

FOREWORD

This manual accounts for “HELI” Forklift Truck of CPCD140~160 type, includes its performance, constructure, safe operation and regular preventive maintenance, so that operators, mechanics and supervisors of Forklift Truck correctly operate and prevent maintenance.

Read and understand this manual before operating your lift truck! This manual is your guide to safe operation and regular preventive maintenance. So as to let the Forklift Truck keep good working conditions.

If any operation or maintenance doesn't accord with requires in this manual, our related promises is inefficacy.

Due to continuous improvements in design, it is possible that the latest description contained herein may differ slightly from the truck delivered to you. Moreover, the specification of the forklift truck may be changed insignificantly depending on its destination.

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I. Safety rules for Operation and Daily Maintenance of Forklift Truck

It is important that driver and manager for forklift trucks remember the principle of the “first safety” and ensure the safety operation as the description in 《OPERATION AND SERVICE MANUAL》.

1. Delivery of Forklift Truck

It must be pay attention to the following items when you delive forklift trucks with container or trucks.

- (1) Apply the parking brake.
- (2) Fix the mast and the balancweight with steel wire. Wedge up all wheels.
- (3) Sling points should be always at the positions specified in sling index plate when hoisting up the forklift truck.

2. Storage of Forklift Truck

- (1) Drain off fuel completely. Don't drain off the cooling water containing antifreeze and rustproof agent.
- (2) Apply antirust to the surface of the parts not painted. Apply lubrication oil to the lift chain.
- (3) Lowing the mast to the lowest position.
- (4) Apply the parking brake.
- (5) Wedged up the wheels.

3. Precautions Before Option

- (1) Don't check fuel leakage and lever or instruments at the place there is open flame. Never fill the fuel tank with the engine running.
- (2) Check the tire inflation pressure.
- (3) The forward-reverse lever should be in neutral.
- (4) Never smoke while the fuel system is under working or the battery is inspected.
- (5) Check all the levers and pedals.
- (6) Complete the provisions before starting.

- (7) Release the parking lever.
- (8) Make trying operation of the mast for lifting, lowering and Fwd/Bwd tilting and the truck for steering and braking.
- (9) The contamination level of the hydraulic oil should be lower than 12 as described in NAS1683.

4. Operation of Forklift Truck

- (1) Only trained and authorized operator shall be permitted to operate the truck.
- (2) Wear all the safety guards, such as shoes, helmet, clothing and gloves while operating the truck.
- (3) Check all the control and warning devices before starting the truck. If any damages or defects are found, operate it after repairing.
- (4) At the rated loading center, either overload or overload operation is strictly prohibited. If the cargo is placed at non-rated loading center, the capacity is decided according to load curve graph. The center of cargo should be in line with the frame center, not out of the line. The fork should insert completely under the cargo and make the cargo placed on it evenly. Do not raise an object with one fork end.
- (5) The starting, turning, driving, braking and stopping operation of the truck should be done smoothly. When steering on the humid or low friction road, the truck should be decelerated.
- (6) Travel with loads as low as possible and tilted backward.
- (7) Be careful when traveling on a slope. When climbing grades with a slope of more than 10%, the truck should forward travel, and when descending so grades, backward travel. Never turning on a slope. Avoid loading and unloading operation when descending.
- (8) Pay attention to pedestrian, obstacle and bumpy road when driving. Pay attention to the clearance over forklift truck.
- (9) Never allow any persons to stand on the forks or the truck to carry persons.

- (10) Never permit anyone to stand or walk under upraised forks.
- (11) Don't operate truck and attachment of it at any position out of the drive seat.
- (12) On the high lift forklift truck, when the lift high more than 3m, it is noted that the goods on it should not fall down or the protection measures must be taken if necessary.
- (13) Tilt the mast of the high lift forklift truck as backward as possible while the truck working. Use minimum forward tilt angle and Min. reverse tilt when loading and unloading.
- (14) Be careful and slowly driving over a dockboard or bridge-plate.
- (15) Shut down the engine and don't stay on the truck when filling fuel. Don't ignite the engine while checking battery or fuel lever.
- (16) The unloaded forklift truck with attachments should be operated as a loaded truck.
- (17) Don't handle unfixed stacked goods. Be careful to bulky goods to be handled.
- (18) If leaving the truck, lower the forks on the ground and let the shift lever to neutral, shut down the engine or cut down electric supply. If parking on a slope is unavoidable, apply the parking brake and block the wheels.
- (19) Don't open the radiator cap when the engine is warm.
- (20) Don't adjust the control valve and relief valve at will to prevent the damage of hydraulic system and its components because of excessive pressure passing them.
- (21) During loading and unloading operations, adjustment of parts, overhauling or maintenance are strictly forbidden;
- (22) Sudden quick turning is strictly forbidden for a going forklift;
- (23) When mast leans forward, cargo lifting and driving lifting with fork are strictly forbidden.

5. Points for attention on use of cooling system

- (1) The cooling medium used for the radiator of the forklift of our company is

generally long-lasting antirust and antifreeze liquid (FD-2 type-35-degree), which is not changed around the year, regardless of summer or winter. Generally, after being used for one year, it should be let out for filtration and purification and then put to use again. The cooling system is furnished with an auxiliary water tank (compensating), on the wall of which are marked with “FULL” and “LOW”, between which the level of antifreeze liquid should stay when the system is in use.

(2) Regularly check the sealing performance of the cooling system and the level of antifreeze liquid and shoot the trouble as early as possible, otherwise, the auxiliary water tank will lose its function, give wrong indication of level and finally shorten the lifetime of the engine.

(3) When antifreeze liquid is used as cooling medium, it is strictly forbidden to add water and different type of antifreeze liquid at will. Antifreeze liquid of same type should be replenished after the liquid leaks or evaporates.

(4) If water is used as cooling medium, it probably freezes in cold winter when the machine is not at work. In this case, the water should be discharged from the radiator. After the radiator works for a period of time, it should be dismantled and put into boiling soda solution for cleaning the scale or sediment accumulated on the inner surface of it.

(5) During operation, if the radiator of forklift “boils” or the temperature of cooling liquid is too high, do not open the cover of radiator immediately. If the cover needs to be removed to find out the cause for it, reduce the rotational speed of engine to the moderate, slowly rotate the cover and not remove it very soon so as to prevent operators from being scalded by the splashing liquid. When recovering the radiator, it must be screwed tightly, otherwise, the system may not be well enclosed and the system pressure stipulated cannot be formed.

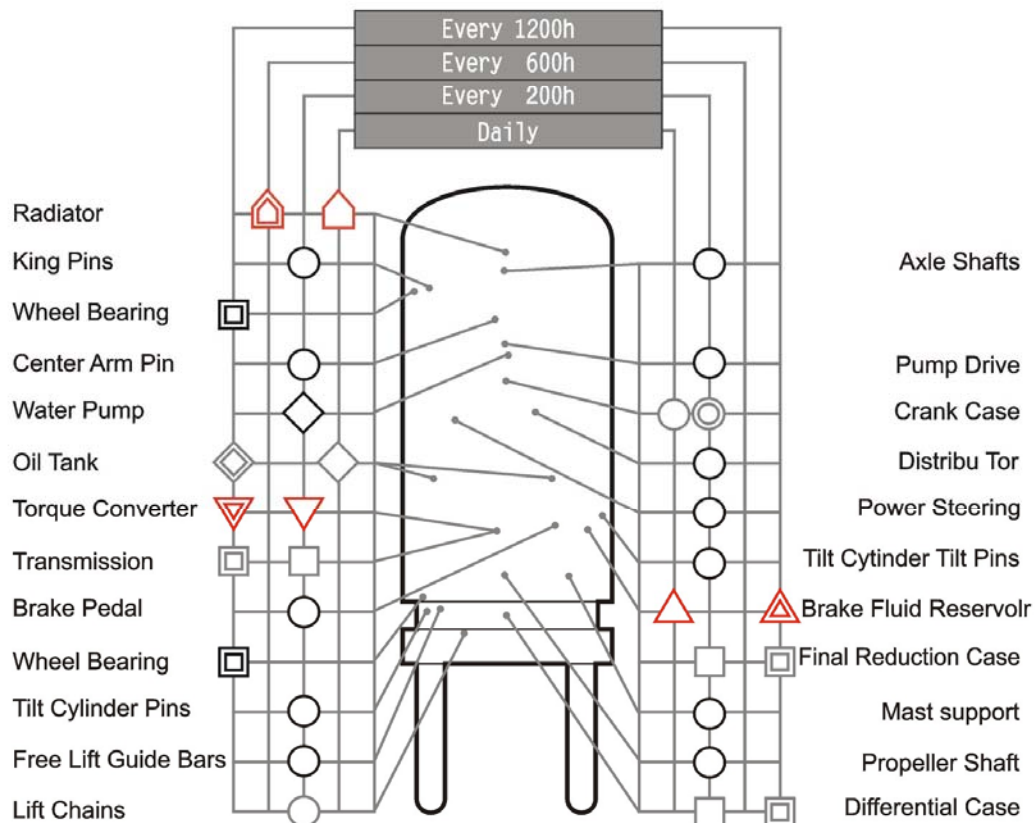
(6) Based on different working conditions, regularly clean the outer surface of the radiator with detergent, compressed air or high-pressure water (no less than 4kg/cm^2).

6. Oil Used for Forklift Truck

Name	Brand (homeland)	Brand (Export)
Fuel (Diesel)	No.0 in summer, No.10 in winter	
Lubricant for Gears		Titan gear LS90 (85W-90)
Hydraulic Oil		L-HM46
Tor-con Oil		SG/CF-4 15W-40
Brake Oil		Titan gear Hydra ZF20W-40
Lubricant for engine		SG/CF-4 15W-40
Grease	No.3 Lithium Base Grease (drop point 170)	

7. The Table of Lubrication System

LUBRICATION CHART



NOTE: Some Models Have Unnecessary Places



- Chassis Grease
- Wheel Bearing Grease
- ◇ Water Pump Grease

- Engine Oil
- Gear Oil
- ◇ Hydraulic Oil

- △ Brake Fluid
- ▽ Torque Converter Oil
- Clean Soft Water

○ ◇ ▽ △ □ Supply

○ ◇ ▽ △ □ Replace

II . Primary Parameter of Forklift Truck

Primary Parameter of Forklift Truck

Performance & Outline Dimensions	Item		Unit	CPCD140	CPCD150	CPCD160-CU2	CPCD160-CU1
	Rated Load		kg	14000	15000	16000	
	Load Centre		mm	900			1200
	Standard Lift Height		mm	3000			
	Mast Tilt (fwd/bwd)		deg	6/12			
	Wheelbase		mm	3650			4000
	Tread (fwd/bwd)		mm	1885/2100			
	Overhang (fwd/bwd)		mm	1040/900			
	Overall Width		mm	2560			
	Overall Length (with Fork)		mm	7410			8380
	Overall Height (at Mast)		mm	3300			
	Min. Under clearance (at Mast)		mm	250			320
	Min. Turning Radius		mm	4970			5600
	Fork Size		mm	1820 × 250 × 100			2440 × 250 × 100
	Fork Space		mm	900-2150			
	Max. Travel Speed (loaded/unloaded)		km/h	30			
	Max. Lifting Speed (loaded/unloaded)		mm/s	400/330		390/320	
	Max. Traction Force (loaded)		kN	105			
	Gradeability (loaded)		%	28			
	Weight (with oil and water)		kg	22500	23000	23500	25000
Engine	Tyre	Front		12.00-24-20PR			
		Rear		12.00-20-20PR			
	Diesel	Type		Cummins6BTA5.9			
		Rated Power / Rated Speed	kW/rpm	138/2400			
		Max. torque / Rotate Speed	Nm/rpm	757/1500			
		Output	L	5.88			

Performance & Outline Dimensions	Item		Unit	CPCD160-CU3	CPCD160-CU4
	Rated Load		kg	16000	16000
	Load Centre		mm	900	1200
	Standard Lift Height		mm	3000	
	Mast Tilt (fwd/bwd)		deg	6/12	
	Wheelbase		mm	3650	4000
	Tread (fwd/bwd)		mm	1885/2120	
	Overhang (fwd/bwd)		mm	1040/900	
	Overall Width		mm	2560	
	Overall Length (with Fork)		mm	7410	8380
	Overall Height (at Mast)		mm	3300	
	Min. Under clearance (at Mast)		mm	250	320
	Min. Turning Radius		mm	5600	
	Fork Size		mm	1820 × 250 × 100	2440 × 250 × 100
	Fork Space		mm	900-2150	
	Max. Travel Speed (loaded/unloaded)		km/h	30	
	Max. Lifting Speed (loaded/unloaded)		mm/s	400/330	390/320
	Max. Traction Force (loaded)		kN	115	
	Gradeability (loaded)		%	28	
	Weight (with oil and water)		kg	23500	25700
	Tyre	Front		12.00-24-20PR	
		Rear		12.00-20-20PR	
Engine	Diesel	Type		CumminsQSB6.7	
		Rated Power / Rated Speed	kW/rpm	142/2300	
		Max. torque / Rotate Speed	Nm/rpm	929/1500	
		Output	L	6.69	

Performance & Outline Dimensions	Item		Unit	CPCD160-CU-06I
	Rated Load		kg	16000
	Load Centre		mm	600
	Standard Lift Height		mm	4000
	Mast Tilt (fwd/bwd)		deg	15/12
	Wheelbase		mm	3650
	Tread (fwd/bwd)		mm	1885/2100
	Overhang (fwd/bwd)		mm	1040/900
	Overall Width		mm	2560
	Overall Length (with Fork)		mm	7510
	Overall Height (at Mast)		mm	3800
	Min. Under clearance (at Mast)		mm	250
	Min. Turning Radius		mm	4970
	Fork Size		mm	1820 × 250 × 100
	Fork Space		mm	900-2150
	Max. Travel Speed (loaded/unloaded)		km/h	30
	Max. Lifting Speed (loaded/unloaded)		mm/s	400/330
	Max. Traction Force (loaded)		kN	105
	Gradeability (loaded)		%	28
	Weight (with oil and water)		kg	24000
	Tyre	Front		12.00-24-20PR
		Rear		12.00-20-20PR
Engine	Diesel	Type		Cummins6BTA5.9
		Rated Power / Rated Speed	kW/rpm	138/2400
		Max. torque / Rotate Speed	Nm/rpm	757/1500
		Output	L	5.88

III. Primary Assembly of Forklift Truck

Primary Assembly of Forklift Truck

No.	Name	Contents
01	Engine Mounting	Includes engine, air cleaner
02	Cooling System	Includes cooler, tubes, compensator
03	Exhaust System	Includes muffler, exhaust, hoses
04	Oil Cooling System of Tor-con	Includes Tor-con oil cooler, tubes
05	Transmission System	Includes transmission, tor-con, transmission shaft etc.
06	Drive Axle	Includes axle house, half shafts, differential, hub reduction, wet-type brake, parking brake
07	Brake System	Includes brake valve, parking brake valve, brake oil pump, filling valve, tubes, accumulator, cut-off valve
08	Steering Axle	Includes axle box, king pin, steering knuckles, hub, linkage, steering cylinder
09	Steering System	Includes powered steering unit, redirector
10	Wheel	Includes front tyre & rim, rear tyre & rim
11	Frame System	Includes frame, tank in frame, hood, floor, counterweight, seat
12	Upper Frame	Includes bottom frame, hood of tilt cylinder
13	Hoist System	Includes outer & inner mast, lift bracket, cylinder positioner, fork, lift cylinder, end roller, side roller, sheave, chain
14	Tilt Cylinder	Includes cylinder body, piston assembly, guide cap, oil seal
15	Hydraulic System	Includes control valve, oil pump, cut-off valve, control valve lever, oil filter, cover plate
16	Electric System	Includes air-conditions, combination meter, lamp, battery

VI. The structure, principle, adjustment and maintenance of forklift

1. Dynamic system

(1) Brief introduction

The dynamic system includes the engine, air inlet system, cooling system and exhaust system, etc. The engine is linked to transmission device. The holder of engine is connected with the frame of the forklift through a rubber cushion to reduce vibration. The power of engine is transferred to the driving system by a flywheel through a torque converter.

The power of forklift CPCD140~160-CU1,CU2,CPCD160-CU-06I is provided by diesel engine Cummins6BTA 5.9 imported from USA. The power of forklift CPCD160Cu3,Cu4 is provided by diesel engine Cummins6QSB6.7 imported from USA. The accessories of the engine such as air filter and silencer are all from the supplier of Cummins equipments to ensure normal operation of the engine. Refer to relevant manual for the details of operation and maintenances for the engine.

(2) Primary Parameter of Cummins Engine(diesel)

Parameter	Cummins6BTA 5.9	Cummins6QSB6.7
Type	Four-stroke, In-line, Increase Pressure and Mid-cooling	
Cylinders No.-Bore*Stroke	6-102x120mm	6-107x124mm
Total output	5.9L	6.7L
Compression Ratio	16.5	17.2
Rated Power/Speed	138kW/2400rpm	142kW/2300rpm
Rated Torque/Speed	757Nm/1500rpm	929Nm/1500rpm
Idle Speed	800rpm	700rpm
Min. Fuel Consume	203g/kW.h	213g/kW.h
Max. Dimensions of Outline	1005x702x957mm	1059x725x960mm
Net Weight	411kg	485kg
Turning Direction	Clockwise direction	
Lubricant	16.4L	19.7L

2. Transmission device

2.1 Introduction

The transmission device is imported from ZF Company of Germany. It consists of hydraulic torque converter, dynamic shifting gearbox, hydraulic system and electrical system and has the following advantages:

- a) Compact structure design and built-in oil circuit;
- b) High-tooth and high-coefficient helical tooth engagement, both reducing noise and improving bearing capacity;
- c) Proportional electromagnetic valve facilitating automatic manipulation and control unit integrating diversified control programs, i.e. EST-37A are adopted.
- d) The inching of electronic controlled program is used and the function is realized by EST -37A control element, so that the micro control accuracy of the driving and heavy load of the forklift can be realized more easily.
- e) The hydraulic clutch is furnished with specially treated paper friction lining and steel sheet to improve its abrasion; the oil circuit of hydraulic torque converter is fixed with a good filter to improve the purity of oil and elongate the service time of the torque converter.

2.2 Base Structure and Performance of Forklift Truck

(1) Structure and Parameter of Transmission

Item			Unit	CPCD140～160-Cu
Torque Convertor	Type			
	Circular Diameter		mm	300
	Stall Torque Ratio			2.066
	Setting pressure		MPa	
Flow of Charging Pump			L/min	
Automatic Gearbox	Type			
	Gear Ratio	1		5.088
		2		2.263
		3		0.994
Net Weight			kg	300
Oil capacity			l	13
Oil Type				SG/CF-4 15W-40

(2) Hydraulic torque converter

a) Function of hydraulic torque converter

Its main functions include: achieving automatic shift (which means to vary speed without pause), increasing traction force, improving the working performance of engine, preventing engine from extinguishing, upgrading speed-varying quality and facilitating gear shift.

b) Structure of hydraulic torque converter

The hydraulic torque converter consists mainly of pump wheel, turbine and guide wheel. The pump wheel is fixed on input shaft, turbine on output shaft and connected with the input shaft of gearbox through a spline, playing the role of transferring power to hydraulic gearbox. The guide wheel is fixed on the shell of torque converter.

c) The working principle of Torque Converter

The pump wheel is rotated by the drive shaft, so that the flow in the pump is forced out by the centrifugal force along the vanes of pump wheel (at this time mechanical energy is converted to kinetic energy).

Thereby the fluid flows into the impeller of turbine wheel, transmitting torque to output shaft. The direction of flow leaving the turbine wheel is changed by the stator wheel so that the liquid flows into the pump wheel at the best angle. At this time a reaction torque pushing the stator is generated, as a result of which the output torque becomes larger than the input torque by the valve and the difference is equal to the reaction torque.

As the rotational speed of turbine wheel increases, approaching to the input rotational speed, the change of flow angle reduces, and the output shaft torque also reduces. And finally the fluid begins to flow contrary to the direction of stator vanes, as a result of which the reaction torque begins to affect in the reverse direction.

In this case the output shaft torque becomes smaller than the input shaft torque. So as to prevent this phenomenon, a free wheel (one-way clutch) is provided on the

stator wheel. When the reaction torque acts in the reverse direction, the stator wheel rotates idly. In this state the input torque becomes equal to the output torque so that high performance is ensured.

As the phase of torque transmission is changed by the mechanical means(clutch), the torque convertor is called the 2-phase type. It features smooth operation and enhanced efficiency.

The torque convertor is fixed to the flywheel through the flex plate so that it rotates always together with the engine.

Inside the torque convertor are mounted the torque convertor case, turbine wheel, pump wheel and stator wheel. The inside of torque convertor is filled with torque convertor fluid.

The pump wheel has gear at its end which is engaged with the drive gear of charging pump to drive it.

The turbine wheel is spline-jointed to the main shaft. It serves to transmit power to the wet-type multidisk clutch.

(3) Dynamic shifting gearbox

Its main functions include: changing transmission ratio, satisfying the need of the traveling forklift under different working conditions and realizing shifting gears without power interruption.

(4) Hydraulic system

Its main functions are: supplying transmission medium -oil to torque converter and ensuring its circular cooling, providing pressure oil for the hydraulic clutch of shifting gearbox to control gear shifting and feeding it with lubricant.

(5) Electrical system

Its main functions are receiving gear-shifting signal, controlling gear-shifting logic and manipulating electromagnetic valve. Based on sensor's signal, it also can control blocking, achieve automatic shifting, prevent overspeed of the engine and

control interlocking etc.

2.3 Manipulation

(1) Before starting the vehicle, the driver must switch the shifting lever of gearbox to neutral position. It would be best not to loosen the parking brake to ensure safety.

(2) The parking brake should be released when the gearbox is put into gear and the vehicle is ready to go.

(3) When the vehicle is driving, the gearbox should be make up and down operation in turn and out of turn operation is not allowed. As for torque converter's structure is backward trailer and one-way clutch, To prevent from the engine runaway, only when the vehicle speed reaches the speed which is the limit one of lower adjacent gear, then shifting to lower gear should be performed. If necessary, pedal brake can be used to slow down the vehicle before changing to low gear.

(4) When the vehicle is coasting along a slope, the rotational speed of engine should not be lower than 1200rpm, otherwise, the gear in gearbox and friction lining will be damaged.

(5) When inverse manipulation is needed for the vehicle (from advancing gear directly to reverse gear, or reverse gear directly to advance gear), the driver should lower the rotational speed of engine and driving speed of the vehicle and the maximum driving speed is not allowed to exceed 10km/h.

(6) When the vehicle stops moving, the engine cannot perform a function as brake due to torque converter, so when the vehicle stops on a slope, the stopper should be placed under the wheel to prevent the vehicle from coasting down.

(7) When the vehicle travels reversely, the driver should lower the rotational speed of engine and the driving at speed 1 or speed 2 is suggested.

(8) When the vehicle is in trouble and needs to be dragged off, the towing speed should be no more than 10km/h and the longest distance no more than 10km. If more distance of towing is required, the transmission shaft between the output end of the

gearbox and the axle should be removed or the vehicle should be shipped.

(9) If the vehicle pulls up and the engine and gearbox linked to it are still running, the engine stalling is not allowed.

2.4 Maintenance

(1) Oil filling

The proper amount of oil stipulated should be filled before the gearbox is used. For the first filling, the oil storage volume of the external components such as filter, oil pipe and cooler etc should be considered, so the oil filled this time should be a bit more than that for future.

The engine should be kept at idle speed state when filling in oil, or the oil of the higher components such as torque converter and cooler etc will flow into gearbox, the oil level will be higher than the normal one and the height of oil level is not easy to be controlled.

The oil level height must be controlled according to the scale of oil gauge.

When the oil temperature is about 40°C, the oil level should be in the lower scale of the oil gauge and when the oil temperature is about 80°C, the oil level should be at the upper scale of the oil gauge.

(2) Oil temperature control

When the forklift is in operation, the driver should pay attention to the oil temperature of the gearbox. The oil temperature of gearbox for normal working is usually between 80°C to 110°C and can reach 120°C instantaneously. If the oil temperature exceeds 120°C, stop it to check. Control the rotation speed of engine at 1200-1500rpm and put the gearbox at idle position. The temperature should decrease to the normal value within 2-3 minutes under the normal condition. Otherwise, it indicates that there are problems in the system and it can only be used again after the troubles are eliminated.

(3) Oil pressure control

The oil pressure of the gearbox should be controlled by pressure control valve, the normally manipulated oil pressure is 15-17bar and the main oil pressure will be decrease at the moment of shifting, which is resulted from the oil filling in oil cylinder of clutch. The oil pressure should return to the normal after shifting and if the oil pressure is lower than the value stipulated, it will result in the slippage and heating of friction lining of clutch, finally burning and damaged . Therefore, the forklift must be stopped for examination and used again after the trouble is eliminated..

(4) Oil changing

The oil in the gearbox should be changed at regular intervals, after 100 hours of working for the first use, then change once every 100 hours. But the oil should be changed at least once for a year and oil level control for filling should follow the method in section 5.1 of this article.

The filter or filter element should be changed each time when oil is changed, the mesh size of the filter element is 0.025mm, the minimum filtration area 5100cm and the flow of the oil filter is about 100dm/min.

(5) Electrical welding

When the lifter needs welding, all the electrical elements of gearbox must be unplugged and disconnected with the electrical system of it, or it will lead to the damage of the electrical elements of gearbox.

As for other detailed content, refer to the document of the gearbox attached with the forklift.

2.5 Trouble shooting

(1) Abnormal noise

Cause for trouble	Check method	Remedy
Fracture of elastic plate	Check the sound of rotation under the low speed	Replace elastic plate
Bearing damaged or worn	Disassemble and check	Replace
Fracture of gear	Disassemble and check	Replace
Spline worn	Disassemble and check	Replace
Big noise of oil supply pump	Disassemble and check	Repair or replace
Loose bolt	Disassemble and check	Tighten or replace
Too high the oil level	Check the scale of oil gauge	Fill the oil as specified
Obstruction of oil suction filter	Check the oil suction filter	Clean or replace

(2) Fail to put into gear or the engine can't be started up

Cause for trouble	Check method	Remedy
Burning of circuit fuse	Disassemble and check	Replace the fuse after trouble is eliminated
Loose cable plug	Disassemble and check each connecting part	Tighten the connecting cable socket at each part

(3) Oil temperature too high

Cause for trouble	Check method	Remedy
Parking brake has not been completely loosened.	Check the working condition of brake	Loosen parking brake
Obstruction of oil suction filter	Disassemble and check	Clean or replace
Oil level is too low.	Check the oil level	Fill the oil as specified
Oil level is too high.	Check oil level	Re-control the height of oil level
Obstruction of oil cooler	Disassemble and check	Cleaning
Slippage of clutch		Replace the friction lining of clutch
Bearing worn or blocked	Disassemble and check	Replace

3. Drive axle

3.1 General description

The drive axle used for the forklift is the Kessler imported from Germany and the international large tonnage forklifts all use the drive axles of the Co. The drive axle is made of differential mechanism, hub reduction gear, wet-type driving brake and caliper disc type parking brake etc and has the following characteristics:

(1) The driving brake of the drive axle adopts multi-plate and fully-enclosed wet typebrake, which is portable and convenient in operation and the axle-load has good

dust and water resistant ability and free from maintenance.

(2) Big braking torque, safe and reliable.

(3) Equipped with caliper disc type parking brake.

3.2 Structure

(1) Differential and hub reduction gear

The differential mechanism is mainly made of differential case, drive bevel gear, driven bevel gear, half shaft gear and bearing etc. Tapered roller bearing is mounted at the both ends of differential for mounting driven bevel gear, two tapered roller bearings are mounted at the rear axle part of drive bevel gear to bear the forward and backward thrust force and a bearing is mounted at the head of gear to bear the radial force.

The hub reduction gear is made of a central gear, a set of planetary gear and an internal gear. The central gear is engaged with planetary gear, which is mounted on the shaft of planet carrier and engaged with the internal gear.

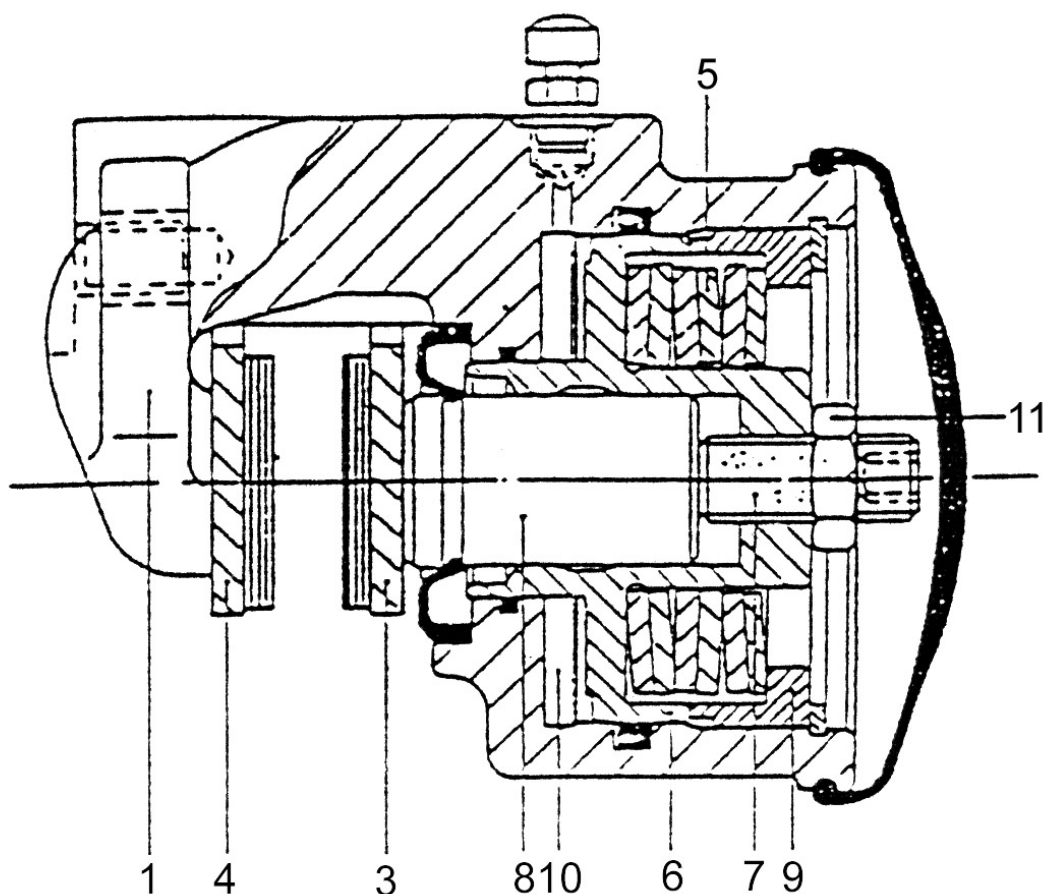
The power is transmitted from drive gear to the driven gear, driving the planetary gear of differential, then transmitted to half axle gear to drive the central gear, which drives the planetary gear and then transmitted to the planet carrier of the driven gear.

(2) Wet-type driving brake

Wet-type brake is made of brake case, parting slip, friction lining and piston etc. The parting slip and brake case are connected with splines and the friction lining is mounted on the brake case. When the brake is stepped on, oil pressure produced by hydraulic oil will push the piston, which compresses tightly the parting slip, thus reducing the speed of the friction lining in rotation and finally resulting in the speed reduction of brake case to its stop.

(3) Parking brake

The parking brake is of caliper disc structure and mounted on the input shaft of the drive axle. The elasticity of the spring in the brake oil cylinder begins to brake when it is neutralized under the hydraulic pressure. The brake cylinder and brake caliper assembly are combined into an organic whole and the parking brake is realized through the parking brake valve in the driver's cab. The parking brake can also be used as an emergency brake, but which will seriously wear the friction lining of parking brake, so the friction lining of parking brake must be replaced after emergency brake has been used twice.



- (1)Oil cylinder and braking caliper assembly (2)Piston (3)Friction lining
 (4)Spring (5)Pushrod (6)Washer (7)Adjusting stud
 (8)Locking nut (9)Oil chamber (10)Oil seal (11)O ring (12)Dust ring

Fig.3-1 Parking Brake

3.3 Primary Parameter of Drive Axle

		CPCD140~160-Cu
Type		Full-flowing, Box-weled axle
Drive Axle	Tire	12.00—24—20PR
	Rim	8.5-24
	Air Pressure	0.88MPa
Differential	Type	Helical Bevel Gear Type
	Speed Reduction Ratio	2.92
Hub Reduction	Type	Planetary Gear Yype
	Speed Reducton Ratio	6.0
Oil Capacity	Differential	19L
	Hub Reduction	2.8x2L
Total Speed Reduction Ratio		17.52
Oil Type		LS90

3.4 Maintenance and Trouble-shooting

(1) Check the oil level of main drive, hub reduction gear and brake oil tank of drive axle for every 100 hours and fill the gear oil of the same type if necessary. Check the working state of ventilation cock and clean it if necessary.

(2) Check the tightening state of connecting bolt of drive axle every 400 hours and tighten the bolt based on the tightening torque of 2000Nm.

(3) Replace the oil of drive gear, hub reduction gear and brake oil tank every 1000 hours with the oil of same type and specification and check if there is any impurities such as metal in these two parts.

(4) Trouble shooting

Trouble	Cause for trouble	Remedy
Oil leakage from the main reduction gearbox	The connecting bolt of main reduction gearbox is loose or the gasket damaged.	Tighten or replace
	Obstruction of ventilation hole	Clean or replace
	Oil seal worn or damaged	Replace
Noise of differential is too big.	Gear worn, damaged or broken	Replace
	Bearing worn, damaged or broken	Replace
	Improper gear backlash	Adjust
	The spline fit connecting half axle gear is loose.	Replace the parts
	Insufficient gear oil	Fill in oil according to the need.

4. Steering System

4.1 General Description

The steering system principally consists of a powered steering unit and a steering cylinder. The handwheel can be tilted properly forward or backward to meet driver's demand.

The powered steering unit has a favourable capacity which can compensate pressure variety for the variety of the steering load. It is fairly no infection between the working circuit of steering system and the others. The main flow preferential provide to the working circuit of steering system. So steering reliably and system economically.

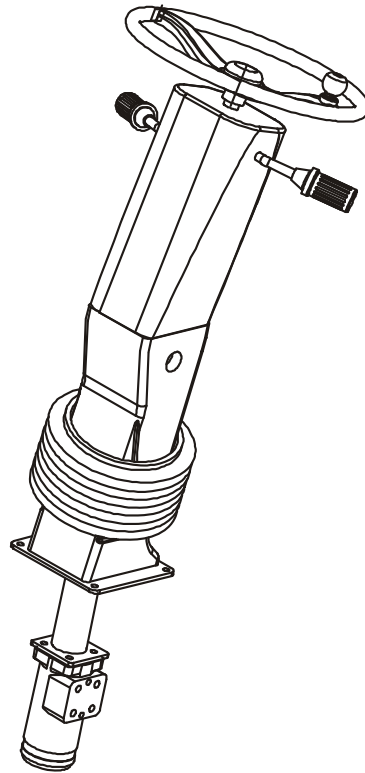


Fig. 4-1 Steering System

The main specifications of the steering system

Item		CPCD140~160
Type of the steering system		Rear wheel with steering powered
Powered Steering Unit	Type	530-5289/842-1256
	Emission Capacity (ml/min)	500
	Max pressure of intake (bar)	172
	Max pressure of working back (bar)	21
Flow-divider	Type	
	Rated flow (l/min)	35

4.2 The principle of steering system

The followed valve which is fitted on the Powered Steering Unit to control the flow direction of oil consists of a valve core, a valve cover and a valve body. The teeth on the rotor mesh with the stator teeth. When hydraulic flow assists in turning, the joggle will be working as a measure component to ensure that the flow in proportion to the turning angle of the handwheel. When steering by manual, the joggle will be working as a oil pump by manual. And the transmission shaft transfers

torsion.

4.3 Steering System Troubleshooting

Problem	Analyses of Trouble	Remedies
Fail to turn handwheel	Pump damaged or breaking down	Replace
	Flow-divider blocked or damaged	Clean or replace
	Hose or joint damaged or pipeline blocked	Clean or replace
hard to turn handwheel	Too low oil pressure from flow-divider	Adjust pressure
	Air in oil circuit of steering system	Exhaust air
	Steering unit fail to reposition due to spring plate damaged or elasticity-insufficient	Replace spring plate
	Excessive inner-leakage in steering cylinder	Check piston seals
	Excessive low level in oil tank	Refill oil
Track snacking or moving with oscillation	Excessive flow as steering	Adjust the flow of flow-divider
Excessive noise	Excessively low level of oil in tank	Refill oil
	Suction pipeline or oil filter blocked	Clean or replace

5. Steering Axle

5.1 General Description

The structure of steering axle is type of section-boxed welded (as follows).It includes axle box, steering cylinder, tie rod, knuckles and steering (rear) wheels. The steering trapezium is made of cranks and blocks. When pressure oil pushes the cylinder piston rod, the tie rod revolve the knuckles, then the truck steers.

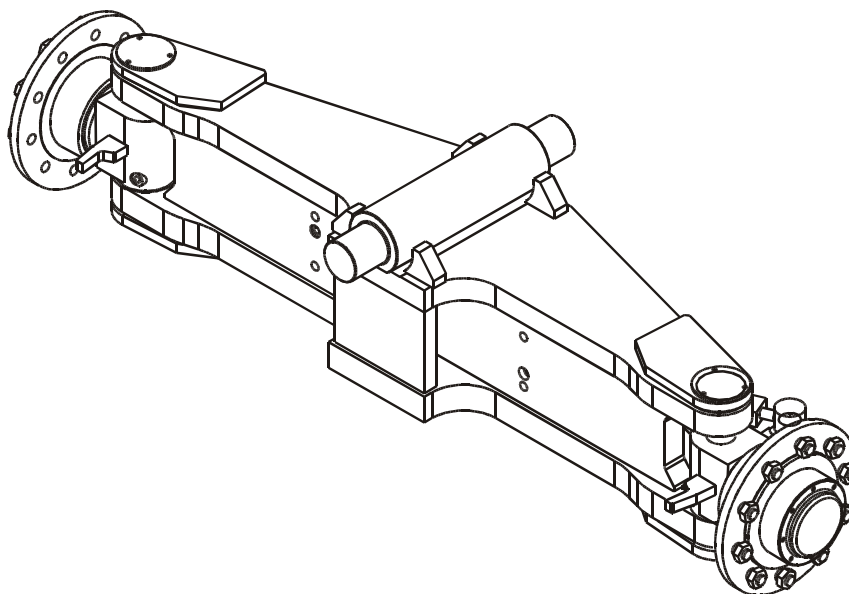


Fig. 5-1 Steering Axle

The main specifications of the steering axle

Model		CPCD140~160	
Steering axle	Type		Supporting in middle
	Steering angle	Inner wheel	80°
		Outer wheel	56.19°
	King pin	Interval	1800mm
		Inner obliquity	0°
		Outer obliquity of wheel	1°
	Weight		1240
Steering(rear) wheel	Tire		12.00-20-18PR
	Rim		8.5-20
	Inflation Pressure		0.88MPa

5.2 Steering Knuckles and King Pin

Both steering knuckles are fitted between the upper and the lower bushes by two king pins, tapered bearings and adjustive pads.

5.3 Steering(rear) Wheel Bearing Pre-load Adjustment

- (1) With lubricating grease, fill up the chamber formed by wheel hubs, wheel hub bearings, wheel hub covers and coat of the lips of the oil seals
- (2) Press the hub bearings into the hub and fit the hub on the knuckle shaft.
- (3) Fit a flat washer and tighten a castle nut to a torque of 206-235Nm and loosen it

and then tighten it again to a torque of 9.8Nm.;

(4) To As shown in follows ,with lubricating grease ,fill up the chamber formed by wheel hubs, wheel hub bearings , wheel hub covers and coat of the lips ensure the installation of the nut is firmed, slightly knock at it with wooden hammer and in the meantime, rotate the nut for 3~4 turns.

(5) Tighten the castle nut and align one of its notches with a cotter pin hole drilled in the steering knuckle.

(6) Again slightly knock at the hub with a wooden hammer and in this time, rotate manually the hub for 3~4 turns to ensure its smooth rotation with a specified torque of 2.94~7.8Nm.

(7) When the torque value measured is up to the specified one ,lock the castle nut with a cotter pin.

6. Brake System

When the vehicle travels, the braking system make the vehicle reduce speed, or make the vehicle park for a long time on flat or ramp.

The vehicle use pan-hydraulic wetness brake.

The system includes the following three parts:

6.1 Walking brake system

It's usually used to control the vehicle's speed and to make it stop. It also can be called foot braking. In the vehicle, it adopts pan-hydraulic wetness braking. This has many excellences such as braking equable 、 response time little 、 reacting sensitiveness、 operating portable、 safety reliable、 and any kind of performance no effecting braking and so on.

6.2 Parking braking system

It's loaded by springs. The system is used when the vehicle has been stoping or when meeting exigent case. Be controled by manual brake valve.

6.3 Cooling system

The system is a independent circuit. The pressure oil is going from the accumulator charge valve the brake fluid box. Oil is passing through the power brake, thus cooling recycle which can run to optimum brake ability.

The system is pan-hydraulic wetness braking (basic circuit showing). It composes of pump、charge valve、globe valve、accumulator、working brake valve、parking valve、pressure switch and tubes. The charge valve stops filling oil to braking system when the oil pressure in the accumulator run to 15MPa, and at the moment it fills oil to cooling circuit. When the oil pressure in the accumulator is lower 12.3MPa, charge valve turns to filling to braking system anew.

The pressure oil from the pump pass through the charge valve, then filled to accumulators which are in walking braking system and parking braking system. When stepping on pedal, the high pressure oil which be stored in accumulators goes into power braking, passing through brake valve, then make wheels stop running. When the pedal is released, the braking is unlocked. The oil in the power brake goes through brake valve and returns to oil tank. The oil pressure of the from the walking brake valve is direct ratio with the force which be on the pedal. A very little power to make the pressure run to 10MPa which walking brake system demands. The globe valve is connect in both walking and parking brake circuit. This can assure one circuit function when another is damaged.

Shortly after the engine start up, the low-pressure warning lamp is brightness for a little time because of the oil pressure in the accumulator lower than warning(10MPa). It turns off until the pressure higher than warning pressure. On this time the manual braking valve can be released. If the vehicle is running, the system occur any kind of trouble which result in the oil pressure in the accumulator lower than 10MPa, then the low-pressure warning lamp is brightness. We must stop working and check brake system on time.

Parking brake consists of a brake disc and a brake working cylinder. The power spring in the cylinder load force on the disc in order to achieve parking. The system can be used as exigent braking. But it cause the disc weared out badly. So it must replace the disc after the second exigent braking. The oil of high pressure in the cylinder (min 10MPa) is offsetting the spring power so that the parking braking can be released. The brake valve controls the hydraulic oil. When the parking brake valve released, the valve is opening. When pulling up the valve, the oil can't go into the working cylinder. The oil in the cylinder flows into the brake oil tank at the time. The brake disc is parking.

Walking brake is oil immersion wetness multiple disc brake. The friction discs and rotating are assembled crosswise on the drive axle hubs. The power pressure oil compress the unit and it produce brake force. The system's excellences are no adjusting、force no run down and wearing fairly little. In addition, for the system is immerses in obturation in oil tank, the water and dirty can't go into the brake. The system has many excellences such as large braking torque, long service life, antiaging, dirt resistance, no servicing and so on.

Cooling system is a independent circuit. It helps to make the system last service life of the wetness friction disc and produce optimum braking effectiveness. The system can dissipate the heat which is produced for braking frequently. The back valve assembled between oil inlet tube and outlet tube ensure the pressure of cooling oil lower than 1 bar, so that the drive axle can be protect.

The accumulator both in walking braking system and in parking braking system are sack-life structure. It's only charged nitrogen gas.

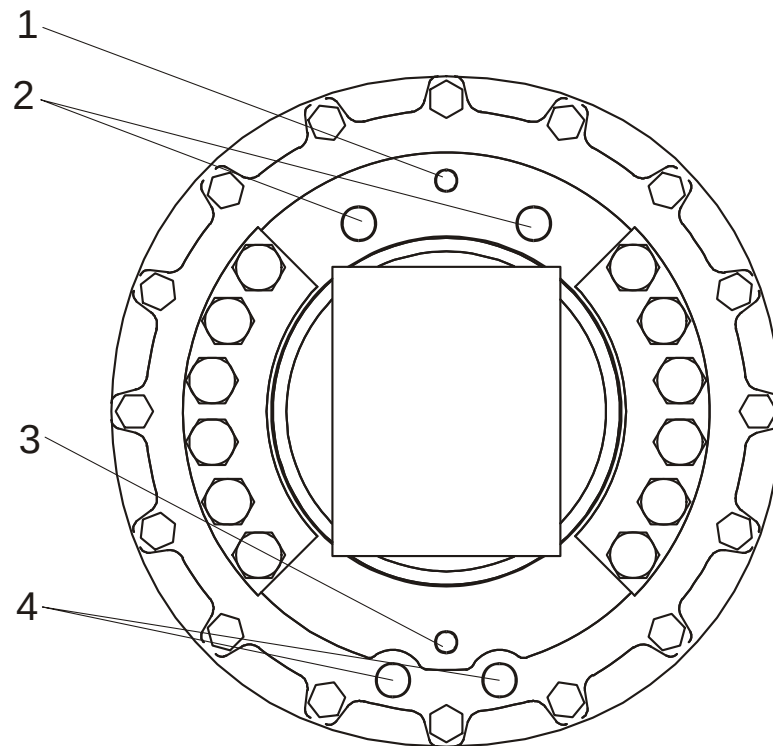
Noticing: Not aerated in oxygen, compressed air or any other gas which is combustible. The gas are aerated by special tools. It's necessary as the accumulator's accessory. It can be filled gas 、be relieved 、check atmospheric pressure and revise the pressure. The pressure in accumulators both in walking braking circuit and in

parking braking Circuit is 7.5MPa. The pressure in the accumulator is checked periodical so that it ensure the vehicle is safety.

The method is as following:

- (1) Pedal eight continuous after stopping and push and pull the manual control valve more than five. So the oil of high pressure in the accumulator is discharged.
- (2) Connect one end of the special tool which has a pressure gauge to the accumulator, the another connected to nitrogen steel bottle.
- (3) Open the switch of steel bottle. When the gauge is stable, open the tools switch, that means to open the back valve in the accumulator and charge into it.
- (4) Notice: pressure may run to parameter designed instantly. Close the nitrogen steel bottle's switch, and check the indication after the pressure gauge's hand being stable. If being lack, charge again.
- (5) When the demanding pressure realized, close the bottle's switch, then close the special tool's switch. Finally move the tool away.
- (6) If the accumulator leakages, knock on the back valve which is in the accumulator slightly by hammer and screwdriver. Make it move down first, then return rapidly. Let the seal area be touched entirely. **Checking: daub engine oil on the end of accumulators. If finding air bubble, the accumulator leakages gas.**

The gas in the tube can effect brake capability. Deflate gas after dismantling and checking or replacing parts and reassembling. Either hub has a bleed screw which is used when deflating. Step on pedal, let oil go out until no air bubble. **Noticing: wind the screw under pedalling.**



- | | |
|--------------------|--|
| (1) Air bleed | (2) Cooling oil outlet or wear inspection hole |
| (3) Hydraulic line | (4) Cooling oil inlet or drain plug |

Fig.6-1 Inside of Hub for Drive Axle

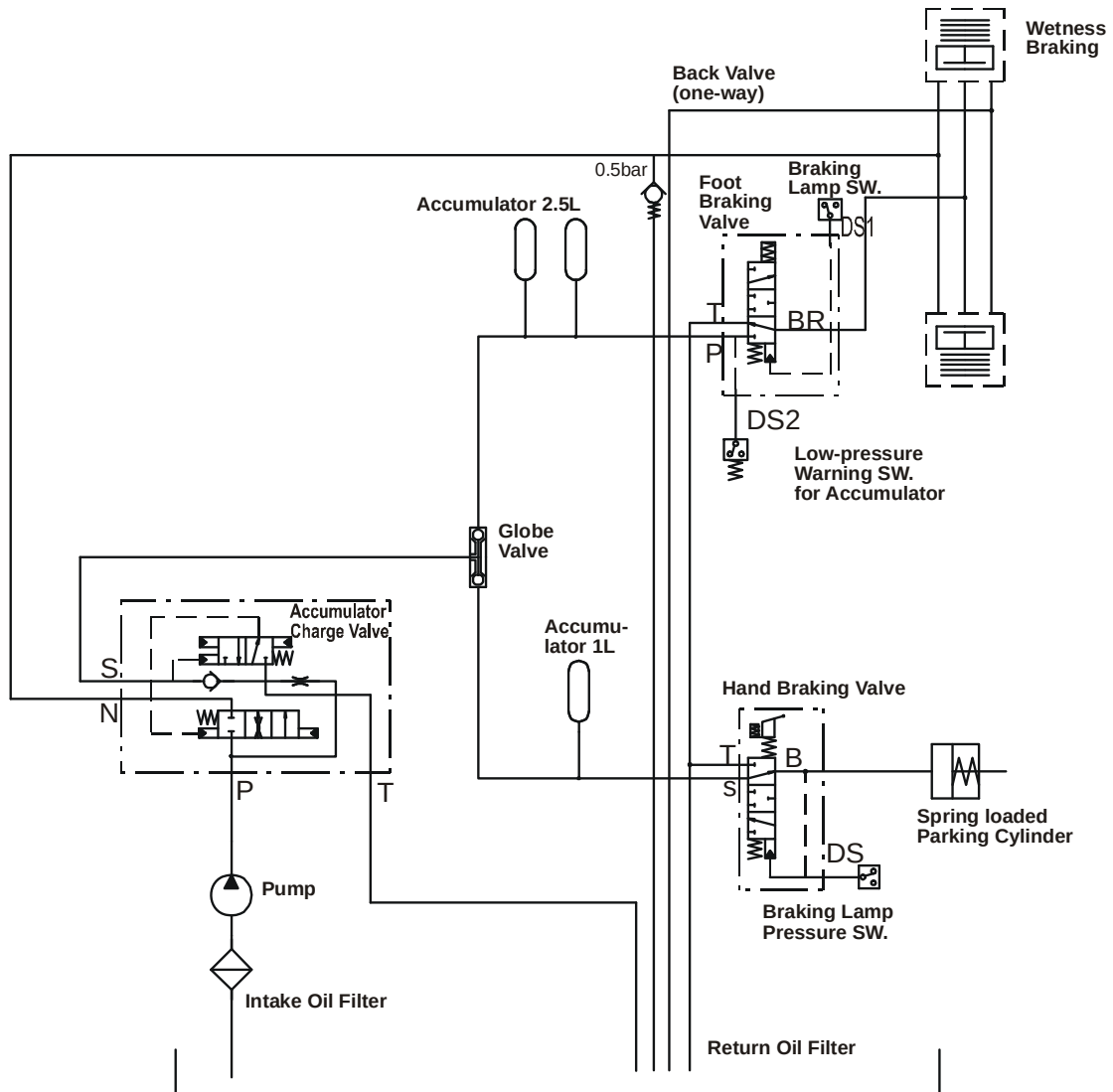


Fig.6-2 Working Principle of Brake System

7. Electric System

7.1 General

The electric system for this forklift truck is of the single-pole type, in which the frame of the truck provides the return path for the electricity. The electric system seems like “the nerve centre” of the truck.

For service and maintenance of Cummins QSB6.7 engine, please refer to the documents supplied together with the machine and attention should be paid to the following points for the entire truck:

- (1) When the key is turned to the ON position, turn on the fault diagnosis switch.

When there are more than one fault existing on the engine, press the Increment and Decrement switch at the right side of the fault diagnosis switch so as to realize the functions of increment and decrement. Please turn off the fault diagnosis switch before engine is started. If the fault diagnosis switch is turned on after engine is started, the engine can't save the fault code. If Increment and Decrement switch at the right side will be adjusted after startup, fine adjustment will be made to the idle speed of the engine. The idle speed will be increased or decreased about 25 rpm respectively for increment or decrement once.

(2) Welding on the parts of the integral machine is not recommended. If the welding is a must, all the socket connectors and power supply of ECM must be disconnected first. The distance between grounding cable of the electric welding machine and welding point is not allowed to exceed 2 feet (0.61m) . The grounding cable of the electric welding machine is forbidden to connect with ECM.

(3) The power supply (general mains switch) for ECM can only be cut off 30 seconds after the ignition key is turned off.

(4) When the oil filter is reinstalled, it's inside must first be topped up with lubrication oil and integral installation can be carried out only after the pipes are connected.

(5) The electronic control QSB6.7 engine is forbidden to be cleaned in water flushing mode to prevent the water from entering into the electronic system, causing short circuit of ECM.

(6) When the fault displayed by fault code is the one concerning the engine body, please contact with the local Cummins agent immediately. The maximum pressure inside the high pressure chamber of high pressure common rail can reach 160MPa, so the high pressure pipes are prohibited to be dismantled without authorization.

7.2 The Buildup of Electric System

(1) Integration Electric Plate

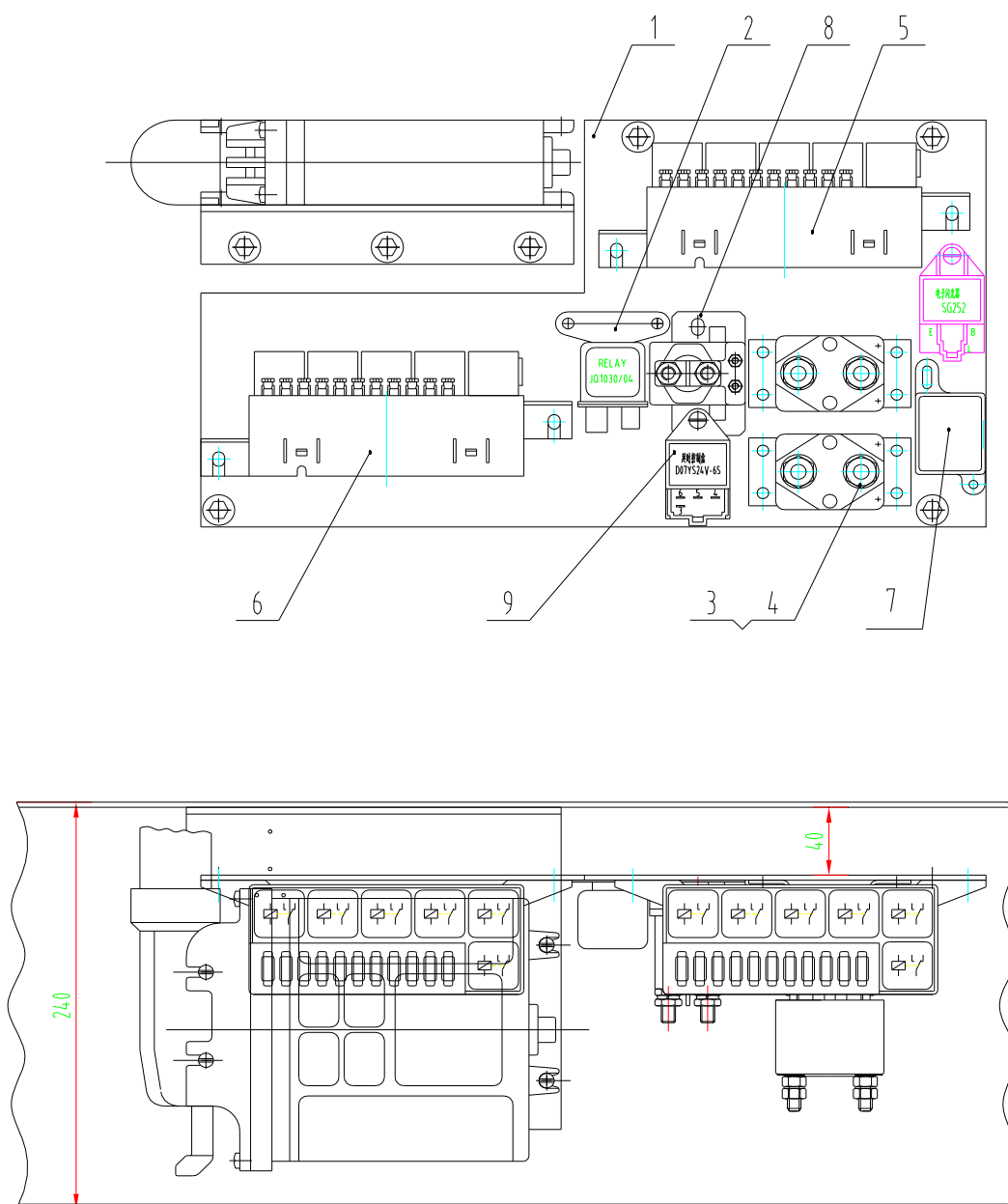


Fig.7-1.1 Integration Electric Plate(CPCD140-160-CU1,CU2,CPCD160-CU-06I)

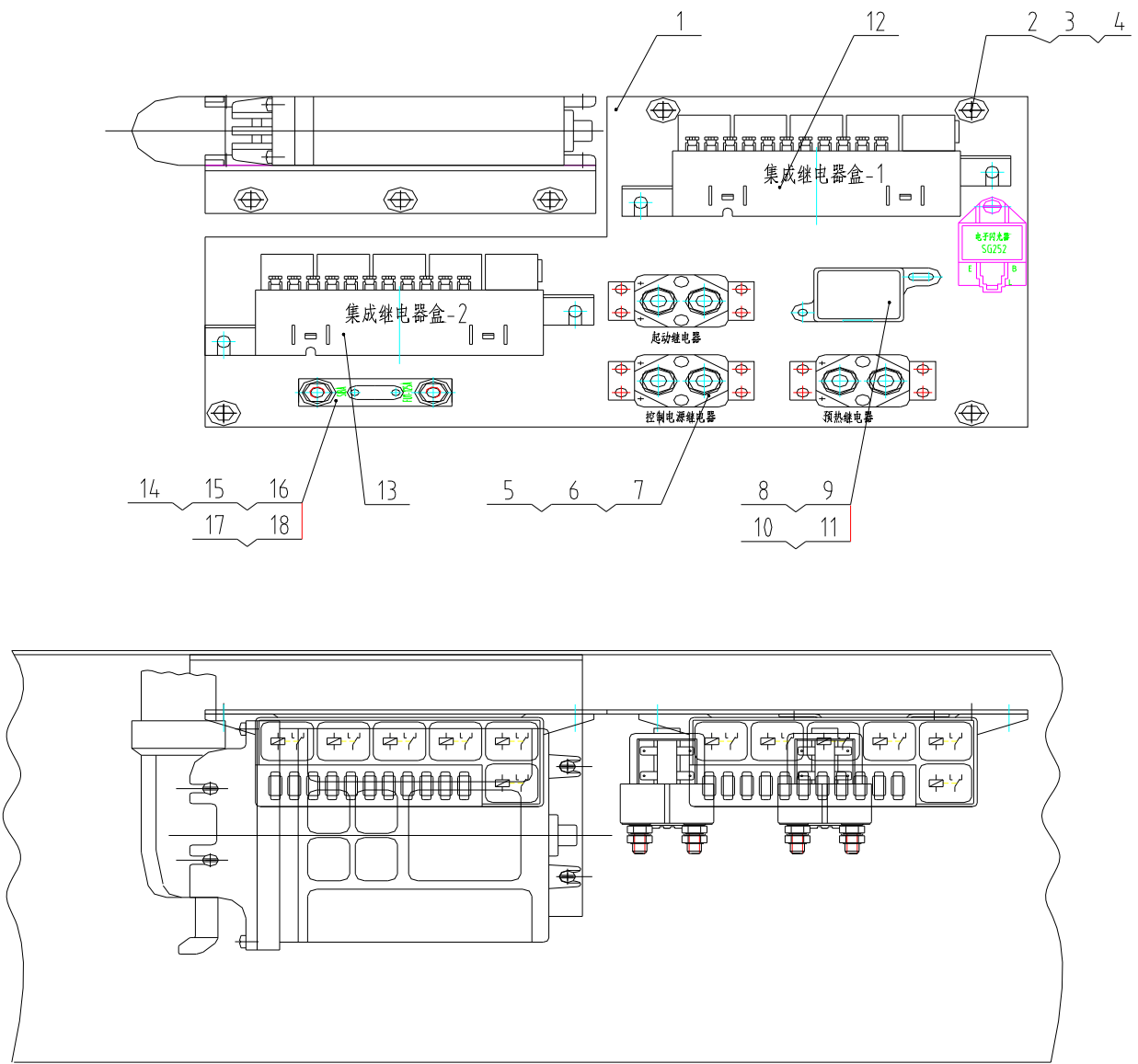


Fig.7-1.2 Integration Electric Plate(CPCD140-160-CU3,CU4)

(2) Charging Devices

This device contains generator, battery, charging indicator, etc. It supplies electric energy for all the electric devices.

Voltage: 24V

(3) Start System

This system mainly consists of automatic pre-heating unit, key switch, start protection circuit, start motor, etc. The function of this system is starting the engine.

(4) Stop System

This system consists of key switch and shut off fuel.

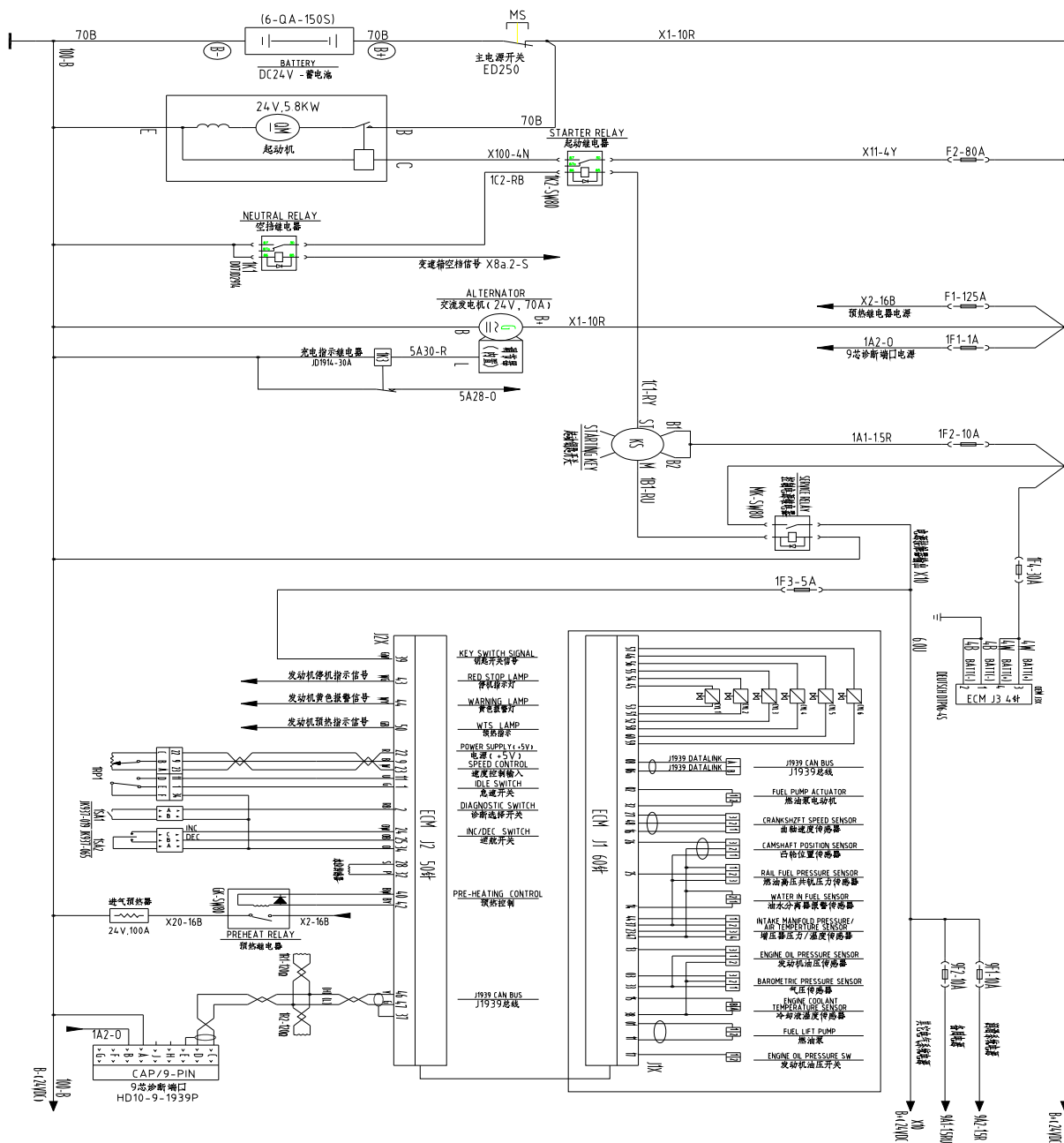


Fig.7-2.2 Electric Principle Drawing(CPCD140-160-CU3,CU4)

(5) Instruments

It mainly consists of hour meter, fuel meter, water temperature meter, voltage meter, tacho meter, oil pressure meter, oil pressure meter, brake pressure meter and charging indicator, oil pressure indicator, left turning indicator, right turning indicator, brake indicator, parking indicator. Alarm lamp of braking oil pressure low, manual/automatic alternative indicator etc. They are all achieve checking instruments

of the forklift truck.

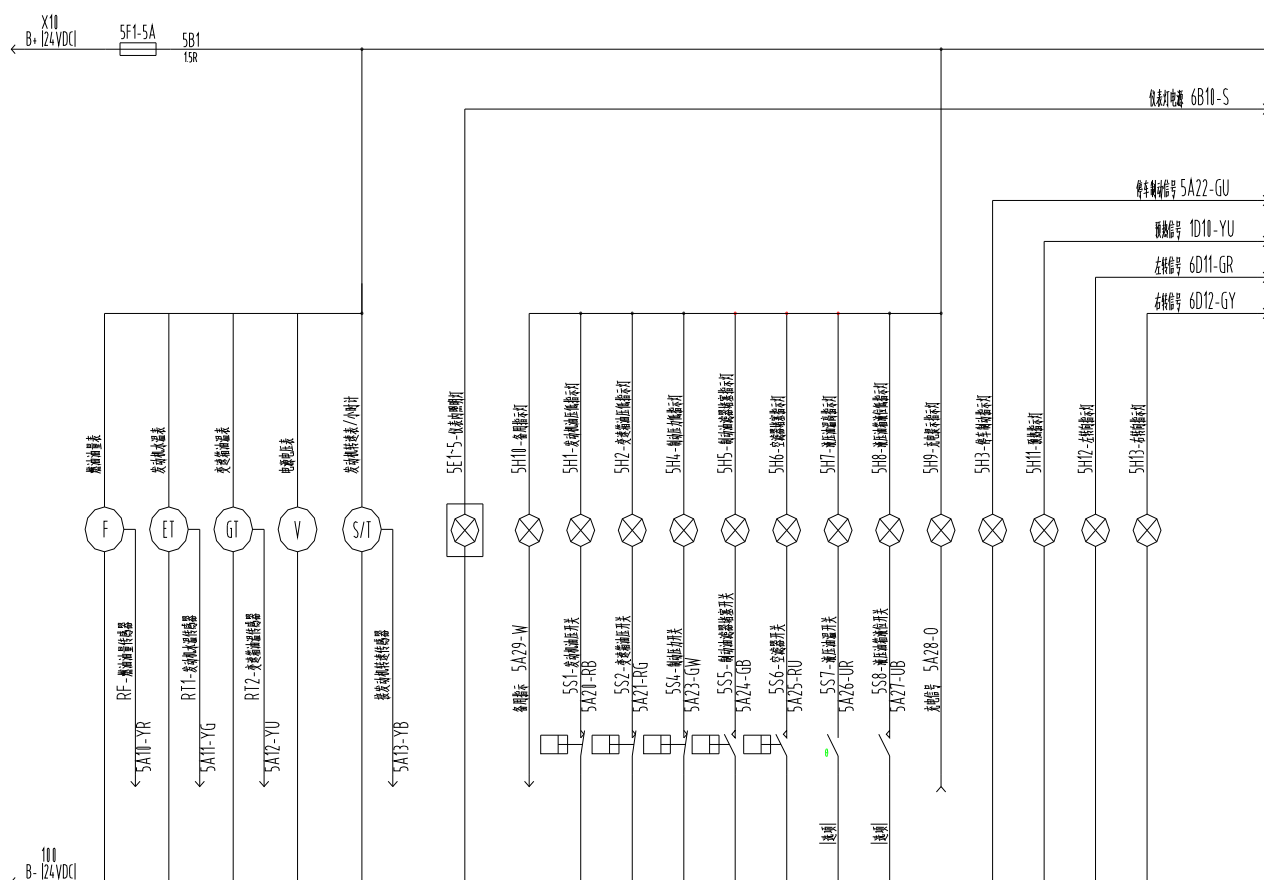


Fig.7-3 Electric Principle Drawing of Instrument

(6) Lighting and Signal Instruments

They include all kinds of illuminating lamps, signal lamp, horn and buzzer, etc.

Headlight: 35W

Front combination lamp: farness light/near light:75W/70W, turning/front: 21W/8W

Rear combination lamp: (turning / rear / reverse / braking): 21W (red) / 8W (red) / 10W (white) / 21W (red)

Warning lamp: (optional)21W

Rear lamp: (optional)70W

Licenese lamp: (optional)10W

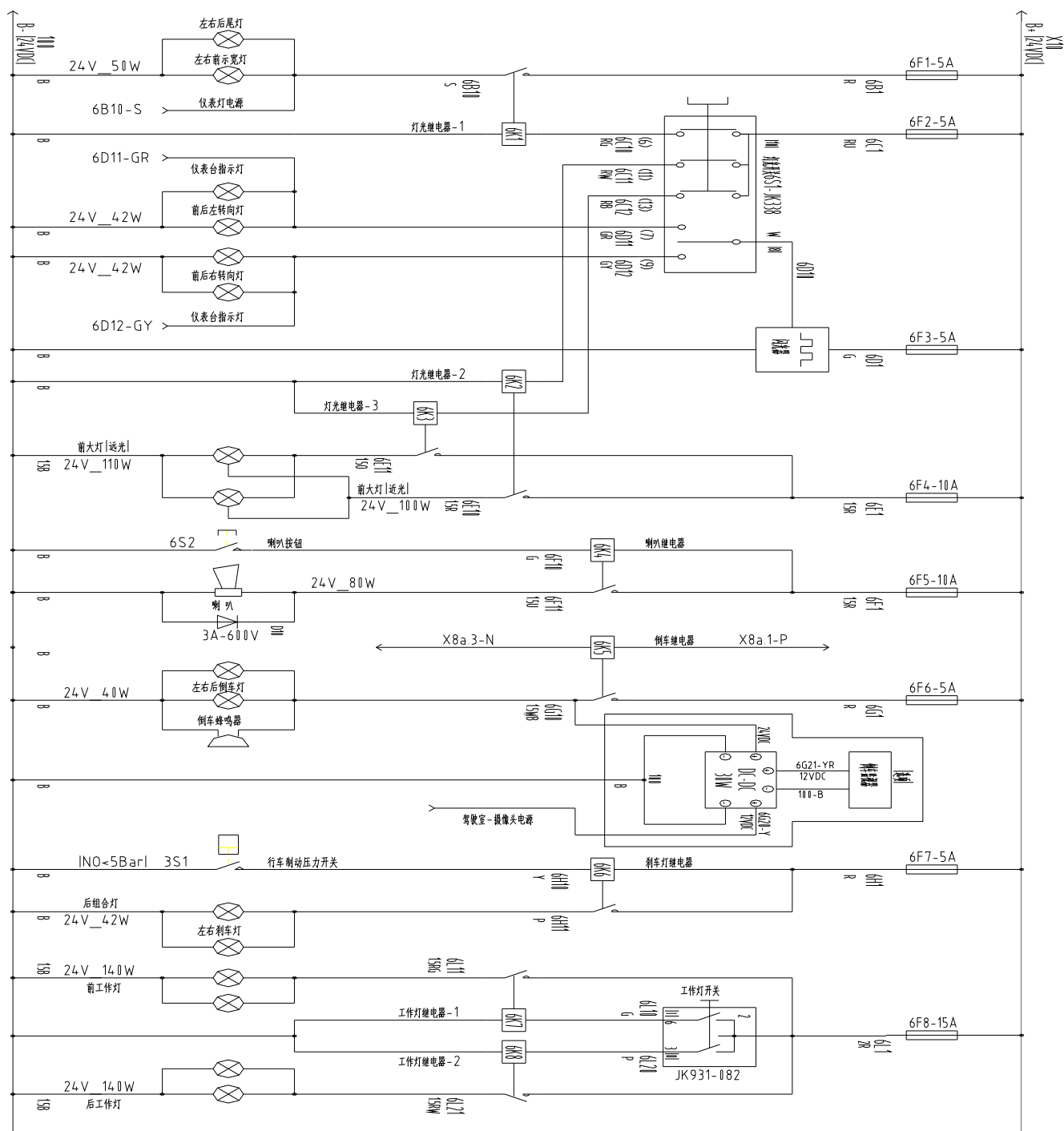


Fig.7-4 Electric Principle Drawing of Lighting and Signal Instruments

(7) Cab

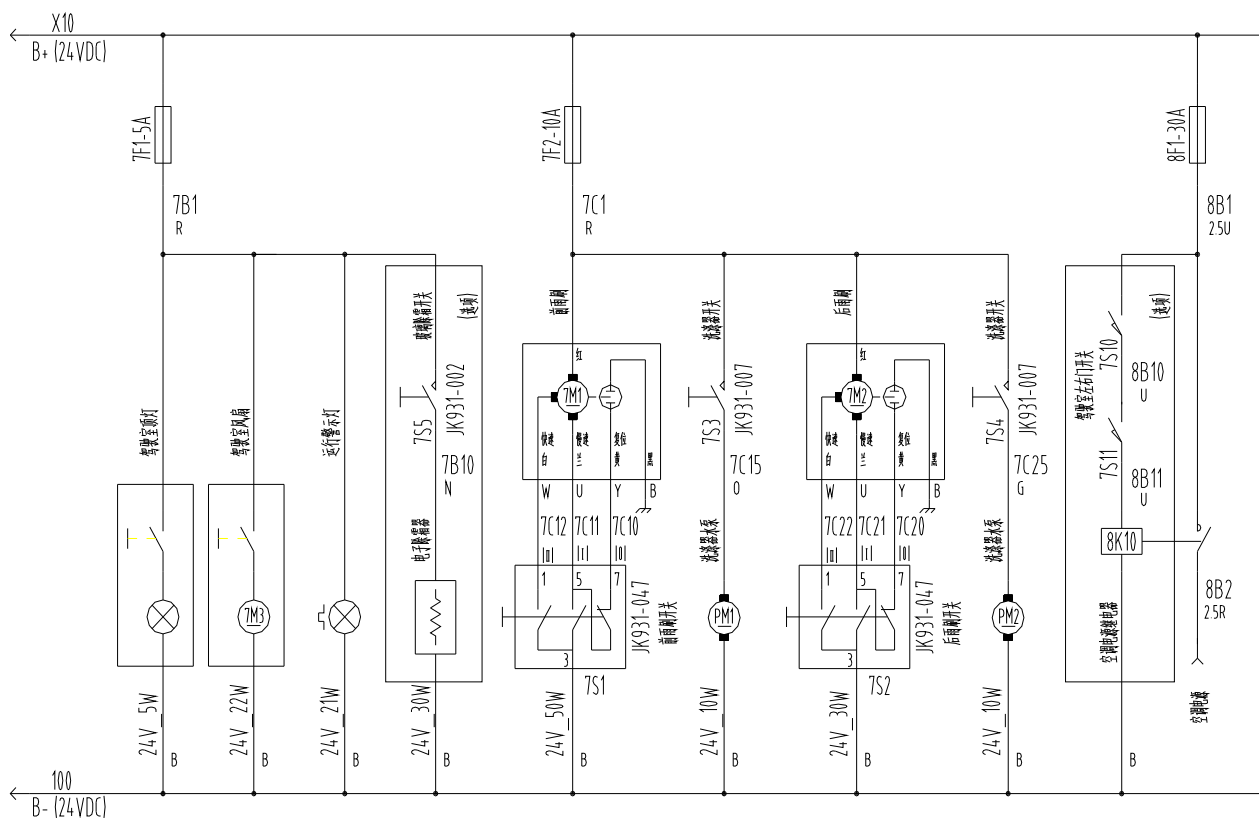


Fig.7-5 Electric Principle Drawing of Cab

(8) Air-condition

It can be cold and warm ,it changes temperature in the cab.

7.3 Brief Explanation for operation

7.3.1 Starting

There is a starting protection circuit in the shiftable forklift truck. You have to shift the shiftable in neutral before you start the engine. Otherwise, you can not start the engine.

Turn the key switch anti-clockwise to the “H” position (pre-heating position), the air of the engine is heated to benefit for starting. Turn the key switch clockwise to the first “on” position, the instrument circuit and the ignition circuit are ready for work.

The key switch as follows:

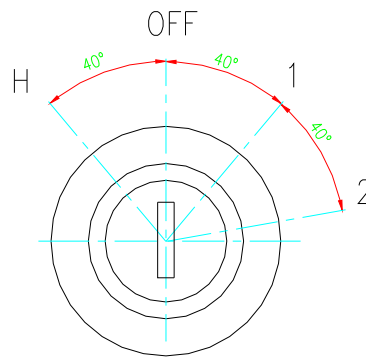


Fig.7-6 Key Switch

Turn the key switch clockwise to the second “on” position (starting position), then start the engine.

Release the brake switch before starting, Otherwise, the forklift truck can not step because the drive unit is cut off.

After engine starting, push the shiftlever forward (that is in forward shifts), then pedal accelerator shift, the forklift truck runs faster and you can begin to work. When pull the shiftlever backward(that is in reverse shifts), the backing lamp is on and the buzzer sounds. Forward and backward are each four shifts. The numeral is more bigger, the speed is more higher.

7.3.2 Lamp Switch

(1) Turn the lamp switch clockwise to the first “on” position, the front lamps and rear lamps are on, turn the lamp switch to the second “on” position, the headlight on near beam are on while the front lamps and rear lamps keep on, turn the lamp switch to the third “on” position, the headlights on full beam are on while the front lamps and rear lamps keep on, but the headlight on near beam is off.

(2) Push the turning switch forward, the left turning lamps on the front combination lamp and the rear combination lamp flash. Pull the turning switch backward, the right turning lamps on the front combination lamp and the rear combination lamp flash.

(3) Brake Signal: When you pedal brake, the brake lamps (red) in the rear combination lamp are on. While the truck brake, the transmission of power is cut

off .

(4) Reverse signal: When you need to reverse the forklift truck, pull the shiftable backward and the transmission is in reverse shift. Then the reverse lamps (white) in the rear combination lamps are on and the buzzer sounds.

(5) Charging Signal: Before you start the engine, put the key switch to the first “on” position and the charging lamp is on. After engine starting, the charging lamp is automatically off. If the charging lamp becomes on while the engine is working, it means something is wrong with the charging circuit and you must stop working and check the charging circuit as soon as possible.

(6) Oil Pressure Signal: Before you start the engine, put the key switch to the first “on” position and the oil pressure alarm lamp is on. After engine starting, the oil pressure alarm lamp is automatically off . If this lamp becomes on while the engine is working, it indicates low lubricating oil pressure and you must stop working and check the lubricating system as soon as possible.

(7) Alarm lamp of Braking oil pressure low: Before you start the engine, put the key switch to the first “on” position and the alarm lamp of Braking oil pressure is on, the alarm lamp is automatically off, if the lamp becomes on while the engine is working, it indicates brake oil pressure low and you must stop working, otherwise it will be danger.

(8) Fuel meter: It indicates how much fuel is left in tank.

(9) Water Temperature Meter: It indicates the temperature of the engine coolant.

(10) Hour Meter: It indicates how many hours the engine has worked .

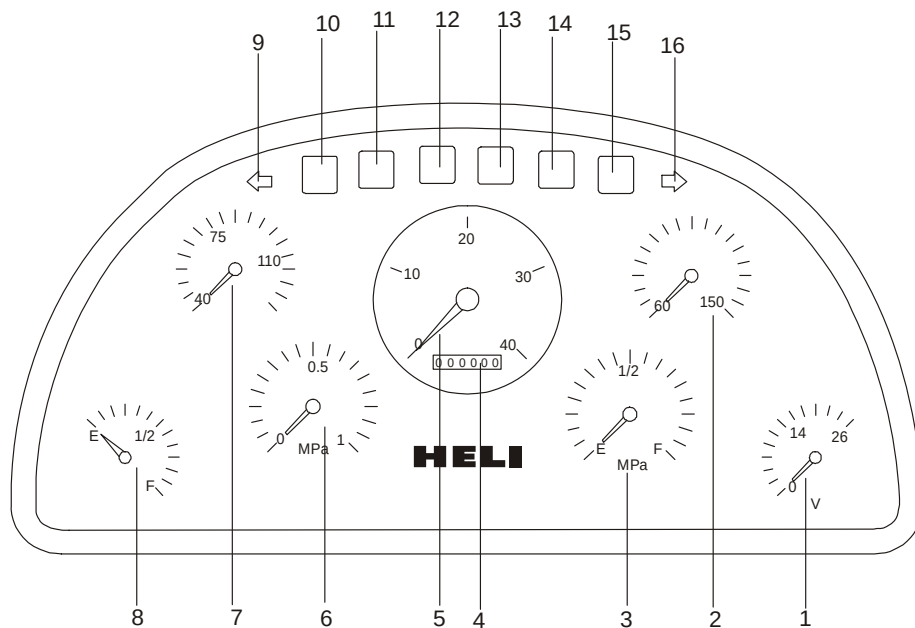
(11) Voltage Meter: It indicates the voltage of system.

(12) Speed Meter: It indicates how many speed the engine.

(13) Brake Pressure Meter: It indicates the pressure of system.

(14) Oil Pressure of the tor-con: It indicates the pressure of the tor-con.

(15) Oil Temperature Meter of the tor-con: It indicates the temperature of the tor-con.



- | | |
|--|---|
| (1)Voltage Meter | (2)Oil Temperature Meter of the tor-con |
| (3)Brake Pressure Meter | (4)Hour Meter |
| (5)Speed Meter | (6)Oil Pressure of the tor-con |
| (7)Water Temperature Meter | (8)Fuel meter |
| (9)Left Turning lamp | (10)Brake signal |
| (11)Charging Signal | (12)Oil Pressure Signal |
| (13)Manual/automatic alternative Signal | |
| (14)Alarm lamp of Braking oil pressure low | |
| (15)the headlights on full beam | (16)Right Turning lamp |

Fig.7-7 Combination M/T DS-ZB208eter

(16) Operation of Air-condition.

The right alternative switch on the control panel is the function alternative switch, you can alternate the heat position or the cold, while pull the switch to the “heat” position, the air condition is heating, while pull the switch to the “cold” position, the air condition is cold. The left alternative switch on the control panel is the wind speed alternative switch, I is the low speed, II is the middle speed, III is the high speed, the wind speed more higher, the noise of wind is more bigger.

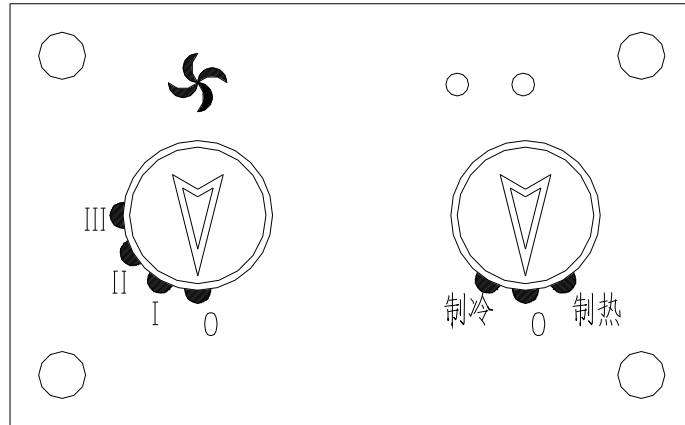


Fig.7-8 Control Panel of Air-condition

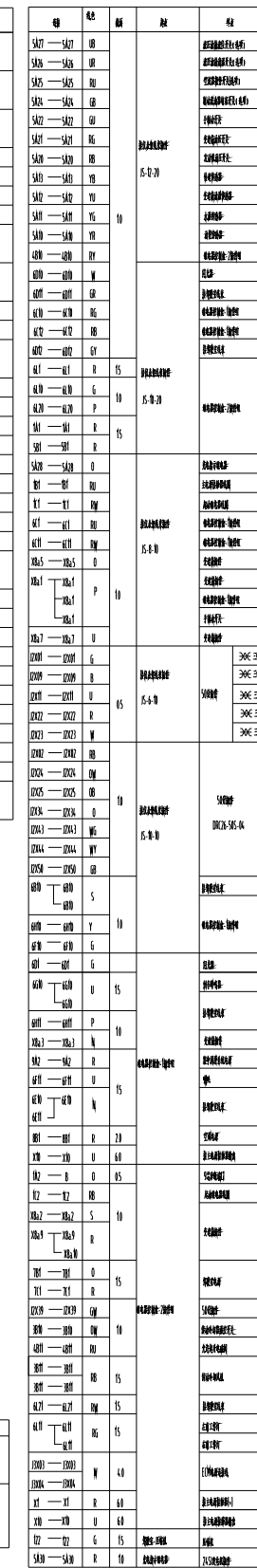
Notice:

- a) The battery can produce combustibility air, it has explosion danger, it must be forbidden short circuit, light and fireworks.**
- b) The electrolyte is a sparse vitriol, it is danger if skin or eye touches it. If shin touches electrolyte, it must be flush with the water immediately. While eye touches it, flush with water and see a doctor immediately.**

Attachment: wiring harness show in Fig. 7-9~7-11.

The GY, GR, GW, WB, YR, RY, RB, LB etc. means a pair of colors line, the former have 2/3, the latter have 1/3.

B	R	G	Y	L	W	Br	Lg	P	V
Black	Red	Green	Yellow	Blue	White	Brown	Pale green	Pink	Violet



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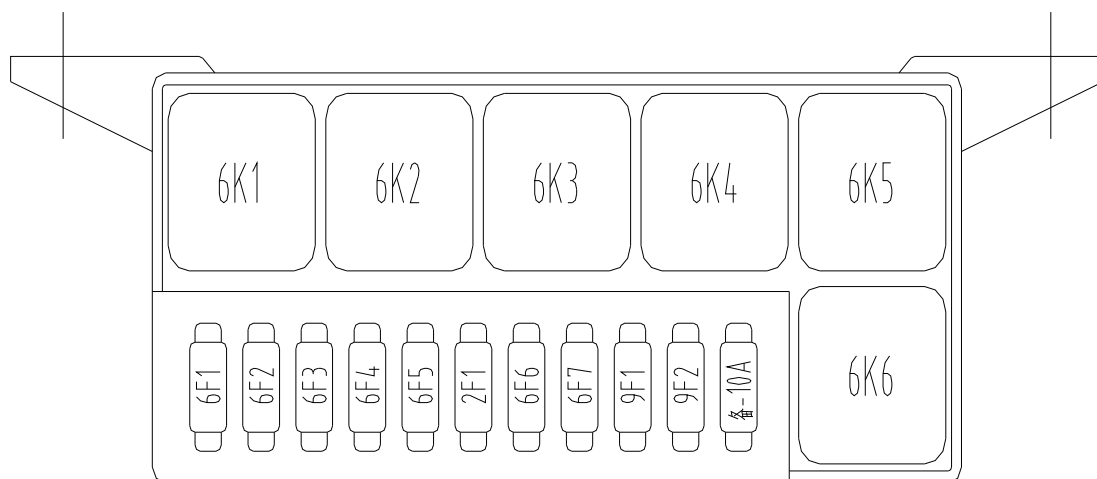


Fig.7-10 Relay Control Box-1

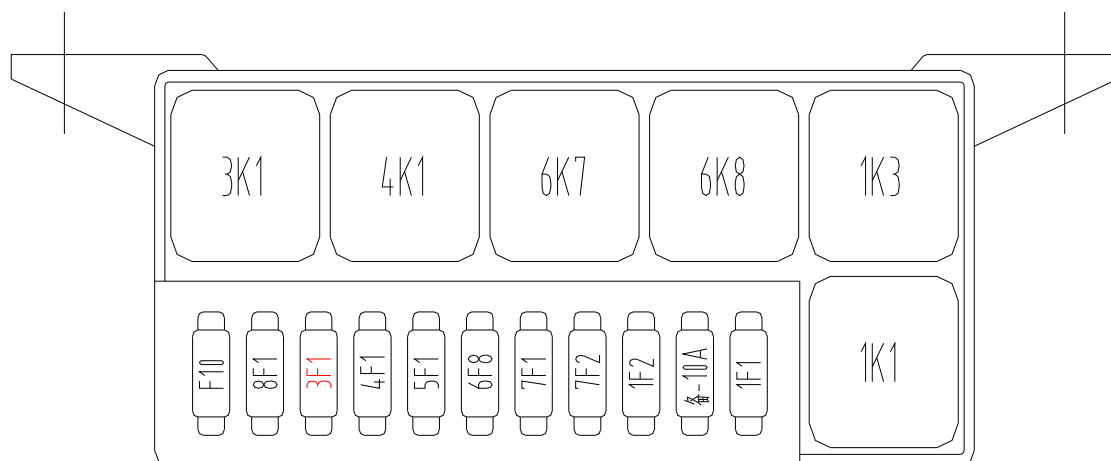


Fig.7-11 Relay Control Box-2

8. Hydraulic System

Primary Parameter of Hydraulic System

Type of Forklift Truck		CPCD140~160	
Hydraulic Pump	Type		A10VO60DFR+A10VO60DFR
	Output	Front Pump	60ml/rpm
		Rear Pump	60ml/rpm
	Driven Type of Pump		Power Output of Transmission
Control Valve	Type		M7-22-3X
Priority-steering valve	Type		M7-22-3X (First-piece of valve)
Pilot Joystick	Type		4TH6E

8.1 General Description

The hydraulic system of forklift truck is load sensing power steering. It consists of main pump, control valve, power steering unit, pilot joystick, pilot oil supply, tilt cylinder, lift cylinder, flow divider, cut-off valve, oil pipe-lines, balance valve, flow regulator valve. The oil tank is right side of the truck. The driver operates the control valve through the pilot joystick so as to control the spot and the speed of the mast .

Compared with the traditional gear pump, because of adopting the high pressure component, new system can endure the pressure being raised. Under the condition of the same loading, it may reduce the size or specification of the components and it is easy to fit; As we know, the hydraulic system is Load sensing power steering, so pump power may be automatic adjustment with the consuming. Without the traditional system's overflow, the system efficiency is higher and more economical on energy.

8.2 Main Pump

The main pump is variable displacement pump. Its principle of working is that flow is proportional to drive speed and displacement. By adjusting the position of the swashplate it is possible to smoothly vary the flow too. Every time flow of the pump and demanding flow of the cylinder is equal. So output pressure of the pump is only higher 14 bar than loading pressure and reduces the energy depletion. It is driven by the PTO device of the gearbox. The oil of the tank flow to the control valve through

the main pump. It has following advantages: long service life, low noise level, wide range of controls, high power/weight ratio. The flow of two Pumps will converge in the control valve first and there is divided by the driver's intention into two parts, one being sent to lift cylinder, tilt cylinder or extension cylinder, and another to the power steering unit in variable flow rate to operate the steering cylinder.

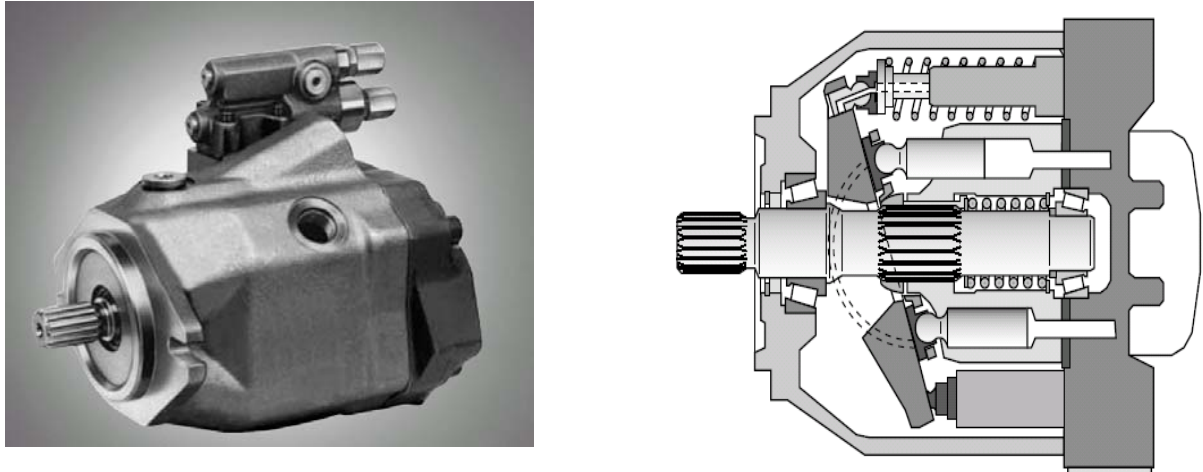


Fig.8-1 Main Pump

8.3 Control Valve

(1) The work principle and structures of Control Valve

The work device of the Hydraulic System adopts the liquid to regulate the Control Valve. here is a Relief Valve in every valve's inlet. So it is sure that flow of every valve is only related with orifice of the valve. In other words, its flow is irrelevant with loading pressure. If the Pump can't provide enough flow to keep on the serval services working at the same time, the speed of the work services reduces with same proportion. And it is not influence to work for the running parts.

When the Main Valve spool is placed in neutral position, maintaining valve and pressure compensated valve will be closed. The oil from the pump outlet can't flow into the main valve spool so as to the work services can't operate.

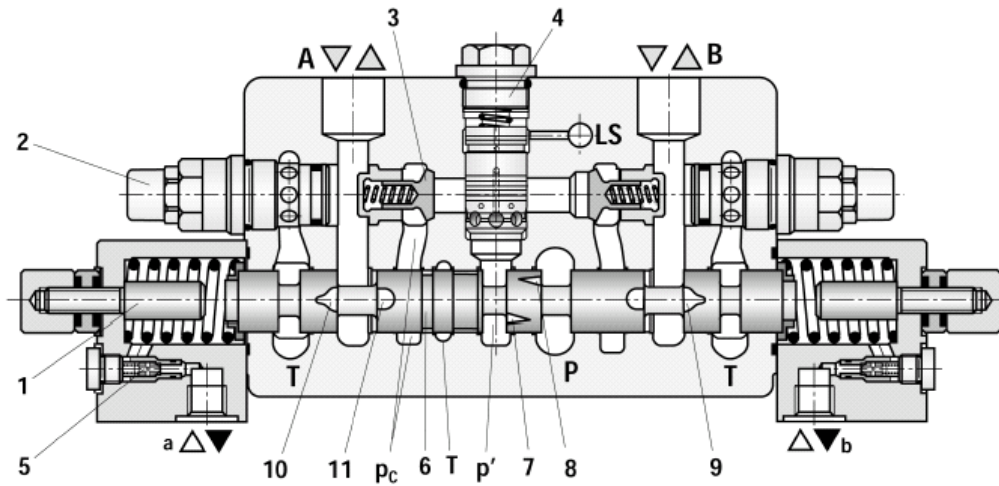


Fig.8-2 The Principle of Control Valve

When the oil from the leader hydraulic control valve puts up the spool of the main valve, its displacement becomes the direct proportion with the pressure. With the valve spool moving, inlet of the throttle measuring box(7) is opened, and then, oil from the pump flows into its inlet. At last, the pressure push up the maintaining Valve(3).

Inlet(A) pressure through the spool of the control valve passage push up the Maintaining Valve(3) and keep it from opening. When inlet(p) pressure raises and exceeds pressure of the orifice, the maintaining valve will be opened. As a result, outlet of the pump linked with the operating cylinder is filled with high pressure oil, and the mast may be up or down. The return oil from the port “B” flows through the throttling grooves passage(9) to the tank. When the spool of the control valve is operated and becomes bigger, flow increases too. It causes the speed of mast is quicker. As long as the pressure of cylinder is under the pressure that the overflow valve (2) is set, the valve keeps on closing. If the system pressure is higher than the setting pressure, the overflow valve will be opened to make the pressure in system lower. If it is not enough oil to supply the cylinders, the overflow valve will be opened too. Then the oil will flow into the cylinders from the tank .According to the require of cylinders, the pressure and flow is set in a piece of valve. In this way, the speed and

movement precision of cylinders will be improved. This causes that the speed of cylinders not only frees from the influence of work pressure, but also operates steady.

(2) Priority Valve

The construction of the Priority Valve is quite simple. There is the priority valve that the oil is supplied by the working service of the pump. Because of this reason, it may reduce a pump that it is used by the steering system and fixing space .

Because of using the Load sensing Steering system, it is be of following advantages:

-----Provides smooth pressure compensated steering , because load variations in the steering circuit do not affect axle response or maximum steering rate.

-----Provides true power beyond system capability by splitting the system into two independent circuits. Pressure transients are isolated in each circuit. Only the flow required by the steering maneuver goes to the steering circuit. Flow not required for steering is available for use in the auxiliary circuits.

-----Faster steering response.

-----Improved cold weather start-up performance.

-----If necessary, the pressure of power steering may be adjusted .

(3) Setting Pressure about the main valve and LS overflow

Do not adjust the pressure of the main relief valve at will. If necessary, you shall perform the adjustment the way that we demand. The main valve of system is set between the high pressure side P orifice and low pressure side T orifice. There is manometric measurement point in the orifice M_p . Ls overflow is mounted between the main valve's LS orifice and the low pressure side T orifice. The point of manometric measurement is set in the MLS1 orifice. If you want to adjust the main valve relief, you first must adjust the screw of the Ls overflow. When the pressure mounts up to 260 bar, you may turn the screw of the main valve and the system of the main pressure mounts up to the demanding parameter (240 bar).After you get the pressure

that you need, screw back the screw of the LS overflow and keeps its pressure on 200 bar.

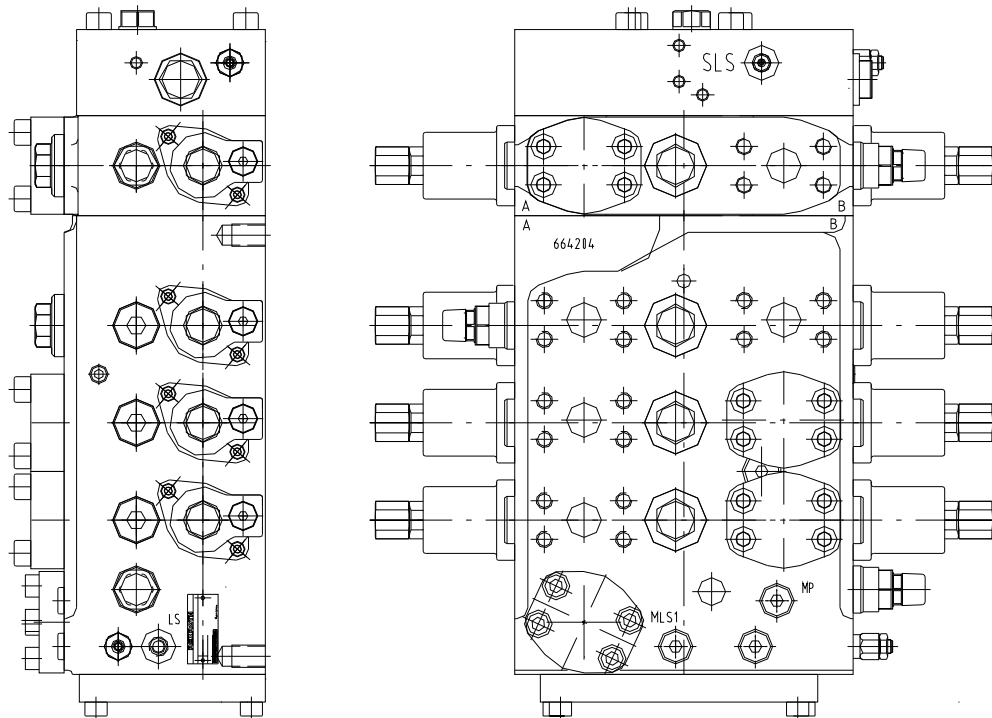


Fig.8-3 Control Valve

(4) Pilot Joystick

The control valve is opened by the pilot pressure controlling. Human factors engineering is used in the Joystick. So it is very comfortable to operate for the driver. It is be of following advantages:

- It is be of responds well
- Operating force is small
- Operating feeling that make for comfort

The principle of pilot pressure controlling is not complex. Delivery pressure of the Pilot joystick and its displacement became proportional. The pressure pushes up the main valve spool and drives it to move .As we all know, displacement of the main valve spool and Joystcik is proportional. The speed and flow of the working service is controlled by Joystick.



It is be of twin shafts about the Joystick.It may control the lift cylinder or tilt cylinder by 360 rotation . when the driver pushes up the Joystick small ,the mast begins to move slowly.If the driver wants to increase the speed of the mast ,he needs continue pushing to the Joystick;When the driver pushes up the Joystick to direction of 45⁰,he can obtain two motions together .Of course ,change the direction and angle of the Joystick,you can control the speed and the direction of mast .

It is comfortable for the single lever too .

Fig.8-4 Pilot Joystick

(5) Pilot Oil Supply

The pilot oil supply provides pressure oil to the leading service of the control valve. It consists of the relief valve, overflow valve, accumulator and so on. Because the pilot joystick requires the pressure is 3.5 bar, intention of the relief valve minishes the pressure. The task of Accumulator provides margin of energy. When the driver operates the Joystick with consecutive and real time, the accumulator will set free its margin of energy. The maximum pressure is limited by the overflow valve.

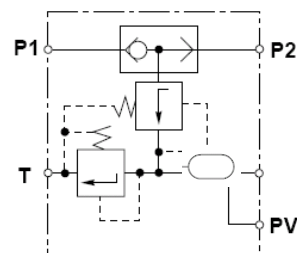
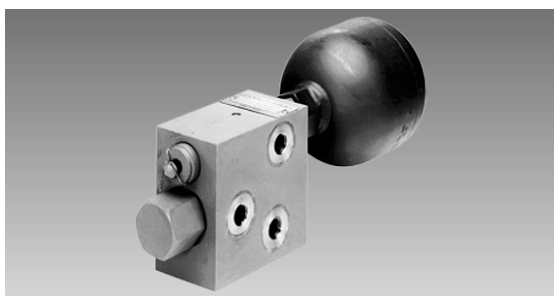


Fig.8-5 Pilot Oil Supply

(5) Cylinder safety lock valve

The Cylinder safety lock valve mainly consists of the crust, the main valve spool, control piston, damping hole. It is provided with the following functions:

-----Prevents uncontrolled movement of the cylinder should a hose or pipe burst.

-----When two cylinders are operated in parallel, the pressure relief valve also prevents excessive cylinder pressure occurring due to uneven loading of the cylinders.

-----With summing circuits, only one pump should be engaged to lower the load in order to avoid pressure intensification.

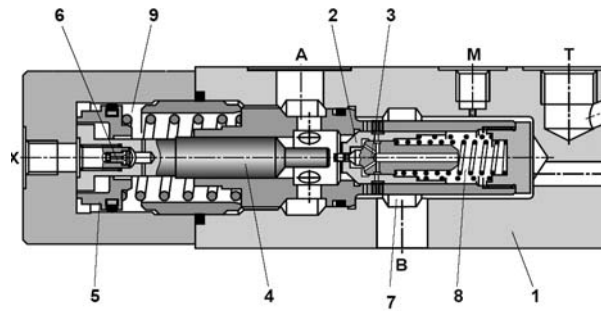


Fig.8-6 Cylinder Safety Lock Valve

(6)The principle of Hydraulic system diagram

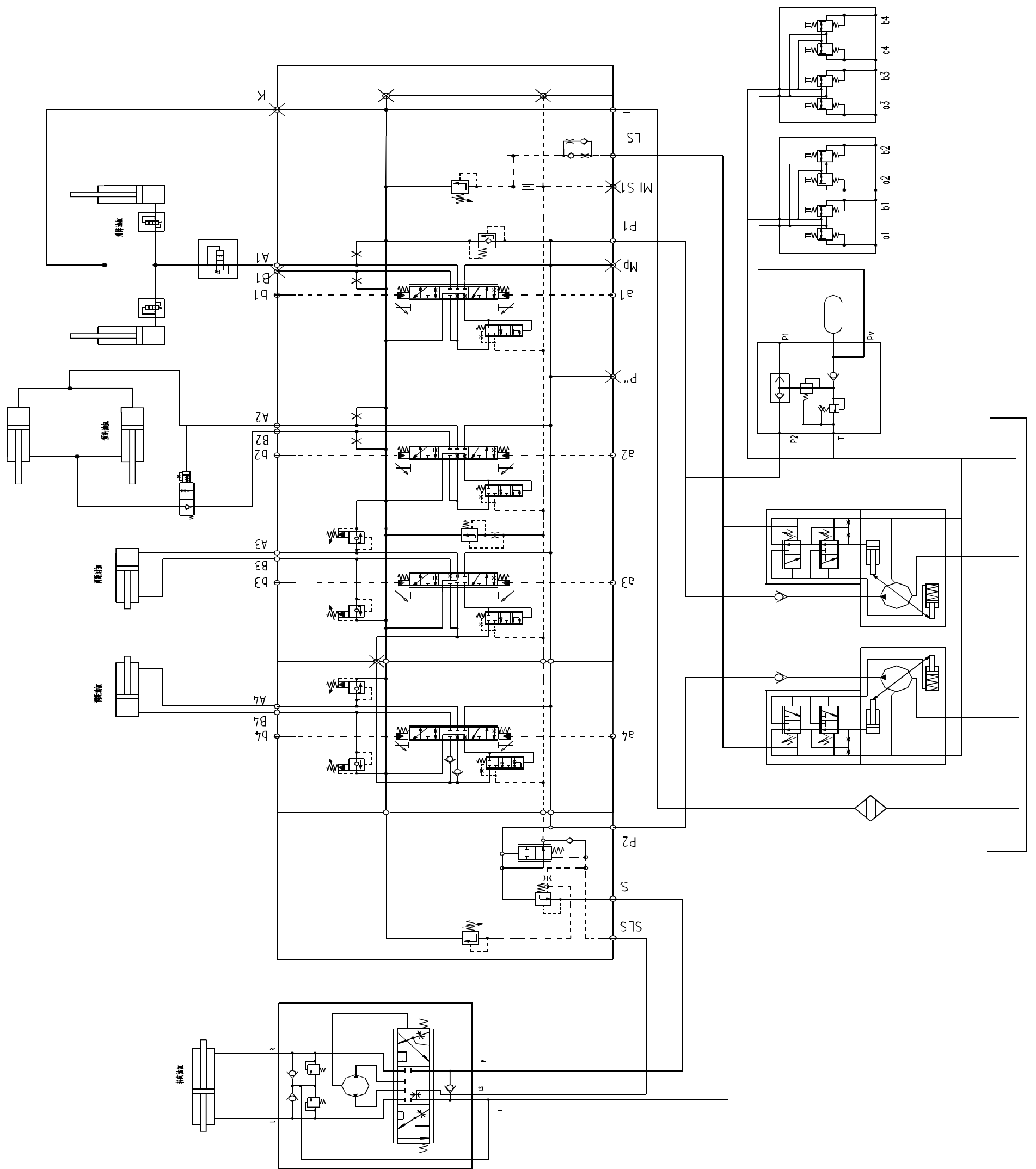
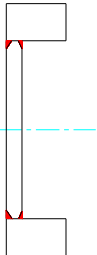


Fig.8-7 The principle of Hydraulic system diagram

9. Hoist System

The main specifications see table:

Model	CPCD140～160-Cu	
Mast type	2-stage telescopic mast, Rolling type, C-shaped outer mast, C-shaped inner mast	
Cross Section of Inner Mast		
Cross Section of Outer Mast		
Max. Lift Height(S.T.D)	3000 mm (standard) -6500mm	
Foreward Tilt	6°、5°、3°	
Backward Tilt	12°、10°、6°	
Rollers	O.D.of End Rollers	240mm
	O.D.of side Rollers	90mm
Lift Chain	LH3244、4X4、P=50.8	
Fork Lifting Method	Hydraulic	
Mast Tilting Method	Hydraulic	
Fork Spacing Adjustment	Hydraulic	

9.1 General Description

The hoist system is adopted the two-stage, rolling telescopic mast type. The inner mast and outer mast frame have C-shape section of CPCD140, CPCD150, CPCD160.

9.2 Outer & Inner Mast

The inner mast make up of top beam assembly, left section steel and right section steel, roll shaft, crossbeam etc. The outer mast make up of left section steel and right section, crossbeam, sustain plank, mounting bracket of lift cylinder etc. Connect the left section steel and the right section steel with top beam and cross beam, the bracket of outer mast connected with frame by pins, outer mast have tilt cylinder bracket, the front end of the tilt cylinder is installed in the bracket by pins. The mast is tilted by operation of the tilt cylinders; forward 6° , backward 12° ; forward 5° , backward 10° ; forward 6° , backward 6° ; forward 3° , backward 6° .End rollers and side rollers of outer & inner mast's maintenance belong to perch maintenance, so that notice safety.

9.3 Lift Bracket

At the lift brackets welded roll shaft, end rollers that roll along the inside of the inner mast frames are installed on the end roller shafts with snap rings. The side rollers that roll along on the inside of the inner mast frames are bolted, being adjusted by shims. Forks or side suspenders installed on the support shaft. The two forks installed on the beam of the lift bracket are made of special alloy steel which has been subjected to heat treatment.

9.4 Adjustment of Hoist System

- (1) Make the forks or suspenders to descend to the ground, adjust the lift chain to assure the distance of the center line of lower rollers on the lift bracket is equal to the bottom line of inner mast.
- (2) Make the mast assembly tilt backward, adjust the pulling force of lift chains and let the strain of each lift chain be equal.
- (3) Travelling distance of two lift cylinders should be equal. Travelling distance may

be adjusted by adjusting the cylinder caps.

(4) Make use of the spacer of the lift cylinder to adjust the error occurred between the right and left cylinders in height.

9.54 Lift Cylinder Assembly

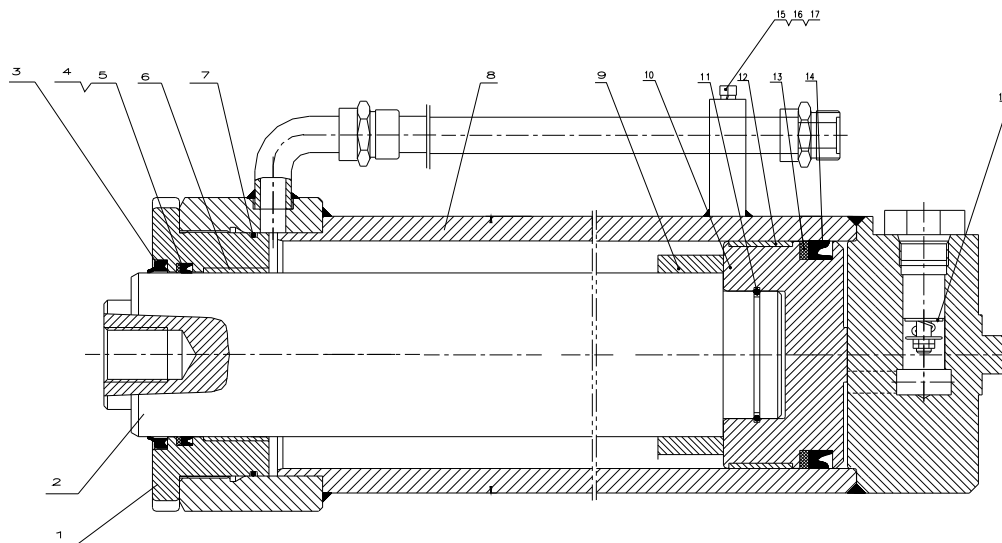
Lift Cylinder Assembly make up of lift cylinders, lift chain assembly, sheave assembly etc.

Each lift cylinder is located behind each side of outer mast frame, cylinder bottom fixed upon the cylinder bracket of outer mast, the upper end of the piston rod is connected with beam set bolts. The travel distance of two lift cylinders should be equal to in-phase, otherwise, adjust the set bolts of the top of cylinder.

The lift cylinder assembly consists primarily of a cylinder body, piston, piston rod and cylinder cap. At the lower part of the cylinder body is arranged an inlet for high-pressure oil, and at the upper part there is an outlet for low-pressure oil above the piston packing, to which a return pipe is connected.

The piston is fastened to the piston rod with steel wire, snap ring, cotter pin, together with an O-ring. An oil seal and bushing are installed on the cylinder cap which is screwed into the cylinder body. The wearing supports the piston rod, and the Dust seal prevents dust from entering the cylinder. The upper end of the piston rod is locked with piston head set bolts on the crossbeam.

When the lift lever is pulled backward, high-pressure oil is sent into the lift cylinders through their inlets to push up the piston rods, the piston head and beam, rising the forks and side suspenders by chains. As the lift lever pushed forward, the pistons of the lift cylinders descend by the weights of the piston rods, lift bracket and forks, pushing oil under the piston to flow out of the cylinders. The oil discharged off the cylinders is regulated by the flow regulator and returns through the control valve to the oil tank.



- | | | | |
|--------------------|----------------|--------------------------|------------------|
| (1)Cap | (2)Rod piston | (3)Seal dust | (4)Snap ring |
| (5) U-ring | (6)Bushing | (7)O-ring | (8)Cylinder body |
| (9)Sleeve adjusted | (10)Piston | (11)Steel wire Snap ring | |
| (12) Wearing | (13)Snap patch | (14)U-ring | (15)Bolt |
| (16)Washer | (17) Nut M6 | (18)Cut-off valve | |

Fig.9-1 CPCD140~CPCD160 Lift cylinder form

9.6 Flow Regulator

Flow Regulator (throttle) is located between the control valve and the high pressure ports of the two lift cylinders, near the left lift cylinder. Flow regulator is used to limit the fall speed of forks and side suspenders when over loading. The structure of the flow regulator as shown in Fig.9-2.

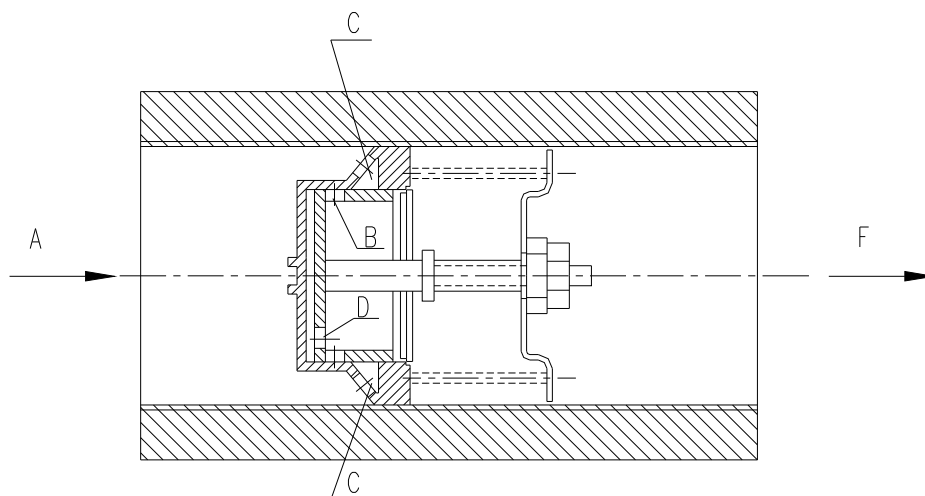


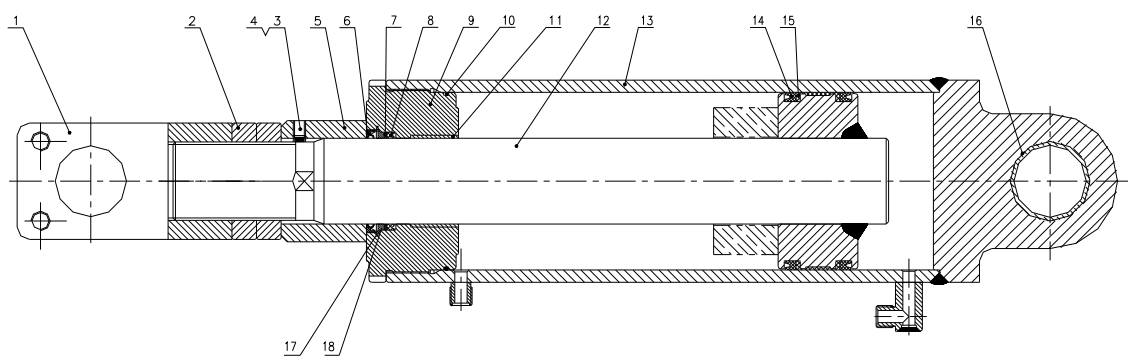
Fig. 9-2 Flow Regulator

The flow regulator serving both as a flow regulating valve while forks are being lowering and a safety device if hoses between the control valve and lift cylinders are damaged due to any reason.

The operation of the flow regulator valve is given below:

See Fig.9-2, With the forks upraised, high pressure oil leads from the control valve then flows into the chamber A, and pushes the sleeve to the left. This opens the opening B, and allows the high pressure oil to flow along the two routes (ACBF and ACDF), and both flows of oil lead to the lift cylinders. In this case, the flows of oil is not regulated. When the forks or the spenders begin to descend, oil discharged off the lift cylinders enters the chamber F and pushes the sleeve to the right until it contacts the nipple. This closes the opening D, so that oil flows through F,B,C and A to the tank. If the flows of oil discharged off the lift cylinders is rapidly increased, the pressure in the chamber F rises, and moves the piston to the right in spite of the spring force, narrowing the opening B. So the flow of oil from the chamber B to the chamber C is decreased so that the descending speed of the forks is controlled.

9.7 Tilt cylinder



- | | | | |
|---------------------------|---------------|-----------------|------------------------|
| (1)Ear ring | (2)Adjust nut | (3)Screw | (4)Plug |
| (5)Spacer | (6)Seal dust | (7)Snap ring II | (8)Yx-ring |
| (9)Guide Sleeve | (10)O-ring | (11)Bushing | (12)Body, piston ass'y |
| (13) Tube, cylinder ass'y | | (14)Yx-ring | (15)Wearing |
| (16)Bushing | (17)Snap ring | (18)Snap ring I | |

Fig.9-3 Tilt Cylinder

Two tilt cylinders of double acting type are mounted on each side of the frame. The front end of the piston rod is installed on the mast and the cylinder tail is on the frame by pins. The tilt cylinder assembly consists primarily of a cylinder body, cylinder cap, piston and piston rod.

The piston is welded to the piston rod. The piston, of which the outside periphery is given two Yx-rings and a dust seal. Rings and dust seal is used for preventing leak and dust (between piston rod and guide sleeve). The guide sleeve, fitted with an O-ring on the outer periphery, is screwed into the cylinder body and fastened with a lock ring.

When the tilt lever in the driver's room is pushed forward, high pressure oil enters from the cylinder tail side to shifts the piston forward, tilting the mast forward 6 degrees. As the tilt lever pulled backward, high pressure oil enters from the cylinder guide sleeve. This shifts the piston to the rear, causing the mast to lilt backward 12 degrees.