Foreword

PD220Y-1 and PD220YS track-type bulldozers are large size bulldozers improved by our plant according to D85 technology imported from Japanese Komatsu. Under the precondition of quality assurance the material、standard parts and fittings are localized at home. Main parts and repair parts have good interchangeability with the same products of Komatsu.

The above rwo bulldozers have adopted the advanced technology of torqflow transmission and hydraulic control and are equipped with 3-level electronic monitoring system. The structure of bulldozer is advanced and reasonable. The bulldozer is reliable in quality、easy in operation and high productive. The all products can be equipped with ordinary cab、ROPS cab、air-conditioned cab、canopy、straight-tilt dozer、angle dozer、U-dozer and ripper etc according to user's requirements.

PD220Y-1 bulldozer is mainly used for earth moving operation at mine、roadbed、reservoir、power station etc and PD220YS bulldozer is used for low ground pressure zone operation、such as swamp etc.

The all products referred in this manual adopt the Cummins series diesel engine manufactured by Chong Qing Automotive Enginge Plant. For the operation maintenance and service of the diesel engine please refer to the operation manual of diesel engine issued by CQAEP.

The content in this manual may differ from real products due to continuous modification of products. Excuse us for that.

In order to carry out the standard of construction machine product model、the product models of our plant are also modified. It is noted that PD220Y-1 and PD220YS are respectively responded to the original PD7-1 and PD7 LGP.

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2. Structure and principle

3. Function and operation of each device

4. Operation

5. Maintenance and service

6. Safety operation rules and techniques

7. Troubleshooting

8. Electrical System

9. Transportation and Storage

1. Outline

1. 1 Description of product

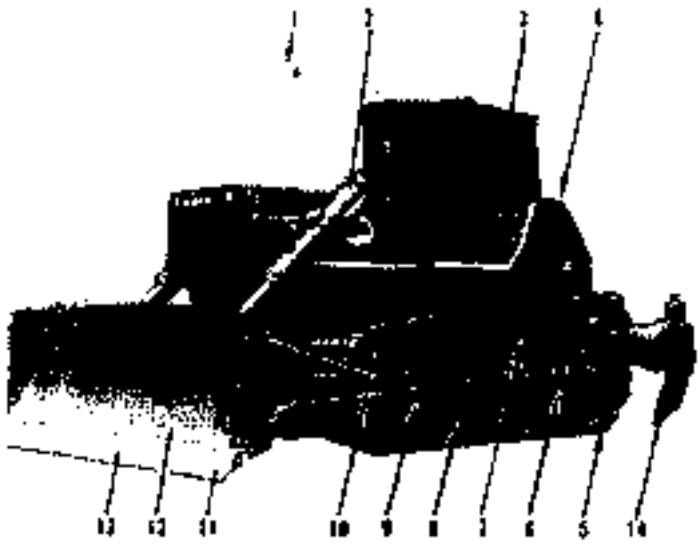


Fig. 1-1 PD220Y-1 track-type bulldozer

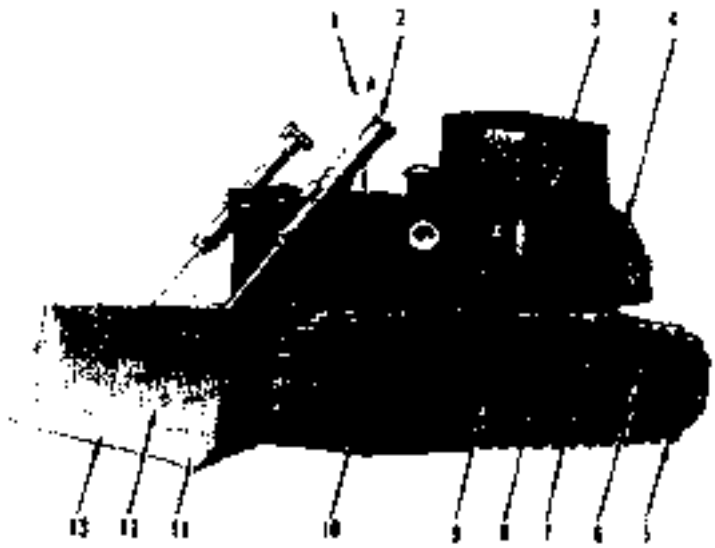


Fig. 1-2 PD220YS track type bulldozer

1. Engine 2. Lift cylinder 3. Cab 4. Fuel tank 5. Track
6. Track roller frame assembly 7. Carrier roller 8. Track roller
9. Push arm 10. Idler 11. End bit 12. Blade 13. Cutting edge 14. Ripper

1.2 Specification

Parameter \ Model			PD220Y－1	PD220YS
Weight(kg) (With straight-tilt blade and ordinary cab)	Operating Weight		25500	26000
	Shipping Weight		25000	25500
	Ground Pressure (MPa)		0.082	0.093
Engine	Model		NT-855-C280	
	Type		Vertical in line, water cooling, PT pump injection, turbocharged	
	Rated speed (r/min)		1800	1800
	Rated Power (HP/kW)		220/164	220/164
	Oil consumption (g/kW)		<235	<225
Travel Speed (km/h)	Forward	1st	0～3.6	0～3.6
		2nd	0～6.5	0～6.5
		3rd	0～11.2	0～11.2
	Reverse	1st	0～4.3	0～4.3
		2nd	0～7.7	0～7.7
		3rd	0～13.2	0～13.2
Power Train	Torque Converter		3-element single-stage and single-phase	
	Transmission		Planetary-gear and multible-disc clutch, hydraulically actuated, force-lubricated	
	Bevel Gear		Spiral bevel gear, single reduction and splash-lubricated	
	Steering Clutch		Wet, multi-disc, spring-applied, hydraulically realesed and hand-operated	
	Steering Brake		Wet, float brake with hydraulic booster	
	Final Drive		Spur gear, double-reduction and splash lubricated	

To be continued

Parameter \ Model		PD220Y－1	PD120YS
Undercarriage	Type	Oscillating diagonal brace type, equalizer bar, suspension	
	No. of Carrier Roller	2, each side	
	No. of Track Roller (each side)	8(4 single, 2 double)	8(5 single, 3 double)
	Track Type	Single grouser (38, each side)	Single grouser (45, each side)
	Shoe Width	560mm	560mm
	Pitch	216mm	216mm
Hydraulic System of Chassis (MPa)	Transmission Setting Pressure	2.45	2.45
	Steering Setting Pressure	1.69	1.69
	Braking Setting Pressure	2.16	2.16
Hydraulic System of Working Equipment	Setting Pressure (MPa)	14.0	
	Working Cylinder Internal Diameter × Stroke × Quantity	120mm × 1054mm × 2	120mm × 1054mm × 2
	Tilt Cylinder Internal Diameter × Stroke × Quantity	200mm × 130mm × 1	200mm × 130mm × 1

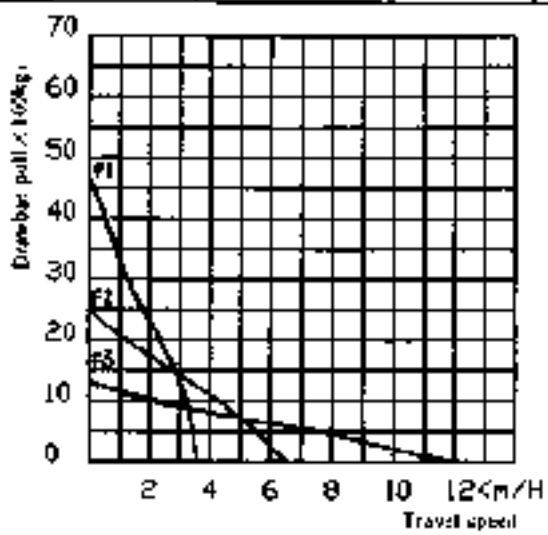


Fig1-3 PD220Y 1,PD220YS Drawbar Pull vs Travel Speed

1.3 Overall Dimension

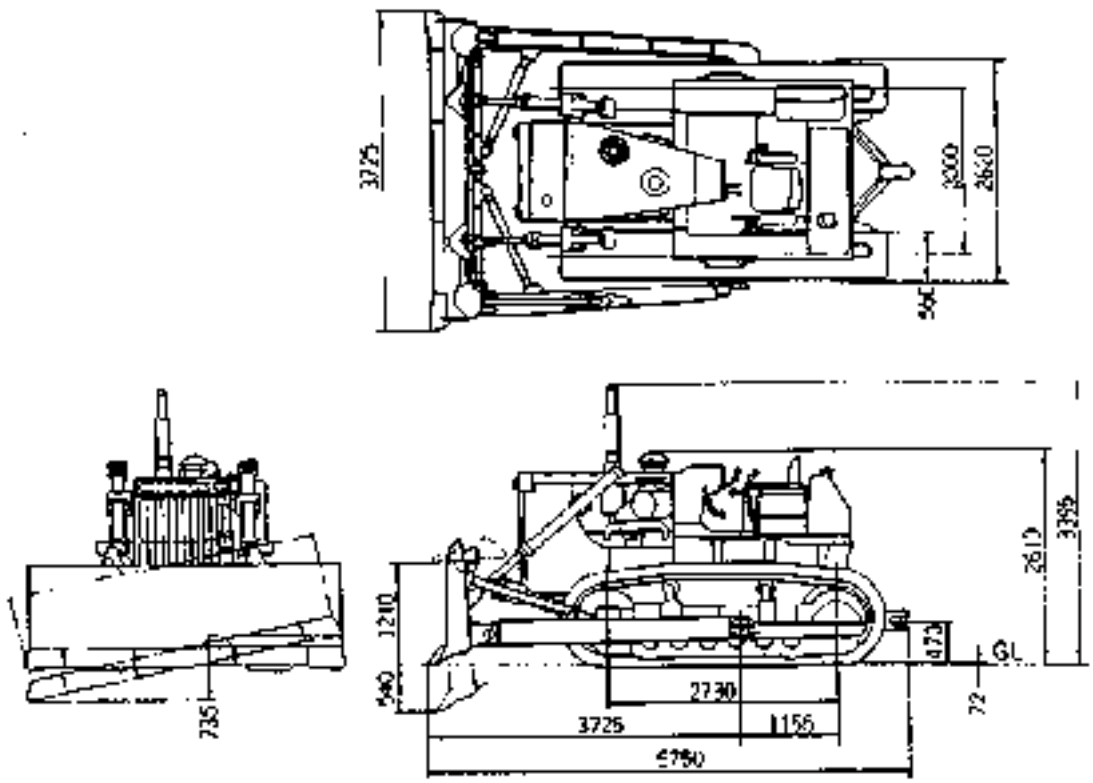


Fig. 1-4 Overall dimension of PD220Y-1 bulldozer

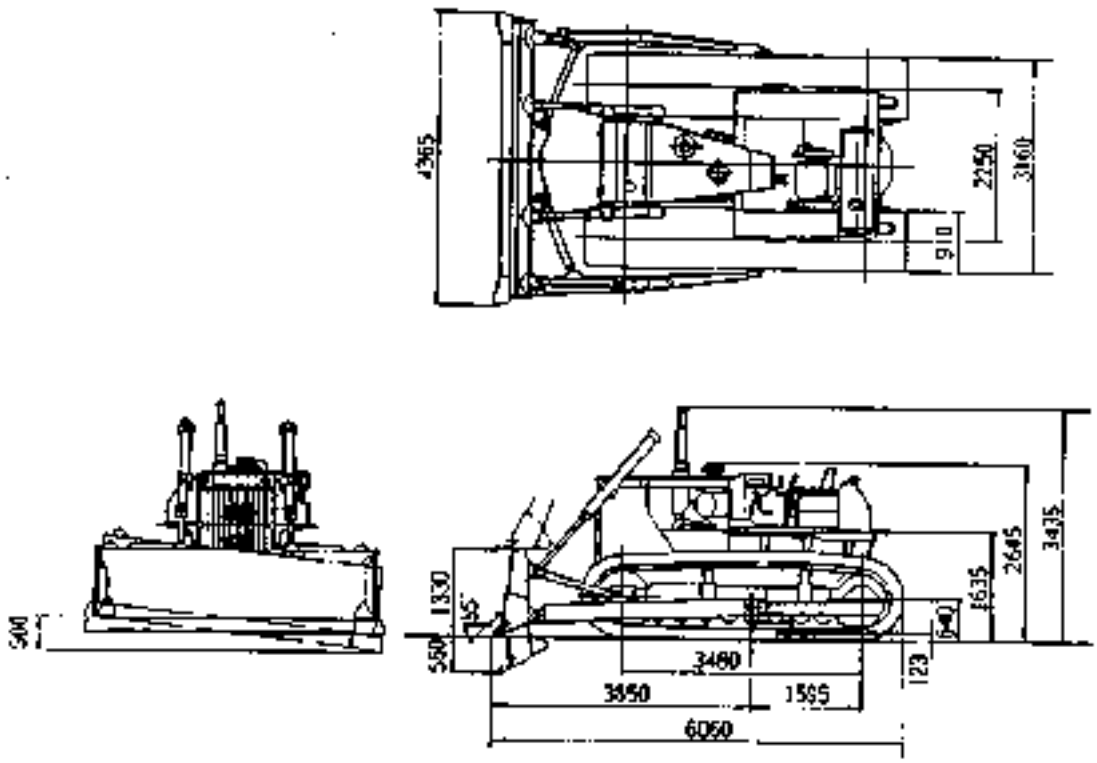


Fig. 1-5 Overall dimension of PD220YS bulldozer

2. Structure and Principle

2. 1 Description of power train

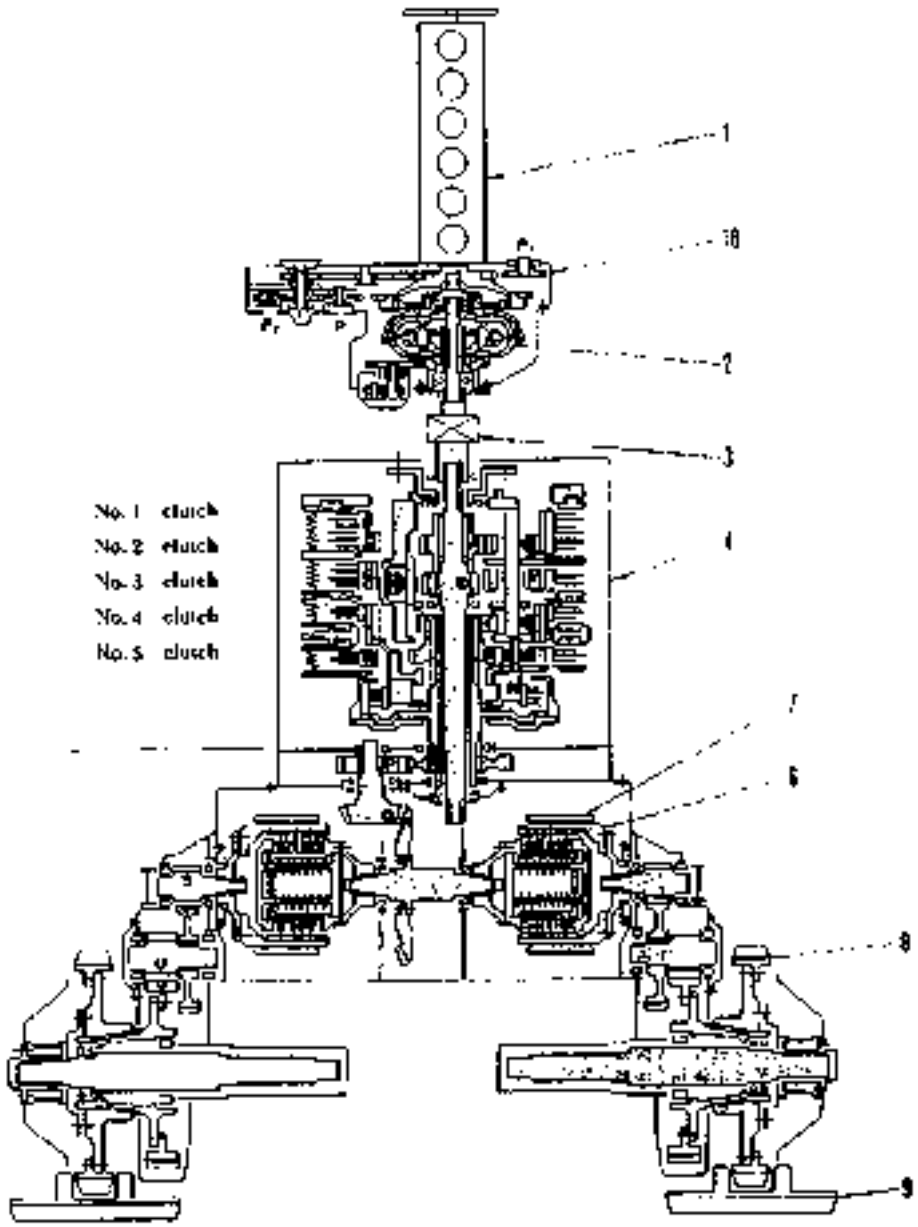


Fig. 2-1 Power train schematic

A NO. 1 Sun gear(no. of teeth 33)
B NO. 1 Planetary gear(no. of teeth 24)
C NO. 1 Ring gear(no. of teeth 81)
D NO. 2 Sun gear(no. of teeth 21)
E NO. 2 Planetary gear(no. of teeth 23)
F NO. 2 Planetary gear(no. of teeth 29)
G NO. 2 Ring gear(no. of teeth 81)
H NO. 3 Sun gear(no. of teeth 33)
I NO. 3 Planetary gear(no. of teeth 24)
J NO. 3 Ring gear(no. of teeth 81)
K NO. 4 Sun gear(no. of teeth 42)
L NO. 4 Planetary gear(no. of teeth 19)
M NO. 4 Ring gear(no. of teeth 81)
N NO. 5 Ring gear(no. of teeth 42)
O Driving gear(no. of teeth 34)
P Driven gear(no. of teeth 23)
Q Bevel pinion(no. of teeth 21)
R Bevel gear(no. of teeth 49)
S NO. Final drive 1st pinion(no. of teeth 12)
T Final drive 1st gear(no. of teeth 45)
U Final drive 2nd pinion(no. of teeth 12)
V Final drive 2nd gear(no. of teeth 55)
P1 Work equipment pump
P2 Transmission pump
P3 Steering pump

1. Engine
2. Torque converter
3. Universal joint
4. Transmission
5. Control valve
6. Steering clutch
7 Steering brake
8. Sprocket
9. Track
10. P. T. O.

Gear speed and power flow

Forward/reverse	Gear speed	Clutches engaged	
Forward	1st	No. 1	No. 5
	2nd	No. 1	No. 4
	3rd	No. 1	No. 3
Reverse	1st	No. 2	No. 5
	2nd	No. 2	No. 4
	3rd	No. 2	No. 3

2.2 Radiator

The radiator is composed of the upper tank 1, radiator core 12, lower tank 10 and other concerned attachments. (See Fig2-2)

The cooling water goes through thermostat and enters into the upper tank 1. After removing air in the water, the water flows to the lower tank 10 through the radiator core 12. When the cooling water flows through the radiator core 12, the fan at the rear of the radiator takes the heat away from the water. Then the cooled water is sent to the engine block by the water pump.

This radiator system is closed one. The pressure valve, which is installed on the upper tank, keeps the tank pressure at less than 0.075 MPa in order to raise the vaporing temperature of cooling water, decrease water loss and increase heat radiation efficiency.

The power of fan 13 is transmitted by V-belt from pulley at front end of engine. Cooling result is intensified by air forced by the fan.

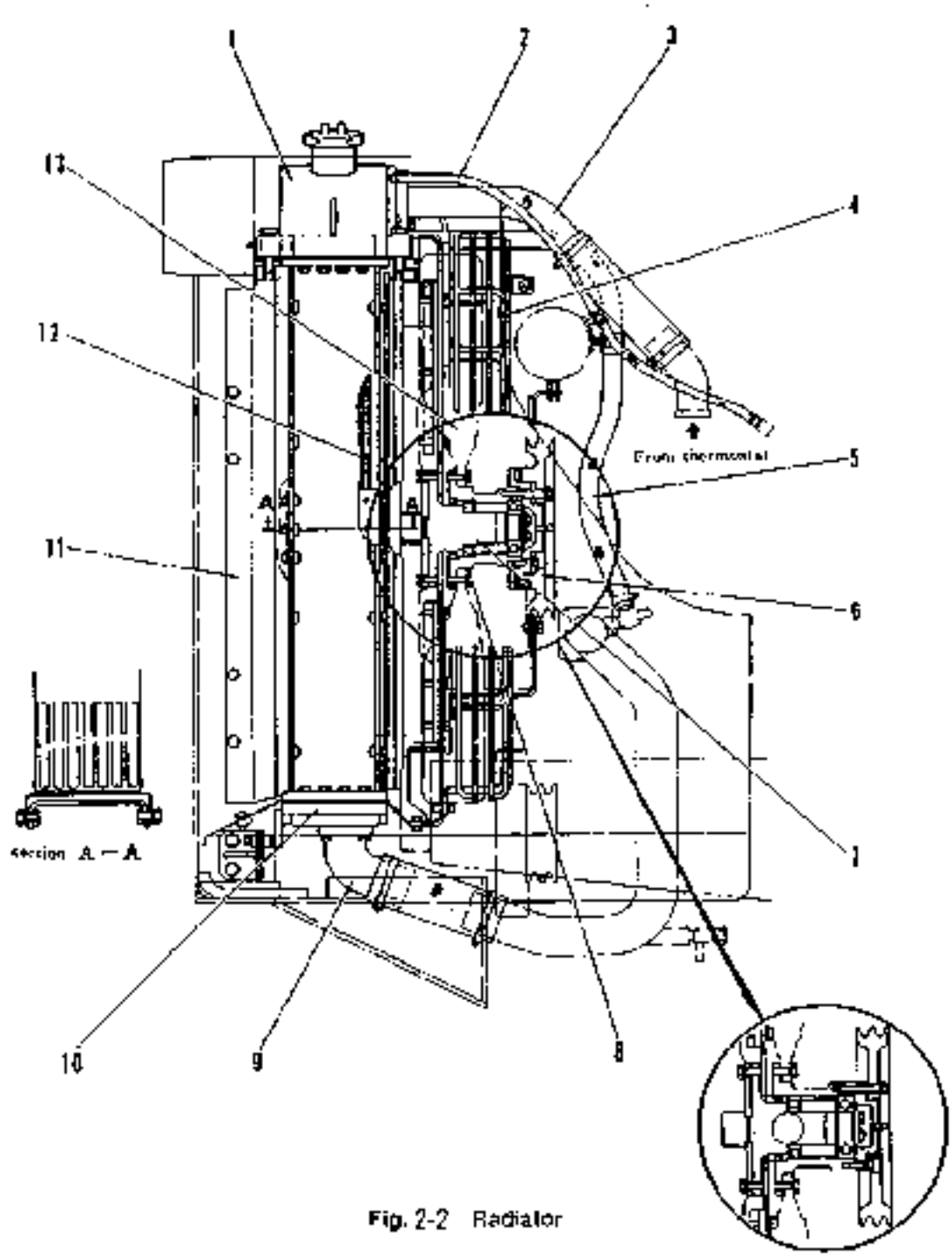


Fig. 2-2 Radiator

1. Upper tank
2. Hose
3. Inlet tube
4. Fan guard
5. Hose
6. Pulley
7. Shaft
8. Shell
9. Outlet tube
10. Lower tank
11. Wind guard
12. Radiator core
13. Fan

2. 3 P. T. O. (Power Take-Off)

Flywheel housing assembly and P. T. O. are shown in Fig. 2-3 and Fig. 2-4. The main function of flywheel housing is to make power take-off.

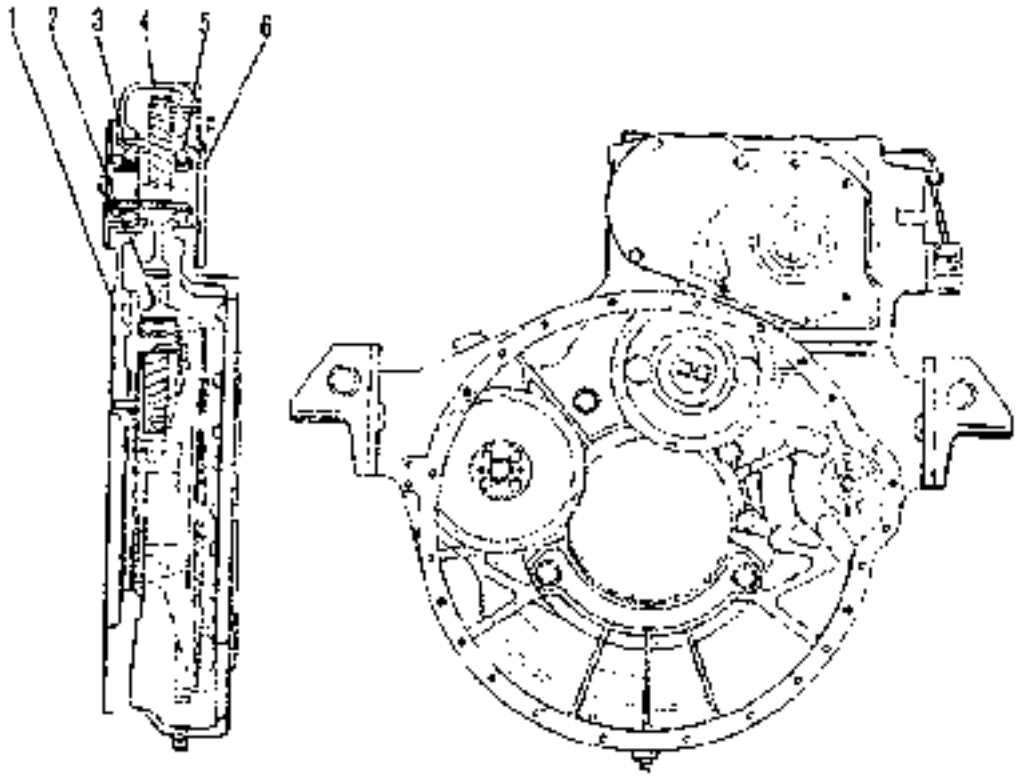


Fig. 2-3 Flywheel Housing Assembly

1. Flywheel housing 2. Idler (Z = 51) 3. Bearing
4. Driving gear of P. T. O. case (Z = 56) 5. Bearing 6. Cover

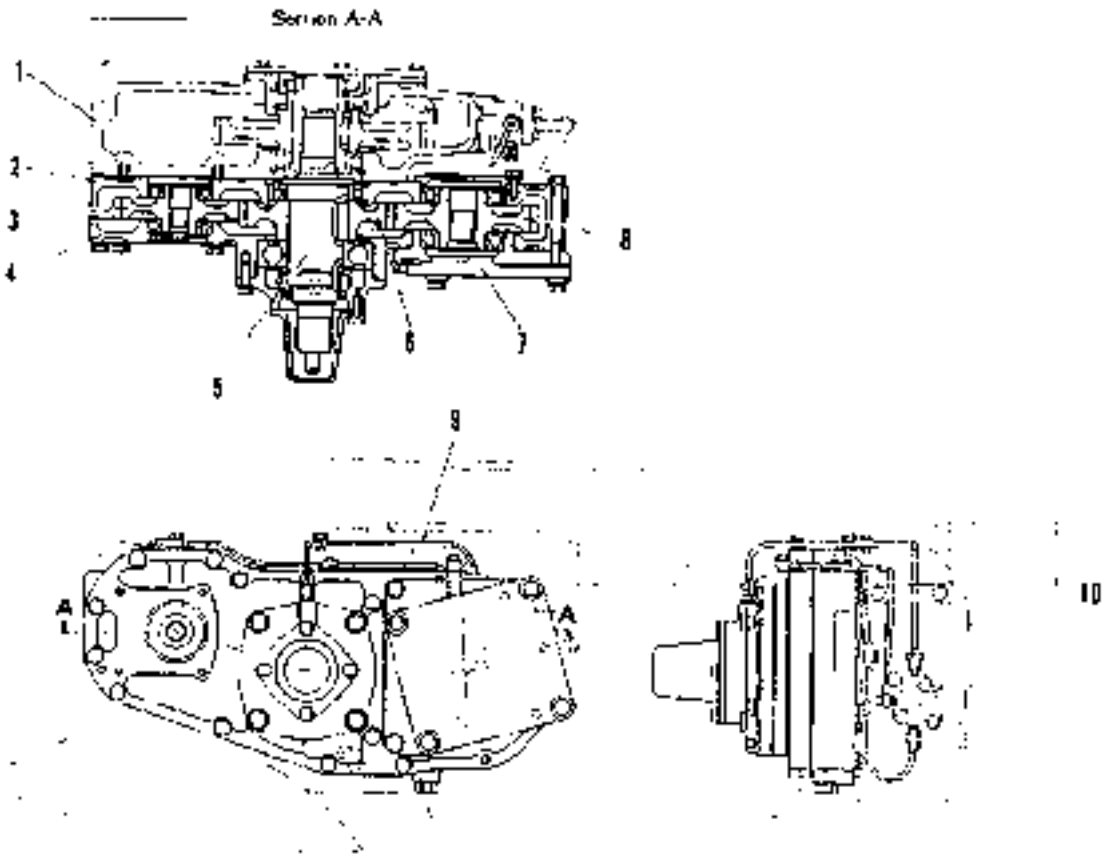


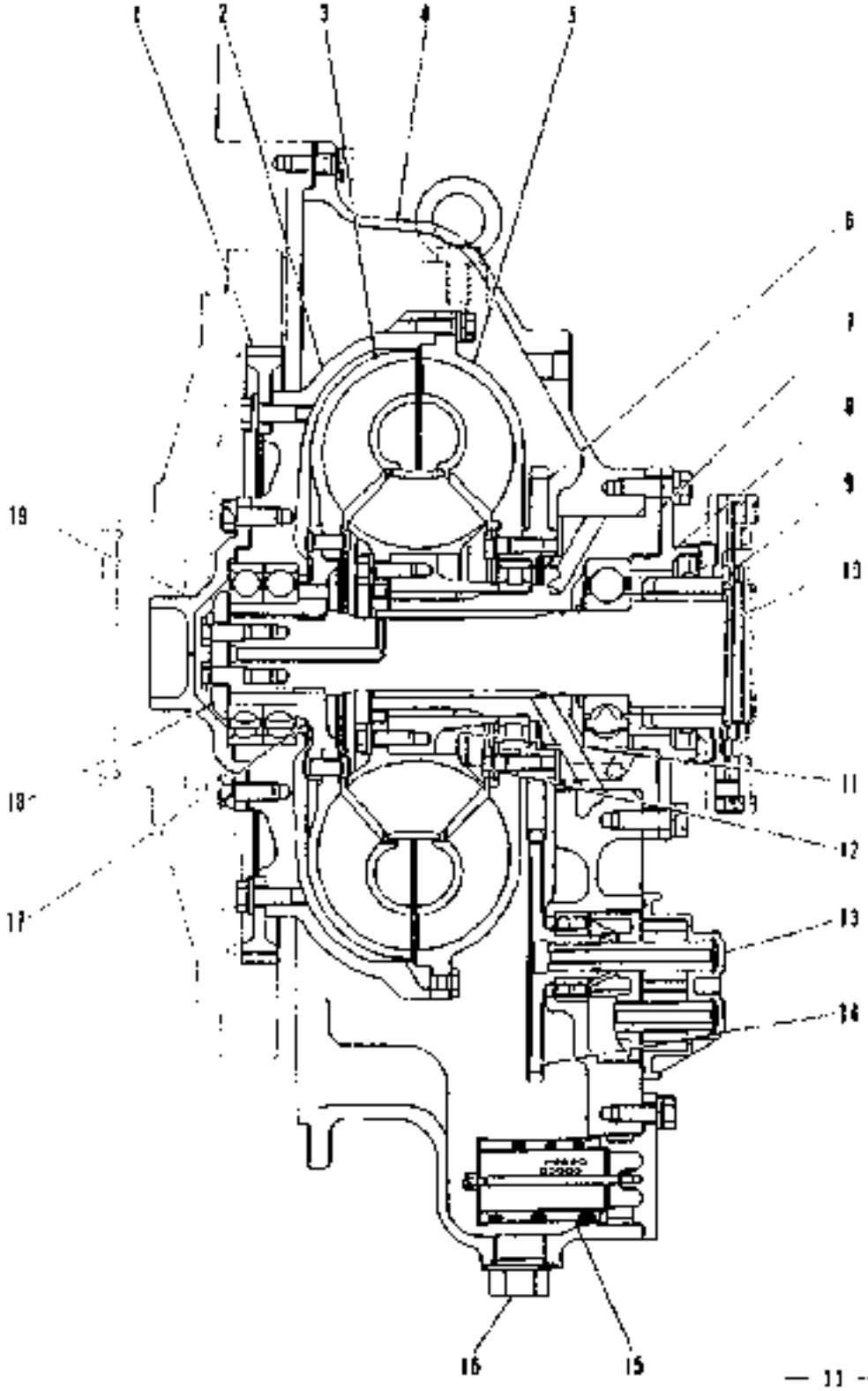
Fig. 2-4 P. T. O. Case Assembly

1. Flywheel housing	2. P. T. O. case	3. Driven gear	
4. Cover of P. T. O. case	5. Shaft	6. Driving gear	
7. Cover	8. Driven gear	9. Lubrication tube	10. Distributor

The P. T. O. case is located at the top of flywheel housing.

The gear at the top of flywheel housing makes the shaft 5 and the driving gear 6 turn, thus enables the driven gear 3 and the driven gear 8 to turn. When remove the cover 7 and install the working oil pump, the driven gear 3 drives the transmission oil pump. The steering oil pump is installed in front of the flywheel housing. The lubricating oil used for gears of P. T. O. case and bearing comes from the return hose of the oil cooler and is distributed by the distributor 10, then goes through the tube 9 to each relative part.

2.4 Torque Converter



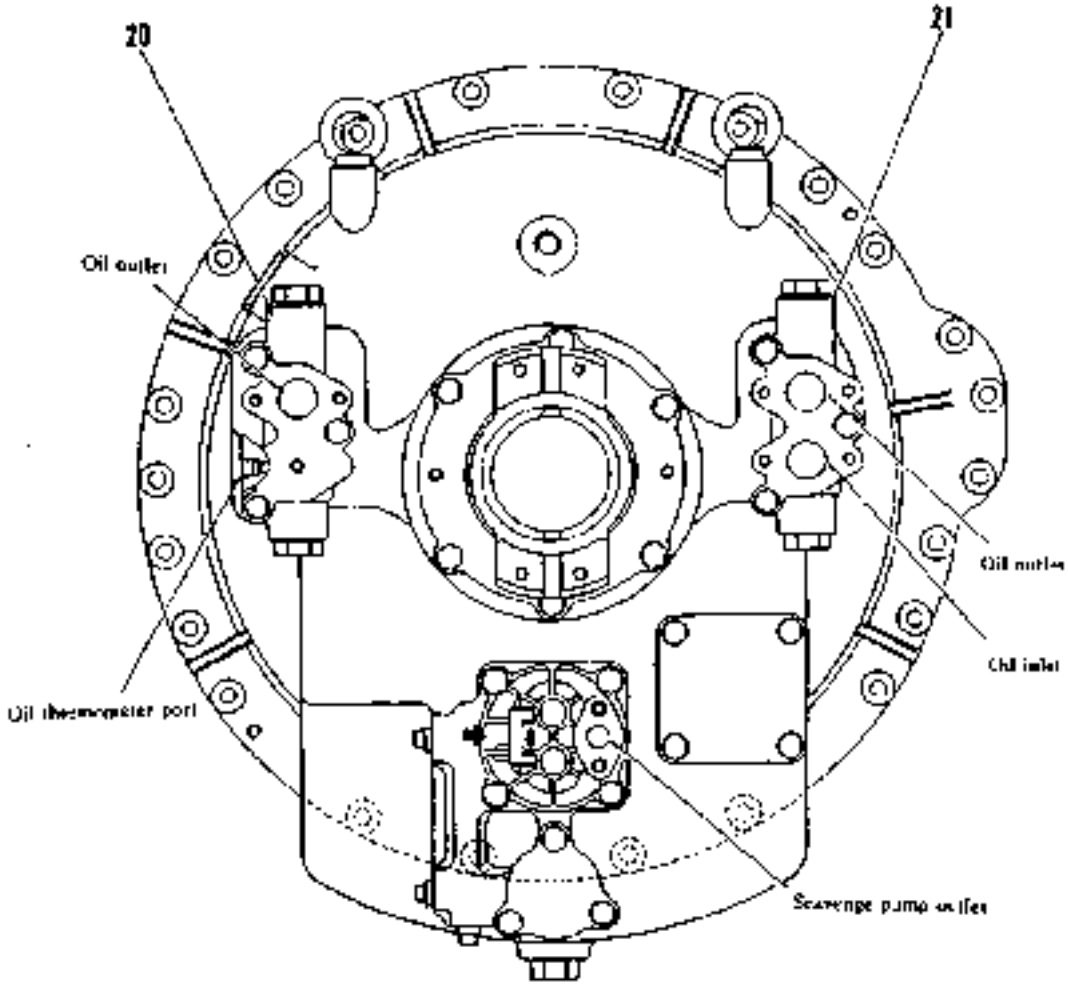


Fig. 2-5 Torque Converter Assembly of PD220Y-1, PD220YS bulldozers

1. Drive case	2. Driving gear	3. Turbine	4. Converter housing
5. Impeller	6. Driving gear	7. Stator shaft	8. Cover
9. Coupling	10. Turbine output shaft	11. Stator shaft boss	12. Stator
13. Pump case	14. Driving gear	15. Strainer	16. Drain plug
17. Turbine boss	18. Plate	19. Pilot	20. Regulator valve
21. Relief valve			

The impeller, turbine and stator are full of working oil. When the impeller is turning, the fluid is thrown to the blades of turbine by the impellet so as to rotate the turbine. The oil goes from the turbine to the stator, from the stator to the impeller inlet, thus the oil circulation is complete.

The fluid rotation can be changed by the stator, thus the turbine torque can be increased. The turbine torque varies with working condition. Therefore, with increasing load the turbine will encounter with a higher resistant moment and automatically slow down, thus smooth mechanical running can be assured by torque converter.

Power input line: driving gear ——→drive case——→impeller

Power output line: turbine——→turbine boss——→turbine output shaft

A relief valve is installed at the oil inlet of the torque converter (see Fig. 2-6). Set the pressure P=0.85～0.89MPa to prevent the torque converter from damage. The oil from the transmission control valve flows through port A and the passage in the torque converter housing to the pump side.

When port A is full of oil and hydraulic pressure applied to the impeller reaches 0.7MPa, the pressure oil compresses spring 1, pushes spool 2 up, and flows through port B into the lubrication relief valve circuit of the transmission. At this time, in order to maximize the performance of the torque converter and maintain a certain amount of oil for the torque converter a regulator valve is installed at the oil outlet port of the torque converter (see Fig. 2-7). Set the pressure P=0.3～0.47MPa. Oil from the torque converter flows through the passage in the torque converter housing to fill the port C. When oil pressure at port C reaches 0.3MPa, oil compresses spring, pushes spool up and flows through port D into the oil cooler circuit.

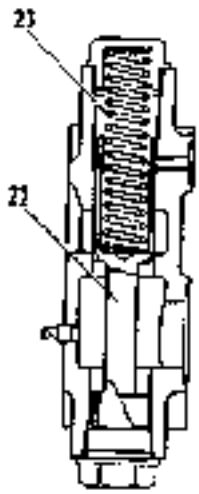


Fig. 2-6 Relief valve

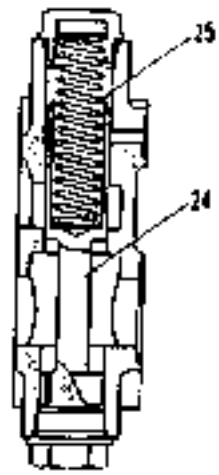


Fig. 2-7 Regulator valve

Moreover, a scavenging pump is installed at the lower part of the torque converter case to collect the operating oil from the P. T. O. case, flywheel housing lubrication and torque converter leakage and send the oil to the steering case.

2. 5 Universal joint

For the structure of the universal joint see Fig. 2-8.

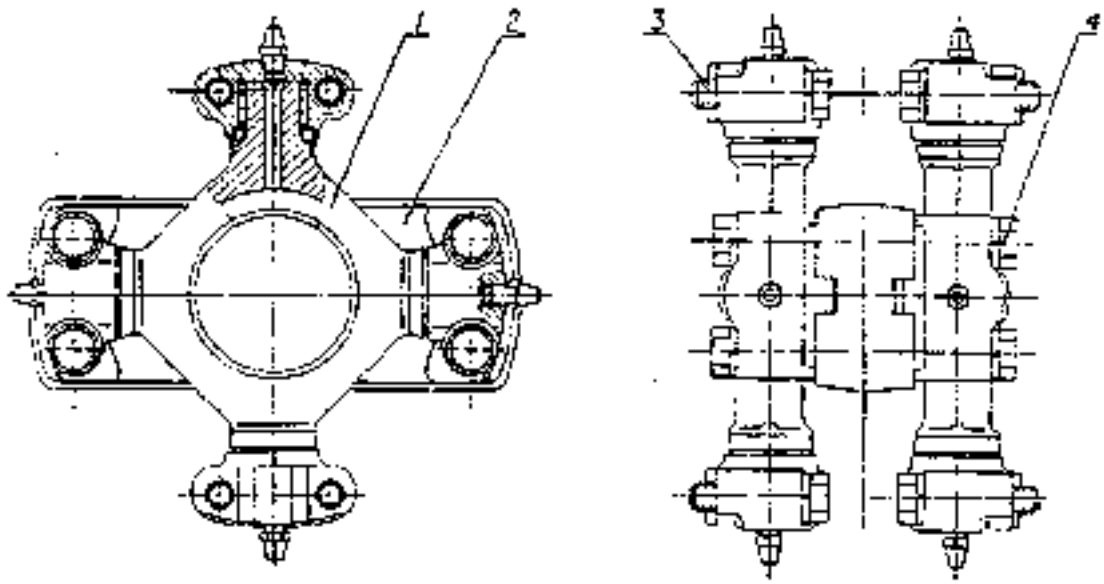


Fig. 2-8 Universal joint

1. Cross coupling assembly 2. Connecting plate 3. Bolt 4. Bolt

The universal joint acts as a power transfer between torque converter and transmission. Smooth power transfer can be assured by the universal joint when the coaxility between turbine output shaft and transmission main shaft center line is within the permissible limit.

2. 6 Transmission

For the structure of the transmission see Fig. 2-9.

The function of the transmission is;

1. Make machine move forward and reverse.
2. To gain different output transmitting ratio(including stop).

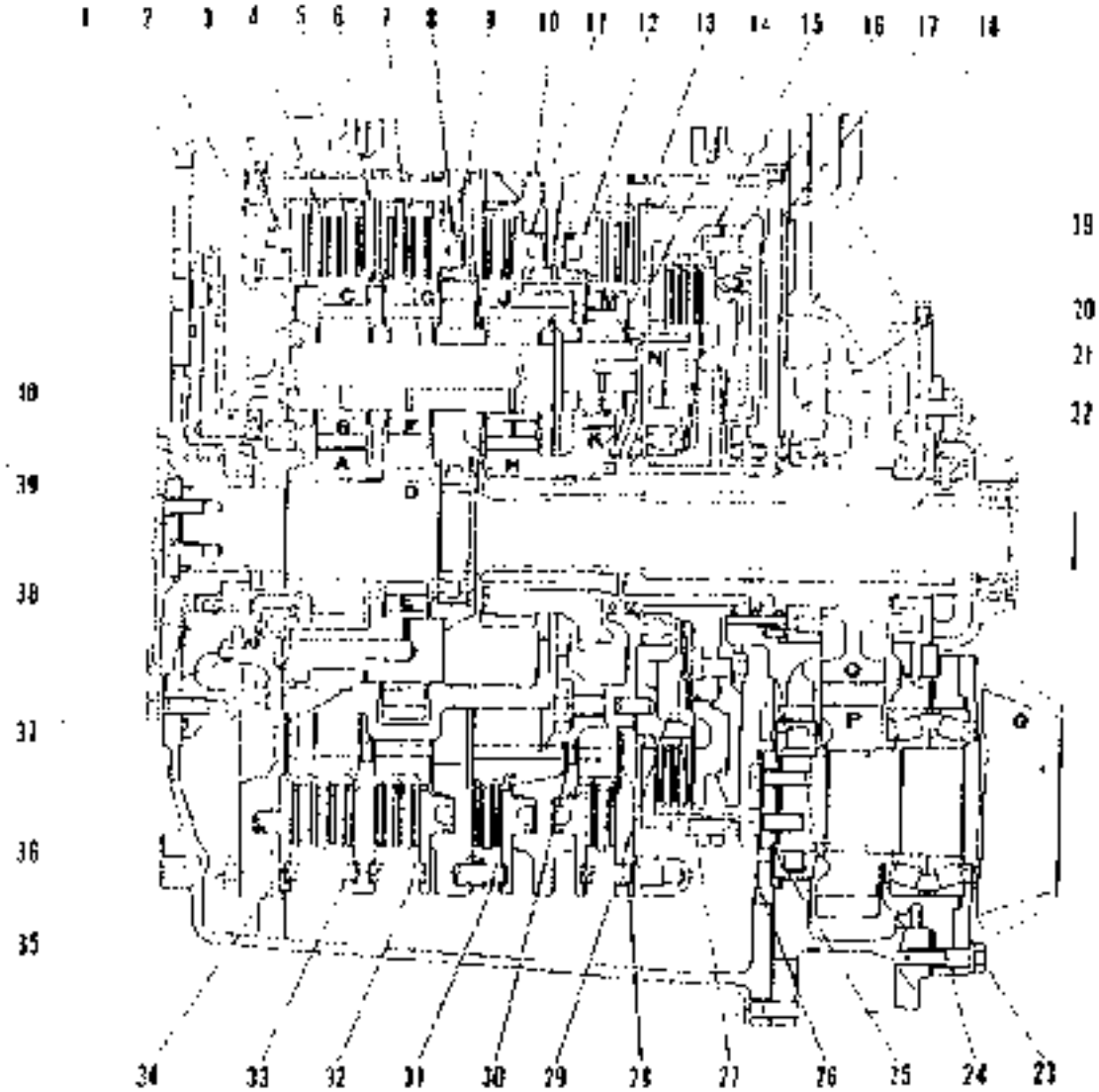


Fig. 2-9 Transmission

1. Transmission case
2. No. 1 clutch cylinder block
3. NO. 1 clutch piston
4. Driving disk of brake
5. Friction plate
6. Plate
7. No. 1, 2 and 3 planetary gear shaft
8. No. 2 clutch piston
9. No. 2 clutch cylinder block
10. No. 3 and No. 4 clutch cylinder block
11. No. 3 clutch piston
12. No. 4 clutch piston
13. Plate
14. No. 4 planetary gear shaft

15. No. 5 clutch external hub
16. No. 5 clutch cylinder block
17. Checkvalve ball
18. Rear case
19. Housing
20. Output shaft
21. Input shaft
22. Bearing seat
23. Cover
24. Bearing cover
25. Bearing shield
26. No. 5 clutch piston
27. No. 5 clutch internal hub
28. No. 4 planetary set spring
29. Disk spring
30. No. 4 planetary carrier
31. No. 3 planetary set spring
32. No. 2 planetary set spring
33. No. 1 planetary set spring
34. No. 1, 2 and 3 planetary carrier
35. Bolt
36. No. 2 planetary gear shaft
37. Bearing cage
38. Bearing cage
39. Shield
40. Coupling

No. 1 clutch is for Forward
No. 2 clutch is for Reverse
No. 3 clutch is for 3rd Speed
No. 4 clutch is for 2nd Speed
No. 5 clutch is for 1st Speed

A First sun gear(33 teeth)
B First planetary gear(24 teeth)
C First ring gear(81 teeth)
D Second sun gear(21 teeth)
E Second planetary gear(23 teeth)
F Second planetary gear(24 teeth)
G Second ring gear(81 teeth)
H Third sun gear(33 teeth)
I Third planetary gear(24 teeth)
J Third ring gear(81 teeth)
K Fourth sun gear(42 teeth)
L Fourth planetary gear(19 teeth)
M Fourth ring gear(81 teeth)
N Fifth ring gear
O Driving gear(34 teeth)
P Driven gear(23 teeth)
Q Bevel pinion(21 teeth)
R Bevel gear(49 teeth)
S Final reduction first pinion(12 teeth)
T Final reduction first gear(45 teeth)
U Final reduction second pinion(12 teeth)
V Final reduction second gear(12 teeth)

The planetary gear multi-plate clutch structure is used in this machine. Forward 3 speed and reverse 3 speed can be gained by control valve hydraulically.

Forward Reverse	Gear Speed	Clutches engaged
Forward	1st	No. 1、No. 5
	2nd	No. 1、No. 4
	3rd	No. 1、No. 3
Reverse	1st	No. 1、No. 5
	2nd	No. 2、No. 4
	3rd	No. 2、No. 3

I. Mechanismic principle of planetary gear and structure of clutch.

1. Operation principle of planetary gear.

The planetary gear system is composed of sun gear(A), planetary gear(B), ring gear(C) and carrier(D) (See Fig. 2-10). The planetary gear(B) is supported on the carrier(D) and meshes with the sun gear(A) and the ring gear(C).

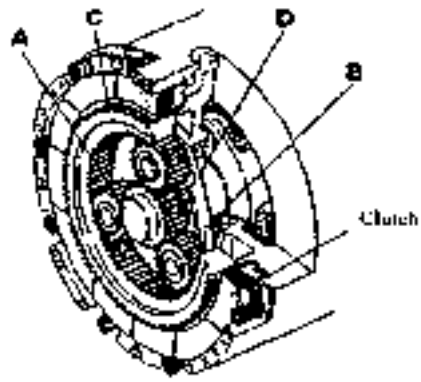


Fig. 2-10 Operation principle of planetary gear

A. Sun gear B. Planetary gear C. Ring gear D. Carrier

When the ring gear is fixed, the rotation of the sun gear(A) is transmitted to the planetary gear(B). While planetary gear(B) is rotating at this time, its axis rotates around the sun gear(A) in the shown structure. The planetary gear(B) rotates in the same direction as the sun gear(A). (See Fig. 2-11).

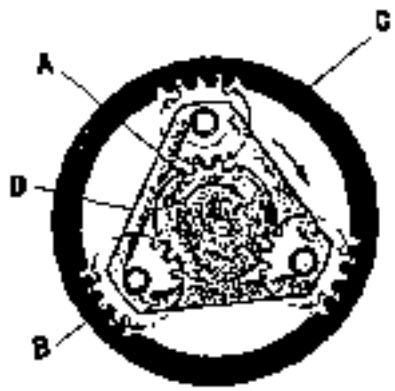


Fig. 2-11

When the carrier(D) is locked, the rotation of the sun gear (A) is transmitted to the planetary gear(B) and then transmitted from the planetary gear(B) to ring gear(C) and the ring gear (C) rotates. The ring gear (C) rotates in the opposite direction to that of the sun gear(A) in the shown structure. (See Fig. 2-12).

Fig. 2-12

The above principle is a structual principle of the first-third and fourth planetary gear system. The sun gear(A) is taken as driving in the first planetary system. The carrier(D) is taken as driving in the third and fourth planetary gear system. If the opposite direction to that of the above mentioned output rotation is wanted, just add a set of planetary gear(E). (See Fig2—13). This transmission type of A—B—E—C is the structural principle of second planetary gear system.

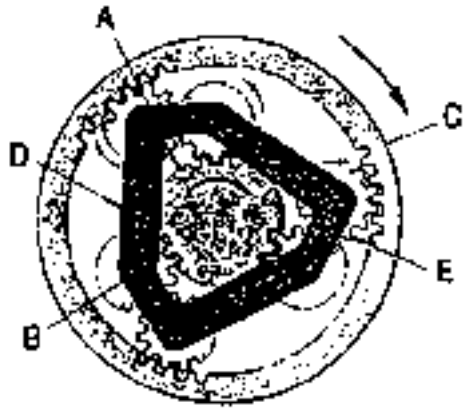


Fig. 2-13

A. Sun gear B. E. Planetary gear C. Ring gear D. Carrier

2. Structure of each clutch

The No. 5 clutch of transmission is a locked clutch. (See Fig. 2-14).

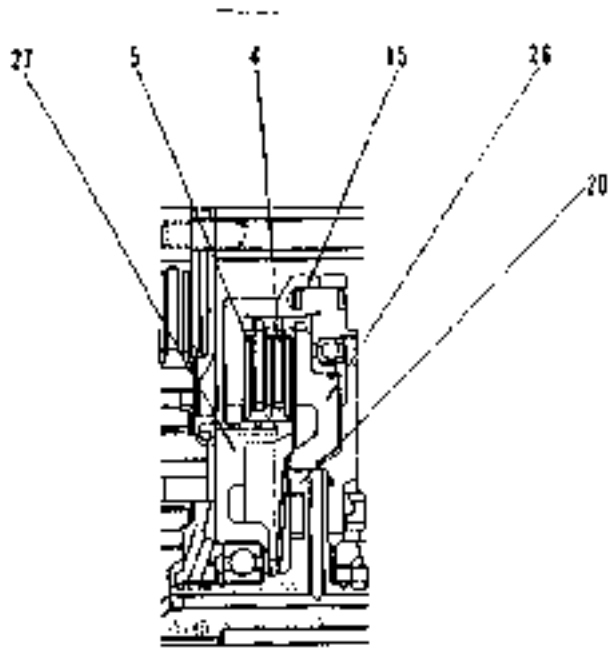


Fig. 2-14 No. 5 Clutch

The fixing of all clutch ring gears is shown in 2 15. It is realized by clutches.

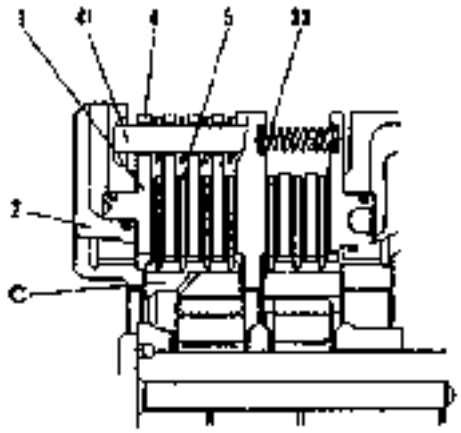


Fig. 2-15 Fixing of Ring Gear

The clutch engagement is realized with pressurized oil from control valve pushing the piston(3). (See Fig. 2-16).

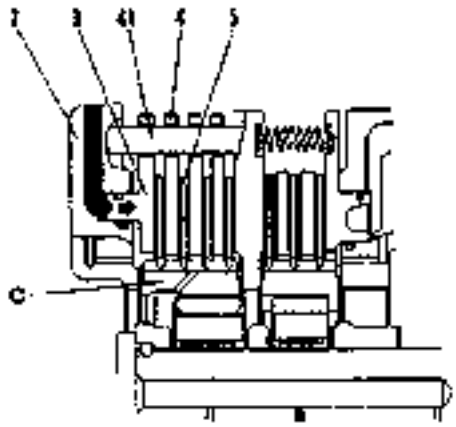


Fig. 2-16 Clutch engagement

Clutch disengagement is realized when pressurized oil cut off and recoil spring(33) push es piston(3) back to original place. (See Fig. 2-17). The disc spring(12) acts for speeding the piston(3) back to improve disengagement of disks and plates.

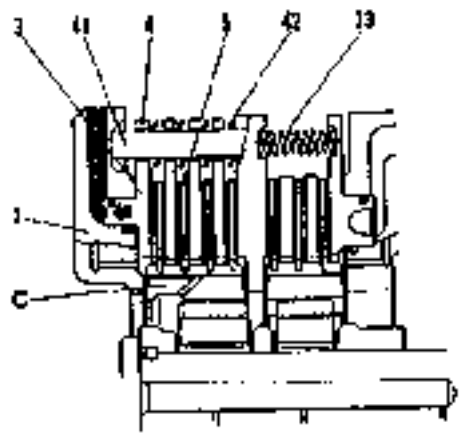


Fig. 2-17 Clutch disengagement

The structure of No. 5 clutch is shown in Fig. 2-18. The oil at the back space of cylinder block(16) remains under centrifugal force due to the revolution even when the clutch is disengaged. The disc spring(29) cannot ensure quick disengagement between disc and plate. This will make the clutch in a state of semi-disengagement and lead to fault during next gearshift. Ball check valve(17) functions to avoid this kind of fault.

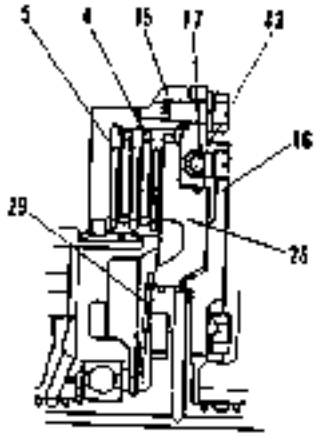


Fig2-18 No. 5 clutch

When No. 5 clutch is engaged(Fig. 2--19), the oil from the control valve under pressure is supplied to the back of the piston(26) and the pressurized oil also pushes the check valve ball(17) to close the valve seat port. The clutch is quickly engaged.

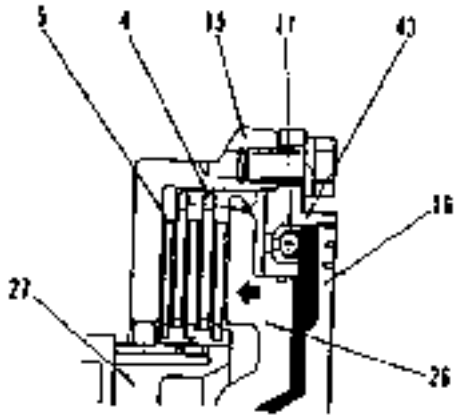


Fig. 2-19 No. 5 Clutch engagement

With the shut off of oil supply from the control valve, ball(17) moves under centrifugal force to the arrowed direction shown in Fig. 2-20. At this time the valve seat port is opened, the oil at the back space of cylinder block(16) can be discharged from it. The normal disengagement of discs and plates is ensured.

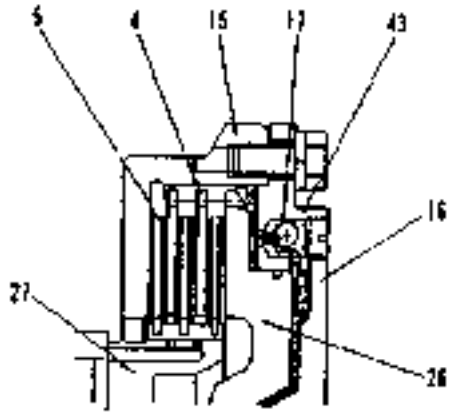


Fig. 2-20 No. 5 clutch disengagement

Ⅱ. Power transmitting line in each speed of transmission

1. Forward 1st speed transmitting line (See Fig. 2-21).

At this point No. 1 and No. 5 clutches are engaged simultaneously.

The power transmitting line is; A→B→(34)—J—O→P→Q(at this time, J, N, H, K, L and No. 5 clutch form a unit).

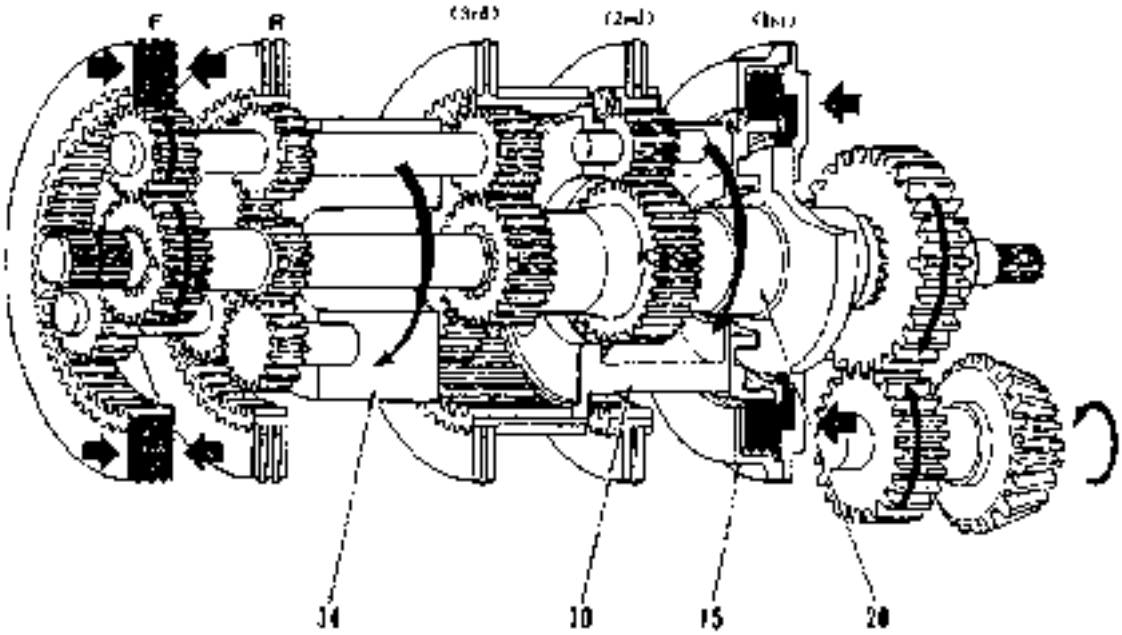


Fig 2-21 Forward 1st speed transmitting line

2. Forward 2nd speed transmitting line (See Fig. 2-22).

At this point No. 1 and No. 4 are engaged simultaneously.

The power transmitting line is; A→B→(34)→J→K→O→P→Q.

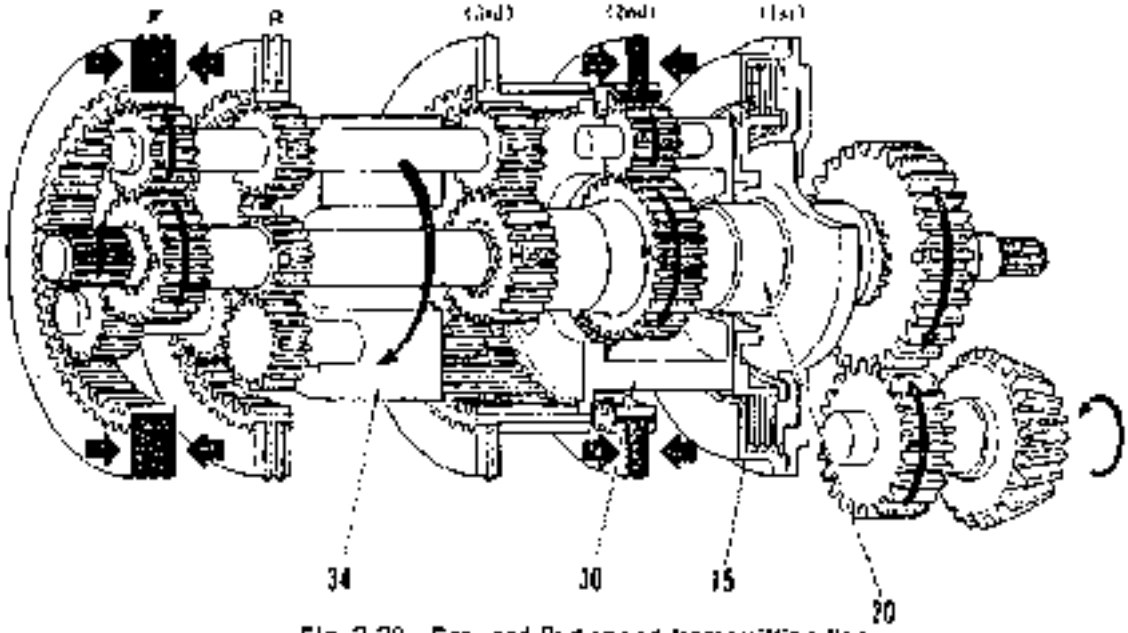


Fig. 2-22 Forward 2nd speed transmitting line

3. Forward 3rd speed transmitting line (See Fig. 2-23).

At this point No. 1 and No. 3 clutches are engaged simultaneously.

The power transmitting line is; A→B→(34)→J→I→H→O→P→Q.

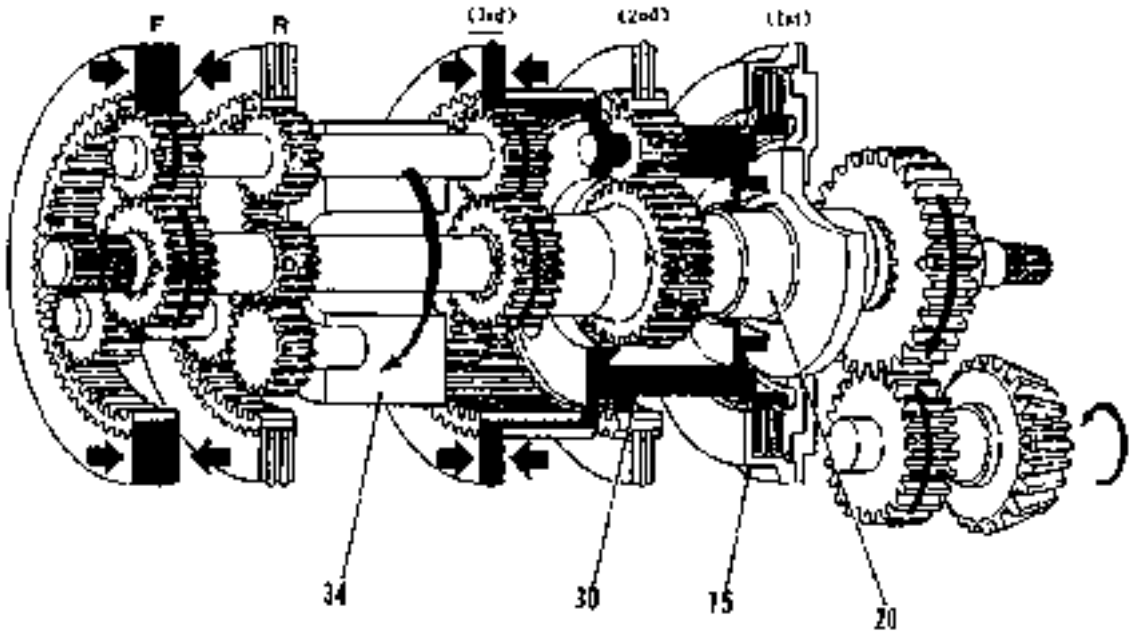


Fig. 2-23 Forward 3rd speed transmitting line

4. Reverse 1st speed transmitting line(See Fig. 2-24)

At this point, No. 2 and No. 5 clutches are engaged simultaneously.

The power transmitting line is:D→E→F→(34)→I→J→(forming a unit with j and k)→O →P →Q.

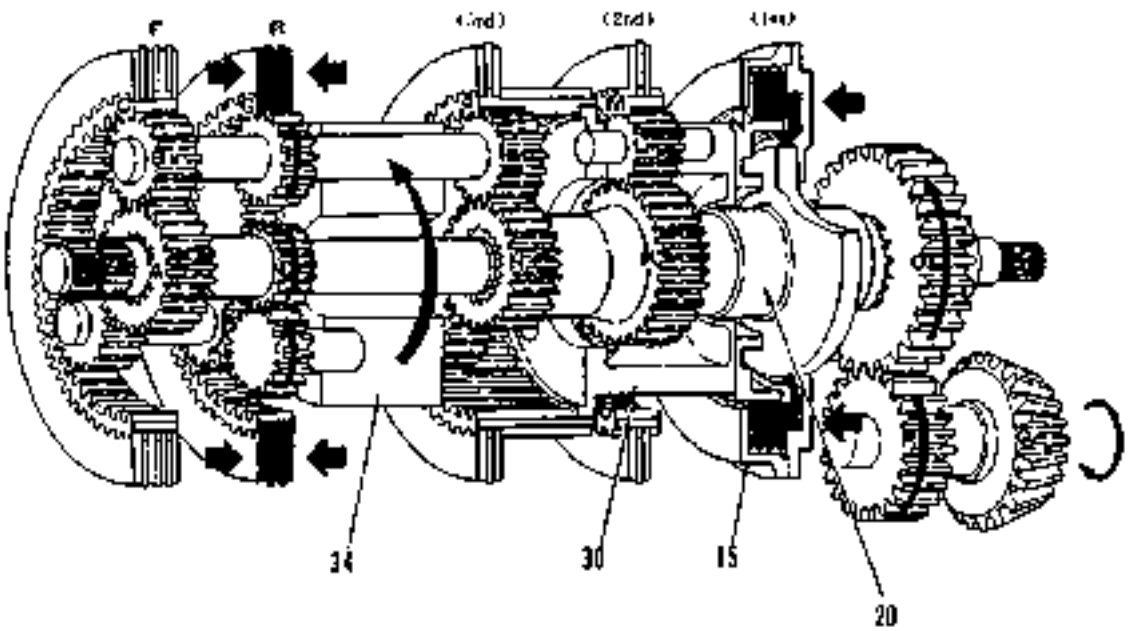


Fig. 2-24 Reverse 1st speed transmitting line

5. Reverse 2nd and 3rd speed transmitting lines are omitted.

The reverse No. 2 and No. 4 speed can be obtained only when No. 2 and No. 4 clutches are engaged simultaneously. When No. 2 and No. 3 clutches are engaged simultaneously the reverse 3rd speed can be obtained.

2. 7 Bevel gear drive

Bevel gear acts for:

1. Changing the power transmitting direction(from longitudinal to crosswise direction).

2. Completing one reduction and increasing torque moment.

The bevel gear drive, steering clutches and steering brakes are installed in the steering case. (See Fig. 2-25).

Bevel gear drive consists of large bevel gear (8) (engaged with the output gear Q of transmission), axle(9), bearing cage(7) and bearing etc. The correct engagement of a pair of bevel gear can be obtained via adjusting the adjusting pad(10) and the pad between the bevel pinion assembly and 1st housing. It can be judged by the gear backlash and contact pattern. A standard gear backlash of a pair of spiral bevel gear is 0. 25~0. 33mm. The contact pattern should be on the mid section of tooth height as shown in Fig. 2-26.

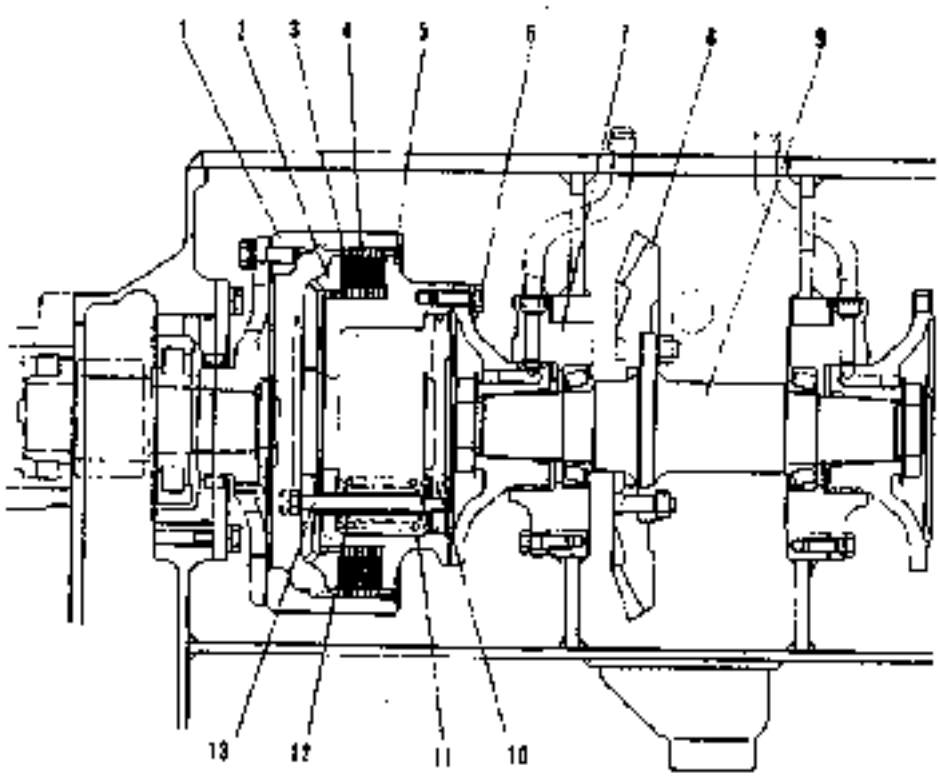
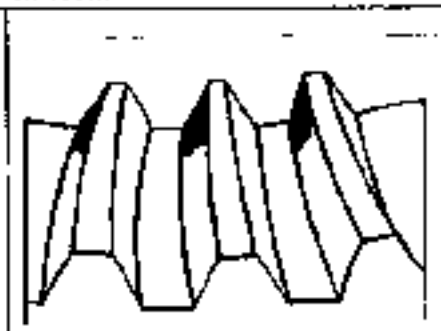
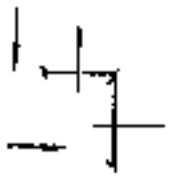
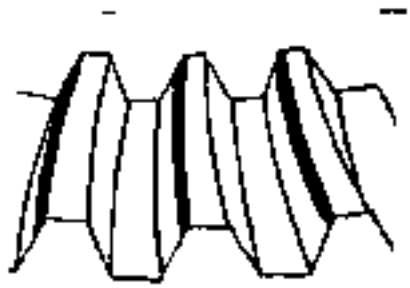
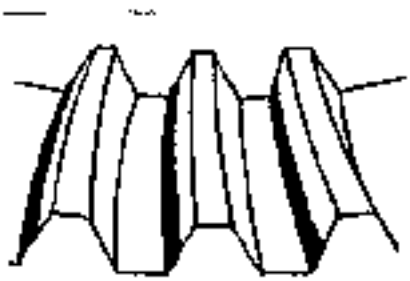


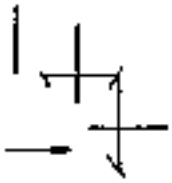
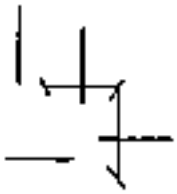
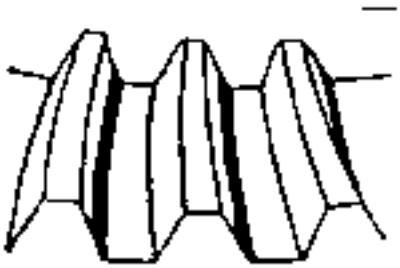
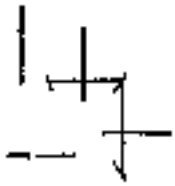
Fig. 2-25 Bevel gear drive and steering clutch

1. Outer drum	2. Pressure plate	3. Friction disc	4. Clutch plate
5. Inner drum	6. Hub	7. Bearing cage	8. Large bevel gear
9. Axle	10. Adjusting pad	11. Large spring	12. Small spring
13. Bolt			

Fig. 2-26 Correct Contact Pattern

If the contact is incorrect, it should be adjusted according to the indicated method below until it is suitable.

Contact pattern position on flank of driven tooth	Adjusting method	Shift direction of gears
Forward 	Move the driven gear to the driving gear. If it leads to a too small backlash, move the driving gear outwards.	
	Move the driven gear away from the driving gear. If it leads to a too large backlash, move the driving gear inwards.	
	Move the driving gear to the driven gear. If it leads to a too small backlash, move the driven gear outwards.	
	Move the driving gear from the driven gear. If it leads to a too large backlash, move the driven gear inwards.	

Reverse		Move the driven gear to the driving gear. If it leads to a too small backlash, move the driving gear outwards.	
		Move the driven gear away from the driving gear. If it leads to a too large backlash, move the driving gear inwards.	
		Move the driving gear to the driven gear. If it leads to a too small backlash, move the driven gear outwards.	
		Move the driving gear away from the driven gear. If it leads to a too large backlash, move the driven gear inwards.	

A semi-submerged and semi-splashed lubrication method is adopted.

2.8 Steering Clutch

The steering clutches are in the left and right chambers of the steering case, one set for each side, to make machine forward, reverse, turning and parking etc by disconnecting or connecting the flow of power from the bevel gear to the final drive.

The structure of the steering clutch is shown in Fig 2-27. It consists of the inner drum, outer drum, pressure plate, plates and discs springs.

The wet type, multiple-plate, spring loaded, hydraulic-disengaged and constant-en-gaged steering clutches are used in the machines mentioned in this manual.

Normally, the discs and plates can be engaged under force of spring. The power from axle is transmitted to the driving flange of final drive via hub(6)→inner drum(5)→clutch plate(4)→friction disc(3)→outer drum(1).

When the pressurized oil from steering control valve goes to the inner chamber of hub (6)(as shown in Fig. 2-27), it pushes the piston(10), bolt and pressure plate(2) to make them move in the direction of arrow(overcome a load of large and small springs), the clutch plate(4)be disengaged from the friction disc(3), outer drum(1) stopped, therefore the power transfer interrupted.

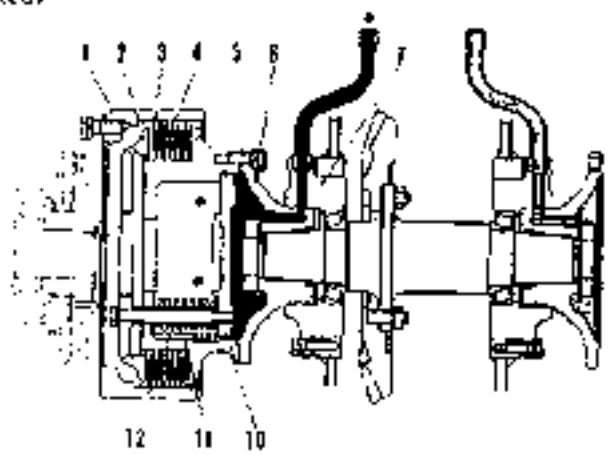


Fig. 2-27

When the oil pressure cut-off, the above parts under the force of large and small spring are forced to move in the direction as shown in the figure to make the clutch plates(4) be engaged with the friction discs and complete the power transfer(See Fig. 2—28).

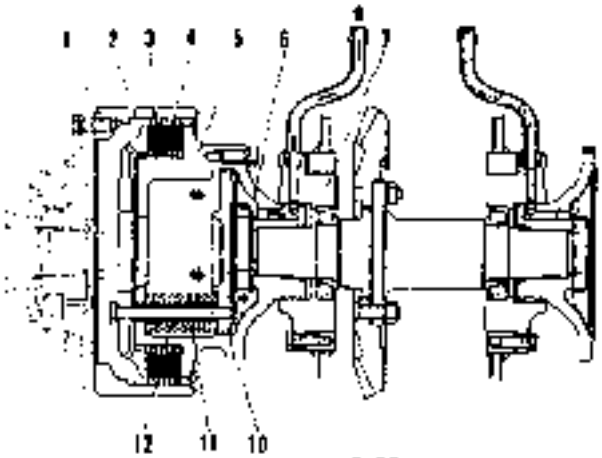


Fig. 2-28

2.9 Steering Brake

Wet, band and floating type brake with hydraulic boost are used in the machines mentioned in this manual(See Fig. 2-29).

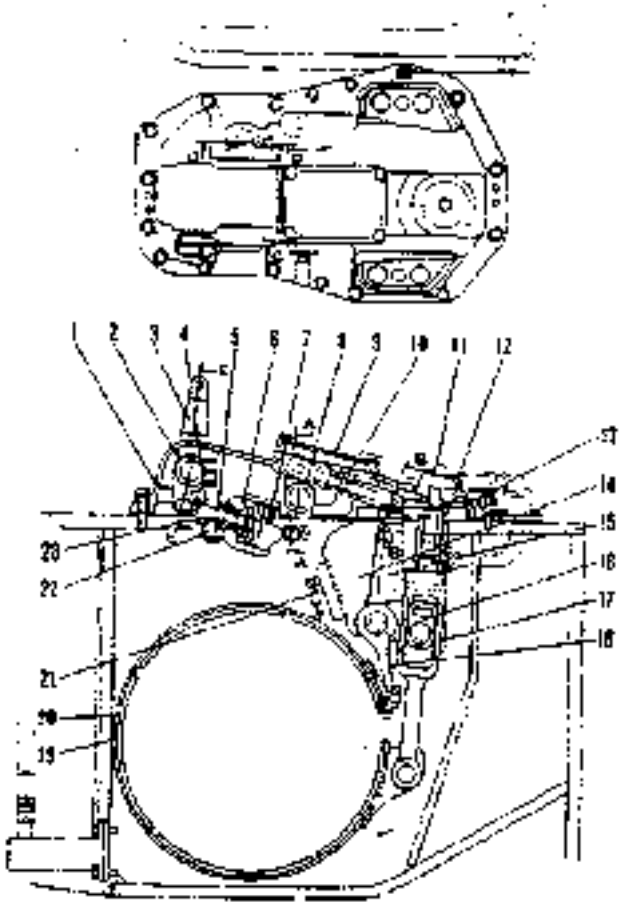


Fig 2-29 Steering Brake

1. Case	2. Rocker	3. Rocker	4. Spring
5. Spool	6. Valve body	7. Piston	8. Rocker
9. Cover	10. Stud	11. Recoil Spring	12. Cover
13. Adjusting bolt	14. Bracket	15. Lever	16. Block
17. Rod	18. End	19. Brake lining	20. Brake
21. Recoil spring	22. Bushing	23. Retainer	

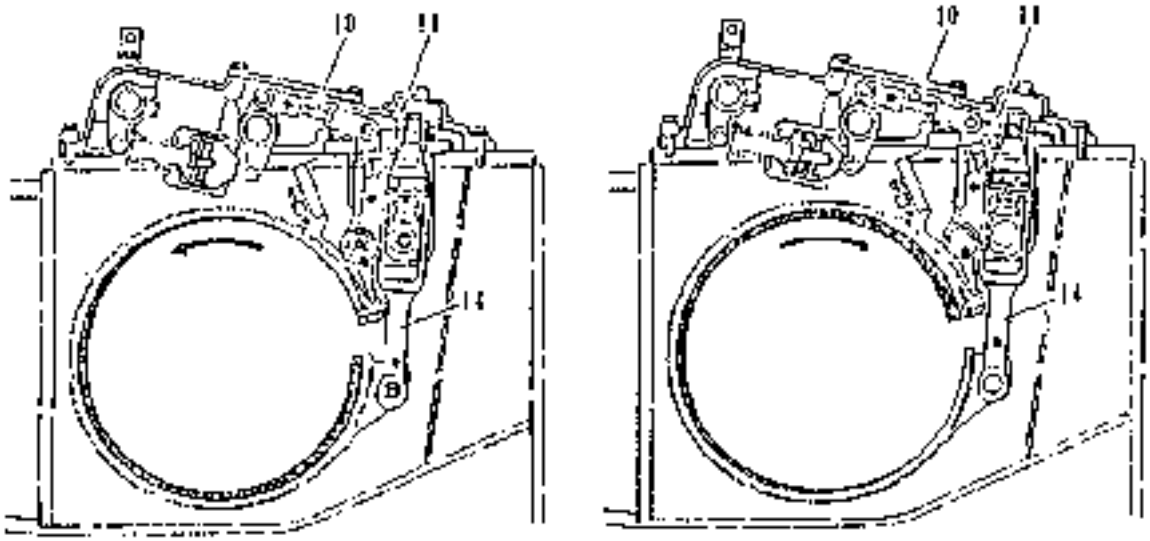
It acts for stopping the gear of final drive via clamping the outer drum of steering clutch to make the machine turn or stop.

1. Operation principle

When the outer drum of steering clutch makes forward turning(See Fig. 2－30a), if the brake pedal is slightly depressed, the clearance between the brake band and drum decreases to some part contact to make the top brake band against the end(18) due to friction, then the pin A enters into the groove of lever(15). When the brake pedal is further depressed, the rod (17), pin B and lever(15) will move in the direction of arrow and the brake band clamps the

drum,now with(A) acting as a supporting point.

As the outer drum of clutch is rotating in the reverse direction(See Fig. 2-30(b), the rod (17),pin B and lever(15) move in the direction as shown in the figure 3 and the brake band clamps the outer drum,but the supporting point is shifted to the point C. The both brake effects are similar.



(a) (b)

Fig. 2-30

Ⅱ. Booster

The steering brake is equipped with a brake booster. It is used to reduce the driver's braking operating force significantly. The booster consists of rocker(2),valve body(6),spool (5),piston(7) and rocker(8) etc. (See Fig. 2—31).

For the hydraulic operation principle see the hydraulic part.

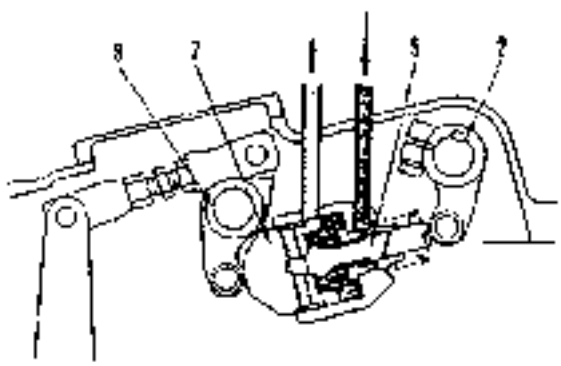


Fig. 2-31 Structure of Booster

2. 10 Final drive

The two-step reduction spur gear reducer is used in this machine. Its structure is shown in Fig. 2-32 and 2-33

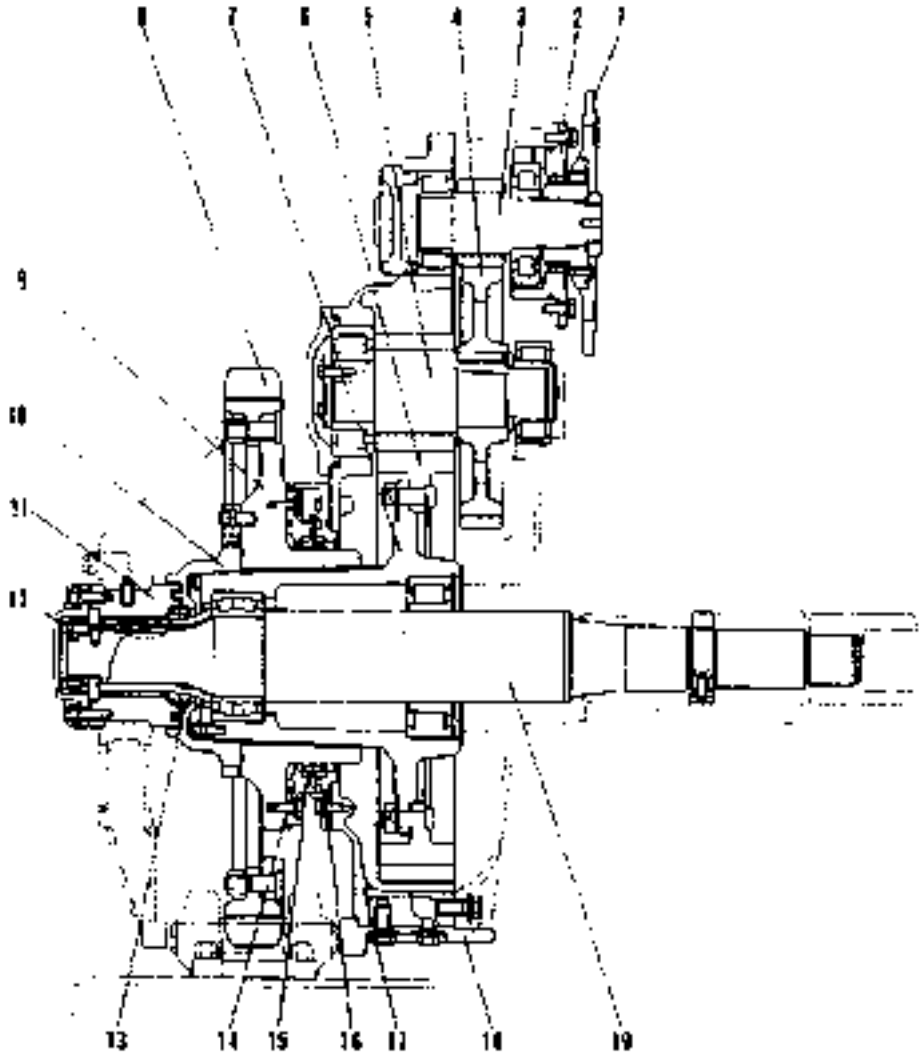


Fig. 2-32 Final Drive(PD220Y-1)

1. Driving flange	2. Bearing cage	3. Ist driving pinion
4. Ist driven gear	5. 2nd driving pinion	6. 2nd driven gear
7. Hub	8. Segment teeth	9. Sprocket hub
10. Sprocket nut	11. Support	12. Cover
13. Floating seal	14. Seal guard	15. Floating seal
16. Seal guard	17. Housing	18. Guard
19. Sprocket shaft		

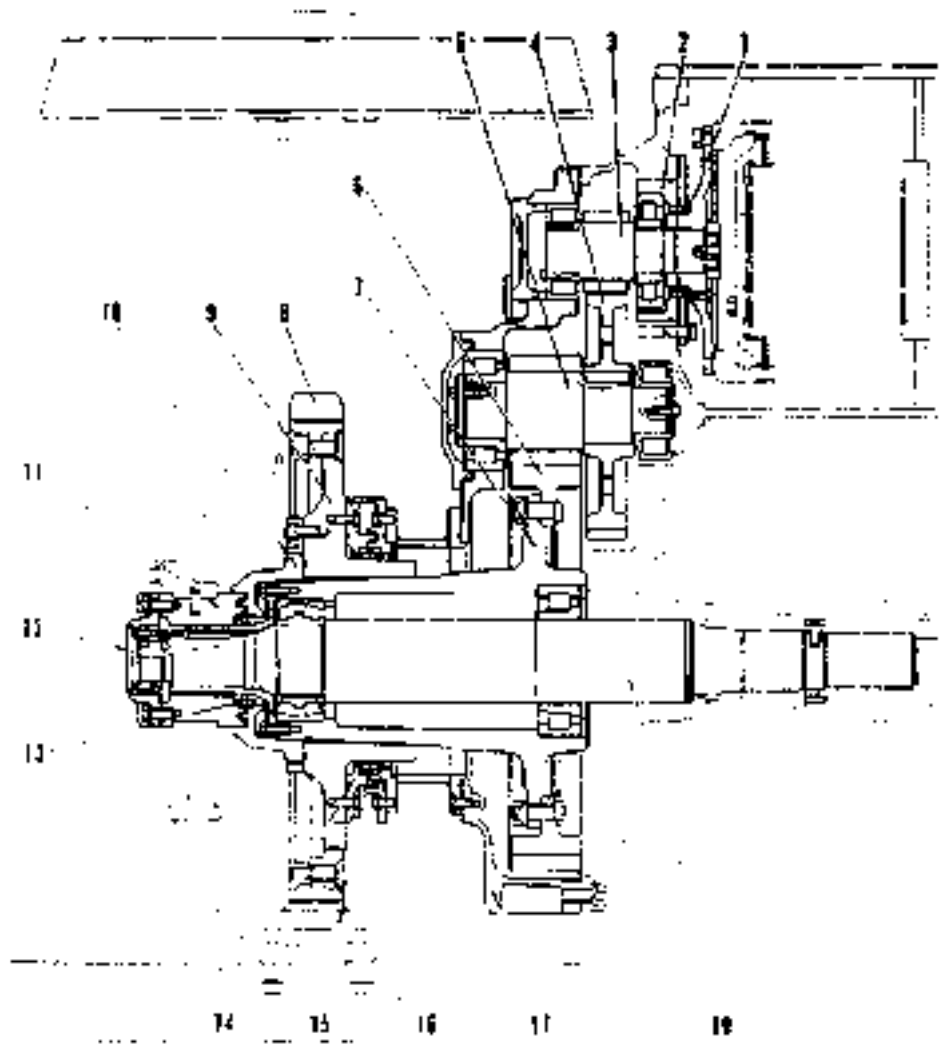


Fig. 2-33 Final Drive(PD220YS)

1. Driving flange	2. Bearing cage	3. 1st driving gear
4. 1st driven gear	5. Secondary driving gear	6. Secondary driven gear
7. Hub	8. Segment teeth	9. Sprocket hub
10. Sprocket nut	11. Support	12. Cover
13. Floating seal	14. Seal guard	15. Floating seal
16. Seal guard	17. Housing	18. Guard
19. Sprocket shaft		

The final drive acts for increasing output torque moment via two step reduction. At this point, the power is transmitted to the undercarriage via the sprocket teeth(8). The splash lubrication and floating seals are used.

2. 11 Undercarriage

The undercarriage mainly consists of track roller frames(7),sprocket covers(3),Idlers (1),track rollers(4),(5),carrier rollers(2),tracks and track tension mechanism. (See Fig. 2-34,2-35). It is used to make the machine move.

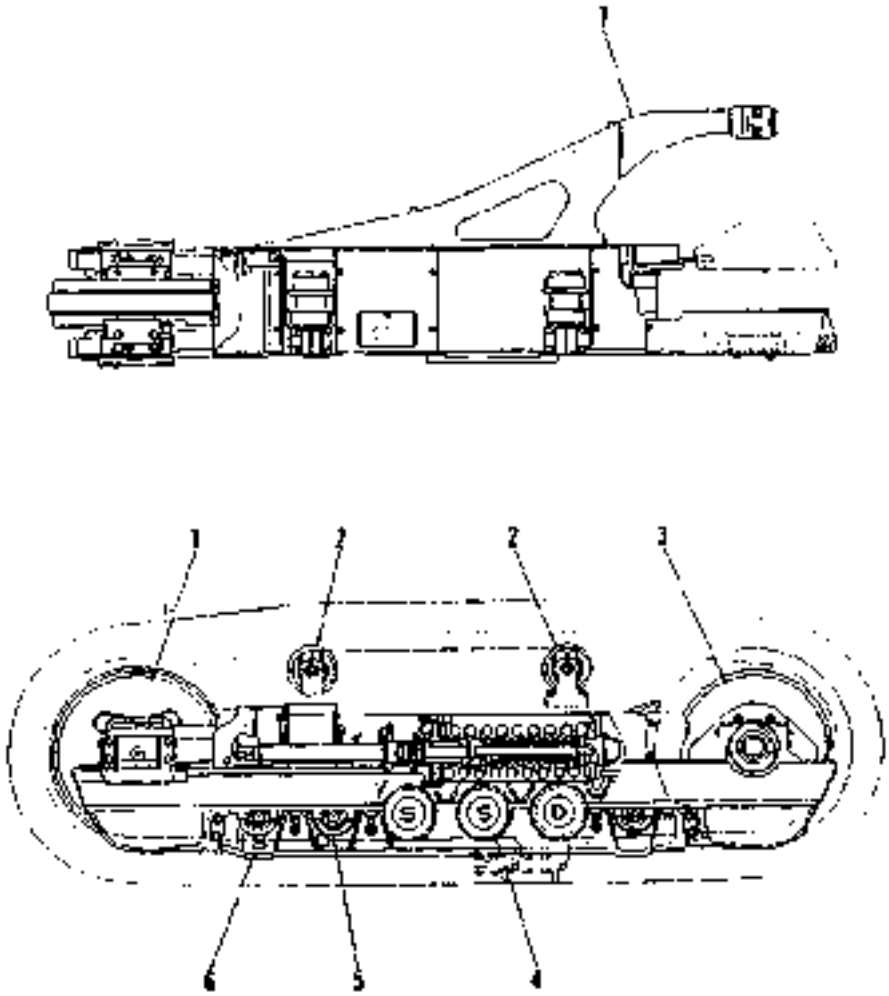


Fig. 2-34 Undercarriage(PD220Y-1)

1. Idler 2. Carrier roller 3. Sprocket cover
4. Track roller(Single flange,4 each side)
5. Track roller(Double flange,2 each side) 6. Guard
7. Track roller frame

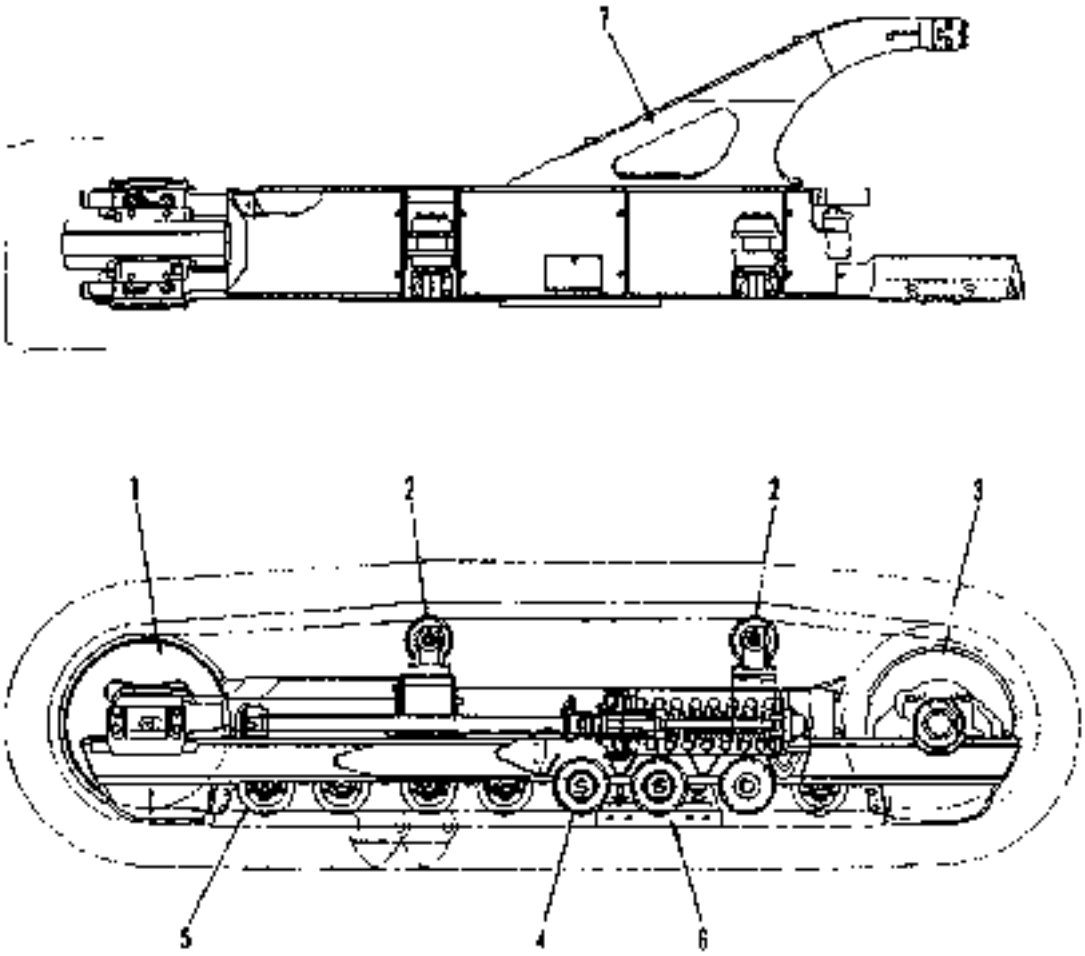


Fig. 2-35 Undercarriage(PD220YS)

1. Idler 2. Carrier roller 3. Sprocket cover
4. Track roller(Single flange, 5 each side)
5. Track roller(Double flange, 3 each side) 6. Guard
7. Track roller frame

1. Track tension mechanism

The track tension mechanism is used to provide enough tension for trackes and reduce track shock during operation and track departure during winding. Its structure is shown in Fig. 2-36.

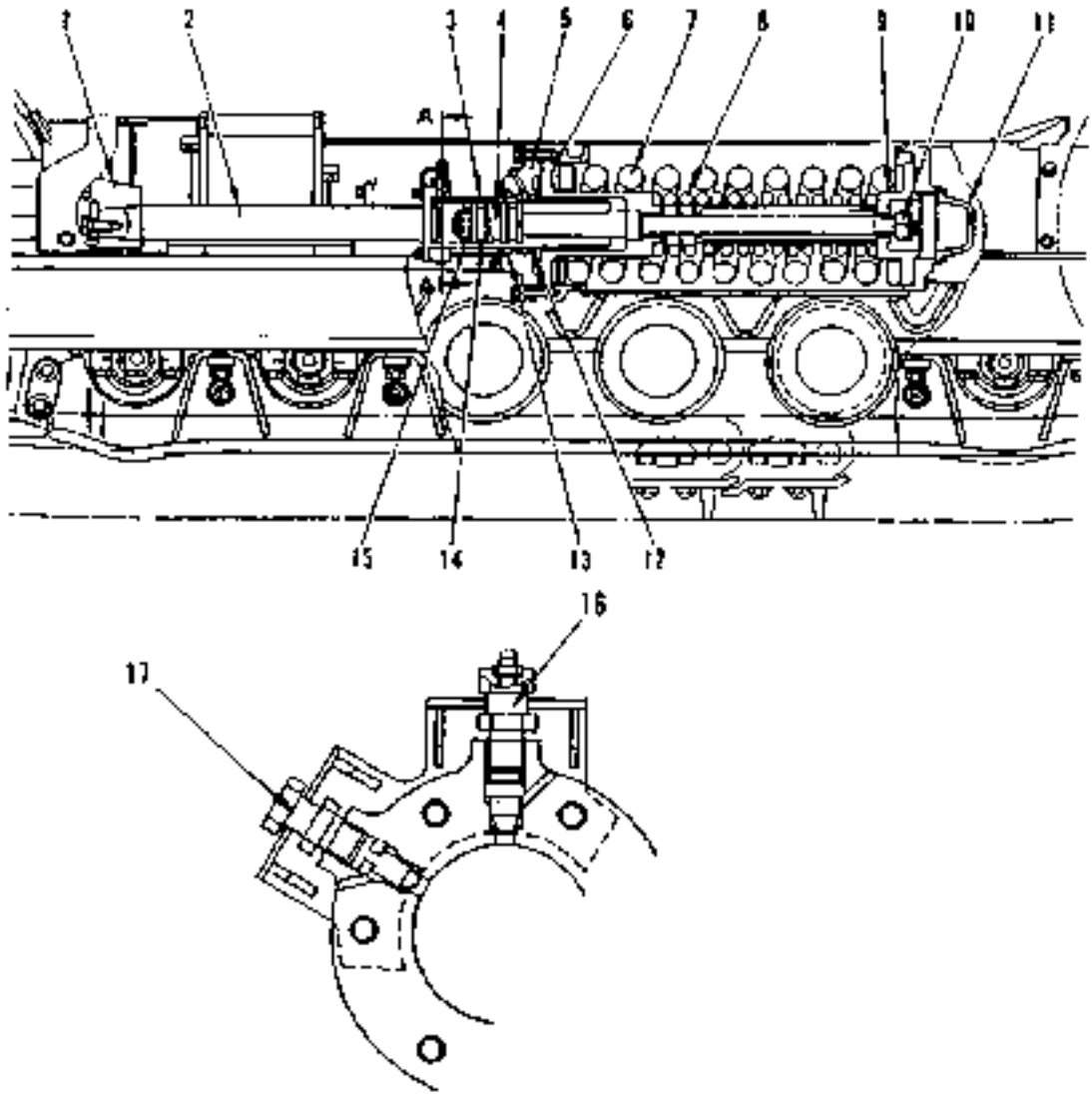


Fig. 2-36 Track tension mechanism

1. Seat	2. Shaft	3. Cylinder	4. Piston
5. End cover	6. Spring front seat	7. Recoil spring(large)	8. Recoil spring(small)
9. Spring rear seat	10. Nut	11. End cover	12. Bushing seat
13. Oil seal	14. Wear ring	15. Oil seal	16. Grease fitting
17. Plug			

1. Idler

The idler is used to guide the links and track, its structure is shown in Fig. 2-37.

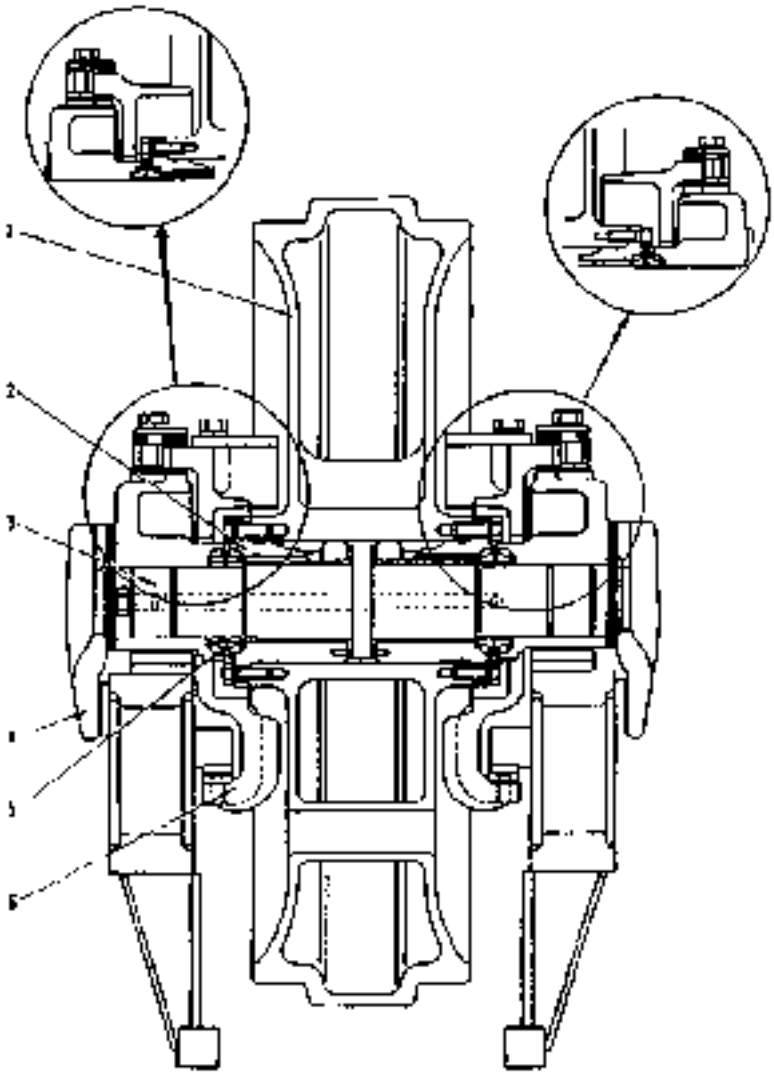


Fig. 2-37 Idler

1. Idler	2. Bushing	3. Shaft
4. Guide plate	5. Floating seal	6. Guide

Ⅲ. Track roller

The track roller is used to support the total weight of the machine and to avoid track transverse sliding. The track roller is divided into single flange track roller and double flange track roller. The double flange track roller is shown in Fig. 2-38. Except for the form of the track roller hub(1), the other structure of single flange track roller is identical with that of double flange track roller.

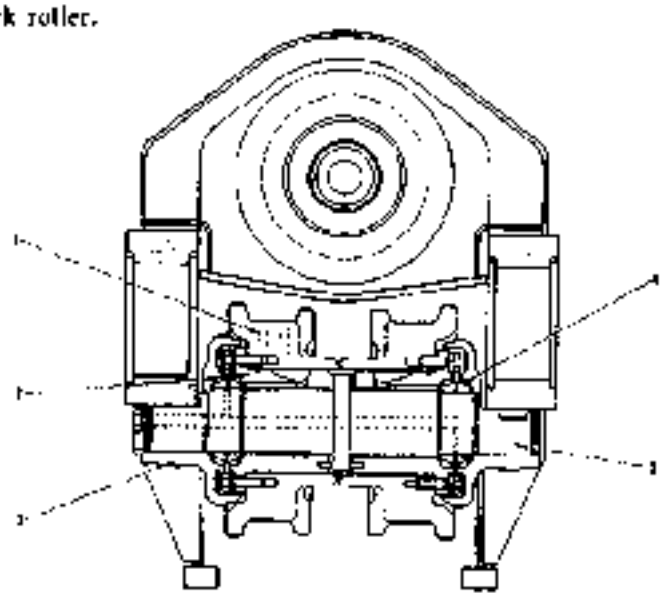


Fig. 2-38 Double flange track roller

1. Track roller hub 2. Bushing 3. Cover 4. Floating seal 5. Shaft

Ⅳ. Carrier roller

The carrier roller is provided to support the track between the sprocker and the idler and avoid track slack and slide off when the machine moves. Its structure is shown in Fig. 2—35.

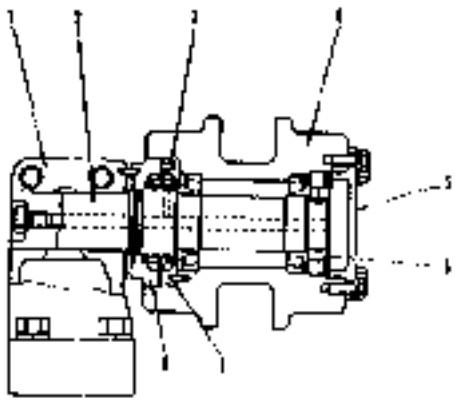


Fig. 2-39 Carrier roller

1. Support 2. Shaft 3. Floating seal 4. Carrier roller
5. Cover 6. Nut 7. Floating seal seat 8. Floating seal seat

V. Track

The function of track is to transmit the weight of the machine to ground, assure the adhesion ability of the machine and provide sufficient driving power to it.

Its structure is shown in Fig. 2—40, 2—41.

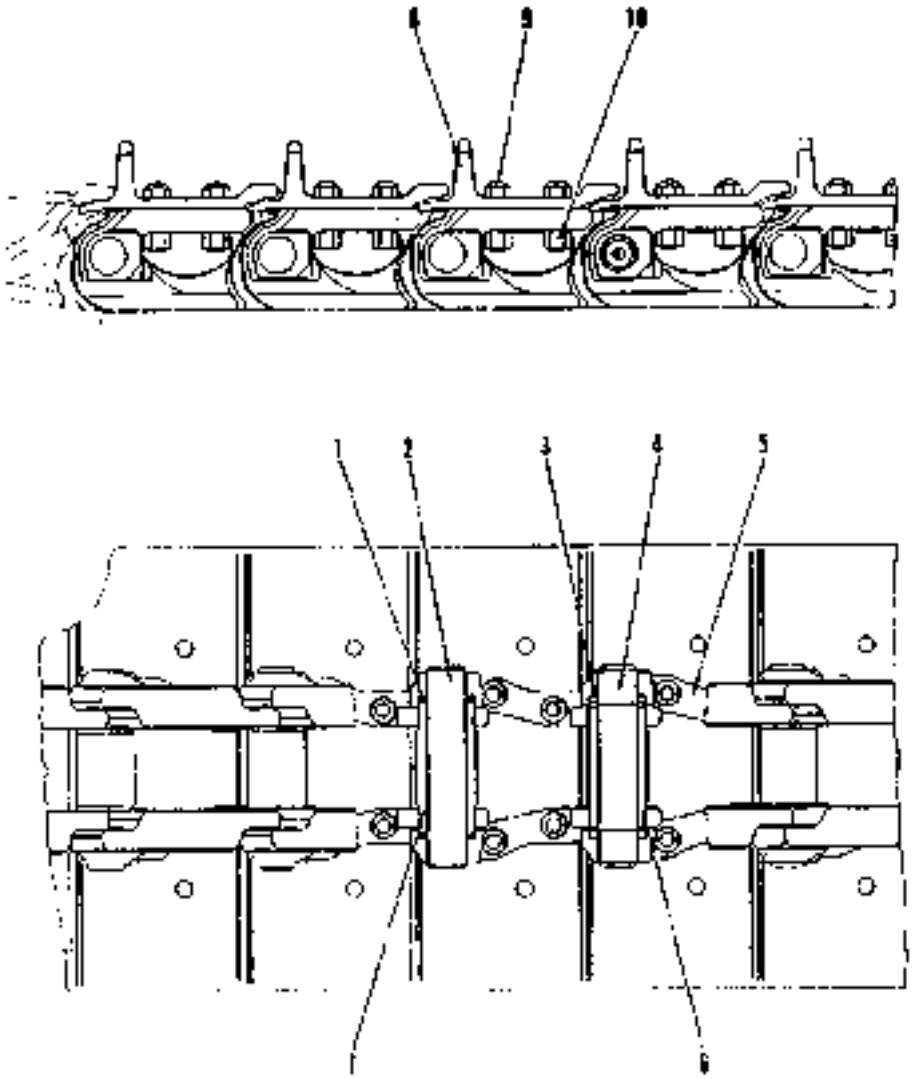


Fig. 2-40 Track assembly(PD220Y-1)

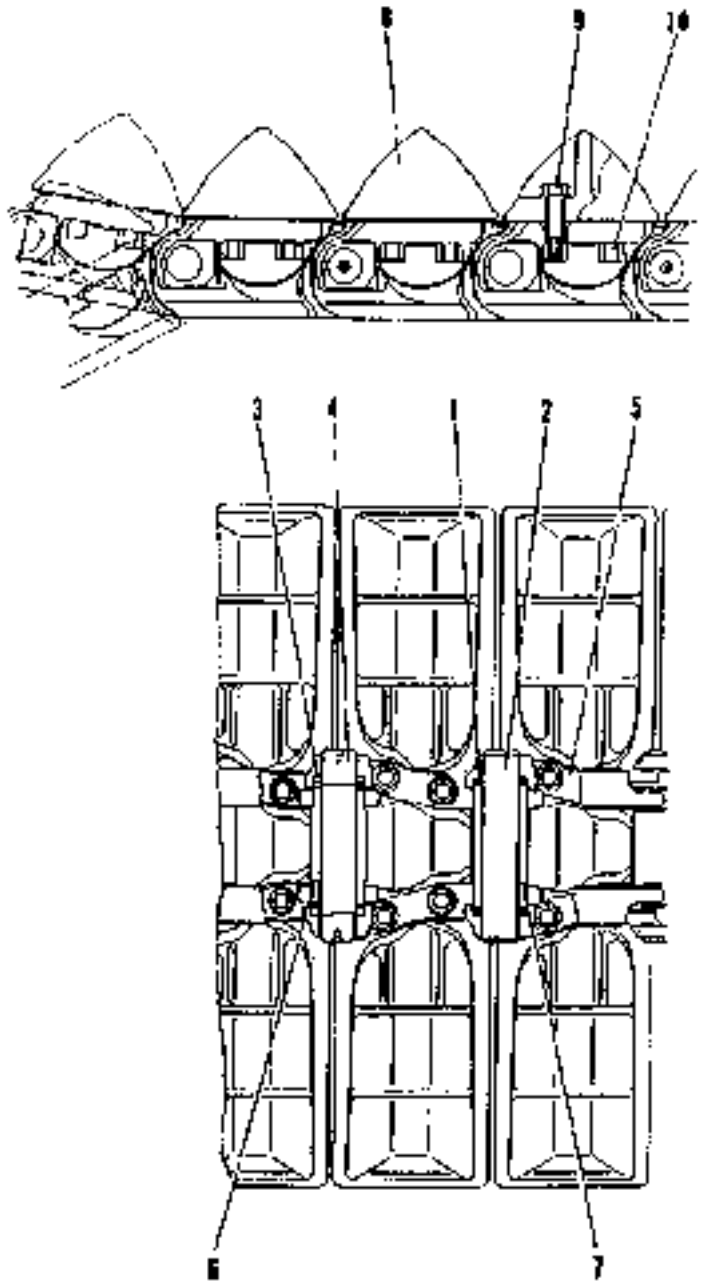


Fig. 2-41 Track assembly (PD220YS)

1. Dust seal	2. Pin	3. Seal ring	4. Master pin
5. Track link	6. Master bushing	7. Bushing	8. Track shoe
9. Track bolt	10. Track nut		

Ⅵ. Equalizer bar

The equalizer bar is used to connect main frame and undercarriage. It acts for a cushion and makes track roller frames swing up and down along with rough terrain.

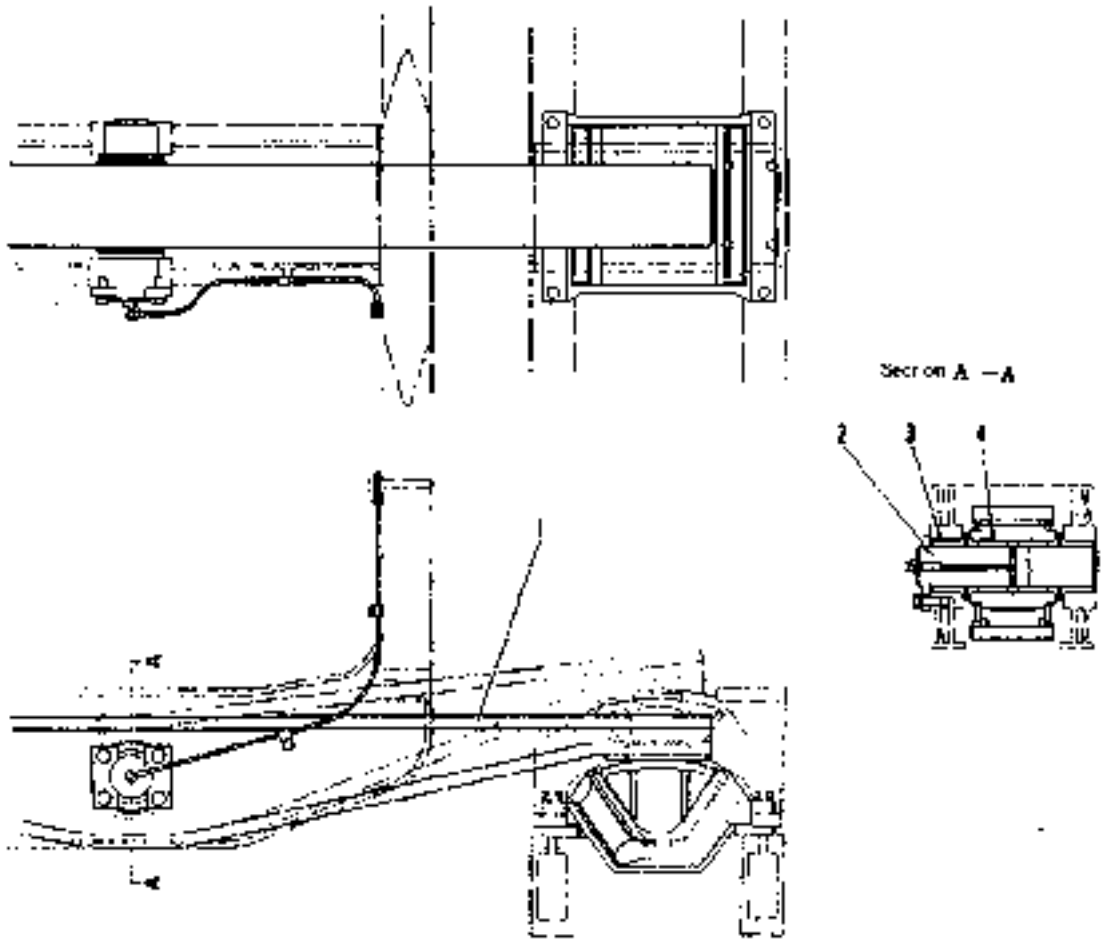


Fig. 2-42 Equalizer bar

1. Equalizer bar 2. Shaft 3. Bushing 4. Bushing

2.12 Hydraulic System

The hydraulic system is composed of the working equipment hydraulic system and the transmission-steering hydraulic system.

Ⅰ. Working equipment hydraulic system

The hydraulic operation principle and structure schematics of PD220Y—1 and PD220YS bulldozers are shown in Fig. 2-43、2-44、2-45 and 2-46 respectively.

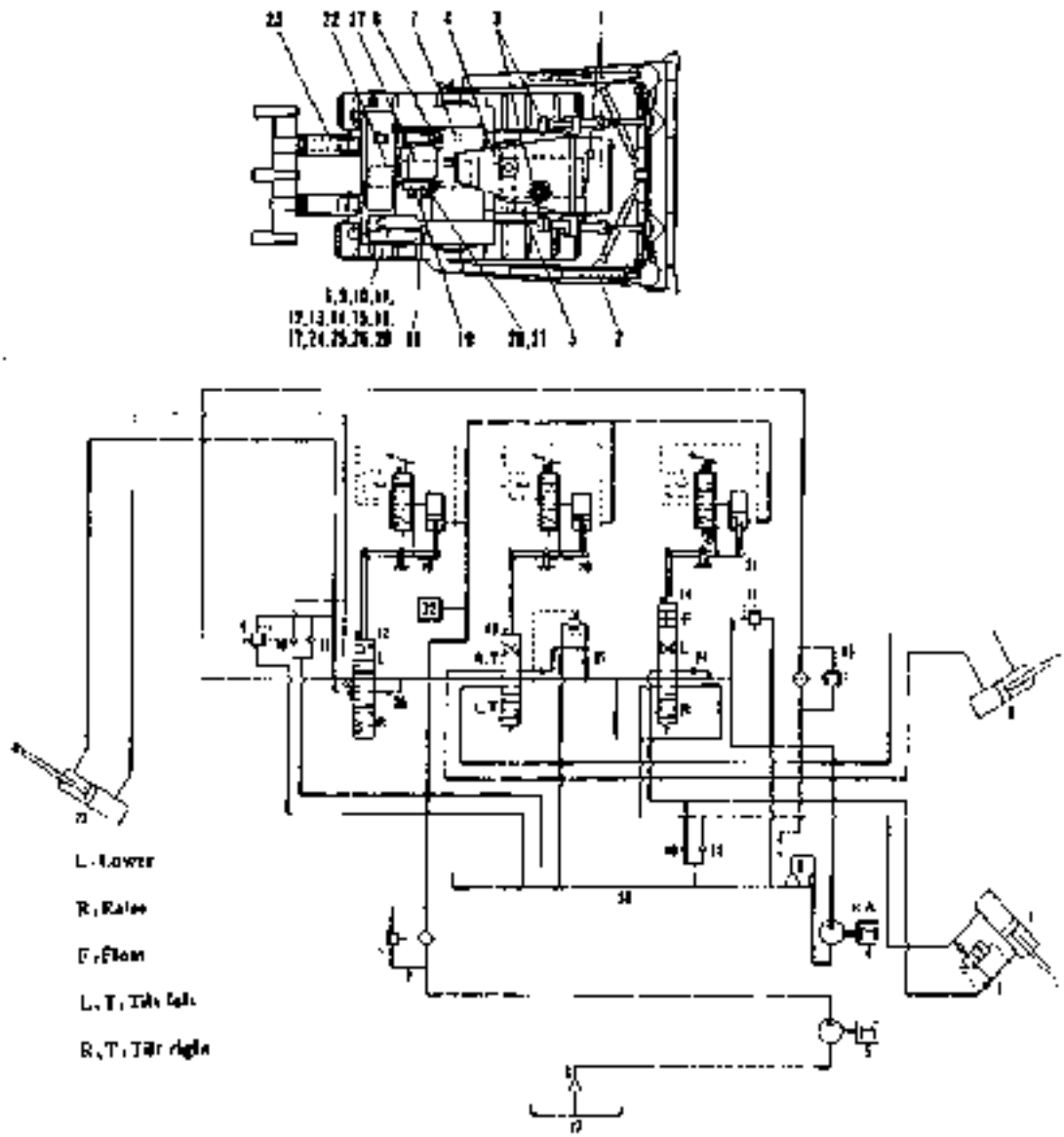


Fig. 2-43 Working equipment hydraulic system (PD220Y-1)

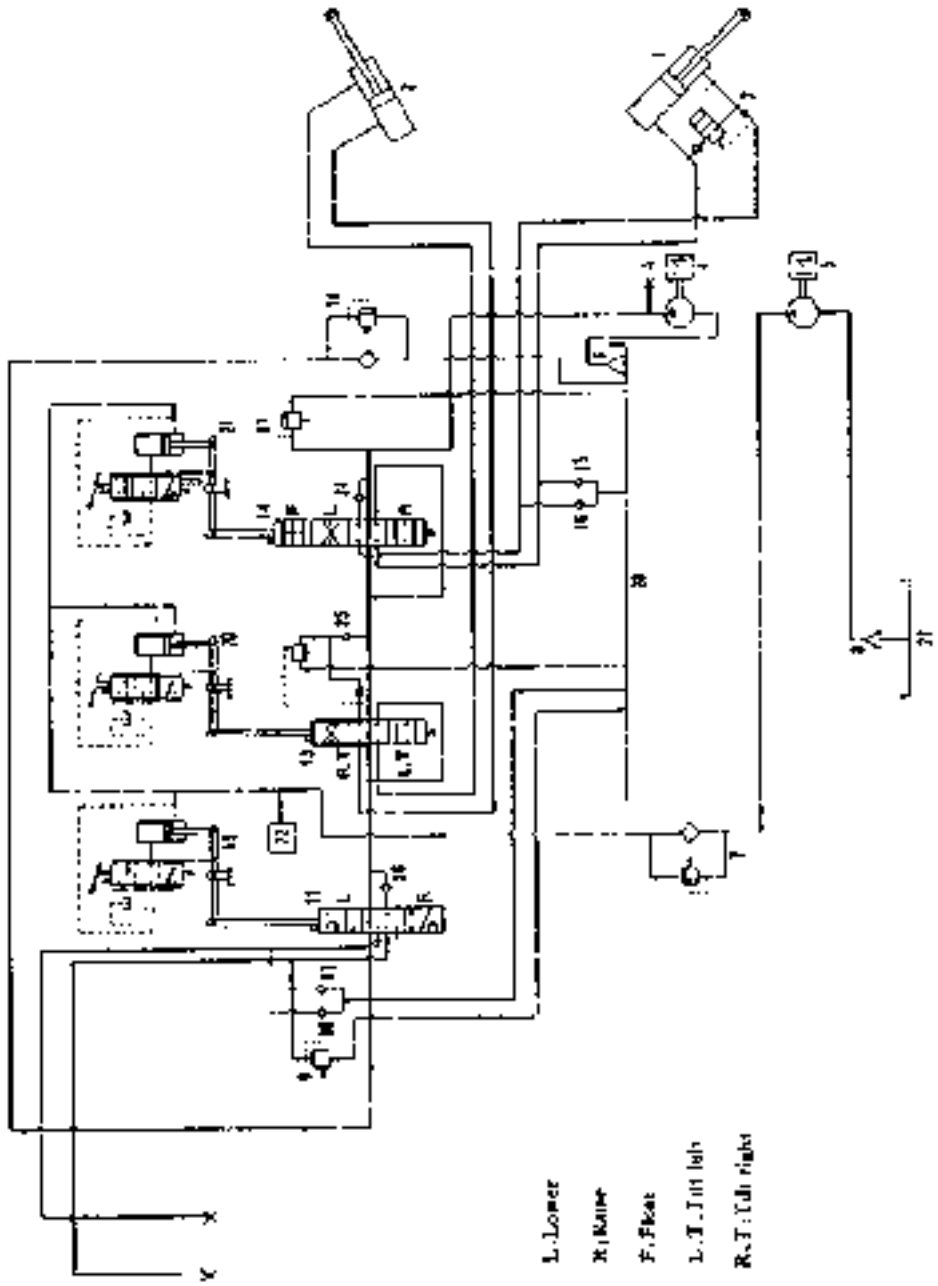


Fig. 2-44 Working equipment hydraulic system (PD220YS)

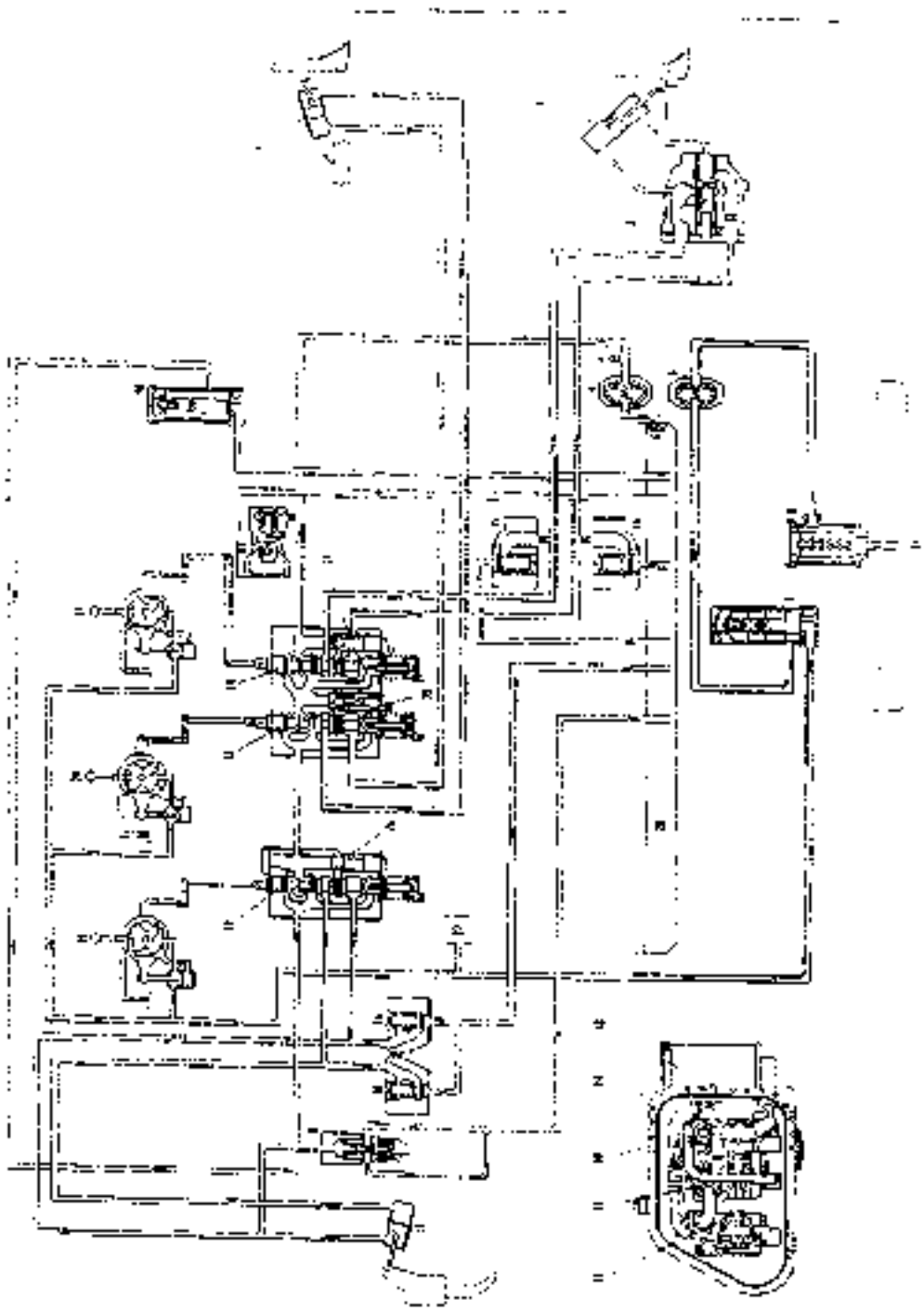


Fig. 2-45 Working equipment hydraulic structure schematic(PD220Y-1)

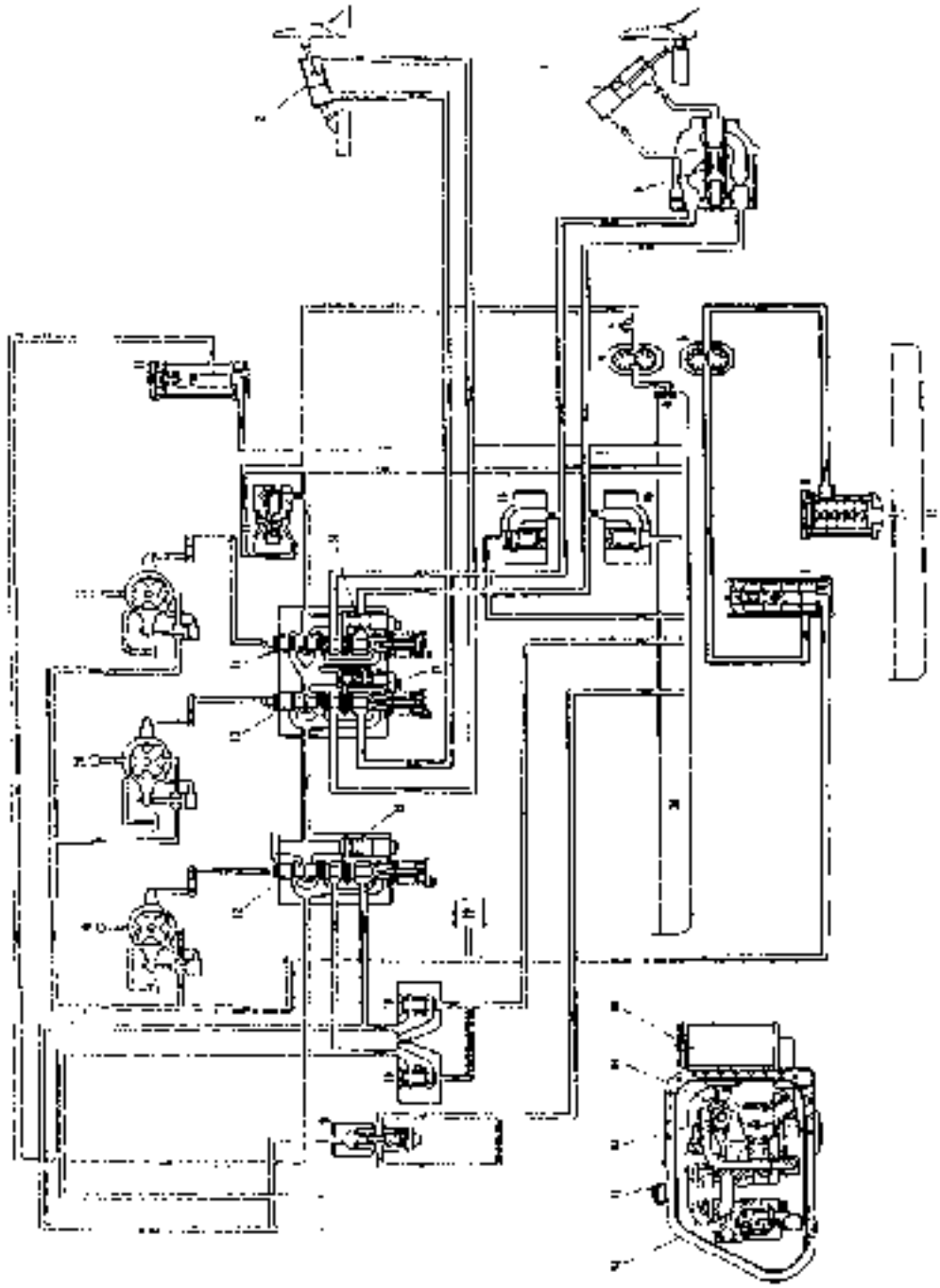


Fig. 2-46 Working equipment hydraulic structure schematic (PD220YS)

1. Blade lift cylinder	2. Tilt cylinder	3. Quick drop valve
4. Working equipment hydraulic pump	5. Steering pump	6. Screen
7. Oil filter	8. Strainer	9. Overload valve
10. Oil make-up valve	11. Oil make up valve	12. Changeover valve
13. Changeover valve	14. Changeover valve	15. Oil make-up valve
16. Oil make-up valve	17. Relief valve	18. Oil filter port
19. Rotary servo valve	20. Rotary servo valve	21. Rotary servo valve
22. Steering-brake valve	23. Ripper cylinder	24. Inlet check valve
25. Inlet flow check valve	26. Inlet check valve	27. Steering case
28. Working equipment		

1. Working pump

Working pump is driven by the gear of power take-off. It is used to change mechanical energy into hydraulic energy. The structure is shown in Fig. 2-47.

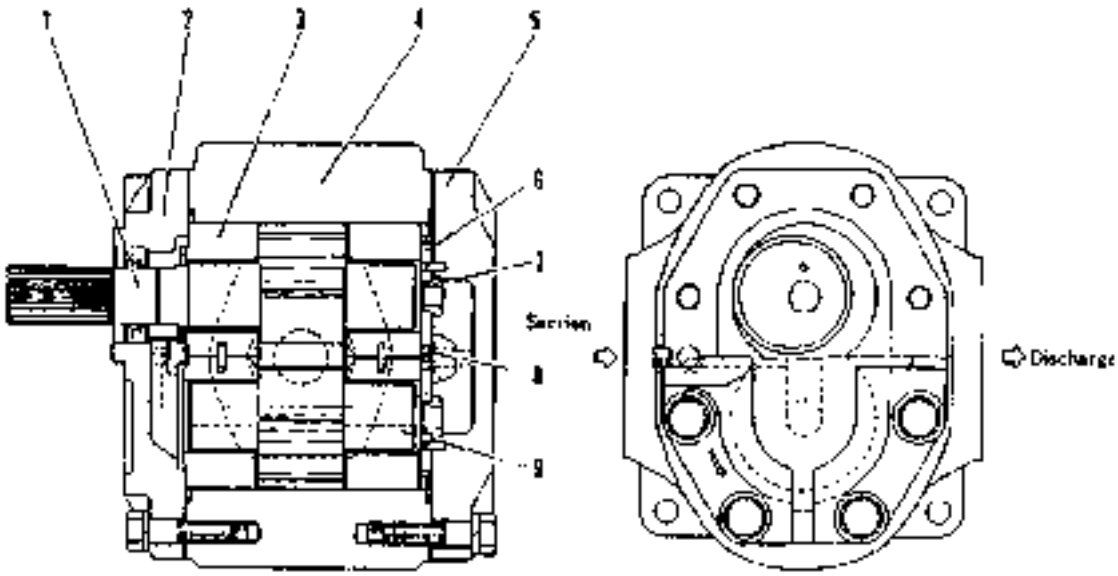


Fig. 2-47 Working pump

1. Driving gear	2. Front cover	3. Bushing	4. Body
5. Rear cover	6. Gasket	7. Ring	8. Seal ring
9. Driven gear			

2. Hydraulic operation principle of working equipment (See Fig. 2-48).

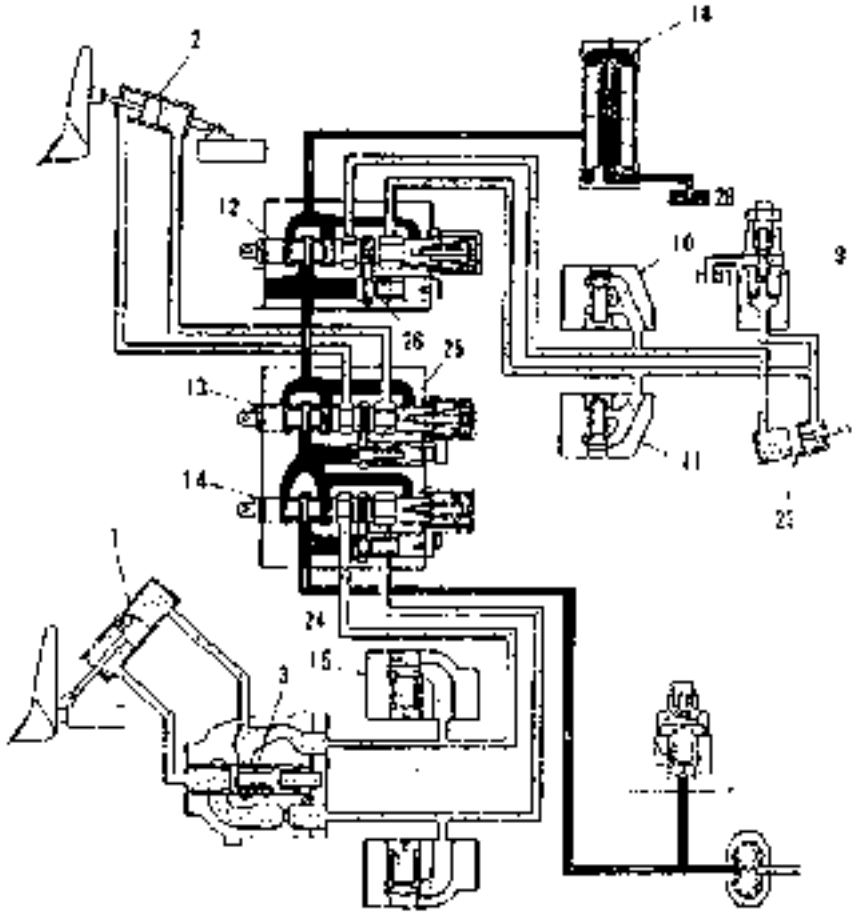


Fig. 2-48 Hydraulic operation principle of working equipment

Operation principle, working oil is pulled from the hydraulic tank(28) and pumped into the changeover valve(12), (13)and(14) by the gear pump. If you do nor operate working equipment, the hydraulic oil flows to the oil filter(18) via changeover valve, then returns to the hydraulic tank(28). If the filter element is blocked, the hydraulic oil pushes off the relief valve of the oil filter, then returns to the hydraulic tank. With the changeover valve(14) or (13) handled, the blade lift cylinder can be controlled to make the blade "Raise", "Lower", "Hold"and "Float"and the tilt cylinder can be controlled to make the blade "Tilt left", "Tilt right". With the changeover valve(12) handled, the ripper cylinder can be controlled to make the ripper "Raise", "Lower" and "Hold".

The inlet check valve(24), (26) are installed before changeover valve to overcome possible nod shock of any operational unit due to changeover.

The flow valve(25) is installed in order to give the tilt cylinder an ideal operating speed.

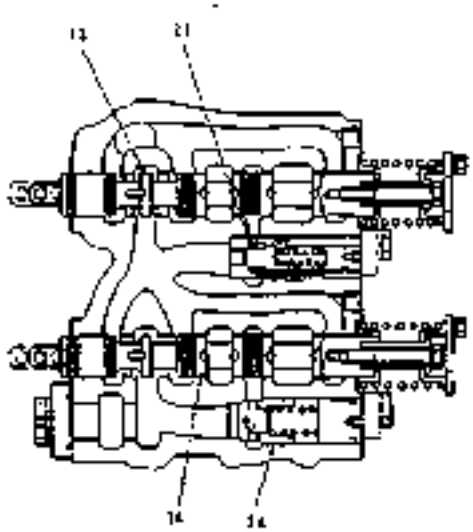


Fig. 2-49 Flow valve

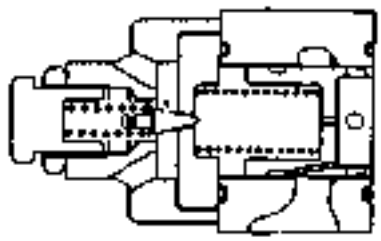
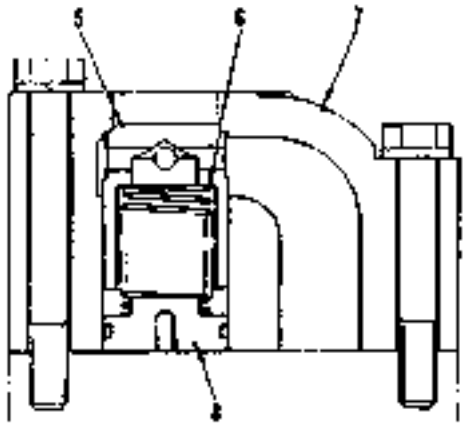


Fig. 2-50 Relief valve

The overload valve(9) is installed to avoid too high pressure of hydraulic system due to overload during ripping operation.

When the load is excess during operation, the pressure of hydraulic system will exceed the adjusted pressure(14.0MPa) momently. At this point the relief valve(17)(See Fig. 2-50) is open and the oil returns to the hydraulic tank via relief valve(17) to protect the hydraulic system.

When the direction of applied force is identical with that of movement of the cylinder's piston, vacuum is formed inside the cylinder. The oil make-up valve(10), (11), (15), (16)in Fig. 2-48 should be installed, their structures are shown in Fig. 2-51 and Fig. 2-52.



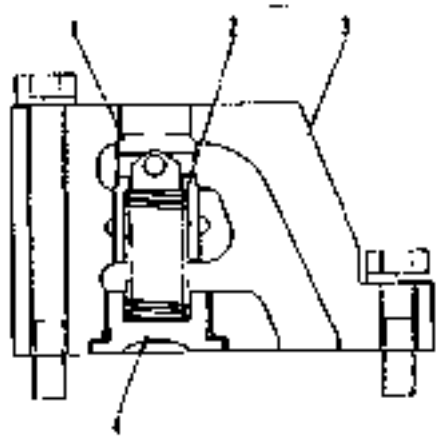


Fig. 2-51 Make-up valve(blade cylinder) Fig. 2-52 Make-up valve(Ripper cylinder)

The above-mentioned valves are all installed in the hydraulic tank of the working equipment.

To prevent the hydraulic oil from contaminating by dust, the hydraulic tank of the working equipment adopts enclosed structure(See Fig. 2-53).

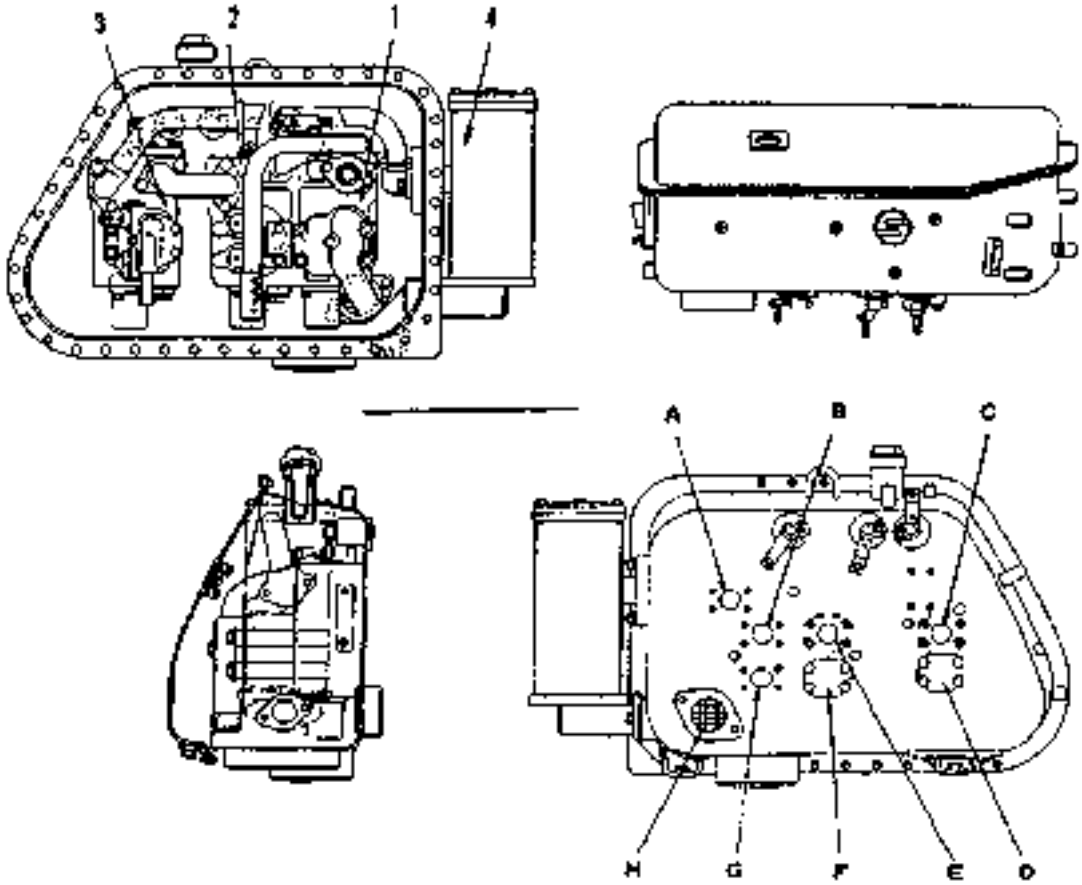


Fig. 2-53 Hydraulic tank

A. Inlet B. To blade cylinder bottom (Lower) C. D. To ripper
E. To tilt cylinder bottom(Tilt left) F. To tilt cylinder head(Tilt right)
G. To blade cylinder head(Raise) H. Pump suction

3. Blade cylinder

Blade cylinder is a double-acting piston one,as shown in Fig. 2-54.

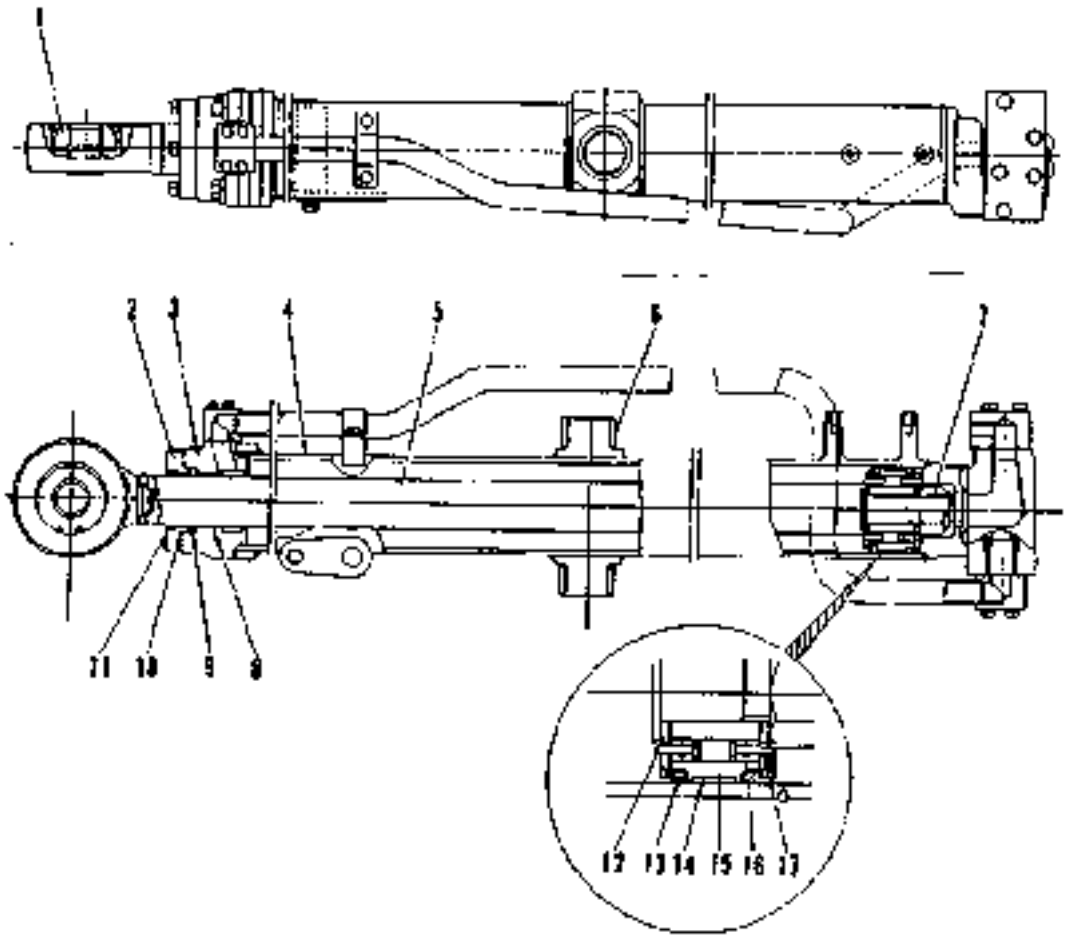


Fig. 2-54 Blade cylinder (PD220Y-1,PD220YS)

1. Bushing	2. Gland	3. Cylinder head	4. Cylinder body
5. Piston rod	6. Bushing	7. Nut	8. Bimetal bushing
9. Packing	10. Bimetal bushing	11. Dust seal	12. Retainer
13. Seal ring	14. Wear ring	15. Piston	16. Valve seat
17. Buffer valve			

To avoid hydraulic shock and too high pressure when the piston moves to the cylinder head or bottom, the buffer valve (17) is installed. Its working principle is as follows: The pressurized oil pushes piston (15) (See Fig. 2-55) to the cylinder bottom. When the piston approaches to the cylinder bottom, the front end of the buffer valve rod contacts the cylinder bottom, that is, the buffer valve rod leaves the conic seal surface, the front chamber and the rear chamber of the cylinder are connected together and the oil pressure releases to decelerate and discharge.

When the piston moves to the cylinder head the buffer valve also acts as decelerating and discharging.

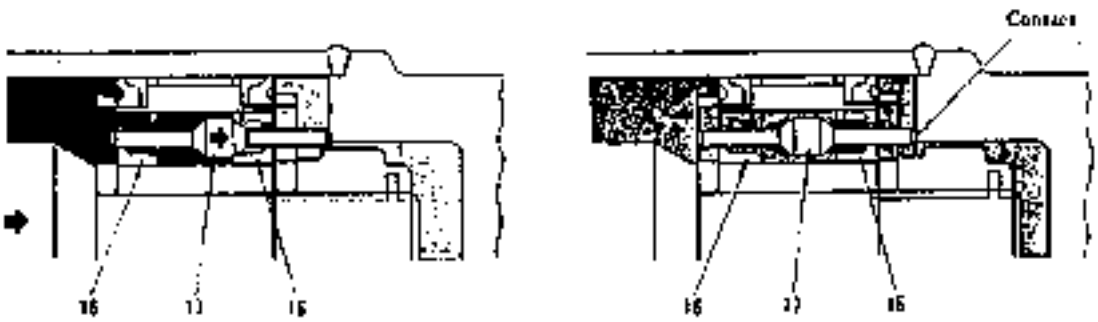


Fig. 2-55 Working principle of buffer valve

A quick drop valve is mounted at the bottom of the blade cylinder as shown in Fig. 2—56. When oil comes in from cylinder bottom (that is, the blade is lowering), the function of this valve is to complete cylinder differential connection automatically to obtain greater lowering speed and reduce occurence of oil vacuum before blade digging.

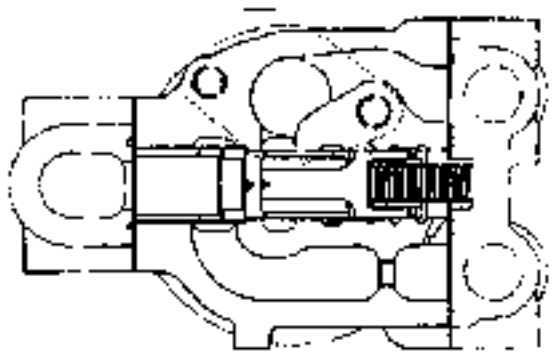


Fig. 2-56 Quick drop valve

The working principle is shown in Fig. 2—57 and Fig. 2—58.

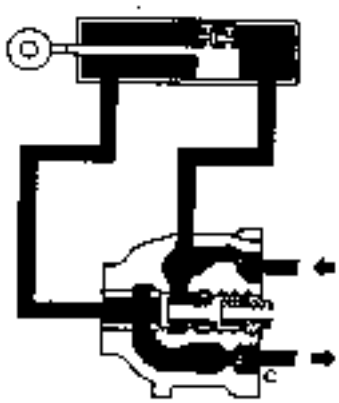


Fig. 2-57

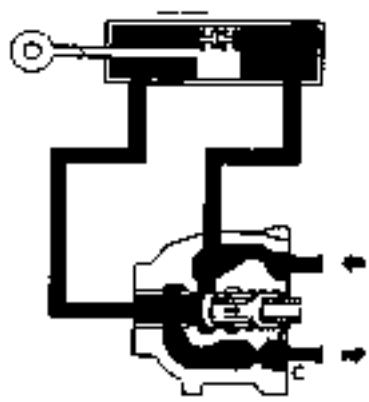


Fig. 2-58

Working principle of quick drop valve

When the oil from changeover valve flows to the cylinder bottom side, the oil comes from port A and the oil at another side of the cylinder returns to oil tank via port B and restrictive hole C. The pressure difference at C occurs due to the restriction function of restrictive hole C. The quick drop valve core is pushed off under this pressure difference, so that the oil flows to port A via port B. Thus the piston travel speed is accelerated and the differential connection is completed.

When the blade is digging, the quick drop valve core is restored, differential connection released and the cylinder could provide enough push due to cylinder travel speed slowdown, restriction function decrease and pressure difference reduction.

As the oil comes from the cylinder head side, the quick drop valve does not function.

4. Tilt cylinder

The tilt cylinder is also a double-acting piston type one and its structure is shown in Fig. 2-59.

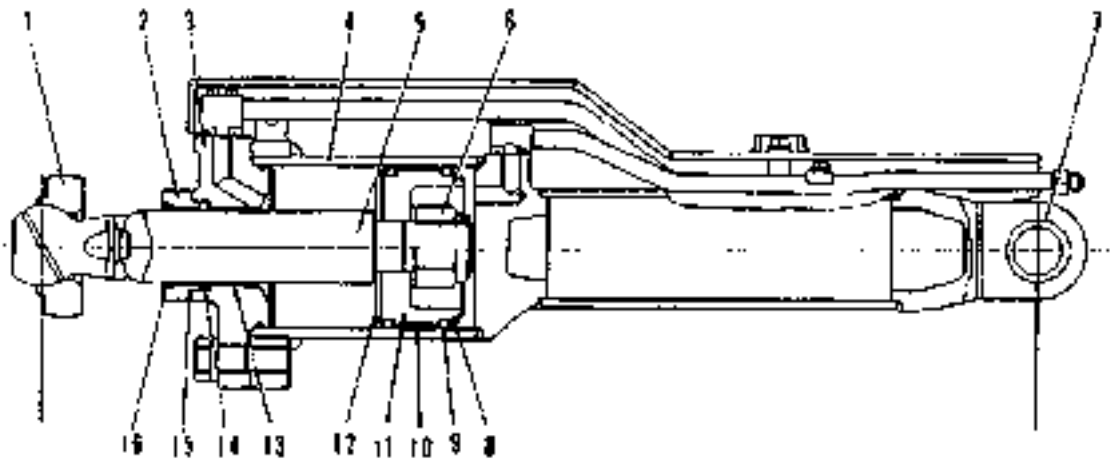


Fig. 2-59 Tilt cylinder

1. Cap	2. Gland	3. Cylinder head	4. Cylinder block
5. Piston rod	6. Nut	7. Seat	8. Retainer
9. Seal ring	10. Wear ring	11. Piston	12. Retainer
13. Bimetal bushing	14. Seal ring	15. Bimetal	16 Dust seal

5. Rotary servo valve

In order to decrease the operating force of changeover valve and improve its inching-control, the rotary servo valve is installed. Its structure is shown in Fig. 2-60.

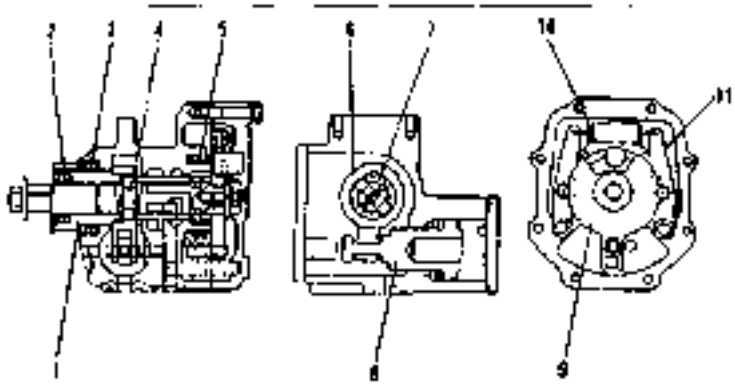


Fig. 2-60 Rotary servo valve

1. Sleeve	2. Oil seal	3. Oil seal	4. Pin
5. Spring	6. Lever	7. Rotor	8. Piston
9. Detent	10. Spring	11. Lever	

The oil of rotary servo valve comes from steering pump and returns to steering case, as shown in Fig. 2-61.

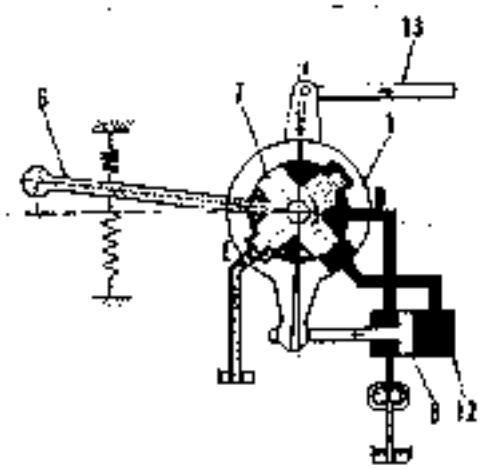


Fig. 2-61 Working principle of rotary servo valve

1. Valve sleeve 6. Handle 7. Valve core 8. Piston 12. Cylinder 13. Linkage

The movement output end of rotary servo valve is connected with changeover valve rod of working equipment through linkage, so that changeover can be made by changeover valve.

There is a positioning unit on "Hold" position. If the handle(6) is moved to make the valve core(7) turn an angle clockwise as shown in Fig. 2-62, the passage between ports A and C is open. The pressurized oil flows to the bottom of the cylinder(12) to push the piston(8) and valve sleeve(1). Thus the sleeve(1) also an angle turns clockwise, so the linkage(13) makes the changeover valve rod shift some distance. The piston(8) stops immediately because turning of the valve sleeve(1) makes the passage between port A and C close at this time. Just continuously shifting the handle(6) can keep continuous movement.

If the handle(6) is moved to make the valve core(7) turn counterclockwise, as shown in Fig. 2-63, the passage between ports B and C is open. The pressurized oil flows to the another side of the cylinder to push the piston(8) and pull the valve sleeve (1). Thus the sleeve(1) also an angle turns counterclockwise, so the linkage(13) makes the changeover valve rod shift some distance. The piston(8) stops immediately because turning of the valve sleeve(1) makes the passage between port B and C close. Just continuously shifting the handle(6) can keep continuous movement.

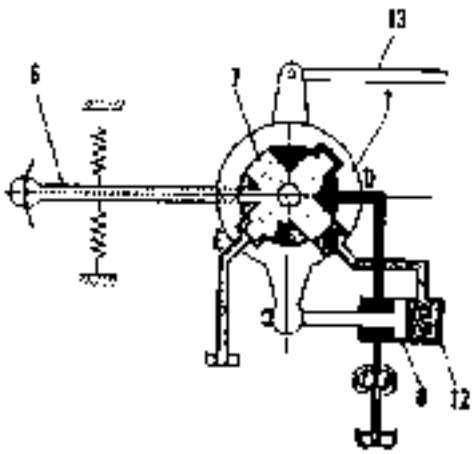


Fig. 2-62

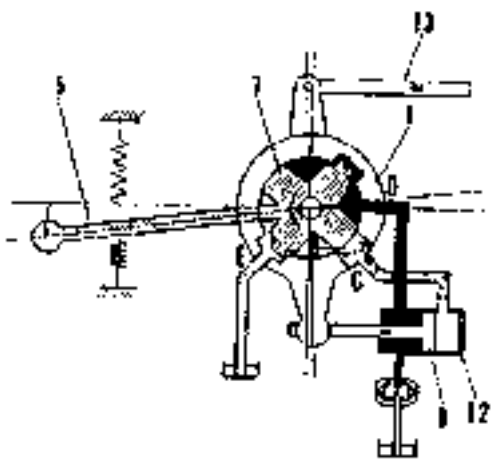


Fig. 2-63

The neutral operating condition is shown in Fig. 2-61. At this time, the passage between A and C or B and D closes, the cylinder piston does not move and the valve sleeve also does not turn.

The operating force is greatly reduced because it is only used to overcome the friction between valve core(7) and valve sleeve(1) and the output force is provided by the cylinder.

It is indicated that the pressurized oil of rotary servo valve comes from the steering pump of chassis hydraulic system and returns to the steering case.

Ⅰ. Chassis hydraulic system

1. Transmission hydraulic circuit system schematic(See Fig. 2-64).

Transmission circuit system structure schematic(See Fig. 2-65).

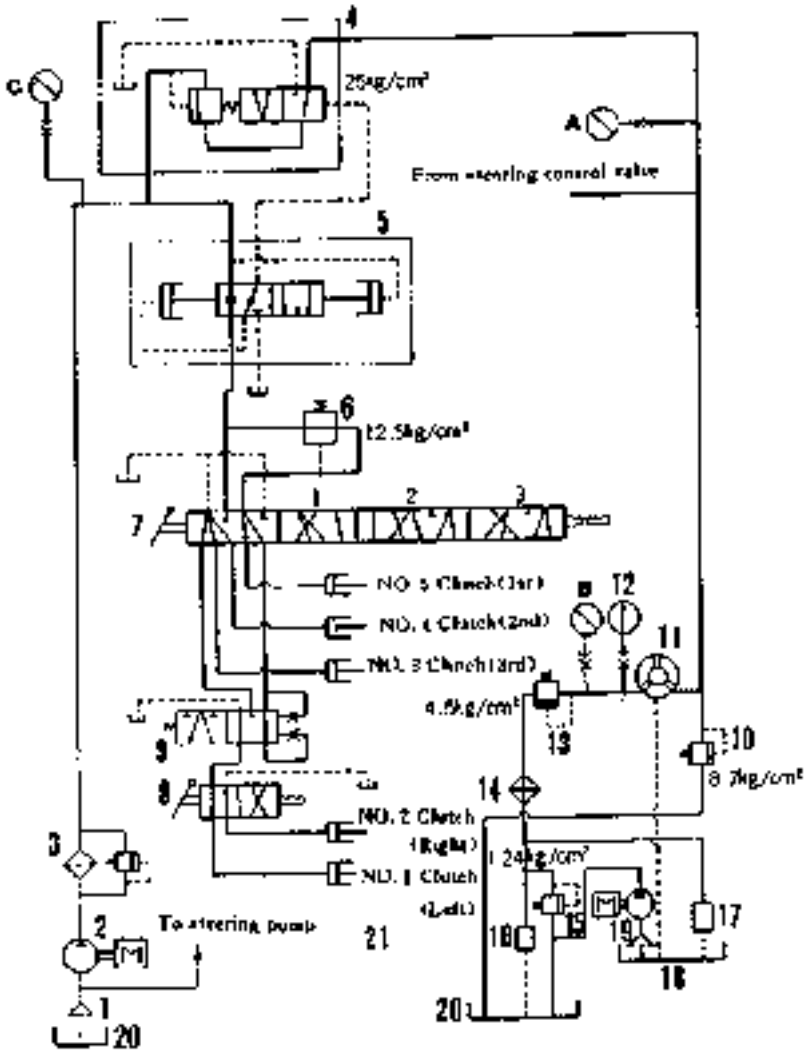


Fig. 2-64 Transmission circuit system schematic

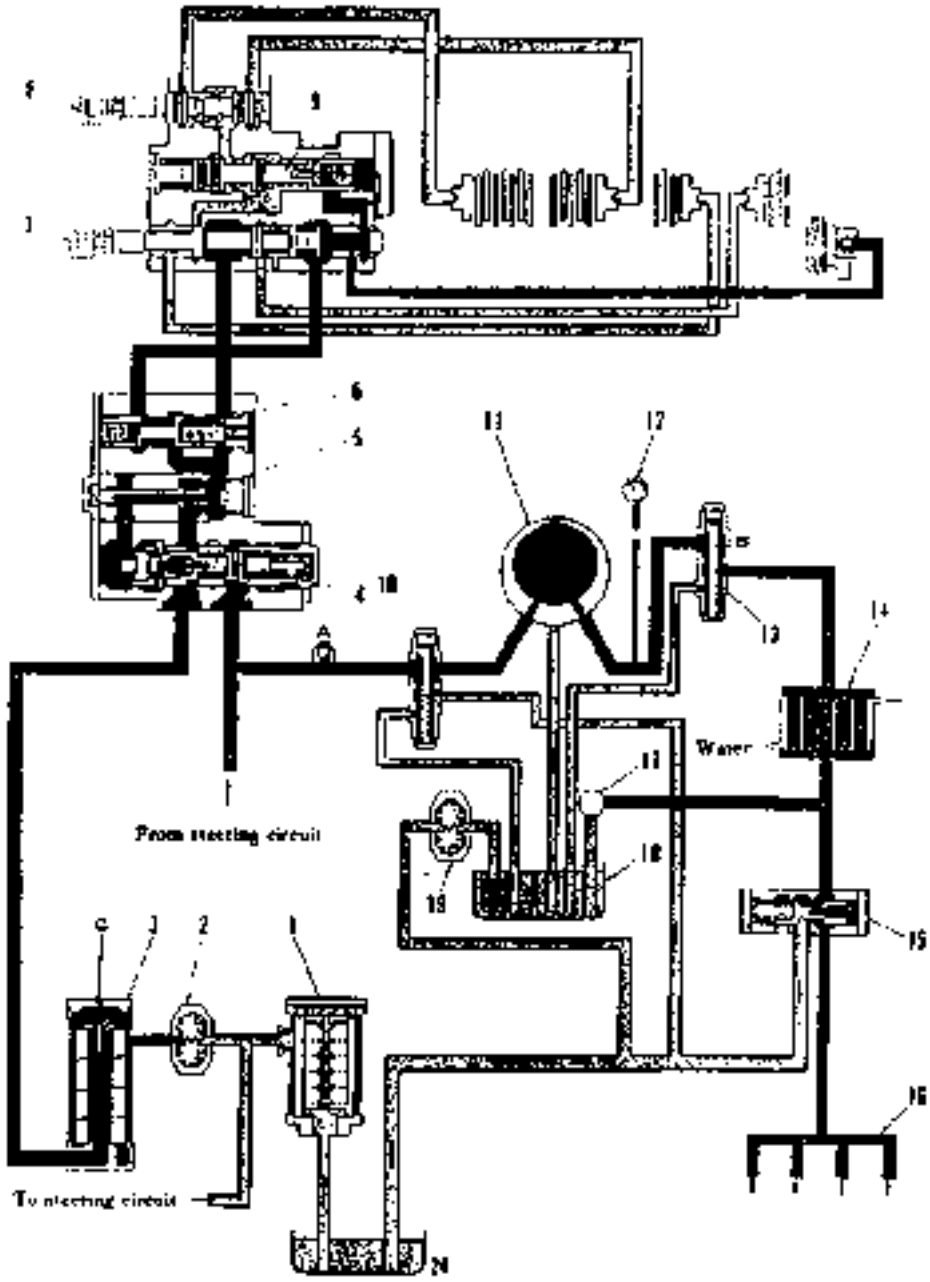


Fig. 2-65 Transmission circuit system structure schematic

1. Magnetic strainer
2. Transmission pump
3. Oil filter
4. Modulating valve
5. Quick return valve
6. Regulator valve
7. Speed valve
8. Directional valve
9. Safety valve
10. Torque converter relief valve
11. Torque converter
12. Oil thermometer of torque converter
13. Regulator valve of torque converter
14. Oil cooler
15. Transmission lubriction relief valve
16. Transmission lubrication
17. P. T. O. lubrication
18. Torque converter case
19. Scavenging pump
20. Steering case
21. Brake lubrication relief valve

A. Pressure tap for torque converter relief valve(PT1/8)

B. Pressure tap for torque converter regulator valve(PT1/8)

C. Pressure tap for trasmission clutch(PT1/8)

The transmission pump is a gear one. It is connected with the P. T. O. and is used to change mechanical energy into hydraulic energy. The oil filtered via a strainer is pulled by transmission pump from the steering case. The sent oil is entered into the transmission valve after it is filtered via an oil filter to realize forward, reverse and gearshift. At the same time, the oil released via transmission relief valve together with the oil released via steering brake valve flows into the torque converter. One relief valve is installed at the inlet of torque converter. The released oil is used to lubricate transmission and transfer case of P. T. O. The oil entered into torque converter is maintained at enough working pressure by the modulating valve at outlet. The oil flowed via the modulating valve and cooled down by the oil cooler is used to lubricate the transmission and P. T. O.

The drained oil, which comes from relief valve, leakage of torque converter and lubrication of P. T. O. is filled in the housing of torque converter. So a scavenging pump is installed in torque converter. The pump is specially used to drain the oil from the housing of torque converter to steering case.

The structure of transmission control valve is shown in Fig. 2-66.

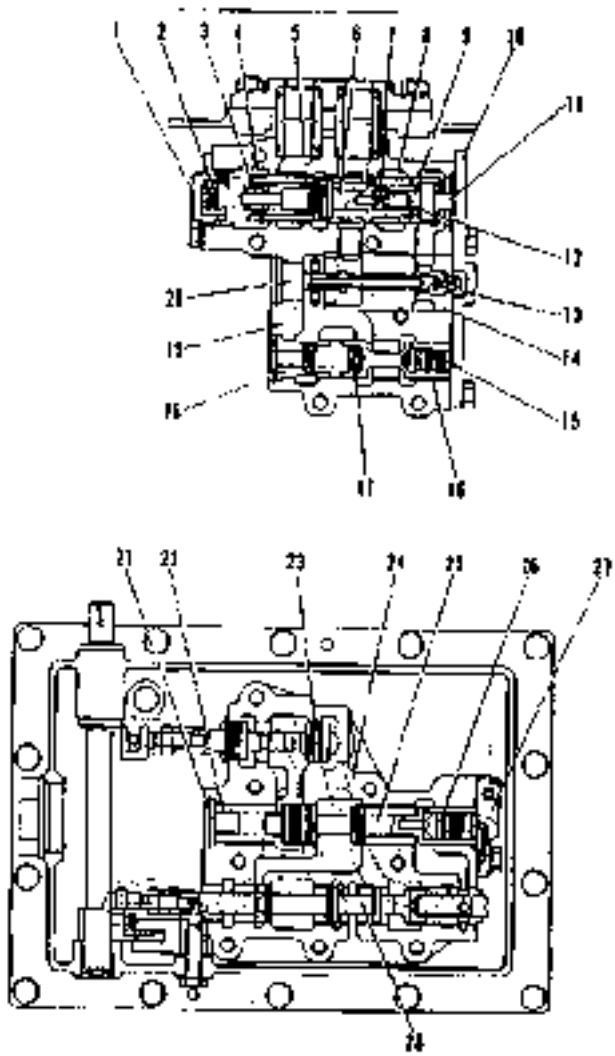


Fig. 2-66 Transmission control valve

1. Stopper cover
2. Modulating valve spring (small)
3. Spring seat
4. Modulating sleeve spring
5. Modulating valve spring
6. Modulating valve
7. Piston valve (A)
8. Modulating valve
9. Piston valve (B)
10. Cover
11. Stopper
12. Piston valve spring
13. Quick return valve
14. Quick return valve sleeve
15. Piston
16. Regulator valve
17. Regulator valve spring
18. Stopper
19. Control valve body (A)
20. Stopper
21. Stopper
22. Safety valve spring
23. Directional valve
24. Control valve body (B)
25. Safety valve
26. Piston
27. Cover
28. Speed valve

1 to 1st speed clutch (No. 5)
2 to 2nd speed clutch (No. 4)
3 to 3rd speed clutch (No. 3)
F to forward clutch (No. 1)
R to reverse clutch (No. 2)

The valve(6) is a modulating valve. The modulating pressure 2.45MPa of PD220Y-1 and PD220YS is used to engage all clutches except for No. 1 clutch. After this pressure is reached, the modulating valve is opened to feed the torque converter with oil.

The valve(13) is a quick return valve. The joint action of the quick return valve(13) and modulating valve(8) makes all clutches of the transmission be smoothly engaged and completely disengaged.

When operate transmission gearshifting, the system pressure is changed according to the curve as shown in Fig. 2-67. At the moment to operate transmission gearshift, the pressure is dropped down immediately to disengage the clutch completely. Then the pressure rises slowly to make clutch be engaged smoothly and avoid its shock. This is a great help to prolong the lifetime of power train.

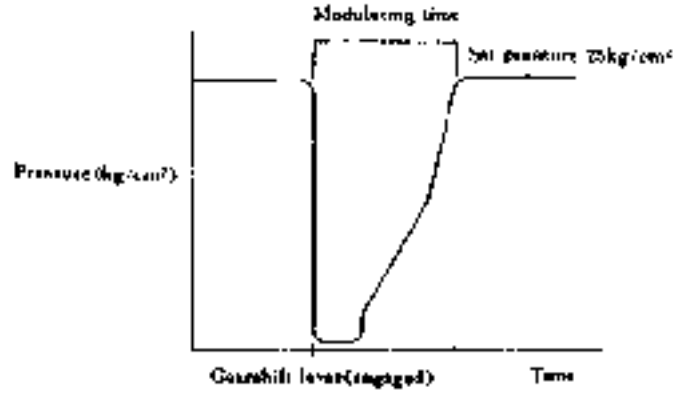


Fig. 2-67 Pressure Change Curve

The valve(16) is a regulator one and installed just for No. 1 clutch. Its outlet pressure is 1.25MPa(i. e. engage pressure of No. 1 clutch).

The valve(25) is a starting safety valve. It is installed to avoid accident, that is, when the gearshift lever is placed on the 1st, 2nd and 3rd positions and at this time the engine is started, the machine will be moved suddenly. The function of this valve is, only put the gearshift lever in the neutral position at first, then put into gear individually, the machine can be successfully started.

The valve(28) is a speed one. It is used to control the movement of all transmission cluches in order to obtain different forward and reverse speeds.

The valve(23) is a directional one. It is used to control the movement of No. 1 clutch and No. 2 clutch of transmission to make machine forward and reverse.

The drain oil from valve(8) to valve(23) are returned to steering case.

2. Steering brake circuit

The structure and principle schematics of steering brake hydraulic circuit are shown in Fig. 2-68 and Fig. 2-69 respectively.

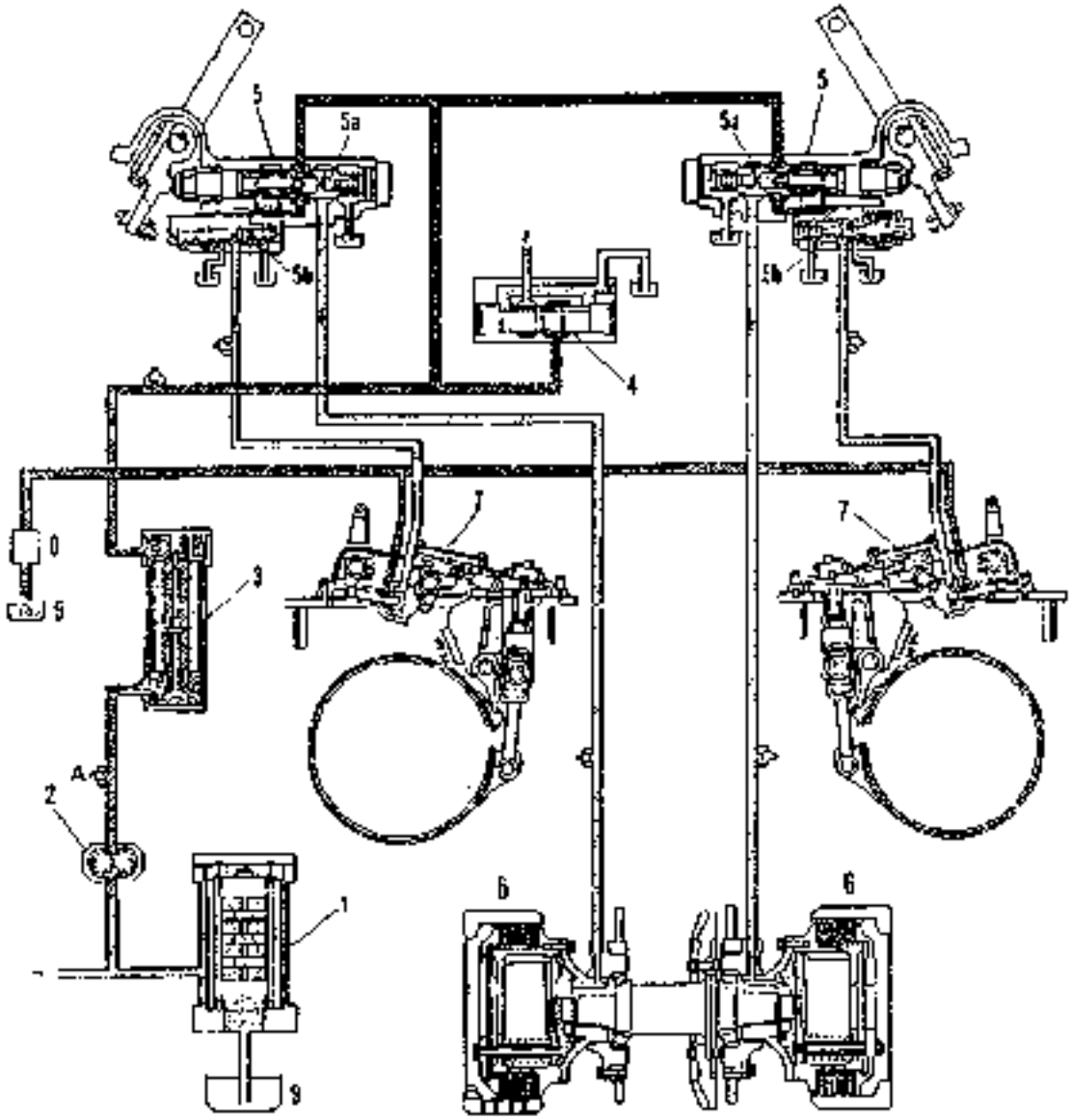


Fig. 2-68 Steering Brake Hydraulic Circuit Structure Schematic

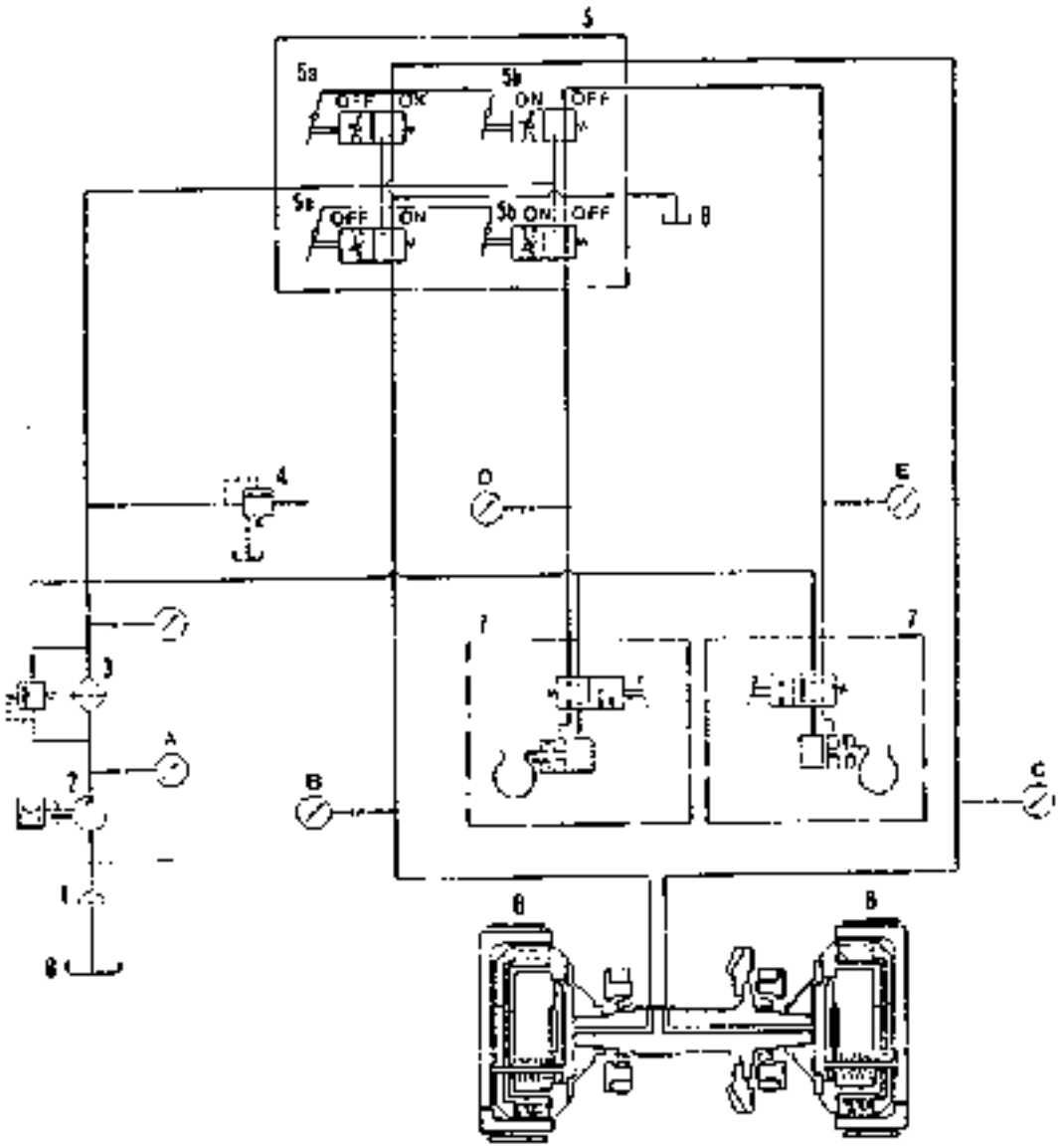


Fig. 2-69 Steering Brake Hydraulic Circuit Principle Schematic

1. Magnetic strainer
2. Steering pump
3. Oil filter
4. Steering main regulator valve
5. Steering control valve
5a. Steering valve
5b. Brake valve
6. Steering clutch
7. Brake booster
8. Steering case
A. Pressure tap for steering main relief
B. Pressure tap for left clutch
C. Pressure tap for right clutch
D. Pressure tap for left brake booster
E. Pressure tap for right brake booster

The steering pump is a gear one. It is connected to the P. T. O. and used to change mechanical energy to hydraulic energy.

The oil in the steering case is pulled through the magnetic strainer by the steering pump, then sent via the oil filter to the steering control valve, brake booster and regulator valve.

The oil released via regulator valve flows into torque converter circuit.

It is indicated that one oil manifold in the steering brake circuit is connected to servo valve. The valve is a rotary servo valve which is used to help driver to operate working equipment and from which the oil returns to the steering case.

The structure of the steering control valve is shown in Fig. 2-70.

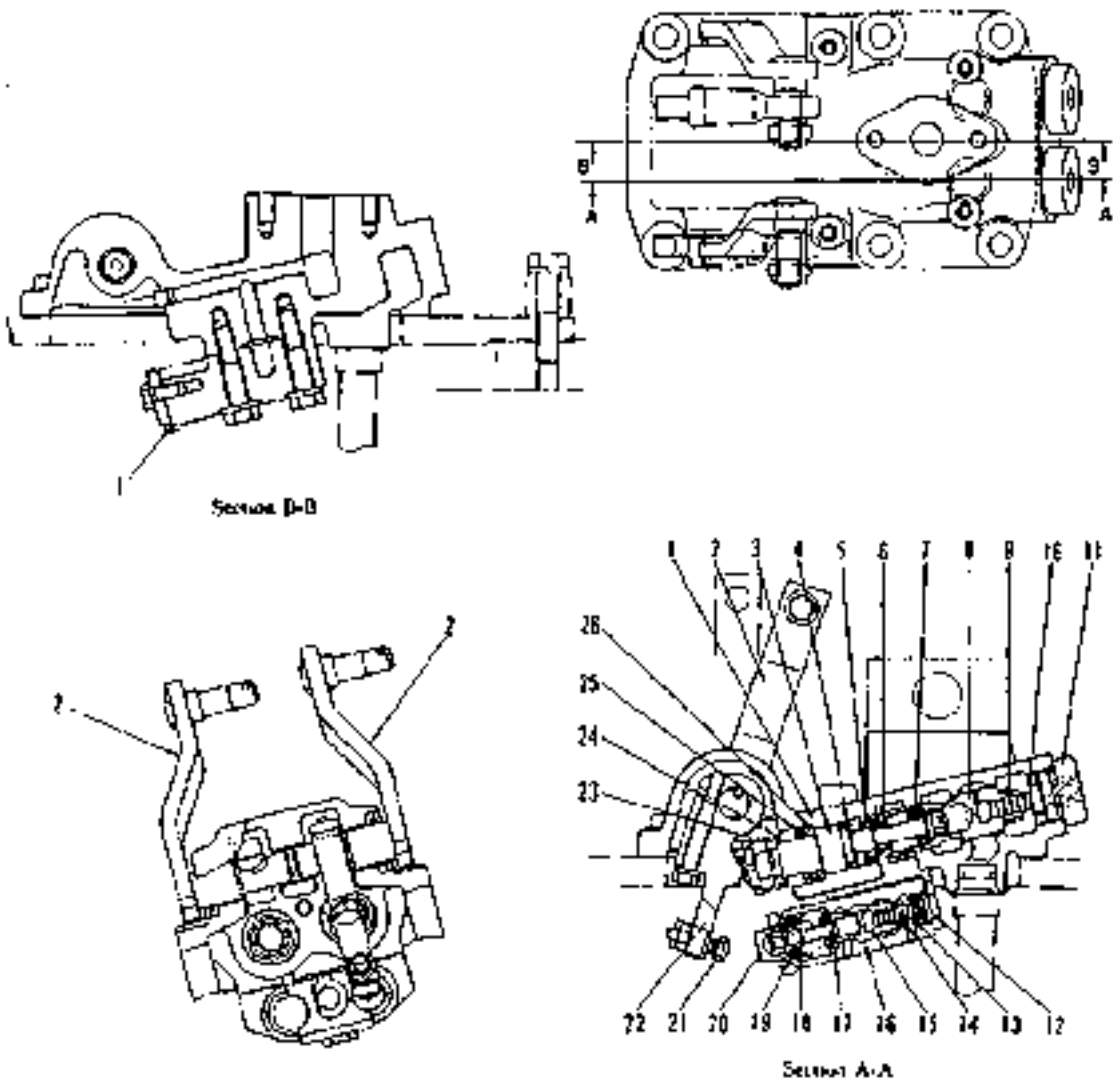


Fig. 2-70 Steering Control Valve

1. Valve body	2. Lever	3. Valve rod	4. Spring
5. Stopper	6. Modulating spring	7. Stopper	8. Steering valve
9. Piston	10. Return spring	11. Plug	12. Plug
13. Return spring	14. Piston	15. Brake valve	16. Valve body
17. Shaft	18. Modulating spring	19. Return spring	20. Guide
21. Adjusting bolt	22. Lever	23. Stopper	24. Return spring
25. Stopper	26. Spacer ring		

Steering control valve has the following functions:

(1)When the steering and brake valves are in neutral:

The oil from the steering pump enters main regulator valve(27) and port A and D of the steering control valve. Since the circuit to the steering clutch and brake booster are closed, the oil pressure in the circuit rises. As a result, main regulator valve(27) opens and the oil flows to the torque converter circuit. If the steering lever is not operated, the oil will continuously be relieved to keep the clutch applied and the brake released. The oil pressure in the circuit in this state is 2.16MPa(as shown in Fig. 2-71).

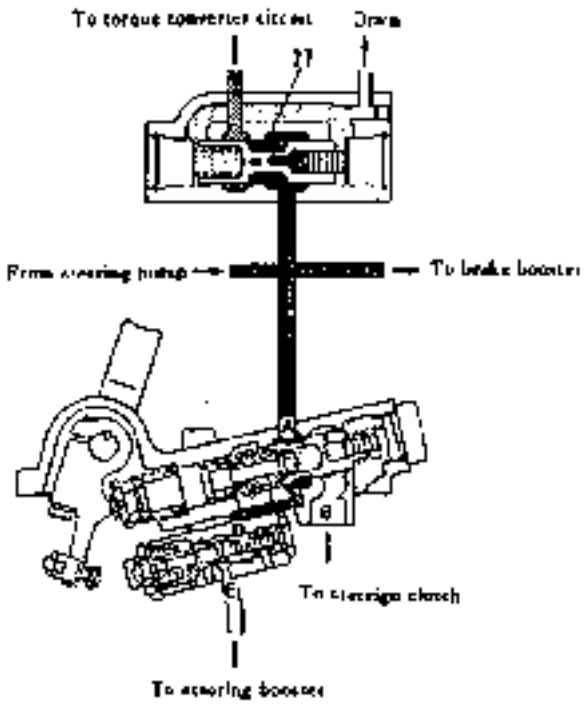


Fig. 2-71

(2)When the oil pressure at the steering valve starts to rise:

When the steering lever is pulled, lever(22) pushes shaft(3) in the direction of the arrow →to compress the spring. The reaction force of compressed spring(6) pushes steering valve (8) in the direction of the arrow→to close the circuit between port B and G.

The passage between port A and B opens at the same time and the oil flows to the steering clutch. When the circuit from the pump to the clutch is filled with oil, the oil pressure

starts to rise again. The oil entering port C through orifice"a" pushes piston(9) and the reaction force pushes back steering valve(8) in the direction of the arrow to compress spring(6) and close the passage between port A and D. In this state,the oil pressure in the circuit from inlet to the clutch balances with the installed load of spring(6) to keep the oil pressure at a constant level. When the steering lever is pulled further,the installed load of spring(6) gradually increases to increase oil pressure in the circuit from port B. As a result,the clutch is partially applied.

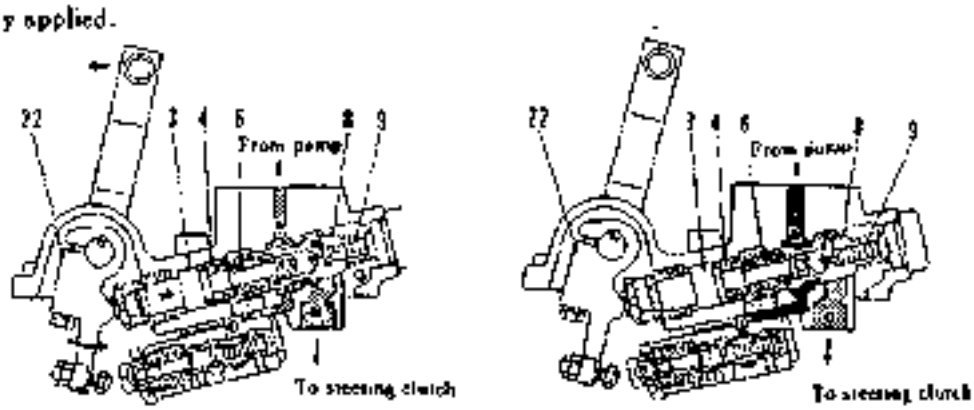


Fig. 2-72

(3)When the oil pressure at the steering valve rises to the maximum valve:

When the steering lever is pulled further from state mentioned in paragraph 2,stopper (6) comes into contact with steering valve(8) and spring(6) assumes the minimum installation height. In this state,shaft(3) starts to push steering valve(8) via spring(4) so that the force required to operate the steering lever rises sharply. When the steering lever is pulled further,shaft(3) compresses spring(4) to gradually increase the installation load and the oil pressure in the circuit after port B. When the installation load of spring(4) is maximized and the oil pressure in circuit reaches 1.57MPa,the clutch is released entirely(as shown in Fig. 2-73).

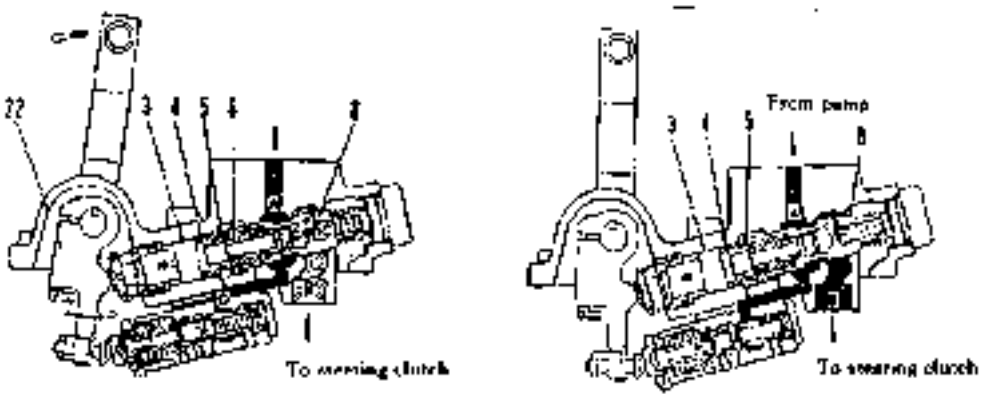


Fig. 2-73

(4)When the oil pressure at the brake valve starts to rise:

When the steering lever is pulled further from the state mentioned in paragraph 3,adjusting bolt(21) pushes shaft(17) in the direction of the arrow to compress brake valve(15).

The passage between ports E and F is closed and the passage between ports D and E is open so that the oil flows to the brake booster. On the other hand, the oil entering the port through orifice"b" pushes piston(14). The reaction force pushes back brake valve(15) in the direction of the arrow to compress spring(1) and close the passage between ports D and E. In this state, the oil pressure in the circuit from port E to the booster balances the installation load of spring(18) to keep the oil pressure at a constant level. If the steering lever is pulled further from this state, the installation load of spring(18) increases gradually and the oil pressure after port E rises to start operation of brake. (See Fig. 3-74).

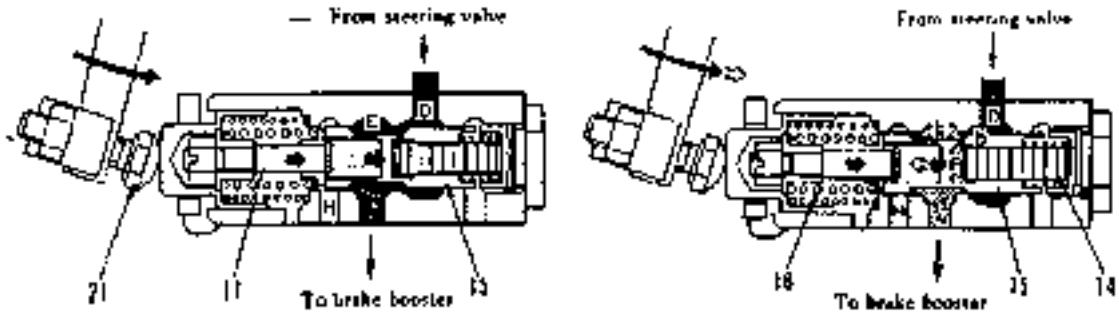


Fig. 2-74

(5) When the oil pressure at the brake valve reaches the maximum valve;

When the steering lever is pulled to its stroke end, shaft(3) moves in the direction of the arrow until it contacts stoppers(23) and (25). Steering valve(8) does not move any more. Adjusting bolt(21) pushes shaft(17) in the direction of the arrow to compress brake valve (15). Shaft(17) does not reach the stroke end even when shaft(3) reaches the stroke end and the oil entering port F via orifice"b"of brake valve(15) pushes piston(14). The reaction force pushes back brake valve(15) in the direction of the arrow to compress spring(18) and close the passage between ports D and E. In this state, the oil pressure in the circuit from the inlet to the booster balances with the tension of spring(18), reaching the maximum installation load so that the oil pressure is kept at a constant value and the brake operation is completed. Under these circumstances oil pressure in the circuit after port E is 1.66MPa(as shown in Fig. 2-75).

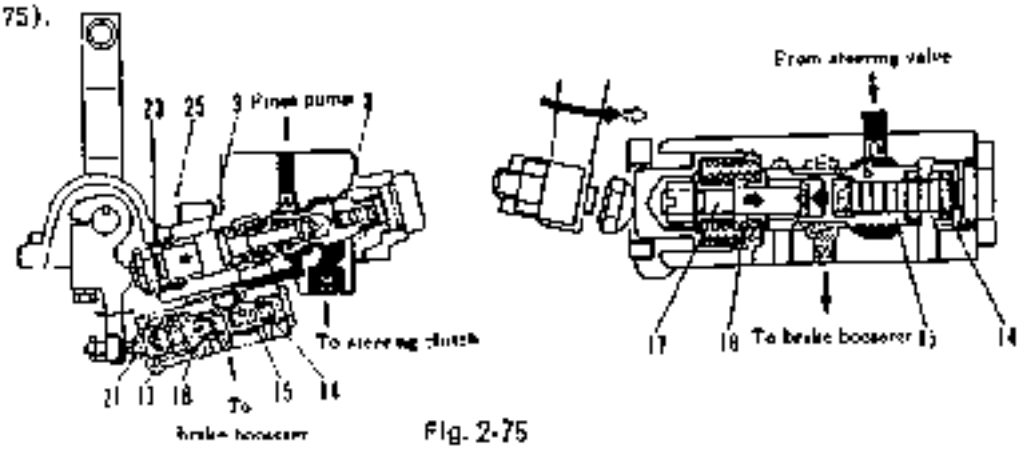


Fig. 2-75

(6)When the steering and brake valves are in neutral:

When the steering level is released, the tension of each spring pushes shaft(3), shaft (17), brake valve(15) and steering valve(8) back in the direction of the arrow, then steering valve(8) closes the passage between ports A and B and opens the passage around port G so that the oil in the steering clutch is drained to the steering case via port G. Brake valve(15) closes the passage between ports D and E and opens the passage between ports E and H so that the oil in the brake booster is drained to the steering case via port H. (as shown in Fig. 2-76).

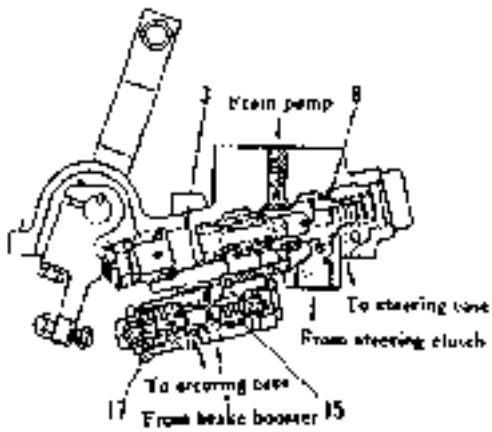


Fig. 2-76

Steering control is equipped with brake booster. Brake booster is used in the machine in order to lighten operating force of steering lever and brake pedal when making steering braking.

When brake is released: There are two oil lines which flow from steering pump. One oil line flows from the steering pump to port A and another oil line flows directly to port B through steering valve. Because the steering lever is not pulled, so interlock control valve does not move. The passage to port A is also closed, so the oil only flows to port B, then through orifice "a" flows to port C. However, the brake pedal is not being depressed, so the passage between port C and port D is shut off. As a result, the oil pressure rises and when it exceeds the setting pressure of the main regulator valve(26), the oil flows to the torque converter. At this time, the normal oil pressure valve in the circuit is 2. 16MPa, as shown in Fig2-77.

When steering lever is pulled and brake applied: The steering lever is pulled fully to make steering valve move and oil from pump flows to part A. The oil at port A pushes piston (6). The direction of arrow(→) indicates pressure increase direction. The top of piston(6) pushes lever(5) to make braking function. At this time, the normal oil pressure valve in the circuit is 1. 66MPa, as shown in Fig. 2-78.

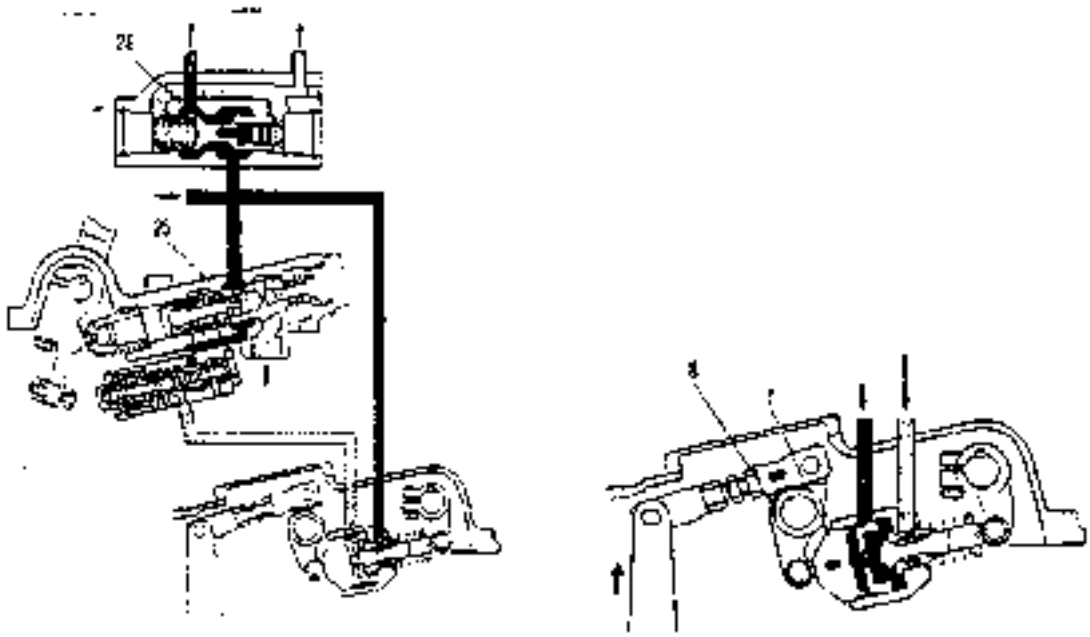


Fig. 2-77

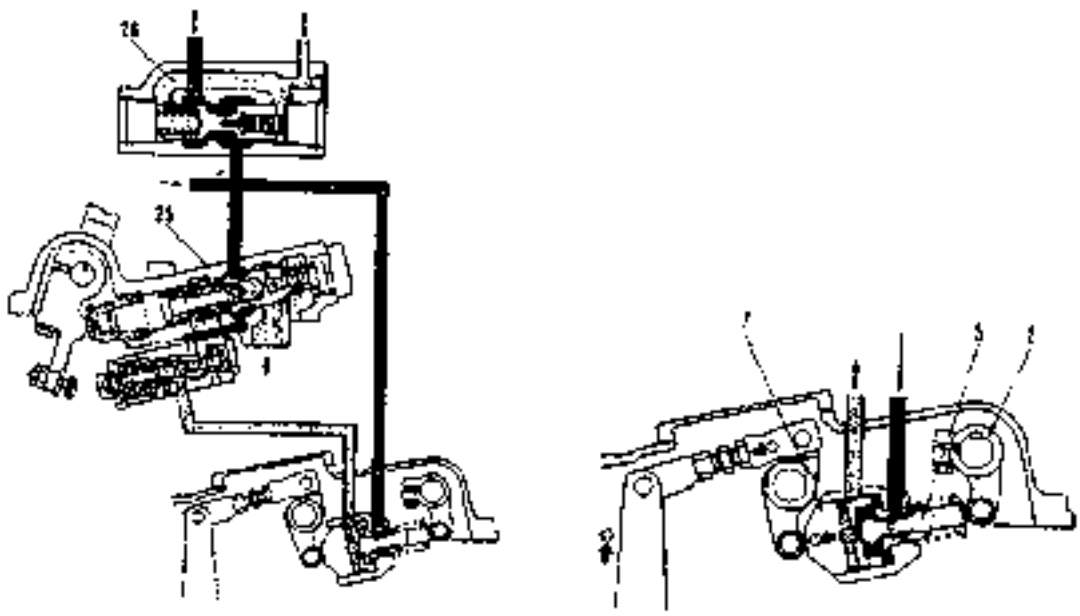


Fig. 2-78

When brake pedal is depressed and brake applied: While the brake pedal is depressed, lever(11) pushes spool(7) in the direction of the arrow(←) and the passage between port C and D is open. So the oil from the pump goes from port B through orifice "a" to port C and D. The oil pushes piston(6) to move in the direction of the arrow(←) and open the passage between port D and port A with increasing oil pressure. The oil then drains from port A to the steering case. The brake pedal is depressed further to compensate the oil loss when the oil passes the opened passage. Finally, the spool(7) makes port A smaller. The above operation runs continuously in a short time, then the piston end pushes the lever(5) down, the brake band contracts smoothly and the braking is applied. When the brake pedal reaches the end of its travel, the passage between port D and A will be shut off. The main regulator valve functions and the oil flows into the torque converter circuit. At this time, the normal oil pressure valve in the circuit is 2.16MPa, as shown in Fig. 2-79.

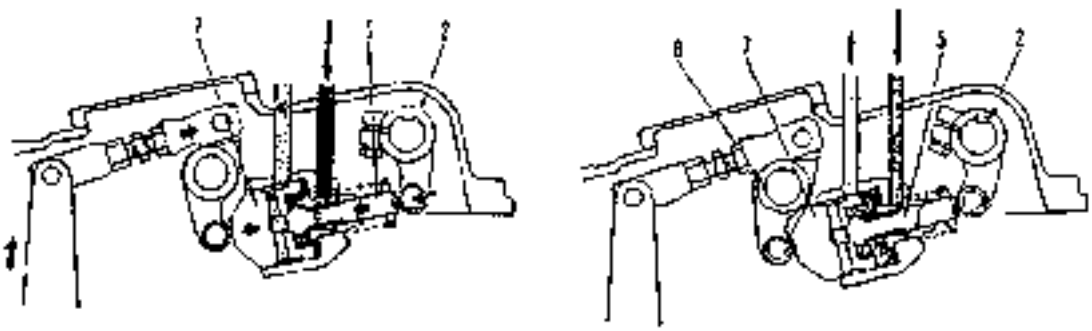


Fig. 2-79

2.13 Electrical system

The electrical system is composed of the following four groups:

2.13.1 Three level electronic alarm monitor (See 8. Electrical system)

2.13.2 Starting motor group

2.13.3 Charging system group

2.13.4 Lighting group

Machine power supply adopts a battery at DC24V and negative pole earthed. (See Fig. 2-80).

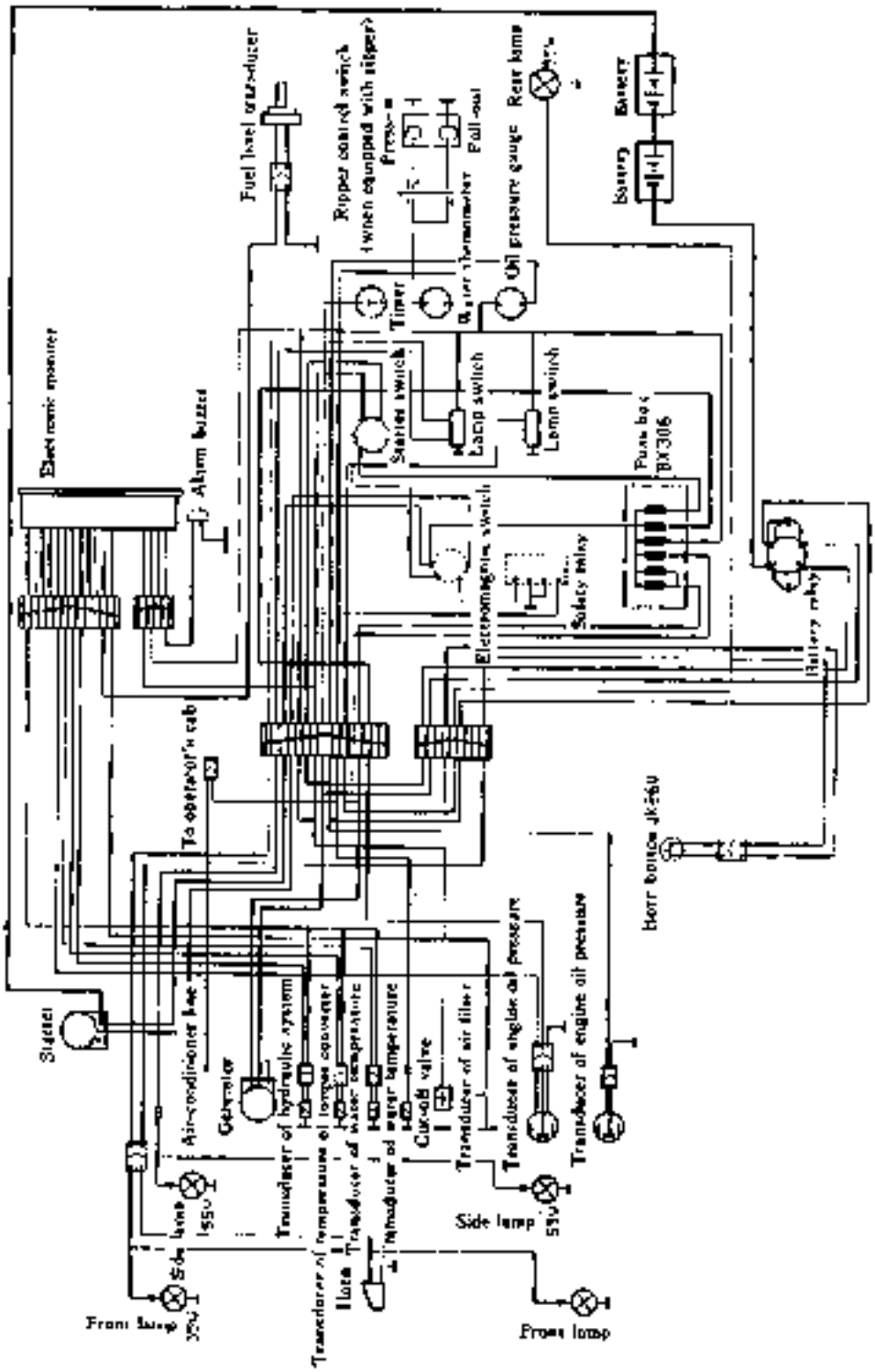


Fig. 2-80 Principle diagram of electrical system

2.14 Working equipment

Working equipment mainly means dozer and ripper. It is used to make different operations of machine.

I Dozer

Different types of dozer are available. The dozers for PD220Y-1 are classified as straight tilt dozer, angle dozer and U-dozer etc. The dozers for PD220YS are classified as straight tilt dozer etc.

1. Straight tilt dozer

Structure of straight tilt dozer is shown in Fig. 2-81, 2-82.

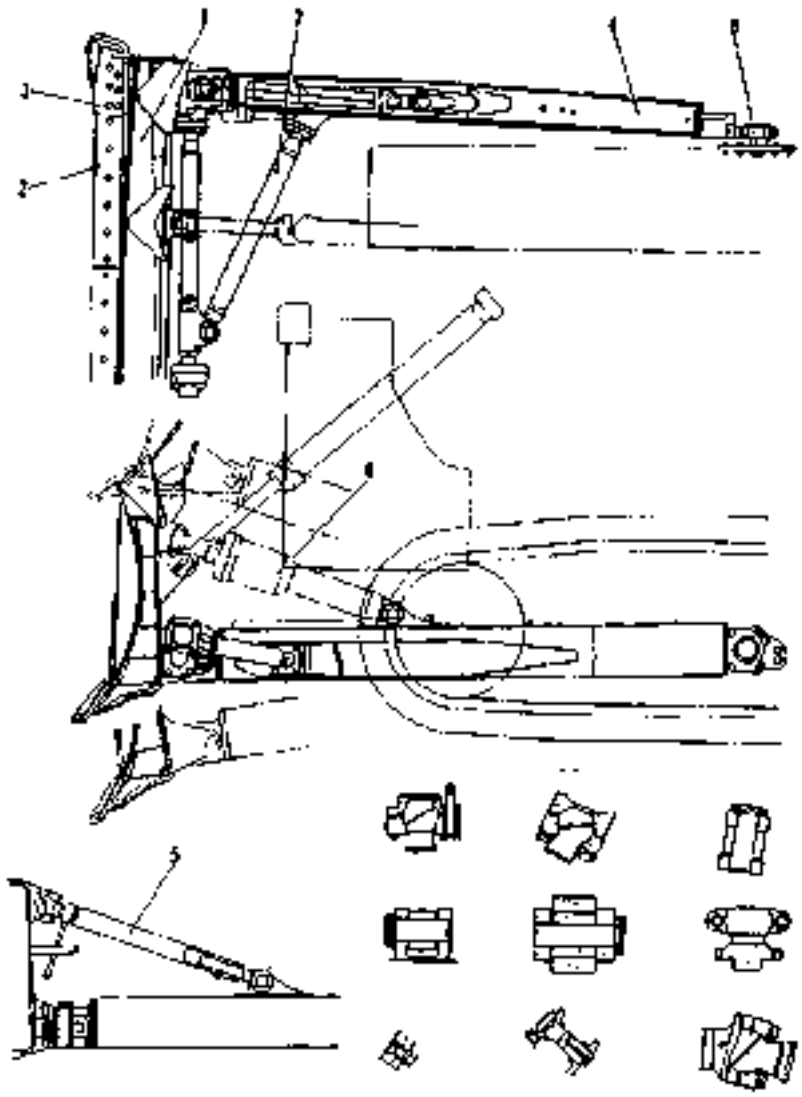


Fig. 2-81 Straight tilt dozer(PD220Y-1)

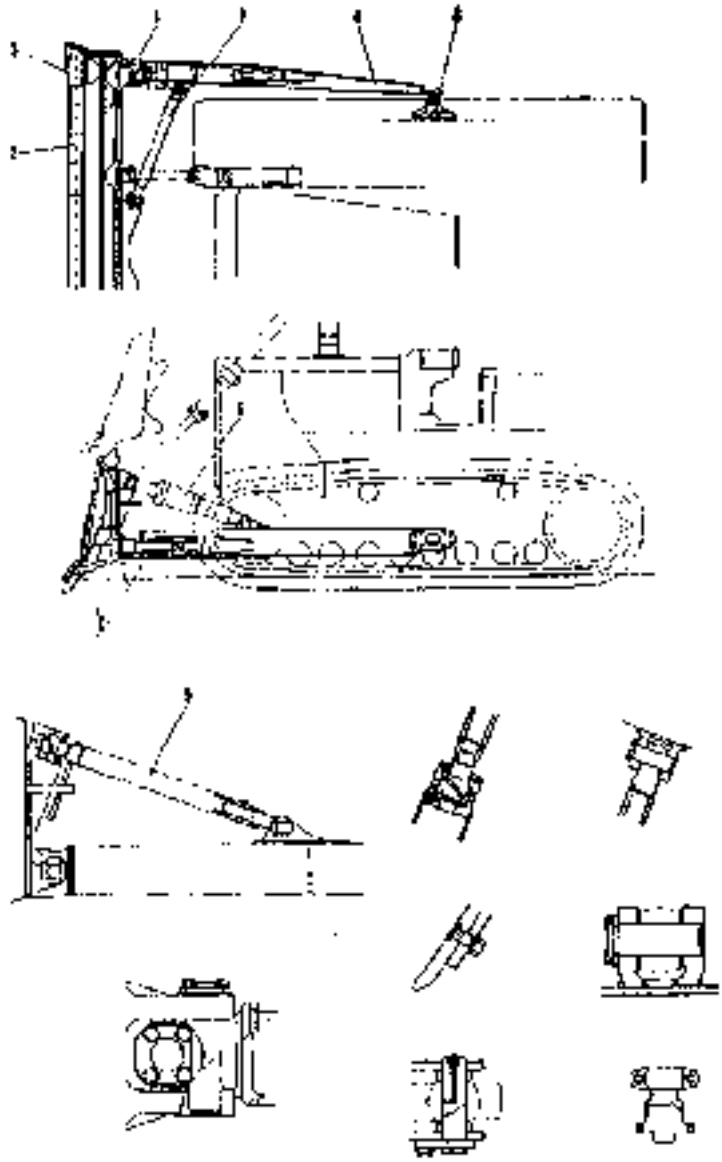


Fig. 2-82 Straight till dozer(PD220YS)

1. Blade	2. Cutting edge	3. End bit	4. Push arm
5. Adjusting screw	6. Tilt cylinder	7. Arm	8. Support

The push arm is constructed box-section. Its bending strength, compression stability and rigidity are excellent. Its front end is articulated to blade with the aid of cross joint and rear end is connected to the support(8) fixed on the track roller frame.

The push arm and the blade swing around the support(8) under the action of the blade lift cylinder to make the blade raise and lower. The cutting angle of blade can be changed with the length of the adjusting screw(5) changed. The left and right tilt of blade in the perpendicular to ground direction can be made by means of the tilt cylinder(6).

When one side of cutting edge(2) has been used for a long time, its upside can be turned down and used.

2. U dozer

The structure of U dozer is similar to the straight tilt one except for blade form.

Connection and movement principle of the U dozer are fully similar to that of the straight tilt dozer.

3. Angle dozer

The structure of angle dozer is shown in Fig. 2-83.

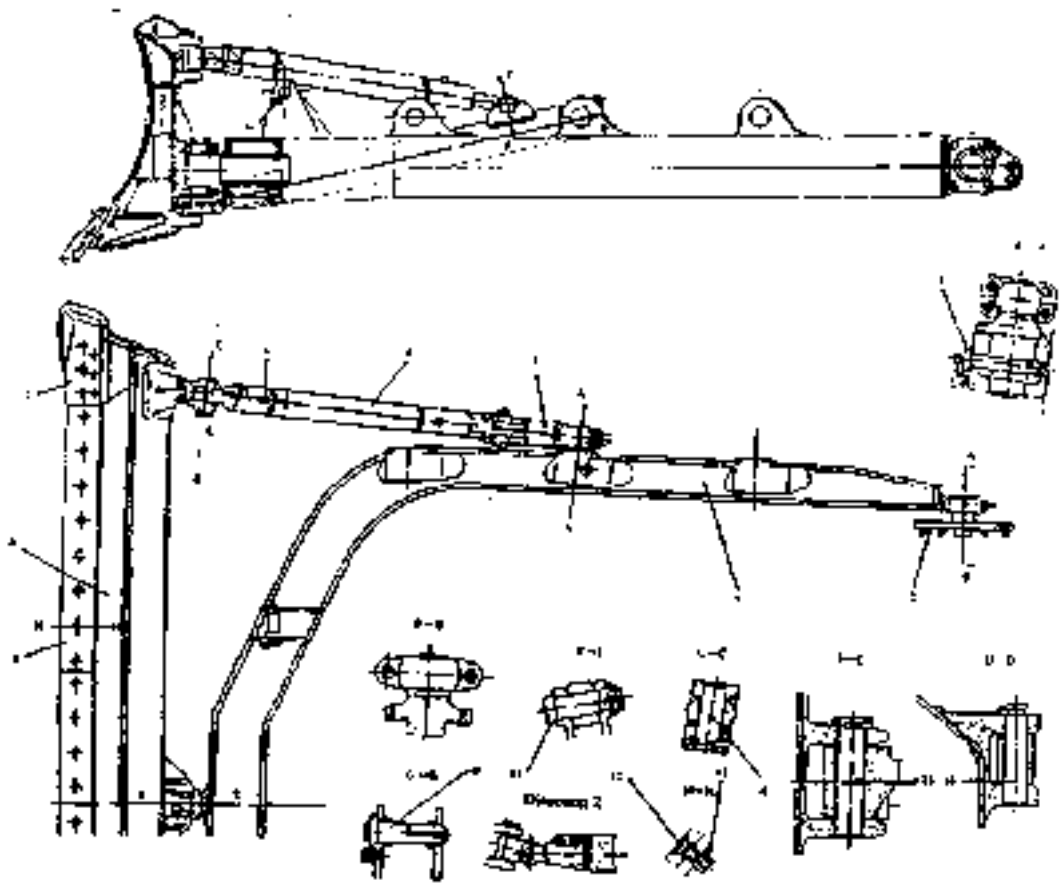


Fig. 2-83 Angle dozer

1. Pin	2. Support	3. C-frame	4. Lower brace
5. Upper brace	6. Screw	7. End bit	8. Blade
9. Cutting edge	10. Pin	11. Pin	12. Bolt
13. Nut	14. Pin	15. Pin	16. Pin

The blade(8) is articulated to C frame(3) by means of upper brace(5) and lower brace (4). C frame(3) is articulated to support(2) fixed on track roller frame. The blade cylinder makes the C frame(including blade) swing around the support(2). The lower brace (4) can be installed at different support of C frame by means of pulling pin(7) out and the blade can obtain 3 different working positions, thus the left and right turning angle 25° can be realized.

8 Ripper

Ripper can be cooperated with blade. It is classified as single shank and multishank.

The structure of 3-shank ripper is shown in Fig. 2-84.

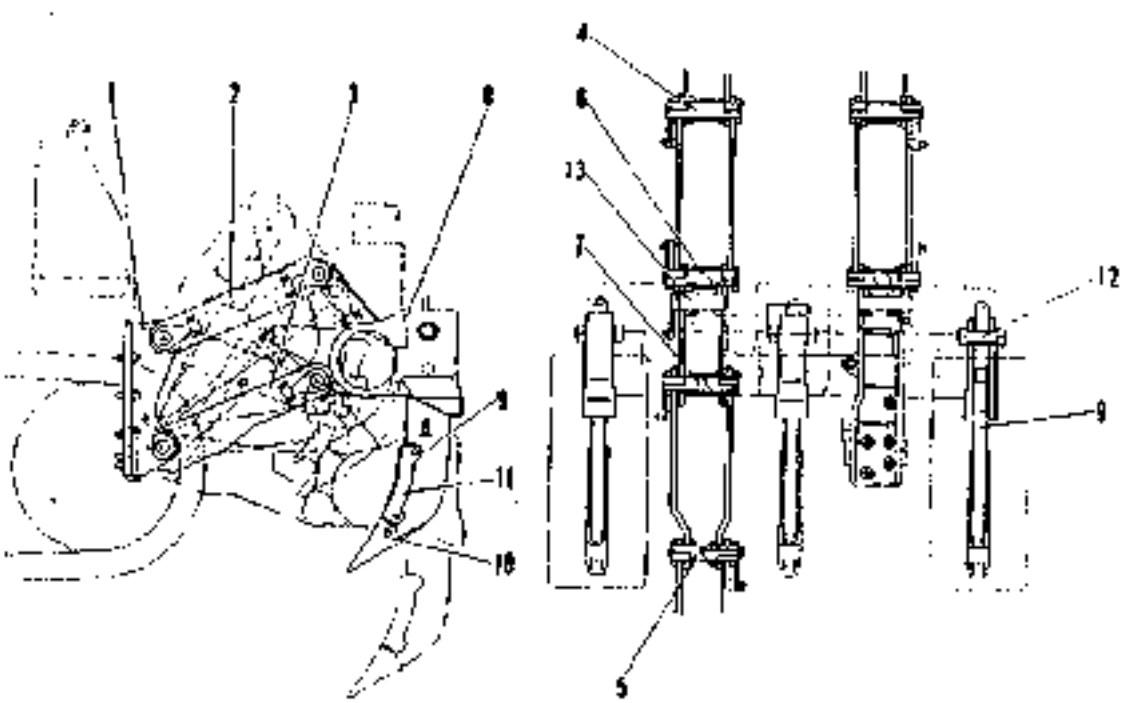


Fig. 2-84 3-shank ripper(PD200Y-1)

1. Bracket	2. Rod	3. Connecting arm	4. Pin
5. Pin	6. Pin	7. Pin	8. Beam
9. Shank	10. Tip	11. Protector	12. Pin
13. Pin			

Ripper is a quadric crank mechanism located behind the main frame. The bracket(1), rod (2), connecting arm(3) and beam(8) are mutually articulated and four articulated points are the vertexes of parallelogram. So the optimun digging angle can be assured when ripper tip digging no matter how the ripper cylinder acts.

There are two groups of holes on the beam(8), so two mounting position can be obtained. After the ripper tip(10) has been used for a long time, turn it 180° to use so as to prolong its lifetime.

The middle shank or two side shanks can be selected to dig hard soil.

The structure of single shank ripper is shown in Fig. 2-85.

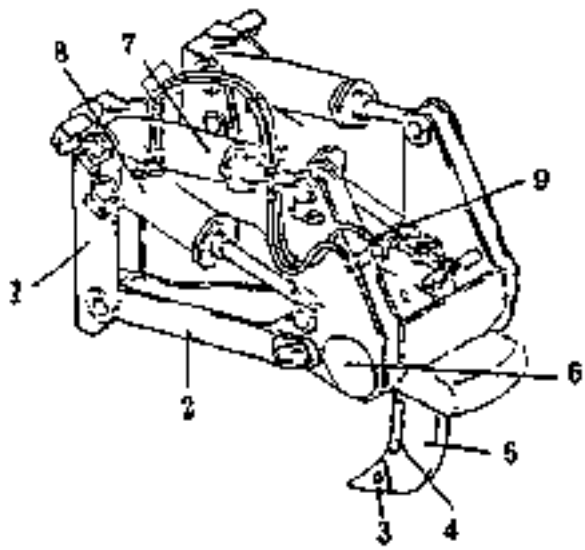


Fig. 2-85 Single shank ripper

1. Bracket	2. Connecting arm	3. Point	4. Protector
5. Shank	6. Beam	7. Tilt cylinder	8. Lift cylinder
9. Pin puller cylinder			

The working principle of single shank ripper is similar to that of 3-shank ripper, except for that the single shank ripper is equipped with a pin puller of shank which is used to adjust shank position and control digging depth.

3 Function and operation of each device

3.1 Arrangement of instruments and control devices

Fig. 3-1

1. Service hour meter
2. Oil pressure gauge
3. 3-level electronic alarm monitor
4. Safety lever for blade control
5. Lamp switch
6. Starting switch
8. Blade control lever
9. Gear shift leve
7. Ripper control lever
11. Right steering lever
12. Left steering lever
10. Fuel control lever
14. Left brake pedal
15. Right brake pedal
13. Safety lever for gear shift
17. Brake lock lever
16. Decelerator pedal

3.2 Operation of instrument and control devices

3.2.1 Fuel control lever

Push the lever forward to position Ⅰ (as shown in Fig. 3-2) which is engine low idling position. Pull the lever backward to position Ⅱ (as shown in Fig. 3-2) and the engine speeds up. The engine reaches its rated rpm(that is the engine normal operation speed when machine operating) when the lever is at position Ⅱ ,as shown in Fig. 3-2.

To stop the engine,place the lever in position Ⅰ "idling"(as shown in Fig. 3-2),then turn off the starting switch.

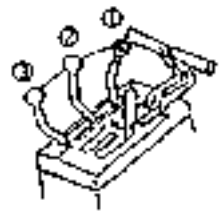


Fig. 3-2 Fuel control lever

3.2.2 Gear shift lever

Three-speed forward and three-speed reverse travels are all controlled by the gear shift lever(as shown in Fig. 3-3). This lever must be set at N position(neutral) before you start the engine. Move the lever to the required position after the engine is started.

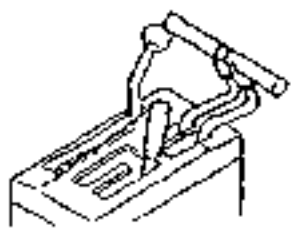


Fig 3-3 Gear shift lever

3.2.3 Safety lever for gear shift

This is the locking device for the shift lever. When park the machine be sure to set the gear shift lever at N position and lock it by this lever(as shown in Fig. 3-4).

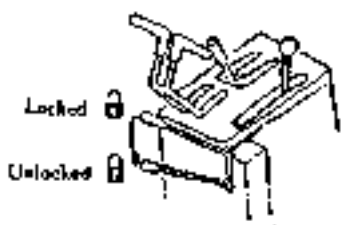


Fig. 3-4 Safety lever for gear shift

3.2.4 Left steering lever

When left steering lever is pulled backward, the left steering clutch is disengaged and the machine turns left. When the left steering lever is pulled backward further to extremity, the left steering brake is actuated and the machine will make a left pivot turn(as shown in Fig. 3-5).

3.2.5 Right steering lever

The right steering lever steers the machine to the right,the operation of which is the same as the left one(as shown in Fig. 3-5).

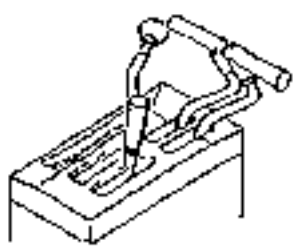


Fig. 3-5 Left and right steering lever

3.2.6 Decelerator pedal

It is as shown in Fig. 3-6. This pedal is used to decelerate engine speed and is designed to control in two stages. Normally, the pedal is used at the first stage (800 ~ 850rpm). If the pedal is further depressed, it comes to the second stage and the engine will run at low idling speed.

When arriving at the top of a slop or when dumping earth at the edge of a cliff, the machine will speed up because of sudden loss of load and thus may cause danger, at that time operator should slow down the machine by depressing the decelerator pedal.

Fig. 3-6 Decelerator pedal

3.2.7 Left, right brake pedals

To aid steering operation, depress one of the brake pedals while pulling back the steering lever as shown in Fig. 3-7.

Pull steering lever back about 90mm, then depress the brake pedal at the same side and the machine will make a pivot turn. If emergent brake is required in particular case while operating the machine on an even ground, depress immediately the joint part of both brakes to actuate both brakes simultaneously.

Do not rest your foot on the brake pedals when it is not necessary to control them.

Fig. 3-7 Left, right brake pedals

3.2.8 Blade control lever

This lever is used to control the blade. The control positions of blade control lever are shown in Fig. 3-8.

Position①: To raise the blade;

Position②: Lock (Hold). To hold the blade at a certain position;

Position③: To lower the blade;

Position④: Float. Blade can move freely up and down following the ground contour (effected by external force) and when released at this position the blade will still be kept in float.

Position A: Tilt right;

Position B: Tilt left.

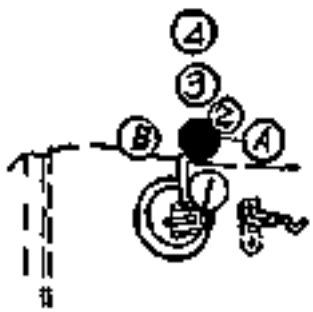


Fig. 3-8

The control lever at positions A and B enable the blade only to be at right left tilt position. Blade can be tilted at raise or lower position. Do not operate blade tilt when it is at top or bottom position.

During tilt operation the pistion rod should be returned quickly if the tilt cylineder is at its stroke end.

3.2.9 Safety lever for blade control

This lever is the lock device for blade control lever. When parking or servicing the machine, be sure to turn the safety lever in direction of the arrow, so as to lock the blade control lever (as shown in Fig. 3-9).

Fig. 3-9 Safety lever for blade control

3.2.10 Horn button

The horn is sounded while push this button.

3.2.11 Brake lock lever

This lever is a lock device for the brake pedals. When this lever is placed in lock the foot can be removed from pedals and both brakes are still in braking (as shown in 3-10).

Fig. 3-10 Brake lock lever

The operations are as follows:

Firstly depress both pedals (depress the joint part of the brake pedals), then put this lever in lock position and both brakes are locked. To release brakes, depress both brake pedals and then set this lever in free position.

When using brake lock lever for locking brakes to stop the machine, be sure to keep the engine running. If the engine is stopped, the hydraulic booster will not work and thus reduce the braking force. Warning: It is highly dangerous when parking the machine on a slope, so this locking device should be operated under engine running.

Fig. 3-11

3.2.12 Ether starting aid knob

It is the quick starting device used in cold weather. To operate, pull the knob out, then push it in, the atomized ether sprays and is sucked into the tube to facilitate the engine starting (as shown in Fig. 3-11).

3. 2. 13 Lamp switch

These switches are for the instrument lamps, front lamps and rear lamps.

3. 2. 14 Starting switch

"OFF" position is the key insertion position and at which all of the circuits are disconnected. At "ON" position, charging and lamp circuits are all connected. At "starting" position the starting motor cranks the engine. The key will return automatically to "ON" position when it is released after the engine starts (as shown in 3-12).

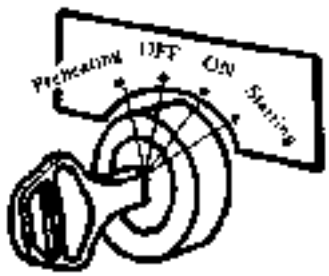


Fig. 3-12 Starting switch

3. 2. 15 Engine oil pressure gauge

When indicator is in the green range during operation, the oil pressure is normal.

When engine temperature goes down, the indicator may moves outside the green range. After warming-up running, the indicator will return to the green range (as shown in Fig. 3-13).

Fig. 3-13 Engine oil pressure gauge

3. 2. 16 Engine water temperature gauge

When indicator is in the green range during opetation, water temperature is normal. If indicator moves from green into red range, reduce the work load and run the engine at low idling speed. Do not start operation until the indicator moves back to the green range (as shown in Fig. 3-14).

Fig. 3-14 Engine water temperature gauge

3. 2. 17 Service hour meter

It indicates the working hours of the engine which is used to determine service intervals.

3. 2. 18 3-level electronic alarm monitor

3-level electronic alarm monitor is used to monitor normal operation and trouble condition of the machine. For the detail see section 8.

4 Operation

4.1 Check before starting (Fig. 4-1)

4.1.1 Check according to routine check items (refer to "Regular service").

4.1.2 Brake pedals (3) should be locked.

4.1.3 Gear shift lever (2) should be in the N (neutral) position and locked there with safety lever.

4.1.4 Blade has been lowered to ground. Blade control lever (6) has been locked with safety lever (7).

4.1.5 Move fuel control lever (1) to engine idling position.

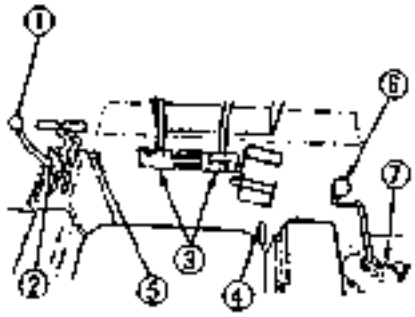


Fig. 4-1

4.2 Starting the engine (Fig. 4-2)

4.2.1 Insert the key into the starting switch and turn it to START. Then, the engine will begin to run.

4.2.2 Observe if the indicator position of the engine oil pressure gauge is normal while starting.

4.2.3 Do not leave key in START for more than 20 seconds.

4.2.4 If engine fails to start, turn the key to OFF immediately. Repeat the starting procedure after an interval of 2 minutes.

4.2.5 If it is still difficult to start the engine the possible cause is that the cut-off valve is not open. Open the cut-off valve with the manual operation knob. Turn the knob back after start-up.

4.2.6 Return the key to ON after start up (it can return automatically).

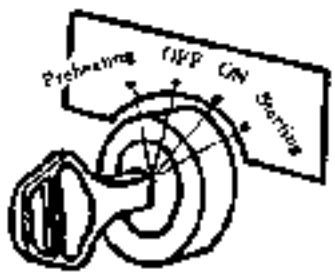


Fig. 4-2

4.3 Cut-off valve manual operation

When there is some trouble with the electric system of the cut-off valve, use the manual operation. Starting instruction is shown in Fig. 4-3. Open the cut-off valve by turning knob (1) inward and let the oil in the PT pump flow into the injector to start the engine. To stop the engine just turn back the knob.

Fig. 4-3

4.4 Running the engine

After starting the engine do not operate at once. Have a warm-up at first. The following steps should be carried out.

(1)Run engine at low idling (put the fuel control lever to engine idling position) and make sure the oil pressure gauge shows green range. Low idling can not exceed 20 minutes, otherwise, oil may leak out from the bottom of the turbocharger.

(2)Pull the fuel lever halfway to run engine at middle speed for about 5 minutes with no load.

(3)Run the engine with light load until engine water temperature gauge indicator moves to normal range.

Check after warm-up runing:

Check all gauges for proper operation; Check for normal coloration of exhaust and any abnormal noise or vibration; Check for any leakage of oil, fuel or water.

4.5 Stopping the engine

(1)Before stopping the engine, cool the engine gradully by running it at low idling speed for 5 minutes. Then stop the engine.

(2)Turn the key at starting switch to OFF and remove the key when stop the engine. If the engine is stopped abruptly before it cools down, engines lifetime would be greatly shortened. Never stop engine abruptly except in case of emergency.

4.6 Starting the machine (Fig. 4-4)

After running the engine normally, machine travel can be initiated (travel forward). The following procedures should be carried out.

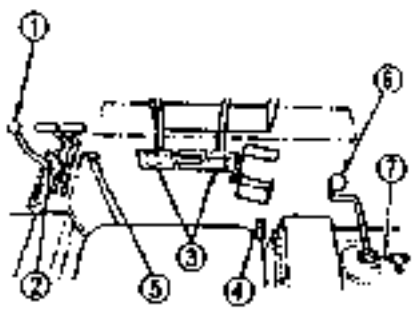


Fig. 4-4

(1)Increase engine speed by pulling the fuel control lever(1).

(2)Release the blade control lever locked by operating safety lever(7) and raise the blade 400—500mm off ground by operating the blade control lever.

(3)Depress the intersecting part of brake pedals(3), release the brake pedals(3) locked by unlocking brake lock lever(4) to make brake pedals return to normal position.

(4)Release the gear shift lever(2) locked by unlocking safety lever(5) for gear shift, then put the gear shift lever in the forward 1st position and initiate machine forward travel.

(5)To start the machine, depress the decelerator pedal and put the gear shift lever in the forward 1-st, and then increase the engine speed gradually by slowly releasing the decelerator pedal, so the machine can starr off without jerking.

(6)After starting the machine, the gear shift lever can be put to a desired position.

4.7 Forward, backward and gear shift of the machine

The gear shift lever should be put in a desired speed position. During machine travel speed can be changed. Need not to stop machine when change speed.

During forward and backward gear shift depress the decelerator pedal first until the engine speed slows down, then operate the gear shift lever to change machine travel direction.

4.8 Turning

To turn the machine to one side during travel, pull the steering lever on the same side halfway. This disengages the steering clutch (it could be felt by hand at this time) and the machine starts to turn slowly (gradual turn). See Fig. 4-5. When this steering lever is further pulled against the stop and the brake pedal on the same side is depressed, the machine will make a sharp turn (pivot turn). See Fig. 4-6.

When making a gradual left turn on a steep downgrade, pull the right steering lever halfway and the machine will make a gradual left turn (operate on the opposite side). When making a pivot left turn, pull the left steering lever against the stop and the machine will make a pivot left turn (the machine turns in the same direction).

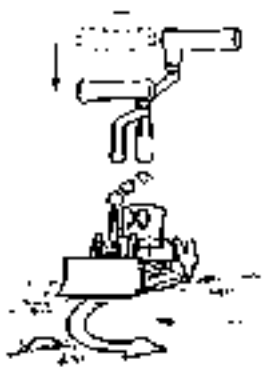


Fig. 4-6

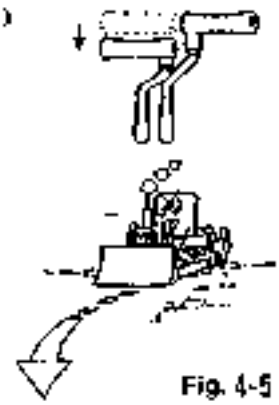


Fig. 4-5

4.9 Stopping the machine temporarily (Fig. 4-7)

When the machine is stopped temporarily there is no need to stop the engine. The following procedure should be carried out.

1. Lower engine speed by pushing fuel control lever (1).
2. Put gear shift lever (2) in N (neutral) and lock the gear shift lever with safety lever (5).
3. Lock brakes by depressing the intersecting part of both brake pedals and pushing the brake lock lever (4).
4. Operating the blade control lever (6), lower the blade to the ground and lock the blade control lever with the safety lever (7).

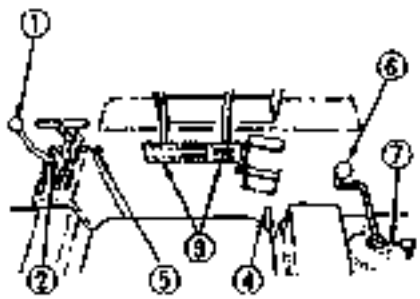


Fig. 4-7

4.10 Cold weather operation

4.10.1 Preparation for low temperature

When temperature is low, the cooling water is liable to freeze and it is difficult to start the engine. Therefore, antifreeze should be added to the cooling water. At ambient temperature below 0℃ add antifreeze according to instruction.

Before filling with antifreeze drain all cooling water, thoroughly flush the cooling system, remove scale deposit and check for leakage of oil in radiator, pump and hoses.

Antifreeze is a inflammable liquid. It must be kept away from fire when used

When there is no antifreeze, since the thermostat open temperature is 77℃ (when the water temperature is lower than 77℃, water can not flow into the radiator) remove the thermostat to prevent water in the radiator from freezing or in order to prevent the engine overcooling install cap-type side cover and radiator shutter etc and sufficient attention should be paid to heat preservation of engine interior.

During operation, often make sure the water temperature gauge pointer is in the green-range.

As ambient temperature drops the battery capacity will drop, battery charge will be reduced, so that, increase the charging rate to more than 75% and pay attention to keep warm.

The variation of charging rate with temperature is shown in chart and converted according to measured specific gravity of electrolyte.

Temperature of fluid / Charging rate	20℃	0℃	-10℃	-20℃
100%	1.28	1.29	1.30	1.31
90%	1.26	1.27	1.28	1.29
80%	1.24	1.25	1.26	1.27
75%	1.23	1.24	1.25	1.26

When distilled water is required to compensate the battery, it must be added in the morning before work instead of after the day's work so as to prevent from freezing.

4.10.2 Starting the engine

When it is difficult to start the engine in cold weather, use the ether starting device. The using method and steps ate as follows (See Fig. 4-8):

Before starting, pull the ether starting handle, 2 or 3 seconds later, turn the starting switch key to START to start the engine. Meanwhile, push the ether starting handle in and ether is ejected in to help engine start. Do not push the ether starting handle over 2 seconds. After start up, return the starting switch key to ON (it can return automatically). If the engine fails to start, repeat the starting procedure after an interval of 2 minutes. When the engine speed is reducing to stop after start-up, spray the ether. During the above operation, the engine speed can not be higher than 1000 rpm. Do not use ether ejection absolutely unless in cold weather. When engine is ejected with more than a certain amount of ether, it will explode

cold weather. When engine is ejected with more than a certain amount of ether, it will explode unnormally, so avoid using too much ether.

Cautions for using ether: Do not expose it to ignition sources; do not touch the ether while using it. If someone does touch it, flush away at once; close the valve stem on the top of the used ether drum and release inside pressure to give all the liquid ether gas off; spare ether drum should be kept in a safe place out of the machine. In mass storage, store rules should be obeyed.

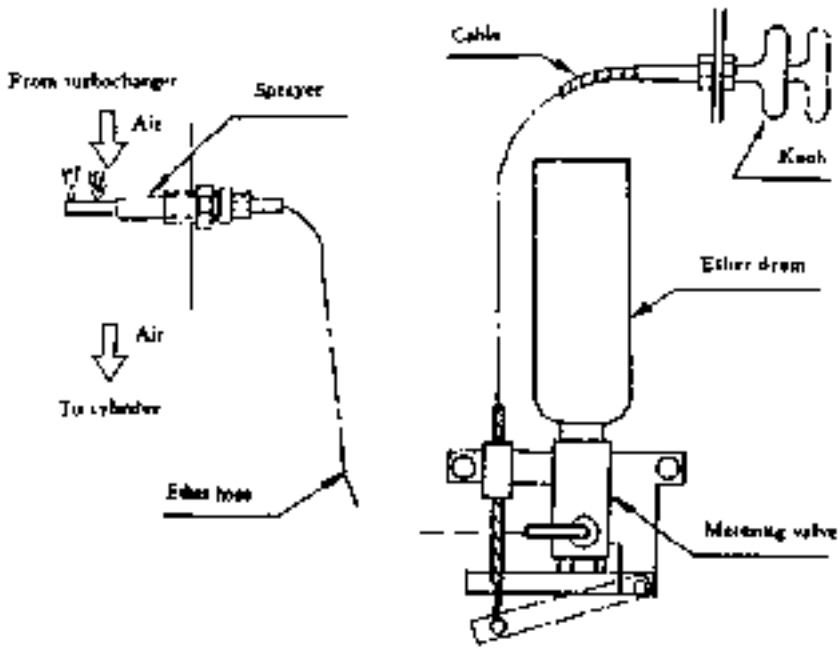


Fig. 4-8

4. 10. 3 Cautions after daily operation

(1)Mud and water on the machine body should be completely washed away. Park the machine on hard, dry concrete ground. If there is no such area, park the machine on wood boards. This will prevent the accessories from freezing or the undercarriage from freezing to the ground thereby the machine could be operated successfuly the next morning;

(2)Water on the surface of the hydraulic cylinder piston rods should be fully wiped off, otherwise mud and frozen water drops would come into seal rings and damage the seal rings;

(3)Open the drain plug and drain away water collected in fuel system to prevent its freezing during the night;

(4)If there is no antifreeze in the cooling water, open the tops(or plug) on the radiator lower tank and behind the right side of cylinders to drain water in order to prevent water from freezing during the night. Caution: If there is anticorrosive in the cooling water, do not waste water, refill it into the water tank the next morning and reuse it;

same time and put three DCA-4L anticorrosives into the anticorrosive devire;

(6)To prevent freezing, remove the anticorrosive device cartridge. It should be kept warm with waste cloth and reinstalled the next day. The tap should be closed when removing the cartridge;

(7)The battery capacity will drop remarkably at low temperature. Therefore, care should be taken to keep warm. Cover it or remove it to a warm place in room and re-install it the next day.

4.10.4 After cold weather period

(1)When temperature rises, change lubricating oil in each unit to that of recommended viscosity.

(2)Completely drain antifreeze from cooling system, fill with soft water after thorough flushing and supply new anticorrosive.

(3)Remove the ether can, store it at special dark site.

5 Maintenance and service

Make technical maintenance correctly and on time, that is, checking, cleaning, lubricating, adjusting, tightening machine etc should be carried out frequently and periodically. This can improve productivity, reduce wearing and avoid accident, that is, increase machine operating economy, prolong machine durability and reduce maintenance cost.

The maintenance interval indicated for this machine is recorded by the service hour meter.

Under severe operating conditions, it is necessary to shorten the maintenance intervals specified in this manual.

5.1 Precautions for maintenance

1. During maintenance, related stipulations of "Safety operation regulations" should be observed.
2. When carrying out maintenance under the machine, mark has to be stood on operation seat or around the machine if it is necessary.
3. When maintenance has to be carried out with the blade raised, it must be supported by blocks to prevent it from falling down.
4. When the machine is raised by blade, set control level to "Lock", support tracks by blocks to prevent machine falling down.
5. Maintenance including cleaning, filling oil, inspecting deflection of fan belt, moving part and its all nearby parts should be always carried out with the engine stopped.
6. When carring out maintenance, inspection and charging of batteries, the engine must be turned off and the battery cover removed. When remove the connection of batteries and charger, the switch of charger must be turned off.
7. During maintenance any secession of flame, including smoking and spark is severely prohibited.
8. When open the gear case be careful not to drop things in.
9. When filling or draining the oil or carring out inspection and other maintenance release the pressure first. The procedure is as follows, lower the blade to the ground and stop the engine, move the control levers to each position two or three times and then slowly loosen the oil filler cap.
10. To avoid accident during hard maintenance special adjusting tools are needed for adjusting hydraulic pressure.
11. During maintenance do not allow any unauthorized person to access.
12. Part to fill oil, oil gauge surface and containers for filling oil should be kept clean. Clean oil and grease must be used. Check or change the oil in a place free of dust, so as to prevent

any dirt from getting into the oil.

13. After oil filter maintenance, run the engine at middle speed for 5—10 minutes and let air to be out of oil circuit.

14 Fill lubricate oil with proper capacity. Don't too more and less.

5. 2 Maintenance chart

1. Table for oil to be used.

Fuel, lubrication and water should be changed according to the following table.

Reservoir	Kind of fluid	According to ambient temperature select fuel and lubrication -10 0 10 20 30	Specified Capacity (L) PD220Y-1	Specified Capacity (L) PD220YS	Changeable Capacity (L) PD220Y-1	Changeable Capacity (L) PD220YS	Substitutor
Engine Oil pan	Engine oil	SAE30 / SAE10W	47	47	27	27	11# boosted diesel engine oil
Steering case bevel gear(including torque converter)	Engine oil	SAE30 / SAE10W	122	122	90	90	8# hydraulic drive oil
Final drive case	Engine oil	SAE30	36 each side	51 each side	36 each side	51 each side	15# hyperbola gear oil
Hydraulic tank	Engine oil	SAE30 / SAE10W	110	110	70	70	8# hydraulic drive oil
Fuel tank	Diesel fuel	0# / -10# / -20#	450	450	-	-	
Cooling system	Water	Antifreeze	79	79	-	-	

Note: In the case of starting engine below 0℃, but the ambient temperature rises to 10℃ at midday, the engine oil SAE 10W must be employed. Use the CD engine oil. If CC oil is used

the oil change interval should be reduced to half.

Ⅰ. Daily service

Item \ Interval	Thorough Check
Oil and water leakage	○
Nut and bolt loosen	○
Short, cut-off circuit and poor connection	○
Coolant amount check and supply	○
Fuel amount check	○
Oil amount in engine oil pan	○
Oil amount in torque convetter, transmission, steering clutch and final drive	○
Water and sediment drainage of fuel tank	○
Electronic monitor check	○
Steering lever travel check	○
Brake pedal travel check	○

Ⅱ. Every 250 and 500 service hours

Item \ Interval		After 250 hours
Refill grease		
Fan pully shaft(1 point)		○
Tension pully shaft(1 point)		○
Arm	Straight tilt blade(1 point)	○
	Angle blade(2 points)	
Ball seat(1 point)		○
Cylinder ball joint(2 points)		○
Cylinder support(4 points)		○
Cylinder support beam(2 points)		○
Tilt cylinder ball joint(1 point)		○
Oblique arm ball joint(2 points)		○
Arm ball joint(3 points)		○

Item \ Interval	After 250 hours	After 500 hours
Check oil level and refill		
Final drive case	○	
Hydraulic tank	○	
Check and adjust alternator drive belt for tension	○	
Clean and replace torque converter, transmission, steering oil and fuel filter elements	○	
Check and retighten track shoe bolt	○	
Check battery electrolyte level	○	
Clean breather		
Clean final drive case breather		○
Clean steering case breather		○
Check ether starting equipment		○

N. Every 1000 service hours

Item \ Interval	After 1000 hours
Refill grease	
Diagonal brace (2 points)	○
Universal joint (2 points)	○
Torque converter main shaft (1 point)	○
Idler adjusting lever (2 points)	○
Check and clean radiator	○
Replace oil in torque converter, transmission case and steering clutch case	○
Clean oil filter elements of torque converter and hydraulic tank	○
Change oil in hydraulic tank and replace oil filter element	○
Change oil in final drive case	○
Check and refill oil in undercarriage components	○

V. Every 2000 hours service

Item \ Interval	After 2000 hours
Refill grease	
Equalizer bar shaft(1 point)	○
Decelerator pedal shaft(2 points)	○
Gear shift lever shaft(3 points)	○
Brake pedal link system shaft(6 points)	○
Fuel control lever link system shaft(3 points)	○
Blade control lever link system shaft(7 points)	○

VI. When required

Change coolant	Twice a year(spring and autumn)or after 1000 service hours
Check,clean and replace air filter	When required
Check and adjust track tension	When required

5.3 Detail description for service

5.3.1 Everyday service

1. Check oil and water leakage

After starting the machine,check whether there are trails of oil and water leakage,especially at the positions of high pressure hose joint,cylinders,floating seals and radiator. If so, analyze the causes and repair it in no time.

2. Check all bolts and nuts of different parts for connection tightness. Retighten any loose especially at the position of air filter,muffler,track rollers and track shoes.

3. Check electrical system and all circuits.

4. Check and supply coolant water capacity. Open the cap shown in figure 5-1. If there is no water on the bottom of filler,supply water to the level shown in the figure. Stop the engine when refill water. After refill run the engine at low idle for about 5 minutes. Then check the water level again if it is not as figure 5-1 shown,supply water again.

Fig. 5-1

If water refill capacity is much more than normal check cooling system for any water

leakage.

Don't open the cap quickly at high water temperature so as to prevent hot water spurting out. The cap should be opened slowly to let water pressure drop before.

5. Check fuel

As shown in Fig. 5-2

Fig. 5-2

Open the cap after operation, check oil level by using oil level gauge G. Fill fuel through the filler F until the fuel tank is full. If the cap is close while the breather is clogged, the fuel in the tank will stop supply. Therefore, the breather should be often checked and cleaned.

6. Check oil level in engine oil pan

As shown in Fig. 5-3, check oil level by using oil level gauge G. If not enough, refill oil through the filler F.

Fig. 5-3

When check oil level with engine stopped, use oil level gauge with the side engraved "ENGINE STOPPED". When check oil level with engine idling, engine pressure gauge pointer and water temperature gauge pointer should stay within green range at first, then check oil level by using oil level gauge with side engraved "ENGINE IDLING".

7. Check oil level of steering case

This checking includes oil level checking of transmission and torque converter. First remove hand rail at right side as shown in Fig. 5-4, check the level by oil level gauge G. If there is no enough oil, supply oil through the oil filler F.

Fig. 5-4

8. Drain water and sediment in fuel tank

Loosen the tap on the bottom of fuel tank. Drain sediment and water out of the fuel tank. During draining oil flows out with.

9. Check electronic monitor (See "8 Electrical System").

10. Check brake pedal travel

The specified brake pedal travel of PD220Y-1 and PD220YS is 120~140mm at engine low idling. If not so adjust according to "PARTS ADJUSTMENT".

11. Check steering lever travel

When engine turns at "ENGINE IDLING", if the steering lever travel is not within specified range at engine low idling adjust according to "PARTS ADJUSTMENT".

When the lever travels from 0~55±5mm, the steering clutch is released. When the lever travels from 55±5~124±5mm, the brake acts.

5.3.2 Every 250 service hours

This service includes first 250 hours service and daily service.

1. Refill grease

Grease should be refilled into the arrowed position in the following Fig. 5-5.

Fig. 5-5

1—Fan shaft(1 point)　2—Belt tension pulley(1 point)
3—Brace screw(1 point)　4—Ball joint(1 point)
5—Cylinder ball joint(2 points)　6—Cylinder support yoke(4 points)
7—Cylinder support beam(2 points)　8—Tilt cylinder ball joint(1 point)
9—Oblique arm ball joint(2 points)　10—Arm ball joint(3 points)

2. Check oil level

(1)Final drive case

As shown in Fig. 5-6. Chick by opening the oil plug G. If the oil level is below the plug bottom,supply oil through the plug-hole.

Fig. 5-6

(2)Check hydraulic oil tank

First lower the blade,then stop the engine for 5 minutes and check the oil indicator G in Fig. 5-7. If the oil level is not between two lines on the indicator,supply oil through the filler F. This check should be carried out before operation.

Fig. 5-7

3. Check of alternator drive belt tension

The proper tension is shown in Fig. 5-8. A dip is approximately 10mm when the belt is depressed by a finger(approximately 60N). Adjust if more than it. Loose bolt(1) and nut(2), remove the alternator to obtain the proper tension.

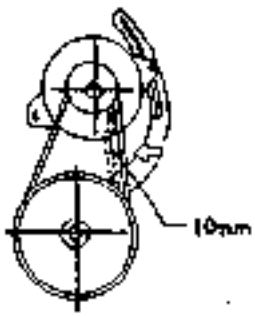


Fig 5-8

When the belts are worn out and strained or lost their amount of tension adjustment, and have break or chap, they must be replaced together. When the belts are replaced, readjust their tension after running-in for an hour.

4. Clean and replace of oil filter element

Transmission and steering clutch oil filter elements should be cleaned and replaced as shown in Fig. 5-9. Remove bolt(2), pull up cover(1) and take out element. Then clean the inside of the case and parts. Change new parts if it is necessary. After changing prats start the engine and loosen air bleeding plug(3). Tighten the plug when oil spurts out.

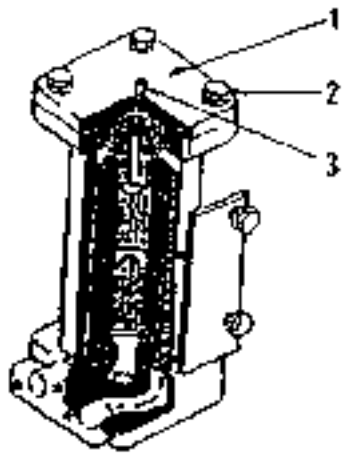


Fig. 5-9

5. Check electrolyte level in battery

As shown in Fig. 5-10, if the electrolyte level is lower than the prescribed level(10 to 12mm above the pole plate), refill with dilute sulfuric acid of the same concentration. When refill with dilute sulfuric acid the metal funnel can not be used. When check electrolyte level, clean the breather of the battery cap.

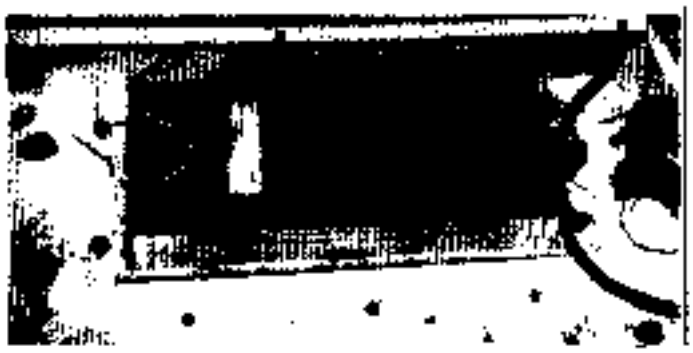


Fig. 5-10

6. Check of track shoe bolt

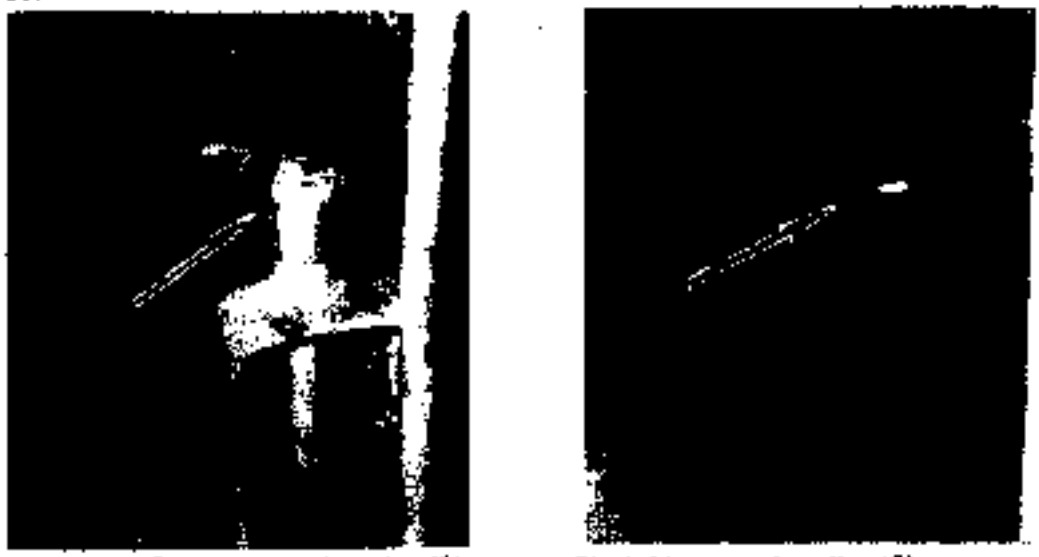
The bolts should be retightened when find loose. The tightening torque is 980~1176N. m.

5-3-3 Every 500 service hours

The maintenance for every 250 hours should be carried out at the same time.

1. Clean of the breather

Remove the breather and wash away dust inside with clean diesel fuel as shown in Fig. 5-11.



Steering case breather(1) Final drive case breather(2)

Fig. 5-11

2. Check of the ether starting device(if any)

As shown in Fig. 5-12.

Fig. 5-12

(1)Remove check valve of ether cartridge and control cable. When remove the ether cartridge, clean the valve to prevent dust entering valve. If the bracket of valve damaged, it must be changed. After removing the ether cartridge, the control cable should move freely.

(2)When the ether cartridge is changed, the checking method is as above.

(3)Inspect the fuel leakage of joint. Installing bolts must be tightened.

(4)Test according to the following steps,

a. Take down the nylon tube from the spray.

b. Take down the spray.

c. Connect the spray to the tube.

d. Place the control cable in running position. After two seconds check the spraying condition of each spray hole. Then place in "OFF" posotion.

5-3.4 Every 1000 service hours

Maintenance for every 250 and 500 hours should be also carried out at the same time.

1. Refill grease

Grease each point indicated by arrows, as shown in Fig. 5-13.

Fig. 5-13

1. Universal joint (2 points) 2. Idler adjusting rod (2 points)
3. Diagonal adjusting rod (2 points)

2. Check of radiator

Mud, dust or leaves blocking the radiator fins should be blown off by compressed air. Water may also be used. Check the rubber hose on this occasion and replace hose that is cracked or aged. And inspect loosened hose clamps at the same time.

3. Replace oil of steering case including transmission, torque converter and bevel gear case and clean oil filter as shown in Fig. 5-14.

(1) Remove drain plug P1 and P2 on the bottom of machine body. After draining oil tighten the plugs.

(2) Remove the left side floor plate. Remove the bolt(1) and the cover(2) and take out the filter strainer(3) and magnet(4).

(3) Remove the bolt(5), do the cover(6) and the torque converter filter together.

(4) Thoroughly clean the parts and strainers removed from the case interior and install to the original positions. If any damage to the strainer and magnet is found, replace them in time.

(5) After replacing the parts of filter, refill the specified quantity of engine oil into the oil filler F (See every 250 hours service).

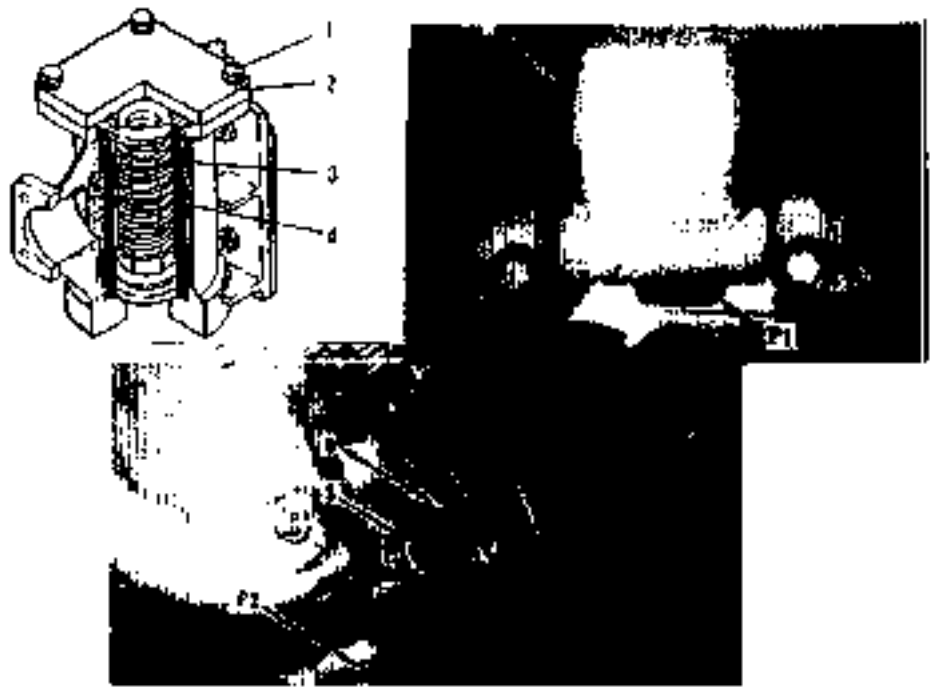


Fig. 5-14

4. Replacement of hydraulic tank oil and cleaning of filter are shown in Fig. 5-15.

(1)Remove the drain plug(1) on the hydraulic tank bottom and loosen the drain valve(2) to drain oil. After draining tighten the drain valve(2).

(2)Remove the tank rear bolt(3),do the cover(4) and take out the element of filter from the tank.

(3)Clean the filter case interior and its parts. If any damage to them,replace them by new parts in time. Then install them to the original position.

(4)After replacing the parts refill the specified quantity of engine oil into the oil filler F.

Fig. 5-15

5. Replacement of the oil of final drive case is shown in Fig. 5-16.

Fig. 5-16

(1)Drain the oil through the opened drain plugs on the each side of the machine body. After draining tighten the drain plugs.

(2)Refill the specified quantity of engine oil through filler F.

6. Replacement of the oil of undercarriage

Stop the machine on a flat ground and check the oil level of track rollers, carrier rollers and idlers according to the following procedure, as shown in Fig. 5-17.

Fig. 5-17

(1)Gradually loosen the seal bolts of each roller. When it is found that oil is oozing through screws, it is the proof that new oil refill is not required. So, retighten the bolt immediately.

(2)When no oil ooses out by loosening and even removing the bolt, it is the proof that oil is lacking and refill new oil at once.

5.3.5 Every 2000 service hours

Maintenance for every 250, 500 and 1000 hours should be also carried out at the same time.

Refill grease. Grease each point indicated by arrows shown in Fig. 5-18.

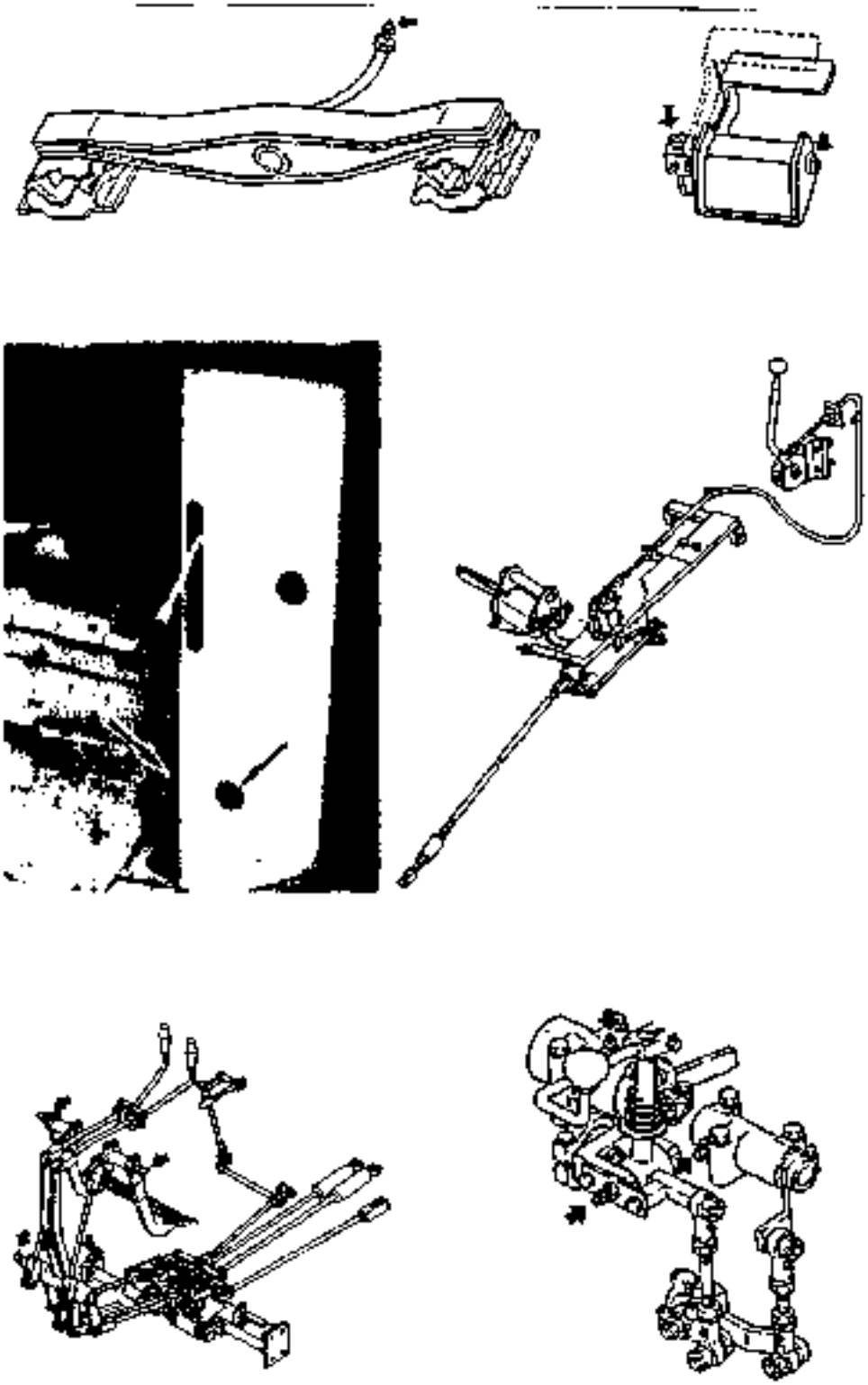


Fig. 5-18

1. Equalizer bar shaft(1 point)　　2. Decelerator pedal shaft(2 points)
3. Gear shift lever shaft(3 points)　　4. Fuel control lever shaft(3 points)
5. Brake pedal linkage shaft(6 points)　　6. Control lever linkage shaft of blade(3 points)

5.3.6 When required

1. Changing coolant

Change coolant twice a year in spring and autum if antifreeze is soluted in it. In case antifreeze solution is not used, change every 1000 hours.

The procedure is as follows.

(1)Park the machine on flat ground, stop engine, tighten corrosion resistor breather and turn loose the radiator cap slowly to relieve water pressure. Pay particular attention to prevent hands from being scalded by hot steam;

(2)Drain coolant completely by opening three drain valves(radiator, cylinder block and oil cooler);

(3)After drainage use detergent for cleaning. For cleaning see the instruction on trade mark;

(4)After cleaning drain all water, close all drain valves and refill clean water up to the required position through water feed port;

(5)Open drain valves while keeping engine at low idling. Keep refilling water until clean water runs out from drain valves, then close drain valves;

(6)Refill water at the full according to requirement up to overflow pipe level through water feed port;

(7)Change the anticorrosive in corrosion resistor breather;

(8)In order to remove air mixing in cooling water, run the engine for five minutes at low idling, then another five minutes at no load high idling;

(9)Stop the engine for three minutes, then refill water up at the full according to the requirement mentioned in "Daily service" through water feed port according to the requirement mentioned on "Every day service" and close the cap tightly.

2. Checking, cleaning or replacing air cleaner

Whenever the air cleaner is warning, clean the air cleaner immediately. Stop the engine at the same time.

(1)As shown in Fig. 5-18 remove cover(1) and outer element(2).

Fig. 5-19

(2)Clean the interior of the air cleaner body and cover.

(3)Clean the outer element(2).

The cleaning methods are as follows:

a. Cleaning with compressed air, that is, direct dry compressed air(more than 0.69MPa) to element inside surface along its folds, then direct air to outside surface along its folds and again to inside surface so as to keep the inside and outside surfaces away from dust;

b. Cleaning with water, that is, dash with city water(less than 0.29MPa) on element inside surface along folds, then on outside surface along folds and again on inside surface check element after dried;

c. For heavy contaminative element the proredure is as follows:

Mix 300g of detergent into 200L of water;

Soak the element in above solution for 15 minutes;

Rinse the element in flowing clean water;

Blow dry by an electric fan(Never attempt to heat it dry), check the element after drying;

d. Rinsing with warm water(about 40℃) would be more effective.

(4)If any damage as small hole is found on element when checked with lamp light after cleaning and drying, replace with a new one.

(5)The outer element which has been cleaned 6 times or has been used for one year should be replaced with a new, it is not allowed to use it continuously. If the air cleaner is still warning when used after cleaning, though the outer element cleaned less than 6 times, replace with a new one at once

(6)When do the outer element, replace the inner element at the same time.

3. Inspection of undercarriage

(1)Inspection of track tension

Park the machine on a flat ground and put a straight rule between the carrier roller and the idler as shown in Fig. 5-20. When the maximum distance between the rule and the shoe

grouser is 29~30mm, the tension is the standard one.

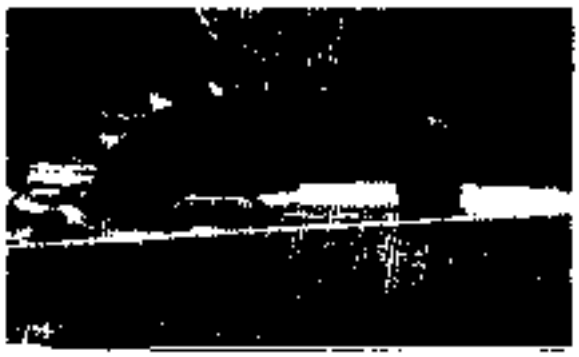


Fig. 5-20

(2)Check the idler guide plate for clearance. If it increases too more, idler may develop side motion and will deviate center of the idler from track. The clearance A less than 4mm is the standard one as shown in Fig. 5-21.

Fig. 5-21

(3)Measuring the link pitch

Insert a wooden block between link and sprocker to take up the slack in track as shown in Fig. 5-22. Take the pin upon the wooden block as a datum. Measure length L of 4 link pitches in straight portion at more than 2 links away from that pin. ¼ L is the link pitch (the master pin may be taken as a datum).

Basic link pitch; 216mm

Reverse link pitch;

Impact 219.25mm

Normal 221.25mm

Fig. 5-22

Note: Basic link pitch should be measured after machine forward travel and stop and reverse link pitch should be measured after backward travel and stop.

(4)Measuring of grouser height

After taking up slack in track measure grouser height A at the center of shoe as shown in Fig. 5-23

Standard height : 72mm

Usable limit : 25mm

Fig. 5-23

(5)Measuring outside diameter of track roller

a. Measure height C between upper and lower surfaces of link as shown in Fig. 5-24.

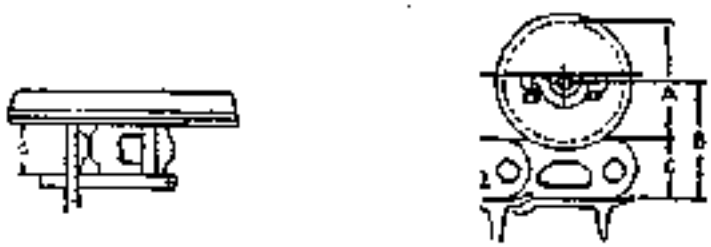


Fig. 5-24

b. Stop machine at position where link tread contacts track roller tread completely. Then measure size B as shown. Outside diameter A of track roller is as follows;

$A = (B - C) \times 2$

Standard size: 222mm

Usable limit: 198mm

(6)Check rollers of all kinds for any oil leakage, connection tightness of bolts and nuts. Repair at once if any problem found.

5.4 Wearing parts such as

As to wearing parts, such as filter parts and blade cutting edge etc, replace parts during the required service or at the wear limit.

List of wearing parts of PD220Y-1 and PD220YS

Item	Number		Description	Quantity	Replace interval
	PD220Y-1	PD220YS			
Steering, transmission oil filter element	49-83 (07000-02115)		Element (O-ring seal)	2 2	Every 250 hours
Hydraulic tank filter	V305-5 (07000-05150)		Element (O-ring seal)	1 1	Every 1000 hours
Air cleaner	00-14		Element assembly	1	—
Blade	T21.71-20(PD220Y-1) T21.71-19(PD220Y-1) T21.71-20(PD220YS)		Cutting edge	1 2 3	
	T21.71-17 T21.71-18 JB2648.2 GB6170 01643-21845		End bit, L.H. End bit, R.H. Bolt Nut Washer	1 1 32 32 32	

Note: Replace parts within( ) at the same time.

5.5 Adjustment

5.5.1 Adjustment of track tension

As shown in Fig. 5-25.

Fig. 5-25

For increasing the track tension refill grease through grease fitting(1). The limit of adjusting distance is S. When S is adjusted to 0 mm, but the track is yet loose, it indicates that the pin and bushing are worn to the limit. It is necessary to change installing position of all the pins and bushings. The method is as follows, Taking the original installing position as a datum, turn the same angle to counter side(change original installing position), then reassembly or replace a new track.

In order to relax the track tension, extract grease by reversely rotating the plug(2) for one turn. Do not loosen the plug(2) over one complete turn. Also, be careful not to loose any part other than the plug(2), so as to prevent the high-pressurized grease ejecting out and incident happening. If the grease does not ooze smoothly, try to move the machine back and forth for a short distance, as shown in Fig. 5-26.

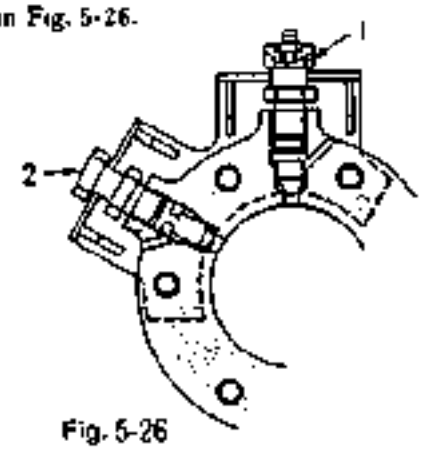


Fig. 5-26

5. 5. 2 Adjustment of clearance of idler. As shown in Fig. 5-27.

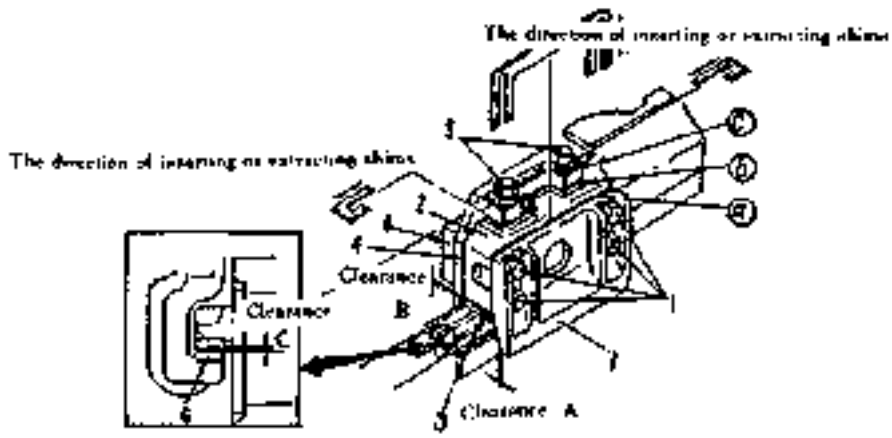


Fig. 5-27

Since the spports(2) can be moved forward and backward along guide plates(3) on the track roller frame when the idlers are under external force, the side guides(9) and guide plates(3) would be worn out gradually. It will cause the movement of idlers from side to side or inclination of the idlers and run out of track links from the idlers to cause premature wear because the flange of track rollers and carrier rollers and the sprocket side interfer tracks.

Therefore each clearance must be adjusted.

1 Adjustment of side clearance

Run the machine 1 or 2 meters on flat ground. If the clearance "A" between the track frame and side guide(9) (there are 4 places: left, right, internal and external) exceeds 4mm, loose the bolts(1), remove shim C to adjust the side clearance to 0.5 1.0mm. The thickness of a shim is 1.0mm as shown in Fig. 5-28.

Fig. 5 28

Note: When loosening the bolts(1), be careful not to turn them more than 3 turns. Otherwise, seat(8) would fall down out of place, causing the troublesome reassembly of it.

2. Adjustment of up-and-down clearance

Measure the clearance B between support(2) and guide plate(3) and the clearance C between the up-and-down guide and track roller frame wearing plate. If the sum of two clearances B and C exceeds 5mm, it must be adjusted. The procedure is as follows:

Reduce it to 2mm by extracting the necessary shims from(c) and adding to the(b). Adjust the clearances (B+C) within 2mm. Clearance C=0 in normal state. This adjustment should be performed according to the following procedure:

1. Measure the clearance B after wearing, then subtract 2mm(normal clearance) from value B. The result corresponds to the adjusting value δ, that is, δ=B−2(mm);
2. Loosen the bolts(5) until no spring force is felt;
3. Loosen the bolts(1) (not more than 3 turns);
4. Raise the up-and-down guide(4) with a bar or bolt(6) in order that the clearance C=0mm. Extract the necessary shims from(c), the thickness of which should be equal to adjusting value δ determined by step 1.
5. Insert the removed shims(thickness δ) from(c) into (b)(8 positions, inside and outside for each left and right side). The total thickness of shims obtained as the sum of shim thicknesses at (c) and (b) should not be varied before and after the adjustment.

Both the shims are composed of two kinds of shims, 1mm thick and 2mm thick. Reduction or addition of the total number of shims would influence the performance of internal

spring, so the total number of shims should not be increased or decreased;

6. Tighten the compressing bolts(5);

7. Tighten the bolts(1) to a specified tightening torque. Tightening torque is 500N. m to 620N. m;

8. Install the cover(7) as before disassembly.

The maximum value δ of adjustment of 6mm is allowed for the up-and-down clearance.

5.5.3 Adjustment of decelerator pedal travel

It is shown in Fig. 5-29.

If the engine speed is not within the range of 800～900 r/m by setting the fuel control lever to 1/2 stroke and depressing the decelerator pedal(clearance A=0), adjust according to the following process.

1. Loosen the lock nut(1) and adjust the adjusting screw(2) until the engine speed will be 800～900r/m(clearance A=0).

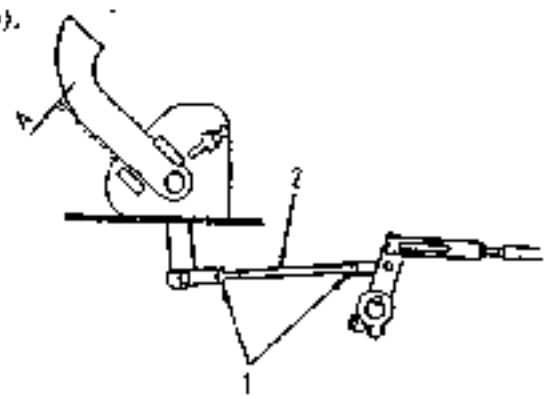


Fig. 5-29

2. Tighten the lock nut(1) after completing the adjustment.

Tachometer is required for setting the engine speed precisely.

5.5.4 Adjustment of brake pedal travel

The brake is of the outside band-type. Wear of the lining will cause the travels of the steering control lever and the brake pedal to increase, thus making the brake action would be weakened. It must be adjusted.

The adjusting procedure is as follows:

It is shown in Fig. 5-30.

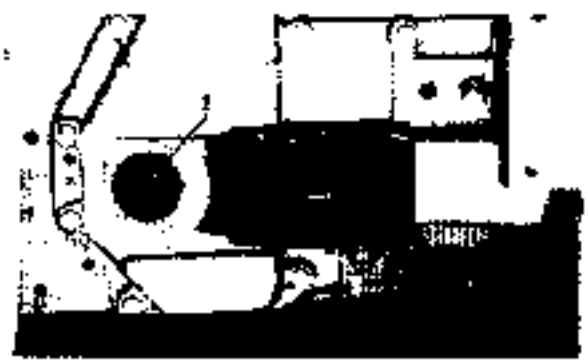


Fig. 5-30

1. Remove the rear cover, then do the brake inspection cover(1);

2. Turn the adjusting bolt(2) which strains the brake band until a sudden risistance is felt and the brake lining will come into contact with the brake drum as shown in Fig. 5-31.

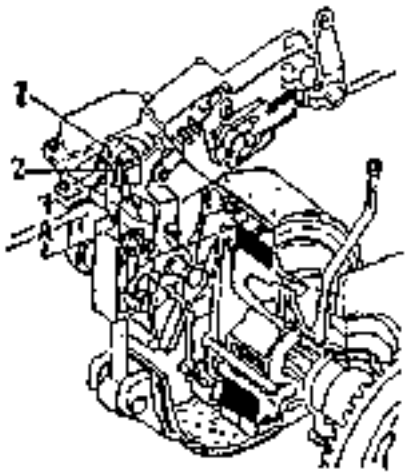


Fig. 5-31

3. Turn back the adjusting bolts(2) about 7/6 turns.

4. With the engine running at a low-idling speed, check the brake pedal travel.

The standard travel of PD220Y-1 and PD220YS is 120~140mm.

5. If the measurement does not enter the above standard range, the adjusting bolt(2) should be adjusted once more. Turn the bolt(2) clockwise to decrease pedal travel and counterclockwise to increase pedal travel.

6. If the dimension A of the adjusting bolt(2), as shown in Fig., is less than 105mm, replace the brake band lining.

7. Adjust the brake pedal to minimize the difference in travel between the right and left pedals. Difference in height position between them must be within 5mm.

5-5-5 Adjustment of steering control lever in travel

Adjustment of steering control lever in travel of PD220Y-1 and PD220YS is shown in Fig. 5-32. The lever(1) should be positioned about 78mm from the guide side and come into contact with the plate(2). When the lever(1) is pushed forward to the machine body and slighdy comes into contact with the plunger, adjust the length of flexible shaft(3) to assure no backlash at lever(1) and make sure that travel of steering control lever is 124±1.0mm.

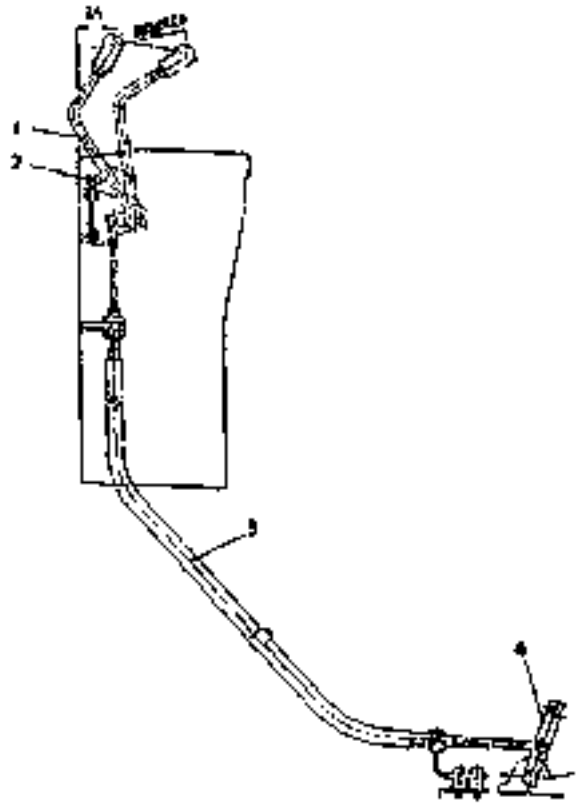


Fig. 5-32

5. 5. 6 Adjustment of operator's seat

In order to make seat convenient for operator its height and angle can be adjusted at will.

It is shown in Fig. 5-33.

Fig. 5-33

1. Forward and backward adjustment of the seat.

Set the seat to the desired position by moving the lever(4) to left, then release the lever

(4).

The seat can be adjusted forward or backward in 140mm(in 7 steps).

2. Height adjustment

To lower seat, turn knob(3) clockwise; to raise, do knob(3) counterclockwise. The adjusting value of height is 50mm.

3. Back cushion adjustment

Set seat in desired position by pulling lever(5) upward, then release it.

4. Seat adjustment according to operator's weight.

Set weight indicator dial to your weight by moving handle(2) up and down. With this operation, the seat will be properly adjusted to your weight.

6. Adjustment of seat direction

The seat can be turned to the right 15° by pulling lever (3) upward. After adjustement of seat direction the handle should be released and locked seriously.

5.5.7 Tilt adjustment of blade

The maximum adjustable tilt 500mm of blade can be obtained by operating control lever. To increase further tilt the length of left brace(1) at joint part between blade and frame must be changed. After adjustment the maximum left and right tilt of PD220Y 1 and PD220YS is 530mm.

The adjusting method is shown in Fig. 5-34.

Fig. 5-34

The brace(1) can be turned by the adjusting rod(2). If the distance L between joints is lengthened, the left tilt is decreased and the righet tilt is increased. If the distance L between joints is shortened, the left tilt is increased and the right tilt is decreased.

Note: During the above-mentioned adjustment the blade must be above the ground.

5.5.8 Spherical joint compensation adjustment

There are seven spherical joints on the blade. They must be compensation-adjusted to assure that the longitudinal clearance is within 1mm(arrowed direction as shown in Fig. 5-35).

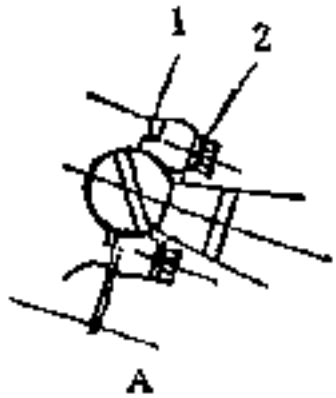


Fig. 5-35

The adjustment method is as follows:

(1)Slacken the nut. Take off the shim(1), then tighten bolt(2) to make spherical joint have no clearance;

(2)Measure clearance A, then slaken bolt(2);

(3)The thickness of shim(1) must be adjusted so that the longitudinal backlash is within 1mm;

(4)After adjustment the all bolts must be tighted. The tightness of bolts must assure that the spherical joint can be turned smoothly.

6 Safety operation rules and safety operation techniques

6.1 Safety operation rules

In order to guarantee the accomplishment of tasks in quality and in quantity as well as safely, the operator, in addition to the understanding of machine construction and operation methods, should also learn machine performances and safety rules.

Injuries and accidents are liable to occur when the operator is careless or slack. It is most important to bear safety operation in mind at all time.

I General safety rules

1. The operator who will drive the machine independently must be trained and have a better knowledge of the machine performances, construction, maintenance, operation method and safety rules, and proved to be qualified.

2. Unqualified operator is forbidden to drive the machine. The learner is not allowed to operate the machine unless he is coached by an experienced operator.

3. Correctly wear saffety clothes and shoes.

4. An operator who is tired out or has drunk wine is forbidden to drive.

5. Follow the rules in the work site to avoid accidents.

6. Fuel oil, anti-freezer and battery are dangerous materials. Do not use them near fire.

7. When operating inside a building, always be sure of the clearance between ceiling, entrances, aisles and the machine, the sufficient load limit of the floor. To run the engine for a long period of time in a poorly ventilated area, set ventilation system against exhaust gas poisoning.

II Before operation

1. Examine the lay of the land and the kind of soil and dangerous spots at the work site to determine the best method of operation. Proceed with the work only after making safety arrangements about the dangerous spots or marking them. When working on dangerous spots, such as cliff etc pay attention to collapse. When operating on dangerous site where rocks may be fallen, you must wear safety helmet, moreover the safety canopy and plate rubber should be used.

2. When there is a leader, determine the specified signals and follow them in operation. Before operating the machine, discern the marks on work site.

3. Learn beforehand the location of fire extinguishers and first-aid boxes and their way of application so that they might be used in accident without delay.

4. Inspect if there are leakages from the fuel, lubricating and hydraulic system or any damages in seal parts. Machine having such failure should not be operated unless repaired.

5. Check the level of fuel and lubricants. Extinguish burning cigarettes when check and re-

fill. Keep away from fire during operation. Check that each oil filler caps or plugs are firmly tightened.

6. Remove fallen leaves, paper or other inflammable materials around the engine against fire.

7. Adjust the operator's seat until it is in the most comfortable position for operation.

8. Before starting the engine check if all control levers are in "Neutral".

9. After starting the engine and before operation confirm the following:

The gauge readings are within the prescribed range.

Check the travels of each lever and pedal and the all levers movement (leave the control lever of transmission at "Neutral" while checking).

Test the machine at a safety place, check the operation of gear shift lever, drive the machine from low speed and check the steering and brake devices at each gear stage.

Carefully examine the colour of exhaust gas and observe if there is any unusual vibration or noises of the machine.

■ During operation

1. Always sit in the seat while operating. Do not operate the machine while away from the seat or standing.

2. When operating, keep the blade 400~500mm above the ground to obtain good visibility in front of the machine.

3. The machine should always be operated correctly and run at normal conditions. Never do the following:

- Overspeed
- Sudden starting and sudden braking, sudden turning
- Snaking
- Long time idling

4. Pay attention to pedestrians and obstacles and keep a distance from other vehicles.

5. Changes in the gauges, sound, vibration, exhaust gas colour or response of various control levers can indicate its occurrence of disorders. If any disorders occur repair it in time.

6. If the machine breaks down and needs to be towed, it should be operated by operator to control the brake unit. Use a proper rope for towing, as shown in Fig. 6-1.

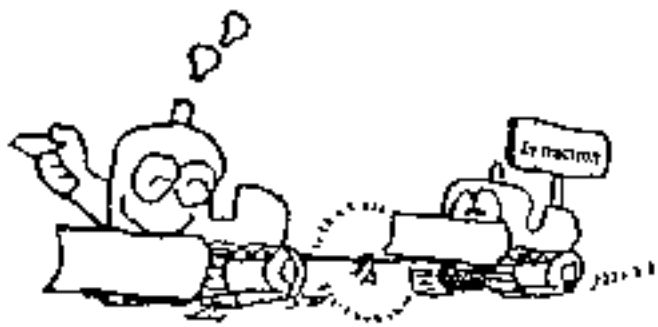


Fig. 6-1

7. Do not allow unauthorized persons into the work site.

N After operation

1. When parking the machine after operation put the gear shift lever to "NEUTRAL" and lower the blade and ripper to the ground. Set all safety levers to the "Lock" and switch the engine off before leaving the cab.

2. The machine should be parked in a specified safety place.

3. If the machine has to be parked on a slope, rocks should be placed in front of tracks, as shown in Fig. 6-2.

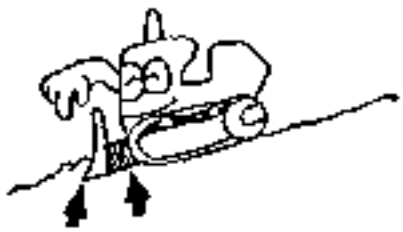


Fig. 6-2

6.2 Safety operation techniques

The machine should be operated systematically. Rash and hasty operation should be avoided, grasp safety operation techniques and focus attention when driving. Under these conditions, the machine can be operated safely and mechanical damages and serious injury accidents can be avoided.

I General operation

1. When operating on uneven ground, drive the machine at a low speed as possible and avoid sudden changes in speed, especially turns at high speed.

2. It is not allowed to drive over large rocks, fallen tree trunks and other obstacles. Use the working equipment to remove them first. In case it is impossible to avoid travelling over them, reduce speed and mount over the obstacle, reducing the vibration to protect the machine.

Fig. 6-3

3. When operating in water, first check the depth and flow speed of water and bed soil condition, taking care not to operate in water beyond the limits. Before operating in water and muddy area securely tighten each drain plug. After completion of work remove mud from machine exteriors and check engine oil pan, torque converter case, steering case, final drive case, hydraulic system and undercarriage etc for oil level, oil leakage and water mixed into oil. Drain water to check the oil tank, if necessary.

Note: Do not operate the machine in such a water depth that the carrier rollers and the cooling fan come into contact with the water.

4. When passing through narrow space be careful of the side and overhead clearances. A leader should be arranged if necessary.

5. When operating at night be sure to arrange adequate lightening systems. Use the headlight and operating lights of machine when it is difficult to arrange lightening equipments, as shown in Fig. 6-4.

Fig. 6-4

6. When working in fog or smoke and bad visibility, pay special attention in operation. Stop the work when visibility affects safety operation.

7. Try, as possible, to remove the power transmission line when carrying out operation nearby it. Set obstacles around the power liges and apply isolation protective devices on the lines if it is impossible to remove. Operator should wear rubber or leather shoes lest there happens an electric shock.

Following is a table specifying the minimum distance between the machine and power line according to the voltage of the transmission line to avoid an electric shock.

Transmission voltage(KV) (No. of isolators)	Min distance(m)
6.6(power transmission line)	3
33.0(1~3 isolators)	4
66.0(5~8 isolators)	5
154.0(10~18 isolators)	8
275.0(16~30 isolators)	10

8. Before passing a bridge, check the load limit of the bridge and run at low speed after safety confirmation.

ty confirmation.

9. When passing across the railway, approach at a right angle, move the machine slowly and it is forbidden to turn the machine on the railway.

■ Operating at a cliff and road shoulder.

Be careful not to approach the edge of the cliff or road shoulder when operating on dangerous spot. When traveling after track trace left last time, reverse the machine if the ground sinks a little and take another investigation of the ground, as shown in Fig. 6-5

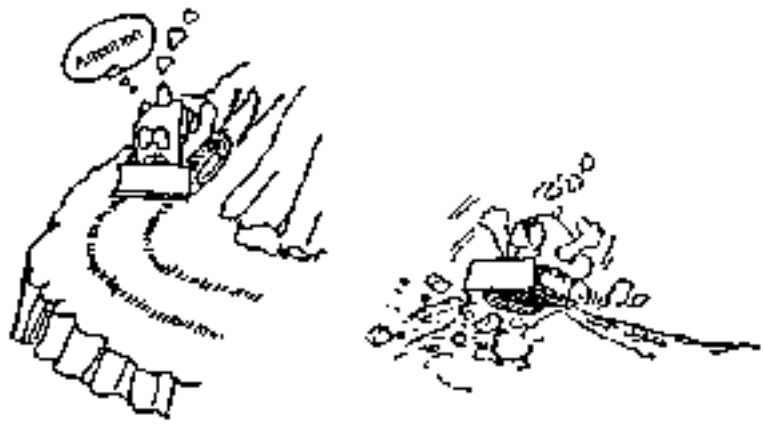


Fig. 6-5

■ Operating on slopes

1. When driving on a slope, always drive the machine parallel to the inclination of the slope. Never drive diagonally across the slope, as this may cause the machine to roll over or slop sideways.

2. Before driving the machine up or down a slope select proper speed. It is strictly forbidden to move gear shift lever while driving on a slope.

3. When going down a sharp or long slope, drive at a low speed and use the engine as a brake. Never coast down a slope with the gear shift lever in "Neutral". If this is not enough to control the speed of the machine depress the brake pedals as well. In this case, the operator should pay special attention to the depressing speed and pedal travel. The operator may also lower the blade to the ground to increase the downslope resistance and decreass the speed. Though the gear shift lever is set at low speed position, the machine still has a tendency of acceleration and its speed would surpass the maximum speed at the same stage when it moves on level ground. Therefore, pay special attention when moving down a slope to avoid accident, as shown in Fig. 6-6.

4. Never use the brake pedals to stop the machine suddenly on slopes.

5. As far as possible avoid turning the machine on a slope. It may cause the machine to slip sideways and roll over especially when turning on a soft or sticky slope.

6. Avoid steel plate, fallen tree trunks and piles of leaves in forest areas while driving.

7. If the engine stalls on a slope, first lower the blade to the ground, park the machine prop-

erly, put the gear shift lever to "Neutral", then start the engine again.

Fig. 6-6

Ⅳ Snow cleaning

1. When cleaning snow, remember that even slight slopes can cause unexpected side sliping and pay special attention to select proper operation speed.

2. Different snow will have different loading conditions. Change the engine load at all time while paying attention to side slipping of the machine in operation.

3. Pay attention to the obstacles covered by snow in operation.

Ⅴ Cutting into hard, frozen ground or ditching.

Effective method is to tilt the blade at inclination position and cut into ground with end bit of tilted blade in operation. If the ground is harder use a ripper attachment to break ground.

Ⅵ Leveling

When leveling surface ground, first the larger drop area should be leveled, then the all area leveled gradually step by step. Operate the machine at low speed. A flat finished surface is also possible by slowly backing the machine with the blade fully "floating". However, avoid backing on rocky or stony ground, as it may damage the blade.

Ⅶ Dozing

1. For dozing, transporting and digging sandy soil a distance per trip should preferably be 70 meters at maximum. If longer, use of a scraper is more economical. Slope excavated can always be most effectively carried out by proceeding from the top downward.

2. When dumping soil over a cliff, dump the first excavated soil without dumping it over and use each succeeding excavated soil to push the previous excavated soil over, as shown in Fig. 6-7.

Fig. 6-7

3. At the instant when the soil is dumped over the cliff or when the machine passes the summit of a slope depress the decelerator pedal slowly to reduce the speed and at the same time return the gear shift lever to "NEUTRAL" to avoid accident due to sudden load decrease and machine automatical acceleration as shown in Fig. 6-8.

Fig. 6-8

Ⅷ Felling and uprooting

A tree, 100 to 300mm in diameter, can be felled by giving 2 or 3 pushes with the blade lifted. Next, lower the blade to cut into the earth, break the roots and push them forward while digging. After uprooting give strong impact to a tree by operating at high speed, as shown in Fig. 6-9.

Fig. 6-9

Ⅸ Construction techniques for longer undercarriage life

lowing points in mind.

1. Select the track shoe that best suits the type of soil to be encountered in service.
2. Avoid sudden starts, acceleration or stops, unnecessarily high speeds and sharp turns.
3. Always operate machine in a straight line whenever possible. Be careful not to turn the machine always in one direction. Make turns with the larger possible radius.
4. Clear stone blocks and other obstacles in operation as far as possible.
5. During dozing when the ground inclines to the right or left do not always operate there. Reverse the machine to the horizontal and resume operation.

7 Troubleshooting Guide

7.1 Electrical system

Trouble	Main causes	Methods of solving problem
Lamps dim as engine runs at high speed; lamps flicker when engine runs	Defective wiring	Loose wire connector, check and repair wires
Alternator issues abnormal noise	Defective alternator	Change and repair
Gear issues noise as the key is inserted into the starting switch during engine running	Defective wiring	Change or repair
Starting motor will not crank up engine as the starting switch key is turned to START	Faulty wiring, battery is not fully charged, defective starting switch, delective battery switch	Check, repair or charge Change switch
Starting motor runs at low speed	Faulty wiring, battery is not fully charged	Check, repair or charge
Starting gears bad departed before engine starting	Faulty wiring battery is not fully charged	Check, repair or charge
All instrument lamps do not light	Cut wires, blow fuse Battery is not fully charged	Check, repair or charge

7.2 Engine

Trouble	Main causes	Methods of solving problem
Oil pressure gauge pointer will not return to "0" when the engine is shut down	Defective oil pressure gauge	Change oil pressure gauge
Oil pressure gauge indicator stays within the red range(Left)on dial	Insulficient oil in oil pan Oil leakage due to loose piping joint or damaged piping Defective oil pressure gauge	Supply oil Check or repair Change oil pressure gauge
Oil pressure gauge indicator stays within the red range(Right) on dial	Oil of too high viscosity, defevtive oil pressure gauge	Change oil, change oil pressure gauge
Steam spreads out through the pressure valve on radiator	Insufficient coolant or coolent leakage	Check and supply coolant
	Loose fan belt	Adjust cension or change belt
	Accumulated scale or durt in the cooling system	Change, clenn

To be continued.

Trauble	Main causes	Methods of solving problem
Water temperature gauge indicator stays within the red range (Right) on dial	Defective water temperature gauge	Change water temperature gauge
	Clogged radiator fins	Clean, repair
	Defective thermostat seal	Change seal
Water temperature gauge indicator stays within the red range (Light) on dial	Defective water temperature gauge	Change water temperature gauge
	Defective radiator	Clean, repair
	Colded engine in cold weather	Change fan, install radiator guard
Starter turns, but engine does not turn	Insufficient fuel and air mixed in fuel system	Supply fuel and drain air
	Starter runs too slow	See electrical system for repair
	Water in fuel system	Drain water
Stop of fuel supply often	Clogged the export pipe of fuel tank	Clean pipe system
Engine emits white or blue-white exhaust gas	Excessive oil in oil pan, insufficient fuel	Change oil
	Clogged the turbocharger oil piping	Check and repair
Engine emits black exhaust smoke	Clogged air cleanet elemeents, too high exhaust pressure.	Clean, change, check, repair
Engine hunting	Air in fuel sypply line	Remove air
Engine creates knocking (combust or mechanical)	Use of improper fuel, overheat. Internal worn of muffler	Change oil Change muffler

7.3 Chassis

Trouble	Main causes	Methods of solving problem
Torque converter overheats	Loose fan belt	Change belt
	Overheated engine water	According to the method shown in "ENGINE"
	Clogged oil cooler	Clean or change
	Restricted flow of lubricating oil due to worn gear pump	Change gear pump

To be continued.

Trouble	Main causes	Methods of solving problem
Machine will not move forward or have no speed after changing speed with transmission lever	Hydraulic pressure of torque converter and transmission is not raised	Check, repair
	Connected positions of valves and pipes are not tighted, air in it or leak oil	Check, repair, change
	Worn out gear pump or blocking	Check, repair, change
	Blocked transmission case oil strainer element	Clean
Machine does not turn, but moves straight when steering clutch lever on either side is pulled	Steering lever fails	Adjust
Steering clutch lever will drag	Poor adjustment of steering clutch and steering brake	Adjust
Machine will not stop when brake pedals are depressed	Brake pedal poor adjustment	Adjust
Trak runs to either side	Loose track tension	Adjust
Abnormal wear occurs on sprocket	Improper track tension	Adjust
Blade rises too slowly or it does not rise	Insufficient hydraulic oil	Supply oil

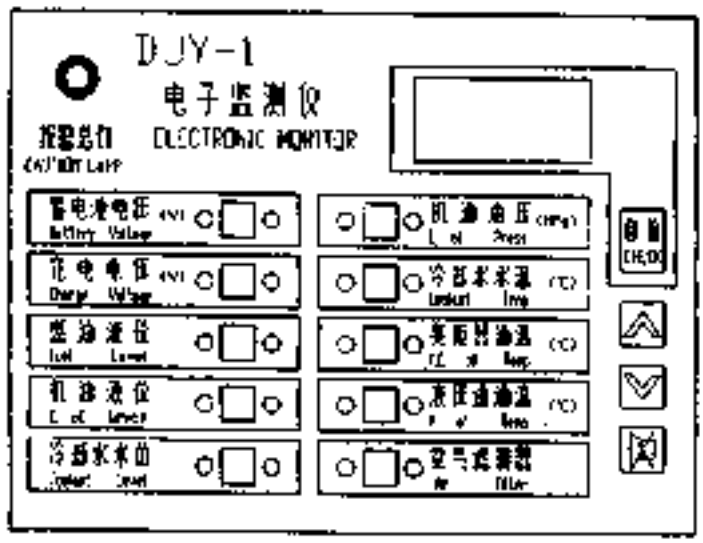
Note: For troubles other than the above-mentioned three kinds of troubles please consult with the manufacturer.

Operators are supposed to take down original notes, for example, machine running, service hours and troubleshooting etc in order to tell the manufacturer to improve the design and quality.

8 Electrical system

8.1 Electronic monitor

8.1.1 Monitor panel arrangement (see the following fig).



8.1.2 Monitoring items

NO	Monitoring item	Unit	Alarm value	Alarm level	Remark
1	Battery voltage	V	<21	First level	Analogue
2	Charge voltage	V	<25	Second level	Analogue
3	Fuel level	mm	<120	Second level	Switching
4	Oil level				Analogue
5	Coolant level				Analogue
6	Oil pressure	MPa	<0.05	Third level	Analogue
7	Coolant temperature	℃	>105	Third level	Analogue
8	Torque converter oil temperature	℃	120	Third level	Analogue
9	Hydraulic oil temperature	℃	>105	Third level	Analogue
10	Air cleaner	mm H_2O	625	Third level	Analogue

8.1.3 Alarm methods and functions

Alarm methods and functions are divided into 3 levels:

1. First level

Item indicating lamp(Red) flickers. It is used to call attention to operator.

2. Second level

Item indicating lamp(Red) and caution lamp flicker. It means that measures should be taken and trouble removed.

3. Third level

Item indicating lamp(Red) and caution lamp flicker and buzzer sounds. It means that machine should be stopped at once and trouble removed.

8.1.4 System operation

1. Turn the starting switch of machine to the "ON". At this time the system is entered into operating state and self-checking functions automatically, item indicating lamp(green) and item alarm lamp(red) light alternatively. And at the same time the caution lamp flickers, the buzzer sounds and "8888" is indicated on display for 3 seconds ("8888" is not indicated on display if the system is abnormal);

2. After self-checking the system is entered into battery voltage item automatically. At this time the item indicating lamp(green) lights and the battery voltage of appoximative 24V is indicated on the display;

3. Diesel engine can be started now(turn the starting switch to the "starting"). After starting the system is still at battery voltage item and all monitering items are entered into monitering state. At this time, depress the "∧" key or "∨" key and the working condition of each part can be observed according to relative item indicating lamp. For example, if you want to read oil pressure, the "∧" key or "∨" key is depressed to make the oil pressure item indicator lamp(green) light and the oil pressure can be indicated on the display.

4. After starting the engine, if the item indicating lamp(red) and caution lamp flicker and the buzzer sounds, it means that a trouble occurs in this system. Depress the self-checking key and the trouble code can be indicated on display. The error item can be found according to the trouble code. The "8888" is indicated if the system is in OK state.

Trouble code table

Error item	Display value
Battery disconnection error	0000
A/D transfer high level error	1111
A/D transfer low level error	2222
* Charge system disconnection error	3333
* Engine lubrication pressure disconnection error	5555
Coolant temperature disconnection error	6666
Torque converter oil temperature disconnection error	7777
Hydraulic system oil temperature disconnection error	9999
OK	8888

Note: The disconnection alarm item with mark "*" is shielded before starting engine.

8.1.5 Main unit maintenance

This system is vehicular electronic monitering one which can not be repaired on site. When trouble or damage of this system is found it should be replaced by spare parts. Therefore, customer should be familiar with trouble judgement method of this system.

1. Trouble judgement and removal

(1) There are no light and sound when power is on. Whether exists 24V power input should be checked. If no, fuse and power line connection should be checked. If damaged, they must be replaced in time.

(2) The system can not be entered into self-checking state after power is on.

At this time, the self-checking key should be depressed once more. If the self-checking still can not be made, it means that a trouble occurs in the monitor and it should be replaced.

(3) The system is entered into self-checking state after power is on. At this time, if an additional buzzer does not sound, depress the silent key. If it is still does not sound, whether its connection is good should be checked. If disconnected lines are jointed and the buzzer still does not sound, whether exists output at output end of monitor should be checked. If no, the monitor should be replaced. If any, change for a qualified buzzer.

(4) After turning on the unit, the monitor should be replaced if some of the monitor lamps do not light.

(5) After turning on the unit and when the system is entered into self-checking state, the "8888" is not indicated on the display, but the other four identical digits are indicated. It means that a failure of some path occurs. First, whether connection is good, then transducer signal output should be checked. If no output or the output exceeds 0~5V, the transducer should be changed and whether exists a signal input at the monitor input end should be

checked. If any, it means that the monitor fails and it should be changed.

2. Change

The unit can be changed by our factory. When ordering the type, sort, specification of it must be explained to assure the interchangeability of system.

8.2 Starting motor group

The starting motor group is composed of starting motor, battery relay, electromagnetic switch, starting switch and safety relay.

When starting switch (JK406) is set to "ON" position, the battery relay is switched on to make the battery negative pole be connected with the unit body. After self-checking of three level alarm electronic monitor for 3 seconds (The "8888" should be indicated for self-checking), the battery voltage (approximate 24V) is indicated on display window. It means that the machine is in normal starting state.

When the starting switch is clockwise turned to "START" position further, the electromagnetic switch inside instrument panel is switched on. Then a pair of connecting points of electromagnetic switch makes the starting electromagnet above the starter move, the gear be pushed out, at the same time, the starting motor be switched on and the diesel engine operated (the starting time normally is 3~5 seconds).

After diesel engine running pay attention to that each display value of three level alarm electronic monitor should be within the allowable range. The output voltage at generator midpoint is approximate 12VDC due to diesel engine running. Meanwhile this voltage makes a safety relay inside the instrument panel attracted and the normal closed contact switches off the starting circuit of starting motor group to avoid starting once more and prevent the starting motor and flywheel from damaging.

8.3 Charging system group

Charging system group is composed of A C generator and charging fuse. The A C generator is the self-rectified one with integrated circuit regulator. The output voltage is 24V and the current is 35 ampere.

The generator is a maintenance free one due to its integration. Just pay attention to the tension of the generator belt which drives the generator.

The charging voltage in the three level alarm electronic monitor just indicates the output voltage of generator, so pay extra attention to fuse in the charging system, because the generator will not charge after fuse blewout, but the charging voltage in the three level alarm electronic monitor is still indicated.

8.4 Lighting group

The lighting of machine is composed of front lamps, side lamps, rear lamp and cab (canopy) lamp. See the Fig. 2—80 Principle Diagram of Electrical System.

9. Transportation and Storage

9.1 Transportation

During transpertation be familiar with and observe the all highway rules and the traffic regulation,such as land transport vehicle and vehicle restriction regulations etc.

Check the load limit of bridge and the space size of tunnel before passing through them.

It is preferable to set up a special load and unload platform. When a ladder is used to load to and unload from trailer,the following rules must be observed(Fig. 9—1):

(a)The trailer must be in a brake state and the tyres fixed by square wood.

(b) The ladder must have an enough width,length and thickness to support machine safety load and unload,it underneath could be strengthened by square wood stipporting underneath if necessary.

(c)Place the ladder correctly,then load and unload slowly.

★When running along the ladder,the running direction can not be adjusted. If direction needs adjustment,the machine should be back to flat ground,then adjust it.

(d)Machine should be put in proper position on the trailer,then put the square wood under the front and rear of the track and fixed by a firm link or cable to avoid accident due to on-the-road slipping out.

(e)Lower the blade and put all levers on the following position.

The fuel control lever should be placed in low idling position and the starting key withdrawn.

The gear shift lever must be set at "NEUTRAL" position.

The blade control lever should be placed in "HOLD" position.

The brake lock lever is placed in "LOCK" position.

★If the blade width exceeds trailer width,the blade should be angled or disassembled and separately shipped.

★For long-distance marine transportation the antirusting measures should be taken. The exposed cylinder piston rod etc should be applied with antirusting oil.

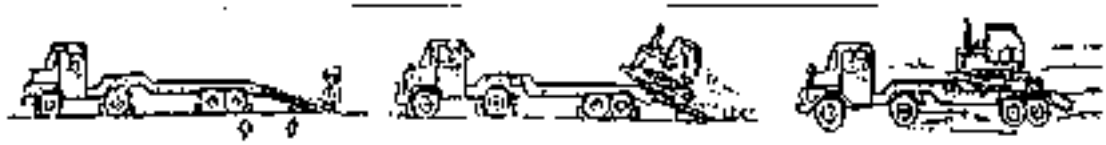


Fig. 9-1

9.2 Storage

9.2.1 Before storage

To place the machine in storage for an extended period, the following measures must be followed to minimize maintenance when reusing.

(a) Thoroughly wash the machine and park it indoors in a dry place. Dont park it outdoors. In case it is indispensable to store the machine outdoors leave it on flat ground with wood plated and cover it with canvas.

(b) Lubricate, grease the machine and replace oil.

(c) Uncovered part of piston rod should be slightly applied with oil.

(d) Conductor at the terminal of battery should be removed and the battery covered or removed and separately stored.

(e) When you estimate that the ambient temperature will fall down below 0℃ add the antifreeze into coolant beforehand.

(f) All controll levers and pedals should be set as follows;

★Gear shift lever is set to neutral position.

★Fuel control lever is set to low idling position.

★Blade control lever is set to holding position.

★Brake pedal is set to free position.

9.2.2 Durings storage

Start the engine and move the machine for a short distance once a month so that new oil film will be formed over the surface of all movable parts and engine components.

When operate working equipment, wipe off the grease on the cylinder piston rod.

9.2.3 After storage

After storage (if the machine is kept without cover or the rust preventive operation once a month is not made), treat the machine as follows before operation;

(a) Remove the drain plug on oil pan and other oil tank to drain the intruded water.

(b) Remove the cylinder head, lubricate the valves and rockers and inspect the valve operation.

(c) To expel air from hydraulic system, turn the engine at low speed and operate as follows;

Each cylinder should move back and forth 4~5 times and piston stop at 100mm far from the stroke end.

Next, each cylinder should move back and forth 3~4 times and move to the stroke end.

★If at the beginning the engine operates at high speed or the piston moves to the stroke end, the intruded air may damage piston pad etc.

(d) After the engine is started, run it until it is warmed up at all.