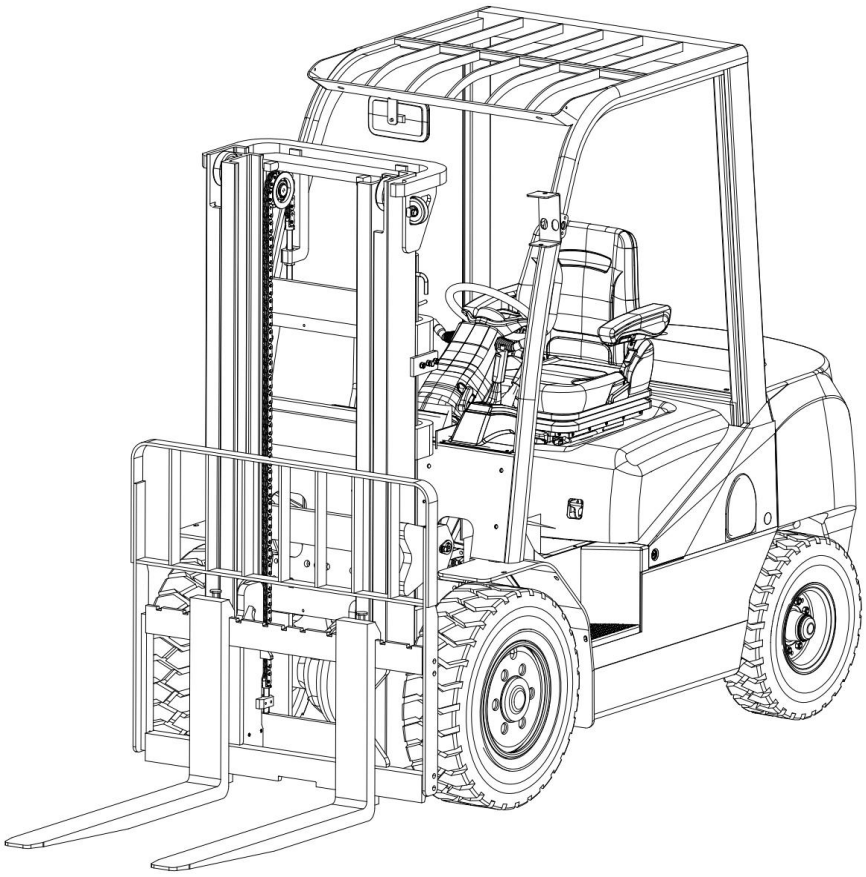
FD18-35N-SMS-001

⚠ WARNING

Do not use the forklift before reading and understanding the operating instructions as well as the waring decals on the truck.
Keep for future reference.



Operation & Maintenance Manual

FD18-35N series

INTERNAL COMBUSTION Forklift

Catalogue

Introduction

This manual briefly describes the technical parameters of the counterbalanced accumulator forklift made by our company, and the structure of its main components, working principle and requirements on operation and maintenance. Please read this manual carefully before operation, so as to achieve proper driving and maintenance, and to ensure safe and effective material handling. Meanwhile, this manual aims to guide operators to use the forklift in an appropriate way and to maximize its performance! We hope that operators and equipment managers could read it carefully before use! Please strictly observe the provisions and cautions stipulated in this manual and operate the forklift with caution and care, so that the forklift can be maintained in its best status and optimal performance can be ensured. When you lease or transfer your forklift, always keep this manual with it.

For highlighting purpose, the following icons are used in this manual:

1. ⃠ ----Refers to a potential danger; if not avoided, it may cause serious human injury, vehicle damage or fire.

2. ⚠ ----Refers to a potential danger; if not avoided，it may cause minor human injury, or local damage to the vehicle.。

3. ☞ ----Refers to general cautions and instructions during use.

⚠ Most parts of the product are made from recyclable steel. The recycling and disposal of cast-offs resulted during use, maintenance, cleaning and disassembling of the product has to comply with local regulations without pollution to the environment. The recycling and disposal of the cast-offs should only be operated by specialised personnel in the designated area. The cast-offs, such as hydraulic oil, batteries and electronic units, if improperly disposed, may be hazardous to the environment and human health.

4. Requirements for the use environment of the truck

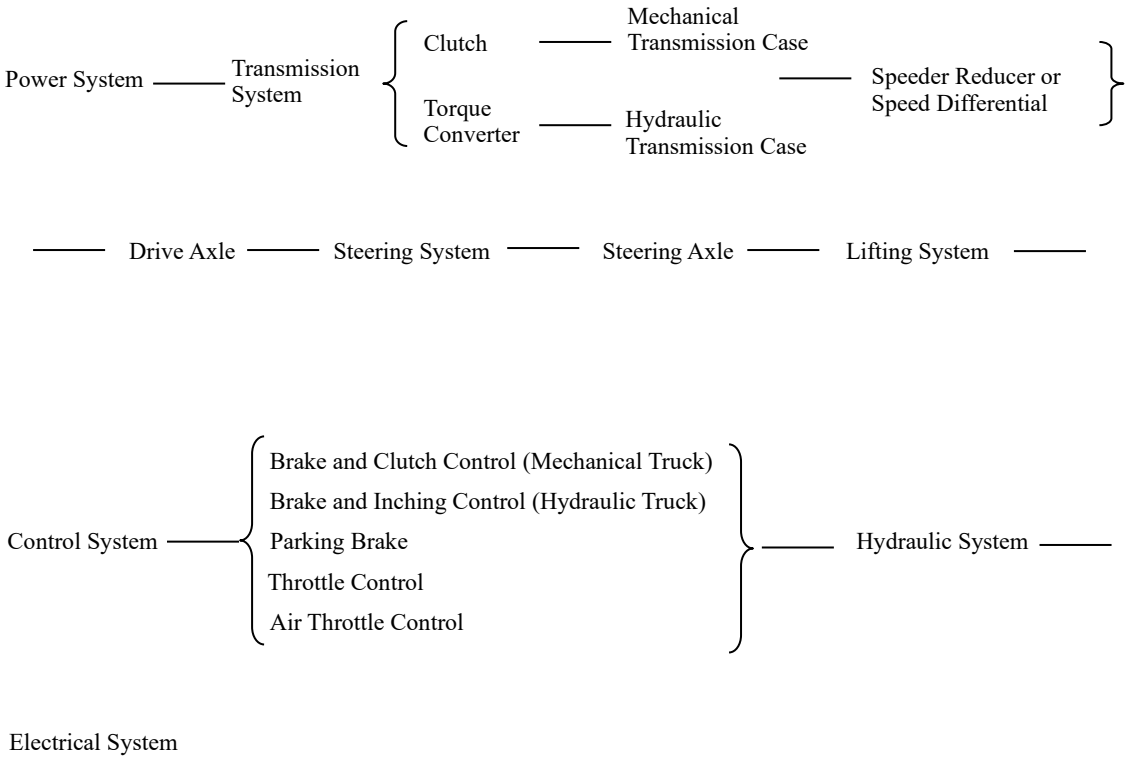
If you need to use in the freezer for a long time, Or in special environment, it is needed to install special attachments. Please contact our technical staff. Product recall service is also available when serial faulties occur.

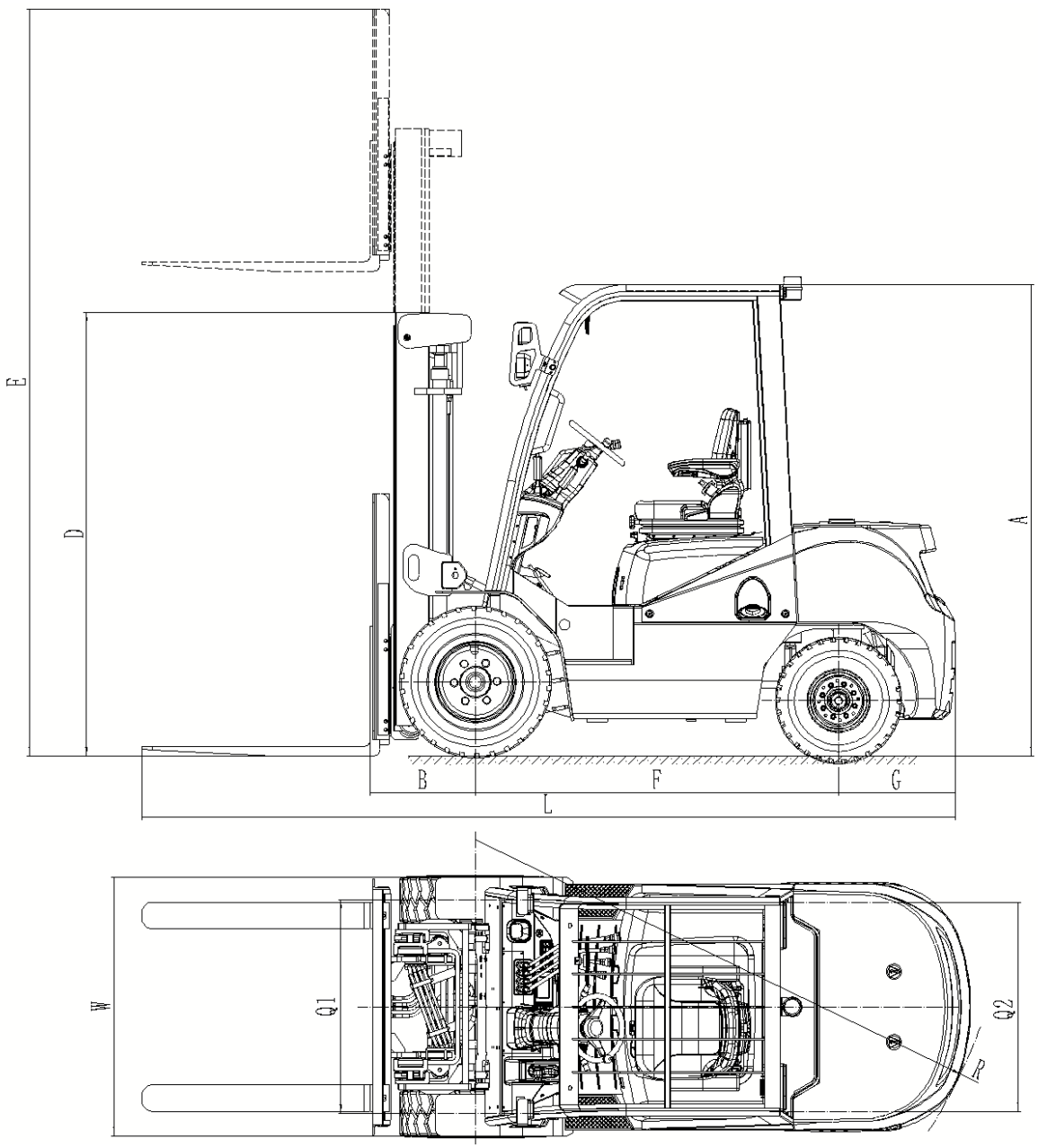
5. Vehicle safety monitoring device

The vehicle can be equipped with a driver authority information collector, through fingerprint, iris, facial features and other biological information or magnetic card and personal identity unique binding media price, verify the driver's operation authority, when the collector is invalid, removed or the driver information is incorrect, the vehicle cannot start.

I. Forklift Truck Main Technical Parameters (Refer to Table 1, Table 2)

II. Description about Forklift Truck Main Parts





Outside Drawing of Forklift Truck

Main Technical Parameters

Table 1

Parameter \ Model				FD18	FD25	FL25	FGL25
Performance Parameter	Rated Load kg			1800	2500		
	Load Center mm			500	500		
	Lifting Height mm			3000	3000		
	Free Lifting Height mm			130			
	Mast Tilt Angle Front/Rear			6/10º			
	Lifting Speed mm/s		No-Load	550	520	470	470
			Full-Load	450	490	430	430
	Running Speed km/h	Hydraulic Truck	Forward	16	18		
			Backward				
	Max Traction Force		No-Load N	13000	15000		
			Full-Load N	15000	17000		
	Gradeability		No-Load %	20			
			Full-Load %	20			
	Min Turning Radius R mm			2100	2230		
	Min Cross Passage Width K mm			1880	2040		

Main Technical Parameters

Table 1 Continued

Parameter \ Model			FD18	FD25	FL25	FGL25
Size Parameter	Whole Length L (Without Fork) mm		2300	2620		
	Whole Width W mm		1090	1150		
	Whole Height D (Mast Retracted) mm		1995	2010		
	Whole Height E (Mast Extended) mm		3955	3974		
	Wheelbase F mm		1400	1600		
	Wheelbase	Front Q1 mm	900	970		
		Rear Q2 mm	930	980		
	Front Clearance B mm		400	478		
	Rear Clearance C mm		500	543		
	Fork Dimension	Length mm	1070	1070		
		Width mm	100	120		
		Height mm	35	40		
	Fork Horizontal Adjustment Quantity mm		200-1040	240-1040		
	Ground Clearance (in the Place of Mast) mm		110	125		
	Self weight kg		2900	3650		

Main Technical Parameters

Table 2

Parameter \ Model				FD30	FL30 FGL30	FD35N	FL35 FGL35
Performance Parameter	Rated Load kg			3000		3500	
	Load Center mm			500			
	Lifting Height mm			3000			
	Free Lifting Height mm			140		145	
	Mast Tilt Angle Front/Rear			6/10º			
	Lifting Speed mm/s		No-Load	460	440	430	410
			Full-Load	430	410	400	380
	Running Speed	Hydraulic Truck	Forward	19	19	19	19
			Backward	19	19	19	19
	Max Traction Force		No-Load N	15000			
			Full-Load N	17000			
	Gradeability		No-Load N	20			
			Full-Load N	20			
	Min Turning Radius R mm			2450		2520	
	Min Cross Passage Width K mm			2000		2070	

Main Technical Parameters

Table 2 Continued

Parameter \ Model			FD30	FL30 FGL30	FD35	FL35 FGL35
Size Parameter	Whole Length L (Without Fork) mm		2735		2815	
	Whole Width W mm		1210			
	Whole Height D (Mast Retracted) mm		2075		2150	
	Whole Height E (Mast Extended) mm		4079			
	Wheelbase F mm		1700			
	Wheelbase	Front Q1 mm	1000			
		Rear Q2 mm	980			
	Front Clearance B mm		483		483	
	Rear Clearance C mm		530		607	
	Fork Dimension	Length mm	1070			
		Width mm	125		125	
		Height mm	45		50	
	Fork Horizontal Adjustment Quantity mm		250-1100			
	Ground Clearance (in the Place of Mast) mm		140		145	
	Self weight kg		4400		4750	

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

Refer to Table 3 and Table 4 for the imported gasoline and diesel engines used for 2.0-3.5t forklift trucks in F series

Table 3

Main Technical Parameters			Gasoline-LPG engine
Model			HMC2.4L
Emission Regulation			EU STAGE5 / EPA TIER4
Type			4-Stroke, Water-Cooling, Straight-Line, and Valve in Head
Cylinder: Number of Cylinders – Cylinder Diameter × Stroke mm			4-Φ88×97
Total DisplacementI			2.359
Compression Ratio			10.5
Rated Power/Speed kw(ps)/rpm			43/2600(GROSS)
Max Torque/Speed N.m(kg.m)/rpm			171/1800
No-Load Min Speed rpm			800rpm
Min Fuel Specific Consumption g/ps.h			235g/kw.h
Whole Length × Whole Width × Whole Height mm			708.9×588.6×728
Movement Direction			In Clockwise Direction Looking from the End of Fan
Firing Order			1-3-4-2
Cooling System			Forced Circulation Water Cooling
Lubricating System			Forced Lubrication
Main Part	Gasoline Pump		Membrane Type
	Air Filter		Paper Element Filter
	Engine Oil Pump		Gear Type
	Oil Rough Filter		Paper Filtration
	Water Pump		Centrifugal Type
	Thermostat		Wax Type
	Generator	Voltage V	12V
		Current A	50A
	Starter	Voltage V	12V
		Output Power kw	1.2kw
	Battery	Voltage V	12
		Capacity Ah	90
Referential Data		Lubricating Oil I	3.5
		Cooling Water I	3.5

Table 4

Parameter \ Model			4TNE98	S4S-455
Type			4-Stroke, Water-Cooling, Straight-Line, and Valve in Head	
Cylinder	Number of Cylinders – Cylinder Diameter x Stroke		4-98×110	4-94×120
	Total Displacement		3.319	3.331
	Compression Ratio		21.3	22
Rated Power/Speed			42.1kw/2300rpm	35.3kw/22250rpm
Max Torque/Speed			206N.m/1700rpm	178N.m/1700rpm
No-Load Min Speed			750rpm	770 rpm
Min Fuel Specific Consumption			265 g/kw.h	255 g/kw.h
Movement Direction			In Clockwise Direction Looking from the End of Fan	
Whole Length × Whole Width × Whole Height			728×526×707	741×559×706
Weight			225kg	245kg
Working Sequence of Cylinder			1-3-4-2	
Cooling System			Forced Circulation Water Cooling	
Lubricating System			Forced Lubrication	
Main Part	Oil Injection Pump		Distributed Type	
	Oil Injector		Throttling Type	
	Air Filter		Paper Filtration	
	Lubricating Oil Pump		Cycloid Pump	
	Water Pump		Eddy Current Type	
	Thermostat		Wax Pellet Type	
	Generator	Voltage	12V	
		Current	40A	50A
		Method of power generation	AC Generation, and Silicon Rectification	
	Starter	Voltage	12	
		Output Power	2.3kw	2.2kw
	Battery		12V 90Ah	

Parameter \ Model			Yanmar 4TNE92
Type			Vertical, 4-stroke water-cooled diesel engine
Emission Regulation			EU Stage III
Cylinder	Number of Cylinders – Cylinder Diameter x Stroke		4-92mm×100mm
	Total Displacement		3.319
	Compression Ratio		21.3
Rated Power/Speed			33kw/2450rpm
Max Torque/Speed			150N.m/1600rpm
No-Load Min Speed			750rpm
Min Fuel Specific Consumption			250 g/kw.h
Movement Direction			Anti-clockwise rotation as viewed from flywheel side
Whole Length × Whole Width × Whole Height			728×526×707
Weight			220kg
Working Sequence of Cylinder			1-3-4-2
Cooling System			Forced Circulation Water Cooling
Lubricating System			Forced Lubrication
Main Part	Oil Injection Pump		Distributed Type
	Oil Injector		Throttling Type
	Air Filter		Paper Filtration
	Lubricating Oil Pump		Cycloid Pump
	Water Pump		Eddy Current Type
	Thermostat		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

Table 5

Parameter \ Model			L4CRTV4（LS）	3E22YG41（xinchai）
Type			4Cycle Water-Cooled, Vertical In-Line, Direct Injection, Turbocharged, Electronic controlled Common Rail Fuel System	high pressure common rail+turbo charger+EGR+DOC+DPF
Emission Regulation			EU Stage V and EPA Tier4	
Cylinder	Number of Cylinders – Cylinder Diameter x Stroke		4-88mm×103mm	3-94mm×107mm
	Total Displacement		2.505L	2.23L
	Compression Ratio		17	
Rated Power/Speed			42kw/2300rpm	37kw/2400rpm
Max Torque/Speed			208N.m/1600rpm	185N.m/1600-1800rpm
No-Load Min Speed			800rpm	900rpm
Min Fuel Specific Consumption			235 g/kw.h	255 g/kw.h
Movement Direction			Anti-clockwise rotation as viewed from flywheel side	
Whole Length × Whole Width × Whole Height			815×570×724	741×559×706
Weight			220kg	245kg
Working Sequence of Cylinder			1-3-4-2	
Cooling System			Forced Circulation Water Cooling	
Lubricating System			Forced Lubrication	
Main Part	Oil Injection Pump		Delphi DFP4.4	Distributed Type
	Oil Injector		Delphi DFI2.5.2	Throttling Type
	Air Filter		Paper Filtration	
	Lubricating Oil Pump		Cycloid Pump	
	Water Pump		Eddy Current Type	
	Thermostat		Wax Pellet Type	
	Generator	Voltage	12V	
		Current	70A	70A
		Method of power generation	AC Generation, and Silicon Rectification	
	Starter	Voltage	12	
		Output Power	2.2kw	2.2kw
	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 Items to be observed for Installation and Operation of Japanese-made Gasoline Engine (Applicable to Nissan K21.K25 and Mitsubishi EPA Gasoline Engines)

(1) Items to be observed for Installation of Japan-made Gasoline Engines

Items to be Observed during Assembly of Forklift Truck		Requirement	Remarks
Cooling System	Allowed Temperature for Cooling Water	80℃ in Common Use and Max 110℃ (Outlet Water Temperature)	To prevent too heated engine
	Pressure of Heat Radiator Cover	88.3kPa(0.9kg/cm^2) in Common Use	Standard Value
	Exhaust	Exhaust shall be performed from the place of pet cock, when cooling water is injected.	
Lubricating System	Allowed Temperature	120℃ Max Oil Temperature inside Oil Pan	

2）Items to be observed for Operation of Japan-made Gasoline Engines

Items to be Observed during Operation		Requirement	Remarks
Cooling System	Air Suction Negative Pressure (Inlet Negative Pressure of Inlet Bell Mouth)	Max 6.18kPa, and below 0.98kPa in Common Use	It is required to use wire mesh air filter core, to be replaced generally after work for 1200 hours in 6 months, while it shall be replaced as soon as possible for 3-shift system or for atrocious environment, and otherwise, the cylinder and piston will be worn out, and CO black smoke will be discharged.
Exhaust System	Exhaust Pressure (Air Vent Outlet Pressure)	13.3kPa (below 100mmHg) in Common Use	Adverse impact will arise for engine power and noise, if too high.
P.T.O (Power-Take-Off) System	Oil Pump Allowable Load	6.7kg mm/3215rpm	Otherwise P.T.O. chain will extend and break, and engine will stall out.
Electrical System	Battery Capacity	Standard Specification: 12V-60Ah	Generally used for -15℃～+35℃
Operating Environment	Ambient Temperature	Standard Situation: -15℃～+35℃	

	Regional Altitude	Standard Specification: Elevation below 1000m	When used at more than 1000m altitude, the mixed compensation shall be performed for gasoline engines in combination with altitudes.

3) Fuel, Lubricating Oil Used for Japan-made Gasoline Engines and Other Requirements

Item		Requirement	Remarks
Fuel		Lead-free general gasoline at 89 octane rating to be used, equivalent to Number JIS K2202-1988 2	Equivalent to Chinese Standard GB484-86RQ-90 Number gasoline, and otherwise, the rotating speed will be instable, it will fail to combust completely, if present with lead gasoline, and will cause wear to parts of gasoline engines, and give rise to environmental pollution.
Lubricating Oil		Application Specifications: API: Above SD Grade (Equivalent to above Chinese QD Grade) SAE: For Normal Regions: 20W Clod Zones: 10W To be replaced after use for 200 hours or 1 month	
Anti-freezing Fluid (LLC-Long Life Coolant)		Equivalent to JIS K2234-1988, 2 Kinds LLC Concentration: Standard Zones (above -15℃) 30% Cold Zones (above -35℃) 50% To be replaced generally for every 2400 hours or 12 months, but it is changeable by taking circumstances into consideration, as operating environments and conditions are different.	Chinese anti-freezing fluids shall be referred to for implementation, and it is recommended to use long-acting antirust anti-freezing fluid (FD-2 Type, -35℃)
Remark	Fuel Filter	Authentic Japan-made products to be used To be replaced for every 2400 hours or 12 months	
	Engine Oil Filter	Authentic Japan-made products to be used o be replaced for every 600 hours or 3 months	
	Air Filter	Authentic Japan-made products to be used To be replaced for every 1200 hours or 6 months	

Note: The period for replacement in the table indicates general situation (8 hours/day), and it shall be replaced earlier for 3-shift system or under atrocious operating conditions.

1.3 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 gasoline engine)

a) Warm up the engine until the temperature of engine cooling water reaches 85℃;

b) Mount tachometer on engine, and use the idle speed adjusting screw of carburetor to adjust the engine speed to 650r/min for 2-3.5t forklift trucks;

c) Adjust the limit screw for the minimum openness of air throttle, in the direction for engine speed to be increased;

d) Use idle speed adjusting screw of carburetor, to adjust the engine for 2-3.5t to 650r/min;

e) Repeat the steps c) and d) until a stable rotating speed of 650r/min.

(2) Adjusting the no-load maximum rotating speed (used for gasoline engine)

a) Warm up the engine until the temperature of engine cooling water reaches 85℃;

b) Shut down, and ensure that the accelerator pedal is pushed down to the bottom and the air throttle is fully open;

c) Start engine, and allow air throttle to be fully open;

d) The adjusting screw for speed limiter may be turned until the specified speed is reached, if the rotating speed of engine is higher or lower than specified value; The maximum no-load rotating speed for 2-3.5t forklift trucks is 2800-3000r/min.

(3) 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):

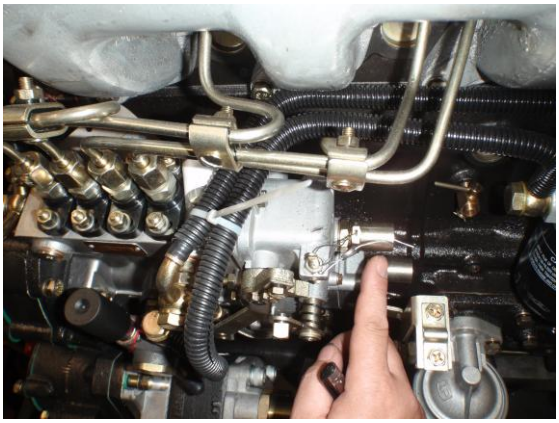


Fig 1-1

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;

(4) 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.

(5) 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.

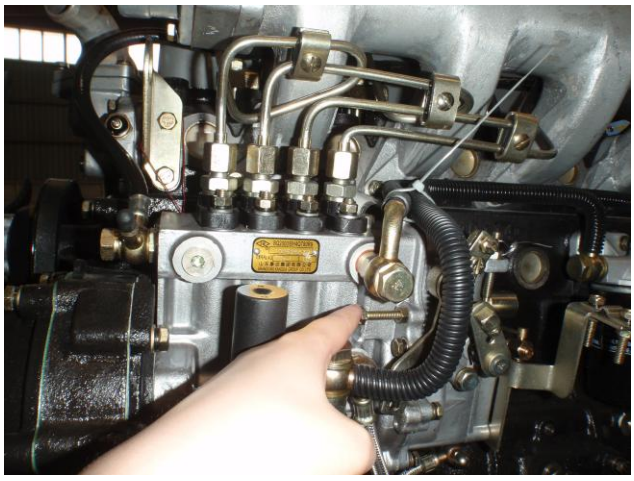


Fig 1-2

1.4 Fuel System:

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

Fig 1-4).

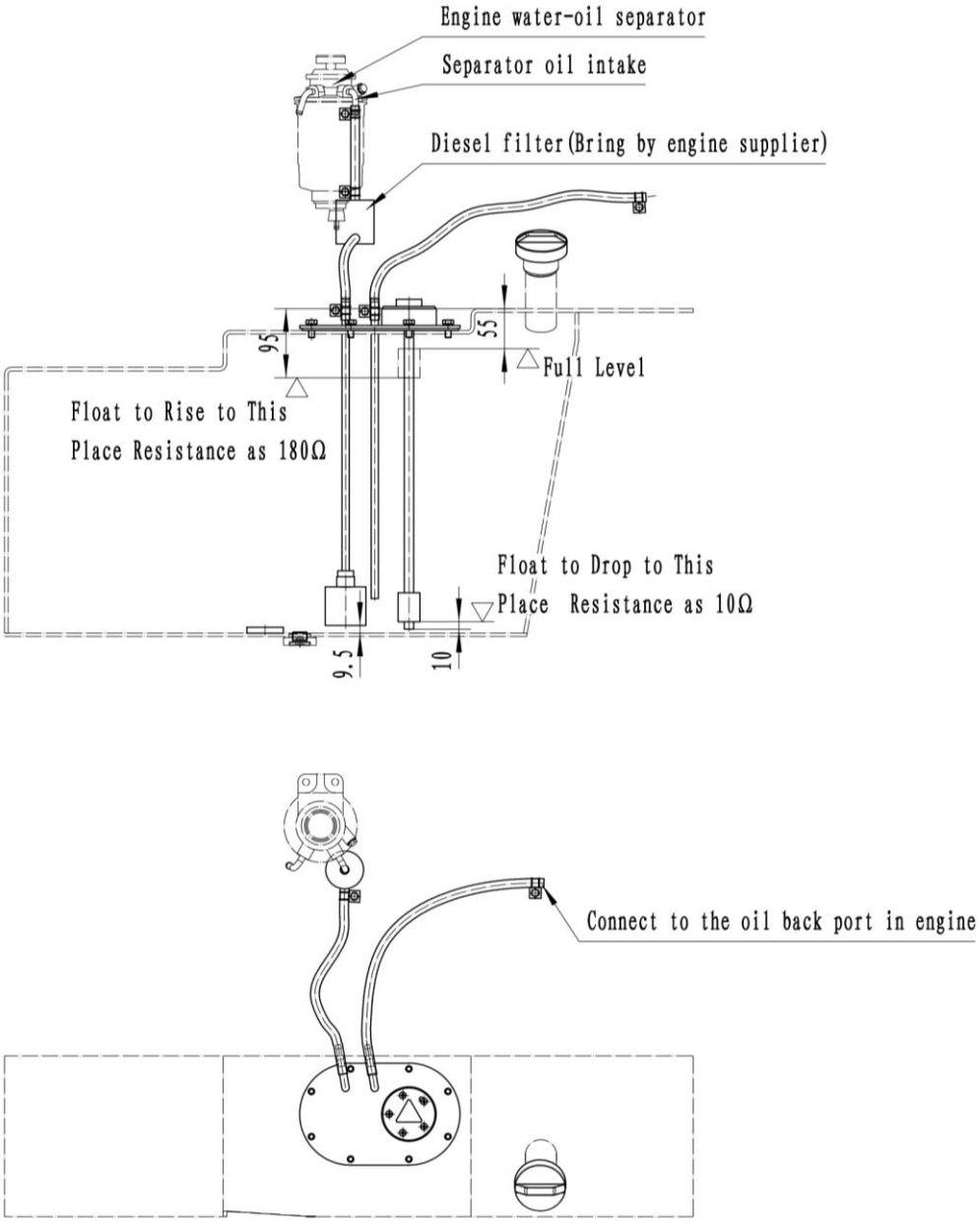


Fig 1-3 Fuel Tank (Diesel Forklift Truck)

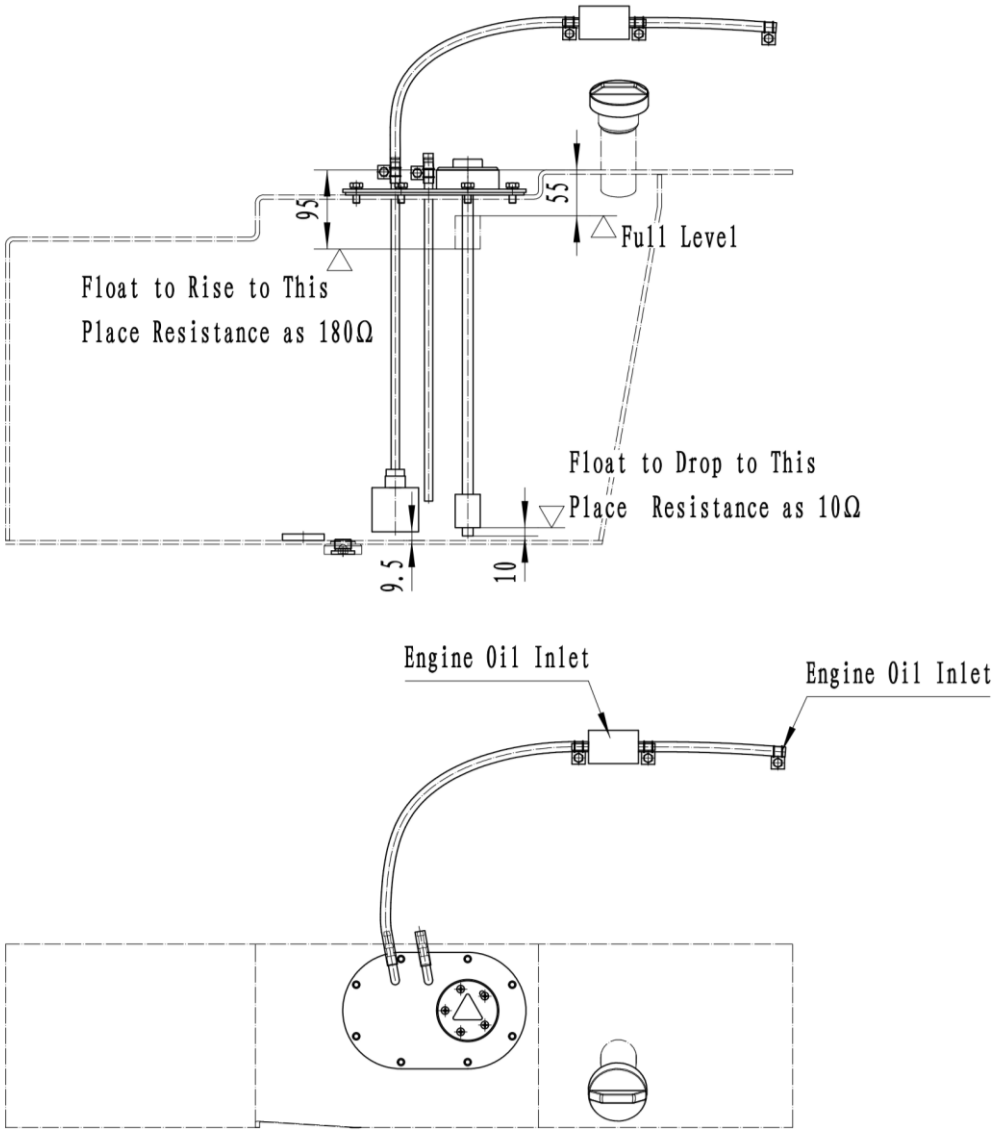
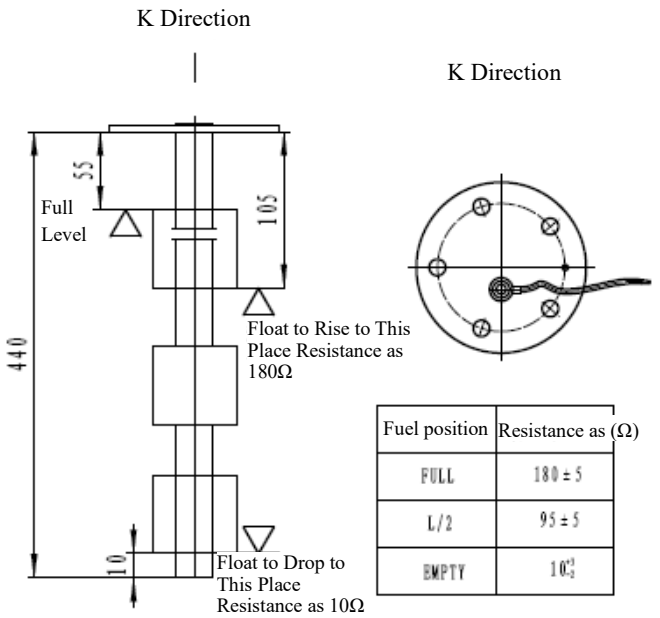


Fig 1-4 Fuel Tank (Gasoline Forklift Truck)

1.4.1 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 fuel tank for 2-2.5t is 52L, 60L for 3-3.5t forklift trucks, and the fuel quantity sensor is fitted on the tank cover of fuel tank to detect the fuel level.

1.4.2 Fuel Quantity Sensor



Fuel position	Resistance as (Ω)
FULL	180 ± 5
L/2	95 ± 5
EMPTY	10^{+3}_{-2}

Fig 1-5 Fuel Quantity Sensor

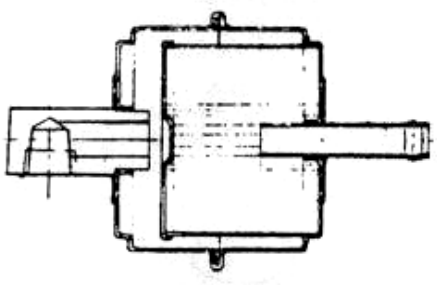


Fig 1-6 Gasoline Filter
(Specially Available for Gasoline Engines)

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.

1.4.3 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).

Service of fuel filter for gasoline engine: (including the two items of A) and B))

A) Fuel Filter I for gasoline engine is in a through or cylindrical type, and it shall be replaced periodically (namely replacement by years). (Refer to Fig 1-6). It is peculiar, with one grade of fuel filtration increased.

B) Fuel filter for gasoline engine (Refer to Fig 1-7.)

a) Take off the oil drain plug 7 (Refer to Fig 1-7) and drain the gasoline in gas cup completely.

b) Loosen Nut 1, and detach Filter Core 4.

c) Clean or replace the filter core.

d) After reassembly is completed, start engine for gasoline to be filled into the gas cup of filter. Examine whether or not gas leak exists, and Parts 8 and 5 seal rings may be replaced if leak exists.

(2) Service of Diesel Engine Fuel Filter

This filter is in cylindrical type, 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.

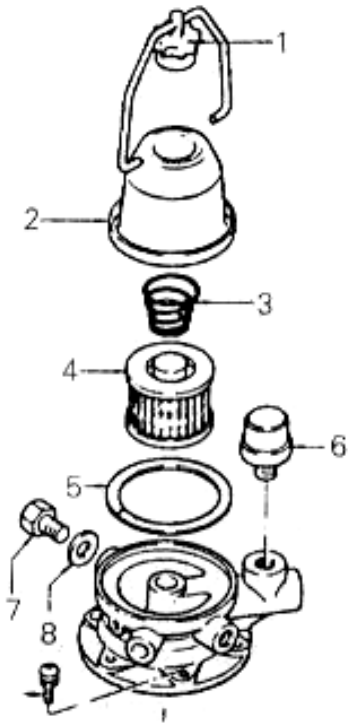


Fig 1-7

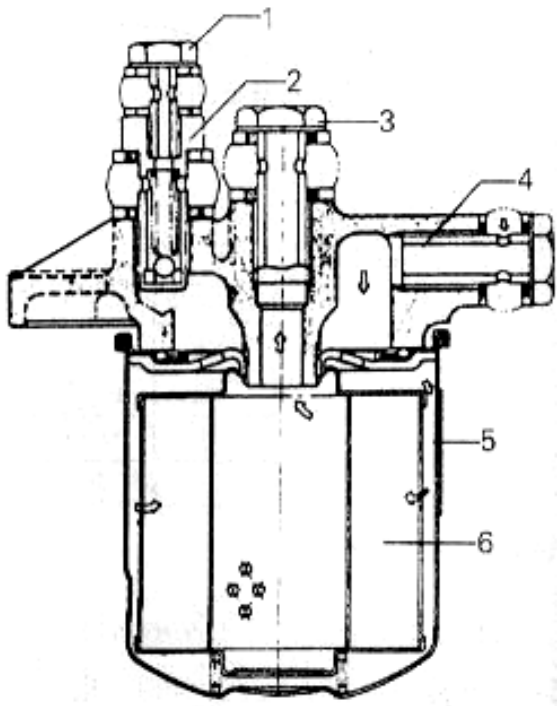


Fig 1-8

(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 1-9).

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.

(4) Cleaning of Fuel Tank

The fuel tank is to be cleaned once for every work of 600 hours, and attention shall be paid to fire control for forklift trucks using gasoline engine during cleaning.

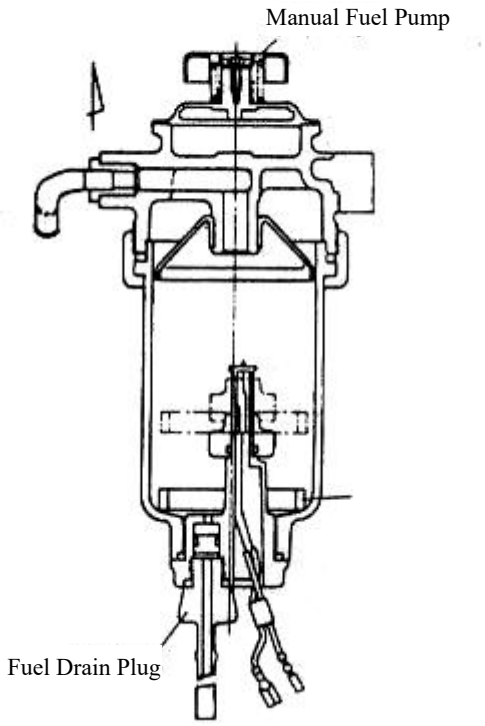


Fig. 1-9

2. Mechanical Transmission Case, Speed Reducer, and Speed Differential

Mechanical Transmission Case	
Type	Manual Gear Shift, Slide Synchromesh Gear
Number of Gears	2 Gears Respectively for Forward and Backward
Speed Ratio: Forward Gear 1/Gear 2	3.253/1.407
Speed Ratio: Backward Gear 1/Gear 2	3.204/1.386
Speed Reducer	
Reduction Gear	Spiral Bevel Gear
Speed Reducing Ratio	2.5 (1-1.8t) 2.1 (2-4t)
Speed Differential	
Reduction Gear	Spur Gear
Speed Reducing Ratio	5.7 (1-1.8t) 6.182 (2-4t)
Differential Gear	Common Bevel Gear
Oil Quantity	8L
Weight (at the Time without Oil)	About 155kg (1-1.8t), about 100kg（2-4t）

2.1 Overview

The transmission device for mechanical drive forklift trucks is in an integrated structure composed of mechanical transmission case, speed reducer, speed differential, and clutch shell (Fig 2-1). Synchromesh gear is fitted with mechanical transmission case for meshing gars to turn synchronously, to avoid gear impact during gear shift, and to be able for gear shift to be steady, to reduce noise arising from gear shift, especially during forward or backward commutation.

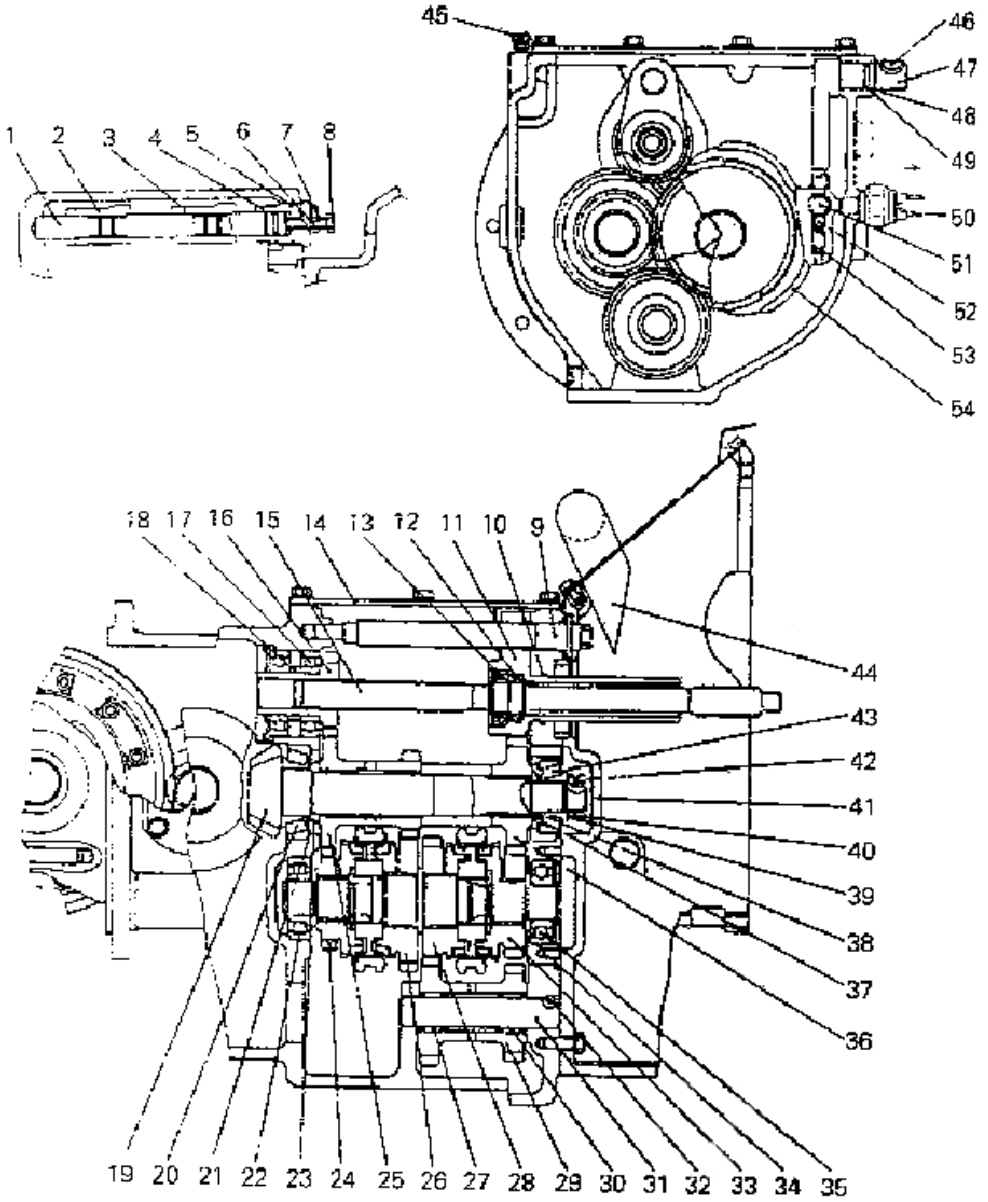


Fig 2-1 Transmission Device

1. Gear Shift Lever
2. Gear Shift Arm
3. Gear Shift Arm
4. Shaft Arm
5. O-ring
6. Lock Nut
7. Adjusting Bolt
8. Catch Bolt
9. Slide Screw Stem
10. O-ring
11. Bearing Bracket
12. Oil Seal
13. Ball Bearing
14. Case Cover
15. Driving Shaft
16. Input Gear
17. Ball Bearing
18. Spacer Sleeve
19. Output Shaft
20. Tapered Roller Bearing
21. Gasket
22. Cylindrical Bearing
23. Thrust Washer
24. High Gear
25. Duplicate Gear
26. Low Gear
27. Needle Roller Bearing
28. Reversing Gear
29. Idler Wheel
30. Needle Roller Bearing
31. Idler Shaft
32. Steel Ball
33. Forward Gear
34. Bearing Shell
35. Ball Bearing
36. Output Gear
37. Spacer Sleeve
38. Gasket
39. Nut
40. Lock Washer
41. Clutch Housing
42. Lock Nut
43. Tapered Roller Bearing
44. Vent Pipe
45. Venthole
46. Key
47. Rotary Rod
48. Retainer Ring
49. O-ring
50. Standby Light Switch
51. Gear Shift Lever
52. Steel Ball
53. Spring
54. Poking Fork

2.2 Mechanical Transmission Case

The mechanical transmission case is composed of one driving shaft, one output shaft, one main shaft, and one idler shaft (used for reversing gear shift), and one or several gears of different number of teeth are available on each shaft. These gears are used for gear shift by making use of gear-shift handle, through two groups of synchromesh gears in the type of engagement sleeve mounted on the main shaft, for the output shaft to transmit the power of engine onto the drive wheel through low-speed gear and speed differential as well as half shaft. The mechanical transmission case is in common use for 1-1.8t and 2-4t, but the structures are the same, as introduced below:

2.2.1 Driving Shaft and Slide Screw

The driving shaft is inserted into the inside ball bearing of flywheel on one end of clutch, and mounted with input gear on the other end of spline (normally engaged with duplicate gear on the output shaft) fixed inside the ball bearing on the transmission case, with middle part mounted on the bearing bracket through ball bearing and snap ring. The bearing bracket is mounted on the transmission case by virtue of slide screw, and the driving shaft and the bearing bracket are able to move together in axial direction through rotating the T-shaped screw thread of slide screw, when it is required to replace the brake shoe assembly of clutch, for the driving shaft to retreat into the transmission case.

2.2.2 Output Shaft

The duplicate gear is mounted on the output shaft through two needle roller bearings and spacer sleeves, with the other end of output shaft mounted with the output gear using spline through spacer sleeve. Tapered roller bearings are mounted on the both ends of output shaft, to adjust the bearing-side clearance using gasket on the rear end. The bull gear in the duplicate gear is engaged with input gear and high-speed gear, while the pinion is engaged with low-speed gear, while the output gear is normally engaged with forward gear and reversing idler gear.

2.2.3 Main Shaft

High-speed gear, low-speed gear, reversing gear, and forward gear are all mounted on the main shaft through needle roller bearings, and as they normally maintain engagement with duplicate gear, reversing idler gear, and input gear, gear shift or reversing may be performed just through operating the synchromesh gear on the main shaft.

2.2.4 Idler Shaft

The idler gear shaft is fixed on the transmission case, positioned using steel ball on the rear end. The idler gear is mounted on the idler gear shaft using needle roller bearing, and this idler gear is respectively engaged with reversing gear and output gear.

2.2.5 Rotary Rod and Gear-Shift Poking Fork (Refer to Fig. 2-2 and Fig. 2-1.)

Two rotary rods are respectively used for shift of speed gear and direction gear. The poking fork is supported on gear-shift lever, locked inside the slot of gear-shift lever, for the convenience to fix gear-shift position.

2.2.6 Synchromesh Gear (Refer to Fig. 2-3.)

Synchromesh gear is composed of synchronous taper, synchronous ring, and insert.

a) Synchronous Taper: Gear 11 or 13 carries a shaft taper face (synchronous taper) and involute spline, to be respectively combined with the synchronous ring (Part 2) and the engagement sleeve (Part 5) through the friction face and spline gear of this taper face.

b) Synchronous Ring: The synchronous ring has a hole taper face, mutually matched with the synchronous taper through the friction face of this taper face. The synchronous ring has three grooves uniformly distributed along the circumference, and these three grooves are correspondingly aligned with the positions of spline for engagement sleeve and the spline for synchronous ring, to facilitate bear down on the synchronous ring through the spline 6 of engagement sleeve.

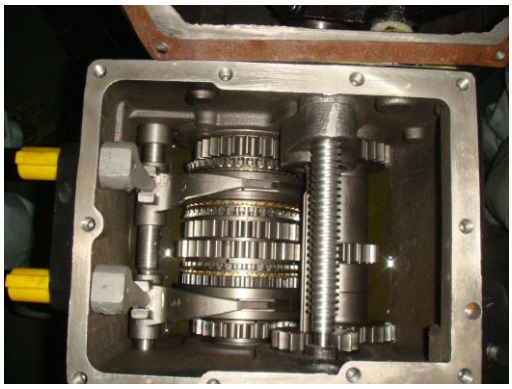


Fig. 2-2 Gear-Shift Mechanism

1. Spline Gear of Synchronous Ring
2. Synchronous Ring
3. Spline Gear of Gear 11
4. Synchronous Taper
5. Engagement Sleeve
6. Spine of Engagement Sleeve 5
7. Insert
8. Spring
9. Clutch Driven Disc Hub
10. Poking Fork
11. Normally Engaged Gear
12. Tooth of Gear 11
13. Normally Engaged Gear
14. Tooth of Gear 13

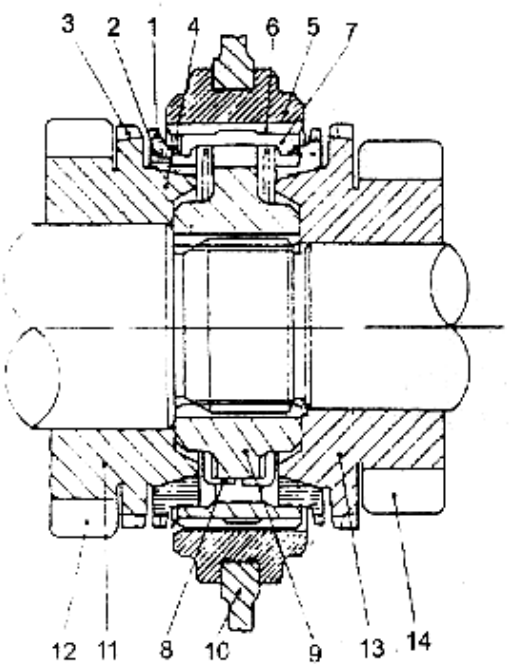


Fig. 2-3 Synchromesh Gear

c) Insert: The bulge in the middle of three inserts are fitted into the spline slot of Engagement Sleeve 5, the parts of its both ends are respectively embedded into the three grooves corresponding to synchronous ring, and the inserts bear down on the top part of spline slot 6 through two Springs 8. This outward spring force facilitates the spline gear of synchronous ring to be frequently at the aligned position.

Operate the synchromesh gear, and it can be divided into undermentioned 6 steps from neutral position to completion of engagement, described in Figs 2-4~2-10.

Step 1: (Refer to Fig 2-4)

The force through action on the gear shift lever during gear shift, is transmitted onto the engagement sleeve 5 through poking fork, and the engagement sleeve 5 and the insert 7 respectively move a distance X_1 and X_2. At this point, the middle bulge of Insert 7 is still in the internal slot of the engagement sleeve.

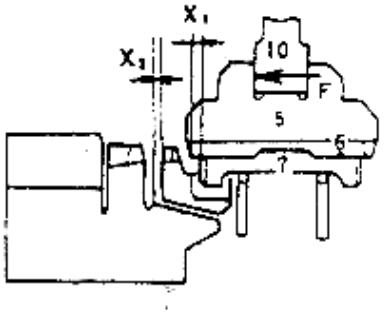


Fig 2-4

Step 2 (Refer to Fig 2-5)

After the clearance between X and X is removed, the acting force is added onto the brake shoe of the insert 7, synchronous ring 2 and the synchronous taper 4. This force overcomes the action of spring force for the insert to tilt to an angle, to form an angle contact as indicated in the figure, and the engagement sleeve moves for a Z distance under the action of this force.

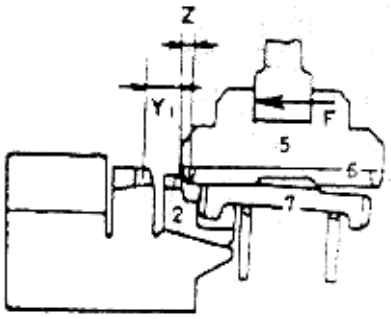


Fig 2-5

Step 3 (Refer to 2-6)

(Instruction: The meshing process as indicated in Fig 2-6~2-10 is the top views in all)

Friction torque is generated on the friction face of Synchronous taper through the force of insert 7 effected on the synchronous ring, and the synchronous ring is allowed to turn an angle, for one side of the synchronous ring groove to get in contact with the side face of the insert. At this point the engagement sleeve is allowed to be located at the position aligned with the synchronous ring.

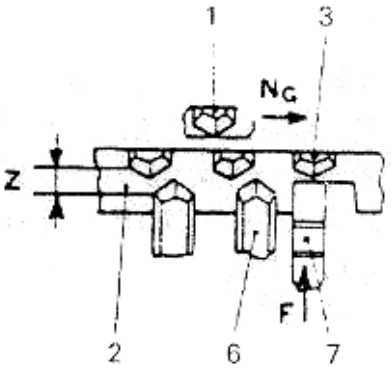


Fig 2-6

Step 4 (Refer to Fig 2-7)

After Step 3 is completed, the synchronous engagement sleeve has displaced for a Z distance, so as for the place 15 of the spline gear for synchronous ring (1) to begin to get into contact with the chamfered part of the spline (6) of the engagement sleeve, and at the same time the required friction torque Tc is gradually achieved on the surface of the synchronous taper, for the original inertial torque Ti of gear to be gradually reduced, namely Ti＜Tc engagement process has begun synchronization.

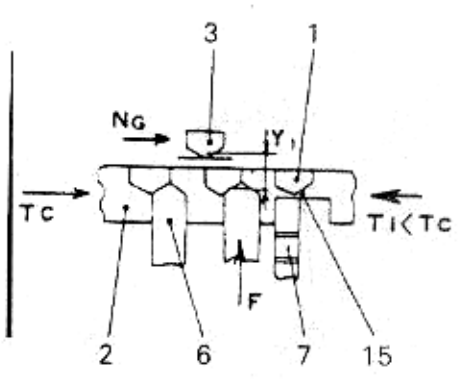


Fig 2-7

Step 5: (Refer to Fig 2-8)

When the relative speed difference of the synchronized normally engaged gear 11 and the engagement sleeve 5 is 0, the inertial torque Ti=0, namely the friction torque overcomes the inertial torque, for the speeds of gear 11 and the main shaft to be the same, to complete synchronization. At this time, for the continuous action of axial force, the synchronous ring turns an angle in circumferential direction, for the gear of engagement sleeve to be located between 3, and at the same time under the external force, the synchronous ring has changed into floating status for the engagement sleeve to be able to pass between the synchronous rings.

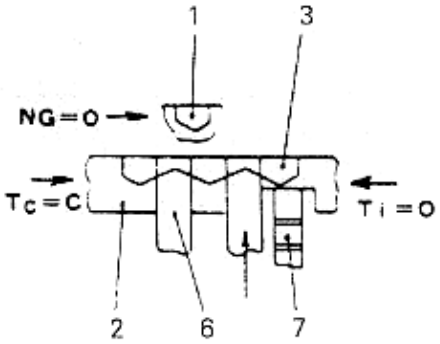


Fig 2-8

Step 6: (Refer to Fig 2-9 and Fig 2-10)

After passing through the synchronous ring, the engagement sleeve has moved a Y distance as indicated in Fig 2-7, for the chamber part of the spline 6 of engagement sleeve to begin getting into contact with the chamber part of spline gear 3 of gear 11 (Refer to Fig 2-9.). The contact of this chamfer adds a torque T on gear 3 through spline of engagement sleeve, for the gear 11 to turn an angle along the circumferential direction relative to engagement sleeve, this to have the spline of engagement sleeve pass between the spline gear 3, and the whole synchronization process is then completed. The power is transmitted through the clutch driven disc hub on main shaft, the engagement sleeve and the gear 11 (namely the speed or direction gear), thus to achieve the gear-shift process.

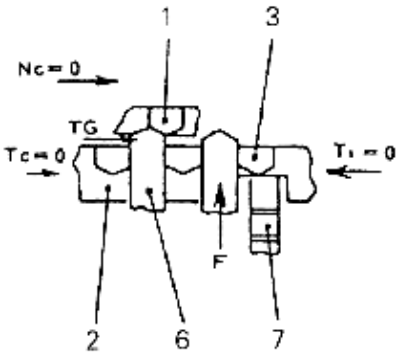


Fig 2-9

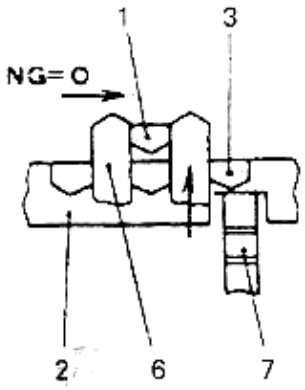


Fig 2-10

1. Driving Shaft 12. Main Shaft
2. Input Gear 13. Reversing Gear
3. Duplicate Gear 14. Synchronous Taper
4. Duplicate Gear 15. Engagement Sleeve
5. Output Gear 16. Clutch Driven Disc Hub
6. High Gear 17. Synchronous Taper
7. Synchronous Taper 18. Forward Gear
8. Engagement Sleeve 19. Reversing Gear
9. Clutch Driven Disc Hub 20. Reversing Gear
10. Synchronous Taper 21. Output Shaft
11. Low Gear 22. Inertial Shaft

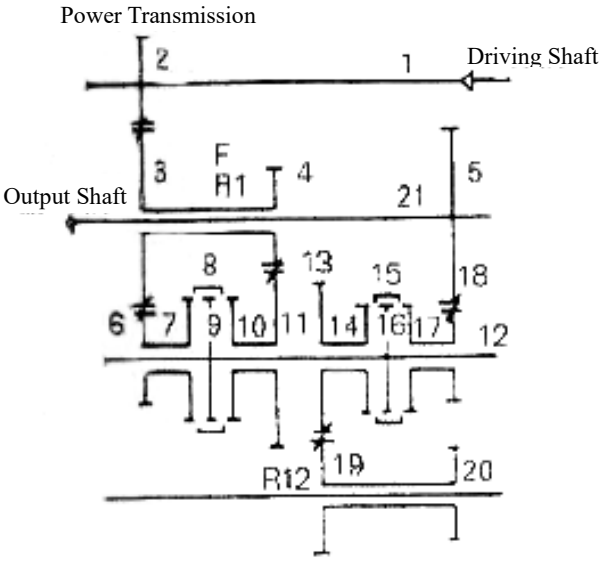


Fig 2-11

Neutral Gear Position——

The power from the driving shaft 1 is transmitted onto the high-speed gear 6 and the low-speed gear 11 through normally engaged input gear 2, as well as duplicate gears 3 and 4, but as the gear-shift engagement sleeve for controlling speed and direction is at the neutral position, the output gear on the main shaft and the output shaft will not rotate, and that's way the power cannot be exported.

Gear-shift Position——

When gear-shift lever of transmission case is turned, the poking fork actuates the movement of engagement sleeve, for respective gears to be engaged through synchromesh gear. The procedure for power transmission is as follows:

Driving Shaft → Input Gear → Duplicate Gear → High-Speed or Low-Speed Gear → Synchromesh Gear → Main Shaft → Synchromesh Gear → Reversing Gear of Forward Gear → Output Gear → Output Shaft to Achieve Power Output

Power Transmission Procedure at 1st Forward Gear:

1—2—3—4—11—10—8—9—12—16—15—17—18—5—21

Power Transmission Procedure at 2nd Forward Gear:

1—2—3—6—7—8—9—12—16—15—17—18—5—21

Power Transmission Procedure at 1st Reversing Gear:

1—2—3—4—11—10—8—9—12—16—15—14—13—19—20—5—21

Power Transmission Procedure at 2nd Reversing Gear

1—2—3—6—7—8—9—12—16—15—14—13—19—20—5—21

2.3 Speed Reducer (Refer to Fig 2-12.)

The part of speed reducer is located on the front part of transmission case. This mechanism has reduced the rotating speed of output shaft from transmission case and increased the torque transmitted from the output shaft, and then sends this torque to the speed differential. The speed reducer is mainly composed of the small spiral bevel gear on the output shaft, one large spiral bevel gear, and one small gear shaft. The large spiral bevel gear is mounted on the small gear shaft through spline, while the two ends of small gear shaft are both supported with tapered roller bearing, and filled with gasket to adjust the side clearance.

1. Gear Ring
2. Bolt
3. Bearing Seat
4. Ball Bearing
5. Thrust Washer
6. Tapered Roller Bearing
7. Bearing Cover
8. Gasket
9. O-ring
10. Output Shaft
11. Spiral Bevel Gear
12. Terminal Bevel Gear Shaft
13. Cylindrical Pin
14. Gear Shaft I
15. Gear Shaft II
16. Half-Axle Gear
17. Gasket
18. Planetary Gear

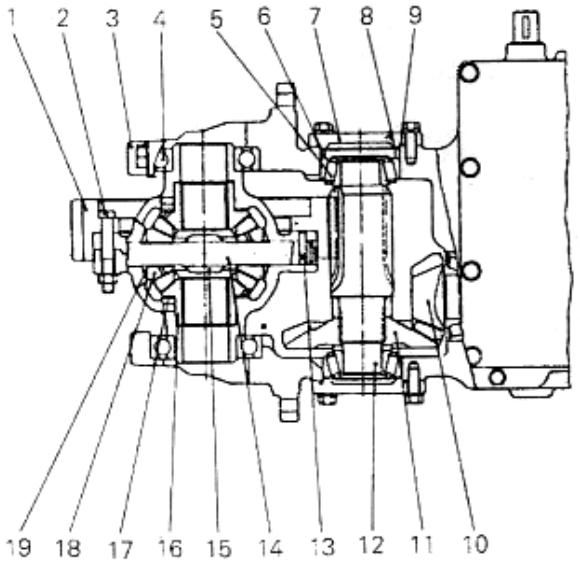


Fig 2-12 Speed Reducer and Speed Differential

2.4 Speed Differential (Refer to Fig 2-12.)

Speed differential is mounted on the front half shell using bearing seat through ball bearings on the two ends, and the front end is connected with axle shell. The shell of speed differential is made into a type of left and right parts, with two half shaft gears and four planetary gears. The thrust washer is mounted between the shell of speed differential and gear and it is allowed for a clearance to be retained between respective gear pairs. The planetary gears are supported using gear shafts I and II, while gear shaft I is fastened onto the body of speed differential using cylindrical pink, and gear ring I is fixed onto the shell of speed differential using articulated bolts.

The power from transmission is generated into differential speed by speed differential through speed reduction transmitted onto the wheels through half shaft gear and half shaft.

2.5 Replacement of Poking Fork

Figs 2-13~2-20 explain some methods for replacement of transmission gear-shift poking fork, with individual parts for driving devise taken as examples in graphic representations, and the replacement method for disassembly and assembly on forklift truck is basically the same as them.

(1) Firstly detach the bolts for mounting shaft arm on the rear end of gear shift lever on the side face. (Fig 2-13)

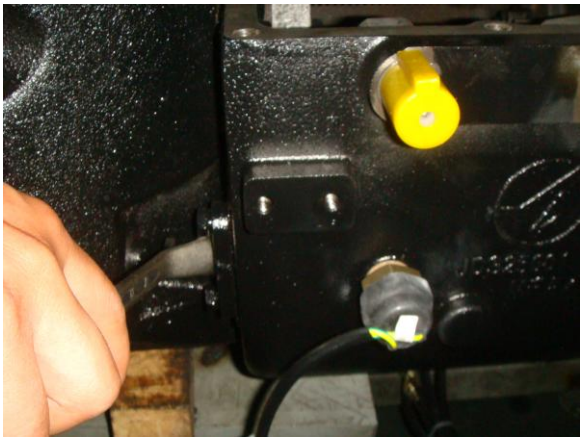


Fig 2-13

(2) Pull out the shaft arm slightly (Fig 2-14).

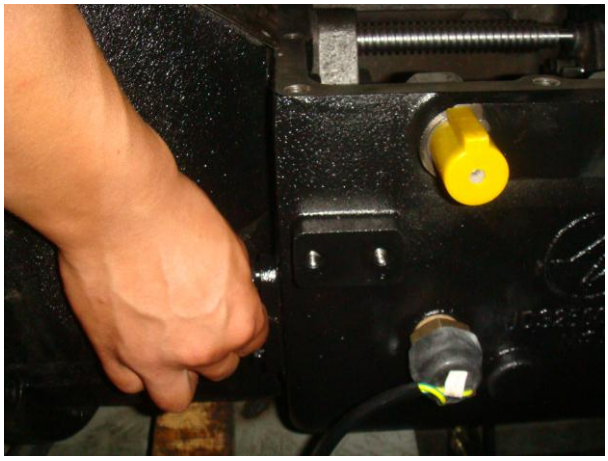


Fig 2-14

(3) Loosen off the mounting bolts on Case cover (Fig 2-15).

Fig 2-15

(4) Perform fast-speed gear shift, from forward to backward, or from backward to forward, for the front end of gear-shift lever to leave the shell of transmission case (Fig 2-16).

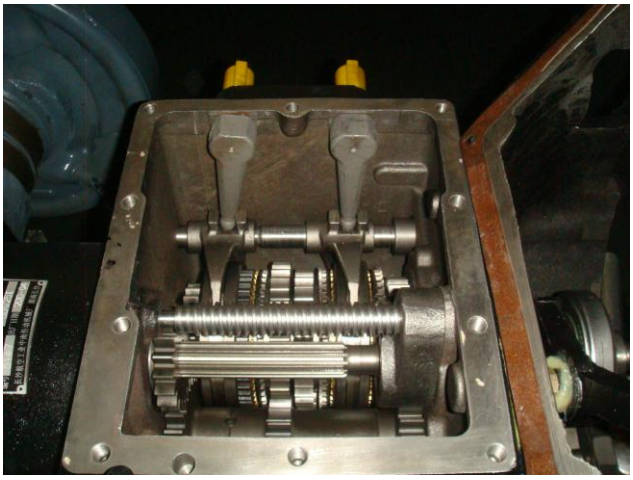


Fig 2-16

(5) Take out the shaft arm (Fig 2-17).

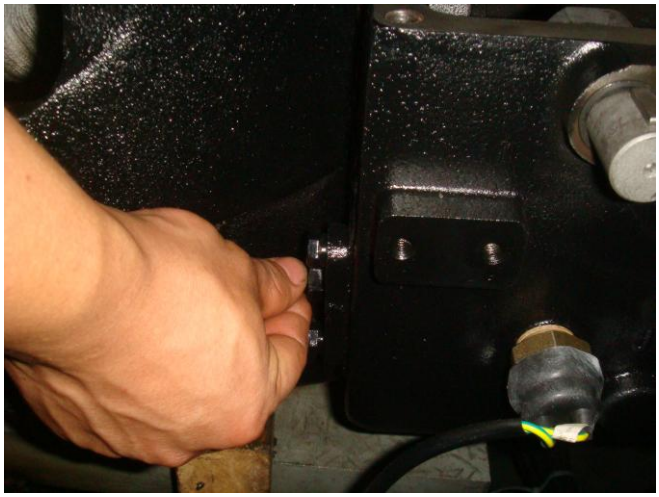


Fig 2-17

(6) Remove the snap ring on the outer end of rotary rod using calipers, and take it off (Fig 2-18).

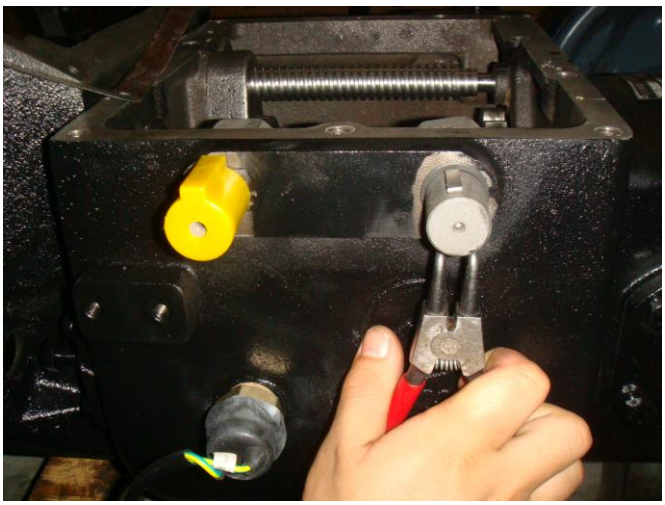


Fig 2-18

(7) Gently knock at the head of rotary rod (Attention: Not to be heavily opened), and taken off the rotary rod (Fig 2-19).

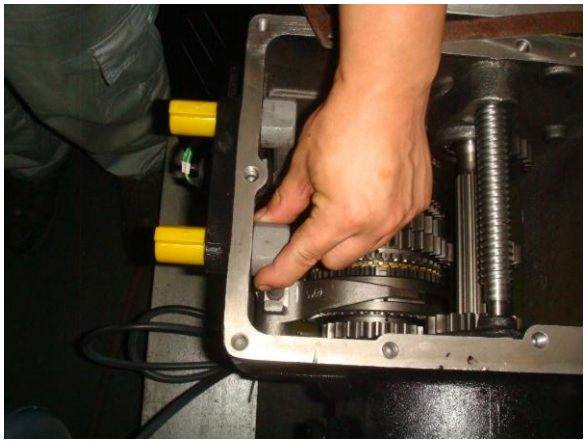


Fig 2-19

(8) Loosen off the poking fork together with gear shift lever. Attention: At this point the position where the poking fork located shall be known clearly (Fig 2-20).

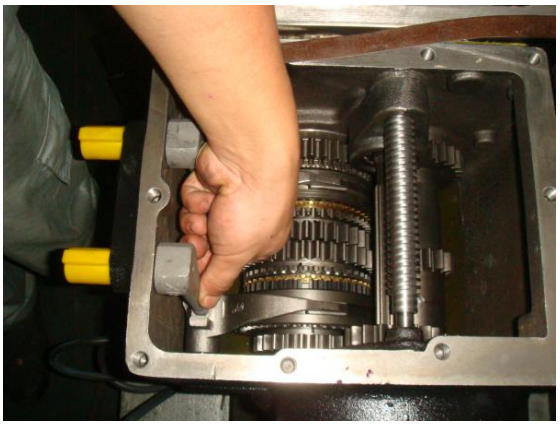


Fig 2-20

2.6 Reassembly of Poking Fork

The procedure for reassembly of poking fork is contrary to the disassembly procedure, but attention shall be paid to the following points:

(1) It shall be reassembled at a clean site, to prevent entry of dust and impurity into the case.

(2) Examine the wearing status of respective parts, and those that are excessively worn shall be

replaced with new ones.

(3) Generally speaking, respective seal parts and O-rings shall be replaced with new ones.

Reassembly procedure is as follows:

(1) Mount the spring and the steel ball into the hole of poking fork, set in the gear shift lever, gently knock at it, and have it properly mounted (Fig 2-21).

Attention: a) The position of poking fork shall be the position when it is disassembled. b) The steel balls on poking fork shall be dropped into the corresponding middle slots of the gear shift lever.

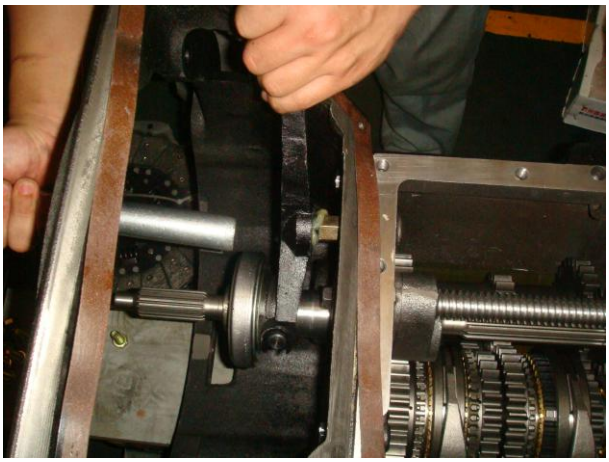


Fig 2-21

(2) Align the poking fork and the slot of engagement sleeve properly, and fit the properly mounted poking fork, and the gear-shift lever into the case (Fig 2-22).

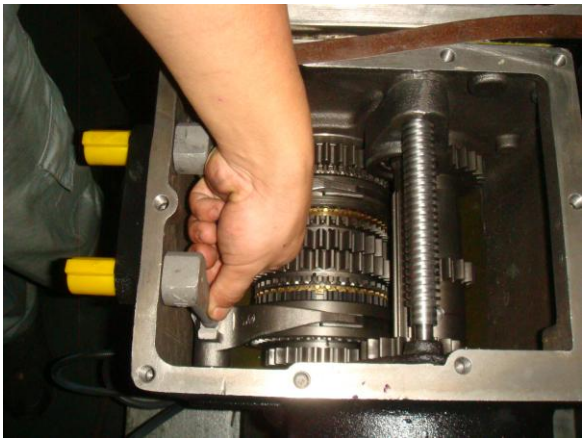


Fig 2-22

(3) Assemble the shaft arm properly (Fig 2-23). At this point attention shall be paid to the position of gear shift lever (Fig 2-24).

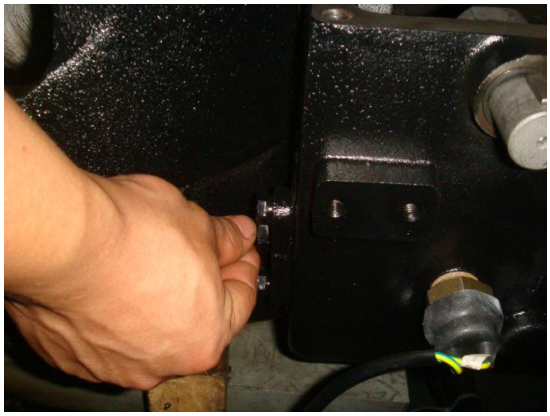


Fig 2-23

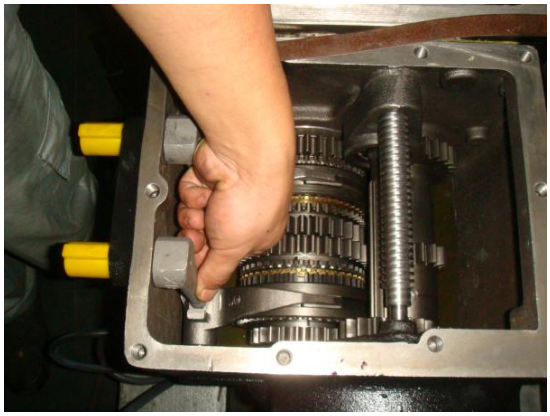


Fig 2-24

(4) The two mounting bolts shall be firstly screwed up using a torque of 28.4-44 N.m (2.9-4.5kg.m), before the lock screw on the end part of shaft arm is tightened up (Fig 2-25).

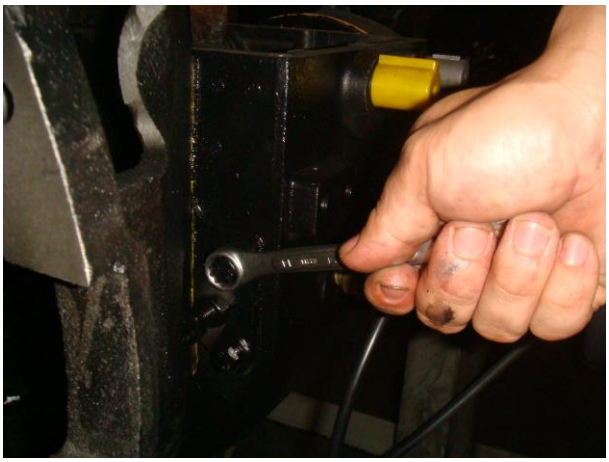


Fig 2-25

(5) After the head of front-end gear shift lever is inserted into the case, tighten up the lock bolt using a torque of 7.8-17.6N.m (0.8-1.8kg.m), and use the torque of 3.7-23.5N.m (1.4-2.4kg.m) to screw up the lock nut. (Figs 2-26, 2-27);

Fig 2-26

Fig 2-27

(6) Fit the rotary rod and O-ring together into the shell (Fig 2-28), and use snap ring to lock it up (Fig 2-29).

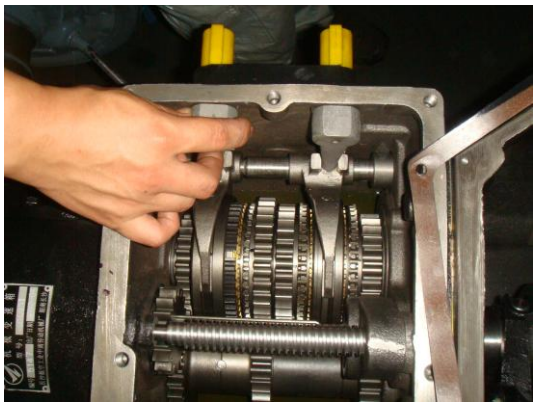


Fig 2-28

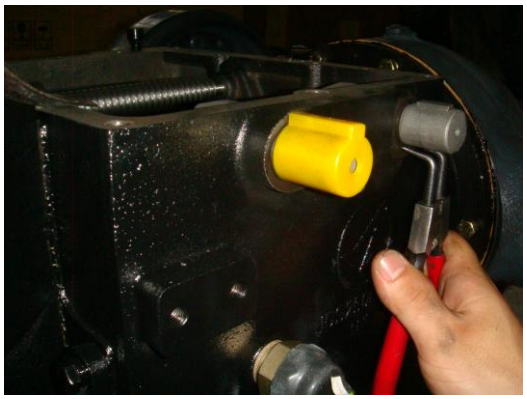


Fig 2-29

(7) Mount the gasket of case cover and the case onto the shell and use the specified torque of 20.6-34.3N.m (2.1-3.5kg.m) to screw down respective bolts (Fig 2-30).

Fig 2-30

3. Hydraulic Transmission Case and Torque Converter

3.1 Overview

FYQXD30 series hydraulic transmission gearbox and FCSQD30 differential assembly constitute a full-floating power transmission system, which is a new-generation forklift transmission system.

FYQXD30 series hydraulic transmission gearbox is composed of hydraulic torque converter and gear shift gearbox, with a front gear and rear gear; FCSQD30 differential assembly uses a pair of cylindrical gears and a pair of bevel gears two-level slowdown, with slowdown and differential transmission. The gearbox output and differential assembly input are in the form of connecting flange, and a connecting way of wing-shaped coupling is used between the two; meanwhile, a rubber shock-absorbing sleeve is used on both sides for auxiliary support respectively, so it has excellent shock absorbing effect; even in the bumpy environment, it also can make operators feel operating on a flat ground, so that the whole vehicle's vibration reaches a minimum, thus greatly improving the job efficiency.

The torque converter equipped with FYQXD30 is a single-stage two-phase integrated hydraulic torque converter with three active wheels; it makes the gearbox with auto-adaptability of hydraulic transmission output, and it can change the output torque and speed accordingly as the external load changes, and can absorb and eliminate impact and vibrations from outside load on the engine and drive system. With electro-hydraulic control gear and with micro valve and cushion valve, it is simple and convenient in operation, and starts smoothly, significantly reducing the intensity of operations.

3.2 Main technical parameters

Rated output speed of matching engine	2000～2300r/min
Rated output power of matching engine	33～45kW
Enter the rotation direction (input-oriented)	Clockwise
Transmission ratio of gearbox:	F1=2.195 R1=2.258
Transmission ratio of differential gear:	i=7.899

Main performance parameters of hydraulic torque converter:

Effective diameter	D=265mm
Torque coefficient under the operating condition of zero speed	K_0=3.0±0.15
Maximum efficiency	η≥0.79
Nominal torque of pump pulley with the maximum efficiency	M_{Bg}=31±1.6N.m
Nominal torque of pump pulley with zero speed	M_{Bg0}=33.5±4N.m
Working oil:	L-TSA32GB11120-89 turbine oil
	Or 6# and 8# hydraulic transmission oil

3.3 Notes to installation and usage

3.1 The main oil pressure of the gearbox is 1.1 MPa~1.4MPa, the oil inlet pressure of the torque converter is 0.4MPa~0.6MPa, and the oil pressure is 0.1MPa~0.3MPa. The connecting position of the pressure gauge is shown in Figure 1.

3.2 The normal working oil is 70℃~90℃, the maximum operating temperature does not exceed 120℃ and the lasting time is no more than 5 minutes.

3.3 The working oil should be kept clean, and there shall be no impurities. The working oil should be replaced 100 hours after starting to work at first at a normal oil temperature, and later, new oil should be replaced every 1000 hours of use or long-time stopping before opening.

3.4 Check the oil level 5 minutes after starting, and the oil surface height should be within the scope of the dipstick.

3.5 When shifting the vehicle gear, the micro valve should be first closed; when shifting or braking, the micro valve must be turned off, to prevent damage to the clutch or brake failure.

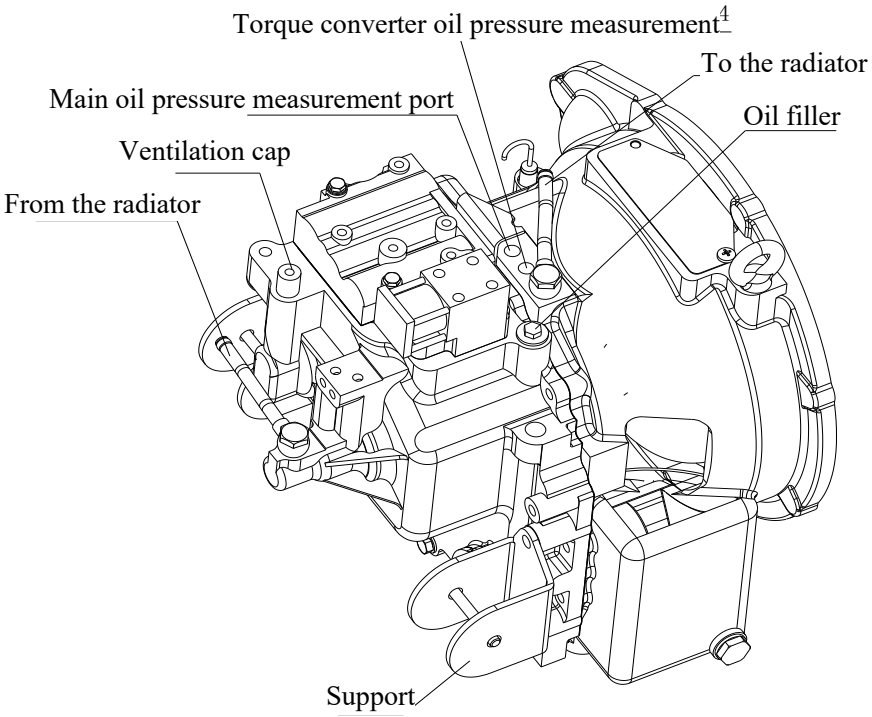


Figure 1

4. Drive Axle

Type	Front Wheel Drive, Axle Body Fixed with Vehicle Chassis, and Fully Floating Type						
Forklift Truck Tonnage	1-1.8t	2 and 2.5t		3 and 3.5t		4t	
	Single Tyre	Single Tyre	Double Tyre	Single Tyre	Double Tyre	Single Tyre	Double Tyre
Tyre Size	2×6.50-10-10 PR	2×7.00-12-12 PR	4×7.00-12-12 PR	2×28×9-15-14 PR	4×28×9-15-14 PR	2×250-15-16 PR	4×250-15-16 PR
Rim Size	5.00F-10	5.00S-12	5.00S-12	7.00T-15	7.00T-15	7.50V-15	7.50V-15
Tyre Pressure	790MPa	860 MPa		970 MPa		930 MPa	

4.1 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.

1-2.5t the wheel rim for single tyre is in partial type, with wide tyre used for 3t and 4t, while 2-4t forklift trucks may be equipped with double tyre (Refer to Fig 4-2.).

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

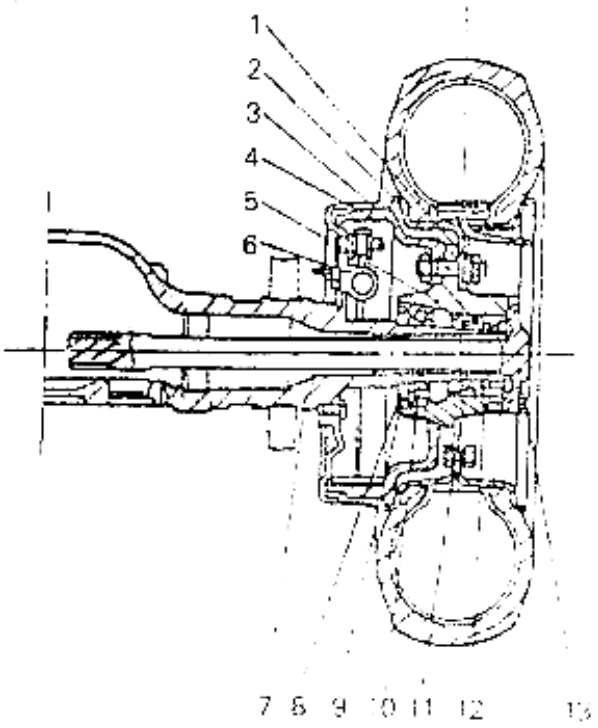


Fig 4-1 Drive Axle

4.2 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 2-4t and is 150-170N.m for 1-1.8t.

(5) Tighten the brake drum mounting nut and its torque is 206-225N for 2-4t and is 120-140N.m for 1-1.8t.

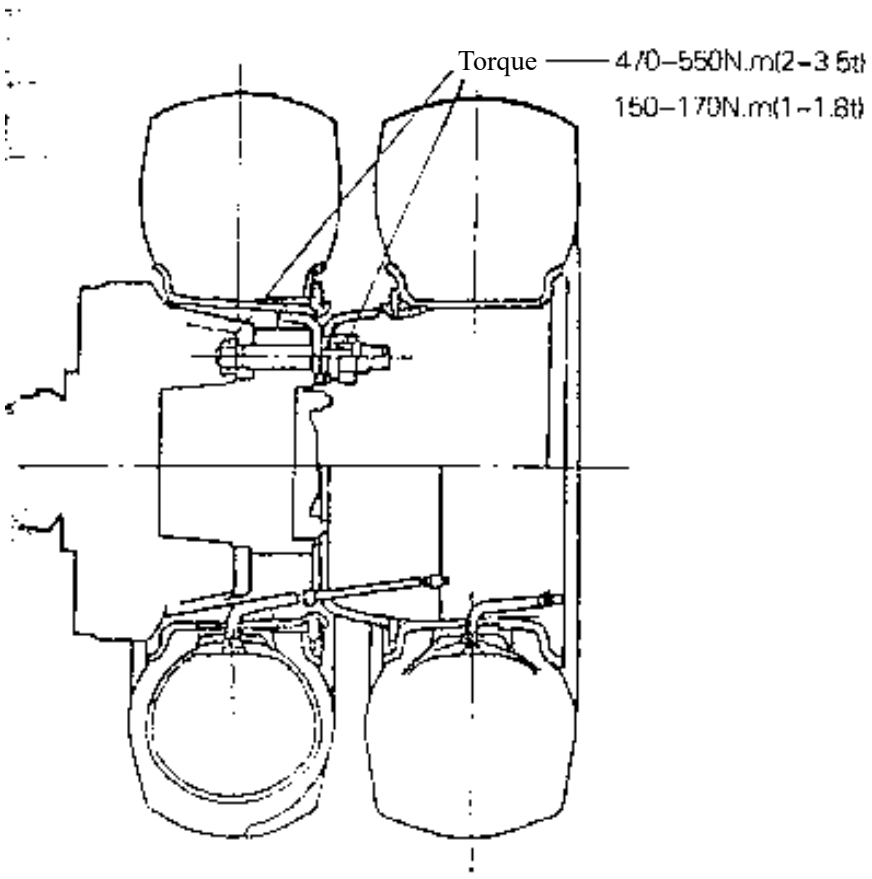


Fig 4-2

5. Steering System

Type of Steering System		Rear Wheel Steering with Power Steering
Power Steering		
Forklift Truck Tonnage		2t, 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
Diameter of Steering Wheel mm		Φ300

5.1 Overview

Steering system is mainly composed of fully hydraulic steering gear, and steering cylinder.

(1) Fully Hydraulic Steering Gear Assembly (Fig 5-1)

It mainly includes cycloid fully hydraulic gear, (Refer to Fig 5-2), steering column, and

steering wheel. The steering column and the steering wheel are able for forward and backward rotation by 4.5º, to adapt to driver's different needs.

Fully hydraulic steering gear is able to transmit the pressure oil from bypass valve to steering cylinder through pipeline according to the size measurement for the rotation of steering wheel. When engine is turned off, oil pump cannot feed oil, and then steering may be achieved manually.

(2) Steering Cylinder (Fig 5-3)

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.

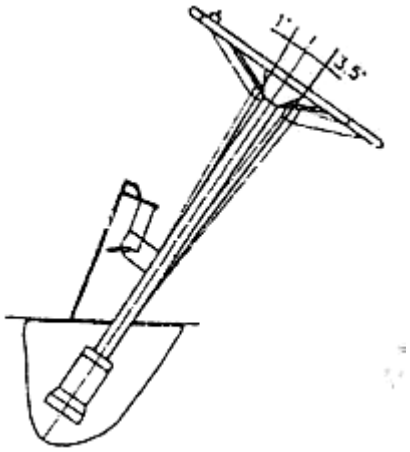


Fig 5-1

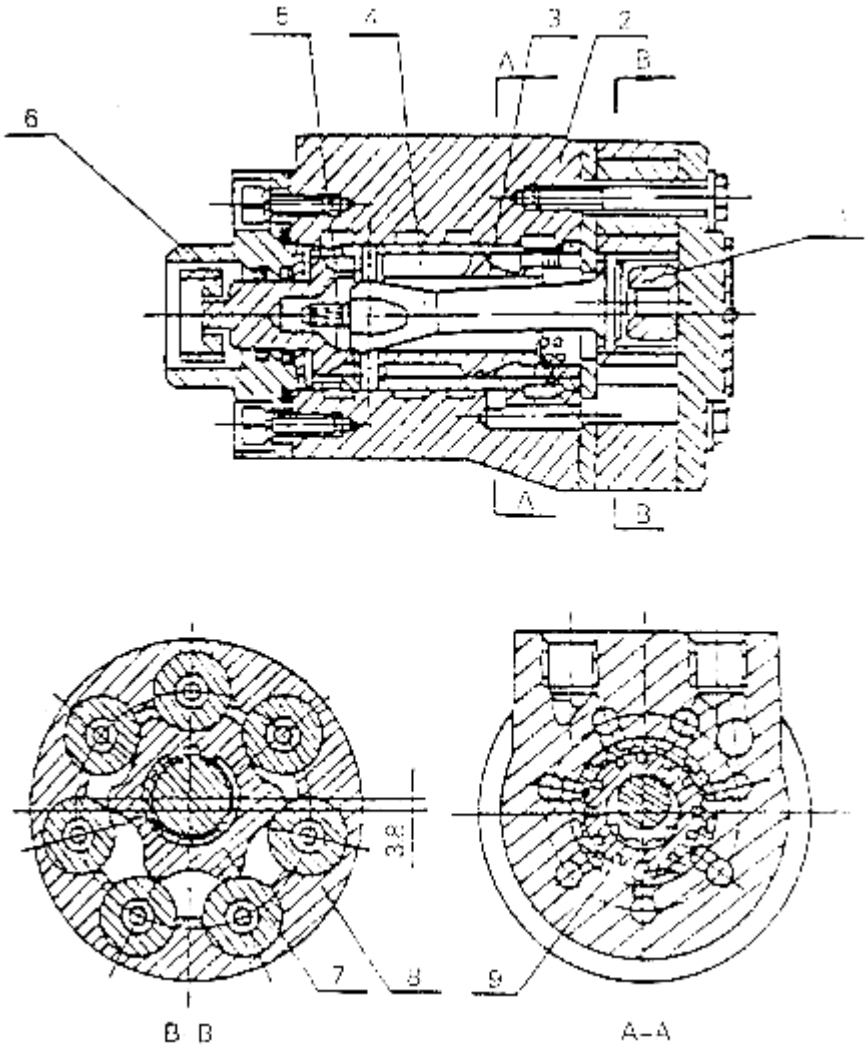


Fig 5-2 Cycloid Fully Hydraulic Steering Gear

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

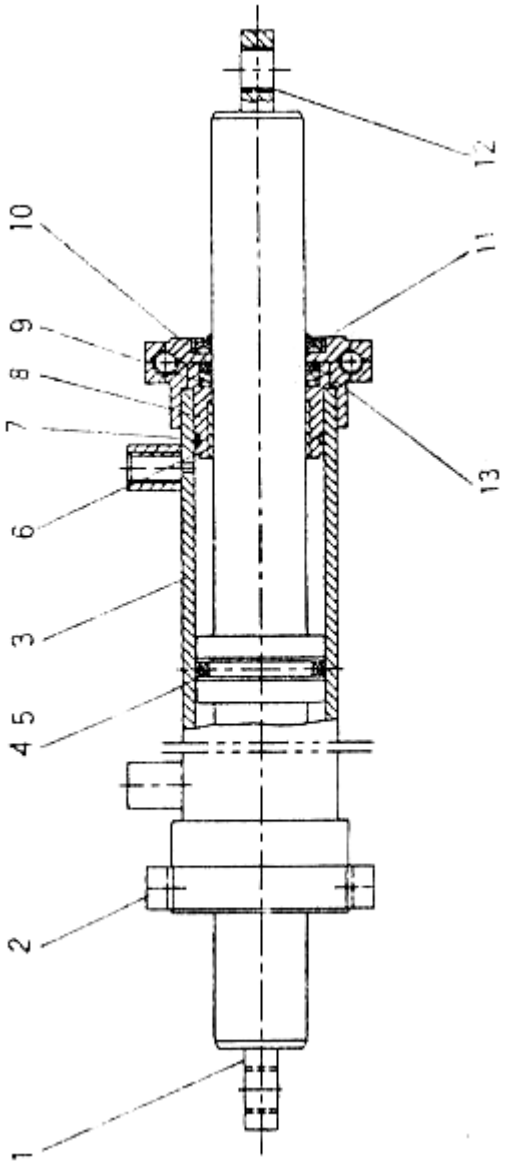


Fig 5-3 Steering Cylinder

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

5.2 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.

5.3 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

6. Cross Cylinder Drive Axle

Tonnage		1t, 1.5t, 1.8t	2t, 2.5t, 3, 3.5t, 4t
Type of Axle Body		Supported with Central Supporting Shaft	
Steering Angle	Inner Side Wheel	78º	
	Outer Side Wheel	52º24’	54º
King Pin	Center Distance of King Pin	780mm	810mm
	Sidewise Inclination Angle	0º	
Wheel Camber Angle		1º	

Wheel

Tonnage	1-1.8t	2-2.5t	3-4t
Tyre	2×5.00-8-8 PR	2×6.00-9-10 PR	2×6.50-10-10 PR
Wheel Rim	3.50D-8	4.00E-9	5.00F-10
Charging Pressure	1000KPa	860KPa	790KPa
Total Weight	About 105kg	About 155kg	

6.1 Overview

Steering axle is in a type of welded structure of a box cross section (Fig 6-1), 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.

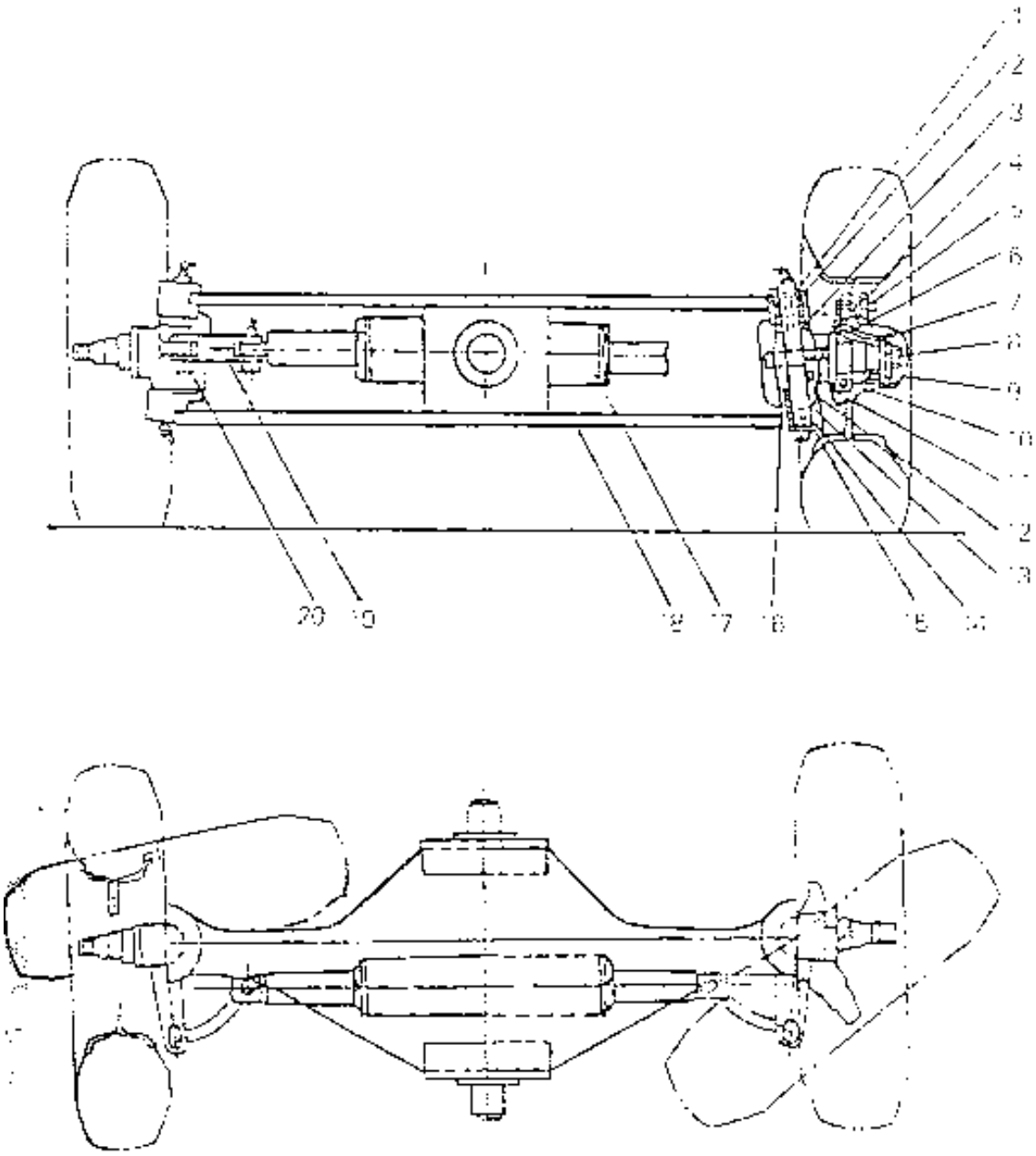


Fig 6-1 Steering Axle

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

6.2 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.

6.3 Adjustment for Pre-tightened Load of Steering Wheel Bearing

(1) As indicated in Fig 6-2, 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.

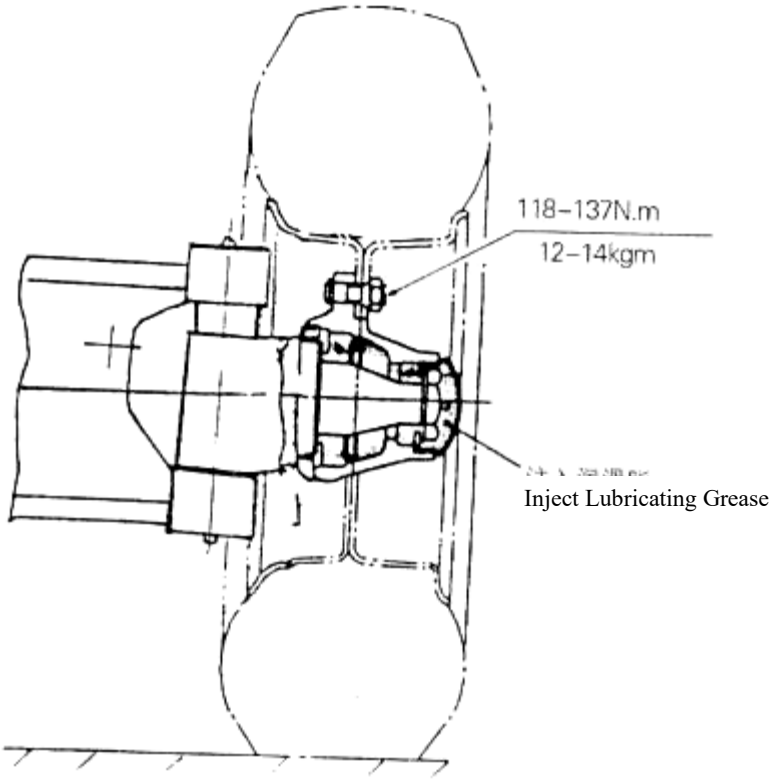


Fig 6-2 Adjustment for Pre-tightened Load

7. Brake System

Type	Front Twin Wheel Brake, Internal Expansion, Hydraulic		
Pedal Lever Ratio	5.66		
Master Cylinder Diameter	19.05mm		
Wheel Brake	1-1.8t	2-2.5t	3-4t
Type	Dual Servo Type with Parking Brake		
Wheel Cylinder Diameter	22.22mm	28.58	
Size of Brake Shoe (L ×W × T)	279×48.5×5mm	324×60×7mm	348×76×8mm
Area of Brake Shoe	135.3cm^2×4	194.4 cm^2×4	264 cm^2×4
Inner Diameter of Brake Drum	254mm	310mm	314mm
Parking Brake	Front Twin Wheel Brake, Internal Expansion, and Hydraulic Type		

7.1 Overview

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

7.2 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.

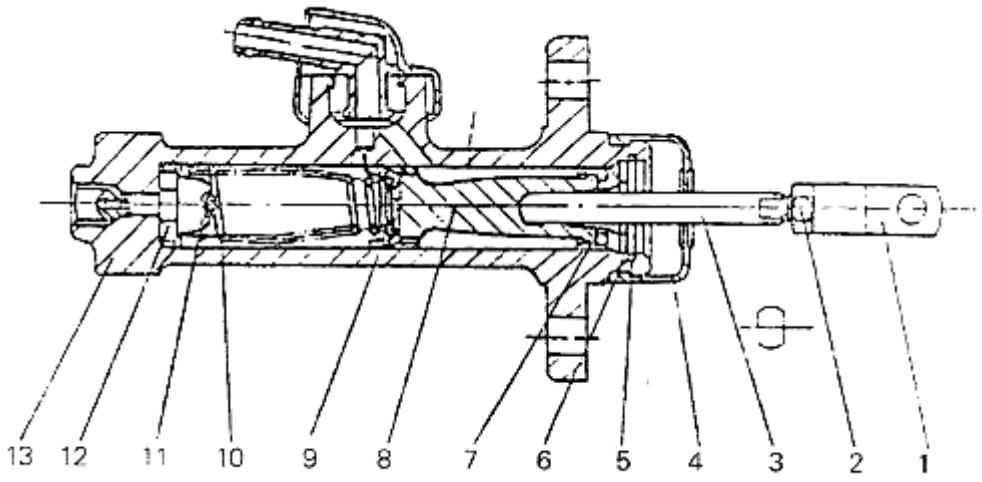


Fig 7-1 Brake Master Cylinder

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	

7.3 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 7-2, Fig 7-3, and Fig 7-4.

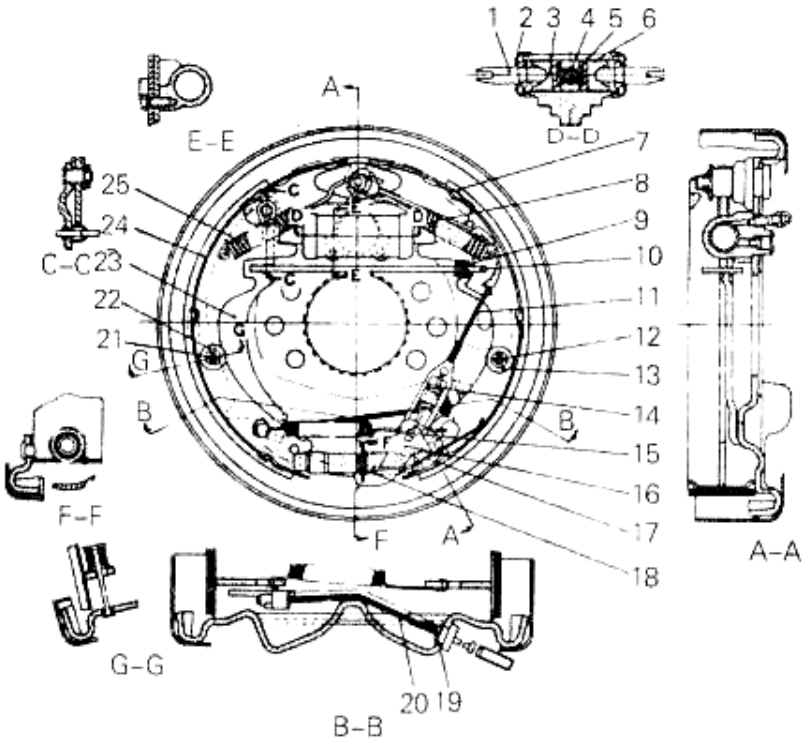
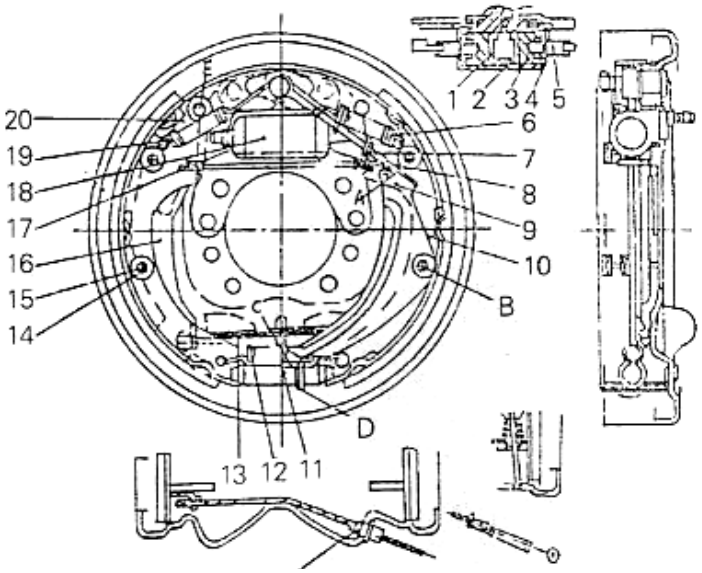


Fig 7-2 1-1.8t Wheel Brake (Left)

1. Wheel Cylinder Piston Top Rod
2. Shield
3. Piston
4. Spring
5. Rubber Cup
6. Body
7. Auxiliary Brake Shoe
8. Brake shoe Return Spring
9. Spring
10. Lever L H Brake
11. Spring Stay Wire Device
12. Pin, shoe hold
13. Washer,cup
14. Spring
15. Return Spring
16. Ratchet
17. Spring
18. Clearance Adjuster
19. “E”-Retainer Ring
20. Parking Brake Steel Cable
21. Pin, shoe hold
22. Washer,cup
23. Lever L H Brake
24. Primary Brake Shoe
25. Return Spring

1. Spring
2. Rubber Cup
3. Piston
4. Cylinder Body
5. Piston Top Rod
6. Return Spring
7. Top Rod
8. Return Spring
9. Adjusting Lever
10. Auxiliary Brake Shoe
11. Clearance Adjuster
12. Spring
13. Brake Steel Cable Assembly
14. Pressure Spring Cap
15. Pin, shoe hold
16. Lever L H Brake
17. Hand Brake Push Rod
18. Brake Cylinder Assembly
19. Return Spring
20. Primary Brake Shoe



E-Shaped Retainer Ring

Fig 7-3 2t and 2.5t Wheel Brakes

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

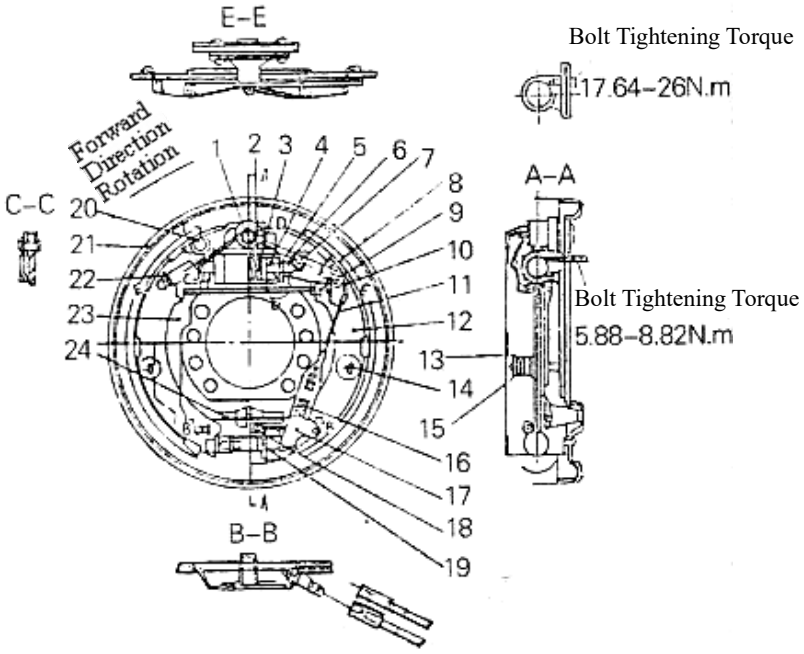


Fig 7-4 3t and 4t Wheel Brakes

The brake action in forward movement is as follows (as indicated in Fig 7-5). 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.

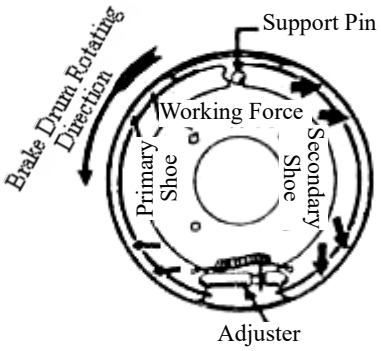


Fig 7-5 Brake Actions during Forward Running Process

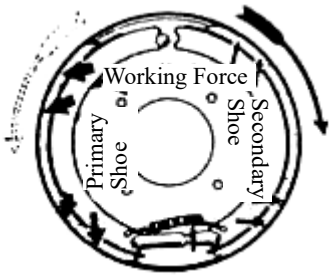


Fig 7-6 Brake Actions during Reversing Process

7.4 Automatic Clearance Regulator (with 2t brake mainly described, and the action principle of 1-4t brakes is the same as that of 2t)

The automatic clearance adjuster is able to automatically maintain the clearance between brake shoe and brake drum between 0.4-0.45mm (0.25-0.4mm for 3, 3.5, and 4t brakes and 0.35-0.55mm for 1-1.8t brakes). 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 8-3.) 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.

7.5 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 and keep regular painting.

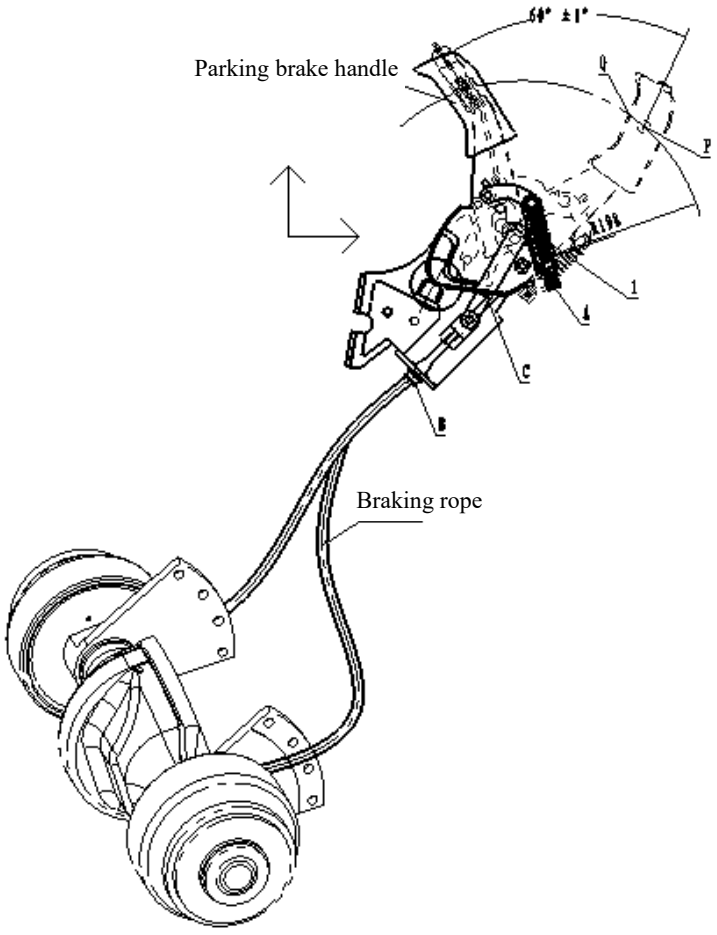


Fig 7-7 Parking Brake Device

7.6 Adjustment of Brake Pedal (Hydraulic Forklift Truck)

Adjust the stop bolts, so that the pedal location is shown in the following and the distance between the front floor and it is 113mm and the pedal stroke is 20mm. Tighten the stop bolts, to ensure that the foot brake can work properly.

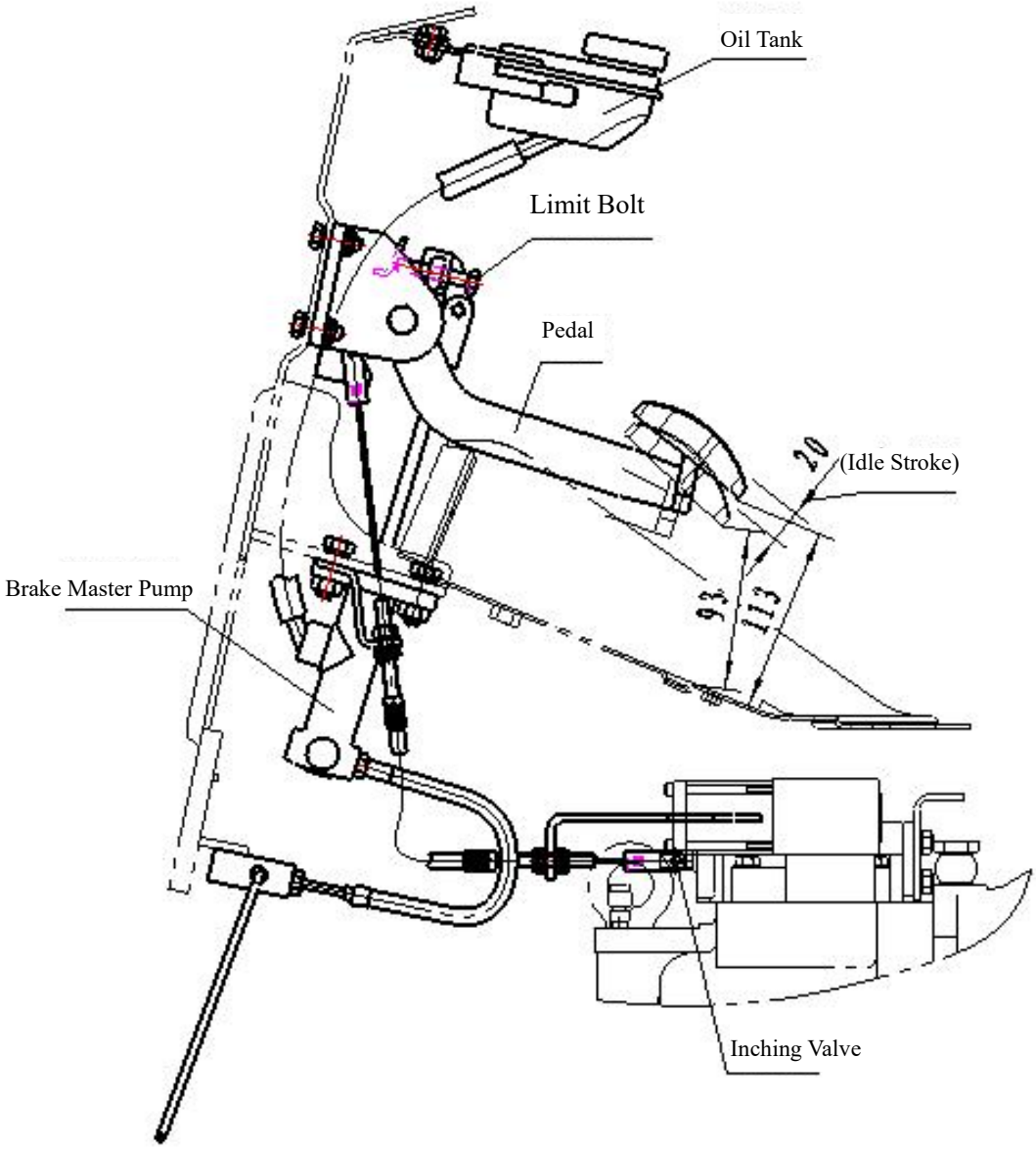


Fig 7-8 Adjustment of Brake Pedal

7.7 Maintenance

This section covers brake disassembly, reassembly, and adjustment (with mainly 2t brake described, while the brakes for 3t, 4t and 1-1.8t brakes are similar. Attention: The following ones with "*" are only the part drawings for 3t brake.).

7.7.1 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 7-9);

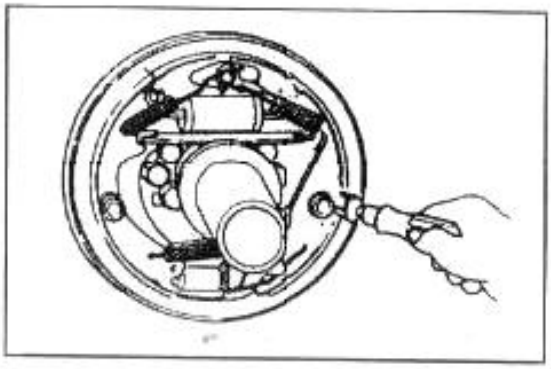


Fig 7-9

(2) Remove the return springs for the two brake shoes (Fig 7-10)

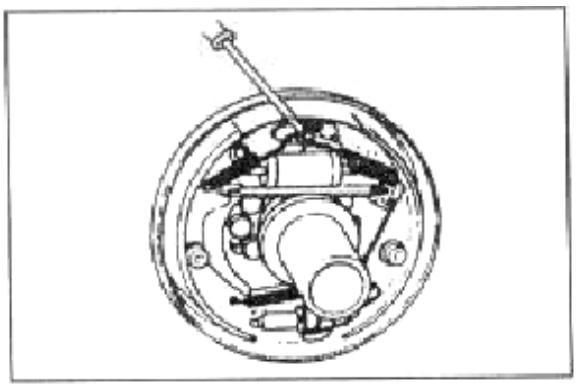


Fig 7-10

(3) Remove the other three fixed springs (Fig 7-11).

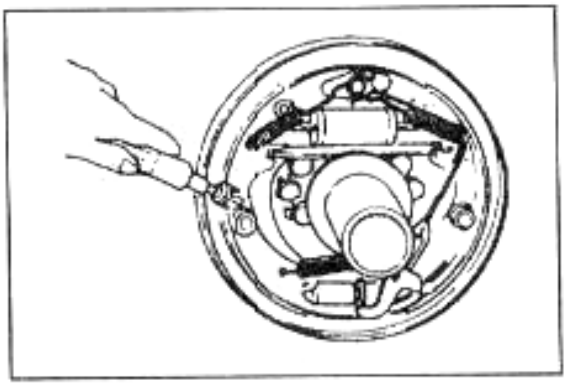


Fig 7-11

(4) Detach the primary brake shoe and the secondary brake shoe, and at the same time remove the spring for adjuster. (Fig 7-12)

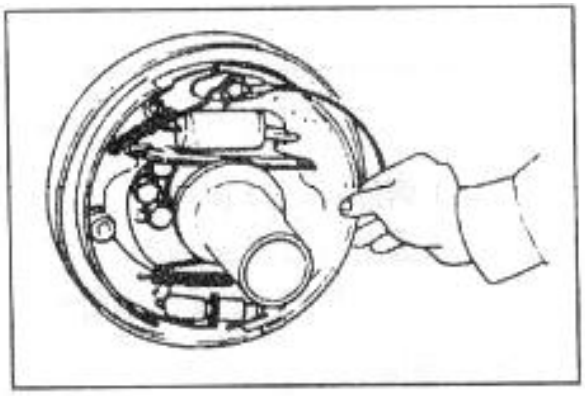


Fig 7-12

(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 7-13)

Fig 7-13

(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 7-14)

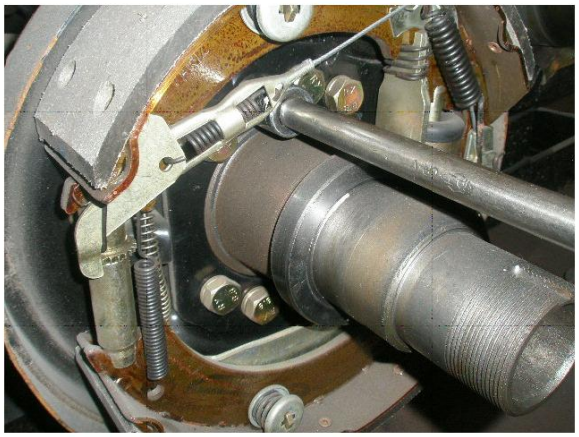


Fig 7-14

(7) Remove the shield for wheel cylinder, and push out all the parts inside the cylinder (Fig 7-15)

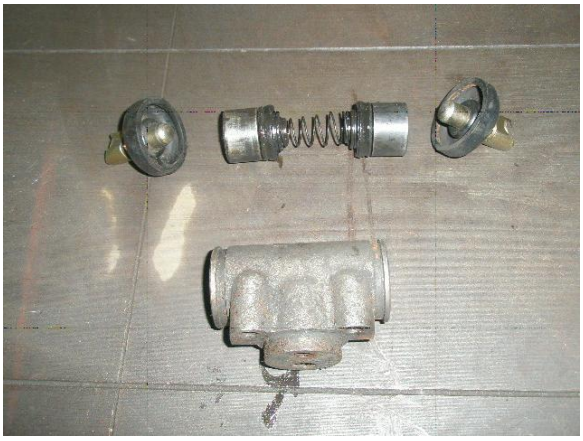


Fig 7-15

7.7.2 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 replace, 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 (2-4t Forklift Truck); and 0.04-0.125 (1-1.8t 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) and $\Phi 23.9 \pm 0.2$ (1-1.8t)

The standard value for interference of rubber cup is 1.52, and the minimum value is 0.42 (2-4t). The standard value is 1.65, and the minimum value is 0.65 (1-1.8t).

(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.

It is 49.5mm for 1-1.8t forklift truck.

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

Specified Thickness: 7.2mm (2t) 8.0mm (3t, 4t) 4.87mm (1-1.8t)

Minimum Thickness: 2.0mm (2t) 1.0mm (3t, 4t and 1-1.8t)

(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.

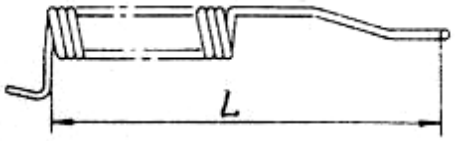


Fig 7-16

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

$254^{+0.13}_{0}$ mm（1-1.8t）

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 7-17). Refer to Part 8 of Fig 8-2, Part 6 of Fig-8-3, and Part 7 of Fig 7-4.)

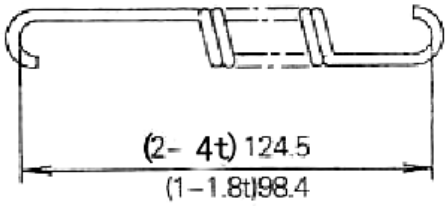


Fig 7-17

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 7-18). (Refer to Part 8 of Fig 7-3, Fig 7-2, and Part 9 of Fig 7-4.)

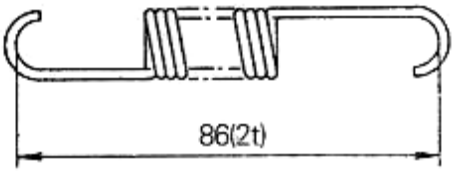


Fig 7-18

Free Length	124.5mm	98.4mm
Installation Length	130mm	136mm
Installation Load	245N	59±6N
Forklift Truck Tonnage	2-4t	1-1.8t

(8) Measure the free length and installation load of adjuster spring (Fig 7-19 and Fig 7-20). (Refer to Part 12 of Fig 7-3, Part 18 of Fig 7-4, and Part 15 of Fig 7-2.)

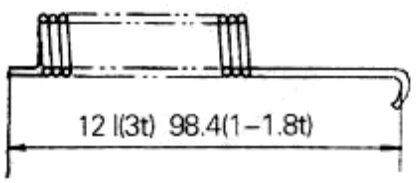


Fig 7-19

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 7-21). Installation Load: 14.7N (3t, 4t) 12N (1-1.8t)

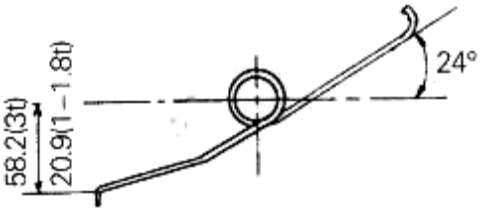


Fig 7-20

(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.

7.7.3 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.

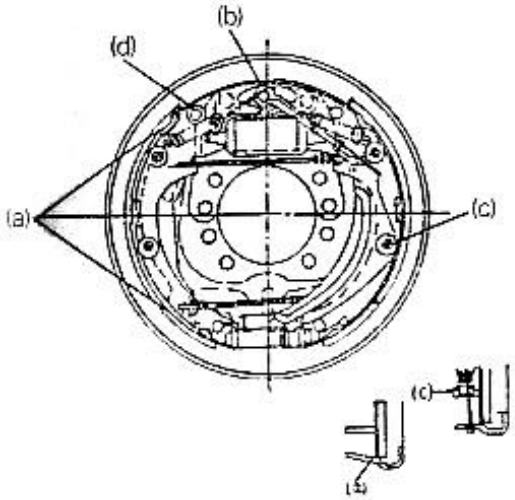
Attention: Ensure that respective parts are all at the correct position during installation, and the bolt tightening torques are 14.7-19.6N.m (2t), 17.6-26.5N.m (3t and 4t), and 8-12N.m (1-1.8t).

(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 7-21 and Fig 7-22, 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



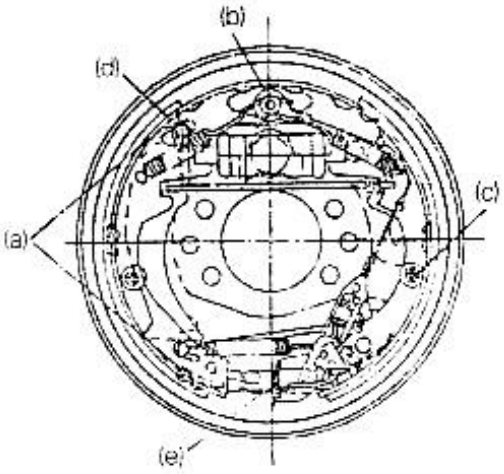


Fig 7-21 2t Forklift Truck

Fig 7-22 1-1.8t Forklift Truck and 3t/4t Forklift Trucks

(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 7-23).

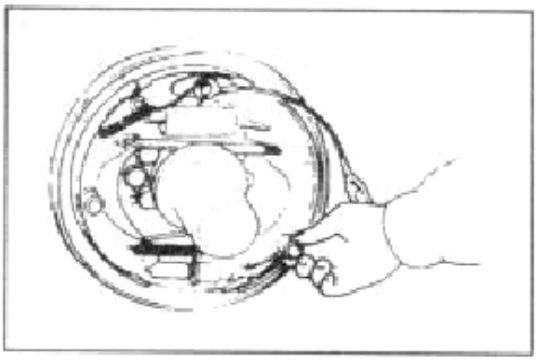


Fig 7-23

(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 7-24).

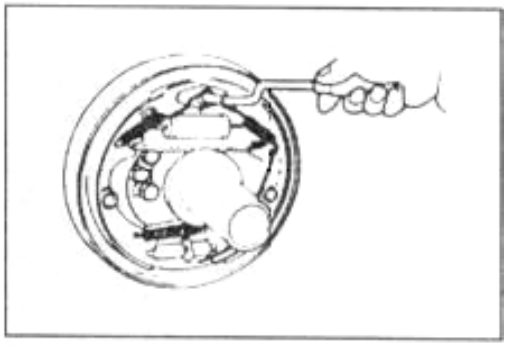


Fig 7-24

(9) Install adjuster, adjuster spring, top rod, and return spring for top rod (Fig 7-25).

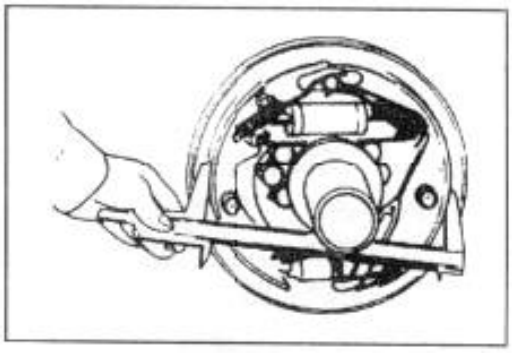


Fig 7-25

Pay attention to the following respective items:

a) Adjuster Threat Direction and Its Installation Direction (In 2t forklift truck, right-hand threat is used for left brake, while the left-hand thread is used for right brake. In 1-1.8 forklift trucks as well as 3t and 4t forklift trucks, 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:

0.8-0.9mm (2t), 0.5-0.8mm (3t, 4t), 1mm (1-1.8t)

7.8 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 7-26 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 7-26 (2t), Fig 7-27 (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.

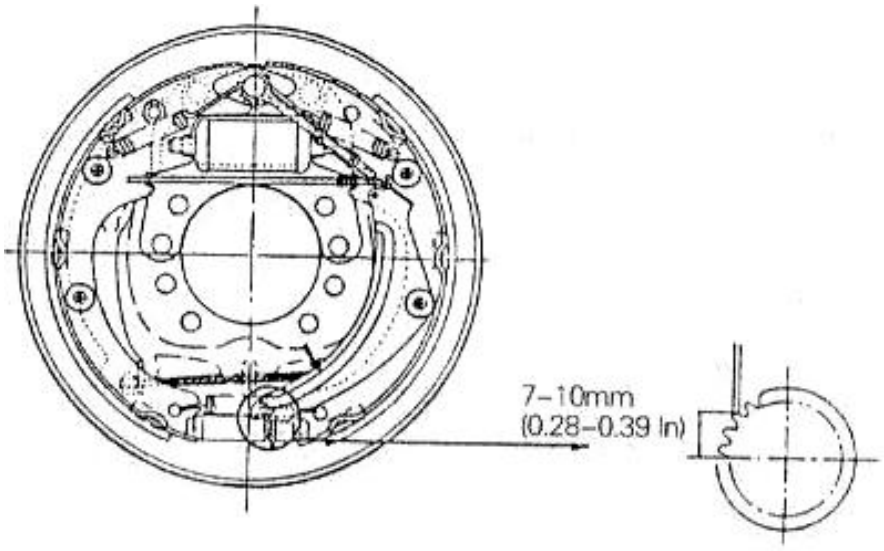


Fig 7-26

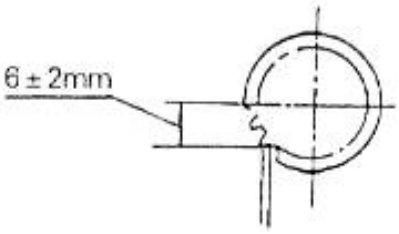


Fig 7-27

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.

7.9 Failure Removal for Wheel Brake

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

8. Hydraulic System

Forklift Truck Tonnage		2t-2.5T			3.0T			3.5t		
Equipped Engine		Mitsubishi S4S	Yangmar	Nissan K25	Mitsubishi S4S	Yangmar	Nissan K25	Mitsubishi S4S	Yangmar	Nissan K25
Main Pump	Model	SGP1A28.2D2H 9-L093C Yangmar, S4S SGP1A28.2D2H 9-R330C Nissan								
	Type	Gear Type								
	Driving	Driving with Engine Power Output Gear								
	Loaded Displacement	72 l/2300r/min		58 l/2300 r/min	72 l/2300r/min		58 l/2300 r/min	72 l/2300r/min		58 l/2300 r/min
	No-load Displacement	76 l/3250r/min		61 l/2300 r/min	76 l/3250r/min		61 l/2300 r/min	76 l/3250r/min		61 l/2300 r/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								
	Bypass Valve – Flow Rate	11 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	3t: Φ56mm	3.5t: Φ63mm
	Stroke	(2nd-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	2-2.5t: Φ70mm	3-3.5t: Φ80mm	
	Piston Rod Outer Diameter	2-2.5t: Φ32mm	3-3.5t: Φ35mm	
	Stroke	2-2.5t: 133 mm	3-3.5t: 133 mm	

8.1 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).

8.2 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.

8.3 Multi-way Valve and Bypass Valve (Fig 9-1)

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.

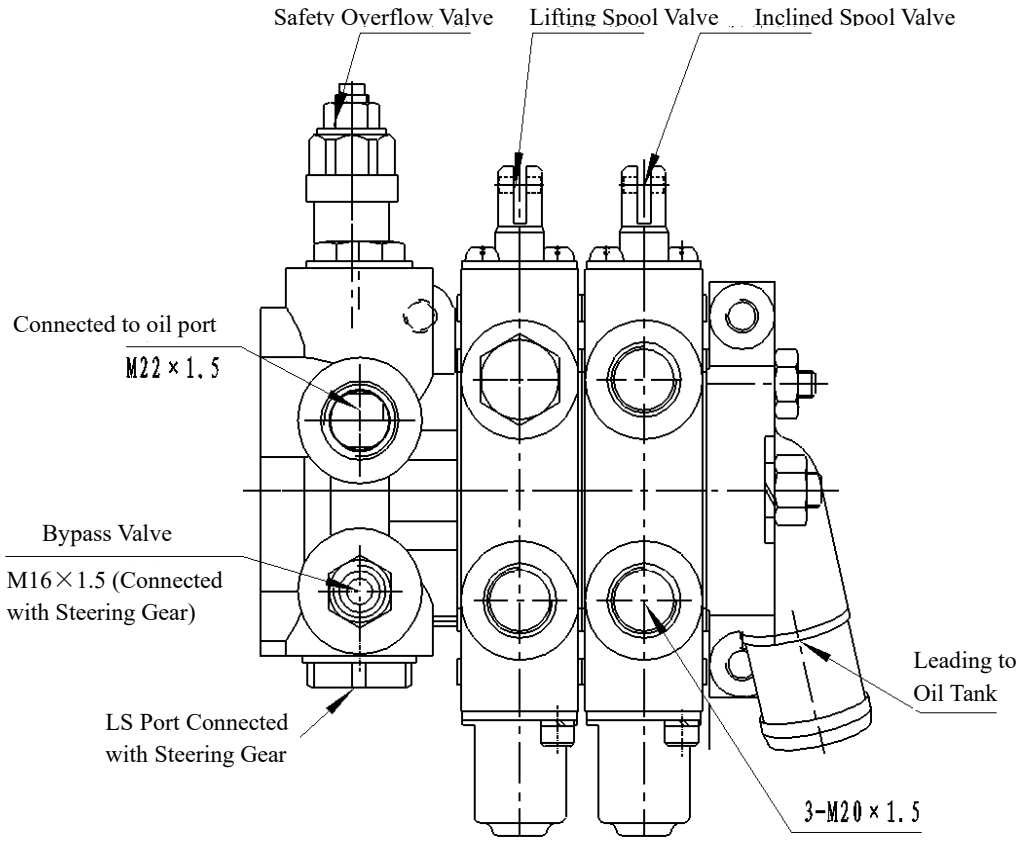


Fig 9-1 Multi-way Valve

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

(1) Neutral Position (Fig 9-2)

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

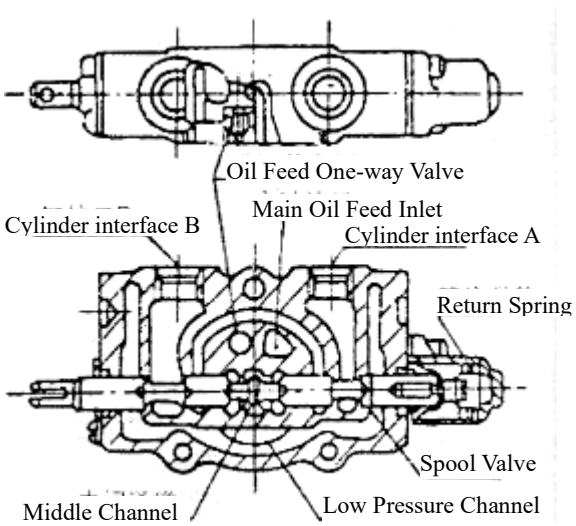


Fig 9-2

(2) Push-in Spool Valve (Fig 9-3):

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.

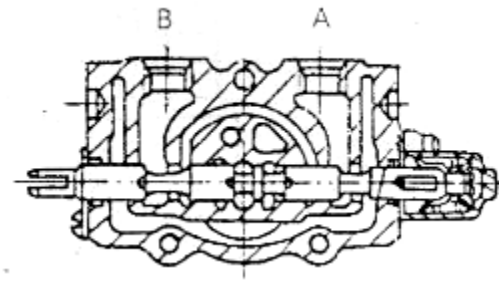


Fig 9-3

(3) Pull-out Spool Valve (Fig 9-4)

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.

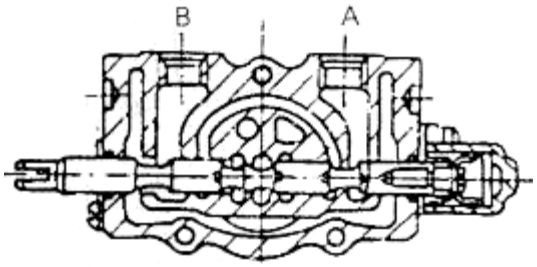


Fig 9-4

8.3.2 Main Safety Overflow Valve and Bypass Safety Valve (Fig 9-5)

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 PE 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.

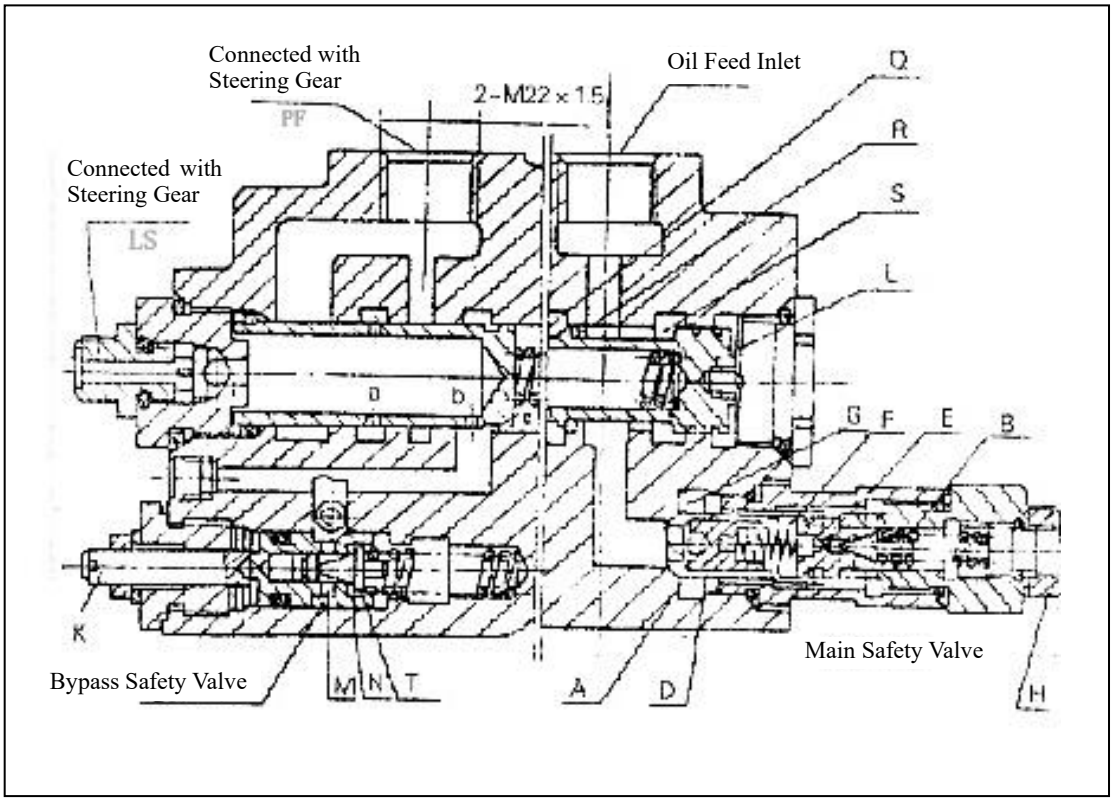


Fig 9-5

8.3.3 Action of Inclined Autolock Valve

The inclined spool valve is mounted with autolock 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 9-6 for its structure.

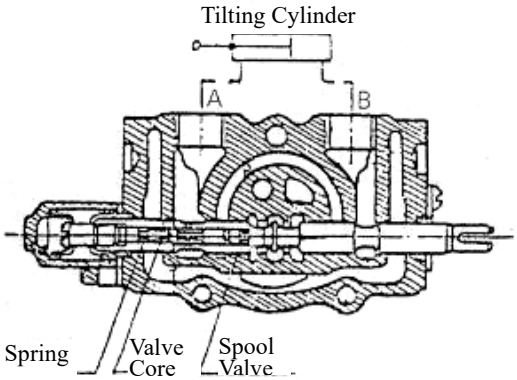


Fig 9-6

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 autolock 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 autolock 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.

8.4 Oil Circuit of Hydraulic System (Main Oil Circuit) (Fig 9-7)

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 lift 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 lift 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 lift 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 tilt cylinder, while the other side is connected with low pressure, for the door frame to achieve the back tip or front tip action.

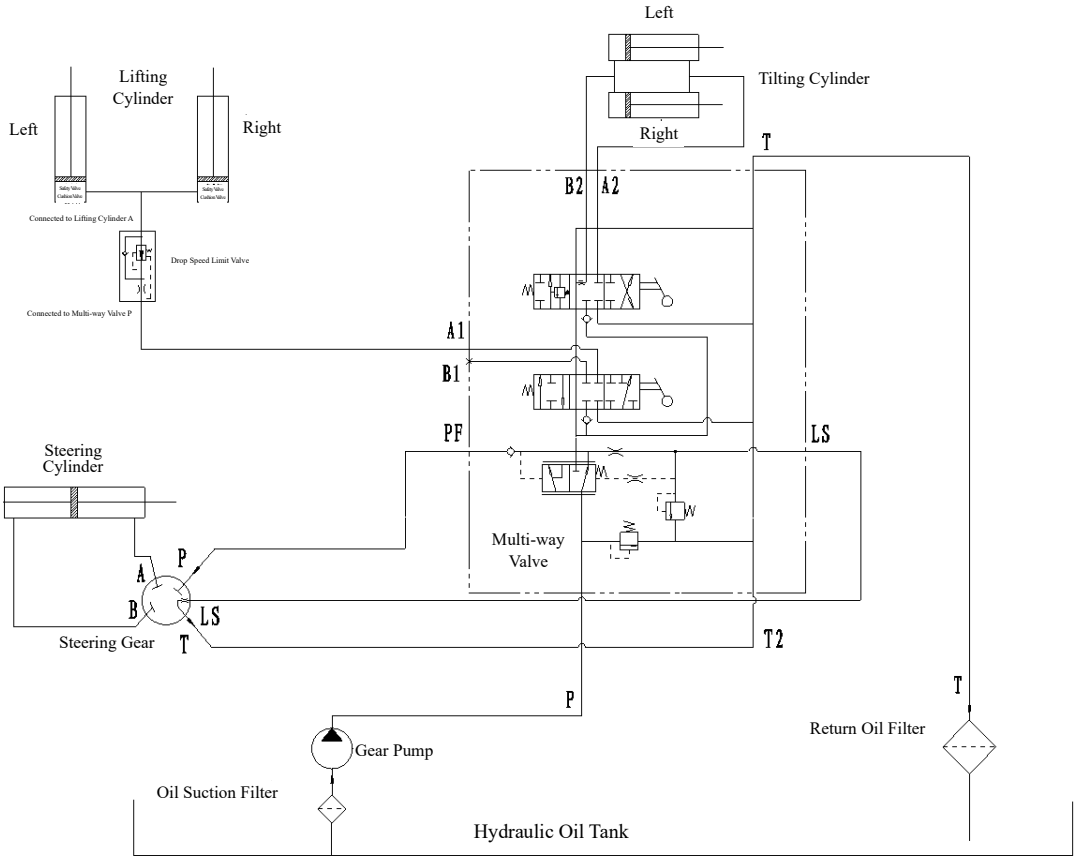


Fig 9-7 Oil Circuit of Hydraulic System

8.5 Lifting Cylinder (Fig 9-8)

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, while one return oil pipe is mounted in the upper part of cylinder body for a small amount of leaked oil above the piston to return to oil tank. 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. Screw Plug

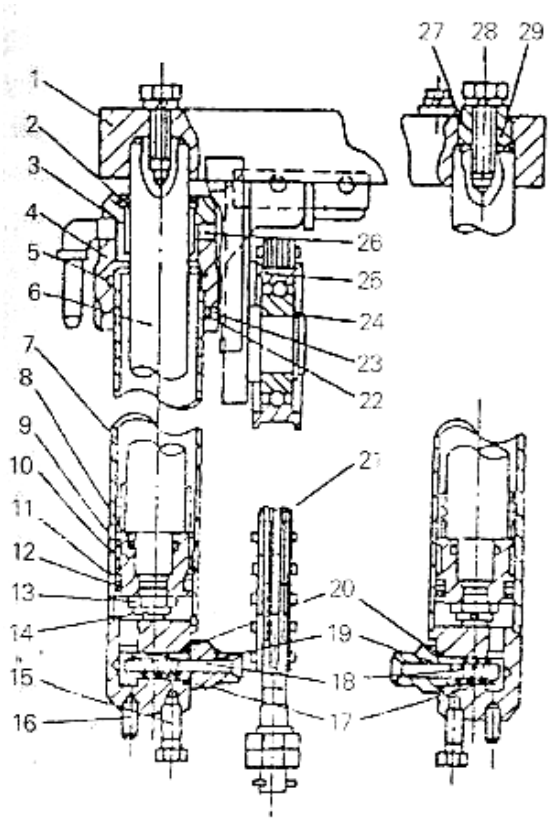
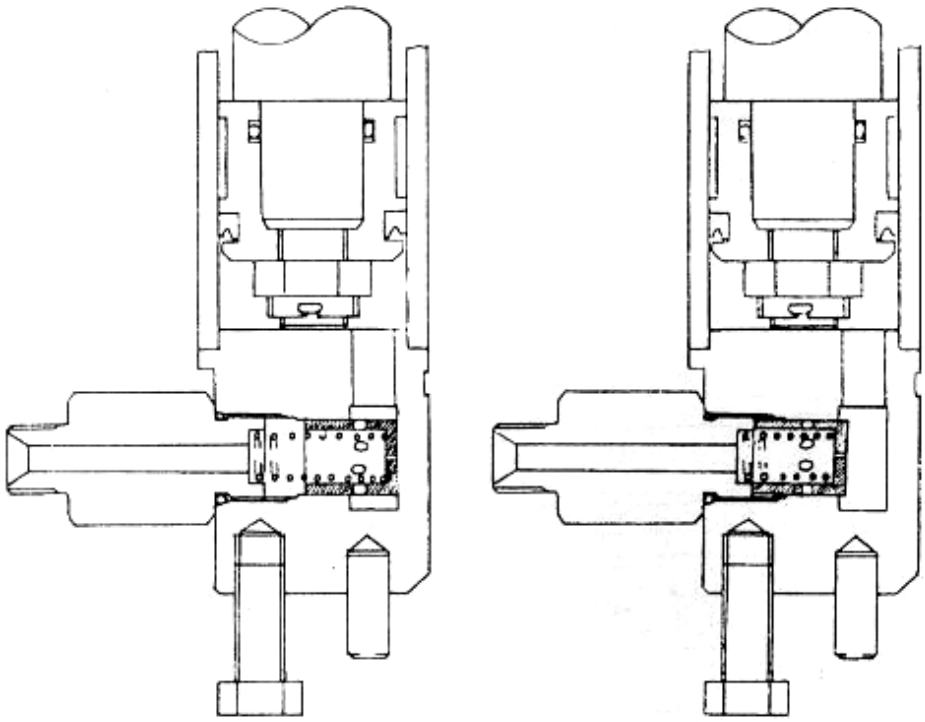


Fig 9-8 Lifting Cylinder

There is one shut-off valve on the bottom of lift cylinder, (Refer to Fig 9-9), 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.

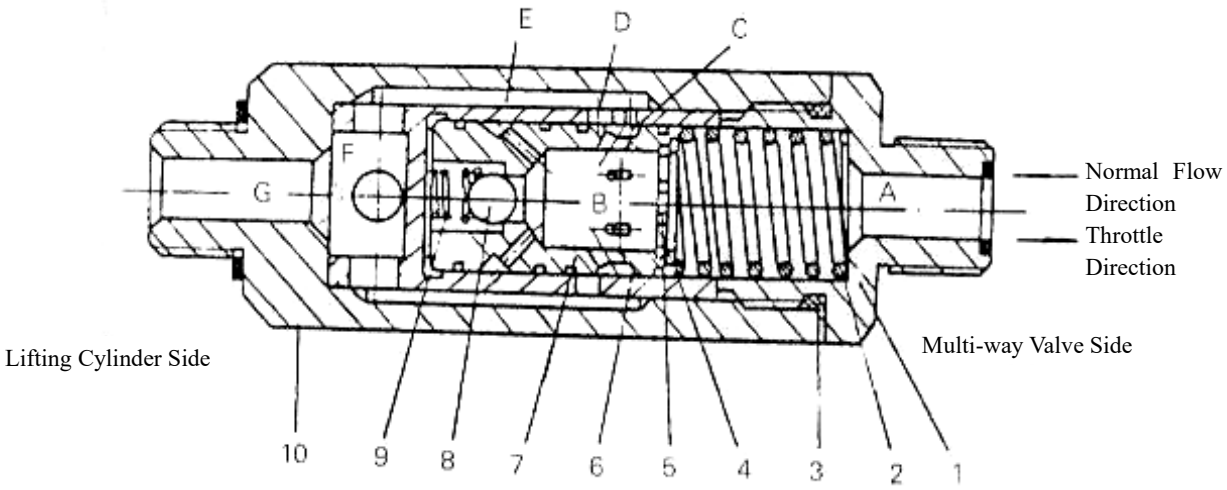


When Normal When Disconnected

Fig 9-9

8.6 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 9-10. 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.



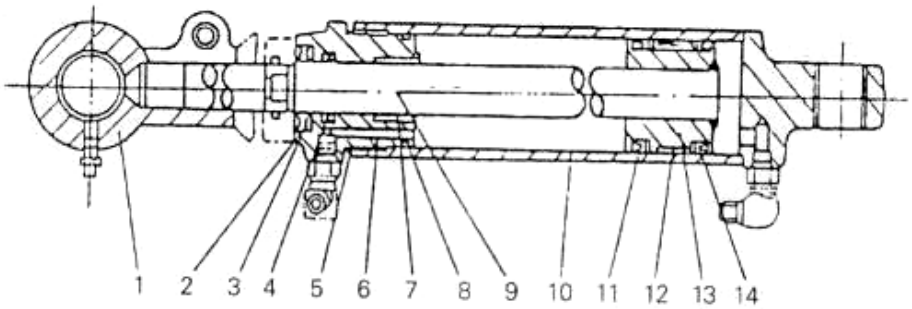
1. Joint	3. O-Ring	5. Throttle Plate	7. Valve Core	9. Spring
2. Spring	4. Retainer Ring	6. Valve Sleeve	8. Nylon Ball	10. Valve Body

Fig 9-10 Limiting Valve

8.7 Tilting Cylinder (Fig 9-11)

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 9-11 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.

8.8 Maintenance of Main Oil Pump

8.8.1 Disassembly (Refer to Fig 9-18 and 9-19 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 9-18 and Fig 9-19, in order to facilitate examination.

8.8.2 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 9-12, 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.

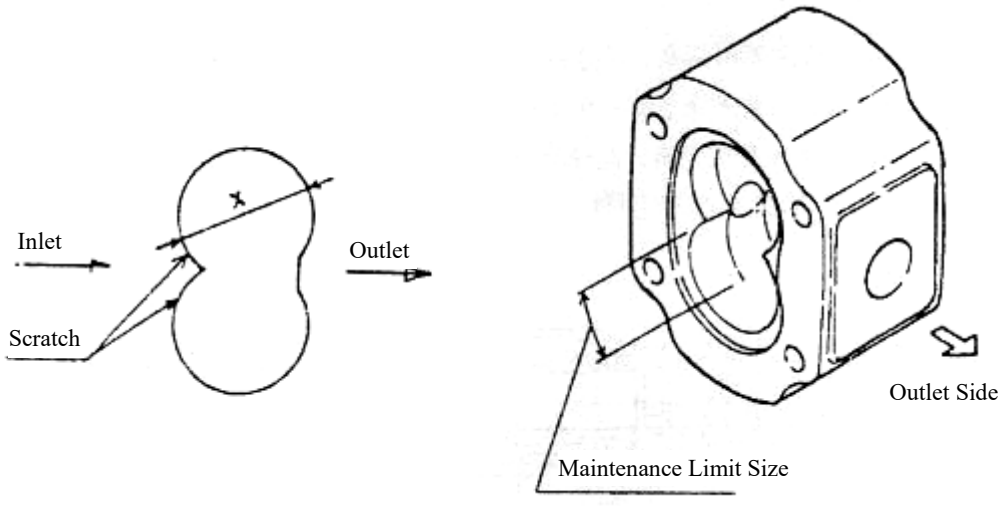


Fig 9-12

(2) Examination of Bearing (Fig 9-13 and Fig 9-14)

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.

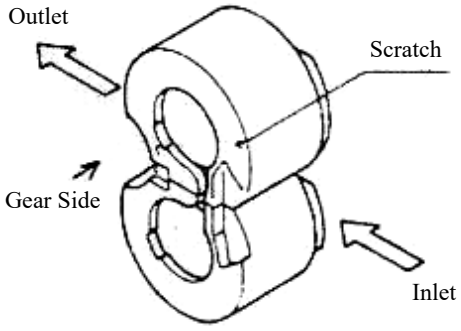


Fig 9-13

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 9-14)

Total Length—26.411mm

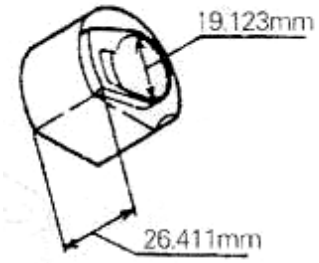


Fig 9-14

(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 9-15).

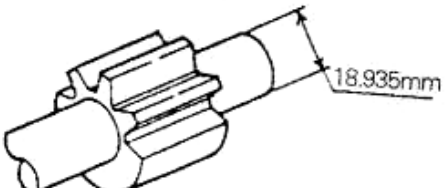


Fig 9-15

(4) Examination of Oil Seal

a) Oil Seal 14: (Refer to Figs 9-18 and 9-19) 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 9-16). 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.

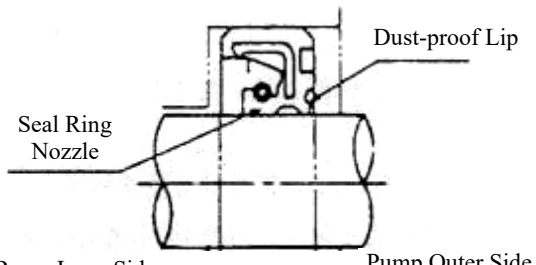


Fig 9-16

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.

8.8.3 Reassembly (Fig 9-17)

(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.

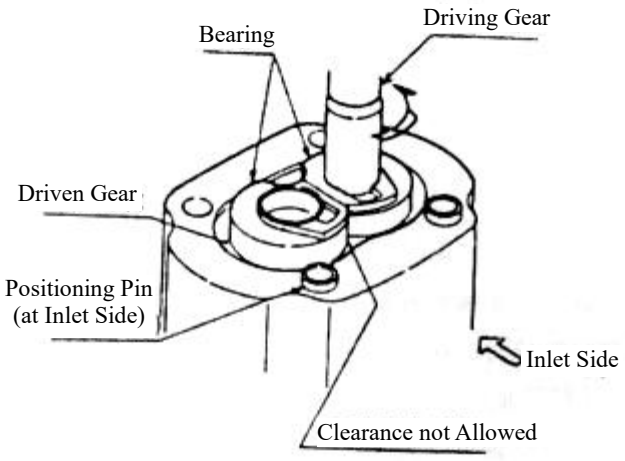


Fig 9-17

(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).

8.8.4 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.

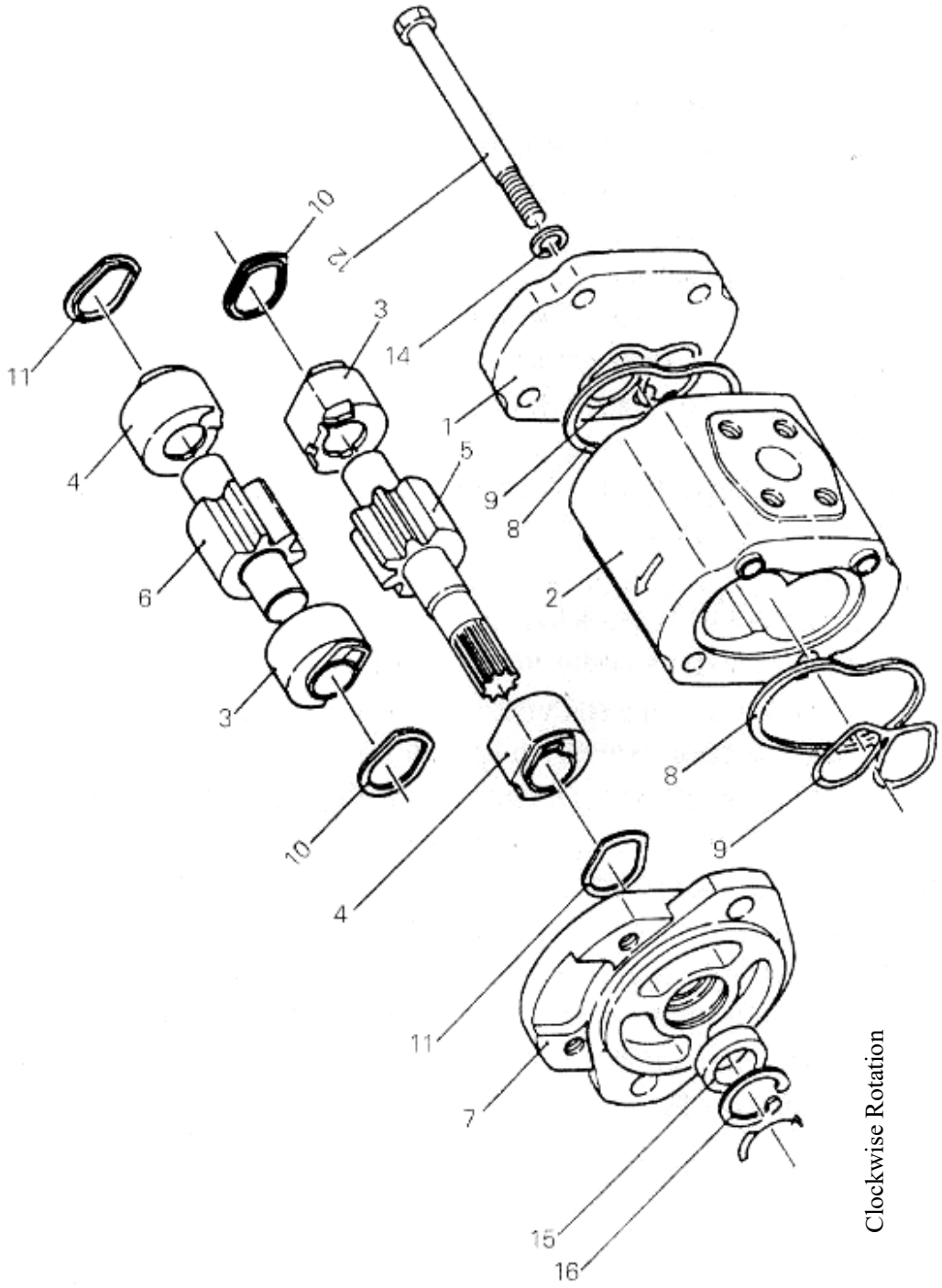
(3) Increase its rotating speed to 1500-2000rpm, and allow it to be idle for 10 minutes.

(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 9-18 and Fig 9-19 respectively indicate the lateral views for structure of gear oil pump in clockwise and counterclockwise rotations, and Fig 9-20 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 9-18 Clockwise Rotation of Gear Pump
(1-1.8t Forklift Trucks and 2-4t 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

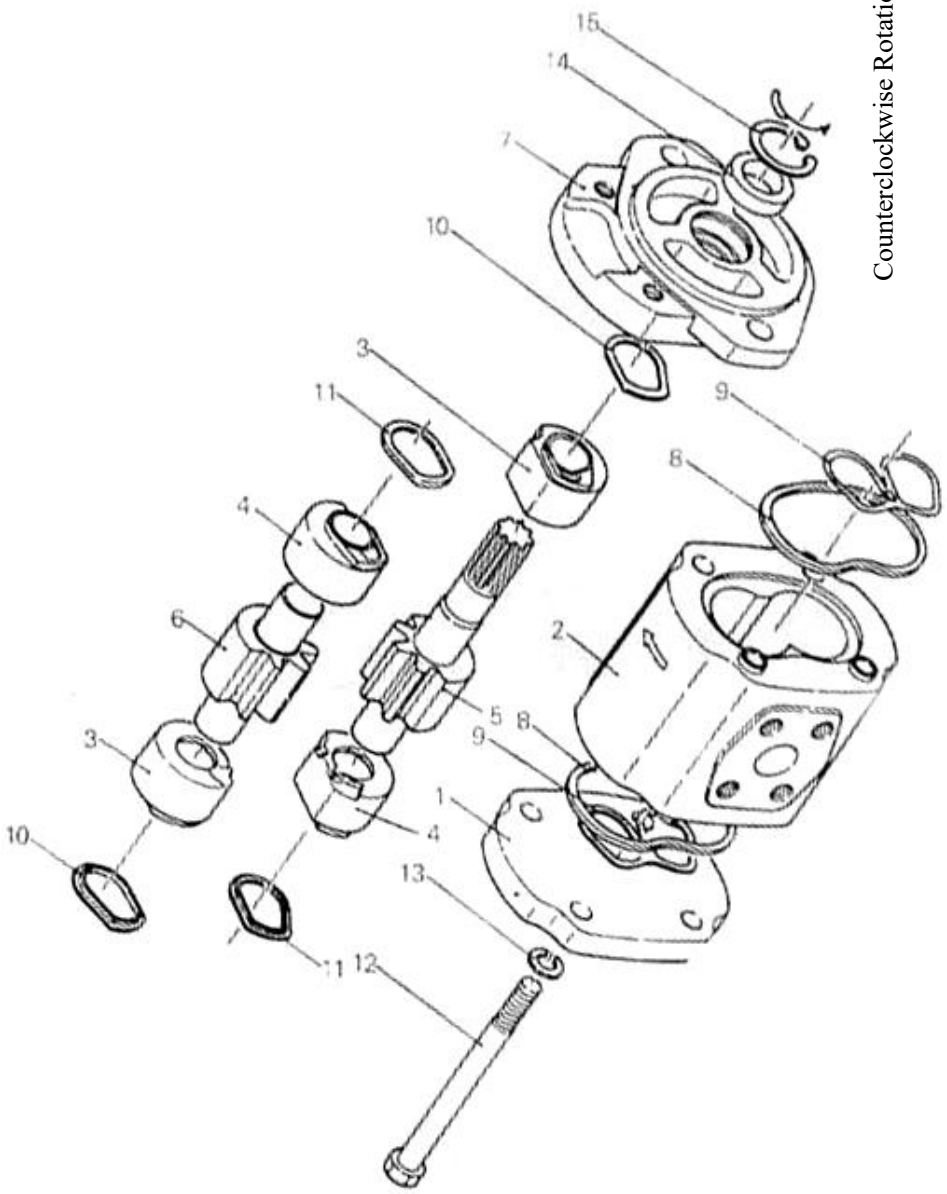


Fig 9-19 Counterclockwise Rotation of Gear Pump
(2-4t Diesel Forklift Truck)

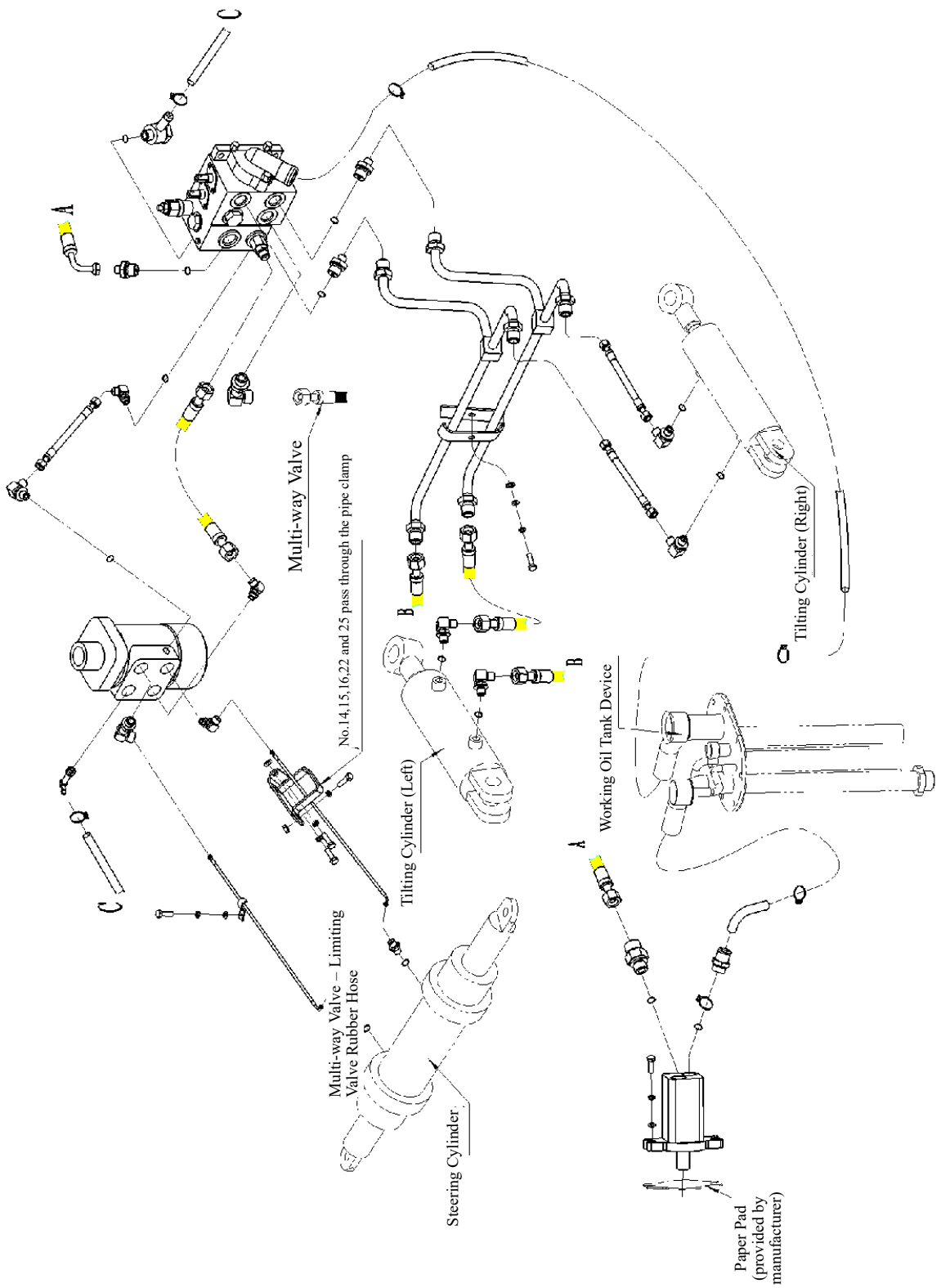


Fig 9-20 Schematic Drawing of Hydraulic Pipeline (Diesel and Gasoline Forklift Trucks)

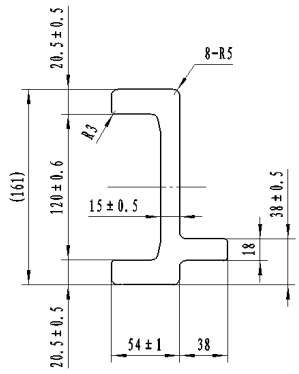
8.8.5 Failure Removal

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) Loosene3d 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

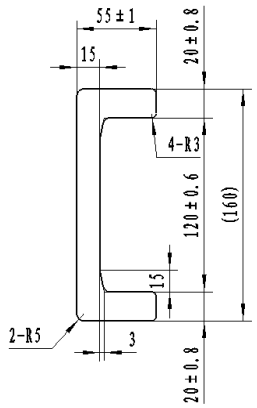
9. Lifting System

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:



9.1 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.

9.2 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 6º 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.

9.3 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 rollers and side rollers 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.

9.4 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 10-1).

(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 9-8.).

(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 10-2.

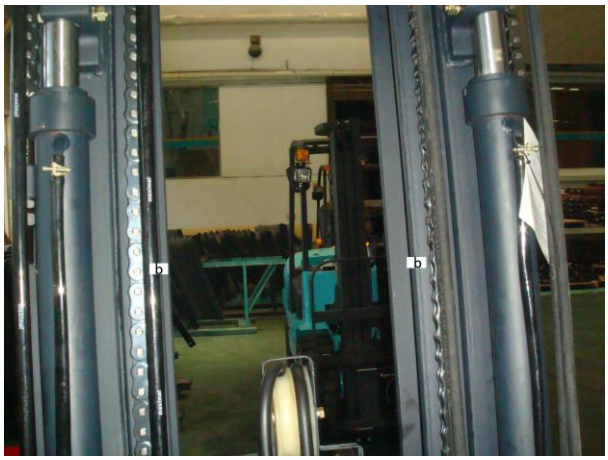


Fig 10-1

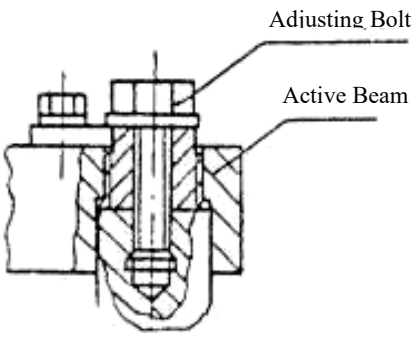


Fig 10-2

10. Electrical System

10.1 Overview

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; it can not 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, width lamp and turn signal three parts;

Tri-color taillight: a tri-color taillight consists of turn signal, width lamp, stop lamp and reversing lamp four parts;

Rear light; Warning light.

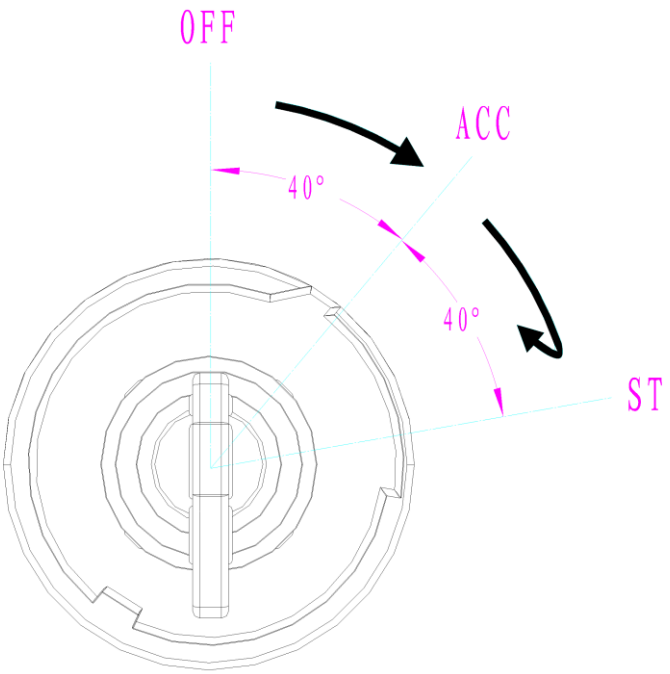
10.2 Summary description of operations:

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;

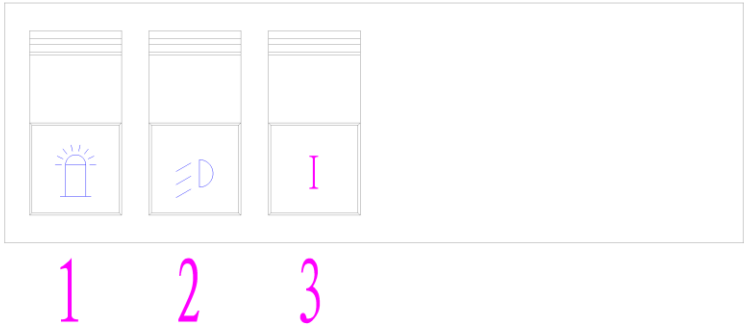
3. When starting, the one-time start time should not exceed 5S, and the twice starting interval is above 120S; if it is impossible to start the engine after starting three times in a row, you should first find out the cause before you start it.

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. Rocker switch

Forklift rocker switch block is mainly used to control various electrical parts of the forklift. 1. It is used to control warning light: turn on it, and the warning light is flashing, turn off it, and the warning light goes out; 2. It is used to control the status of the rear working light: after opening it, when the gear shift lever is put to the reverse gear, the rear working light is on; after it is closed, the rear working light under any conditions will not be on; 3. It is used to control fuel switching, and control the use of any fuel while the engine is working.



4. Horn button

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

5. Reversing light and signals

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

6. Light control

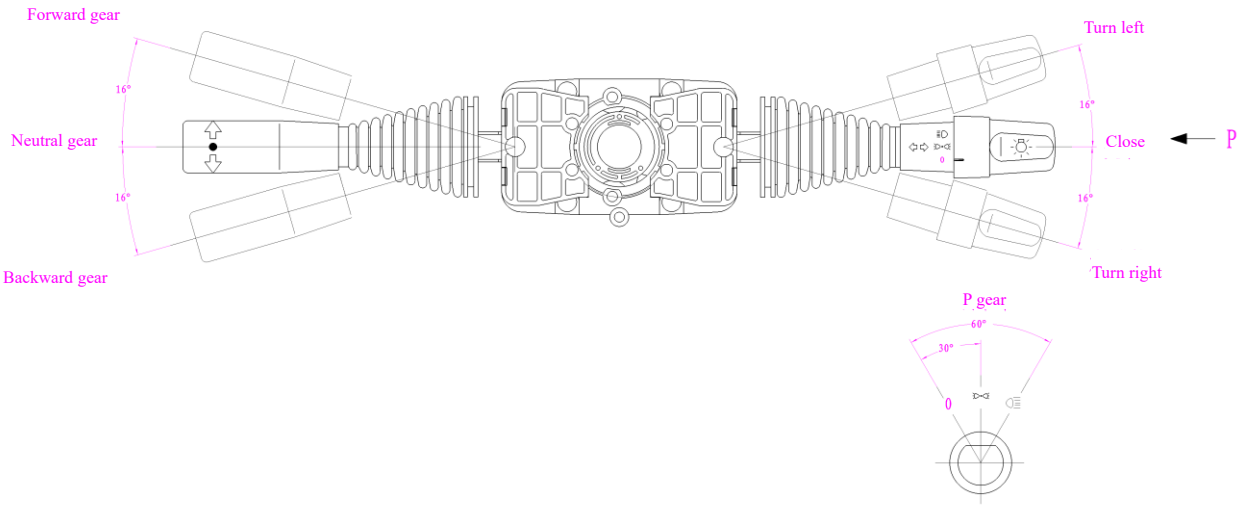
Rotate the light switch to the first gear, and the front and rear width lamp work; rotate it to the second gear, and the headlight works, in which case the width lamp still works.

7. 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.

8. Braking signal

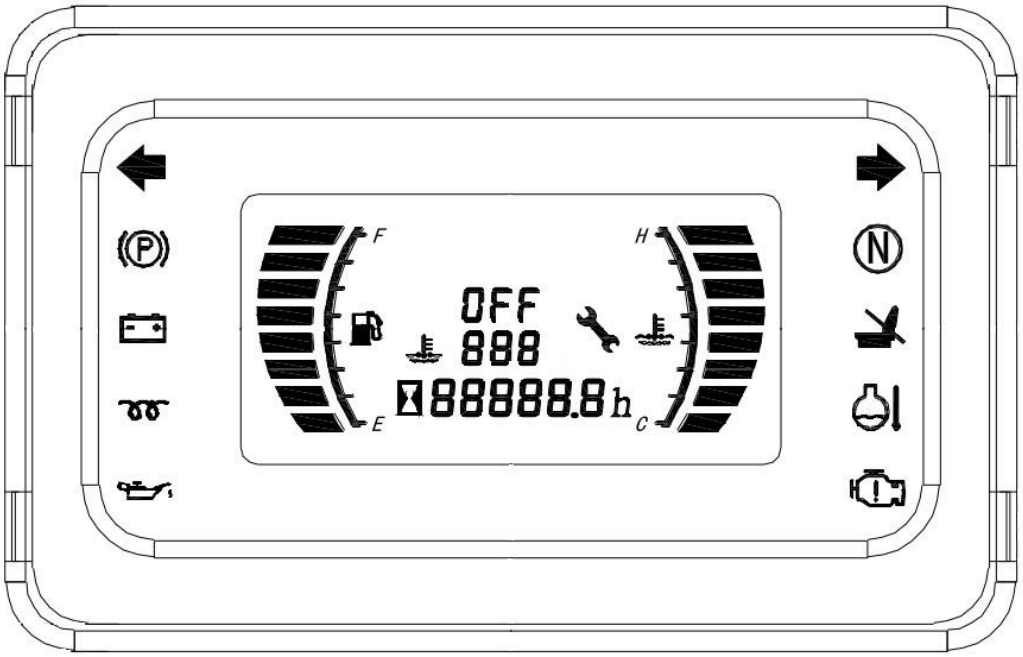
When the forklift needs to be braked, step on the brake pedal, and the brake light works and the forklift is in the braking state.



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.



Note: the hourmeter and weighing meter share a digital display zone; when it is powered on, it displays the hour counter and funnel chart; press any key, and it displays the weight value and "kg" and at the same time, the hourmeter funnel chart is off.


:Turn left light, the forklift's left turn signal light works;


: Turn right light, the forklift's right turn signal light works;


: Engine oil pressure alarm light;


: Fault indicator light, engine failure;


: Preheat indicator, the working state of the preheating system;


: Manual brake indicator light, handbrake in the pulled state;


: Charging light, generator not charging the battery;

 : Seat light, operator not seated correctly;

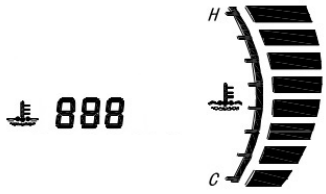
 : Neutral indicator light;

 : Engine failure alarm light;

 : Display the transmission torque converter oil temperature;

 : Fault code display , Off indicates that the engine does not have CAN communication or CAN communication is interrupted;

 : display the forklift running time when starting;

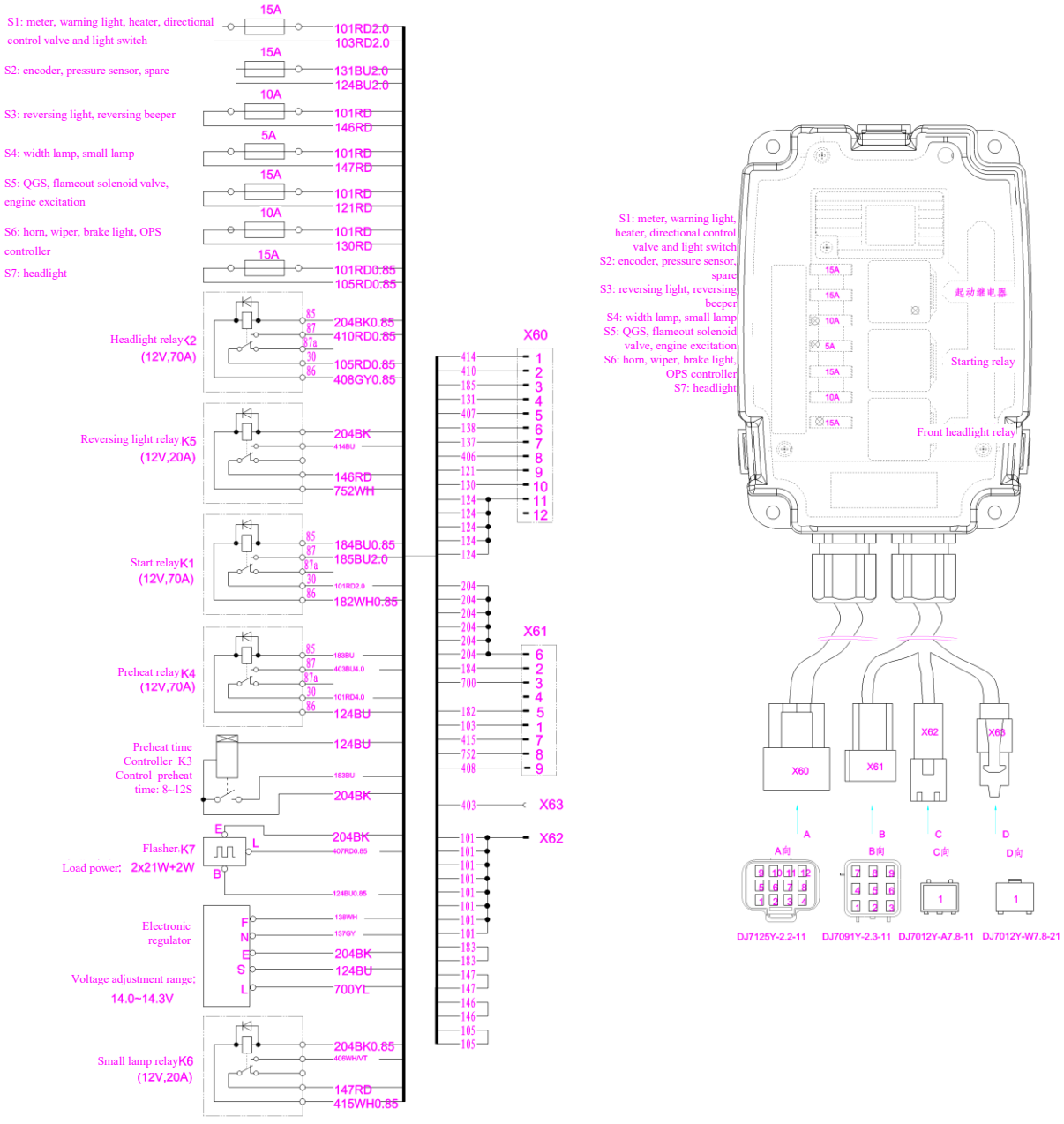


: Display engine water temperature;

: Display the amount of remaining oil in the fuel tank.

Introduction to electrical box:

The electrical box is used to install a chip fuse and relay. The chip fuse is are 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.



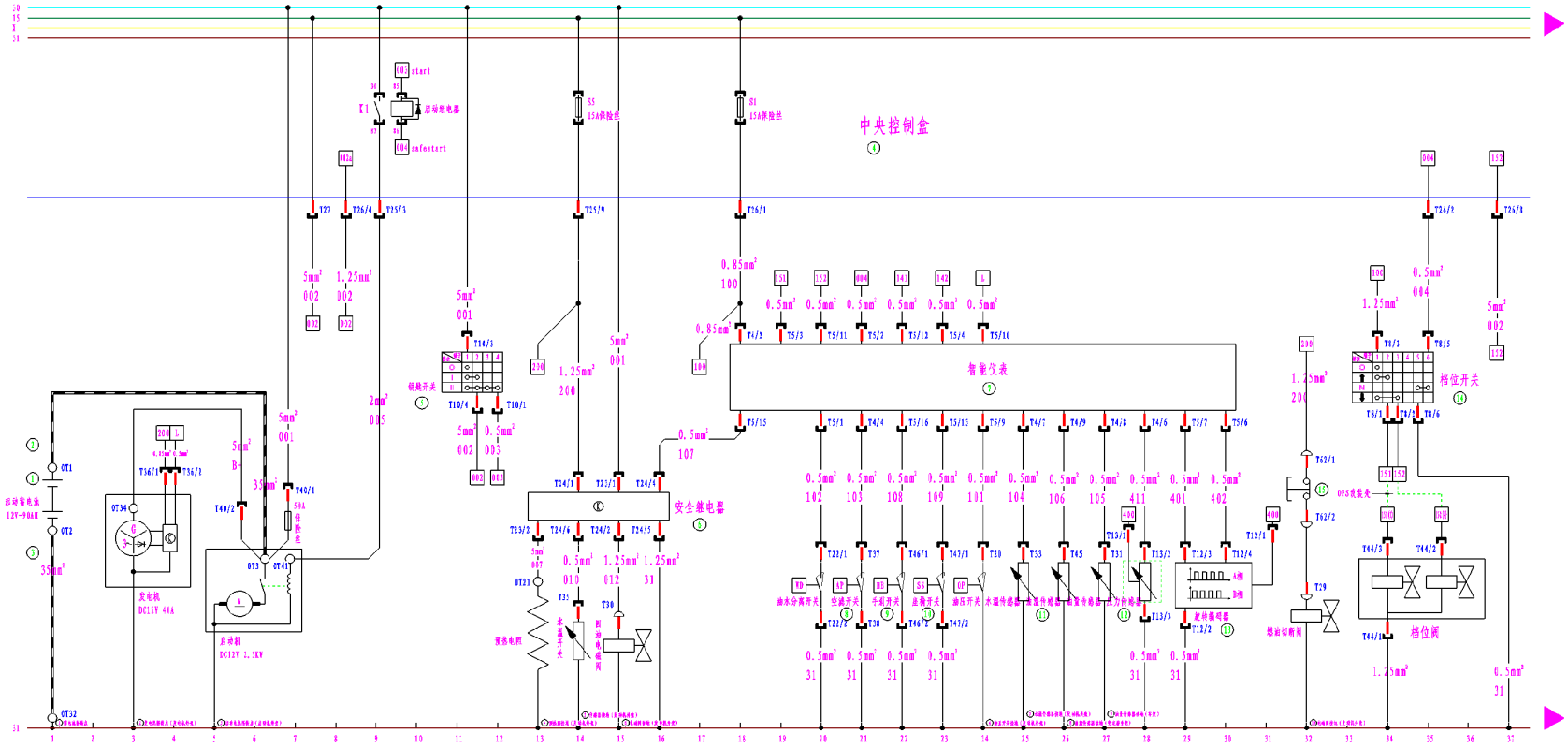
Battery:

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

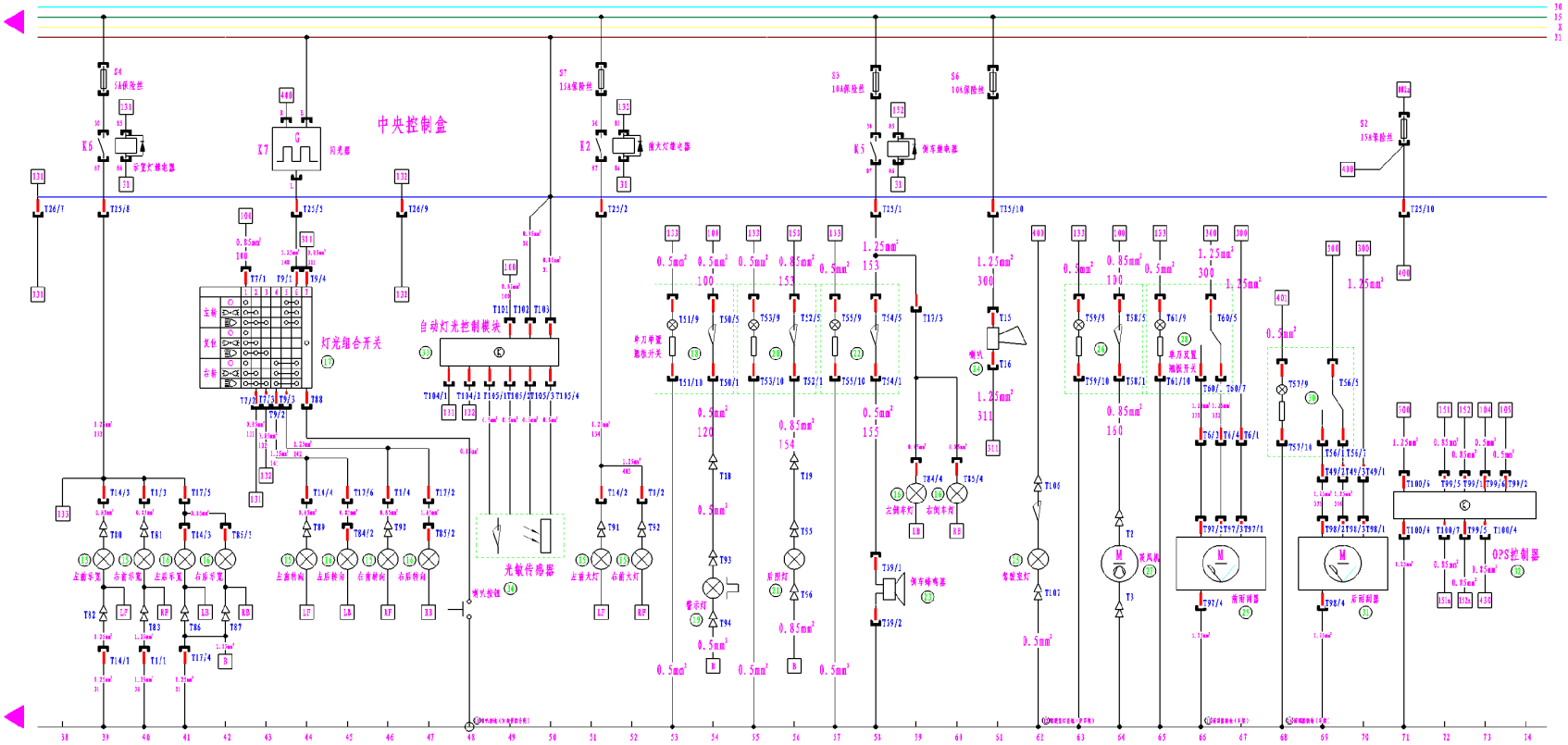
1) The battery can produce flammable gases, so there is a danger of explosion. Therefore you should avoid short circuit and sparks, and firework is strictly prohibited, to prevent the occurrence of fire or explosion.

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.



15	15	急停开关			天得	选配
14	14	档位开关			温州凯海	选配
13	13	旋转编码器	ETF50-TS		上海托菲	选配
12	12	压力传感器	LD183A1S2G9A51GP			选配
11	11	油温传感器			合肥协力	选配
10	10	座椅开关	/	/	座椅自带	选配
9	9	手刹开关			天德	选配
8	8	空滤开关	/	/	空滤自带	选配
7	7	智能仪表			苏州柯蒂斯	标配
6	6	安全继电器	129930-77970	/	发动机自带	标配
5	5	钥匙开关			上海捷野	标配
4	4	中央控制盒	46C5939		合肥协力	标配
3	3	电瓶负极线	/		杭州民丰	标配
2	2	电瓶正极线	/		杭州民丰	标配
1	1	运动蓄电池			合肥万达	标配
序号	代号	名称	型号	美科斯图号	供应商	备注



14	28	前雨刮开关	/		苏州交通电器	选配							
13	27	暖风机				选配							
12	26	暖风机开关			苏州交通电器	选配							
11	25	雾驶室灯				选配							
10	24	喇叭			浙江声达	标配							
9	23	倒车蜂鸣器			合肥金光	标配							
8	22	蜂鸣器开关	/		苏州交通电器	选配							
7	21	后照灯			泰兴福利工厂	选配							
6	20	后照灯开关	/		苏州交通电器	选配	20	34	光敏传感器				选配
5	19	警示灯			泰兴福利工厂	选配	19	33	自动灯光控制模块				选配
4	18	警示灯开关	/		苏州交通电器	选配	18	32	OPS控制器			合肥协力	选配
3	17	灯组合开关			温州瓯海	标配	17	31	后雨刮器				选配
2	16	三色尾灯	/		常州华龙	标配	16	30	前雨刮开关	/		苏州交通电器	选配
1	15	高低台灯	/		常州华龙	标配	15	29	前雨刮器				选配
序号	代号	名称	型号	美科斯图号	供应商	备注	序号	代号	名称	型号	美科斯图号	供应商	备注

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.

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.

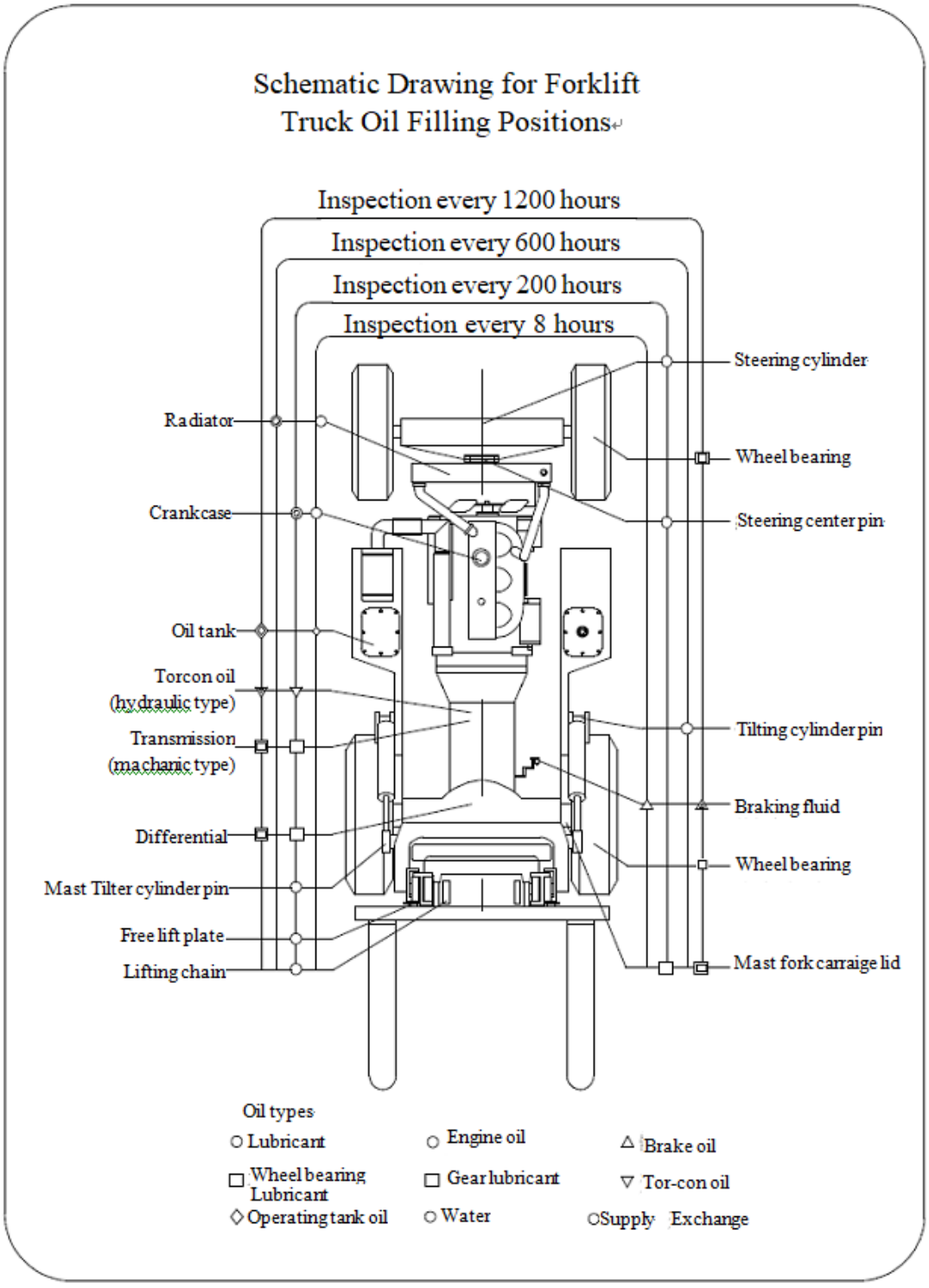
Anti-freezing fluid is generally used both in winter and summer, not changed for four seasons. It shall be drained out for filtration and purification treatment after use for one year in general, to be then further used.

(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 DOT4 Synthetic Brake Fluid
Lubricating Oil	3# Lithium Base Lubricating Grease Drop Point 170

7. Drawing of Lubricating System



Maintenance record form

No.	Date	Contents of Maintenance	Recoder