Introduction

This manual main introduces the items in the aspects of performance, structure, and operation, as well as maintenance and service, etc of the ordinary rough-terrain forklift trucks, so that the operators are able for a correct use and maintenance.

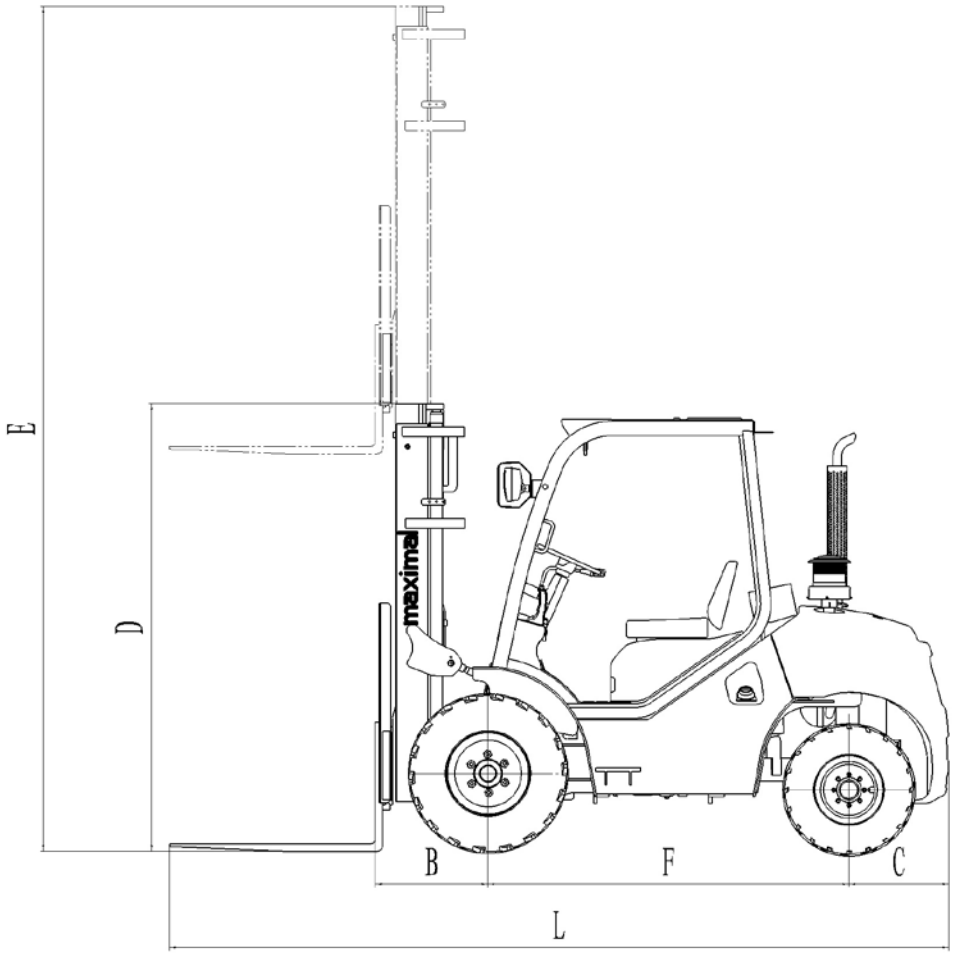
During the user operating process, the operators and equipment management personal involved shall carefully follow the relevant regulations of this manual, for the forklift truck to maintain its good technical conditions.

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I. Forklift Truck Main Technical Parameters



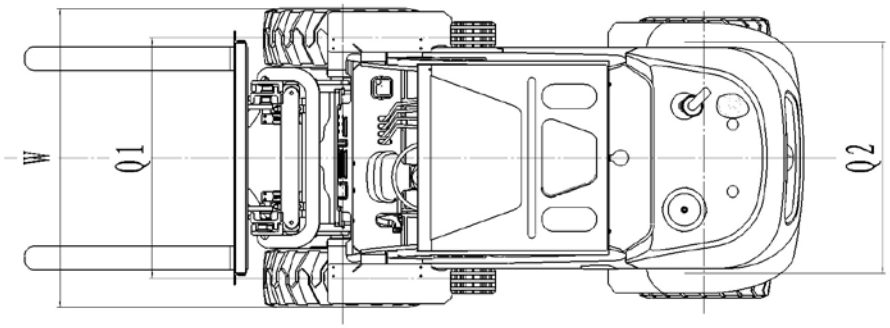


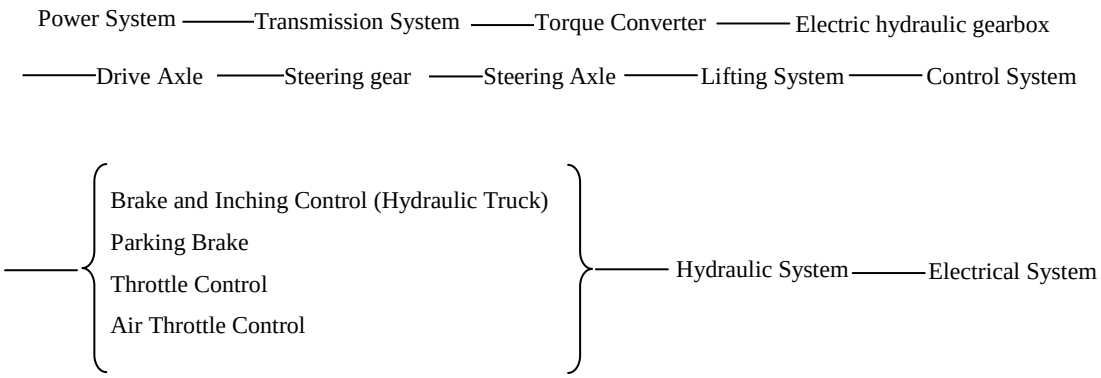
Table 1

Parameter \ Model				FD20	FD25	FD30	FD35
Performance Parameter	Rated Load kg			2000	2500	3000	3500
	Load Center mm			500			
	Lifting Height mm			3000			
	Free Lifting Height mm			160		165	
	Mast Tilt Angle Front/Rear			10/12°			
	Lifting Speed mm/s		No-Load	600		540	
			Full-Load	570		450	
	Running Speed km/h	Hydraulic Truck	Forward	19	19	19	19
			Backward	19	19	20	20
	Max Traction Force		No-Load N	15000			
			Full-Load N	17000			
	Gradeability		No-Load %	20		20	
			Full-Load %	20		16	
	Min Turning Radius R mm			2783			
	Min Cross Passage Width K mm			1970		2040	

Table 2

Parameter \ Model			FD20	FD25	FD30	FD35
Size Parameter	Whole Length L (Without Fork) mm		2946		2956	
	Whole Width W mm		1557.5		1600.5	
	Whole Height D (Mast Retracted) mm		2265		2330	
	Whole Height E (Mast Extended) mm		4175		4305	
	Wheelbase F mm		1880			
	Wheelbase	Front Q1 mm	1250.5			
		Rear Q2 mm	1205			
	Front Clearance B mm		586		601	
	Rear Clearance C mm		520			
	Fork Dimension	Length mm	1100		1220	
		Width mm	122		125	
		Height mm	40		45	
	Fork Horizontal Adjustment Quantity mm		250-1160			
	Ground Clearance (in the Place of Mast) mm		270		270	
	Self weight kg		4465		5180	

II. Description about Forklift Truck Main Parts



III. Structure, Principle, Adjustment, and Maintenance of Forklift Truck

In order for operators to use, service, and maintain the forklift truck in a better way, the items of such aspects as the structure, principle, adjustment, disassembly and assembly, maintenance, and failure removal, etc related to the forklift truck are now introduced one by one, respectively.

1. Power System

1.1 Engine Overview

At present, the diesel engine used by 2.0-3.5t ordinary rough-terrain forklift is shown in Table 3

Table 3

Parameter \ Model			4TNE98
Type			4-Stroke, Water-Cooling, Straight-Line, and Valve in Head
Cylinder	Number of Cylinders – Cylinder Diameter × Stroke		4-98×110
	Total Displacement		3.319
	Compression Ratio		21.3
Rated Power/Speed			42.1kw/2300rpm
Max Torque/Speed			206N.m/1700rpm
No-Load Min Speed			750rpm
Min Fuel Specific Consumption			265 g/kw.h
Movement Direction			In Clockwise Direction Looking from the End of Fan
Whole Length × Whole Width × Whole Height			728×526×707
Weight			225kg
Working Sequence of Cylinder			1-3-4-2
Cooling System			Forced Circulation Water Cooling
Lubricating System			Forced Lubrication
Main Part	Distributed Type		Distributed Type
	Throttling Type		Throttling Type
	Paper Filtration		Paper Filtration
	Cycloid Pump		Cycloid Pump
	Eddy Current Type		Eddy Current Type
	Wax Pellet Type		Wax Pellet Type
	Generator	Voltage	12V
		Current	40A
		Method of power generation	AC Generation, and Silicon Rectification
	Starter	Voltage	12
		Output Power	2.3kw
	Battery		12V 90Ah

Refer to their respective engine operation and maintenance manuals for the introduction about homemade engines used for 2-3.5t forklift trucks.

The power of engine is mainly transmitted to the transmission system from flywheel through clutch or torque converter, and as engine itself carries working oil pump, it is relatively convenient for engine to replace fan belt.

1.2 Engine Adjustment

It is required to adjust the rotating speed of engine as it produces influence over operating efficiency with both running speed and lifting speed of forklift truck, and the rotating speed of engine shall be adjusted according to the undermentioned methods, if it fails to reach the specified value.

(1) Adjusting idle speed (used for diesel engine)

The speed of diesel engine is controlled by speed limiter of fuel injection pump, and the latter has been properly adjusted on test bed in general, while it can no longer be adjusted after engine is mounted. The steps for adjustment using test bed are given as follows (for reference):

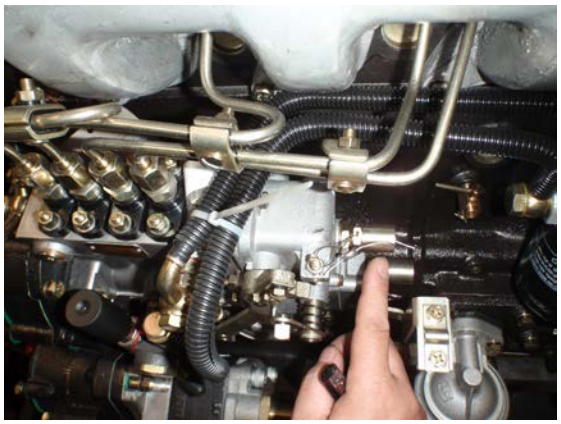


Fig 1-1

a) Control the zero adjustment of gear rack, mount the control rack for measurement device onto the end face of control rack for oil injection pump, and align the zero position of control rack for measurement device with the zero position of graduated scale.

b) Fully tilt the control rod in the direction for fuel to be increased, and ensure that the control rack extends by more than 15mm. Then fully tilt the control rod in the direction for fuel to be stopped, and ensure that the control rack on the graduated scale is less than 1mm.

c) Adjust the oil injection timing and injection speed.

d) Adjust the pressure from the minimum negative pressure.

(2) Examining whether or not air leak exists, by making use of adjusting rack to adjust the negative pressure of oil injection pump in reference to Fig 1-2

(3) Adjusting the limit of smoke by making use of adjusting screw for limit of

smoke, while the operators shall pay attention that please never adjust it for imported engines, when they are basically under normal operating conditions.

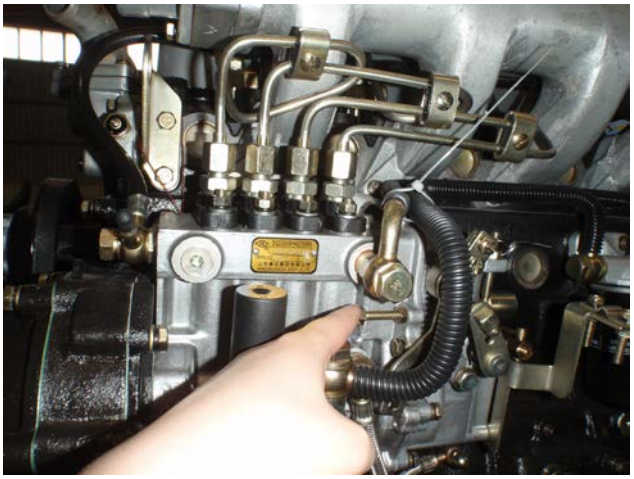


Fig 1-2

1.3 Fuel System

Fuel system is composed of fuel tank, oil quantity sensor, and oil quantity indicator (Fig 1-3 and Fig 1-4)

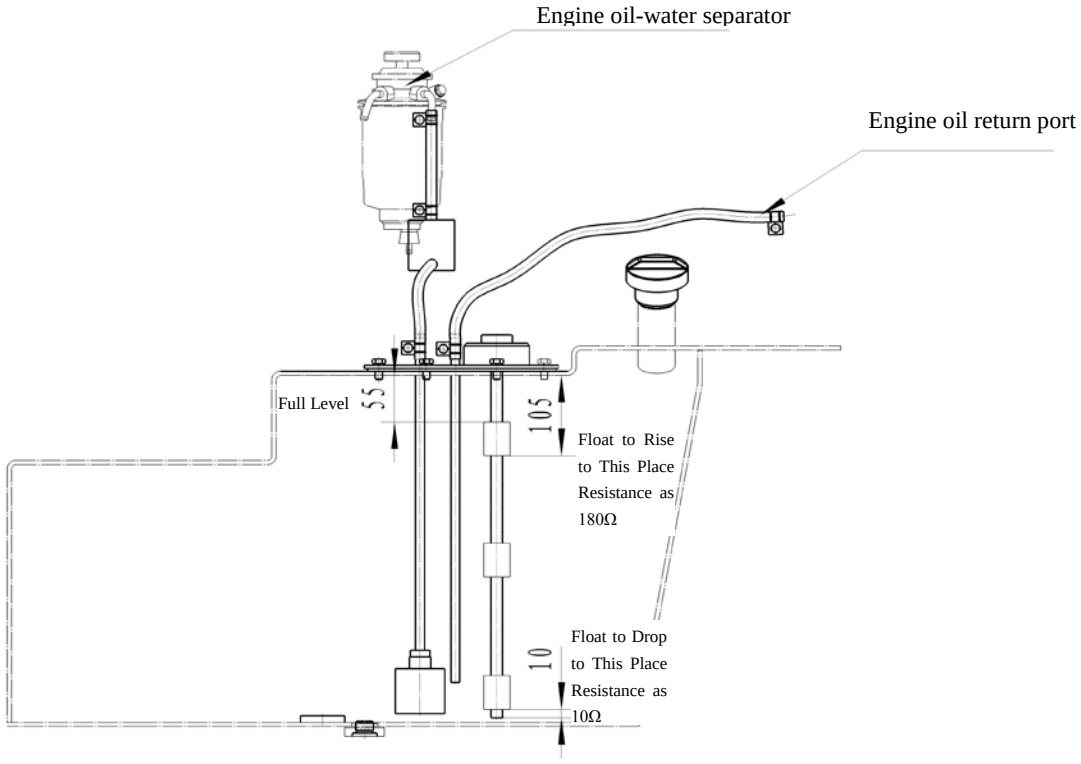


Fig 1-3 Fuel Tank (Diesel Forklift Truck)

1.3.1 Fuel Tank

Fuel tank is an integrated welded structure connected with vehicle chassis into a whole, located on the left side of vehicle chassis. The capacity of 2-3.5t ordinary

rough-terrain forklift is 55.5L and the fuel quantity sensor is fitted on the tank cover of fuel tank to detect the fuel level.

1.3.2 Fuel Quantity Sensor

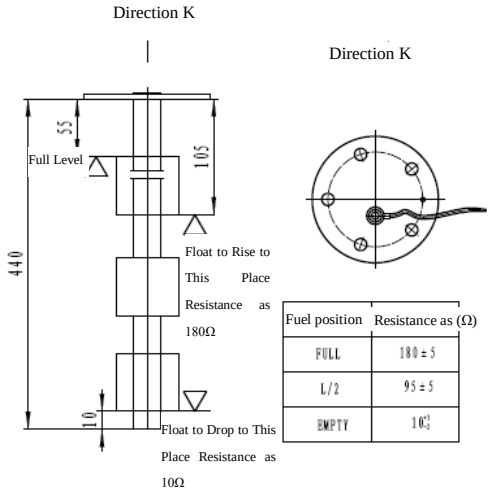


Fig 1-5 Fuel Quantity Sensor

The fuel quantity sensor is used to convert the remaining fuel quantity in fuel tank into voltage, and refer to Fig 1-5. The value of resistance will change, when float moves upward and downward, by making use of alloy steel wire to be fabricated into slide resistance connected with float, and the storage fuel quantity inside fuel tank can be read out from the instrument panel through electromagnetic fuel gauge.

1.3.3 Maintenance of Fuel System

The fuel system is to be maintained and serviced once for every work of 100 hours, with the following method, and the fuel tank shall be cleaned once for every work of 600 hours.

(1) Fuel Filter

Fuel filter is used for remove dust and impurity in fuel, and this fuel filter is located between the fuel tank and the gasoline pump (gasoline engine) or oil delivery pump and oil injection pump (diesel engine).

(2) Service of Diesel Engine Fuel Filter

This filter is in cylindrical type (Refer to Fig 1-6), not detachable generally, and it shall be replaced in complete set if required.

a) For every work of 100 hours, dismount the cylindrical shell using special tools, and take out the filter core.

b) For every work of 600 hours, the entire filter shall be replaced.

c) It is required to pay attention to examining as to whether or not fuel leak exists after reassembly.

d) Pay attention to examining the working status of Part 1 overflow valve.

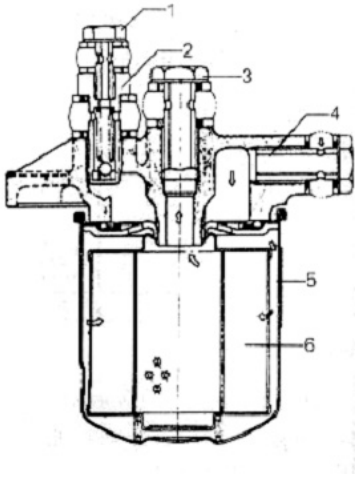


Fig 1-6

(3) Fuel-Water Separator (Sediment Bowl)

As VE oil injection pump is lubricated with fuel internally, water content in fuel must be separated, and therefore sediment bowl is used. If indicator light of fuel-water separator turns on, water shall be drained. (Fig 1-7)

a) Water Drain

Loosen off the fuel drain plug and allow fuel drain plug to drain water manually. Then tighten the fuel drain pump and start the pump for multiple times. It shall be ensured that no fuel leak exists, engine is started, and warning light is turned off. Firmly tighten the fuel drain plug.

b) Air Exhaust

Loosen off the air exhaust plug (overflow valve) of oil injection pump, and press the main pump until no air emits. It shall be ensured that no fuel leak exists.

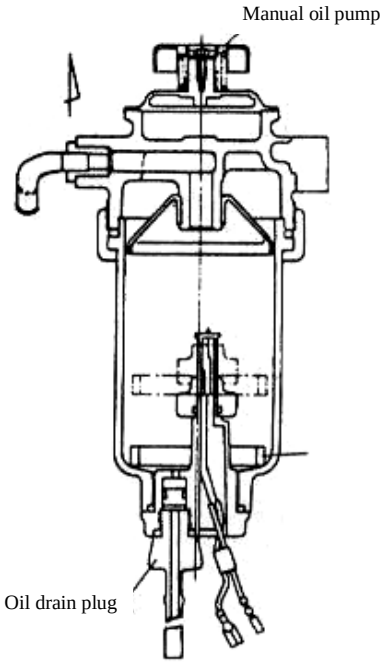


Fig 1-7

2. Transmission Case

2.1 Overview

YQXD30-XH and YQXD40MKS-XH limited slip hydraulic-drive gearbox are composed of hydraulic torque converter and electro-hydraulic gearbox with one front and rear gear, and are used for forklifts, tractors and other construction vehicles.

The torque converter installed on the YQXD30-XH and YQXD40MKS-XH limited slip hydraulic-drive gearbox is a single-stage two-phase three-wheel integrated hydraulic torque converter. The hydraulic torque converter enables the hydraulic-drive gearbox to have automatic adaptation of hydraulic transmission output, change its output torque and speed with a change in external load and absorb and remove the impact and vibration on the transmission system from the engine and external load. The hydraulic drive gearbox outputs with the half-axle gear of limited slip differential. The mode of shifting used is an electro-hydraulic control shift and a inching valve and cushion valve are also arranged, so that it is simple and convenient to manipulate, and they start smoothly, thus significantly reducing the labor intensity of operators.

When the left and right driving wheels of the forklift can not move ahead due to one-side skidding, the limited slip differential can assign most of the torque to the side not slipping by the frictional moment, thus overcoming the shortcoming of the torque distribution of general differential mechanisms, so that the forklift can move ahead.

2.2 Main technical parameters

Item		YQXD40MKS-XH	YQXD30-XH
Rated power of matching engine kW		33～40	33～40
Rated speed of matching engine r/min		2250～2650	2250～2650
Drive ratio	Forward	18.947	17.4972
	Backward	18.947	17.4972
main oil pressure Mpa		1.1～1.4	1.1～1.4
Torque converter inlet pressure Mpa		0.5～0.7	0.5～0.7
Hydraulic torque converter	Model	YJH265	YJH265
	Effective diameter mm	265	265
	Stall condition torque ratio	K0≥3	K0≥3
	Peak efficiency	≥0.8	≥0.8
	Pump impeller with the stall condition N.m	$33.5^{0}_{-3.35}$	$33.5^{0}_{-3.35}$
	Working condition of the highest efficiency Nominal torque of pump wheel N.m	30^{0}_{-3}	0^{0}_{-3}
Direction of rotation (face the input)		Clockwise	Clockwise

Working fluid	No.6 or 8 hydraulic transmission oil	No.6 or 8 hydraulic transmission oil
Working oil temperature ℃	70～95	70～95
Maximum working oil temperature	120 (≤5min)	120 (≤5min)
Overall dimensions (length× width × height) mm×mm×mm	830×470×450	830×470×450
Net weight kg	190	190

2.3 Operating principle

2.3.1 Transmission principle

The transmission diagram of the hydraulic transmission gearbox is shown in figure 2-1. The hydraulic torque converter is engine-driven through the elastic connecting plate 1 to drive the pump wheel 4 to rotate, so that the fluid flows along the direction of its blade into the turbine 2 with a high speed, thus to push the turbine to turn. The guide wheel 3 causes the torque converter to form torque, and through the turbine shaft 5, the torque is passed to the input shaft assembly 11 of the hydraulic drive gearbox. When the forward gear is set, return the clutch to idle, and the delivery order is the part 11→part 7→part 21 →part 20→part 17→part 12→part 13 to drive the limited slip differential 15 to output. When the backward gear is set, the forward clutch idles, and the delivery order is part 11 →part 10 →part 18→part 19→part 21→part 20 →part 17 →part 12 →part 13 to drive the limited slip differential 15 to output. The forward and reverse clutches are controlled by the shift valve. The oil pump 6 is an internal gear pump, and is driven directly by the engine through the pump wheel; the oil pump provides the system with pressure oil; after the hydraulic torque converter works, the oil flows into the vehicle's radiator, and then into the lubricating friction plate, bearing and gear of the gearbox.

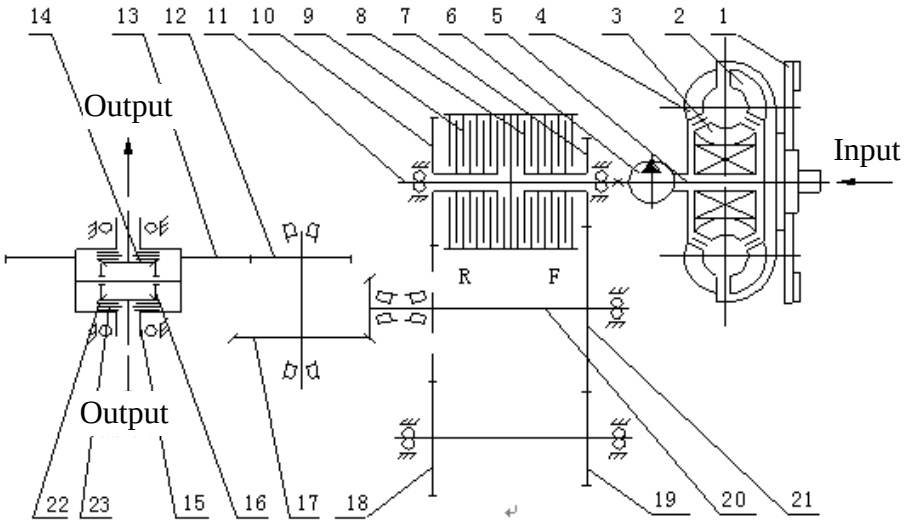


Figure 2-1 Transmission diagram of YQXD40MKS-XH limited slip hydraulic transmission gearbox

1-Elastic connecting plate 7-Forward gear 13-Gear ring 19-Idler gear
2-Turbine 8-Friction plate 14-Half-axle gear 20-Output shaft
3-Guide wheel 9-Spacer 15-Limited slip differential assembly 21-Output gear
4- Pump wheel 10-Reverse gear 16- Planet gear 22-Internal friction plate
5-Turbine shaft 11-Input shaft assembly 17-Spiral bevel gear shaft
6-Oil pump 12-Gear shaft 18- Idler shaft 23-External friction plate

2.3.2 Principle of oil circuit

The schematic diagram of hydraulic transmission gearbox oil circuit is shown in figure 2. Of which F represents forward gear, R means the backward gear, and N represents the neutral gear.

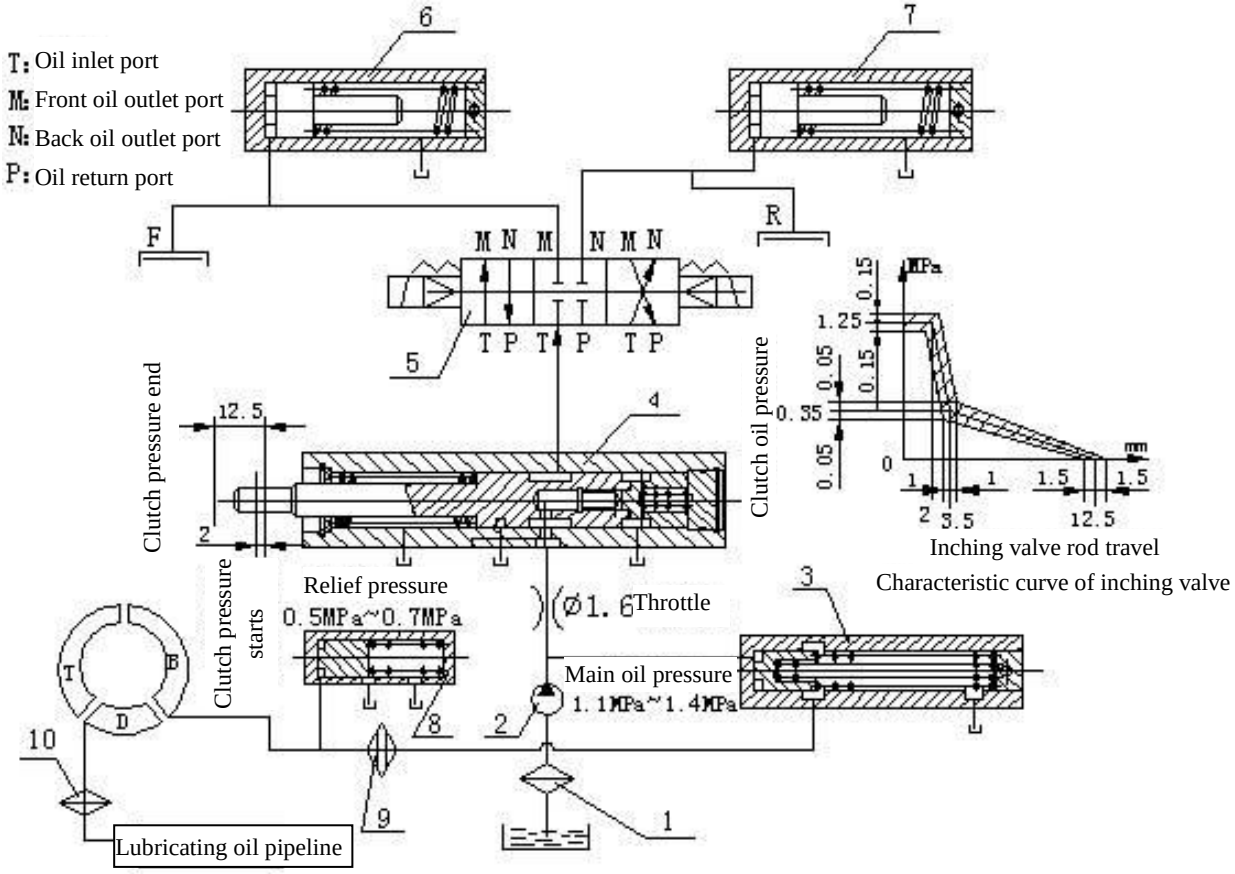


Figure 2-2 Schematic diagram of oil circuit of YQXD40MKS-XH limited slip hydraulic drive gearbox

1- Coarse oil filter 4-Inching valve 7- Cushion valve 10- On-board cooler
2- Oil pump 5--Solenoid valve 8- Relief valve
3-Main pressure regulating valve 6-Cushion valve 9-Fine oil filter

2.4 Introduction to hydrodynamic gearbox structure

2.4.1 Structure profile

The structure of the hydraulic drive gearbox is shown in Figure 2-3, and its working principle is described above. The hydraulic drive gearbox is composed of hydraulic torque converter 13, gearbox, reducer and limited slip differential mechanism. Engine power is input into the clutch assembly 6 on the gearbox through the role of the torque converter by torque converter turbo-shaft. The gearbox includes a clutch assembly 6, idler 11, output gear 12, idler shaft 9, electro-hydraulic control valve assembly 5, inching valve assembly 14, and oil supply pump assembly 4 and other major parts and components. The reducer mainly consists of output shaft 10, spiral bevel gear 16 and gear shaft 1 and other components; both ends of the gear shaft are supported by the tapered roller bearing 2, and an adjustment gasket is arranged on both ends respectively, used to adjust the color prints, backlash and bearing clearance of the bevel gear. The power from the gearbox through the reducer is passed to the wheels via the axle shaft gear and axle shaft after differential driving is generated by the limited slip differential assemly 15. Part 8 is the gearbox housing, in which a gear shift gear, shift clutch, reducer gear and limited-slip differential mechanism are installed. It itself also plays a role of oil tank.

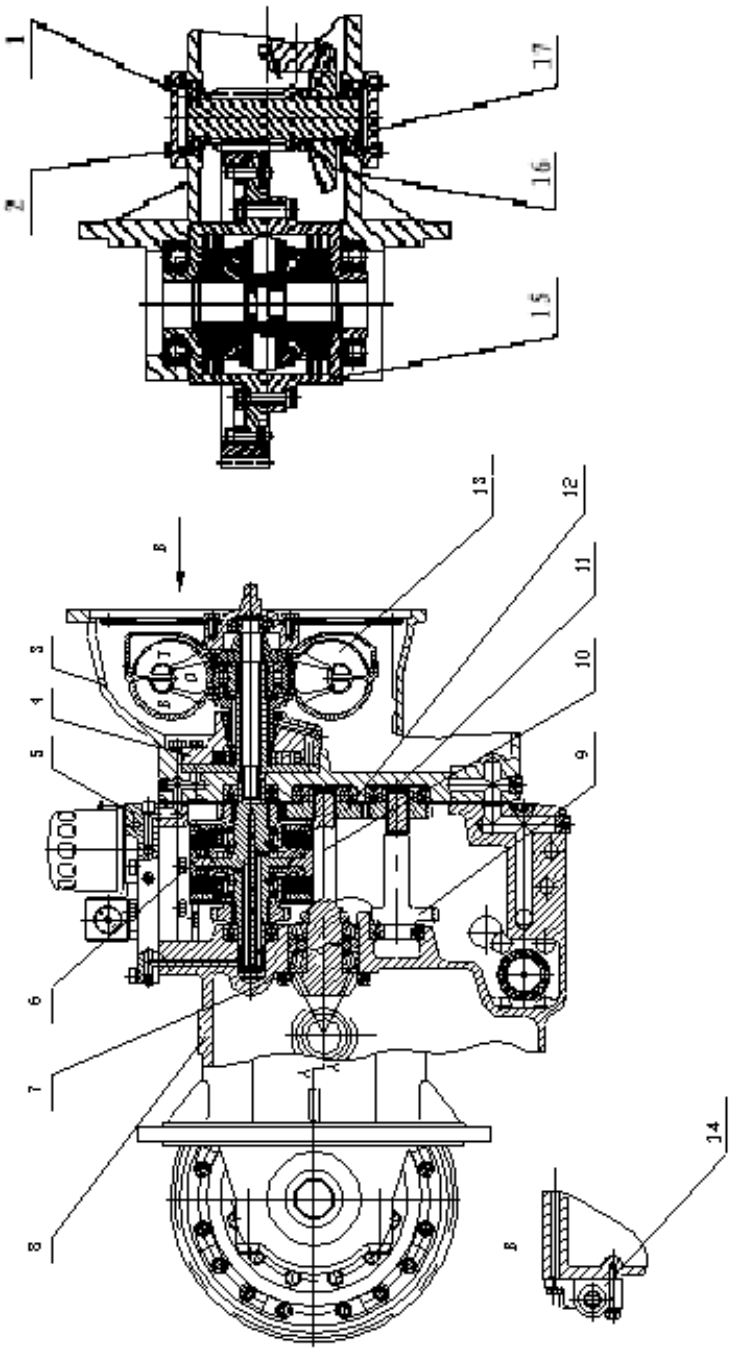


Figure 2-3 Structure chart of YQXD40MKS-XH limited slip hydraulic drive gearbox
1-Gear shaft 2- Tapered roller bearing 3-Torque converter shell components 4-Oil supply pump assembly 5-Electro-hydraulic control valve assembly 6-Clutch bearing shell 7-Supporting part 8-Shell 9-Idler shaft 10-Output shaft 11-Idler 12-Output gear 13-Hydraulic torque converter 14-Inching valve assembly 15-Limited slip differential mechanism assembly 16-Spiral bevel gear 17-Bearing cover

2.4.2 Disassembly and assembly sequence

Disassembly and decompose the hydraulic drive gearbox in the following order:

a) Open the oil drain plug and drain the oil;

b) Take out the hydraulic torque converter 13;

c) Disassemble the limited slip differential mechanism assembly 15, electro-hydraulic control valve assembly 5, oil supply pump assembly 4, torque converter shell component 3, clutch assembly 6, and inching valve assembly 14;

d) Open the bearing cover 17, take down the gear shaft 1 and spiral bevel gear 16 and decompose tapered roller bearing 2;

e) Take down the supporting part 7, and take out the output shaft 10 and all the parts on the shaft;

f) Take down other parts and components.

The assembly sequence is reverse to the disassembly sequence.

2.4.3 Hydraulic torque converter

The structure of YJH265 hydraulic torque converter is shown in Figure 2-4. It is mainly composed of turbine shaft 1, pump wheel 2, guide wheel 3, turbine 4 and elastic connecting plate 5 and other components.

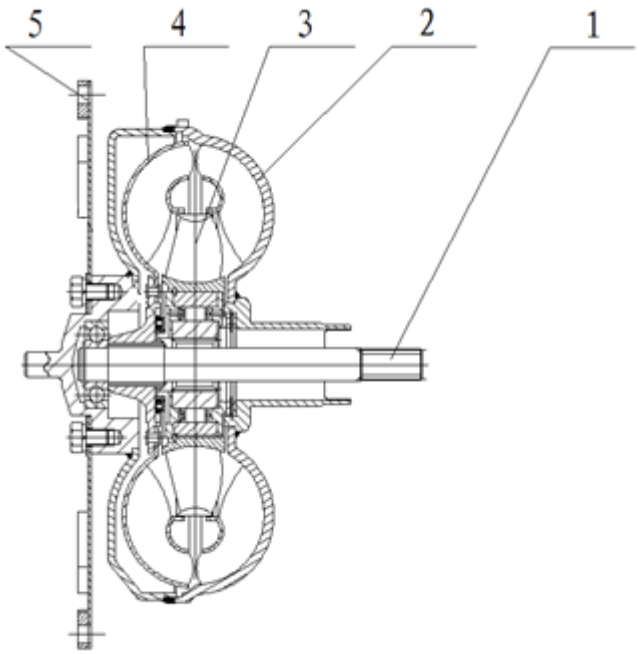


Figure 2-4 Structure chart of YJH265 hydraulic torque converter

1- Turbine shaft 2- Pump wheel 3-Guide wheel 4- Turbine 5- Elastic connecting plate

The pump wheel 2 is connected with engine flywheel by the elastic connecting plate 5. The pump wheel changes the engine's mechanical energy into kinetic energy of the working fluid, and the fluid flows along the flow direction of the blades into the turbine 4 with a high speed to drive the turbo-shaft to rotate; the fluid flows out of the turbine shaft 1 and the torque and speed are passed to the gearbox. After the fluid flows out of the turbine, it enters the guide wheel 3. When the torque converter is in the turbine stage of large load and low speed torque, the guide wheel wedged by one-way clutch cannot rotate, and the torque acted by fluid flow on the stator is counteracted on the turbine, so that the torque on the turbine is equal to the sum of the pump wheel and

guide wheel. Thus the output torque is greater than the input torque, and a bending moment is automatically generated. When the ratio of the turbine speed and the pump speed is greater than a certain value, the guide wheel is out and rotates freely, and the bending moment is terminated, this state is a coupled state.

YJH265 is a punching welding hydraulic torque converter, which is indecomposable.

2.4.4 Oil supply pump assembly

The structure of YDS30.906 oil supply pump assembly is shown in Figure 2-5. It mainly consists of driving gear 1, guide wheel base 2, driven gear 3, pump shell 4 and other parts. The oil supply pump assembly is mounted on the torque converter shell, the guide wheel base 2 is connected with torque converter stator by splines, and the pump casing 4 is a casting with high-pressure cavity and low-pressure cavity; the driving gear 1 is connected with the torque converter pump wheel, which is driven by the engine to lead the driven gear 3 to turn, so that the internal gear pump supplies oil to the system.

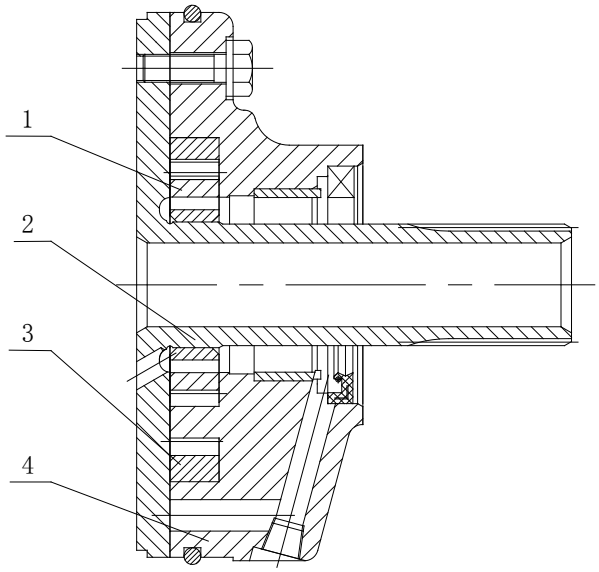


Figure 2-5 Structure chart of YDS30.906 oil supply pump assembly
1- Driving gear 2-Guide wheel base 3-Driven gear 4-Pump shell

2.4.5 Clutch assembly

2.4.5.1 Introduction to YDS40HST.901 clutch assembly structure

The structure of YDS40HST.901 clutch assembly is shown in Figure 2-6. It is used for YQXD40MKS-XH limited slip hydraulic drive gearbox. The clutch assembly is composed of input shaft 1, forward shift gear 2, piston 4, clutch housing 5, friction plate 7, baffle 8, return spring 9, reversing gear 10, seal ring 11 and other parts and components. The left and right clutch are a wet multi-disc hydraulic clutch, and both are fitted with 4 baffles and 4 friction plates which are assembled line to line, and the clutch housing is welded with the input shaft, and the pressure oil assigned through the control valve flows into the forward or reverse clutch, to achieve forward and

backward gear shift. The excircle of the piston is equipped with a seal ring 6, and the O seal ring is mounted on the input shaft 3, to ensure the sealing when the clutch is working. When the gear is empty, no pressure oil flows into the clutch, and the piston returns under the spring force, so that the baffle and friction plate are in a detached state. When shifting the gear, the oil pressure acts on the piston, so that the baffle and friction plate are combined with each other, and the power from the torque converter is passed to the forward gear or reverse gear relying on friction.

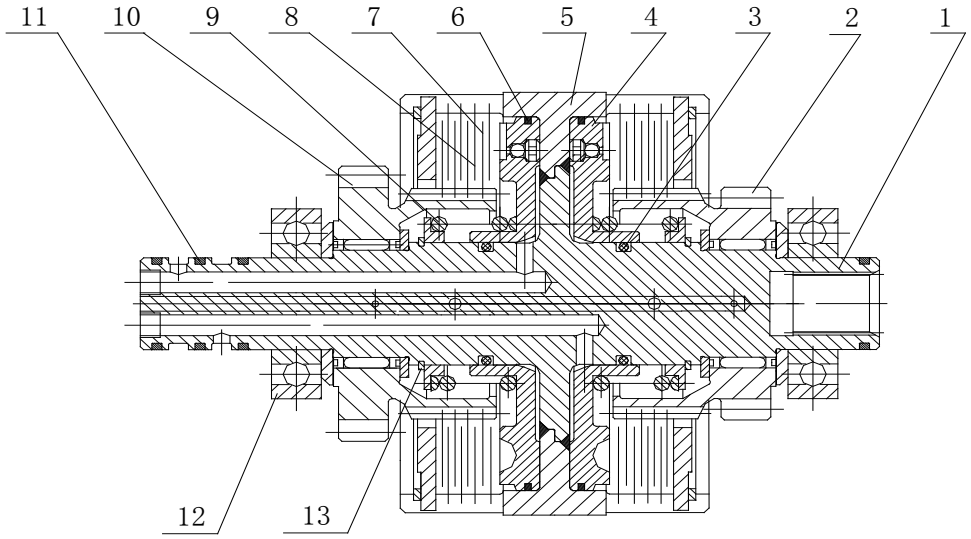


Figure 2-6 Structure chart of YDS40HST.901 clutch assembly

1-Input shaft 2-Forward gear 3-O-seal ring 4- Piston 5-Clutch shell 6-Seal ring 7-Friction plate 8-Baffle 9-Return spring 10-Reverse gear 11-Seal ring 12-Bearing gear 13-Clamp ring

2.4.5.2 Disassembly and assembly sequence

Disassemble and decompose the clutch assembly in the following sequence:

Take down the bearing 12 on the left and right ends, and remove the forward gear 2 and reverse gear 10 and friction plate 7 and baffle 8, respectively; compress the return spring 9 on both ends separately, take out the retaining ring 13 and dismantle the piston 4 and return spring 9.

The assembly sequence is reverse to the disassembly sequence.

2.5YDS40-XH.905 limited-slip differential mechanism assembly

The structure of YDS40-XH.905 limited-slip differential mechanism assembly is shown in Figure 2-7, and it is supported on the gearbox housing through the ball bearing 3 at both ends. The limited-slip differential mechanism assembly has two axle shaft gears 9 and 4 planetary gears 8, and the planetary gears are supported with cross axle 6. The washer 7 is mounted on the limited-slip differential mechanism shell and planetary gears. The limited slip differential mechanism is internally provided with internal friction plate 13, external friction plate 14, end plate 15, needle roller bearing thrust washer 5, positioning shaft 11 and belleville spring 16. The limited-slip differential housing be split into left and right, limited-slip differential left shell 10

limited-slip differential mechanism shell 2 is connected through the bolt 17, and the gear ring 1 is fixed with the bolt 18 onto the right limited-slip differential mechanism shell 2.

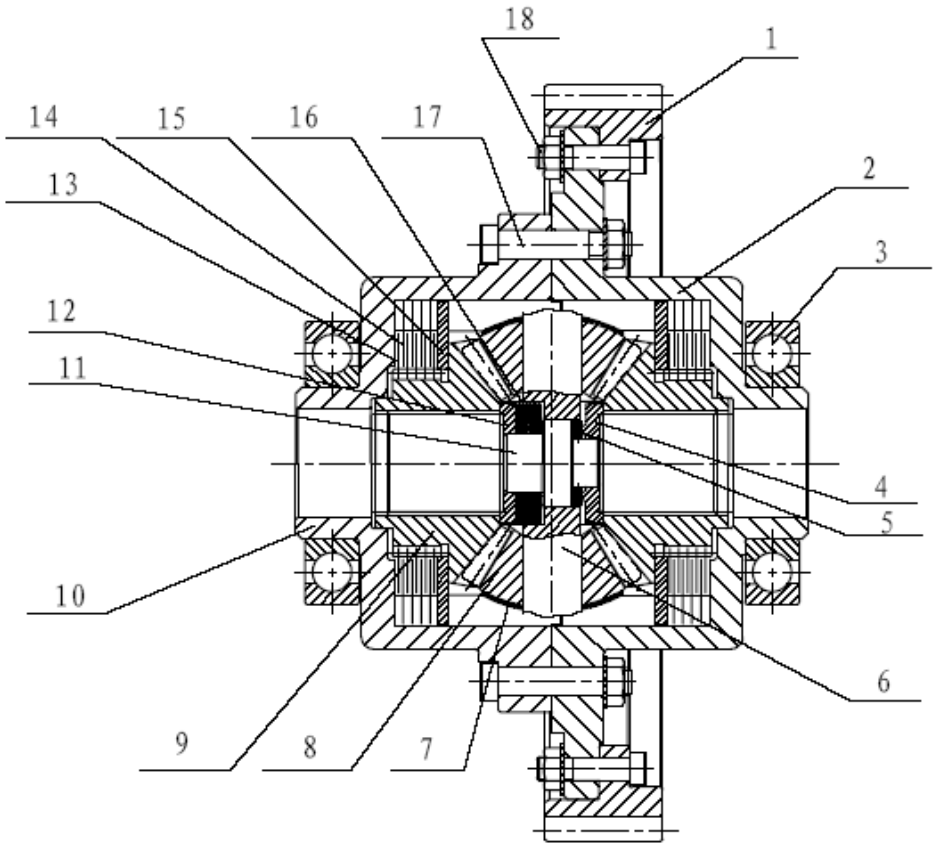
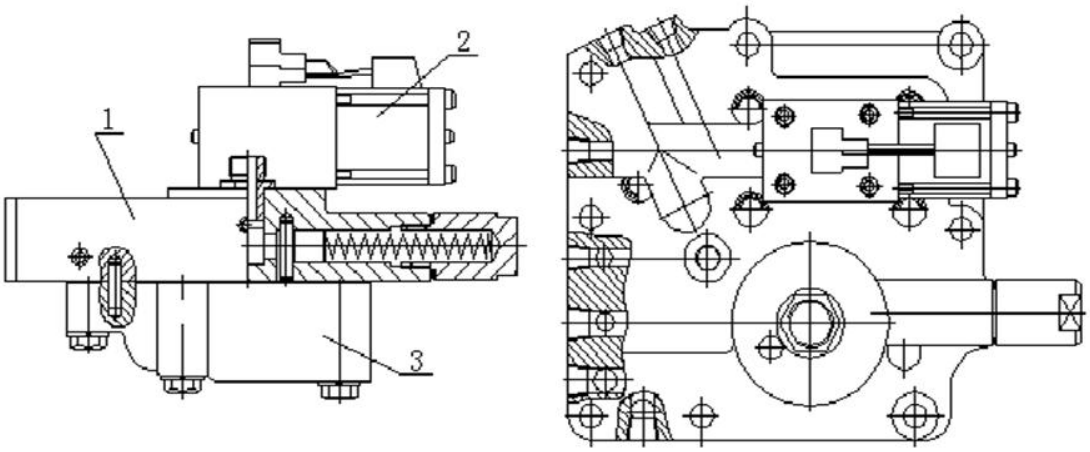


Figure 2-7 Structure chart of YDS40-XH.905 limited slip differential mechanism assembly

1- Gear ring 2-Right limited slip differential mechanism shell 3- Bearing 4-Right pressure plate 5-Thrust needle roller bearing and thrust washer 6-Cross axle 7-Washer 8-Planetary gear 9- Axle shaft gear 10-Left limited slip differential mechanism shell 11-Positiong shaft 12-Internal pressure plate 13-Internal friction plate 14-External friction plate 15-End plate 16- Belleville spring 17-Bolt 18-Bolt

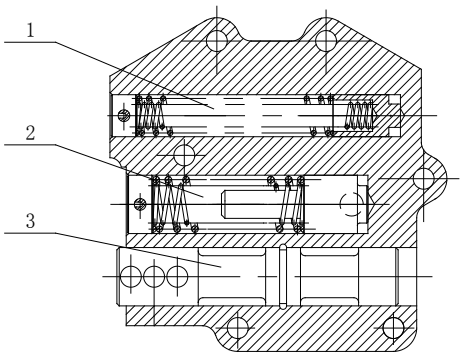
2.6 DCCT5 electro-hydraulic control valve

The structure of DCCT5 electro-hydraulic control valve is shown in Figure 2-8. It consists of a shell cover, solenoid directional valve, control valve assembly and other components. The control valve assembly is located inside the shell cover, and the shell cover is equipped with a torque converter oil pressure relief valve. The control valve contains a main pressure valve and two buffer valves. The main pressure valve controls the clutch pressure within the range of 1.1MPa~1.4MPa, part of the oil flows from the inching valve into the control valve to achieve the shift, and part of the oil flows into the relief valve, so that the hydraulic pressure is adjusted within 0.5 MPa~0.7MPa, and then it enters into the torque converter. The buffer valve is used to reduce the impact when the clutch is open and closed.



1- Shell cover 2- Solenoid valve 3- Control valve assembly

Figure 2-8 Structure chart of DCCT5 electro-hydraulic control valve



1- Main pressure valve 2-Buffer valve 3-Control valve

Figure 2-9 Structure chart of control valve assembly

2.7 Notes to installation, oil pressure measurement and use

1. When installing the product, first wipe and clean the seal oil on the surface of the product. In order to prevent oil leakage when it is used, any demolition or decomposition of the product is prohibited.

2. The mounting surfaces, torque converters and exposed gears should be prevented from being knocked on and collided, so as not to affect the accuracy of installation and use.

3. Inspect that the center mounting hole of the engine flywheel is not more than 0.15mm, and the side beating of the flywheel is greater than 0.1mm; the side beating of the flywheel installation face is greater than 0.2mm, and the location of two locating pin holes in the mounting surface is not more than φ0.1mm.

4. The forklift control mechanism should be able to ensure accurate and reliable positioning of the steering valve rod and inching valve rod. The inching valve rod should be able to reset after releasing the pedal by operator. The characteristic curve of the inching valve is shown in Figure 2. When you install the inching valve rod, it should be connected with the brake pedal, and you must ensure the brake pedal to

brake after the inching valve inches. Before shifting the vehicle gear, you should turn off the inching valve at first.

5. When lifting this product, try to keep the level to prevent the torque converter slipping out.

6. It is prohibited to change the oil system of the gearbox. To ensure that the gearbox works properly and lubricates well, the circulating oil of the gearbox cannot be used for other purposes. The working fluid should meet the grade required in this manual.

7. The working fluid should be kept clean, and there shall be no other impurities. After a new gearbox has initially begun working for 100 hours, new oil should be replaced; then, every 1000 hours of use or when it is permanently disabled, it should be replaced with new oil. New oil is changed every 600 hours of working in a high dust environment. When replacing the new oil, it is important to clean the coarse oil filter and replace the fine oil filter at the same time.

8. Inject the working fluid, check the oil level after 5min driving with empty gear, and it should be within the prescribed limits of the dipstick. The filler cap is also used as the ventilation hood.

9. The cartridge coarse oil filter is replaced every 10,000 km or after 250 hours of working.

10. After the external coarse oil filter has worked for 500 hours (or 5 months) the filter cartridge is cleaned as required. Check it on a regular basis in the future.

11. First installation and commissioning of the hydraulic drive gearbox on the forklift truck

1) Before inspection and commissioning, you should first add enough oil, to keep the oil level above the minimum of the dipstick. Oil must be clean, and you should prevent impurities and water into the oil when refueling, because the water being evaporated is easy to produce bubbles, which will reduce the engine efficiency and damage the seals.

2) When the reversing switch is in the neutral position, and the engine speed is 600-800r/min, commission for 1-2min, and the oil level should be checked and should be in the range of the dipstick after stopping. Then connect the forward and backward for 1-2min respectively. You should also check the tightness of the connecting parts, and there shall be no oil leakage.

3) After repeated changes above, it can continue operating for 40min; then you can continue to check the oil temperature in the hydraulic drive gear, which should be in the range of 80-100℃. If the oil temperature is too high, the cooling system should be checked, and the blockage, rupture and whether the oil level is too low or whether there are air bubbles in the system should be removed.

3. Drive Axle

Type	Front Wheel Drive, Axle Body Fixed with Vehicle Chassis, and Fully Floating Type	
Forklift Truck Tonnage	2.0-2.5t	3.0-3.5t
	Single Tyre	Single Tyre
Tyre Size	2×12-16.5	2×14-17.5-12PR
Rim Size	9.75-16.5	10.5-17.5
Tyre Pressure	6.2bPa	4.83bPa

3.1 Overview

Drive axel is mainly composed of axle housing, wheel hub, half shaft, and brake. The axle housing is in an integrated cast structure. The tyre is prized on wheel hub through wheel rim using stub bolt and nut. The power is transmitted to half shaft through speed differential, and finally the front wheel is actuated by wheel hub for rotation. Each wheel hub is mounted on axle housing through two tapered roller bearings, so the half shaft only bears the torque transmitted by wheel hut. Oil seal is fitted inside the wheel hub, to prevent entry of water and dust, or oil leak.

The structure of 2.0-3.5t drive axle is as shown in Figure 3-1

1. Conical Nut
2. Bolt Stud
3. Brake Drum
4. Wheel Hub
5. Brake Cylinder
6 Axle Housing
7. Oil Seal Retainer Ring
8. Oil Seal
9. Tapered Roller Bearing
10. Tapered Roller Bearing
11. Round Nut
12. Half Shaft

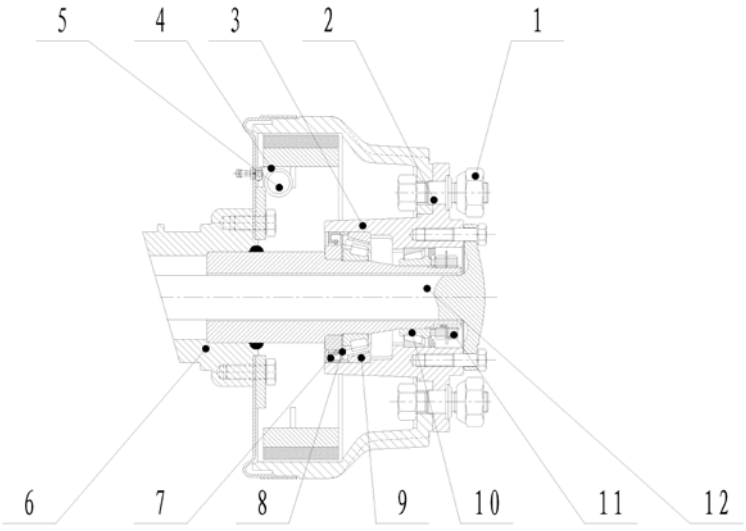


Fig 3-1 Drive Axle

3.2 Maintenance of Drive Axle

The wheel hut of drive axle shall be reassembled according to the following procedure:

(1) Coat lubricating grease on the tapered roller bearing.

(2) When the lock nuts for tapered roller bearing inside the wheel hub is tightened, attention shall be paid that the rotating torque of wheel hub is 9.8-29.4N.m (1-3kg.m) after tightening (or return by about 1/8 circles after tightening, for wheel hub to be able to rotate freely).

(3) Tighten the half shaft mounting nut and its torque is 96-111N.m (9.8-11.3kg.m).

(4) Tighten the wheel mounting nut and its torque is 470-550N.m for 2-3.5t.

(5) Tighten the brake drum mounting nut and its torque is 206-225N for 2-3.5t.

4. Steering System

Type of Steering System		Rear Wheel Steering with Power Steering
Power Steering		
Forklift Truck Tonnage		2.0t, 2.5t, 3t, 3.5t
Cycloid Full Hydraulic Steering Gear		BZZ7-125
Steering Cylinder	Cylinder Diameter mm	Φ70
	Diameter of Piston Rod mm	Φ50
	Stroke mm	198 (total travel)
Diameter of Steering Wheel mm		Φ360

4.1 Overview

Steering system is mainly composed of steering wheel, fully hydraulic steering gear, cross cylinder steering axle, steering cylinder and pipeline, etc.

The steering wheel can be adjusted depending on the driver's operating habits. When the steering wheel rotates, the motion is passed to the full hydraulic steering gear, and the full hydraulic steering gear based on the turning angle of the steering wheel passes metrically the pressure oil from the diverter valve to the fuel tank through the pipeline; when the engine is shut off, the oil pump cannot supply oil and any manual steering can be achieved, but laborious.

(1) Steering gear (Figure 4-1)

The structure of the steering gear is shown in Figure 4-1, and it mainly includes cycloidal full hydraulic steering gear (see Figure 4-2), steering pipe column, connecting shaft and steering wheel; the steering pipe column and steering wheel can turn 5º forward and 15º backward to adapt to different needs of drivers; a horn button is arranged on the center of the steering wheel. The steering shaft through a universal joint is attached to the connecting shaft, and the connecting shaft is connected to the full hydraulic steering gear.

(2) Steering Cylinder (Fig 4-3)

Steering cylinder is in dual-action through type. The two ends of piston rod are connected with steering knuckle through link. Pressure oil from fully hydraulic steering gear enables the piston rod to move leftward or rightward through steering cylinder, thus to achieve leftward or rightward steering.

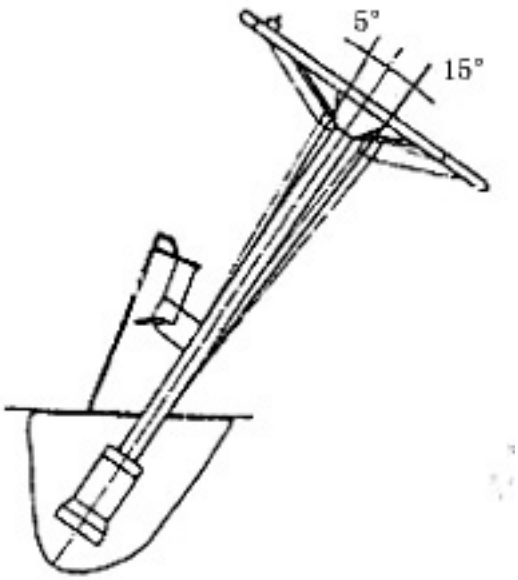


Fig 4-1 Steering gear

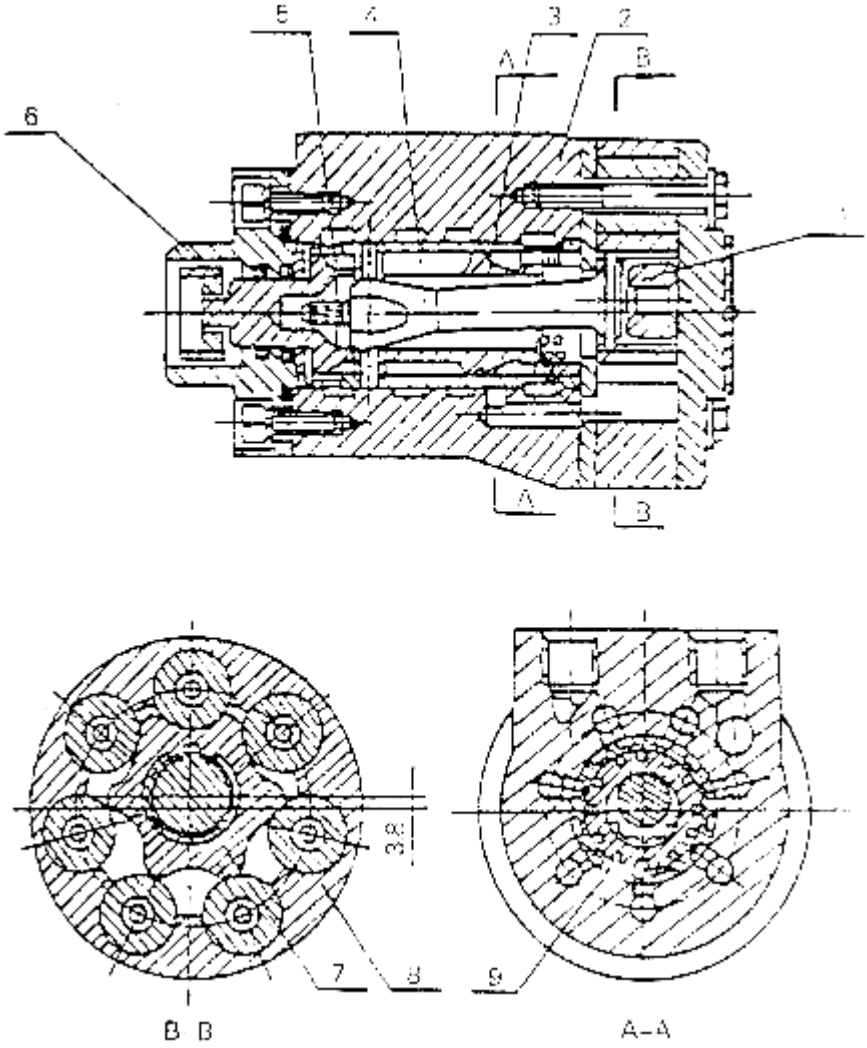


Fig 4-2 Cycloid Fully Hydraulic Steering Gear

1. Limit Post
2. Valve Body
3. Valve Core
4. Universal Driving Shaft
5. Leaf Spring
6. Connecting Block
7. Rotor
8. Stator
9. Valve Sleeve

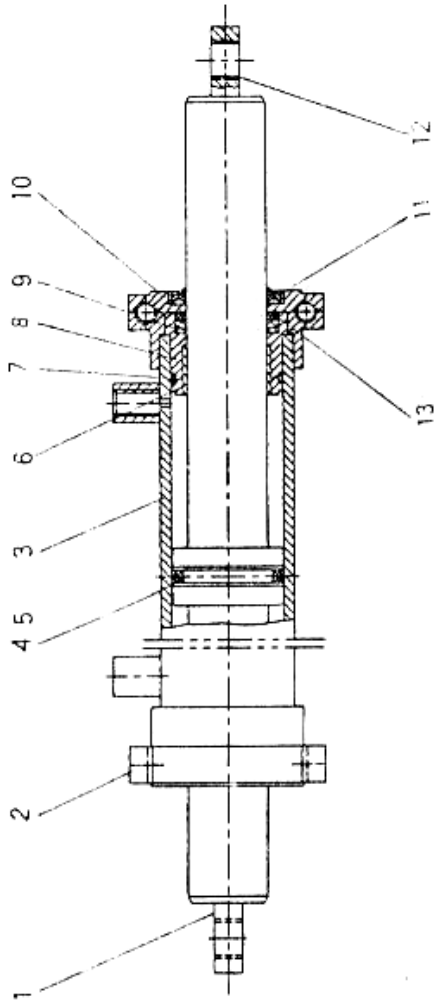


Fig 4-3 Steering Cylinder

1. Piston Body
2. Cylinder Cover
3. Cylinder Body
4. O-ring
5. Wear Ring
6. Shaft Sleeve
7. O-ring
8. Shaft Sleeve
9. YX Seal Ring
10. Gasket
11. Dust Ring
12. Lining
13. Block Film

4.2 Examination after Reassembly of Steering System

(1) Turn the steering wheel leftward and rightward thoroughly to see whether or not left and right force applications are uniform, and whether or not rotation is steady.

(2) Examine whether or not oil pressure pipeline is correctly arranged, and whether or not the left and right steering are reversely assembled.

(3) Jack up the rear wheels, and slowly turn the steering wheel leftward and

rightward. Repeat it for several times, and remove the air in the hydraulic pipeline and the cylinder.

4.3 Failure Removal for Steering System

Problem	Analysis Cause of Generation	Removal Method
Steering Wheel Fixed	Oil pump damaged or out of action	To be replaced
	Bypass valve blocked or damaged	To be cleaned or replaced
	Rubber hose joint damaged or pipeline blocked	To be replaced or cleaned
Steering Operation Toilsome	Bypass valve pressure too low	Pressure to be adjusted
	Air present in oil circuit	Air to be removed
	Reset of steering gear out of operation, and positioning leaf spring broken or elasticity insufficient	Leaf spring to be replaced
	Excessive internal leak of steering cylinder	Sealing of piston to be examined
Forklift Truck Serpentine or Swinging	Excessive steering flow	Flow of bypass valve to be adjusted
Abnormal Noise	Oil tank level low	Oil to be added
	Suction pipe or oil filter blocked	To be cleaned or replaced
Oil Leak	Sealing of steering cylinder guide sleeve damaged or pipeline or joint damaged	To be replaced

5. Cross Cylinder Steering Axle

Tonnage		2.0t、2.5t、3.0t、3.5t
Type of Axle Body		Supported with Central Supporting Shaft
Steering Angle	Inner Side Wheel	76º
	Outer Side Wheel	54º
King Pin	Center Distance of King Pin	1000mm
	Sidewise Inclination Angle	0º
Wheel Camber Angle		1º

Wheel

Tonnage	2.0t-3.5t	
Tyre	27×10-12-14PR	27×10-12-14PR
Wheel Rim	8.00G	8.00G
Charging Pressure	6.5bar	6.5bar
Total Weight	About 20Kg	About 20Kg

5.1 Overview

Steering axle is in a type of welded structure of a box cross section (Fig 5-1), and it is composed of steering axle body, steering cylinder, link, and steering wheel. Slider-crank mechanism is applied to steering trapezium. The steering knuckle is actuated by cylinder piston rod through link for rotation, for steering wheel to deflect, thus to achieve steering. Steering axle is prized on the tail bracket in the rear part of truck frame using bolts through bearing seas via forward and backward pin shafts, for the axle body is able to swing round the pin shaft. One left and right steering knuckle is available respectively on left and right of steering axle. The rear wheel hub is mounted on the shaft of steering knuckle using two tapered roller bearings. The wheel is prized on the wheel hub through wheel rim. Oil seal is fitted on the inner side of bearing, for lubricating grease to be retained inside the wheel hub and the steering knuckle.

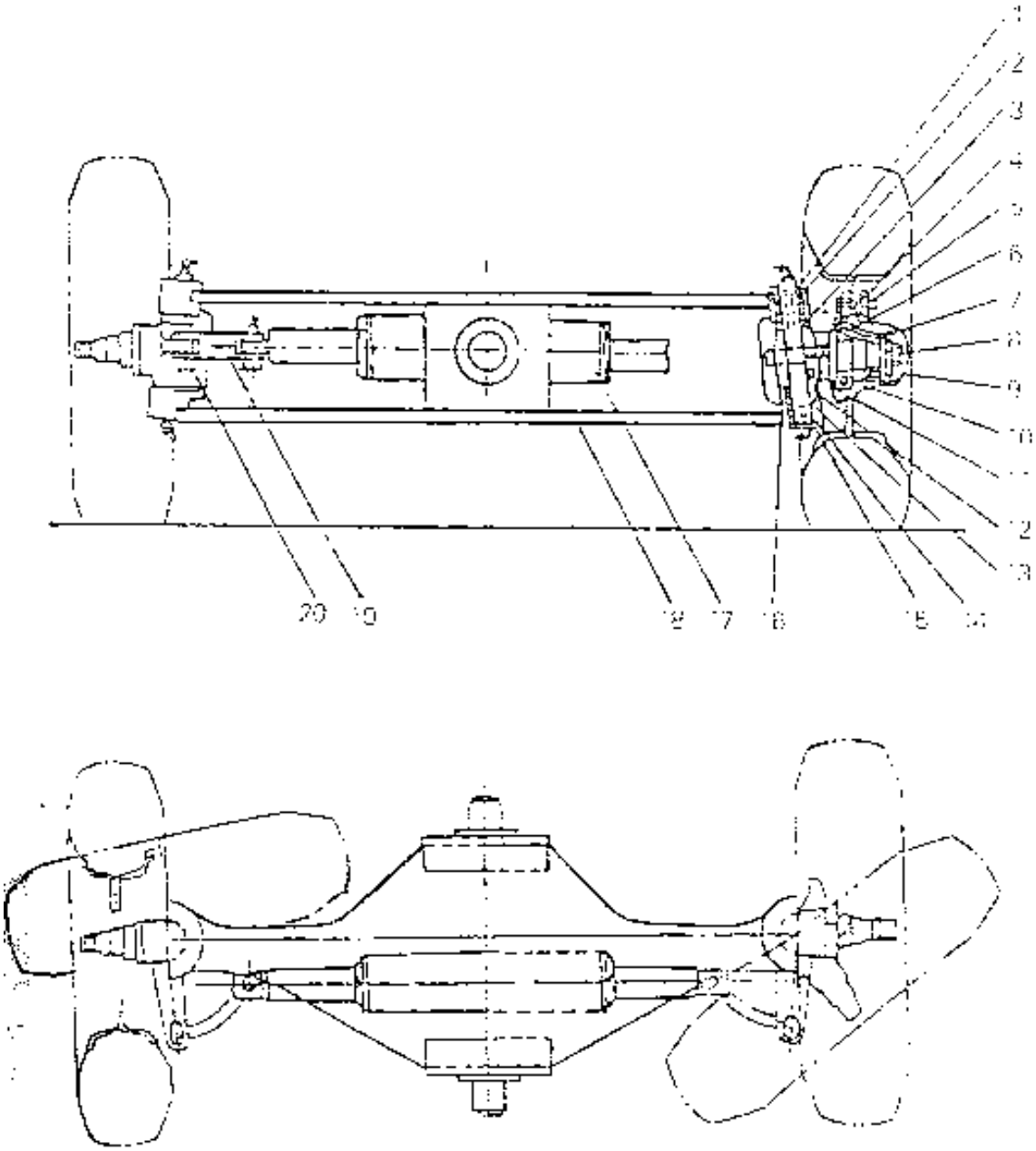


Fig 5-1 Steering Axle

1. Oil Seal
2. Needle Roller Bearing
3. Thrust Bearing
4. Oil Seal
5. Wheel Hub Nut
6. Tapered Roller Bearing
7. Tapered Roller Bearing
8. Lock Nut
9. Wheel Hub Cover
10. Steering Wheel Hub
11. Lock Pin
12. Adjusting Washer
13. Needle Roller Bearing
14. Oil Seal
15. Steering Knuckle King Pin
16. Steering Knuckle
17. Steering Cylinder
18. Steering Axle Body
19. Link
20. Pin Shaft

5.2 Steering Knuckle and Steering King Pin

Steering knuckle is mounted between the upper and lower shaft sleeves on the two ends of steering axle body using steering knuckle king pin, thrust bearing, and gasket.

The middle part of king pin is locked on steering knuckle using lock pin, while the two ends of king pin are supported by needle roller bearings pressed on the axle body. Oil seals are mounted on the two ends of needle roller bearings, and oil cup is fitted on the king pin.

5.3 Adjustment for Pre-tightened Load of Steering Wheel Bearing

(1) As indicated in Fig 5-2, the internal cavities of internal and external bearings as well as wheel hub cover are added with lubricating grease, and at the same time some lubricating grease shall also be coated on the lip of oil seal.

(2) Fix the bearing outer ring onto the wheel hub, and mount the wheel hub onto the shaft of steering knuckle.

(3) Mount the flat washer and tighten the slot nut, and its torque is 206-235N.m (21-24kgm). Loosen the slot nut and then tighten this nut, with its torque as 9.8N.m (1kgm).

(4) Knock at the wheel hub gently using wood hammer, turn the wheel hub manually by 3-4 circles, to ensure a steady rotation, and measure the rotating torque, with its value as 2.94-7.8N.m (0.3-0.8kgm).

(7) When rotating torque is higher than the specified value, it may be returned by 1/6 circles, and then measure its rotating torque.

(8) Lock up the slot nut using cotter pin, when specified rotating torque is reached.

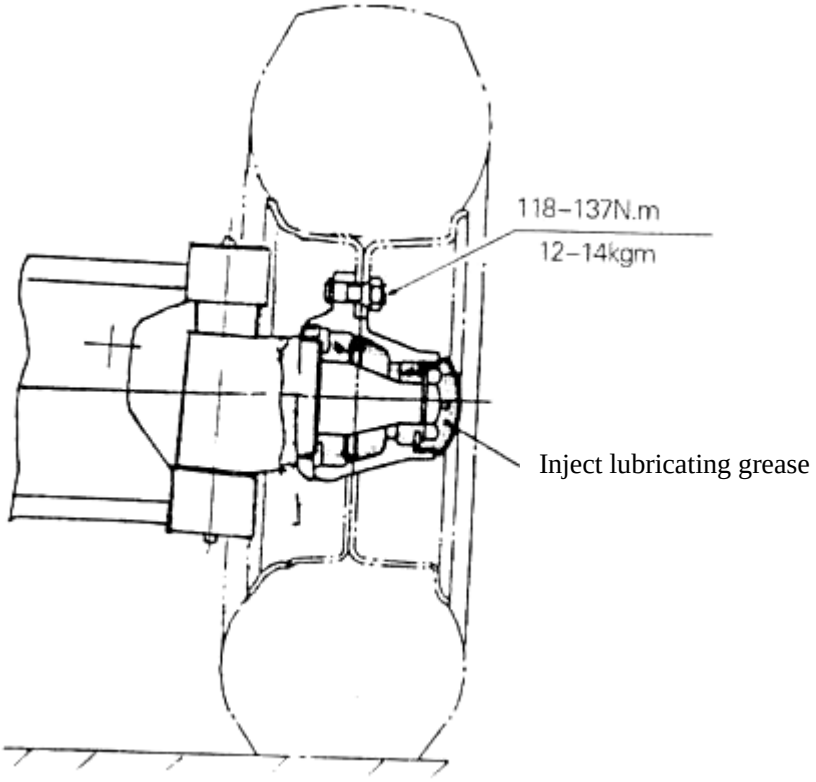


Fig 5-2 Adjustment for Pre-tightened Load

6. Brake System

Type	Front Twin Wheel Brake, Internal Expansion, Hydraulic	
Pedal Lever Ratio	5.66	
Master Cylinder Diameter	19.05mm	
Wheel Brake	2-2.5t	3-4t
Type	Dual Servo Type with Parking Brake	
Wheel Cylinder Diameter	28.58	
Size of Brake Shoe (L ×W × T)	324×60×7mm	348×76×8mm
Area of Brake Shoe	194.4 cm^2×4	264 cm^2×4
Inner Diameter of Brake Drum	310mm	314mm
Parking Brake	Front Twin Wheel Brake, Internal Expansion, and Hydraulic Type	

6.1 Overview

Brake system is in a front double-wheel brake type, and it is composed of brake master cylinder, brake, and brake pedal mechanism.

6.2 Brake master cylinder

Brake master cylinder includes one valve seat, one one-way valve, and one return spring, as well as rubber cup, piston, and auxiliary rubber cup. The end part is fixed using thrust washer and stop steel wire, while and external part is protected through rubber dust cap. The master cylinder piston acts through push rod through operating brake pedal. When brake pedal is pushed down, the push rod pushes forward the piston, and the brake fluid in the cylinder body flows back to oil tank through return oil port, until the main rubber cup blocks the return oil hole. After main rubber cup has pushed the return oil port, the brake fluid in front cavity of master cylinder is compressed and opens the one-way valve, thus to flow to the wheel cylinder through bypass pipeline. In this way, the pistons of respective wheel cylinders extend outwards, for the friction plate of brake shoe and the brake drum to get into contact with each other, to achieve the effect of deceleration or brake. At this point, the rear cavity of piston is supplemented with the brake fluid from return oil port and oil inlet port. When brake pedal is loosened, the piston is pressed by return spring, and at the same time the brake fluid in respective brake cylinders are likewise compressed by return spring of brake shoe, for brake fluid to return to the master cylinder (the front cavity of piston) through one-way valve. The piston will return to original place, the brake fluid in master cylinder will flow back to oil tank through return oil port, and the pressure of one-way valve is adjusted to certain proportion to the remaining pressure in brake cylinders, so that the rubber cup of wheel cylinder is correctly placed to prevent oil leak, and to eliminate the effect of choke that may possibly arise during emergency brake.

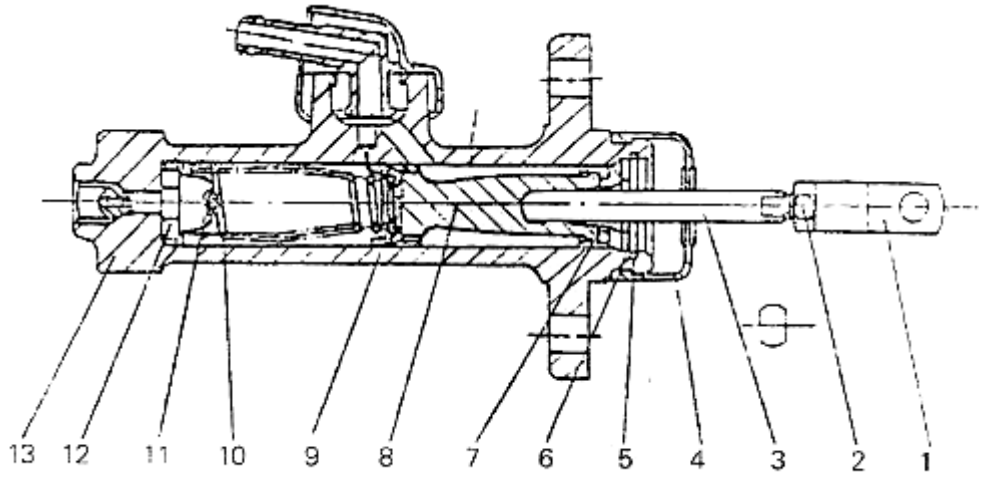


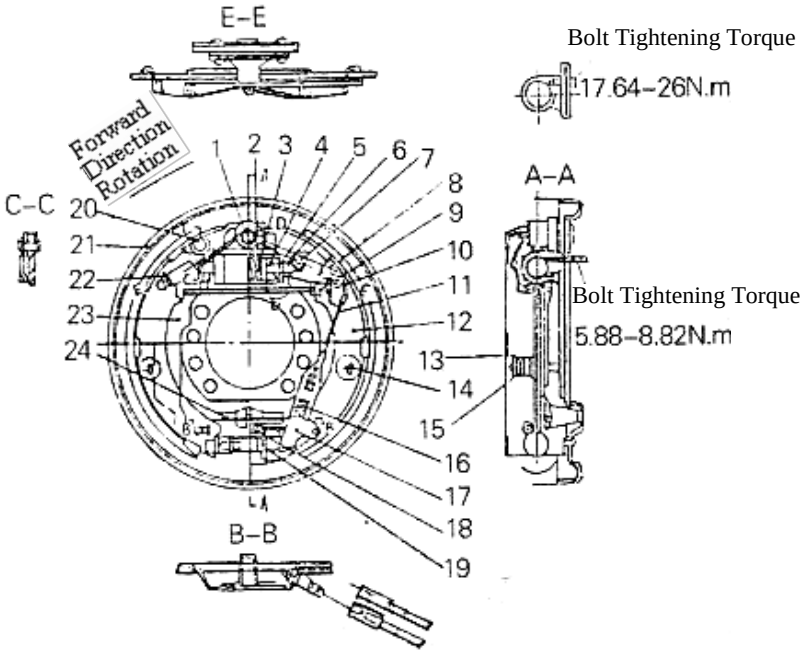
Fig 6-1 Brake Master Cylinder

1. Clevis	5. Stop Steel Wire	9. Main Cup	13. Pump Body
2. Lock Nut	6. Stop Washer	10. Spring	
3. Push Rod	7. Auxiliary Cup	11. One-way Valve	
4. Dust Cap	8. Piston	12. Valve Seat	

6.3 Wheel Brake

Wheel brake is in an internal expansion and hydraulic type, and it is composed of brake shoe, spring, wheel cylinder, adjuster, and bottom plate. The two brakes are respectively mounted on the two ends of front axle. One end of brake shoe is connected with support pin, while the other end is connected with clearance adjuster, and bears down onto the bottom plate by spring and tension spring pull rod. Lever L H Brake is mounted on primary brake shoe, while adjustment pull rod for automatic clearance adjuster is fitted on secondary brake shoe. Refer to Fig 6-2.

1. Brake Cylinder Assembly
2. Spring
3. Rubber Cup
4. Piston
5. Wheel Cylinder Shield
6. Piston Top Rod
7. Brake Shoe Return Spring
8. Brake Shoe
9. Spring
10. Hand Brake Push Rod
11. Spring Stay Wire Device
12. Brake Shoe
13. Washer,cup
14. Pin, shoe hold
15. Pressure Spring
16. Spring



17. Ratchet
18. Spring
19. Clearance Adjuster Assembly
20. Pin
21. Bottom Plate
22. Brake Shoe Return Spring
23. Lever L H Brake
24. Brake Steel Cable Assembly

Fig 6-2 Wheel Brakes

The brake action in forward movement is as follows (as indicated in Fig6-3). Through operating brake wheel cylinder, the primary brake shoe and the secondary brake shoe are effected by two forces of equal size but reverse directions, respectively, for brake shoe and brake drum to get into contact with each other, while the primary brake shoe is pressed onto the adjuster with support of friction force between brake shoe and brake drum, thereby for clearance adjuster to generate a larger force used to operate the wheel cylinder to push the secondary brake shoe, and to force the upper end of secondary brake shoe to bear down on the support pin, thus to get a relatively large brake force. In another connection, the reversing brake action is performed in reverse direction, but the brake force is the same as that during forward movement.

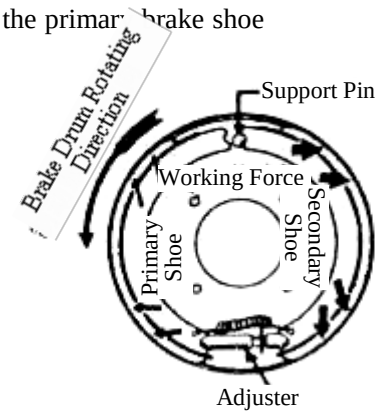


Fig 6-3 Brake Actions during Forward Running Process

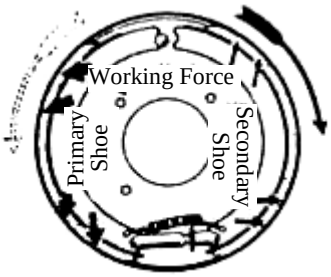


Fig 6-4 Brake Actions during Reversing Process

6.4 Automatic Clearance Regulator

The automatic clearance adjuster is able to automatically maintain the clearance between brake shoe and brake drum between 0.25-0.4mm. However this adjuster only acts during reversing brake. During reverse movement, the brake shoe will disengage once the brake pedal is pushed down, thereby, the secondary and the primarily brake shoes will begin to get into contact with brake drum for rotation together, until the upper end of primarily brake shoe begins to get into contact with support pin.

Meanwhile when secondary brake shoe is released from the support ping, the A

part of adjusting lever (Refer to Fig 6-5.) is relatively in tension, thus for adjusting lever to rotate around the B part, for C part to lower, and the D part of adjuster to rotate leftward, so as to achieve the objective of automatic adjustment. When brake pedal is further pushed down, the pressure applied to both ends of adjust is larger, which has increased the resistance to thread rotation, for the force of adjusting lever to be unable to actuate rotation of part D.

6.5 Manual brake

Manual brake adopts a hand-pull flexible shaft body; together with the foot brake, it uses an automatic power shoe brake that acts on the front wheels. Only when the forklift truck has parked, the manual brake can be used.

Before adjusting the manual brake, decide whether the drive axle braking system functions properly. 1) Adjust the nut B, so the length is equal to 68mm, and then tighten the lock nut B. 2) Screw and adjust the nut A to adjust the manual brake's pulling force. The pulling force is 147-196N on the P point in the Q direction of the locking handle. 3) After the manual brake lever is correctly adjusted, release the manual brake lever, to ensure the brake is fully released. 4) Ensure that the manual brake works properly through the above adjustments.

Note: coat appropriate amount of lithium base grease onto the guide rail C and keep regular painting.

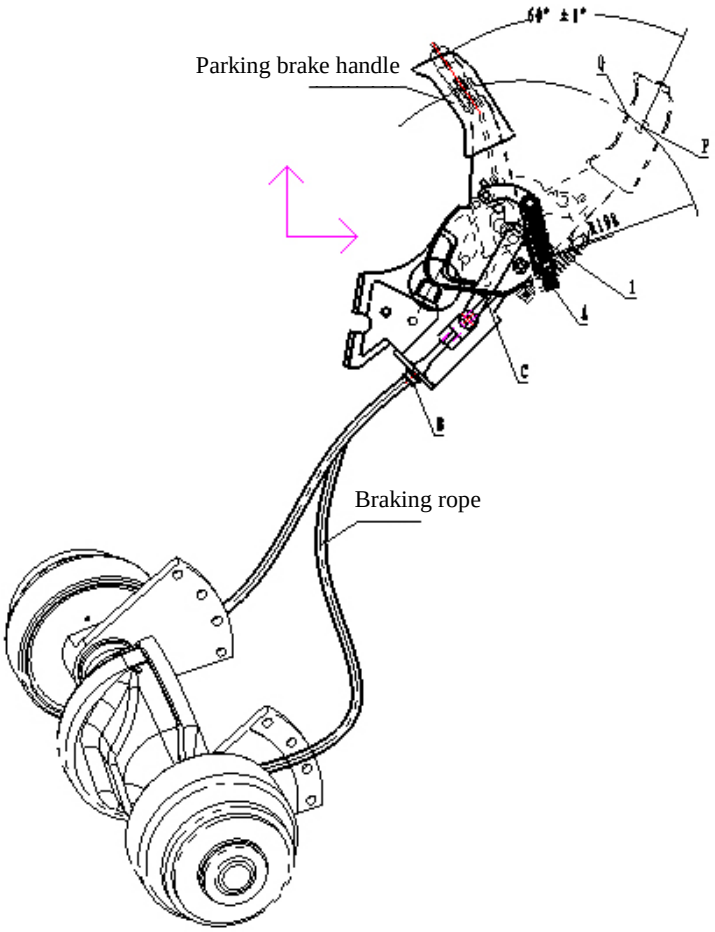


Fig 6-5 Parking Brake Device

6.6 Adjustment of Brake Pedal

Adjust the stop bolts, and the pedal stroke is 20mm. Tighten the stop bolts, to ensure that the foot brake can work properly.

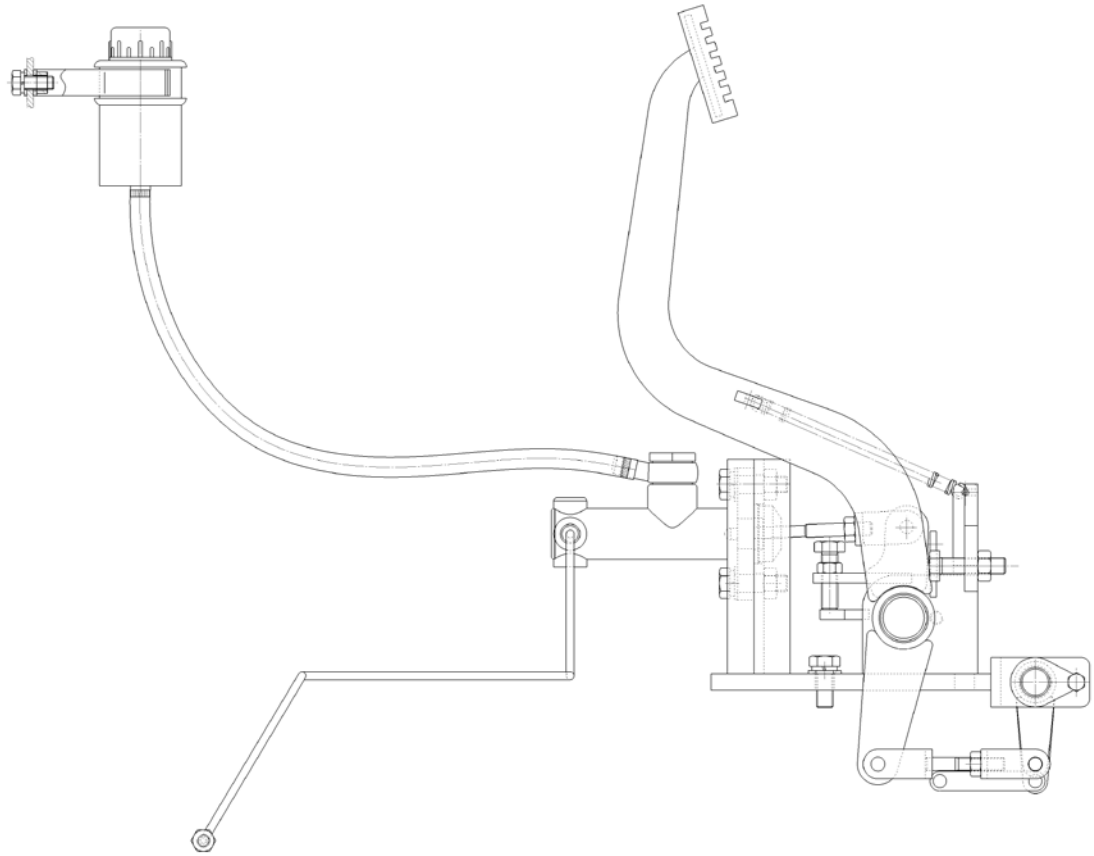


Fig 6-6 Adjustment of Brake Pedal

6.7 Maintenance

This section covers brake disassembly, reassembly, and adjustment.

6.7.1 Disassembly of Wheel Brake

(1) Remove the fixed spring of secondary brake shoe, and take off the adjusting lever, top lever, and the top lever return spring (Fig 6-7);

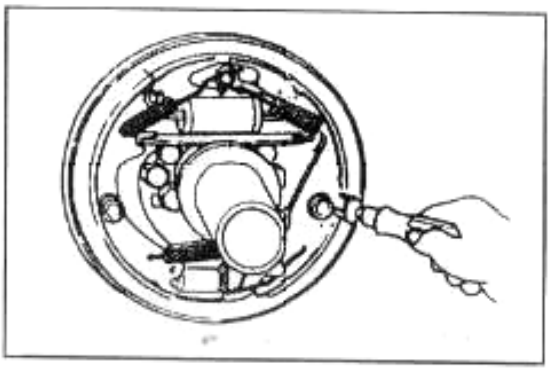


Fig 6-7

(2) Remove the return springs for the two brake shoes (Fig 6-8)

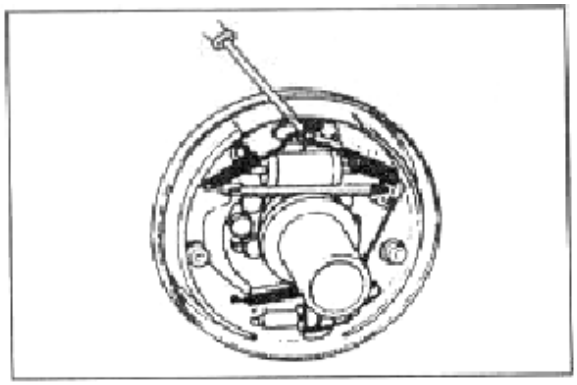


Fig 6-8

(3) Remove the other three fixed springs (Fig 6-9)

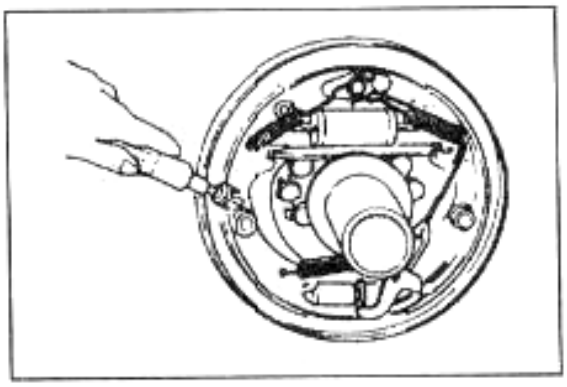


Fig 6-9

(4) Detach the primary brake shoe and the secondary brake shoe, and at the same time remove the spring for adjuster. (Fig 6-10)

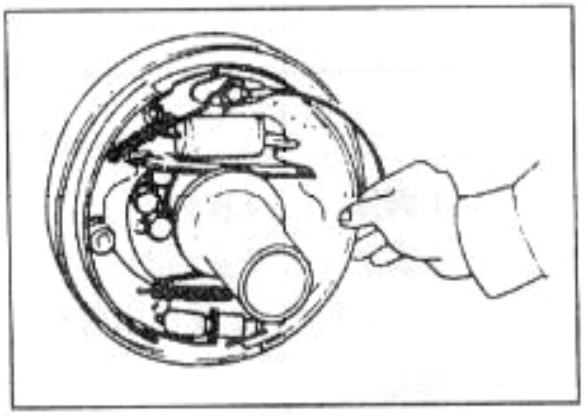


Fig 6-10

(5) Demount the brake oil pip on the wheel Cylinder, then remove the mounting bolts for wheel cylinder, and separate the wheel cylinder from the bottom plate. (Fig 6-11)



Fig 6-11

(6) Remove the E-shaped retainer ring that fastens the brake cable onto the bottom plate, then remove the mounting bolts on bottom plate, and detach the bottom plate from the axle. (Fig 6-12)·

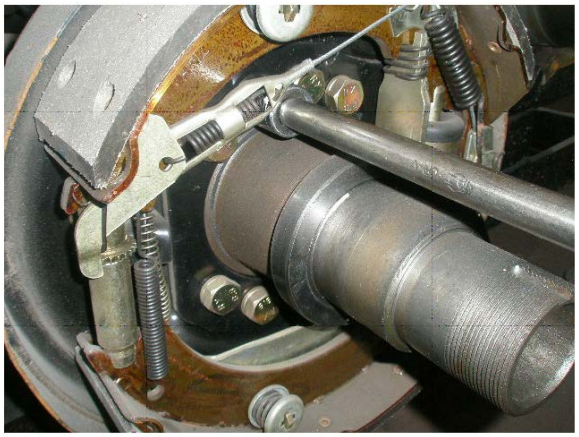


Fig 6-12

(7) Remove the shield for wheel cylinder, and push out all the parts inside the cylinder (Fig 6-13)



Fig 6-13

6.7.2 Examination of Wheel Brake

Examine all the parts as to whether or not any of them is worn or damaged, and it shall be repaired or replaced, if incompliant.

(1) Examine whether or not the inner surface of wheel cylinder body and the surface of piston column are rusted, and then measure the clearance between piston and cylinder body.

Specified Value: 0.065mm-0.150mm (2-3.5t Forklift Truck);

Maximum Value: 0.15

(2)Visually check whether or not the pump rubber cup is damaged or distorted, and replace it if incompliant.

Outer Diameter of Rubber Cup: $\Phi 30.1_{-0.2}$ (2-3.5t)

The standard value for interference of rubber cup is 1.52, and the minimum value is 0.42 (2-3.5t)

(3) Examine the free length of wheel cylinder spring, and replace it is improper.

It is specified that the free lengths of wheel cylinder springs for 3t, and 3.5t forklift trucks as well as 2t forklift truck are respectively 58mm and 60mm.

(4) Examine the thickness of brake shoe, and replace it if it is found to be excessively worn out.

Specified Thickness: 7.2mm (2-3.5t) 8.0mm (3t-3.5t)

Minimum Thickness: 2.0mm (2-3.5t) 1.0mm (3t-3.5t)

(5) Examine the status of inner surface of brake drum, and it shall be rehabilitated or replaced, if it is found to be excessively worn out.

Standard Value: 310mm(2t) 314mm(3t,4t)

$254^{+0.13}_{0}$ mm（1-1.8t）

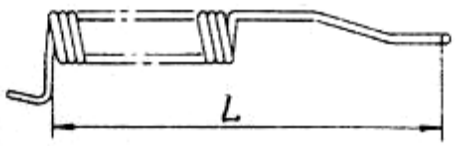


Fig 6-14

Maximum Value after Rehabilitation: 312mm (2t) 316mm(3t,4t)

256mm (1-1.8t)

(6) Measure the free length and installation load of return spring for brake shoe (Fig 6-15). Refer to Part 7 of Fig 6-2

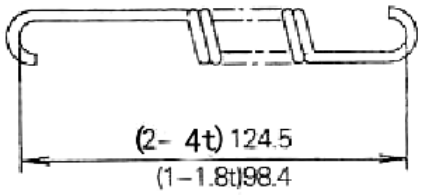


Fig 6-15

Free Length: L=106mm (2t) L=102mm (1-1.8t)

L=115.1mm (3t, 4t)

Installation Length: 116mm (2t) 111mm (1-1.8t)

122mm (3, 4t)

Installation Load: 246N (2t) 157±15N (1-1.8t)

225N (3t, 4t)

(7) Measure the free length and installation load of return spring for top rod (Fig 6-16). (Refer to Part 9 of Fig 6-2)

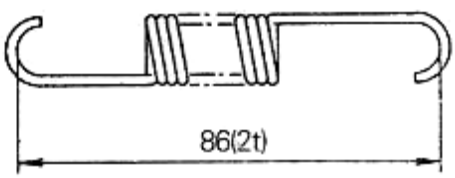


Fig 6-16

Free Length	124.5mm
Installation Length	130mm
Installation Load	245N
Forklift Truck Tonnage	2-4t

(8) Measure the free length and installation load of adjuster spring (Fig 6-17 and Fig 6-18). (Refer to Part 18 of Fig 6-2)

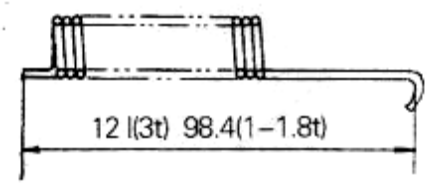


Fig 6-17

Free Length: 86mm (2t) 121mm (3t,4t)
98.4mm(1-1.8t)
Installation Length: 97mm (2t) 137mm (3t,4t)
126mm (1-1.8t)
Installation Load: 153N (2t) 71.5N (3t,4t)
50±5N (1-1.8t)

(9) Measure free length and installation load of ratchet spring (Fig 6-18). Installation Load: 14.7N (3t, 4t) 12N (1-1.8t)

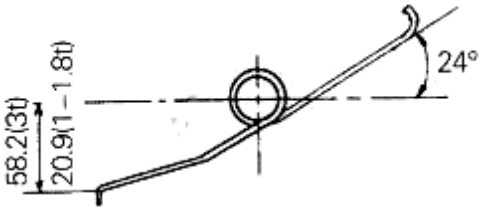


Fig 6-18

(10) Examine whether or not the adjusting mechanism is damaged, how the operating status is, and also examine whether or not the contact of adjusting lever is out of order, and replace it when necessary.

6.7.3 Reassembly of Wheel Brake

(1) Firstly dip the wheel cylinder rubber cup and the piston with brake fluid, and then assemble spring, rubber cup, piston, and shield in turn.

(2) Mount the wheel cylinder on bottom plate.

Attention: Ensure that respective parts are all at the correct position during installation, and the bolt tightening torques are 17.6-26.5.N.m (3t-5t).

(3) Mount the bottom plate onto the front axle.

Bolt Tightening Torque: 120-140N.m

(4) Add #2 calcium base lubricating grease at a, b, c, d respective lubricating pints as indicated in Fig 6-19, and be careful not to allow this grease to be adhibited on brake shoe.

(a) Support Face of Bottom Plate (b) Support Pin of Lever L H Brake

(c) Support Pin (d) Adjuster Thread and Other Rotating Parts

(e) Contact Face of Brake Shoe and Washer Cup

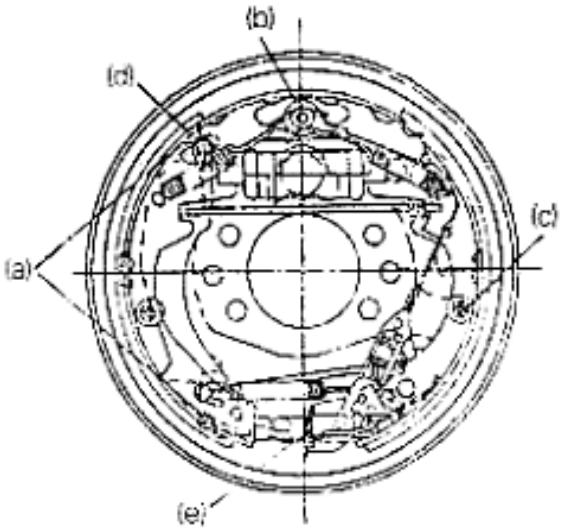


Fig 6-19 2t-3.5t Forklift Truck

(5) Mount the brake cable assembly onto the bottom plate using E-shaped retainer ring.

(6) Mount the brake shoe onto the bottom plate using fixing spring, but the bottom part of secondary brake shoe shall be mounted with fixing spring after the washer, cup and the adjusting lever have been properly installed, to ensure that the pressure seat is fitted in the holes of brake shoe and adjusting lever (Fig 6-20).

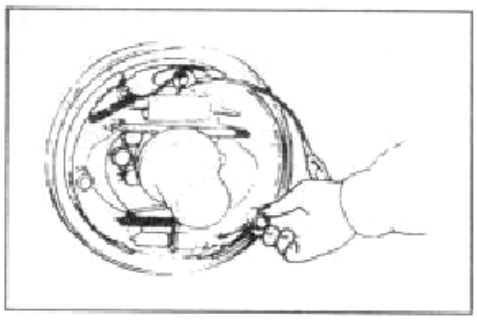


Fig 6-20

(7) Mount the compressed spring onto the hand brake push rod, and then install the push rod onto the brake shoe.

(8) Mount the guide plate of brake shoe onto the support pin, and then install the return spring of brake shoe (Fig 6-21)

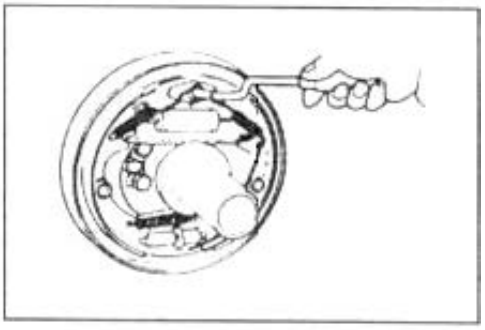


Fig 6-21

(9) Install adjuster, adjuster spring, top rod, and return spring for top rod (Fig 6-22).

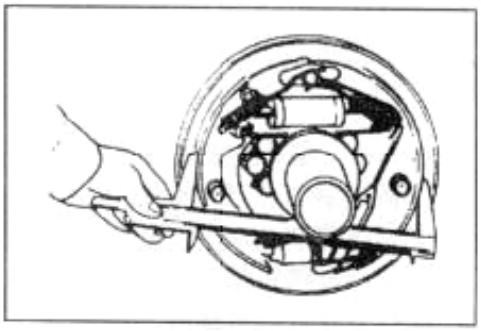


Fig 6-22

Pay attention to the following respective items:

a) Adjuster threat direction and its installation direction (left-hand thread is used for left brake, while right-hand thread is used for right brake.)

b) Adjuster spring direction (It is not allowed for the tooth part of adjuster to contact the spring.)

c) Top rod return spring direction (At the end of support pin, the spring hook shall be fixed on the opposite side of top rod.)

d) Top rod and top rod return spring shall be fixed inside the sloth of support pin.

e) Make sure that the lower end of adjusting lever shall be in contact with the tooth part of adjuster.

(10) Connect the brake oil pip onto the wheel cylinder.

(11) Measure the inner diameter of brake drum, and adjust the adjuster for the differences between the inner diameter of brake drum and the friction plate of brake shoe to be: 0.5-0.8mm (2-3.5t).

6.8 Operating Test on Automatic Clearance Regulator

(1) Firstly allow the diameter of brake shoe to approach the installation size, and pull the adjusting lever with hand in the direction as indicated by the arrow in Fig 6-25 for adjust to rotate. When hand is released, the adjusting lever returns to its original place, while the gear of adjuster will not rotate.

Attention: Even if when hand is released, and the adjuster gear and the adjusting lever return together, the adjuster is still able for normal work after being assembled.

(2) In the case when adjusting lever is pulled, and the adjuster cannot do the abovementioned action, the following items shall be examined:

a) Mount the adjusting lever, the top rod, the top rod spring, and the washer,cup firmly.

b) Examine whether or not the relationship in arrangement between adjusting lever and adjusting gear is correct. Refer to Fig 6-25 (2t), Fig 6-26 (3t, 4t, and 1-1.8t), and replace the parts if not satisfactory. In addition, examine whether or not lever and gear are in contact with each other.

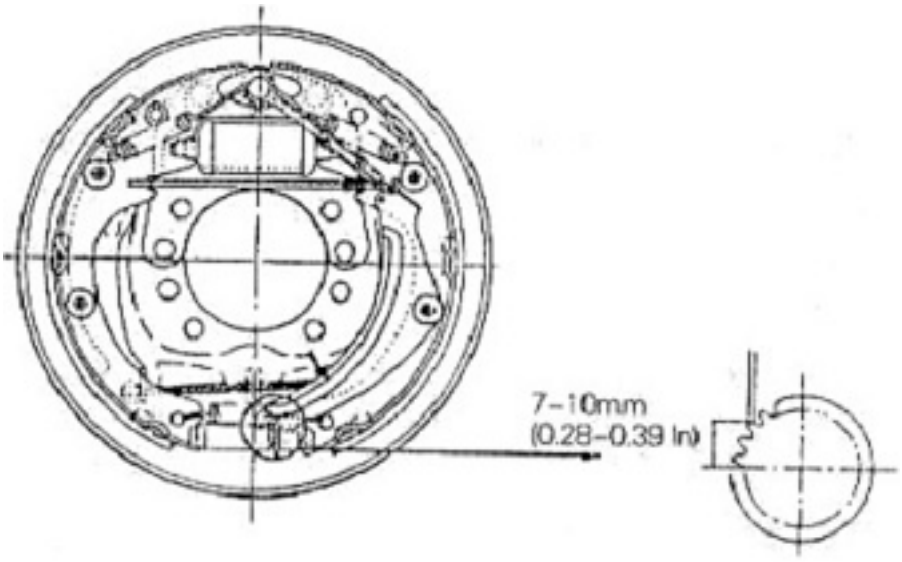


Fig 6-23

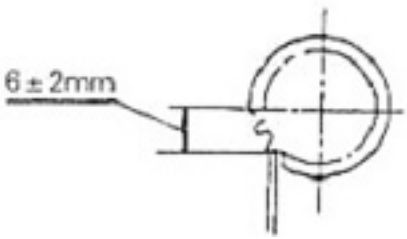


Fig 6-24

c) Examine whether or not the return spring of top rod and the spring for adjuster are damaged, and then examine the rotating status of adjuster gear and whether or not its engaged part is excessively worn out or damaged.

6.9 Failure Removal for Wheel Brake

Problem	Analysis for Cause of Generation	Removal Method
Brake under Poor Condition	1. Oil leak with brake system 2. Clearance of brake shoe not properly adjusted 3. Brake too hot 4. Contact between brake drum and brake shoe under poor condition 5. Impurity attached on brake shoe 6. Impurity blended into brake fluid 7. Brake pedal (inching valve) improperly adjusted	To be repaired Adjuster to be adjusted Examine whether or not skidding exists To be readjusted To be repaired or replaced Brake fluid to be examined To be adjusted
Noise Present with Brake	1. Surface of brake shoe hardened or impurity attached on it 2. Bottom plate distorted or bolt loosened 3. Brake shoe distorted or installation incorrect 4. Brake shoe worn 5. Bearing of wheel loosened	To be repaired or replaced To be repaired or replaced To be repaired or replaced To be replaced To be repaired
Brake Un-uniform	1. Oil stain present on surface of brake shoe 2. Clearance of brake shoe not properly adjusted 3. Wheel cylinder out of operation 4. Brake shoe return spring damaged 5. Brake drum deflected	To be repaired or replaced Adjuster to be adjusted To be repaired or replaced To be replaced To be repaired or replaced
Brake Weak	1. Oil leak with brake system 2. Clearance of brake shoe not properly adjusted 3. Air blended into brake system 4. Adjustment of brake pedal incorrect	To be repaired or replaced Adjuster to be adjusted Air to be bled To be readjusted

7. Hydraulic System

Forklift Truck Tonnage			2-2.5t	3.5t
Equipped Engine			4TNE98	
Main Pump	Model		SGP1A28.2D2H 9-R330C	
	Type		Gear Type	
	Driving		Driving with Engine Power Output Gear	
	Loaded Displacement		72 L/Min	
	No-load Displacement		76 L/Min	
Multi-way Valve	Model		CDB3-F15XF-02	
	Type		Double Spool Valve, with Overflow Valve, Bypass Valve, and Inclined autolocking Valve, Pilot valve load feedback	
	Adjusting Pressure		20MPa	
	Bypass Valve	Pressure	10 MPa	
		Flow Rate	12 L/Min	
Lift Cylinder	Type		Single Act Piston Type, with Shutoff Valve, one-way valve and lower buffer	
	Cylinder Inner Diameter		2-2.5t: Φ50mm	3.5t: Φ56mm
	Stroke		(2^{nd}-grade Standard Mast at 3m Lifting Height) 1495mm (Varying along with Type of Mast and Lifting Height)	
Tilt Cylinder	Type		Double Act	
	Cylinder Inner Diameter		Φ80mm	
	Piston Rod Outer Diameter		Φ35mm	
	Stroke		174.5	

7.1 Overview

Hydraulic system is composed of main oil pump, multi-way valve, lift cylinder, tilt cylinder, and oil pipeline, as well as the direct transmission oil pump of engine power-take-off (P.T.O).

7.2 Main Oil Pump

The main oil pump is a gear pump, mainly composed of pump body, pump cover, one pair of gears, bearing, and seal ring. Load balanced bearing and special lubricating method are applied to main oil pump, for the end face of gear to gain the minimum clearance.

As pump body and pump cover are light and firm, as they are made of alloy aluminum. The two shafts respectively provided for driving gear and driven gear are separately installed on the bearing of pump body. These bearings are made of special material, to bear the radial load of gear shaft on one hand, and to serve as the baffle seat for the end face of gear on another.

On the side of drive shaft, one oil seal is pressed and fitted on the pump body, to ensure the sealing property. The sealing between pump body and cover is ensured with seal ring in special shape mounted.

7.3 Multi-way Valve and Bypass Valve (Fig 7-1)

The 2-disk multi-way valve consists of four-plate valve body, two spool valves, one safety overflow valve, and one bypass valve. The four-plate valve body is assembled using three stub bolts and nuts, and the inclined spool valves are mounted with inclined autolocking valve.

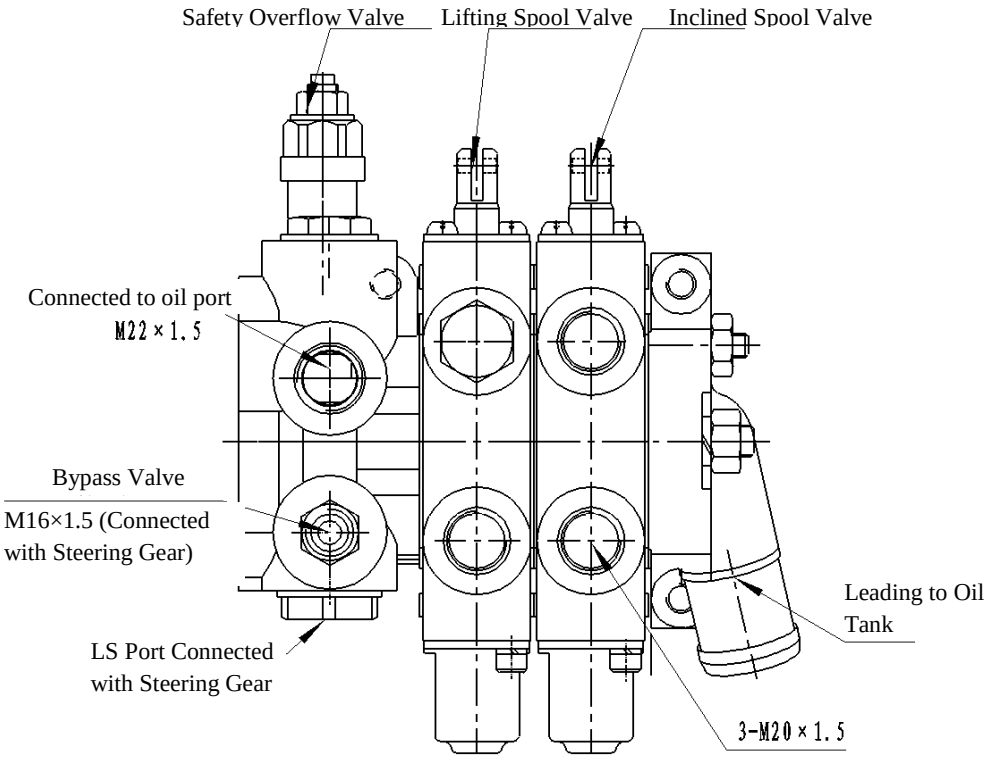


Fig 7-1 Multi-way Valve

7.3.1 Operation of Spool Valve (Taking inclined Spool Valve as example)

(1) Neutral Position (Fig 7-2)

At this point the High-pressure oil drained from oil pump returns to oil tank through neutral position.

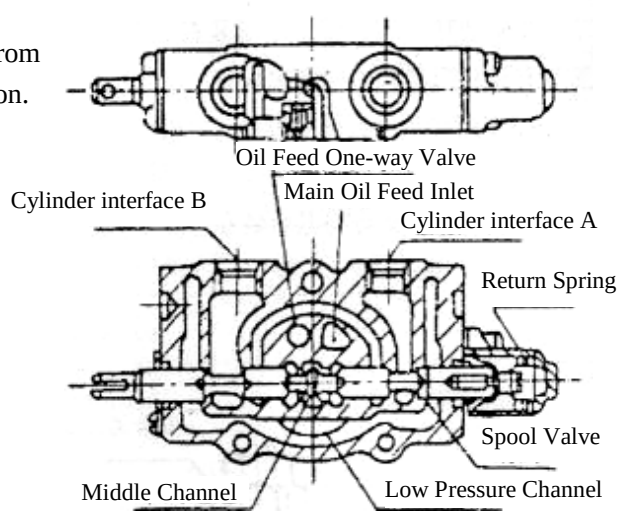


Fig 7-2

(2) Push-in Spool Valve (Fig 7-3):

At this point middle channel is closed, the oil from oil inlet port opens the one-way valve and flows to the interface B of cylinder, while the oil from cylinder interface A flows to oil tank through low-pressure channel. By virtue of return spring, it may allow the spool valve to return to neutral position.

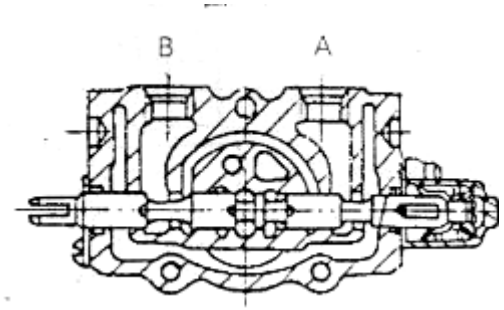


Fig 7-3

(3) Pull-out Spool Valve (Fig 7-4)

At this point when neutral position is closed, the oil from the oil inlet port opens the one-way valve and flows to the cylinder interface A, while the oil from cylinder interface B flows to the oil tank through low-pressure channel. By virtue of return spring, it may allow the spool valve to return to neutral position

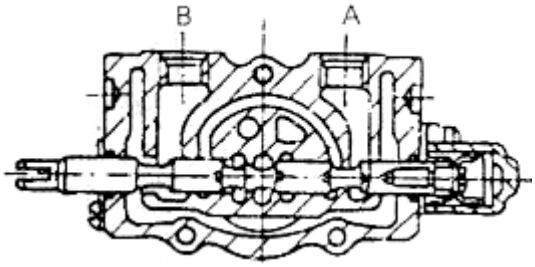


Fig 7-4

7.3.2 Main Safety Overflow Valve and Bypass Safety Valve (Fig 7-5)

The main safety overflow valve is composed of the two parts including main valve A and pilot valve B. When multi-way valve is reserved, the high-pressure oils in cavity C and working mechanisms (such as lift cylinder and tilt cylinder) are connected, the pressure oil acts on the pilot valve B, through the fixed throttle holes D and E. When system pressure is larger than the system regulated pressure, the pilot valve B is

opens, for the pressure in cavity F to drop. The valve core of the entire main valve A moves rightwards, for the pressure oil to be directly connected with low-pressure channel G, for cavity C to be relieved, in order to ensure the stability of system pressure. Adjusting screw H may be used to adjust the stable pressure value of the system.

The bypass safety valve is in a relatively simple structure, as a direct-acting type of overflow, to get a stable pressure value for steering system by making use of the principle for direct balance of liquid pressure with spring force. When operating wheel is operated, the oil cavity M is connected with high-pressure oil circuit. When system pressure is larger than spring pressure, the valve core N moves rightwards, and pressure oil is connected with low-pressure oil circuit through cavity T, for cavity M to be relieved, in order to ensure the stability for the pressure of steering system. Adjusting screw K may be used to adjust the stable pressure value of the system.

L valve is a balanced spool valve, and the spool valve L moves leftwards and rightwards through continuous change in flow and pressure to change the openness in the two places of R and S, to ensure that the flows to working cavity Q and outlet PS to fully hydraulic steering gear are automatically balanced, and to be passed by steadily according to proportion. a, b, and c are the fixed throttle holes

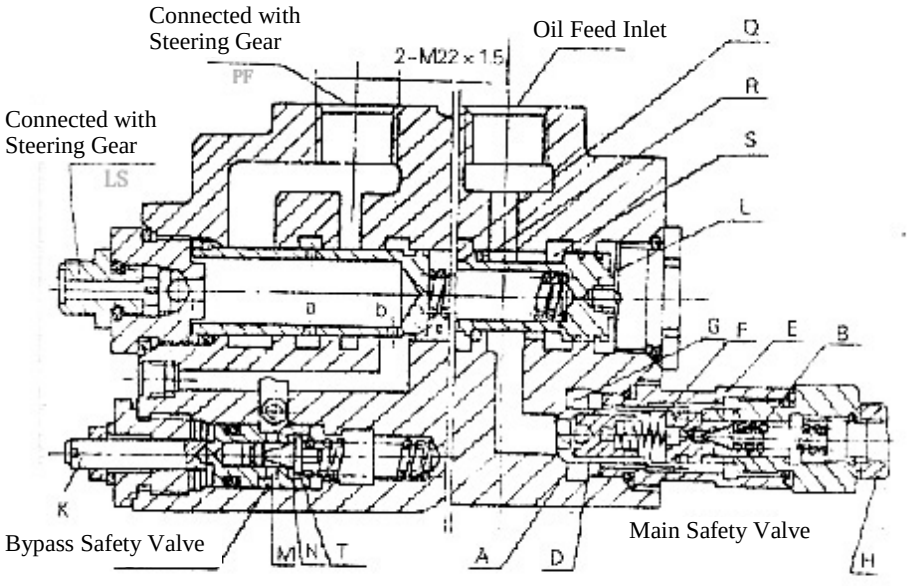


Fig 7-5

7.3.3 Action of Inclined Auto-lock Valve

The inclined spool valve is mounted with auto-lock valve, mainly used to prevent vibration possibly arisen from internal negative pressure of tilting cylinder, and avoid severe aftereffect caused by misoperation. For general conventional structure, the inclined spool valve can still be operated for it to tip forward after engine is turned off. However, when this tilt autolock valve is used, it cannot make the mast tip forward, even if the valve is operate with a big push, in the case when engine is turned off. Refer to Fig 7-6 for its structure.

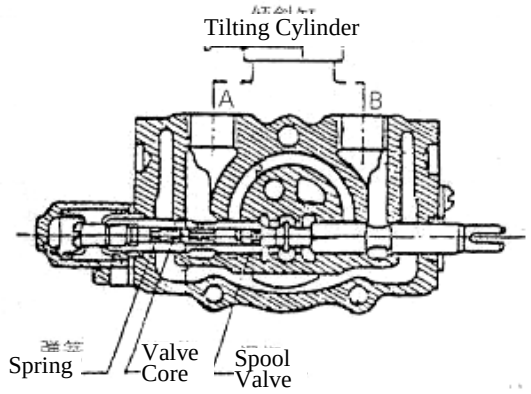


Fig 7-6

The interfaces “A” and “B” of valve body are respectively connected to the front and rear cavities of piston for tilting cylinder. When spool valve is pulled out, the high-pressure oil (P) enters into interface “A”, while the oil in the rear cavity returns from “B” to oil tank (T), and at this point the mast is under the back-tip status.

When inclined spool valve is pushed, the high-pressure oil enters into interface “B”, to allow the auto-lock valve in spool valve to act by virtue of high-pressure oil, while “A” is connected with low pressure. When engine turns off or stop rotation, there is no high-pressure oil for auto-lock inside the spool valve to act, hence the interface “A” cannot be connected with low pressure, the mast will not tip forward, and negative pressure can neither be formed in tilt cylinder.

7.4 Oil Circuit of Hydraulic System (Main Oil Circuit)

As in Fig 7-7, The high-pressure oil from the main oil pump reaches the multi-way pump, divided into two parts via multi-way valve and through the bypass valve therein: One part for high-pressure oil to be divided into lifting cylinder or tilt cylinder, and the other part is divided at an invariable flow rate into steering gear (with pilot valve load feedback), to control the steering cylinder. When lift and tilt two spool valves are at the neutral position, the high-pressure oil returns to oil tank directly through channel. When lift spool valve is pulled, the high-pressure oil passes through the throttle valve, and then pushes the piston rod upwards from downward of lift cylinder piston. When lift spool valve is pushed, the lower part of lifting cylinder piston is connected with low pressure, for piston rod to drop depending on self weight and cargo weight. At this point the oil flowing out from lifting cylinder passes through the throttle valve for the dropping speed to be controlled. When tilt spool valve is operated, the high-pressure oil may flow into the front cavity of tilting cylinder, while the other side is connected with low pressure, for the door frame to achieve the back tip or front tip action.

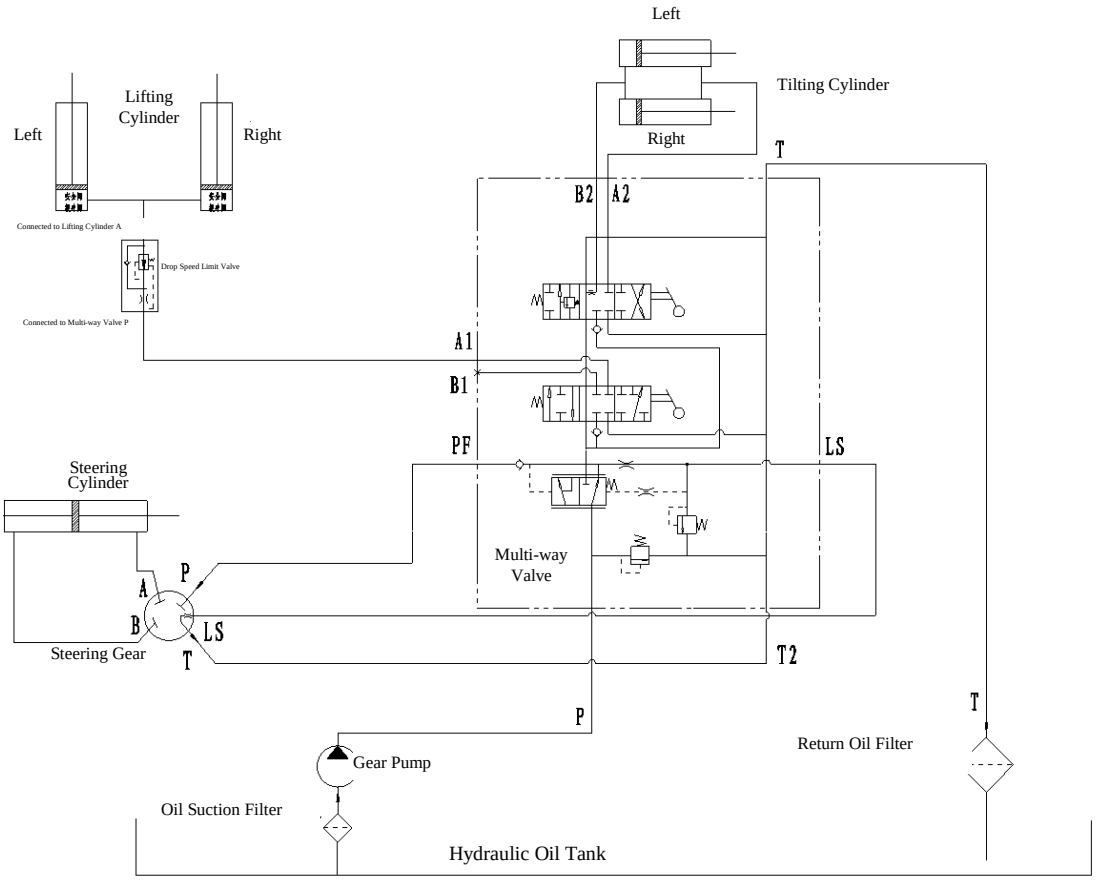


Fig 7-7 Oil Circuit of Hydraulic System

7.5 Lifting Cylinder

As in Fig 7-8, Two single-acting lifting cylinders are fixed on the rear side of channel steel for the outside mast, and the bottom part of cylinder is fixed on the bracket of lift cylinder on the outside mast using pins and bolts, while the top part of cylinder (namely the top part of piston rod) is connected with active beam. The piston strokes for the two cylinders shall be adjusted to be consistent, for the two cylinders to lift synchronously, and the part 29 may be adjusted to achieve the synchronization, if they are still not synchronized.

The lifting cylinder is mainly composed of cylinder body, piston, piston rod, cylinder cover, cylinder bottom and sealing parts. One oil port is available in the lower part of cylinder body, The piston is fastened onto the piston rod using slot nut and cotter pine, and one YX seal ring, retainer ring and wear ring are fitted on the outer edge of piston. This piston moves along the inner surface of cylinder body under the action of high-pressure oil. Shaft sleeve and dust ring pressed and matched are mounted in the inner hold of cylinder cover, and this shaft sleeve supports the piston rod, while the dust ring is able for cylinder body to resist dust. The stroke of piston may be adjusted by making use of cylinder cover.

When the lift spool valve of multi-way valve is pulled backwards, the high-pressure oil enters through the bottom part of lift cylinder, to push the piston and

the piston rod, for fork and inside mast to lift by virtue of lift chain. When lift spool valve is pushed forward, the piston of lift cylinder drops under the effect of piston rod, bracket, fork and cargo weight, for the oil under the piston to flow out. The oil drained out from lift cylinder is controlled by throttle valve, and returns to oil tank through multi-way valve.

1. Active Beam
2. Dust Ring
3. Shaft Cap
4. Cylinder Cover
5. O-Ring
6. Piston Rod
7. Cylinder Body
8. O-Ring
9. Piston
10. Wear Ring
11. Retainer Ring
12. Yx Seal Ring
13. Nut
14. Cotter Pin
15. Bolt
16. Pin
17. Spool Valve
18. Spring
19. Joint
20. O-Ring
21. Hoisting Chain
22. Plug
23. Screw
24. Retainer Ring
25. Sheave
26. Plug
27. Chuck Plate
28. Bolt
29. adjusting Washer

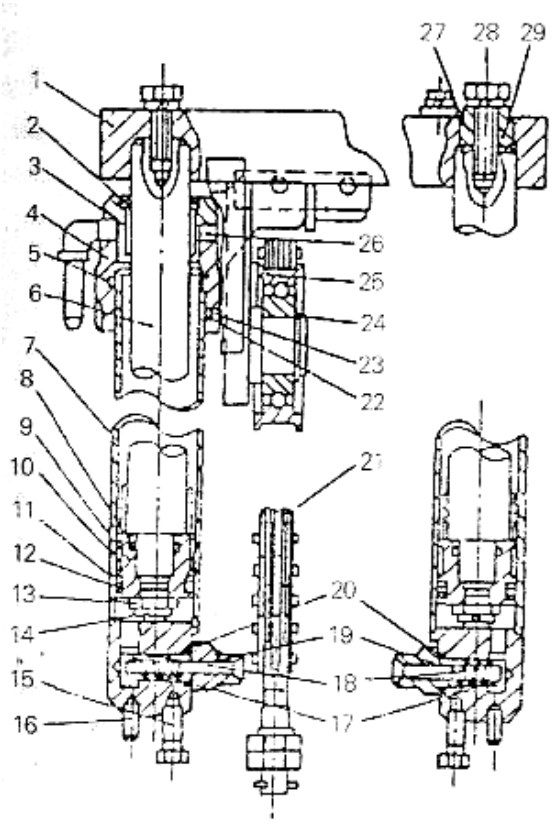
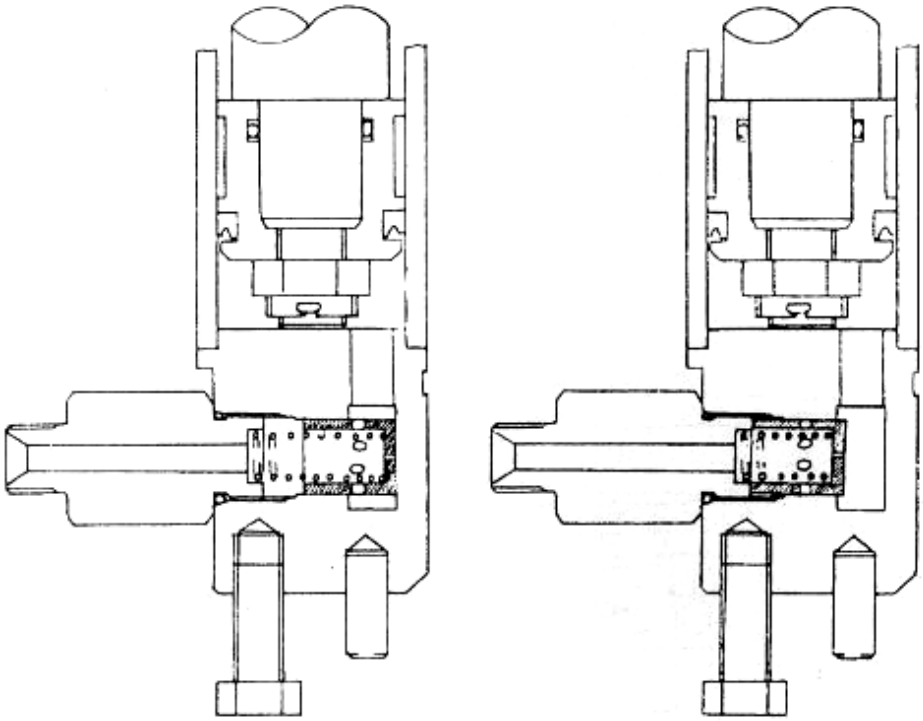


Fig 7-8 Lifting Cylinder

There is one shut-off valve on the bottom of lift cylinder, (Refer to Fig 7-9), to prevent cargo from abrupt drop, when high-pressure rubber hose is suddenly cracked. The oil from lift cylinder passes through the spool valve of shut-off valve, and the oil holes around the spool valve allow the two rubber hoes to generate pressure difference. When this pressure difference is smaller than the spring force, the spool valve will not act. If the high-pressure rubber hose is cracked, a very huge pressure difference is formed, for the spool valve to move and block up its surrounding oil holes, only to allow a small amount of oil to flow through the pores on the end part of spool valve, for fork to slowly drop.

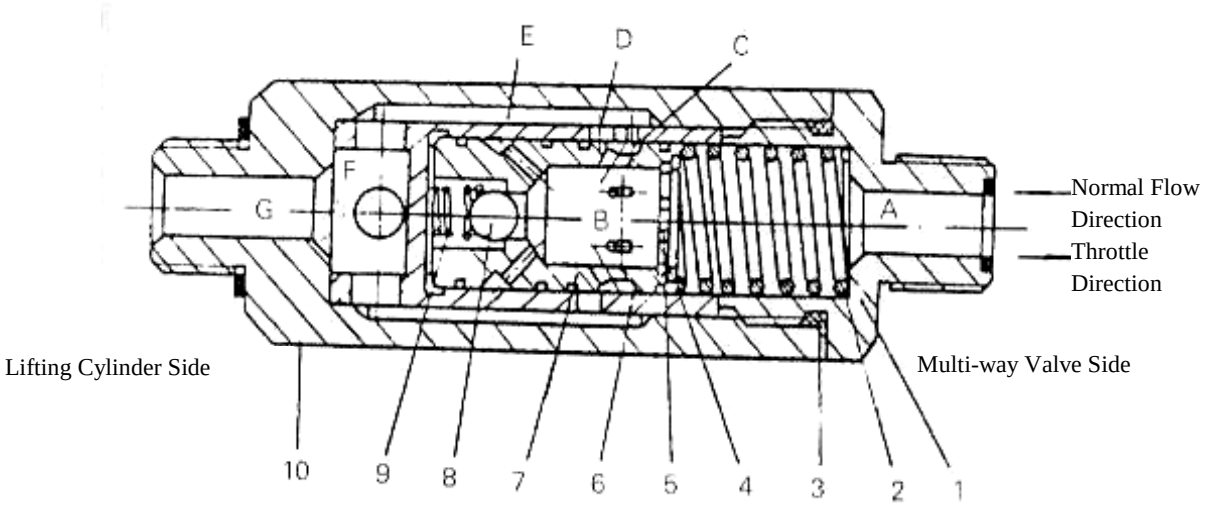


When Normal When Disconnected

Fig 7-9

7.6 Limiting Valve

Speed limiting valve (namely throttle valve) is mounted in the oil circuit of lift cylinder, to restrain the dropping speed when fork carries a heavy load, and its structure is indicated as in Fig 7-10. When spool valve of multi-way valve is at the “Lift” position, the high-pressure oil from multi-way valve passes through cavities A and B as well as holes C, D, E, and F, and cavity G under the condition when it is not throttled, and then flows into the lift cylinder. When spool valve of multi-way valve is at the “Drop” position, the oil from lift cylinder passes cavity G, oil holes F, E, D, and C, as well as cavities B and A thought the entire valve. At this point, pressure difference is generated between cavity A and cavity B, and opens the ball valve (Part 8). When pressure difference exceeds the spring force of spring 2, the valve core 7 moves rightwards, for the flow quantity of oil to drop for diminish of D and C holes, which has also reduced the flow quantity through the throttle hole.



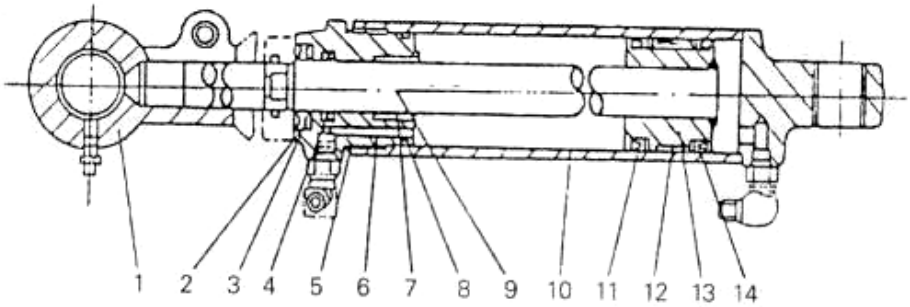
1. Joint 3. O-Ring 5. Throttle Plate 7. Valve Core 9. Spring
2. Spring 4. Retainer Ring 6. Valve Sleeve 8. Nylon Ball 10. Valve Body

Fig 7-10 Limiting Valve

7.7 Tilting Cylinder (Fig 7-11)

Tilting cylinder is in a double-acting type, mounted on the two sides of mast. Its end of piston rod is connected with mast, and the bottom of tilt cylinder is connected with truck frame using pins.

The tilting cylinder assembly comprises of piston, piston rod, cylinder body, cylinder bottom, guide sleeve, and sealing parts. Welded structure is applied to piston and piston rod. One wear ring and two Yx seal rings are mounted on the outer edge of piston, while Yx seal ring, retainer ring, and dust ring are fitted in the inner hold of guide sleeve, pressed and matched with shaft sleeve. This shaft sleeve supports the piston rod, while the seal ring, retainer ring, and dust ring are able to prevent oil leak and dust, screwed onto the cylinder body together with O-ring.



1. Clevis 4.Yx Seal Ring 7. Bearing 10. Cylinder Body 13. Piston
2. Dust Ring 5. O-Ring 8. O-Ring 11. Yx Seal Ring 14. Yx Seal Ring
3. Baffle Ring 6. Guide Sleeve 9. Piston Rod 12. Wear Ring

Fig 7-11 Tilting Cylinder

When tilt spool valve is pushed forward, the high-pressure oil enters from the bottom of cylinder, thus to push forward the piston for mast to tip forward by 6º, and when spool valve is pulled backwards, the high-pressure oil enters from the front end of cylinder body, to push backward the piston, until the mast tips backwards by 12º.

7.8 Maintenance of Main Oil Pump

7.8.1 Disassembly

(Refer to Fig 7-18 and 7-19 for Imported Main Oil Pump in combination.)

(1) Clamp the pump gently on the vice stand after cleaning, and firstly remove the bolt 12.

(2) Detach pump cover 1 and seal rings 8, 9, 10, and 11.

(3) Remove the front-end cover 7, and 8, 9, 10, and 11.

(4) Demount bearings 3 and 4, as well as gears 5 and 6 from pump body 2, and bearings may be dismounted through pressing the gears, if it is difficult to disassemble them.

It is the best to make arrangement according to the sequences in Fig 7-18 and Fig 7-19, in order to facilitate examination.

7.8.2 Examination and Repair

The parts that have been disassembled, except rubber, shall be cleaned firstly with oil, and examined, repaired, or replaces according to following steps.

(1) Examination of Pump Body

High-efficiency gear pump is designed into that the crest of gear rotates along the inner surface of pump body through slight press and touch, and the trace of scratch will be generated around the inner surface of the crest and the pump body. Under normal situation, its trace shall not exceed a length 1/3 of the inner edge of the pump body, and if it reaches 1/2 length, it indicates that the bearing and gear shaft are severely worn out. In Fig 7-12, when size X exceeds 39.180mm, or the trace of scratch on inner edge exceeds one half, it is required to replace the pump body.

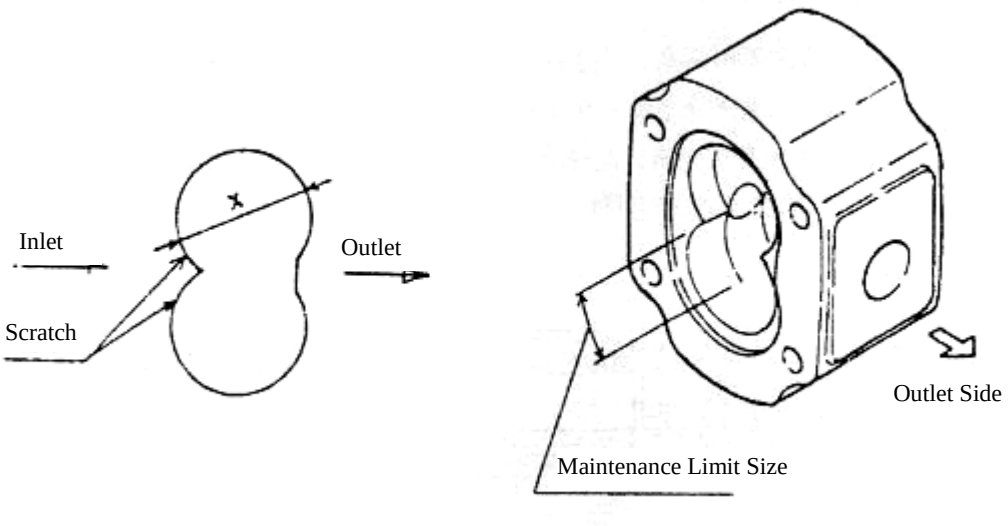


Fig 7-12

(2) Examination of Bearing (Fig 7-13 and Fig 7-14)

The ideal situation is to require that the inner surface of bearing is not coarse, and the contact surface with brightness is shown at the position about 1/2 at the inlet side. The bearing shall be replaced, if any of the undermentioned cases occurs.

a) The trace of contact appears on the entire slide inner surface, and a feeling of obvious coarseness exists when it is scraped with finger nail.

b) Crack appears around the end face, and a severe coarseness is felt when it is scraped with finger nail.

c) The bonding trace with other extraneous substance appears on the internal slide surface and the end face.

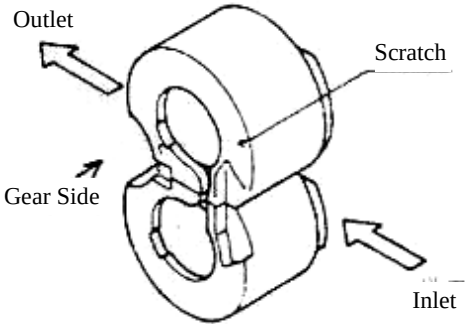


Fig 7-13

Most cases of abovementioned failures are aroused by un-cleaned hydraulic oil. At this point the whole oil circuit may be cleaned or the oil may be replaced. Some individual cases are attributed to overloaded safety valve, air corrosion, or too high temperature, or too low viscosity. In the case when the abovementioned failures occur, leading to coarseness or severe wear on the gear shaft or the end face of gear, the gear and bearing shall be replaced. The limit size for bearing maintenance is:

Inner Diameter—19.123mm (Fig 7-14)

Total Length—26.411mm

(3) Examination of Gear

So long as clean hydraulic oil is used, generally speaking, gear shaft and gear end face will not be damaged. In the case when a coarseness to a certain degree is felt when it is scraped with finger nail on the end face of bearing and gear, or crack occurs on the gear end face, or severe un-uniform wear is present on the gear end face, the gear shall be replaced at this point. When gear surface is worn or discolored, it indicates that failure has also occurred with bearing or pump body, and it shall be examined. The limit size for the axial diameter of gear shaft is 18.935mm (as indicated in Fig 7-15).

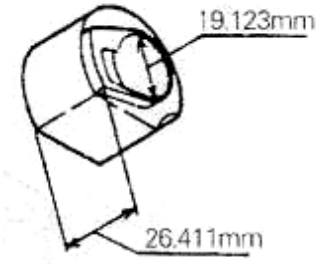


Fig 7-14

(4) Examination of Oil Seal

a) Oil Seal 14: (Refer to Figs 7-18 and 7-19) Oil seal 14 is a combination seal, and the lip at inner side of the pump shaft plays the sealing function, while the lip at the outer side is mainly for dust resistance (as in Fig 7-16). It is mainly required to examine whether or not crack, wear, or distortion exists with oil seal, and it is also required to examine whether or not the elasticity of rubber is enough, and it shall be replaced once it is out of order.

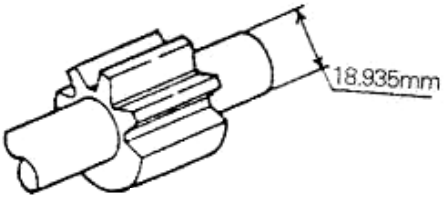


Fig 7-15

b) Seal Rings 8 and 9;

Seal ring 8 for pump body and seal ring 9 for bearing shall be replaced with new ones, when pump body is reassembled.

c) Seal Rings 10 and 11: Examine whether or not they are worn and damaged.

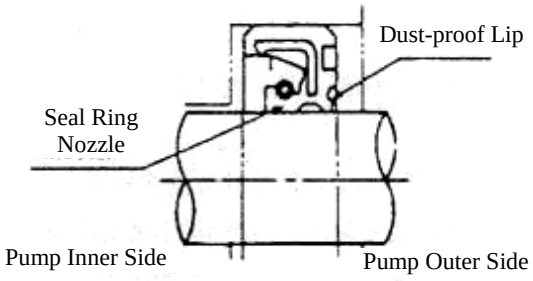


Fig 7-16

7.8.3 Reassembly (Fig 7-17)

(1) Clean the disassembled parts.

(2) Coat a thin layer of clean grease on the lips of oil seals 8, 9, 10, 11, and 14.

(3) Place the pump body 2 and the pump cover 1 on a flat stand, and coat the inner surface of pump body with clean hydraulic oil.

(4) Put bearings 3 and 4 into the pump body, and pay attention not to misplace their mutual positions. Place the bearing at correct position, and it may be taken out for reassembly, in the case of difficulty. It is never allowed to knock it gently or press it in forcibly.

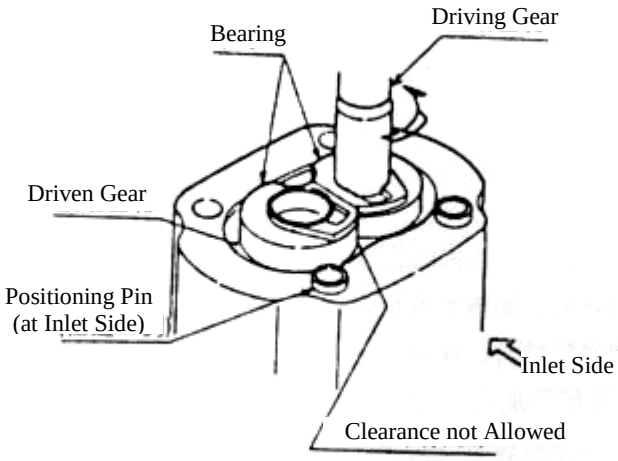


Fig 7-17

(5) Turn over the pump body, put the driving and driven gears 5 and 6 into the pump body, and allow the engaged teeth to be at the same engagement positions prior to disassembly.

(6) Mount the bearings 3 and 4 on one side of the front end cover using the same method as in Step (4).

(7) Mount the seal ring for pump body 8, the seal ring for bearing 9, and seal rings 10 and 11, and pay attention not to allow the seal rings to be overlaid in the middle.

(8) Assemble the front end cover 7, and in this case, wrap the band around the end of driving gear, to avoid damage of oil ring lip, and don’t forget removing such band after the front end cover is mounted.

(9) When pump body is turned over to mount end cover, pay attention to prevent the slide of seal rings installed during step (7).

(10) Mount seal rings 8, 9, 10, and 11, with the same method as in step (7).

(11) Put on the end cover 1.

(12) Mount spring washer 13 and bolt 12, and tighten the bolt with a torque of

$47\,^{+0.25}_{0}$ N.m ($4.7\,^{+0.26}_{0.}$ kgm).

Examine the gear pump as to whether or not it is assembled completely and properly. Place the driving shaft into the vice stand, the turn this pump, and the rotation of this pump shall be quite light. It is required to reexamine the pump, in the case when it is difficult to rotate.

Before this pump is assembled onto the machine, it is required to examine for a second time whether or not the assembly of the hydraulic pump is correct, and whether or not the rotating direction is correct.

Attention shall be paid to the following items when the pump is assembled:

a) Examine whether or not the lower part based on centerline is damaged or present with dust.

b) Examine whether or not the flange face of pipeline is damaged or present with dirt.

Mount O-ring, after the abovementioned has been examined (pipeline flange).

7.8.4 Test Run

Operation shall be carried out after assembly. Observe whether or not the pump has the specified performance after reassembly, and do running-in. It is required for test run to be performed when pump is assembled on forklift truck, and test run shall be conducted according to the following method. If pump is blocked or its internal part is excessively worn out, oil shall be replaced and filter shall be replaced or cleaned.

(1) Install pressure gauge on high-pressure pipeline near the pump.

(2) Place the control valve at neutral gear, for pump to run at a speed of 500-1000rpm. As this valve is at neutral gear, the reading of pressure gauge shall be slightly lower than 1MPa (10kg/cm), and keep the pump running for 10 minutes under such status.

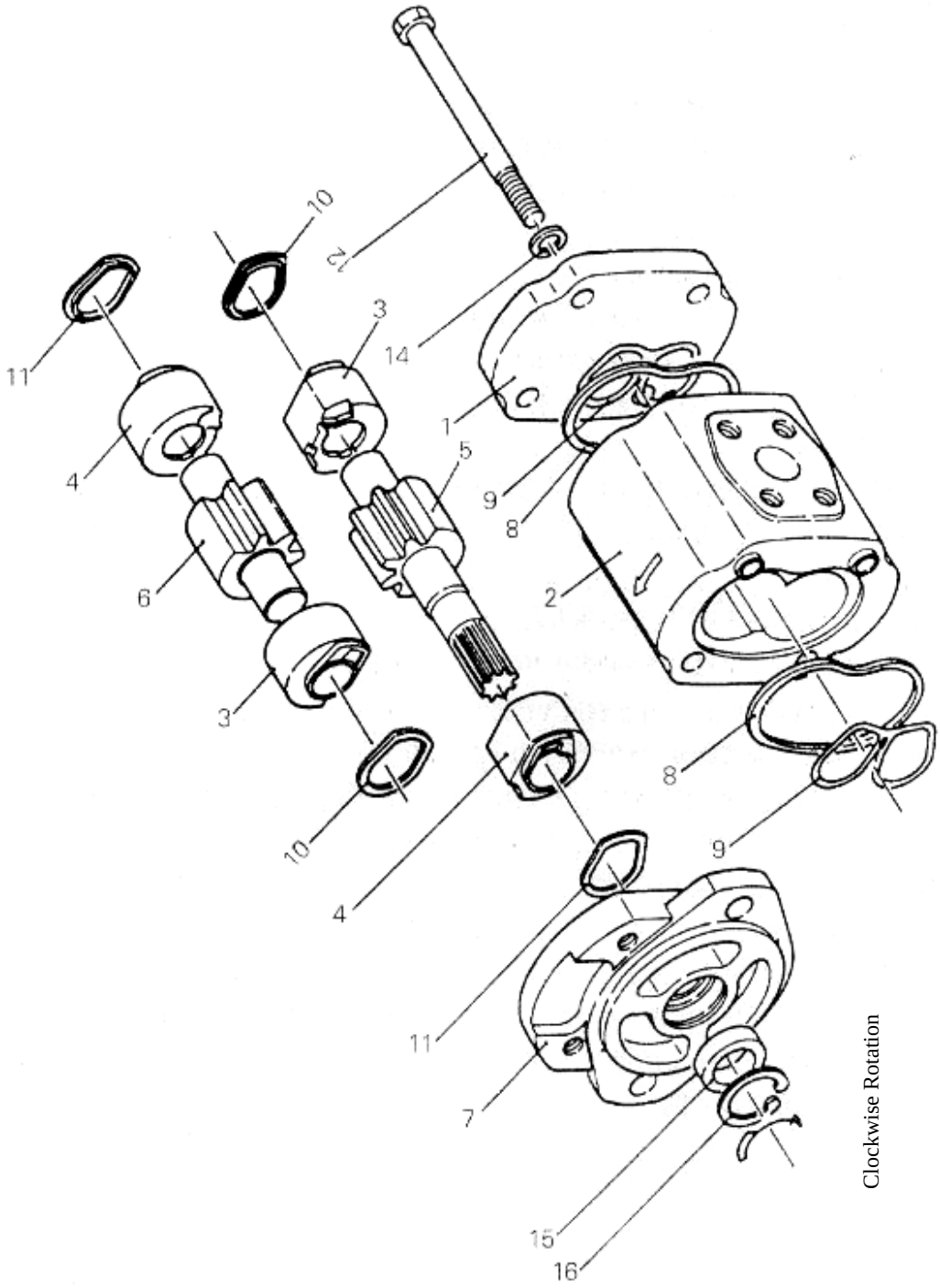
(3) Increase its rotating speed to 1500-2000rpm, and allow it to be idle for 10 minutes.

(4) Keep the rotating speed at Step (3) unchanged, increase the pressure to 2-3MPa (20-30kg/cm) for a further operation for 5 minutes, and repeat such operation until maximum pressure is reached. During this process, use overflow valve to increase load so as to adjust pressure. Allow each oil circuit to work for 5 minutes, and replace or clean the filter core of return oil filter. When pressure is boosted, attention shall be paid to oil temperature, as well as the surface temperature and working sound of pump body. If oil temperature or pump temperature is too high, the pump shall be unloaded immediately to lower the temperature, and then this process is to be repeated.

(5) After the above procedure is completed, readjust the overflow valve to the original working condition and perform unloading test.

(6) No matter it is loading or not loaded, unloading test shall be made in either cases, to ensure that this device has a proper speed.

Fig 7-18 and Fig 7-19 respectively indicate the lateral views for structure of gear oil pump in clockwise and counterclockwise rotations, and Fig 7-20 represents the schematic diagram of hydraulic pipeline, for your information.



1. End Cover 2. Pump Body 3. Bearing 4. Bearing 5. Driving Gear 6. Driven Gear 7. Front End Cover 8. Seal Ring 9. Seal Ring 10. Seal Ring 11. Seal Ring 12 Bolt 13. Lock Washer 14. Oil Seal 15. Locking Collar

Fig 7-18 Clockwise Rotation of Gear Pump (2-3.5t Gasoline Forklift Trucks)

1. End Cover
2. Pump Body
3. Bearing
4. Bearing
5. Driving Gear
6. Driven Gear
7. Front End Cover
8. Seal Ring
9. Seal Ring
10. Seal Ring
11. Seal Ring
12. Bolt
13. Lock Washer
14. Oil Seal
15. Locking Collar

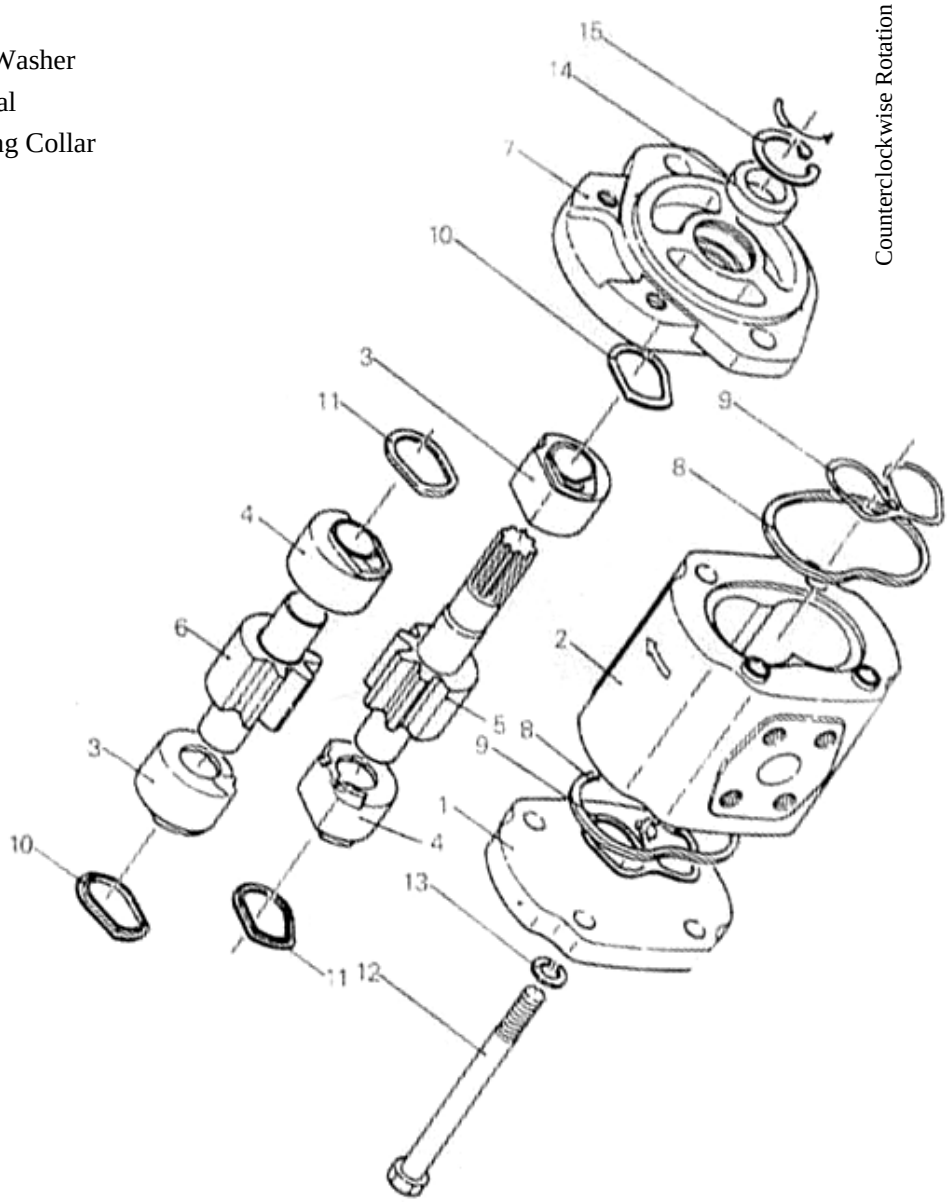


Fig 7-19 Counterclockwise Rotation of Gear Pump (2-3.5t Diesel Forklift Truck)

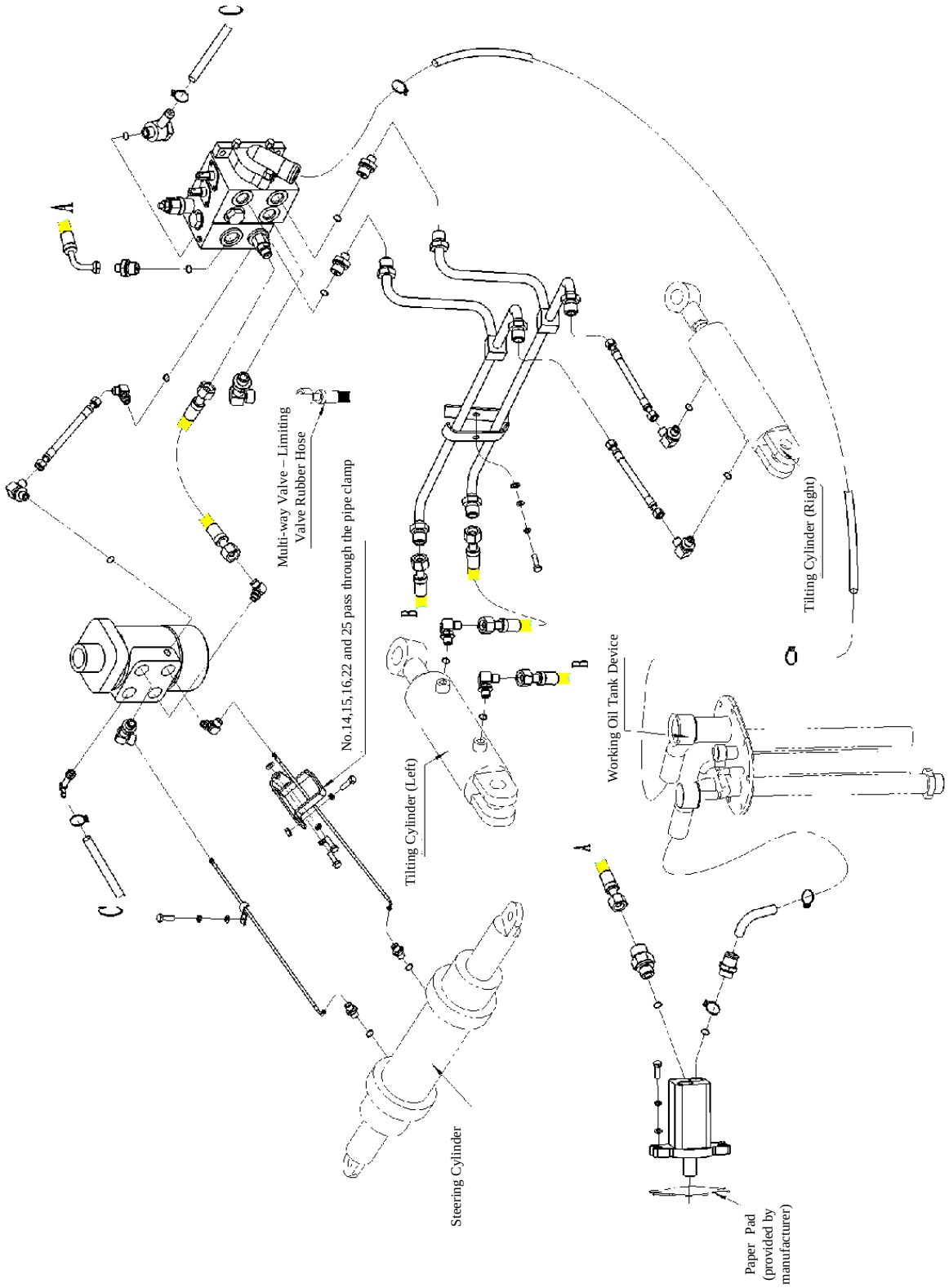


Fig 7-20 Schematic Drawing of Hydraulic Pipeline (Diesel Forklift Trucks)

7.8.5 Failure Removal

Problem	Possible Cause	Removal Method
Oil of Oil Pump Staying away	Oil level in oil tank to the low end	Oil to be filled to the specified oil level
	Oil suction side pipeline or filter blocked	To be cleaned, and oil to be replaced if it is dirty
Failure of Gear Pump for Supercharge	Bearings 3 and 4 worn, and bearing seal ring 9 or filler seal rings 10 and 11 at fault	To be replaced
	Overflow valve misadjusted	Pressure to be raised based by virtue of pressure gauge
	Air blended into pump	(1) Loosened joint at suction pipe side to be re-tightened (2) Oil to be added into oil tank (3) Oil seal of pump to b e examined (4) Pump to be started only until there is no more air bubble in oil tank
Noise of Gear Pump Loud	Oil suction side hose twisted, or cavity aroused by blockage of oil filter	Oil filter to be cleaned and hose to be adjusted
	Air sucked inside due to loosening of oil suction side joint	Each joint to be re-tightened
	Cavity aroused due to excessive viscosity	(1) Oil of proper viscosity to be used (2) Work to be started only when oil temperature is normal
	Non-concentric	To be concentric
	Air bubble present in hydraulic oil	Cause for generation of air bubble to be examined and to be repaired
Oil Leak with Pump	(1)Oil seal and seal ring 8 of pump at fault (2)Sliding face worn (for internal leak to be increased)	To be replaced

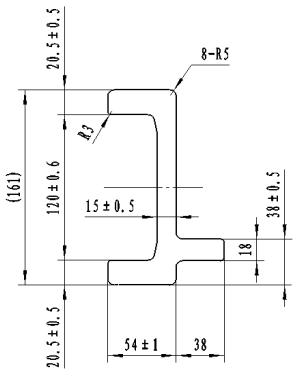
8. Lifting System

Note: this vehicle is strictly prohibited to tilt forward where the system's lifting load is more than 300 mm

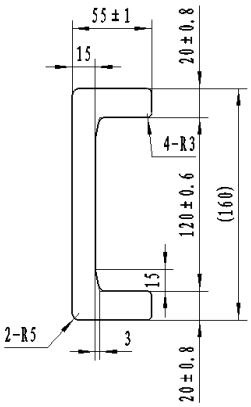
2-3.5t Type

Roller type, "J"-shaped inside mast, "C"-shaped outside mast with free lifting, two-stage telescopic mast

End Face of Inside Mast:



End Face of Outside Mast:



8.1 Overview

Lifting system is a two-stage rolling telescopic mast, with the outside mast typical of a "C" shaped end face, and the inside mast in a "J" shaped end face. The fork and the bracket comply with the international standard, with a free lift of about 160mm during operation.

8.2 Inside and Outside Masts

The mast assembly is composed of inside and outside masts. The lower part of the outside mast is connected with drive axle, with weight mainly supported on axle housing. The bracket of tilt cylinder on the outer side in the middle of outside mast is connected with piston rod of tilt cylinder. The mast is able to tip forward for 10º and backward for 12º through operating the inclined spool valve of multi-way valve. The inside and outside masts are welded parts, to bear the longitudinal and traverse loads through rollers and side rollers, and to allow the inside mast to rise and fall steadily.

8.3 Bracket

The bracket is also in a structure of welded part, to allow the bracket to move upward and downward steadily along the inner edges of the channel steel for the inside mast and to bear the longitudinal and traverse loads through composite roller and single roller with clearance adjustable. As for 2-3.5t forklift truck frame, each side has two groups of composite rollers and a group of single roller, a total of four groups of composite rollers and two groups of single rollers make the forklift frame move on the portal frame channel steel from up to down smoothly. When the fork rises to the maximum height, one pair of main rollers on left and right on top will extend to the upper edge of the inside mast.

The fork is locked inside the groove on the bracket using lock pins, and the spacing of fork may be adjusted on the left or right manual. International standard (ISO) is applied to fork and bracket, to facilitate common use and interchange.

8.4 Adjustment of Lifting System

(1) Drop the fork to the ground, and adjust the lift chain, to ensure that the distance between the lower roller center of bracket and the lower edge of inside mast is 15-20mm.

(2) Tip back the mast and adjust the tensioning force of lift chain, for the tensioning degrees of lift chain at places b to be equivalent (Fig 8-1).

(3) The strokes of left and right lift cylinders shall be equivalent, and their strokes may be adjusted using cylinder cover 4 (Refer to Fig 7-8.).

(4) Adjust the error of position for the height of left and right lift cylinders by making use of the adjusting bolt on the upper end of right lift cylinder as indicated in Fig 8-2.

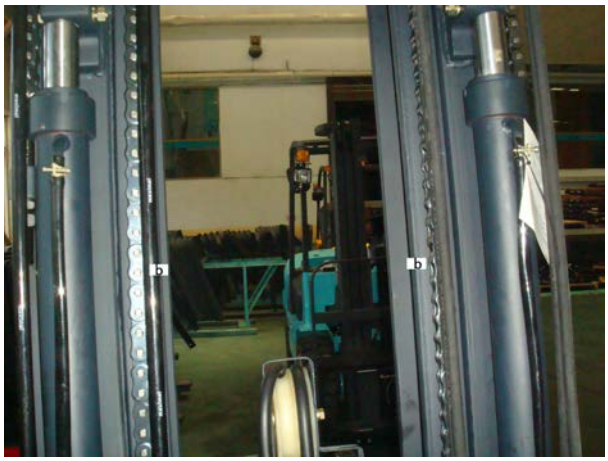


Fig 8-1

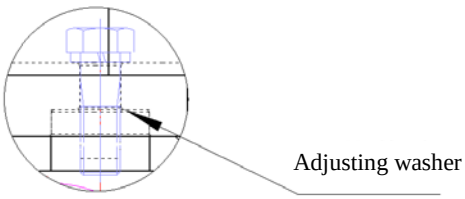


Fig 8-2

9. Electrical System

The electrical system of the series models is a single-line electrical system with anode bonding, and it's like a forklift truck’s "nervous system" to ensure that the forklift truck is working properly. The electrical equipment is mainly composed of following several systems:

1. Power supply system

Power supply system mainly consists of battery, generator, charging indicator light and other components, and supplies power to the electric equipment of the forklift truck. The battery provides power before starting the forklift; the generator provides power when the forklift runs, and at the same time charges the battery, and the charging indicator light is used to display the charging status.

2. Starting System

Starting system is mainly composed of heater plug, key switch, neutral switch, and starter lamp; its function is to start the engine. After the key switch is turned on, the heater plug works, make sure the preheating has completed and the heater plug has stopped working before starting. The starting system has neutral protection function; only if the shift lever is at the neutral position, the engine starts correctly; otherwise it cannot start.

3. Stop control system

Stop control system is mainly composed of key switch and fuel solenoid valve. When downtime is needed, rotate the key switch to OFF, cut off the power supply of the fuel solenoid valve, and the fuel solenoid valve cuts off oil supply and the engine stops automatically.

4. Instrument system

Instrument system is primarily composed of intelligent instrument, water temperature sensor, oil temperature sensor, fuel sensor, oil pressure switch, oil-water separation switch and other components. Its function is to detect the operation of the forklift truck and displays it through the dashboard, allowing operators to get a good understanding of the state of the forklift.

5. Lighting and sound and light alarm system

The system includes a variety of lighting equipment, signal lights, horn, reversing buzzer, etc.

Front combination lamp: a front combination lamp consists of lights (55W), width lamp (5W) and turn signal (21W) three parts;

Tri-color taillight: a tri-color taillight consists of turn signal (21W), width lamp (5W), stop lamp (21W) and reversing lamp (10W) four parts;

Rear light (55W);

Warning light (2W).

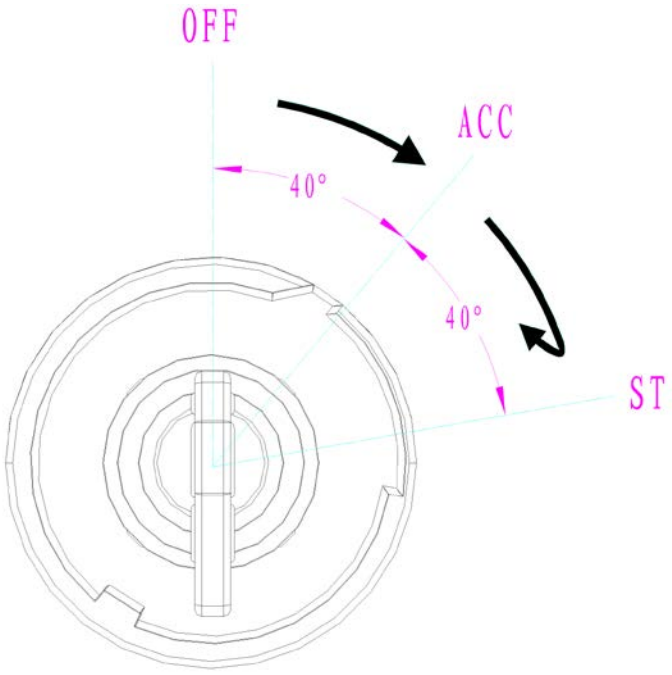
Description of operations:

1. Start and stop

Before the engine starts, you should first ensure that the gear control lever is at the neutral position, in which case the meter displays neutral (N), or else the engine will not start. This is because the forklift has a function of starting protection, to prevent danger.

When the key switch is OFF, you can insert/remove the key; in case that the engine has started, return the key switch to OFF, and the engine will automatically stop.

Rotate the key switch clockwise to the ACC gear, and the forklift is powered on and the preheating system works automatically to heat the air; the preheating indicator light is on, indicating the state of the preheating system. After 8~12S, the preheating is completed, and the preheating system stops automatically, then rotate the key switch clockwise to ST gear, and start the engine. After the engine starts, release the key switch, and reset the key switch to ACC.



Note:

1. After the engine has stopped, do not place the key switch to ACC gear, so as to avoid the power loss to the battery;
2. When the engine is running, do not start rotate the key switch to ST gear, to prevent damage to the motor;
3. When starting, the one-time start time should not exceed 5S, and the twice starting interval is above 120S; if it is impossible to start the engine after starting three times in a row, you should first find out the cause before you start it.

2. Forklift running

After the engine starts, push the gear shift lever forward, switch the gearbox to the forward gear, and the forklift moves forward and the forward speed of the forklift is controlled by controlling the gas pedal; dial the gear shift lever backward, switch the gearbox to the back speed, and the forklift returns and the backward speed of the forklift is controlled by controlling the gas pedal.

3. Horn button

Horn button is positioned at the center of the steering wheel, and the horn sounds after you press it.

4. Reversing light and signals

Put the gear shift lever to the reverse gear, and the rear light, reversing light and parking sensor buzzer work.

5. Light control

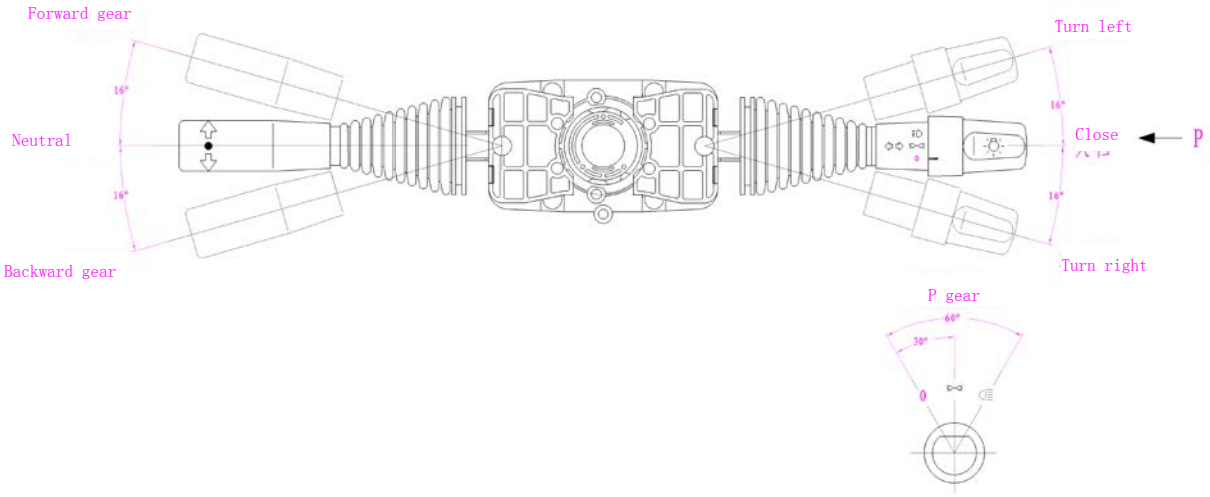
Rotate the light switch to the first gear, and the front and rear width lamp work; rotate it to the second gear, and the headlight works, in which case the width lamp still works.

6. Turn signal

Push the steering switch forward, and the forklift is ready to turn left and the forklift's left turn signal is flashing at a certain frequency; pull the turn switch backward, and the forklift is ready to turn right and the forklift's right turn signal is flashing at a certain frequency.

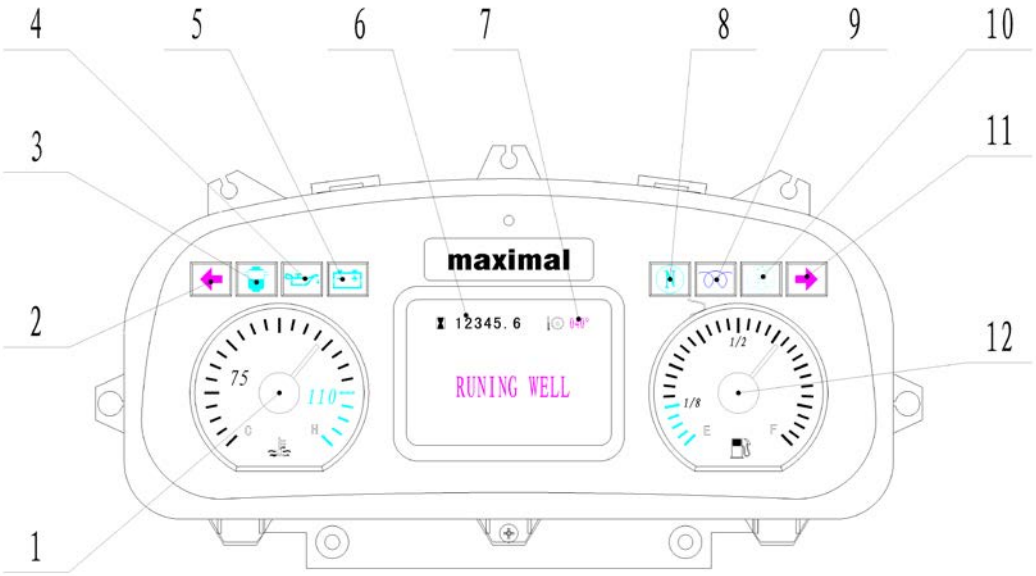
7. Braking signal

When the forklift needs to be braked, step on the brake pedal, and the brake light works and the forklift is in the braking state.



Introduction to instrument:

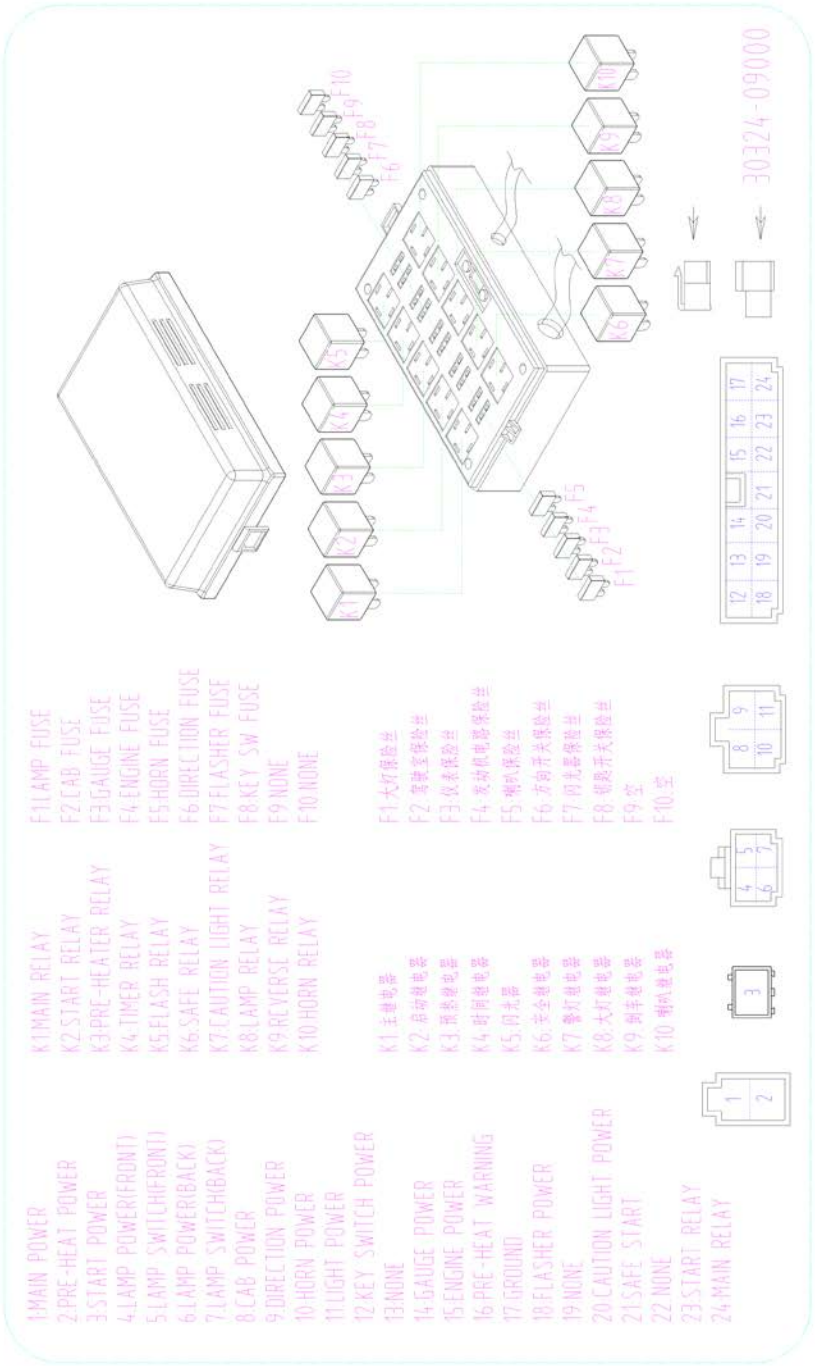
The instrument is used to indicate the working conditions of various critical systems of the forklift, and operators can quickly determine system failure prior to maintenance.



1: Water temperature gauge, indicates the water temperature of forklift truck engine;
2: Left turn indicator light, indicates the left turning work of the forklift;
3: Oil-water separation indicator indicates that the water content in the oil-water separator is too high, you need to manually drain;
4. Low oil pressure indicator light indicates low engine pressure;
5: Charge indicator light indicates the generator charging the battery;
6: Timer counts the working hours of the engine;
7. Torque converter oil temperature display shows the oil temperature of the gearbox torque converter;
8. Display gear state, neutral if N point flashes;
9: Preheating indicator, indicates the engine air preheating in progress;
10: Air filter clogging indicator, indicates the air filter clogged;
11: Right turn indicator light, indicates the right turning work of the forklift;
12: Show the amount of fuel oil remaining in the fuel tank.

Introduction to electrical box:

The electrical box is used to install a chip fuse and relay. The chip fuse is used to protect the circuits to prevent electrical appliances and wire being burnt due to short circuit. The relay is used to expand the switch capacity, making the small-capacity switch can control high-power electrical appliances.



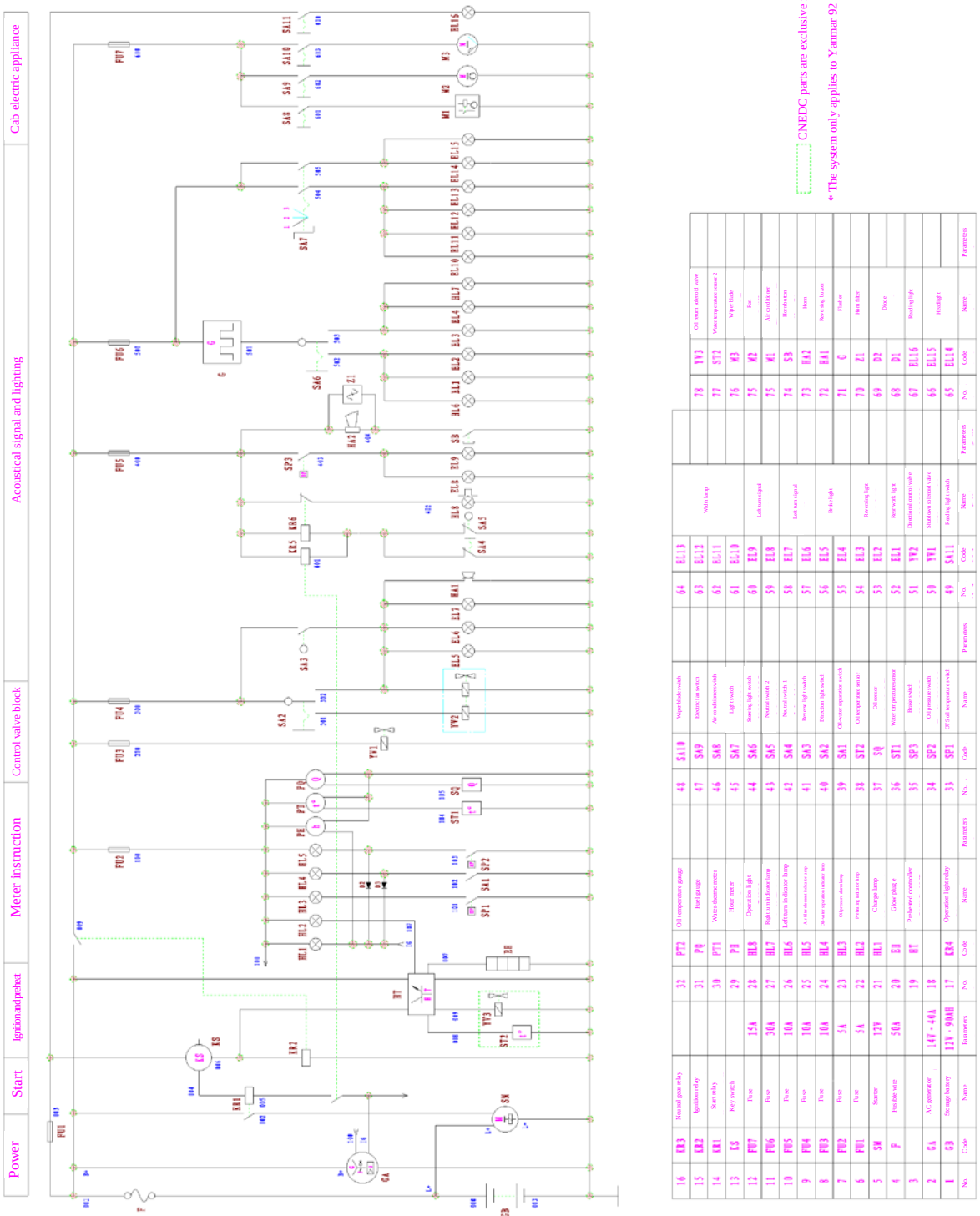
Battery:

The following matters should be paid attention to when the battery is used:

1) The battery can produce flammable gases, so there is a danger of explosion. Therefore you should avoid short circuit and sparks, and firework is strictly prohibited, to prevent the occurrence of fire or explosion.

2) The battery's electrolyte is dilute sulfuric acid, and it is very dangerous where it is exposed to the skin or eyes, because it can cause burning or blindness. When the electrolyte comes into contact with the skin, rinse immediately with plenty of water, and when it contacts with the eyes, rinse immediately with plenty of water and seek medical advice in a timely manner.

3) The battery has self-discharge phenomenon; when the forklift truck is not used for a long time, the battery should be well maintained, and it should be charged on a regular basis.


Power
Start
Ignitionandpreheat
Meter instruction
Control valve block
Acoustical signal and lighting
Cab electric appliance
CNEDC parts are exclusive for Yanmar 98
* The system only applies to Yanmar 92 and 98 engine

IV. Drive, Operation, and Routine Maintenance of Forklift Truck

The forklift drivers and management personnel must bear in mind “Safety First”, and perform safety operation and standard operation according to the forklift truck operation and maintenance manual as well as driver manual.

1. Conveyance of Forklift Truck

Attention must be paid to following items when container or motor vehicle is used to convey forklift trucks:

(1) Trigger the parking brake.

(2) It is required to fasten properly the front part and the rear part of the mast and the counter weight using steel wire, and to wedge up properly the corresponding positions of front and rear wheels using wedge blocks.

(3) Hoist according to the “Lift Label Plate” of forklift truck during lifting operation.

2. Storage of Forklift Truck

(1) Drain the fuel completely (Cooling water is not to be drained if it is the antirust and anti-freezing fluid.).

(2) Coat antirust oil on the surface of un-painted parts, and coat lubricating oil on the lift chain.

(3) Drop the door to the lowest position.

(4) Trigger the parking brake.

(5) Fill the front and rear wheels properly using wedge blocks.

3. Preparation prior to Operation

(1) Avoid examining fuel, oil leak, and oil level as well as examining electrical instrument in the place with open fire, and avoid adding fuel during operation.

(2) Examine air pressure of tyres.

(3) The handle for forward and reversing gear shall be placed at the middle position (the position of part).

(4) Don’t smoke when fuel system is work and when battery is examined.

(5) Examine the status of respective handles and pedals.

(6) Get well prepared prior to start.

(7) Loosen the parking brake.

(8) Perform the test actions for lift and drop, forward and backward tip of mast as well as steering and brake of forklift truck.

(9) The degree for contamination of hydraulic oil is larger than Grade 12, and the NAS1638 “Requirement for Cleanliness of Parts with Hydraulic System” is to be followed as test standard.

4. Operation of Forklift Truck

(1) The forklift truck shall be driven by drivers who have been trained and hold driving license.

(2) The operators shall wear shoes, helmet, clothes, and gloves usable for safety protection during operation.

(3) Examine respective controls and warning devices before truck is driven, and it

is required to operate the truck after repair in the case when any damage or defect is found.

(4) Load shall not exceed the specified values during conveyance. Fork must be completely inserted under the cargo, and cargo shall be uniformly placed on the fork. It is not allowed to pick up cargo using single fork tip.

(5) Smoothly perform start, turning, driving, brake, and stop. Slow down at turning, on wet or smooth pavements.

(6) It is required to place cargo as low as possible, and to keep the mast tilt backwards, when cargo is load for driving.

(7) It is required to be careful during driving on a ramp. It is required to drive forward during upgrade and drive reversely during downgrade, when the truck is driven on a ramp larger than 1/10. Turning shall be avoided by all means, and please never perform loading-unloading operation when forklift truck is running downgrade.

(8) It is required to pay attention to passengers, obstacles, and low-lying pavements, and pay attention to the clearance above the forklift truck, during driving.

(9) It is not allowed for anyone to stand on fork and it is not allowed for anyone to be carried on truck.

(10) It is not allowed for anyone to stand under the fork, or to walk under the fork.

(11) It is not allowed to control the truck and spreaders at any position other than the driver seat.

(12) It is required to pay attention to the fall of cargo from above, for any high lift forklift trucks with a lifting height larger than 3m, and protective measures must be taken, when necessary.

(13) Try as much as possible to tip backward the mast for high-lift forklift trucks during work, and it is required to perform front or back tip within the minimum range during loading-unloading operation.

(14) It is required to take a doubled care, and to drive slowly, during running on dock or on temporary planks.

(15) Driver shall not stay on the truck, when fuel is added, and the engine shall be turned off. Ignition is to be avoided when battery or level of oil tank is examined.

(16) The forklift trucks with spreaders shall be operated as loaded forklift trucks during empty-load operation.

(17) Don’t convey unfixed or loosely stacked cargo, and take care when cargo of relatively large size is conveyed.

(18) Drop the fork onto the ground, and put the handle for gear position to neutral gear, and turn off the engine or disconnect the power supply when driver leaves the truck. Pull the parking brake device properly when truck is parked on a ramp, while wedge blocks must be used to fill up the wheels when the truck is to be parked there for a long time.

(19) It is not allowed to open water tank cover carelessly, under the condition when engine is very hot.

(20) The pressures of multi-way valve and safety valve have been properly adjusted before delivery of forklift truck from factory, and users shall not adjust them at discretion during use, to avoid damage of entire hydraulic system and hydraulic

components due to excessively high adjustment.

(21) The value of air pressure specified on the label plate of “Tyre Air Pressure” shall be followed for tyre air charge.

(22) The maximum noise outside the forklift truck is not to be larger than 89dB (A), and JB/T3300 shall be followed as test method.

(23) The forklift with a self-locking function, turn speed must not be greater than 5KM/h.

(24) Heavy-lifting height exceeding 1200, not leaning forward.

5. Notices for application of Cooling System

(1) When forklift truck is being used, in the case when radiator is overheated or temperature of coolant is excessively high, try as much as possible not to open the radiator cover immediately. Examine the liquid level, in order to find the overheating cause. When cover has to be opened, it is required to drop engine to medium speed. Turn the radiator cover slowly and loosen off the cover after waiting for a while, to avoid scald of operator by splash of coolant.

Make sure to screw the radiator cover properly in place, when it is tightened up, and otherwise it is difficult to build up a specified pressure system.

(2) Regarding the radiator with coolant used as cleaning water, the water in radiator shall be drained out, only when truck is parked in cold weather and risk exists for water to be frozen. The radiator shall be detached, after it has worked for a period of time, and shall be cleaned in the boiled soda solution, to remove the scale or sediment formed on respective inner surfaces of radiator.

(3) Regarding radiator with long-acting antirust and anti-freezing fluid (model as FD-2 type -35℃) used for coolant, it is strictly prohibited to randomly add water and anti-freezing fluid of different models. The antirust and anti-freezing fluid of the same model shall be supplemented after anti-freezing fluid is leaked or evaporated.

Anti-freezing fluid is generally used both in winter and summer, not changed for four seasons. It shall be drained out for filtration and purification treatment after use for one year in general, to be then further used.

(4) According to different work conditions, the smudge on the outer surface of radiator shall be periodically cleaned and removed, either to be soak cleaned using detergent, or to be flushed using compressed air or high-pressure water (pressure not larger than 4kg/cm).

6. Oils Used for Forklift Truck

Name	Brand or Code (Domestic)
Gasoline	93#
Diesel Oil	To be selected and used according to diesel engine operation and maintenance manual, or according to GB252-81 Light Diesel Oil. Summer 0# Winter -10~35#
Lubricating Oil	To be selected and used according to engine operation and maintenance manual, or according to gasoline engine: GB485-84 Diesel Engine: To be selected and used according to GB5323-85 Standard requirements and the atrocious degree of its working conditions
Hydraulic Oil	L-HM32
Hydraulic Drive Oil	6# Hydraulic Drive Oil
Gear Oil	85W/90
Brake Fluid	ZSM207 DOT3 Synthetic Brake Fluid
Lubricating Oil	3# Lithium Base Lubricating Grease Drop Point 170

7. Drawing of Lubricating System

