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I. Safety rules for driving and operation of battery forklift

1.1 Overview

The concept of "Safety First" has to be borne in mind by the driver and unit manager. The safety operation in accordance with the Forklift Use and Maintenance Manual and Driver' Safety Operation Manual has to be observed.

1.2 Forklift transportation

1.2.1 The forklift must be tied as specified during transport:

1.2.2 Draw the parking brake and underlay the counterweight with the lumps of wood:

1.2.3 The lifting is done according to the position as indicated by the "Lifting Sign".

1.3 Precautions on Parking

1.3.1 Lay the pallet fork on ground:

1.3.2 Turn off the electric lock, place all joysticks on N-position and unplug the power plug:

1.3.3 Tighten the hand brake;

1.3.4 For the forklift out of service for long-term, the wheels should be built on stilts and the battery should be charged once a month.

1.4 Preparations before use

1.4.1 Read the instructions and accompanying documents and be familiar with the positions of instruments and every control mechanism (Fig.1-1), driver has to know about the structure and properties of forklift and certify for the post with the driving license;

1.4.2 Check whether the instruments work properly;

1.4.3 Check whether the battery voltage is within the normal range and whether the electrolyte solution gravity and liquid level are appropriate;

1.4.4 Check whether all connectors and plugs of electric system are in reliable contact and whether the pedal adjustment are flexible;

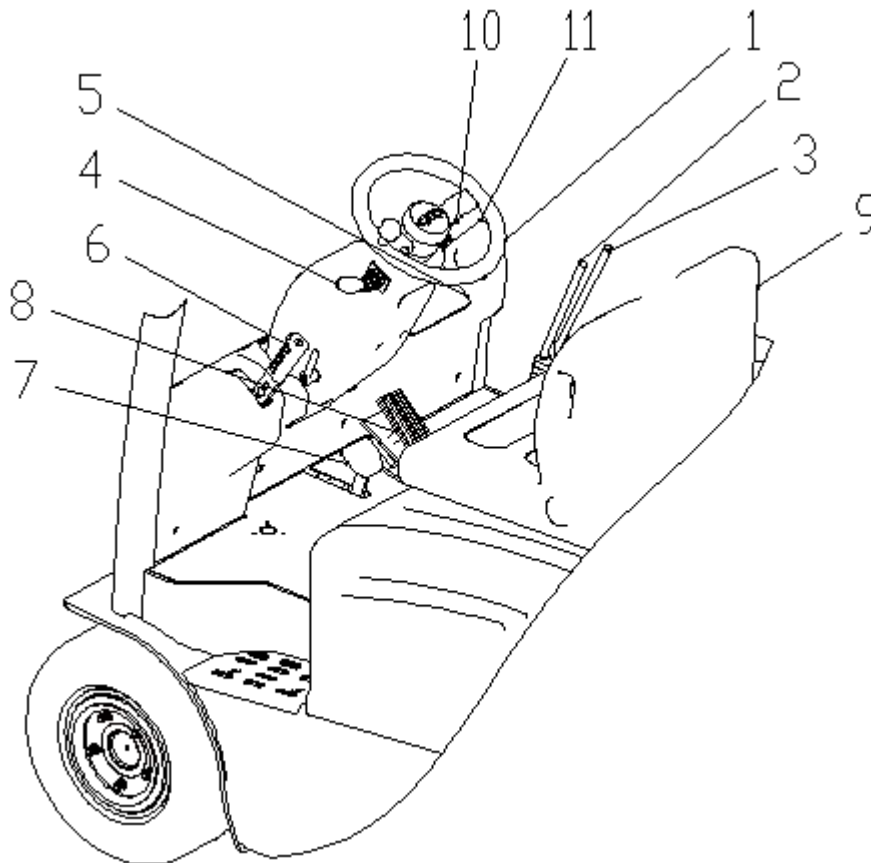
1.4.5 Check whether the foot brake and hand brake are reliable;

1.4.6 Check whether the hydraulic oil and brake fluid are normal;

1.4.7 Check whether the lighting and signal light are normal.

1.5 Precautions on operation

1.5.1 Pay attention to the performances and working conditions of mechanic, hydraulic, electric and AC motor governor controller;



- | | | | |
|-------------------|---------------------|-----------------------|------------------------------|
| 1. Steering wheel | 4. Direction switch | 7. Brake pedal | 10. Turn signal light switch |
| 2. Lift lever | 5. Instrument panel | 8. Acceleration pedal | 11. Light switch |
| 3. Tilting lever | 6. Hand brake lever | 9. Seat | |

Fig.1-1

1.5.2 To connect voltage, turn on the key switch at first, be sure of the position of direction switch, rotate the steering wheel and check whether the forklift runs properly, slowly step the governor control pedal while holding appropriate starting acceleration:

1.5.3 Observe the instrument panel. If the display of battery capacity is lower than 10%, you should stop the operation immediately and charge or replace the battery:

1.5.4 Slow down in advance when making the turns:

1.5.5 When driving and stacking cargo, it is inappropriate to carry out the joint operation. The lifting weight and running speed should be reduced when working on poorer site pavement:

1.5.6 Overload is not allowed. If the cargo is in larger dimension, the ratings as indicated in the load curve sign should be observed when the gravity moves forward:

1.5.7 The pallet fork should be kept in appropriate distance to avoid the eccentric load:

1.5.8 When the cargo approaches the fork wall, it should be lowered in height as much as possible, the mast leaned back to allow the driving of forklift:

1.5.9 To ensure safety, no persons are allowed to stand beneath and on the pallet fork for lifting:

1.5.10 When the cargo is lifted or lowered, the initial velocity should be not too fast:

1.5.11 When the mast tilts forward or backward to the limiting position or the pallet fork lifted to the maximum height, the operating handle should be quickly returned to the middle position:

1.5.12 When the cargo is conveyed by a forklift, use of emergency braking should be avoided as much as possible to prevent the cargo from being thrown out or personnel injury.

1.6 Charge of battery pack

1.6.1 When the battery pack is charged initially and added afterward, the provisions in the battery instructions should be strictly observed:

1.6.2 When the forklift is in operation, the battery capacity on the instrument panel is less than 10% or the voltage of any single battery lower than 1.70V, you must stop working with the forklift until the battery pack has been charged or replaced:

1.6.3 When in charge, check always the gravity, liquid level and temperature of electrolyte solution.

1.7 The maximum allowable noise value of battery forklift shall not be greater than 80dB (A) and the test method adopted as per JB/T3300.

II. Dimension drawing of battery forklift

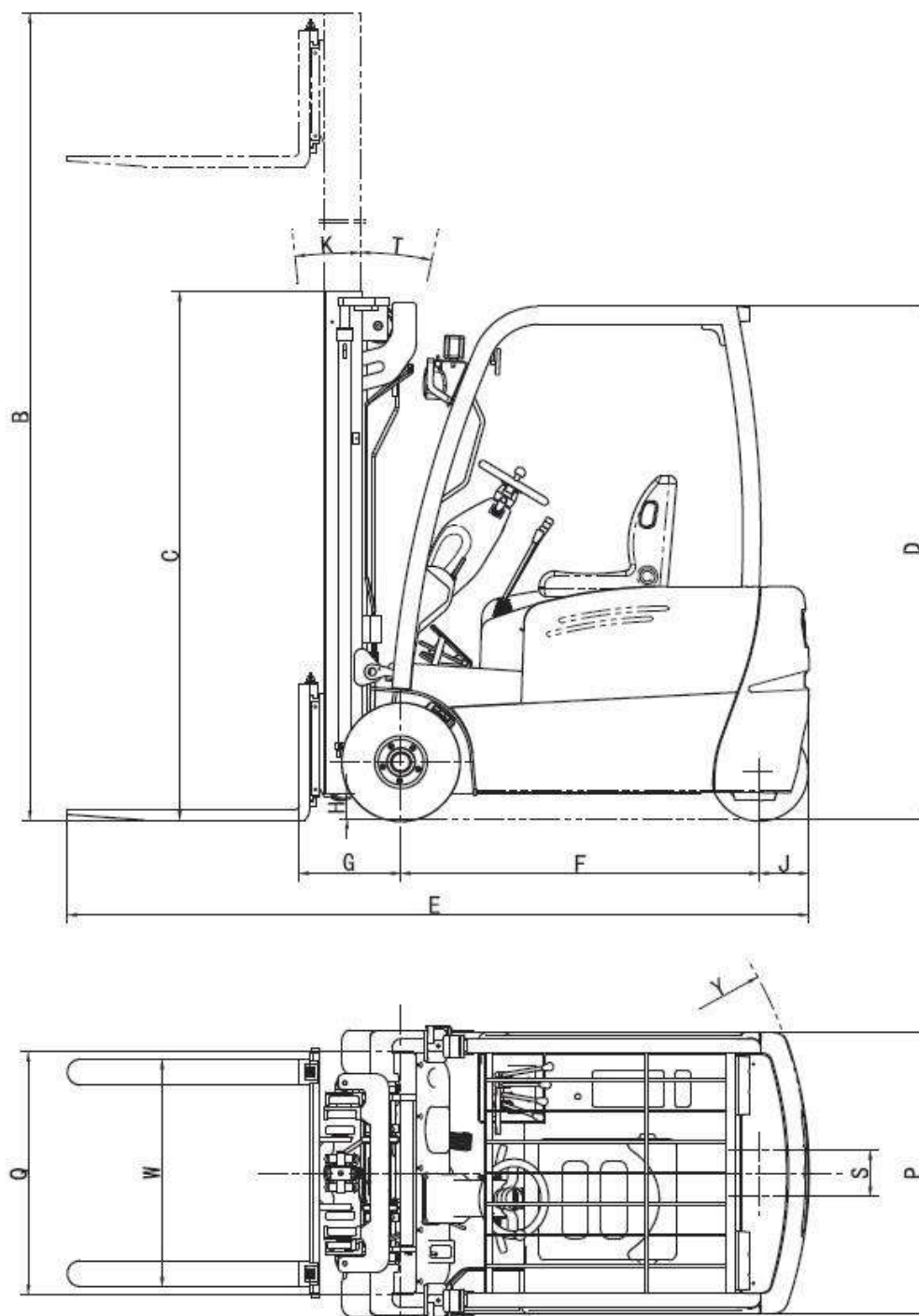


Fig.2 1 Profile of the FE forklift with the triple-pivot battery counterweight

III. Main technical parameters of 1-12T triple-pivot battery forklift

3.11 Main technical parameters of 1.3T battery forklift

Specifications	1	Model			FE10	FE13
	2	Rated lifting weight		kg	1000	1300
	3	Load center		mm	500	500
	4	Great lifting height		mm	3300	3300
	5	Specification of pallet fork	Length X Width X Thickness	mm	920×100×35	920×100×35
	6	Inclination of mast	Front/rear (α°/β°)	Deg	6/6.5	6/6.5
Dimensions	7	Overall dimensions	All in shortage (No pallet fork)	mm	1854	1854
	8		Full width	mm	1100	1100
	9		The height where the mast cannot be lifted	mm	2165	2165
	10		Height of mast lifting (with the load-backrest)	mm	4300	4300
	11		Height of overhead guard	mm	1990	1990
	12	Minimum turn radius		mm	1480	1480
	13	Front overhang		mm	375	375
	14	Wheel track	Front/rear	mm	940/180	940/180
	15	Min. ground clearance		mm	95	95
	16	Wheel base		mm	1290	1290
	17	The adjusting range of pallet fork	Max./min.	mm	200/950	200/950
Performance	18	Speed	Run (full load)	km/h	13	13
	19		Lifting (full load)	mm/s	300	300
	20	Gradeability	Full load	%	15	15
	21	Dead weight (including the battery)		kg	2800	2800
	22	Tire	Front		18X7-8	18X7-8
	23		Rear		15X4.5-8	15X4.5-8
Drive	24	Motor	Drive motor	kw	4.5*2	4.5*2
	25		Pump motor	kw	10	10
	26	Battery	standard	V/Ah	48/400	48/400
	27	Controller	Manufacturer		CURTIS	CURTIS
	28	Working pressure		Mpa	14.5	14.5

3.21. Main technical parameters of 6-2T triple pivot battery forklift

Specifications	1	Model			FE16	FE18	FE20
	2	Rated lifting weight		kg	1600	1800	2000
	3	Load center		mm	500	500	500
	4	Great lifting height		mm	3300	3300	3300
	5	Specification of pallet fork	Length X Width X Thickness	mm	920×100×35	920×100×35	920×100×35
	6	Inclination of mast	Front/rear (α°/β°)	Deg	6/6.5	6/6.5	6/6.5
Dimensions	7	Overall dimensions	Full length	mm	1954	1954	1954
	8		Full width	mm	1100	1100	1100
	9		The height where the mast cannot be lifted	mm	2165	2165	2165
	10		Height of mast lifting (with the load-backrest)	mm	4300	4300	4300
	11		Height of overhead guard	mm	1990	1990	1990
	12	Minimum turn radius		mm	1580	1580	1580
	13	Front overhang		mm	375	375	375
	14	Wheel track	Front/rear	mm	940/180	940/180	940/180
	15	Min. ground clearance		mm	95	95	95
	16	Wheel base		mm	1390	1390	1390
	17	The adjusting range of pallet fork	Max./min.	mm	200/950	200/950	200/950
Performance	18	Speed	Run (full load)	km/h	13	13	13
	19		Lifting (full load)	mm/s	320	300	290
	20	Gradeability	Full load	%	15	15	15
	21	Dead weight (including the battery)		kg	3150	3300	3380
	22	Tire	Front		18X7-8	18X7-8	18X7-8
	23		Rear		15X4.5-8	15X4.5-8	15X4.5-8
Drive	24	Motor	Drive motor	kw	4.5*2	4.5*2	4.5*2
	25		Pump motor	kw	10	10	10
	26	Battery	standard	V/Ah	48/500	48/500	48/500

	27	Controller	Manufacturer		CURTIS	CURTIS	CURTIS
	28	Working pressure		Mpa	17.5	17.5	17.5

IV. Structure and working principle of forklift

4.1 Drive system (Fig.4-1)

The travel of forklift with double motors on the triple-pivoted front wheels is powered by the battery. Two motors respectively drive two set of transmission devices which are driven by the secondary planetary gear. The motor drives the wheels through the transmission device and moves the vehicle ahead. The moving direction of vehicle is where the vehicle is changed to drive toward by the change in the rotation direction of drive motor, so that the vehicle achieves the forward or backward motion. Two wheels drive the forklift when making the turns, two motors respectively controlled by two controllers, rotate the wheels at different speed as required by cornering to achieve the purpose of turning around.

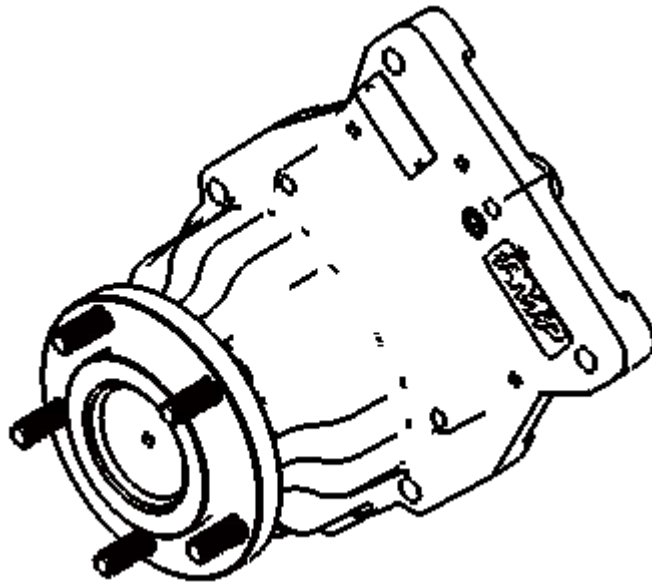


Fig.4-1 Gearbox/drive axle

4.1.1 Drive axle

The axle housing is the mono-block cast structure. The drive axle and the gearbox are designed in integrated structure and available with one brake system. The power is driven by the secondary planetary gear and the front wheel finally driven by the wheel hub. The tires are fitted on the wheel hub through the wheel hub with the stud and nut.

4.2 Steering system

The steering system is composed of the steering oil pump, full hydraulic steering gear, steering cylinder and steering axle etc.,. The steering shaft is connected to the steering gear through the universal joint and the coupling shaft to steering wheel through the universal joint. The steering column can tilt backward to the suitable position. The steering axle is mounted on the tail bracket behind the frame and moved around and rotated by the helical gear and rack on the steering wheel engaged with the gears on the piston rod inside the steering cylinder to achieve the steering. (Fig. 4-2)

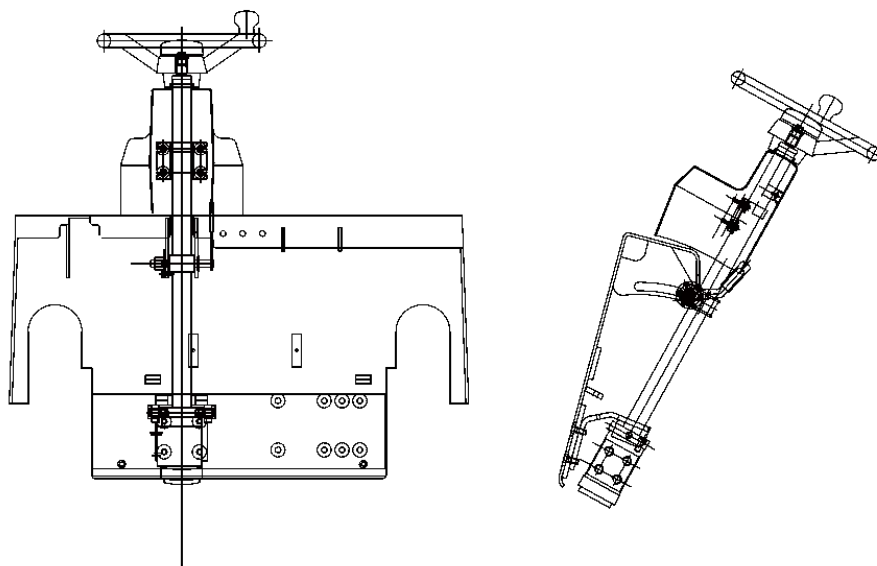
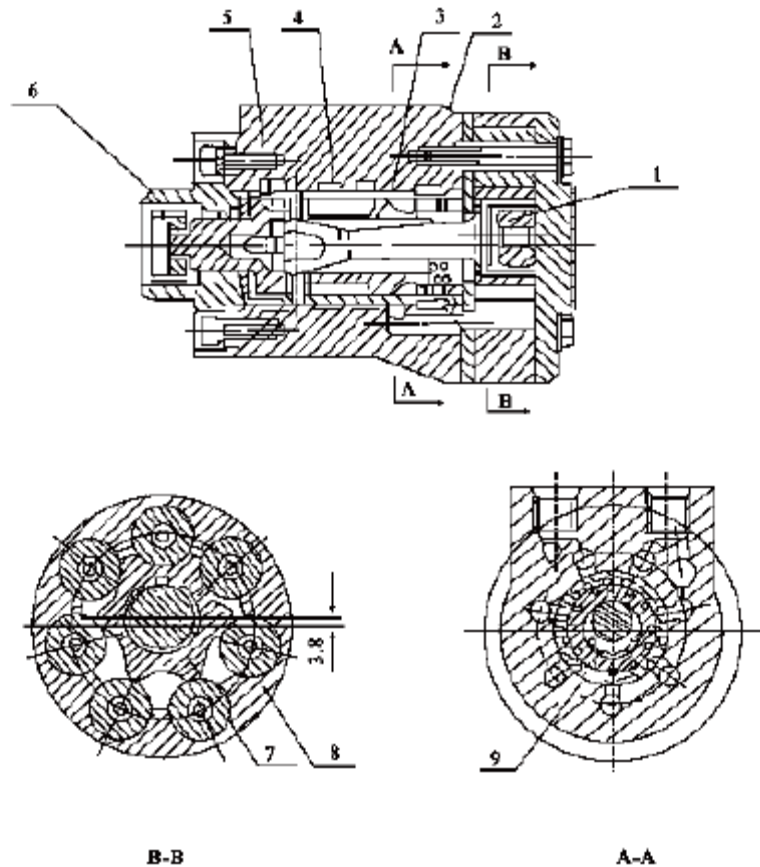


Fig.4-2 Steering system

4.2.1 Full hydraulic steering gear

The full hydraulic steering gear is referred to as the cycloidal full hydraulic steering gear, which is composed of a common steering gear and a combination valve. The hole on the cap of the combination valve serves as the system safety valve. In addition, there is a two-way overload valve inside the valve body. It will produce the high within the hydraulic system when the forklift wheels are subject to accidental shocks during the running. When being under pressure, it plays the role of protection to prevent the damage on parts. The safety valve and two-way overload valve were adjusted in plant. Users do absolutely not make adjustment. (Fig. 4-3)

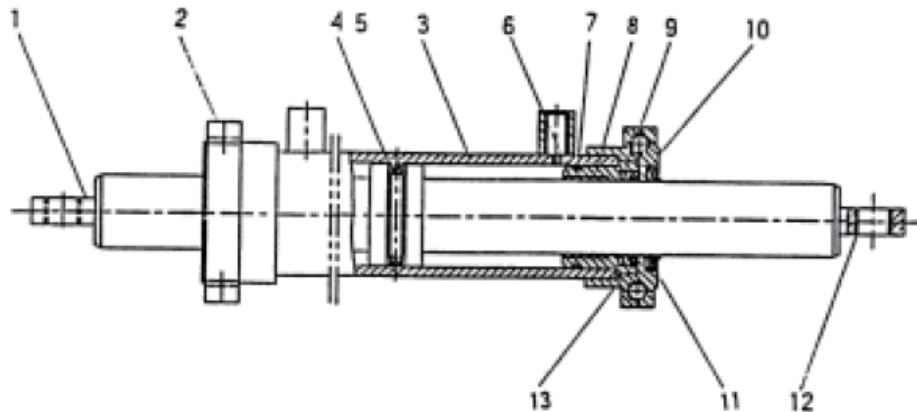


- | | | |
|------------------|----------------------------|-----------------|
| 1. Limited post | 4. Universal driving shaft | 7. Rotor |
| 2. Valve body | 5. Leaf spring | 8. Stator |
| 3. Valve element | 6. Link block | 9. Valve sleeve |

Fig.4-3 Steering system

4.2.2 Steering cylinder (Fig.4-4)

The steering cylinder is the double-acting piston type. There are oil inlets respectively located at both ends of the piston rod. The pressure oil from the full hydraulic steering gear makes the piston rod move around through the oil cylinder and thereby to achieve the turning to the left and right.



- | | | | |
|-----------------|------------------|-------------------|-------------|
| 1. Piston rod | 2. Cylinder head | 3. Cylinder block | 4. "O" ring |
| 5. Support ring | 6. Bushing | 7. "O" ring | 8. Bushing |
| 9. Yx seal ring | 10. Gasket | 11. Dust ring | 12. Sleeve |
| 13. Baffle | | | |

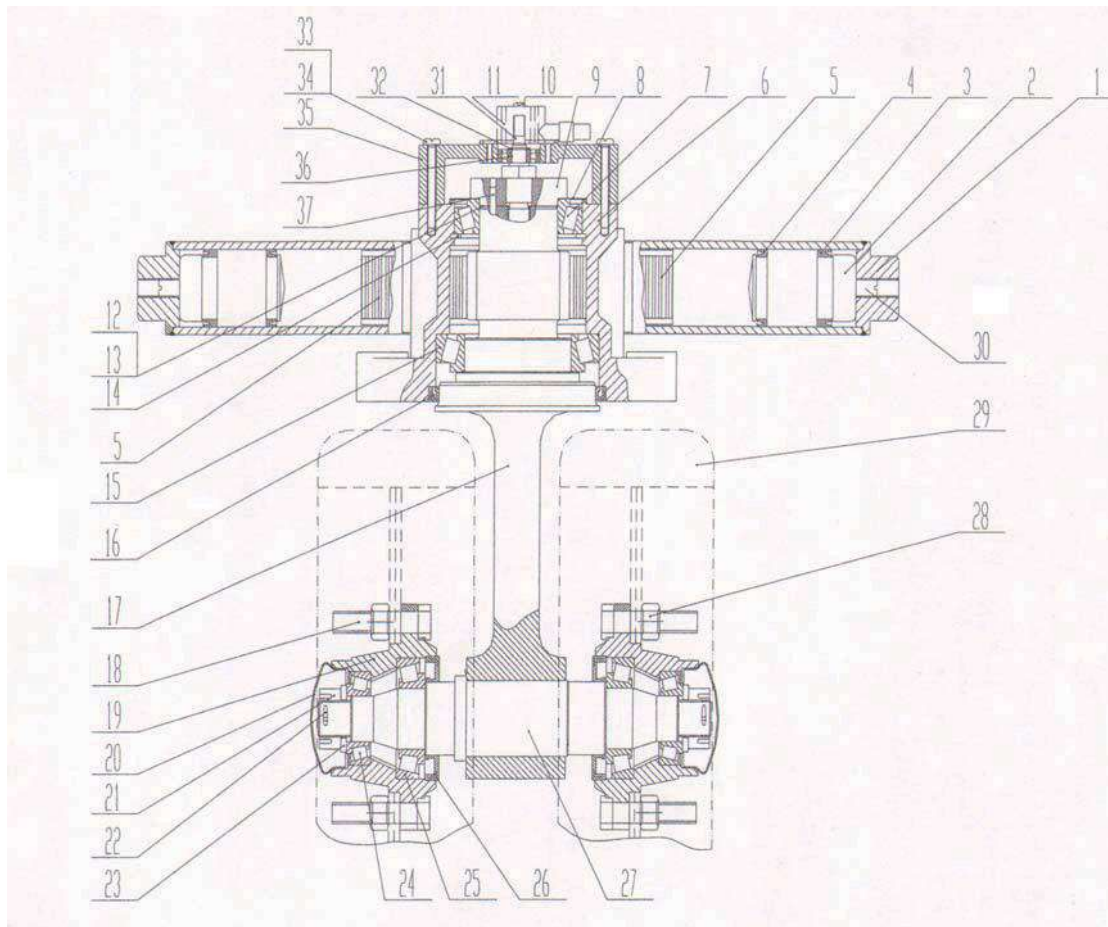
Fig.4-4 Steering cylinder

4.2.3 Steering axle (Fig.4-5)

The steering axle is composed of the steering axle, steering axle housing, oil cylinder, rack drive and steering wheel assembly etc. Move around by the oil cylinder piston rod engaged with the gear through the gear rack, making the steering wheel turn to achieve the cornering. The steering axle is bolted on the tail bracket behind the frame.

After the maintenance or replacement of hydraulic parts of steering system, you should carefully check whether the pipeline is correctly connected, the L/R rotation of steering wheel is normal and the air in the system is exhausted to avoid accident. During the exhaust, the motor should be activated slightly. When turning the steering wheel by hand (turn off the power supply at once if there is abnormal phenomenon and find out the causes for troubleshooting), it should feel easy and flexible, and the steering wheels should deflect accordingly. Keep rotating around so forth to exhaust the air from the system.

The steering of forklift is activated by the accelerator switch control. Only when the accelerator switch is in Open state, the motor starts working, the steering acts. In case no driving is carried out, the time for one steering last about 5~8s, and then the motor will stop running. If continue to make the steering, it is necessary to trigger once the accelerator switch.



1 Component of oil cylinder	2 Piston	3 Seal ring UN40F, 40×50×10	4 Seal ring UN40D, 40×50×7.3
5 Rack	6 Steering gearbox	7 Tapered roller bearing 32011(Class D)	8 Dust ring
9 Briquetting	10 Cross recessed pan head screw M4 × 35	11 Potentiometer	12 Adjustment of gasket (I)
13 Adjustment of gasket (II)	14 Circlip for the hole 90	15 Tapered roller bearing 32015 (Class D)	16 Two lips-frame typed rubber oil seal 110-125-9
17 Gear shaft	18 T-screw of tire: M14×45	19 Hub	20 Wheel hub cover
21 Thin hexagon slotted nut M24×2	22 Cutter pin 5×40	23 Washer 24	24 Tapered roller bearing 30206 (Class D)
25 Tapered roller bearing 30208 (Class D)	26 Two-lips frame typed rubber seal 48-82-11	27 Steering wheel shaft	28 Conical locknut of tire: M14
29 Steering wheel	30 Fine tuning of screw-plug	31 Coupling shaft of potentiometer	32 Circlip for the shaft 10
33 Hexagon socket cap screw M6×55	34 Spring washer 6	35 Potentiometer seat	36 Deep groove ball bearing 6200(with the dust ring)
37 Elastic cylindrical pin 4×18			

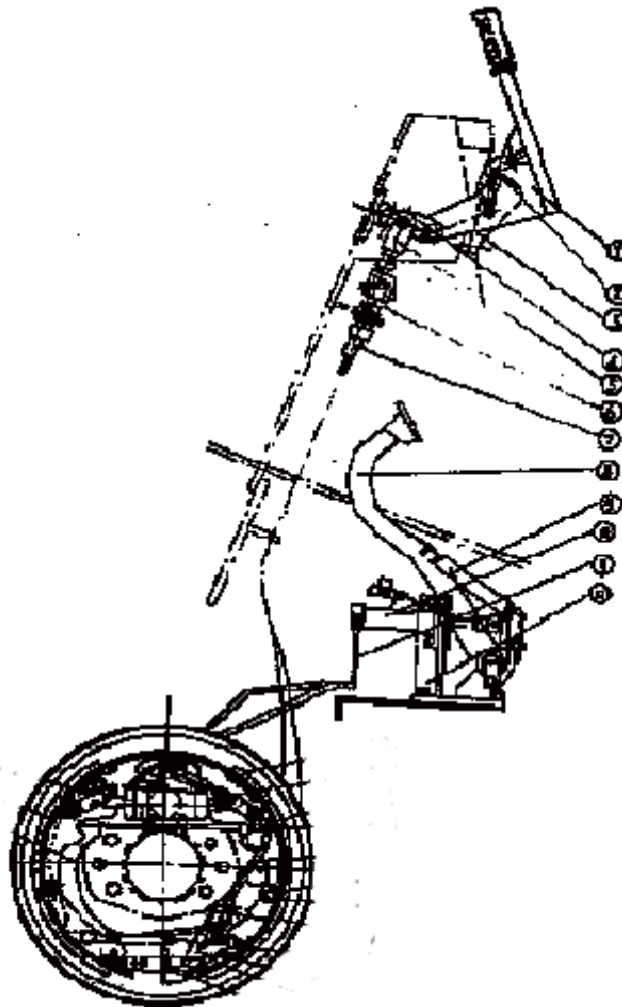
Fig 4-5 Steering axle

Principle of steering axle:

This steering axle uses the hydraulic oil cylinder 1 as the power, which pushes the gear rack to drive the gear shaft 17, hence drives the steering wheel shaft 27 to rotate around the center of gear shaft and achieve the turning of steering wheel. The rotation angle of steering wheel feeds back the message through the cornering potentiometer to the electronic controller governed by double motors, which enables two motors to control the rotation of motor at different speed according to various rotation angles and achieve the harmonized steering of vehicle.

4.3 Brake system (Fig.4-6)

Brake system includes the service brake and parking brake.



- | | | | | | | |
|-------------------|------------------|-------------------|---------------------------|--------------|-------------------|----------------|
| 1. Control handle | 2. Latch | 3. Quadrant plate | 4. Rotating sleeve | 5. Connector | 6. Adjusting bolt | 7. Steel cable |
| 8. Brake pedal | 9. Return spring | | 10. Brake master cylinder | | 11. Oil pipe | 12. Bracket |

Fig.4-6 Brake system

4.3.1 Service brake

The service brake is composed of the brake system master cylinder, brake and brake pedal etc., When it is necessary to brake during the travel of forklift, you can depress the brake pedal, which will drive the brake master cylinder, and transfer the hydraulic oil to the brake systems in the L/R gearboxes. The brake disc will brake up the wheel load under the effect of oil pressure. (Fig. 4-7)

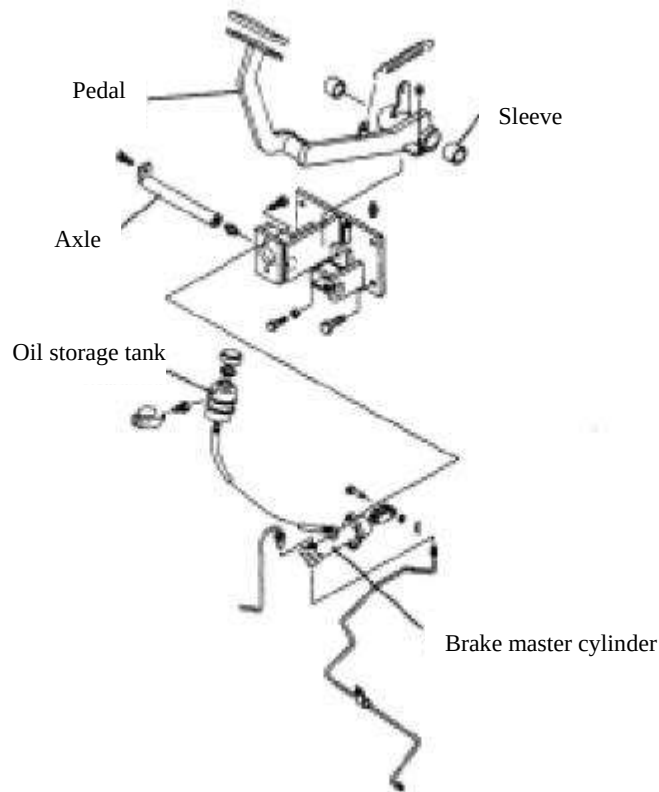


Fig.4-7 Service brake

4.3.2 Brake master cylinder

The master cylinder includes a valve seat, a check valve, a return valve and leather cup, piston and auxiliary leather cup. The end is fixed with the stop washer and locking wire. The external is protected with the rubber dust cover. The master cylinder piston is controlled by operating the brake pedal through the push rod. When the brake pedal is depressed, the push rod will push forward the piston and the brake fluid in the pump body flows back to the oil tank through the return opening until the oil drain hole is banned by the primary cup. After the primary cup is pushed over the return opening, the brake fluid in the front cavity of master cylinder will be compressed and open the check valve resulting in flowing toward the slave cylinder through the brake pipeline. So each position of slave cylinder piston will extend outward making the friction plate of brake shoe get contact with the brake drum to achieve the effect of speed reduction or brake. Now, the rear cavity of piston is supplemented by the brake fluid originated from the return opening and oil inlet. After the brake pedal is released, the piston is pressed by the reset spring, and at the same time, the brake fluid in each brake slave cylinder is compressed by the return valve of brake shoe, which brings the brake fluid back to the master cylinder through the check valve (front cavity of piston) and resets the piston. The brake fluid in the master cylinder flows back to the oil tank through the return opening. Check the valve pressure and adjust it to a proportion with residual pressure in the brake pipeline and sub-pump of brake, making the leather cup of slave

cylinder be correctly positioned to prevent the oil leakage, and eliminate the air resistance possibly occurred in case of emergency brake.

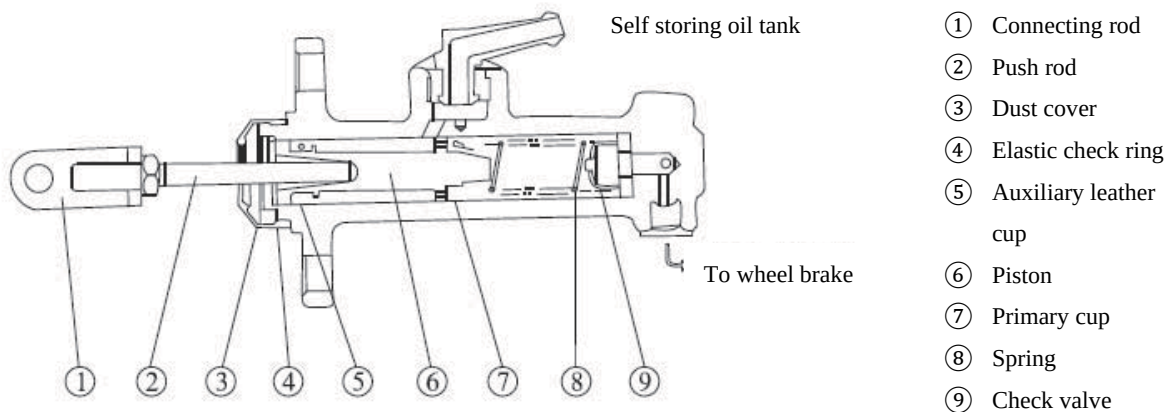


Fig. 4-8 Brake master cylinder

4.3.3 Adjustment of brake pedal

- (1) Shorten the push rod;
- (2) Adjust the lock bolt like the pedal height as adjusted in Fig.4 9;
- (3) Depress the brake pedal, adjust the push rod until the front end of push rod touches the piston of master cylinder;
- (4) Tighten the lock nut of push rod.

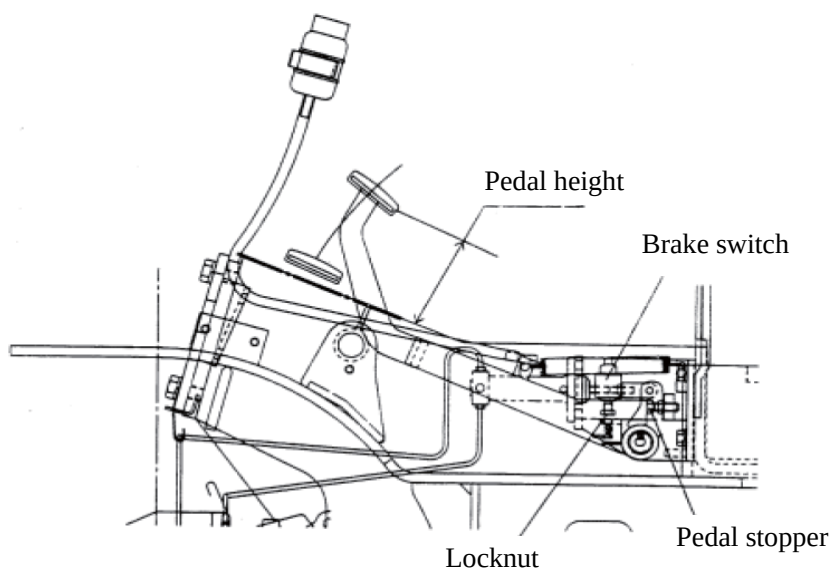
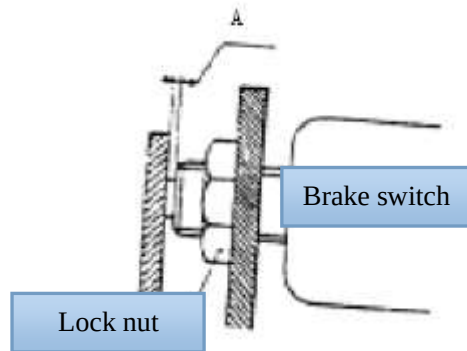


Fig. 4-9

Adjustment of brake switch

- (a) After the height of brake pedal has been well adjusted, loosen the lock nut of brake switch;
- (b) Unplug the plug to disconnect the lead;
- © Turn the switch so that the clearance A is equal to 1 mm;
- (d) Confirm that the brake light is On when the brake pedal is depressed.



4.3.4 Parking brake

The parking brake is mechanic and internal expanding. It is built-in on the wheel brake. It shares the brake shoe and drum with the foot brake. When the handle of parking brake is drawn, the brake handle drives the hand tie rod through the brake dragline (Fig.4-10). This tie rod pushes the push rod of hand brake to the right with the help of the pin playing the role of pivot and enables the brake shoe and brake drum to tension and keeps the wheel from running.

During the driving, you have to completely loosen the parking joystick to get the parking brake switch engaged, otherwise, the forklift won't be activated.

Adjustment of brake force: when the regulator is turned clockwise, the brake force increases; when turned counterclockwise, the brake force decreases.

Traction: 20~30kgNote: adjust by turning the screw inside the regulator.

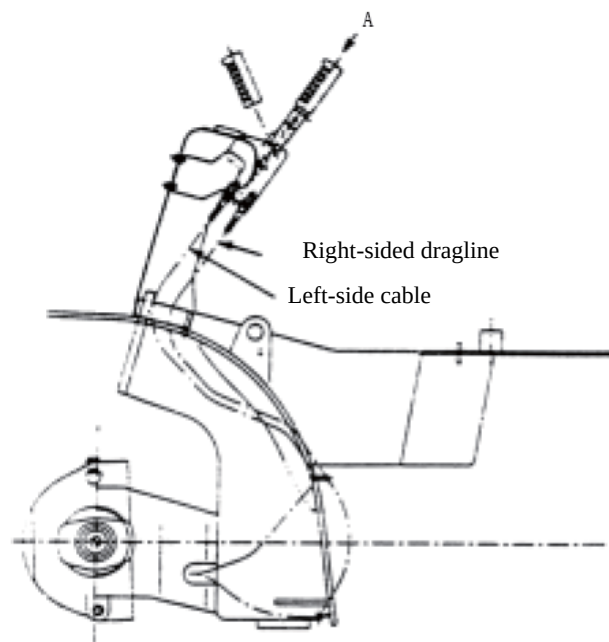


Fig.4-10 Service brake

4.4 Hydraulic system (Fig.4-11)

The hydraulic system is composed of the working pump, multi-way valve, lifting cylinder, tilt cylinder and pipeline etc.

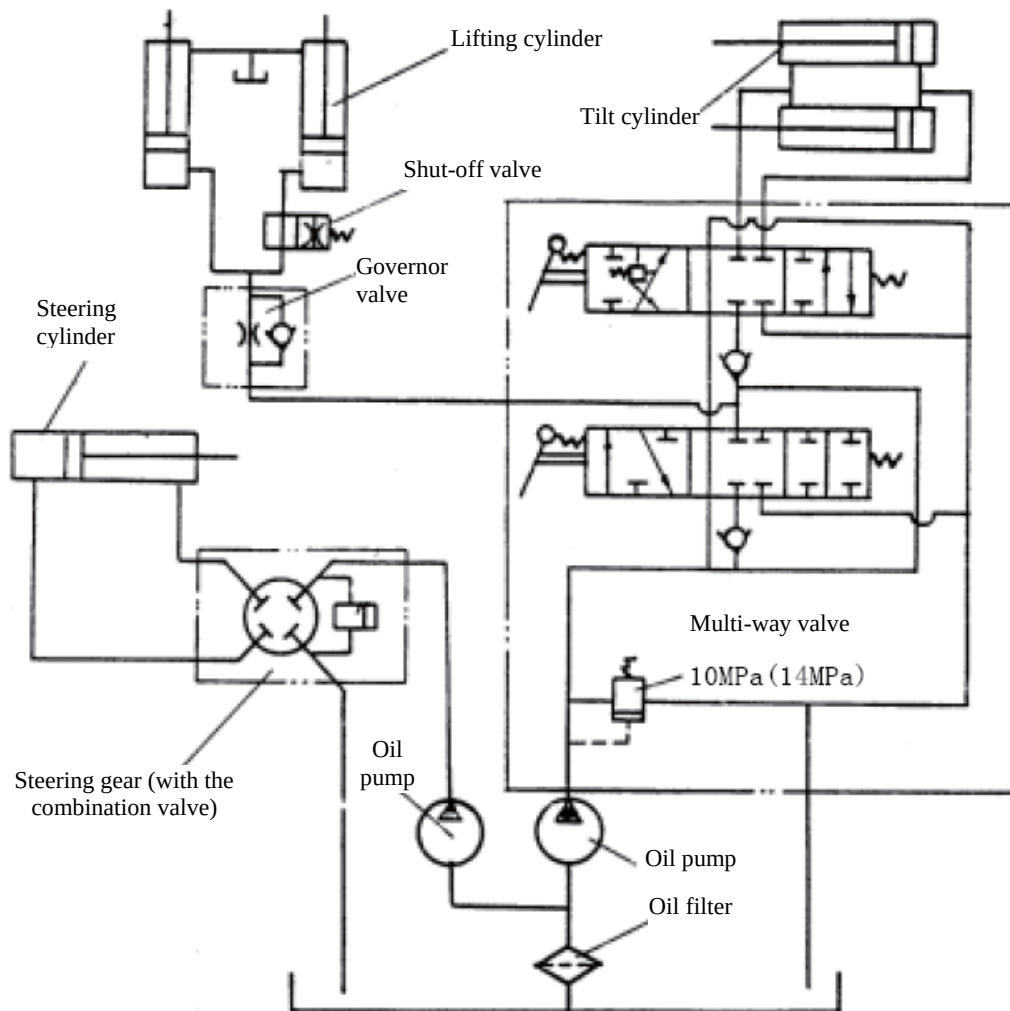
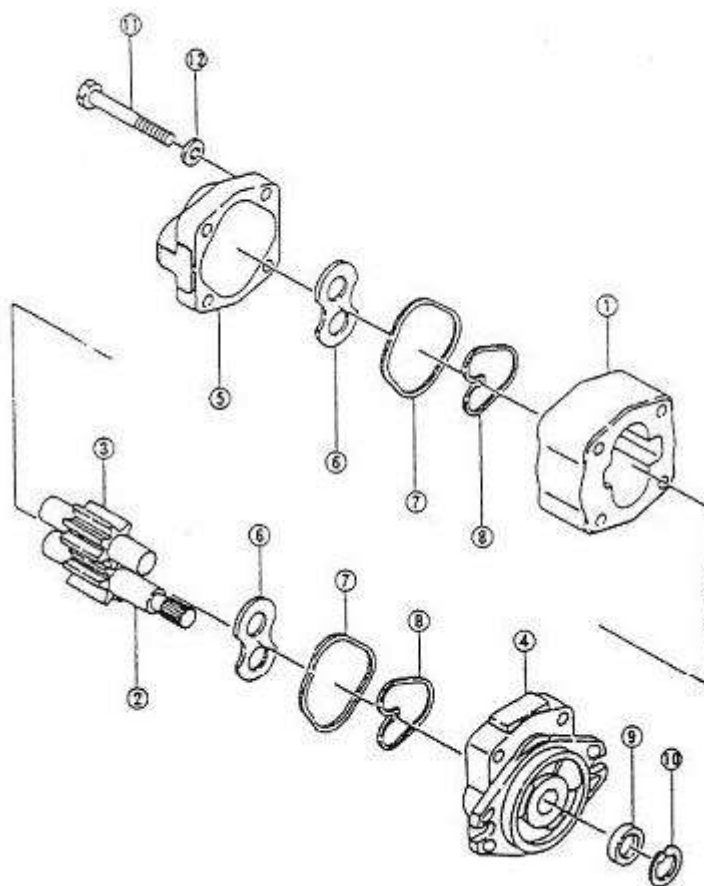


Fig.4-11 Hydraulic system

4.4.1 Lifting oil pump and steering oil pump (Fig.4-12)

The lifting oil pump is the gear pump and the forklift FE10-20, CBHCB-F18-AL ø.



- | | |
|------------------|--------------|
| ① Pump body | ⑦ Seal ring |
| ② Drive gear | ⑧ Check ring |
| ③ Driven gear | ⑨ Oil seal |
| ④ Front housing | ⑩ Circlip |
| ⑤ Rear end cover | 11 Bolt |
| ⑥ Lining board | 12. Washer |

Fig.4-12 Gear pump

4.4.2 Multi-way valve (Fig.4-13)

The multi-way valve uses 2PC type. The hydraulic oil from the working pump distributes the high pressure oil into the lifting cylinder or tilt cylinder through the control of multi-way valve rod. Inside there are the safety valve and self-lock valve. The safety valve is set at the oil inlet of multi-way valve. The upper side of opening can control the system pressure and the adjusted pressure FE10-13: 14.5MPa, FB16-20: 17.5Mpa. The self-lock valve is set on the tilt valve, which is mainly purposed to prevent the tilt cylinder from serious consequence due to misoperation of joystick in case of no pressure source. By use of the tilting self-lock valve, the mast will not tilt forward even though the joystick is sharply pushed, when the oil pump is out of service.

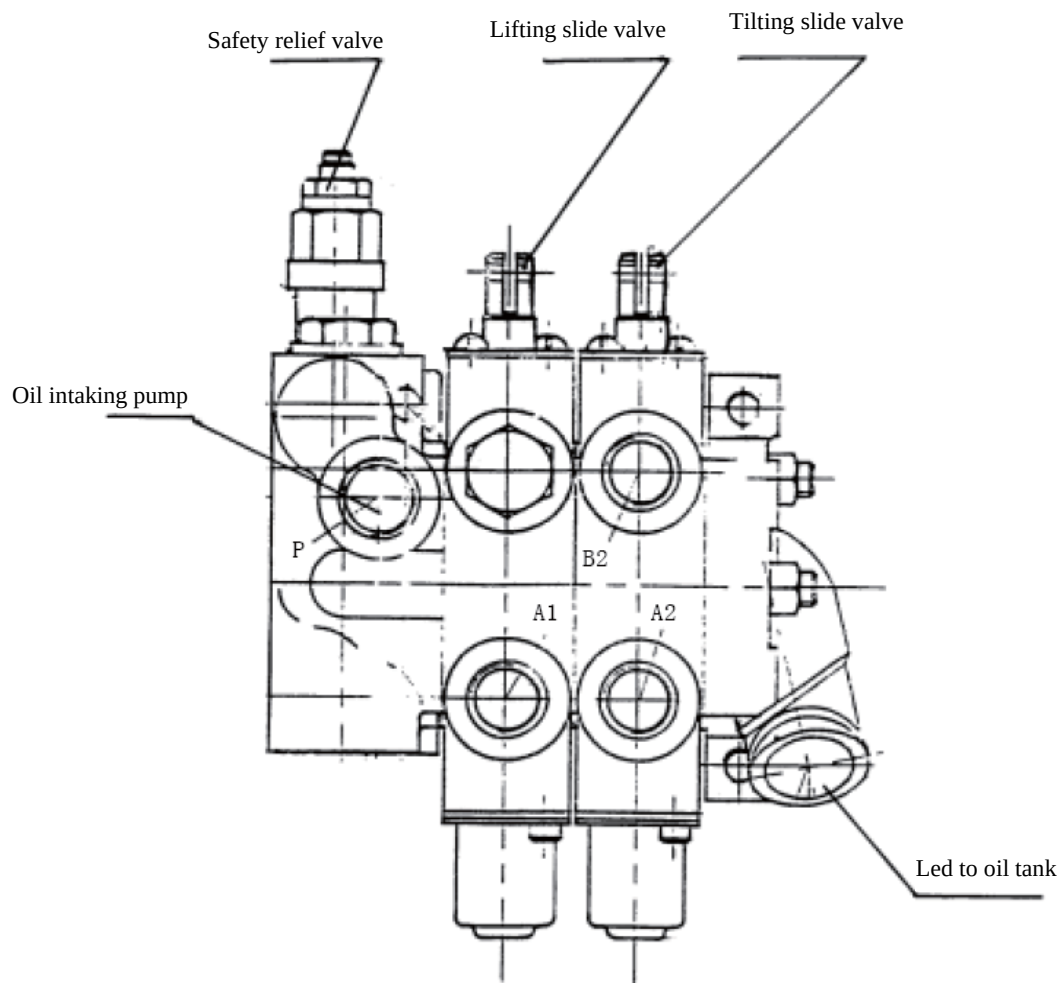


Fig.4-13 Profile drawing of multi-way valve

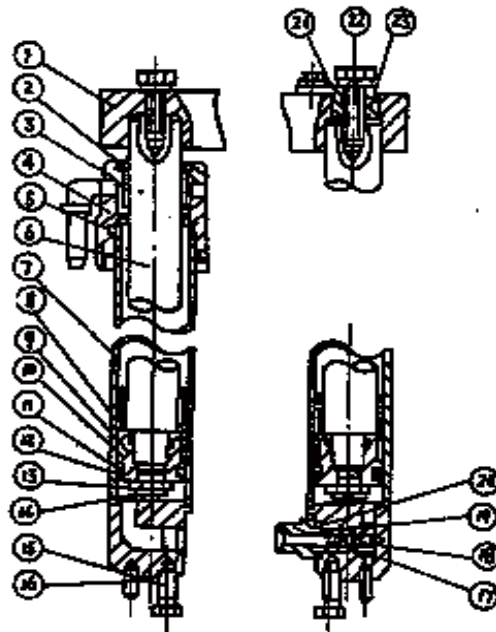
Pressure adjustment of multi-way valve:

	1-1.3T	1.6-1.8T	2T
Mpa of safety valve	14.5Mpa	17.5Mpa	17.5Mpa
Setting of the pressure of steering gear	4.5Mpa	6.3Mpa	6.8Mpa

The specific regulating method is shown as below:

When adjusting according to the direction indicated by the arrow in Fig.4-13 (i.e. clockwise facing the pressure adjusting nut), the pressure increases, otherwise the pressure decreases. The pressure of master safety valve shall be adjusted by use of the hydraulic pressure gauge. The pressure of steering gear is regulated through the adjustment of steering gear and the pressure of safety valve regulated through the adjustment of nut.

4.4.3 Lifting cylinder (Fig.4-14)



- | | | | | | | |
|-----------------|----------------|------------------|------------------|------------------|---------------|-------------------|
| 1. Walking beam | 2. Dust ring | 3. Guide sleeve | 4. Cylinder head | 5. "O" ring | 6. Piston rod | 7. Cylinder block |
| 8. "O" ring | 9. Piston | 10. Support ring | 11. Check ring | 12. Yx seal ring | 13. Nut | 14. Cutter pin |
| 15. Bolt | 16. Pin | 17. Slide valve | 18. Spring | 19. Connector | 20. "O" ring | 21. Snap-gauge |
| 22. Bolt | 23. Screw-plug | | | | | |

Fig.4-14 Lifting cylinder

The lifting cylinder is the oil cylinder of single acting piston and composed of the cylinder block, piston rod, piston and cylinder head etc., It is fixed behind the U-steel of outer mast. The bottom of oil cylinder is fixed by use of pin and bolt on the outer mast. The oil cylinder piston rod is connected with the walking beam. The stroke and lifting of twin-cylinder piston are synchronized, which is achieved by the adjusting bolt on the walking beam. On the oil port at the bottom of the right lifting cylinder, a shut-off valve is fitted. When the HP rubber hose is suddenly blown up, the cargo will drop sharply, producing the great difference in pressure, enabling the movement of inner slide valve to clog the oil port, and only few amount of oil to pass through the small hole at the end of the sliding valve, so that the pallet fork slowly lowers to prevent from the accident.

4.4.4 Governor valve

The governor valve controls the lowering speed of pallet fork and plays the safety role in case of accidents etc., like the rubber hose broken under high pressure. Refer to the figure (Fig.4-15)

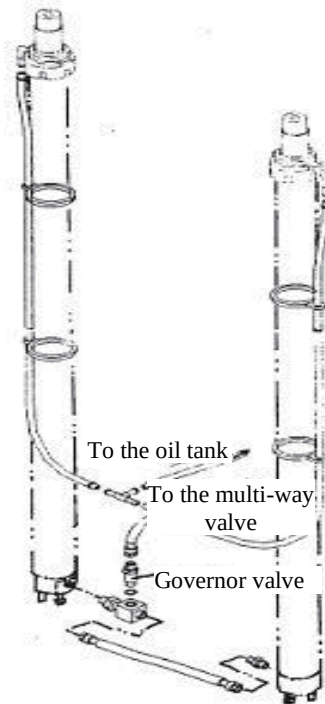


Fig.4-14 Lifting cylinder

The governor valve (I.e. throttle valve) is installed in the lifting oil line to restrict the falling speed when the pallet fork is under heavy load. The structure is shown in Fig.4-16. When the slide valve of multi-way valve is placed at the position "Lifting", the high pressure oil from the multi-way valve passes through A, B, the holes C, D, E, F and the cavity G, and flows into the lifting cylinder without subject of throttle. When the multi-way valve is at the position "Lowering", the oil from the lifting cylinder will flow the whole valve through the cavity G, the holes F, E, D, C and B, A. Now the pressure difference will produce between the cavities A and B and draw up the ball valve. When the difference of pressure is more than the elastic force of spring, the valve element will move to the right resulting in the reduction of oil mass with the decrease of the holes D and C, as well as the flow through the throttle hole.

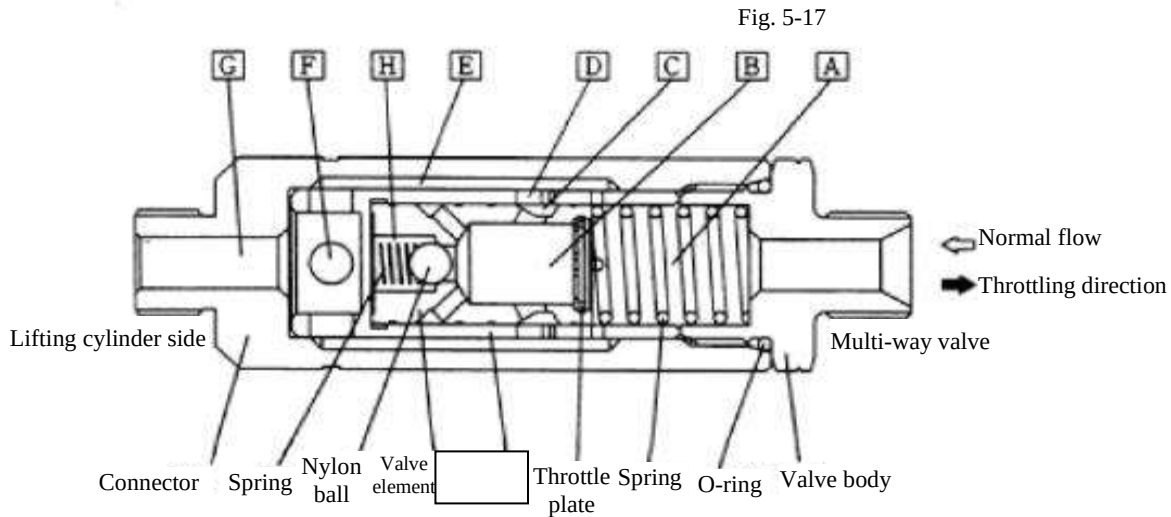
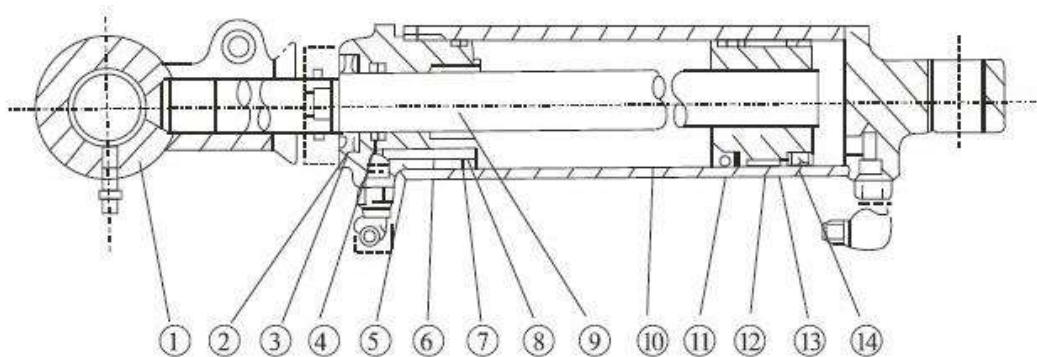


Fig.4-16 Governor valve

4.4.5 Tilt cylinder (Fig.4-17)

The tilt cylinder is the dual acting piston and composed of the cylinder block, piston rod, piston and cylinder head. the front end of piston rod is fixed at both sides of gantry, the rear end of cylinder block is fixed on the frame. It can make the mast tilt 60° forward and 120° backward, so to keep the cargo in stable state when the forklift performs the lifting and handling. The synchronization of left/right tilting cylinders will be achieved by the adjusting piston rod.



- | | | | | | | |
|-------------|---------------|--------------------|------------------|------------------|-----------------|------------------|
| 1. Lug | 2. Dust ring | 3. Baffle ring | 4. Yx seal ring | 5. "O" ring | 6. Guide sleeve | 7. Bearing |
| 8. "O" ring | 9. Piston rod | 10. Cylinder block | 11. Yx seal ring | 12. Support ring | 13. Piston | 14. Yx seal ring |

Fig.4-17 Tilt cylinder

4.4.6 Hydraulic system fault diagnosis

If there is a fault in the hydraulic system, the causes should be identified according to the following table and repair as necessary.

(1) Multi-way valve

fault	Causes	Repair method
The pressure of lifting oil line cannot increase	The oil valve is stuck	Cleaning after disassembly
	Oil hole is clogged	Cleaning after disassembly
The shock pressure increases slowly	The slide valve is stuck	Cleaning after disassembly
	Insufficient exhaust	Adequate exhaust
The pressure of steering oil line is more than the specified value	The slide valve is stuck	Cleaning after disassembly
	Oil hole is clogged	Cleaning after disassembly
Failed to reach the specified oil amount	Improperly adjusted overflow valve	Adjustment
Noise	Improperly adjusted overflow valve	Adjustment
	The sliding face is worn	Replace the relief valve
Oil leakage (external)	O ring is aged or damaged	Replace the O-ring
Low setting pressure	Spring ring	Replace the spring
	The surface of valve seat is damaged	Adjust or replace the relief valve
Oil leakage (internal)	The surface of valve seat is damaged	Amend the surface of valve seat
High setting pressure	The valve is stuck	Cleaning after disassembly

(2) Oil pump

fault	Causes	Repair method
Few oil discharge	Low level in the oil tank	Refuel up to the specified amount
	Oil pipe or filter is clogged	Clean or replace as needed
The pump pressure is low	The lining board is damaged The support is damaged The seal ring, bushing seals or check ring are in poor condition.	Replace
	The relief valve is improperly adjusted	A pressure gauge should be used to adjust the relief valve pressure to the specified value
	There is air in the system	Retighten the oil pipe at the suction side Refueling Change oil seal of oil pump
Noise is produced only once in	The oil suction pipe is damage or oil filter is clogged	Check the pipes or maintain the oil filter.

fault	Causes	Repair method
operation	The oil suction side is loose and leaks	Tighten all loose places
	The oil viscosity is too high	Replace with the oil, whose viscosity is compatible with the running temperature of pump.
	There are bubbles in oil	Find out the causes of bubbles and take the countermeasures
The pump has oil leakage	The oil seal or seal ring of pump is damaged	Replace
	The pump is damaged	Replace

4.5 Lifting system

The lifting system is composed of the inner & outer mast, sliding bracket, pallet fork, rolling bearing and sprocket set.

4.5.1 Inner/outer mast (Fig.4-18)

Connect the frame through two bearing seats at the bottom of outer mast and the middle part to the frame through the tilt cylinder. In operation, the free lifting amount of pallet fork FE10 and 13 are 85mm, FE16, 18 and 20 are 90mm. Adjustment method of system: ① Adjust the tilt cylinder to have the mast lean forward 6°, and backward 6.5°. The tilting forward and backward of twin-cylinders are synchronized; ② Set the mast perpendicular, let the pallet fork lower on the ground. Adjust the lifting chain to ensure that the pallet fork touches the ground. Adjust the lifting chain, to ensure that the center of lower roller under the pallet fork bracket keeps the distance of 15~20mm away from the lower edge of inner mast and enable two chains to have same tensioning force; ③ Adjust the synchronization between the L/R lifting cylinders.

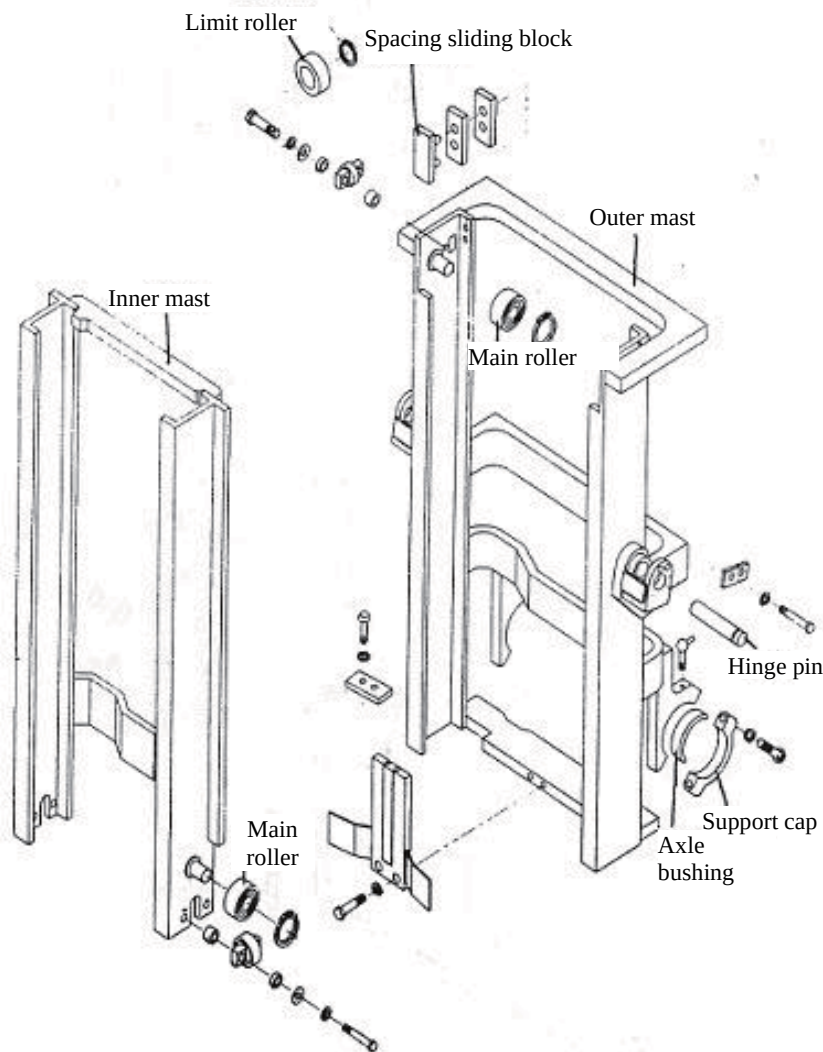
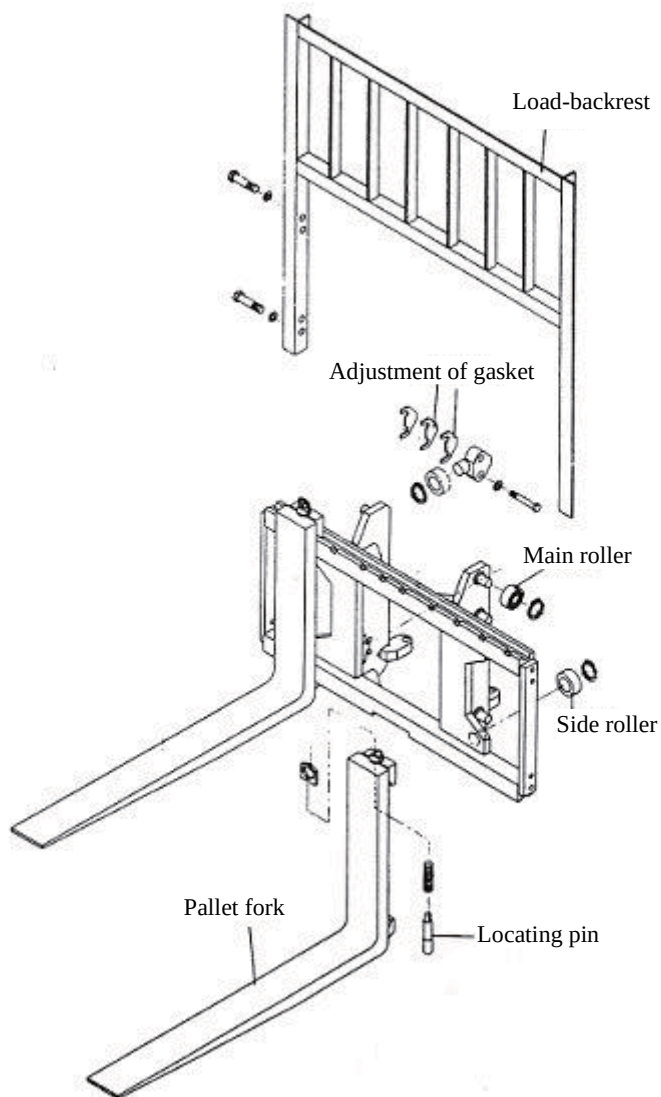


Fig.4-18 Inner/outer mast

4.5.2 Pallet fork bracket and load backrest (Fig.4-19)

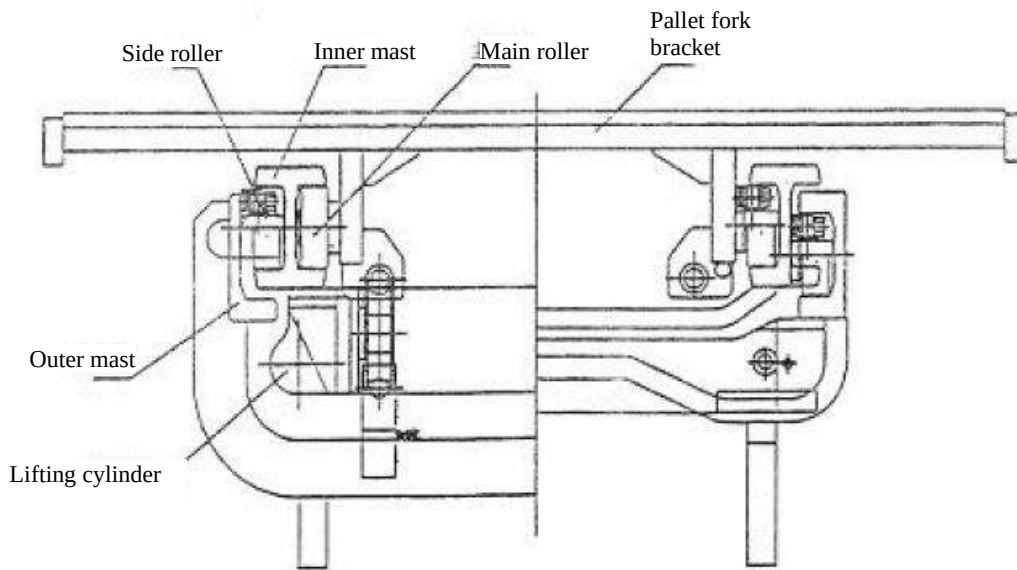
The pallet fork bracket is rolling inside the inner mast through the main roller. The main roller is fitted on the main roller shaft and clamped with the circlip. The main roller shaft is welded on the pallet fork bracket. The side roller is fixed by the bolt on the pallet fork bracket. Roll along the inner mast fender. To prevent the rolling gap, use two fixed side-rollers to roll along the outside of the inner mast fender. The vertical load is borne by the main roller. When the pallet fork is lifted to the top, the upper roller comes out from the head of mast. The cross load is borne by the side roller. The load-backrest is skid mounted, through the both sided bolts on both sides of the load-backrest to prevent the vehicle or the mast from tilting back during the running and the loaded cargos from dumping over the side of mast, serve to some extent, as the protector for the cargo.



(Fig.4-19) Pallet fork bracket and load-backrest

4.5.3 Position of roller (Fig.4-20)

There are two types of rollers: main roller and side roller which are respectively fitted on the outer mast, inner mast and pallet fork bracket. The main roller bears the loads in both forward and backward directions, and the side roller is under the lateral load, enabling the inner mast and pallet fork bracket to move.



Note:

- (a) Adjust the space of side roller to 0.5mm;
- (b) Add grease on the surface of main roller and contact area of mast

Fig.4-20 Position of roller

4.5.4 Forklift fittings

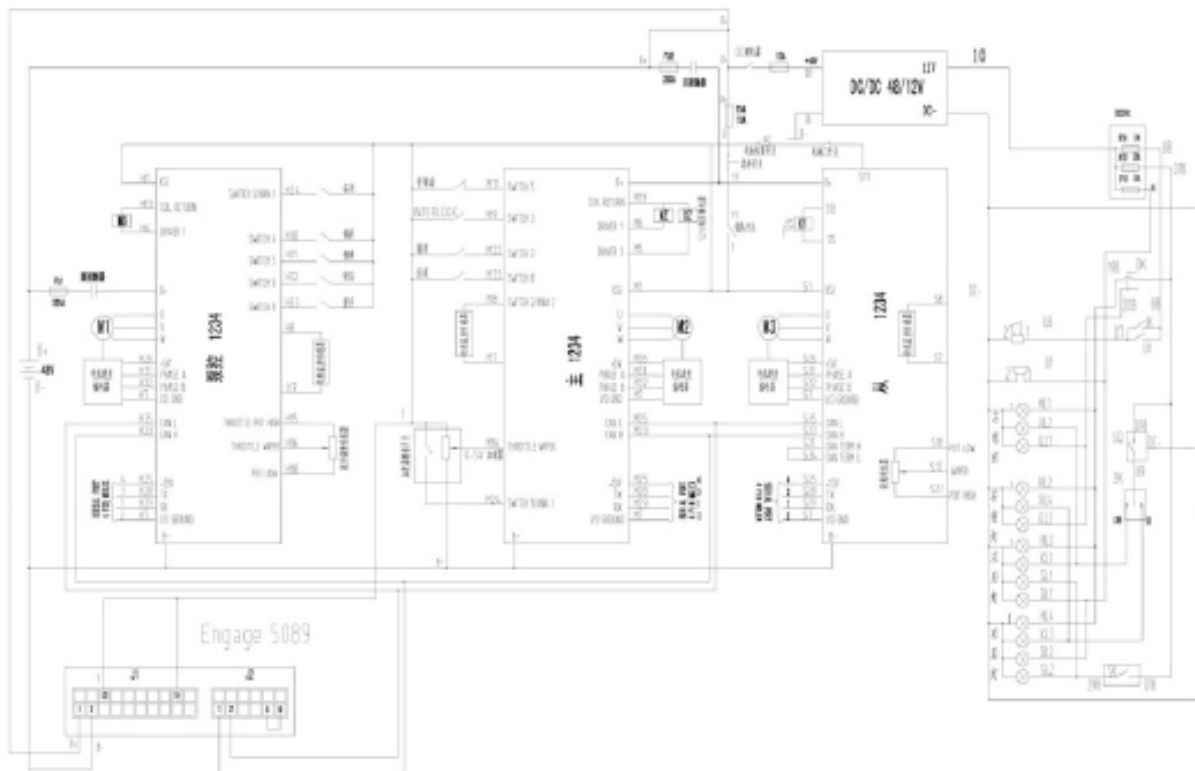
Because different occasions where the forklift is used and various loaded cargos, the common pallet fork with the single forking function cannot meet the demands of many working conditions. The forklift fittings belong to one part of the forklift working device. Its rational application makes the forklift a kind of multi-purpose, high efficient materials handling tool, which can fork, clamp, lift, rotate, move sideways, push and pull or rollover, and considerably widen the scope of forklift application, enhance the handling efficiency of forklift and promote the automation development level of material handling industry. There are many types of forklift fittings with their different performances to meet the requirements of different working environment. Hence the methods of their classification also vary. According to the oil line needed by the fittings, the fittings are divided into the mechanic and hydraulic types. The former needs no auxiliary refueling line, the original working device of forklift possesses the lifting and tilting oil lines, which are fitted with the 2PC valve: E.g.: Through-bar, jib, foldable pallet fork etc., It is necessary for the latter to be added with an auxiliary refueling circuit (group I or II). These fitted with the group I of auxiliary refueling circuit is normally referred to "3PC valve fittings" which possess a single function: these fitted with the group II of auxiliary refueling circuit normally referred to "4PC valve fittings" which have two single functions and so on. Each time a single function is added, it is necessary to supplement a group of auxiliary refueling circuit, and one piece of multi-way valve will be added. E.g.: side shifter (3PC valve fittings), rotating clamp (4PC valve fittings), pusher (3PC valve fittings) etc.

4.6. Electric System

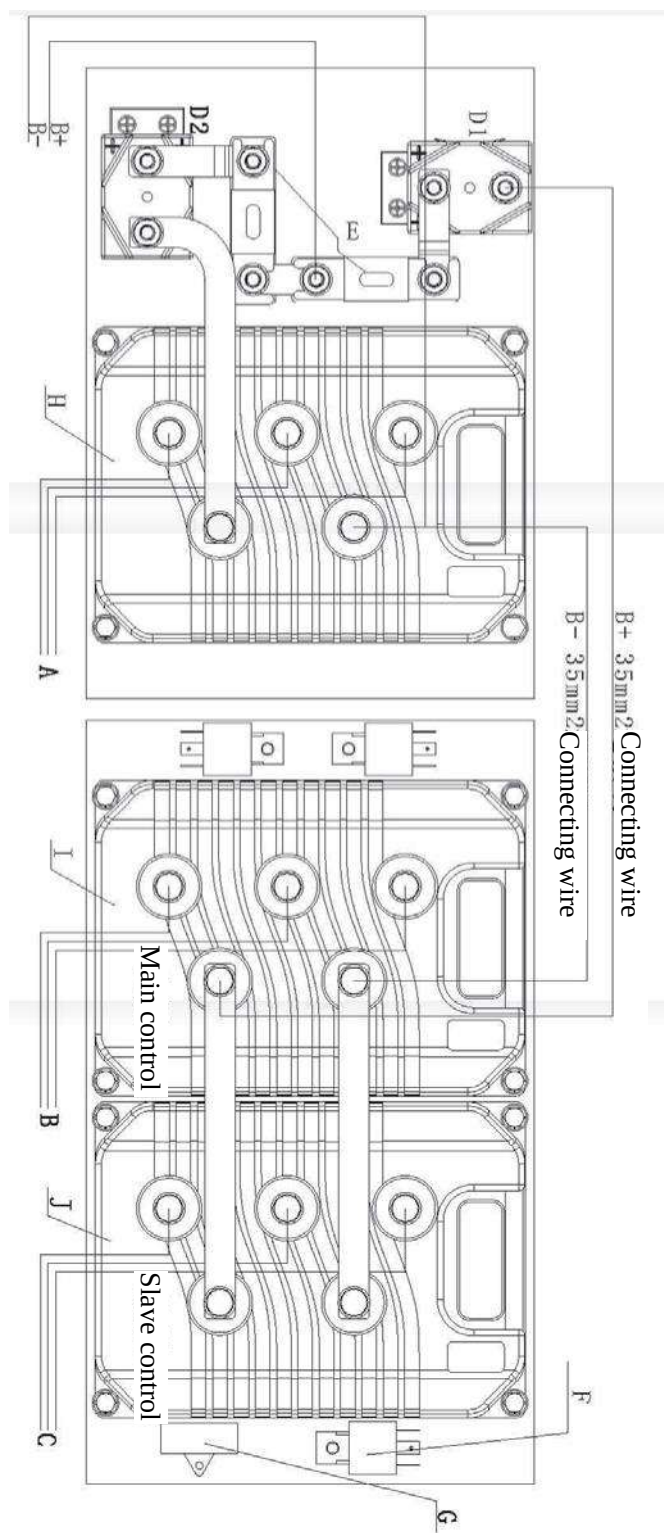
4.6.1 Overview

The electric system mainly includes the devices like the battery, traveling motor, lifting motor, electronic control assembly, control switch, combination instrument and lighting lamp etc.

Electric principle drawing as shown in Fig.4-21



M0	Contactor of pump control	M2	Drive motor	JK	Foot horn switch	HL1	Left clearance light	XL4	Right turn signal light	DL1	Left back-up light
M1	Pump motor	M3	Driven motor	LK	Horn switch	XL1	Left turn signal light	QL2	Right headlamp	XL3	Right turn signal light
MZ	Master contactor	K2	DCDC relay	LB	Horn	QL1	Headlamp	HL3	Rear left clearance light	DL2	Rear left clearance light
DZ	Back-up buzzer	DK	Lighting switch	DF	Back-up buzzer	HL2	Right clearance light	SL1	Left brake light	SL2	Right brake light
										DL1	Brake light switch



Electronic control device

A	Pump controller cables	D2	Contactor of lifting control system	H	Pump controller
B	Drive controller cable	E	Fuse	I	Drive controller
C	Cable of driven controller	F	Relay	J	Driven controller
D1	Travel system contactor	G	Resistance of static electricity		

The forklift uses the AC governor controller and AC oil pump governor controller and features the stepless speed variation, smooth lifting and stable operation and has reliable performance. The maintenance load is low. In comparison with the resistance speed regulation, it can save ca. 20-30% electricity. The working principle is summarized as below: The AC controller and AC traveling motor are connected in series on the voltage of battery pack, because of the modification of the pulse width produced by the micro-processing logic unit, which changes the average current at the motor, so the speed of motor is also changed and possesses at the meantime the regenerative braking function. For the detailed working principle, please read the Electric Control Instructions.

The voltage of battery pack is 48V. Each one is composed of 24 batteries with the voltage 2V. The main loop and control loop are powered by 48V voltage. The lighting lamp and buzzer etc., are powered by 12V voltage.

The protections of main circuit overload and short-circuit will be achieved by the fuses F1 and F3 and the short-circuit protections of control and lighting loops are implemented by F4~F7 fuses.

4.6.2 Operating method

When it is necessary to work with the forklift, insert at first the power plug, turn off the hand brake switch, turn on the key switch, the indicator light on the instrument panel is lit. If it is necessary to have the forklift move, push the direction switch to the preset position (forward or backward), and then depress the acceleration pedal, the controller is working, the traveling motor starts running and the forklift will move in the preset direction. The travel speed is determined by the journey of pedal depressed. When the pedal is depressed to the end, the speed maximizes, when the driver's foot leaves the brake pedal, the pedal will reset under the effect of spring and the controller works, so the traveling motor stops running and the forklift stops the operation. When the forklift is climbing on slope or drives at full speed, you should depress to end the pedal. Now, the controller has the motor output the maximum torque and the forklift can produce the maximum driving force. When the cargo handling is required, you just place the lift lever or tilting lever to the corresponding position and close the lifting switch MK, the lifting motor starts working. E.g. the lifting of pallet fork: When the goods lifting is needed, just place the lift lever onto the lifting position, the lifting motor starts working, the pallet fork rises. Release the handle until it is lifted to the preset position, the lifting switch MK is disconnected, the lifted motor stops working and the pallet fork stops lifting. Both the tilting forward and backward of pallet fork are similar. When the pallet fork is lifted to the top and tilts forward or backward to the limiting position, the operation handle should be quickly returned to the middle position.

Headlamp, clearance light and tail lamp are controlled by the light switch on the instrument panel. The 1st position is the clearance light and rear clearance lamp; the 2nd, the headlamp and turn signal light are controlled by the turn signal light switch fitted on the instrument panel. Besides, the turning indicator light is also fitted on the instrument panel. When the alarm is necessary, just pressed the horn button, the horn will be buzzing. The brake light is controlled by the brake light switch.

4.6.3 Battery

4.6.3.1 Construction of battery

The battery is mainly composed of the positive plate, negative plate, partition, battery cap and electrolyte solution.

4.6.3.2 Battery specification

Item/Model	Model	Capacity	Voltage	Number of 单体
FE10 FE13	DA400	400Ah/5	48V	24
FE16 FE18 FE20	DA500	500Ah/5	48V	24

4.6.3.3 Use of battery

(1) Before use of battery, dust and dirt should be removed from the appearance, and check should be made piece by piece for any damage. If there is any damage, it can be repaired or replaced as the case may be.

(2) Preparations before charge:

- (a) Check the charge equipment, instrument and tools. If there is any shortage or fault, it should be timely prepared or repaired.
- (b) The capacity and voltage of charge equipment must match with those of the battery.
- (c) The DC power supply should be used for charge. The positive (+) and negative (-) of charge device are respectively connected to the positive (+) of battery pack

The pole and pole connection (I) allows absolutely no wrong connection to prevent the damage on the battery.

- (d) In charge, the temperature of electrolyte solution is controlled between 15~45°C.

(3) Maintenance and precautions of battery

- (a) The surface of battery should be kept clean and dry.
- (b) When the discharge begins and the density of electrolyte solution (30°C) failed to reach $1.28 \pm 0.01 \text{g/cm}^3$, the adjustment should be made.

Adjustment method:

When the density is low, a part of electrolyte solution should be taken to pour the sulfuric acid solution in pre-prepared density not more than 1.400g/cm^3 . If the density is high, a part of electrolyte solution can be taken to pour the distilled water for adjustment.

- (c) The level of electrolyte solution should be 15~20mm higher than the grid guard.
- (d) After the discharge of battery, the charge should be given in time. The delay time cannot be more than 24h.
- (e) For the battery, the overcharge, over-discharge and insufficient charge should be avoided, otherwise, they will shorten the service life of battery.

- (f) No harmful impurities are allowed to fall in the battery. The instrument and tool designated to measure the density of electrolyte solution, intensity and level should be kept clean so to prevent the impurities from entry into the battery.
- (g) No conducting materials are allowed to place on the battery cap so as to avoid the short circuit of battery.
- (h) In the charger room, there should be well ventilated condition. Fire is forbidden to prevent the accidents
- (i) During use of battery, if the voltage of each individual in the battery pack is uneven and consumed not too often, the equalizing charge should be made once every month, i.e. the proper overcharge.

(4) Preservation and storage

- (a) The battery should be stored in a dry, clean and well-ventilated warehouse, where the ambient temperature is around 5~40°C.
- (b) Prevent the battery from direct sunlight, the sun and the rain and keep it at least 2m away from the heat source.
- (c) It is prohibit to upside down, lie on, throw, flip over, and load over the battery.
- (d) Try to avoid contact with any toxic and corrosive goods.
- (e) It is not allowed to store the battery with the electrolyte solution. When the special storage is necessary, sufficient charge should be made and the level and density of electrolyte solution properly adjusted. During the period of storage, the common charge of battery should be made once every month according to the general charge method.

(5) Common faults and troubleshooting

There are many causes of battery fault. Except for the manufacturing quality and the affection by the transport and preservation, the majority of insufficiencies are caused by improper maintenance. Analyze timely the causes when a fault is detected. Efficient measures should be taken as soon as possible for troubleshooting. The characteristics, causes and inspection method of battery common faults are shown as below:

fault	Characteristics	Causes	Remedy and preventive measure
The polar plate is irreversibly sulphating	1. The battery capacity is reduced 2. The density of electrolyte solution is lower than the normal value 3. The battery-end voltage is too high when the charge is started and finished 4. The premature bubbles are produced when charging or bubbles occur once the charge starts 5. In charge, the temperature of electrolyte solution increases too fast.	1. Insufficient initial charge 2. Unused for too long time in discharged or half-discharged state 3. Undercharged for a long time. 4. Often over-discharge 5. The density of electrolyte solution exceeds the specified value 6. The level of electrolyte solution is too low resulting in the exposure of the upper part of polar plate over the level. 7. Failed to timely make the equalizing charge	1. In less serious case, the method of equalizing charge should be taken 2. In serious case, the "Hydrotherapy" should be adopted 3. Over-discharge is not allowed 4. The density of electrolyte solution density cannot exceed the specified value 5. The electrolyte solution level and impurity content should be kept within the prescribed scope.

fault	Characteristics	Causes	Remedy and preventive measure
		8. The discharge current is too large or too small 9. Impure electrolyte solution 10. Local effect or electric leakage in the internal short-circuit	

4.6.4 ENGAGE IV instruments

4.6.4.1 Overview

The instrument ENGAGE IV is applied in combination with the Electronic control assembly, CURTIS series, which is purposed to achieve the auxiliary control function and provide the driver with the visual interface of vehicle running. This instrument can monitor the following parameters or states: battery power, working modes, actual working mode (e.g.: move forward, backward, N-gear, parking brake, modes), the encoding status of fault, alarm and the run time of vehicle. There are three working modes available for option. The switching operation between modes is easy and visual. When the vehicle runs on a darker place, the backlight of instrument will enable the driver to easily observe all parameters and status indication on the instruments.

4.6.4.2 Display



4.6.4.3 Function and application:

- Applicable to the counterweight electric forklift and forward electric forklift and other materials handling vehicles: it can display in digitals the fault signals output by the walking controller and pump controller, The "TRAVEL" represents the walking controller. If the instrument is used for the single drive forklift, the "HYD" represents the pump controller;
- Display of electric quantity and alarm of insufficient electricity: when the electricity is insufficient, the lifting lockup function can be available;

(c) There are three modes, which are respectively: The message of mode selection "   ", "   " and "   " will be sent to the controller through the CAN.

(d) When the sign "  " indicates the moving forward, the high level triggers: when the sign "  " indicates the moving backward, the high level triggers: the sign "  " represents the parking brake, the high level triggers: when the sign "  " represents the lifting lockup, the instrument control: when the sign "  " represents the maintenance of vehicle, the instrument controls:

(e) The hour meter, clock and maintenance hour meter: (f) LED flashing alarm:

4.6.4.4 Instructions for use

a) Turn on the key switch, the power supply 12V will feed the instrument, at the meantime the PS 48V will be added on the instrument and electric control loop through the starter relay in the relay box. On gauge, the LC instrument shows the vehicle information "TRAVEL" and "HYD", on the right side, displays "OK", that means that the control device is in normal working state.

b) The hand brake is displayed when the brake is applied. On the gauge, the indication "  " will show up: when the hand brake is released, the indication will go off.

c) Travel direction display

When the direction switch is placed in N-gear, no direction is displayed on the instrument: when the forward gear is shifted, the indication "  " is shown and the backward gear engaged, the indication "  " displayed with the beeps of back-up buzzer.

d) Battery capacity display

After the instrument is turned on, the battery voltmeter will show the class of current battery power. The voltmeter can display in total 10 cross-bars and 10 grades of capacity. The battery voltage range is between 41.5V~56V. The top one is lightened. It means the battery power is full. When two lowest bars flash alternatively, it means that the battery is short of power and must be charged at once. Once the cross-bar in display is lowered one scale, it means that the capacitance is reduced about 8%.

e) Low limit alarm of battery capacity

When the voltmeter shows the last two cross-bars, the battery power has reached the lower limit. Now the sign "!" is shown at the right side of the instrument. The indicator light turns yellow and flashes over at the meantime. When the voltmeter shows the last cross-bar, the sign "!" will be shown at the right side of instrument. The indicator light turns red and flashes over at the meantime. At the meantime, the protection relay of lifting power supply loop moves in action. The protection relay has two motion: When

the lifting motor failed to act, the power supply loop of lifting contactor will be disconnected immediately. If the lifting motor is in motion, cut off the power supply loop of lifting contactor after 10s delay (fed for the completion of one lifting motion).

f) Display of fault code

The instrument possesses the fault display function of electronic control. The fault category is represented in 2 digital decimal number and a number of fault categories can be displayed. When there is a fault in the part of electronic control, the fault indicator light on the gauge is lit at the same time. If more than two faults coincide, the "Fault Code Window" always shows the fault, which is shown finally (Determined by the electronic control device). When this fault is troubleshot, the next one will be on display until all faults have been eliminated and the "OK" is shown.

Rational table between the fault codes and phenomenon prompts

On the controller housing, there are the red and yellow LED lamps. The different flashings represent various faults, as shown in the following table:

Situation in display	Meanings
Both lights are not lit	The controller has no power supply, because there is no electricity in the battery or a fault on the line
The yellow light is flashing	The controller is working properly
Both the yellow and red lights are constantly lit	The controller is updating the software
Both the yellow and red lights are flashing	The controller has a fault

Code	Fault display	Possible causes
1, 2	Controller Overcurrent	1. The connecting wire U, v or W of motor is short-circuited. 2. Wrong setting of motor parameters 3. Controller fault
1, 3	Current Sensor Fault	1. The U, V, W are short-circuited relative to the vehicle body (The motor stator short-circuited) 2. Controller fault
1, 4	Pre-charge failed	1. Connect the external loading at the capacitor bank (B + Terminal) to prevent the capacitor from charge. 2. Check the capacitance voltage under the monitoring menu.
1, 5	Controller Severe Undertemp.	1. The controller is working under the limiting environment (low than -40°C). 2. Check the controller temperature under the monitoring menu.
1, 6	Controller Severe Overtemp.	1. The controller is working at the limiting temperature (Higher than 95°C). 2. Vehicle overload. 3. Improper installation of controller. 4. Check the controller temperature under the monitoring menu.
1, 7	Severe Undervoltage	1. Wrong setting of battery voltage parameters. 2. The battery power runs out. 3. The inner resistance of battery is too high. 4. In driving, the battery is not connected. 5. Check the capacitance voltage under the monitoring menu. 6. The B + fuse burn or the master contactor unclosed.

Code	Fault display	Possible causes
1, 8	Severe Overvoltage	1. Wrong setting of battery voltage parameters. 2. When the current of regenerative brake is produced, the battery resistance is too high. 3. The battery is not connected in regenerative braking. 4. Check the capacitance voltage under the monitoring menu.
2, 1	Controller Undertemp. Cutback	1. The low temperature reduction function of controller takes effect. 2. The controller working under limiting conditions. 3. Check the controller temperature under the monitoring menu.
2, 2	Controller Overtemp. Cutback	1. The reduction of over-heated controller takes effect. 2. The controller is working at the limit temperature. 3. Vehicle overload. 4. Improper installation of controller. 5. Check the controller temperature under the monitoring menu.
2, 3	Undervoltage Cutback	1. Under normal operation, the battery needs the charge and the low pressure limit function of controller takes effect. 2. Wrong setting of battery voltage parameters. 3. The battery power runs out. 4. The inner resistance of battery is too high. 5. The connection wire of battery shall be disconnected when driving. 6. Check the capacitance voltage under the programmer monitoring menu. 7. The B + fuse burn or the master contactor unclosed.
2, 4	Overvoltage Cutback	1. Normal operation. During the regenerative braking, the current of regenerative brake will have the fault in display by making the battery voltage too high and the overpressure of controller will limit the entry into effect of parameters. 2. Wrong setting of battery voltage parameters. 3. When the current of regenerative brake is produced, the battery resistance is too high. 4. In regenerative braking, the battery connection is open circuited. 5. Check the capacitance voltage under the programmer monitoring menu.
2, 5	+ 5V Supply Failure	1. The resistance value of external loading connecting to the + 5V supply side (pin 26) is too low. 2. In charge, the current is supplied by 5V and Ext under the programmer monitoring menu.
2, 6	Digital Out 6 Overcurrent	1. The resistance value of external loading connecting to the digit output drive 6 (pin19) is too low.
2, 7	Digital Out 7 Overcurrent	1. The resistance value of external loading connecting to the digit output drive 7 (pin19) is too low.
2, 8	Motor Temp Hot Cutback	1. The temperature of motor exceed the setting parameters, therefore, the requested current is reduced. 2. The control parameters of motor temperature are not correctly adjusted. 3. Check the motor temperature and input of Analog2 under the programmer monitoring menu. 4. If use of electrothermic regulator is exempted, the temperature compensation and temperature disconnection should be set at OFF
2, 9	Motor Temp Sensor Fault	1. The temperature sensor of motor is improperly connected. 2. If without use of electrothermic regulator, the temperature compensation and temperature disconnection should be set at OFF 3. The motor temperature is out of the maximum setting value.

Code	Fault display	Possible causes
3, 1	Coil1 Driver Open/Short	1. The connected earthed load is open-or short circuited. 2. The connection terminal is contaminated. 3. The harness is damaged or the connection is wrong.
	Main Open/Short	1. The coil of master contactor is open or short circuited. 2. The connection terminal is contaminated. 3. The harness is damaged or the connection is wrong.
3, 2	Coil2 Open/Short Driver	1. The connected earthed load is open-or short circuited. 2. The connection terminal is contaminated. 3. The harness is damaged or the connection is wrong.
	EM Brake Open/Short	1. Earthed load open or short circuit. 2. The connection terminal is contaminated. 3. The harness is damaged or the connection is wrong.
3, 3	Coil 3Open/Short Driver	1. Earthed load open or short circuit. 2. The connection terminal is contaminated. 3. The harness is damaged or the connection is wrong.
3, 4	Coil 4 Open/Short Driver	1. Earthed load open or short circuit. 2. The connection terminal is contaminated. 3. The harness is damaged or the connection is wrong.
3, 5	PD Open/Short	1. Earthed load open or short circuit. 2. The connection terminal is contaminated. 3. The harness is damaged or the connection is wrong.
3, 6	Encoder Fault	1. Moor encoder fault. 2. The harness is damaged or the connection is wrong. 3. Check the motor monitor menu: Motor RPM
3.7	Motor Open	1. The wires U, V, and W of motor are open-circuited. 2. Cable damage or connection error.
3, 8	Main Contactor Welded	1. The contact of master contactor is bonded. 2. The connecting wire U of motor is in poor contact or open-circuited. 3. An alternating voltage path (as an external preliminary charging resistor) provides the capacitor bank (B + end) with the current.
3, 9	Main Contactor Did Not Close	1. The master contactor is unclosed. 2. The master contactor is burn or in poor contact. 3. The external loading at the capacitor bank (B + terminal) prevents the capacitor bank from charging. 4. B + fuse blown.
4, 1	Throttle Wiper High	1. The voltage at the sliding end of accelerator is too high. 2. Check the accelerator input of monitoring menu.
4, 2	Throttle Wiper Low	1. The voltage at the sliding end of accelerator is too low. 2. Check the accelerator input of monitoring menu.
4, 3	Brake Wiper High	1. The sliding end of brake potentiometer is under high voltage. 2. Check the input of the brake potentiometer of monitoring menu.
4, 4	Brake Wiper Low	1. The voltage at the sliding end of brake potentiometer is too low. 2. Check the input of the brake potentiometer of monitoring menu.
4, 5	Pot Low Overcurrent	a) The resistance value at the low end of potentiometer connected to the potentiometer combination is too low. b) Check the low-end output of monitoring menu potentiometer.

Code	Fault display	Possible causes
4, 6	EEPROM Failure	1. The write-in EEPROM memory is failed. EEPROM memory reads in through VCL, CAN bus, the adjustment of 1311 parameters or new SW loading to the controller, which will be possible causes of fault.
4, 7	HPD/Sequencing Fault	1. The input of key switch, interlocking, direction and accelerator is in wrong sequence. 2. The input wires of key switch, interlocking, direction and accelerator are badly connected or the switch has a fault. 3. Check the input page of programmer monitoring menu.
4, 8	Emer Rev HPD	1. The emergency reverse operation is terminated, but the accelerator, forward and rearward input and interlocking switch failed to reset to the N-position.
4, 9	Parameter Change Fault	1. 1.The safety fault is caused due to the change in some of 1311 parameter setting which can be eliminated through turning on the power supply switch again. E.g., if users modified the type of accelerator, such errors will come out. The vehicle can be operated only after the power supply switch is turned on again.
5, 1-6, 7	OEM Faults	1. These faults belong to the class OEM and can be visualized only through the programmer of higher class.
6, 8	VCL Runtime Error	2. The VCL code run time is wrong. 3. See 1311- Controller monitor menu: VCL error module and VCL error. This type of fault can be compared to the error codes as defined in detail in the VCL module ID at run time and the file of OS system information.
6, 9	External Supply Out of Range	1. The current produced by any external loading connecting to either 5V or 12V is too high or too low. 2. The external max. and min. inputs of parameters in the fault checking menu are incorrectly adjusted. 3. See 1311 input test menu: external input current.
7, 1	OS General	1. Internal controller fault.
7, 2	PDO Timeout	1. The receipt time for the CAN PDO communication exceeds the PDO time-out interval.
7, 3	Stall Detect	1. The motor stops running. 2. Moor encoder fault. 3. The harness is damaged or the connection is wrong. 4. Problems come up with the supply of encoder power. 5. See1311-Electric motor monitor menu: motor RPM.
8, 7	Motor Characterization Fault	1. The motor in the description of motor is in wrong characterization.
8, 8	Encoder Characterization Fault	1. The encoder in the description of Encoder is wrong. 2. The pulse frequency of motor encoder is not a standard value (32, 48, 64, 80ppr)
8, 9	Motor Type Fault	1. The parameter value of motor model is out of the range.
9, 2	EM Brake Failed to Set	1. The vehicle continues to run after the braking signal has been given. 2. The electromagnetic brake cannot lock up the running motor.
9, 3	Limited Operating Strategy (LOS)	1. Regardless of the Encoder fault (code 36) or stalling detecting fault (code73), the result is that the control mode of limit operation is activated. 2. Moor encoder fault. 3. The harness is damaged or the connection is wrong. 4. Vehicle stalls
9, 4	Emer Rev Timeout	a. The emergency inversing stops working in activated state because of the overtime: b. Connection of emergency reversing signal

4.6.4.5 Use and maintenance

1. Because the working temperature designed for the electronic control assembly is within the range of -40°C ~ $+ 50^{\circ}\text{C}$, so it is inappropriate for the vehicles using the electronic control assembly to work beyond the range of ambient temperature (especially at high temperature). When this scope is exceeded, the warming up more than half an hour is necessary at the low temperature. At the high temperature, it should be noted that an inspection is taken after working about 1 hour, i.e. it should be checked that the temperature of radiation plate should not be over 85°C , otherwise, the electronic control device will be protected against the overheat.
2. It is necessary to check often the connection terminal and the touch-point of contactor etc., and clean dust and greasy dirt etc., to ensure the reliable contact.
3. Regularly check all mounting points, electric junction points and the reliability of fastens. Check the arc burns at each touch point of contactor. When the contact is seriously burn, it should be replaced in time.
4. Please charge timely the battery once the battery power reaches the second counted backward from the left so as to avoid over-discharge and shorten the service life of battery.
5. When the wear parts like the contactor need to be replaced, the original specification and model should be applied. If it is necessary to use the replacements, the agreement should be granted by the professional maintenance personnel or our company technical personnel.
6. When the controller or instrument works improperly, please get contact in time with our company or our authorized service shop for maintenance.

V. Common fault analysis and possessing method of forklift

5.1 Drive system

Problems	Possible causes	troubleshooting
The gear is too noisy in driving	1. The gear clearance is too large	Adjustment
	2. The gear are worn	Replace
	3. Short of oil in the gearbox	Check the refueling
The driving reversing has strong rushing sound	1. The gear clearance is too large	Adjustment
	2. The gear are worn	Replace

5.2 Steering system

fault	Analysis of causes	Troubleshooting
The steering wheel does not work	The oil pump damaged or fault occurred.	Replace
	The rubber hose or connector is damaged or the pipeline is clogged.	Replace or clean
Weight of steering wheel	Too low pressure of safety valve	Adjust the pressure
	Air exists in the oil line	Exhaust the air
Weight of steering wheel	The reset of steering gear doesn't work and the locating leaf spring is broken or weak in elasticity	Replace the leaf spring
	Excessive inner leakage of steering cylinder	Check the piston sealing
High noise	Low level in the oil tank	Refueling
	The suction pipe or oil filter is clogged	Clean or replace it
Oil leakage	The guide sleeve sealing of steering cylinder, the pipeline or connector is damaged.	Replace

5.3 Brake system

Poor braking	1. The brake system has oil leakage	Inspect and repair
	2. Air exists in the pipeline	Exhaust
	3. The clearance between the brake shoe plates is not well adjusted	Adjustment
	4. Over-heated brake	Inspect and repair
	5. The brake pedal is not properly adjusted	Adjustment
The brake is noisy	1. The surface of worn location is hardened with foreign matter.	Repair or replace it
	2. The baseboard is deflected or the bolt is loose	Repair or replace it
	3. The brake shoe is deflected or incorrectly mounted	Repair or replace it
	4. Worn friction plate	Replace
	5. The wheel bearing is loose	Inspect and repair
Poor effect of hand brake	1. The steel cable is uneven in length	Adjust or replace
	2. The handle is adjusted improperly	Adjustment

5.4 Hydraulic system

No or less oil in system	1. The pipeline or connector has air leakage	Inspect and repair
	2. Lower level in the oil tank	Check the refueling
	3. Too much impurity in oil and the oil filter clogged	Change oil
	4. Excessive wear of gear pump	Replace
	5. The seal ring in the gear pump is damaged.	Check and replace
Weak lifting force or unable to lift	1. Excessive wear of gear pump	Replace
	2. Insufficient system pressure	Adjust the safety valve pressure
	3. The multi-way valve and valve rod are worn	Replace or renew valve rod
	4. The lifting cylinder leaks inside	Replace the seal ring
	5. The safety valve doesn't reset.	Inspect and repair

5.5. Electric System

No voltage when the key switch is turned on.	1. The key switch is in poor contact.	Replace
	2. Disconnection	Reconnection
	3. The connector is in poor contact	Replace or repair
	4. The connector of battery is loose	Tighten the connecting bolt.
When the acceleration pedal is depressed, the forklift doesn't move.	1. Disconnection	Reconnection
	2. The connector is in poor contact	Replace or repair
	3. The direction switch is in poor contact.	Replace or repair
	4. The speeder has a fault	Check or replace
The lifting motor doesn't run	1. The speeder has a fault	Replace the contactor
	2. The lifting switch doesn't work properly.	Check or replace
	3. Disconnection	Reconnection
	4. The connector is in poor contact.	Replace or repair
The lifting motor permanently rotates	1. The lifting switch doesn't work properly.	Repair
The lighting lamp doesn't work properly	1. The fuse is burn out	Replace
	2. The connector is in poor contact.	Replace or repair
	3. The bulb is damaged	Replace
The horn doesn't sound	1. The connector is in poor contact.	Replace or repair
	2. The horn switch is in poor contact.	Repair
	3. Horn ring	Replace
The horn keeps buzzing	1. The horn switch is in constant connection.	Repair

VI. Maintenance of FE triple pivot battery forklift

When a forklift is brought into use, cares must be given to the operation. Adjustment, maintenance and service should be done in time so as to keep the forklift constantly in good working condition. The following measures should be taken for this purpose.

6.1 For a new forklift, the gear oil in the differential and reduction gear should be replaced at the 100th working hour and retighten all fasteners.

6.2 The clearance between the drive and driven gear in reduction gear should be adjusted again after operated for the 200th hour.

6.3 The maintenance of motor, electronic control and battery pack should be done respectively according to the provisions in their instructions.

6.4 All connectors should be checked once every month.

6.5 Waterproof measures should be taken for the forklift. Rinsing with the hydraulic giant should be avoided. Outdoor use in rain day should be avoided.

6.6 For the lifting motor switch, dirt on the photoelectric coupler should be often cleaned.

6.7 The surface of battery should be kept clean and dry and dirt should be often removed.

6.8 After normal use, the forklift should be subject of regular maintenance according to the following table.

S/N	Item	Content of maintenance	Maintenance cycle	Remark
1	Steering wheel bearing	Replace the grease	1000 hours	
2	Drive wheel bearing	Replace the grease	1000 hours	
3.	Steering linkage	Replace the grease	1000 hours	
4.	Each moving point is braked with the hand brake	Add grease	200 hours	
5	Foot brake hinge pin	Add grease	200 hours	
6	Drive axle	Replace the gear oil	2400 hours	
7	Brake oil	Add	Anytime	
8	Hinge pin of tilt cylinder	Super grease	400 hours	
9	Kingpin of steering knuckle	Replace the grease	1000 hours	
10	Hydraulic oil tank and strainer	Cleaning	1000 hours	
11	Hydraulic oil	Replace	1000 hours	
12	Lifting chain	Replace	3000 hours	Replace whenever the damage is detected
13	HP rubber hose	Replace	3000 hours	Replace whenever the damage is detected
14	Motor switch	Clean dirt from the optical coupler	200 hours	
15	Traveling motor carbon brush (DC)	Inspection	1000 hours	
16	Hoisting motor carbon brush (DC)	Inspection	1000 hours	