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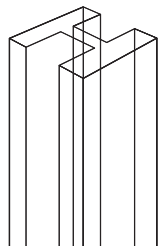


G series 1-3.5t

Battery Counterbalanced
Forklift Trucks

OPERATION SERVICE MANUAL

HELI 安徽合力股份有限公司
ANHUI HELI CO., LTD.

FOREWORD

Battery counterbalanced forklift truck is designed on the base of advantages of some trucks made by domestic and foreign manufacturers and developed in introduced technology from abroad. These trucks are all suited for handling and stacking packed goods in stations, ports, goods yards and warehouses and used widely in food processing, light and textile, mining industries and other factories, with some of attachments fitted, the trucks can be applied more and more.

These trucks feature a wide-visible hoisting system, full powered steering unit, self-energizing brake, continuous speed control, overhead guard with opened port and high quality motor, battery, so they have a lot of advantages such as good performance, easy operation, wide visibility of operator, flexible steering, reliable braking, powerful and smooth power, low noise, no contamination to environment and beautiful contour.

This manual states the trucks' specifications, operation, maintenance, service, main assemblies' constructions and working principles 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 or service personnel serve these trucks.

The rules and notices in the manual should be abided seriously by all of relative personnel to enable these trucks in optimized working state for long period and bring the highest efficiency.

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.

CONTENTS

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

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

1. Delivery of Forklift Truck

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

(1) Apply the parking brake.

(2) Fix the mast and the balance weight with steel wire. Wedge up all wheels.

(3) Sling points should be always at the positions specified in sling index plate when hoisting up the forklift truck.

2. Storage of Forklift Truck

(1) Drain off fuel completely. Don’t drain off the cooling water containing antifreeze and rustproof agent.

(2) Apply antirust to the surface of the parts not painted. Apply lubrication oil to the lift chain.

(3) Lowing the mast to the lowest position.

(4) Apply the parking brake.

(5) Wedged up the wheels.

3. Precautions Before Operation

(1) Don’t check fuel leakage and lever or instruments at the place where there is open flame. Never fill the fuel tank with the truck running.

(2) Check the tire inflation pressure.

(3)Check the devices of lighting, sound and alarm: check the lights, buzzer and horn (button on the handle included).

(4) The forward-reverse lever should be in neutral.

(5) Check all the levers and pedals.

(6) Complete the provisions before starting.

(7) Release the parking lever.

(8) Make trying operation of the mast for lifting, lowing and Fwd/Bwd tilting and the truck for steering and braking.

4. Operation of Forklift Truck

(1) Only trained and authorized operator shall be permitted to operate the truck.

(2) Wear all the safety guards, such as shoes, helmet, clothing and gloves while operating the truck.

(3) Check all the control and warning devices before starting the truck. If any damages or defects are found, operate it after repairing.

(4) At the rated loading center, either overload or overload operation is strictly prohibited. The center of cargo should be in line with the frame center, not out of the line. The fork should insert completely under the cargo and make the cargo placed on it evenly. Do not raise an object with one fork end.

(5) The starting, turning, driving, braking and stopping operation of the truck should be done smoothly. When steering on the humid or low friction road, the truck should be decelerated.

(6) Travel with loads as low as possible and tilted backward.

(7) Be careful when traveling on a slope. When climbing grades with a slope of more than 10%, the truck should forward travel, and when descending so grades, backward travel. Never turning on a slope. Avoid loading and unloading operation when descending.

(8) Pay attention to pedestrian, obstacle and bumpy road when driving. Pay attention to the clearance over forklift truck.

(9) Never allow any persons to stand on the forks or the truck to carry persons.

(10) Never permit anyone to stand or walk under upraised forks.

(11) Don’t operate truck and attachment of it at any position out of the drive seat.

(12)On the high lift forklift truck, when the lift high more than 3m, it is noted that the goods on it should not fall down or the protection measures must be taken if necessary.

(13) Tilt the mast of the high lift forklift truck as backward as possible while the truck working. Use minimum forward tilt angle and Min. reverse tilt when loading and unloading.

(14) Be careful and slowly driving over a dockboard or bridge-plate.

(15) Shut down the truck and don't stay on the truck when checking battery or fuel lever.

(16) The unloaded forklift truck with attachments should be operated as a loaded truck.

(17) Don't handle unfixed stacked goods. Be careful to bulky goods to be handled.

(18) If leaving the truck, lower the forks on the ground and let the shift lever to neutral, shut down the engine or cut down electric supply. If parking on a slope is unavoidable, apply the parking brake and block the wheels.

(19) Don't adjust the control valve and relief valve at will to prevent the damage of hydraulic system and its components because of excessive pressure passing them.

(20) Inflate a tyre according to it's stated air pressure. Never over inflate a tyre.

(21) According to the measure method specified in JB/T 3300, the max. noise at the outboard of the truck should be not more than 80dB(A).

(22) Be familiar with and pay attention to the functions of the decals on the forklift trucks.

5. Daily Maintenance of Forklift Trucks

(1) Inspection before startup

a) Hydraulic oil volume: oil level should stay in the middle of oil meter scale;

b) Check piping, joints, pumps and valves for leaks or damages;

c) Check service brake:

The free travel of brake pedal should be within the range of 20-30mm;

The clearance between the front floor and the pedal should be bigger than 20mm;

d) Check parking brake. The unladen truck can park on the 15% grade ramp, when

the parking lever is pulled to the bottom;

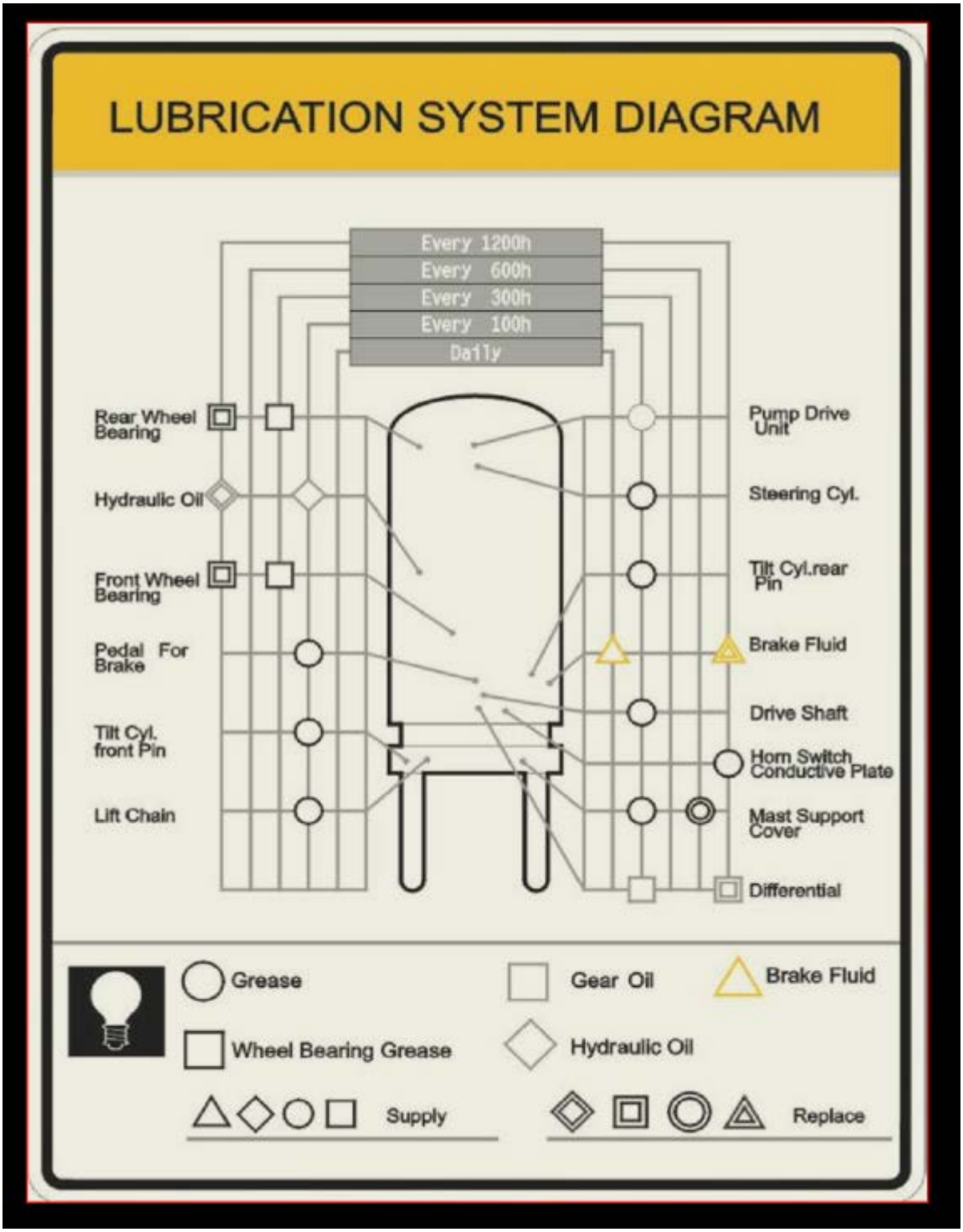
e) Check instruments, lighting, switches and wiring to see if they work normally or not.

(2) Oil used for forklift trucks

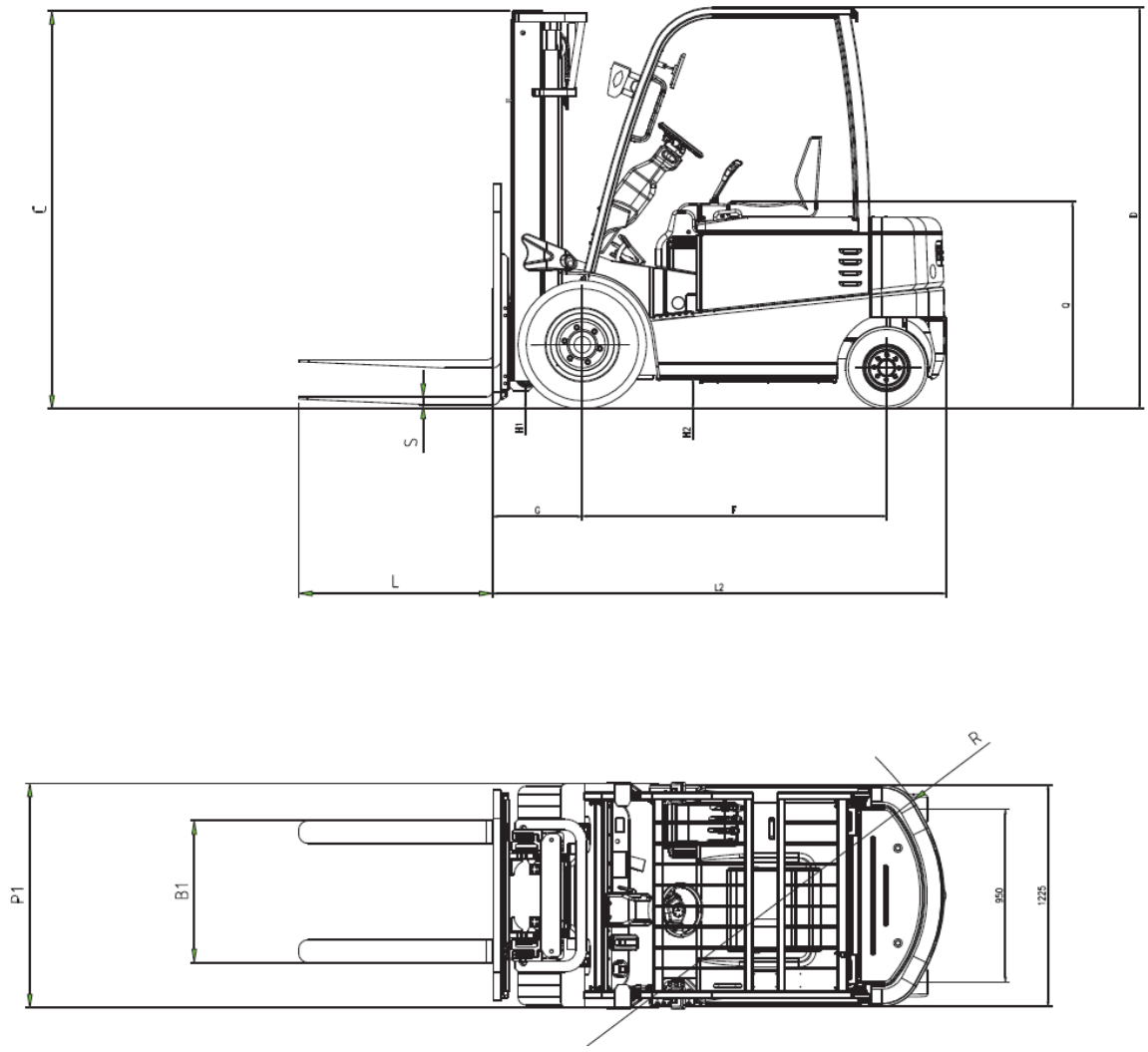
Name	Recommended brand	Brand and temperature of using		
Hydraulic oil	Chang cheng	Sticky grade	L-HM32 wearable hydraulic oil	L-HV32 low temp. wearable hydraulic oil
		Temp. of using (℃)	⩾-5	⩾-20 (cold region)
Brake fluid	Chong qing yi ping	4604 compound brake fluid GB 12981 HZY4		
Lubricating grease	Chang cheng	3# lithium base grease (-20℃～+120℃)		
Gear oil of heavy-laden truck	Hai pai	Sticky grade	85W/90GL-5	80W/90GL-5
		Temp. of using (℃)	-15～+49	-25～+49

- **Apply lubricating grease NYOGEL 782G to the conductive plate which the connecting point of the steering wheel horn switch acts on.**

(3) The table of lubrication system



Ⅱ. Main Specifications of Forklift Truck



Enternal view of forklift trucks

Main Specifications

Model	Unit	CPD10	CPD15	CPD18
		GC/GD	GC/GD	GC/GD
Rated capacity	kg	1000	1500	1750
Load center	mm	500		
Lifting height	mm	3000		
Free lifting height	mm	145		
Mast tilt angle (fwd/bwd) (K/T)	°	6/8		
Fork size (L×S×E)	mm	770×100×32		920×100×35
Wheelbase F	mm	1380		
Tread (front/rear) (B1/B2)	mm	910/920		
Overall length (without forks) L2	mm	2070		
Overall width (front/rear) (P1/P2)	mm	1086/1070		
Overall height (mast/overhead guard) (C/D)	mm	1985/2130		
Seat height Q	mm	1030		
Under-clearance (H1/H2)	mm	95/90(in the middle of the truck body)		90/80(in the middle of the truck body)
Min. turning radius R	mm	1750		
Travelling speed (loaded/unloaded)	km/h	15/16		
Lifting speed (loaded/unloaded)	mm/s	AC: 410/600	400/600	380/600
		DC:290/450	270/450	280/530
Descending speed (loaded/unloaded)	mm/s	400/500		
Gradeability (loaded/unloaded)	%	20/25	19/24	17/22
Tyre (front/rear)		6.0-9/16×6-8		
Traction motor	kW	8.2 (AC)		
Pump motor	kW	10.6 (AC)		
Battery	V/Ah	48/400 (st.)	48/480 (st.)	48/480 (st.)
		48/480 (op.)	48/600 (op.)	48/600 (op.)
		48/600(op.)		
Service weight	kg	2920	3030	3220

Main Specifications

Model	Unit	CPD20	CPD25
		GB/GC /GD	GB/GC /GD
Rated capacity	kg	2000	2500
Load center	mm	500	
Lifting height	mm	3000	
Free lifting height	mm	145	
Mast tilt angle (fwd/bwd) (K/T)	°	6/8	
Fork size (L×S×E)	mm	920×100×45	1070×122×40
Wheelbase F	mm	1550	
Tread (front/rear) (B1/B2)	mm	960/950	
Overall length (without forks) L2	mm	2285(GC/GD) 2270(GB)	2295(GC/GD) 2280(GB)
Overall width (front/rear) (P1/P2)	mm	1170/1150 (solid tyre)	
		1185/1150 (pneumatic tyre)	
Overall height (mast/overhead guard) (C/D)	mm	1995/2150	
Seat height Q	mm	1050	
Under-clearance (H1/H2)	mm	110(at mast)/115(in the middle of the truck body)	
Min. turning radius R	mm	2000	2020
Travelling speed (loaded/unloaded)	km/h	14.5/15(GC/GD)	14/14(GB)
Lifting speed (loaded/unloaded)	mm/s	GC: 280/490	260/490
		GD: 350/510	330/510
		GB: 320/430	280/430
Descending speed (loaded/unloaded)	mm/s	410/490(GC/GD)	450/500(GB)
Gradeability (loaded/unloaded)	%	20/24	18/22
Tyre (front/rear)		23×9-10/18×7-8	
Traction motor	kW	11.5 (AC)	
Pump motor	kW	GB: 12 (AC)	
		GC: 10.5 (DC)	
		GD: 15 (AC)	
Battery	V/Ah	48/600	48/700
		48/600 (standard for GC)	
		48/700 (standard for GD)	
Service weight	kg	4050(GC/GD) 4000(GB)	4300(GC/GD) 4150(GB)

Main specifications

Model	Unit	CPD30	CPD35
		GC /GD	GC /GD
Rated capacity	kg	3000	3500
Load center	mm	500	
Lifting height	mm	3000	
Free lifting height	mm	145	150
Mast tilt angle (fwd/bwd) (K/T)	deg.	6/10	
Fork size (L×S×E)	mm	1070×125×45	1070×125×50
Wheelbase F	mm	1685	
Tread (front/rear) (B1/B2)	mm	1000/950	
Overall length (without forks) L2	mm	2485	2550
Overall width (front/rear) (P1/P2)	mm	1238/1225	
Overall height (mast/overhead guard) (C/D)	mm	2075/2215	2180/2215
Seat height Q	mm	1165	
Under-clearance (H1/H2)	mm	150（at mast）/165（in the middle of the truck body）	
Min. turning radius R	mm	2210	2270
Travelling speed (loaded/unloaded)	km/h	15/15.5	14.5/15
Lifting speed (loaded/unloaded)	mm/s	DC: 280/490	260/490
		AC: 340/460	325/450
Lifting speed (loaded/unloaded)	mm/s	420/510	
Gradeability (loaded/unloaded)	%	15	12
Tyre (front/rear)		28x9-15/18x7-8	
Traction motor	kW	16.6 (AC)	
Pump motor	kW	13 (DC)	
		13.5 (AC)	
Battery	V/Ah	80/480(standard)	
		80/600(optional)	
Service weight	kg	4810	5500

Size and weight of the main parts that can be disassembled

		Counter weight		Overhead guard		Mast （lifting height 3000mm）	
		Max. outline dimension	Weight	Max. outline dimension	Weight	Max. outline dimension	Weight
Unit		mm	Kg	mm	Kg	mm	Kg
CPD10	GC/GD	300×825×1070	500	1050×1414×1551	72	1010×480×1925	450
CPD15	GC/GD	300×825×1070	500	1050×1414×1551	72	1010×480×1925	450
CPD18	GC/GD	300×825×1070	720	1050×1414×1551	72	1010×480×1925	450
CPD20	GB/GC/GD	370×890×1150	940	1100×1457×1515	86	1102×506×1930	745
CPD25	GB/GC/GD	380×890×1150	1080	1100×1457×1515	86	1102×506×1930	745
CPD30	GC/GD	405×895×1225	1000	1140×1578×1573	77	1164×459×1957	785
CPD35	GC/GD	465×895×1225	1330	1140×1578×1573	77	1164×464×1957	815

Ⅲ. Construction, Principle, Adjustment and Maintenance of Forklift Trucks

1. Transmission System

1.1 General description

The transmission system consists of differential assembly and gearbox & axle assembly. With direct connection of the drive gear and the drive motor, the travel speed of the truck can be changed with the speed of the motor, and the travel direction can be changed with the rotation direction of the motor.

1.2 Differential assembly

The differential is respectively installed on the main housing of the reducer casing and spindle head assembly of the axle housing through bearings on both ends. The differential housing of 1-2.5t truck is of integral type (see figure 1-1). And the 1-3.5t truck, it is left-right split type (see figure 1-2). The differential includes two half-shaft gears and two planet gears.

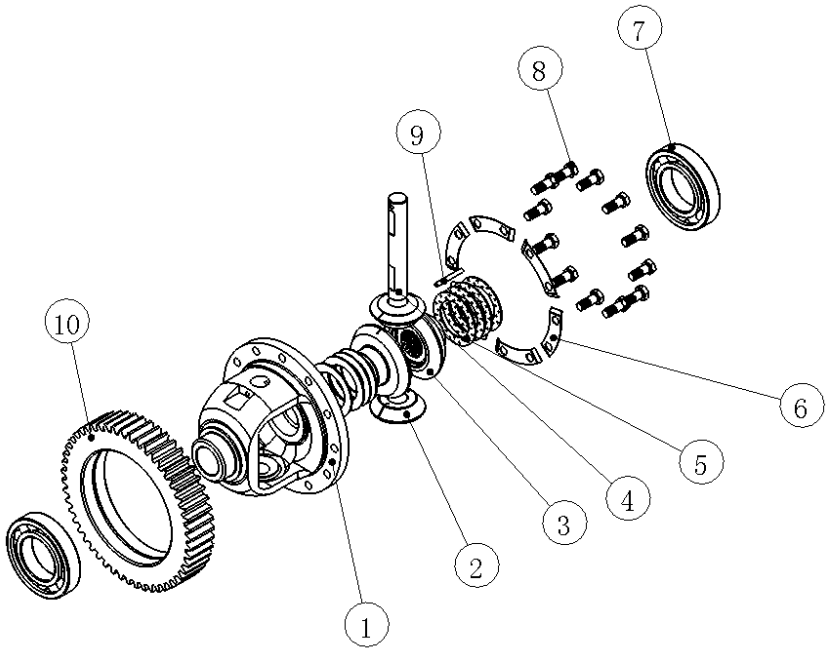


Fig. 1-1 Differential assembly (1-2.5t)

1. Differential house 2. Planetary gear 3. Half axle gear 4. One-line axle
5. Half axle gear adjusting gasket 6. Duplex stopping locking plate 7. Bearing
8. Bolt (9) pin (10) gear ring

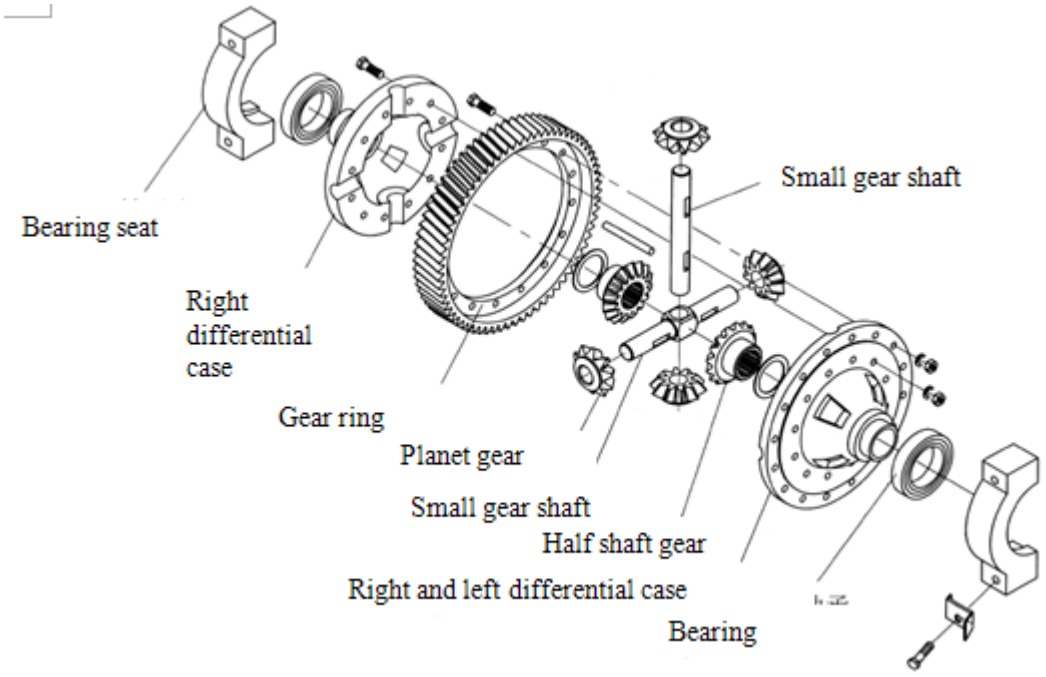


Figure 1-2 differential assembly (3-3.5t)

1.3 Gearbox & axle assembly

The gearbox & axle assembly mainly consists of the housing, differential, half shaft, wheel hubs, brake and the wheels. It is installed in the front of the frame.

The housing of 1-2.5t truck is an fission cast. The housing of 3-3.5t truck is of wholly casted structure. The tyre with the rim is fixed to the hub with bolts and nuts. The power is transmitted to the half-shafts through the differential and drives the front wheels through the hubs. Each hub is fixed on the housing with two tapered roll bearings, so that the half-shafts bear only the torque transmitted to the hubs. In the inside of the hub are oil seals to prevent water and dust from entering or oil leakage. (See Fig. 1-3,1-4,1-5)

The tyre, rim and the pressure of the front wheel are followed. (See Table 1-1)

Table 1-1

Truck model	1t、1.5t	1.8t	2t、2.5t	3t	3.5t
Tyre size	6.0-9-10PR	6.0-9	23×9-10-16PR	28×9-15-14PR	28×9-15
Rim size	4.00E		6.50F-10	7.00-15	
Tyre pressure	860kPa	Solid tyre	1030kPa	830kPa	Solid tyre

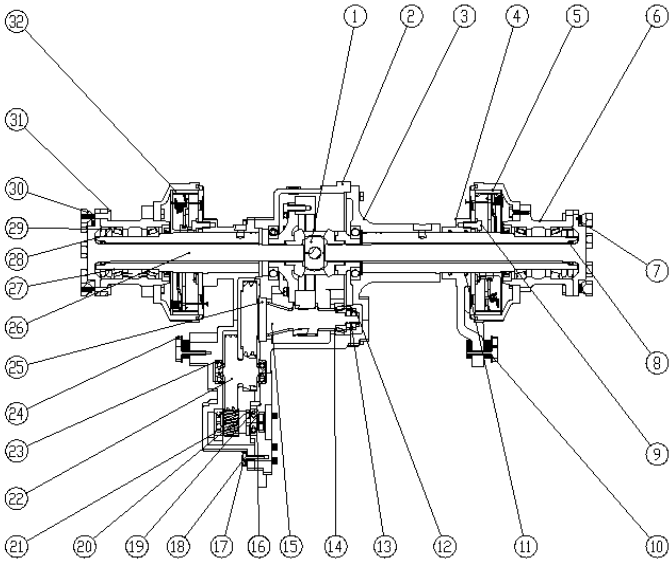


Fig. 1-3 Gearbox & axle assembly (1-2.5t)

(1) Differential assembly (2) Main housing of the reducer casing (3) Spindle head assembly of the axle housing I (4) Connecting plate (5) Brake assembly (R) (6) Brake drum hub assembly
(7) Half-shaft I (8) Oil seal AE2483E0 (9) Bolt (10) Washer 20 (11) O-ring seal 90×5.3
(12) Nut M30×1.5 (13) Washer 30 (14) Bearing 32208 (15) Dual gear II
(16) Bearing 6010/C3 (17) Washer 12 (18) Bolt M12×40 (19) Oil seal AE2791A0
(20) Pinion (21) Bearing 6208 (22) Dual gearI (23) Bearing 6306 (24) BoltM20×1.5×55
(25) Bearing 32915 (26) Half-shaft II (27) Spindle head assembly of the axle housing II
(28) Washer 75 (29) Nut M75×2 (30) Cone nut (31) Bolt M18×1.5 (32) Brake assembly (L)
Note: the bolts (9)(18)(24) should be applied with GY-340 adhesive; the o-ring shown in (11) used on 1-1.8t truck is 75×5.3 and other trucks are 90×5.3.

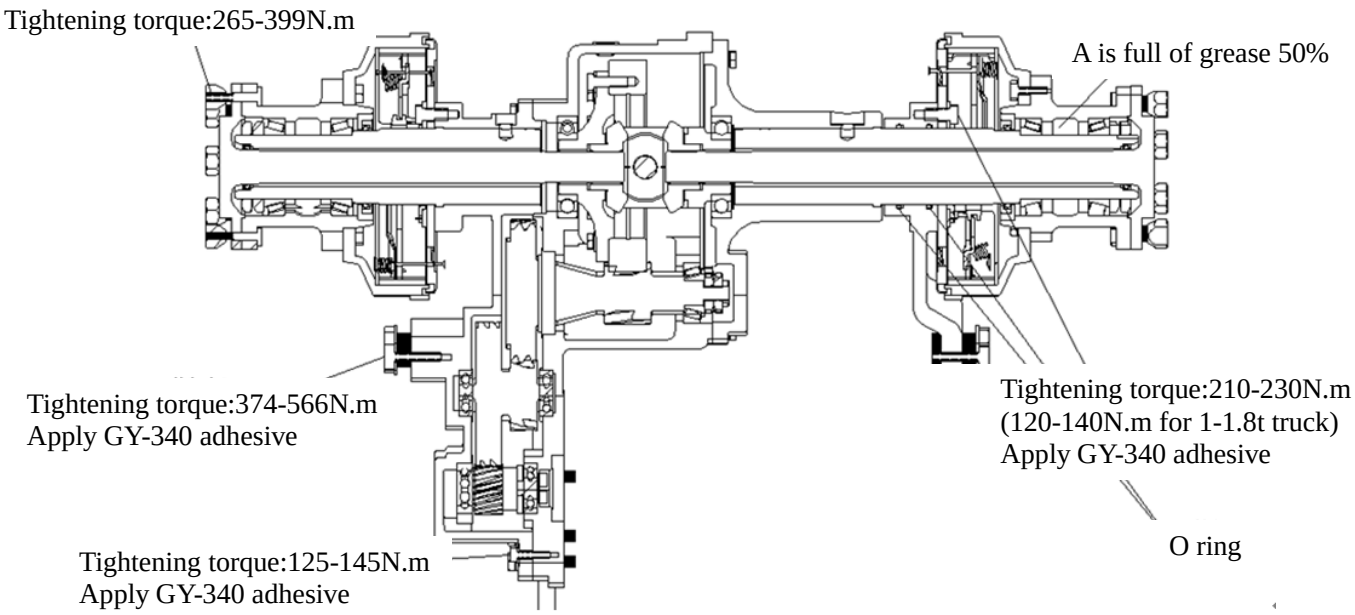


Fig. 1-4 Gearbox & axle assembly(1-2.5t)

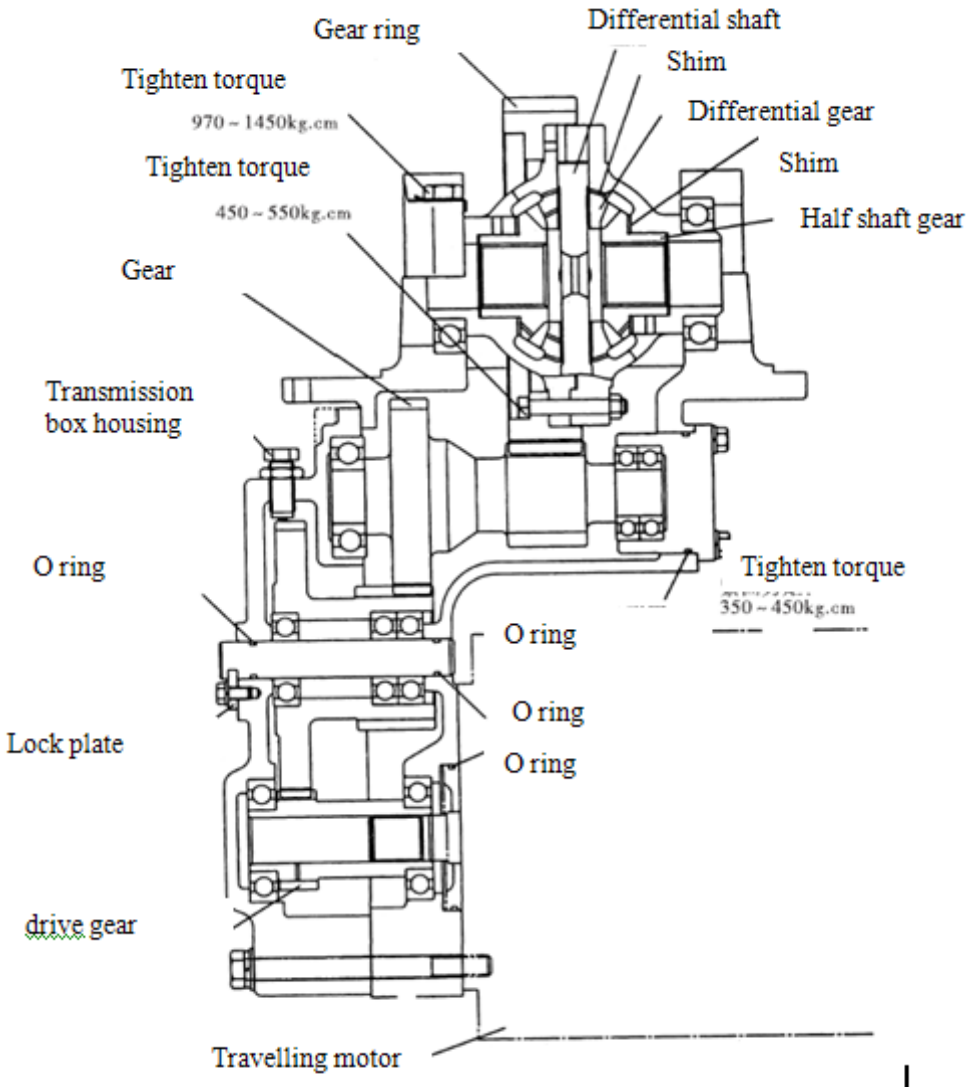


Figure 1-5 reducer and differential (3-3.5t)

1.4 Assembly of wheel hub

(1) Fill the chamber of wheel hub with lubricating grease about 100cc, and then fit the hub on the housing.

(2) Screw down the hub nut to a torque of 1kg.m, then loosen it for 1/2 turn.

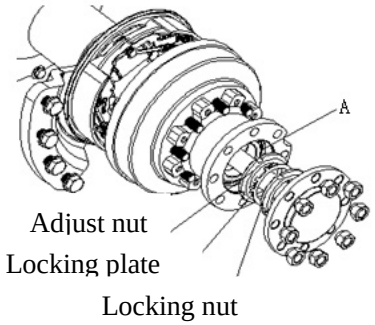


Fig. 1-6 Fill lubricating grease

(3) Measure the torque value that the wheel hub starts rotating. When the torque value measured is up to 5-15kg.m, screw down the hub nut.

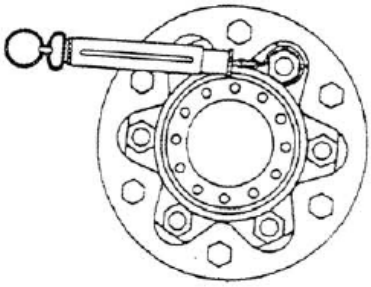


Fig. 1-7 Measure the torque value

(4) Screw down the locking nut and lock the locking pin.

(5) Reassembly of tyre

Fix the drain tap and the cover on the tyre, and install rim. Take care of the following notes:

NOTE: a) the exhaust valve rod points outside and lies on the gap of the rim.

b) Make sure the hub nut head point outside.

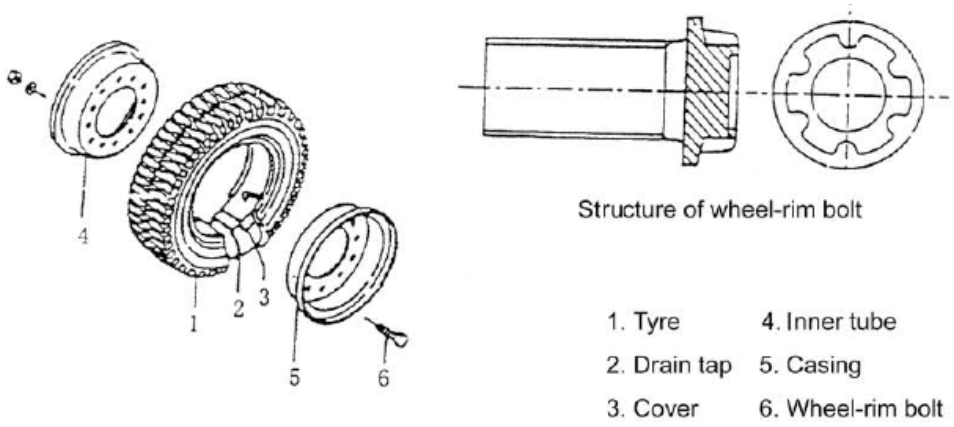


Fig. 1-8 Reassembly of tyre

2. Brake System

2.1 General description

The brake system is the front two-wheel braking type consisting of brake pedal, master cylinder and wheel brakes.

2.1.1 Brake pedal

The service brake system is made up of brake pedal, master cylinder, sub-cylinder and brake. The service braking principle diagram is shown in Fig.2-1.1. The structure of the brake pedal is shown in Fig. 2-1.2.

The force acts on the pedal is changed to brake fluid pressure through the push rod of the master brake cylinder.

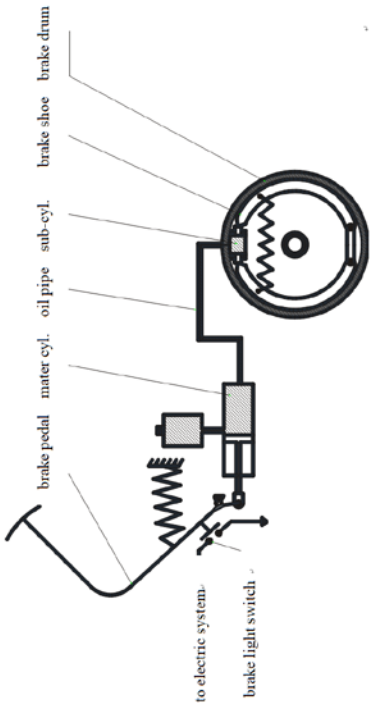


Fig. 2-1.1 Service braking principle diagram

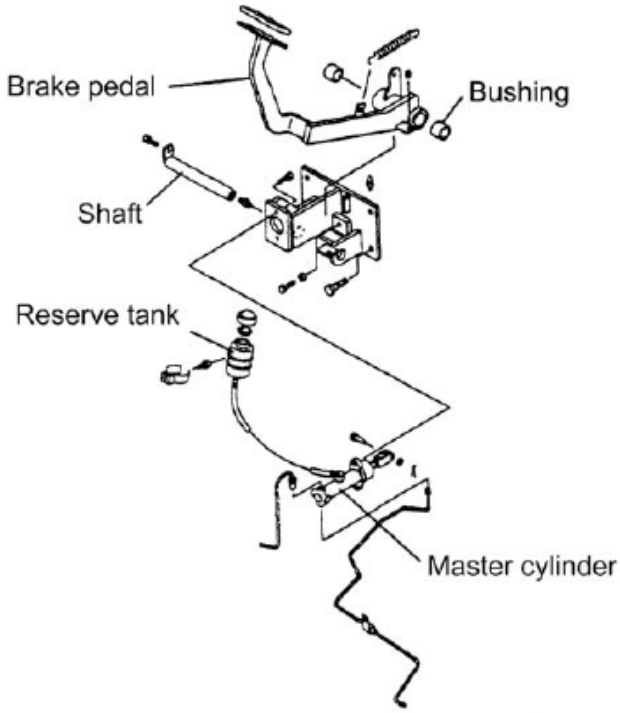


Fig. 2-1.2 Brake pedal

2.1.2 Master cylinder

The cylinder contains valve seat, return spring, primary cup, piston and secondary cup, which are all kept in place with a stop washer and a stop wire. The exterior of the cylinder is protected from the dust by means of a rubber dust cover. The piston is actuated

through the push rod by operation of brake pedal. As the brake pedal is pressed, the push rod pushes the piston forward. The brake fluid in the cylinder flows 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, flowing through the brake pipeline to the sub cylinder. Thus, each sub cylinder piston is forced outwards. This brings the friction pieces on the brake shoes into contact with the brake drum and slows or stops the truck. Meanwhile, the cavity caused behind the piston is filled with brake fluid led through the return port and inlet port. When the brake pedal is released, the piston is forced back by the return spring. At the same time, the brake fluid in each sub cylinder is pressured by the return spring, returning into the mast cylinder through the check valve. With the piston in its original position, the fluid in the master cylinder flows into the reserve tank through the return port. The brake fluid in the brake pipelines and sub cylinders has a residual pressure proportioned to the set pressure of the check valve, which makes each sub cylinder piston cup securely seated to prevent oil leakage and eliminates a possibility of air locking when the truck is sharply braked.

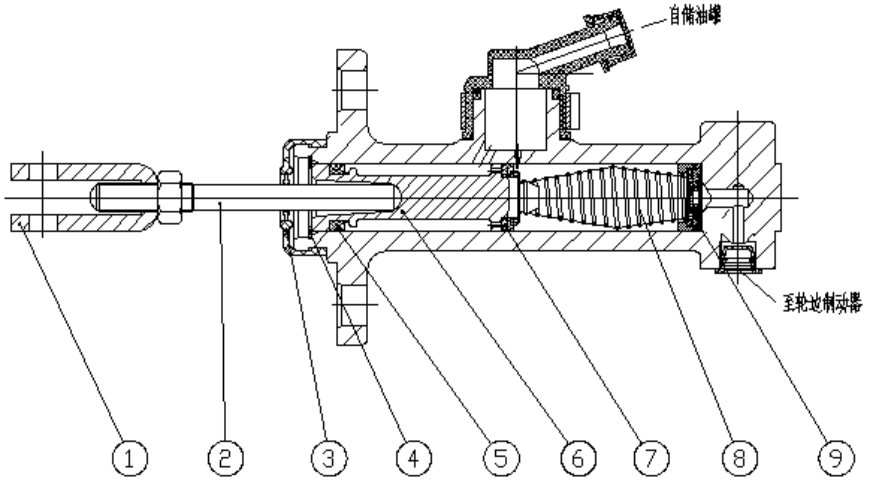


Fig. 2-2 Master cylinder

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

2.1.3 Wheel brake

The wheel brake is of double brake shoe type which is fitted to the each end of the gearbox & axle assembly.

The wheel brake is made up of two brake shoe, sub cylinder and adjuster.

The brake shoe, one end of it being connected to the anchor pin and the other to the adjuster, is stressed on backing plate by the spring and spring pull rod.

In addition, a parking brake and a clearance self-adjusting mechanism are fitted on the wheel brake.

(1) Braking operation

The primary and secondary shoes are respectively forced by a force equal in value by master cylinder until the upper end of the secondary shoe is against the anchor pin and the brake shoe moves towards the rotation direction of the brake drum.

The friction force between the friction piece and brake drum increases when the anchor pin is laid against. A large braking force is produced because the secondary brake shoe bears a larger force from the primary shoe than from the sub cylinder. (See Fig. 2-3)

The operation of the brake is opposite from forward travelling when travelling backward. (See Fig. 2-4)

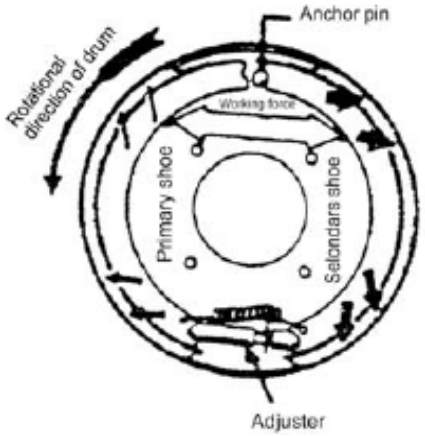


Fig. 2-3 Braking operation in forward travel

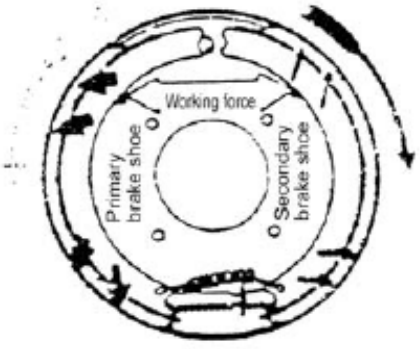


Fig. 2-4 Braking operation in backward travel

(2) Parking brake

The parking brake is built in the wheel brake which is made up of push rod and pull rod.

The pull rod is mounted to the primary shoe side by pin. The move of the pull rod is transmitted to the secondary shoe side through push rod. (See Fig. 2-5)

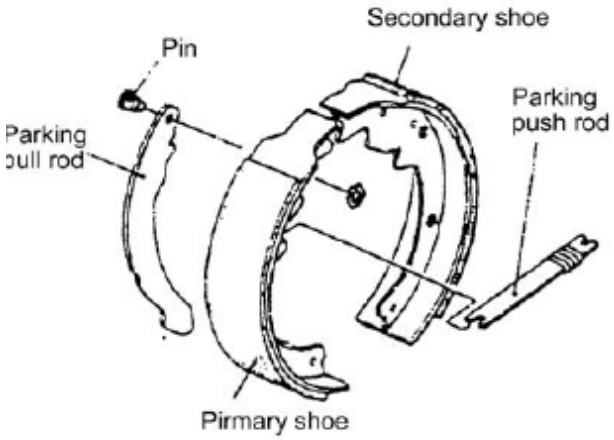


Fig. 2-5 Parking brake

(3) Clearance self-adjusting mechanism

A proper clearance between the friction piece and the brake drum is maintained by the clearance self-adjusting mechanism. (See Fig. 2-6)

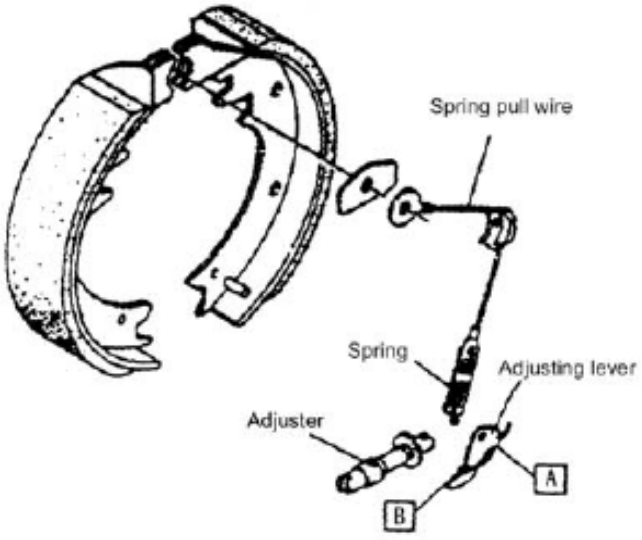


Fig. 2-6 Clearance self-adjuster

The clearance self-adjusting mechanism actuates only when the truck in reverse

travel.

▲Operation of the clearance self-adjuster

When brake during travelling backward, the secondary brake shoe contact with main brake shoe and rotate together. Then the pulling rod turn right with point A as pivot and thus B point is raised up. See figure 2-6. When brake is released, the pulling rod turn left under the spring action and thus B point lowers. When the clearance between friction disc and brake drum increases, b rotating vertical dimension increases. The clearance decreases with the elongating of adjusting rod when the adjuster is stirred one gear. See figure 2-7. See the follow table for clearance adjusting range:

	1-1.8t	2-2.5t	3-3.5t
Clearance	0.35～0.55	0.5～0.55	0.25-0.4

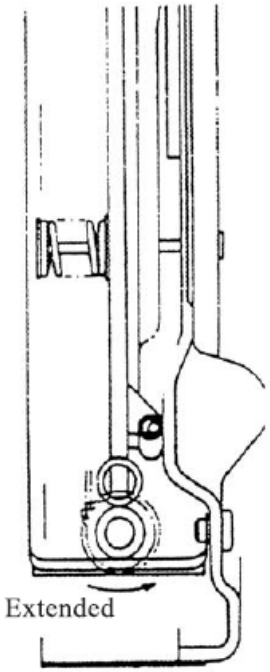


Fig. 2-7 Clearance self-adjuster

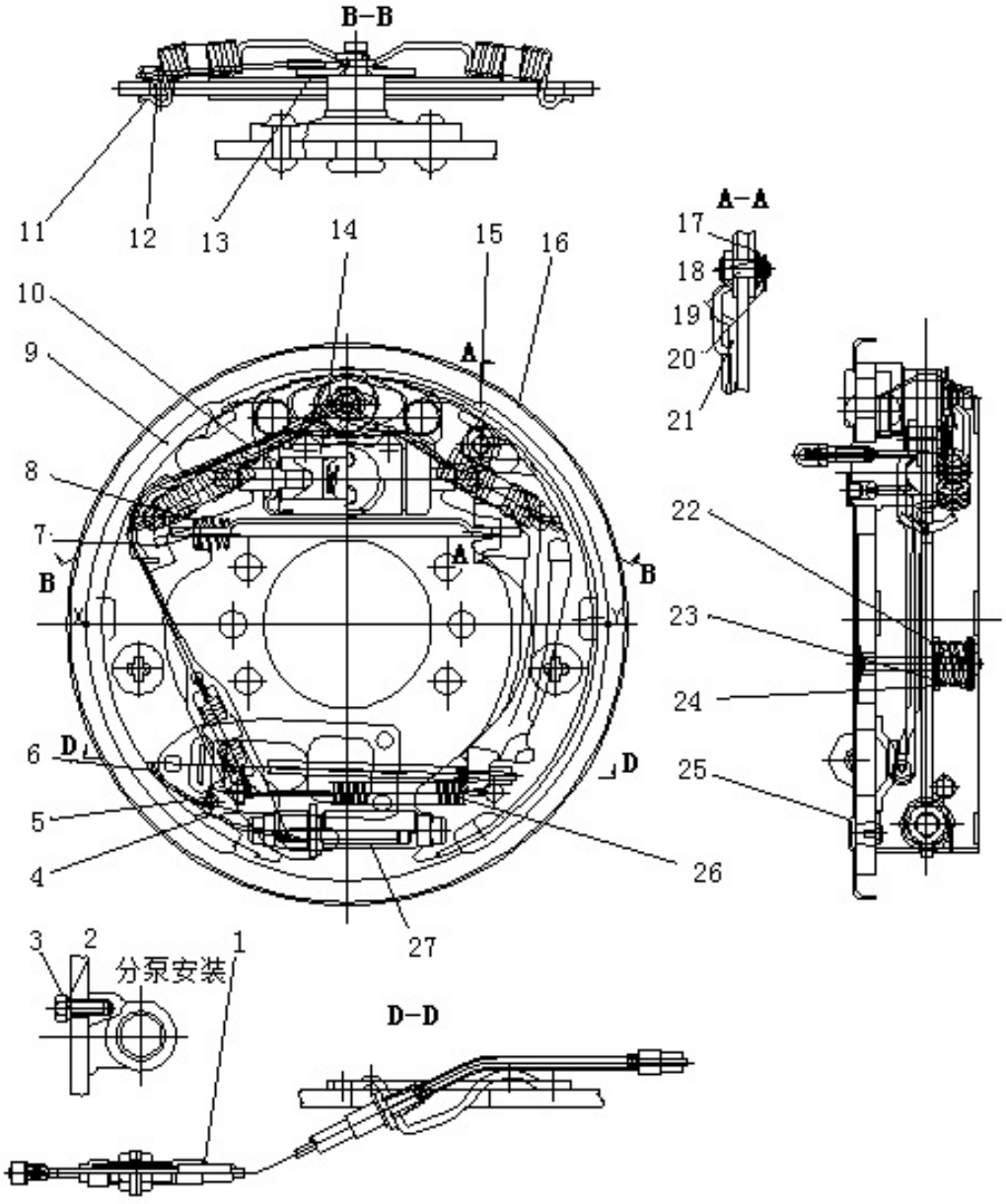


Fig. 2-8 Wheel brake

(1) Braking cable ass'y (2) Washer 8 (3) Bolt M8×20 (4) Ratchet pawl (5) Pin roll
(6) Torsional spring (7) Parking push rod (8) Spring (9) Rear brake shoe with friction plate
(10) Spring pull rod (11) Return spring for brake shoe (12) Guide pad (13) Guide plate
(14) Brake cylinder ass'y (15) Front brake shoe with friction plate (16) Bassplate ass'y
(17) Washer 10 (18) Spring washer (19) Pin roll for pull rod (20) Snap ring
(21) Parking pull rod (22) Spring pull rod (23) Spring seat (24) Spring (25) Plug
(26) Pullback spring (27) Clearance self-adjuster

2.1.4 Operating device of the parking brake

The parking brake lever is of a ratchet type. Different brake force can be achieved on

slope and ground.

Brake force adjustment: When you turns the adjuster clockwise, the force increases, otherwise, when you turns the adjuster counter clockwise, the force decreases. (See Fig. 2-9)

Pull force: 20 to 30kg.

Note: Adjuster is inside the cover. Cover need to be disassembled before adjusting.

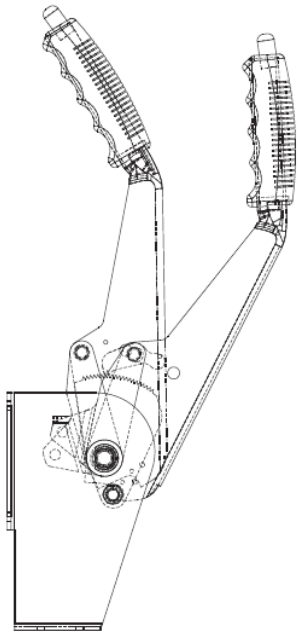


Fig. 2-9 parking brake shank

2.2 Maintenance of wheel brake

This paragraph covers the disassembly, reassembly and adjustment of the wheel brake in the state of the wheels and hubs are disassembled. It also covers the adjustment method of the brake pedal. (The description here is mainly for 2.5ton truck brake, the other truck brake is similar to it in general.)

2.2.1 Wheel brake disassembly

(1) Remove the support pin, adjusting lever, adjusting device and spring of secondary shoe. (See Fig. 2-10)

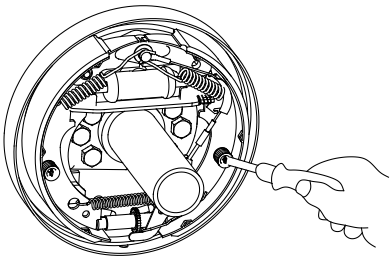


Fig. 2-10

(2) Remove two shoes return springs. (See Fig.2-11)

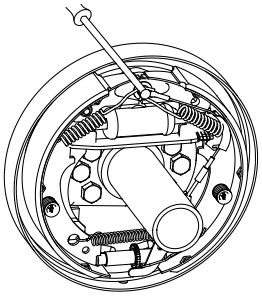


Fig. 2-11

(3) Remove three hold-down springs. (See Fig. 2-12)

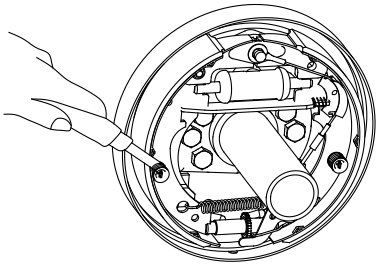


Fig. 2-12

(4) Remove the primary and secondary shoes. At the same time, remove adjuster spring. (See Fig. 2-13)

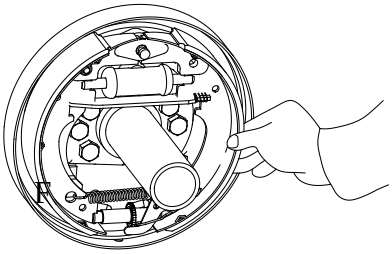


Fig. 2-13

(5) Remove the brake line from the wheel cylinder. Remove wheel cylinder mounting bolts and detach the wheel cylinder from the backing plate. (See Fig. 2-14)

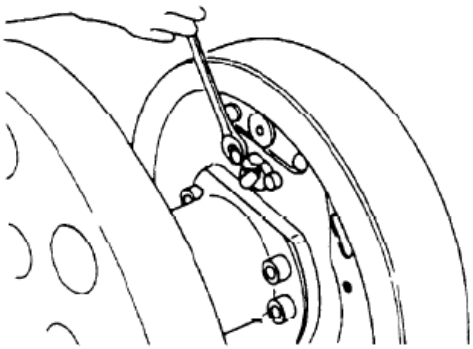


Fig. 2-14

(6) Remove the E-retainer for securing the parking brake cable to the backing plate. Remove the backing plate mounting bolts and detach the backing plate from the axle. (See Fig. 2-15)

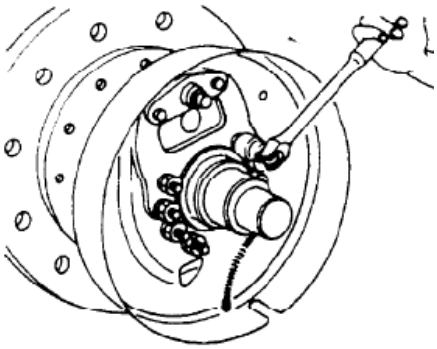


Fig. 2-15

(7) Remove the boot and push the piston assembly out of the operating cylinder. (See Fig. 2-16)

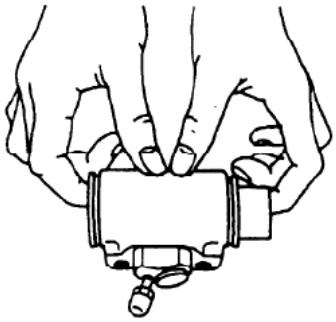


Fig. 2-16

2.2.2 Inspection of wheel brake

Inspect all parts to make sure if there's any worn or damaged part. If unsatisfactory, repair or replace with new one.

(1) Check the operating cylinder inner surface and the piston periphery surface for rusting. Then, measure the clearance between the piston and cylinder. (See Fig.2-17)

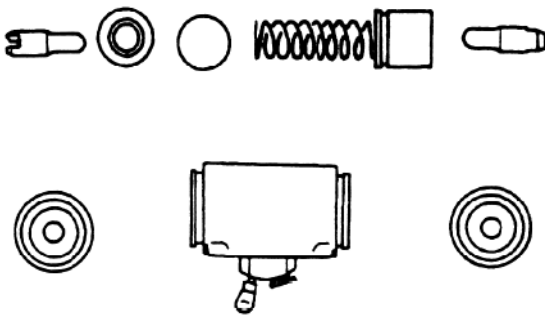


Fig. 2-17

Standard: 0.03-0.10mm

Maximum clearance: 0.15mm

(2) Visually check the piston cup for damage or deformation. If unsatisfactory, replace with new one.

(3) Check the free length of the operating cylinder spring. If unsatisfactory, replace it.

(4) Check the friction piece for thickness to see if it is excessive worn. If necessary, replace it. (See Fig. 2-18)

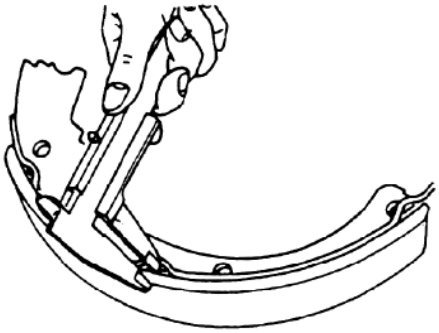


Fig. 2-18

Unit：mm

	1.0～1.8t	2.0～2.5t	3~3.5t
Standard	4.8	5.7	8.0
Limiting	2.5	3.5	6.0

(5) Check the condition of the brake drum inner surface. If any damage or excessive wear is found, repair by machining or replace it. (See Fig.2-19)

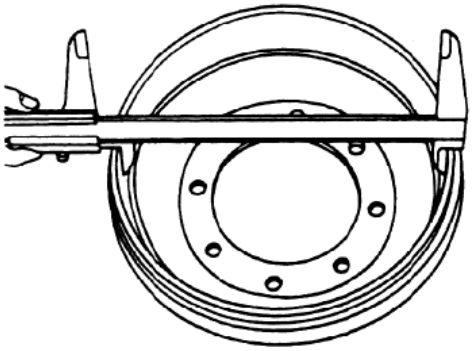


Fig. 2-19

Unit：mm

	1.0～1.8t	2.0～2.5t	3~3.5t
Standard	Φ254	Φ280	Φ314
Limiting	Φ256	Φ282	Φ316

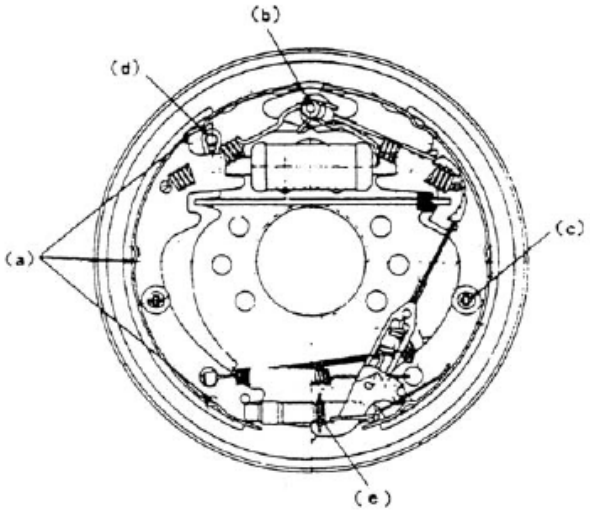
2.2.3 Wheel brake reassembly

(1) Apply brake fluid to the piston and the piston cup, and reinstall the spring, cup, the piston and the dust cover in this order.

(2) Install the operating cylinder on the backing plate.

(3) Install the backing plate on the front axle.

(4) Apply heat-resisting grease on the points indicated in Fig. 2-20, with care not to contaminate the friction piece with grease.



(a) Backing plate bearing surfaces
(b) Anchor pin
(c) Contact surfaces between brake shoe and spring seat
(d) Parking pull rod pin
(e) Surfaces of the screw of the adjuster and other rotating part.

Fig. 2-20

(5) Install the brake cable assembly on the backing plate with an E-retainer.

(6) Install shoes on the backing plate with hold-down springs.

(7) Put the spring on the parking push rod then install the rod on the shoe. (See Fig. 2-21)

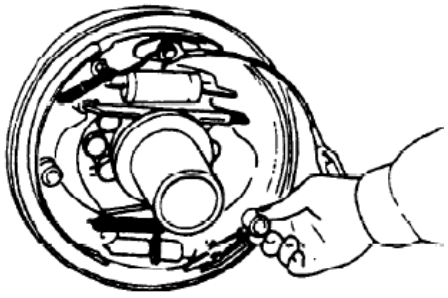


Fig. 2-21

(8) Install the shoe guide plate on the anchor pin, and install the shoe return spring. (See Fig. 2-22)

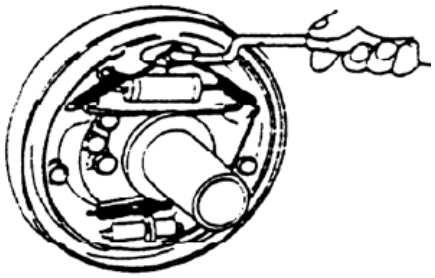


Fig. 2-22

(9) Install the adjuster, adjuster spring, push rod and its return spring.

Pay attention to the following points:

a) Adjuster thread direction and its mounting direction.

b) Adjuster spring direction. (Do not allow the adjuster gear teeth to contact with the spring)

c) Return spring direction of the push rod: Spring hook at anchor pin side should be located at the opposite side to push rod.

d) Make sure that the adjusting lever end is in contact with the adjuster gear teeth. (See Fig. 2-23)

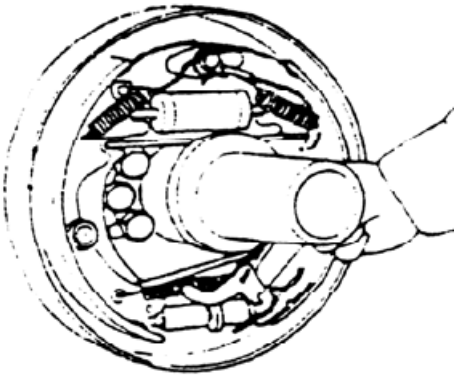


Fig. 2-23

(10) Install the brake line on the operating cylinder.

(11) Measure the inner diameter of drum and the outer diameter of brake shoe. Adjust the adjuster to obtain the 1mm difference needed between the drum inner diameter and the friction piece outer diameter. (See Fig. 2-24)

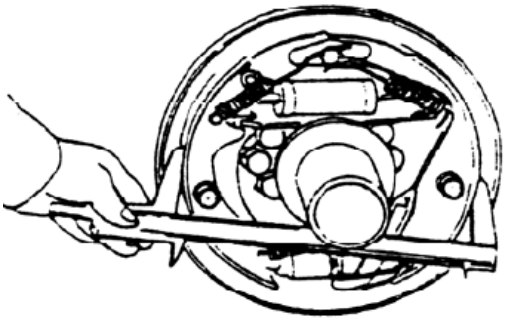


Fig. 2-24

2.2.4 Operation test to clearance-self-adjuster

(1) Make the brake shoe diameter approach the specified mounting size, and pull the

adjusting level with your finger along the arrow marks to turn the adjuster gear. When removing off your finger, the adjusting lever should return to its original position without rotation of the adjuster gear.

Note: Even if the adjuster gear turn back along the adjusting lever motion when removing your finger, the adjuster will still operate normally after it is built in the machine.

(2) If the adjuster fail to do the above operation when the adjusting lever is pulled, proceed with the following inspection:

a) Make sure that the adjusting lever, push rod and the return spring for push rod are securely installed.

b) Check the push rod return spring and adjuster spring for deterioration, and also check the adjuster gear for rotating condition and undue wear or damage of the meshing section.

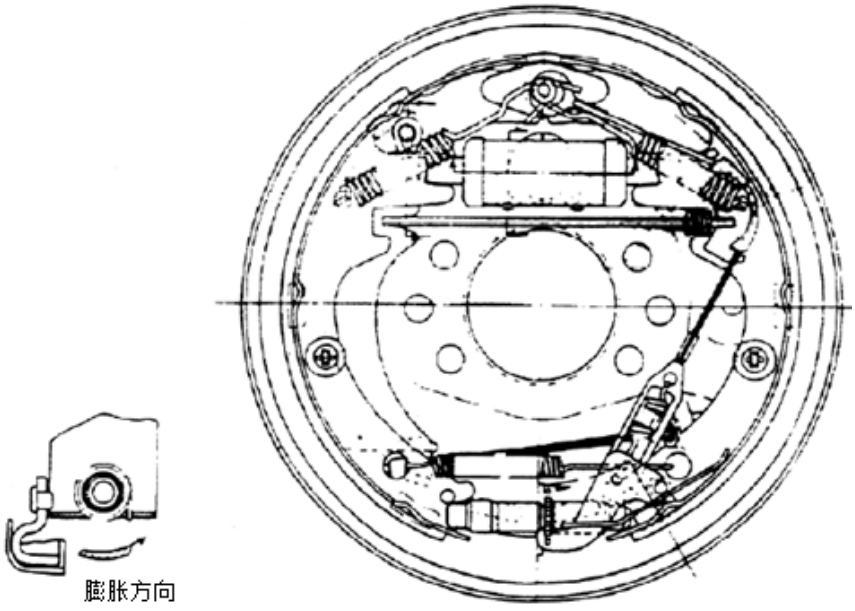


Fig. 2-25

2.2.5 Brake pedal adjustment

(1) Make the push rod short.

(2) Adjust the stopper bolt and the height of the pedal. (See Fig. 2-26)

(3) Press the brake pedal. Pull the push rod out until its front end comes into contact with the master cylinder piston.

(4) Tighten the push rod locking nut.

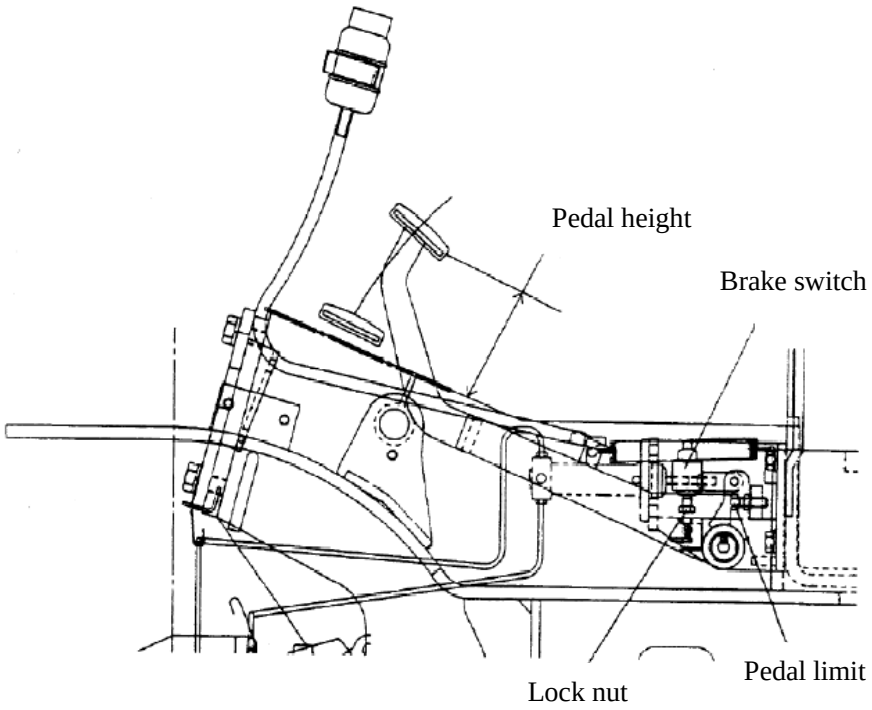


Fig. 2-26

▲ Brake switch adjustment

a) After you adjust the height of the brake pedal, loose the lock nut of the brake switch.

b) Pull the plug out to let the lead separate.

c) Turn the switch to make the clearance about 1mm.

d) Make sure that when you press the brake pedal the brake lamp light at the same time. (See Fig.2-27)

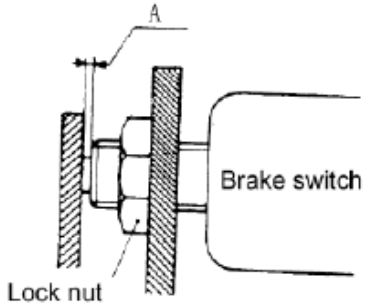


Fig. 2-27

2.2.6 Wheel brake troubleshooting (See Table 5)

Table 5

Problem	Possible cause	Remedy
Poor braking	1) Fluid leaks from brake system. 2)Poor adjustment of brake shoe clearance. 3)Brake overheating. 4)Poor contact between the brake drum and friction piece. 5)Foreign matter adhered on friction piece. 6)Foreign matter mixed in brake fluid. 7)Poor adjustment of brake pedal.	Repair Adjust the adjuster Check for dragging Readjust Repair or replace Check brake fluid Adjust
Noisy brake	1)Hardened friction piece surface or foreign matter adhered thereto. 2)Deformed backing plate or loose bolts. 3)Deformed shoe or incorrect installation. 4)Worn friction piece. 5)Loose wheel bearing.	Repair or replace Repair or replace Repair or replace Replace Repair
Uneven braking	1)Oil-contaminated friction piece. 2)Poor adjustment of brake shoe piece. 3)Malfunctioning sub cylinder. 4)Shoe return spring deteriorated. 5)Deflected drum.	Repair or replace Adjust the adjuster Repair or replace Replace Repair or replace
Soft or spongy brake	1)Brake fluid leaks from braking system. 2)Poor adjustment of brake shoe clearance. 3)Air mixed in brake system. 4)Poor adjustment of brake pedal.	Repair Adjust the adjuster Bleed air Readjust

3. Steering System

3.1 General Description

The function of steering system of forklift is to change the driving direction of the forklift or keep the forklift in straight line driving. The performance of steering system directly concerns with the driving safety, operation efficiency of forklifts and labor intensity of drivers. The steering system is divided into two categories of mechanical steering system (manual steering system) and power steering according to the power source of steering. The mechanical steering system is operated to overcome steering resistance moment fully by relying on the force and skill of driver, while in power steering system, the energy consumed to overcome the steering resistance moment is provided by prime mover and the driver can operate the system to control the turning direction with very small force.

As requested by the working characteristic of the forklifts, the operation site and driving pass are relatively narrow, changing-over is frequent and the minimum radius turnings are often needed, therefore, the steering system is required to be reliable and light in operation. Since the load of steering axle occupies about 60% of the vehicle weight in case of idling, G-series forklifts of 1.0～3.5t produced by our Co. adopt fully hydraulic power system to alleviate the labor intensity of the driver.

3.2 Working Principle

When the forklifts turn round, the steering moment applied by driver on the steering wheel (steering control mechanism) makes steering wheel rotate and shift and is transmitted to the steering gear through steering shaft. Steering gear sends the pressure oil of appropriate volume to the steering oil cylinder through pipes and the oil cylinder pushes steering wheel through trapezoidal steering mechanism, thus direction change is realized.

The difference between fully hydraulic and hydraulic power steering gears is the first substitutes the mechanical elements such as steering gear and longitudinal tie etc and has high pressure oil pipe connecting fully hydraulic steering gear with oil cylinder. The pressure-gradient control valve mounted in the loop of load- sensing and fully hydraulic steering system can ensure distribution of flow to steering system first and sufficient oil supply at any working conditions. There is less flow passing through steering gear when it is at neutral position to save the energy.

3.3 Composition of Steering System

(1) Control mechanism of steering

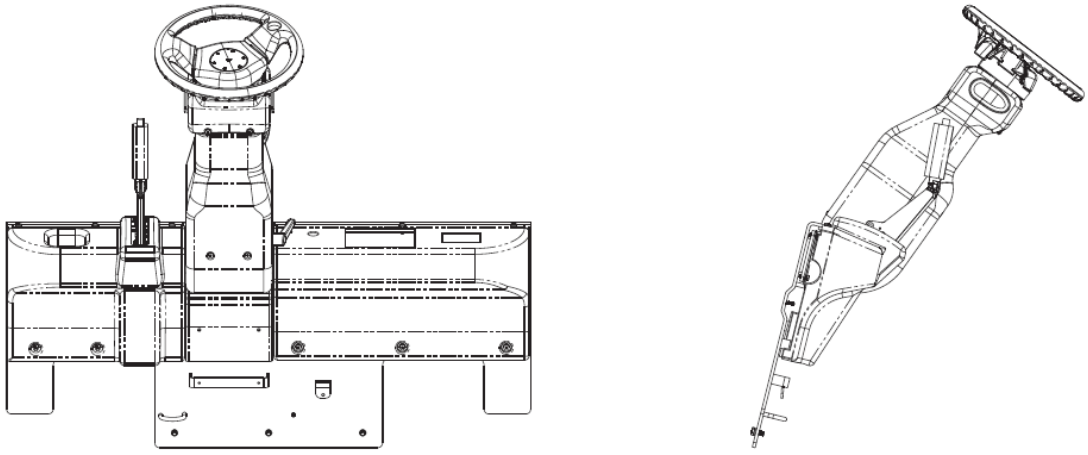


Fig. 3-1 Steering control device

The control mechanism of G-series forklift of 1.0-3.5t mainly consists of steering wheel, tubular column, coupling, steering gear and mounting support etc (as shown in Fig.3-1). They are fixed on the instrument panel by mounting support, steering wheel, tubular column and coupling are connected together. The steering gear is fixed at the lower end of coupling and the rotation of steering wheel will bring along the steering gear. Adjustment of handle can adjust the steering wheel to the comfortable position that drivers feel.

(2) Steering gear

G-series forklift of 1.0～3.5t adopts cycloid rotary valve type fully hydraulic steering gear and it is a closed-type dynamic load steering gear. Refer to hydraulic system for details).

(3) Transmission gear for steering

The mechanism that deflects the right and left wheels according to a certain relation through oil cylinder and steering mechanism with power output by steering gear is called transmission gear and it is realized though horizontal style oil cylinder steering axle assemblies. (Refer to the chapter relating to steering axle for more information).

3.4 Steering Axle

The steering axle of 1-3.5t truck (See Fig. 3-2) includes axle body, steering cylinder, tie rods and knuckle. The steering trapezium is made of cranks and blocks. When pressure oil moves the cylinder piston rod, the tie rod revolves the knuckles, then the truck may be steered. The steering axle is fixed with bolts through support on the tail bracket at rear of the frame after bumper block is mounted on the front and end plate so that the axle can sway around the pin roll on the end plate and obtains certain shock-absorbing effect due to bumper block. Left and right knuckles are positioned at two sides of the steering axle respectively. The rear wheel hubs are fitted to the knuckle shafts through tapered roll bearings with oil seals keeping the grease in the chambers of the hubs and the knuckles.

The steering rim and the pressure of the steering wheel are followed:

Table 3-1

Truck model	1t, 1.5t,1.8t	2t, 2.5t	3t	3.5t
Tyre size	16×8-8-10PR	18×7-8-14PR	18×7-8-14PR	18×7-8
Rim size	4.33R	4.33R	4.33 R	
Tyre pressure	860kPa	900kPa	900kPa	Solid tyre

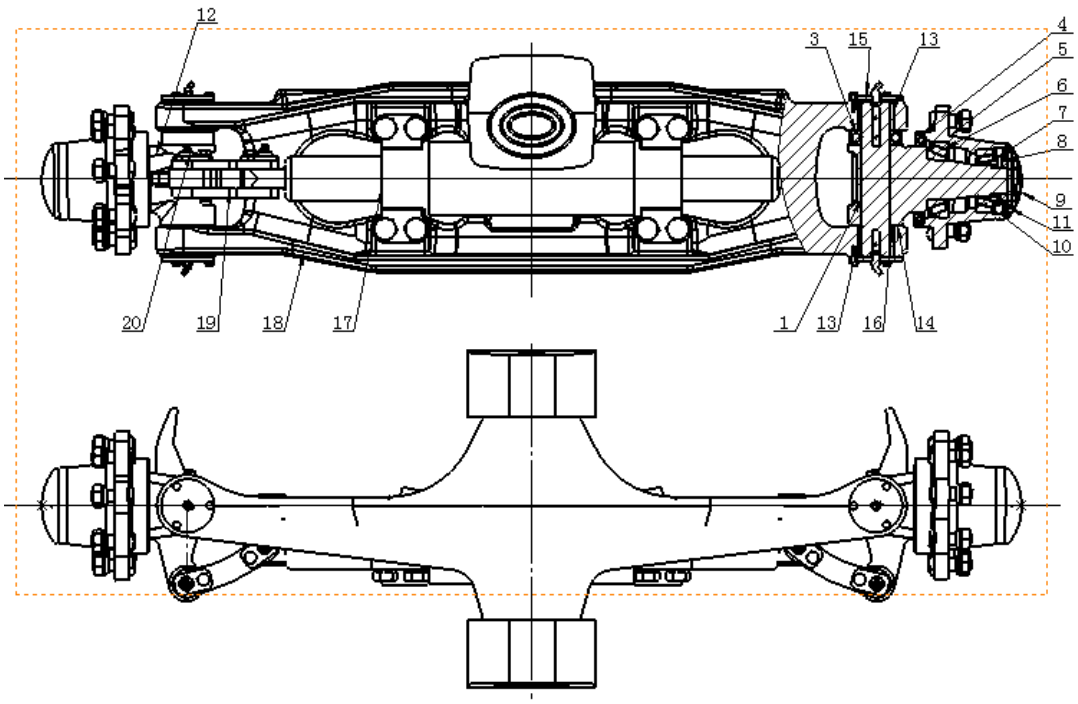


Fig. 3-2 Steering axle

(1) steering knuckle main pin (2) needle bearing (3) thrust bearing (4) oil seal (5) Steering hub (6) tapered roller bearing (7) washer (8) lock nut (9) hub cover (10) tapered roller bearing (11) pin (12) steering knuckle (13) needle bearing (14) adjusting shim (15) dust proof cover (16) seal ring (17) steering cylinder (18) steering axle body (19) link rod (20) pin axle

(1) Steering knuckle

Both steering knuckles are fitted between the upper and the lower steering axle body through two king pins, thrust bearings, needle bearings, dust covers and seal rings. The king pin is locked on the steering knuckle with a lock pin. The upper end of the knuckle is supported on the steering axle body by thrust bearing. Both ends of the king pin are supported on the steering axle body by needle bearing. (See Fig. 3-3)

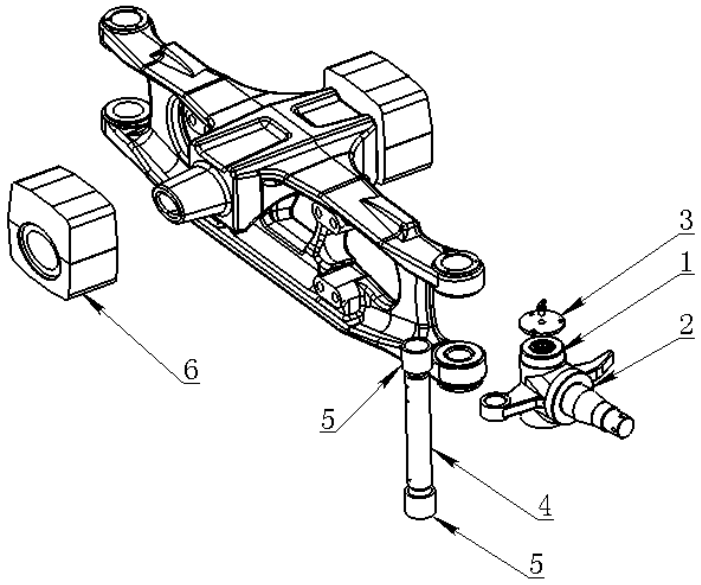


Figure 3-3 Steering knuckle

1. thrust bearing 2. Steering knucle 3. Dust-proof cover
4. Steering knuckle main pin 5. needle bearing 6. Shock absorption blcok

(2) Steering cylinder

The steering cylinder is of double-action piston type. Both ends of the piston rod are connected with steering knuckles through connection rod. Left or right of the truck turning is achieved with the help of the left or right travel of the piston rod driven by the pressure oil from the powered steering unit. The seal unit consists of the supporting ring and O-ring seal, U-ring seal is adopted between the cylinder head and the piston rod. The cylinder is fitted to the steering axle through two cylinder seats. (See Fig. 3-4)

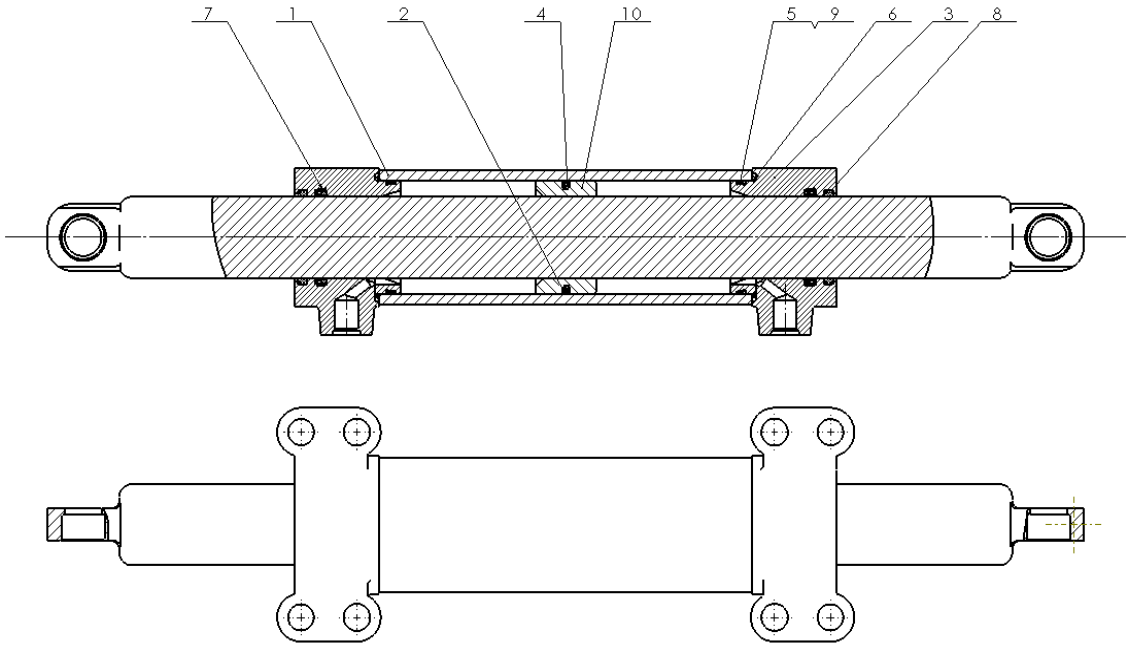


Fig. 3-4 Steering cylinder

(1) cylinder bore (2) supporting ring (3) cylinder cover (4) O ring (5) O ring (6) O ring (7) U ring (8) dust proof ring (9) retainer ring (10) piston rod assembly

(3) Hub

The hub is fixed to the steering knuckle shaft with two tapered roller bearing. The wheels are assembled on the hubs through rims. Oil seal is assembled on the inner side of the bearing to keep the lubrication oil in the hub and steering knuckle cavity. The nut is used to adjust the tightness of the nut.

3.5 Adjustment and Maintenance

3.5.1 Rear wheel bearig pre-load adjustment

(1) As shown in Fig. 3-5, fill up the chamber formed by wheel hubs, wheel hub bearings and wheel hub covers with lubricating grease. Coat the lips of the oil seals with lubricating grease.

(2) Press the hub bearing into the hub and fit the hub on the knuckle shaft.

(3) Fit a flat washer and tighten a castle nut to a torque of 206-235Nm (21-24kgm) and

loosen it, and then tighten it again to a torque of 9.8Nm (1kgm).

(4) To ensure firm installation of the hub, slightly knock at it with a wooden hammer and in the meantime, rotate the hub for 3-4turns.

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

(6) Again slightly knock at the hub with a wooden hammer and in this time, rotate manually the hub for 3-4turns to ensure its smooth rotation with a specified torque of 2.94-7.8Nm (0.3-0.8kgm).

(7) If the torque value necessary to rotate the hub is more than the specified one above-mentioned, screw out the castle nut for 1/6 turn and measure the torque value then.

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

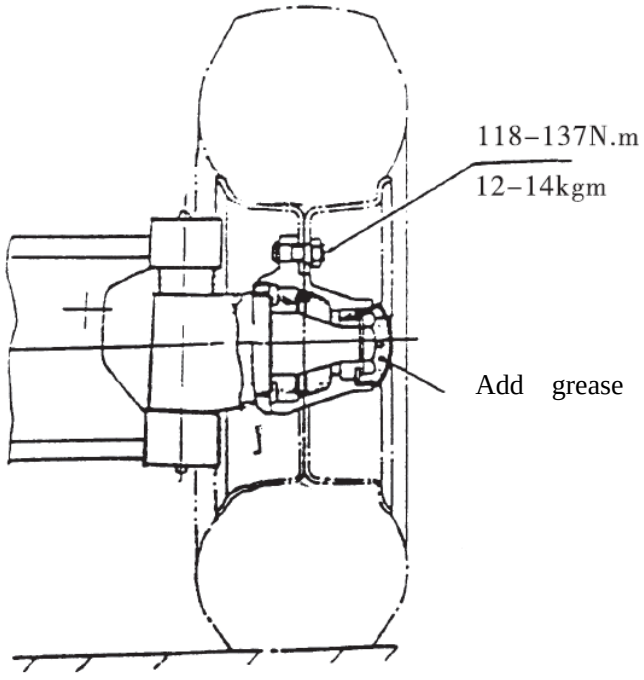


Fig. 3-5 Fill lubricating grease and pre-load adjustment

When changing the tires, the hub bolts should be coated with sealant after a new tire

is mounted to ensure the tightening torque of the hub bolts is 160N.m for1～3.5t forklifts.

3.5.2 Maintenance and service of steering system

(1) The steering king pin needs to be checked every 40 hours and grease be replenished to the bent neck type grease fittings of king pin every 300 hours, piston rod and link rod of steering oil cylinder, rotation connection parts of right and left knuckle arm need to be checked every 40 hours and lubrication grease replenished every 300 hours.

(2) Change the grease of the bearing of steering hub every 1200 hours.

(3) Pay attention to the working condition of steering system during routine maintenance. The manual operation force on the steering wheel should be 6-20N during steering and the difference of right and left acting force is not more than 5N. When the forklift runs in straight line at maximum speed, obvious S-shaped phenomenon is not allowed. Make analysis and remedies by contrasting Table 3-2 “Fault Analysis Table for Steering System”.

(4) Apply special lubricating grease to the conductive plate which the steering wheel horn switch connecting point acts on every 1200h.

3.6 Main Failure and Troubleshooting of the Steering System

3.6.1 Inspect after reassembling the steering system

(1) Turning the steering wheel right and left, inspect whether the steering power is smooth.

(2) Inspect connection of the hydraulic pipeline whether is correct by turning the steering hand-wheel ring and left.

(3) Lift up the rear wheels and slowly turn the steering hand-wheel ring and left several times to exhaust air from the hydraulic pipeline and the steering cylinder.

3.6.2 Steering system troubleshooting

Table 3-2

Problem	Analyses of trouble	Remedies
Fail to turn hand-wheel	Pump damaged or breaking down.	Replace
	Hose or joint damaged or pipeline blocked.	Clean or replace
Difficult to turn hand-wheel	The pressure of the relief valve is too low.	Adjust the pressure
	Air in steering oil circuit.	Exhaust air
	Steering unit fail to recover due to spring piece damaged or elasticity-insufficient.	Replace spring piece
	Oil leakage in the steering cylinder.	Inspect the seal of the piston
Truck's snacking or moving with oscillation	Spr ing 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	Seals of guide sleeve, pipeline or joint damaged.	Replace

4. Electric System

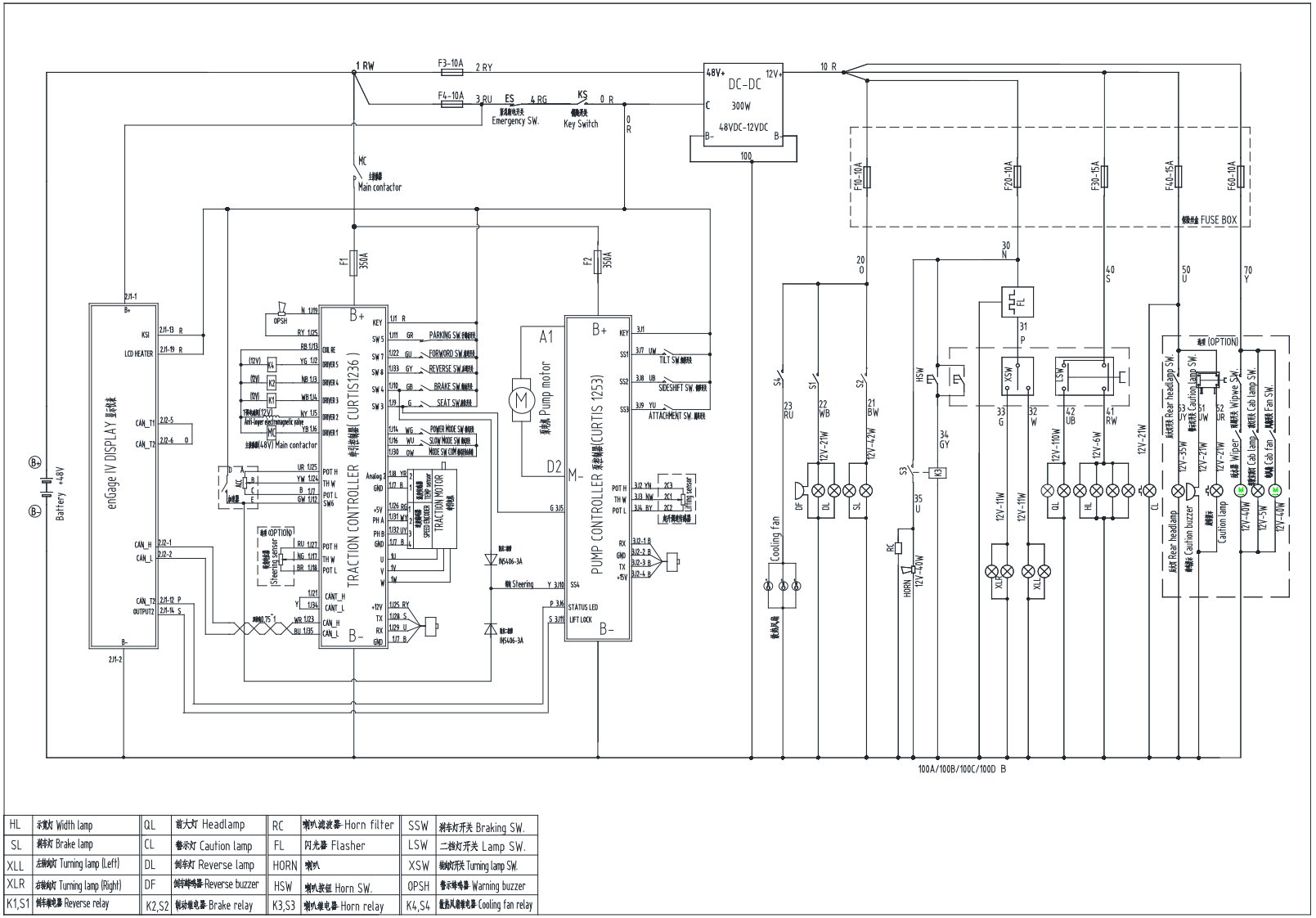
4.1 General Description

The standard scheme of the electric system include of two controllers. It can succeed in operating the forklift low-noisily, efficiently, smoothly and safety.

The electric system is composed of instrument, control system, traction motor, pump motor, battery pack, control switch, lighting and wiring harness etc..

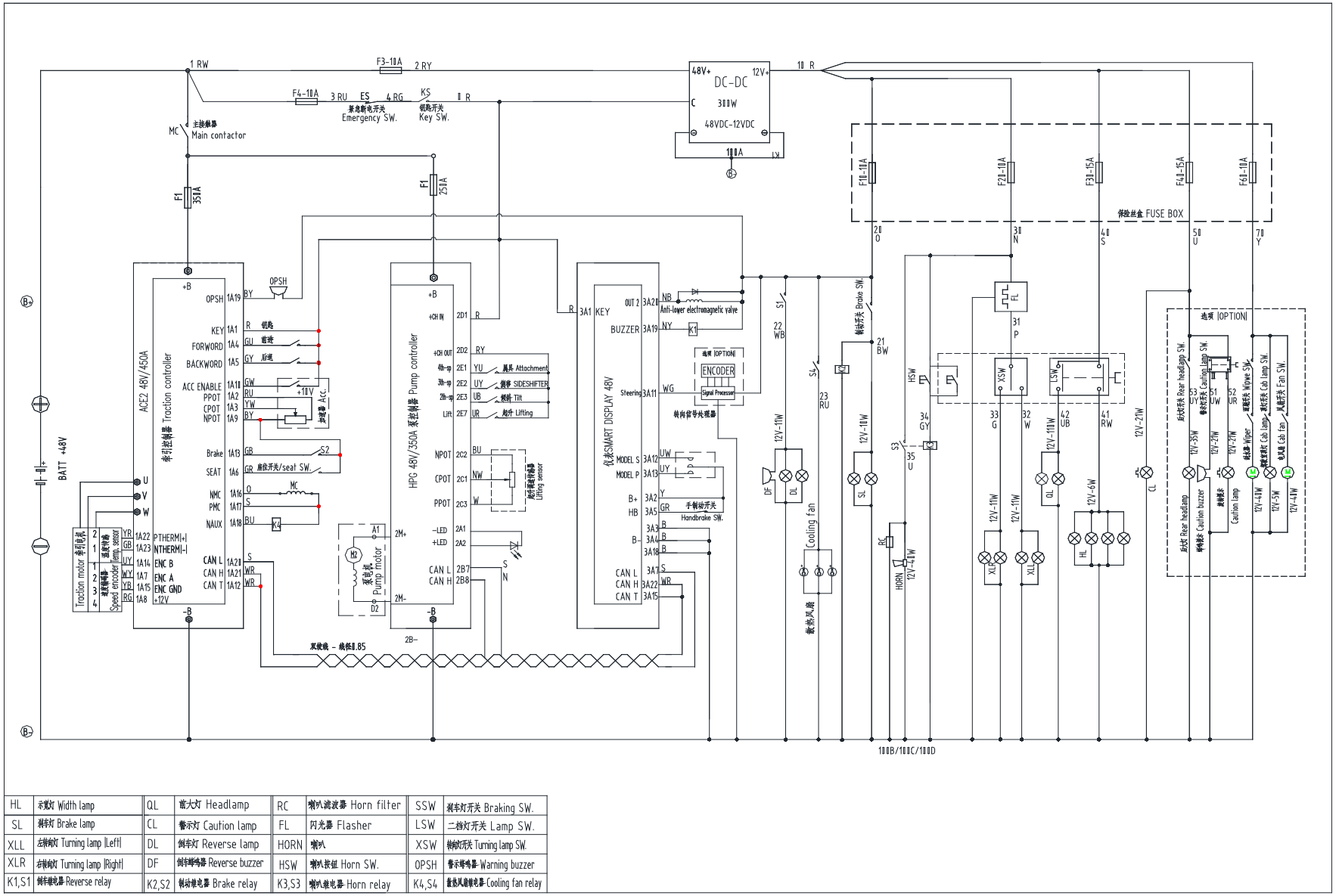
Notice: Our Company has the right to improve on the production. Please contact with our company if there is any difference between the product and the manual.

The circuit diagram of electric system are shown in Fig.4-1～Fig. 4-17.



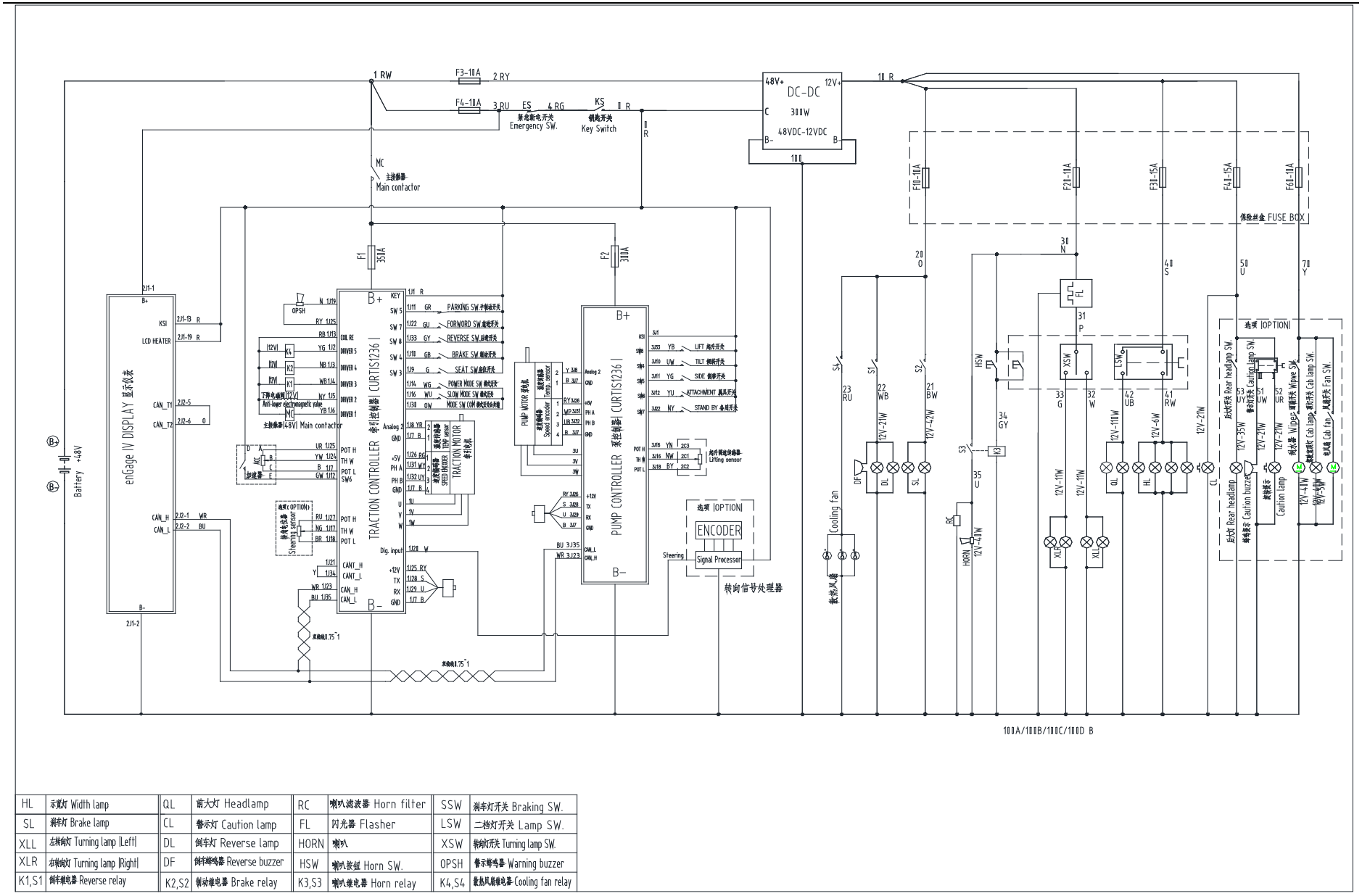
HL	示宽灯 Width lamp	QL	前大灯 Headlamp	RC	喇叭滤波器 Horn filter	SSW	刹车灯开关 Braking SW.
SL	刹车灯 Brake lamp	CL	警示灯 Caution lamp	FL	闪光器 Flasher	LSW	二挡灯开关 Lamp SW.
XLL	左转向灯 Turning lamp (Left)	DL	倒车灯 Reverse lamp	HORN	喇叭	XSW	转向灯开关 Turning lamp SW.
XLR	右转向灯 Turning lamp (Right)	DF	倒车蜂鸣器 Reverse buzzer	HSW	喇叭按钮 Horn SW.	OPSH	警示蜂鸣器 Warning buzzer
K1,S1	倒车继电器 Reverse relay	K2,S2	制动继电器 Brake relay	K3,S3	喇叭继电器 Horn relay	K4,S4	散热风扇继电器 Cooling fan relay

Fig. 4-1 Circuit diagrams of electric system (CPD10～18-GC1)



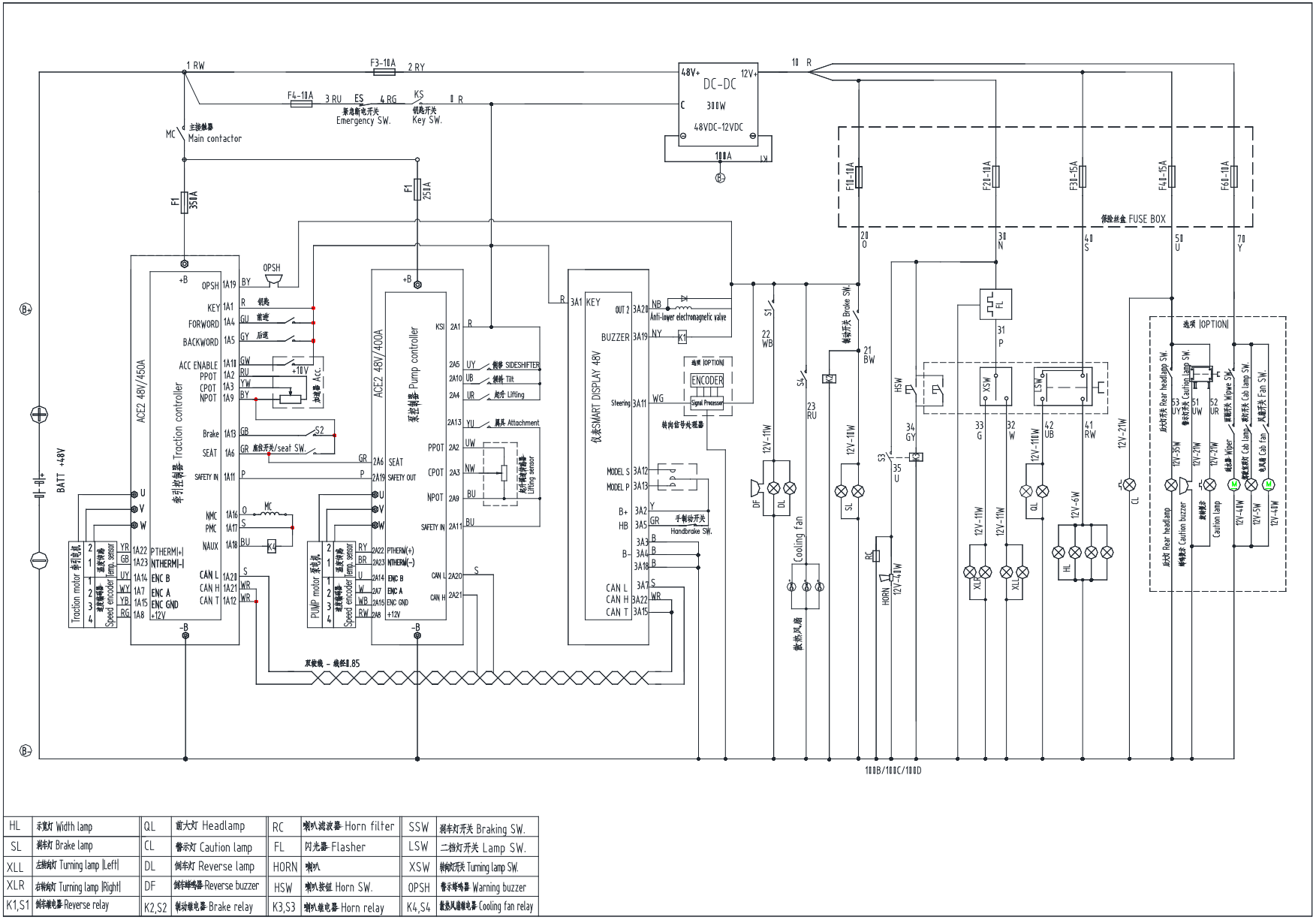
HL	示宽灯 Width lamp	QL	前大灯 Headlamp	RC	喇叭滤波器 Horn filter	SSW	刹车灯开关 Braking SW.
SL	刹车灯 Brake lamp	CL	警示灯 Caution lamp	FL	闪光器 Flasher	LSW	二档灯开关 Lamp SW.
XLL	左转向灯 Turning lamp [Left]	DL	倒车灯 Reverse lamp	HORN	喇叭	XSW	转向灯开关 Turning lamp SW.
XLR	右转向灯 Turning lamp [Right]	DF	倒车蜂鸣器 Reverse buzzer	HSW	喇叭按钮 Horn SW.	OPSH	警示蜂鸣器 Warning buzzer
K1,S1	倒车继电器 Reverse relay	K2,S2	制动继电器 Brake relay	K3,S3	喇叭继电器 Horn relay	K4,S4	散热风扇继电器 Cooling fan relay

Fig. 4-2 Circuit diagrams of electric system（CPD10～18-GC2）



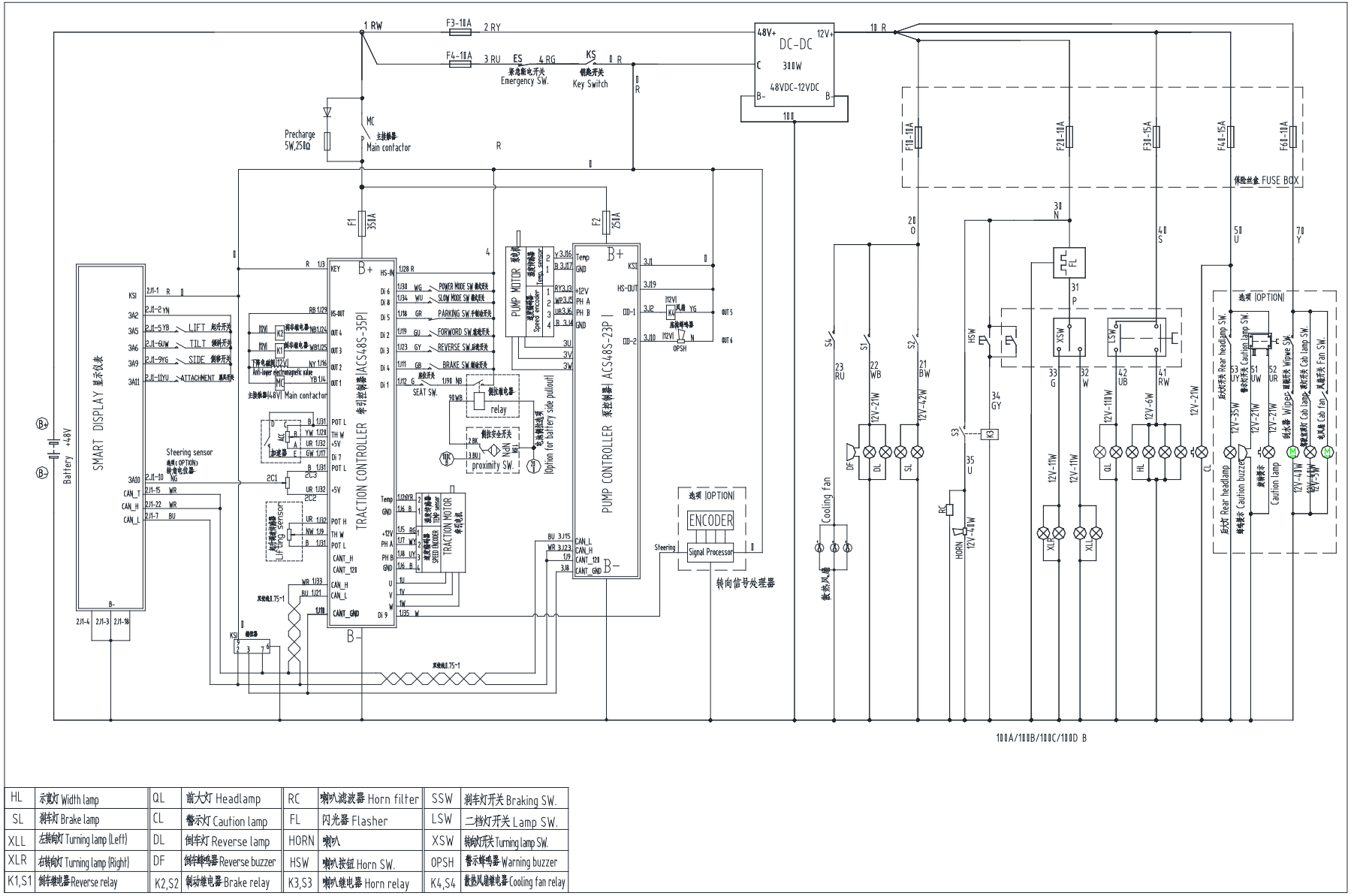
HL	示宽灯 Width lamp	QL	前大灯 Headlamp	RC	喇叭滤波器 Horn filter	SSW	刹车灯开关 Braking SW.
SL	刹车灯 Brake lamp	CL	警示灯 Caution lamp	FL	闪光器 Flasher	LSW	二档灯开关 Lamp SW.
XLL	左转向灯 Turning lamp |Left|	DL	倒车灯 Reverse lamp	HORN	喇叭	XSW	转向灯开关 Turning lamp SW.
XLR	右转向灯 Turning lamp |Right|	DF	倒车蜂鸣器 Reverse buzzer	HSW	喇叭按钮 Horn SW.	OPSH	警示蜂鸣器 Warning buzzer
K1,S1	倒车继电器 Reverse relay	K2,S2	制动继电器 Brake relay	K3,S3	喇叭继电器 Horn relay	K4,S4	散热风扇继电器 Cooling fan relay

Fig. 4-3 Circuit diagrams of electric system (CPD10～18-GD1)



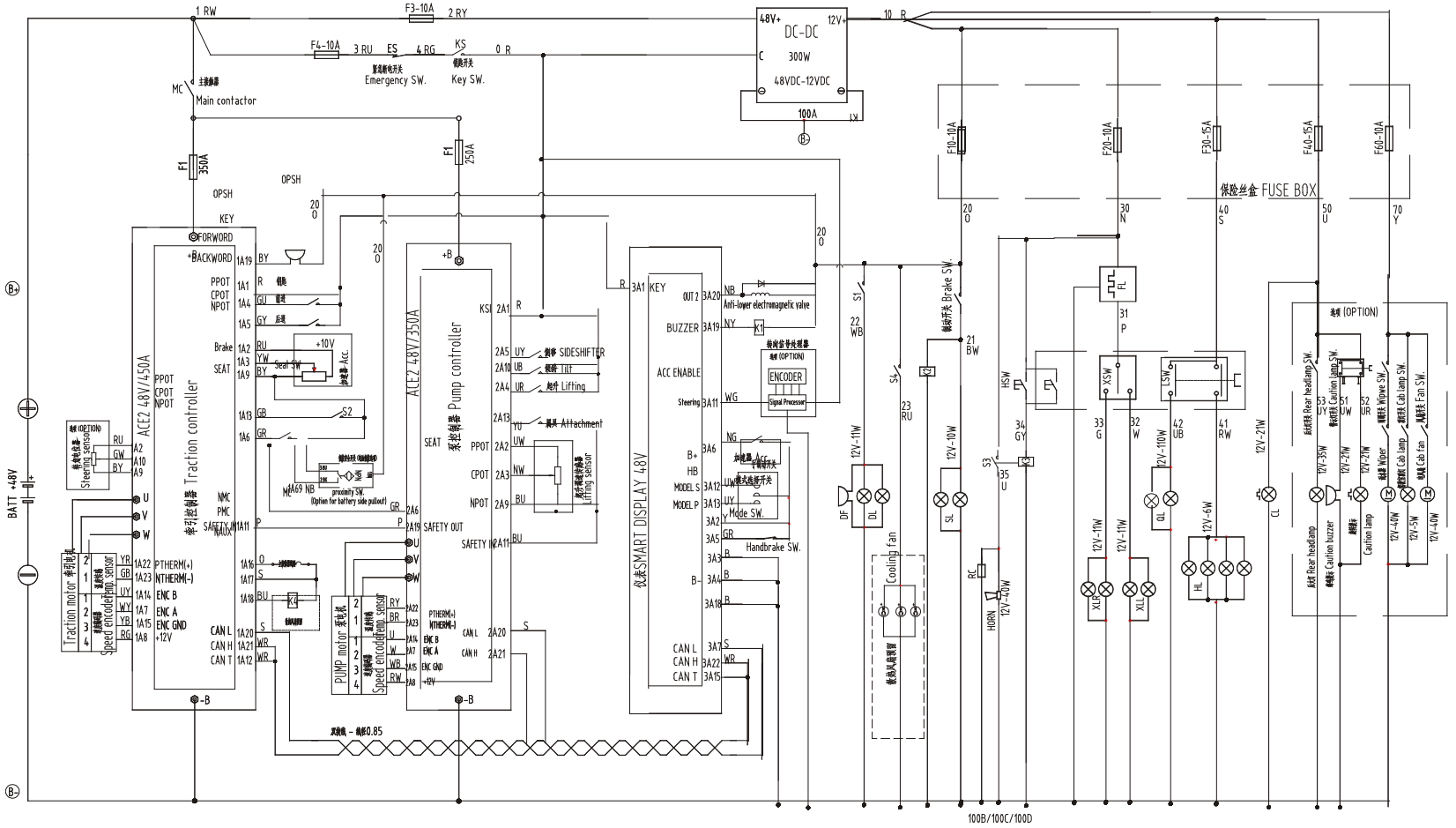
HL	示宽灯 Width lamp	QL	前大灯 Headlamp	RC	喇叭滤波器 Horn filter	SSW	刹车灯开关 Braking SW.
SL	刹车灯 Brake lamp	CL	警示灯 Caution lamp	FL	闪光器 Flasher	LSW	二档灯开关 Lamp SW.
XLL	左转向灯 Turning lamp |Left|	DL	倒车灯 Reverse lamp	HORN	喇叭	XSW	转向灯开关 Turning lamp SW.
XLR	右转向灯 Turning lamp |Right|	DF	倒车蜂鸣器 Reverse buzzer	HSW	喇叭按钮 Horn SW.	OPSH	警示蜂鸣器 Warning buzzer
K1,S1	倒车继电器 Reverse relay	K2,S2	制动继电器 Brake relay	K3,S3	喇叭继电器 Horn relay	K4,S4	散热风扇继电器 Cooling fan relay

Fig. 4-4 Circuit diagrams of electric system (CPD10～18-GD2)



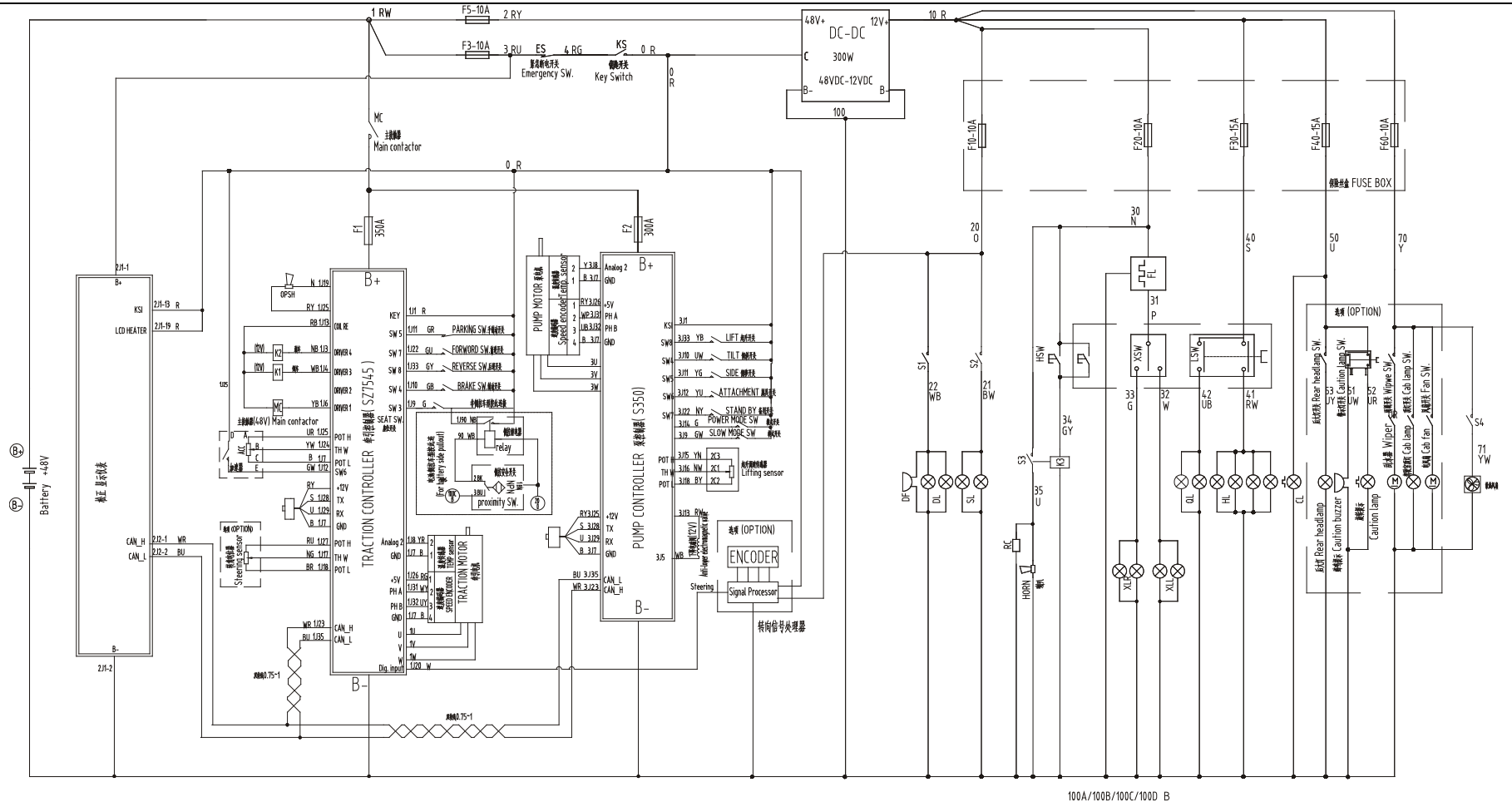
HL	示宽灯 Width lamp	QL	前大灯 Headlamp	RC	喇叭滤波器 Horn filter	SSW	刹车灯开关 Braking SW.
SL	刹车灯 Brake lamp	CL	警示灯 Caution lamp	FL	闪光器 Flasher	LSW	二档灯开关 Lamp SW.
XLL	左转向灯 Turning lamp (Left)	DL	倒车灯 Reverse lamp	HORN	喇叭	XSW	转向灯开关 Turning lamp SW.
XLR	右转向灯 Turning lamp (Right)	DF	倒车蜂鸣器 Reverse buzzer	HSW	喇叭按钮 Horn SW.	OPSH	警示蜂鸣器 Warning buzzer
K1,S1	倒车继电器 Reverse relay	K2,S2	制动继电器 Brake relay	K3,S3	喇叭继电器 Horn relay	K4,S4	散热风扇继电器 Cooling fan relay

Fig. 4-5 Circuit diagrams of electric system (CPD10～18-GD3)



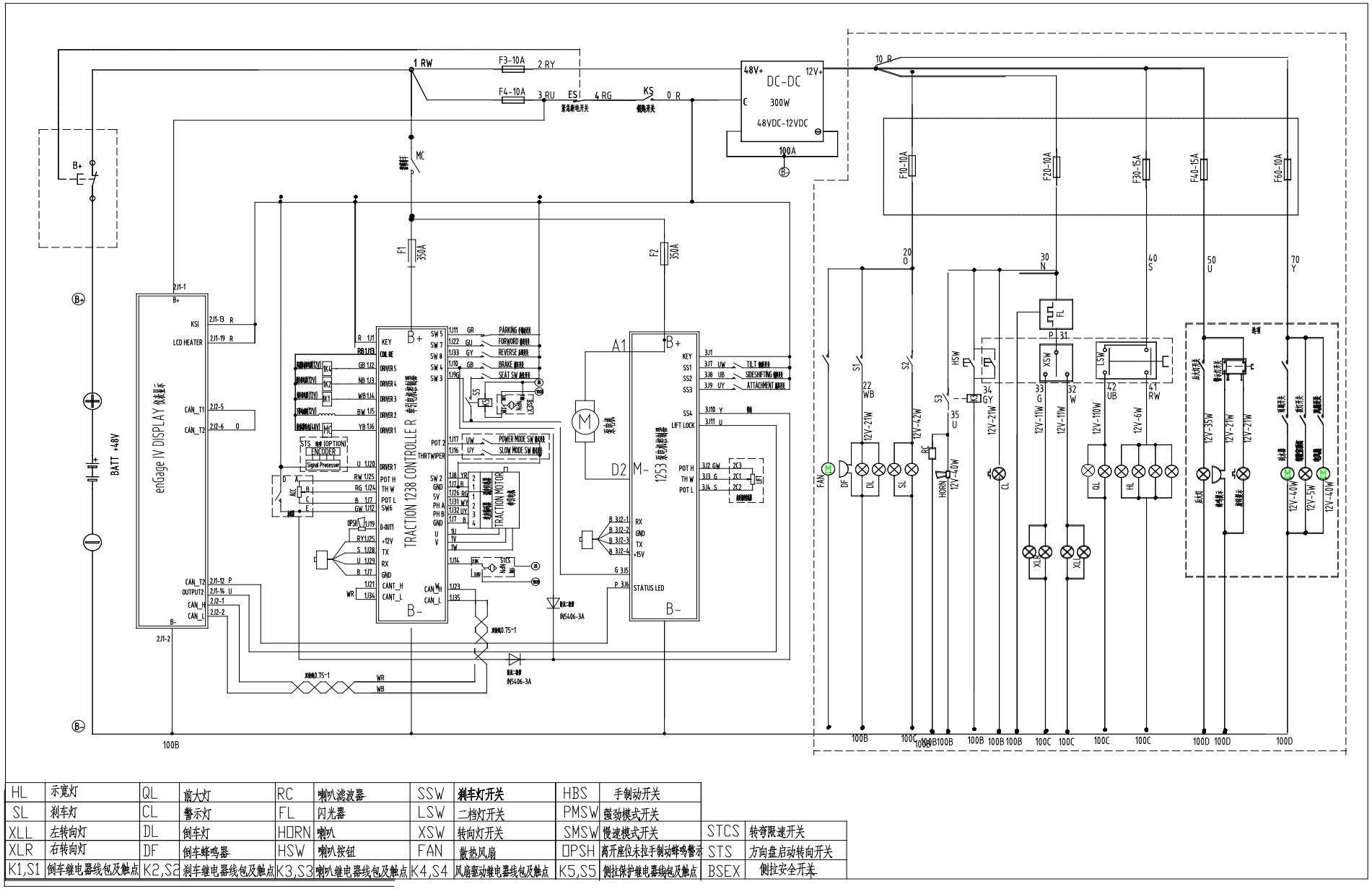
HL	示宽灯 Width lamp	QL	前大灯 Headlamp	RC	喇叭滤波器 Horn filter	SSW	制动灯开关 Braking SW.
SL	刹车灯 Brake lamp	CL	警示灯 Caution lamp	FL	闪光器 Flasher	LSW	二档灯开关 Lamp SW.
XLL	左转向灯 Turning lamp (Left)	DL	倒车灯 Reverse lamp	HORN	喇叭	XSW	转向灯开关 Turning lamp SW.
XLR	右转向灯 Turning lamp (Right)	DF	倒车蜂鸣器 Reverse buzzer	HSW	喇叭按钮 Horn SW.	OPSH	警示蜂鸣器 Warning buzzer
K1,S1	倒车继电器 Reverse relay	K2,S2	制动继电器 Brake relay	K3,S3	喇叭继电器 Horn relay	K4,S4	散热风扇继电器 Cooling fan relay

Figure 4-6 Circuit diagrams of electric system (CPD20~25-GB2)



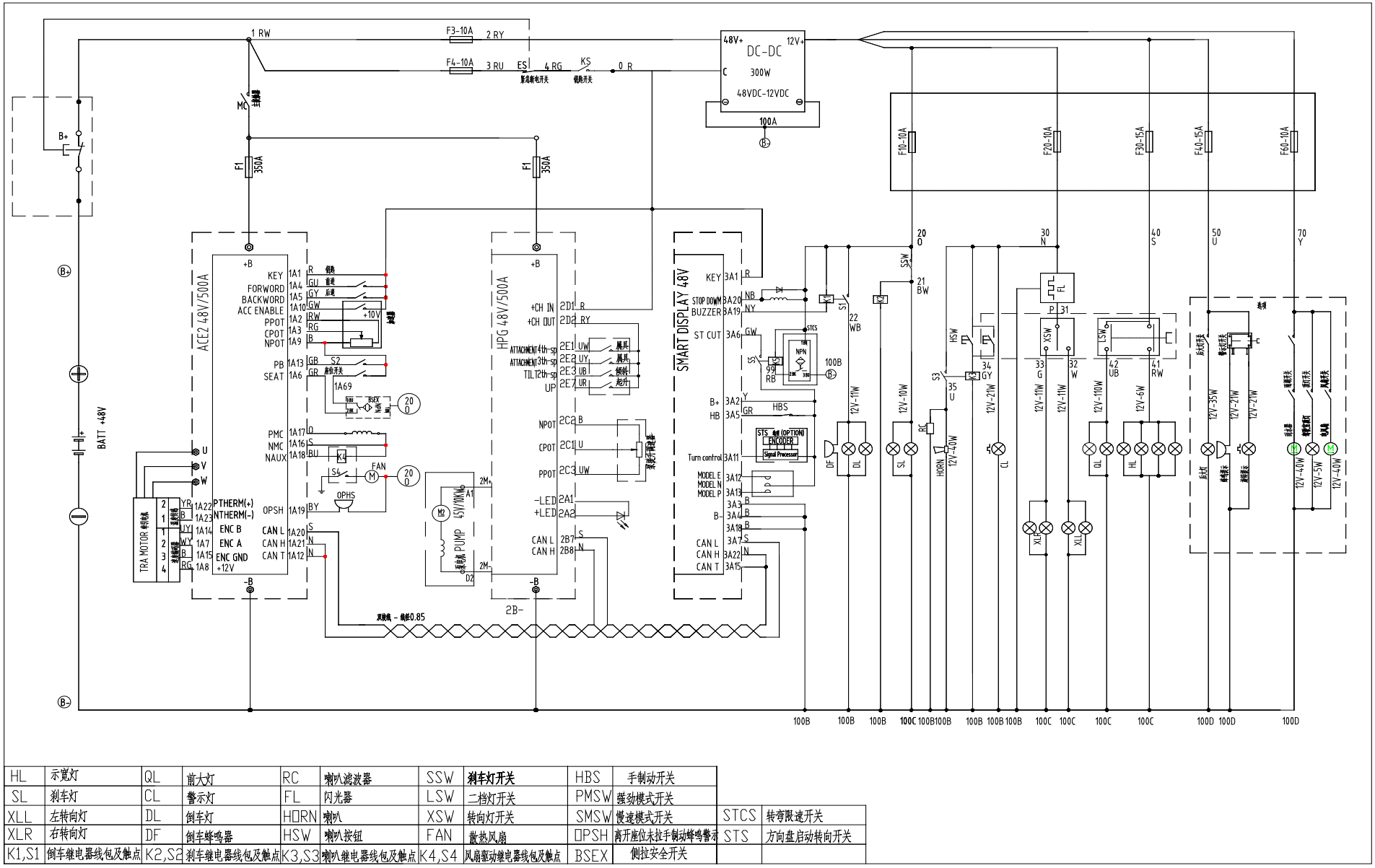
HL	示宽灯 Width lamp	QL	前大灯 Headlamp	RC	喇叭滤波器 Horn filter	SSW	刹车灯开关 Braking SW.
SL	刹车灯 Brake lamp	CL	警示灯 Caution lamp	FL	闪光器 Flasher	LSW	二档灯开关 Lamp SW.
XLL	左转向灯 Turning lamp (Left)	DL	倒车灯 Reverse lamp	HORN	喇叭	XSW	转向灯开关 Turning lamp SW.
XLR	右转向灯 Turning lamp (Right)	DF	倒车蜂鸣器 Reverse buzzer	HSW	喇叭按钮 Horn SW.	OPSH	警示蜂鸣器 Warning buzzer
K1,S1	倒车继电器 Reverse relay	K2,S2	制动继电器 Brake relay	K3,S3	喇叭继电器 Horn relay	K4,S4	散热风扇继电器 Cooling fan relay

Figure 4-7 Circuit diagrams of electric system (CPD20~25-GB7)



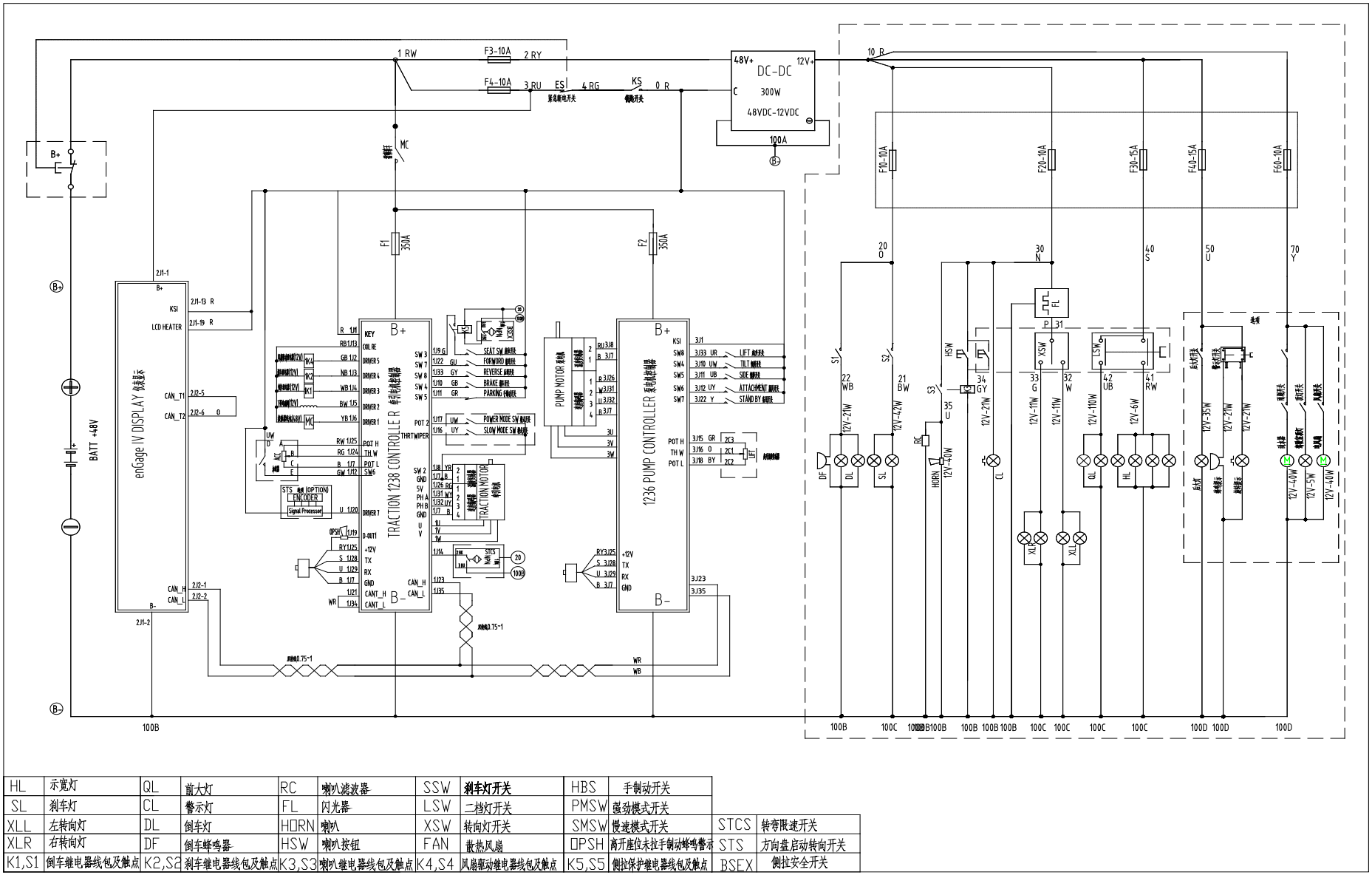
HL	示宽灯	QL	前大灯	RC	喇叭滤波器	SSW	刹车灯开关	HBS	手制动开关		
SL	刹车灯	CL	警示灯	FL	闪光器	LSW	二档灯开关	PMSW	强劲模式开关		
XLL	左转向灯	DL	倒车灯	HORN	喇叭	XSW	转向灯开关	SMSW	慢速模式开关	STCS	转弯限速开关
XLR	右转向灯	DF	倒车蜂鸣器	HSW	喇叭按钮	FAN	散热风扇	OPSH	离开座位未拉手制动蜂鸣警示	STS	方向盘启动转向开关
K1,S1	倒车继电器线包及触点	K2,S2	刹车继电器线包及触点	K3,S3	喇叭继电器线包及触点	K4,S4	风扇驱动继电器线包及触点	K5,S5	侧拉保护继电器线包及触点	BSEX	侧拉安全开关

Fig. 4-8 Circuit diagrams of electric system（CPD20～25-GC1）



HL	示宽灯	QL	前大灯	RC	喇叭滤波器	SSW	**刹车灯开关**	HBS	手制动开关		
SL	刹车灯	CL	警示灯	FL	闪光器	LSW	二挡灯开关	PMSW	强劲模式开关		
XLL	左转向灯	DL	倒车灯	HORN	喇叭	XSW	转向灯开关	SMSW	慢速模式开关	STCS	转弯限速开关
XLR	右转向灯	DF	倒车蜂鸣器	HSW	喇叭按钮	FAN	散热风扇	OPSH	离开座位未拉手制动蜂鸣警示	STS	方向盘启动转向开关
K1,S1	倒车继电器线包及触点	K2,S2	刹车继电器线包及触点	K3,S3	喇叭继电器线包及触点	K4,S4	风扇驱动继电器线包及触点	BSEX	侧拉安全开关		

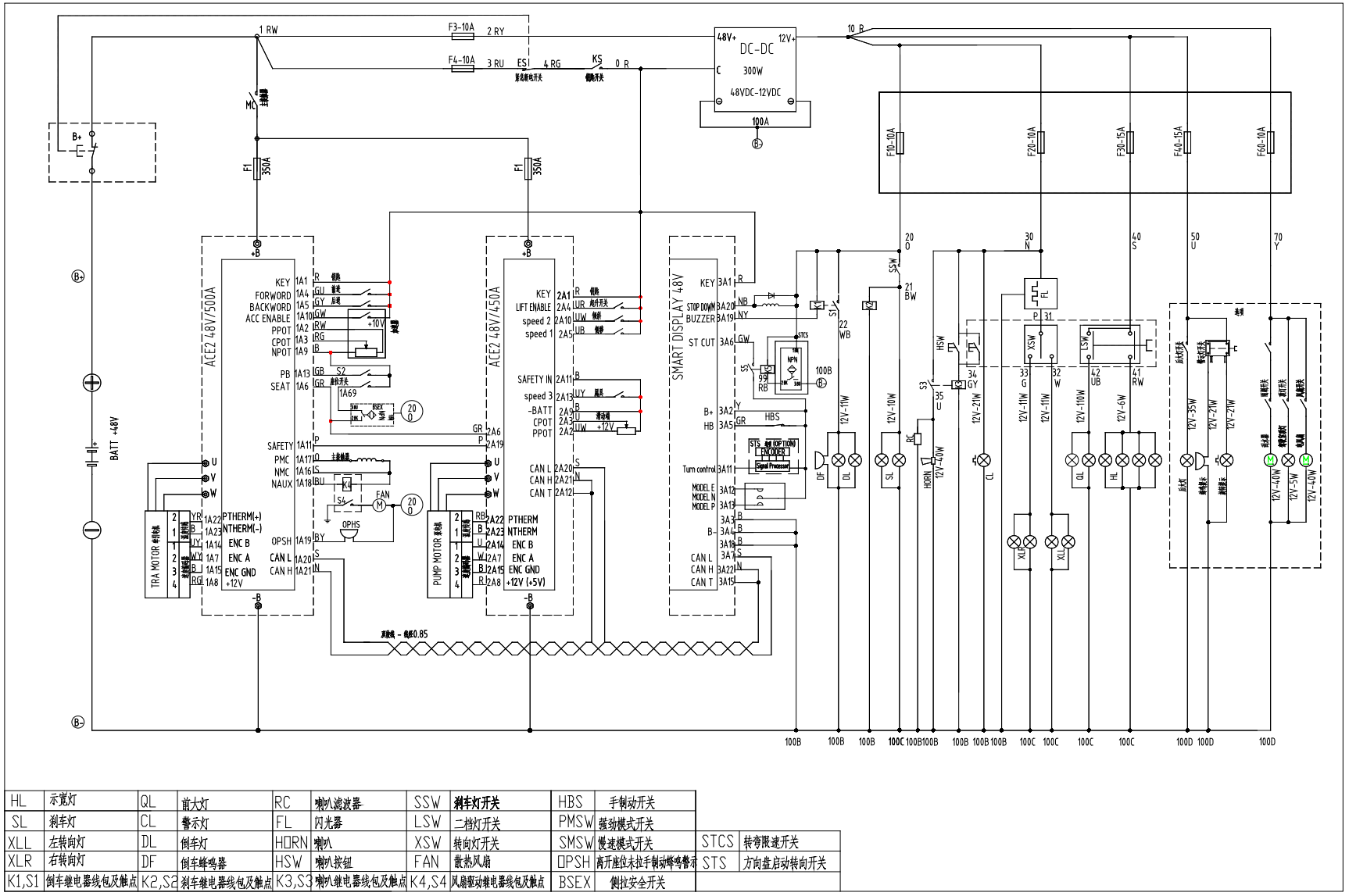
Fig. 4-9 Circuit diagrams of electric system（CPD20～25-GC2）



HL	示宽灯	QL	前大灯	RC	喇叭滤波器	SSW	刹车灯开关	HBS	手制动开关
SL	刹车灯	CL	警示灯	FL	闪光器	LSW	二挡灯开关	PMSW	强劲模式开关
XLL	左转向灯	DL	倒车灯	HORN	喇叭	XSW	转向灯开关	SMSW	慢速模式开关
XLR	右转向灯	DF	倒车蜂鸣器	HSW	喇叭按钮	FAN	散热风扇	OPSH	离开座位未拉手制动蜂鸣警示
K1,S1	倒车继电器线包及触点	K2,S2	刹车继电器线包及触点	K3,S3	喇叭继电器线包及触点	K4,S4	风扇驱动继电器线包及触点	K5,S5	侧拉保护继电器线包及触点

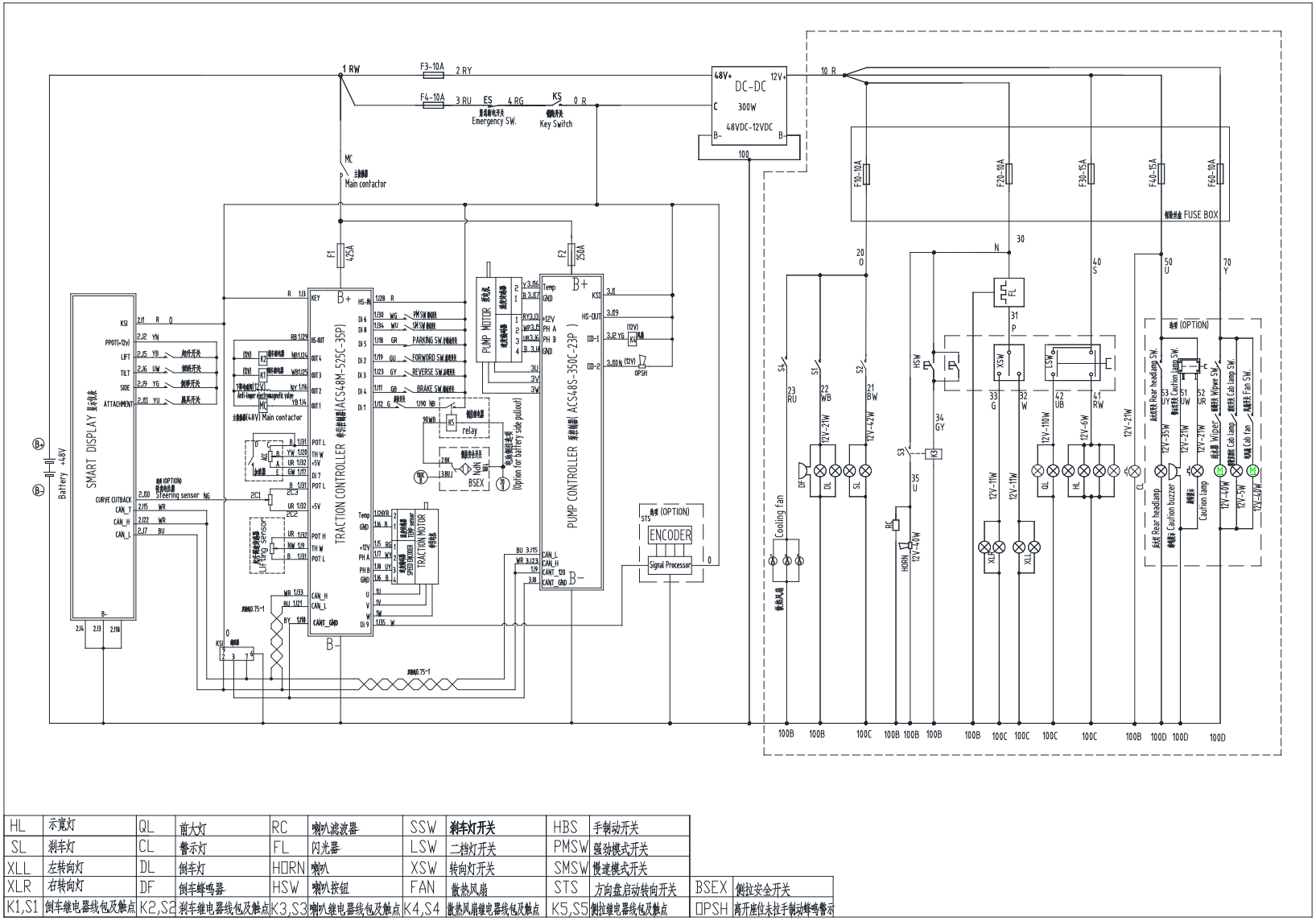
STCS	转弯限速开关
STS	方向盘启动转向开关
BSEX	侧拉安全开关

Fig. 4-10 Circuit diagrams of electric system（CPD20～25-GD1）



HL	示宽灯	QL	前大灯	RC	喇叭滤波器	SSW	刹车灯开关	HBS	手制动开关		
SL	刹车灯	CL	警示灯	FL	闪光器	LSW	二档灯开关	PMSW	强劲模式开关		
XLL	左转向灯	DL	倒车灯	HORN	喇叭	XSW	转向灯开关	SMSW	慢速模式开关	STCS	转弯限速开关
XLR	右转向灯	DF	倒车蜂鸣器	HSW	喇叭按钮	FAN	散热风扇	OPSH	离开座位未拉手制动蜂鸣警示	STS	方向盘启动转向开关
K1,S1	倒车继电器线包及触点	K2,S2	刹车继电器线包及触点	K3,S3	喇叭继电器线包及触点	K4,S4	风扇驱动继电器线包及触点	BSEX	侧拉安全开关		

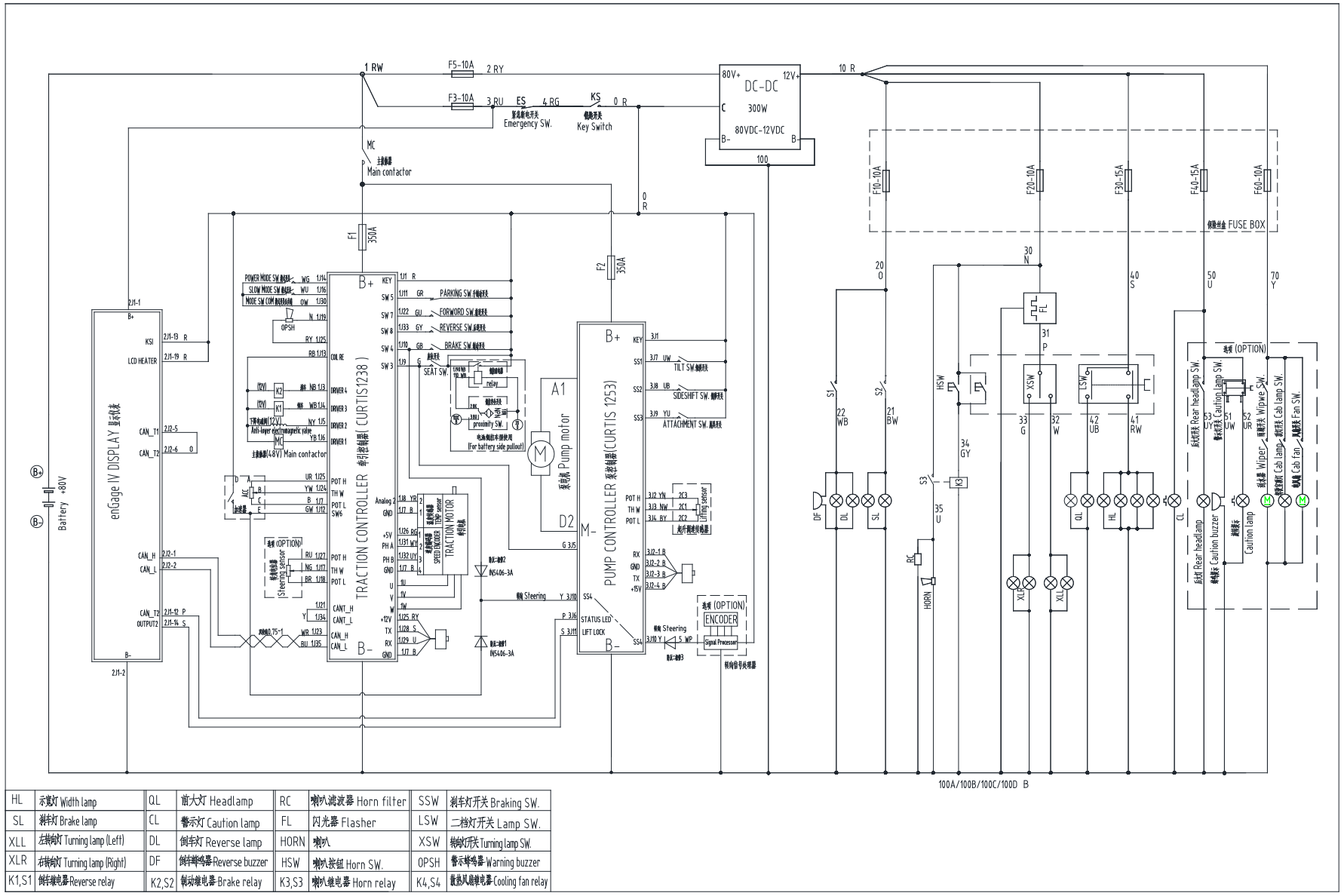
Fig. 4-11 Circuit diagrams of electric system（CPD20～25-GD2）



HL	示宽灯	QL	前大灯	RC	喇叭滤波器	SSW	刹车灯开关	HBS	手制动开关
SL	刹车灯	CL	警示灯	FL	闪光器	LSW	二档灯开关	PMSW	强劲模式开关
XLL	左转向灯	DL	倒车灯	HORN	喇叭	XSW	转向灯开关	SMSW	慢速模式开关
XLR	右转向灯	DF	倒车蜂鸣器	HSW	喇叭按钮	FAN	散热风扇	STS	方向盘启动转向开关
K1,S1	倒车继电器线包及触点	K2,S2	刹车继电器线包及触点	K3,S3	喇叭继电器线包及触点	K4,S4	散热风扇继电器线包及触点	K5,S5	侧拉继电器线包及触点

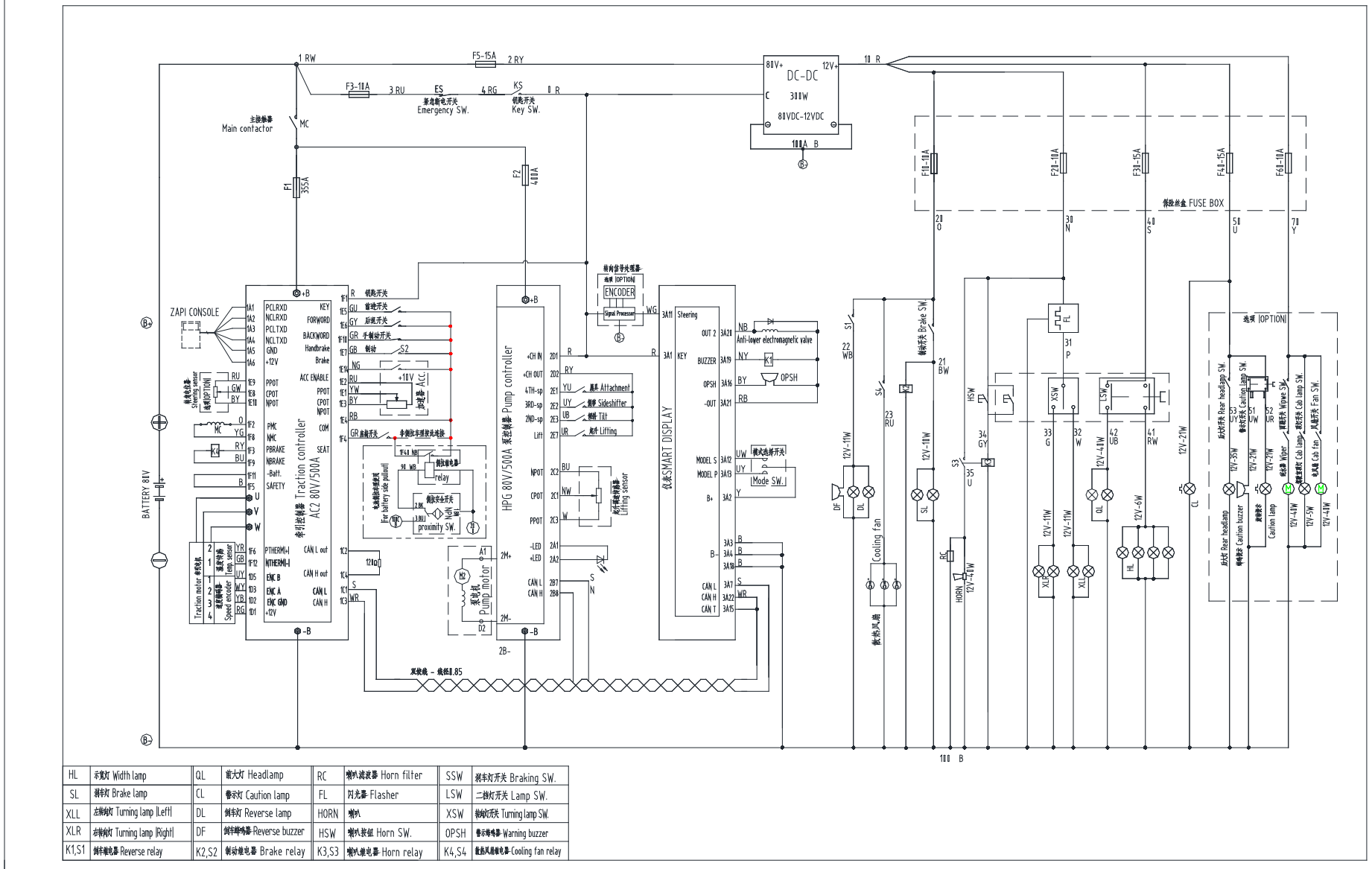
BSEX	侧拉安全开关
OPSH	离开座位未拉手制动蜂鸣警示

Figure 4-12 Circuit diagrams of electric system（CPD20～25-GD3）



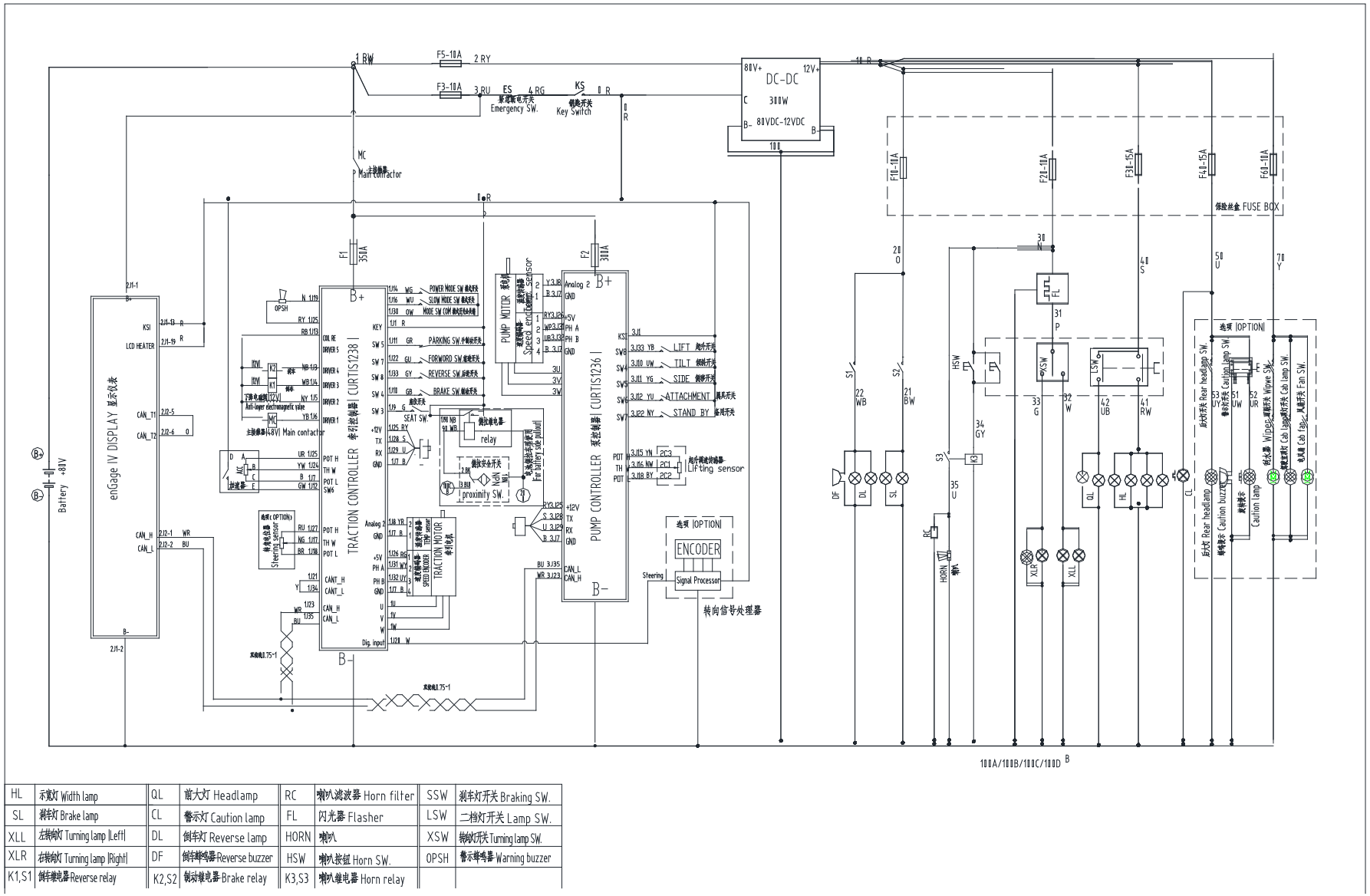
HL	示宽灯 Width lamp	QL	前大灯 Headlamp	RC	喇叭滤波器 Horn filter	SSW	刹车灯开关 Braking SW.
SL	刹车灯 Brake lamp	CL	警示灯 Caution lamp	FL	闪光器 Flasher	LSW	二挡灯开关 Lamp SW.
XLL	左转向灯 Turning lamp (Left)	DL	倒车灯 Reverse lamp	HORN	喇叭	XSW	转向灯开关 Turning lamp SW.
XLR	右转向灯 Turning lamp (Right)	DF	倒车蜂鸣器 Reverse buzzer	HSW	喇叭按钮 Horn SW.	OPSH	警示蜂鸣器 Warning buzzer
K1,S1	倒车继电器 Reverse relay	K2,S2	制动继电器 Brake relay	K3,S3	喇叭继电器 Horn relay	K4,S4	散热风扇继电器 Cooling fan relay

Figure 4-13 Circuit diagrams of electric system（CPD30～35-GC1）



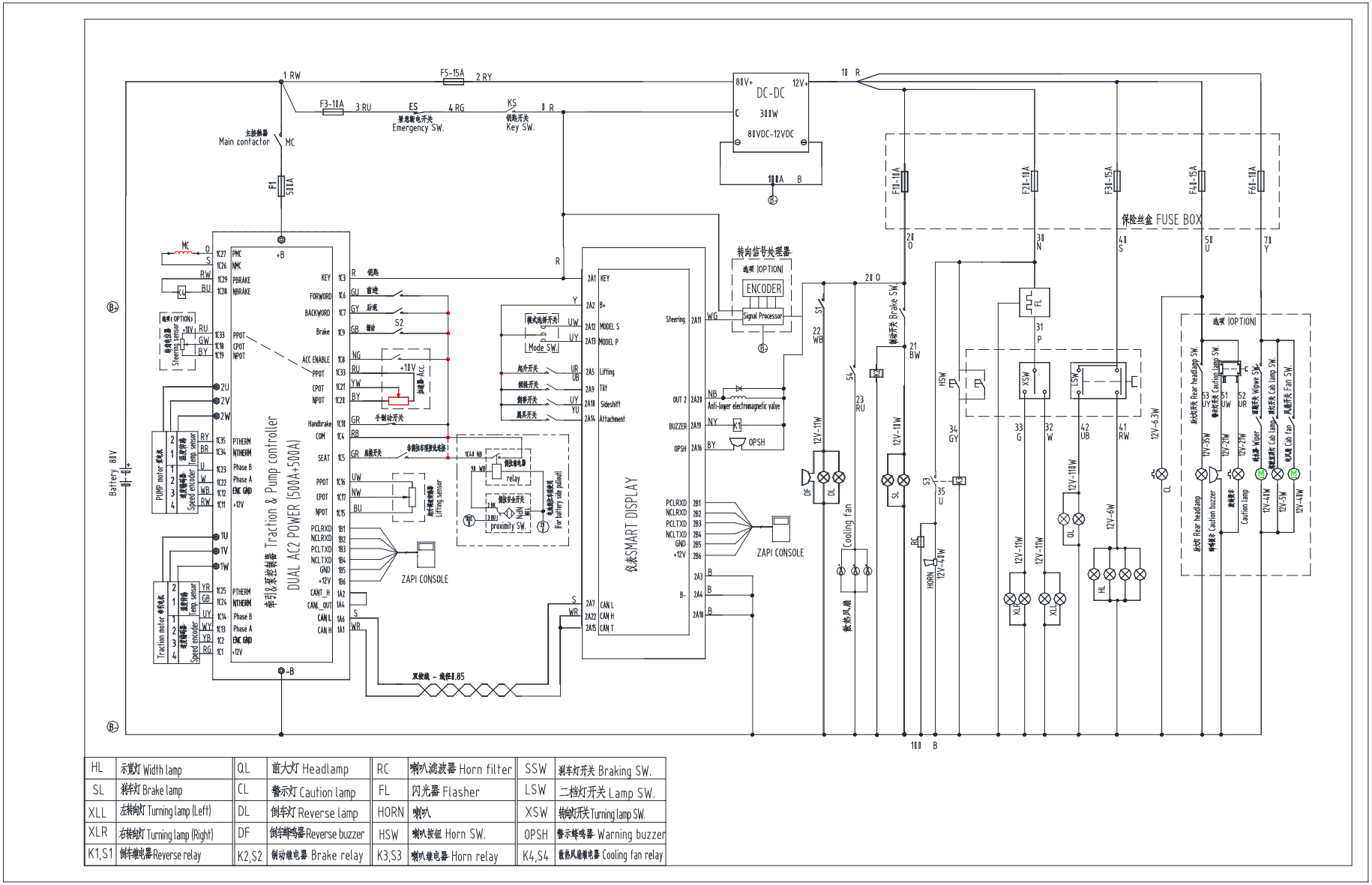
HL	示宽灯 Width lamp	QL	前大灯 Headlamp	RC	喇叭滤波器 Horn filter	SSW	刹车灯开关 Braking SW.
SL	刹车灯 Brake lamp	CL	警示灯 Caution lamp	FL	闪光器 Flasher	LSW	二挡灯开关 Lamp SW.
XLL	左转向灯 Turning lamp (Left)	DL	倒车灯 Reverse lamp	HORN	喇叭	XSW	转向灯开关 Turning lamp SW.
XLR	右转向灯 Turning lamp (Right)	DF	倒车蜂鸣器 Reverse buzzer	HSW	喇叭按钮 Horn SW.	OPSH	警示蜂鸣器 Warning buzzer
K1,S1	倒车继电器 Reverse relay	K2,S2	制动继电器 Brake relay	K3,S3	喇叭继电器 Horn relay	K4,S4	散热风扇继电器 Cooling fan relay

Figure 4-14 Circuit diagrams of electric system（CPD30～35-GC2）



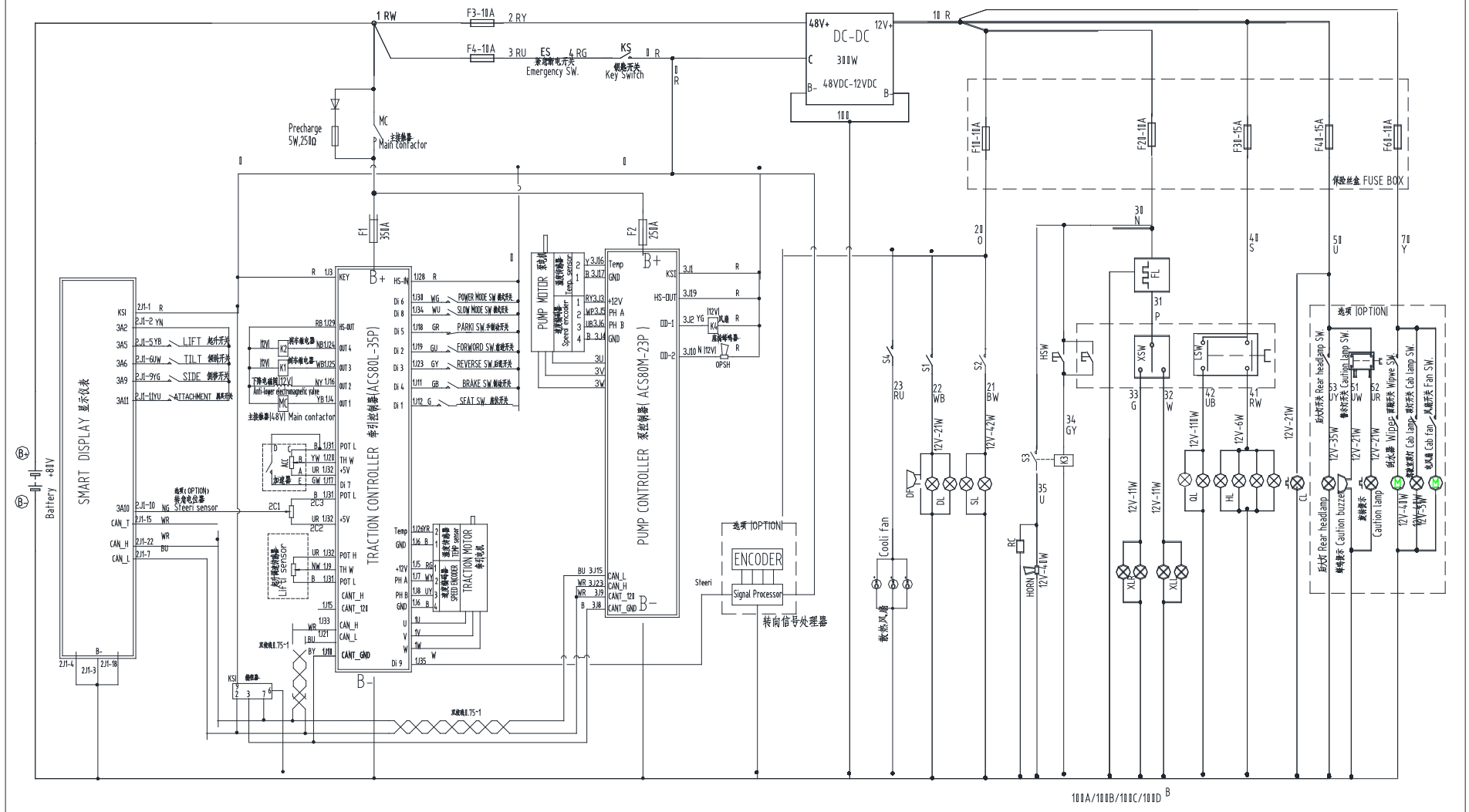
HL	示宽灯 Width lamp	QL	前大灯 Headlamp	RC	喇叭滤波器 Horn filter	SSW	刹车灯开关 Braking SW.
SL	刹车灯 Brake lamp	CL	警示灯 Caution lamp	FL	闪光器 Flasher	LSW	二档灯开关 Lamp SW.
XLL	左转向灯 Turning lamp |Left|	DL	倒车灯 Reverse lamp	HORN	喇叭	XSW	转向灯开关 Turning lamp SW.
XLR	右转向灯 Turning lamp |Right|	DF	倒车蜂鸣器 Reverse buzzer	HSW	喇叭按钮 Horn SW.	OPSH	警示蜂鸣器 Warning buzzer
K1,S1	倒车继电器 Reverse relay	K2,S2	制动继电器 Brake relay	K3,S3	喇叭继电器 Horn relay		

Figure 4-15 Circuit diagrams of electric system（CPD30～35-GD1）



HL	示宽灯 Width lamp	QL	前大灯 Headlamp	RC	喇叭滤波器 Horn filter	SSW	刹车灯开关 Braking SW.
SL	刹车灯 Brake lamp	CL	警示灯 Caution lamp	FL	闪光器 Flasher	LSW	二档灯开关 Lamp SW.
XLL	左转向灯 Turning lamp (Left)	DL	倒车灯 Reverse lamp	HORN	喇叭	XSW	转向灯开关 Turning lamp SW.
XLR	右转向灯 Turning lamp (Right)	DF	倒车蜂鸣器 Reverse buzzer	HSW	喇叭按钮 Horn SW.	OPSH	警示蜂鸣器 Warning buzzer
K1,S1	倒车继电器 Reverse relay	K2,S2	制动继电器 Brake relay	K3,S3	喇叭继电器 Horn relay	K4,S4	散热风扇继电器 Cooling fan relay

Figure 4-16 Circuit diagrams of electric system（CPD30～35-GD2）



HL	示宽灯 Width lamp	QL	前大灯 Headlamp	RC	喇叭滤波器 Horn filter	SSW	刹车灯开关 Braking SW.
SL	刹车灯 Brake lamp	CL	警示灯 Caution lamp	FL	闪光器 Flasher	LSW	二档灯开关 Lamp SW.
XLL	左转向灯 Turning lamp (Left)	DL	倒车灯 Reverse lamp	HORN	喇叭	XSW	转向灯开关 Turning lamp SW.
XLR	右转向灯 Turning lamp (Right)	DF	倒车蜂鸣器 Reverse buzzer	HSW	喇叭按钮 Horn SW.	OPSH	警示蜂鸣器 Warning buzzer
K1,S1	倒车继电器 Reverse relay	K2,S2	制动继电器 Brake relay	K3,S3	喇叭继电器 Horn relay	K4,S4	散热风扇继电器 Cooling fan relay

Figure 4-17 Circuit diagrams of electric system（CPD30～35-GD3）

4.2 Instrument

4.2.1 CURTIS instrument

(1) Display of the instrument

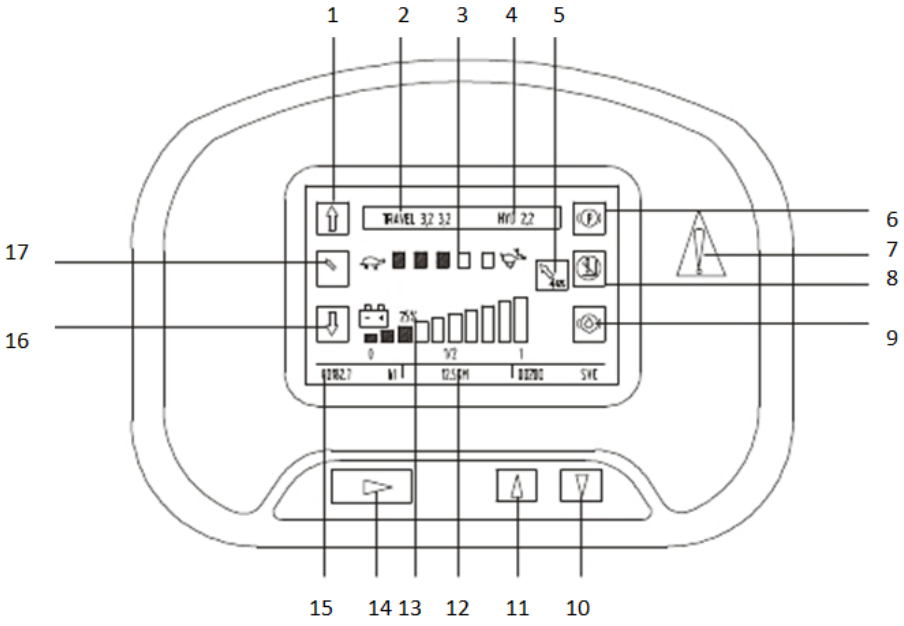


Fig. 4-18 Display of the CURTIS ENGAGE IV instrument

(1) Forward indication light (2) Fault code of traction controller (3) Speed status indicator
(4) Fault code of pump controller (5) Steering angle display (6) State of hand brake
(7) Fault LED (8) Lift lockout display (9) Travelling mode indicator
(10) Selection button (11) Selection button (12) Speed display (13) Battery capacity display
(14) Menu button (15) Hour meter display (16) Backward indication light
(17) Seat switch status indicator

(2) Function and application

CURTIS ENGAGE Ⅳ instrument receives the fault signal in serial mode from the fault outlet end of walking controller and pump controller and is displayed on the instrument in digital form. “TRAVEL” indicates walking controller and “HYD”, the pump controller. Power display and insufficient power warning: The lift locking function can be provided when power is insufficient.

Icons “ ” and “ ”indicate speed; there are five markers between them displaying the change of the speed. The five markers display is based on 0～5V output signal of accelerator, hysteretic response. “ ” is forward indicator, high level trigger;

“ ”is back off indicator, high level trigger; “ ”indicates neutral, low level trigger; “ ”indicates parking brake, high level trigger; “ ” indicates lift locking, instrument control; “”indicates the travelling mode of the traction system is economic mode and the mode is the default setting. There are powerful mode “” and slow mode “” for choose. “ ”means truck maintenance, instrument control.

There is LED flashing warning on instrument: 2 LED indicators display different information through combination of different-color lightings as shown in the following table. (Refer to table4-1)

Table 4-1 Description of LED indication information

Indication	Information
LED lamp does not work.	Power supply of controller has not been connected or the battery of vehicle uses up or other serious faults.
Yellow LED lamp flickers.	Controller works normally.
Yellow and red LED lamps are often on.	Controller is at program loading status.
Red LED is often on.	Watchdog no longer works or software. Not installed. Restart with the key switch. Reinstall the software if needed.
Yellow and red flicker alternatively.	Controller has fault. Fault display code consists of 2 digits. The red lamp flickering times indication code is the first digit or the second one and the yellow lamp flickering times stands for the concrete digit of corresponding digit.

4.2.2 SMART instrument (with ZAPI, Inmotion controller)

(1) Display of the instrument

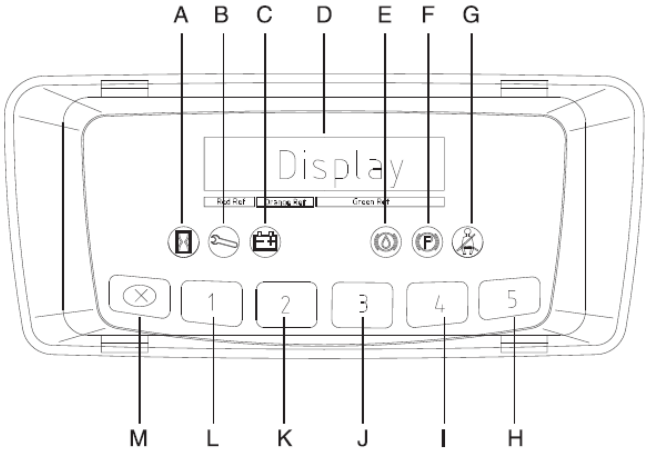


Fig. 4-19 Display of the ZAPI SMART instrument

(A) Hand brake condition indicator (B) Fault LED (C) Low state of battery LED

(D) LCD (E) Moderate traction speed working indicator
(F) Low traction speed working indicator (G) Warning lights for seat switch
(H) High/moderate/low speed switch/Out button (I) Set down key (J) Set up key
(K) Roll down key (L) Roll up key (M) Menu key

(2) Function and application

SMART DISPLAY is an intelligent dashboard connected to the truck system by CANBUS line. This dashboard provides the diagnostic and set-up of the whole truck system.

Connecting the ZAPI handset or PCWIN tool to SMART DISPLAY, it is possible to read and modify the setting of all the modules present on the CANBUS net. The display implements an interface to the operator through a main page and a number of submenus.

a) Turn on the key switch. When the instrument gets power “HELI AC SYSTEM” is displayed on the LED screen. After system self-testing, battery capacity, truck speed, the default setting (economic mode) and traction hours will be indicated on the main page, as shown in Fig. 4-20.

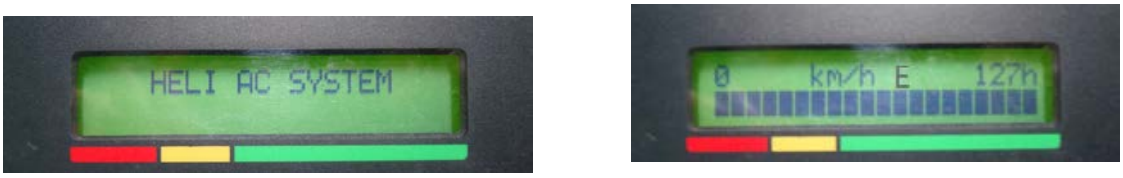


Fig. 4-20 Display of the SMART instrument when power on (fault-free)

b) Battery capacity display: There are 20 grids on the battery capacity indicator. After the truck is powered, the indicator is fully lit (20 grids) if the battery is fully charged. After battery discharge, the battery capacity is reducing, so are the grids of the indicator. When 20 grids of the battery capacity indicator are all off, the fault warning symbol and battery low symbol will flash at the same time and the travelling speed slow down, lifting action cut off. Charge the battery in time.

c) Traction travelling mode display: the driver can choose the mode through the mode switch. The current mode is shown on the meter . There are three modes for choose:

E refers to economic mode, P refers to powerful mode and S refers to slow speed mode.

d) Fault code display : If fault appears,  is often on and refer to Table 4-2 for the fault code (the first line) displayed in the WINDOW， the control module No. (the second line) of CANBUS net where the fault happens and CANBUS net information of ZAPI.

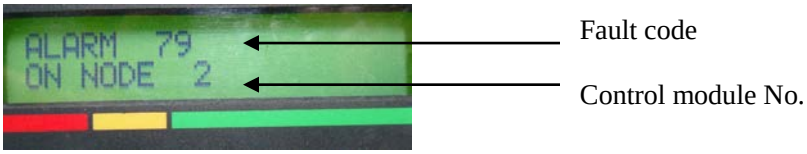


Fig. 4-21 Fault display interface of ZAPI instrument

Table 4-2 ZAPI CANBUS net information

Number associated in CANBUS net	Module
01	SICOS
02	TRACTION
03	TRACTION MASTER
04	TRACTION SLAVE
05	PUMP
06	EPS-AC
09	MHYRIO
16	SMART DISPALY

4.2.3 Songzheng instrument

4.2.3.1 Panel layout

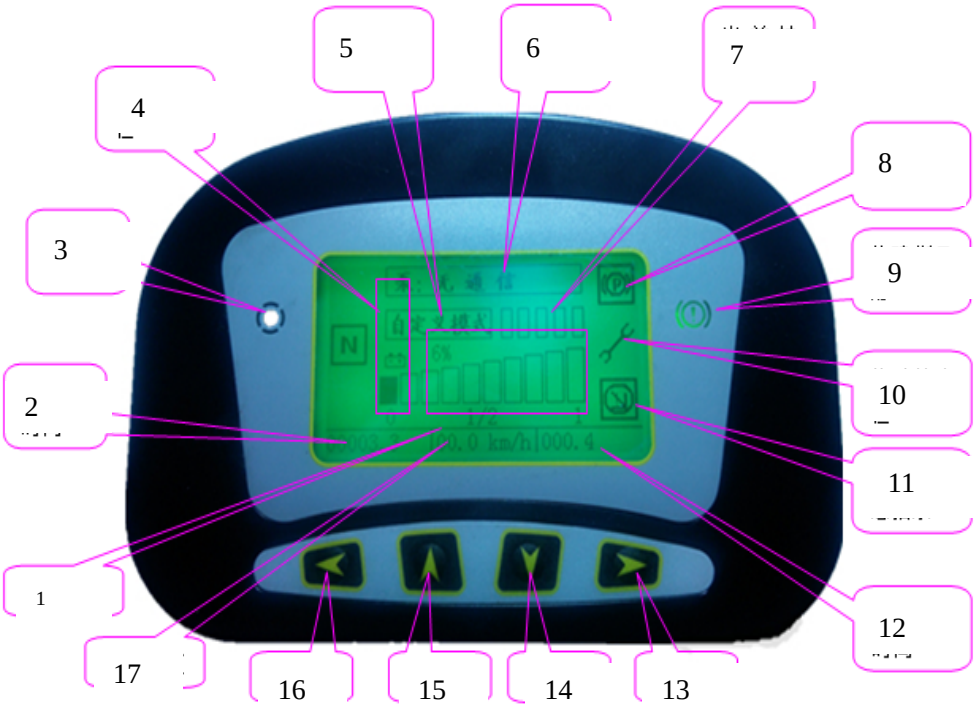
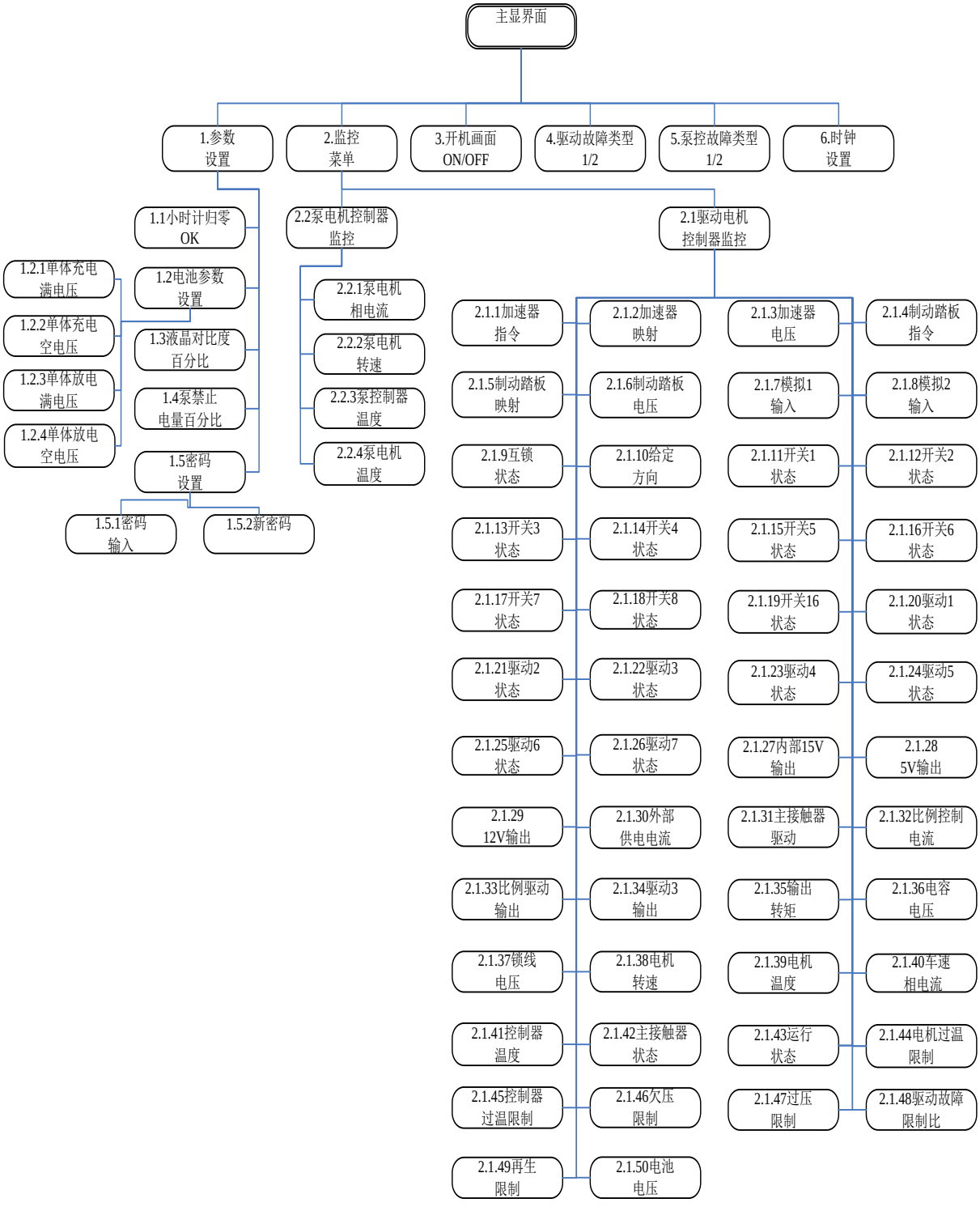


Figure 4-22 Songzheng instument panel

1. battery electricity quanity 2. Total working time 3. Light sensor
4. truck gears 5. Controller mode display 6. Fault display
7. current rotating speed display 8. Hand brake display 9. Fault indicator
10. fault state 11. Pump prohibited state display 12. Working time of this travel
13. enter 14. Page down 15. Page up 16. Backspace 17. Current speed

4.2.3.2 Instrument parameter introduction

(1) Instrument interface display tree diagram


主显界面
1.参数设置
2.监控菜单
3.开机画面ON/OFF
4.驱动故障类型1/2
5.泵控故障类型1/2
6.时钟设置
1.1小时计归零OK
1.2电池参数设置
1.3液晶对比度百分比
1.4泵禁止电量百分比
1.5密码设置
1.2.1单体充电满电压
1.2.2单体充电空电压
1.2.3单体放电满电压
1.2.4单体放电空电压
1.5.1密码输入
1.5.2新密码
2.2泵电机控制器监控
2.2.1泵电机相电流
2.2.2泵电机转速
2.2.3泵控制器温度
2.2.4泵电机温度
2.1驱动电机控制器监控
2.1.1加速器指令
2.1.2加速器映射
2.1.3加速器电压
2.1.4制动踏板指令
2.1.5制动踏板映射
2.1.6制动踏板电压
2.1.7模拟1输入
2.1.8模拟2输入
2.1.9互锁状态
2.1.10给定方向
2.1.11开关1状态
2.1.12开关2状态
2.1.13开关3状态
2.1.14开关4状态
2.1.15开关5状态
2.1.16开关6状态
2.1.17开关7状态
2.1.18开关8状态
2.1.19开关16状态
2.1.20驱动1状态
2.1.21驱动2状态
2.1.22驱动3状态
2.1.23驱动4状态
2.1.24驱动5状态
2.1.25驱动6状态
2.1.26驱动7状态
2.1.27内部15V输出
2.1.28 5V输出
2.1.29 12V输出
2.1.30外部供电电流
2.1.31主接触器驱动
2.1.32比例控制电流
2.1.33比例驱动输出
2.1.34驱动3输出
2.1.35输出转矩
2.1.36电容电压
2.1.37锁线电压
2.1.38电机转速
2.1.39电机温度
2.1.40车速相电流
2.1.41控制器温度
2.1.42主接触器状态
2.1.43运行状态
2.1.44电机过温限制
2.1.45控制器过温限制
2.1.46欠压限制
2.1.47过压限制
2.1.48驱动故障限制比
2.1.49再生限制
2.1.50电池电压

1.Parameter setting
1.1 hour meter clear OK
1.2 battery parameter setting
1.2.1 single cell charging full of voltage
1.2.2 single cell charging empty voltage
1.2.3 single cell discharging full of voltage
1.2.4 single cell discharging empty voltage
1.3 Liquid crystal contrast percentage
1.4 pump prohibitive electicity quanity percentage
1.5 password setting
1.5.1 password input
1.5.2 new password

2. Monitor menu
2.1 drive motor controller monitor
2.1.1 Accelerator order
2.1.2 Accelerator mapping
2.1.3 Accelerator voltage
2.1.4 brake pedal order
2.1.5 brake pedal mapping
2.1.6 brake pedal voltage
2.1.7 analog 1 input
2.1.8 analog 2 input
2.1.9 interlock state
2.1.10 preset direction
2.1.11-2.1.19 switch 1-8,16 state

2.1.20-2.1.26 Drive1-7 state
2.1.27 internal 15Voutput
2.1.28 5v output
2.1.29 12V output
2.1.30 External power supply current
2.1.31 main contactor drive
2.1.32 proportion control current
2.1.33 proportion drive output
2.1.34 drive 3 output
2.1.35 output torque
2.1.36 capacitance voltage
2.1.37 locking wire voltage
2.1.38 motor speed
2.1.39 motor temperature
2.1.40 speed phase current
2.1.41 controller temperature
2.1.42 main contactor state
2.1.43 operation state
2.1.44 motor over temperature limit
2.1.45 controller over temperature limit
2.1.46 under voltage limit
2.1.47 over voltage limit
2.1.48 drive fault limit ratio
2.1.49 regenerating limit
2.1.50 battery voltage

2.2 pump motor controller monitoring
2.2.1 pump motor phase current
2.2.2 pump motor speed
2.2.3 pump controller temperature
2.2.4 pump motor temperature
3. Startup ON/OFF
4. Drive fault type 1/2
5. Pump control fault type 1/2
6. Clock set

(2) Parameter explanation

● Startup ON/OFF: Turn on and off the meter startup page.

● Drive fault type 1/2: 1 means the drive fault communication type is CAN communication; 2 means drive fault type is fault code communication; (for the meter with the function)

● Pump control fault type 1/2: 1 means the pump control fault communication type is CAN communication; 2 means pump control fault type is fault code communication; (for the meter with the function)

● Clock set: Set the meter time to be actual time. The time needs reset if there is a power failure.

● Hour meter clear: The parameter can clear the hour meter. The hour meter means the meter total time. (The function needs to enter password.)

● liquid crystal contrast percentage: through the parameter, the contrast can be adjusted (it can not be adjusted to 0 or 100%)(The function needs to enter password.)

● Pump prohibitive electricity quantity percentage: through the parameter, adjust the electricity quantity when pump stops lifting or tilting. (The function needs to enter password.)

● Password input: Before setting the parameter, the parameter can only be modified after reenter the password. (The default password is 000001).

●New password: Modify the password after enter password through the parameter.

● Drive motor controller monitor: Under the menu, the travelling controller state is monitored.

● Pump motor controller monitor: Under the menu, the pump controller state is monitored.

4.3 Controller

4.3.1 General description

The counterbalanced forklift of this series adopts the CURTIS motor controller imported from America or ACE2 motor controller imported from Italy, so it has advantages of advanced technology of high frequency MOS tube, superior speed regulating performance, good safety, flexibility and first-class protection etc.

The controller assembly includes motor controller, contactor, relay set, fuse ,OPS warning buzzer, electronic protector (CURTIS system), radiation fan (ZAPI system） and the related harness.

4.3.2 Controller

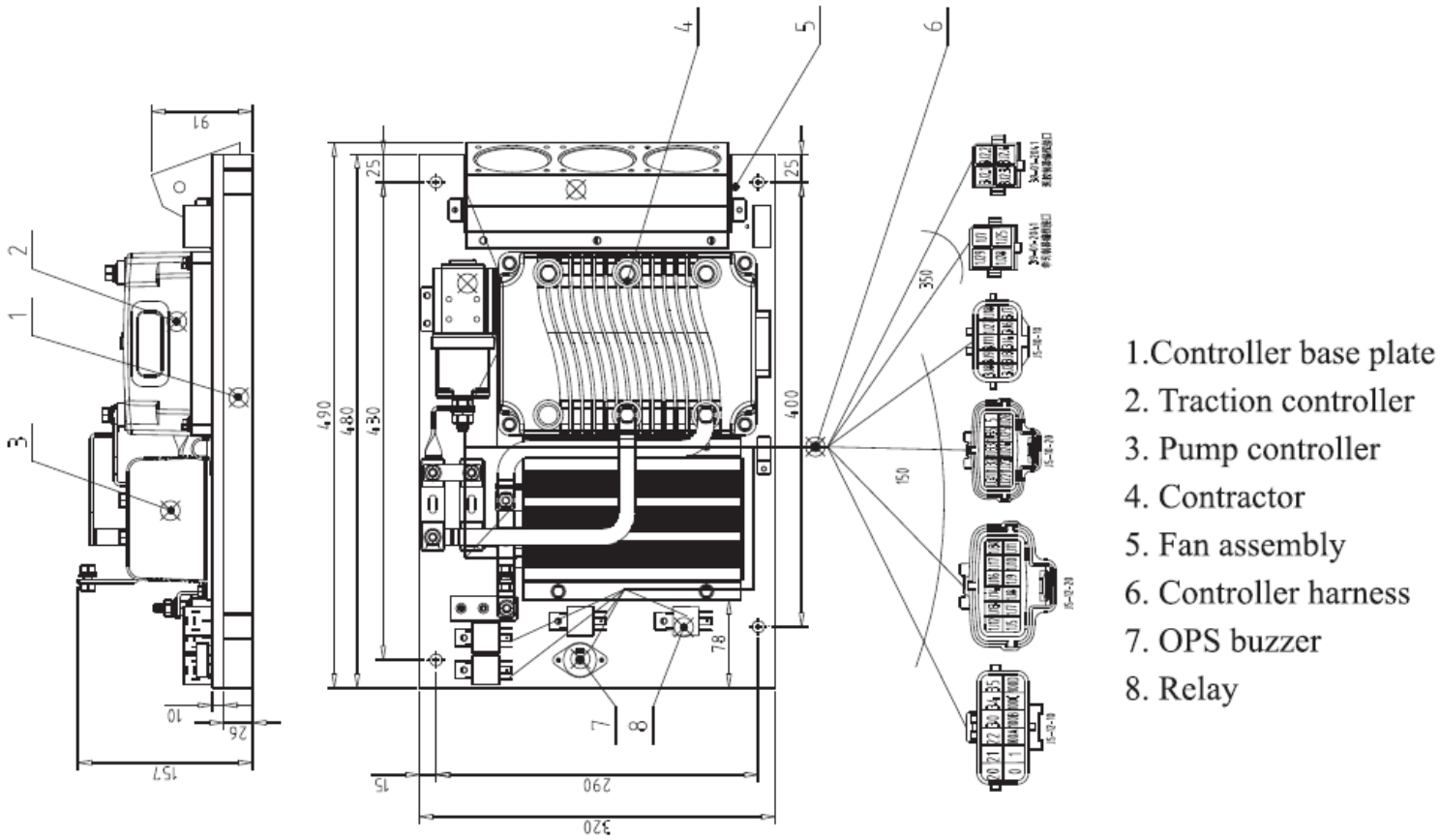
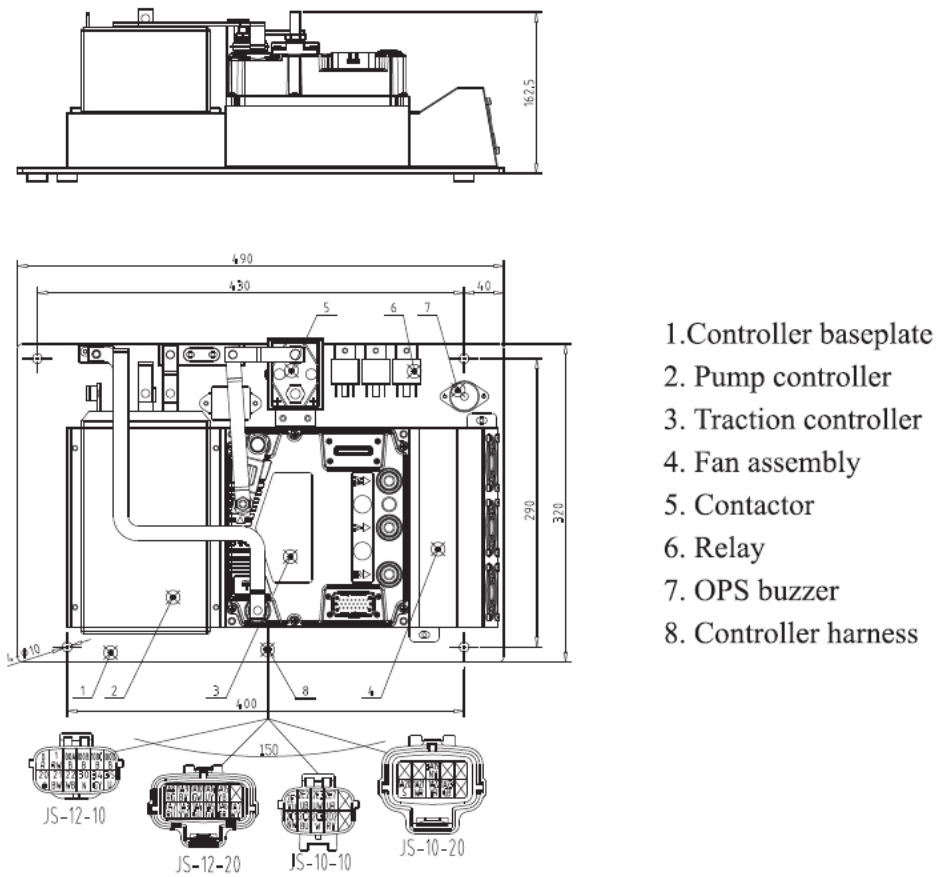


Fig. 4-23The controller of CPD10～18-GC1



1.Controller baseplate
2. Pump controller
3. Traction controller
4. Fan assembly
5. Contactor
6. Relay
7. OPS buzzer
8. Controller harness

Figure 4-24 The controller of CPD10～18-GC2

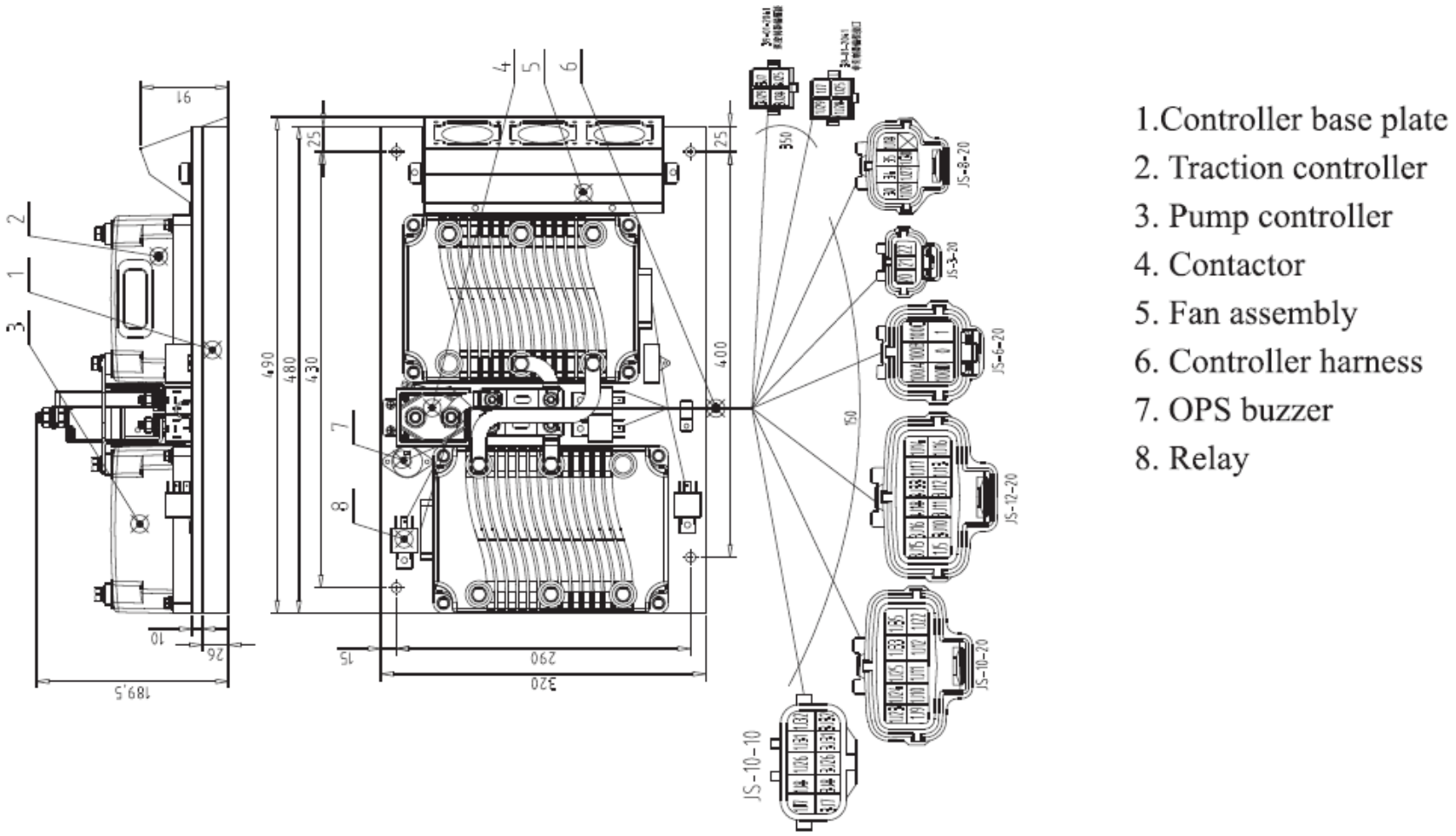


Fig. 4-25 The controller of CPD10-18-GD1

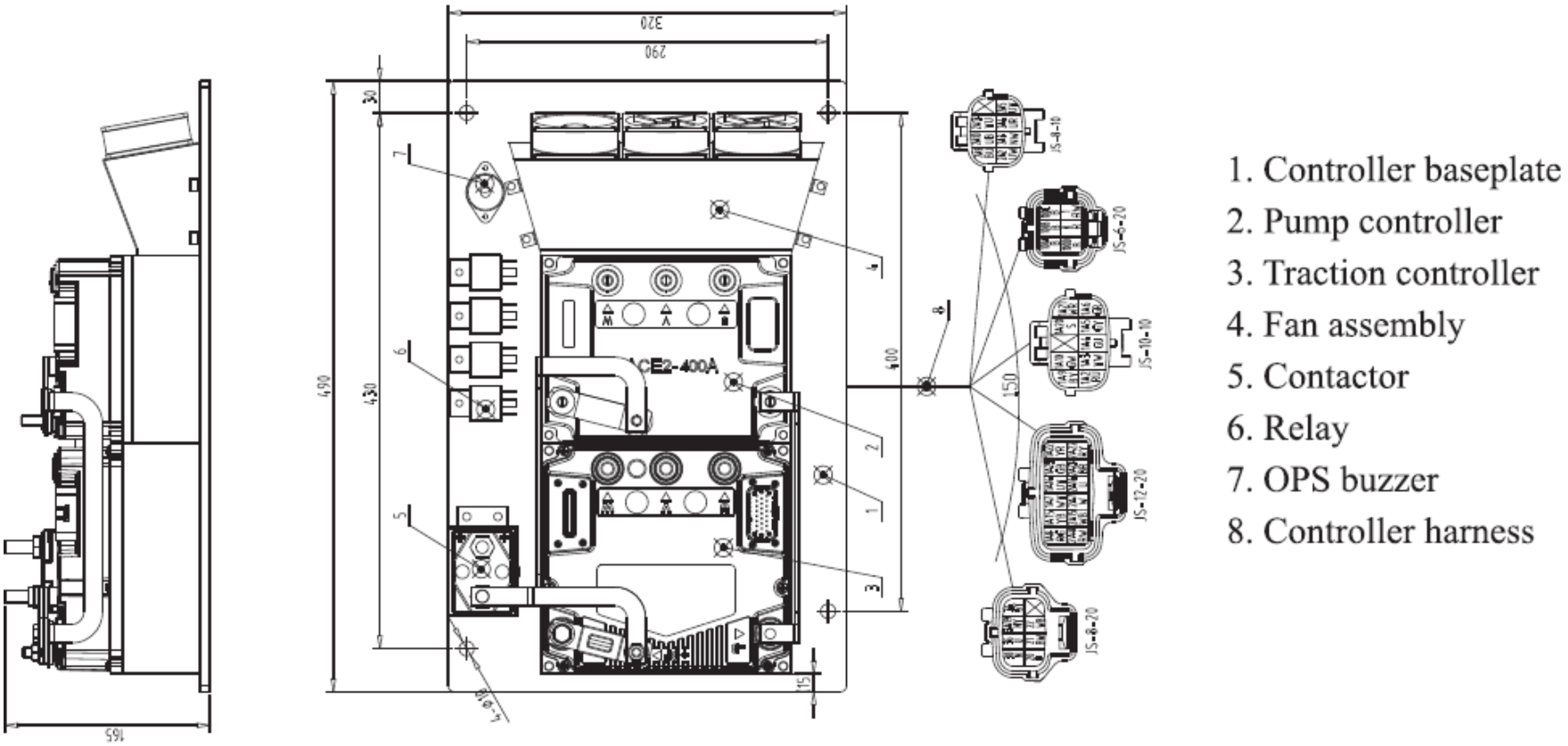


Figure 4-26 The controller of CPD10～18-GD2

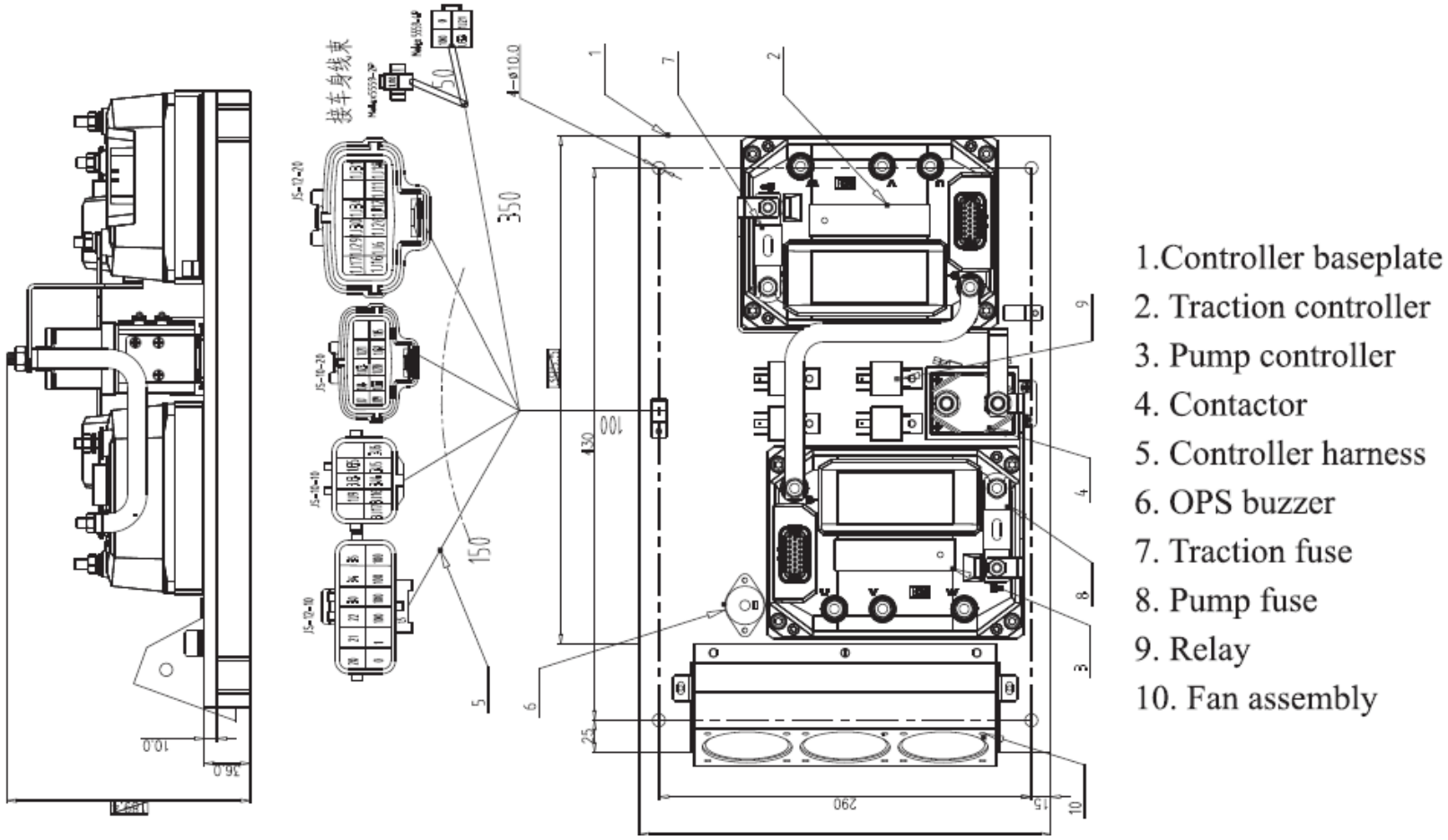


Figure 4-27 The controller of CPD10～18-GD3

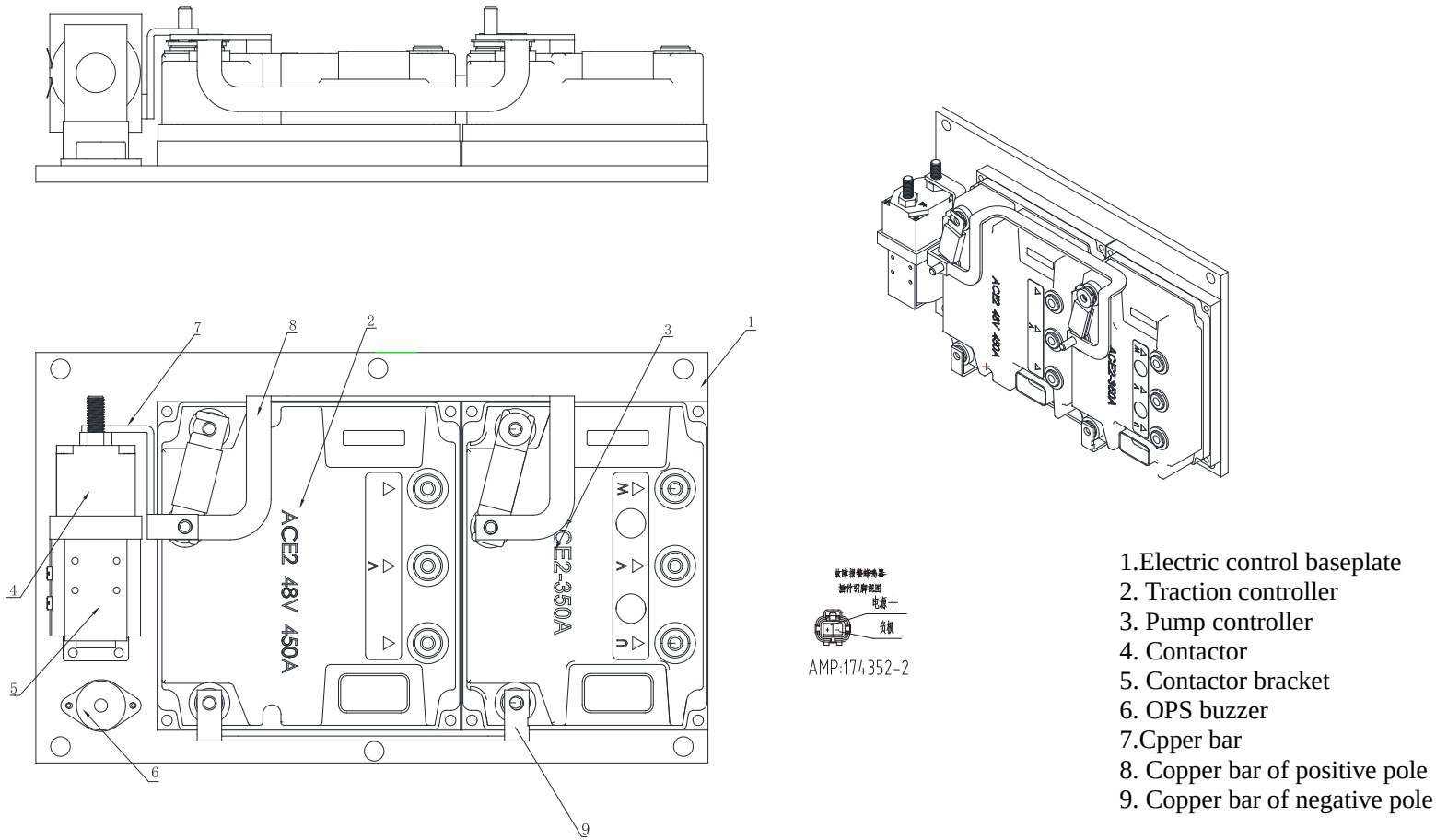


Fig. 4-28 The controller of CPD20~25-GB2

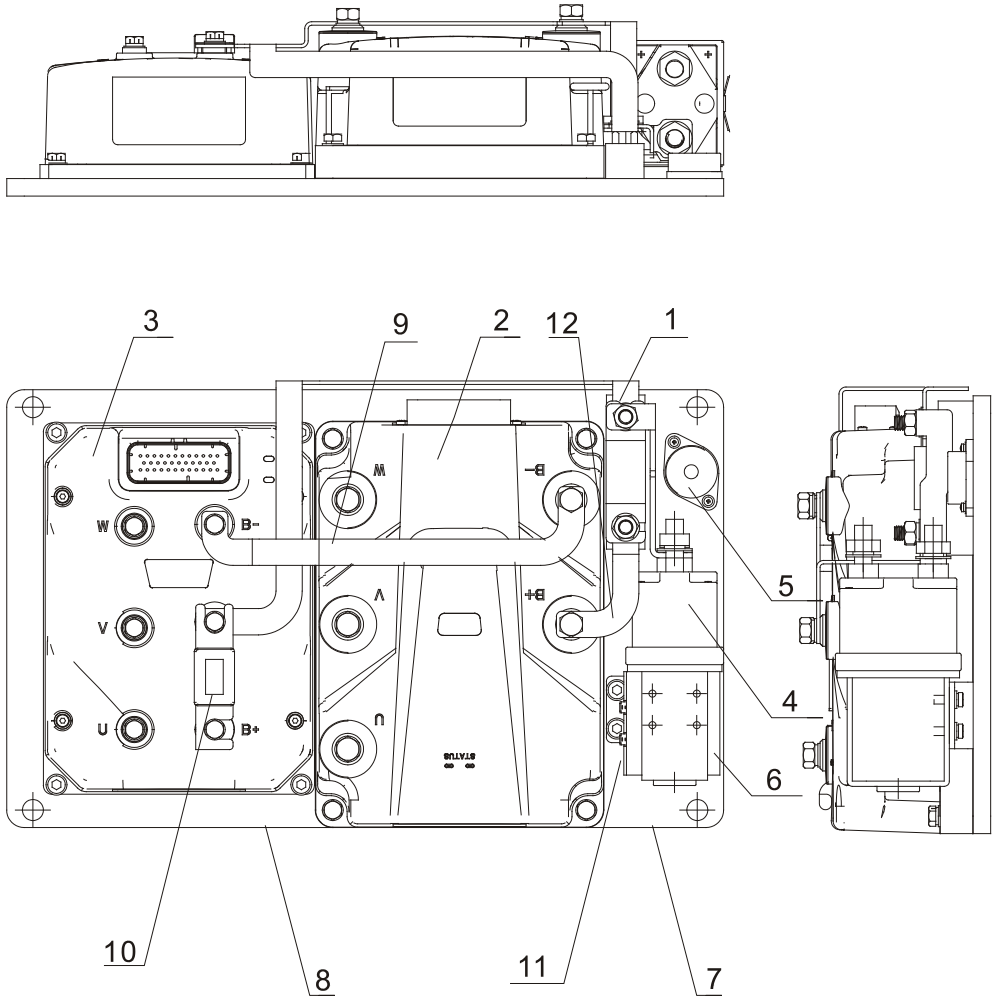
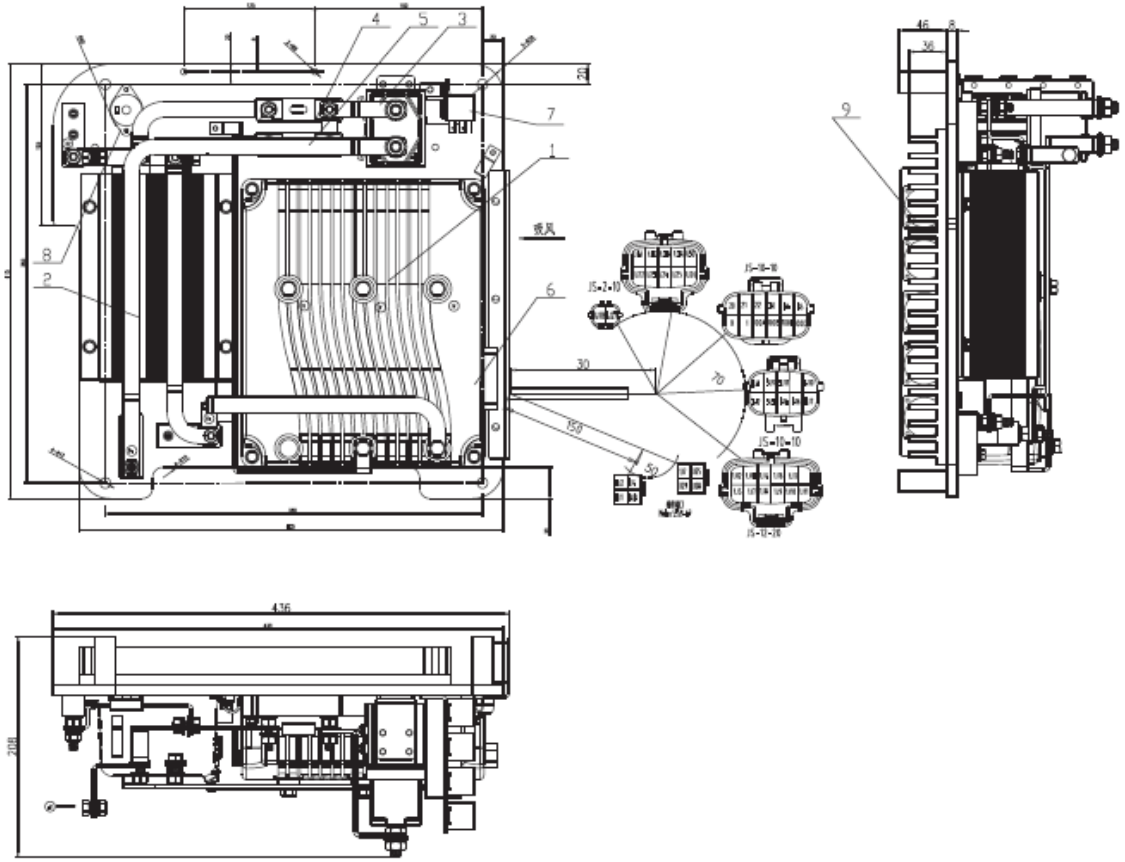


Fig. 4-29 The controller of CPD20~25-GB7

1.Electric control baseplate
2. Traction controller
3. Pump controller
4. Contactor
5. Contactor bracket
6. OPS buzzer
7.Cpper bar
8. Copper bar of positive pole
9. Copper bar of negative pole
10. Fuse
11. Fuse
12. Copper bar of positive pole



1.Traction controller
2. Pump controller
3. Contactor
4. Fuse
5. Fuse
6. Electronic protector
7. Relay 12V
8. Sound remind module
9. Cooling fan

Figure 4-30 The controller of CPD20～25-GC1

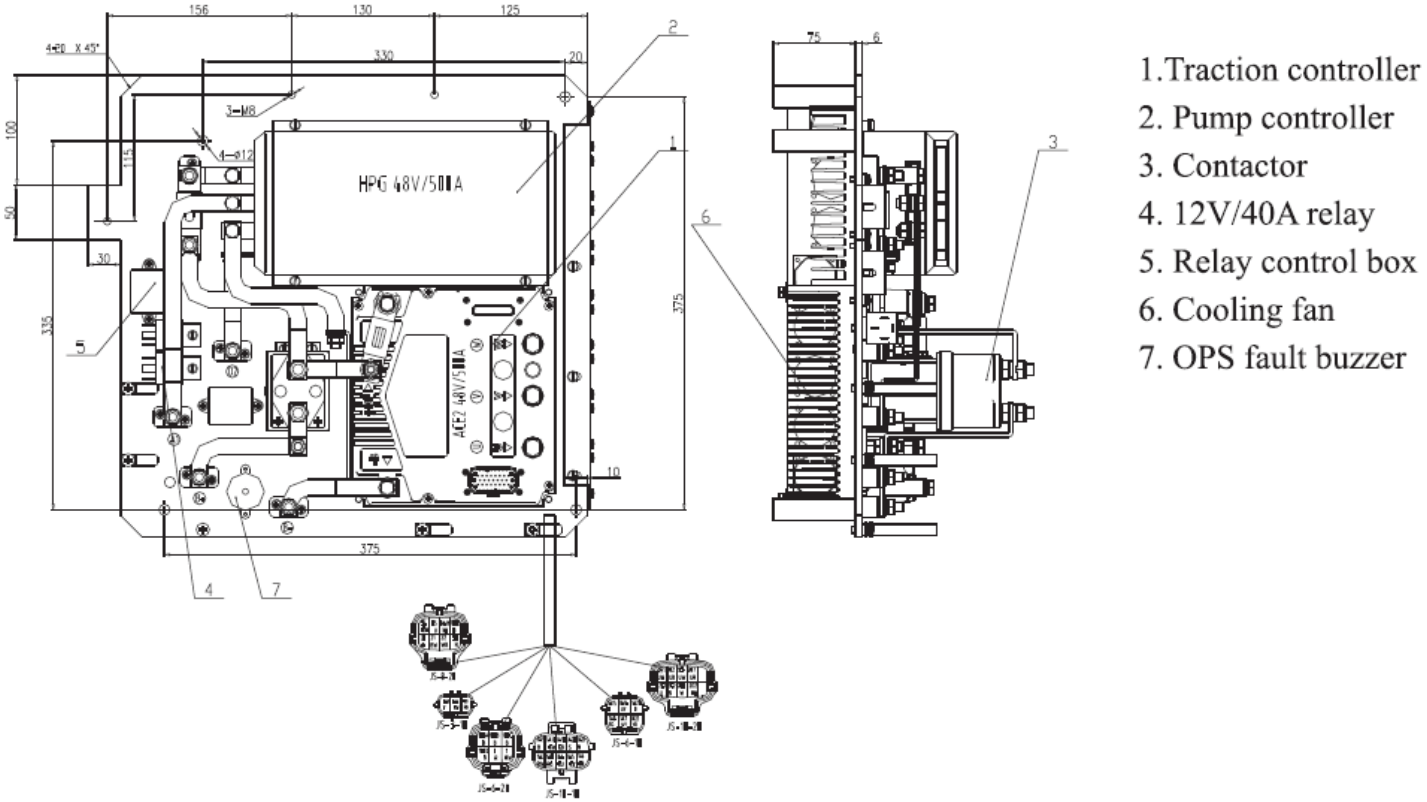
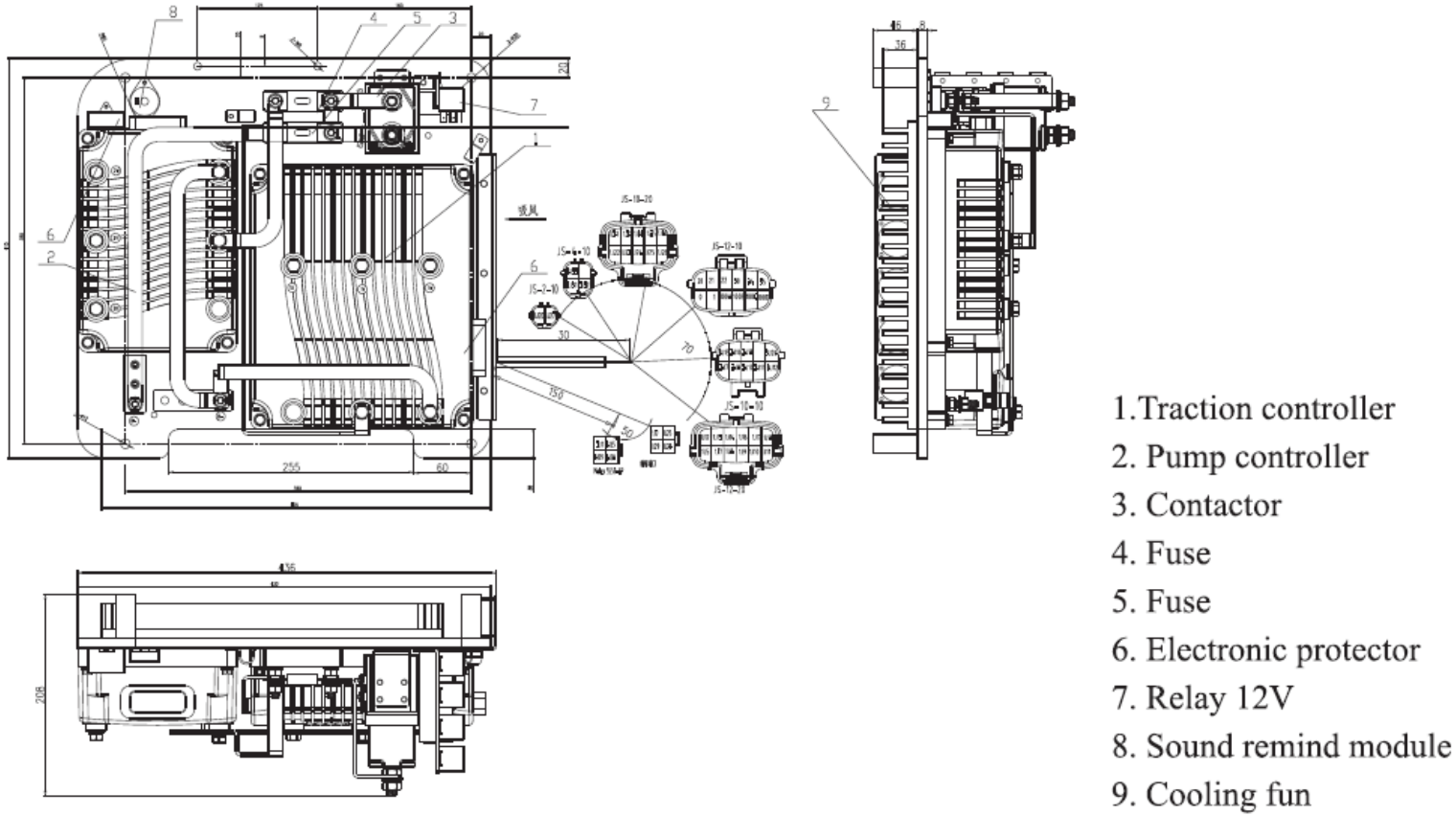


Figure 4-31 The controller of CPD20～25-GC2



1.Traction controller
2. Pump controller
3. Contactor
4. Fuse
5. Fuse
6. Electronic protector
7. Relay 12V
8. Sound remind module
9. Cooling fun

Figure 4-32 The controller of CPD20～25-GD1

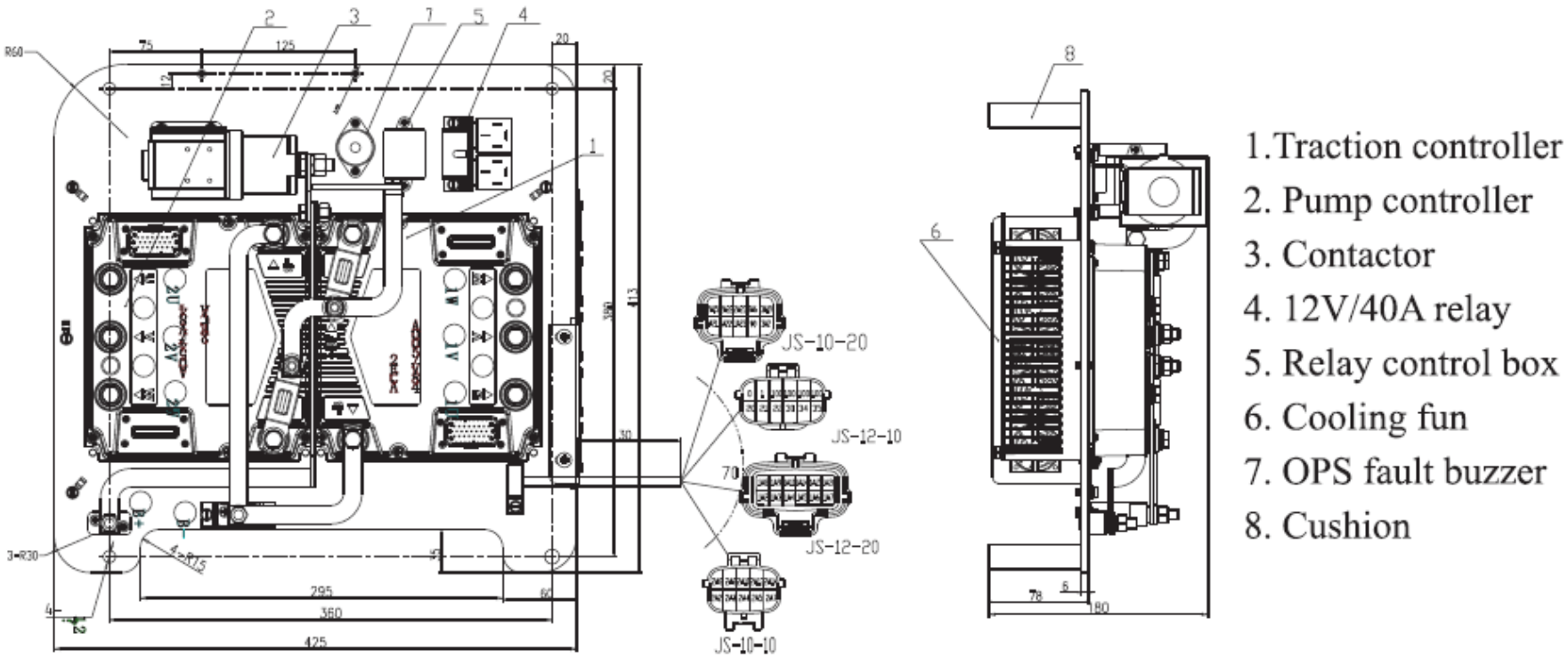
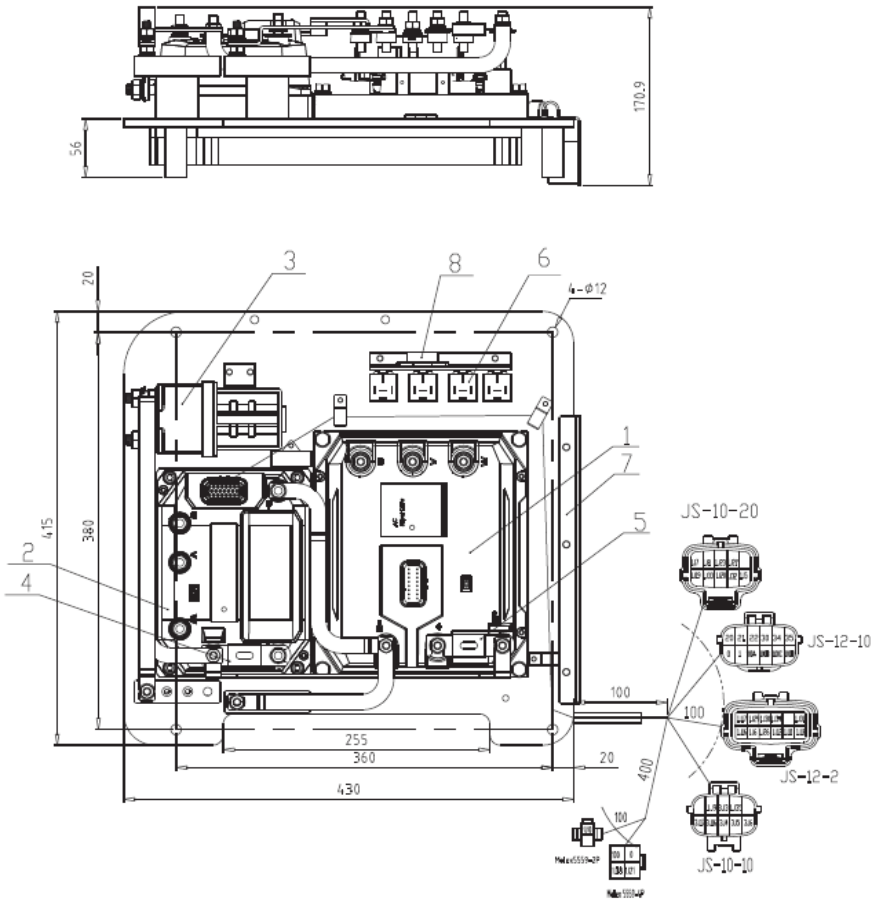


Figure 4-33 The controller of CPD20～25-GD2



1.Traction controller
2. Pump controller
3. Contactor
4. Fuse
5. fuse
6. Relay
7. Cooling fan
8. Sound remind module

Figure 4-34 The controller of CPD20～25-GD3

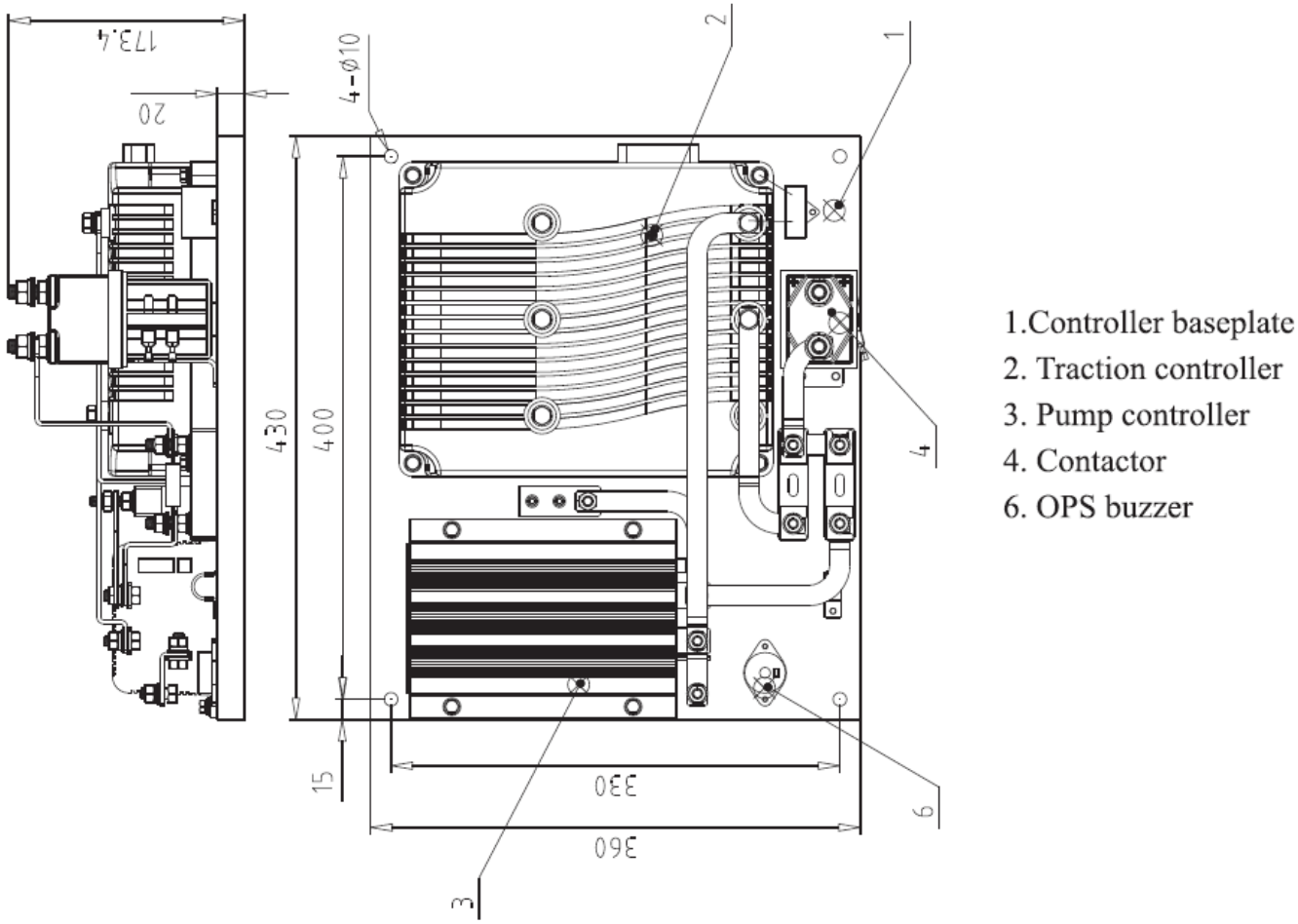


Figure 4-35 The controller of CPD30～35-GC1

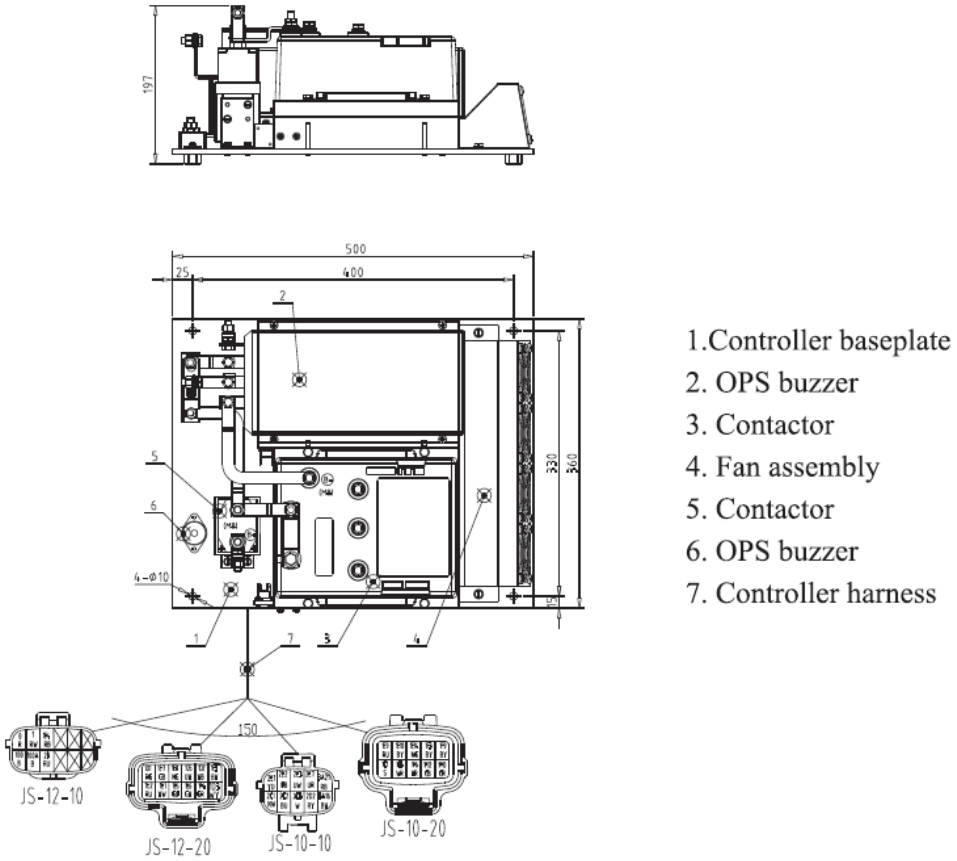


Figure 4-36 The controller of CPD30～35-GC2

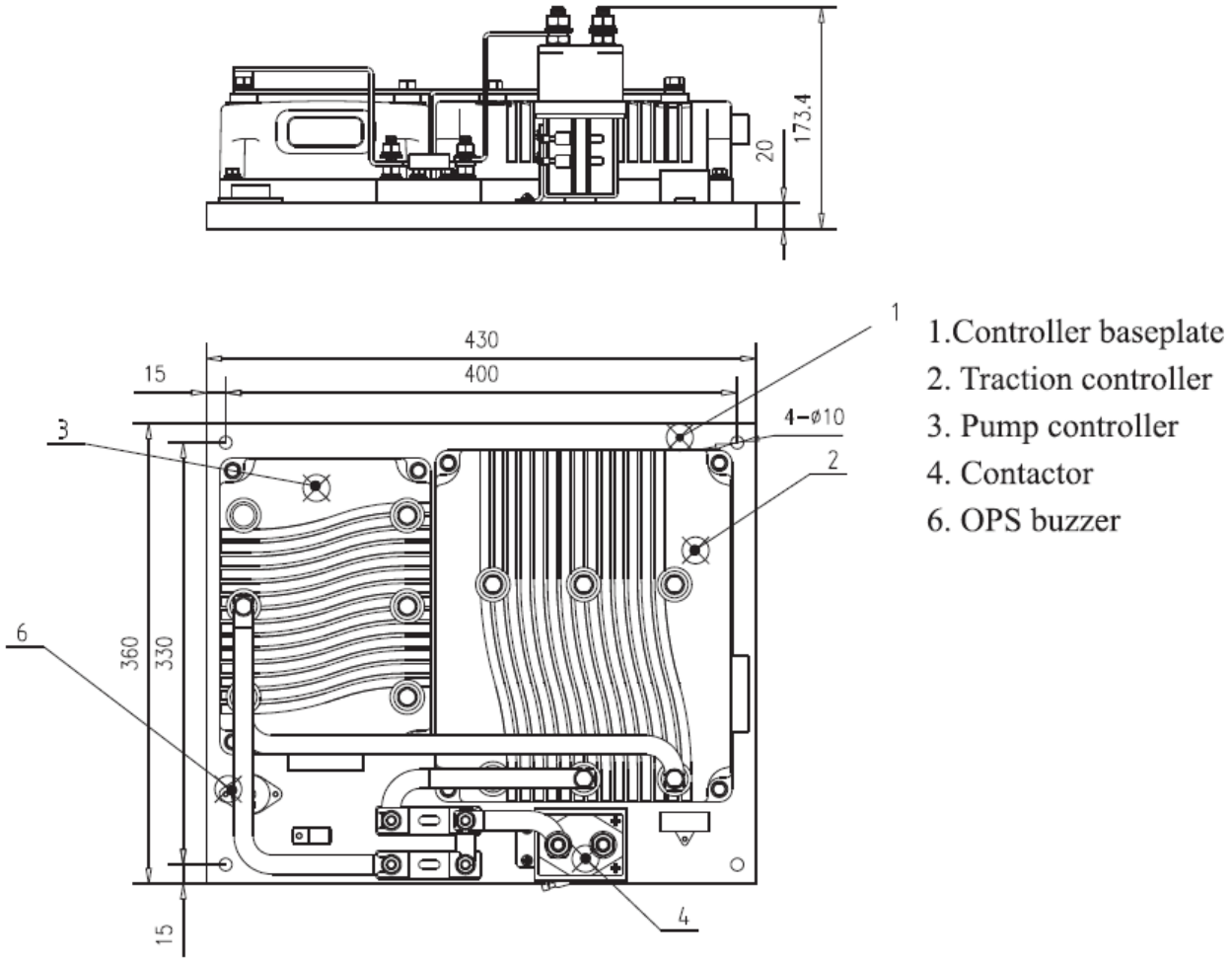
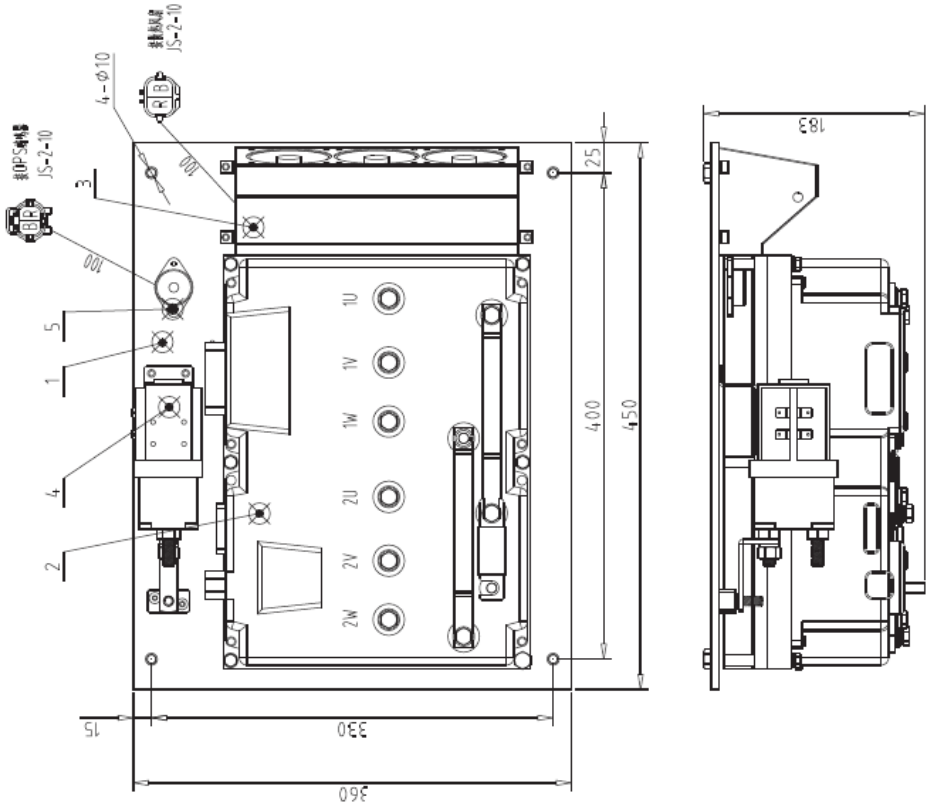


Figure 4-37 The controller of CPD30～35-GD1



1.Controller baseplate
2. AC controller
3. Fan assembly
4. Contactor
5. OPS buzzer

Figure 4-38 The controller of CPD30～35-GD2

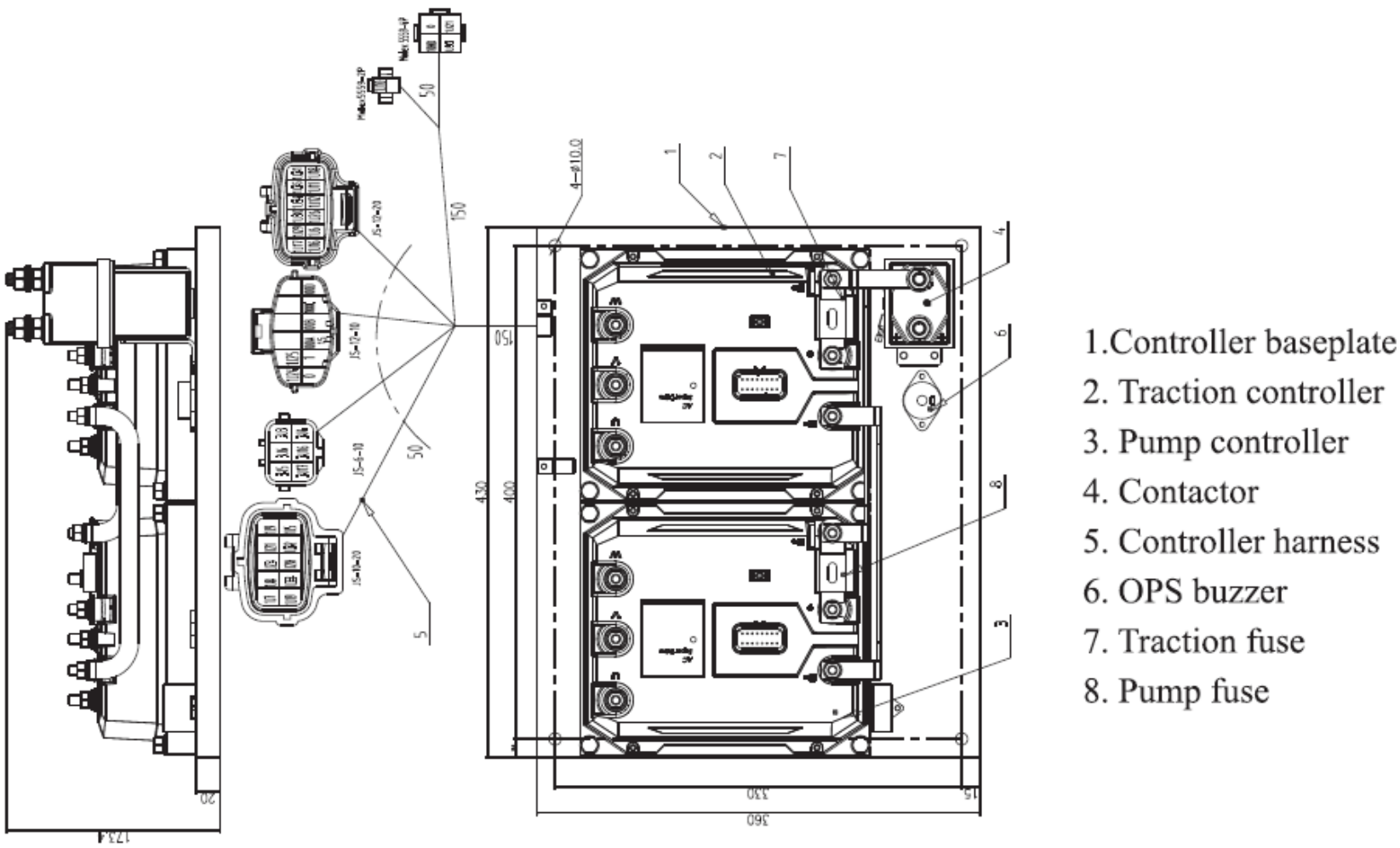


Figure 4-39 The controller of CPD30～35-GD3

Notice: The manufacturer will provide quality warranty for motor controller and the manufacturer will be informed in time for after sales service in case of fault. Please do not open it for maintenance without authorization of manufacturing. The users will be responsible for the personal and property losses caused by maintenance at their own will.

4.4 Motor

4.4.1 Specifications of motors

Table 4-3 Specifications of motors

Item \ Truck model	CPD10～18-GD	CPD10～15-GC	CPD18-GC	CPD20～25-GC	CPD20～25-GD	CPD30~35-GC	CPD30~35-GD
Traction motor model Rated output Rated voltage Rated current Rated speed	YDQ8.2-4-6190 8.2kW 32.3V 214A 1140 r/min	YDQ8-4-6190 8.2kW 32.3V 214A 1140 r/min	YDQ8-4-6190 8.2kW 32.3V 214A 1140 r/min	YDQ11.1-4HL 11.1kW 34V 238A 1205r/min	YDQ11.1-4HL 11.1kW 34V 238A 1205r/min	TSP180/4-200LT62 16.6kW 52V 250A 3100rpm	TSP180/4-200LT62 16.6kW 52V 250A 3100rpm
Lift motor model Excitation mode Rated output Rated voltage Rated current Rated speed	/	XQD-7.5-3S Series excitation 7.5kW 48V 210A 1550r/min	XQD-8.6-3S Series excitation 8.6kW 48V 260A 1550r/min	XQD-10-4S Series excitation 10.5kW 48V 275A 1600r/min	/	XQD-10-4S Series excitation 10KW 45V 275A 1600rpm	/
AC lift motor model Rated output Rated voltage Rated current Rated speed	YDB10.6-4-6190 10.6kW 31V 262A 2200 r/min	/		/	YDB15-4HL 15kW 31V 395A 2200r/min	/	TSW132/4-195LP72 13.5kW 43V 250A 1765rpm

4.4.2 Check and maintenance of the DC motor

(1) Daily check

a) Insulated resistance. Limit value (≥1 MΩ)

b) Rotor should running agilely without touch.

c) Check up the motor connection whether exact and firm.

d) Check up between commutating piece of commutator whether clean.

Notice: During maintenance, the oil contamination on the commutator should be wiped clean by lint free cloth dipped in alcohol and electric brush powder between commutators should be clean up with hairbrush.

e) The fastener whether become flexible and brush rack whether firm.

f) The space between the brush holder of brush rack and the surface of commutator whether correct and transmuted. (2~4mm)

g) Whether the brush is integrity and glides agilely, the pressure of the balance spring in gear.

h) The area of interface between brush and commutator should not less than 80%, and require polished with 00 type of thin emery cloth before instead.

(2) Daily maintenance

Notice the surface of motor, for example the mud or other adherent matter on the housing, to avoid affect motor dispel heat. Check every half a year in gear, main work as:

a) Check outside and surface of motor and clean, cleanup dust.

b) Check, clean and replace bearing, carefully notice whether exist abnormity noise.

c) Check and replace the brush, check and maintain the commutator.

It is normal that the surfaces of commutator assume accordant light red after used a long time.

Carve and polish the brush

a) Polish the brush with 00 type of thin emery cloth, drag the emery cloth right or left during polishing.

b) After polishing brush with emery cloth and cleanup the commutator, the motor should running with limit speed to assure safety, until the working surface of brush polished.

(3) Working environment

a) Not higher than 1200m altitude.

b) Temperature between -25ºC ~ +40ºC.

c) Relative humidity large to 100%, form curding dew at surface of motor.

(4) Faults and troubleshoot

The faults of DC motor mostly focus on the commutator department, characteristic and causation as the following table.

Table 4-4 Faults and troubleshoot of motor

No.	The characteristic of commutator	Causation
1	All sheet copper is black.	Wrong press of brush.
2	The commutating piece change black in group with regulation.	Between commutating piece or armature winding short, welding bad or the commutating piece and armature winding bad or turn off.
3	The commutating piece change black in group without regulation.	The center of commutator moved, and the surface of commutator is not circle or flat.
4	The brush is frayed, change color and disintegrated.	The motor vibrate, the space between brush holder and brush is too big, the space between brush holder and the surface of commutator is too big. The talc between the commutating piece extruded, the material or type of brush is wrong.
5	The sparkle of commutator is big.	Motor over loading, the commutator is not clean, the brush contact is bad, the press is not enough or the brush is locked, brush rack become flexible or vibrate, wrong the polarity of pole and sequence.
6	Brush and brush plait heat.	The sparkle of brush is big, the contact between brush and soft wire is bad, the section area of soft wire is too small.
7	Exist noise during the brush running.	The surface of commutator is not enough smooth.

Notice: In case of backfire, one must shut off the power when checking and

maintaining the motor.

4.5 Battery

4.5.1 Specifications of battery

Table 4-5 Specifications of battery (standard)

Truck model / Item	CPD10-GD/C	CPD15～18-GD/C	CPD20～25-GC	CPD20～25-GD	CPD30~35-GC/D
Model	4PZS400	4PZS480	DA600	DA700	4PZS480
Capacity	400Ah	480Ah	600Ah/5	700Ah/5	480Ah
Voltage	48V	48V	48V	48V	80V
No. of the cell	24	24	24	24	40

Notice: High-capacity or import battery can be provide if the user need.

4.5.2 Use of battery

The correct use and daily maintenance of lead-acid battery have a great influence on the performance and service life of battery, therefore, the users must make maintenance and service by contrast with the actual condition and according to the maintenance instruction provided by manufacturer.

4.5.3 Maintenance of battery and matters for attention

(1) The surface of battery should be kept clean and dry. Its terminal and wiring parts should be frequently maintained and loosening or poor contact found should be timely eliminated.

(2) No conductive articles are allowed to put on battery to avoid its short circuit.

(3) The first charge of new battery before use is the initial charge and charges in the later use course are the common ones. The charging time of the common charge is different with battery capacity and discharging degree and usually discharging of 70%～100% needs continuous charge of about 8～12 hours.

(4) Open the filling cap during battery charging and close it when charging is finished.

(5) Hydrogen and oxygen gas are separated out during battery charge, therefore, ensure good ventilation condition and prohibit the fire and smoke to prevent explosion.

(6) In use and charging course, the natural evaporation and electrolysis of water content in electrolyte will result in level decrease of electrolyte and increase of density, so distilled water should be frequently added in order to keep height and density of electrolyte normal.

(7) In the course of use, the excessive discharge (i.e. the voltage drop of monomer battery is lower than 1.70V) and excessive charge should be avoided, because, these would seriously affect the service life and performance of battery.

(8) Battery after use should be charged within 24 hours. Failure to charge the battery timely, undercharge, excessive discharge or unused for a long time without additional charging will vulcanize polar plate of battery and result in performance degradation and use difficulty when serious.

(9) In the course of use, equalizing charge should be made to the battery once a month so that all monomers of battery can reach well-balanced and good state when in use.

(10) For battery compartment without liquid leakage hole, check if there is hydrops inside of compartment every month. If there is electrolyte spillage caused by improper adding of distilled water, please clean the hydrops in the compartment with sucker in time.

（11） Auto liquid replenishing device of battery

a) Diagram of auto liquid replenishing device

At the end of battery charging, liquid replenishing will be carried out automatically. The special water in the storage tank is pumped out by automatic liquid filling plug, and liquid is injected into each battery unit through liquid injection pipe and flow indicator with filter.

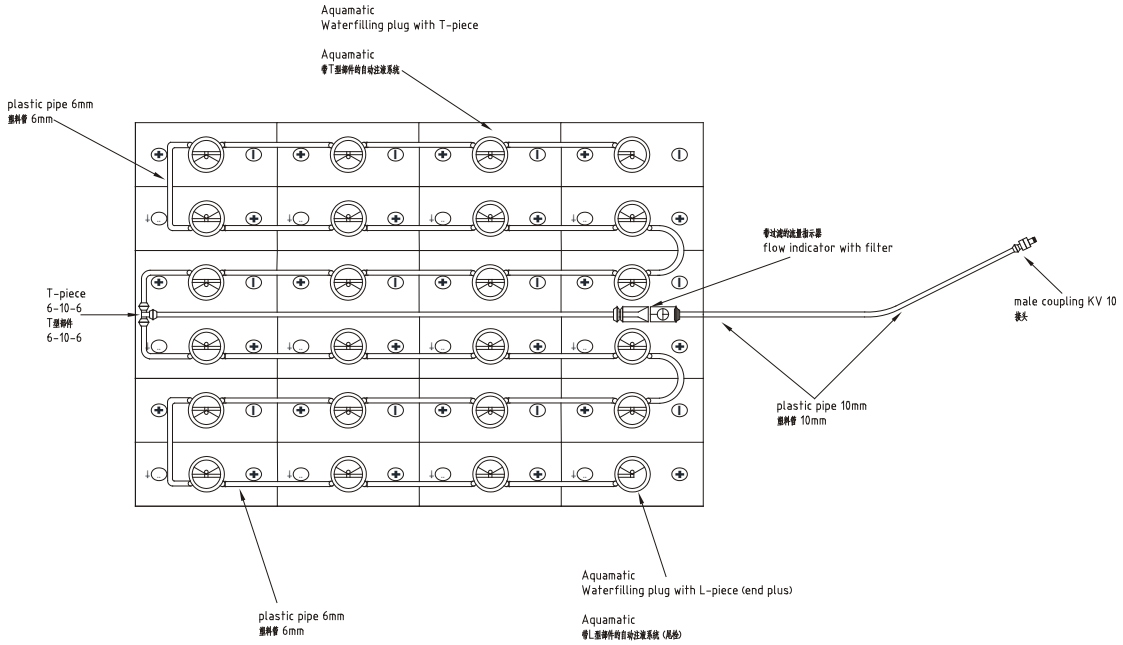


Figure 4-40 Diagram of auto liquid replenishing device

b) Use notice:

● Auto liquid replenishment shall be carried out at the end of charging, and it is strictly prohibited to be done before charging.

●The auto liquid replenishment device shall ensure the correct liquid pressure.

● Liquid storage devices and pipelines shall be kept clean and there shall be no dirt.

●Only special liquid for batteries shall be used.

●It is strictly forbidden to flush the injection plug with tap water.

● Pay attention to the temperature to prevent the auto liquid replenishment system from freezing.

4.5.4 Care and storage

(1) The battery should be stored in a warehouse which is dry, well ventilated and away from direct shinning. The temperature inside should stay between 5-40℃。

(2) Keep the battery from the heat source at least at a distance of 2m.

(3) The battery should not lie upside down or on the side. It should not bear any mechanical shock or any heavy load.

(4) Keep off any liquid and harmful foreign matter. Be care with the falling of the any metal impurity.

(5) Do not store the battery with electrolyte in. If it is necessary, charge the battery fully. Adjust the lever and density of the electrolyte well. Charge the battery once a month during its storage.

Notice:

(1) During battery charging, the charge should be temporally suspended in the place where the temperature of electrolyte exceeds 40ºC.

(2) In battery charging, the service life of battery will be affected if the temperature of electrolyte is more than 50ºC.

(3) Do not charge the battery at low temperature (e.g. cold outdoor), this would affect the service life of battery.

Notice:

(1) The rated voltage of traction battery is not the safe voltage and there is electric shock injury danger if touched, so take safety precautions.

(2) Traction battery is lead-acid battery and electrolyte is dilute sulphuric acid. So when the battery is tested, fed and adjusted etc, wear safety device to avoid accident.

(3) The shell of charger is of metal conductor, therefore the reliable connection of grounding protection line of charger should be ensured to prevent the electric shock accident.

(4) Pulling out battery connectors should be avoided when charger is not turned off. Special care should be taken as this will make battery undercharged which produces dangerous electric spark.

4.5.5 Fault and troubleshooting

The causes that make the battery fault are various, except the 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.

Table 4-6 Fault and troubleshoot of battery

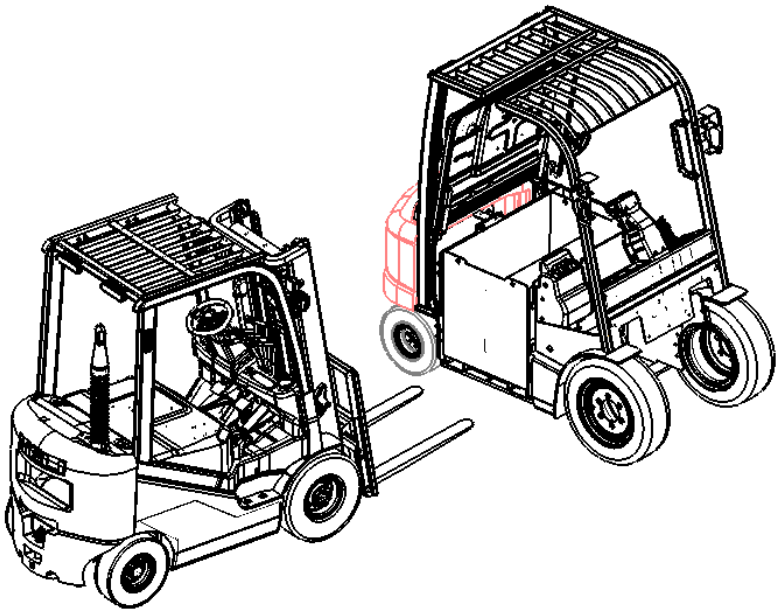
Fault	Characteristics	Causation	Repair measure
Pole plate sulfide	1) Decrease of the battery capacity. 2) Low density of the electrolytic (below the normal lever). 3) High battery voltage when beginning or finishing the	1) Inefficient first charging. 2) Inefficient charging for a long time. 3) Discharging for many times. 4) No timely charging after discharging.	1) Adopt the measure of balanced charging when the actuality is not severity. 2) Adopt the hydrotherapeutics when the actuality is

	charging. 4) Air bubble in the early time of charging or beginning. 5) High rising of the electrolytic temperature when charging.	5) High density of the electrolytic. 6) Low lever of electrolytic. 7) No timely balanced charging. 8) Too low or high discharging current. 9)Impure of the electrolytic. 10) Short inside or creepage.	severity. 3) Do not over discharging. 4) The density of the electrolytic should below the regular lever. 5) The lever of the electrolytic and content of the impurity should be in the prescribed range.
Inside short circuit	1) Low battery voltage or close to zero indeed when charging. 2) Few or no air bubble at the end of the charging. 3) High rising of electrolytic temperature or slow or no rising of electrolytic density. 4) Low battery voltage under the condition of open circuit or a quick drop to the limit value when discharging. 5)Serious self-discharging.	1) Curve pole plate; expanded reactive matter; desquamated reactive matter. 2) Much precipitate. 3) Falling of conductor to the battery.	1) Replace the plate. 2) Clean the precipitate and conductor. 3) Replace the plate.
Shedding off of the reactive matter	1) Decrease of the battery capacity. 2) Turbid electrolytic. 3) Much precipitate.	1) Being unsuitable to the electrolytic quality standard. 2) Frequent discharging and charging or over charging or discharging. 3)High electrolytic temperature when charging. 4) Outside short circuit when discharging.	1) Clean the precipitate when the actuality is not severity. 2) Discard when severity.

4.5.6 Introduction on battery side changing way

Traditional lifting method is standard for electric truck's battery changing and side changing way is optional for G series 1-3.5t truck. To be more specified, battery side changing ways include two ways, one is side-pull way and the other is side-lift way. For the side lift way, it means when changing battery, lift the battery with a forklift truck. We recommend the side lift way for 3-3.5t forklift truck because it is heavy. For the side pull way, it means when changing the battery, pull the battery to the transfer trolley and then change the battery. This way may be used for 1-2.5t forklift truck because the truck is light. Please refer the following information for details.

4.5.6.1 Side lift way for battery changing

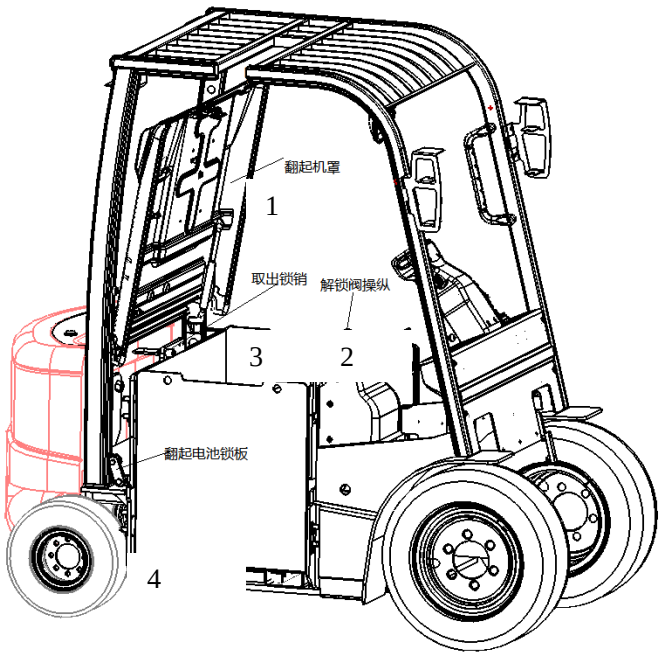


(1) Turn the key switch to off position and unlock the valve operation. Turn the bracket for valve operation upside down.

(2) Turn on the hood hook and open the hood. Disconnect the power plugs and sockets and remove the battery lock pin.

(3) Remove the plate and door on the right side of the truck.

(4) Remove the battery pre-tighten bar and turn the battery lock plate upside down.

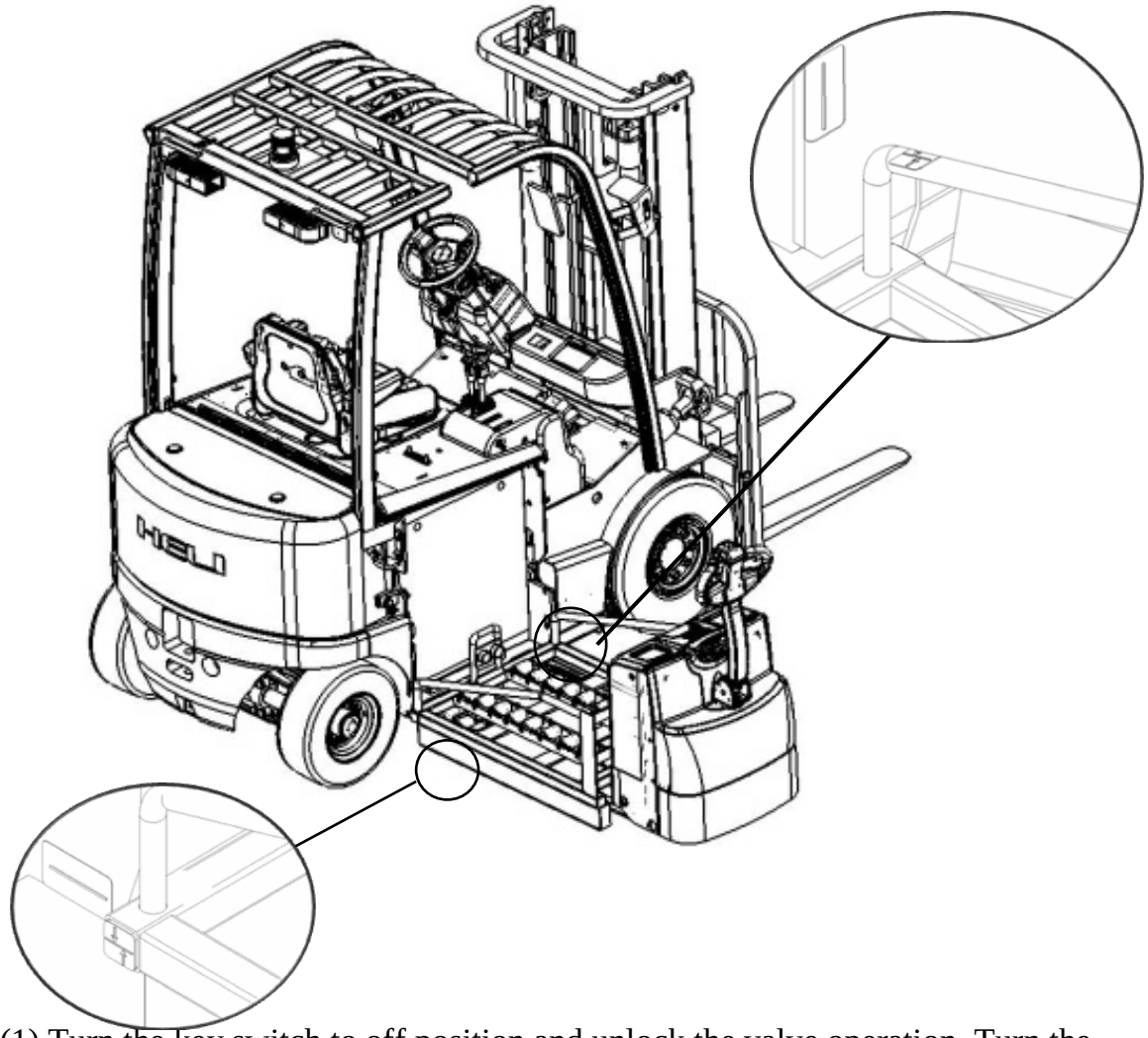


1. Open the hood 2. Unlock the valve operation
3. Remove the lock pin 4. Turn the battery lock plate

(5) Lift the battery with the other forklift truck to change the battery.

(6) Install the battery according to the procedures in reverse order.

4.5.6.2 Side pull way for battery changing

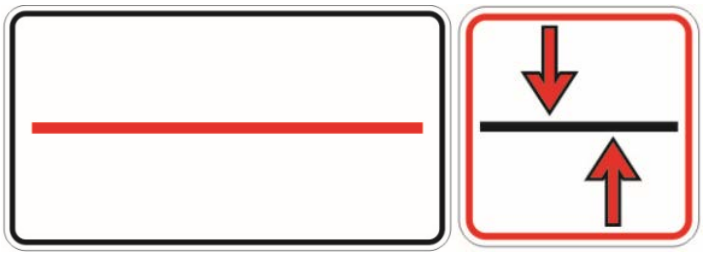


(1) Turn the key switch to off position and unlock the valve operation. Turn the bracket for valve operation upside down.

(2) Turn on the hood hook and open the hood. Disconnect the power plugs and sockets and remove the battery lock pin.

(3) Remove the plate and door on the right side of the truck.

(4) Remove the battery stop pin on the transport holder. Pick up the transport holder with pallet truck and make it be close to the truck body. Adjust the position of transport holder to make truck body to be aligned with the arrows on the transport holder and thus to make it to be centering with battery.

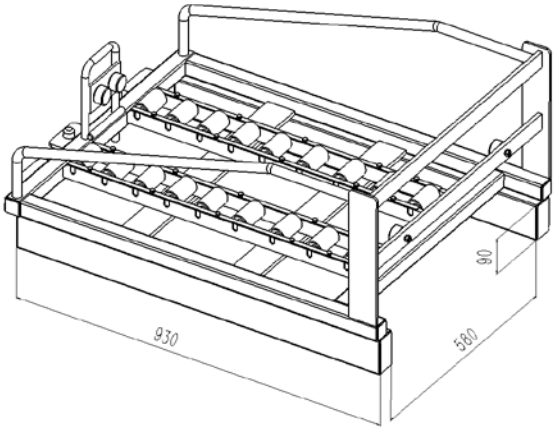


(5) Make the pillar on the transport holder be aligned with the round hole on truck and nylon piece contact with truck body.

(6) Remove the battery pre-tighten bar and turn the battery lock plate upside down. Pull the battery to the transport holder.

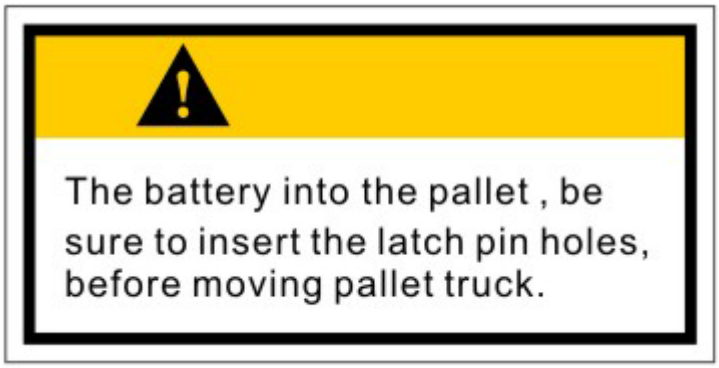
(7) Install battery stop pin on the transport holder, lower the pallet truck to make the pillar on the transport holder to be away from the round hole on the truck body. Back up to shift the pallet truck out.

(8) Install the battery according to the procedures in reverse order.



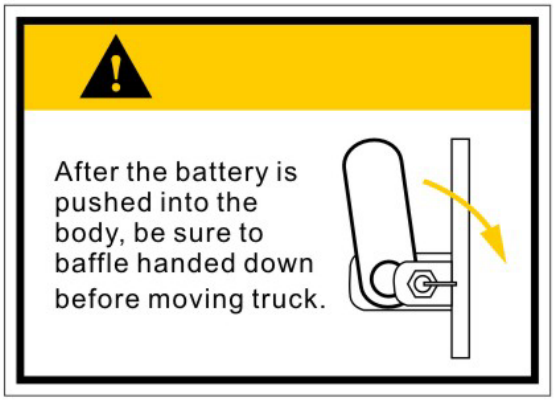
4.5.6.3 Notes

(1) When handling the battery with pallet truck, make sure the stop pin of the transport trolley is well installed.



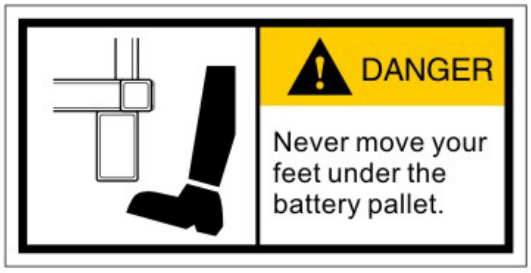
(2) When the battery is installed, make sure the battery lock plate is lowered and

the pre-tighten bar is well installed.



(3) when the battery is installed, make sure the battery lock pin is well installed.

(4) Never put your feet under the transport holder.



(5)If possible, please wear protective clothes and gloves.

(6)It is prohibited to knock the battery pole and wire clamp.

(7)Avoid strong shock during transporting.

(8) Recheck if the battery is well installed.

4.6 Daily Maintenance

(1) Check the wear condition of the contactor. Change it if necessary. Check the contactor every three months.

(2) 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.

(3) 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.

(4) 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.

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

Notice: After chopper is installed, raise the wheel of vehicle (off the ground) for test. In this way, there will be no danger even connection is wrong.

After electric lock switch is off, there is a certain voltage left in filter capacitor within a period of time. Cut off the battery power first if the inverter is repaired at this time and then connect the resistance of 10～100Ω to the positive and negative poles of inverter to make the voltage on the capacitor short-circuited.

4.7 Troubleshoot

4.7.1 CURTIS control system

This control system use serial mode to input the fault code of travel and pump controllers into the instrument and display on the instrument with the form of digital. “TRAVEL” indicates the travel controller and “HYD” indicates the pump controller.

(1) 1236/1238 series controllers

Table 4-7 Fault code and troubleshooting of 1236/1238 series controllers

Code	Programmer LCD display	Possible cause	Set/Clear conditions
12	Controller Overcurrent	External short of phase U, V or W motor connections.	Phase current exceeded the current measurement limit.
		Motor parameters are mis-tuned.	
		Controller defective.	
13	Current Sensor Fault	Leakage to vehicle frame from phase U, V or W (short in motor stator).	Controller current sensors hove invalid offset reading.
		Controller defective.	
14	Precharge Failed	External load on capacitor bank (B+	The voltage of

		connection terminal) that prevents the capacitor bank from charging.	capacitor is low.
15	Controller Severe Undertemp	The temperature of controller is lower than -40℃.	The temperature of controller is lower than -40℃.
		Controller defective.	
16	Controller Severe Overtemp	The temperature of controller exceed 95℃.	The temperature of controller exceed 95℃.
		Excessive load on vehicle.	
		Improper mounting of controller.	
17	Sever Undervoltage	The selection of controller's voltage parameter is wrong.	Capacitor voltage too low inside the controller.
		Overcurrent when start.	
		Battery resistance too high.	
		Battery disconnected while driving.	
		Battery fuse burn or main contact not actuation.	
18	Sever Overvoltage	The selection of controller's voltage parameter is wrong.	Controller's capacitor voltage too high.
		Battery resistance too high for given regen current.	
		Battery disconnected while regen braking.	
22	Controller Overtemp Cutback	Controller is operating in an extreme environment.	The temperature of controller exceed 85℃.
		Excessive load on vehicle.	
		Improper mounting of controller.	

23	Undervoltage Cutback	The batteries need recharging.	Controller's capacitor voltage low.
		The selection of controller's voltage parameter is wrong.	
		External oversize load lead to reduce the battery voltage.	
		Battery resistance too high.	
		Battery loosen.	
		Main contact get out of, fuse burn.	
24	Overvoltage Cutback	Battery voltage too high while regen braking.	Capacitor bank voltage exceeded the set value.
		The selection of controller's voltage parameter is wrong.	
		Battery resistance too high.	
		Battery disconnected while regen braking.	
25	5V Supply Failure	5V supply overload.	5V supply (pin 26) outside the 5V±10% range.
26	Digtial Out 6 Overcurrent	Digital Output 6 overcurrent.	Digital Output 6 (pin19) current exceeded 15mA.
27	Digtial Out 7 Overcurrent	Digital Output 7 overcurrent.	Digital Output 7 (pin20) current

			exceeded 15mA.
28	Motor Temp Hot Cutback	Motor temperature is too high. The parameter adjustment of temperature sensor is wrong.	Motor temperature is too high.
29	Motor Temp Sensor Fault	Motor temperature sensor is not connected properly. The parameter adjustment of temperature sensor is wrong.	Motor temperature sensor input (pin8) is at the voltage rail (0 or 10V).
31	Coil1 Driver Open/Short (Main Open/Short)	Open or short on driver load. Bad contact. Wiring error.	Check COIL1 for open or short.
32	Coil2 Driver Open/Short (EMBrake Open/Short)	Open or short on driver load. Bad contact. Wiring error.	Check COIL2 for open or short.
33	Coil3 Driver Open/Short	Open or short on driver load. Bad contact. Wiring error.	Check COIL3 for open or short.
34	Coil4 Driver Open/Short	Open or short on driver load. Bad contact. Wiring error.	Check COIL3 for open or short.
35	PD Open/Short	Open or short on driver load. Bad contact. Wiring error.	Check PD for open or short.
36	Encoder Fault	Motor encoder failure. Wiring error.	Check encoder for fault.
37	Motor Open	Motor phase is open. Bad crimps or faulty wiring.	Check motor phase U, V or W for open.

38	Main Contactor Welded	Main contactor welded. An alternate voltage path (such as external precharge resistor) is providing a current to the capacitor bank.	Check B+ or B- voltage of main contactor and controller.
39	Main Contactor Did Not Close	Main contactor did not close. Main contactor tips are oxidized. External load on capacitor bank that prevents capacitor bank from charging. Blown B+ fuse.	Check contactor and fuse.
41	Throttle Wiper High	Throttle pot wiper voltage too high.	Replace throttle 1.
42	Throttle Wiper Low	Throttle pot wiper voltage too low.	Bring throttle pot2 wiper (pin16) voltage above the fault threshold.
43	Pot2 Wiper High	Throttle pot2 wiper voltage too high.	Replace throttle 2.
44	Pot2 Wiper Low	Throttle pot2 wiper (pin17) voltage is lower than set value.	Bring throttle pot2 wiper (pin17) voltage above the fault threshold.
45	Pot Low Overcurrent	Pot low (pin18) current exceeds 10mA.	Check pot low.
46	EEPROM Failure	Modification controller parameter and	Modification controller

		cycle KSI.	parameter and cycle KSI.
47	HPD/Sequencing Fault	Throttle initial value >25% or applied in incorrect sequence.	Check F, R, interlock and throttle.
48	EMR REV HPD	After strike EMR, F, R, interlock and throttle don't return 0.	Check F, R, interlock and throttle.
49	Parameter Change Fault	Cycle KSI.	
51	CAN Communications Fault	CAN communications do not built, the instrument doesn't respond.	Check CAN communication
52	CAN PDO Timeout	CAN communications between instrument and controller is fault while travelling, the instrument doesn't respond.	Check CAN communication
53-67	OEM Fault	VCL running overtime.	
68	VCL Run Time Error		Modify VCL.
69	External Supply Out of Range	12V，5V supply output current out of range.	Check for power supply load.
71	OS General	Operating system error.	Cycle KSI.
72	PDO Timeout	CAN communication overtime.	Cycle KSI.
73	Stall Detected	Stalled motor.	Check brake.
		Velocity sensor failure.	Check encoder.
87	Motor Characterization Fault	Encoder failure.	Check encoder.
		Motor doesn't match under unloaded state.	Match again.
		Motor parameter out of the range of controller.	
89	Motor Type Fault	Motor type is out of OS system.	Select correct motor type, cycle KSI.
91	VCL/OS Mismatch	The VCL software in the controller doesn't match the OS software in the controller.	Download the correct VCL and OS software into the controller.
92	EM Brake Failed to Set	Vehicle movement sensed after the EM brake has been commanded to set.	Adjust the braking force of the EM brake.
93	Encoder LOS (Limited Operating Strategy)	Motor encoder failure.	Cycle KSI.
			Check encoder.
94	Emer Rev Timeout	EMR timeout timer has expired or EMR input is closed.	Cycle KSI again.
			Check EMR for close.
95	Illegal Model Number	The hardware in the controller doesn't match the software in the controller.	Replace controller.

(2) 1253 series controller

Table 4-8 Fault code and troubleshooting of 1253 series controllers

Code	Status LED	Description	Possible cause
LED OFF		No power or defective controller.	
Solid ON		Controller or microprocessor fault.	
0,1	■ ¤	Controller operational, no	

		known faults.	
1,1	¤ ¤	EEPROM fault.	1) EEPROM data lose or damaged. 2) EEPROM checksum error. Can be cleared via modify any parameter value in program menu of 1311.
1,2	¤ ¤¤	HW FAILSAFE	1) MOSFET shorted. 2) Motor connection is open.
1,3	¤ ¤¤¤	MOTOR SHORTED	Motor is shorted.
2,1	¤¤ ¤	UNDERVOLTAGE CUTOFF	Battery voltage < LOVLOT CUTOFF
2,2	¤¤ ¤¤	LIFT LOCKOUT	1) Controller received effective lift lockout signal. 2) SS LIFT LOCKOUT parameter is not set correctly.
2,3	¤¤ ¤¤¤	SEQUENCE ERROR (Statup lockout)	1) Improper sequence of throttle/SS input and KSI or interlock input. 2) Wrong startup lockout type selected. 3) Misadjusted throttle.
2,4	¤¤ ¤¤¤¤	THROTTLE FAULT	1) Throttle wire open/short. 2) Defective throttle. 3) Wrong throttle type selected.
3,1	¤¤¤ ¤	CONT DRVR OC	Contactor coil shorted.
3,2	¤¤¤ ¤¤	MAIN CONT WELEDE	1) Main contactor is welded. 2) “CONTACT CNTRL” setting is not correct. 3) Main contactor driver shorted.
3,3	¤¤¤ ¤¤¤	PRECHARGE FAULT	1) Precharge circuit failure. 2) External short or leakage between B+ and B-.
3,4	¤¤¤ ¤¤¤¤	MAIN CONT DNC	1) Main contactor coil connection loose. 2) Main contactor did not close. 3) CONTACT CNTRL parameter not correct.
4,1	¤¤¤¤ ¤	LOW BATTERY VOLTAGE	1) Battery voltage < LOVOLT CUTBACK. 2) Corroded battery terminal. 3) Loose battery or controller terminal.
4,2	¤¤¤¤ ¤¤	OVER VOLTAGE	1) Battery voltage > overvoltage shutdown limit. 2) Operation with charger attached.
4,3	¤¤¤¤ ¤¤¤	THERMAL CUTBACK	1) Temp > 85℃ or < -25℃. 2) Excessive load on pump motor. 3) Improper mounting of controller. 4) Working in extreme environment. 5) Thermistor failure.

4.7.2 ZAPI control system

4.7.2.1 ZAPI AC2/ACE2 controller

(1) Common fault of travelling system (The second line of instrument indicates “ON NODE 2”)

Table 4-9 Common fault of travelling system of AC2/ACE2

Fault Code	Implication	Note	Measures
13	EEPROM KO	EEPROM damaged	The fault is in the internal memory for storing and regulating parameters. When the fault appears, the machine automatically stops. If the fault still exists, when reconnecting it after switching off the electric lock, change the controller. If the fault disappears, the parameters previously stored will be replaced with default value.
17	LOGIC FAILURE #3	Logic card failure 3	Current protection function failure of logic card: change the controller.
18	LOGIC FAILURE #2	Logic card failure 2	Circuit failure of phase voltage feedback hardware on logic card. Change the controller.
19	LOGIC FAILURE #1	Logic card failure 1	The failure produced when the function of low or over voltage acts. In 24V system, the voltage detected by controller exceeds 45V or lower than 9V. In 48V system, the voltage detected by controller exceeds 65V or lower than 11V. Possible causes: (1) Check if there is short circuit in the electric circuit system such as DC-DC and brake coils etc or if the input power supply contact of controller is good. (2) If the battery voltage is excessively low or high. (3) Check B+ and B and see if the power cable on the wiring terminal of contactor etc is tightly fixed. (4) If the voltage calibration parameter of controller is in consistent with actual voltage. (5) There is circuit fault of overvoltage protection hardware on logic card, change the controller.
30	VMN LOW	Low VMN	Cause：The high-end voltage of MOS during startup is 66% smaller than the capacitor voltage or this voltage is smaller than the required value in the operation of motor. Possible causes: (1) Wiring of motor is incorrect or there is circuit problem in motor. Check if three-phase connection of motor is correct, if there is any leakage of electricity on ground and circuit break of motor coil. (2) If actuation of main contactor is rigid and if there is any wearing on contact? (3) Change the controller .
31	VMN HIGH	High VMN	Cause：During startup, the low-end voltage of MOS tube is 10% higher than that of normal battery voltage or the phase voltage is higher than 1/2 of battery voltage. Possible cause： (1) The wiring of motor is incorrect or there exists problem in motor circuit . Check if three-phase connection of motor is correct, if there is any leakage of electricity on the ground and circuit break of motor coil. (2) Change the controller
37	CONTACTOR CLOSED	Adhesion of contactor	When the coil of main contactor is closed, the controller should first check if the contact of main contactor is adhered. Try to discharge the capacitance. If the capacitance voltage is reduced by 20% of the battery

			voltage, the fault possibly appears. (1) Suggest to check if the contact of contactor is adhered or change the contactor.
38	CONTACTOR OPEN	Contactor open	Logic card drives the coil of main contactor, but the contactor does not close, possible causes: (1) Mechanical fault and locking etc of contactor. (2) Poor contact of contactor. (3) If contactor works normally, change the controller.
53	STBY I HIGH	High standby current	The signal output by current sensor detected by micro-control system exceeds the scope allowed for non-operation current. The trouble has nothing to do with the peripheral parts, so the controller needs to be changed.
60	CAPACITOR CHARGE	Wrong capacitance charge	When the electric lock is switch on, inverter will charge the capacitance through power resistance and check if capacitance is fully charged within the time stipulated, otherwise, the capacitance voltage remains 20% lower than battery voltage, the inverter will give alarm and the main contactor will not close. Possible causes： (1) Peripheral equipment, e.g. DC-DC, motor or other equipment etc interfere with the charging process of controller and these interferences need to be eliminated. (2) The charging resistance is disconnected, there is fault on charging circuit and power module ,so controller needs to be changed.

62	TEMPERAURE	Over-high temperature	In case that total power is allowed, the temperature of controller exceeds 85℃(it relates to the parameter " MAXIMUM CURRENT".) Their corresponding relations are as follows: Parameter set alarm temperature MAXIMUM CURRENT=50% 96℃ MAXIMUM CURRENT=60% 94℃ MAXIMUM CURRENT=70% 92℃ MAXIMUM CURRENT=80% 90℃ MAXIMUM CURRENT=90% 88℃ MAXIMUM CURRENT=100% 86℃ Now, the max. current of controller decreases with the increase of the max. current temperature. When the temperature is 105℃, the current of controller decreases to zero. The fault appears if chopper is in the cold state: (1) Temperature calibration parameter of logic card is incorrect, check parameters. (2) The internal temperature sensor of controller has trouble and change the controller.
65	MOTOR TEMPERAT.	High motor temperature	If temperature digital switch of motor is turned on or analog signal exceeds the cutoff value, the trouble is produced. When the motor temperature reaches 120℃, the controller gives alarm, the vehicle can move at this time.

			But the max. current and performance are cut down. When the motor temperature reaches 125℃, motor stops working. Now try to lower the temperature of the motor. If the fault still exists when motor is cooled, check the circuit and change the controller if he circuit is OK.
66	BATTERY LOW	Low capacity of battery	If parameter of "BATTERY CHECK" for battery test is not set as 0 and when charging capacity of battery is lower than 15% and there is no grid on instrument, fault alarm is given and the lifting function is locked, now charge it timely. In case the battery has electricity, check if the value of parameter "ADJUST BATTERY" of controller is consistent with battery voltage.
74	DRIVER SHORTED	Short circuit of driver	When electric lock is close, the microprocessor will detect if driver of main contactor is short-circuited and alarm will be given if yes. Check if there is short circuit on the positive pair A 16 of main contactor coil or negative pole. Change the controller if everything is OK.
75	CONTACTOR DRIVER	Fault of contactor driver	The coil of main contactor can not be normally driven and change the controller if the coil of main contactor has no fault.

78	VACC NOT OK	Accelerator error	Detection time : Standby state The alarm indicates the voltage of accelerator is 1V larger than the min. value set in the signal scope （PROGRAM VACC）of accelerator. Possible causes： (1) The upper and lower voltage limit values of accelerator have not been collected and do it again when entering into PROGRAM VACC. (2) Accelerator error: Accelerator pedal possibly fails to return or internal error of accelerator. (3) The failure of controller
79	INCORRECT START	Incorrect starting sequence	Possible causes for incorrect starting sequence: (1) Direction switch is closed before starting. (2)Incorrect operation sequence. (3)Incorrect wire joining. (4)If the trouble still can not be eliminated, change the controller.
80	FORW+BACK	Forward and backward signals exist at the same time(adhesion of direction switch)	The machine will keep on detecting. But when there are signals requesting operation from two directions at the same time, alarm is given. Possible causes: (1) The wire is damaged. (2) Direction switch fault. (3)Improper operation. (4) Change the controller if the trouble still can not be eliminated.
82	ENCODER ERROR	Encoder error	The controller detects the great difference between two consecutive speed readings of encoder. As the encoder in the system can not change great speed within very short

			time, so, the encoder may have the trouble (the circuits of one or two encoders are destroyed or broken). Check the mechanical and circuit function of the encoder. The alarm is possibly caused by the electromagnetic noise on the bearing of sensor. If not, change the controller.
220	PROG VACC NOT OK	Programming error of accelerator	If “2.5 POT” is set as “ON”, controller will check the max. and min values of potentiometer recorded during programming. If the min. value of forward is smaller than the max. value of backward or the min. value of backward is bigger than the max. value of forward, the fault will appear. Check if the potentiometer is correct, or make a data acquisition again.
222	WAITING FOR NODE	Waiting for node signal	In CAN communication network, a controller receives a signal that the other controller can not make normal communication and the controller always is always in the waiting state until CAN communication network is completely normal. Check why the wiring of the modules that fails to communicate is abnormal and see if the software edition or parameter setting is correct.

223	WATCHDOG #1	Watchdog fault 1	During startup, watchdog circuit is activated before software is started. The watchdog signal is invalid in standby or operation state(alarm state) Fault analysis：Hardware circuit of watchdog or output of micro-controller is damaged. The above two cases have nothing to do with external parts, so change the controller.
224	COIL SHORTED EF	Short circuit of auxiliary coil	When the electromagnetic brake connecting to the output terminal of CNA#18IS or auxiliary coil is shorted, the fault signal is produced. Withdraw from the fault state through releasing brake after eliminating the overload condition so that the running request is valid. Fault analysis：Generally, the fault code indicates that the trouble is on the harness or loading coil. So check the connection between controller output and load first. If there is no trouble of external load, the trouble is inside the controller and the controller needs to be changed.
227	WATCHDOG #2	Watchdog fault 2	Cause：During startup, the watchdog circuit is activated before software is started. The watchdog signal is invalid (alarm state)in case of standby or operation state. Fault analysis: The hardware circuit of watchdog or output of micro-controller is damaged. The above two cases has nothing to do with external parts, so change the controller.
228	TILLER OPEN	TILLE off	When tiller input switch is off, about 30S later, the main contactor will be off and warning is given. The warning disappears for next operation.
229	SAFETY INPUT	Safety Input fault	When the safety input switch is off, so is the main contactor, meanwhile the electromagnetic brake or auxiliary output coil is driven. Check if the port of A11 is correctly connected. Change the controller if other parts are correct.

230	COIL SHORTED MC	Coil short circuit of main contactor	CAUSE: When the short circuit coil of main contactor is connected to the output port of CAN#16, the fault signal is produced. After overload is removed, it automatically withdraw from fault state through releasing brake and then the running instruction is valid. Fault analysis：Generally, the fault code indicates that the trouble is on the harness or loading coil. So check the connection between controller output and load first. If there is no trouble of external load, the trouble is inside the controller and the controller needs to be changed.
231	COIL SHORTED HW KO	Fault of coil protection circuit	Short circuit fault of the coil protection circuit used to drive main contactor, electromagnetic brake or auxiliary devices Fault analysis: Change the controller

232	KEYOFF SHORTED	Short circuit of key switch	At start-up stage, if controller detects that there is low logic level signal when key switch is off, there is a fault. Fault analysis: Most possibly is that the voltage is excessively low, suggest to check the followings : (1) If the key switch is based on external load (e.g. the starting of DC-DC converter, the input signal of relay or contactor switch is lower than starting voltage). (2) Check the positive and negative poles of power cable and cell end and the connection between –BATT and +BATT of main contactor and controller. It must be connected with screw and the torsion scope is 13NM~15NM.. (3) If no voltage drop has been detected on the power supply line, the fault signal is produced every time when the key switch is on. The fault may be possibly in the hardware of the controller; therefore, the controller needs to be changed.
233	POWER MOS SHORTED	Short circuit of power MOS	Software will check the power bridge before main contactor is closed: It converts into low-end power of MOS and the phase voltage value drops to –BATT (rise to +BATT). If the change of phase voltage value does not conform to the instruction, this fault signal is produced. Change the controller.
235	HANDBRAKE	Fault of handbrake switch	Handbrake input signal is valid when the running instruction is issued. Resolution：Possible causes for the fault : (1) Handbrake switch is damaged or wiring is wrong. (2) Handbrake switch works normally. In TESTER menu, handbrake is always ON. This is a logic fault, so change the controller.
236	CURRENT GAIN	Fault of current gain	The maximum current gain parameter is a factory set value, which indicates that the max. current regulating parameter program has not be used. Resolution: Correctly set program for current gain parameter by ZAPI technical personnel.
237	ANALOG INPUT	Fault of Analog Input	The fault signal is produced when A/D of all analog signals is converted into a fixed value and delay exceeds

			400 millisecond. This function is used to check the fault of A/D converter or analog signal conversion. Fault analysis: Change the controller if the fault always exists.
238	WRONG ZERO VOLTAGE	Wrong Zero Voltage	During startup, the feedback value of high end voltage of VMN is not at about 2.5V. The circuit of controller is damaged. Fault analysis : The following checks are suggested: (1) Internal connection of motor. (2) Power cable connection of motor. (3) Drain current between motor and vehicle casing. (4) If the motor connection is good, the problem is inside the controller and changes it.

239	SAFETY OUTPUT	Failure of safety output	Driver short circuit of safety output. Fault analysis: Check if there is short circuit or Low impedance push-pull output betweenA19 and -BATT. If it is the circuit trouble of driver of logic card, change the controller.
240	HARDWARE FAULT	Hardware circuit fault	Before driving the coil of main contactor, controller tests MOS driver or the auxiliary output drive is the invalid watchdog circuit signal. If it is not driven, there produces a fault signal. Fault analysis: Change the controller.
241	FLASH CHECKSUM	Flash Memory fault	When key is switched on, the program is a positive value in flash memory and the fault signal is produced in case of negative value. Fault analysis: The problem is on flash memory of microcontroller. The flash memory may be damaged or the program stored destroyed. Try to reset the program of logic card. The fault exists in the microcontroller if the fault still exists, Change the controller.
242	ENCODER LOCKED	Feedback signal fault of encoder	Under normal condition， if the target speed is greater than10 Hz and the rotation speed of motor higher than 1.5 Hz, the feedback signal of encoder checked by controller should exceed a threshold value. If not, the controller will give alarm. Test the motor encoder and see if motor or wiring is normal and if installation correct. Change the controller if periphery is normal.
243	SENS MOT TEMP KO	Fault of temperature sensor	Phenomenon：The output signal of temperature sensor of motor exceeds the scope. Solution: Check the value of sensor and connection of wires and the fault is inside the controller in case of no problem found.
244	SOFTWARE ERROR	Software error	During software testing, there are many reasons for such fault such as: CAN communication fault and EEPROM READ/WRITE ERROR etc. Check the parameter of “DEBUG MODE”, the value must be “OFF”.
245	WRONG RAM MEMORY	Dynamic memory fault	Wrong contents are found when testing the main memory: The registration address is “DIRTY” and the fault will restrict the operability of vehicle.

			Fault analysis: Switch on the key after switching it off and change the controller if the trouble still exists.
246	AUX DRIVER OPEN	Auxiliary output drive fault	Auxiliary coil drive circuit can not drive load. The equipment or drive coil is damaged. Change the controller.
247	DATA ACQUISITION	Data acquisition	The fault will be hinted when calibrating the current gain. No treatment is needed and it will automatically disappear when calibration is finished.
248	NO CAN MESSAGE	NO CAN signal	CAN communication fault between pump and traction. Check CAN wiring, software setting and edition information.
249	CHECK UP NEED	Service time	It is the time for service and maintenance is needed.

250	THERMIC SENS KO	Temperature sensor fault	The output signal of temperature sensor of controller exceeds the range. The fault has nothing to do with external parts and change the controller.
251	WRONG SET BATTERY	Wrong set of battery	During startup, the controller tests if the voltage of battery is within the nominal scope. Check if the value of BATTERY VOLTAGE parameter in the menu conforms to that on the voltmeter. If not, make them conform to each other with the function of ADJUST BATTERY. Change the battery.
253	SLIP PROFILE	Slip fault	Wrong selection of SLIP PROFILE PARAMETERS. Check the setting of these values in the hardware setting parameters.
254	AUX DRIVER SHORTED	Auxiliary drive shorted	Short circuit of the driving electric circuit of the electromagnetic brake or auxiliary electric brake. Check if there is short circuit between the A16 and BATT. Circuit ault of the drive unit of the logic card; change the controller.

(2) Common fault of pump control system (The second line of instrument indicates “ON NODE 5”)

Table 4-10 Common fault of pump control system

Fault Code	Implication	Note	Measures
13	EEPROM KO	EEPROM damaged	The fault is in the internal memory for storing and regulating parameters. When the fault appears, the machine automatically stops. If the fault still exists, when reconnecting it after switching off the electric lock, change the controller. If the fault disappears, the parameters previously stored will be replaced with default value.
17	LOGIC FAILURE #3	Logic card failure 3	Current protection function failure of logic card: change the controller.
18	LOGIC FAILURE #2	Logic card failure 2	Circuit failure of phase voltage feedback hardware on logic card. Change the controller.

19	LOGIC FAILURE #1	Logic card failure 1	The failure produced when the function of low or over voltage acts. In 24V system, the voltage detected by controller exceeds 45V or lower than 9V. In 48V system, the voltage detected by controller exceeds 65V or lower than 11V. Possible causes: (1) Check if there is short circuit in the electric circuit system such as DC-DC and brake coils etc or if the input power supply contact of controller is good. (2) If the battery voltage is excessively low or high. (3) Check B+ and B and see if the power cable on the wiring terminal of contactor etc is tightly fixed. (4) If the voltage calibration parameter of controller is in consistent with actual voltage. (5) There is circuit fault of overvoltage protection hardware on logic card, change the controller.
30	VMN LOW	Low VMN	Cause：The high-end voltage of MOS during startup is 66% smaller than the capacitor voltage or this voltage is smaller than the required value in the operation of motor. Possible causes: (1) Wiring of motor is incorrect or there is circuit problem in motor. Check if three-phase connection of motor is correct, if there is any leakage of electricity on ground and circuit break of motor coil. (2) If actuation of main contactor is rigid and if there is any wearing on contact? (3) Change the controller .
31	VMN HIGH	High VMN	Cause：During startup, the low-end voltage of MOS tube is 10% higher than that of normal battery voltage or the phase voltage is higher than 1/2 of battery voltage. Possible cause： (1) The wiring of motor is incorrect or there exists problem in motor circuit . Check if three-phase connection of motor is correct, if there is any leakage of electricity on the ground and circuit break of motor coil. (2) Change the controller
53	STBY I HIGH	High standby current	The signal output by current sensor detected by micro-control system exceeds the scope allowed for non-operation current. The trouble has nothing to do with the peripheral parts, so the controller needs to be changed.
60	CAPACITOR CHARGE	Wrong capacitance charge	When the electric lock is switch on, inverter will charge the capacitance through power resistance and check if capacitance is fully charged within the time stipulated, otherwise, the capacitance voltage remains 20% lower than battery voltage, the inverter will give alarm and the main contactor will not close. Possible causes： (1) Peripheral equipment, e.g. DC-DC, motor or other equipment etc interfere with the charging process of controller and these interferences need to be eliminated. (2) The charging resistance is disconnected, there is fault on charging circuit and power module ,so controller needs to be changed.

62	TEMPERAURE	Over-high temperature	In case that total power is allowed, the temperature of controller exceeds 85℃(it relates to the parameter " MAXIMUM CURRENT".) Their corresponding relations are as follows: Parameter set alarm temperature MAXIMUM CURRENT=50% 96℃ MAXIMUM CURRENT=60% 94℃ MAXIMUM CURRENT=70% 92℃ MAXIMUM CURRENT=80% 90℃ MAXIMUM CURRENT=90% 88℃ MAXIMUM CURRENT=100% 86℃ Now, the max. current of controller decreases with the increase of the max. current temperature. When the temperature is 105℃, the current of controller decreases to zero. The fault appears if chopper is in the cold state: (1) Temperature calibration parameter of logic card is incorrect, check parameters. (2) The internal temperature sensor of controller has trouble and change the controller.
65	MOTOR TEMPERAT.	High motor temperature	If temperature digital switch of motor is turned on or analog signal exceeds the cutoff value, the trouble is produced. When the motor temperature reaches 120℃, the controller gives alarm, the vehicle can move at this time. But the max. current and performance are cut down. When the motor temperature reaches 125℃, motor stops working. Now try to lower the temperature of the motor. If the fault still exists when motor is cooled, check the circuit and change the controller if he circuit is OK.
74	DRIVER SHORTED	Short circuit of driver	When electric lock is close, the microprocessor will detect if driver of main contactor is short-circuited and alarm will be given if yes. Check if there is short circuit on the positive pair A 16 of main contactor coil or negative pole. Change the controller if everything is OK.
78	VACC NOT OK	Accelerator error	Detection time : Standby state The alarm indicates the voltage of accelerator is 1V larger than the min. value set in the signal scope （PROGRAM VACC）of accelerator. Possible causes： (1) The upper and lower voltage limit values of accelerator have not been collected and do it again when entering into PROGRAM VACC. (2) Accelerator error: Accelerator pedal possibly fails to return or internal error of accelerator. (3) The failure of controller
79	INCORRECT START	Incorrect starting sequence	Possible causes for incorrect starting sequence: (1) Direction switch is closed before starting. (2)Incorrect operation sequence. (3)Incorrect wire joining. (4)If the trouble still can not be eliminated, change the controller.

82	ENCODER ERROR	Encoder error	The controller detects the great difference between two consecutive speed readings of encoder. As the encoder in the system can not change great speed within very short time, so, the encoder may have the trouble (the circuits of one or two encoders are destroyed or broken). Check the mechanical and circuit function of the encoder. The alarm is possibly caused by the electromagnetic noise on the bearing of sensor. If not, change the controller.
221	SEAT MISMATCH	Seat switch signal fault	If the parameter of the "SAFE OUT CONFIG" is 1, the fault may occur. If the traction seat switch signal is different from the pump controller sear switch signal, the fault may occur. Check the seat switch connecting.
222	WAITING FOR NODE	Waiting for node signal	In CAN communication network, a controller receives a signal that the other controller can not make normal communication and the controller always is always in the waiting state until CAN communication network is completely normal. Check why the wiring of the modules that fails to communicate is abnormal and see if the software edition or parameter setting is correct.
223	WATCHDOG #1	Watchdog fault 1	During startup, watchdog circuit is activated before software is started. The watchdog signal is invalid in standby or operation state(alarm state) Fault analysis：Hardware circuit of watchdog or output of micro-controller is damaged. The above two cases have nothing to do with external parts, so change the controller.
227	WATCHDOG #2	Watchdog fault 2	Cause：During startup, the watchdog circuit is activated before software is started. The watchdog signal is invalid (alarm state)in case of standby or operation state. Fault analysis: The hardware circuit of watchdog or output of micro-controller is damaged. The above two cases has nothing to do with external parts, so change the controller.
229	SAFETY INPUT	Safety Input fault	When the safety input switch is off, so is the main contactor, meanwhile the electromagnetic brake or auxiliary output coil is driven. Check if the port of A11 is correctly connected. Change the controller if other parts are correct.
232	KEYOFF SHORTED	Short circuit of key switch	At start-up stage, if controller detects that there is low logic level signal when key switch is off, there is a fault. Fault analysis: Most possibly is that the voltage is excessively low, suggest to check the followings : (1) If the key switch is based on external load (e.g. the starting of DC-DC converter, the input signal of relay or contactor switch is lower than starting voltage). (2) Check the positive and negative poles of power cable and cell end and the connection between –BATT and +BATT of main contactor and controller. It must be connected with screw and the torsion scope is 13NM~15NM.. (3) If no voltage drop has been detected on the power supply line, the fault signal is produced every time when the key switch is on. The fault may be possibly in the hardware of the controller; therefore, the controller needs

			to be changed.
233	POWER MOS SHORTED	Short circuit of power MOS	Software will check the power bridge before main contactor is closed: It converts into low-end power of MOS and the phase voltage value drops to –BATT (rise to +BATT). If the change of phase voltage value does not conform to the instruction, this fault signal is produced. Change the controller.
237	ANALOG INPUT	Fault of Analog Input	The fault signal is produced when A/D of all analog signals is converted into a fixed value and delay exceeds 400 millisecond. This function is used to check the fault of A/D converter or analog signal conversion. Fault analysis: Change the controller if the fault always exists.
238	WRONG ZERO VOLTAGE	Wrong Zero Voltage	During startup, the feedback value of high end voltage of VMN is not at about 2.5V. The circuit of controller is damaged. Fault analysis : The following checks are suggested: (1) Internal connection of motor. (2) Power cable connection of motor. (3) Drain current between motor and vehicle casing. (4) If the motor connection is good, the problem is inside the controller and changes it.
239	SAFETY OUTPUT	Failure of safety output	Driver short circuit of safety output. Fault analysis: Check if there is short circuit or Low impedance push-pull output betweenA19 and -BATT. If it is the circuit trouble of driver of logic card, change the controller.
240	HARDWARE FAULT	Hardware circuit fault	Before driving the coil of main contactor, controller tests MOS driver or the auxiliary output drive is the invalid watchdog circuit signal. If it is not driven, there produces a fault signal. Fault analysis: Change the controller.
241	FLASH CHECKSUM	Flash Memory fault	When key is switched on, the program is a positive value in flash memory and the fault signal is produced in case of negative value. Fault analysis: The problem is on flash memory of microcontroller. The flash memory may be damaged or the program stored destroyed. Try to reset the program of logic card. The fault exists in the microcontroller if the fault still exists, Change the controller.
242	ENCODER LOCKED	Feedback signal fault of encoder	Under normal condition， if the target speed is greater than10 Hz and the rotation speed of motor higher than 1.5 Hz, the feedback signal of encoder checked by controller should exceed a threshold value. If not, the controller will give alarm. Test the motor encoder and see if motor or wiring is normal and if installation correct. Change the controller if periphery is normal.
243	SENS MOT TEMP KO	Fault of temperature sensor	Phenomenon：The output signal of temperature sensor of motor exceeds the scope. Solution: Check the value of sensor and connection of wires and the fault is inside the controller in case of no problem found.

244	SOFTWARE ERROR	Software error	During software testing, there are many reasons for such fault such as: CAN communication fault and EEPROM READ/WRITE ERROR etc. Check the parameter of “DEBUG MODE”, the value must be “OFF”.
245	WRONG RAM MEMORY	Dynamic memory fault	Wrong contents are found when testing the main memory: The registration address is “DIRTY” and the fault will restrict the operability of vehicle. Fault analysis: Switch on the key after switching it off and change the controller if the trouble still exists.
247	DATA ACQUISITION	Data acquisition	The fault will be hinted when calibrating the current gain. No treatment is needed and it will automatically disappear when calibration is finished.
248	NO CAN MESSAGE	NO CAN signal	CAN communication fault between pump and traction. Check CAN wiring, software setting and edition information.
249	CHECK UP NEED	Service time	It is the time for service and maintenance is needed.
250	THERMIC SENS KO	Temperature sensor fault	The output signal of temperature sensor of controller exceeds the range. The fault has nothing to do with external parts and change the controller.
251	WRONG SET BATTERY	Wrong set of battery	During startup, the controller tests if the voltage of battery is within the nominal scope. Check if the value of BATTERY VOLTAGE parameter in the menu conforms to that on the voltmeter. If not, make them conform to each other with the function of ADJUST BATTERY. Change the battery.
253	SLIP PROFILE	Slip fault	Wrong selection of SLIP PROFILE PARAMETERS. Check the setting of these values in the hardware setting parameters.

4.7.2.2 ZAPI HP-CAN controller

(1) Common fault of control system (The second line of instrument indicates “ON NODE 5”)

Table 4-11 Common fault of control system

CODE	NOTE
13	EEPROM KO
241	CAN BUS KO
243	KEYOFF
244	WATCHDOG
76	COIL SHORTED
74	DRIVER SHORTED
53	STANDBY HIGH CURRENT
30	VMN LOW
49	CURRENT ALWAYS EQUAL 0
33	FULL CONDUCTION KO
78	VACC NO OK
62	THERMIC SENSOR KO
66	BATTERY LOW

79	INCORRECT START
7	CHOPPER NOT CONFIG
242	BATTERY OVERVOLTAGE
246	WAIT MAIN CONTAC

(2) Fault explain of HP-CAN controller

a) <WATCHDOG>

It is the self diagnosis of logic card and real time test is carried out during running and when standby; if it has fault, change the logic card.

b) < INCORRECT START>

The fault is caused by incorrect start sequence and it is kind of safety protection of controller.

Possible causes:

- valve control switch is stuck or the wire is incorrectly connected.

c) < VMN LOW>

The check is carried out when the truck is standby. If the voltage between battery negative pole and M terminal of pump controller is lower than 1/3 of the battery voltage, the fault occurs.

Possible causes:

- Motor incorrect connection;
- Controller is damaged and it needs to be replaced;

d) < FULL CONDUCTION KO >

The controller checks the input voltage of M terminal under full connected condition. If it is higher than 1/3 of the battery voltage, the controller stops work and the fault occurs. If the fault occurs, change the logic card.

e) < VACC NOT OK >

The controller checks the output voltage of speed governing sensor when standby. If the output voltage is 1v higher than min. voltage storing in PROGRAM VACC, the fault

occurs.

Possible causes:

- The speed governing sensor has fault; (change)
- The wire of speed governing sensor is incorrectly connected; (the C2 terminal of controller does not connect.)
- The set value in PROGRAM VACC is incorrect.

f) < STANDBY HIGH CURRENT >

The controller checks if the pump motor current is 0 when standby; if it is not 0, controller stops working and the fault occurs.

Possible causes：

- The logic card inside of the controller has fault; (change the logic card)
- The current sensor inside of the controller has fault. (change controller)

g) < DRIVER SHORTED >

The controller checks if the contactor's driving voltage is the same with the set value when standby. If they are not the same, fault occurs.

Possible causes:

- logic card is damaged. (Contactor coil discharge or drive unit loop has fault, change the logic card.)

h) < COIL SHORTED >

Contactor drive output is overloaded or is short circuit with battery positive pole.

Possible causes:

- Contactor coil has short circuit or contactor coil current is higher than 6A.
- Contactor coil wires have short circuit with battery positive pole and driver overload protection is caused.
- Contactor connection fault or logic card fault.

i) < CHOP NO CONF. >

Parameters memory such as working mode, function set and so on of memory controller has fault. if the fault still exist after close electric lock repeatedly, change the logic card; if the fault disappear, the memorized parameters has changed, reset the parameters.

(3) Common fault for ZAPI instrument system (The second line of instrument indicates "ON NODE 16"）

Table 4-12 Common fault for instrument system

Fault Code	Implication	Note	Measures
13	EEPROM KO	EEPROM damaged.	Trouble is in the internal memory to store and regulate the parameters. Machine will automatically stops in case of trouble. The controller should be changed if the trouble still exists after reconnection when the electric lock is turned off. If the trouble disappears, the parameters stored before will be replaced with default value.
18	LOGIC FAILURE #2	Logic card failure 2	Circuit failure of A19 or A20 output port，change the instrument if it has nothing to do with external components.
76	COIL SHORT	Coil short	Drive coil short circuit: Test if there is short circuit on the device connecting with output port of the instrument, otherwise, change the instrument.
102	CAN BUS KO MASTER	CAN communication failure	Instrument no longer receives the data from CAN BUS data wire. In case that the fault code and other alarm signal are displayed together, the fault may possibly be on the CAN interface of the instrument, because the instrument can not receive any message. So, suggest to check the wiring and connection of CAN , or the CAN interface fault of other modules will appear in the CAN network.
103	SERVICE REQUIRED	Maintenance is Needed.	It is the time for maintenance (service).
104	HYDRAULIC OIL		The input of hydraulic oil level is valid during startup. Trouble Diagnosis： Check if the related digital input on instrument （A9）is valid（Refer to TESTER MENU） Check the effective level form（+VB or GND） of the input end (Refer to SET OPTION MENU). (1) If the input is valid, check the relating switch, circuit and oil level. (2) If the input is invalid, there might have an input circuit trouble in the intelligent instrument.

4.7.3 INMOTION control system

Table 4-13 INMOTION controller fault code and troubleshooting

Fault code	Fault	Remedy
20	ERROR: Acceleration pedal is activated when starts.	Release acceleration pedal
21	ERROR: Direction switch is activated when starts.	Shift direction switch to neutral gear
22	ERROR: front and rear direction switches are activated at the same time.	direction switch failure
23	ERROR acceleration pedal analog quality exceeds range	Acceleration pedal fault or recalibrate analog quality
24	ERROR: acceleration pedal analog failure	
31	ERROR : CAN communication of driver failure	Check CAN bus or controller; Or Instrument is disconnected.
32	ERROR: Low battery voltage	Charging is needed.
34	ERROR: CPU inner failure	It is suggested to change hardware test.
36	ERROR: Tilt switch is activated when starts.	Restore tilt switch.
37	ERROR: Side shift is activated when starts.	Restore side shift switch.
38	ERROR : Attachment switch is activated when starts.	Restore attachment switch.
39	ERROR: Lifting switch is activated when starts.	Restore lifting switch.
40	ERROR: lifting analog quantity exceeds range.	Lifting analog quantity is damaged or recalibrate analog quality
43	ERROR: steering angle analog quantity exceeds range.	steering angle analog quantity is damaged or recalibrate analog quality
44	WARNING of traction driver speed protection	Alarm of high truck speed
45	WARNING: fault of traction driver encoder	Check if encoder harness is poor connected.
81	WARNING: low traction driver temperature	Over low environment temperature
82	WARNING: high traction driver temperature	Traction driver temperature is over high and its power is limited.
83	ERROR: traction driver temperature sensor failure	Change driver
84	WARNING: low traction motor temperature	Over low environment temperature
85	WARNING: high traction motor temperature	Traction motor temperature is over high and its power is limited.
86	ERROR: traction motor temperature sensor failure	Traction motor temperature sensor is abnormal and please check sensor or harness.
87	ERROR: traction motor speed sensor failure	Traction motor speed encoder is abnormal and please check encoder or harness.
88	WARNING: high traction driver DC bus voltage	The input voltage connected to driver is detected to be over high.
89	WARNING: low traction driver DC bus voltage	Charge the battery or check power harness.
90	WARNIN: traction driver default value is loaded.	Safe protection after refreshing procedures. it will be ok after restart the key switch.
91	WARNING : traction driver performance limiting mode	Low battery quantity and truck performance is limited.

97	ERROR: traction driver output port failure.	Check if the output port harness is short circuit or open circuit(such as main contactor, backward relay and so on).
98	WARNING： traction driver over current or short circuit	Check power harness
101	ERROR: traction motor driver short circuit	
102	ERROR: high traction driver temperature	Cool driver
103	ERRO: high traction motor temperature	Cool motor
104	ERROR: traction driver over current	Check power harness
105	ERROR: overtime of traction driver precharging	Change precharging resistance
110	ERROR: low traction driver DC bus voltage	Driver input voltage is overlow, please check battery voltage or check if contactor is connected.
111	ERROR: high traction driver DC bus voltage	driver input voltage is overhigh, please check battery voltage.
112	ERROR: high traction driver DC bus voltage(hardware monitor)	
114	ERROR: interior power supply failure	Check motor encoder and temperature sensor harness
121	WARNING: low pump driver temperature	Overlow environment temperature
122	WARNING: high pump driver temperature	Pump driver temperature is high and its power is limited.
123	ERROR pump driver temperature sensor failure	Change driver
124	WARNING: low pump motor temperature	Overlow environment temperature
125	WARNING: high pump motor temperature	Pump motor temperature is overhigh and its power is limited.
126	ERROR: pump motor temperature sensor failure	Pump motor temperature sensor is abnormal and please check sensor or harness.
127	ERROR: pump driver speed sensor failure	Pump motor speed encoder is abnormal and check encoder or harness.
128	WARNING: pump driver DC bus voltage is high.	The input voltage connected to driver is detected to be overhigh.
129	WARNING: pump driver DC bus voltage is low.	Charge or check the power harness.
130	WARNING: pump default value is loaded.	Safe protection after refreshing procedure and it will be ok after restart the key.
132	WARNING : pump driver performance is limited.	Battery quantity is low and charge the battery.
137	ERROR: pump driver output port failure	Check if output port harness has short circuit or open circuit.
138	WARNING: pump driver over current or short circuit.	Check power harness.
141	ERROR: pump drive short circuit	
142	ERROR: pump driver temperature is high.	Cool driver.
143	ERROR: high pump motor temperature.	Cool motor.
144	ERROR: pump driver current calibrating failure	Restart.
145	ERROR pump driver precharging overtime	Change precharging resistance.
150	ERROR: pump driver DC bus voltage low.	Driver input voltage is overlow and check

		battery voltage or check if contactor is connected.
151	ERROR: pump driver DC bus voltage high.	Driver input voltage is overhigh and check battery voltage.
152	ERROR pump driver DC bus voltage high (hardware monitor)	
153	ERROR pump driver interior fault.	Check motor encoder and temperature sensor harness.
154	ERROR: pump driver speed control failure.	Check encoder or harness.

4.7.4 Songzheng control system

Table 4-14 Songzheng controller fault code and troubleshooting

No.	fault phenomenon	Fault name	Fault reasons	Remedy
1	1. contactor disconnected immediately after it is closed. 2 fault codes 3-7 alarm.	Open circuit of motor phase line	There is more than one phase line is unconnected.	1.Connect the phase line correctly. 2.Turn on the key switch.
2	1.Main contactor is disconnected. 2. Fault codes 3-1alarm.	open circuit or short circuit of main contactor coil	DRV1 short circuit or DRV1open circuit	1.connect DRV1 coil; 2.restart the interlock switch
3	1. Main contactor does not connected. 2. Fault codes3-8 alarm in 2 seconds.	main contactor sticks	main contactor sticks	1.change main contactor 2. restart the interlock switch
4	1. Main contactor does not connected. 2. Fault codes1-4 alarm in 2 seconds.	precharging fault	Precharging failure	1.Make sure B+ 、B-connection is correct. 2. restart the interlock switch
5	1.controller output failure; 2. Fault codes 4-7alarm.	High foot pedal	Turn off key switch, preset direction or oil throttle is less than 25%.	Neutral gear and oil throttle is no more than 25%.
6	1.Limut the max. current of the controller in proportion; 2.fault codes 2-3 alarm.	Under voltage	Battery voltage≤ allocated under voltage ±2V	Battery voltage >(allocated under voltage+2V)±2V
7	1 Controller output failure 2.fault codes 1-7 alarm.	Severe under voltage	battery voltage≤ serious under voltage under voltage value ±2V (note: serious under voltage value=allocated voltage	Battery voltage >(serious under voltage+2V)±2V

			value+ battery voltage power extraction range)	
8	1.Limut the max. current of the controller in proportion; 2.fault codes 2-4alarm.	Over voltage	Battery voltage ≥ allocated over voltage ±2V	Battery voltage<allocated over voltage +2V)±2V
9	1 Controller output failure 2.fault codes 1-8alarm.	Serious over voltage	Battery voltage≥ serious over voltage±2V (note: serious over voltage=allocated over voltage +10V）	1. battery voltage <serious over voltage ±2V. 2. restart the key.
10	1.Limut the max. current of the controller in proportion; 2.fault codes 2-8alarm.	Motor over temperature	Motor temperature ≥motor over temperature value	Motor temperature<motor over temperature value
11	1.Limut the output of controller to be 50% of its max. 2.fault codes 2-9alarm.	Motor temperature sensor fault	Motor temperature sensor is unconnected or its output forms short circuit to earth.	Connect the motor temperature sensor correctly.
12	1 Controller output failure 2.fault codes 1-5alarm.	Controller temperature is over low.	Controller temperature ≤-40℃	1.controller temperature >-40℃； 2.restart the key
13	1.Limut the max. current of the controller in proportion; 2.fault codes 2-2 alarm.	controller temperature over high	Controller temperature ≥85℃	Controller temperature <85±℃
14	1 Controller output failure 2.fault codes 1-6alarm.	Controller temperature over high	Controller temperature ≥95℃	1.controller temperature <95℃； 2.restart the key
15	Fault codes 2-5,6-9 alarm.	External 5V fault External power supply over loaded	External +5Vvoltage <4.5V or >5.5V External power output current<allocated min. current value or >allocated max. current value.	External +5V voltage ≥4.5V and ≤5.5V. External power output current≥allocated min. current value and ≤allocated max. current value.

16	1. Accelerator equivalent output is 0. 2. fault codes 4-1 alarm.	Accelerator output is high.	Accelerator is disconnected or accelerator output voltage ≥5.5V.	Connect the accelerator correctly.
17	1. oil throttle equivalent output is full brake value. 2. Fault codes 4-3 alarm。	Brake output is high.	Brake is disconnected or output ≥5.5V	Connect the brake correctly.
18	1. oil throttle equivalent output is 0. 2. brake equivalent output full brake value. 3. fault codes 4-5 alarm.	Accelerator over current	Accelerator or brake low end current is too large (100mA)	Connect the accelerator or brake correctly
19	1 Controller output failure 2.fault codes 4-6 alarm.	EEPROM write failure	1. Correct data can not be written into EEPROM. 2. The data written in is out of range.	1. Make sure hardware is connected correctly. 2. Write correct data. 3. restart the key.
20	1. controller operates with default parameter; 2. Fault codes 4-8 alarm.	EEPROM read failure.	1. It is unable to read correct date from EEPROM. 2. The read data is out of the range.	1. Make sure hardware is connected correctly. 2. Write correct data.
21	1 Controller output failure 2. Fault codes 4-9 alarm.	Important parameter modification fault	Upper computer modified important parameter after the contactor is closed.	Restart the key.
22	1 Controller output failure 2. Fault codes 1-2alarm.	Controller over current	Controller output phase current ＞700A	Restart the key.
23	1 Controller output failure 2. Fault codes 1-1 alarm.	DSP configuration parameter fault.	Fault occurs when allocating DSP parameter.	Restart the key.
24	1 Controller output failure 2. Fault codes 2-1 alarm.	MCU and DSP CAN Transmit-receive fault	Communication fault between MCU and DSP	Restart the key.

Note:

1. The truck will travel with the defaulted setting (economic mode) when the signals of the three modes (powerful mode/economic mode/slow speed mode) of the traction system are transmitted to the controller at the same time or they are not transmitted to the controller at the same time.

2. The truck will travel with the limited speed when the steering signal device is ineffective.

5 Hydraulic System

5.1 General Description

The hydraulic system consists of oil pump, control valve, lift cylinder, tilt cylinder, high & low pressure oil pipe an joint etc.. The pump is driven directly by the electromotor. The hydraulic oil flow to control valve through the pump and are distribute to cylinders by the control valve.

5.1.1 Oil pump

The main parts of the gear oil pump for forklift are a pair of external gears mutually meshed and their working principle is as shown in Fig. 5-1.

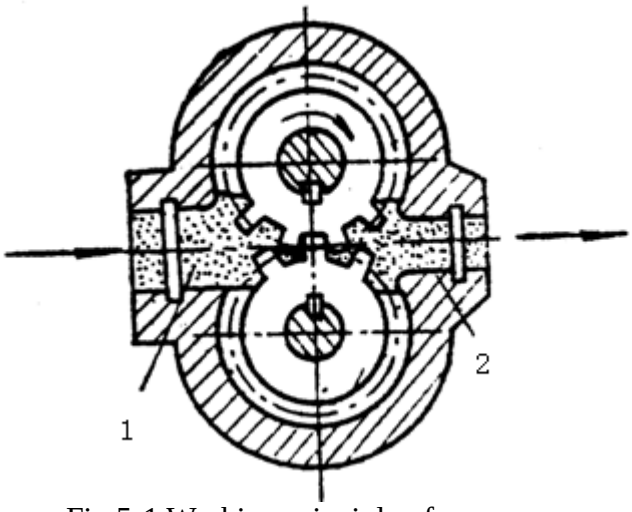


Fig 5-1 Working principle of gear pump
(1) Oil suction cavity (2) Oil pressing cavity

A pair of meshed involute gear is mounted inside the housing, the two end face of gear seals and gear separate the pump housing into two sealing oil cavities as shown 1 and 2 in the Fig. When the gear of gear pump rotates in the direction shown in the Fig, the volume of space shown by 1 (engaging part for gear disengagement) changes from small to big and forms vacuum. The oil in the oil tank enters into oil suction cavity under the action of atmospheric pressure to fill the intertooth space through the oil suction pipe of pump. While 2 indicates that the volume of space (engaging part for gear entering)

changes from big to small and press the oil into pressure oil circuit, i.e.1 is oil suction cavity, 2 is oil pressing cavity and they are separated by meshing point of two gears. With constant rotation of gear, the suction and discharge outlets of the pump continuously absorb and drain oil.

Oil pump is to turn the mechanical energy of motor into hydraulic energy, so the oil pump is the actuating unit of hydraulic system of the forklift.

The main pump consists mainly of a pump body, a pair of gears, lining plates and oil seals. This pump uses pressure-balance type bearings and a special lubrication method so as to minimum the clearance of the gear face. (See Fig. 5-2)

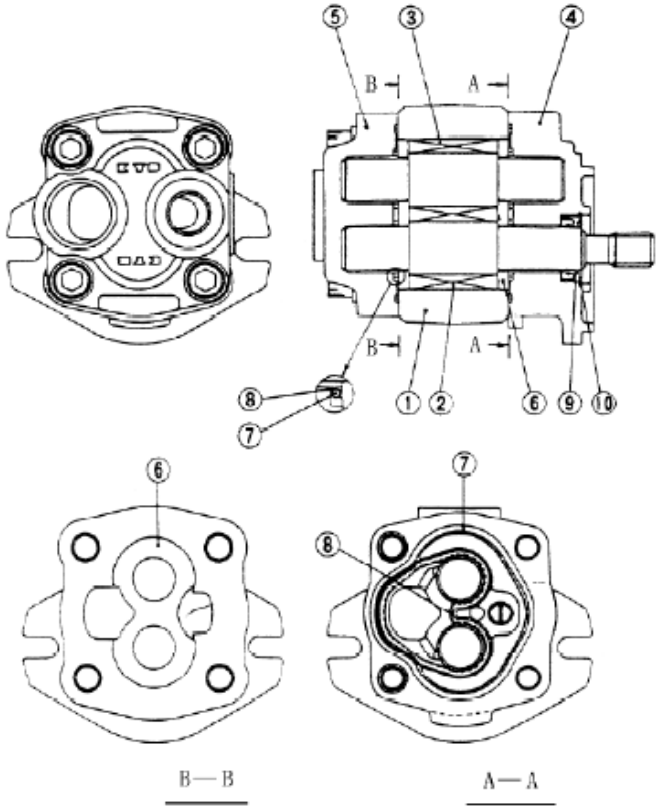


Fig. 5-2 Main pump

(1) Pump body (2) Driving gear (3) Driven gear (4) Front cover (5) Rear cover
(6) Lining plate (7) Seal ring (8) Ring (9) Oil seal (10) Snap ring

5.1.2 Control Valve

The external of the control valve as shown in Fig. 5-3.

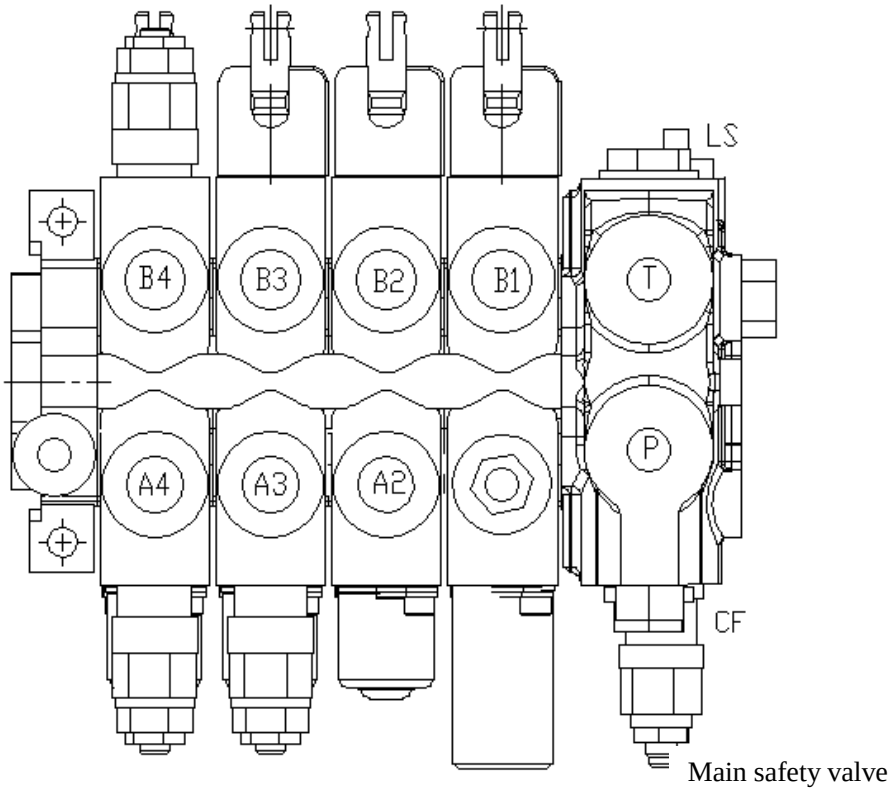


Fig. 5-3 Control valve

The control valve adopts two pieces and four body type. The hydraulic oil from working pump distributes the high-pressure oil to the lifting cylinder or tilting cylinder through the control of valve stem. There are safety relief and tilt-locking valves inside the control valve. The safety relief valve is at the top of oil inlet of control valve to control the pressure of the system. The tilt-locking valve is on the tilt valve block and is mainly used to prevent the serious consequence due to wrong operation of control rod when the tilt cylinder has no pressure source. The check valve is mounted between oil inlet and inlet port of lifting valve block and between oil inlets of lifting and tilt valve blocks.

(1) Spool operation (take the tilt spool valve for example)

a) Neutral position (See Fig. 5-4)

The high-pressure oil from lift pump returns to the oil tank through the mid-passage.

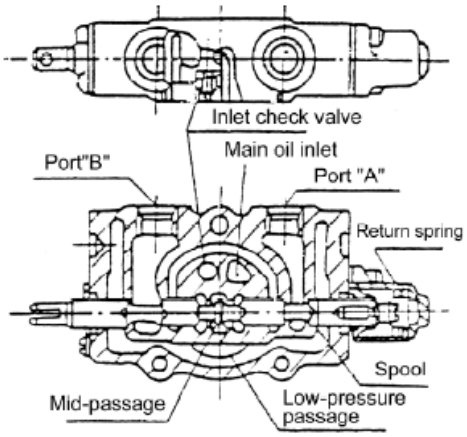


Fig. 5-4 Neutral position

b) Pushing-in of spool (See Fig. 5-5)

In this time, the spool is pushed in to close the mid-passage. This causes the oil from the main oil-inlet to push up the inlet check valve and to flow into the port “B”. The return oil from the port “A” flows through the low-pressure passage to the tank and the spool is restored to its neutral position by the return spring.

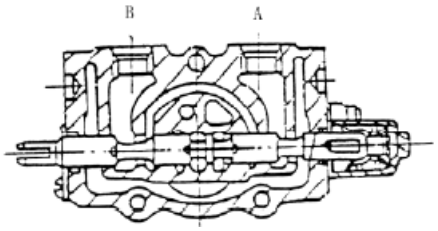


Fig. 5-5 Push in spool

c) Drawing-out of spool (See Fig. 5-6)

With the mid-passage closed, the oil from the main oil-inlet pushes up the check valve and flows into the port “A”. The return oil from the port “B” flows through the low-pressure passage to the tank. The spool can be restored to its neutral position by return spring.

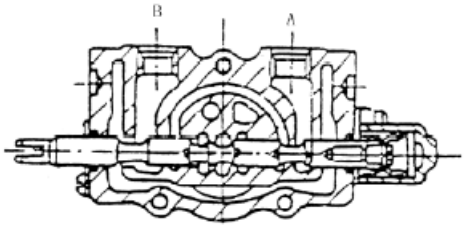


Fig. 5-6 Draw out spool

(2) Motion of safety relief valve

The relief valve is mounted between “HP” nozzle of oil pump and “LP” passage. Oil passing through lifting valve C acts on different areas of diameters “A” and “B”, thus, “K” of check valve and “D” of overflow lift valve are on the valve seat as shown in Fig. 5-7.

When the pressure regulated in “HP” passage of oil pump acts on the spring of pilot valve, the check valve “E” will open. The oil flows into “LP” side through holes around the valve as shown in Fig. 5-8.

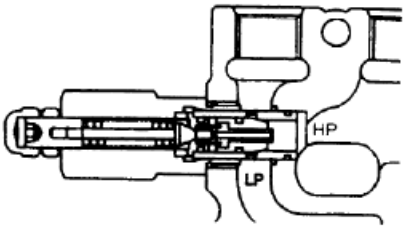


Fig. 5-7

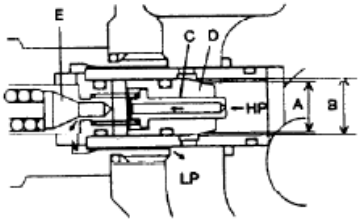


Fig. 5-8

Once the pilot valve “E” opens, the pressure inside valve “C ” will drop, valve “E” and valve “C” are on the valve seat. The liquid flowing to the rear of the valve “D” will be closed, so the pressure inside will be decreased. (See Fig. 5-9)

The “HP” passage pressure and inside pressure of oil pump are not even, the valve “D” opens with the action of pressure difference and oil directly flows into the low pressure circuit “LP”. (Refer to Fig. 5-10).

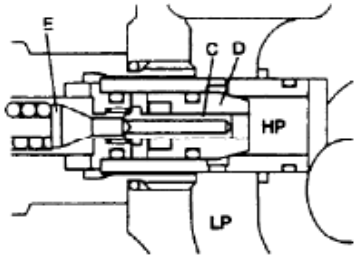


Fig. 5-9

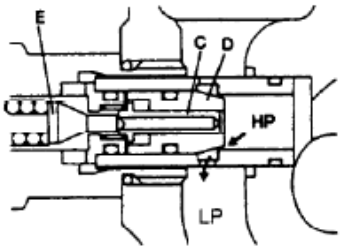


Fig. 5-10

(3) Action of tilt-lock valve

Tilt spool valve housing contains a tilt-lock valve. The tilt lock valve is intended to prevent vibrations of the mast resulting from the negative pressure in the tilt cylinder and also to avoid danger incurred from mishandling of the spool. When the lift motor isn't running, the mast doesn't be tilted forward by push the tilt lever.

See Fig. 5-11, when the spool is pushed in. See Fig. 5-12, when the lift motor stops.

a) The spool is pushed in

The pressure oil flows through the port "B" to tilt cylinder and moves the tilt-lock valve to let the port "A" connect with the low-pressure tank. The tilt cylinder and the mast is tilted forward.

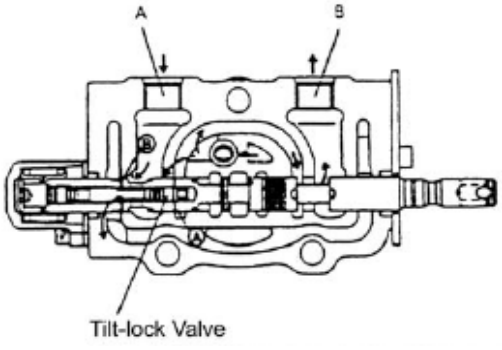


Fig. 5-11

b) The spool is pushed in (when the lift motor stops)

When the lift motor stops, no pressure oil flows to the tilt-lock valve. The port "A" can't connect with the low-pressure tank and the mast doesn't be tilted forward.

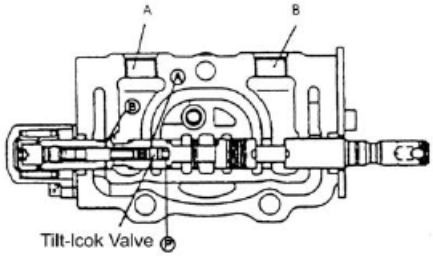


Fig. 5-12

(4) Operation of the control valve

The control valve is operated with the valve levers. All valve levers are assembled

together with a shaft and the shaft is assembled on the valve joint plate with the bracket. The valve levers operate the control valve with the joints. (See Fig. 5-13)

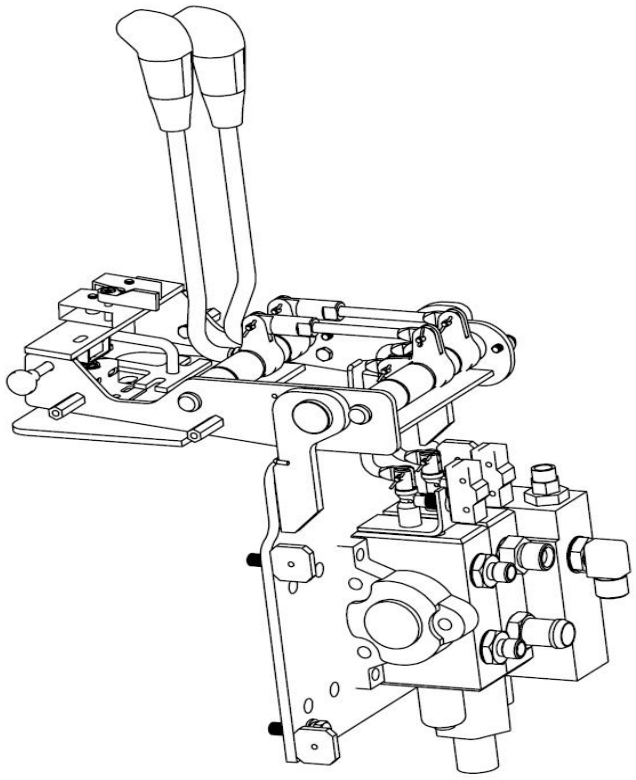
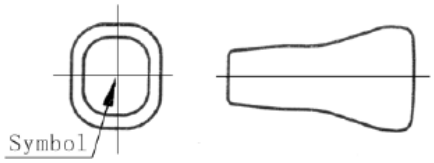


Fig. 5-13 Operation of the control valve

As you see in Fig. 5-14, the mast lift up when you push the lift lever forward, the mast fall down when you pull the lift lever backward. The mast tilt forward when you push the tilt lever forward, the mast tilt backward when you pull the tilt lever backward.



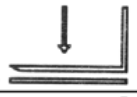
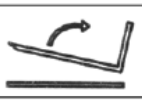
No.	Symbol	Name
1		Lift or Fall
		
2		Tilt Forward or Backward
		

Fig. 5-14 The symbol on the operation lever

(5) Setting pressure of the control valve (See Fig. 5-15)

The pressure of the safety valve shall not be adjusted by non-professional personnel. The adjustment shall follow following procedures:

a) Screw off the plug of the measuring hole on the inlet of the control valve. Install an oil pressure gauge capable of measuring 25MPa.

b) Operate tilting lever and measure the pressure at the end of the cylinder stroke.

c) If the oil pressure is different with the specified value, loosen the locking nut of the relief valve and turn the adjusting screw left and right until the pressure reaching the specified value. Turn left when the pressure is high and turn right when the pressure is low.

d) Tighten the nut after adjusting.

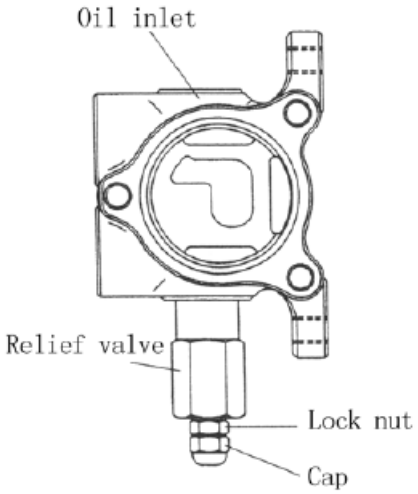


Fig. 5-15

5.1.3 Lift cylinder

The lift cylinder is of single-acting piston type. It consists of cylinder body, piston, piston rod, cylinder cap, cut-off valve and oil seals. The cylinder head is equipped with bushing and oil seal and the bushing supports the piston rod and the oil seal keeps dust off. (See Fig. 5-16)

When the hoist valve of control valve is placed at lifting position, hydraulic oil

enters into the lower part of piston of hydraulic cylinder from pressure-gradient control valve to selector valve to push rising of piston and lifting of the goods. When the hoist valve of control valve is placed at descending position, the piston rod drops with the action of goods, mast, fork bracket and piston itself, the hydraulic oil is pressed back to oil tank. If the cut-off valve is mounted at the bottom of cylinder (See Fig. 5-17), it can play the role of protection if the mast rises when high-pressure pipe cracks.

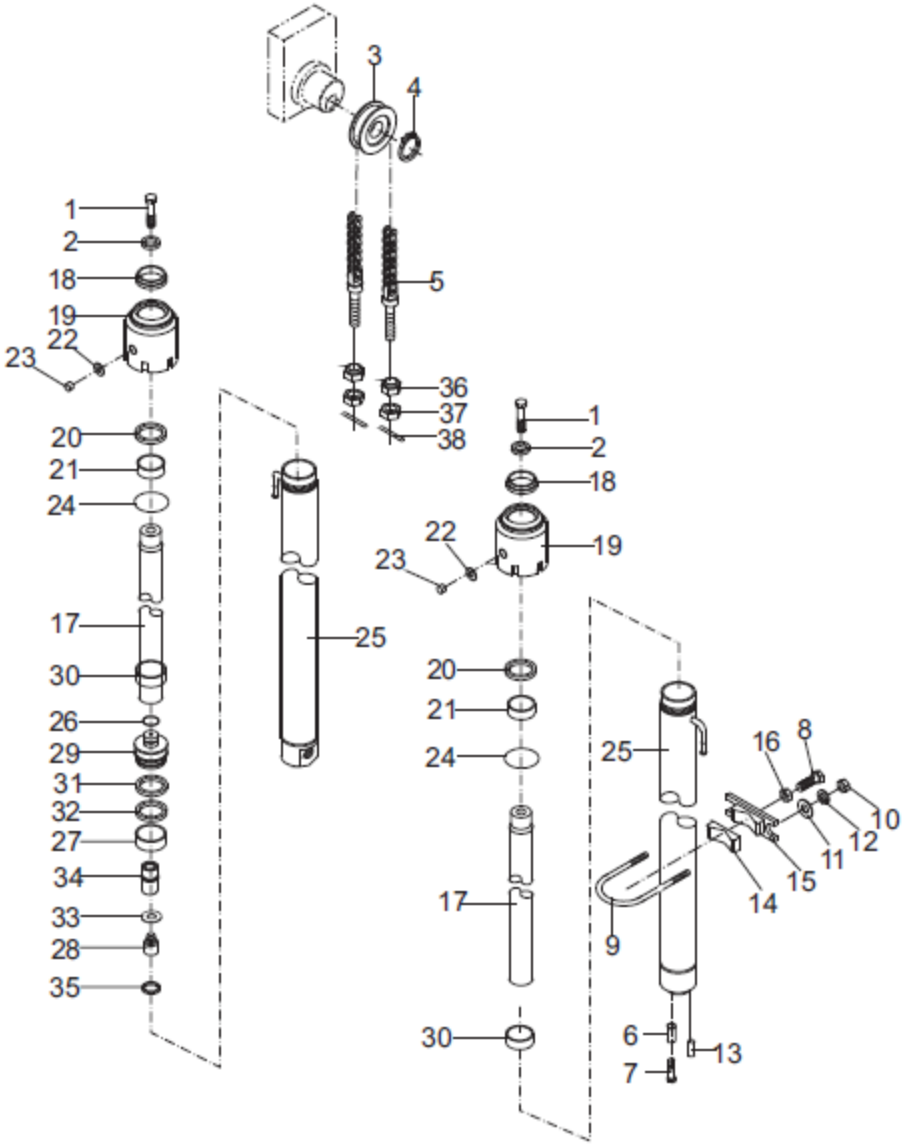


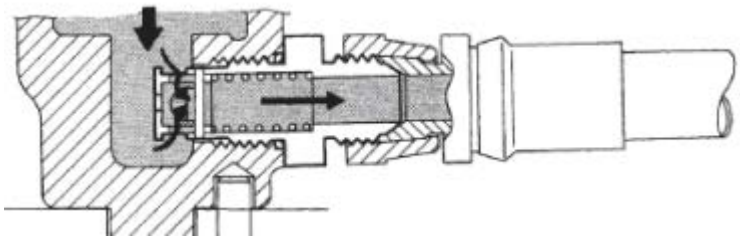
Fig. 5-16 Lift cylinder

1. Bolt M16×1.5×40 2.washer 16 3.chain wheel 4. Snap ring 40
5. Chain wheel assembly 6.spacer bush 7. Bolt M12×1.25×25
8. Bolt M12×1.25×50 9.U type bolt 10.Nut M10×1.25 11.waher 10

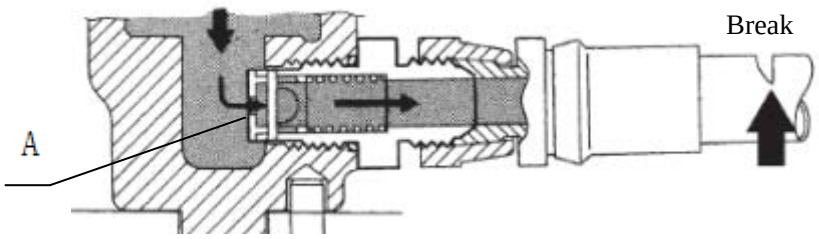
12.washer 10　13. Pin B10×26　14. Adjusting block　15.Oil cylinder support block
16. Nut M12×1.25　17.Piston rod　18.dust proof ring 40×52×7/10　19.guide sleeve
20. Seal ring 40×50×6　21. Steel-backed bearing 4030　22.Shim　23. Screw M5×6
24. O ring d49.7×2.4　25. Cylinder body　26. Steel cable baffle ring
27.support ring 50×10×2.5　28. Valve assembly 29. Piston
30. Adjusting sleeve ϕ48×40.5　31.retaining plate 50×40×3
32.seal ring for hole 50×40×6　33.shim　34.sleeve 35.steel-cable baffle ring for hole
36.Spherical nut　37. Nut M14×1.5　38. Pin 3.2×30

5.1.4 Cut-off valve

The cutoff valve is mounted at the bottom of the hoist cylinder (See Fig. 5-17) to prevent the goods from falling suddenly when the high pressure pipe is broken. The oil from hoist cylinder passes through the hole A on the outer circumference of the spool when returning to oil tank, if flow rate of oil through the hole is less than the setting value of the valve and the pressure difference before and after spool smaller than spring force, the spool will not move at this time and slide valve does not work. If the flow rate through the spool hole exceeds the setting value due to high pressure pipe cracking or other reasons, the pressure difference before and after spool will be larger than the spring force and move the spool to the left. In this way, hole A is closed, only small amount of oil flows out from the small clearance of spool and valve bush and the goods descends slowly.



Flow less than the setting valve



Flow more than the setting valve

Fig. 5-17 Working principle of the cut-off valve

5.1.5 Flow regulator valve

The flow regulator valve, located in the lift cylinder circuit to limit the descending speed of loaded forks, has the construction as shown in Fig. 5-18.

When the lift spool is placed in the “lift” position, the oil from the control valve flows through the oil chambers A and B, oil holes C, D, E and F, and the chamber G to the lift cylinder without any regulation. When the lift spool is placed in the “down” position, the oil pusses the orifice plate and a pressure difference generates between the chambers A and B, the pressure difference overcomes the force of the spring and moves the valve core right, thus the oil flow being decreased by narrowing of the hole D and C, and reduces the oil flow passing through the orifice plate.

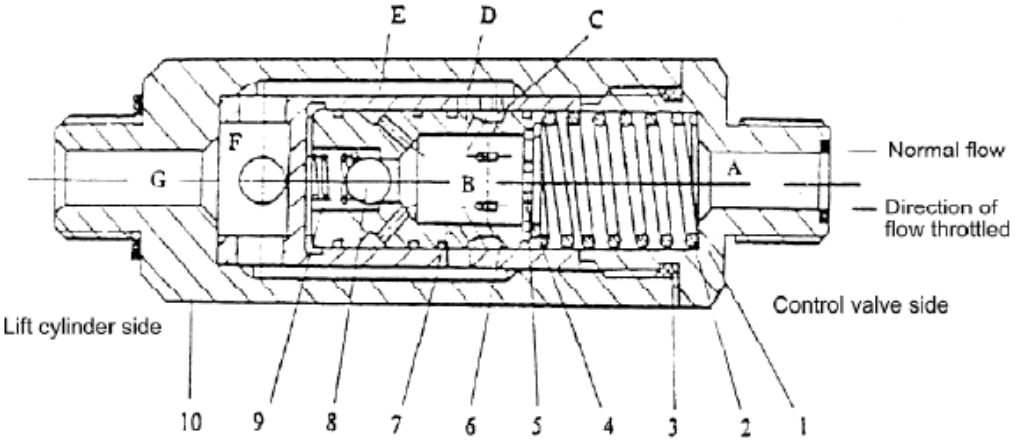


Fig. 5-18 Flow regulator valve

(1) Nipple (2) Spring (3) Ring seal (4) Snap ring (5) Spool (6) Sleeve (7) Steel ball (8) Spring of the check valve (9) Valve body

5.1.6 Tilt cylinder

The tilt cylinder is of double-action and piston type hydraulic cylinder and is mounted at both sides of mast with its piston rod end connecting with mast. The bottom of tilt cylinder is connected through dowel with connecting end of frame and mast and the forward and backward tilting of the mast are fulfilled by the motion of tilt cylinder.

The tilt cylinder consists primarily of piston, piston rod, cylinder body, cylinder base, guide sleeve and seals. The piston, welded to the piston rod, is fitted with two Yx-rings and one wear ring on its circumference. A bushing press-fitted to the inner side of the guide sleeve supports the piston rod. The guide sleeve is with dust seal, snap ring, Yx-ring and O-ring to prevent oil leakage and keep dust off. Fitted with them, the guide sleeve is screwed into the cylinder body. When piston moves, oil enters from one port and exits from the other. The piston rod is furnished with adjusting threads to adjust the difference between the dip angles. (See Fig. 5-19)

When the tilt lever is pushed forward, the high-pressure oil enters into the cylinder body from the cylinder tail, moving the piston forward and causing the mast assembly to tilt forward until 6 degrees. When the tilt lever is pulled backward, high-pressure oil enters into the cylinder body from the guide sleeve and moves the piston backward, tilting the mast assembly backward.

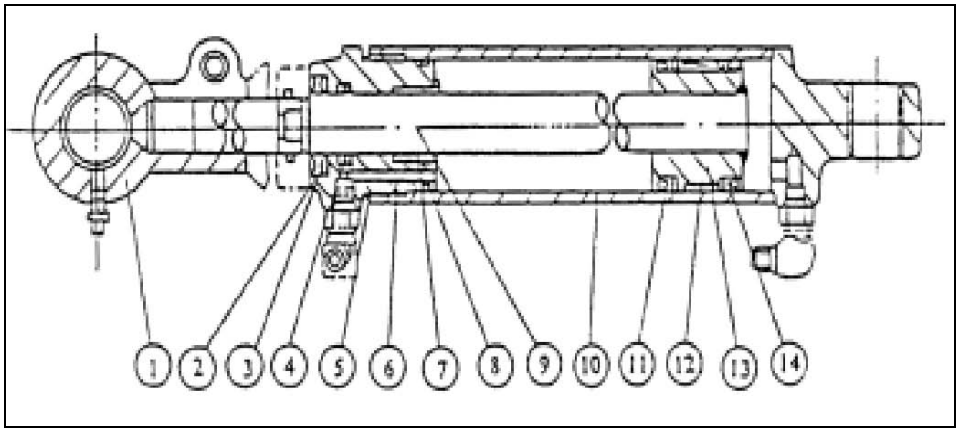


Fig. 5-19 Tilt cylinder

(1) Ear ring (2) Dust ring (3) Snap ring (4) Yx-ring (5) O-ring (6) Guide sleeve (7) Bushing (8) O-ring (9) Piston rod (10) Cylinder body (11) Yx-ring (12) Wearing (13) Piston (14) Yx-ring

5.1.7 Oil tank

Oil suction filter is fixed in the oil tank while the return oil filter is fixed in the oil returning pipelines to make sure the cleanness of the supplied oil.

5.1.8 Hydraulic oil circuit

The hydraulic system principle diagram see Fig. 5-20 and the hydraulic oil circuit see Fig. 5-21.

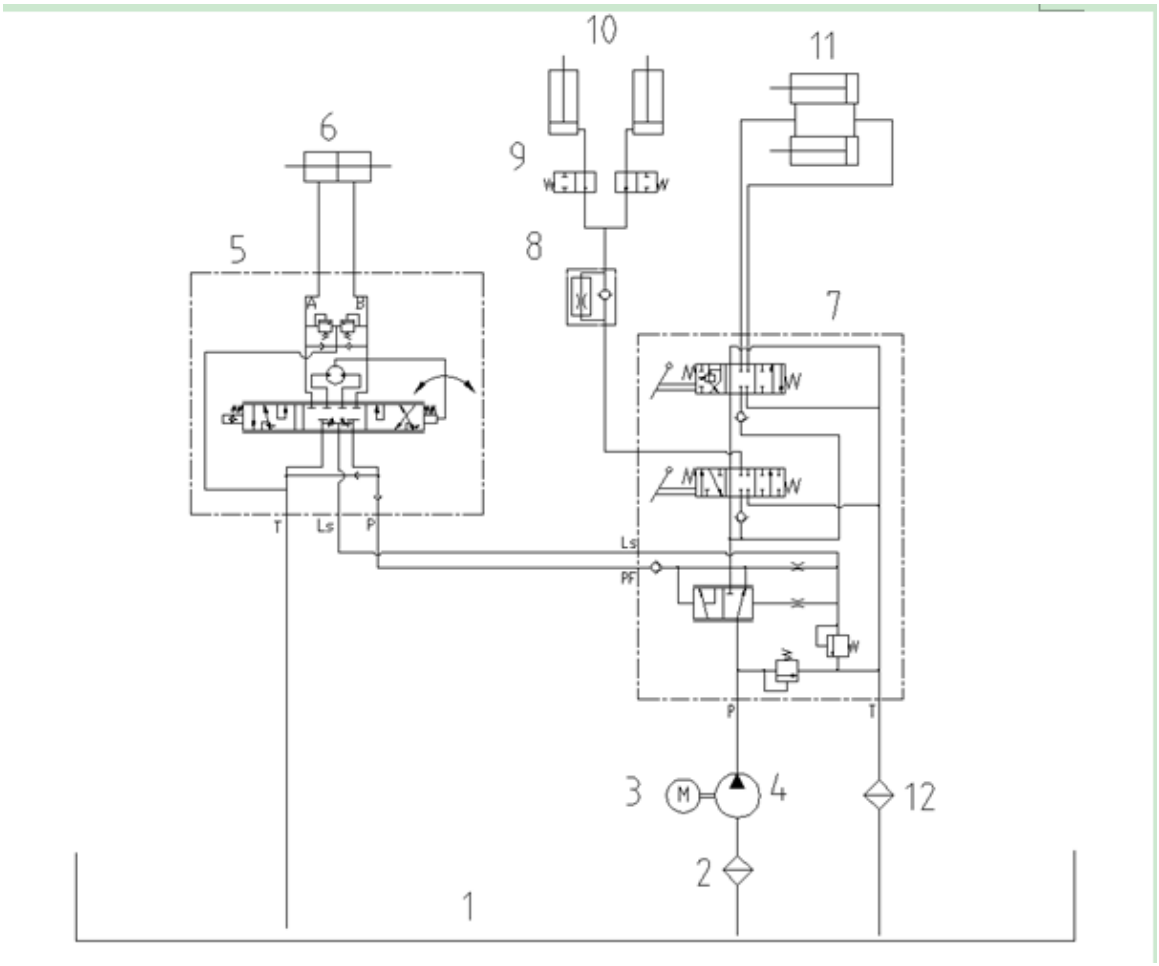


Fig. 5-20 Hydraulic system principle diagram

(1) Oil tank (2) Oil suction filter (3) Pump motor (4) Gear pump (5) Steering unit
(6) Steering cylinder (7) Control valve (8) Flow regulator valve (9) Cut-off valve
(10) Lift cylinder (11) Tilt cylinder (12) Return oil filter

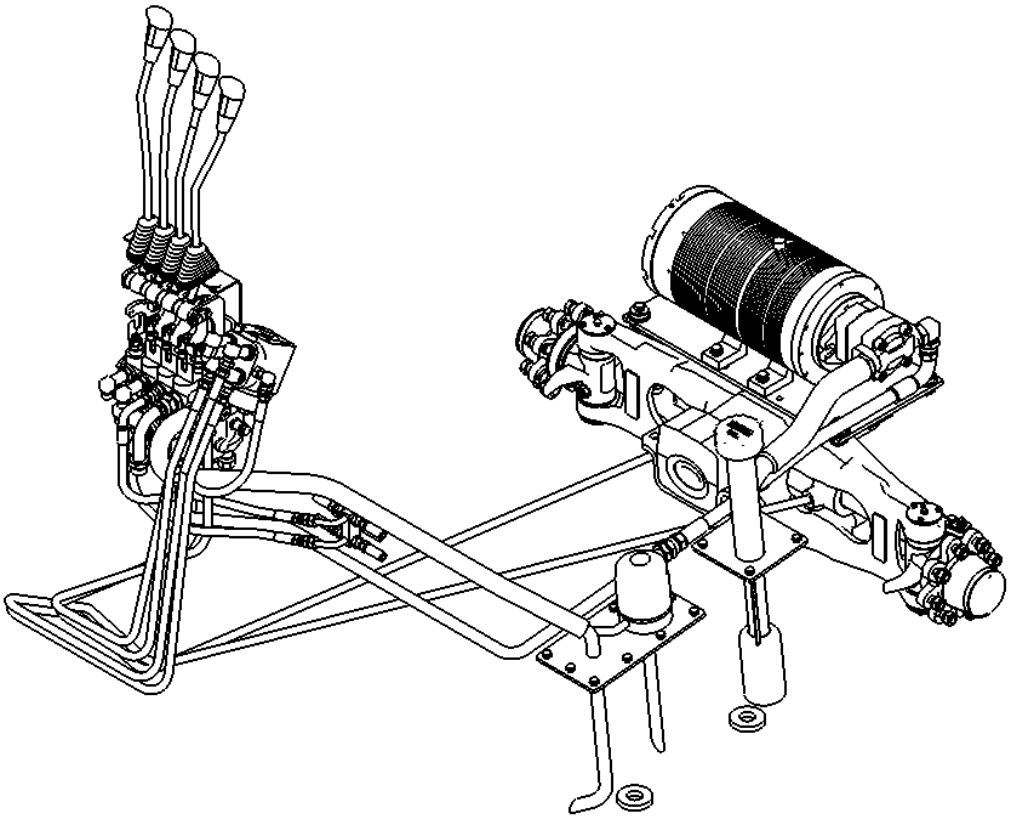


Fig. 5-21 hydraulic oil circuit

5.2 Maintenance，Fault Analysis and Remedies

5.2.1 Maintenance

Check if there is any seepage and serious oil leakage on the pipe fittings of hydraulic drive system, hoist cylinder, tilt cylinder, oil pump, fully hydraulic steering gear and steering cylinder before and after each shift. Check if the working oil inside work oil tank is sufficient and check and clean the strainer mesh of oil filter mounted in the work oil tank once every week.

Normally, change the oil in the work oil tank once every 1200-1500 hours of work and mixed use of oils of different brands is not allowed.

5.2.2 Maintenance of lift pump

(1) Disassembly

Before disassembling the pump, put the removed parts on the paper or cloth. Don't damage the parts. (See Fig. 5-23)

a) Hold the pump cleaned in a vice by lightly clamping the flange section.

b) Remove bolts 11, pump cover 5, pump body 1.

c) Remove lining plate 6, drive gear2, driven gear 3.

d) Remove the seal ring 7 and ring 8 from front cover or rear cover.

Notice: Don't remove the seal ring and ring from the front cover and rear cover, if the seal ring and ring needn't be replaced.

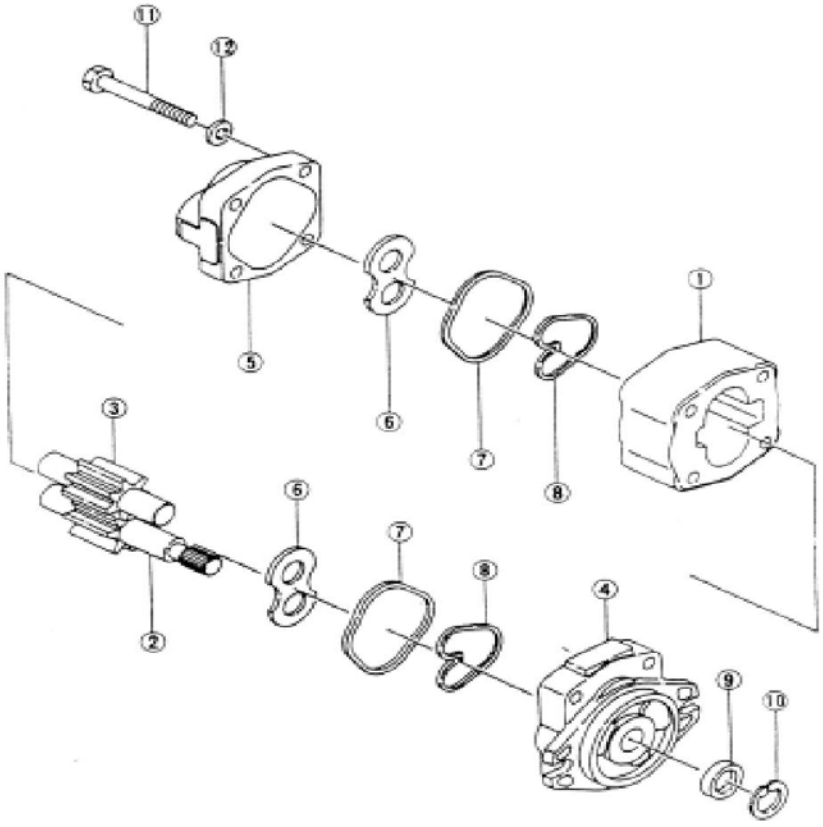


Fig. 5-22 Gear pump

(1) Pump body (2) Drive gear (3) Driven gear (4) Front cover (5) Rear cover
(6) Lining plate (7) Seal ring (8) Ring (9) Oil seal (10) Snap ring

(2) Inspection

Check the disassembled parts and wash them with light oil. Don't wash the rubber items with light oil.

a) Body inspection (See Fig. 5-23)

If the contact length between pump body lumen and gear longer than 1/2 long of the perimeter, replace the pump body.

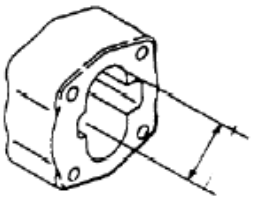


Fig. 5-23

b) Lining plate inspection (See Fig. 5-24)

Inspect the contact surface of the lining plate. If the surface is worn or its thickness is smaller than the specified value, replace the lining plate.

The specified thickness of the lining plate: 4.94mm.

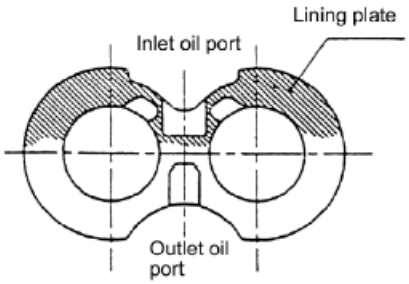


Fig. 5-24

c) Front and rear pump cover

If the color changed range of the inner surface of the bushing exceed 150 ° , replace the bushing.

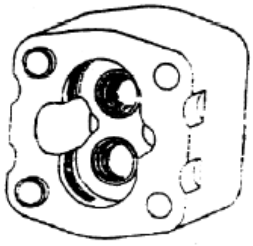


Fig. 5-25

d) Inspect the drive gear and the driven gear from front and rear. If they are worn excessively, replace them. If the dimension “D” is smaller than the specified value, replace them in pairs. D=20.961mm

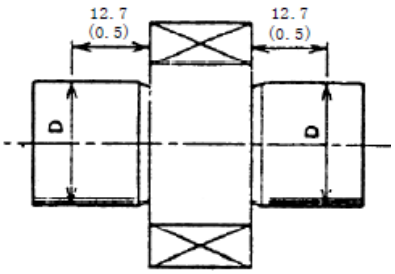


Fig. 5-26

e) Replace seal rings, bushings, seal rings, rings, oil seals and snap rings as required.

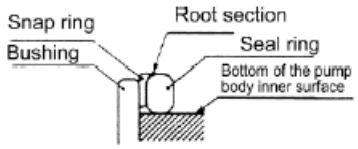


Fig. 5-27

(3) Reassembly

a) Fixed the front cover on the clamping. (See Fig. 5-28)

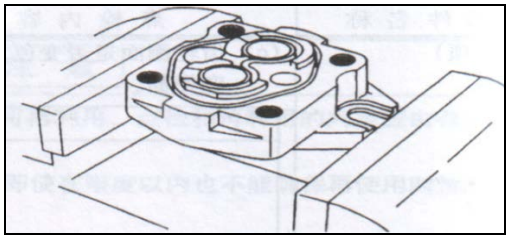


Fig. 5-28

b) Install a new seal ring on the front cover of the pump.

Notice: Don't twist.

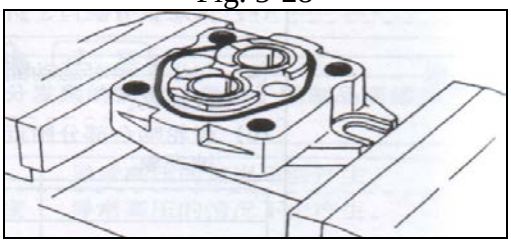


Fig. 5-29

c) Install a new ring on the front cover of the pump. The direction of the installation see Fig. 5-30.

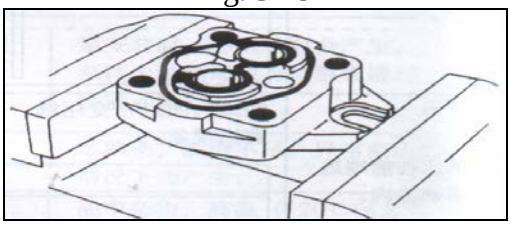


Fig. 5-30

d) Install the pump body on the front cover. Pay attention to the direction of the pump body.

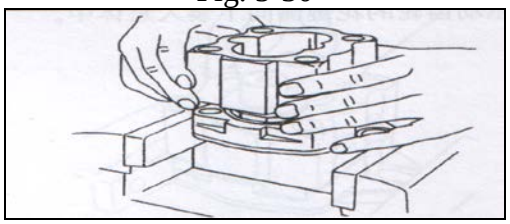


Fig. 5-31

e) Install the lining plate on the groove of the front cover, don't confuse the inlet oil port and the outlet oil port. Pay attention to the direction of the lining plate.

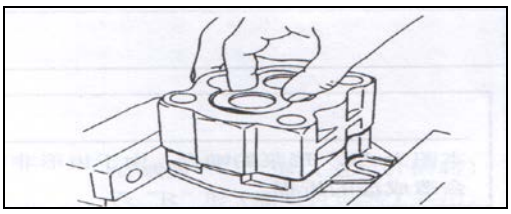


Fig. 5-32

f) Install the drive gearon the pump body with the side of the spline downward.

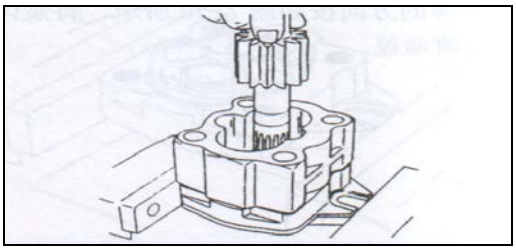


Fig. 5-33

g) Install the driven gear on the pump body as the direction shown in Fig. 5-34.

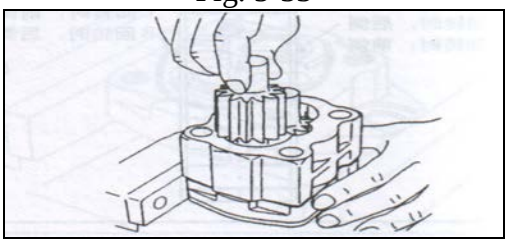


Fig. 5-34

h) Install the lining plate on the side of the gear, don't confuse the inlet oil port and the outlet oil port.

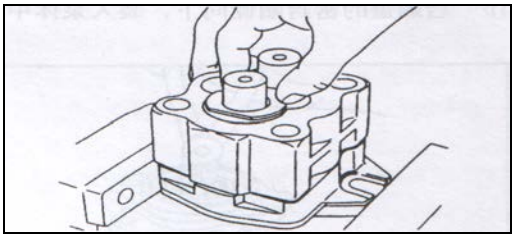


Fig. 5-35

i) Install a new seal ring and a new ring on the groove of the rear cover. Apply lubricating grease on the seal ring.

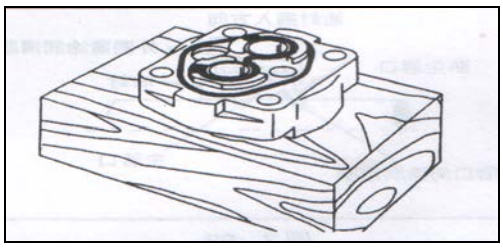


Fig. 5-36

j) Install the rear cover on the pump body with it's seal ring downward, don't confuse the inlet oil port and the outlet oil port.

Fig. 5-37

k) Tighten up the connecting bolts with a specified torque of 9 to 10kg.m after all.

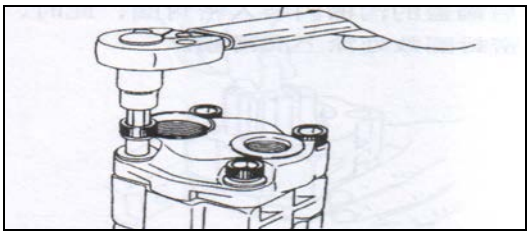


Fig. 5-38

l) Take down the pump from the clamping. Apply lubricating grease on the outside circle and lip of the oil seal, install it on the front cover with mould.

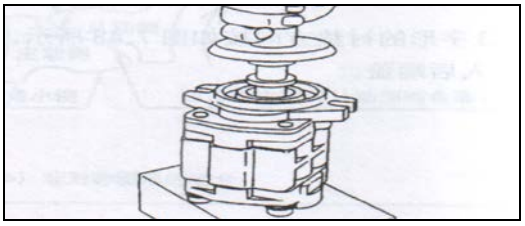


Fig. 5-39

m) Install the snap ring with callipers, fixed the oil seal.

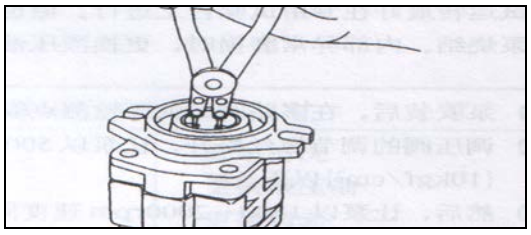


Fig. 5-40

(4) Test run

The test run is a running-in period for the oil pump and a inspection whethter the running of the pump is normal. Test the oil pump on the test station. And also the test can be done on the forklift truck according to the following procedures:

(If the oil pump needs maintenance because of serious wear or its being stuck caused by the hydraulic oil, change the hydraulic oil or filter before carrying out the test run on the forklift truck.)

a) Install the pump onto the truck and the pressure gauge onto the pressure test end of the control valve.

b) Loose the adjusting screw of the relief valve and make the pump running at a speed of 500～1000rpm for 10 minutes. Make sure the oil pressure be lower than 10kg/cm^2.

c) Increase the pump speed to 1500～2000rpm for 10 minutes.

d) Make the pump running at a speed of 1500～2000rpm for 5 minutes and increase

the pressure to 210kg/ cm^2 (for 1-1.5t truck, it is 175 cm^2)by 20～30kg/cm^2 each time. Then make each oil circuit works for 5 minutes and then change the oil filter.

Inspect the temperature of the oil, the temperature of the surface of the pump and the running noise when increasing the oil pressure. If the oil temperature or the temperature of the pump's surface increases to a over high degree, reduce the load and lower the oil temperature. And then go on carrying on the trail.

e) Make the relieving pressure at 210kg/ cm^2 (for 1-1.5t truck, it is 175 cm^2)after the test and measure the flowl. Measure the oil lever through the lifting speed.

5.2.3 Troubleshooting

Trouble	Cause	Trouble shooting
Insufficient lifting capacity or unable to lift	1) Excessive wearing between the oil pump gear and pump body and wider-than-normal gap.	1) Replace the wearable parts or oil pump.
	2) Wearing and wider-than-normal gap of the piston sealing part in the lifting cylinder, excessive inner leakage.	2) Replace with new piston sealing ring.
	3) Failure of safety valve spring of control valve.	3) Replace with new spring.
	4) Excessive oil leakage due to wearing between the control valve rod of control valve and valve body.	4) Chromium plating the valve rod to couple with the hole with the gap at 0.01～0.02.
	5) Oil leakage among valve bodies of the control valve .	5) Change the sealing ring, screw tight the screw in sequence.
	6) Oil leakage in hydraulic pipe.	6) Check to see whether there is damage to the sealing ring or connecting nut and screw tight the pipe joint.
	7) Higher-than-normal temperature of hydraulic oil (should be ≤80℃), excessive oil dilution and insufficient flow.	7) Replace the unqualified hydraulic oil, stop operation to lower oil temperature and try to find the cause of over high oil temperature.
	8) Excessive load.	8) Lift load according to requirements.
Insufficient pressure of oil pump	1) Oil leakage due to wearing of ring seal at fasteners.	1) Replace the ring seal.
	2) Hydraulic oil is contaminated with air to form foam, air leakage at oil suction pipe-work, insuffi-cient hydraulic oil.	2) Discharge air and add hydraulic oil.
	3) Damaged ring seal inside the pump cover groove.	3) Replace.
	4) Wearing of the end face of bearing sleeve.	4) Replace.
	5) Oil pump gear wears.	5) Replace the oil pump.
	6) Wrong rotation direction of oil pump.	6) Correct.

Trouble	Cause	Trouble shooting
Excessive self tilting of the tilting cylinder	1) Inner leakage of control valve.	1) Replace O-ring seal, repair valve rod and reassign the coupling gap between valve rod and hole to 0.01～0.02.
	2) Inner leakage due to the damaged O-ring seal of piston rod of the tilting cylinder.	2) Replace.
	3) Oil leakage due to the damaged YX-ring seal and O-ring seal in the pilot sleeve.	3) Replace.
Heavy Steering	1) Insufficient oil supply of oil pump, the slow-steering hand wheel feels relatively light and the fast-steering hand wheel heavy.	1) Select appropriate oil pump or check to see if the oil pump is normal.
	2) Air in the steering system, foam in oil, making irregular noise, the hand wheel can rotate while the oil cylinder can not keep continuous motion.	2) Discharge air in the system and check the oil suction pipe-work.
	3) Failure of the steel ball one-way valve in the valve body, both the fast and slow steering hand wheels are heavy, also no pressure at steering.	3) Check if the steel ball exists and if there is dirty stuff blocking the steel balls.
	4) Pressure of the overflow valve is lower than working pressure or the overflow valve is blocked by dirty stuff, light steering in case of light or no load, heavy steering when adding load.	4) Adjust pressure of the overflow valve or clean it.
	5) Excessive viscosity of the oil liquid	5) Use oil liquid with recommend-ded viscosity.

6. Lifting System

6.1 General Description of basic type lifting system

The lifting system is of the two-stage roller type with veritical up and down. It consists of two masts, two rear lifting cylinders and fork bracket.

6.1.1 Inner and Outer Masts

The inner and outer masts both are welded parts. The bottom of outer mast is connected with the drive axle and the weight mainly support on the axle housing. The middle of outer mast is connected with the frame by tilt cylinders. The mast assembly can be tilted forward and backward by operating tilt cylinders. The outer mast has C-shaped cross section. The outer mast fixed with main rollers and side rollers on the top of it. And the inner mast has jb-shaped cross section. It fixed with main rollers at the bottom of it. The inner mast moves up and down smoothly with the main and side rollers rolling.

The maintenance of the roller and the side rollers on the inner and outer masts belong to exalted maintenance. Please be careful.

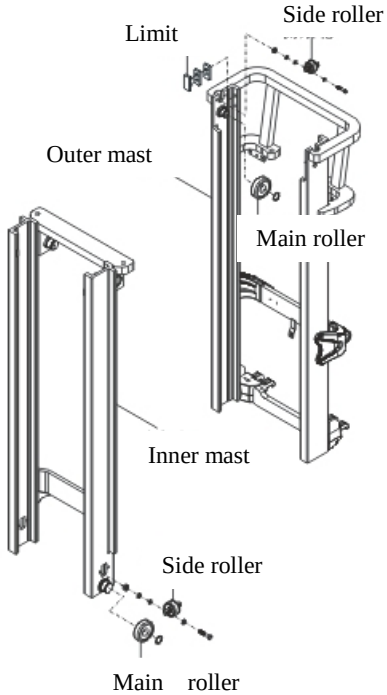


Figure 6-1 Inner and outer mast

6.1.2 Fork Bracket

The fork bracket moves up and down smoothly along the channel of the inner mast through main rollers. The main roller is fixed on the axis of the main roller by snap ring. And the axis of the main roller is welded on the fork bracket. But the side roller is assembled on the fork bracket with bolts. Main rollers sustain the longitudinal loads. And side rollers sustain the transverse loads. When forks reach its maximum height, the upper pair of main rollers will come out from the inner mast top.

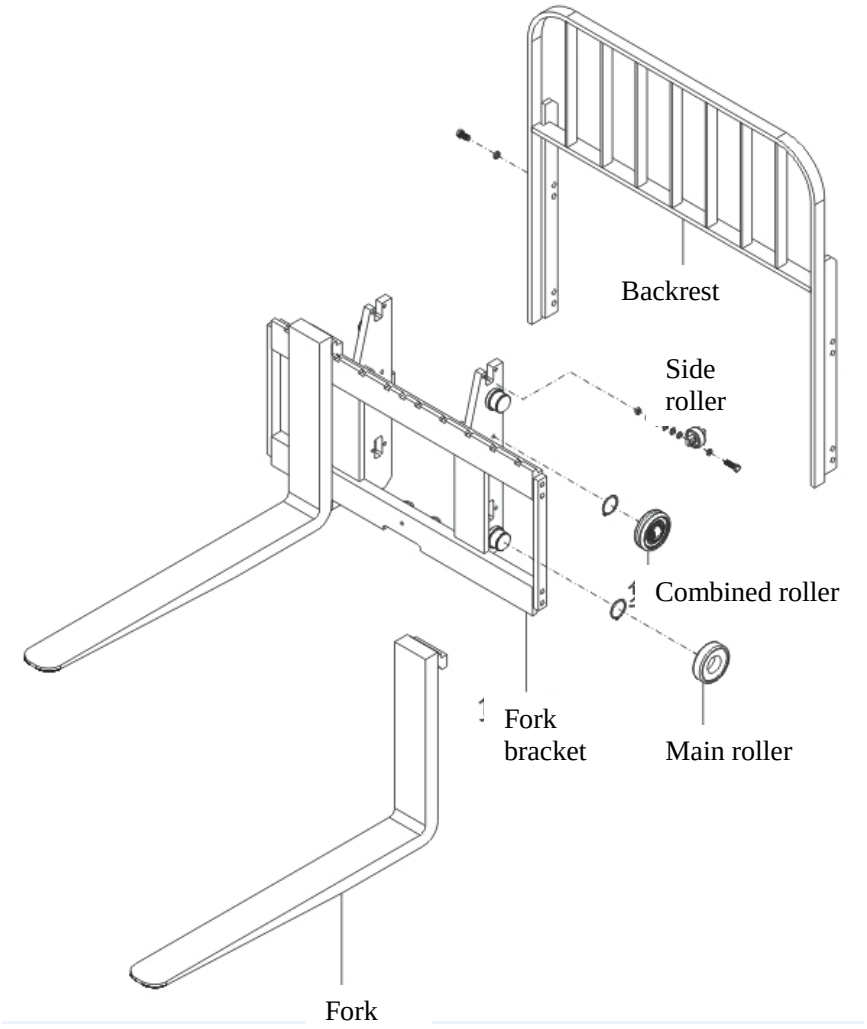


Figure 6-2 Fork bracket

6.1.3 Layout of Rollers

Ten main rollers are separately installed on the upper end of the outer mast (two), lower end of the inner mast (two) and both side of the fork bracket upright (six).

Ten side rollers are separately installed on the upper end of the outer mast (two), lower end of the inner mast (two) and the fork bracket (six).

With the aid of main rollers and side rollers to sustain the longitudinal and transverse load, the inner mast and the fork bracket can operate smoothly.

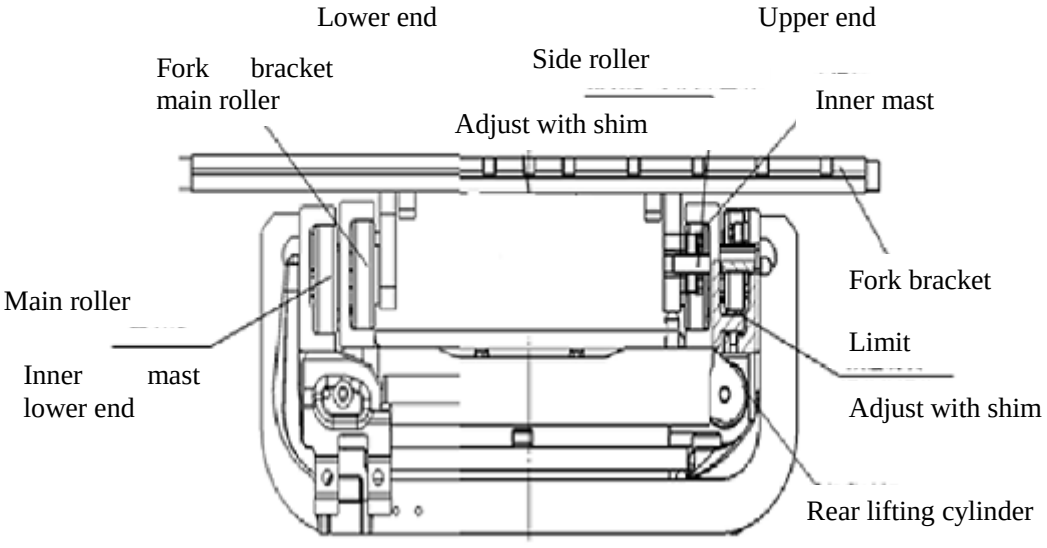


Figure 6-3 Roller layout

Note: (a) The clearance of the side roller is 0-0.5mm.

(b) Apply grease onto the contacting face of the main roller surface and mast.

6.1.4 Maintenance

a) Adjust lift cylinder

Readjust the stroke of the lift cylinder when the lift cylinder, the inner mast or the outer mast is replaced. As following:

(1) Place piston rod heads into the upper beam of the inner mast without shims.

(2) Ensure that two lift cylinders are lifted at the same time when the mast ascended the

ultimately stroke. If they not lifted synchronously, add shims between the upper beam of the inner mast and the piston rod head which reaches the lift cylinder's ultimately stroke in movement. The shims' thickness is 0.2mm or 0.5mm.

(3) Then lower the inner mast slowly and check if the two cylinders are synchronous. If not, refer to the adjusting method above to adjust.

(4) Adjust the tightness of lift chains.

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

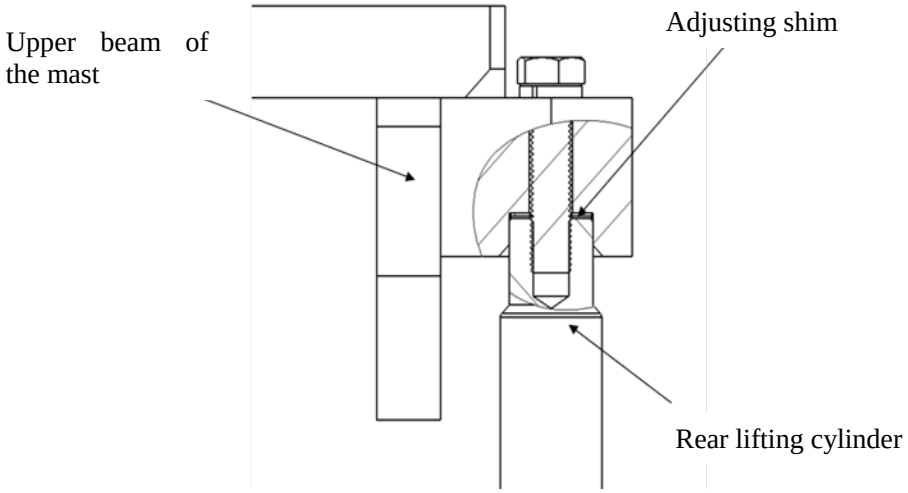


Fig. 6-4 Adjust lift cylinder

b) Adjust fork bracket's height

(1) The truck should be stopped on horizontal ground. And ensure the masts erect.

(2) Lower the forks on the ground, adjust the set nut of tie-in on the upper of chains and there is a distance A between main rollers and the fork bracket.

Truck type	A mm
1-1.8t	36-41
2-2.5t	24-29
3-3.5t	19-24

(3) Make the mast assembly tilt backward when forks descended to the ground, adjust the pulling force of lift chains and let the tightness of lift chains be equal.

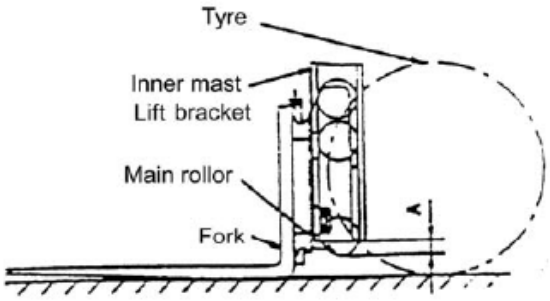


Fig. 6-5 Adjust fork bracket's height

c) Replacing rollers of the fork bracket

(1) Place a salver on the forks and make the forklift stop on the horizontal ground.

(2) Make the forks and salver descend to the ground.

(3) Take down tie-in on top of the chains. And take out chains from sheave. (See Fig. 6-6)

(4) Make the inner mast rise.

(5) The forklift can be removed when the fork bracket disengaged from the outer mast.

(6) Replacing main rollers

(a) Take apart all of snap ring from the fork bracket and take out main rollers. Take care to keep adjusting shim.

(b) Fit the new main roller (the same type as the old one) on the fork bracket and fastened with snap ring.

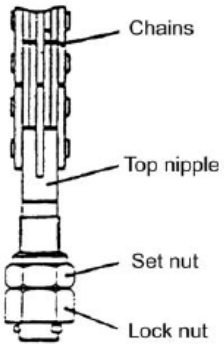


Fig. 6-6

d) Replacing rollers of masts

(1) Take apart the fork bracket from the inner mast, then replace the main roller follows the way as c).

(2) Park the truck on the horizontal ground and lift up the front-wheel 250～300mm from the ground.

(3) Pull parking brake level fully, and use a wedge to make back-wheel stationary.

(4) Take apart bolts which fastened lift cylinders and the inner mast. Hang up the inner mast without losing shims of the piston rod heads carefully.

(5) Take apart bolts which jointed lift cylinders and the bottom of outer mast and take apart the oil-pipe between two lift cylinders without loosing the nipple.

(6) Main rollers on the upper outer mast will be showed on the top of the inner mast as soon as main rollers were taken apart from bottom of the inner mast after laying down the inner mast.

(7) Replacing main rollers

a) Take apart the upper main rollers without losing shims.

b) Fit the new main roller and shims together on the outer mast.

(8) Hang up the inner masts and let all rollers in the inner mast.

(9) Assembly the lift cylinder and the fork bracket as disassembly contrarily.

Note: This manual is based on general model. For the detailed structures of structural part and combined roller, please adhere to the real object. For any technical questions, please contact with us.

6.2 General Description of two stage free lift lifting system

The lifting system is of the two-stage roller type with veritical up and down. It consists of two masts, two rear lifting cylinders, one front cyliner and fork bracket.

6.2.1 Inner and outer mast

The inner and outer masts both are welded parts. The bottom of outer mast is connected with the drive axle and the weight mainly support on the axle housing. The middle of outer mast is connected with the frame by tilt cylinders. The mast assembly can be tilted forward and backward by operating tilt cylinders. The outer mast has C-shaped cross section. The outer mast fixed with main rollers and side rollers on the top of it. And the inner mast has jb-shaped cross section. It fixed with main rollers at the bottom of it. The inner mast moves up and down smoothly with the main and side rollers rolling.

The maintenance of the roller and the side rollers on the inner and outer masts belong to exalted maintenance. Please be careful.

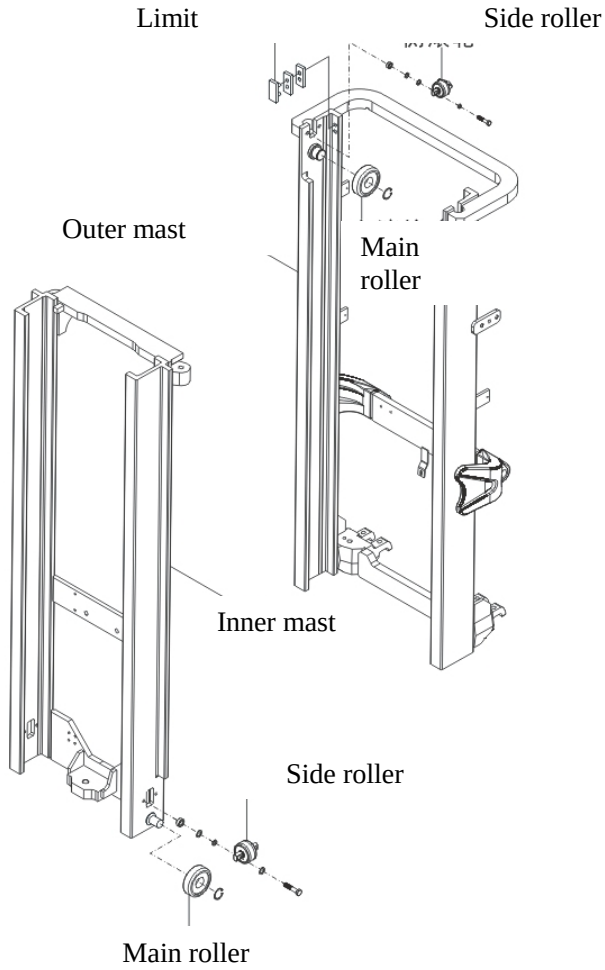


Figure 6-7 inner and outer mast

6.2.2 Fork bracket

Fork bracket rolls inside of inner mast through main roller. The main roller is mounted on main roller axle with elastic snap ring; the middle roller is combined roller. The main roller axle is welded on fork bracket. The roller on upright plate side is fixed onto fork bracket with bolt. The longitudinal load is sustained by main roller. When forks reach its maximum height, the upper pair of main rollers will come out from the inner mast top. And side rollers sustain the transverse loads.

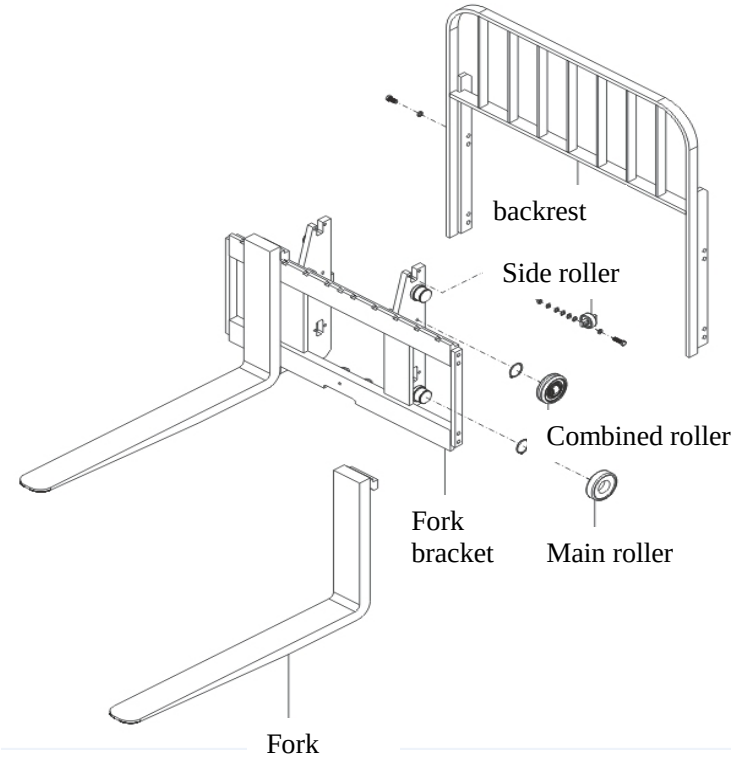


Figure 6-8 fork bracket

6.2.3 Layout of Rollers

Ten main rollers are separately installed on the upper end of the outer mast (two), lower end of the inner mast (two) and both side of the fork bracket upright (six).

Ten side rollers are separately installed on the upper end of the outer mast (two),

lower end of the inner mast (two) and the fork bracket (six).

With the aid of main rollers and side rollers to sustain the longitudinal and transverse load, the inner mast and the fork bracket can operate smoothly.

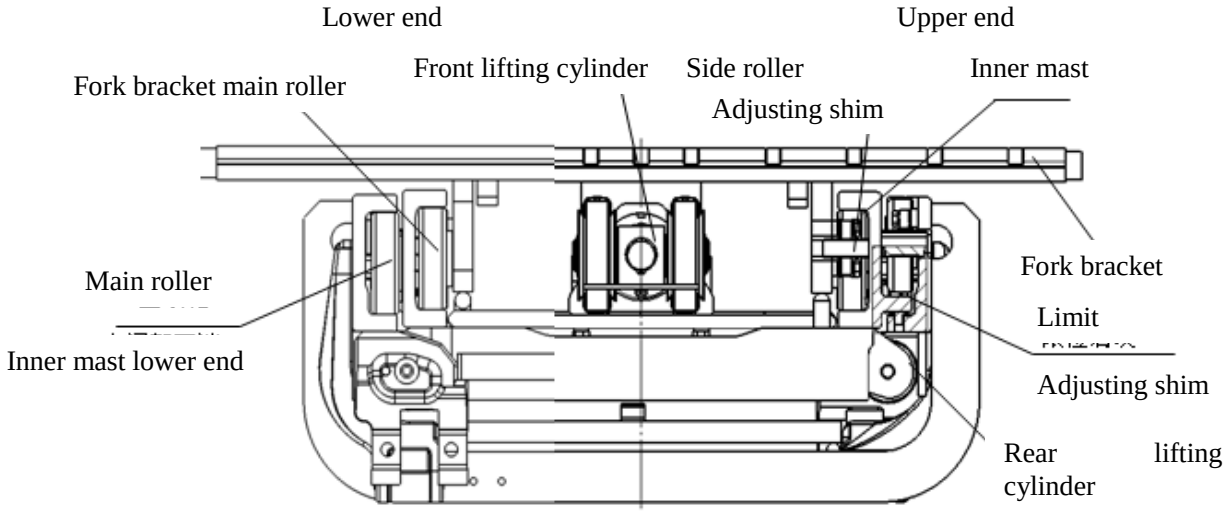


Figure 6-9 roller layout

Note: (a) The clearance of the side roller is 0-0.5mm.

(b) Apply grease onto the contacting face of the main roller surface and mast.

6.2.4 Maintenance

a) Adjust lift cylinder

Readjust the stroke of the lift cylinder when the lift cylinder, the inner mast or the outer mast is replaced. As following:

(1) Place piston rod heads into the upper beam of the inner mast without shims.

(2) Ensure that two lift cylinders are lifted at the same time when the mast ascended the ultimately stroke. If they not lifted synchronously, add shims between the upper beam of the inner mast and the piston rod head which reaches the lift cylinder's ultimately stroke in movement. The shims' thickness is 0.2mm or 0.5mm.

(3) Then lower the inner mast slowly and check if the two cylinders are synchronous. If not, refer to the adjusting method above to adjust.

(4) Adjust the tightness of lift chains.

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

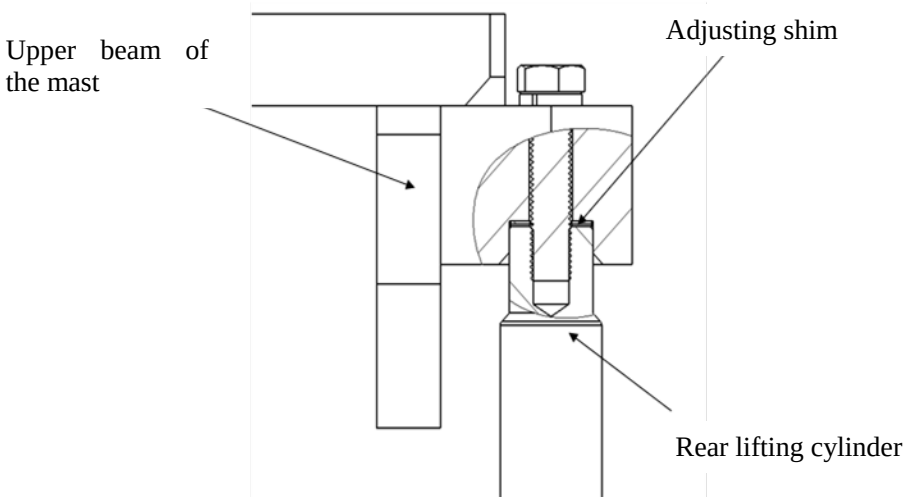


Fig. 6-10

(5) If the front cylinder needs replace, the fork bracket needs to be disassembled. Refer to step C) for disassembling. Disassemble the fork bracket and then replace the front lifting cylinder. See the figure below for detail.

b) Adjust fork bracket's height

(1) The truck should be stopped on horizontal ground. And ensure the masts erect.

(2) Lower the forks on the ground, adjust the set nut of tie-in on the upper of chains and there is a distance A between main rollers and the fork bracket.

Truck type	A mm
1-1.8t	36-41
2-2.5t	24-29
3-3.5t	19-24

(3) Make the mast assembly tilt backward when forks descended to the ground, adjust the pulling force of lift chains and let the tightness of lift chains be equal.

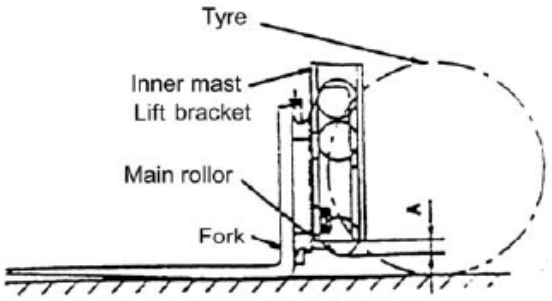


Fig. 6-11 Adjust fork bracket's height

c) Replacing rollers of the fork bracket

(1) Place a salver on the forks and make the forklift stop on the horizontal ground.

(2) Make the forks and salver descend to the ground.

(3) Take down tie-in on top of the chains. And take out chains from sheave. (See Fig. 6-12)

(4) Make the inner mast rise.

(5) The forklift can be removed when the fork bracket disengaged from the outer mast.

(6) Replacing main rollers

(a) Take apart all of snap ring from the fork bracket and take out main rollers. Take care to keep adjusting shim.

(b) Fit the new main roller (the same type as the old one) on the fork bracket and fastened with snap ring.

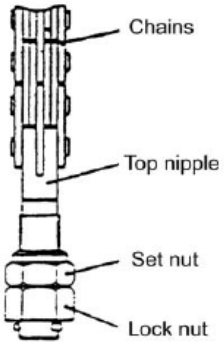


Fig. 6-12

d) Replacing rollers of masts

(1) Take apart the fork bracket from the inner mast, then replace the main roller follows the way as c).

(2) Park the truck on the horizontal ground and lift up the front-wheel 250～300mm from the ground.

(3) Pull parking brake level fully, and use a wedge to make back-wheel stationary.

(4) Take apart bolts which fastened lift cylinders and the inner mast. Hang up the inner mast without losing shims of the piston rod heads carefully.

(5) Take apart bolts which jointed lift cylinders and the bottom of outer mast and take apart the oil-pipe between two lift cylinders without loosing the nipple.

(6) Main rollers on the upper outer mast will be showed on the top of the inner mast as soon as main rollers were taken apart from bottom of the inner mast after laying down the inner mast.

(7) Replacing main rollers

a) Take apart the upper main rollers without losing shims.

b) Fit the new main roller and shims together on the outer mast.

(8) Hang up the inner masts and let all rollers in the inner mast.

(9) Assembly the lift cylinder and the fork bracket as disassembly contrarily.

Note: This manual is based on general model. For the detailed structures of structural part and combined roller, please adhere to the real object. For any technical questions, please contact with us.

6.3 General Description of three stage free lift lifting system

The lifting system is of the three-stage roller type with veritical up and down. It consists of three masts, two rear lifting cylinders, one front lifting cyliner and fork bracket.

6.3.1 Inner mast, middle mast and outer mast

The inner, middle and outer masts are welded parts. The bottom of outer mast is connected with the drive axle and the weight mainly support on the axle housing. The middle of outer mast is connected with the frame by tilt cylinders. The mast assembly can be tilted forward and backward by operating tilt cylinders. The outer mast has C-shaped cross section. The outer mast fixed with main rollers and side rollers on the top of it. And the middle mast has jb-shaped cross section. Both the top and bottom ends have one pair of main roller and side roller respectively. The inner mast has jb-shaped cross section. It fixed with main rollers at the bottom of it. The inner mast moves up and down smoothly with the main and side rollers rolling.

The maintenance of the roller and the side rollers on the inner, middle and outer masts belong to exalted maintenance. Please be careful.

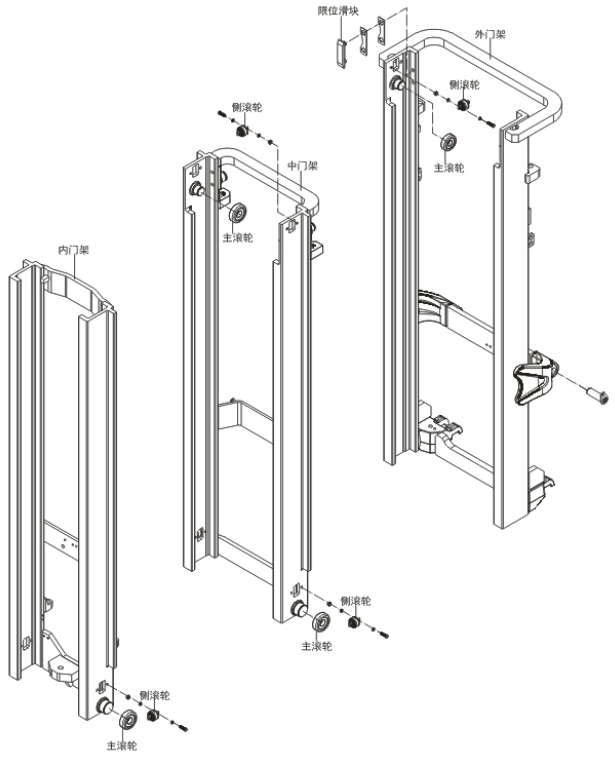


Figure 6-13 inner, middle and outer mast

6.3.2 Fork Bracket

The fork bracket moves up and down smoothly along the channel of the inner mast through main rollers. The main roller is fixed on the axis of the main roller by snap ring. And the axis of the main roller is welded on the fork bracket. But the side roller is assembled on the fork bracket with bolts. Main rollers sustain the longitudinal loads. And side rollers sustain the transverse loads. When forks reach its maximum height, the upper pair of main rollers will come out from the inner mast top.

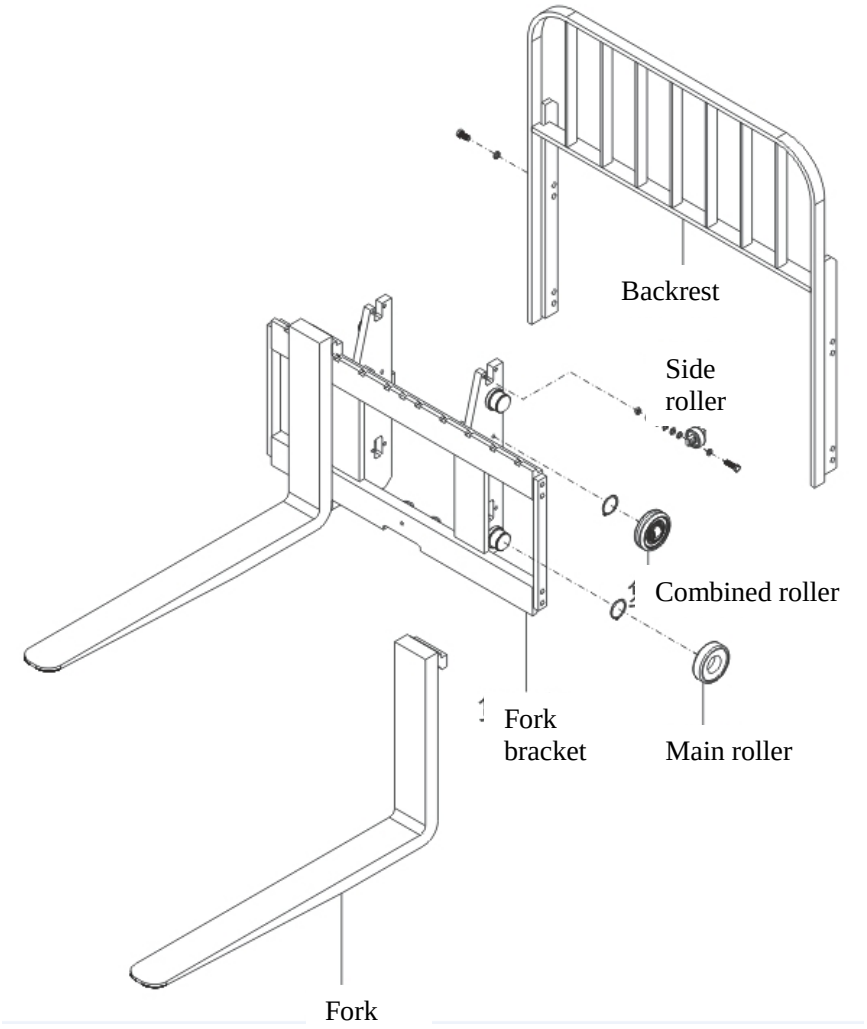


Figure 6-14 Fork bracket

6.3.3 Roller layout

14 main rollers are separately installed on the upper end of the outer mast (two), upper end of middle mast (two), lower end of middle mast (two), lower end of the inner mast (two) and both side of the fork bracket upright (six, of which two are combiend rollers).

14 side rollers are separately installed on the upper end of the outer mast (two), upper end of middle mast (two), lower end of middle mast (two), lower end of the inner mast (two) and fork bracket upright (six, of which two are combiend rollers).

With the aid of main rollers and side rollers to sustain the longitudinal and transverse load, the inner mast and the fork bracket can operate smoothly.

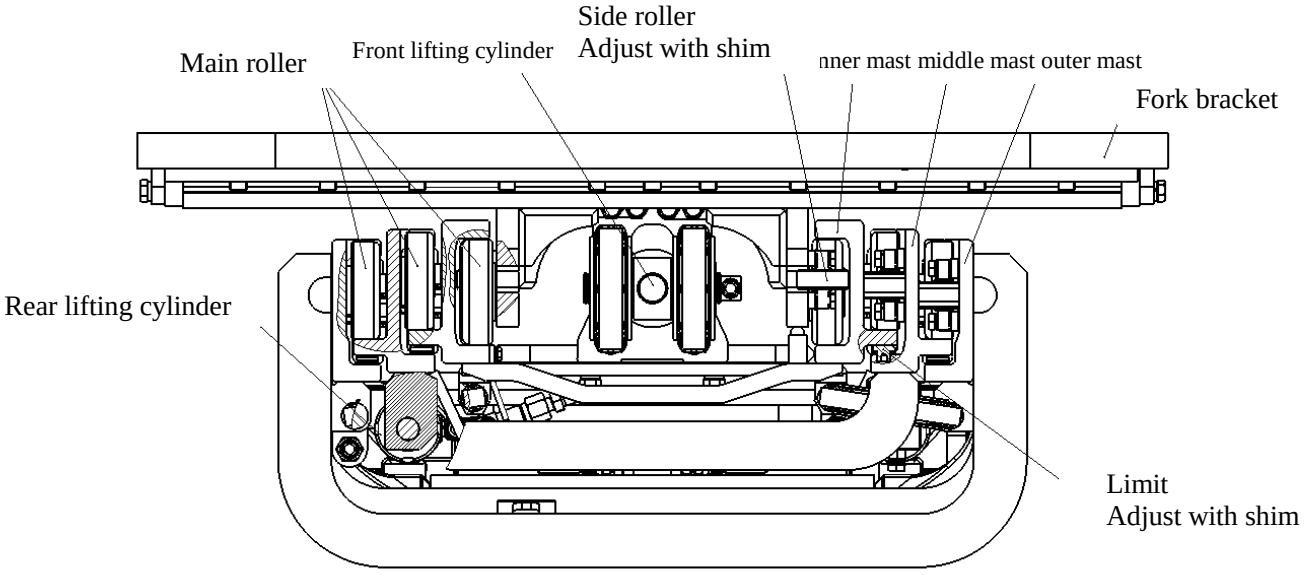


Figure 6-15 roller layout

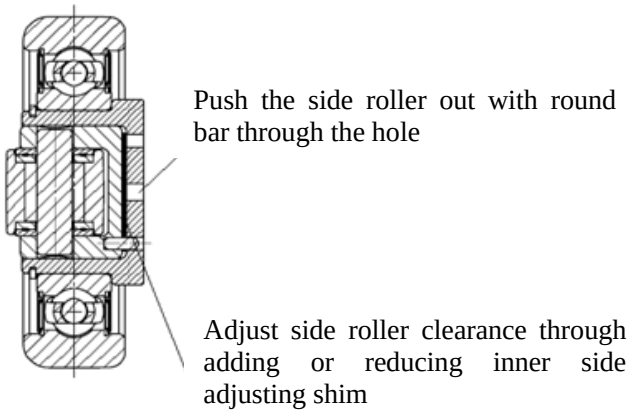


Figure 6-16 Combined roller

Note: (a) The clearance of the side roller is 0-0.5mm.

(b) Apply grease onto the contacting face of the main roller surface and mast.

6.3.4 Maintenance

a) Adjust lift cylinder

Readjust the stroke of the rear lift cylinder (the front lift cylinder does not need readjust)when the lift cylinder, the inner mast or the outer mast is replaced. As following:

(1) Install piston rod head without adjusting shim into middle mast cylinder support.

(2) Ensure that two lift cylinders are lifted at the same time when the mast ascended the ultimately stroke. If they not lifted synchronously, add shims between the upper beam of the inner mast and the piston rod head which reaches the lift cylinder's ultimately stroke in movement. The shims' thickness is 0.2mm or 0.5mm.

(3) Then lower the inner mast slowly and check if the two cylinders are synchronous. If not, refer to the adjusting method above to adjust.

(4) Adjust the tightness of lift chains.

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

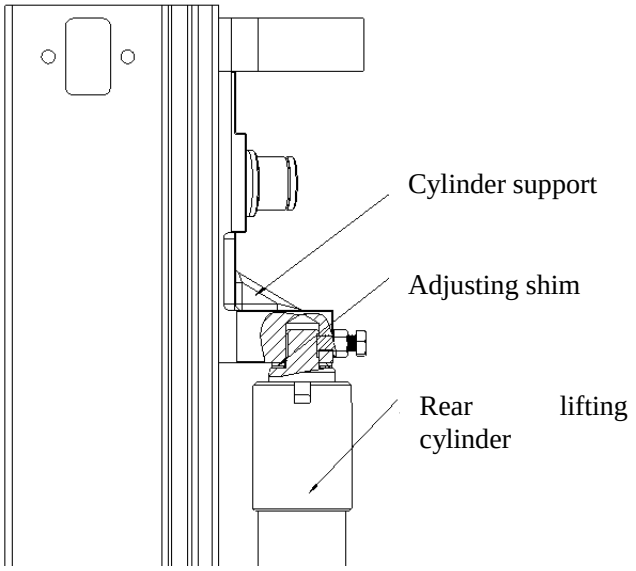


Figure 6-17 Rear lifting cylinder adjusting

(5) If the front cylinder needs replace, the fork bracket needs to be disassembled. Refer to step C) for disassembling. Disassemble the fork bracket and then replace the front lifting cylinder. See the figure below for detail.

b) Adjust fork bracket's height

(1) The truck should be stopped on horizontal ground. And ensure the masts erect.

(2) Lower the forks on the ground, adjust the set nut of tie-in on the upper of chains and there is a distance A between main rollers and the fork bracket.

Truck type	A mm
1-1.8t	36-41
2-2.5t	24-29
3-3.5t	19-24

(3) Make the mast assembly tilt backward when forks descended to the ground, adjust the pulling force of lift chains and let the tightness of lift chains be equal.

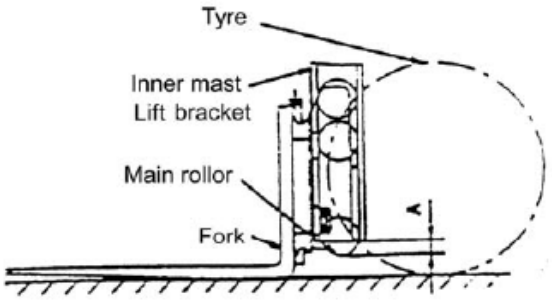


Fig. 6-18 Adjust fork bracket's height

c) Replacing rollers of the fork bracket

(1) Place a salver on the forks and make the forklift stop on the horizontal ground.

(2) Make the forks and salver descend to the ground.

(3) Take down connector on top of the chains. And take out chains from sheave. (See Fig. 6-19)

(4) Make the inner mast rise.

(5) The forklift can be removed when the fork bracket disengaged from the outer mast.

(6) Replacing main rollers

(a) Take apart all of snap ring from the fork bracket and take out main rollers. Take care to keep adjusting shim.

(b) Fit the new main roller (the same type as the old one) on the fork bracket and fastened with snap ring.

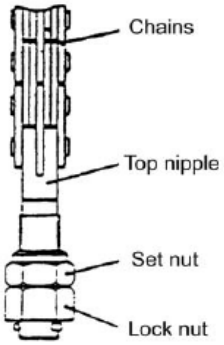


Fig. 6-19

d) Replacing rollers of masts

(1) Take apart the fork bracket from the inner mast, then replace the main roller follows the way as c).

(2) Park the truck on the horizontal ground and lift up the front-wheel 250～300mm from the ground.

(3) Pull parking brake level fully, and use a wedge to make back-wheel stationary.

(4) Take apart bolts which fastened lift cylinders and the inner mast. Hang up the inner mast without losing shims of the piston rod heads carefully.

(5) Take apart bolts which jointed lift cylinders and the bottom of outer mast and take apart the oil-pipe between two lift cylinders without loosing the nipple.

(6) Main rollers on the upper outer mast will be showed on the top of the inner mast as soon as main rollers were taken apart from bottom of the inner mast after laying down the inner mast.

(7) Replacing main rollers

a) Take apart the upper main rollers without losing shims.

b) Fit the new main roller and shims together on the outer mast.

(8) Hang up the inner masts and let all rollers in the inner mast.

(9) Assembly the lift cylinder and the fork bracket as disassembly contrarily.

Note: This manual is based on general model. For the detailed structures of structural part and combined roller, please adhere to the real object. For any technical questions, please contact with us.

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