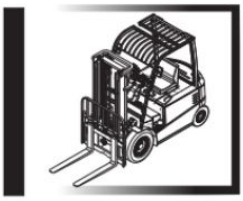

OPERATION & SERVICE MANUAL

1–3.5t lithium battery
counterbalanced forklift truck

HELI Forklift Operation Manual

CPCD35 HELI Lithium Forklift Truck
For HELI G Series 1-3.5T Lithium Battery Counterbalanced Forklift Truck

This HELI forklift operation and service manual is for a G series 1-3.5T lithium battery counterbalanced forklift truck. It should be abided seriously by all of the relative personnel to enable these forklift trucks in an optimized working state for a long period and bring the highest efficiency.

This manual states the HELI forklift truck's specifications, operation, maintenance, service, construction, and working principles to help operators use the forklift trucks correctly and attain the highest functions.

Anhui Leading Forklift Parts Co., Ltd.
www.leadingforkliftparts.com
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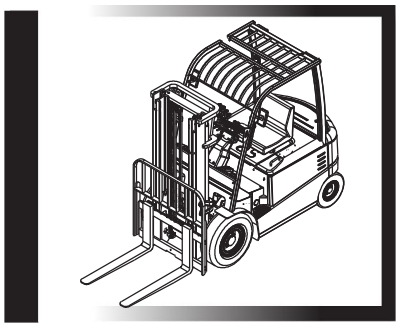
OPERATION & SERVICE MANUAL



1–3.5t lithium battery
counterbalanced forklift truck

安徽合力股份有限公司

ANHUI HELI CO., LTD.

FOREWORD

G series 1-3.5t lithium battery counterbalanced forklift truck is designed on the base of G series 1-3.5t battery counterbalanced forklift truck combined with lithium battery manage system. The truck has characters of environment friendliness, maintenance free, long service life, high efficient, energy saving, safety and it is suitable for low temperature. 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, continuously variable speed adjuster , overhead guard with opened port and high quality motor, battery, MOSFET controller and LED display with large screen 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.

(4) Charge the battery to make the electricity quantity to stay between 40% and 60% and press the emergency button.

2. Storage of Forklift Truck

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

(2) Lower the mast to the lowest position.

(3) Apply the parking brake.

(4) Wedged up the wheels.

(5) Charge the battery to make the electricity quantity to be more than 60% and press the emergency button.

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 fuel level.

(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 its stated air pressure. Never over inflate a tyre.

(21) 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 40mm;

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;

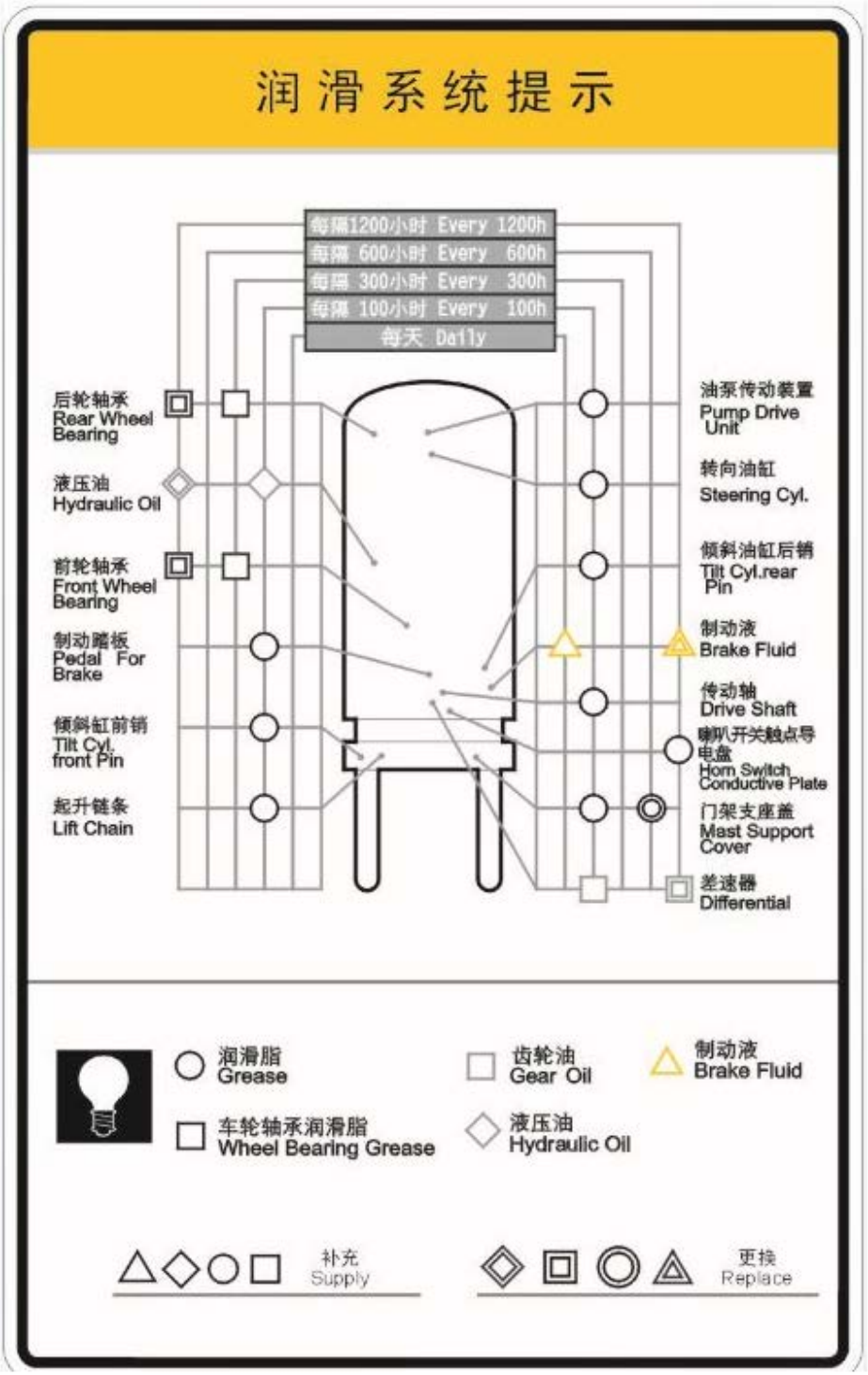
e) Check instruments, lighting, switches and wiring to see if they work normally or not.

(2) Oil used for forklift trucks

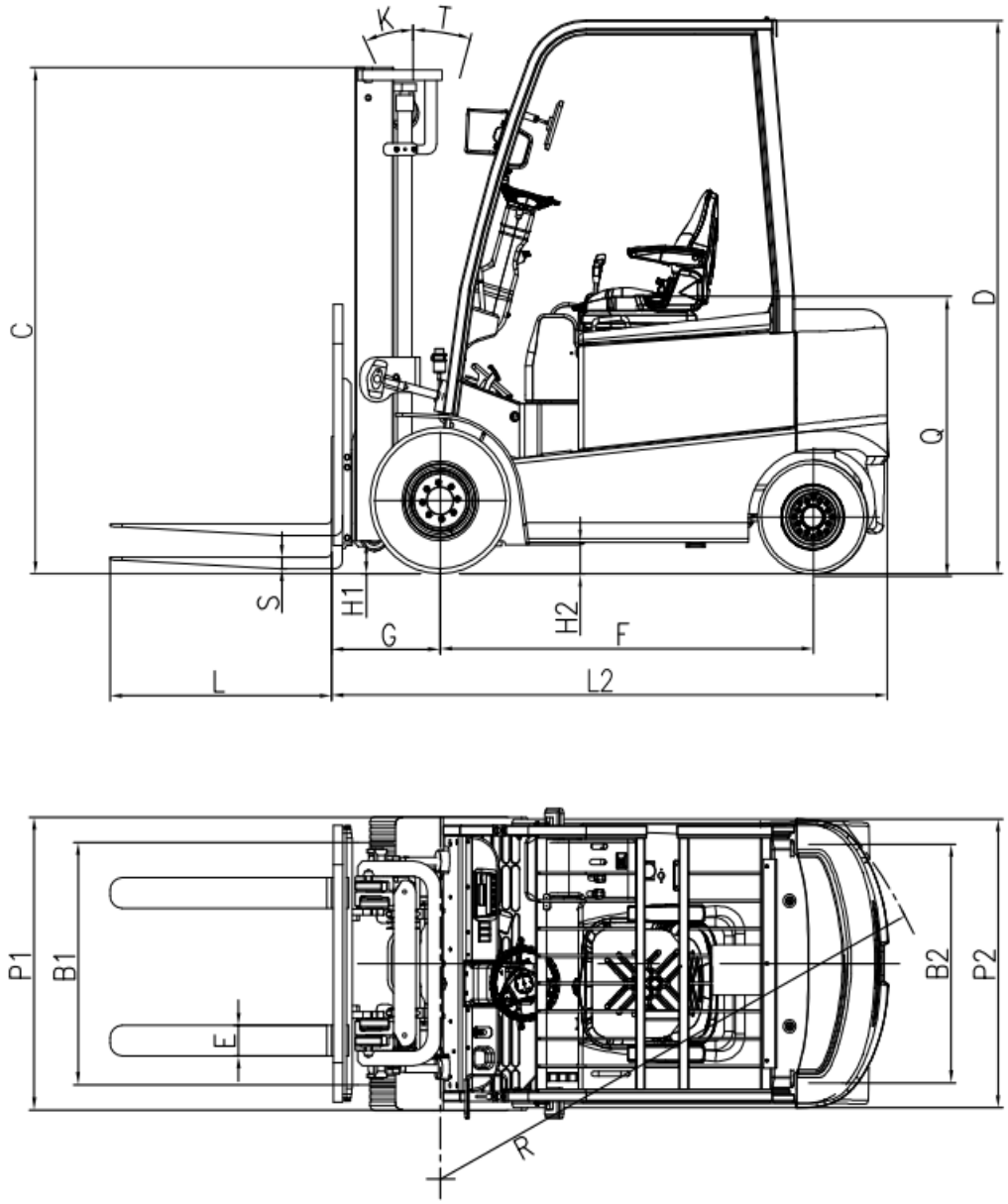
<table>
<tr><td rowspan="2">Name</td><td rowspan="2">Recommended brand</td><td colspan="3" rowspan="2">Brand and temperature of using</td><td colspan="3">Level per unit (L)</td></tr>
<tr><td>1-1.8t</td><td>2-2.5t</td><td>3-3.5t</td></tr>
<tr><td rowspan="2">Hydraulic oil</td><td rowspan="2">Long pan</td><td>Sticky grade</td><td>L-HM32 wearable hydraulic oil</td><td>L-HV32 low temp. wearable hydraulic oil</td><td rowspan="2">25</td><td rowspan="2">34</td><td rowspan="2">40</td></tr>
<tr><td>Temp. of using (℃)</td><td>≥-5</td><td>≥-20 (cold region)</td></tr>
<tr><td>Brake fluid</td><td>Chong qing yi ping</td><td colspan="3">4604 compound brake fluid GB 12981 HZY4</td><td colspan="3">0.2</td></tr>
<tr><td>Lubricating grease</td><td>Long pan</td><td colspan="3">2# L-XDCBB2 low temperature lubrication grease (-40℃～+120℃)</td><td colspan="3"></td></tr>
<tr><td rowspan="2">Gear oil of heavy-laden truck(GL-5)</td><td rowspan="2">Long pan</td><td>Sticky grade</td><td>85W/90</td><td>80W/90</td><td rowspan="2">3.2</td><td rowspan="2">3.2</td><td rowspan="2">8</td></tr>
<tr><td>Temp. of using (℃)</td><td>-15～+49</td><td>-25～+49</td></tr>
</table>

- **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 GC1Li /GD1Li	CPD15 GC1Li /GD1Li	CPD18 GC1Li /GD1Li
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 (S×E ×L)	mm	32×100×770	35×100×920	
Wheelbase F	mm	1380		
Tread (front/rear) (B1/B2)	mm	910/920		
Overall length (without forks) L2	mm	2070		
Overall width	mm	1086		
Overall height (mast/overhead guard) (C/D)	mm	1985/2130		
Seat height Q	mm	1080		
Under-clearance (H1/H2)	mm	90/80(in the middle of the truck body)		80/75(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	DC: 290/450	270/450	280/530
		AC: 410/600	400/600	380/600
Descending speed (loaded/unloaded)	mm/s	400/500		
Gradeability (loaded/unloaded)	%	20/25	19/24	17/22
Tyre (front/rear)		6.00-9-10PR/16×6-8-10PR		6.00-9/16×6-8-10PR
Traction motor power	kW	8.2 (AC)		
		7.5(DC)		8.6(DC)
Pump motor power	kW	10.6 (AC)		
Battery	V/Ah	48/400(standard)		
		48/500(optional)		
Service weight (with/without battery)	kg	2700/2350	2955/2605	3105/2755
Battery weight	kg	350		

Main Specifications

Model	Unit	CPD20	CPD25
		GC1Li /GD1Li	GC1Li/GD1Li
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 (S×E×L)	mm	40×122×920	40×122×1070
Wheelbase F	mm	1550	
Tread (front/rear) (B1/B2)	mm	960/950	
Overall length (without forks) L2	mm	2285	2335
Overall width (front/rear)	mm	1185	
Overall height (mast/overhead guard) (C/D)	mm	1995/2150	
Seat height Q	mm	1100	
Under-clearance (H1/H2)	mm	110(at mast)/115(in the middle of the truck body)	
Min. turning radius R	mm	2000	2060
Travelling speed (loaded/unloaded)	km/h	14.5/15	
Lifting speed (loaded/unloaded)	mm/s	DC: 250/450	240/450
		AC: 320/465	305/465
Descending speed (loaded/unloaded)	mm/s	410/490	
Gradeability (loaded/unloaded)	%	20/24	20/22
Tyre (front/rear)		23×9-10-16PR/18×7-8-14PR	
Traction motor	kW	11.5 (AC)	
Pump motor	kW	10.5 (DC)	
		15 (AC)	
Battery	V/Ah	48/500	
		48/600(optional)	
Service weight(with/without battery)	kg	3615/3215	4035/3635
Battery weight	kg	400	
		500(optional)	

Main Specifications

Model	Unit	CPD30	CPD35
		GC1Li /GD1Li	GC1Li /GD1Li
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 (S×E×L)	mm	45×125×1070	50×125×1070
Wheelbase F	mm	1685	
Tread (front/rear) B1/B2	mm	1000/950	
Overall length (without forks) L2	mm	2545	2550
Overall width (front/rear)	mm	1238	
Overall height (mast/overhead guard) (C/D)	mm	2075/2215	2180/2215
Seat height Q	mm	1165	
Under-clearance (H1/H2)	mm	135（at mast ）/145（in the middle）	
Min. turning radius R	mm	2240	2260
Travelling speed (loaded/unloaded)	km/h	15/15.5	14.5/15
Lifting speed (loaded/unloaded)	mm/s	DC:280/460	270/440
		AC:340/460	325/460
Descending speed (loaded/unloaded)	mm/s	420/510	
Gradeability (loaded/unloaded)	%	17/20	15/20
Tyre ,front		28x9-15-12PR	28x9-15
Tyre, rear		18x7-8-14PR	18x7-8
Traction motor	kW	16.6 (AC)	
Pump motor	kW	13 (DC)	
		13.5 (AC)	
Battery	V/Ah	80/400（standard）	
		80/500（optional）	
Service weight(with/without battery)	kg	4890/4330	5330/4770
Battery weight	kg	560	

Main dismountable parts size and weight

	Counterweight		Overhead guard		Mast （lifting height 3000mm）	
	Max. outline dimension	Weight	Max. outline dimension	Weight	Max. outline dimension	Weight
Model	mm	Kg	mm	Kg	mm	Kg
CPD10-GC1Li /GD1Li	300×825×1070	500	1050×1414×1551	72	1010×480×1925	450
CPD15-GC1Li /GD1Li	300×825×1070	720	1050×1414×1551	72	1010×480×1925	450
CPD18-GC1Li /GD1Li	300×825×1070	770	1050×1414×1551	72	1010×480×1925	450
CPD20-GC1Li /GD1Li	370×890×1150	790	1100×1457×1515	86	1102×506×1930	745
CPD25-GC1Li /GD1Li	420×920×1150	1160	1100×1457×1515	86	1102×506×1930	745
CPD30-GC1Li /GD1Li	405×895×1225	1330	1140×1578×1573	77	1164×459×1957	785
CPD35-GC1Li /GD1Li	465×895×1225	1490	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. The differential of 3-3.5t truck is of right and left split type. The differentials include two half-shaft gears and two planet gears. (See Fig. 1-1)

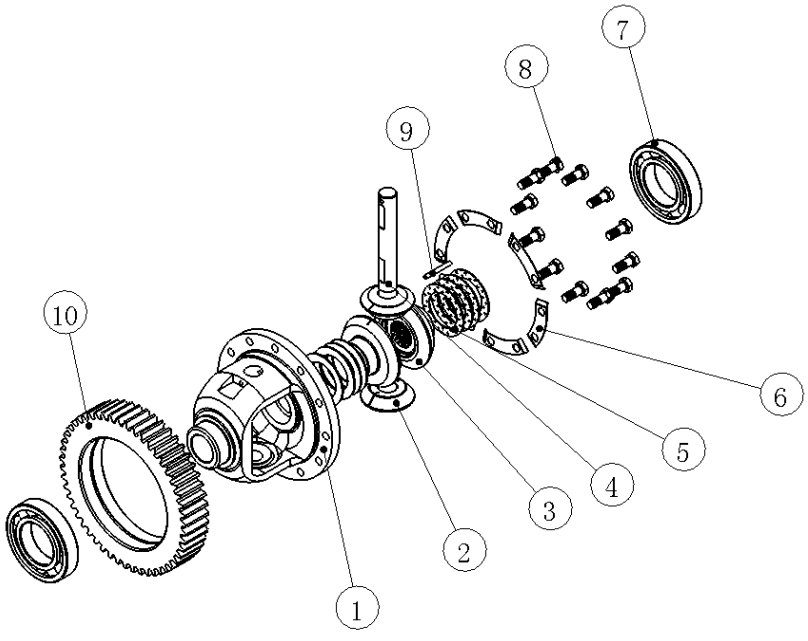


Fig. 1-1 Differential assembly

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

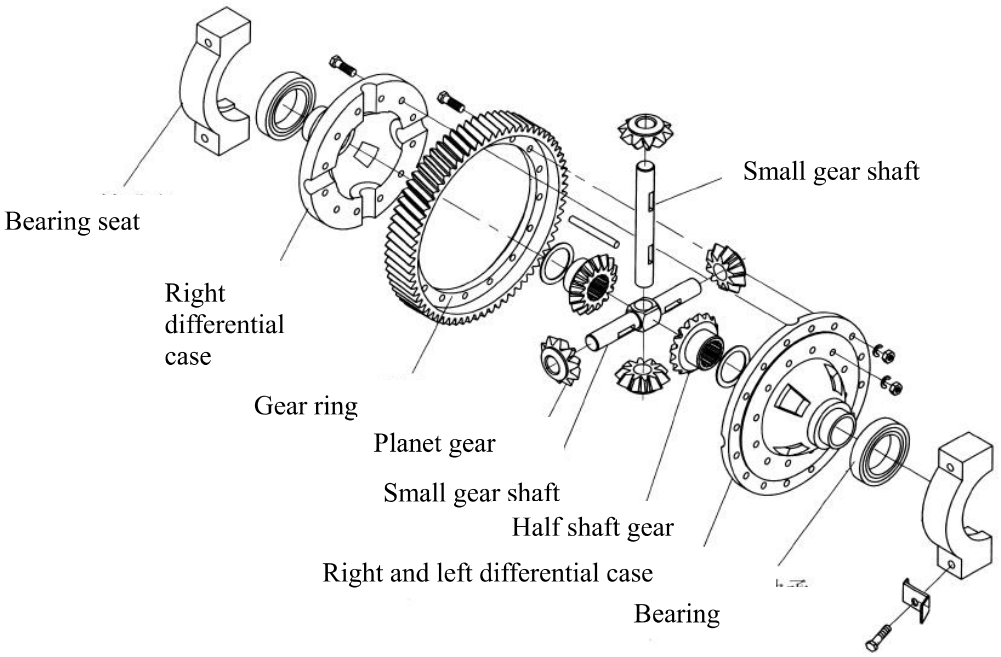


Figure 1-2 differential assembly (3-3.5t)

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. 1-2)

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
	4.00E		6.50F-10	7.00-15	
Tyre pressure	860kPa	Solid tyre	1030kPa	830kPa	Solid tyre

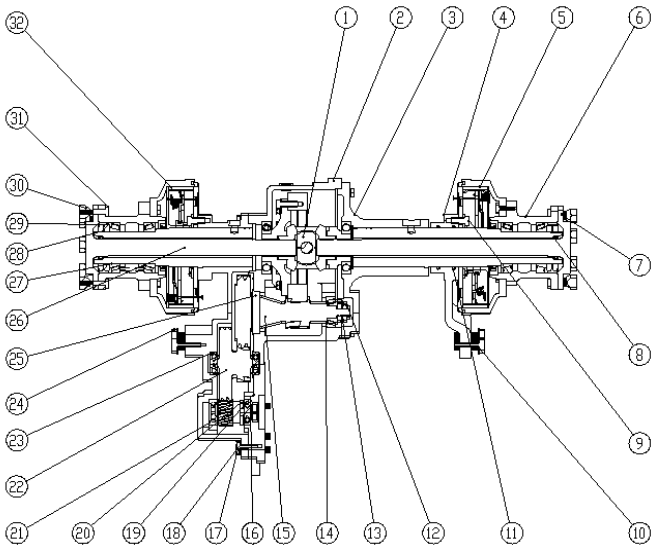


Fig. 1-3 Gearbox & axle assembly

(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 6206 (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 75×5.3.

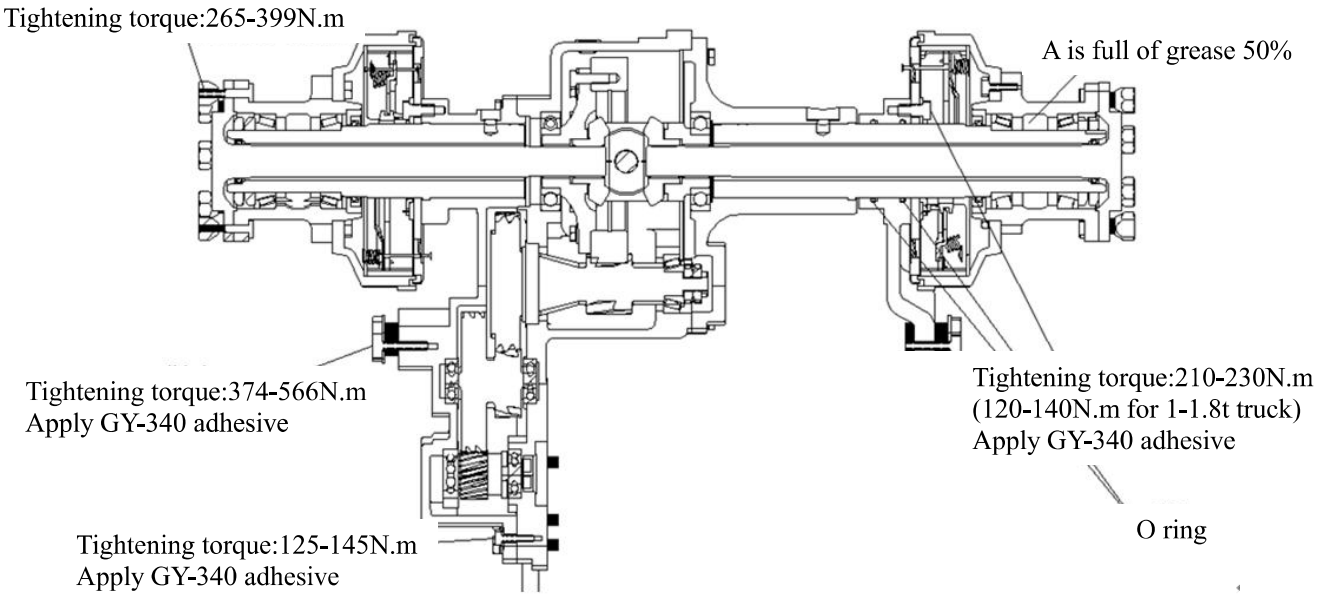


Fig. 1-4 Gearbox & axle assembly(1-1.8t,2t,2.5t)

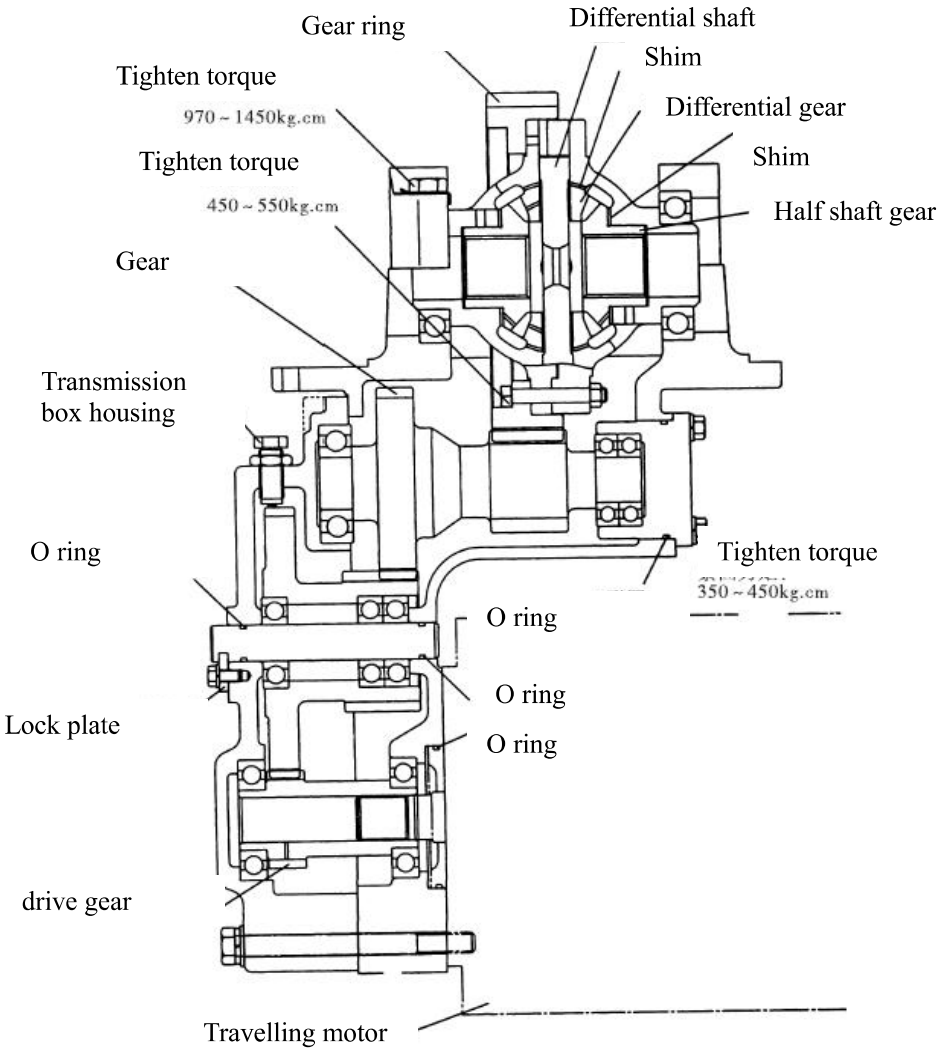


Figure 1-5 reducer and differential (3-3.5t)

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.

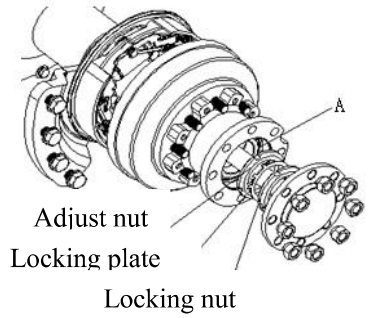


Fig. 1-6 Fill lubricating grease

(3) Measure the torque value that the wheel hub starts rotating. When the torque value measured reaches to regulated value, screw down the hub nut.

Initial torque: 5-15kg.m

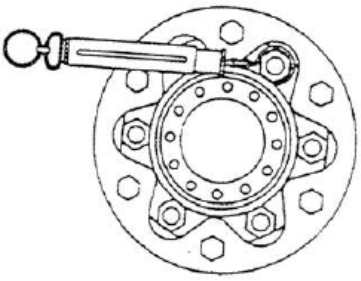


Fig. 1-7 Measure the torque value

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

(5) Assembly of tyre

Fix the drain tap and the cover on the tyre, and screw down wheel-rim bolts.

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.

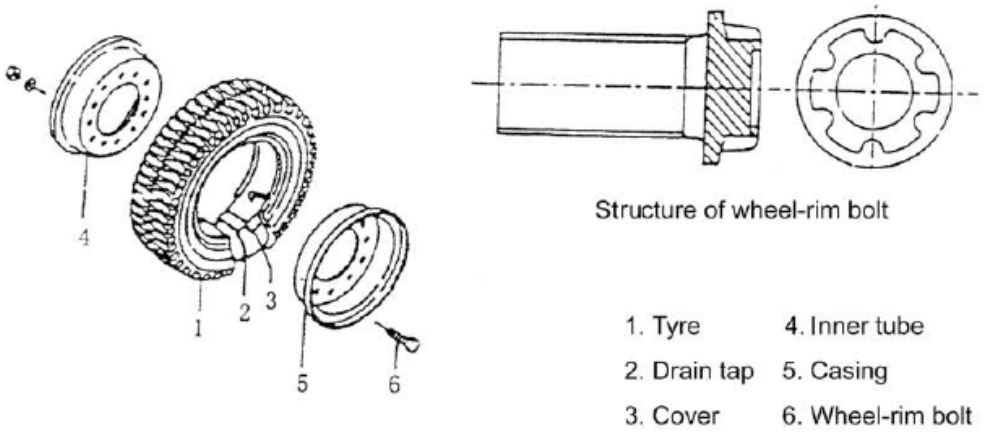


Fig. 1-8 Assembly of tyre

2. Brake System

2.1 General description

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

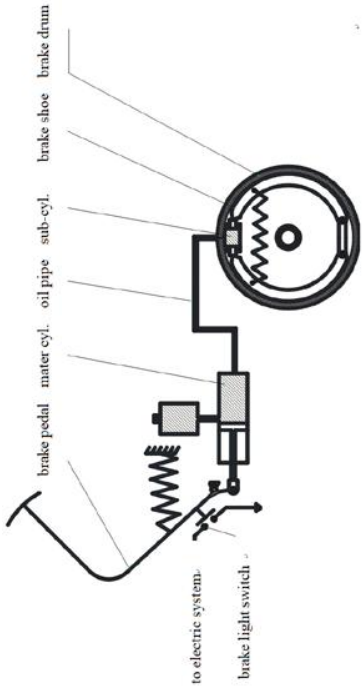


Fig. 2-1.1 Service braking principle diagram

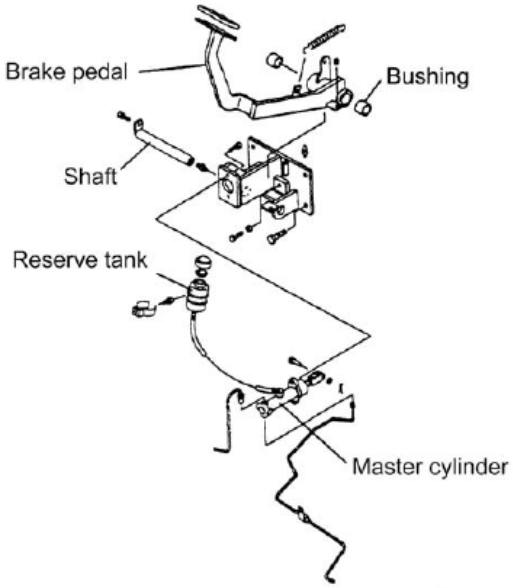


Fig. 2-1.2 Brake pedal

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.

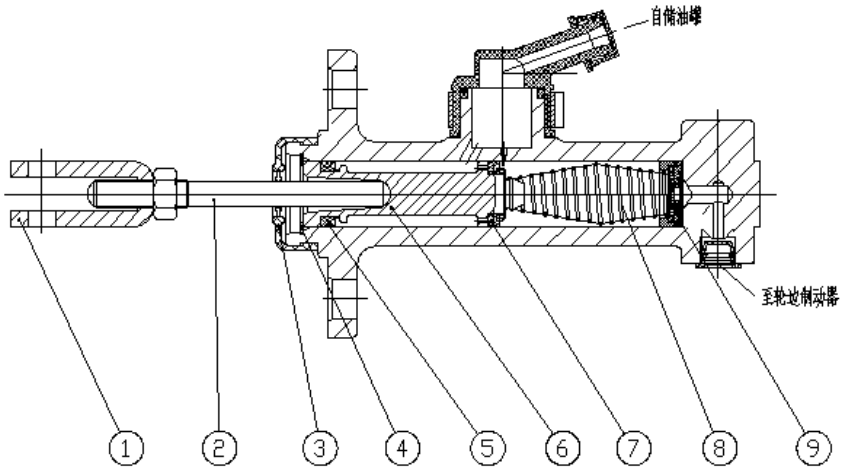


Fig. 2-2 Master cylinder

(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 Service brake

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

The service 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 service brake. (See Fig. 2-8, 2-9, 2-10)

(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)

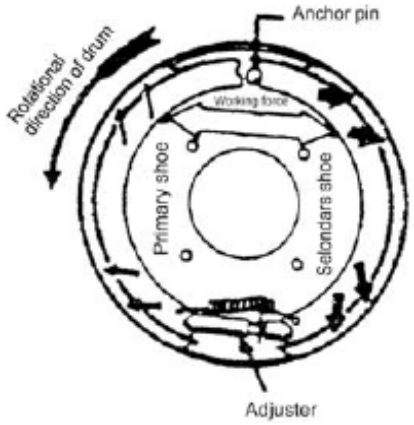


Fig. 2-3 Braking operation in forward travel

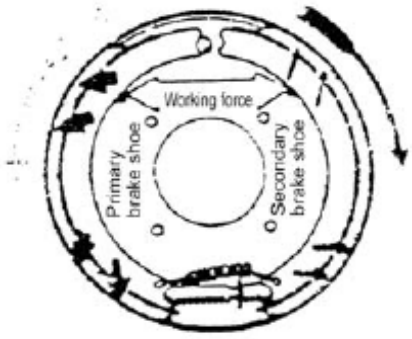


Fig. 2-4 Braking operation in backward travel

(2) Parking brake

The parking brake is built in the service 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)

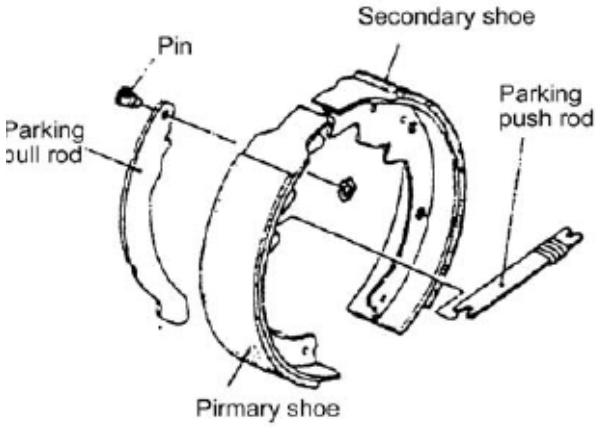


Fig. 2-5 Parking brake

(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)

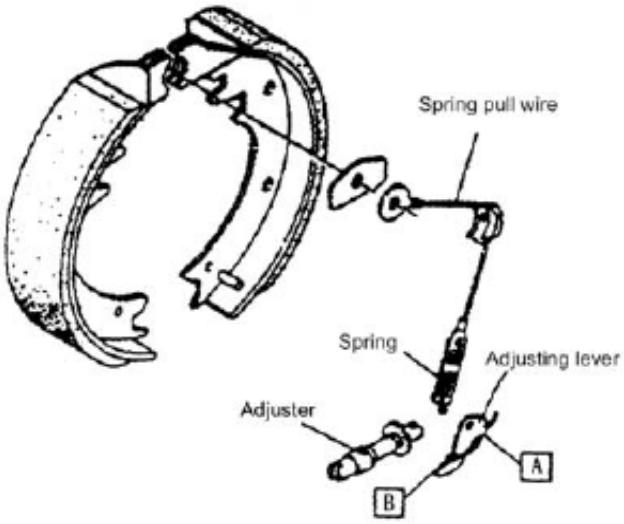


Fig. 2-6 Clearance self-adjuster

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

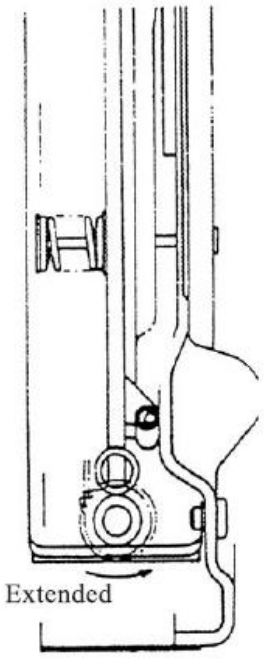


Fig. 2-7 Clearance self-adjuster

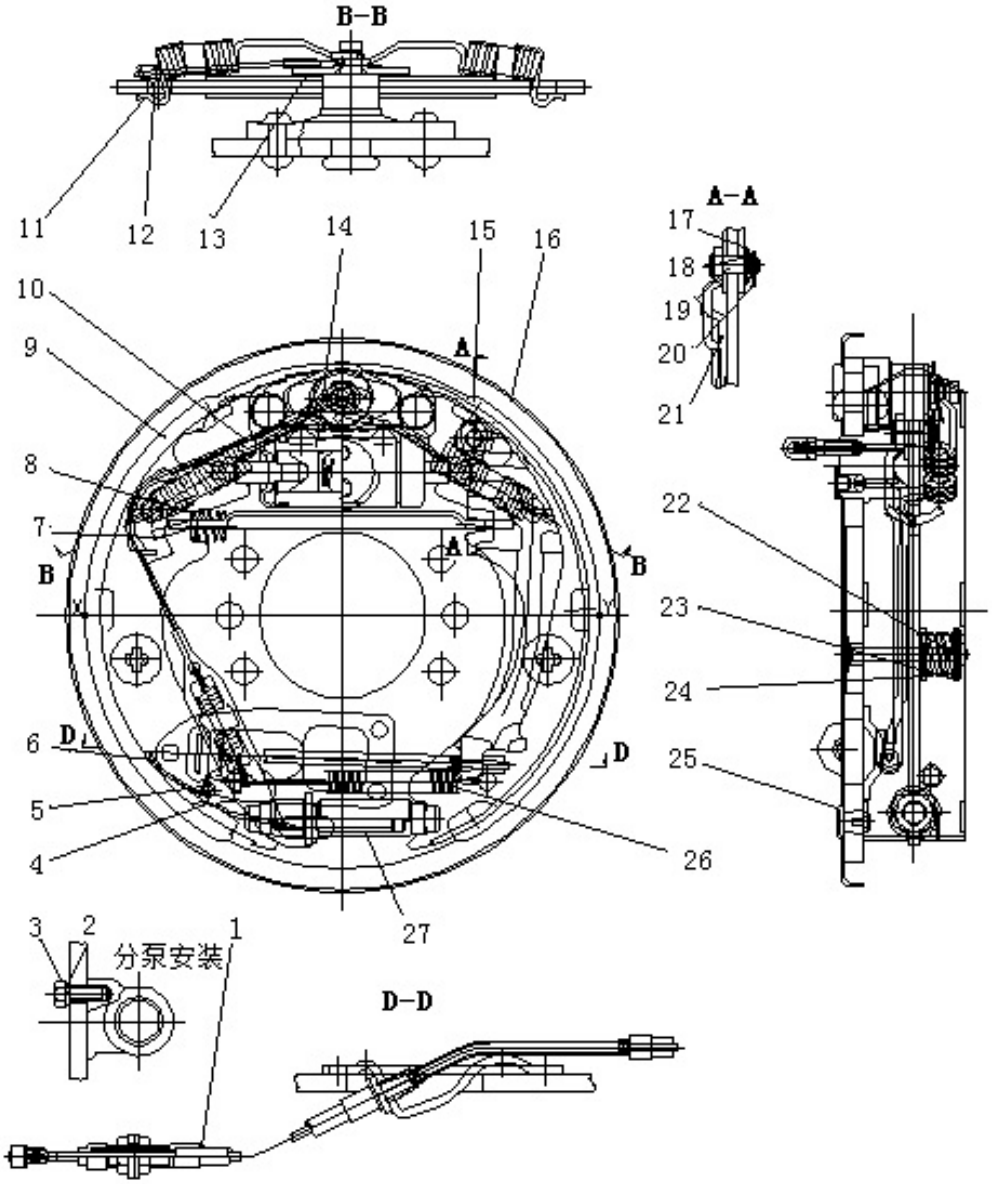


Fig. 2-8 Brake assembly

(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.

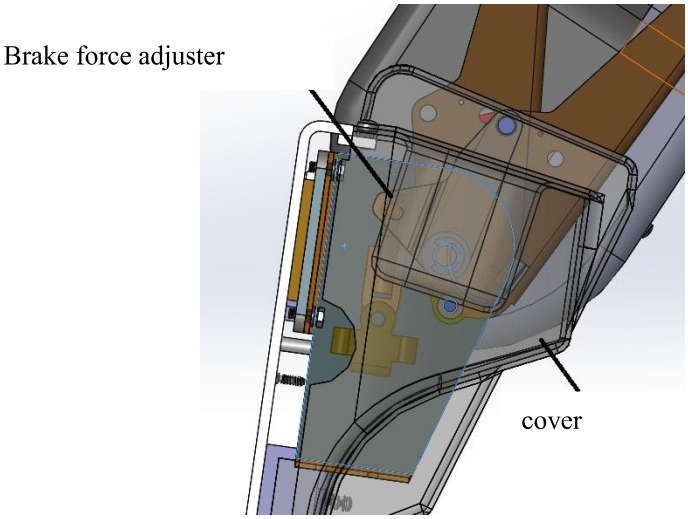


Fig. 2-9 parking brake shank

2.2 Assembling and disassembling, adjustment of brake

This paragraph covers the disassembly, reassembly and adjustment of the 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 Service brake disassembly

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

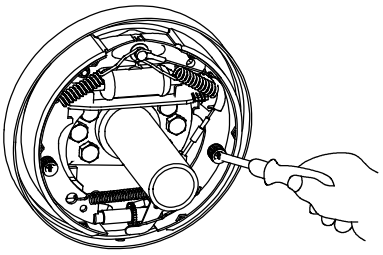


Fig. 2-10

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

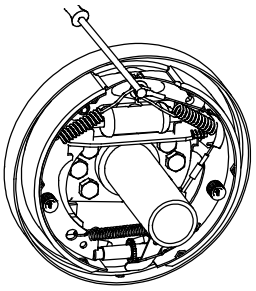


Fig. 2-11

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

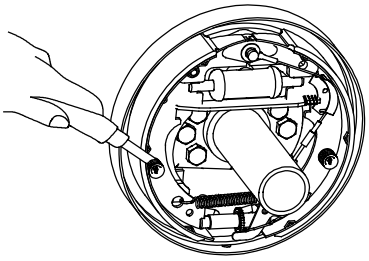


Fig. 2-12

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

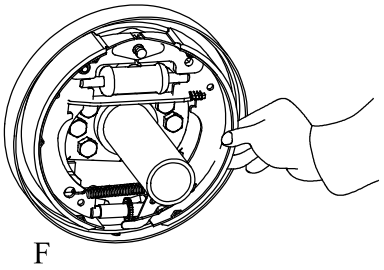


Fig. 2-13

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

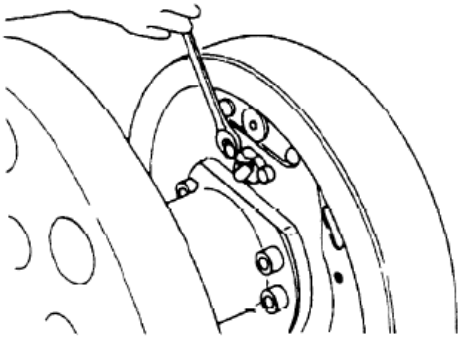


Fig. 2-14

(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)

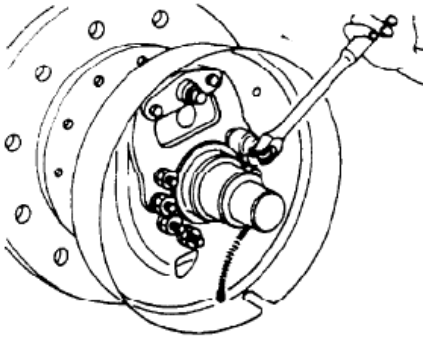


Fig. 2-15

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

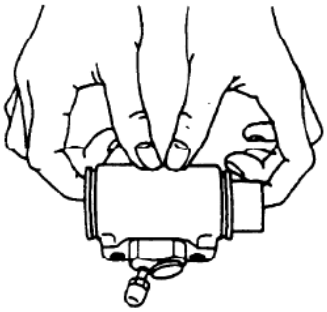


Fig. 2-16

2.2.2 Inspection of 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)

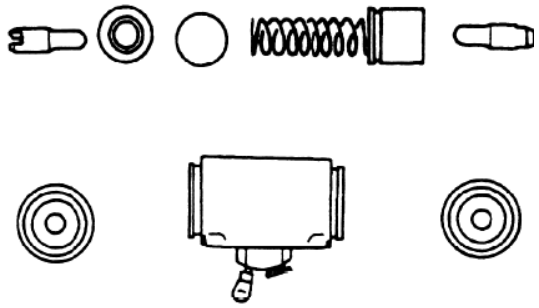


Fig. 2-17

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)

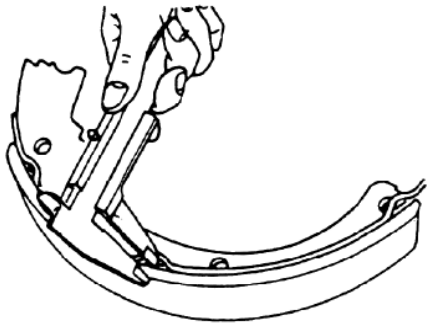


Fig. 2-18

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)

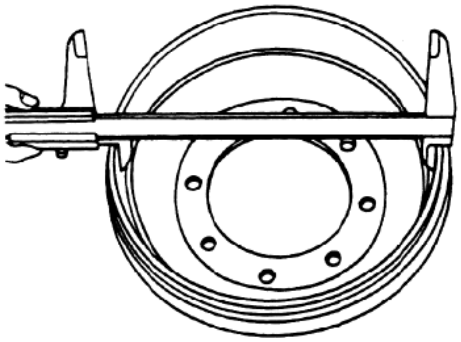


Fig. 2-19

Unit：mm

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

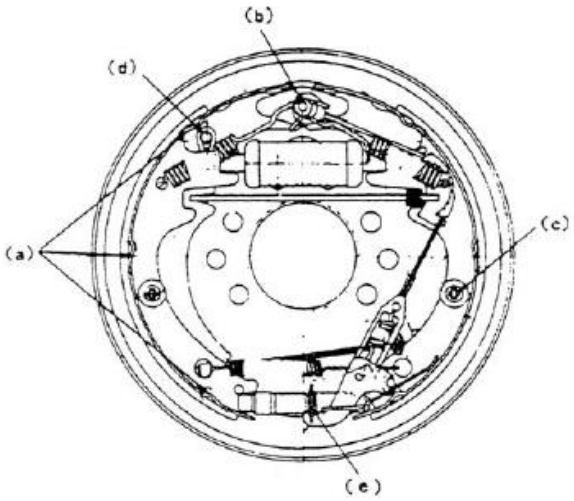
2.2.3 Service brake reassembly

(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)

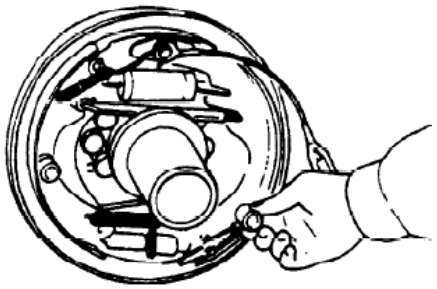


Fig. 2-21

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

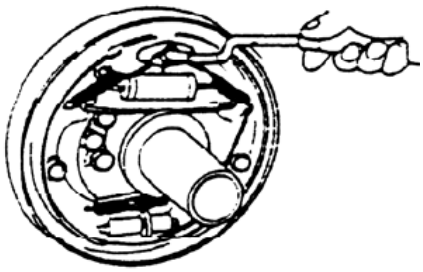


Fig. 2-22

(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)

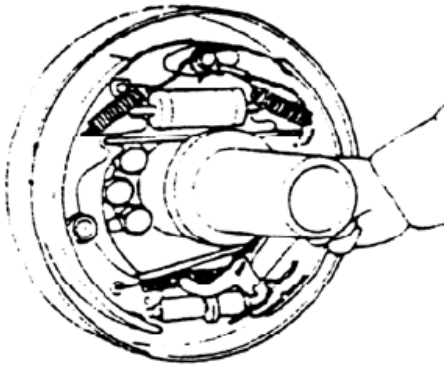


Fig. 2-23

(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)

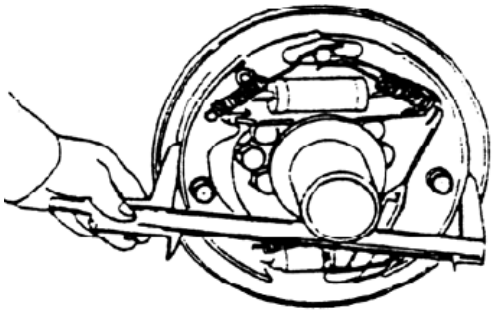


Fig. 2-24

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. Change if necessary.

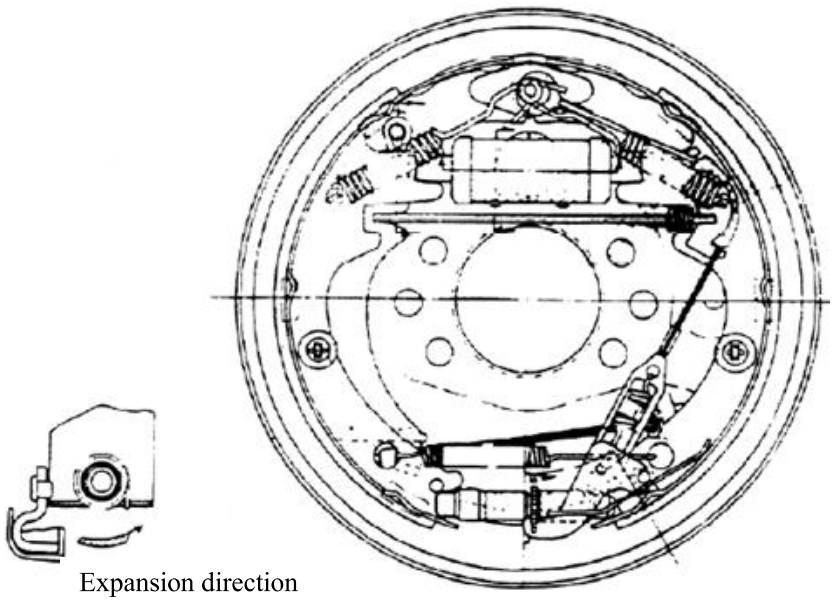


Fig. 2-25

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.

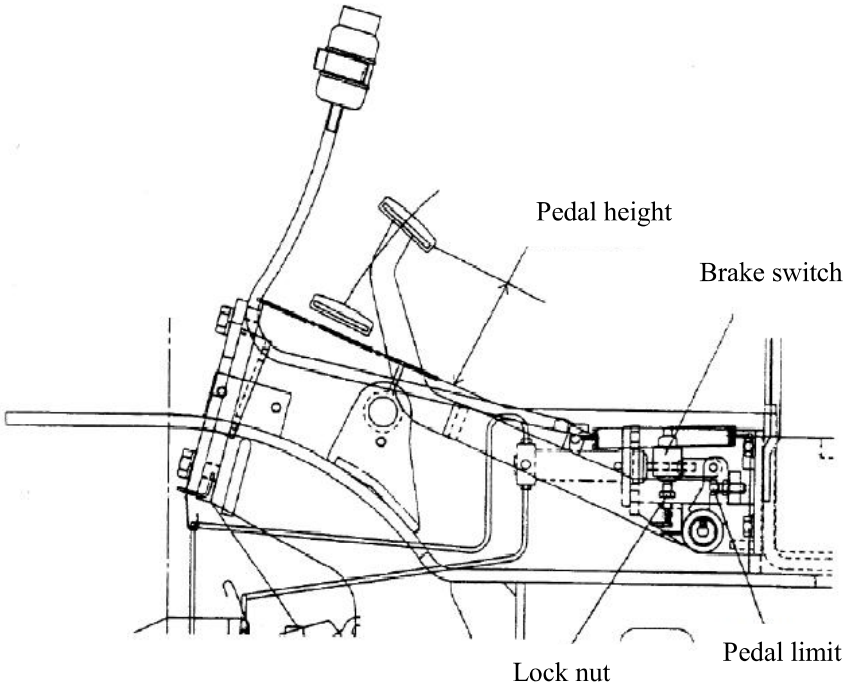


Fig. 2-26

▲ 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)

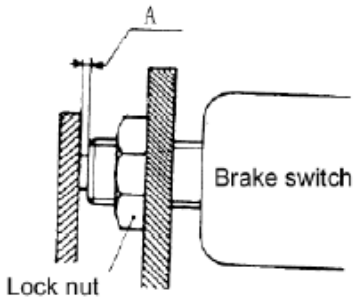


Fig. 2-27

2.2.6 Service 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

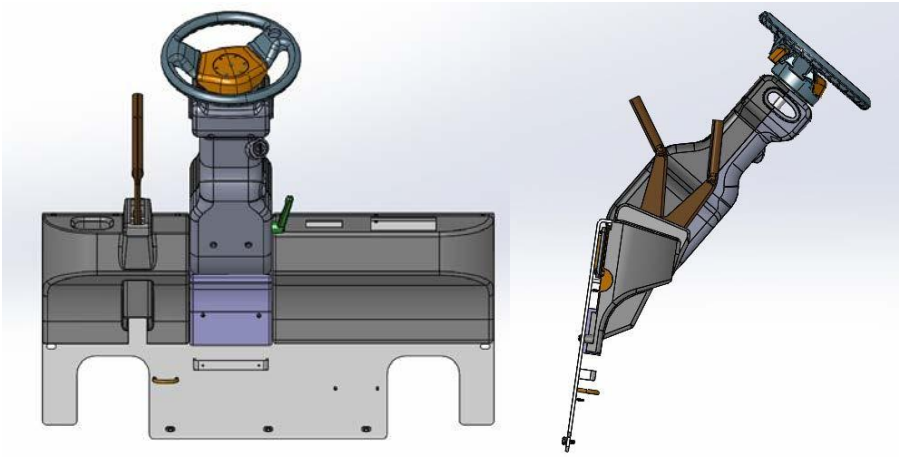


Fig. 3-1 Steering control device

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	4.33R	4.33R
Tyre pressure	860kPa	900kPa	900kPa	Solid tyre

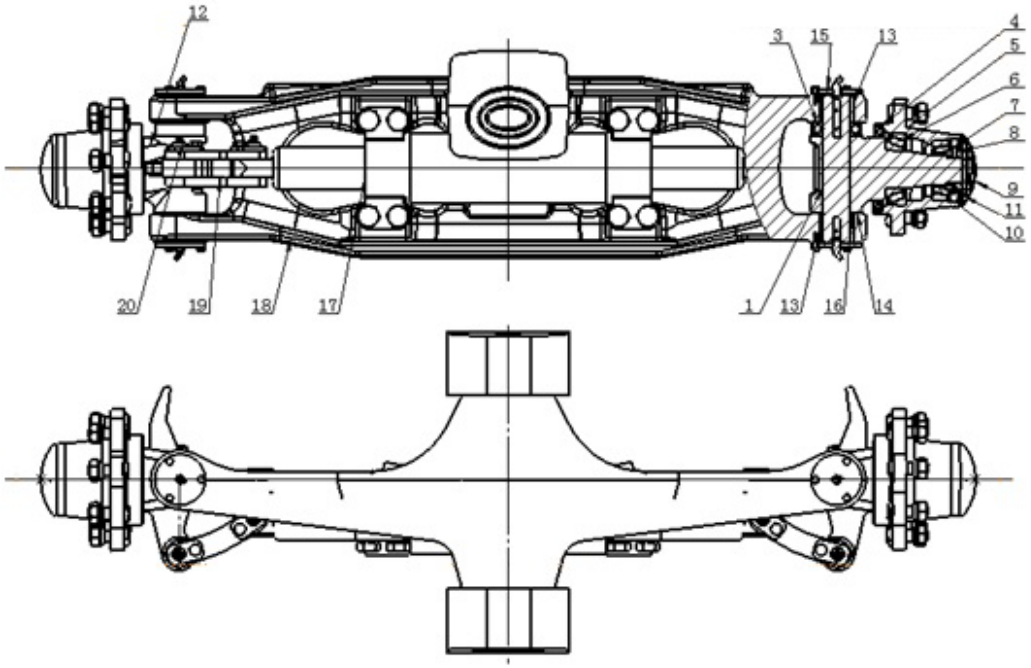


Figure 3-2 steering axle

(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) oil seal (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)

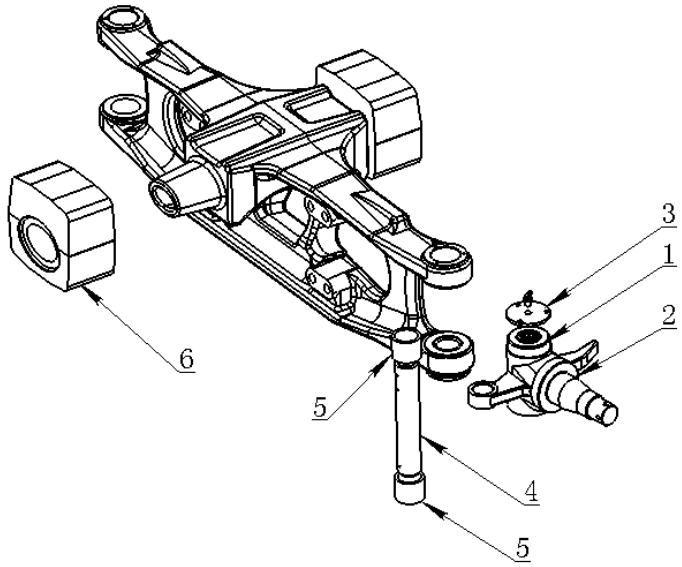


figure 3-3 Steering knuckle

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 is consist 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)

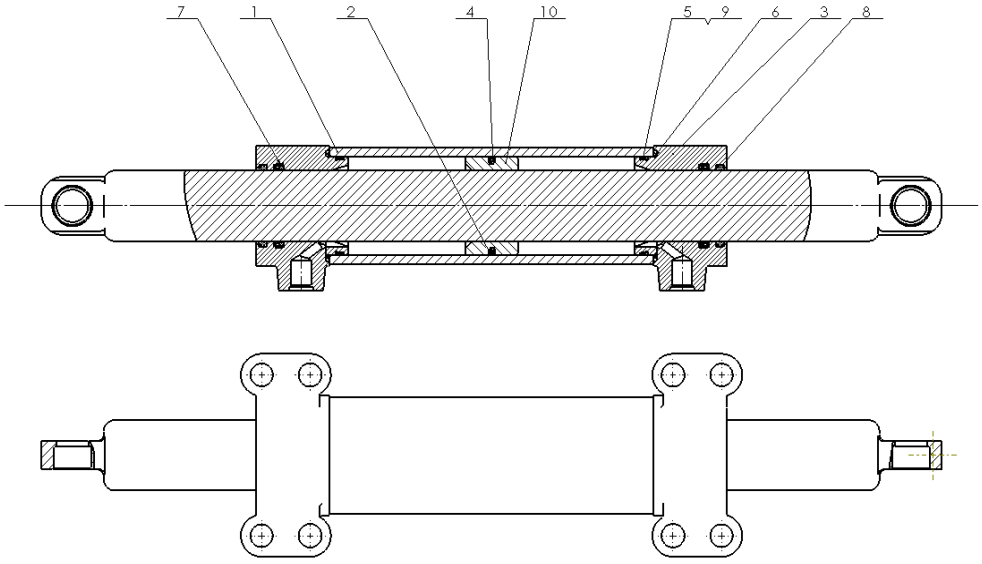


Figure 3-4 steering cylinder

(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.

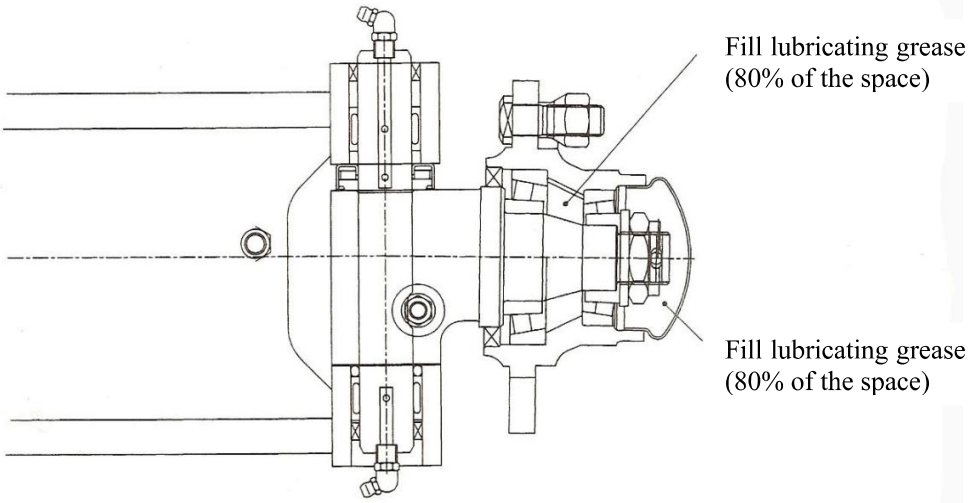


Fig. 3-5 Fill lubricating grease and pre-load adjustment

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 10-25N during steering and the difference of right and left acting force is not more than 10N. 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 is smooth.

(2) Check if the hydraulic pipeline is correctly connected and the right and left steering are installed correctly.

(3) Lift up the rear wheels and slowly turn the steering hand-wheel right 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
	Splite flow valve blocked or damaged	Clean or 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	Spring damaged or elasticity-insufficient.	Replace
	Large steering flow	Adjust Splite flow valve flow
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

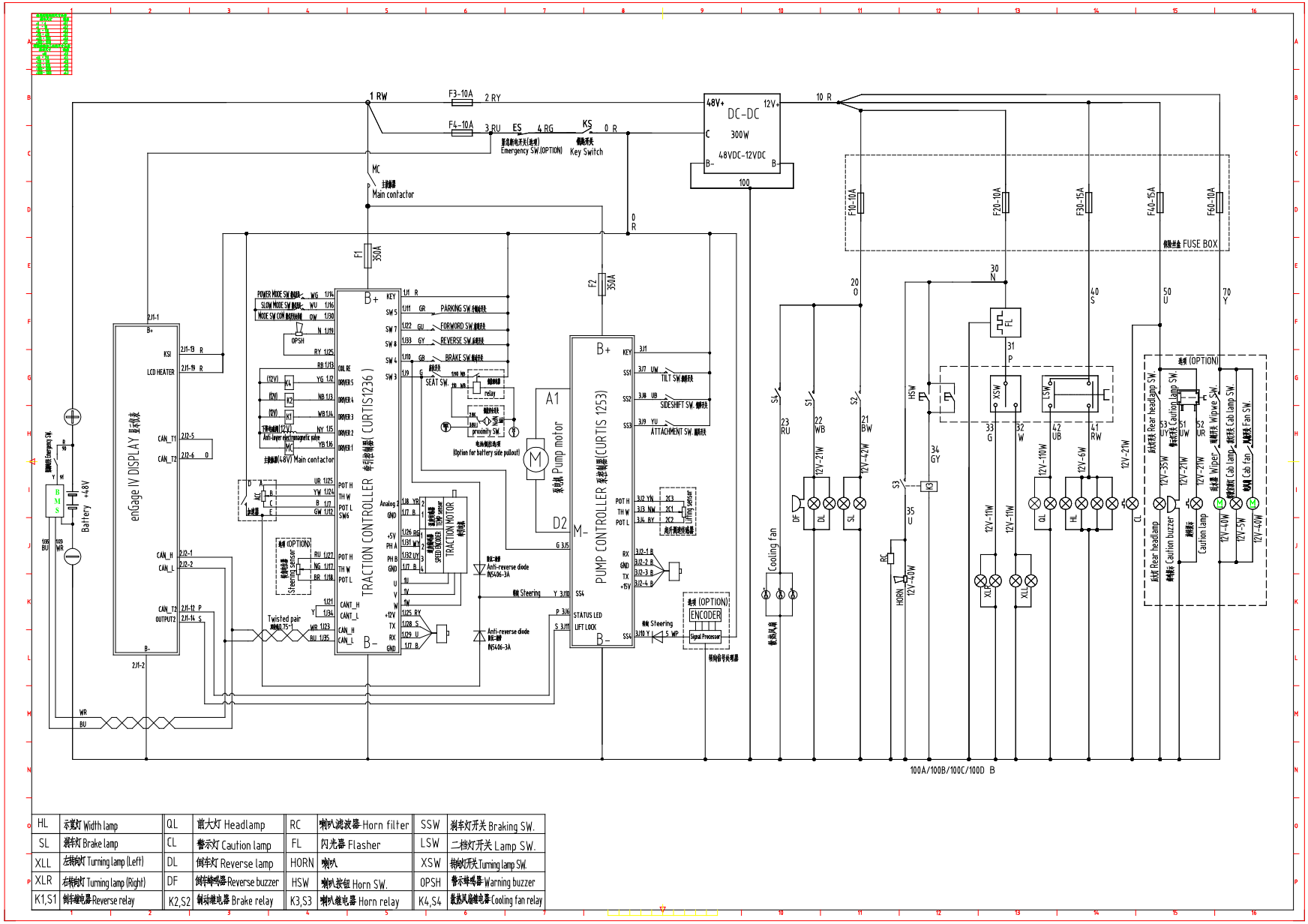
4.1 General Description

CURTIS electric control system is G series 1-3.5t lithium battery forklift truck standard equipment which offers low noisy, high efficient, smooth and safe control.

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. 4-6.



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. 4-1 Circuit diagrams of electric system (CPD10～18-GC1Li)

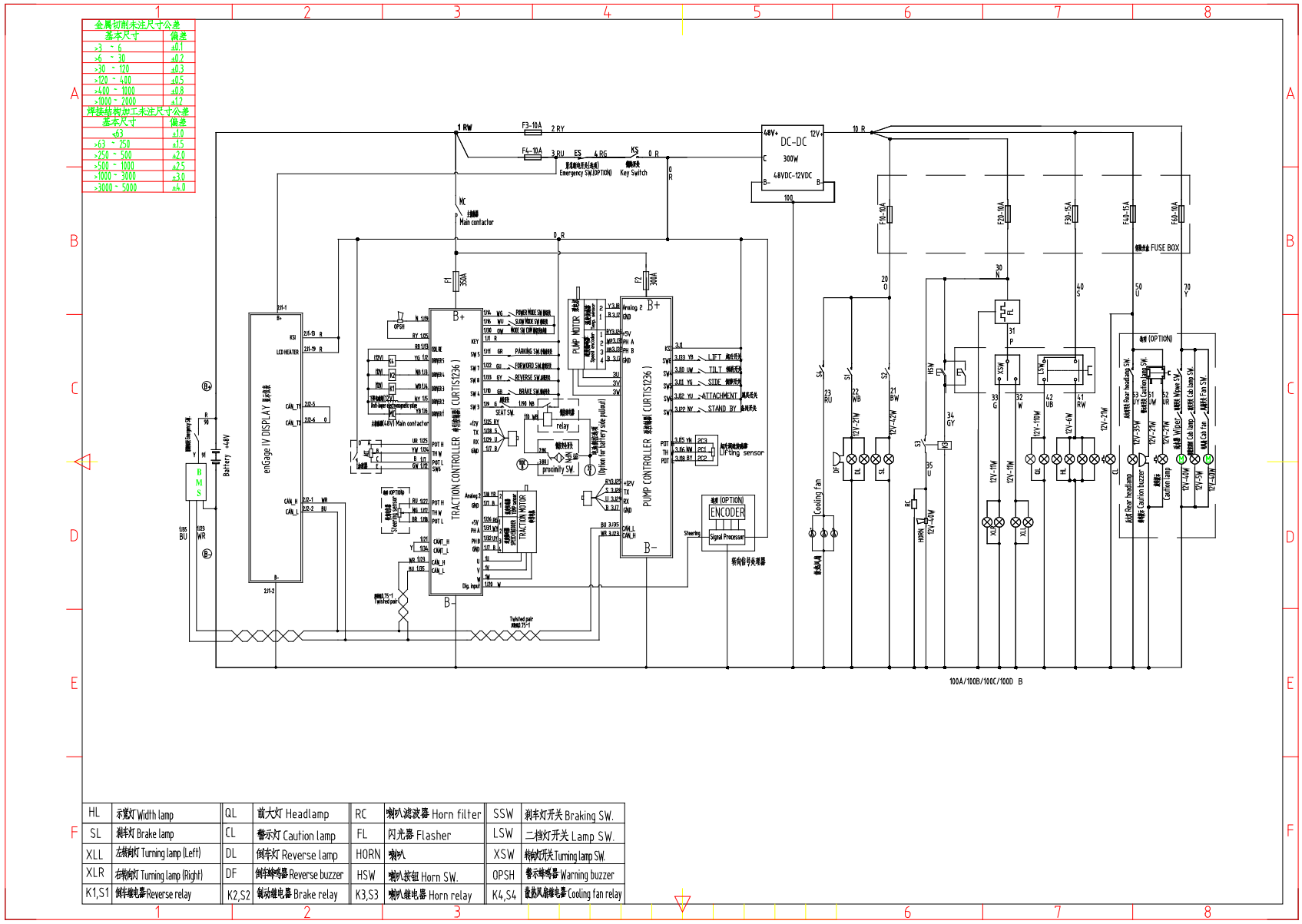
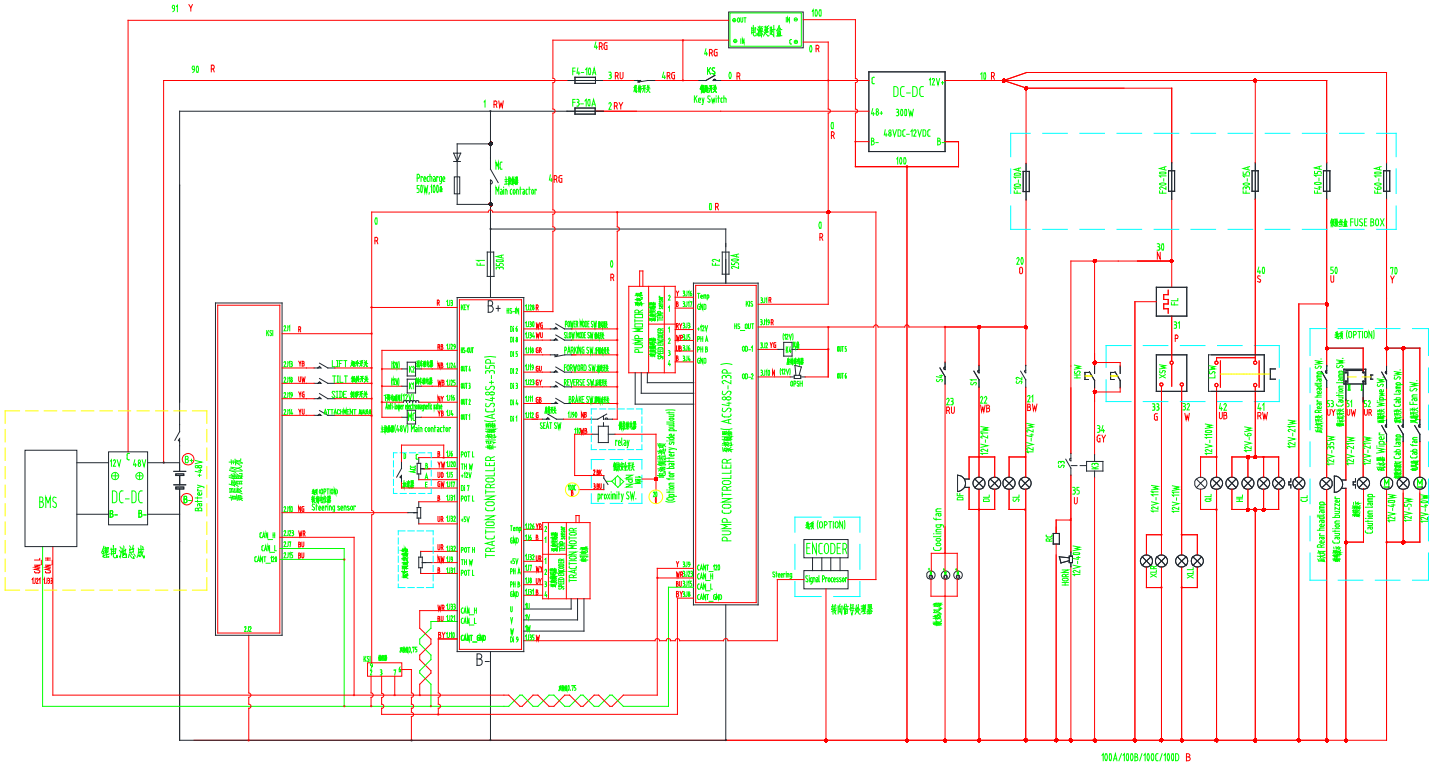
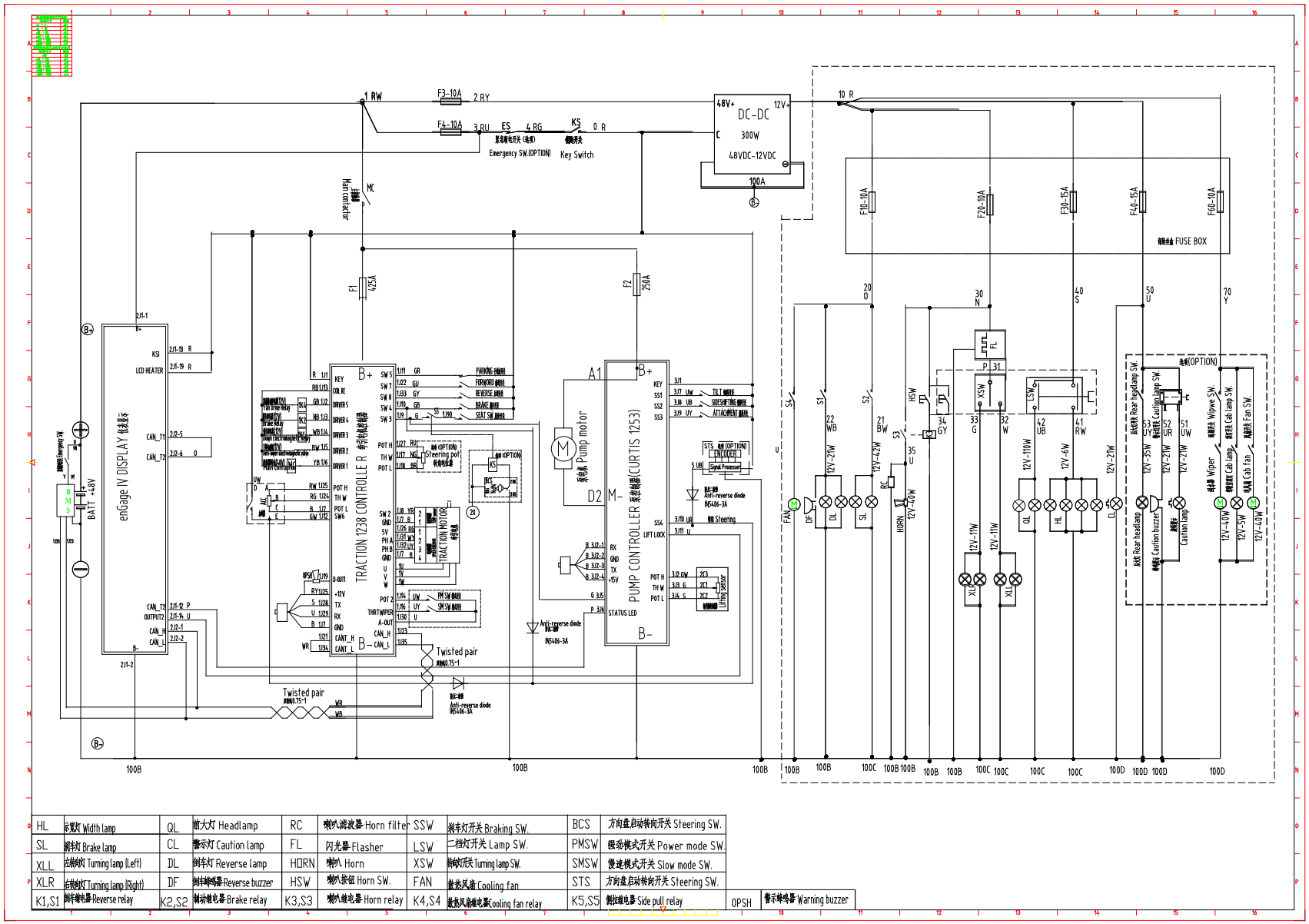


Fig. 4-2 Circuit diagrams of electric system (CPD10～18-GD1Li)



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 4-3 Circuit diagrams of electric system（CPD10～18-GD3Li）



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.	BCS	方向盘启动转向开关 Steering 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.	PMSW	强劲模式开关 Power mode SW.		
XLL	左转向灯 Turning lamp (Left)	DL	倒车灯 Reverse lamp	HORN	喇叭 Horn	XSW	转向灯开关 Turning lamp SW.	SMSW	慢速模式开关 Slow mode SW.		
XLR	右转向灯 Turning lamp (Right)	DF	倒车蜂鸣器 Reverse buzzer	HSW	喇叭按钮 Horn SW.	FAN	散热风扇 Cooling fan	STS	方向盘启动转向开关 Steering SW.		
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	K5,S5	侧拉继电器 Side pull relay	OPSH	警示蜂鸣器 Warning buzzer

Fig. 4-4 Circuit diagrams of electric system (CPD20～25-GC1Li)

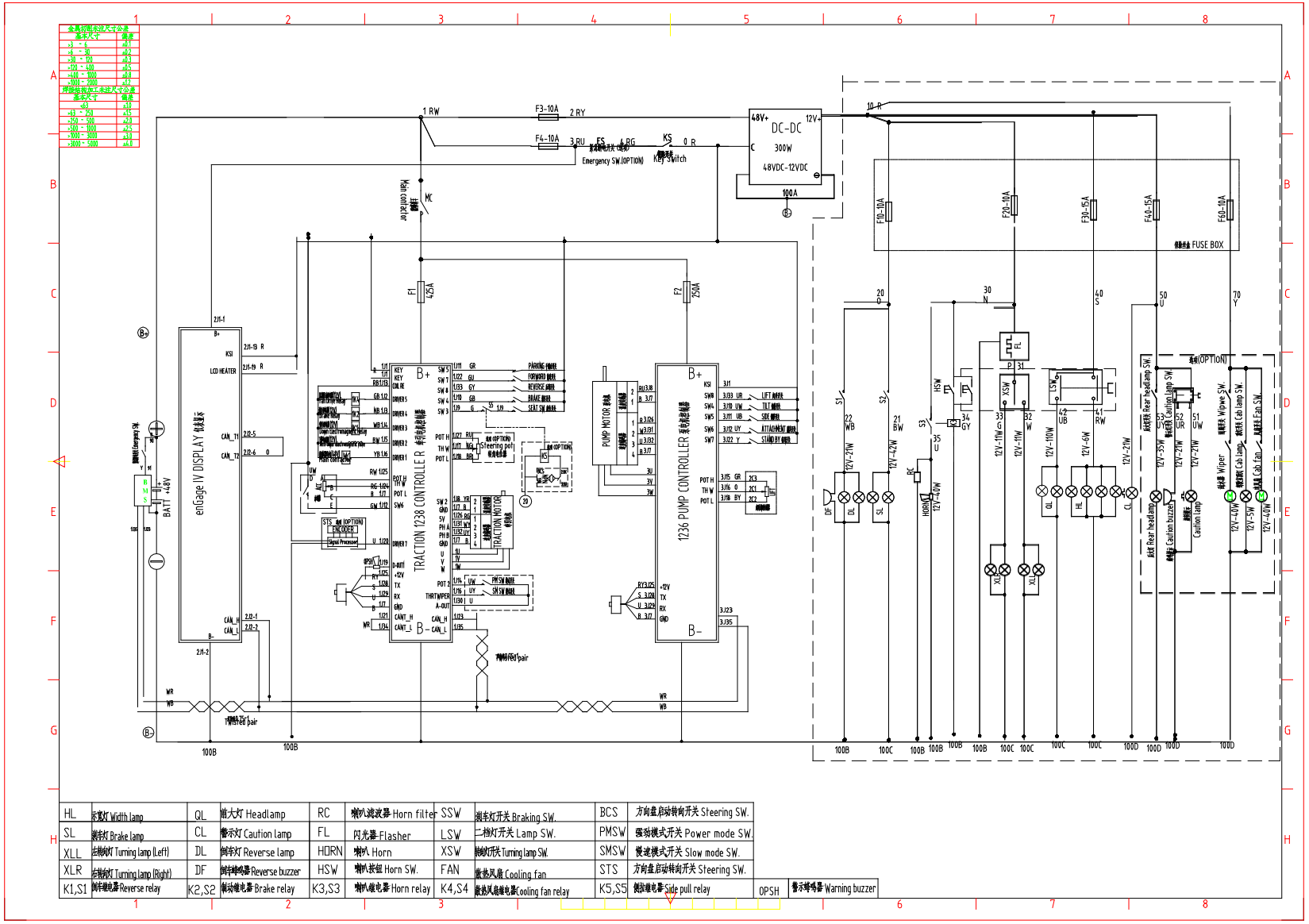
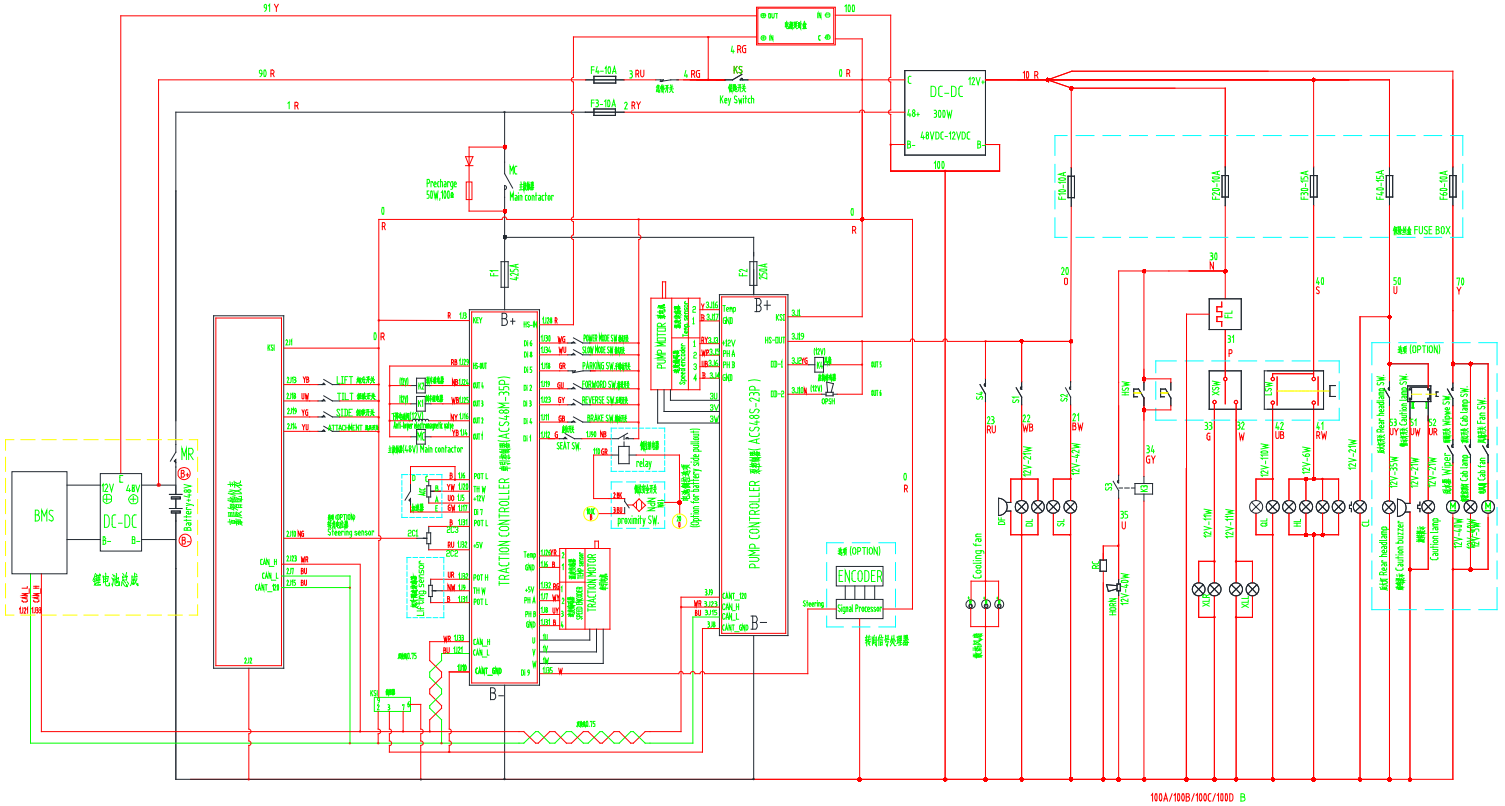
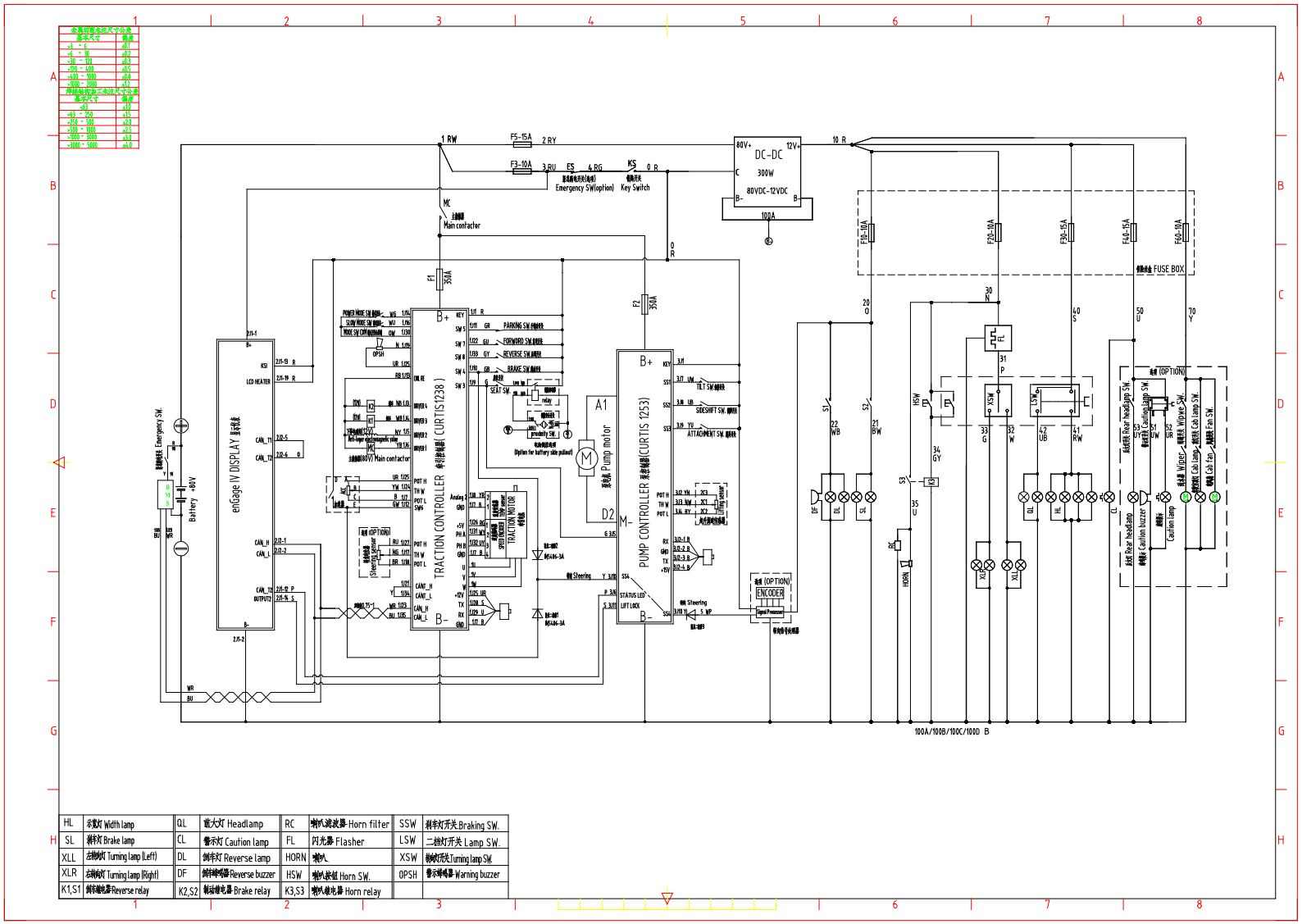


Fig. 4-5 Circuit diagrams of electric system（CPD20～25-GD1Li）



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 4-6 Circuit diagrams of electric system（CPD20～25-GD3Li）



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		

Fig. 4-7 Circuit diagrams of electric system CPD30～35-GC1Li)

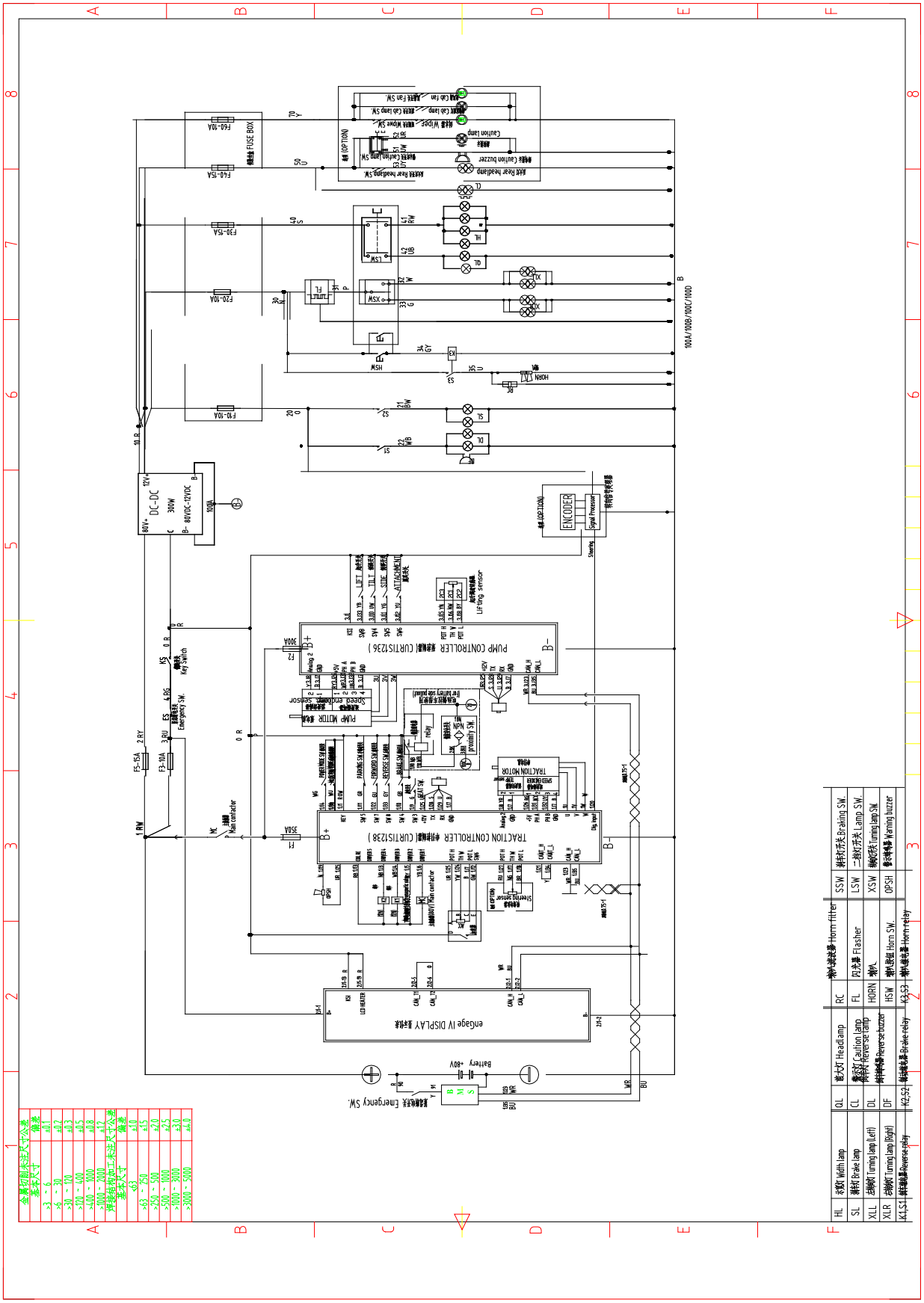
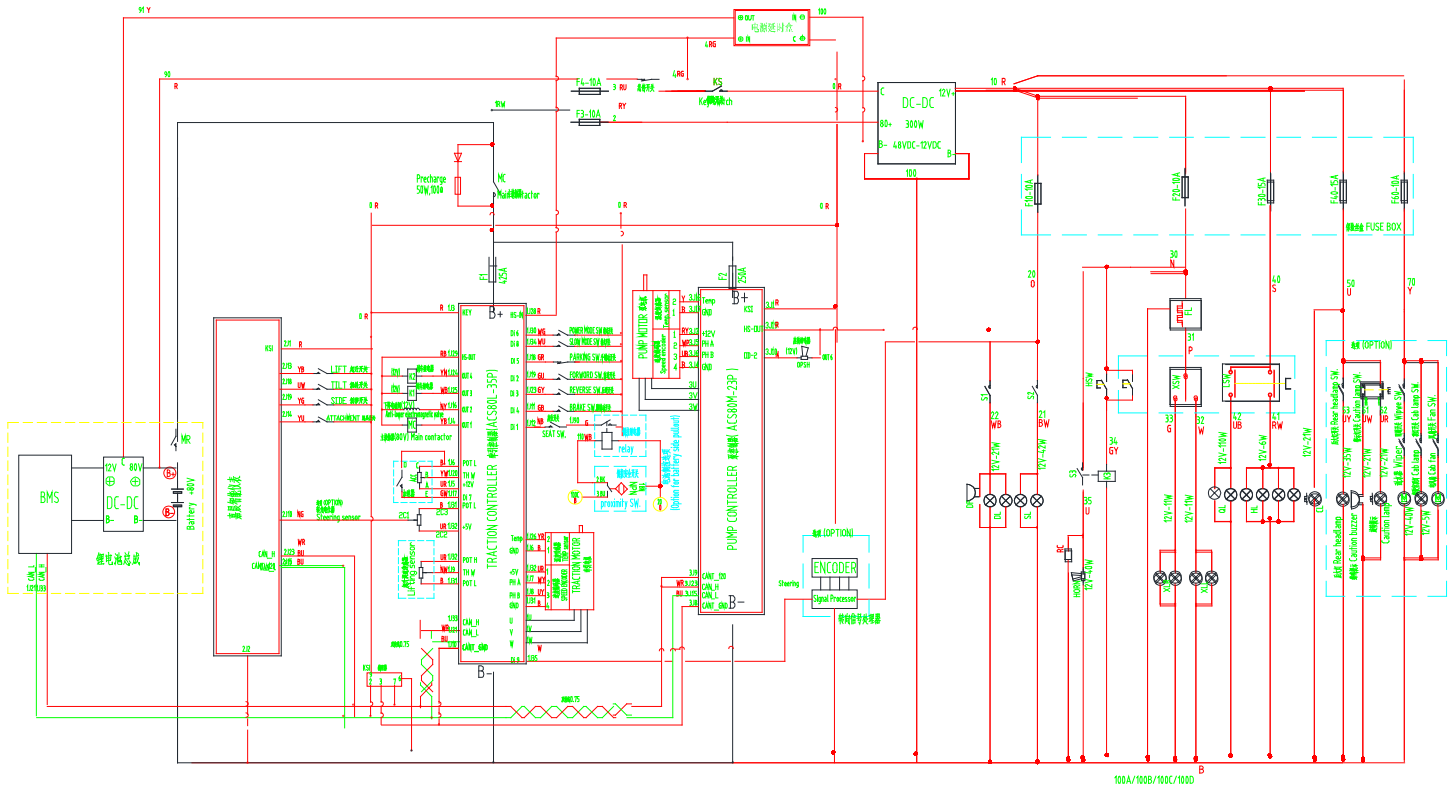


Fig. 4-8 Circuit diagrams of electric system CPD30～35-GD1Li)



HL	示宽灯 Width lamp	QL	前大灯 Headlamp	RC	喇叭滤波器 Horn filter		
SL	刹车灯 Brake lamp	CL	警示灯 Caution lamp	FL	闪光器 Flasher	SSW	刹车灯开关 Braking SW.
XLL	左转向灯 Turning lamp (Left)	DL	倒车灯 Reverse lamp	HORN	喇叭	LSW	二档灯开关 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.	XSW	转向灯开关 Turning lamp SW.
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	OPSH	警示蜂鸣器 Warning buzzer

Figure 4-9 Circuit diagrams of electric system (CPD30～35-GD3Li)

4.2 Instrument

4.2.1 ENGAGE IV instrument (for Curtis controller)

(1) Display of the instrument

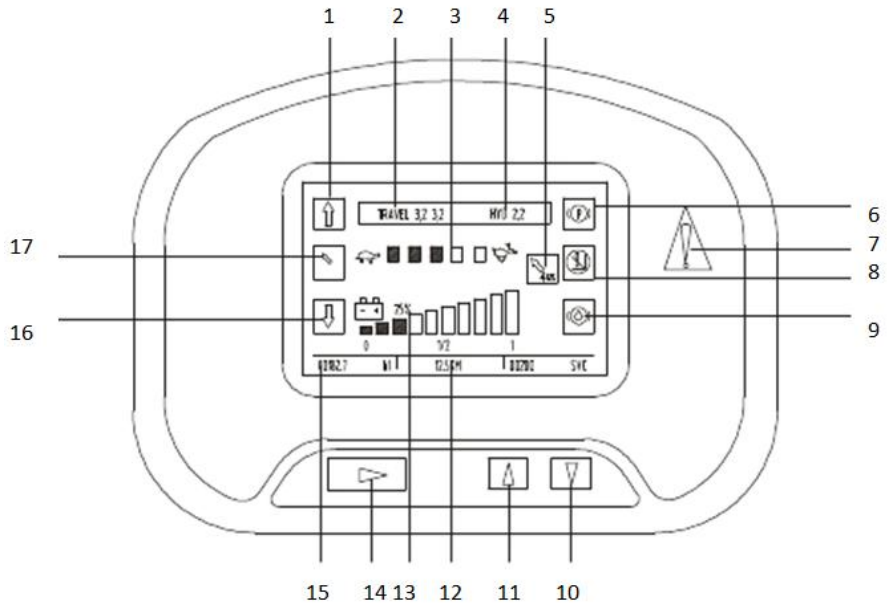


Fig. 4-10 Display of the CURTIS ENGAGE IV instrument

(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 Jiacheng intelligent instrument (for inmotion controller)

(1) Panel layout

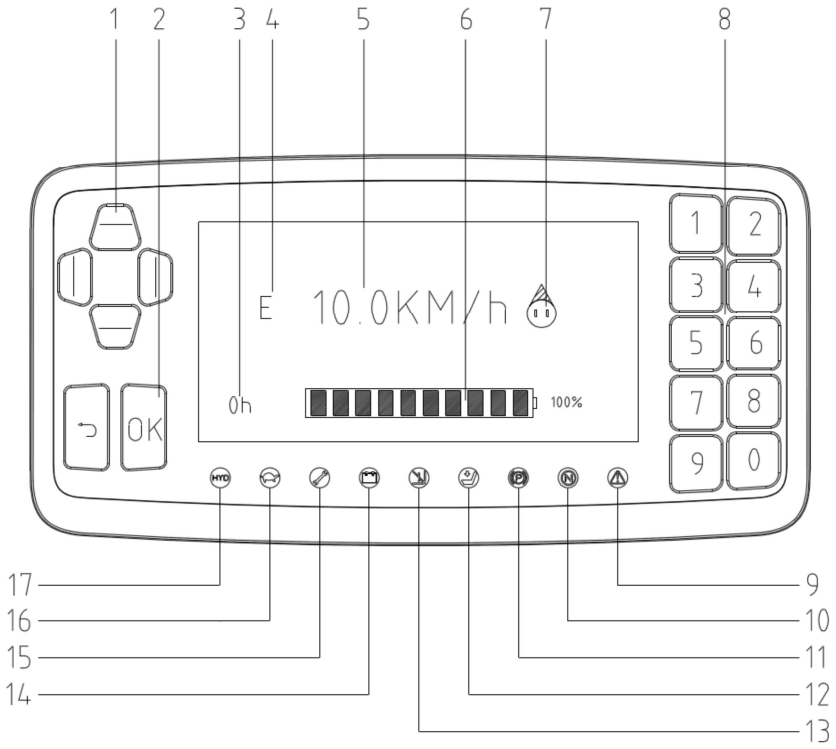


Figure 4-11 Panel of Jiacheng intelligent instrument

1. Navigation key 2. Menu enter/confirm key 3. Hour meter
4. Display of travelling mode 5. Display of travelling speed
6. Display of battery dump energy 7. Display of steering angle 8. Numeric key
9. Alarm indicator 10. Neutral indicator 11. Display of hand brake state
12. Display of seat switch 13. Lifting lock indicator
14. Undervoltage alarm indicator 15. Fault alarm indicator
16. Tuttle speed indicator 17. Fault indicator of DC pump

(2) Functions and usage

Jiacheng intelligent instrument is a kind of truck instrument based on CAN and wireless communication. The instrument can not only show truck speed, working time, battery dump energy , dual language display, password protection, fault code and so on, it also can realize long distance voice alarm, arrangement, vehicle positioning, long distance truck locking, long distance assist and other industrial engineering functions. It also can reset truck parameters, offer on line real time communication, data storage and background monitor and so on.

a) Turn on the key switch, “HELI,LIFTING THE FUTURE” will be shown on the instrument when the power is on. Then instrument self check will be finished and battery

dump energy, truck speed, current default travelling mode(E) and traction hours will be shown on the instrument homepage.

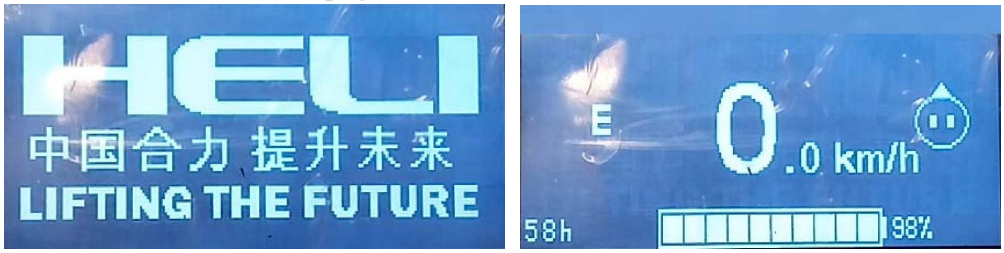


Figure 4-12 Instrument display interface of Jiacheng instrument (fault free condition)

b) Battery dump energy: the figure of battery dump energy has 10 squares. When the battery is full, the 10 squares are on under power on condition. Then the squares will reduce with the discharging of battery. Alarm of low battery dump energy: when there is only one square, the figure of low battery dump energy alarm is on to remind operator to charge the battery. When the 10 squares are off, fault remind figure and lifing lock figure will be on. and at that time, the travelling speed will be reduced and the lifting operation is null. Charge the battery in time.

c) Display of travelling mode: the operator can choose travelling mode through mode switch. The current mode is shown on instrument interface (see figure 4-12). The system has three modes: P refers to power mode, E refers to economc mode (default mode) and S refers to slow mode.

d) Display of fault code: if there is fault, the figure will be on. The fault code and fault are displayed.

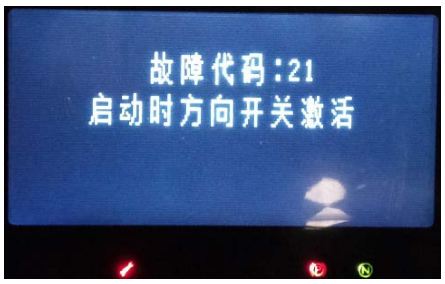


Figure 4-13 Fault display on the instrument

4.3 Controller

4.3.1 General description

The counterbalanced forklift of this series adopts the CURTIS motor controller imported from America or inmotion controller imported from Sweden. The Curtis controller has advantages of advanced technology of high frequency MOS tube, superior speed regulating performance, good safety, flexibility and first-class protection etc. The inmotion controller has the advantages of advanced AC magnetic flux vector control technology, programmable acceleration and deceleration characteristics and best performance curve and so on.

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

4.3.2 CURTIS control device

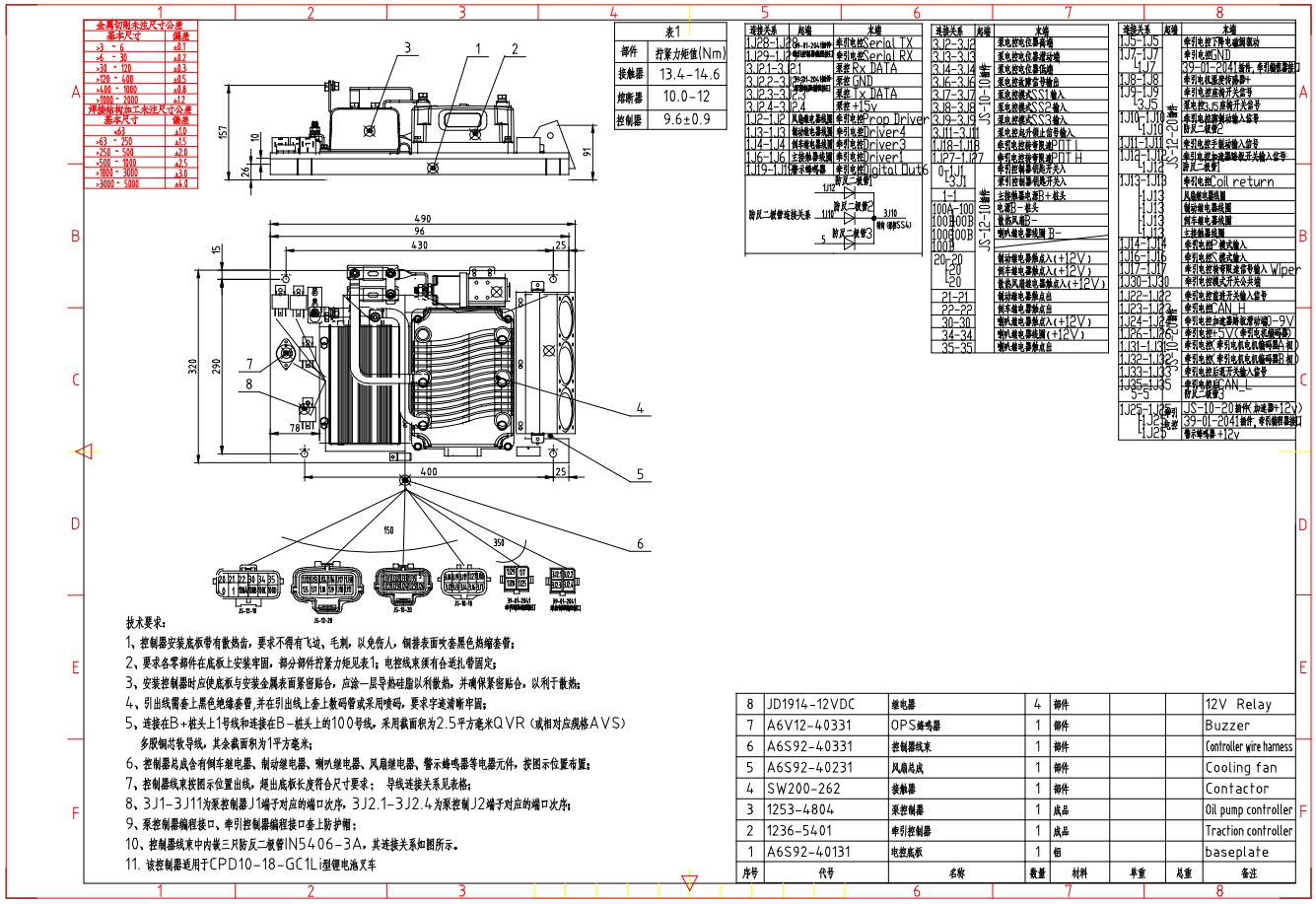


Fig. 4-14 The controller of CPD10-18-GC1Li

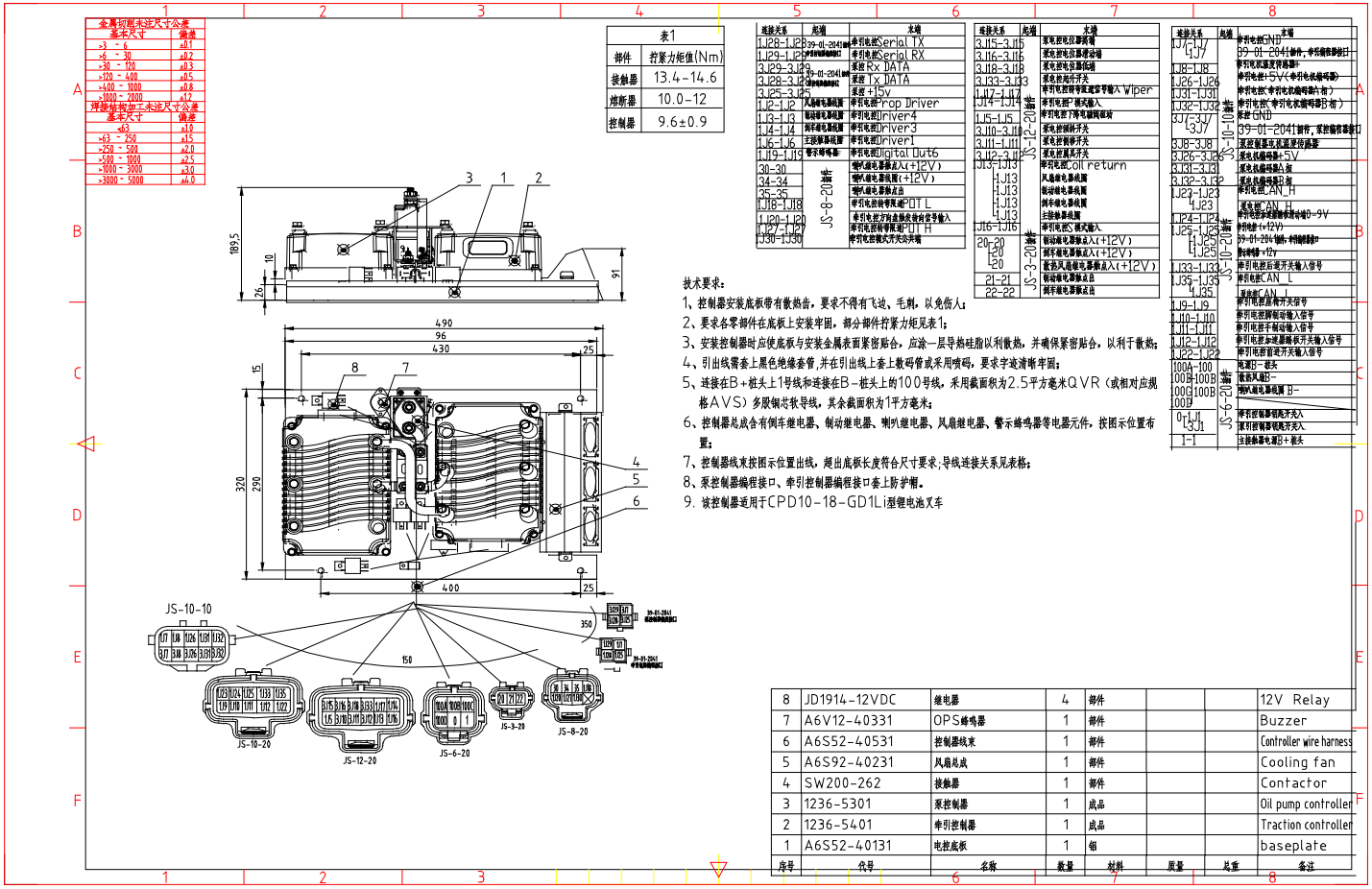


Fig. 4-15 The controller of CPD10～18-GD1Li

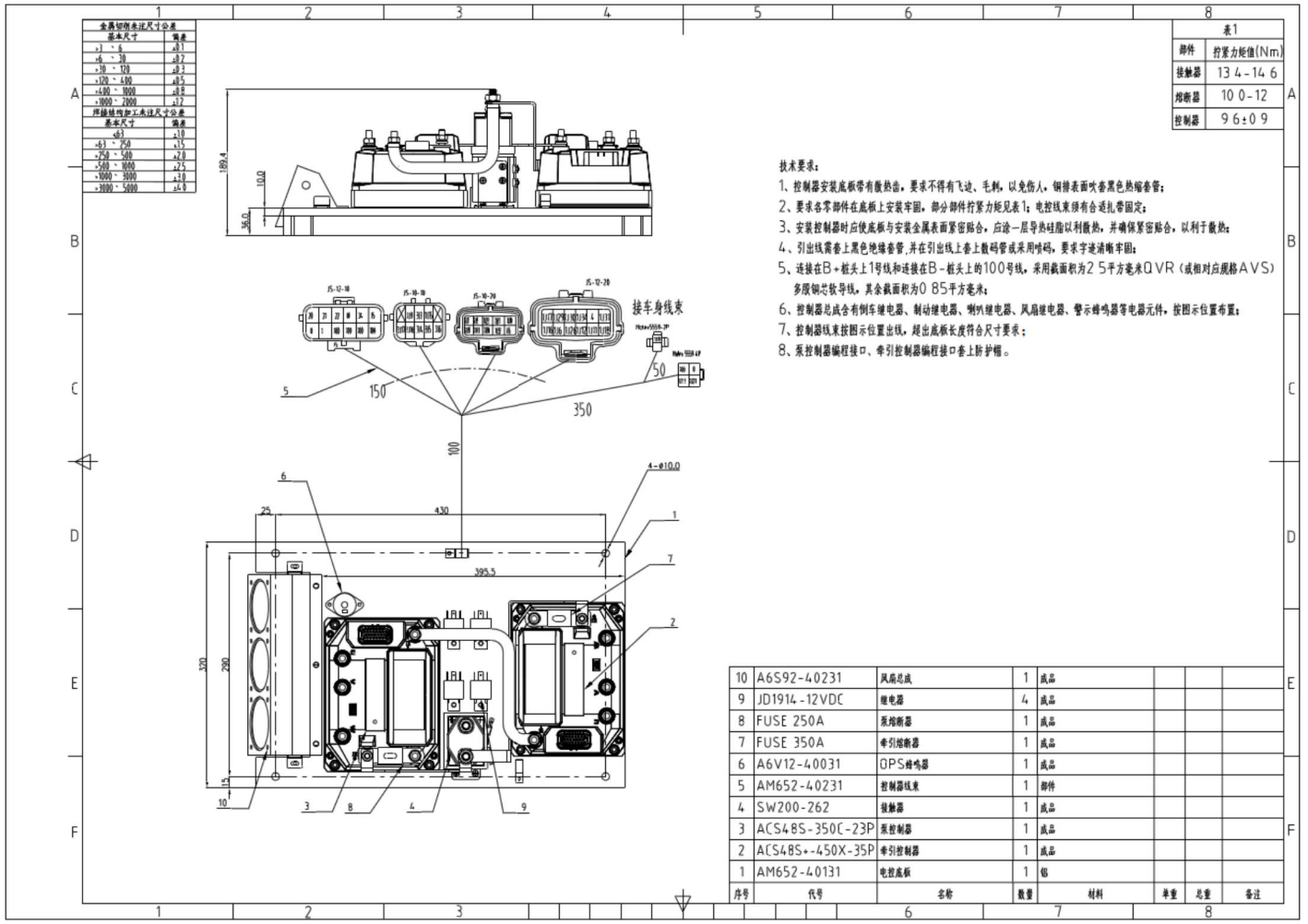


Figure 4-16 The controller of CPD10～18-G31Li

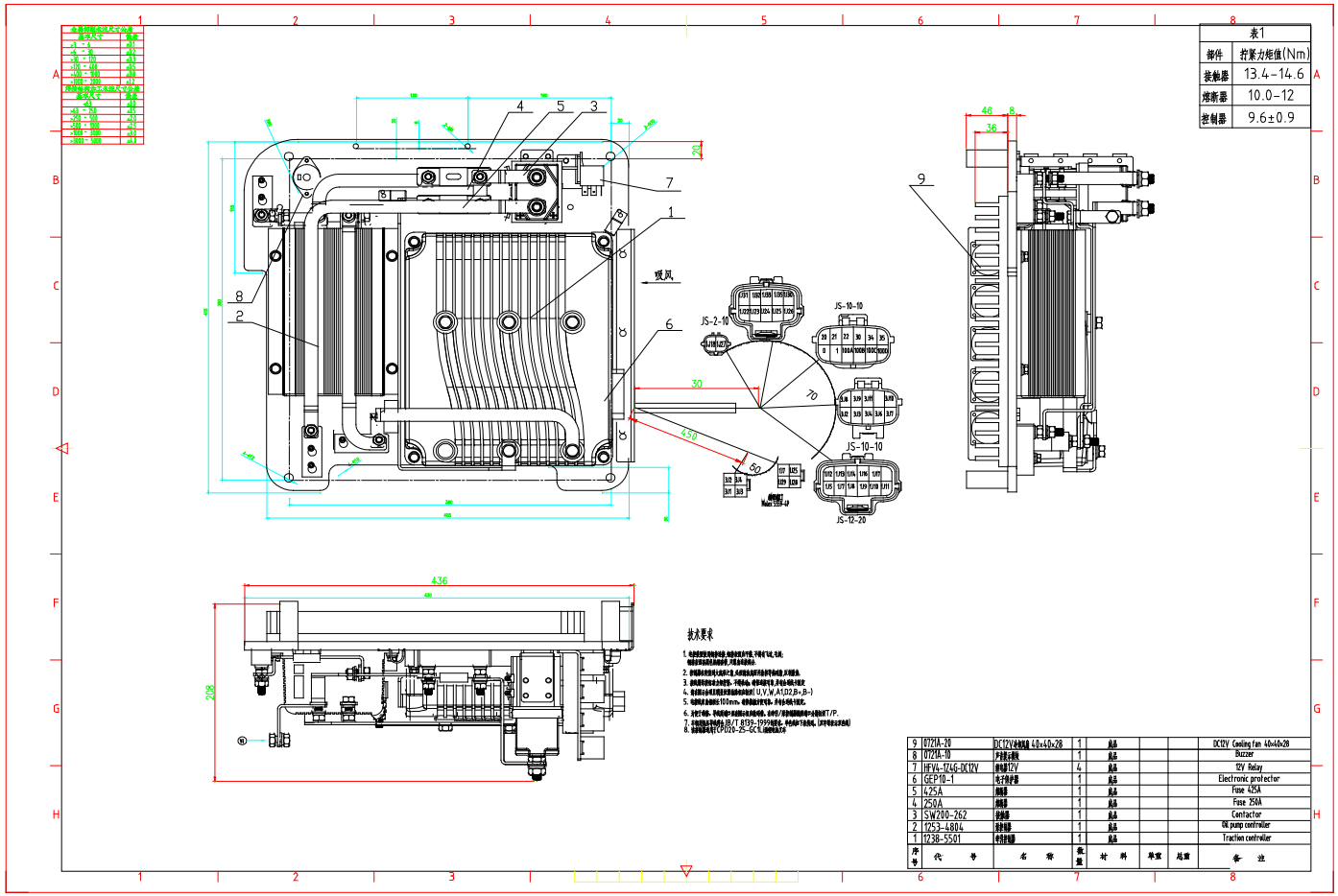


Fig. 4-17 the controller of CPD20～25-GD1Li

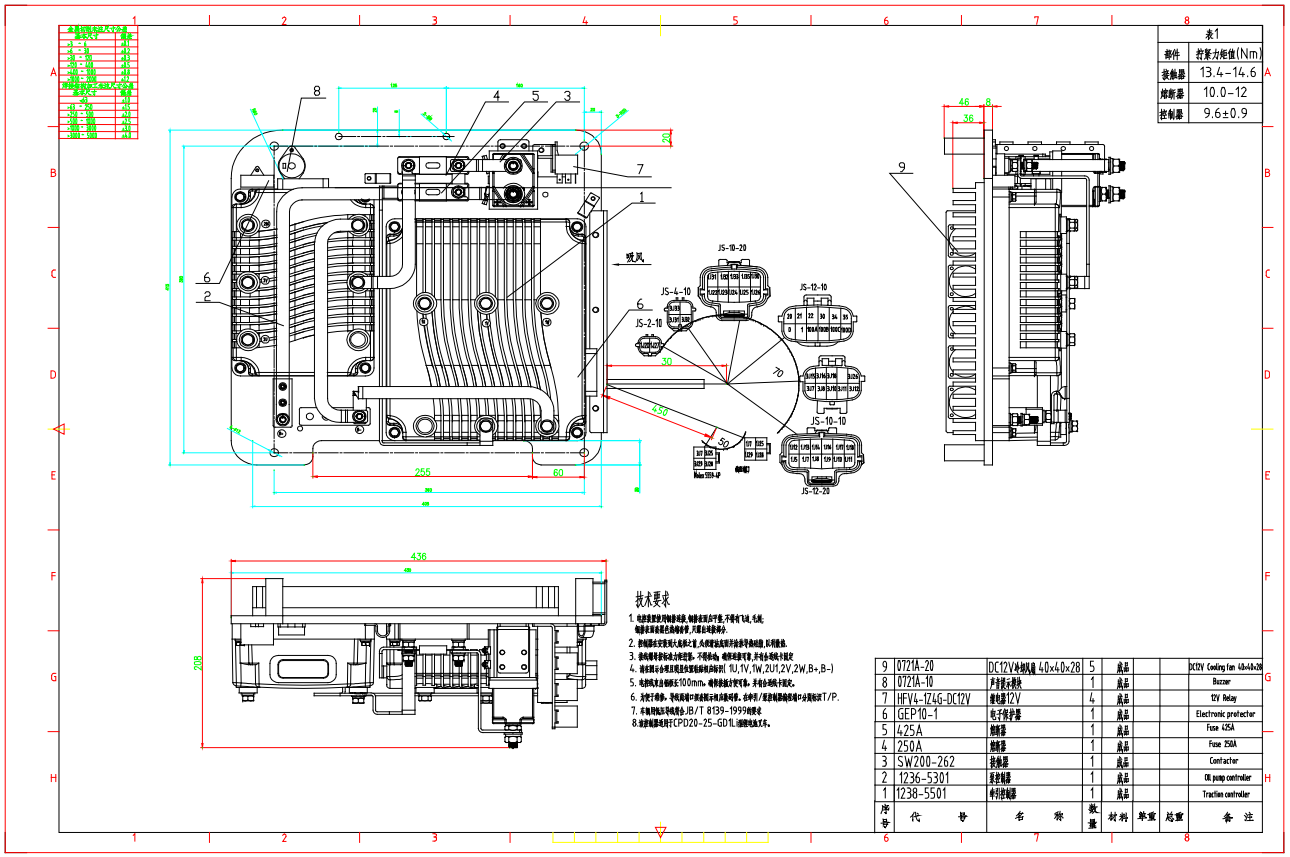


Fig. 4-18 controller of CPD20～25-GD1Li

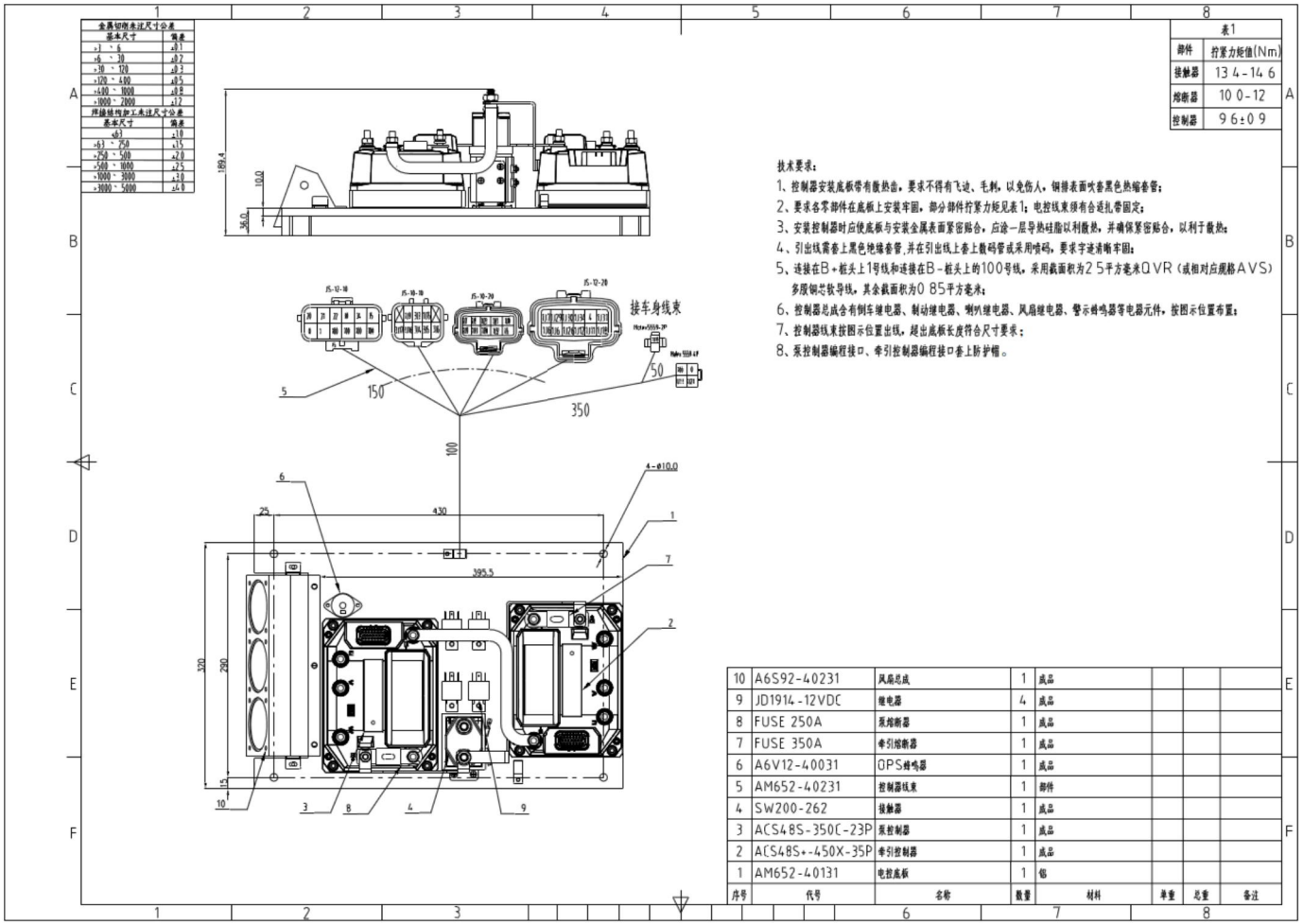


Figure 4-19 The controller of CPD20～25-GD3Li

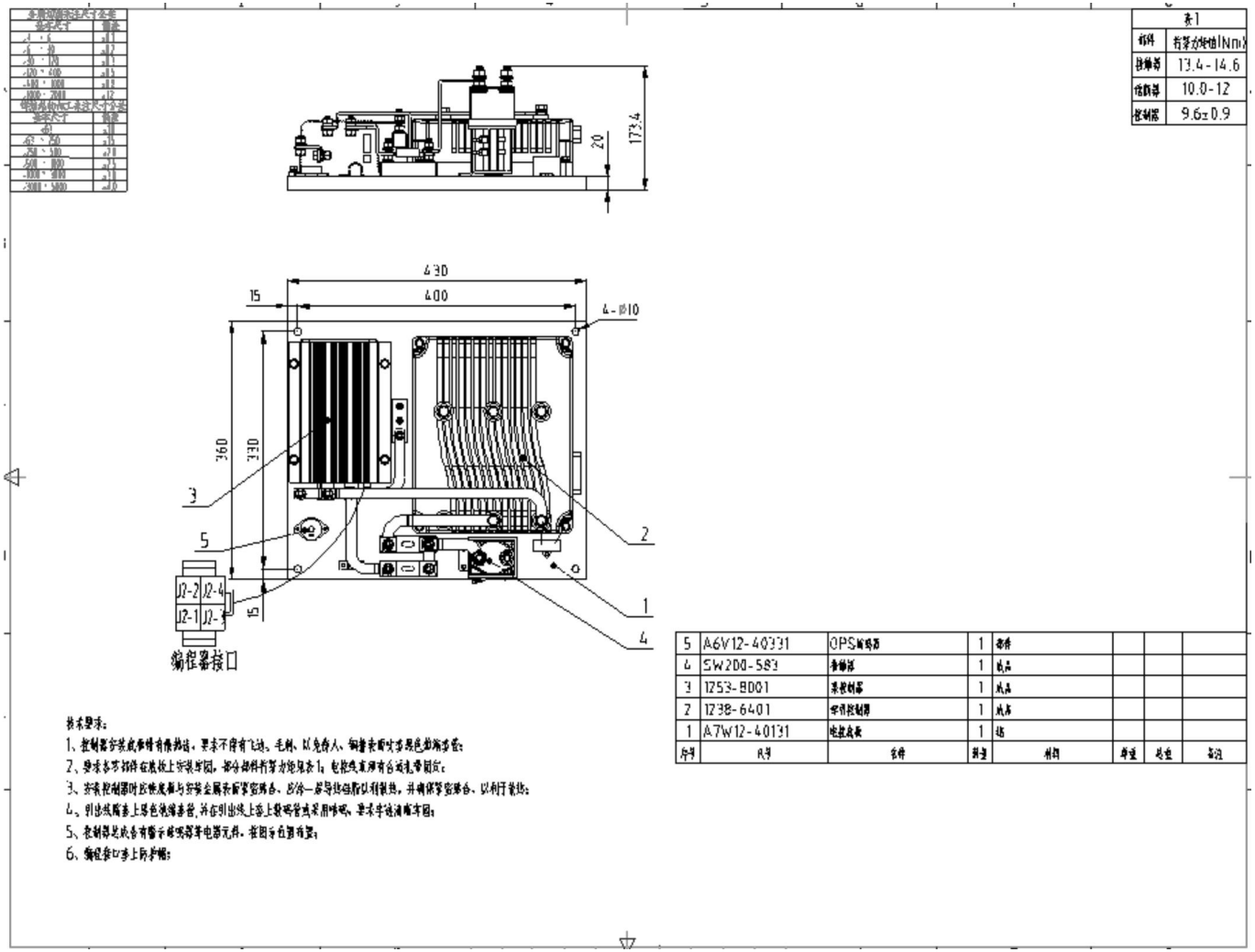


表1

部件	扭矩值(Nm)
接触器	13.4-14.6
熔断器	10.0-12
控制器	9.6±0.9

序号	代号	名称	数量	材料	单重	总重	备注
5	A6V12-40331	OPS编程器	1	部件			
4	SW200-583	接触器	1	成品			
3	1253-BD01	泵控制器	1	成品			
2	1238-6401	举升控制器	1	成品			
1	A7W12-40131	控制底板	1	钣			

Figure 4-20 controller of CPD30～35-GC1Li

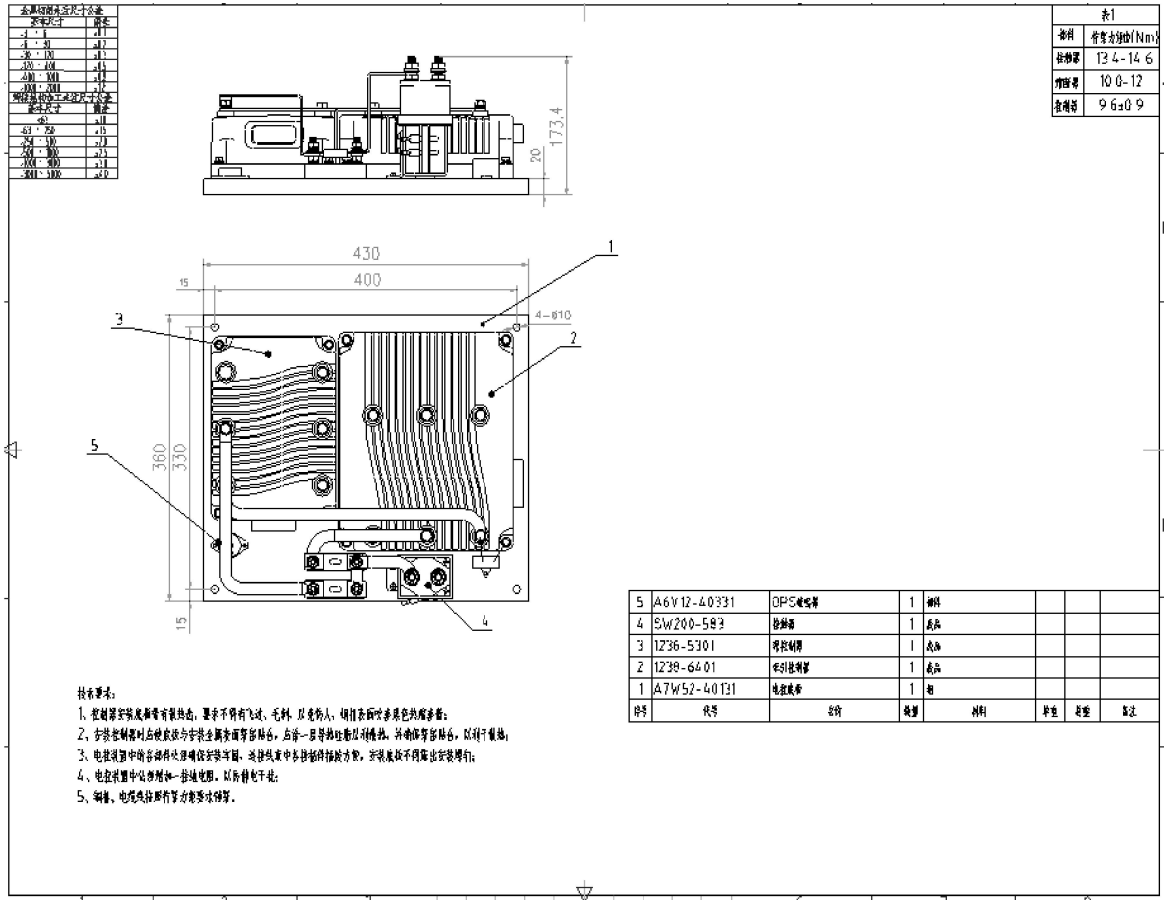


Figure 4-21 controller of CPD30～35-GD1Li

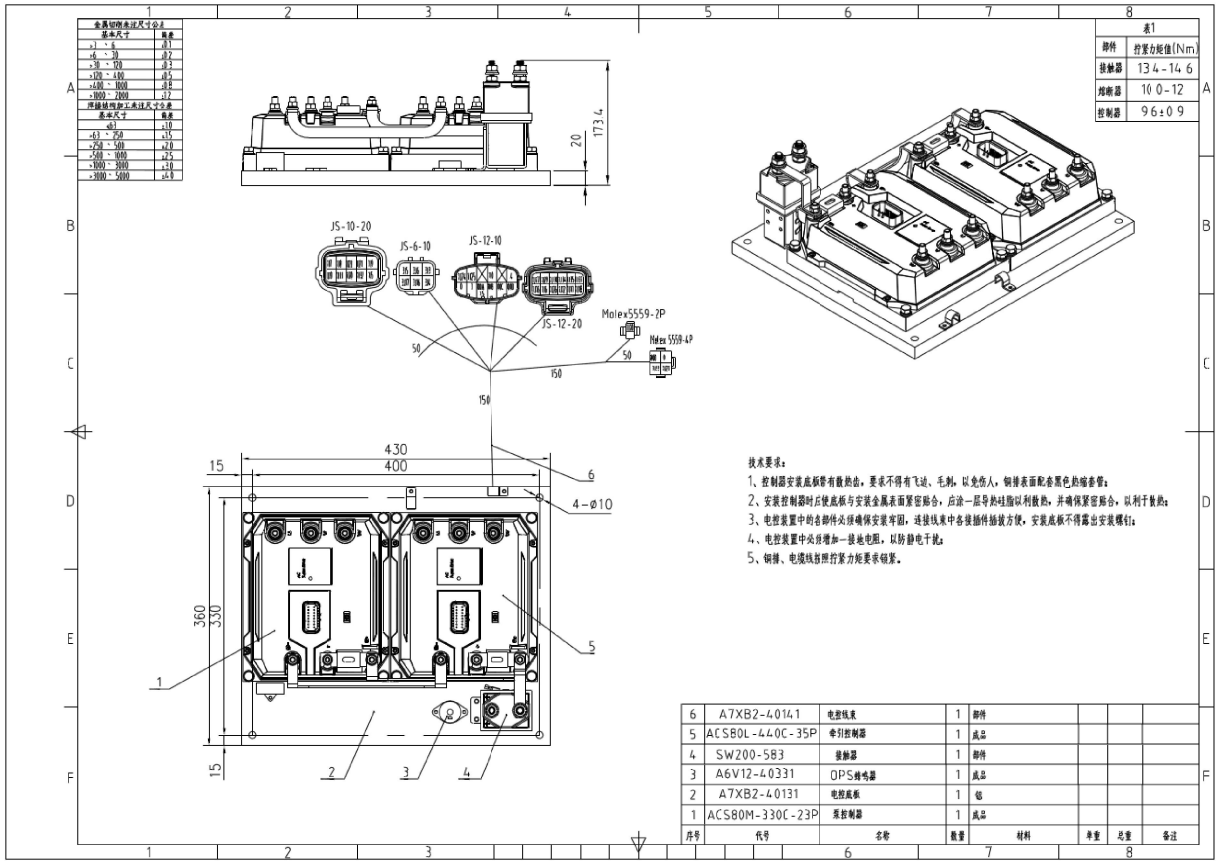


Figure 4-22 The controller of CPD30～35-GD3Li

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 \ Model	CPD10～18-GD1Li	CPD10～15-GC1Li	CPD18-GC1Li	CPD20～25-GC1Li	CPD20～25-GD1Li	CPD30～35-GCLi	CPD30～35-GDLi
Travelling motor model	YDQ8.2-4-6190	YDQ8-4-6190	YDQ8-4-6190	YDQ11.5-4-6190	YDQ11.5-4-6190	TSP180/4-200LT62	TSP180/4-200LT62
Rated power	8.2kW	8.2kW	8.2kW	11.5kW	11.5kW	16.6kW	16.6kW
Rated voltage	32.3V	32.3V	32.3V	33V	33V	52V	52V
Rated current	214A	214A	214A	260A	260A	250A	250A
Rated speed	1140r/min	1140r/min	1140r/min	1800r/min	1800r/min	3100r/min	3100r/min
Lifting motor model	/	XQD-7.5-3S	XQD-8.6-3S	XQD-10-4S	/	XQD-13-4S	/
Excitation way		Series excitation	Series excitation	Series excitation		Series excitation	
Rated power		7.5kW	8.6kW	10.5kW		13kW	
Rated voltage		48V	48V	48V		75V	
Rated current		210A	260A	275A		210A	
Rated speed		1550r/min	1550r/min	1600r/min		1500r/min	
AC lifting motor model	YDB10.6-4-6190	/		/	YDB15-4HL		TSW132/4-195LP72
Rated power	10.6kW				15kW		13.5kW
Rated voltage	31V				31V		43V
Rated current	262A				395A		250A
Rated speed	2200r/min				2200r/min		1765r/min

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 4-3 Faults and troubleshoot of motor

No.	Commutator fault	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	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 Lithium battery and charger

4.5.1 Battery specification

Item	Specification		Note
Nominal capacity	CPD10～18-GC1/GD1Li	400Ah（standard） 500Ah（optional）	
	CPD20～25-GC1/GD1Li	500Ah（standard） 600Ah（optional） 750Ah（optional）	
	CPD30～35-GC1/GD1Li	80V/400Ah（standard） 80V/500Ah（optional） 80V/600Ah（optional）	
Rated voltage	48V		
Working voltage range	42V—55V		Actual working voltage
Rated charging current	200A		Constant current charging way
Charging temperature	0--40℃		Charge as soon as it finishes work under 0℃.
discharging temperature	-25℃--50℃		

4.5.2 Lithium battery usage

The correct use and daily maintenance of lithium battery have a great influence on the performance and service life of battery, therefore, the users must make maintenance and service referring to the actual condition and according to the maintenance instruction on lithium battery provided by manufacturer. Please read the manual carefully before using the electric truck and operate and use according to the procedures and methods regulated in the manual so as to avoid unnecessary personal injury and property loss.

If there is any question, please contact with HELI technical department or after sale service department.

1）Lithium battery safety notes

(1) Keep the battery away from dangerous objects or environment such as electric conduction materials, corrosive chemicals, flammable and combustible objects, dangerous mechanical equipments and high temperature and so on.

(2) Improper using of the product may lead to smoking such as external short circuit, overcharging, over high temperature and so on. If smoking occurs, cut off the power at once and put out the fire with sand or dry power extinguisher. At the same time, evacuate people and call the police at the same time.

(3) Improper using of the product may lead to battery cell ballooning which may even cause plastic housing broken or crack. If occurs, stop using the truck at once and contact with HELI technical department or after sale service department.

(4) It is prohibited to disassemble, press, impale, storing under high temerature or firing battery case to prevent the battery from high strength shaking, external impact force and falling down. The operation may lead to person injuries or property loss.

(5) It is prohibited to make battery positive and negative pole short circuit. Do not make the battery pole connect with metals or other electricity conductive objects except bolt and conductive band. The operation may lead on injuries or property loss.

(6) It is prohibited to expose or store battery in an environment higher than 55°C. Do not heat or put battery in fire. The operation may lead on injuries or property loss.

(7) It is prohibited to charge the battery without proper charging protection devices (such as lithium battery protective circuit board, battery management system) or with battery manufacturer authorized charging equipments (charger, DC power included). The operation may lead on injuries or property loss.

(8) Non manufacturer authorized technician are prohibited to disassemble and assemble battery. The operation may lead on injuries or property loss.

(9) It is prohibited to put battery into water or other conductive liquid. The operation may lead on injuries or property loss.

(10) Before operate the truck, read the manual carefully and children and other untrained persons are prohibited to use the truck.

(11) It is prohibited to use the lithium battery with other type or model battery in series or parallel. The operation may lead on injuries or property loss.

(12) It is prohibited to make the lithium battery protective circuit board or battery management system power system in series or parallel with other system. The operation may lead on injuries or property loss. If necessary, contact with HELI technical department or after sale service department.

2) Lithium battery using notes

(1) Charging temperature range: 0-40℃. Charging under low temperature is bad for battery. Please charge the battery after using at once in low temperature that is below 0℃.

(2) Discharging temperature range: -25~50℃, discharging capacity under low temperature (-25~0℃) is poorer than under normal temperature. This is normal. The battery can be used under 40-50℃, but high environment temperature especially staying that environment for a long time will speed up the aging of battery internal material and shorten battery service life. So it is not recommended to use the truck under this temperature for a long time.

(3) Storage and long time operation below -25 ℃ or above 55 ℃ are prohibited.

(4) When the truck has to be stored for a long time, keep the battery electricity to be 40%~60% and store it in dry and shady environment and charge the battery according to the manual to prevent over low electricity because of self discharge in long time storing

which may cause irreversible capacity loose.

(5) Lithium battery self discharging is affected by environment temperature and humidity. High temperature and humid temperature will speed up battery self discharging. The battery is suggested to be stored under -10℃-45℃ dry environment.

(6) Unauthorized person are not allowed to touch, move, disassemble battery and corresponding high voltage cable or parts with high voltage marking.

(7) If the truck suffers from violent impact, stop the truck in safe area and check if the battery is well.

(8) If the battery leaks (liquid or smoke) or is damaged, please go to the safe place and contact with after sale service person.

(9) If the electrolyte leaks, do not touch it. If it is touched accidently, wash with plenty of water at once. If it goes into eye, wash with plenty of boric acid solution at once and receive medical treatment.

(10) When the truck or battery is on fire, go to the safe area at once. Put the fire with sand or dry powder extinguisher. It is prohibited to put fire with water or improper extinguisher.

(11) Please charge the battery with lithium battery special charger. It is prohibited to charge the battery with bad quality charger or other type charger.

(12) Disconnect the connection between the battery and the truck and charging equipments during transporting. Make sure there is no any charging and discharging.

3) Lithium battery maintenance notes

(1) When the battery is lower than 20%. Charge it in time and it is prohibited to over discharge.

(2) Charge the battery full after using. It is prohibited to over charge.

(3) When the truck has to be stored for a long time, keep the battery electricity to be

40%~60%. Do not be full. Charge the battery before using.

(4) Check the lithium battery charging socket regularly and make sure the frame is firm, the socket cover plate is well sealed, and the terminal inside of the battery is not rusty and has no foreign matters such as dust, rain and so on.

(5) Keep the lithium battery dry and clean and it is prohibited to wash battery with water.

(6) Make sure the battery be fully discharged and charged at least once a month.

4.5.3 Charger using notes

(1) Charge the battery in a safe environment where is away from dust, fire source and corrosion.

(2) There should be equipped with fire extinguishing devices such as sand and dry powder extinguisher for emergent fire extinguishment.

(3) Make sure there is no foreign matters such as dust and water in charger and socket. If there is, clean it before charging, or poor connection between charger and socket may cause over heat even fire.

(4) Do not modify or disassemble charging port and charging equipment or fault or fire may be caused.

(5) Keep the following precautions during charging in order to avoid serious harm:

a) Do not contact charging terminal or terminal inside of the charging spearhead.

b) When there is lighting, do not charge the battery or touch the truck. if it is hit by the lighting, charging equipment may be damaged and human injury may occur.

(6) When charging is finished, do not disconnect charging equipment with wet hand or standing in water, or electric shock may occur and human injury may be caused.

(7) When charging is finished, close the battery charging opening cover to prevent foreign matters falling into the opening during travelling or opening is easy to be

damaged.

(8) Pay attention to the following things to avoid the damage of charging equipment:

a) Do not close the charging opening cabin door without close the charging opening cover.

b) Do not pull the or twist charging cable.

c) The charging equipment should not bear shock.

d) Do not store or use the charging equipment when the temperature is higher than 50℃.

e) It is prohibited to disconnect the changer when there is current output or electric arc may be produced which will cause person injury or property loss.

f) Keep the charging equipment away from the heater or other heat sources.

4.5.4 Charger type

No.	Item	Note
1	D80V-200A-Li lithium battery fast charger	80V/48Vcompatibility
2	D48V-200A-Li lithium battery fast charger	48V

4.6 Emergency button

Emergency button is used to cut load current and overload current and it is acts as safety button. The emergency button on the truck is used under the following application:

(1) It acts as safety switch. Press the button in emergency to ensure truck safety. it is prohibited to press the button frequently if it is not emergency or parts service lift will be badly affected.

(2) Press the emergency button in the following cases to prevent battery feed:

a) When the truck will not be used for more than 72h, press the button when the battery quantity meeting storing requirements (refer to lithium battery operation and

service manual for detail).

b) When transporting press the button when the battery quantity meeting transporting requirements (refer to lithium battery operation and service manual for detail).

c) When maintaining the truck, press the button.

Note: if the button is not pressed when not use for a long time, battery feed may be caused and truck may be badly affected.

4.7 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 controller 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.

4.8 Troubleshoot

4.8.1 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 4-5 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+ connection terminal) that prevents the capacitor bank from charging.	The voltage of 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. Excessive load on vehicle. Improper mounting of controller.	The temperature of controller exceed 85℃.

23	Undervoltage Cutback	The batteries need recharging. 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.	Controller's capacitor voltage low.
24	Overvoltage Cutback	Battery voltage too high while regen braking. The selection of controller's voltage parameter is wrong. Battery resistance too high. Battery disconnected while regen braking.	Capacitor bank voltage exceeded the set value.
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 cycle KSI.	Modification controller 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	GPS lock the truck	The truck is located through GPS and is locked.	Check GPS module
52	CAN PDO Timeout	CAN communications between instrument and controller is fault while travelling, the instrument doesn't respond.	Check CAN communication
53	Traction HPD	There is direction input and acceleration signal input before starting	Check the steering wheel and accelerator
54	Throttle Open	Accelerator signal lower than set value	Check accelerator
55	Turn sensor open	Turn sensor open	Check turn sensor
56	Turn enable setting fault	It is valid when the turn sensor and	Check turn sensor and

		turn switch is set at the same time.	turn switch
57	BMS hot	The temperature inside of battery is high	Check battery
58	BMS severe overvoltage	Battery severe overvoltage	Check battery
59	GPS lock the truck	CAN bus disconnect and truck is locked	Check if CAN bus of OPS is disconnected.
61	Unmatched display	Unmatched meter	Change meter
62	BDI is low	SOC value is low	Check battery quantity
64	Battery charging		
65	BMS overcurrent	Battery overcurrent	Check battery
66	BMS CAN PDO timeout	During the CAN communication between BMS and controller, there is fault and the meter does not respond.	Check harness Check battery Change meter
67	BMS undervoltage	BMS undervoltage	Check battery
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

The controller can send fault into meter to receive diagnosis information through LED flickering times and serial port.

Table 4-6 Fault code and troubleshooting of 1235 series controllers

Code	Status LED	Description	Possible cause

LED OFF	off	No power or defective controller.	
Solid ON	On all the time	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.

4.8.2 INMOTION controller

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.
157	BMS over temperature protection	BMS temperature is over high and it need to be cool down.
158	BMS unit is over discharged.	BMS low battery voltage and charging is needed.
159	BMS over voltage protection	BMS low battery voltage and charging is needed.
163	BMS over current	BMS output current is large.
164	Charging protection	BMS is charging and the truck does not work.
156	Temperature protection	BMS temperature is over high and it need to be cool down.
168	BMS current limit protection	BMS limit output current and please check battery.
169	BMS current cutout protection	BMS cut output current and please check battery.
171	BMS communication error	Please check CAN, controller and battery.

NOTE:

1. The truck will travel with default mode (E) when three kinds of travelling mode (P/E/S) are or are not input at the same time.

2. When turn signal device is invalid, the truck will travel with limited speed.

5 Hydraulic System

5.1 General Description

The hydraulic system consists of oil pump, control valve, priority 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.

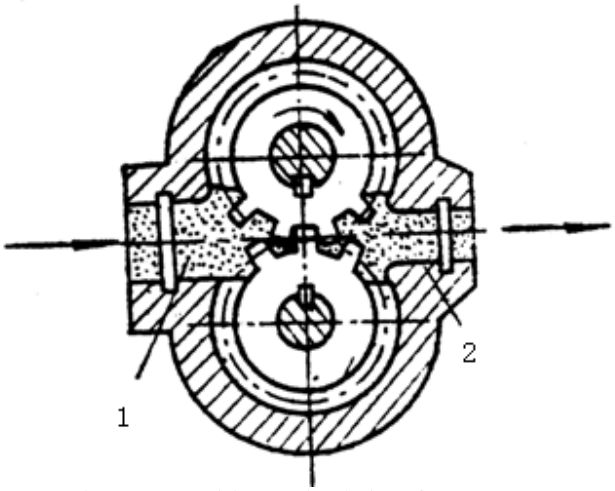


Fig 5-1 Working principle of gear pump
(1) Oil suction cavity (2) Oil pressing cavity

A pair of meshed involute gear is mounted inside the housing, the two end face seals of gear 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)

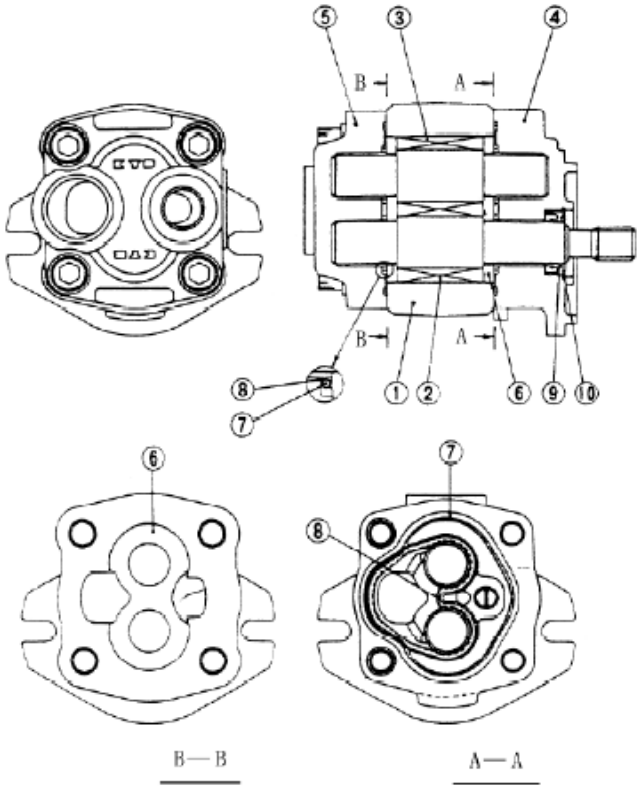


Fig. 5-2 Main pump

(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.

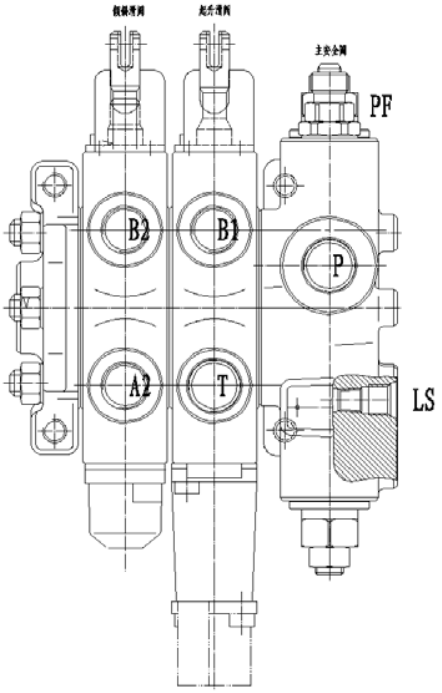


Fig. 5-3 Control valve

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.

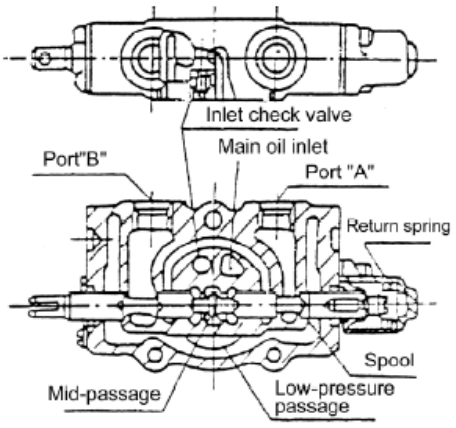


Fig. 5-4 Neutral position

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.

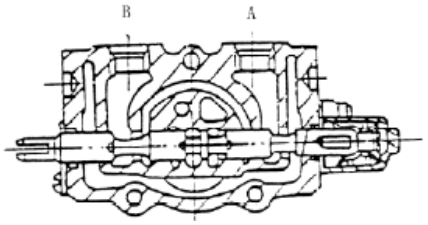


Fig. 5-5 Push in spool

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.

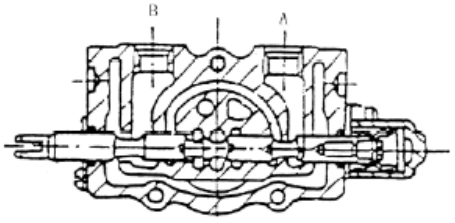


Fig. 5-6 Draw out spool

(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.

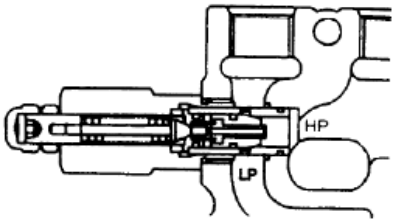


Fig. 5-7

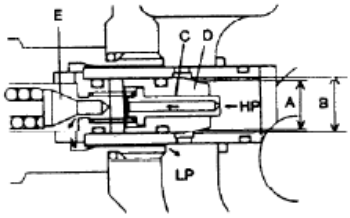


Fig. 5-8

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).

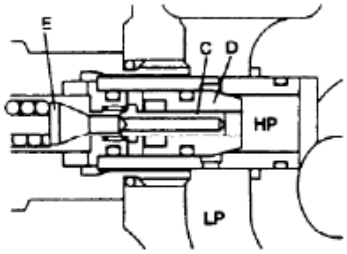


Fig. 5-9

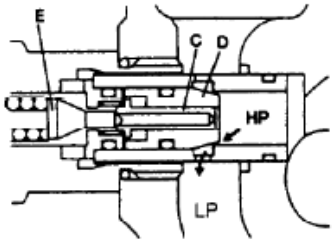


Fig. 5-10

(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.

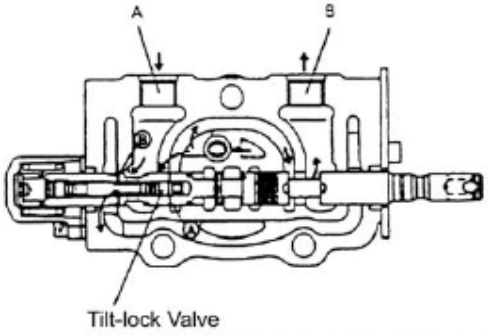


Fig. 5-11

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.

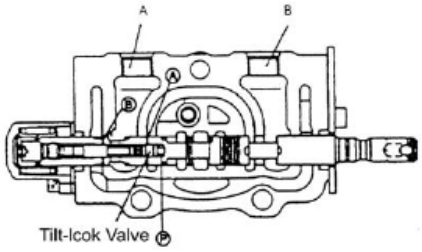


Fig. 5-12

(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)

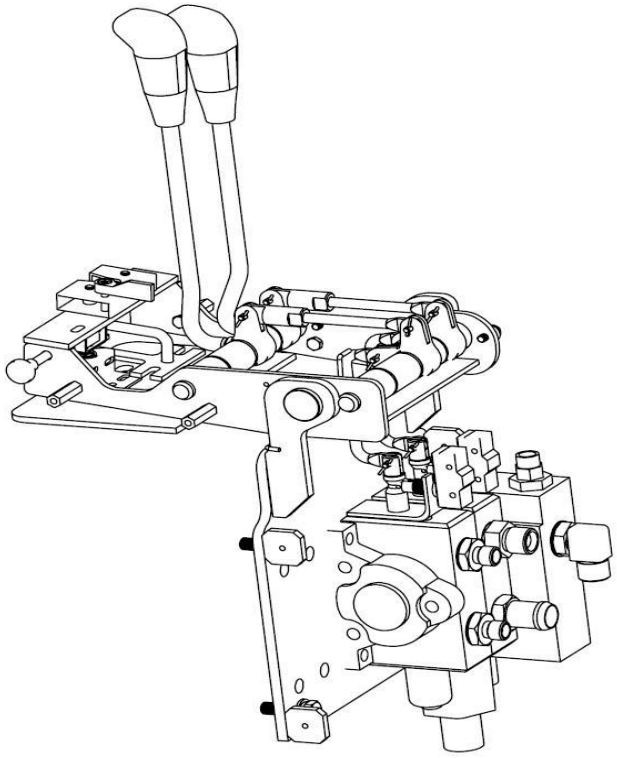
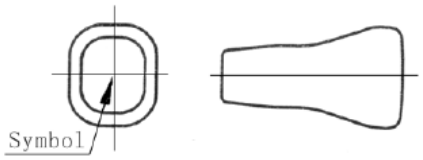


Fig. 5-13 Operation of the control valve

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.



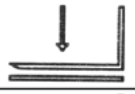
No.	Symbol	Name
1		Lift or Fall
		
2		Tilt Forward or Backward
		

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.

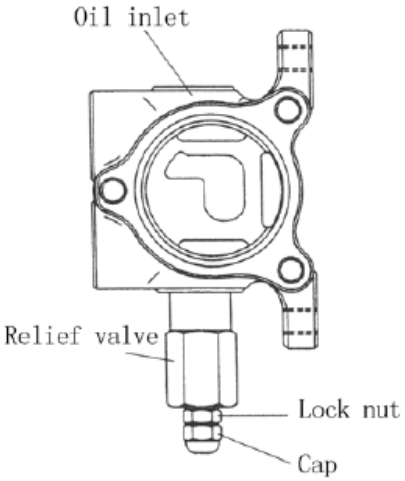


Fig. 5-15

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.

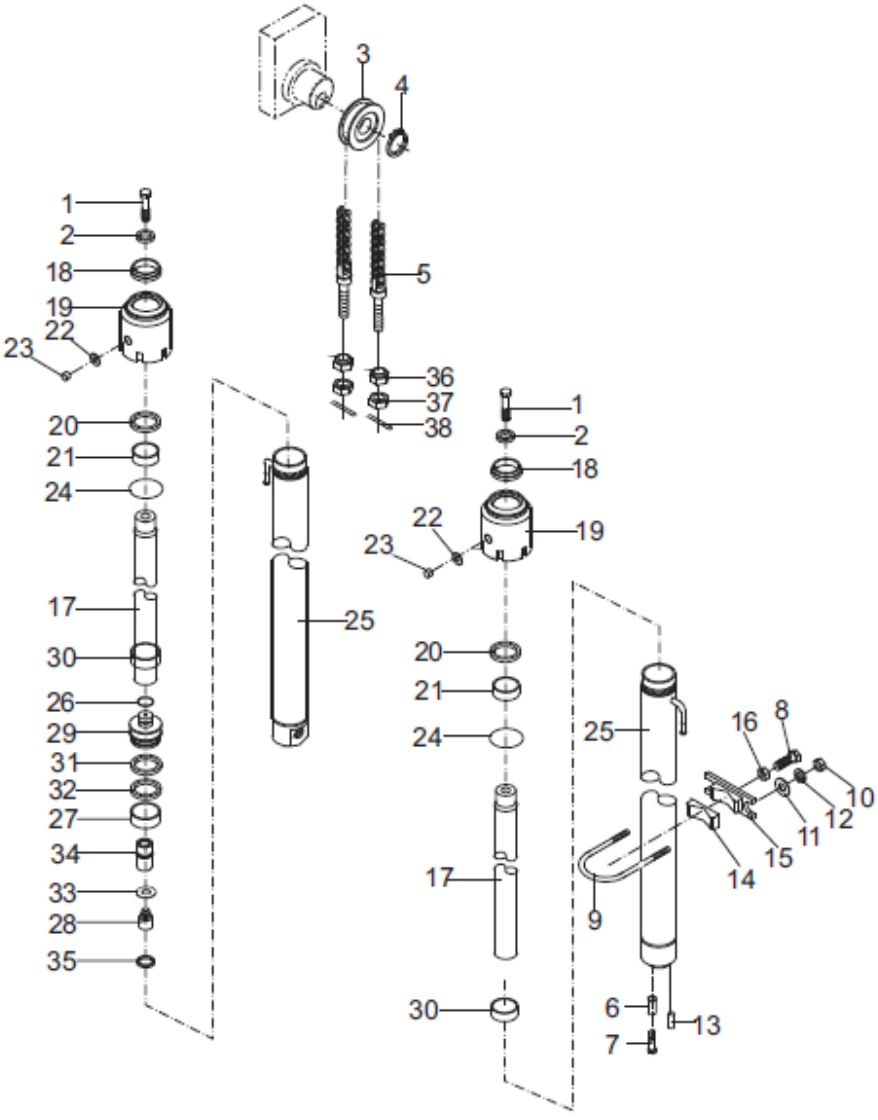


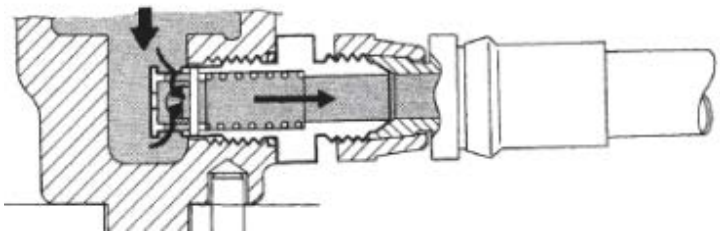
Fig. 5-16 Lift cylinder

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

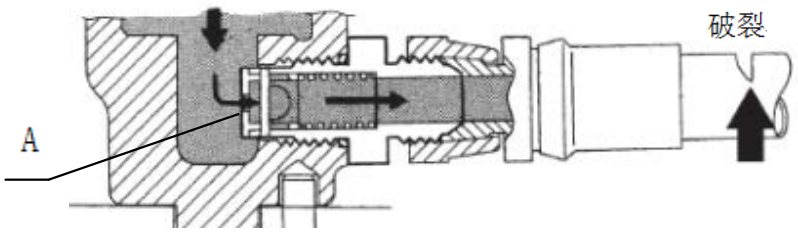
12.washer 10　13. Pin B10×26　14. Adjusting block　15.Oil cylinder support block
16. Nut M12×1.25　17.Piston rod　18.dust proof ring 40×52×7/10　19.guide sleeve
20. Seal ring 40×50×6　21. Steel-backed bearing 4030　22.Shim　23. Screw M5×6
24. O ring d49.7×2.4　25. Cylinder body　26. Steel cable baffle ring
27.support 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.

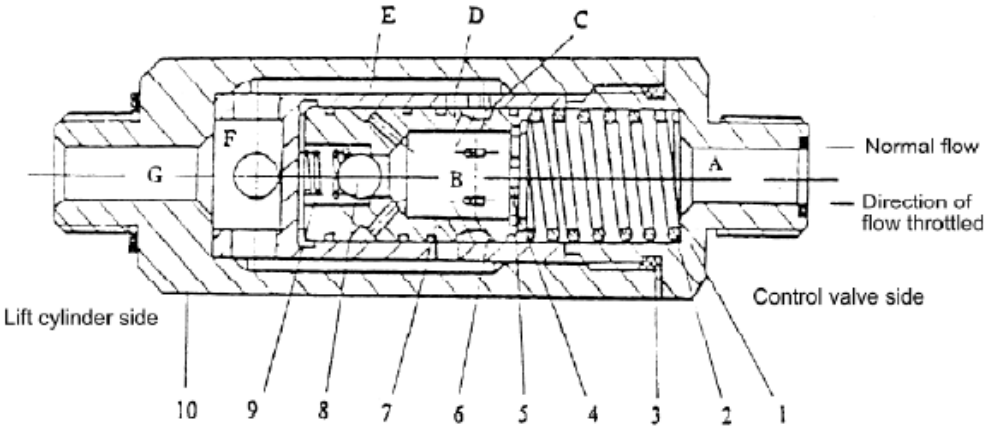


Fig. 5-18 Flow regulator valve

(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.

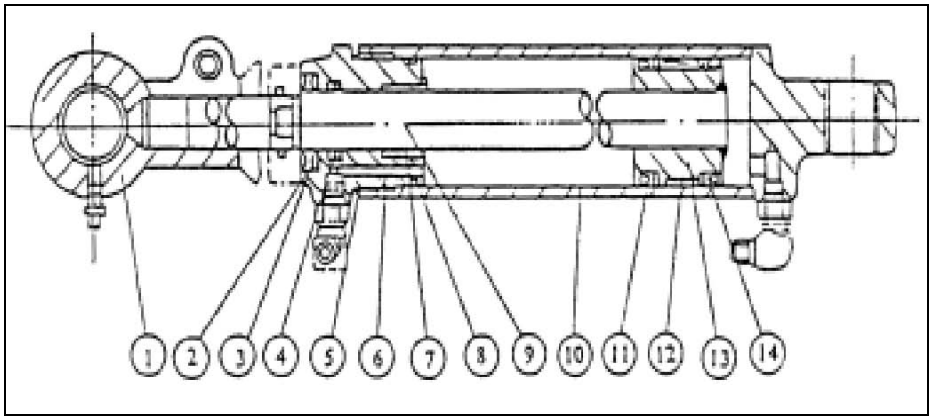


Fig. 5-19 Tilt cylinder

(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, return oil filter and breather are 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.

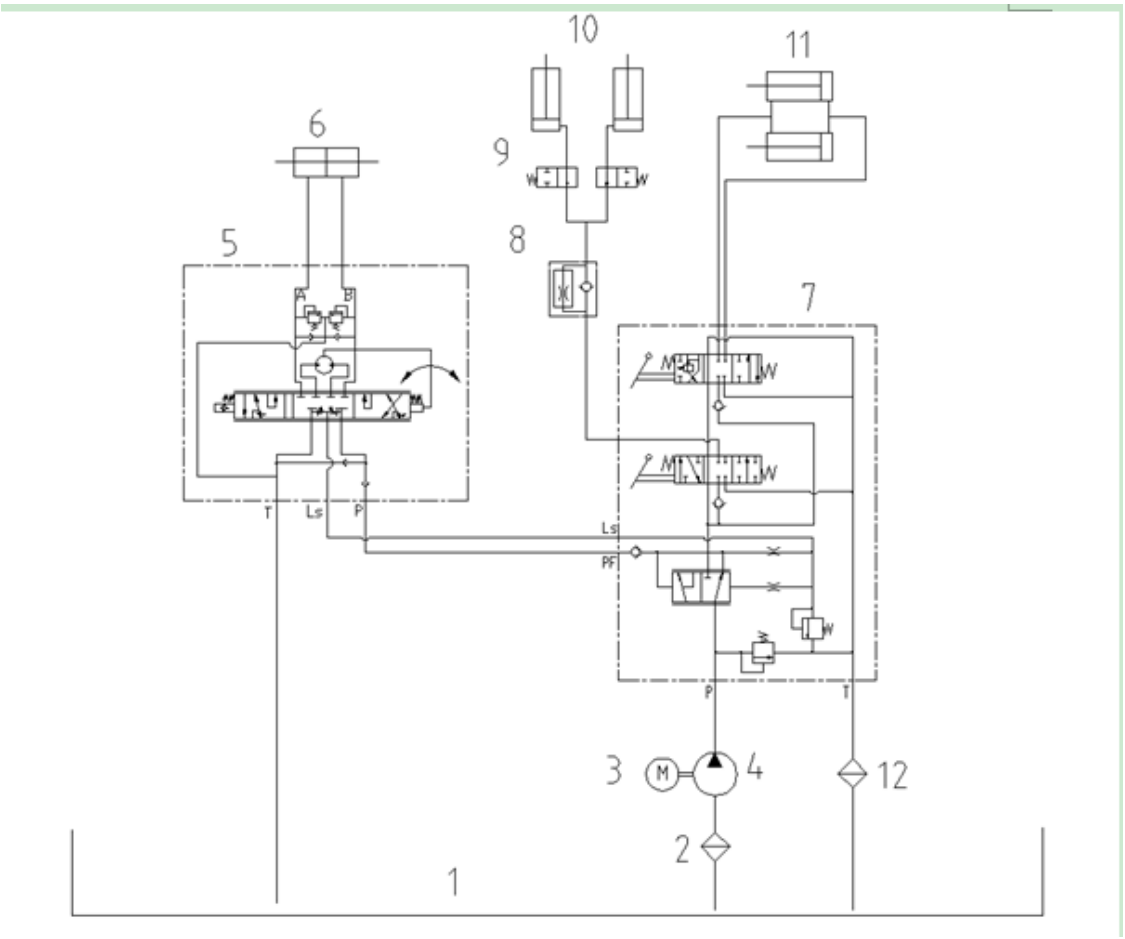


Fig. 5-20 Hydraulic system principle diagram

(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

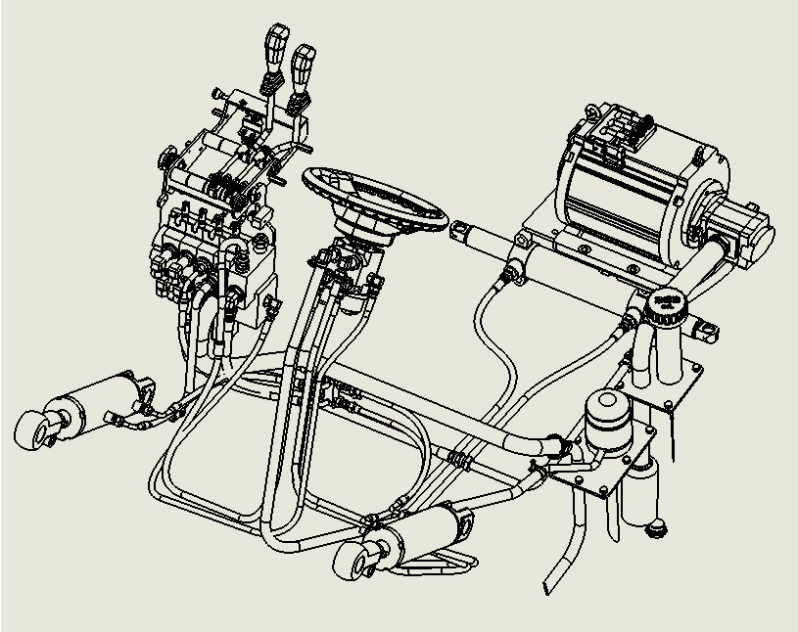


Fig. 5-21 hydraulic oil circuit

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 brand number 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.

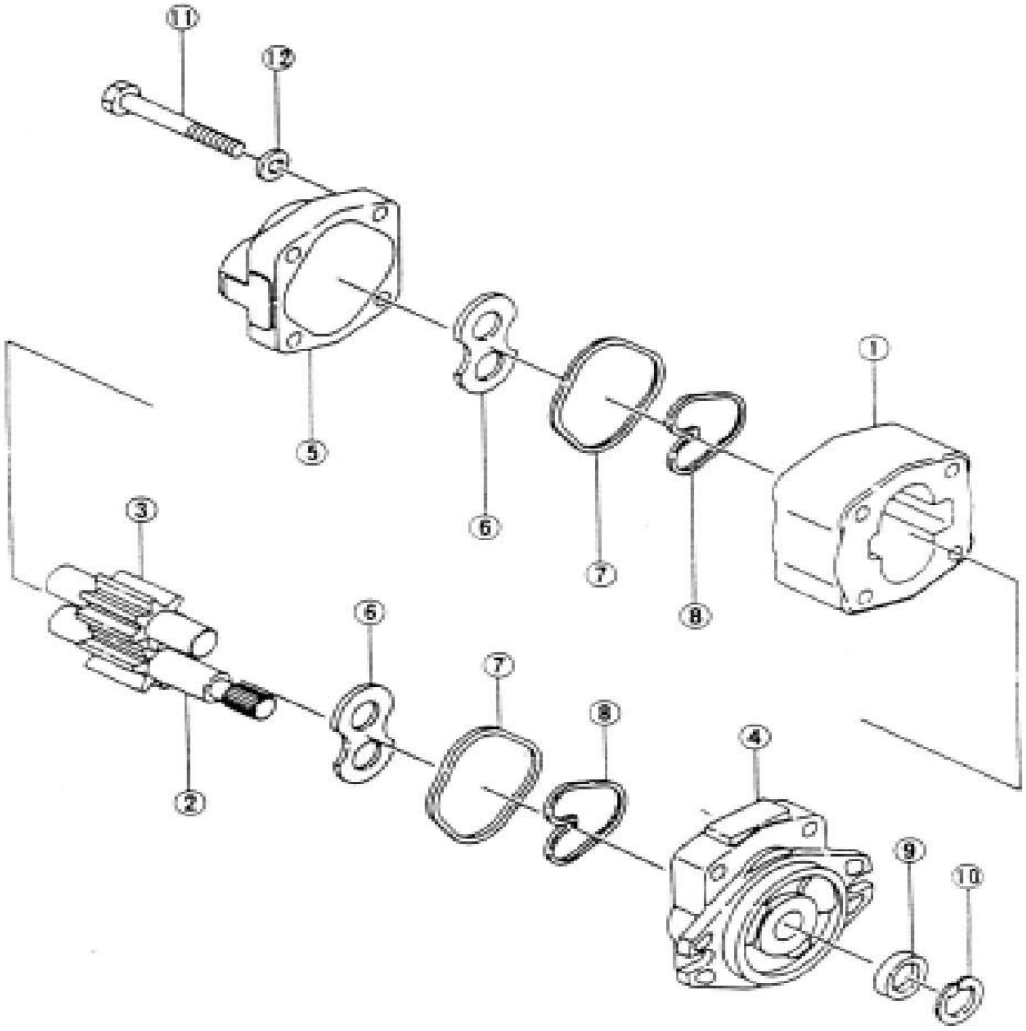


Fig. 5-22 Gear pump

(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 gasoline (except rubber parts)

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.

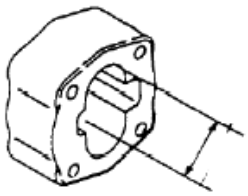


Fig. 5-23

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.

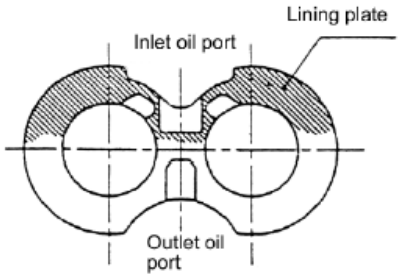


Fig. 5-24

c) Front and rear pump cover

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

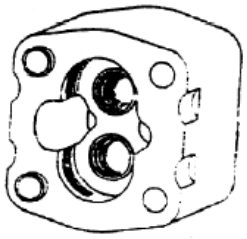


Fig. 5-25

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

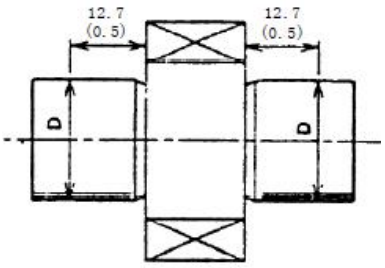


Fig. 5-26

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

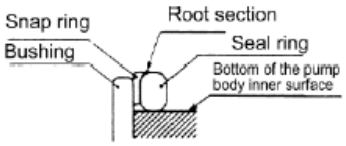


Fig. 5-27

(3) Reassembly

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

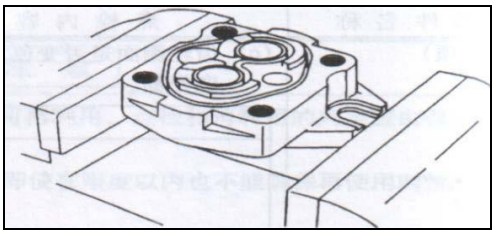


Fig. 5-28

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

Notice: Don't twist.

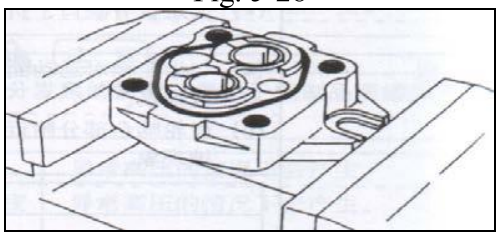


Fig. 5-29

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

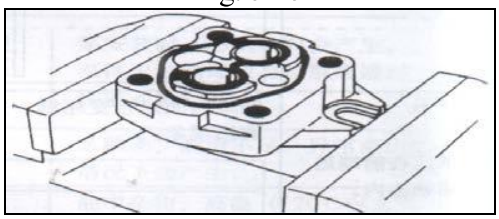


Fig. 5-30

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

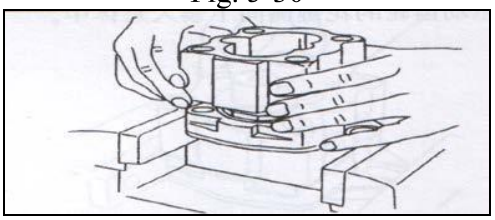


Fig. 5-31

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.

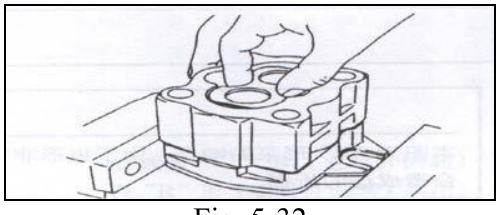


Fig. 5-32

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

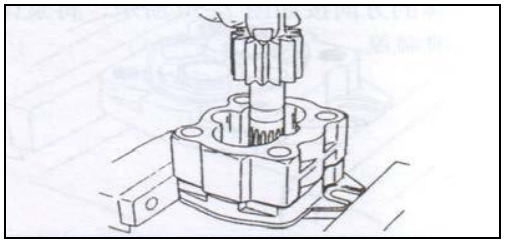


Fig. 5-33

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

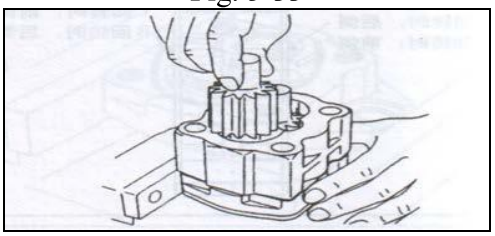


Fig. 5-34

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

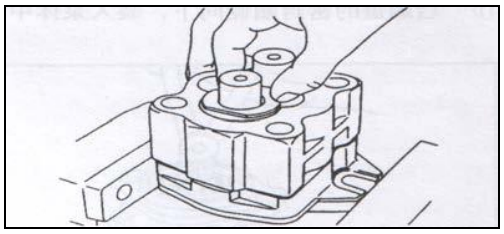


Fig. 5-35

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

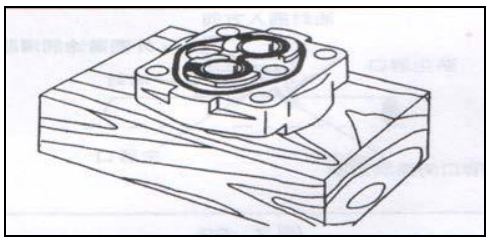


Fig. 5-36

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.

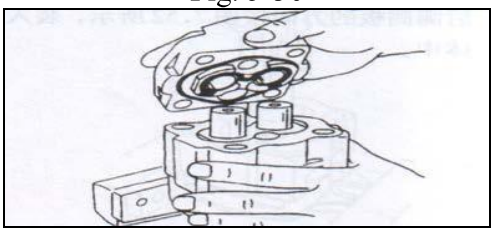


Fig. 5-37

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

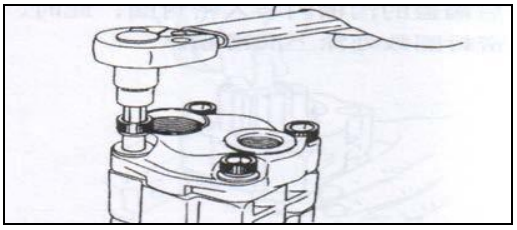


Fig. 5-38

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.

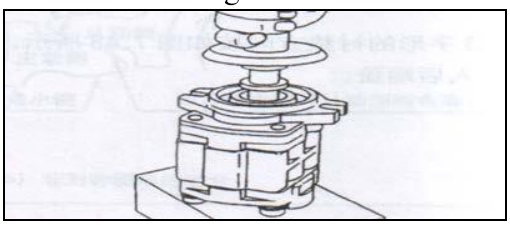


Fig. 5-39

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

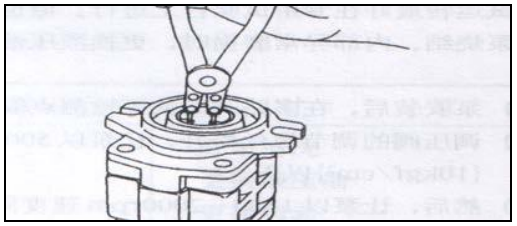


Fig. 5-40

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

The lifting system is of the two-stage roller type with veritical up and down. It consists of the inner mast, the outer mast and the lift bracket.

6.2 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 outside 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 L-shaped cross section. It fixed with main rollers at the bottom of it. The main rollers bear both radial force and lateral force by adjusting it's clearance. 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.

6.3 Lift Bracket

The lift bracket moves up and down smoothly along the channel of the inner mast with 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 lift bracket. But the side roller is assembled on the lift 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.

6.4 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 lift bracket upright (six).

Eight side rollers are separately installed on the upper end of the outer mast (two), lower end of the inner mast (two) and the lift bracket (four).

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

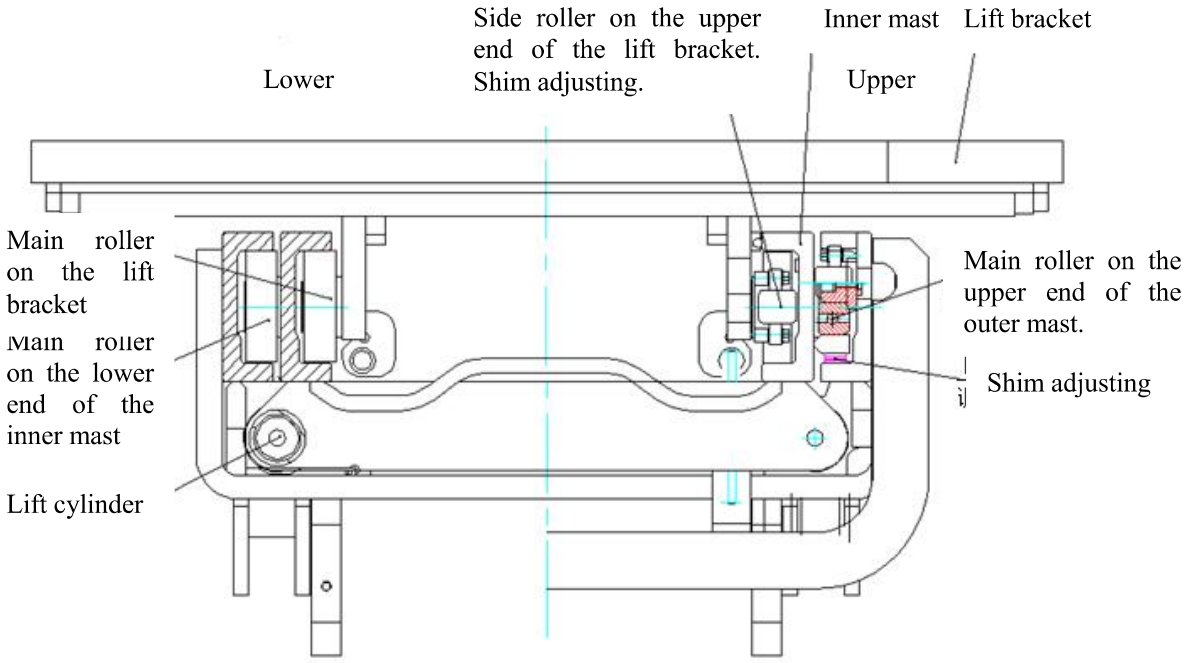
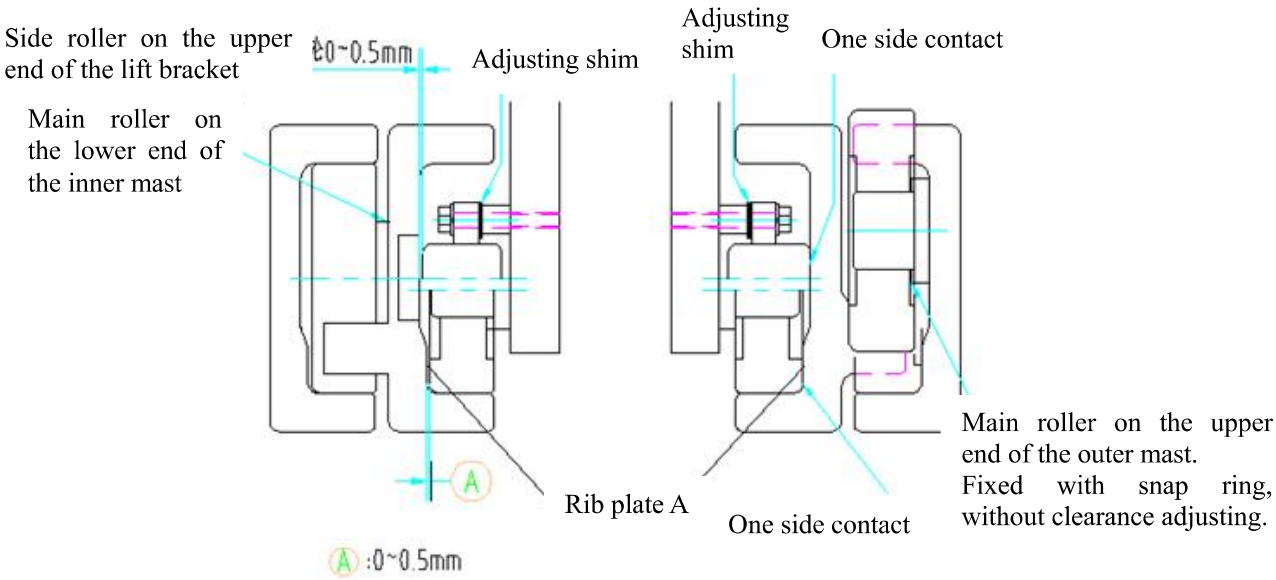


Fig. 6-1 Layout of the rollers



Notice: Please add butter on the surface of main rollers and the interface of masts.

Fig. 6-2 Adjusting method and request of the main and side rollers

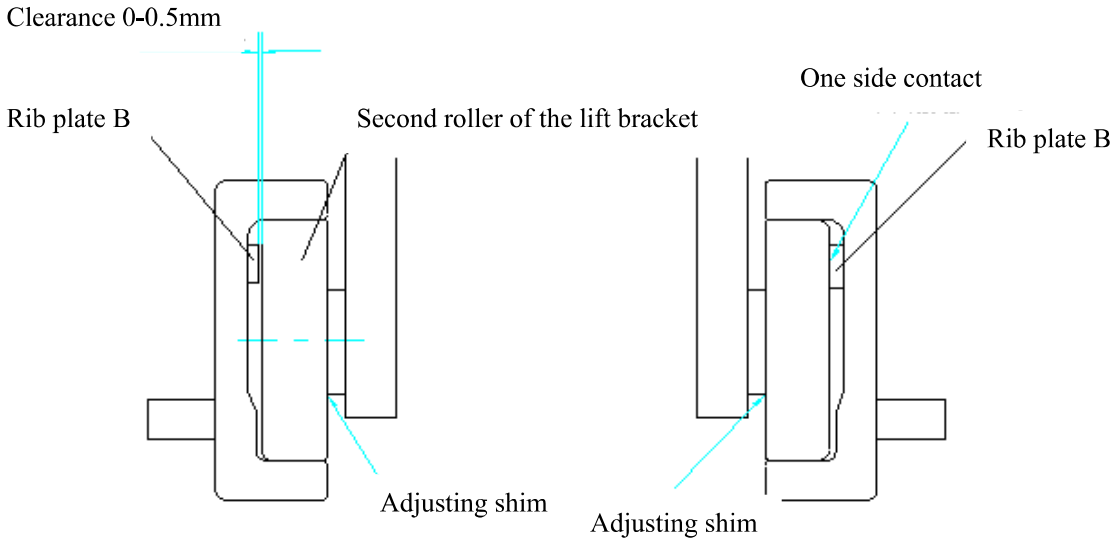


Fig. 6-3 Adjusting method and request of the second roller of the lift bracket

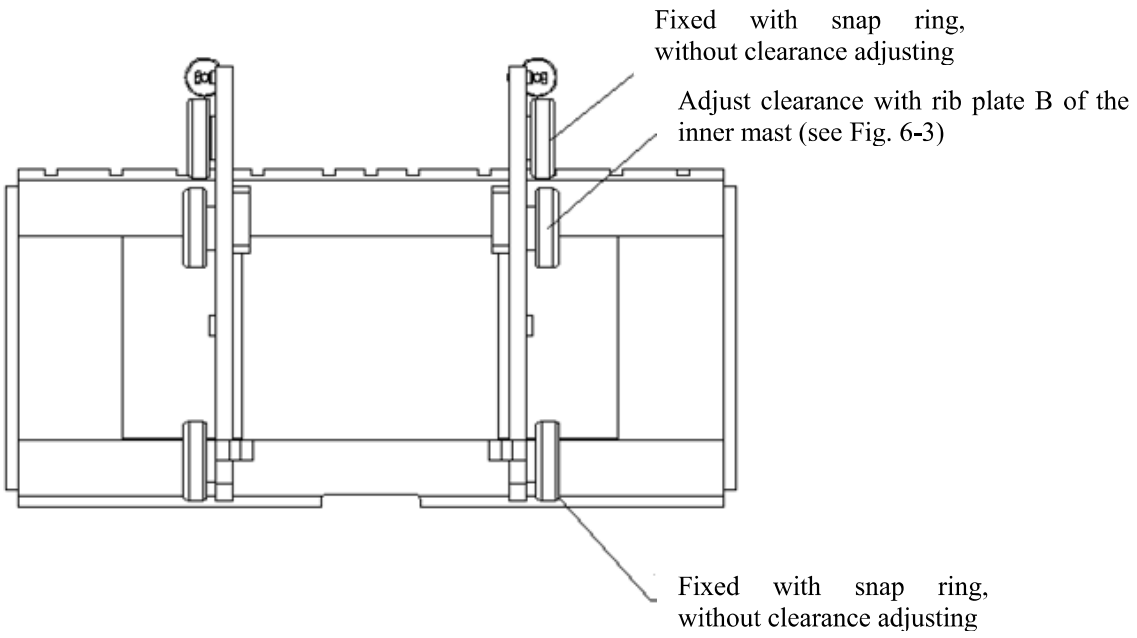


Fig. 6-4 Additional remarks for the roller adjusting of the lift bracket

6.5 Maintenance

6.5.1 Adjust lift cylinder

It must readjust 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.

(3) 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.

(4) Adjust the tightness of lift chains.

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

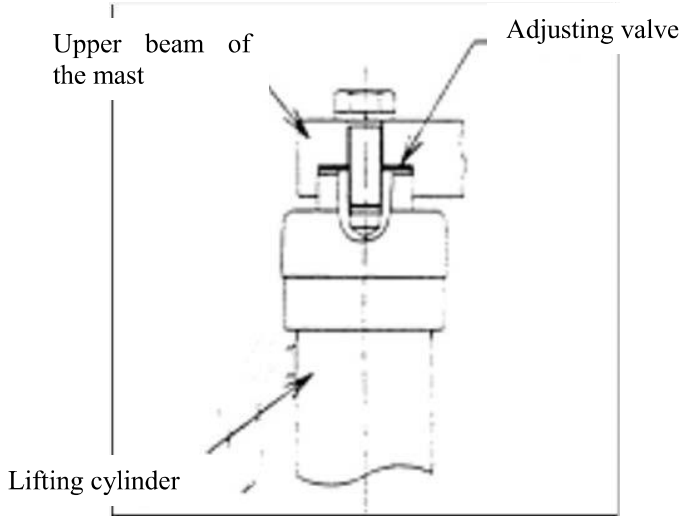


Fig. 6-5 Adjust lift cylinder

6.5.2 Adjust lift 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 to assure the distance A = 19mm～20mm between main rollers and the lift bracket.

(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.

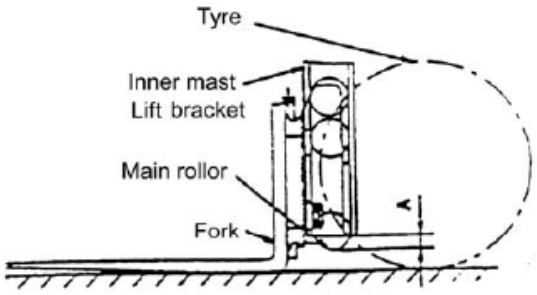


Fig. 6-6 Adjust lift bracket's height

6.5.3 Replacing rollers of the lift 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. 6-7)

(4) Make the inner mast rise.

(5) The forklift can be reversed when the lift bracket disengaged from the outer mast.

(6) Replacing main rollers

(a) Take apart all of snap ring from the lift bracket and take out main rollers.

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

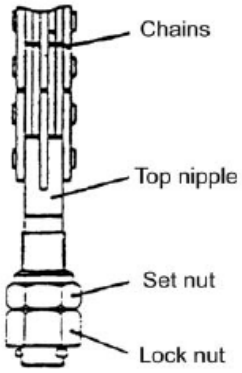


Fig. 6-7

6.5.4 Replacing rollers of masts

(1) Take apart the fork bracket from the inner mast, then replace the main roller follows the way as 6.5.3.

(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 lift bracket as disassembly contrarily.

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