling in a straight line in forward or reverse

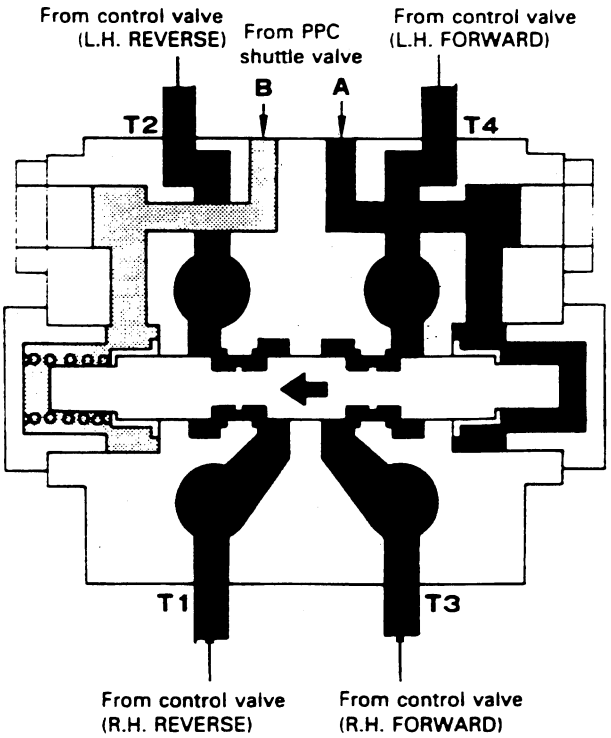
- When traveling forward (or in reverse), there is no difference in the pilot pressure from the PPC shuttle valve (the output pressure of each PPC valve), so the spool is balanced in the middle. In this condition, the R.H. FORWARD and L.H. FORWARD, and R.H. REVERSE and L.H. REVERSE are interconnected through the spool.



205F06109

When steering in forward or reverse

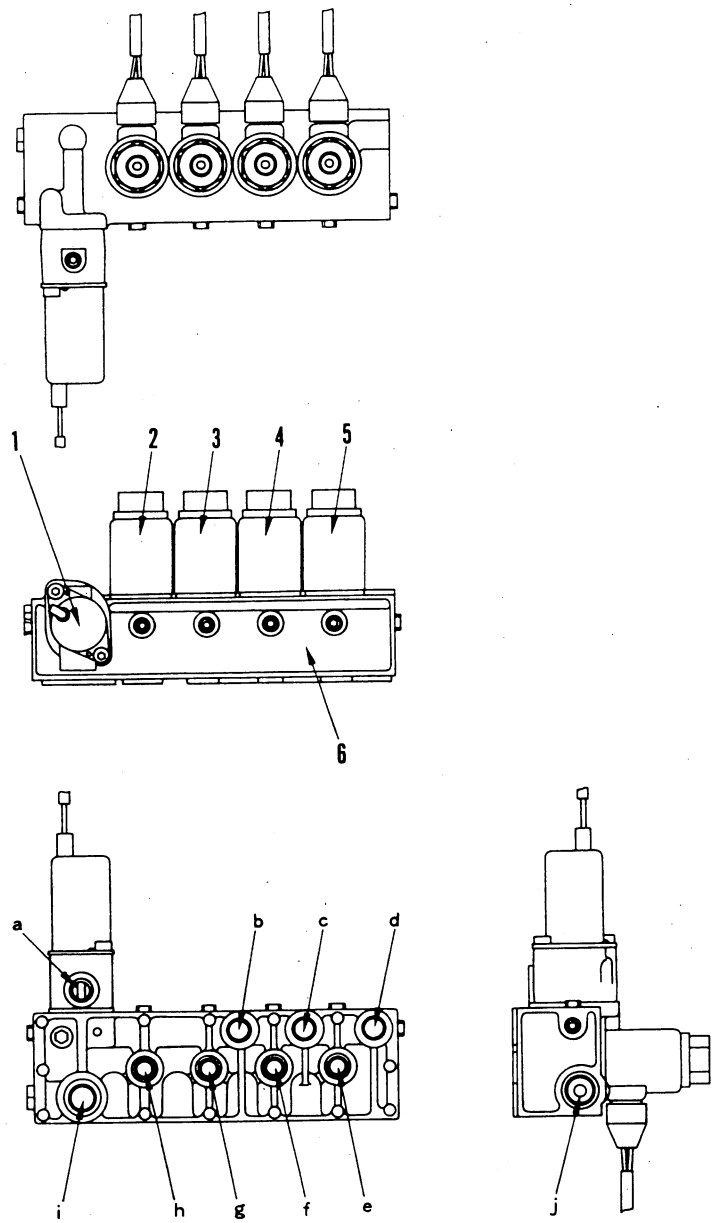
- When the steering is operated in forward (or reverse), if the difference in the pilot pressure from the PPC shuttle valve becomes greater than the switching pressure (spring force), the spool moves to the right or left and the L.H. and R.H. forward and L.H. and R.H. reverse passages are separated. Because of this, a difference in pressure is created in the L.H. and R.H. circuits, and the steering can be operated.



205F06110

EPC • SOLENOID VALVE

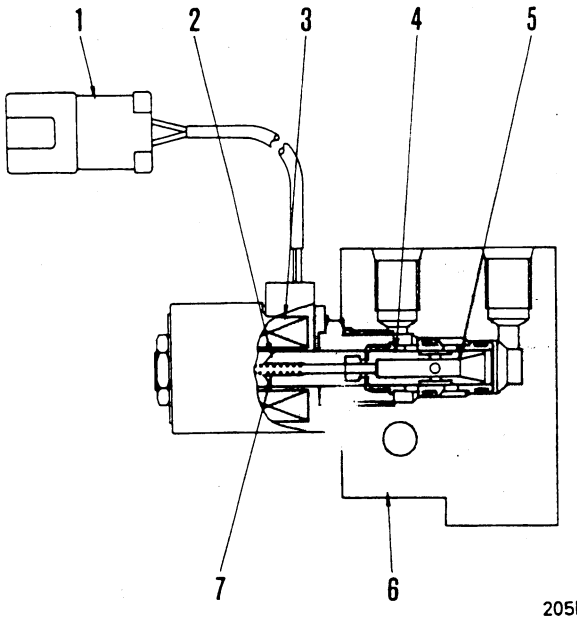
LS SELECT, 2-STAGE RELIEF, TRAVEL SPEED, SWING BRAKE SOLENOID VALVE



202F06123

a. Port **A5** (to pump LS valve)
b. Port **T2** (to LS select valve)
c. Port **T1** (from PPC valve)
d. Port **T0** (to tank)
e. Port **A1** (to L.H. and R.H. travel motor)
f. Port **A2** (to swing motor)
g. Port **A3** (to main relief valve)
h. Port **A4** (to LS bypass valve)
i. Port **P1** (to PPC valve)
j. Port **P0** (from control pump)

1. LS control EPC valve
2. LS bypass solenoid valve
3. 2-stage relief solenoid valve
4. Swing brake solenoid valve
5. Travel speed solenoid valve
6. Valve block



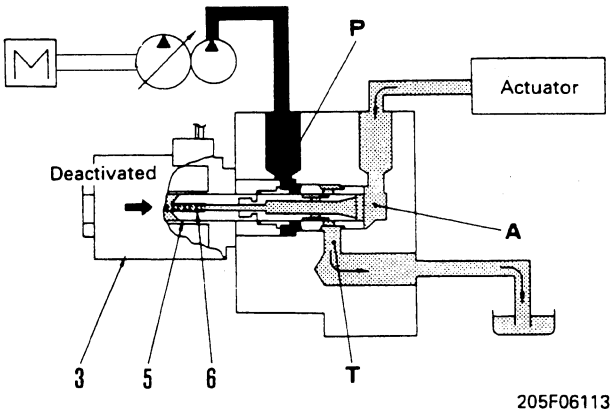
205F06112

1. Connector
2. Variable core
3. Coil
4. Cage
5. Spool
6. Block
7. Spring

OPERATION

When solenoid is deactivated

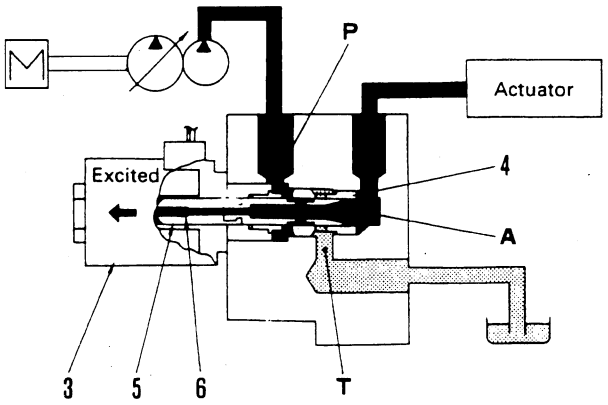
- The signal current does not flow from the controller, so coil (3) is deactivated.
  For this reason, spool (5) is pushed to the right in the direction of the arrow by spring (6).
  As a result, the circuit between ports **P** and **A** closes and the pressurized oil from the control pump does not flow to the actuator.
  At the same time, the pressurized oil from the actuator flows from port **A** to port **T**, and is then drained to the tank.



205F06113

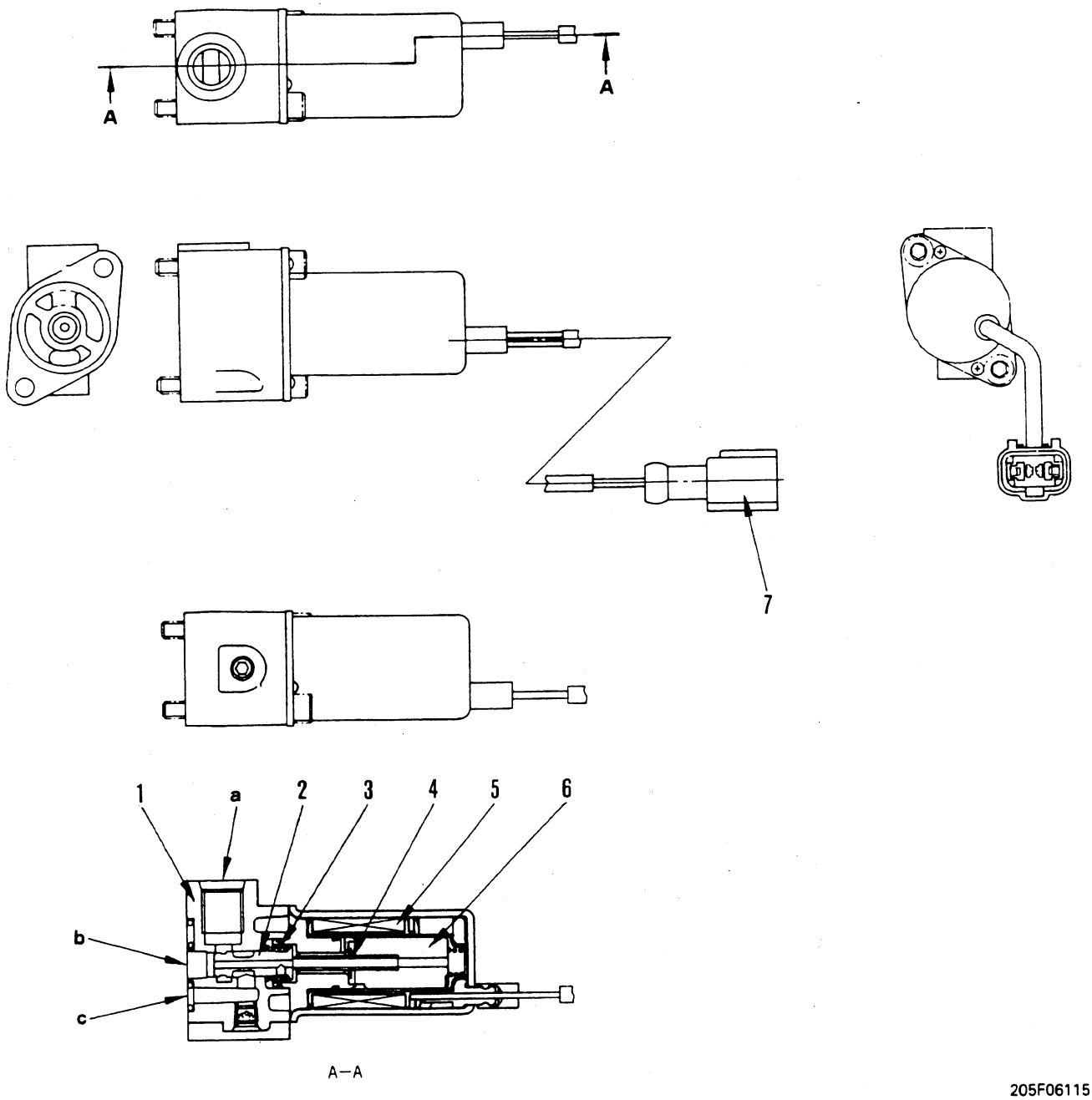
When solenoid is excited

- When the signal currenct flows from the controller to coil (3), coil (3) is excited.
  For this reason, spool (5) is pushed to the left in the direction of the arrow.
  As a result, the pressurized oil from the control pump flows from port **P** through the inside of spool (5) to port **A**, and then flows to the actuator.
  At the same time, port **T** is closed, and this stops the oil from flowing to the tank.



205F06114

LS CONTOL EPC VALVE



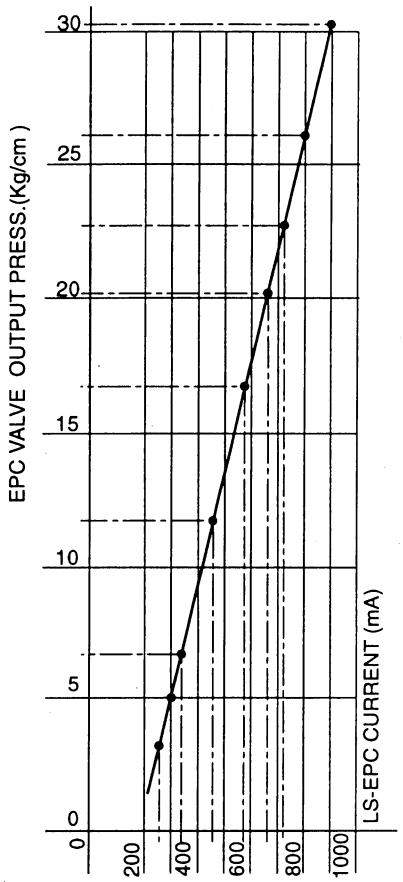
205F06115

1. Body
2. Spool
3. Spring
4. Push pin
5. Coil
6. Plunger
7. Connector

a. Port **C** (to LS valve)
b. Port **T** (to tank)
c. Port **P** (from control pump)

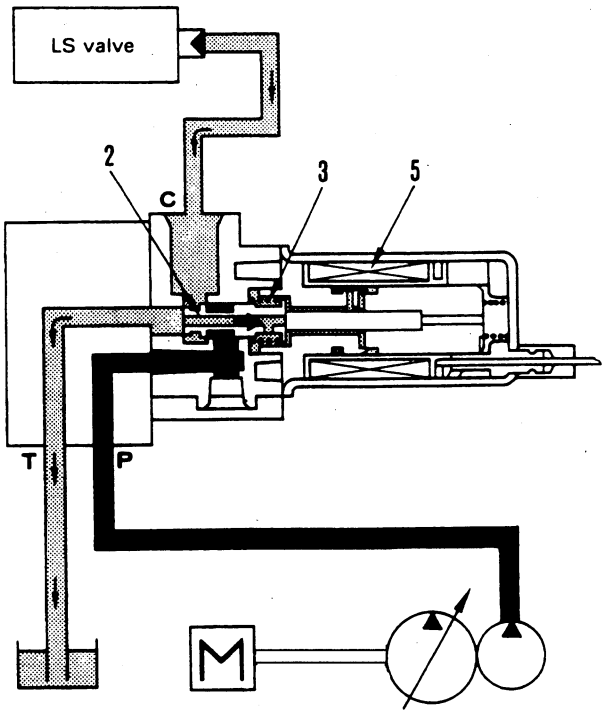
FUNTION

- The EPC valve consists of the proportional solenoid portion and the hydraulic valve portion.
- When it receives signal current "i" from the valve controller, it generated the EPC output pressure in proportion to the size of the signal, and outputs it to the control valve.



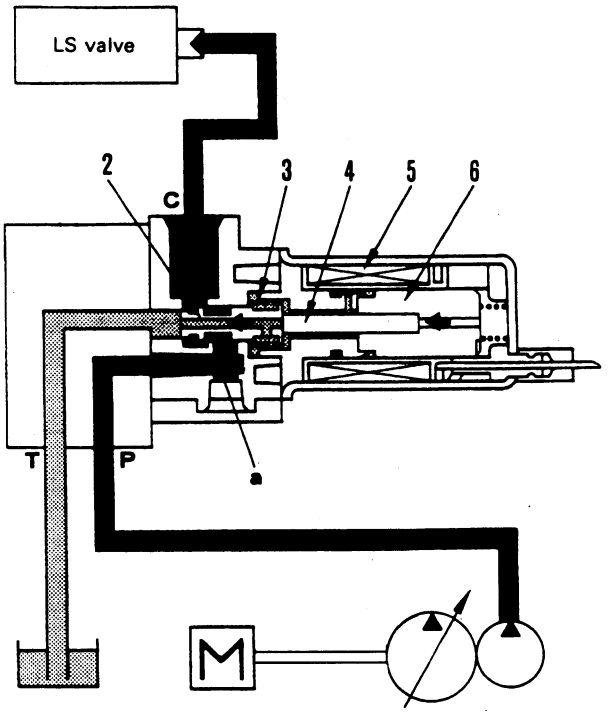
OPERATION

1. When signal current is 0 (coil deactivated)
- There is no signal current flowing from the controller to coil (5), coil (5) is deactivated.
- For this reason, spool (2) is pushed to the right in the direction of the arrow by spring (3).
- As a result, port **P** closes and the pressurized oil from the control pump does not flow to the LS valve.
  At the same time, the pressurized oil from the LS valve passes from port **C** through port **T** and is drained to the tank.



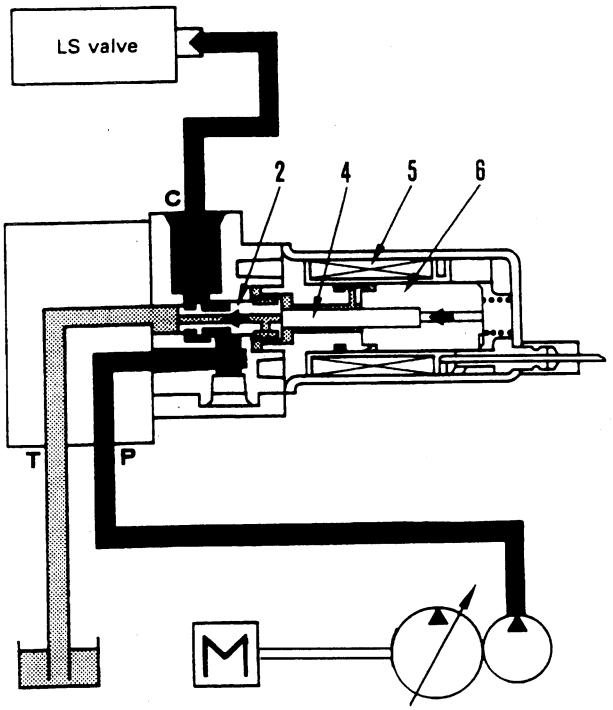
2. When signal current is very small (coil excited)

- When a very small signal current flows to coil (5) is excited, and a propulsion force is generated, which pushes plunger (6) to the left in the direction of the arrow.
- Push pin (4) pushes spool (2) to the left in the direction of the arrow, and pressurized oil flows from port **P** to port **C**.
- When the pressure at port **C** rises and the load of spring (3) + the force acting on surface "**a**" of spool (2) becomes greater than the proportion force of plunger (6), spool (2) is pushed to the right in the direction of the arrow. The circuit between port **P** and port **C** is shut off, and at the same time, port **C** and port **T** are connected.
- As a result, spool (2) is moved to the left or right until the propulsion force of plunger (6) is balanced with the load of spring (3) + pressure of **port** C.
- Therefore, the circuit pressure between the EPC valve and the LS valve is controlled in proportion to the size of the signal current.



3. When signal current is maximum (coil excited)

- When the signal current flows to coil (5), coil (5) is excited.
- When this happens, the signal current is at its maximum, so the propulsion force of plunger (6) is also at its maximum.
- For this reason, spool (1) is pushed to the left in the direction of the arrow by push pin (4).
- As a result, the maximum flow or pressurized oil from port **P** flows at its maximum to port **C**, and the circuit pressure between the EPC valve and LS valve becomes the maximum.
- At the same time, port **T** closes and stops the oil from flowing to the tank.



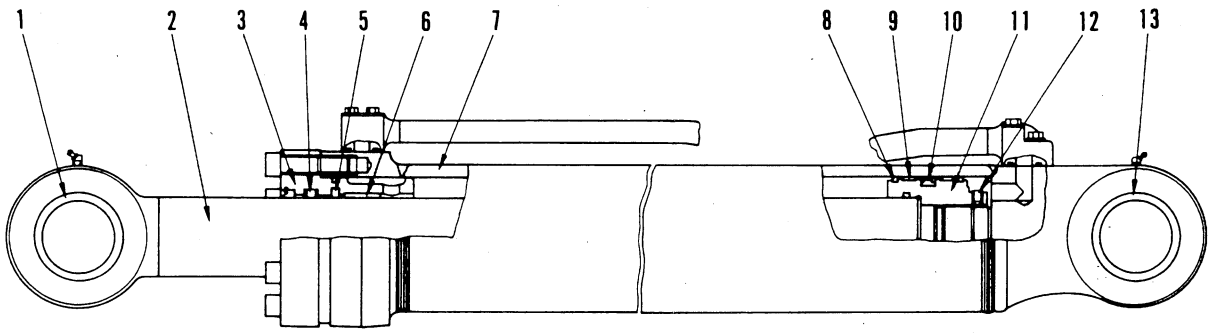
HYDRAULIC CYLINDER

SPECIFICATIONS

Unit: mm

Item	Boom		Arm		Bucket	
	PC180LC-6K	PC160-6K	PC180LC-6K	PC160-6K	PC180-6K	PC160-6K
Outside diameter of piston rod	75	75	85	85	75	70
Inside diameter of cylinder tube	110	110	120	120	110	105
Stroke	1170	1170	1352	1352	1013	1013
Max. stroke	2805	2805	3285	3285	2560	2560
Min. stroke	1635	1635	1933	1933	1547	1547

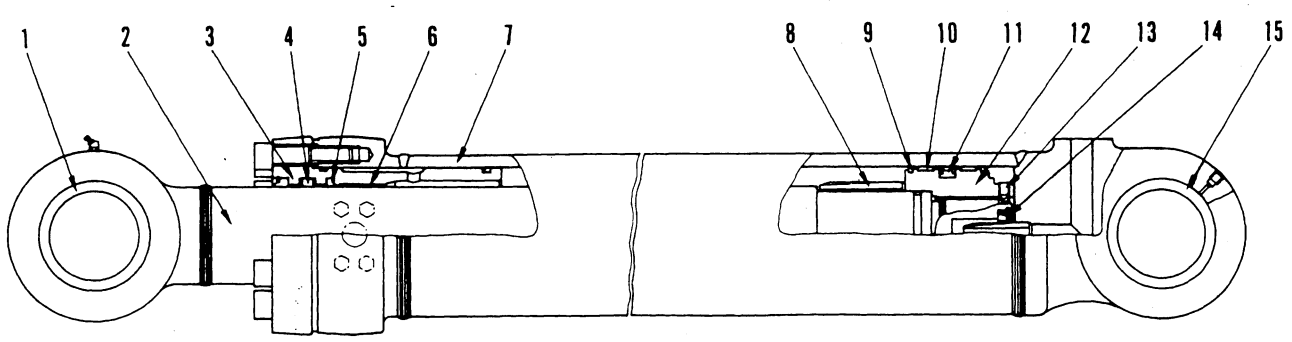
BOOM CYLINDER



FK203P5016

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

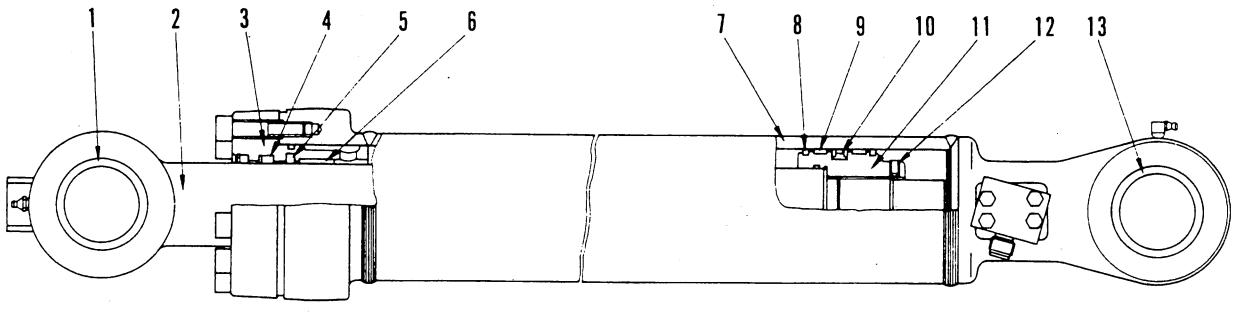
ARM CYLINDER



FK203P5018

1. Rod side bushing
2. Piston rod
3. Cylinder head
4. Rod packing
5. Buffer ring
6. Wear ring
7. Cylinder
8. Head side cushion plunger
9. Castingring
10. Wear ring
11. Piston ring
12. Piston
13. Set screw
14. Bottom side cushion plunger
15. Bottom side bushing

BUCKET CYLINDER

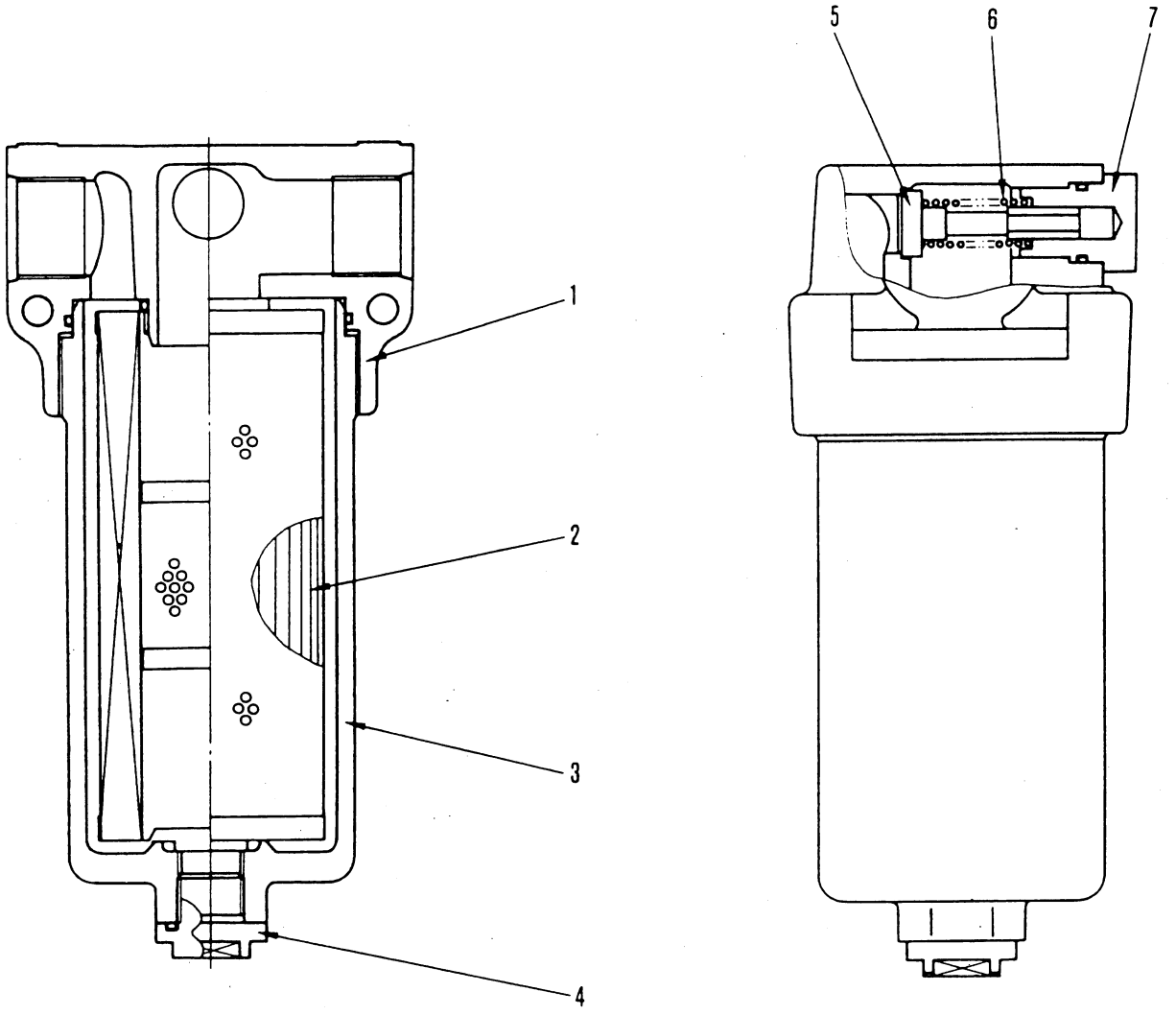


FK203P5021

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

ADDITIONAL FILTER FOR BREAKING

★ **For machine equipped with breaker**



205F06096

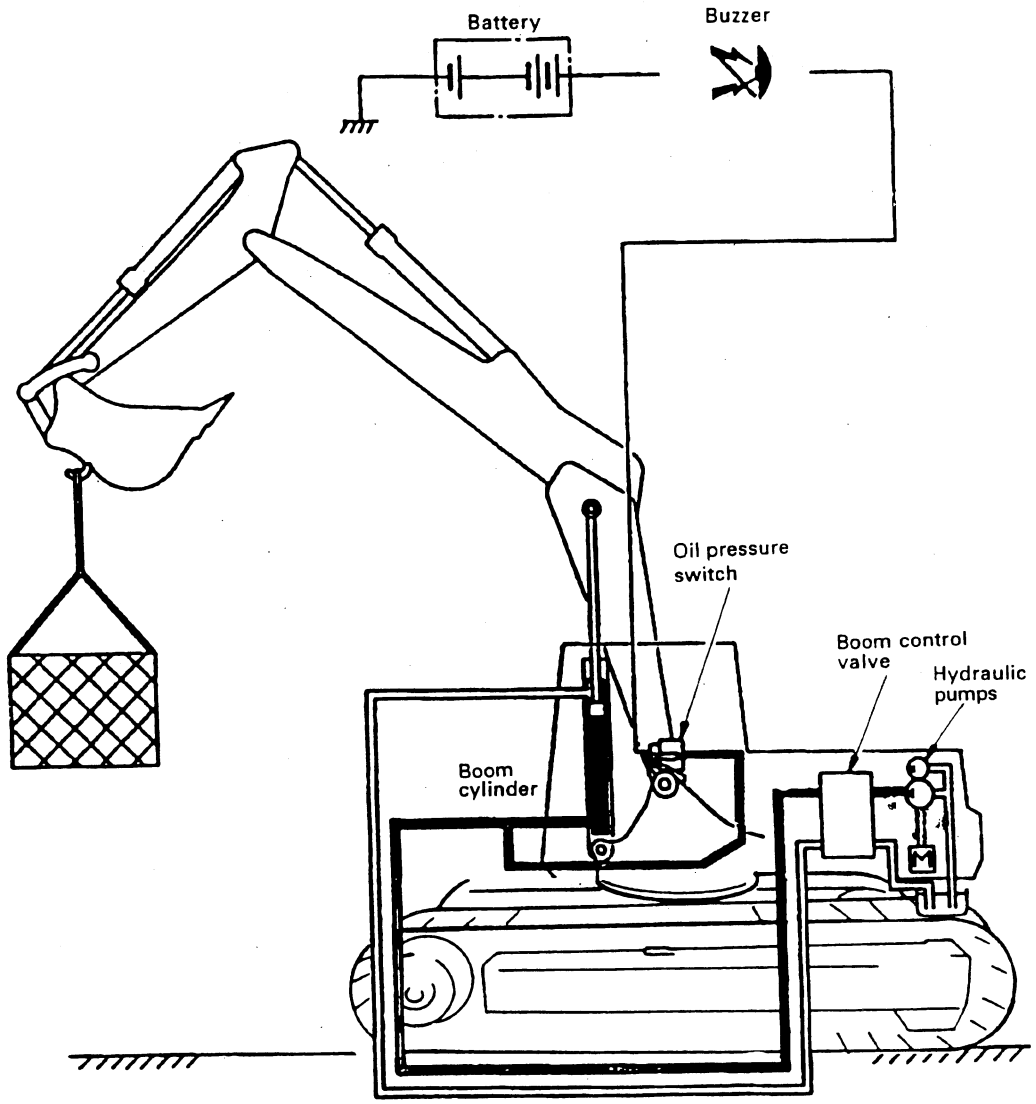
1. Head cover
2. Element
3. Case
4. Drain plug
5. Valve
6. Spring
7. Spring set plug

SPECIFICATIONS

Rated pressure	: 6.86 MPa (70 kg/cm²)
Flow	: 107ℓ/min
Relief valve cracking pressure	: 0.34 ± 0.049 MPa (3.5 ± 0.5 kg/cm²)
Filter mesh size	: 6 µm
Filtering area	: 3160 cm²

OVERLOAD WARNING DEVICE

1. OUTLINE



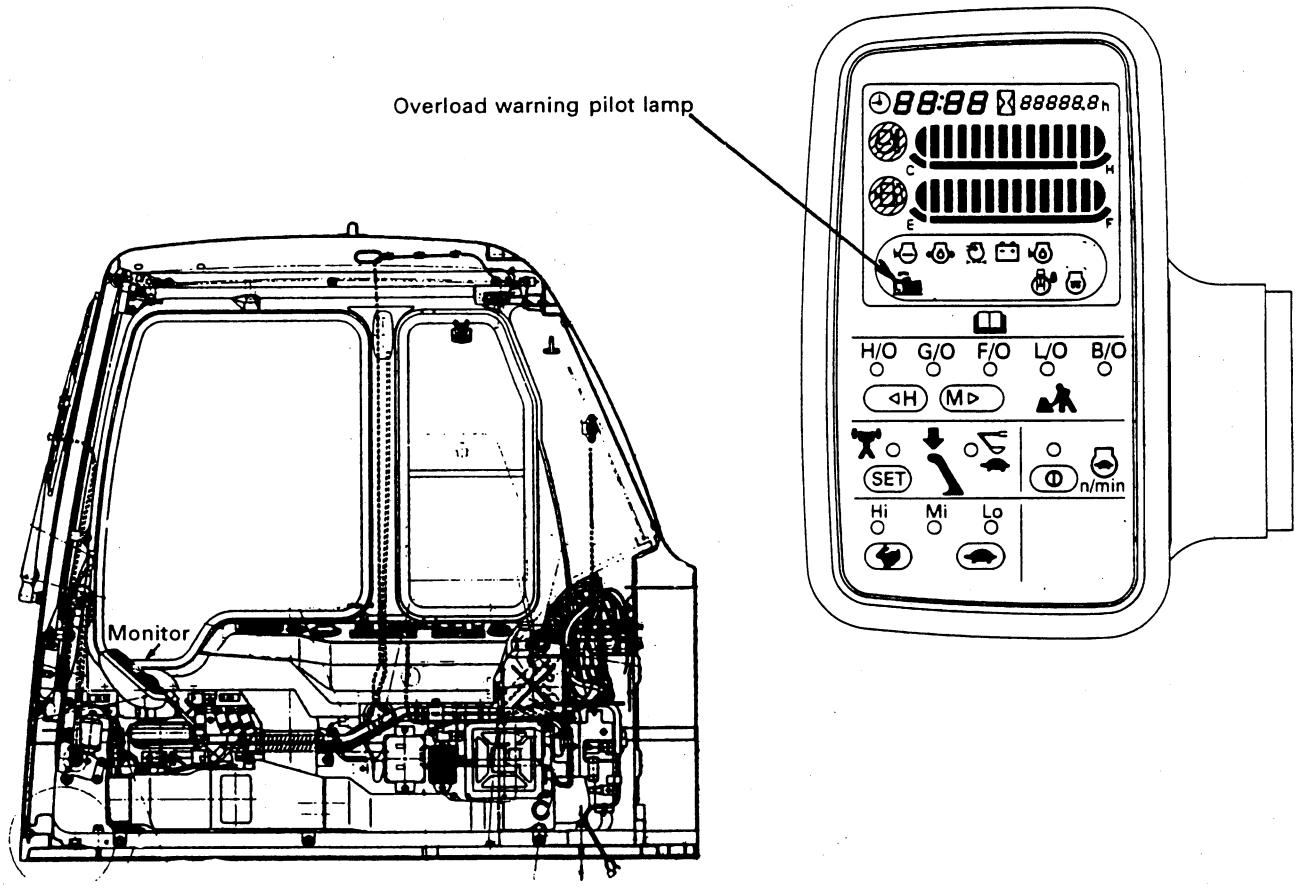
FUCTION

- This device is installed to warn the operator when the machine is close to tipping over when it lifts and excessive weight while being used as a crane.

STRUCTURE

- When an excessive weight is lifted, the oil pressure goes up at the bottom side of the boom cylinders. When this happens, the pressure switch senses the rising pressure, turns the pressure switch on, and lights the monitor lamp to warm the operator. When the monitor lamp lights, immediately lower the weight to the ground or bring the arm closer in to the operator to prevent the machine from tipping over.

Control panel



2. OPERATION

- Hose (2) directs the oil pressure from the bottom side of the boom cylinders to pressure switch (3).

a. When the boom is in the lowest position

- When boom (5) is in the lowest position, lever (4) takes position **A** in Fig. 1 and the pressure to activate its switch (closed and open) becomes 60 kg/cm^2.

b. When the boom is in the highest position

- When the boom is in the highest position, lever (4) takes position **B** in Fig. 1 and the pressure to activate the switch becomes 360 kg/cm^2.

c. When the boom is in an arbitrary position

- When the boom is in a position anywhere between the lowest and the highest points, the operating pressure of switch (3) will be somewhere between 360 kg/cm^2, based on the boom position.
  For instance, when the boom is in a certain position between the lowest and the highest points, lever (4) takes a position which corresponds to that boom position.

If lever (4) is in the position to make the operating pressure of the pressure switch 150 kg/cm^2 (which is thesame pressure as the bottom side of the boom cylinder), the pressure switch will turn on when excessive weight is lifted by the boom and the oil pressure of the bottom of the boom cylinders exceeds 150 kg/cm^2.

⚠ When the machine is performing any kind of operation other than lifting loads, fasten the pressure switch lever (4) with the bolt (6) to prolong the life at the pressure switch.

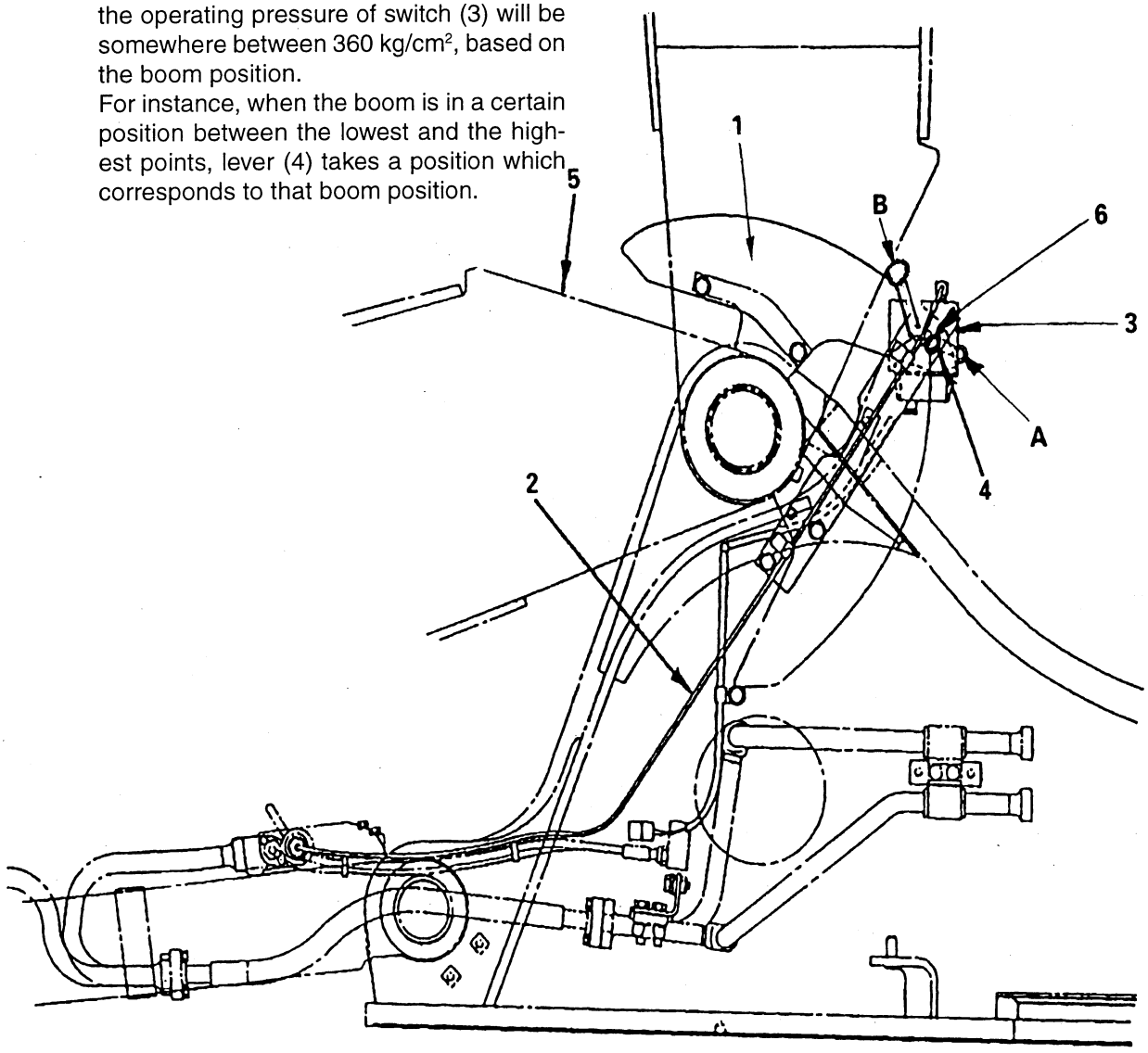
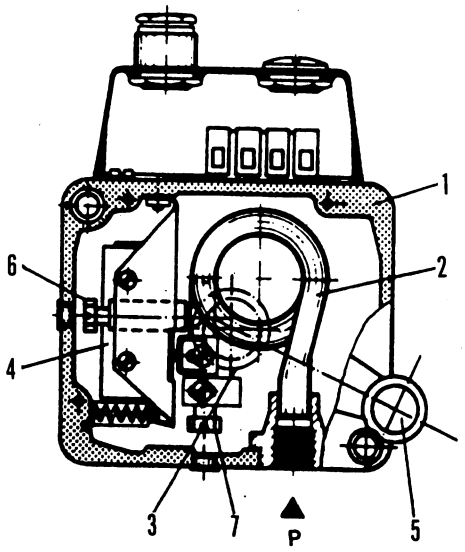


FIG.1

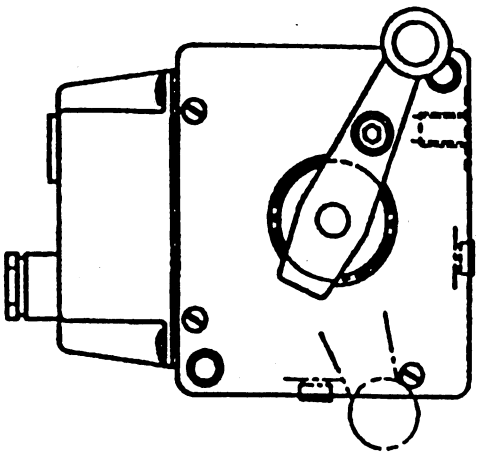
3. ADUSTING PRESSURE OF THE OIL PRESSURE SWITCH

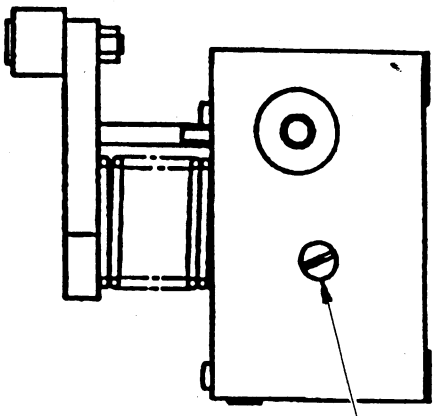
- **Screw D: Pressure range adjustment screw**
  To make an adjustment so that the oil pressure switch acts normally when checking the operation of the overload warning device.
  Turning to the left makes the pressure range wider.
- **Screw E: Zero point adjustment screw**
  Turning to the right one complete turn raises the pressure by 57 kg/cm^2.
  Each complete turn to the left lowers the pressure by 57 kg/cm^2.

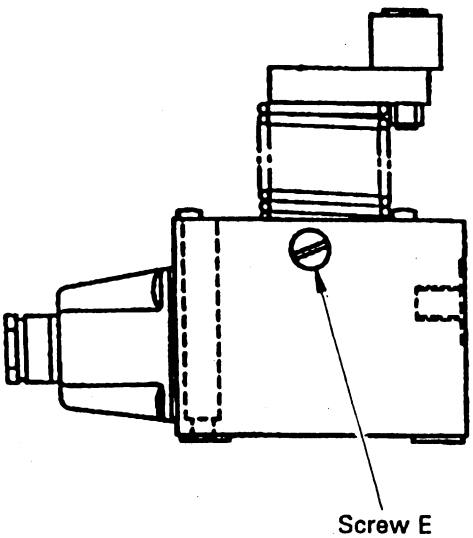
⚠ When an adjustment is required, contact your Komatsu distributor and have him make the adjustment.



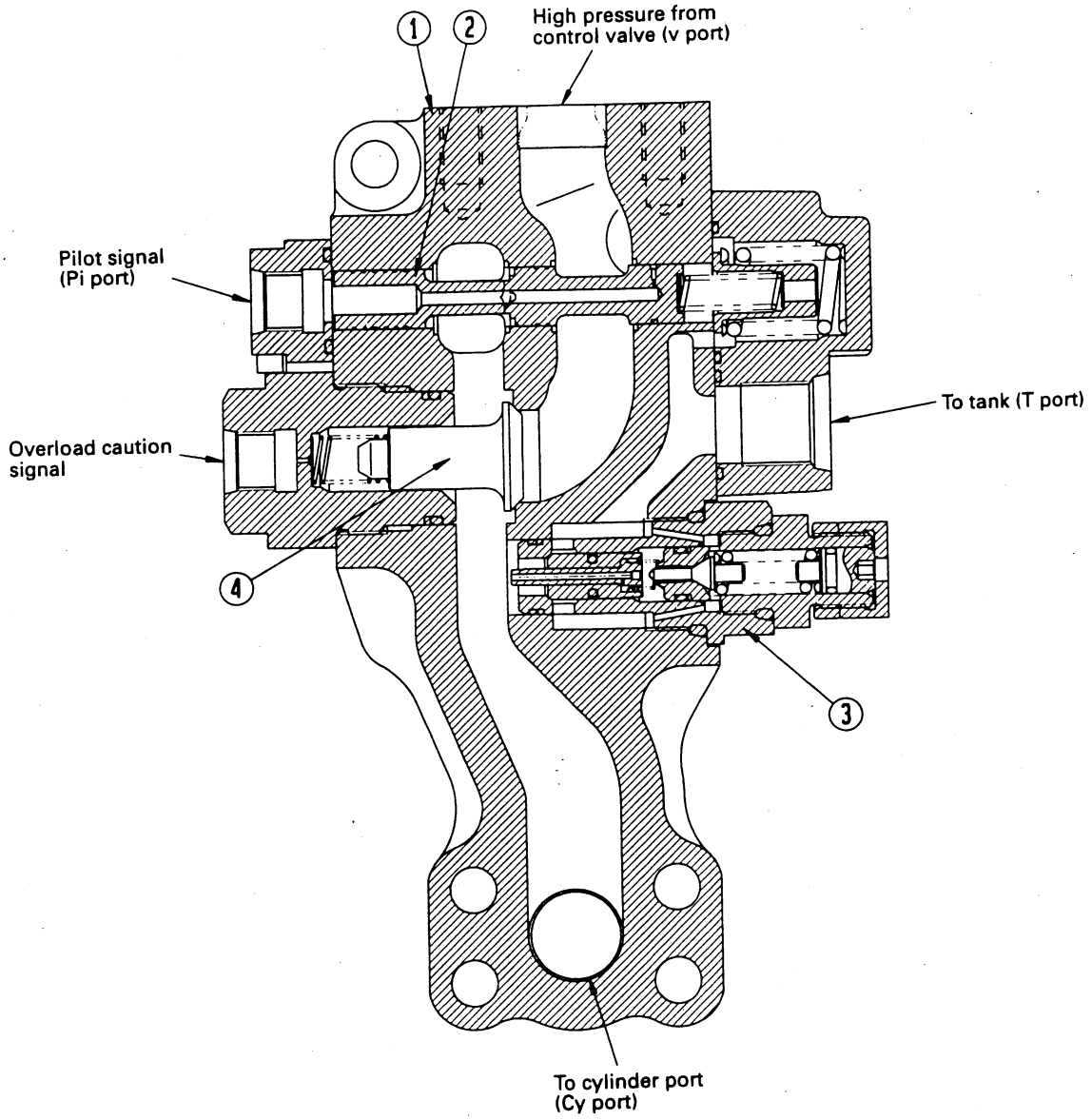
1. Body
2. Boudon tube
3. Eccentric disc
4. Microswitch
5. Lever and roller
6. Adjustment screw (E)
7. Adjustment screw (D)







HOSE BURST PROTECTION VALVE (BOOM)

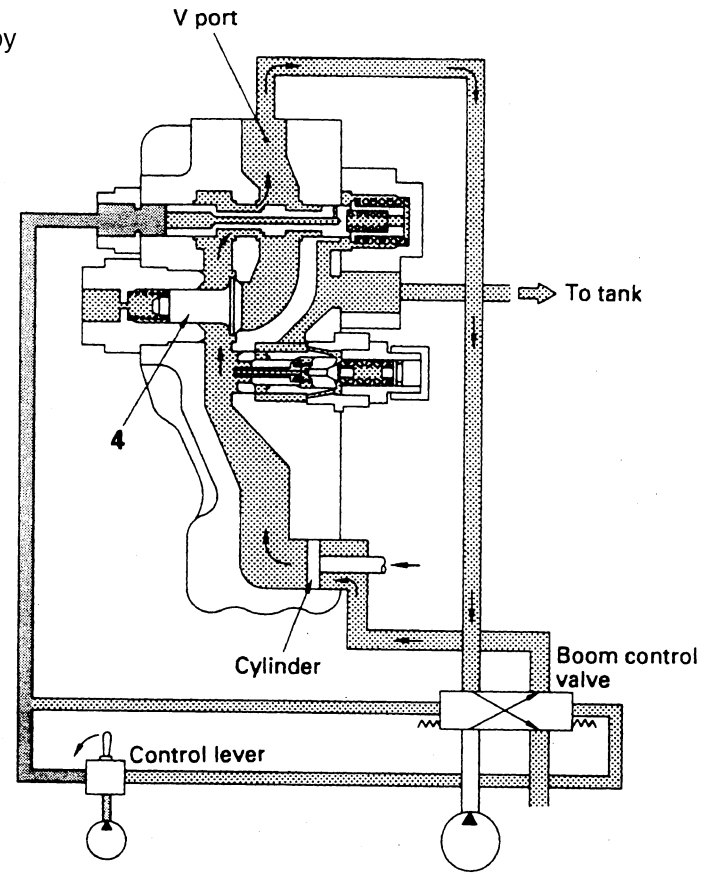


FUNCTION

- This valve prevents sudden uncontrolled lowering of the boom, when lifting, due to the burst of a hose in the boom cylinder line. In such a condition this valve will hold the load until operator lowers the boom in a controlled way using the normal wrist control.

When hose burst occurs
(Operation to lower safety)

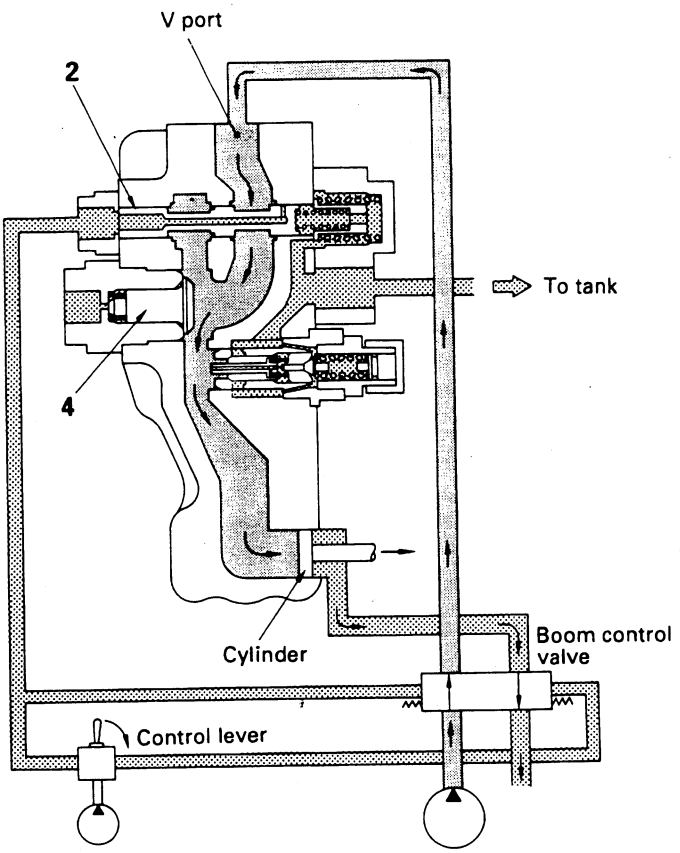
- The sudden loss of pressure at port **V** will cause check valve (4) to re-seat and so the valve is locked.
- The boom can be lowered in a controlled way by operating the wrist control in the normal way.



OPERATION

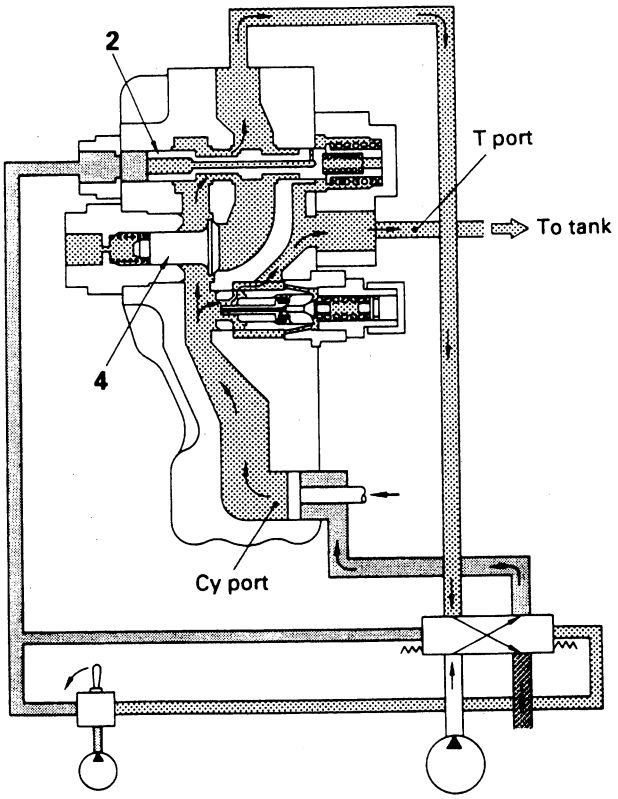
BOOM RAISE

- During boom raising the pilot signal from wrist control operates control valve spool to direct high pressure oil to port **V** of hose burst valve.
- This pressure lifts check valve (4) from seat & high pressure oil flows in the bottom of the cylinder raising the boom.

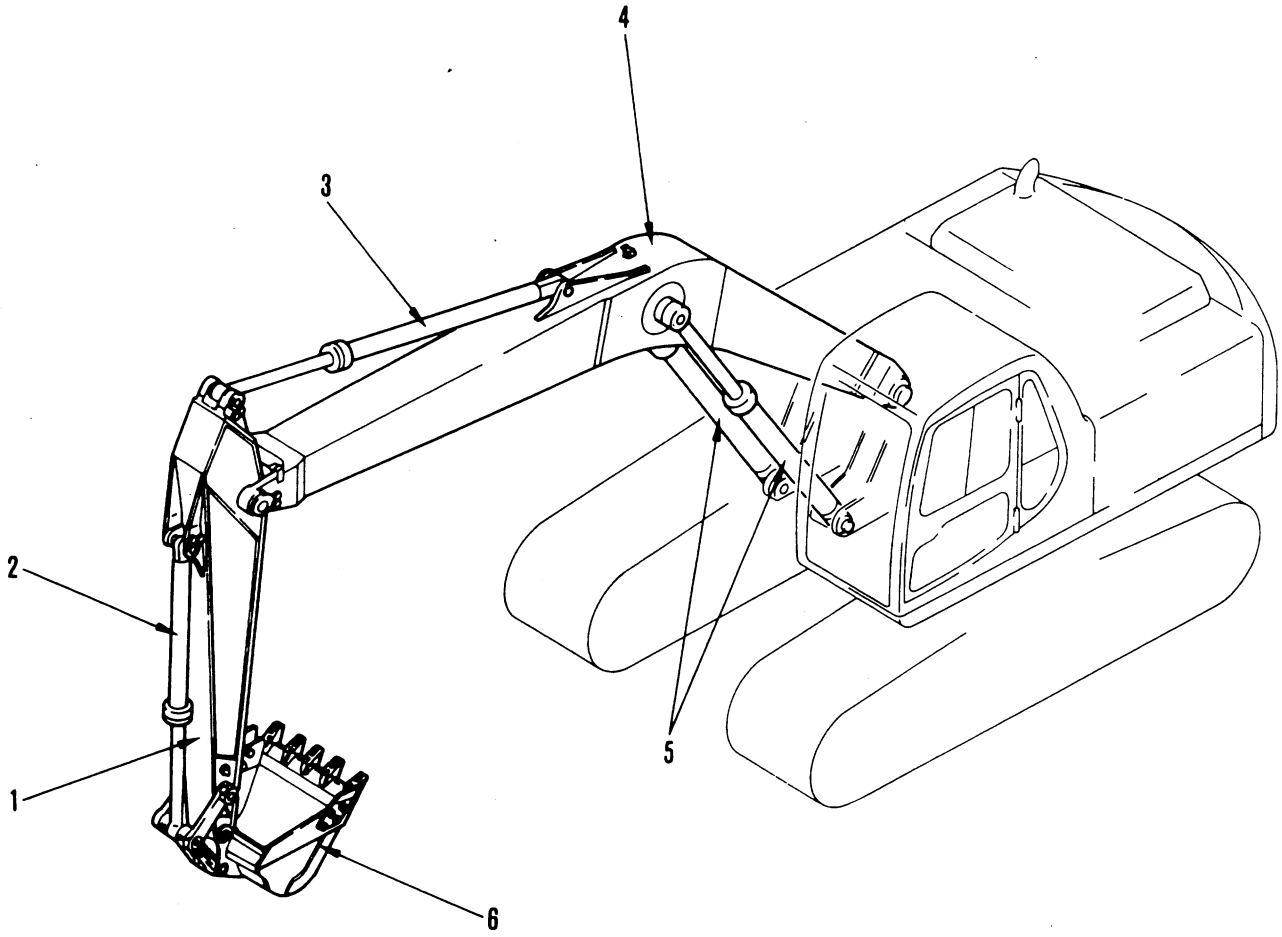


BOOM LOWER

- During boom lowering the pilot signal reverses the front through the control valve spool. High pressure oil flows to the head side of the cylinder. Oil in the bottom side of the cylinder flows through the port Cy of the valve but cannot flow past the check valve. the pilot signal also opens the spool (2) of the hose burst valve and allows oil to flow back to tank.

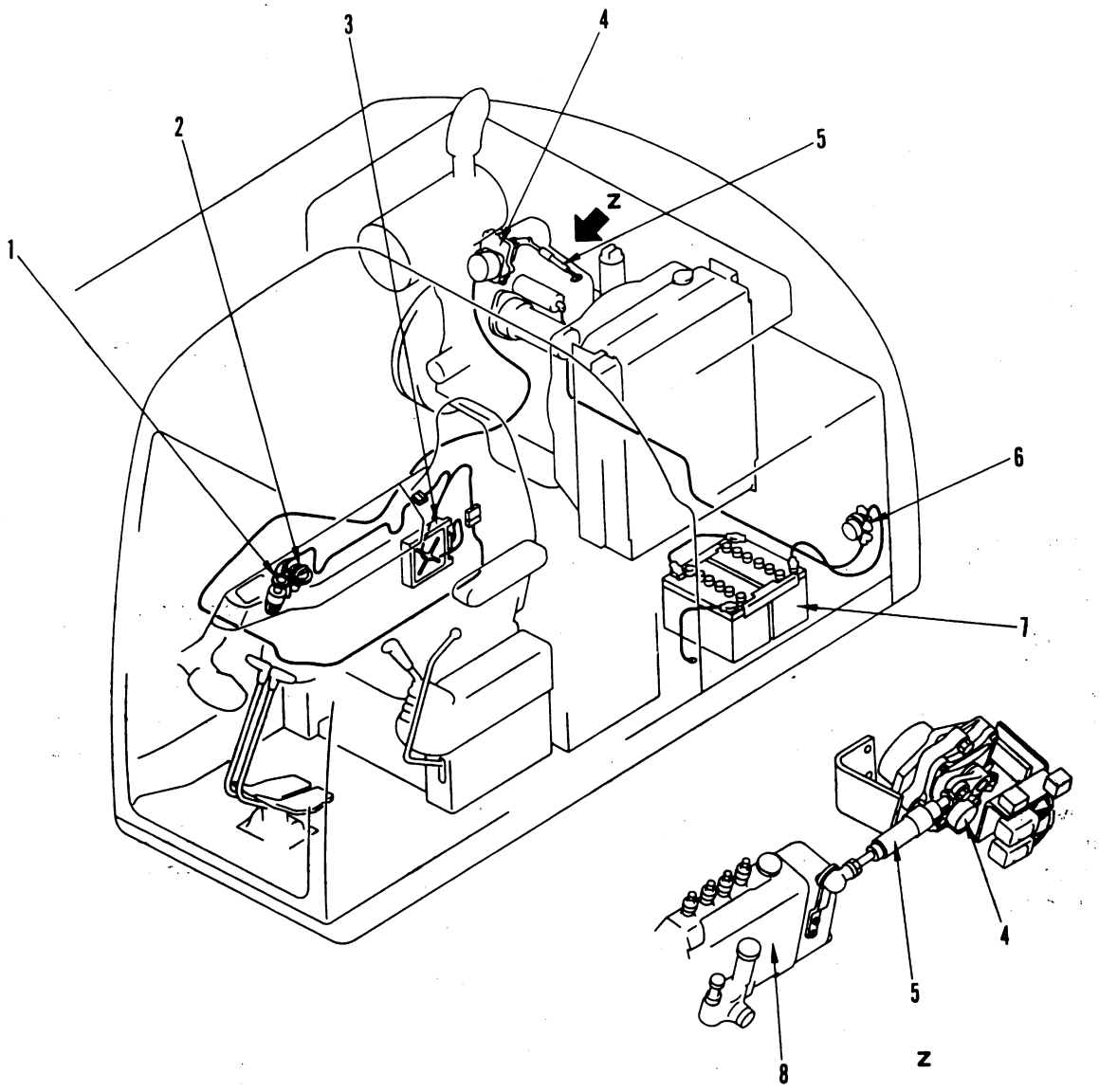


WORK EQUIPMENT



1. Arm
2. Bucket cylinder
3. Arm cylinder
4. Boom
5. Boom cylinder
6. Bucket

ENGINE CONTROL SYSTEM



202F06148

1. Starting motor
2. Fuel control dial
3. Pump end engine throttle controller
4. Governor motor
5. Loose spring
6. Battery relay
7. Battery
8. Fuel injection pump

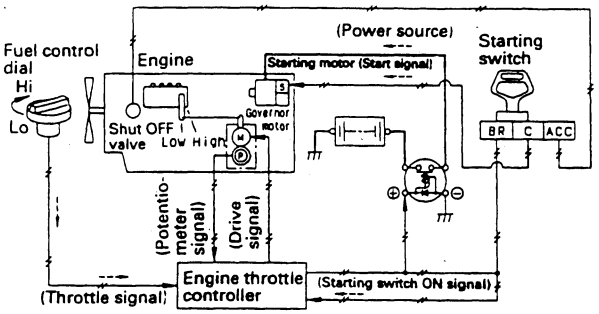
FUNCTION

- The engine can be started and stopped simply by using the starting switch.
- A dial type engine control is used to control the engine speed. The engine throttle controller receives the control signal from the fuel control dial, sends a drive signal to the governor motor, and controls the angle of the governor lever in the fuel injection pump.
- At the same time, the engine throttle controller also receives signals from other controllers to control the engine speed.

1. OPERATION OF SYSTEM

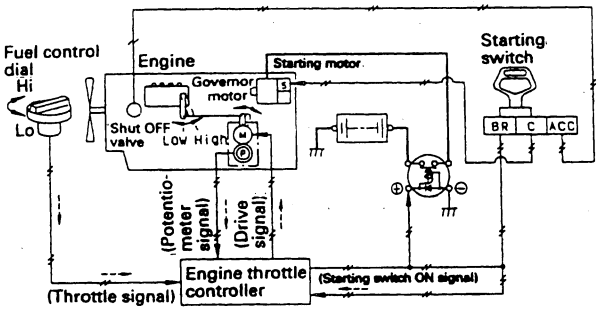
Starting engine

- 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.



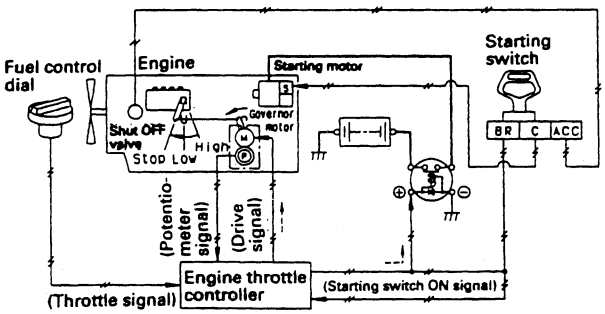
Engine speed control

- 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 drive 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.



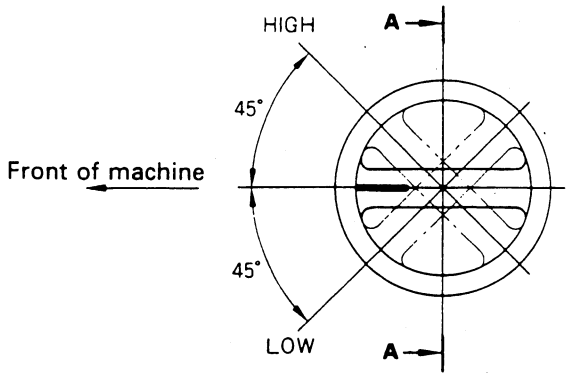
Stopping engine

- 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.

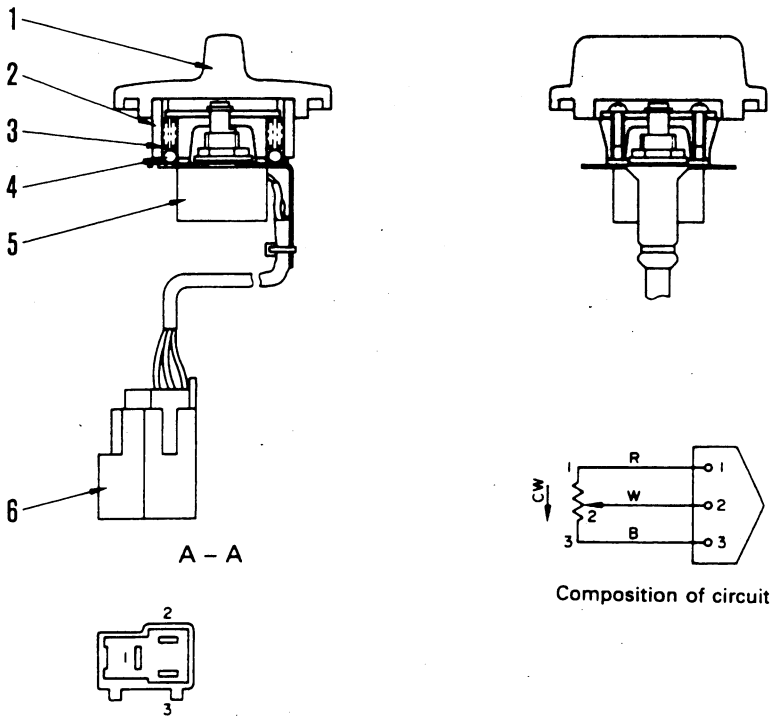


2. COMPONENTS OF SYSTEM

1) FUEL CONTROL DIAL



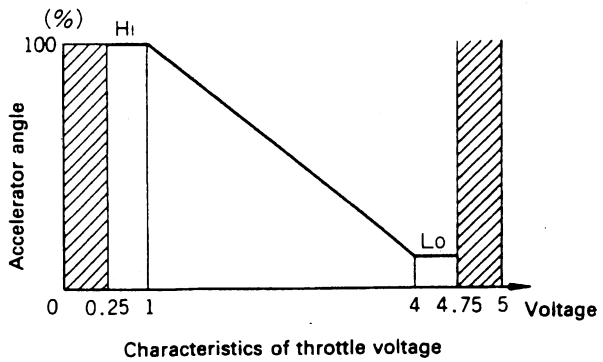
1. Knob
2. Dial
3. Spring
4. Ball
5. Potentiometer
6. Connector



205F05113

FUNCTION

- The fuel control dial is installed at the bottom of the monitor panel. A potentiometer is installed under the knob, and when the knob is turned, it rotates the potentiometer shaft.
  When the shaft rotates, the resistance of the variable resistor inside the potentiometer changes,a nd the desired throttle signal is sent to the engine throttle controller.
  The shaded area in the graph on the right is the abnormality detection area and the engine speed is set at low idling.

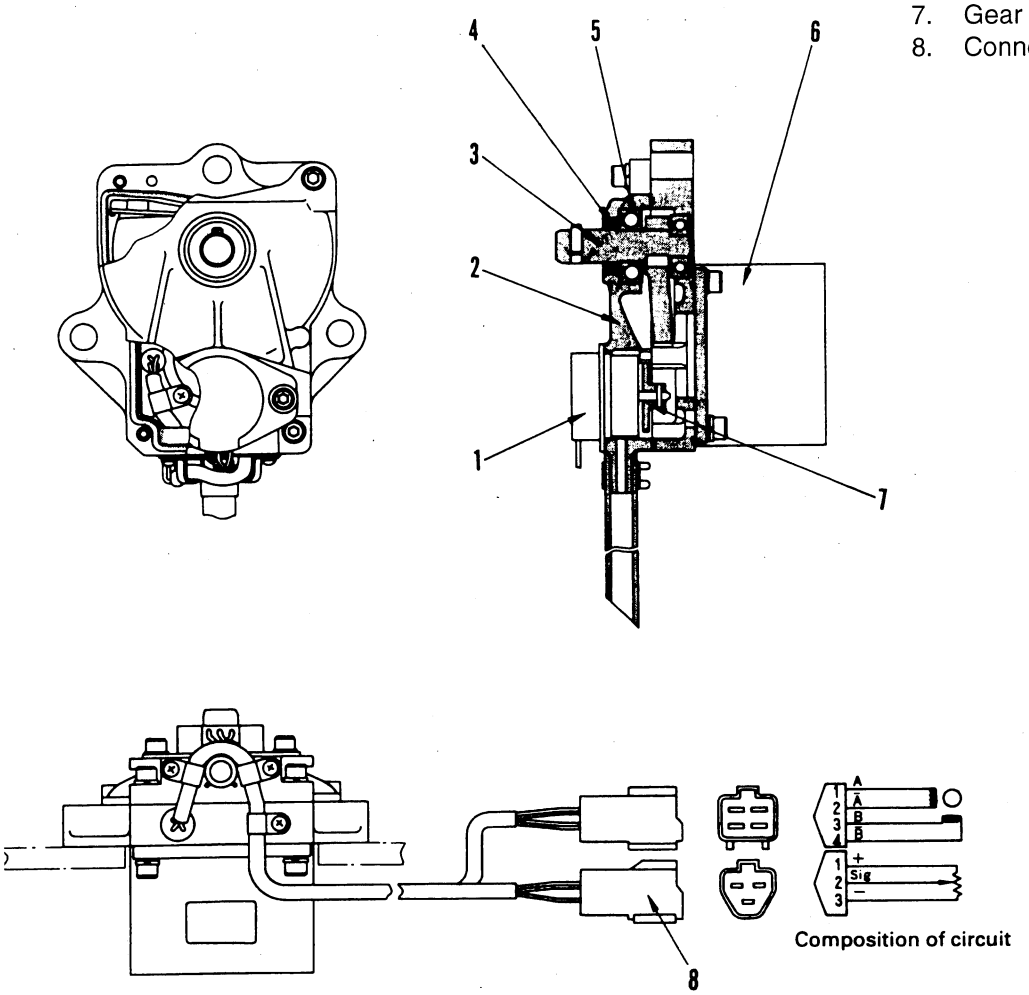


Characteristics of throttle voltage

205F05114

2) GOVERNOR MOTOR

1. Potentiometer
2. Cover
3. Shaft
4. Dust seal
5. Bearing
6. Motor
7. Gear
8. Connector



202F06149

FUNCTION

- The motor is rotated and the governor lever of the fuel injection pump is controlled by the drive signal from the engine throttle controller.
- A stepping motor is used for the motor which provides the motive power.
- In addition, a potentiometer for giving feedback is installed to allow observation of the operation of the motor.
  The rotation of the motor is transmitted to the potentiometer through a gear.

OPERATION

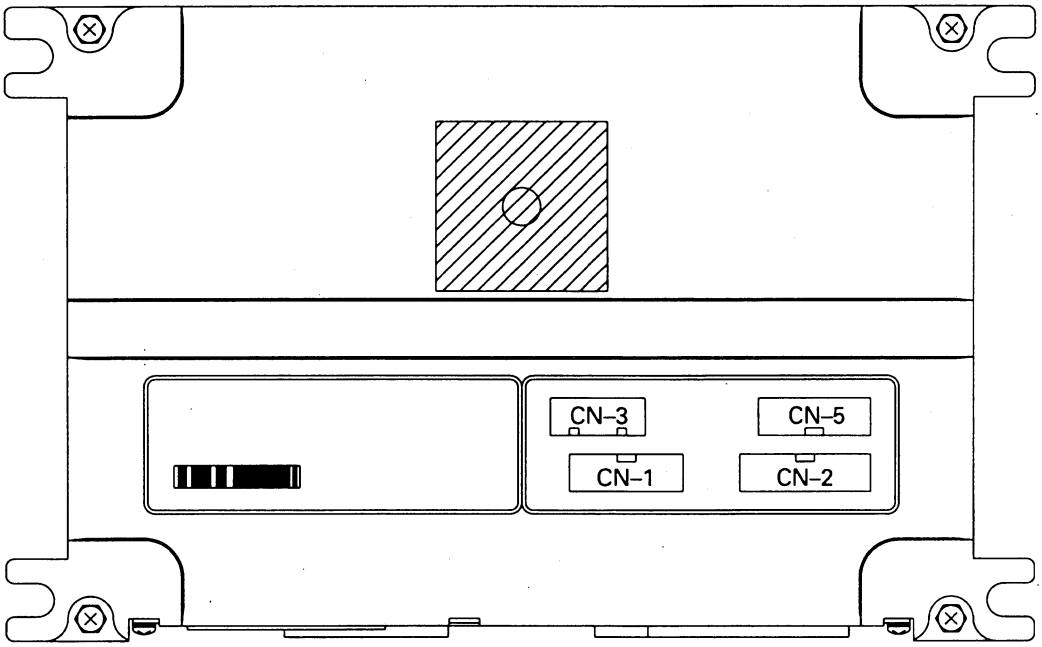
Motor stationary

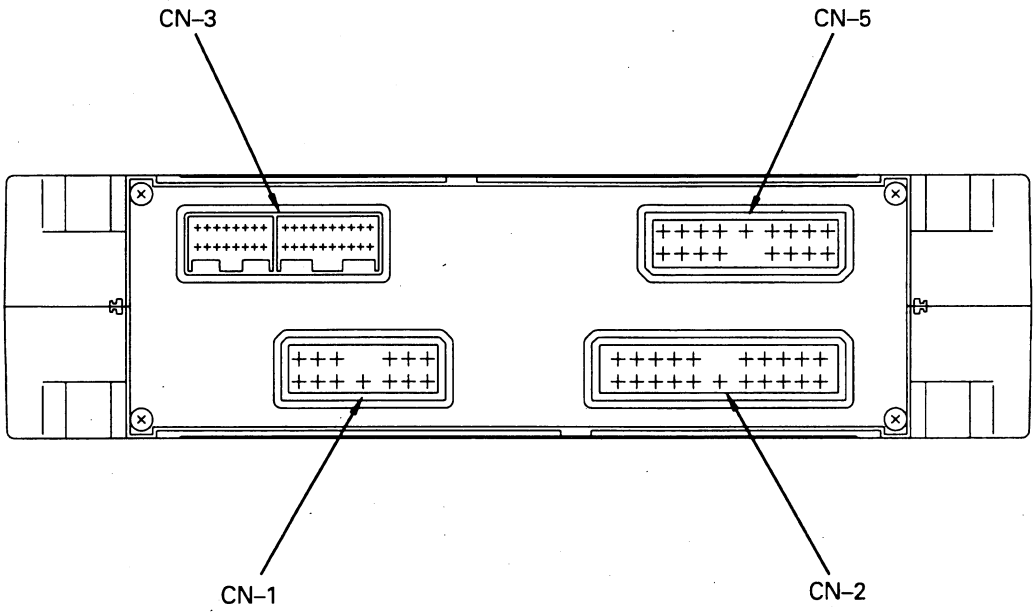
- Both A phase and B phase of the motor are continuous, and a holding torque is generated in de motor.

Motor rotating

- A pulse current is applied to the A phase and B phase from the engine throttle controller to give synchronous rotation with the pulse.

Governor, pump controller





SAP00327

Input and output signals

CN-1

Pin. No.	Name of signal	Input/ output
1	Battery relay drive output	Output
2	Pump merge/divider solenoid /NC	Output
3	Swing holding brake solenoid	Output
4	NC	
5	NC	
6	GND	Input
7	Power source (+24V)	Input
8	NC	
9	Travel selector solenoid	Output
10	2-stage relief solenoid	Output
11	NC	
12	GND	Input
13	Power source (+24V)	Input

CN-2

Pin. No.	Name of signal	Input/ output
1	Solenoid power source (+24V)	Input
2	Governor motor phase A (+)	Output
3	Governor motor phase A (-)	Output
4	Governor motor phase B (+)	Output
5	Governor motor phase B (-)	Output
6	NC	
7	LS-EPC solenoid (+)	Output
8	TVC solenoid 1 (+)	Output
9	NC	
10	NC	
11	PGND	Input
12	Solenoid power source (+24V)	Input
13	NC	
14	NC	
15	NC	
16	NC	
17	LS-EPC solenoid (-)	Output
18	TVC solenoid 1 (-)	Output
19	NC	
20	NC	
21	PGND	Input

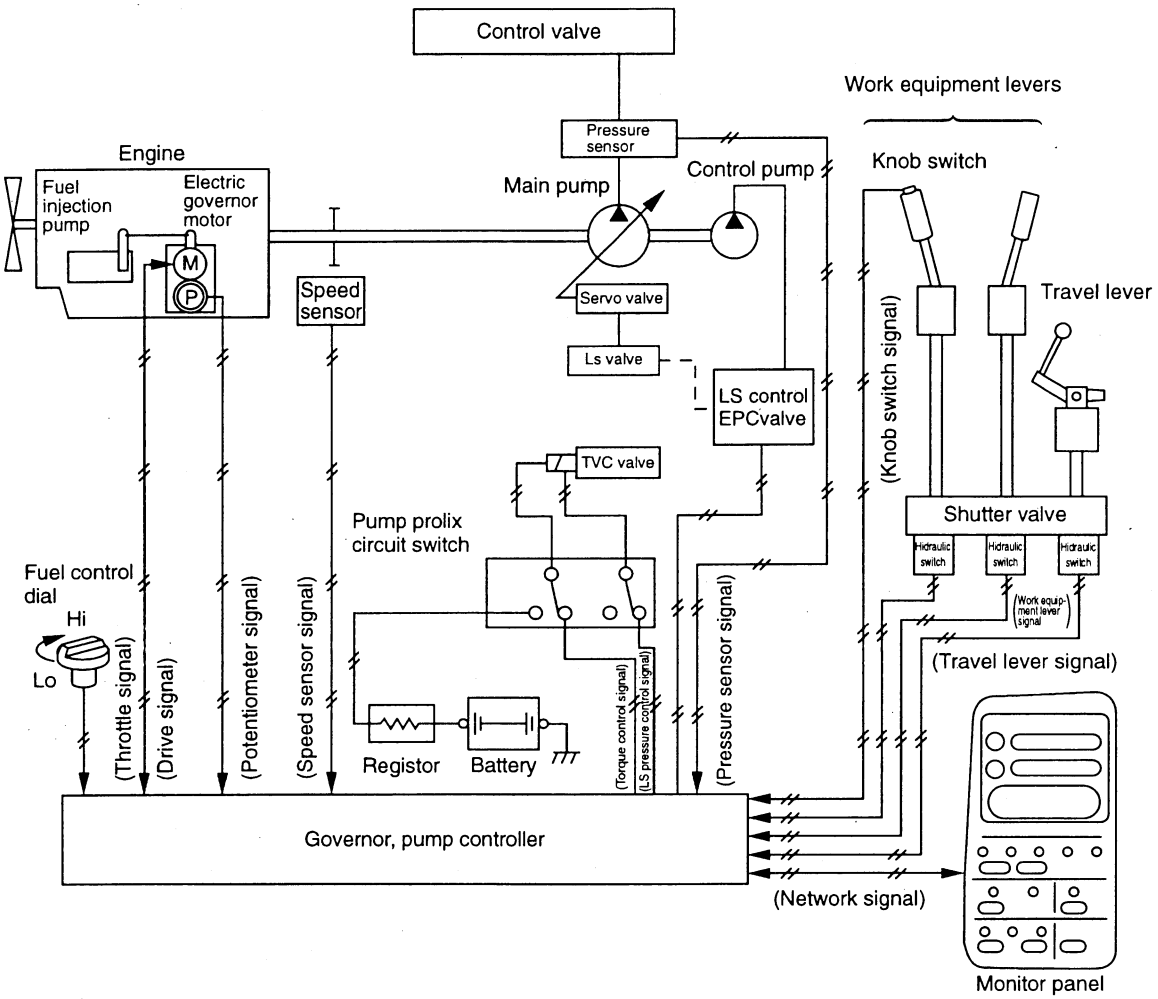
CN-3

Pin. No.	Name of signal	Input/ output
1	Engine water temperature sensor	Input
2	Fuel level sensor	Input
3	Pump F pressure input	Input
4	Throttle potentiometer input	Input
5	NC	
6	Pressure sensor power source (+24V)	Output
7	Potentiometer power source (+5V)	Output
8	Starting switch (ACC)	Input
9	Knob switch	Input
10	NC	
11	NC	
12	Battery charge (alternator terminal R)	Input
13	NC	
14	Feedback potentiometer input	Input
15	NC	
16	Pressure sensor GND	Input
17	Potentiometer GND	Input
18	Starting switch (terminal C)	Input
19	Automatic greasing controller abnormality	Input
20	NC	
21	NC	
22	Boom RAISE pressure switch	Input
23	Arm IN pressure switch	Input
24	S-NET(+)	Input, output
25	Model selection 1	Input
26	Model selection 3	Input
27	Model selection 5	Input
28	Swing prolix switch	Input
29	Overload sensor	Input
30	Boom LOWER pressure switch	Input
31	Arm OUT pressure switch	Input
32	S-NET(+)	Input, output
33	Model selection 2	Input
34	Model selection 4	Input
35	Kerosene mode selection	Input
36	Swing lock switch	Input

CN-5

Pin. No.	Name of signal	Input/ output
1	Engine speed sensor GND	Input
2	Engine speed sensor	Input
3	S-NET (-)	Input/ output
4	GND	Input
5	Swing pressure switch	Input
6	Service valve pressure switch	Input
7	Engine oil pressure sensor H	Input
8	Radiator water level sensor	Input
9	NC	
10	NC	
11	Bucket CURL pressure switch	Input
12	Bucket DUMP pressure switch	Input
13	Travel pressure switch	Input
14	NC	
15	Engine oil pressure sensor L	Input
16	Engine oil level sensor	Input
17	Air cleaner clogging sensor	Input

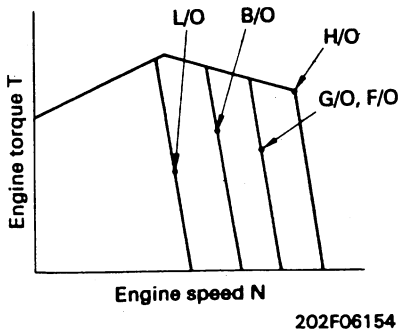
1. Pump & Engine Mutual control system



FUNCTION

- There are five modes available for selection with the working mode switch on the monitor panel. These modes are the heavy-duty operation (H/O) mode, general operation (G/O) mode, finishing operation (F/O) mode, lifting operation (L/O mode), and the breaker operation (B/O) mode. It is possible to select the most suitable engine torque and pump absorption torque to match the nature of the work.
- The pump controller detects the actual engine speed and the speed set by the engine governor through the fuel control dial matches the pump absorption torque set for each mode, and carries out control so that the pump absorbs all of the torque at each output point of the engine.

- **Engine torque curve**



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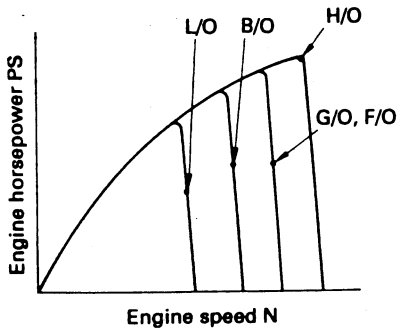
- **Engine horsepower curve**



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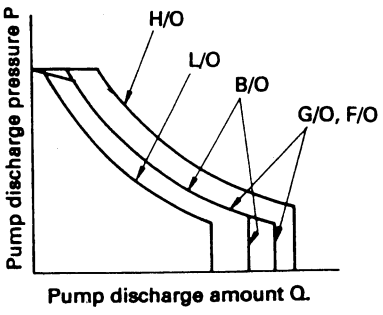
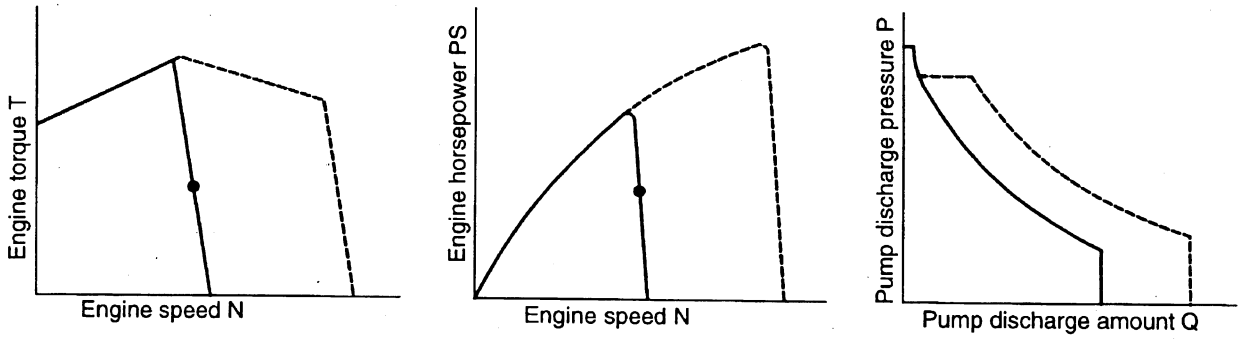
- **Pump output curve**



1) Control method in each mode Heavy-duty operation (H/O) mode

Model	PC180,PC150-6K
Heavy-duty operation (H/O)	81 kW (107 Hp) 2,100 rpm

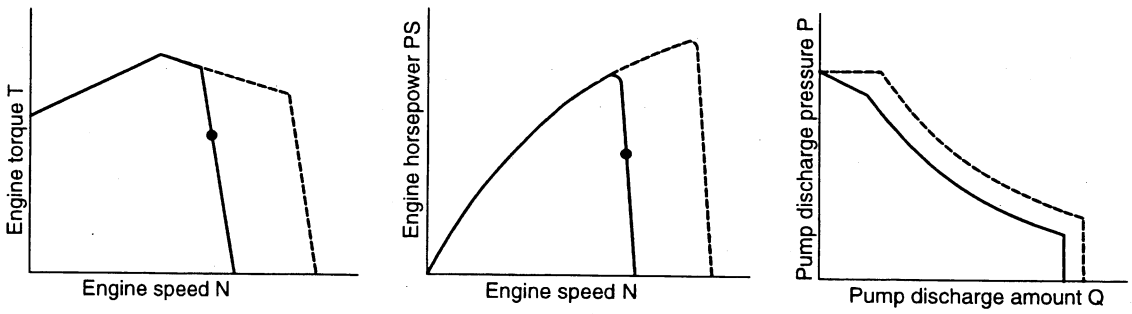
- Matching point in heavy-duty operation mode: Rated output point
- When the load on the pump rises and the pressure rises, the engine speed goes down. When this happens, the pump discharge amount is reduced, and the engine speed is controlled so that it becomes the rated speed. Just the cut-off at relief is canceled and the oil flow at relief is increased.
- If the reverse happens and the pressure goes down, the system is controlled so that the pump discharge amount is increased until the engine speed reaches the rated speed. By repeating this control, the engine can always be used at near the rated output point.



General operation (G/O), finishing operation (F/O) mode

Model	PC180,PC160-6K
General operation (G/O), Finishing operation (F/O)	60 kW (81 Hp) 1,910 rpm

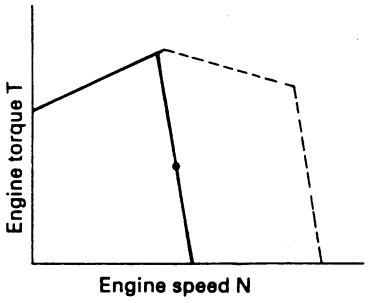
- Matching point in general operation and finishing operation modes: 75% partial output point.
- When the load on the pump rises and the pressure rises, the engine speed goes down. When this happens, mutual control of the engine and pump is used to control the system so that the pump absorption torque follows the equal horsepower curve of the engine, and the engine speed is lowered while keeping the torque constant.
- In this way, the engine is used in a range which provides good fuel efficiency.



Lifting operation (L/O) mode

- Matching point in lifting operation mode: 65 % partial output point
- When the lifting operation mode is selected, the engine speed is automatically lowered to the partial position.
  The cut-off function is canceled and also the relief pressure is increased.
- In this condition, control is carried out in the same way as for the general operation and finishing operation modes to match the load on the pump.
- In this way, the fuel consumption is reduced and the fine control ability is improved.

Model	PC180,PC160-6K
Lifting operation (L/O)	53 kW (70HP) 1,780 rpm



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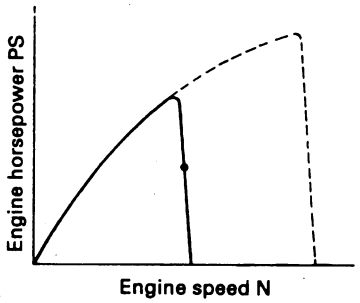

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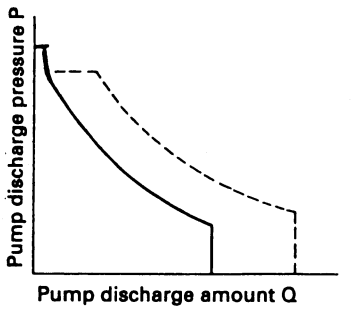

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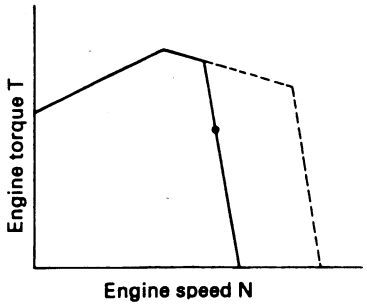
Breaker operation (B/O) mode

- Matching point in breaker operation mode: 75% partial output point
- The pump absorption torque in the breaker operation mode is the same as for the general operation and finishing operation modes, and is controlled to become an even lower speed.
- As a result, the pump absorption torque needed to ensure the breaker drive is ensured, and the engine is used in a range that provides a much better fuel consumption ration than for the general operation mode or finishing mode.

Model	PC180,PC160-6K
Breaker operation (B/O)	60 kW (81 HP) 1,910 rpm



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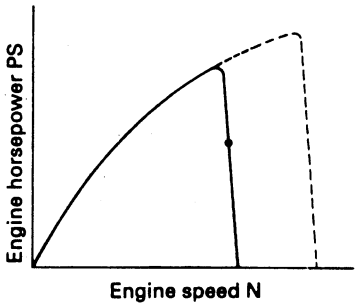

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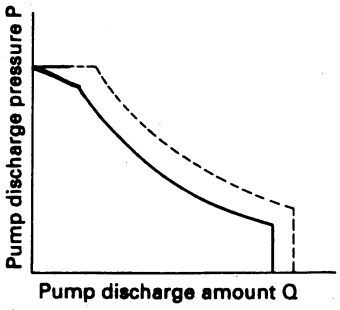

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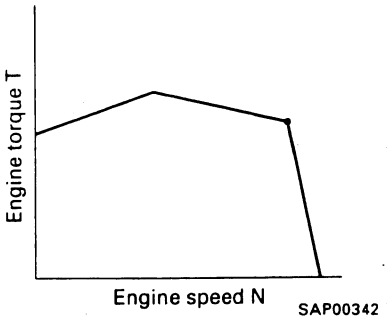
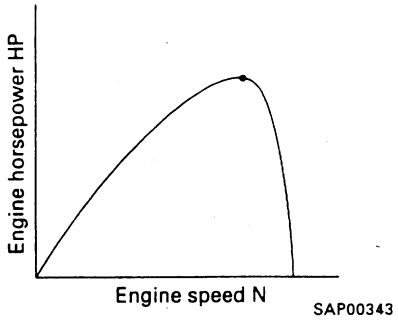
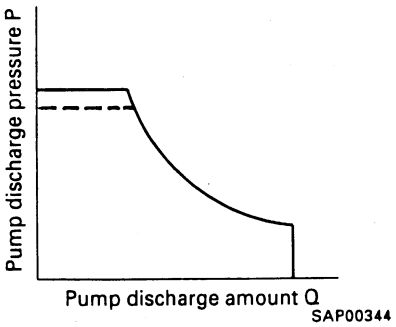
Power max. mode







- Matching point in power max. mode:

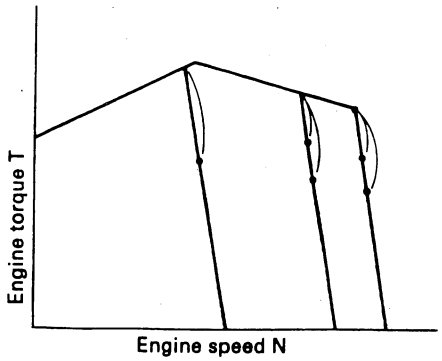
Rated output point

Mode \ Model	PC180, PC160K
Power max.	81 kW (107 HP) 2100 rpm

- When the pump load increases, the engine speed drops.
  When this happens, the pump discharge is reduced to prevent the engine speed from going down and to ensure that the engine is used at near the rated output point.
  The cut-off at relief is canceled and the oil flow at relief is increased.
  And also the relief pressure is increased.

2) Pump control function when traveling

- 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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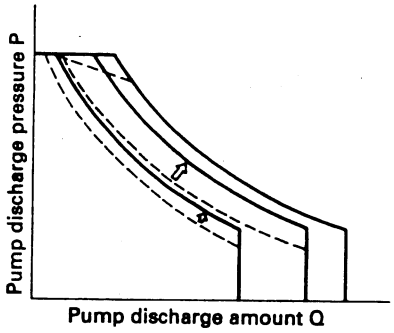

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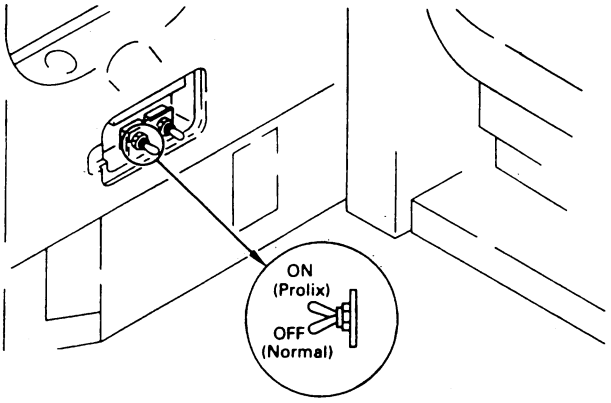
3) Control function when TVC prolix swithch is ON.

- 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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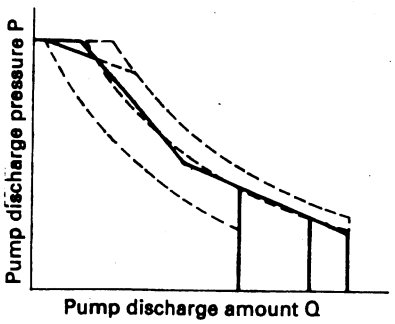

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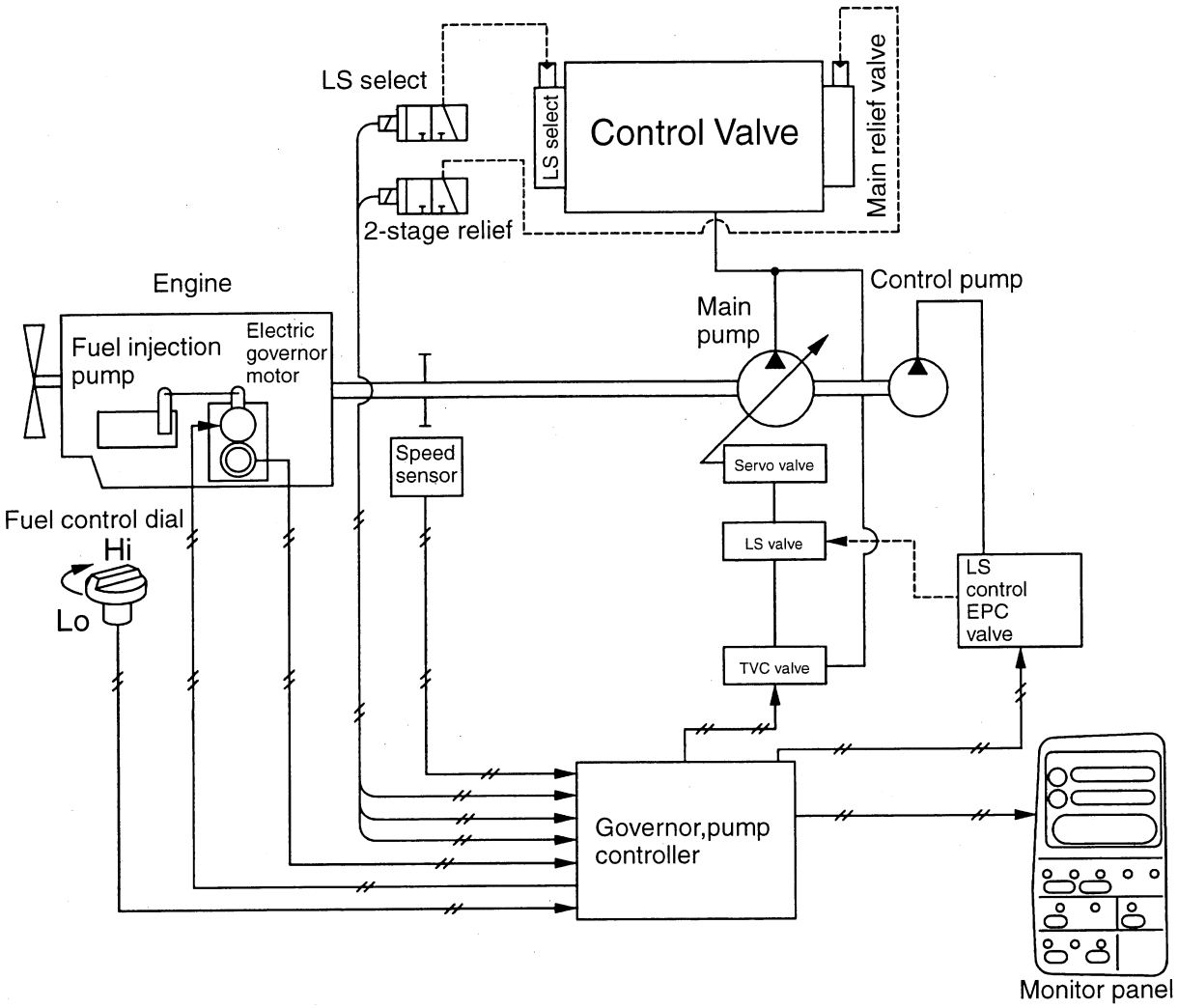
2. Pump and valve control function



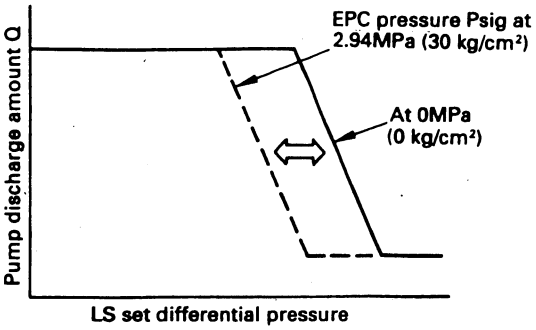
FUNCTION

- The following functions are available to provide the optimum matching under various working conditions: a cut-off function which reduces the relief loss; a function which cancels the cut-off function and prevents the speed from dropping; a 2-stage relief function which increases the digging power; and a fine control mode function which improves the ease of fine control.

1) LS control function

- The switching point (LS set differential pressure) for the pump discharge amount inside the LS valve is changed by changing the output pressure from the LS control EPC valve to the LS valve according to the engine speed and operating condition of the actuator.
- Because of this, the timing for starting the discharge amount from the pump can be optimized, to give excellent ease of compound operation and fine control.

★ For details of the operation, see HYDRAULIC PUMP.



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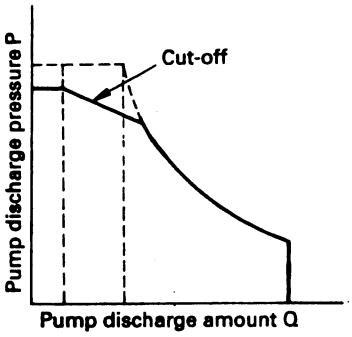
2) Cut-off function

- If the load becomes larger during operation, and the pump discharge pressure rises to close to the relief pressure, the pump pressure sensor detects this, and the controller sends a signal to the TVC valve to reduce the relief loss.

★ For details of the operation, see CLSS.



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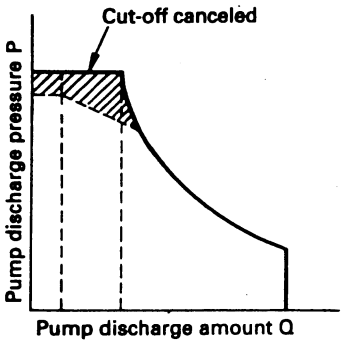
3) Cut-off cancel function

- The cut-off cancel function acts to stop the operation of the cut-off function in order to ensure the pump flow when close to the relief pressure, thereby preventing any drop in speed.
- The relief pressure when the cut-off is operated is 31.85MPa (325 kg/cm²), and when the cut-off cancel function is operated, the relief pressure becomes approx. 32.83 MPa (335 kg/cm²).
- Actuation conditions for cut-off cancel function



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	Working mode switch				Swing lock	Switch	Knob switch	
	H/O	G/O, F/O, B/O	L/O	Travel ON	ON	OFF	ON	OFF
Cut-off function	Canceled	Actuated	Canceled	Canceled	Canceled	Actuated	Canceled	Actuated
2-stage relief function	-	-	Actuated	Actuated	Actuated	-	Actuated at H/O, G/O	-

★ Quick warming up for hydraulic oil when swing lock switch is ON:
When the swing lock switch is turned ON, the cut-off function is canceled, and the 2-stage relief function is actuated.
If the work equipment is relieved in this condition, the temperature of the hydraulic oil can be raised more quickly to reduce the warming up time.

4) 2-stage relief function

- The relief pressure for normal operations is 31.85MPa (325 kg/cm^2), but when the 2-stage relief function is actuated, the relief pressure rises to approx. 34.79MPa (355 kg/cm^2).
  Because of this, the hydraulic pressure is increased by one stage.
- When the 2-stage relief function is actuated, the cut-off cancel function is also actuated automatically.
- Actuating conditions for 2-stage relief function

Conditions	Relief pressure
• When traveling • When swing lock switch is ON • In lifting operation (L/O) mode • When power max. fucntion or swift slow-down function are actuated	31.85 MPa (325kg/cm^2) ⇩ 34.79 MPa (355kg/cm^2)

5) Fine control mode function

- When the finishing operation (F/O) mode is selected from the working mode, the pump LS valve is controlled, and the pump discharge amount is reduced to improve the ease of fine control and the precision when finishing.

6) LS bypass function

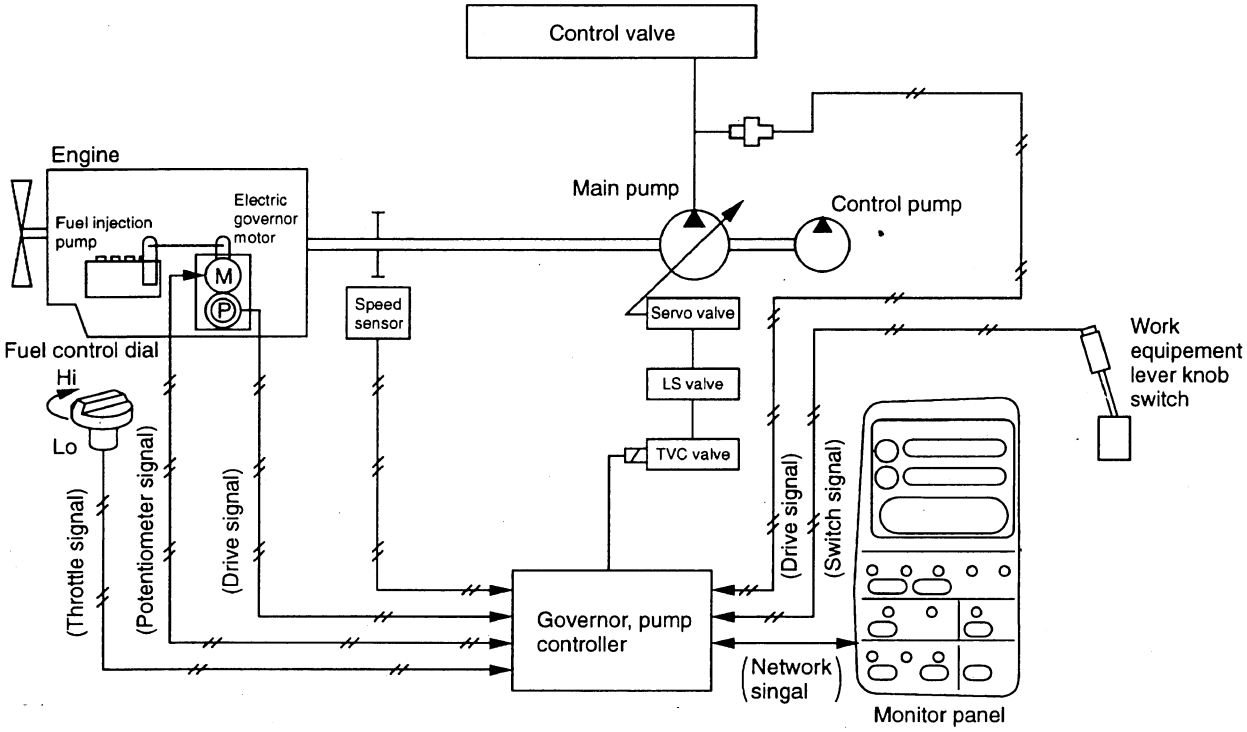
- When the travel is operated at the same time as the work equipment or swing, the pressure compensation function in the CLSS circuit is weakened to reduce the drop in the travel speed to the minimum.
- With this mechanism, the pressure is controlled so that the LS pressure in the CLSS circuit is made lower than the actual pressure when the travel is operated together with the work equipment or swing. In this way the pressure compensation fucntion is weakened.

★ For details of the operation, see CLSS.

- Relationship between working mode and pump discharge amount (for independent operation) (%)

Mode	Boom		Arm		Bucket	Swing
Actuator	RAISE	LOWER	IN	OUT		
Heavy-duty operation (H/O)	100	50	100	100	50	50
General operation (G/O)						
Finishing operation (F/O)	80	40	60	80	40	40
Lifting operation mode (L/O)	100	50	100	100	50	50
Breaker operation (B/O)	100	50	100	100	50	50

3. Power max. function, swift slow-down function



FUNCTION

- This function provides an increase in the digging power for a certain time or switches the working mode to the lifting operation (L/O) and reduced the speed. It is operated using the L.H. knob switch to momentarily match the operating conditions.

★ The power max. function and swift slow-down function are operated with the same switch. Only one of these functions can be selected at any time; they cannot both be operated together.

1) Power max. function

- During digging operations, when that extra bit of digging power is needed (for example, when digging up boulders), the L.H knob switch can be pressed to raise the hydraulic pressure by approx. 10% and increase the digging force.
- If the L.H. knob switch is pressed ON when the working mode is at H/O or G/O, each function is automatically set as follows.

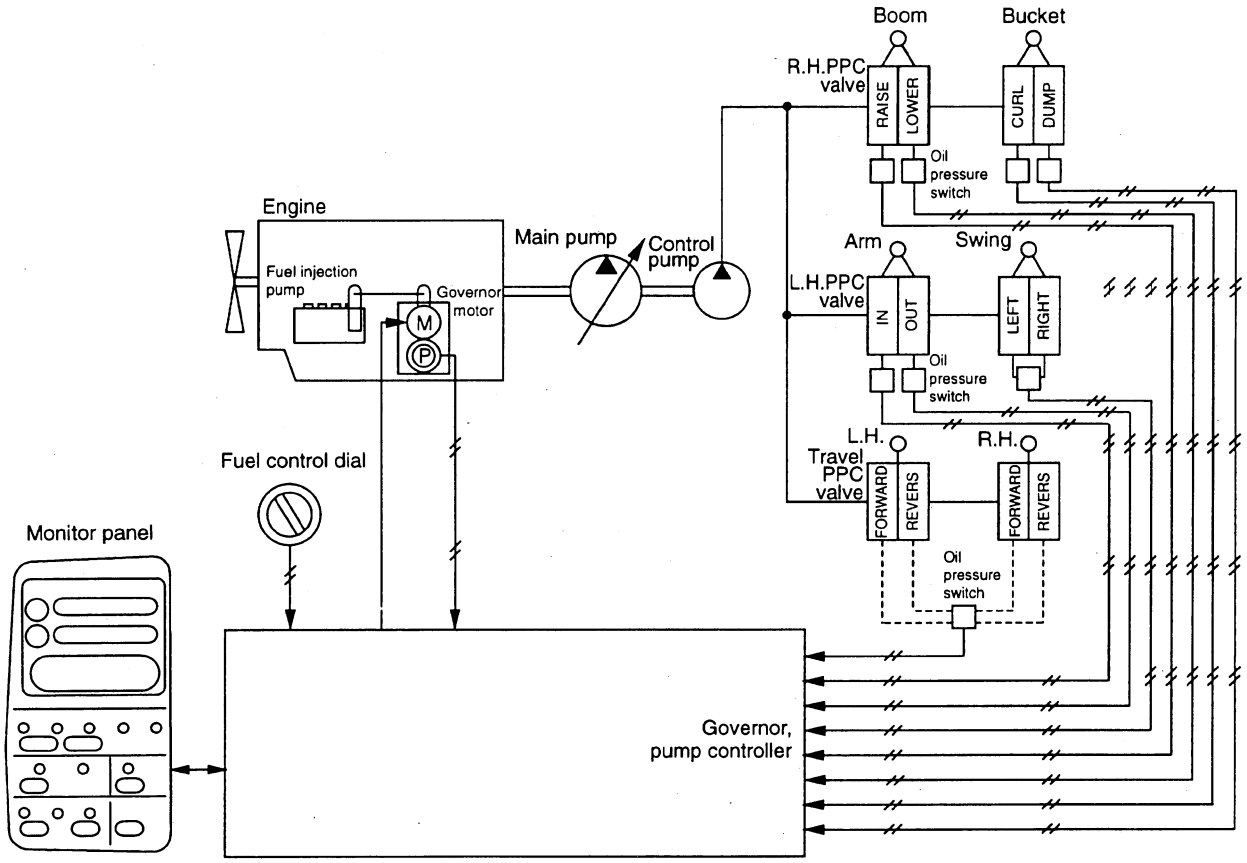
Working mode	Cut-off function	2-stage relief function	Actuating time
Heavy-duty operation (H/O)	Canceled	Actuated (31.85 34.79 MPa) (325 355 kg/cm^2)	Automatically canceled after 8.5 sec

2) Swift slow-down function

- During normal operations, if it is desired to carry out lifting operations or finishing operations for a moment, the working mode can be switched to lifting operation (L/O) mode by operating the L.H. knob switch.p
- If the L.H. knob switch is pressed ON when the working mode is at H/O or G/O, each function is automatically set as follows.

Working mode	Actuating time
Lifting operation (L/O)	While switch is kept pressed

4. AUTO-DECELERATION FUNCTION



FUNCTION

- If all the control levers are at neutral when waiting for work or waiting for a dump truck, the engine speed is automatically reduced to a midrange speed to reduce fuel consumption and noise.
- If any lever is operated, the engine speed returns immediately to the set speed.

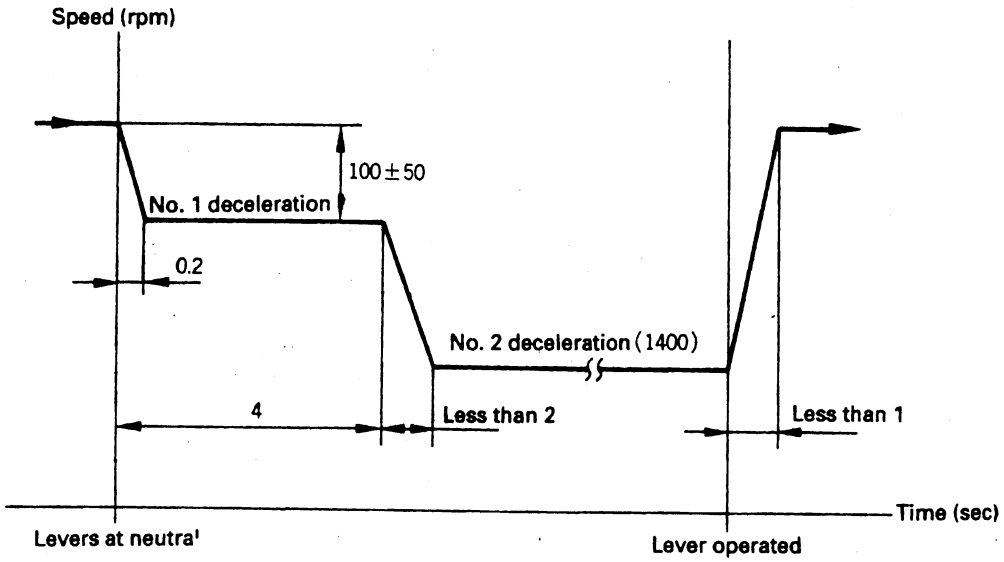
OPERATION

Control levers at neutral

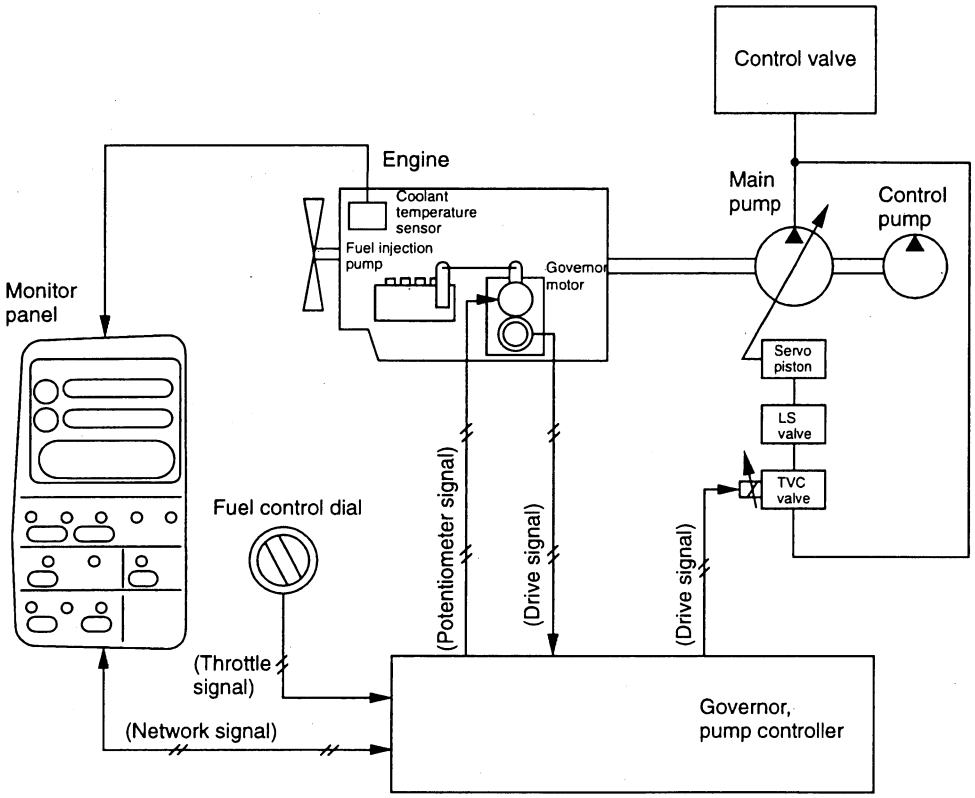
- If the engine is running at above the deceleration actuation speed (approx. 1400 rpm), and all the control levers are returned to neutral, the engine speed drops immediately to approx. 100 rpm below the set speed to the No. 1 deceleration position.
- If another 4 seconds passes, the engine speed is reduced to the No. 2 deceleration position (approx. 1400 rpm), and is kept at that speed until a lever is operated.

When control lever is operated

- If any control lever is operated when the engine speed is at No. 2 deceleration, the engine speed will immediately rise to the speed set by the fuel control dial.



5. AUTOMATIC WARMING-UP AND ENGINE OVERHEAT PREVENTION FUNCTION



FUNCTION

- If the coolant temperature is low, this automatically raises the engine speed to warm up the engine after it is strarted. (Automatic warming-up function)
  In addition, if the coolant temperature rises too high during operations, it reduces the load of the pump to prevent overheating. (Engine overheat prevention function)

1) Engine automatic warming-up function

- After the engine is started, if the engine coolant temperature is low, the engine speed is automatically raised to warm up the engine.

Conditions for actuation (both are necessary)	
Coolant temperature:	Less than 30°C
Engine speed:	Less than 1,400 rpm

⇒

Actuation
Engine speed: 1,250 rpm or below

Conditions for cancellation (any one)	
Automatic	Coolant temperature: 30°C or above
	Automatic warming-up time: 10 minutes or more
Manual	Fuel control dial: Held at more than 70% of full throttle for mor than 3 seconds

⇒

Cancellation
Engine speed: As desired

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 temperture 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)

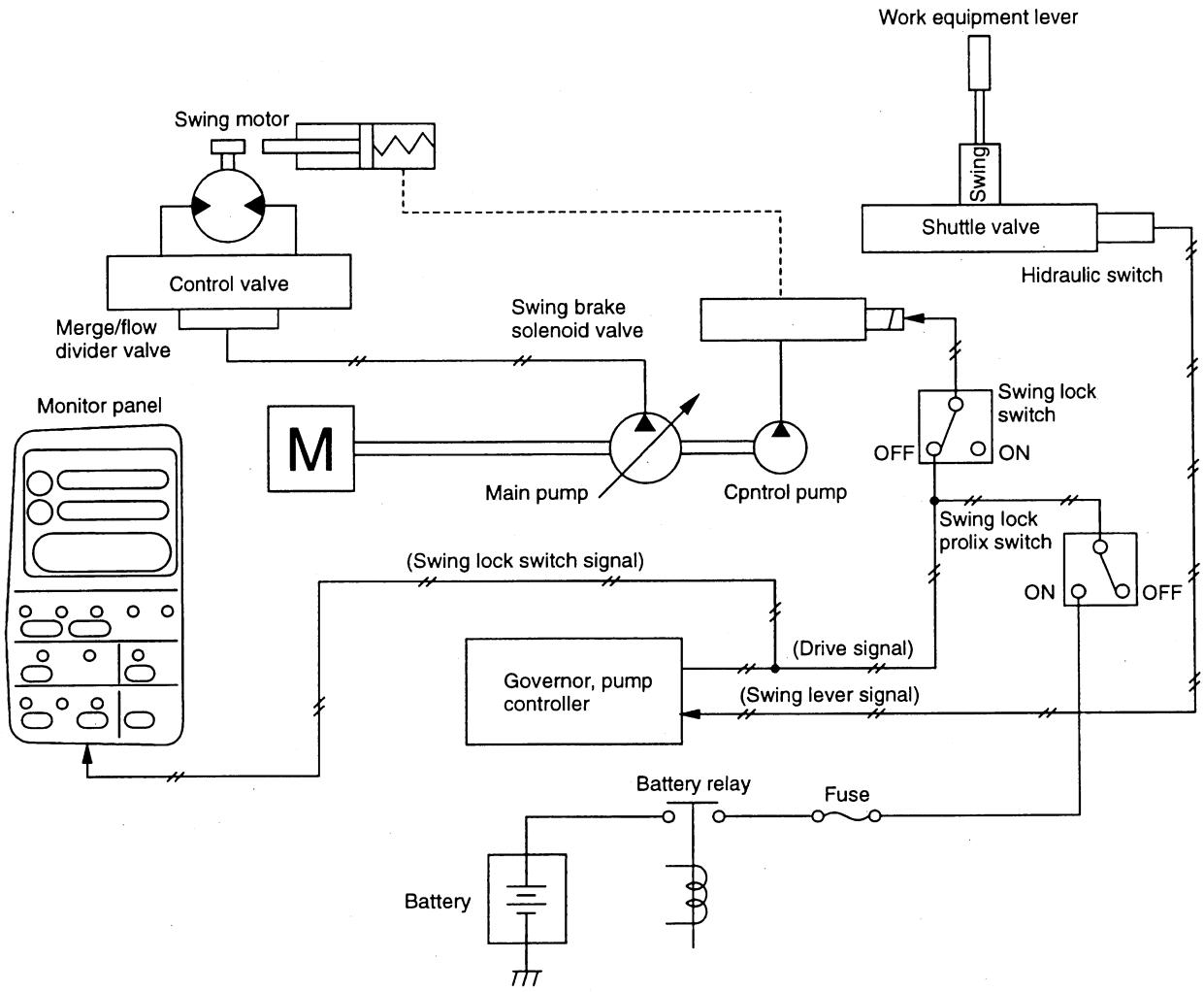
Actuation condition	
2nd stage	Coolant temperature: 105°C and above (Coolant temperature gauge: Red range)

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 postion When the above conditions are met, the system returns to the condition before the overheat prevention function was actuated (manual reset).

6. SWING CONTROL FUNCTION

7. Swing control system



Function

- The system is provided with a swing lock and swing holding brake function.

1) Swing lock, swing holding brake function

- The swing lock (manual) can be locked at any desired position, and the swing holding brake (automatic) is interconnected with the swing, so it prevents any hydraulic drift after the swing is stopped.

※ Operation of swing lock prolix switch

- If any abnormality should occur in the controller, and the swing holding brake is not actuated normally and the swing cannot be operated, the siwng lock prolix switch can be operated to cancel the swing lock and allow the swing to be operted.

★ Even when the swing lock prolix switch is turned ON, the swing lock switch stays ON and the swing brake is not canceled.

★ When the swing brake is canceled, the swing has only a hydraulic brake operated by the safety valve, so if the swing is stopped on a slope, there may be hydraulic drift.

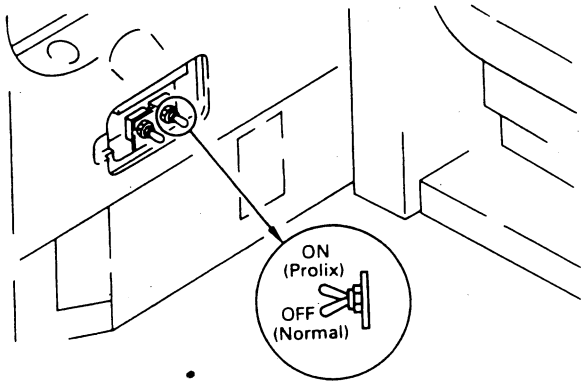
2) Hydraulic oil quick warm-up function when swing lock switch is ON

★ For details, see PUMP AND VALVE CONTROL FUNCTION.

- Swing lock switch and wing lock, holding brake

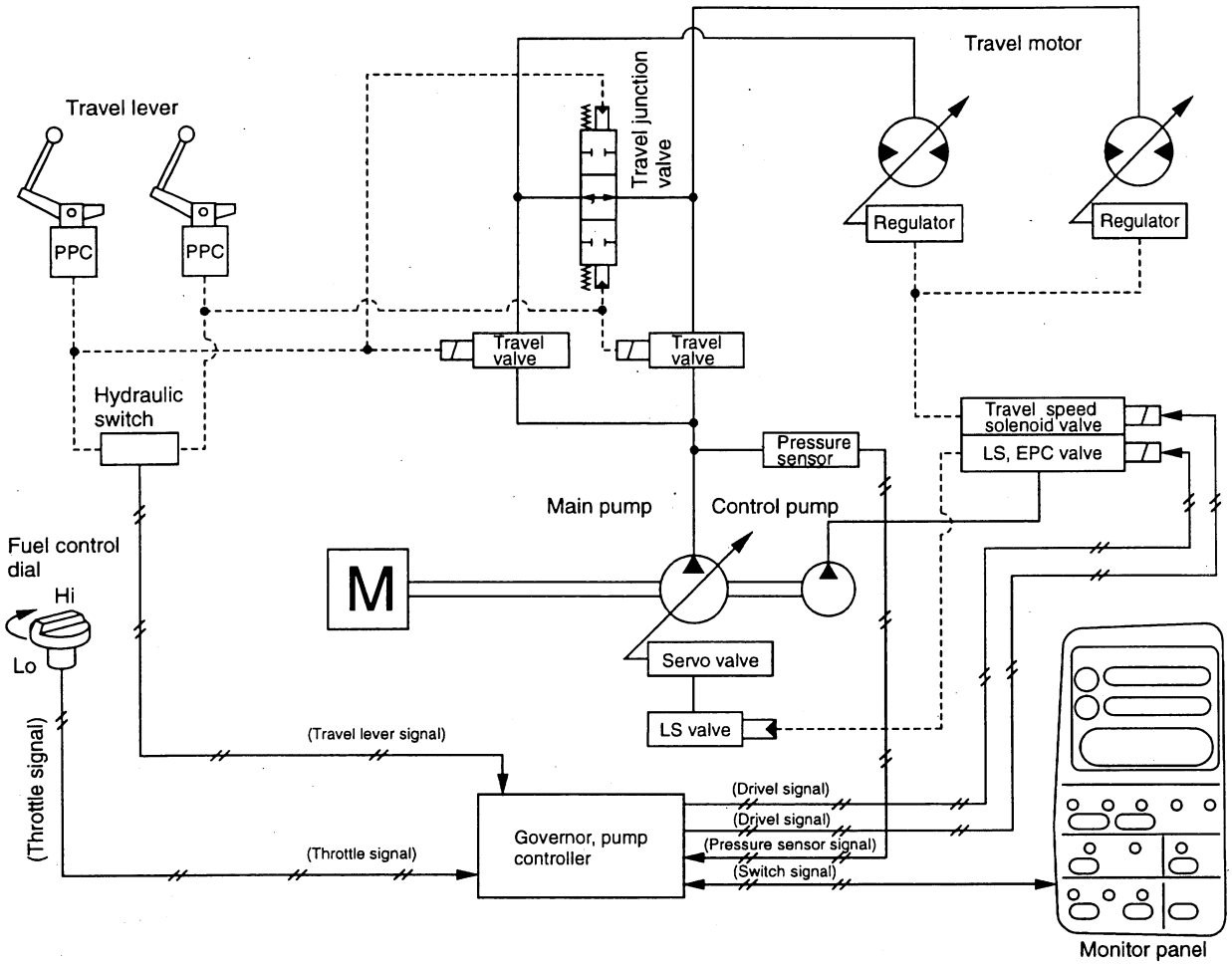
Lock switch	Lock lamp	Function	Operation
OFF	OFF	Swing holding brake	When swing lever is placed at neutral, swing brake is applied after approx. 4 sec; when swing lever is operated, brake is canceled and swing can be operated freely.
ON	ON	Swing lock	Swing lock is actuated and swing is held in position. Even when swing lever is operated, swing lock is not canceld and swing does not move.

Swing lock prolix switch	ON (when controller is abnormal)		OFF (when controller is normal)	
Swing lock switch	ON	OFF	ON	OFF
Swing brake	Swing lock applied	Swing lock canceled	Swing lock applied	Swing holding brake applied



202F06182

8. Travel control system



Function

- When traveling, the pump control is carried out, and the travel speed can be selected manually or automatically to give a travel performance that suits the nature of the work or the jobsite.

1) Pump control function when traveling

- If the travel is operated in any working mode other than the heavy-duty operation (H/O) mode, this increases the pump absorption torque while keeping the working mode and engine speed as they are.

★ For details, see PUMP & ENGINE MUTUAL CONTROL FUNCTION.

2) LS bypass function during simultaneous operation of travel + work equipment or swing

- When the travel is operated simultaneously with the work equipment or swing, the pressure compensation funtion of the CLSS circuit is weakened and the drop in the travel speed is kept to the minimum.

★ For details, see PUMP AND VALVE CONTROL FUNCTION.

Travel speed switch	Lo (Low speed)	Mi (Midrange speed)	Hi (High speed)
Pump flow (%)	80	80	100
Motor volume	Max.	Min.	Min.
Travel speed (km/h)	2.7	4.0	5.5

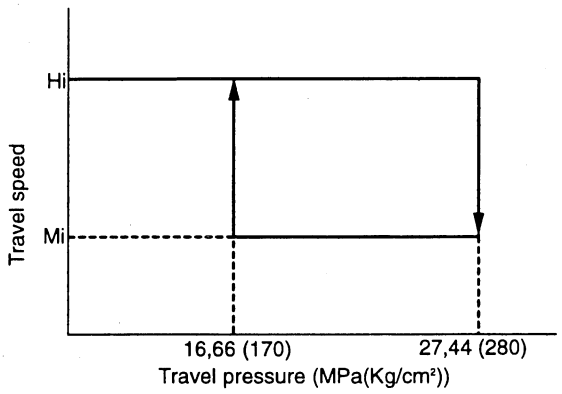
3) Travel speed selection function

i) Manual selection using travel speed switch
If the travel speed switch is set to Lo, Mi, or Hi, the pump controller controls the pump flow and motor volume at each speed range as follows to switch the travel speed.

ii) Automatic selection according to engine speed
If the engine speed is reduced to below 1400 rpm by the fuel control dial:

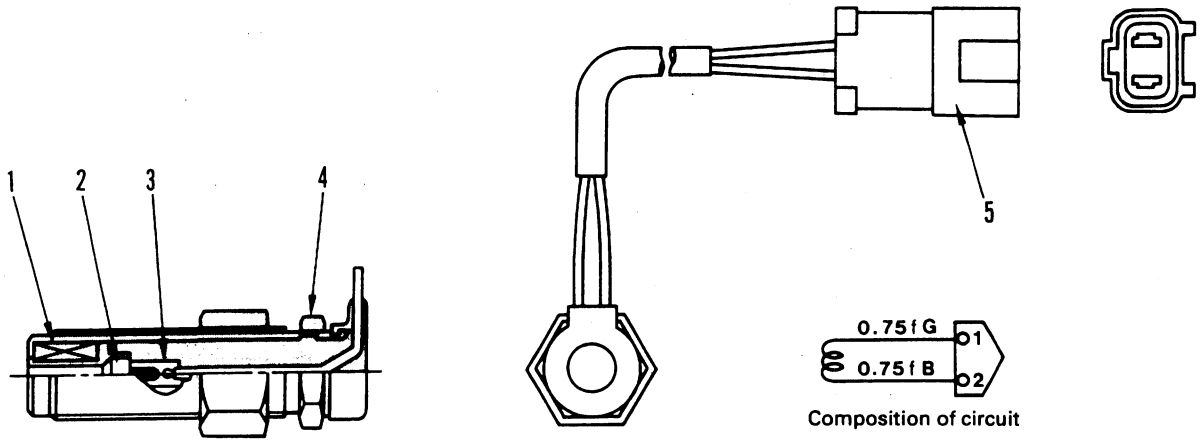
- If the machine is traveling in Lo, it will not shift even if Mi or Hi are selected.
- If the machine is traveling in Mi, it will not shift even if Hi is selected.
- If the machine is traveling in Hi, it will automatically shift to Mi.

iii) Automatic selection according to pump discharge pressure
If the machine is traveling with the travel speed switch at Hi, and the load increases, such as when traveling up a steep hill, if the travel pressure continues at 27.44 Mpa (280 kg/cm²) for more than 0.5 sec, the motor volume is automatically switched and the travel speed changes to Mi.
(The travel speed switch stays at Hi.)
The machine continues to travel in Mi, and when the load reduced, such as when the machine travels again on flat ground or goes downhill, and the travel performance stays at 16.66 MPa (170 kg/cm²) or less for more than 0.5 sec, the motor volume is automatically switched and the travel speed returns to Hi.



8. COMPONENTS OF SYSTEM

1) ENGINE SPEED SENSOR



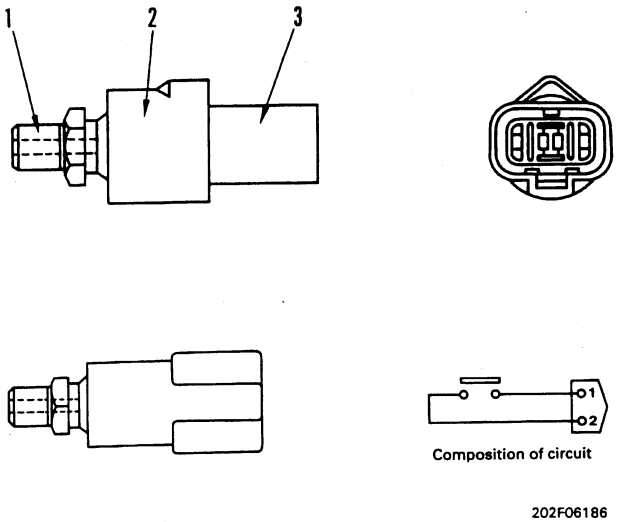
202F06185

1. Wire
2. Magnet
3. Terminal
4. Housing
5. Connector

FUNCTION

- The engine speed sensor is installed to the ring gear portion of the engine flywheel. It counts electrically the number of gear teeth that pass in front of the sensor, and sends the results to the pump controller.
- This detection is carried out by a magnet, and an electric current is generated every time the gear tooth passes in front of the magnet.

2) PPC OIL PRESSURE SWITCH



202F06186

1. Plug
2. Switch
3. Connector

SPECIFICATIONS

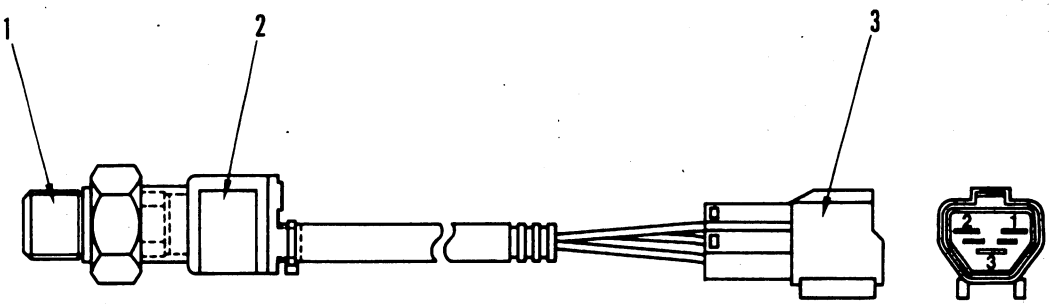
Composition of points: N.O. points
Actuation (ON) pressure:
0.49 ± 0.1MPa (5.0 ± 1.0 kg/cm^2)
Reset (OFF) pressure:
0.29 ± 0.05 MPa (3.0 ± 0.5 kg/cm^2)

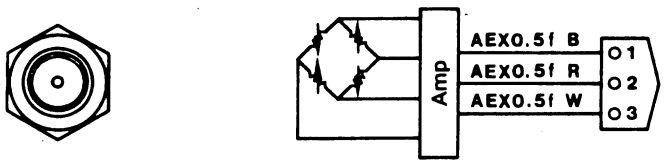
FUNCTION

- There are 8 switches installed to the PPC shuttle valve. The operating condition of each actuator is detected from the PPC pressure, and this is sent to the pump controller.

3) PUMP PRESSURE SENSOR

1. PLug
2. Sensor
3. Connector



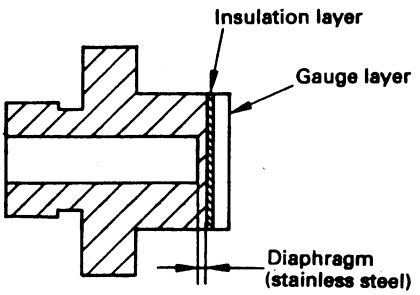


Composition of circuit

202F06187

FUNCTION

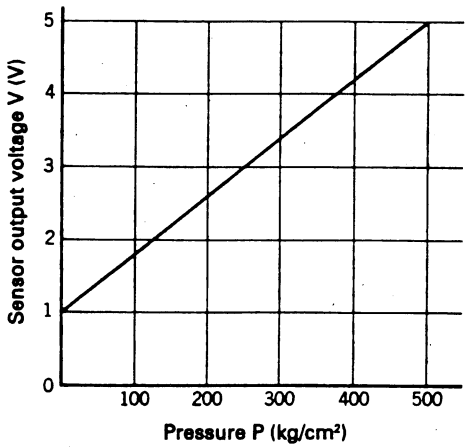
- This sensor is installed to the inlet port circuit of the control valve. It converts the pump discharge pressure to a voltage and sends this to the controller.



202F06188

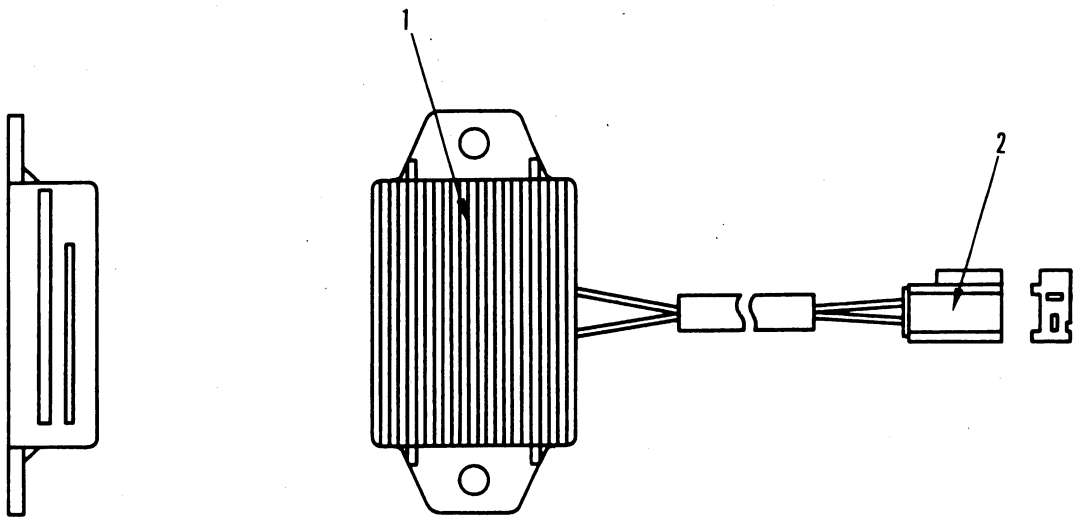
OPERATION

- When the pressurized oil entering from the pressure introduction portion pressurizes the diaphragm deflects and changes shape.
- A gauge layer is installed to the face opposite the diaphragm, and the resistance of the gauge layer converts the deflection of the diaphragm into an output voltage and sends it to the amp (voltage amplifier).
- The voltage is further amplified by the amplifier and is sent to the pump controller.
- Relationship between P (kg/cm^2) and output voltage (V)
  V=0.008 x P = + 1.0
  ★ 1 kg/cm^2 =0.098 MPa



202F05163

5) TVC PROLIX RESISTOR



202F06216

1. Resistor
2. Connector

SPECIFICATION
Resistance: 30 Ω

FUNCTION
- This resistor acts to allow a suitable current to flow to the TVC solenoid when the TVC prolix switch is ON.
- No current flows when the TVC prolix switch is OFF.

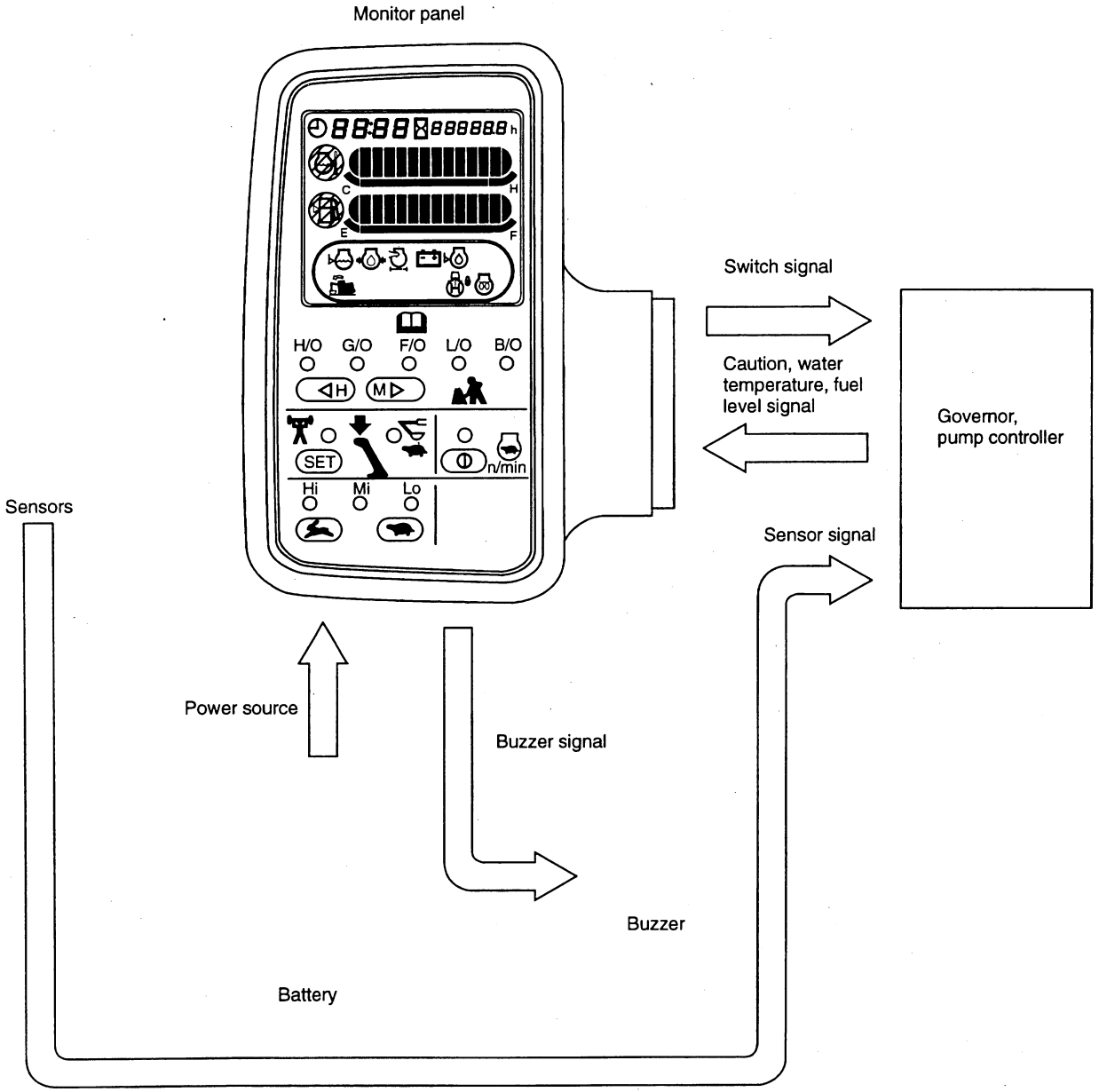
6) FUEL CONTROL DIAL, GOVERNOR MOTOR, ENGINE THROTTLE CONTROLLER
★ See ENGINE CONTROL SYSTEM.

7) MONITOR PANEL
★ See MONITORING SYSTEM.

8) TVC VALVE
★ See HYDRAULIC DUMP.

9) LS CONTROL EPC VALVE
LS BYPASS SOLENOID VALVE
TRAVEL SPEED SOLENOID VALVE
SWING BRAKE SOLENOID VALVE
2-STAGE RELIEF SOLENOID VALVE
★ See EPC • SOLENOID VALVE.

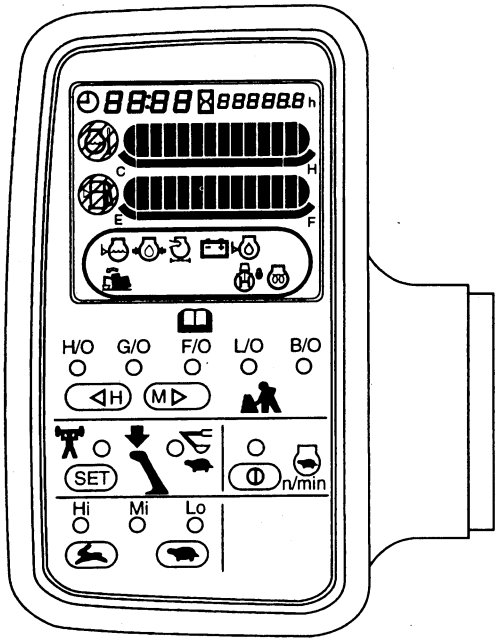
MACHINE MONITOR SYSTEM

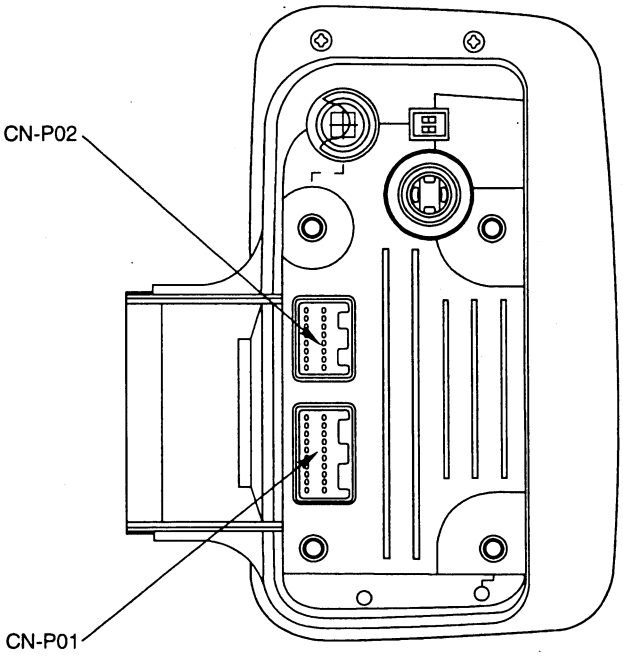


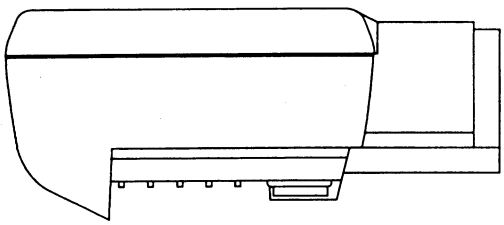
Function

- The machine monitor system uses the sensors installed to all parts of the machine to observe the condition of the machine. It processes this information swiftly, and displays it on a panel to inform the operator of the condition of the machine.
  The content of the information displayed on the machine can broadly be divided as follows.
  1. Monitor portion
     This gives an alarm if any abnormality occurs in the machine.
  2. Gauge portion
     This always displays the condition of the machine (coolant temperature, fuel level).
- The monitor panel also has various built-in mode selector switches, and functions as the control panel for the machine control system.

1. Monitor panel







Outline

- The monitor panel consists of the switches for the monitor display functions, mode selector, and electrical components.
  It has a built-in CPU (Central Processing unit), and processes, diplays, and outputs the information.
  The monitor display panel uses a liquid crystal display (LCD). The mode switches are flat sheet switches.Input and output signals

Input and output signals

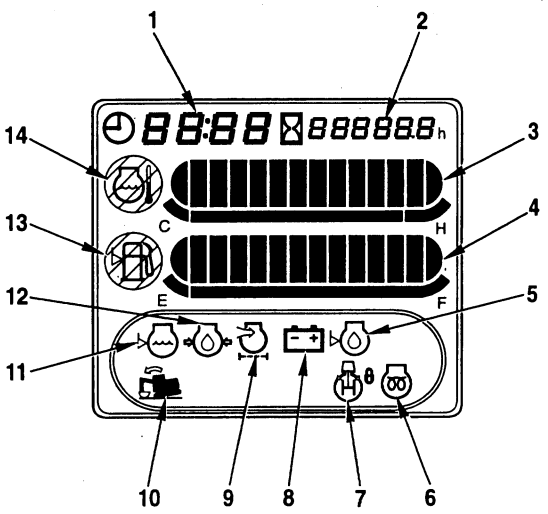
CN-P01

Pin No.	Name of signal
1	N/W signal
2	N/W GND
3	ND
4	NC
5	Swing lock
6	Buzzer stop
7	Buzzer output
8	Lamp
9	Key ON signal
10	Terminal BR
11	N/W signal
12	N/W GND
13	NC
14	NC
15	NC
16	NC
17	NC
18	Preheating
19	Start signal
20	NC

CN-P02

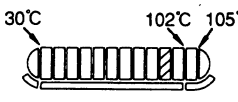
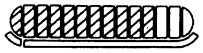
Pin No.	Name of signal
1	GND
2	NC
3	NC
4	NC
5	NC
6	NC
7	NC
8	+VB
9	GND
10	NC
11	NC
12	NC
13	NC
14	NC
15	NC
16	+VB

DISPLAY MONITOR

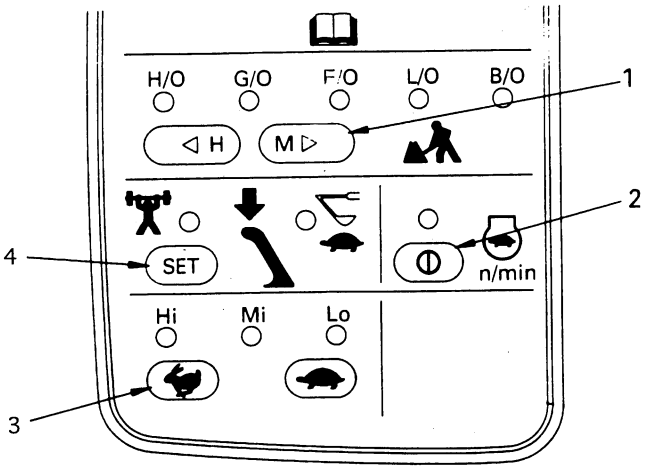


1. Clock (displays error code when error occurs)
2. Service meter
3. Coolant temperature gauge
4. Fuel gauge
5. Engine oil level caution lamp
6. Preheating pilot lamp
7. Swing holding brake pilot lamp
8. Charge level caution lamp
9. Air cleaner clogging caution lamp
10. Overload caution lamp
11. Coolant level caution lamp
12. Engine oil pressure caution lamp
13. Fuel level caution lamp
14. Coolant temperature caution lamp

Content of display

Symbol	Display item	Display range	When engine is stopped	When engine is running
SAP00519	Coolant level	Below low level	Flashes when abnormal	Flashes and buzzer sounds when abnormal
SAP00520	Engine oil pressure	Below 1,500 rpm: below 0.05 MPa (0.5 kg/cm²) Above 1,500 rpm: below 0.15 MPa (1.5 kg/cm²)	Lights up when normal (goes out when engine starts)	Flashes and buzzer sounds when abnormal
SAP00521	Air cleaner clogging	When clogged	OFF	Flashes when abnormal
SAP00522	Charge level	When charging is defective	Lights up when normal (goes out when engine starts)	Flashes when abnormal
SAP00523	Engine oil level	Below low level	Flashes when abnormal	OFF
SDP00688	Over load	Above high level	OFF	Flashes when abnormal
SDP00582	Parking	When swing is locked	Lights up when swing lock switch is ON, flashes when swing lock prolix switch is ON	
SAP00526	Preheating	During preheating	Lights up for 30 seconds when starting switch is at HEAT, then flashes for 10 seconds to indicate that preheating is completed	
SAP00703	Coolant temperature	Flashes when above 102°C, flashes and buzzer sounds when above 105°C	 SAP00529	
SAP00704	Fuel level	Flashes when below low level	 SAP00530	

MODE SELECTION SWITCHES



1. Working mode switch
2. Auto deceleration switch
3. Travel speed switch
4. Power max./Swift slow-down switch

- The switch portion consists of five mode selection switches, and the condition of the machine changes each time that any switch is pressed. The LED above the switch lights up to display the present condition of the machine.

Switch actuation table

Switch	Item	Action
◁ H M ▷ SDP00692	WORKING MODE	H/0 ⟷ **G/O** ⟷ F/O ⟷ L/O ⟷ B/O
SET SDP00693	KNOB BUTTON	**(POWER UP)** ⟷ (SPEED DOWN) SDP00694
n/min SDP00695	AUTO DECEL	**ON** ⟷ OFF
SDP00696	TRAVEL SPEED	Hi ⟷ Mi ⟷ **Lo**

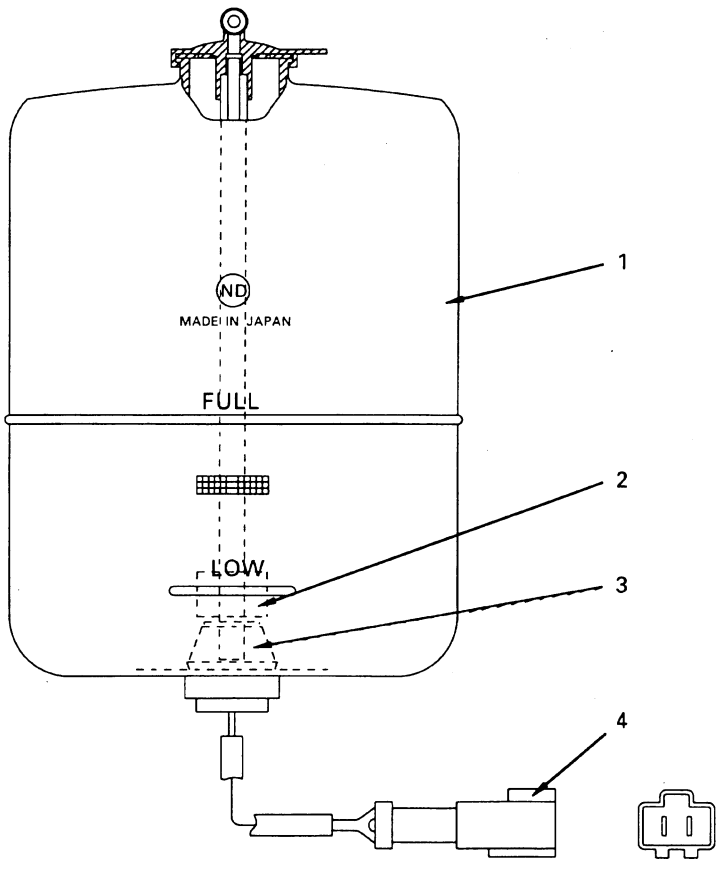
2. Sensors

- The signals from the sensor are input directly to the monitor panel.
  The contact type sensors are always connected at one end to the chassis GND.

Name of sensor	Type of sensor	When normal	When abnormal
Coolant level	Contact type	ON (closed)	OFF (open)
Engine oil level	Contact type	ON (closed)	OFF (open)
Engine oil pressure	Contact type	OFF (open)	ON (closed)
Coolant temperature	Resistance type	-	-
Fuel level	Resistance type	-	-
Air cleaner clogging	Contact type	OFF (closed)	ON (open)

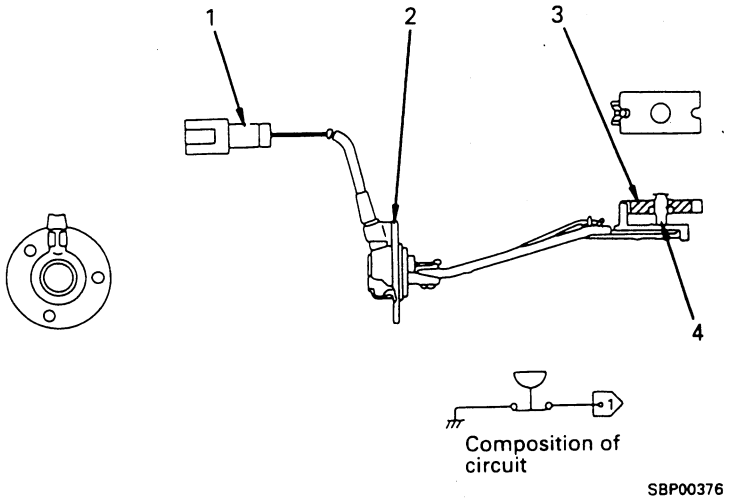
Coolant level sensor

1. Sub-tank
2. Float
3. Sensor
4. Connector



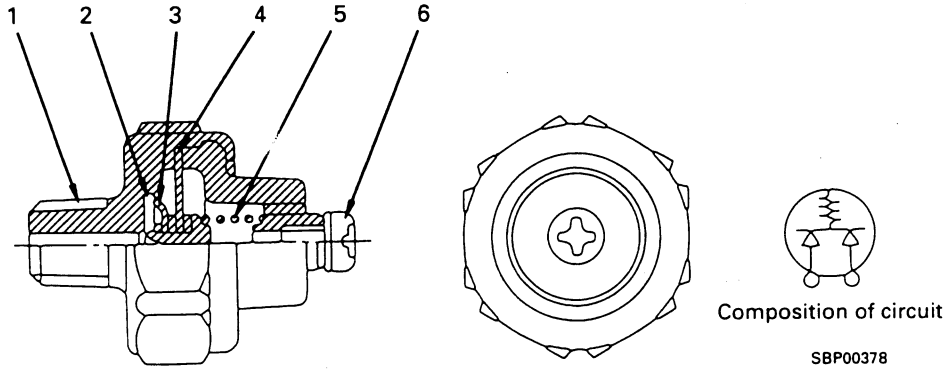
SAP00375

Engine oil level sensor



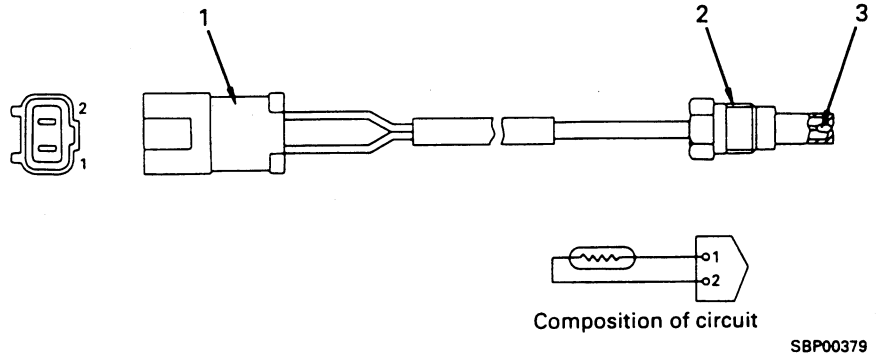
1. Connector
2. Bracket
3. Float
4. Switch

Engine oil pressure sensor (both Lo and Hi)



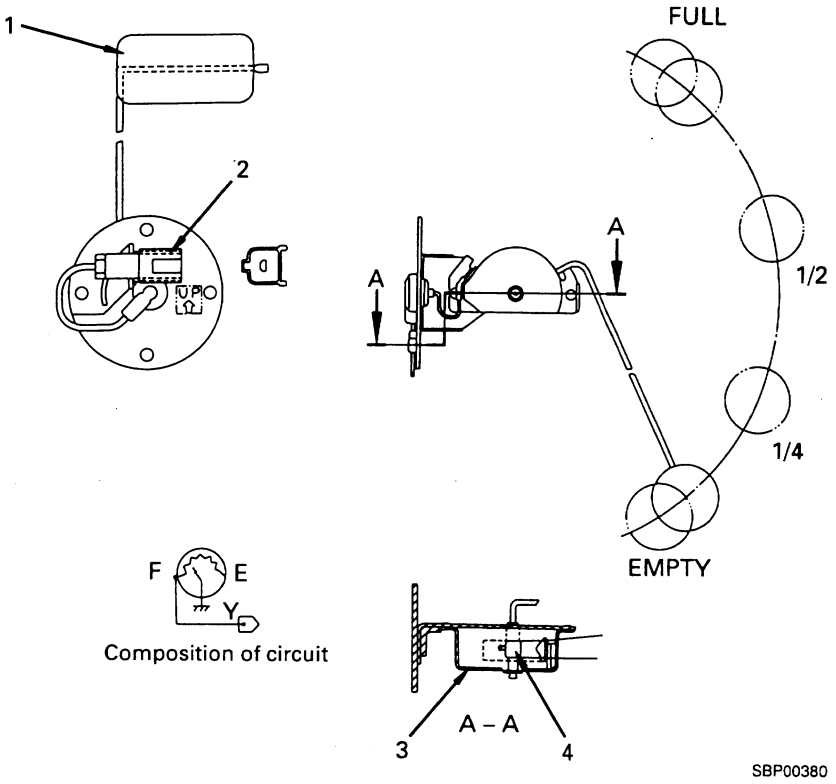
1. Plug
2. Contact ring
3. Contact
4. Diaphragm
5. Spring
6. Terminal

Coolant temperature sensor



1. Connector
2. Plug
3. Thermistor

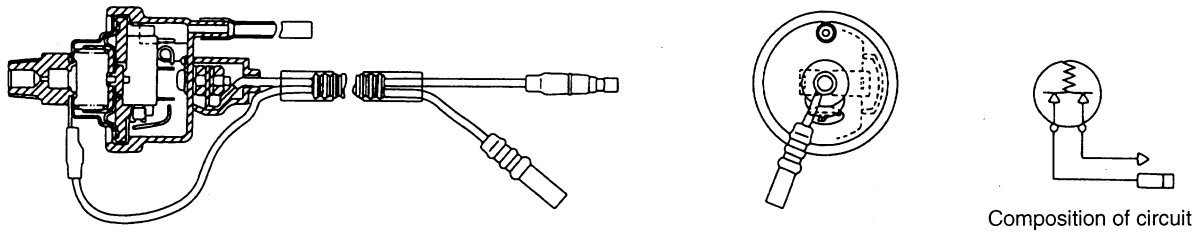
FUEL LEVEL SENSOR



SBP00380

1. Float
2. Connector
3. Cover
4. Variable resistor

Air cleaner clogging sensor



SBP00381

20

20 TESTING AND ADJUSTING

⚠ When carrying out testing, adjusting, or troubleshooting, park the machine on level ground and use the safety pins and blocks to prevent the machine from moving.

⚠ When carrying out work together with other workers, always use signals and do not let unauthorized people near the machine.

⚠ When checking the water level, always wait for the water to cool down. If the radiotor cap is removed when the water is still hot, the water will spurt out and cause burns.

⚠ Be careful not to get caugt in the fan, fan belt, or other rotating parts.

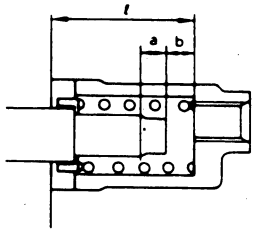
TABLE OF JUDGEMENT STANDARD VALUE

• FOR ENGINE

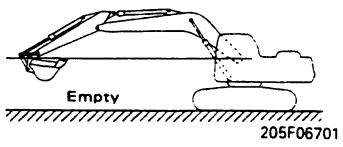
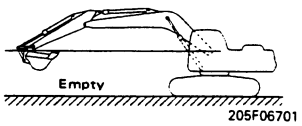
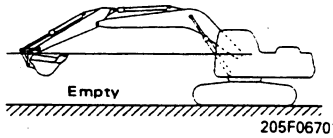
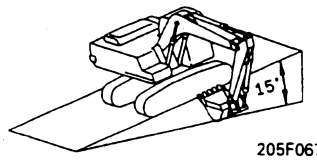
Machine model			PC180 LC-6K / PC160-6K	
Engine			SA4DI02E	
Item	Measurement conditions	Unit	Standard value	Permissible value
Engine speed	High idling	rpm	2450 $^{+60}_{-100}$	2450 $^{+60}_{-100}$
	Low idling	rpm	950 ±5 0	950 ± 50
	Rated speed	rpm	2100	2100 ± 100

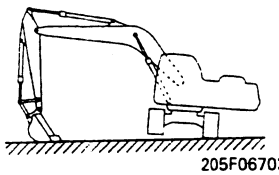
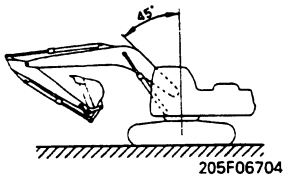
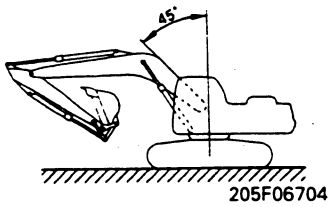
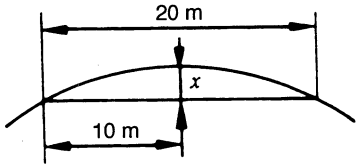
• FOR CHASSIS

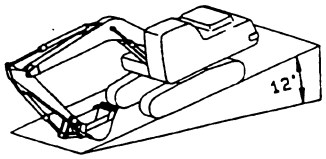
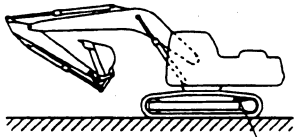
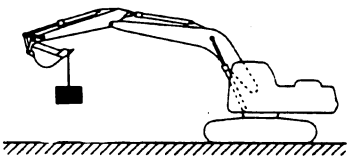
★ The standard values and permissible values in this tabel are all values for H/O (heavy-duty operation) mode.

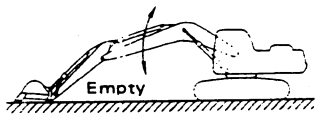
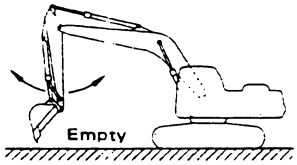
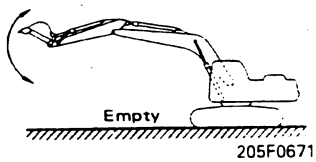
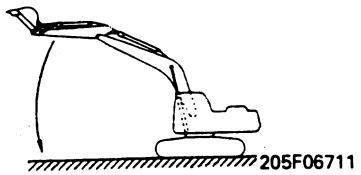
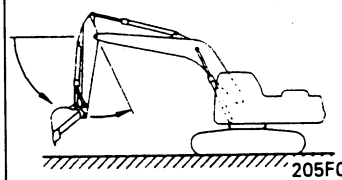
Machine model					PC180LC-6K/PC160-6K					
Cate-gory	Item		Measurement conditions	Unit	Standard value			Permissible value		
Engine speed	At 2-pump relief	Normal	• Swing lock off • Engine at high idling • Hydraulic oil temperature: 45 - 55°C • Coolant temperature: Within operating range • 2-pump relief:	rpm	2,100 ± 100			-		
		At travel lever operate	• Arm relief • Arm relief • Travel lever operated in small movements • Engine at high idling		2,100 ± 100			2,100 ± 100		
	Speed when autodeceleration is operated		• Fuel control dial at MAX. • Control lever at neutral		1,400 ± 120			1,400 ± 120		
Spool stroke	Boom control valve Arm control valve Bucket control valve Swing conrol valve Travel control valve		 202F2302	mm	l	a	b	l	a	b
					-	8 ± 0.5	8 ± 0.5	-	8 ± 0.5	8± 0.5
Travel of control levers	Boom control lever		• Center of lever knob • Read max. value to end of travel • Engine stopped • Excluding neutral play	mm	76 ± 8			Max. 84 Min. 68		
	Arm control lever				76 ± 8			Max. 84 Min. 68		
	Bucket control lever				76 ± 8			Max. 84 Min. 68		
	Swing control lever				76 ± 8			Max. 84 Min. 68		
	Travel control lever				115 ± 11			Max. 126 Min. 104		
	Play of control lever				Max. 10			Max. 15		
Operating force of control levers	Boom control lever		• Engine at high idling • Oil temperature: 45 - 55°C • Fit push-pull scale to center of control lever knob to end of travel • Measure max. value to end of travel	N (kg)	117. ± 3.9 (1.8 ± 0.4)			Max. 24.5 (Max. 2.5)		
	Arm control lever				17.7 ± 3.9 (1.8 ± 0.4)			Max. 24.5 (Max. 2.5)		
	Bucket control lever				14.7 ± 3.9 (1.5 ± 0.4)			Max. 21.6 (Max. 2.2)		
	Swing control lever				14.7 ± 3.9 (1.5 ± 0.4)			Max. 2.6 Max. 2.2)		
	Travel control lever	Lever			24.5 ± 5.9 (2.5 ± 0.6)			Max. 39.2 (Max. 4.0)		
		Pedal			74.5 ± 18.6 (7.6 ± 1.9)			Max. 107.8 (Max. 11)		

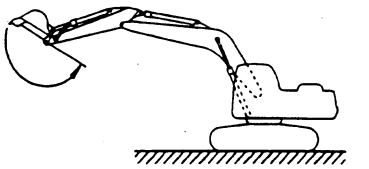
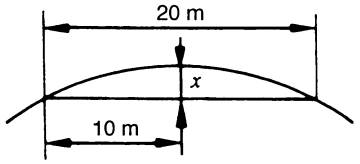
Machine model					PC180LC-6k/PC160-6k	
Cate-gory	Item	Measurement conditions		Unit	Standard value for new machine	Service limit value
Hydraulic pressure	Boom	• Hydraulic oil temperature: 45 - 55 C • Relief pressure with engine at high idling (Relieve only circuit to be measured) • In G/O mode • Swing lock off • Knob switch off • Figures in [ ] are when power max. function is used (reference) • Pump outlet port pressure ★ 1: For travel, measure oil pressure for relief on one side		Mpa (kg/cm^2)	31.85 ± 0.98 (325 ± 10) [$34.79^{+1.47}_{-0.98}$ (355^{+15}_{-10})]	Max. 33.81 (Max.345) Min. 30.38 (Min. 310) [Max. 37.24 (Max. 380) Min.33.81 (Min. 345)]
	Arm				$31.87^{+1.47}_{-0.98}$ (325^{+15}_{-10})	Max. 33.83 (Max. 345) Min. 30.40 (Min. 310)
	Bucket				$34.79^{+1.47}_{-0.98}$ (355^{+15}_{-10})	Max. 37.24 (Max. 380) Min. 33.81 (Min. 345)
	Swing				$2.94^{+0.59}_{0}$ (30^{+6}_{0})	Max. 3.53 (Max. 36) Min. 2.94 (Min. 30)
	Travel				3.9 ± 1.0 (40 ± 10)	3.9 ± 1.0 (40 ± 10)
	Control pump				2.5 ± 0.1 (25 ± 1)	2.5 ± 0.1 (25 ± 1)
	LS differential pressure	• Hydraulic oil temperature: 45 - 55°C • Engine at high idling • In H/O mode	Levers at neutral			
			Travel speed HI, rotating under no load			
	TVC valve output pressure (servo piston input pressure)	• Engine at high idling • Hydraulic oil temperature: 45 - 55°C • In H/O mode	Control lever no load			
			1-pump relief: Normal operation			
			1-pump relief: When power max. funtion is used			

Machine model				PC180LC-6k/PC160-6k	
Category	Item	Measurement conditions	Unit	Standard value	Permissible value
Swing	Swing brake angle	Work equipment posture Max. reach  205F06701 • Engine at high idling • Hydraulic oil temperature : 45 - 55°C • Stop after swinging one turn and measure distance that swing circle moves	Deg.	Max. 100	Max. 120
	Time taken to start swing	Work equipment posture Max. reach  205F06701 • Engine at high idling • Hydraulic oil temperature: 45 - 55 C • In H/O mode • Time taken to swing 90° and 180° from starting position	90° 180°	Sec	3.1 ± 0.3 4.9 ± 0.5	Max. 4.0 Max. 6.0
	Time taken to swing	Work equipment posture Max. reach  205F06701 • Engine at high idling • Hydraulic oil temperature: 45 - 55°C • In H/O mode. • Swing one turn, and measure time taken to swing next 5 turns	Sec	25.0 ± 1.5	Max 30
	Hydraulic drift of swing	 205F06702 • Engine stopped • Hydraulic oil temperature: 45 - 55°C • Set machine on 15°slope, and set upper structure at 90° to the side. • Make match marks on swing circle outer race and track frame. • Measure distance that match marks move apart after 5 minutes.	mm	0	0
	Leakage from swing motor	• Engine at high idling • Hydraulic oil temperature: 45 - 55°C • Swing lock switch ON • Relieve swing circuit.	ℓ/min	Max. 5	Max. 10

Machine model					PC180LC-6k/PC160-6k			
Category	Item	Measurement conditions		Unit	Standard value		Permissible value	
					PC180	PC160	PC180	PC160
Travel	Travel speed (1)	 205F06703 • Engine at high idling • Hydraulic oil temperature: 45 - 55°C • In H/O mode • Raise track on one side at a time, rotate one turn, then measure time taken for next 5 turns with no load.	Lo	Sec	59 ± 6	53 ± 6	53 - 70	47 - 64
			Mi		36.5 ± 4	34 ± 4	32.5 - 44.5	30 - 42
			Hi		29.5 ± 3	27 ± 3	24.5 - 36	24 - 33.5
	Travel speed (2)	 205F06704 • Engine at high idling • Hydraulic oil temperature: 45 - 55°C • In H/O mode • Run up for at least 10 m, and measure time taken to travel next 20 m on flat ground.	Lo	Sec	26.7 ± 3.0		23.7 - 32.7	
			Mi		18 ± 2.0		16 - 22.0	
			Hi		13.3 ± 1.0		12.3 - 15.3	
	Travel deviation	 205F06704 • Engine at high idling • Hydraulic oil temperature: 45 - 55°C • Run up for at least 10 m, and measure deviation when traveling next 20 m on flat ground. ★ Use a hard horizontal surface.  205F2402 ★ Measure dimension		mm	Max. 200		300	

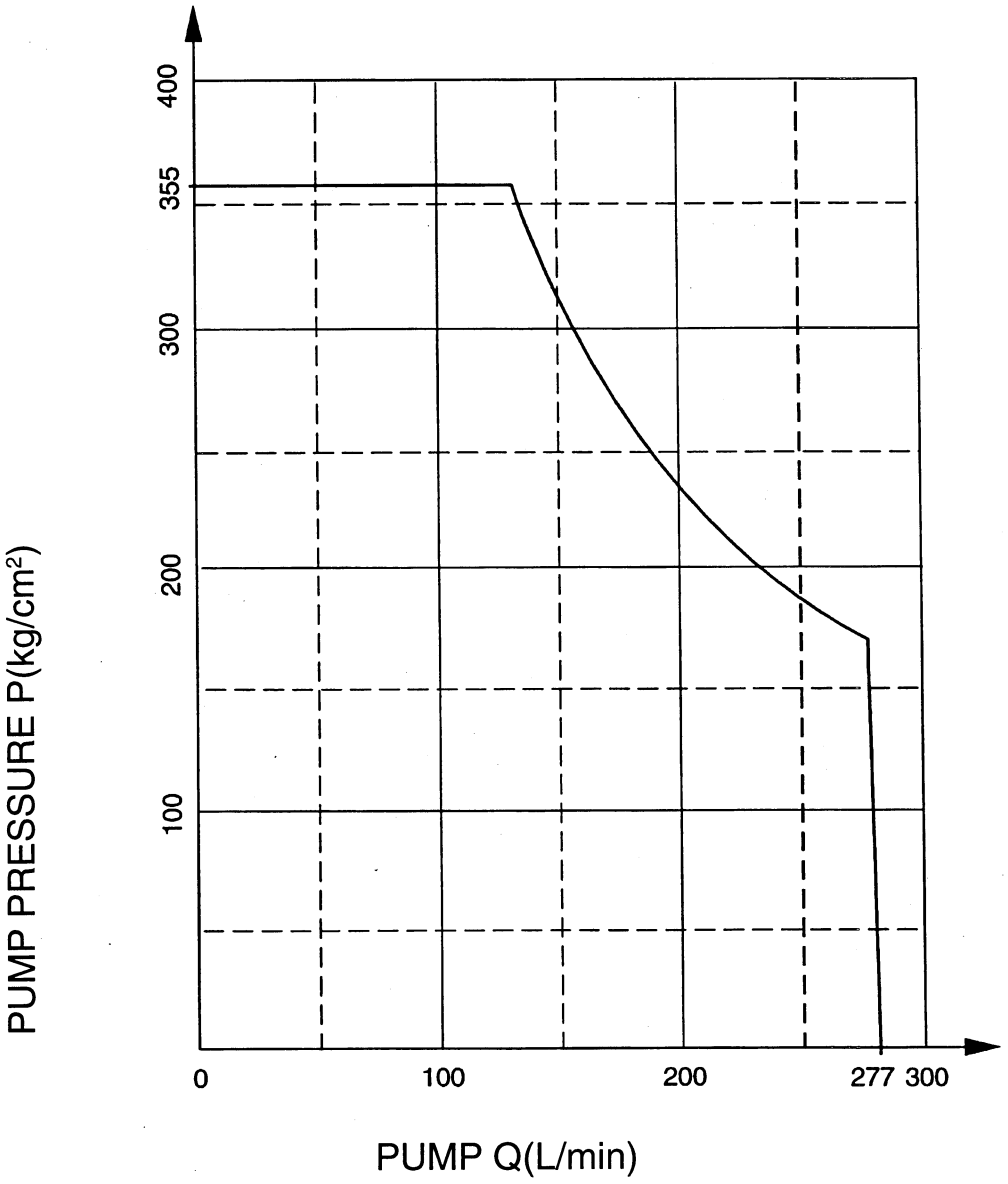
Machine model					PC180LC-6K/PC160-6K	
Category	Item		Measurement conditions	Unit	Standard value	Permissible value
Travel	Hydraulic drift of travel		 205F06705 • Engine stopped • Hydraulic oil temperature: 45 - 55 °C • Stop machine on 12° slope with sprocket facing straight up the slope. • Measure the distance the machine moves in 5 minutes.	mm	0	0
	Leakage of travel motor		 205F06706 • Engine at high idling • Hydraulic oil temperature: 45 - 55°C • Lock shoes and relieve travel circuit.	ℓ/mm	13.6	27.2
Work equipment	Hydraulic drift work equipment	Total work equipment (hydraulic drift at tip of bucket teeth)	Posture for measurement  205F06707 • Place in above posture and measure extension or retraction of each cylinder downward movement at tip of bucket teeth. • Bucket: Rated load • Horizontal, flat ground • Levers at neutral • Engine stopped • Hydraulic oil temperature: 45 - 55°C • Start measuring immediately after setting. • Measure hydraulic drift every 5 minutes, and judge from results for 15 minutes.	mm	Max. 400	Max.600
		Boom cylinder (amount of retraction of cylinder)			Max. 14	Max. 21
		Arm cylinder (amount of extension of cylinder)			Max. 110	Max. 165
		Bucket cylinder (amount of retraction of cylinder)			Max. 28	Max. 42

Applicable model					PC180LC-6K/PC160-6K	
Category	Item	Measurement		Unit	Standard value	Permissible value
Work equipment	Work equipment speed	Boom Bucket teeth in contact with ground	 205F06708	RAISE	3.7 ± 0.4	Max 4.5
		Cylinder fully extended	• Engine at high idling • Hydraulic oil temperature: 45 - 55°C • In H/O mode	LOWER	2.8 ± 0.3	Max 3.2
		Arm Cylinder fully retraced	 205F06709	IN	3.7 ± 0.4	Max 4.6
		Fully extended	• Engine at high idling • Hydraulic oil temperature: 45 - 55°C • In H/O mode	OUT	3.0 ± 0.3	Max. 3.6
		Bucket Cylinder fully retraced	 205F06710	CURL	3.6 ± 0.4	Max 4.3
		Fully extended	• Engine at high idling • Hydraulic oil temperature: 45 - 55°C • In H/O mode	DUMP	2.2 ± 0.3	Max. 2.8
	Time lag	Boom	 205F06711 • Lower boom and measure time taken from point where bucket contracts ground to point where chassis rises from ground • Engine at low idling • Hydraulic oil temperature: 45 - 55°C		Max. 2.0	Max. 3
		Arm	 205F06712 • Stop arm suddenly and measure time taken for arm to stop • Engine at low idling • Hydraulic oil temperature: 45 - 55°C	sec	Max. 1.0	Max. 2.8

Machine model					PC180LC-6k/PC160-6k	
Category		Item	Measurement conditions	Unit	Standard value	Permissible value
Work equipment	Time lag	Bucket	 205F06713 • Stop bucket suddenly and measure time taken for bucket to stop at bottom and then start again • Engine at low idling • Hydraulic oil temperature: 45 - 55°C	Sec	Max. 2.0	Max. 3.0
	Internal leakage	Cylinders	• Hydraulic oil temperature: 45 - 55°C • Engine at high idling • Relieve circuit to be measured	cc/min	Max 3.5	15
		Center swivel joint			10	50
Performance in compound operation		Travel deviation when work equipment + travel are operated	• Engine at high idling • Hydraulic oil temperature: 45 - 55 C ★ Use a hard horizontal surface.  205F2402 * Measure dimension	mm	Max. 200	Max. 220
Performance of hydraulic pump	Hydraulic pump delivery	Control pump	• Oil temperature: 45 - 55 C • Measure with engine at rated speed • At relief valve set pressure 3.14 MPa (32 kg/cm²)	ℓ/min	Min. 29	Min. 26
		Piston pump	See next page		See next page	

Category: Performance of hydraulic pump

PC180LC-6K/PC160-6K (H/O WORK. TRAVEL)



- Pump speed: At 2,200 rpm, TVC current 330 mA

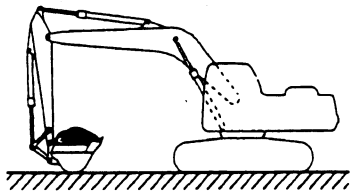
Check point	Test pump discharge pressure (MPa (kg/cm²))	Standard value for discharge amount Q (ℓ/min)	Judgement standard lower limit Q (ℓ/min)
As desired	P	See graph	See graph

★ As far as possible, bring pump discharge pressures P as close as possible to the average pressure when measuring.
The error is large near the point where the graph curves, so avoid measuring at this point.

★ When measuring with the pump mounted on the machine, if it is impossible to set the engine speed to the specified speed with the fuel control dial, take the pump discharge amount and the engine speed at the point of measurement, and use them as a base for calculating the pump discharge amount at the specified speed.

Flow control characteristics of TVC valve (STD)

★ The values in this table are used as reference values when carrying out troubleshooting.

Cate-gory	Item	Measurement conditions	Unit		
Performance in compound operations	Time taken for swing for boom RAISE + starting swing	 205F06714 •Engine at high idling •Hydraulic oil temperature: 45 - 55°C •In H/O mode •Load the bucket with the rated load and measure the time taken from the postition of starting the swing to the point of passing the 90° position.	Sec		

STANDARD VALUE TABLE FOR ELECTRICAL PARTS

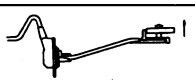
System	Name of component	Connector No.	Inspection method	Judgement table	Measurement conditions
Control system	Fuel control dial	E06 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal Between (1) - (2): 0.25 - 7 kΩ Between (2) - (3): 0.25 - 7 kΩ Between (1) - (3): 4 - 6 kΩ	1) Turn starting switch OFF. 2) Disconnect connector.
	Governor motor: Potentiometer	E04 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal 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.
	Governor motor: Motor	E05 (male)	Measure resistance	If the condition is as shown in the table below, it is normal 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.
	Engine speed sensor	E07	Measure resistance	If the condition is within the range shown in the table below, it is normal Between(male) (1) - (2): 500 - 1,000 Ω Between(male) (2) - chassis: Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector.
			Measure voltage	Measure with AC range Between (1) - (2): 0.5 - 3.0 V	1) Start engine. 2) Insert T-adapter.
			Adjust	1) Screw in rotation sensor until it contacts ring gear, then turn back 1 ± 1/6 turns. 2) It must work normally when adjusted as above.	
	PPC oil pressure switch	Travel S01 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 Between (male) (1) - (2): All levers at neutral: Min 1 MΩ Between (male) (1) - (2): 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
	Fuel shut-off valve	E09 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal Between (A) - (C): 46.5 - 56.9 kΩ Between (B) - (C): 0.87 - 1.07 kΩ	1) Turn starting switch OFF 2) Disconnect connector

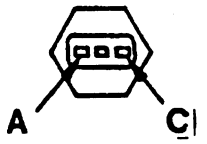
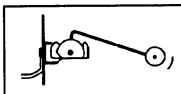
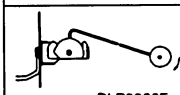
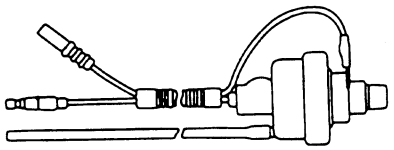
System	Name of component	Connector No.	Inspection method	Judgement table	Measurement conditions
Control system	Pump pressure sensor	C08 (male) (front)	Measure voltage	If the condition is as shown in the table below, it is normal Between (2) - (1): 18 - 28 V Between (3) - (1): All levers at neutral: 0.5 - 1.5 V; At arm IN relief: 3.1 - 4.5 V	1) Start engine. 2) Turn fuel control dial to MAX position 3) Insert T - adapter
	Swing lock switch	X05 (female)	Measure resistance	It the condition is as shown in the table below, it is normal Between (1) - (2) / Between (3) - (4): When switch is OFF: Min. 1 MΩ; When switch is ON: Max. 1 Ω	1) Turn starting switch OFF. 2) Disconnect connector C02
	TVC solenoid valve	C13 (male)	Measure resistance	If the condition is as shown in the table below, it is normal Between (1) - (2): 10 - 22 Ω Between (1), (2) - chassis: Min. 1 MΩ	1) Turn TVC prolix switch OFF. 2) Turn starting switch OFF. 3) Disconnect connector C13
	Swing holding brake solenoid valve	V06 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal Between (1) - (2): 20 -60 Ω Between (1), (2) - chassis: Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector VO6
	Travel speed solenoid valve	V04 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal Between (1) - (2): 20 -60 Ω Between (1), (2) - chassis: Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector V04
	LS bypass solenoid valve	V05 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal Between (1) - (2): 20 -60 Ω Between (1), (2) - chassis: Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector V05.
	2 step relief solenoid valve	V25 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal Between (1) - (2): 20 -60 Ω Between (1), (2) - chassis: Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector V25

System	Name of component		Connector No.	Inspection method	Judgement table	Measurement conditions
Control system	LS-EPC solenoid		C10 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal Between (1) - (2): 7 - 14 Ω Between (1), (2) - chassis: Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector C10.
	Covernor, pump controller	Power source voltage	C01 C02	Measure voltage	If the condition is within the range shown in the table below, it is normal Between C01 (7), (13) - (6), (12): 20 - 30 V Between C02 (11), (21) - (12): 20 - 30 V	1) Turn starting switch ON. 2) Insert T - adapter
		Fuel control dial	C03	Measure voltage	If the condition is as shown in the table below, it is normal Between (7) - (17) (power source): 4.75 - 5.25 V Between (4) - (17) (low idling): 4.0 - 4.75 V Between (4) - (17) (high idling): 0.25 - 1.0 V	1) Turn starting switch ON. 2) Insert T - adapter
		Governor potentiometer	C03	Measure voltage	If the condition is as shown in the table below, it is normal Between (14) - (17) (low idling): 2.9 - 3.3 V Between (14) - (17) (high idling): 0.5 - 0.9 V Between (7) - (17) (power source): 4.75 - 5.25 V	1) Turn starting switch ON. 2) Insert T - adapter
		Coolant temperature sensor	P07 (male)	Measure resistance	If the condition is as shown in the table below, it is normal Normal temperature (25°C): Aprrox. 37 - 50 kΩ 100°C: Aprrox. 3.5 - 4.0 kΩ	1) Turn starting switch OFF. 2) Disconnect connector P07 3) Insert T - adapter into connector at sensor end.
		Governor motor	C02	Measure voltage	If the condition is as shown in the table below, it is normal Between (2) - (3): 1.8 - 4.6 V Between (4) - (5): 1.8 - 4.6 V	1) Turn starting switch ON. 2) Insert T - adapter.
		Battery relay	C01	Measure voltage	If the condition is within the range shown in the table below, it is normal Between (1) - (6): 20 - 30 V ★This is only for 2.5 sec after the starting switch is operated ON → OFF; at other times it must be 0 V.	1) Turn starting switch ON. 2) Insert T - adapter.

System	Name of component	Connector No.	Inspection method	Judgement table	Measurement conditions
Control system	Governor, pump controller — Swing holding brake solenoid	C01	Measure voltage	If the condition is as shown in the table below, it is normal When either swing or work equipment control lever is operated (solenoid ON, swing holding brake canceled) — Between (3) - (6), (12) — 0 - 3 V Approx. 5 sec after swing lever and work equipment control levers are placed at neutral (solenoid OFF, swing holding brake applied) — Between (3) - (6), (12) — 20 - 30 V	1) Start engine. 2) Turn swing lock switch OFF. 3) Turn swing lock prolix switch OFF. 4) Insert T - adapter. ★ The lever can be operated slightly (without moving the equipment).
	Governor, pump controller — Travel speed solenoid	C01	Measure voltage	If the condition is as shown in the table below, it is normal With travel speed switch at Hi or Mi (solenoid ON, travel motor swash plate angel MIN) — Between (9) - (6), (12) — 0 - 3 V When travel speed switch is at lo (solenoid OFF travel motor swash plate angle MAX) — Between (9) - (6), (12) — 20 - 30 V	1) Start engine. 2) Insert T - adapter. 3) Turn fuel control dial to MAX position. 4) Operate the lever slightly not enough to move the machine. To check that the solenoid is OFF, measure with the fuel control dial at LOW (1200 rpm or below)
	Governor, pump controller — LS bypass solenoid	C01	Measure voltage	If the condition is as shown in the table below, it is normal When swing lock switch is OFF, and swing + travel levers are operated simultaneously (solenoid ON, LS not divided) — Between (2) - (6), (12) — 0 - 3 V When sing lock switch is ON (solenoid OFF, LS not divided) — Between (2) - (6), (12) — 20 - 30 V	1) Turn starting switch ON. 2) Isert T - adapter. ★ The lever can be operated slightly (without moving the equipment).
	Governor, pump controller — 2-stage relief solenoid	C01	Measure voltage	If the condition is as shown in the table below, it is normal. When travel is operated independently (solenoid ON) — Between (10) - (6), (12) — 0 - 3 V When levers and pedals are at neutral (solenoid OFF) — Between (10) - (6), (12) — 20 - 30 V	1) Turn starting switch ON. 2) Insert T - adapter. ★ The lever can be operated slightly (without moving the equipment).

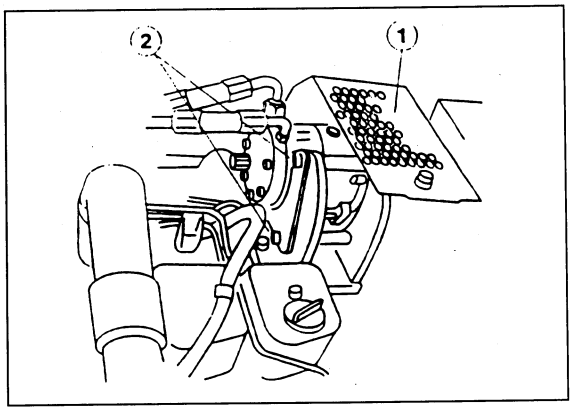
System	Name of component	Connector No.	Inspection method	Judgement table	Measurement conditions
Control system / Governor, pump controller	TVC solenoid valve (default value)	C02	Measure current	If the condition is as shown in the table below, it is normal • G/O mode (Hi-idle, swing lock off lever neutral Between front (8) - (18): 410 ± 40 mA	1) Turn starting switch ON. 2) Turn fuel control dial to MAX positon 3) Turn prolix switch OFF.
	LS-EPC solenoid valve (default value)	C02	Measure current	If the condition is as shown in the table below, it is normal • G/O mode Between (7) - (17): 800 ± 80 mA	1) Turn starting switch ON. 2) Turn fuel control dial to MAX position 3) All levers at neutral.
	L.H. knob switch	C03	Measure voltage	If the condition is as shown in the table below, it is normal When switch is ON: Between (9) - GND: 20 - 28 V When switch is OFF: Between (9) - GND: 0 - 1 V	1) Turn starting switch ON. 2) Insert T - adapter.
	S-NET	C17	Measure voltage	If the condition is as shown in the table below, it is normal Between (4), (12) - GND: 4 - 8 V	1) Turn starting switch ON. 2) Insert T - adapter
	Kerosene mode	C17	Measure voltage	If the condition is as shown in the table below, it is normal Standard mode: Between (15) - GND: 20 - 28 V Kerosene mode: Between (15) - GND: 0 - 2 V	1) Turn starting switch ON. 2) Insert T- adapeter
	No. 2 throttle signal	Monitoring code 16	Engine speed	If the condition is as shown in the table below, it is normal High idling (rpm) H/O: Approx. 2450 G/O: Approx. 2030 F/O: Approx. 2030 L/O: Approx. 1890 Power max. (H/O) (G/O): Approx. 2450 Swift slow-down (H/O) (G/O): Approx. 1890	1) Start engine. 2) Set monitoring code to 10 or 16 (command value). 3) Operate working mode switch and L.H. knob switch.
	Model selection	C17 - C02	Continuity	If the condition is as shown in the table below, it is normal Between selection 1: C17 (5) - C02 (11): No continuity Between selection 2: C17 (13) - C02 (11): Continuity Between selection 3: C17 (6) - C02 (11): No continuity Between selection 4: C17 (14) - C02 (11): No continuity Between selection 5: C17 (7) - C02 (11): No continuity	1) Turn starting switch OFF. 2) Disconnect connector. 3) Connect T - adapter to wiring harness end.

<table>
<tr><th>System</th><th>Name of component</th><th>Connector No.</th><th>Inspection method</th><th>Judgement table</th><th>Measurement conditions</th></tr>
<tr><td rowspan="6">Monitor</td><td>Air cleaner clogging sensor</td><td>P11 (male)
P12 (male)</td><td>Continuity</td><td>If the condition is as shown in the table below, it is normal
<table><tr><td>Air cleaner normal</td><td rowspan="2">Between P11 - P12</td><td>Continuity</td></tr><tr><td>Air cleaner clogged</td><td>No continuity</td></tr></table></td><td>1) Start engine.
2) Disconnect P11, P12.</td></tr>
<tr><td rowspan="3">Engine speed sensor</td><td rowspan="3">E07</td><td>Measure resistance</td><td>If the condition is within the range shown in the table below, it is
<table><tr><td>Between (1) - (2)</td><td>500 - 1000 Ω</td></tr><tr><td>Between (2) - chassis</td><td>Min. 1 MΩ</td></tr></table></td><td>1) Turn starting switch OFF.
3) Disconnect connector.</td></tr>
<tr><td>Measure voltage</td><td>Measure with AC range
<table><tr><td>Between (1) - (2)</td><td>0.5 - 3.0 V</td></tr></table></td><td>1) Start engine.
2) Insert T - adapter.</td></tr>
<tr><td>Adjust</td><td>1) Screw in rotation sensor until it contacts ring gear, then turn back 1 ± 1/6 turns
2) It must work normally when adjusted as above.</td><td></td></tr>
<tr><td>Coolant level sensor</td><td>P08 (male)</td><td>Measure resistance</td><td>If the condition is as shown in the table below, it is normal
<table><tr><td>Above LOW level in sub-tank</td><td>Max. 1Ω</td></tr><tr><td>Below LOW level in sub-tank</td><td>Min. 1MΩ</td></tr></table></td><td>1) Turn starting switch OFF.
2) Disconnect connecter P08.
3) Insert T - adapter into connector at sensor end.</td></tr>
<tr><td>Engine oil level sensor</td><td>P05 (male)</td><td>Measure resistance</td><td>If the condition is as shown in the table below, it is normal
<table><tr><td> 
BLP00002</td><td>Raise float</td><td>Max. 1Ω</td></tr><tr><td> 
BLP00003</td><td>Lower float</td><td>Min. 1MΩ</td></tr></table></td><td>1) Turn starting switch OFF.
2) Disconnect connector P05
3) Drain oil, then remove sensor.</td></tr>
<tr><td>Coolant temperature sensor</td><td>P07 (male)</td><td>Measure resistance</td><td>If the condition is as shown in the table below, it is normal
<table><tr><td>Normal temperature (25°C)</td><td>Approx. 70 - 78 kΩ</td></tr><tr><td>100°C</td><td>Approx. 3 kΩ</td></tr></table></td><td>1) Turn starting switch OFF.
2) Disconnect connector P07.
3) Put testr in contact between sensor terminals and check resistance</td></tr>
</table>

<table>
<tr><th>System</th><th>Name of component</th><th>Connector No.</th><th>Inspection method</th><th>Judgement table</th><th>Measurement conditions</th></tr>
<tr><td rowspan="3">Monitor</td><td>Engine oil pressure sensor</td><td>P10</td><td>Measure resistance</td><td>If the condition is as shown in the table below, it is normal.
Low pressure sensor
<table><tr><td>Pressure rising</td><td>Opens at 0.110 ± 0.014 MPa (Non continuity) (1.12 ± 0.14 kg/cm²)</td></tr><tr><td>Pressure dropping</td><td>Closes at 0.08 ± 0.014 MPa (Continuity) (0.85 ± 0.14 kg/cm²)</td></tr></table>Sensor connector
 
</td><td>1) Install oil pressure measuring gauge.
2) Remove wiring harness terminal.
3) Start engine.
4) Put tester in contact between sensor terminals A & C.</td></tr>
<tr><td>Fuel level sensor</td><td>P06 (male)</td><td>Measure resistance</td><td>If the condition is as shown in the table below, it is normal
<table><tr><td> 
BLP00004</td><td>Raise float to stopper</td><td>Approx. 12 Ω or below</td></tr><tr><td> 
BLP00005</td><td>Lower float to stopper</td><td>Approx. 85 - 110 Ω</td></tr></table></td><td>1) Turn starting switch OFF.
2) Disconnect connector P06.
3) Drain fuel, then remove sensor.
4) Insert T - adapter into sensor.
★ Connect the T - adapter to the connector and sensor flange.</td></tr>
<tr><td>Air cleaner clogging sensor</td><td>P11
P12</td><td>Measure resistance</td><td>If the condition is as shown in the table below, it is normal
<table><tr><td>Air cleaner normal</td><td>Continuity</td></tr><tr><td>Air cleaner clogged</td><td>No continuity</td></tr></table> 
BLP00006</td><td>1) Start engine.
2) Disconnect P11, P12.
3) Put tester in contact with connector at sensor end to measure.</td></tr>
</table>

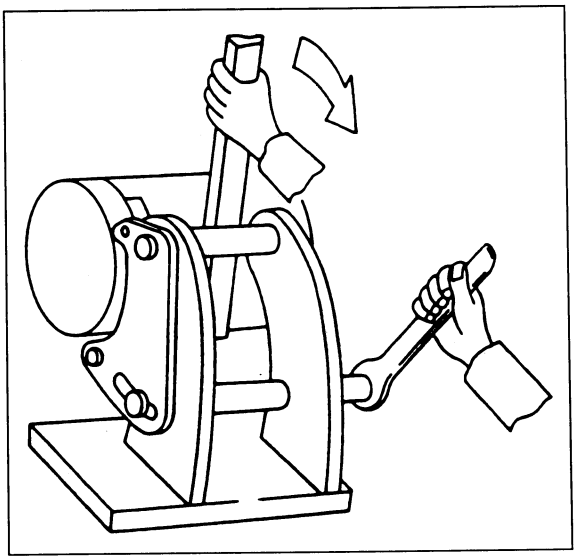
<table>
<tr><th>Name of component</th><th>Connector No.</th><th>Inspection method</th><th>Judgement table</th><th>Measurement conditions</th></tr>
<tr><td>Alternator</td><td>Between alternator terminal R and chassis</td><td>Measure voltage</td><td>When engine is running (1/2 throttle or above) below, the sensor is defective.
→ 27.5 - 29.5 V
★ If the battery is old, or after starting in cold areas, the voltage may not rise for some time.</td><td>1) Start engine</td></tr>
<tr><td rowspan="2">Gauges</td><td colspan="3"><table>
<tr><td></td><td>Position of gauge display</td><td>Display level resistance kΩ (Monitor panel input resistance)</td></tr>
<tr><td></td><td>Starting switch ON</td><td>Starting switch OFF</td></tr>
<tr><td>Measure resistance between coolant temperature gauge C03 (female) (1) - C03 (female) (16)</td><td>Right side
↑
Display position
↓
Left side</td><td>ALL OFF (15)
14
13
12
11
10
9
8
7
6
5
4
3
2
1</td><td>Min. - Max.
- 0.646
0.575 - 3.420
3.156 - 3.708
3.422 - 3.804
3.512 - 3.900
3.600 - 4.125
3.807 - 4.349
4.015 - 5.122
4.728 - 5.899
5.445 - 6.818
6.294 - 7.910
7.302 - 9.210
8.502 - 10.774
9.946 - 36.535
33.725 -</td></tr>
</table>★ Levels 13 and 14 flash</td><td>1) Insert a dummy resistance with the starting switch OFF, or measure the resistance of the sensor.
2) Check the display with the starting switch ON.</td></tr>
<tr><td colspan="3"><table>
<tr><td></td><td>Position of gauge display</td><td>Display level resistance kΩ (Monitor panel input resistance)</td></tr>
<tr><td></td><td>Starting switch ON</td><td>Starting switch OFF</td></tr>
<tr><td>Measure resistance between fuel level gauge C03 (female) (2) - chassis</td><td>Right side
↑
Display position
↓
Left side</td><td>14
13
12
11
10
9
8
7
6
5
4
3
2
1
ALL OFF (0)</td><td>Min. - Max.
- 13.82
11.71 - 17.43
15.18 - 21.25
18.90 - 25.05
22.59 - 28.45
25.82 - 31.85
29.18 - 35.22
32.45 - 39.91
37.00 - 44.60
41.77 - 48.72
45.52 - 55.14
50.42 - 64.35
60.61 - 77.07
72.98 - 69.15
638.00 - 69.15</td></tr>
</table>★ Level 1 flashes.</td><td>1) Insert a dummy resistance with the starting OFF, or measure the resistance of the sensor.
2) Check the display with the starting switch ON.</td></tr>
</table>

CHECKING AND ADJUSTING BELT TENSION FOR AIR CONDITIONER COMPRESSOR



CHECKING

1. Remove belt guard ①.
2. Press compressor drive belt midway between fan pulley and compressor pulley. The belt should normally deflect by about 15-18 mm (0.60-0.70 inch) when pressed with the finger (with a force of approx. 6kg (13 1b.)



ADJUSTING

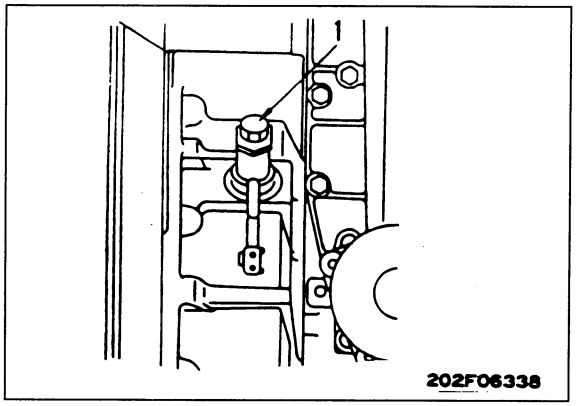
1. Loosen two nuts and bolts ②.
2. Carefully lever compressor housing as shown to tighten belt to tightness criteria. Tighten lower bolt to hold in position.
3. Tighten upper bolt.
4. Check each pulley for damage, wear of the V-groove and wear of the V-belt. In particular, be sure to check the V-belt is not touching the bottom of the V-groove.
5. Replace belt if it has streched, leaving no allowance for adjustment, or if there is a cut or crack on belt.
6. Refit belt guard.
7. When the new belt is set, readjust it after operating for one hour.

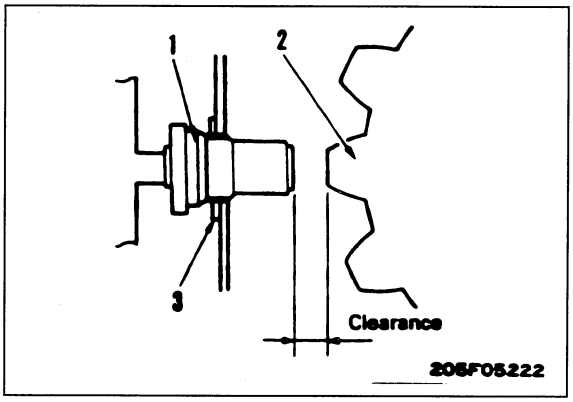
ADJUSTING ENGINE SPEED SENSOR

1. Screw in until the tip of sensor 91) contact gear (2).
2. When gear (2) contact sensor (1), turn back one turn.
3. Tighten locknut (3).

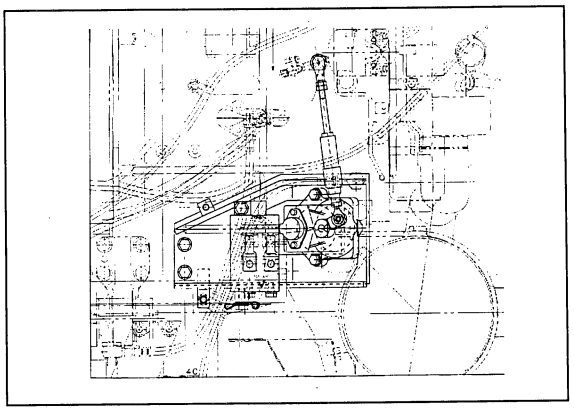
★ Be particularly careful when securing the sensor wiring to ensure that no excessive force is brought to bear on the wiring.

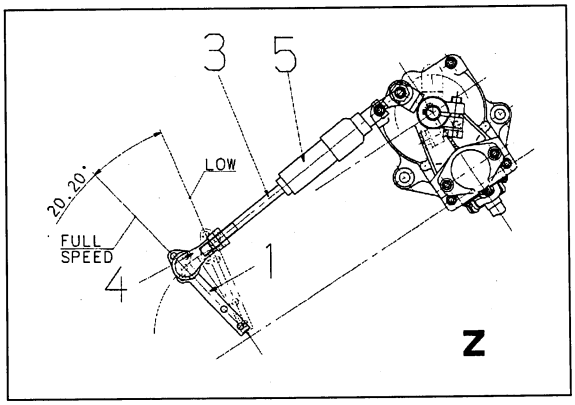
★ Be careful not to let the tip of the sensor be scratched or to let any iron particles stick to the sensor tip.





TESTING AND ADJUSTING GOVERNOR MOTOR LEVER STROKE





TESTING

★ Use the governor motor adjustment mode.

1. In the time mode display, keep the time switch + travel speed R.H. switch + working mode R.H. switch presssed for 2.5 seconds.
2. In this condition, check the governor lever and spring rod.
3. After checking, repeat the procedure in Step 1) to finish the governor motor adjustment mode.

ADJUSTING

1. Turn the starting switch OFF, then remove then nut and disconnect joint (1) from governor lever (4).
2. Repeat the procedure in Step 1 above to set to the governor motor adjustment mode.
3. Set governor lever (4) to a position where it contacts the full speed stopper of the injection pump, then adjust the length of spring assembly (5) and rod (3), and connect joint (1) with the nut.
4. From the above position, turn joint (1) back 4 turns, and secure in position with locknut (6).

★ **Caution**
When the spring assembly is removed and the starting switch is at the OFF position, if the governor motor lever is moved suddenly, the governor motor will generate electricity, and this may cause a failure in the engine throttle controller.

5. Confirm engine speeds are within tolerance according to:

No load engine speeds

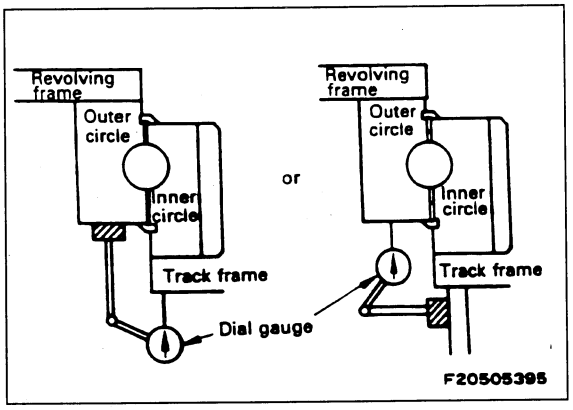
Condition	Fuel dial	PC180/PC160
Low idle	Min.	950 ± 50
Auto decel	Max	1.400 ± 70
L.O.	Max.	1890 ± 100
G.O, F.O.	Max.	2030 ± 100
H.O.	Max.	2450 ± 70
Travel*	Max.	

★ **To check travel condition, ensure H.O working mode is selected then move travel lever so that auto decel is cancel but machine does not move.**

TESTING CLEARANCE OF SWING CIRCLE BEARING

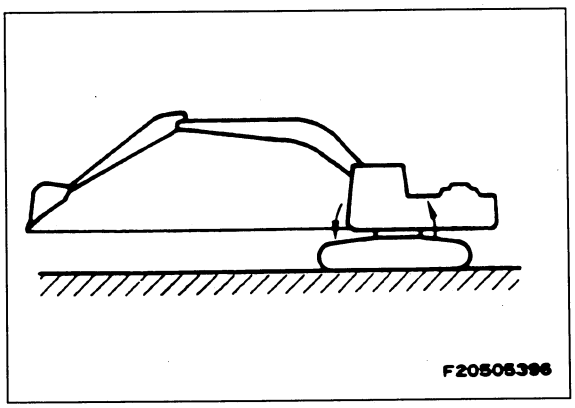
Method of testing clearance of swing circle bearing when mounted on machine

1. Fix a magnet-type dial gauge to the outer circle (or inner circle) of the swing circle, and put the tip of the probe in contact with the inner circle (or outer circle). Set the dial gauge at the front or rear.



2. Extend the work equipment to the maximum reach, and set the tip of the bucket to the same height as the bottom of the revolving frame.
   When this is done, the upper structure will tilt forward, so the front will go down and the rear will rise.

3. Set the dial gauge to the zero point.

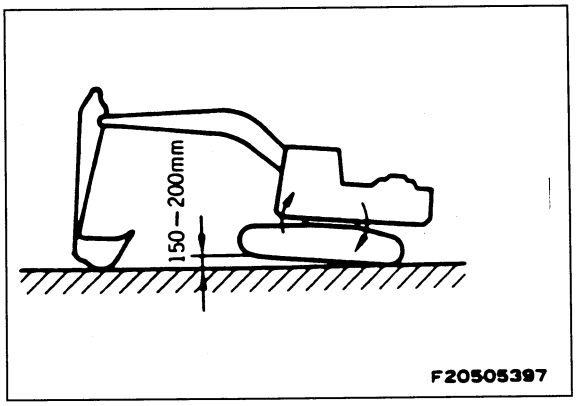


4. Set the arm more or less at right angles to the ground surface, then lower the boom until the front of the machine comes off the ground.
   When this is done, the upper structure will tilt back, so the front will rise and the rear will go down.

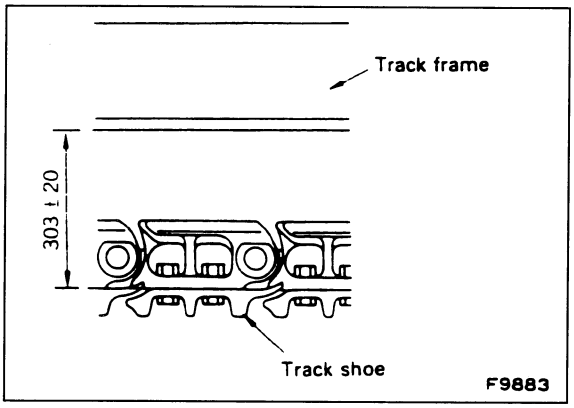
5. Read the value on the dial gauge at this point. The value on the dial gauge is the clearance of the swing circle bearing.

⚠ When carrying out the measurment, do not put your hand or feet under the undercarriage.

6. Return tot the condition in Step 2, and check that the dial gauge has returned to the zero point. If it has not returned to the zero point, repeat Steps 2 to 5.



TESTING AND ADJUSTING TRACK SHOE TENSION



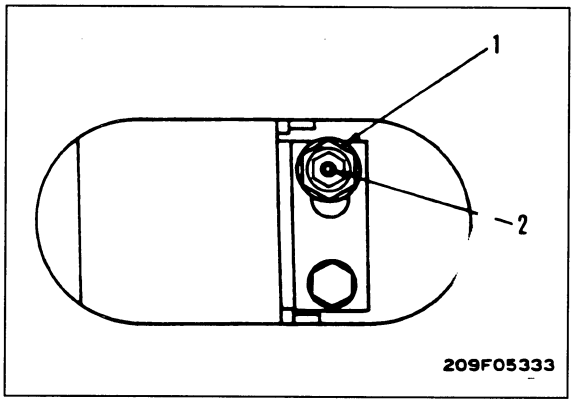
TESTING

1. Raise the track frame using the arm and boom, and measure the clearance between the bottom of the track frame and the top of the track shoe.
   - Clearance: 303 ± 20 mm
     Measurement position
     PC/180LC: 4th track roller from the sprocket.

ADJUSTING

★ If the shoe tension is not within the standard value, adjust as follows.

1. When the tension is too high:
   Loosen plug (1) gradually, and release the grease.
   ⚠ There is danger that the plug may fly out under the high internal pressure of the grease, so never loosen plug (1) more than 1 turn.
   ★ If the grease does not come out easily, move the machine backwards or forwards slowly.



2. If track is too loose:
   Pump in grease through grease fitting (2).
   ★ If the grease cannot be pumped in easily, move the machine backwards and forwards slowly.

TESTING AND ADJUSTING HYDRAULIC PRESSURE IN WORK EQUIPMENT, SWING, TRAVEL CIRCUIT

MEASURING

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

⚠ Lower the work equipment to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then put the safety lock lever in the LOCK position.

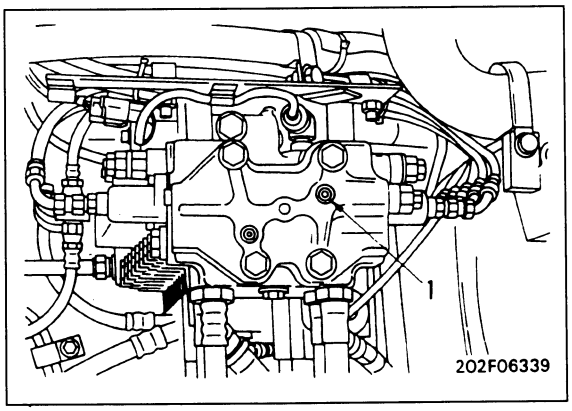
- Remove pressure pick-up plug (1) (Thread dia.= 10, Pitch= 1.25mm) from the circuit to be measured, then install oil pressure gauge **C1** (58.8 MPa (600kg/cm²)).

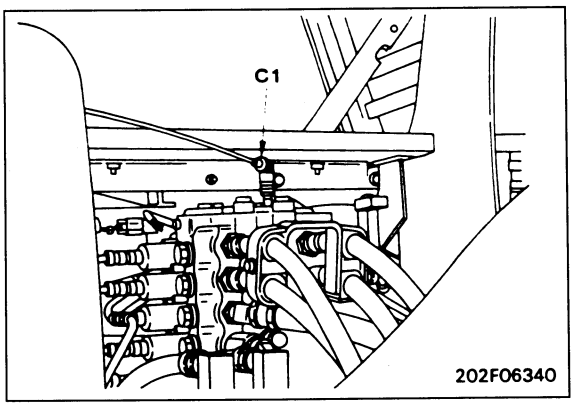
- **Measuring unload pressure**

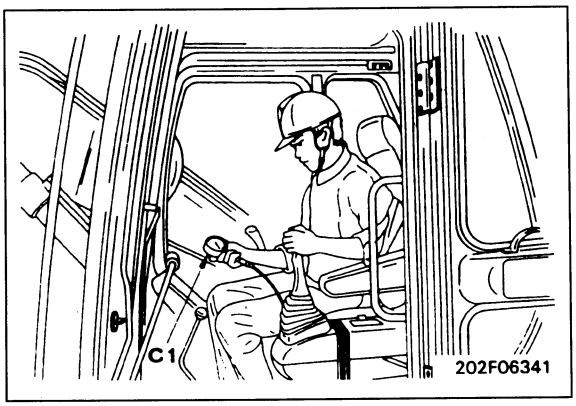
1. Measure the oil pressure in H/O mode with the engine at high idling and the control levers at neutral.

- **Measuring pump relief pressure**

1. Oil pressure when main pressure is at low pressure (31.9 kg/cm2))
   1) Measure the pressure when each actuator except the travel is relieved in G/O mode with the engine at high idling.
   ★ Note that the set pressure of the safety valve for the swing motor is lower than the main relief pressure, so the value measured will be the relief pressure of the safety valve.
   If the swing lock switch is turned ON, the pressure will rise, so always keep the lock switch OFF when measuring.

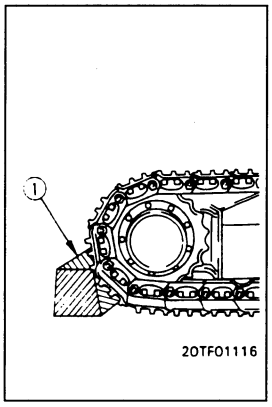


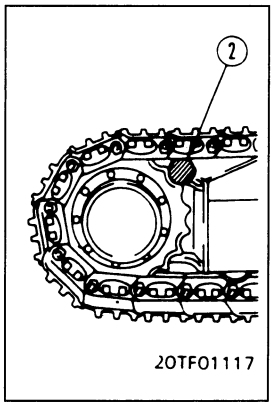




2. When main relief pressure is raised (34.8 MPa (355 kg/cm^2))
   1) When travel is operated

   Measure the oil pressure when the travel is relieved on each side separately in H/O mode with the engine at high idling.
   ★ To relieve the travel circuit, put block ① under the track shoe grouser, or put block ② between the sprocket and frame to lock the track.
   2) When power max. function is actuated when measuring the oil pressure in G/O or H/O mode with the engine at high idling and the power max. function actuated, relieve one of the boom, arm, or bucket circuits, and measure the oil pressure.





ADJUSTING

1. Main relief valve

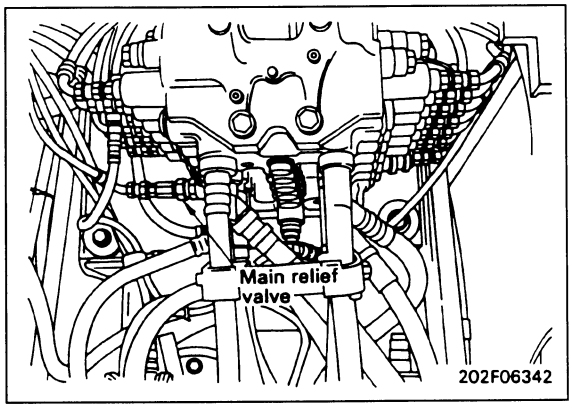
- Adjusting high set pressure end
  1) Loosen locknut (5).
     ★ Check that elbow (6) can move.
  2) Loosen locknut (3), then turn holder (4) to adjust.
     ★ Turn the holder to adjust as follows.
       - To INCREASE pressure, turn CLOCKWISE.
       - To DECREASE pressure, turn COUNTERCLOCKWISE.
     ★ Amount of adjustment for one turn of adjustment screw: 12.6 MPa (128 kg/cm²)

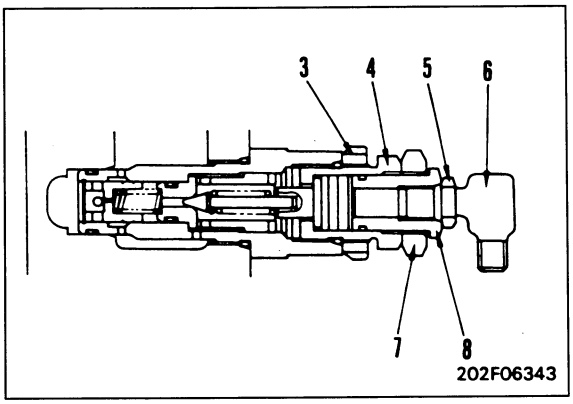
  kgm Locknut:
  58.8 ± 4.9 Nm (6 ± 0.5 kgm)

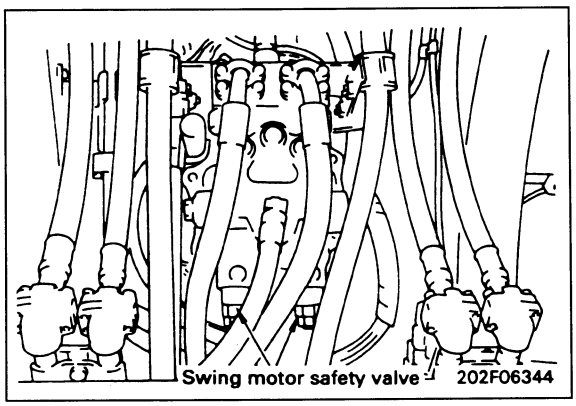
  ★ When the high pressure end is adjusted, the low pressure end also changes, so adjust the low pressure end also.
- Adjusting low set pressure end
  1) Loosen locknut (5).
     ★ Check that elbow (6) can move.
  2) Loosen locknut (7), then turn holder (8) to adjust.
     ★ Turn the holder to adjust as follows.
       - To INCREASE pressure, turn CLOCKWISE.
       - To DECREASE pressure turn COUNTERCLOCKWISE.
     ★ Amount of adjustment for one turn of adjustment screw: 12.6 MPa (128 kg/cm²)

  kgm Locknut:
  44.1 ± 4.9 Nm (4.5 ± 0.5 kgm)

  ★ Normally, there is a pressure of approx. 1.27 MPa (13 kg/cm²) or less applied to port Pr, but at the high pressure setting the pressure is approx. 2.94 MPa (30kg/cm²).

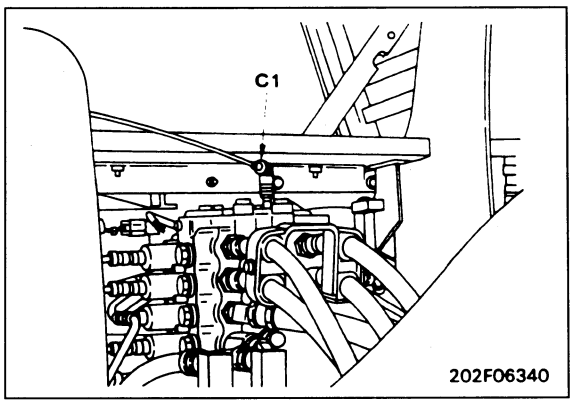




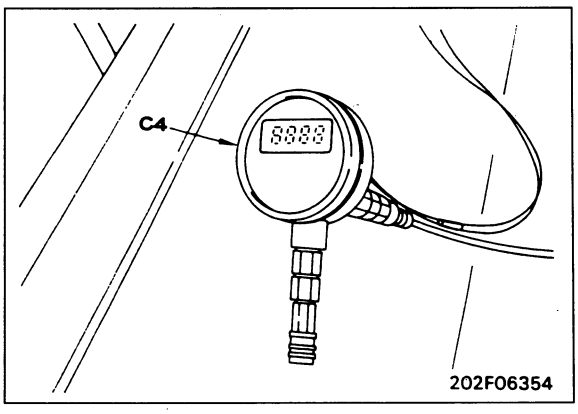


2. Measuring LS differential pressure
   1) Measuring with a differential pressure gauge
      i) Remove oil pressure measurement plug (1) (Thread dia.= 10mm, Pitch=1.25mm), and install differential pressure gauge C4.
      ii) Set to the conditions in Table 2 and measure the LS differential pressure.

Working	Fuel control dial	Operation	Differential pressure (MPa(kg/cm²)
H/O mode	MAX	Levers at neutral	3.9 ± 1.0 (40 ± 10)
H/O mode	MAX	Travel speed: Hi Travel circuit under no load (lever half operated)	2.5 ± 0.1 (25 ± 1)



   2) Measuring with oil pressure gauge
      ★ The maximum differential pressure is 3.9 ± 1.0 MPa (40 ± 10 kg/cm²), so measure with the same gauge.
      i) Remove oil pressure measurement plug (1) (thread dia.= 10mm, pitch=1.25mm), and install the plug inside hydaulic tester **C1**.
      ii) Install oil pressure gauge **C1** (58.8 MPa (600 kg/cm²)) to the measurement plug for the pump discharge pressure.
         * Use a gauge with a scale in units of 0.98 MPa (10 kg/cm²).
           If no 58.8 MPa (600 kg/cm2) pressure gauge is available, a 39.2 MPa (400 kg/cm²) pressure gauge can be used.
      iii) Set to the conditions in Table 2 and measure the pump discharge pressure.
         ★ Stand direclty in front of the indicator and be sure to read it correctly.
      iv) Remove oil pressure gauge **C1**, then install to the LS pressure measurement plug.
      v) Set to the conditions in Table 2 and measure the LS pressure.
         ★ Stand directly in front of the indicator and be sure to read it correctly. (pump discharge pressure) - (LS pressure) = Differential pressure

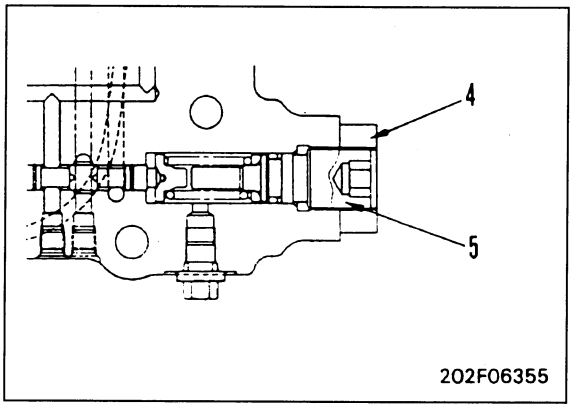


ADJUSTING

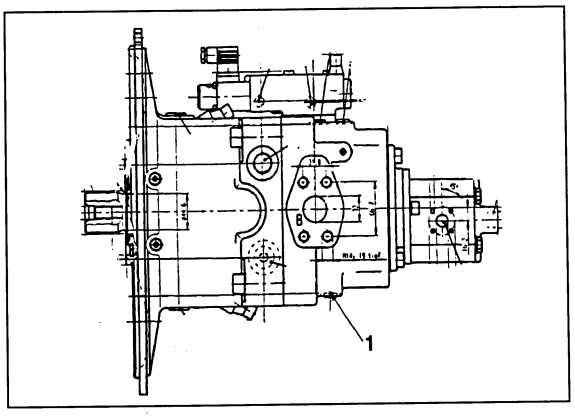
1. Adjusting LS valve
   When the differential pressure is measured under the conditions above, and the results show that the differential pressure is not within the standard value, adjust as follows.
   1) Loosen locknut (4) and turn screw (5) to adjust the differential pressure.
      ★ Turn the screw to adjust the differential pressure as follows.
      - To INCREASE pressure, turn CLOCKWISE
      - To DECREASE pressure, turn COUNTERCLOCKWISE
   2) After adjusting, tighten locknut (4).

      kgm Locknut:
      29.4 ± 4.9 Nm (3.0 ± 0.5kgm)

Note: Always measure the differential pressure while adjusting.



TESTING AND ADJUSTING TVC VALVE OUTPUT PRESSURE (SERVO PISTON INPUT PRESSURE)



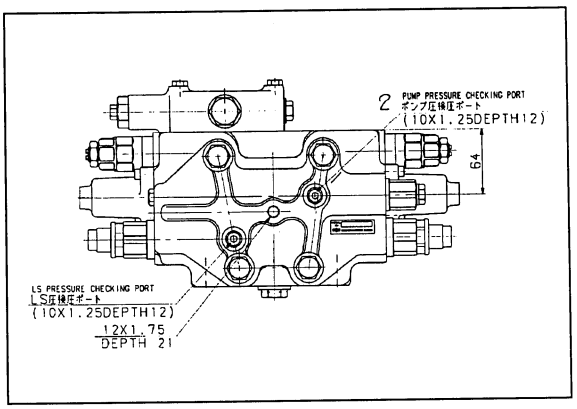
MEASURING

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

• Measure the oil pressure when the circuit is relieved in the pressure rise mode.

1. Remove pressure measurement plugs (1) and (2) and install oil pressure gauge C1.
   ★ Install a 39.2 MPa (400 kg/cm²) gauge to the servo end, and a 58.8 MPa (600 kg/cm²) gauge to the pump outlet port end.
2. Set the swing lock switch ON.
3. Set the working mode to H/O mdoe.
4. Run the engine at high idling, push the L.H. knob switch ON, and measure the oil pressure when the arm IN curcuit is relieved.

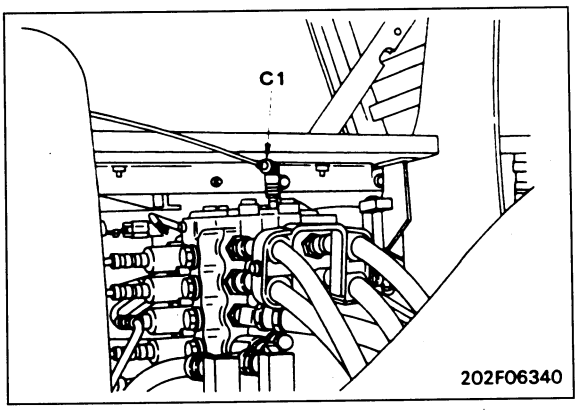
* Check that the servo piston input pressure is APPROX 1/3 of the poump discharge pressure.

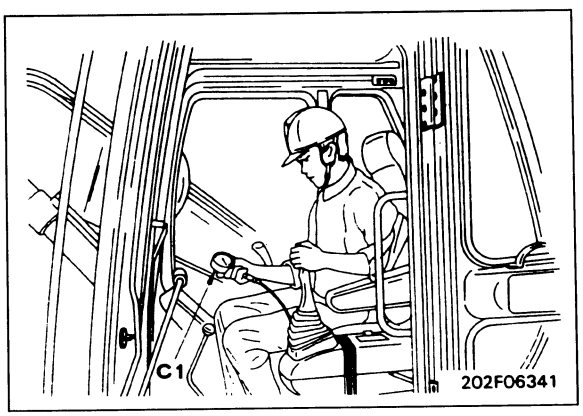


[Reference]

If there is any abnormality in the LS valve or servo piston, the servo piston input pressure will be almost the same or 0 of the pump discharge pressure.

★ (2) Thread dia. = 10mm, Pitch=1.25mm
(1) Thread dia= 12 mm Pitch =1.5 mm





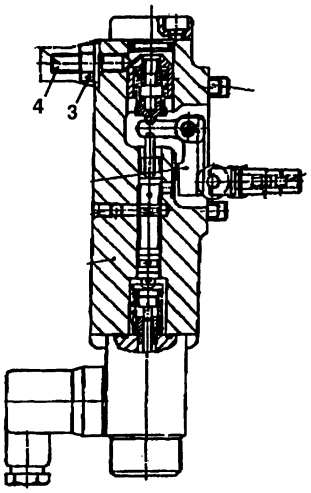
ADJUSTING

★ If the load becomes larger, the engine speed wil drop. Or if the engine speed remains normal, the work equipment speed will drop. In such cases, if the pump discharge pressure and LS differential pressure are normal, adjust the TVC valve as follows.

1. Loosen locknut (3), and if the speed is slow, turn screw (4) to the left; if the engine speed drops, turn the screw to the right.
   ★ If the screw is turned to clockwise the pump absorption torque will be increased, and if it is turned to anticlockwise pump absorption torque will be reduced.
2. After completing the adjustment, tighten the locknut.

kgm Locknut: Nm (kgm)

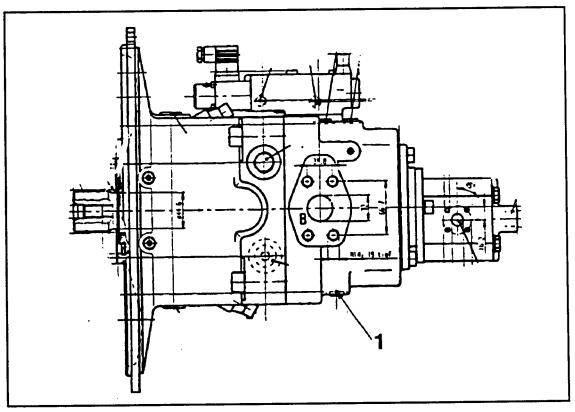
★ Before the screw is adjusted please mark there to make clear the original position of the screw.



(TVC valve of main pump)

TESTING AND ADJUSTING LS VALVE OUTPUT PRESSURE (SERVO PISTON INPUT PRESSURE) AND LS DIFFERENTIAL PRESSURE

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



MEASURING

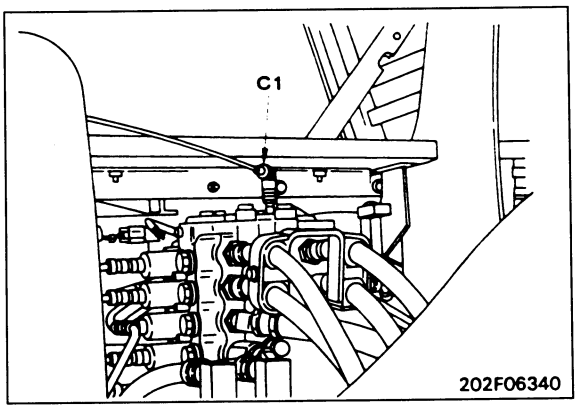
1. Measuring LS valve output pressure (servo piston input pressure)
   1) Remove pressure measurement plugs (1) and (2) and install oil pressure gauge C1.
      ★ Install a 39.2 MPa (400 kg/cm²) gauge to the servo end, and a 58.8 MPa (600 kg/cm²) gauge to the pump outlet port end.

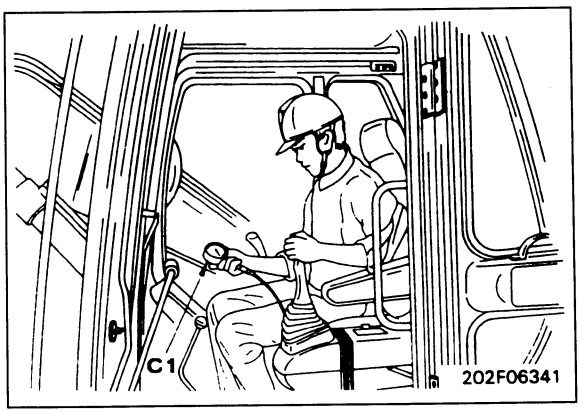
- Oil pressure when travel is rotating under no load (wheels OFF the ground).
  i) Set the working mode to H/O mode, and turn the travel speed switch to Hi.
  ii) Use the work equipment and/or undercarriage attachment to raise the wheels OFF the ground.
  iii) Measure the oil pressure with the engine at high idling and the travel pedal operated to the end of its stroke to rotate the wheels under no load.
  Run the engine at high idling, operate the travel pedal to the end of its stroke, and measure the oil pressure when the working mode and travel speed are switched as shown in Table 1.

Table 1

Working mode	Travel pedal	Pump pressure MPa (kg/cm²)	Servo inlet port pressure (MPa(kg/cm²)	Remarks
H/O mode	Neutral	3.9 ± 1.0 (4.0 ± 1.0)	3.9 ± 1.0 (40 ± 10)	About same pressure
H/O mode	Full	6.8 ± 2.0 (90 ± 20)		About of pressure

★ (2) Thread dia= 10mm
(1) Thread dia= 12mm





2. Measuring LS differential pressure
   1) Measuring with a differential pressure gauge
      i) Remove oil pressure measurement plug (1) (Thread dia.=12mm, Pitch=1.5 mm), and install differential pressure gauge **C4**.
      ii) Set to the conditions in Table 2 and measure the LS differential pressure.

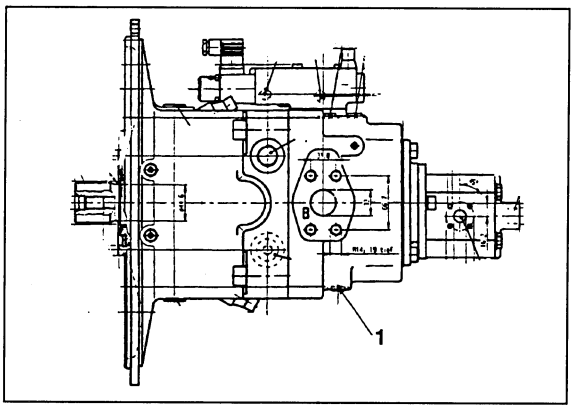
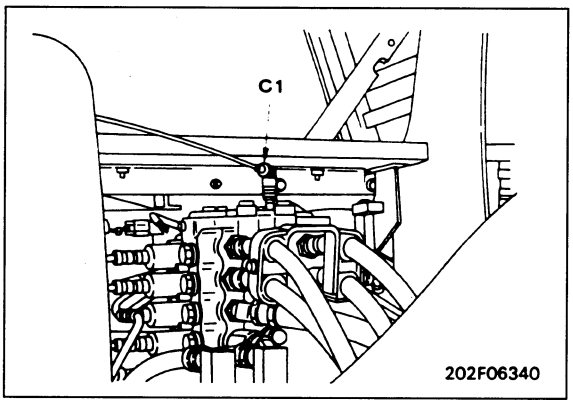


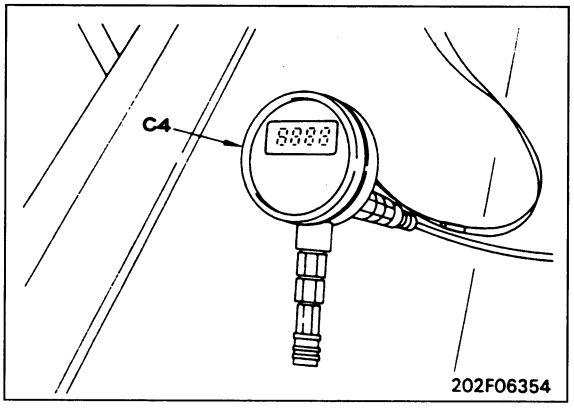
Table 2

Working mode	Fuel control dial	Operation	Differential pressure (MPa (kg/cm²)
H/O mode	MAX	Pedal at neutral	3.9 ± 1.0 (40 ± 10)
H/O mode	MAX	Travel speed: Hi Travel circuit under no load (pedal fully operated)	2.5 ± 0.1 (25 ± 1)

Note: When all control levers are at neutral, the LS differential pressure is the same as the unload pressure



2) Measuring with oil pressure gauge
   ★ The maximum differential pressure is 3.9MPa (40kg/cm²), so measure with the same gauge.
   i) Remove oil pressure measurement plug (1) (thread dia.=12mm, pitch=1.5mm), and install the plug inside hydraulic tester **C1**.
   ii) Install oil pressure gauge **C1** (58.8 MPa (600 kg/cm²)) to the measurement plug for the pump discharge pressure.
      ★ Use a gauge with a scale in units of 0.98 MPa (10 kg/cm²).
      If no 58.8 MPa (600 kg/cm²) pressure gauge is available, a 39.2 MPa (400 kg/cm²) pressure gauge cna be used.
   iii) Set to the conditions in Table 2 and measure the pump discharge pressure.
      ★ Stand directly in front of the indicator and be sure to read it correctly.
   iv) Remove oil pressure gauge **C1**, then install to the LS pressure measurement plug.
   v) Set to the conditions in Table 2 and measure the LS pressure.
      ★ Stand direclty in front of the indicator and be sure to read it correctly. (Pump discharge pressure) - (LS pressure)= differential pressure

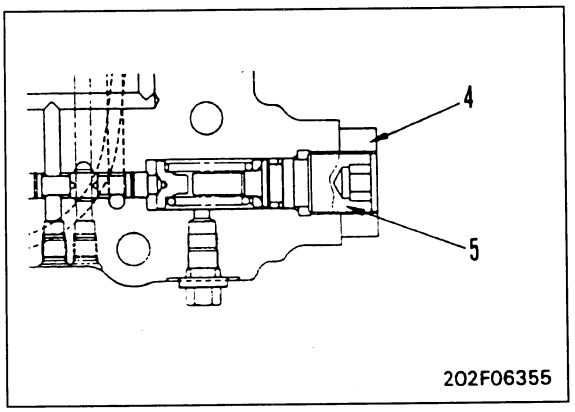


ADJUSTING

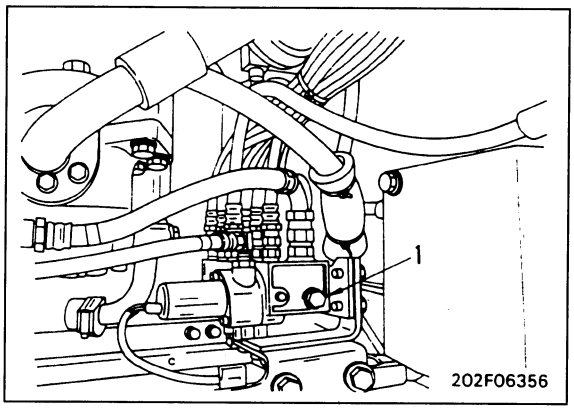
1. Adjusting LS valve
   When the differential pressure is measured under the conditions above, and the results show that the differential pressure is not within the standard value, adjust as follows.
   1) Loosen locknut (4) and turn screw (5) to adjust the differential pressure.
      ★ Turn the screw to adjust the differential pressure as follows.
      - To INCREASE pressure, turn CLOCKWISE
      - To DECREASE pressure, turn COUNTERCLOCKWISE
   2) After adjusting, tighten locknut (4).

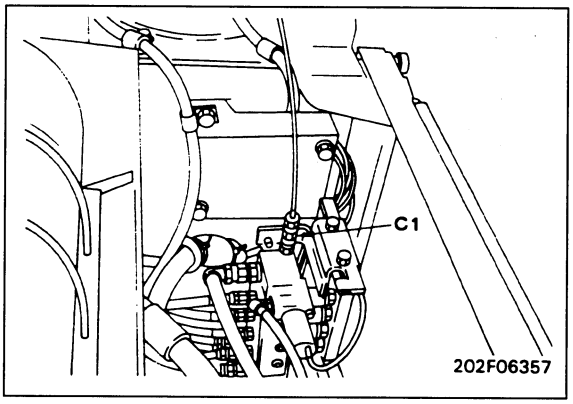
      kgm Locknut:
      29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)

Note: Always measure the differential pressure while adjusting.



CONTROL PUMP CIRCUIT OIL PRESSURE





MEASURING

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

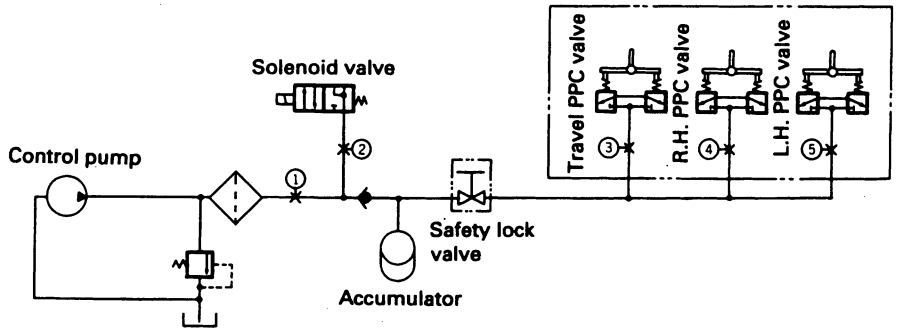
1. Remove pressure pick-up plug (1) (Thread dia.= 10mm, Pitch=1.25mm), and install oil pressure gauge C1 (5.88 MPa (60 kg/cm^2).
2. Start the engine and measure with the engine at high idling.
   ★ When testing for internal leakage of the equipment in the control circuit, use the parts given below to shut off the circuit for the following sections when measuring the relief pressure.

No.	Section of hydraulic circuit shut off	Component that can be checked
1	Control pump outlet port	Control pump
2	Solenoid valve inlet port	Solenoid valve
3	Travel PPC valve inlet port	Travel PPC valve
4	R.H. PPC valve inlet port	R.H. PPC valve
5	L.H. PPC valve inlet port	L.H. PPC valve

★ Items No. 2 and below can be checked if the equipment in the previous number is normal.

★ Use the following parts to shut off the circuit.

- For elbow
  Sleeve nut: 07221-20210, 07221-20315 07221-20422
  Plug: 07222-00210 07222-00315 07222-00414
- For hose
  Plug: 07376-50210, 07376-50315 07376-50422



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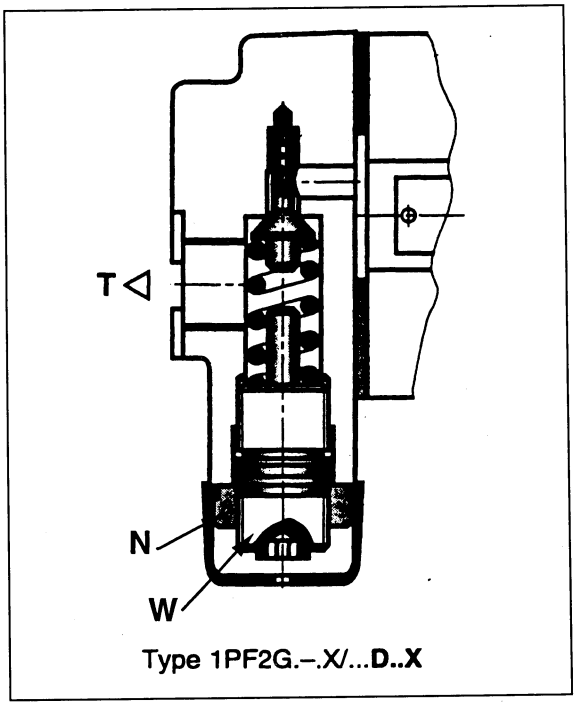
ADJUSTING

1. Loosen locknut (2) and turn adjustment screw (3) to adjust.
   - ★ Turn the adjustment screw as follows.
     - To INCREASE pressure, turn CLOCKWISE
     - To DECREASE pressure, turn COUNTER-CLOCKWISE
   - ★ Amount of adjustment for one turn of adjustment screw: MPa (kg/cm²)

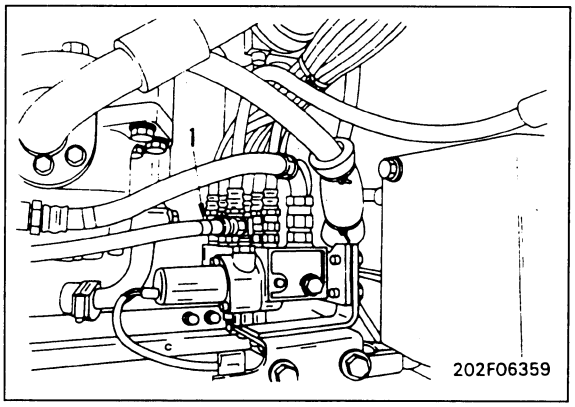
   kgm Locknut: Nm (± kgm)

   - ★ After completion of adjustment, repeat the procedure in MEASURING to check the set pressure again.



Type 1PF2G.–.X/...D..X

TESTING EPC VALVE, SOLENOID VALVE OUTPUT PRESSURE



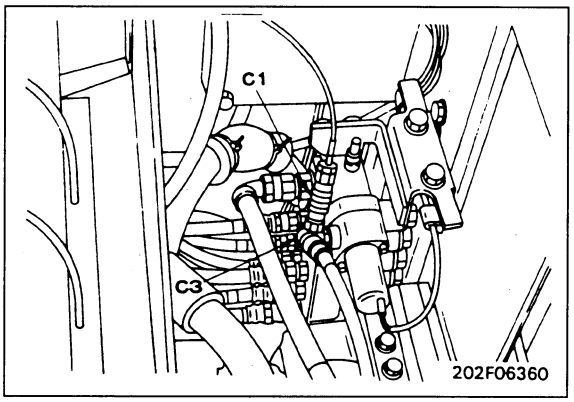
MEASURING

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

1. Measuring output pressure of LS control EPc solenoid valve
   1) Disconnect output hose (1) of the LS control EPC valve, then use adapter **C3** in the oil pressure gauge kit to install oil pressure gauge **C1** (5.9 MPa (60 kg/cm^2)).
   2) Measure the output pressure under the conditions in Table 1.

Table 1

Operation	Engine speed (rpm)	Output t pressure MPa (kg/cm^2)	[Reference] Current (A)
All control levers at neutral	Min. 1100	2.5 (26)	800±80
Travel lever operated, travel speed Hi	Max. 1900	0.2 ± 0.2 (2±2)	0



★ Monitoring code 10 or 40 for engine speed
Monitoring code 15 for LS control EPC current

2. Measuring output pressure of ON/OFF solenoid valve
   1) Disconnect outlet hose (2) of the solenoid valve, then use adapter **C3** in the oil pressure gauge kit to install oil pressure gauge **C1** (5.9 MPa (60 kg/cm^2).
   2) Measure the output pressure under the conditions in Table 2.

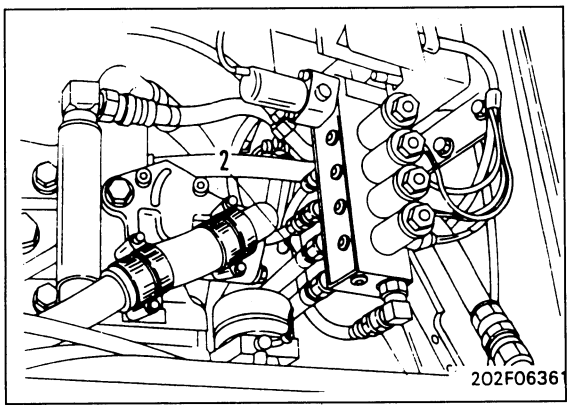
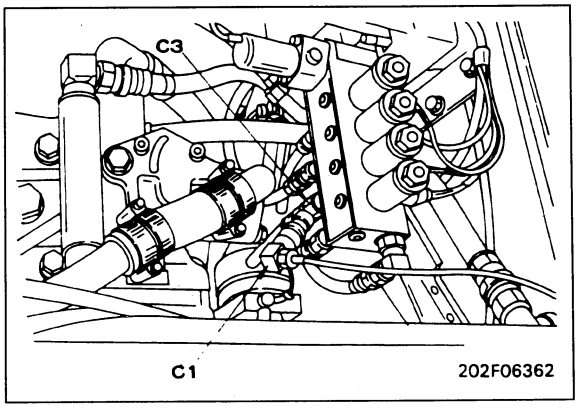


Table 2

Name of solenoid		Measurement conditions	Operating condition	Condition of solenoid	Oil pressure (MPa (kg/cm^2))	Remarks
1	Swing brake	Swing or work equipment lever operated	Brake canceled	ON	2.94±0.49 (30±5)	
		All levers except travel at neutral (5 sec after returning to neutral)	Brake actuated	OFF	0	
2	Travel speed	Travel speed switch at Hi Engine speed 1500 rpm or above Travel lever operated	Travel speed Hi	ON	2.94 ±0.49 (30±5)	Motor swash plate angle at minimum
		Travel speed selected switch at to or engine speed 1500 rpm or below	Travel speed Lo	OFF	0	Motor swash plate angle at maximum
3	2-stage relief	Swing lock switch ON + work equipment lever operated	pressure rise	ON	2.94 ±0.49 (30±5)	
		All levers at neutral	Normal pressure	OFF	0	
4	LS select	Compound operation of travel + work equipment or swing	LS circuit pressure bypassed	ON	0	
		Any operation except above	Ls circuit pressure not bypassed	OFF	2.94±0.49 (30±5)	

★ Operation of solenoid valve
ON: Continuous (oil pressure generated)
OFF: Not continuous (oil pressure: 0)
However, for LS bypass only:
ON: continuous (oil pressure: 0)
OFF: Not continuous (oil pressure: 30)



MEASURING PPC VALVE OUTPUT PRESSURE AND TESTING PPC SHUTTLE VALVE

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

1. Measuring PPC valve output pressure

1) Disconnect the hose of the circuit to be measured (see next page).
2) Install adapter **C3** between the hose and elbow.
3) Install oil pressure gauge **C1** (5.9 MPa (60 kg/cm^2)) to adapter **C3**.
4) Run the engine at high idling, operate the control lever of the circuit to be measured, and measure the oil pressure.

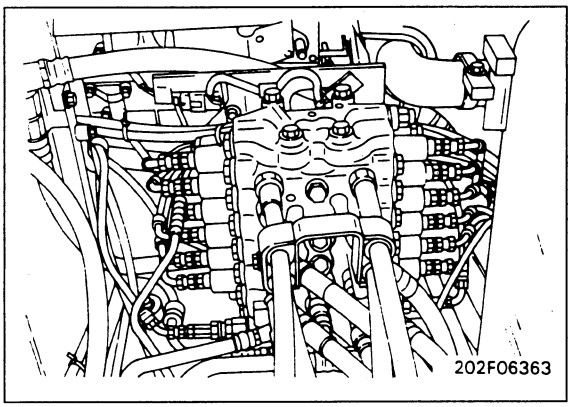
2. Checking PPC shuttle valve

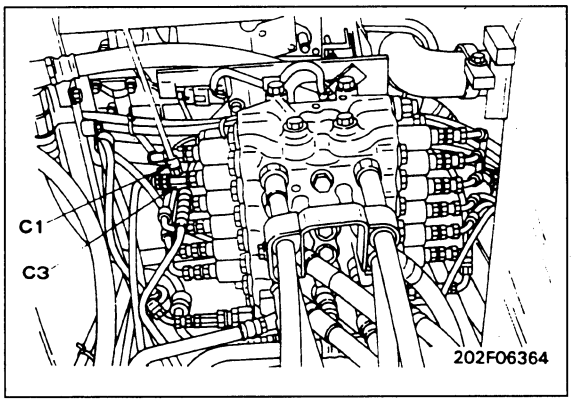
If the output pressure at the control valve end is low, check for leakage of oil from the PPC shuttle valve as follows.

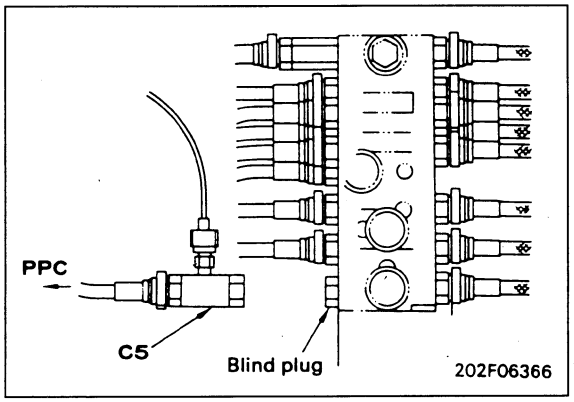
1) Disconnect the hose between the PPC valve and the shuttle block at the block end.
2) Install an adapter for measuring the oil pressure to the tip of the hose, then install blind plugs to the tip and shuttle block end.
3) Operate the control lever and measure the output pressure.
   ★ If the output pressure becomes normal, there is leakage from the PPC shuttle valve; if there is no change, the PPC valve is defective.

3. Checking defective operation of PPC shuttle valve

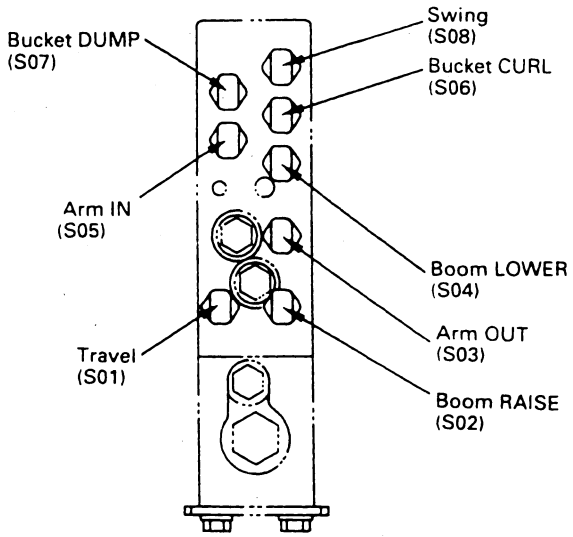
1) Remove the oil pressure switch, fit adapter **C5**, then install oil pressure gauge **C1** (5.9 MPa (60 kg/cm^2)).
2) Operate the applicable lever.
   ★ If no oil pressure is generated or if oil pressure is generated when another lever is operated, the operation of the PPC shuttle valve is defective.







Pressure switch location diagram
Shuttle block seen from rear of machine



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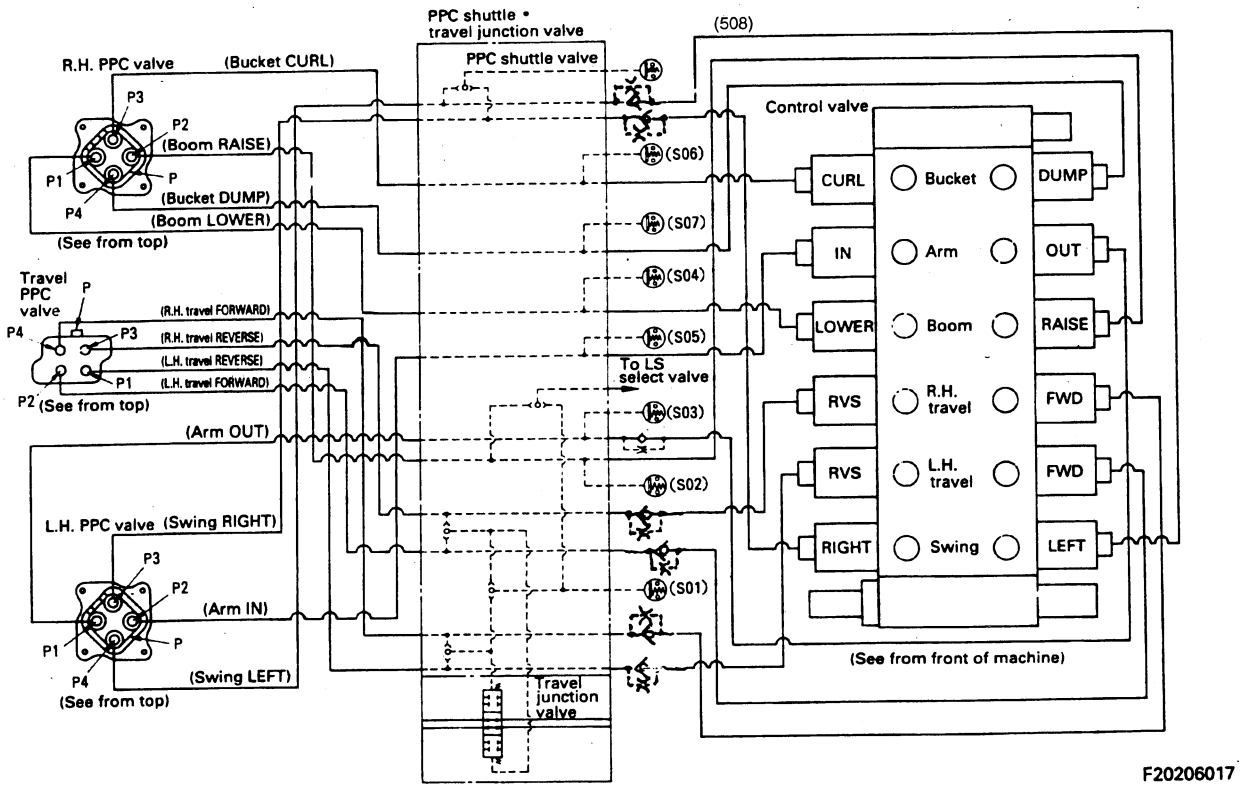
- **Circuit diagram**



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1. Swing PPC shuttle valve
2. PPC shuttle valve for LS select
3. PPC shuttle valve for L.H. travel FORWARD, R.H. travel REVERSE
4. Travel PPC shuttle valve
5. PPC shuttle valve for R.H. travel FORWARD, L.H. travel REVERSE

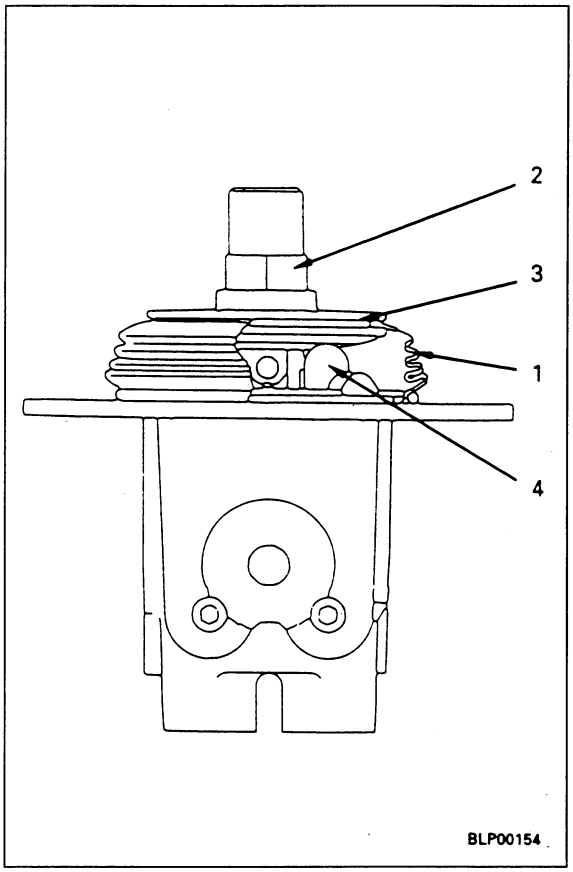
ADJUSTING WORK EQUIPMENT, SWING PPC VALVE

★ If there is excessive play in the work equipment or swing lever, adjust as follows.

⚠ Lower the work equipment to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then set the safety lock lever to the LOCK position.

1. Remove the PPC valve.
2. Remove boot (1).
3. Loosen locknut (2), then screw in disc (3) until it contacts the 4 heads of piston (4).
   * When doing this, do not move the piston.
4. Secure disc (3) in position, then tighten locknut (2) to the specified torque.
   kgm Locknut:
   112.7 ± 14.7 Nm (115.5±1.5 kgm)
5. Install boot (1).

★ With the above adjustment, the clearance between disc (3) and piston (4) becomes 0.

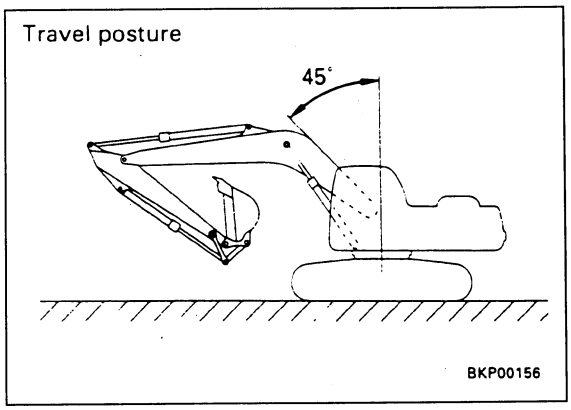


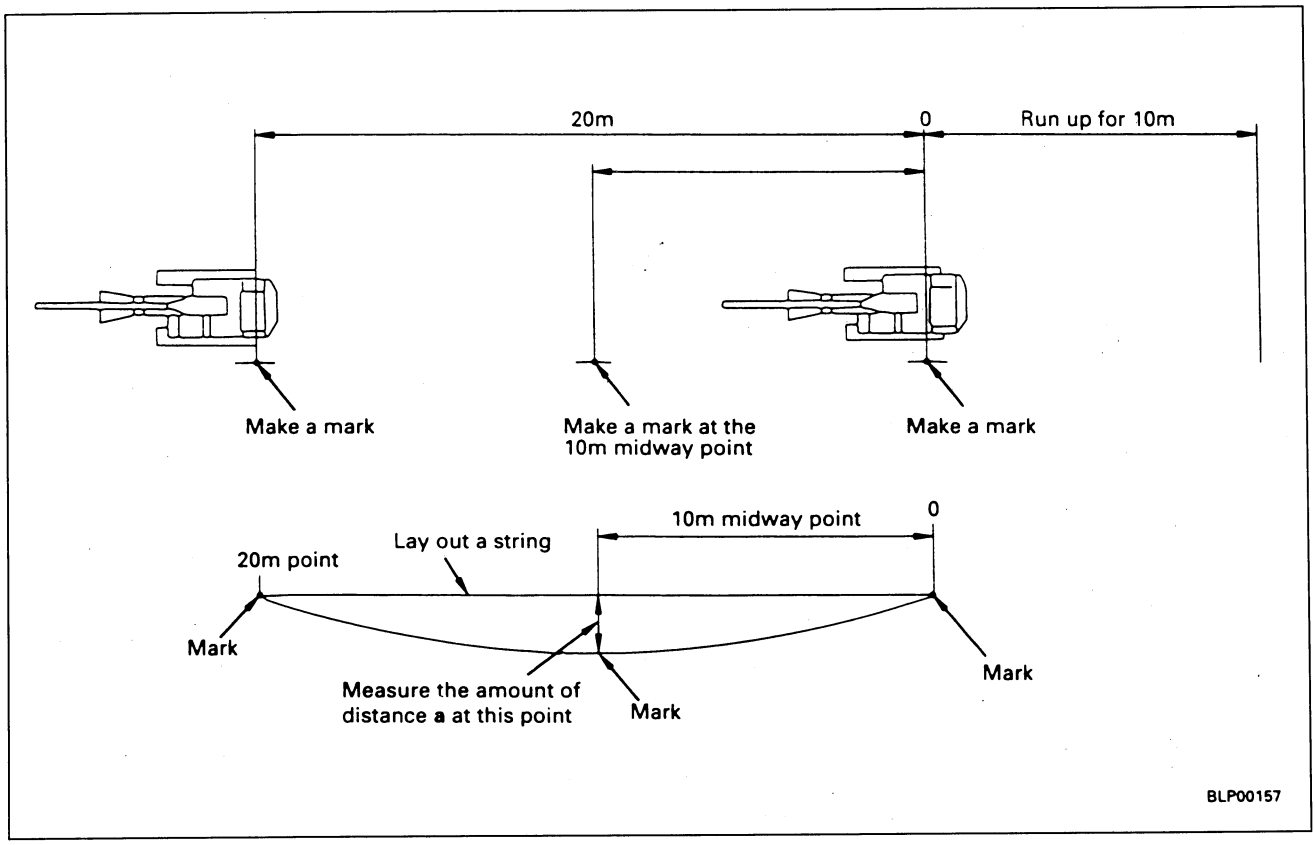
TESTING TRAVEL DEVIATION

★ When traveling on level ground.

1. set the machine in the travel posture.
   ★ For the travel posture, extend the bucket and arm cylinder rods fully, and hold the boom angle at 45°.

2. Travel for 10 m, then measure the deviation when traveling for the next 20m.
   ★ Set to H/O mode and measure with the engine at full throttle.
   ★ Install the hydraulic pressure gauge and measure the pump discharge pressure at the same time.





TESTING LOCATIONS CAUSING HYDRAULIC DRIFT OF WORK EQUIPMENT

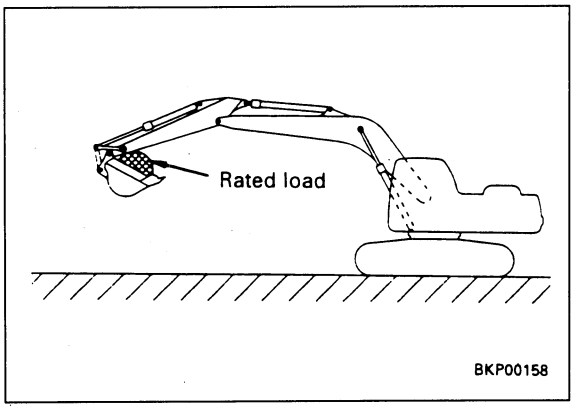
★ If there is any hydraulic drift in the work equipment (cylinders), check as follows to determine if the cause is in the cylinder packing or in the control valve.

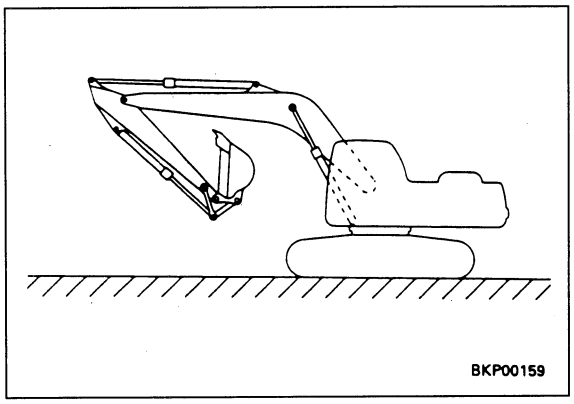
1. Checking for defective cylinder packing

1) Checking boom and bucket cylinders
   i) Set in the same posture as when measuring hydraulic drift, and stop the engine.
   ii) Operate the boom control lever to RAISE or the bucket contol lever to CURL.
      - If the lowering speed increases, the packing is defetive.
      - If there is no change, the boom lock vavle (boom) or the control valve (bucket) is defective.
2) Checking arm cylinder
   i) Operate the arm cylinder to move the arm in fully, then stop the engine.
   ii) Operate the control lever to arm IN.
      - If the lowering speed increases, the packing is defective.
      - If there is no change, the control valve is defective.
      - ★ If the pressue in the accumulator has dropped, run the engine for approx. 10 seconds to charge the accumulator again before operating.

[Reference] If the cause of the hydraulic drift is in the packing, and the above operation is carried out, the downward movement becomes faster for the following reasons.

1) If the work equipment is set to the above posture (holding pressure applied to the bottom end), the oil at the bottom end leaks to the head end. However, the volume at the head end is smaller than the volume at the bottom end by the volume of the rod, so the internal pressure at the head end increases because of the oil flowing in form the bottom end.
2) when the internal pressure at the head end increases, the pressure at the bottom end also rises in proportion to this. The balance is maintained at a certain pressure (this differs according to the amount of leakage) by repeating this procedure.
3) When the pressure is balanced, the downward movement becomes slower. If the lever is then operated according to the procedure given above, the circuit at the head end is opened to the drain circuit (the bottom end is closed by the check valve), so the oil at the head end flows to the drain circuit and the downward movement becomes faster.





2. Checking PPC valve

If the hydraulic drift differs when the safety lock lever is in the LOCK or FREE position, (engine running), the PPC valve is defective.

MEASURING OIL LEAKAGE

★ Oil temperature when measuring: 45 - 55°C

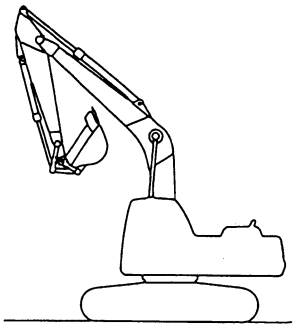
1. Work equipment cylinder

★ If the hydraulic drift of the work equipmetn is outside the standard value, measure the leakage inside the cylidner 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.

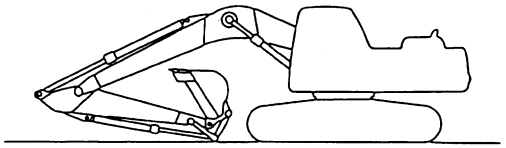
1) Fully extend the rod of the cylinder to be measured, then stop the engine.
2) Disconnect piping (1) at the head end, then block the piping at the chassis end with a blind plug.
   ⚠ Be careful not to disconnect the piping at the bottom end.
3) Start the engine and apply the relief pressure to the bottom end of the cylinder with the engine at full throttle.
   ★ Boom cylinder: RAISE
   Arm cylinder: IN
   Bucket cylinder: CURL
4) Continue this condition for 30 seconds, then measure the oil leakage for the next one minute.

Posture for measuring boom cylinder



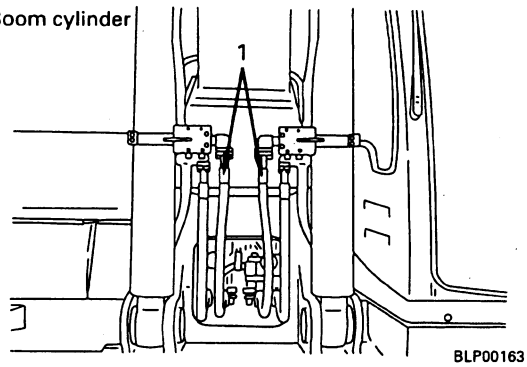
BLP00161

Posture for measuring arm, bucket cylinder



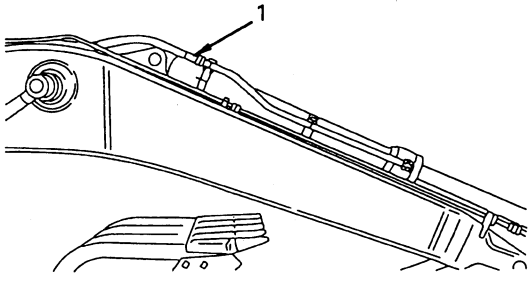
BLP00162

Boom cylinder



BLP00163

Arm cylinder



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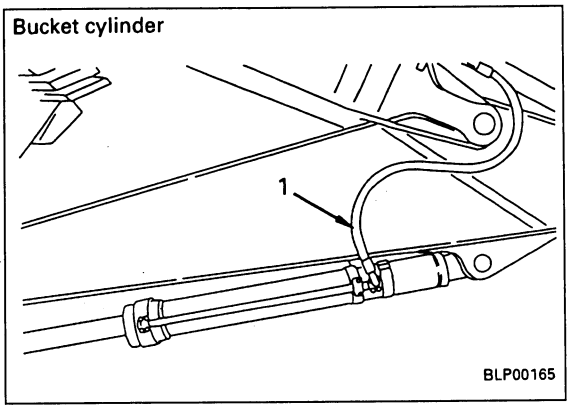
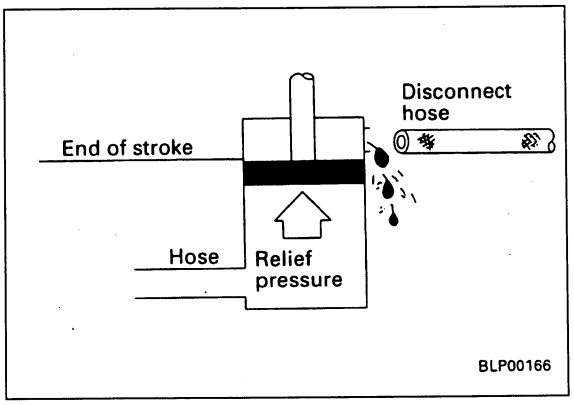
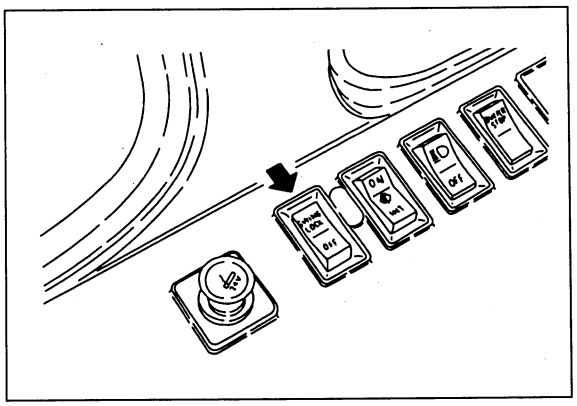




2. Swing motor

1) Disconnect drain hose from the swing motor, then install a blind plug at the tank end.
2) Turn the swing lock switch ON.
3) Start the engine and operate the swing relief with the engine at full throttle.
4) continue this condition for 30 seconds, then measure the oil leakage for the next one minute.
   ★ After measuring, swing 180° and measure again.



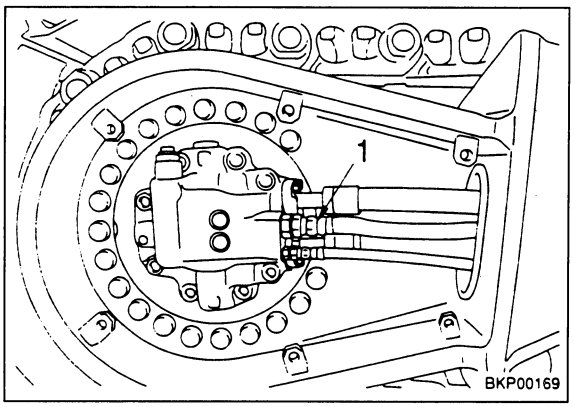
3. Travel motor

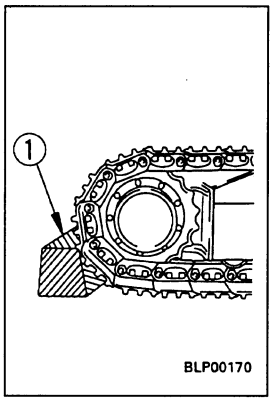
1) Disconnect drain hose (1) from the travel motor, then fit a blind plug at the hose end.
2) Fit block ① under the track shoe grouser, or fit block ② between the sprocket and frame to lock the track.
3) Start the engine and operate the travel relief with the engine at full throttle.

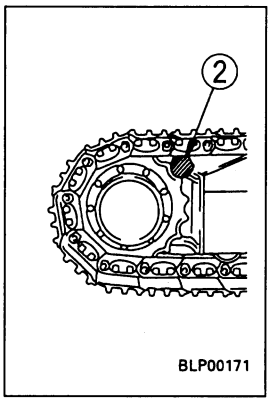
⚠ When measuring the oil leakage from the travel motor, mistaken operation of the control lever may lead to a serious accident, so always use signals and check when carrying out this operation.

4) Continue this condition for 30 seconds, then measure the oil leakage for the next one minute.

★ When measuring, move the motor slighltly (to change the position between the valve plate and cylinder, and piston and cylinder), and measure serveral times.







RELEASING REMAINING PRESSURE IN HYDRAULIC CIRCUIT

★ If the piping between the hydraulic cylinder and the control valve is to be disconnected, release the remaining pressure form the circuit as follows.
The travel circuit is an open circuit, so there is no remaining pressure. It is enough to remove the oil filler cap.

1. Loosen the oil filler cap slowly to release the pressure inside the tank.

2. Operate the control levers.
   ★ When the levers are operated 2 - 3 times, the pressure stored in the accumulator is removed.

3. Start the engine, run at low idling for approx. 5 minutes, then stop the engine and operate the control levers.
   ★ Repeat the above operation 2 - 3 times to release all the remaining pressure.

TROUBLESHOOTING

POINTS TO REMEMBER WHEN TROUBLESHOOTING

⚠ Stop the maichine in a level place, and check that the safety pin, blocks, and parking brake are securely fitted.

⚠ When carrying out the operation with two or more workers, keep strictly to the agreed signal, and do not allow any unauthorized person to come near.

⚠ If the radiator cap is removed when the engine is hot, hot water may spurt out and cause burns, so wait for the engine to cool down before starting troubleshooting.

⚠ Be extremely careful not to touch any hot parts or to get caught in any rotating parts.

⚠ When disconnecting wiring, always disconnect the negative (-) teminal of the battery first.

⚠ When removing the plug or cap from a location which is under pressure from oil, water, or air, always release the internal pressure first. When installing measuring equipment, be sure to connect it properly.

The aim of troubleshooting is to pinpoint the basic cause of the failure, to carry out repairs swiftly, and to prevent reoccurrence of the failure.
When carrying out troubleshooting, an important point is of course to understand the structure and function. However, a short cut to effective troubleshooting is to ask the operator various questions to form some idea of possible causes of the faillure thaat would produce the reported symptoms.

1. When carrying out troubleshooting, do not hurry to disassemble the components.
   If components are disassembled immediately any failure occurs:
   - Parts that have no connection with the failure or other unnecessary parts will be disassembled.
   - It will become impossible to find the cause of the failure.

   It will also cause a waste of manhours, parts, or oil or grease, and at the same time, will also lose the confidence of the user or operator.
   For this reason, when carrying out troubleshooting, it is necessary to carry out thorough priorinvestigation and to carry out troubleshooting in accordance with the fixed procedure.
2. Points to ask user or operator
   1) Have any other problems occurred apart from the problem that has been reported?
   2) Was there anything strange about the machine before the failure occurred?
   3) Did the failure occur suddenly, or were there problems with the machine condition before this?
   4) Under what conditions did the failure occur?
   5) Had any repairs been carried out before the failure?
      When were these repairs carried out?
   6) Has the same kind of failure occurred before?
3. Check before troubleshooting
   1) Check the oil level
   2) Check for any external leakage of oil from the piping or hydraulic equipment.
   3) Check the travel of the control levers.
   4) Check the stroke of the control valve spool.
   5) Other maintenance items can be checked externally, so check any item that is considered to be necessary.
4. Confirming failure
   - Confirm the extent of the failure yourself, and judge whether to handle it as a real failure or as a problem with the method of operation, etc.
     ★ When operating the machine to reenact the troubleshooting symptoms, do not carry out any investigation or measurement that may make the problem worse.
5. Troubleshooting
   - Use the results of the investigation and inspection in items 2-4 to narrow down the causes of failure, then use the troubleshooting flowchart to locate the position of the failure exactly.

   ★ The basic procedure for troubleshooting is as follows.
   1) Start from the simple points.
   2) Start form the most likely points.
   3) Investigate other related parts or information.
6. Measures to remove root cause of failure
   - Even if the failure is repaired, if the root cause of the failure is not repaired, the same failure will occur again.
     To prevent this, always investigate why the problem occured. Then, remove the root cause.

SEQUENCE OF EVENTS IN TROUBLESHOOTING

Office, shop

TEW00180

Jobsite

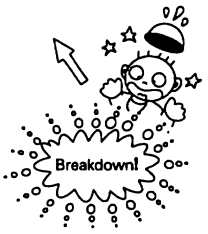
TEW00181

Step 1

Examination, confirmation of symptoms

1) When a request for repairs is received, first ask the following points.
   - Name of customer
   - Type, serial numer of machine
   - Details of jobsite, etc.
2) Ask questions to gain an outline of the problem.
   - Condition of failure
   - Work being carried out at the time of the failure
   - Operating environment
   - Past history, details of maintenance, etc.

TEW00182

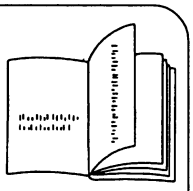


TEW00183

Step 2

Determining probable location of cause

1) Look at the troubleshooting section of the shop manual to find locations of possible causes.



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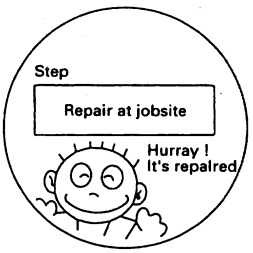


TEW00185

Step 3

Preparation of troubleshooting tools

1) Look at the table of troubleshooting tools in the shop manual and prepare the necessary tools.
   - T - adapter
   - Hydraulic pressure gauge kit. etc.
2) Look in the parts book and prepare the necessary replacement parts.

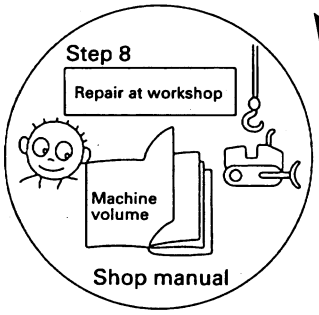
TEW00186

Step 7

- Pinpoint locations of failure (carry out troubleshooting)
- Decide action to take

1) Before starting troubleshooting, locate and repair simple failures.
   - Check before starting items
   - Other check items
2) See the Troubleshooting Section of the shop manual, select a troubleshooting flowchart that matches the symptoms, and carry out troubleshooting.

TEW00187



TEW00188

Step 6

Re-enacting failure

- Drive and operate the machine to confirm the condition and judge if there is really a failure.

Step 4

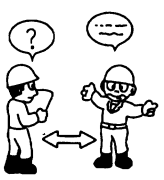
Go to jobsite

TEW00189

Step 5

Ask operator questions to confirm details of failure

- Was there anything strange about the machine before the failure occurred?
- Did the failure occur suddenly?
- Had any repairs been carried out before the failure?



TEW00190

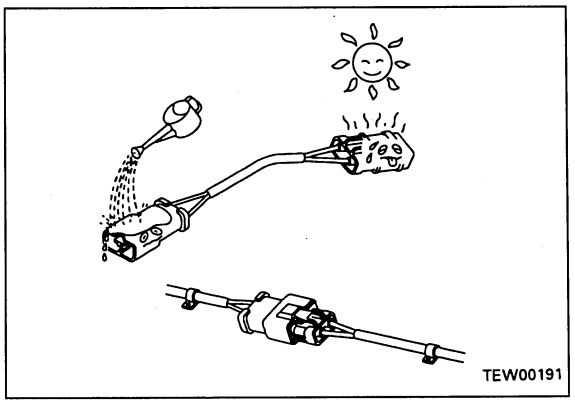
PRECAUTIONS WHEN CARRYING OUT MAINTENANCE

To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct operation, maintenance and inspection, troubleshooting, and repairs must be carried out. This section deals particularly with correct repair procedures for mechatronics and is aimed at improving the quality of repairs. For this purpose, it gives sections on "Handling electric equipment" and "Handling hydraulic equipment" (particlularly hydraulic oil).

1. PRECAUTIONS WHEN HANDLING ELECTRIC EQUIPMENT

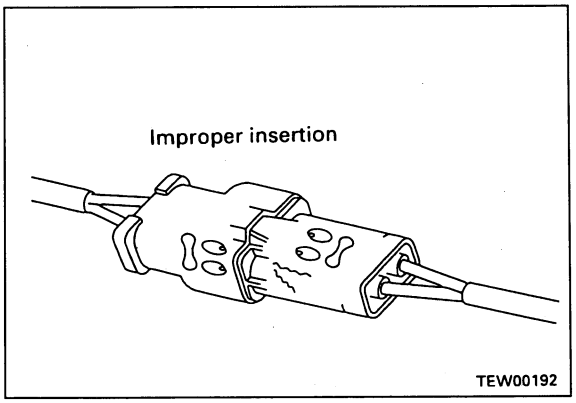
1) Handling wiring harnesses and connectors

Wiring harnesses consist of wiring connecting one component to antoher component, connectors used for connecting and disconnecting one wire from another wire, and protector or tubes used for protecting the wiring. Compared with other electrical components fitted in boxes or cases, wiring harnesses are more likely to be affected by the direct effects of rain, water, heat, or vibration. Furthermore, during inspection and repair operations they are frequently removed and installed again, so they are likely to suffer deformation or damage. For this reason, it is necessary to be extremely careful when handling wiring harnesses.


TEW00191

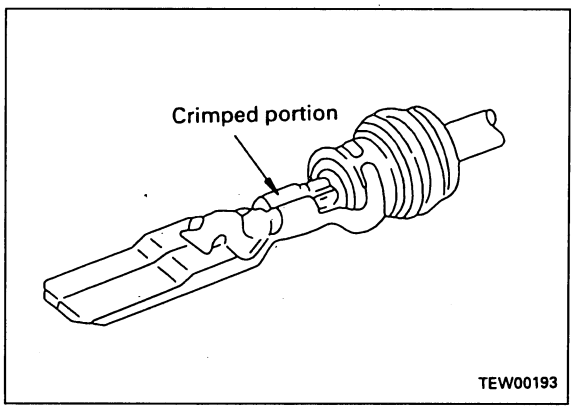
Main failures occurring in wiring harness

(1) Defective contact of connectors (defective contact between male and female) Problems with defective contact are likely not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned, or because there is corrosion or oxidization of the contact surfaces.



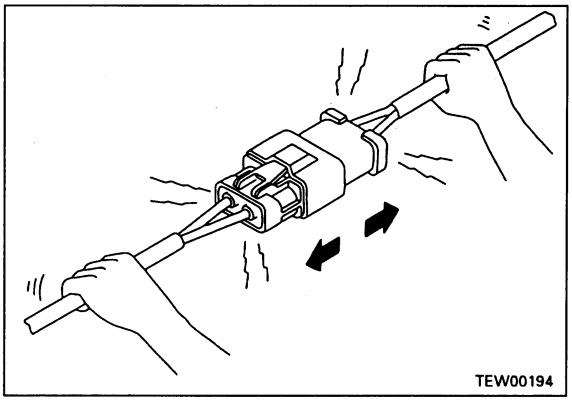
TEW00192

(2) Defective compression or soldering of connectors
The pins of the male and feamle connectors are in contact at the compressed terminal or solered portion, but there is excessive force on the wiring, and the plating peels to cause improper correction or breakage.



(3) Disconnections in wiring
If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the compression of the connector may be lost, or the soldering may be damaged, or the wiring may be broken.

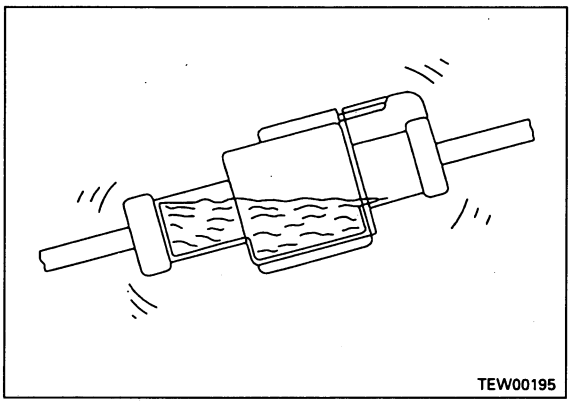
(4) High pressure water entering connector
The connector is disigned to make it dificult for water to enter (drip-proof structure), but if high pressure water is sprayed directly on the connector, water may enter the connector depending on the direction of the water jet.
The connector is designed to prevent water from entering, but at the same time, if the water does enter, it is difficult for it to be drained. Therefore, if water should get into the connector, the pins will be short-circuited by the water, so if any water gets in, immediately dry the connector or take other appropriate action before passing electricity through it.

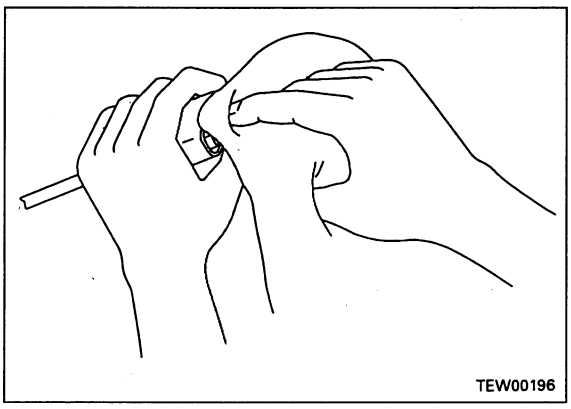


(5) Oil or dirt stuck to connector
If oil or grease are stuck to the connector and an oil film is formed on the mating surface between the male and female pins, the oil will not let the electricity pass, so there will be defective contact. If there is oil or grease or dirt stuck to the connector, wipe it off with a dry cloth or blow dry with air, and spray it with a contact restorer.

★ When wiping the mating portion of the connector, be careful not to use excessive force or deform the pins.

★ If there is water or oil in the air, it will increase the contamination of the points, so clean with air from which all the water and oil has been removed.

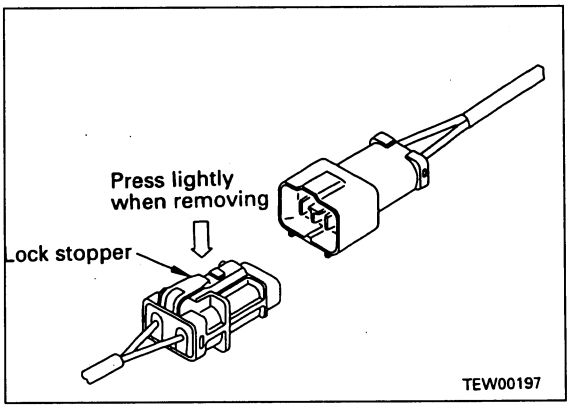




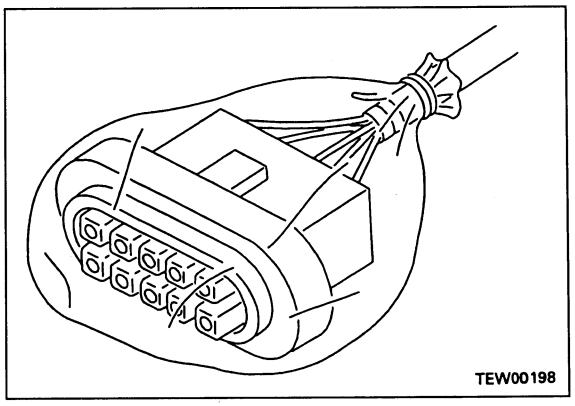
2) Removing, installing, and drying connectors and wiring harness

Disconnecting connectors

(1) Hold the connectors when disconnecting.
When disconnnecting the connectors, hold the connectors and not the wires.
For connectors held by a screw, loosen the screw fully, then hold the male and female connectors in each hand and pull apart. For connectors which have a lock stopper, press down the stopper with your thumb and pull the connectors apart.



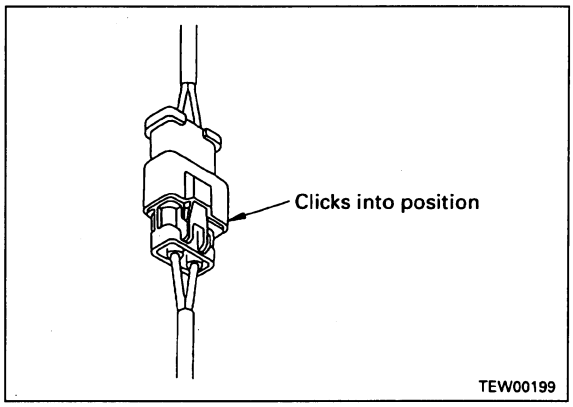
(2) Action to take after removing connectors
After removing any connector, cover it with a vinyl bag to prevent any dust, dirt, oil, or water from getting in the connector portion.



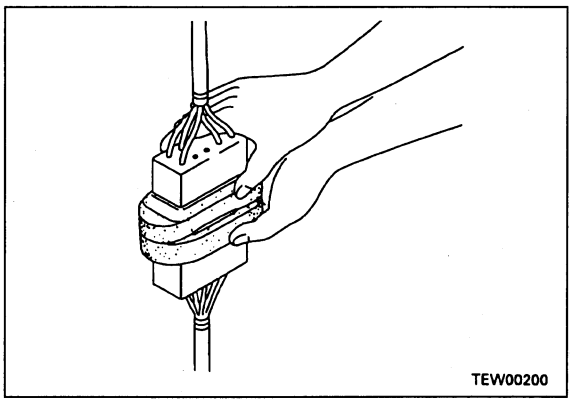
Connecting connectors

(1) Check the connector visually.
a. Check that there is no oil, dirt or water stuck to the connector pins (mating portion).
b. Check that there is no deformation, defective contact, corrosion, or damage to the connector pins.
c. Check that there is no damagge or breakage to the outside of the connector.
★ If there is any oil, water, or dirt stuck to the connector, wipe it off with a dry cloth. If any water has got inside the connector, warm the inside of the wiring with a dryer, but be care ful not to make it too hot as this will cause short circuits.
★ If there is any damage or breakage, replace the connector.

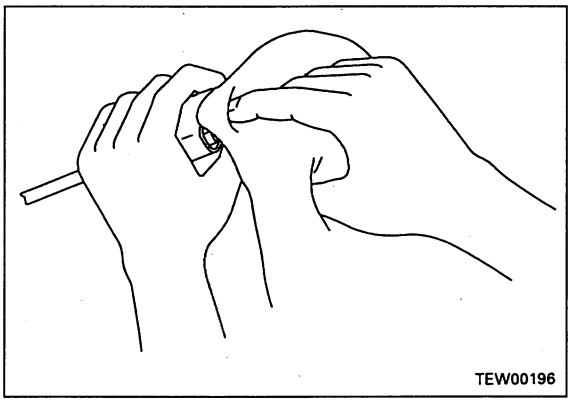
(2) Fix the connector securely.
Align the position of the connector correctly, then insert it securely.
For connectors with lock stopper
Push in the connector until the stopper clicks into position.



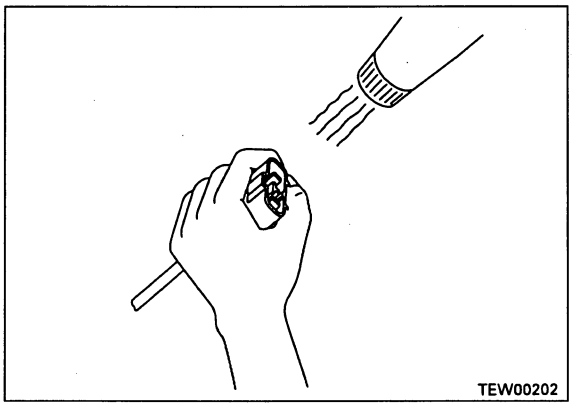
(3) Correct any protrusion of the boot and any misalignment of the wiring harness
For connectors fitted with boots, correct any protrusion or the boot. In addition, if the wiring harness is misaligned, or the clamp is out of position, adjust it to its correct position.
★ When blowing with dry air, there is danger that the oil in the air may cause improper contact, so clean with air from which all the water and oil has been removed.



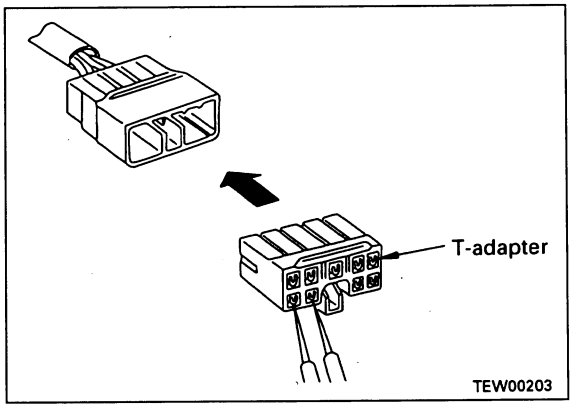
Drying wiring harness
If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high pressure water or steam directly on the wiring harness. If water gets directly on the connector, do as follows.
(1) Disconnect the connector and wipe off the water with a dry cloth.
★ If the connector is blown dry with air, there is the risk that oil in the air may cause defective contact, so avoid blowing with air.



(2) Dry the inside of the connector with a dryer.
If water gets inside the connector, use a dryer to dry the connector.
★ Hot air from the dryer can be used, but be careful not to make the connector or related parts too hot, as this will cause deformation or damage to the connector.

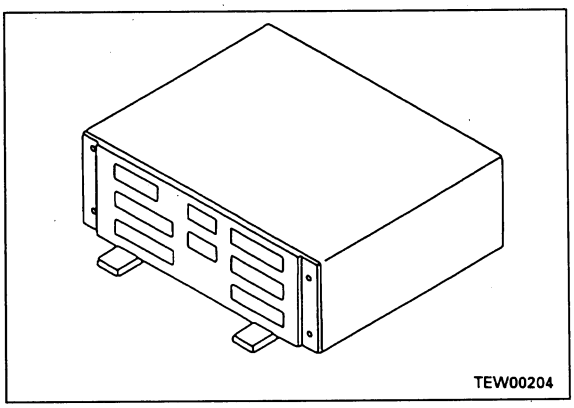


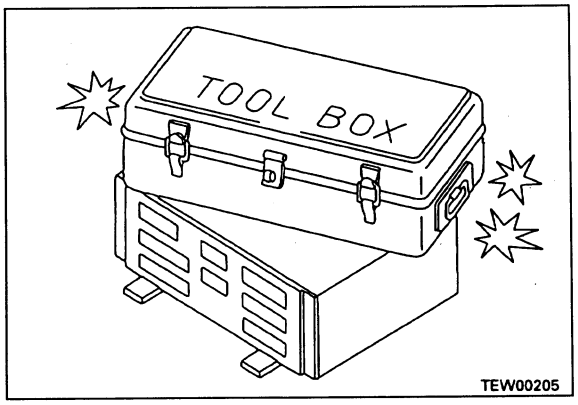
(3) Carry out a continuity test on the connector.
After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.
★ After completely drying the connector, blow it with contact restorer and reassemble.

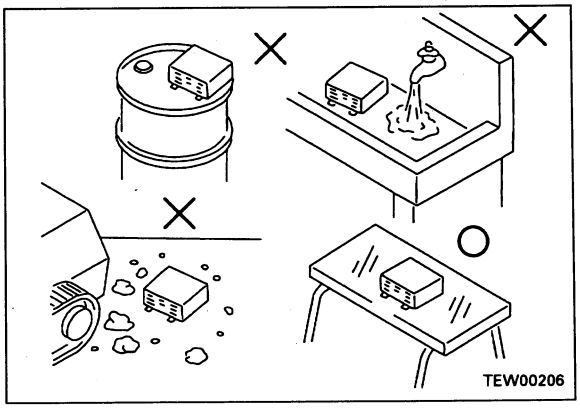


3) Handling control box

(1) The control box contains a microcomputer and electronic control circuits.
These control all of the electronic circuits on the machine, so be extremely careful when handling the control box.
(2) Do not open the cover of the control box unless necessary.
(3) Do not place objects on top of the control box.
(4) Cover the control connectors with tape or a vinyl bag.
(5) During rainy weather, do not leave the control box in a place where it is exposed to rain.
(6) Do not place the control box on oil, water, or soil, or in any hot place, even for a short time. (Place it on a suitable dry stand)
(7) Precautions when carrying out arc welding
When carrying out arc welding on the body, disconnect all wiring harness connectors connected to the control box. Fit an arc welding ground close to the welding point.





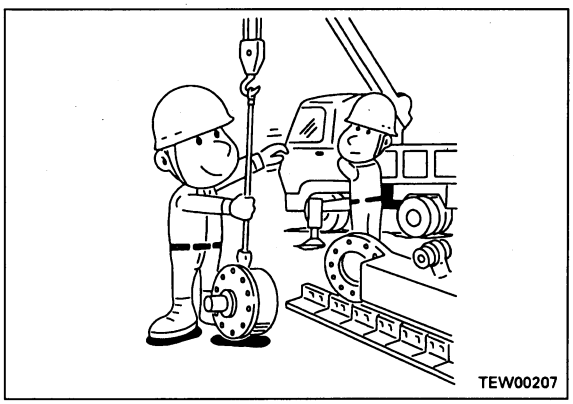


2. POINTS TO REMEMBER WHEN HANDLING HYDRAULIC EQUIPMENT

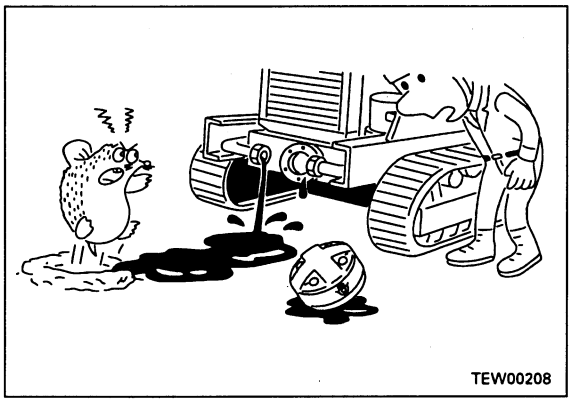
With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

1) **Be careful of the operating environment.**
Avoid adding hydraulic oil, replacing filters, or repairing the machine in rain or high winds, or places where there is a lot of dust.

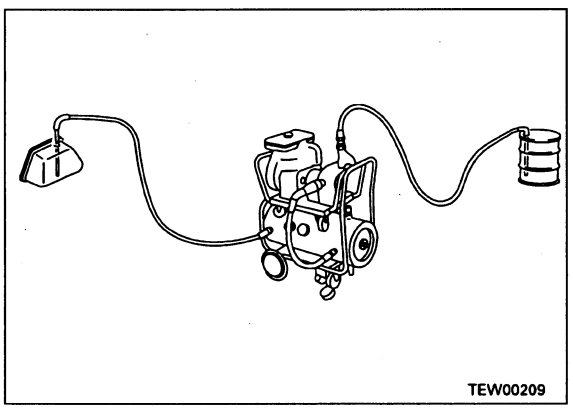
2) **Disassembly and maintenance work in the field**
If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to confirm the performance after repairs, so it is desirable to use unit exchange. Disassembly and maintanance of hydraulic equipment should be carried out in a specially prepared dustproof workshop, and the performance should be confirmed with special test equipment.


TEW00207

3) **Sealing openings**
After any piping or equipment is removed, the openings should be sealed with caps, tapes, or vinyl bags to prevent any dirt or dust from entering. If the opening is left open or is blocked with a rag, there is danger of dirt entering or of the surrounding area being made dirty by leaking oil so never do this.
Do not simply drain oil out on to the ground, collect it and ask the customer to dispose of it, or take it back with you for disposal.

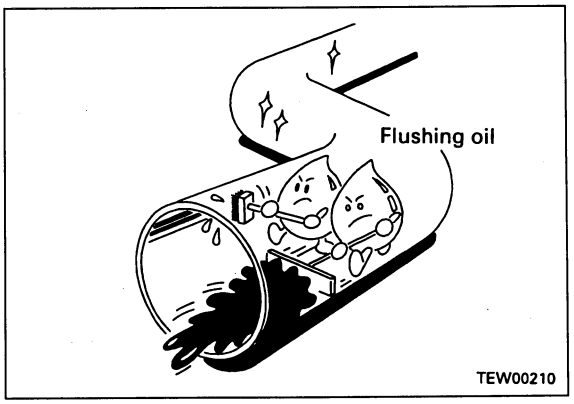

TEW00208

4) **Do not let any dirt or dust get in during refilling operations.**
Be careful not to let any dirt or dust get in when refilling with hydraulic oil. always keep the oil filler and the area around it clean, and also use clean pumps and oil containers. If an oil cleaning device is used, it is possible to filter out the dirt that has collected during storage, so this is an even more effective method.

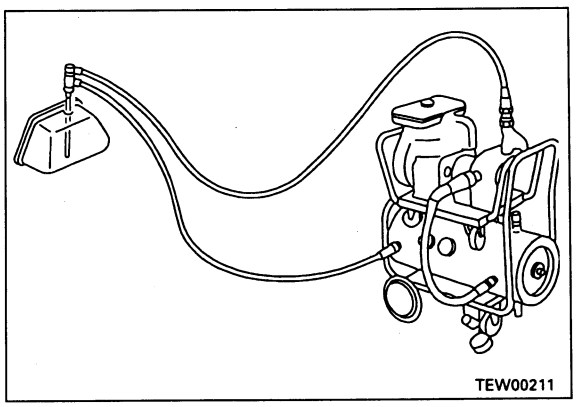

TEW00209

5) **Change hydraulic oil when the temperature is high.**
When hydraulic oil or other oil is warm, it flows easily. In addition, the sludge can also be drained out easily form the circuit together with the oil, so it is best to change the oil when it is still warm. When changing the oil, as much as possible of the old hydraulic oil must be drained out. (Do not drain the oil from the hydraulic tank; also drain the oil from the filter and from the drain plug in the circuit.) If any old oil is left, the contaminants and sludge in it will mix with the new oil and will shorten the life of the hydraulic oil.

6) **Flushing operations**
After disassembling and assembling the equipment, or changing the oil, use flushing oil to remove the contaminants, sludge, and old oil from the hydraulic circuit.
Normally, flushing is carried out twice: primary flushing is carried out with flushing oil, and secondary flushing is carried out with the specified hydraulic oil.



7) **Cleaning operations**
After repairing the hydraulic equipment (pump, control valve, etc.) or when running the machine, carry out oil cleaning to remove the sludge or contaminants in the hydraulic oil circuit.
The oil cleaning equipment is used to remove the ultrafine (about 3 u) particles that the filter built into the hydraulic equipment cannot remove, so it is an extremely effective device.



CHECKS BEFORE TROUBLESHOOTING

	Item	Judgement standard	Action
Lubricating oil, cooling water	1. Check fuel level	-	Add fuel
	2. Check for dirt or water in fuel	-	Clean, drain
	3. Check hydraulic oil lever	-	Add oil
	4. Check hydraulic oil strainer	-	Clean, drain
	5. Check swing machinery oil level	-	Add oil
	6. Check engine oil level (Level of oil in oil pan)	-	Add oil
	7. Check cooling water level	-	Add water
	8. Check condition of dust indicator	-	Clean or replace
	9. Check hydraulic oil filter		Replace
Electrical equipments	1. Check for loose or corroded battery terminals	-	Tighten or replace
	2. Check for loose or corroded alternator terminals	-	Tighten or replace
	3. Check for loose or corroded straight motor terminals	-	Tighten or replace
Hydraulic, mechanical equipments	1. Check for abnormal noise or smell		Repaire
	2. Check for oil leakage	-	Repaire
	3. Bleed air from system	-	Bleed air
Electrical components	1. Check battery voltage (engine stopped)	20 - 30 V	Replace
	2. Check level of battery electrolyte	-	Add or replace
	3. Check for discolored, burnt, or bare wiring	-	Replace
	4. Check for missing wiring clamps, hanging wires	-	Repair
	5. Check for getting wet onto wiring (check carefully getting wet at connectors and terminals)	-	Disconnect connector and dry connection
	6. Check for broken or corroded fuses	-	Replace
	7. Check alternator voltage (engine running at over half throttle)	27.5 - 29.6 V	Replace
	8. Noise when battery relay is operated (switch starting switch from ON to OFF)	-	Replace

CONNECTOR TYPES AND MOUNTING LOCATIONS

Connector No.	Type	No. of pins	Electrical component	Address
A01	KES1	2	Window washer circuit	
A03	KES1	2	LS select solenoid circuit	
A04	KES1	2	2-stages relief solenoid circuit	
A05	KES1	2	Swing brake solenoid circuit	
A06	KES1	2		
A07	KES1	2	Travel speed solenoid circuit	
A08	KES1	2	Heater circuit	
A09	KES1	2	Lower wiper circuit	
A11	KES1	2	Alarm buzzer circuit	
A13	KES1	2	Starter relay circuit	
A14	KES1	2	Battery relay drive circuit	
A16	KES1	2	Fuel shut off circuit	
A17	KES1	2	Starter circuit	
C01	MIC	13	Governor, pump controller	
C02	MIC	21	Governor, pump controller	
C03	040	20	Governor, pump controller	
C17	040	16	Governor, pump controller	
C05	S	10	TVC prolix switch	
C06	M	2	TVC prolix resistor	
C07	X	3		
C08	X	3	Front pump pressure sensor	
C09	S	8	Model selection connector	
C10	X	2	LS control EPC solenoid valve	
C13	X	2	Front pump TVC valve	
C16	MIC	17	Governor, pump controller	
E04	X	3	Governor potentiometer	
E05	X	4	Governor motor	
E06	M	3	Fuel control dial	
E07	X	2	Engine speed sensor	
E08	SWP	14	Intermediate connector	
E09		3	Fuel shut off valve	
F01	X	2	Travel alarm	

Connector No.	Type	No. of pins	Electrical component	Address
E11	RING	1	Heater relay	
H07	S	12	Intermediate connector	
H08	M	6	Intermediate connector	
H12	S	16	Intermediate connector	
H13	S	16	Intermediate connector	
H14	M	6	Intermediate connector	
H15	L	2	Intermediate connector	
E15	-	1	Safety relay	
K01	-	1	Aircon controller	
K02	-	1	Aircon pressure switch	
K03	-	1	Aircon pressure switch	
M02	X	2	Safety relay	
M06	M	4	Heater switch	
M08	KES1	2	Right front light	
M09	KES1	2	Working lamp (boom)	
M10	M	1	Intermediate connector	
M11	L	2	Fusible link	
M12	M	4	Heater	
M13	AMP	8	Speaker	
M14	L	2	Fusible link	
M16	-	1	Horn (high sound)	
M17	-	1	Horn (low sound)	
M18	M	4	Wiper, washer switch	
M20	-	-	Cigarette lighter	
M23	M	2	Horn swithc, R.H. knob switch	
M26	AMP	11	Air conditioner	
M28	KES0	2	Window washer motor	
M34	Simple connector	1	Electromagnetic clutch for air conditioner compressor	
M35	X	4	Condenser for air conditioner	
M38	M	3	Light switch	
M21			Intermediate connector (Radio circuit)	

Connector No.	Type	No. of pins	Electrical component	Address
M40	KES1	2	Right working light	
M41	KES1	2	Left working light	
M42	KES1	2	Rear working light	
M43	X	2	Intermediate connector	
M45	M	3	Network bus	
M49	-	1	Refuel pump	
M58	KES1	2	Rear light	
M51	KES1	2	Left front lamp	
M52	X	2	Overload alarm switch	
M53		2	Heated seat	
M55	M	2	Beacon switch	
M56	M	2	Heated seat switch	
M57	-	1	Intermediate connector	
M61	-	1	Engine room lamp	
P01	040	20	Monitor panel	
P02	040	16	Monitor panel	
P03	M	2	Buzzer cancel switch	
P04	M	2	Alarm buzzer	
P05	X	1	Engine oil level sensor	
P06	X	1	Fuel level sensor	
P07	-	2	Coolant temperature sensor	
P08	X	2	Coolant level sensor	
P10		3	Engine oil pressure switch	
P11	-	1	Air cleaner, clogging sensor	
P12	-	1	Air cleaner clogging sensor	
R04	Shina-gawa	5	Light relay	
R05	Shina-gawa	5	Light relay	
R10	Shina-gawa	5	Light relay	
R11	Shina-gawa	5	Lower wiper relay	
S01	X	2	Travel oil pressure switch	
M71		1	Intermediate connector	

Connector No.	Type	No. of pins	Electrical component	Address
S02	X	2	Boom RAISE oil pressure switch	
S03	X	2	Arm OUT oil pressure switch	
S04	X	2	Boom LOWER oil pressure switch	
S05	X	2	Arm IN oil pressure switch	
S06	X	2	Bucket CURL oil preessure switch	
S07	X	2	Bucket DUMP oil pressure switch	
S08	X	2	Swing oil pressure switch	
S09	X	2	Att. pedal pressure switch	
S10		2	Att. pedal pressure switch	
S11		2	Att. pedal pressure switch	
V05	X	2	LS	
V06	X	2	Swing brake solenoid valve	
V25	X	2	2-stage relief solenoid valve	
V04	X	2	Travel speed solenoid valve	
W04	M	6	Wiper motor	
W08	070	18	Wiper motor controller	
W10	M	4	Rear limit switch	
W15	KESO	4	Lower wiper	
W16	M	2	Lower wiper switch	
X01	MIC	21	Intermediate connector	
X05	M	4	Swing lock switch	
X07	MIC	17	Intermediate connector	
E14		1	GRID HEATER	
E13		2	STARTER	
E12		3	ALTERNATOR	
E10		1	SHUT-OFF VALVE CIRCUIT GRD.	
E02		1	ADDITIONAL LAMP CIRCUIT GRD	
E03		1	ADDITIONAL LAMP CIRCUIT GRD	
E01		1	ADDITIONAL LAMP CIRCUIT GRD	

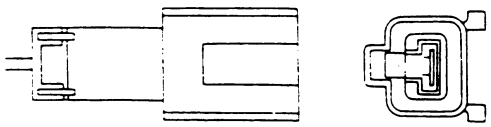
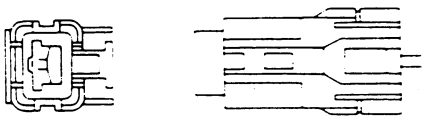
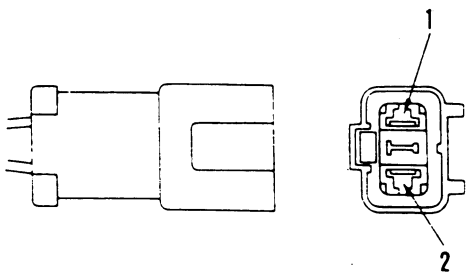
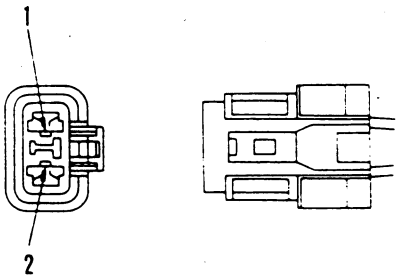
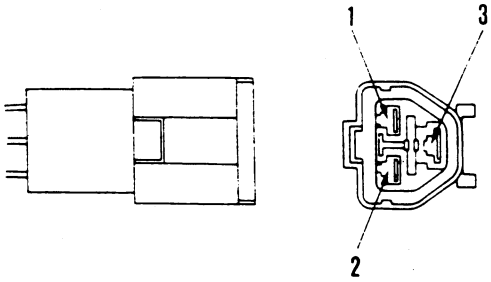
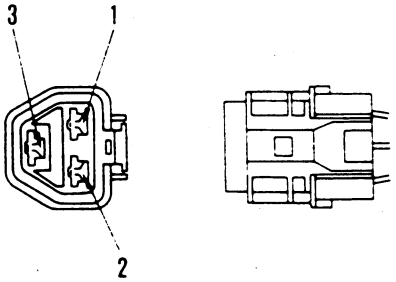
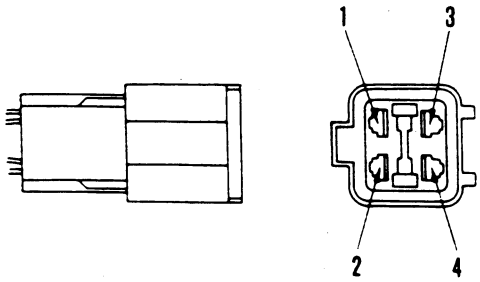
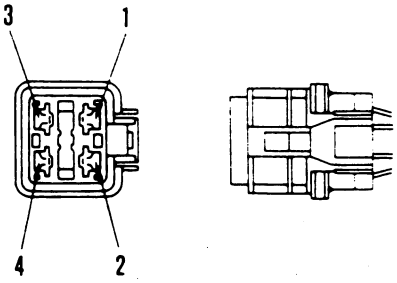
CONNECTOR TYPES AND MOUNTING LOCATIONS

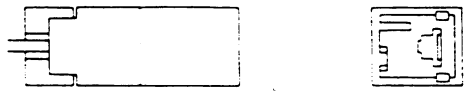
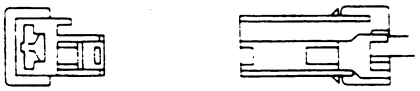
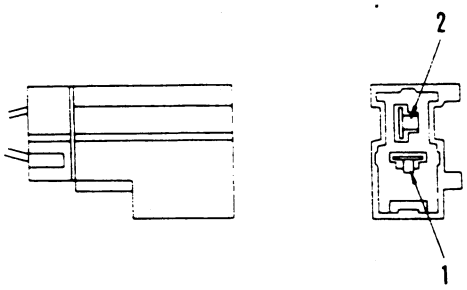
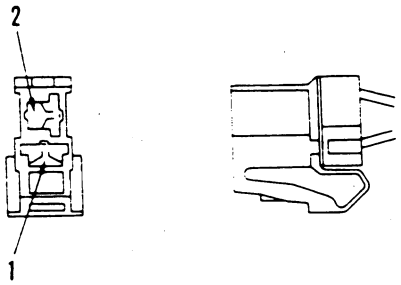
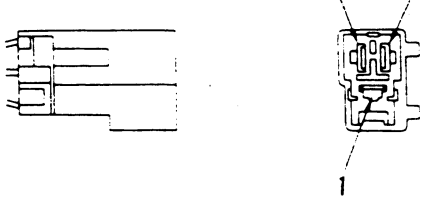
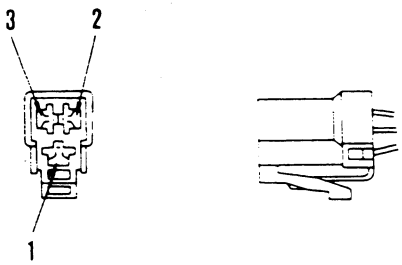
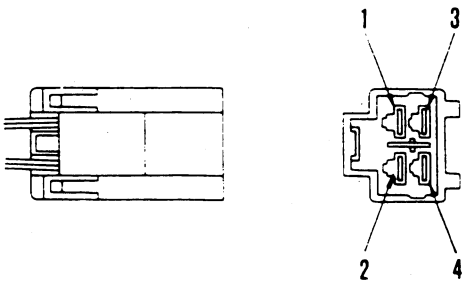
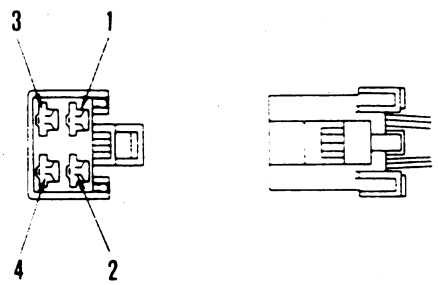
Connector No.	Type	No. of pins	Electrical component	Address
W03			Intermediate connector (rear limit switch)	
G26	X	3	(Clamshell rot/braeker solenoid valve)	
G163		1	Window washer motor	
G30	M	4	Intermediate connector (knob switch)	
SW01			Swing redundancy switch	
SW03			Battery relay	
SW02			Starter switch	
M36	M	1	KEROSENE MODE SWITCH	
T02			GRD (Revo frame)	
T04			GRD (safety relay)	
T03			GRD (Revo frame)	
T05			GRD (Floor frame)	

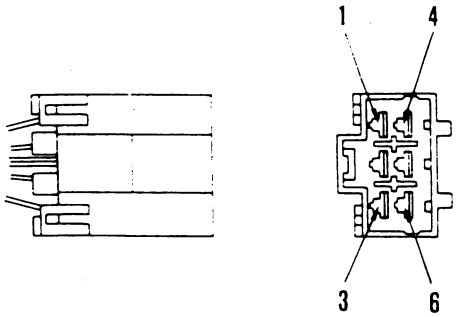
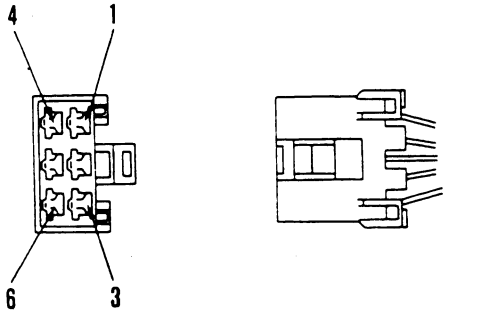
Connector No.	Type	No. of pins	Electrical component	Address

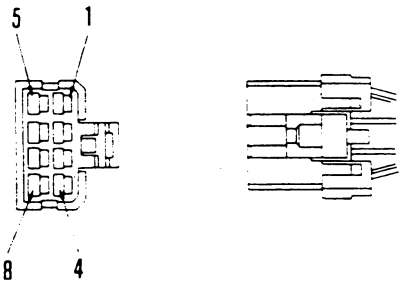
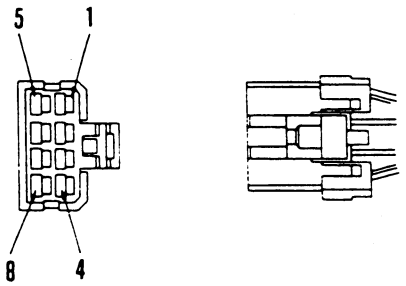
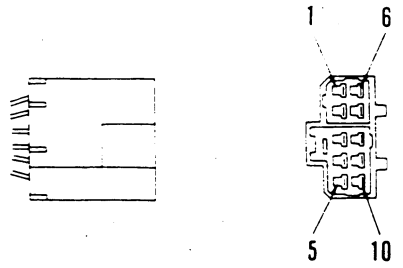
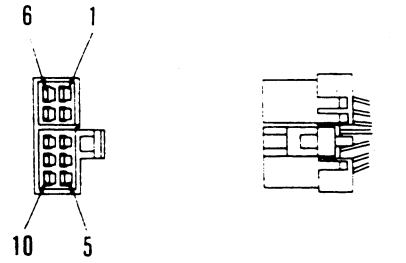
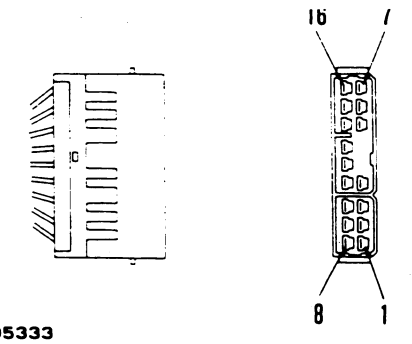
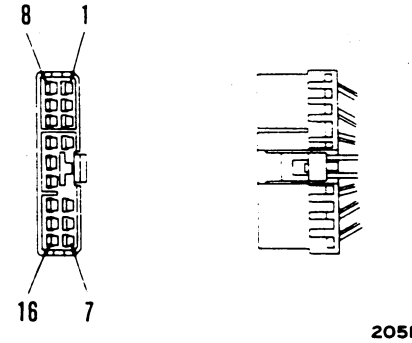
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

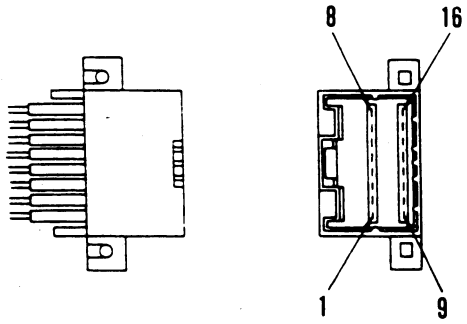
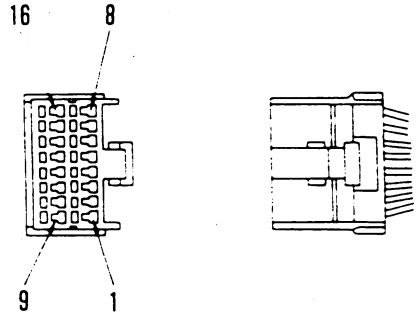
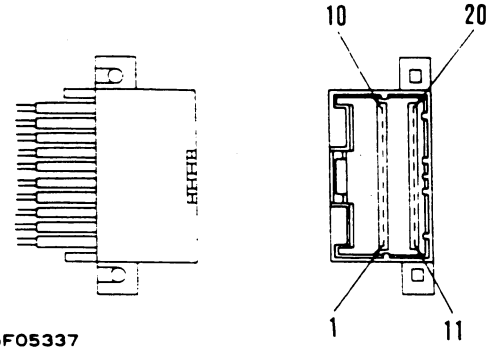
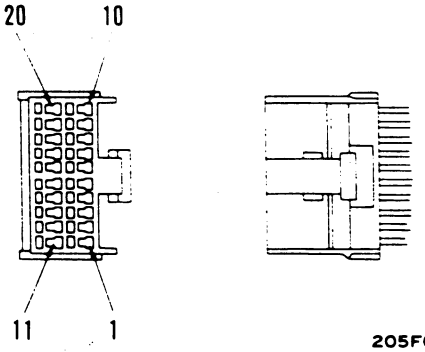
★ The terms male and female refer to the pins, while the terms male housing and female housing refer to the mating portion of the housing.

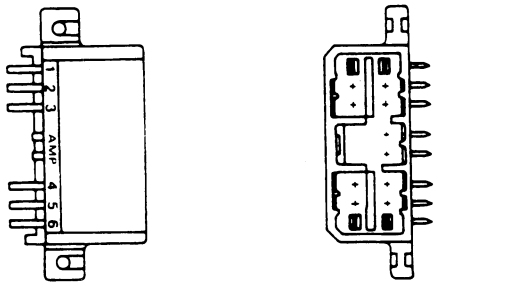
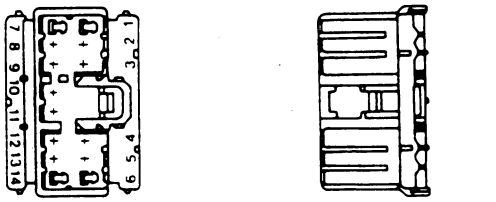
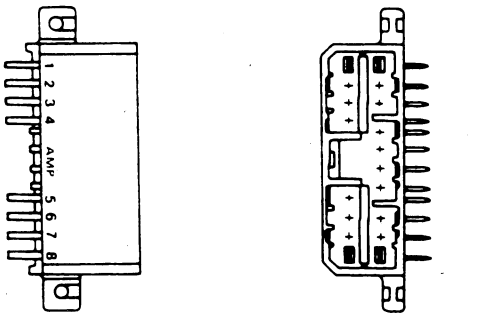
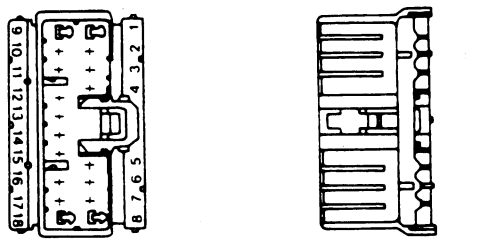
No. of pins	X type connector	
	Male (female housing)	Female (male housing)
1	 205F05309	 205F05310
2	 205F05311	 205F05312
3	 205F05313	 205F05314
4	 205F05315	 205F05316

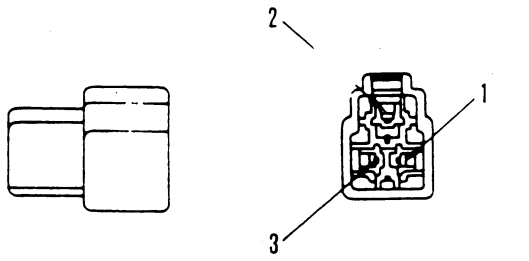
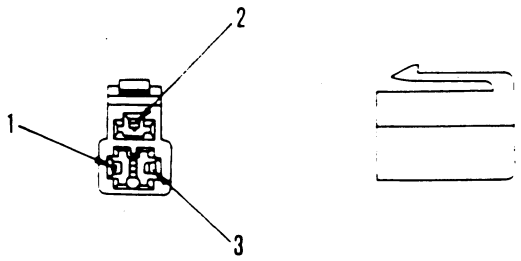
No. of pins	M type connector	
	Male (female housing)	Female (male housing)
1	 205F05317	 205F05318
2	 205F05319	 205F05320
3	 205F05321	 205F05322
4	 205F05323	 205F05324

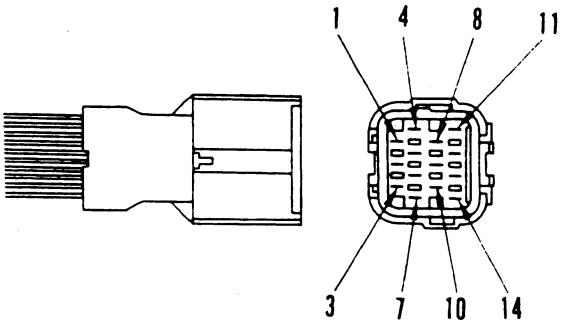
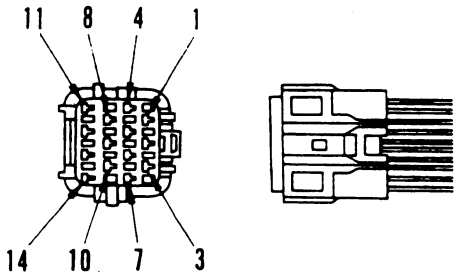
No. of pins	M type connector	
	Male (female housing)	Female (male housing)
6	 205F05325	 205F05326

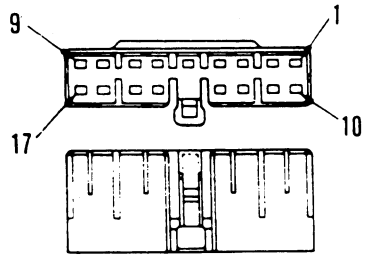
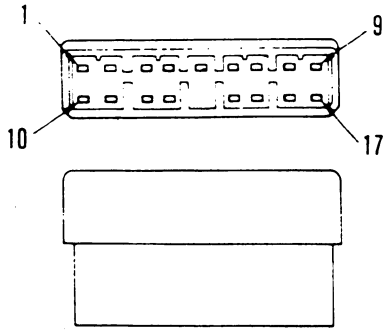
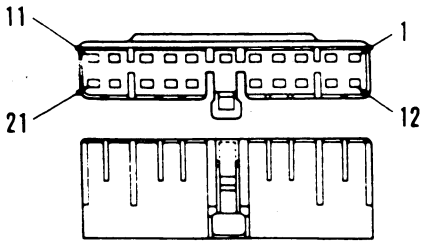
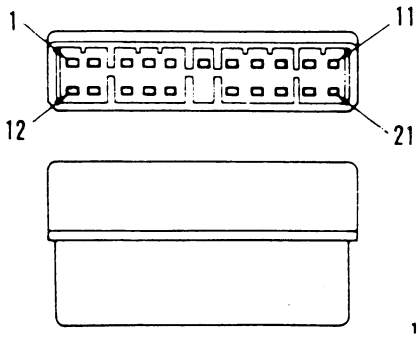
No. of pins	S type connector	
	Male (female housing)	Female (male housing)
8	 205F05327	 205F05328
10	 205F05329	 205F05330
16	 205F05333	 205F05334

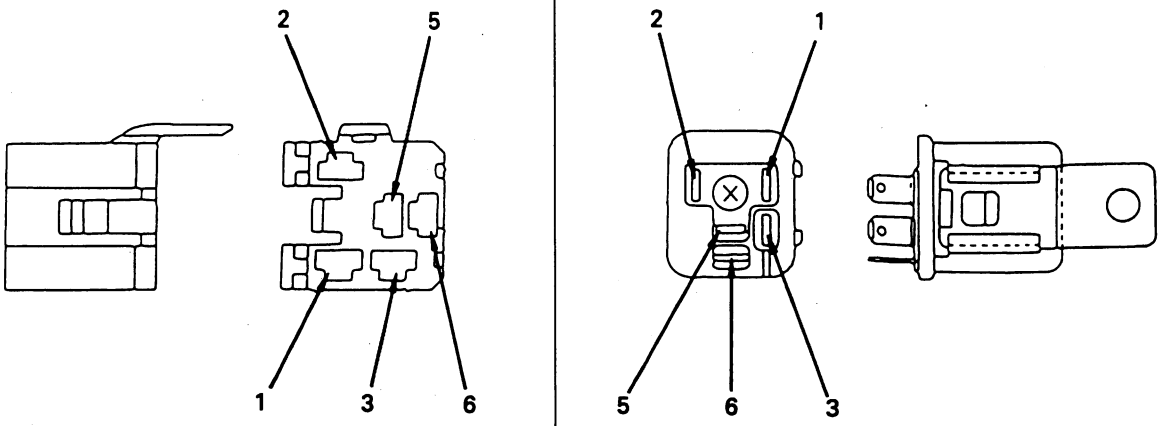
No. of pins	AMP040 type connector	
	Male (female housing)	Female (male housing)
16	 205F05335	 205F05336
20	 205F05337	 205F05338

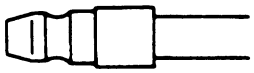
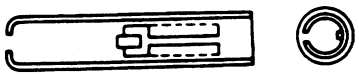
No. of pins	AMP070 type connector	
	Male (female housing)	Female (male housing)
14	 205F06364	 205F06365
18	 205F06366	 205F06367

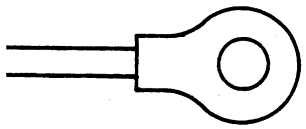
No. of pins	AMP250 type connector	
	Male (female housing)	Female (male housing)
3	 205F06368	 205F06369

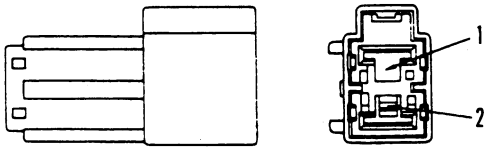
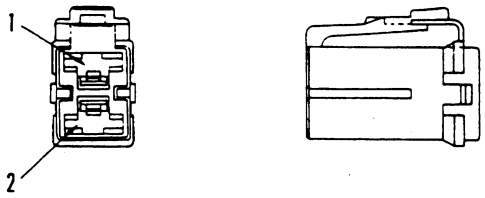
No. of pins	SWP type connector	
	Male (female housing)	Female (male housing)
14	 F56103087	 F56103088

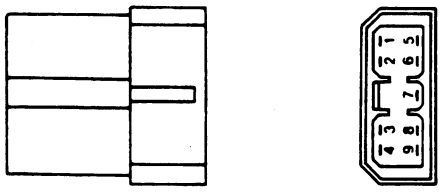
No. of pins	MIC connector	
	Male (female housing)	Female (male housing)
17	 142F414	 142F415
21	 142F416	 142F417

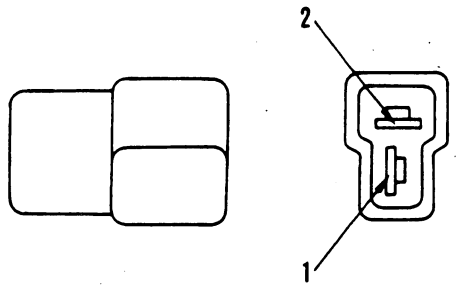
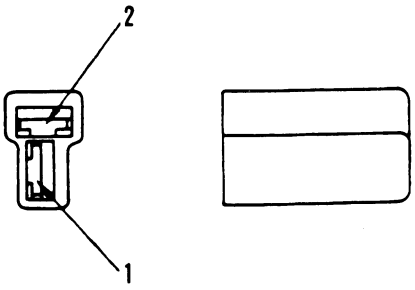
No. of pins	Relay connector	
	Male (female housing)	Female (male housing)
5		

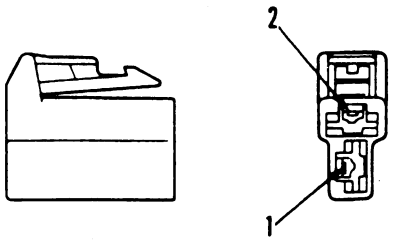
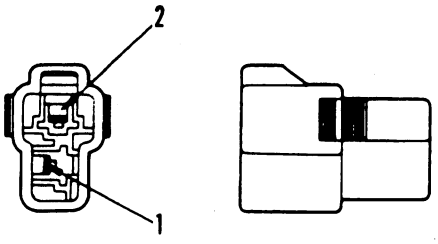
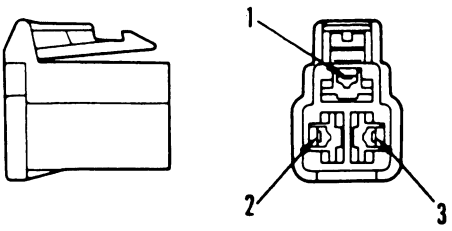
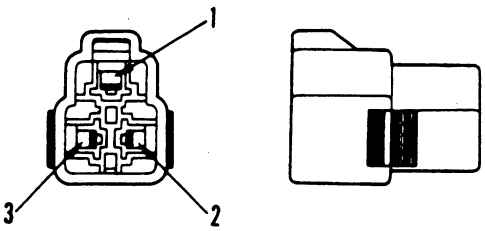
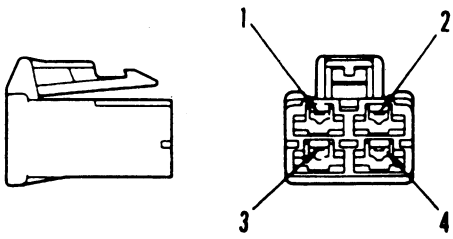
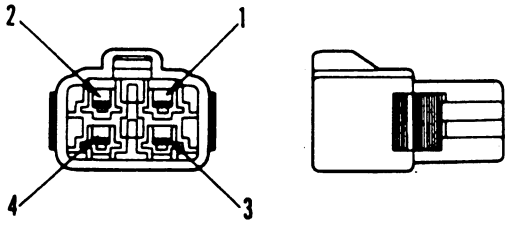
No. of pins	Simple connector	
	Male (male housing)	Female (female housing)
1	 195F05128	 195F05129

No. of pins	Ring connector
1	

No. of pins	L type connector	
	Male (female housing)	Female (male housing)
2	 20TF01149	 20TF01150

No. of pins	PA type connector	
	Male (female housing)	Female (male housing)
9	 205F06370	 205F06371

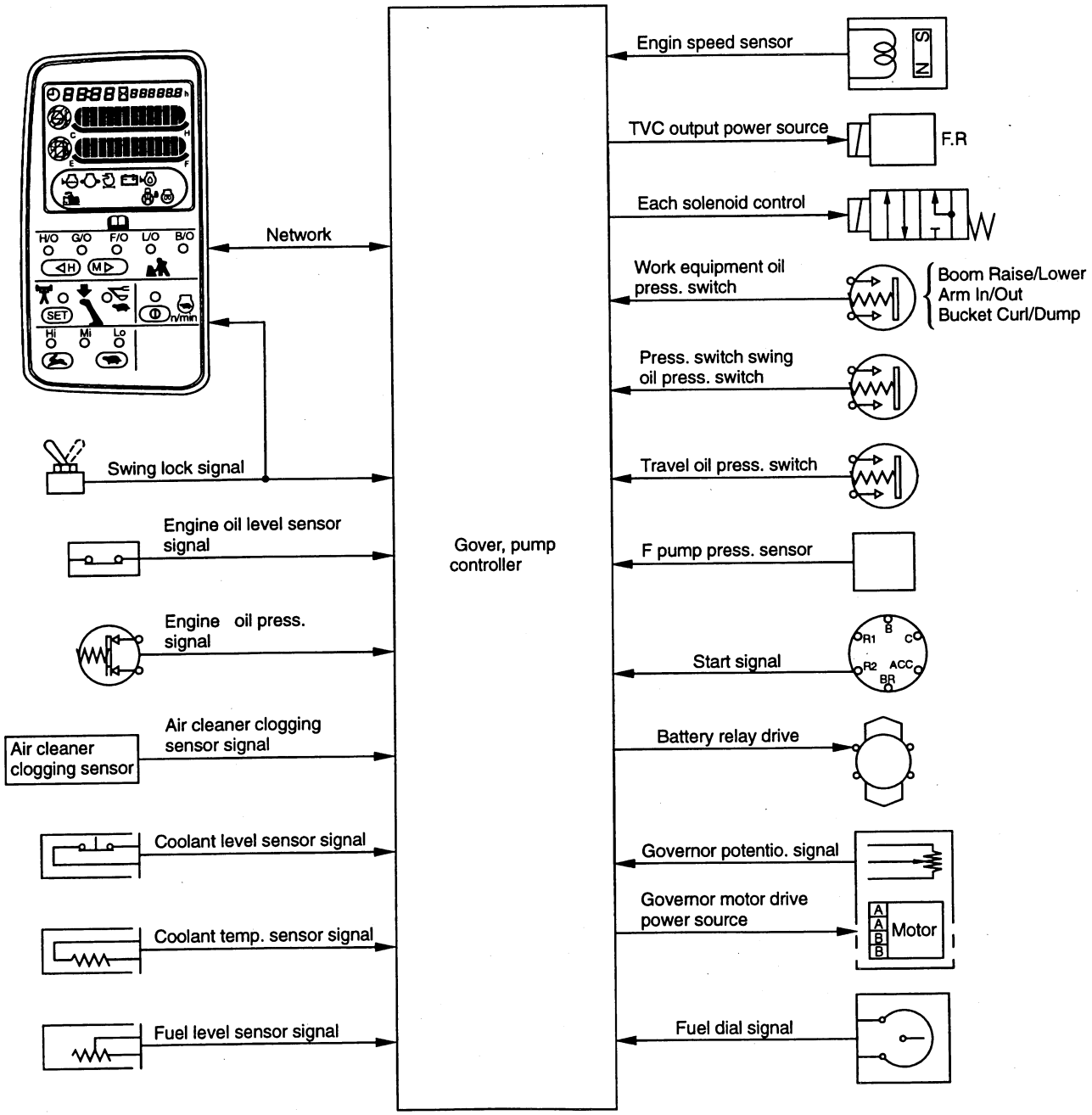
No. of pins	Automobile connector (KESO)	
	Male (female housing)	Female (male housing)
2	 205F06372	 205F06373

No. of pins	Automobile conector (KES1)	
	Female (male housing)	Male (female housing)
2	 423F349	 423F350
3	 423F351	 423F352
4	 423F353	 423F354

EXPLANATION OF CONTROL MECHANISM FOR ELECTRICAL SYSTEM

1. Explanation of machine control functions

The control mechanism for the electrical system consists of the monitor panel and governor and pump controller. The monitor panel and the governor and pump controller input the signals that are necessary, and together with the signals seleced by the monitor panel, the governor and pump controller outputs or inputs the necessary signals and control the pump absorption torque and engine output.



DISPLAY METHOD AND SPECIAL FUNCTIONS OF MONITOR PANEL

1. Display on machine monitor

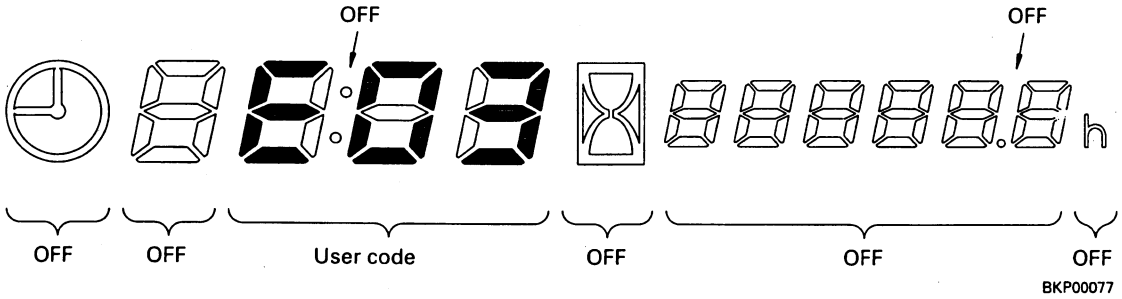
When the starting switch is turned on, all the monitor and gauge lamps light up for approx. 3 seconds, and the buzzer sounds for approx. 1 second. During this time, the monitor itself carries out self diagnosis, and after it has finished, it returns to the normal display.

2. Recording of service codes and user code display function

1) All the abnormality data for the governor and pump controller is sent to the monitor panel.
When the monitor panel receives this data, it records the abnormality data, and at the same time, depending on the nature of the abnormality, it displays the user code on the time display panel to advise the operator of the action to take.
However, in cases of abnormalities which are not urgent and do not require the user code to be displayed, only the content of the abnormality is recorded, and no display is given.

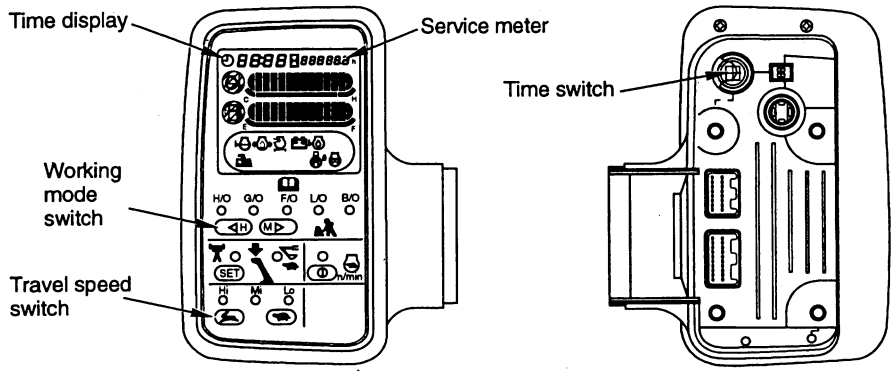
2) Types of user code and system
E02 (TVC system)
E03 (Swing holding brake system)
E05 (Governor motor system)
★ For details of the service codes included in the user code, see the action taken by the controller when an abnormality occurs, the symptoms on the machine or the judgement table.

3) Displaying user code
If it becomes necessary to display the user code, the time displayed panel is automatically switched to advise the operator to take the necessary action.
• Actual display (Example: Disconnection in the cancel solenoid system for the swing holding brake)

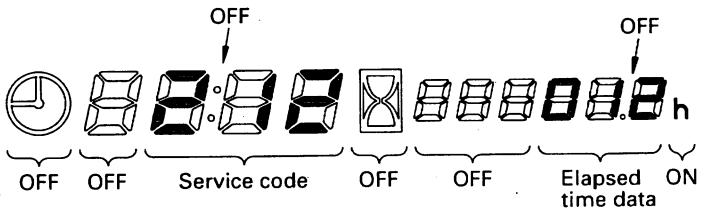
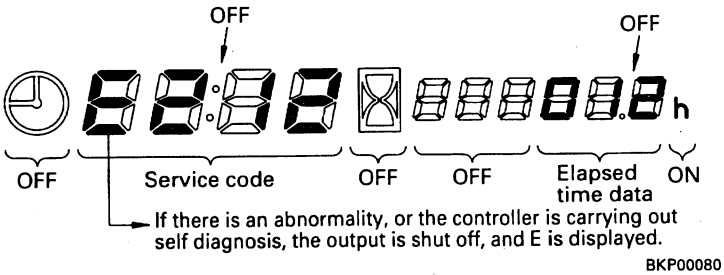


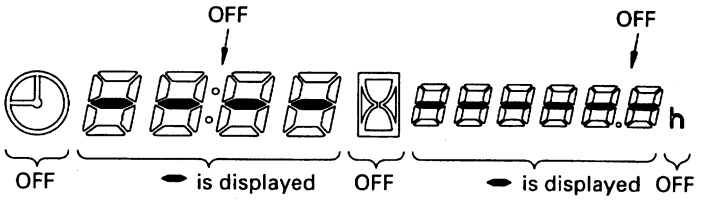
4) Display of trouble data
The monitor panel records both service codes which are included in the user code, and service codes which are not included. This data can be displayed on the time display as follows.

★ For details of the service codes that are not included in the user code, see ACTION TAKEN BY CONTROLLER WHEN ABNORMALITY OCCURS AND PROBLEMS ON MACHINE or the JUDGEMENT TABLE



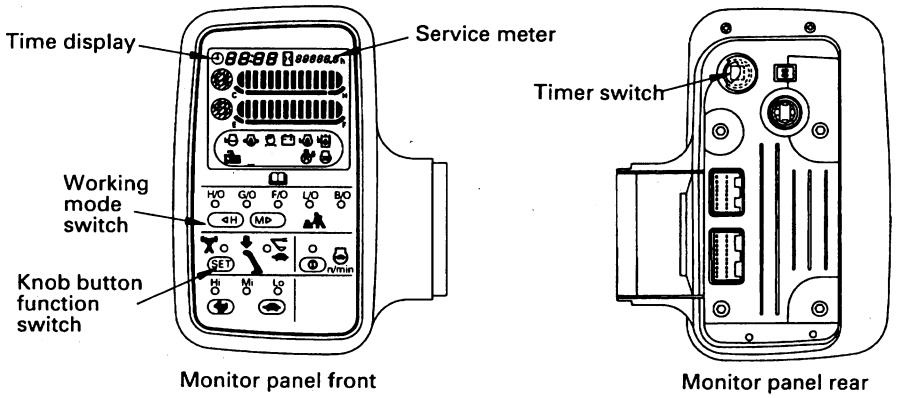
i) Method of displaying trouble data

Operation	Display
1. To set to the trouble data display mode, Keep the TIME switch + L.H. travel speed switch pressed for 2.5 seconds. Note: It is possible to call it up at the following times. 1) In the normal mode 2) In the user code display mode 3) In the machine data monitoring mode 4) In the time adjustment mode 2. To go to the next service code display, press the time switch + R.H. woking mode switch. 3. To go back to the previous service code display, press the time switch + L.H. woking mode switch.	1. On the time display and service meter display, the service code and number of hours (service meter hours) that have elapsed since the occurrence of the abnormality are displayed. • Example of display : When E212 has occurred 12 hours before (service meter) 1) Display of service code 2) Display of elapsed time  BKP00079 3) If any abnormality exists at this time, the E mark is displayed.  BKP00080

Operation	Display
4. To finish with the trouble data display mode, keep the TIME switch + L.H. travel speed switch pressed for 2.5 seconds. 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.	4) If there is no abnormality code in memory  BKP00081

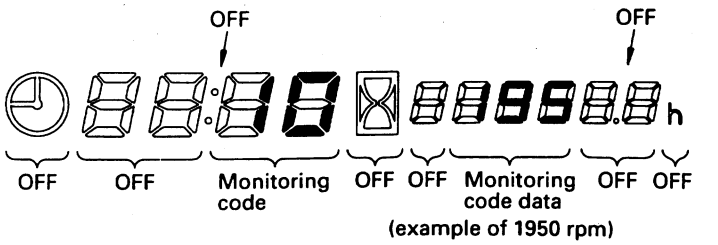
3. Machine data monitoring function

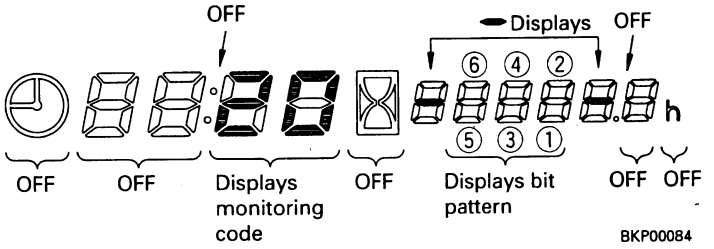
The input signals from the sensors and the output signals to drive the solenoid are displayed on the time display and service meter display.



TAP00176

1) Method of displaying monitoring code

Operation	Display
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 follwing times. 1) During the normal code 2) During the user code display 3) During the time adjustment mode 4) During the trouble data display mode	1. On the time display and service meter display, the monitoring code and data are displayed. • Example of display 1) When engine speed is monitoring (monitoring code 10)  BKP00083

Operation	Display
2. To go to the next monitoring code display, press the time switch + R.H. working mode switch. 3. To go back to the previous monitoring code display, press the time switch + L.H. working mode switch. 4. To finish with the machine data monitoring code mode, keep the time switch + knob button function switch pressed for 2.5 seconds.	2) When displaying bit pattern • For monitoring codes 08, 20 - 24, 36, 37, 47 - 49, 4A, display the bit pattern. • Example of monitoring code 20  • The code No. is displayed in the monitoring code portion, and the display lights up to display bit patterns (1) - (6).

2) Table of machine data monitoring codes

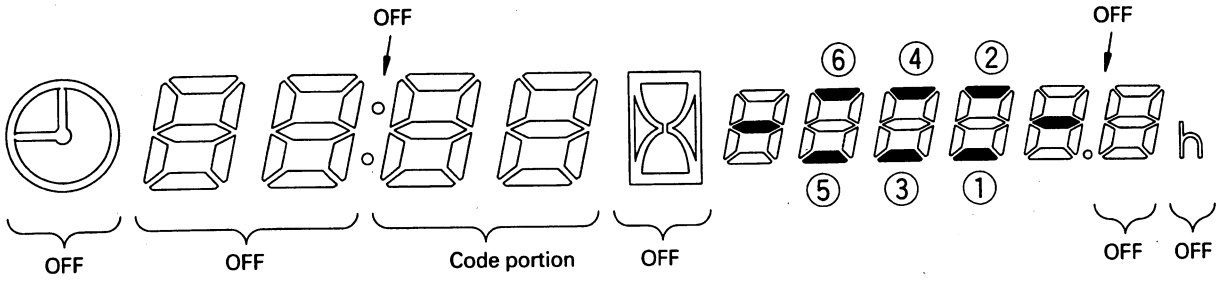
★ For details of the B in the Unit column, see the bit pattern chart in the next section.

No.	Item	Unit	Name of component
01	Monitor model code	-	Monitor panel
02	Governor, pump controller model code	-	Governor, pump controller
03	Governor, pump controller model code	-	Governor, pump controller
08	S-NET component condition display	B	Governor, pump controller
10	Engine speed	10rpm	Governor, pump controller
11	Pump discharge pressure input	MPa (kg/cm²)	Governor, pump controller
13	TVC current output	10mA	Governor, pump controller
15	LS-EPC current output	10mA	Governor, pump controller
16	No. 2 throttle command	10mA	Governor, pump controller
20	Governor, pump controller PPC oil pressure switch input signal (1)	B	Governor, pump controller
21	Governor, pump controller PPC oil pressure switch input signal (2)	B	Governor, pump controller
22	Governor, pump controller PPC oil pressure switch input signal (3)	B	Governor, pump controller
23	Governor, pump controller solenoid actuation	B	Governor, pump controller
24	Input condition of sensor for governor, pump controller monitor warning 1	B	Governor, pump controller
30	Fuel control dial input value	10mV	Governor, pump controller
31	Potentiometer voltage	10mV	Governor, pump controller
32	VBB voltage (battery voltage)	100mV	
25	Input condition of sensor for governor, pump controller monitor warning 2	B	Governor, pump controller

★ For details of the B in the Unit column, see the bit pattern chart in the next section

No.	Item	Unit	Name of component
33	Governor motor A phase current	10mV	Governor, pump controller
34	Governor motor B phase current	10mV	Governor, pump controller
35	Battery relay output voltage	100MV	Governor, pump controller
36	Governor governor input condition	B	Governor, pump cotnroller
37	Governor governor output condition	B	Governor, pump controller
40	Engine speed	10rpm	Governor, pump controller
41	Coolant temperature sensor voltage	10mV	Governor, pump controller
42	Fuel sensor input voltage	10mV	Governor, pump controller
43	Battery charge input voltage	100mV	Governor, pump controller
47	Monitor panel output condition 1	B	Governor, pump controller
48	Monitor panel input condition 1	B	Governor, pump controller
49	Monitor panel input condition 2	B	Governor, pump conroller
4A	Monitor panel input condition 3	B	Governor, pump controller
4C	Monitor panel output condition 2	B	Governor, pump controller

3) Bit pattern chart
As shown in the diagram below, the time dispay has bit numbers light up to show that the signal is being transmitted. (For details, see METHOD OF DISPLAYING MONITORING CODE.)



BKP00085

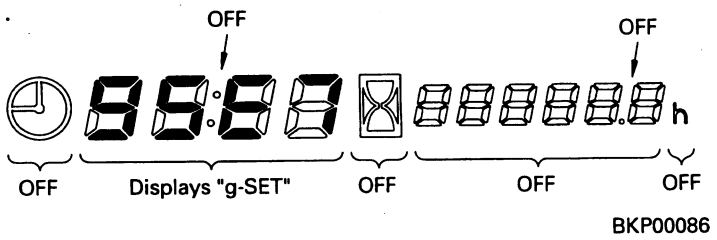
Code	Content	Bit	Details (condition when lighted up)
08	Connection of S-NET components	(1)	Governor, pump controller connected (ID=2)
		(2)	Governor, pump controller connected (ID=3)
		(3)	
		(4)	
		(5)	
		(6)	
20	Input condition of governor, pump controller PPC switches	(1)	Swing switch ON
		(2)	Travel switch ON
		(3)	Boom LOWER switch ON
		(4)	Boom RAISE switch ON
		(5)	Arm IN switch ON
		(6)	Arm OUT switch ON
21	Input condition of governor, pump controller PPC switches and other switches	(1)	Bucket CURL switch ON
		(2)	Bucket DUMP switch ON
		(3)	Swing lock switch ON
		(4)	Service switch ON
		(5)	Model selection 5
		(6)	Swing prolix switch ON
22	Input condition of governor, pump controller model selection and other switches Drive condition of governor,	(1)	Model selection 1 GND connected
		(2)	Model selection 2 GND connected
		(3)	Model selection 3 GNC connected
		(4)	Model selection 4 GND connected
		(5)	Kerosene mode.input GND connected
		(6)	Knob switch ON
25	Input condition 2 of sensor for governor, pump controller monitor warning	(1)	
		(2)	Overload sensor Open
		(3)	
		(4)	
		(5)	
		(6)	

Code	Content	Bit	Details (condition when lighted up)	
23	Pump controller ON/OFF solenoid valves	(1)	LS bypass solenoid	
		(2)		
		(3)	Swing holding brake ON	
		(4)		
		(5)	2 stage relief solenoid ON	
		(6)	Travel speed selector solenoid ON	
24	Input condition 1 of sensor for governor, pump controller monitor warning	(1)	Above engine oil pressure sensor Lo set pressure	
		(2)	Above engine oil pressure sensor Hi set pressure	
		(3)	Radiator water level sensor abnormal	
		(4)	Engine oil level sensor abnormal	
		(5)	Hydraulic oil level sensor abnormal	
		(6)	Air cleaner clogging sensor abnormal	
36	Input condition of governor, pump controller	(1)		
		(2)		
		(3)		
		(4)		
		(5)	Starting switch ON	
		(6)		
37	Output condition of governor, pump controller	(1)	Battery relay: Actuated	
		(2)		
		(3)		
		(4)		
		(5)		
		(6)		
47	Monitor panel output condition 1	(1)		
		(2)	Alarm buzzer: when operated machine	
		(3)		
		(4)		
		(5)		
		(6)		
49	Monitor panel input condition 2	(1)	KEY ON SW	OFF
		(2)	Terminal BR	Voltage Hi
		(3)	LIGHT SW	OFF
		(4)	Preheating switch	OFF
		(5)	START C	Sometimes turns ON
		(6)		
48	Monitor panel input condition 1	(1)	Wiper (ON)	OFF
		(2)	Wiper (INT)	OFF
		(3)	Wiper (WASHER)	OFF
		(4)	Window LIMIT SW	OPEN
		(5)	LIMIT SW (W)	OPEN
		(6)	LIMIT SW (B)	OPEN

Code	Content	Bit	Details (condition when lighted up)	
4A	Monitor panel INPUT condition 3	(1)	Time switch	OFF
		(2)	PPC oil pressure selector switch	OFF
		(3)	Overload selector switch	OFF
		(4)	STD/DLX selection	STD
		(5)	Swing lock switch	OFF
		(6)	Buzzer cancel switch	OFF
4C	Monitor panel output conditon 2	(1)		
		(2)	Wiper motor normal rotation relay output	At abnormal current
		(3)	Wiper motor reverse rotating relay output	At abnormal current
		(4)	Window washer motor drive output	At abnormal current
		(5)		
		(6)		

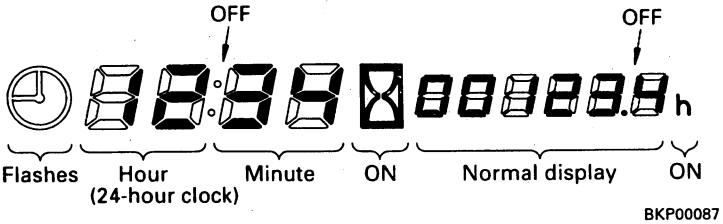
4. Governor motor adjustment mode

This is used when adjusting the linkage between the governor motor and the injection pump. (For details of the procedure, see TESTING AND ADJUSTING.)

Operation	Display
1. To set the governor motor adjustment mode, press the time switch + R.H. travel speed switch + R.H. working mode switch.	1.  BKP00086
2. To return to the time display mode use the same procedure as in Step 1.	2. Buzzer sounds once a second

5. Time adjustment mode

To adjust the time, do as follows.

Operation	Display
1. To set the time adjustment mode, keep the time switch depressed for 2.5 seconds. 2. Use the L.H. working mode switch to advance the hour. 3. Use the R.H. working mode switch to advance the minute. 4. To return to the time display mode use the same procedure as in Step 1.	1. The time mark portion flashes  BKP00087 ★ The example shows the situation when setting to 12:34.

METHOD OF USING JUDGEMENT TABLE

This judgement table is a tool to determine if the problem with the machine is caused by an abnormality in the electrical system or by an abnormality in the hydraulic or mechanical system. The symptoms are then used to decide which troubleshooting table (E-◯◯ , S-◯◯, C-◯◯, F-◯◯, H-◯◯, M-◯◯) matches the symptoms. The judgement table is designed so that it is easy to determine form the user code and service code which troubleshooting table to go to.

★ The abnormality display (warning) given by the monitor panel leads directly to troubleshooting of the machine monitor (M-◯◯). (See troubleshooting of the machine monitor system)

1. When using judgement table for governor, pump controller (governor control system) and engine related parts

- If a service code is displayed on the monitor panel, go to the troubleshooting code at the bottom of the judgement table (E-◯◯).
  (A ● Mark is put at the places where the failure mode and service code match.)
- If a problem has appeared but no service code is displayed on the monitor panel, go to the point where the failure mode matches the troubleshooting code on he right of the judgement table (E- or S-).

<Example> Failure mode "Engine does not start".

Procudure: Check if the service code is being displayed on the monitor panel.

Failure mode		User code	E05						
		Service code	308	317	318	306	315	316	
1	Engine does not start easily								
2	Engine does not start								
3	Engine speed stays at low idling, and does not follow accelerator; or engine pickup is poor		●	●	●	●	●		
4	Engine stops during operation								
5	Engine rotation is irregular	When idling speed is irregular							
		When there is hunting		●	●	●	●		●
6	Lack of output (engine high idling speed is too low)			●			●		
7	Auto-deceleration does not work								
8	Engine does not stop		●		●	●	●	●	●
9	Warming-up operation is defective								
10	Exhaust gas is black								
11	Oil consumption is excessive, or exhaust gas is blue								
12	Oil becomes dirty prematurely								
13	Fuel consumption is excessive, or exhaust gas is blue								
14	Oil is mixed in coolant								
15	Engine oil pressure caution lamp lights up								
16	Oil level rises								
17	Coolant temperature rises too high (overheating)								
18	Abnormal noise is generated								
19	There is excessive vibration								
20	Engine speed does not change even when working mode is switched								
	Troubleshooting code when service code is displayed		E-1	E-2	E-3	E-4	E-5	E-6	E-7
	Troubleshooting code when there is abnormality in monitoring or machine monitor check		-	-	-	-	-	-	-

Governor pump controller, engine related parts (E3 system)
Self-diagnostic display
Abnormality in governor, pump controller power source system
Abnormality in fuel control dial input value
Abnormality (disconnection) in motor drive system
Abnormality (short circuit) in motor drive system
Abnormality in feedback potentiometer system
Abnormality (short circuit) in battery relay output
Abnormality (step-out) in motor

• : This shows applicable item for service code
★ : This shows item that needs only checking with monitoring

Checking monitoring check items							Machine monitor check item			Troubleshooting code if no service code display is given
Battery relay drive signal	No. 2 throttle command value	Fuel control dial command value	Governor motor potentiometer	Governor motor A phase current	Governor motor B phase current	Coolant temperature voltage	102°C or above	105°C or above	Does starting motor turn?	
Monitoring code							Is the range displayed?			
35	16	30	31	33	34	41		108		
										S-1
									○	S-2
		✱	✱	✱	✱			○		S-3
										S-4
			✱							E-9A), S-5
										E-9A), S-5
	✱	✱				○				E-10, S-6
										E-3. E-4
○				✱	✱					E-11
						○		○		E-3 . E-4
										S-7
										S-8
										S-9
										S-10
										S-11
										S-12
										S-13
							○	○		S-14
										S-15
										S-16
	✱									E-3 . E-4
-	-	-	-	-	-	-	-	-	-	
E-12	-	-	-	-	-	-	M-14	M-13	M-13	E-8

○: This shows item to check with monitoring or machine monitor

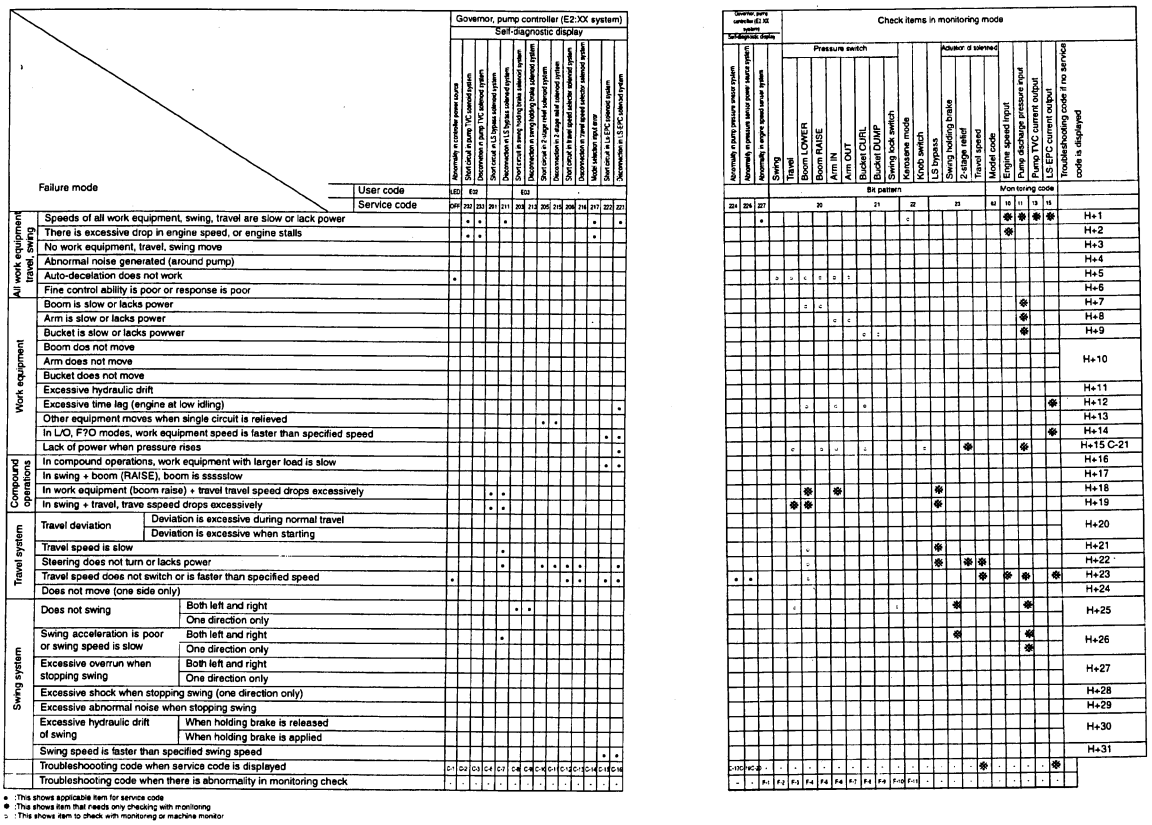
[Judgement]

1) If a service code is being displayed on the monitor panel...go to troubleshooting [E3:◯◯] for the governor, pump controller (governor control system).
2) If no service code is displayed on the monitor panel, and the engine does not start:

- Check that starting motor rotates
  - Starting motor rotates ..... Go to troubleshooting S-2 of mechanical system
  - Starting motor does not rotate ..... Go to troubleshooting E-8 of electical system

2. When using judgement table for governor, pump controller (governor control system) and hydraulic related parts
   - If a service code is displayed on the monitor panel, go to the troubleshooting code at the bottom of the judgement table (C-◯◯).
     (A ● mark is put at the places where the failure mode and service code match.)
   - If a problem has appeared but no service code is displayed on the monitor panel, go to the point where the failure mode matches the input signal, and check the display for the input signal (the display at the place with a ◯ mark)
     - If it is displayed normally, go to the troubleshooting code on the right of the judgement table (H-◯◯).
     - If the input signal is not displayed on the monitor panel, go to the troubleshooting code at the bottom of the judgement table (F-◯◯).

<Example> Failure mode "Upper structure does not swing".



● :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

Procedure: check if the service code is being displayed on the monitor panel.

[Judgement]

1) If a service code is being displayed on the monitor panel...go to troubleshooting [E2:] for the governor, pump controller (pump controller system).
2) If no service code is displayed on the monitor panel, and the upper structure does not swing:

- Check governor, pump controller input signal (Check in monitoring mode)
  - There is a signal ..... Go to troubleshooting H-25 of mechanical system
  - There is no signal ..... Go to troubleshooting F-◯◯ of governor, pump controller input signal system (F mode for applicable system)

METHOD OF USING TROUBLESHOOTING CHARTS

1. Category of troubleshooting code number

Troubleshooting Code No.	Component	Service code
N-○○	Troubleshooting of communication abnormality system	E218 group
E-○○	Troubleshooting of electrical system for governor, pump controller (governor control system)	E3-○○ group
S-○○	Troubleshooting of engine related parts	-
C-○○	Troubleshooting of electrical system for governor, pump controller (pump control system)	E2- ○○ group
F-○○	Troubleshooting of governor, pump controller (input signal system)	-
H-○○	Troubleshooting of hydraulic, mechanical system	-
M-○○	Troubleshooting of machine monitor	E1-○○ group

2. Method of using troubleshooting table for each troubleshooting mode

1) Troubleshooting code number and problem
The title of the troubleshooting chart gives the troubleshooting code, service code, and failure mode (problem with the machine). (See Example (1))

2) Distinguishing conditions
Even with the same failure mode (problem), the method of troubleshooting may differ according to the model, component, or problem. In such cases, the failure mode (problem) is futher divided into sections marked with small letters (for example, a), so go to the appropriate section to carry out troubleshooting. (See Example (2)) If the troubleshooting table is not divided into sections, start troubleshooting form the first check item in the failure mode.

3) Method of following troubleshooting chart
- Check or measure the item inside ▭ and according to the answer follow either the YES line or the NO line to go to the next ▭. (Note: The number written at the top right corner of the ▭ is an index number; it does not idicate the order to follow.)
- Following the Yes or NO lines according to the results of the check or measrument will lead finally to the Cause column. Check the cause and take the action given in the Remedy column on the right. (See Example (3))
- Below the ▭ there are the methods for inspection or measurement, and the judgement values. If the judgement values below the ▭ are correct or the answer to the question inside the ▭ is YES, follow the YES line; if the judgement value is not correct, or the answer to the question is NO, follow the NO line.
- Below the ▭ is given the preparatory work needed for inspection and measurement, and the judgement values. If this preparatory work is neglected, or the method of operation or handling is mistaken, there is danger that it may cause mistaken judgement, or the quipment may be damaged. Therefore, before starting inspection or measurement, always read the instructions carefully, and start the work in order from Item 1).

4) General precautions
When carrying out troubleshooting for the failure mode (problem), precautions that apply to all items are given at the top of the page and marked with ★ (See Example (4)).
The precautions marked ★ are not given in the ▭, but must always be followed when carrying out the check inside the ▭.

5) Troubleshooting tools
When carrying out the troubleshooting, prepare the necessary troubleshooting tools. for detais, see TOOLS FOR TESTING, ADJUSTING, AND TROUBLESHOOTING.

6) Installation position, pin number
A diagram or chart is given for the connector type, installation position, and connector pin number connection. When carrying out troubleshooting, see this chart for details of the connector pin number and location for inspection and measurement of the wiring connector number appearing in the troubleshooting flow chart for each failure mode (problem).

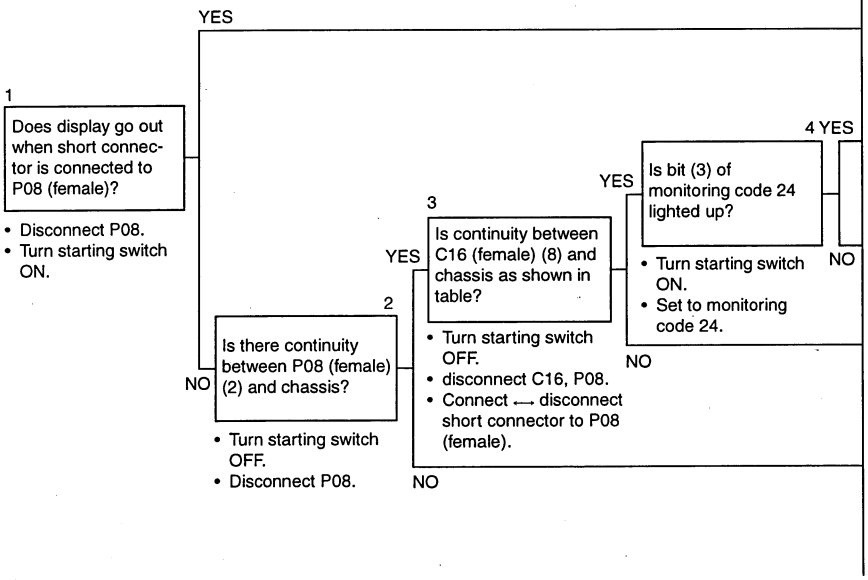
<Example>

(1) M-9 When starting switch is turned ON (engine stopped), check item for previous troubleshooting flashes

(4) ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.
★ Check that the coolant is at the specifies level before carrying out troubleshooting

(2) a)  (coolant level) flashes
SAP00519
Divided into sections a) and b)
b)  (engine oil level) flashes
SAP00523

(3)



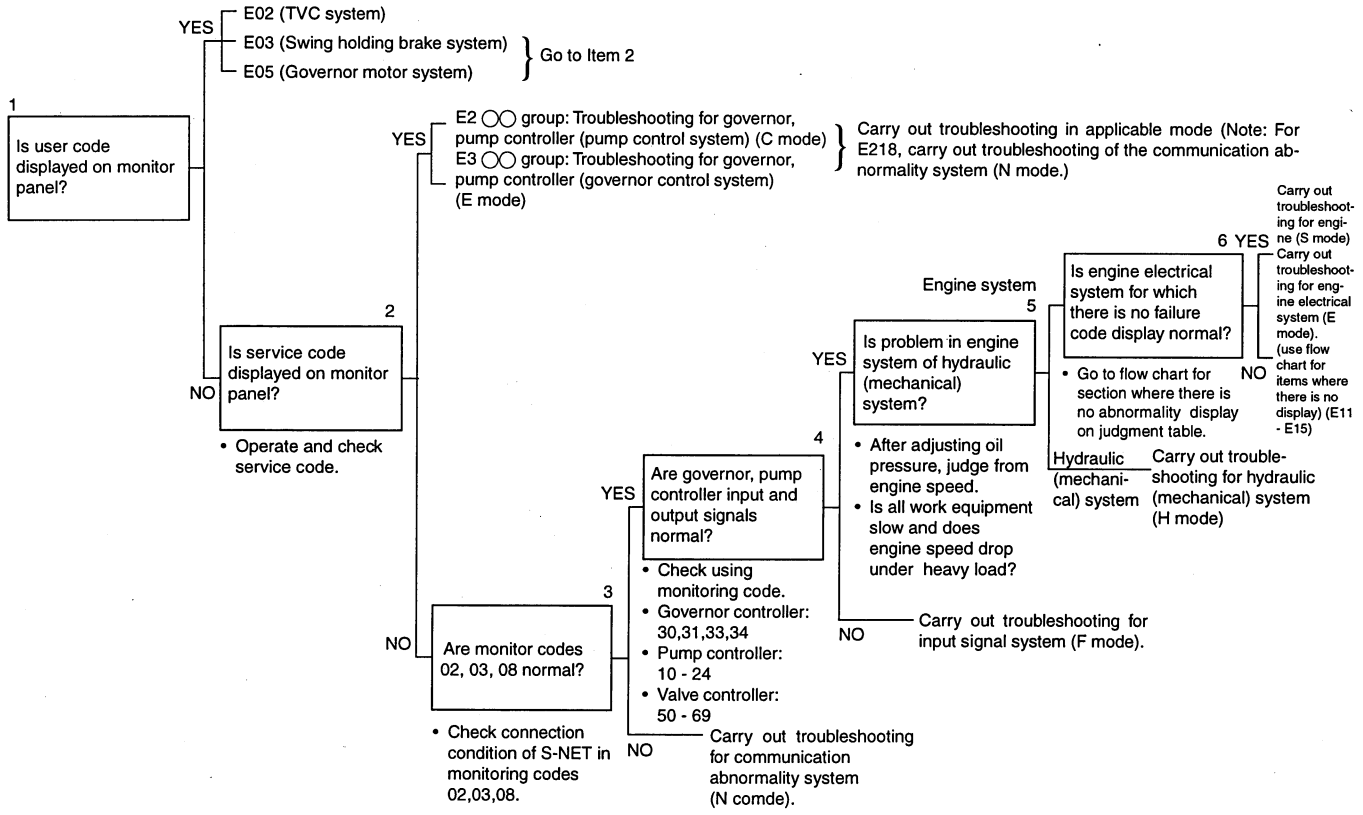
Table

Short connector	Continuity
Connected	Yes
Disconnected	No

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.

If there is no abnormality display in the communications system transmitted in S-NET, it can be taken that the output signal from the monitor panel has been transmitted. However, even if there is no abnormality display, if the operation is defective, use the following procedure when checking directly. If any abnormality occurs in the S-NET system, the system is automatically switched to the following default mode, so be careful when carrying out troubleshooting.

Default Mode when communications cannot be carried out for the monitor and governor, pump controller

Set mode	Pump Control	Governor control
1 Working mode	G/O mode	H/O mode
2 Throttle signal	FULL	FULL
3 Auto-deceleration	ON (deceleration mode)	ON (deceleration mode)
4 Coolant temperature signal	OFF	-
5 Priority mode	OFF	-
6 Power max. mode	ON (power max. possible)	-
7 Travel speed	Lo	-
8 Automatic warming up	_	ON (automatic warming-up mode)

1. Procedure for checking monitor panel output signal

★ For details of operating the monitoring mode, see MONITOR PANEL DISPLAY AND SPECIAL FUNCTIONS.

1. Connnection condition of components
   1) Set to the monitoring mode and display monitoring code 08.
   2) The time display (bits) will light up to display the components that are connected.
      ★ Governor, pump controller (pump control system) (1) and governor, pump controller (governor control system) (2) will light up.

2. Checking working mode signal (check No. 2 throttle signal monitoring code 16) at the same time)
   1) Set to the monitoring mode and display monitoring code 10.
   2) Switch the working mode as shown in Table 1 and check that the engine speed changes.

Table 1

Working mode	High idling speed (rpm) [The figures in ( ) are the rated speed]
H/O	Approx. 2450 (2100)
G/O	Approx. 2030 (1910※ 1)
L/O	Approx. 1890 (1780)

※ 1 Swing Lock ON

3. Checking travel speed selection signal
   1) Set to the monitoring mode and display monitoring code 23.
   2) Change the speed selector switch to Hi or Mi and run the engine at 1500 rpm or above.
      Check that bit (6) lights up when traveling at Hi or Mi (front or rear pump oil pressure: 21.6 - 32.3 MPa (220 - 330 kg/cm^2)

2. Checking input signal of governor, pump controller

★ Check the input signals for each controller as follows.

• Pump control system

1. Checking input signal
   1) Check hydraulic switch
      i) Set to the monitoring mode, and display monitoring code 20 and 21.
      ii) Operate each work equipment lever, and check how the bit pattern lights up.
         ★ For details of the bit pattern chart, see MONITOR PANEL DISPLAY AND SPECIAL FUNCTIONS.
   2) Check speed sensor (check engine speed)
      i) Set to the monitoring mode, and display monitoring code 10.
      ii) Use the fuel control dial to change the speed, and measure the speed when this is done.
   3) Check pump discharge pressure sensor
      i) Set to the monitoring mode, and display monitoring codes 11.

4) Check kerosene mode input signal
   i) Set to the monitoring mode, and display monitoring code 22.
   ii) Connect the CN-M36 connector and check that bit (5) lights up.
5) Check knob switch input signal.
   i) Set to the monitoring mode, and display monitoring code 22.
   ii) Turn the knob switch ON and check that bit (6) lights up.

2. Check output signals
   i) Check LS-EPC solenoid output current
   ii) Run the engine at high idling with all the levers at neutral and in the G/O or H/O mode, and measure the current.
      ★ All levers at neutral: 900 ± 80 mA
      Engine at high idling, any lever operated (other than travel): 0 A
2) No. 2 throtlle signal
   i) Set to the monitoring mode, and display monitoring code 16.
   ii) Use the procedure in Item 2 for checking the monitor panel output signal, and measure the engine speed.
3) Checking ON ⟷ OFF solenoid condition
   i) Set to the monitoring mode, and display monitoring code 23.
   ii) Refer to Table 3 and check that the applicabel bit light up.

Table 3 Types of solenoid and conditions for actuation

Name of solenoid	Actuation condition	Bit that lights up
LS bypass	Swing lock switch OFF, swing + travel lever operated simultaneously	(1)
Swing holding brake	Swing or work equipment lever operated	(3)
2-stage relief ON release	Travel operated independently	(5)
Travel speed selector	Travel speed selector switch Hi or Mi	(6)

★ Operate the lever slightly not enough to move the machine.

4) Check TVC solenoid output current
   i) Set to the monitoring mode, and display monitoring codes 13
   ii) With the starting switch kept at the ON position (G/O mode), measure the current when the fuel control dial is turned to the MAX position.
   • Current with starting switch ON (G/O mode) and fuel control dial at MAX 410 ± 80 (mA)

- **Governor control system**
  1. Check input signal
     1) Check fuel control dial input voltage
        i) Set to the monitoring mode, and display monitoring code 30.
        ii) Measure the voltage when the fuel control dial is turned from low idling to high idling.
            ★ Voltage: 0.25 - 4.75 V
     2) Check governor potentiometer voltage
        i) Set to the monitoring mode, and display monitoring code 31.
        ii) Measure the potentiometer voltage when the fuel control dial is turned from low idling to high idling.
            ★ Voltage: 0.5 - 3.3 V

  2. Check output signal
     1) Check governor motor drive current
        i) Set to the monitoring mode, and display monitoring codes 33 and 34.
            ★ Code 33 is the A phase (engine speed acceleration direction) and code 34 is the B phase (engine speed deceleration direction)
        ii) Measure the governor motor drive current when the fuel control dial is turned in the acceleration direction and deceleration direction.
            ★ Current: 700 ± 70 (mA)

     2) Measure battery relay drive output voltage
        i) Set to the monitoring mode, and display monitoring code 35.
        ii) Measure the battery realy drive output voltage when the starting switch is turned from ON to OFF.
        or
        iii) Set to the monitoring mode, and display monitoring code 37.
        iv) Check that bit (1) lights up when the starting switch is turned from ON to OFF.

SERVICE CODE TABLE

Service code	Abnormal system	User code
E101	Abnormality in error history data	
E102	Abnormality in time data	
E103	Short circuit in buzzer output, contact with 24 V wiring harness for buzzer drive	
E104	Air cleaner clogging detected	
E106	Abnormality in engine oil pressure sensor (Hi) detected	
E108	Water temperature over 105*C	
E201	Short circuit in LS bypass solenoid system	
E203	Short circuit in swing holding brake solenoid system	E03
E206	Short circuit in 2-stage relief solenoid system	
E206	Short circuit in travel speed solenoid system	
E211	Disconnection in LS bypass solenoid system	
E213	Disconnection in swing holding brake solenoid system	
E215	Disconnection in 2-stage relief solenoid system	E03
E216	Disconnection in travel speed solenoid system	
E217	Error in model selection input	
E218	Network response overtime error	
E222	Short circuit in LS-EPC solenoid system	
E223	Disconnect in LS-EPC solenoid system	
E224	Abnormality in pump pressure sensor system	
E226	Abnormality in pressure sensor system power source	
E227	Abnormality in engine speed sensor	
E232	Short circuit in pump TVC solenoid system	E02
E233	Disconnection in pump TVC solenoid system	E02
E306	Abnormality in feedback potentiometer system	
E308	Abnormality in fuel control dial input value	E05
E315	Short circuit in battery relay output system	
E316	Step-out in governor motor	
E317	Disconnection in governor motor system	E05
E318	Short circuit in governor motor system	E05

Service code	Abnormal system	User code
E112	Short circuit in relay drive R	
E113	Short circuit in relay drive L	
E114	Short circuit in window washer drive	

TROUBLESHOOTING OF COMMUNICATION ABNORMALITY SYSTEM (N MODE)

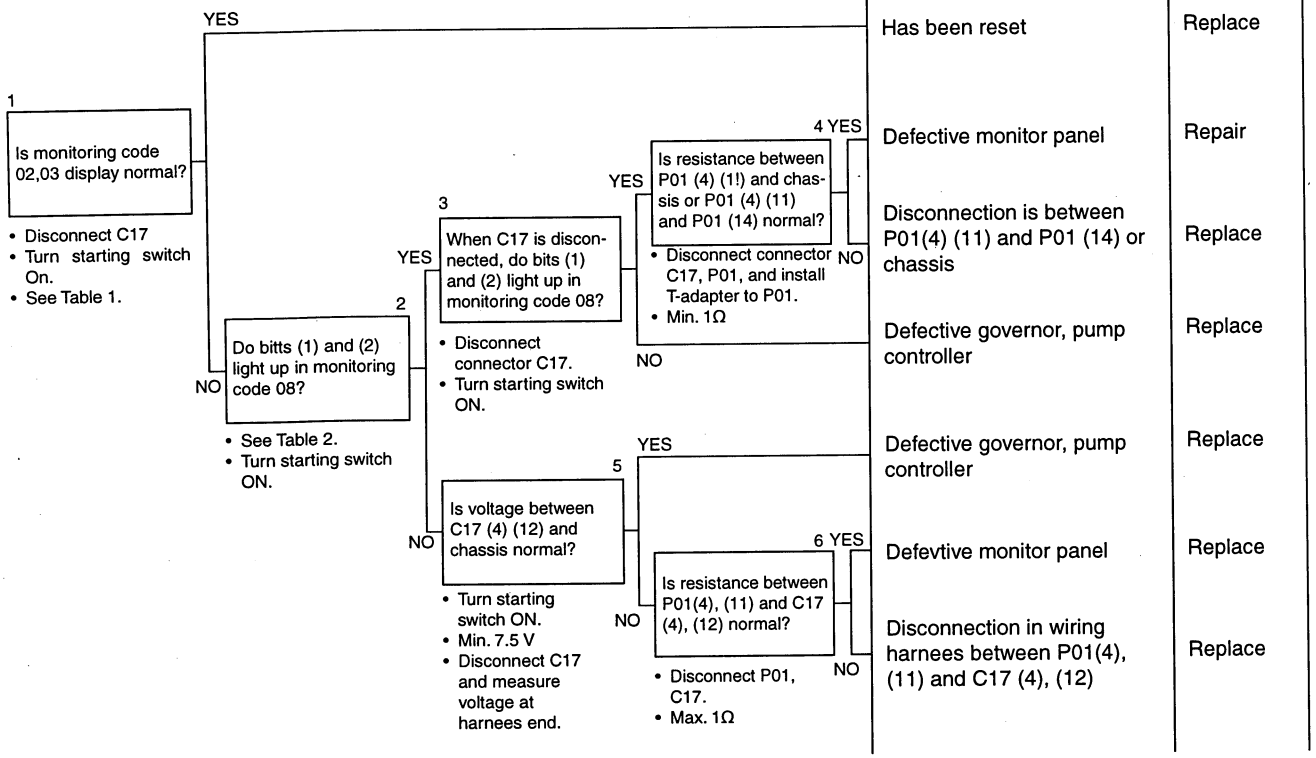
N-1 [E218] Communication abnormality

★ 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 service code E is not displayed, the problem has been removed.

★ If the starting switch was turned off after the abnormality occurred, turn the starting switch on and check that the service code displays E. (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
Has been reset	Replace
Defective monitor panel	Repair
Disconnection is between P01(4) (11) and P01 (14) or chassis	Replace
Defective governor, pump controller	Replace
Defective governor, pump controller	Replace
Defevtive monitor panel	Replace
Disconnection in wiring harnees between P01(4), (11) and C17 (4), (12)	Replace

Table 1

Monitoring code		Display
01	Monitor panel model code	150
02	Governor, pump controller model code	150
03	Governor, pump controller model code	150

- When each controller is connected to the network,"_" is displayed. If the correct alphanumerics are not displayed (another model is displayed), each controller shows model selection abnormal.

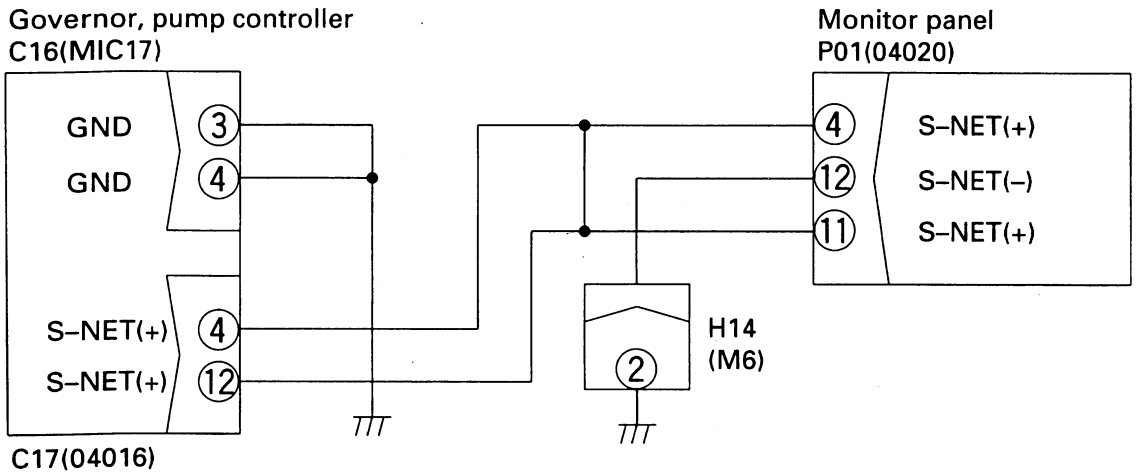
Table 2

Monitoring code \ Display	
08	Network connection condition

- Light up when connected
  (1) Governor, pump controller
  (2) Governor, pump controller

- Note: Checks can be carried out with code 08 only when there is a disconnection. The display does not change when there is a short circuit.
  Therefore, checks when there is a short circuit should be carried out basically using Table 1

N-1 Related electric circuit diagram

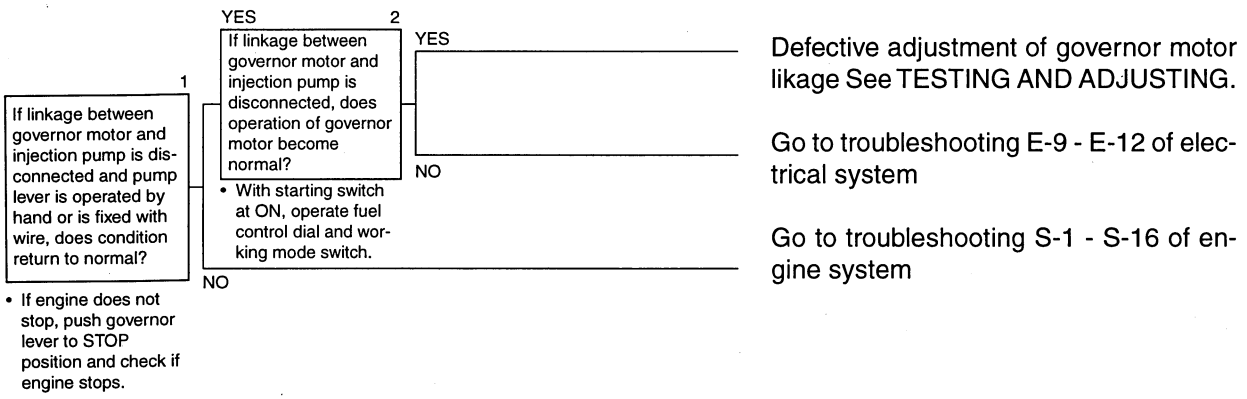


TROUBLESHOOTING OF GOVERNOR, PUMP CONTROLLER (GOVERNOR CONTROL SYSTEM) (E MODE)

POINTS TO REMEMBER WHEN CARRYING OUT TROUBLE-SHOOTING OF GOVERNOR, PUMP CONTROLLER SYSTEM

1. Points to remember when there is abnormality which is not displayed by user code
   The engine is controlled by the governor and pump controller.
   The problems that may occur with this system include the following.
   1. Idling speed is too high (too low)
   2. High idling speed is too low
   3. Auto-deceleration speed is too high (too low)
   4. Engine speed for automatic warming-up operation is too high (too low)
   5. There is hunting
   6. Engine does not stop

   If any abnormality occurs, and the abnormality is displayed on the time display portion of the monitor panel, use the troubleshooting table to determine the appropriate troubleshooting flow chart form E-1 to E-12. However, if there is any abnormality in the machine and no abnormality display is given, it is necessary to determine whether the problem is in the mechanical system or in the electrical system. If the linkage between the governor motor and the injectionpump is not properly adjusted, problems 1 to 6 listed above may occur. Therefore, if there is no abnormality display, but one of problems 1 to 6 above has occurred, carry out troubleshooting as follows.



   Disconnect the linkage as explained above, or check the adjustment and go to the troubleshooting flow chart for the mechanical system or electrical system.
   For details of the procedure for adjusting the linkage, see TESTING AND ADJUSTING.

2. **Points to remember if abnormality returns to normal by itself**
   In the following two cases, there is a high probability that the same problem will occure again, so it is desirable to follow up this problem carefully.
   1) If any abnormality returns to normal by itself, or
   2) If the connector is disconnected and the T-adapter is inserted, or if the T-adapter is removed and the connector is returned to its original position when carrying out troubleshooting of the failure, and the service code is no longer displayed, or if the monitor display returns to normal.
   3) After completing troubleshooting, always erase the service code form memory.

3. **User code memory retention function**
   When displaying the abnormality code in memory and carrying out troubleshooting, note down the content of the display, then erase the display. After trying to re-enact the problem, carry out troubleshooting according to the failure code that is displayed.
   (There are cases where mistaken operation or abnormalities that occur when the connector is disconnected are recorded by the memory retention function. Erasing the data in this way saves any wasted work.)

ACTION TAKEN BY CONTROLLER WHEN ABNORMALITY OCCURS AND PROBLEMS ON MACHINE

User code	Service code	Abnormal system	Nature of abnormality
E05	E308	Abnormality in fuel control dial input valvue	1. Short circuit in wiring harness between C03 (7) - (14), (7) - (17), (14) - (17) 2. Short circuit in wiring harness between E04 (1) - (2), (1) - (3), (2) - (3) 3. Short circuit in wiring harness between E06 (1) - (2), (1) - (3), (2) - (3) 4. Short circuit in wiring harness between C03 (7) - (4), (4) - (17) 5. Disconnection in wiring harness between C03 (7) - X07 (6) - E06 (1) 6. Disconnection in wiring harness between C03 (4) - X07 (5) - E06 (2) 7. Disconnection in wiring harness between C03 (17) - X07 (4) - E06 (3) 8. Defective fuel control dial 9. Defective contact of C03, X07, E06 connectors
	E317	Abnormality (disconnection) in motor drive system	1. Disconnection inside governor motor 2. Sisconnection in wiring harness between C02 (2) - E05 (1) 3. Disconnection in wiring harness between C02 (4) - E05 (3) 4. Disconnection in wiring harness between C02 (3) - E05 (2) 5. Disconnection in wiring harness between C02 (5) - E05 (4) 6. Defective contact of E05 connector
	E318	Abnormality (short circuit) in motor drive system	1. Short circuit inside governor motor 2. Wiring harness between C02 (2) - E05 (1) and between C02 (4) - E05 (3) short circuiting with wiring harness between C02 (3) - E05 (2) 3. Wiring harness between C02 (4) - E05 (3) and between C02 (2) - E05 (1) short circuiting with wiring harness between C02 (5) - E05 (4) 4. Wiring harness in Items 2 and 3 short circuiting with ground

<table>
<tr><th>Condition when normal (voltage, current, resistance)</th><th>Action by controller when abnormality is detected</th><th>Problem that appears on machine when there is abnormality</th></tr>
<tr><td>
<table>
<tr><th>C03 (female)</th><th>E06 (male)</th><th>Resistance value</th></tr>
<tr><td>(7) - (4)</td><td>(1) - (2)</td><td>0.25 - 7kΩ</td></tr>
<tr><td>(4) - (17)</td><td>(2) - (3)</td><td>0.25 - 7kΩ</td></tr>
<tr><td>(7) - (17)</td><td>-</td><td>2 - 3kΩ</td></tr>
<tr><td>-</td><td>(1) - (3)</td><td>4 - 6kΩ</td></tr>
<tr><td>Between each pin and chassis</td><td>-</td><td>Min. 1 MΩ</td></tr>
</table>
</td><td>Maintains engine speed at position of fuel control dial immediately before abnormality occurred</td><td>1. Does not become partial speed when set at MAX position
2. Does not reach high idling when set at partial speed
3. There are cases of hunting
4. Lacks output (max. speed of engine is too low)</td></tr>
<tr><td>
<table>
<tr><th>E05 (male)</th><th>C02 (female)</th><th>Resistance value</th></tr>
<tr><td>(1) - (2)</td><td>(2) - (3)</td><td>0.25 - 7kΩ</td></tr>
<tr><td>(3) - (4)</td><td>(4) - (5)</td><td>0.25 - 7kΩ</td></tr>
<tr><td>(1) - (3)</td><td>(2) - (4)</td><td>Min. 1 MΩ</td></tr>
<tr><td>(1) _ 94)</td><td>(2) - (5)</td><td>Min. 1 MΩ</td></tr>
<tr><td>Between pins (1), (2), (3), (4) and chassis</td><td>Between pins (2), (3), (4), and (5) and chassis</td><td>Min. 1 MΩ</td></tr>
</table>
Motor drive current: Hold: 0.7 A
Start: 0.84 A
</td><td>Takes no particular action</td><td>1. When there is a disconnection in both the A phase and B pahse at the same time, the problem is the same as for a short circuit in the governor motor system
2. When there is a disconnection in only one of A phase or B phase
1) Engine does not stop
2) Stops moving at position immediately before failure, so engine speed cannot be controlled
3) There are cases of hunting</td></tr>
<tr><td>
<table>
<tr><th>E05 (male)</th><th>C02 (female)</th><th>Resistance value</th></tr>
<tr><td>(1) - (2)</td><td>(2) - (3)</td><td>0.25 - 7kΩ</td></tr>
<tr><td>(3) - (4)</td><td>(4) - (5)</td><td>0.25 - 7kΩ</td></tr>
<tr><td>(1) - (3)</td><td>(2) - (4)</td><td>Min. 1 MΩ</td></tr>
<tr><td>(1) - (4)</td><td>(2) - (5)</td><td>Min. 1 MΩ</td></tr>
<tr><td>Between pins (1), (2), (3), (4) and chassis</td><td>Between pins (2), (3), (4), and (5) and chassis</td><td>Min. 1 MΩ</td></tr>
</table>
Motor drive current: Hold: 0.7 A
Start: 0.84 A
</td><td>Sets motor drive current to 0</td><td>1. If during operation
1) Set to low idling
2) Engine does not stop
3) There are cases of hunting
2. When stopped
1) Engine starts, but stays at low idling
2) Engine does not stop after starting
3) There are cases of hunting</td></tr>
</table>

User code	Service code	Abnormal system	Nature of abnormality
-	E306	Abnormality in feedback potentiometer system	1. Short circuit in wiring harness between C03 (7) - (14), (7) - (17), (14) - (17) 2. Short circuit in wiring harness between E04 (1) - (2), (1) - (3), (2) - (3) 3. Short circuit in wiring harness between E06 (1) - (2), (10 - (3), (2) - (3) 4. Short circuit in wiring harness between C03 (7) - (4), (4) - (17) 5. Disconnection in wiring harness between C03 (7) - E04 (1) 6. Disconnection in wiring harness between C03 (14) - E04 (2) 7. Disconnection in wiring harness between C03 (17) - E04 (3) 8. Defective governor motor potentiometer 9. Defective contact of C03, E04 connectors
-	E315	Abnormality (short circuit) in battery relay output system	If excess current flows between C03 (1) and battery relay ★ This occurs only when turning starting switch to OFF and stopping engine
-	E316	Abnormality (step-out) in motor	1. Defective adjustment of rod or scuffing of loose spring
			2. Abnormality in governor motor
			3. Abnormality in govenor, pump controller

<table>
<tr><th>Condition when normal (voltage, current, resistance)</th><th>Action by controller when abnormality is detected</th><th>Problem that appears on machine when there is abnormality</th></tr>
<tr><td>
<table>
<tr><th>C03 (female)</th><th>E04 (male)</th><th>Resistance value</th></tr>
<tr><td>(7) - (14)</td><td>(1) - (2)</td><td>0.25 - 7kΩ</td></tr>
<tr><td>(7) - (17)</td><td>(2) - (3)</td><td>0.25 - 7kΩ</td></tr>
<tr><td>(14) - (17)</td><td>-</td><td>2 - 3kΩ</td></tr>
<tr><td>-</td><td>(1) - (3)</td><td>4 - 6kΩ</td></tr>
<tr><td>Between each pin and chassis</td><td>-</td><td>Min. 1 MΩ</td></tr>
</table>
</td><td>Calculates position of motor and carries out control from value of voltage immediately befor abnormality occurred</td><td>1. Precision of engine speed control may be reduced.
For example:
1) Engine does not rise to high idling speed (a little too low)
2) Engine does not go down to low idling speed (a little too high)
3) Defective engine speed for autodeceleration or automatic warming-up
4) Engine may not stop
★ The governor motor moves in the direction to stop the engine, but the motor may not move completely to the position to stop the engine.
5) There are cases of hunting</td></tr>
<tr><td>Between C03 (1) and chassis: 20 - 30 V
★ Holds with the motor in the stop position for 2 - 2.5 sec, returns to the low idling position, the turns then battery relay OFF.</td><td>Sets battery relay drive current to 0</td><td>Engine does not stop</td></tr>
<tr><td>1. Linkage adjustment correct</td><td rowspan="3">1. Displays when returning from high idling to low idling
★ Starts again (repeats step-out)
2. In some cases it may not display when returning from partial speed to low idling</td><td rowspan="3">Engine speed cannot be controlled (particularly at high idling), so there is hunting</td></tr>
<tr><td>2. Must move lightly when connector is removed</td></tr>
<tr><td>3. Normal</td></tr>
</table>

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

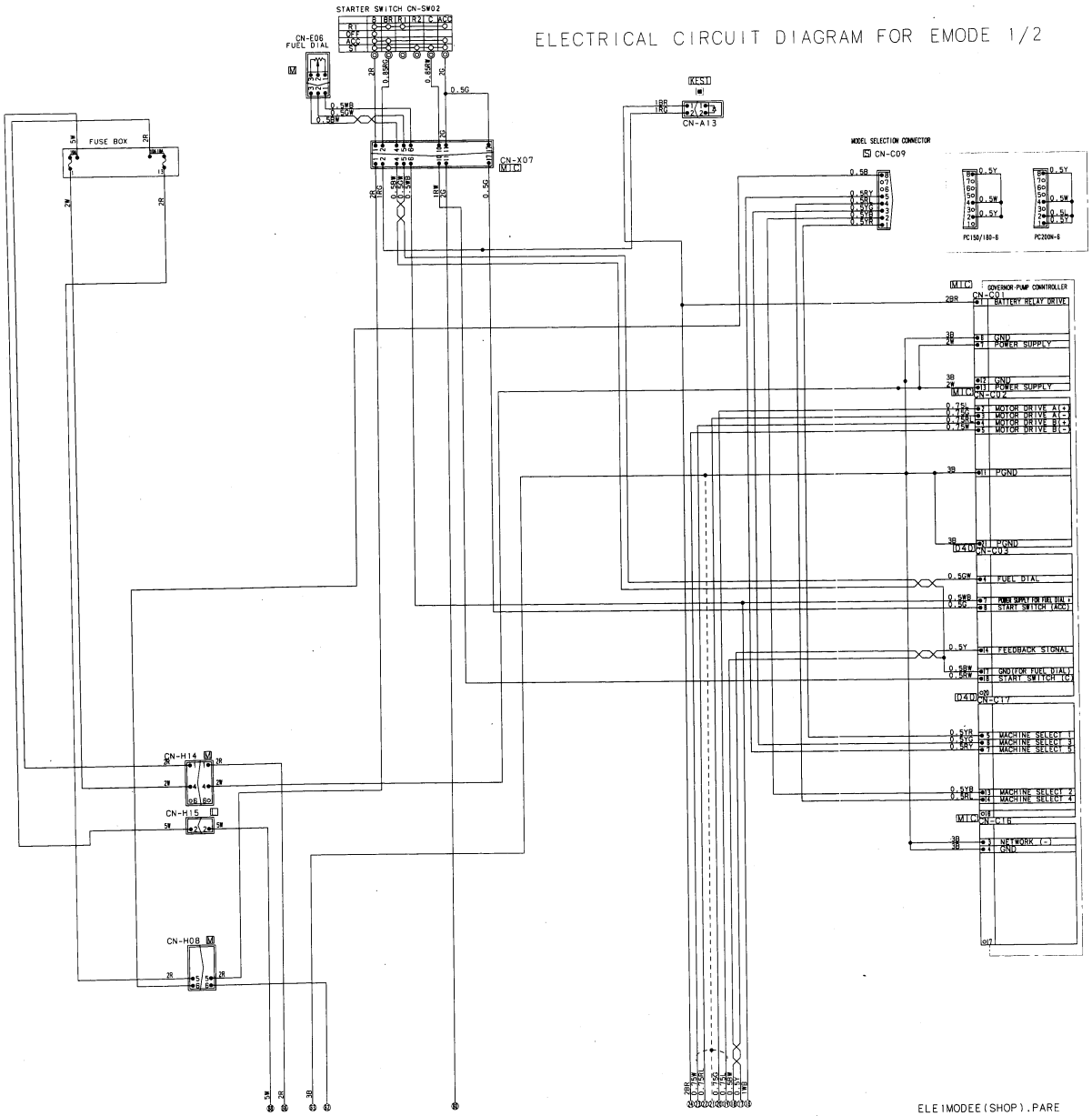
Failure mode			Abnormality in governor, pump controller power source system	Governor, pump controller, engine related parts (E3: system)					
				Self-diagnostic display					
				Abnormality in fuel control dial input value	Abnormality (disconnection) in motor drive system	Abnormality (short circuit) in motor drive system	Abnormality in feedback potentiometer system	Abnormality (short circuit) in battery relay output	Abnormality (step-out) in motor
		User code		E05					
		Service code	308	317	318	306	315	316	
1	Engine does not start easily								
2	Engine does not start								
3	Engine speed stays at low idling, and does not follow accelerator; or engine pickup is poor		●	●	●	●	●		
4	Engine stops during operation								
5	Engine rotation is irregular	When idling speed is irregular							
		When there is hunting		●	●	●	●		●
6	Lack of output (engine high idling speed is too low)			●			●		
7	Auto-deceleration does not work								
8	Engine does not stop		●		●	●	●	●	●
9	Warming-up operation is defective								
10	Exhaust gas is black								
11	Oil consumption is excessive, or exhaust gas is blue								
12	Oil becomes dirty prematurely								
13	Fuel consumption is excessive, or exhaust gas is blue								
14	Oil is mixed in coolant								
15	Engine oil pressure caution lamp lights up								
16	Oil level rises								
17	Coolant temperature rises too high (overheating)								
18	Abnormal noise is generated								
19	There is excessive vibration								
20	Engine speed does not change even when working mode is switched								
Troubleshooting code when service code is displayed			E-1	E-2	E-3	E-4	E-5	E-6	E-7
Troubleshooting code when there is abnormality in monitoring or machine monitor check			-	-	-	-	-	-	-

• : This shows applicable item for service code
★ : This shows item that needs only checking with monitoring

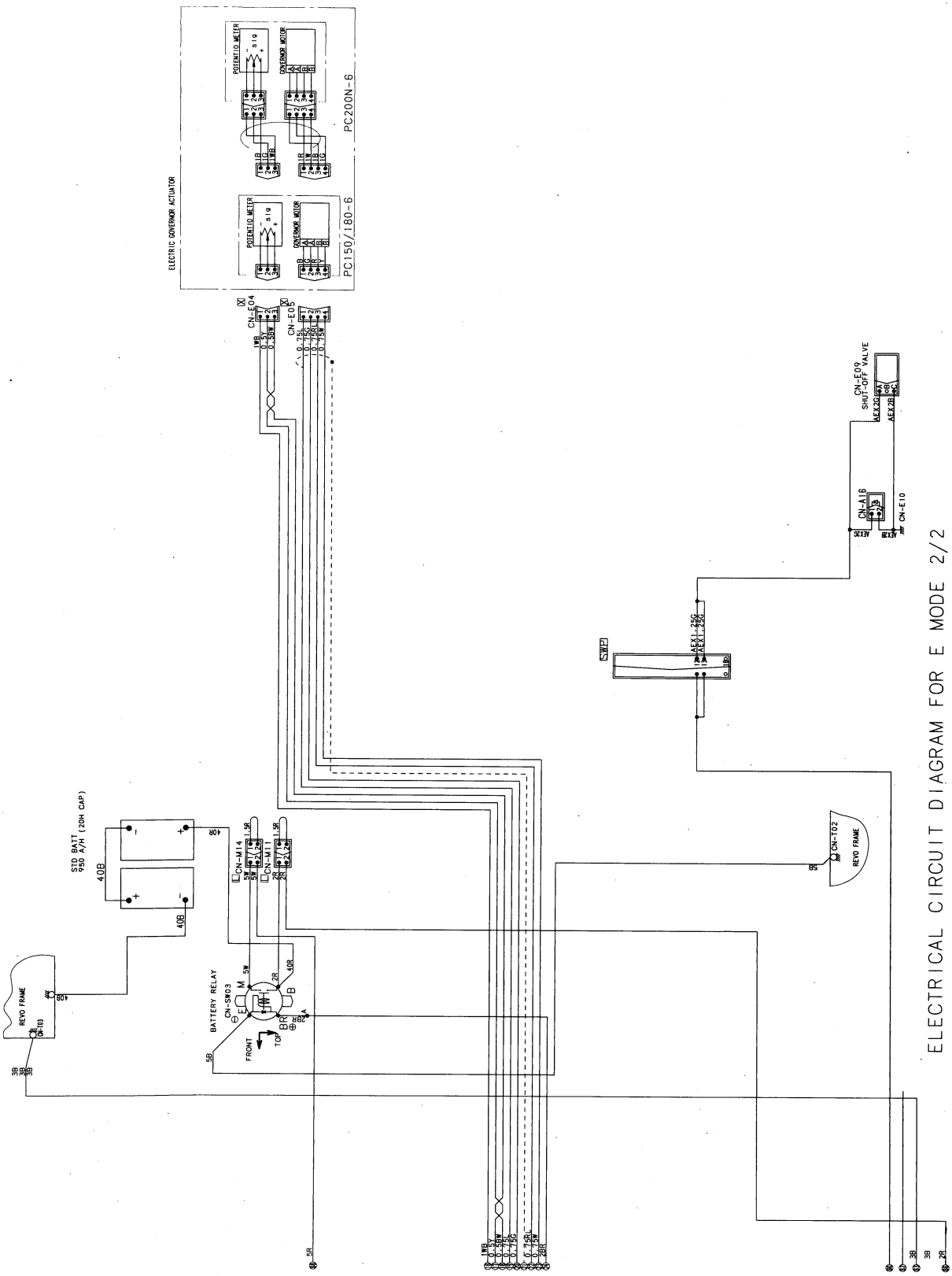
Checking monitoring, check items								Machine monitor check item			Troubleshooting code if no service code display is given
								Is the range displayed?			
Battery relay drive signal	No. 2 throttle command value	Fuel control dial command value	Governor motor potentiometer	Governor motor A phase current	Governor motor B phase current	Coolant temperature voltage		102°C or above	105°C or above	Does starting motor turn?	
Monitoring code											
35	16	30	31	33	34	41			108		
											S-1
										○	S-2
		※	※	※	※				○		S-3
											S-4
											E-9A), S-5
			※								E-9A), S-5
	※	※				○					E-10, S-6
											E-3. E-4
○				※	※						E-11
						○			○		E-3 . E-4
											S-7
											S-8
											S-9
											S-10
											S-11
											S-12
											S-13
						○	○				S-14
											S-15
											S-16
	※										E-3 . E-4
-	-	-	-	-	-	-	-	-	-	-	
E-12	-	-	-	-	-	M-14	M-13	M-13	E-8		

○: This shows item to check with monitoring or machine monitor

ELECTRICAL CIRCUIT DIAGRAM FOR E MODE 1/2

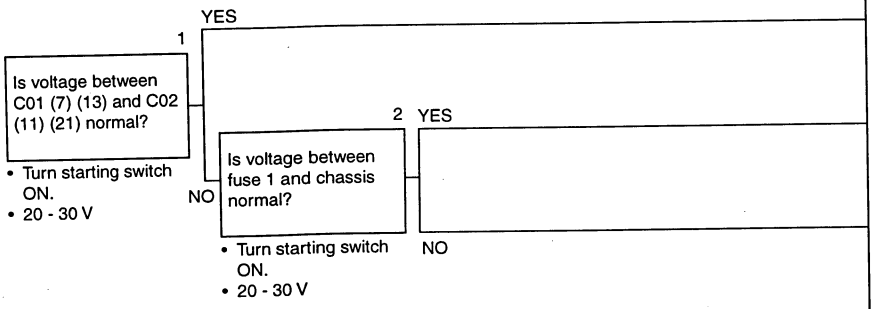


ELECTRICAL CIRCUIT DIAGRAM FOR E MODE 2/2



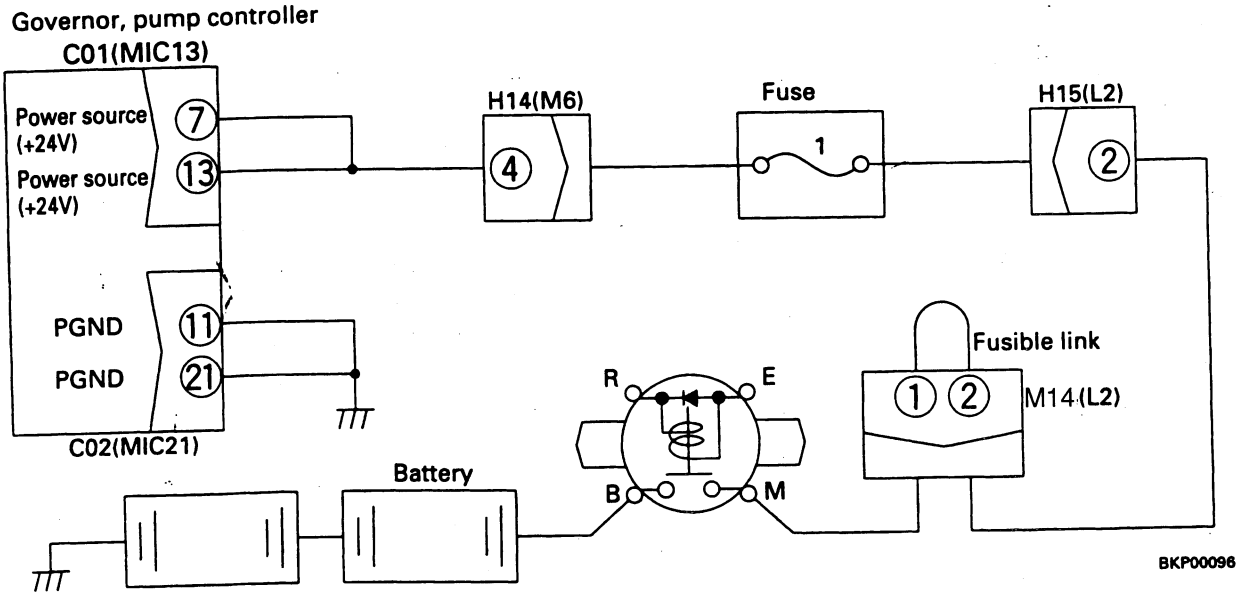
E-1 Abnormality in governor, pump controller power source (controller LED is OFF)

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter 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 connecotrs 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
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

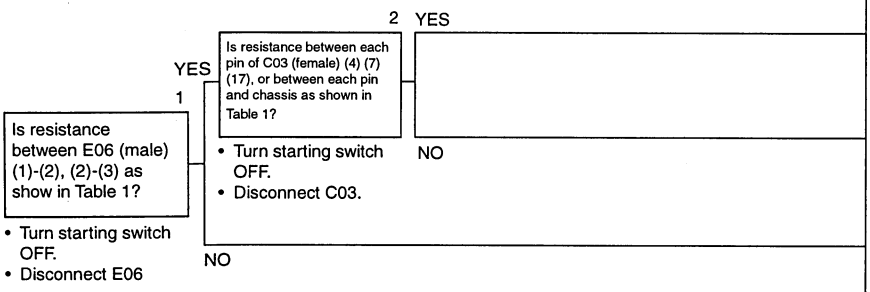


E-2 [E308] Abnormality in fuel control dial input value is displayed

★ **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 the service code E 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.



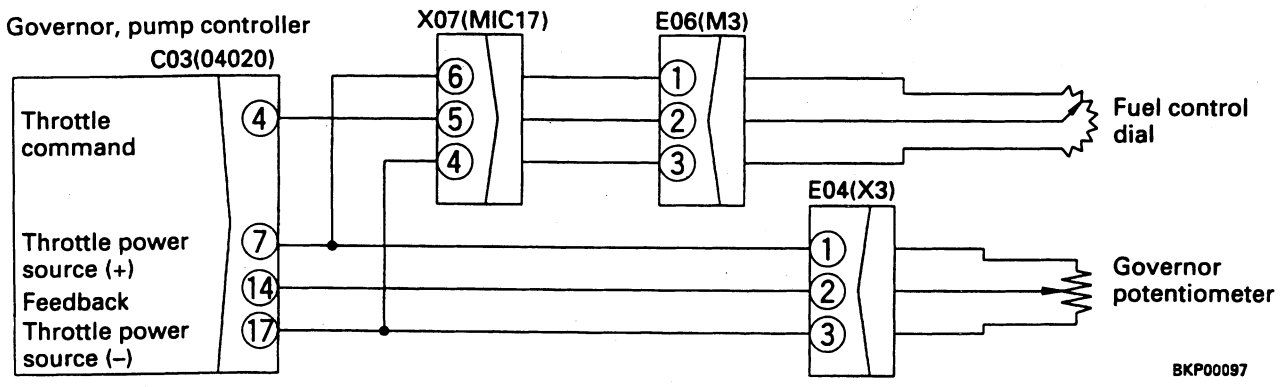
Cause	Remedy
Defective governor, pump controller	Replace
Defective wiring harness in system with defective resistance	Replace
Defective fuel control dial	Replace

★ If E306 also occurs at the same time, check the wiring harness below.
- Wiring harness between C03 (female) (7) - E04 (female) (1) short circuiting with groud, or contact with other wiring harness

Table 1

C03 (female)	E04 (male)	Resistance value
(7) - (4)	(1) - (2)	0.25 - 7kΩ
(4) - (17)	(2) - (3)	0.25 - 7kΩ
(7) - (17)	-	2 - 3kΩ
-	(1) - (3)	4 - 6kΩ
Between each pin and chassis	-	Min. 1 MΩ

E-2 Related electric circuit diagram



E-3 [E317] Abnormality (disconnection) in motor drive system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connecotr and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code E is not displayed, the problem has been removed.**

★ During operation, if there is
1) a simultaneous disconnection in A phase and B phase:
   1) the engine will run at low idling
   2) the engine will not stop
2) a disconnection in either A phase or B phase, the engine speed will remain the same as before the abnormality occurred

★ If the problem occurs when the engine is stopped,
1) the engine can be started, but it stays in low idling, or 2) it will not stop after it is started.

⚠ Check with the engine stopped (push the fuel control lever of the fuel injection pump to the NO INJECTION position).

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

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

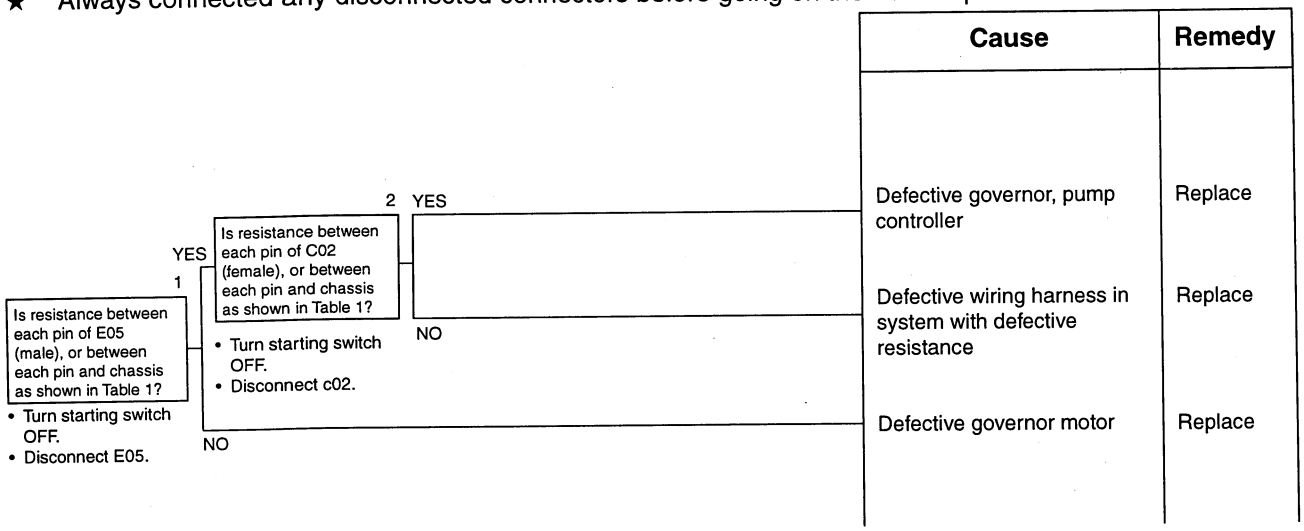
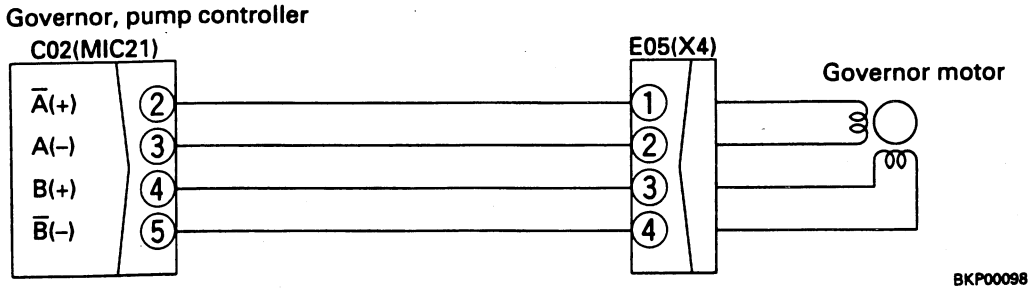


Table 1

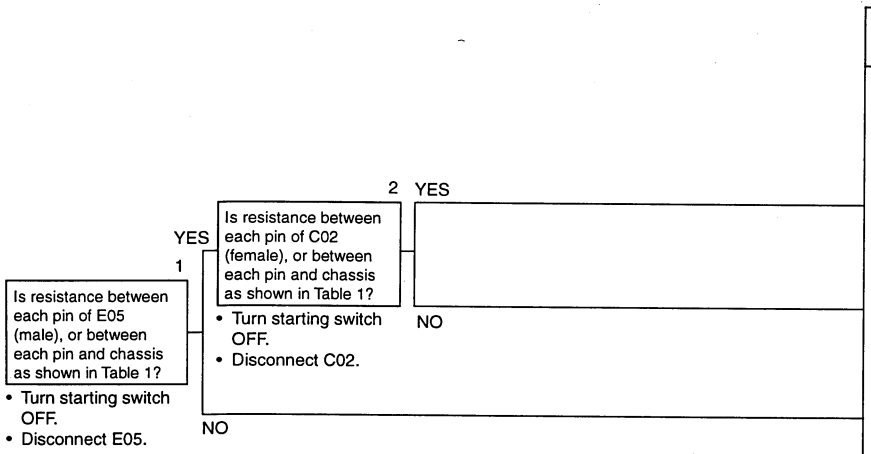
E05 (male)	C02 (female)	Resistance value
(1) - (2)	(2) - (3)	2.5 - 7.5 kΩ
(3) - (4)	(4) - (5)	2.5 - 7.5 kΩ

E-3 Related electric circuit diagram



E-4 [E318] Abnormality (short circuit) in moter drive 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 postion, if the service code E is not displayed, the problem has been removed.**
★ If the abnormality occurs during operation, because of the force of the spring,
1) the engine will run at low idling
2) the engine will not stop
★ If the problem occurs when the engine is stopped,
1) the engine can be started, but it stays in low idling, or 2) it will not stop after it is started.
⚠ Check with the engine stopped (push the fuel control lever of the fuel injection pump to the NO INJECTION position).
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connertors before going on the next step.

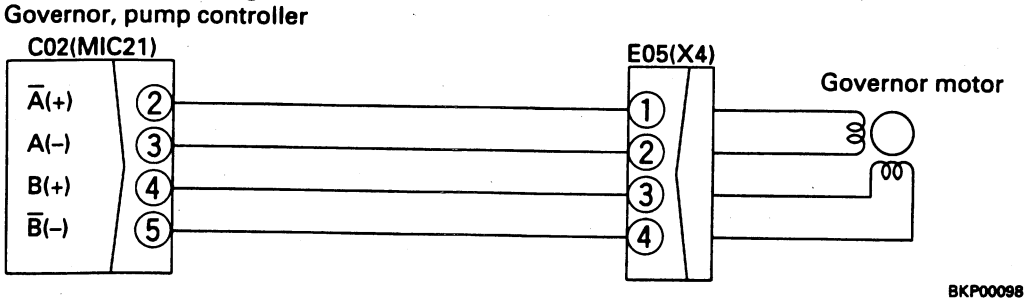


Cause	Remedy
Defective governor, pump controller	Replace
Defective wiring harness in system with defective resistance	Replace
Defective governor motor	Replace

Table 1

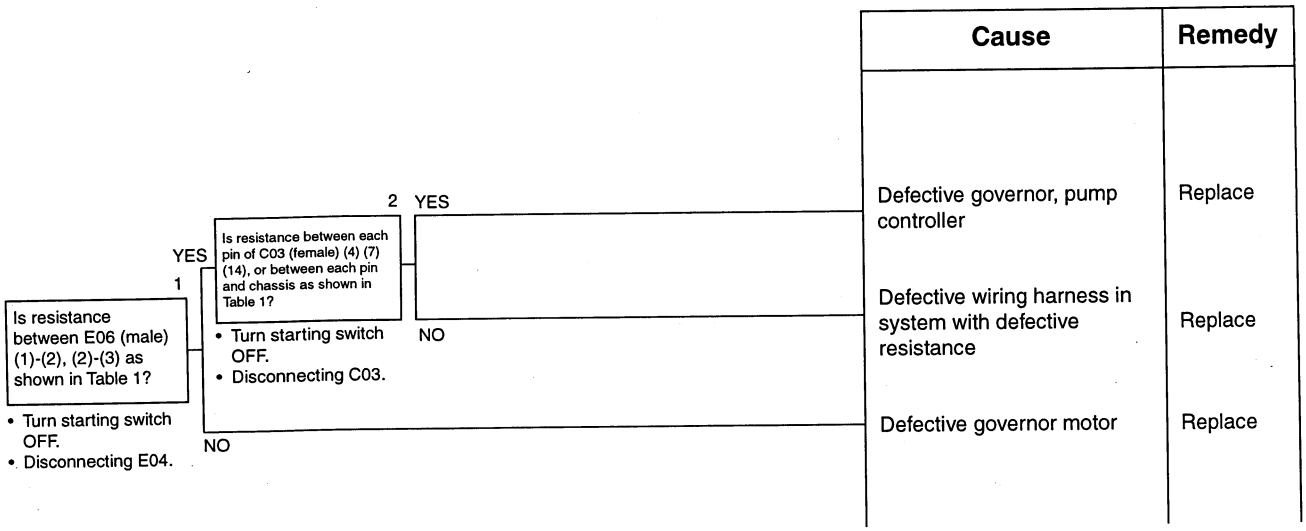
E05 (male)	C02 (female)	Resistance value
91) - (2)	(2) - (3)	2.5 - 7.5 kΩ
(3) - (4)	(4) - (5)	2.5 - 7.5 kΩ
(1) - (3)	(2) - (4)	Min. 1 MΩ
(1) - (4)	(2) - (5)	Min. 1 MΩ
Between chassis and pins (1) (2) (3) (4)	Between chassis and pins (2) (3) (4) (5)	Min. 1 MΩ

E-4 Related electric circuit diagram



E-5 [E306] Abnormality in feedback potentiometer 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 the service code E 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.

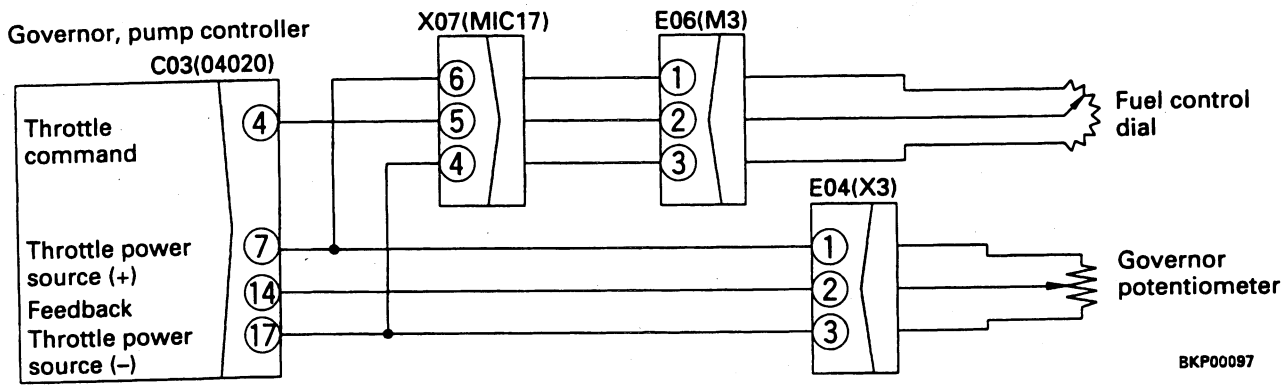


★ If E308 also occurs at the same time, check the wiring harness below.
- Wiring harness between C03 (female) (7) - x07 (6) - E06 (female) (1) short circuiting with ground, or contact with other wiring harness

Table 1

C03 (female)	E04 (male)	Resistance value
(7) - (4)	(1) - (2)	0.25 - 7kΩ
(14) - (17)	(2) - (3)	0.25 - 7kΩ
(7) - (17)	-	2 - 3kΩ
-	(1) - (3)	4 - 6kΩ
Between each pin and chassis	-	Min. 1 MΩ

E-5 Related electric circuit diagram



E-6 [E315] Abnormality (short circuit) in battery relay output system is displayed

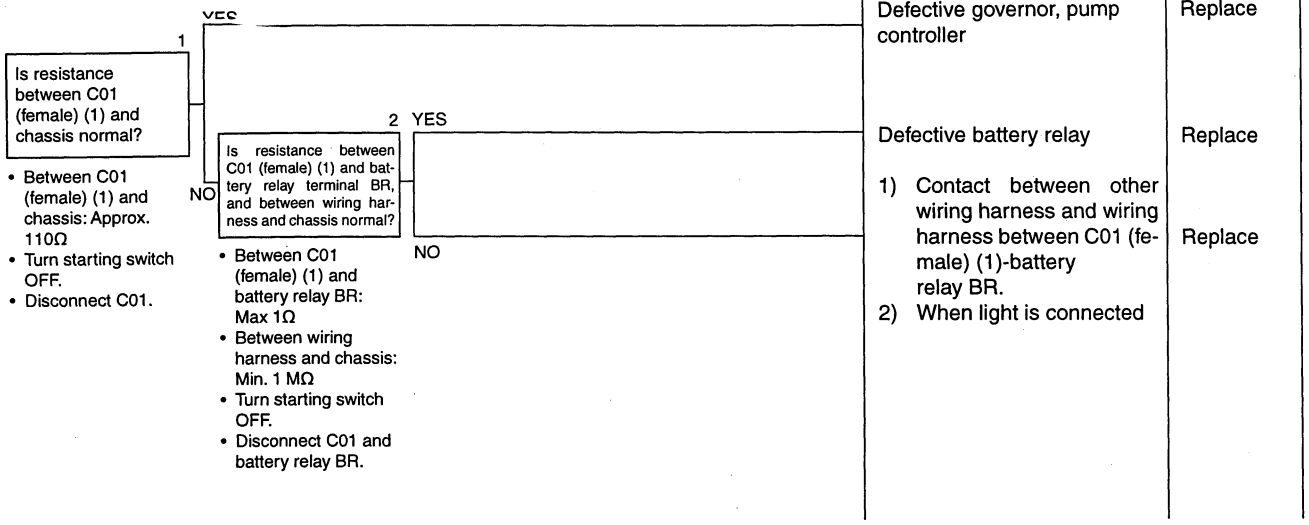
★ This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its oringinal position, if the service code E is not displayed, the problem has been removed.

⚠ Check with the engine stopped (push the fuel control lever of the fuel injection pump to the NO INJECTION position.

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

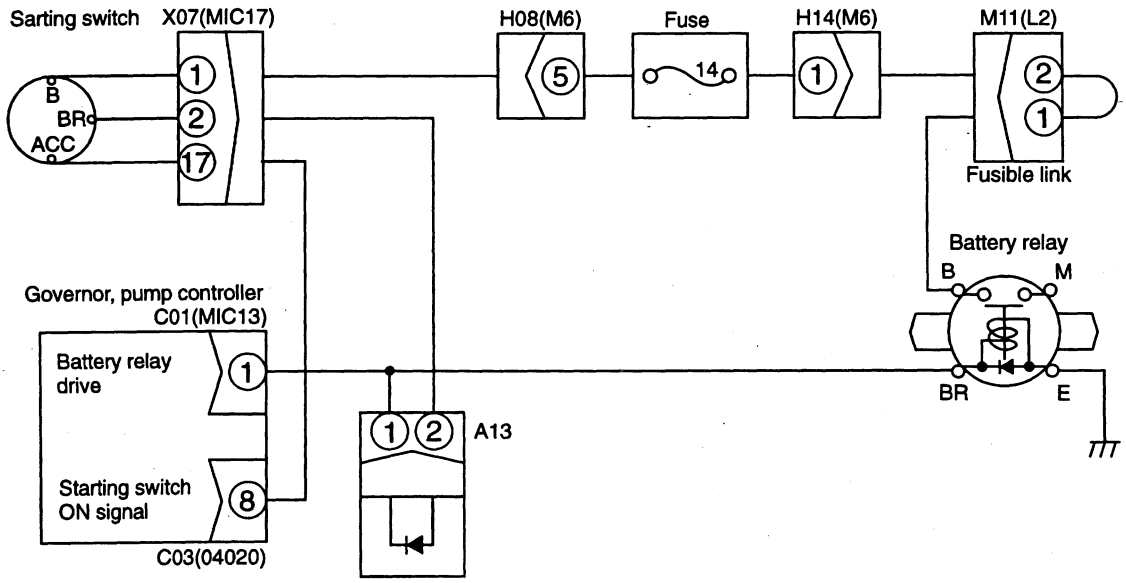
★ Always connect any disconnected connectors before going on the next step.

★ This only occurs when the engine is stopped and the starting switch is turned OFF.



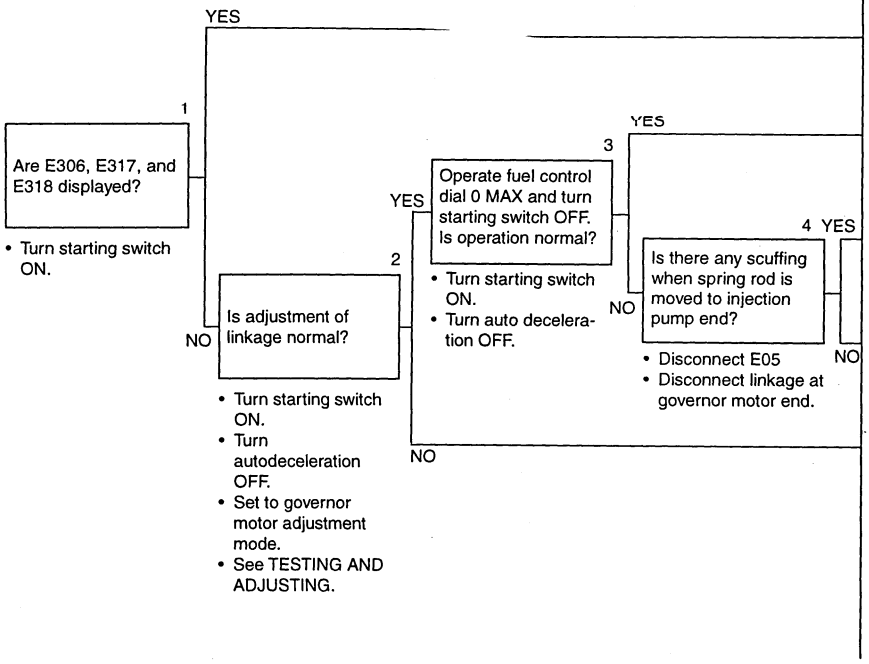
Cause	Remedy
Defective governor, pump controller	Replace
Defective battery relay	Replace
1) Contact between other wiring harness and wiring harness between C01 (female) (1)-battery relay BR. 2) When light is connected	Replace

E-6 Related electric circuit diagram



E-7 [E316] Abnormality (step-out) in motor is displayed

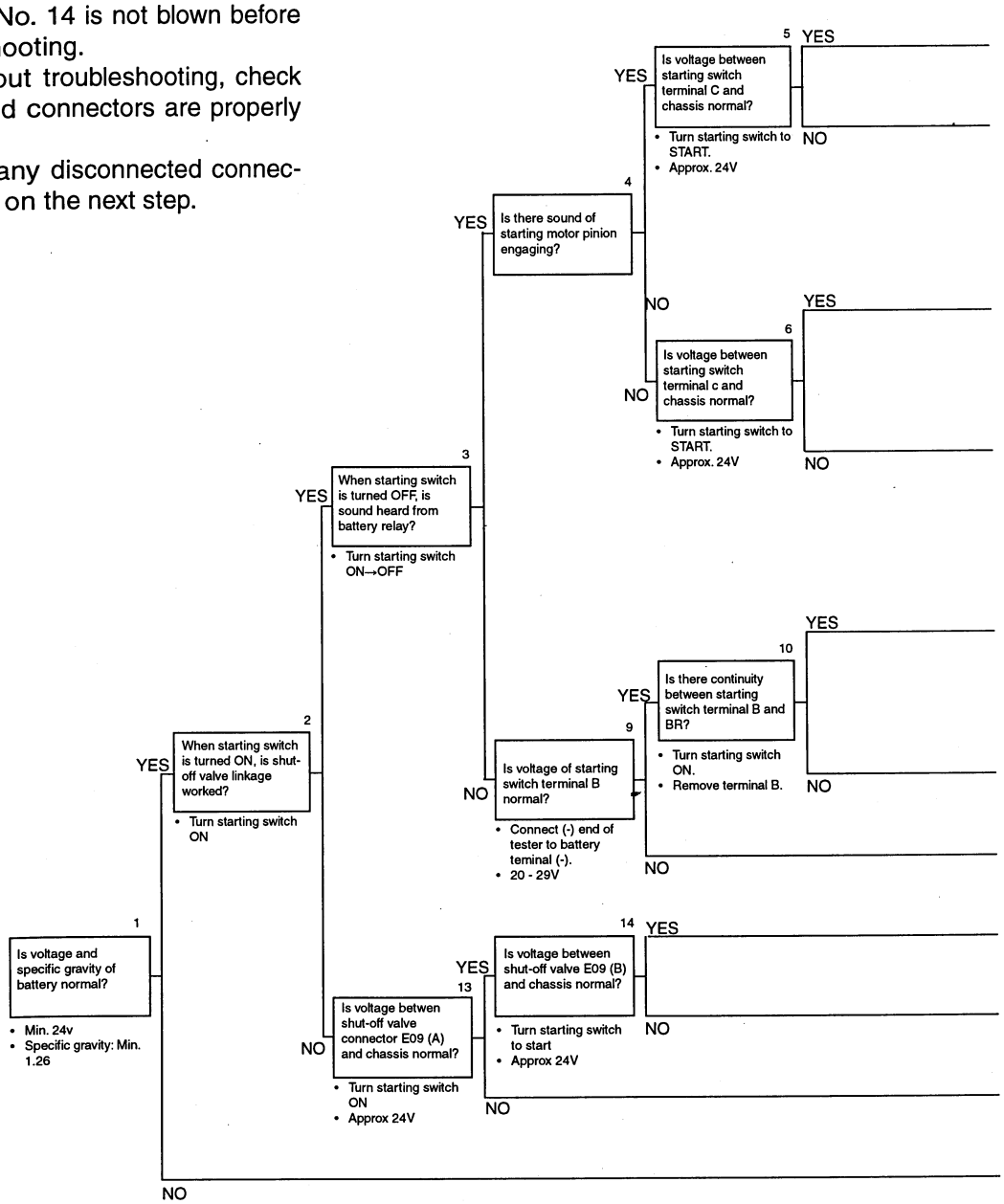
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code E is not displayed, the problem has been removed.**
★ If any other service code [E306] - [E318] has occured at the same time, start troubleshooting from the code exept code [E316].
★ Check that the fuse is normal.
★ Read the precautions given in TESTING AND ADJUSTING, "Adjusting travel of governor motor lever" before carrying out the troubleshooting.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.



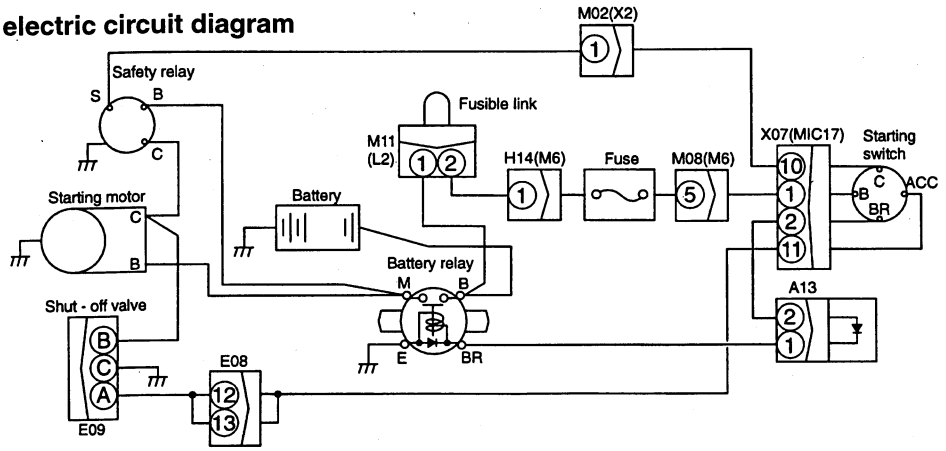
Cause	Remedy
Go to applicable failure mode	-
Defective governor, pump controller	Replace
1) Defective linkage 2) Defective injection pump	Adjust or replace
Defective governor motor	Replace
Defective governor linkage	Adjust (For details, see TESTING AND ADJUSTING)

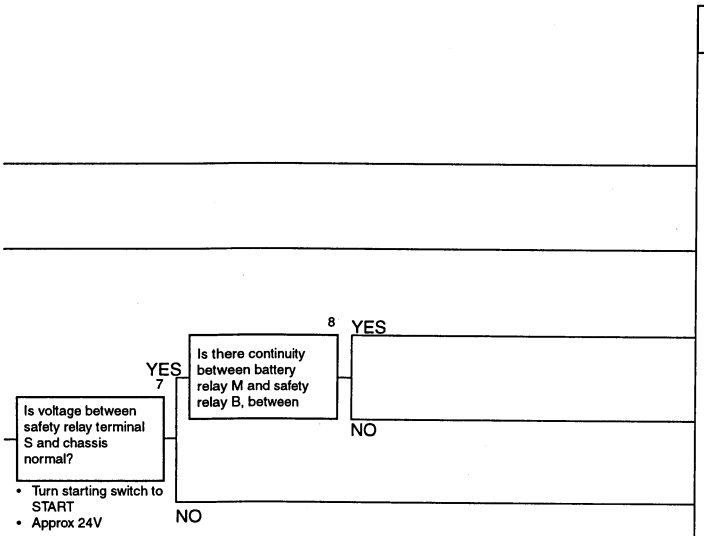
E-8 Engine does not start

★ When starting motor does not rotate.
★ Check that fuse No. 14 is not blown before starting troubleshooting.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.



E-8 Related electric circuit diagram





Cause	Remedy
Defective starting motor	Replace
Defective contact of wiring harness between battery (+)-battery relay B-battery releay M-starting motor terminal B (including battery relay)	Replace
Defective safeyt relay	Replace
Defective contact, or discon-nectionin wiring harness be-tween battery relay terminal M and safety relay terminal B, between safety relay terminal C and starting motor terminal C	Replace
Defective contact, or discon-nection in wiring harness be-tween starting switch terminal C-X07(10)-M02(1)-safety relay terminal S	Replace
Defective starting switch (between terminals B and C)	Replace
Defective battery relay	Replace
Defective contact or wiring harness between battery relay terminal E and revolving frame grond connection terminal	Replace
Defective contact, or disconnection in wiring harness between starting switch terminal BR-D13-battery relay terminal BR	Replace
Defective starting switch (between B and BR)	Replace
Defective contact, or disconnection in wiring harness between battery terminal (+)-M11-H05 (6)-X07 (1)-starting switch terminal B (including fusible link)	Replace
Defective shut-off valve	Replace
Defecitve contact, or disconnection in wiring harness between starting motor terminal C and shut-off valve E09 (B)	Replace
Defective contact, or disconnection in wiring harness between starting switch terminal ACC-X07(11)-E08 (12, 13) -shut-off vlave E09 (A).	Replace
Lack of battery capacity	Replace

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

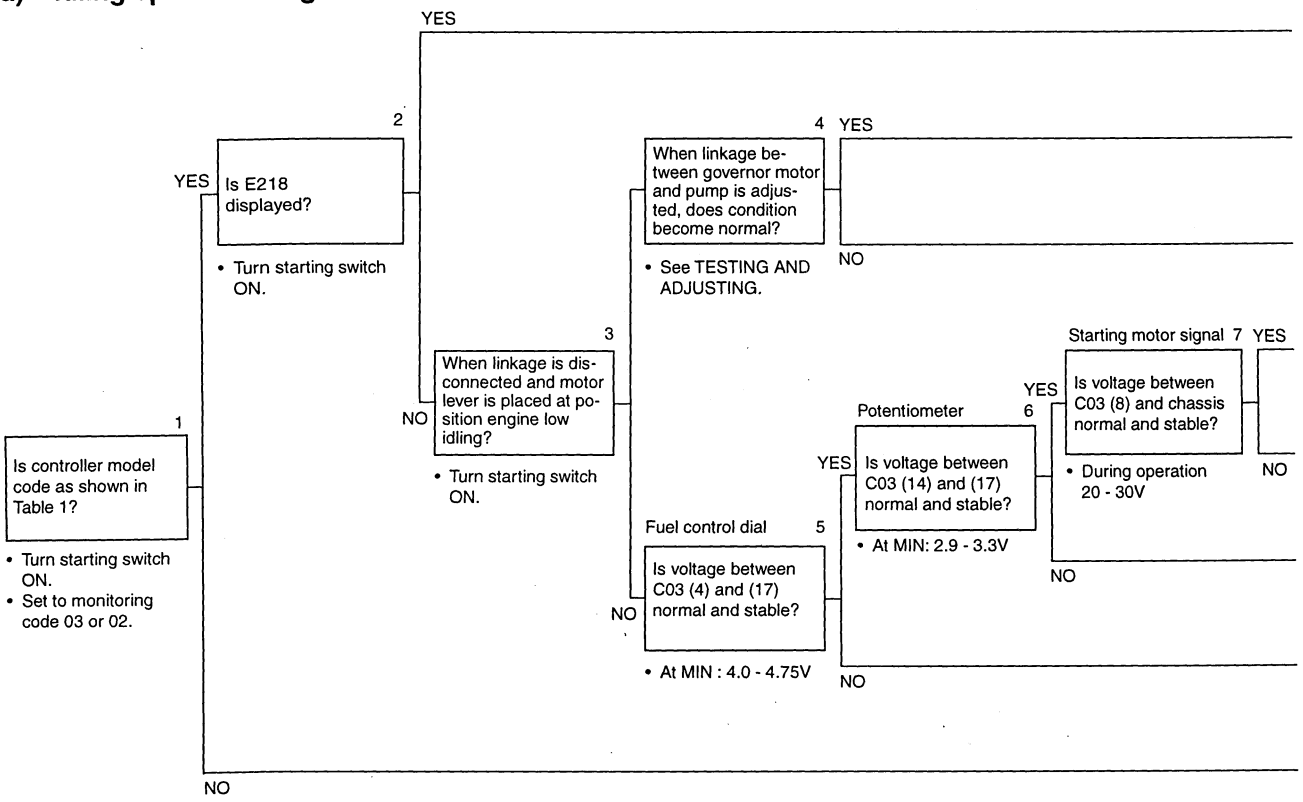


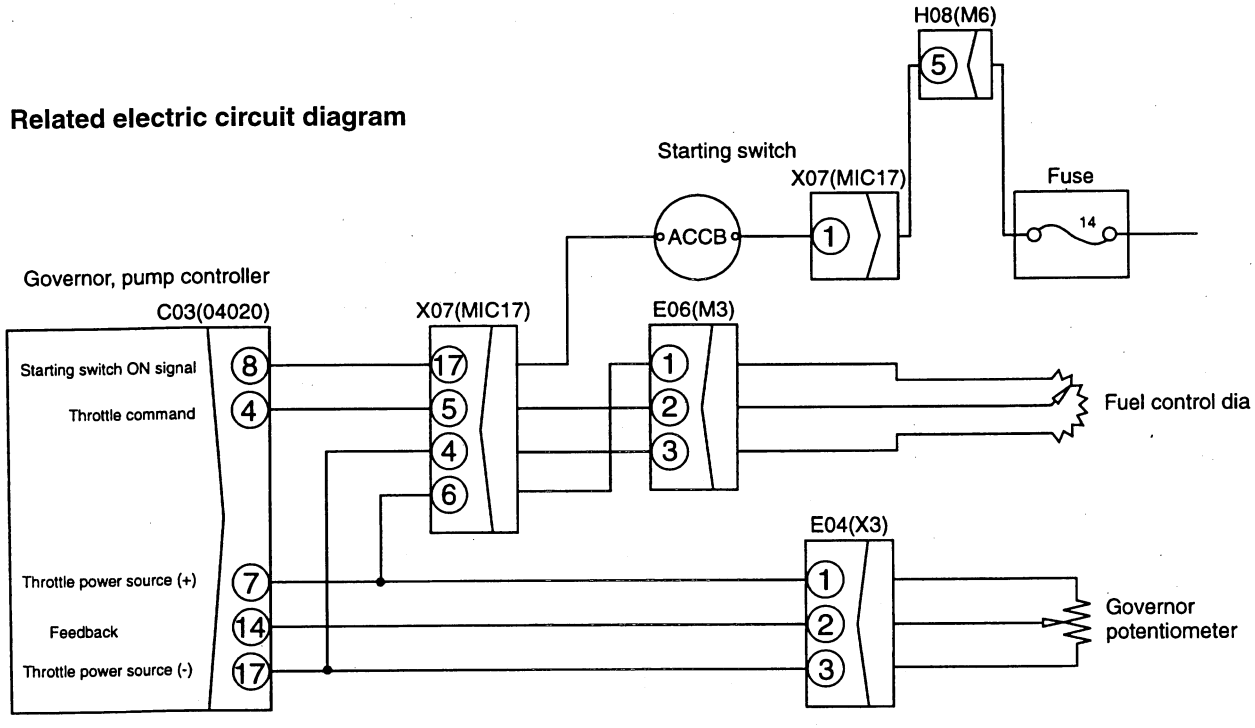
Table 1

Controller model code
03 150

★ The diagram shows monitoring code 03.

Cause	Remedy
See N mode	
Defective adjustment of linkage	Adjust
Defective injection pump	See S mode
Defective governor motor	Replace
Defective contact of wiring harness between starting switch ACC-X07 (17)-C03 (femal) (8), or defective starting switch	Repair or replace
See E-5	-
See E-2	-
See C-14	-

E-9 Related electric circuit diagram



b) There is hunting

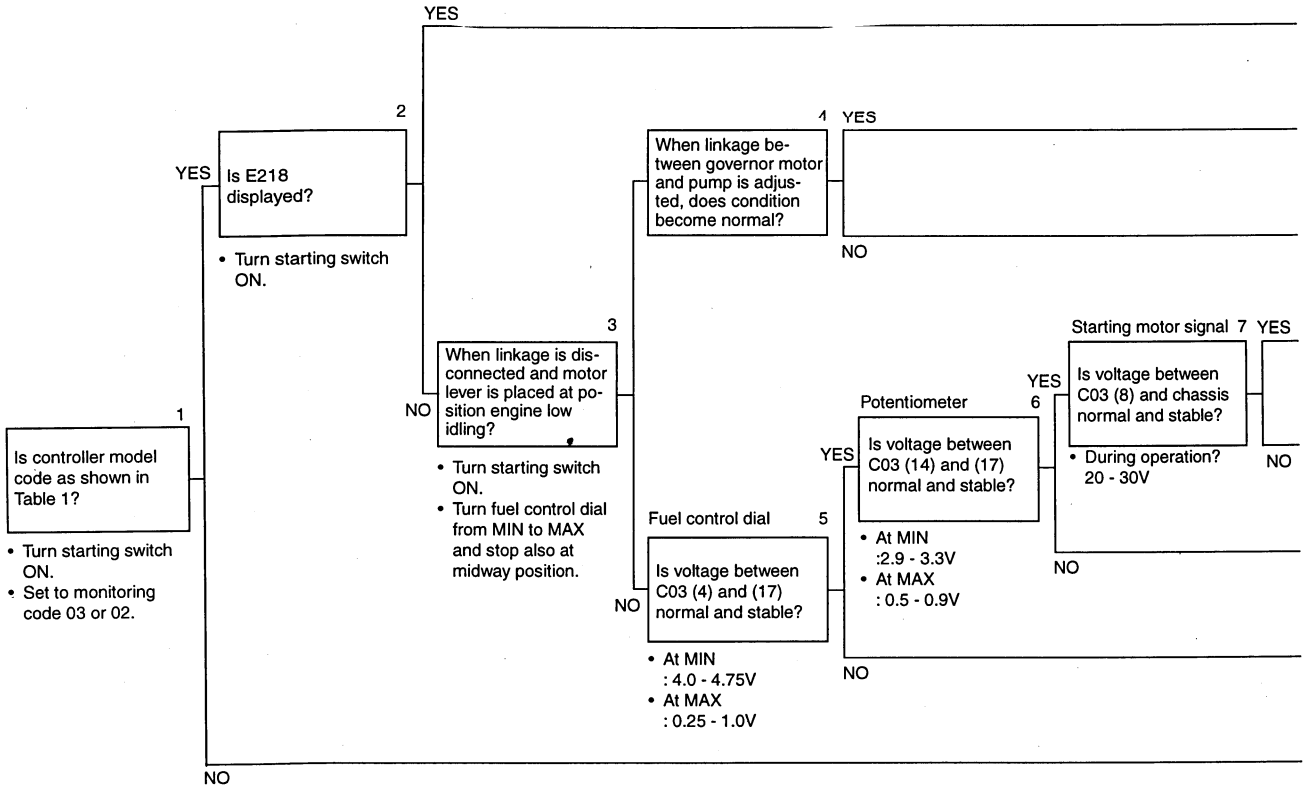


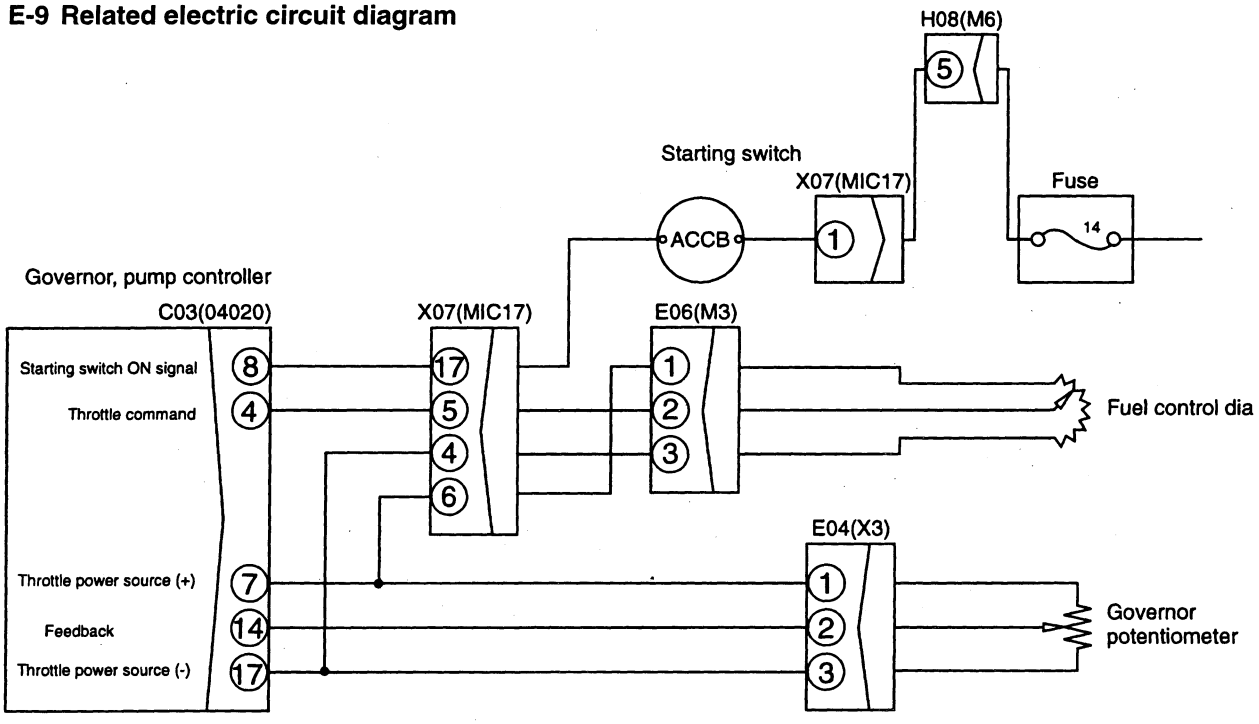
Table 1

Controller model code
03 150

★ The diagram shows monitoring code 03.

Cause	Remedy
See N mode	
Defective adjustment of linkage	Adjust
Defective injection pump	See S mode
Defective governor motor	Replace
Defective contact of wiring harness between starting switch ACC-X07 (17)-C03 (femal) (8), or defective starting switch	Repair or replace
See E-5	-
See E-2	-
See C-14	-

E-9 Related electric circuit diagram



E-10 Lack of output (engine high idling speed is too low)

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

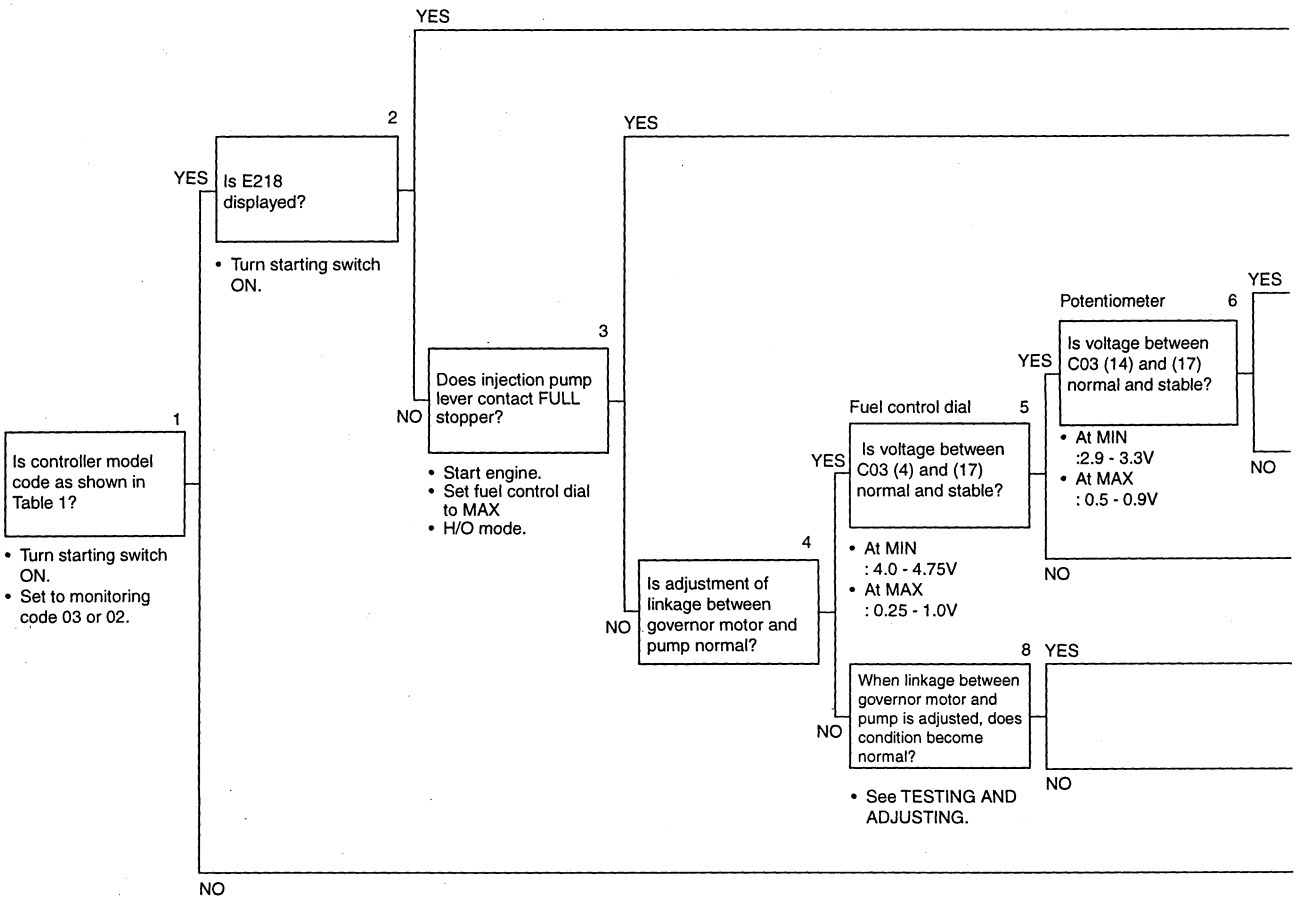


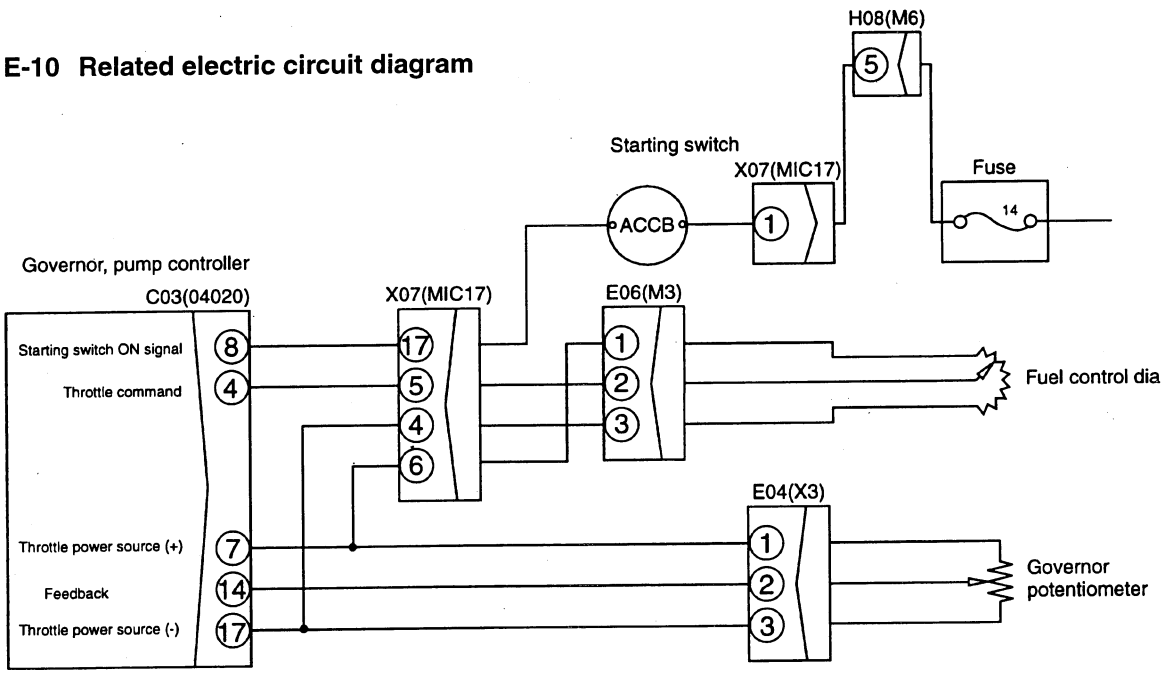
Table 1

Controller model code
03 150

★ The diagram shows monitoring code 03.

	Cause	Remedy
	See N mode	-
	Defective injection pump	See S mode
Starting motor signal 7 YES	Defective governor motor	Replace
Is voltage between C03 (8) and chassis normal and stable?	Defective contact of wiring harness between starting switch ACC - X07 (17) - C03 (female) (8), or defective starting switch	Repair or replace
• During operation? 20 - 30V NO		
	See E-5	
	See E-2	
	Defective adjustment of governor motor linkage	
	See S mode	Adjust
	See C-14	-

E-10 Related electric circuit diagram



E-11 Engine does not stop

⚠ Check with the engine stopped (push the fuel control lever of the fuel injection pump to the NO INJECTION position).

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

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

★ Read the precautions given in TESTING AND ADJUSTING, "Adjusting travel of governor motor lever" before carrying out the troubleshooting.

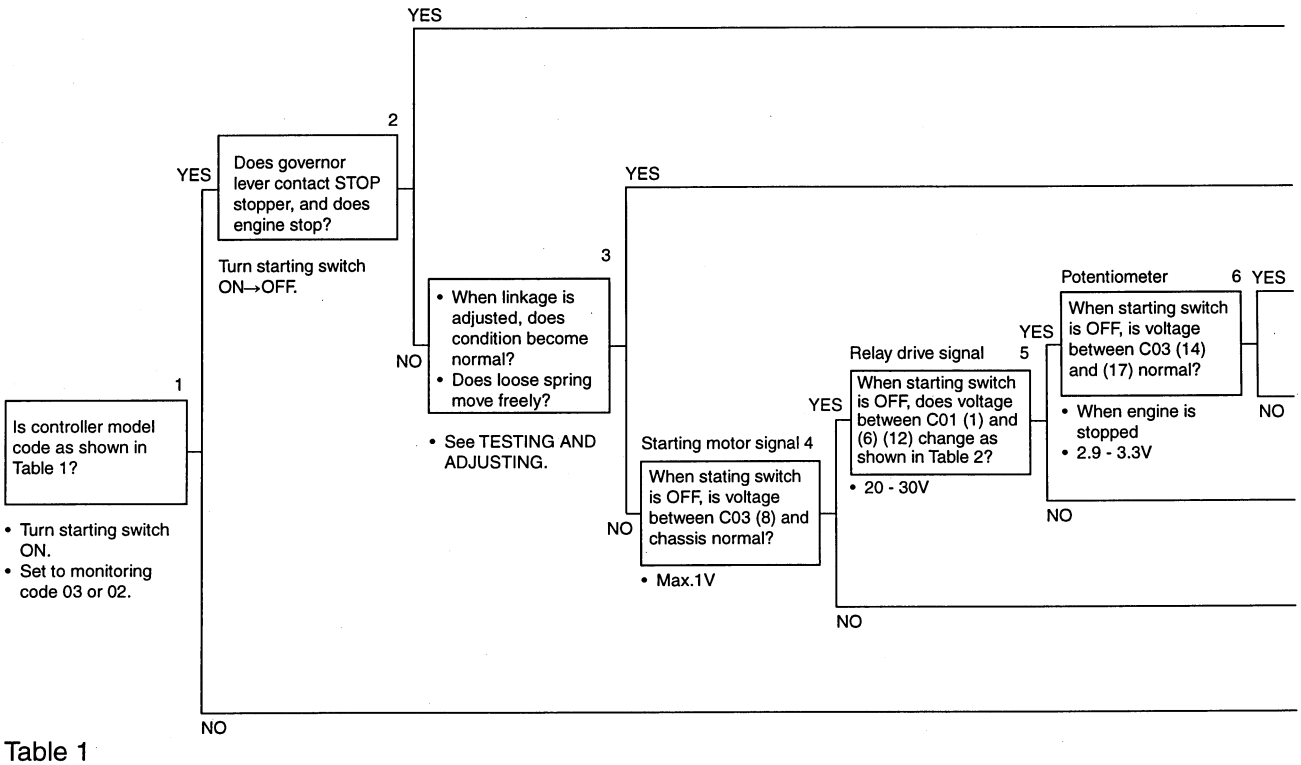
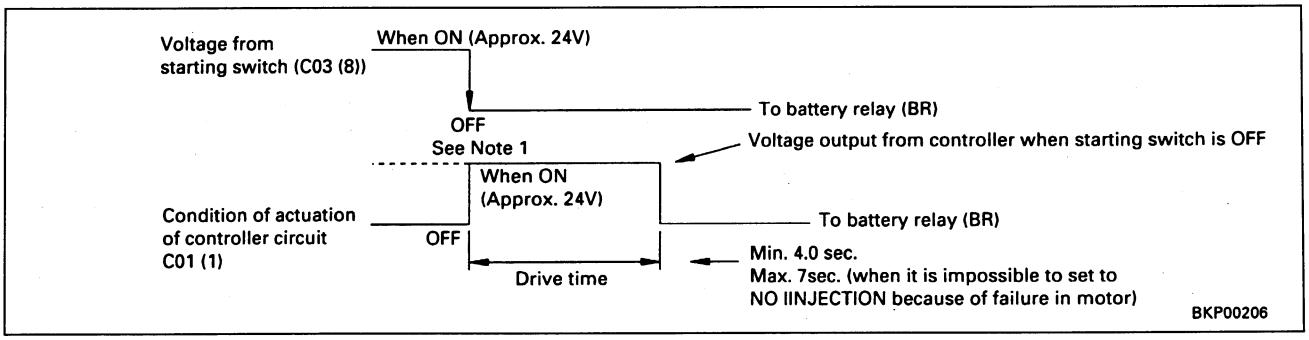


Table 1

Controller model code
03 150

★ The diagram shows monitoring code 03.

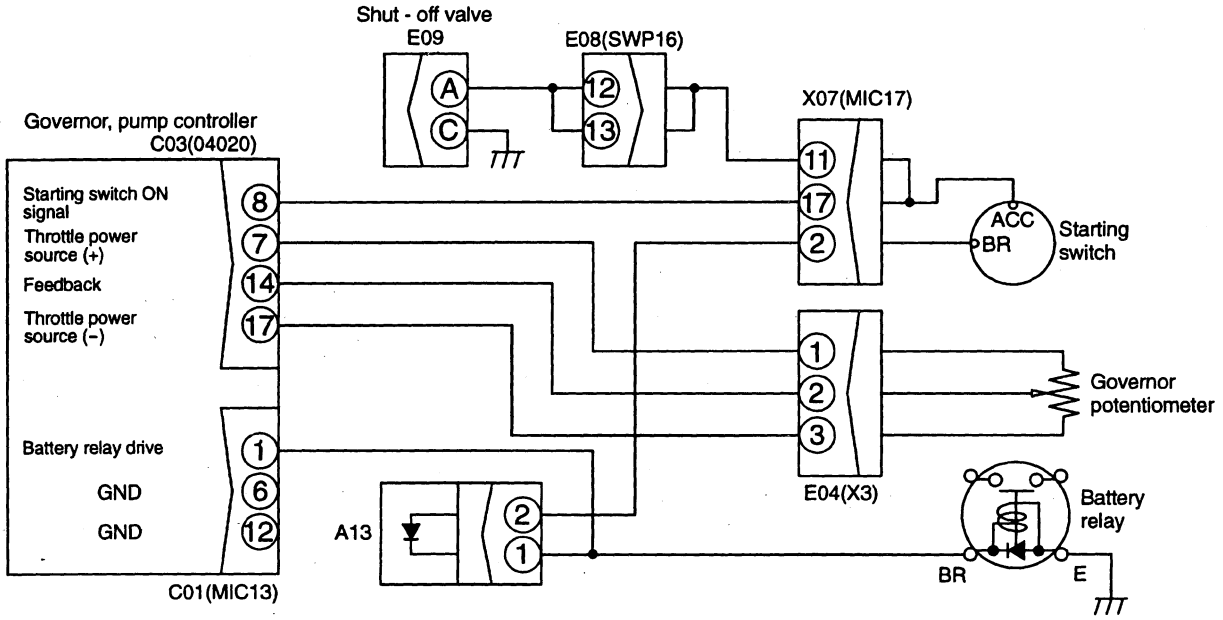
Table 2



Note 1: When the starting switch is ON, the controller end is OFF, but a voltage of approx. 20 - 30V is always flowing from starting switch BR, so if the voltage is measured at C01 (1), there is a voltage of 20 -30V

	Cause	Remedy
7 When shut-off vlave connector E09 is disconnected, does Engine stop? — YES	Defective wiring harness between starting switch Terminal ACC-X07 (11) -E08 (12, 13) -shut-off valve connecter E09 (A)	Replace
NO	Defective shut-off valve	See S mode
	Defective adjustment of linkage	Adjust
	Defective governor motor	Replace
	See E-5	-
	Defective governor, pump controller	Replace
	Contact with 24V wiring harness of wiring harness between starting switch ACC-X07 (17)- C03 (female) (8), or defective starting switch	Replace
	See C-14	-

E-11 Related electric circuit diagram



E-12 Defective operation of battery relay system (engine does not stop)

★ This only occurs when the engine is stopped and the starting switch is turned OFF.
⚠ Check with the engine stopped (push the fuel control lever of the fuel injection pump to the NO INJECTION position).
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

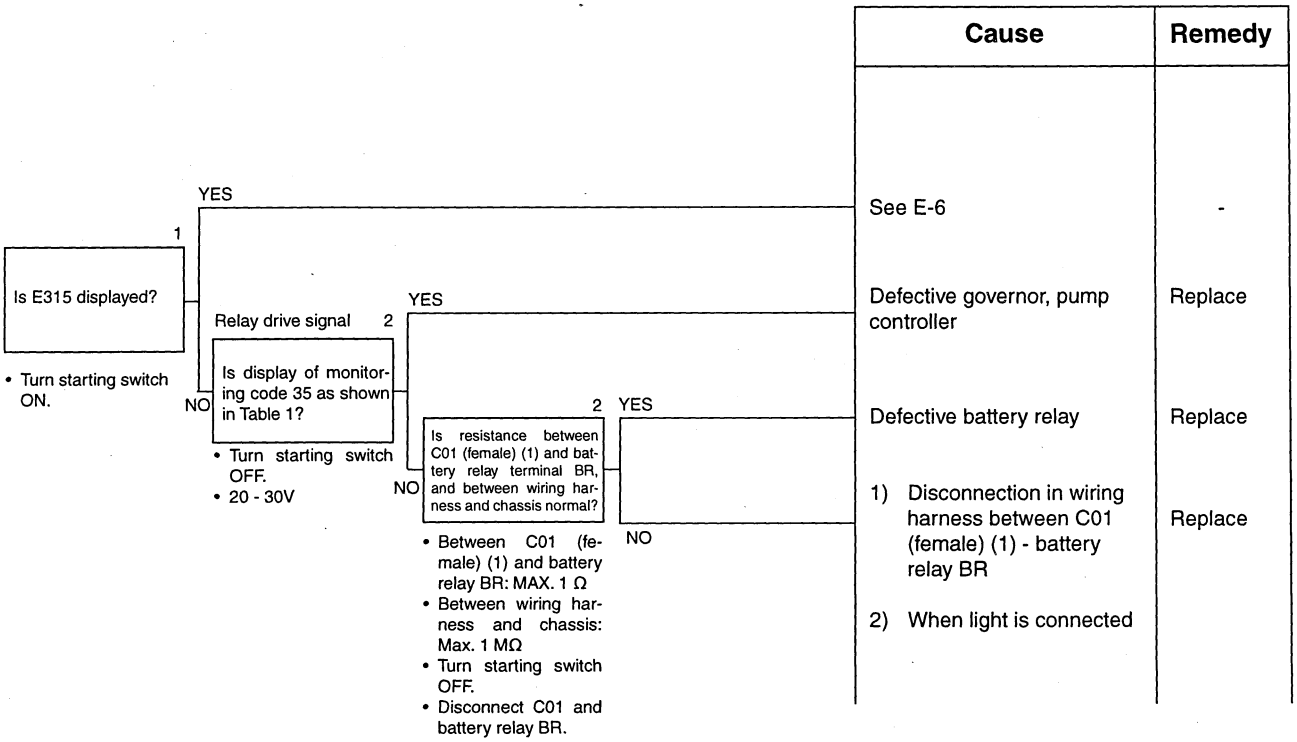
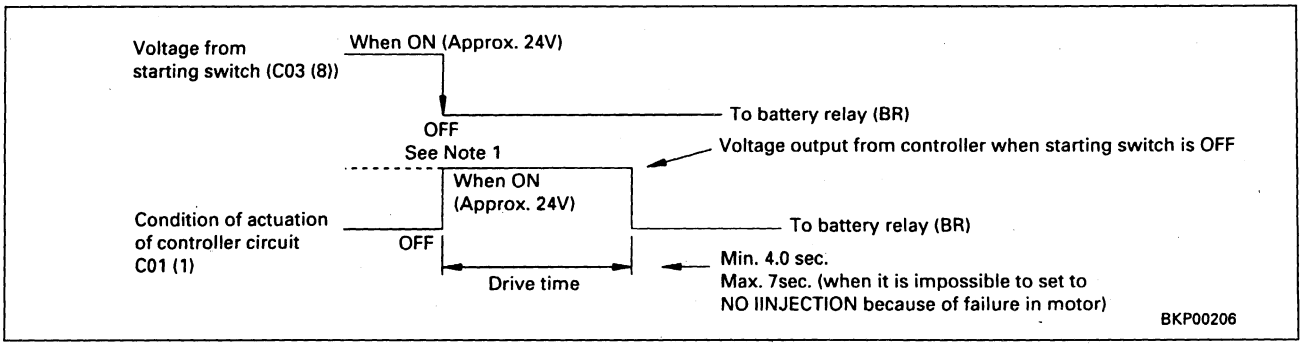


Table 1



Note 1: When the starting switch is ON, the controller end is OFF, but a voltage of approx. 20 - 30V is always from starting switch BR, so if the voltage is measured at C01 (1), there is a voltage of 20 - 30V.

TROUBLESHOOTING OF ENGINE SYSTEM (S MODE)

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.

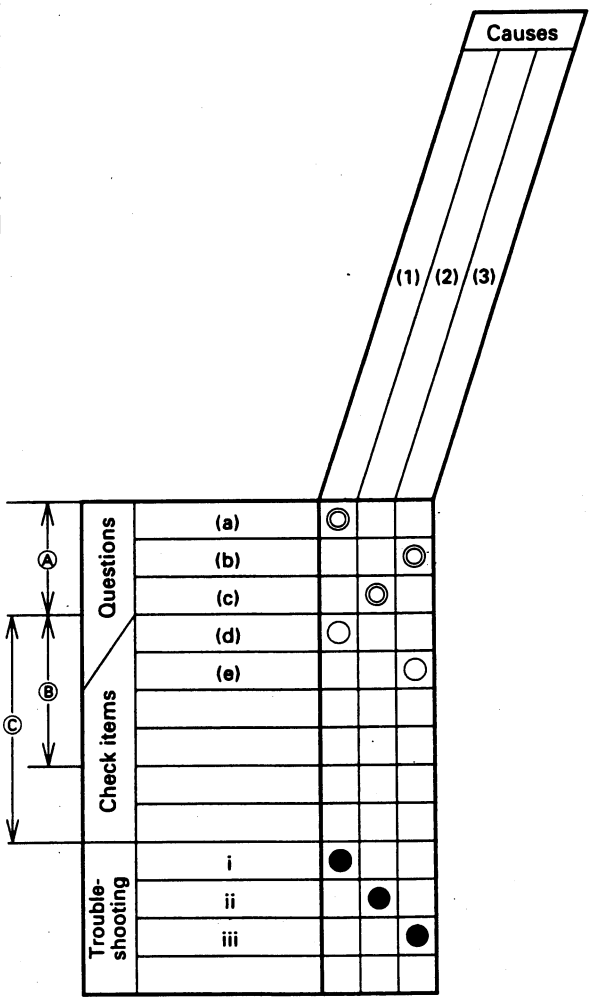
[Check items]

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]

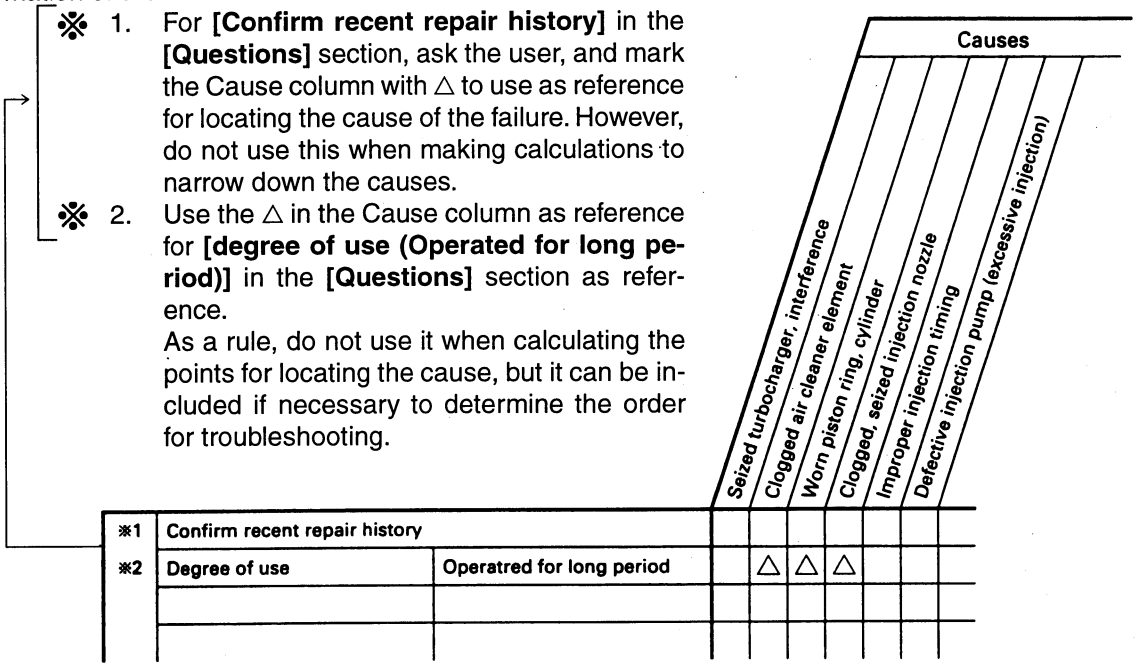
Troubleshooting is carried out in the order of probability, starting with the causes that have been marked as having the highest probability from information gained from **[Questions]** and **[Check items]**.



The basic method of using the troubleshooting chart is as follows.
Items listed for **[questions]** and **[check items]** that have a relationship with the Cause items are marked with ○, and of these, causes that thave a high probability are marked with ◎.
check each of the **[Questions]** and **[Check items]** in turn, and marked the ○ or ◎ in the chart for items where the problem appeared. The vertical column (Causes) that has the highest number of points is the most probable cause, so start troubleshooting for that item to make final confirmation of the cause.

※ 1. For **[Confirm recent repair history]** in the **[Questions]** section, ask the user, and mark the Cause column with △ to use as reference for locating the cause of the failure. However, do not use this when making calculations to narrow down the causes.

※ 2. Use the △ in the Cause column as reference for **[degree of use (Operated for long period)]** in the **[Questions]** section as reference.
As a rule, do not use it when calculating the points for locating the cause, but it can be included if necessary to determine the order for troubleshooting.

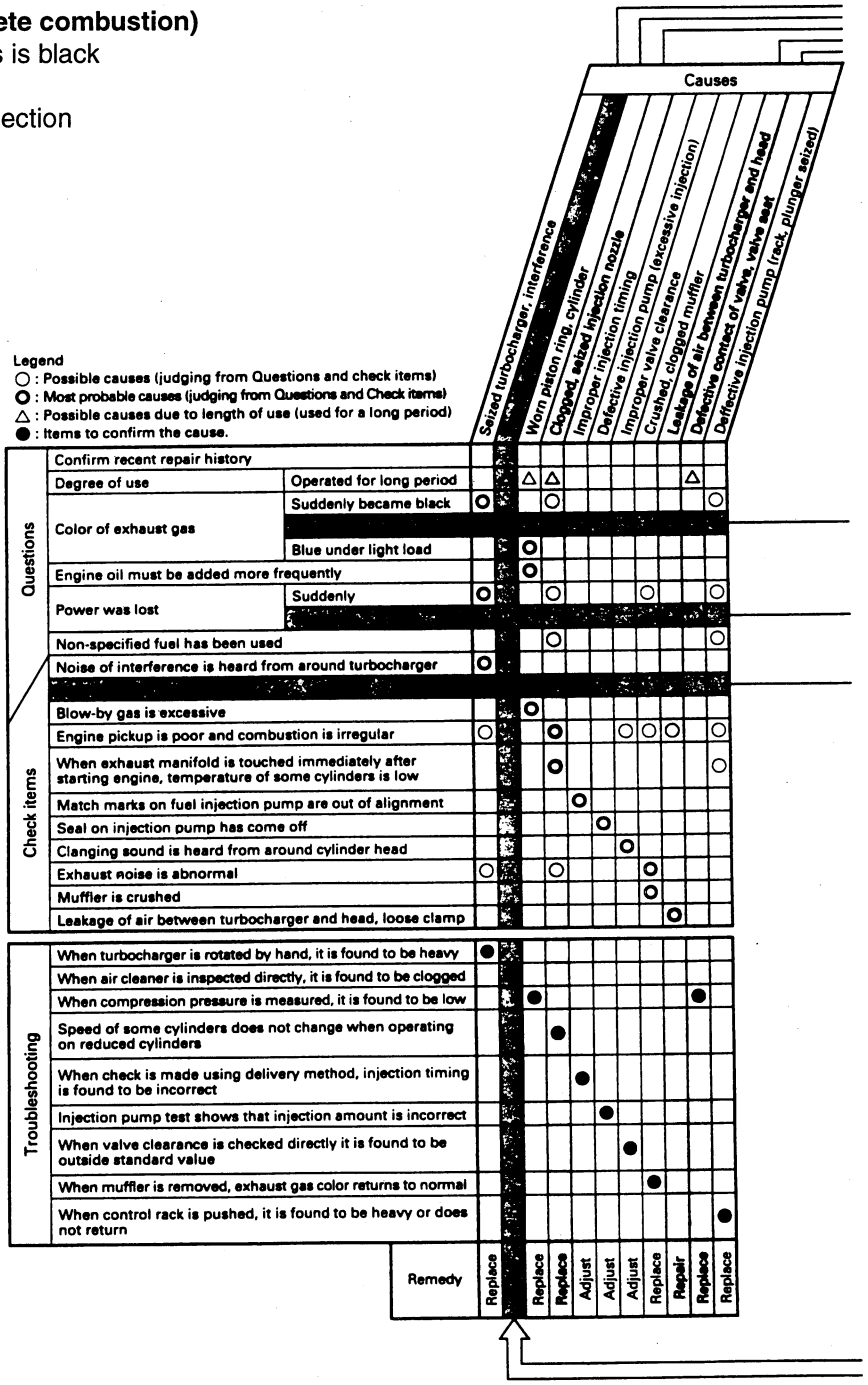


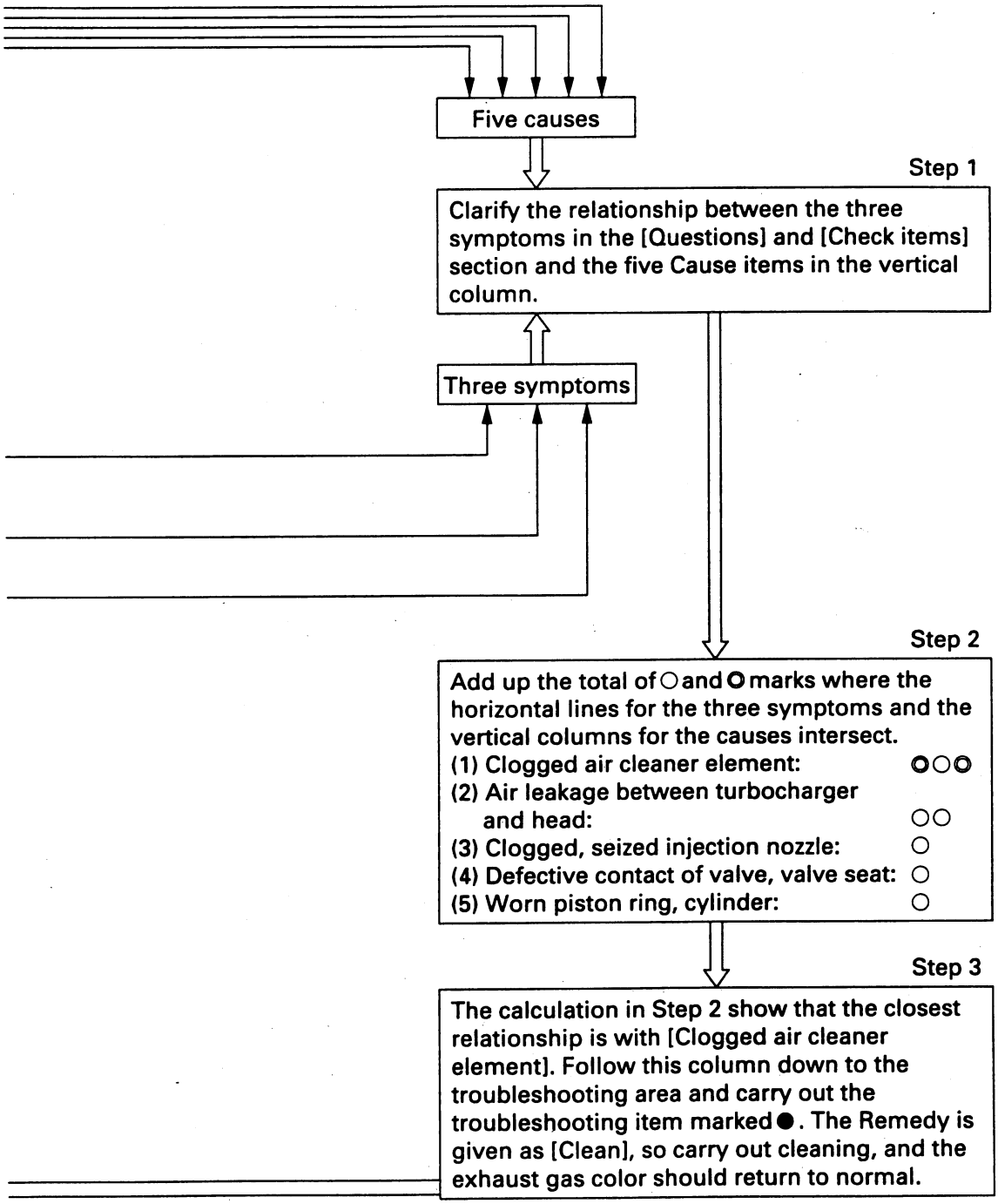
- **Example of troubleshooting when exhaust gas is black**
  Let us assume that [clogged air cleaner] is taken to be the cause of black exhaust gas. Three symptoms have causal relationship with this problem: [Exhaust gas slowly became black], [Power slowly became weaker], and [dust indicator is red].
  If we look from these three symptoms to find the causes, we find that there is a relationship with five causes. Let us explain here the method of using this causal relationship to pinpoint the most probable cause.

S-7 Exhaust gas is black (incomplete combustion)

General causes why exhaust gas is black

- Insufficient intake of air
- Improper condition of fuel injection
- Excessive injection of fuel




Five causes
Step 1
Clarify the relationship between the three symptoms in the [Questions] and [Check items] section and the five Cause items in the vertical column.
Three symptoms
Step 2
Add up the total of ○ and ◎ marks where the horizontal lines for the three symptoms and the vertical columns for the causes intersect.
(1) Clogged air cleaner element: ◎○◎
(2) Air leakage between turbocharger and head: ○○
(3) Clogged, seized injection nozzle: ○
(4) Defective contact of valve, valve seat: ○
(5) Worn piston ring, cylinder: ○
Step 3
The calculation in Step 2 show that the closest relationship is with [Clogged air cleaner element]. Follow this column down to the troubleshooting area and carry out the troubleshooting item marked ●. The Remedy is given as [Clean], so carry out cleaning, and the exhaust gas color should return to normal.

S-1 Starting performance is poor (starting always takes time)

★ Check that the monitor panel does not display any abnormality in the governor control system.
General causes why exhaust smoke comes out but engine takes time to start

- Defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- improper selection of fuel
  (At ambient temperature of 10°C or below, use ASTM D975 No. 1)

★ Battery charging rate

Charging rate / Ambient temperature	100%	90%	80%	75%	70%
20°C	1.28	1.26	1.24	1.23	1.22
0°C	1.29	1.27	1.25	1.24	1.23
-10°C	1.30	1.28	1.26	1.25	1.24

- The specific gravity should exceed the value for the charging rate of 70% in the above table.
- In cold areas the specific gravity must exceed the value for the charging rate of 75% in the above table.

Legend
○ : Possible causes (judging from Questions and check items)
O : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause

			Causes: Worn piston ring, cylinder	Defective contact of valve, valve seat	Clogged air cleaner element	Clogged fuel filter, strainer	Clogged feed pump strainer	Starting aid	Defective regulator	Electrical intake air heater	Defective alternator	Defective or deteriorated battery	Defective injection nozzle	Defective injection timing	Leakage, clogging, air in fuel piping	Clogged pump (rack, plunger stuck)	Clogged air breather hole in fuel tank cap
Questions	Confirm recent repair history																
	Degree of use of machine	Operated for long period			△	△	△			△							
	Ease of starting	Gradually became worse	O	O	○	○	○										
		Starts when warm						O		○							
	Indicator lamp does not light up							O									
	Engine oil must be added more frequently		O														
	Replacement of filters has not been carried out according to Operation Manual				O	O	O					○		○			
	Air cleaner clogging caution lamp flashes				O												
	Non-specified fuel is being used					○	○					○		○			
	Battery charge lamp is ON								O	O							
	Starting motor cranks engine slowly										○						
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low											O					
	Engine does not pick up smoothly, and combustion is irregular		○	○								O					
	Blow-by gas is excessive		O														
	Match marks on fuel injection pump are out of alignment												O				
	Mud is stuck to fuel tank cap																○
	When engine is cranked with starting motor, 1) Little fuel comes out even when injection pump sleeve nut is loosened													O			
	2) Little fuel comes out even when fuel filter air bleed plug is loosened				O	O								O			
	Leakage from fuel piping														○	O	
	There is hunting from engine (rotation is irregular)				○	○									O	○	
Troubleshooting	When compression pressure is measured, it is found to be low		●	●													
	When air cleaner element is inspected directly, it is found to be clogged				●												
	When fuel filter, strainer are inspected directly, they are found to be clogged				●											●	
	When feed pump strainer is inspected directly, it is found to be clogged					●											
	Heater mount does not become warm						●										
	Is voltage 26 – 30V between alternator terminal R and terminal E with engine at low idling?	Yes ※						●									
		No							●								
	Either specific gravity of electrolyte or voltage of battery is low									●							
	Speed does not change when operation of certain cylinders is stopped										●						
	When check is made using delivery method, injection timing is found to be incorrect											●					
	When control rack is pushed, it is found to be heavy or does not return (when blind cover at rear of pump is removed, it can be seen that plunger control sleeve does not move)													●			
	When fuel cap is inspected directly, it is found to be clogged																●
	Remedy		Replace	Correct	Clean	Clean	Clean	Replace	Replace	Replace	Replace	Replace	Adjust	Replace	Correct	Clean	

※ It is not permitted to replace only the regulator.

S-2 Engine does not start

(1) Engine does not turn

General causes why engine does not turn
- Internal parts of engine seized
  - ★ If internal parts of the engine are seized, carry out troubleshooting for "Engine stops during operations".
- Defective electrical system

Legend
◯: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

			Causes: Defective wiring of starting circuit	Defective or deteriorated battery	Defective starting motor	Broken ring gear	Defective safety relay or safety switch	Defective battery relay	Defective battery terminal connection	Defective starting switch
Questions	Confirm recent repair history									
	Degree of use of machine	Operated for long period		△		△				
	Condition of horn when starting switch is turned ON	Horn sounds	◎						◯	◯
		Horn does not sound or volume is low		◎						
Check items	When starting switch is turned to START, pinion moves out, but	Makes grating noise			◎	◎				
		Soon disengages again					◎			
		Makes rattling noise and does not turn	◎							
	When starting switch is turned to START, pinion does not move out									
	When starting switch is turned to ON, there is no clicking sound							◎		
	Battery terminal is loose								◎	
	When battery is checked, battery electrolyte is found to be low			◎						
Troubleshooting of electrical system	Specific gravity of electrolyte, voltage of battery is low			●						
	For the following conditions 1) - 5), turn the starting switch OFF, connect the cord, and carry out troubleshooting at ON									●
	1) When terminal B and terminal C of starting switch are connected, engine starts									
	2) When terminal B and terminal C of starting motor are connected, engine starts				●					
	3) When terminal B and terminal C of safety relay are connected, engine starts						●			
	4) When terminal of safety switch and terminal B of starting motor are connected, engine starts						●			
	5) There is no 24V between battery relay terminal M and terminal E							●		
	When ring gear is inspected directly, tooth surface is found to be chipped						●			
	Remedy		—	Replace	Replace	Replace	Replace	Replace	Replace	Replace

(2) Engine turns but no exhaust smoke comes out (fuel is not being injected)

★ check that the monitor panel does not display any abnormality in the governor contol system.

General causes why engine turns but no exhaust smoke comes out

- Supply of fuel impossible
- Supply of fuel is extremely small
- Improper selection of fuel (particularly in winter)

★ Standard for use of fuel

Type of fuel	Ambient temperature
	-22 -4 14 32 50 68 86 104°F
	-30 -20 -10 0 10 20 30 40°C
Diesel fuel	ASTM D975 No.2
	ASTM D975 No.1

Legend
◯: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

		Causes: Broken injection pump drive shaft, key	Defective injection pump (rack, plunger seized)	Seized, broken feed pump piston	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged, leaking fuel piping	Clogged air breather hole in fuel tank cap	Improper fuel used
Questions	Confirm recent repair history								
	Degree of use of machine — Operated for long period				△	△		△	
	Exhaust smoke suddenly stops coming out (when starting again)	◎	◎	◎					
	Replacement of filters has not been carried out according to Operation Manual				◎	◎			
	There is leakage from fuel piping						◎		
	Mud is stuck to fuel tank cap							◎	
	When fuel filter is drained, fuel does not come out								◎
Check items	When engine is cranked with starting motor, 1) Injection pump coupling does not turn	◎							
	2) No fuel comes out even when fuel filter air bleed plug is loosened	◎			◯	◯			◯
	3) No fuel spurts out even when injection pipe sleeve nut is loosened	◎	◎	◎					
	Rust and water are found when fuel tank is drained				◯	◯			
Troubleshooting	Inspect injection pump directly	●							
	When control rack is pushed, it is found to be heavy, or does not return		●						
	Inspect feed pump directly			●					
	When fuel filter, strainer are inspected directly, they are found to be clogged				●				●
	When feed pump strainer is inspected directly, it is found to be clogged					●			
	When fuel cap is inspected directly, it is found to be clogged							●	
	Remedy	Replace	Replace	Replace	Clean	Clean	Correct	Correct	Replace

(3) Exhaust smoke comes out but engine does not start (Fuel is being injected)

★ General causes why exhaust smoke comes out but engine does not start
- Lack of rotating force due to defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel and oil

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

		Causes												
		Defective, broken valve system (valve, rocker lever, etc.)	Defective injection pump (rack, plunger stuck)	Worn piston ring, cylinder liner	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged air cleaner element	Electrical intake air heater	Defective or deteriorated battery (Starting aid)	Leakage, clogging, air in fuel system	Clogged injection nozzle, defective spray	Clogged air breather hole in fuel tank cap	Improper fuel used
Questions	Confirm recent repair history												
	Degree of use of machine: Operated for long period			△	△	△				△			
	Suddenly failed to start	◎	◎										
	When engine is cranked, abnormal noise is heard from around head	◎											
	Engine oil must be added more frequently			○									
	Non-specified fuel is being used		○							○			
	Replacement of filters has not been carried out according to Operation Manual				○	○	○						
	Rust and water are found when fuel tank is drained						○						
	Air cleaner clogging caution lamp flashes				○	○							
	Preheating indicator lamp does not light up							○					
	Starting motor cranks engine slowly								◎				
	Mud is stuck to fuel tank cap											○	
Check items	When fuel lever is placed at FULL position, it does not contact stopper		○										
	When engine is cranked with starting motor, 1) Little fuel comes out even when injection pump sleeve nut is loosened		◎										
	2) No fuel comes out even when fuel filter air bleed plug is loosened				○	○							○
	There is leakage from fuel piping								○				
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low									○			
	When fuel filter is drained, no fuel comes out												○
Troubleshooting	Remove head cover and check directly	●											
	When control rack is pushed, it is found to be heavy, or does not return		●										
	When compression pressure is measured, it is found to be low			●									
	When fuel filter, strainer are inspected directly, they are found to be clogged				●								●
	When feed pump strainer is inspected directly, it is found to be clogged					●							
	When air cleaner element is inspected directly, it is found to be clogged						●						
	Heater mount does not become warm							●					
	Either specific gravity of electrolyte or voltage of battery is low								●				
	When feed pump is operated, operation is too light or too heavy									●			
	When injection nozzle is tested as individual part, spray condition is found to be poor										●		
	When fuel cap is inspected directly, it is found to be clogged											●	
	Remedy	Replace	Replace	Replace	Clean	Clean	Clean	Replace	Replace	Correct	Clean	Clean	Replace

S-3 Engine does not pick up smoothly (follow-up is poor)

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

General causes why engine does not pick up smoothly

- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Improper fuel used

Legend
◯: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

			Causes: Clogged air cleaner element	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged injection nozzle, defective spray	Seized injection pump plunger	Worn piston ring, cylinder liner	Seized turbocharger, interference	Improper valve clearance	Clogged air breather hole in fuel tank cap	Clogged, leaking fuel piping	Defective contact of valve and valve seat
Questions	Confirm recent repair history												
	Degree of use of machine	Operated for long period	△	△	△			△					△
	Replacement of filters has not been carried out according to Operation Manual		◎	◎	◎								
	Non-specified fuel is being used			◎	◎	◎	◎						
	Engine oil must be added more frequently							◎					
Check items	Rust and water are found when fuel tank is drained		◎										
	Air cleaner clogging caution lamp flashes			◎	◎								
	Noise of interference is heard from around turbocharger								◎				
	Engine pick-up suddenly became poor					◯			◎		◯	◯	
	Color of exhaust gas	Blue under light load						◎					
		Black	◎			◎			◎				◯
	Clanging sound is heard from around cylinder head									◎			
	Mud is stuck to fuel tank cap										◎		
	There is leakage from fuel piping											◎	
	High idling speed under no load is normal, but speed suddenly drops when load is applied			◎	◎						◯		
	There is hunting from engine (rotation is irregular)			◯	◎	◯					◯		
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎	◯						
	20. Blow-by gas is excessive						◎						
Troubleshooting	When air cleaner element is inspected directly, it is found to be clogged		●										
	When fuel filter, strainer are inspected directly, they are found to be clogged			●									
	When feed pump strainer is inspected directly, it is found to be clogged				●								
	Speed does not change when operation of certain cylinders is stopped					●							
	When control rack is pushed, it is found to be heavy, or does not return						●						
	When compression pressure is measured, it is found to be low							●					●
	When turbocharger is rotated by hand, it is found to be heavy								●				
	When valve clearance is checked directly, it is found to be outside standard value									●			
	When fuel cap is inspected directly, it is found to be clogged										●		
	When feed pump is operated, operation is too light or too heavy											●	
		Remedy	Clean	Clean	Clean	Correct	Replace	Replace	Replace	Adjust	Clean	Correct	Replace

S-4 Engine stops during operations

★ Check that the monitor panel fuel level display shows that there is still fuel remaining.

General causes why engine stops during operations

- Seized parts inside engine
- Insufficient supply of fuel
- Overheating

★ If there is overheating and the engine stops, carry out troubleshooting for overheating.

- Failure in main piston pump

★ If the engine stops because of a failure in the main piston pump, carry out troubleshooting for the hydraulic system (H MODE).

Legend
◯ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes: Broken, seized piston, connecting rod	Broken, seized crankshaft bearing	Broken valve system (valve, rocker lever, etc.)	Broken, seized gear train	Broken fuel pump drive shaft, key	Clogged fuel filter, strainer	Clogged feed pump strainer	Broken, seized feed pump piston	Clogged, leaking fuel piping	Clogged air breather hole in fuel tank cap	Defective injection pump (rack, plunger stuck)	Failure in main pump	
Questions	Confirm recent repair history														
	Degree of use of machine	Operated for long period						△	△						
	Condition when engine stopped	Abnormal noise was heard and engine stopped suddenly	◎	◎	◎	◎	◎			◯			◯	◎	
		Engine stopped slowly	◎	◯											
		There was hunting and engine stopped						◯	◯						
		Engine overheated and stopped						◯	◯			◯			
	Replacement of filters has not been carried out according to Operation Manual							◎	◎						
	Non-specified fuel is being used							◯	◯	◯			◯		
	When feed pump is operated, operation is too light or too heavy							◯	◯	◎	◯				
	Mud is stuck to fuel tank cap											◎			
	Try to turn by hand using barring tool	Does not turn at all	◎	◎											See troubleshooting of hydraulic, mechanical system (H mode)
		Turns in opposite direction			◎										
		Moves amount of backlash				◎									
	Rust and water are found when fuel tank is drained						◎	◎							
	Metal particles are found when oil is drained		◎	◎				◯	◯						
Troubleshooting	When oil pan is removed and inspection is made directly, it is found to be abnormal		●	●											
	When head cover is removed and inspection is made directly, it is found to be abnormal				●										
	When gear train is inspected, it does not turn					●									
	When fuel filter, strainer are inspected directly, they are found to be clogged							●							
	When feed pump strainer is inspected directly, it is found to be clogged								●						
	Inspect feed pump directly									●					
	When control rack is pushed, it is found to be heavy, or does not return												●		
	Remedy		Replace	Replace	Replace	Replace	Replace	Clean	Clean	Replace	Correct	Clean	Replace	—	

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).

Legend
○: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

			Causes: Defective operation of governor	Defective adjustment of governor	Defective operation of control rack	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	Clogged air breather hole in fuel tank cap
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						◎	◎			
Check items	Rust, water are found when fuel tank is drained						○	○			
	Leakage from fuel piping								◎	◎	
	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

S-6 Engine lacks output (no power)

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

Measure the engine speed and judge if the cause is in the engine or in the chassis.

General causes why engine lacks output

- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Improper fuel used (if non-specified fuel is used, output drops0
- Lack of output due to overheating

★ If there is overheating and insufficient output, carry out troubleshooting for overheating.

Legend
○ : Possible causes (judging from Questions and check items)
O : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes: Clogged air cleaner element	Seized turbocharger, interference	Worn piston ring, cylinder liner	Clogged fuel filter, strainer	Clogged feed pump strainer	Seized injection nozzle, defective spray	Improper injection pump plunger	Defective valve clearance	Bent fuel control linkage, defective adjustment	Clogged, leaking fuel piping	Clogged air breather hole in fuel tank cap	Overheating
Questions	Confirm recent repair history													
	Degree of use of machine	Operated for long period	△		△	△	△			△				
	Power was lost	Suddenly		O										O
		Gradually	○		○	○	○	○		○				
	Engine oil must be added more frequently				O									
	Replacement of filters has not been carried out according to Operation Manual		O			O	O							
	Non-specified fuel is being used					O	O	O	O					
Check items	Air cleaner clogging caution lamp flashes		O											
	Color of exhaust gas	Black	O	O										
		Blue under light load			O									
	Noise of interference is heard from around turbocharger			O										
	Blow-by gas is excessive				O									
	Engine pickup is poor and combustion is irregular			O				O				○	○	
	High idling speed under no load is normal, but speed suddenly drops when load is applied					O	O						○	
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low							O	○					
	There is hunting from engine (rotation is irregular)					○	○					○	○	
	Clanging sound is heard from around cylinder head									O				
	High idling speed of engine is low							○			O			
	Leakage from fuel piping											O		
	Water temperature gauge is in red range													O
Troubleshooting	When air cleaner element is inspected directly, it is found to be clogged		●											
	When turbocharger is rotated by hand, it is found to be heavy			●										
	When compression pressure is measured, it is found to be low				●					●				
	When fuel filter, strainer are inspected directly, they are found to be clogged					●								
	When feed pump strainer is inspected directly, it is found to be clogged						●							
	Speed does not change when operation of certain cylinders is stopped							●						
	When control rack is pushed, it is found to be heavy, or does not return								●					
	When valve clearance is checked directly, it is found to be outside standard value									●				
	When lever is placed at FULL position, it does not contact stopper										●			
	When feed pump is operated, operation is too light or too heavy											●		
	When fuel cap is inspected directly, it is found to be clogged												●	
		Carry out troubleshooting for overheating												—
		Remedy	Clean	Replace	Replace	Clean	Clean	Correct	Replace	Adjust	Replace	Adjust	Correct	Clean	—

S-7 Exhaust smoke is black (incomplete combustion)

General causes why exhaust smoke is black
- Insufficient intake of air
- Improper condition of fuel injection
- Excessive injection of fuel

Legend
◯: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

			Causes: Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder liner	Clogged injection nozzle, defective spray	Improper injection timing	Defective injection pump (excessive injection)	Improper valve clearance	Crushed, clogged muffler	Leakage of air between turbocharger and head	Defective contact of valve and valve seat	Defective injection pump (rack, plunger seized)
Questions	Confirm recent repair history												
	Degree of use of machine	Operated for long period		△	△	△						△	
	Color of exhaust gas	Suddenly became black	◎										◯
		Gradually became black	◎	◎						◯			
		Blue under light load			◎								
	Engine oil must be added more frequently				◎								
	Power was lost	Suddenly	◎			◯				◯			◯
		Gradually		◯	◯						◯	◯	
	Non-specified fuel is being used					◯							◯
	Noise of interference is heard from around turbocharger		◎										
Check items	Air cleaner clogging caution lamp flashes			◎									
	Blow-by gas is excessive				◎								
	Engine pickup is poor and combustion is irregular		◯			◎			◯	◯	◯		◯
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎							◯
	Match marks on fuel injection pump are out of alignment						◎						
	Seal on injection pump has come off							◎					
	Clanging sound is heard from around cylinder head								◎				
	Exhaust noise is abnormal		◯			◯				◎			
	Muffler is crushed									◎			
	Leakage of air between turbocharger and head, loose clamp										◎		
Troubleshooting	When turbocharger is rotated by hand, it is found to be heavy		●										
	When air cleaner is inspected directly, it is found to be clogged			●									
	When compression pressure is measured, it is found to be low				●							●	
	Speed does not change when operation of certain cylinders is stopped					●							
	When check is made using delivery method, injection timing is found to be incorrect						●						
	Injection pump test shows that injection amount is incorrect							●					
	When valve clearance is checked directly it is found to be outside standard value								●				
	When muffler is removed, exhaust color returns to normal									●			
	When control rack is pushed, it is found to be heavy, or does not return												●
		Remedy	Replace	Clean	Replace	Replace	Adjust	Adjust	Adjust	Replace	Correct	Replace	Replace

S-8 Oil consumption is excessive (or exhaust smoke is blue)

★ Do not run the engine at idling for more than 20 minutes continuously. (Both low and high idling)

General causes why oil consumption is escessive

- Abnormal combustion of oil
- Eternal leakage of oil
- Wear of lubrecation system

Legend
◯: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

			Causes												
			Broken piston ring	Worn piston ring, cylinder liner	Clogged breather or breather hose	Leakage from oil filter or oil cooler	Leakage from oil piping	Leakage from oil drain plug	Leakage from oil pan or cylinder head	Broken oil cooler	Turbocharger: Worn seal at turbine end	Turbocharger: Worn seal at blower end	Turbocharger: Worn, broken rear seal, seal surface	Turbocharger: Dust sucked in from intake system	Turbocharger: Worn valve (stem, guide), broken seal
Questions	Confirm recent repair history														
	Degree of use of machine	Operated for long period		△						△	△				△
	Oil consumption suddenly increased		◎						◯						
	Engine oil must be added more frequently			◎					◯						
	Engine oil becomes contaminated quickly		◯	◎	◯										
	Exhaust smoke is blue under light load		◎	◎											
Check items	Amount of blow-by gas	Excessive	◎	◎							◯				◯
		None			◎										
	Area around engine is dirty with oil					◎	◎	◎	◎						
	There is oil in engine cooling water								◎						
	When exhaust pipe is removed, inside is found to be dirty with oil									◎					◯
	When turbocharger air supply pipe is removed, inside is found to be dirty with oil										◎				
	Oil level in PTO chamber rises											◎			
	Clamps for intake system are loose												◎		
Check items	When compression pressure is measured, it is found to be low		●	●											
	When breather element is inspected, it is found to be clogged with dirty oil				●										
	There is external leakage of oil from engine					●	●	●	●						
	Pressure-tightness test of oil cooler shows there is leakage									●					
	Excessive play of turbocharger shaft										●	●			
	Inspect rear seal directly												●		
	When intake manifold is removed, dust is found inside													●	
	When intake manifold is removed, inside is found to be dirty with oil														●
	Remedy		Replace	Replace	Clean	Correct	Correct	Correct	Correct	Replace	Replace	Replace	Correct	Correct	Correct

S-9 Oil becomes contaminated quickly

General causes why oil becomes contaminated quickly
- Intake of exhaust gas due to internal wear
- Clogging of lubrication passage
- Improper fuel
- Improper oil used
- Operation under excessive load

Legend
○: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

			Causes: Worn piston ring, cylinder liner	Clogged breather, breather hose	Clogged oil filter	Worn valve, valve guide	Clogged oil cooler	Clogged turbocharger drain pipe	Defective seal at turbocharger turbine end	Defective safety valve	Exhaust smoke is black
Questions	Confirm recent repair history										
	Degree of use of machine	Operated for long period	△			△			△		
	Engine oil must be added more frequently		◎								
	Non-specified oil is being used				○						
Check items	Color of exhaust gas	Blue under light load	◎								
		Black									◎
	Amount of blow-by gas	Excessive	◎			○		○	○		
		None		◎							
	When oil filter is inspected, metal particles are found		○		◎	○					
	When exhaust pipe is removed, inside is found to be dirty with oil					◎					
	Engine oil temperature rises quickly						◎				
Troubleshooting	When compression pressure is measured, it is found to be low		●			●					
	When breather element is inspected directly, hose is broken or is found to be clogged with dirty oil			●							
	When oil filter is inspected directly, it is found to be clogged				●						
	When oil cooler is inspected directly, it is found to be clogged						●				
	Turbocharger drain tube is clogged							●			
	Excessive play of turbocharger shaft								●		
	When safety valve is directly inspected, spring is found to be catching or broken									●	
		Remedy	Replace	Clean	Replace	Replace	Clean	Clean	Replace	Replace	—

Carry out troubleshooting for "Exhaust smoke is black".

S-10 Fuel consumption is excessive

General causes why fuel consumption is excessive
- Leakage of fuel
- Improper condition of fuel injection
- Excessive injection of fuel

Legend
◯: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

			Causes: Defective injection pump (excessive injection)	Defective nozzle holder spray	Defective injection pump plunger	Defective fuel injection timing	External leakage from fuel piping, fuel filter	Leakage of fuel inside head cover	Defective oil seal inside feed pump (piston)	Defective adjustment of fuel control linkage
Questions	Confirm recent repair history									
	Degree of use of machine	Operated for long period		△	△				△	
	Condition of fuel consumption	More than for other machines of same model	◎			◯				
		Gradually increased		◯	◯					
		Suddenly increased					◯	◯		
Check items	Exhaust smoke color	Black	◎	◯		◯				◯
		White						◯		
	Seal on injection pump has come off		◎							
	There is irregular combustion			◎						
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low			◎	◯					
	Match mark on injection pump is misaligned					◎				
	There is external leakage of fuel from engine						◎			
	Engine oil level rises and smells of diesel fuel		◯					◎	◎	
	Engine low idling speed is high		◯							◎
Troubleshooting	Injection pump measurement shows that injection amount is excessive		●							
	Speed does not change when operation of certain cylinders is stopped			●						
	When control rack is pushed, it is found to be heavy, or does not return				●					
	When check is made using delivery method, injection timing is found to be incorrect					●				
	Remove head cover and inspect directly							●		
	Remove feed pump and inspect directly								●	
	When engine speed is measured, low idling speed is found to be high									●
Remedy			Adjust	Replace	Replace	Adjust	Correct	Correct	Correct	Adjust

S-11 Oil is in cooling water, or water spurts back, or water level goes down

General causes why oil is in cooling water
- Internal leakage in lubrication system
- Internal leakage in cooling system

Legend
◯: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

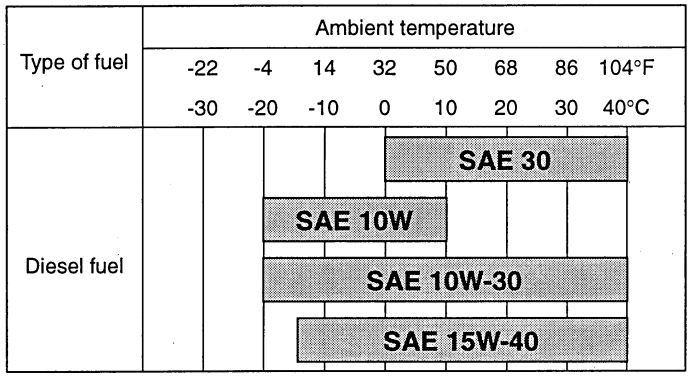
			Causes: Broken oil cooler core, O-ring	Broken cylinder head, head gasket	Insufficient protrusion of liner	Broken liner O-ring, holes caused by pitting	Internal cracks in cylinder block
Questions	Confirm recent repair history						
	Degree of use of machine	Operated for long period	△			△	
	Oil level	Suddenly increased	◯	◯			
		Gradually increased				◯	◯
Check items	Hard water is being used as cooling water		◯			◯	
	Engine oil level has risen, oil is cloudy white		◎			◯	◯
	Excessive air bubbles inside radiator, spurts back			◎	◎		
Troubleshooting	Pressure-tightness test of oil cooler shows there is leakage		●				
	Pressure-tightness test of cylinder head shows there is leakage			●			
	Remove cylinder head and inspect directly				●		
	Remove oil pan and inspect directly					●	●
Remedy			Replace	Replace	Replace	Replace	Replace

S-12 Oil pressure caution lamp lights up (drop in oil pressure)

★ Check that the monitor panel engine oil level lamp is not lighted up.
★ When the oil pressure sensor is normal (see M mode).

General causes why oil pressure lamp lights up
- Leakage, clogging, wear of lubricating system
- Defective oil pressure control
- Improper oil used (improper viscosity)
- Deterioration of oil due to overheating

★ Standards for engine oil selection



Legend
◯: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

			Causes: Clogged oil filter	Worn bearing, journal	Clogged strainer inside oil pan	Clogged, broken oil pipe inside oil pan	Broken suction pipe brazing	Defective oil pump	Defective regulator valve	Defective main relief valve	Leaking, crushed hydraulic piping	Defective oil pressure sensor	Water, fuel in oil
Questions	Confirm recent repair history												
	Degree of use of machine	Operated for long period	△	△				△					
	Replacement of filters has not been carried out according to Operation Manual		◎										
	Non-specified oil is being used		◯	◯									
Check items	Condition when oil pressure lamp lights up	Lights up at low idling		◎						◯			
		Lights up at low, high idling			◎	◎	◎	◎	◯	◯			
		Sometimes lights up							◎	◎		◯	
	There is clogging, leakage from hydraulic piping (external)										◎		
	Metal particles are found when oil is drained			◎									
	Metal particles are stuck to oil filter element			◎				◯					
	Oil is cloudy white or smells of diesel oil												◎
Troubleshooting	When oil filter is inspected directly, it is found to be clogged		●	●									
	Remove oil pan and inspect directly				●	●	●						
	Oil pump rotation is heavy, there is play							●					
	There is catching of relief valve or regulator valve, spring or valve guide is broken								●	●			
	When oil pressure is measured, it is found to be within standard value											●	
			Carry out troubleshooting for "Oil level rises".										
	Remedy		Clean	Clean	Clean	Clean	Correct	Replace	Adjust	Adjust	Correct	Replace	—

S-13 Oil level rises (water, fuel in oil)

★ If there is oil in the cooling water, carry out trouble-shooting for "Oil is in cooling water".

General causes why oil level rises

- Water in oil
- Fuel in oil (diluted, and smells of diesel fuel)
- Entry of oil from other component

Legend
○: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

		Causes: Broken oil cooler core, O-ring	Defective nozzle holder sleeve	Broken cylinder head, head gasket (precombustion chamber)	Clogged water pump breather hole, defective seal	Worn, damaged rear seal surface	Defective main pump seal	Leakage of fuel inside head cover	Defective part inside injection pump (flange type)	Defective thermostat seat portion	Damaged liner O-ring, holes made by pitting · Defective thermostat seat	Cracks inside cylinder block
Questions	Confirm recent repair history											
	Degree of use of machine — Operated for long period		△		△	△	△				△	
	When engine is first started, drops of water come from muffler		◎									
	Exhaust smoke is white		◎				○		○	○		
	There is oil in radiator cooling water	◎	○	○							○	○
Check items	Leave radiator cap open. When engine is run at idling, an abnormal number of bubbles appear, or water spurts back			◎							○	
	Water pump breather hole is clogged with mud				◎							
	When water pump breather hole is cleaned, water comes out				◎							
	Oil level goes down in damper chamber					◎						
	Oil level goes down in hydraulic tank						◎					
	Engine oil smells of diesel fuel							◎	◎	◎		
	Fuel must be added more frequently							◎	◎	◎		
Troubleshooting	Pressure-tightness test of oil cooler shows there is leakage	●										
	Pressure-tightness test of cylinder head shows there is leakage		●									
	When compression pressure is measured, it is found to be low			●								
	Remove water pump and inspect directly				●							
	Remove rear seal and inspect directly					●						
	When main pump is removed, seal is found to be damaged						●					
	Remove head cover and inspect directly							●				
	Remove injection pump and inspect directly								●			
	Defective contact of thermostat seal valve									●		
	Remove oil pan and check directly										●	●
	Remedy	Replace	Replace	Replace	Replace	Correct	Replace	Correct	Replace	Replace	Replace	Replace

S-14 Water temperature becomes too high (overheating)

★ Check that the monitor panel coolant level caution lamp is not lightend up.
★ When the monitor panel water temperature gauge is normal, go to troubleshooting of machine monitor system (M mode).

General causes why water temperature becomes too high
- Lack of cooling air (deformation, damage of fan)
- Drop in heat dissipation efficiency
- Defective cooling circulation system

★ Carry out troubleshooting for chassis.

Legend
◯: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

			Causes: Broken water pump	Clogged, crushed radiator fins	Clogged radiator core	Defective thermostat (does not open)	Defective water temperature gauge	Fan belt slipping, worn fan pulley	Clogged, broken oil cooler	Defective radiator pressure valve	Broken head, head gasket	Damaged liner O-ring, holes made by pitting	External leakage from cooling water piping
Questions	Confirm recent repair history												
	Degree of use of machine	Operated for long period		△	△						△	△	
	Condition of overheating	Suddenly overheated	◎					◯					
		Always tends to overheat		◎	◎	◯		◯					
	Water temperature gauge	Rises quickly				◎							
		Does not go down					◎						
Check items	Fan belt whines under sudden load							◎					
	Cloudy white oil is floating on cooling water								◎				
	Cooling water flows out from overflow hose									◎			
	Excessive air bubbles inside radiator, water spurts back										◎		
	Engine oil level has risen, oil is cloudy white							◯				◎	
	There is play when fan pulley is rotated		◎										
	Radiator shroud, inside of underguard are clogged with dirt or mud			◎									
	When light bulb is held behind radiator, no light passes through			◎									
	Water is leaking because of cracks in hose or loose clamps												◎
	When belt tension is inspected, it is found to be loose						◎						
Troubleshooting	Temperature difference between top and bottom radiator tanks is excessive		●										
	Temperature difference between top and bottom radiator tanks is slight			●									
	When water filler port is inspected, core is found to be clogged				●								
	When function test is carried out on thermostat, it does not open even at cracking temperature					●							
	When water temperature is measured, it is found to be normal						●						
	When oil cooler is inspected directly, it is found to be clogged							●					
	When measurement is made with radiator cap tester, set pressure is found to be low								●				
	When compression pressure is measured, it is found to be low									●			
	Remove oil pan and inspect directly										●		
		Remedy	Replace	Correct	Correct	Replace	Replace	Correct	Replace	Replace	Replace	Replace	Correct, replace

S-15 Abnormal noise is made

★ Judge if the noise is an internal noise or an external noise.

General causes why abnormal noise is made

- Abnormality due to defective parts
- Abnormal combustion
- Air sucked in from intake system

Legend
◯: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

			Causes: Excessive wear of piston ring, cylinder liner	Seized turbocharger, interference	Missing, seized bushing	Clogged, seized injection nozzle	Defective injection pump	Defective injection pump (rack, plunger seized)	Deformed fan, fan belt interference	Defective adjustment of valve clearance	Broken dynamic valve system (valve, rocker lever, etc.)	Improper gear train backlash	Leakage of air between turbocharger and head	Defect inside muffler (dividing board out of position)
Questions	Confirm recent repair history													
	Degree of use of machine	Operated for long period	△											
	Condition of abnormal noise	Gradually occurred	◯						◯					
		Suddenly occurred		◯	◯					◯				
	Non-specified fuel is being used					◯	◯							
	Engine oil must be added more frequently		◎											
	Color of exhaust gas	Blue under light load	◎											
		Black		◎						◎			◎	
Check items	Metal particles are found in oil filter		◎		◎									
	Blow-by gas is excessive		◎											
	Noise of interference is heard from around turbocharger			◎										
	Engine pickup is poor and combustion is abnormal					◎								
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎	◯							
	Seal on injection pump has come off							◎						
	Abnormal noise is loud when accelerating engine					◯	◯	◯	◯	◯		◯		
	Clanging sound is heard from around cylinder head									◎	◎			
	Leakage of air between turbocharger and head, loose clamp												◎	
	Vibrating noise is heard from around muffler													◎
Troubleshooting	When compression pressure is measured, it is found to be low		●											
	When turbocharger is rotated by hand, it is found to be heavy			●										
	Remove gear cover and inspect directly				●							●		
	Speed does not change when operation of certain cylinders is stopped					●								
	When control rack is pushed, it is found to be heavy, or does not return						●							
	Injection pump test shows that injection amount is incorrect							●						
	Fan is deformed, belt is loose								●					
	When valve clearance is checked, it is found to be outside standard value									●				
	Remove cylinder head cover and inspect directly										●			
	When muffler is removed, abnormal noise disappears													●
	Remedy		Replace	Replace	Replace	Replace	Correct	Replace	Correct	Replace	Correct	Replace	Replace	Replace

S-16 Vibration is excessive

★ If there is abnormal noise together with the vibration, carry out troubleshooting for "Abnormal noise is made".

General causes why vibration is excessive

- Defective parts (abnormal wear, breakage)
- Improper alignment

* Abnormal combustion

Legend
○: Possible causes (judging from Questions and check items)
◎: Most probable causes (judging from Questions and Check items)
△: Possible causes due to length of use (used for a long period)
●: Items to confirm the cause.

			Causes: Worn connecting rod, main bearing	Worn balancer, cam bushing	Loose engine mounting bolts, broken cushion	Broken part inside output shaft (damper)	Improper gear train backlash	Defective dynamic valve system (valve, rocker lever, etc.)	Defective injection pump (excessive injection)
Questions	Confirm recent repair history								
	Degree of use of machine	Operated for long period	△	△	△				
	Condition of vibration	Suddenly increased				○		○	
		Gradually increased	○	○	○				
	Non-specified oil is being used		○	○					
Check items	Metal particles are found in oil filter		◎	◎					
	Metal particles are found when oil is drained		◎	◎					
	Oil pressure is low at low idling		○	○					
	Vibration occurs at mid-range speed				○	○			
	Vibration follows engine speed				○	○	○		
	Exhaust smoke is black							◎	○
	Seal on injection pump has come off								◎
Troubleshooting	Remove oil pan and inspect directly		●						
	Remove side cover and inspect directly			●					
	Inspect directly for loose engine mounting bolts, broken cushion				●				
	Inspect inside of output shaft (damper) directly					●			
	Remove front cover and inspect directly						●		
	Remove head cover and inspect directly							●	
	Injection pump test shows that injection amount is incorrect								●
		Remedy	Replace	Replace	Replace	Replace	Correct	Replace	Adjust

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

POINTS TO REMEMBER WHEN TROUBLESHOOTING PUMP CONTROLLER SYSTEM

1. **Points to remember if abnormality returns to normal by itself**
   In the following two cases, there is a high probability that the same problem will occur again, so it is desirable to follow up this problem carefully.
   1) If any abnormality returns to normal by itself, or
   2) If the connector is disconnected and the T-adapter is inserted, or if the T-adapter is removed and the connector is returned to its original position when carrying out troubleshooting of the failure, and the service code is no longer displayed, or if the monitor display returns to normal.
   3) After completing troubleshooting, always erase the user code from memory.

2. **User code memory retention function**
   When displaying the abnormality code in mememory and carrying out troubleshooting, note down the content of the display, then erase the display. After trying to re-enact the problem, carry out troubleshooting according to the failure code that is displayed.
   (There are cases where mistaken operation or abnormalities that occur when the connector is disconnected are recorded by the memory retention function. erasing the data in this way saves any washed work.)

ACTION TAKEN BY CONTROLLER WHEN ABNORMALITY OCCURS AND PROBLEMS ON MACHINE

User code	Service code	Abnormal system	Nature of abnormality
E02	E232	Short circuit in pump TVC solenoid system	1. Short circuit with ground, short circuit inside pump TVC solenoid 2. Short circuit with power source, short circuit with ground in wiring harness between controller C02 (8) and TVC solenoid C13 (1) ((+) side) 3. Short circuit with power source in wiring harness between controller C02 (18) and TVC solenoid C13 (2) ((-) side) 4. Defective governor, pump controller
	E233	Disconnection in pump TVC solenoid sytem	1. Disconnection, defective contact inside pump TVC solenoid 2. Disconnection, defective contact in wiring harness between controller C02 (8) and TVC solenoid C13 (1) ((+) side) 3. Disconnection, defective contact, short circuit with ground in wiring harness between controllerC02 (18) and TVC solenoidC13 (2) ((-) side) 4. Defective governor, pump controller
E03	E203	Short circuit in swing holding brake solenoid system	1. Short circuit with ground, short circuit inside swing holding brake solenoid 2. Short circuit with ground in wiring harness between controller C01 (3) and solenoid V06 (2) ((+) side) 3. Defective governor, pump controller
	E213	Disconnection in swing holding brake solenoid system	1. Disconnection, defective contact inside swing holding brake solenoid 2. Disconnection, defective contact, short circuit with power source in wiring harness between controller C01 (3) and solenoid V06 (2) ((+) side) 3. Disconnection, defective contact in wiring harness between solenoid V06 (1) and chassis ground ((-) side) 4. Defective governor, pump controller

Condition when normal (voltage, current, resistance)	Action by controller when abnormality is detected	Problem that appears on machine when there is abnormality
• Resistance of solenoid: 10 - 22Ω	1. Make output to TVC solenoid 0. 2. Displays user code E02 on monitor panel. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	1. No current flows to the pump TVC solenoid. Therefore, when the load is large, there is a big drop in the engin speed which may result in the engine stalling. 2. The swing acceleration is poor
• Resistance of solenoid: 10 - 22Ω • Current: 1000 mA (H/O mode, auto-deceleration ON, levers at neutral, fuel control dial at MAX.)	1. The current stops flowing to the TVC solenoid, so no particular action is taken. 2. If there is a short circuit with the ground at the (-) end, the current (min. 1A) continues to flow to the TVC solenoid. 3. It displayes user code E02 on the monitor panel. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	1. In the case of 1, it is the same as E232. 2. In the case of 2, the current (min. 1A) continues to flow to the pump TVC solenoid, so the output of the pump TVC valve increases and the overall speed becomes slower.
• Resistance of solenoid: 20 - 60Ω	1. Makes output to TVC solenoid 0. 2. displays user code E03 on monitor panel. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	When the swing is operated, the motor brake is not released, so the upper structure does not swing.
• Resistance of solenoid: 20 - 60 Ω	1. The current stops flowing to the solenoid, so no particular action is taken. 2. Displays user code E03 on monitor panel. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	Same as display for E203

User code	Service code	Abnormal system	Nature of abnormality
-	E201	Short circuit in LS bypass solenoid system	1. Short circuit with ground, short circuit inside LS bypass solenoid 2. Short circuit with ground in wiring harness between controller c01 (2) and solenoid V05 (2) ((+) side) 3. Defective governor , pump controller
-	E205	Short circuit in 2-stage relief solenoid system	1. Short circuit with ground, short circuit inside 2-stage relief solenoid 2. Short circuit with ground in wiring harness between controller c01 (10) and solenoid V25 (2) ((+) side) 3. Defective governor, pump controller
-	E206	Short circuit in travel speed solenoid system	1. Short circuit with ground, short circuit inside travel speed solenoid 2. Short circuit with ground in wiring harness between controller C01 (9) and solenoid V04 (2) ((+) side) 3. Defective governor, pump controller
-	E211	Disconnection in LS bypass solenoid system	1. Disconnection, defective contact inside LS bypass solenoid 2. Disconnection, defective contact, short circuit with power source in wiring harness between controller C01 (2) and solenoid V05 (2) ((+) side) 3. disconnection, defective contact in wiring harness between solenoid V05 (1) and chassis ground ((-) side) 4. Defective governor, pump controller
-	E215	Disconnection in 2-stage relief solenoid system	1. Disconnection, defective contact inside 2-stage relief solenoid 2. Disconnection, defective contact, short circuit with power source in wiring harness between controller C01 (10) and solenoid V25 (2) ((+) side) 3. Disconnection, defective contact in wiring harness between solenoid V25 (1) and chassis ground ((-) side) 4. Defective governor, pump controller
-	E216	Disconnection in travel speed solenoid system	1. Disconnection, defective contact inside travel speed solenoid 2. Disconnection, defective contact, short circuit with power source in wiring harness between controller C01 (9) and solenoid V04 (2) ((+) side) 3. Disconnection, defective contact in wiring harness between solenoid V04 (1) and chassis ground ((-) side) 4. Defective governor, pump controller
-	E217	Model selection input error	1. Disconnection, defective contact, short circuit with ground in model selection wiring harness C17 (5) (6) (7) (13) (14) 2. Defective governor, pump controller

Condition when normal (voltage, current, resistance)	Action by controller when abnormality is detected	Problem that appears on machine when there is abnormality
• Resistance of solenoid: 20 - 60Ω	1. Makes output to solenoid O. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	1. With swing + boom RAISE, the boom is slow. 2. With swing + arm IN, the arm IN movement is slow. 3. With swing + arm OUT, the arm OUT movement is slow. 4. With swing+ travel, there is a big drop in the travel speed.
• Resistance of solenoid: 20 - 60 Ω	1. Makes output to solenoid O. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	The pump merge/divider valve continues to merge the oil flow. 1. In the L/O and F/O modes, the work equipment and swing speeds become faster. 2. The steering is difficult to turn.l
• Resistance of solenoid: 20 - 60Ω	1. Makes output to solenoid O. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	Even if the travel speed is switched, the travel speed does not change (remains at Lo)
• Resistance of solenoid: 20 - 60Ω	1. The current stops flowing to the solenoid, so no particular action is taken. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	Same content as display for E201
• Resistance of solenoid: 20 - 60 Ω	1. The current stops flowing to the solenoid, so no particular action is taken. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	Same content as display for E205
• Resistance of solenoid: 20 - 60 Ω	1. The current stops flowing to the solenoid, so no particular action is taken. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	Same content as display for E206
• Between C17 (13) and chassis: Max. 1 Ω Between C17 (5), (7), (14) (6) and chassis: Min. 1 MX	Detect abnormality in input 1) Retains data when starting switch is ON	1. Engine stalls, or 2. Work equipment, swing, travel speeds are all slow, and there is no power

User code	Service code	Abnormal system	Nature of abnormality
-	E218	Network response overtime error	1. Disconnection, short circuit, short circuit with ground in network wiring harness 2. Abnormality in governor, pump controller 3. Abnormality in monitor
-	E222	Short circuit in LS-EPC solenoid system	1. Short circuit with ground, short circuit inside LS-EPC solenoid 2. Short circuit with power source, short circuit with ground in wiring harness between controller C02 (7) and solenoid C10 (1) ((+) side) 3. Short circuit with power source in wiring harness between controller C02 (17) and solenoid C10 (2) ((-) side) 4. Defective governor, pump controller
-	E223	Disconnection in LS-EPC solenoid system	1. Disconnection, defective contact inside LS-EPC sollenoid 2. Disconnection, defective contact in wiring harness between controller C02 (7) and solenoid C10 (1) ((+) side) 3. Disconnection, defective contact, short circuit with ground in wiring harness between controller C02 (17) and solenoid C10 (2) ((-) side) 4. Defective governor, pump controller
-	E224	Abnormality in pump pressure sensor system	1. Disconnection, defective contact, short circuit, short circuit with ground inside pump pressure sensor 2. Disconnection, defective contact, short circuit in wiring harness between controller C03 (6) and pressure sensor C08 (2) ((+) side) and between C03 (16) and C08 (1) ((-) side) 3. Disconnection, defective contact, short circuit with power source, short circuit with ground in wiring harness between controller C03 (3) and pressure sensor C08 (3) (SIG side) 4. Defective governor, pump controller
-	E226	Abnormality in pressure sensor power source system	1. Short circuit, short circuit with ground inside pump pressure sensor 2. Short circuit, short circuit with ground in wiring harness between controller C03 (6) and fron pressure sensor C08 (2) 3. Defective governor, pump controller
-	E227	Abnormality in speed sensor system	1. Disconnection defective contact, short circuit inside engine speed sensor 2. Disconnection, defective contact, short circuit with ground in wiring harness between controller C16 (1) and speed sensor E07 (2) ((-) side) and between C16 (2) and E07 (1) (SIG side) 3. Defective governor, pump controller

Condition when normal (voltage, current, resistance)	Action by controller when abnormality is detected	Problem that appears on machine when there is abnormality
	1. When communications are impossible with the monitor, control is carried out with the following settings. ① Working mode: G/O ② Priority mode: OFF ③ Travel speed: Lo ④ Auto-deceleration: ON ⑤ Power max. : ON (others are as usual)	1. ① Even when travel is operated, the power max. function does not work ② The swift speed-down function does not wor ③ The auto-deceleration cannot be canceled ④ The travel speed does not increase ⑤ The priority mode has no effect ⑥ the automatic mode has no effect
• Resistance of solenoid: 7 - 14 Ω	1. Makes output to LS-EPC solenoid O. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	1. The Lo travel speed is too fast. 2. In L/O and F/O modes, the work equipment speed is too fast. 3 When the engine is running at low idling, the swing speed is too fast.
• Current: Approx. 705 mA (Levers at neutral, low idling)	1. The current stops flowing to the LS-EPC solenoid, so no particular action is taken. 2. If there is a short circuit with the ground at the (-) end, the current (min. 1A) continues to flow to the LS-EPC solenoid. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	1. In the case of 1, it is the same as E222 2. In the case of 2, electric current (min. 1A) continues to flow to the LS-EPC solenoid, so the work equipment, travel, and swing speeds are slow
• Between C03 (3) and (16): 0.5 - 4.5 V • Between C03 (6) and (16): 18 - 28 V • Between C03 (female) (3) and (16), (3) and chassis • Resistance: Min. 1 MΩ (Disconnect connectors C03 and C08.)	1. Takes pump pressure as O MPa (0 kg/cm²)when actuating. * If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	1. The travel speed does not automatically shift (it does not change from Hi to Lo). ★ If the button is operated manually, the panel display is switched.
• Voltage between C03 (6) and (16): 18 - 28 V	1. Takes front pump and rear pump pressure as O MPa (0 kg/cm²) when actuating. 2. When abnormality is detected, it switches the output OFF, and when all levers are returned to neutral, it outputs again. ★ This automatic resetting is repeated up to 3 times.	1. The travel speed dos not automatically shift (it does not change form Hi to Lo). ★ If the button is operated manually, the panel display is switched.
• Resistance: 500 - 1000 Ω • Voltage (AC range) : 0.5 - 3.0 V (engine started)	1. It functions in the equivalent of the G/O mode (the speed rises)	It operated about the same as G/O mode (prolix) (the power is slightly lower)

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

			Governor, pump controller (E2:XX system) Self-diagnostic display														
			Abnormality in controller power source	Short circuit in pump TVC solenoid system	Disconnection in pump TVC solenoid system	Short circuit in LS bypass solenoid system	Disconnection in LS bypass solenoid system	Short circuit in swing holding brake solenoid system	Disconnection in swing holding brake solenoid system	Short circuit in 2-stage relief solenoid system	Disconnection in 2-stage relief solenoid system	Short circuit in travel speed selector solenoid system	Disconnection in travel speed selector solenoid system	Model selection input error	Short circuit in Ls-EPC solenoid system	Disconnection in LS-EPC solenoid system
Failure mode		User code	LED	E02				E03		-							
		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		•													
	Fine control ability is poor or response is poor															
Work equipment	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														•	•
	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 work equipment (BOOM RAISE) + travel travel speed drops excessively					•	•									
	In swing + travel, travel speed drops excessively					•	•									
Travel system	Travel deviation	Deviation is excessive during normal travel														
		Deviation is excessive when starting														
	Travel speed is slow						•									
	Steering does not turn or lacks power						•			•	•	•	•			•
	Travel speed does not switch or is faster than specified speed		•									•	•		•	•
	Does not move (one side only)															
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 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

★ If service code E218 (abnormality in network system) is displayed, go to troubleshooting for N mode.

Governor, pump controller (E2:XX system) / Self-diagnostic display			Check items in monitoring mode																					
				Pressure switch										Actuation of solennoid										
Abnormality in pump pressure sensor system	Abnormality in pressure sensor power source system	Abnormality in engine speed sensor system	Swing	Travel	Boom LOWER	Boom RAISE	Arm IN	Arm OUT	Bucket CURL	Bucket DUMP	Swing lock switch	Kerosene mode	Knob switch	LS bypass	Swing holding brake	2-stage relief	Travel speed	Model code	Engine speed input	Pump discharge pressure input	Pump TVC current output	LS-EPC current output	Troubleshooting code if no service code is displayed
Bit pattern																		Monitoring code					
224	226	227	20						21			22		23				02	10	11	13	15	
		•										○							※	※	※	※	H-1
																			※		※		H-2
																							H-3
																							H-4
			○	○	○	○	○	○	○	○													H-5
																							H-6
					○	○														※			H-7
							○	○												※			H-8
									○	○										※			H-9
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				○		○	○		○				○			※				※			H-15 C-21
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				※		※								※									H-18
			※	※										※									H-19
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				○										※									H-21
				○										※		※	※						H-22
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			○								○				※					※			H-25
															※					※			H-26
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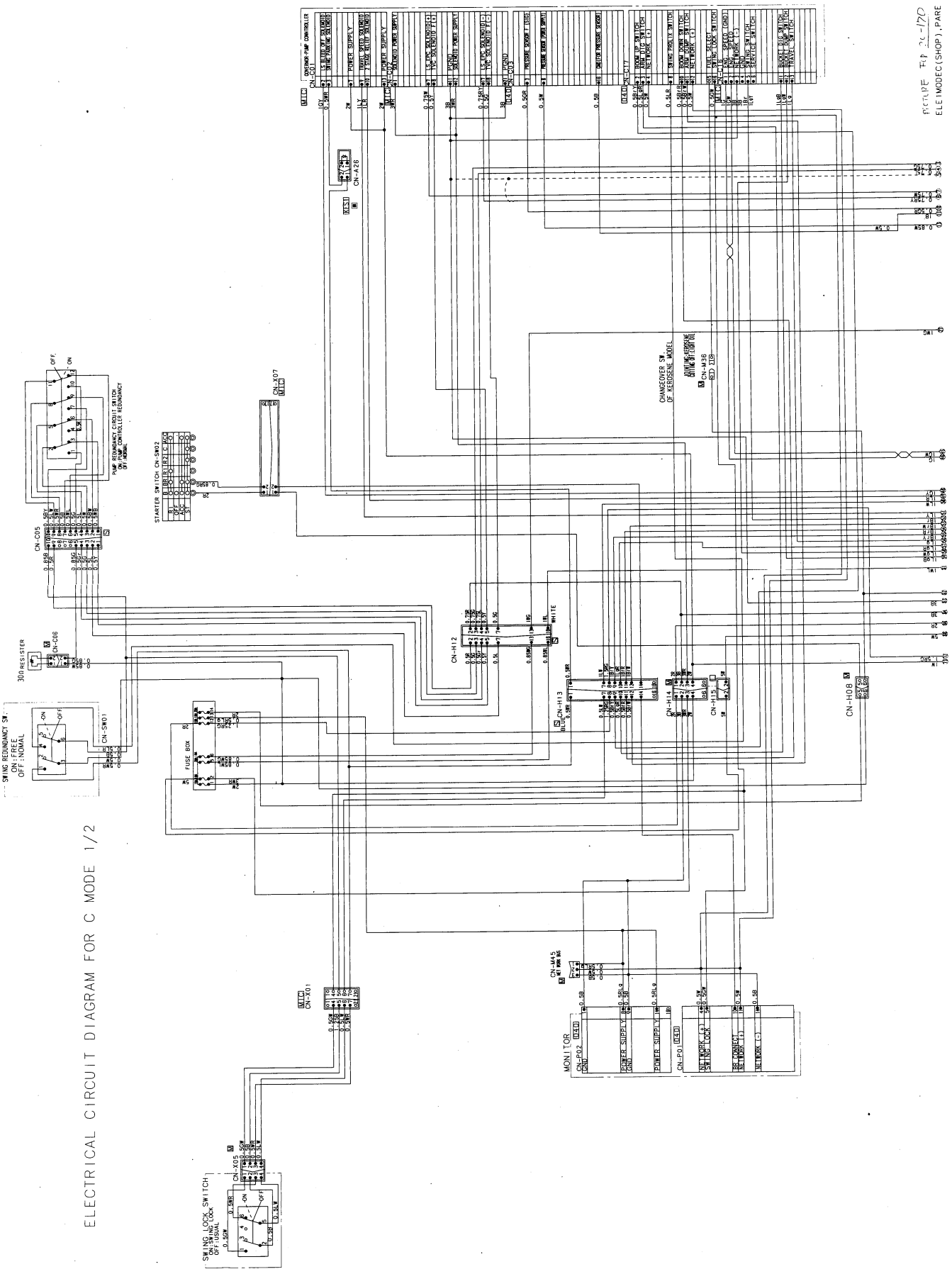
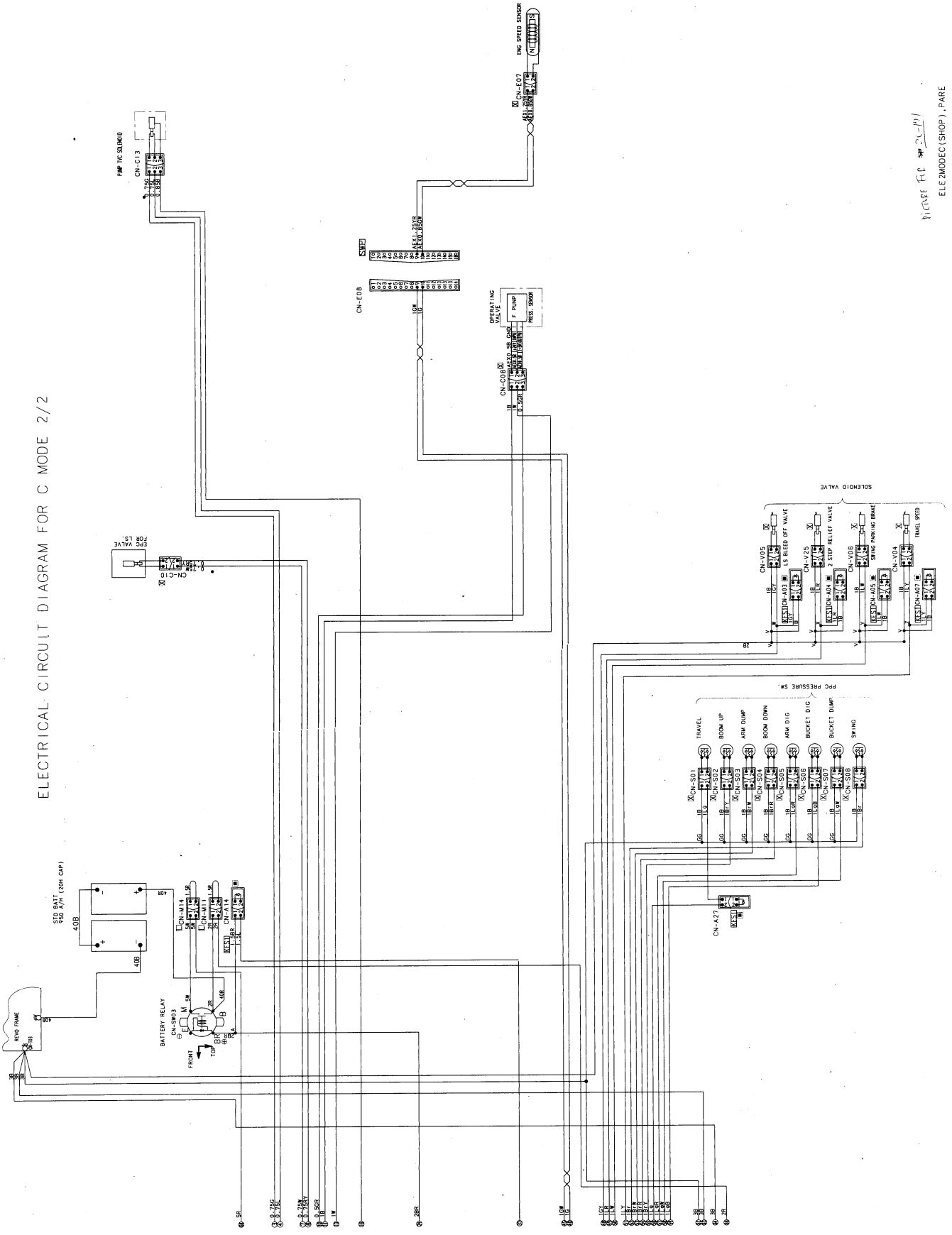
																							H-27
																							H-28
																							H-29
																							H-30
																						※	H-31
C-17	C-19	C-20	-	-	-	-	-	-	-	-	-	-	-	-	-	※	-	-	-	-	-	※	
-	-	-	F-1	F-2	F-3	F-4	F-5	F-6	F-7	F-8	F-9	F-10	F-11	-	-	-	-	-	-	-	-	-	

ELECTRICAL CIRCUIT DIAGRAM FOR C MODE 1/2

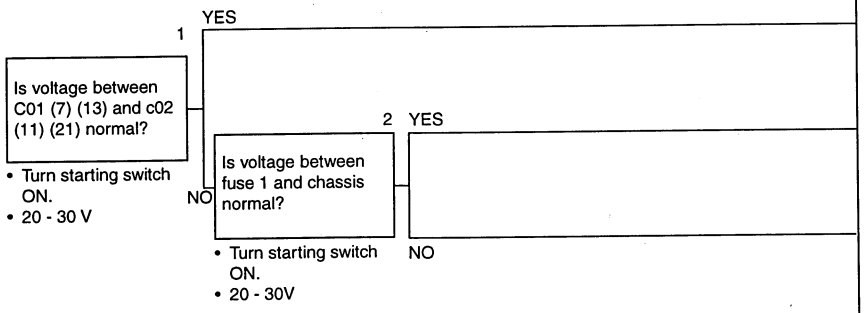


ELECTRICAL CIRCUIT DIAGRAM FOR C MODE 2/2



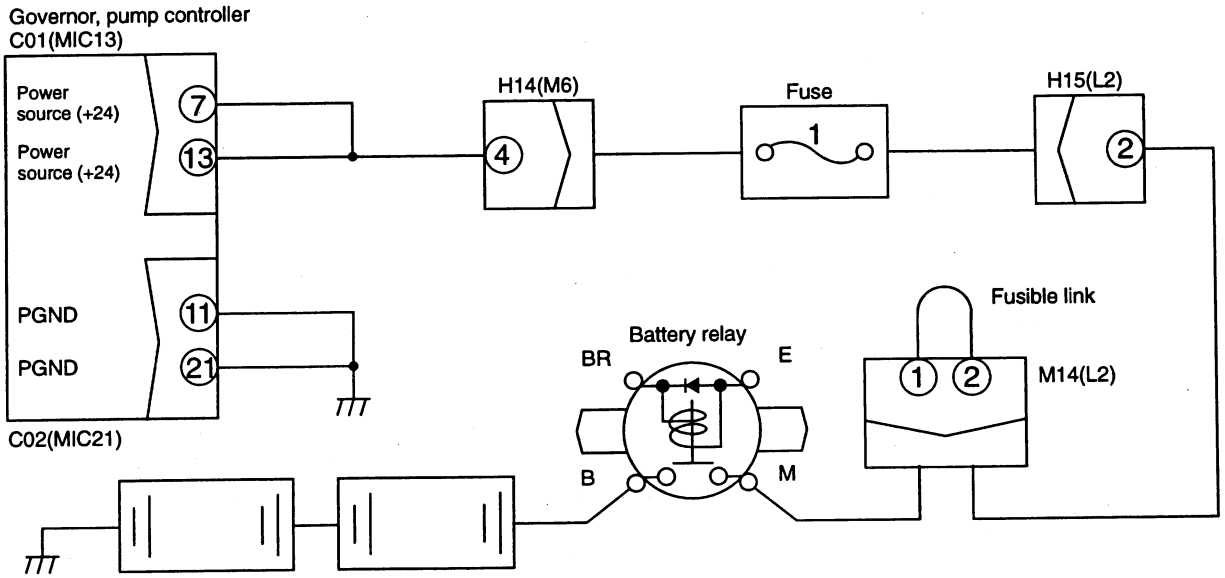
C-1 Abnormality in controller power source system (controller LED is OFF)

★ **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.**
★ 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 normally. (If the starting motor also does not rotate, go to E-8.)



Cause	Remedy
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

C-1 Related electric circuit diagram



C-2 [E232] Short circuit in pump TVC solenoid 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.)
★ Always turn the TVC prolix switch OFF.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

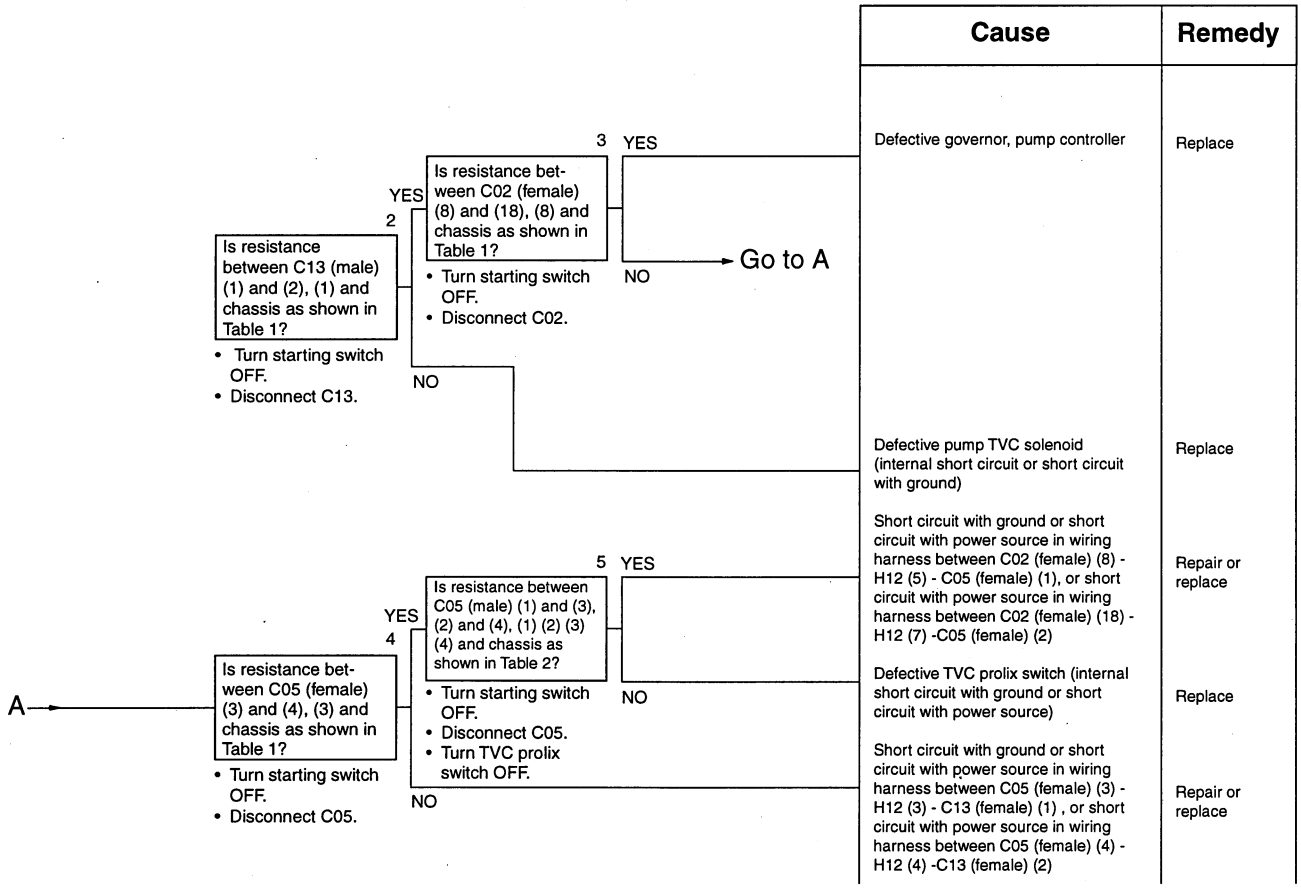


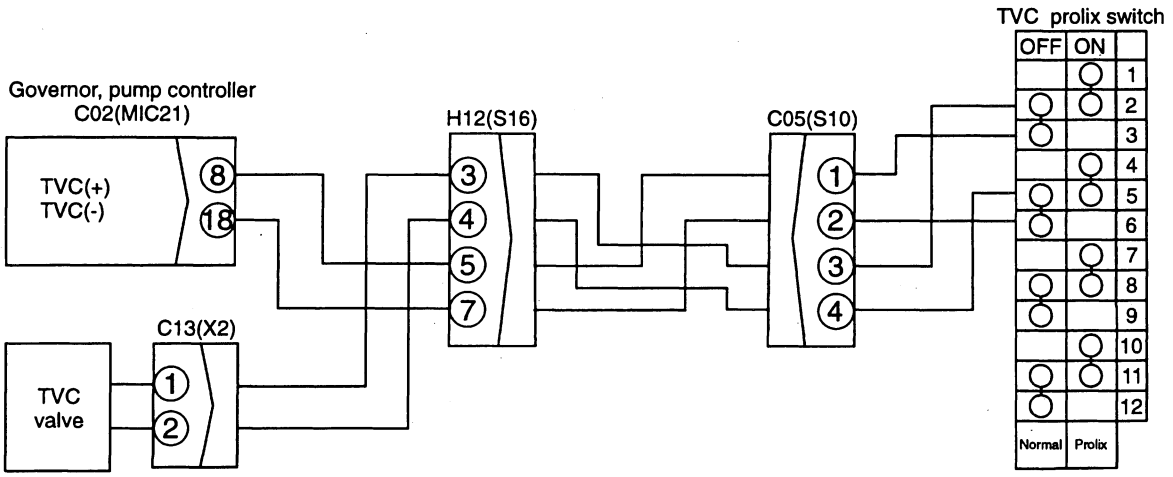
Table 1

Troubleshooting No.2	Troubleshooting No. 3	Troubleshooting No.4	Resistance value
Between C13 (male) (1) - (2)	Between C02 (female) (8) - (18)	Between C05 (female) (3) - (4)	10 - 22 Ω
Between C13 (male) (1) - chassis	Between C02 (female) (8) - chassis	Between C05 (female) (3) - chassis	Min. 1 MΩ

Table 2

Troubleshooting No.5	Resistance value
Between C05 (male) (1) - (3), (2) - (4)	Max. 1 Ω
Between C05 (male) (1) (2) (3) (4) - chassis	Min. 1 MΩ

C-2 Related electric circuit diagram



C-3 [E233] Disconnection in pump TVC solenoid 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.)

★ If there is a disconnection in the solenoid or wiring harness, no current flows to the solenoid. If the No. 2 pin of the solenoid is short circuiting with the ground, the current (approx. 1 A) continues to flow to the solenoid.

★ Always turn the TVC prolix switch OFF.

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

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

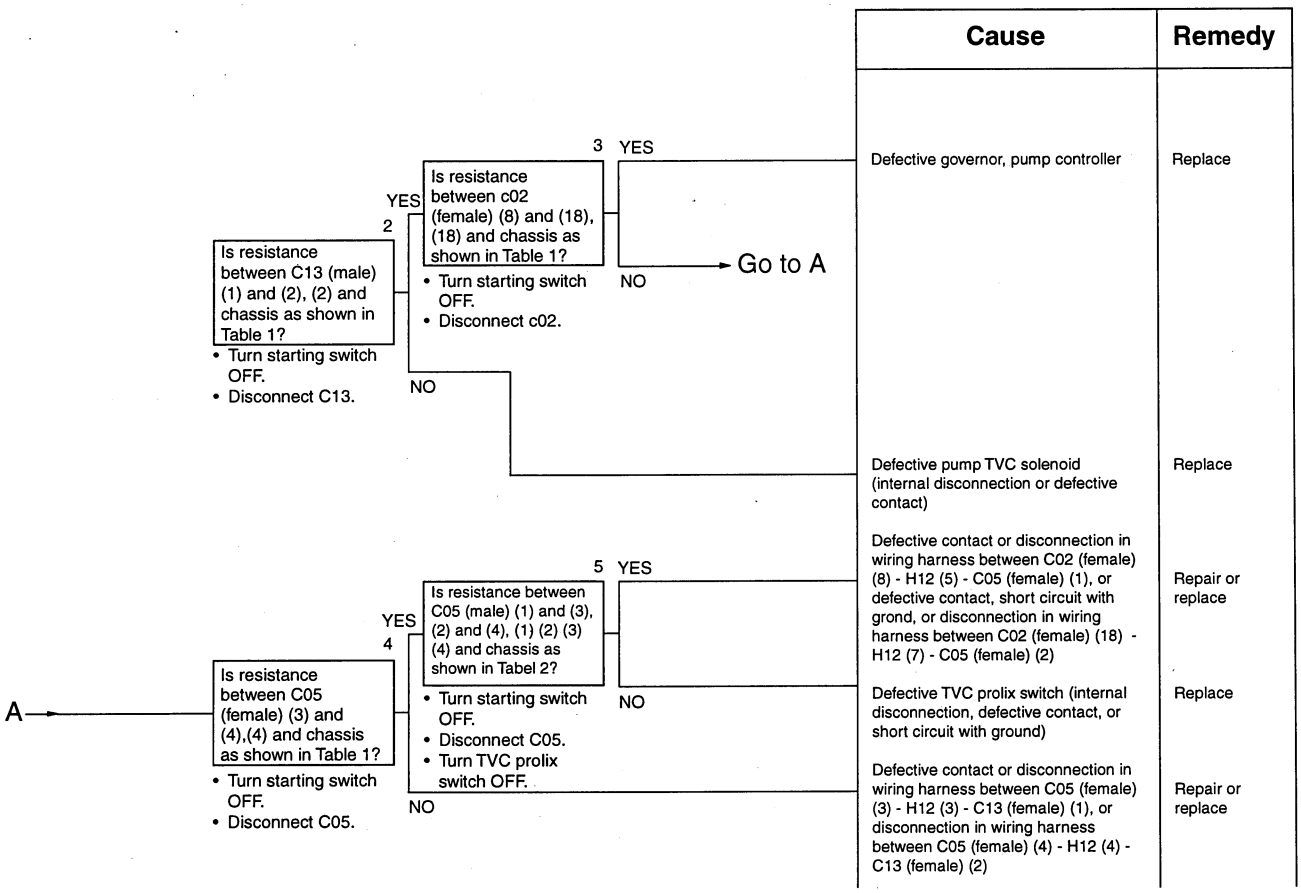


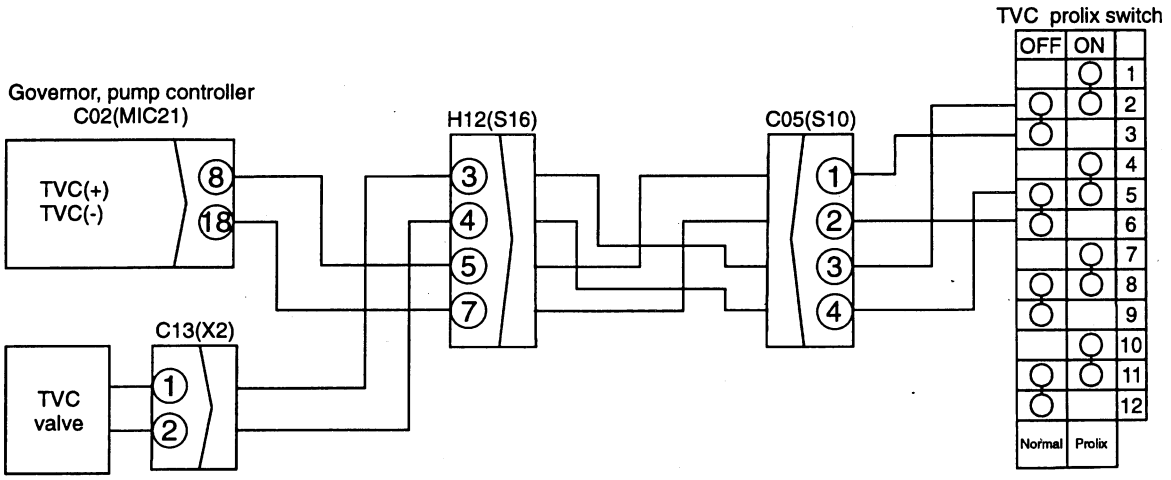
Table 1

Troubleshooting No.2	Troubleshooting No. 3	Troubleshooting No.4	Resistance value
Between C13 (male) (1) - (2)	Between C02 (female) (8) - (18)	Between C05 (female) (3) - (4)	10 - 22 Ω
Between C13 (male) (2) - chassis	Between C02 (female) (18) - chassis	Between C05 (female) (4) - chassis	Min. 1 MΩ

Table 2

Troubleshooting No.5	Resistance value
Between C05 (male) (1) - (3), (2) - (4)	Max. 1 Ω
Between C05 (male) (1) (2) (3) (4) - chassis	Min. 1 MΩ

C-3 Related electric circuit diagram



C-6 [E201] Short circuit in LS bypass solenoid 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-adaper 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 displyed, 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.

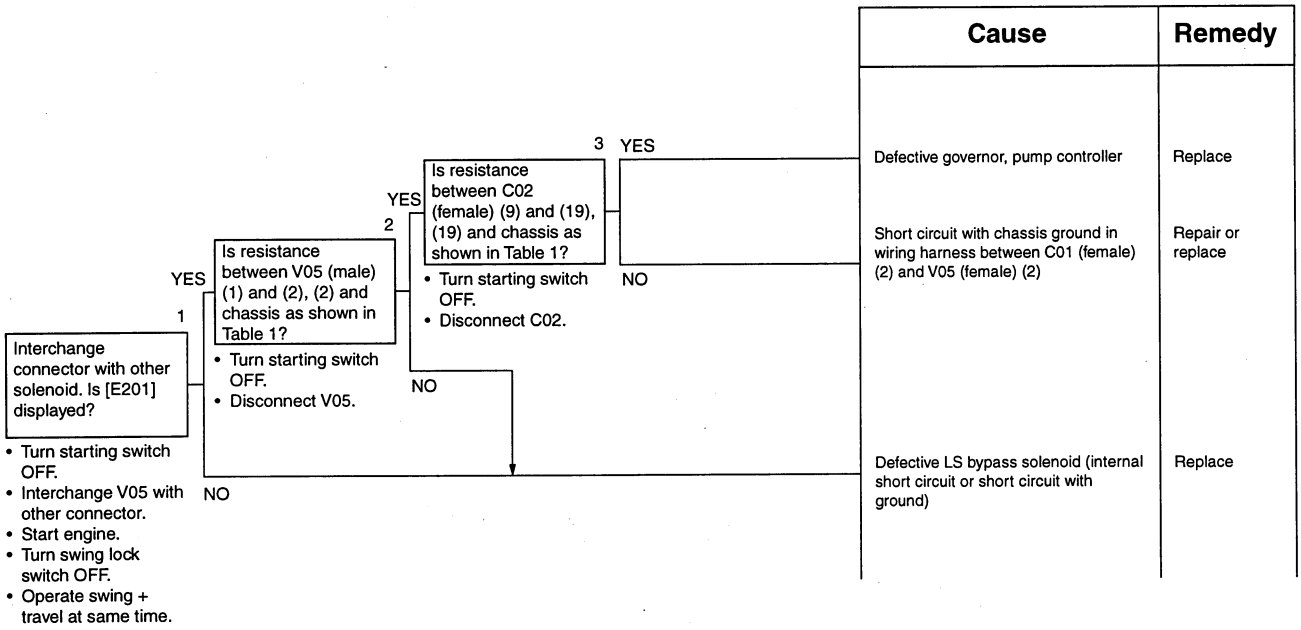
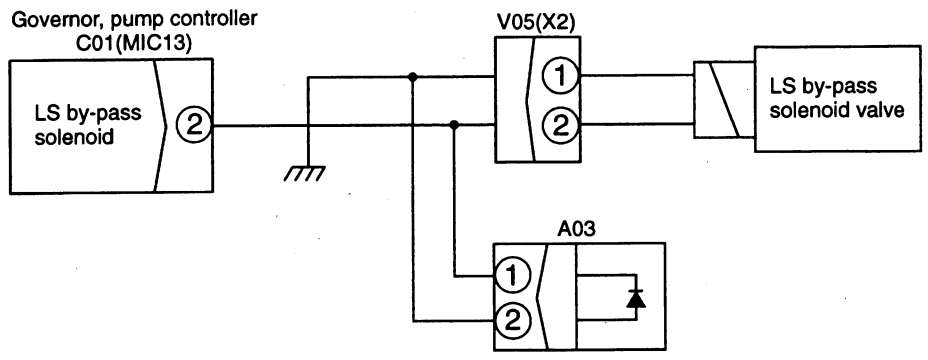


Table 1

Between V05 (male) (1) - (2)	20 - 60 Ω
Between v05 (male) (2) - chassis	Min. 1 MΩ

C-6 Related electric circuit diagram



C-7 [E211] Disconnection LS bypass solenoid 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 displayd, 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.

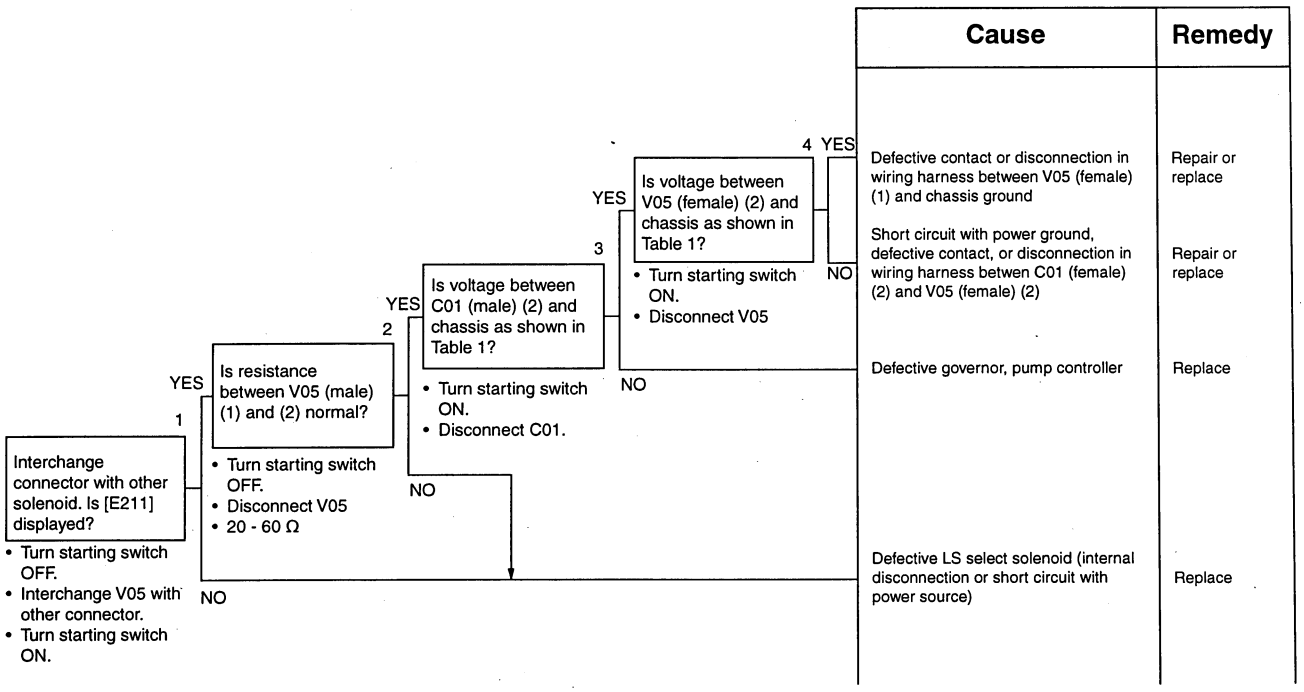
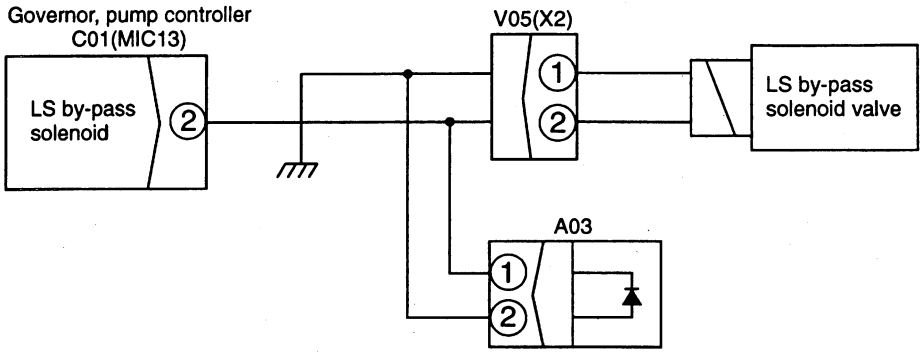


Table 1

Troubleshooting No. 3	Troubleshooting No. 4	Voltage	Measurement condition
Between C01 (male) (2) - chassis	Between V05 (female) (2) - chassis	0 - 3V	When swing lock switch is ON
		20 - 30V	When swing lock switch is OFF
			When swing and travel are operated at same time

C-7 Related electric circuit diagram



C-8 [E203] Short circuit in swing brake solenoid 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 probem 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.
★ Always turn the swing lock prolix switch OFF, then turn the swing lock switch OFF before checking.

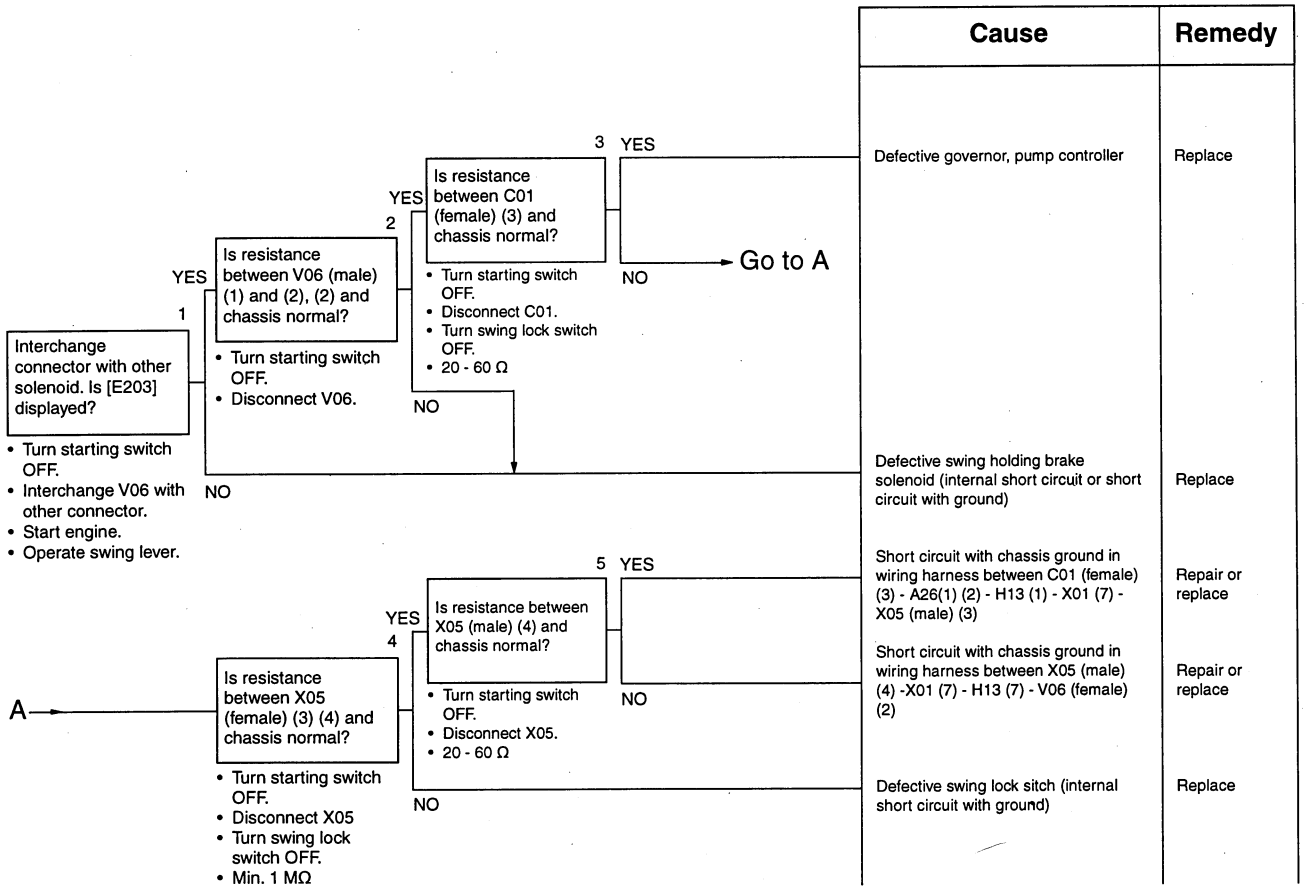
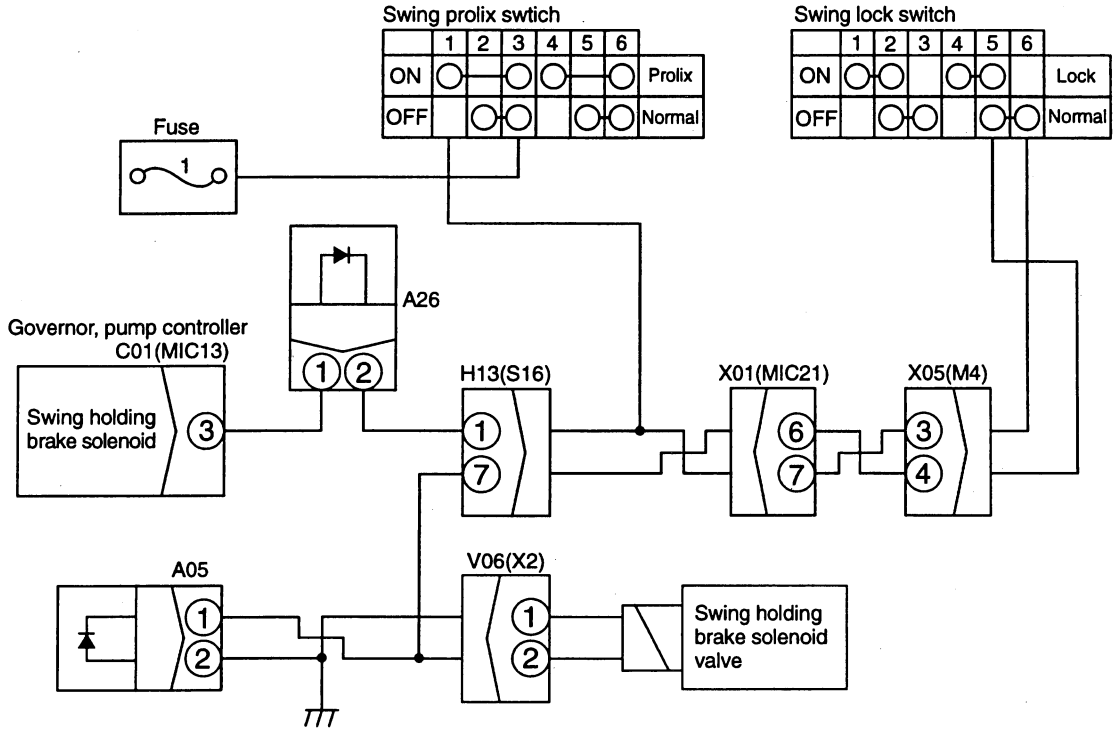


Table 1

Between V06 (male) (1) - 92)	20 - 60 Ω
Between V06 (male) (2) - chassis	Min. 1 MΩ

C-8 Related electric circuit diagram



C-9 [E213] Disconnection in swing brake solenoid 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 orginal 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.)
★ Always turn the swing lock prolix switch OFF, then turn the swing lock switch OFF before checking.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

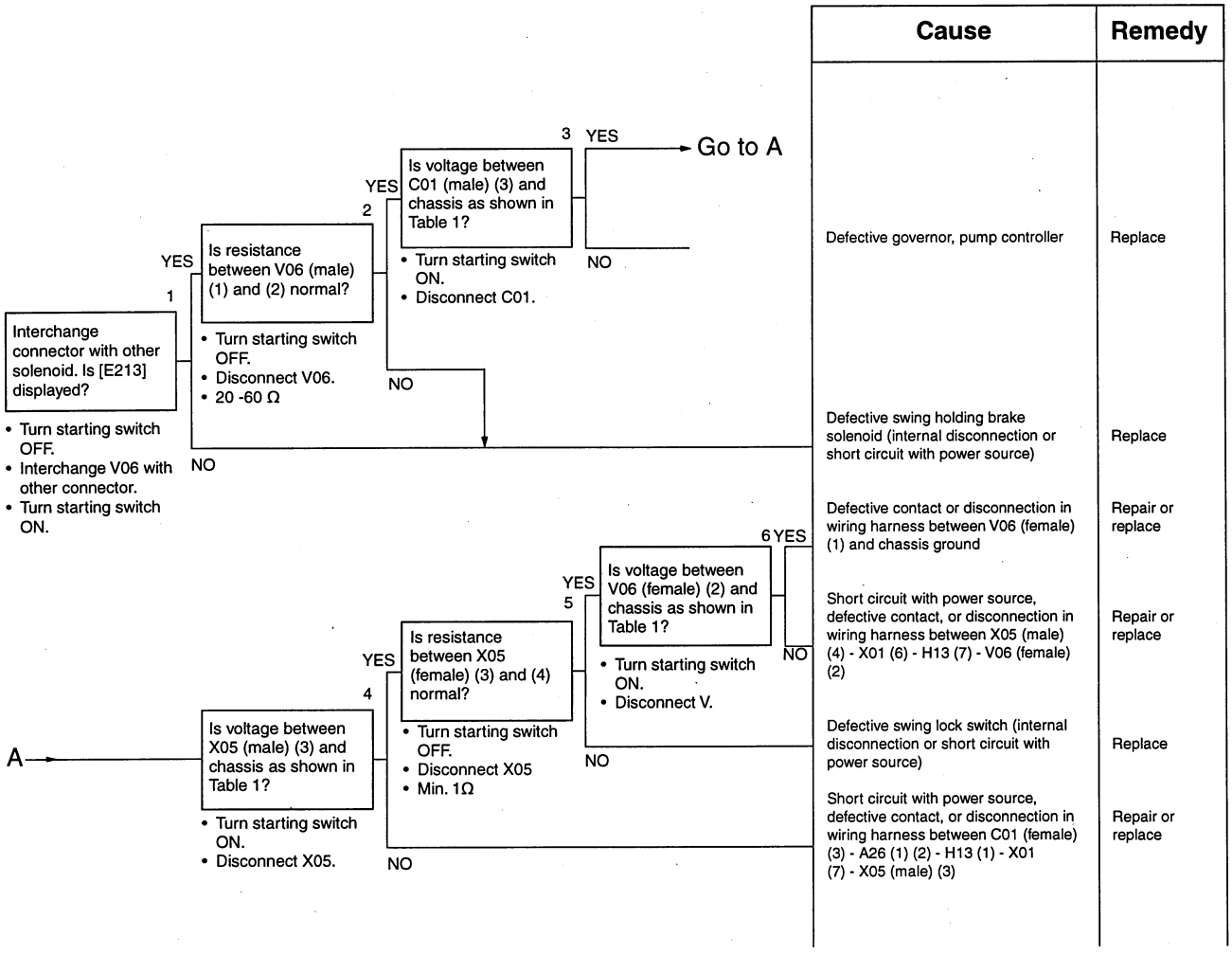
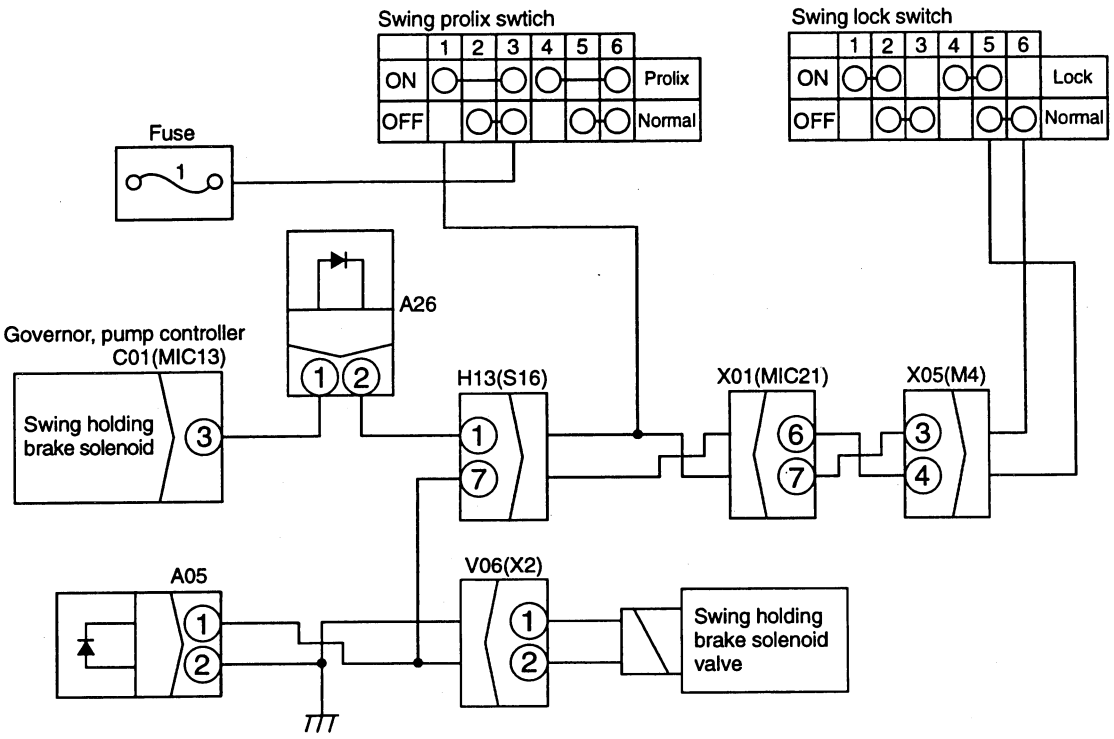


Table 1

Troubleshooting No. 3	Troubleshooting No. 4	Troubleshooting No. 6	Voltage	Measurement condition
Between C01 (male) (3) - chassis	Between X05 (male) (3) - chassis	Between V06 (male) (2) - chassis	0 - 3V	5 seconds after all levers are returned to neutral
			20 - 30V	Swing lever operated

C-9 Related electric circuit diagram



C-10 [E205] Short circuit in 2-stage relief solenoid system is displayed

★ **This troubleshooting is caried 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 displyed, 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.

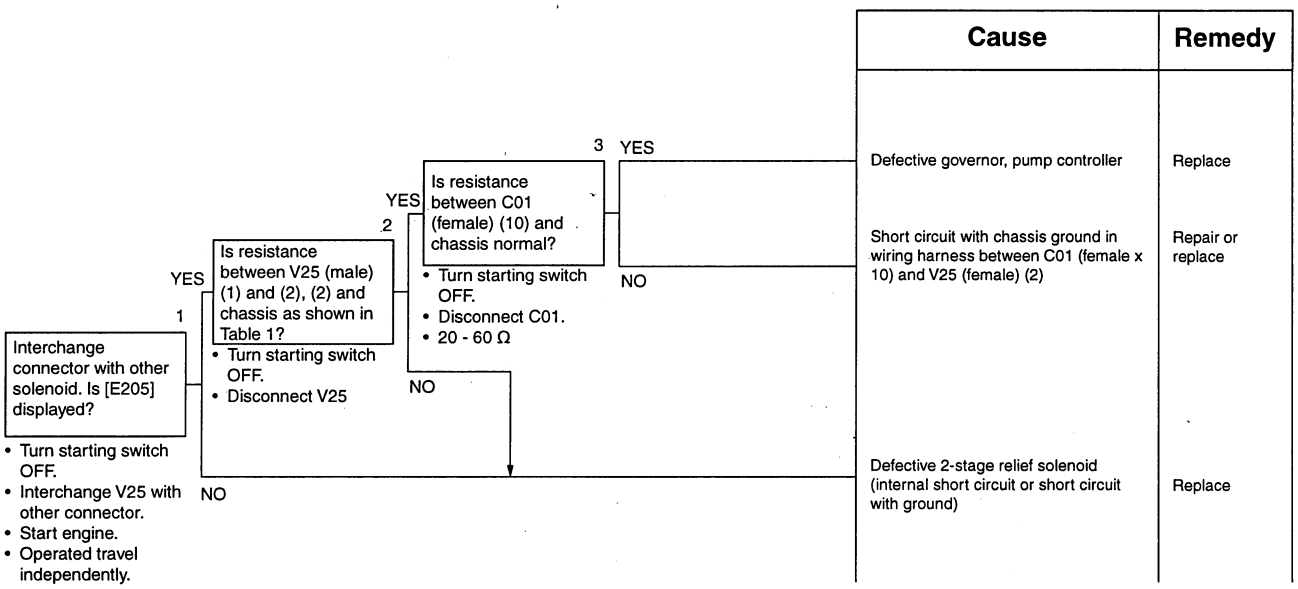
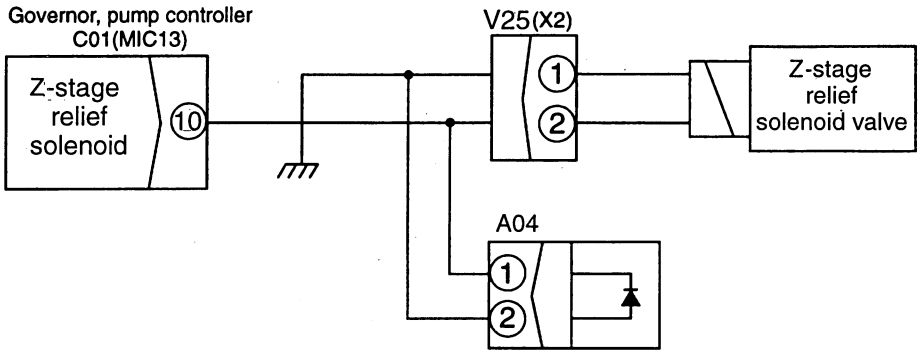


Table 1

Between V25 (male) (1) - (2)	20 - 60 Ω
Between v25 (male) (2) - chassis	Min. 1 MΩ

C-10 Related electric circuit diagram



C-11 [E215] Disconnection in 2-stage relief solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormlaity, 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 displyed, 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.

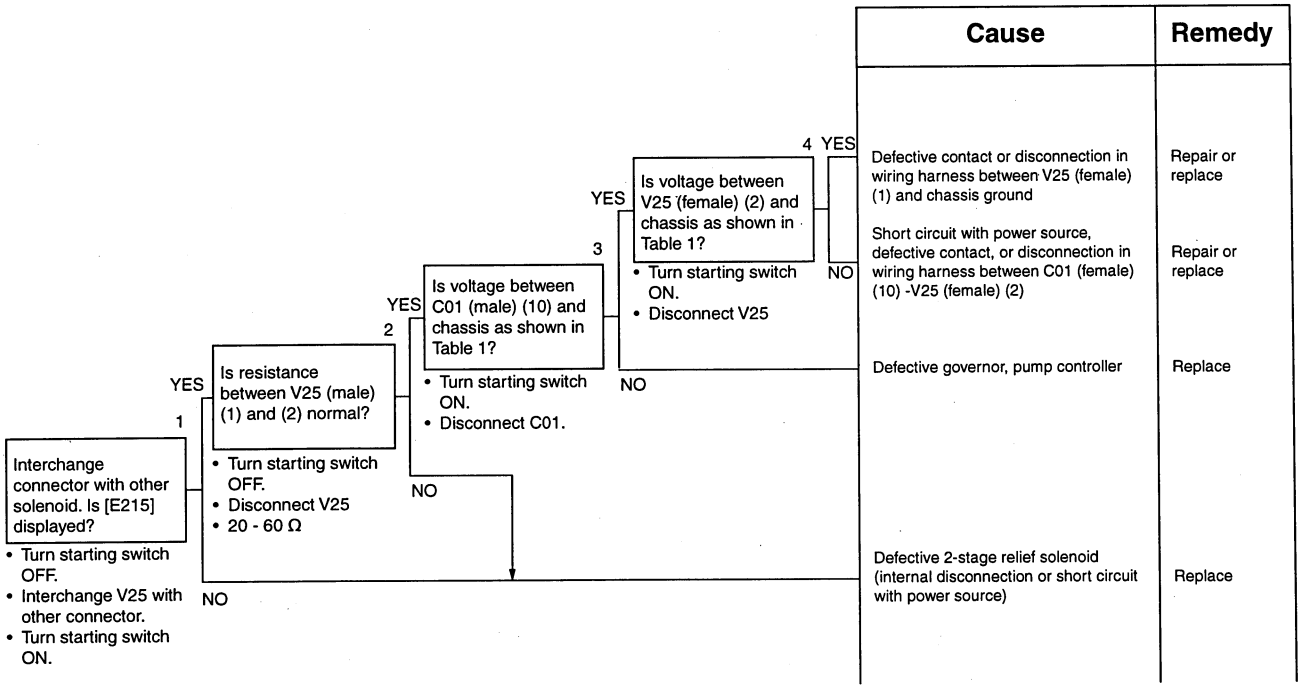
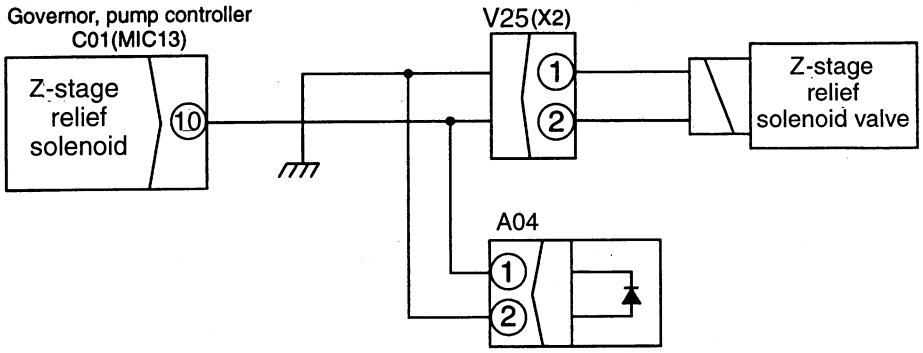


Table 1

Troubleshooting No. 3	Troubleshooting No. 4	Voltage	Measurement condition
Between C01 (male) (10) - chassis	Between V25 (female) (2) - chassis	0 - 3V	All levers at neutral
		20 - 30V	Travel operated independently

C-11 Related electric circuit diagram



C-12 [E206] Short circuit in travel speed solenoid 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.

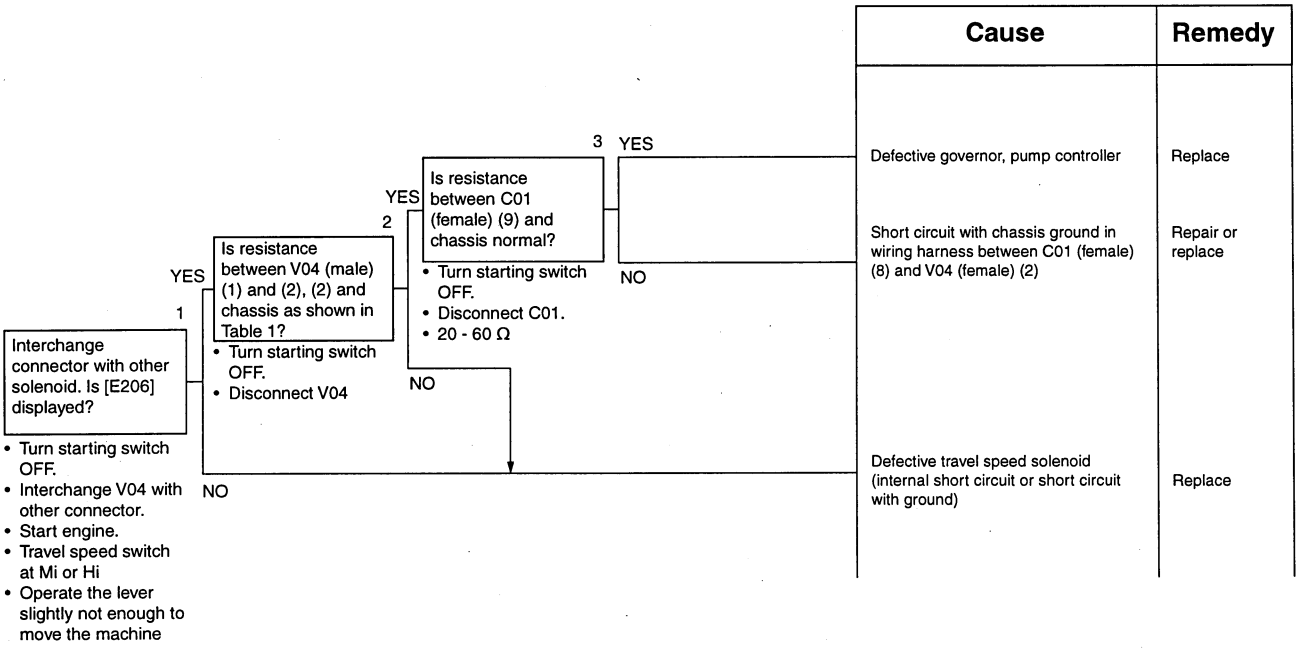
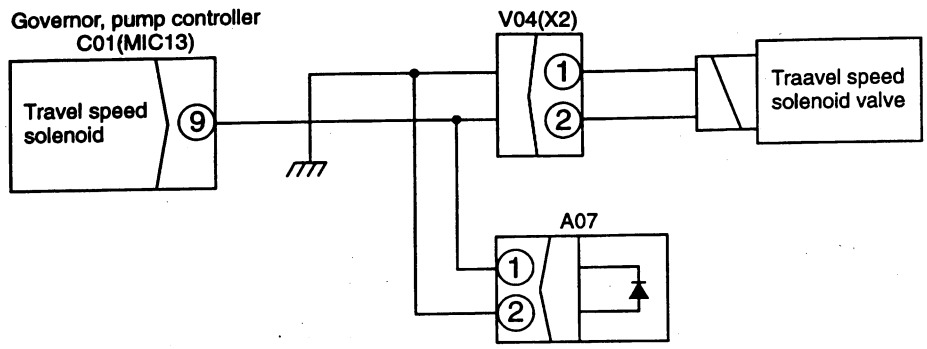


Table 1

Between V04 (male) (1) - (2)	20 - 60 Ω
Between v04 (male) (2) - chassis	Min. 1 MΩ

C-12 Related electric circuit diagram



C-13 [E216] Disconnection in travel speed selector solenoid 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 carryuing out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

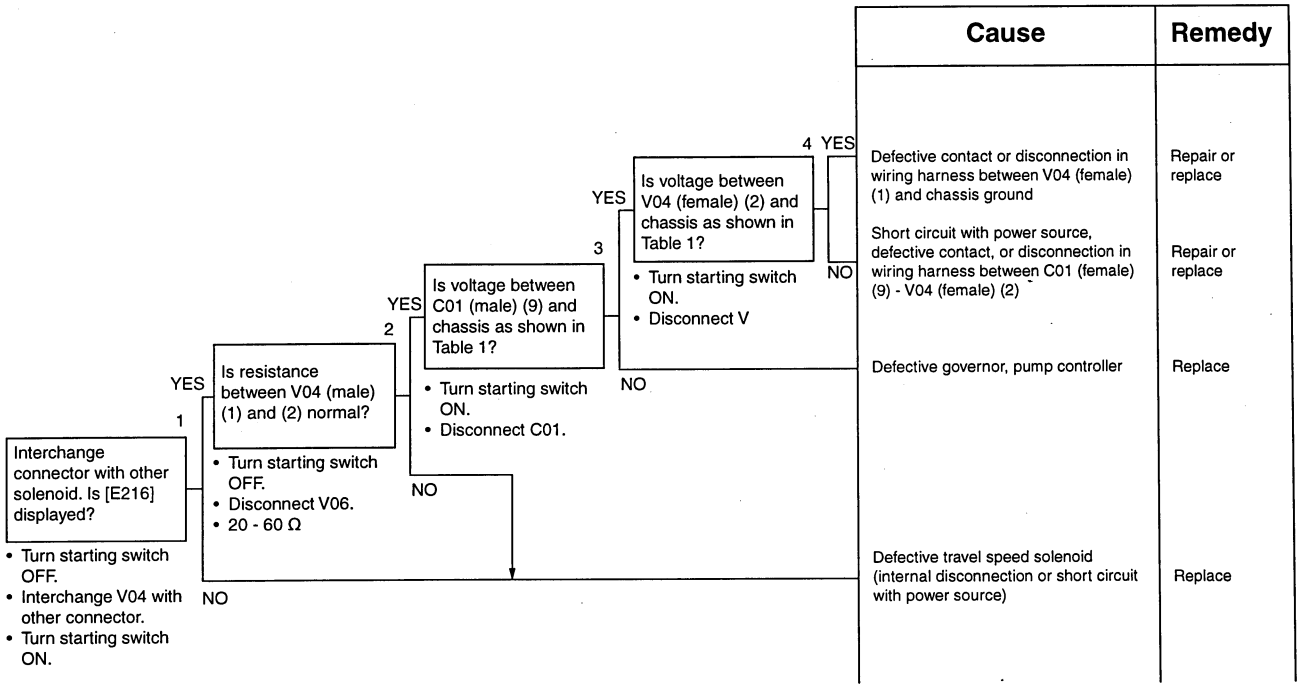
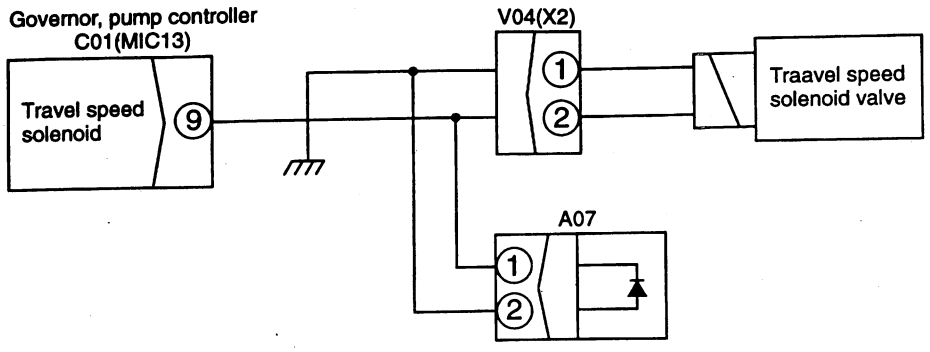


Table 1

Troubleshooting No. 3	Troubleshooting No. 4	Voltage	Measurement condition
Between C01 (male) (10) - chassis	Between V04 (female) (2) - chassis	0 - 3V	Travel speed switch at Lo
		20 - 30V	Travel speed switch at Mi or Hi
			Operate the lever slightly not enough to move the machine

C-13 Related electric circuit diagram



C-14 [E217] Model selection input error 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.

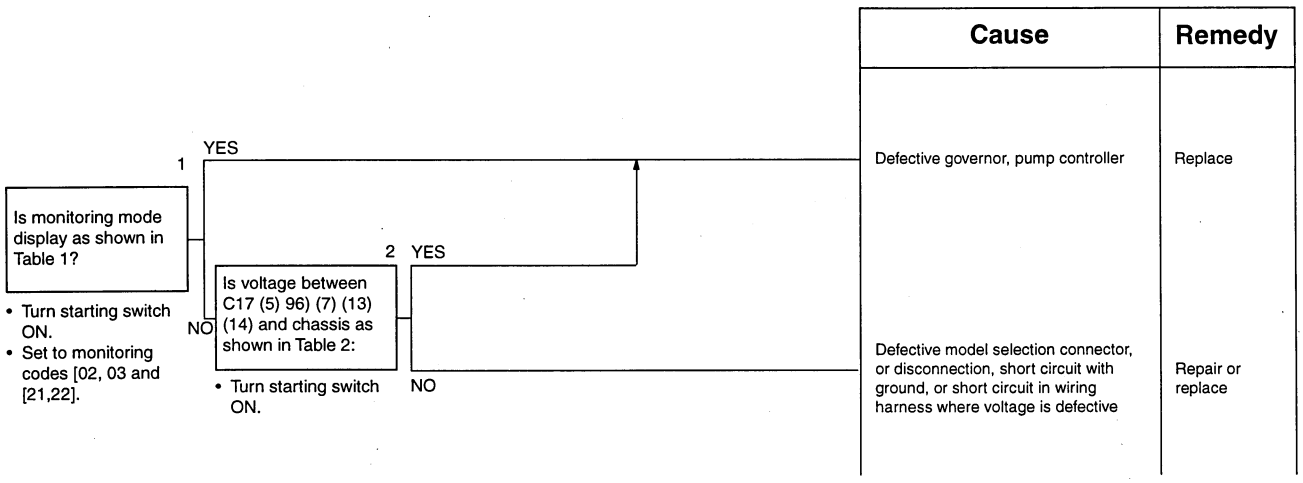
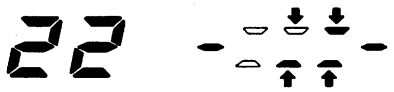


Table 1 Monitoring code display

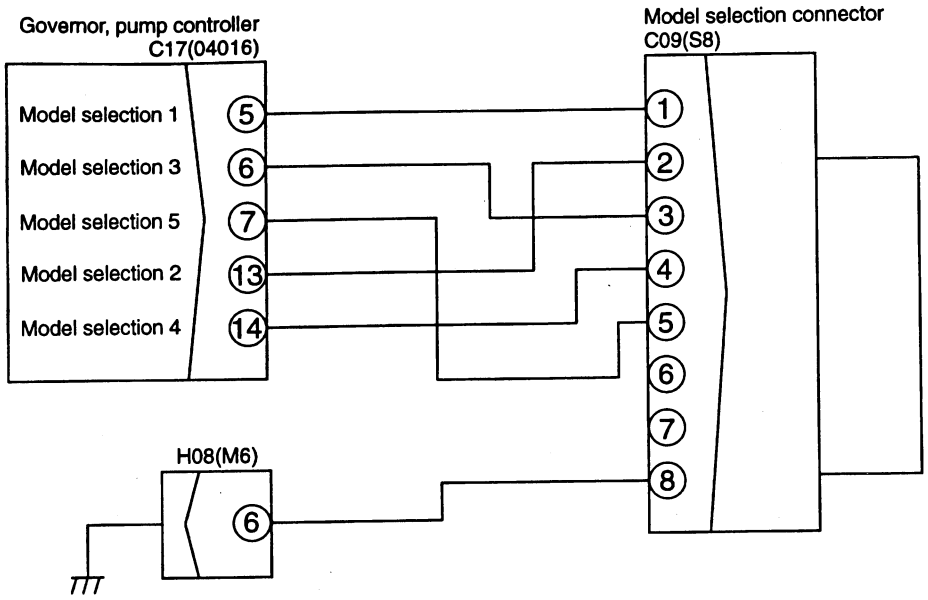
Model code display	Model selection signal input display	
Monitoring codes 02, 03	Monitoring code 21	Monitoring code 22
	 BKP00194	 BKP00198

★ The diagram shows monitoring code 02.
★ Check the bit pattern display marked with ←.

Table 2 Voltage of wiring harness

C17	Between (5) - chassis	Between (6) - chassis	Between (7) - chassis	Between (13) - chassis	Between (14) - chassis
Voltage	Max. 1 V	20 - 30 V	20 - 30 V	Max. 1 V	20 -30 V

C-14 Related electric circuit diagram



C-15 [E222] Short circuit in LS-EPC solenoid 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.

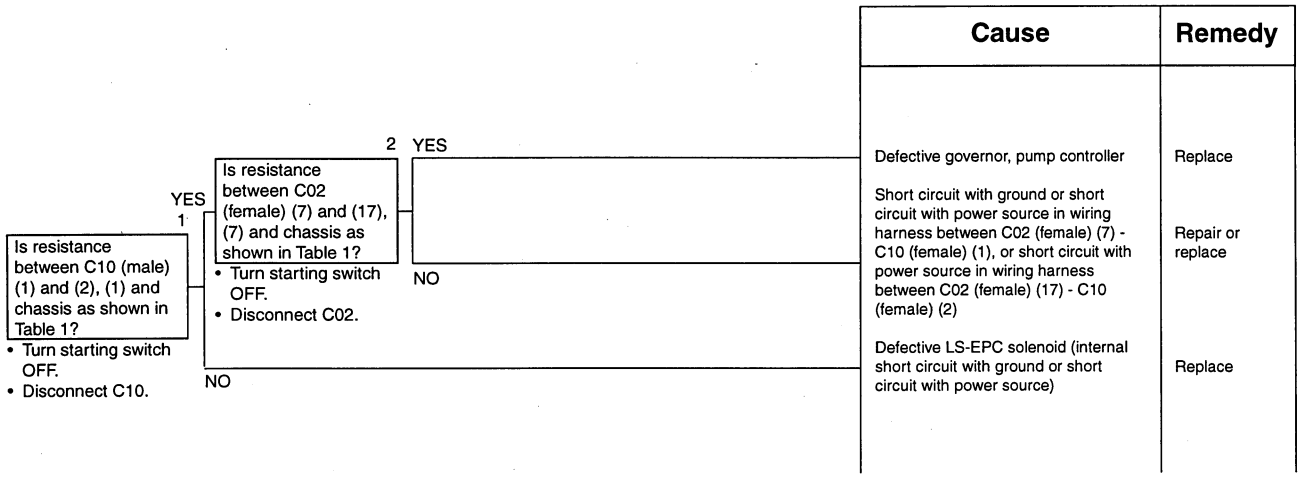
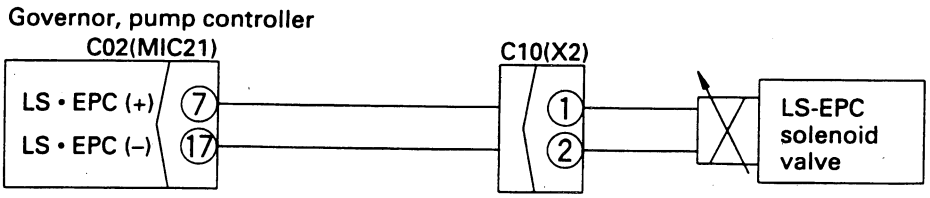


Table 1

Troubleshooting No. 1	Troubleshooting No. 2	Resistance value
Between C10 (male) (1) - (2)	Between C02 (female) (7) - (17)	7 - 14 Ω
Between C10 (male) (1) - chassis	Between C02 (female) (7) - chassis	Min. 1 MΩ

C-15 Related electric circuit diagram



BKP00251

C-16 [E223] Disconnection in LS-EPC solenoid system displays

★ **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.

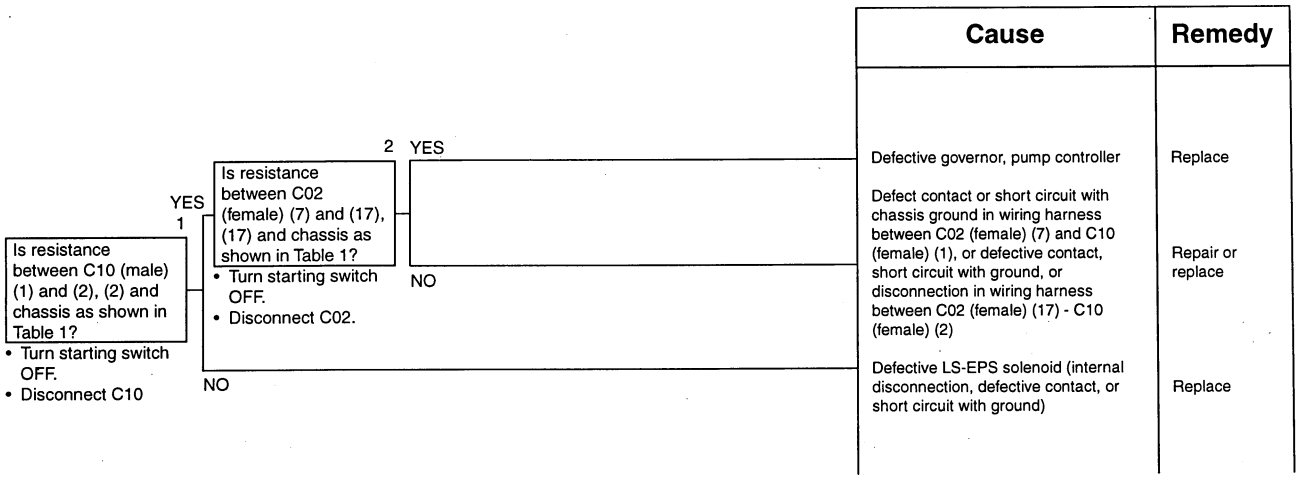
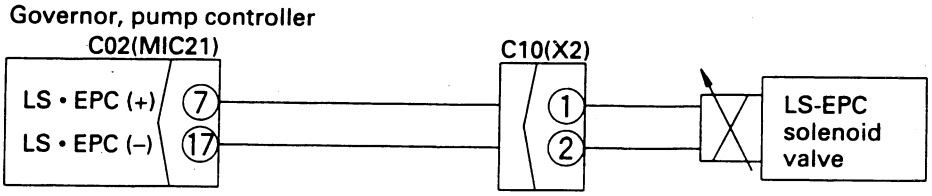


Table 1

Troubleshooting No. 1	Troubleshooting No. 2	Resistance value
Between C10 (male) (1) - (2)	Between C02 (female) (7) - (17)	7 - 14 Ω
Between C10 (male) (1) - chassis	Between C02 (female) (7) - chassis	Min. 1 MΩ

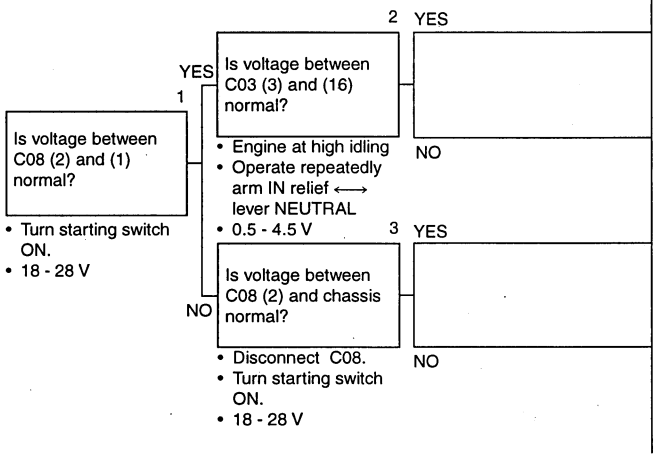
C-16 Related electric circuit diagram



BKP00251

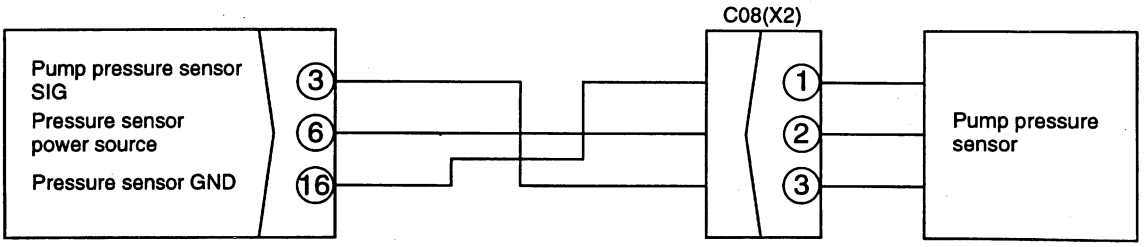
C-17 [E224] Abnormality in pump pressure sensor system is displayed

★ **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 hs been removed.)
★ Before carrying out troubleshooting, check that all the related connecotrds are properly inserted.
★ Always connect any disconnected connectors before going on the next step.



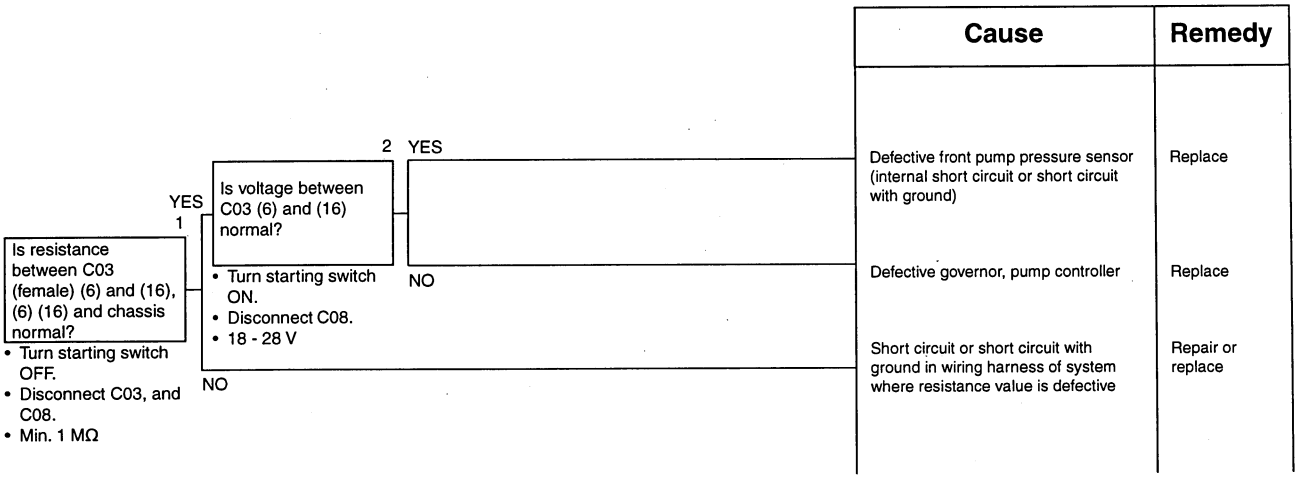
Cause	Remedy
Defective governor, pump controller	Replace
Short circuit with power source, defective contact, or disconnection in wiring harness between C03 (female) (3) - C08 (female) (3)	Repair or replace
Short circuit with ground, defective contact, or disconnction in wiring harness between C03 (female) (6) and C08 (female) (1)	Repair or replace
Short circuit with ground, defective contact, or disconnection in wiring harness between C03 (female) (6) and C08 (female) (2)	Repair or replace

C-17 Related electric circuit diagram

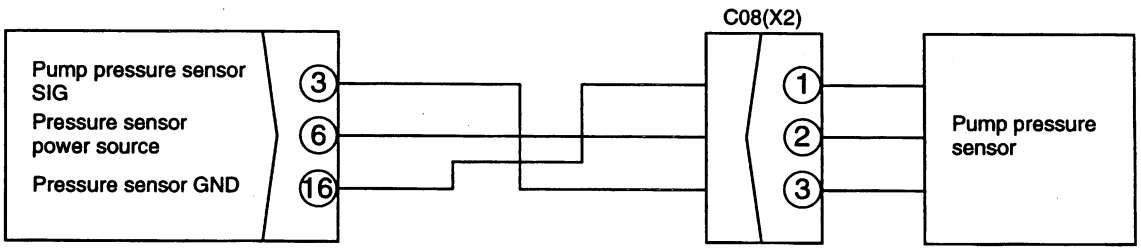


C-19 [E226] Abnormality in pressure sensor power source system is displayed

★ **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 abnormaltiy 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.

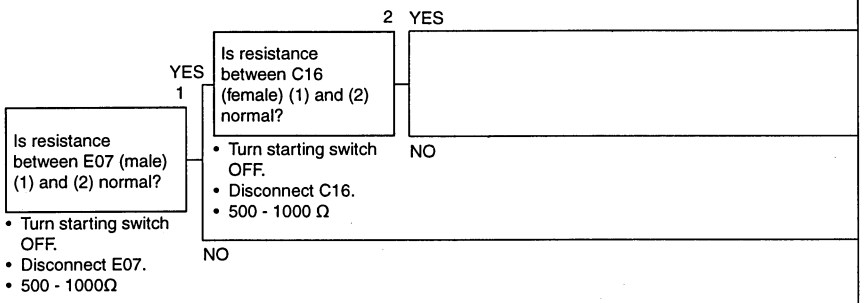


C-19 Related electric circuit diagram



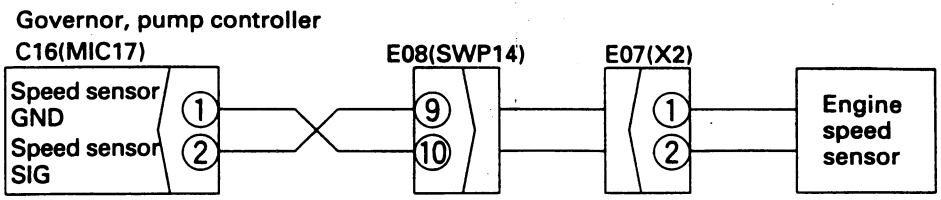
C-20 [E227] Abnormality in engine speed sensor system is displayed

★ **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
Defective govenror, pump controller	Replace
Short circuit with ground, defective contact, or disconnection in wiring harness between C16 (female) (1) - E08 (10) - E07 (female) (2), or between C16 (female) (2) - E08 (9) - E07 (female) (1)	Repair or replace
Defective engine speed sensor (internal disconnection, defective contact, or short circuit with ground)	Replace

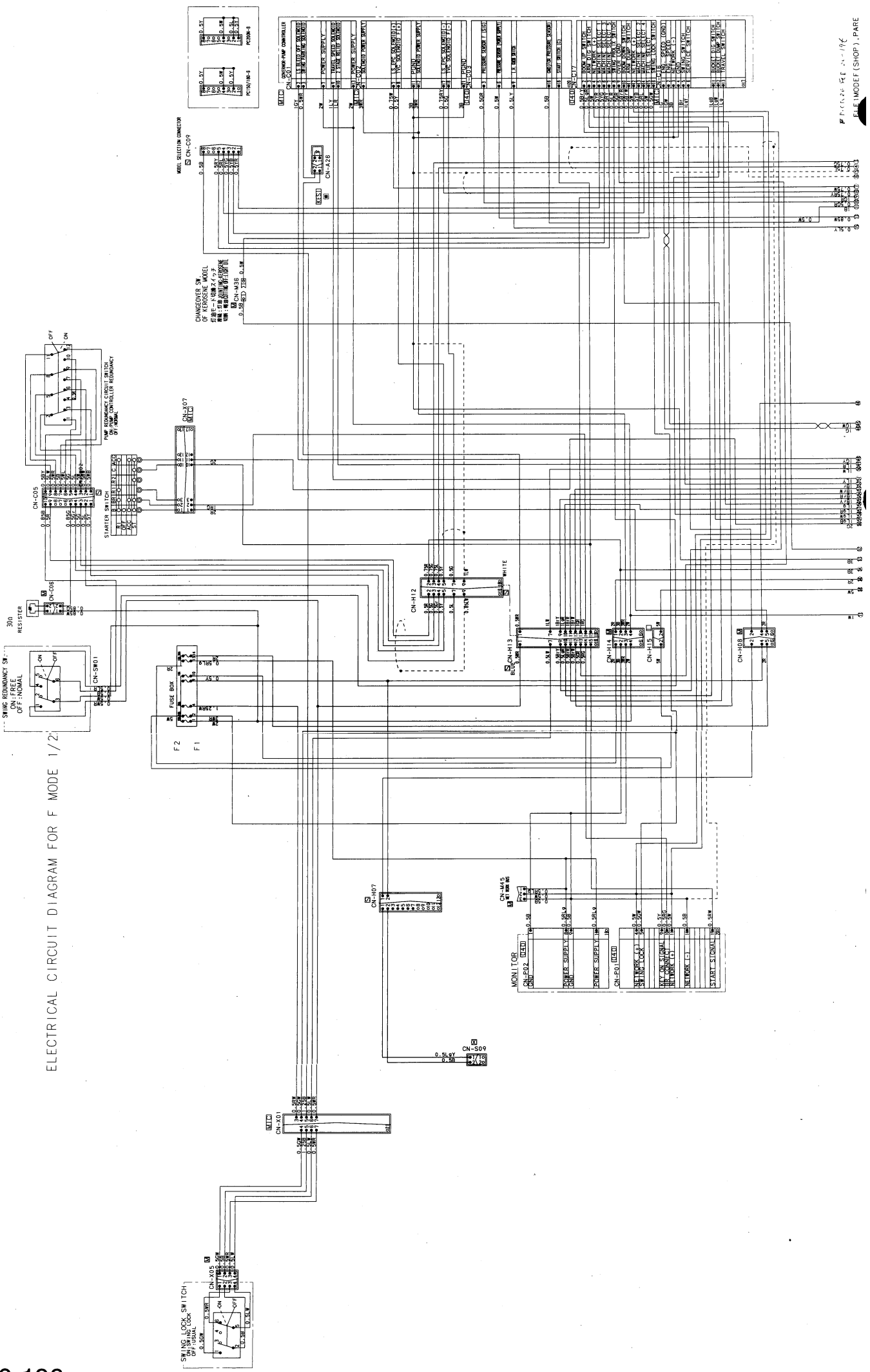
C-20 Related electric circuit diagram



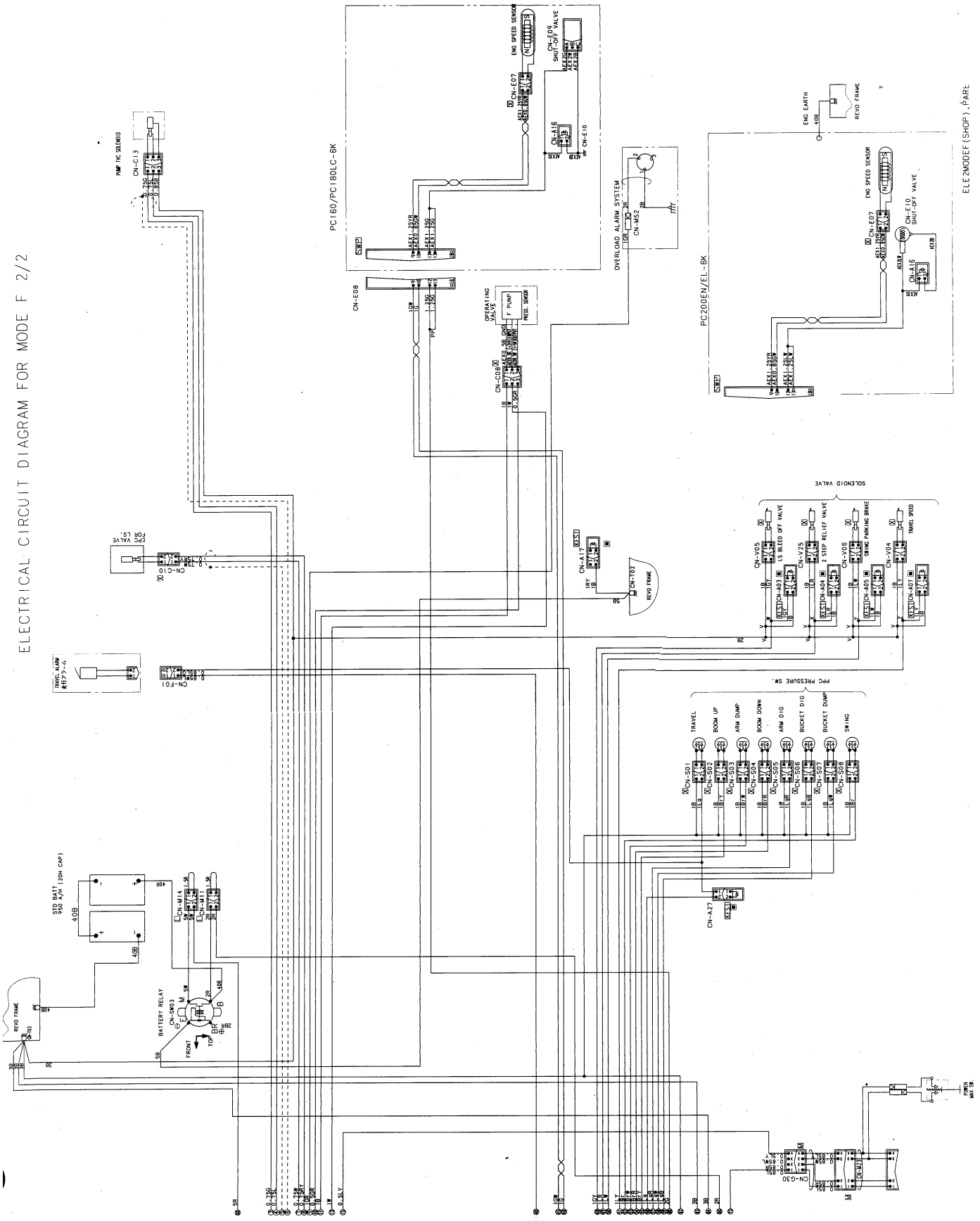
BKP00255

TROUBLESHOOTING OF GOVERNOR, PUMP CONTROLLER (INPUT SIGNAL SYSTEM) (F MODE)

ELECTRICAL CIRCUIT DIAGRAM FOR F MODE 1/2



ELECTRICAL CIRCUIT DIAGRAM FOR F MODE 2/2



F-1 Bit pattern 20-(1) Swing oil pressure switch does not light up

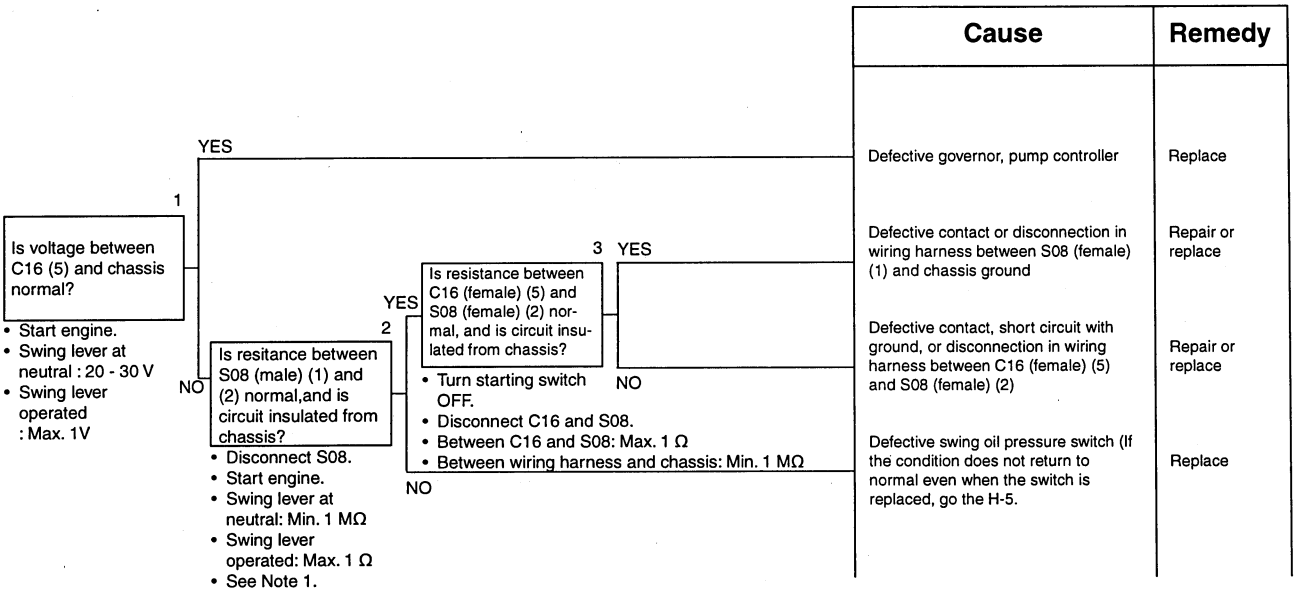
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the monitor code display returns to normal, the problem has been removed.**

⚠ Turn the swing lock switch ON before operating the swing lever.

★ If there is no display when the lever is operated on one side, the PPC shuttle valve is defective. (See H-5) (When measuring with the engine stopped, charge the accumulator first.)

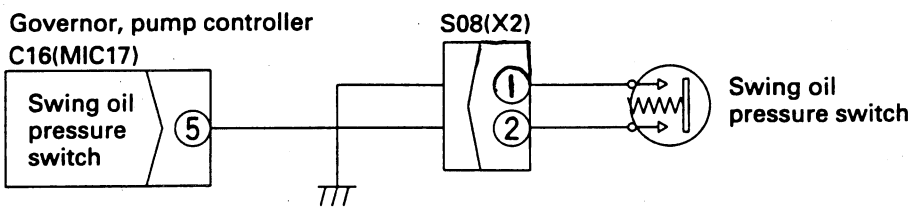
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

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



Note 1: It is also possible to fit a short connector and judge the condition. In this case, check the voltage between C16 (5) and the chassis.
- If it is 20 - 30 V: Go to Yes
- If it is less than 1 V: Go to No

F-1 Related electric circuit diagram



F-2 Bit pattern 20-(2) Travel oil pressure switch does not light up

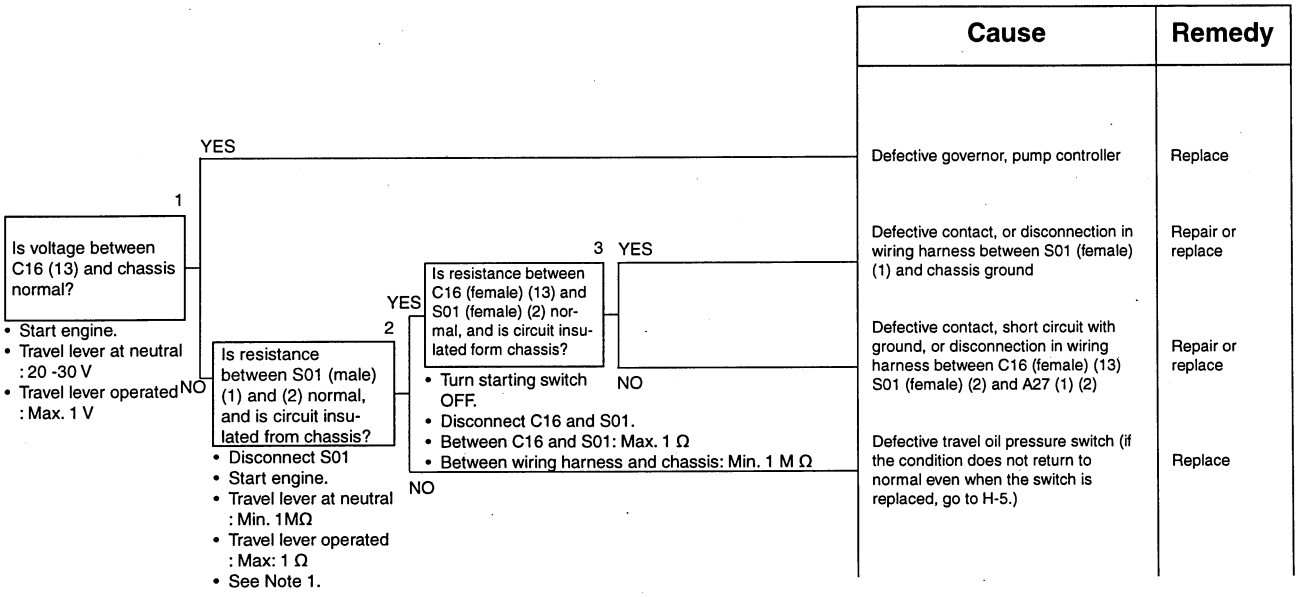
★ **This troubleshooting is carried out when there is still an abnormality, so when the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the monitor code display returns to normal, the problem has been removed.**

⚠ Before operating the travel lever, check that the surrounding area is safe.

★ If there is no display when the travel lever is operated on one side, the PPC shuttle valve is defective. (See H-5)

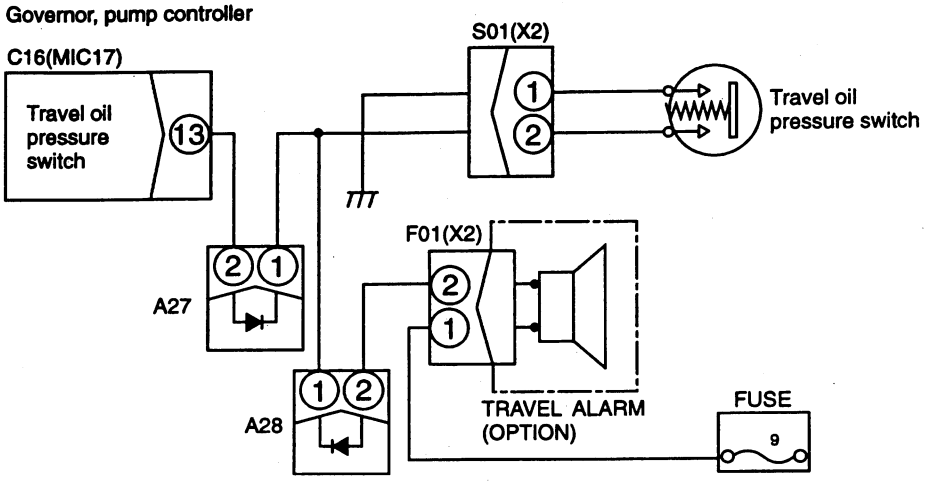
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

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



Note 1: It is also possible to fit a short connector and judge the condition. In this case, check the voltage between C16 (13) and the chassis.
- If it is 20 - 30 V: Go to YES
- If it is less than 1 V: Go to NO

F-2 Related electric circuit diagram



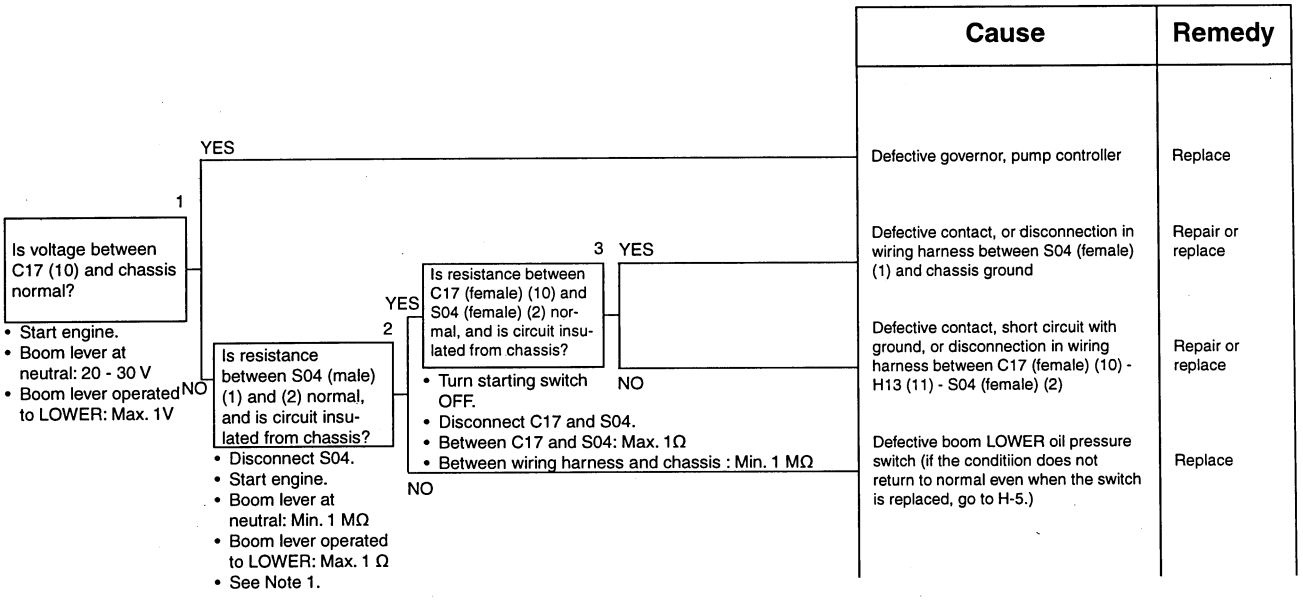
F-3 Bit pattern 20-(3) Boom LOWER oil pressure switch does not light up

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adpate, 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.)

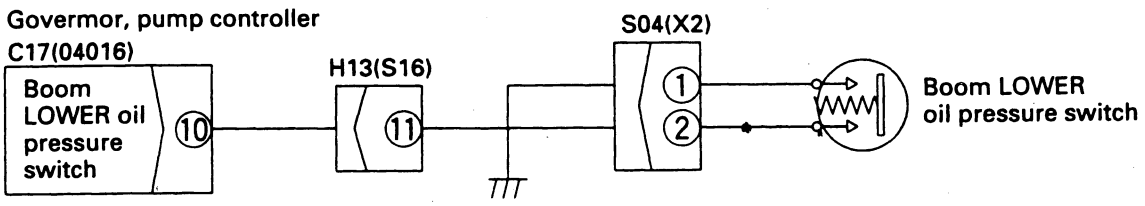
★ Before carrying out troubelshooting, check that all the related connectors are properly inserted.

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



Note 1: It is also possible to fit a short connector and judge the condition. In this case, check the voltage between C17 (10) and the chassis.
- If it is 20 - 30 V: Go to YES
- If it is less than 1 V: Go to NO

F-3 Related electric circuit diagram



BKP00259

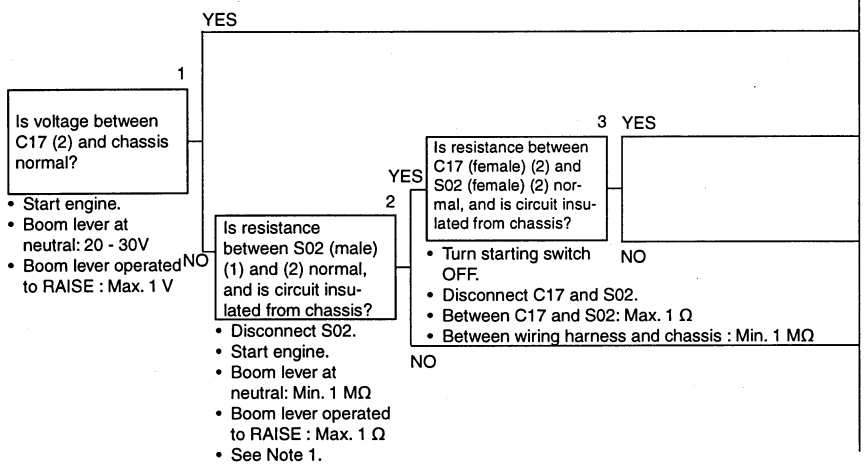
F-4 Bit pattern 20-(4) Boom RAISE oil pressure switch does not light up

★ **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.

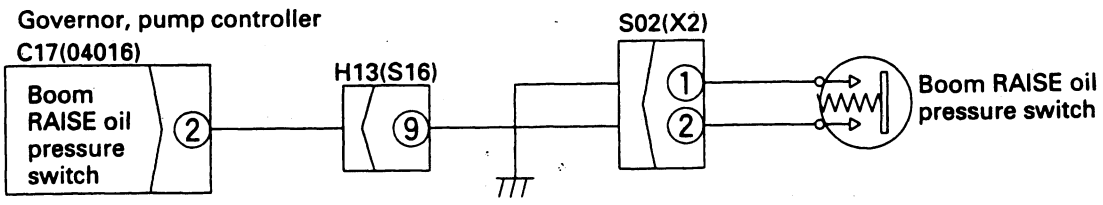
★ Always connect any disconnected connectors before going on the next step.



Cause	Remedy
Defective governor, pump controller	Replace
Defective contact, or disconnection in wiring harness between S02 (female) (1) and chassis ground	Repair or replace
Defective contact, short circuit with ground, or disconnection in wiring harness between C17 (female) (2) - H13 (9) - S02 (female) (2)	Repair or replace
Defective boom RAISE oil pressure switch (If the condition does not return to normal even when the switch is replaced, go to H-5.)	Replace

Note 1: It is also possible to fit a short connector and judge the condition. In this case, check the voltage between C17 (2) and the chassis.
- If it is 20 - 30V : Go to YES
- If it is less than 1V: Go to NO

F-4 Related electric circuit diagram



BKP00260

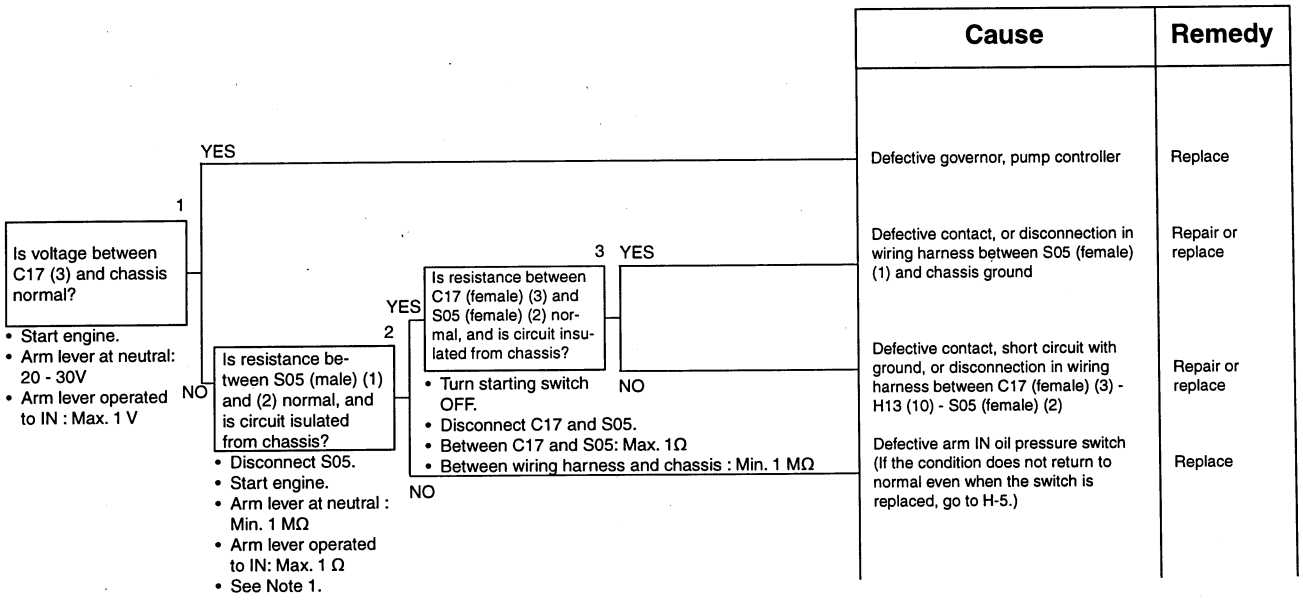
F-5 Bit pattern 20-(5) Arm IN oil pressure switch does not light up

★ **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.)

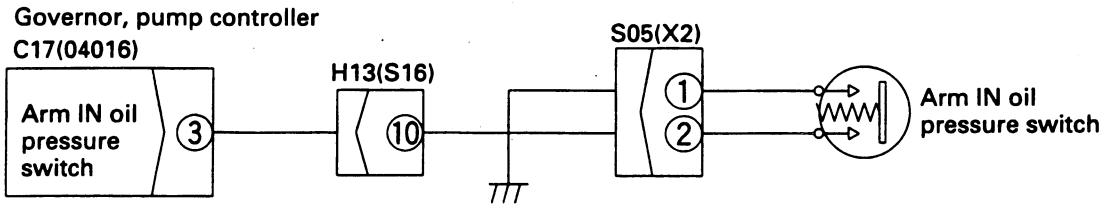
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

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



Note 1: It is also possible to fit a short connecotr 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

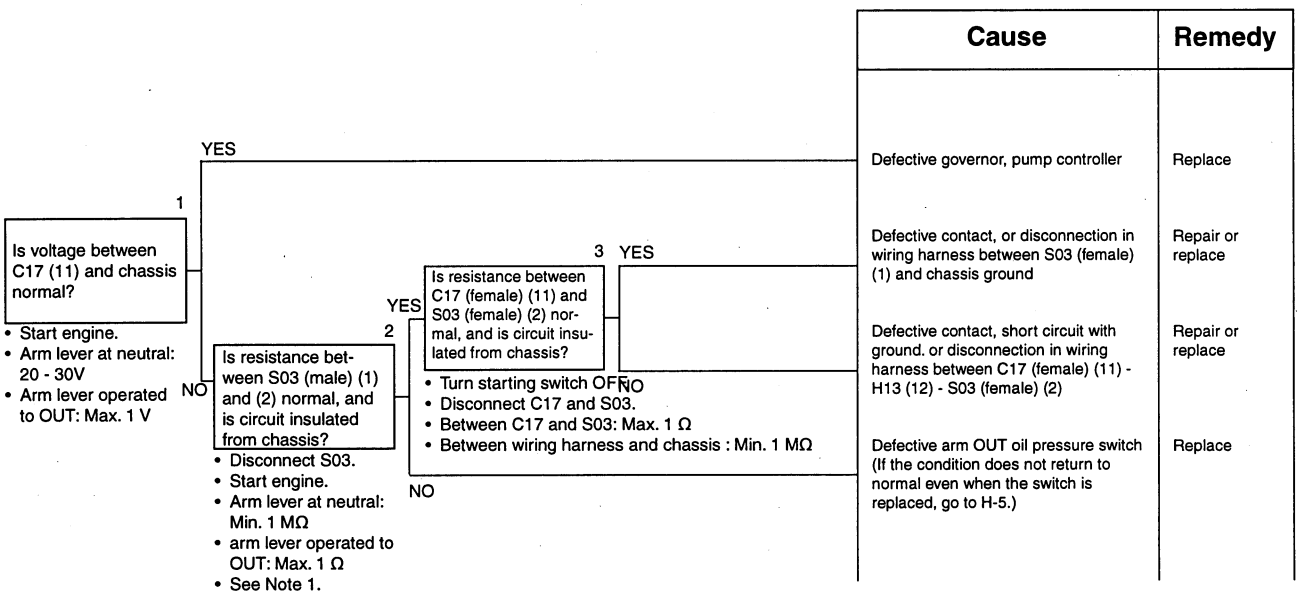
F-6 Bit pattern 20-6 Arm Out oil pressure switch does not light up

★ **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.)

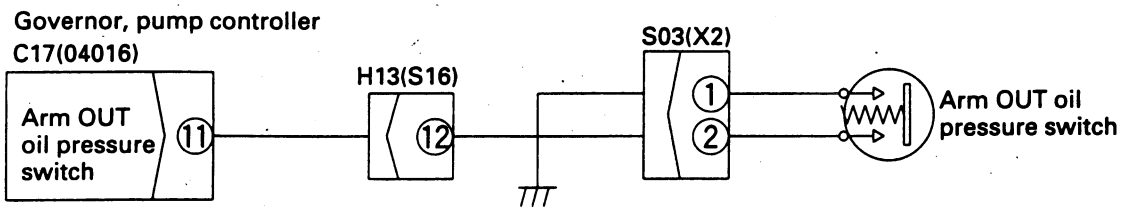
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

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



Note 1: It is also possible to fit a short connector and judge the condition. In this case, check the voltage between C17 (11) and the chassis.
- If it is 20 - 30V: Go to YES
- If it is less than 1V: Go to NO

F-6 Related electric circuit diagram



BKP00262

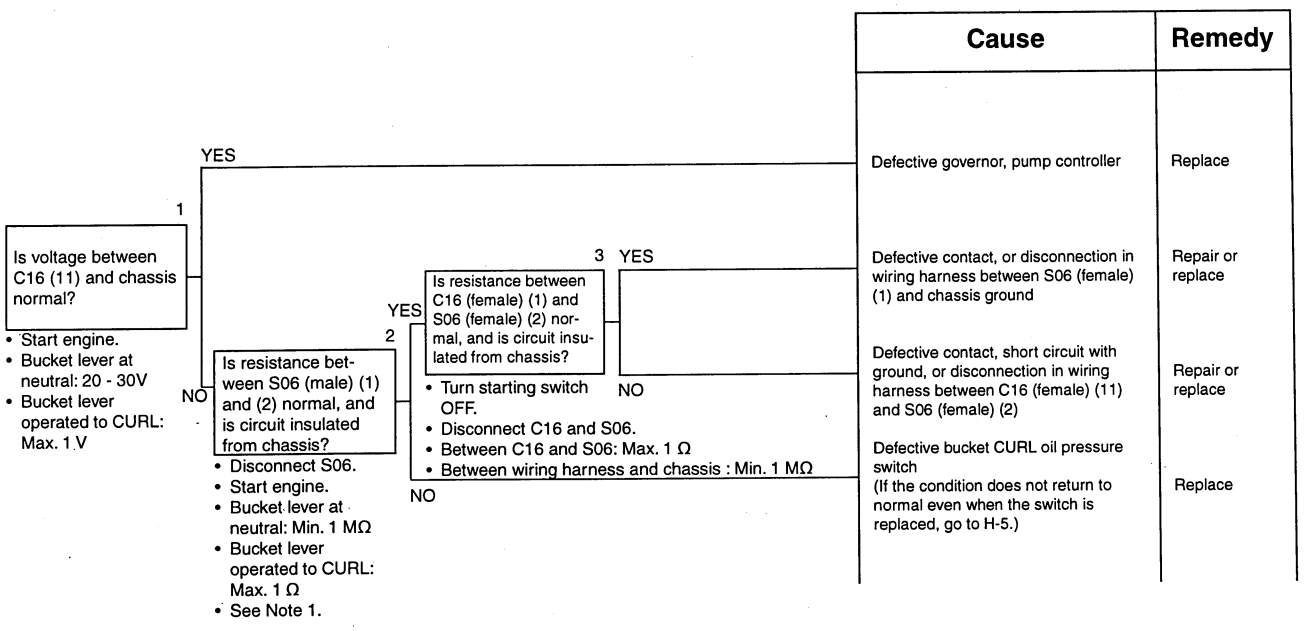
F-7 Bit pattern 21-(1) Bucket CURL oil pressure switch does not light up

★ **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.)

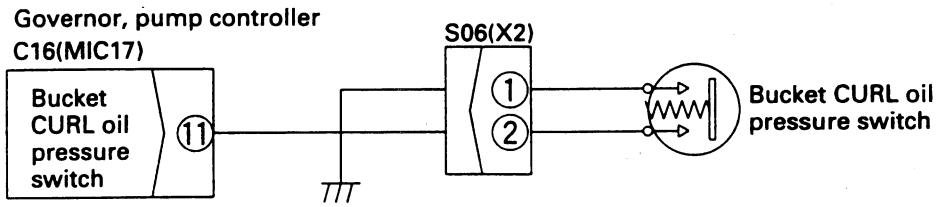
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

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



Note 1: It is also possible to fit a short connector and judge the condition. In this case, check the voltage between C16 (11) and the chassis.
- If it is 20 - 30V: Go to YES
- If it is less than 1V: Go to NO

F-7 Related electric circuit diagram



BKP00263

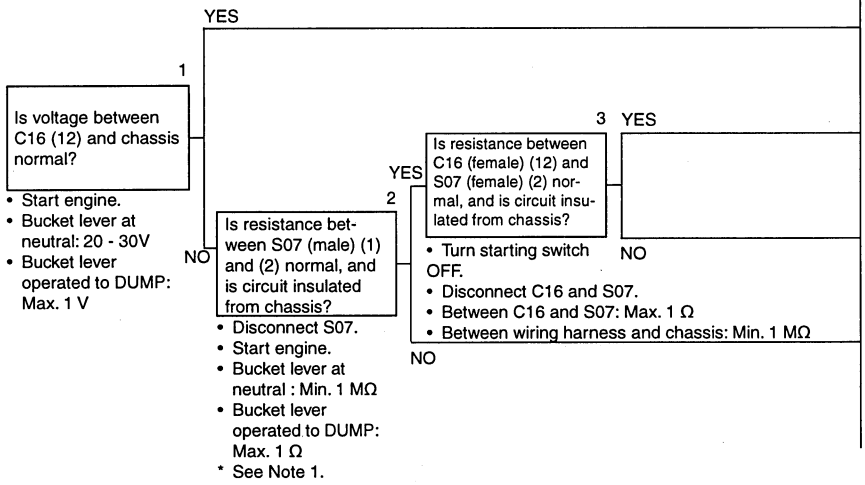
F-8 Bit pattern 21-(2) Bucket DUMP oil pressure switch does not light up

★ **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.

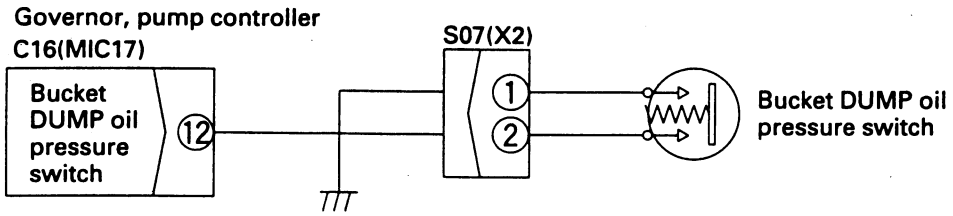
★ Always connect any disconnected connectors before going on the next step.



Cause	Remedy
Defective governor, pump controller	Replace
Defective contact or disconnection in wiring harness between S07 (female) (2) and chassis ground	Repair or replace
Defective contact, short circuit with ground, or disconnection in wiring harness between C16 (female) (12) and S07 (female) (2)	Repair or replace
Defective bucket DUMP oil pressure switch (If the condition does not return to normal even when the switch is replaced, go to H-5.)	Replace

Note 1: It is also possible to fit a short connector and judge the condition. In this case, check the voltage between C16 (12) and the chassis.
- If it is 20 - 30V: Go to YES
- If it is less than 1V: Go to NO

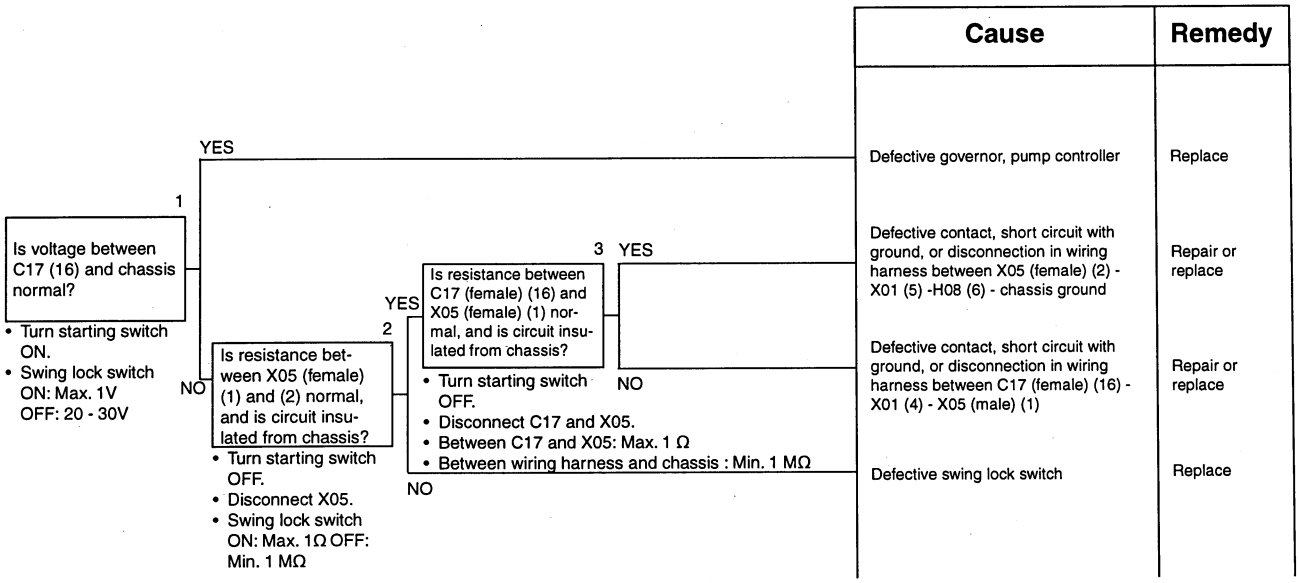
F-8 Related electric circuit digram



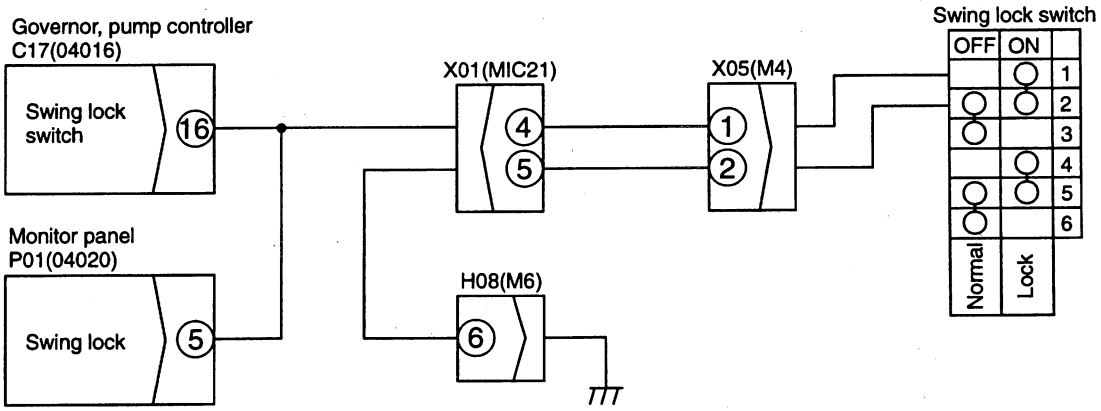
BKP00264

F-9 Bit pattern 21-(3) Swing lock 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.**
★ If the panel display is normal. (If the swing lock lamp does not light up, go to M-21.)
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

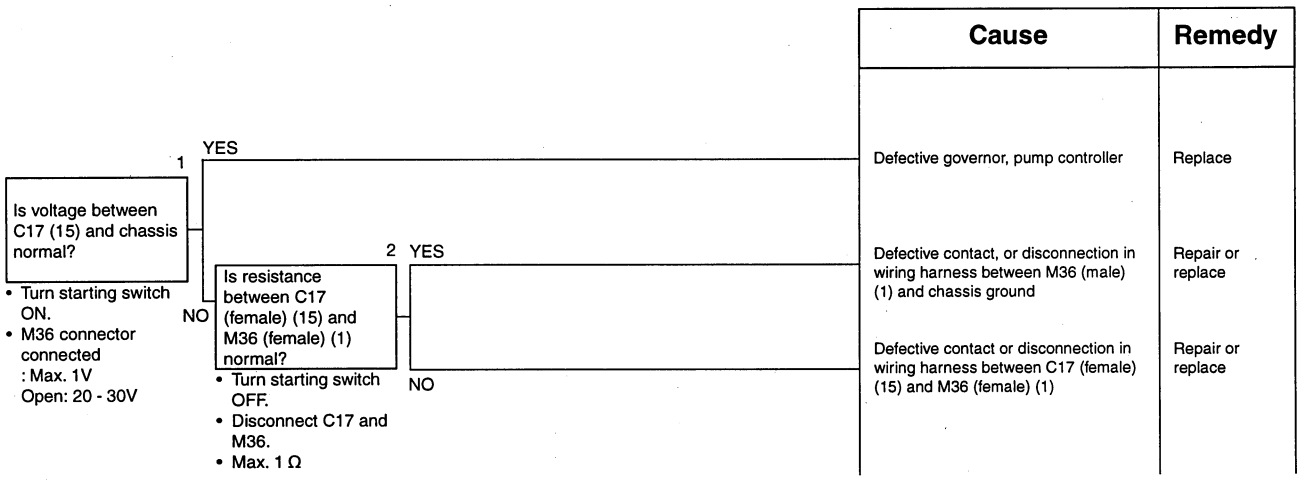


F-9 Related electric circuit diagram

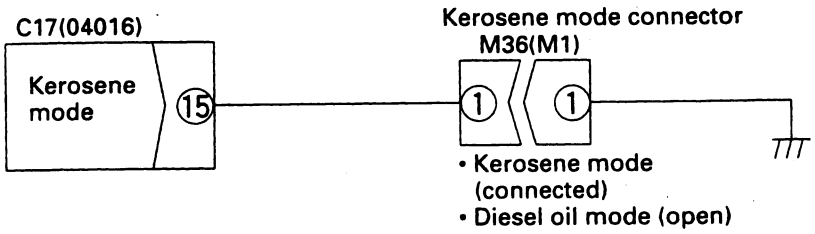


F-10 Bit pattern 22-(5) Kerosene mode connection does not light up

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



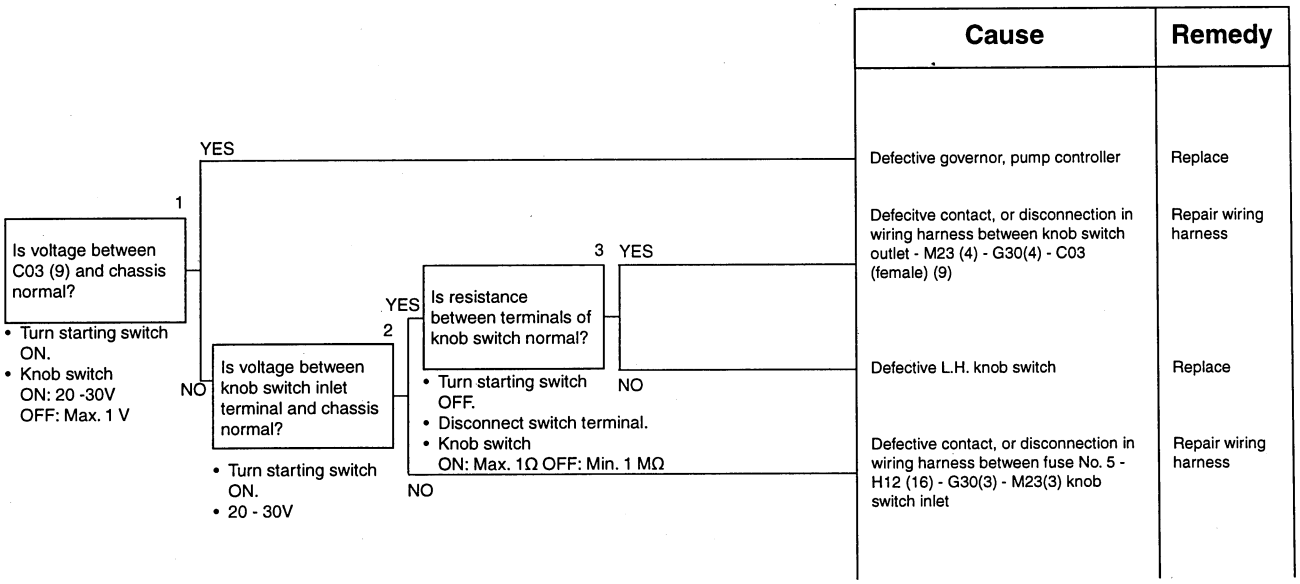
F-10 Related electric circuit diagram



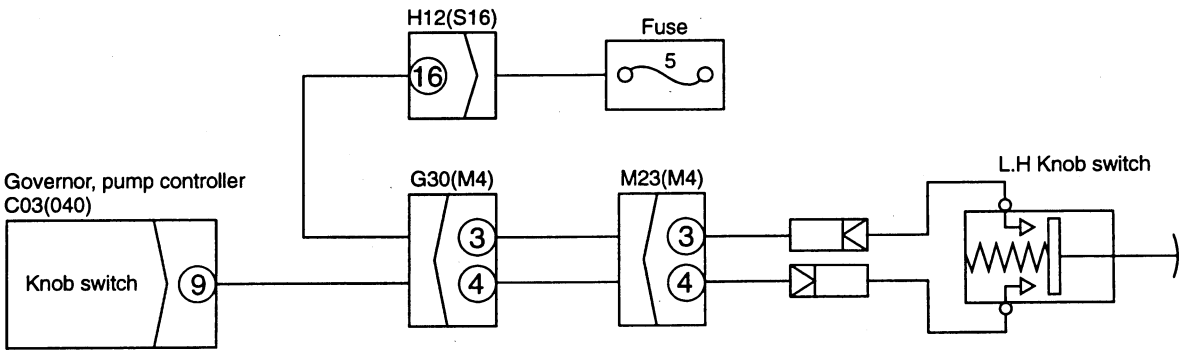
BKP00266

F-11 Bit pattern 22-(6) L.H. knob 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 fuse No. 5 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.



F-11 Related electric circuit diagram



TROUBLESHOOTING OF HYDRAULIC, MECHANICAL SYSTEM (H MODE)

TABLE OF FAILURE MODES AND CAUSES (1/2)

Failure mode \ Parts causing failure			Piston pump							Control valve
			TVC valve	LS valve	Servo piston	Pump proper	Control pump	Strainer	Damper	Spool
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 is 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 deviation	Deviation excessive during normal travel								○
		Deviation is excessive when starting								
	Travel speed is slow									○
	Steering does not turn or lacks power									
	Travel speed does not switch or is faster than specified speed									
	Does not move (one side only)									
Swing system	Does not swing	Both left and right								
		One direction only								○
	Swing acceleration is pour 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									
	Exessive 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 independent operations are normal

Control valve																							
										Regeneration valve													
Main relief valve	Unload valve	Pressure compensation valve	LS circuit check valve	LS shuttle valve	LS select valve	LS circuit throttle	Arm counterbalance valve	Boom	Arm	Safety-suction valve	Suction valve	LS bypass valve	PPC valve	PPC shuttle	Safety lock vlave	Swing PPC slow return valve	Swivel joint	Engine system	Troubleshooting code
○	○											○							H-1
																		○	H-2
															○				H-3
																			H-4
														○					H-5
						○													H-6
		○		○				○			○		○						H-7
		○		○			○		○	○			○						H-8
		○								○			○						H-9
													○						H-10
													○						
													○						
		○								○									H-11
		○						○	○	○									H-12
		○																	H-13
																			H-14
○																			H-15
																			H-16
					○									○					H-17
					○							○		○					H-18
												○							H-19
		○											○	○					H-20
		○		○							○	○	○	○					H-21
		○		○							○	○				○			H-22
											○								H-23
																			H-24
																			H-25
													○						
				○								○							H-26
		○								○			○	○					
																			H-27
													○			○			
													○			○			H-28
																			H-29
																			H-30
		○																	
																			H-31

TABLE OF FAILURE MODES AND CAUSES (2/2)

Failure mode \ Parts causing failure			Solenoid valve					Swing motor	
			LS-EPC	LS bypass	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			○					
	IIn work equipment boom raise + travel, travel speed drops excessively			○					
Travel system	Travel deviation	Deviation excessive during normal travel							
		Deviation is excessive when starting							
	Travel speed is slow		○	○					
	Steering does not turn or lacks power						○		
	Travel speed does not switch or is faster than specified speed		○				○		
	Does not move (one side only)								
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							○	
	Exessive 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 independent operations are normal

Travel motor													Pressure switch									Pump pressure sensor	Troubleshooting code
													Boom		Arm		Bucket						
Safety valve	Counterbalance valve	Check valve	Travel speed selector servo piston	Leakage, breakage inside body	Swing machinery	Final drive	Hydraulic cylinder	Boom lock valve	Back pressure valve (Lift check valve)	Travel junction valve	Holding brake (Swing machinery)		RAISE	LOWER	IN	OUT	CURL	DUMP	Swing	Travel		
																							H-1
																							H-2
																							H-3
																							H-4
													○	○	○	○	○	○	○	○			H-5
																							H-6
							○	○					○	○									H-7
							○								○	○							H-8
							○										○	○					H-9
																							H-10
							○	○															H-11
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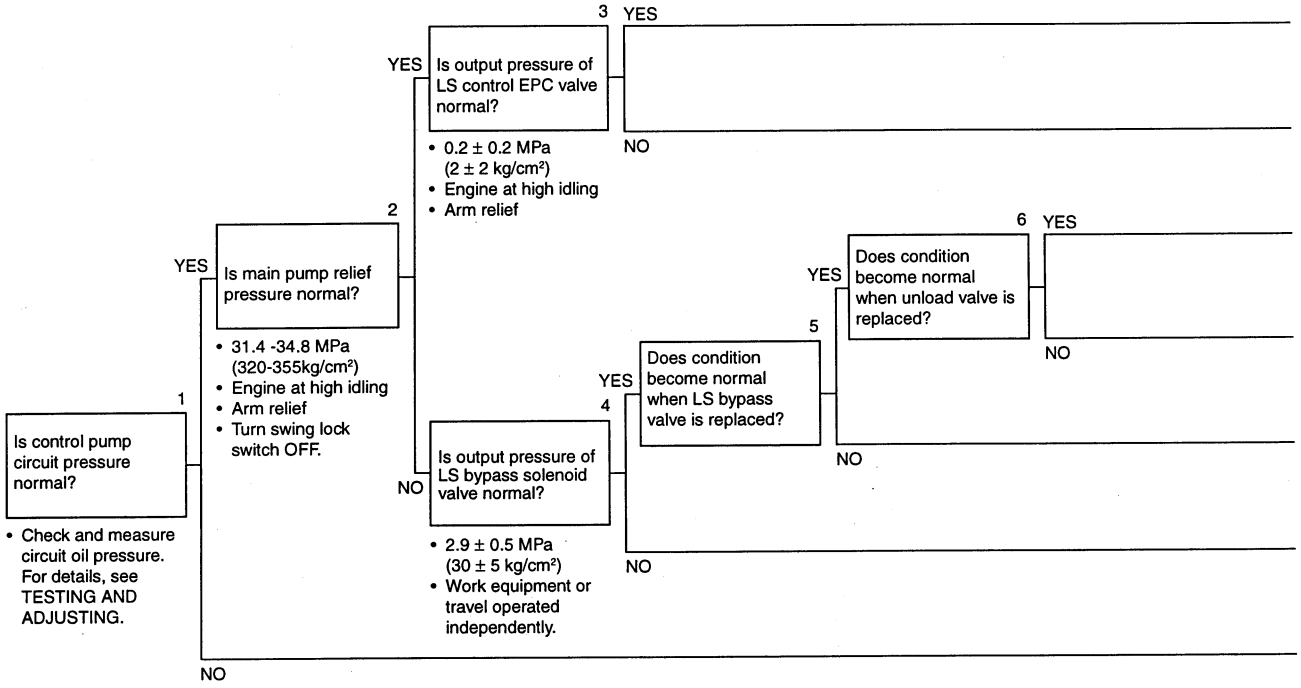
				○						○													H-20
	○																						
				○						○									○				H-21
○		○								○									○				H-22
			○																○				H-23
○				○		○																	H-24
					○						○							○					H-25
																							H-26
																							H-27
																							H-28
					○				○														H-29
											○												H-30
																							H-31

H-1 Speeds of all work equipment, swing, travel are slow or lack power

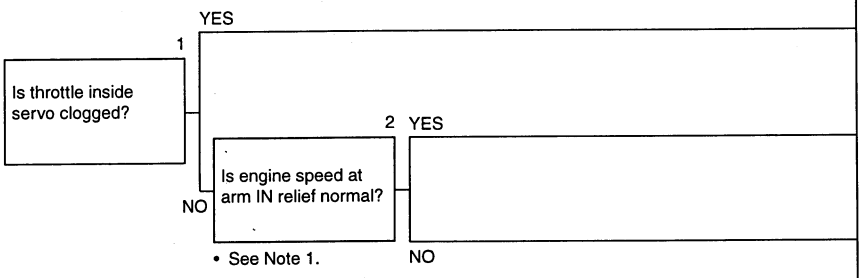
★ Carry out troubleshooting in the H/O mode.
★ Check that no abnormal noise is being generated from the main pump before carrying out troubleshooting. (If there is any abnormal noise, carry out troubleshooting for H-4.)



Cause	Remedy
Defective piston pump assy.	Replace
Defective operation of LS control EPC solenoid valve	Replace
Defective operation of unload valve	Repair or replace
Defective operation of main relief valve	Replace
Defective operation of LS bypass valve	Replace
Defective operation of LS bypass solenoid valve	Replace
Defective hydraulic equipment in control pump circuit (See TESTING AND ADJUSTING)	Adjust or replace

H-2 There is excessive drop in engine speed, or engine stalls

★ Carry out troubleshooting in the H/O mode.
★ Check that the main relief pressure is normal.

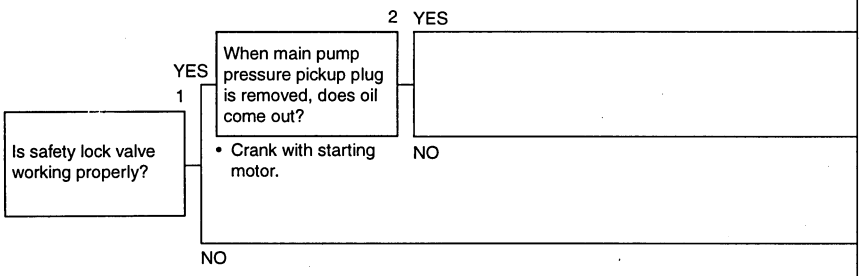


Cause	Remedy
Clogged throttle inside servo	Clean
Defective piston pump Assy	Replace
See troubleshooting for engine (S mode)	-

* Engine speed (reference) at arm IN relief when engine and pump are normal

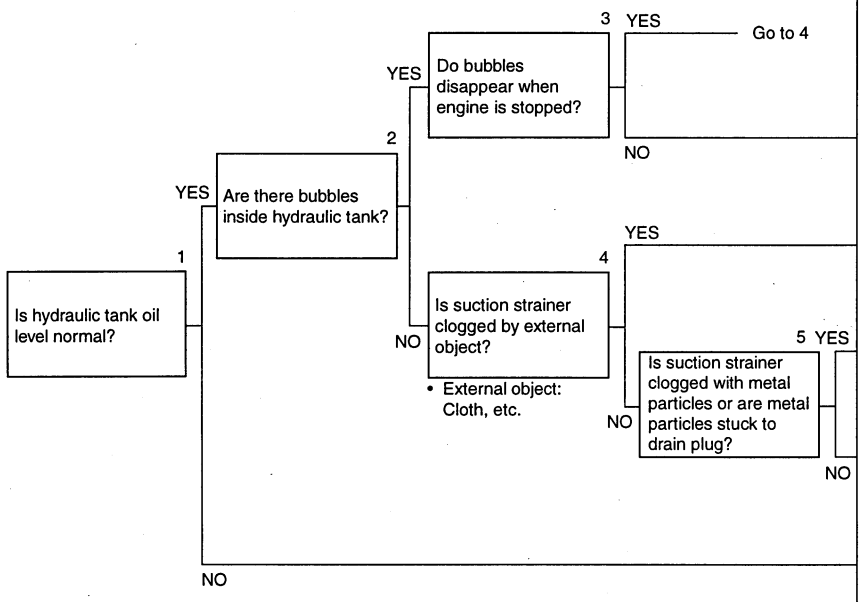
Engine speed at arm IN relief	Conditions
2.100 ± 100rpm	• Engine at high idling • Power max.mode • Swing lock switch ON • Measure the speed at the point where the drop in engine speed is greatest when the arm cylinder is at the end of stroke and the lever is operated slowly to the full position.

H-3 No work equipment, travel, swing move



Cause	Remedy
Defective control pump, defective control relief vlave, defective control circuit, or defective main piston pump	Replace
Defective damper	Replace
Defective operation of safety lock valve or safety linkage	Adjust

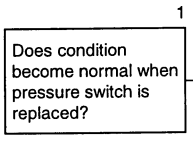
H-4 Abnormal noise generated (around pump)



Cause	Remedy
Improper hydraulic oil	Change hydraulic oil
Clogged by external object (cloth, etc.)	Remove
Defect inside pump	Repair or replace
Operate for a short time and watch for any change in symptoms	Inspect again (depending on changes in symptoms)
Lack of hydraulic oil	Add hydraulic oil

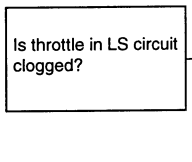
H-5 Auto-deceleration does not work (when PPC shuttle valve is cause)

★ The control pressure for the travel and swing passes through the PPC shuttle valve and is supplied to the pressure switch.



	Cause	Remedy
1 YES	Defective pressure switch	Replace
NO	Defective operation of PPC shuttle valve in applicable system (swing or travel)	Repair or replace

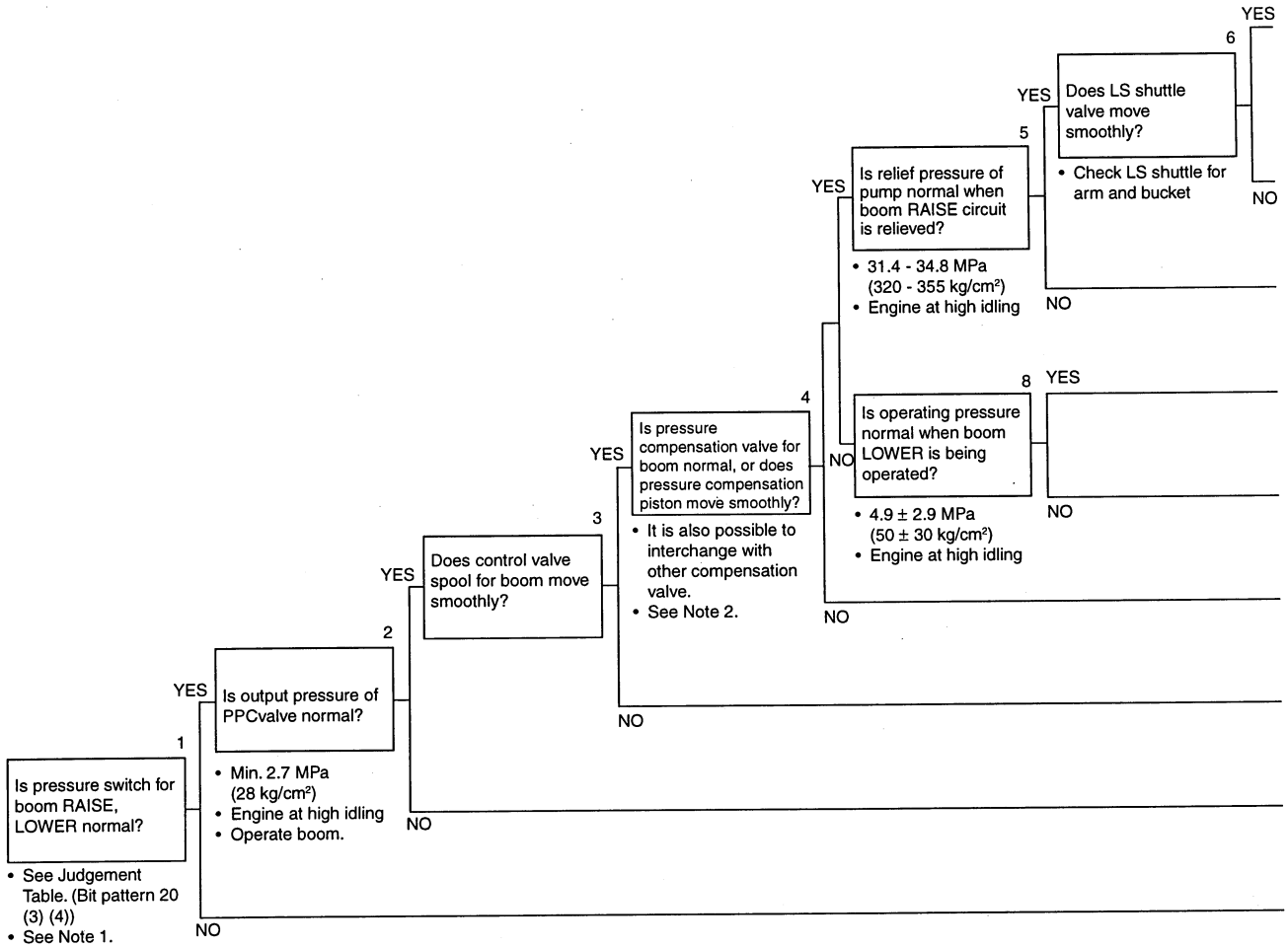
H-6 Fine control ability is poor or response is poor



	Cause	Remedy
1 YES	Cloggd throttle in LS circuit	Clean
NO	Defective servo valve assembly (LS valve), or defective servo piston	Replace

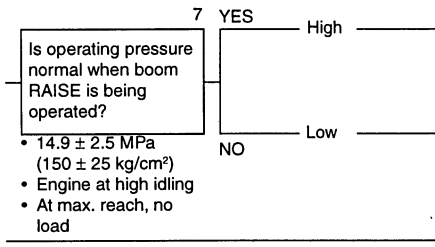
H-7 Boom is slow or lacks power

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



Note 1: If auto-deceleration is canceled when boom RAISE or boom LOWER is operated, system is normal.

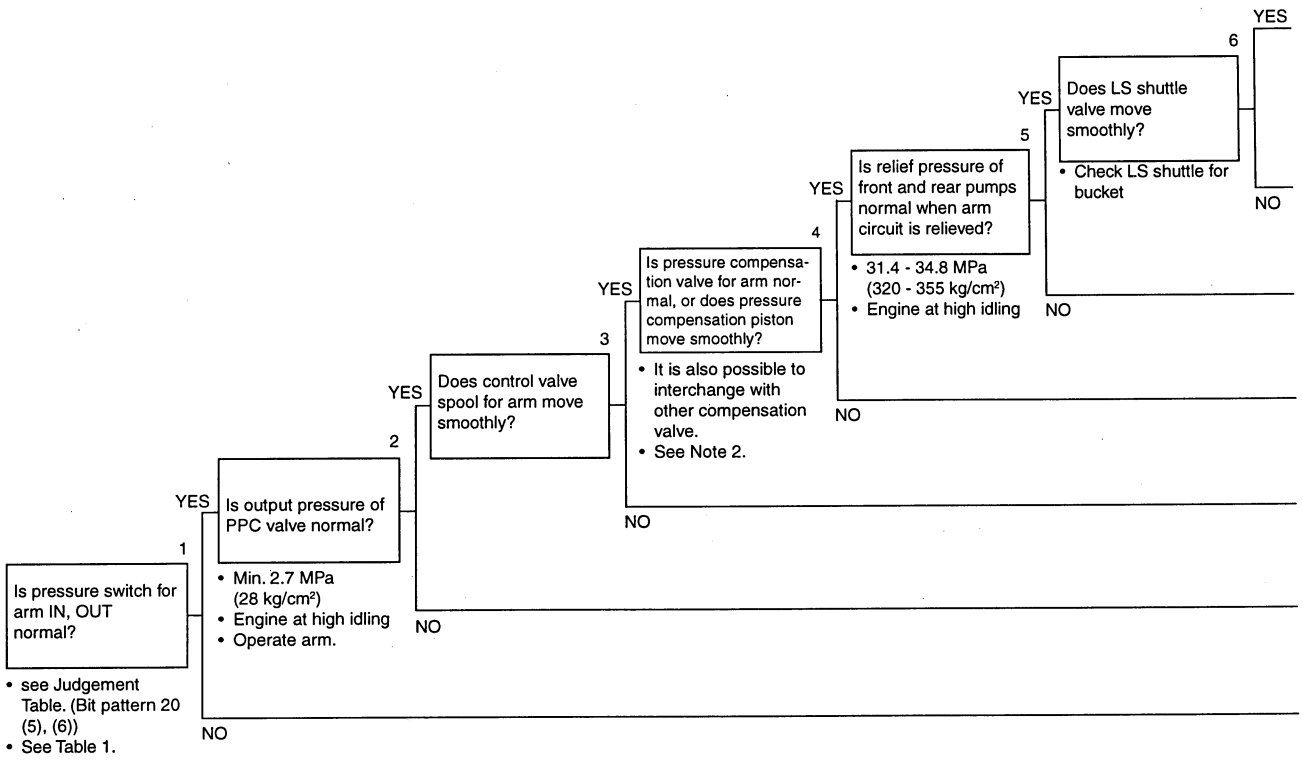
Note 2: After inspection, do not forget to return the interchanged valves to the original position.



Cause	Remedy
Defective operation of boom lock valve	Correct or replace
Defective boom cylinder piston packing	Correct or replace
Defective operation of LS shuttle valve (LS shuttle for arm or bucket)	Correct or replace
Defective boom lock valve or suction valve for boom in control valve	Replace
Defective operation of boom lock valve	Correct or replace
Defective operation of boom regeneration valve	Correct or replace
Defective operation of boom pressure compensation valve or pressure compensation piston (for boom RAISE end)	Correct or replace
Defective operation of control valve spool (for boom RAISE end)	Correct or replace
Defective PPC valve	Replace
Defective boom RAISE or boom LOWER pressure switch	Replace

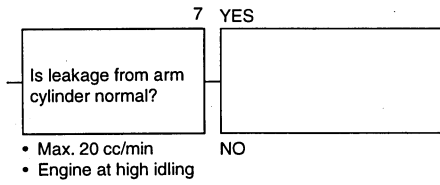
H-8 Arm is slow or lacks power

★ 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.

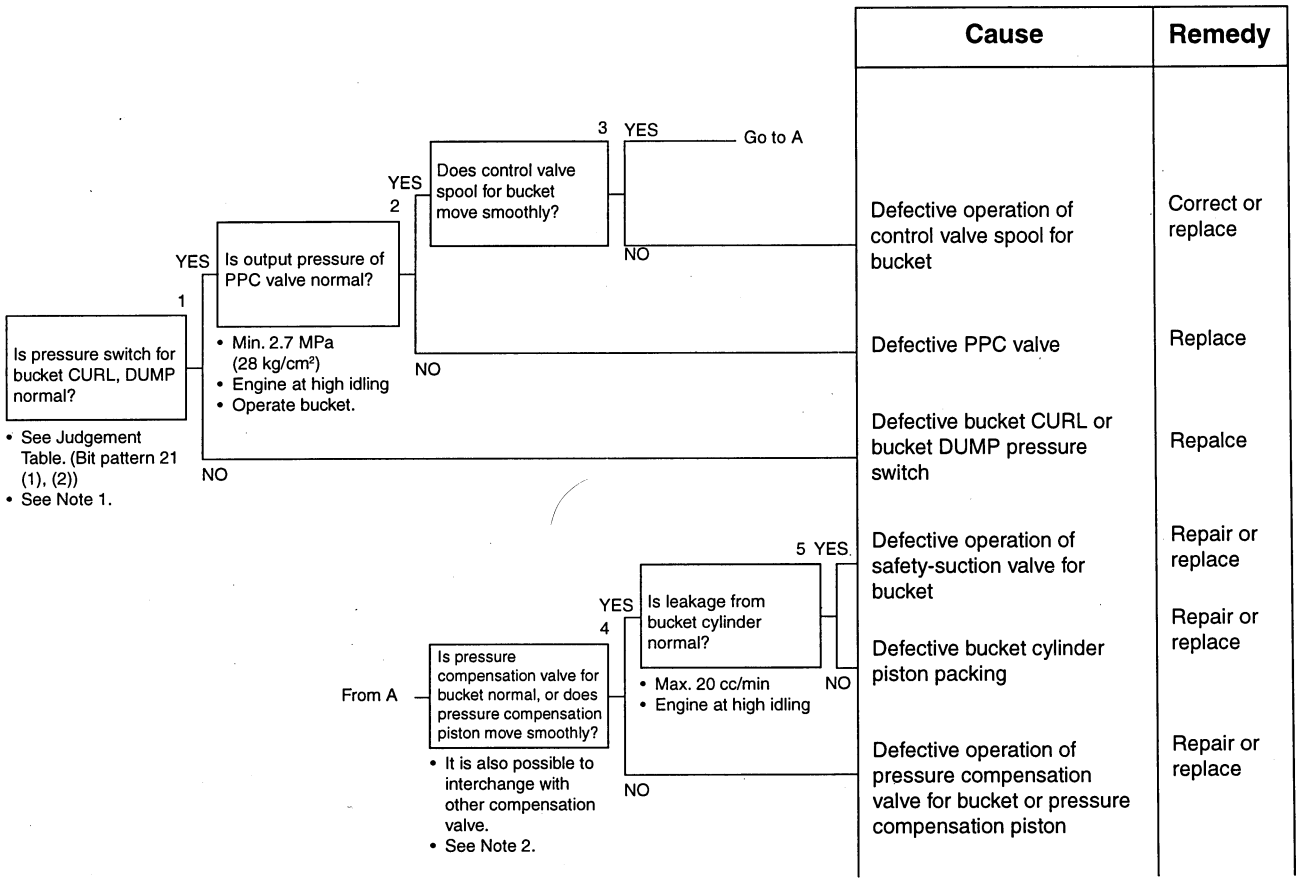
Note 2: After inspection, do not forget to return the interchanged valves to the original position.



Cause	Remedy
Defective operation of arm regeneration valve or arm counterbalance valve.	Correct or replace
Defective arm cylinder piston packing	Correct or replace
Defective operation of LS shuttle valve (LS shuttle for bucket)	Correct or replace
Defective safety-suction valve for arm	Replace
Defective operation of arm pressure compensation valve or pressure compensation piston	Corrrect or replace
Defective operation of control valve spool	Correct or replace
Defective PPC valve	Replace
Defective arm IN or arm OUT pressure switch	Replace

H-9 Bucket is slow or lacks power

★ When travel and swing speeds are normal.

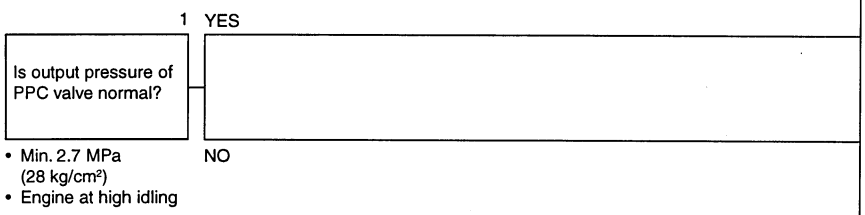


Note 1: If the auto-deceleration is canceled when bucket CURL or bucket DUMP is operated, the system is normal.

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

H-10 Work equipment (boom, arm, bucket) does not move (but travel and swing are normal)

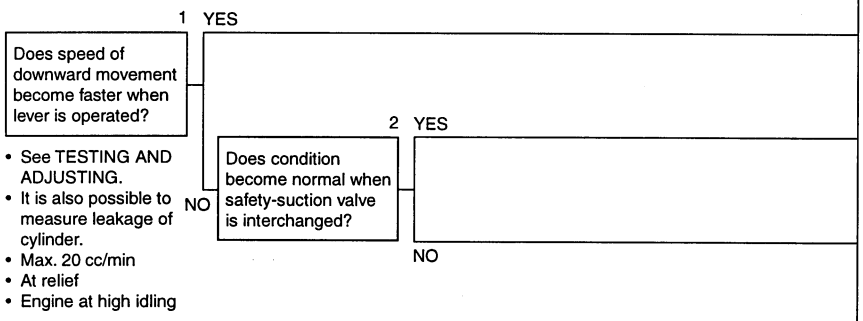
★ When boom, arm, and bucket are each operated independently.



Cause	Remedy
Defective control valve spool	Correct or replace
Defective PPC valve	Replace

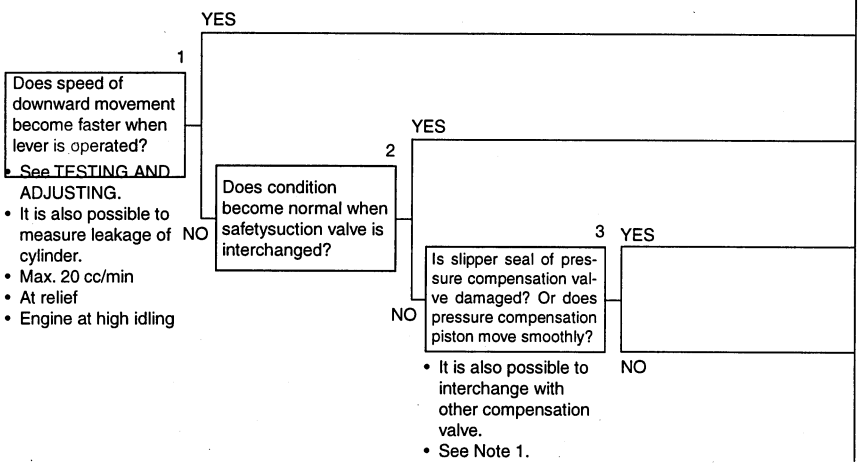
H-11 Excessive hydraulic drift (boom, arm, bucket)

1) Excessive hydraulic drift of boom



Cause	Remedy
Defective hydraulic cylinder piston packing	Replace
Defective operation of safety-suction valve	Replace
Defective operation of boom lock valve	Correct or replace

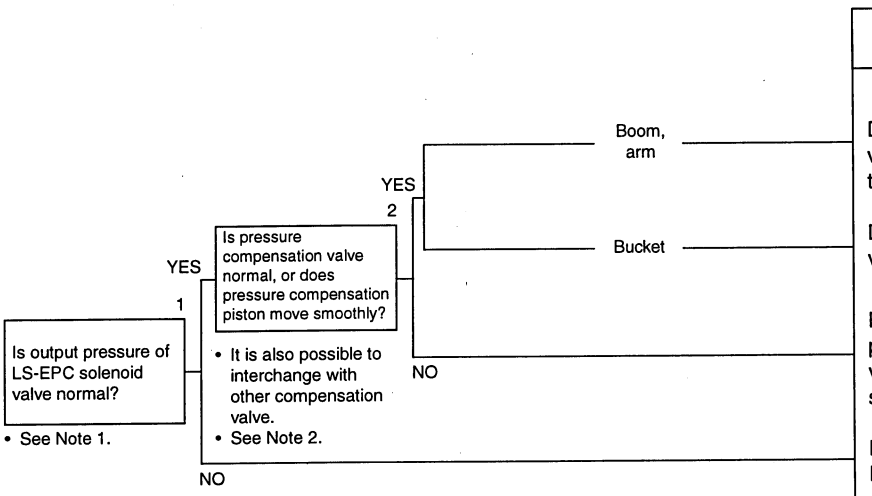
2) Excessive hydraulic drift of arm or bucket



Cause	Remedy
Defective hydraulic cylinder piston packing	Replace
Defective operation of safety-suction valve	Replace
Defective control valve spool	Replace
Damaged slipper seal of pressure compensation valve, or defective operation of pressure compensation piston	Correct or replace

Note 1: After inspection, do not forget to return the interchanged valves to the original position.

H-12 Excessive time lag (engine at low idling)

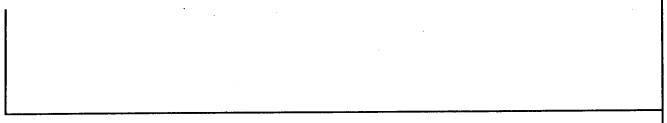


Cause	Remedy
Defective safety-suction valve, or defective regeneration valve	Replace
Defective safety-suction valve	Replace
Defective operation of pressure compensation valve or pressure compensation piston	Correct or replace
Defective operation of LS-EPC sloenoid valve	Correct or replace

Note 1: Output pressure of LS-EPC solenoid
- Approx 2.5 MPa (Approx 26 kg/cm^2) is output from the LS-EPC solenoid when the engine is at low idling (approx. 1100 rpm or below) regardless of the working mode.

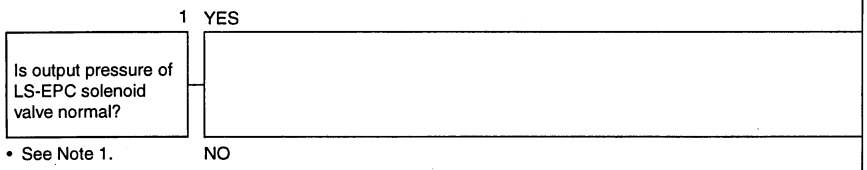
Note 2: After inspection, do not forget to return the interchanged valves to the original postition.

H-13 Other equipment moves when single circuit is relieved



Cause	Remedy
Defective operation of pressure compensation valve slipper seal (The slipper seal in the pressure compensation valve of the circuit that moved is defective.)	Replace

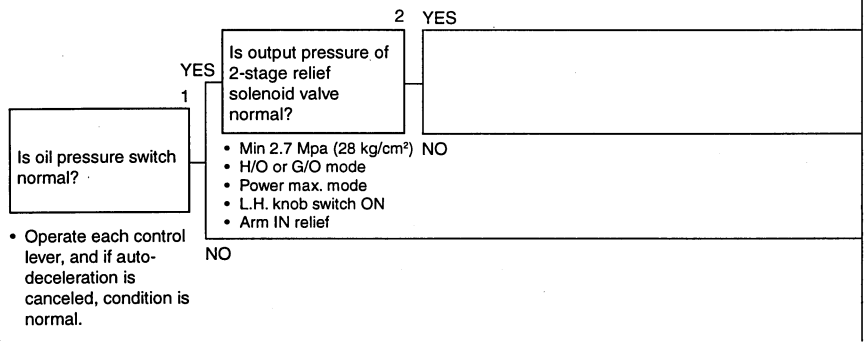
H-14 In F/O modes, work equipment speed is faster than specified speed



Cause	Remedy
Defective LS valve	Correct or replace
Defective operation of LS-EPC solenoid valve	Correct or replace

★ Output pressure of LS control EPC solenoid (travel OFF)
Approx 2.5 MPa (Approx 26 kg/cm²) is output from the LS control EPC solenoid when the engine speed is approx. 1100 rmp or less in the F/O mode. (In the F/O mode, the engine speed is set at 1900 rpm when the fuel control dial is at the MAX position.)

H-15 Lack of power when pressure rises



Cause	Remedy
Defective main relief valve	Replace
Defective operation of 2-stage relief solenoid valve	Repair or replace
Defective oil pressure switch	Replace

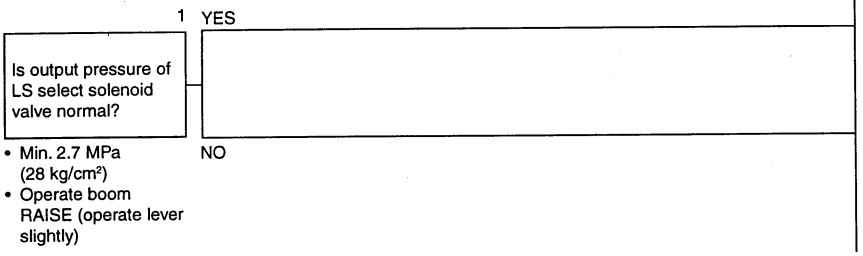
H-16 In compound operations, work equipment with larger load is slow

Cause	Remedy
Defective operation of pressure compensation valve	Replace (replace pressure compensation valve on side where load is lower)

	Combination of compound operation	Side where load is larger
1	Boom RAISE + arm IN	Boom RAISE
2	Boom RAISE + arm OUT	Arm OUT
3	Boom RAISE + bucket CURL	Boom RAISE
4	Arm OUT + bucket CURL	Arm OUT
5	Boom LOWER + arm OUT	Arm OUT

H-17 In swing + boom RAISE, boom RAISE is slow

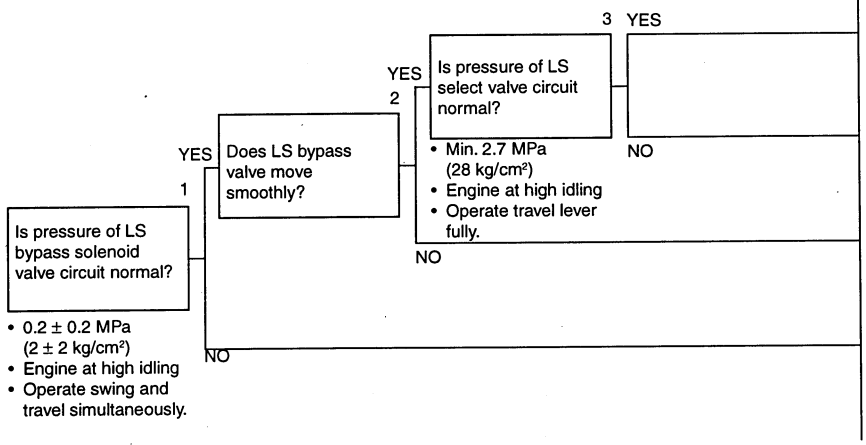
★ If swing and boom RAISE work normally when operated independently.



Cause	Remedy
Defective operation of LS select valve	Correct or replace
Defective operation of PPC shuttle valve for LS select circuit	Correct or replace

H-18 In swing + travel, travel speed drops excessively

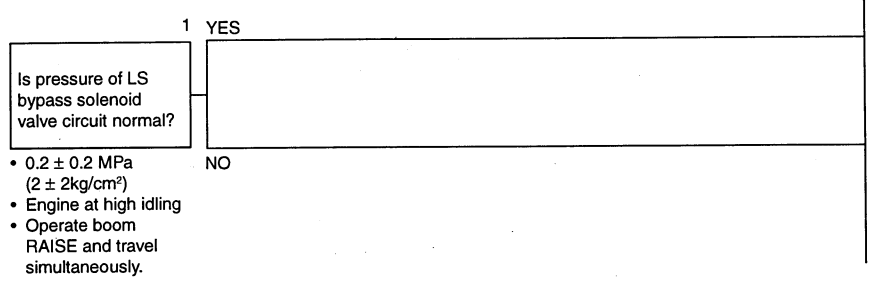
★ If swing and travel work normally when operated independently.



Cause	Remedy
Defective operation of LS select valve	Repair or replace
Defective operation of PPC shuttle valve (PPC shuttle for LS select)	Repair or replace
Defective operation of LS bypass valve	Repair or replace
Defective operation of LS bypass solenoid valve	Repair or replace

H-19 In work equipment boom RAISE + travel, travel speed drops excessively

★ If work equipment (boom RAISE) and travel work normally when operated independently.

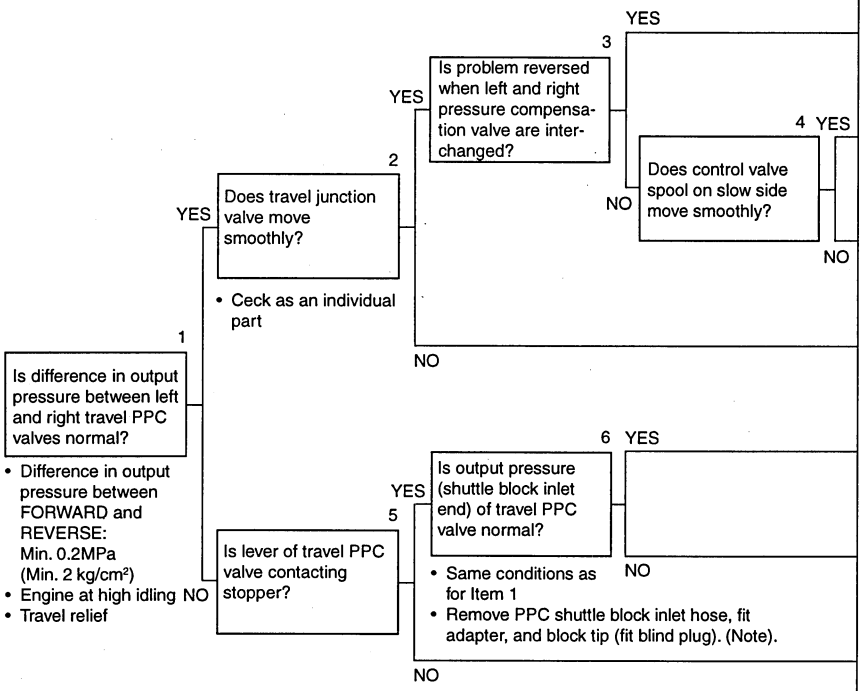


Cause	Remedy
Defective operation of LS bypass valve	Repair or replace
Defective operation of LS bypass solenoid valve	Repair or replace

H-20 Travel deviation

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

a) When there is deviation in normal travel



Cause	Remedy
Defective operation of pressure compensation valve or pressure compensation valve piston	Repair or replace
Defective travel motor assembly (counterbalance valve or check (valve)	Repair or replace
Defective operation of control valve spool	Repair or replace
Defective operation of travel junciton valve	Repair or replace
Defective PPC shuttle (3 places, for travel)	Repair or replace
Defective travel PPC valve	Replace
Defective adjustment of travel lever linkage	Adjust

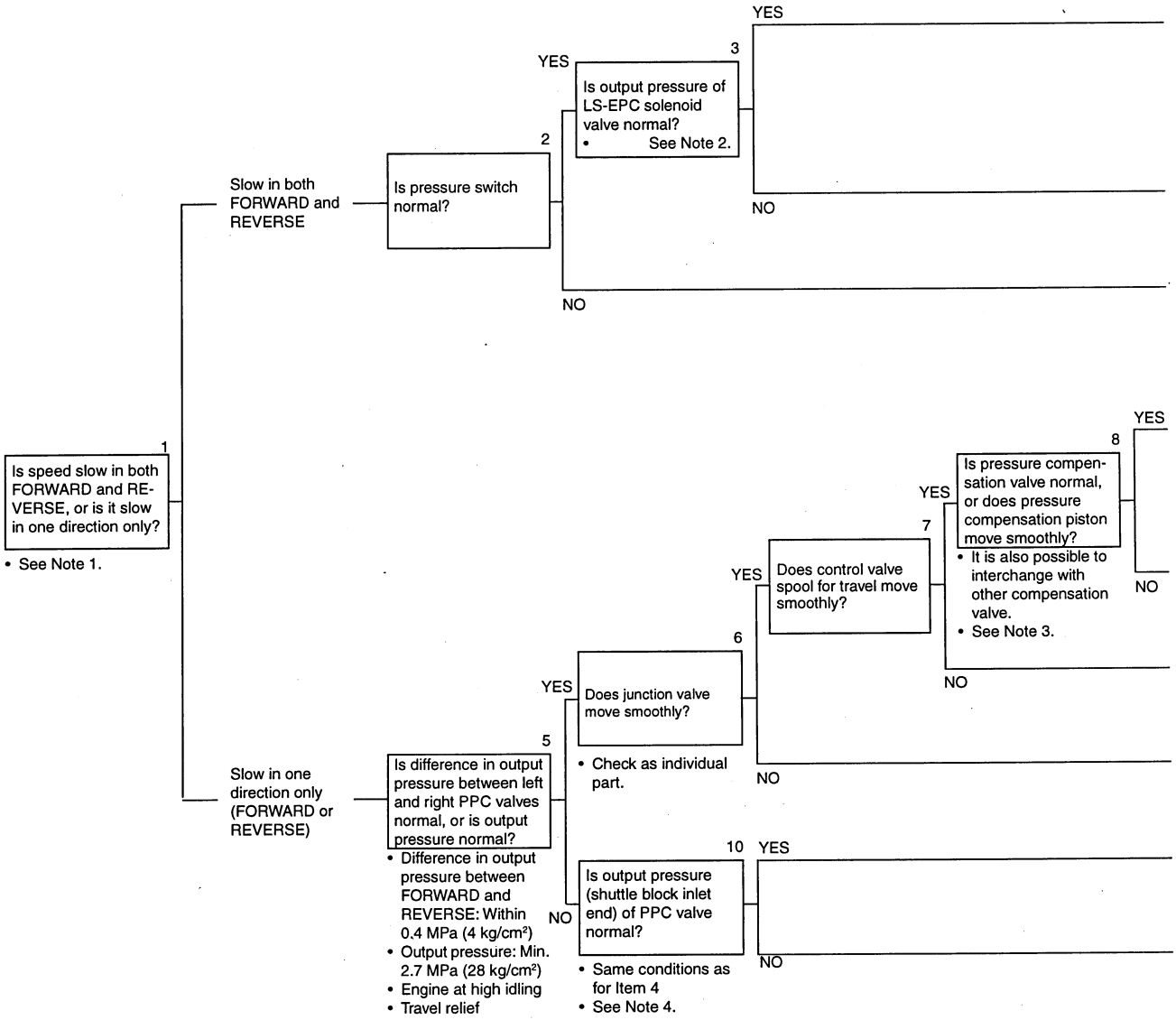
Note 1: Remove the PPC shuttle block inlet hose, fit an adapter, and block the tip,
If the adapter for blocking the circuit is not available, interchange the travel PPC hoses with the PPC hoses for the bucket (CURL, DUMP), boom (LOWER), or arm (IN) at both the inlet and outlet ports of the shuttle block, and check operation.

b) Excessive travel deviation when starting

Cause	Remedy
Defective operation of travel counterbalance valve	Correct or replace
Defective operation of travel parking brake (mechanical brake)	Correct or replace.

H-21 Travel speed is slow

★ Check that the spool of the travel PPC valve is moving the full stroke before carrying out troubleshooting.
★ Carry out troubleshooting in the H/O mode.
★ When swing and work equipment speeds are normal.

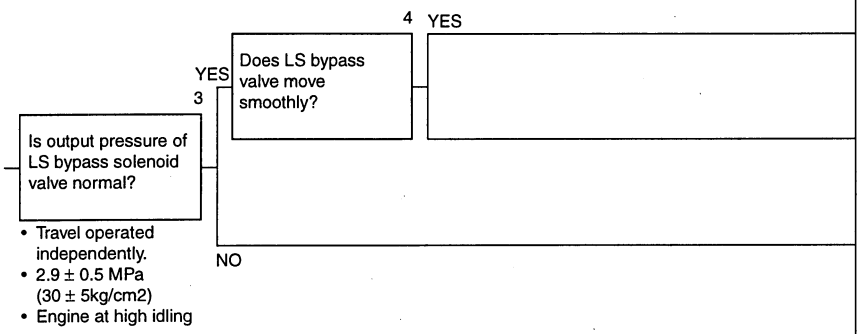


Note 1: • Measure the travel speed under no load or measure the time taken to travel 20 m. (See MAINTENANCE STANDARD FOR CHASSIS RELATED PARTS.)
• When measuring the speed of the travel motor under no load → Remove connector of LS control EPC solenoid, and measure travel speed in Lo and Hi.

Note 2: Output pressure of LS-EPC solenoid

unit: MPa (kg/cm²)

Lo	Mi	Hi
2.0 ± 0.2 (20.0 ± 2.0)	2.2 ± 0.2 (22.7 ± 2.0)	0.2 ± 0.2 (2.0 ± 2.0)
• Engine at high idle. • Travel lever at time control postition (auto-deceleration canceled)		

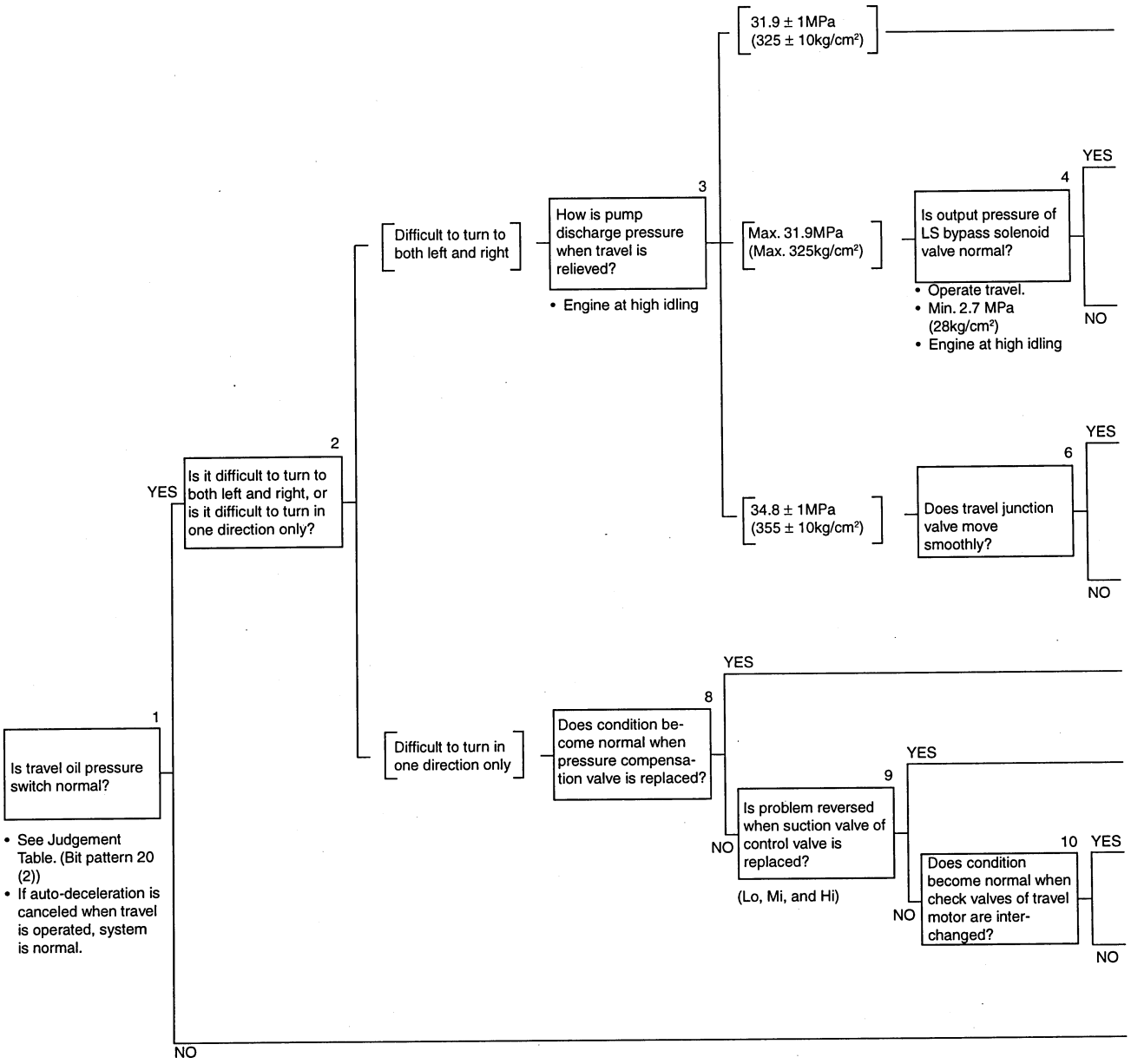


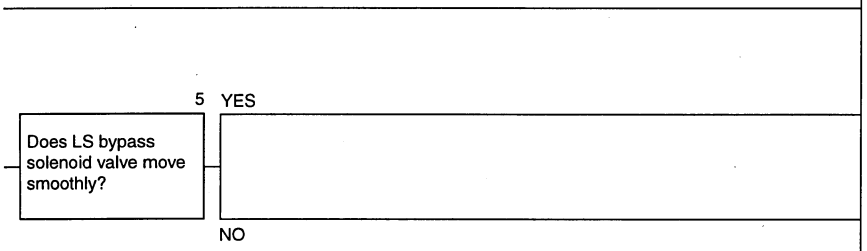
Cause	Remedy
Defective operation of LS shuttle valve (for boom, arm, bucket)	Repair or replace
Defective operation of LS bypass valve	Repair or replace
Defective operation of LS bypass solenoid valve	Replace
Defective operation of LS-EPC solenoid valve	Correct or replace
Defective travel pressure switch	Replace
Defective operation of travel suction valve for control valve	Correct or replace
Defective travel motor assembly	Correct or replace
Defective pressure compensation valve, or defective operation of pressure compensation piston	Correct or replace
Defective operation of travel spool for control valve	Correct or replace
Defective operation of junction valve	Correct or replace
Defective PPC shuttle	Correct or relace
Defective PPC valve	Replace

Note 3: After inspection, do not forget to return the interchanged valves to the original position.
Note 4: Remove the PPC shuttle block inlet hose, fit an adapter, and block the tip.
If the adapter for blocking the circuit is not available, interchange the travel PPC hoses with the PPC hoses for the bucket (CURL, DUMP), boom (LOWER), or arm (IN) at both the inlet and outlet ports of the shuttle block, and check operation.

H-22 Steering does not turn easily or lacks power

★ Carry out troubleshooting in the H/O mode.

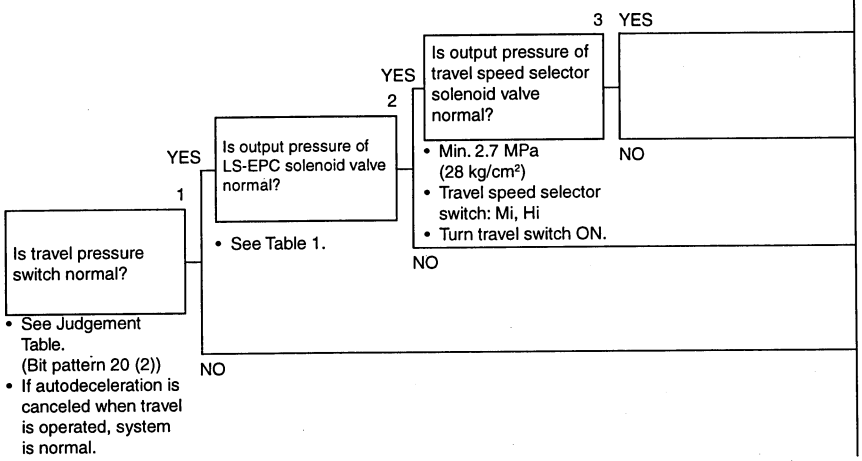




Cause	Remedy
Go to H-13	-
Defective operation of LS shuttle valve (any one of boom, arm, or bucket)	Repair or replace
Defective operation of LS bypass valve	Repair or replace
Defective operation of LS bypass solenoid valve	Repair or replace
Defective travel ,motor servo piston or center swivel joint	Repair or replace
Defective operation of travel speed solenoid valve	Repair or replace
Defective operation of travel junction valve	Repair or replace
Defective operation of pressure compensation valve or pressure compensation valve piston	Repair or replace
Defective operation of suction valve of control valve	Repair or replace
Defective travel motor check valve	Replace
Defective travel motor safety valve	Replace
Defective travel oil pressure switch	Replace

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

★ Carry out troubleshooting in the H/O mode.



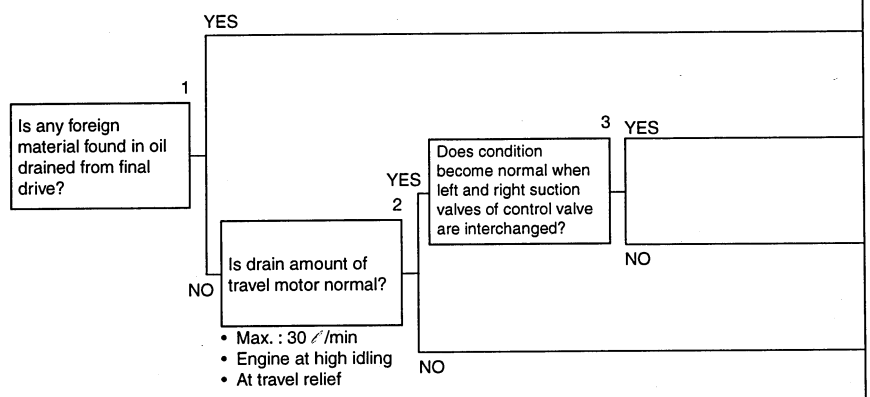
Cause	Remedy
Defective operation of travel speed selector servo piston in travel motor	Replace
Defective operation of travel speed selector solenoid valve	Correct or replace
Defective operation of LS-EPC solenoid valve	Correct or replace
Defective travel pressure switch	Replace

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	• Engine at high idling • Operate travel lever slightly (auto-deceleration cancel position)		

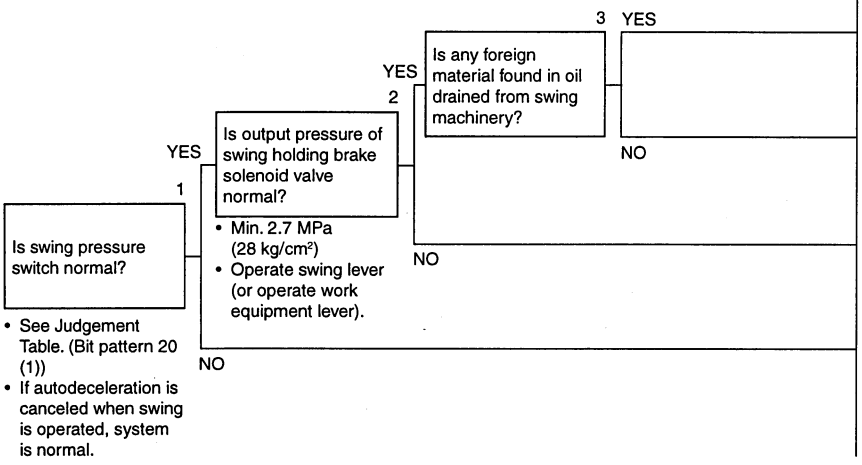
H-24 Travel does not move (one side only)



Cause	Remedy
Defective final drive	Repair or replace
Defective operation of suction valve of control valve	Replace
Defective operation of counterbalance valve or travel motor safety valve	Replace
Defective travel motor	Replace

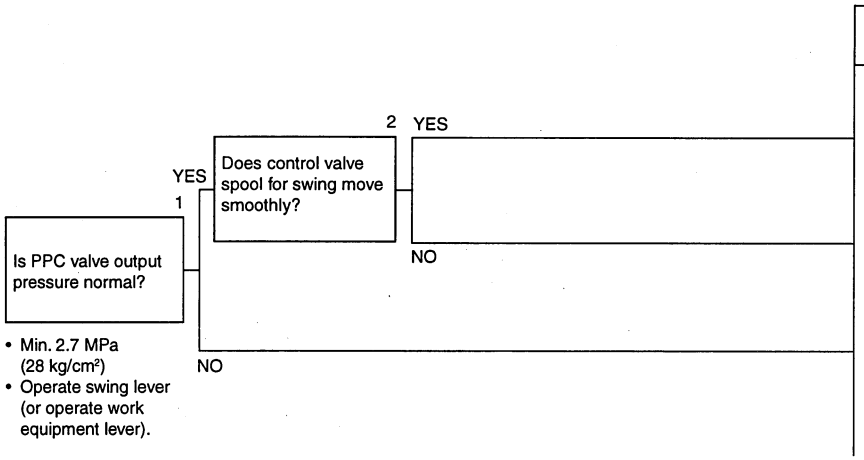
H-25 Does not swing

a) Does not swing to either left or right



Cause	Remedy
Defective swing machinery	Repair or replace
Defective swing holding brake or swing motor	Repair or replace
Defective operation of holding brake solenoid valve	Correct or replace
Defective swing pressure switch	Replace

b) Does not swing in one direction

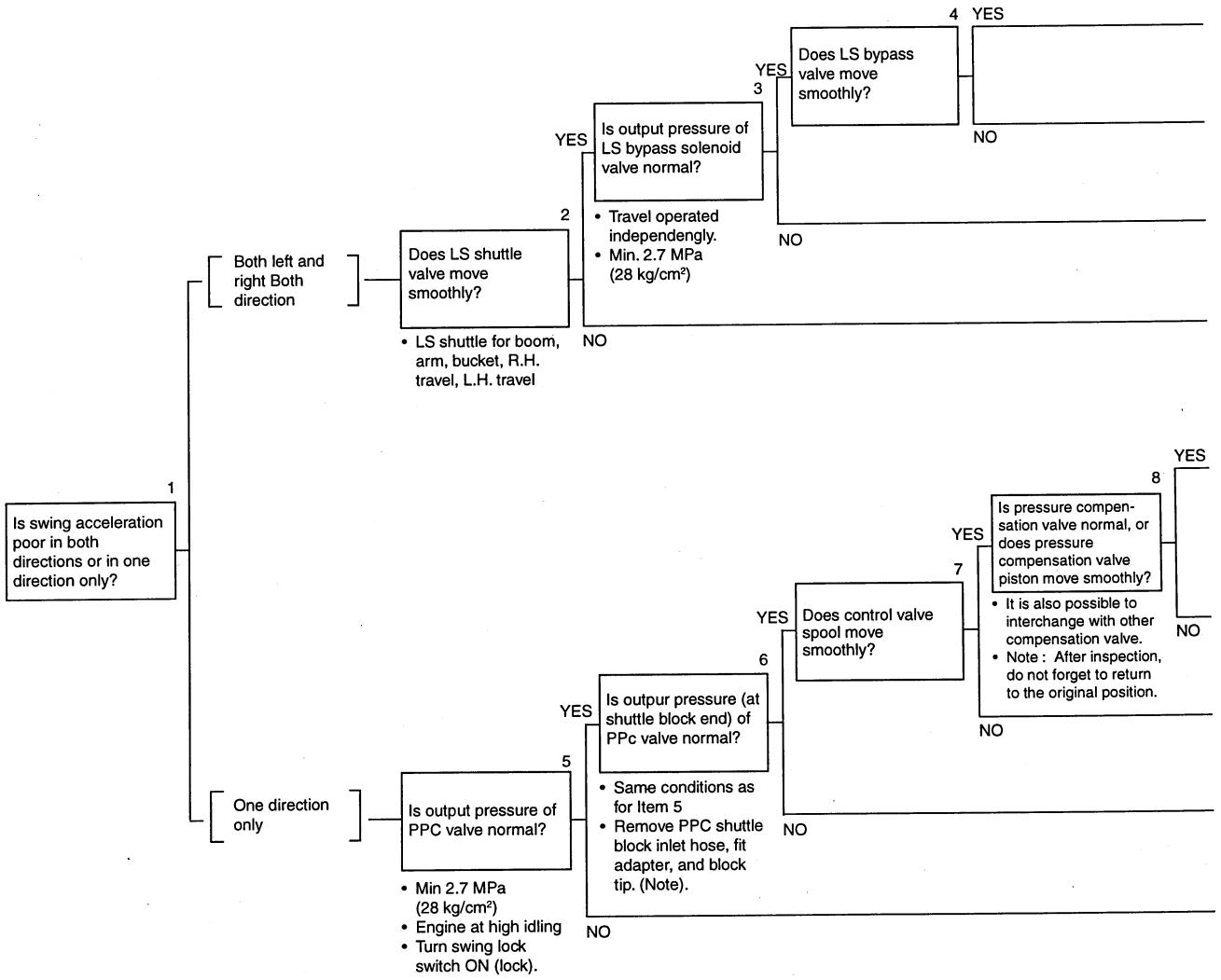


Cause	Remedy
Defective swing motor safety valve or suction valve	Replace
Defective operation of control valve spool for swing	Correct or replace
Defective PPC valve	Replace

H-26 Swing acceleration is poor or swing speed is slow

★ Carry out troubleshooting in the H/O mode.
★ If condition is normal when work equipment is operated independently.

a) Swing acceleration is poor



Note: If the adapter for blocking the circuit is not availabel, interchange PPC hose of swing with one of bucket (CURL, DUMP), boom (LOWER), or arm (IN).

9 Does condition become normal when left and right safety valves of motor are interchanged?

YES

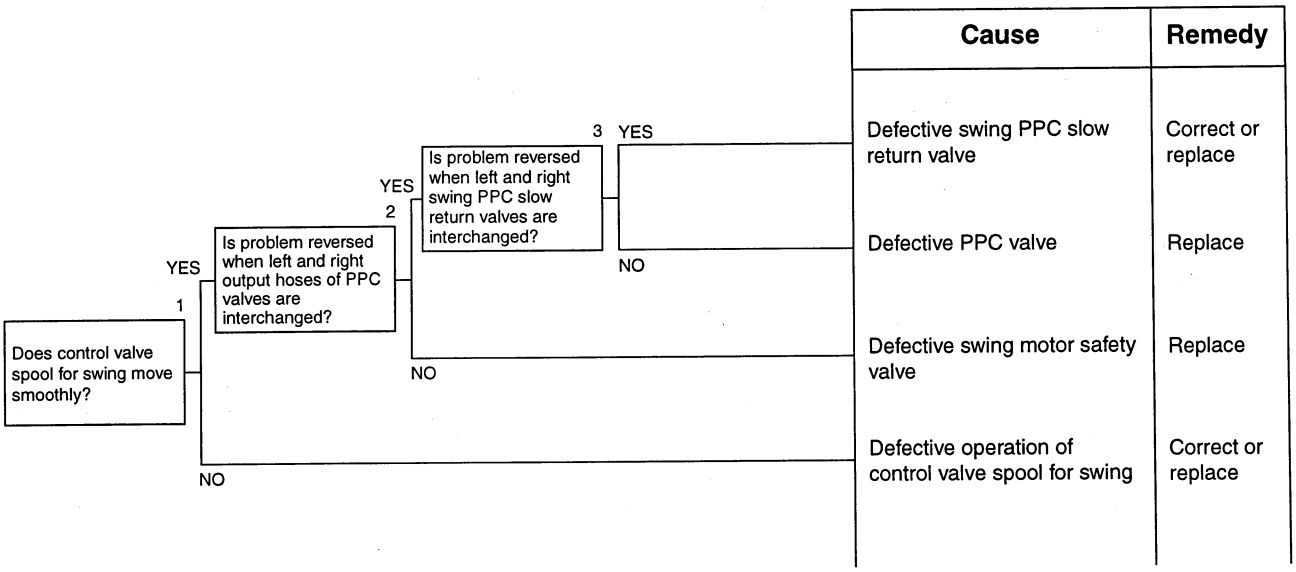
NO

* It is also possibele to measure relief pressure of motor.
• Relief pressure: 30,4 - 33.8 MPa (310 - 345 kg/cm²)

Cause	Remedy
Defective swing motor assembly	Repair or replace
Defective LS bypass valve	Replace
Defective LS bypass solenoid valve	Repalce
Defective operation of LS shuttle valve (all LS shuttles)	Repair or replace
Defective swing motor safety valve	Replace
Defective swing motor suction valve	Replace
Defective operation of pressure compensation valve or compensation valve piston	Repair or replace
Defective operation of control valve spool	Repair or replace
Defective operation of PPC shuttle valve (for swing)	Repair or replace
Defective PPC valve	Replace

H-27 Excessive overrun when stopping swing

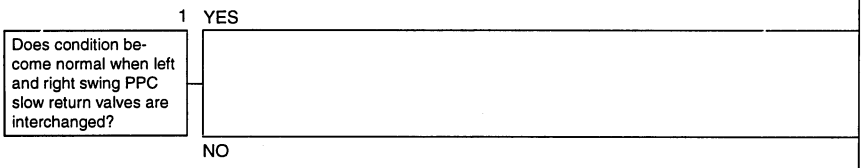
a) One direction only



b) Both directions

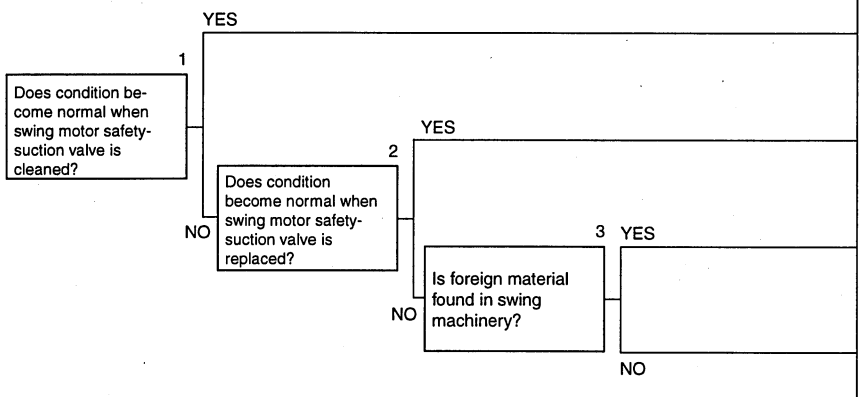
Cause	Remedy
Defective swing motor	Repair or replace

H-28 Excessive shock when stopping swing (one direction only)



Cause	Remedy
Defective swing PPC slow return valve (check valve)	Correct or replace
Defective PPC valve	Replace

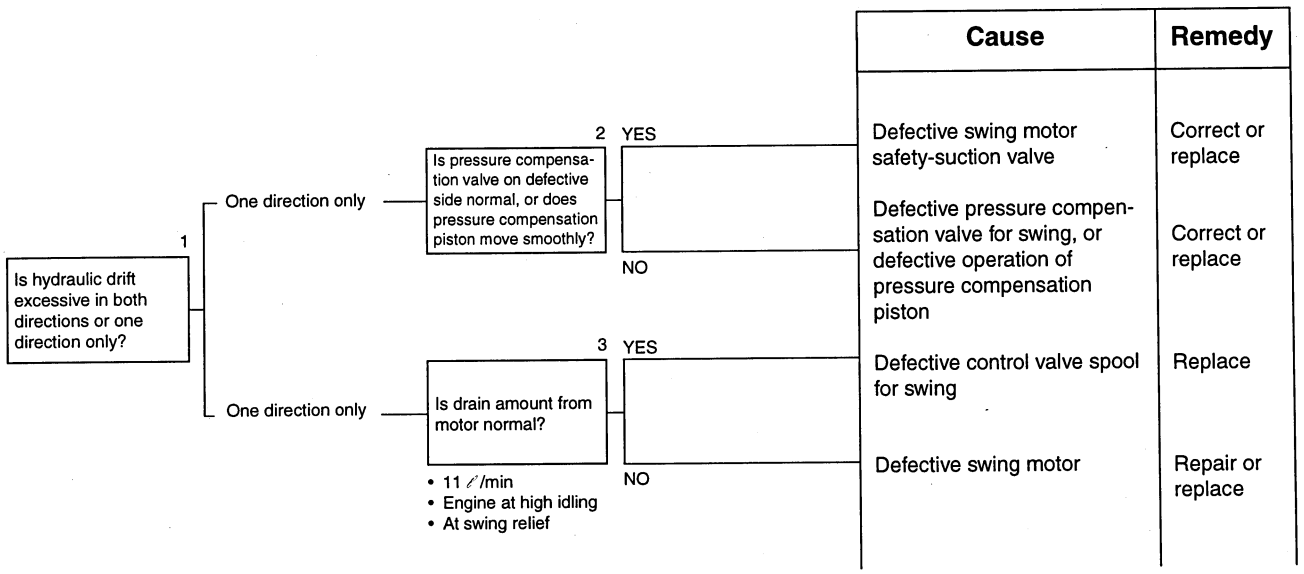
H-29 Excessive abnormal noise when stopping swing



Cause	Remedy
Defective operation of swing motor safety-suction valve	Clean
Defective swing motor safety-suction valve	Replace
Defective swing machinery	Repair or replace
Defective back pressure valve	Correct or replace

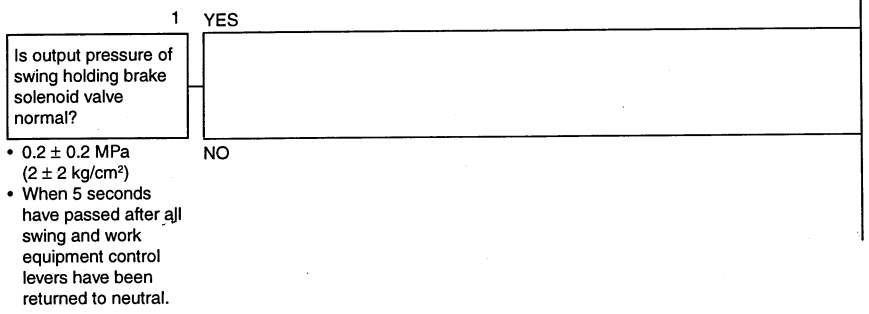
H-30 Excessive hydraulic drift of swing

a) When swing holding brake is released



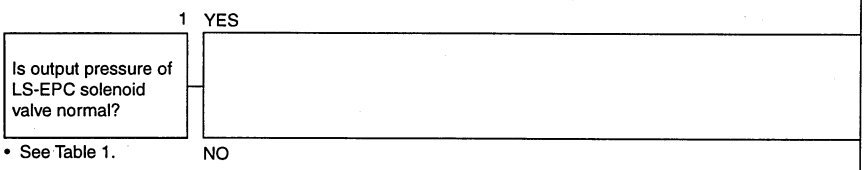
Cause	Remedy
Defective swing motor safety-suction valve	Correct or replace
Defective pressure compensation valve for swing, or defective operation of pressure compensation piston	Correct or replace
Defective control valve spool for swing	Replace
Defective swing motor	Repair or replace

b) When swing holding brake is applied



Cause	Remedy
Defective operation of swing holding brake	Repair or replace
Defective operation of swing holding brake solenoid valve	Correct or replace

H-31 Swing speed is faster than specified swing speed



Cause	Remedy
Defective operation of LS valve	Replace servo assembly
Defective LS-EPC solenoid	Correct or replace

Table 1. Output pressure of LS-EPC solenoid valve

unit: MPa (kg/cm²)

H/O mode	G/O mode	F/O mode	L/O mode
0.2 ± 0.2 (2.0 ± 2.0)	0.2 ± 0.2 (2.0 ± 2.0)	1.2 ± 0.2 (12 ± 2.0)	0.2 ± 0.2 (2.0 ± 2.0)
• Enginge at high idling • Travel OFF • Swing lock switch OFF			

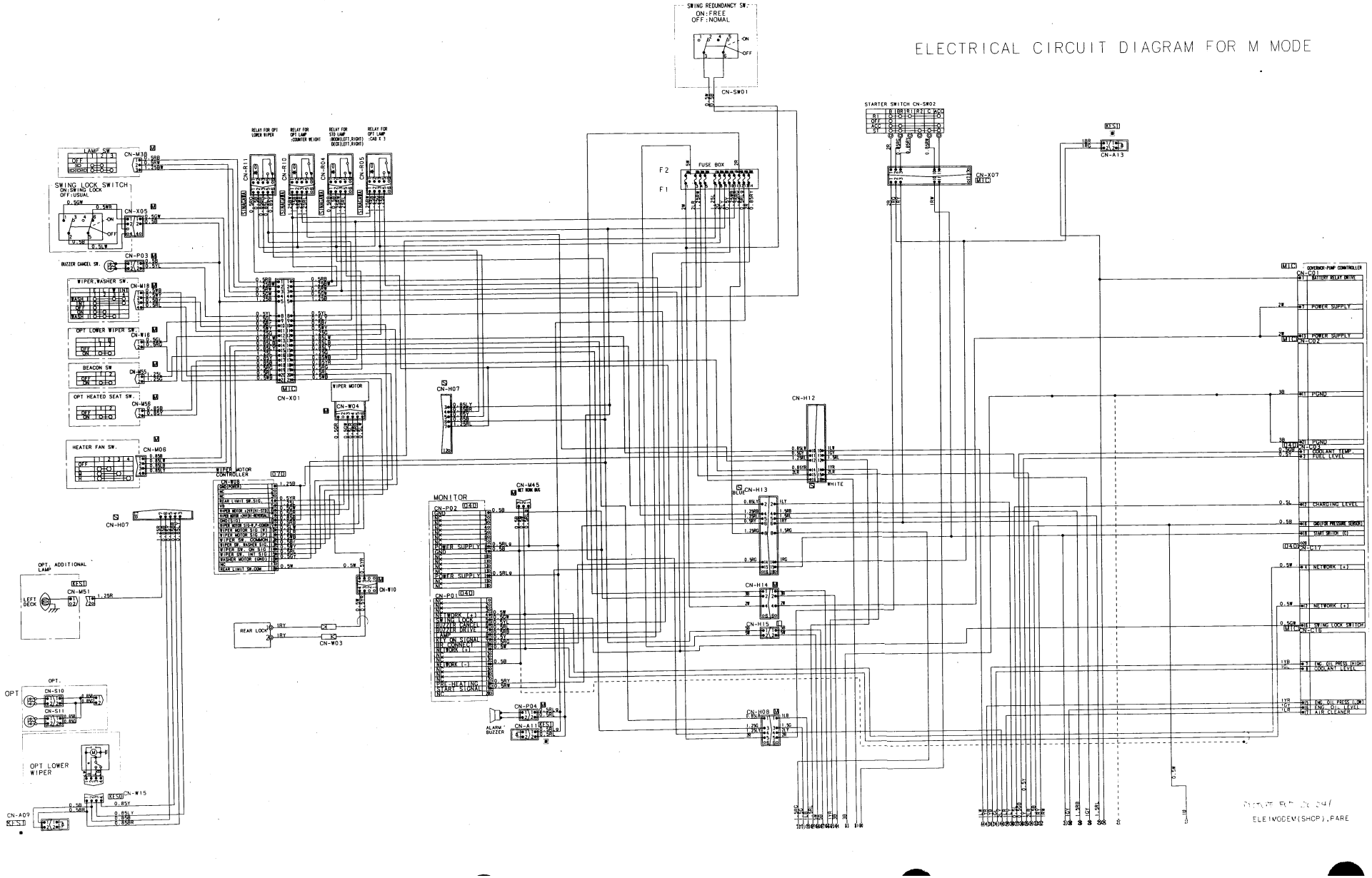
TROUBLESHOOTING OF MACHINE MONITOR SYSTEM (M MODE)

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

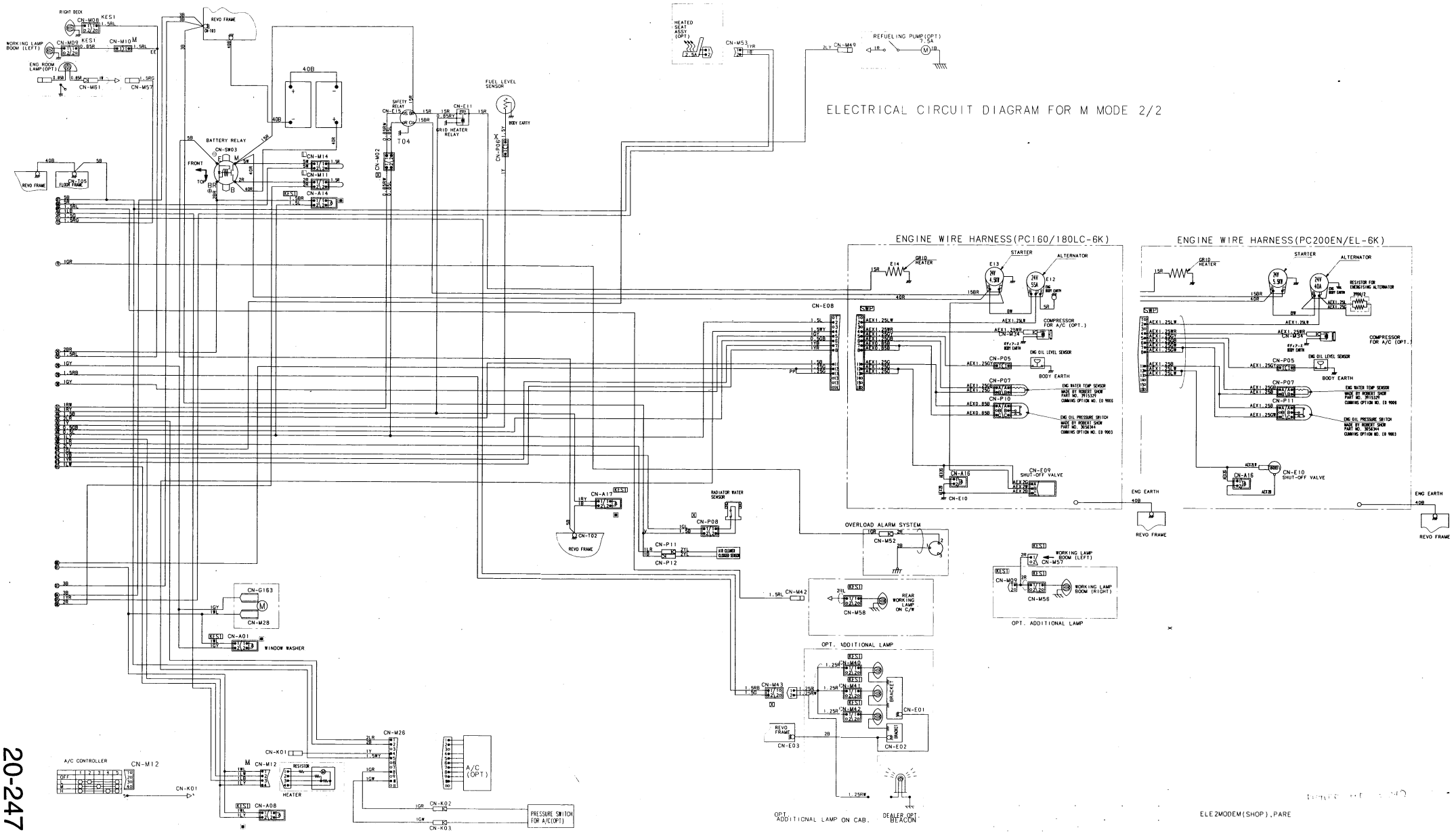
User code	Service code	Abnormal system	Nature of abnormality
-	E101	Abnormality in error data	1. Abnormality in internal memory 2. Excess voltage (more than 36V) has occurred 3. Low voltage (less than 12V) has occurred 4. Connector has separated
-	E102	Abnormality in clock data	1. Abnormality in internal 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	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	1. Air cleaner clogging sensor has detected clogging
-	E106	Drop in engine oil Hi pressure detected is displayed	1. Engine oil pressure Hi sensor has detected drop in oil pressure
-	E108	Engine water temperature 105°C detected is displayed	1. Coolant temperature gauge has detected water temperature of 105°C

Condition when normal (voltage, current, resistance)	Action by controller when abnormality is detected	Problem that appears on machine when there is abnormality
• When starting switch is turned ON, keep time switch pressed for 5 seconds to actuated clear function	-	1. Service code cannot be cleared 2. Time becomes 00:00
	-	1. Service code cannot be cleared 2. Time becomes 00:00 3. Clock does not advance.
• Voltage between P01 (7) - chassis Buzzer On: Max. 1V Buzzer OFF: 20 - 30V ★ When there is a disconnection, E103 is not displayed and the buzzer does not sound	-	1. Buzzer does not sound
• Resistance between P11 (male) - P12 (male): Min 1Ω (engine started)	-	1. If abnormality detection continues, air cleaner clogging caution lamp flashes and buzzer sounds
• Resistance between sensor terminal and chassis: Min. 1 MΩ (engine at mid-range speed or above)	-	1. If abnoramlity detection continues, engine oil pressure caution lamp flashes and buzzer sounds
• Resistance between P07 (1) - (2): Min. 3.156 Ω (engine started)	-	1. If anbormality detection continues, coolant temperature caution lamp flashes and buzzer sounds 2. If abnormality detection continues, engine speed is reduced to low idling

ELECTRICAL CIRCUIT DIAGRAM FOR M MODE 1/2

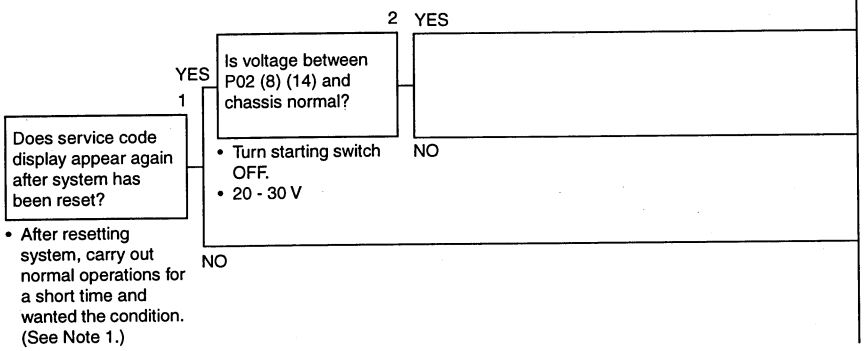


ELECTRICAL CIRCUIT DIAGRAM FOR M MODE 2/2



M-1 [E101] Abnormality in error data is displayed [E102] Error in clock data is displayed

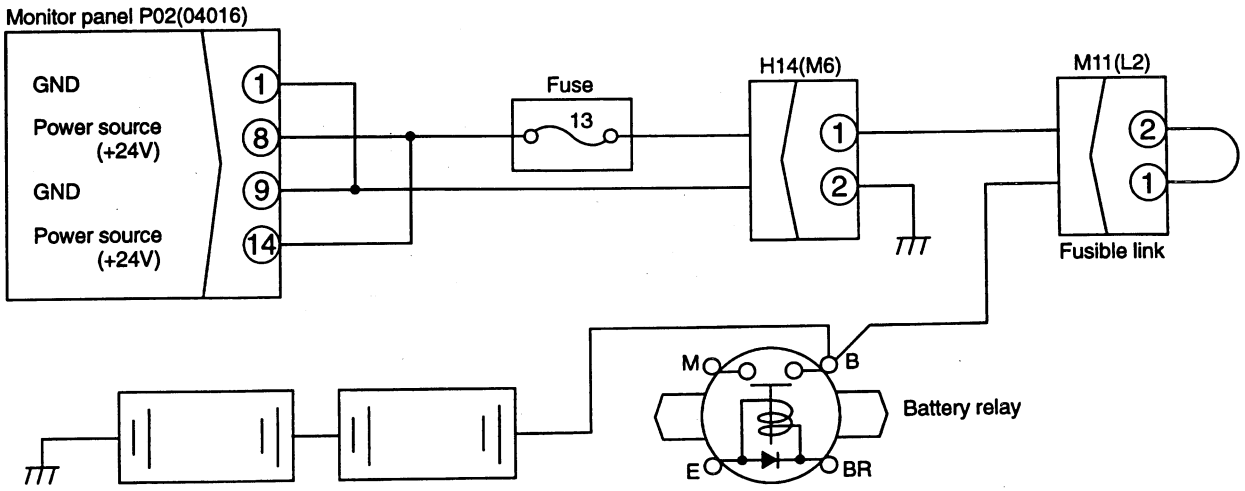
★ This is not an abnormality. It occurs during troubleshooting when disconnecting and connecting connector P02 (for the monitor panel electrical system), fuse No. 13, connector M14, connector M11, battery relay treminal B, or the battery terminal.
(When the monitor panel power source circuit is shut off with the starting switch turned OFF.)
★ If the service code display appears again after the system has been reset, carry out troubleshooting as follows.
★ 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
Defective monitor panel	Replace
Disconnecton, defective contact, short circuit with ground in wiring harness between battery - battery relay B - M11 (1) (2) - H14 (1) - fuse No. 13 - P02 (female) (8) (14)	Repair or replace
Normal	-

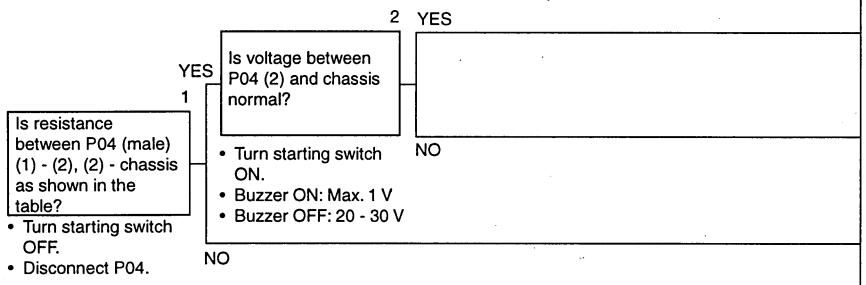
Note 1: Resetting operation:
Turn the starting switch OFF. Then keep the time switch at the back of the monitor panel depressed, switch the starting switch ON again, and keep the time switch depressed for 5 seconds to return the system to normal.
(With this operation, all the service codes in the internal memory are erased.)

M-1 Related electric circuit diagram



M-2 [E103] Short circuit in buzzer output or contact of 24 V wiring harness with buzzer drive harness is displayed

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

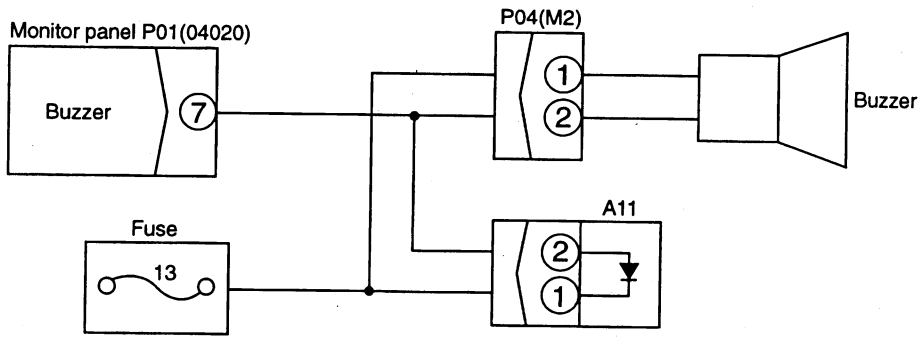


Cause	Remedy
Defective monitor panel	Replace
Short circuit with power source in wiring harness between P01 (female) (7) and P04 (female) (2) or short circuit in wiring harness between P04 (1) and (2)	Repair or replace
Defective buzzer	Replace

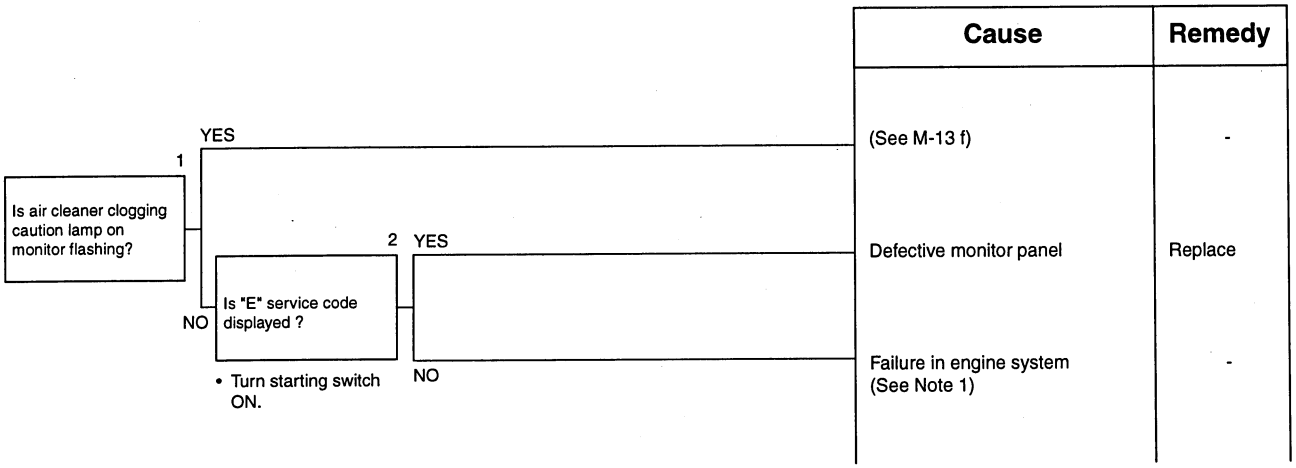
Table

P04 (male)	Resistance value
Between (1) and (2)	200 - 300 Ω
Between (2) and chassis	Min. 1 M Ω

M-2 Related electric circuit diagram



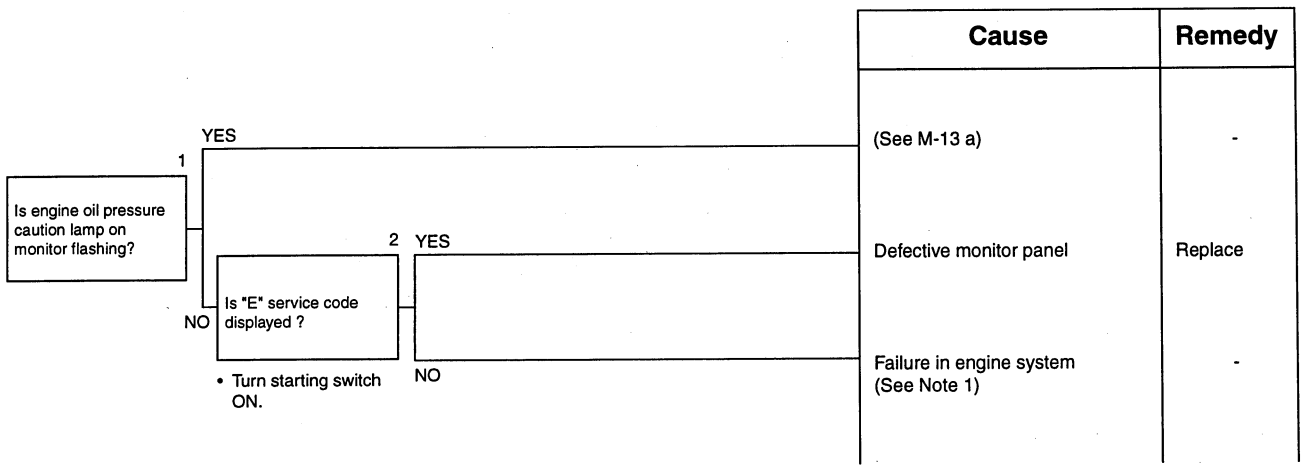
M-3 [E104] Air clogging detected is displayed



Cause	Remedy
(See M-13 f)	-
Defective monitor panel	Replace
Failure in engine system (See Note 1)	-

Note 1: The monitor panel display has returned to normal, but the air cleaner clogging sensor has detected symptoms of clogging in the past, so carry out troubleshooting of the engine to remove the problem

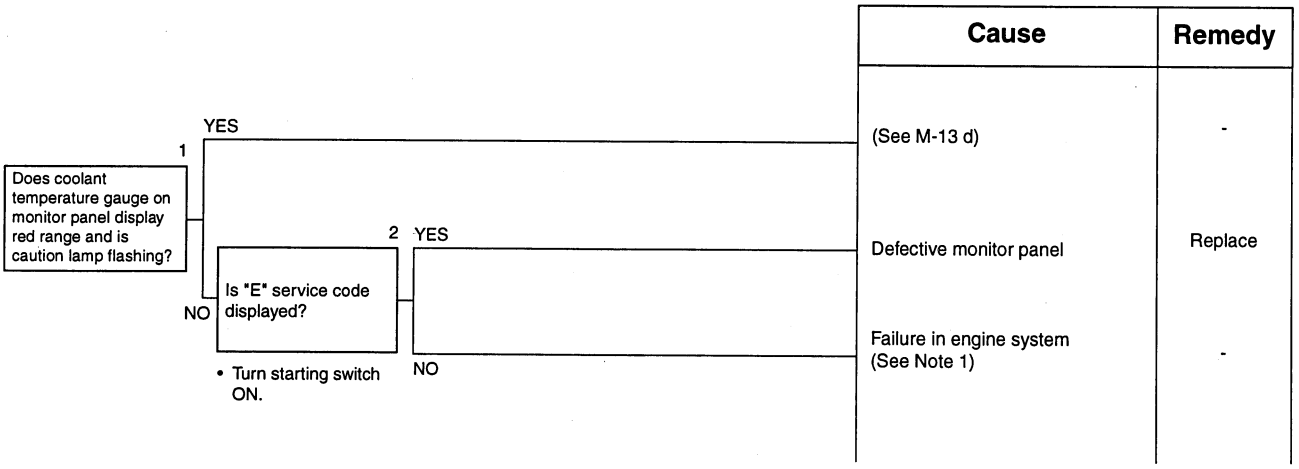
M-4 [E106] Drop in engine oil pressure detected is displayd



Cause	Remedy
(See M-13 a)	-
Defective monitor panel	Replace
Failure in engine system (See Note 1)	-

Note 1: The monitor panel display has returned to normal, but the engine oil pressure sensor has detected symptoms of a drop in the oil pressure in the past, so carry out troubleshooting of the engine to remove the problem.

M-5 [E108] Engine water temperature 105°C detected is displayed

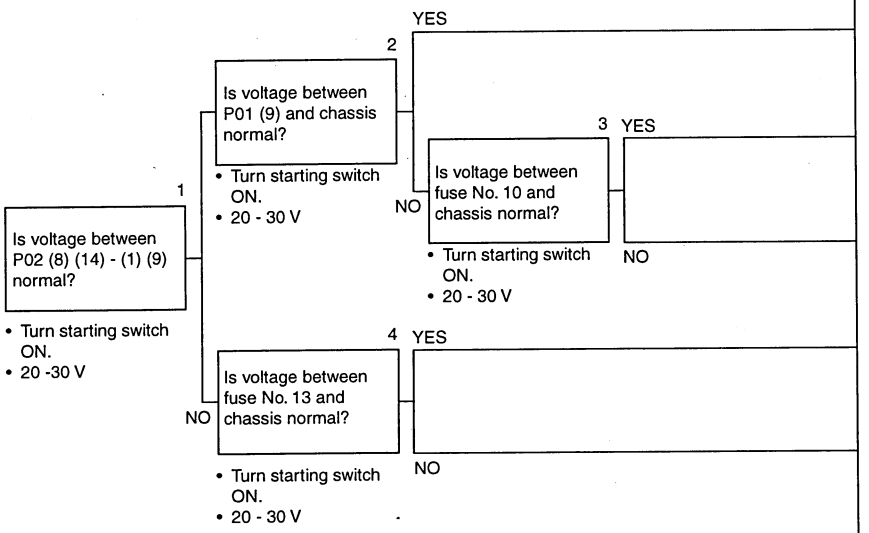


Note 1: The monitor panel display has returned to normal, but the coolant temperature sensor has detected symptoms of the coolant temperature reaching 105°C in the past, so carry out troubleshooting of the engine to remove the problem.

M-6 When starting switch is turned ON, none of the lamps on the monitor panel light up

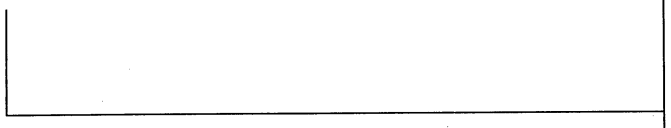
★ Check that fuses No. 10 and 13 are not blown.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

a) None of lamps on monitor panel light up



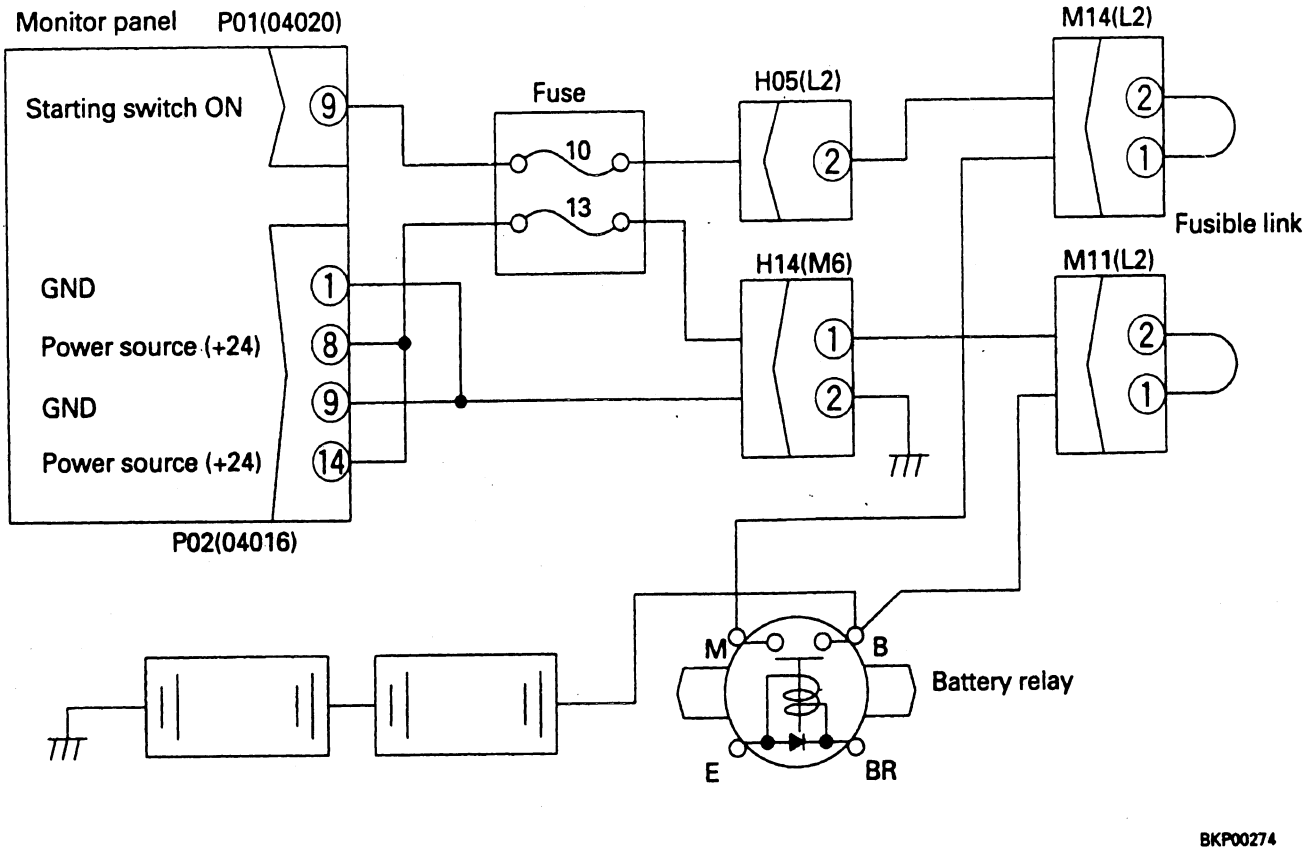
Cause	Remedy
Defective monitor panel	Replace
Disconnetion, defective contact, short circuit with ground in wiring harness between P01 (female) (9) and fuse No. 10	Repair or replace
Disconnection, defeictive contact, short circuit with ground in wiring harness between fuse No. 10 - H05 (2) - M14 (2) (1) - battery relay M	Repair or replace
Disconnection, defective contact, short circuit with ground in wiring harness between P02 (female) (8) (14) and fuse No. 13	Repair or replace
Disconnection, defective contact, short circuit with ground in wiring harness between fuse No. 13 - H14 (2) - M11 (2) (1) - battery relay B	Repair or replace

b) Some of lamps on monitor panel do not light up



Cause	Remedy
Defective monitor panel	Replace

M-6 a) Related electric circuit diagram



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

Cause	Remedy
Defective monitor panel	Replace

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

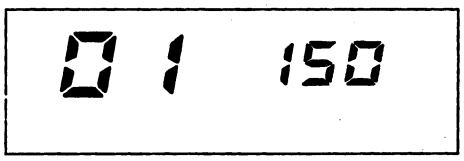
★ Immediately after replacing the monitor panel, turn the starting switch OFF, then turn it On again

Cause	Remedy
Defective monitor panel	Replace
Go to troubleshooting for C mode (See C-14)	-

1 Is display of monitoring code 01 as shown in table?
- YES
- NO

- Turn starting switch ON.
- Set to monitoring code 01.

Table



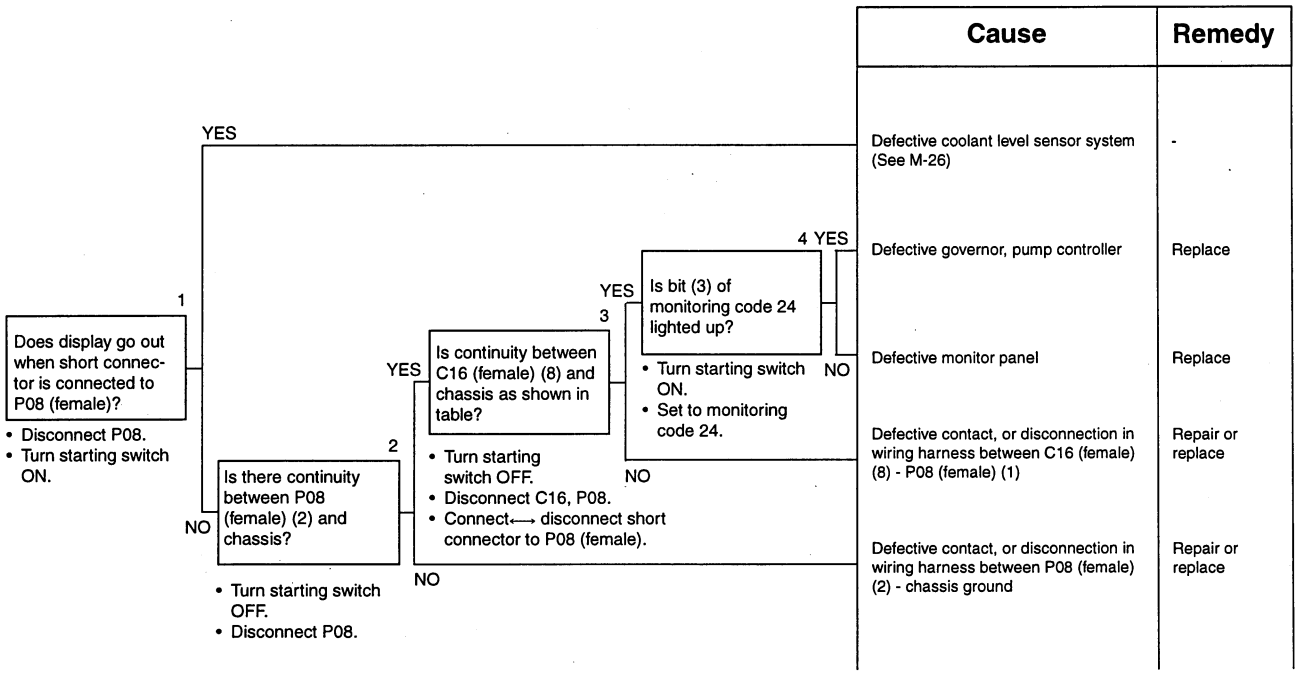
M-9 When starting switch is turned ON (engine stopped), basic check items flashes

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

a) (coolant level) flashes

SAP00519

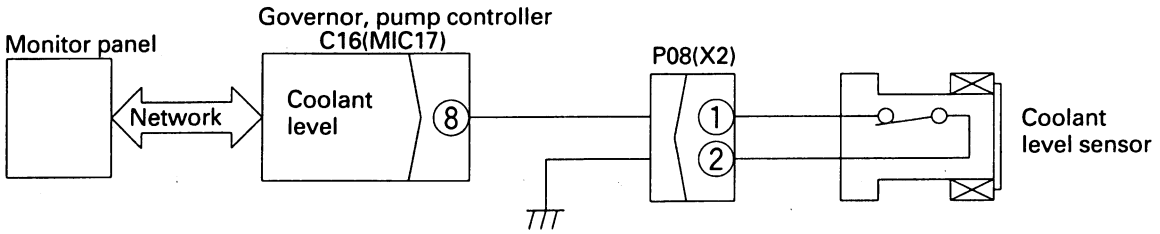
★ Check that the coolant is at the specified level before carrying out troubleshooting.



Table

Short connector	Continuity
Connected	Yes
Disconnected	No

M-9 a) Related electric circuit diagram

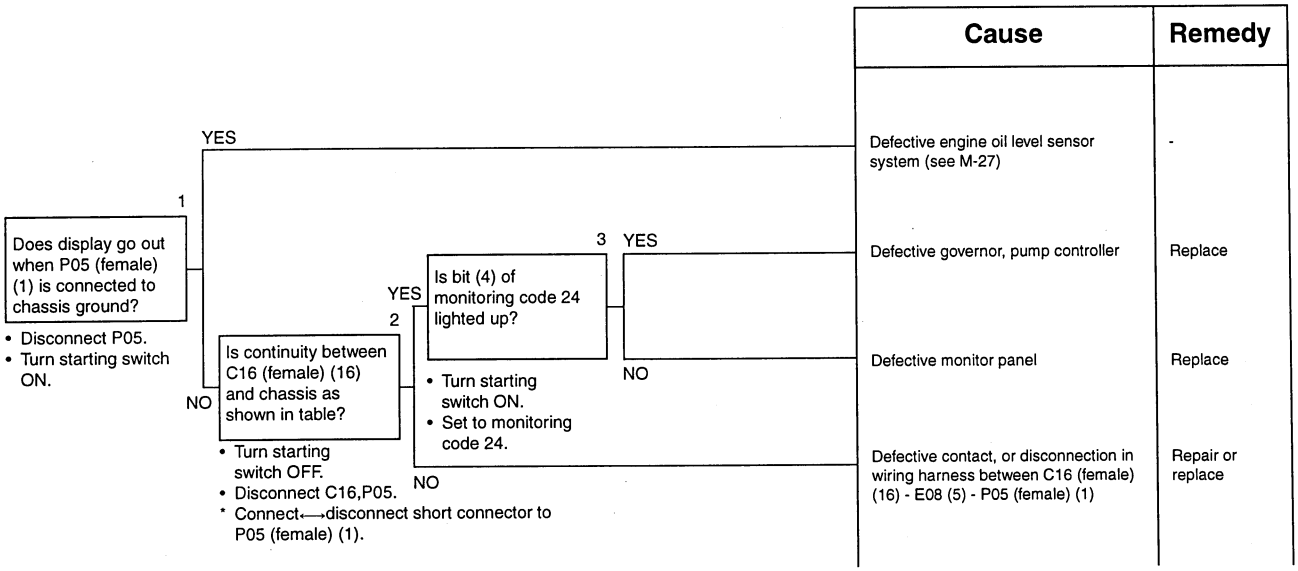


BKP00277

b) (coolant level) flashes

SAP00523

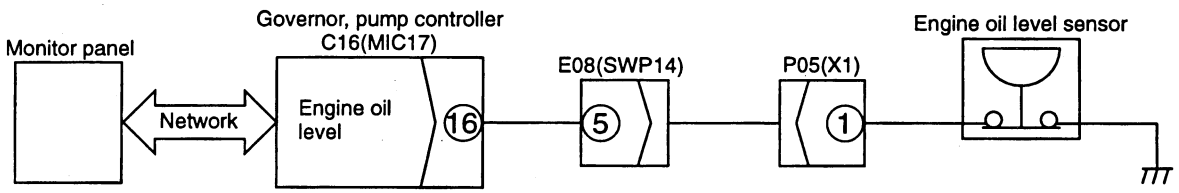
★ Chek that the engine oil is at the specified level before carrying out troubleshooting.



Table

Chassis ground	Continuity
Connected	Yes
Disconnect	No

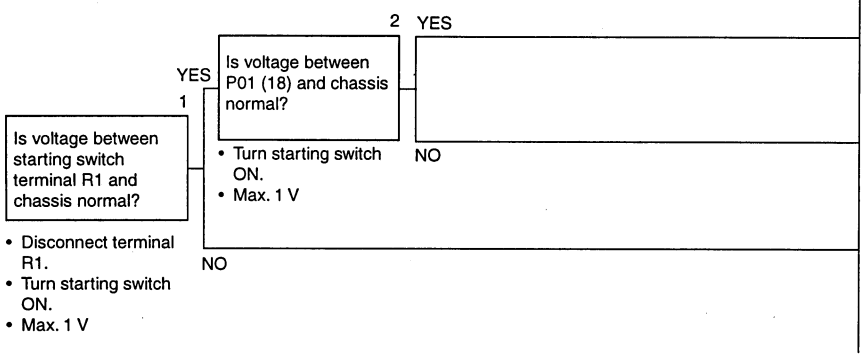
M-9 b) Related electric circuit diagram



M-10 Preheating is not being used but (preheating monitor) lights up

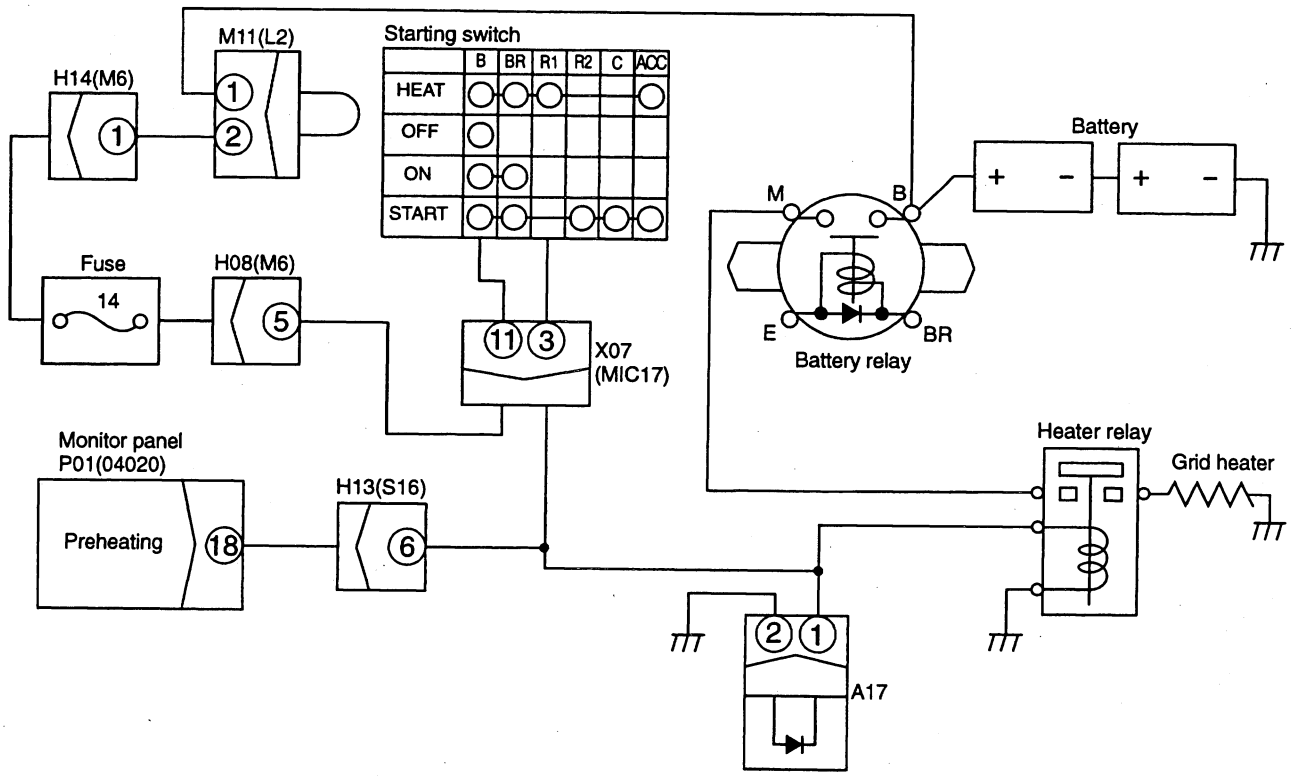
SAP0052C

★ 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
Defective monitor panel	Replace
Short circuit with power source in wiring harness between starting switch R1 - X07 (3) - H13 (6) - P01 (female) (18) or heater relay- H13 (female) (6)	Repair or replace
Defective starting switch	Replace

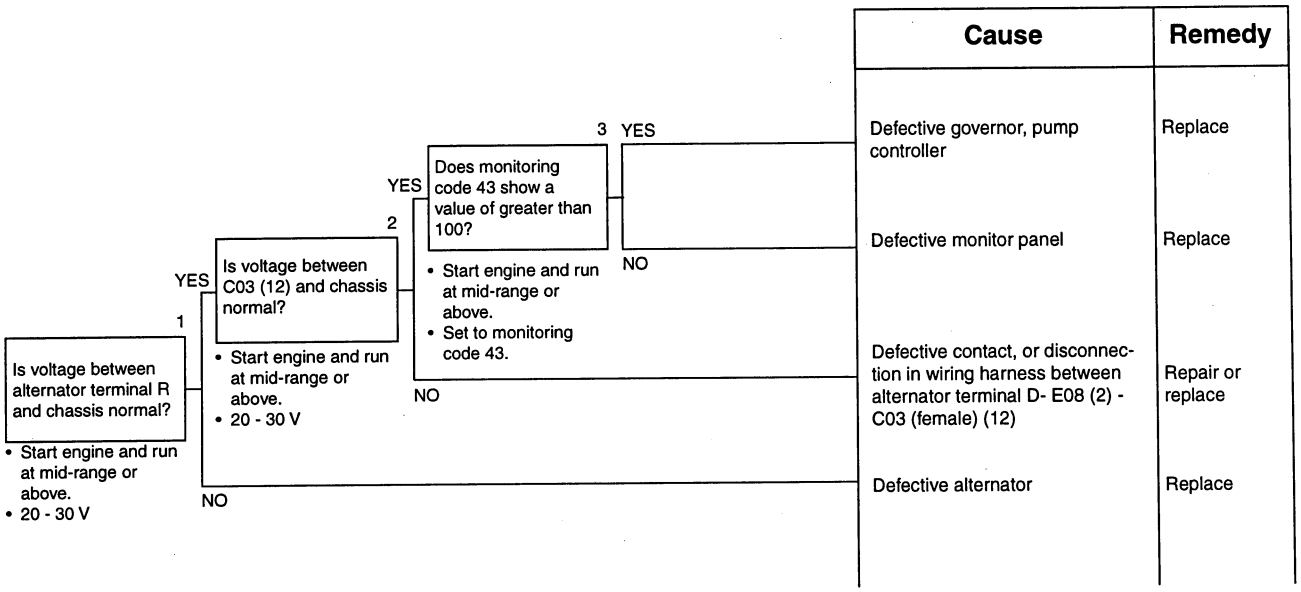
M-10 Related electric circuit diagram



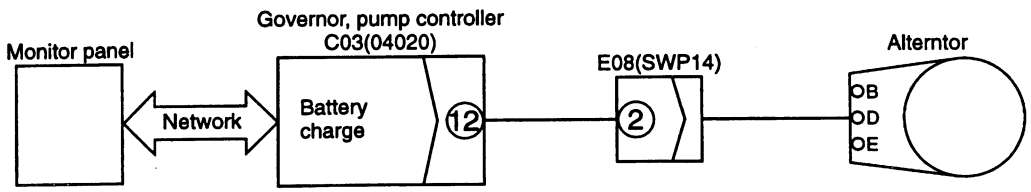
M-11 When starting switch is turned ON and engine is started, basic check items flash

★ Before carrying out troubleshooting, check that all the related connectors sare properly inserted.
★ Always connect any disconnected connectors before going on the next step.
★ Check both the alternator system and the engine oil pressure system.

a) Alternator system

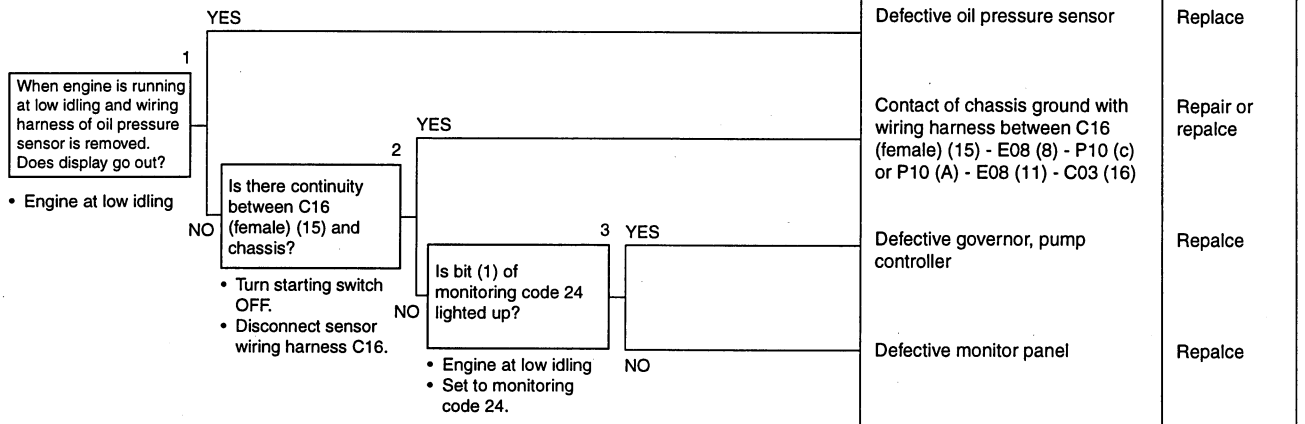


M-11a) Related electric circuit diagram



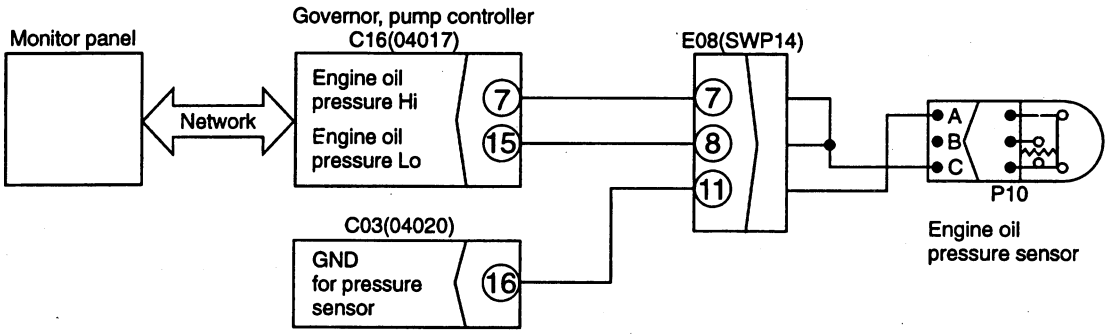
b) Engine oil pressure system

★ When engine oil pressure is normal.



Cause	Remedy
Defective oil pressure sensor	Replace
Contact of chassis ground with wiring harness between C16 (female) (15) - E08 (8) - P10 (c) or P10 (A) - E08 (11) - C03 (16)	Repair or repalce
Defective governor, pump controller	Repalce
Defective monitor panel	Repalce

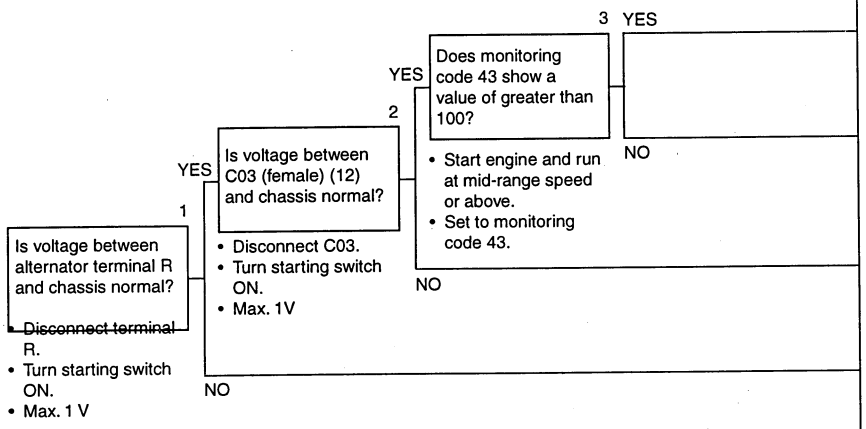
M-11b) Related electric circuit diagram



M-12 When starting switch is turned ON (engine stopped), caution items, emergency items flash (battery, engine oil pressure lamps do not light up)

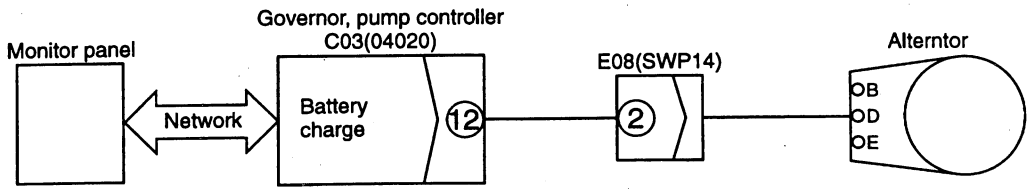
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.
★ Check both the alternator system and the engine oil pressure system.

a) Alternator system



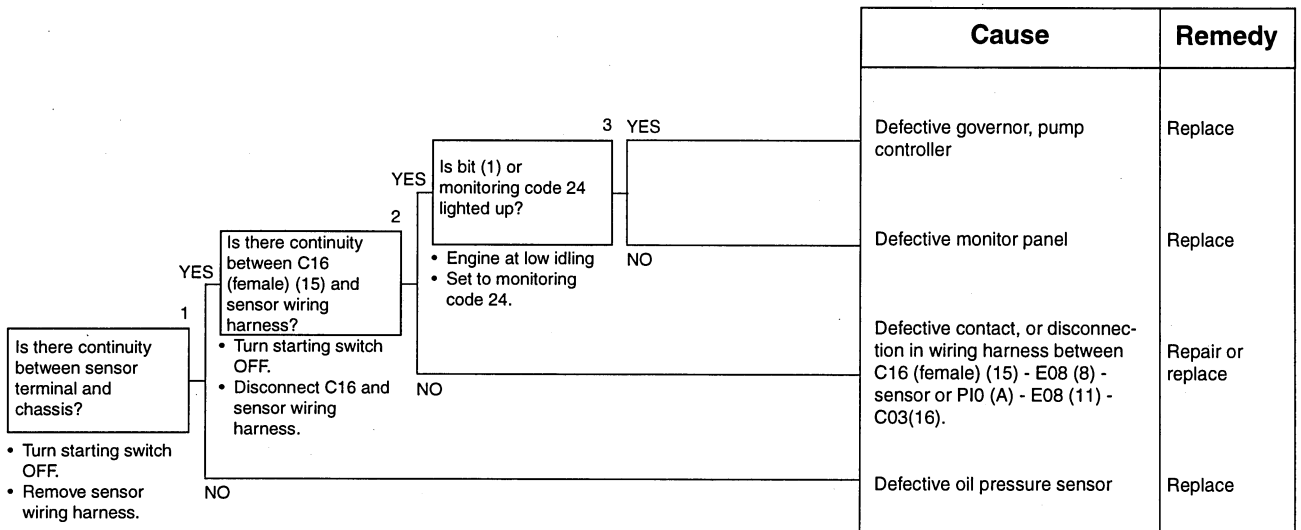
Cause	Remedy
Defective governor, pump controller	Replace
Defective monitor panel	Repalce
Short circuit with power source in wiring harness between C03 (female) (12) - E08 (2) - alternator D	Repair or replace
Defective alternator	Replace

M-12 a) Related electric circuit diagram

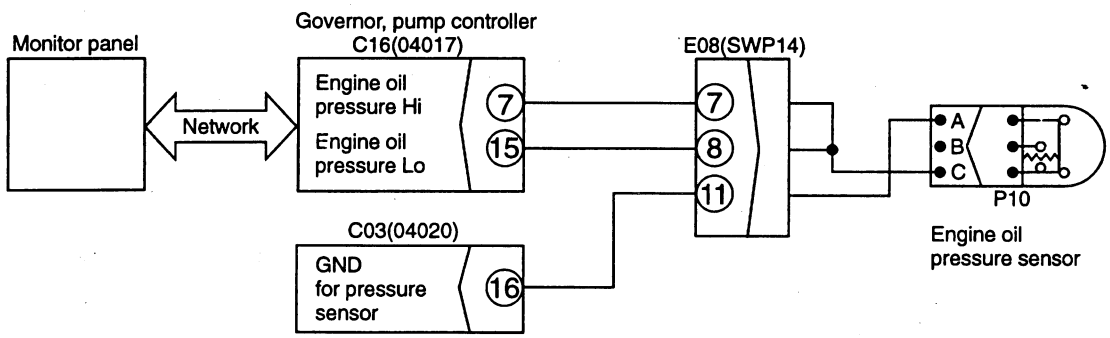


b) Engine oil pressure sensor system

★ When engine oil pressure is normal.



M-12b) Related electric circuit diagram



M-13 When starting switch is turned ON and engine is started, caution items, emergency items flash (when there is no abnormality in engine or items to check before troubleshooting)

★ 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)  **(engine oil pressure) flashes**

SAP00520

★ Check that the engine oil pressure is normal before carrying out troubleshooting.

Cause	Remedy
See M-11 b)	-

b)  **(coolant level) flashes**

SAP00519

★ Check that the coolant level is normal before carrying out troubleshooting.

Cause	Remedy
See M-9 a)	-

c)  **(battery charge) flashes**

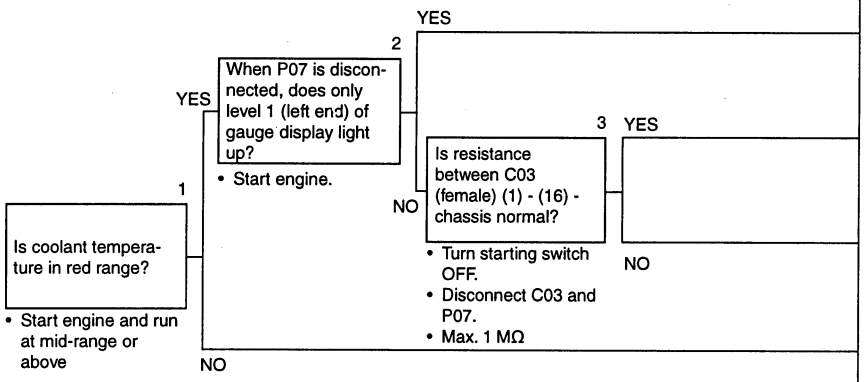
SAP00522

Cause	Remedy
See M-11 a)	-

d) (coolant temperature) flashes

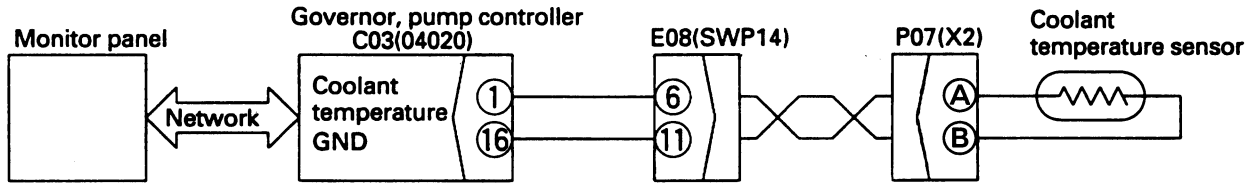
SAP00527

★ Check that the coolant temperature is normal before carrying out troubleshooting



Cause	Remedy
Defective coolant temperature sensor system (see M-26)	-
Defective governor, pump controller	Replace
Short circuit of wiring harness between, C03 (female) (A) - E08 (6) - P07 (female) (1) and wiring harness between C03 (female) (16) - E08 (11) - P07 (female) (B)	Repair or replace
Defective monitor panel	Replace

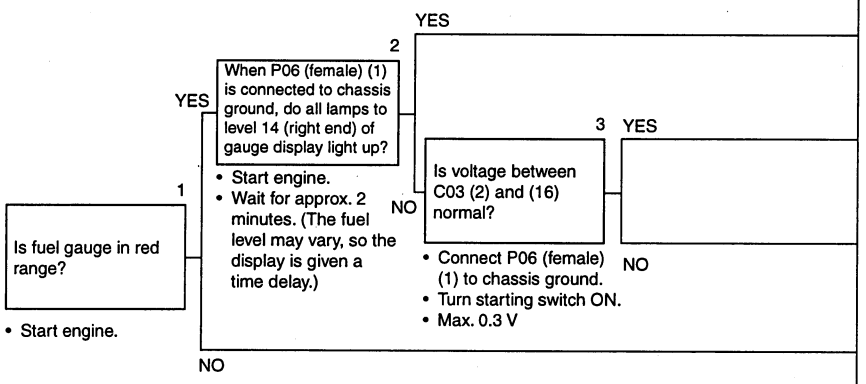
M-13 d) Related electric circuit diagram



e) (fuel level) flashes

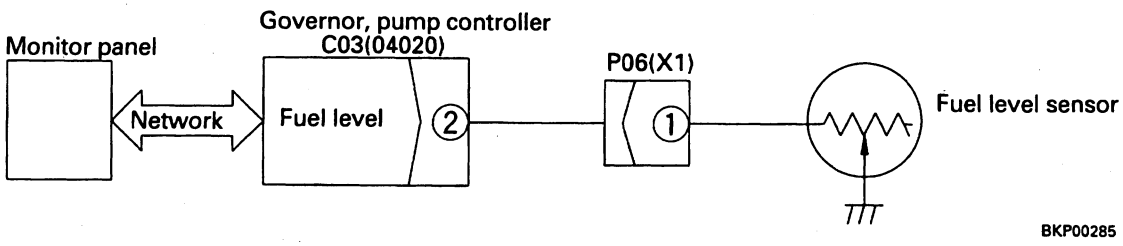
SAP00528

★ Check that there is fuel before carrying out troubleshooting.



Cause	Remedy
Defective fuel level sensor system (see M-25)	-
Defective governor, pump controller	Replace
Defective contact or disconnection in wiring harness between C03 (female) (2) and P06 (feamle) (1)	Repair or replace
Defective monitor panel	Replace

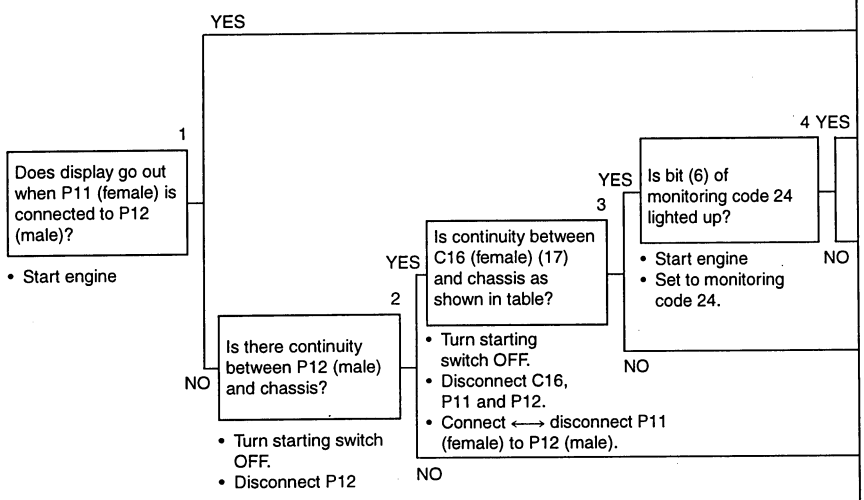
M-13 e) Related electric circuit diagram



f)  (air cleaner clogging) flashes

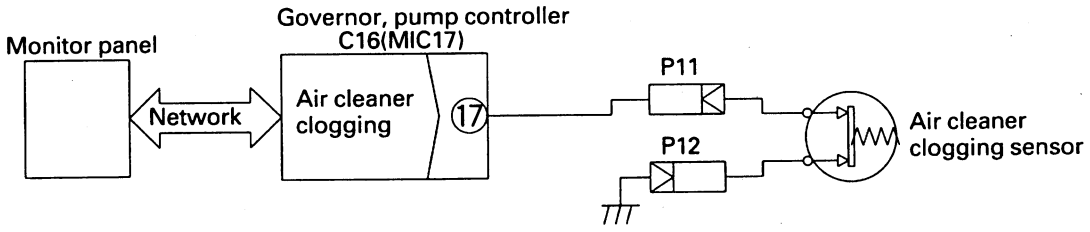
SAP00521

★ 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 disconnectrion in wiring harness between P12 (male) and chassis ground	Repair or replace

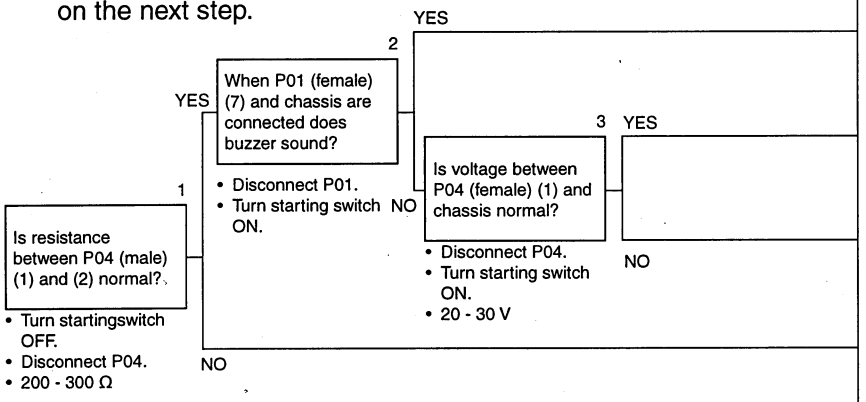
M-13 f) Related electric circuit diagram



BKP00286

M-14 When starting switch is turned ON (engine stopped), buzzer does not sound for 1 second Caution item flashes but buzzer does not sound

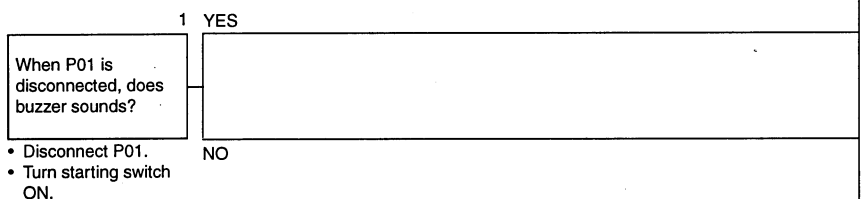
★ Of the caution items, the buzzer will not sound even if there is an abnormality in the battery charge or fuel level.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.



Cause	Remedy
Defective monitor panel	Replace
Defective contact or disconnection in wiring harness between P01 (female) (7) and P04 (female) (2)	Repair or replace
Disconnection, defective contact, short circuit with ground in wiring harness between P04 (female) (1) and fuse No. 13	Repair or replace
Defective buzzer	Repalce

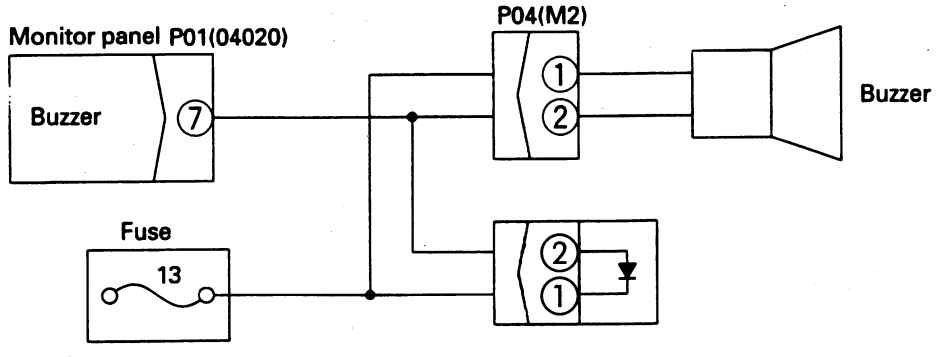
M-15 No abnormality is displayed on monitor but buzzer sounds

★ When the buzzer sounds continuously.
If the buzzer sounds intermittently, carry out troubleshooting M-14.)
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.



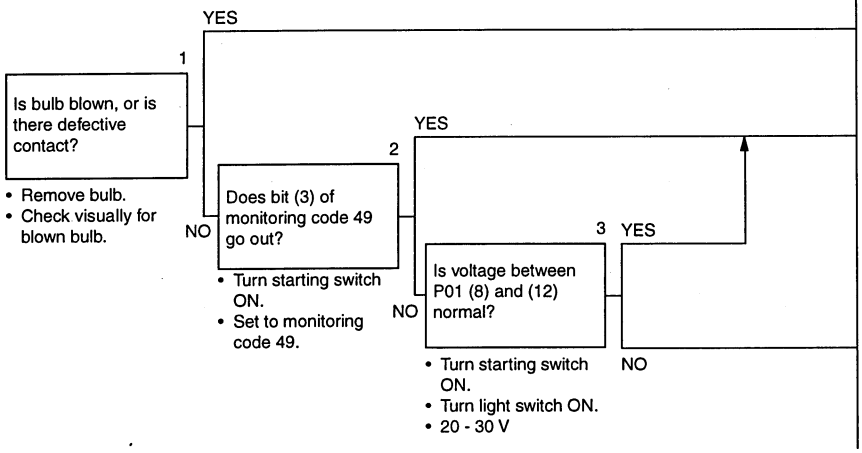
Cause	Remedy
Contact of chassis ground with wiring harness between P01 (female) (7) and P04 (female) (2), or defective buzzer	Repair or replace
Defective monitor panel	Replace

M-14, 15 Related electric circuit diagram



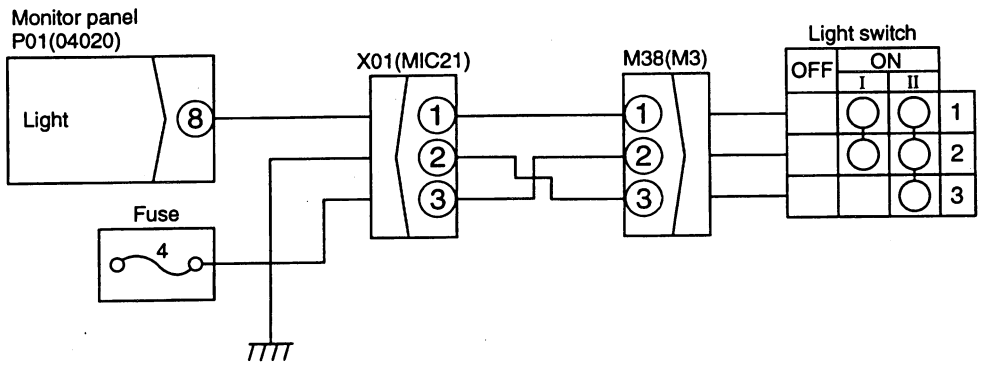
M-16 Night lighting on monitor panel does not light up (liquid crystal display is normal)

★ When the front lamp and working lamp light up normally.



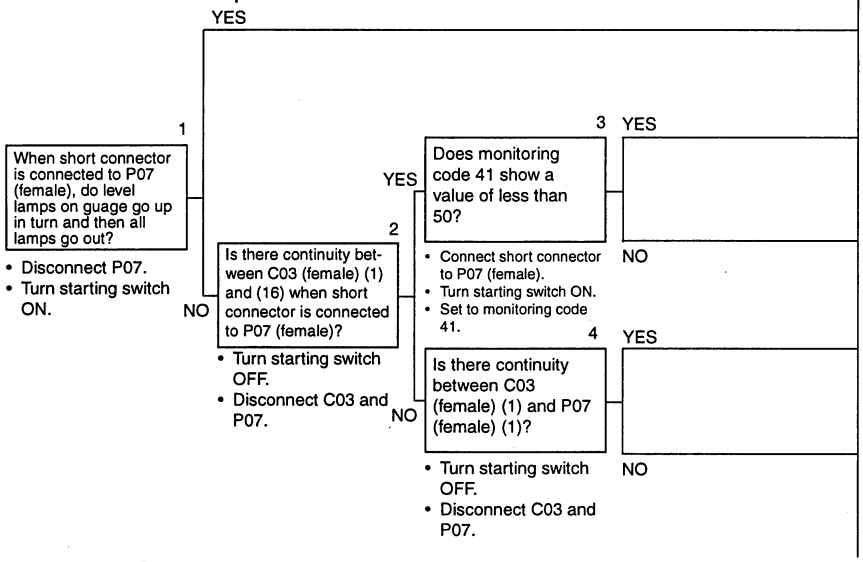
Cause	Remedy
Blown bulb or defective contact of bulb	Replace bulb, or clean (defective contact)
Defective monitor panel	Replace
Defective contact, or disconnection in wiring hanress between P01 (female) (8) - X01 (1) - M38 (female) (1)	Repair or replace

M-16 Related electric circuit diagram



M-17 Coolant temperature gauge does not rise

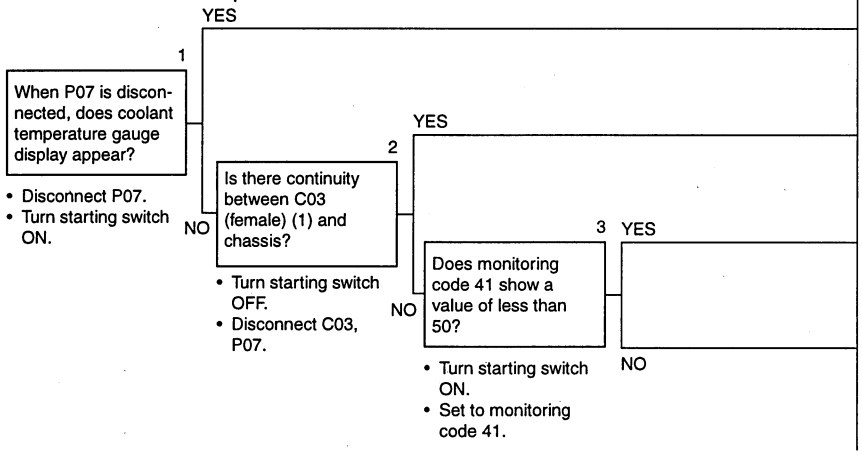
★ If the coolant temperature actually does not rise, check the engine system.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.



Cause	Remedy
Defective coolant temperature sensor system (see M-26)	-
Defective monitor panel	Replace
Defective governor, pump controller	Replace
Defective contact, or disconnection in wiring harness between C03 (female) (16) - E08 (11) - P07 (female) (B)	Repair or replace
Defective contact or disconnection in wiring harness between C03 (female) (1) - E08 (6) - P07 (female) (A)	Repair or replace

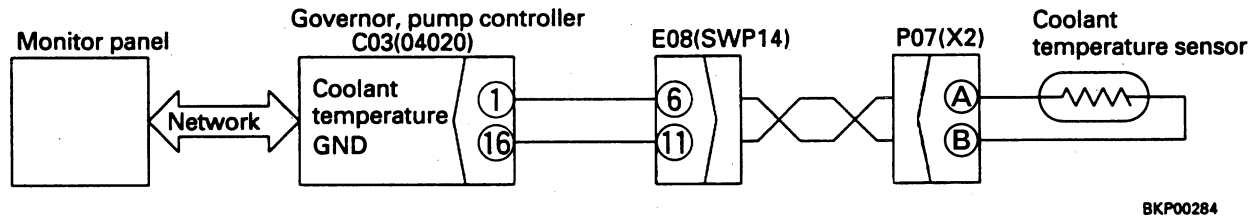
M-18 Coolant temperature gauge does not give any display (none of gauge lamps light up during operation)

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



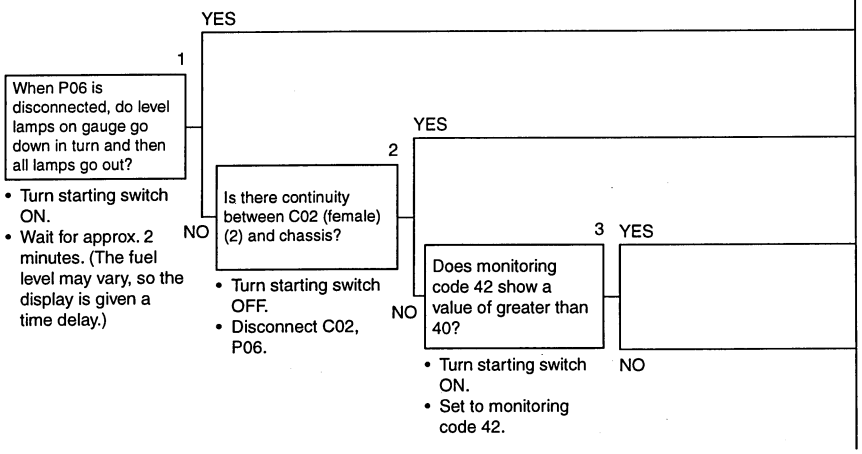
Cause	Remedy
Defective coolant temperature sensor system (see M-26)	-
Contact of chassis ground with wiring harness between C03 (female) (1) - E08 (6) - P07 (female) (A)	Repair or replace
Defective governor, pump controller	Replace
Defective monitor panel	Replace

M-17, 18 Related electric circuit diagram



M-19 Fuel level gauge always displays FULL

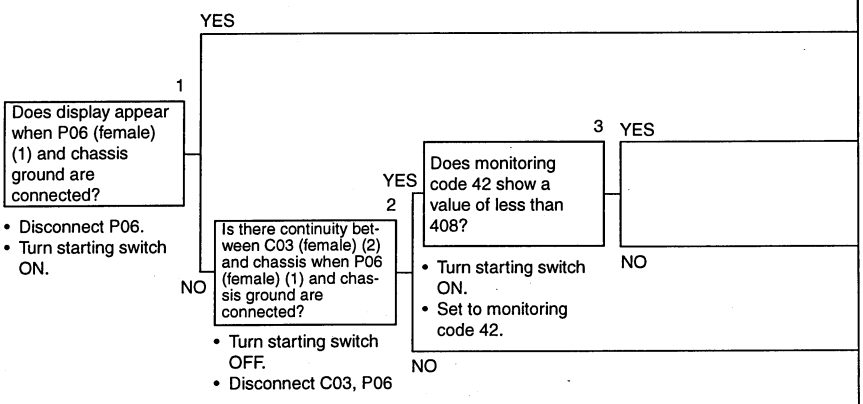
★ Check if the taqnk is actually full before carrying out troubleshooting.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.



Cause	Remedy
Defective fuel level senor system (see M-25)	-
Contact of chassis ground with wiring harness between C03 (female) (2) and P06 (female) (1)	Repair or replace
Defective monitor panel	Replace
Defective governor, pump controller	Replace

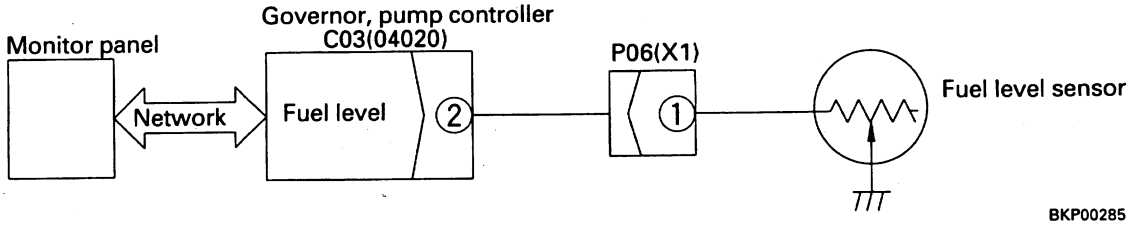
M-20 Fuel level gauge does not give display

★ Check that there is actually no fuel before carrying out troubleshooting.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.



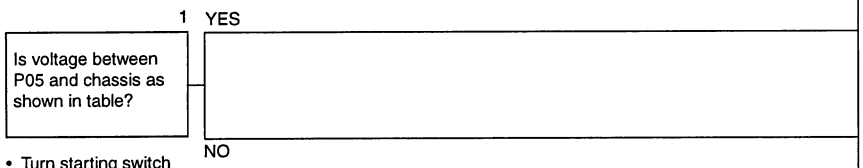
Cause	Remedy
Defective fuel level sensor system (see M-25)	-
Defective governor, pump controller	Replace
Defective monitor panel	Replace
Defective contact, or disconnection in wiring harness between C03 (female) (2) and P06 (female) (1)	Repair or replace

M-19, 20 Related electric circuit diagram



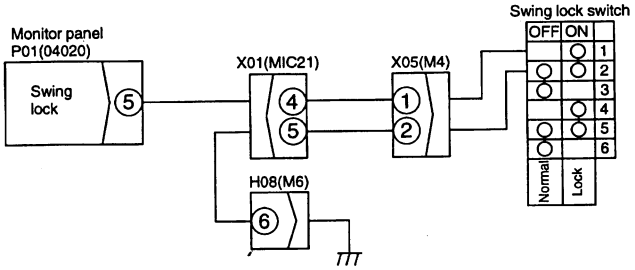
M-21 Swing lock switch is turned ON (LOCK) but (swing lock monitor) does not light up

★ Carry out this troubleshooting only if the swing lock is actually being actuated.
★ 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
Defective monitor panel	Replace
Defective contact or disconnection in wiring harness between P01 (female) (5) - X01 (4) - X05 (male)	Repair or replace

M-21 Related electric circuit diagram

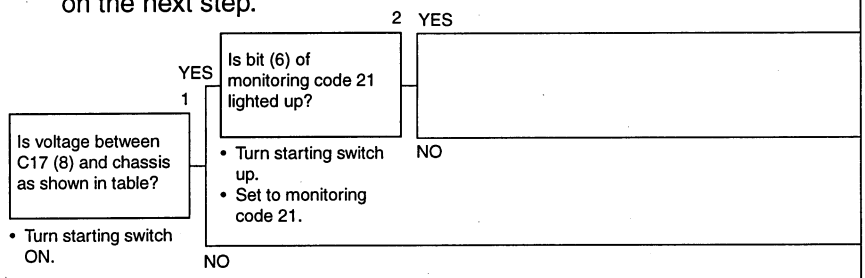


Table

Swing lock switch ON	Max. 1 V
Swing lock switch OFF	20 - 30 V

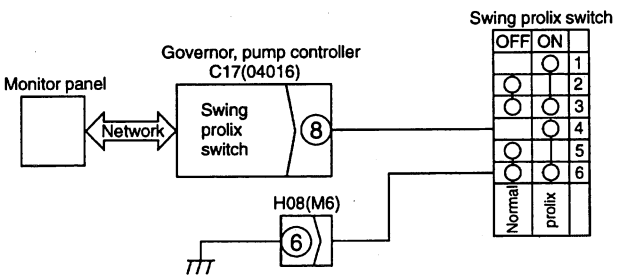
M-22 Swing prolix switch is turned ON (prolix), but (swing lock monitor) does not flash

★ Carry out this troubleshooting only if the swing prolix is actually being actuated.
★ 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
Defective monitor panel	Replace
Defective governor, pump controller	Replace
Defective contact or disconnection in wiring harness between C17 (female) (8) and prolix switch (4)	Repair or replace

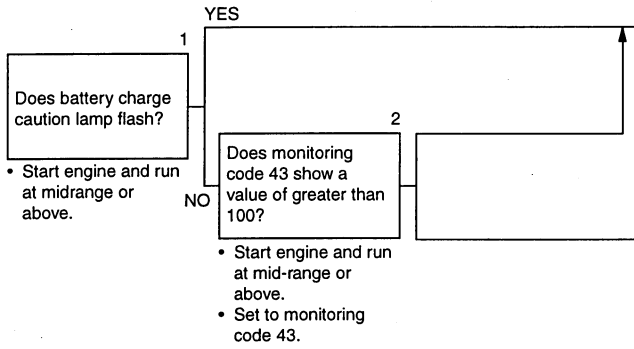
M-22 Related electric circuit diagram



Table

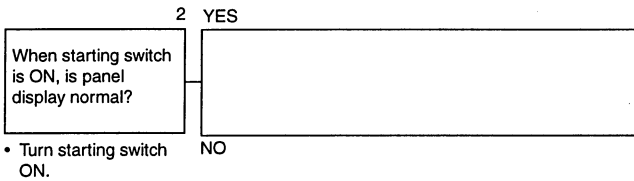
Swing prolix switch ON	Max. 1 V
Swing prolix switch OFF	20 - 30 V

M-23 Service meter does not advance while engine is running



Cause	Remedy
See M-13 d)	-
Defective monitor panel	Replace
Defective governor, pump controller	Replace

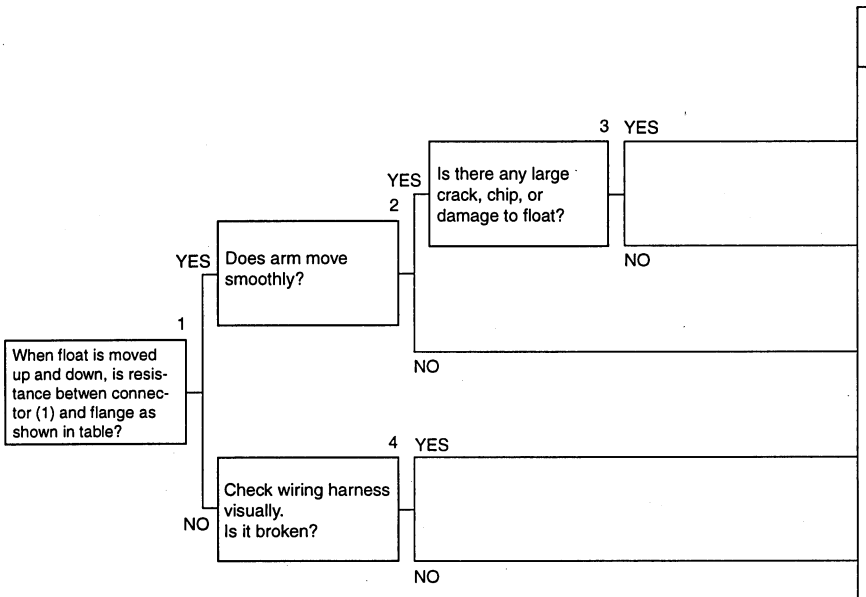
M-24 When starting switch is at OFF and time switch is pressed, time and service meter are not displayed



Cause	Remedy
Defective monitor panel	Replace
See M-6	-

M-25 Defective fuel level sensor system

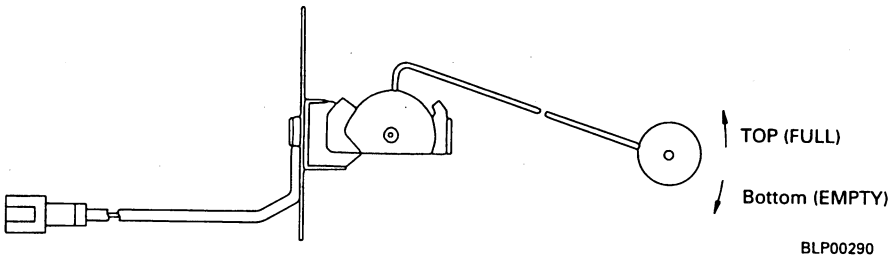
★ Remove the fuel level sensor when carrying out thetroubleshooting



Cause	Remedy
Interference with sensor inside tank	Replace (See Note 2)
Defective contact of connector	Clean connector or replace
Defective sensor (See Note 2)	Replace
Disconnection in wiring harness (See Note 3) (defective clamp) (external force applied)	Replace sensor
Defective sensor	Replace

Table

Top (FULL) stopper postion	Approx. 12Ω or below
Bottom (EMPTY) stopper position	Approx. 85 - 110 Ω

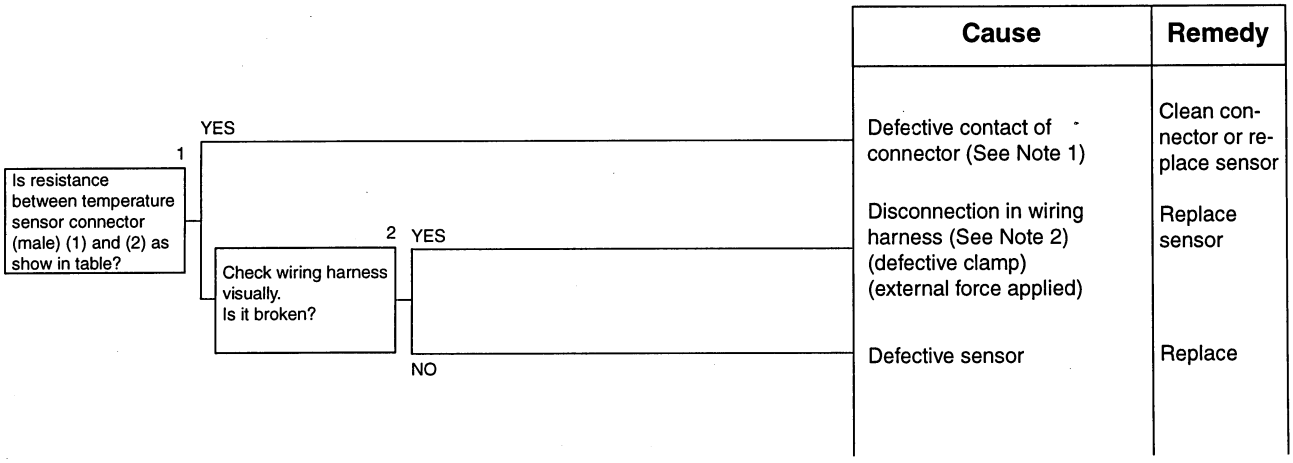


Note 1: Difference between fuel level and gauge display
For guage display position 14 (FULL), the amount of fuel is 78-100%; and for display position 1 (EMPTY) it is below 14,5%. If the chassis is at an angle, the displayed amount of fuel will be different from the actual amount. Therefore, when checking, stop the machine at a horizontal place and wait for at least 2 minutes before checking the gauge. (The display is given a time delay so that the gauge can deal with sudden changes in the fuel level.)

Note 2: There is the possibility of defective installation or interference with the sensor inside the tank, so be careful when installing.

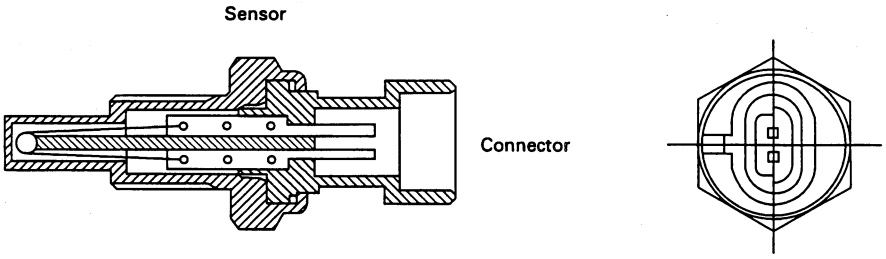
Note 3: Check for vibration at the connector mount. If there is excessive vibration, take the appropriate action.

M-26 Defective coolant temperature sensor system



Table

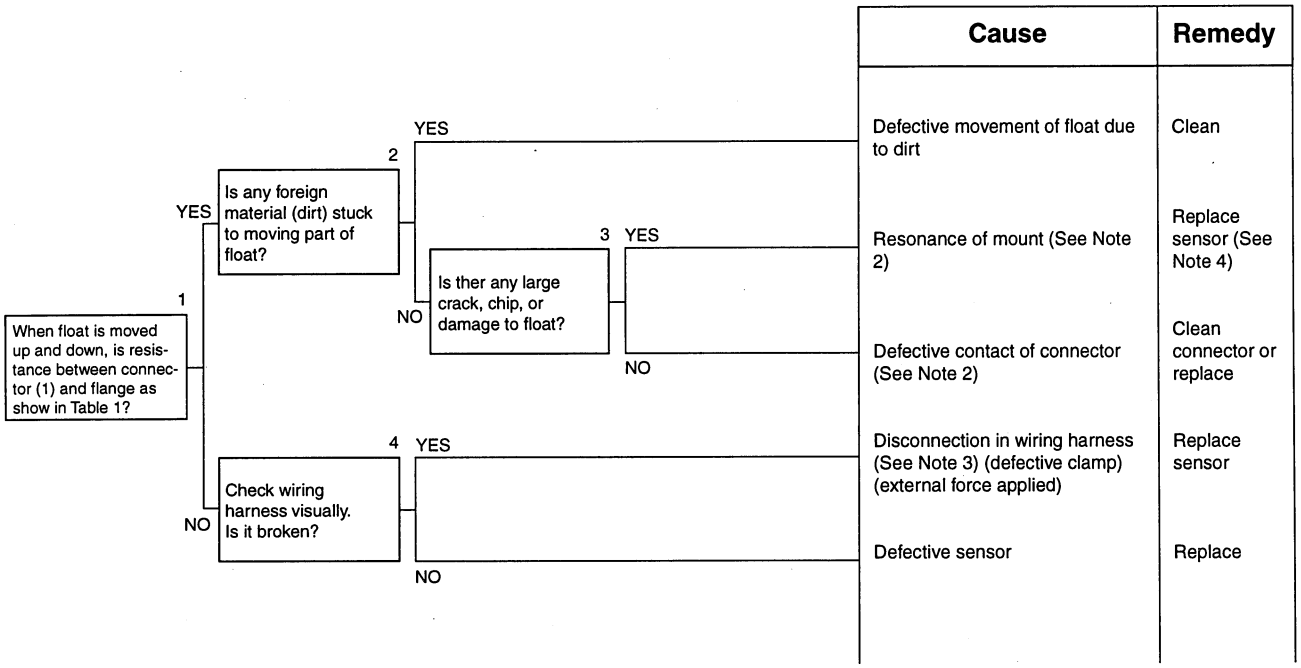
Normal temperature (20°C)	Approx. 70 ~ 78 kΩ
100°C	Approx. 3Ω



Note 1: 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 2: Check for vibration at the connector mount. If there is exessive vibration, take the appropriate action.

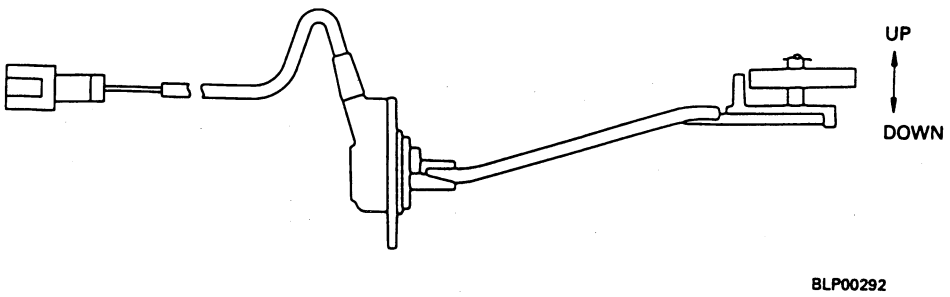
M-27 Defective engine oil level sensor system

★ Remove the engine oil level sensor when carrying out troubleshooting



Table

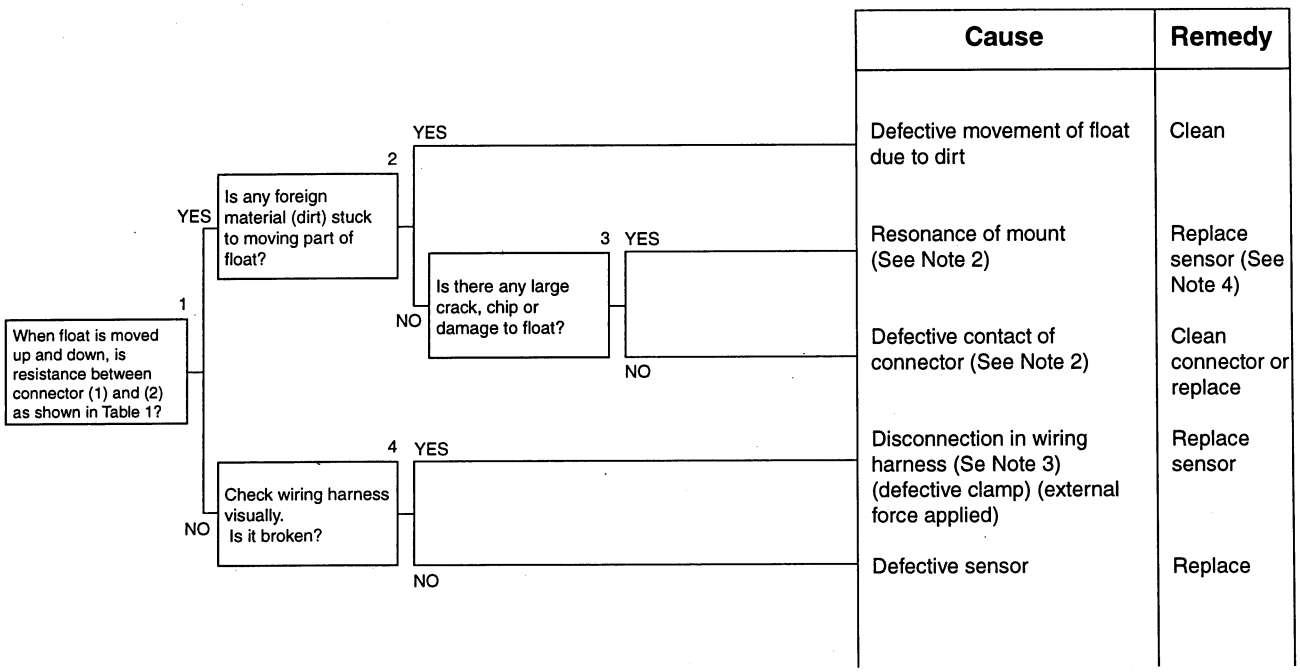
Float UP	Max. 1 Ω
Float DOWN	Min. 1 MΩ



Note 1: Variations in oil level.
The oil level may change according to the angle of the machine, the engine speed, or the temperature of the oil, so if there is any display, check the oil 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 any vibration of the mount, and if there is excessive vibration, take the appropriate action.

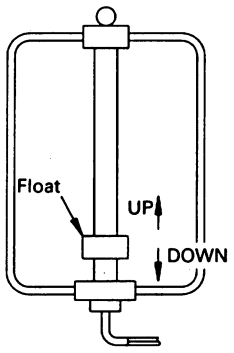
M-28 Defective coolant level sensor system

★ Remove the coolant level sensor when carrying out troubleshooting.



Table

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



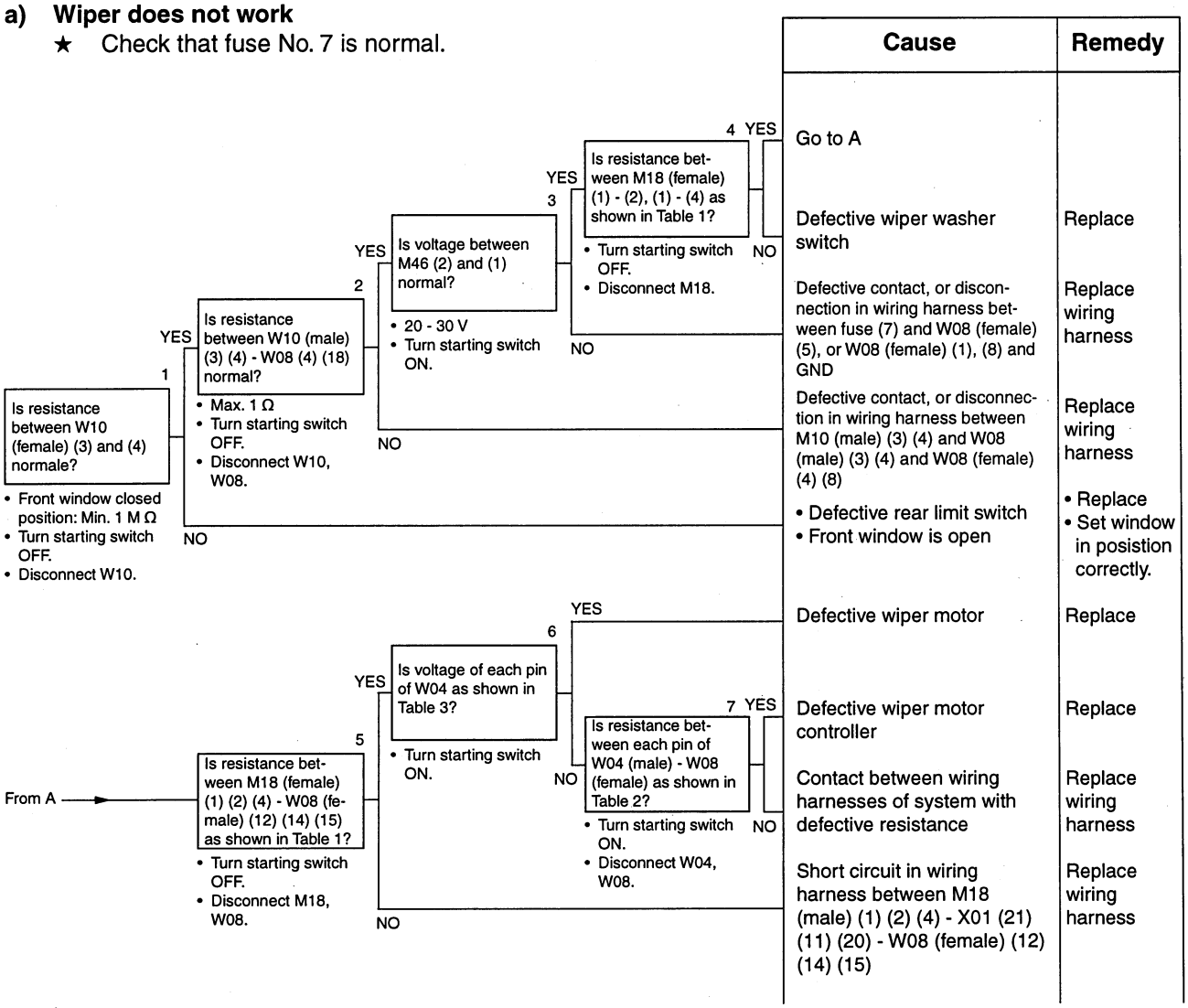
BLP00293

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 installing. If the problem occurs again, check for any vibration of the mount, and if there is excessive vibration, take the appropriate action.

M-30 Wiper does not work or switch is not being used but wiper is actuated

a) Wiper does not work

★ Check that fuse No. 7 is normal.



Cause	Remedy
Go to A	
Defective wiper washer switch	Replace
Defective contact, or disconnection in wiring harness between fuse (7) and W08 (female) (5), or W08 (female) (1), (8) and GND	Replace wiring harness
Defective contact, or disconnection in wiring harness between M10 (male) (3) (4) and W08 (male) (3) (4) and W08 (female) (4) (8)	Replace wiring harness
• Defective rear limit switch • Front window is open	• Replace • Set window in posistion correctly.
Defective wiper motor	Replace
Defective wiper motor controller	Replace
Contact between wiring harnesses of system with defective resistance	Replace wiring harness
Short circuit in wiring harness between M18 (male) (1) (2) (4) - X01 (21) (11) (20) - W08 (female) (12) (14) (15)	Replace wiring harness

Table 1

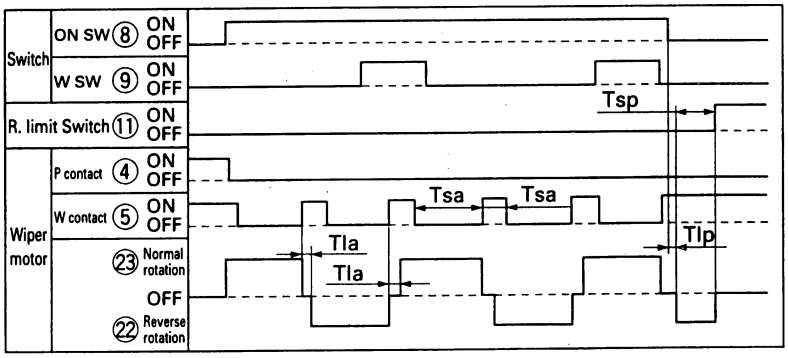
Actuation mode	M18 (female)	W08 (female)	Resistance (Ω)
INT mode	Between (1) - (4)	Between (12) - (15)	Max. 1 Ω
	Between (1) - (2)	Between (12) - (14)	Max. 1 MΩ
	Between (2) - (4)	Between (14) - (15)	
OFF mode	Between (1) - (2)	Between (12) - (14)	Max. 1 MΩ
	Between (1) - (4)	Between (12) - (15)	
	Between (2) - (4)	Between (14) - (15)	
ON mode	Between (1) - (2)	Between (12) - (14)	Max. 1 Ω
	Between (1) - (4)	Between (12) - (15)	Max. 1 MΩ
	Between (2) - (4)	Between (14) - (15)	

Table 2

Between W04 (female) (1) - W08 (female) (7)	Max. 1 Ω
Between W04 female) (3) - W08 (female) (6)	
Between W04 (female) (4) - w08 (female) (11)	
Between W04 (female) (5) - W08 (female) (9)	
Between W04 (female) (6) - W08 (female) (10)	
Between w04 (female) (1) (3) (4) (5) (6) - GND	Min. 1 MΩ

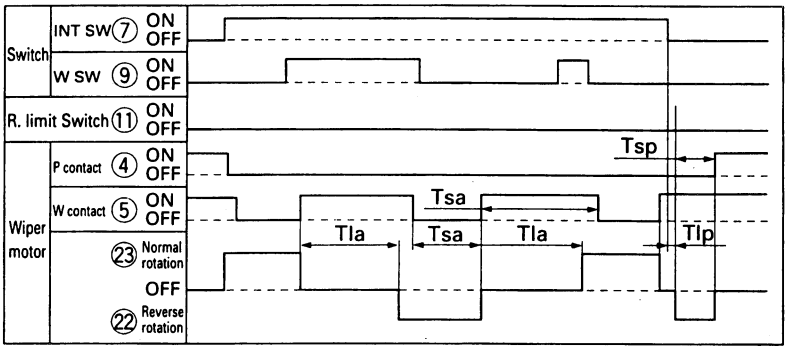
Table 3

Timing chart (when wiper is ON)



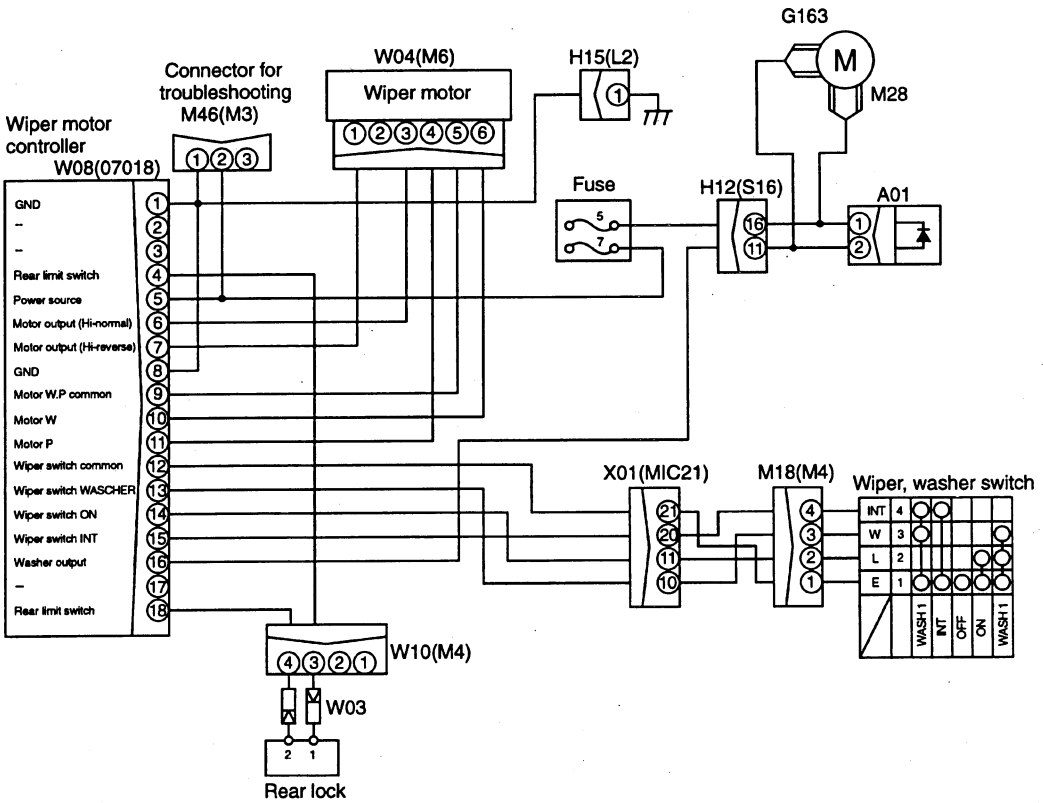
Item	Symbol	Set time
Length of pause until next actuation	Tla	0.13 sec
Safety circuit during operation of wiper [safety function (1)]	Tsa	10 sec
Length of pause when stowing wiper blade	Tlp	1.5 sec
Safety circuit during stowing of wiper [safety function (2)]	Tsp	10 sec

Timing chart (for wiper INT)



Item	Symbol	Set time
Length of pause until next actuation	Tla	4 sec
Safety circuit during operation of wiper [safety function (1)]	Tsa	10 sec
Length of pause when stowing wiper blade	Tlp	1.5 sec
Safety circuit during stowing of wiper [safety function (2)]	Tsp	10 sec

M-30 Ralated electric circuit diagram



b) Wiper switch is not being used but wiper is actuated

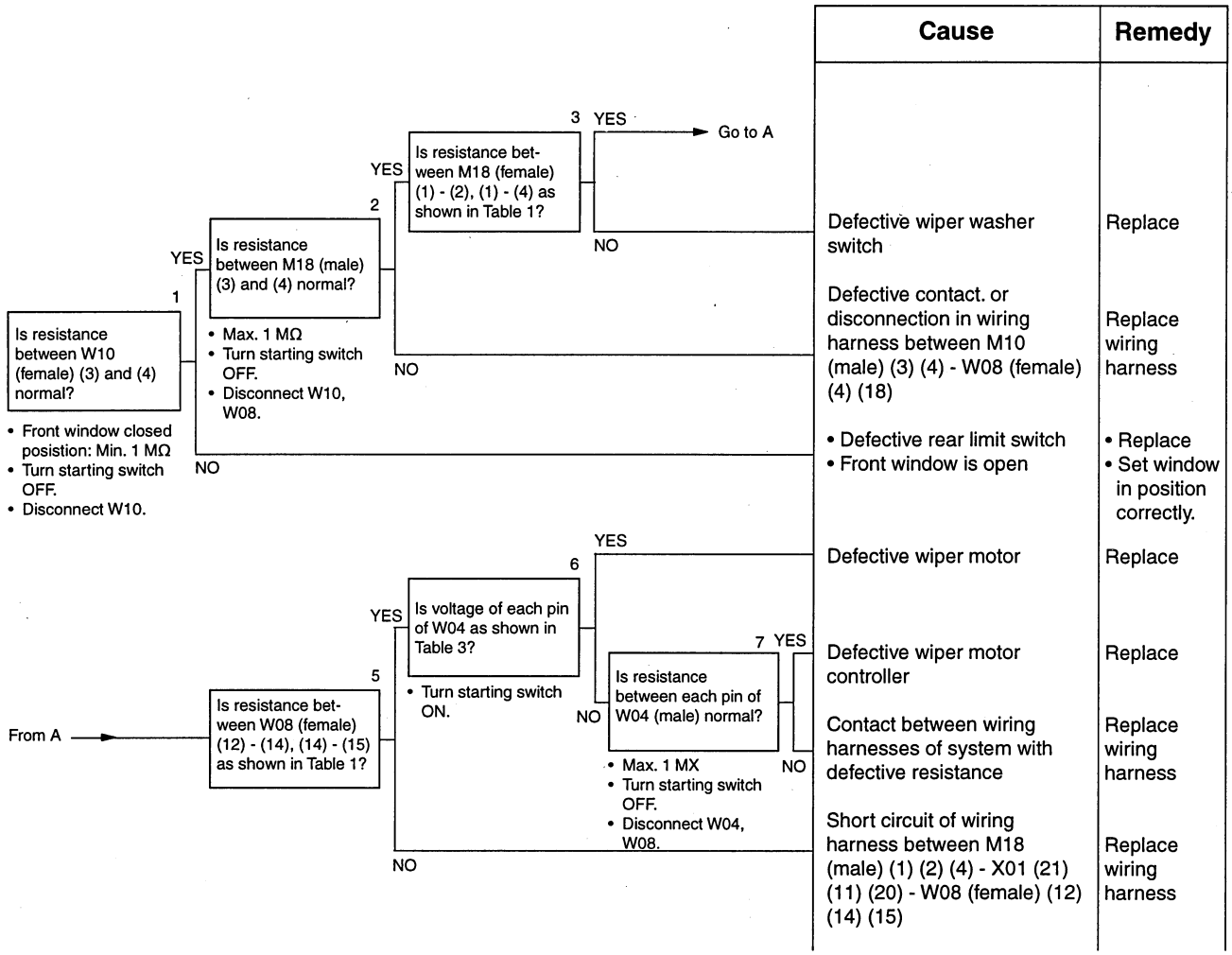
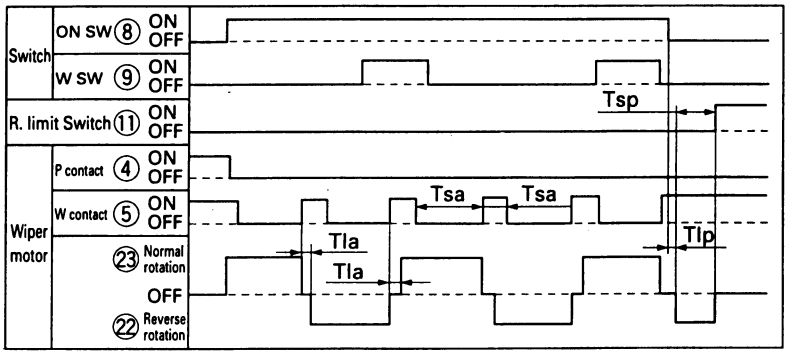


Table 1

Actuation mode	M18 (female)	W08 (female)	Resistance (Ω)
INT mode	Between (1) - (4)	Between (12) - (15)	Max. 1 Ω
	Between (1) - (2)	Between (12) - (14)	Max. 1 MΩ
	Between (2) - (4)	Between (14) - (15)	
OFF mode	Between (1) - (2)	Between (12) - (14)	Max. 1 MΩ
	Between (1) - (4)	Between (12) - (15)	
	Between (2) - (4)	Between (14) - (15)	
ON mode	Between (1) - (2)	Between (12) - (14)	Max. 1 Ω
	Between (1) - (4)	Between (12) - (15)	Max. 1 MΩ
	Between (2) - (4)	Between (14) - (15)	

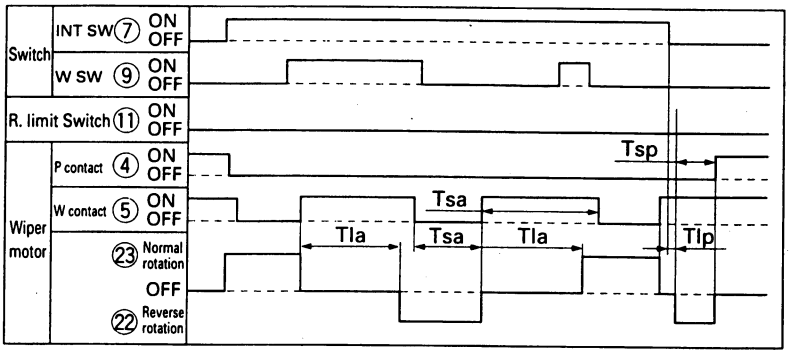
Table 3

Timing chart (when wiper is ON)



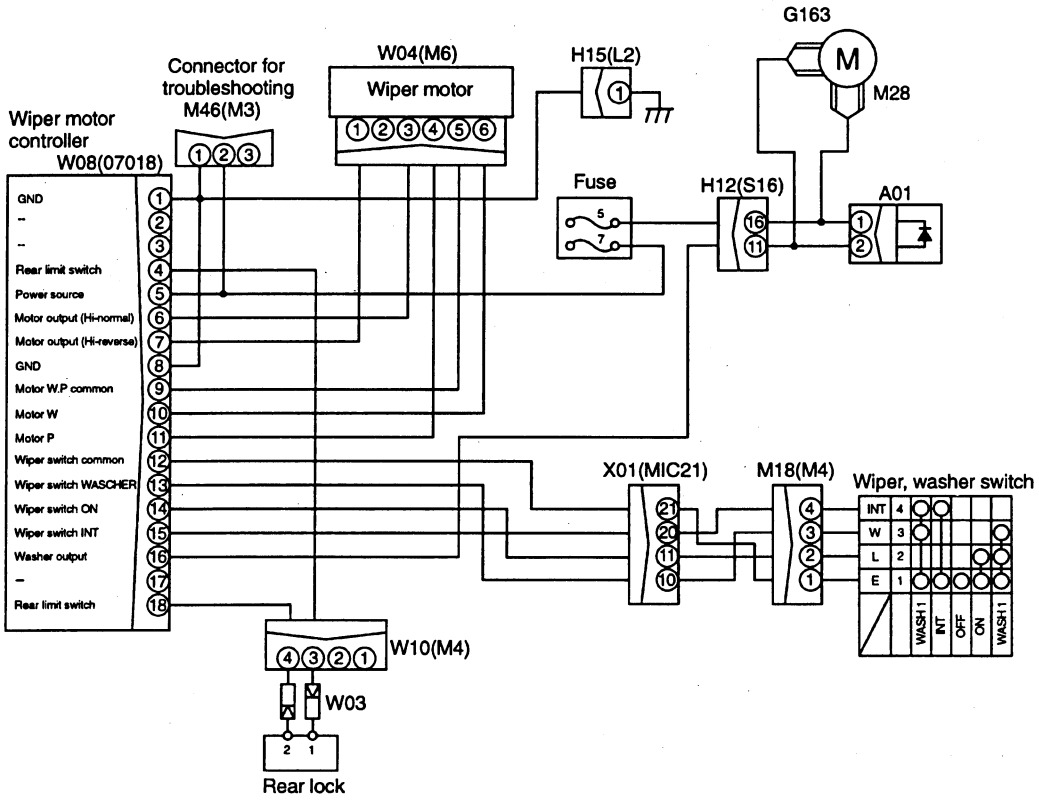
Item	Symbol	Set time
Length of pause until next actuation	Tla	0.13 sec
Safety circuit during operation of wiper [safety function (1)]	Tsa	10 sec
Length of pause when stowing wiper blade	Tlp	1.5 sec
Safety circuit during stowing of wiper [safety function (2)]	Tsp	10 sec

Timing chart (for wiper INT)



Item	Symbol	Set time
Length of pause until next actuation	Tla	4 sec
Safety circuit during operation of wiper [safety function (1)]	Tsa	10 sec
Length of pause when stowing wiper blade	Tlp	1.5 sec
Safety circuit during stowing of wiper [safety function (2)]	Tsp	10 sec

M-30 Ralated electric circuit diagram



30 DISASSEMBLY AND ASSEMBLY

METHOD OF USING MANUAL

1. When removing or installing unit assemblies

① When removing or installing a unit assembly, the order of work and techniques used are given for the removal operation; the order of work for the installation operation is not given.

② Any special techniques applying only to the installation procedure are marked [*1], and the same mark is placed after the relevant step in the removal procedure to indicate which step in the installation procedure it applies to.

(Example)

REMOVAL OF ○○○○ ASSEMBLY ..... Title of operation

⚠ ..... Precautions related to safety when carrying out the operation

1. XXXX(1) ..... Step in operation

★ ..... Technique or important point to remember when removing XXXX (1).

2. Δ Δ Δ Δ (2): ..... [※ 1] Indicates that a technique is listed for use during installation

3. □□□□ assmelby (3)

..... Quantity of oil or water drained

INSTALLATION OF ○○○○ ASSEMBLY ..... Title of operation

- Carry out installation in the reverse order to removal.

[※ 1] ..... Technique used during installation

★ ..... Technique or important point to remember when installing Δ Δ Δ Δ (2).

- Adding water, oil ..... Step in operation

★ ..... Point to remember when adding water or oil

..... Quantity when filling with oil and water

2. General precautions when carrying out installation or removal (disassembly or assembly) of units are given together as PRECAUTIONS WHEN CARRYING OUT OPERATION, so be sure to follow these precautions when carrying out the operation.

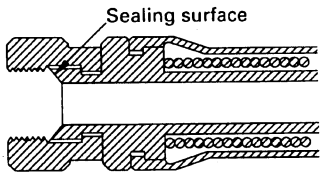
3. Listing of special tools

① For details of the description, part number, and quantity of any tols (**A1**, etc.) that appear in the operation procedure, see the SPECIAL TOOLS LIST given in this manual.

4. General tightening torque table (when using torque wrench)

★ In the case of metric nuts and bolts for which there is no special instruction, tighten to the torque given in the table below.

Thread diameter	Width across flats	 SAD00481	 SAD00482
mm	mm	kgm	Nm
6	10	1.35 ± 0.15	13.2 ± 1.4
8	13	3.2 ± 0.3	31.4 ± 2.9
10	17	6.7 ± 0.7	65.7 ± 6.8
12	19	11.5 ± 1.0	112 ± 9.8
14	22	18.0 ± 2.0	177 ± 19
16	24	28.5 ± 3	279 ± 29
18	27	39 ± 4	383 ± 39
20	30	56 ± 6	549 ± 58
22	32	76 ± 8	745 ± 78
24	36	94.5 ± 10	927 ± 98
27	41	135 ± 15	1320 ± 140
30	46	175 ± 20	1720 ± 190
33	50	225 ± 25	2210 ± 240
36	55	280 ± 30	2750 ± 290
39	60	335 ± 35	3280 ± 340



SAD00483

5. Table of tightening torques for flared nuts

★ In the case of flared nuts for which there is no special instruction, tighten to the torque given in the table below.

Thread diameter	Width across flats	Tightening torque	
mm	mm	kgm	Nm
14	19	2.5 ± 0.5	24.5 ± 4.9
18	24	5 ± 2	49 ± 19.6
22	27	8 ± 2	78.5 ± 19.6
24	32	14 ± 3	137.3 ± 29.4
30	36	18 ± 3	176.5 ± 29.4
33	41	20 ± 5	196.1 ± 49
36	46	25 ± 5	245.2 ± 49
42	55	30 ± 5	294.2 ± 49

6. Table of tightening torques for split flange bolts

★ In the case of split flange bolts for which there is no special instruction, tighten to the torque given in the table below.

Thread diameter	Width across flats	Tightening torque	
mm	mm	Kgm	Nm
10	14	6.7 ± 0.7	65.7 ± 6.8
12	17	11.5 ± 1	112 ± 9.8
16	22	28.5 ± 3	279 ± 29

PRECAUTIONS WHEN CARRYING OUT OPERATION

[When carrying out removal or installation (disassembly or assembly) of units, be sure to follow the general precautions given below when carrying out the operation.]

1. Precautions when carrying out removal work

- If the coolant contains antifreeze, dispose of it correctly.
  After disconnecting hoses or tubes, cover them or fit blind plugs to prevent dirt or dust from entering.
- When draining oil, prepare a container of adequate size to catch the oil.
- Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.
- To prevent any excessive force from being applied to the wiring, always hold the connectors when disconnecting the connectors. Do not pull the wires.
- Fit wires and hoses with tags to show their installation position to prevent any mistake when installing.
- Check the number and thickness of the shims, and keep in a safe place.
- When raising components, be sure to use lifting equipment of ample strength.
- When using forcing screws to remove any components, tighten the forcing screws uniformly in turn.
- Before removing any unit, clean the surrounding area and fit a cover to prevent any dust or dirt from entering after removal.

★ Precautions when handling piping during disassembly
Fit the following blind plugs into the piping after disconnecting it during disassembly operations.
1) Hoses and tubes using sleeve nuts

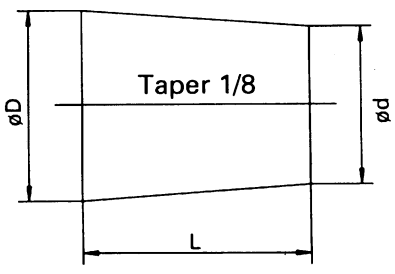
Nominal number	Plug (nut end)	Sleeve nut (elbow end) Use the two items below as a set
02	07376-50210	07221-20210 (Nut), 07222-00210 (Plug)
03	07376-50315	07221-20315 (Nut), 07222-00312 (Plug)
04	07376-50422	07221-20422 (Nut), 07222-00414 (Plug)
05	07376-50522	07221-20522 (Nut), 07222-00515 (Plug)
06	07376-50628	07221-20628 (Nut), 07222-00616 (Plug)
10	07376-51034	07221-21034 (Nut), 07222-01018 (Plug)
12	07376-51234	07221-21234 (Nut), 07222-01219 (Plug)

2) Split flange type hoses and tubes

Nominal number	Flange (hose end)	Sleeve head (tube end)	Split flange
04	07379-00400	07378-10400	07371-30400
05	07379-00500	07378-10500	07371-30500

3) If the part is not under hydraulic pressure, the following corks can be used.

Nominal number	Part Number	Dimensions		
		D	d	L
06	07049-00608	6	5	8
08	07049-00811	8	6.5	11
10	07049-01012	10	8.5	12
12	07049-01215	12	10	15
14	07049-01418	14	11.5	18
16	07049-01620	16	13.5	20
18	07049-01822	18	15	22
20	07049-02025	20	17	25
22	07049-02228	22	18.5	28
24	07049-02430	24	20	30
27	07049-02734	27	22.5	34



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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 plated 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 caoting 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 tighenting 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 form 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.

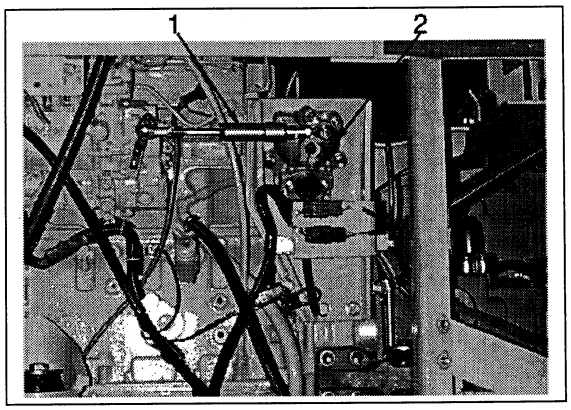
SPECIAL TOOL LIST

Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks
• Engine • hydraulic pump assembly • Radiator • hydraulic oil cooler assembly • Control pump assembly • Hydraulic pump assembly • Removal, installation of TVC • LS valve assembly	B		796-460-1210	Oil stopper	1	
Disassembly of center swivel joint assembly	D		790-101-2501	Push-puller	1	
Removal installation of swing circle	E		790-331-1110	Wrench	1	Tightening of circle bolt
Removal, installation of recoil spring assembly	H	1	791-600-2001 or 791-685-8005	Compressor (A) Compressor (B)	1 1	Removal, press fitting of master pin
			791-635-3160	Extension	1	
			790-101-1600	Cylinder (70 ton)	1	
			790-101-1102	Pump	1	
		2	790-201-1500 • 790-201-1620 • 790-101-5021 • 01010-50816	Push tool kit • Plate • Grip • Bolt	 1 1 1	Installation of recoil spring piston dust seal
Removal, installation of track shoe assembly	I		790-630-3000	Remover & Installer	1	Removal, press fitting of master pin
			790-101-1300	Cylinder (70 ton)	1	
			790-101-1102	Pump	1	

Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks
Assembly of idler assembly	P	1	790-434-1630	Installer	1	Installation of floating seal
		2	791-601-1000	Oil pump	1	Charging with oil, checking for air leakage
Disassembly, assembly of track roller assembly	K	1	790-434-1640	Installer	1	Installation of floating seal
		2	791-601-1000	Oil pump	1	Charging with oil, checking for air leakage
		3	790-331-1110	Wrench	1	Tightening of track roller assembly mounting bolt
Disassembly, assembly of carrier roller assembly	L	1	797-101-1121	Wrench	1	Removal, installation of nut
		2	796-430-1110	Push tool	1	Press fitting of bearing
		3	791-434-1650	Installer	1	Installation of floating seal
		4	791-601-1000	Oil pump	1	Charging with oil, checking for air leakage
Installation of track roller	M		790-331-1110	Wrench	1	Tightening of track roller bolt
Disassembly, assembly of hydraulic cylinder	O	1	790-502-1003	Cylinder repair stand	1	
			790-101-1102	Pump	1	
		2	790-102-1330	Socket (wdth across flats: 75 mm)	1	
			790-302-1430	Socket (width across flats: 85 mm)	1	
		3	790-720-1000	Expander	1	Expansion of piston ring
		4	796-720-1670	Ring	1	
			07281-01279	Clamp	1	
			796-720-1660	Ring	1	
			07281-01159	Clamp	1	

Nature of work	Symbol	Part No.	Part Name	Q'ty	Remarks
• Removal, installation of work equipment assembly • Boom assembly	P	792-785-1100	Remover	1	Removal of boom foot pin
		790-101-3800	Puller (50 ton long)	1	
		790-101-1102	Pump (30 ton)	1	

REMOVAL OF GOVERNOR MOTOR ASSEMBLY



⚠ Disconnect the cable from the negative (-) terminal of the battery.

1. Open engine hood and disconnect governor motor connector.
2. Remove motor rod (1).
3. Remove governor motor assembly (2). [※ 1]
   ★ Rotate the shaft of the governor motor and do not stop it suddenly.

INSTALLATION OF GOVERNOR MOTOR ASSEMBLY

- Carry out installation in the reverse order to removal.

[※ 1]
★ Adjust the rod. For details, see TESTING AND ADJUSTING, Testing and adjusting of governor motor lever stroke.

REMOVAL OF HYDRAULIC OIL COOLER ASSEMBLY

⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

- Remove the hydraulic tank strainer, and using tool **B**, stop the oil.
  - When not using tool **B**, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.

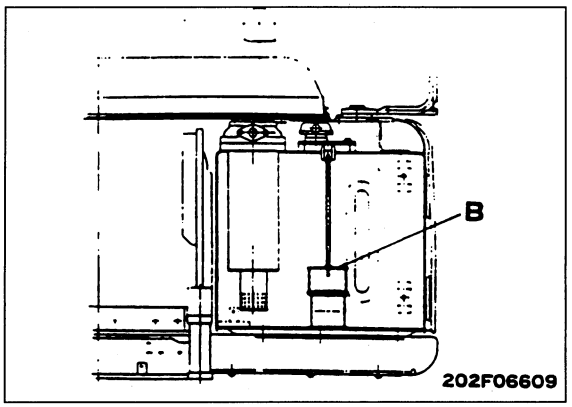
Hydraulic tank: Approx. 120 ℓ

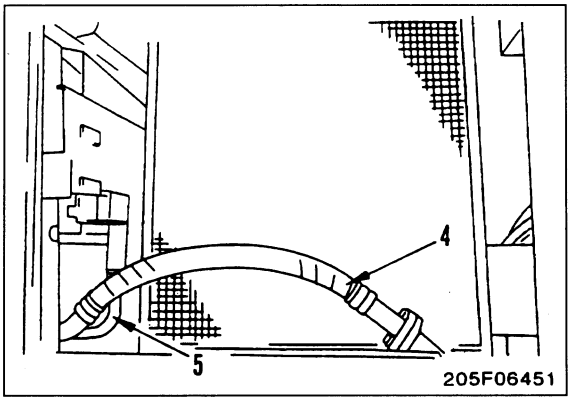
1. Remove battery and set oil container under chassis.
2. Disconnect hoses (4) and (5).
   - ★ Disconnect hose (4) at the cooler end, and hose (5) at the chassis end.
   - ★ Put blind plugs in the places that have been disconnected.
3. Remove mounting bolts (6) at side of hydraulic oil cooler assembly.
4. Sling hydraulic oil cooler assembly (7), remove 2 mounting bolts each on left and right, then lift off hydraulic oil cooler assembly (7).

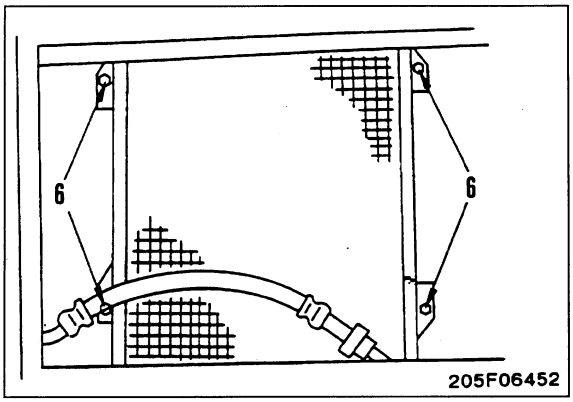
kg Hydraulic oil cooler assembly: 60 kg

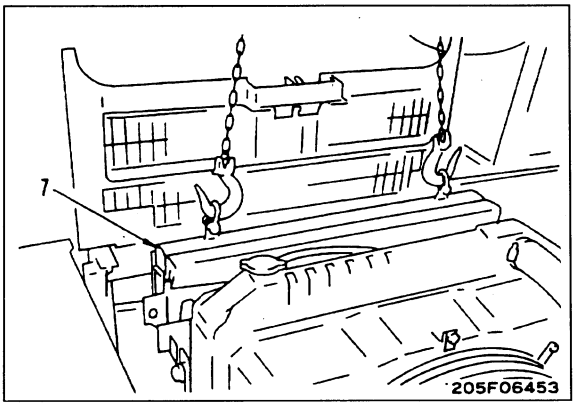
INSTALLATION OF HYDRAULIC OIL COOLER ASSEMBLY

- Carry out installation in the reverse order to removal.
- Refilling with oil (hydraulic tank)
  - ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

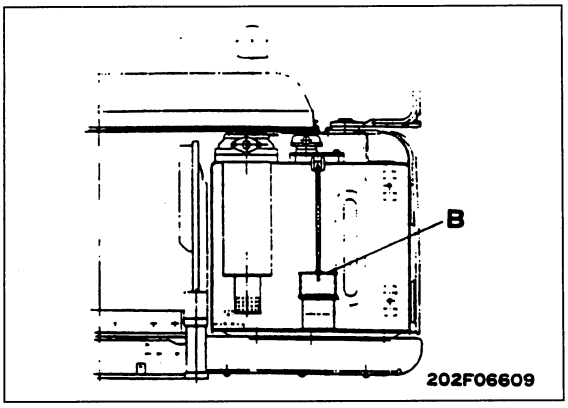








REMOVAL OF RADIATOR • HYDRAULIC OIL COOLER ASSEMBLY

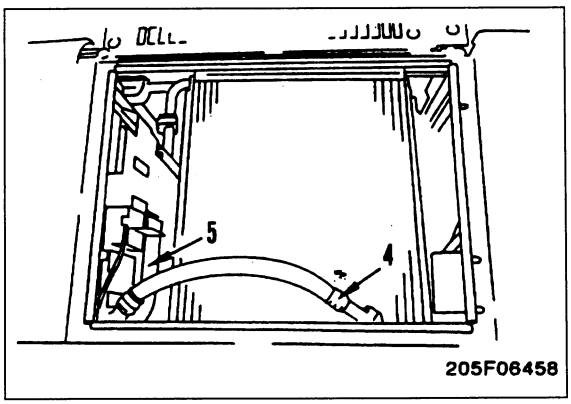


⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

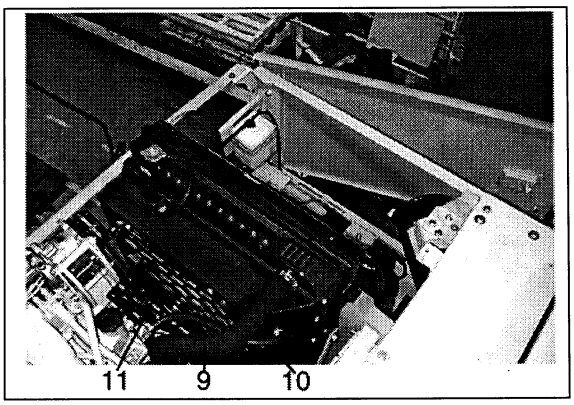
- Remove the hydraulic tank strainer, and using tool **B**, stop the oil.
  - When not using tool **B**, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.

  Hydraulic tank: Approx. 120 ℓ
- Drain engine coolant.

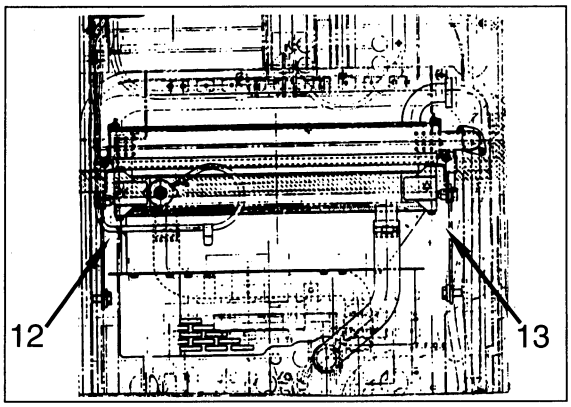
1. Remove undercover under radiator.
2. Disconnect small diameter from radiator (near cap) to reservoir tank.
3. Disconnect cooler hoses (4) and (5).



4. Disconnect radiator upper hose (9), and remove clamps of heater hose (10) from right side of radiator assembly.
5. Remove fan guard (11).



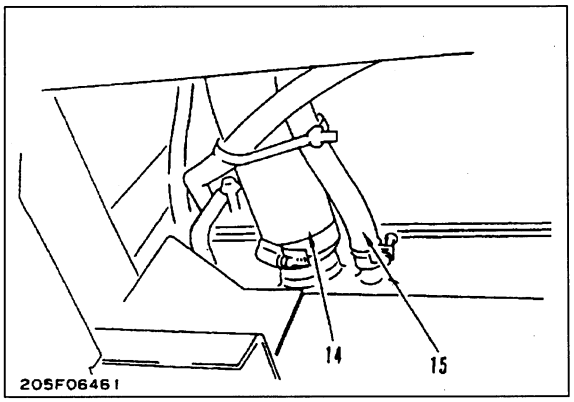
6. Disconnect radiator support rods (12) and (13).
   ★ Loosen the mounting bolts, then remove the top mounting bolts and move the rods towards the rear of the engine.



7. Disconnect radiator lower hose (14) and heater hose (15).
   ★ The radiator lower hose is fixed by a clamp to the radiator, so always disonnect the clamp.

8. Sling radiator and hydraulic oil cooler assembly, remove 4 bottom mounting bolts, then lift off radiator and hydraulic oil cooler assembly.
   ★ When raising the radiator and hydraulic oil cooler assembly, check the position carefully and do not let it hit the fan when removing it.

   kg Radiator • hydraulic oil cooler assembly : 115 kg



INSTALLATION OF RADIATOR • HYDRAULIC OIL COOLER ASSEMBLY

- Carry out installation in the reverse order to removal.

- Refilling with water
  ★ Add water through the water filler to the specified level. Run the engine to circulate the water through the system. Then check the water level again.

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

REMOVAL OF ENGINE • HYDRAULIC PUMP ASSEMBLY

⚠ Disconnect the cable from the negative (-) terminal of the battery.

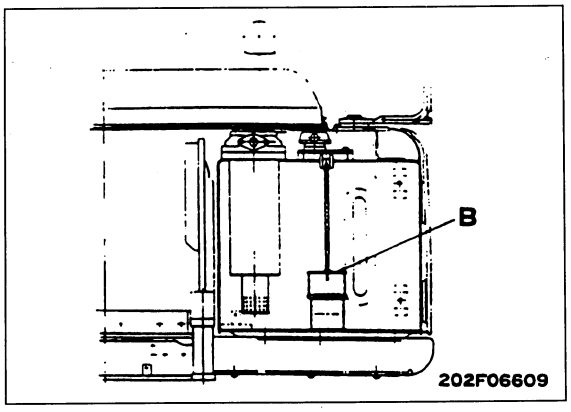
⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

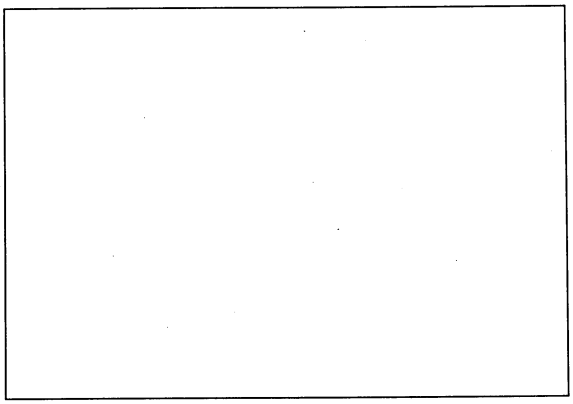
- Remove the hydraulic tank strainer, and using tool **B**, stop the oil.
  - when not using tool **B**, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.

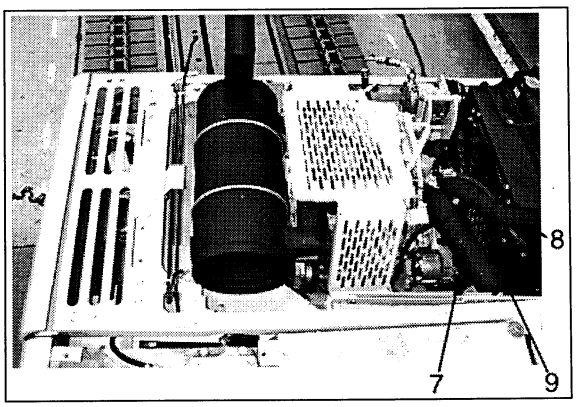
    Hydraulic tank: Approx. 120 ℓ
- Drain engine coolant.

1. Remove pump bottom cover and engine bottom cover.
2. Open engine hood and remove pump top cover.
3. Remove engine step, control valve top cover, partition, and exhaust muffler cover .
4. Disconnect alternator wiring (5).
   ★ Mark the wiring with tags to show the connection position.
5. Disconnect engine oil pressure sensor wiring.
6. Disconnect intake hose (7).
7. Remove radiator inlet hose (8).
8. Remove fan guard (9) and belt guards.
9. Loosen fan belt, remove connecting bolt at pulley and spacer, then remove fan.

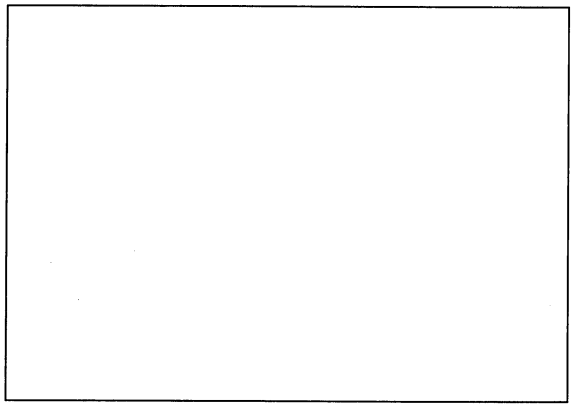
※ 1



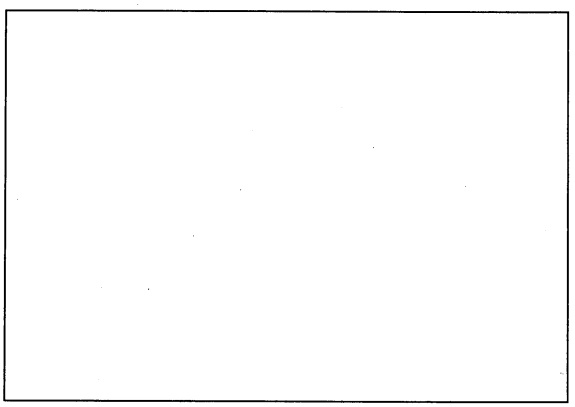


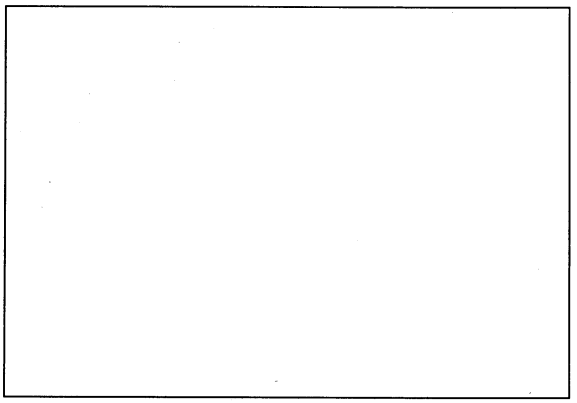


10. Disconnect heater hose (12).
11. Disconnect water pump inlet hose (13).

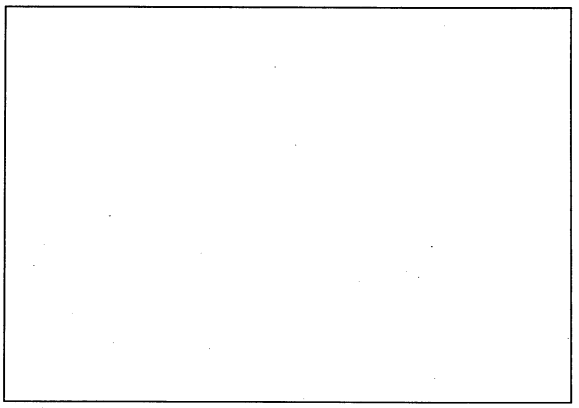


13. Disconnect coolant temperature sensor wiring connector (14).
14. Disconnect electrical intake air heater wiring (15).
15. Disconnect governor motor wiring connector (16)
16. Disconnect TVC • LS valve wiring connector (17).
17. Remove clamp (18), and remove spill hose (19).
18. Disconnect fuel hose (20)
    ★ When the hose is disconnected, fuel will flow out, so insert a wooden plug into the hose to prevent the fuel from leaking out.
19. Disconnect starter motor wiring (21).

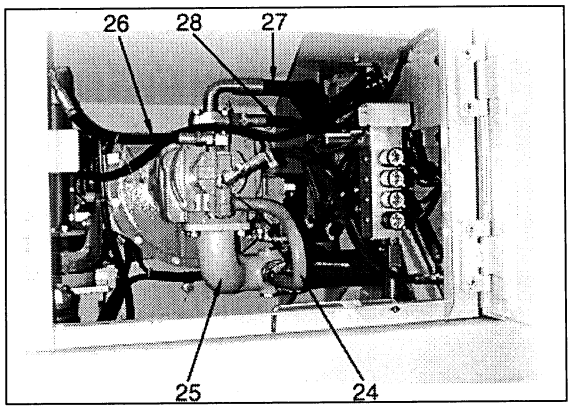




20. Disconnect engine oil level sensor wiring connector (22).
21. Disconnect starting motor wiring connector (23).



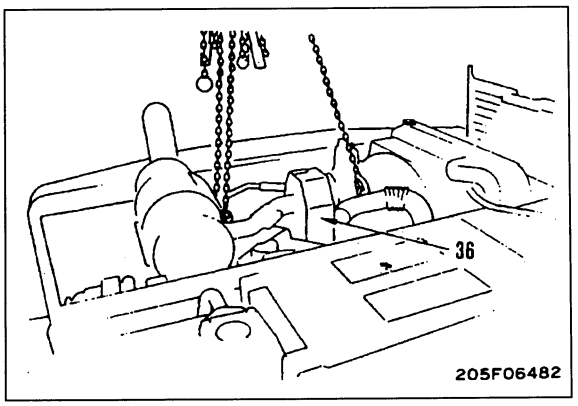
22. Remove control pump suction tube (24).
23. Disconnect main pump suction tube (25).
24. Disconnect control pump outlet hose (26).
25. Disconnect main pump outlet hose (27).
26. Disconnect main pump drain hose (28).
27. Disconnect TVC • LS valve inlet hoses at side of main pump.



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 asembly, check that all wiring and piping has been disconnected, and be careful not to hit any part when removing.

kg Engine • hydraulic pump assembly: 600 kg



INSTALLATION OF ENGINE • HYDRAULIC PUMP ASSEMBLY

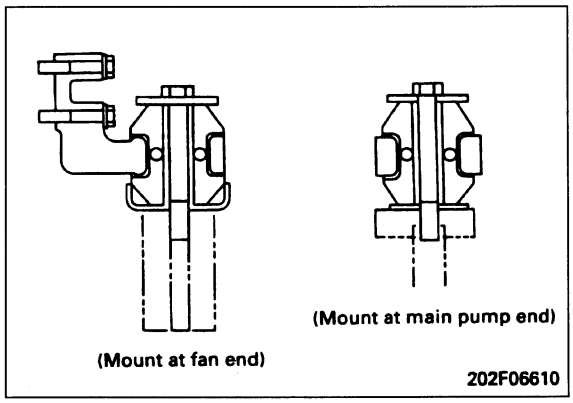
- Carry out installation in the reverse order to removal.

※ 1
★ Adjust the fan belt tension.
For details, see TESTING AND ADJUSTING, Testing and adjusting fan belt tension.

※ 2
★ Check that the O-ring is not damaged or deteriorated, then connect the hoses.

※ 3
★ Set the engine mount rubber as shown in the diagram, then install the engine and hydraulic pump assembly.

kgm Engine mount mounting bolt:
276.9 ± 31.9 Nm(28.25 ± 3.25 kgm)



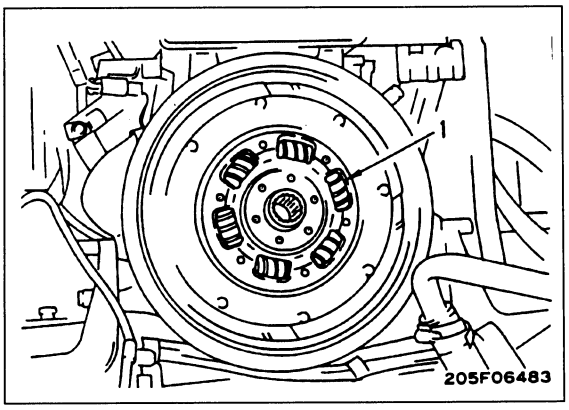
- Refilling with water
  ★ Add water through the water filler to the specified level.
  Run the engine to circulate the water through the system. Then check the water level again.

- Refilling with oil (hydraulic tank)
  ★ Add oil throught the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air
  ★ Bleed the air from the hydraulic pump.
  For details, see TESTING AND ADJUSTING, Bleeding air.

- Fill with refrigerant (R-134a).

REMOVAL OF DAMPER ASSEMBLY



1. Remove main pump assembly. For details, see REMOVAL OF MAIN PUMP ASSEMBLY.
2. Remove damper assembly (1). ※ 1

INSTALLATION OF DAMPER ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

kgm Damper mounting bolt;
171.05 ± 7.35 Nm (7.25 ± 0.75 kgm)

Thread of Damper mounting bolt;
Thread tightener (LT-2)

REMOVAL OF FUEL TANK ASSEMBLY

⚠ Disconnect the cable from the negative (-) terminal of the battery.

1. Loosen drain valve (1) of fuel tank and drain fuel.

   Fuel tank: Approx. 250 ℓ (when tank is full)

2. Disconnect fuel supply hose (2) and return hose (3).

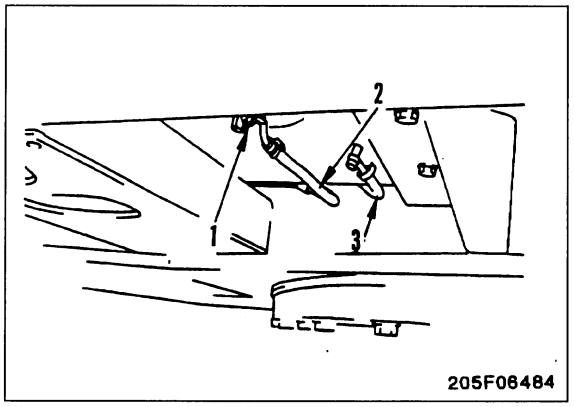
3. Remove handrail (4), battery case (5), and cover (6).

4. Remove connector (7) from holder, and disconnect it.
   ★ Remove the wiring from the clamp, then disconnect from the fuel tank.

5. If refueling pump is fitted disconnect hose from tank tube.

6. Remove mounting bolts, and lift off fuel tank assembly (8) ※ 1

   kg Fuel tank assembly: 100 kg



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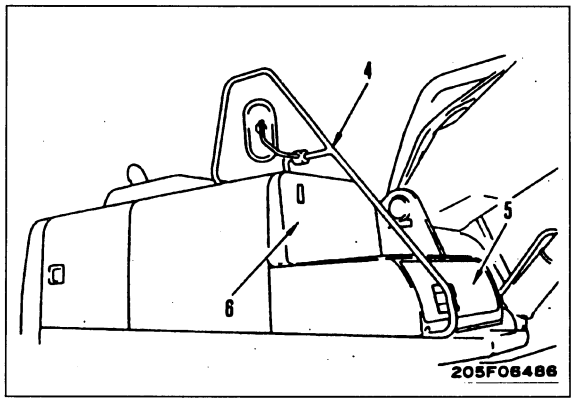

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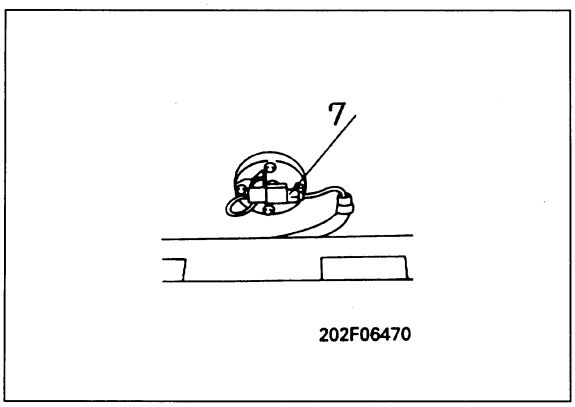
INSTALLATION OF FUEL TANK ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1
kgm Fuel tank mounting bolt:
276.9 ± 31.9 Nm (28.25 ± 3.25 kgm)

- Refilling with oil (fuel tank)
  Add fuel.



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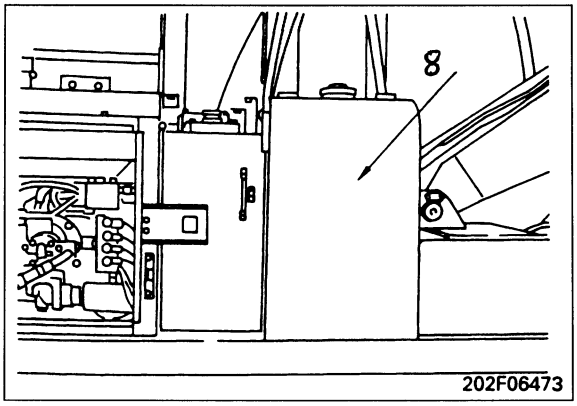

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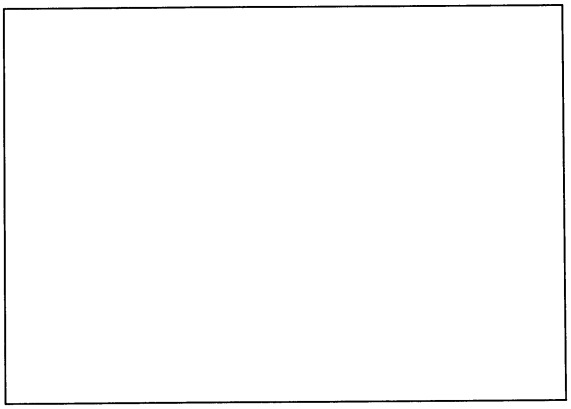
REMOVAL OF CENTER SWIVEL JOINT ASSEMBLY

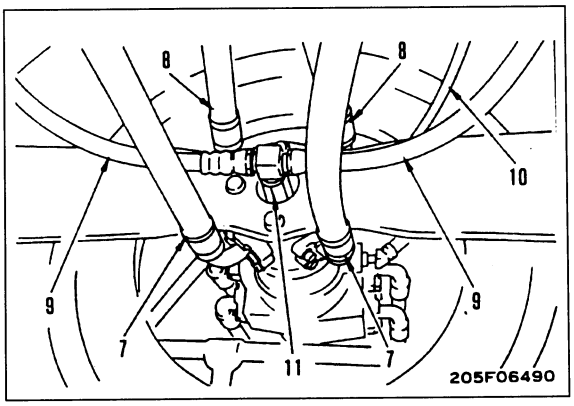
⚠ Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING. Releasing remaining pressure from hydraulic circuit.

★ Mark all the piping with tags to prevent mistakes in the mounting position when installing.

1. Disconnect hoses (1), (2), (3), and (4) and tubes (5) and (6), and remove filter and bracket assembly.
   ★ Machines equipped with additional attachment circuit.
2. Disconnect hoses (7), (8), (9), and (10) between travel motor and swivel joint.
3. Remove elbow (11).
4. Disconnect drain hose (12).
5. Disconnect hoses (13) and (14) between control valve and swivel joint.
6. Disconnect travel speed selector hose (15).
7. Disconnect plate (16).
8. Remove center swivel joint assembly (17). [※ 1]

kg Center swivel joint assembly: 45 kg



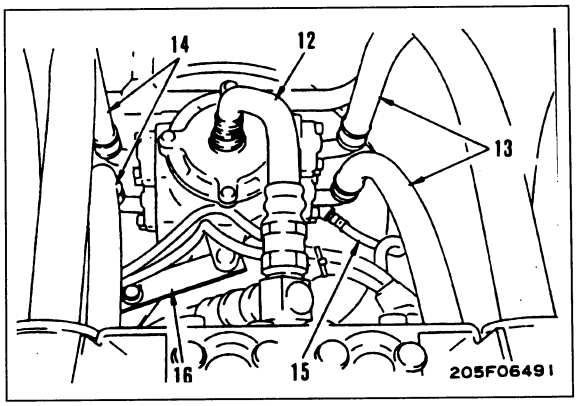


INSTALLATION OF CENTER SWIVEL JOINT ASSEMBLY

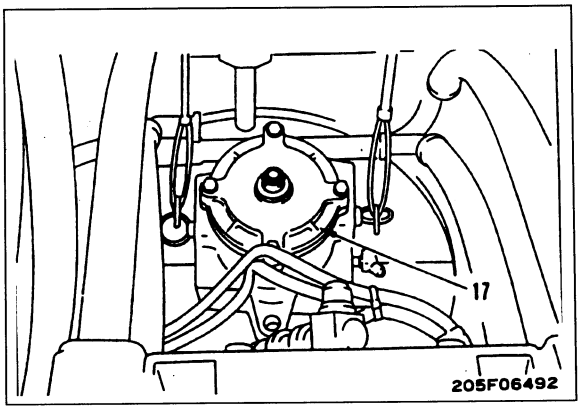
- Carry out installation in the reverse order to removal.

[※ 1]

★ Assemble the center swivel as shown in the diagram below.

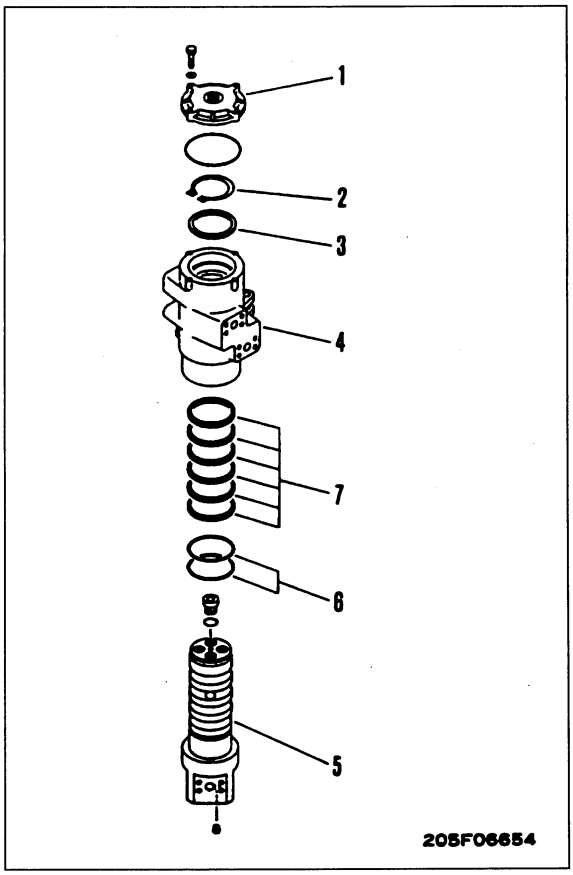


- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- Bleeding air
  ★ Bleed the air from the travel motor. For details, see TESTING AND ADJUSTING, Bleeding air.



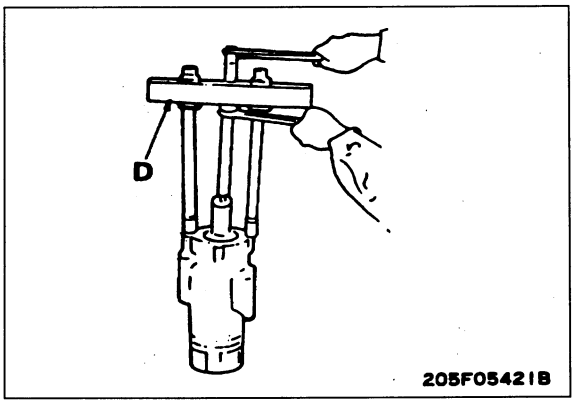
DISASSEMBLY OF CENTER SWIVEL JOINT ASSEMBLY

1. Remove cover (1).
2. Remove snap ring (2).
3. Using tool **D**, pull out swivel rotor (4) and ring (3) from swivel shaft (5).
4. Remove O-ring (6) and slipper seal (7) from swivel rotor.



ASSEMBLY OF CENTER SWIVEL JOINT ASSEMBLY

1. Assemble slipper seal (7) and O-ring (6) to swivel rotor.
2. Set swivel shaft (5) to block, then using push tool, tap swivel rotor (4) with a plastic hammer to install.
   Contact surface of rotor, shaft: Grease (G2-LI)
   ★ When installing the rotor, be extremely careful not to damage the slipper seal and the O-ring.
3. Install ring (3) and secure with snap ring (2).
4. Fit O-ring and install cover (1).
   kgm Mounting bolt: 31.4 ± 2.9 Nm (3.2 ± 0.3 kgm)



REMOVAL OF TRAVEL MOTOR ASSEMBLY

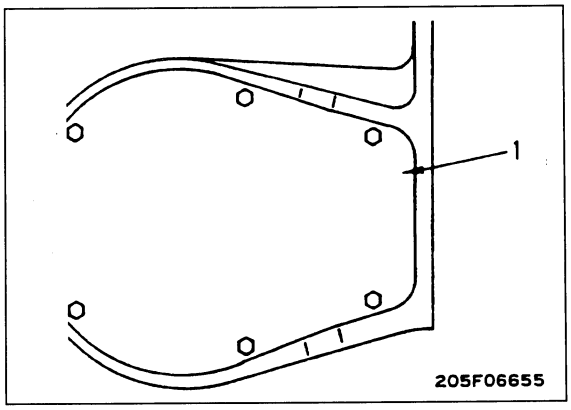
1. Remove sprocket. For details, see REMOVAL OF SPROCKET.

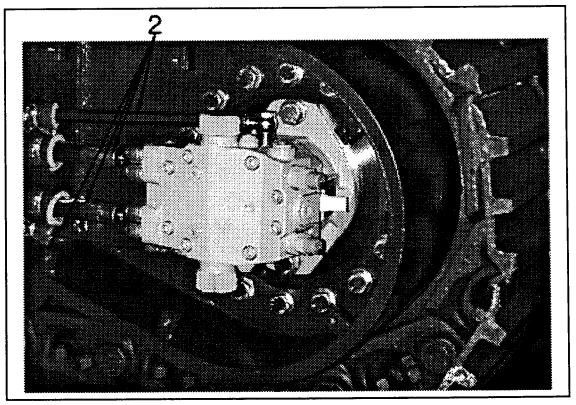
⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

2. Remove cover (1).

3. Disconnect 4 travel motor hoses (2),a nd lift off final drive assembly (3). ※ 1
   ★ Be extremely careful not to damage the nipple tool surface of the hose mount.

kg Travel motor: 95 kg



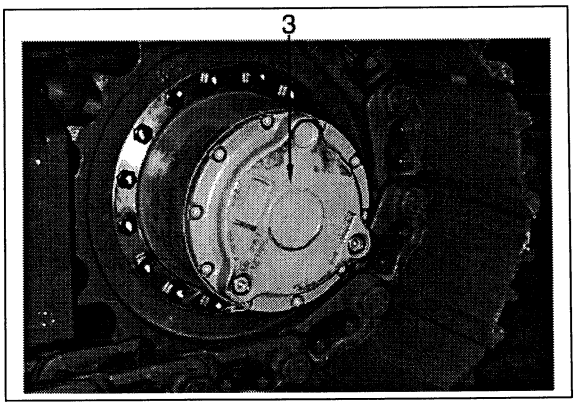


INSTALLATION OF TRAVEL MOTOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

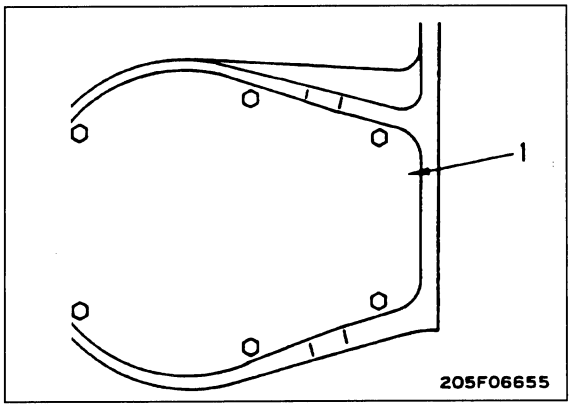
kgm Travel motor mounting bolt:
549 ± 59 Nm (56 ± 6 kgm)



- Bleeding air
  ★ Bleed the air from the travel motor. For details, see TESTING AND ADJUSTING, Bleeding air.

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

REMOVAL OF FINAL DRIVE ASSEMBLY

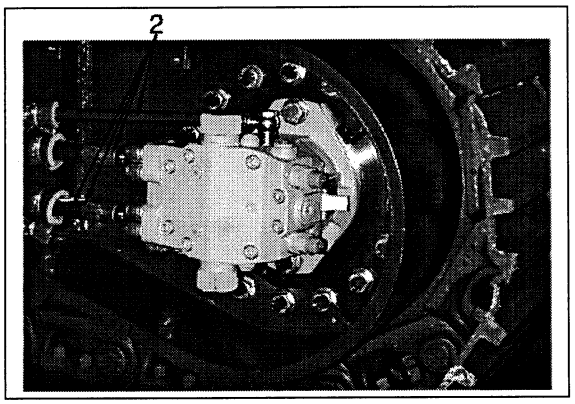


1. Remove sprocket and travel motor .For details, see REMOVAL OF SPROCKET and REMOVAL OF TRAVEL MOTOR.

⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

2. Remove cover 1

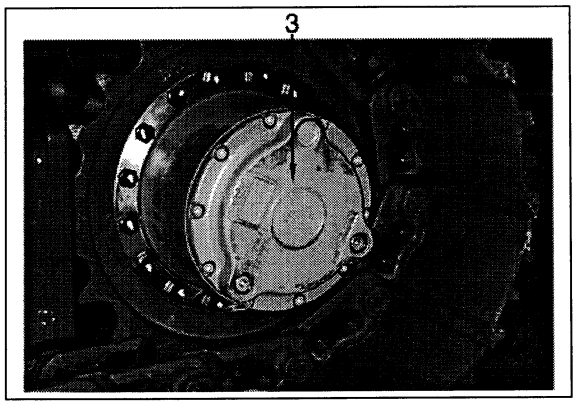
3. Disconnect 4 travel motor hoses (2), and lift off final drive assembly (3). [※ 1]
   ★ Be extremely careful not to damage the nipple tool surface of the hose mount.



kg Final drive assembly:
195 kg (without travel motor and sproket)
330 kg (with travel motor and sprocket)

INSTALLATION OF FINAL DRIVE ASSEMBLY

- Carry out installation in the reverse order to removal.



[※ 1]

kgm Final drive mounting bolt:
549 ± 59 Nm (56 ± 6 kgm)

- Bleeding air
  ★ Bleed the air from the travel motor.For details, see TESTING AND ADJUSTING, Bleeding air.

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

FITTING OF THE HYDRAULIC MOTOR.

Clean the matin area and the pilot diameter of the gearbox where the motor is to be mounted.
After mounting the motor, verify, through of a depth slide gauge, the axial dimension of the gearbox measured from input side of the flanged hub to the brake shaft:

Axial dimension = 111,4 - 112,2 mm

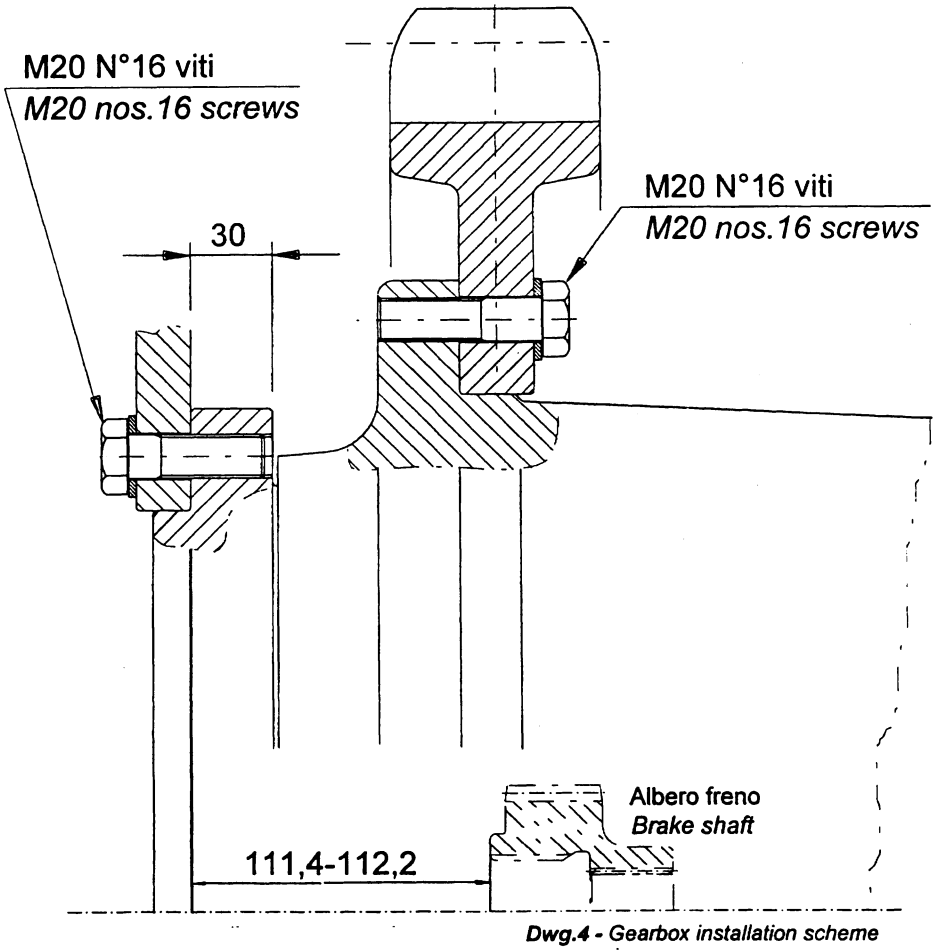
Place the hydraulic motor and tighten the 2 hexagonal head screws M20x60, grade 8.8, by a torque wrench at atorque of 41,5 daNm.

INSTALLATION OF THE GEARBOX TO THE MACHINE

a) Clean the mating surfaces from oils or paint and fit the gearbox to the undercarriage.

b) Fix the gearbox to the frame with 16 screws M20 minimum grade 8.8, tightened by a torque wrench at a torgue of 41,5 daNm.

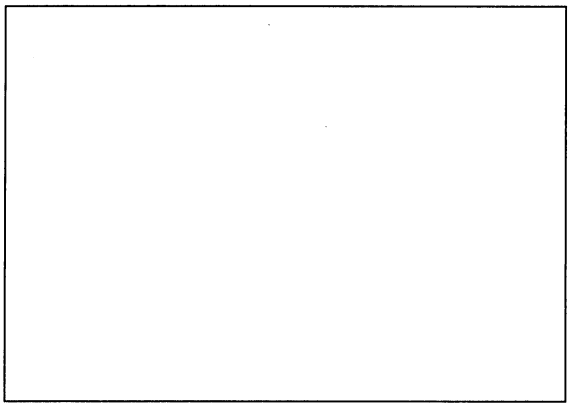
c) Clean the area which mates to the sprocket. To fit the sprocket use 16 screws M20, grade 8.8, tightened at 41,5 daNm torque.



Dwg.4 - Gearbox installation scheme

REMOVAL OF SPROCKET

1. Remove track shoe assembly. For details, see REMOVAL OF TRACK SHOE ASSEMBLY.
2. Swing work equipment 90°, then push up chassis with work equipment and set block 1 between track frame and track shoe.
3. Lift off sprocket (1). ※ 1



INSTALLATION OF SPROCKET

- Carry out installation in the reverse order to removal.

※ 1

Thread of sprocket mounting bolt:
Thread tightener (LT-2)

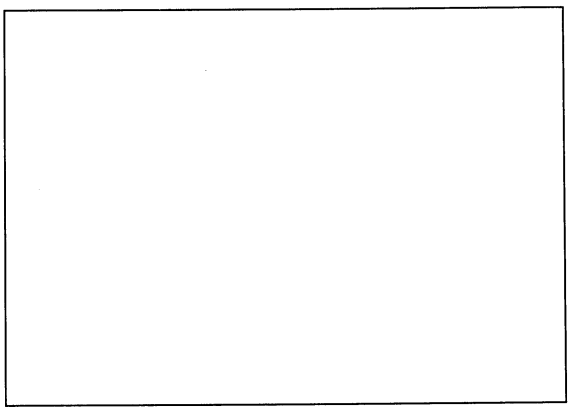
kgm Sprocket mounting bolt:
637 ± 49Nm (65 ± 5 kgm)

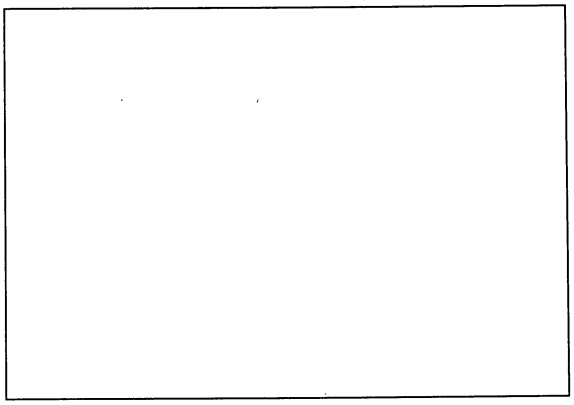
REMOVAL OF SWING MOTOR ASSEMBLY

⚠ Lower the work equipment completely to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then set the safety lock lever to the LOCK position.

1. Disconnect hoses (1), (2), (3), and (4), and tubes (5) and (6), then remove filter and bracket assembly.
   ★ Machines equipped with additional attachment circuit
2. Remove hose clamps (7) and (8).
3. Disconnect swing motor inlet and outlet hoses (9), (10), and (11).
4. Remove bracket (12).
5. Disconnect drain hoses (13) and (14).
6. Disconnect pilot hose (15).
7. Remove swing motor assembly (16). ※ 1

   kg Swing motor assembly 30 kg





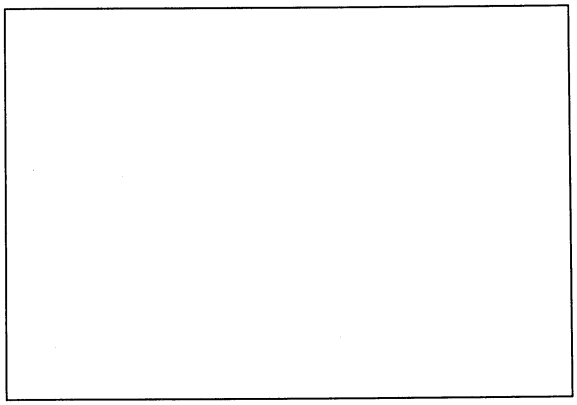
INSTALLATION OF SWING MOTOR ASSEMBLY

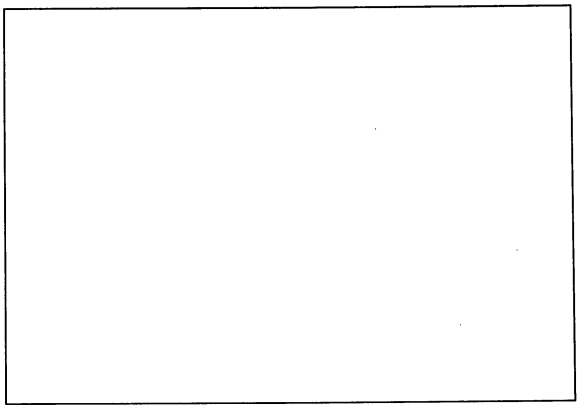
- Carry out installation in the reverse order to removal.
- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

★ Bleeding air
  ★ Bleed the air from the swing motor. For details, see TESTING AND ADJUSTING, Bleeding air.

※ 1

kgm Swing motor mounting bolt:
277 ± 32 Nm (28.3 ± 3.3 kgm)





REMOVAL OF SWING MACHINERY ASSEMBLY

1. Remove swing motor assembly. For details, see REMOVAL OF SWING MOTOR ASSEMBLY.

2. Using eyebolts ①, remove swing machinery assembly (1). ※ 1
   ★ When removing the swing machinery assembly, lift off slowly and be careful not to damage the hoses.

   kg Swing machinery assembly: 120 kg

INSTALLATION OF SWING MACHINERY ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1
kgm Swing machinery mounting bolt:
548.8 ± 49 Nm (56 ± 5 kgm)

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

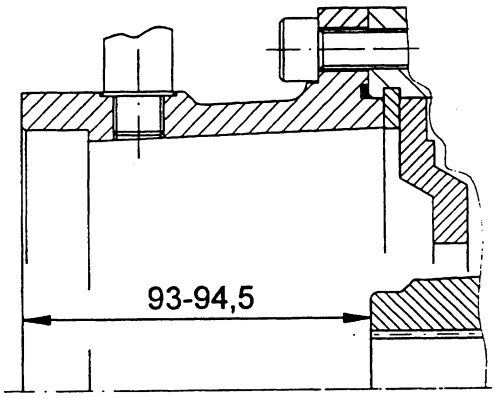
- Bleeding air
  ★ Bleed the air from the swing motor. For details, see TESTING AND ADJUSTING, Bleeding air.

FITTING OF THE HYDRAULIC MOTOR

Clean the mating area and the pilot diameter of the gearbox where the motor is to be mounted.
After mounting the motor, verify, through of a depth slide gauge, the axial dimension of the gearbox measured from input side of the motor adaptor flange to the brake shaft:

Axial dimension = 93 - 94,5 mm.

Place the hydraulic motor and tighten the 2 hexagonal head screws M16 x 40, grade 8.8, by a torque wrench at a torque of 21,5 daNm.

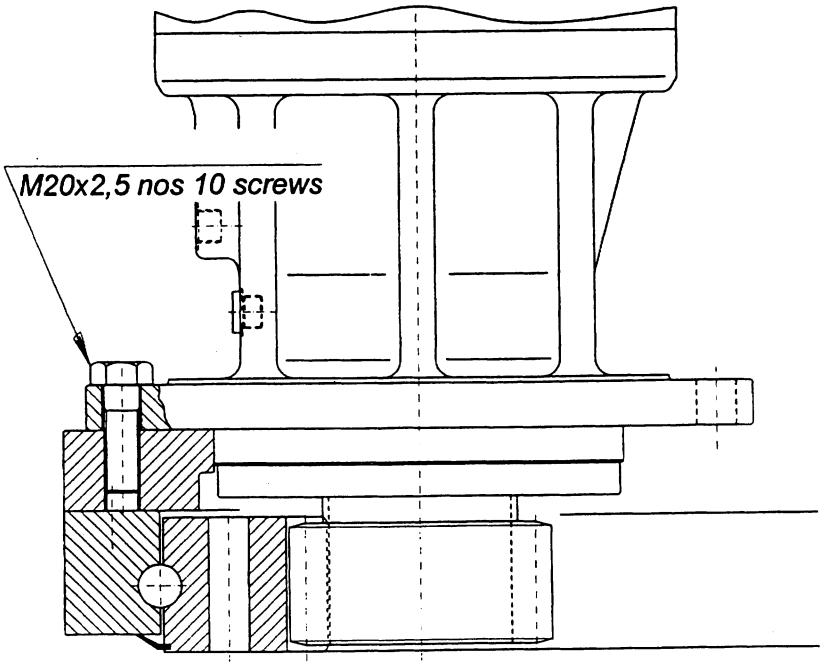


Dwg. Verify the axial dimension of the gearbox

INSTALLATION OF THE SLEW DRIVE TO THE MACHINE

a) Clean the mating surfaces from oils or paint and fit the gearbox to the undercarriage.

b) Fix the slew drive to the frame with 10 screws M20 minimum grade 8.8, tightened by a torque wrench at a torque of 41,5 daNm.

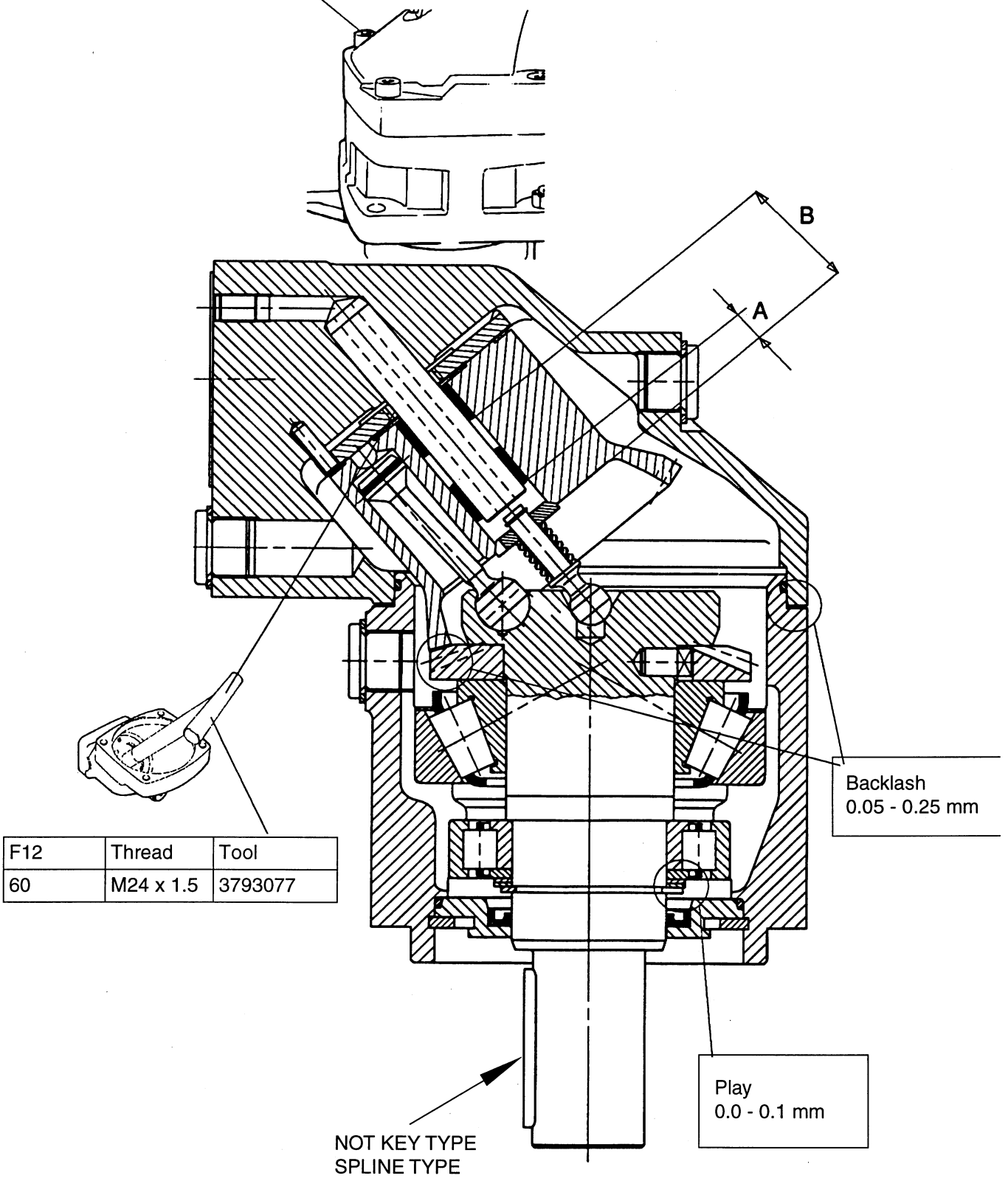


Dwg. - Gearbox installation scheme

DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

F12	Nm ± 10
60	60

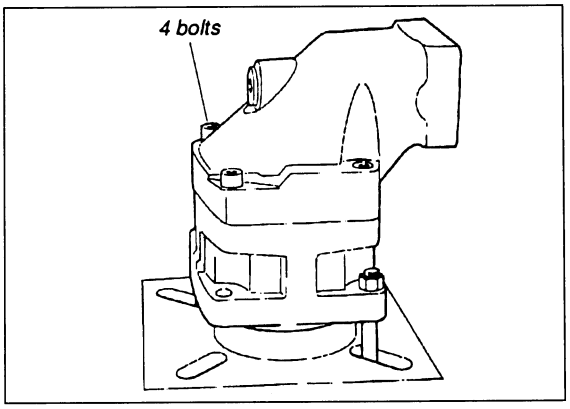
F12	A±0.25 mm	B±0.25 mm	Tool
60	11	38.0	3894185



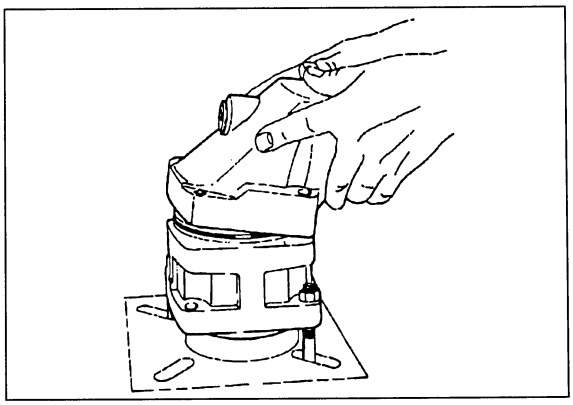
F12	Thread	Tool
60	M24 x 1.5	3793077

Dissasembly

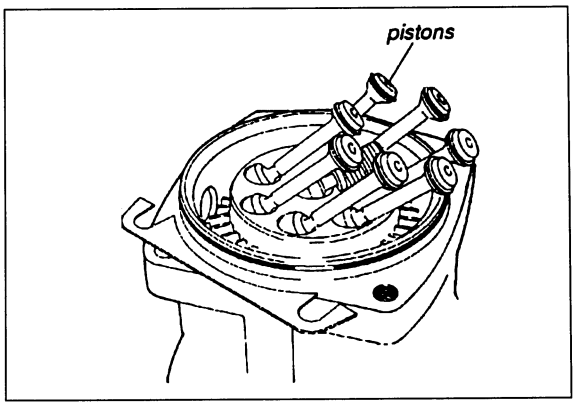
Put the unit in a bench with a hole or place it on a fixture for assembly Loosen the 4 bolts.



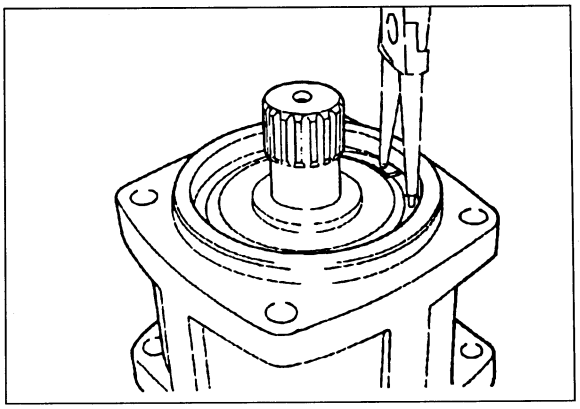
Lift off the housing



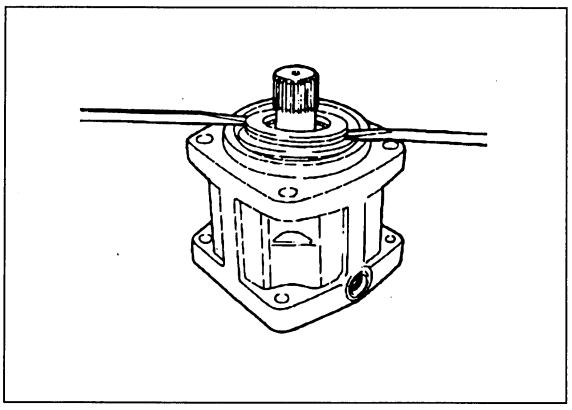
Lift out the pistons



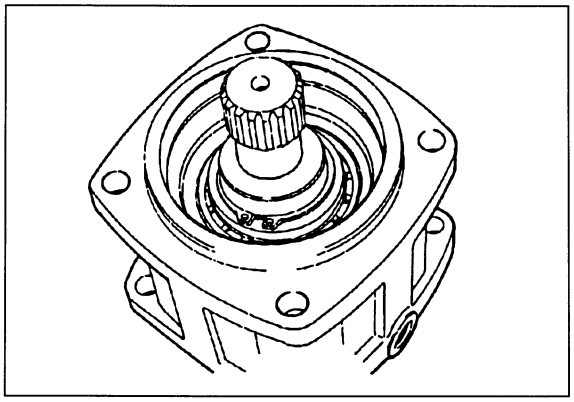
Turn the bearing housing upside down and loosen the retaining ring holding the seal ring carrier.



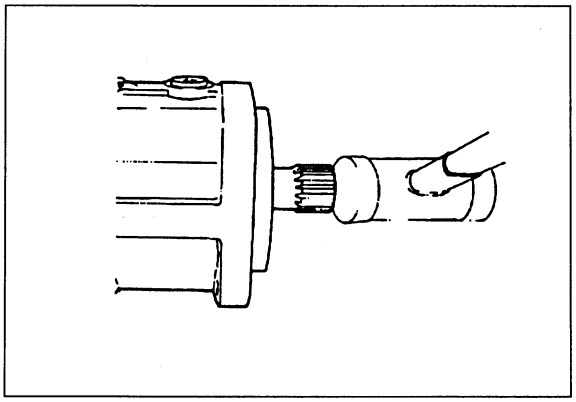
Loosen the seal carrier using two screwdrivers.



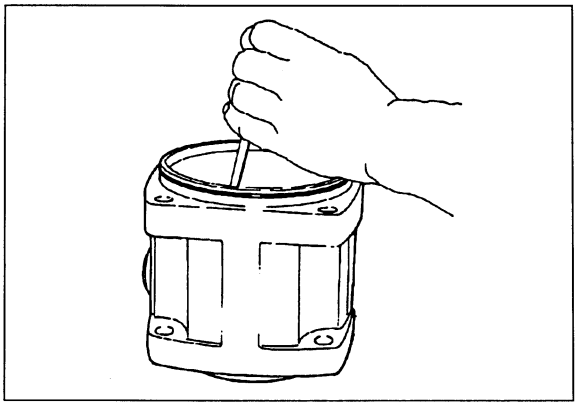
Loosen the retaining ring holding the bearing and bearing play adjustment washers.



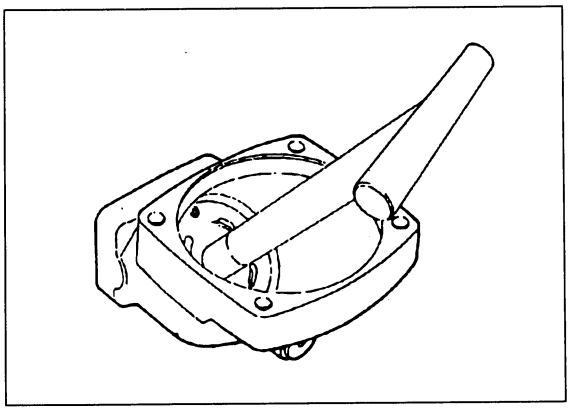
Push out the shaft with a press or a plastic mallet.



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



For disassembly the valve plate has got a thread in the centre. Use the special tool to pull it out.

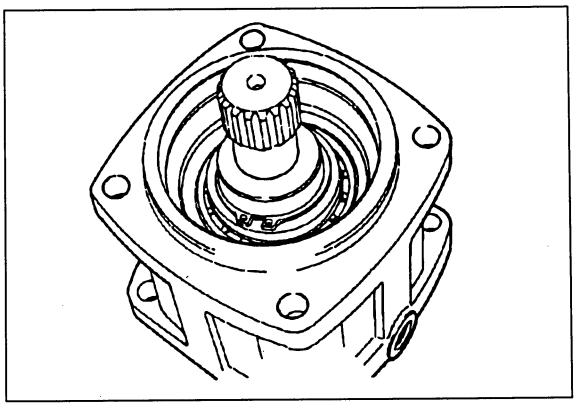


Thread specification:

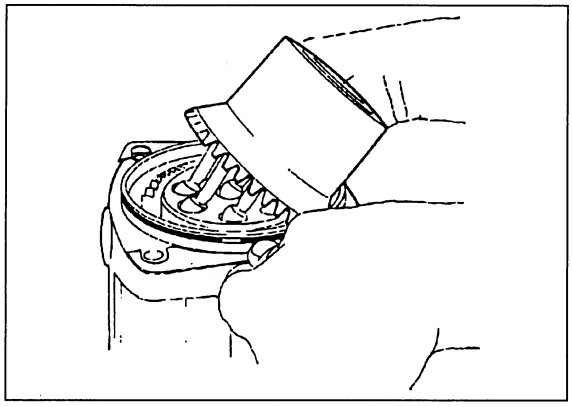
F12	Thread	Tool
60	M24x1.5	3793077

Assembly

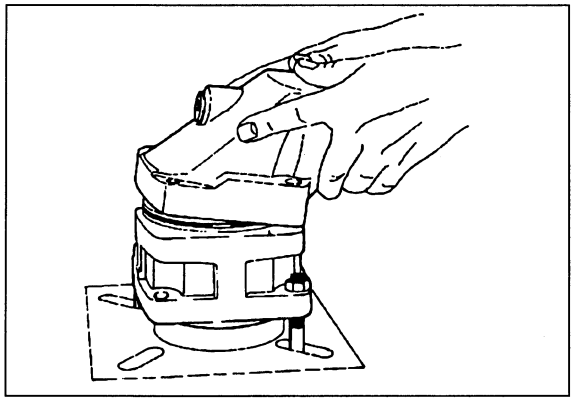
Push the shaft into the bearings in the housing. Use as many washers as needed to just allow the retaining ring on the shaft to enter into its groove.



Install pistons, cylinder barrel support and cylinder barrel.
Note: The shaft has got one tooth marked with a punchmark and the barrel has got one space marked. It is absolutely necessary that these are mating to ensure correct alignment for the pistons in the cylinders. Also choose correct adjustment shim to ensure correct backlash.



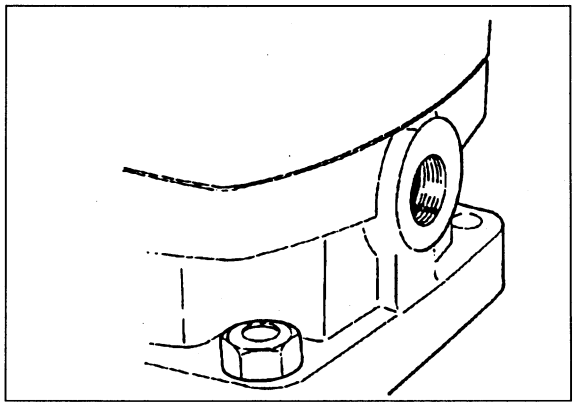
Install the barrel housing and tighten the screws.



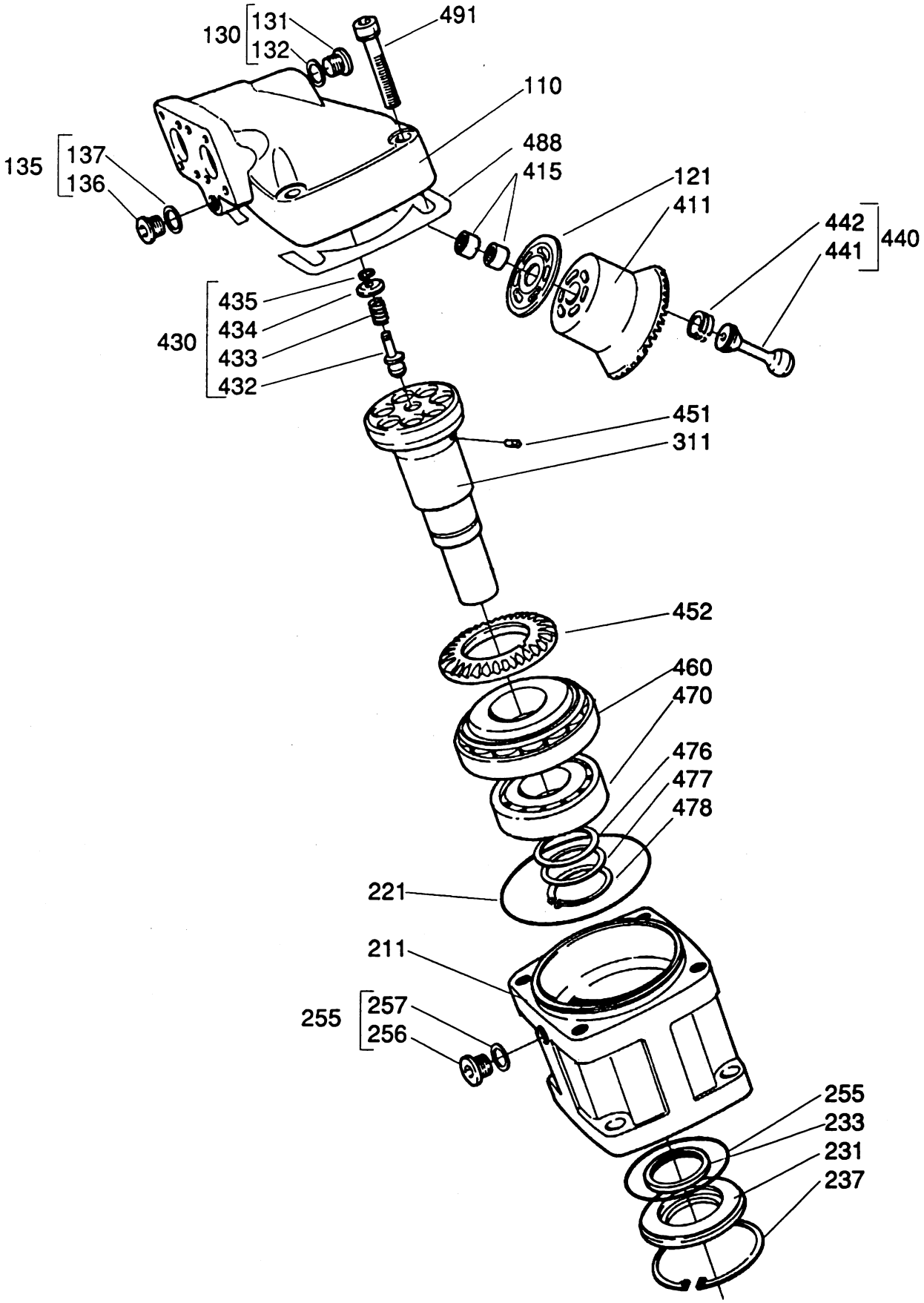
Backlash and correct timing can be checked through the drainhole.

Correct tightening torque is:

F12 Nm ± 10	
60	60



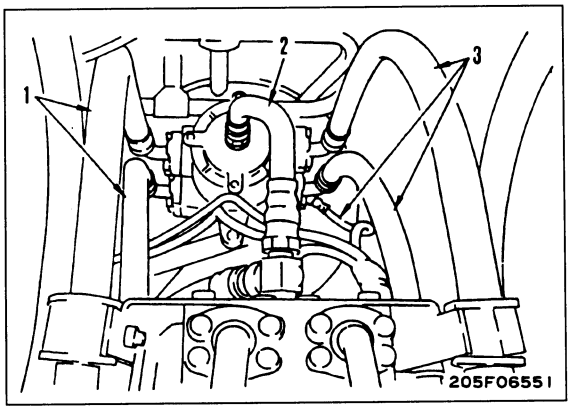
Item	*Title*
110	BARREL HOUSING ASSY
121	VALVE PLATE
131	BLEEDER PLUG
132	SEAL WASHER
211	BEARING HOUSING
221	O-RING
225	O-RING
229	O-RING
231	SEAL CARRIER
233	SHAFT SEAL
237	RETAINING RING
256	PLUG
257	SEAL WASHER
311	SHAFT TYPE
411	CYLINDER BARREL
415	NEEDLE BEARING
430	BARREL SUPPORT
440	PISTON ASSY
442	PISTON RING
451	GUIDE PIN
452	RING GEAR
460	TAP ROL BEARING
470	CYL BEARING
476	SPACER WASHER
478	RETAINING RING
488	SHIM
491	HEX SOCKET SCREW

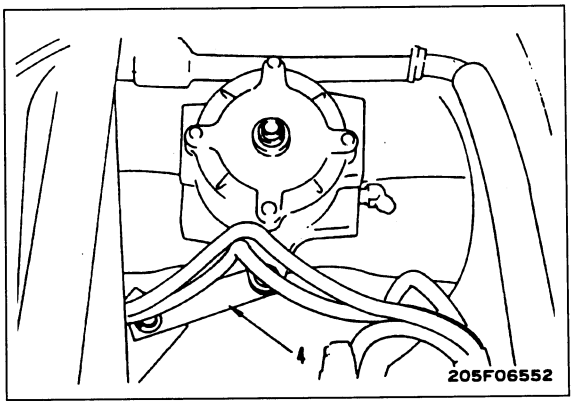

130
131
132
491
110
488
415
135
137
136
121
411
442
441
440
430
435
434
433
432
451
311
452
460
470
476
477
478
221
211
255
257
256
255
233
231
237

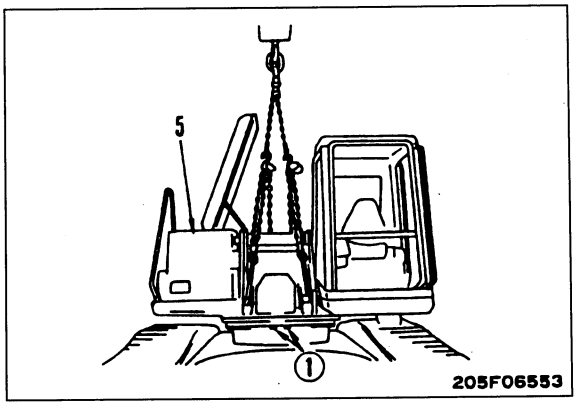
REMOVAL OF REVOLVING FRAME ASSEMBLY

1. Remove 2 boom cylinder assemblies. For details, see REMOVAL OF BOOM CYLINDER ASSEMBLY.
2. Remove work equipment assembly. For details, see REMOVAL OF WORK EQUIPMENT ASSEMBLY.
3. Remove counterweight assembly. For details, see REMOVAL OF COUNTERWEIGHT ASSEMBLY.
4. Disconnect top mounting hoses (1), (2), and (3) of swivel joint assembly at swivel joint assembly end.
5. Remove stopper link (4).
6. Remove mounting bolts, then lift off revolving frame assembly (5). [*1]
   ★ Leave 2 bolts ① each at the front and rear, use a lever block to adjust the balance of the revolving frame assembly to the front and rear, and left and right, then remove the remaining bolts, and lift off.
   ⚠ When removing the revolving frame assembly, be careful not to hit the center swivel joint assembly.

   kg Revolving frame assembly: 7100 kg (without work equipment)



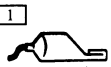




INSTALLATION OF REVOLVING FRAME ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

 Mating surface of swing circle:
Gasket sealant (LG-1)

 Thread of revolving frame mounting bolt:
Thread tightener (LT-2)

 Revolving frame mounting bolt:

Item / Model	Mounting bolt		Mounting bolt tightening torque
	Size	Q'ty	Nm (kgm)
	20-105	26	549 ± 59 (56 ± 6)

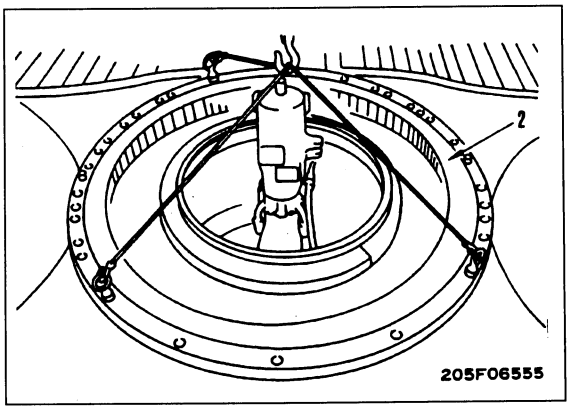
- Refilling with oil (hydraulic tank)
  - ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

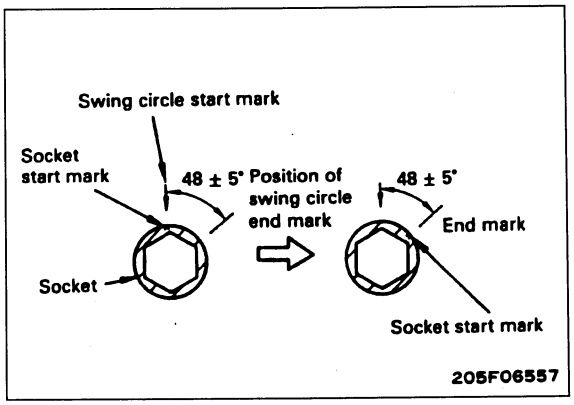
- Bleeding air
  - ★ Bleed the air. For details, see TESTING AND ADJUSTING, Bleeding air.

REMOVAL OF SWING CIRCLE ASSEMBLY

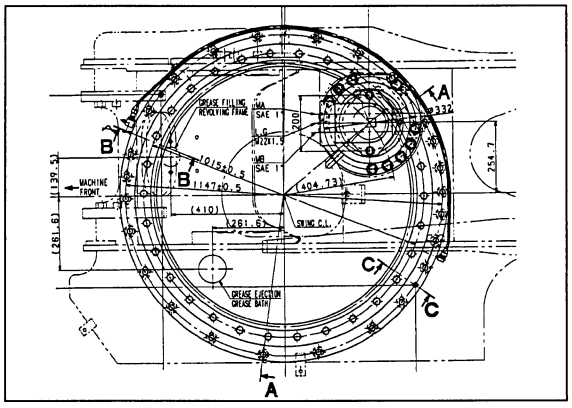
1. Remove revolving frame assembly. For details, see REMOVAL OF REVOLVING FRAME ASSEMBLY.
2. Remove swing circle mounting bolts (1), leaving 1 bolt each in front and rear direction. ※ 1
   ★ Swing circle assembly mounting bolts: 30
3. Sling swing circle assembly (2) at three points, then remove remaining mounting bolts.
4. Lift off swing circle assembly (2). ※ 2

   kg Swing circle assembly 240 kg





INSTALLATION OF SWING CIRCLE ASSEMBLY



- Carry out installation in the reverse order to removal.

[※ 1]

Thread of swing circle mounting bolt:
Thread tightener (LT-2)

kgm Swing circle mounting bolt:
549 ± 49Nm (56 ± 6 kgm)

[※ 2]

★ Set the soft zone **S** mark on the inside ring of the inner race facing the right side as shown in the diagram, then install to the track frame.

Swing circle: Grease (G2-LI) 8ℓ

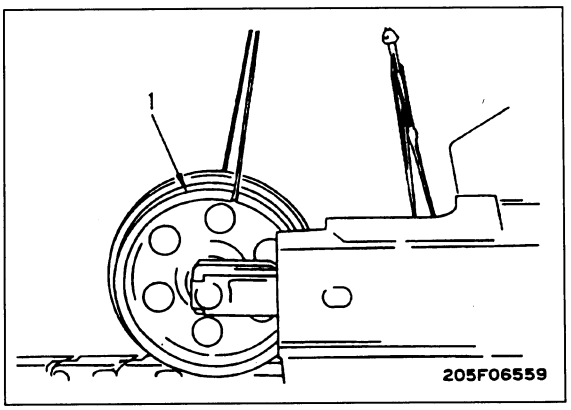
REMOVAL OF IDLER • RECOIL SPRING ASSEMBLY

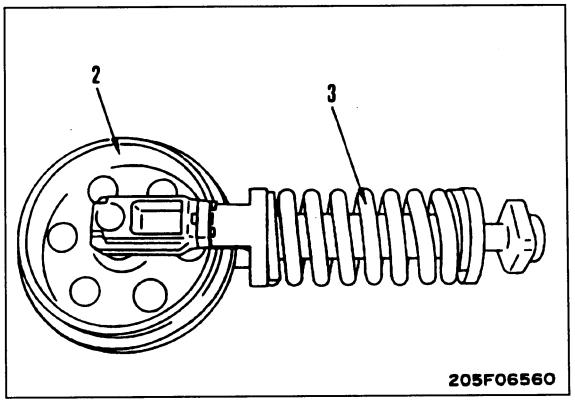
1. Remove track shoe assembly. For details, see REMOVAL OF TRACK SHOE ASSEMBLY.
2. Sling idler and recoil spring assembly (1), and pull out to the front to remove.

   kg Idler • recoil spring assembly: 275 kg
3. Disconnect recoil spring assembly (3) from idler assembly (2). ※ 1

   kg Idler assembly: 140 kg

   kg Recoil spring assembly: 135 kg





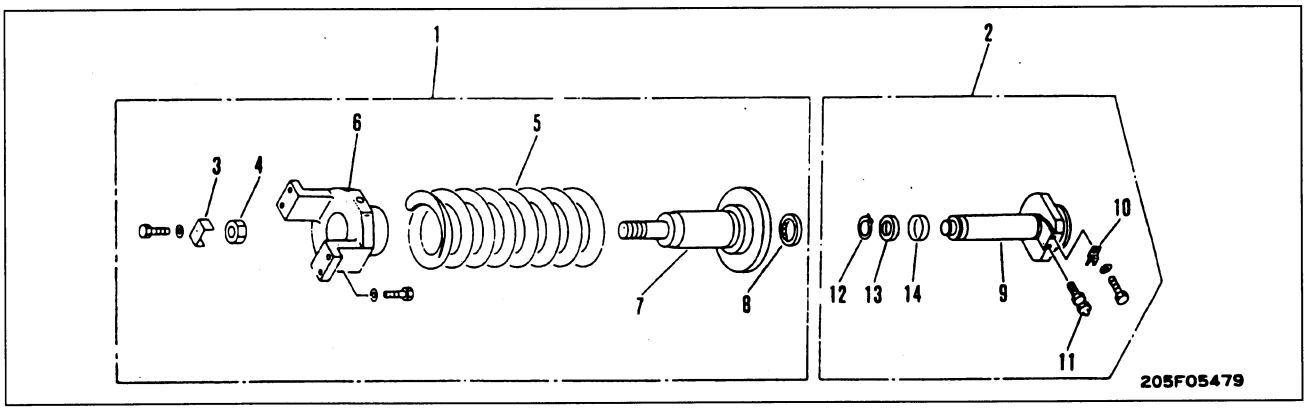
INSTALLATION OF IDLER • RECOIL SPRING ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 2

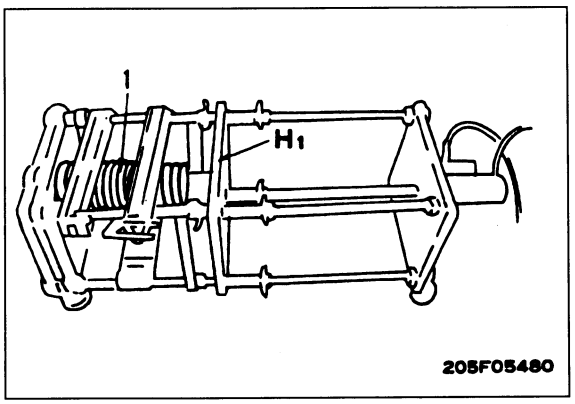
★ When installing the idler assembly and recoil spring assembly, assemble so that the position of the greasing plug on the idler is on the outside for the right side of the machine and on the inside for the left side of the machine.

DISASSEMBLY OF RECOIL SPRING ASSEMBLY



1. Remove piston assembly (2) from recoil spring assembly (1).

2. Disassembly of recoil spring assembly
   1) Set recoil spring assembly (1) to tool H1.
      ⚠ The recoil spring is under large installed load, so be sure to set the tool properly. Failure to do this is dangerous.
      ★ Installed load of spring: 133,000 N (13,610 kg).

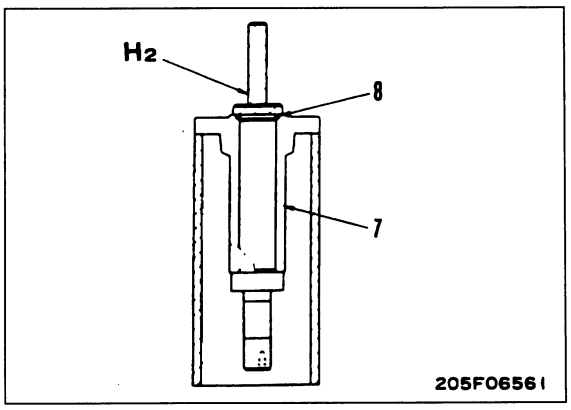


   2) Apply hydraulic pressure slowly to compress spring, and remove lock plate (3), then remove nut (4).
      ★ Compress the spring to a point where the nut becomes loose.
      ★ Release the hydraulic pressure slowly and release the tension of the spring.
      ★ Free length of spring: 587.5 mm

   3) Remove yoke (6), cylinder (7), and dust seal (8) from spring (5).

3. Disassembly of piston assembly
   1) Remove lock plate (10) from piston (9), then remove valve (11).
   2) Remove snap ring (12), then remove U-packing (13) and ring (14).

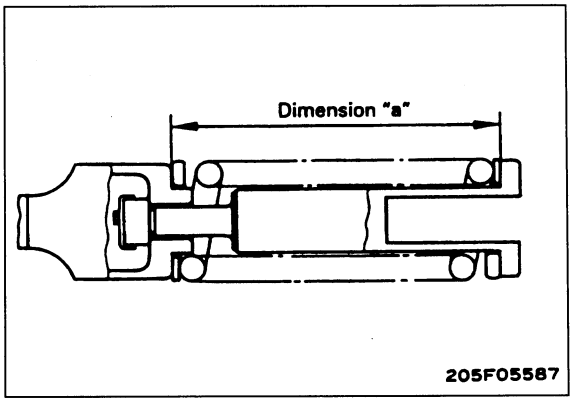
ASSEMBLY OF RECOIL SPRING ASSEMBLY



1. **Assembly of piston assembly**
   1) Assemble ring (14) and U-packing (13) to piston (9), and secure with snap ring (12).
   2) Tighten valve (11) temporarily, and secure with lock plate (10).

2. **Assembly of recoil spring assembly**
   1) Using tool **H2**, install dust seal (8) to cylinder (7).
   2) Assemble cylinder (7) and yoke (6) to spring (5), and set in tool **H1**.

   Sliding portion of cylinder: Grease (G2-LI)
   3) Apply hydraulic pressure slowly to compress spring, and tighten nut (4) so that installed length of spring is dimension "**a**", then secure with lock plate (3).
      ★ Installed length "**a**" of spring : 466 mm.
   4) Remove recoil spring assembly (1) from tool **H1**.

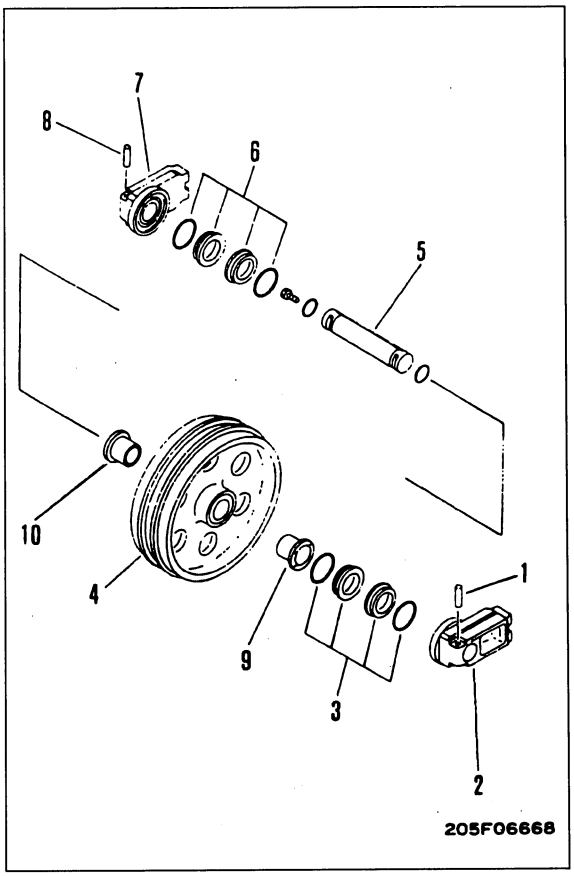


3. **Assemble piston assembly (2) to recoil spring assembly (1).**

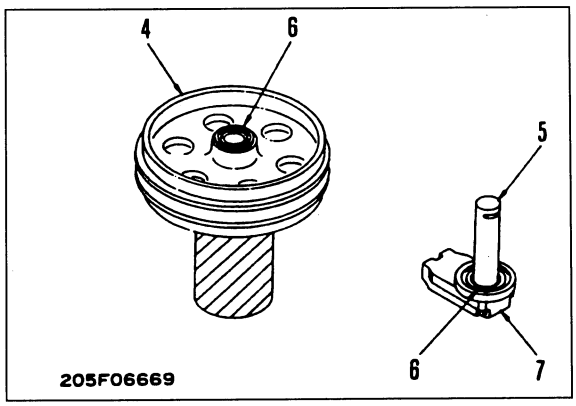
   Sliding portion of piston, wear ring: Grease (G2-LI)
   ★ Assemble the cylinder assembly so that the mounting position of the valve is 90° to the side.
   ★ Fill the inside of the cylinder with 300 cc of grease (G2-LI), then bleed the air and check that grease comes out of the grease hole.

DISASSEMBLY OF IDLER ASSEMBLY

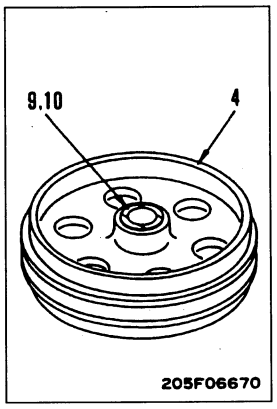
1. Remove dowel pin (1), then remove support (2).
2. Remove floating seal (3) from support (2) and idler (4).
3. Pull out idler (4) from shaft (5) and support (7) assembly.
   ★ It is filled with 80 cc. of oil, so drain the oil at this point or lay a cloth to prevent the area from becoming dirty.

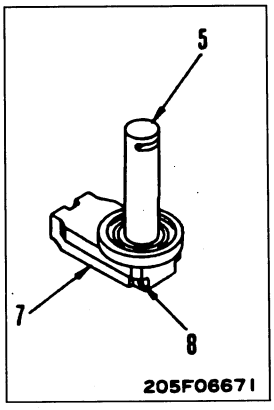


4. Remove floating seal (6) on opposite side from idler (4) and shaft (5) and support (7) assembly.



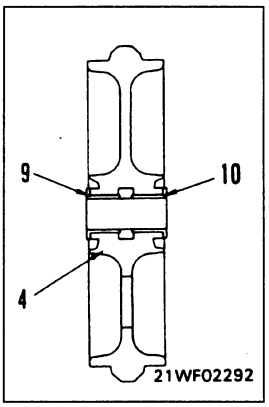
5. Remove dowel pin (8), then remove support (7) from shaft (5).
6. Remove bushings (9) and (10) from idler (4).

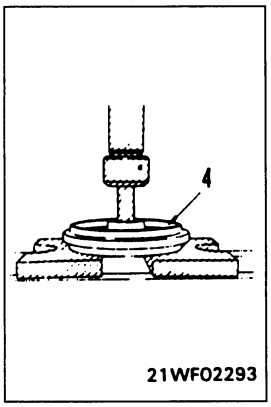




ASSEMBLY OF IDLER ASSEMBLY

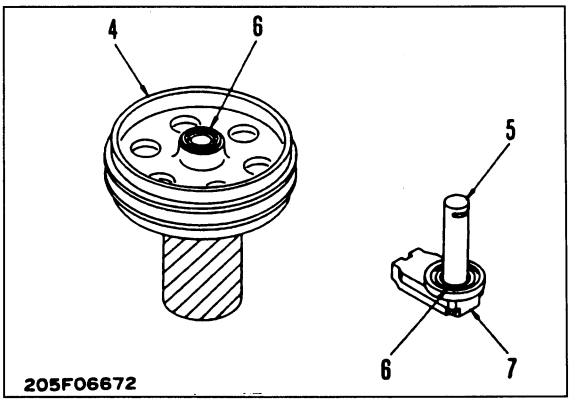
1. Press fit bushings (9) and (10) to idler (4).

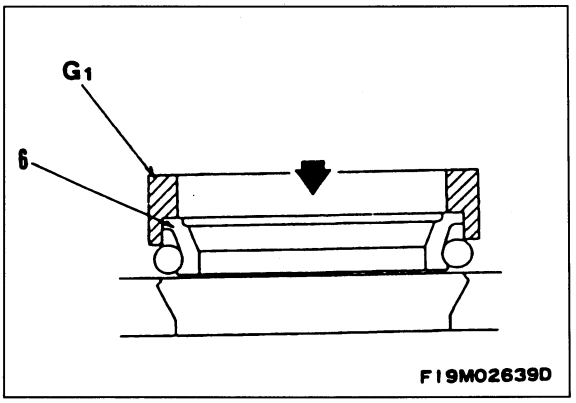




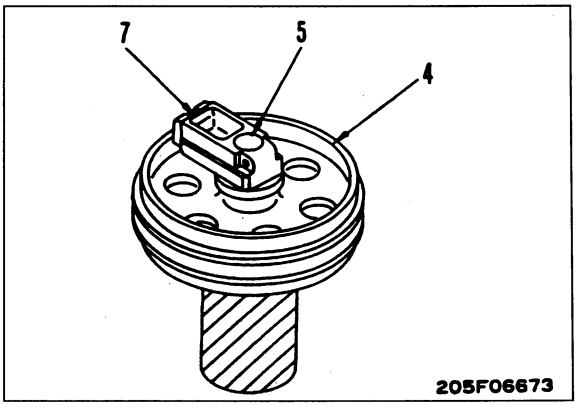
2. Fit O-ring and install support (7) to shaft (5) with dowel pin (8).

3. Using tool **G1**, install floating seal (6) to idler (4) and shaft (5) and support (7) assembly.
   - ★ Coat the sliding surface of the floating seal with oil, and be careful not to let any dirt or dust get stuck to it.
   - ★ Remove all grease and oil from the contact surface of the O-ring and the floating seal.

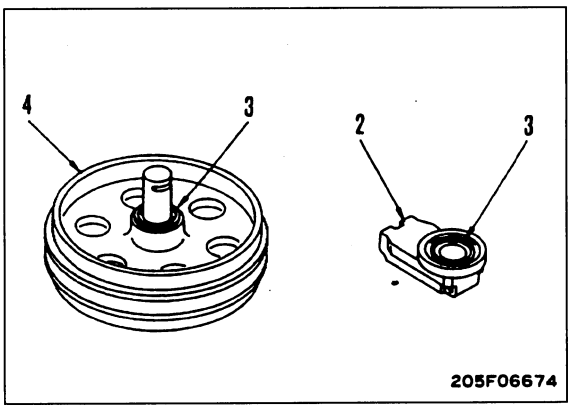


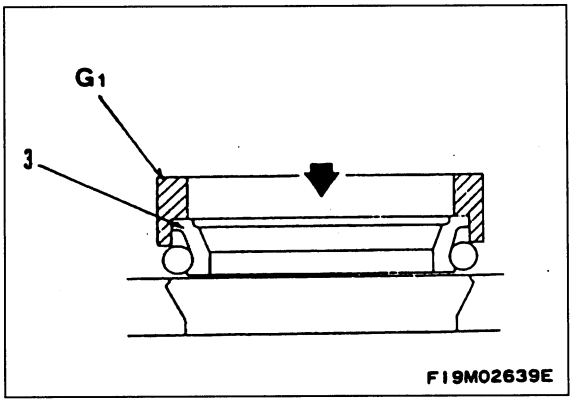


4. Assembe shaft (5) and support (7) assembly to idler (4).



5. Using tool **G1**, install floating seal (3) to idler (4) and support (2).
   - ★ Coat the sliding surface of the floating seal with oil, and be careful not to let any dirt or dust get stuck to it.
   - ★ Remove all grease and oil from the contact surface of the O-ring and the floating seal.



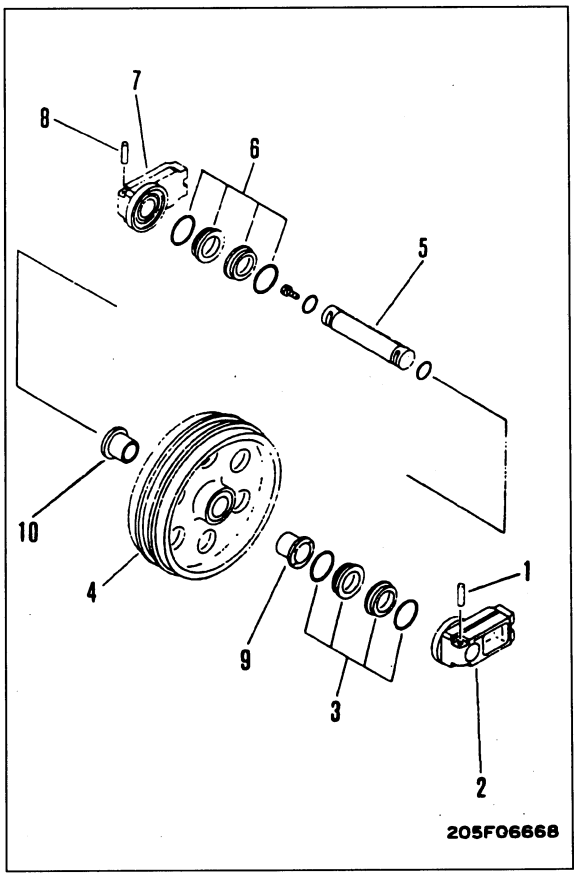


6. Install O-ring, then install support (2) with dowel pin (1).

7. Add oil and tighten plug.

   Oil: Approx. 80 cc (SAE30)

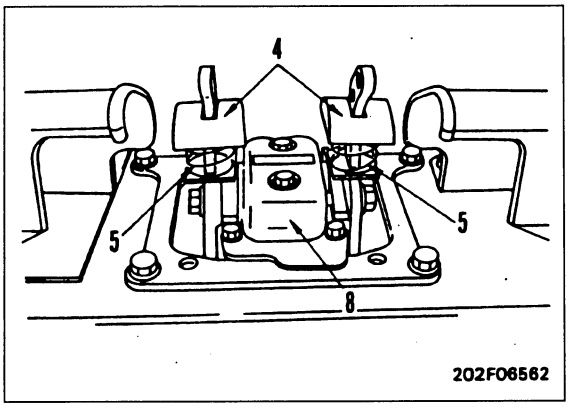
   kgm Plug: 205.9 ± 49 Nm (21 ± 5 kgm)



REMOVAL OF TRACK ROLLER ASSEMBLY

1. Lower work equipment, then loosen lubricator (1), and relieve track tension. ※ 1
   The adjustment cylinder is under extremely high pressure. Never loosen the lubricator more than one turn. If the grease does not come out easily, move the machine backwards and forwards.
2. Remove mounting bolts of track roller, then swing work equipment 90°, jack up machine, and remove track roller assembly (2) towards outside of machine. ※ 2

kg Track roller assembly: 40 kg

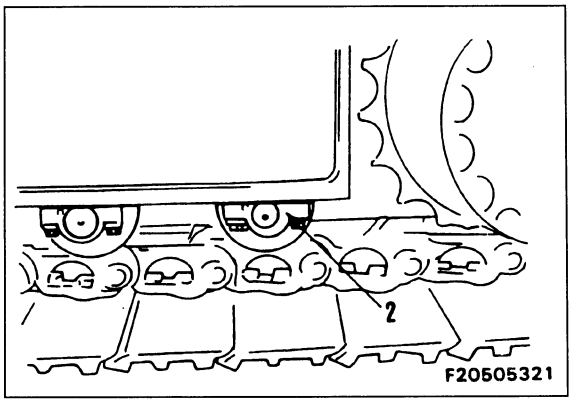


INSTALLATION OF TRACK ROLLER ASSEMBLY

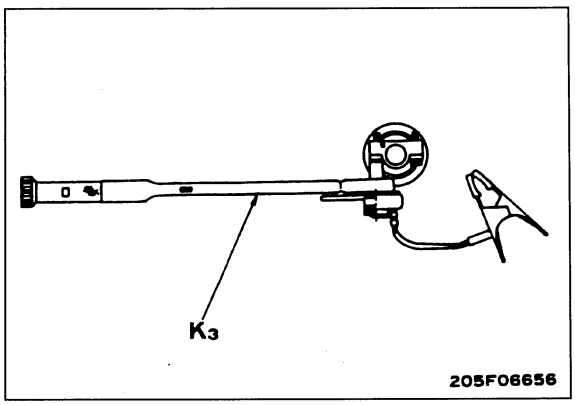
- Carry out installation in the reverse order to removal.

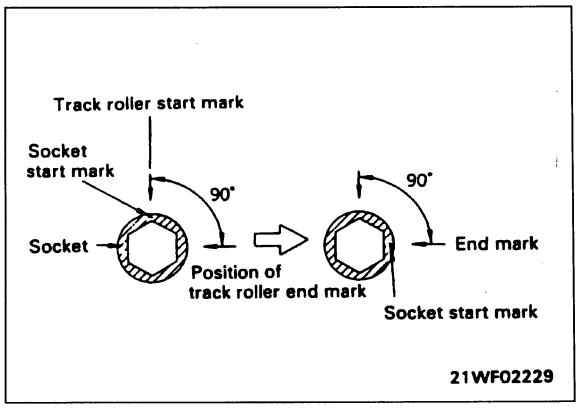
※ 1
- ★ Adjust the track tension. For details, see TESTING AND ADJUSTING, Testing and adjusting track tension.

※ 2
- ★ Place the plug on the outside of the chassis, and set the track roller assembly in the mounting position.
- ★ Operate the work equipment levers to lower the machine slowly, then tighten the mounting bolts temporarily.
- ★ Operate the work equipment levers to lower the machine completely to the ground, then tighten the mounting bolts fully.

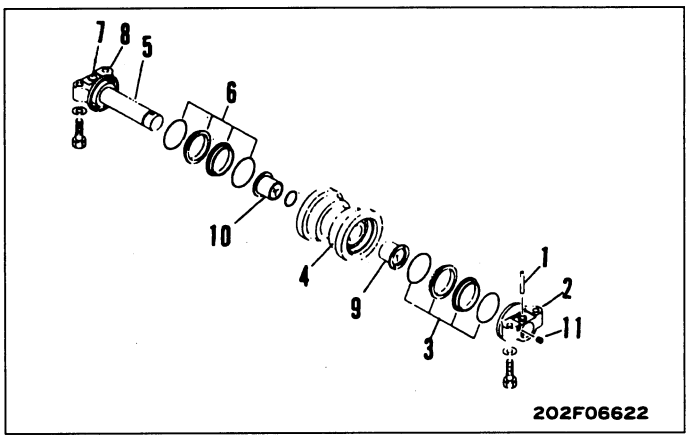


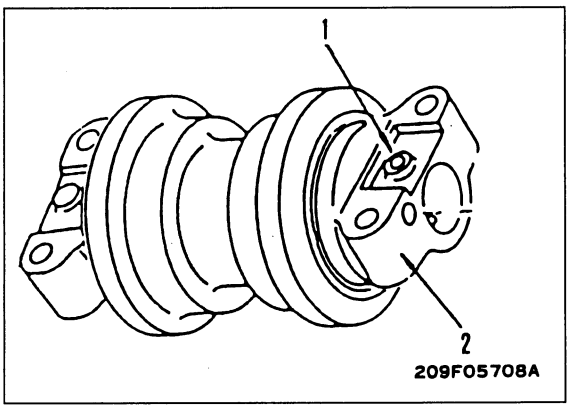
kgm Track roller assembly mounting bolt:
1st pass: Tighten to 196.1 ± 19.6 Nm (20 ± 2 kgm)
2nd pass:
1. When using tool K3.
   - Using an angle tightening wrench, tighten bolt 90 ± 5°.
2. When not using tool K3.
   1) Using the angle of the bolt head as the base, make start marks on th track roller and socket.
   2) Make an end mark at a point 90 ± 5° from the start mark.
   3) Tighten so that the start mark on the socket is aligned with the end mark on the track roller at the 90 ± 5° position.



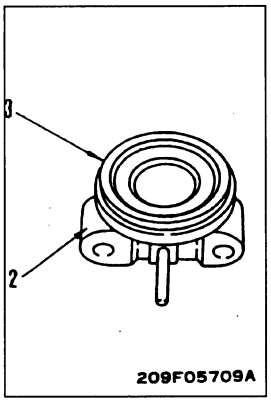


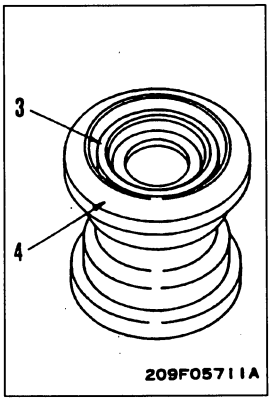
DISASSEMBLY OF TRACK ROLLER ASSEMBLY



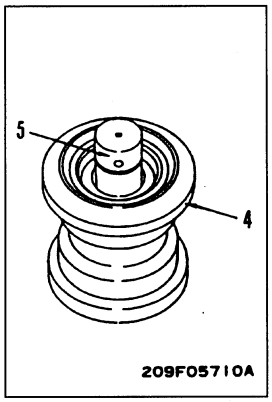


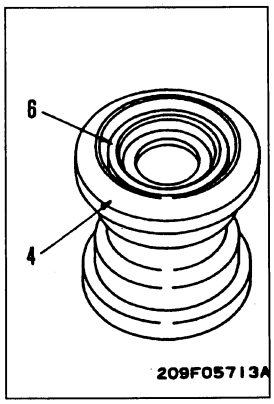
1. Remove pin (1), then remove collar (2).
2. Remove floating seal (3) from collar (2) and roller (4).



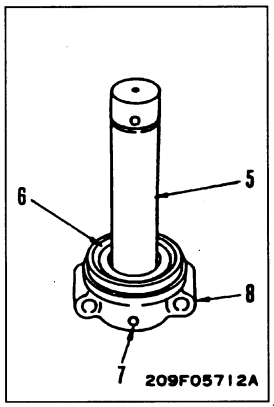


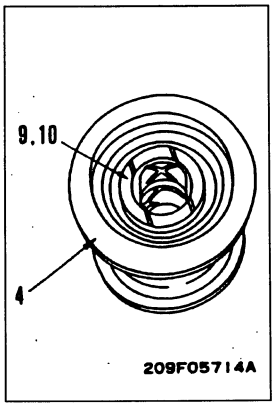
3. Pull out roller (4) from shaft (5).
   ★ It is filled with 190 - 215 cc. of oil, so drain the oil at this point or lay a cloth to prevent the area from becoming dirty.
4. Remove floating seal (6) on opposite side from roller (4) and shaft (5).





5. Remove pin (7), then remove collar (8) from shaft (5).
6. Remove bushings (9) and (10) from roller (4).





ASSEMBLY OF TRACK ROLLER ASSEMBLY

1. Using push tool ①, press fit bushings (9) and (10) to roller (4).

2. Assemble collar (8) to shaft (5), and install pin (7).

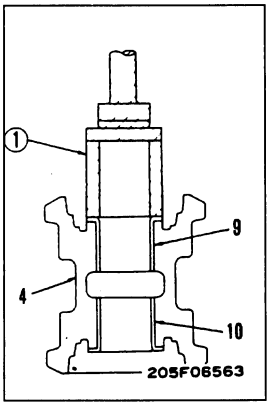
3. Using tool **K1**, install floating seal (6) to shaft (5).
   ★ When assembling the floating seal, clean the contact surface of O-ring (6c) and floating seal (6a), remove all grease and oil, and dry it. Make sure that no dirt or dust sticks to the contact surface of the floating seal.

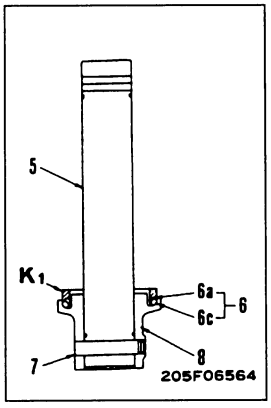
4. Using tool **K1**, install floating seals (6) and (3) to roller (4).
   ★ For details of the precautions when installing floating seals (6b) and (6d), and (3b) and (3d), see the precaution for Step 3.

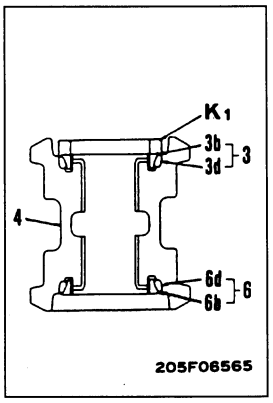
5. Assemble shaft (5) to roller (4).

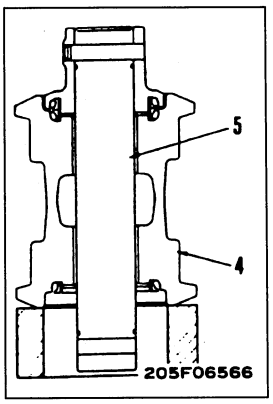
6. Turn over roller (4) and shaft (5) assembly.

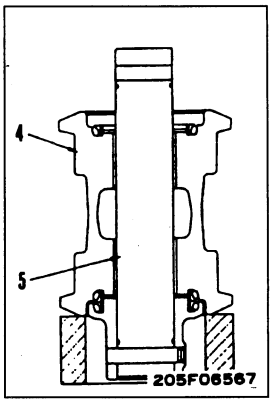
7. Using tool **K1**, install floating seal (3) to collar (2).
   ★ For details of the precautions when installing floating seals (3a) and (3c), see the precaution for Step 3.

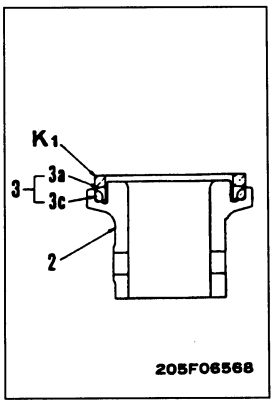




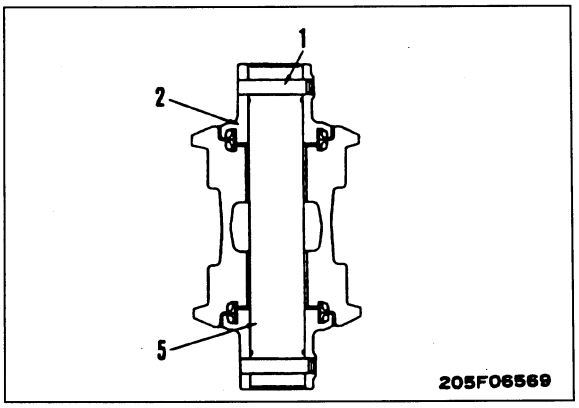




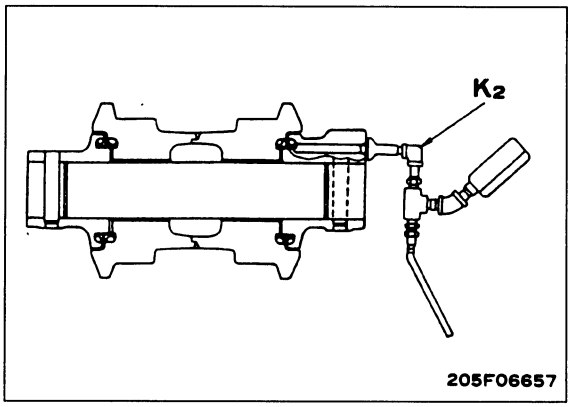




8. Assemble collar (2) to shaft (5), and install pin (1).



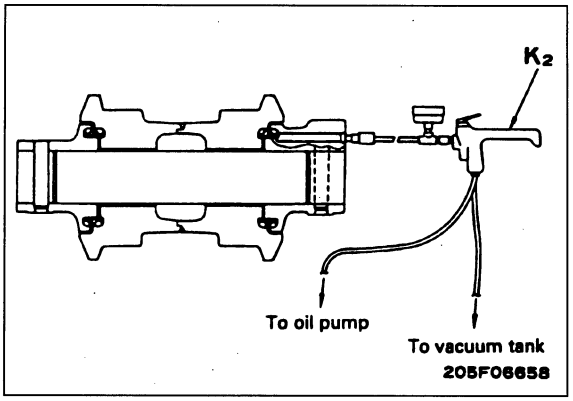
9. Using tool **K2**, apply basic pressure to roller oil filler port, and check for leakage of air from seal.
   - ★ Basic pressure: 98 kPa (1 kg/cm²)
   - ★ The basic pressure shall be maintained for 10 seconds and the indicator of the gauge shall not go down.

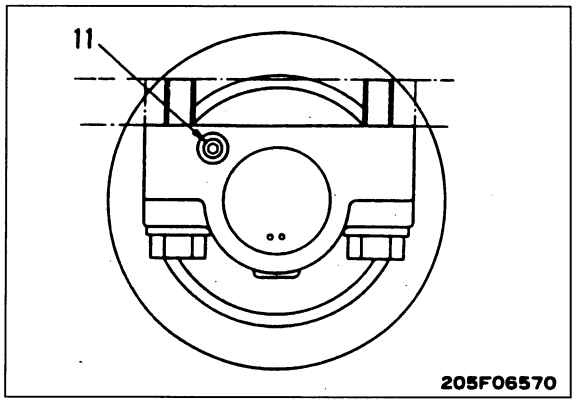


10. Using tool **K2**, fill track roller assembly with oil, then tighten plug (11).

kgm Plug: 14.7 ± 4.9 Nm (1.5 ± 0.5 kgm)

Track roller oil: 190 - 215 cc (SAE30)



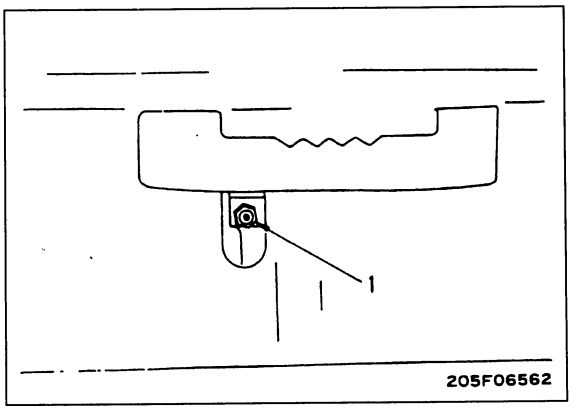


REMOVAL OF CARRIER ROLLER ASSEMBLY

1. Lower work equipment, then loosen lubricator (1), and relieve track tension. ※ 1

   ⚠ The adjustment cylinder is under extremely high pressure. Never loosen the lubricator more than one turn. If the grease does not come out, move the machine backwards and forwards.

2. Using hydraulic jack ①, push up track to a position where carrier roller assembly can be removed, then remove carrier roller assembly (2). ※ 2



INSTALLATION OF CARRIER ROLLER ASSEMBLY

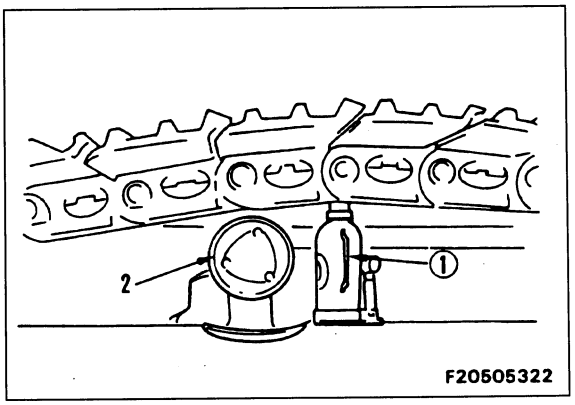
- Carry out installation in the reverse order to removal.

※ 1

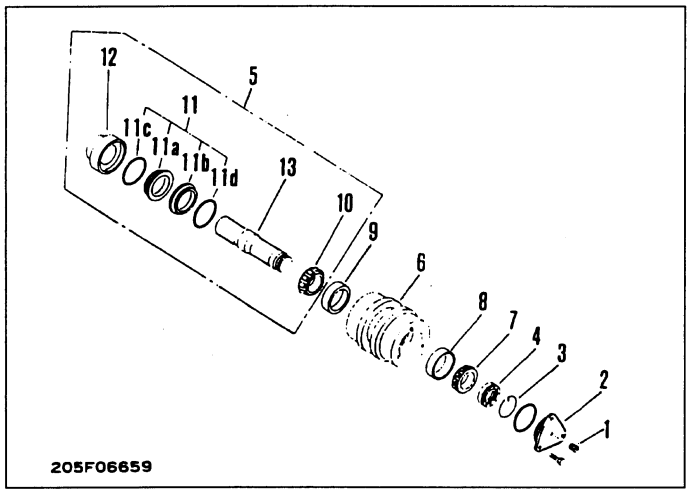
★ Adjust the track tension. For details, see TESTING AND ADJUSTING, Testing ans adjusting track tension.

※ 2

Thread of carrier roller assembly mounting bolt:
Thread tightener (LT-2)



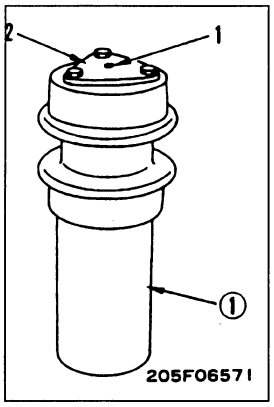
DISASSEMBLY OF CARRIER ROLLER ASSEMBLY

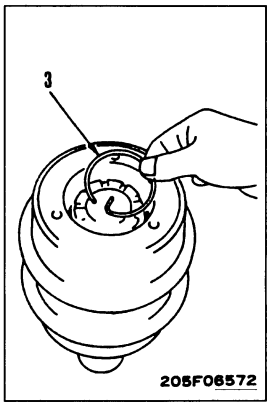


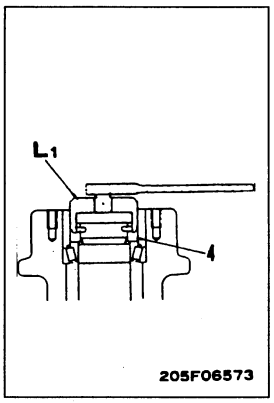
1. Remove plug (1) and drain oil.

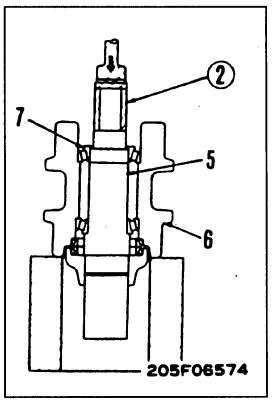
   Carrier roller assembly : 230 - 250 cc
2. Set carrier roller assembly on stand ①.
3. Remove cover (2).
4. Remove ring (3).
5. Using tool **L1**, remove nut (4).
6. Using push tool ②, pull out shaft assembly (5) from roller (6) with press, then remove inner race (7).
7. Remove outer races (8) and (9) from roller (6).

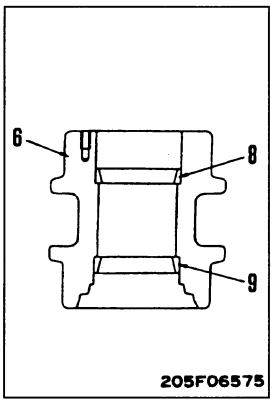
8. **Disassembly of shaft assembly**
   1) Using puller ③, remove inner race (10).

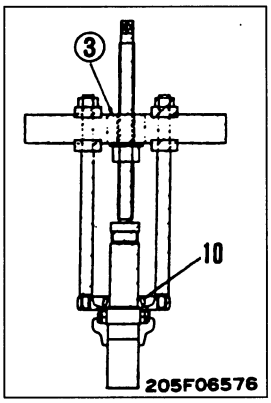




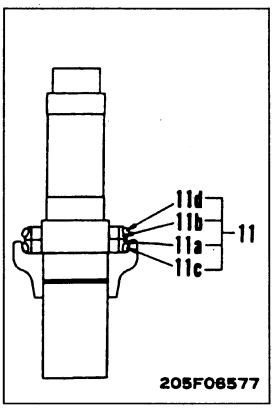


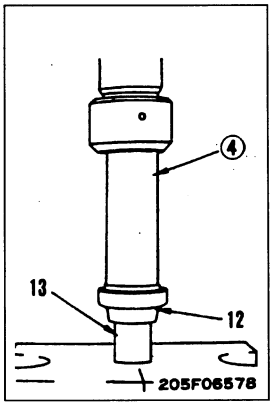






   2) Remove floating seals (11).
   3) Using push tool ④, remove collar (12) from shaft (13).





ASSEMBLY OF CARRIER ROLLER ASSEMBLY

1. Using push tool ⑤, press fit outer races (8) and (9) to roller (6).

2. **Assembly of shaft assembly**
   1) Using push tool ⑥, press fit collar (12) to shaft (13).
      ★ When press fitting, be careful that there is no scuffing.

      Fitting portion of shaft: SAE30
   2) Using tool **L3**, assemble floating seals (11).
      ★ When assembling the floating seal, clean the contact surface of O-ring (11c) and floating seal (11a), remove all grease and oil, and dry it. Make sure that no dirt or dust sticks to the conact surface of the floating seal.
   3) Assemble floating seals (11), then using push tool ⑦, press fit inner race (10).
      ★ For details of the precautions when installing floating seals (11b) and (11d), see the precaution for Step 2).

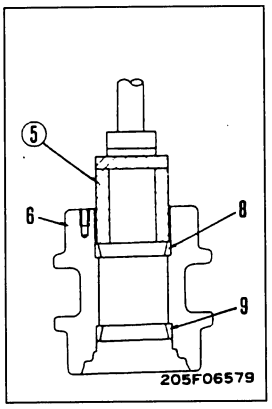
3. Assemble roller (6) to shaft assembly (5).

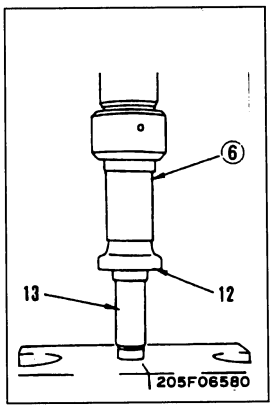
4. Using push tool ⑧, press fit inner race (7).
   ★ When press fitting the bearing, rotate the roller, and press fit to a point where the rotation becomes slightly heavier.

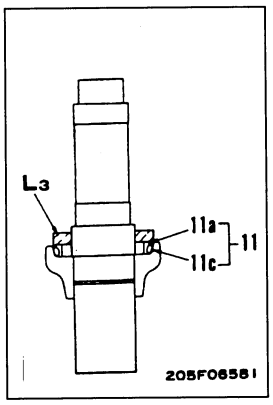
5. Using tool **L1**, tighten nut (4) to a point where drill hole in shaft is aligned with drill hole in nut.

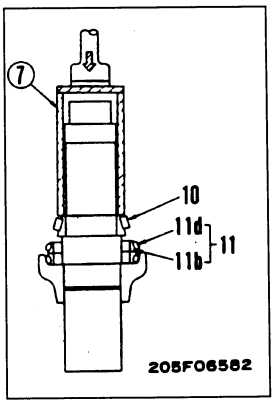
6. Install ring (3).

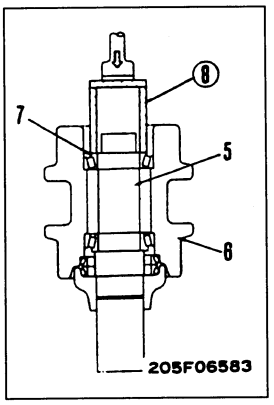
7. Using push scale ⑨, check that it rotates smoothly.

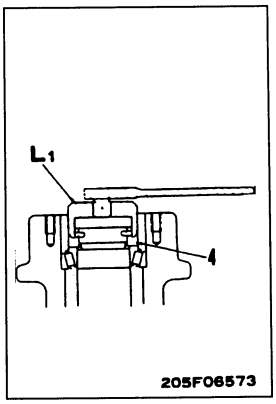


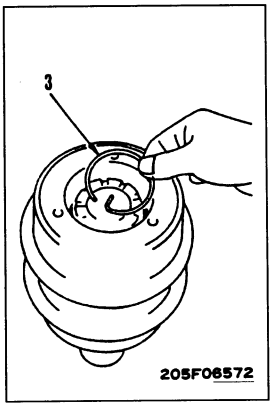


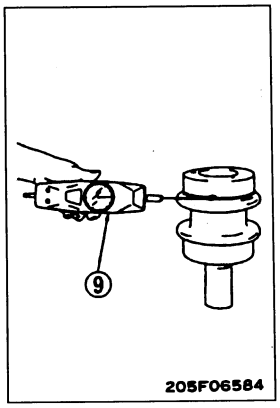




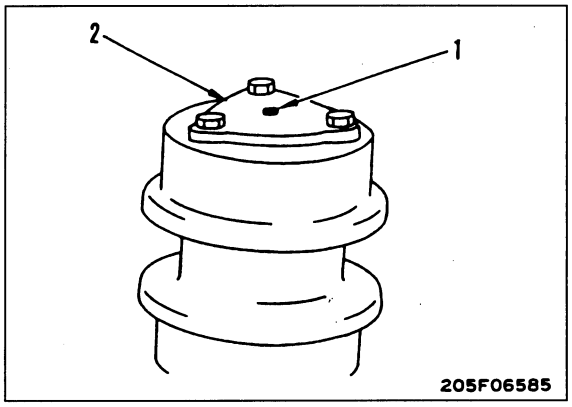




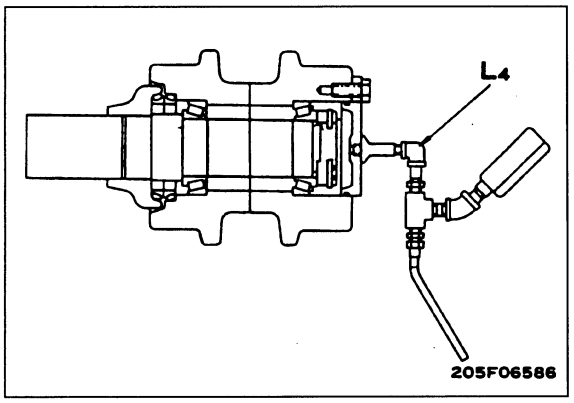




8. Fit O-ring and install cover (2).

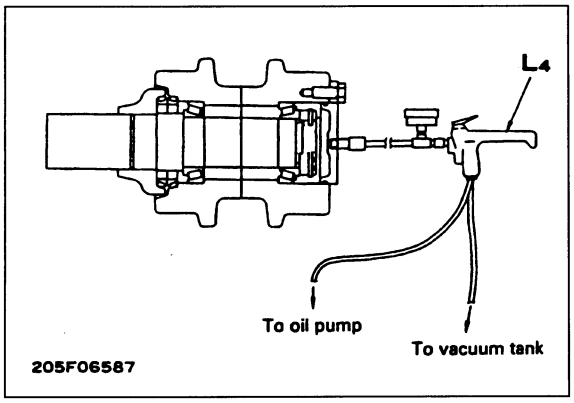


9. Using tool **L2**, apply basic pressure to roller oil filler port, and check for leakage of air from seal.
   - ★ Basic pressure: 98 kPa (1 kg/cm²)
   - ★ Method of checking
     The basic pressure shall be maintained for 10 seconds and the indicator of the gauge shall not go down.



10. Using tool **L4**, fill carrier roller assembly with oil, then tighten plug (1).

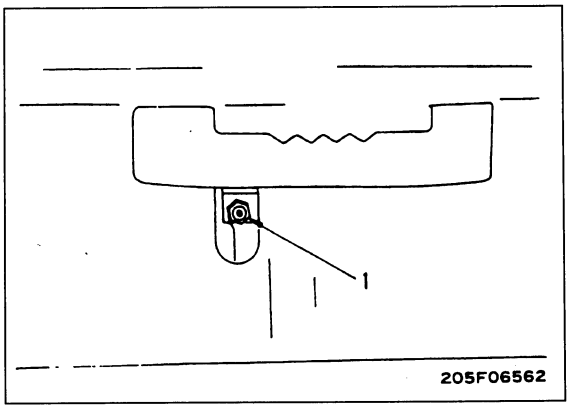
Carrier roller oil: 230 - 250 cc (SAE30)



REMOVAL OF TRACK SHOE ASSEMBLY

1. Stop machine at a point where master pin is midway between idler and carrier roller, and where there is space to lay out track assembly on ground.

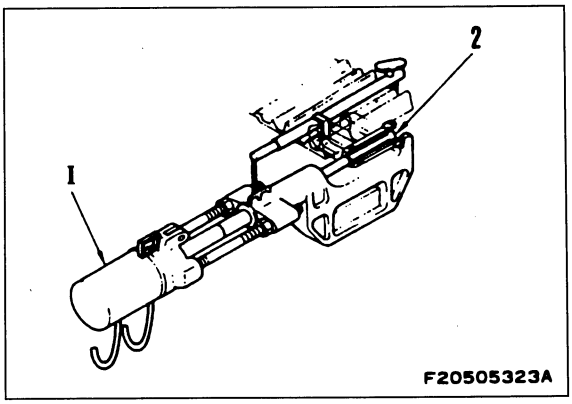
2. Lower work equipment, then loosen lubricator (1), and relieve track tension. ※ 1
   ⚠ The adjustment cylinder is under extremely high pressure. Never loosen the lubricator more than one turn. If the grease does not come out, move the machine backwards and forwards.



3. Using tool **I**, pull out master pin (2) ※ 2

4. Remove tool **I**, and move machine forward so that position of temporary pin ② is at front of idler, and set block ① in position.

5. Remove temporary pin ②, and remove dust seal, then drive machine in reverse to lay out track 3. ※ 3

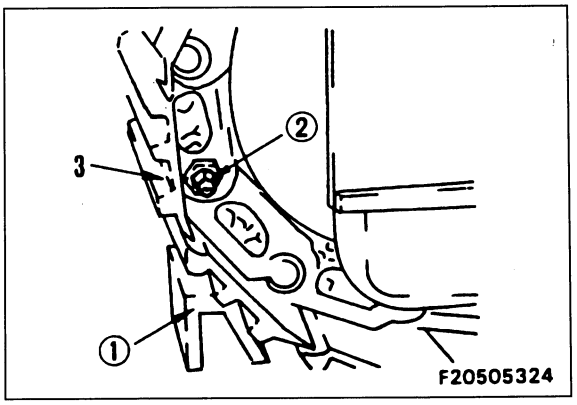


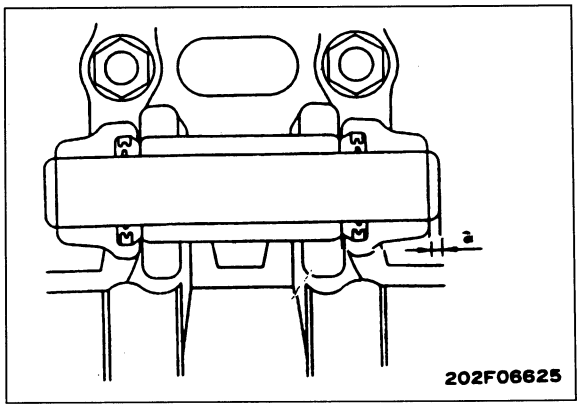
INSTALLATION OF TRACK SHOE ASSEMBLY

※ 1
★ Adjust the track tension. For details, see TESTING AND ADJUSTING, Testing and adjusting track tension.

※ 2
★ Use tool **I** and press fit so that the protrusion of the master pin is dimension "**a**".
Protrusion "**a**" of master pin: 4 ± 2 mm

※ 3
★ When assembling the dust seal, coat the bushing contact surface with grease (G2-LI).



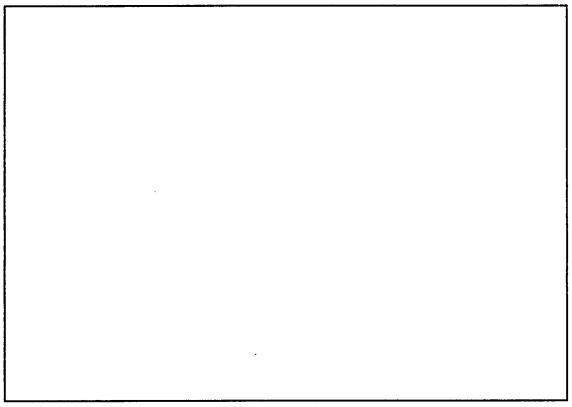


REMOVAL OF HYDRAULIC TANK ASSEMBLY

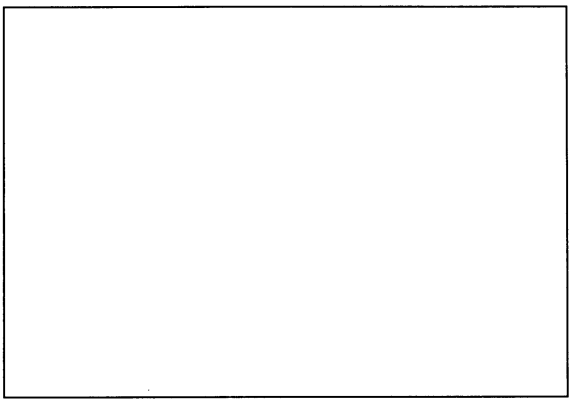
1. Drain oil from hydraulic tank.

   Hydraulic tank: Approx. 120 ℓ

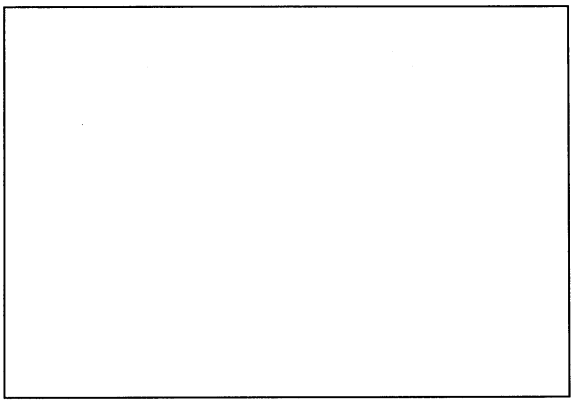
2. Open engine hood, and remove covers (1), (2), (3), and (4).



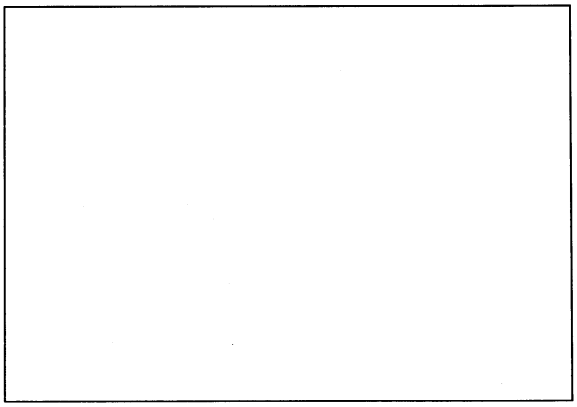
3. Remove engine room partition plate (5), then remove partition plate (6).
4. Remove frame (7).



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

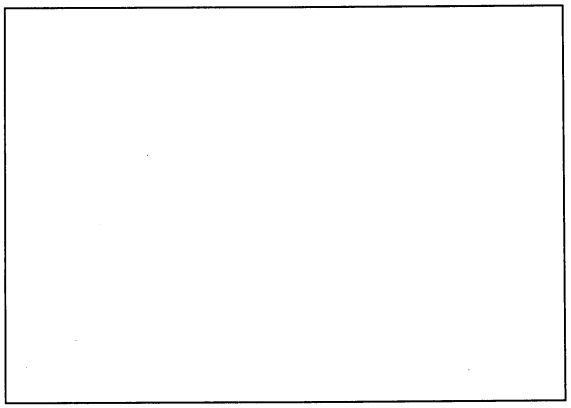


6. Remove pressure sensor wiring clamps (12).
7. Remove solenoid valve wiring clamp (13).
9. Remove wiring connector bracket (15).



10. Disconnect hydraulic tank inlet hose (16).
11. Remove main pump inlet tube (17), then remove pump suction tube (18).
12. Remove mounting bolts, and lift off hydraulic tank assembly (19). [※ 1]

    kg Hydraulic tank assembly: 125 kg



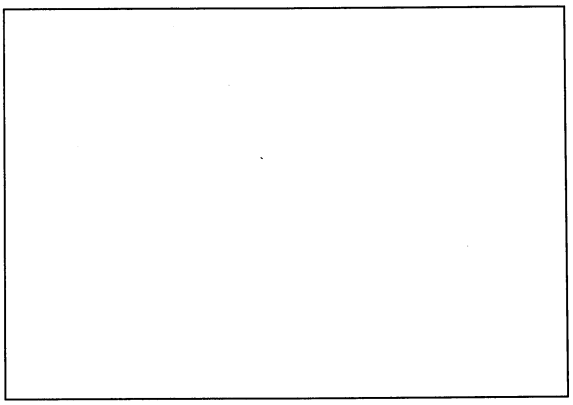
INSTALLATION OF HYDRAULIC TANK ASSEMBLY

- Carry out installation in the reverse order to removal.

[※ 1]

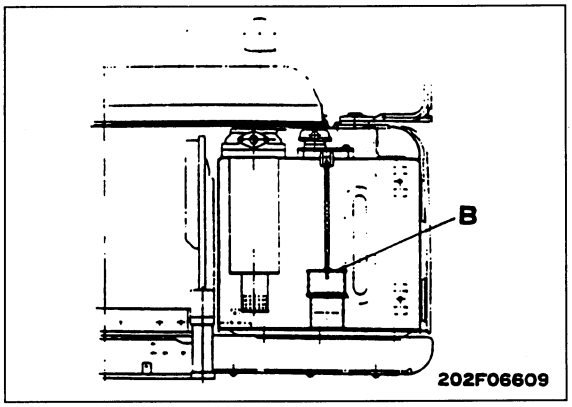
Thread of hydraulic tank mounting bolt:
Thread tightnener (LT-2)

kgm Hydraulic tank mounting bolt:
276.9 ± 31.9 Nm (28.25 ± 3.25 kgm)



- Refilling with oil (hydraulic tank)
  - ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- Bleeding air
  - ★ Bleed the air.
    For details, see TESTING AND ADJUSTING, Bleeding air.

REMOVAL OF MAIN PUMP ASSEMBLY



⚠ Disconnect he cable from the negative (-) terminal of the battery.

⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

- Remove the hydraulic tank strainer, and using tool **B**, stop the oil.
  - When not using tool **B**, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.

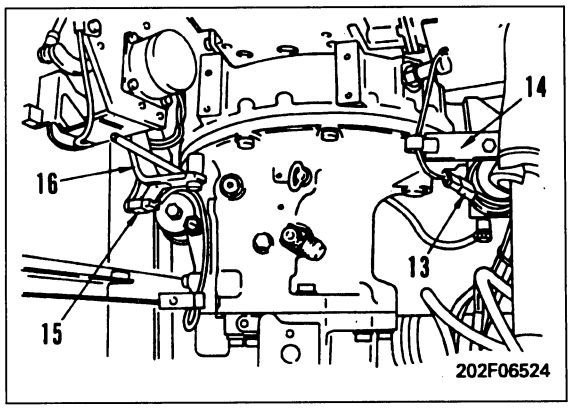
Hydraulic tank: Approx. 120 ℓ

2. Open engine hood, and remove main pump top cover, then remove exhaust muffler covers (1) and (2).
3. Disconnect connecting pipe portion at turbocharger end, and remove exhaust muffler (3) together with bracket.
4. Disconnect hoses (4),a nd remove filter assembly (5) together with bracket.
5. Remove control pump suction tube (6).
6. Disconnect main pump suction tube (7).
8. disconnect control pump outlet hose (9).
9. Disconnect main pump outlet hose (10)
10. Disconnect main pump drain hose (11).
11. Disconnect TVC • LS valve inlet hoses (12).

12. disconnect engine speed sensor wiring connector (13), and remove bracket (14).
13. Disconnect TVC solenoid wiring connector (15), and remove bracket (16).
14. Disconnect ground connection (17).
15. Remove exhaust drain pipe (18).
16. Sling main pump assembly (19), remove mounting bolts, then use forcing screws ① to remove.

※ 1

kg Main pump assembly: 100 kg

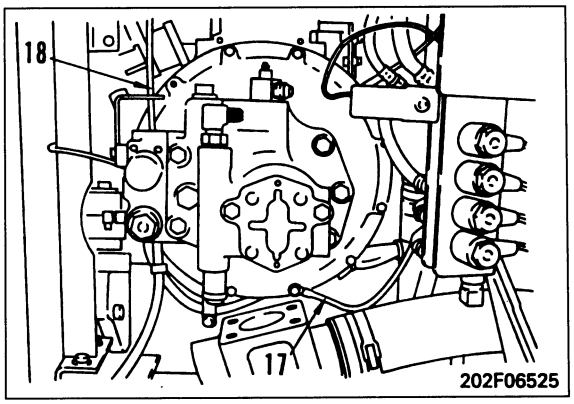


INSTALLATION OF MAIN PUMP ASSEMBLY

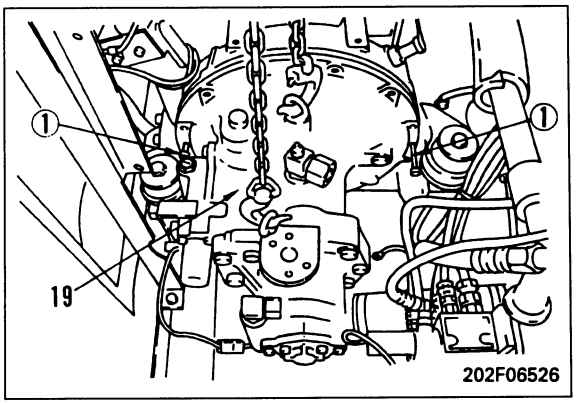
- Carry out installation in the reverse order to removal.

※ 1

Mating surface of pump case:
Gasket sealant (LG-6)



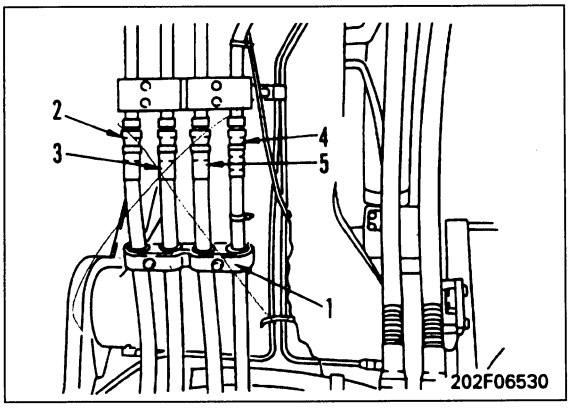
- Refilling with oil (PTO gear case)
  ★ Add engine oil through the oil filler to the specified level.
- Refilling with oil (hydraulic tank)
  ★ Add oil throught the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.
- Bleeding air
  ★ Bleed the air from main pump.
  For details, see TESTING AND ADJUSTING, Bleeding air.

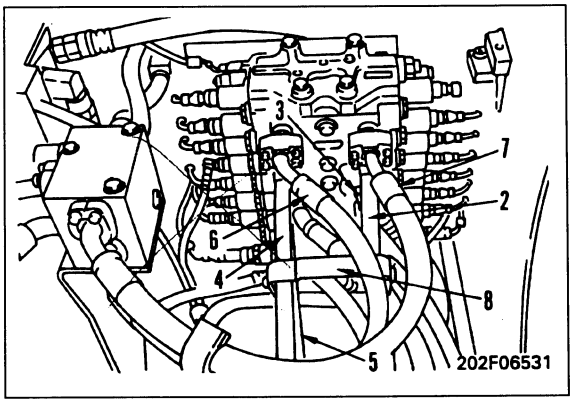


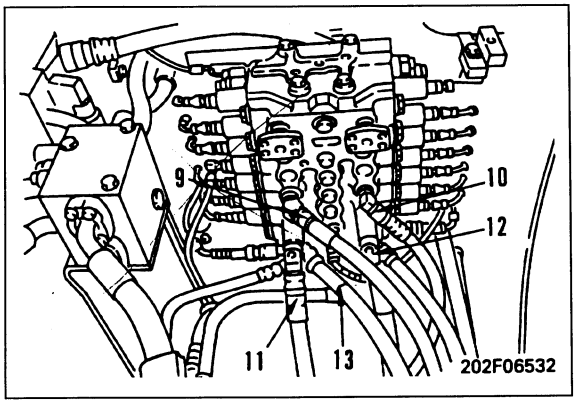
REMOVAL OF CONTROL VALVE ASSEMBLY

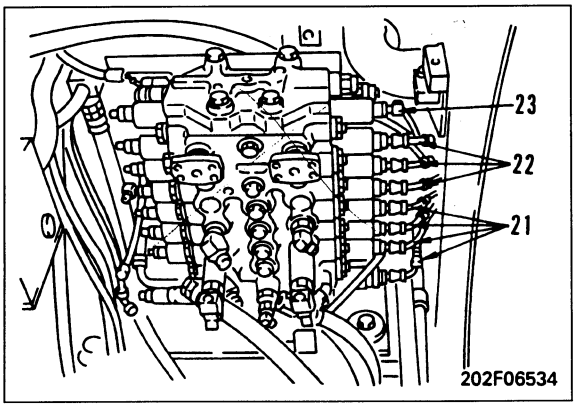
⚠ Release the remaiing pressure in the hydraulic circuit.
For details, see TESTING AND ADJUSTING, Releasing pressure in hydraulic circuit.

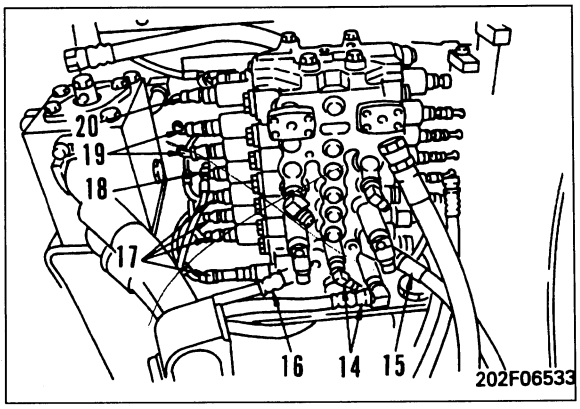
1. Remove engine room partition plate and chassis bodywork cover above control valve assembly.
2. Remove clamp (1), then disconnect hoses (2), (3), (4), and (5).
3. Disconnect hoses (6) and (7).
4. Remove clamp (8), then remove hoses (2), (3), (4), and (5).
5. Disconnect hoses (9), (10), (11), (12), and (13).
6. Disconnect hoses (14), (15), and (16).
7. Disconnect hoses (17), (18), (19), and (20).
   ★ Disconnect 2 hoses (18).
8. Disconnect hoses (21), (22), and (23).











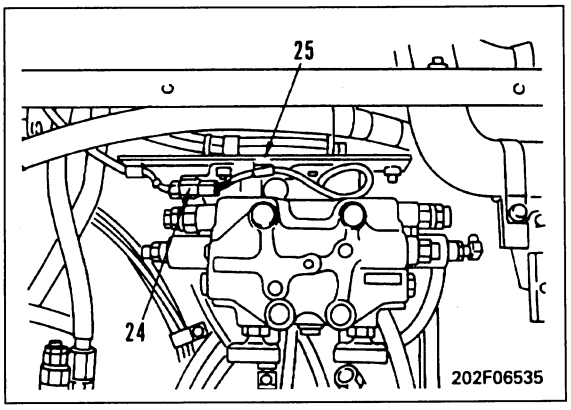
9. Remove connector (24) from clip, then disconnect it.
   ★ Disconnect the wiring harness form the harness clamps (3 places)

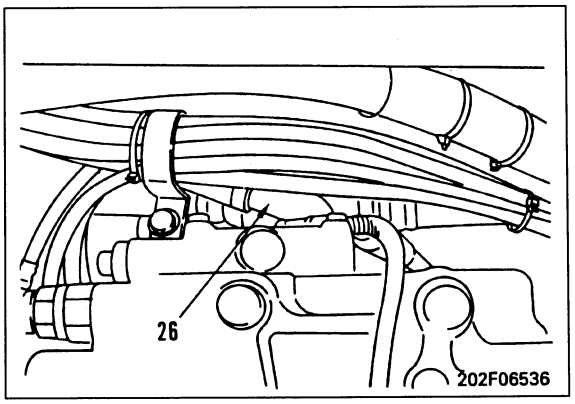
10. Remove harness bracket (25).

11. Disconnect hose (26).

12. Remove mounting bolts, and lift off control valve assembly (27).

   kg Control valve assembly : 70 kg



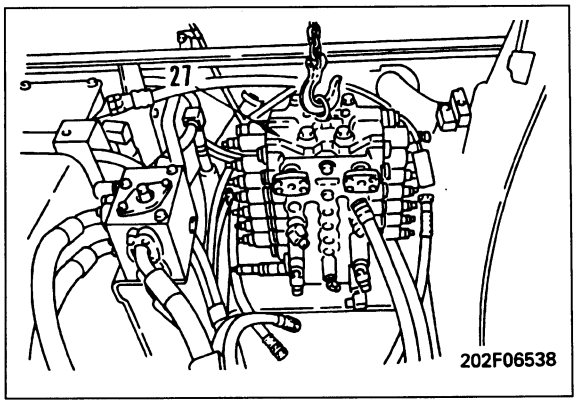


INSTALLATION OF CONTROL VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air
  ★ Bleed the air from the circuit between the valve and the hydraulic cylinder.
  For details, see TESTING AND ADJUSTING, Bleeding air.



DISASSEMBLY OF CONTROL VALVE ASSEMBLY

★ The set pressure of the safety valve and arm counterbalance valve, cannot be adjusted when they are installed on the machine, so do not disassemble.
• The following explanation describes the spools control valve.

1. **Main relief valve**
Remove main relief valve (1).

2. **Unload valve, safety-suction valves, suction valves**
   1) Remove unload valve (3)
   2) Remove safety-suction valves (4), (5), (6), (7), and (8).
   3) Remove suction valves (9) and (10).

3. **Pressure compensation valves**
   ★ Before removing any pressure compensation valve, check and mark its mounting position.
   1) Remove bucket CURL pressure compensation valve (11), arm IN pressure compensation valve (11), boom LOWER pressure compensation valve (11), Right travel REVERSE pressure compensation valve (12), Left travel REVERSE pressure compensation valve (12), and swing RIGHT pressure compensation valve (13) and service valve pressure compensation valve (14).
      ★ After removing the pressure compensation valves, remove check valve (17) from each pressure compensation valve mount.
   2) Remove bucket DUMP pressure compensation valve (18), arm OUT pressure compensation valve (19), boom RAISE pressure compensation valve (19), Right travel RORWARD pressure compensation valve (20), Left travel FORWARD pressure compensation valve (20), and swing LEFT pressure compensation valve (21), and service valve pressure compensation valve (22).
      ★ After removing the pressure compensation valves, remove check valve (24) from each pressure compensation valve mount.

4. **LS shuttle, LS select valve**
Remove LS shuttle valves (25a) and (25b), and LS select valve (26).
   ★ Mark the mounting positions of LS shuttle valves (25a), and (25b), and be careful not to make any mistake when installing.

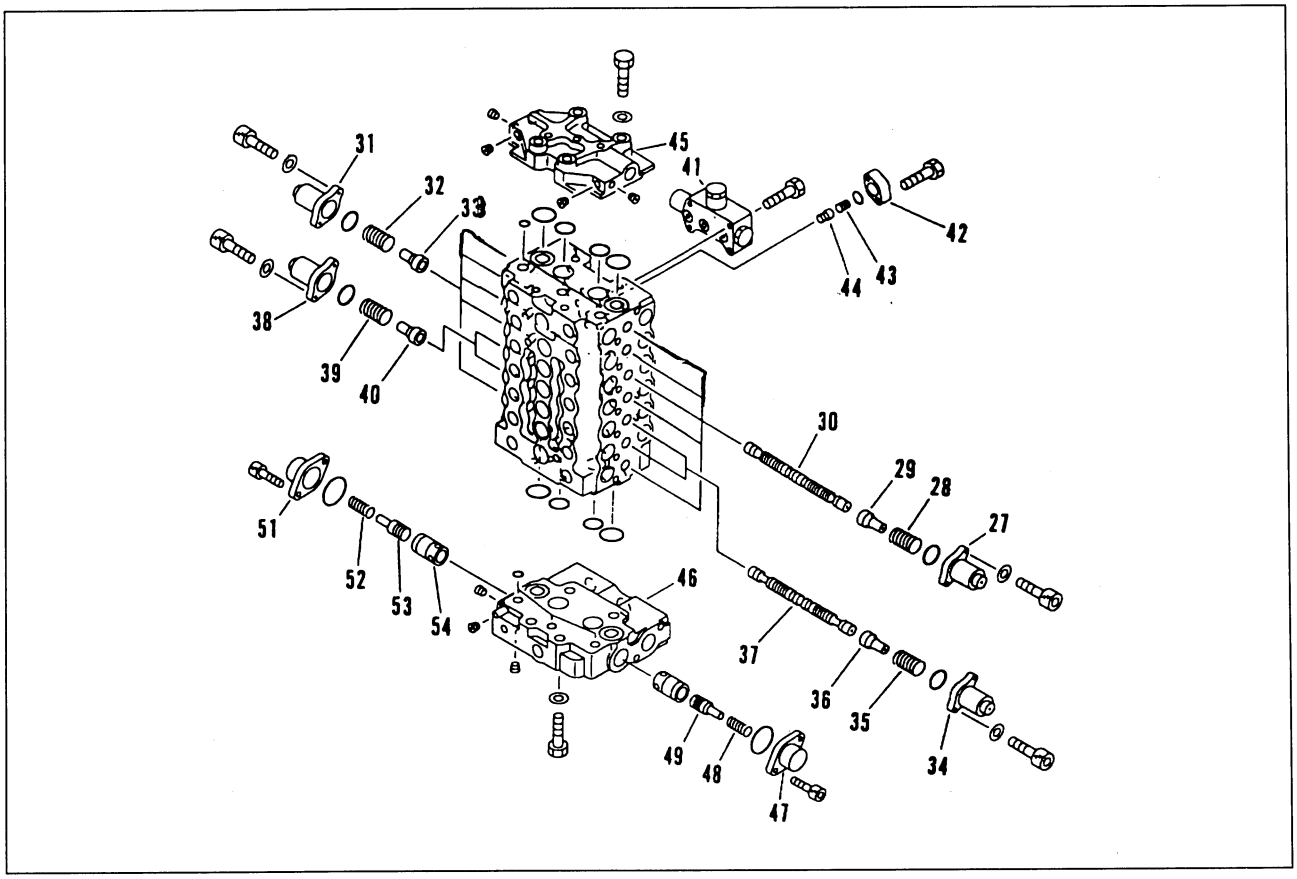
5. **Bucket control valve, arm control valve, boom control valve, swing control valve, service control valve**
   1) Remove case (27), then remove spring (28) and retainer (29).
   2) Remove spool assembly (30).
      ★ Do not disassemble spool (30).
   3) Remove case (31), then remove spring (32) and retainer (33).
      ★ To avoid assembling spring (32) in mistake for spring (39), mark with tags.

6. **Right travel control valve, Left travel control valve**
   1) Remove case (34), then remove spring (35) and retainer (36).
   2) Remove spool assembly (37).
      ★ Do not disassemble spool (37)
   3) Remove case (38), then remove spring (39) and retainer (40).
      ★ To avoid assembling the spring of the control valve in Step 5 in mistake for spring (39), mark with tags.

7. **Arm counterbalance valve, check valve, cover**
   1) Remove arm counterbalance valve (41).
   2) Remove flange (42), then remove spring (43) and check valve (44).
   3) Remove covers (45) and (46).

8. **Lift check valve**
Remove case (47), then remove spring (48), piston (49), and sleeve (50).

9. **Cooler bypass valve**
Remove case (51), then remove spring (52), piston (53), and sleeve (54).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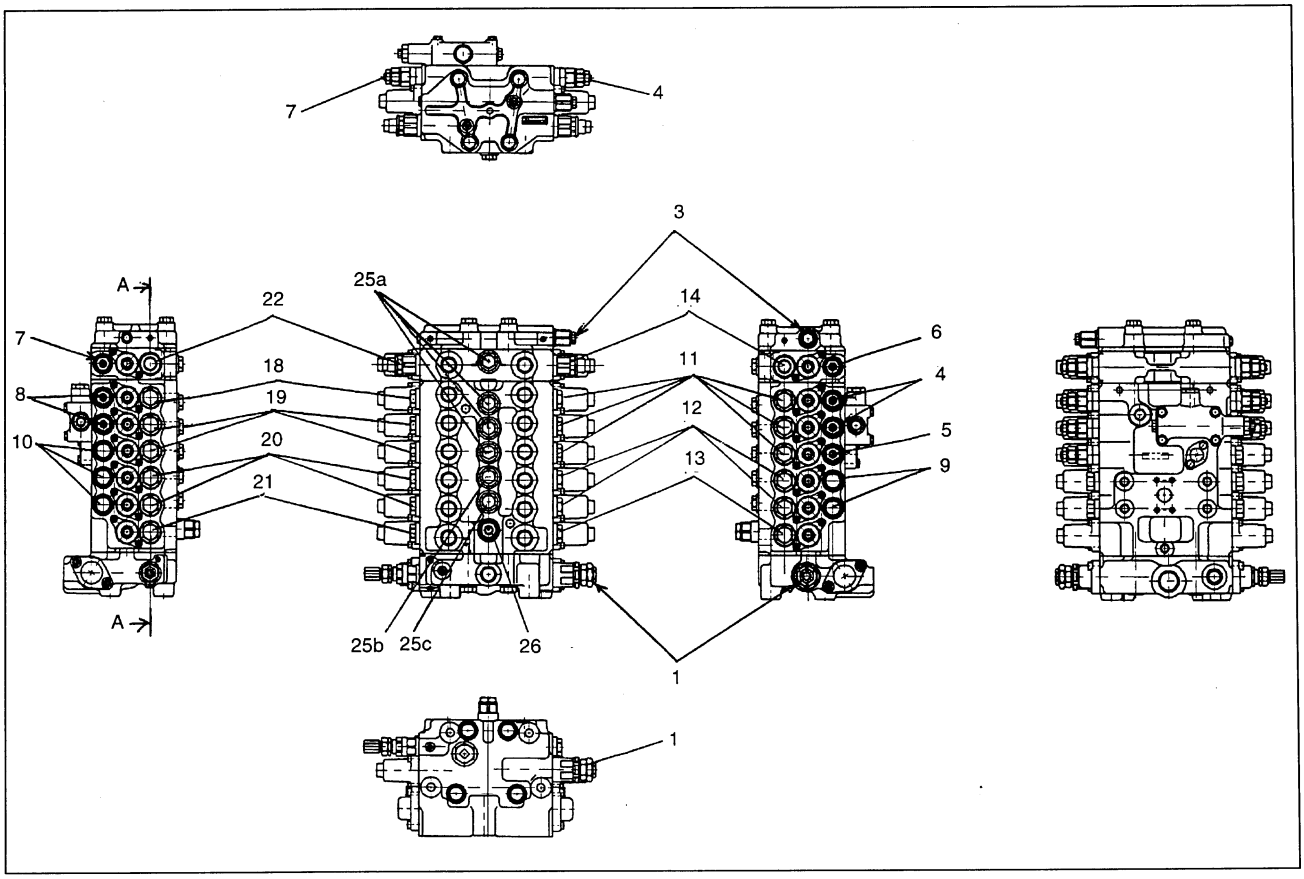
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1

ASSEMBLY OF CONTROL VALVE ASSEMBLY

- Before assembling coat the sliding surface with engine oil.

1. **Cooler bypass valve**
   Assemble sleeve (54), piston (53), and spring (52) to cover (46), then fit O-ring to case (51) and install.
2. **Lift check valve**
   Assemble sleeve (50), piston (49), and spring (48) to cover (46), then fit O-ring to case (47) and install.
3. **Cover, check valve, arm counterbalance valve**
   1) Fit O-rings and install cover (46) and (45).

   kgm Mounting bolt of cover (46):
   277.1 ± 32.3 Nm (28.3 ± 3.3 kgm)

   kgm Mounting bolt of cover (45):
   166.3 ± 10.3 Nm (17 ± 1 kgm)
   ★ Tighten the mounting bolts in the order shown in the diagram.
   2) Assemble check valve (44) and spring (43), then fit O-ring to flange (42) and install.
   3) Fit O-ring to arm counterbalance valve (41) and install.

   kgm Mounting bolt:
   31±3.5 Nm(3.2±0.4 kgm)
   ★ Tighten the mounting bolts in the order shown in the diagram.
4. **Travel control valve, stabiliser control valve**
   1) assemble spool assembly (37) to valve body.
   2) Assemble retainer (40) and spring (39) to spool, then fit O-ring to case (38) and install.
   ★ Check springs (32) and (39), and be careful not to mistake them when installing.

   kgm Mounting bolt:
   11.3± 1.5 Nm (1.2 ± 0.2 kgm)
5. **Bucket control valve, arm control valve, boom control valve, swing control valve**
   1) Assemble spool assembly (30) to valve body.
   2) Assemble retainer (33) and spring (32) to spool, then fit O-ring to case (31) and install.
   ★ Check spring (32) when installing.

   kgm Mounting bolt:
   11.3 ± 1.5 Nm (1.2 ± 0.2 kgm)
   3) Assemble retainer (29) and spring (28) to spool, then fit O-ring to case (27) and install.

   kgm Mounting bolt:
   11.3 ± 1.5 Nm (1.2 ± 0.2 kgm)
6. **LS shuttle valve, LS select valve**
   1) Fit O-ring and install LS select valve (26).

   kgm LS select valve:
   127.5 ± 19.6 Nm (13±2 kgm)
   2) Fit O-rings and install LS shuttle valves (25a) and (25b).

   kgm LS shuttle valve:
   166.7 ± 19.6 Nm (17 ± 2.0 kgm)
   ★ Check valve (25a) and (25b) and be careful not to mistake them when installing.
7. **Pressure compensation valve**
   Check marks made on each pressure compensation valve when disassembling, and install pressure compensation valves in correct position.
   1) Before installing pressure compensation valves below, install check valves (17) and (24).
   2) Fit O-ring, then install swing LEFT pressure compensation valve (21) Right and Left, travel FORWARD pressure compensation valve (20), boom RAISE pressure compensation valve (19), arm OUT pressure compensation valve (19), and bucket DUMP pressure compensation valve (18)
   3) Fit O-ring, then install swing RIGHT pressure compensation valve (13), Right and Left travel REVERSE pressure compensation valve (12), boom LOWER pressure compensation valve (11), arm IN pressure compensation valve (11), and bucket CURL pressure compensation valve (11).

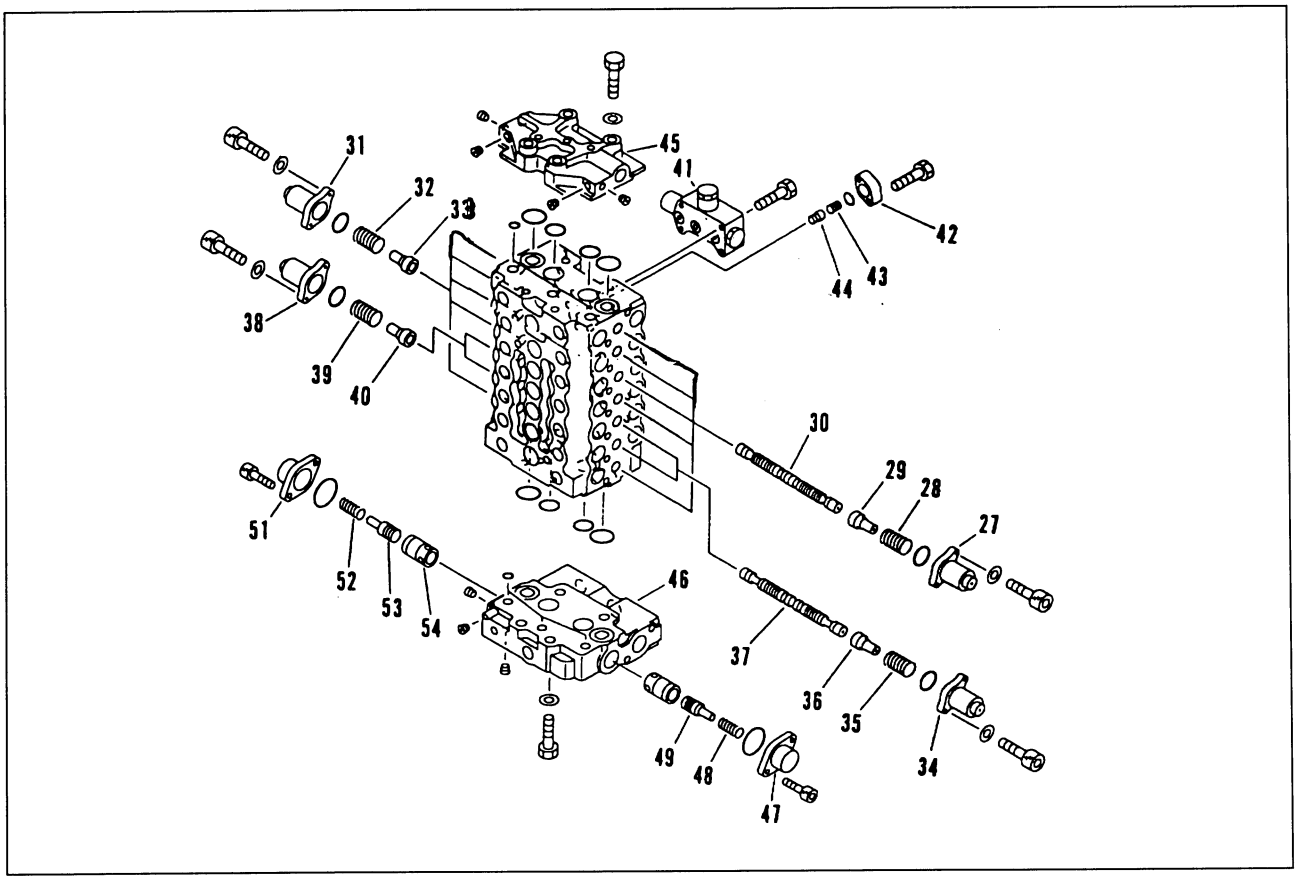
   kgm Pressure compensation valve:
   225.5±19.5 Nm (23±2 kgm)
8. **Suction valves, safety-suction valves, unload valve**
   1) Fit O-rings and install suction valves (10) and (9).

   kgm Suction valve:
   147.1±9.8 Nm (15±1 kgm)
   2) Fit O-rings and install safety-suction valves (8), (7), (6), (5) and (4).

   kgm Safety-suction valve:
   147.1 ± 9.8 Nm (15±1 kgm)
   3) Fit O-ring and install unload valve (3).

   kgm Unload valve :
   166.7±19.7 Nm (17±2 kgm)
9. **Main relief valve**
   1) Fit O-ring and install main relief valve (1).

   kgm Main relief valve:
   98.1±9.8 Nm (10±1 kgm)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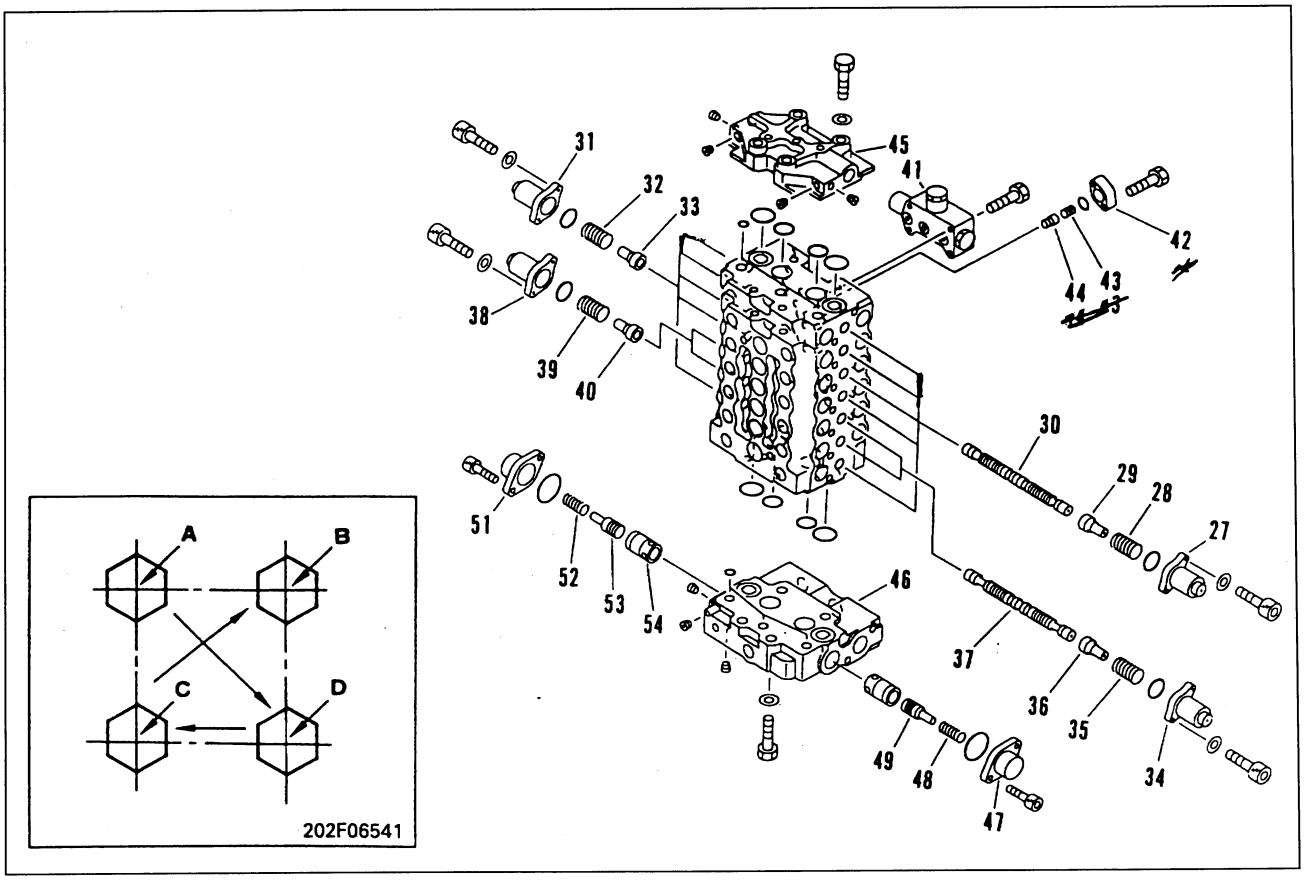
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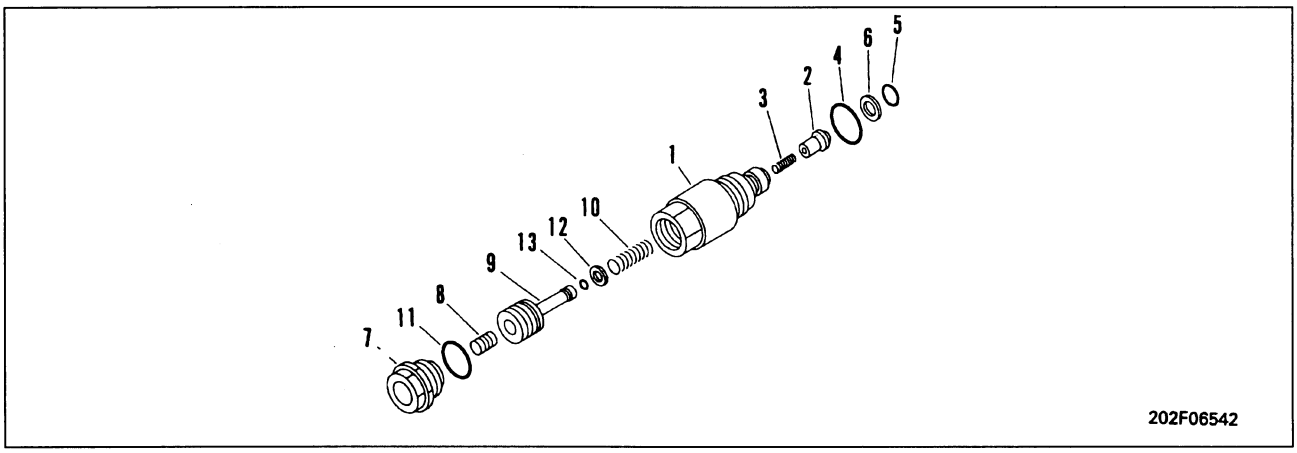
DISASSEMBLY OF LS SELECT VALVE



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

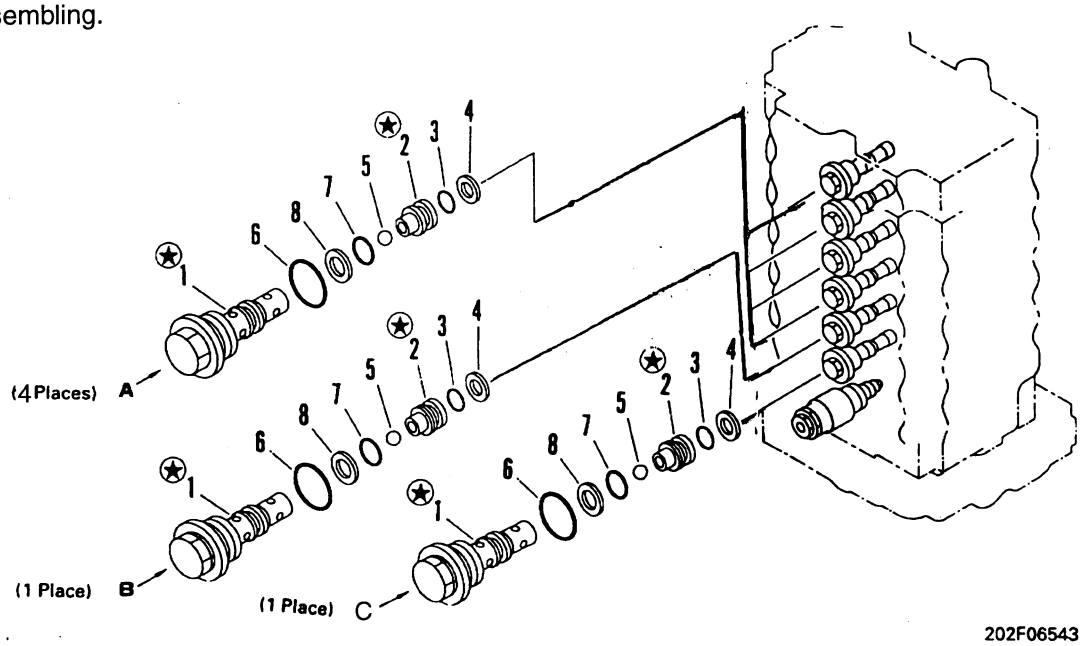
- Before assembling coat the sliding surface with engine oil.

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).

   kgm 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 LS SHUTTLE VALVE

A: LS shuttle valve for work equipment (bucket, arm, boom).
B: LS shuttle valve for right travel C: LS shuttle valve for left travel
★: The structure of the parts is the same, but the parts number for the assembly is different, so be careful when assembling.



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1. Remove seat (2) from plug (1), then remove O-ring (3) and ring (4).
2. Remove ball (5) from plug (1), then remove O-rings (6) and (7), and ring (8).
   ★ After disassembling, if there is any abnormality in plug (1), seat (2), or ball (5), replace the whole LS shuttle valve assembly.

ASSEMBLY OF LS SHUTTLE VALVE

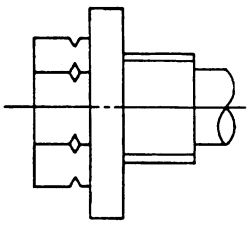
- Before assembling coat the sliding surface with engine oil.

1. Install ring (8) and O-rings (7) and (6) to plug (1).
2. Fit ring (4) and O-ring (3) to seat (2), then assemble ball (5) to plug (1), and install seat (2).

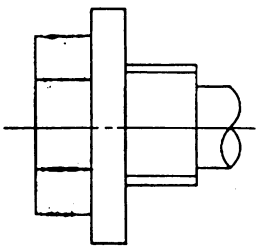
INDENTIFICATION OF LS SHUTTLE VALVE

Shuttle valves are identified by markings on the valve assembly.
Type A - 1 mark
Type B - No mark
Type C - 3 marks

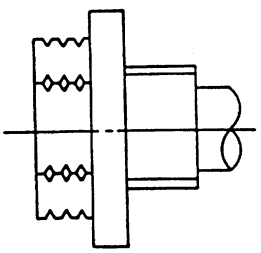
Type A



Type B

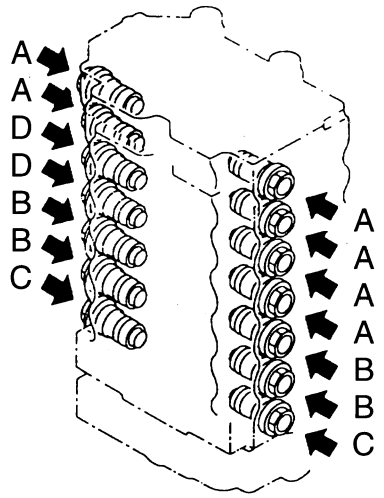


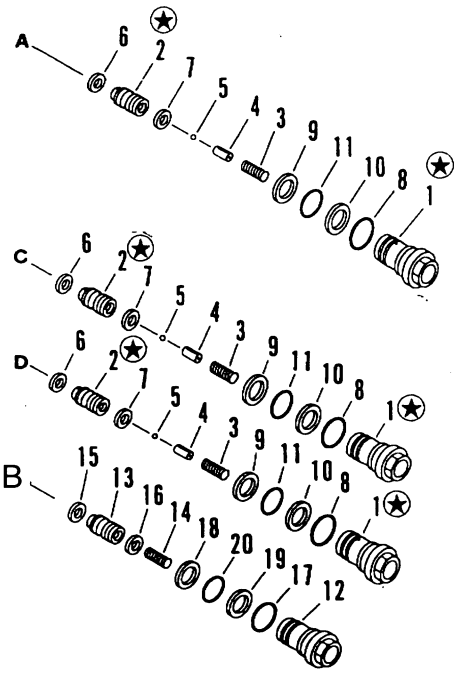
TypeC



DISASSEMBLY OF PRESSURE COMPENSATION VALVE ASSEMBLY

Pressure compensation valves
A: For bucket CURL/DUMP, boom Lower arm IN
C: For swing LEFT/RIGHT
D: For arm OUT, boom RAISE
B: For travel





- **Disassembly of pressure compensation valves A,C,D**
- The structure of the parts for pressure compensation valves A, C en D is the same, but the part number for the assembly marked ★ is different, so be careful when assembling.

1. Remove piston (2) and spring (3) from sleeve (1).
2. Remove plug (4) and ball (5) form piston (2).
3. Remove seals (6) and (7) from piston (2).
4. Remove O-ring (8) from sleeve (1), then remove seals (9) and (10), and O-ring (11).

* After disassembling, if there is any abnormality in sleeve (1), piston (2), plug (4), ball (5), or seals (6) and (7), replace the whole pressure compensation valve assembly.

- **Disassembly of pressure compensation valve B**

1. Remove piston (13) and spring (14) from sleeve (12).
2. Remove seals (15) and (16) from piston (13), then remove O-ring (17), seals (18) and (19), and O-ring (20) from sleeve (12).

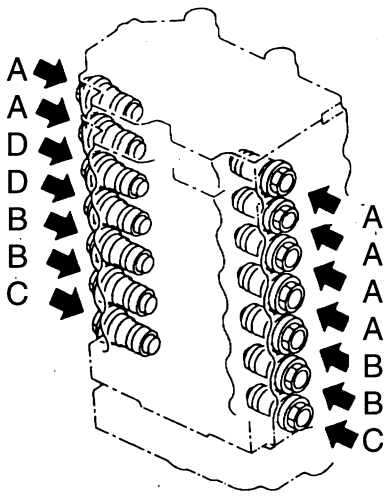
* After disassembling, if there is any abnormality in sleeve (12), piston (13), or seals (15) and (16), replace the whole pressure compensation valve assembly.

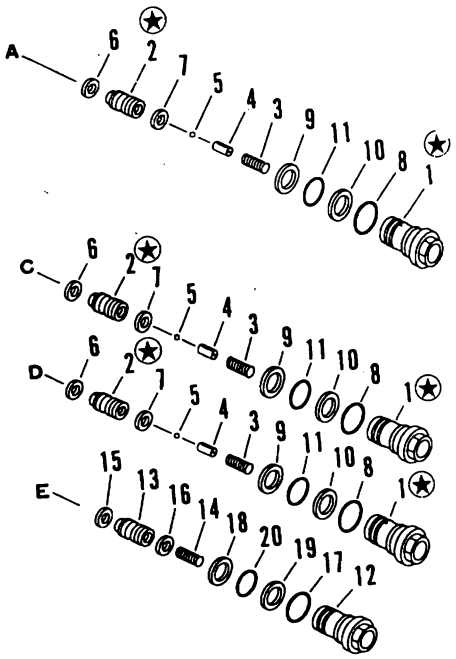
IDENTIFICATION OF PRESSURE COMPENSATION VALVE ASSEMBLY

Valves are identified by markings on the valve assembly.
Type A - 1 mark.
Type C - 3 marks.
Type D - 4 marks.
Type B - No mark.

ASSEMBLY OF PRESSURE COMPENSATION VALVE ASSEMBLY

Pressure compensation valves
A: For bucket CURL/DUMP, boom Lower, arm IN.
C: For swing LEFT/RIGHT
D: For arm OUT, boom RAISE
B: For travel





- Before assembling coat the sliding surface with engine oil.

- **Assembly of pressure compensation valve B**

1. Install O-rings (17) and (20), and seals (19) and (18) to sleeve (12).

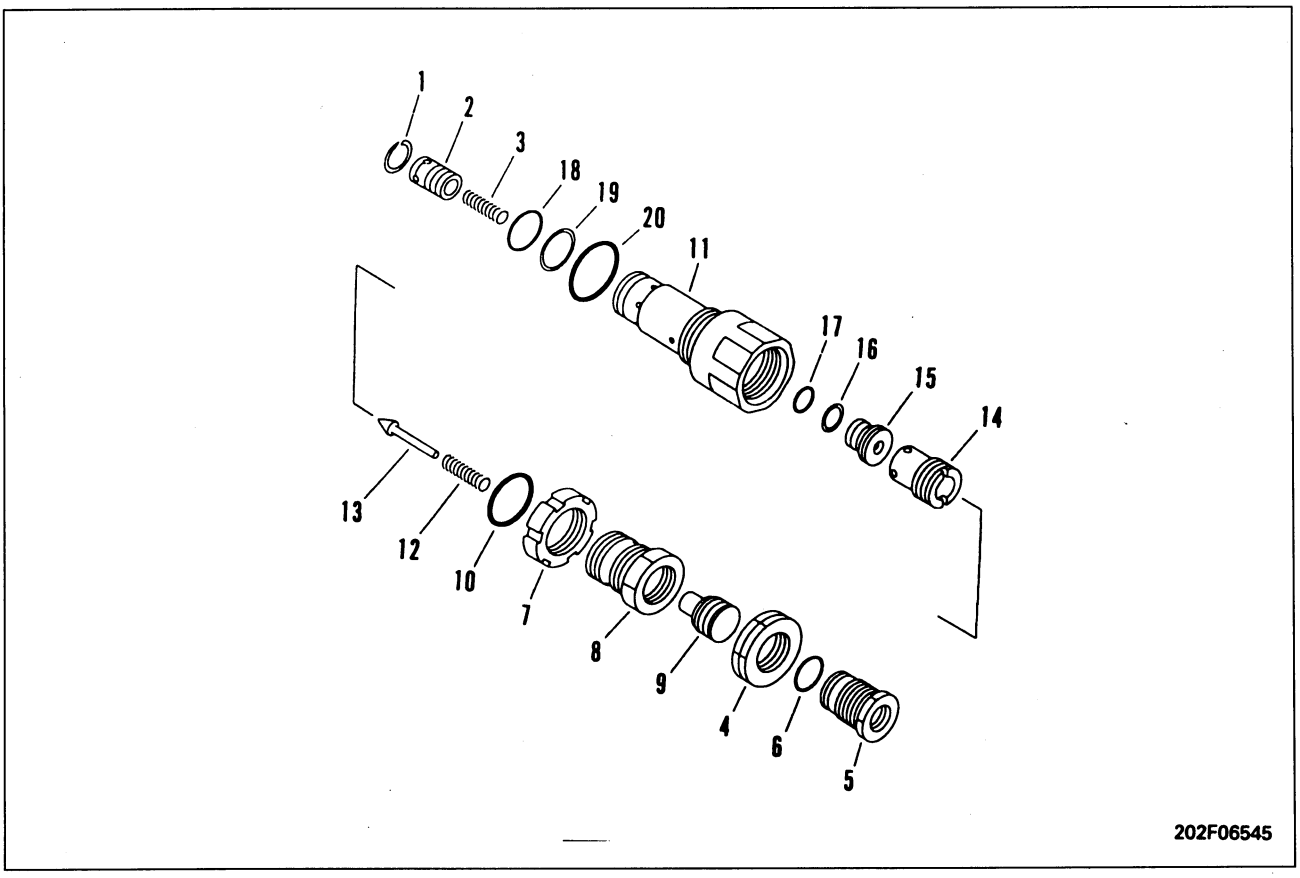
2. Fit seals (16) and (15) to piston (13), then assemble spring (14) and install to sleeve (12).

- **Assembly of pressure compensation valves A, C , D**

1. Install O-rings (8) and (11), and seals (10) and (9) to sleeve (1).

2. Fit seals (7) and (6) to piston (2), then assemble ball (5), plug (4), and spring (3), and insall to sleeve (1).

DISASSEMBLY OF MAIN RELIEF VALVE ASSEMBLY



1. Remove ring (1), then remove valve (2) and spring (3).

2. Loosen nut (4) and remove plug (5), then remove O-ring (6) and nut (4) from plug (5).

3. Loosen nut (7) and remove holder (8), then remove retainer (9), O-ring (10), and nut (7) from holder (8).

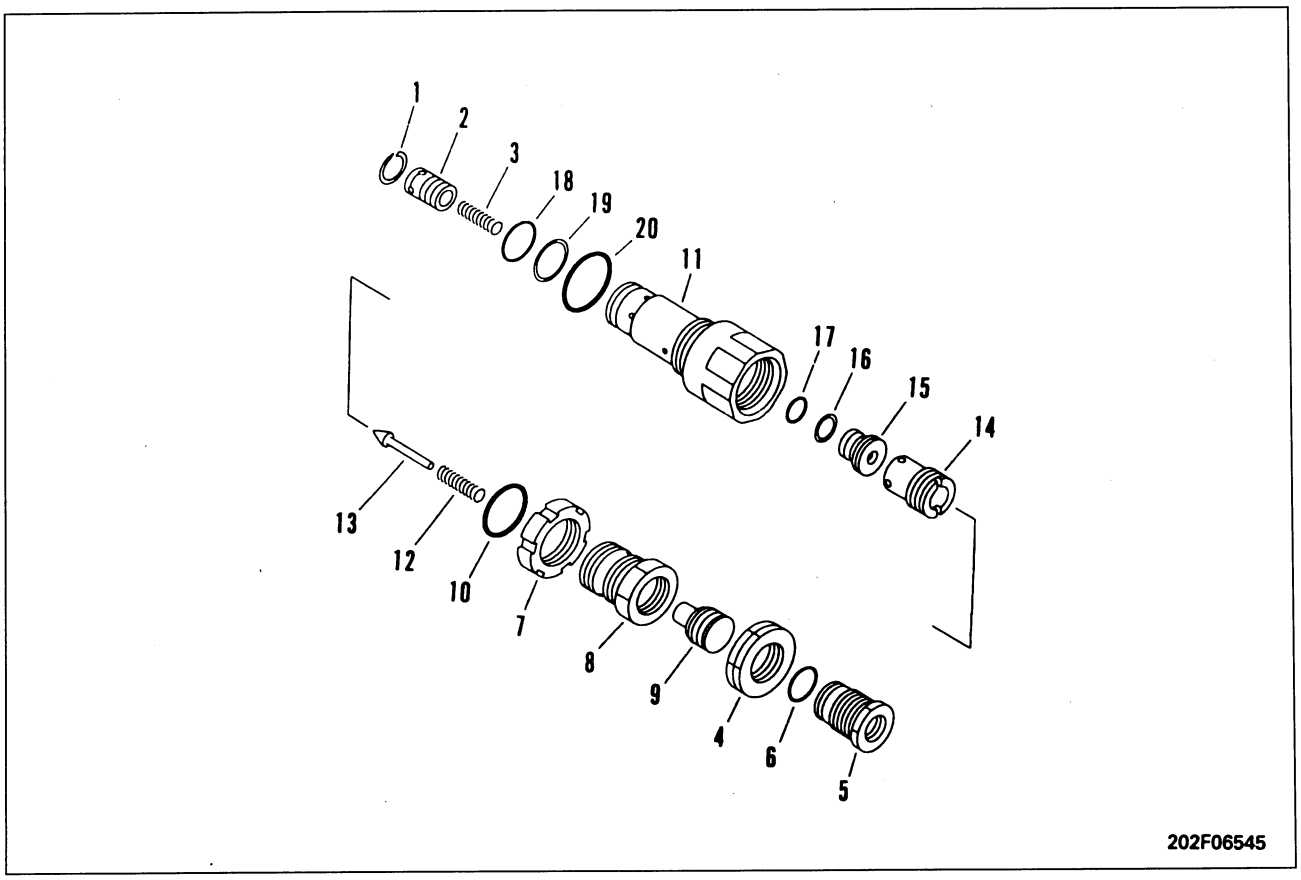
4. Remove spring (12) and poppet (13) from sleeve (11), then remove sleeve (14) and seat (15).

5. Remove ring (16) and O-ring (17) from seat (15).

6. Remove O-ring (18), seal (19), and O-ring (20) from sleeve (11).

★ After disassembling, if there is any abnormality in valve (2), holder (8), retainer (9), sleeve (14), seat (15), ring (16), O-ring (17), or sleeve (11), replace the whole main relief valve assembly.

ASSEMBLY OF MAIN RELIEF VALVE ASSEMBLY



- Before assembling coat the sliding surface with engine oil.

1. Install O-ring (17) and ring (16) to seat (15), and assemble sleeve (11).
2. Assemble sleeve (14) to sleeve (11).
3. Install nut (7) and O-ring (10) to holder (8), then assemble retainer (9), poppet (13), and spring (12), and install to sleeve (11).
   ★ Set contact surface of seat (15) and poppet (13) in position securely.
4. Assemble nut (4) and O-ring (6) to plug (5), and install to holder (8).
5. Assemble spring (3) and valve (2) to sleeve (11), and install ring (1).
6. Install O-rings (20) and (18), and seal (19) to sleeve (11).
7. Tighten nut (7) to specified torque.

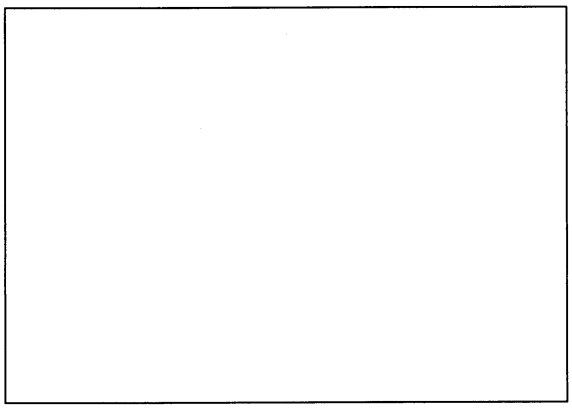
kgm Nut: 58.8±4.9 Nm (6±0.5 kgm)

8. Tighten nut (4) to specified torque.

kgm Nut: 44.1±4.9 Nm (4.5±0.5 kgm)

★ After installing to the control valve assembly, adjust the pressure.
For details, see TESTING AND ADJUSTING, Testing and adjusting oil pressure of work equipment, swing, travel circuits.

REMOVAL OF LS CONTROL EPC VALVE ASSEMBLY



1. Remove cover.
2. Disconnect wiring connector (1).
3. Disconnect hose (2).
4. Remove LS control EPC valve assembly (3). [※ 1]

INSTALLATION OF LS CONTROL EPC VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

[※ 1]

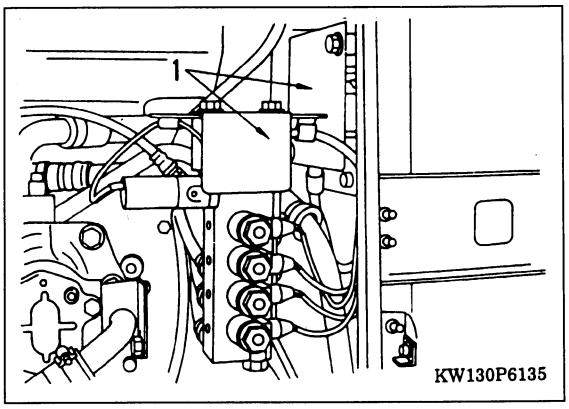
kgm LS control EPC valve mounting bolt:
11.3±1.5 Nm(1.15±0.15 kgm)

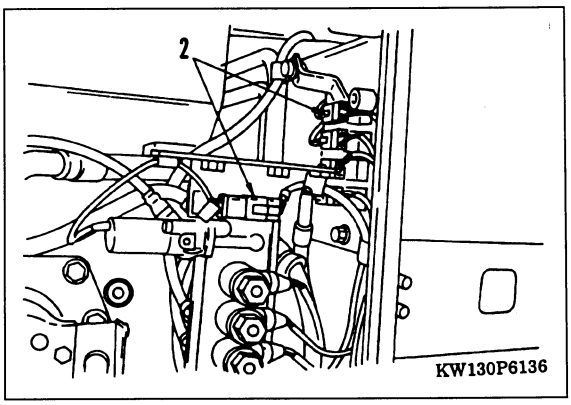
REMOVAL OF SOLENOID VALVE ASSEMBLY

⚠ Disconnect the cable from the negative (-) terminal of the battery.

1. Open R.H. side cover.
2. Remove wiring connector cover (1).
3. Remove 5 solenoid wiring connectors (2) from clip, then disconnect.
   ★ Mark the male and female ends of each connector with tags to prevent mistakes when connecting.
4. Disconnect 10 hoses (3).
   ★ Fit tags on the hoses.
5. Remove mounting bolts, then remove solenoid valve assembly (4).

- When removing solenoid valve as an individual part Remove mounting nut (5), then remove solenoid valve (6). ※ 1





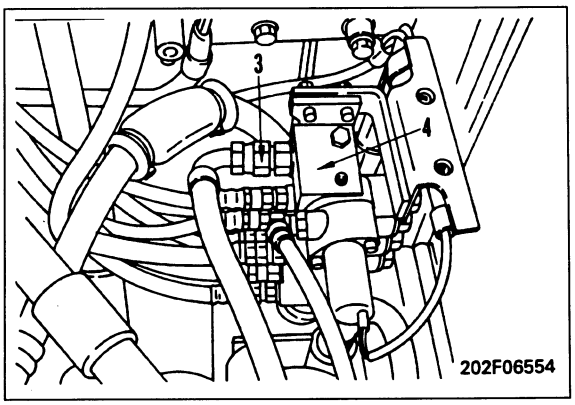
INSTALLATION OF SOLENOID VALVE ASSEMBLY

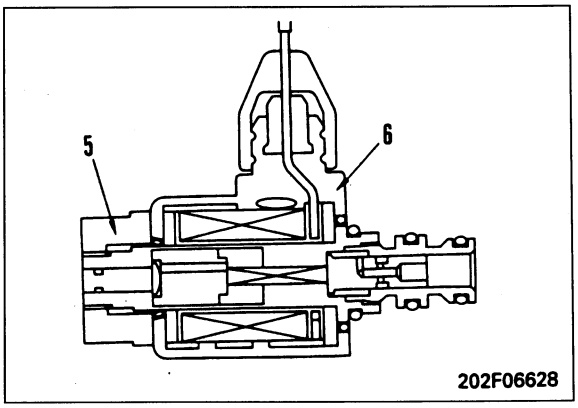
- Carry out installation in the reverse order to removal.

※ 1

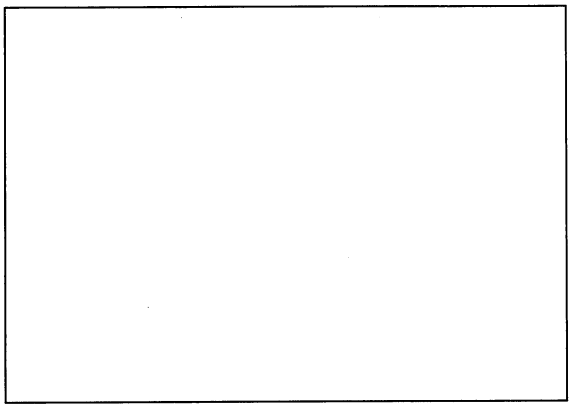
kgm Mounting nut (5):
4.9±0.98 Nm (0.5±0.1 kgm)

kgm Solenoid valve (6) (individual part):
39.2±9.8 Nm (4±1 kgm)



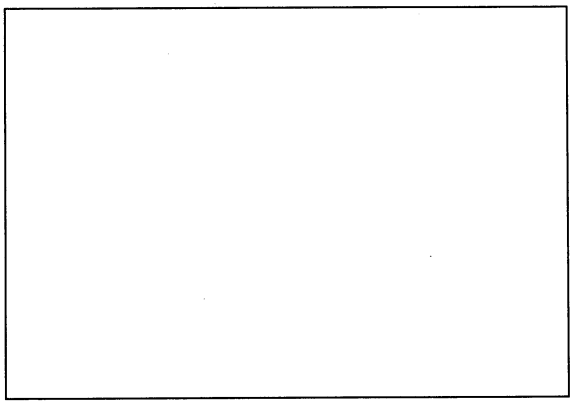


REMOVAL OF PPC SHUTTLE VALVE ASSEMBLY

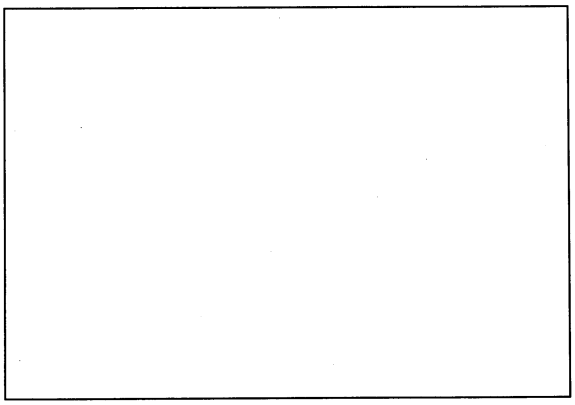


⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

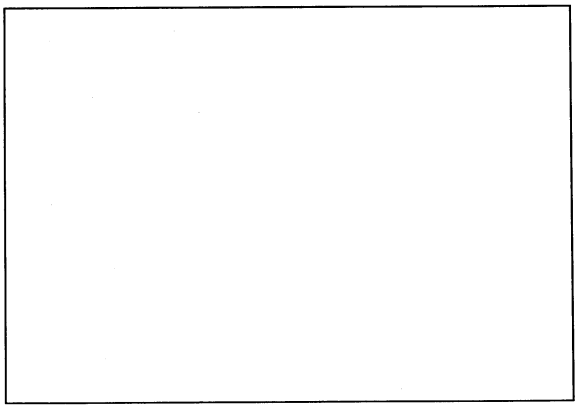
1 Disconnect the cable from the negative (-) terminal of the battery.
- ★ Make match marks at the male and female ends of the oil pressure switch connectors.
- ★ Before disconnecting any hoses, check the distinguishing tape stuck to the hose, or make match marks.



1. Disconnect 8 oil pressure switch connectors (1).
2. Disconnect 12 PPC hoses (2). ※ 1

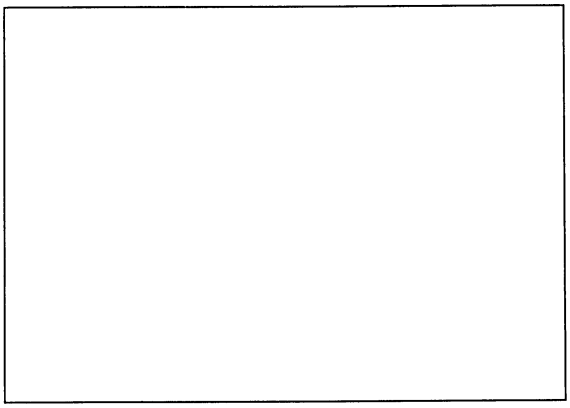


3. Disconnect 15 control valve hoses (3) (quick joint connection). ※ 1



4. Disconnect 4 straight-travel hoses (4).
   - ★ The elbows on the front two hoses are long, so hold the elbow with a wrench when disconnecting the hoses.

5. Disconnect clamp (5).
6. Remove mounting bolts, then remove PPC shuttle valve assembly (6).



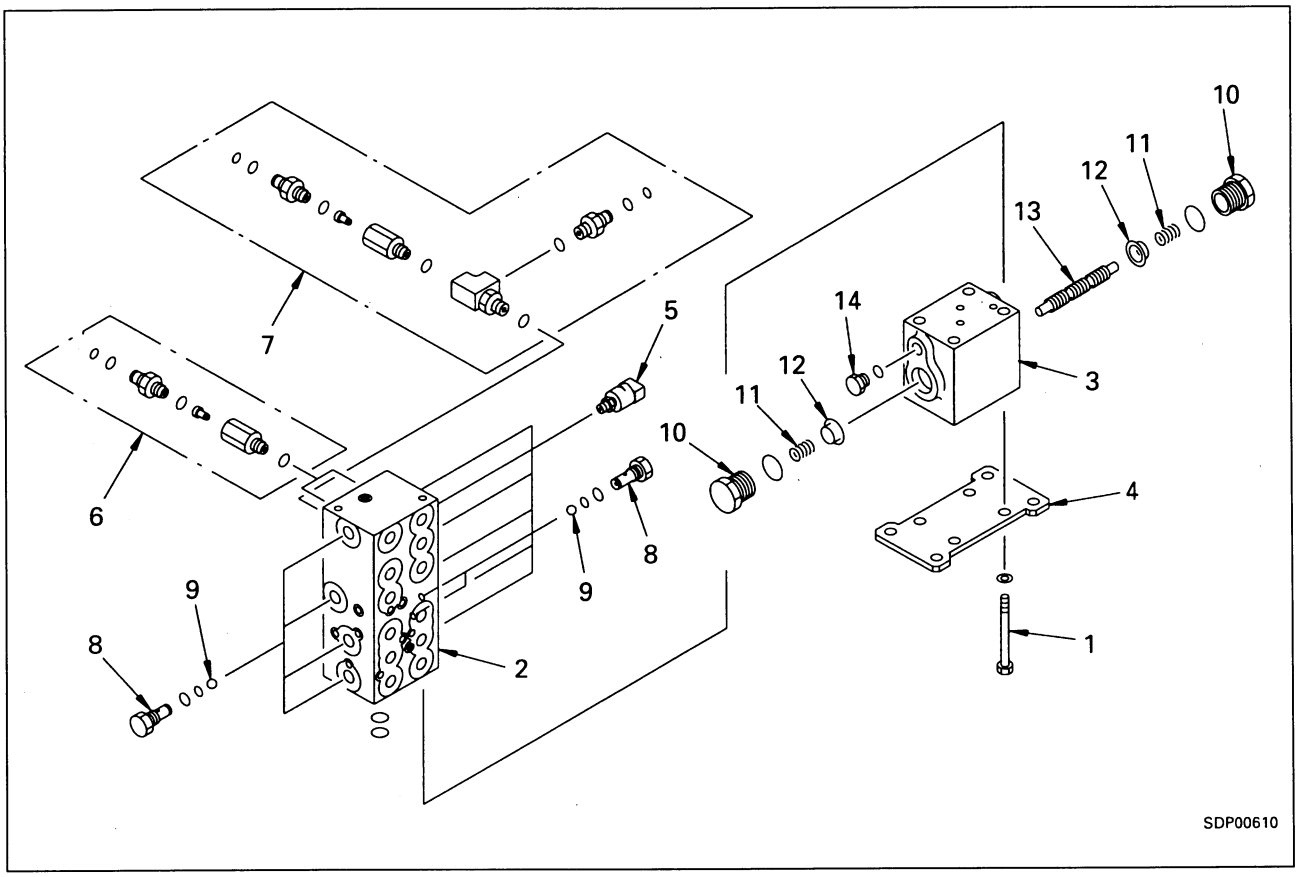
INSTALLATION OF PPC SHUTTLE VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

[※ 1]

- Check that the quick joint does not come out when the hose is pulled.
- **Refilling with oil (hydraulic tank)**
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

DISASSEMBLY OF PPC SHUTTLE VALVE ASSEMBLY

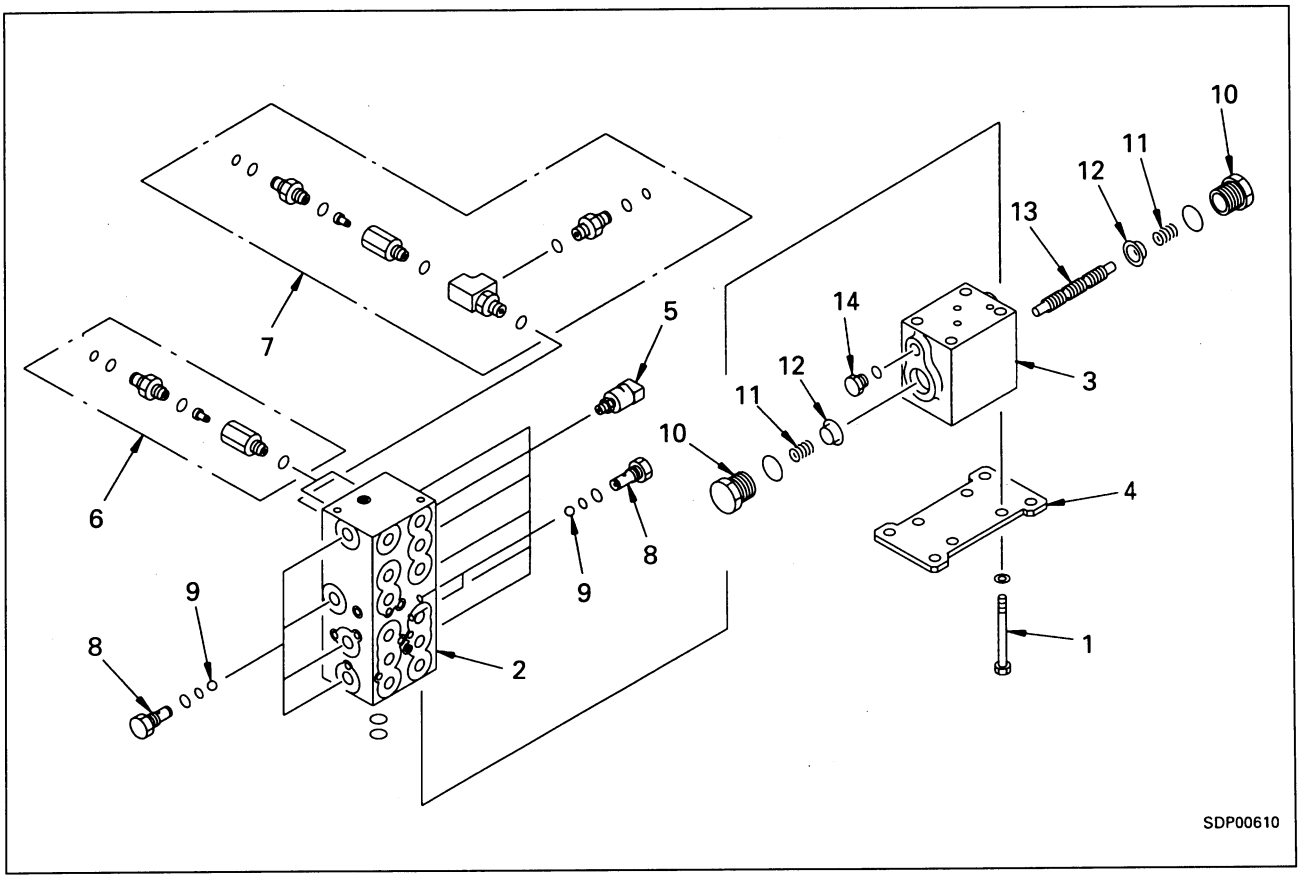


1. **Disconnection of valve**
   Remove mounting bolts (1), and disconnect shuttle valve assembly (2), travel junction valve assembly (3) and plate (4).

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.

3. **Disassembly of travel junction valve assembly**
   1) Remove 2 each of plug (10), spring (11), and retainer (12).
   2) Remove spool (13).
   3) Remove 2 plugs (14).

ASSEMBLY OF PPC SHUTTLE VALVE ASSEMBLY



1. **Assembly of travel junction vlave assembly.**
   1) Fit O-ring and install 2 plugs (14).
      kgm Plug:
      17.16±2.45 Nm (1.75±0.25 kgm)
   2) Assemble spool (13), and install 2 retainers (12) and springs (11).
   3) Fit O-ring and install 2 plugs (10).
      kgm Plug:
      107.9±14.7 Nm (11.0 ± 1.5 kgm)

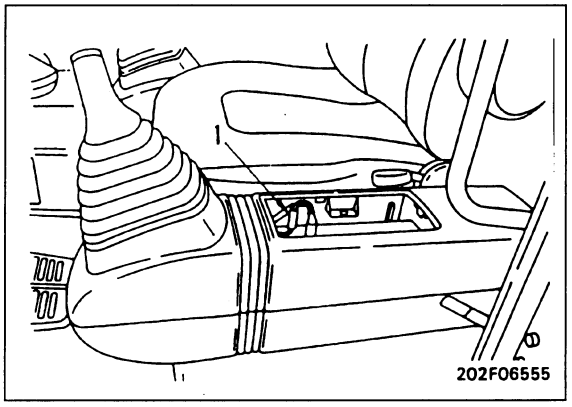
2. **Assembly of shuttle valve assembly**
   1) Fit O-ring and assemble balls (9), then install plugs (8).
   ★ There are 6 plugs and 6 balls.
      kgm Plug:
      34.3 ± 4.9 Nm (3.5 ± 0.5 kgm)
   2) Fit O-ring and install shuttle valve (7).
      ★ If the shuttle valve has been disassembled, be careful of the direction of installation of the poppet when assembling.
   3) Fit O-ring and install 2 slow return valves (6).
      ★ If the slow return valve has been disassembled, be careful of the direction of installation of the poppet when assembling.
   4) Install 8 oil pressure switches (5).

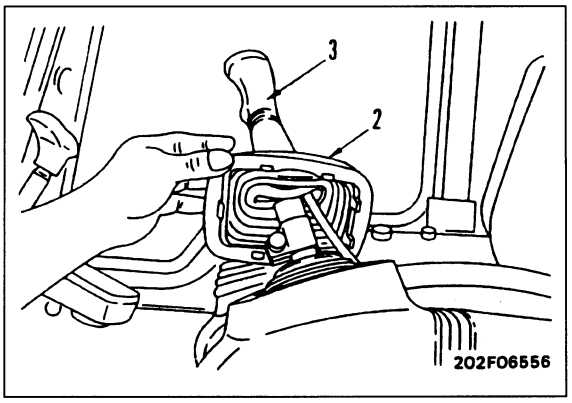
3. **Connection of valve**
   Fit O-ring and assemble shuttle valve assembly (2), travel junction valve assembly (3) and plate (4), then tighten mounting bolts (1).
   kgm Mounting bolt:
   66.19±7.35 Nm (6.75±0.75 kgm)

REMOVAL OF WORK EQUIPMENT • SWING PPC VALVE ASSEMBLY

⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap solwly to release the pressure inside the hydraulic tank.

1. Remove armrest and rubber boot, remove cover, and disconnect wiring connector (1).
2. Remove boot (2) from cover, raise boot, then remove lever (3).
   ★ Mark the mounting position of the lever before removing.
3. Remove 4 mounting bolts (5) of cover (4), then remove.
   ★ Remove the lock with a screwdriver and gradually lift the cover up to remove.
4. Remove joint bolt (6), and disconnect hose (7). ※ 1
5. Remove mounting bolts, raise PPC valve assembly (8). Then disconnect hoses (9) and (10), and remove. ※ 2
   ★ Mark the connecting position of the hoses before disconnecting.





INSTALLATION OF WORK EQUIPMENT • SWING PPC VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

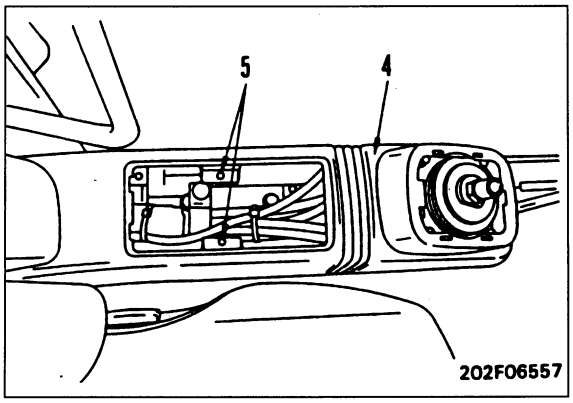
※ 1

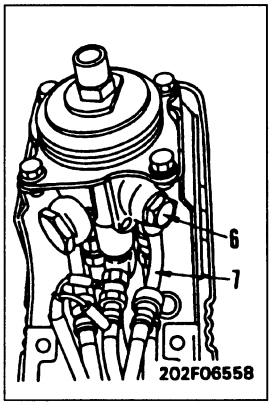
kgm Hose mounting joint bolt:
29.4±4.9 Nm (3.0±0.5 kgm)

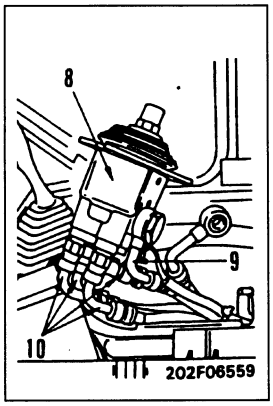
※ 2

kgm Hose mounting joint bolt:
39.2±4.9 Nm (4.0±0.5 kgm)

★ If there is excessive play in the control levers, adjust the PPC valve. for details, see TESTING AND ADJUSTING, Adjusting PPC valve.



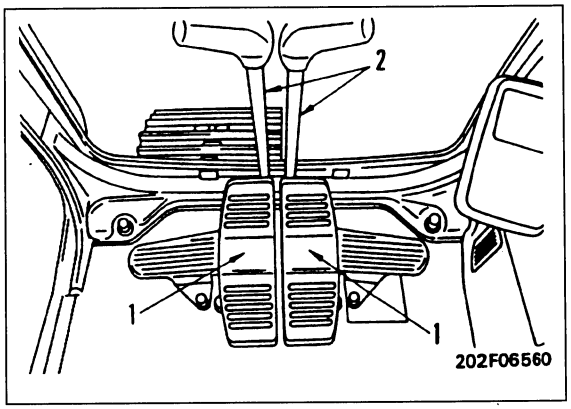


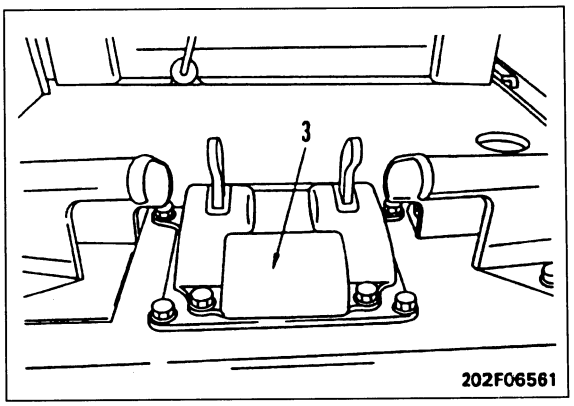


REMOVAL OF TRAVEL PPC VALVE ASSEMBLY

⚠ Lower the work equipment completely to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then set the safety lock lever to the LOCK position.

1. Remove floor mat.
2. Remove travel PPC valve bottom cover.
3. Remove pedals (1) and levers (2). ※ 1
4. Remove cover (3). ※ 2
5. Remove covers (4), then remove springs (5).
6. Disconnect 6 PPC Hoses (7), and remove travel PPC valve assembly (8). ※ 4





INSTALLATION OF TRAVEL PPC VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

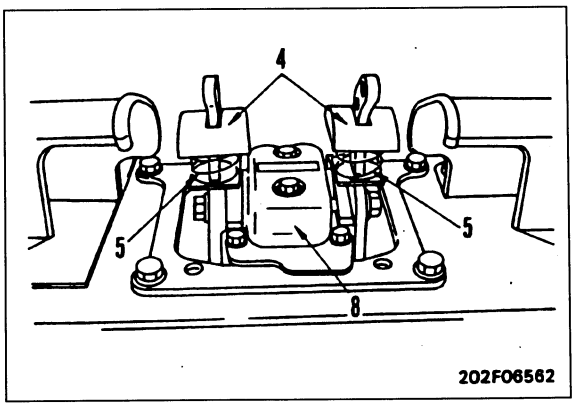
※ 1
★ Adjust the travel lever. For details, see TESTING AND ADJUSTING, Adjusting travel lever.

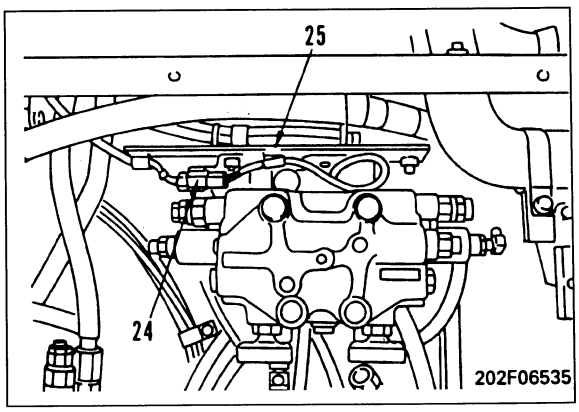
※ 2
kgm Cover mounting bolt: 19.6±2 Nm (2.0±0.2 kgm)

※ 3
Sliding portion of pin: Grease (G2-LI)

※ 4
kgm Hose mounting joint bolt (width across flats: 30 mm): 39.2 ± 4.9 Nm (4.0 ± 0.5 kgm)

kgm Hose mounting joint bolt (width across flats: 22 mm) 29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)





DISASSEMBLY OF TRAVEL PPC VALVE ASSEMBLY

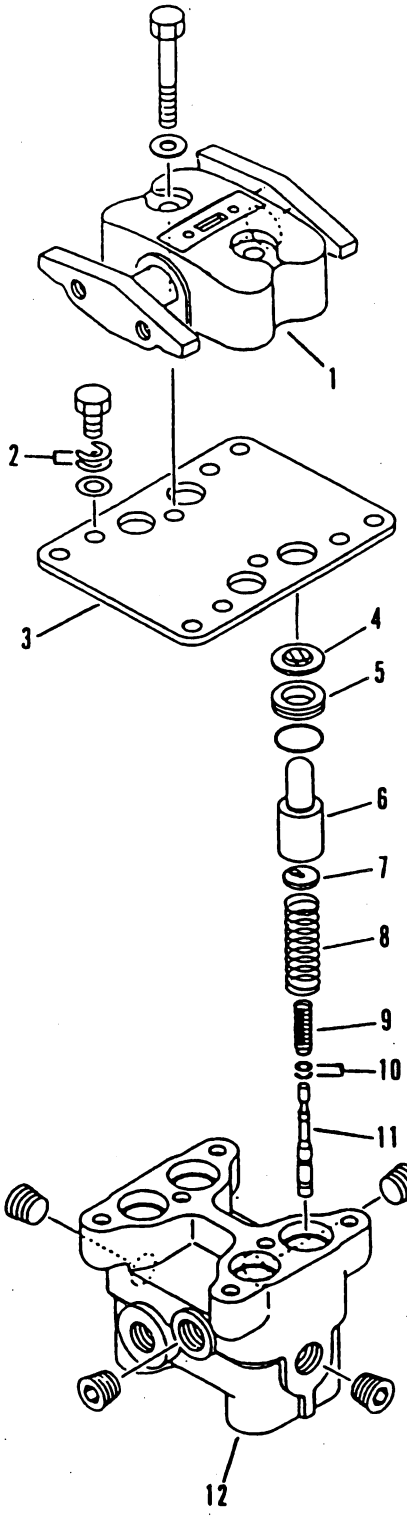
1. Remove cover and cam assembly (1), then remove shims (2).
   ★ Check the number and thickness of shims (2) for each mounting position, and keep in a safe place.
2. Remove plate (3).
3. Remove seal (4) and collar (5).
4. Pull out piston (6), and remove retainer (7), springs (8) and (9), and shims (10).
   ★ Check the number and thickness of shims (10) for each mounting position, and keep in a safe place.
5. Pull out valve (11) from body (12).

ASSEMBLY OF TRAVEL PPC VALVE ASSEMBLY

1. Assemble valve (11) in body (12).
2. Assemble shims (10) and spring (9) to valve (11).
   ★ Assemble the same number and thickness of shims (10) as was removed during disassembly. Standard shim thickness: 0.3 mm
   ★ Spring (9) is not symmetrical at the top and bottom, so assemble with the small coil diameter (inside diameter) at the shim end.
3. Assemble spring (8), retainer (7), and piston (6).

   Outside circumference of piston, body hole: Grease (G2-LI)
4. Fit O-ring to collar (5) and assemble in body (11), then install seal (4).
5. Assemble plate (3).
6. Fit cover and cam assembly (1) and assemble shims (2), then tighten with bolt.

   Sliding portion of shaft, connecting portion of lever and piston: Grease (G2-LI)



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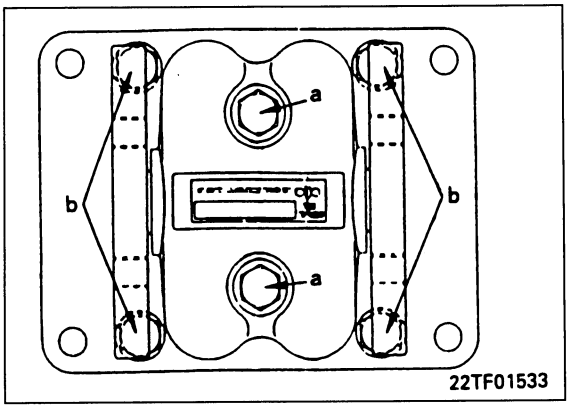
★ Assemble the same number and thickness of shims (2) as was removed during disassembly.
Standard shim thickness: 1,6 mm

kgm Mounting bolt (a):
27.9 ± 3.4 Nm (2.85±0.35 kgm)

kgm Mounting bolt (b):
30.9 ± 3.4 Nm (3.15 ± 0.35 kgm)



REMOVAL OF BOOM CYLINDER ASSEMBLY

⚠ Extend the arm and bucket fully, lower the work equipment completely to the ground, and put the safety lock lever in the LOCK position.

1. Disconnect grease hose (1).

2. Sling boom cylinder assembly (2), and remove lock bolt (3). ※ 1

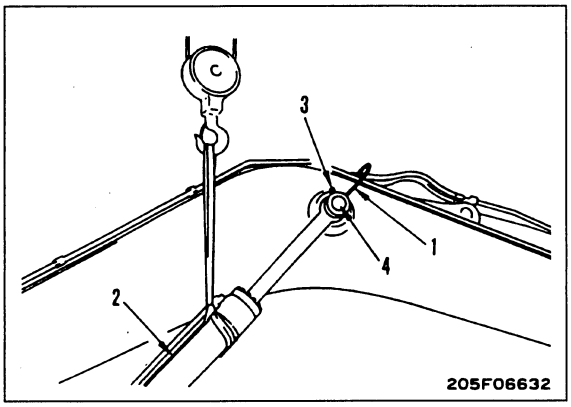
3. Remove plate, then remove head pin (4). ※ 2
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

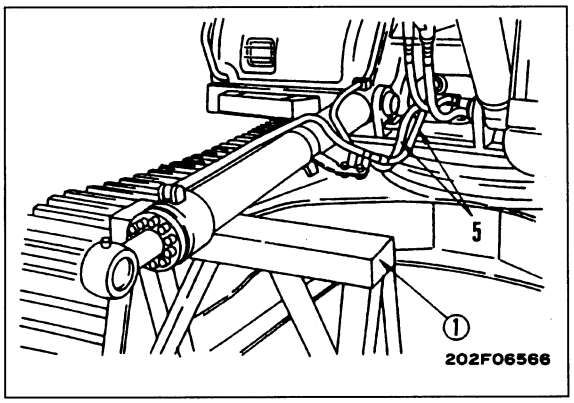
4. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out.
   ★ Set stand ① under the cylinder assembly, and adjust the positon for slinging.
   ⚠ Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.

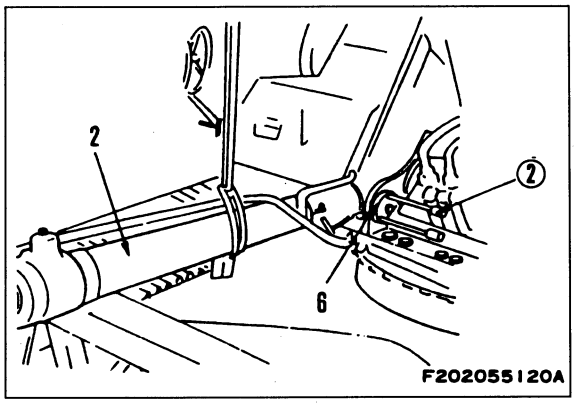
5. Disconnect hoses (5).

6. Remove plate, then using forcing screws ②, remove bottom pin (6), and remove boom cylinder assembly (2). ※ 3
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

kg Boom cylinder assembly 135 kg





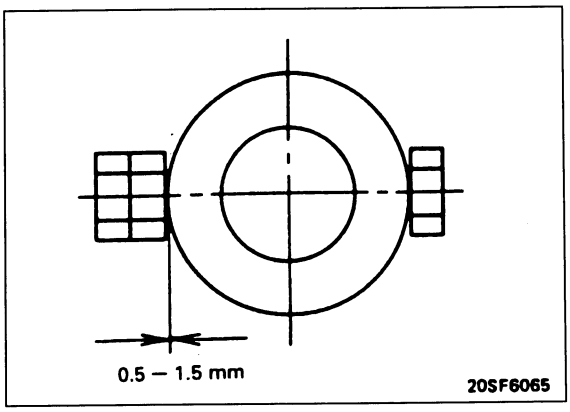


INSTALLATION OF BOOM CYLINDER ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

★ When tightening the locknut, tighten so that the clearance between the plate and nut is 0.5 - 1.5 mm.



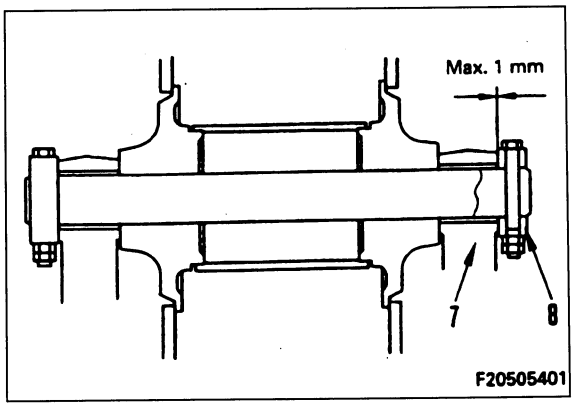
※ 2

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Greasing after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between cylinder rod (7) and plate (8) is below 1 mm.
★ Standard shim thickness: 0.5 mm, 1.0 mm



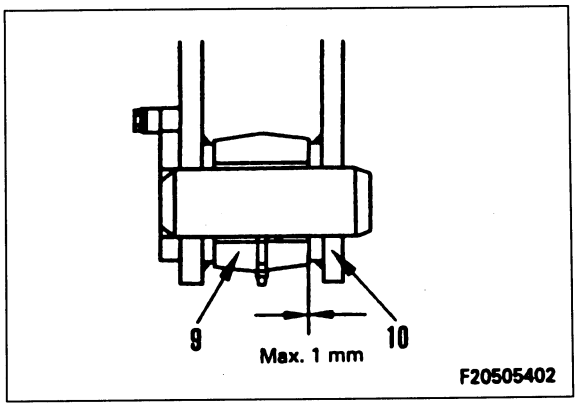
※ 3

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Greasing after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

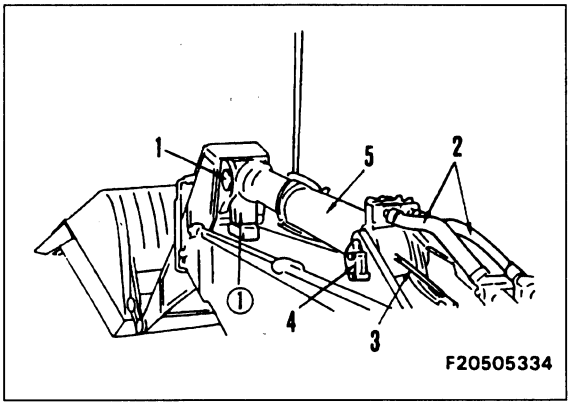
★ Adjust the shim thickness so that the clearance between cylinder bottom (9) and bracket (10) is below 1 mm.
★ Standard shim thickness: 0.8 mm, 1.5 mm



- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air
  ★ Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.

REMOVAL OF ARM CYLINDER ASSEMBLY

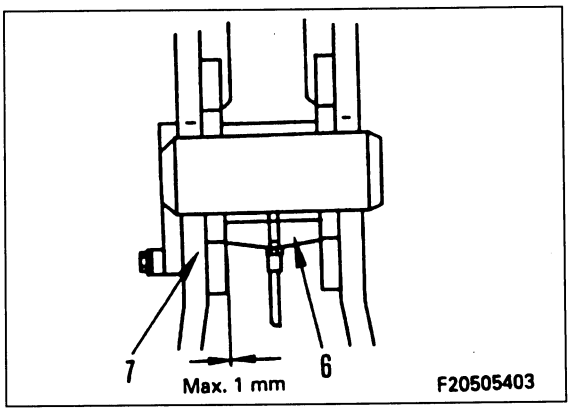


⚠ Extend the arm cylinder piston rod approx. 200 mm, lower the work equipment completely to the ground, then set the remaining safety lock lever to the LOCK position.

1. Set block ① between arm cylinder and boom.
2. Remove plate, then remove head pin (1). ❄ 1
3. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out.
   ⚠ Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.
4. Disconnect hoses (2).
5. Disconnect grease hose (3).
6. Raise arm cylinder assembly, remove plate, remove bottom pin (4), then remove arm cylinder assembly (5). ❄ 2
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

   kg Arm cylinder assembly 200 kg

INSTALLATION OF ARM CYLINDER ASSEMBLY



- Carry out installation in the reverse order to removal.

[※ 1]

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Greasing after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

[※ 2]

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Greasing after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between cylinder bottom (6) and bracket (7) is below 1 mm.
  ★ Standard shim thickness: 0.8 mm, 1.5 mm

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

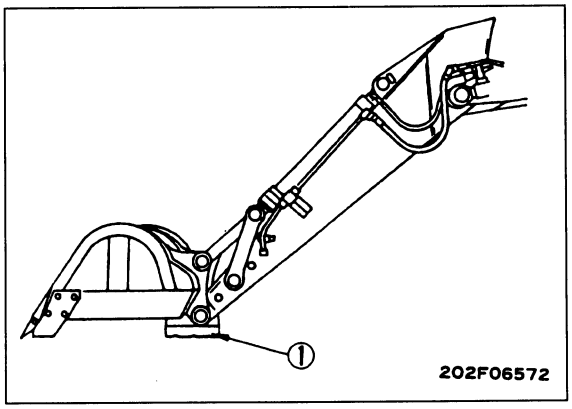
- Bleeding air
  ★ Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.

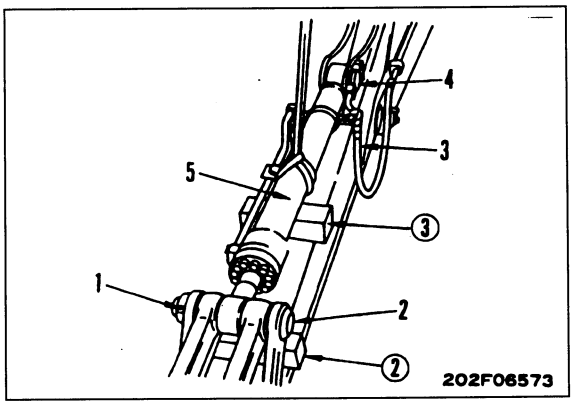
REMOVAL OF BUCKET CYLINDER ASSEMBLY

⚠ Extend the bucket cylinder piston rod approx. 200 mm, lower the work equipment completely to the ground, then set the safety lock lever to the LOCK position.

1. Set block ① under arm top.
2. Set block ② between link and arm, and block ③ between bucket cylinder and arm.
3. Remove lock bolt (1). ❄ 1
4. Remove plate, then remove head pin (2). ❄ 2
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.
5. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out.
   ⚠ Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.
6. Disconnect 2 hoses (3).
7. Raise bucket cylinder assembly, remove plate, remove bottom pin (4), then remove bucket cylinder assembly (5). ❄ 3
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

kg Bucket cylinder assembly: 130 kg





INSTALLATION OF BUCKET CYLINDER ASSEMBLY

- Carry out installation in the reverse order to removal.

[※ 1]

★ When tightening the locknut, tighten so that the clearance between the plate and nut is 0.5 - 1.5 mm.

[※ 2]

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between link (6) and link (7) is below 1 mm.

[※ 3]

★ Standard shim thickness: 0.8 mm, 1.5 mm

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)

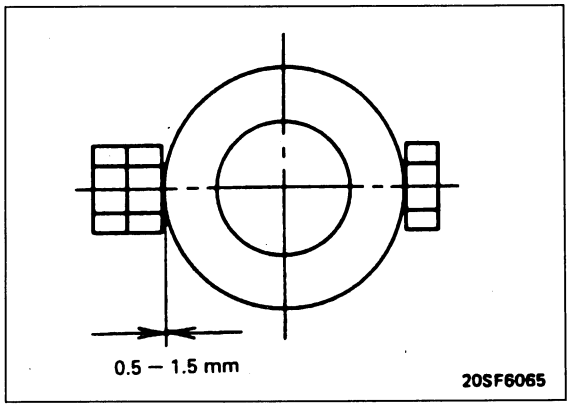
⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

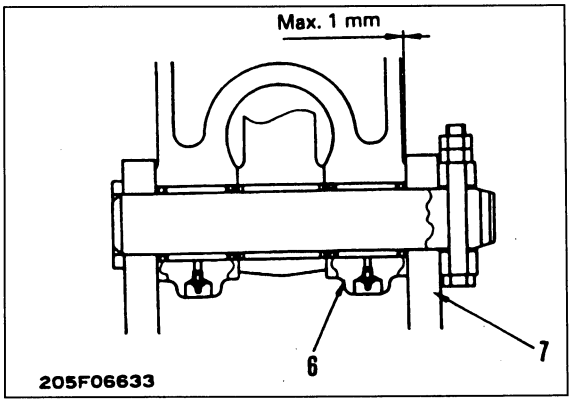
★ Adjust the shim thickness so that the clearance between cylinder bottom (8) and bracket (9) is below 1 mm.

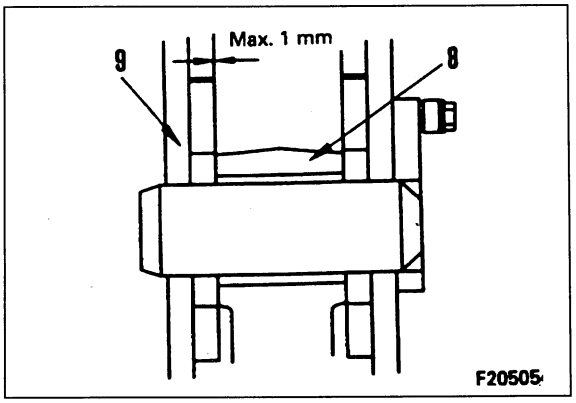
★ Standard shim thickness: 0.8 mm, 1.5 mm

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air
  ★ Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.







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.

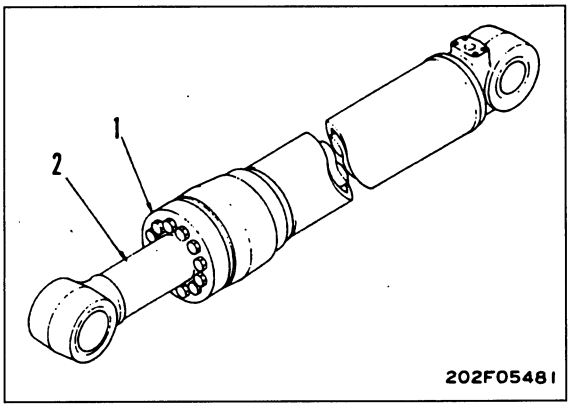
   4) Disassemble piston rod assembly as follows.
      i) Set piston rod assembly (2) in tool **O1**.
      ii) Using tool **O2**, remove nut (3).
         ★ Width across flats of nut

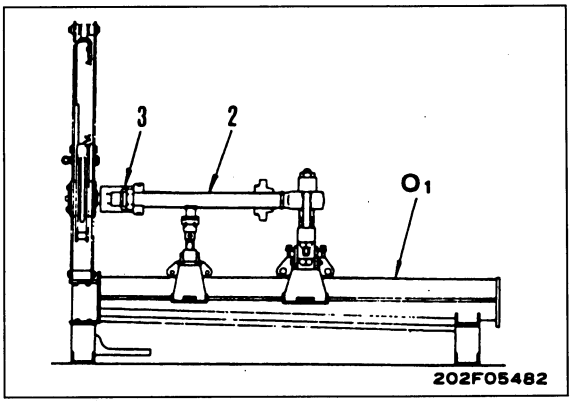
Unit: mm

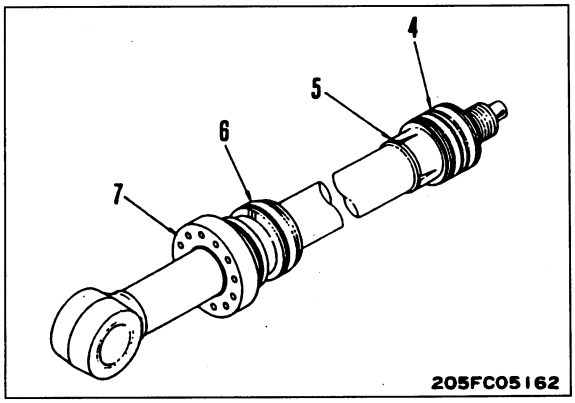
Model \ Cylinder	Boom	Arm	Bucket
PC180/PC160	75	85	75

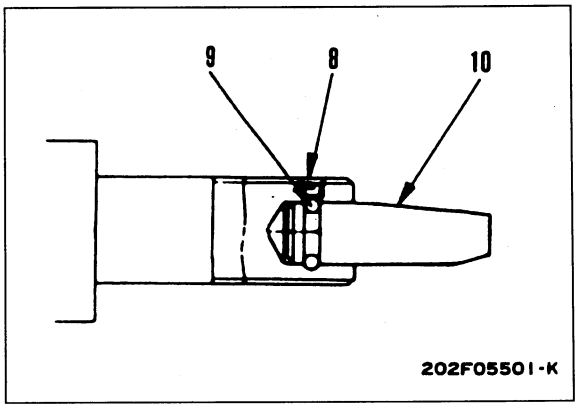
      iii) Remove piston assembly (4).
      iv) Remove plunger (5).
         • Boom and arm cylinder only
      v) Remove collar (6).
         • Boom and arm cylinder only
      vi) Remove head assembly (7).

      vii) Remove cap (8), and pull out 12 balls (9), then remove plunger (10)
         • Arm cylinder only



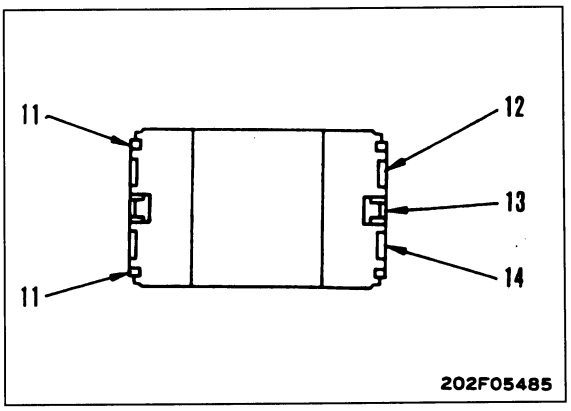






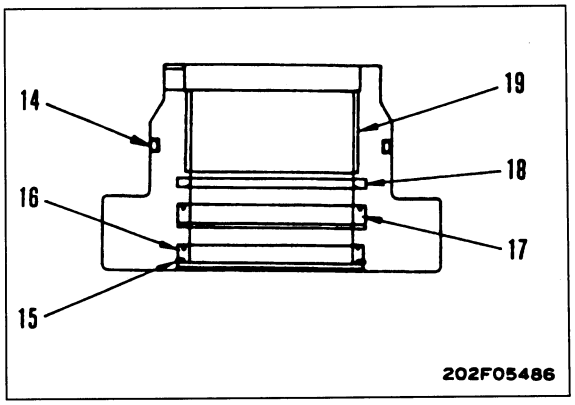
2. Disasssembly of piston assembly

1) Remove rings (11).
2) Remove wear rings (12).
3) Remove piston ring (13).



3. Disassembly of cylinder head assembly

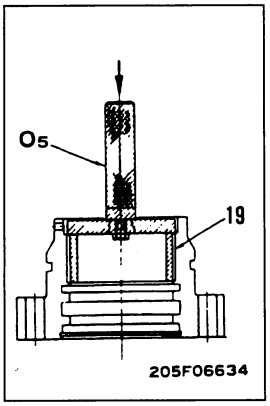
1) Remove O-ring and backup ring (14).
2) Remove snap ring (15), then remove dust seal (16).
3) Remove rod packing (17).
4) Remove buffer ring (18).
5) Remove bushing (19).

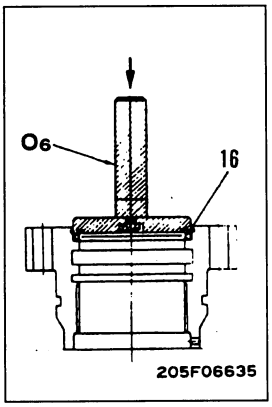


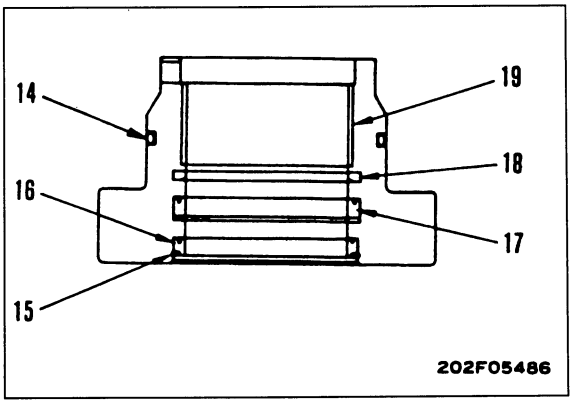
ASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

★ Be careful not to damage the packings, dust seals, and O-rings.
★ Do not try to force the backup ring into position. Warm it in warm water (50 - 60°C) before fitting it.

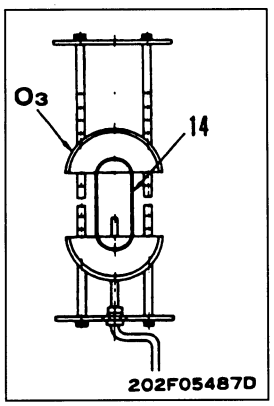
1. Assembly of cylinder head assembly
1) Using tool **O5**, press fit bushing (19).
2) Assemble buffer ring (18).
3) Assemble rod packing (17).
4) Using tool **O6**, install dust seal (16), and secure with snap ring (15).
5) Install backup ring and O-ring (14).

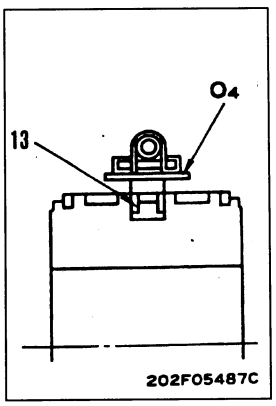






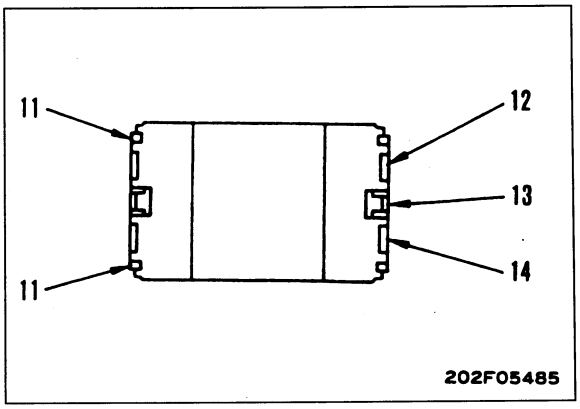
2. Assembly of piston assembly
1) Using tool **O3**, expand piston ring (13).
★ Set the piston ring on the tool **O3**, and turn the handle 8 - 10 times to compress the ring.
2) Set tool **O4** in position, and retract piston ring (13).





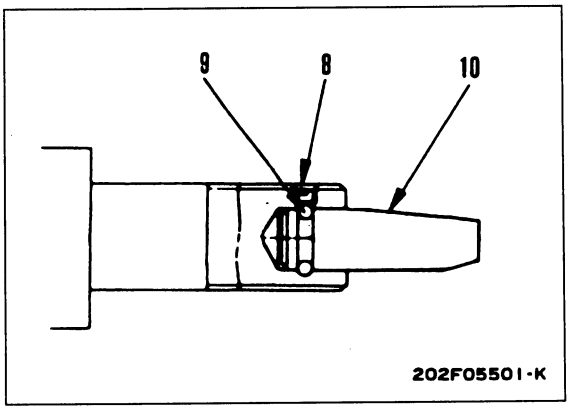
3) Assemble wear ring (12).
4) Assemble ring (11).
★ Be careful not to open the end gap of the ring too wide.

Ring groove: Grease (G2-LI)

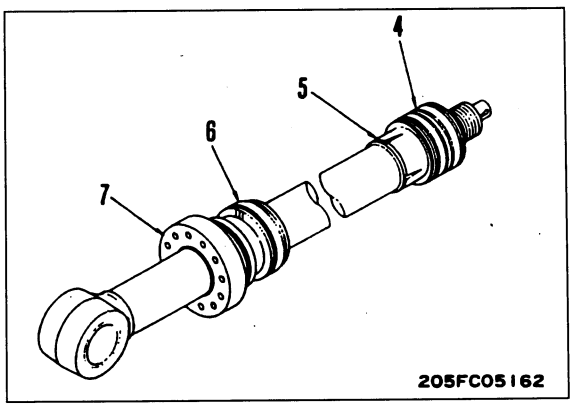


3. Piston rod assembly

1) Set plunger (10) to piston rod, and assemble 12 balls (9), then secure with cap (8).
   ★ Check that there is a slight play at the tip of the plunger.
   • Arm cylinder only



2) Assemble head assembly (7).
3) Fit O-ring and backup ring, and assemble collar (6).
   • Boom and arm cylinder only
4) Assemble plunger (5).
   • Boom and arm cylinder only
5) Assemble piston assembly (4).



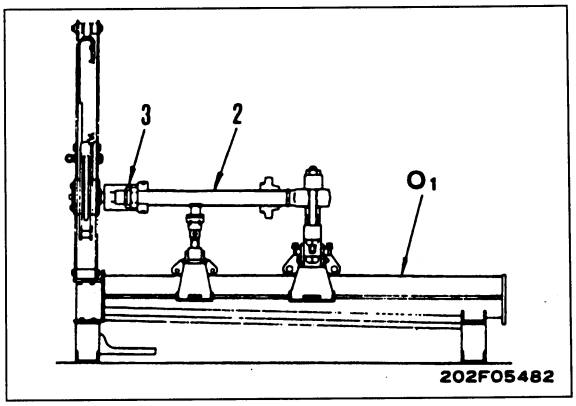
6) Set piston rod assembly (2) to tool **O1**.
7) Using tool **O2**, tighten nut (3).

Nut: Thread tightener (LT-2)

kgm Nut:

Unit: kNm (kgm)

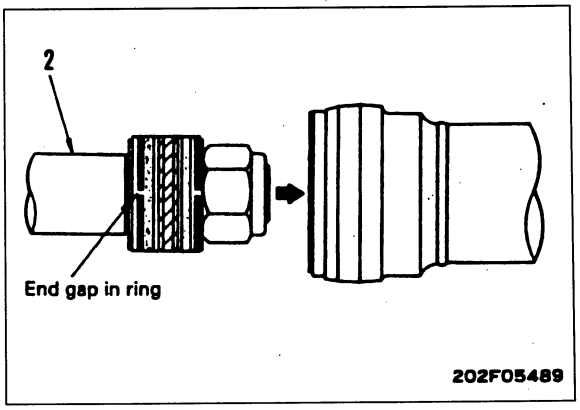
Cylinder / Model	Boom	Arm	Bucket
PC180	6.3±0.1	7.75±0.25	6.3±0.1
PC160	(642.5±10.5)	(790.5±25.5)	(642.5±10.5)



8) Assemble pison rod assembly (2).

Seal: Grease (G2-LI)

★ Set the end gap of the ring at the horizontal (side) position, align the center of shaft and cylinder tube, then insert.
★ After inserting, check that the ring is not broken and has not come out, then push in fully.

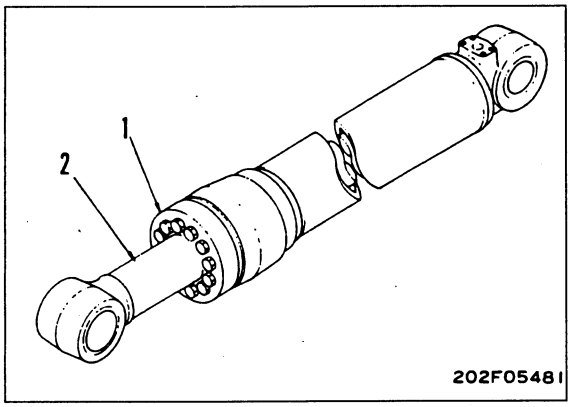


9) Tighten head assembly (1) with mounting bolts.

kgm Mounting bolt:

Cylinder	Tightening torque
Boom Arm Bucket	330±10 Nm (33.7±1.0 kgm)

10) Install piping.



REMOVAL OF WORK EQUIPMENT ASSEMBLY

⚠ Extend the arm and the bucket fully and lower the work equipment completely to the ground, then operate the control levers 2 to 3 times.

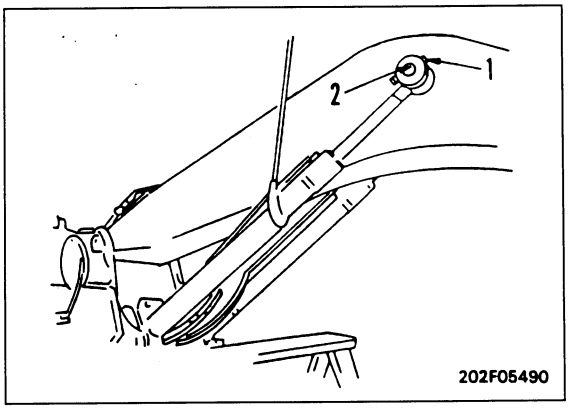
1. Remove lock bolt (1). (See F) ※ 1
2. Remove pin (2). (See F1) ※ 2
   ★ Sling the boom cylinder assembly and remove the pin.

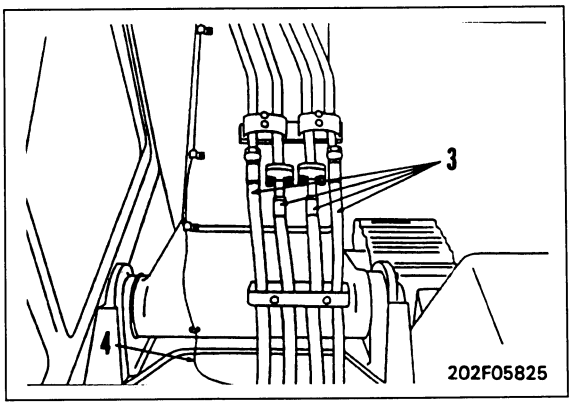
   ⚠ Start the engine and retract the boom cylinder rod, then tie the rod with wire to prevent it from coming out, and lower it onto the block.

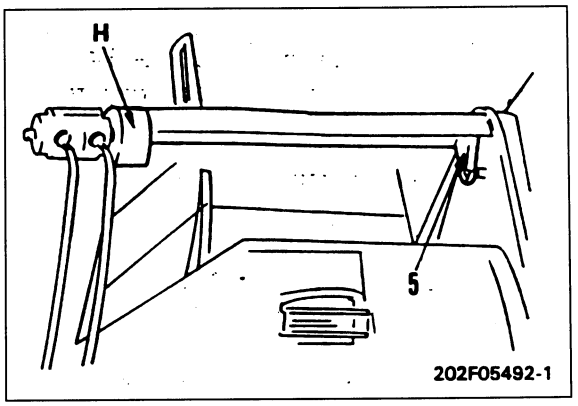
   ★ Disconnect the boom cylinder on the opposite side in the same way.

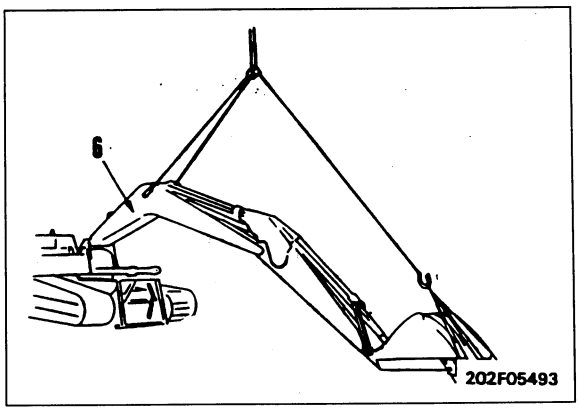
   ⚠ Release the remaining pressure in the circuit. For details, see TESTING AND ADJUSTING, Releasing pressure in hydraulic circuit for machines with PPC valve.
3. Disconnect hoses (3). (See F2)
4. Disconnect wiring (4). (See F2)
5. Remove pin (5). (See F3)
   ★ Sling work equipment assembly (6), then using tool **H**, remove the pin.
6. Remove work equipment assembly (6). (See F4)

   kg 600kg









INSTALLATION OF WORK EQUIPMENT ASSEMBLY

- Carry out installation in the reverse order to removal.

[※ 1]

★ When tightening the locknut, tighten so that the clearance between the plate and nut is 0.5 - 1.5 mm.

[※ 2]

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between cylinder rod (10) and plate (11) is below 1 mm.

★ Standard shim thickness: 0.8 mm, 1.5 mm

[※ 3]

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)

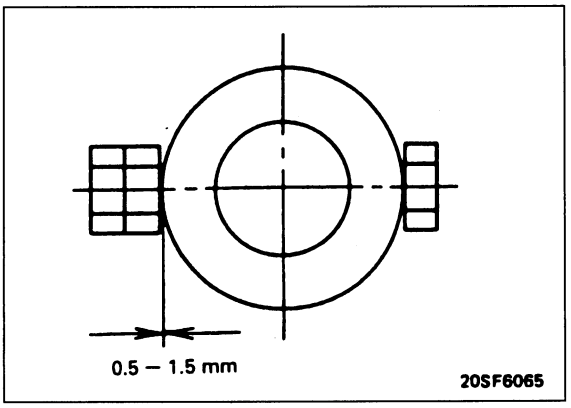
⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

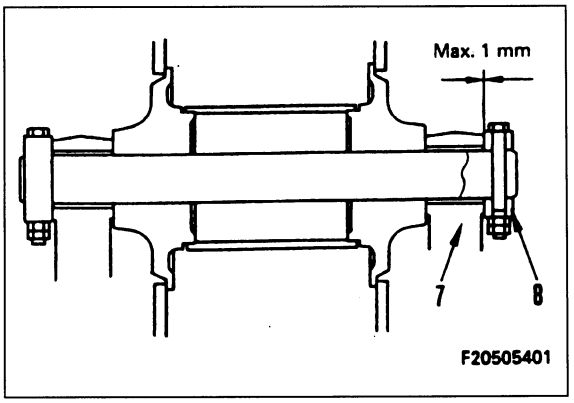
★ Adjust the shim thickness so that the clearance between boom (12) and bracket (13) is below 1 mm.

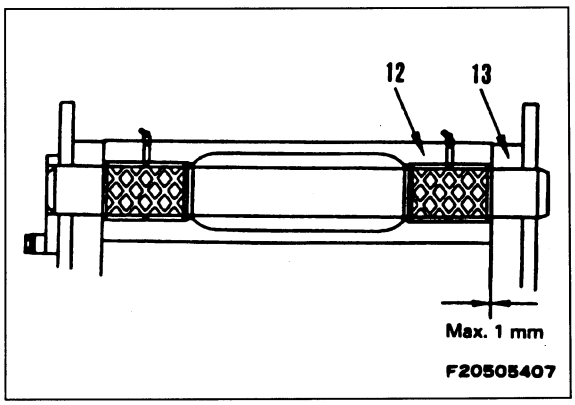
★ Standard shim thickness: 0.5 mm. 1.0 mm

- Refilling with oil (hydraulic tank)
  - ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

- Bleeding air
  - ★ Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.







REMOVAL OF BUCKET ASSEMBLY

⚠ Set the back of the bucket facing down, lower the work equipment completeley to the ground, and operate the control levers 2 of 3 times.

1. Remove lock bolt (1). (See F1) [※ 1]
2. Remove plate (2). (See F1) [※ 2]
3. Remove pin (3). (See F1) [※ 3]
4. Remove lock bolt (4). (See F1) [※ 4]
5. Remove pin (5). (See F1)
6. Remove bucket assembly (6). (See F1)
   ★ Raise the work equipment and disconnect the arm from the bucket.

kg 600 kg

INSTALLATION OF BUCKET ASSEMBLY

- Carry out installation in the reverse order to removal.

[※ 1] [※ 4]
★ Tighten with the locknut so that the clearance between the bucket boss and nut is 0.5 - 1.5mm. (See F2)

[※ 2]
★ Adjust the shim thickness so that the clearance between bucket boss (7) and spacer (8) is 2mm. (See F3)

[※ 3]
★ When aligning the position of the pin hole, run the engine at low idling, and align slowly.
Never insert your fingers in the pin hole.

REMOVAL OF ARM ASSEMBLY

1. Bucket assembly
   For details, see REMOVAL OF BUCKET ASSEMBLY.

2. Set work equipment
   ★ Secure the bucket cylinder assembly to the arm, then pull in the arm, and lower it onto block ①.

3. Remove pin (1). (See F4) [※ 1]
   ★ Sling the arm cylinder assembly, and remove the pin.

⚠ Start the engine, and retract the arm cylinder rod, then tie the rod with wire to prevent it from coming out.

↘ ⚠ ↙
↑ Release the remaining pressure in the circuit. For details, see TESTING AND ADJUSTING, Releasing pressure in hydraulic circuit for machines with PPC valve.

4. Disconnect hoses (2). (See F4)

5. Remove pin (3). (See F4)

6. Remove arm assembly (4). (See F4)
   ★ Raise the boom and disconnect the boom from the arm.

kg See Weight Table.

INSTALLATION OF ARM ASSEMBLY

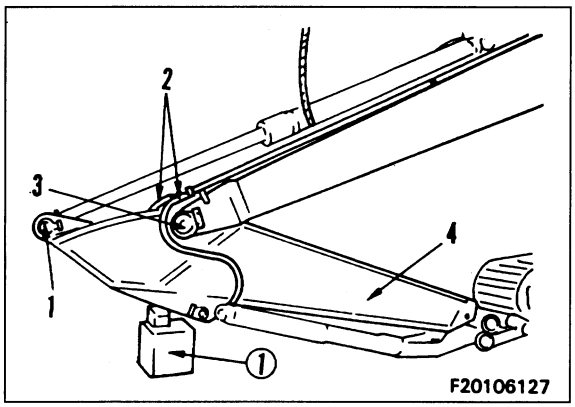
- Carry out installation in the reverse order to removal.

[※ 1]

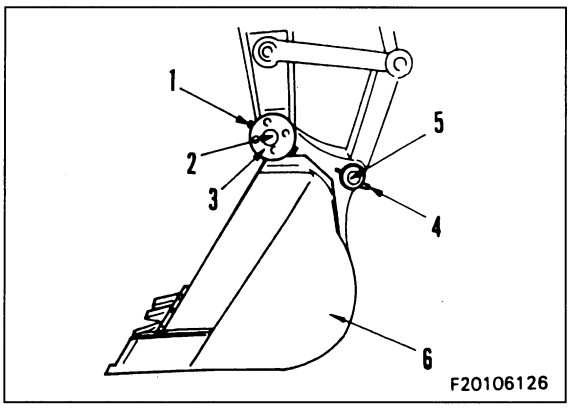
⚠ When aligning the position of the pin hole, run the engine at low idling, and align slowly.
Never insert your fingers in the pin hole.

- Bleeding air
  ★ Bleed the air from the cylinder.
  For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.
  ★ After bleeding the air from the cylinder, check the level of the oil in the hydraulic tank.

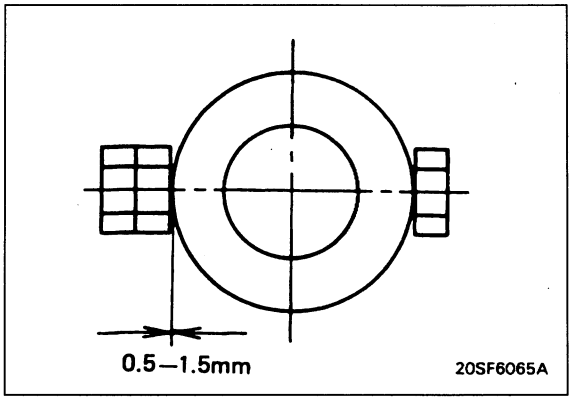
F4



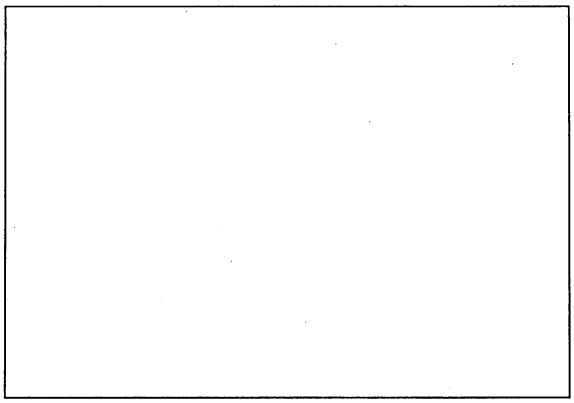
F1



F2



F3



REMOVAL OF ARM, BUCKET ASSEMBLY

Extend the arm and bucket fully, lower the work equipment completely to the ground, and operate the control levers 2 or 3 times.

1. Remove pin (1). (See F1) [* 1]
   ★ Set block ① between the arm and the boom, then sling the arm cylinder, and remove the pin.

   ⚠ Start the engine, and retract the arm cylinder rod, then tie the rod with wire to prevent it from coming out.

   ⚠ Release the remaining pressure in the circuit. For details, see TESTING AND ADJUSTING, releasing pressure in hydraulic circuit for machines with PPC valve.

2. Disconnect hose (2). (See F2)

3. Remove pin (3). (See F2)
   ★ Sling the arm and bucket assembly, then remove the pin.

4. Remove arm and bucket assembly (4). (See F2)

   kg See Weight Table.

INSTALLATION OF ARM, BUCKET ASSEMBLY

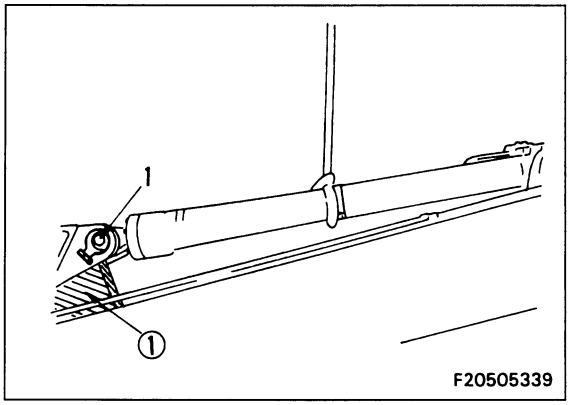
- Carry out installation in the reverse order to removal.

[* 1]

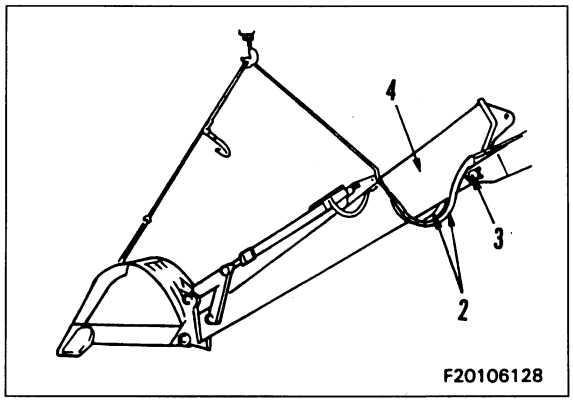
⚠ When aligning the position of the pin hole, run the engine at low idling, and align slowly. Never insert your fingers in the pin hole.

- Bleeding air
  ★ Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.
  ★ After bleeding the air from the cylinder, check the level of the oil in the hydraulic tank.

F1



F2



REMOVAL OF BOOM ASSEMBLY

1. Arm and bucket assembly
   For details, see REMOVAL OF ARM, BUCKET ASSEMBLY.

2. Remove lock bolt (1). (See F1) [※ 1]

3. Remove pin (2). (See F1) [※ 2]
   ★ Sling the boom cylinder assembly, and remove the pin.

   ⚠ Start the engine, and retract the boom cylinder rod, then tie the rod with wire to prevent it from coming out, and lower it into the block.

   ★ Disconnect the boom cylinder assembly on the opposite side in the same way.

   ↘⚠↙ ↑ Release the remaining pressure in the circuit. For details, see TESTING AND ADJUSTING, Releasing pressure in hydraulic circuit for machines with PPC valve.

4. Disconnect hose (3). (See F1)

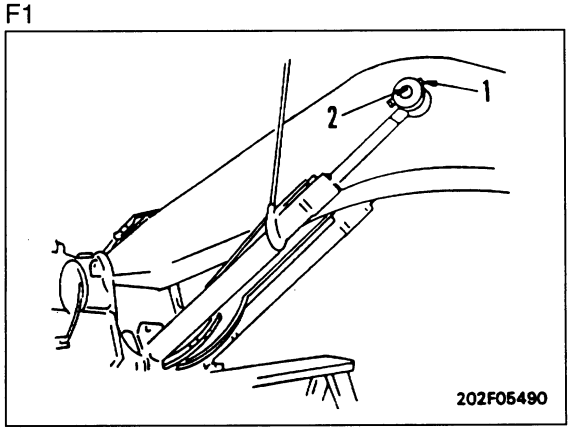
5. Disconnect wiring (4). (See F2)

6. Remove pin (5). (See F3)
   ★ Sling the boom assembly, then use tool **H** to remove the pin.

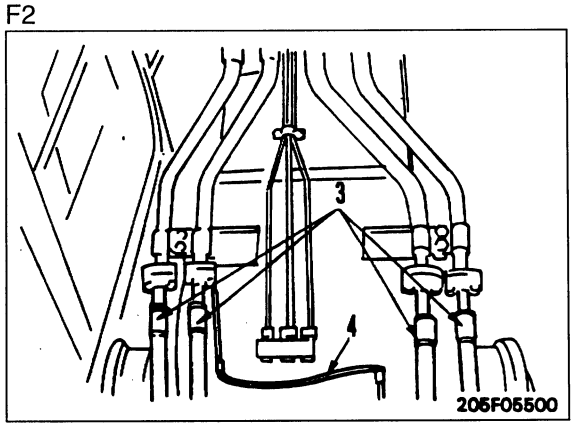
7. Remove boom assembly (6). (See F4)

   kg See Weight Table.

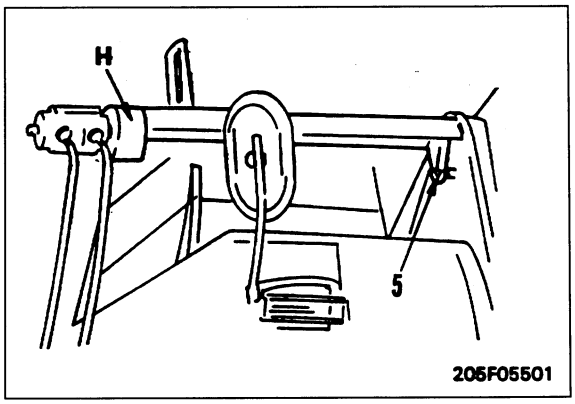
F1



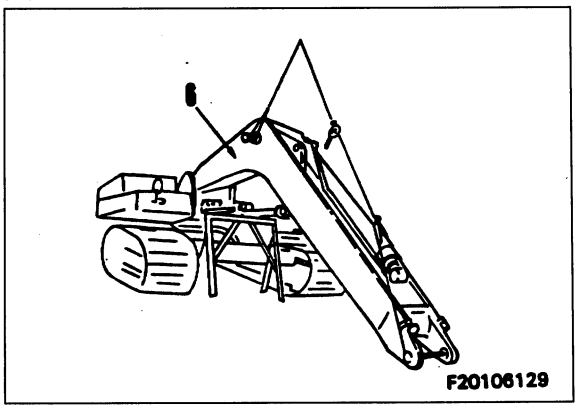
F2



F3



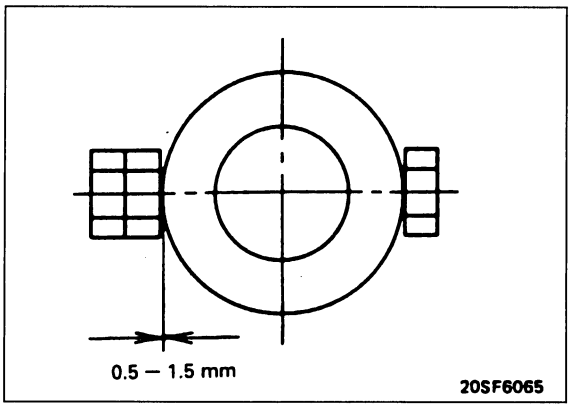
F4



INSTALLATION OF BOOM ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1
★ When tightening the locknut, tighten so that the clearance between the plate and nut is 0.5 - 1.5 mm.



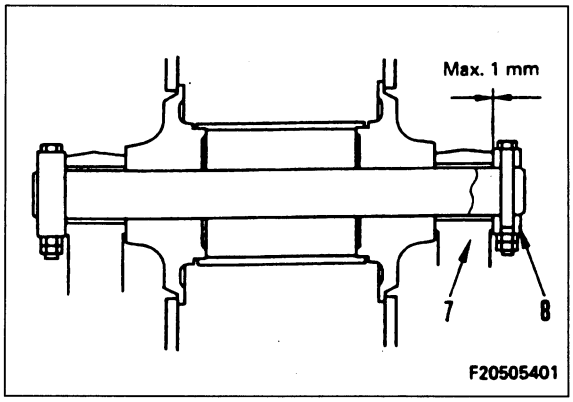
※ 2

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM-G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between cylinder rod (10) and plate (11) is below 1 mm.
★ Standard shim thickness: 0.8 mm, 1.5 mm



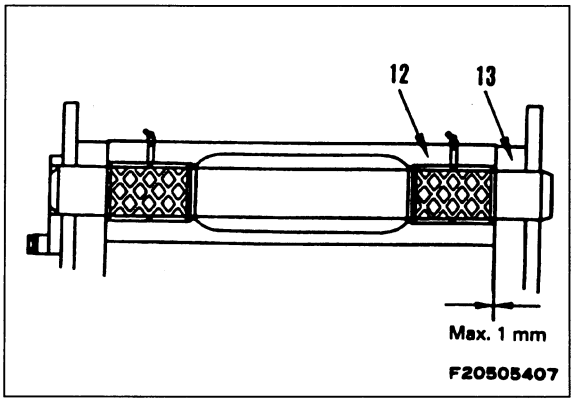
※ 3

Inside surface of bushing when assembling pin: Anti-friction compound (LM-P)

Grease after assembling pin: Grease (LM_G)

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between boom (12) and bracket (13) is below 1 mm.
★ Standard shim thickness: 0.5 mm, 1.0 mm



Refilling with oil (hydraulic tank)

★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

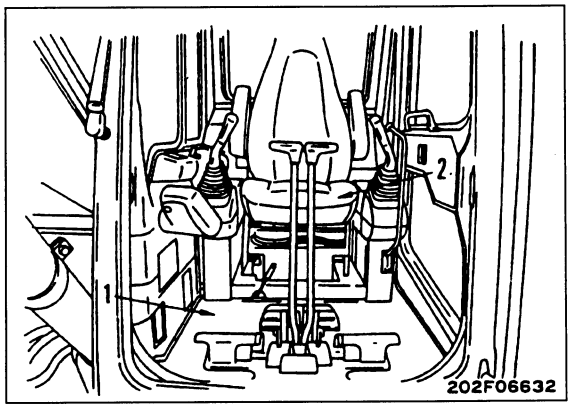
- Bleeding air
  ★ Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder.

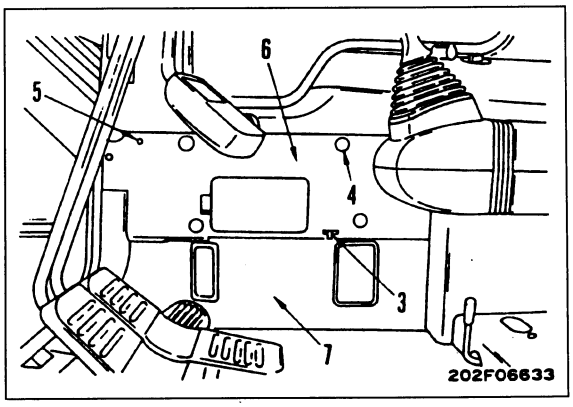
REMOVAL OF OPERATOR'S CAB ASSEMBLY

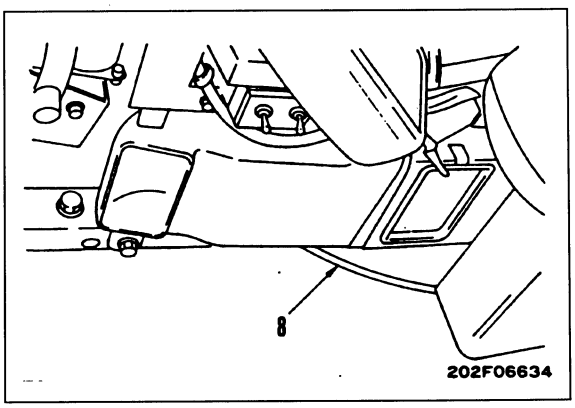
⚠ Disconnect the table from the negative (-) terminal of the battery.

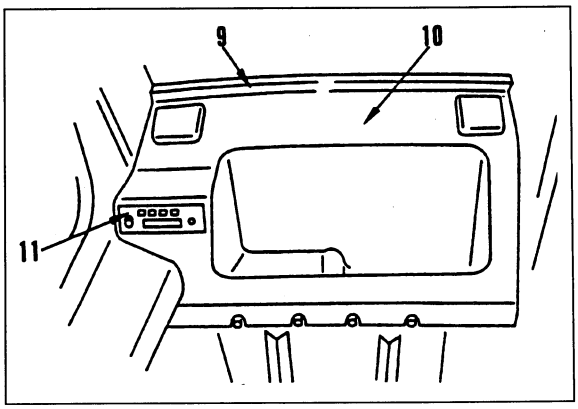
1. Remove floor mat (1).
2. Remove operator's seat assembly (2).

   kg Operator's seat assembly: 40 kg
3. Remove knob (3).
4. Remove 4 caps (4) and clip (5), then remove middle panel (6).
5. Remove bottom panel (7).
   ★ The panel is held by a clip, so remove the clip when removing the panel and be careful not to damage it.
6. Disconnect washer hose (8).
7. Remove radio (11) if fitted (refer to radio operation manual).
   ★ Remove plate (9), then remove cover (10).
8. Lift cover (10) away carefully to locate speaker harness connector. Disconnect and remove panel completely.





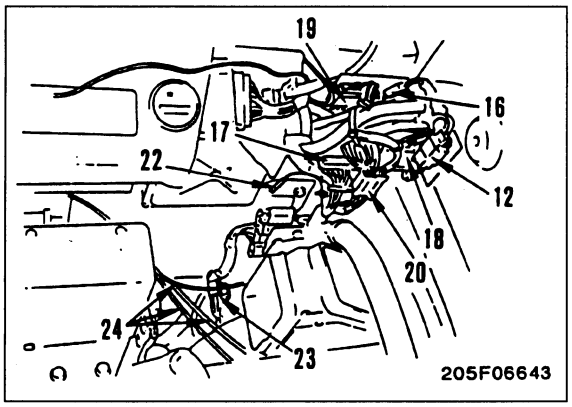


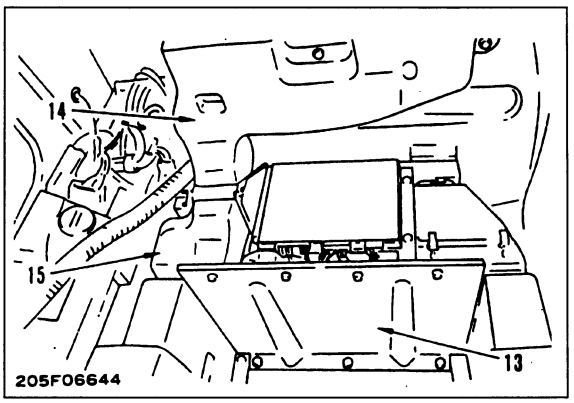


9. Remove divider board (13).

10. Remove heater duct of air conditioner ducts (14) and (15) (if fitted).

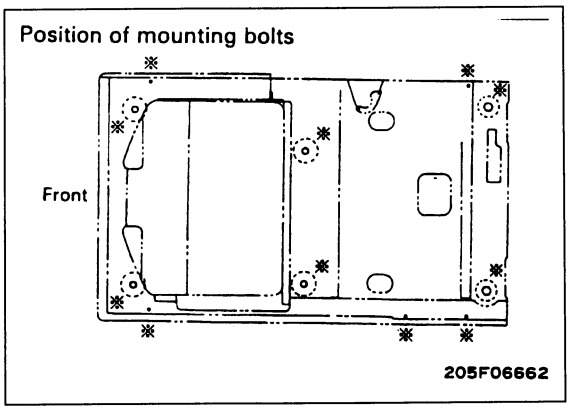
11. Disconnect wiring connectors CN-H01 (16), CN-H02 (17), CN-H03 (18), CN-H04 (19), CN-H05 (20), CN-H06 (21), CN-K01 (22), CN-H07 CN-H08 CN-H09





12. Disconnect heater cables or air conditioner cables (24) (if fitted).

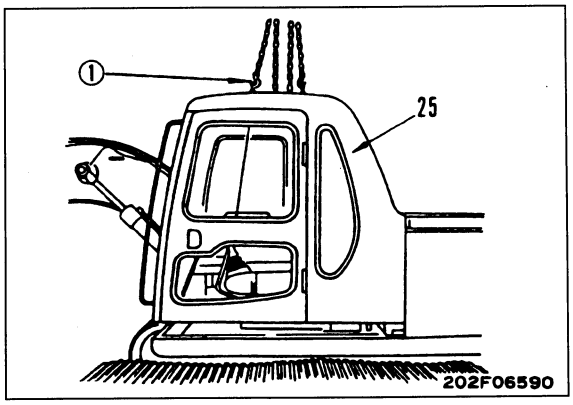
13. Remove 11 cab mounting bolts (marked ※).



14. Using eyebolts ①, remove opeator's cab assembly (25).

kg Operator's cab assembly: 300 kg

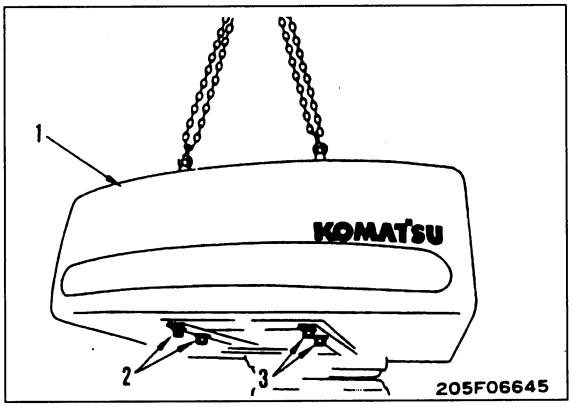
★ When raising the cab assembly, check that all the wiring has been disconnected, then lift off slowly and be careful not to hit any part.



INSTALLATION OF OPERATOR'S CAB ASSEMBLY

- Carry out installation in the reverse order to removal.

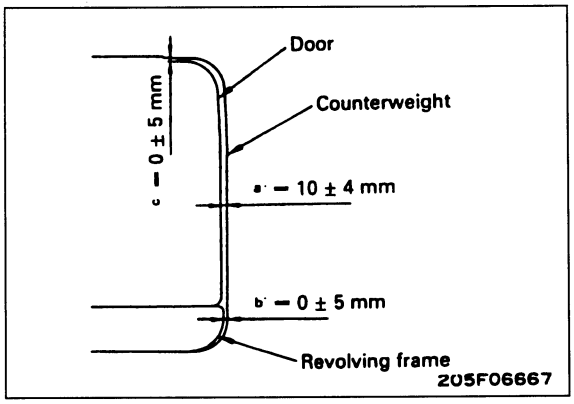
REMOVAL OF COUNTERWEIGHT ASSEMBLY



1. Set lifting hook chains of counterweight assembly in position, and sling.
2. Remove mounting bolts (2) and (3). [※ 1]
   ★ Be careful not to lose the shims when removing.
3. Lift off counterweight (1) horizontally with wire or chain block. [※ 2]
   ★ Be careful not to hit the engine, radiator and cooler assembly.

kg Counterweight assembly: 2950 kg

INSTALLATION OF COUNTERWEIGHT ASSEMBLY



- Carry out installation in the reverse order to removal.

[※ 1]

Thread of counterweight mounting bolt: Thread tightener (LT-2)

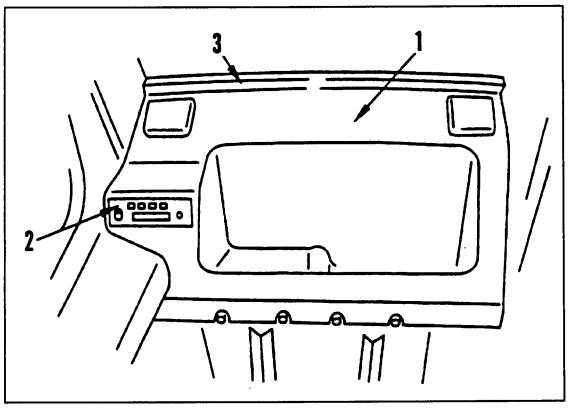
kgm Counterweight mounting bolt: 1,720 ± 190Nm (175±20kgm)

[※ 2]

★ Installing and adjusting counterweight

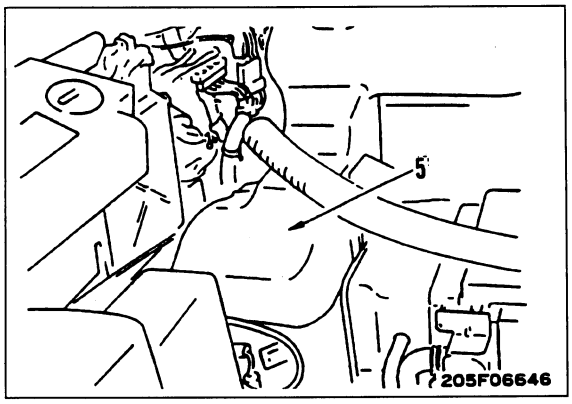
1) Sling counterweight with crane and set in position on frame.
2) Use counterweight pusher bolt ② and align mounting bolts holes. Then install shim and mounting bolts (2) and (3), and adjust to following dimensions.
   - Clearance from revolving frame: 10 ± 5 mm (left and right)
   - Clearance from bodywork door: 10±5 mm (left and right)
   - Stepped difference ⓑ from revolving frame in left-to-right direction: Max. 5 mm
   - Stepped difference ⓐ from bodywork door in left-to-right direction: 10 ± 4 mm
   - Stepped difference ⓒ from bodywork top cover in up-down direction: Max. 5 mm

REMOVAL OF GOVERNOR PUMP CONTROLLER ASSEMBLY

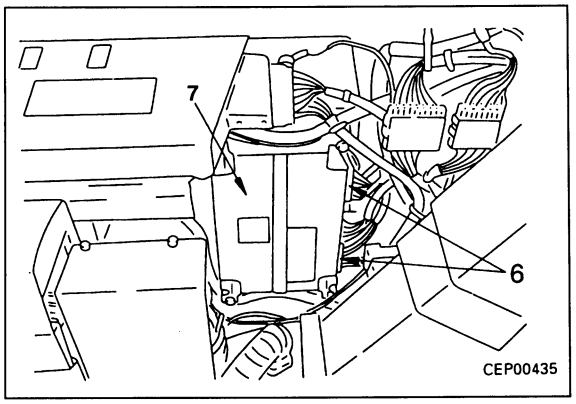


⚠ Disconnect the cable from the negative (-) terminal of the battery.

1. Remove radio (2) if fitted.
2. Remove plate (1), then remove cover (3).
3. Lift cover (3) away carefully to locate speaker harness connector. Disconnect and remove panel completely.
4. Remove divider board (5).
5. Remove heater / air conditioner duct (5).
6. Disconnect 3 wiring connectors (6), then remove governor and pump controller assembly (7).



INSTALLATION OF GOVERNOR, PUMP CONTROLLER ASSEMBLY

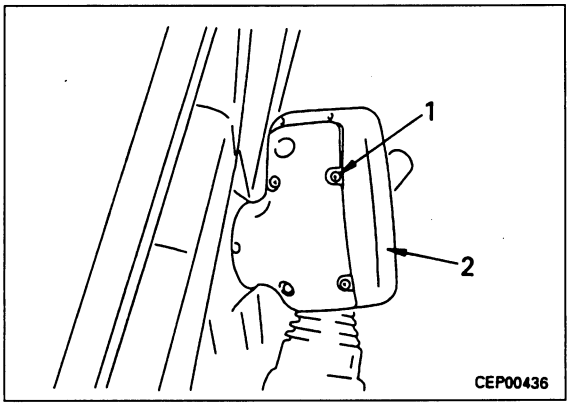


- Carry out installation in the reverse order to removal.

[❄ 1]

- Check the performance of the work equipment, travel, and swing. For details, see TESTING AND ADJUSTING.

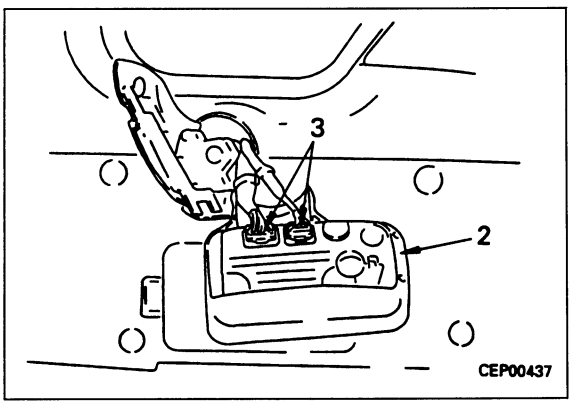
REMOVAL OF MONITOR PANEL ASSEMBLY



⚠ Disconnect the cable from the negative (-) terminal of the battery.

1. Remove 4 screws (1), and disconnect monitor panel assembly (2) from bracket.
2. Disconnect connectors (3), then remove monitor panel assembly (2). ※ 1

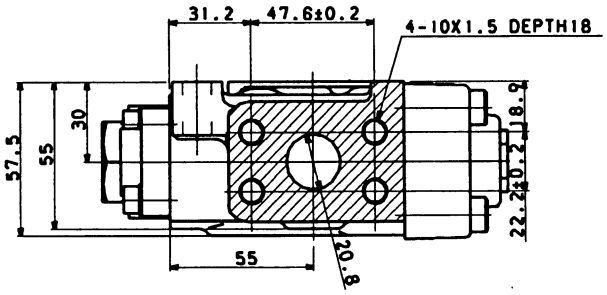
INSTALLATION OF MONITOR PANEL ASSEMBLY

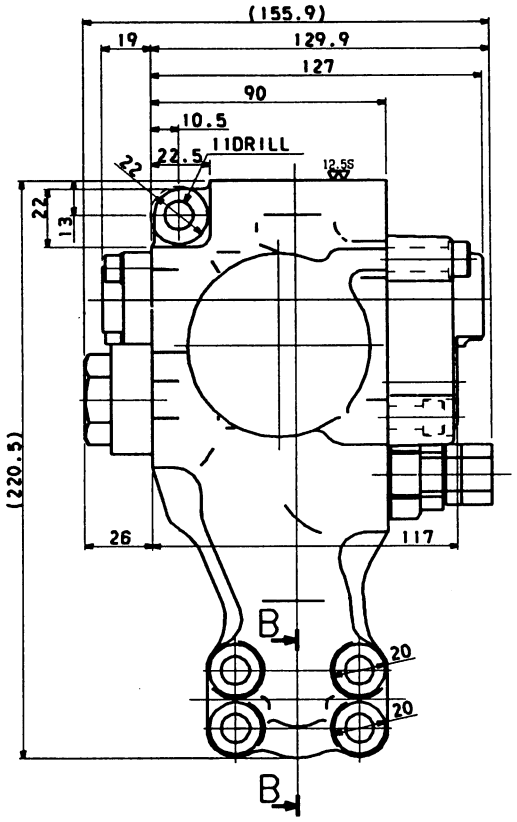


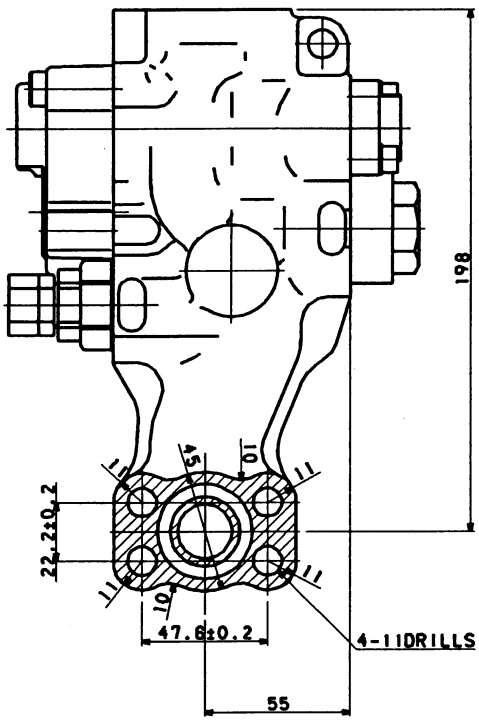
- Carry out installation in the reverse order to removal.

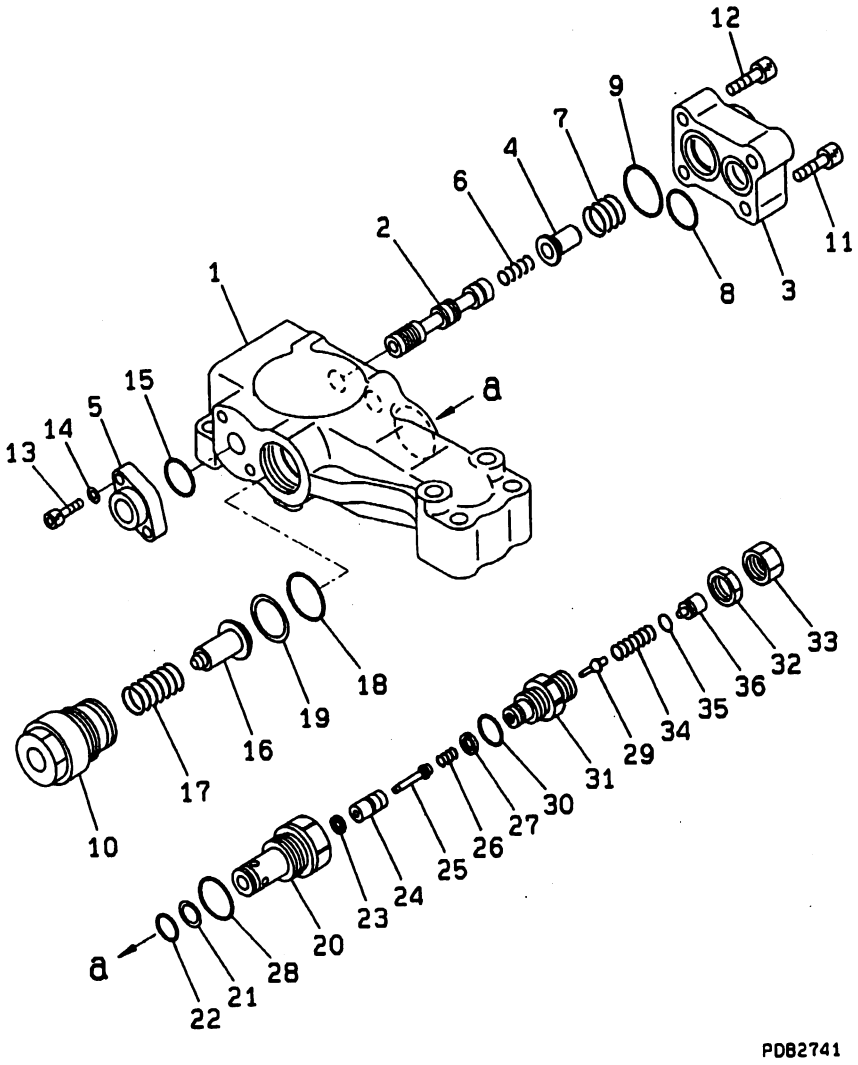
※ 1

- Check the mode setting and display function. For details, see TESTING, AND ADJUSTING, AND TROUBLESHOOTING.


31.2
47.6±0.2
4-10X1.5 DEPTH18
57.5
55
30
55
20.8
22.2±0.2
18.9


(155.9)
19
129.9
127
90
10.5
11DRILL
22.5
12.55
22
13
(220.5)
26
117
B
B
20
20


198
22.2±0.2
45°
10
11
11
11
11
10
47.6±0.2
4-11DRILLS
55


12
9
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2
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3
a
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14
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PDB2741

ADAPTER WELDING INSTRUCTION - ELECTRODE WELDING

BE SAFE!

When performing the procedures described in this catalog, you should WEAR OSHA-approved hard hat, safety glasses, work gloves and safety shoes.

IMPORTANT!

ESCO weld-on Helilok adapters are hardened typically to 415BHN. In order to eliminate cracking commonly associated with welding steel at these hardness levels, follow these procedures carefully and employ good welding techniques and practices.

Summary of Welding Procedures

Mating surfaces to be welded should be shiny base metal, free of carbon arc surface, hardfacing, grease or dirt.

Use E-7016 or E-7018 low-hydrogen electrodes (keep dry!), or E-70T-5 low-hydrogen wire.

Preheat the lip and adapter to 200°F (95°C); 350° to 400°F (117° to 204°C) if surrounding air temperature is 40°F (5°C) or less. Measure temperature with a Tempilstik®.

Maintain preheat temperature while welding.

Maximum interpass temperature should not exceed 500°F (260°C).

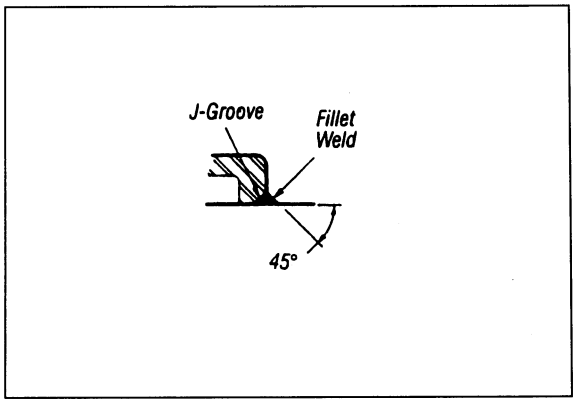
After welding, postheat to 350° to 400°F (117° to 204°C) if surrounding air temperature is 40°F (5°C) or less, then let air-cool. If air temperature is above 40°F, postheating is not necessary.

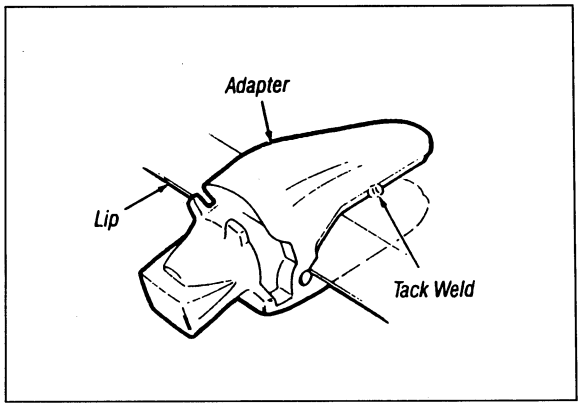
Welds should fill J-grooves to a 45° angle. If an adapter does not have a J-groove, apply fillet welds according to the following:

Bucket Size (volume)

Yards ^{3}	Meter ^{3}	Fillet Size
2	1.8	1/2" (13mm)
2 1/4 - 5	2 - 4.6	5/8" (16mm)
5 1/2 - 12	5 - 11	3/4" (19mm)
above 12	above 11	1" (25mm)

For complete welding information and procedures, refer to ESCO Products Maintenance Manual, Catalog 100-A, "How to weld ESCO alloy 12 series."

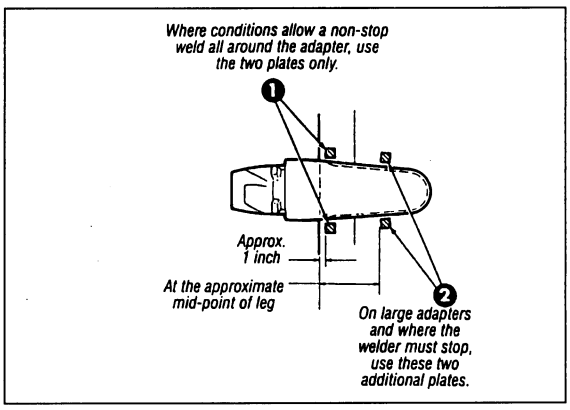




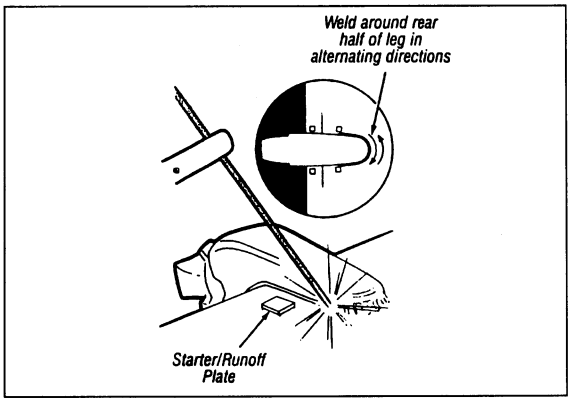
Lip Adapter Installation

1. Locate the adapters on a clean bucket, then tackweld them in place, followed by a root layer all the way around.

2. To prevent the introduction of weld-weakening impurities, every weld pass should begin and end across a starter/runoff plate. Install these plates, made from scrap steel, as shown in the diagram.
   Do not stop or start a weld at the rear of the adapter leg!
   If rod length, adapter size, and welder position allow a continuous weld without stopping, use two starter/runoff plates near the lip leading edge.
   On large adapters and where stops for welder repositioning are required, use two additional starter/runoff plates at the midpoint on both sides of the adapter.
   These procedures also apply to the bottom leg of 1 1/2- and 2-leg adapters.



3. If using four starter/runoff plates, weld the rear half of the adapter with alternating clockwise and counter clockwise passes. Build up the weld to a full fillet.
   If using only two starter/runoff plates, use the same technique, welding to the ends of the J-groove, then proceed to step 5. **Do not weld to the lip leading edge!**

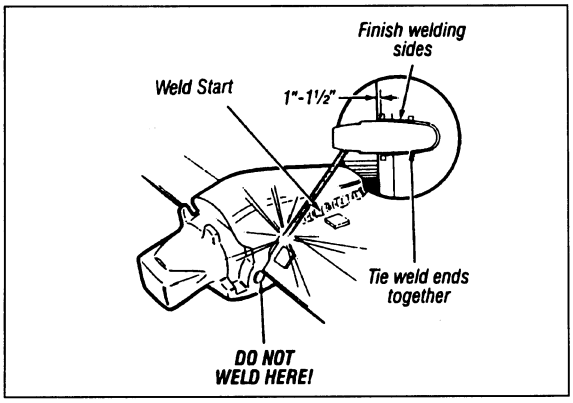


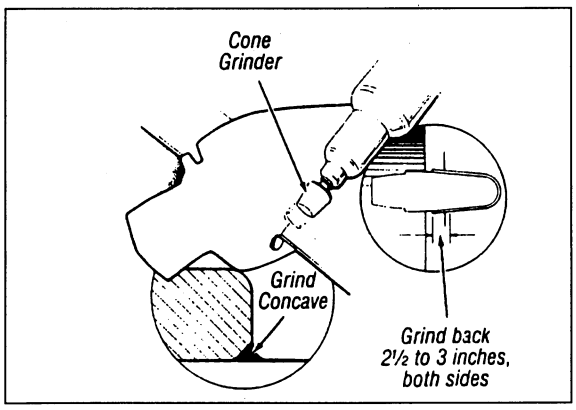
4. If using four plates, continue welding to the ends of the J-groove. **Do not weld to the lip leading edge!** Alternate from side to side until the weld is complete. Maintain a full fillet weld and tie weld ends together.

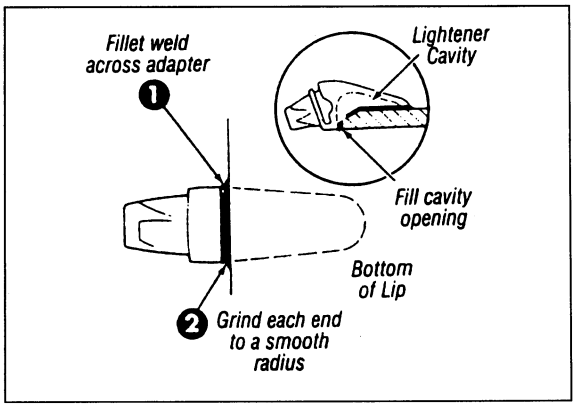
5. Remove the starter/runoff plates, then smooth the forward edge of the welds with a conical grinder.
   Blend the welds concave to remove stress concentrations.

6. Turn the bucket over.

7. **One-leg Flushmount Adapters** fillet weld across the adapter equal to the lip leading edge thickness. Grind the ends smooth at weld junctions. If a lighter cavity extends forward of the lip leading edge, cover the opening with weld. Maintain a full fillet width over the entire weld.







Corner Adapter Modification and Installation

Helilok adapters can be modified by cutting to fit bucket side plates. A **bucket should never be cut to fit an adapter!**

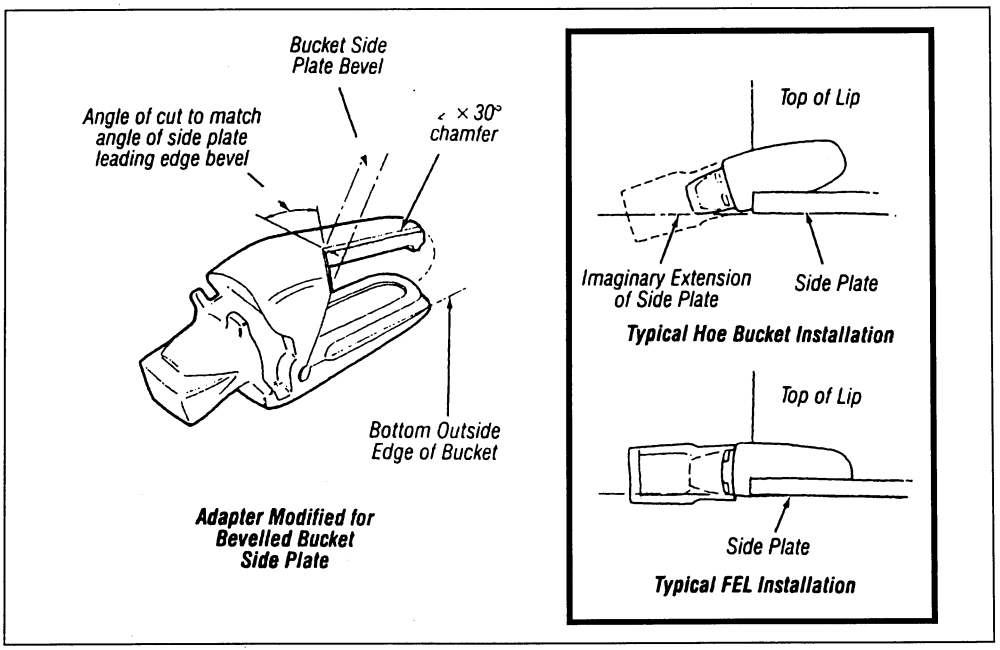
The corner adapter should be positioned so the point cuts clearance for the bucket. The best bucket wear protection is achieved when the adapter is positioned so the nose is flush with an imaginary line extending forward from the outside edge of the bucket side plate.

If a clean trench is desired, corner adapters can be mounted so points are positioned flush with the outside of the bucket.

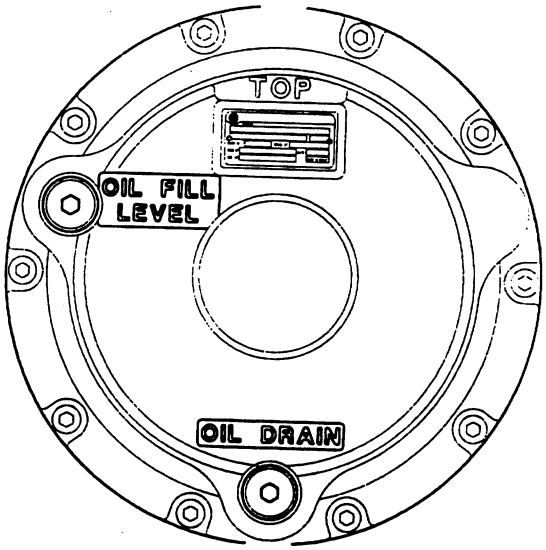
When modifying an adapter, **never remove more than 50% of the adapter top leg.** The edges of the cuts should be chamfered 1/2" X 30° for weld preparation.

Following welding procedures descrebed in "Lip Adapter Installation."

Install Helilok points according to the procedures described in ESCO Maintenance Catalog 100-1B (Rev. 1), Helilok Tooth System Installation and Removal instructions.



DISASSEMBLY OF FINAL DRIVE ASSEMBLY



Filling, draining and oil level scheme

1. START UP

Operate the gearbox after the motor is filled with hydraulic oil.
Leave breather open and fill with oil until flows out without foam. Add more oil if necessary.
Air trapped in the hydraulic system may generate noise in motor and valves as well as foaming in the tank.
Start the gearbox at low speed and increase speed gradually after checking that the gearbox runs smoothly with no noise or vibrations.

Do not run at max pressure until all solid particles are captured and removed by the filler.

Checks the following points:
- no oil leaks,
- revolution and direction of rotation are correct,
- the oil temperature (both motor and gearbox) does not rise exceed prescribed values,
- operation is smooth without noise or vibrations,
- no other defects.

2. MAINTENANCE

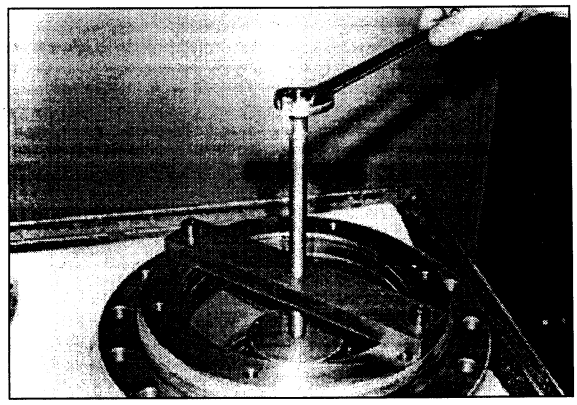
Under normal operating circumstances, no routine maintenance is required, other than routine oil checks and oil changes. As recomended in this manual, unusual operating characteristics, such as noise or overheat, should indicate further investigation

3. DSASSEMBLING

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

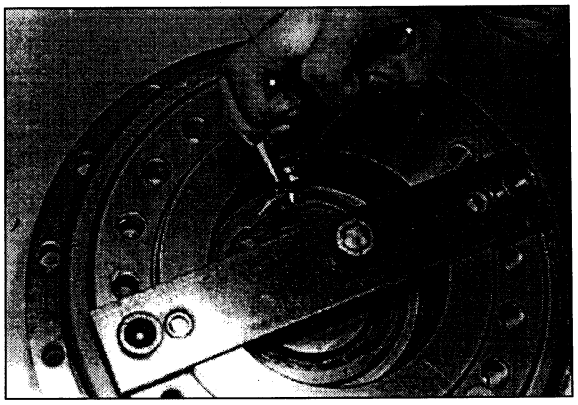
STEP 1

Fix the equipment AT709C15 on the flanged hub (pos. 18), by screwing the threaded bar, push the disc on the discs retainer (pos. 21), thus removing the force of the springs (pos. 22) on the circlip (pos. 20) and allowing its disassembling.



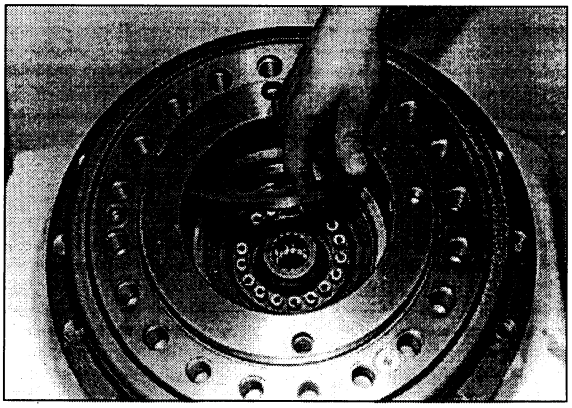
STEP 2

Using pliers remove the circlip (pos. 20) from its grove in the the flanged hub (pos. 18).

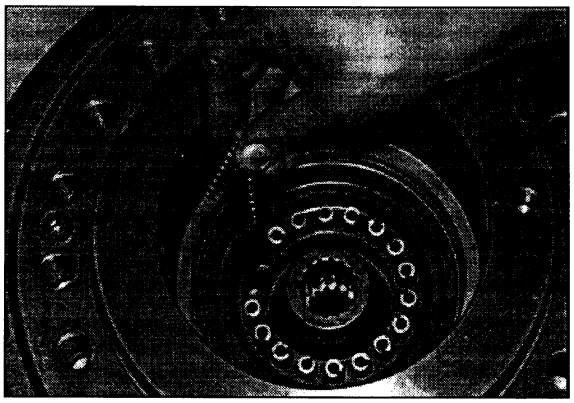


DISASSEMBLING

STEP 3
Remove springs retainer (pos. 21) from the flanged hub (pos. 18)



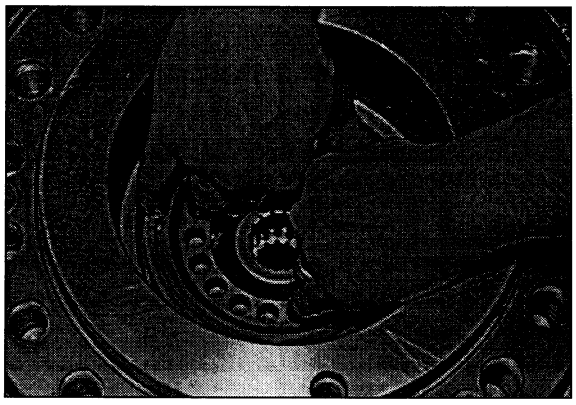
STEP 4
Remove the springs (pos. 22) from their groves in the brack piston (pos. 23).



STEP 5
Remove the brake piston (pos. 23)

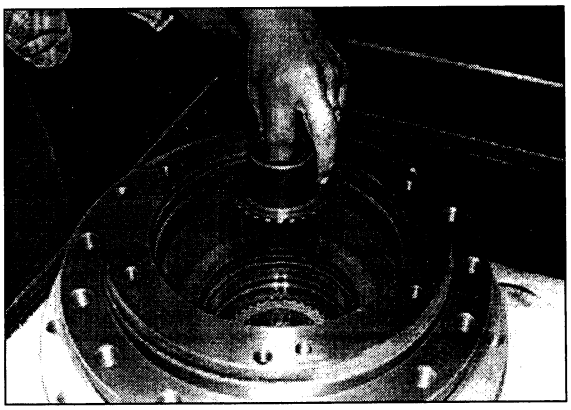
⚠ Caution

To get it easier, pumping compressed air into the brake port hole (max. 0,2 bar).

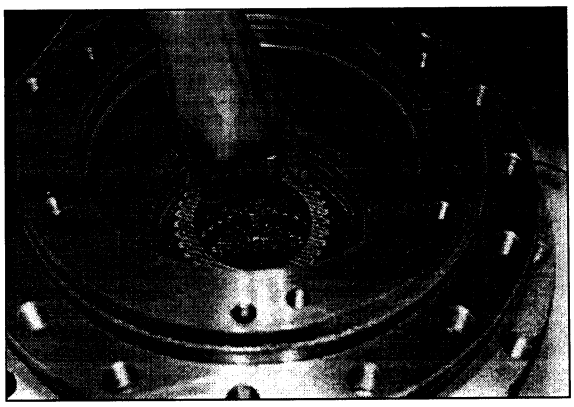


DISASSEMBLING

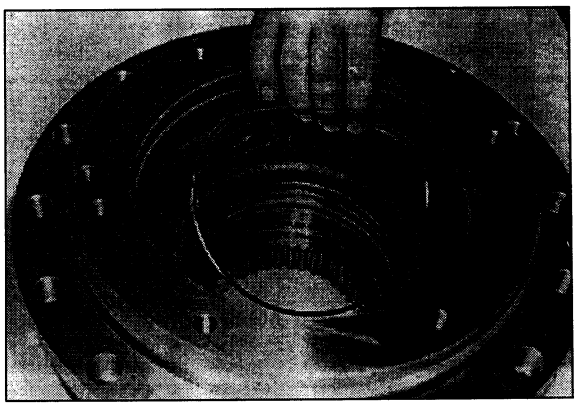
STEP 6
Remove the brake shaft (pos. 27).



STEP 7
Remove brake discs pack (pos. 25-26).

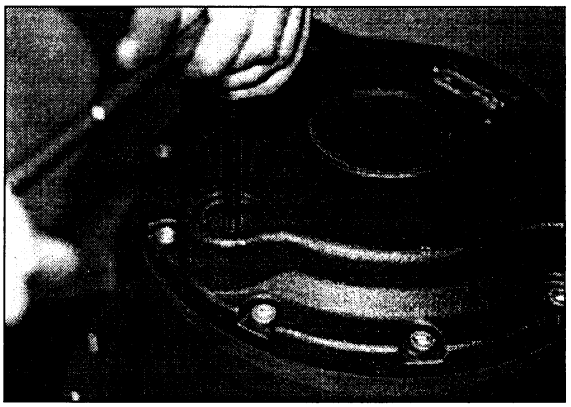


STEP 8
Remove the O-rings (pos. 28-29) from their groves in the flanged hub (pos. 18).

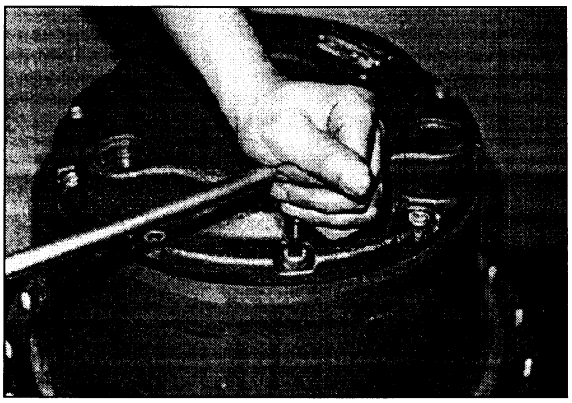


DISASSEMBLING

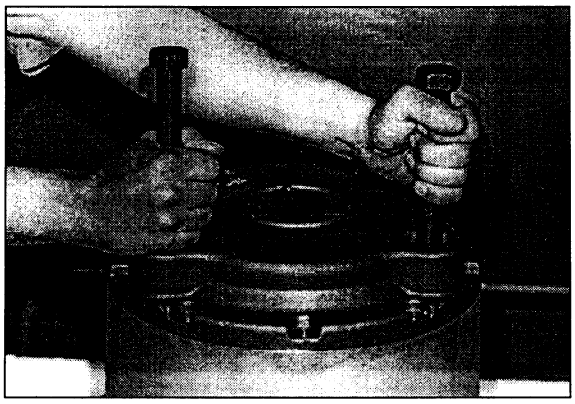
STEP 9
Overturn the gearbox, unscrew and remove the 2 plugs M22x1,5 (pos. 4) and the 2 washers (pos. 3) from the end cover (pos. 2).



STEP 10
Unscrew and remove the 10 socket head screws M10x25 (pos. 1), grade 12.9, from the cover (pos. 2).

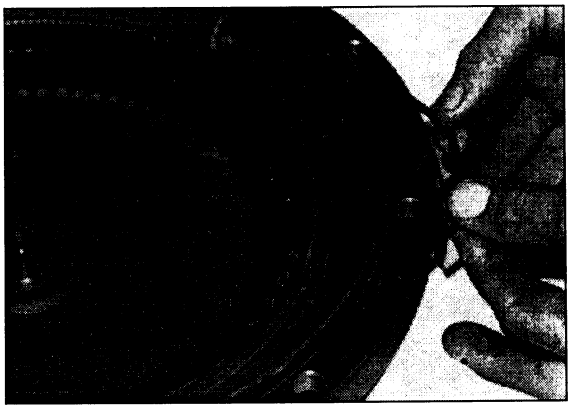


STEP 11
Remove the end cover (pos. 2) using 2 screw M22x1,5 tightened to the oil plugs holes.

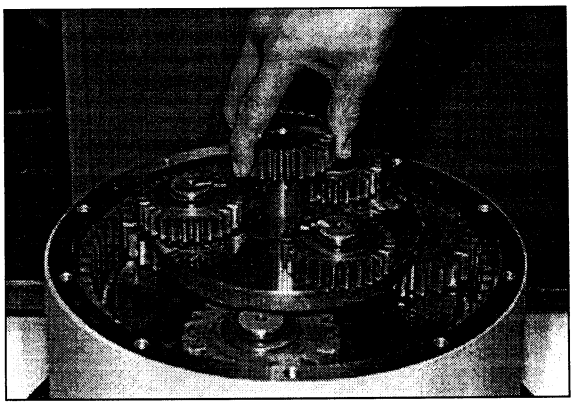


DISASSEMBLING

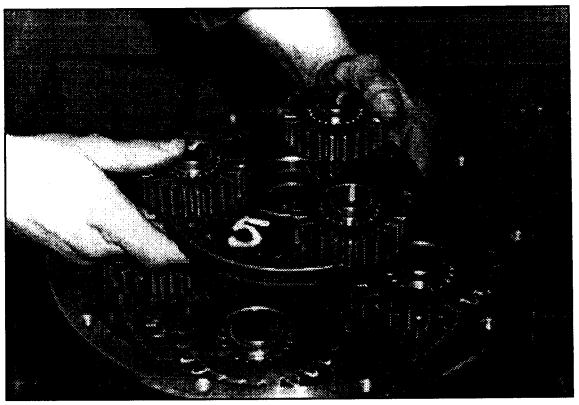
STEP 12
Remove the O-ring (pos. 5) from its grove in the end cover (pos. 2).



STEP 13
Remove the 1st stage sun gear (pos. 7).

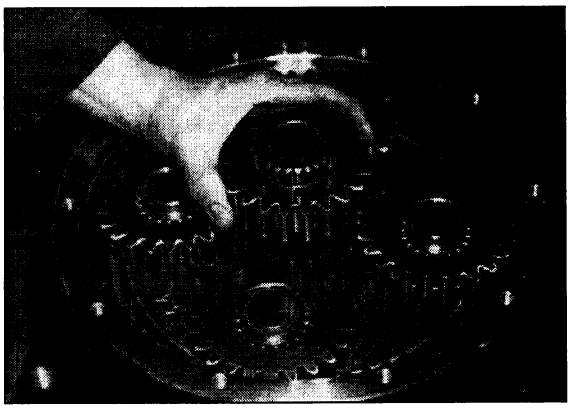


STEP 14
Remove the 1st reduction assembly (pos. 8).

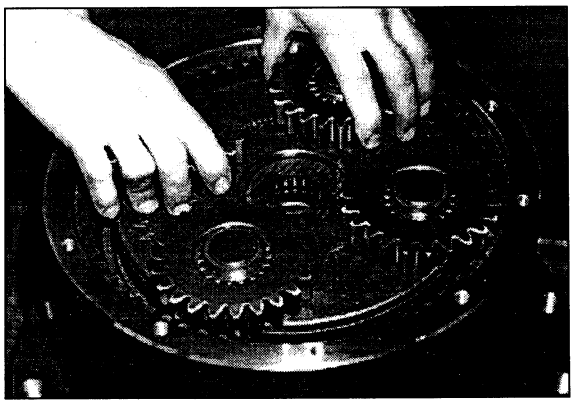


DISASSEMBLING

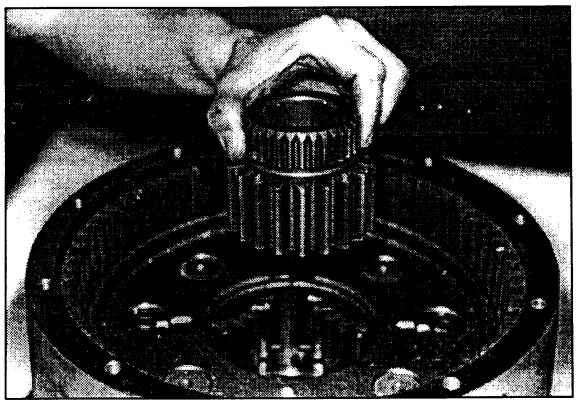
STEP 15
Remove the 2nd stage sun gear (pos. 9)



STEP 16
Remove the 2nd reduction assembly (pos. 10)

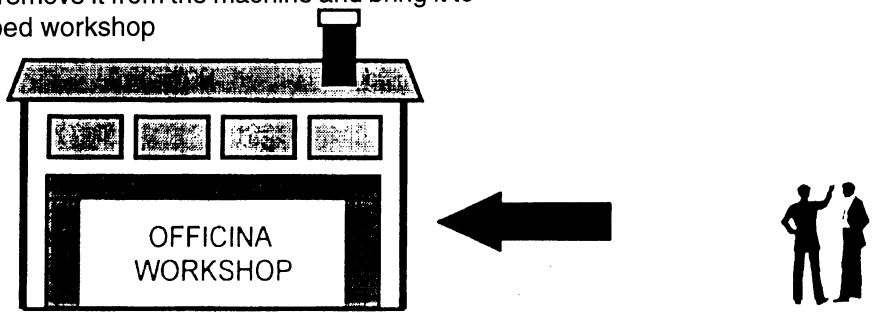


STEP 17
Remove the 3rd stage sun gear (pos. 11)

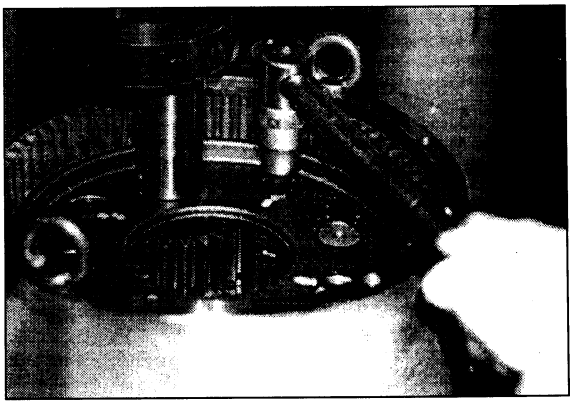


Note

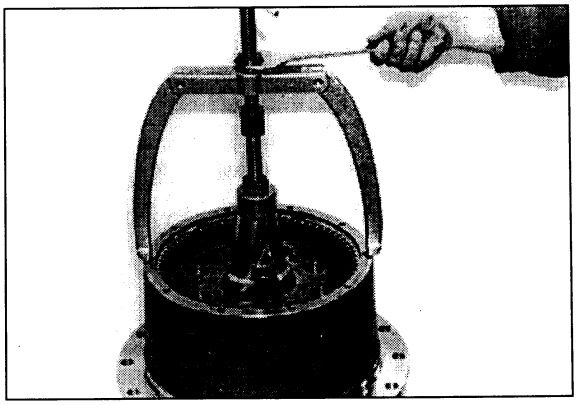
In order to proceed with the slew drive disassembling, it is not necessary to remove it from the machine and bring it to a properly equipped workshop



STEP 18
Unscrew the 4 socket head screws M20x100 (pos. 12), grade 10.9, fixing the 3rd reduction assembly (pos. 13) to the flanged hub (pos. 18)

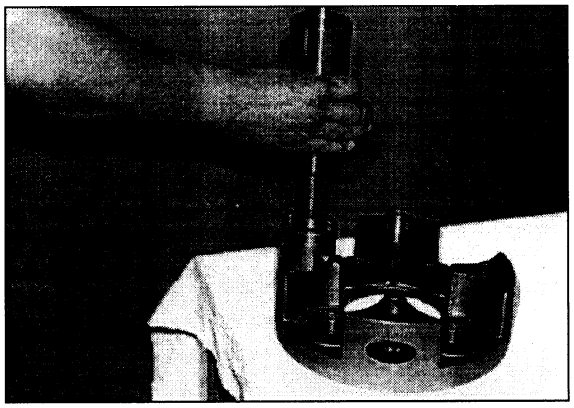


STEP 19
By means of a puller, remove the 3rd reduction planet carrier from the flanged hub (pos. 18).

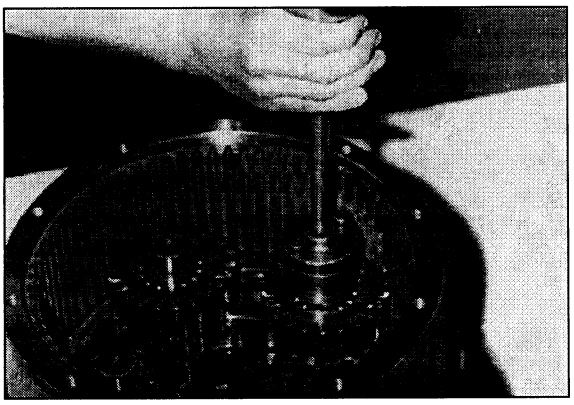


DISASSEMBLING

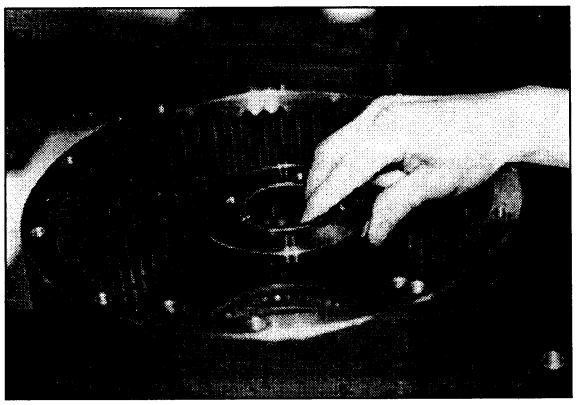
STEP 20
Using the equipment AT709C16, remove the bush (pos. 14) from the flanged hub (pos. 18) or from the 3rd reduction planet carrier.



STEP 21
Using the equipment AT709C16 remove the 4 planet assemblies of the 3rd reduction (pos. 13).

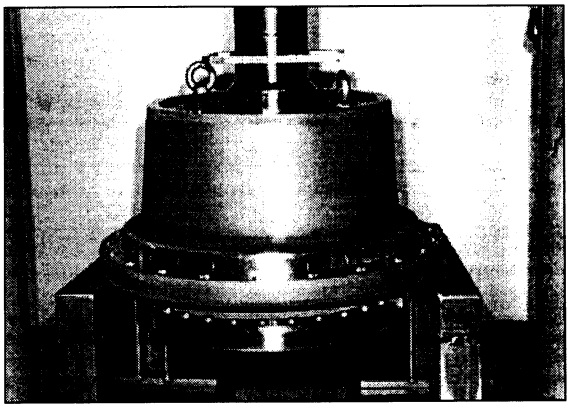


STEP 22
Remove the centering ring (pos. 17) from the flanged hub (pos. 18).



DISASSEMBLING

STEP 23
Using a press and a metal stopper, remove the flanged hub (pos. 18) from the gearbox housing (pos. 15).

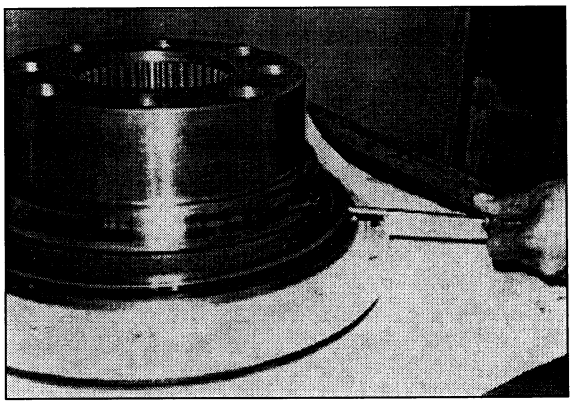


4. LIFETIME SEAL CHECK

⚠ Caution

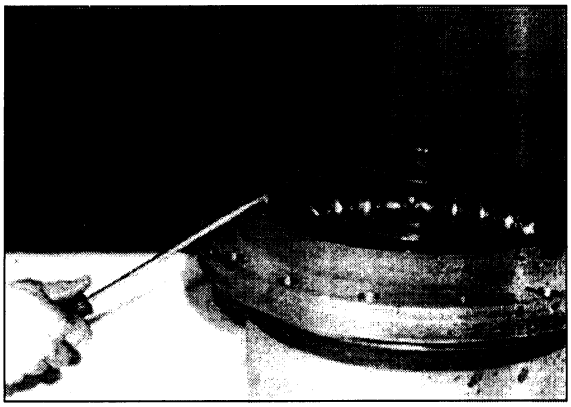
In case of oil leakages, it should be necessary to check and eventually replace the livetime seal (pos. 16), wich means both the metal rings parts and the O-rings.

STEP 24
Using the equipment AT709C16 remove the 4 planet assemblies of the 3rd reduction (pos. 13).

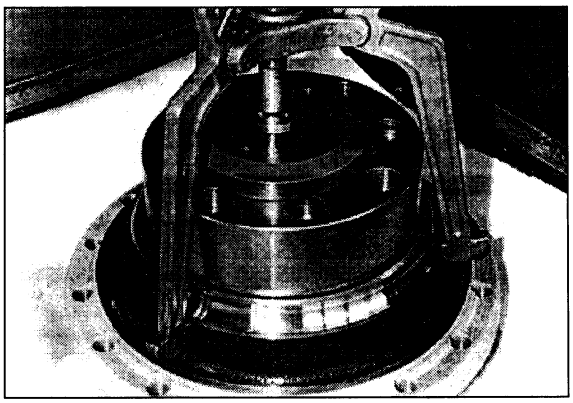


DISASSEMBLING

STEP 25
Remove the 2°nd half seal (pos. 16) from the gearbox housing (pos. 15).



STEP 26
Using a puller remove the inner ring of the bearing from the flanged hub (pos. 18).



Note

The track drive disassembling ends with the above operation: all items are now available for the necessary inspections.

ASSEMBLY OF FINAL DRIVE ASSEMBLY

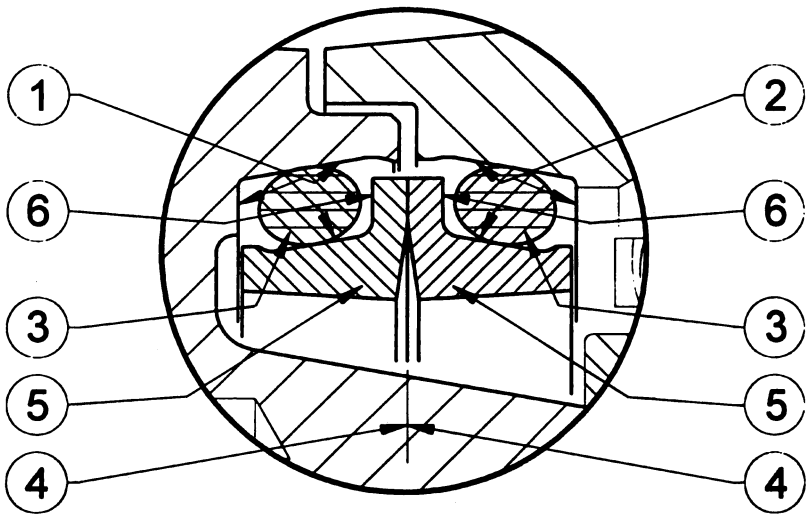
7. ASSEMBLY

1.1 IMPORTANT NOTES BEFORE ASSEMBLY

When proceeding with the gearbox reassembly, it is necessary to follow up the rules listed below:

a) In case of damaged gears, for example a planet, do not replace the single gear, but th whole reduction stage.

b) Always replace the O-rings of the item to be reassembled after having carefully cleaned the seats and having buttered some grease on the groves themselves and on the O-rings to make easier the reassembly.



Dwg. - Detail of seal

1.2 INSTRUCTIONS FOR THE INSTALLATION OF THE HALF SALES.

To follow these instructions at the time of fitting, in order to obtain the correct seal:

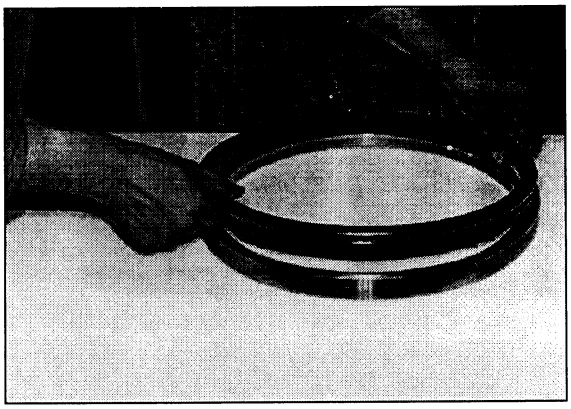
a) Carefully clean the seats "1" and "2" using, if necessary, metal brushes or solvent (surfaces in contact with or "3" must be perfectly clean and dry).

b) Make sure that sealing surfaces "4" of metal rings "5" are free from scratches, dinges or foreign substances; metal ring surfaces must be perfectly clean and dry.

c) Carefully clean the lapped surface "4" of metal rings "5" and remove dust or fingerprints. Then lubrificate them with a thin oil film, taking care not to oil the other components.

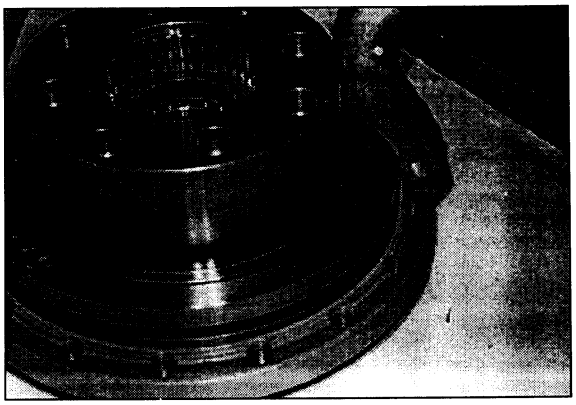
ASSEMBLING

STEP 27
Assemble the half seals (pos. 16) on the tool AT709C07.

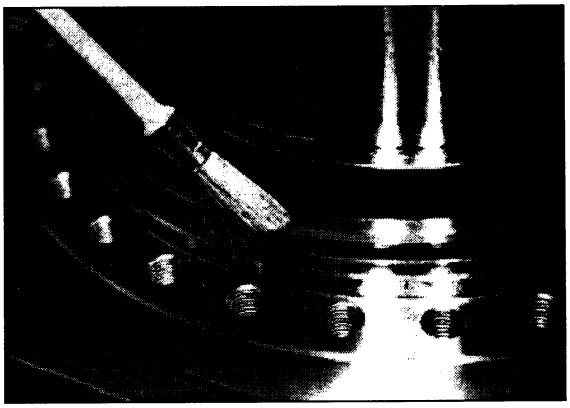


STEP 28
Assemble the 1st half seal (pos. 16) on the gearbox housing (pos. 15).

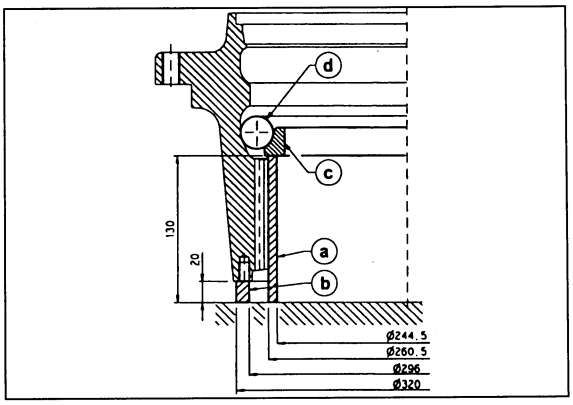
STEP 29
Assemble, by using the same tool AT709C07, the half seal (pos. 15) on the flanged hub (pos. 18).



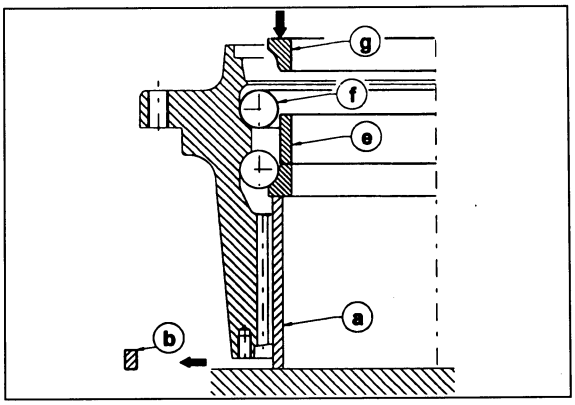
ASSEMBLING



STEP 30
Clean carefully the metallic faces of the half-seals, and Lube them metallic with a thin oil film.



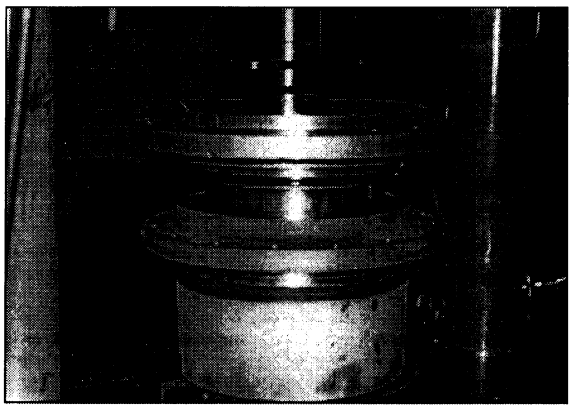
STEP 31
Fit the lower ball row (ref. d), into the gearbox housing (pos. 15) holding the inner raceway (ref. c) with spacers (ref. a-b)



STEP 32
Remove the spacer (ref. b).
Place the bearing spacer (ref. e) into its position and drop the upper ball row (ref. f).
Drop the inner raceway (ref. g).

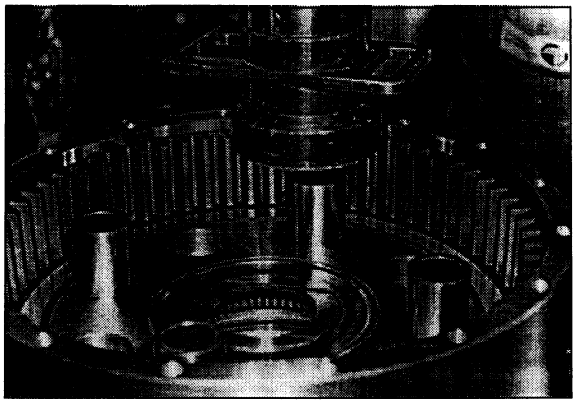
ASSEMBLING

STEP 33
Place the flanged hub (pos. 18) inside the gearbox housing (pos. 15). Using a press and a metallic stopper, push the flanged hub (pos. 18) against the shoulder on the gearbox housing (pos. 15) untill assembling of the unit is complete.



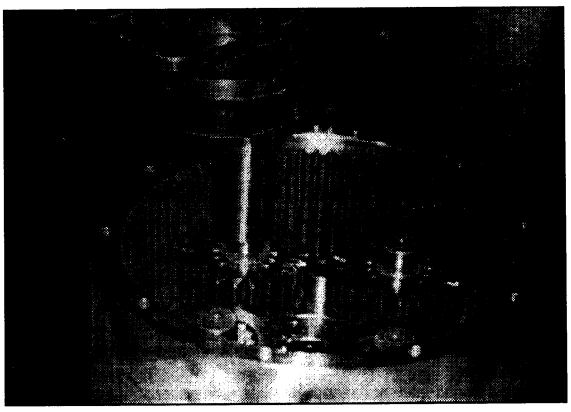
STEP 34
Assemble correctly the discs retainer (pos. 17) in the flanged hub (pos. 18)

STEP 35
Place the 4 bushes (pos. 14) into their groves on the flanged hub (pos. 18).
Through a press, push the bushes (pos. 14) against the shoulder inside their groves into the flanged hub (pos. 18) until assembling is complete.

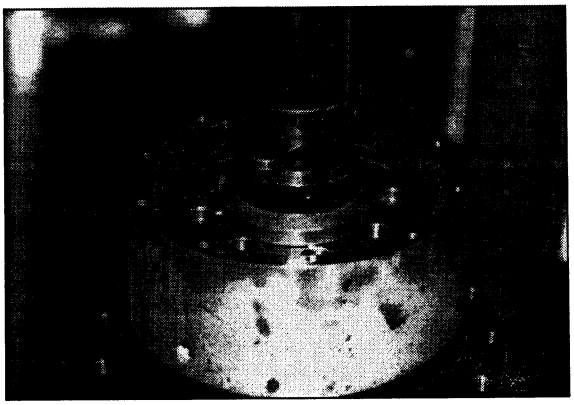


ASSEMBLING

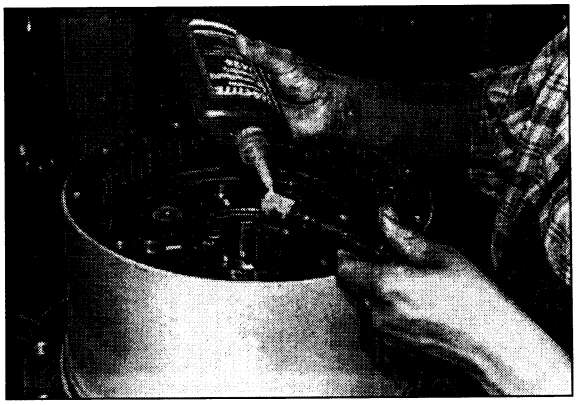
STEP 36
Using a press, push the 4 planet assemblies of the 3rd reduction (pos. 13) against the shoulder on the flanged hub (pos. 18).



STEP 37
Place the 3rd reduction planet carrier (pos. 13) on the flanged hub (pos. 18) and trough a press push it against the shoulder until assembling is complete.

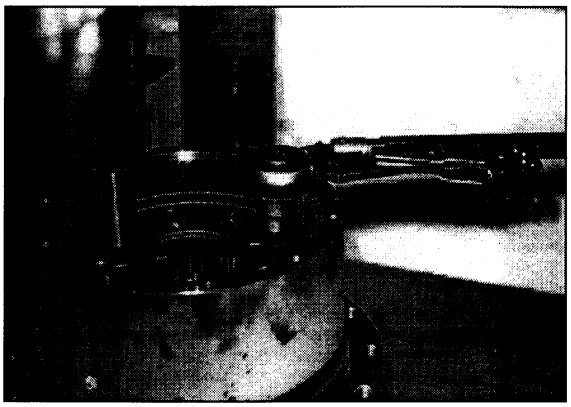


STEP 38
Apply LOCTITE type 242 on the 4 socket head screws M20x100 (pos. 12), grade 10.9, and insert them in the thread holes.

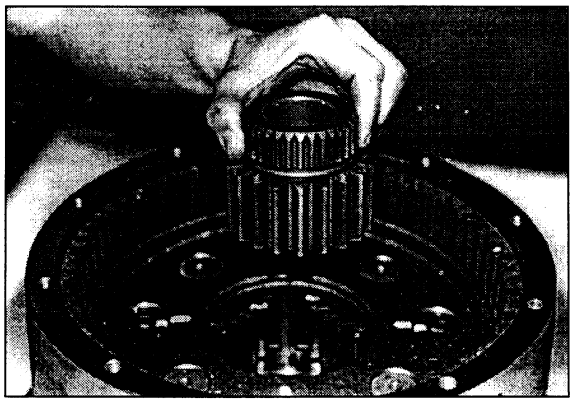


ASSEMBLING

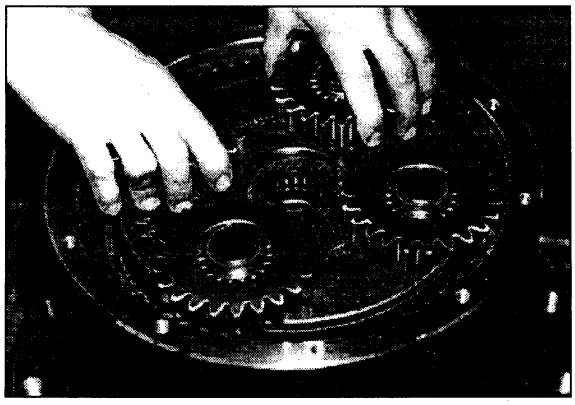
STEP 39
Tighten the 4 socket head screws M20x100 (pos. 12), grade 10.9, by a torque wrench at a torque of 58,5 daNm.



STEP 40
Insert the 3rd stage sun gear (pos. 11).

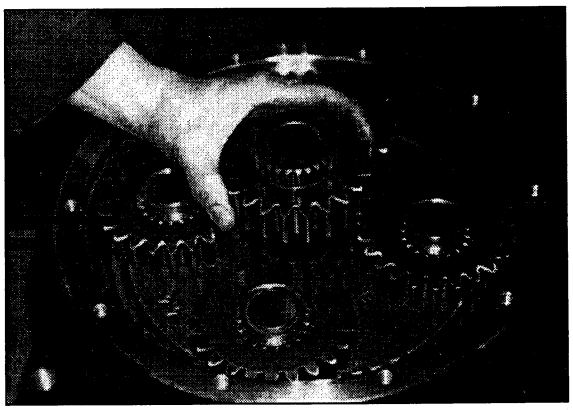


STEP 41
Assemble the 2nd reduction assembly (pos. 10).

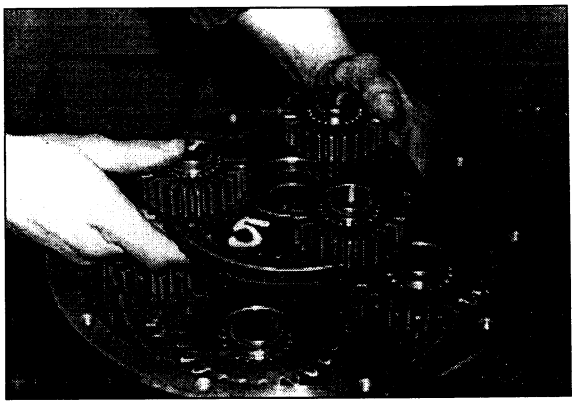


ASSEMBLING

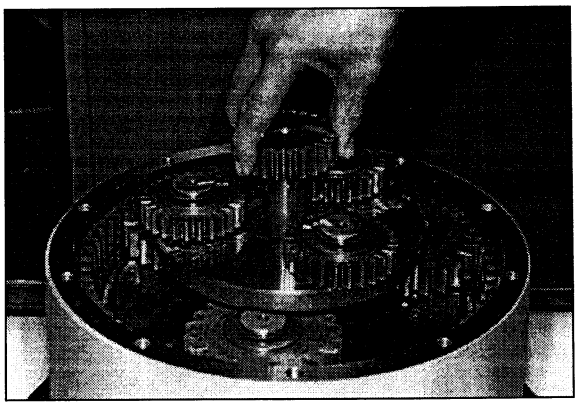
STEP 42
Insert the 2nd stage sun gear (pos. 90



STEP 43
Assemble the 1st reduction assembly (pos. 8).

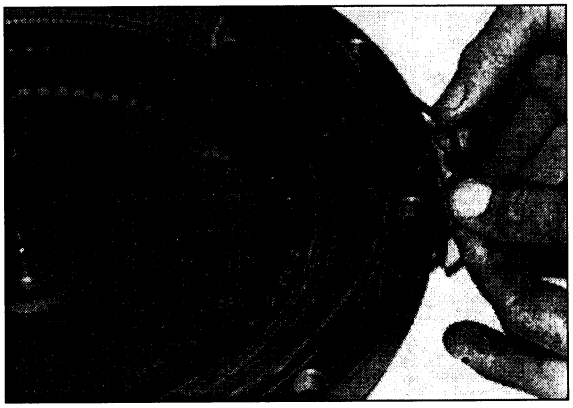


STEP 44
Insert the 1st stage sun gear (pos.7).

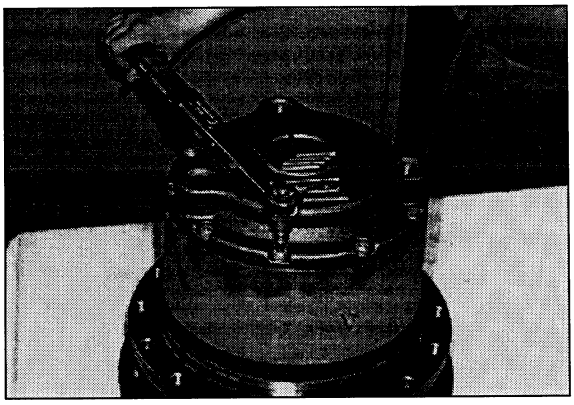


ASSEMBLING

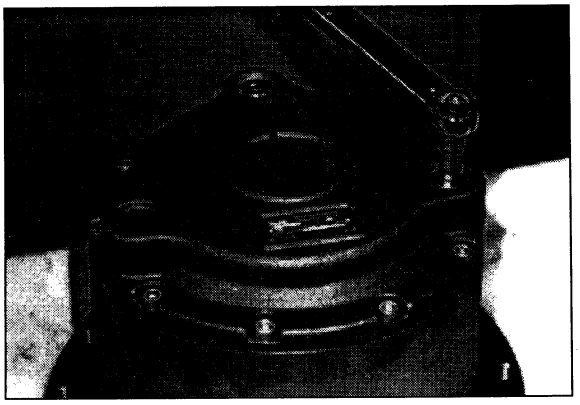
STEP 45
Mount the O-ring (pos. 5) into its grove in the cover (pos. 2).



STEP 46
Place the cover (pos. 2) on the gearbox housing (pos. 15) and fix it through 10 socket head screws M10x25 (pos. 1) grade 12.9, tightened by a torque wrench at a torque of 7,5 daNm.

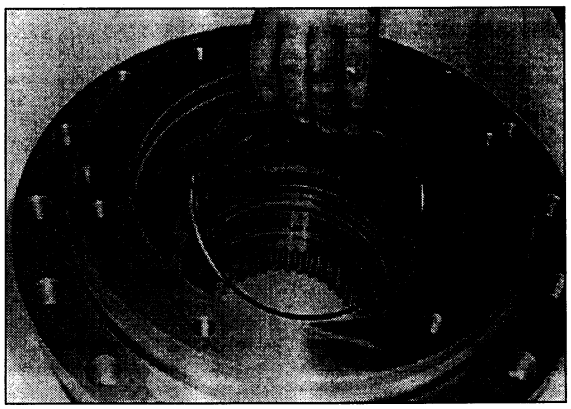


STEP 47
Mount the washers (pos. 3) and tighten the plugs M22x1,5 (pos. 4) by a torque wrench at a torque of 6-8 daNm.

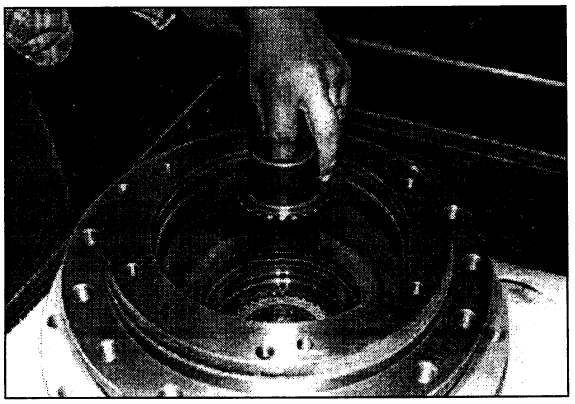


ASSEMBLING

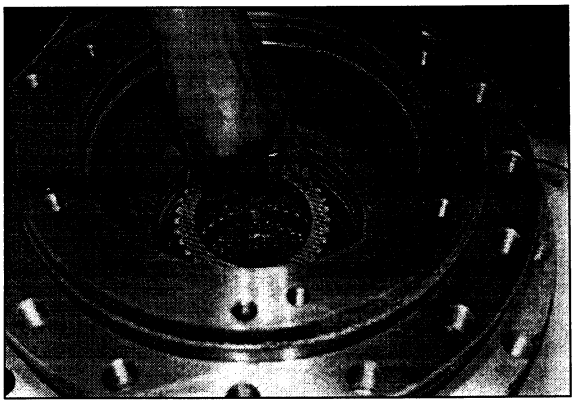
STEP 48
Apply in the internal seal's groves of the flanged hub (pos. 18) a coat of grease, and insert the O-rings (pos. 28-29)



STEP 49
Assemble the brake shaft (pos. 27)

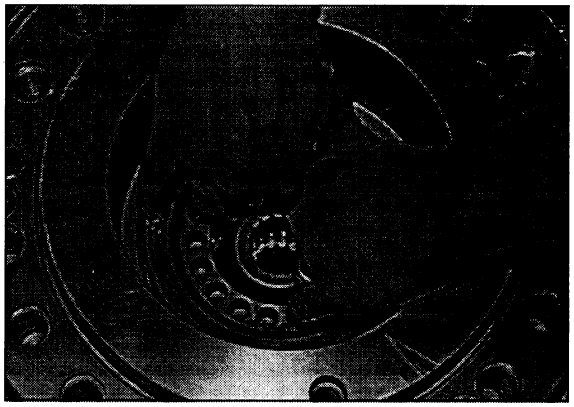


STEP 50
Assemble a new brake discs package according to the following order: firstly insert an external toothed sintered bronze disc (pos. 26). Then insert, an internal toothed steel disc (pos. 25). Repete the operating untill reaching the nummer of 6 sintered broze and 5 steel discs.

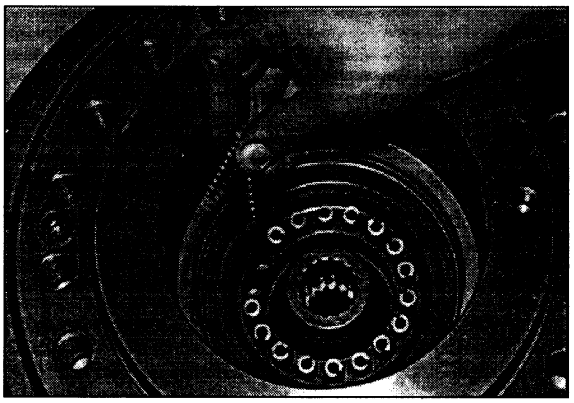


ASSEMBLING

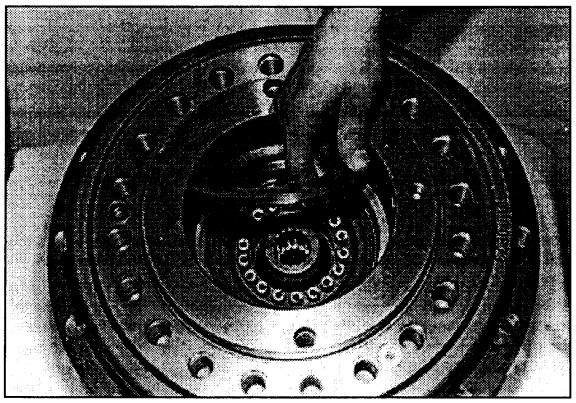
STEP 51
Insert the brake piston (pos. 23) inside the flanged hub (pos. 18), paying attention not to damage the seals already fitted.



STEP 52
Insert the springs (pos. 22) into the groves in the brake piston (pos. 23).

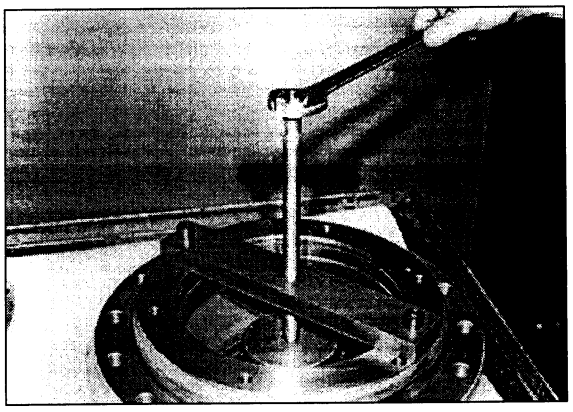


STEP 53
Insert the springs retainer (pos. 21).

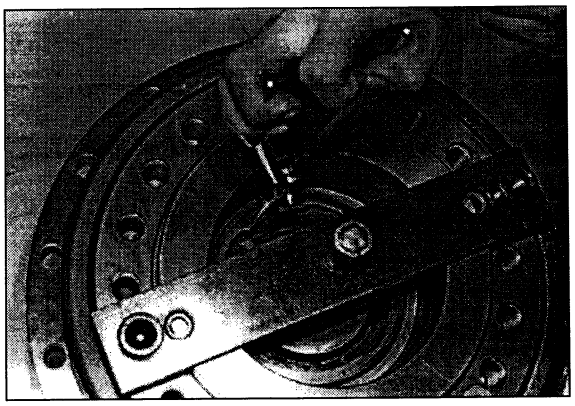


ASSEMBLING

STEP 54
Fixed the equipment AT709C15 to the flanged hub (pos. 18) and screw the threaded screw up the springs retainer disc (pos. 21) is lowerd below the circlip grove (pos. 20).



STEP 55
Through pliers, assemble the circlip (pos. 20) into grove.

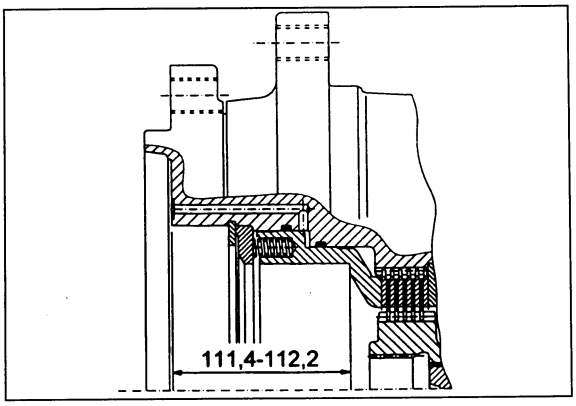


STEP 56

⚠ Note

Ater mounting the hydraulic motor, verify, trough a depth slide gauge, the axial dimension of the gearbox measured by input side of the flanged hub (pos. 18) to the brake shaft (pos. 27).

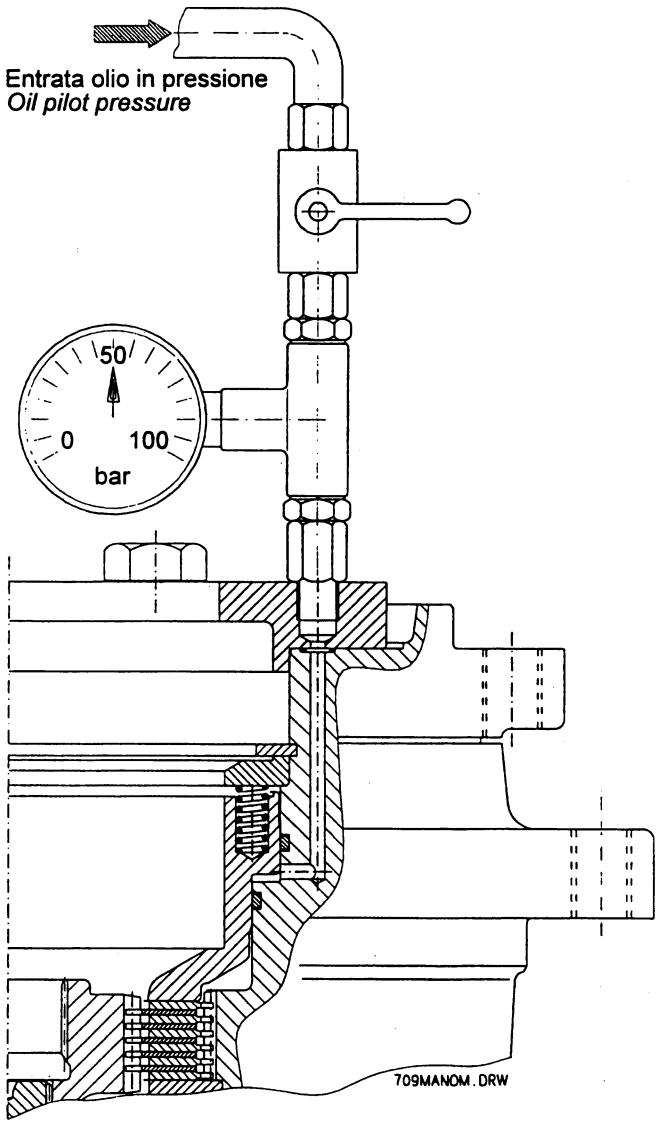
Asial dimension = 111,4 - 112,2 mm



2.1 BRAKE CHECK

In order to verify the conrrect assembly of the brake group, it is necessary to carry out a test of the seal rings. Connect the brake port to a pump and release the brake by pumping oil. By means of a pressure gauge verify that the pressure does not decrease (see dwg). In Otherwise case, the seal rings of the brake leak oil and it is necessary to disassembly the brake and provide for their replacement.

Test data: Oil pressure = 50 bar
Test duration = 3 minutes

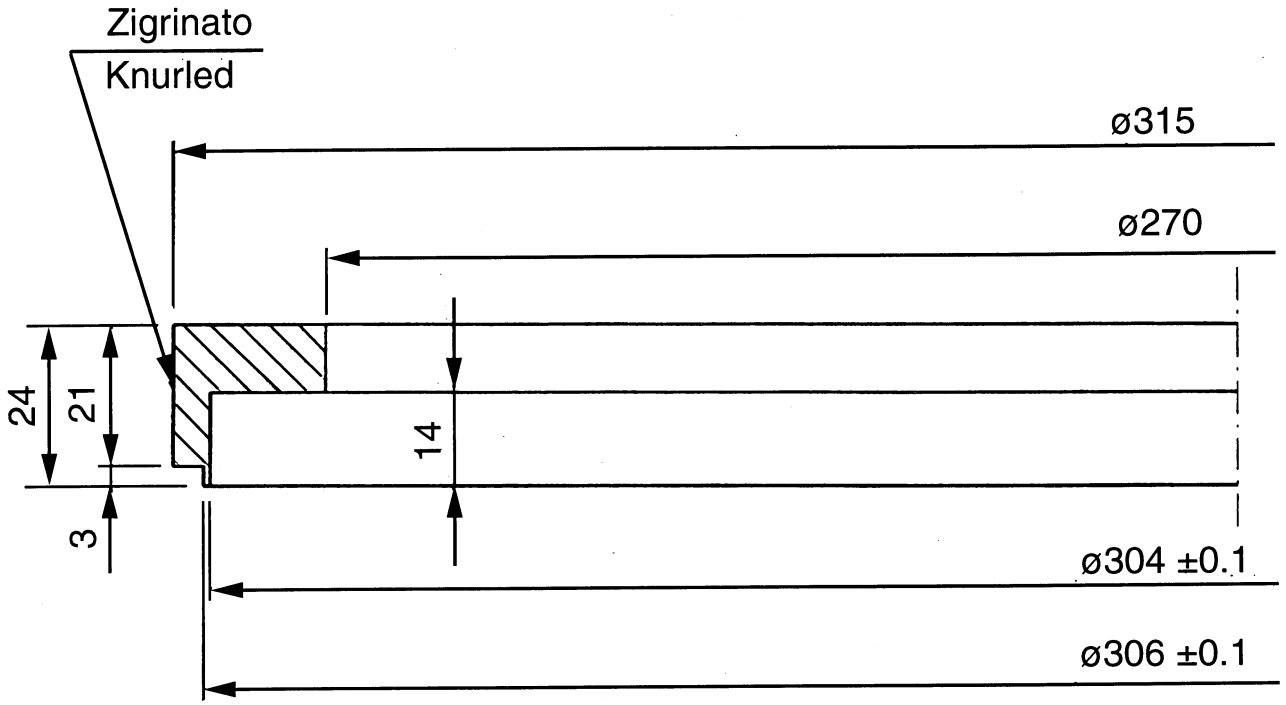


***Dwg.** - Correct brake assembly check*

STEP 57

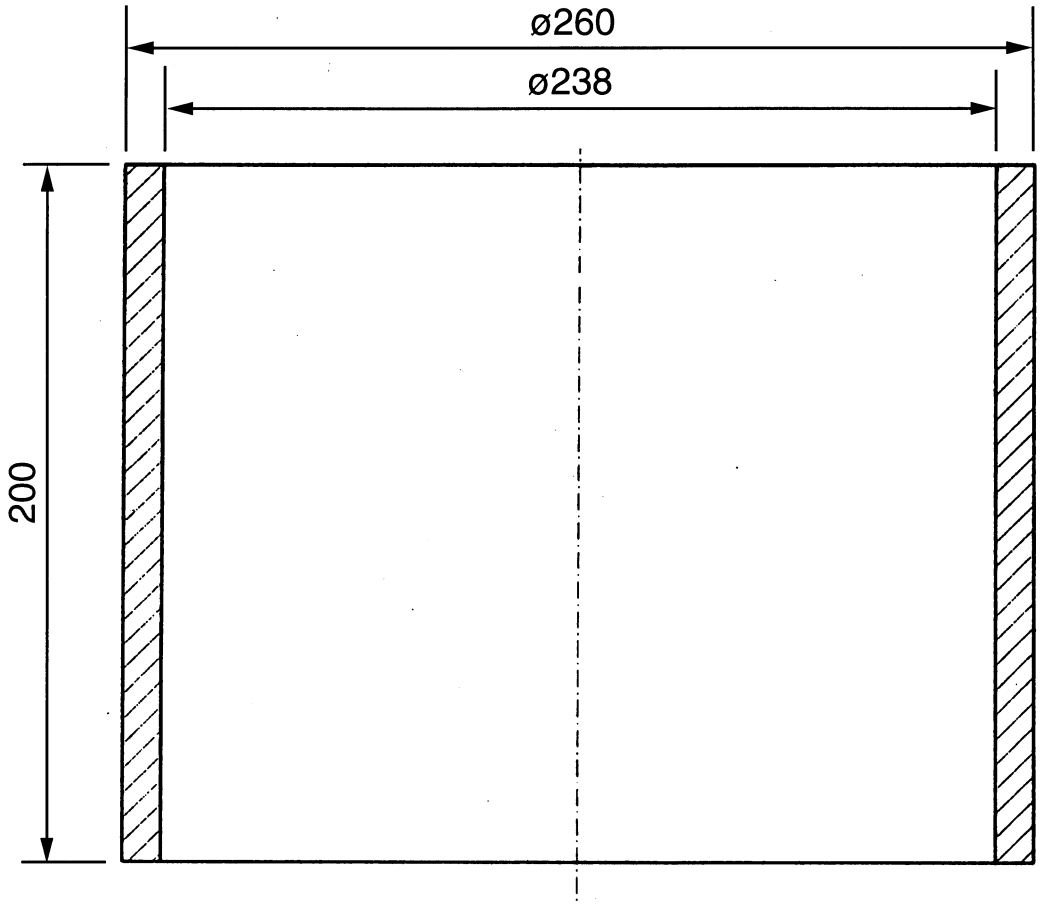
After having reassembled the gearbox, fit the hydraulic motor (taking care to include the O-ring (pos. 19), through 2 fixing screws M20x50 (pos. 24), grade 8,8 tightened at a torque of 41,5 daNm. Fill the gearbox with the lubricant oil as shown in section 4.2.

(SPECIAL TOOLS FOR FINAL DRIVE)



TOOL FOR HALF SEALS MOUNTING TRACK DRIVES

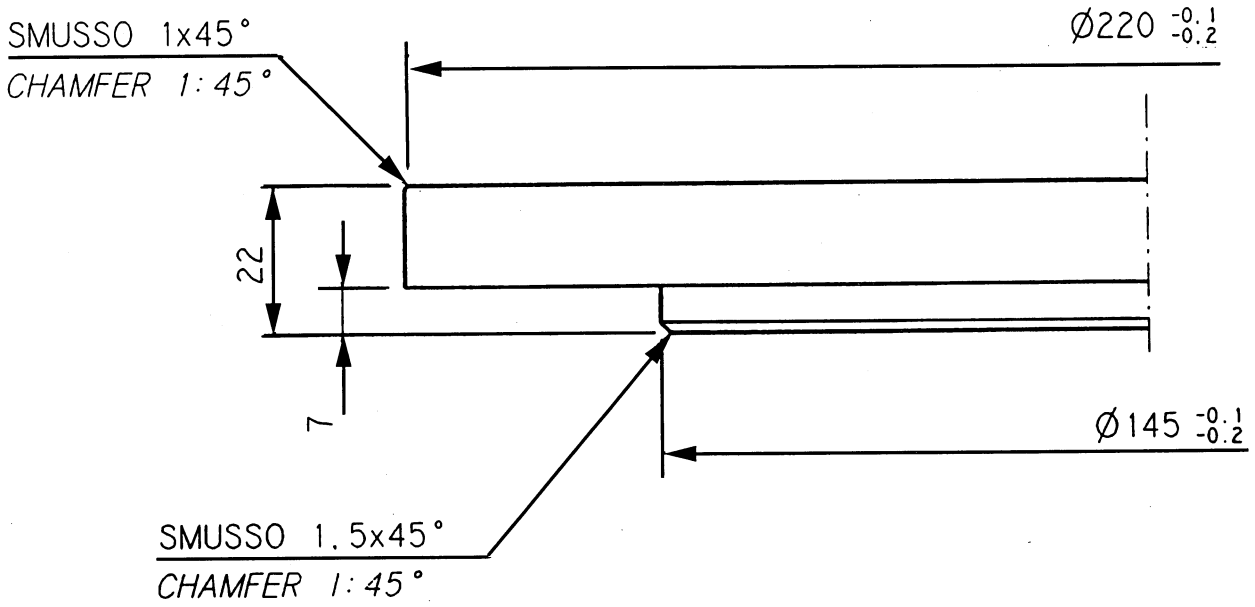
(SPECIAL TOOLS FOR FINAL DRIVE)



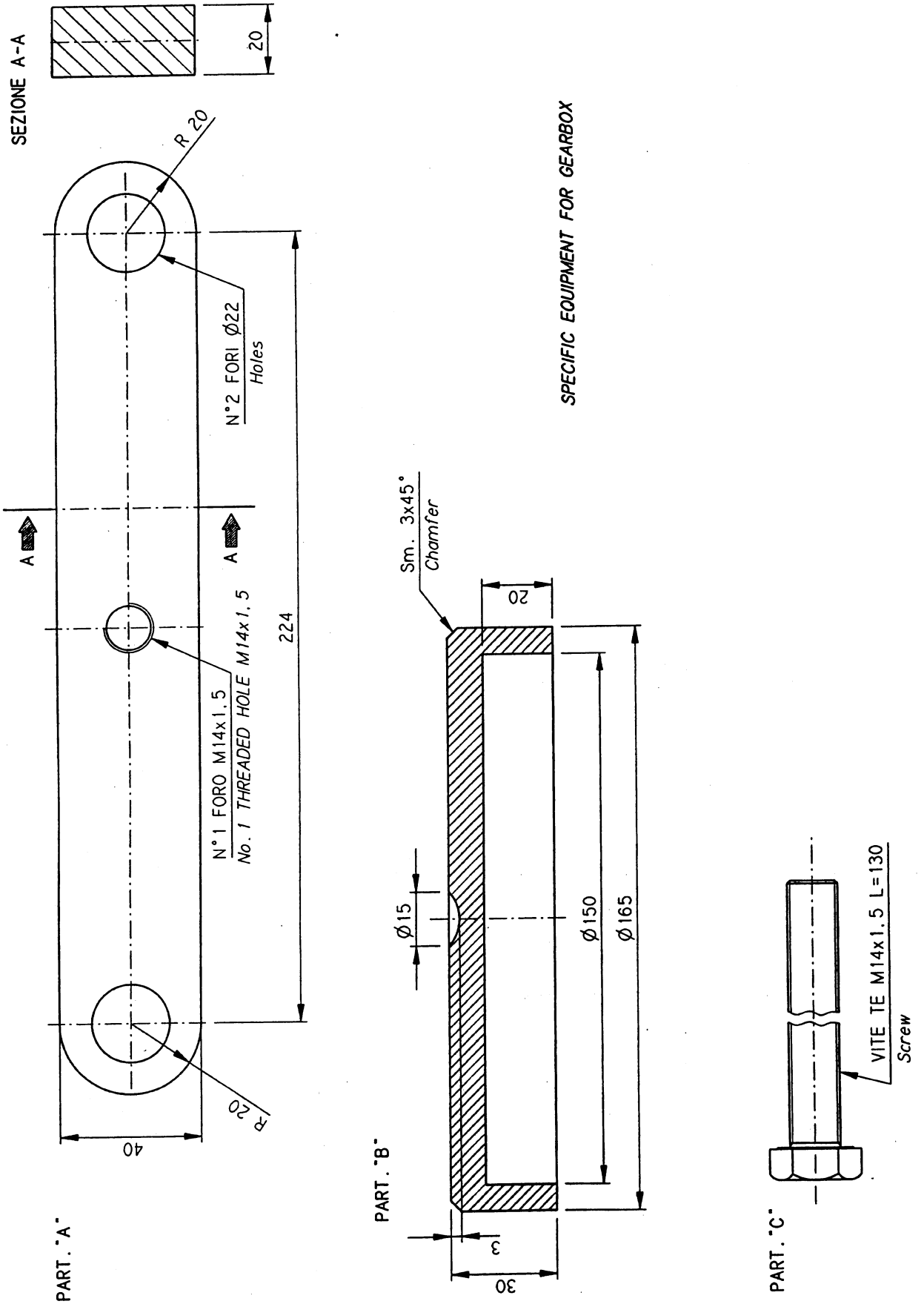
TUBE GUIDE FOR FITTING MAIN BEARING AND HOUSING TO THE GEARBOX 709C3B

12.5

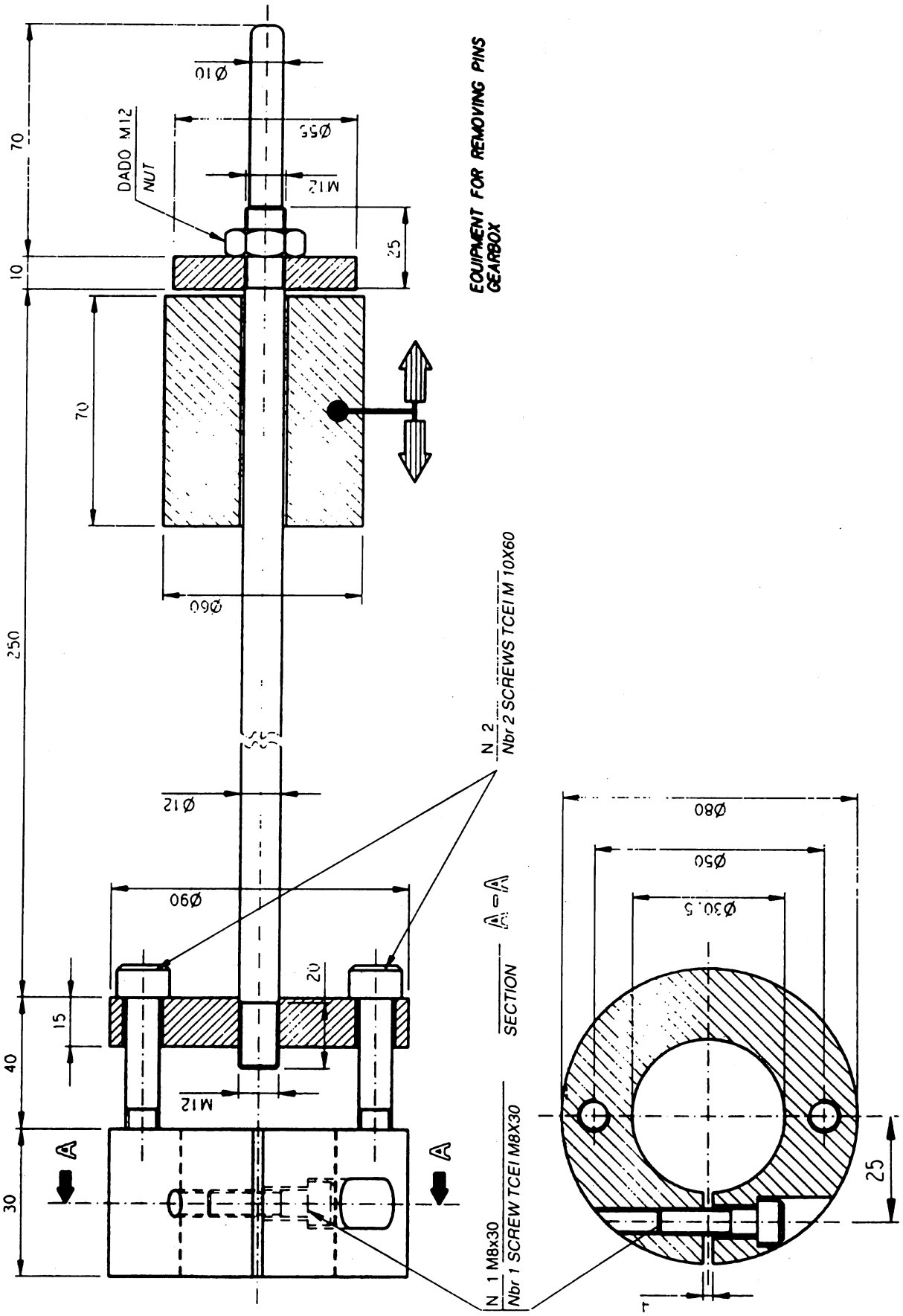
(SPECIAL TOOLS FOR FINAL DRIVE)

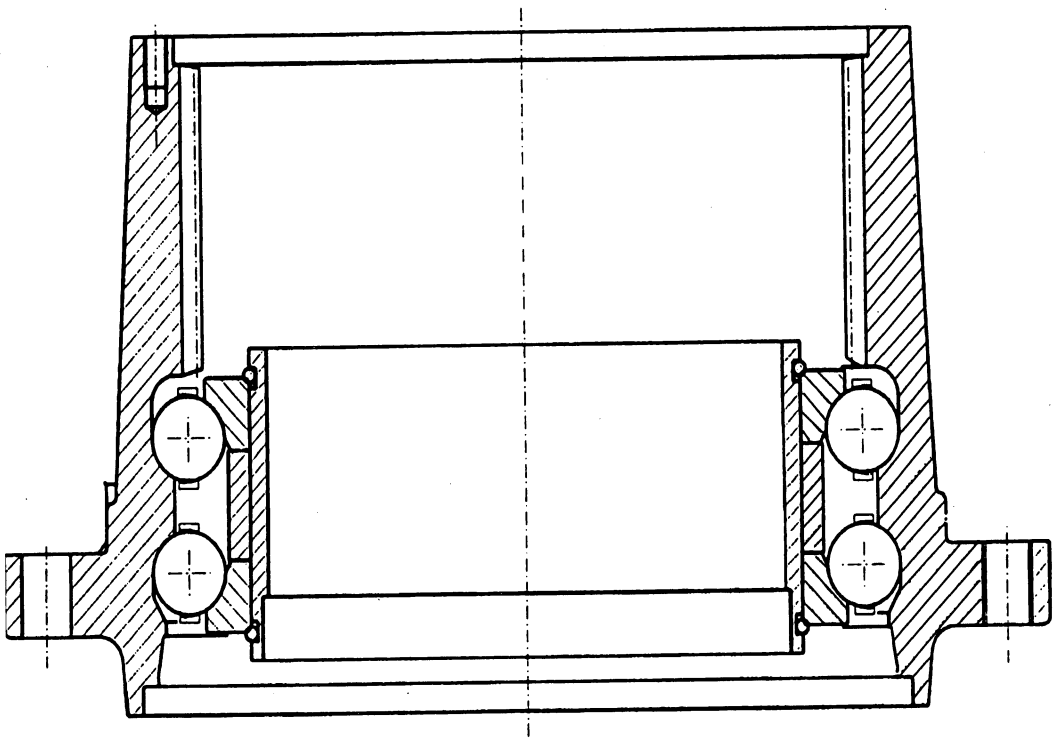


(SPECIAL TOOLS FOR FINAL DRIVE)

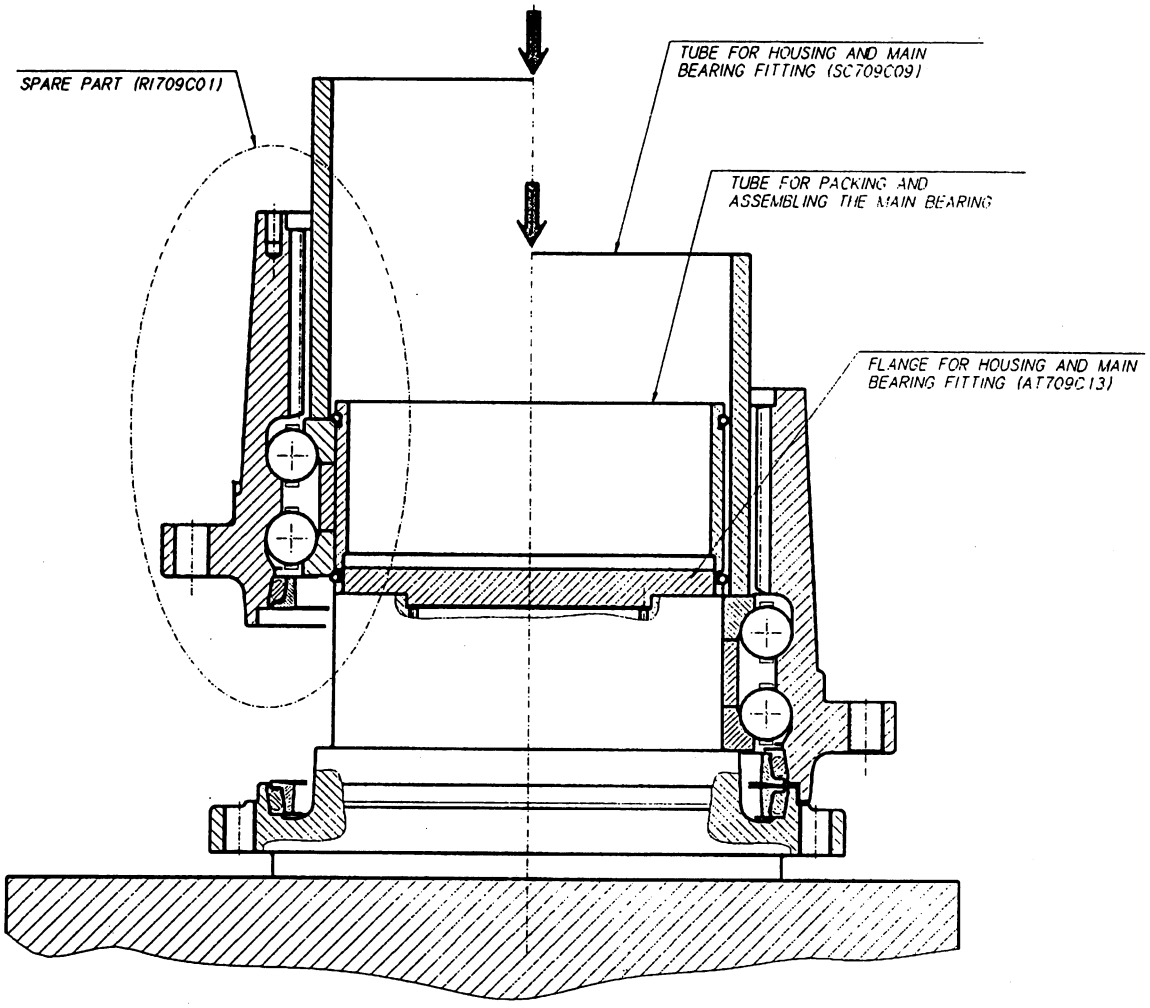


(SPECIAL TOOLS FOR FINAL DRIVE)





SPARE PART INCLUDING HOUSING AND MAIN BEARING GEARBOX


SPARE PART (RI709C01)
TUBE FOR HOUSING AND MAIN BEARING FITTING (SC709C09)
TUBE FOR PACKING AND ASSEMBLING THE MAIN BEARING
FLANGE FOR HOUSING AND MAIN BEARING FITTING (AT709C13)

DISASSEMBLY OF SWING MACHINERY ASSEMBLY

1. START UP

Operate the track drive after the motor is filled with hydraulic oil.
Leave breather open and fill with oil until oil flows out without foam. Add more oil if necessary.
Air trapped in the hydraulic system may generate noise in motor and valves as well as foaming in the tank.
Start the track drive at low speed and increase speed gradually after checking that the track drive runs smoothly with no noise or vibrations.
Do not run at max pressure until all solid particles are captured and removed by the filter.

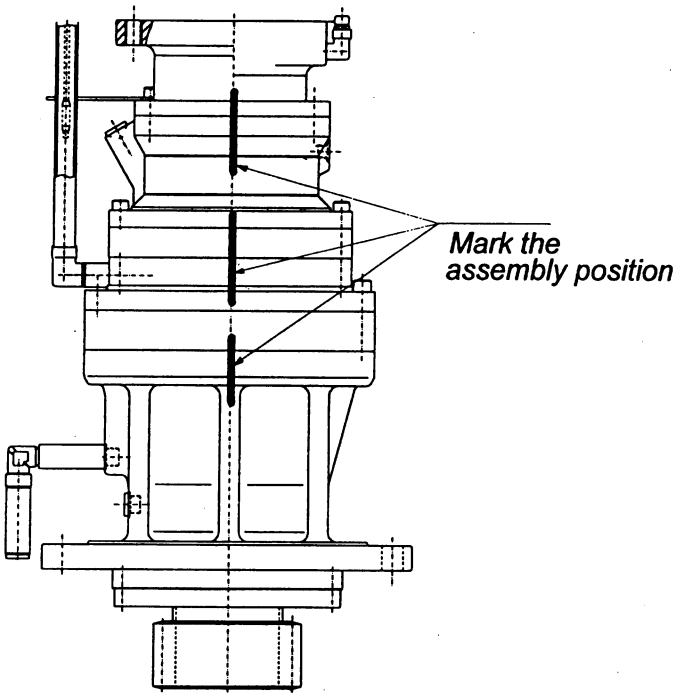
Checks the following points:
- no oil leaks,
- revolution and direction of rotation are correct,
- the oil temperature (both motor and gearbox) does not rise exceed prescribed values,
- operation is smooth without noise or vibrations,
- no other defects.

2. MAINTENANCE

Under normal operating circumstances, no routine maintenance is required, other than routine oil checks and oil changes. As recomended in this manual, unusual operating characteristics, such as noise or heat, should indicate further investigation

3. DISASSEMBLING

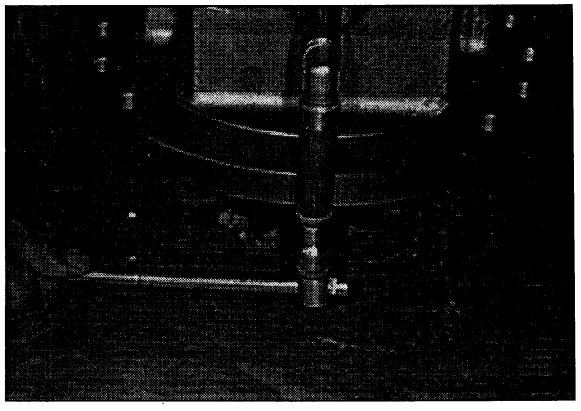
Initial inspection of the gears and the hydraulic motor, can be made without dismantling the slew drive from the machine.



Note

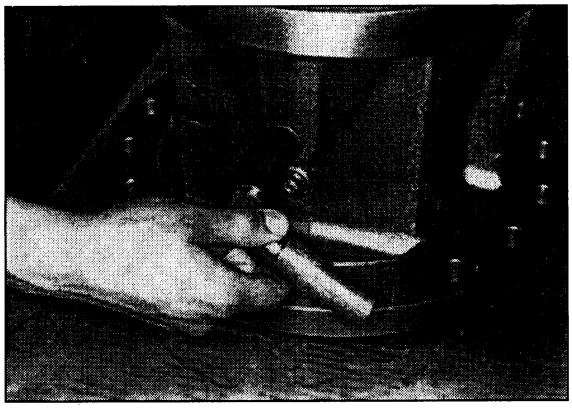
Before starting the gearbox disassembly, it is better to mark the assembly position of: motor adaptor (pos. 50), brake housing (pos. 32), toothed rings (pos. 25-18), cover (pos. 21) and gearbox housing (pos. 7) in order to obtain an exact reference of position at reassembly.
Unscrew and remove the 2 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.

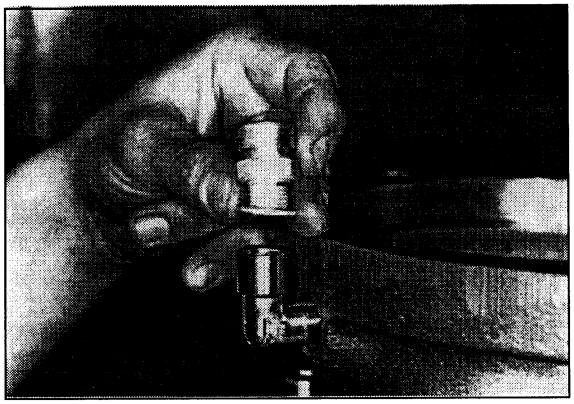


DISASSEMBLING

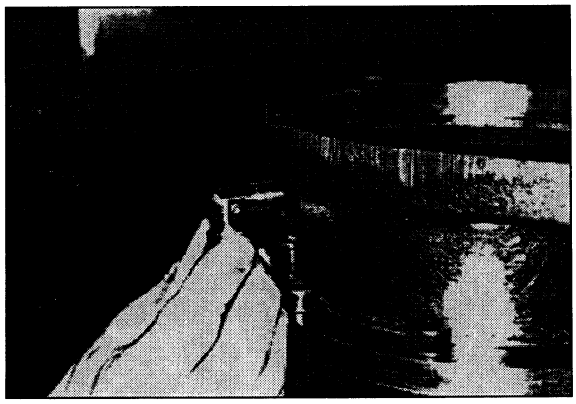
STEP 2
Remove the extentions (pos. 10), the elbow (pos. 11) and the washer (pos. 8) from the gearbox housing (pos. 7).



STEP 3
Unscrew the plug G1/4 (pos. 47) from the motor adaptor (pos. 50)

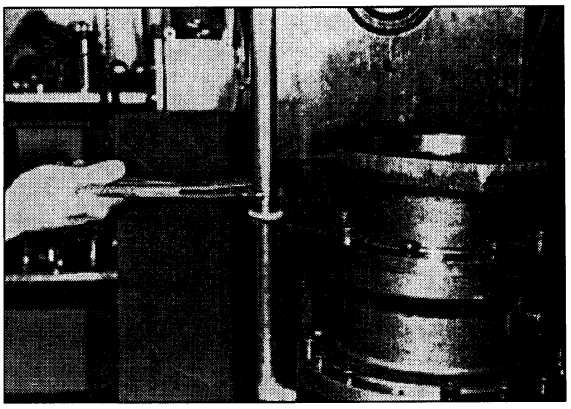


STEP 4
Unscrew the elbow (pos. 46) from the motor adaptor (pos. 50).

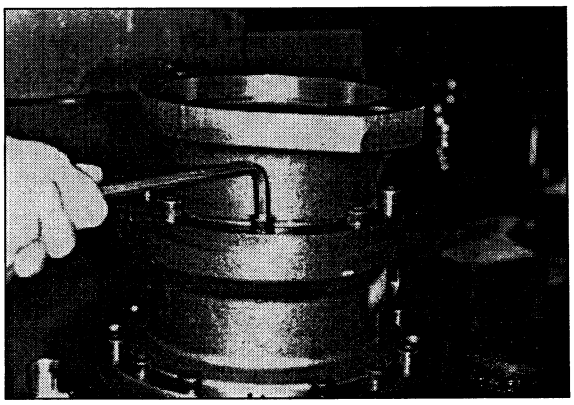


DISASSEMBLING

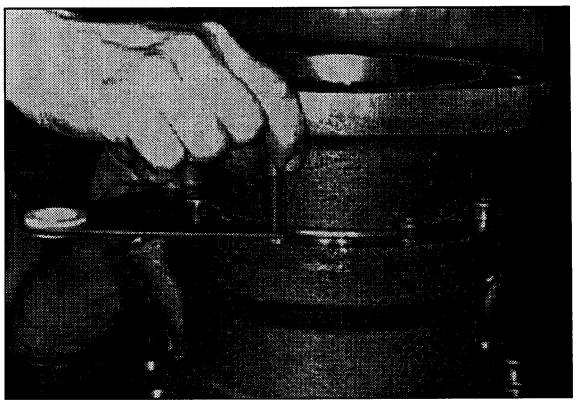
STEP 5
Unscrew the dipstick for oil filling and level kit (pos. 52).



STEP 6
Unscrew the 8 socket head screws M10x30 (pos. 48) grade 8.8, fixing the motor adaptor (pos. 50) to the brake housing (pos. 32).

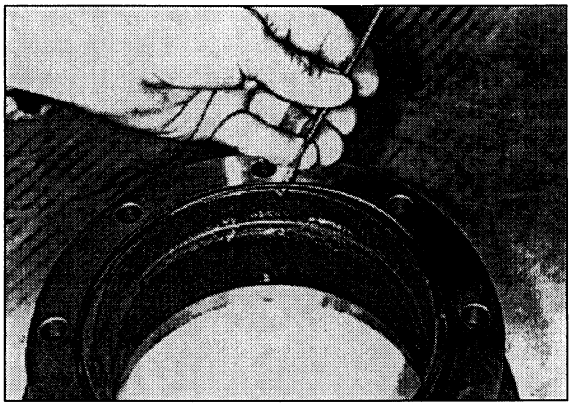


STEP 7
Remove the 8 socket head screws (pos. 48), the bracket of oil filling and level kit (pos. 52) and remove the motor adaptor (pos. 50).

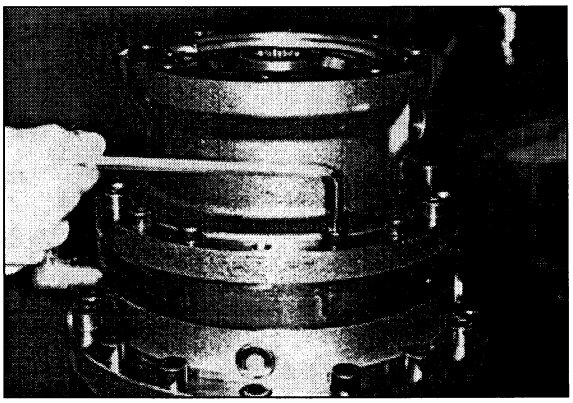


DISASSEMBLING

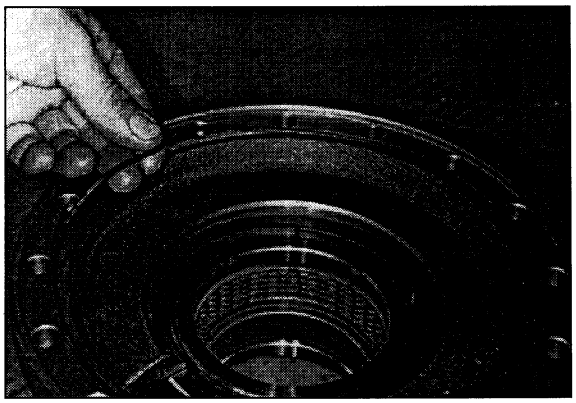
STEP 8
Remove the O-ring (pos. 44) from its seat in the motor adaptor (pos. 50).



STEP 9
Unscrew the 11 socket head screws M10x70 (pos. 33) grade 8.8 and remove the brake assembly.

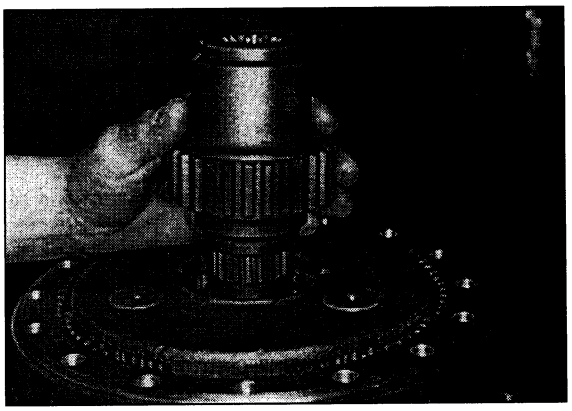


STEP 10
Overturn the brake assembly and remove the O-ring (pos. 24) from its seat in the break housing (pos. 33).

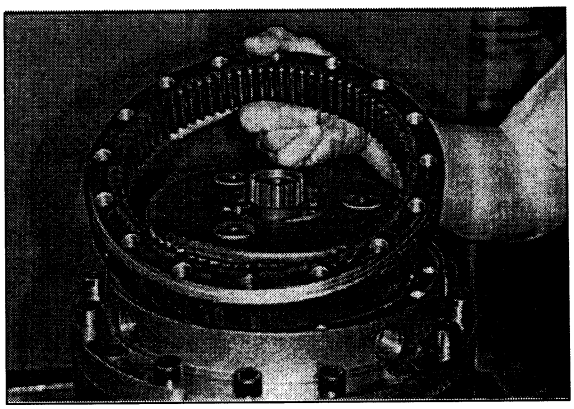


DISASSEMBLING

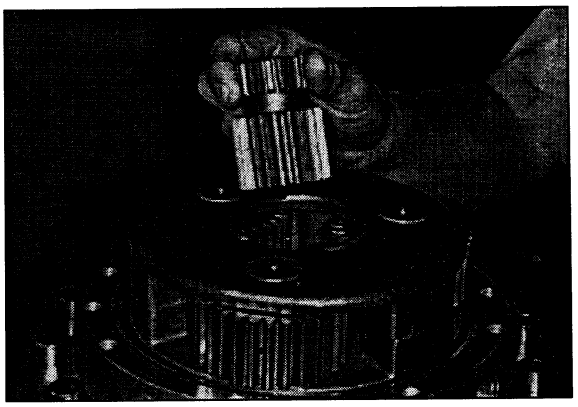
STEP 11
Remove the brake shaft (pos. 35).



STEP 12
Remove the toothed ring (pos. 25).

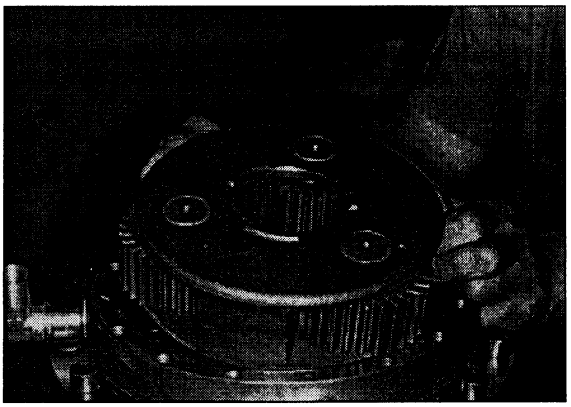


STEP 13
Remove the 1st stage sun gear (pos. 27).

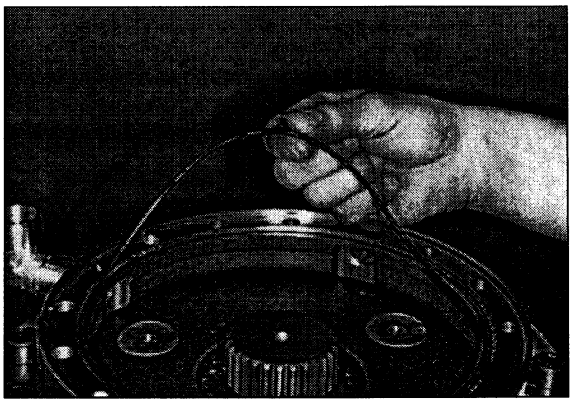


DISASSEMBLING

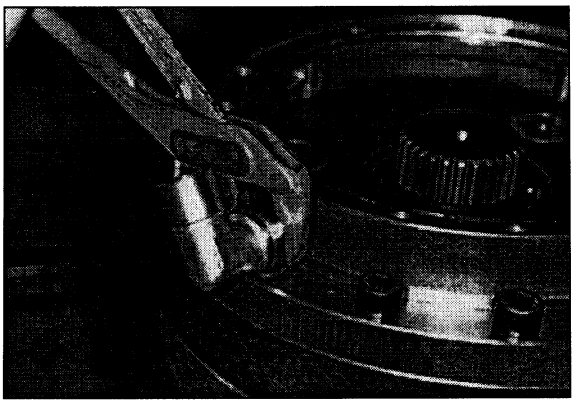
STEP 14
Remove th 1st reduction assembly (pos. 26).



STEP 15
Remove the O-ring (pos. 24) from its seat in the cover (pos. 21).

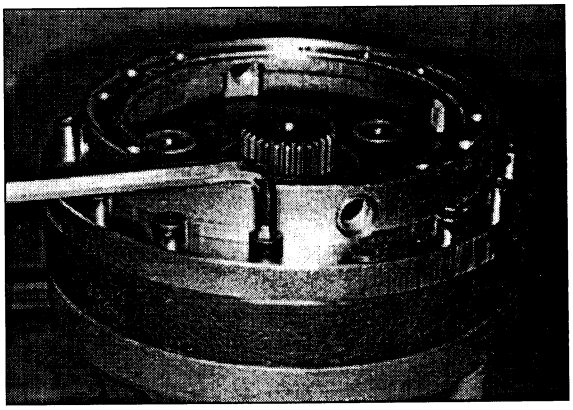


STEP 16
Using pliers remove the elbow and the extension of the oil filling and level kit (pos. 52) from the cover (pos. 21) and all plugs and washers present in the gearbox too.

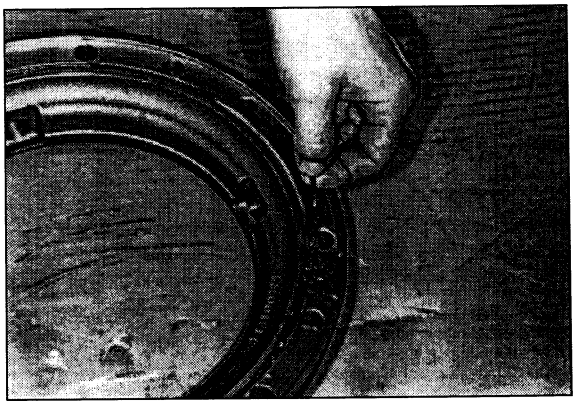


DISASSEMBLING

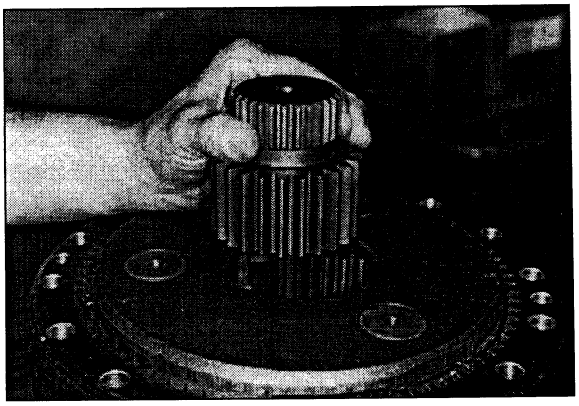
STEP 17
Unscrew the 4 socket head screws M12x80 (pos. 22), grade 12.9, and the 12 socket head screws M12x90 (pos. 23), grade 12.9, and remove the cover (pos. 21).



STEP 18
Remove the O-ring (pos. 12) from its seat in the end cover (pos. 21).

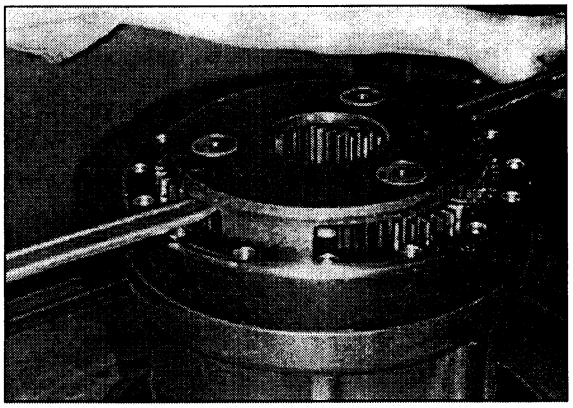


STEP 19
Remove the 2nd stage sun gear (pos. 19).

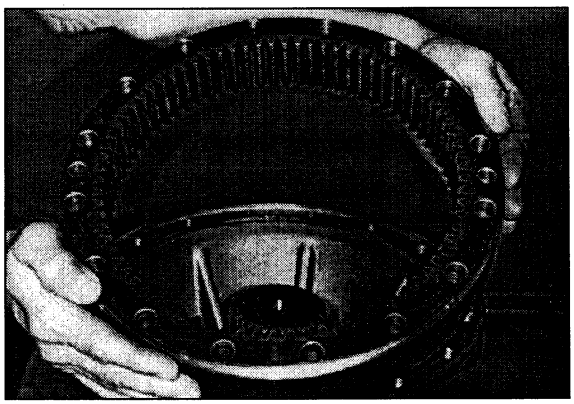


DISASSEMBLING

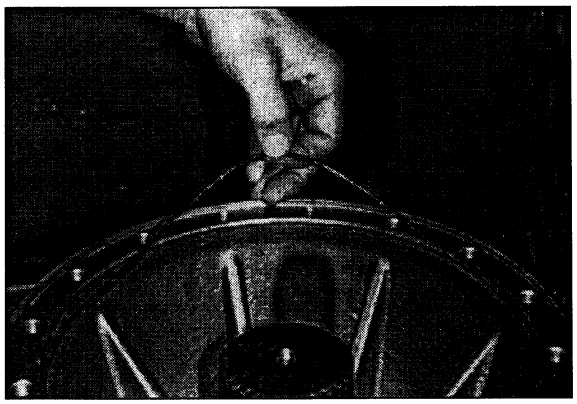
STEP 20
Remove the 2nd reduction assembly (pos. 17).



STEP 21
Remove the toothed ring (pos. 18).

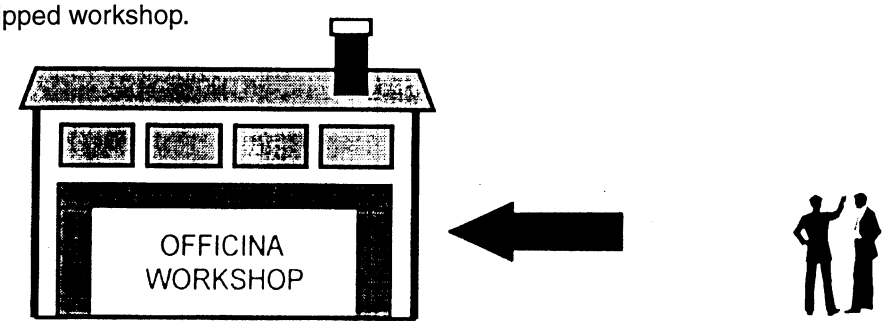


STEP 22
Remove the O-ring (pos. 12) from its seat in the gearbox housing (pos. 7).

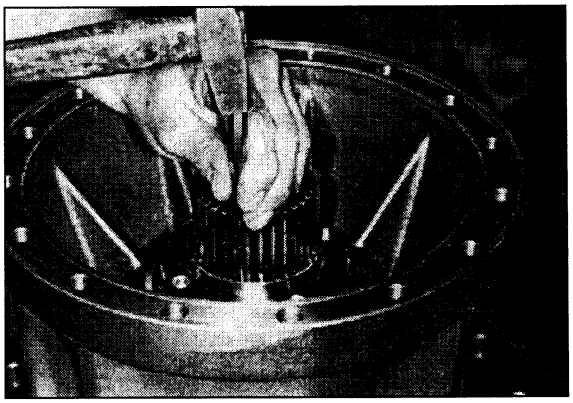


Note

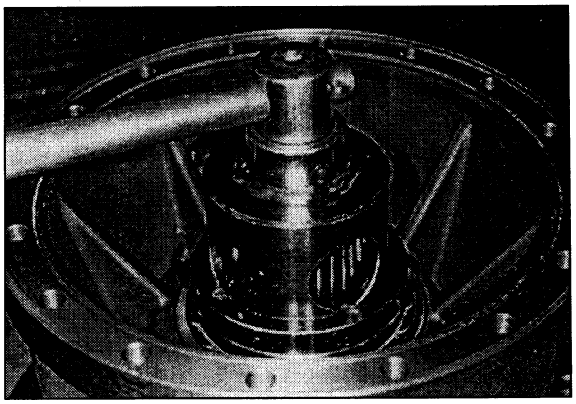
In order to proceed with the slew drive disassembling, it is now necessary to remove it from the machine and bring it to a properly equipped workshop.



STEP 23
By means of a punch, remove the caulking in the edge of the nut (pos. 15).

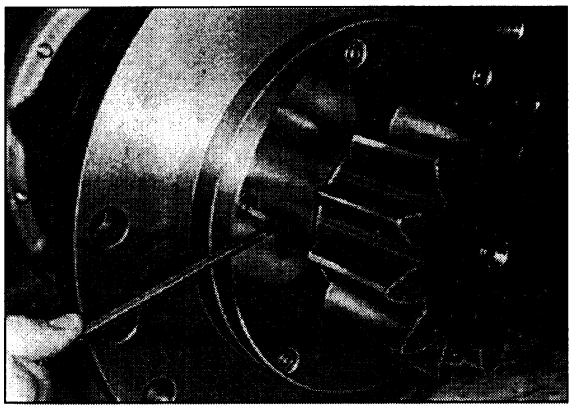


STEP 24
Using the tool AT709C06, unscrew the nut M75x2 (pos. 15).

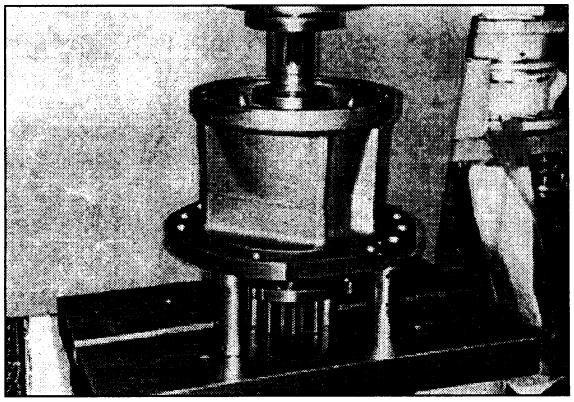


DISASSEMBLING

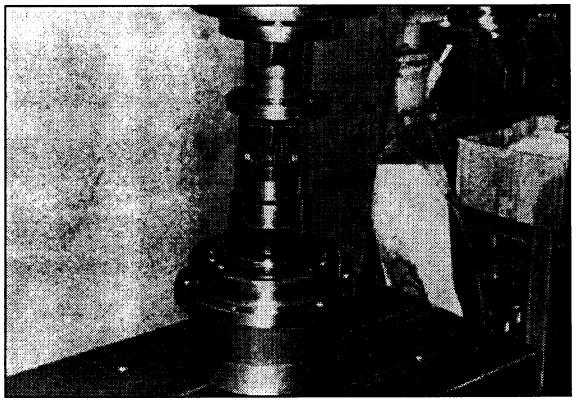
STEP 25
Overturn the output assembly (pos. 16), unscrew and remove the 8 socket head screws M8x20 (pos. 4), grade 8.8, from the front cover (pos. 5)



STEP 26
Place the gearbox housing (pos. 7) on three spacers and through a press push on the pinion shaft (pos. 1) and remove it from the gearbox housing (pos. 7).

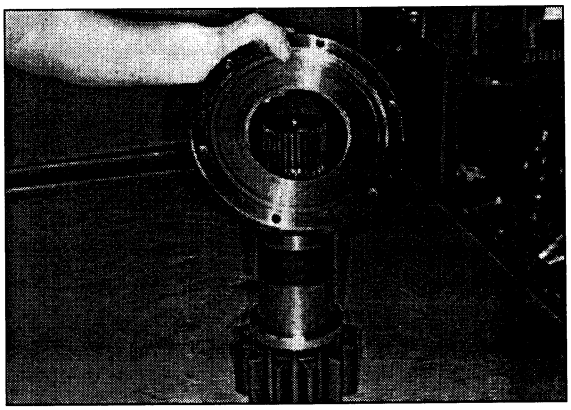


STEP 27
Place the pinion shaft (pos. 1), front cover (pos. 5) and bearing (pos. 6) group on a spacer.
Through a press push on the pinion shaft (pos. 1) and extract the bearing (pos. 6).

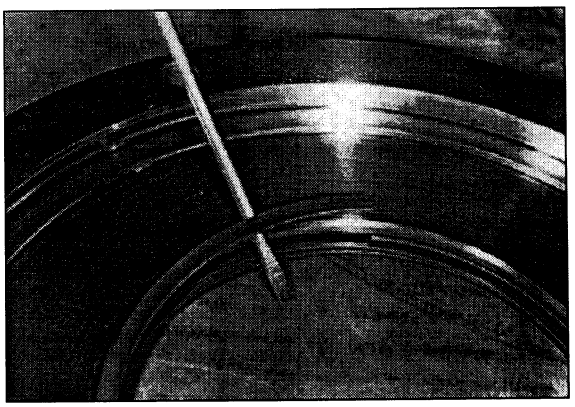


DISASSEMBLING

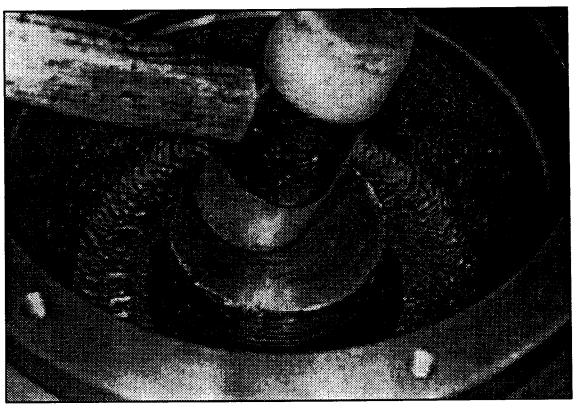
STEP 28
Remove the front cover (pos. 5).



STEP 29
Use a screwdriver to remove the ringseals (pos. 3) from their grove in the front cover (pos. 5)

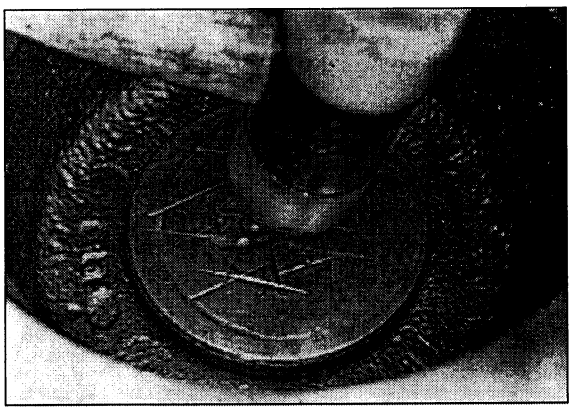


STEP 30
Use a rubber hammer a metal stopper to remove the bearing (pos. 14) from the the gearbox housing (pos. 7).



DISASSEMBLING

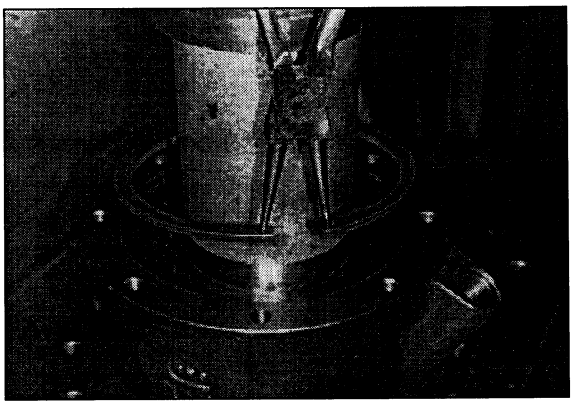
STEP 31
Use a rubber hammer a metal stopper to remove the seal ring (pos. 13). from the the gearbox housing (pos. 7).



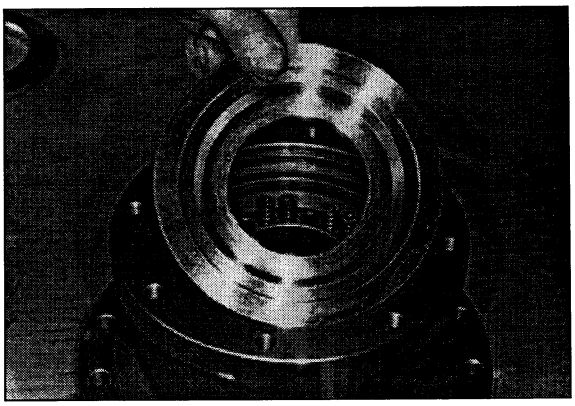
⚠ Important

Disassemble the seal ring only in case it has to be replaced.

STEP 32
Through a press and a metal stopper, push on the spring retainer (pos. 42), thus removing the force of the springs (pos. 41) on the circlip (pos. 43) and through pliers remove it.

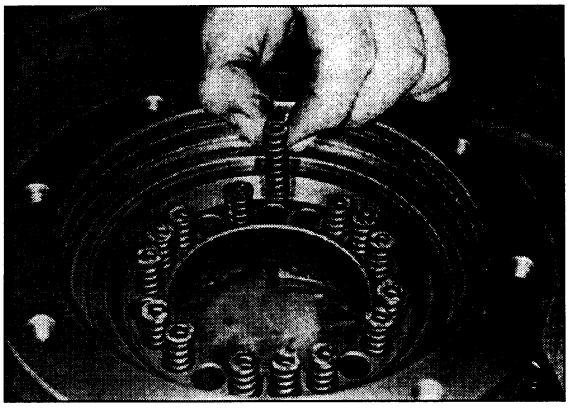


STEP 33
Remove the springs retainer (pos. 42).

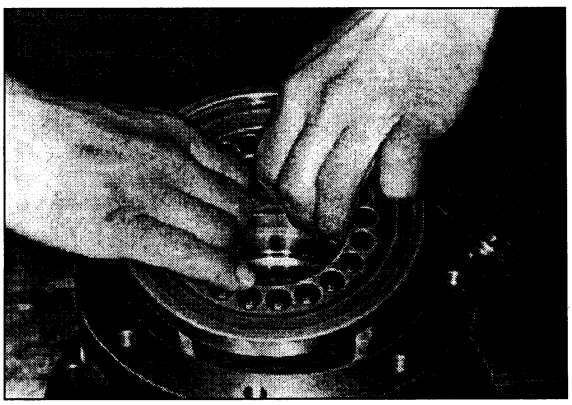


DISASSEMBLING

STEP 34
Remove the springs (pos. 41) from their groves in the brake piston (pos. 40).



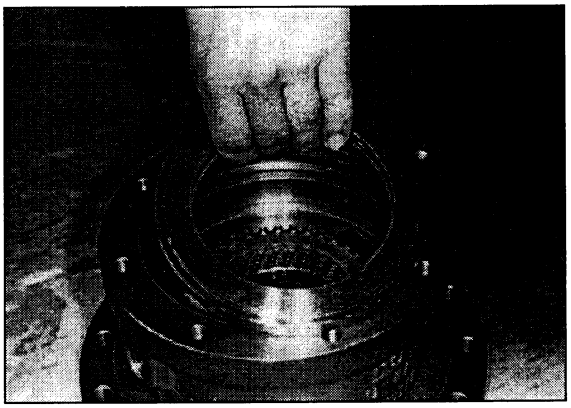
STEP 35
Remove the brake piston (pos. 40).
To get it easier, pumping compressed air into the brake port hole (max. 0,2 bar), taking care the piston (pos. 40) doesn't jump out the brake housing (pos. 32).



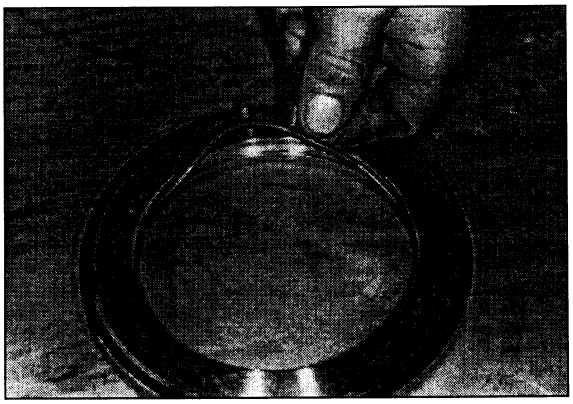
STEP 36
Remove the 1 st O-rings (pos. 34) from its seat in the brake housing (pos. 32).

DISASSEMBLING

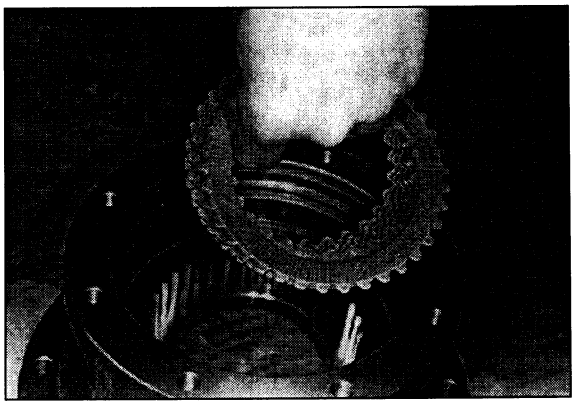
STEP 37
Remove spacer (pos. 38) and remove the 2nd O-rings (pos. 34) from its grove in the brake housing (pos. 32).



STEP 38
Remove the O-ring (pos. 39) from its seat in the spacer (pos. 38).

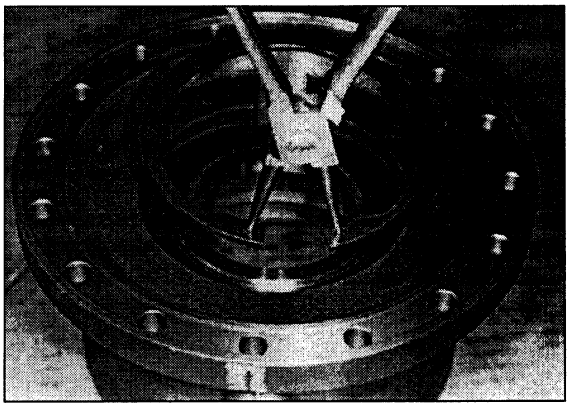


STEP 39
Remove brake discs pack (pos. 36-37).

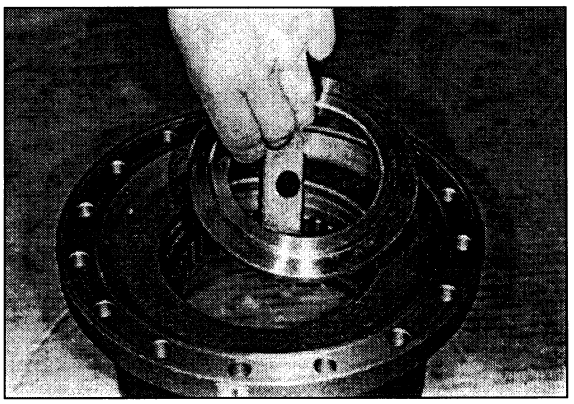


DISASSEMBLING

STEP 40
Through pliers remove the circlip (pos. 29) from its grove in the brake housing (pos. 32).



STEP 41
Remove the discs retainer (pos. 30)



⚠ Note
The gearbox disassembling ends with the above operation: all items are now available for the necessary inspections.

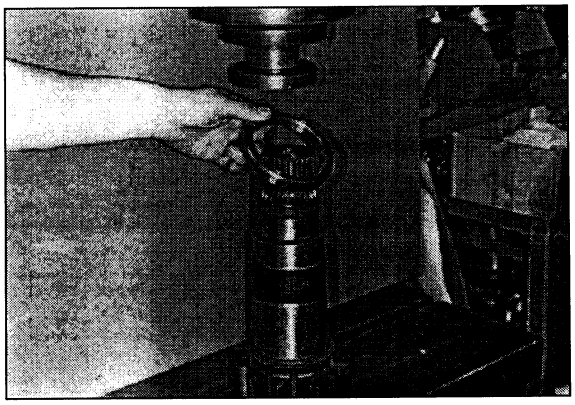
4. ASSEMBLY

4.1 IMPORTANT NOTES BEFORE THE ASSEMBLING

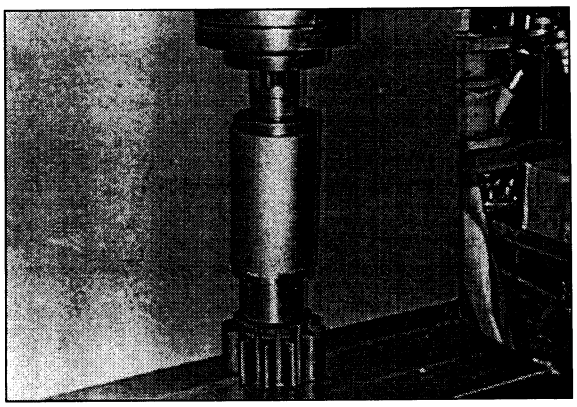
When proceeding with the gearbox reassebly, it is necessary to follow up the rules listed below:

a) In case of damaged gears, for example a planet, **do not replace the single gear, but the whole reduction stage.**
b) **Always replace the O-rings of the item to be reassembled** after having carefully cleaned the seats and having butterd some grease on the groves themselves and on the O-rings to make easier the reassembly.

STEP 42
Place correctly the spacer (pos. 2) on th pinion shaft (pos. 1).



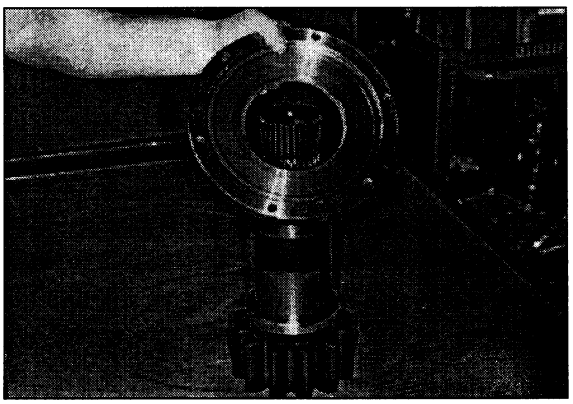
STEP 43
Through a press and a metal stopper push the spacer (pos. 2) against the shoulder on the pinion shaft (pos. 1) untill assembling is complete.



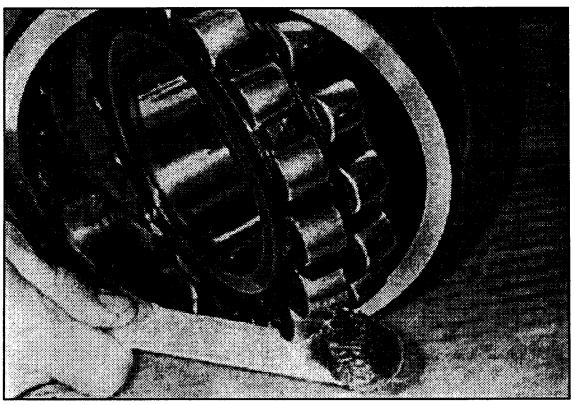
ASSEMBLING

STEP 44
Mount the seal ring (pos. 3) into its grove in the front cover (pos. 5).

STEP 45
Mount the front cover (pos. 5) on the pinion shaft (pos. 1).

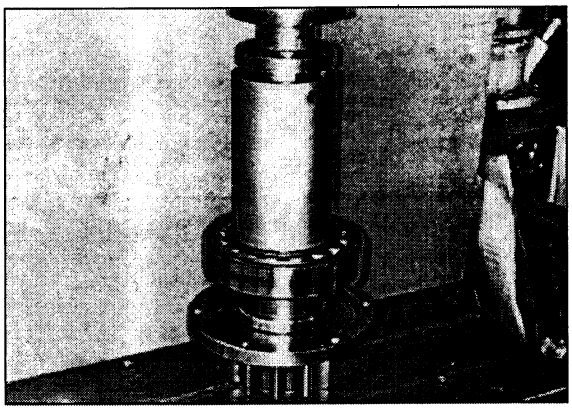


STEP 46
Apply on the bearing (pos. 6) a coat of grease type **NGLI 2 with EP characteristics.**

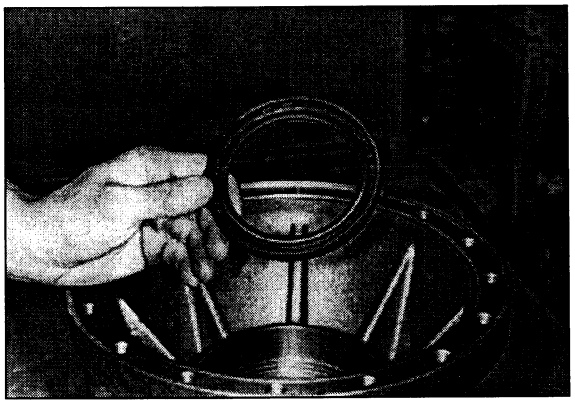


ASSEMBLING

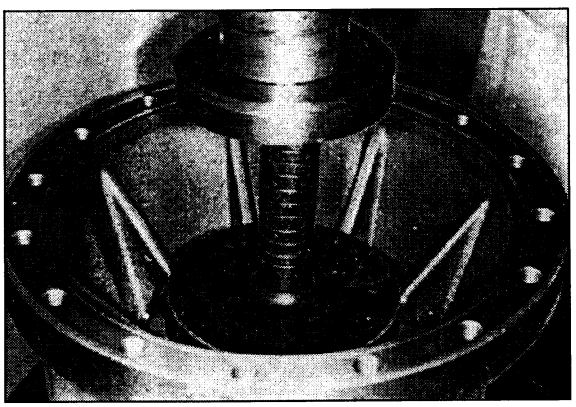
STEP 47
Place the bearing (pos. 6) on the pinion shaft (pos. 1). Through a press and a metal stopper, push the bearing (pos. 6) against the spacer shoulder (pos. 2).



STEP 48
Pace the seal ring (pos. 13) inside the gearbox housing (pos. 7).

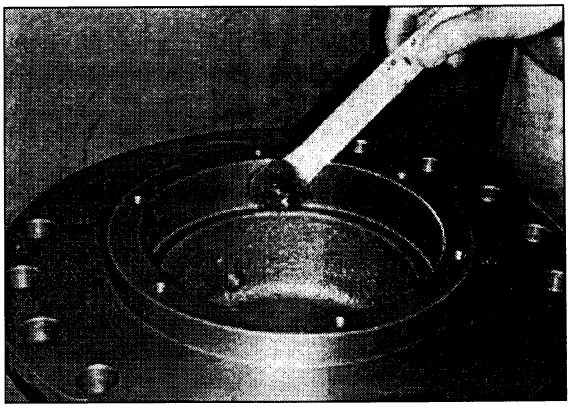


STEP 49
Through a press and the proper metal stopper AT709C14, push the seal ring (pos. 13) against the shoulder on the gearbox housing (pos. 7).

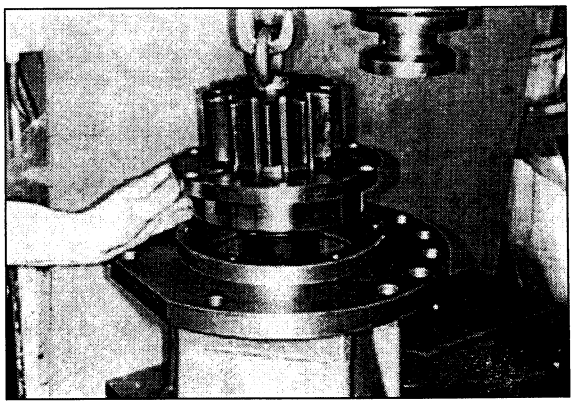


ASSEMBLING

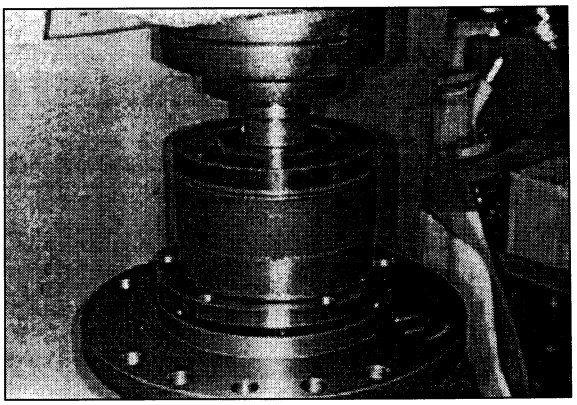
STEP 50
Overturn the gearbox housing (pos. 7) and fill with grease type **NGLI 2 with EP characteristics** the upper chamber placed between the seal ring (pos. 13) and the bearing (pos. 6).



STEP 51
Place the pinion shaft (pos. 1) -spacer (pos. 2) -front cover (pos. 5) -bearing (pos. 6) group in the gearbox housing (pos. 7).

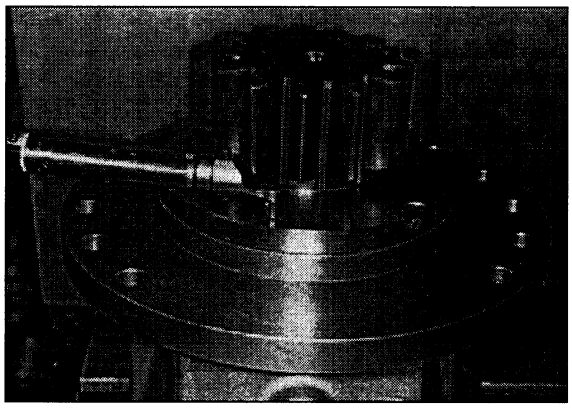


STEP 52
Usa a press and a proper metal stopper to push the pinion shaft (pos. 1) against the shoulder on the gearbox housing (pos. 7 until assembling of the unit is complete.

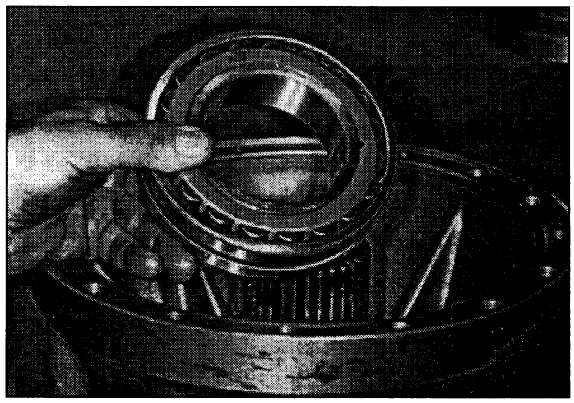


ASSEMBLING

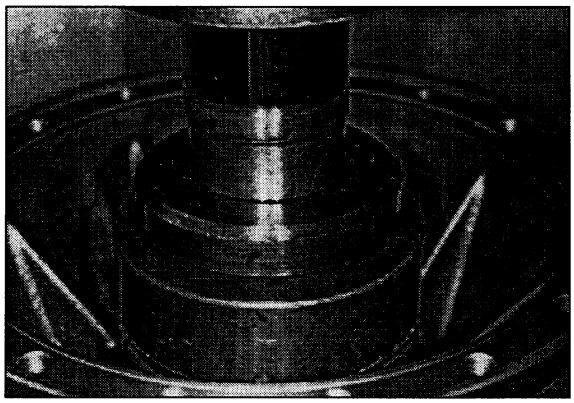
STEP 53
Tighten the 6 socket head screws M8x20 (pos. 4), grade 8.8, by a torque wrench at a torque of 2,5 daNm.



STEP 54
Overturn the gearbox (pos. 7) and place inside it the bearing (pos. 14).

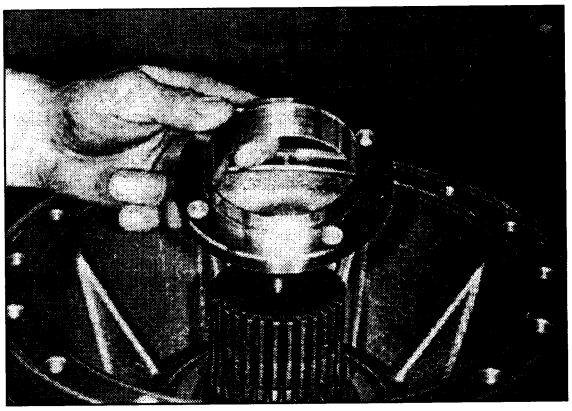


STEP 55
Use a press and the metal stopper to push the bearing (pos. 14) against the shoulder in the gearbox housing (pos. 7).

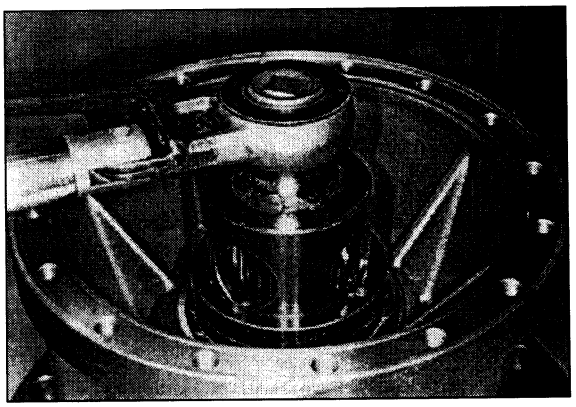


ASSEMBLING

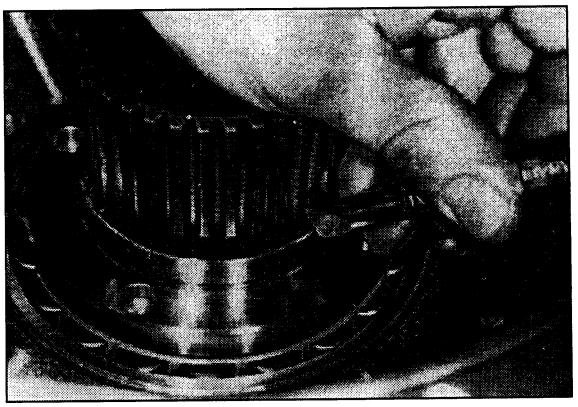
STEP 56
Place a new ring nut (pos. 15) on the pinion shaft (pos. 1). Never use the nut disassembled because already deformed.



STEP 57
Use the tool AT709C06 to tighten the ring nut M75x2 (pos. 15), by a torque wrech, at a torque of 110-120 daNm.

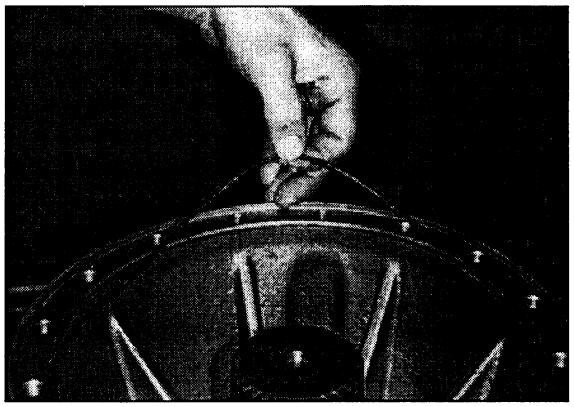


STEP 58
Caulk the ring nut (pos. 13) next to 3 spaces placed at 120° of the pinion shaft spline (pos. 1).

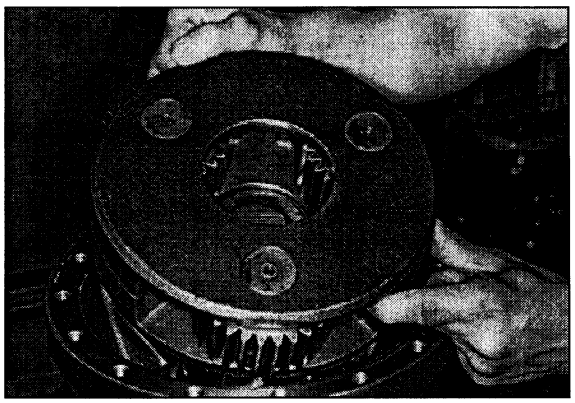


ASSEMBLING

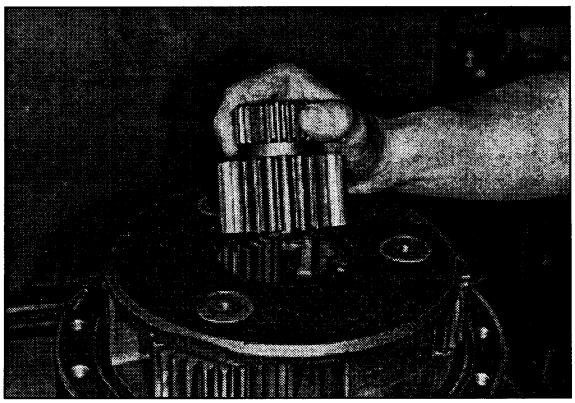
STEP 59
Apply in the O-ring's seat in the gearbox housing (pos. 7) a coat of grease.
Mount the 1st O-ring (pos. 12).



STEP 60
Assemble the 2nd reduction assembly (pos. 17).

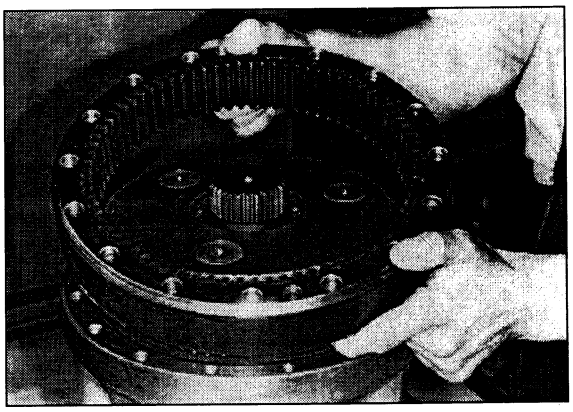


STEP 61
Insert the 2nd stage sun gear (pos. 19).

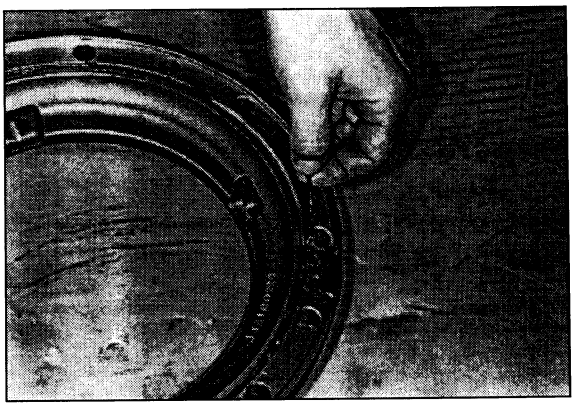


ASSEMBLING

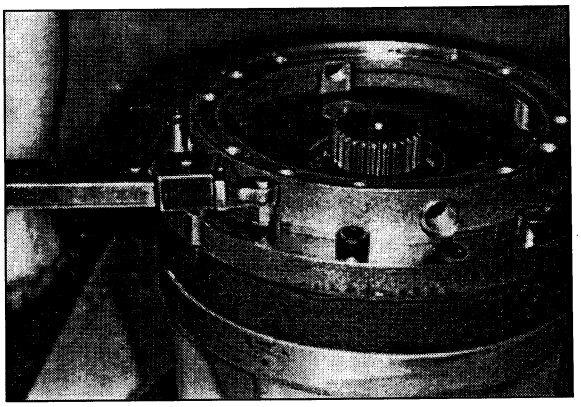
STEP 62
Assemble the toothed ring (pos. 18).



STEP 63
Apply in the O-ring's seat in the cover (pos. 21) a coat of grease.
Mount the 2nd O-ring (pos. 12).

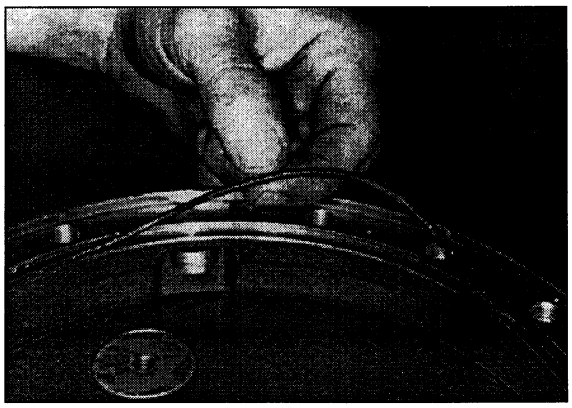


STEP 64
Place the cover (pos. 21) on the toothed ring (pos. 18) and fix it through 4 socket head screws M12x80 (pos. 22), grade 8.8, and through 12 socket head screws M12x90 (pos. 23), grade 8.8, tightened by a torque wrench at 12 daNm torque.

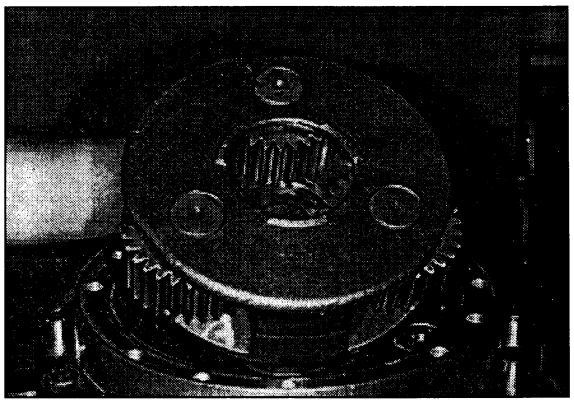


DISASSEMBLING

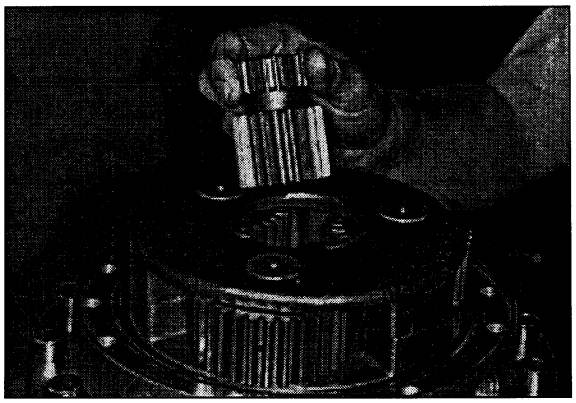
STEP 65
Apply in the O-ring's seat in the cover (pos. 17) a coat of grease.
Mount the 1st O-ring (pos. 24).



STEP 66
Assemble the 1st reduction assembly (pos. 26).

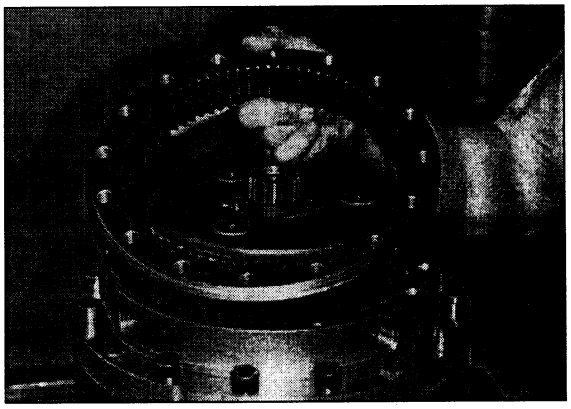


STEP 67
Insert the 1st stage sun gear (pos. 27).

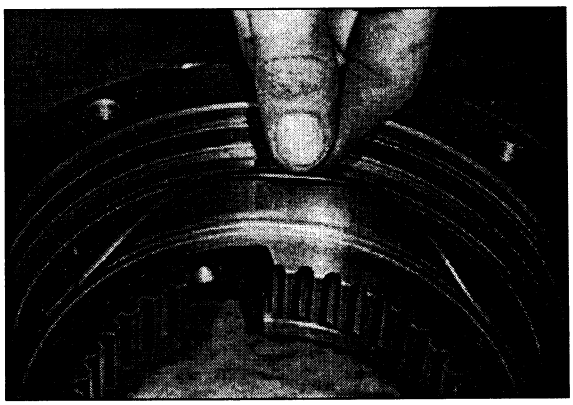


ASSEMBLING

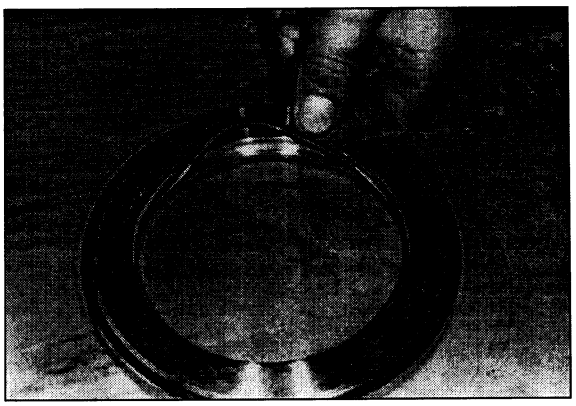
STEP 68
Assemble the toothed ring (pos. 25).



STEP 69
Apply in the internal seal's groves of the brake housing (pos. 32) a coat of grease, and insert the O-rings (pos. 34).

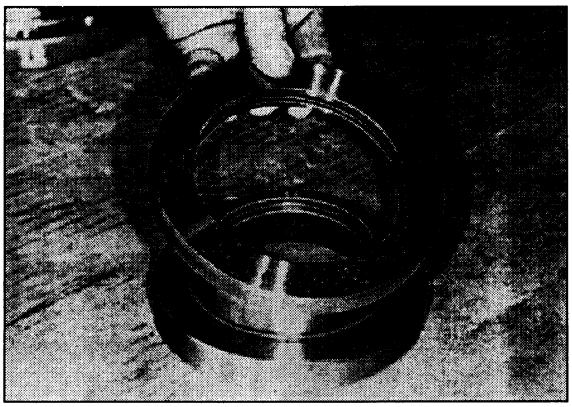


STEP 70
Apply in the inside surface of the spacer (pos. 38) a coat of grease.
Fit the O-ring (pos. 39) into its seat in the spacer (pos. 38).

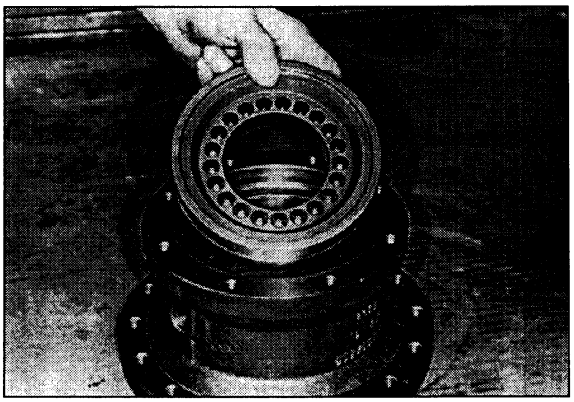


ASSEMBLING

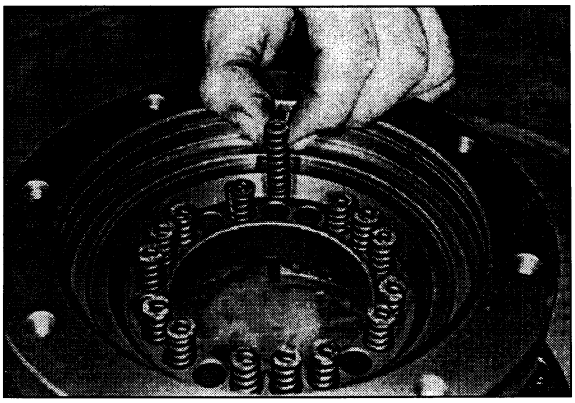
STEP 71
Assemble corectly the spacer (pos. 38) to the brake piston (pos. 40), paying attention not to damage the O-ring (pos. 39) already fitted.



STEP 72
Insert the brake piston-spacer group (pos. 40-38) inside the brake housing (pos. 32), paying attention not to damage the seals already fitted.

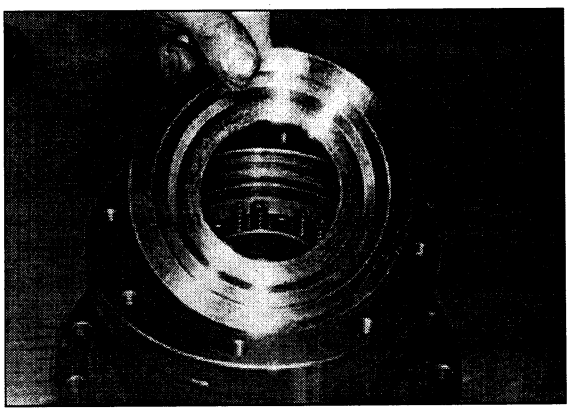


STEP 73
Insert the springs (pos. 41) into the holes in the brake piston (pos. 40), according the picture arangement.

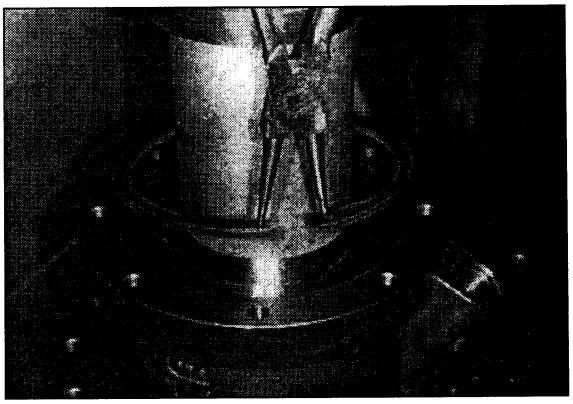


ASSEMBLING

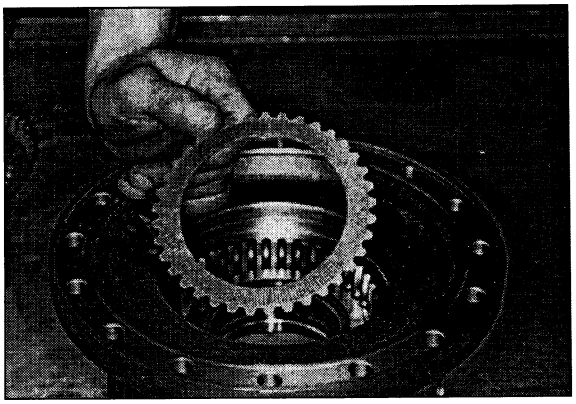
STEP 74
Insert the springs retainer (pos. 42).



STEP 75
Through a press and a metal stopper, push on the springs retainer (pos. 42), in lowering it in order to permit the assembly of the circlip (pos. 43) in its grove in the brake housing (pos. 32).

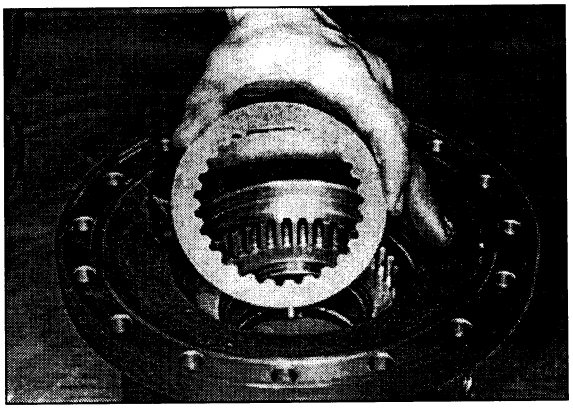


STEP 76
Overturn the brake housing (pos. 32) and assemble the brake discs package according to the following order:
firstly insert an external toothed sintered bronze disc (pos. 37).

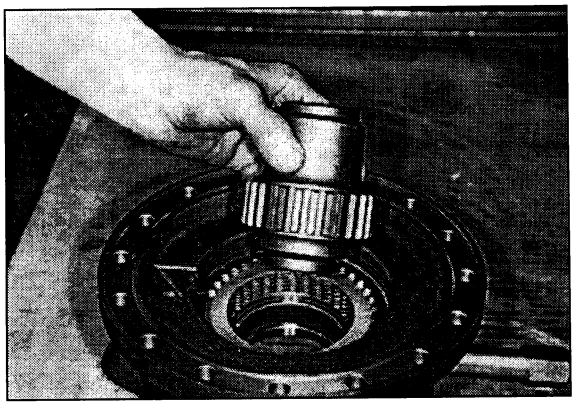


ASSEMBLING

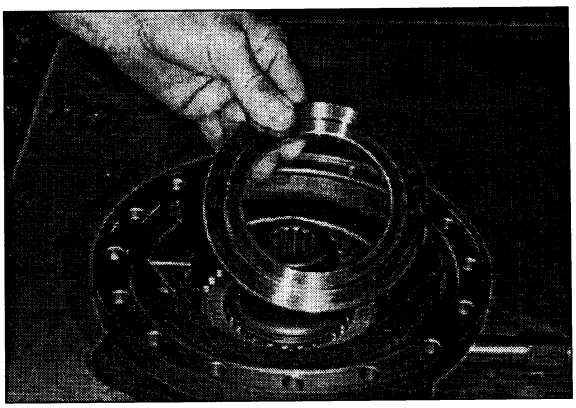
STEP 77
Then insert, an internal toothed steel disc (pos. 36).
Repete the operation untill reaching the number of 6 sintered bronze and 5 stell discs.



STEP 78
Assemble the brake shaft (pos. 35) and insert oil at a pressure of 20 bar from the brake pilot port (see installation drawing ref. 4) in order to permit the assembling of the last sintered bronze disc (pos. 37) and the discs retainer (pos. 30).

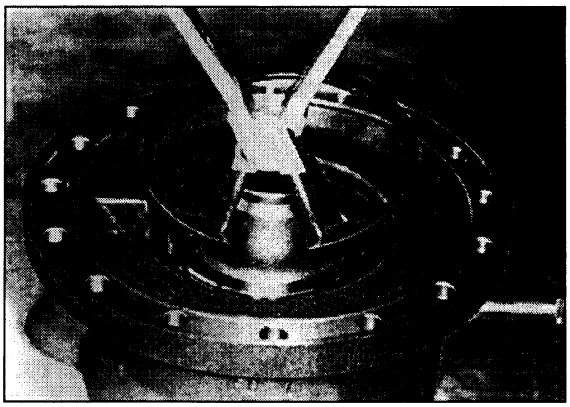


STEP 79
Assemble correctly the discs retainer (pos. 30) in the brake housing (pos. 32).

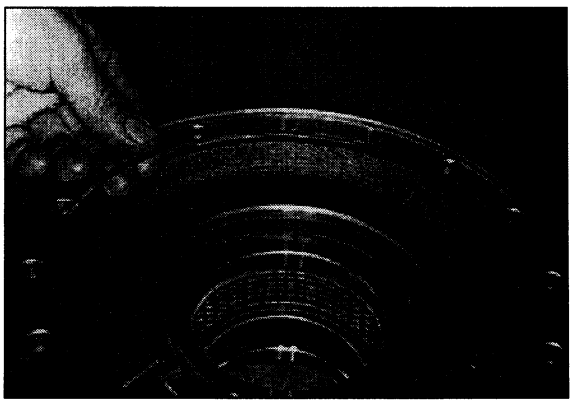


ASSEMBLING

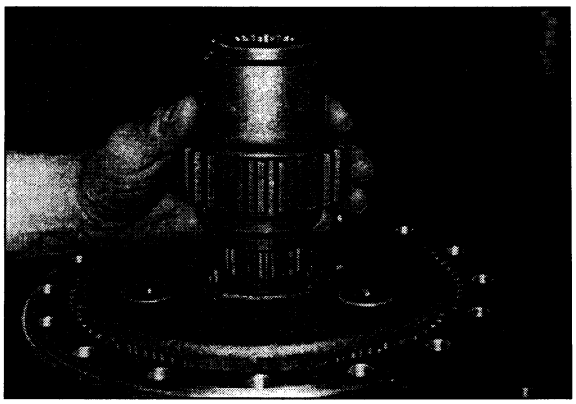
STEP 80
Through pliers, assemble the circlip (pos. 29) into its grove. Then remove the compressed air from the brake assembly and dismount the brake shaft (pos. 35).



STEP 81
Apply in the O-ring's seat in the brake housing (pos. 32) a coat of grease.
Mount the 2nd O-ring (pos. 24).

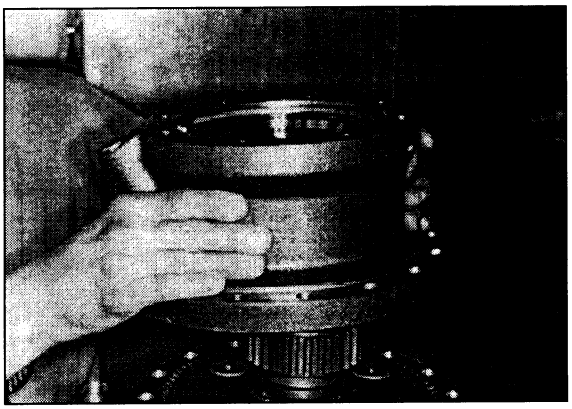


STEP 82
Assemble the brake shaft (pos. 35).

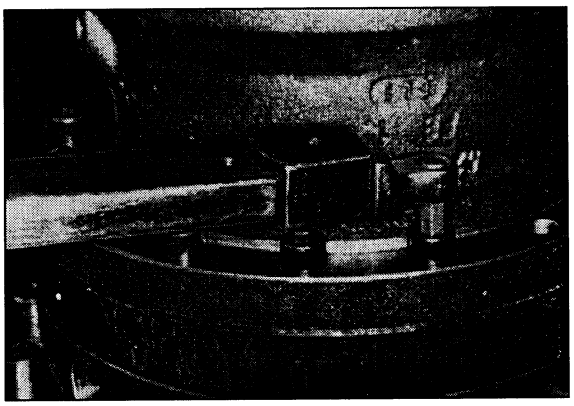


ASSEMBLING

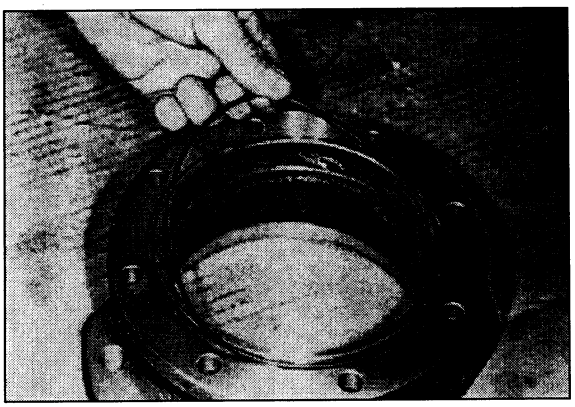
STEP 83
Assemble the brake assembly.



STEP 84
Tighten the 11 socket head screws M10x70 (pos. 33), grade 8.8, by a torque wrench at 5 daNm torque.

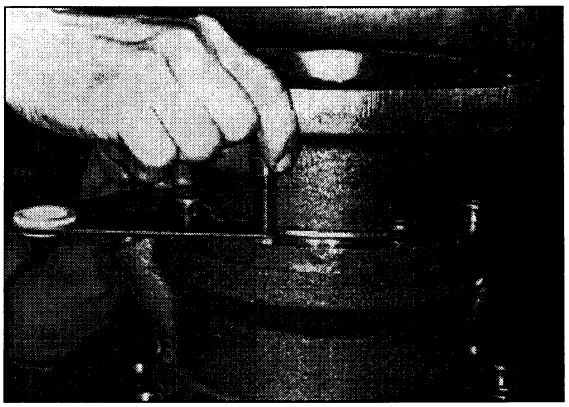


STEP 85
Mount the O-ring (pos. 44) into its seat in the motor flange (pos. 50).

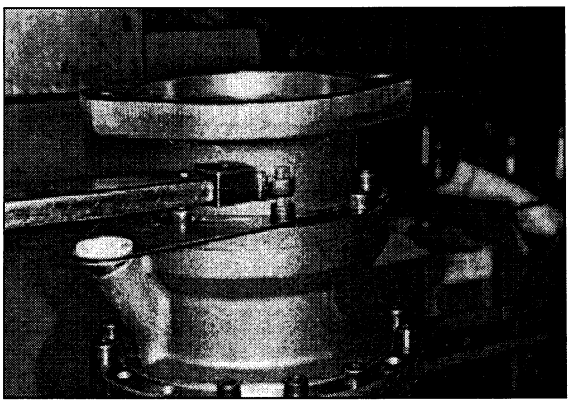


ASSEMBLING

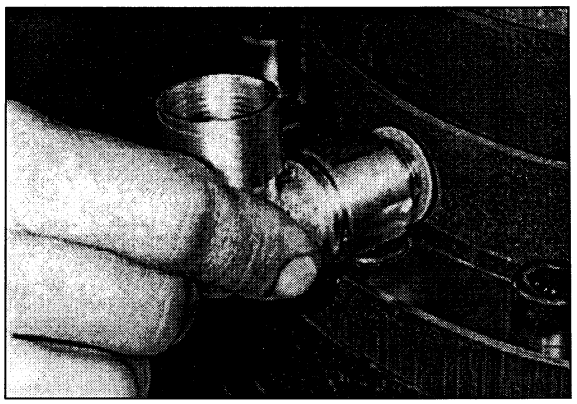
STEP 86
Place the motor flange (pos. 50) on the brake housing (pos. 32) and insert the 8 socket head screws M10x30 (pos. 48) grade 8.8.
Contemporary assemble the flask of the filling and oil level kit (pos. 52).



STEP 87
Tighten the 8 socket head screws M10x30 (pos. 48), grade 8.8, by a torque wrench at 5 daNm torque.

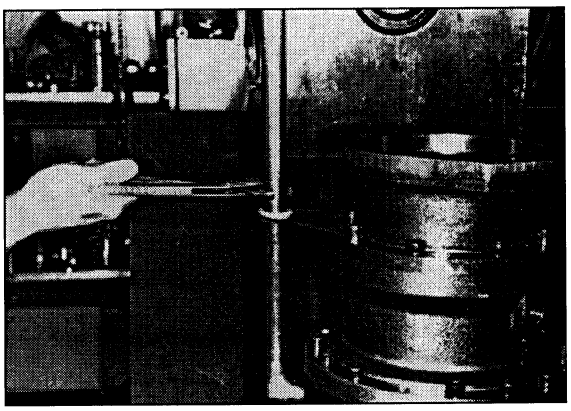


STEP 88
Using pliers, screw the washer (pos. 8), the elbow and the extension of the filling and oil level kit (pos. 52) in the cover (pos. 21).

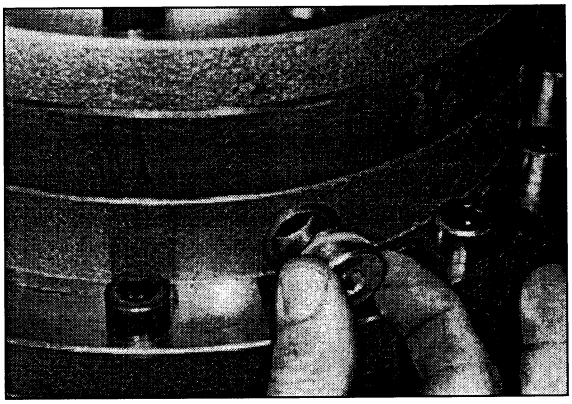


ASSEMBLING

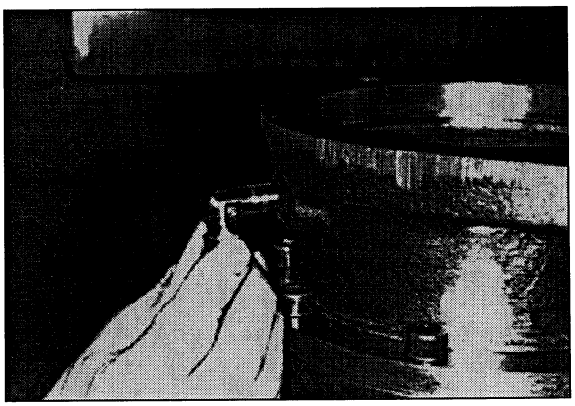
STEP 89
Mount and tighten the dipstick of the filling and oil level kit (pos. 52).



STEP 90
Insert and screw all plugs M18x1,5 (pos. 9) and washers (pos. 8) in the gearbox.

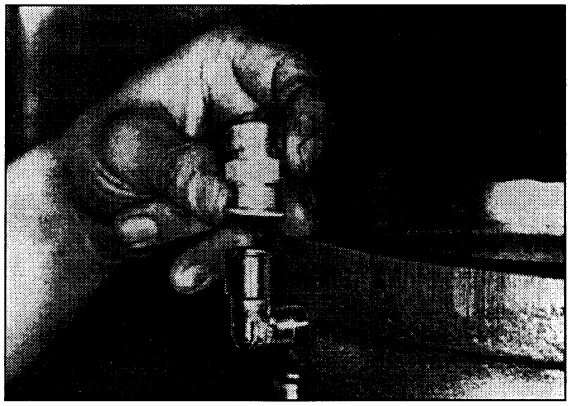


STEP 91
Assemble the angle (pos. 46) in the motor flange (pos. 50).

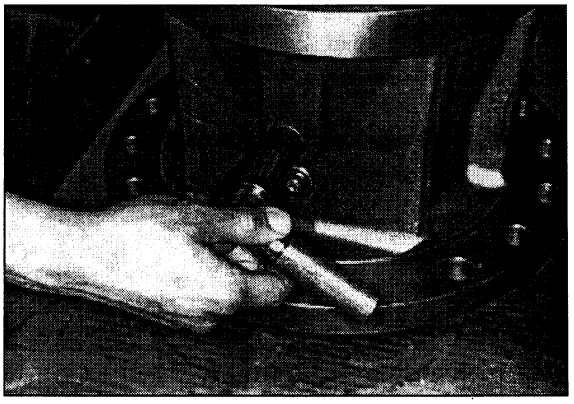


ASSEMBLING

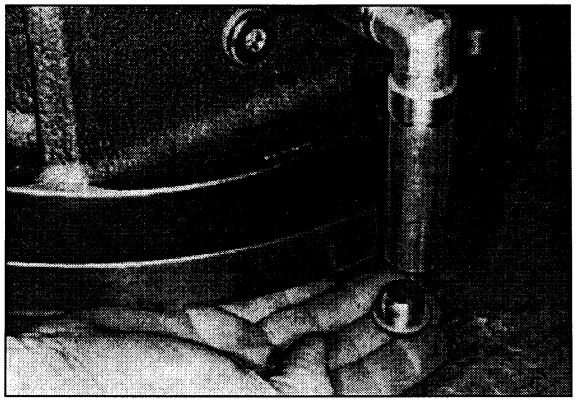
STEP 92
Assemble the breather plug G1/4 (pos. 47).



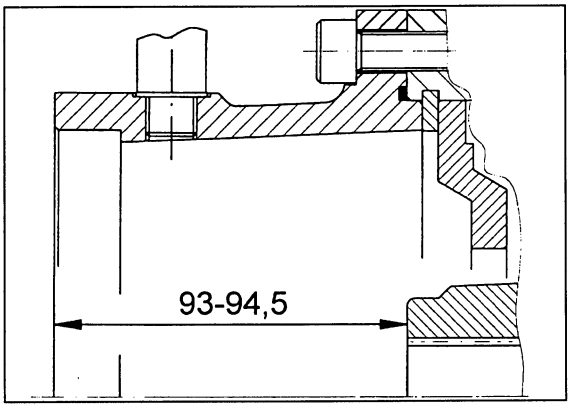
STEP 93
Asemble the extensions (pos. 10), the angle (pos. 11) and the washer (pos. 8) in the gearbox housing (pos. 7).



STEP 94
Assemble the plug M18x1,5 (pos. 9).



ASSEMBLING



STEP 95

⚠ Important

After mounting the hydraulic motor, verify, through a depth slide gauge, the axial dimension of the gearbox measured by input side of the motor adaptor (pos. 50) to the brake shaft (pos. 35).
Axial dimension = 93-94,5 mm.

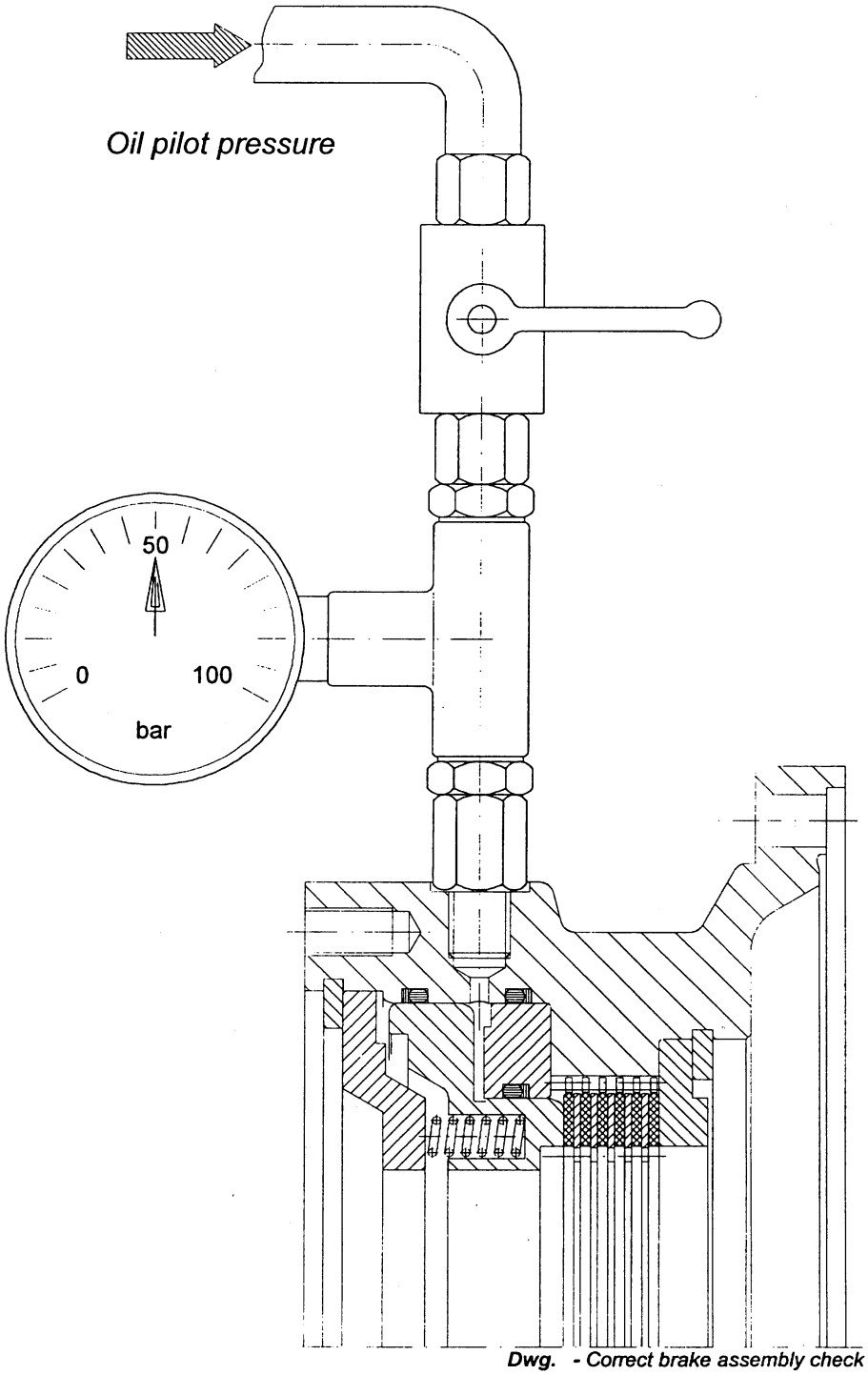
STEP 96

After having reassebled the gearbox, fit the hydraulic motor (taking care to include the O-ring pos. 51), throurgh 2 fixing screws M16x40 (pos. 49), grade 8.8 tightened at a torque of 21,5 daNm. Fill the gearbox with the lubricant oil as shown in section 4.2.

5. BRAKE CHECK

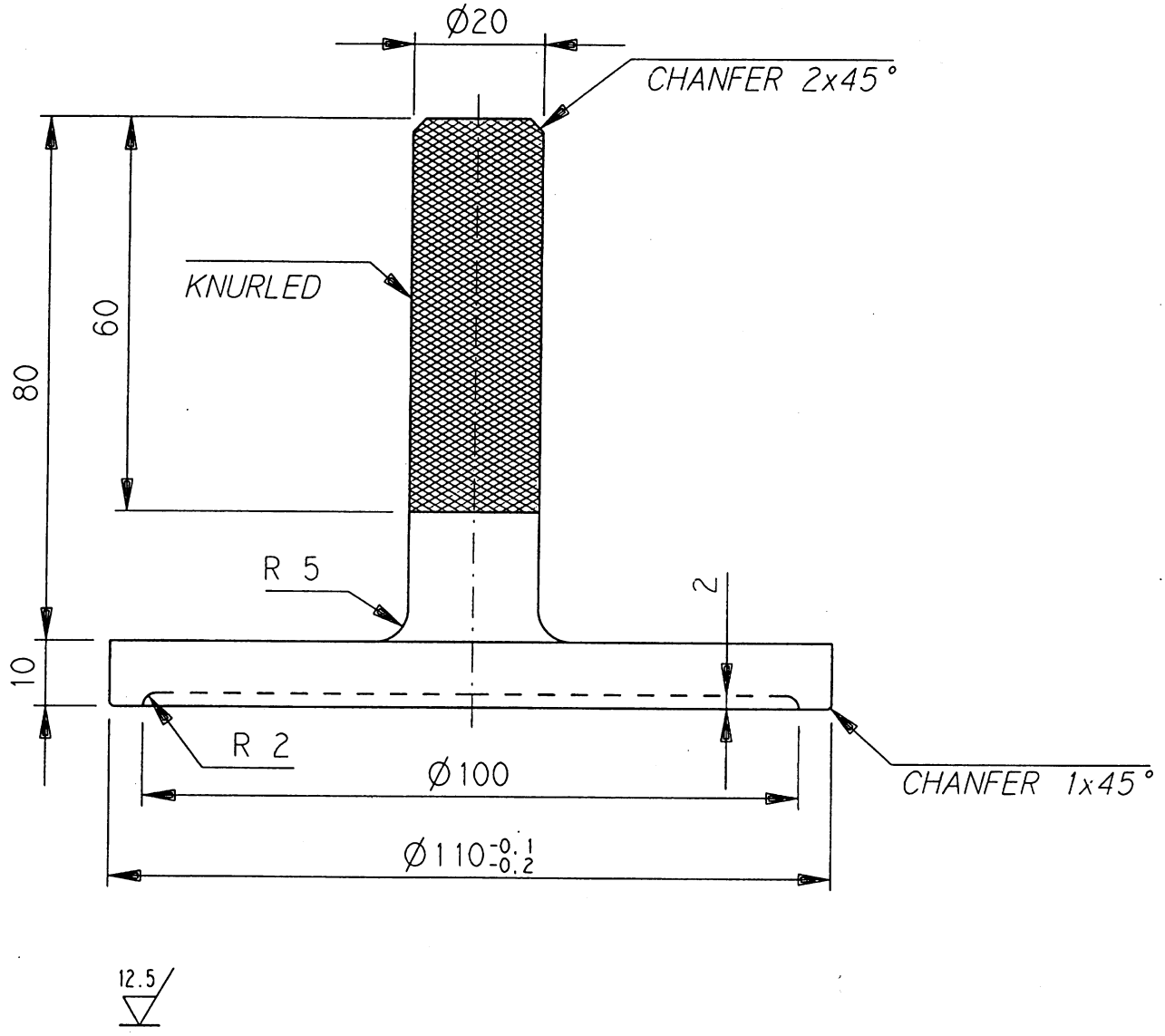
In order to verify the correct assembly of the brake group, it is necessary to carry out a test of the seal rings. Connect the brake port to a pump and release the brake by pumping oil. By means of a pressure gauge verify that the pressure does not decrease (see dwg. 6). In Otherwise case, the seal rings of the brake leak oil and it is necessary to disassembly the brake and provide for their replacement.

Test data: **Test duration = 3 minutes.**

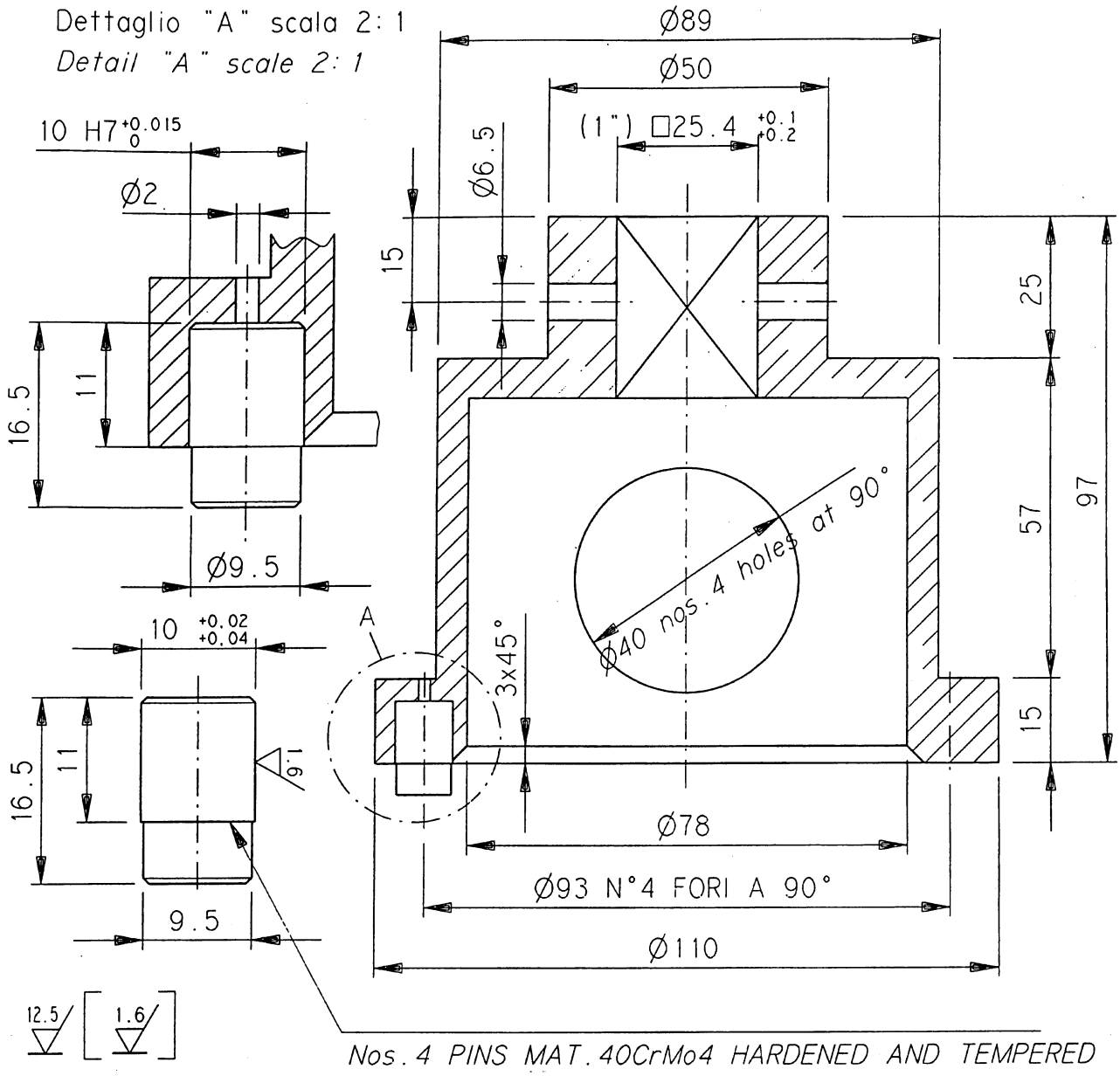


Dwg. - Correct brake assembly check

(SPECIAL TOOLS FOR SWING MACHINERY)

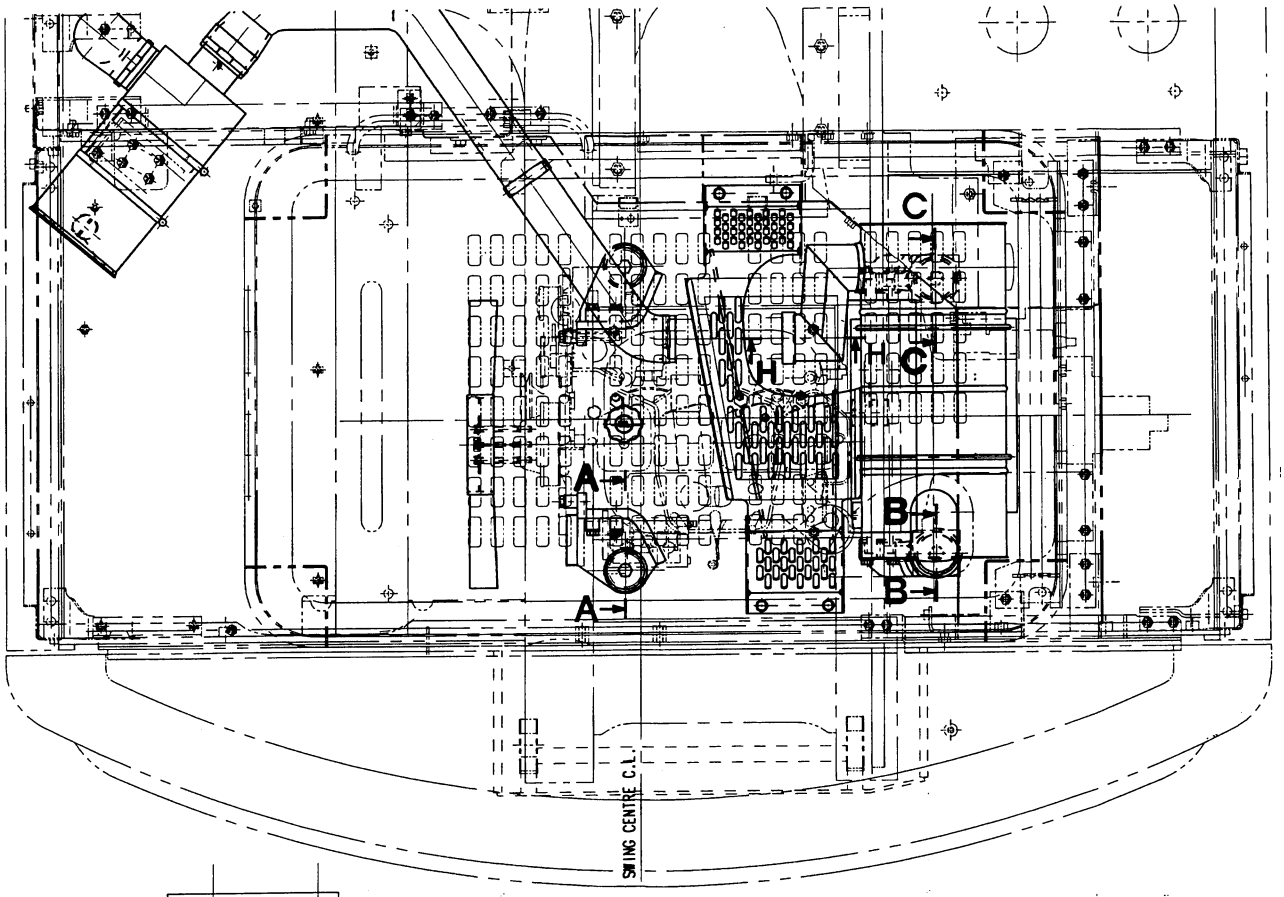


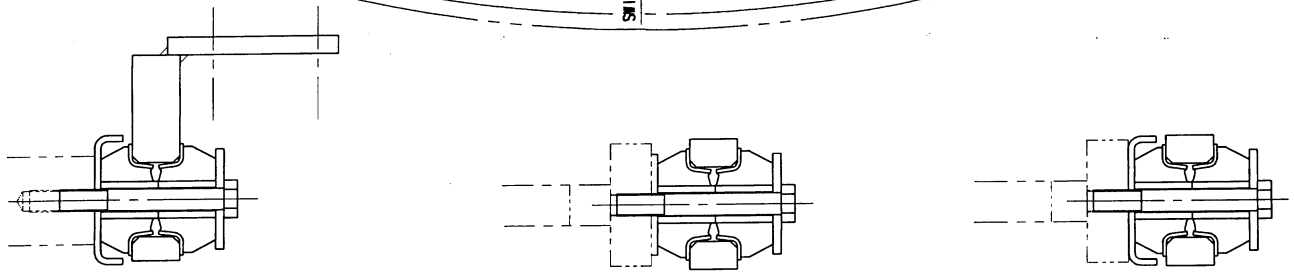
(SPECIAL TOOLS FOR SWING MACHINERY)



40 MAINTENANCE STANDARD

ENGINE MOUNT



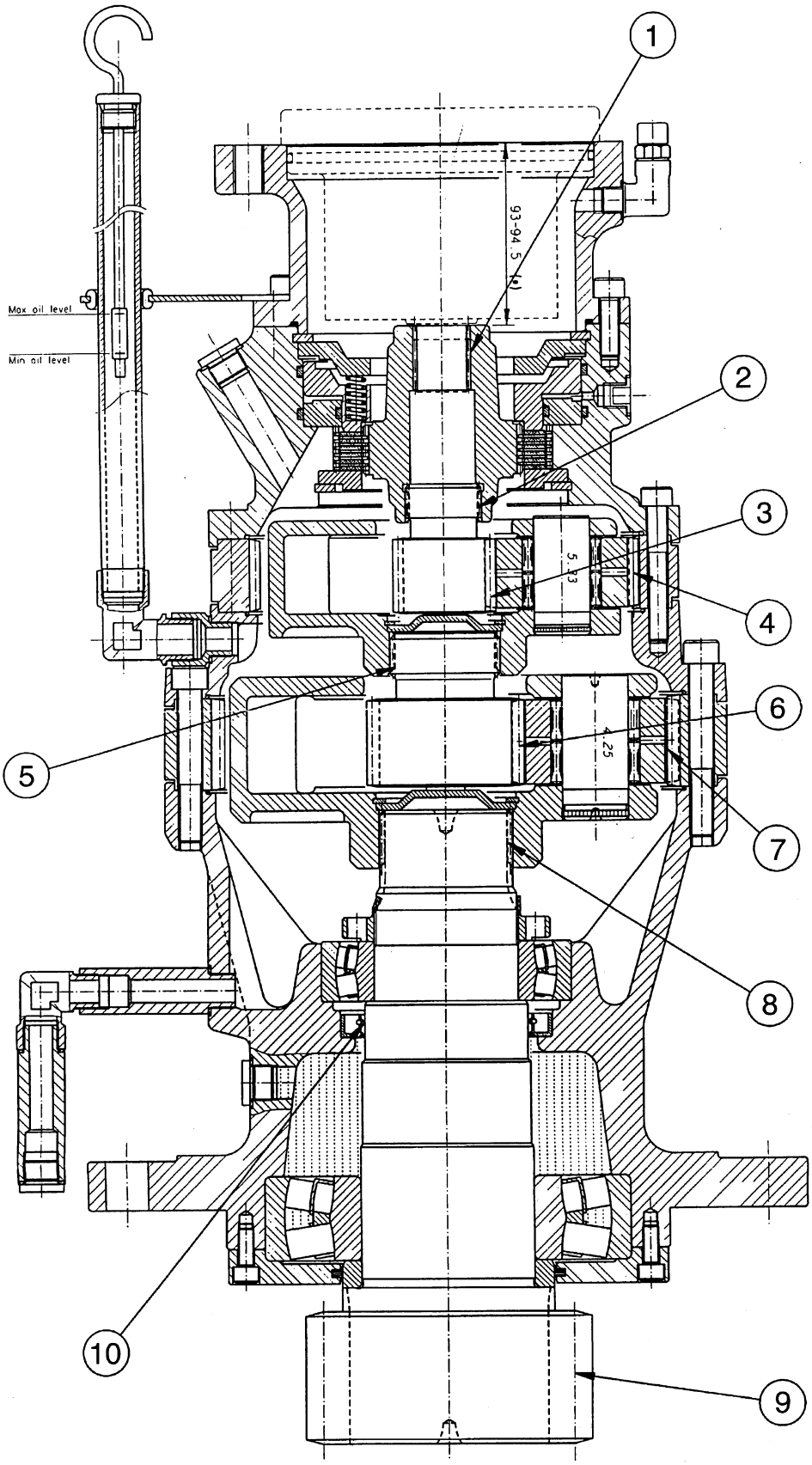


A-A B-B C-C

Unit:mm

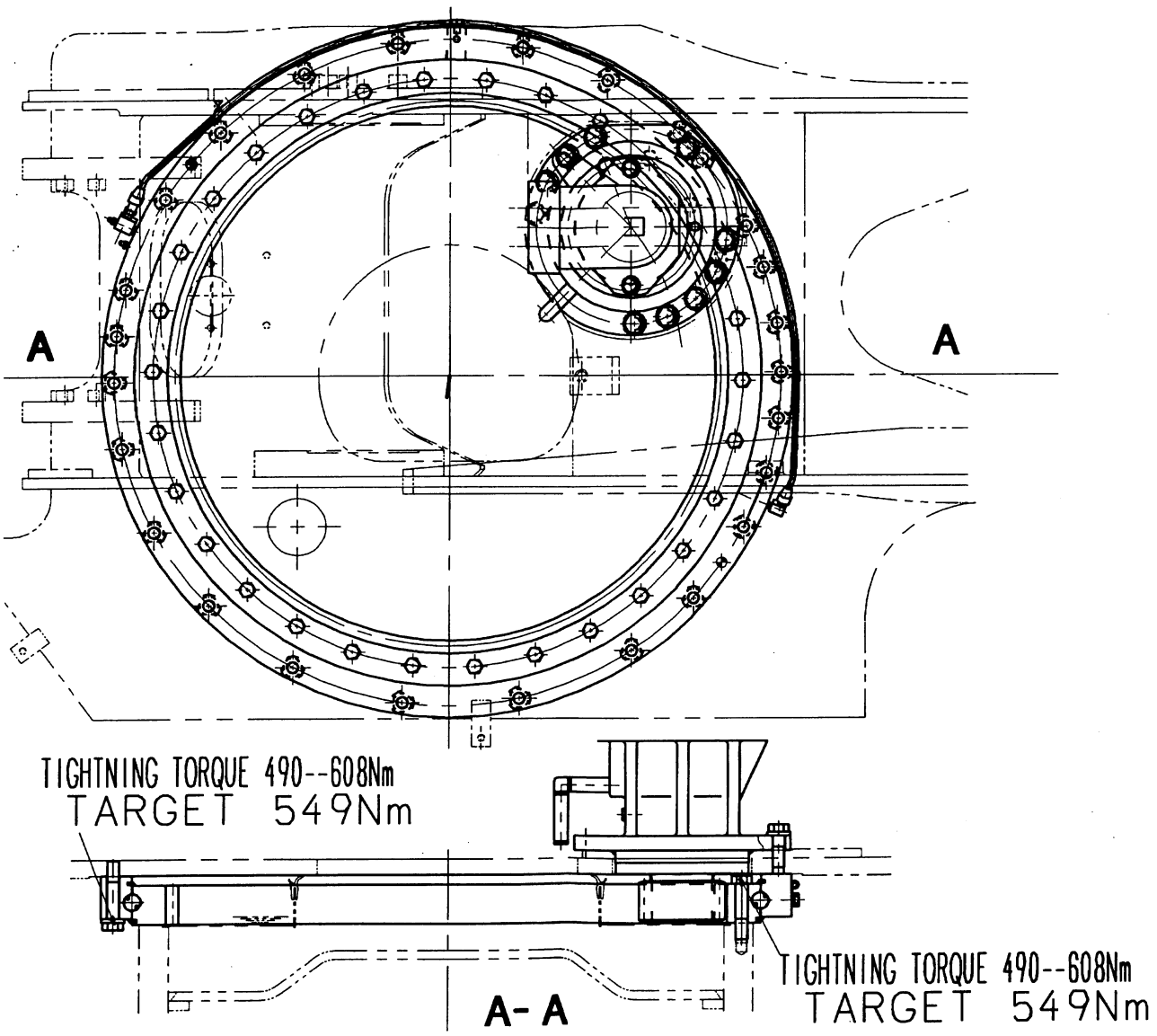
No.	Check item	Criteria		Remedy
1	Free height of front mount rubber A	Standard size	Repair limit	Replace
		84	-	
2	Free height of rear mount rubber B & C	84	-	

SWING MACHINERY



Pos.	Check item	Standard clearance (mm)	Clearance limit (mm)	Component	Check measurement standard (mm)	Check measurement limit (mm)
1	Backlash between motor shaft and brake shaft	0,064- 0,155	0,33	Motor Shaft:	Measurement over pin ø4mm 34,144 -0,054 -0,120	Measurement over pin ø4mm 33,90
				Brake shaft:	Measurement over pin ø3,5mm 22,484 +0,171 +0,063	Measurement over pin ø3,5mm 22,85
2	Backlash between brake shaft and 1st stage sun gear	0,020 - 0,098	0,27	Brake shaft:	Measurement over pin ø3,5mm 32,611 +0,101 +0,001	Measurement over pin ø3,5mm 32,89
				Sun gear:	Measurement over pin ø3,5mm 43,311 -0,030 -0,076	Measurement over pin ø3,5mm 43,10
3	Backlash between 1st stage sun gear and 1st stage planet gear	0,093 - 0,165	0,43	Sun gear:	Span measurement over 4 teeth 27,729 -0,037 -0,080	Span measurement over 4 teeth 27,52
				Planet gear:	Span measurement over 4 teeth 27,531 -0,050 -0,075	Span measurement over 4 teeth 27,33
4	Backlash between 1st stage planet gear and toothed ring	0,133 - 0,213	0,48	Planet gear:	Span measurement over 4 teeth 27,531 -0,050 -0,075	Span measurement over 4 teeth 27,33
				Toothed ring:	Measurement over pin ø4mm 192,072 +0,350 +0,210	Measurement over pin ø4mm 192,77
5	Backlash between 1st stage planet carrier and 2nd stage sun gear	0,020 - 0,098	0,27	Planet carrier:	Measurement over pin ø3,5mm 49,879 +0,088 +0,002	Measurement over pin ø3,5mm 50,12
				Sun gear:	Measurement over pin ø3,5mm 59,847 -0,029 -0,075	Measurement over pin ø3,5mm 59,64
6	Backlash between 2nd stage sun gear and 2nd stage planet gear	0,112 - 0,192	0,51	Sun gear:	Span measurement over 4 teeth 33,511 -0,045 -0,090	Span measurement over 4 teeth 33,27
				Planet gear:	Span measurement over 4 teeth 32,911 -0,060 -0,090	Span measurement over 4 teeth 32,67
7	Backlash between 2nd stage planet gear and toothed ring	0,160 - 0,255	0,58	Planet gear:	Span measurement over 4 teeth 32,911 -0,060 -0,090	Span measurement over 4 teeth 32,67
				Toothed ring:	Measurement over pin ø5mm 299,720 +0,426 +0,256	Measurement over pin ø5mm 230,57
8	Backlash between 2nd stage planet carrier and swing pinion	0,020 - 0,098	0,27	Planet carrier:	Measurement over pin ø4mm 60,579 +0,094 -0,002	Measurement over pin ø4mm 60,84
				Pinion shaft:	Measurement over pin ø4mm 73,232 -0,034 -0,082	Measurement over pin ø4mm 73,01
9	Backlash between swing pinion and swing circle	0,018 - 1,235	2,30	Pinion shaft:	Span measurement over 3 teeth 78,90 -0,050 -0,200	Span measurement over 3 teeth 78,20
				Swing circle:	Measurement over pin ø15mm 924,3 +2,260 +0,470	Measurement over pin ø15mm 927,98
10	Wear of swing pinion oil seal contact surface					ø84,5

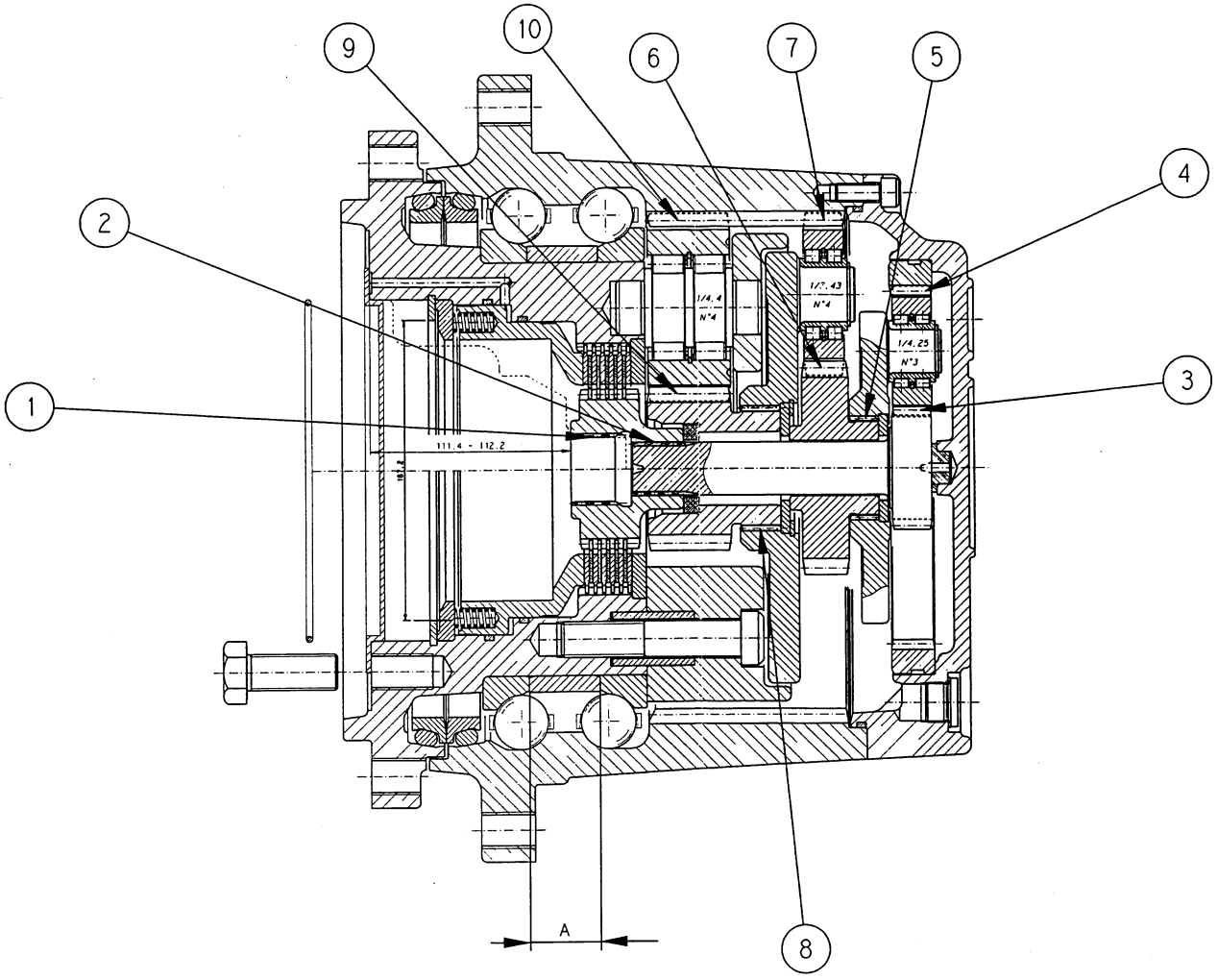
SWING CIRCLE

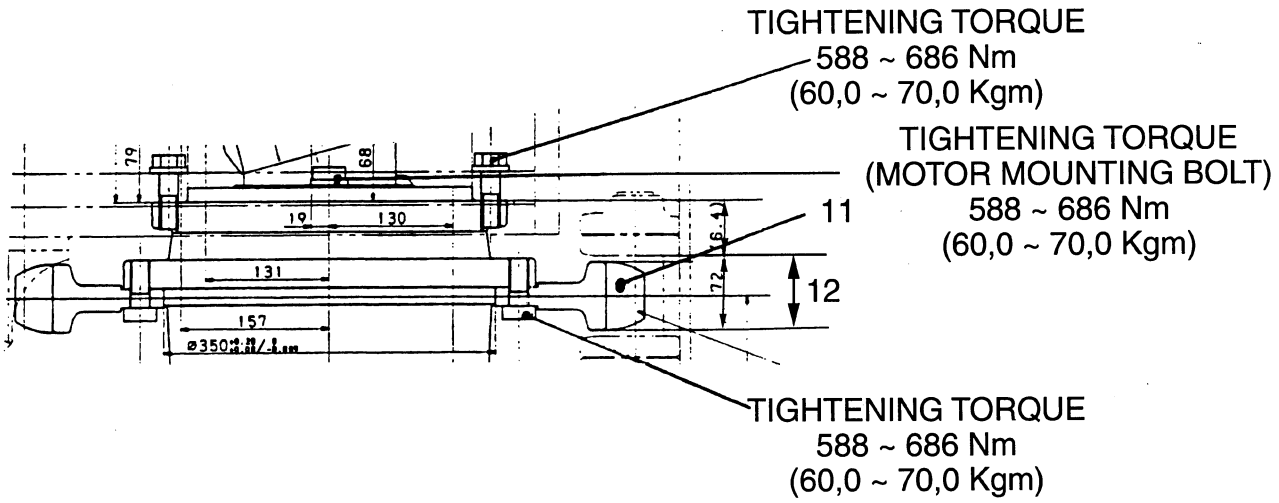


Unit: mm

No.	Check item	Criteria		Remedy
1	Axial clearance of bearing (When mounted on machine)	Standard clearance	Clearance limit	Replace
		0.5 - 1.6	3.2	

FINAL DRIVE



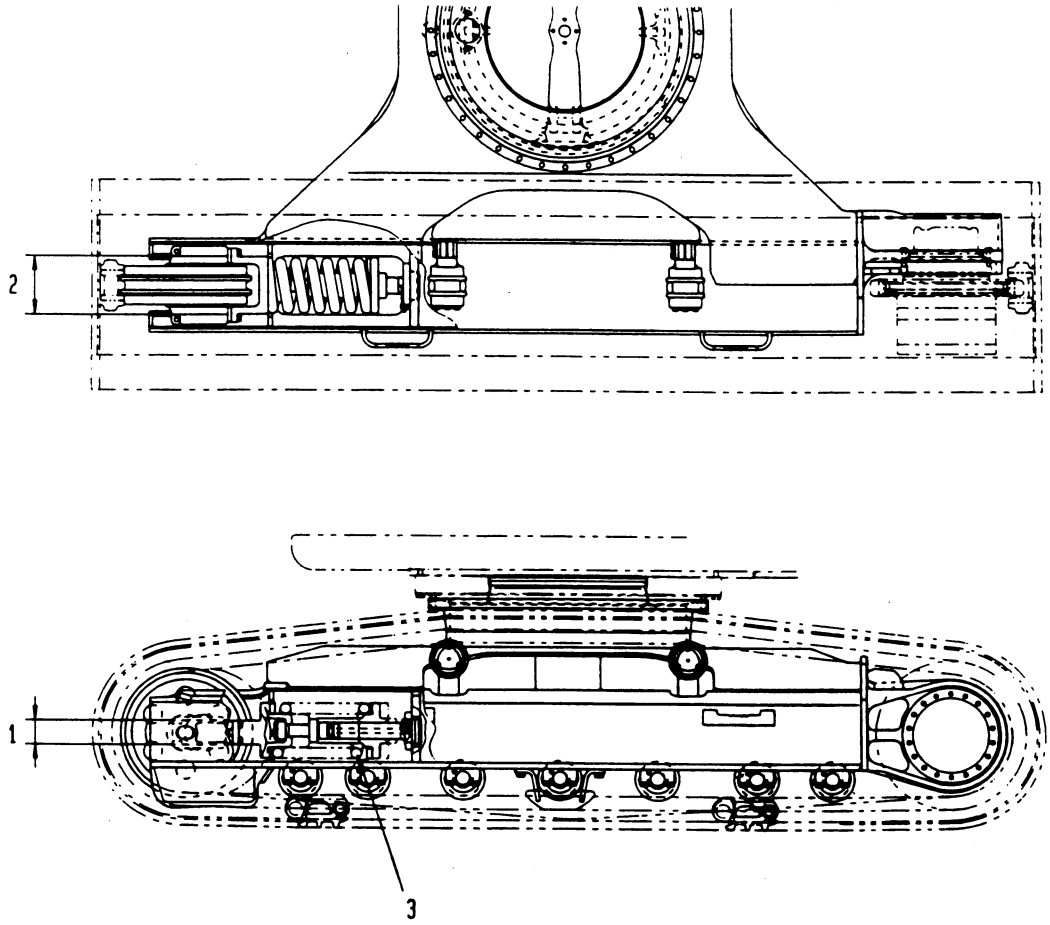


Unit: mm

Pos.	Check item	Standard clearance (mm)	Clearance limit (mm)	Component	Check measurement standard (mm)	Check measurement limit (mm)
1	Backlash between motor shaft and brake shaft	0,064- 0,154	0,33	Motor Shaft:	Measurement over pin ø4,5mm 45,137 -0,050 -0,111	Measurement over pin ø4,5mm 44,91
				Brake shaft:	Measurement over pin ø3,5mm 32,739 +0,121 +0,044	Measurement over pin ø3,5mm 33,01
2	Backlash between brake shaft and 1st stage sun gear	0,064- 0,155	0,33	Brake shaft:	Measurement over pin ø3,5mm 22,484 +0,171 +0,063	Measurement over pin ø3,5mm 22,85
				Sun gear:	Measurement over pin ø4mm 34,144 -0,054 -0,120	Measurement over pin ø4mm 33,90
3	Backlash between 1st stage sun gear and 1st stage planet gear	0,096 - 0,165	0,43	Sun gear:	Span measurement over 4 teeth 27,93 -0,040 -0,080	Span measurement over 4 teeth 27,73
				Planet gear:	Span measurement over 4 teeth 27,425 -0,050 -0,075	Span measurement over 4 teeth 27,23
4	Backlash between 1st stage planet gear and toothed ring	0,133 - 0,213	0,48	Planet gear:	Span measurement over 4 teeth 27,531 -0,050 -0,075	Span measurement over 4 teeth 27,23
				Toothed ring:	Measurement over pin ø4mm 192,072 +0,350 +0,210	Measurement over pin ø4mm 192,77
5	Backlash between 1st stage planet carrier and 2nd stage sun gear	0,020 - 0,098	0,27	Planet carrier:	Measurement over pin ø3,5mm 49,879 +0,088 +0,002	Measurement over pin ø3,5mm 50,12
				Sun gear:	Measurement over pin ø3,5mm 59,847 -0,029 -0,075	Measurement over pin ø3,5mm 59,64
6	Backlash between 2nd stage sun gear and 2nd stage planet gear	0,149 - 0,255	0,68	Sun gear:	Span measurement over 4 teeth 43,996 -0,060 -0,120	Span measurement over 4 teeth 43,68
				Planet gear:	Span measurement over 4 teeth 43,996 -0,060 -0,120	Span measurement over 4 teeth 43,52
7	Backlash between 2nd stage planet gear and toothed ring	0,213 - 0,399	0,83	Planet gear:	Span measurement over 4 teeth 43,996 -0,060 -0,120	Span measurement over 4 teeth 43,52
				Toothed ring:	Measurement over pin ø6,5mm 266,50 +0,720 +0,340	Measurement over pin ø6,5mm 267,78
8	Backlash between 2nd stage planet carrier and 3rd stage sun gear	0,020 - 0,098	0,27	Planet carrier:	Measurement over pin ø4mm 60,579 +0,094 -0,002	Measurement over pin ø4mm 60,84
				Sun gear:	Measurement over pin ø4mm 73,232 -0,034 -0,082	Measurement over pin ø4mm 73,01
9	Backlash between 3rd stage sun gear and 3rd stage planet gear	0,149 - 0,255	0,68	Sun gear:	Span measurement over 3 teeth 32,08 -0,060 -0,120	Span measurement over 3 teeth 31,76
				Planet gear:	Span measurement over 4 teeth 43,90 -0,080 -0,120	Span measurement over 4 teeth 43,58
10	Backlash between 3rd stage planet gear and toothed ring	0,213 - 0,399	0,83	Planet gear:	Span measurement over 4 teeth 43,90 -0,080 -0,120	Span measurement over 4 teeth 43,52
				Toothed ring:	Measurement over pin ø4mm 266,50 +0,720 +0,340	Measurement over pin ø6,5mm 267,78
11	Wear of sprocket teeth	Repair limit: 6				
12	Sprocket tooth width	Standard size	Repair limit	Rebuild or replace		
		72	68			

TRACK FRAME, RECOIL SPRING

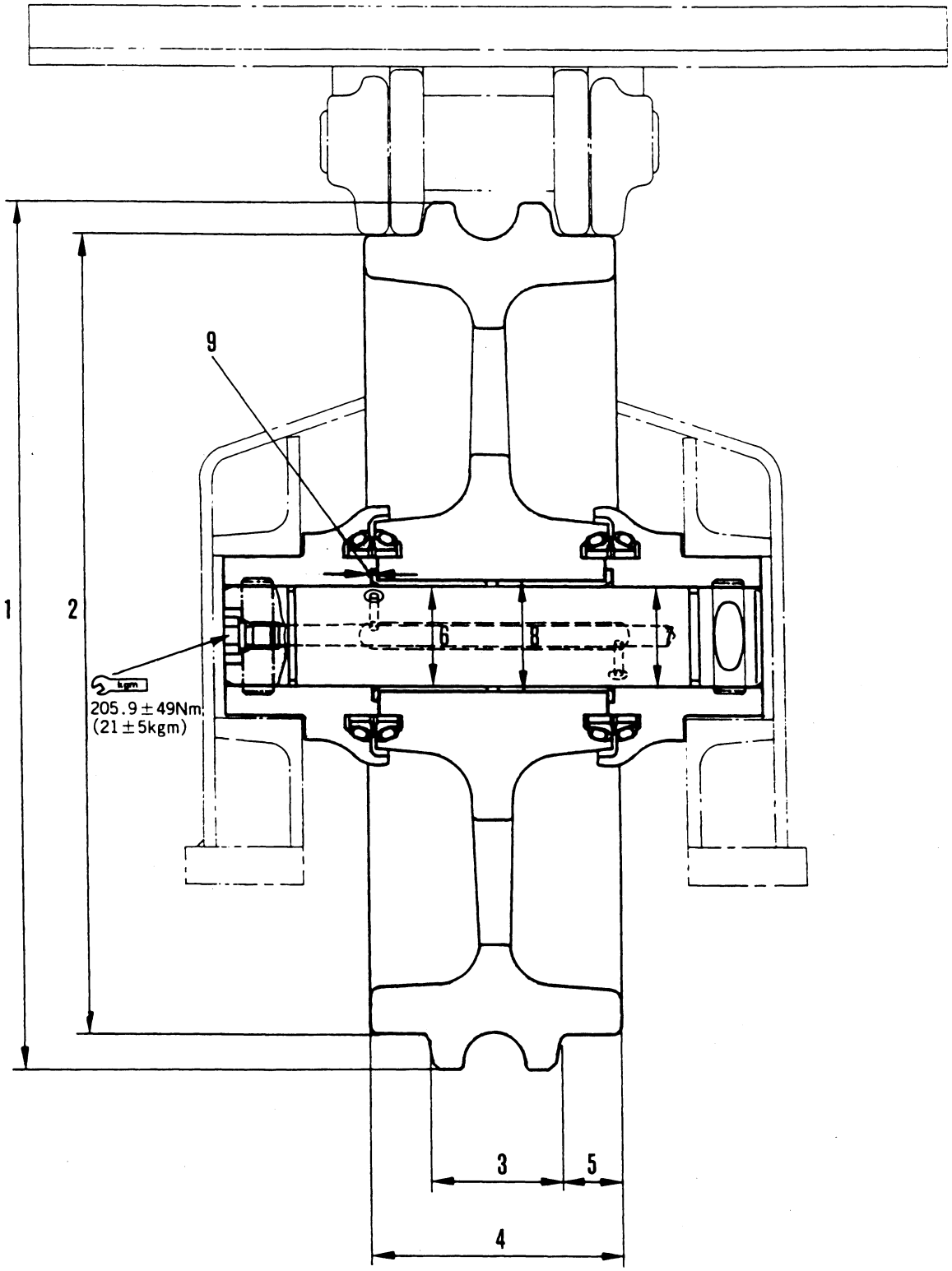
★ Figure shows the PC180LC-6K



Unit: mm

No.	Check item		Criteria					Remedy
1	Vertical width of idler guide			Standard size	Tolerance	Repair limit		Rebuild or replace
			Track frame	107				
			Idler support	105				
2	Horizontal width of idler guide		Track frame	250				
			Idler support	247.4				
3	Recoil spring		Standard size			Repair limit		Replace
			Free length X O.D.	Installed length	Installed load	Free length	Installed load	
		PC180/160	587.5 x 243	466	133.5 kN (13,610 kg)	576	106,8 kN (10,885 kg)	

IDLER

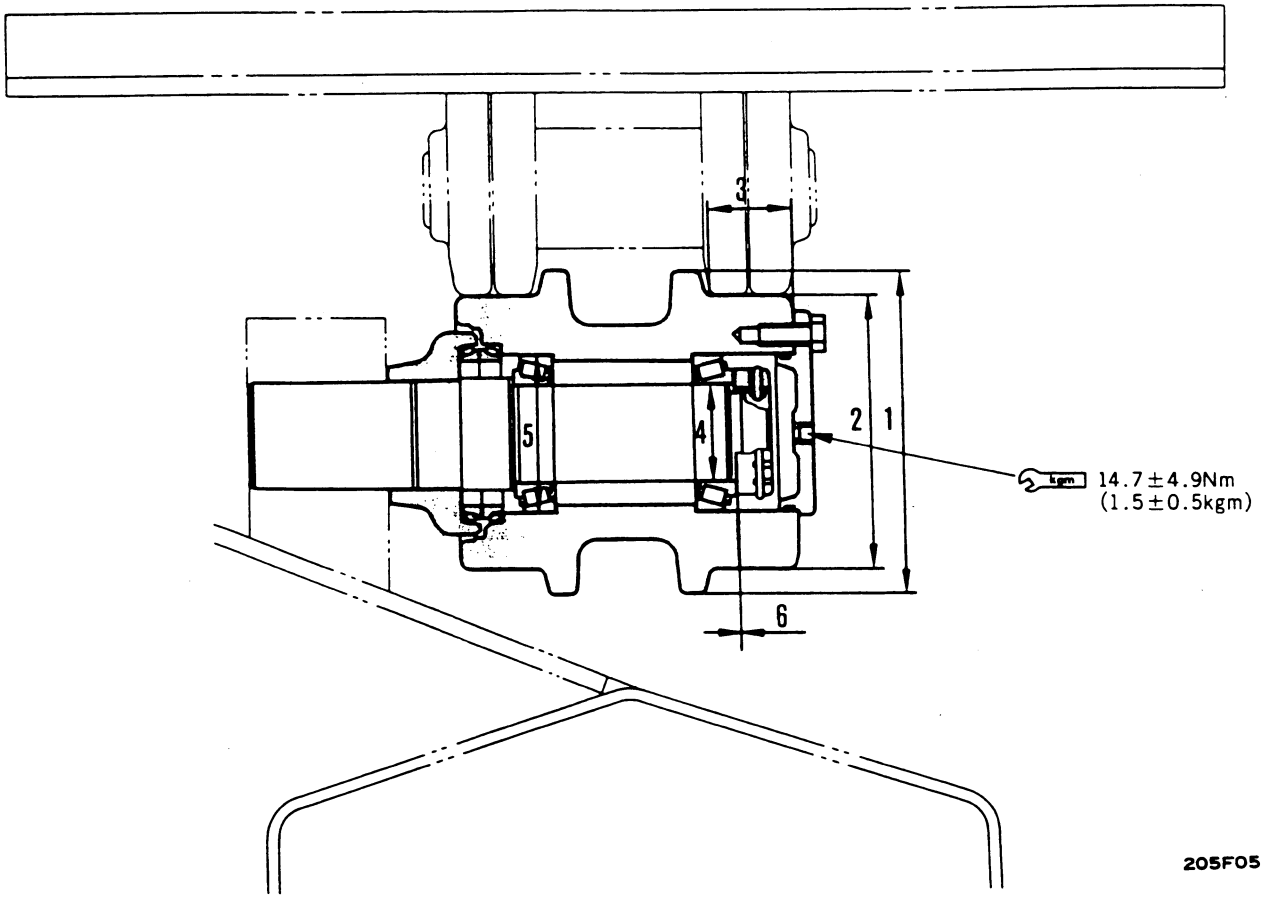


205F05186

Unit: mm

No.	Check item	Criteria					Remedy
1	Outside diameter of protrusion	Standard size		Repair limit			Rebuild or replace
		560		-			
2	Outside diameter of tread	520		508			
3	Width of protrusion	85		-			
4	Total width	164		-			
5	Width of tread	39.5		45.5			
6	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		65	-0.250 -0.350	+0.074 -0.036	0.214 - 0.424	1.5	
7	Clearance between shaft and support	65	-0.250 -0.290	-0.110 -0.220	0.03 - 0.180	-	Replace
8	Interference between idler and bushing	Standard size	Tolerance		Standard interference	Interference limit	Replace bushing
			Shaft	Hole			
		72	+0.089 +0.059	-0.006 -0.072	0.065 - 0.161	-	
9	Side clearance of idler (each)	Standard clearance		Clearance limit			
		0.39 - 1.00		1.5			

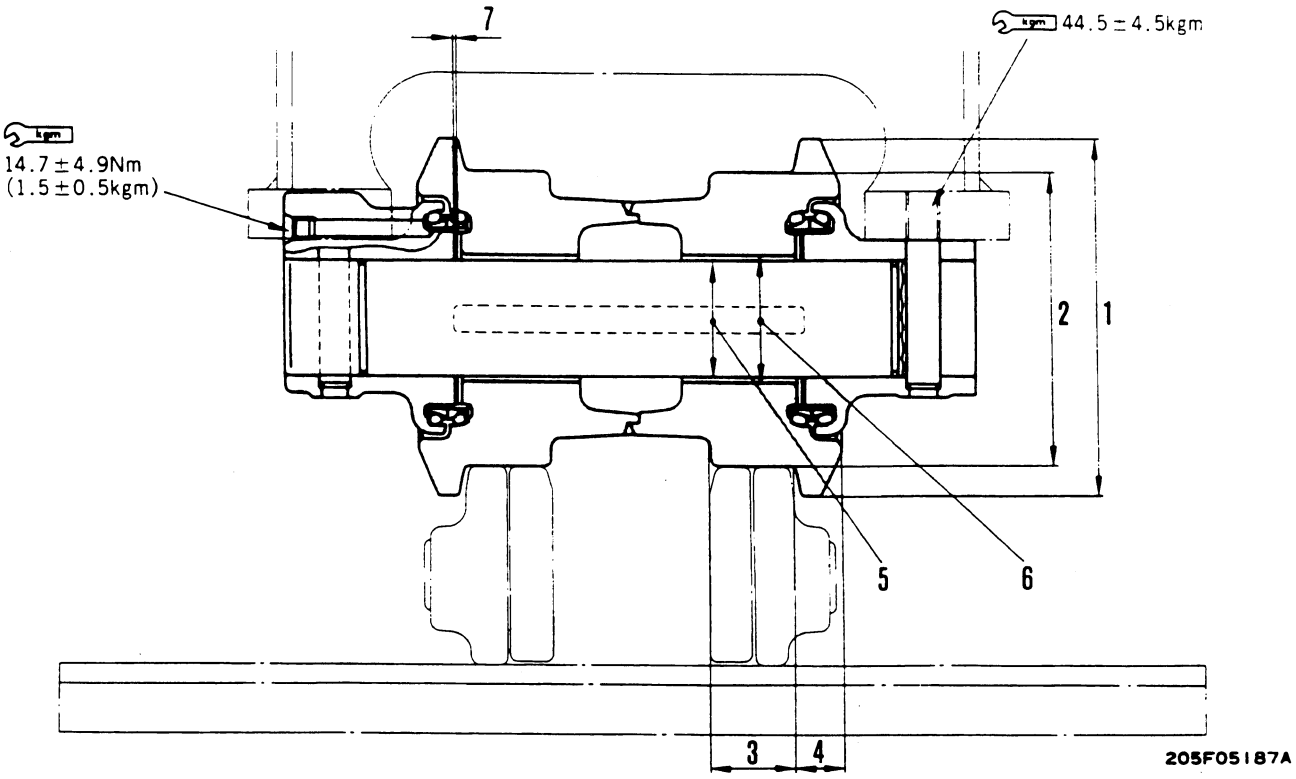
CARRIER ROLLER



Unit: mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange (outside)	Standard size		Repair limit		Rebuild or replace
		165		-		
2	Outside diameter of tread	140		130		
3	Width of tread	43		50		
4	Interference between shaft and bearing	Standard size	Tolerance		Standard interference	Interference limit	Replace
			Shaft	Hole		
		50	0 -0.016	0 -0.012	-0.016 - 0.012	-
5	Interference between roller and bearing	80	0 -0.013	-0.021 -0.051	0.008 - 0.051	-
6	Side clearance of roller	Standard clearance		Clearance limit		
		0.01 - 0.18		-		

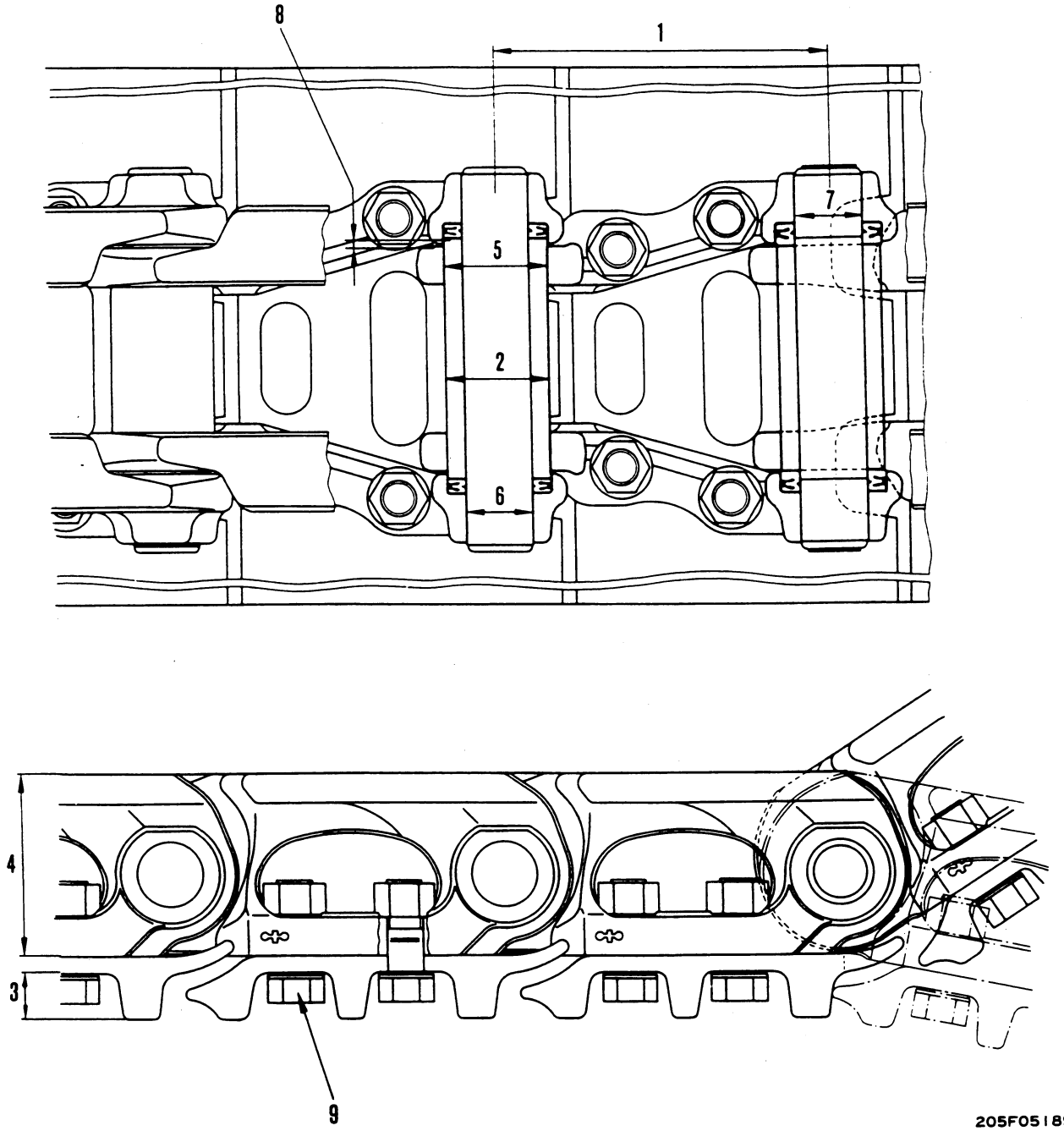
TRACK ROLLER



Unit: mm

No.	Check item	Criteria					Remedy
1	Outside diameter of flange (outside)	Standard size		Repair limit			Rebuild or replace
		186		-			
2	Outside diameter of tread	154		142			
3	Width of tread	44.5		52			
4	Width of flange	24.4		-			
5	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		60	-0.215 -0.315	+0.195 0	0.215 - 0.510	1.5	
6	Interference between roller and bushing	Standard size	Tolerance		Standard interference	Interference limit	
			Shaft	Hole			
		67	+0.153 +0.053	+0.030 0.	0.023 - 0.153	-	
7	Side clearance of roller (both sides)	Standard clearance		Clearance limit			Replace
		0.41 - 0.95		1.5			

TRACK SHOE

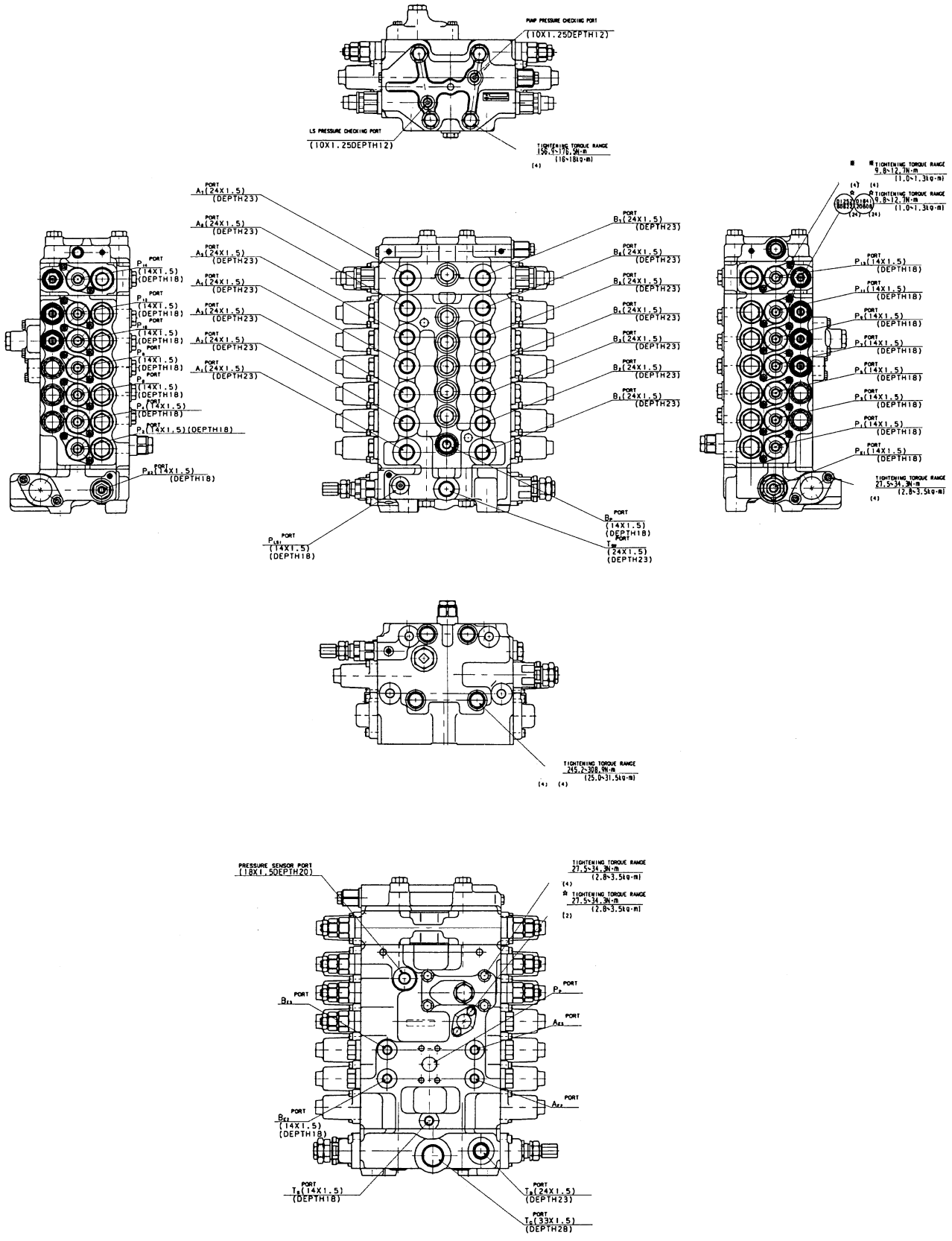


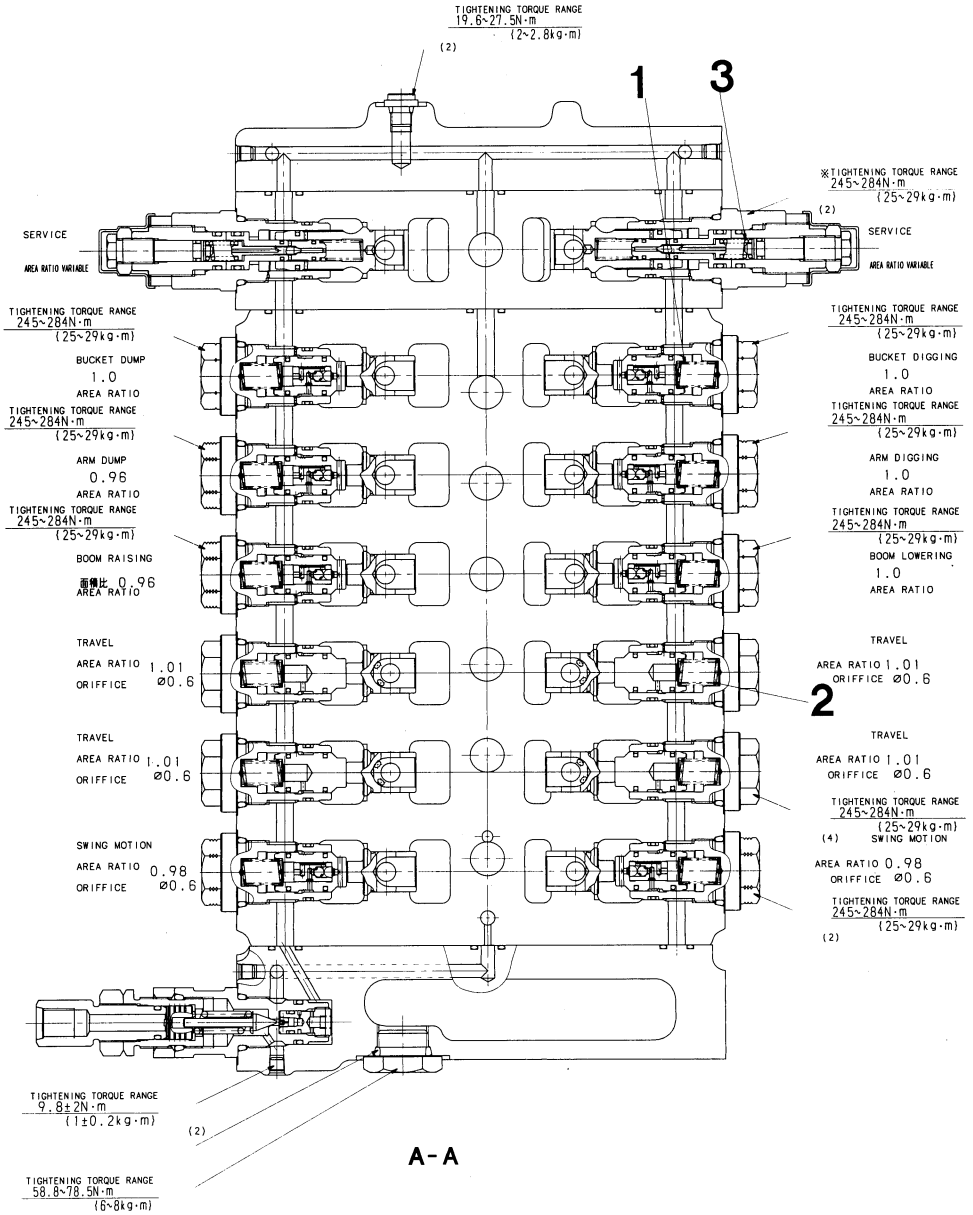
205F05189-1

Unit: mm

No.	Check item		Criteria					Remedy
1	Link pitch		Standard size		Repair limit			Turn or replace
			190.25		194.25			
2	Outside diameter of bushing		59.3		54.3			
3	Height of grouser	Triple	26		16			Lug welding rebuild or replace
		Swamp	102.5		90.5			
4	Height of link		105		97			
5	Interference between bushing and link		Standard size	Tolerance		Standard interference	Interference limit	Replace with over size
				Shaft	Hole			
			59	+0.304 +0.264	+0.074 0	0.190 - 0.304	0.100	
6	Interference between regular pin and link		38	+0.222 +0.072	-0.138 -0.200	0.210 - 0.422	0.140	
7	Interference between master pin and link		37.8	+0.230 +0.200	+0.062 0	0.138 - 0.230	0.130	
8	Protrusion of bushing		4.85					Adjust
9	Tightening torque of shoe bolt		Initial tightening torque: 392 ± 39.2 Nm (40 ± 4 kgm) Additional tightening angle: 120° ± 10°					Tighten

CONTROL VALVE

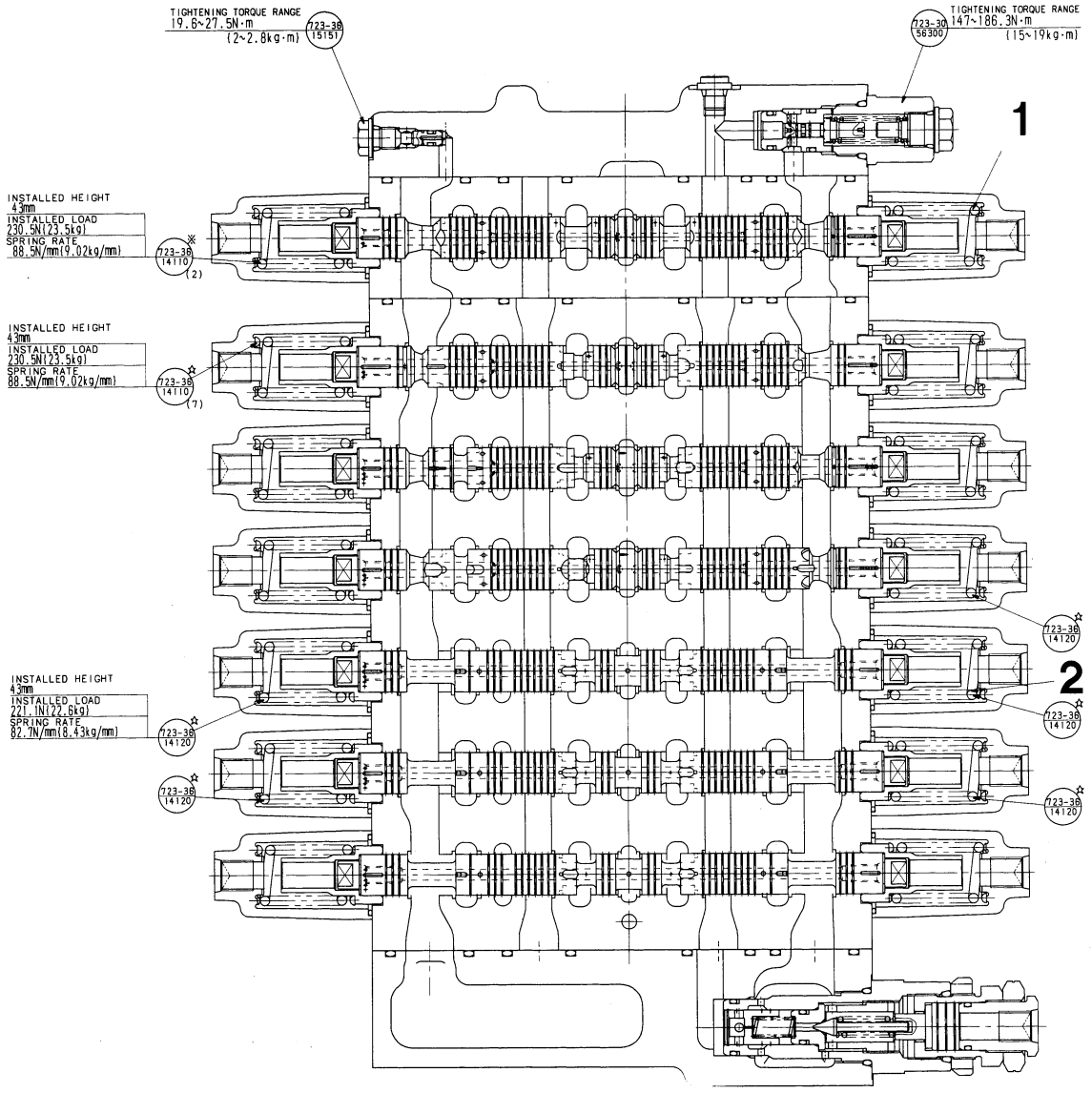




A-A

Unit: mm

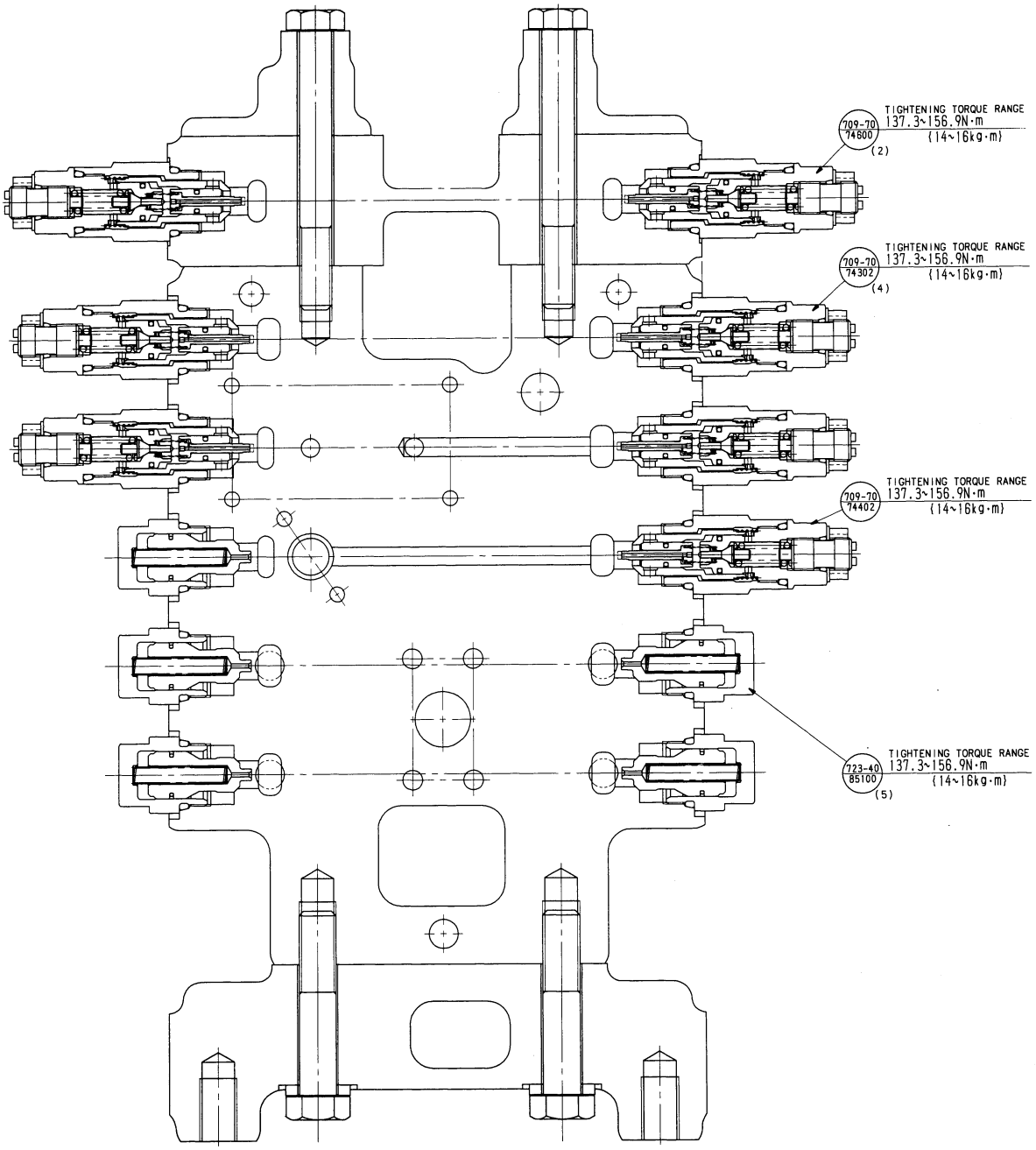
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Pressure compensation valve spring (work equipment, swing)	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformations are found.
		34.4 x 12	20	17.6 ± 1.0 N (1.8 ± 0.1 kg)	-	13.2 N (1.3 kg)	
2	Pressure compensation valve spring (travel)	27.3 x 12	20	25.5 N (2.6 kg)	-	19.6 N (2.0 kg)	
3	Pressure compensation valve adjuster spring service	16.9	15.5	74.5 N (7.6 kg)	-	55.9 N (5.7 kg)	



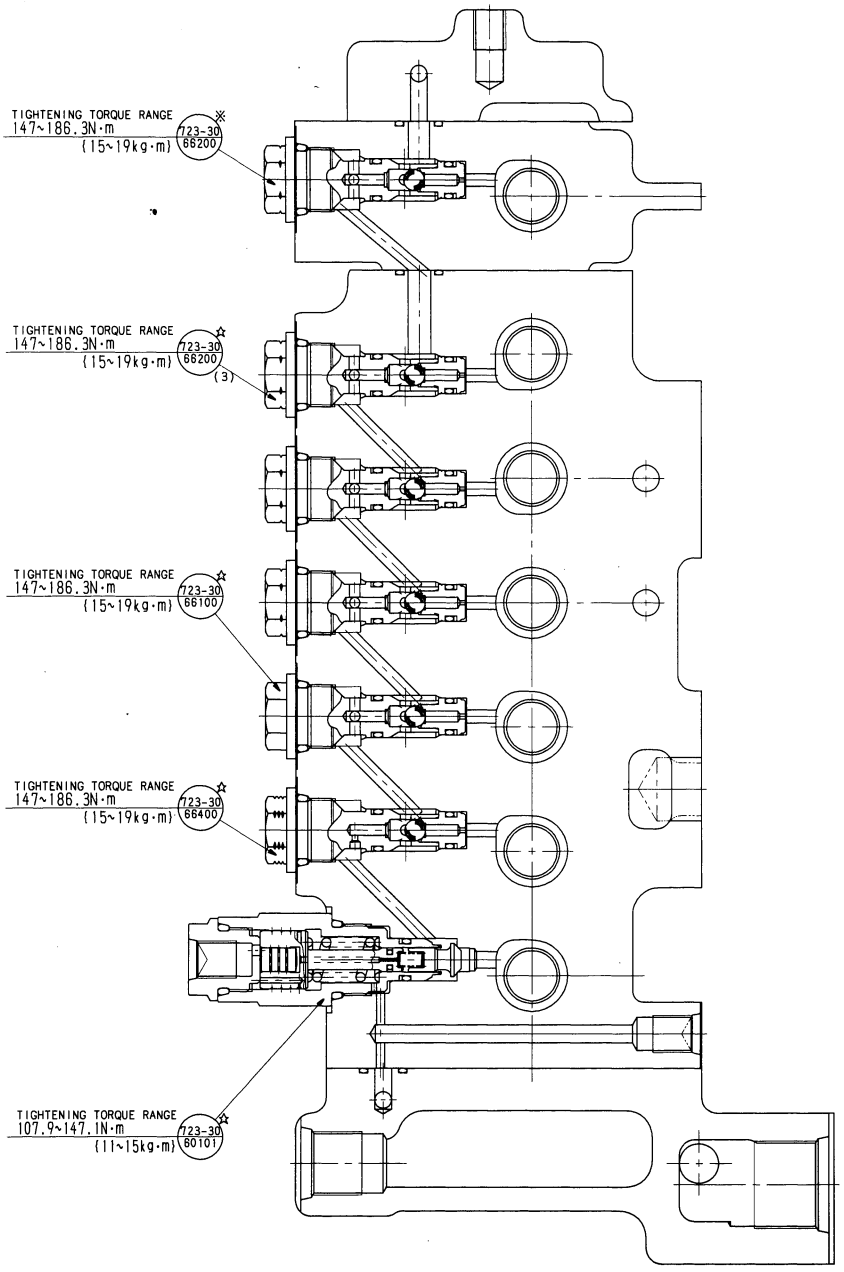
B-B

Unit: mm

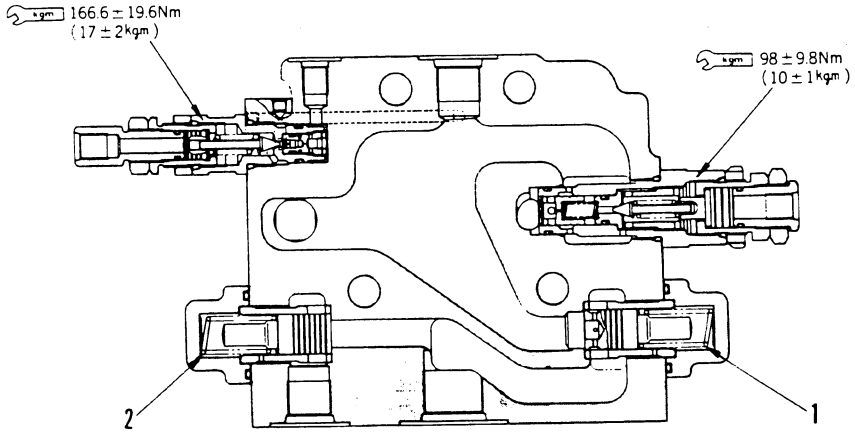
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Spool return spring (work equipment, swing)	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformations are found.
		45.6 x 28	43	230.3 ± 14.7 N (23.5 ± 1.5 kg)	-	208.7 N (21.3 kg)	
2	Spool return spring (travel)	45.7 x 28	43	221.5 ± 13.7 N (22.6 ± 1.4 kg)	-	179.3 N (18.3 kg)	


709-70-74600
(2)
TIGHTENING TORQUE RANGE
137.3~156.9N·m
{14~16kg·m}
709-70-74302
(4)
TIGHTENING TORQUE RANGE
137.3~156.9N·m
{14~16kg·m}
709-70-74402
TIGHTENING TORQUE RANGE
137.3~156.9N·m
{14~16kg·m}
723-40-85100
(5)
TIGHTENING TORQUE RANGE
137.3~156.9N·m
{14~16kg·m}

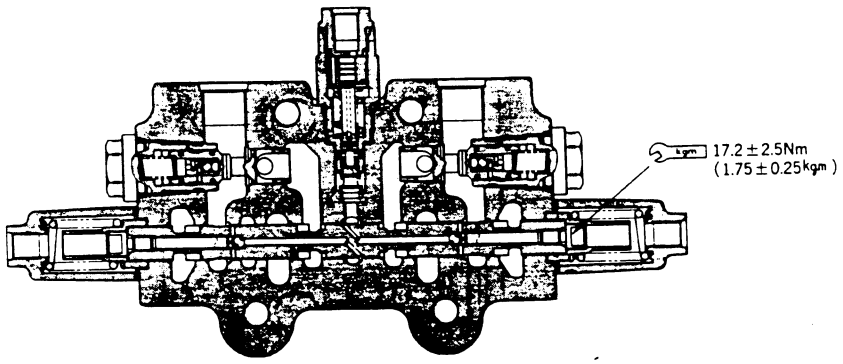
C-C


TIGHTENING TORQUE RANGE
147~186.3N·m
{15~19kg·m}
723-30
66200
※
TIGHTENING TORQUE RANGE
147~186.3N·m
{15~19kg·m}
723-30
66200
☆
(3)
TIGHTENING TORQUE RANGE
147~186.3N·m
{15~19kg·m}
723-30
66100
☆
TIGHTENING TORQUE RANGE
147~186.3N·m
{15~19kg·m}
723-30
66400
☆
TIGHTENING TORQUE RANGE
107.9~147.1N·m
{11~15kg·m}
723-30
60101
☆

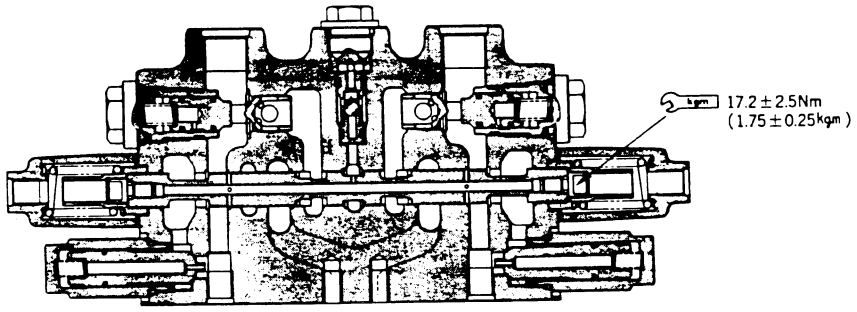
D-D



E–E



F–F

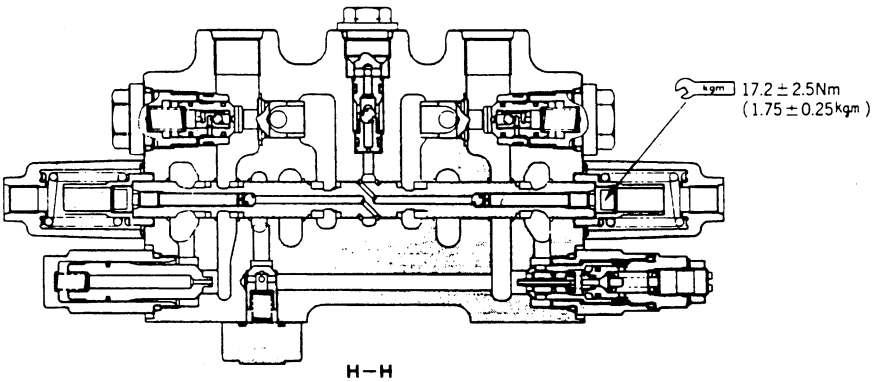


G–G

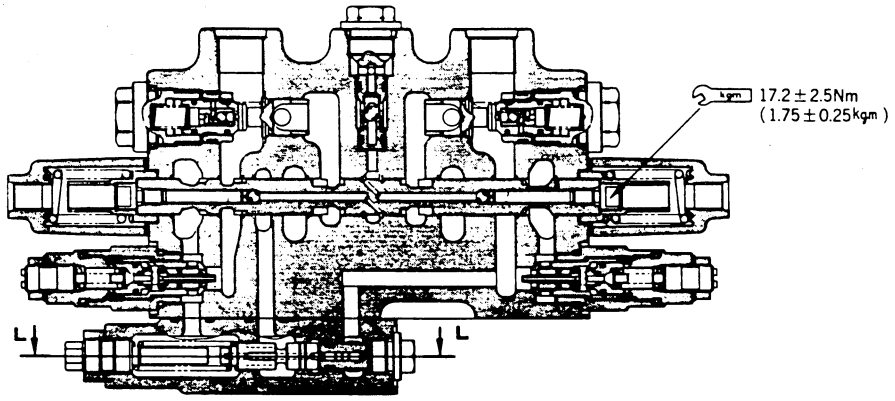
202F06295

Unit: mm

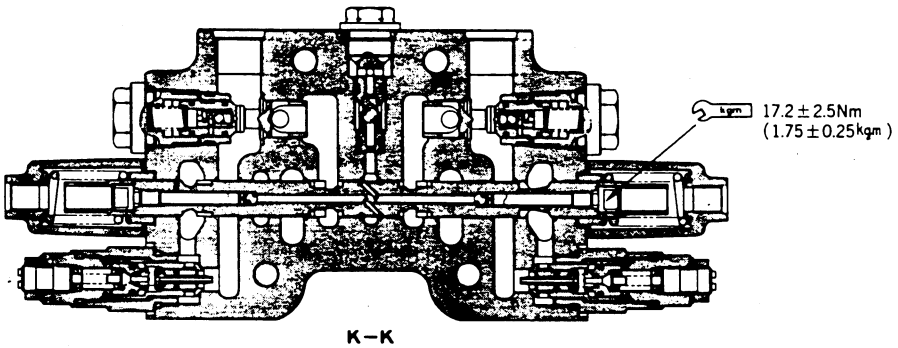
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Lift check valve spring.	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformations are found.
		72.7 x 20.6	42.5	135.2 ± 4.9 N (13.8 ± 0.5 kg)	-	112.7 N (11.5 kg)	
2	Cooler bypass valve spring.	72.7 x 20.6	42.5	135.2 ± 4.9 N (13.8 ± 0.5 kg)	-	112.7 N (11.5 kg)	



H–H

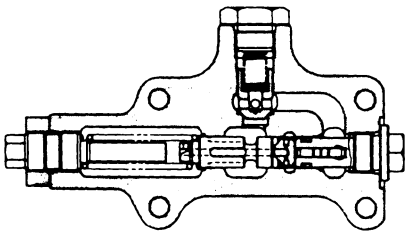


J–J

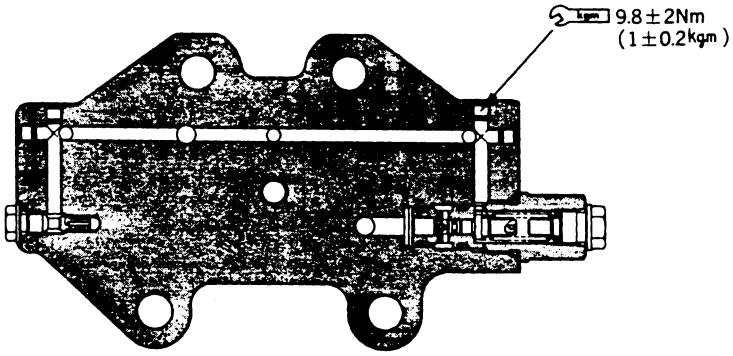


K–K

202F06296



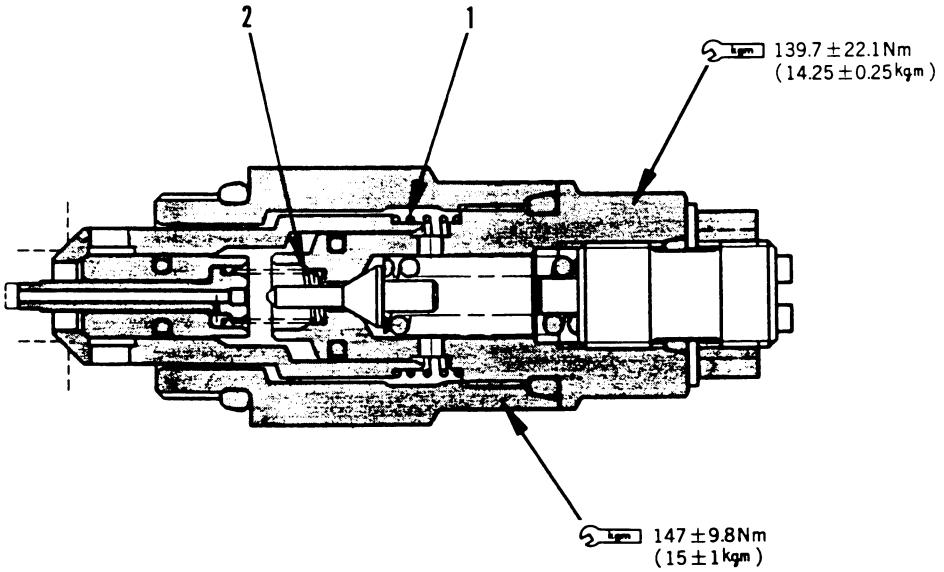
L–L



M–M

202F06297

SUCTION-SAFETY VALVE
FOR SERVICE VALVE

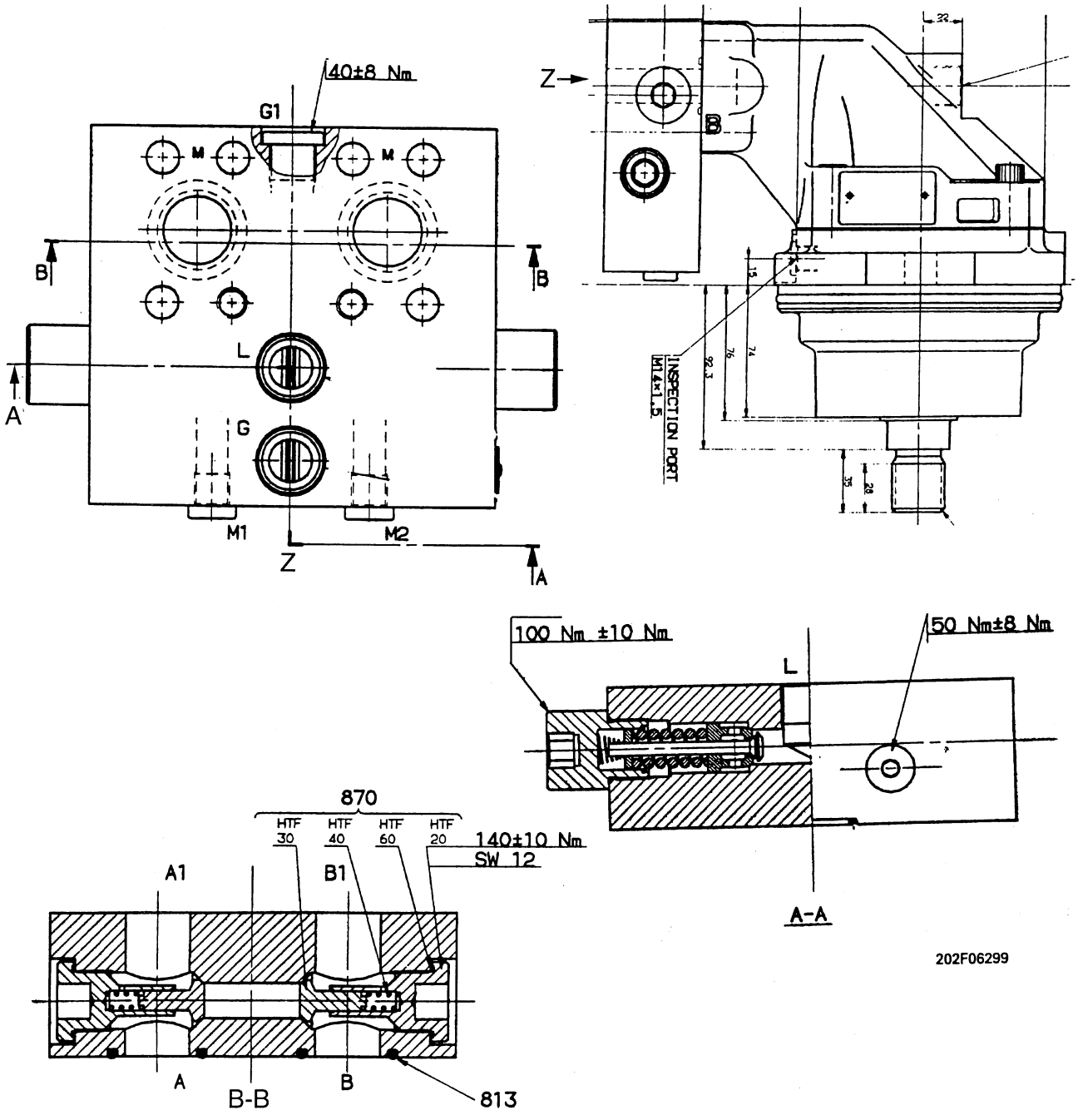


202F06298

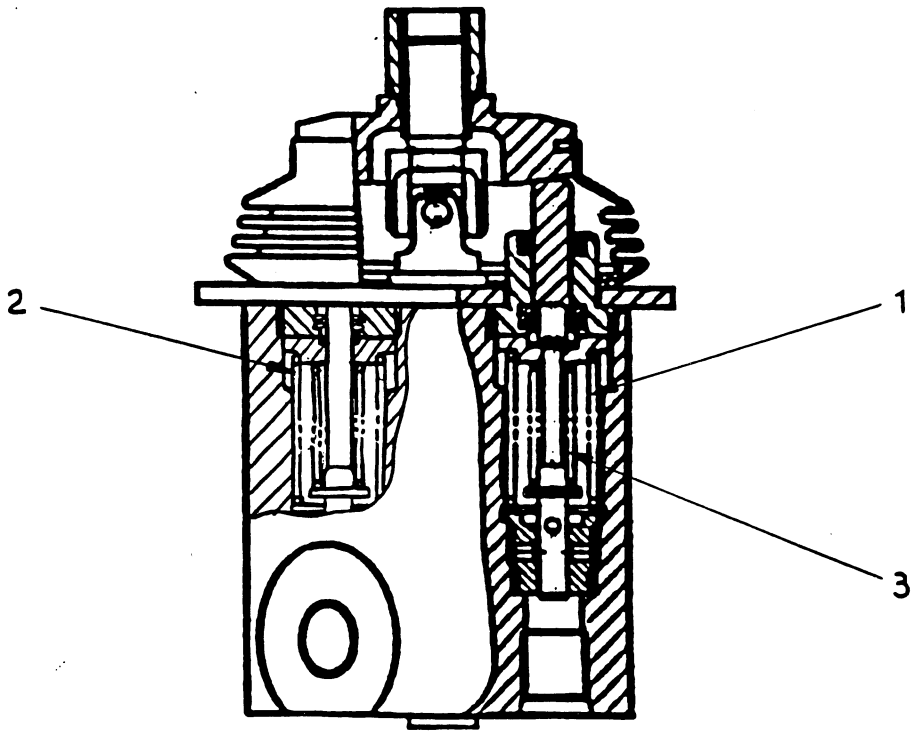
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Suction valve spring.	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformations are found.
		16.3 x 21.3	9.5	2.1 N (0.21 kg)	-	1.6 N (0.16 kg)	
2	Main valve spring	20 x 7	14	2.1 N (0.21 kg)	-	1.6 N (0.16 kg)	

SWING MOTOR


40±8 Nm
G1
M
M
B
B
L
A
G
M1
M2
Z
A
Z
B
INSPECTION PORT
M14×1.5
100 Nm ±10 Nm
50 Nm±8 Nm
L
A-A
870
HTF 30
HTF 40
HTF 60
HTF 20
140±10 Nm
SW 12
A1
B1
A
B-B
B
813
202F06299

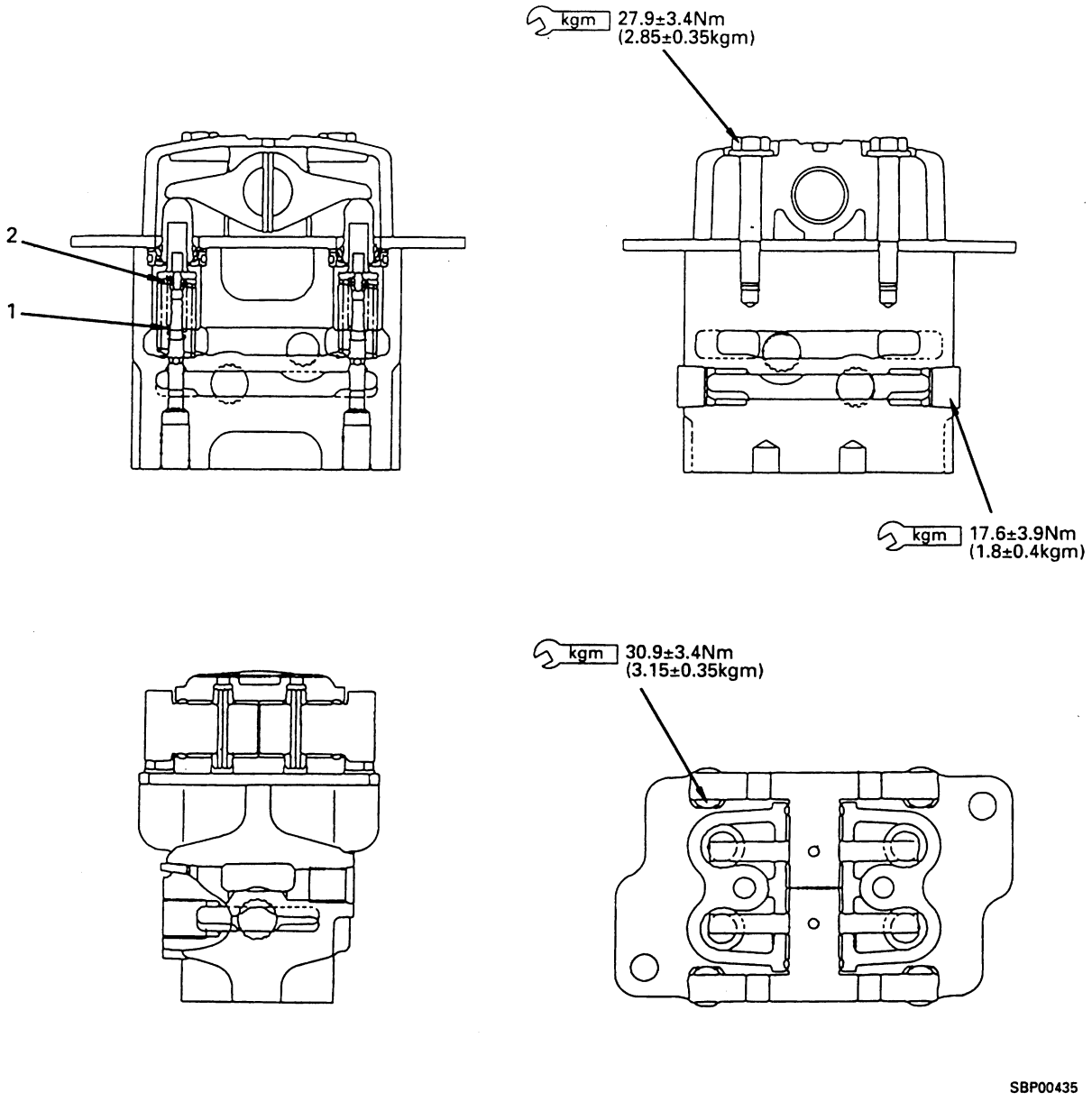
WORK EQUIPMENT, SWING PPC VALVE



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Centering spring (for P3, P4)	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if there is damage or deformation
		43.3 X 19.5	33.5	17.7 N (1.8 kg)	-	13.7 N (1.4 kg)	
2	Centering spring (for P1, P2)	45.5 X 19.6	33.5	29.0 N (3.0 kg)	-	23.2 N (2.4 kg)	
3	Metering spring	27.6 X 9.5	26	16.7 N (1.7 kg)	-	13.7 N (1.4 kg)	

TRAVEL PPC VALVE

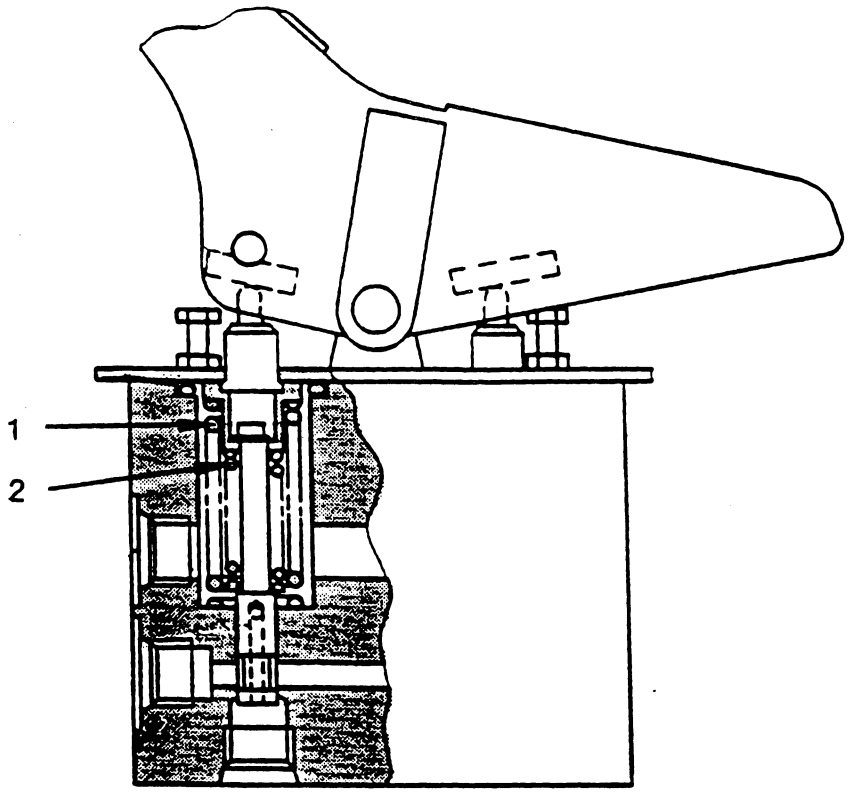


SBP00435

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Metering spring	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if there is damage or deformation
		26.5 X 8.15	24.7	16.7 N (1.7 kg)	-	13.7 N (1.4 kg)	
2	Centering spring	48.1 X 15.5	32.5	107.9 N (11 kg)	-	86.3 N (8.8 kg)	

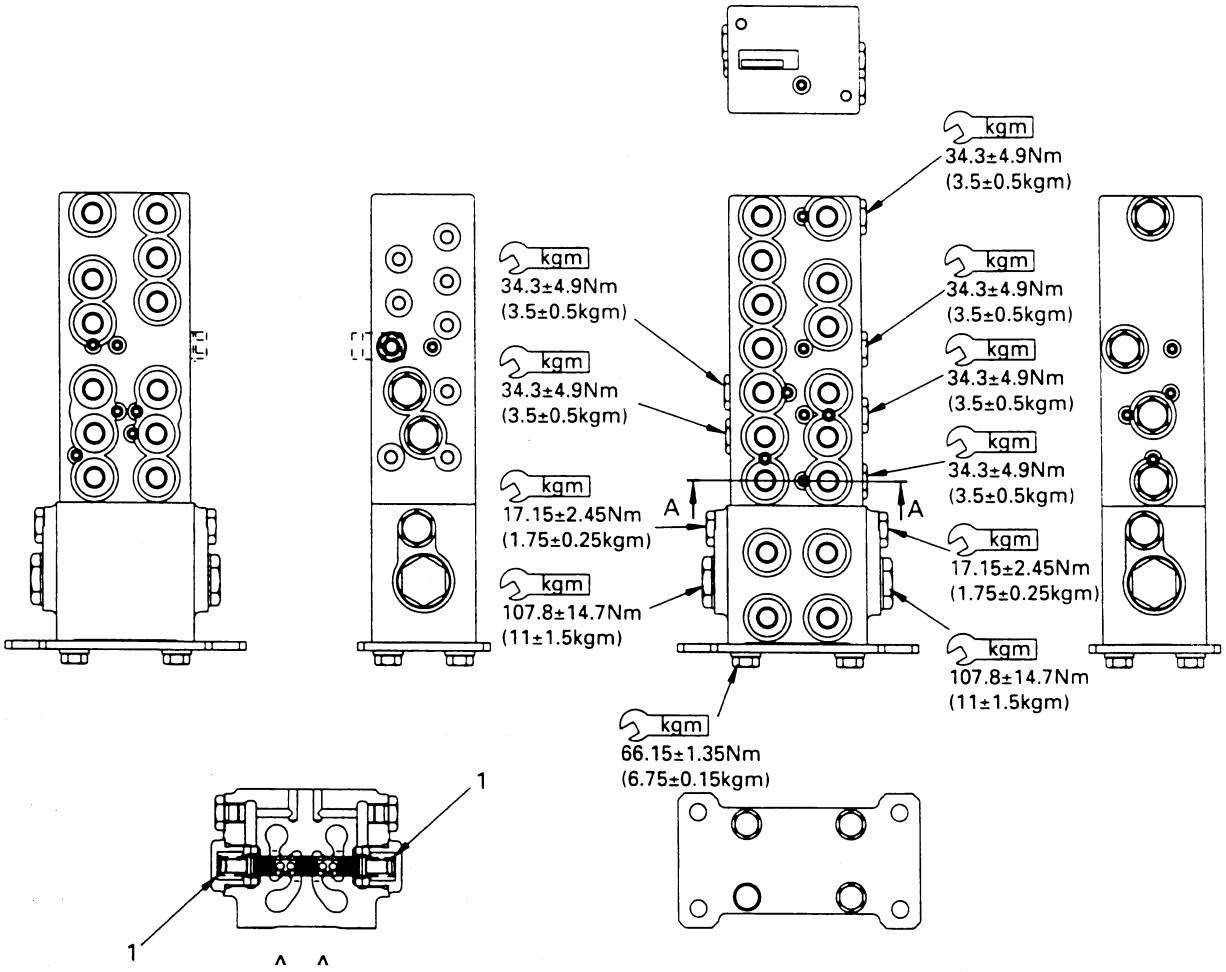
SERVICE PPC VALVE



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Centering spring	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if there is damage or deformation
		41.5 X 18.2	31.5	60 N (6.1 kg)	(40.3)	57.5 N (5.8 kg)	
2	Metering spring	28.5 X 7.6	26.5	17 N (1.7 kg)	(27.6)	16.3 N (1.7 kg)	

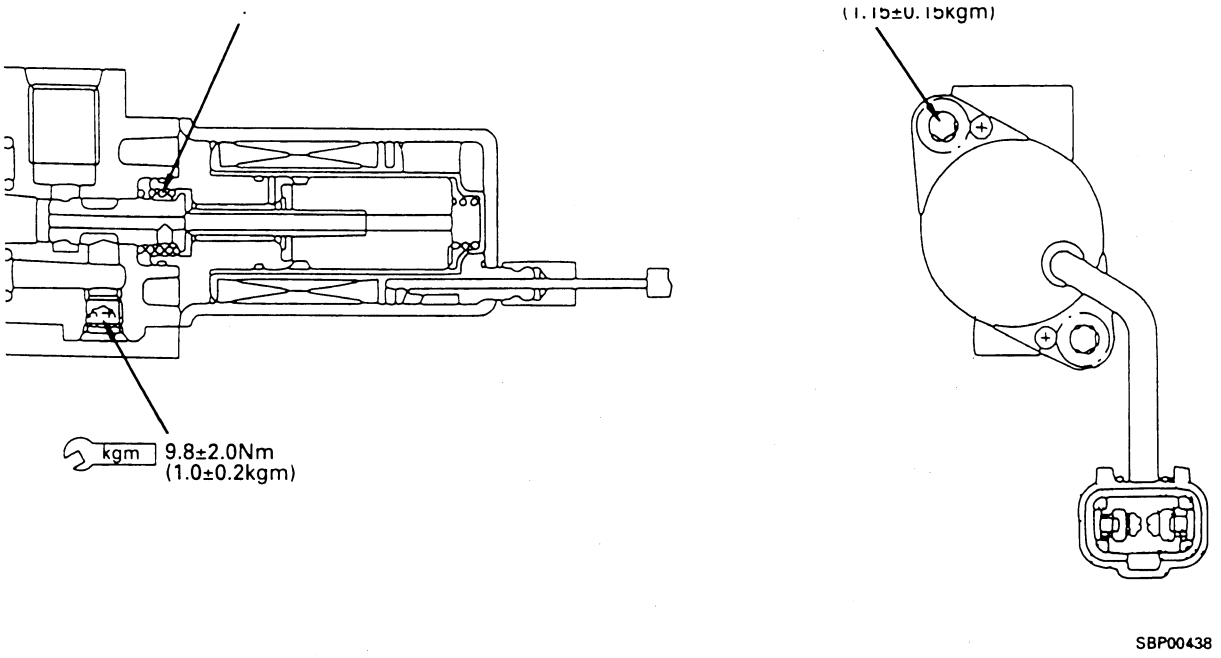
PPC SHUTTLE VALVE, TRAVEL JUNCTION VALVE



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Spool return spring	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if there is damage or deformation
		23.6 x 13.3	20	14.7 N (1.5 kg)	-	11.8 N (1.2 kg)	

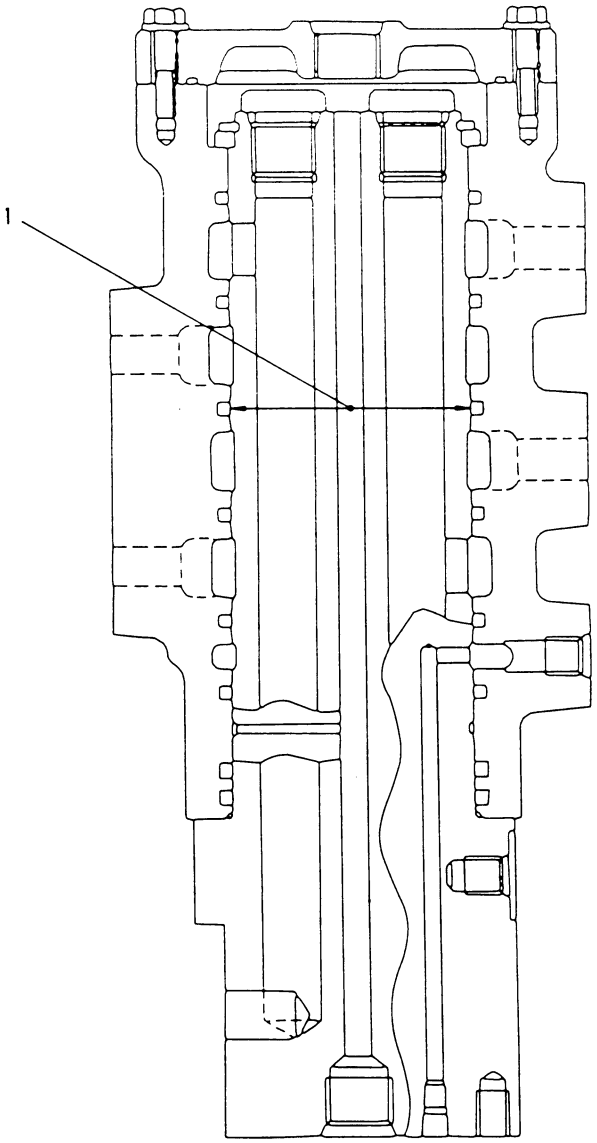
EPC SOLENOID VALVE
FOR LS VALVE



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Return spring	Free length X O.D.	Installed length	Installed load	Free length	Installed load	Replace EPC valve assembly if there is damage or deformation
		9.0 x 11.4	7.9	3.14 N (0.32 kg)	-	-	

CENTER SWIVEL JOINT



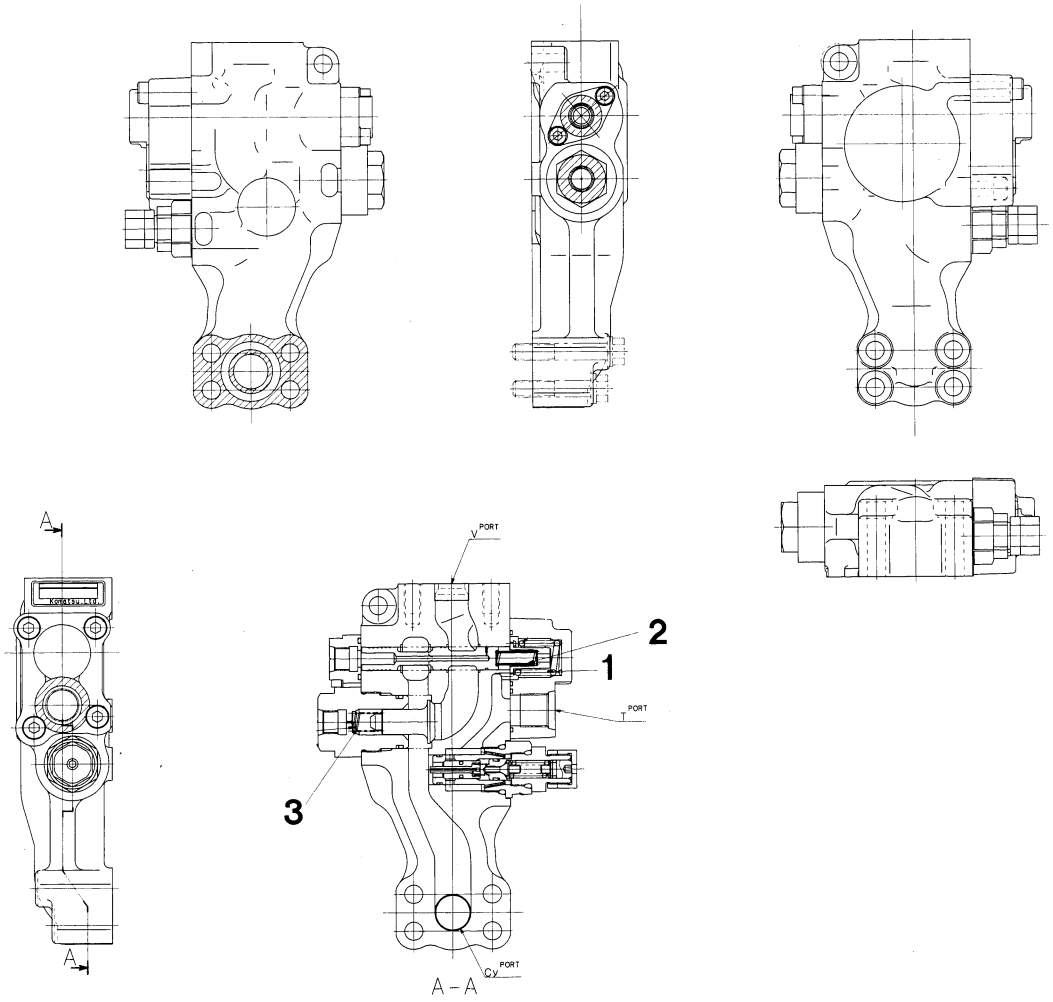
SBP00439

Unit: mm

No.	Check item	Criteria			Remedy
1	Clearance between rotor and shaft	Standard size	Standard clearance	Clearance limit	Replace
		90	0.56 - 0.105	0.111	

ARM, BOOM SAFETY VALVE

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

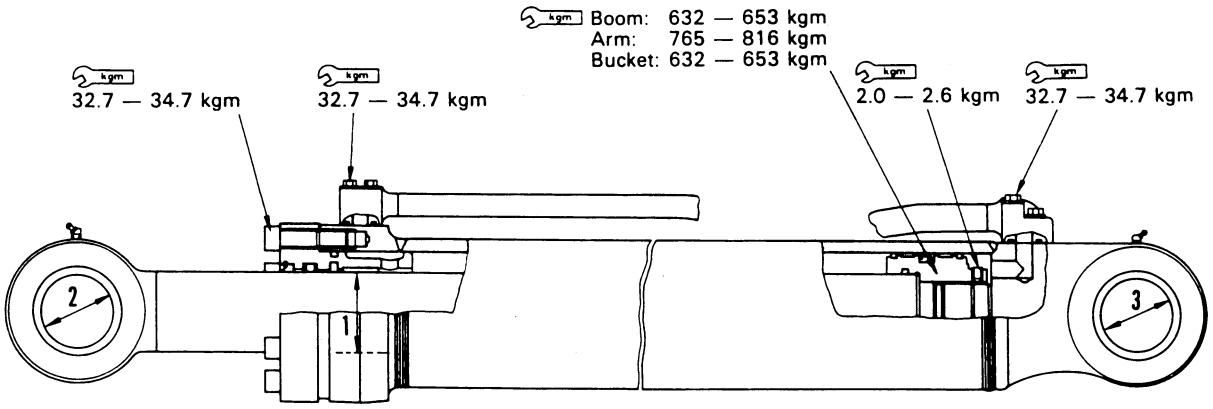


Unit: mm

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)	

HYDRAULIC CYLINDER

PC160-6k, PC180LC/NLC-6K



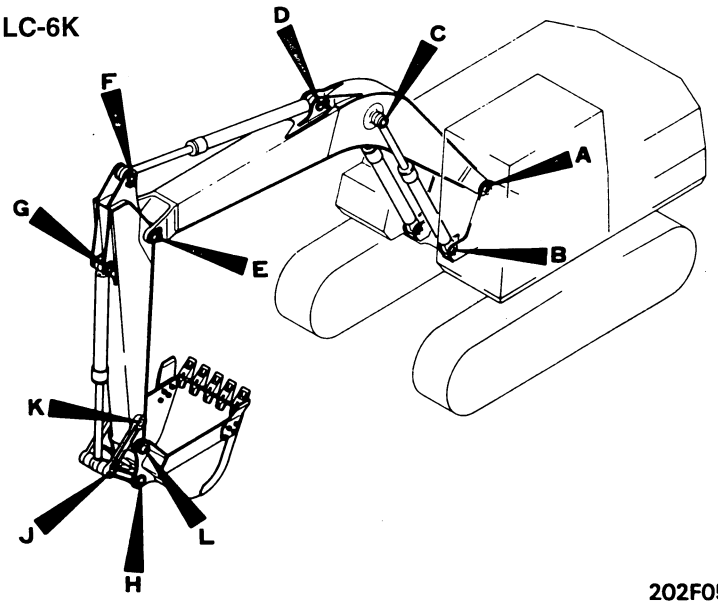
FK203P5097

Unit: mm

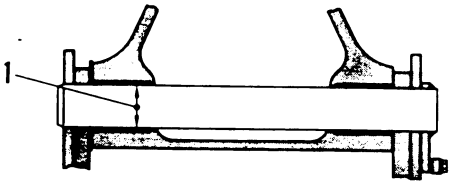
No.	Check item	Name of cylinder	Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Boom	75	-0.030 -0.076	+0.270 +0.065	0.095 - 0.346	0.446	Replace bushing
		Arm	85	-0.036 -0.090	+0.222 +0.047	0.083 - 0.312	0.412	
		Bucket	75	-0.030 -0.076	+0.270 +0.065	0.095 - 0.346	0.446	
2	Clearance between piston rod support and bushing	Boom	70	-0.030 -0.104	+0.198 +0.124	0.154 - 0.302	1.0	Replace pin and bushing
		Arm	80	-0.030 -0.104	+0.211 +0.124	0.154 - 0.315	1.0	
		Bucket	70	-0.030 -0.076	+0.198 +0.124	0.154 - 0.274	1.0	
3	Clearance between cylinder bottom support shaft and bushing	Boom	70	-0.030 -0.100	+0.198 +0.124	0.154 - 0.298	1.0	
		Arm	80	-0.030 -0.104	+0.211 +0.124	0.154 - 0.315	1.0	
		Bucket	70	-0.030 -0.104	+0.198 +0.124	0.154 - 0.315	1.0	

WORK EQUIPMENT

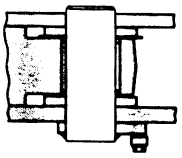
PC160-6k, PC180LC/NLC-6K



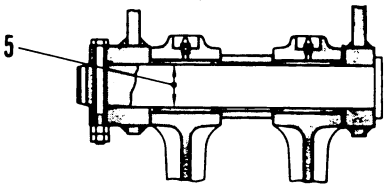
202F05664



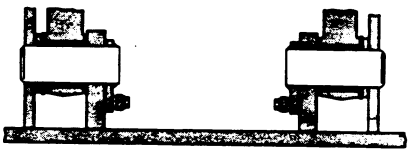
Section A—A



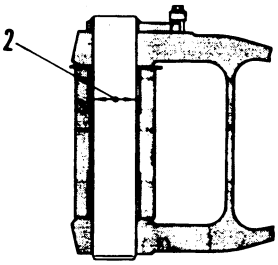
Section D—D



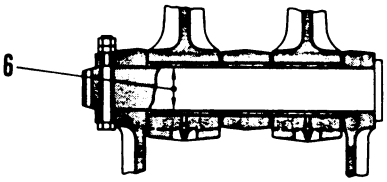
Section H—H



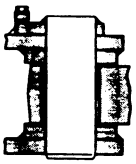
Section B—B



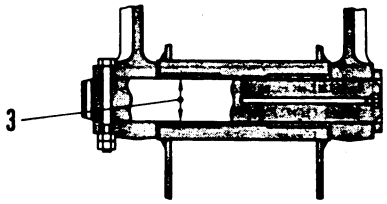
Section E—E



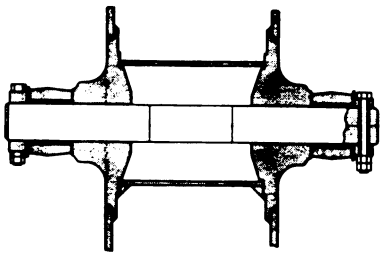
Section J—J



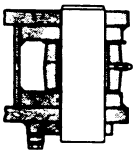
Section F—F



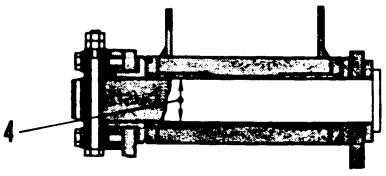
Section K—K



Section C—C



Section G—G



Section L—L

202F05665

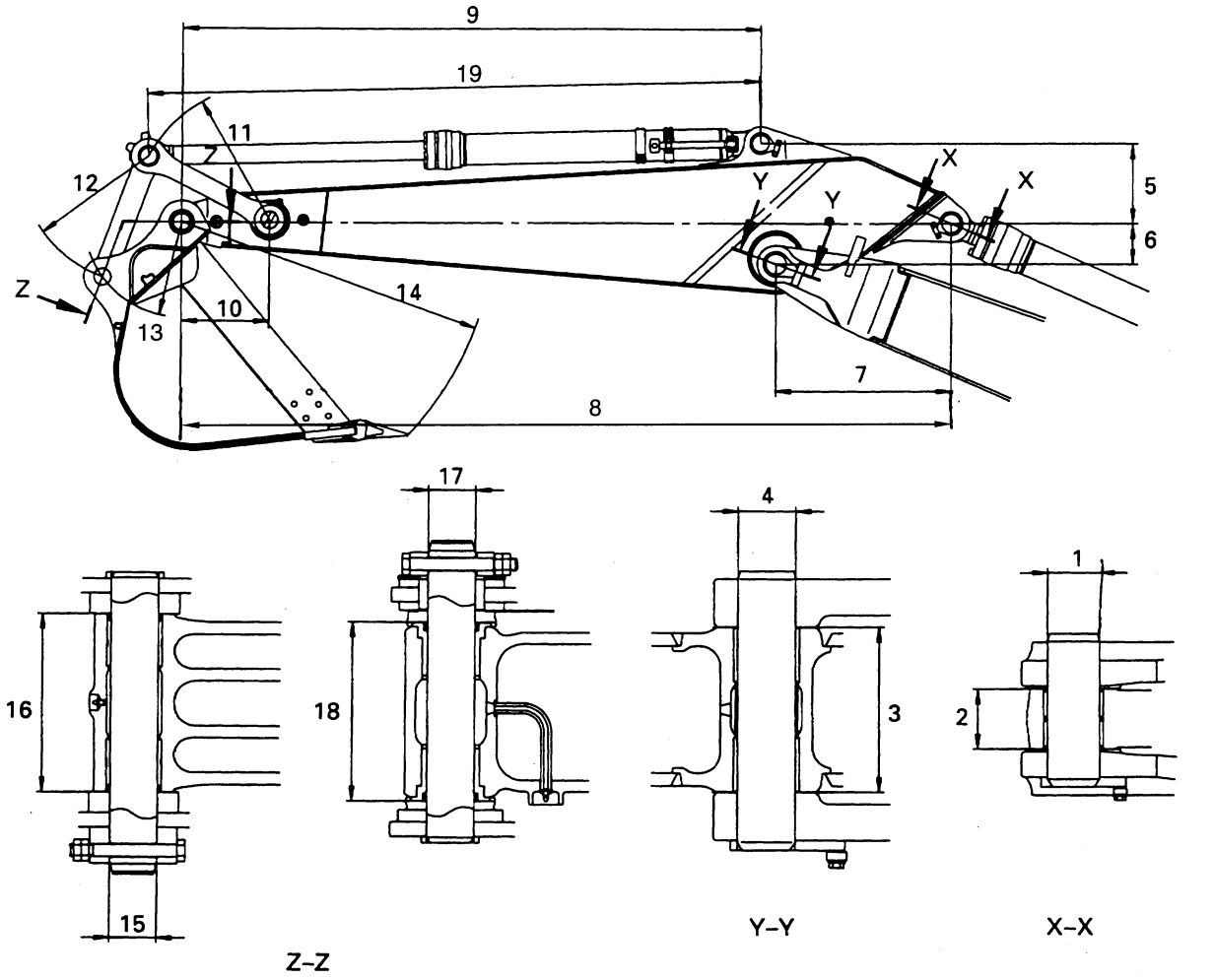
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between bushing and connecting pin of revolving frame and boom	80	-0.030 -0.104	+0.331 +0.265	0.295 - 0.435	1.0	Replace
2	Clearance between bushing and connecting pin of boom and arm	80	-0.030 -0.104	+0.337 +0.273	0.303 - 0.441	1.0	
3	Clearance between bushing and connecting pin of arm and link	70	-0.030 -0.076	+0.331 +0.270	0.300 - 0.407	1.0	
4	Clearance between bushing and connecting pin of arm and bucket	70	-0.030 -0.076	+0.331 +0.270	0.300 - 0.407	1.0	
5	Clearance between bushing and connecting pin of link and bucket	70	-0.030 -0.076	+0.335 +0.275	0.305 - 0.411	1.0	
6	Clearance between bushing and connecting pin of link and link	70	-0.030 -0.076	+0.335 +0.275	0.305 - 0.411	1.0	

DIMENSIONS OF WORK EQUIPMENT

PC180LC-6K, PC160-6K

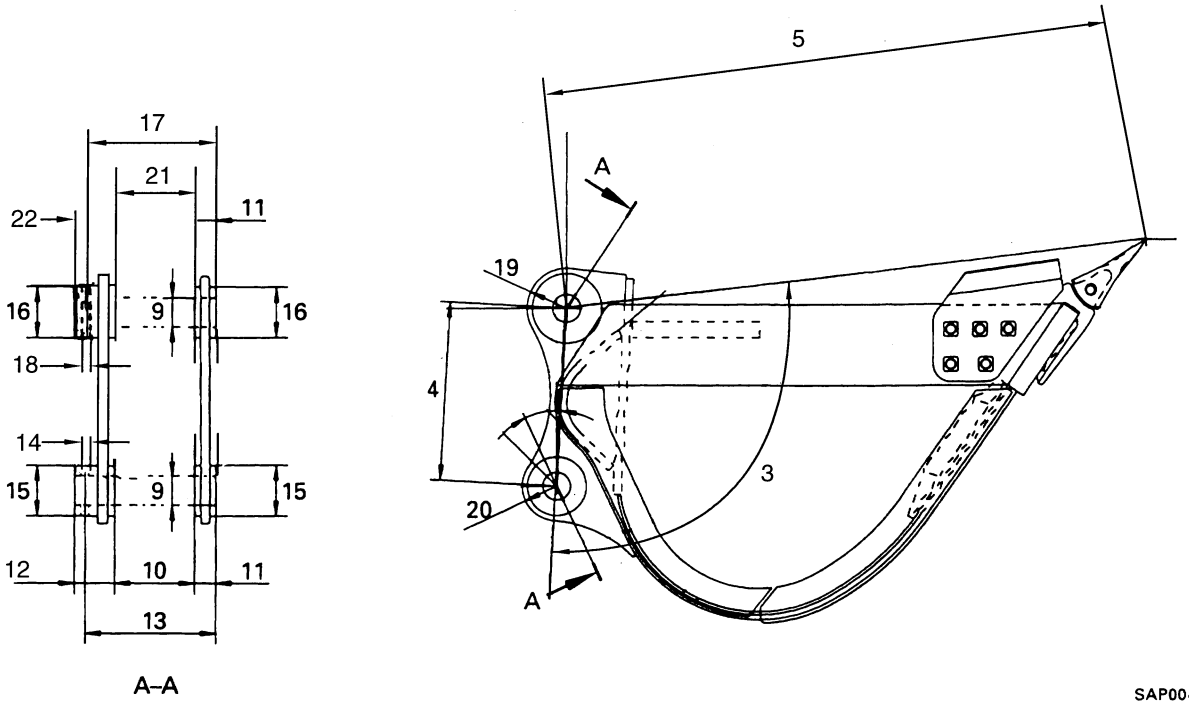
1. ARM

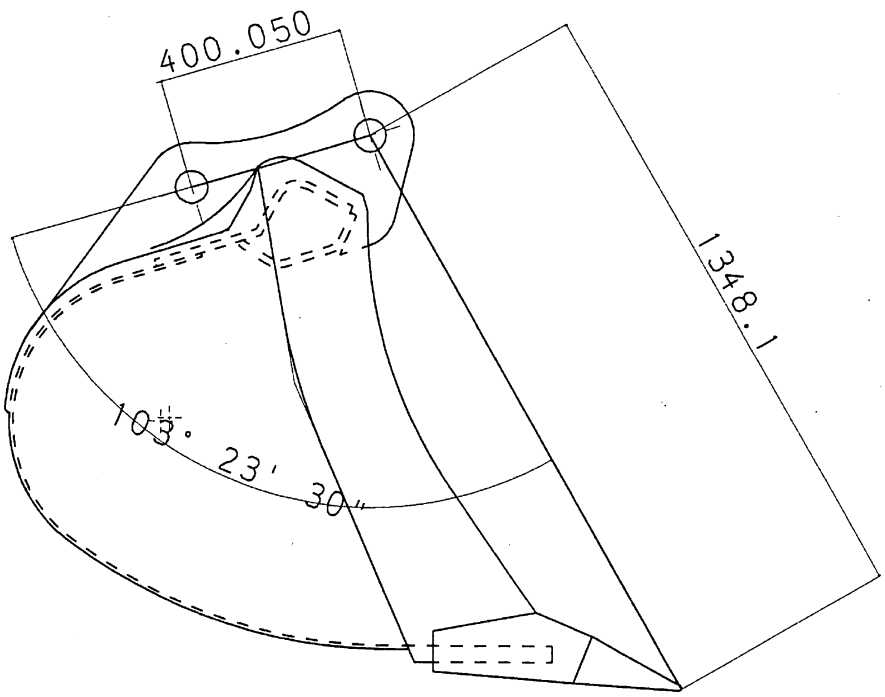


SAP00446

No. \ Model		2.25 m ARM	2.6 m ARM
1		ø80 $^{+0.1}_{0}$ / $^{-0.030}_{-0.104}$	ø80 $^{+0.1}_{0}$ / $^{-0.030}_{-0.104}$
2		98 $^{+1.0}_{0}$ 96 ± 1.2	98 $^{+1.0}_{0}$ 96 ± 1.2
3		284 $^{+0.5}_{0}$ / $^{-0.3}_{-0.8}$	284 $^{+0.5}_{0}$ / $^{-0.3}_{-0.8}$
4		ø80 $^{+0.337}_{+0.273}$ / $^{-0.030}_{-0.104}$	ø80 $^{+0.337}_{+0.273}$ / $^{-0.030}_{-0.104}$
5		395.8 ± 2	399.5 ± 2
6		203.8 ± 1	173.8 ± 1
7		745.3 ± 1	753 ± 1.0
8		2995.3	3357.6 ± 3
9		2377 ± 1.0	2377 ± 1.0
10		330 ± 0.5	330 ± 0.5
11		583 ± 0.5	583 ± 0.5
12		524 ± 0.5	524 ± 0.5
13		400.8	400.8
14		(1348)	(1348)
15		ø70 $^{+0.2}_{0}$ / $^{-0.030}_{-0.076}$	ø70 $^{+0.2}_{0}$ / $^{-0.030}_{-0.076}$
16		311.5 ± 1	311.5 ± 1
17		ø70 $^{+0.2}_{0}$ / $^{-0.030}_{-0.076}$	ø70 $^{+0.2}_{0}$ / $^{-0.030}_{-0.076}$
18	Arm as individual part	276 $^{0}_{-0.5}$	276 $^{0}_{-0.5}$
	When press fitting bushing	310	310
19	Min.	1547	1547
	Max.	2560	2560

1. BUCKET


17
21
22
11
16
9
16
18
14
15
9
15
12
10
11
13
A–A
5
A
19
4
3
20
A
SAP00447


400.050
1348.1
103° 23' 30"

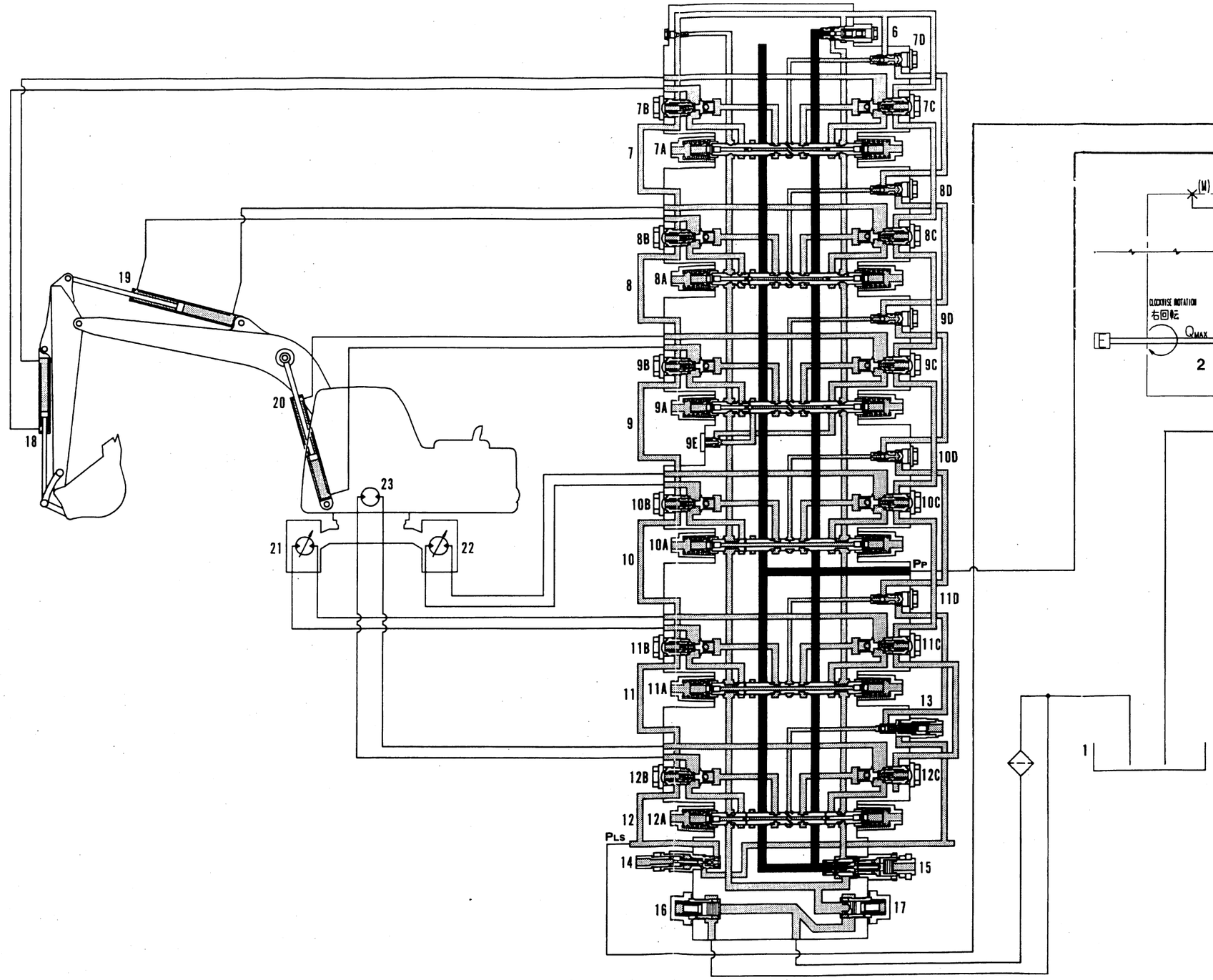
No. \ Model	PC180LC-6K, PC160-6K
3	103° 23'
4	400
5	1348
7	-
9	ø70 $^{+0.3}_{+0.2}$
10	311.5 $^{+0.2}_{0}$
11	50
12	96
13	440 $^{+1}_{0}$
14	ø18
15	ø130
16	ø130
17	440 $^{+0.1}_{0}$
18	ø18
19	R95
20	R95
21	311.5 $^{+0.2}_{0}$
22	96

OPERATION OF CLSS SYSTEM AS A WHOLE

1. When all work equipment is at neutral

★ The diagram shows the situation when all work equipment is at neutral.

★ The valves and circuits that are not conected with the explanation of the operation of the CLSS hydraulic system have been omitted.



Operation

- When the levers are at neutral, the pump is at the minimum swash plate angle, and the oil flow is drained from unload valve (6).
- The LS pressure is connected to hydraulic tank (1) by LS bypass valve (14). The LS differential pressure P_{LS} (unload pressure - tank pressure) at this point is P_{LS} > pump LS control pressure, so the pump swash plate angle is the minimum.

1. Hydraulic tank

Hydraulic pump

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

Control valve

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. R.H. travel valve
    - 10A. Spool
    - 10B. Pressure compensation valve (FORWARD)
    - 10C. Pressure compensation valve (REVERSE)
11. L.H. travel valve
    - 11A. Spool
    - 11B. Pressure compensation valve (FORWARD)
    - 11C. Pressure compensation valve (REVERSE)
    - 11D. LS shuttle valve
12. Swing valve
    - 12A. Spool
    - 12B. Pressure compensation (LEFT)
    - 12C. Pressure compensation valve (RIGHT)
13. LS select valve
14. LS bypass valve
15. Main relief valve
16. Cooler bypass valve
17. Lift check valve

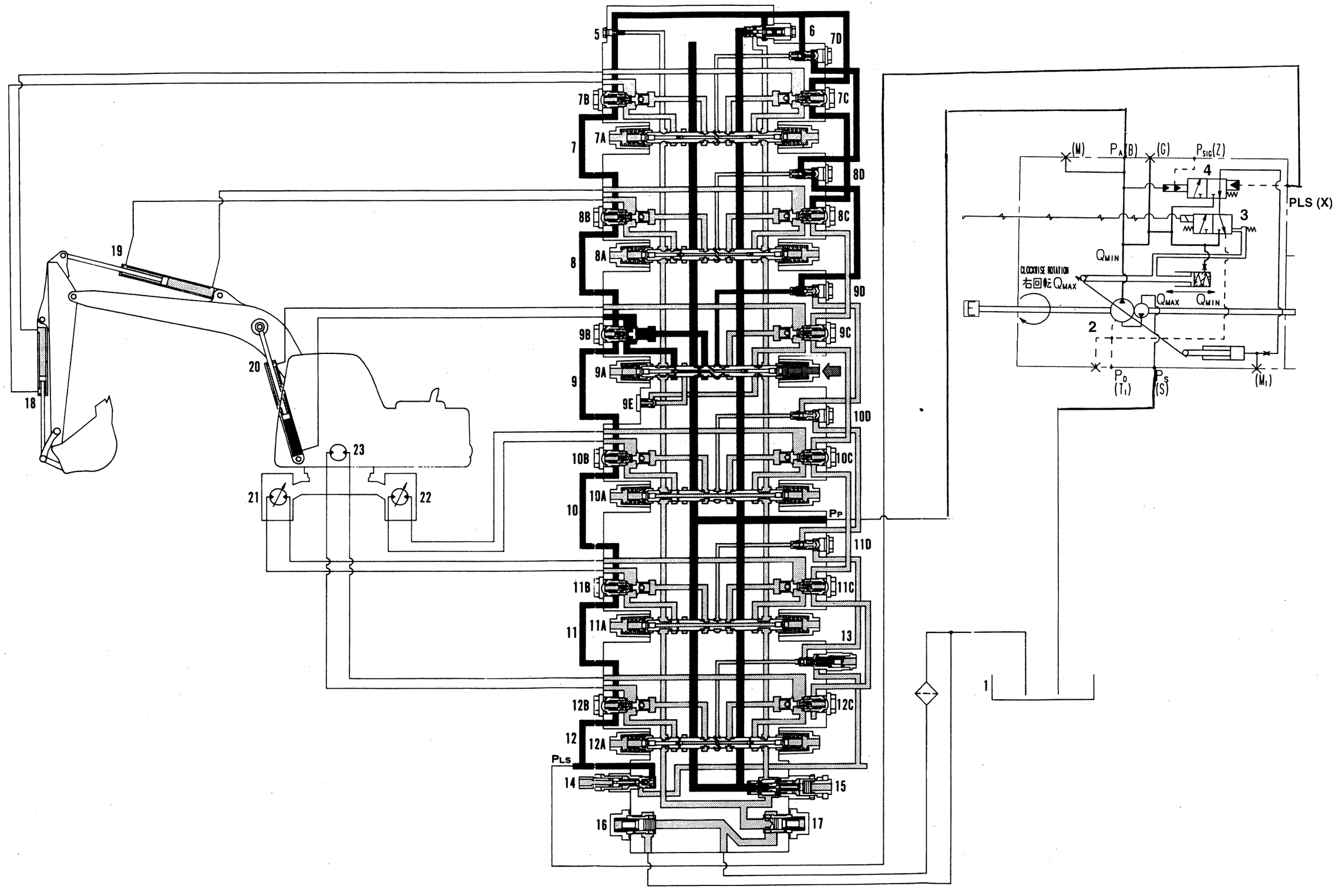
Actuator

18. Bucket cylinder
19. Arm cylinder
20. Boom cylinder
21. L.H. travel motor
22. R.H. travel motor
23. Swing motor

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

Boom RAISE

★ The diagram shows the boom RAISE



Operation

- When the boom RAISE is operated, main pump (2) is at the maximum swash plate angle, and unload vale (6) is closed.
- At this point, for the meter-in opening of boom spool (9A) even if main pump is at the maximum swash plate angle, the LS differential pressure is set to be smaller than the pump LS control pressure.
  In other words, LS differential pressure ΔP_{LS} is ΔP_{LS} < pump Ls control pressure, so the pump swash plate angle becomes the maximum.

1. Hydrraulic tank

Hydraulic pump

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

Control valve

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 shuttle
   - 9A. Spool
   - 9B. Pressure compensation valve (RAISE)
   - 9C. Pressure compensation valve (LOWER)
   - 9D. LS shuttle valve
   - 9E. Check valve
10. R.H. travel valve
    - 10A. Spool
    - 10B. Pressure compensation valve (FORWARD)
    - 10C. Pressure compensation valve (REVERSE)
    - 10D. LS shuttle valve
11. L.H. travel valve
    - 11.A Spool
    - 11B. Pressure compnesation valve (FORWARD)
    - 11C. Pressure compensation valve (REVERSE)
    - 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 valve
15. Main relief valve
16. Cooler bypass valve
17. Lift check valve

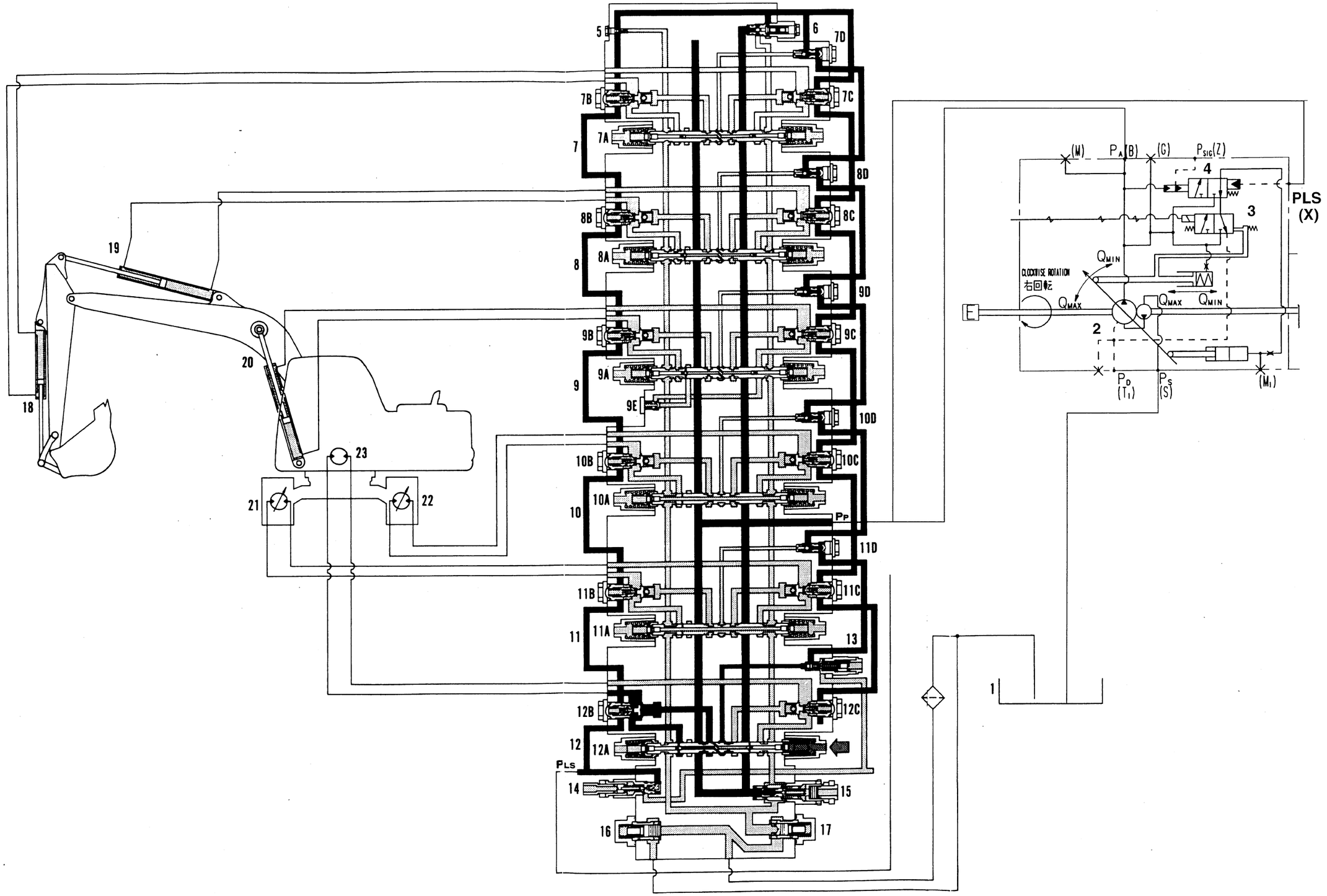
Actuator

18. Bucket cylinder
19. Arm cylinder
20. Boom cylinder
21. L.H. travel motor
22. R.H. travel motor
23. Swing motor

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

Swing operated independently

★ The diagram shows the swing operated independently



Operation

- When the swing is operated, main pump (2) of the arm group is at the maximum swash plate angle, and unload valve (6) is closed.
  LS pressure **PLS** becomes the load pressure of swing motor (23).
- In the swing circuit, the difference between pump discharge pressure **Pp** and LS pressure **PLS** (LS differential pressure **ΔPLS**) becomes the same pressure as the LS set pressure of LS valve (4).
- As a result, the swash plate of main pump (2) is kept at a position midway between the minimum and maximum swash plate angle, and the main pump discharges the demand flow (approx. 50%) for the swing circuit.
- When the swing is operated independently, pump discharge amount **Q** does not become 100%.

1. Hydraulic tank

Hydraulic pump

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

Control valve

6. Unload valve
7. Bucket valve
   - 7A. Spool
   - 7B. Pressure compensation vavle (DUMP)
   - 7C. Pressure compensation valve (CURL)
   - 7D. LS shuttle valve
8. Arm valve
   - 8A. Spool
   - 8B. Pressure compensation valve (RAISE)
   - 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. R.H. travel valve
    - 10A. Spool
    - 10B. Pressure compensation valve (FORWARD)
    - 10C. Pressure dcompensation valve (REVERSE)
    - 10D. LS shuttle valve
11. L.H. travel valve
    - 11A. Spool
    - 11B. Pressure compensation valve (FORWARD)
    - 11C. Pressure compensation valve (REVERSE)
    - 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 valve
15. Main relief valve
16. Cooler bypass valve
17. Lift check valve

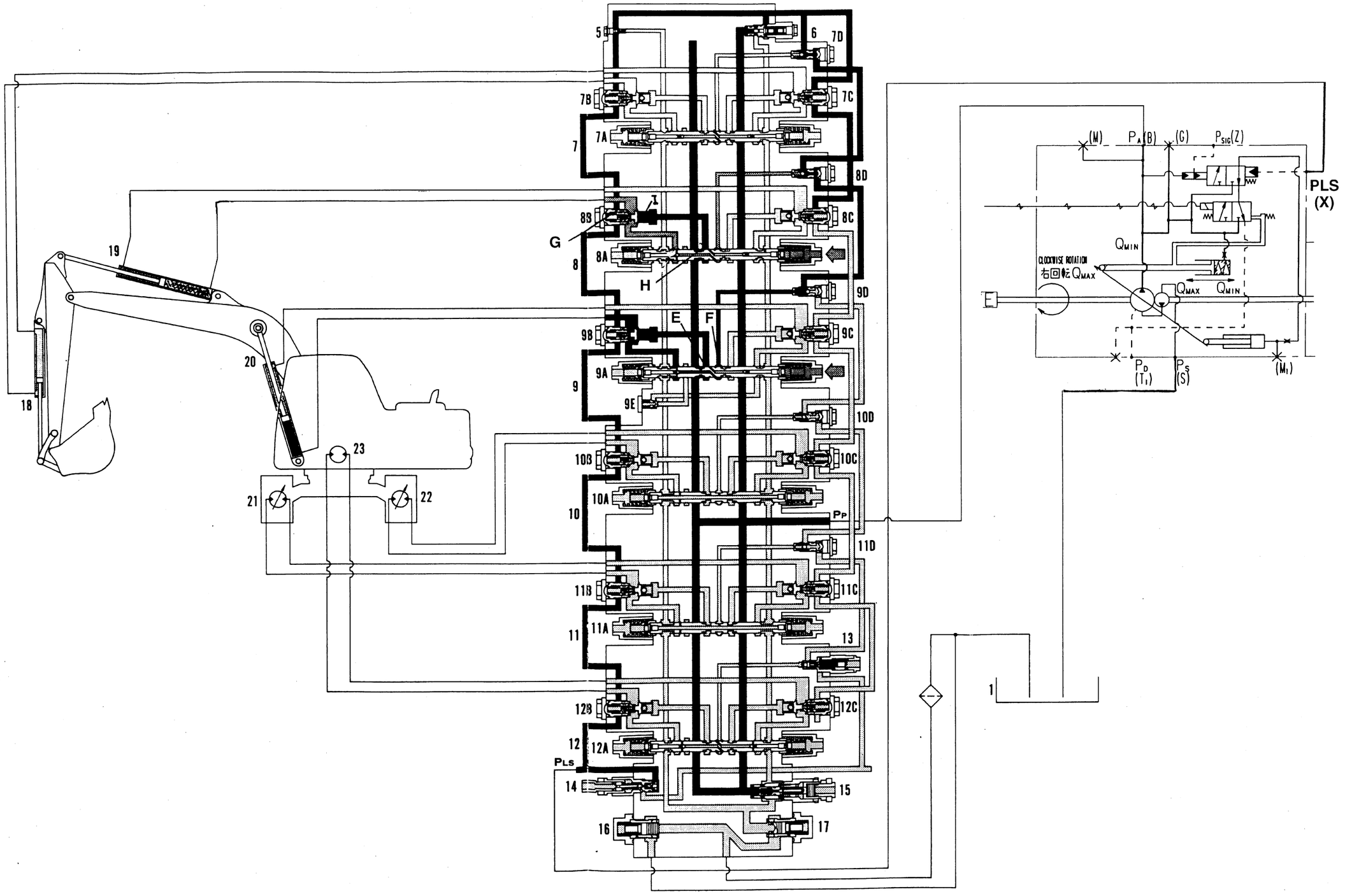
Actuator

18. Bucket cylinder
19. Arm cylinder
20. Boom cylinder
21. L.H. travel motor
22. R.H. travel motor
23. Swing motor

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

Compound operation

★ The diagram shows the boom RAISE + arm IN



Operation

1) When the arm and boom are operated simultaneously, the swash plate angle for main pump becomes the maximum.
When this happens, the load pressure at the boom RAISE side is higher than at the arm side, so the LS pressure passes through ports **E** and **F** of boom spool (9A), enters LS shuttle valve (9,0) and is sent to the LS circuit. This LS pressure is transmitted to port **G** of arm pressure compensation valve (8B), and acts to increase the set pressure of the pressure compensation valve. because of this, the pressure between port **H** or arm spool (8A) and port **I** or pressure compensation valve (8B) rises, and pool meter-in LS differential pressure (pump pressure - LS pressure = ΔP_{LS}) becomes the same as that at the boom end.

2) Because of the above operation, the oil flow is divided in proportion to the size of the operning area of boom spool (9A) and the opening area to arm spool (8A).
Meter-in LS differential pressure ΔP_{LS} during boom RAISE + arm IN is ΔP_{LS} < boom LS control pressure, so the main pump swash plate angle is set to maximum.

1. Hydraulic tank

Hydraulic pump

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

Control valve

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 (IN)
   - 8C. Pressure compensation valve (OUT)
   - 8D. LS shuttle valve
9. Boom vlave
   - 9A. Spool
   - 9B. Pressure compensation valve (RAISE)
   - 9C. Pressure compensation valve (LOWER)
   - 9D. LS shuttle valve
   - 9E. Check valve
10. R.H. travel valve
    - 10A. Spool
    - 10B. Pressure compensation valve (FORWARD)
    - 10C. Pressure compensation valve (REVERSE)
    - 10D. LS shuttle valve
11. L.H. travel valve
    - 11A. Spool
    - 11B. Pressure compensation valve (FORWARD)
    - 11C. Pressure compensation valve (REVERSE)
    - 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 valve
15. Main relfief valve
16. Cooler bypass valve
17. Lift check valve

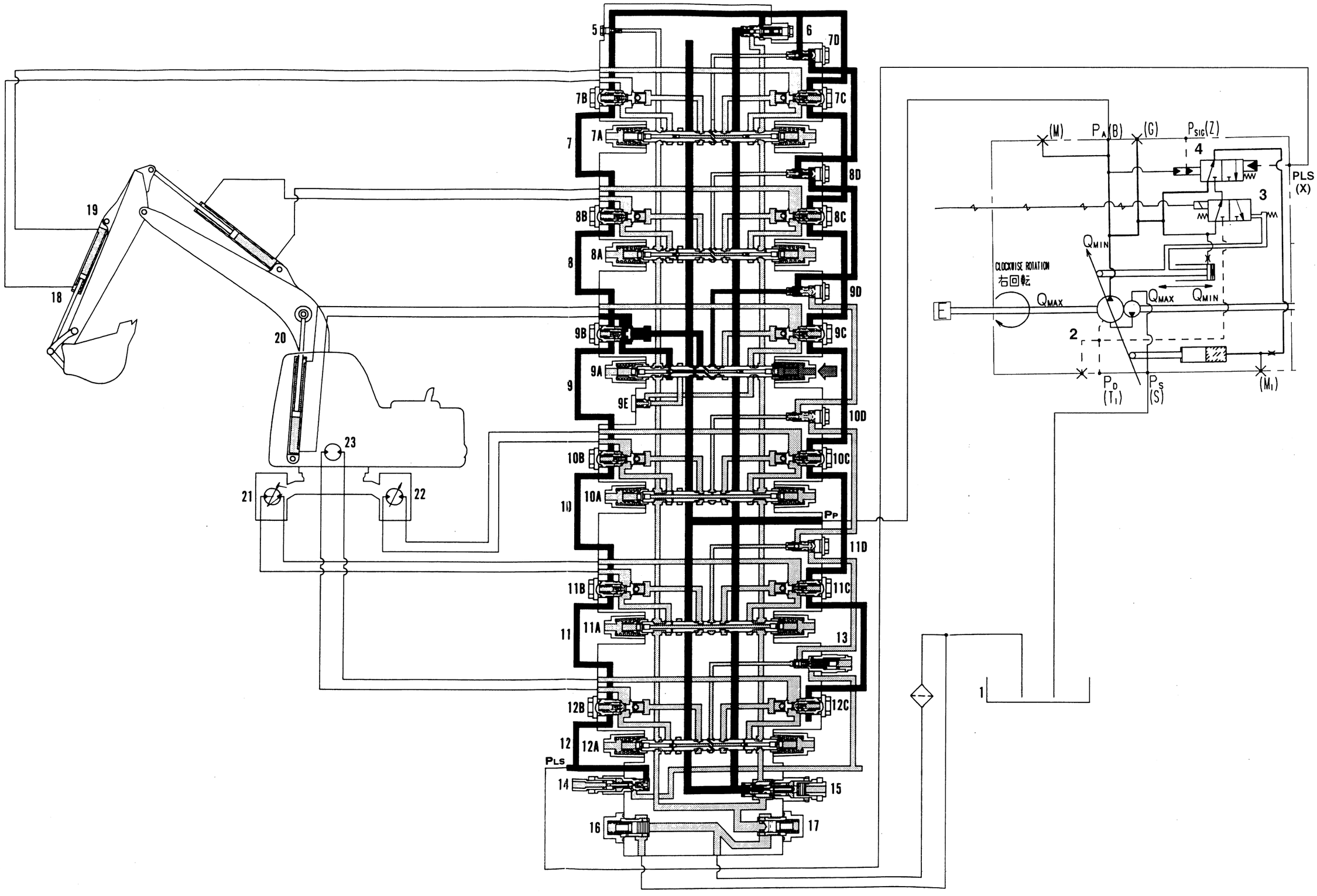
Actuator

18. Bucket cylinder
19. Arm cylinder
20. Boom cylinder
21. L.H. travel motor
22. R.H. travel motor
23. Swing motor

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

Boom OUT, standard mode relief (cut-off control)

★ The diagram shows the boom DUMP and standard mode relief



Operation

- 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 **Pp** 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 **Pp** 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

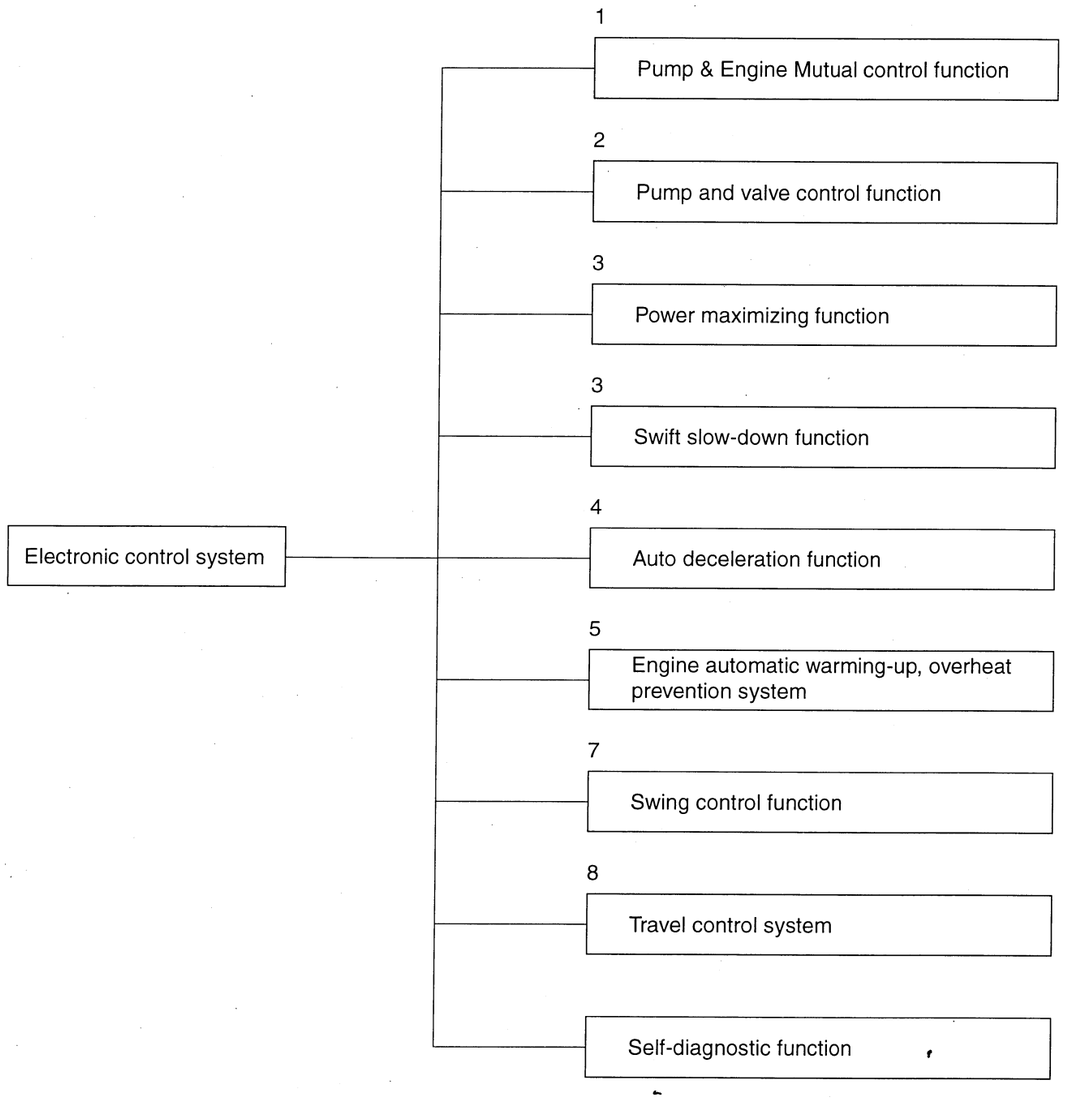
5. LS bypass valve
6. Unload valve
7. Bucket valve
   - 7A. Spool
   - 7B. Pressure compensation valve (DUMP)
   - 7C. Pressure compensation valve (CURL)
   - 7D. LS shuttle valve
8. Arm valve
   - 8A. Spool
   - 8B. Pressure compensation valve (OUT)
   - 8C. Pressure compensation valve (IN)
   - 8D. 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. R.H. travel valve
    - 10A. Spool
    - 10B Pressure compensation valve (FORWARD)
    - 10C. Pressure compensation valve (REVERSE)
    - 10D. LS shuttle vlave
11. L.H. travel valve
    - 11A. Spool
    - 11B. Pressure compensation valve (FORWARD)
    - 11C. Pressure compensation valve (REVERSE)
    - 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 valve
15. Main relief valve
16. Cooler bypass valve
17. Lift check valve

Actuator

18. Bucket cylinder
19. Arm cylinder
20. Boom cylinder
21. L.H. travel motor
22. R.H. travel motor
23. Swing motor

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

ELECTRONIC CONTROL SYSTEM
CONTROL FUNCTION



★ For details of the self-diagnostic function, see TROUBLESHOOTING

TOTAL SYSTEM DIIAGRAM

PC180LC-6k, PC160-6k