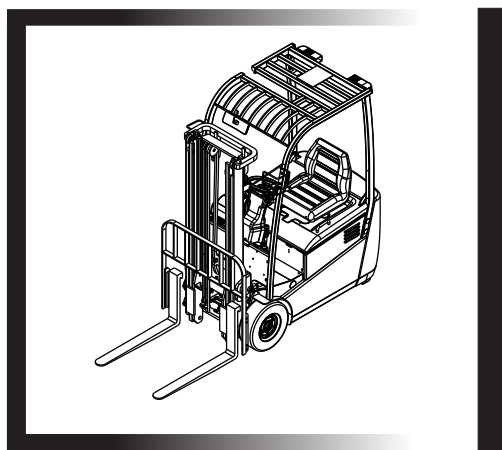




OPERATION & SERVICE MANUAL



Three-wheel battery forklift
truck with rear drive axle

HELI

安徽合力股份有限公司

ANHUI HELI CO., LTD.

OPERATION & SERVICE MANUAL

Three-wheel battery forklift truck with rear drive axle

FORWARD

Three-wheel battery forklift trucks with rear drive axle are the new offering of HELI to meet the needs of market. They are environment friendly products. They are applied to handle and stack goods in stations, ports, logistics transportation enterprises, machinery manufacturing enterprises, food processing enterprises, military enterprises and so on, with some attachments fitted, they can be applied in more working condition. With the small turning radius and narrow right-angle stacking aisle, these trucks are suitable for small space and warehouse working environment.

These trucks feature a wide-visible lift system, full hydraulic-powered steering unit, oil-cooled wet-disc brake, rear drive axle, stepless speed regulation accelerator, AC drive and pump motor, AC control system, CAN bus communication, so they have a lot of advantages such as good performance, wide visibility of operator, flexible steering, reliable braking, high drive efficiency, low energy consumption, etc.

This manual states the trucks' specifications, main assemblies' constructions and working principles, operation, maintenance service so as to help operators to use the trucks correctly and attain the highest functions. It is necessary to read over the manual before they operate the trucks.

Because of the place constraint, the pictures and diagrams are not real scale in this manual, so we can't get the parts' real size and weight from them. These diagrams aim to point out the correct operation methods of the parts.

This manual content might not correspond with the actual condition because of the improving of our products. Our products are subject to improvements and changes without notice.

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1. Safety Instructions of Operation and Driving

1.1 Drivers and equipment keepers should keep “safety first” in mind and operate according to the operation and service manual.

1.2 Transporting

Pay attention to the following instructions before transporting the forklift with containers or trucks.

1.2.1 Make the mast be vertical, place the forks on the floor, turn off the key switch, press the red emergency button, pull out the plug from the battery set ,place all operating levers in neutral position and pull the parking brake.

1.2.2 Hang up the forklift according to the plate or get into or out the truck directly by platform.

1.2.3 Fix the overhead guard and mast with wire and wedge wheels securely when delivering the forklift.

1.3 Storage

1.3.1 Lower the forks to the floor.

1.3.2 Turn off the key switch, press the red emergency switch, pull out the plug from the battery set, and place all operating levers in neutral position.

1.3.3 Pull the parking brake.

1.3.4 Put up the wheels and recharge the battery once every month when the forklift is lying for a long time.

1.4 Preparations before start

1.4.1 Read the manual carefully to get familiar with the instruments, operating levers (Fig.1-1), construction and functions of the forklift before driving. The drivers must have license.

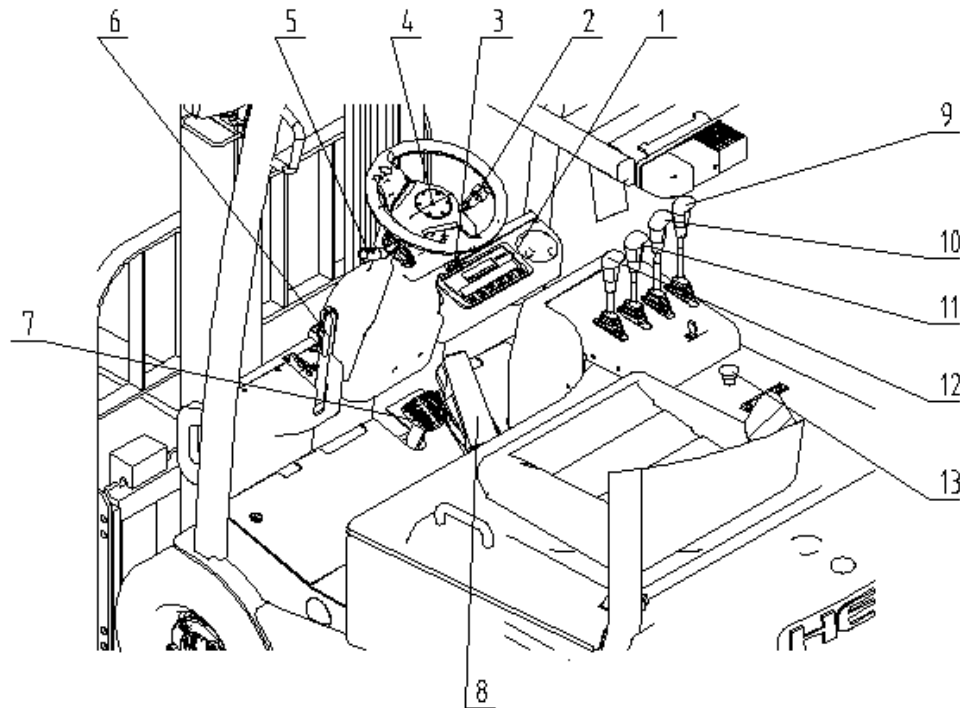


Fig. 1-1 Arrangement of the operation levers

1.liquid crystal display 2.lighting and turn signal switch 3.key switch

4.steering hand-wheel and horn 5. forward and backward switch

6.parking brake lever 7.brake pedal 8.accelerator pedal

9.the forth operation lever 10.the third operation lever

11.tilting operation lever 12.lifting operation lever 13.emergency switch

1.4.2 Check all instruments for normal functions.

1.4.3 Check all wheels whether have cracks or deformation.

1.4.4 Check all operating levers and pedals.

1.4.5 Check the battery of output voltage, specific gravity and state of battery capacity.

1.4.6 Check all connectors and plugs in the electric system for reliable contact and accelerator pedal for effectiveness and flexibility.

1.4.7 Check hydraulic oil, electrolyte and brake fluid for leakage.

1.4.8 Check main fixing parts for tightness.

1.4.9 Check the mast for lifting, lowering, forward and backward tilting and the truck for steering and braking.

1.5 Precaution during driving

1.5.1 Grasp the handle on the left side of the forklift when getting on the forklift. Do not grasp the hand wheel.

1.5.2 Pay attention to the state of mechanical, hydraulic, electrical system and MOSFET speed adjuster.

1.5.3 Pull the plug into the battery plug, pull up the emergency switch, turn on the key switch, set the direction to the desired position, depress the accelerator pedal gradually and keep suitable acceleration speed.

1.5.4 Read the electric quantity on the instrument and charge the battery or change a full one when the capacity of the battery is less than one LED.

1.5.5 Do not over load, insert the forks to pallet correctly and do not hand off-center loads.

1.5.6 Starting, steering, driving, braking and stopping should go well. Slow down when steering.

1.5.7 Do not stand under the fork and on the fork when lifting the fork.

1.5.8 Do not operate the lever or attachment out of the seat.

1.5.9 Once the mast is tilted backward or forward to respective terminal position or the fork reach the highest position, the tilt lever or lift lever should return to respective neutral position.

1.5.10 When the forklift travels with loads, place the load as low as possible and tilt back the mast. Do not drive or steer with fork lifting up.

1.5.11 Be careful of the passersby, obstacles and rough road when driving. And make sure there is enough clearance between the mast and the entrance.

1.5.12 Do not brake suddenly when driving with load.

1.5.13 Before leaving the forklift truck, lower the fork fully, place levers in neutral position, turn off the battery and pull the parking brake.

1.5.14 Do not adjust the pressure of control valve which has been adjusted well in our

company.

1.5.15 Check the chain regularly.

1.5.16 According to the measurement method specified in JB/T3300, the maximize noise at the outboard of the forklift should be no more than 80dB(A).

1.6 Charging

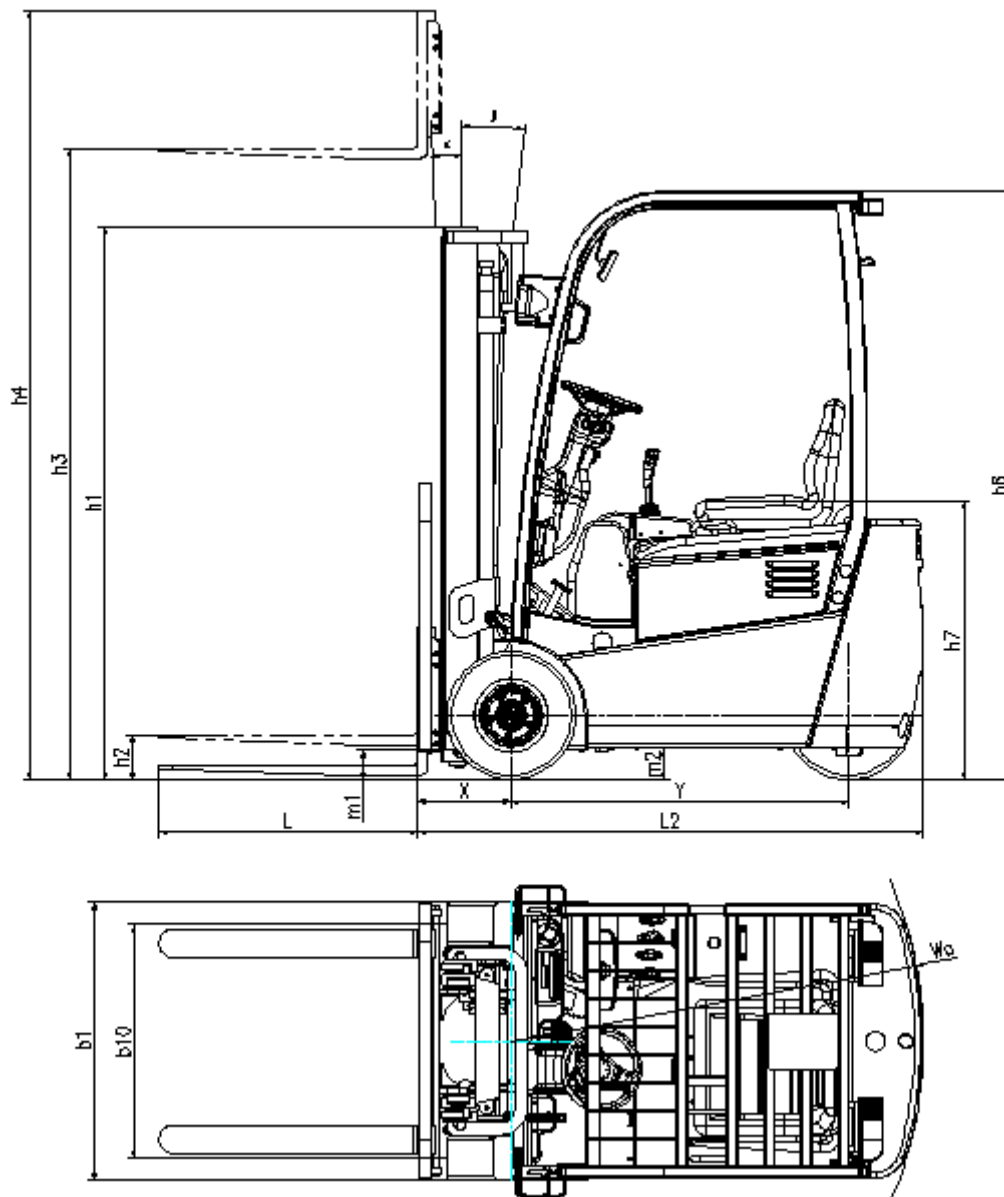
1.6.1 Obey the stipulations strictly in operation instruction for battery when first charging or recharging.

1.6.2 If the output voltage of the battery is reduced to 20.5V or the voltage of anyone lower than 1.7V or the instrument alarms, the truck should stop working immediately until the battery is replaced or charged.

1.6.3 Check the specific gravity, liquid level and temperature of the electrolyte when charging.

1.6.4 Charge the battery as soon as possible (in 24 hours) after working. Do not undercharge or overcharge in case of damage to the battery.

2. External view of the Forklift Truck



3. Specification

Model		CPD15SH-GA1/ 2/3	CPD15SH-GB1/2/3	CPD13SH-GB1/2/3
Load Capacity	Kg	1500	1500	1250
Load Center	mm	500	500	500
Standard Mast Lift Height	mm	3000	3000	3000
Mast Tilt Angle (Front/Rear)	deg	3/6	3/6	3/6
Height with fork to the ground (Mast Vertical)	mm	1975	1975	1975
Free Lift Height	mm	110	110	110
Height with Mast Extended (with Backrest)	mm	4008	4008	4008
Load Distance	mm	330	330	330
Wheelbase	mm	1200	1200	1146
Turning Radius	mm	1467	1467	1413
Overhead Guard Height	mm	2080	2080	2080
Seat Height	mm	980	980	980
Ground Clearance at Centre of Wheelbase	mm	100	100	100
Ground Clearance at Mast	mm	90	90	90
Fork Size	mm	35×100×920	35×100×920	35×100×920
Length to Fork Face	mm	1797	1797	1743
Overall Width	mm	990	990	990
Tread (Front/Rear)	mm	838/-	838/-	838/-
Tyre Size (Front/Rear)		18×7-8/18×7-8	18×7-8/18×7-8	18×7-8/18×7-8
Drive Motor Rating	Kw	4.23	5	5
Pump Motor Rating	Kw	6.3	6.3	6.3
Battery Voltage/Rated Capacity	V/Ah	24/720	24/720	24/630
Battery Weight (with Battery Box)	Kg	660	660	565
Battery Box Size	mm	830×489×627	830×489×627	830×435×627
Drive Motor Control Method		Mosfet-AC	Mosfet-AC	Mosfet-AC
Pump Motor Control Method		Mosfet-AC	Mosfet-AC	Mosfet-AC
Service Weight (with Battery)	Kg	2897	2897	2684

Size and weight of main assemblies

Model		Unit	CPD15SH-GA1/ 2/3	CPD13SH-GB1/2/ 3
Specification				
Counterbalance	Size	mm	450×974×873	396×974×873
	Weight	kg	837	734
Overhead Guard	Size	mm	1278×974×1579	1278×974×1579
	Weight	kg	60.6	60.6
Mast (Lifting Height 3000mm)	Size	mm	295×940×1885	295×940×1885
	Weight	kg	500	500

4. Drive equipment

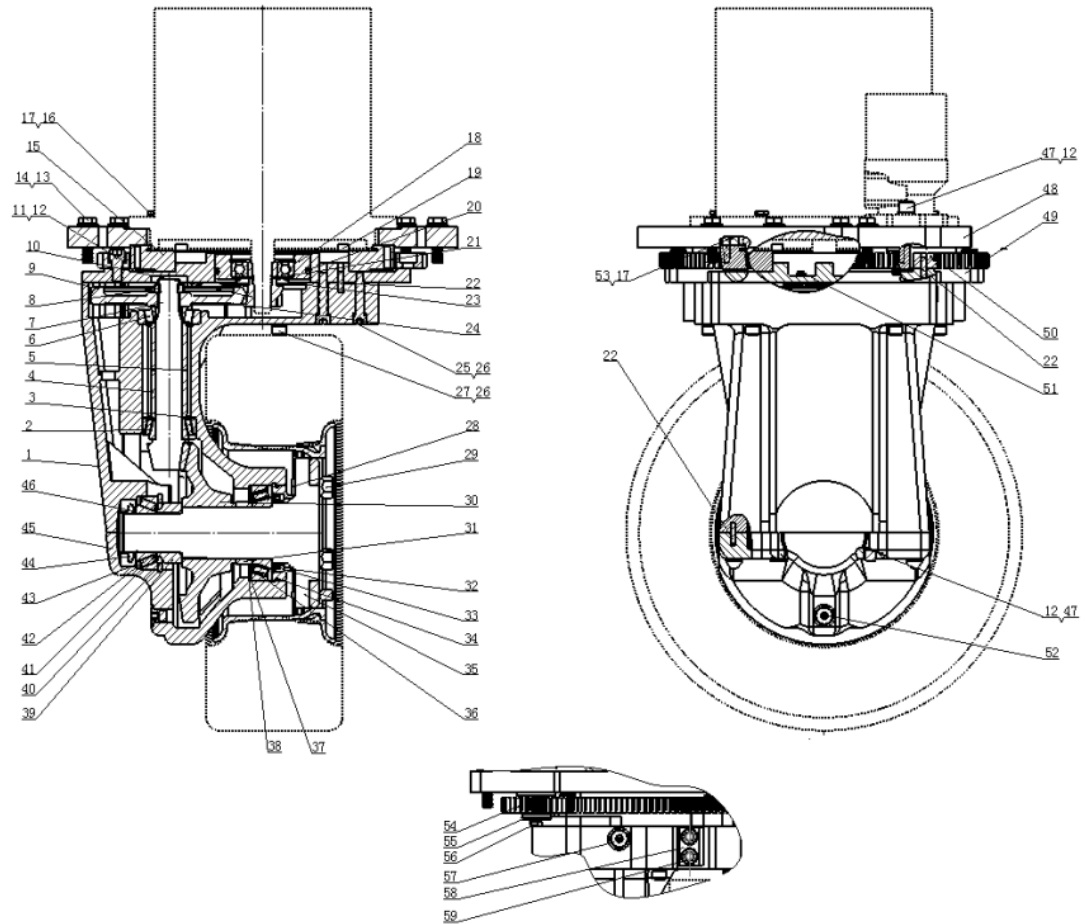
4.1 Drive equipment (standard type, for GA model)

4.1.1 Drive equipment brief description

The drive equipment mainly is mechanical reducer box. Refer to the table 4-1 for its main specifications and figure 4-1 for drive equipment assembly. The working principle is that: the output shaft of the motor is connected with the small gear (part 10) through spline. Snap ring is used to fix them. The first-stage speed reducing is achieved through the mesh-type transmission of the small gear (part 10) and large gear (part 9), and then second-stage speed reducing is achieved through the mesh-type transmission of the input shaft (part 7) and bevel gear (part 30). Then power is transmitted to the drive shaft (part 35), thus the drive wheel will rotate. Steering of the whole drive equipment is achieved by the gear drive turned by the hydraulic motor. The steering ratio is 5.

Table 4-1. specifications of the mechanical transmission box

Item	Item
Type	Stepless speed
Ratio(forward gear)	25.23
Ratio(reverse gear)	25.23
Drive wheel (diameter×width)	φ457×157
Type of oil	80W/90GL-5
Gross weight (no include motor and drive wheel)	103Kg



1.case base	2.roller bearing	3.shim	4.spacer
5.shim	6.roller bearing	7. shaft	8.locking nut
9. large gear	10. small gear	11.screw	12.washer
13.bolt	14.washer	15.bearing support	16.bolt
17.washer	18.roller	19.bolt	20.O-ring
21.shim	22.pin	23.oil seal	24.snap ring
25.screw	26.washer	27.screw	28.bolt
29. nut	30. bevel gear	31.spacer	32.bracket
33.oil seal	34.O-ring	35.Drive shaft	36.roller bearing
37.snap ring	38.shim	39.spacer	40.snap ring
41.shim	42.roller bearing	43.oil seal	44.locking nut
45.case cover	46.shim	47.screw	48.joint plate
49.coupling chassis	50.gear	51.breather	52.plug
53.screw	54.gear	55.shim	56.bolt
57.plug	58.stopper	59.bolt	

Fig4-1.The structure of drive equipment

4.1.2 Drive wheel demounting method

- 1) Block up frame after sling counter weight and stop the front with padding

block;

- 2) Turn the steering hand wheel and make the fixing side of the drive wheel nut (part 29) face outside;
- 3) Remove all nuts (part 29 in fig4-1) from the wheel
- 4) Take out the drive wheel

4.1.3 Drive wheel installation

- 1) Fix the drive wheel and make the hole of the wheel fits bolt (part 28 in fig4-1) of the drive wheel.
- 2) Tighten the nuts with a torque of 140 N m
- 3) Turn the hand wheel back to make the drive wheel return to the going straight position
- 4) Remove the padding block

4.2 Drive equipment (Enhanced type, for GB model)

4.2.1 Drive equipment brief description

The drive equipment mainly is mechanical reducer box. Refer to the table 4-2 for its main specifications and figure 4-2 for drive equipment assembly. The working principle is that: the output shaft of the motor is connected with the small gear (part 34) through spline. Nut (part 35) is used to fix them. The first-stage speed reducing is achieved through the mesh-type transmission of the small gear (part 34) and large gear (part 10), and then second-stage speed reducing is achieved through the mesh-type transmission of the input shaft (part 4) and spiral bevel gear (part 47). Then power is transmitted to the drive shaft (part 46), thus the drive wheel will rotate. Steering of the whole drive equipment is achieved by the gear drive turned by the hydraulic motor. The steering ratio is 5.

Table 4-2. specifications of the mechanical transmission box

Item	Item
Type	Stepless speed
Ratio(forward gear)	25.23
Ratio(reverse gear)	25.23
Drive wheel （diameter×width）	φ457×157
Type of oil	80W/90GL-5
Gross weight （no include motor and drive wheel）	103Kg

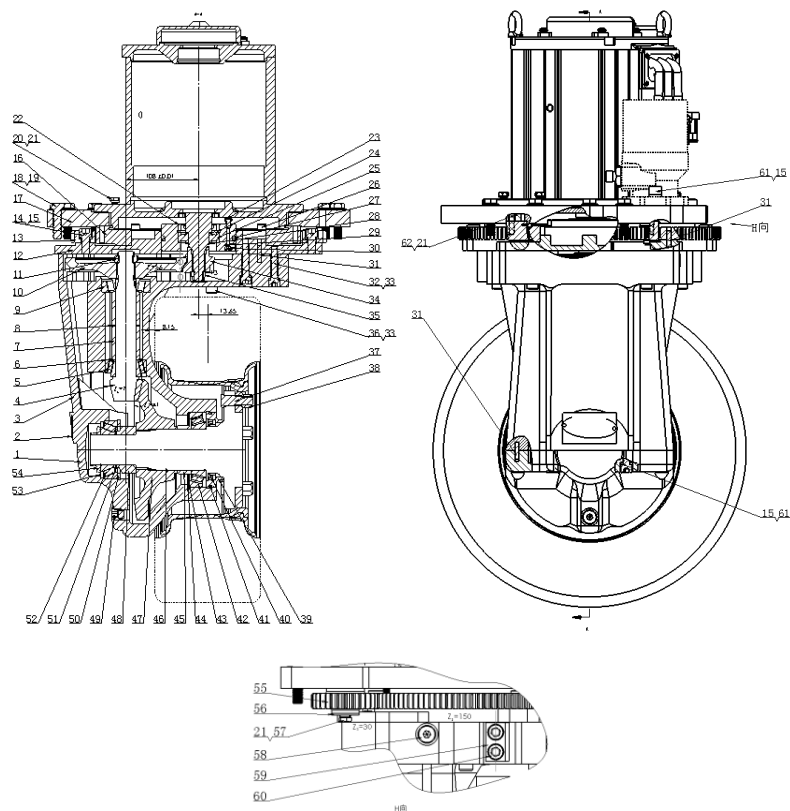


Figure 4-2 Mechanical transmission box structure

- | | | |
|-----------------------|---------------------------|----------------------|
| 1. reducer case cover | 2. transmission box plate | 3. reducer case seat |
| 4. input shaft | 5. bearing | 6. washer |
| 7. bushing | 8. washer | 9. bearing |
| 10. large gear | 11. lock nut | 12. connecting plate |
| 13. steering gear II | 14. screw | 15. washer |
| 16. slewing bearing | 17. connecting plate | 18. bolt |
| 19. washer | 20. bolt | 21. washer |
| 22. oil seal | 23. breather plug | 24. retainer ring |
| 25. bearing | 26. screw | 27. O ring |
| 28. retainer ring | 29. bearing seat | 30. plug |
| 31. pin | 32. screw | 33. washer |

34. small gear	35. nut	37. hub bolt
38. rim nut	39. oil seal holder	40. oil seal
41. O ring	42. bearing	43. retainer ring
44. retainer ring	45. spacer bush	46. drive axle
47. spiral bevel gear	48. spacer bush	49. oil draining plug
50. retainer ring	51. washer	52. bearing
53. oil retainer	54. lock nut	55. steering gear
56. cover plate	57. bolt	58. plug
59. stopper	60. screw	61. screw
62. screw		

4.2.2 Drive wheel demounting method

- 1) Block up frame after sling counter weight and stop the front with padding block;
- 2) Turn the steering hand wheel and make the fixing side of the drive wheel nut (part 38) face outside;
- 3) Remove all nuts (part 38) from the wheel
- 4) Take out the drive wheel

4.2.3 Drive wheel installation

- 1) Fix the drive wheel and make the hole of the wheel fits bolt (part 37) of the drive wheel.
- 2) Tighten the nuts with a torque of 140 N m
- 3) Turn the hand wheel back to make the drive wheel return to the going straight position
- 4) Remove the padding block

5. Front Axle

5.1.The main specifications of the front axle see table 5.1

Rated capacity Type		1-1.5T
Wet type front axle		Cast-installing
Hub reduction	type	Planetary gear type
	ratio	6
Friction discs number		4
Spacer number		3
Oil amount		300-350ml

5.2.General description

The front axle consists of output half-shaft(part31), planet carrier (part 25) planetary gear assembly (part23) ,inner gear (part24) ,sun gear (part22) , friction disc (part10) , spacer (part9) , brake sub cylinder assembly (part 16), axle housing (part1),shell cover(part19)and so on(see fig5-1,5-2).the output half-shaft(part31)is connected to planet carrier (part25) which is limited in axis position by locked nut(part26)with spline. The planet gears are riveted in the planet carrier. Ring gear (part24) is connected to the axle housing (part 1) by the bolt (part 5). There are three return springs (part21) among the press plate (part 8),sun gear(part22),and piston(part11) which are bolted together to the sun gear housing(part35). the sun gear housing (part35)is limited in axial and radial direction to the shell cover through snap ring (part18)and bearing (part22).one end of the sun gear (part22) and sun housing (part35) are locked in the shell cover(part19),and the other end is located by the bearing(part27).each end of the sun gear(part22) has involute teeth, the planet assembly (part23)engages with the ring gear (part24)for internal transmission and sun gear(part22) for external transmission. The friction discs (part10)of the wet type brake

are limited about the outside by the circumferential ring gear(part24).and the opposite direction is limited by the snap ring(part7) to the shell cover(part20).the discs clutch-inner(part9) are connected with the sun gear(part22) by the rear involute gear as one unit. The brake cylinder assembly (part16) is located to the shell cover (part19) by the pin (part17).One end of the cylinder assembly (part16) is connected to the bar (part14), and the other end is to the shell cover (part19).

Under the rear drive axle, the output half shaft rotates turned by the front wheel. The output half shaft is connected to the planet carrier through the inner spline and planet carrier is limited in the axle through lock nut. So the rotating of the planet carrier turns the output shaft rotate; and thus the plenty gears riveted on the carrier rotate. A planet system with different speeds among the planet gear assembly, inner ring and sun gear is formed. In this system, planet gear assembly and the inner ring are in inner mesh-type transmission and sun gear in outer mesh-type transmission. In that case, sun gear is driven to rotate.

Friction discs rotate driven by the sun gear if the friction disc and spacer of the wet-type brake are not pressed tightly by the piston. Friction discs are limited to the gear rings by the circumference. When the friction discs and spacers are pressed tightly by the piston, brake power is produced between the contacting faces.

The force conquers the spring(part41)force and pushes the piston (part45)of the brake cylinder assembly(part16) to move forward when the brake fluid flowed into the brake cylinder inner chamber through the high pressure steel pipe(part46).the axle housing builds up a reverse force while it pushing the bar(part43) against the shell cover(part19).the bar(part43) moves ahead and push the sliding bearing(part13) to enable the discs clutch-inner(part9) and the discs clutch-outer(part10) to be locked together. The sun gear(part22) is blocked by the force which comes from the engagement of the friction disc and the spacers. When the hydraulic system pressure is removed, the three return springs (part21) will push the piston back (part11), then

the service brake is released.

Brake cable is connected to the brake cylinder assembly (part16) through the screw hole. the brake cylinder assembly(16) revolves around the pin(part17) when pulled the brake cable. Then the head of the assembly pushes the bar (part14) moves ahead and push the sliding bearing (part13) to enable the friction discs and the spacers to be locked together. The sun gear (part22) is blocked by the force which comes from the engagement of the friction discs and spacers. When the force of the brake cable is released, .the three return springs (part21) will push the piston (part11) back, and then the parking brake is released.

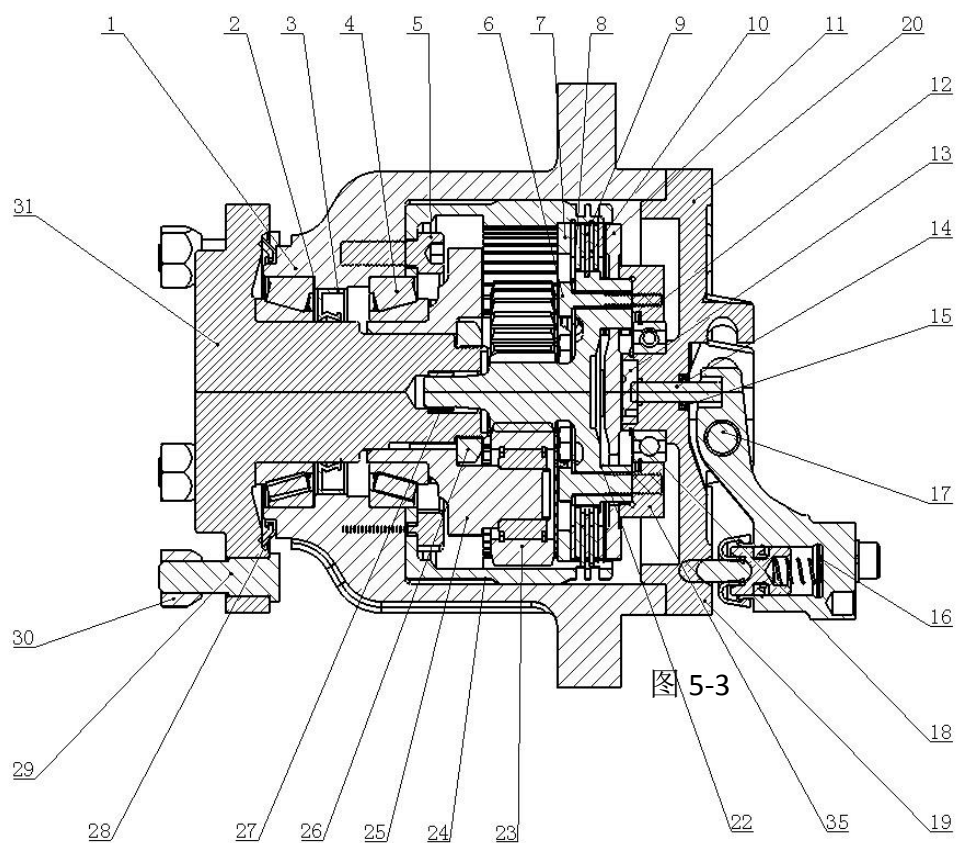


Fig 5-1 axle assembly sectional view

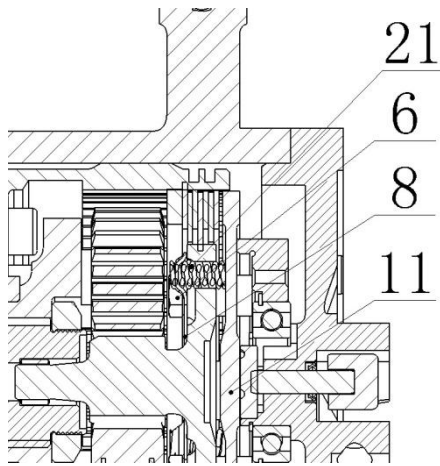


Fig 5-2 parts of axle ass'y sectional view

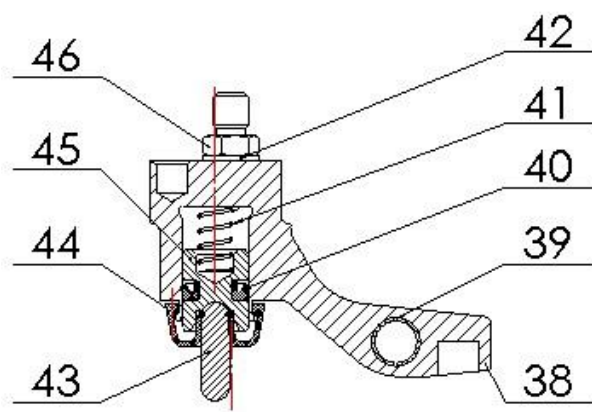


Fig 5-3 brake cylinder ass'y sectional view

1	AP613-02011	housing(right)	20	AP613-02041	Sun gear housing
2	A75B3-42221	washer	21	A75B3-42231	spring
3	A75B3-42361	Oil seal55X80X10	22	A75B3-42081	Sun gear
4	Z-32011	Bearing32011	23	A75B3-40231	Planetary assy
5	B8030-10030	screwM10x30	24	A75B3-42181	Ring gear
6	B0230-08035	boltM8x35	25	A75B3-42191	Planet carrier
7	A75B3-42131	snapping	26	B4832-00036	NutM36x1.5
8	A75B3-42141	Plate - End	27	Z-K121610	BearingK12x16x10
9	A75B3-42121	Disc Clutch-inner	28	A75B3-40251	GAMMAseals
10	A75B3-42111	Disc Clutch-outer	29	Q70B1-02031	Hub bolt
11	A75B3-42091	piston	30	Q70B1-02041	Hub nut
12	AP613-02031	Shell cover	31	A75B3-42211	Output axle
13	Z-6006NR	Bearing 6006NR	32	B3120-06030	pinB6x30
14	A75B3-42071	Sliding bearing	33	B6250-00009	snapping9
15	A75B3-42051	Push bar	34	B8030-06030	screwM6x30
16	A75B3-42391	seals8X14X4	35	22518-40151	plug1/8"
17	A75B3-42061	pin	36	B8050-14040	screwM14x40
18	B6150-00030	snapping30	37	AP613-02051	Bearing cover
19	A75B3-40221	Brake cylinder assy (left)	38	B3120-04014	pinB4x14

5.3 Trouble shooting

Fault	Causes	Remedy
Loud noise	Improper gear clearance in the first stage speed reducing	Regulate
	Worn or broken bearing in the shell cover	Replace
Oil leaks from the flange of the haft shaft	Loose lock nut of the	Regulate
Poor wet-type brake performance	Worn of the friction discs and spacers	Replace
	Damage of the master brake cylinder	Replace

5.4.Service information

Tighten torque between part.29&30 and rim	Apply GY340 adhesive , 110-130N.m
Tighten torque of part 26	480-520N.m
Roller bearing on the output half shaft must be applied with lubrication oil	Proper amount
Apply GY340 adhesive to part 6, Tighten torque	68N.m
Apply GY340 adhesive to part 6, Tighten torque	30N.m
Part 31proper resistance torque when rotating around its center after assembly	3-8N.m
Oil adding amount of the axle assembly	300-350ml
Oil adding type	Mobil ATF200

6. Brake System

6.1 General Description

The brake system consists of brake pedal mechanism, master cylinder, pipe system and oil-cooled wet-disc brake. The wet-disc brakes are installed in the front axle and the friction linings are cooled by the oil. This eliminates the damage caused by dust and foreign bodies, avoids overheating, reduces the wear of friction lining, prolongs the life time of brake, and reduces the maintenance cost.

6.1.1 Brake pedal mechanism

The structure of the brake pedal mechanism is shown in Fig. 6-1. The brake pedal mechanism is installed on the frame. As the brake pedal is pressed, the brake pedal arm pushes the piston forwards. The force applied on the pedal converts into the brake fluid pressure, at the same time, the brake fluid compress the friction lining to stop the truck.

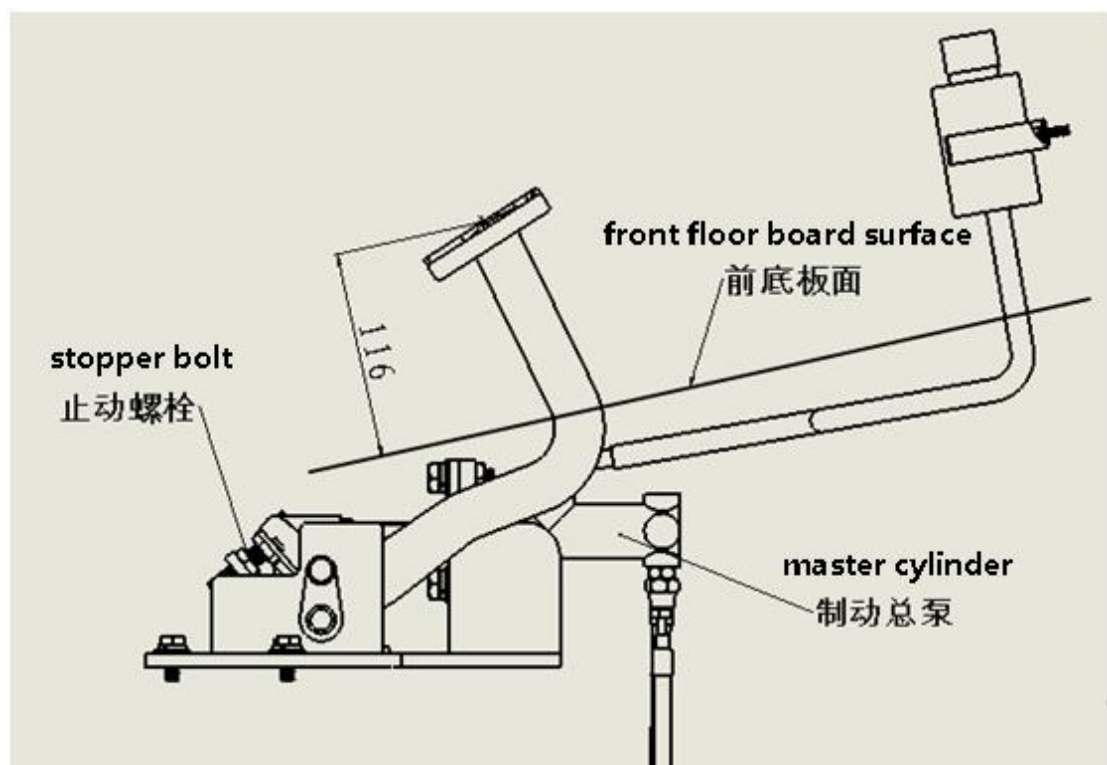


Fig. 6-1 Brake pedal mechanism

Adjustment of brake pedal

- 1) Make the push rod short
- 2) Adjust the pedal to the height shown in Fig. 6-1 with stopper bolt, tighten the locking nut
- 3) Adjust the push rod until the clearance between the push rod and master cylinder piston to 0-1mm
- 4) Tighten the push rod locking nut

6.1.2 Master cylinder

The structure of master is shown in Fig. 6-2. It contains link rod (item 1), push rod (item 2), dust cover (item 3), snap ring (item 4), secondary cup (item 5), piston (item 6), primary cup (item 7), spring (item 8), and check valve (item 9). The master cylinder is fixed on the brake support by bolt; brake pedal arm and the push rod are connected by a cylindrical pin. As the brake pedal is pressed, the push rod pushes the piston forwards. The brake fluid flow back to the reserve tank through the return port until the primary cup blocks up the return port. After the primary cup passes through the return port, the brake fluid in the cylinder is pressurized and opens the check valve, flows to the operating cylinder through the brake pipeline. Thus each operating cylinder piston is forced outwards. This compresses or impacts the disc brake to slow or stop the truck.

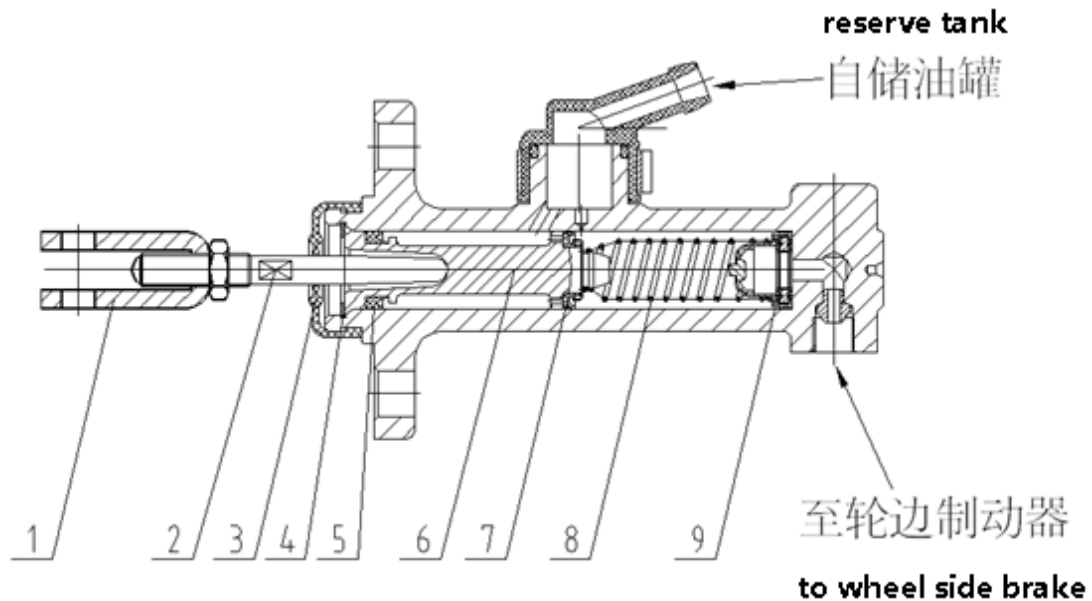


Fig. 6-2 Master Cylinder

1. Link rod 2. Push rod 3. Dust cover 4. Snap ring 5. Secondary cup
6. Piston 7. Primary cup 8. Spring 9. Check valve

As the brake pedal is released, the piston is forced back by the return spring. At the same time, the brake fluid in each operating cylinder is pressurized by the return spring, returning into the master cylinder through the check valve. With the piston in its original position, the fluid in the master cylinder flow into the reserve tank through the return port.

The brake fluid in the brake pipelines and operating cylinders has a residual pressure proportioned to the set pressure of the check valve, which makes each operating cylinder piston cup securely seated to prevent oil leakage and eliminates a possibility of air locking when the truck is sharply braked.

6.1.3 Connecting between the brake and front axle

Three connection ports are provided for connecting the brake system in front axle. Two connection ports are used to connect the hydraulic brake system and the parking brake, the other one is used to bleed the brake system (Fig.6-3).

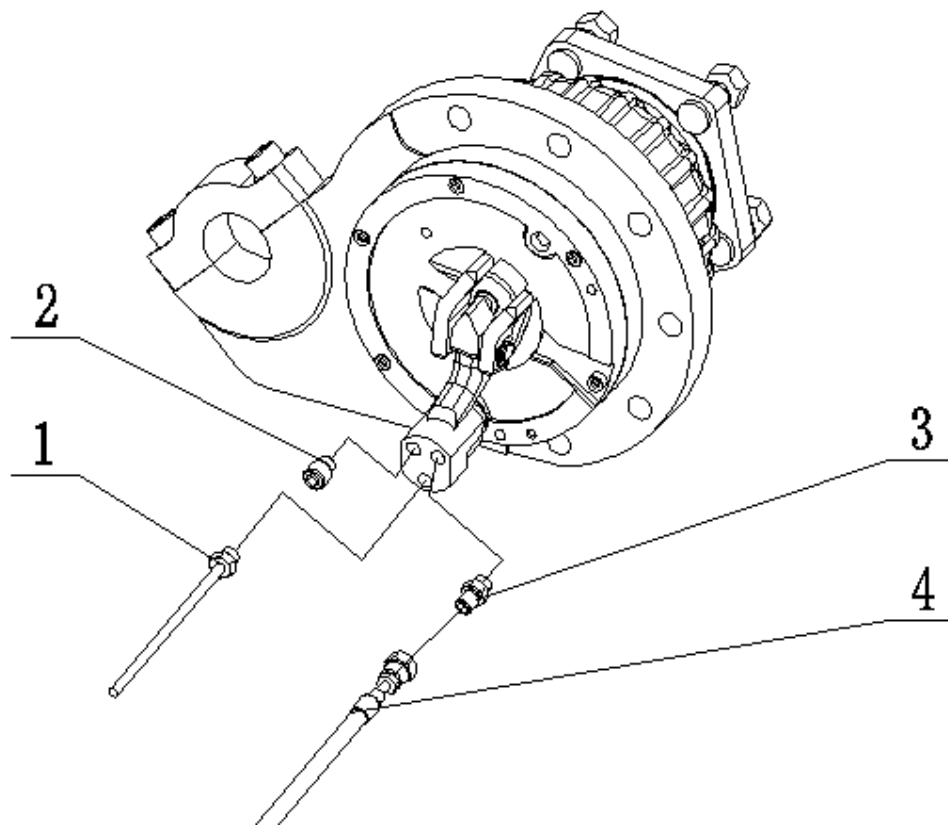


Fig.6-3 Connecting between the brake and front axle

a) Connecting of the service brake

The brake pipe joint (item 3) connects to the top right threaded hole and the brake pipe (item 4), tightening torque: 12-16 Nm. When placing the brake pipe, the bending radius should be kept as large as possible to keep the resistance against the restoring forces for lifting the brake as small as possible.

b) Connecting of the parking brake

The brake cable (item 1) connects to the bottom threaded hole, tightening torque: 50Nm. As well, when placing the brake cable, the bending radius should be kept as large as possible to keep the resistance of the brake sub cylinder after releasing the brake pedal as small as possible.

6.1.4 Bleed the Brake System

The brake system must be bled after replenishing with brake fluid. The bleeder device is shown in Fig. 6-3.

a) Tighten the bleeder valve (item 2), apply pressure by operating the brake

pedal.

- b) Loosen the bleeder valve (item 2), bleed the brake system.
- c) When brake fluid escapes without bubbles, press the brake pedal, tighten the bleeder valve, tightening torque: 50Nm.
- d) Check the braking effect

6.1.5 Parking Brake Lever

The parking brake lever is of teeth type as shown in figure 6-4. One end of the brake cable is connected to the driven arm of the parking brake lever through pin and the other end is fixed to the brake sub cylinder through the cable connector. When the parking brake knob is pulled up, the brake cable is pulled also and thus the brake sub cylinder is pulled. In that case, brake sub cylinder presses the brake disc tightly through press plate mechanism. Thus the parking brake works.

Usually, brake force is not necessary to be adjusted. Original clearance can be adjusted through adjusting the tightness of the cable by the nut, so that the brake knob can work in a reasonable range. In general the maximum brake force is 200-300N.

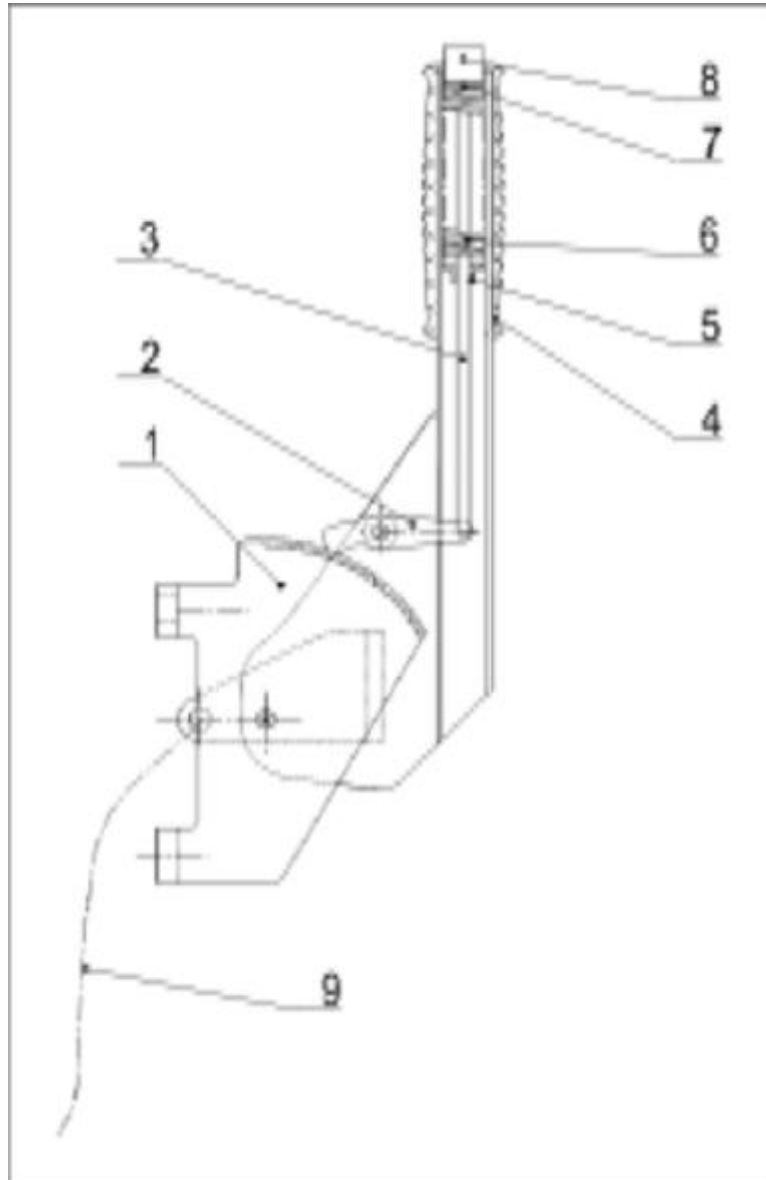


Fig. 6-4 parking btake

1.Sector gear plate 2.lock 3.rod 4.handle sets 5.pad
6.spring 7.nut 8.button 9.cable (each side has one)

6.1.6 Brake system operation

There are two independent braking systems: service brake and parking brake. Press the brake pedal and the service brake works; the parking brake knob is on the left side of the instrument panel. Pull up the brake knob and the parking brake works.

6.2 Maintenance and Adjustment of the Brake System

This chapter states the checking, maintenance and adjustment of the brake system.

6.2.1 Checking and Maintenance of the Brake System

a) Parking brake (daily check)

First check if the parking brake functions well; then check if the inching switch works when parking brake is pulled up, that is the electricity power can be disconnected.

Attention: adjust the parking brake after the truck works 150 hours, make sure the brake force is approx 100N.

b) Service brake (daily check)

Check the brake fluid level in tank first and then check if the brake pedal can return back, that is whether the spring functions.

c) Fluid leakages

In case of fluid leakages braking performance is poor and the brake pedal travel is extended thus jeopardizing the truck safety. Carefully check the braking system line and replace it if necessary. Check that fittings are tightened and, if necessary, fill up to the level marked on the tank.

d) Brake pump

When braking, if you feel that the pedal travel increases progressively up to the end of travel, replace the hydraulic gaskets inside the brake pump. If there is air inside the braking system the pedal will reach its end of travel with no braking effect. Use the braking unit cylinders to bleed the air.

e) Brake cable

When pulling the parking brake lever, if the two front wheels can't be locked at the same time, check the braking synchronicity of the two brake cable. If they are not synchronism, you can adjust them by screwing the nut at the end of brake cable

6.2.2 Adjustment of brake pedal

Adjust the brake pedal as followed:

a) Make the push rod short

- b) Adjust the pedal to height with the stopper bolt.
- c) With the brake pedal depressed by the idle stroke, pull the rod out until its front end is 1mm distant from the master cylinder piston.
- d) Tighten the push rod locking nut.

6.2.3 Adjustment of brake switch

- a) Loose the brake switch locknut, after adjusting the pedal height
- b) Pull the plug, separate the wire
- c) Adjust the clearance between the brake switch and the block of brake pedal to 1mm, tighten the locknut
- d) Make sure the stoplights are bright when depress the brake pedal.

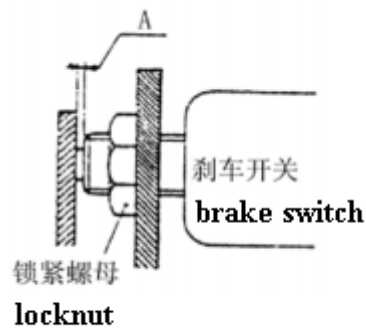


Figure 6-5 brake light

7 Steering System

7.1 General Description

The steering system consists of steering hand-wheel, steering column, steering shaft, powered steering unit with load sensing, priority valve and steering motor assembly. The steering controls are installed on the instrument panel assembly (Fig. 7-1). Driver can move the steering hand-wheel to proper position by adjust the steering column tilting angle in front-rear direction. The steering shaft is installed in the steering column. Both ends of steering shaft are connected with the steering unit and steering hand-wheel. The steering motor is installed on the rear axle fixed plate. As the gear in motor meshes with the gear in steering device, hydraulic motor outputs torque steer the driving wheel.

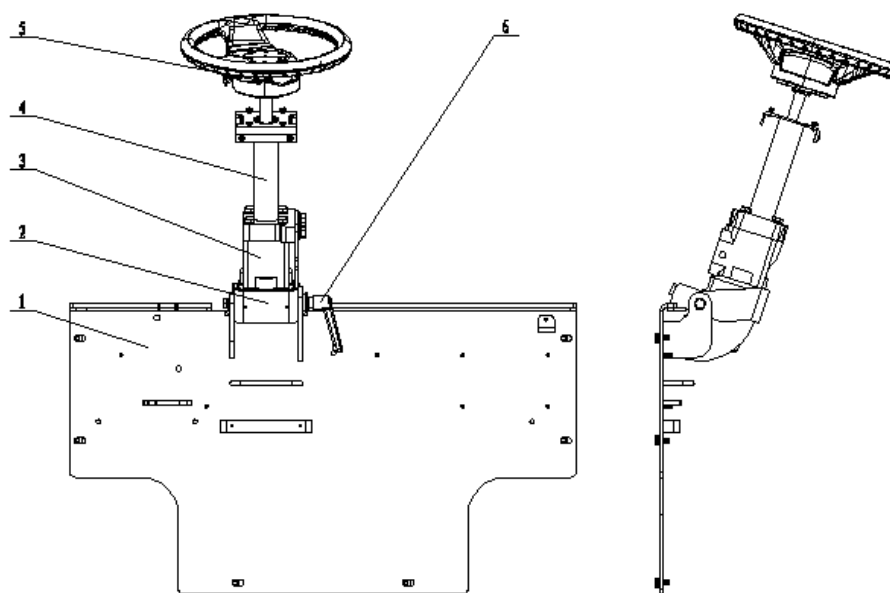


Fig. 7-1 Steering system

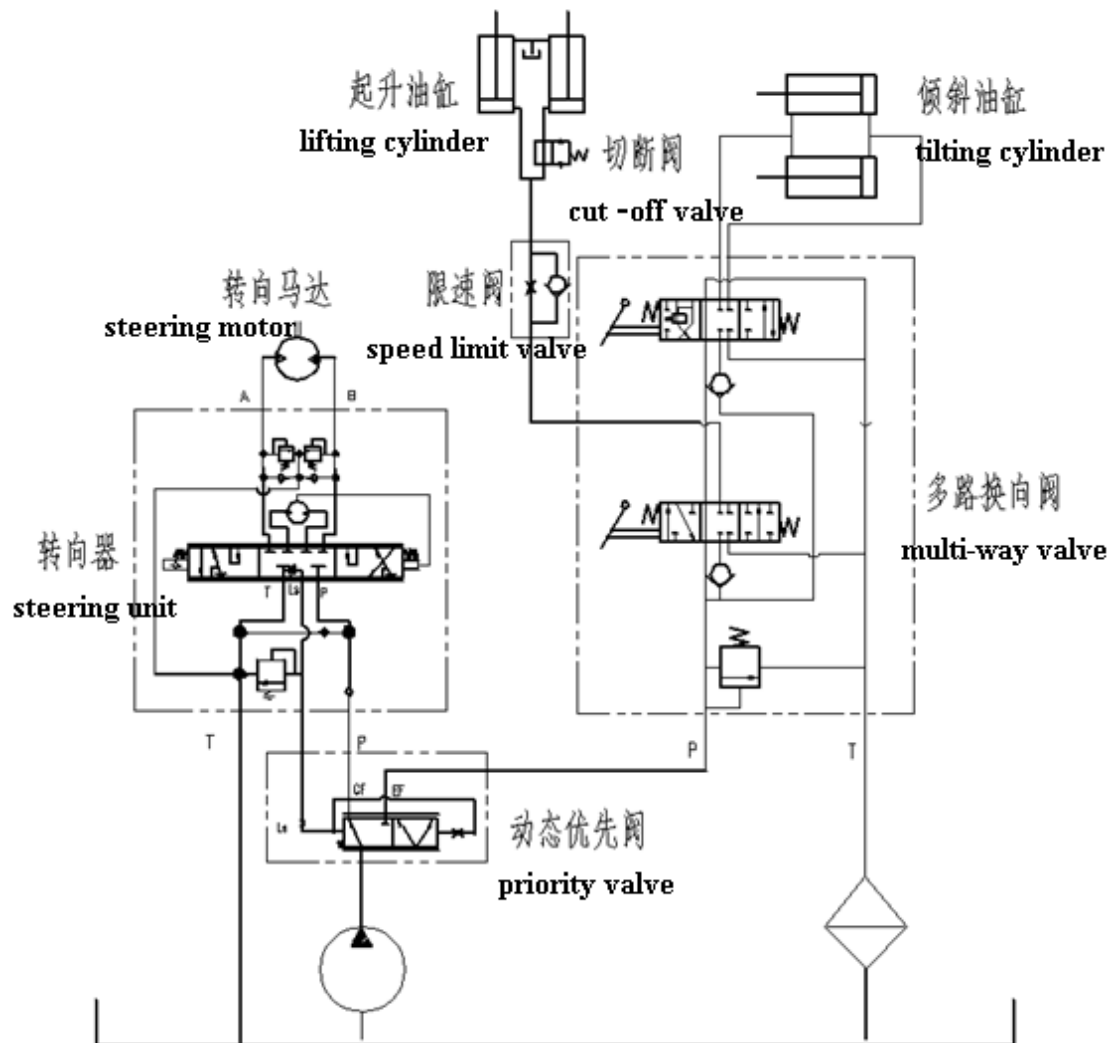
- | | |
|-----------------------------|-----------------------------|
| 1.Instrument panel assembly | 2.Mounting bracket assembly |
| 3.Steering unit assembly | 4.Steering column assembly |
| 5.Steering hand-wheel | 6.handle assembly |

● The principium of load sensing hydraulic- powered steering system

There is a pump provide oil to the steering system and lifting system in the truck. The principium of hydraulic-powered steering system is shown in Fig. 7-2. The

priority valve, steering unit and steering motor are used for steering.

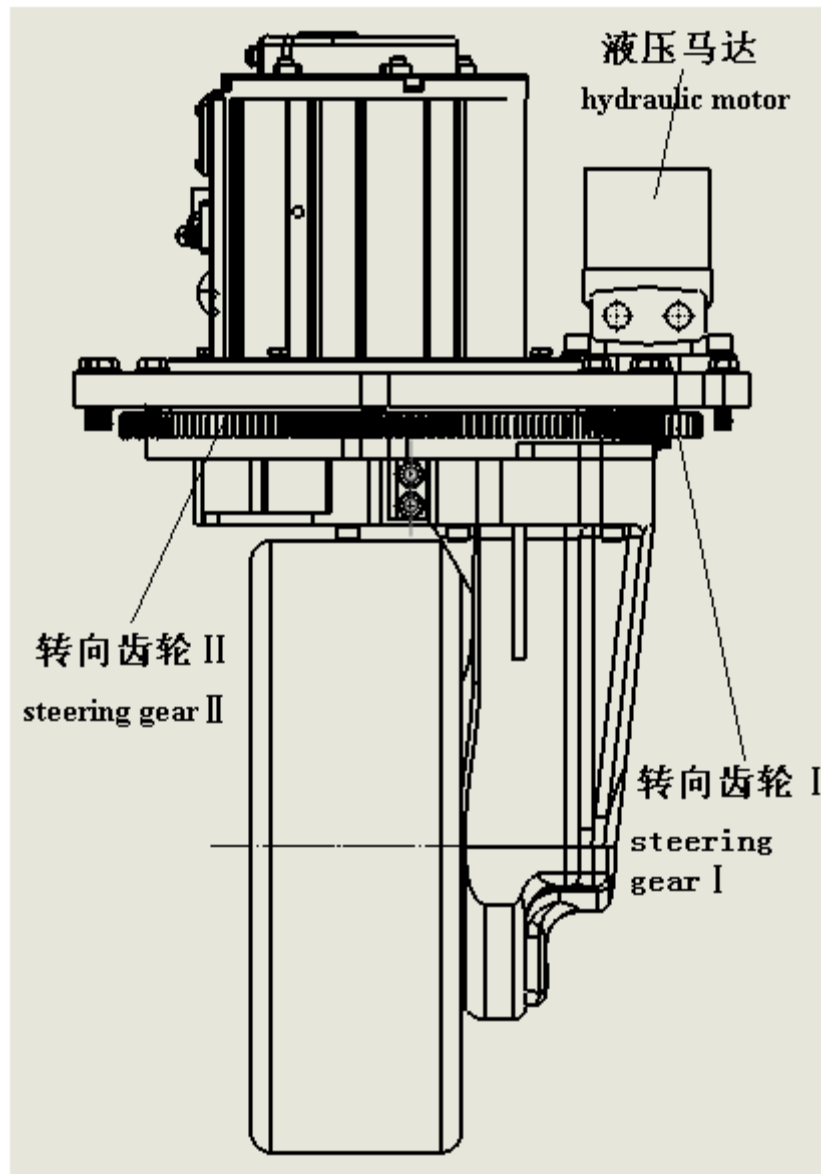
When do not turn the steering hand-wheel, the priority valve is at the equilibrium, only a little oil flow back to the tank, Most of oil flow to other circuit. When turning steering hand-wheel, the variable throttle valve port is opened and the oil pressure in steering system is changed. The oil flows to the priority valve through LS pipe, thus the flow of CF pipe is increased. This oil flow to the steering system steer the truck. After steering, priority valve return to equilibrium.



● Steering device

The steering device consists of hydraulic motor, steering gear I and steering gear II. Steering gear I is installed on the output shaft of steering motor, the steering gear II is fixed on the steering device box. When turning the forklift, the steering

gear I meshes with the steering gear II, the hydraulic motor steers the truck.



7.2 Adjustment and Maintenance

7.2.1 Installation of steering wheel

- Make sure the mounting surface of wheel shaft and wheel is clean, check the shaft and wheel whether have damage;
- Assure alignment of rim holes and hub bolts;
- Tighten the hub bolts. Tightening torque: 140Nm.

7.2.2 Check after reassembling the steering system

- Lift up the rear wheel and slowly turn the steering hand-wheel right and left

several times to exhaust air from the hydraulic pipeline and the steering cylinder;

- b) Turn the steering hand-wheel right and left, check the steering power whether is smooth;
- c) Turn the steering hand-wheel right and left, check the connection of the hydraulic pipeline whether is correct.

7.2.3 Steering system troubleshooting

Problem	Analyses of Trouble	Remedies
Fail to turn hand-wheel	Pump damaged or breaking down	Replace
	Hose or joint damaged or pipeline blocked	Replace or clean
Difficult to turn hand wheel	The pressure of relief valve is too low	Adjust the pressure of relief valve
	Air in the steering oil circuit	Exhaust the air
	Steering unit fail to recover due to spring piece damaged or elasticity insufficient	Replace the spring piece
	Oil leakage in the steering cylinder	Check the seal of piston
Truck's snacking or moving with oscillation	Spring damaged or elasticity insufficient	Replace
Excessive noise	Too low oil level in the oil tank	Refill oil
	Suction pipeline or oil filter blocked	Clean or replace
Oil leakage	Hydraulic seals, pipeline or joint damaged	Replace

Pump motor provides oil to the steering system and lifting system in the truck.

The pump motor is working in the following situations:

- a) Place the direction switch in the forward or backward position, depress the accelerator pedal;
- b) Operate the multi-way valve lever;
- c) For reducing the energy consumption and driving safety, the pump delays work after loose the accelerator pedal. In general, the delay time is approx 15 seconds.

Exhaust air: start pump motor and slowly turn the steering hand-wheel right and left several times, exhaust the air in steering system. If there are any abnormal situations in this process, we should turn off the power, find out the cause and troubleshoot

8 Electric System

Dual electric controlling system with high performance is applied in this truck. It can provide quite, efficient, smooth and safe control for the vehicle.

The electric system is formed with the control system, the display, motors, batteries, switches, lights and wiring harnesses.

8.1 Control system

8.1.1 DANAHER Control system (for CPD15SH-GA3)

DANAHER control system for this truck is combining with a traction controller, a pump controller, a contactor and a pre-charger. The controller is the core of the system; it has outstanding performance, high power efficiency and smaller volume, it also has reliable quality, integrated software configuration with highly integrated interface and reliable CAN open communication.

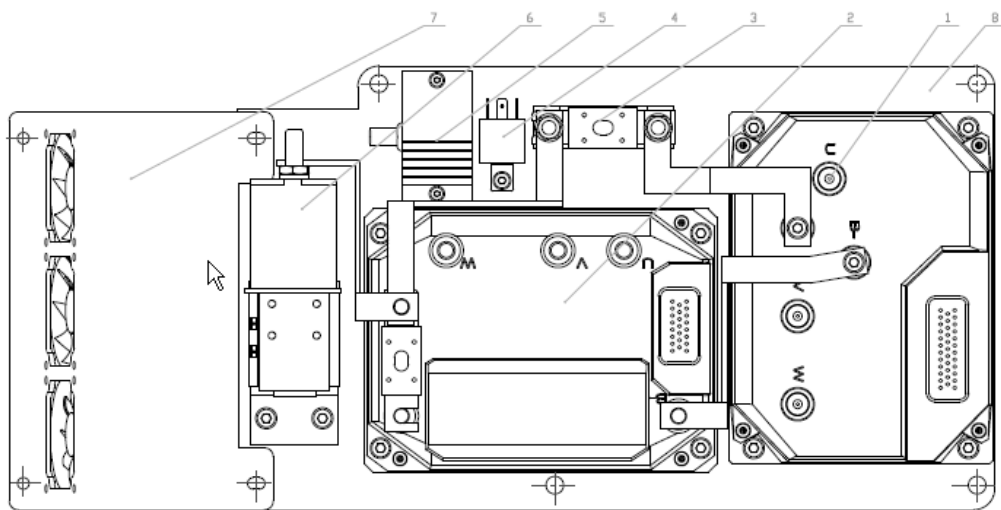


Fig. 8-1 DANAHER controller assembly

- | | |
|---------------------------------|-------------------------------------|
| 1. Pump controller(ACS24XS-35P) | 2, Traction controller (ACS24S-23p) |
| 3, Fuse | 4, Reverse Relay |
| 5, Pre-charger | 6, Contactor (SW200) |
| 7, Cooling fan | 8, Baseboard |

a) Controller

Traction Controller: ACS24S-23P 24V 500A

Pump Controller: ACS24XS-35P 24V 350A

The Kollmorgen manufactured AC super controller (ACS) is the key component for the driving and speed control of a forklift. Benefit by its state of the art AC technology with flux vector control, ACS greatly increases the performance and the operate efficiency of the vehicle, and also with it's high torque-to-inertia ratio, outstanding reliability, wide range of motor speed control, good torque and speed characteristic, regenerate braking function, CAN open interface and digital control of the microprocessor based on motor speed feedback.

Operating temperature: -30°C~40°C.

Allowable highest working temperature: 85°C.

b) Safety features of the traction controller

- 1) Battery reverse polarity protection;
- 2) Connection error protection;
- 3) Overheating protection; overload and short circuit protection;
- 4) Protection class: IP54;
- 5) Fail safe, start-up sequence protection;
- 6) Battery over discharge protection;
- 7) False start-up protection

Caution:

The quality assurance of controller will be provided by the drive manufacture, when malfunction occurs, contact the manufacture for service as soon as possible; any personnel or property damage caused by unauthorized modification or alter of the electric system by and will be undertaken by the user.

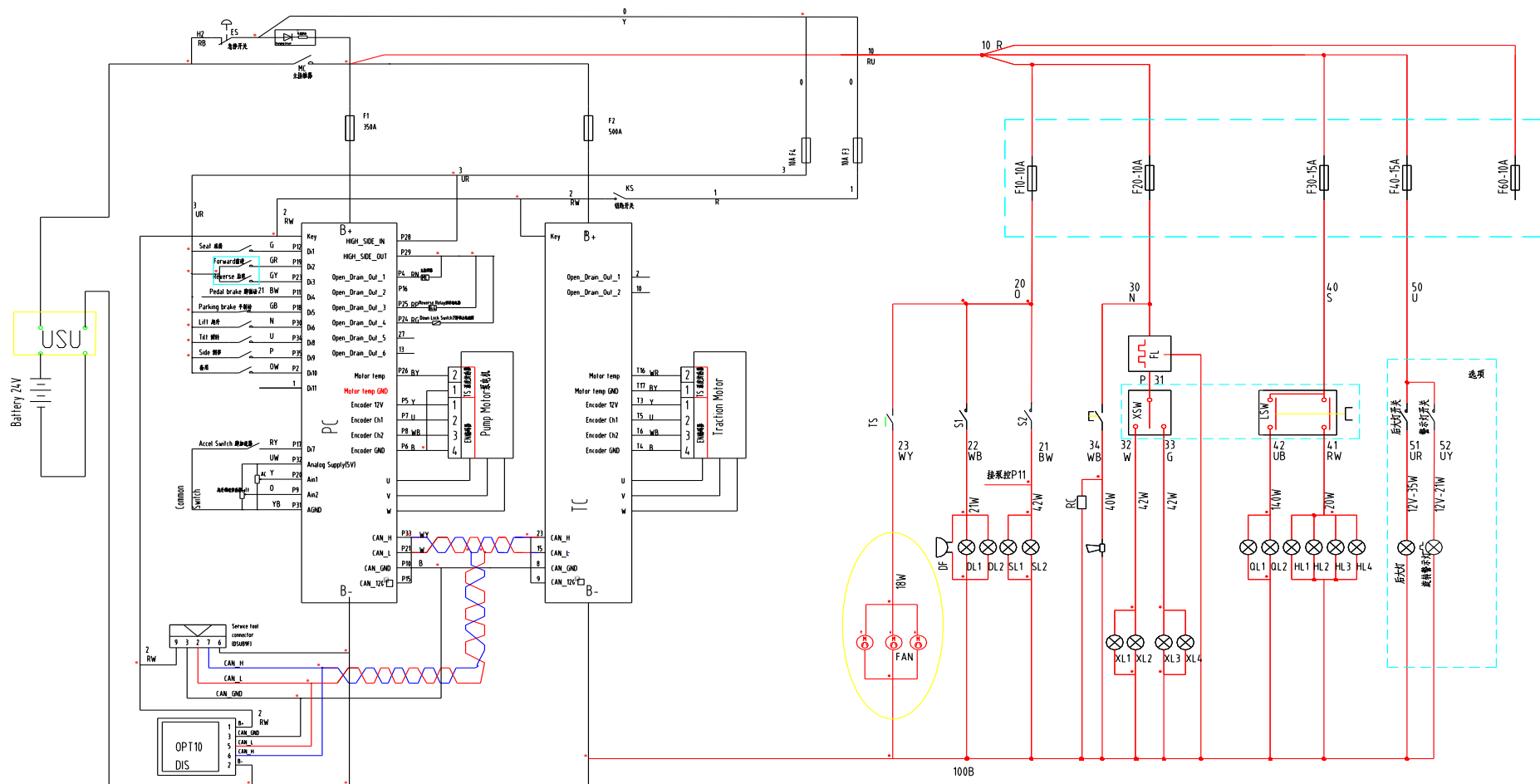


Fig.8-2 The circuit diagram of electric system

8.1.2 ZAPI control system (for CPD15SH-GA2,CPD15SH-GB2,CPD13SH-CB2)

ZAPI control system includes traction controller, pump controller, contactor etc.

The controller is the core component of the system, which can provides excellent control to vehicle AC traction motor. When the truck has a default, but also can stop it quickly, to protect the driver and motor effectively.

At the same time, the controller will detect the fault information, via the ZAPI MDI display fault code, for the user to check and maintenance for traction control system in convenience.

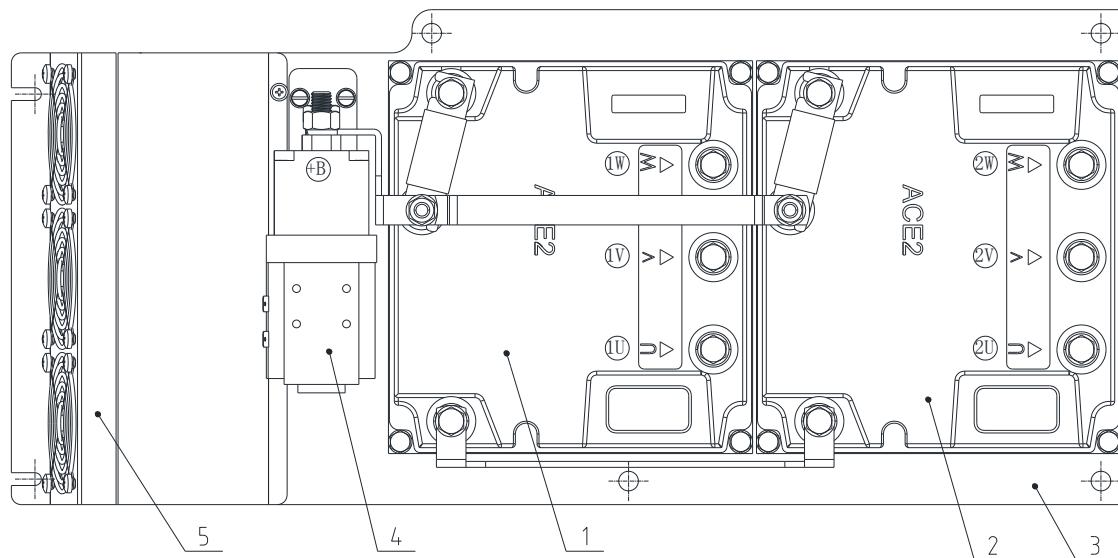


Fig.8-3 ZAPI controller ass'y

- | | |
|------------------------------|---------------------------|
| 1、 Traction controller(ACE2) | 2、 Pump controller (ACE2) |
| 3、 controller base plate | 4. Contactor (SW200) |
| | 5. Fan assembly |

a) Controller type

Traction controller: ZAPI ACE2 24V/550A (CPD13/15SH-GB2)

ZAPI ACE2 24V/500A (CPD15SH-GA2);

Pump controller: ZAPIA ACE2 24V/500A

ACE2 controller is AC asynchronous 3-phase inverter which has regenerative braking functions, CAN-BUS interface, Digital control based upon a microcontroller.

Maximum inverter temperature :85°C

External temperature rang: -30°C ~+40°C

b) Protection features :

- 1) Battery polarity protection
- 2) Connections errors protection
- 3) Thermal protection; overloaded protection; short circuit protection
- 4) Controller protection degree IP54
- 5) Out of control protection
- 6) Over discharging protection
- 7) Operation order protection

c) Console functions :

- 1) Adjustment of parameters and changes to the inverter's configuration on-line;
- 2) Adjustment of accelerator signal on-line;
- 3) Default detection and inquiry ,which is convenient for the system

maintenance.

d) CAN BUS functions

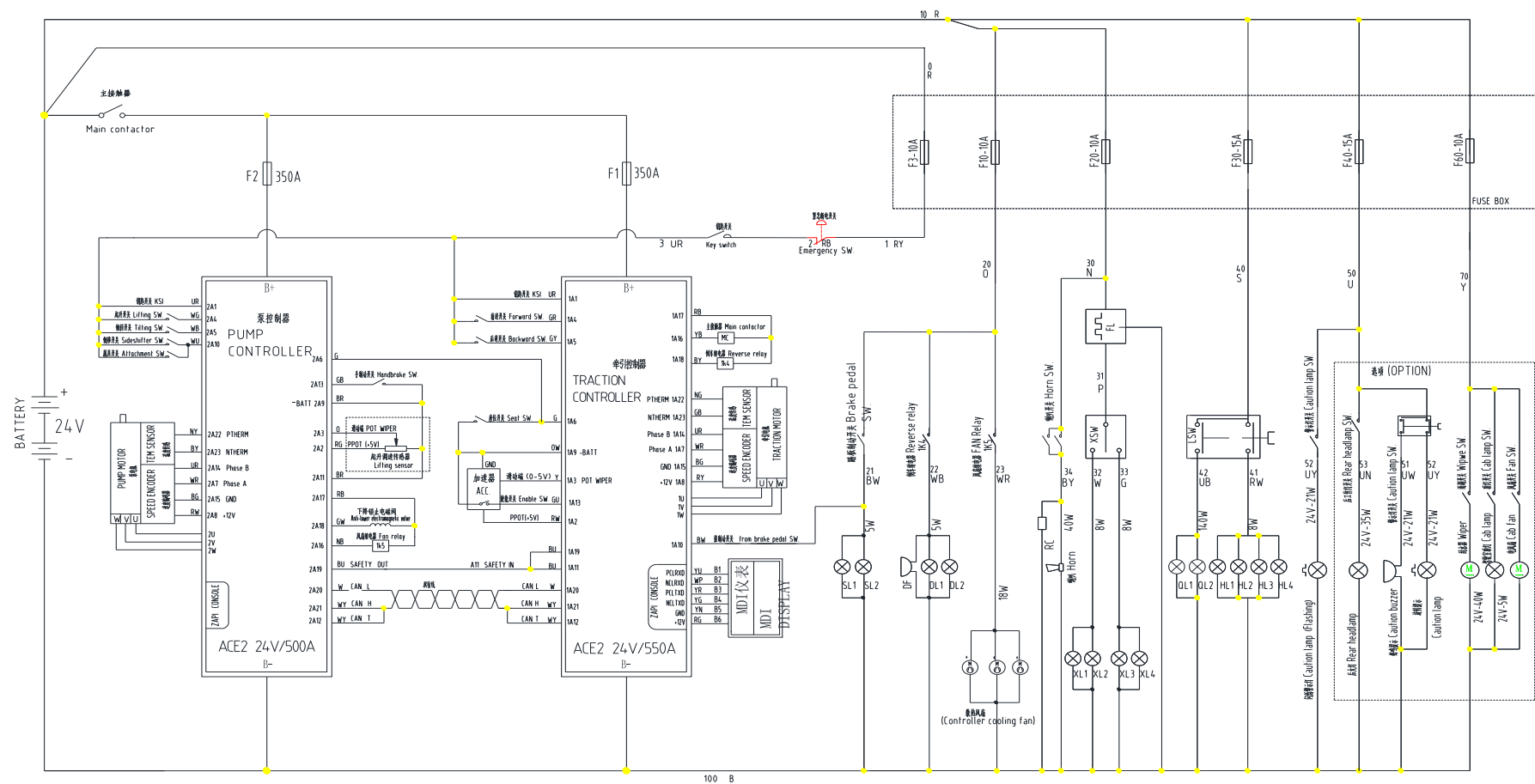
Using CANBUS link, every module connected to CAN net can act as the “access node” to CANBUS net from external work. ZAPI console unit can be connected to one module and virtually any other module in the network through CAN bus. Submenu SET MODEL can be used to choose the module customer wanted to link. Following the numbers associated to each module in ZAPI CANBUS system are showed:

Number associated in CAN BUS net	Module
01	SICOS
02	TRACTION
03	TRACTION MASTER
04	TRACTION SLAVE
05	PUMP
06	EPS-AC
09	MHYRIO/HVC
16	SMART DISPLAY

Table 8-1 CAN BUS MODULE

Notice

Any variations or special requirements should be made after consulting a ZAPI agent. The supplier is not responsible for any problem, if you mended without authorizatio



SL1 SL2	刹车灯 Brake lamp	FL	闪光灯 Flasher	LSW	二档灯开关 Lamp Switch
DF	倒车蜂鸣器 Reverse buzzer	XSW	转向灯开关 Turning lamp switch	OL1 OL2	前大灯 Headlamp
DL1 DL2	倒车灯 Reverse lamp	XL1 XL2	右转向灯 Turning lamp (Right)	HL1	示宽灯 Width lamp (Front)
RC	喇叭滤波器 Horn filter	XL3 XL4	左转向灯 Turning lamp (Left)	HL2	示宽灯 Width lamp (Rear)

Fig.8-4 The circuit diagram of electric system

8.1.3 CURTIS control system (CPD15SH-GA1)

CURTIS control system includes traction controller, pump controller, contactor etc. The controller is the core component of the system, which can provide excellent control to vehicle AC traction motor. When the truck has a default, but also can stop it quickly, to protect the driver and motor effectively. At the same time, the controller will detect the fault information, via the CURTIS 840 display fault code, for the user to check and maintenance for traction control system in convenience.

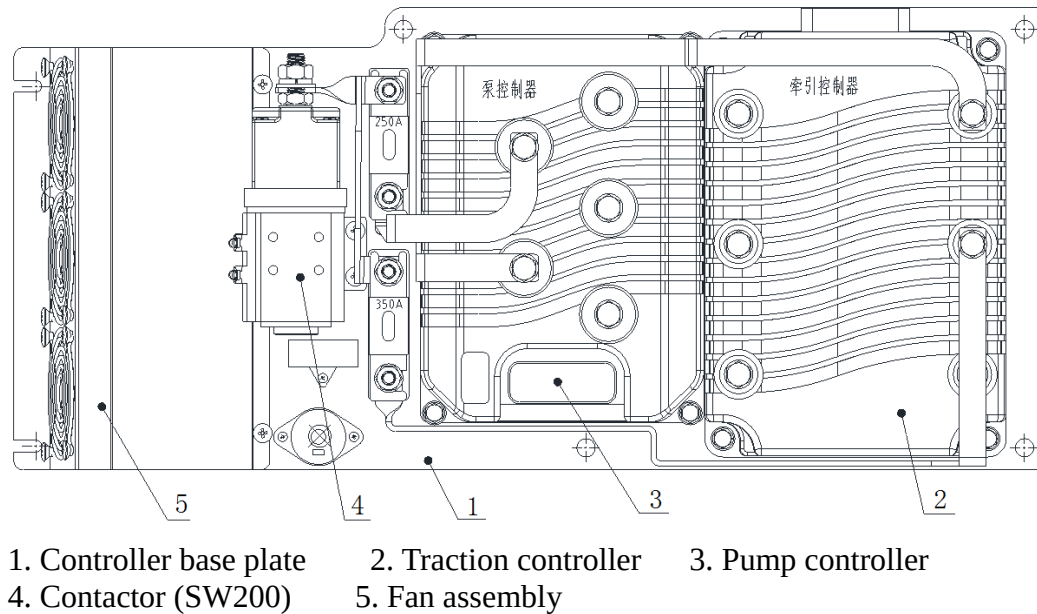


Figure 8-5 Controller assembly

a) Controller type

Traction controller: Curtis 1236-5401 24V/500A;

Pump controller: Curtis 1234-2371 24V/350A.

The controller is AC asynchronous 3-phase inverter which has regenerative braking functions, CAN-BUS interface, Digital control based upon a microcontroller.

External temperature rang: -40°C ~+50°C

When the temperature reaches to 85°C, the power begins to reduce and the temperature reaches to 95°C, the output is cut. The controller protection degree is IP65.

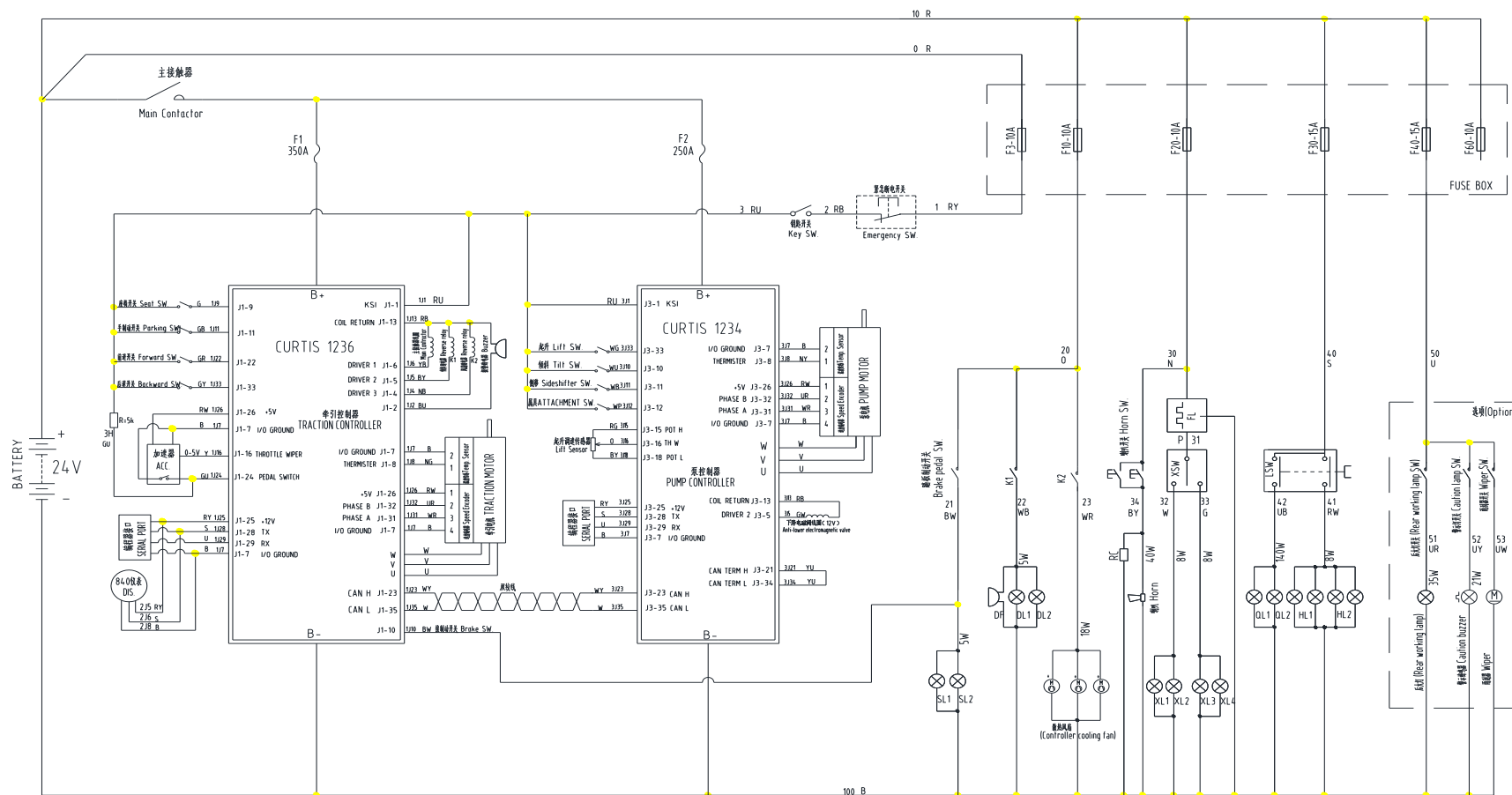
b) Protection features :

1) Battery polarity protection

- 2) Connections errors protection
- 3) Thermal protection; overloaded protection; short circuit protection
- 4) Controller protection degree IP65
- 5) Out of control protection
- 6) Over discharging protection
- 7) Operation order protection

c) Console functions :

- 1) Adjustment of parameters and changes to the inverter's configuration on-line;
- 2) Adjustment of accelerator signal on-line;
- 3) Default detection and inquiry ,which is convenient for the system maintenance.



SL1 SL2	刹车灯 Brake lamp	FL	闪光灯 Flasher	LSW	二档灯开关 Lamp Switch
DF	倒车蜂鸣器 Reverse buzzer	XSW	转向灯开关 Turning lamp switch	QL1 QL2	前大灯 Headlamp
DL1 DL2	倒车灯 Reverse lamp	XL1 XL2	右转向灯 Turning lamp (Right)	HL1	示宽灯 Width lamp (Front)
RC	喇叭滤波器 Horn filter	XL3 XL4	左转向灯 Turning lamp (Left)	HL2	示宽灯 Width lamp (Rear)

Figure 8-6 CURTIS system electric principle diagram

8.2 Combined Instrument

8.2.1 OPT10 meter

The meter that is used in a DANAHER system is the OPT10. The OPT10 is a multifunctional, microprocessor based operator terminal that can be factory or user defined to monitor various functions, input of user action and more.

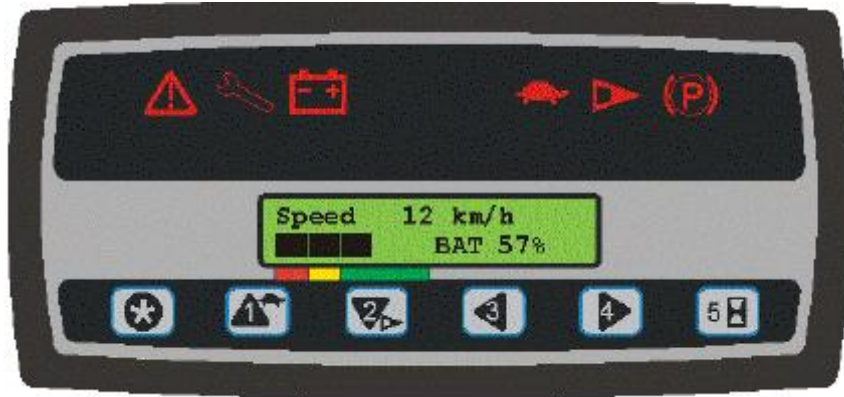


Fig.8-7 OPT10 meter

a) Features:

- Wide operating voltage from 24 V to 80 V.
- Built-in under voltage, overvoltage, and reverse polarity protection.
- Six LED indications.
- Built in nonvolatile memory stores all strings and configuration.
- Physical size compatible with OPT100.
- Possible to customize with branded keyboard foil.
- Fully configurable menu system.
- Diagnostic function for showing up to 750 parameters.
- Parameter setting for up to 750 parameters.
- Language can be changed by downloading new strings with Truck Service

Tool or similar.

- Functionality for passwords/users makes it possible to have different allowed modes for different drivers.

- The OPT10-unit is a slave unit that needs to be connected to a CAN open master.

- Four-level functionality for normal user or service use.
- 2x255 definable error/warning/information strings.
- Standard CAN open interface for simple and reliable communication.
- Support for service, diagnostic and down loading of software with Truck

Service Tool.

b) Application:

The display is designed for Lift trucks and other electrical vehicles. It's used to display status, warning, errors and diagnostic information as well as changing vehicle settings and operating modes.

The displayed is built in with six red LEDs to provide the driver some basic state of the vehicle.  Turtle mode;



Battery low voltage;



Seat switch is not connected;



On when Error or Warning occurs;



On when Hand Brake is triggered;



Reserved.

c) Operator guide

1. By pressing the button "1", you can change between normal state and low speed state;

2. By pressing the button "2", travelling acceleration can between normal state and low speed state.

3. By pressing the button "5", you can change the information that is display on the screen between traction speed, total key on time, total traction working time and total pump working time.

d) Reading errors

When there is an error in the systems, the red error LED will be on, and the screen

will display the error code and the error information, as shown below, the error code would be 104 and “tract pot value out of range error” indicates the pedal is either not well connected or damaged.



Figure 8-8 OPT10 meter

Notice:

Please refer to table 8-2 for error code explanations.

Table 8-2 DANAHER system error code

Code	Fault	Meaning
101	ACCEL SWITCH ACTIVE AT KEY ON	The acceleration switch is on when key on
102	DIR. SWITCH ACTIVE AT KEY ON	At least one of direction switches is on when key on
103	DIR. SWITCH BOTH ON ERROR	Both of the direction switches are on at the same time
104	TRACT POT VALUE OUT OF RANGE	The value of traction pot is out of range(<30 or >2800)
105	TRACT SWITCH OFF WITH LARGE POT VALUE	The acceleration switch is off but the value of traction pot is more than 30%
111	CAN COMMUNICATION ERROR	CAN communication error
114	BATTERY LOW ERROR	The battery is low. BDI value<25 warning, <15% slow the truck
115	START UP ERROR	Internal error when start up
117	PSPEED1 SWITCH ACTIVE	The pump speed1 switch is on when key on

	AT KEY ON	
118	PSPEED2 SWITCH ACTIVE AT KEY ON	The pump speed2 switch is on when key on
119	PSPEED3 SWITCH ACTIVE AT KEY ON	The pump speed3 switch is on when key on
120	PSPEED4 SWITCH ACTIVE AT KEY ON	The pump speed4 switch is on when key on
121	PUMP POT VALUE OUT OF RANGE ERROR	The value of pump pot is out of range(<30 or >2800)
125	MAIN CONTACTOR OFF ERROR	Main contactor is off
301	ACS TEMP LOW	ACS temperature is lower than -20 °C
302	ACS TEMP HIGH	ACS temperature is higher than 85 °C
303	ACS TEMP SENSOR	ACS temperature sensor not connected or short circuit
304	MOTOR TEMP LOW	Motor temperature is lower than -35 °C
305	MOTOR TEMP HIGH	Motor temperature is higher than 145 °C
306	MOTOR TEMP SENSOR	Motor temperature sensor not connected or short circuit
307	SPEED SENSOR	Speed sensor not connected or short circuit
308	HIGH VOLTAGE	The ACS voltage is higher than 98V
309	LOW VOLTAGE	The ACS voltage is lower than 60V
310	DEFAULT PAR. LOADED	Default parameters are loaded
311	REDUCED POWER	The ACS output power has been reduced
317	OPEN DRIAN ERROR	The open drain output is not connected
318	WARNING MISC.	Other warnings
351	SHORT CIRCUIT	There is a short circuit among B+,B-,U,V,W
352	ACS TEMP HIGH	ACS temperature is higher than 125 °C
353	MOTOR TEMP HIGH	Motor temperature is higher than 180 °C
354	CURR SENS. ERROR	Current sensor error
355	CAP. NOT CHARGING	ACS capacitor is not charged up to 85% in 10s
360	LOW VOLTAGE	The ACS voltage is lower than 40V
361	HIGH VOLTAGE (SW)	The ACS voltage is higher than 106V
362	HIGH VOLTAGE (HW)	The ACS voltage is higher than 106V
364	MISC.	Other errors
401	ACS TEMP LOW	ACS temperature is lower than -20 °C
402	ACS TEMP HIGH	ACS temperature is higher than 85 °C
403	ACS TEMP SENSOR	ACS temperature sensor not connected or short circuit

405	MOTOR TEMP HIGH	Motor temperature is higher than 145 °C
406	MOTOR TEMP SENSOR	Motor temperature sensor not connected or short circuit
407	SPEED SENSOR	Speed sensor not connected or short circuit
408	HIGH VOLTAGE	The ACS voltage is higher than 98V
409	LOW VOLTAGE	The ACS voltage is lower than 60V
410	DEFAULT PAR. LOADED	Default parameters are loaded
411	REDUCED POWER	The ACS output power has been reduced
417	OPEN DRIAN ERROR	The open drain output is not connected
418	WARNING MISC.	Other warnings

8.2.2 ZAPI meter

ZAPI meter is kind of meter based on the micro processor which is not only reliable in calculating on the electricity quantity and time but also has strong adaptability to the battery voltage.



Fig. 8-9 ZAPI meter

a) Functions:

- (1) Battery quantity
- (2) Run time
- (3) Default indicate

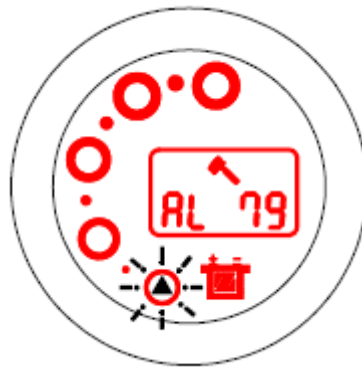
b) Application:

ZAPI has five built-in red diodes, which supply operator an easy information of

vehicle state.  means turtle speed. When the controller is default or the low battery charge,  will flash. When battery charge is lower than the value set,  will light and flash.

c) Fault reading

d) The red LED will flash, the  will light on and the fault code will display when there is alarm. “79” fault code is display as shown in the figure, that means “fault of starting order”.



Fault code	Meaning	Explanation
07	CHOPPER NOT CONF	Truck can not travel and logic card has memorizing fault.
08	WHACHDOG	Watchdog fault and change the watchdog when the fault occurs.
13	EEPROM OFFLINE	If the fault still exist when the electric lock is closed, change the logic card.
17	LOGIC FAILURE #3	Logic card fault
18	LOGIC FAILURE #2	Logic card fault
19	LOGIC FAILURE #1	Logic card fault
28	PUMP VMN LOW	VMN low
30	VMN LOW	VMN low
31	VMN HIGH	VMN high
33	NO FULL COND.	Not completely conduct
34	RGT NO FULL COND	Right steering not completely conduct
35	LFT NO FULL COND	Left steering not completely conduct
36	PU NO FULL COND	Lifting not completely conduct
37	CONTACTOR CLOSED	Contactator closed
38	CONTACTOR OPEN	Contactator open
49	1=0 EVER	Current is 0
53	STBY I HIGH	High current when standby
60	CAPACITOR CHARGE	Capacitor capacity
61	HIGH TEMPERAURE	Overhigh temperature
62	TH. PROTECTION	thermal protection
63	THERMIC LEVEL #2	Thermal level 2
64	PUMP TEMPERATURE	High pump temperature

65	MOTOR TEMPERAT	High motor temperature
66	BATTERY LOW	Battery low
67	BATTERY LEVEL #2	Battery level #2
68	BATTERY LEVEL #1	Battery level #1
69	CURRENT SENS. KO	Current sensing fault
70	POWER FAILURE#3	Power failure #3
71	HIGH CURRENT	high current
72	POWER FAILURE #2	Power failure #2
73	POWER FAILURE #1	Power failure #1
74	DRIVER SHORTED	Driver shorted
75	CONTACTOR DRIVER	Contacto driver fault
76	COIL SHORTED	Coil shorted
77	COIL INTERRUPTED	Coil interrupted
78	VACC NOT OK	Accelerator fault
79	INCORRECT START	Incorrect start
80	FORW+BACK	There are both forward signal and backward signal.)
82	ENCODER ERROR	Encoder error
83	BAD ENCODER SIGN	Bad encoder signal
84	STEER SENSOR KO	Steering sensor fault
85	STEER HAZARD	Steering danger signal
86	PEDAL WIRE KO	Incorrect pedal wire connection
87	PEDAL FAILURE	Pedal fault
88	TRACTION BRUSHED	Traction motor brush fault
89	PUMP BRUSHES	Pump motor brush fault
90	DRIVER 1 KO	Drive 1 fault
91	DRIVER 2 KO	Drive 2 fault
92	DRIVER 1 SIC. KO	Driver 1SICfault
93	DRIVER 2 SIC. KO	Driver 2 SIC fault
94	INPUT ERROR #6	Input error 6
95	INPUT ERROR #5	Input error 5
96	INVERTION	Rapid inversion
97	POSITION HANDLE	Handle position
98	INPUT ERROR #2	Input error 2
99	INPUT ERROR #1	Input error 1
Traction controller fault code		
Fault code	Meaning	Explanation
241	DATA ACQUISTION	Data acquisition fault
242	PUMP WARNING	Pump warning signal
244	MOTOR STALL	Motor stall
245	WRONG SET BAT.	Wrong battery set
246	PUMP KO	Pump fault
247	NO CAN MSG N.4	No CAN message in node 4
248	CHECK UP NEEDED	Check up needed
249	THERMIC SENS. KO	Temperature sensor fault 温
250	HANDBRAKE	Hand brake fault
251	WAITING FOR NODE 5#	Waiting for node 5 signal
253	AUX OUTPUT KO	Auxiliary output fault 辅
Pump controller fault code		
	Meaning	Explanation
241	DATA ACQUISTION	Data acquisition
242	PUMP TEMPERATURE	High pump temperature
243	PUMP INCOR. START	Incorrect pump start
244	PUMP VACC NOT OK	Pump accelerator fault

245	MOTOR STALL	Pump motor temperature sensor fault
246	MASTER KO	Tractor master fault
247	NO CAN MAS N. 3	No CAN message in node 3
249	THERMIC SENS. KO	Temperature sensor fault
250	INPUT MISMATCH	Poor input contact
251	WAITING FOR N.3	Wait for node 3 signal
253	AUX OUTPUT KO	Auxiliary output fault
254	ENCODER LOCKED	Encoder locked

Table 8-3 ZAPI fault code

8.2.3 Curtis 840 meter

Curtis 840 meter is simple and compact which is made up of 3 LCD display and 3 LED indicator to show battery electric quantity, working time and fault code and so on.



Figure 8-10 Curtis 840 meter

a) functions:

- (1) show battery electric quantity
- (2) truck working time
- (3) fault indication

b) Application

when the key switch turns on, curtis 840 shows working time. Normally when the truck is started, battery quantity is shown and the green LED indicator  lights on. when there is fault, the red LED indicator  flickers. And at this time, traction controller fault code and pump controller fault code display alternately. When the battery quantity is reduced to certain level, yellow LED indicator . when the battery electric quantity is lower than 10%, lift can not be realized.

c) Fault code reading

when there is fault, red LED flickers and fault code is displayed. For example, when the fault “TRAC 29” occurs as in the figure below, it means the traction motor

temperature sensor or harness has fault”. if “pump 47” occurs, it means “incorrect pump operation order” is detected.



Figure 8-11 Curtis 840 meter fault display

Fault code shown in meter	Fault code shown in the hand console	Possible reasons
1, 2	Controller Overcurrent	1.Motor external connecting end U, V or W has short circuit. 2.incorrect adjustment of motor parameters 3.controller fault
1, 3	Current Sensor Fault	1.U, V, W has short circuit to truck body. 2. .controller fault
1, 4	Precharge Failed	1. External load on the B+ end prevent capacitor charging . 2. Refer to battery check menu1311: capacitor voltage.
1, 5	Controller Severe Undertemp	1.controller works below -40℃ . 2.refer to 1311 controller monitor menu: temperature
1, 6	Controller Severe Overtemp	1. Controller works above +95℃ . 2.truck overload 3.improper installment of controller 4. refer to 1311 controller monitor menu: temperature
1, 7	Severe Undervoltage	1. incorrect adjustment of battery parameters 2. truck overload 3.high battery internal resistance 4.battery unconnected when driving 5.refer to 1311battery monitor menu: capacitor voltage 6.B+fuse is burn or main contactor unconnected
1, 8	Severe Overvoltage	1. incorrect adjustment of battery parameters 2.high resistance when battery produce rated regenerated current 3.battery unconnected when regenerated brake occurs 4. refer to 1311battery monitor menu: capacitor voltage
2, 1	Controller Undertemp Cutback	1.controller does not work under -25℃ . 2.controller work under ultimate temperature 3. refer to 1311 controller monitor menu: temperature
2, 2	Controller Overtemp Cutback	1.controller work above 85℃ 2. controller work under ultimate temperature 3.truck overloaded 4.improper installment of controller 5. refer to 1311 controller monitor menu: temperature
2, 3	Undervoltage Cutback	1.Normally, fault shows the battery needs charging. Controller is limited under this voltage. 2. Battery parameter on controller is unadjusted.

		3.Check if there is anything else consume battery. 4.high battery internal resistance 5.battery unconnected when driving 6. refer to 1311battery monitor menu: capacitor voltage 7. B+fuse is burn or main contactor unconnected
2, 4	Overvoltage Cutback	1. Normal operation, the fault shows the regenerated brake current increases battery voltage when regenerated brake acts. Controller is limited in this voltage. 2. Battery parameter is improper adjusted. 3. The internal resistance is high when battery gains rated regenerated current. 4.The battery is unconnected when regenerated brake acts. 5. refer to 1311battery monitor menu: capacitor voltage
2, 5	+5V Supply Failure	1.The external load resistance on +5V supplying terminal (pin 26) is too low. 2.Refer to 1311 input monitor menu: 5V and Ext supplying current.
2, 6	Digital Out 6 Overcurrent	1. The external load resistance on the digit output drive terminal 6(pin 19) is too low.
2, 7	Digital Out 7 Overcurrent	1. The external load resistance on the digit output drive terminal 6(pin 19) is too low.
2, 8	Motor Temp Hot Cutback	1.motor temperature is higher or equal to set heat protection temperature, motor temperature is higher than 145℃. 2. Motor temperature control parameter is not adjusted. 3. Refer to 1311 motor check menu: temperature and motor input: analog 2. 4.if there is no thermistor, the temperature compensation and temperature protection should be OFF.
2, 9	Motor Temp Sensor Fault	1.Motor thermistor is improperly connected. 2.. if there is no thermistor, the temperature compensation and temperature protection should be OFF. 3. refer to 1311motor monitor menu: temperature and motor input: analog 2.
3, 1	Coil 1 Driver Open/Short	1.driver load open circuit or short circuit. 2.pin foot gets dirty. 3.harness is damaged or improperly connected.
3, 1	Main Open/Short	1.driver load open circuit or short circuit. 2.pin foot gets dirty. 3.harness is damaged or improperly connected.
3, 2	Coil2 Driver Open/Short	1.driver load open circuit or short circuit. 2.pin foot gets dirty. 3.harness is damaged or improperly connected.
3, 2	EM Brake Open/Short	1.driver load open circuit or short circuit. 2.pin foot gets dirty. 3.harness is damaged or improperly connected.
3, 3	Coil3 Driver Open/Short	1.driver load open circuit or short circuit. 2.pin foot gets dirty. 3.harness is damaged or improperly connected.
3, 4	Coil4 Driver Open/Short	1.driver load open circuit or short circuit. 2.pin foot gets dirty. 3.harness is damaged or improperly connected.
3, 5	PD Open/Short	1.driver load open circuit or short circuit. 2.pin foot gets dirty. 3.harness is damaged or improperly connected.
3, 6	Encoder Fault	1.motor encoder has fault. 2. harness is damaged or improperly connected. 3.refer to 1311 motor monitor menu: motor RPM.

3, 7	Motor Open	1.motor U、 V、 W phase has open circuit. 2.cable is damaged or improperly connected.
3, 8	Main Contactor Welded	1.main contactor pin end connects. 2.Motor U phase is unconnected or open circuit. 3.A alternant voltage way (such as a external precharging resister) supplies a current a current to capacitor group (B+ terminal).
3, 9	Main Contactor Did Not Close	1.Main contactor can not connects. 2.Main contactor pin foot is oxidation. 3.The external load on capacitor group (B+ terminal) prevents capacitor from charging. 4.B+ fuse is burn out.
4, 1	Throttle Wiper High	1.The voltage on accelerator input end is too high. 2.Refer to 1311 input monitor menu: accelerator end potential.
4, 2	Throttle Wiper Low	1.The voltage on accelerator input end is too low. 2.Refer to 1311 input monitor menu: accelerator end potential.
4, 3	Brake Wiper High	1.The voltage on brake input end is too high. 2. Refer to 1311 input monitor menu: brake end potential.
4, 4	Brake Wiper Low	1.The voltage on brake input end is too low. 2. Refer to 1311 input monitor menu: brake end potential.
4, 5	Pot Low Overcurrent	1.The resistance value of the potentiometer connected to the low end 2.refer to 1311 input check menu: low end.
4, 6	EEPROM Failure	1.it is failed to write into EEPROM memory storage. Fault may be solved by VCL, CAN bus, 1311 parameters or upload new software.
4, 7	HPD/Sequencing Fault	1. Switch, interlock, direction and accelerator sequence has fault. 2.switch, interlock, direction or accelerator wire, harness or transition has fault. 3.refer to 1311 input monitor menu.
4, 7	Emer Rev HPD	1.Emergent reversing operation is stopped but the accelerator, forward, backward input and interlock do not return to neutral gear.
4, 9	Parameter Change Fault	1.it is caused by the change of a 1311 parameter. Restart the electric switch For example, if users change accelerator type, the fault will occur. Operate the truck after restart the electric switch.
5, 1	CAN Communications Fault	CAN communication between meter and controller fails and the meter does not respond.
5, 2	CAN PDO Timeout	CAN communication between meter and controller fails and the meter does not respond during travelling.
6, 8	VCL Runtime Error	1. VCL code working time fault. 2.refer to 1311 controller monitor menu: VCL fault module and VCL fault.
6, 9	External Supply Out of Range	1.external loaded 5V and 12V produce either too large or too small current. 2.External max. current and min. current are improper adjusted. 3.refer to 1311 input check menu: external input current.
7, 1	OS General	1.internal controller fault
7, 2	PDO Timeout	1.CAN PDO's communication receiving time exceeds PDO timeout period.
7, 3	Stall Detect	1. Motor stops working.

		2. Motor encoder fault. 3. Harnness damaged or improper connected. 4. Encoder power supply has fault. 5. Refer to 1311 motor monitor menu: motor RPM.
8, 7	Motor Characterization Fault	1. Motor character description fault.
8, 8	Encoder Characterization Fault	1. Encoder character description fault. 2. motor encoder pulse frequency is not a standard value (32, 48, 64, 80ppr)
8, 9	Motor Type Fault	1. motor type parameter value exceeds range.
9, 2	EM Brake Failed to Set	1. Truck still travels after the brake signal is sent out. 2. EM brake can not stop the running motor.
9, 3	Limited OperatingStrategy (LOS)	1. limit operating mode is activated no matter encoder fault (code 36) or stop detect fault (code 73). 2. Motor encoder fault. 3. Harnness damaged or improper connected. 4. Truck stall.
9, 4	Emer Rev Timeout	1. Emergent reversing is activated but is not work because emergent reversing is over time. 2. Emergent reversing signal contacts.

8.3 Motor

8.3.1 Motor type

The electric three-wheel forklift trucks include two motors: traction motor(5kw)、pump motor(6.5kw).

	Traction motor	Pump motor
Power	5kW (CPD13/15SH-GB1/2/3) 4.2kW (CPD15SH-GA1/2/3)	6.2kW
Rated voltage	AC 16V	AC 16V
Excitation type	AC type	AC type

8.3.2 Maintenance of the three-phase asynchronous motor

Maintain the motor so as to keep it in good condition. Use the following methods to maintain and check it:

Look:

(1) Check if the wire to the earth of the motor is well connected; check if the

housing of the motor has cracks; check if the foot screw and the end cap screw of the motor are loose.

(2) Check the ventilation and environment of the motor; keep the motor clean; the ambient environment should be less than 40°C.

(3) Check if the working current exceeds the rated current.

Listen:

(4) Check if there is abnormal noise;

(5) check if the bearing of the motor has abnormal noise;

Feel:

(6) Check if the motor is overheating;

(7) Check if there is abnormal vibration

Smell:

(8) Check if there is abnormal smell;

(9) Check if there is smell of grease on the bearing parts;

Ask:

(10) Ask operators if there is something abnormal.

8.3.3 Trouble shooting of the three-phase asynchronous motor

During the daily maintenance of the three-phase asynchronous motor, if anything abnormal is inspected, record it and report to leaders in time except for corresponding handling. Then related technical staff should check the motor has fault, find out the fault reasons according to related standard of the motor's normal running and his experience and remove the fault.

Refer to the following table for the troubleshooting of the three-phase asynchronous motor.

No.	Fault	Reasons	Remedies
1	The motor can not start.	1. the electricity is not connected;	1.check the voltage, switch, circuit, contactor;

		2. fuse is burnt; 3. Incorrect connecting of the controller circuit; 4. cur circuit of the stator or rotor winding; 5. short circuit or connect to earth among the stator windings;	2. find out the fuse burning reasons and then change a new one; 3. check if the circuit is properly connected and correct if necessary; 4. check the reason why the windings are cut circuit and reconnect them; 5. Check if the current is balanced; and check if the windings are connected to earth and repair.
2	Motor only has noise with electricity but it can not start	1. low power voltage; 2. the power lacks phase; 3. load is over heavy or the mechanism is blocked; 4. the assembly is too tight or the lubrication is poor.	1. Check the power voltage quality, contact with the power supply department; 2. Check power voltage, contactor, fuse, switch, poor linking wire and repair it if necessary; 3. Exclude the mechanical fault or change the motor. 4. Reassemble or change lubrication oil.
3	The housing of the motor has electricity.	1. The windings become damp or aging;	1. Dry the windings or change the aging windings.

4	Great vibration when the motor is working.	1. improper installment of the gears; 2. bearing is worn out, the clearance is big; 3. imbalance of the rotator; 4.the iron core is out of shape or loose; 5. revolving shaft is bent; 6. winding is short circuit; 7. winding of the stator forms short circuit, cut circuit or incorrect connected.	1. reassemble; 2. check the bearing clearance or change the bearing; 3. clean the rotor and tighten the screw; 4. regulate the iron core or reassemble; 5. Regulate the stator position; 6. Find the short circuit and troubleshooting; 7. Find out the fault and trouble shooting.
5	The motor is overheating or smoking	1. Over high voltage or over low voltage; 2. The motor is working in single phase;	1. Check the output voltage of the controller; 2. check power, fuse and contactor;
6	Insulating resistance is low.	1. insulation for the windings become damp; 2. windings are dirty; 3. insulation for the windings become aging; 4. Wire linking plate is broken; the leading wire is aging.	1. heat and dry it; 2. clean it; 3. dry it or change the insulation; 4. wrap the leading insulation; replace or repair the linking plate.

8.3.4 Operating ambient

Motor can be operating as follows:

- below sea level 1200mm
- ambient temperature from -25℃ ~ +40℃
- opposite humidity to 100%

Notice:

In case of danger, one must shut off the power when examining and maintaining the motor.

8.4 Battery

8.4.1 Construction

Traction batteries are made of negative plate, positive plate, cell, cover and electrolyte.

8.4.2 Battery specifications

Item	CPD15/CPD13
Monomer type	8PZS720 (CPD15) /7PZS630 (CPD13)
capability	720Ah (CPD15) /630Ah (CPD13)
voltage	24V
density of the electrolyte	1.280-1.290g/cm ³ (25℃)
Monomer number	12
Charge model	D24V/100A

Remark : The configuration can be customized.

8.4.3 Applications

Whether this lean-acid battery is manipulated properly or preserved well daily has much influence on its span of service time, thus, it is necessary for the workers who manipulates this battery to maintain and pre-serve this product just as the directions

say.

a) Battery maintenance and notes

1) Keep the surface of the battery clean and dry. Maintain the pole pillar, bolts and connecting parts often. If it is loose or poor connected, remove it;

2) Never put any object that can conduct electricity on the battery avoiding battery short circuit;

3) The first charging of the new battery before using is called initial charging and the later charging during usage is called normal charging. The charging time of normal charging differs from the battery capacity and discharging degree. Usually, charge the battery continually for 8-12 hours if the electricity is discharged for 70% to 100%;

4) Open the liquid adding hole cap when charging; close it after charging;

5) Keep the charging place with good ventilation because there is oxyhydrogen producing out when charging. Smoke and fire are strictly prohibited avoiding explosion;

6) During the using and charging, the electrolyte level will be lower and its density will be increased because of the evaporation and electrolyzation of the moisture in the electrolyte. Add distilled water often to keep the proper electrolyte level and density. Check the electrolyte often which should be $1.28 \pm 0.01 \text{g/cm}^3$ when the electrolyte is full. If the density is low, remove some electrolyte and add sulfuric acid prepared before; if the density is high, remove some electrolyte and regulate with proper amount of distilled water;

7) Avoid over discharging (that is the voltage per unit is lower than 1.70V) and over charging during the usage. Over charging and over discharging will affect the service life and performance badly of the battery;

8) Charge the battery in 24h. Not in time charge, insufficient charging, over discharging and long time storage without proper charging will cause vulcanization of battery plate and performance reduction.

9) During the usage of the battery, carry out one equalizing charge once a month to keep the good equalizing condition of each unit during the usage;

b) Battery storage

1) The batteries should be stored in a storehouse, which is dry, clean and well ventilated ,and the temperature stays between 5-40 °C.

(2)The batteries should not be exposed to direct shining or scorching sunlight or drench ingrain. The batteries should be kept off any heat source at least at a distance of two meters.

(3)The batteries should not be placed, upside down or side or tossed or rolled, nor pressed heavily.

(4)The batteries should be kept off any poisonous or corrosive goods. It must be certain that no metal and foreign substances drop into the batteries.

(5)Don't store batteries with electrolyte in. When it is necessary to do so, they should be fully charged. The level height and the density of the electrolyte must be regulated. In storage period it is necessary to charge the batteries once a month in the normal charging way.

Notice:

① **Stop charging at once if the electrolyte temperature exceeds 40°C when charging;**

② **Battery service life will be affected f the electrolyte temperature exceeds 50°C when charging;**

③ **Do not charge the battery in low temperature (such as cold outdoor) or the battery service will be affected;**

Important notice:

① **The rated voltage of the battery assembled on the tractor. It is dangerous to be hit. So be careful.**

② **The battery assembled on the tractor is of lead-acid type and the**

electrolyte is dilute sulfuric acid. So please wear safe guard when testing battery, adding liquid, regulating and carrying out other operations in preventing of accident.

③ The housing of the charger is metallic conductor. Make sure the wiring of the motor to earth is well connected in preventing of electric shock accident.

④ Avoid pull out the battery plugs and sockets when the charger is not disconnected. Spark will be produced because of insufficient charging. Please be careful.

8.4.4 Troubleshooting

The cause that made the battery error is various, except the effect of quality manufacture and transport storage, mostly due to the improper maintenance.

Find out faults and analyze the causation in time, take effective measure as soon as possible to exclude. The characteristic of faults, causation and repair measure are shown in the following figure.

Table 8-6 Battery troubleshooting

Faults	Characteristic	Causation	Repair Measure
Vulcanization of the pole pillar	1.Battery capacity is low; 2.The density of electrolyte under the normal. 3.The voltage of battery over the normal when begin to and done with battery charge. 4.The temperature rise too quickly during charging 5. Prematurely or at start produce air bubble during charging. .	1. Insufficient initial charging 2. Insufficient charging for a long time 3. Often over discharge 4. Not in time charging after discharging 5.The density of electrolyte over the prescribed value. 6.The level of the electrolyte too low that the top of plate exposed. 7.Can not carry out equalizing charging in	1.Adopt the measure of proportion charging to deal with when the actuality isn't severity. 2.Adopt the“hydroth-erapeutics” when the actuality is severity hydrotherapeutics. 3.Don't over discharge. 4.The density of electrolyte don't over the prescribed value. 5.The level of the electrolyte and the content of impurity should be in the prescribed range.

		time. 8.Discharge over current or undercurrent . 9.The electrolyte isn't pure. 10. Partial short circuit inside or electricity leakage	
Short circuit inside	1.The voltage of battery is very low during charging, close to zero indeed. 2.Few or none air bubble when charging later. 3.The temperature of electrolyte rise quickly while the density of electrolyte slow or didn't rise indeed. 4.The voltage of battery is low and drop to the limit value ahead during discharging. 5.Self discharging is very serious.	1.The plate curve、Reactive matter expand or desquamate, so the clapboard mangled, that the battery short inside. 2. Overmuch precipitate result in the battery shorting. 3.Conducting matter fall into the battery, result in shorting.	1.Replace plate 2.Offload the precipitate and conducting matter. 3.Replace pole plate
The reactive matter in the pole plate desquamate	1.The capacity of battery decrease. 2.The electrolyte turbid. 3.The precipitate is overmuch.	1. The electrolyte does not meet the standard. 2. Charge and discharge too frequent . 3.The temperature of the electrolyte too high during charging. 4.Short outside during	Offload the precipitate when the actuality isn't severity, and discard when severity.

		discharging.	
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8.5 Lighting and Signal Devices

a) Combined instrument

There is a combined Switch on the right of the instrument panel. Each switch has corresponding symbol to control the dipped beam (width light), high beam, working light (optional) and warning light(optional) and so on.

Turn the switch to the first gear: dipped beam (width light) lights on;

Turn the switch to the second gear: dipped beam and high beam light on.

b) Steering light switch and direction switch

Push the steering light switch forward, the left steering lamps flash;

Pull the steering light switch backward, the right steering lamps flash.

When direction switch is pushed forward, step on the accelerator pedal and the truck will travel forward; when direction switch is pulled backward, step on the accelerator pedal and the truck will travel backward. And at the same time, backward light (white) in the combined light turns on and the backward buzzer sounds up.

c) When stepping on the foot brake, the foot brake switch is connected and the brake light (red) in the combined light turns on.

d) Horn. There is a horn on the truck integrated on the instrument panel. When pressing on the horn, the switch is connected and the horn sounds.

8.6 Daily Maintenance

a) Check the wear condition of the contactor. Change it if necessary. Check the contactor every three months;

b) Check the pedals or manual inching switch; measure the voltage drop between the inching switch ends; there is no resistance when the inching switch is closed; there is ringing sound when release. Check every three months;

c) Check the main circuit, connecting cable among battery, converter and motor. Make sure the well insulation condition of the cables and circuits are tightly connected. Check it every three months;

d) Check the mechanical moving of the pedal and knob; check if the spring is out of shape; check if the spring of the potentiometer can reach to the max. length or set length. Check it every three months;

e) Check the mechanical moving of the contactor every three months; if there is any damage or condition affecting the safety, contact with controller dealer.

9. Hydraulic system

9.1 General Description

The hydraulic system consists of pump, control valve, lift cylinder, tilt cylinder, priority valve, steering unit, steering motor and hydraulic lines. See fig.9-1 and table 9-1.

The hydraulic oil is supplied by the gear pump connected to the motor. Hydraulic oil is in prior distribution to the steering system through the priority valve and thus steering has priority. Then the remaining oil is distributed to the working cylinders through control valve.

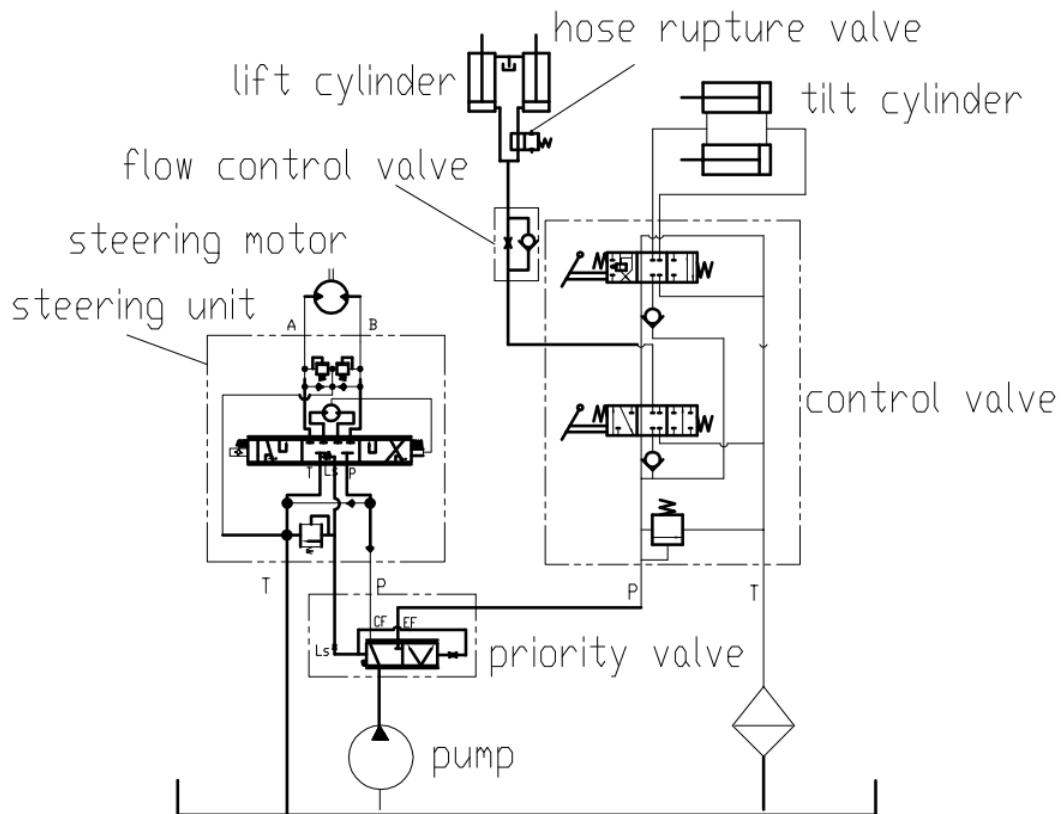


Fig.9-1 hydraulic system principle

Table 9-1 parameter of main parts of hydraulic system

Pump	Model	DSG05C12
	Type	Gear pump
	Displacement	12ml/r
	Output pressure	200bar
	Highest pressure	250bar
Control valve	Model	MSV04
	Type	With relief valve and tilt lock valve
	Pressure setting	175bar
Lift cylinder	Model	plunger
	Diameter	Φ40mm
Tilt cylinder	Model	plunger
	Diameter of pistong	Φ30mm
	Diameter of cylinder	Φ63mm
	Stroke	61mm
Steering motor	Model	BME2-100-HG2-A-LS
	Type	Hydraulic cycloid motor
	Displacement	100ml/r
	Output pressure	125bar
	Highest pressure	190bar

9.2 Hydraulic Pump

Hydraulic pump is double row gear external gear pump with small pulse and low noise. The principle is shown in the figure 9-2. Two pairs of engaged involute gears are installed inside of the case. Two ends of the gear are sealed up. Gears divides the case into two closed oil cavities-oil suction cavity and oil discharge cavity. When the gear rotates in the direction shown in the figure, the right volume increases and vacuum is formed. Oil in the tank flows into the oil suction cavity by the atmospheric pressure and fills the gears. With the rotating of the gear, the gears bring the oil from right cavity to the left cavity and thus the oil pressure in the left cavity increases and oil is output from the oil port. Oil is sucked and discharged by the oil suction and discharge port continually with the rotating of gears.

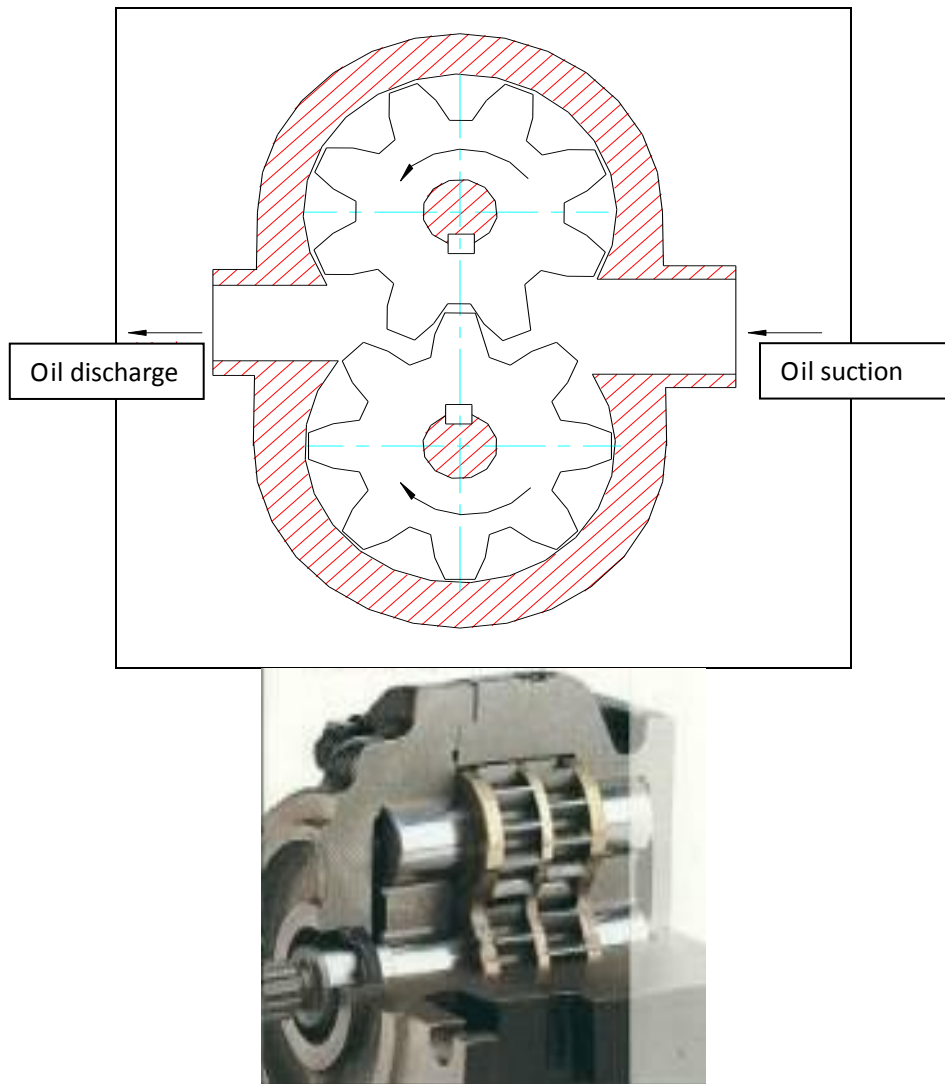


Fig.9-2 principle of gear pump

9.3 Priority valve

Priority valve (fig.9-3) provide flow to steering valve first, remainder flow can offer to other workgroup.

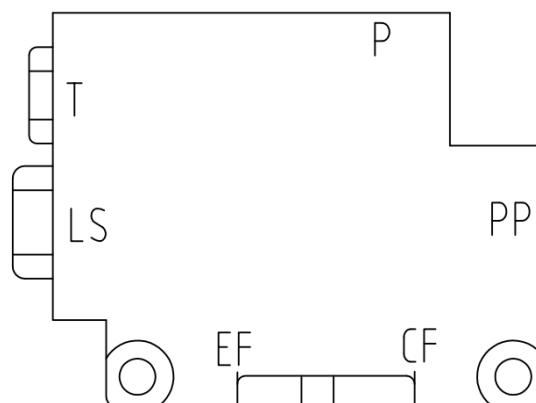


Fig.9-3 priority valve

9.4 Control valve

Control valve (fig.9-4) is made up of four valve bodies, two slide valve, one safe overflow valve and one shunt valve. Three bolts and nuts connect the four bodies. Tilt self lock valve is installed in the slide valve.

One-way valve is installed between the oil inletting port and oil suction port of the lifting valve, oil inletting port of the lifting valve and the oil inletting port of the tilting valve.

When lifting lever and tilting lever are operated at the same time, oil will flow from the heavy load side to the light load side. One-way valve will protect the oil flow back.

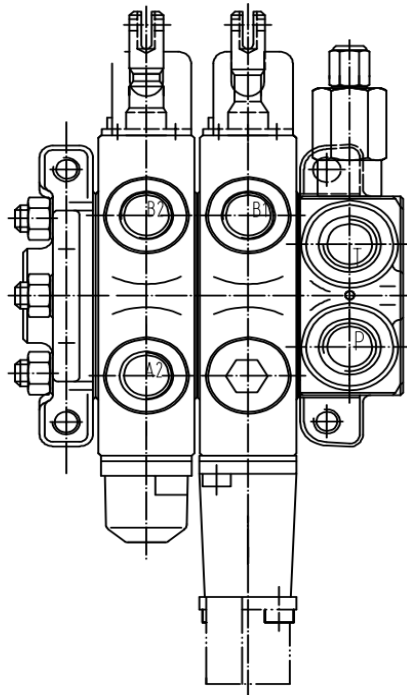
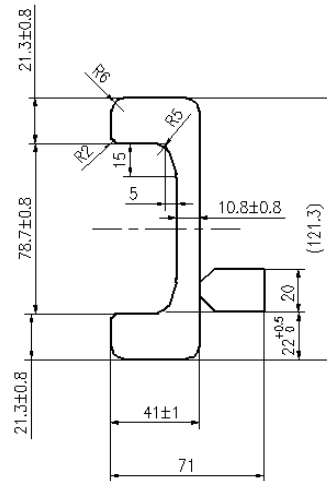


Fig.9-4 Control valve

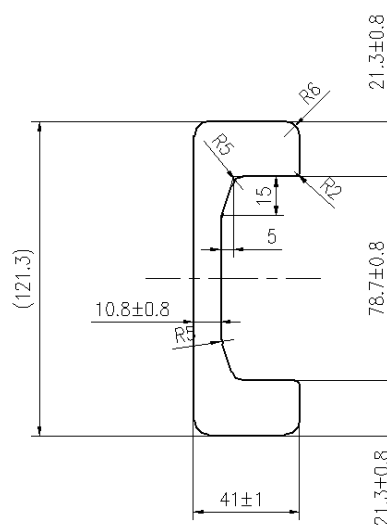
10. Lifting System

Type: Rolling type: L-Shaped inner mast, C-shaped outer mast with free lift. 2-stage telescopic mast.

Cross section of inner mast:



Cross section of outer mast:



Roller:

Combined roller diameter	Φ77.7mm
Main roller diameter	Φ77.7mm
Side roller diameter	Φ40mm

Lifting:

Lifting chain	LH1223
Fork, mast lifting system	Hydraulic
Fork spacing adjustment	Manual
Tilting system of mast	Hydraulic

10.1 General Description

The loading system is of the two-stage, rolling telescopic mast type and consists of inner mast, outer mast and carriage.

10.2 Inner and outer masts

The inner and outer masts are welded parts. The bottom of outer mast is connected with the arrester through supporting axle. At the outside middle of outer mast, there are tilt cylinder connected with the frame. The mast assembly can be tilt forward and backward by operating the tilt cylinder.

The outer mast has C-shaped cross section and there are combined rollers on the upper part of it.

The inner mast has L-shaped cross section and there are combined rollers at the bottom of it. The combined rollers roll along the flank plate of the mast and may adjust with shims. So they can sustain the longitudinal loads and transverse loads.

The maintenance of the combined rollers on the inner and outer masts belongs to exalted maintenance. Please be careful.

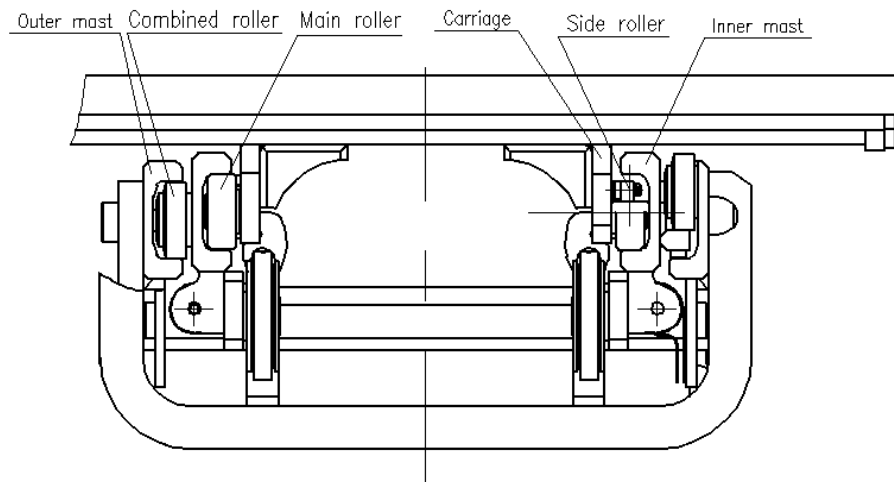
10.3 Carriage

The carriage moves up and down smoothly along the channel of the inner mast with main rollers and combined rollers. Side rollers on the top end are fixed in the bracket by the bolts. The main rollers mounted on the main roller shafts and blocked by snap rings. Side roller and combined rollers bear the yawing force by adjusting the clearance between the channel steel through shims. The main rollers and combined rollers sustain the longitudinal loads. When the fork is lifted to the max. height, the top end side rollers and main rollers are revealed from the mast top end.

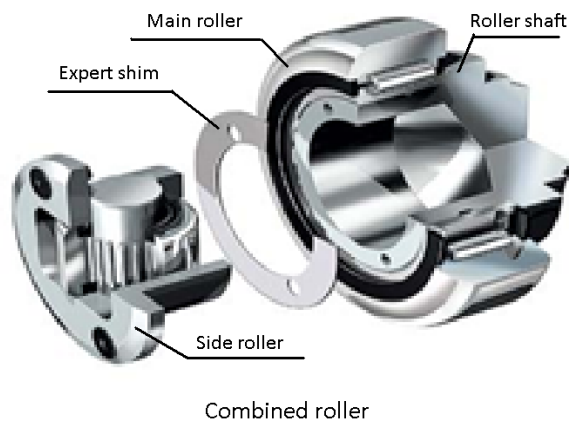
10.4 Roller position

There are three kinds of rollers, main roller, side roller and combined roller. Main

rollers and side rollers are on the top end of the bracket, the other rollers are combined rollers. The main rollers sustain the loads from front and rear direction. The combined rollers sustain t from front and rear direction and the side loads.



Attention :(a) Clearance of the side roller is 0.5mm. adjust the clearance with special shims.

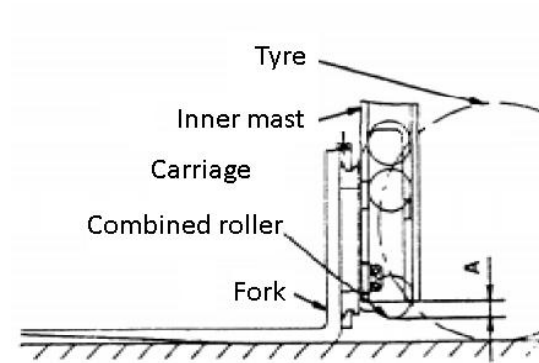
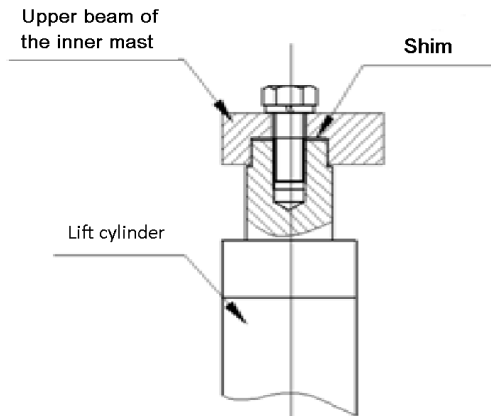


(b)Please add butter on the surface of rollers and the interface of masts.

10.5 Maintenance

10.5.1 Adjustment of lift cylinder

When replace the lift cylinder, inner mast or outer mast, we shall readjust the stroke of the lift cylinder as following.



(1) Install the piston rod in the upper beam of the inner mast without shims.

(2) Lift the mast slowly to the max. Stroke of the cylinder and check the two cylinders synchronize or not. Adjust until they are synchronized.

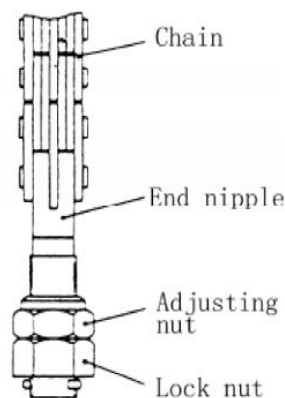
(3) Adjust the tightness of lift chains.

The adjustment of lift cylinder also belongs to exalted maintenance. Please be careful.

10.5.2 Carriage adjustment

(1) Let the truck parking on the horizontal ground and make the mast vertical.

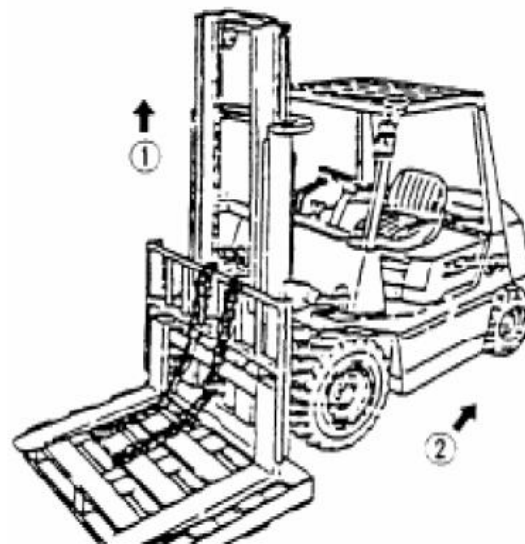
(2) Let the bottom of the fork contact with the ground. Adjust the adjusting nut for the end nipple of the upper chain and make a distance A between the main roller and the carriage. $A=19\sim 20\text{mm}$.



(3) Make the fork down to the ground and tilt backward fully. Adjust the adjusting nut for the end nipple of the upper chain and make the two chains' tightness equal.

10.5.3 Carriage rollers replace

- (1) Fork a tray on the fork and let the truck parking on the horizontal ground.
- (2) Make the fork and the tray down to the ground.
- (3) Disassemble the end nipple of the upper chain and take the chain down from the sheave.
- (4) Lift the inner mast.(see ①)
- (5) Make the truck back-up if the carriage is fully separated from the outer mast. (See ②)

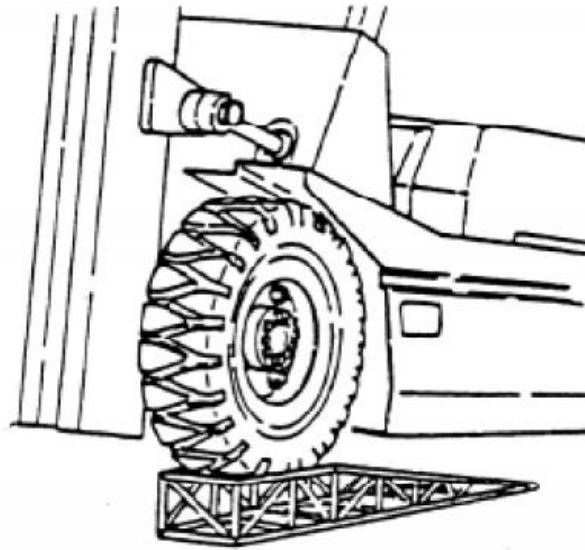


- (6) Replace the main rollers.
 - (a) Disassemble all the bolts and take the side rollers down and remain the shims. Disassemble the main rollers with a drawing tool.
 - (b) Ensure the new rollers are equal to the replaced ones. Install the new rollers inside the carriage. Tightening torque of the bolts is 3.3Nm.

10.5.4 Mast rollers replace

- (1) Use the same way as 10.5.3 to disassemble the carriage from the inner mast.
- (2) Let the truck parking on the horizontal ground and wedge up the front wheels

for 250 to 300mm.



(3)Apply the parking brake and wedge up the rear wheels.

(4)Disassemble the fitted bolts for the lift cylinder and the inner mast. Hang up the inner mast not to loose the shims for the top of the piston rod.

(5)Disassemble the connecting bolts for the lift cylinder and the bottom of the outer mast. Disassemble the lift cylinders and the oil pipes between the two cylinders without loosen the oil pipe joints.

(6)Put down the inner mast. Disassemble the Combined rollers under the bottom of the inner mast.

(7)Replace the main rollers.

(8)Hang up the inner mast to let all the rollers go into the mast.

(9)Reassemble the lift cylinder and the carriage.

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