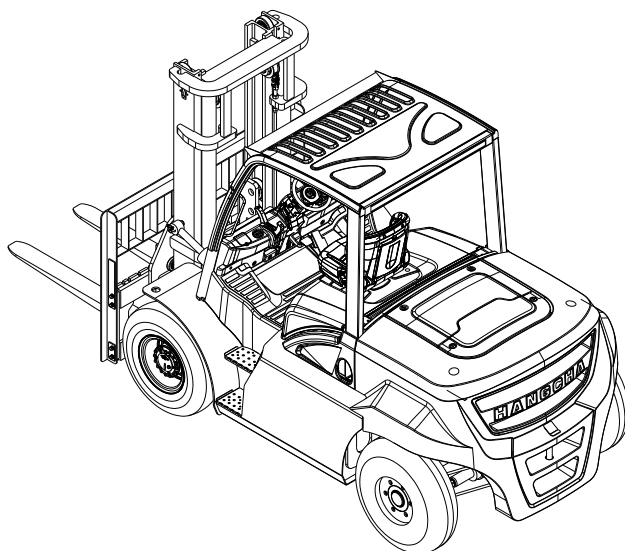




# **XH Series**

High-voltage lithium battery forklift  
truck  
ELECTRIC FORKLIFT TRUCK

# **Service Manual**



Original Instruction

**HANGCHA GROUP CO., LTD**  
**05/2023**

# FOREWORD

Thank you very much for purchasing heavy-duty high-voltage lithium battery forklift truck of Hangcha Group.

XH series counterbalanced high-voltage lithium battery forklift, It is a new generation product developed by our company. This product adopts a new type of electric counterbalanced forklift independently developed by a high-voltage system. It has obvious advantages in terms of comfort, advancement, reliability, maintainability and intelligence.

This manual is about the structure, working principle and maintenance of XH series counterbalanced high-voltage lithium battery forklifts. In order to ensure safety and give full play to the performance of the forklift you have purchased, relevant operators, equipment managers and maintenance personnel should carefully read this manual.

Forbid repairing the truck if you haven't been trained.

Our product design will update and perform better, so the content in this manual may be not the same as the forklift you owned.

If you have any questions please keep touches with HANGCHA GROUP CO., LTD. sales department or let the agents know.

## WARNING



- 
- a) For any inspection, maintenance, and repair, please be sure to cut off the power supply of the high-voltage system, that is, unplug the MSD maintenance switch on the junction box and wait for 15~20 minutes, during which no operation is allowed, otherwise it will cause personal safety accidents.
  - b) For the following inspections, maintenance and other situations, please be sure to consult and have Hangcha professional maintenance technicians to conduct on-site service processing:
    - Involving the inspection, maintenance, and replacement of high-voltage components, components, and circuits;
    - Check and maintain non-high-voltage components and circuits, but are affected by the assembly and disassembly of high-voltage components, components, and circuits;
    - The fault may be caused by high voltage or non-high voltage crossing;
    - Unable to judge whether the fault is caused by high voltage or non high voltage;
    - Others that need to be touched or may touch high-voltage components or high-voltage lines.
  - c) The inspection and maintenance of high-voltage parts shall be subject to special training on high-voltage electrical knowledge and obtain corresponding certificates. The internal inspection and maintenance of the lithium battery must be completed by a professional manufacturer.
  - d) Any inspection, maintenance, and repair should strictly abide by the relevant high-voltage electric forklift safety precautions, operating specifications, safety rules, and the use of safety protection products and tools in this manual.
-



# Content

## FOREWORD

|                                                                                                  |    |
|--------------------------------------------------------------------------------------------------|----|
| 1、 Safety regulations .....                                                                      | 1  |
| 1.1 Brief introduction of high voltage components .....                                          | 1  |
| 1.2 Safety precautions and operating specifications for high-voltage electric forklift trucks .. | 5  |
| 1.3 First aid for high-voltage accident .....                                                    | 9  |
| 2、 Drive system .....                                                                            | 10 |
| 2.1 Drive System Removing and Installation .....                                                 | 10 |
| 2.2 Traction motor controller 2 in 1 .....                                                       | 13 |
| 2.3 Drive axle assembly .....                                                                    | 14 |
| 3、 Steering system .....                                                                         | 27 |
| 3.1 Structure of Steering System .....                                                           | 27 |
| 3.2 Steering device structure .....                                                              | 28 |
| 3.3 Steering axle .....                                                                          | 29 |
| 3.4 Precautions for installation of steering system .....                                        | 31 |
| 3.5 Dismounting and Adjustment of steering axle .....                                            | 31 |
| 3.6 Troubleshooting and corrections on the steering system .....                                 | 34 |
| 4、 Control and brake system .....                                                                | 35 |
| 4.1 Brake pedal assembly .....                                                                   | 35 |
| 4.2 Foot brake piping system .....                                                               | 37 |
| 4.3 Hand brake .....                                                                             | 44 |
| 4.4 Foot brake .....                                                                             | 46 |
| 4.5 Schematic diagram of braking system .....                                                    | 54 |
| 5、 Hydraulic system .....                                                                        | 55 |
| 5.1 Hydraulic system circuit .....                                                               | 55 |
| 5.2 Hydraulic system principle .....                                                             | 56 |
| 5.3 Fault and elimination .....                                                                  | 57 |
| 5.4 Oil pump unit .....                                                                          | 59 |
| 5.5 Multiway valve .....                                                                         | 61 |
| 5.6 Fully hydraulic steering redirector .....                                                    | 64 |
| 5.7 Steering cylinder .....                                                                      | 70 |
| 5.8 Tilt cylinder .....                                                                          | 71 |
| 5.9 Lifting cylinder .....                                                                       | 75 |
| 6、 Lifting system .....                                                                          | 78 |
| 6.1 General description .....                                                                    | 78 |
| 6.2 Data of assembly and debugging .....                                                         | 80 |
| 6.3 Fault diagnosis and corrections .....                                                        | 81 |
| 6.4 Mast disassembly and installation .....                                                      | 82 |
| 7、 Electrical system .....                                                                       | 88 |
| 7.1 Special safety rules for high-voltage electric forklift .....                                | 90 |
| 7.2 Electric drive system .....                                                                  | 93 |

|     |                                            |     |
|-----|--------------------------------------------|-----|
| 7.3 | Safe operation specification .....         | 104 |
| 7.4 | Control box assembly.....                  | 111 |
| 7.5 | Lighting System.....                       | 113 |
| 7.5 | Switch .....                               | 115 |
| 7.6 | Battery thermal management unit assy ..... | 120 |
| 7.7 | Cooling system assembly .....              | 121 |
| 7.8 | Electrical schematic diagram .....         | 123 |

# 1、 Safety regulations

## 1.1 Brief introduction of high voltage components

### (1) Power battery assembly

6t-7t:

The lithium battery assembly of this forklift equips with 2 lithium battery boxes as standard, and an additional lithium battery box is optional. The standard 2 lithium battery boxes have a total length of 1385, width of 694, height of  $594\pm1$ , nominal voltage of 309.12V, nominal capacity of 228Ah, and protection level IP68 with automatic emergency fire extinguishing device.

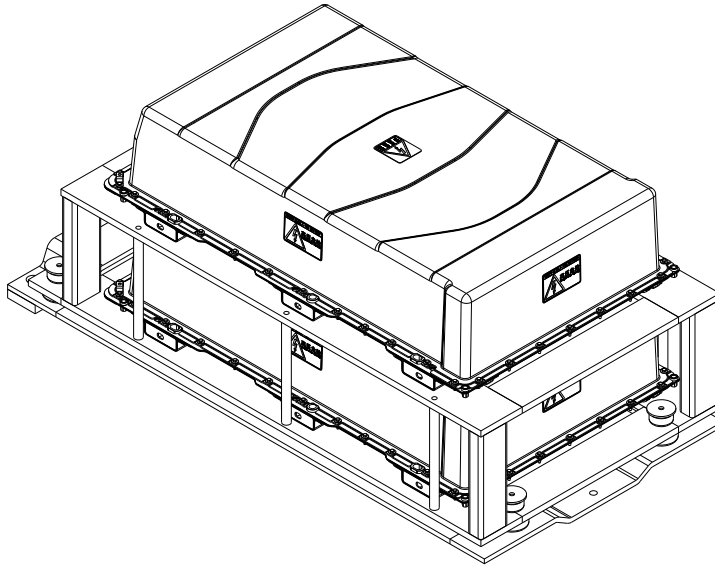


Fig.1-1 Power battery assembly for 6t-7t forklift

8t-10t:

The lithium battery assembly of this forklift is equipped with 3 lithium battery boxes, including 1 electric box C, 2 electric box G. The standard 3 lithium battery boxes have a total length of 1429, width of 694, height of  $876.2 \pm 1$ , nominal voltage 309.12V, nominal capacity 302Ah, and protection level IP68 with automatic emergency fire extinguishing device.

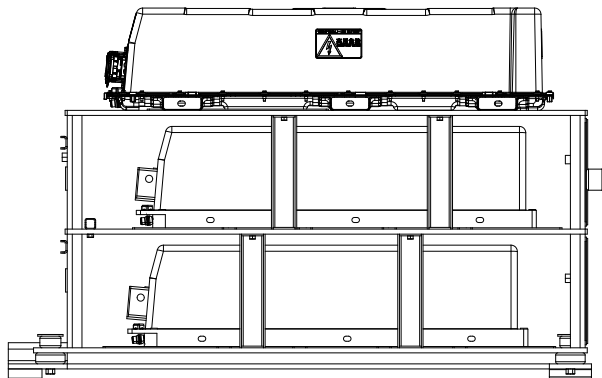


Fig.1-2 Power battery assembly for 8t-10t forklift

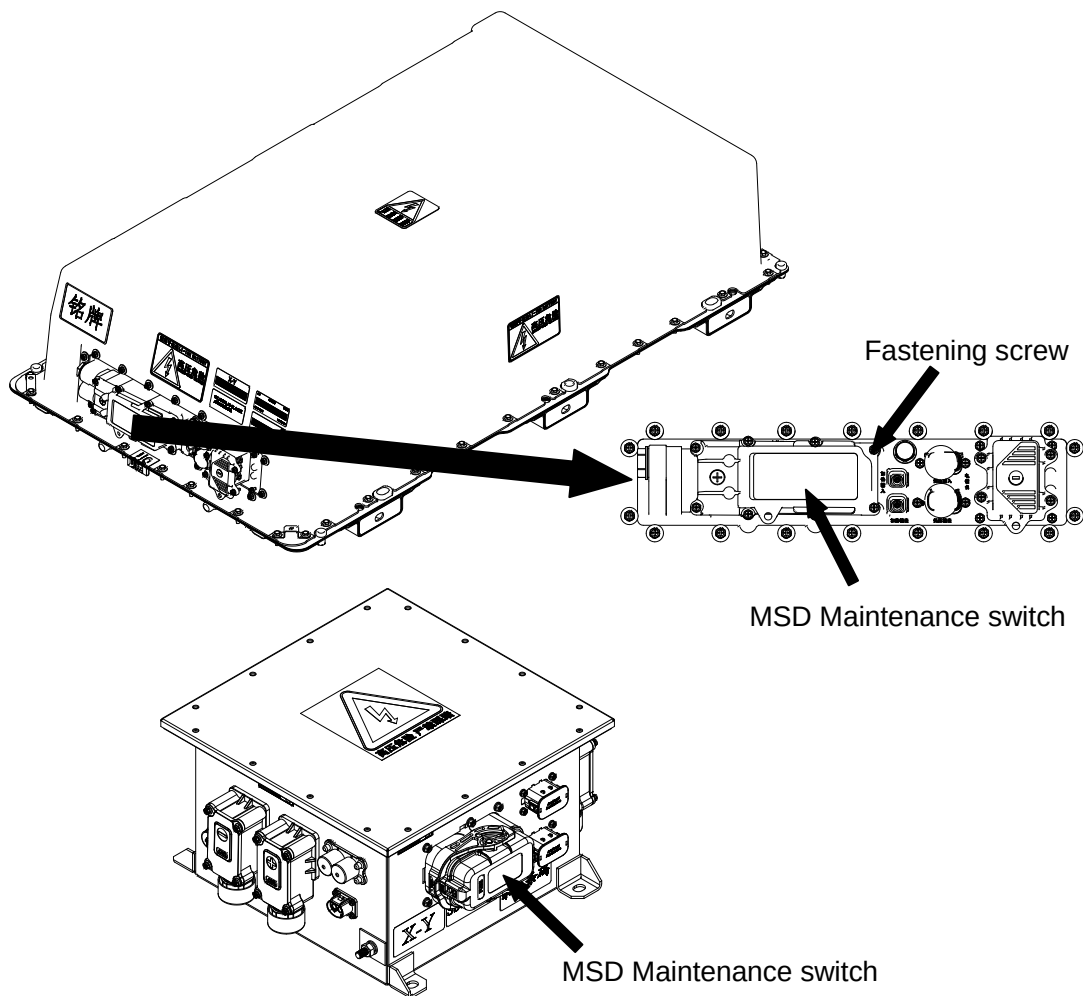


Fig. 1-3 MSD maintenance switch on junction box and lithium battery

WARNING



- The weight and size of the lithium battery has a significant impact on the stability and load carrying capacity of the vehicle operation.
- When installing or replacing the lithium battery, pay attention to the fixed position of the lithium battery on the vehicle.
- Before performing any maintenance, cut off the power supply of the high-voltage system, unplug the MSD maintenance switch from the junction box and wait 15~20 minutes for the high voltage system to be powered off.
- The MSD maintenance switch on the lithium battery can be used when replacing the lithium battery or overhauling the lithium battery, just remove 8 fastening screws and pull out the MSD maintenance switch, wait for 15-20 minutes and then the lithium battery will be powered off. The inspection and maintenance of the lithium battery must be done by the professional personnel designated by Hangcha, and other personnel are strictly prohibited to overhaul.

(2) Two-in-one power supply

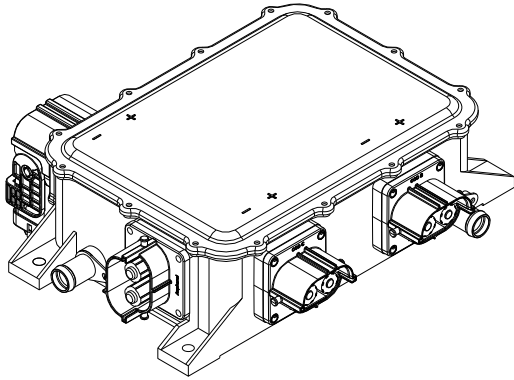


Fig. 1-4 Two-in-one power supply

(3) Motor (traction/oil pump)

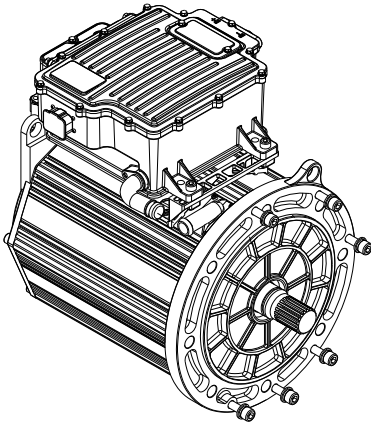
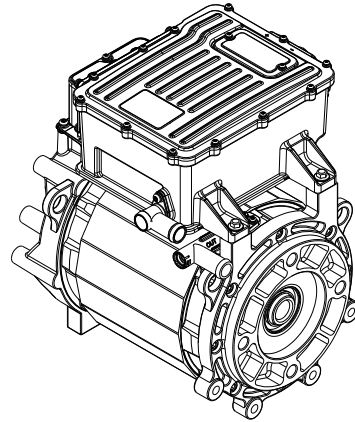


Fig. 1-5 Motor (traction/oil pump)

#### (4) National standard charging base

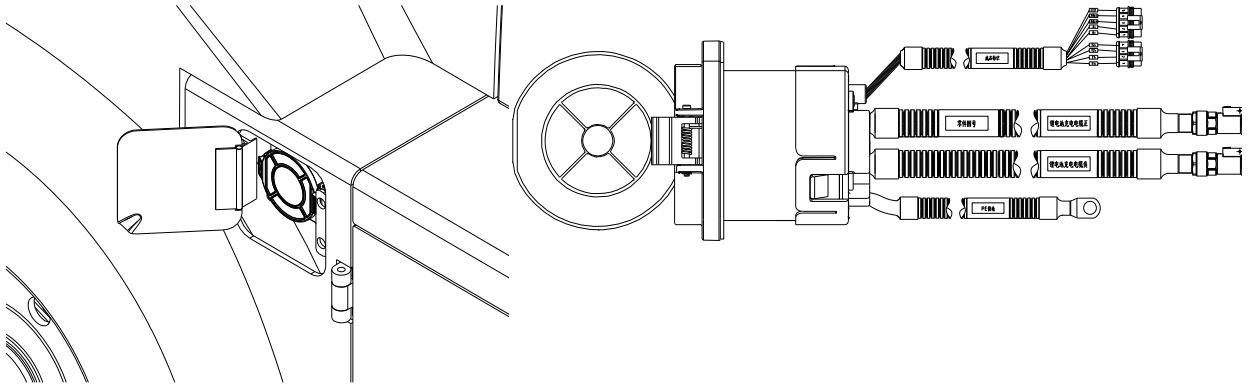


Fig. 1-6 Electric control (traction/oil pump)

#### (5) High voltage connection cable



Fig. 1-7 High voltage connection cable

WARNING



Inspection and maintenance of high-voltage parts should be specially trained in high-voltage electrical appliances and obtain corresponding certificates. The internal inspection and maintenance of the lithium battery must be completed by a professional manufacturer.

## 1.2 Safety precautions and operating specifications for high-voltage electric forklift trucks

The following safety precautions for high-voltage electric forklift trucks, regarding your personal safety, must be strictly observed during inspection, maintenance and repair, otherwise it will cause serious injury and even life-threatening.



Fig.1-8 Warning signs for high voltage components

The connecting wires of the high voltage part are orange, and there are warning signs on the high voltage parts. When inspecting high-voltage parts, you should follow:

1. Inspection or maintenance personnel should wear insulated shoes; wear 1000V insulated gloves to check whether the gloves are damaged or aging, otherwise they must not be used. It is forbidden to directly contact the high voltage part without wearing gloves.

2. Dry insulating pads should be laid on the lower part of the truck body and the standing parts of maintenance personnel.

3. Place a warning triangle "Danger of touching during high-voltage operation".

4. Inspection and maintenance personnel are not allowed to carry or wear metal objects;

5. First confirm that there is no water (water accumulation, water droplets) in the ground and vehicle body. It is not allowed to work in a humid environment. Never perform high-voltage work when hands are wet, and do not work with wet high voltage parts. When the ground or surrounding humidity is too high, the operation should be stopped.

6. Dry powder fire extinguishers should be installed in the work area. Do not use other fire extinguishers.

7. Prepare the necessary maintenance tools, and the maintenance tools are insulated.

8. Cut off the high-voltage system power supply, first cut off the manual maintenance switch (MSD).

### Safe operation specification

1. Before maintenance work, please take safety isolation measures (use the warning fence to isolate), and place high-voltage warning signs to warn relevant personnel and avoid safety accidents.

2. Before repairing high-voltage components, connect the body with the ground wire to the ground wire of the dedicated repair station for the electric forklift.

3. High-voltage components and storage batteries are carried out by Hangcha or authorized institutions and personnel with special training (different from ordinary forklift training).

4. When repairing high-voltage battery packs with electrolyte leakage, you must wear protective glasses to prevent electrolyte from splashing into your eyes.

5. Before turning on the key switch of the vehicle, pay attention to confirm whether there are

people performing high-voltage maintenance operations to avoid accidents.

6. When examining and repairing the high-voltage wiring harness, any removed high-voltage wiring should be immediately wrapped and insulated with green tape.

7. Do not touch the live parts of the high-voltage wiring harness connector with your fingers to avoid electric shock. In addition, prevent small metal tools or iron bars from contacting the live parts of the connector.

8. In the event of an abnormal accident or fire, the operator should immediately cut off the high-voltage circuit, and other personnel should immediately use a fire extinguisher to fight the fire (use dry powder fire extinguishers, water-based fire extinguishers are strictly prohibited).

9. When the battery leaks electrolyte, do not touch it with your hands. The electrolyte needs to be diluted with calcium gluconate ointment, not with water.

10. Pay attention to the colors or markings used for high-voltage components and area prompts during operation.

11. It is forbidden to get hands, truck body, parts, or environment wet, otherwise no operation is allowed.

## **Maintenance equipment and site configuration**

### **1. Common tools and equipment**

Table 1-1 Basic tools and equipment for high-voltage electric forklifts

| Tool equipment name                   | Specifications/Technical Standards                                                                                                                                                                                                                                                                          |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test pencil                           | ①Contactless. Sound and light prompt<br>②Testable voltage range: 90~1000V AC/DC : 90~1000V AC/DC                                                                                                                                                                                                            |
| Digital clamp meter                   | Voltage measurement 1000V AC/DC                                                                                                                                                                                                                                                                             |
| Megger (insulation resistance tester) | ①Output voltage: 250V/500V/1000V<br>②Test current: 250V(R=250K $\Omega$ )1mA; 500V(R=500K $\Omega$ )1mA; 1000V(R=1M $\Omega$ )1mA<br>③Insulation resistance: 250V, 0.1~20M $\Omega$ ; 500V, 0.1~50M $\Omega$ ; 1000V, 0.1~100M $\Omega$<br>④Test voltage: AC750V                                            |
| Three-phase AC phase sequence meter   | ①Phase sequence detection voltage range: 200~480V<br>②Phase sequence detection frequency range: 20~400Hz<br>③Used for the forward, reverse and open phase inspection of the phase sequence of three-phase sinusoidal AC power supply<br>④LCD and buzzer indicate normal phase, reverse phase and phase loss |

## 2、Safety protective gear and equipment

Safety protection equipment used for maintenance of high-voltage electric forklifts are shown in table 1-2. Part of the protective equipment is shown below

Table 1-2 Safety protection appliances and equipment for maintenance of high-voltage electric forklifts

| name                         | unit  | quantity | Specifications and requirements                                                                                                                          |
|------------------------------|-------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Insulating gloves            | pair  | 2        | Withstand DC voltage above 1000V                                                                                                                         |
| Insulating shoes             | pair  | 2        | Withstand DC voltage above 1000V                                                                                                                         |
| Insulating rubber pad        | piece | 12       | Single piece 1 m <sup>2</sup> , withstand DC voltage above 1000V                                                                                         |
| protective glasses           | piece | 1        | Acid and alkali resistance                                                                                                                               |
| Anti-acid and alkali gloves  | pair  | 1        | Acid and alkali resistance                                                                                                                               |
| Safety warning sign          | piece | 1        | Specifications: 30cm×60cm, high-strength ABS plastic; content: "Danger! keep away " and high-voltage signs                                               |
| Electrical tape              | roll  | 2        | Size: 18mm×20mm×0.18mm<br>Voltage level: 600V; dielectric strength 1000V/mil (39.37kV/mm)<br>Insulation resistance: >10 <sup>12</sup> Ω                  |
| Dry powder fire extinguisher | piece | 2        | If the vehicle catches fire, the fire is small and slow, please use a dry powder fire extinguisher to extinguish the fire, and call for help immediately |



Dry powder fire extinguisher



Insulating gloves



Insulating rubber shoes



Insulating rubber pad



Protective glasses

Fig.1-9 Protective equipment entity

### 3. Maintenance station configuration standard

#### (1) Configuration standard for safe maintenance site of high voltage electric forklift

- ① Set up a dedicated maintenance station (equipped with a crane above 6t).
- ② Adopt safety isolation measures and set up high-voltage warning signs. The supplies are as shown in the figure below.



Fig.1-10 Maintenance station warning sign and isolation fence

③ *Safety operation specification for maintenance of high voltage electric forklift* is pasted on the wall.

④ The dedicated maintenance station is equipped with a single-phase and effectively grounded standard three-hole socket with a rated voltage of 250V and a rated current of 16A in accordance with GB2099.1.

#### (2) Specification of auxiliary materials for safety maintenance station of high-voltage electric forklift

- ① High-voltage warning signs (30cmx60cm, high-strength ABS plastic)
- ② Warning fence (total height 90cm, drawstring width 5cm, drawstring length 200cm, 300cm, 500cm, drawstring color is red);
- ③ The insulating ground glue (insulates 1000V voltage, the waterproof level is similar to the plastic or rubber material, the size is 7mx4m), the paving effect is as shown in the figure below

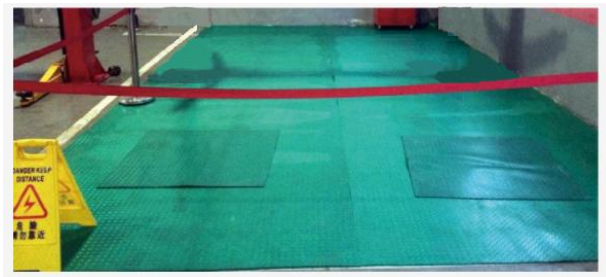


Fig.1-11 Ground layout of maintenance station

---

### 1.3 First aid for high-voltage accident

#### 1、First aid measures for electric shock accident

When rescuing a person injured in an electrical accident, do not touch anyone who is still in contact with electricity. If possible, power off the electrical system immediately (turn off the key switch or pull out the maintenance switch immediately). Use non-conductive objects (wood strips, bamboo poles, etc.) to separate the rescued person or the conductive body from the discharge body.

When performing first aid after an electric shock accident, if the rescued person does not respond, the following rescue measures should be taken: first confirm that the victim has signs of life, such as pulse and breathing; immediately call the emergency doctor, or immediately ask others to call; perform artificial respiration and cardiopulmonary press until the doctor arrives; if breathing stops, use a defibrillator (if available) for rescue.

If the rescued person can respond to the inquiry, the following first aid measures should be taken: cool down the burn and wrap it with a sterile lint-free cloth; even if the rescued person refuses, he should be required to receive treatment (to avoid long-term sequelae)

#### 2、First aid measures for high-voltage battery accidents

When the high-voltage battery catches fire, please perform the following operations according to the actual situation:

- ① Turn off the key switch, and disconnect the 12V battery when conditions permit;
- ② Disconnect the maintenance switch;
- ③ Look for fire extinguishers nearby (dry powder fire extinguishers should be used, and water-based fire extinguishers should not be used);
- ④ If the vehicle catches fire, the fire is small and slow, please use a dry powder fire extinguisher to extinguish the fire, and call for help immediately;
- ⑤ If the fire is large and develops rapidly, please stay away from the vehicle immediately and call the fire telephone to wait for rescue;

If the high-voltage battery leaks (there is obvious liquid outflow), please operate the vehicle according to the following methods:

- ① Turn off the key switch and disconnect the 12V battery when conditions permit;
- ② Disconnect the maintenance switch;
- ③ When a small amount of leakage occurs, please stay away from fire, use absorbent cloth to absorb and place in a closed container, or dispose of by incineration. Please wear acid and alkali-proof gloves before operation;
- ④ When a large amount of leakage occurs, please collect them and treat them in accordance with hazardous chemicals. Add calcium gluconate solution to treat the generated gas;
- ⑤ When the human body accidentally touches the leaked liquid, rinse immediately with plenty of water (10-15) min. If there is pain, coat with 2.5% calcium gluconate ointment, or soak with 2%-2.5% calcium gluconate solution for pain relief, if there is no improvement or uncomfortable symptoms, please seek medical attention immediately.

## 2、 Drive system

The Drive system is composed of drive axle assembly, reduction gearbox, tire assembly, etc.

### WARNING



- a) When repairing the transmission system, it is necessary to disconnect the high-voltage cable on the traction motor's electronic control 2-in-1, which involves the high-voltage part!  
Therefore, it is necessary to strictly follow the safety regulations in Chapter 1 for operation!
- b) Before maintenance, it is necessary to disconnect the power supply of the entire vehicle and the lithium battery MSD maintenance switch, and let it sit for 15-20 minutes before operation!

### 2.1 Drive System Removing and Installation

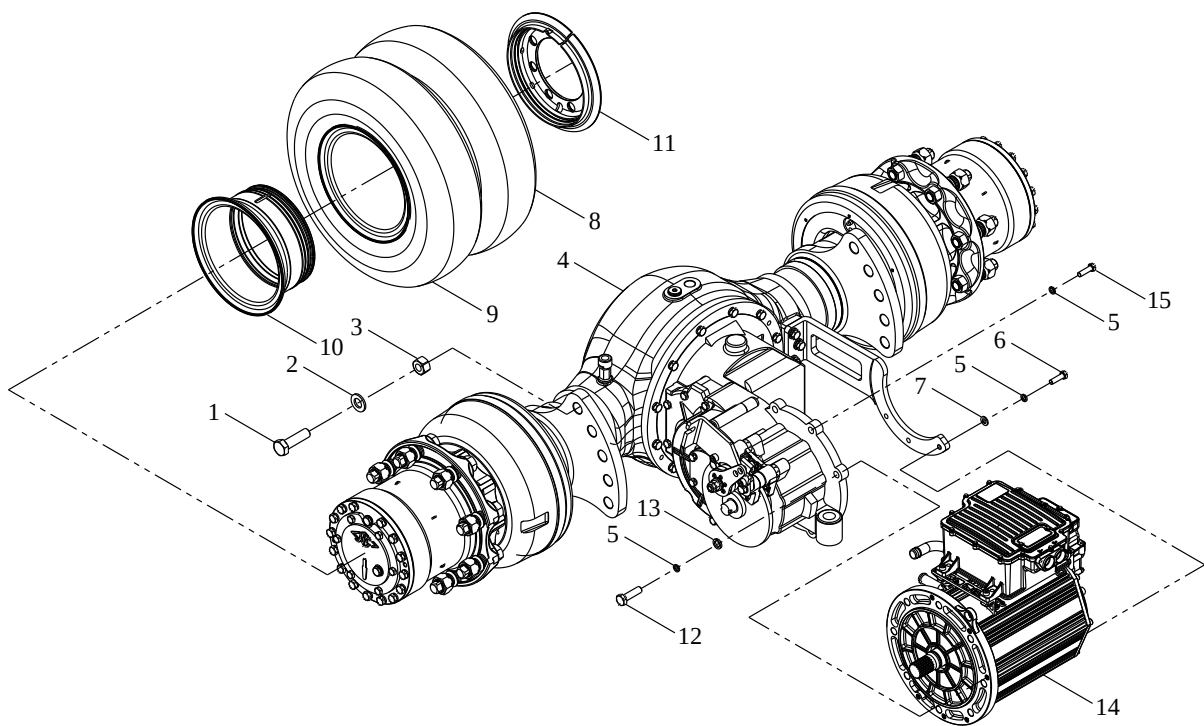


Fig.2-1 6t-7t Drive System

|                              |          |                   |                   |          |           |          |
|------------------------------|----------|-------------------|-------------------|----------|-----------|----------|
| 1-Bolt                       | 2-Washer | 3-Nut             | 4-Drive axle assy | 5-Washer | 6-Bolt    | 7-Washer |
| 8-Tire                       | 9-Tire   | 10-Wheel rim assy | 11-Retaining ring | 12-Bolt  | 13-Washer |          |
| 14-Traction motor&controller | 15-Screw |                   |                   |          |           |          |

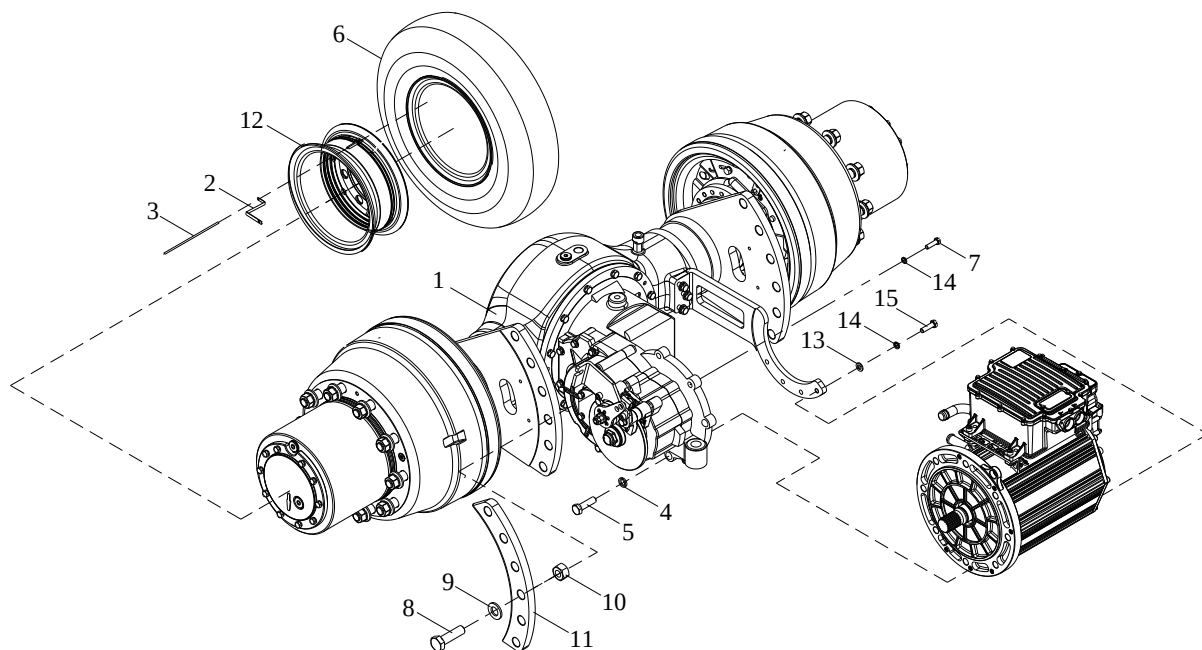


Fig.2-2 8t-10t Drive System

|                   |               |                  |           |         |
|-------------------|---------------|------------------|-----------|---------|
| 1-Drive axle assy | 2-Fixed plate | 3-Extension tube | 4-Washer  | 5-Screw |
| 6-Tyre            | 7-Screw       | 8-Bolt           | 9-Washer  | 10-Nut  |
| 11-Washer         | 12-Tyre       | 13-Washer        | 14-Washer | 15-Bolt |

### 2.1.1 Remove the drive system from the truck(take 6t-7t as an example, 8t-10t steps are similar)

The whole drive system is fastened to the frame by bolt 1. The vehicle is equipped with a high-powered traction motor, which makes the vehicle travel at a much higher speed. The gearbox and motor 14 are fastened by bolt 12 and bolt 6.

- 1、 Lift the front end of the forklift and support the frame with a wooden block or a secure holder;
- 2、 Remove the mast tilt cylinder, remove the bearing cap bolts connecting the mast and the drive axle; hang the mast down (See 5.4 Mast disassembly and installation adjustments for details)
- 3、 Remove the front tire;
- 4、 Remove the brake lines on the left and right brakes of the drive axle;
- 5、 Remove the high-voltage cable, low-voltage signal line, grounding line, water inlet pipe and water outlet pipe on the two-in-one traction motor controller;
- 6、 Remove bolt 1, lift the drive axle, motor and gearbox with lifting device and place them properly.
- 7、 The installation method is opposite to the removal method.

## WARNING



- a) Always disconnect the service device (MSD) before starting work.
- b) When removing the tire from the hub, only remove the rim bolts and nuts after deflating it.

### Caution!

- a) After removing the brake pipe, put a rubber plug on the brake pipe port to prevent the brake fluid from flowing out.
- b) During installation, bolt 1 and nut 3 are pre-coated with Loctite 262 to prevent loosening.
- c) During installation, be careful not to damage the motor splines.

### 2.1.2 Remove the two-in-one traction motor controller(take 6t-7t as an example, 8t-10t steps are similar)

- 1、The drive axle is placed flat, and the motor side is slightly higher by 1 cm;
- 2、Loosen bolts 12 and 6, remove the two-in-one traction motor controller14, and place them on a clean tool rack;
- 3、The installation process is the opposite of disassembly.

### Caution!

- a) Brush HR-P high temperature resistant grease on the traction motor connecting spline with a brush before installation.
- b) The outer spline of the motor should be aligned with the inner spline of the gearbox, and rotate the motor to engage.
- c) During installation, be careful not to damage the motor splines.

### 2.1.3 Tightening torque

Table 2-1 Tightening torque table of 6t-7t drive system

| No.            | Tightening torque N·m | Conneting part                               |
|----------------|-----------------------|----------------------------------------------|
| 1 Bolt (M24)   | 441~539               | Connect the drive axle assembly to the frame |
| 6 Bolt (M10)   | 65~78                 | Connect the motor to the reduction gearbox   |
| 12 Bolt (M12)  | 110~130               | Connect the motor to the reduction gearbox   |
| 15 Screw (M10) | 65~78                 | Connect the motor to the reduction gearbox   |

Table 2-2 Tightening torque table of 8t-10t drive system

| No.           | Tightening torque N·m | Conneting part                               |
|---------------|-----------------------|----------------------------------------------|
| 5 Bolt (M12)  | 71.4~85.5             | Connect the motor to the reduction gearbox   |
| 7 Screw (M10) | 40.9~49               | Connect the motor to the reduction gearbox   |
| 8 Bolt (M24)  | 597~716               | Connect the drive axle assembly to the frame |
| 15 Bolt (M10) | 40.9~49               | Connect the motor to the reduction gearbox   |

## 2.2 Traction motor controller 2 in 1

### 2.2.1 Traction motor

6t-7t traction motor adopts a 54.5kW AC motor. See the table below for other parameters.

Table 2-3 Parameters of traction motor

| Model            | Rated Power   | Insulation Grade | Cooling method | Protecting Grade |
|------------------|---------------|------------------|----------------|------------------|
| TZ220XS45kW309VT | 45kW          | H                | liquid cooling | IP67             |
|                  | Rated current | Rated voltage    | Rated speed    | Duty             |
|                  | 175A(AC)      | 309V(DC)         | 9350r/min      | S2               |

8t-10t traction motor adopts a 54.5kW AC motor. See the table below for other parameters.

Table 2-4 Parameters of traction motor

| Model              | Rated Power   | Insulation Grade | Cooling method | Protecting Grade |
|--------------------|---------------|------------------|----------------|------------------|
| TZ220XS54.5kW309VT | 54.5kW        | H                | liquid cooling | IP67             |
|                    | Rated current | Rated voltage    | Rated speed    | Duty             |
|                    | 200A(AC)      | 309V(DC)         | 8000r/min      | S2               |

**Caution!**

AC motor don't have commutator and brush, not need maintain. You must check and clear dust everyday.

### 2.2.2 Traction controller

Table 2-5 Parameters of 6t-10t traction controller

| Model  | Continuous working current | Insulation Grade    | Cooling method   | Protecting Grade |
|--------|----------------------------|---------------------|------------------|------------------|
| MC3906 | 180A                       | H                   | liquid cooling   | IP67             |
|        | Short-term working current | Rated input voltage | number of phases | Duty             |
|        | 320A                       | 309V(DC)            | 3                | S9               |

2.3 Drive axle assembly

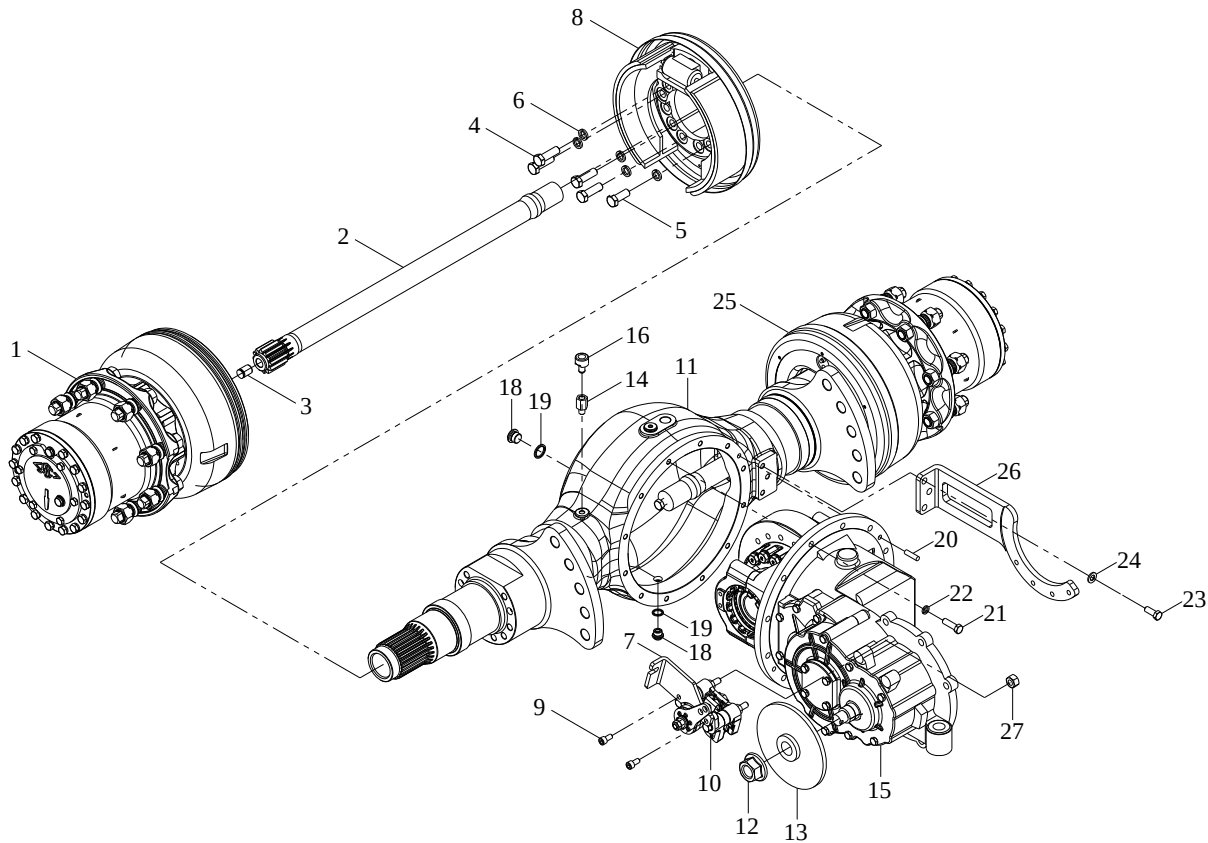


Fig.2-3 6t-7t Drive axle assy

- |                           |                            |                 |                |            |
|---------------------------|----------------------------|-----------------|----------------|------------|
| 1-Wheel edge reducer assy | 2-Half shaft               | 3-Adjust pillar | 4-Bolt         | 5-Bolt     |
| 6-Washer                  | 7-Hand brake cable support | 8-Left brake    | 9-Screw        |            |
| 10-Parking brake          | 11-Drive axle housing assy | 12-Nut          |                |            |
| 13-Hand brake disc        | 14-Vent plug seat          | 15-Reducer      | 16-Respirator  |            |
| 17-Plug                   | 18-Plug                    | 19-Washer       | 20-Pin         | 21-Bolt    |
| 22-Washer                 | 23-Bolt                    | 24-Washer       | 25-Right brake | 26-Support |
|                           |                            |                 |                | 27-Nut     |

Table 2-6 Tightening torque of drive axle assembly

| NO.                             | Tightening torque N·m |
|---------------------------------|-----------------------|
| 4-Bolt ( M16 ) 5-Bolt ( M16 )   | 240~280               |
| 9-Screw ( M10 )                 | 65~75                 |
| 21-Bolt ( M12 ) 23-Bolt ( M12 ) | 105~115               |

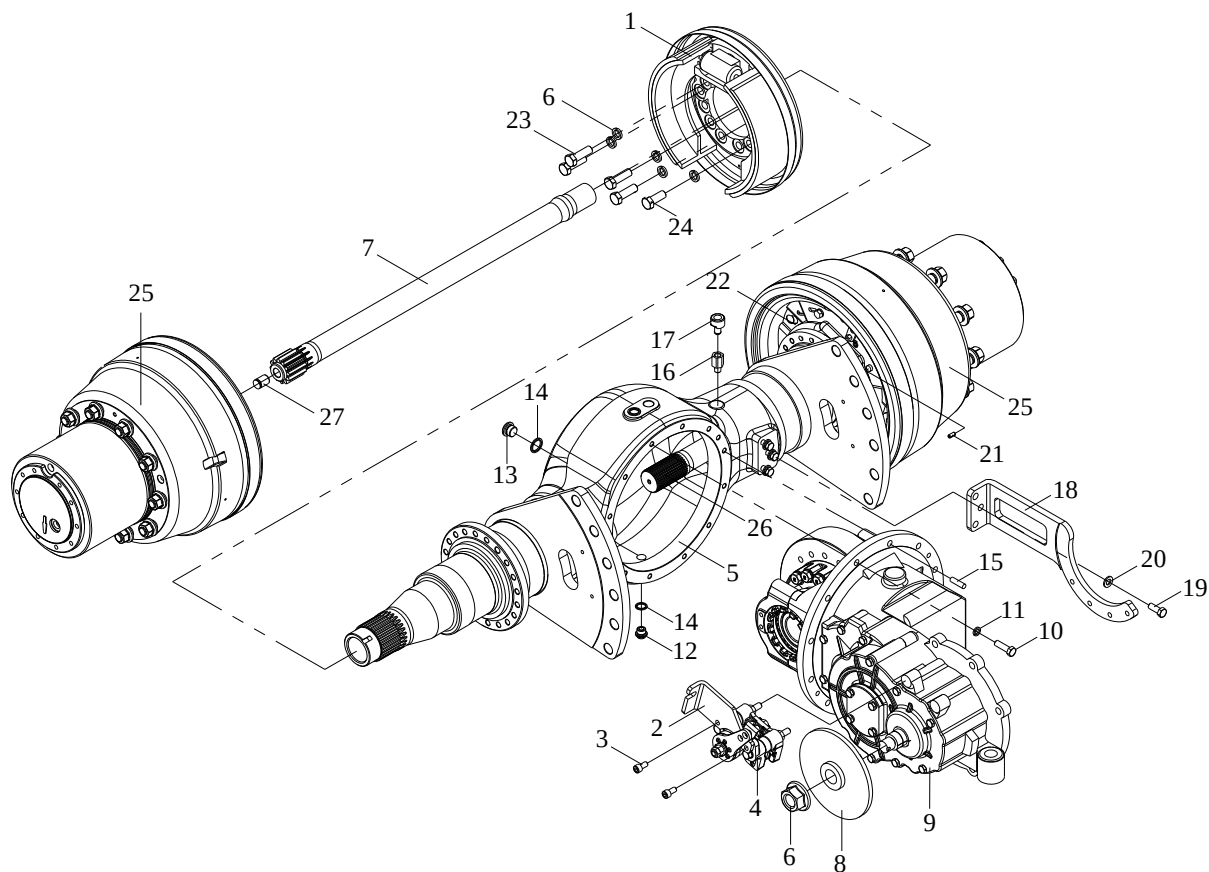


Fig.2-4 8t-10t Drive axle assy

|                                |                            |                   |                   |
|--------------------------------|----------------------------|-------------------|-------------------|
| 1.Brake assy,LH                | 2.Hand brake cable bracket | 3.Screw           | 4.Parking brake   |
| 5.Housing,driving axle         | 6.Nut                      | 7.Shaft axle,left | 8.Brake disc      |
| 9.Reduction gearbox            | 10.Bolt                    | 11.Washer         | 12.Plug           |
| 13.Plug                        | 14.Washer                  | 15.Parallel pin   | 16.Vent plug seat |
| 17.Respirator                  | 18.Bracket                 | 19.Bolt           | 20.Washer         |
| 21.Parallel pin                | 22.Brake assy,RH           | 23.Screw          | 24.Screw          |
| 25.Wheel reducer gear assembly | 26.Shaft axle,right        | 27.Strut,thrust   |                   |

Table 2-7 Tightening torque of drive axle assembly

| NO.                         | Tightening torque N·m |
|-----------------------------|-----------------------|
| 3-Screw (M10)               | 65~75                 |
| 10-Bolt (M12)、19-Bolt (M12) | 105~115               |
| 23-Bolt (M16)、24-Bolt (M16) | 180~200               |

### 2.3.1 Basic structure and working principle of drive axle

#### 2.3.1.1 Basic structure and working principle

The basic structure of the drive axle is shown in Fig.1-3、 Fig.1-4: it is mainly composed of the axle housing, the reduction box assembly, the half shaft, the wheel side reducer and the drum brake.

Its working principle is shown in Fig.1-5: the transmission torque is input to the reduction box, through which the direction of the power is changed, the speed is reduced, the transmitted torque is increased, and transmits the power to the wheel through differential and half shaft, and then transmits the motion and torque to two driving wheels after further deceleration by wheel reducing mechanism.

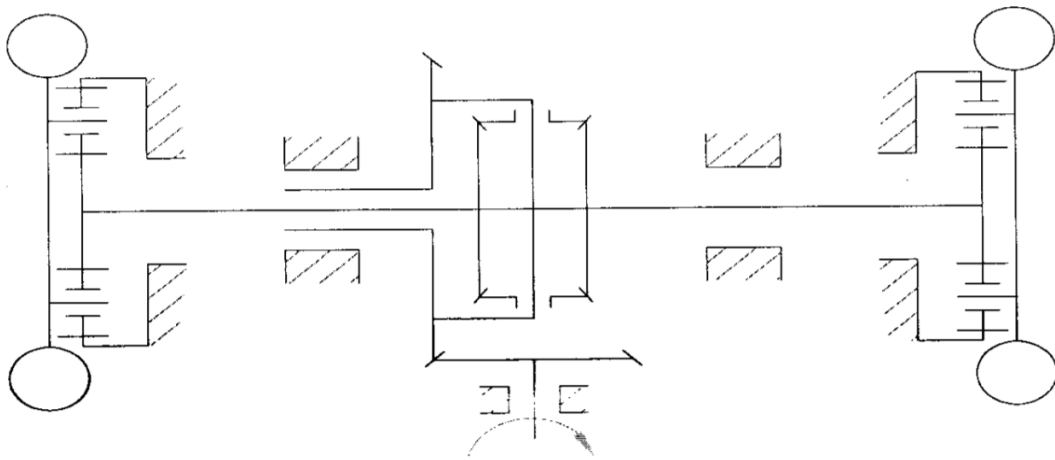


Fig.2-5

#### 2.3.1.2 Hub reduction and axle housing structure

Hub reduction is a planetary reducer mechanism, mainly composed of planet carrier, inner gear, planetary gear and central gear. Inner gear is fixed on the axle by spline, and the planet carrier is fixed with hub.

#### 2.3.1.3 Reduction gearbox

JETH70A/100A battery reduction gearbox is suitable for 6-10t electric counterbalanced forklift truck. It is a drive unit composed of differential and drive device. It adopts H-type structure layout design, which reduces the overall structure, and makes the forklift layout more reasonable and reduces the vehicle turning radius.

JETH70A/100A battery reduction gearbox is a three-stage reducer composed of three external meshing gears placed into the box. The motor shaft of the driving motor is connected to the internal spline of the pinion, and the power is input into the reducer, and the power is output by the half-shaft gear of the differential after the three-stage gear reduction. Therefore, it has the characteristics of high efficiency, large transmission ratio range, compact structure, small size, etc. The gearbox does not need to shift, change direction operation and directly rely on the forward and reverse rotation of the motor to achieve forward or backward operation, easy to use and maintain. Technical parameters are shown in Table 1-8

Table 2-8 Reduction gearbox parameters table

|                   |                              |
|-------------------|------------------------------|
| Model             | JETH70A                      |
| Motor power (MAX) | 113kW                        |
| Speed ratio       | 11.591                       |
| Max. input torque | 580N·m                       |
| Max. motor speed  | rpm 9500rpm                  |
| Noise             | ≤75 dB (A)                   |
| Drive efficiency  | ≥0.95                        |
| Lubricant         | GL-5 85W-90 Vehicle gear oil |

#### 2.3.1.4 Drum brake structure

Drum brake is used for braking. The drum brake is mainly composed of brake pad, brake shoe, brake pump and bracket. See braking system in detail.

#### 2.3.1.5 Main technical parameters

Table 2-9 Parameters of drive axle assembly

| Type                                  | 6t-7t                                                             | 8t-10t  |
|---------------------------------------|-------------------------------------------------------------------|---------|
| Drive axle Installing mode            | The axle is directly installed with the frame, front-wheel driven |         |
| total reduction ratio                 | 50.189                                                            | 50.455  |
| Speed ratio of deceleration box       | 11.591                                                            | 14.507  |
| Wheel side deceleration ratio         | 4.33                                                              | 3.478   |
| Wheel side deceleration device        | Cylindrical planetary gear type                                   |         |
| Brake                                 | Drum brake                                                        |         |
| Tyre inflation pressure (front wheel) | 0.83MPa                                                           | 0.76MPa |

---

## 2.3.2 Periodical technical maintenance for drive axle

### 2.3.2.1 Level I technical maintenance(about work 50 hours)

- ①If it is new truck running-in, replace gear oil.

**Caution!**

- 
- a) When replacing oil, first warm the truck, release oil, and then wash with carbon oil. After that, add oil to specified position.
- b) When discharging oil for main reducing gear, open drain plug and release oil . When discharging oil for hub reduction gear, place the oil hole at left and right hub reduction gear to lowest place,open drain plug and release oil .
- 

- ②Check each drive parts move condition, abnormal noise is not allowed.

- ③Check if hub reduction gear, main driver and brake outer fastener loosen and screw down.

- ④Check brake pad wear condition.

- ⑤Check each part oil leak condition and repair in time. All sealing elements are not allowed to reuse once dismantle.

### 2.3.2.2 Grade II technical maintenance (working time about 1000hours)

- ①Check and adjust bearing and basin tooth clearance.

- ②Replace gear oil according to season or major repair requirement. When replacing oil, first drive truck warming, release oil, and then wash with carbon oil. After that, add oil to specified position.

- ③Check and clean greasy dirt, soil and dust, especially breather plug on the axle housing should keep smooth.

- ④Check and fasten external fastener. If any loosen, apply Letai 242 anti-loose glue and screw down.

### 2.3.3 Drive axle oil adding /drainage way and fuel-injection quantity

When adding oil, place the oil hole at left and right hub reduction gear to highest place(lowest place when discharging oil), open the vent plug, oil level plug and oil plug at left and right hub reduction gear, add lubrication oil to the left, right and middle position, until overflow from the oil level, refer to the fig.1-6.

When adding oil for two hub reduction gear,please rotate hub reduction gear and make the end caps on the arrow "↓" logo vertically downward. Fuel-injection quantity see the following chart.

**Caution!**

---

Specified injection of fuel is approximate, Prevail along the flush to the oil surface and the filling hole.

---

Table 2-10 Drive-axle Refueling Scale

| Lubricating part   | Lubricating oil type | Oil capacity (L) |        |
|--------------------|----------------------|------------------|--------|
| Main reducing gear | GL—5 85W/90 Gear oil | ≈8               | 6t-10t |
| Hub reduction gear | GL—5 85W/90 Gear oil | ≈1.5 (One side)  | 6t-7t  |
|                    |                      | ≈2.5 (One side)  | 8t-10t |

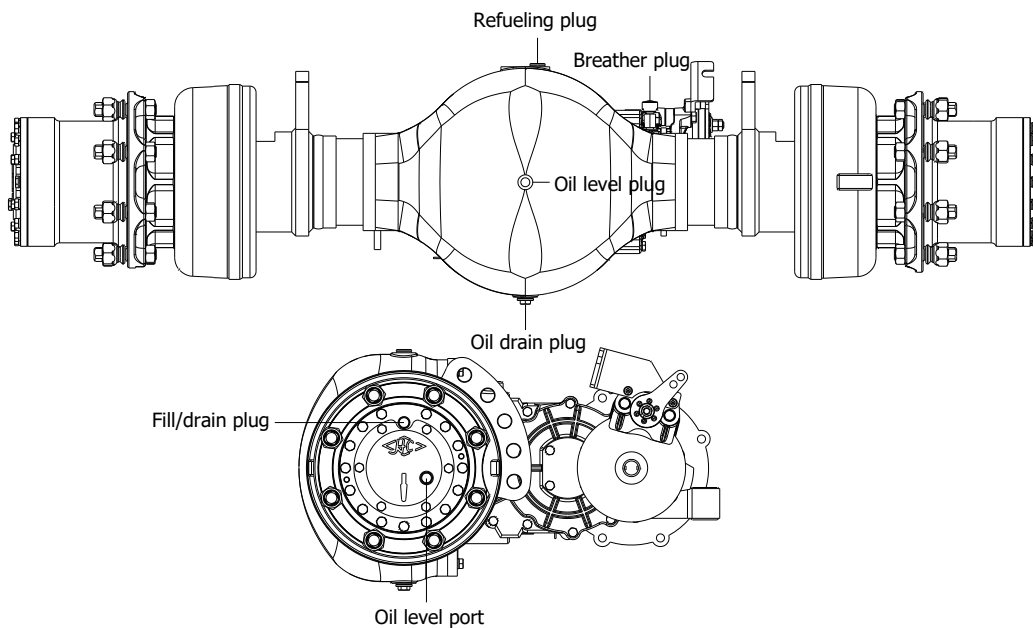


Fig.2-6

### 2.3.4 Drive axle hoisting

When hoisting the drive axle, hoist through rope according to the arrow listed place, if shovel needed, shovel according to the arrow listed place. No matter hoist or shovel, collision or obscission is prohibited.

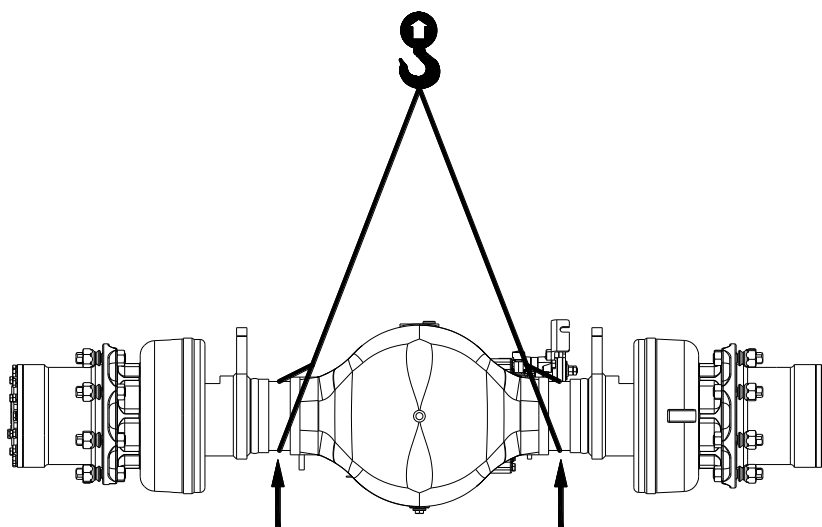


Fig.2-7

### 2.3.5 Fault diagnosis and corrections

Table 2-11 Drive axle fault diagnosis table

| Condition                                                                                                                     | Possible reason                                               | Corrections                   |
|-------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|-------------------------------|
| Abnormal noise<br>Before correction, make sure noise is from half axle but not from hub reduction gear or main reducing gear. | Drive axle supporting cover and chassis connecting bolt loose | Tightening                    |
|                                                                                                                               | Wheel nut loose                                               | Tightening                    |
|                                                                                                                               | Other installing parts loose                                  | Tightening                    |
|                                                                                                                               | Hub bearing damage or wear                                    | Replace                       |
|                                                                                                                               | Bad gear engagement                                           | Re-adjust assemble            |
|                                                                                                                               | Incorrect hub bearing adjustment                              | Adjust                        |
|                                                                                                                               | Half shaft spline wear                                        | Replace                       |
|                                                                                                                               | Insufficient lubrication                                      | Add lubricating oil           |
| Unstable move<br>This diagnosis and corrections is also apply to rear wheel                                                   | Wheel nut loosen                                              | Tightening                    |
|                                                                                                                               | Wheel deformation                                             | Replace                       |
|                                                                                                                               | Hub bearing wear or damage                                    | Replace                       |
|                                                                                                                               | Drive axle supporting cover and chassis connected bolt loosen | Tightening                    |
|                                                                                                                               | Incorrect hub Bearing adjustment                              | Adjust                        |
|                                                                                                                               | Incorrect tyre pressure                                       | Adjust                        |
| Oil leakage                                                                                                                   | Axle oil sealing wear or damage                               | Replace                       |
|                                                                                                                               | Incorrect main drive device installation                      | Replace paper gasket          |
|                                                                                                                               | Fill oil and oil plug loosen                                  | Tightening                    |
|                                                                                                                               | Bad lubrication                                               | Improve lubrication           |
|                                                                                                                               | ·Over high oil level                                          | Add oil to specified position |

2.3.6 Disassembly and installation of reduction gearbox assembly

CAUTION!

-----  
Please place a container under the axle housing to drain the gear oil from the housing before  
disassembly.  
-----

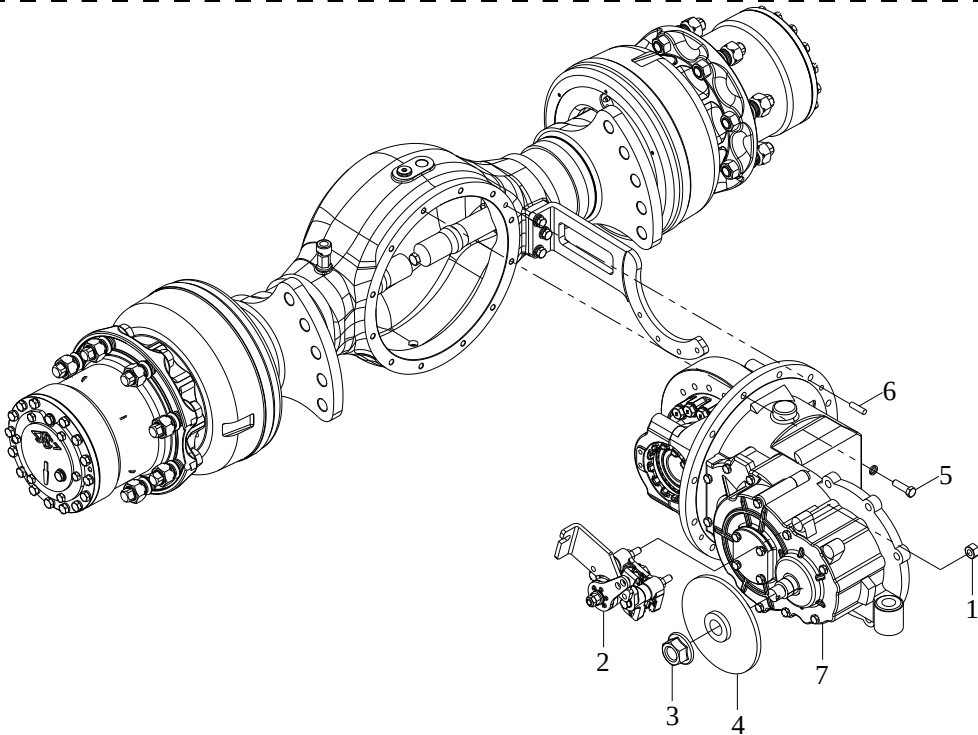


Fig. 2-8

- 1、 Loosen nut 1 and remove hand brake 2.
- 2、 Loosen nut 3 and remove hand brake disc 4.
- 3、 Loosen bolt 5 and pin 6, and remove gearbox assembly 7;
- 4、 The installation process is the opposite of the disassembly process, and the tightening torque is shown in Table 2-12.

Table 2-12 Tightening torque table of drive axle assembly

| NO.          | Tightening torque N·m |
|--------------|-----------------------|
| 1-Nut (M12)  | 71.4~85.8             |
| 5-Bolt (M12) | 105~115               |

2.3.7 Removal and installation of wheel reducer assembly

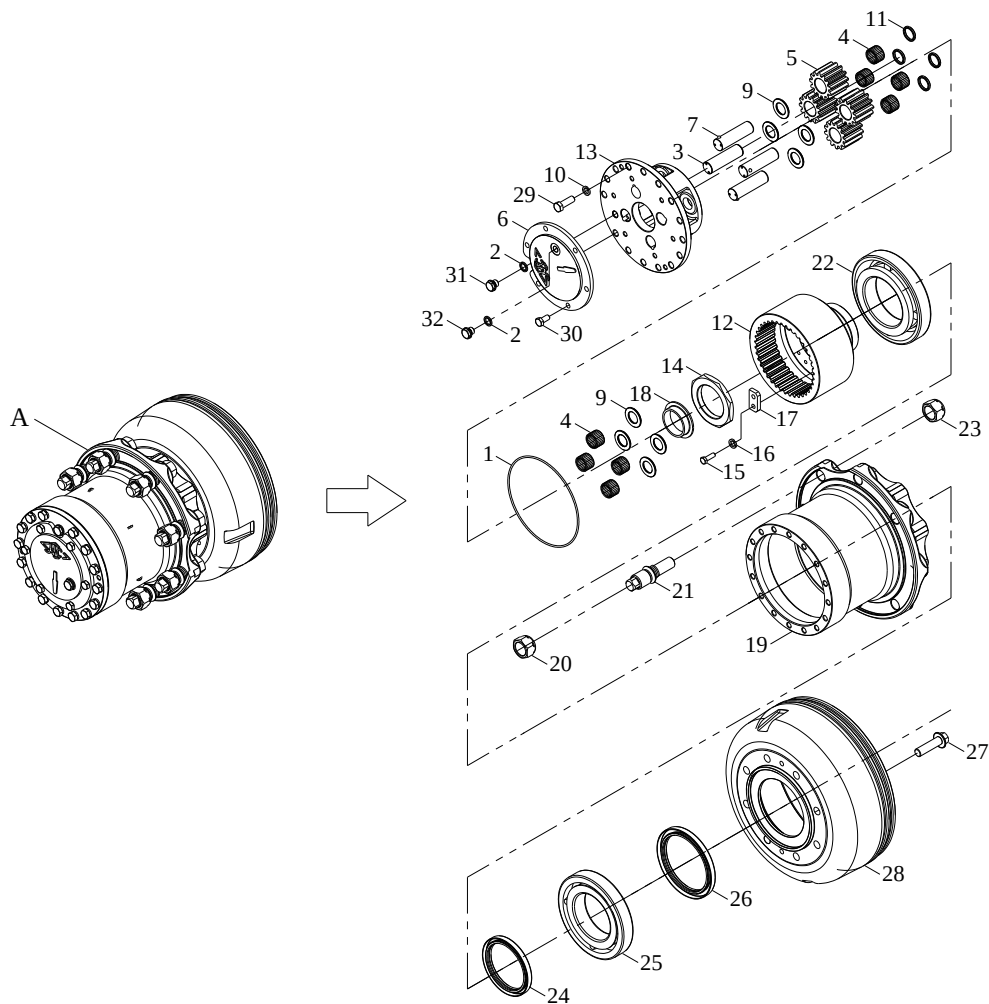


Fig.2-9 6t-7t Wheel reducer assy

|                |              |                          |                     |                  |
|----------------|--------------|--------------------------|---------------------|------------------|
| 1-O-ring       | 2-Washer     | 3-Planets wheel          | 4-Rolling bearing   | 5-Planetary gear |
| 6-End cover    | 7-Steel ball | 8-Washer                 | 9-Planets wheel pad | 10-Washer        |
| 11-Spacer bush | 12-Ring gear | 13-Planets wheel carrier | 14-Nut              | 15-Bolt          |
| 16-Washer      | 17-Plate     | 18-Spacer bush           | 19-Wheel hub        | 20-Nut           |
| 21-Bolt        | 22-Bearing   | 23-Nut                   | 24-Oil seal         | 25-Bearing       |
| 26-Oil seal    | 27-Bolt      | 28-Brake drum            | 29-Bolt             | 30-Bolt          |
| 31-Plug        | 32-Plug      |                          |                     |                  |

1、 See Figure 1-8. After loosening plug 32, plug 31, washer 2, and bolt 30, remove the end cap 6.

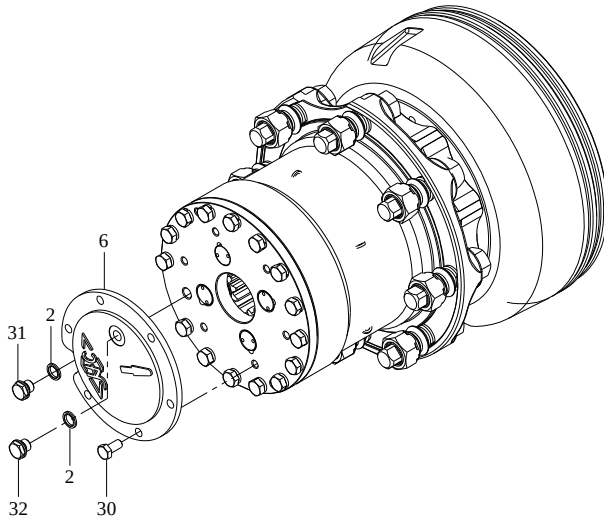


Fig. 1-10

2、 See Figure 1-9. Remove adjusting strut 33 and half-shaft 34, and after loosening bolts 29 and washers 10, remove the planets wheel carrier 13.

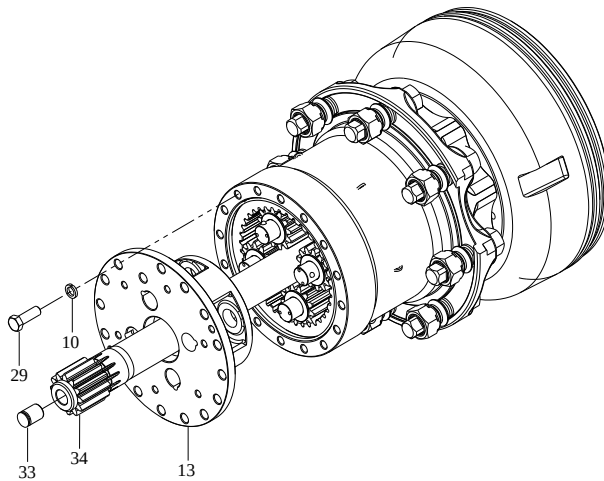


Fig. 1-11

3、 Remove O-ring 1, steel ball 7, planets wheel pad 9, planetary gear 5, rolling bearing 4, spacer bush 11, planets wheel 3, spacer bush 18, bolt 15, washer 16, plate 17, nut 14, ring gear 12, bearing 22, oil seal 24, bearing 25, oil seal 26, bolt 27, brake drum 28 in order.

4、 The installation process is the reverse of the

disassembly process.

**CAUTION!**

- a) Before assembly, all parts must be cleaned, no iron filings, rust, oil and other defects
- b) The inner core of bearing 25 and the outer ring should be filled with lithium-based grease.
- c) After assembling oil seal 24 and oil seal 26. A little lithium grease should be applied evenly on the lip.
- d) Apply Loctite 598 sealant on the joint surface of hub 19 and brake drum 28, planetary carrier 13 and end cover 6; bolt 15 tightening torque 22 ~ 30N-m, bolt 27 tightening torque 280 ~ 330N-m, bolt coated with Loctite 263 thread adhesive; bolt 29 tightening torque 78 ~ 104N-m, bolt 30 tightening torque 45 ~ 59N-m, nut 23 tightening torque 450 ~ 500N-m.
- e) Tighten the lock nut 14 until the hub cannot be rotated, so that the hub bearing is in the correct position, and then loosen the bolt 21 slightly, so that the hub can be rotated with a force of 60~90N at the rim bolt, and align the plate 17 with the two threaded holes of the gear ring 12.
- f) After the assembly is completed, the planetary carrier and planetary wheel should be able to rotate freely.

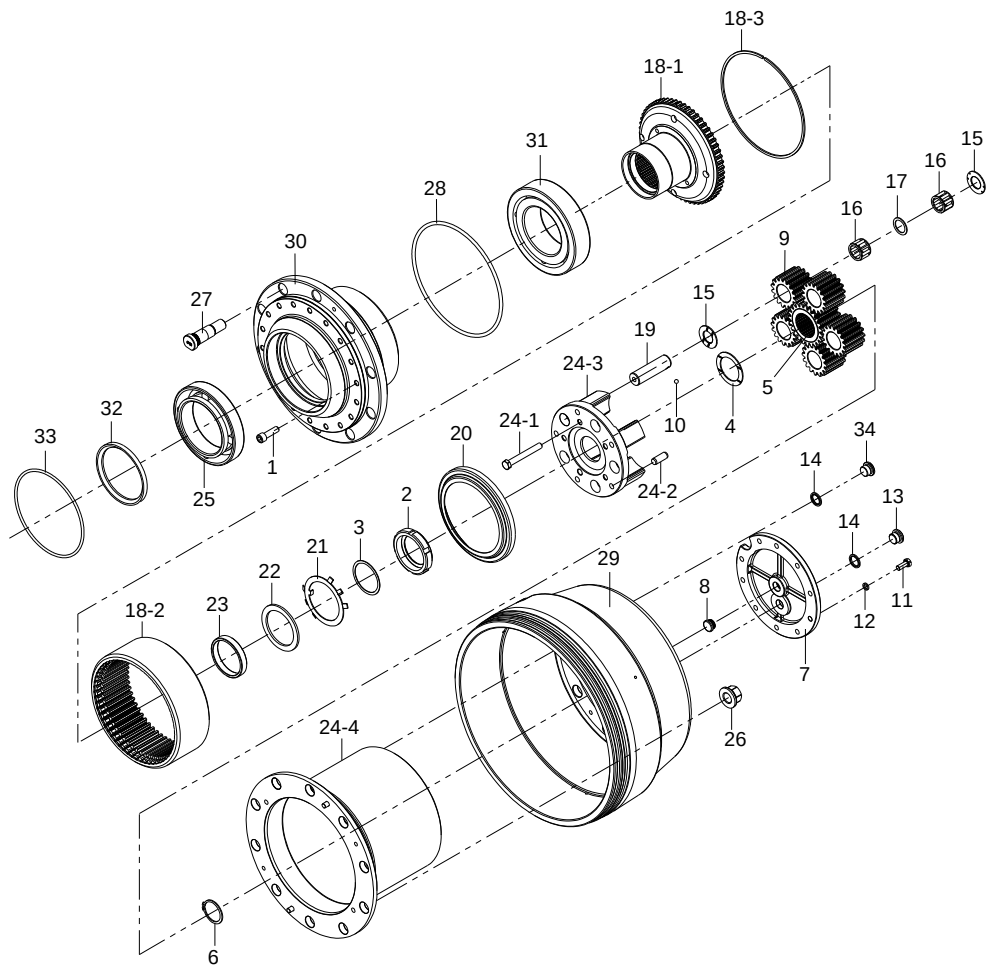
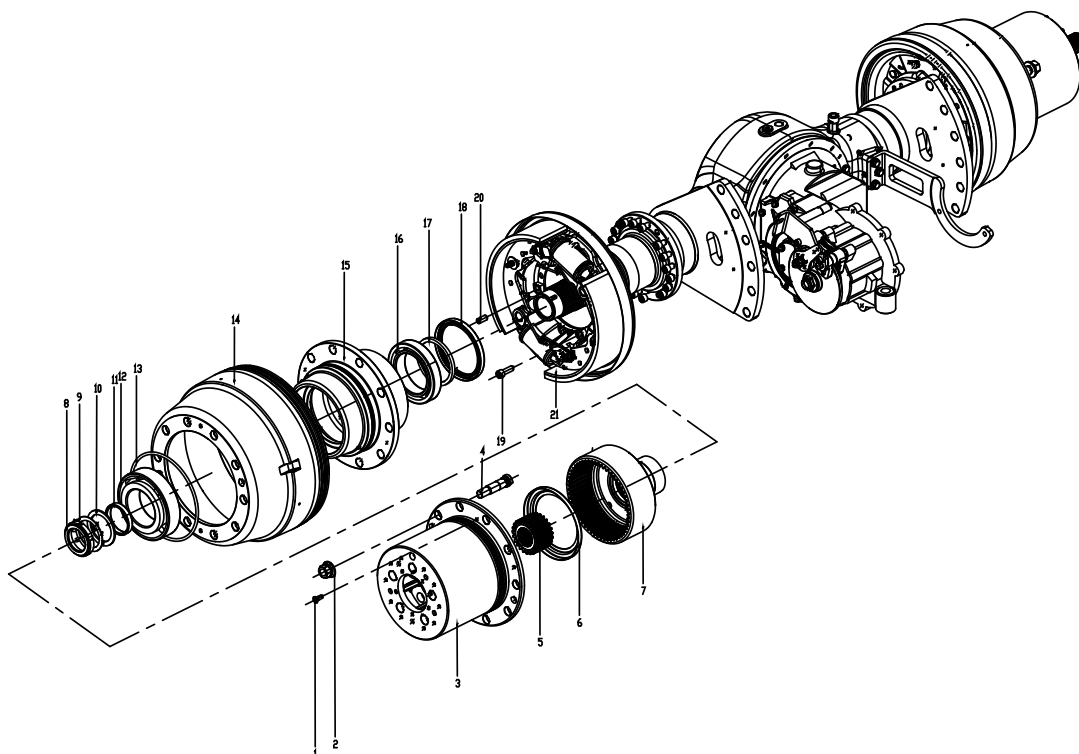


Fig.2-12 8t-10t Wheel reducer assy

|                               |                    |                      |                          |                        |
|-------------------------------|--------------------|----------------------|--------------------------|------------------------|
| 1-Screw                       | 2-Nut              | 3-Adjustment washer  | 4-Washer                 | 5-Gear-sun             |
| 6-Check ring                  | 7-Cover            | 8-Spacing block      | 9-Gear-Planet            | 10-Ball                |
| 11-Bolt                       |                    |                      |                          |                        |
| 12-Washer                     | 13-Plug screw      | 14-Washer            | 15-Washer                | 16-Bearing             |
| 17-Spacer sleeve              |                    | 18-Gear ring support |                          | 18-1-Gear ring support |
| 18-2-Gear ring                | 18-3-Clamping ring |                      | 19-Planetary axle        |                        |
| 20-Carrier-pinion gear cover  | 21-Washer          | 22-Spacer            | 23-Sleeve                |                        |
| 24-Round shell carrier-pinion | 24-1-Bolt          | 24-2-Pin             | 24-3-Carrier-pinion gear |                        |
| 24-4-Round shell              |                    | 25-Bearin            | 26-Nut                   | 27-Bolt                |
| 28-O-ring                     | 29-Drum            | 30-Hub               | 31-Bearing               | 32-Spacer sleeve       |
| 33-Oil seal                   | 34-Plug screw      |                      |                          |                        |

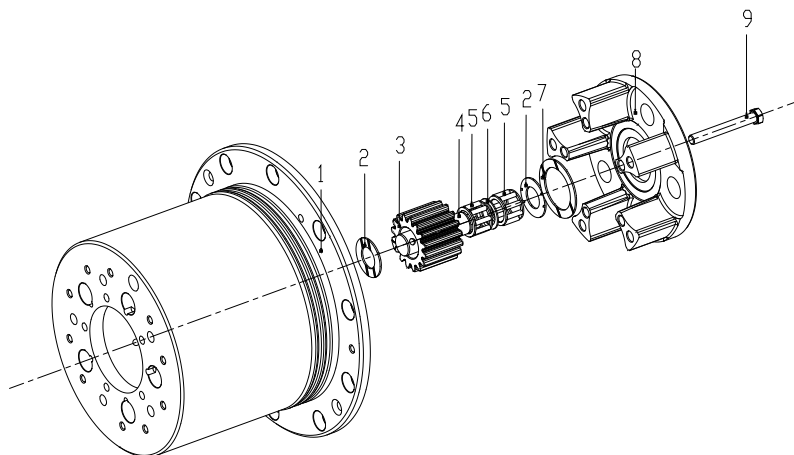


1) Remove the following parts from the drive axle in sequence:

Bolts (1), nuts (2), wheel housing and planet carrier assembly (3), sun gear (5), planet wheel carrier cover (6), ring gear support assembly (7), slot nut (8), circle nut stop washer(9), washer(10), sleeve(11), bearing 32222(12), O-ring(13), brake drum(14), hub(15), hub bolt(4), bearing 32222 (12), O-ring (13), brake drum (14), hub (15), hub bolt (4), bearing 32024 (16), spacer (17), sealing ring (18), bolt (19), pin (20), brake assembly (21).

**Caution!**

- a) The optional pad (10) adjusts the bearing (12) clearance to 0.07-0.17;
- b) Tightening torque of slot nut (8) is 340-400Nm;
- c) When assembling, apply Loctite 598 sealant on the joint surface of the wheel housing planet carrier assembly and the end cover.



2) Remove the following parts in sequence from the wheel housing and planetary wheel carrier assembly (1):

Fine pitch hexagon head bolt (9), planet carrier (8), sun gear pad (7), planetary axle (4), planetary gear (3), needle bearing (5), spacer (6), planetary gear pad (2), wheel housing (1).

**Caution!**

-----  
The planetary gear of the assembled wheel reducer should rotate flexibly  
-----

### 3、Steering system

#### 3.1 Structure of Steering System

The steering system consists of steering device、steering tire and steering axle assembly. See fig.3-1.

The steering device is composed of steering wheel assembly, steering tube device, locking handle and the hydraulic diverter. See figure 2-2.Both the steering column and steering wheel can be put forward and backward by an angle of  $8.8^{\circ}$  which can meet the requirements of different operators.In the power-off state, the steering wheel is gently turned with a force of 1 kg. After releasing the hand, the steering wheel should be able to automatically return about  $10^{\circ}$ .

The steering axle assembly is composed of the steering axle, steering knuckle, steering hub, steering wheels and steering cylinders. See figure 3-3.

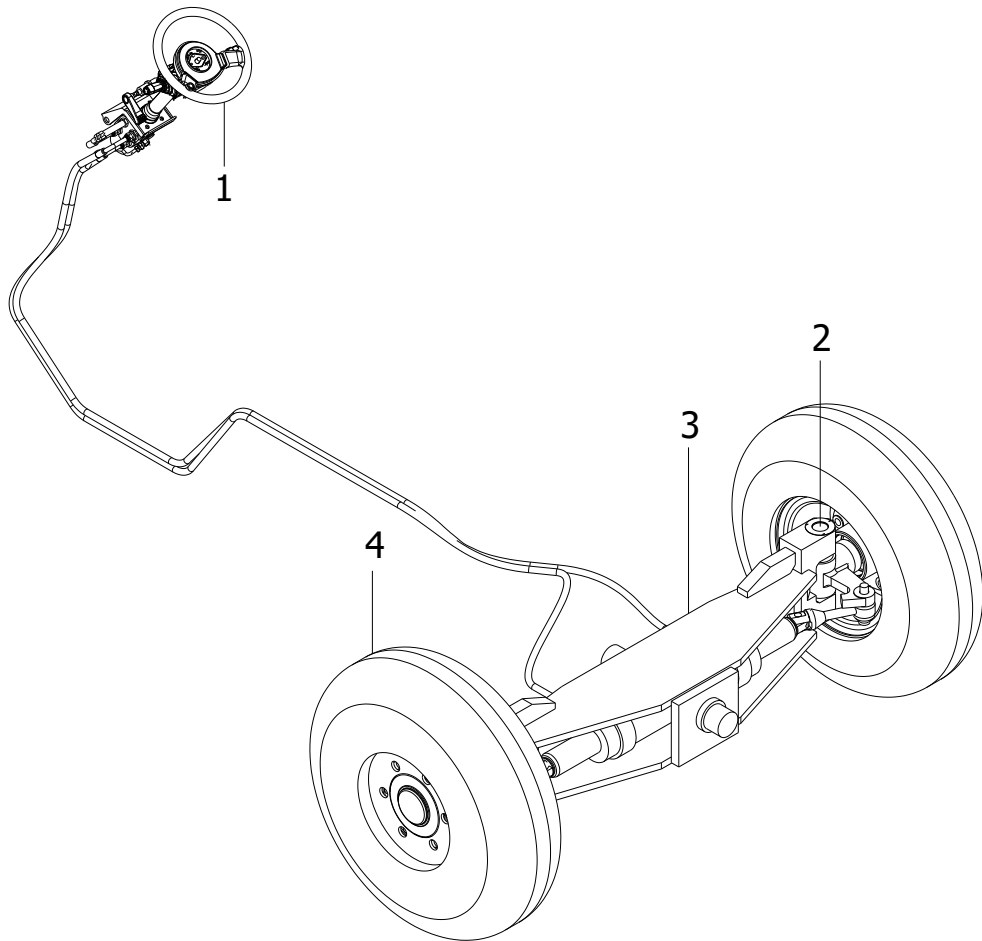
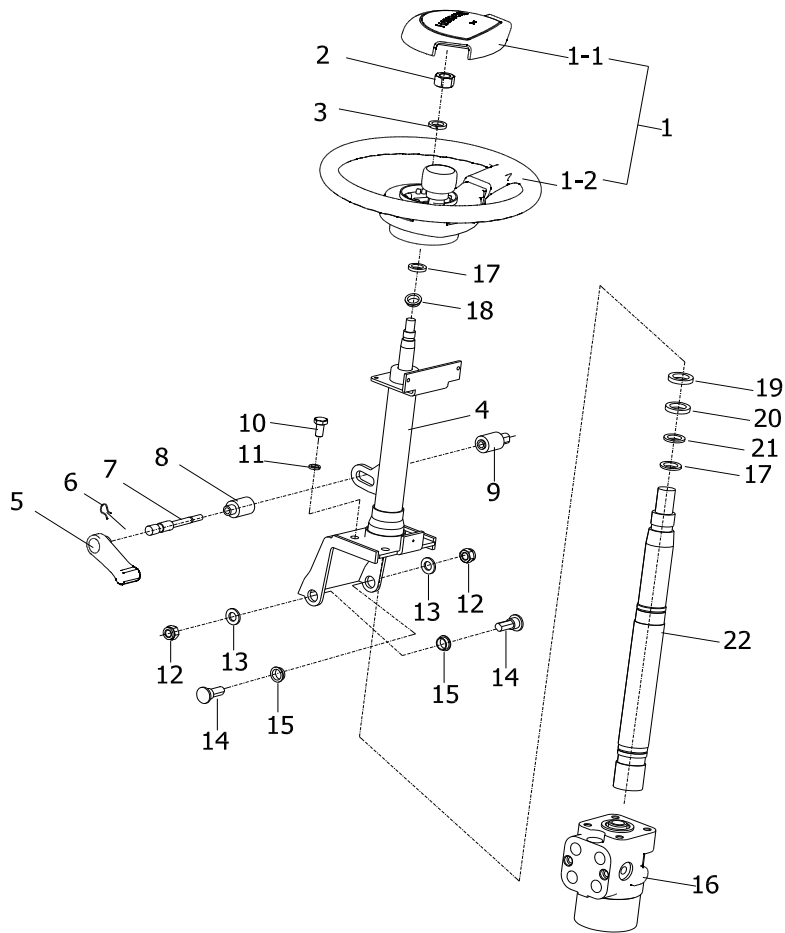


Fig.3-1 Steering System

1.Steering device      2.Angle sensor      3.Steering axle      4.Tire assembly

### 3.2 Steering device structure



### Fig.3-2 Steering device

|                       |                   |                 |                  |               |
|-----------------------|-------------------|-----------------|------------------|---------------|
| 1-Steering wheel assy | 2-Nut             | 3-Washer        | 4-Steering pipe  | 5-Lock Handle |
| 6-Snap ring           | 7-Lock shaft      | 8-Lock sleeve I | 9-Lock sleeve II | 10-Bolt       |
| 11-Washer             | 12-Nut            | 13-Washer       | 14-Bolt          | 15-Spacer     |
| 16-Steering device    | 17-Snap ring      | 18-dust cover   | 19-Bush          | 20-Washer     |
| 21-Washer             | 22-Steering shaft |                 |                  |               |

### Table 3-1 Tightening torque of relevant fasteners of steering device

| No. | Specification | Tightening torque | Remarks            |
|-----|---------------|-------------------|--------------------|
| 2   | M16×1.5       | 26.5 N·m～32.5N·m  | Steering wheel nut |
| 10  | M10×20        | 15.7 N·m～21.6N·m  | Bolt               |
| 12  | M12           | 58 N·m～78 N·m     | Nut                |

### 3.3 Steering axle

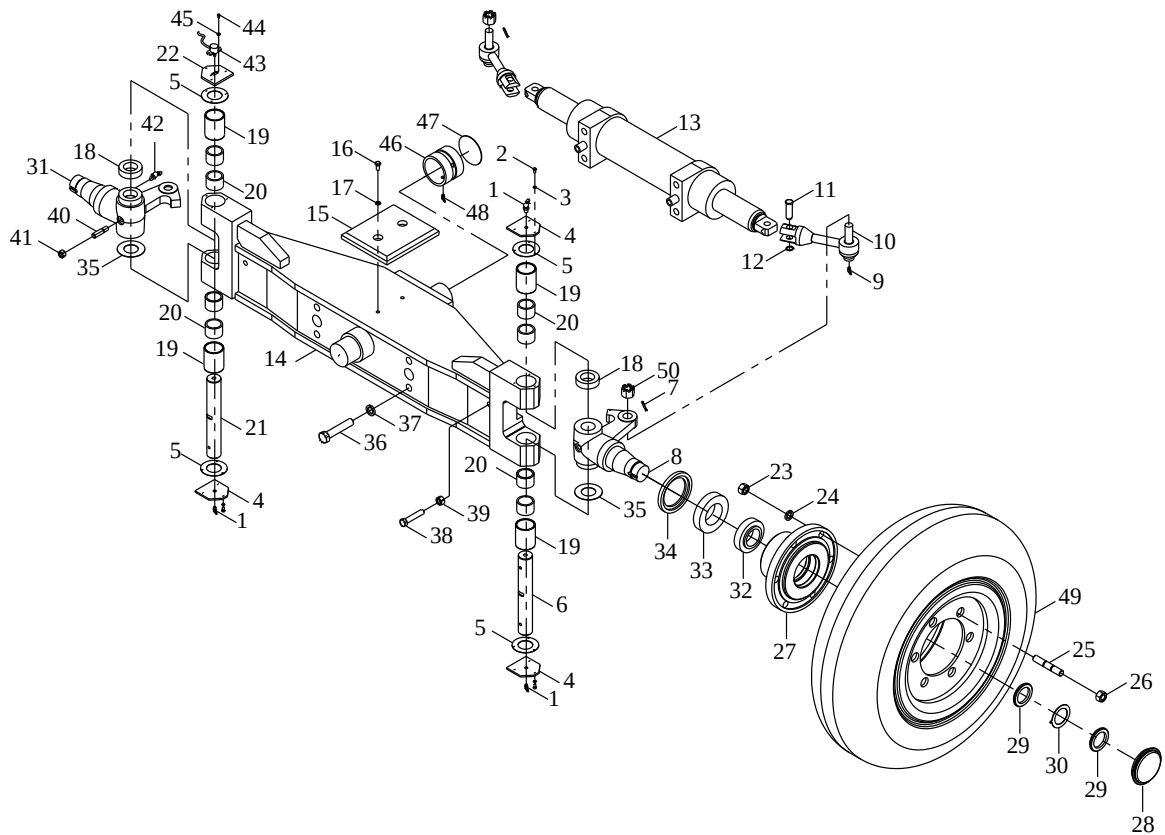


Fig.3-3 Steering axle

|                          |                       |                           |                         |
|--------------------------|-----------------------|---------------------------|-------------------------|
| 1-Grease nipple          | 2-Bolt                | 3-Washer                  | 4-Cover plate           |
| 5-Gasket                 | 6-Pin                 | 7-Pin                     | 8-Left steering knuckle |
| 9-Grease nipple          | 10-Rod device         | 11-Pin shaft              | 12-Retainer ring        |
| 13-Steering cylinder     | 14-Steering axle body | 15-Buffer block           | 16-Bolt                 |
| 17-Washer                | 18-Bearing            | 19-Steel bushing          | 20-Bearing K455538      |
| 21-Right master pin assy | 22-Sensor cover plate | 23-Nut                    | 24-Washer               |
| 25-Tyre bolts            | 26-Tyre nut           | 27-Wheel hub              | 28-End cover            |
| 29-Nut                   | 30-Washer             | 31-Right steering knuckle | 32-Bearing              |
| 33-Bearing               | 34-Oil seal           | 35-Adjusting shim         | 36-Bolt                 |
| 37-Washer                | 38-Limit bolt         | 39-Nut                    | 40-Set screw            |
| 41-Nut                   | 42-Grease nipple      | 43-Angle sensor assy      | 44-Scre                 |
| 45-Washer                | 46-Bushing            | 47-Adjusting shim         | 48-Grease nipple        |
| 49-Steering wheel assy   | 50-Nut                |                           |                         |

Table 3-2 Tightening torque of relevant fasteners of steering device

| No. | Specification | Tightening torque | Remarks |
|-----|---------------|-------------------|---------|
| 16  | M10×1.25×20   | 31N·m~42N·m       | Bolt    |
| 23  | M20×2         | 343N·m~441N·m     | Nut     |
| 26  | M38           | 441N·m~558N·m     | Nut     |
| 36  | M22×1.5×60    | 512N·m~683N·m     | Bolt    |
| 41  | M14×1.5       | 31.2N·m~42.1N·m   | Nut     |
| 50  | /             | 343N·m~392N·m     | Nut     |

### 3.3.1 Master data

| Steering axle body type                      | Maximum steering angle of inside wheels  |        |     |
|----------------------------------------------|------------------------------------------|--------|-----|
| Steering angle                               | Maximum steering angle of inside wheels  | 6t~7t  | 80° |
|                                              |                                          | 6t~7t  | 77° |
|                                              | Maximum steering angle of outside wheels | 6t~10t | 53° |
| Longitudinal clearance mm                    | 0~1                                      |        |     |
| Adjusting washers for longitudinal clearance | (δ=0.5mm、1.0mm、1.6mm)                    |        |     |

### Hub bearing

|                     |                                                                                                                                                               |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pretightening force | Screw down the nut of knuckle till the hub cannot be removed with hand. Or stop when the torque of ≤25.5N. Turn the nut slightly to 1/8 to 1/6 of one circle. |
| Axial clearance     | ≤0.08                                                                                                                                                         |

### 3.4 Precautions for installation of steering system

Caution!

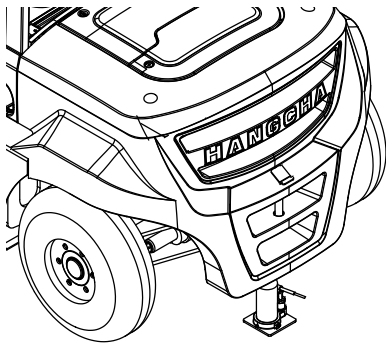
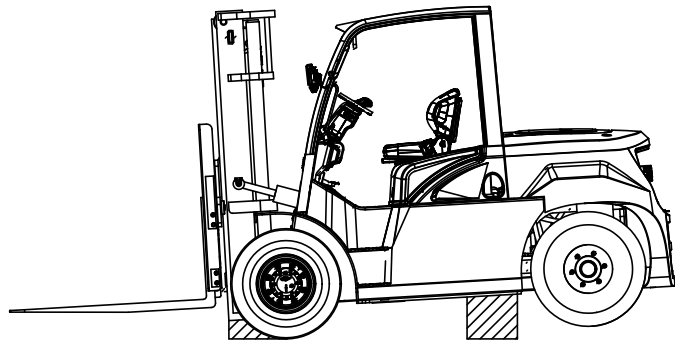
- 
- a) Make sure the hydraulic connectors, bolts and hoses are clean before installing.
  - b) Check if the pipeline work is correct and make sure the left and right steering direction is not fitted reversely.
  - c) Turn the steering wheel to the left and right fully and check if the force is even on both sides and check for the stability of the truck.
  - d) Jack up the rear wheels. Turn the steering wheel to left and right slowly for several times. Bleed the air in hydraulic pipes and in the cylinders.
  - e) When the engine shuts down, turning the steering wheel with 1kg force. Releasing the hand and the steering wheel should turns back with 10° automatically.
- 

### 3.5 Dismounting and Adjustment of steering axle

#### 3.5.1 Dismounting

##### 3.5.1.1 Wheel hub

- 1) Jack up and support forklift truck body with wooden blocks.



- 2) See Figure 3-3. Loosen nut 23, washer 24, bolt 25 and nut 26, and remove the tire;

WARNING



- 
- a) Always turn on the maintenance switch before carrying out operations!
  - b) When removing the tire from the hub, only remove the rim bolts and nuts after deflating it.
  - c) Ensure that the wooden pad used to support the forklift is one piece and solid enough.
  - d) When supporting the forklift with wooden blocks only, your body should never get under the forklift.
- 

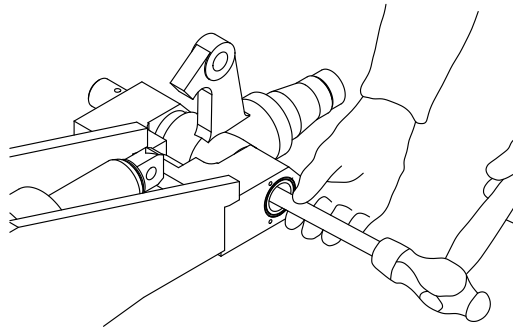
- 3) See Figure 3-3 and remove end cap 28.
- 4) See Figure 3-3, remove the steering knuckle lock nut 29, stop washer 30.
- 5) See Figure 3-3, pull out hub assembly 27.
- 6) See Figure 3-3. Remove bearing 32, bearing 33, and oil seal 34.

**Caution!**

- a) Not to drop bearing inner race.
- b) Be careful not to damage oil seal.

### 3.5.1.2 Master pin and steering spindle

- 1) See figure 3-3, pull the dustproof sleeve, remove retainer ring 12, pin 11, remove pin 7, loosen nut 50, and remove the rod device 10 ;
- 2) See Figure 3-3. Loosen nut 41 and set screw 40 and remove grease nipple 42 from the steering knuckle.
- 3) See Figures 3-3. Loosen the cover bolt 2 and remove the cover 4 together with the oil cup 1, the sensor cover 22 and the angle sensor assembly 43 and the gasket 5.
- 4) See Figure 3-3, remove the left steering main pin 6 and the right steering main pin 21 (the left and right main pins are different)



**Caution!**

Hold master pin to prevent it from dropping

- 5) Remove the complete set of steering knuckle (including needle bearing 20, thrust bearing 18, steel bushing 19, spacer 35;).

**Caution!**

Don't put it wrong, there is a difference between the left and right steering knuckles and the steering kingpin.

### 2.5.2 Inspection:

- 1) Replace spindle if cracked.
- 2) Replace bearing if its rollers or roller Surfaces are rusted or nicked.
- 3) Replace needle bearing if it is damaged
- 4) Replace thrust bearing and dust cap if them damaged.

### 2.5.3 Installation

Installation procedures are in reverse sequences of dismounting. Pay attention to the following notes.

- 1) Always insert master pin from the bottom.

---

2) When mounting the thrust ball bearing 18, the tight ring is at the bottom and the retainer and loose ring are at the top.

3) Axial clearance is obtained by adding or removing shims. Axial clearance is less than 0.2 mm.

**Caution!**

-----  
Thrust ball bearing is installed on the upper side of the steering knuckle. Adjusting washer is mounted on the bottom of the knuckle.  
-----

4) Apply lubrication grease to inner dustproof shell, loose ring and straining ring;

5) The sealing rubber ring with the letter faces outward. Apply grease to the rollers and cages of the roller bearing, and apply grease to the lip surface of the sealing rubber ring and the concave pocket;

6) Put enough grease on all grease nipples.

#### 2.5.4 Adjust wheel bearing

1) Apply grease or anti-rust oil to the bearing mating surface and the threaded surface of the steering knuckle nut;

2) Rotate the hub with one hand, tighten the steering knuckle nut with the other hand until the hand does not stop, and then rotate 1/8 to 1/6 turn in the opposite direction;

3) Rotate the hub 2~3 turns to rotate the bearing rollers in place

4) Repeat action 2), then put in the non-return washer, install the steering knuckle nut and lock it;

5) Rotate back and forth for 2~3 turns, measure the initial rotational force (moment) and axial clearance, and meet the following requirements: initial rotational force  $\leq 25.5\text{N}$ , (at the position of the hub connecting bolt) axial clearance  $\leq 0.08$ . Otherwise, repeat the adjustment until the requirements are met.

### 3.6 Troubleshooting and corrections on the steering system

| Condition              | Possible reason                                                                                                  | Corrections                   |
|------------------------|------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Steering wheel failure | Pump damaged or fault                                                                                            | Replace                       |
|                        | Priority valve blocked or damaged                                                                                | Clean or replace              |
|                        | Pipes or connections damaged or passage blocked                                                                  | Replace or clean              |
| Hard steering          | Low oil pressure in the steering gear overflow valve                                                             | Adjust pressure               |
|                        | Air in oil line                                                                                                  | Eliminate air                 |
|                        | Priority valve control pipe blocked                                                                              | Clean or replace              |
|                        | Priority valve damaged                                                                                           | Check or replace              |
|                        | The steering gear fails to turn to its natural position, retaining spring broken or insufficient spring pressure | Replace spring piece          |
|                        | Too much internal leakage in steering cylinder.                                                                  | Check piston for sealing      |
| Abnormal noises        | Oil is not sufficient in oil tank.                                                                               | Fill oil                      |
|                        | Suction piping or filter clogged.                                                                                | Clean or replace              |
| Leakage                | Damaged sealing of oriented bush of steering cylinder or hose or connector.                                      | Replace                       |
| Unstable driving       | Steering wheel lock nut is loose                                                                                 | Tighten                       |
|                        | Wheel bearing out of adjusting range                                                                             | Adjust                        |
|                        | Improper installation of end axle adjusted shims                                                                 | Adjust                        |
|                        | Steering system fault                                                                                            | Refer to Steering system part |
| Noises                 | Insufficient lubrication                                                                                         | Apply lithium base grease     |
|                        | Bolts and nuts looseness                                                                                         | Tighten                       |
|                        | Improper installation of end axle adjusting shims                                                                | Adjust                        |
|                        | knuckle bearing on both ends of connecting rod damage                                                            | Replace                       |

## 4、Control and brake system

Brake system of this truck is composed of service brake and parking brake. Service brake refers to the hydraulic brake depressed on the hydraulic system by foot while parking brake refers to the mechanical brake applied by hand. Both service brake and parking brake function together with the drive axle left and right wet disc brakes.

### 4.1 Brake pedal assembly

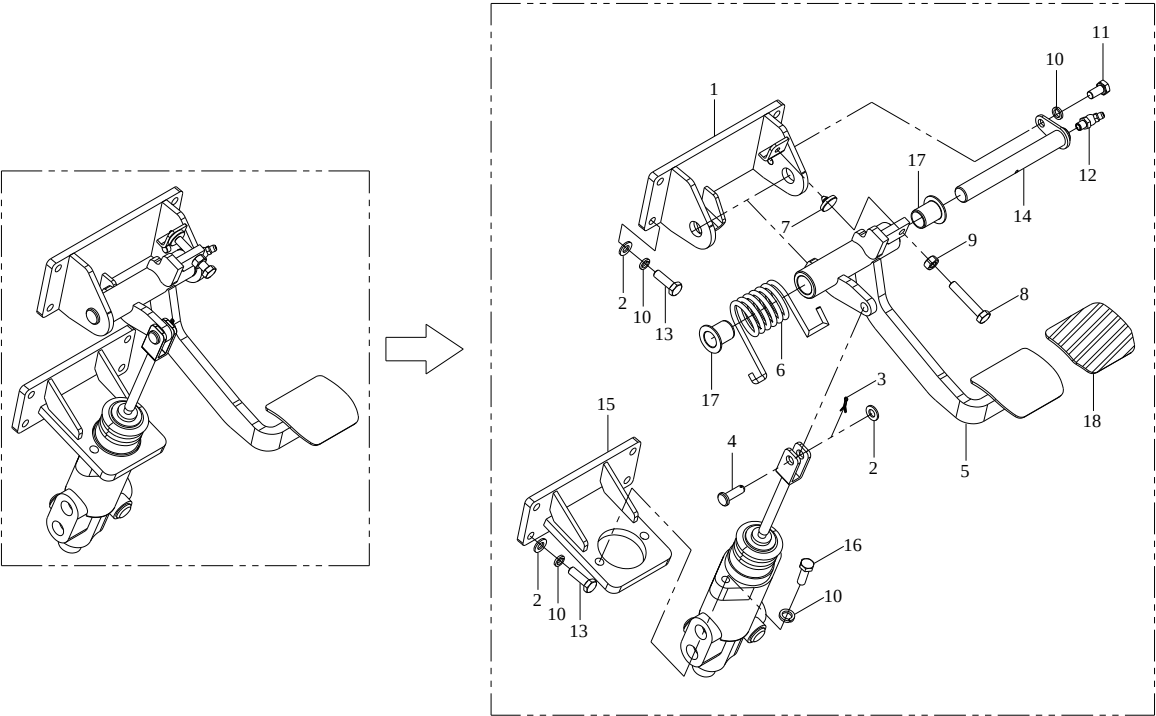


Fig.4-1

|                 |                |                        |                  |
|-----------------|----------------|------------------------|------------------|
| 1-Brake bracket | 2-Washer       | 3-Pin shaft            | 4-Pin            |
| 5-Brake pedal   | 6-Brake spring | 7-Thrust ring          | 8-Bolt           |
| 9-Nut           | 10-Washer      | 11-Bolt                | 12-Grease nipple |
| 13-Bolt         | 14-Pin shaft   | 15-Brake valve bracket | 16-Bolt          |
| 17-Bushing      | 18-Pedal pad   |                        |                  |

Table 4-1 Tightening torque of relevant fasteners of brake pedal assembly

| NO. | Specification | Tightening torque | Remarks |
|-----|---------------|-------------------|---------|
| 13  | M8×25         | 20 N·m~23N·m      | Bolt    |

#### Brake pedal adjustment:

- 1) Adjust brake pedal stop bolt(8), make the pedal pad point P  $145\pm 5\text{mm}$  from the front base plate and screw down the bolt nut.
- 2) Adjust the brake valve push rod length, and make the spare travel of the point P to point Q is  $1\sim 3\text{mm}$ , and lock the nut;
- 3) When the brake pedal is gradually depressed  $10\sim 20\text{mm}$ , the brake light switch is completely connected, and release the foot to this state, brake light switch should disconnect.

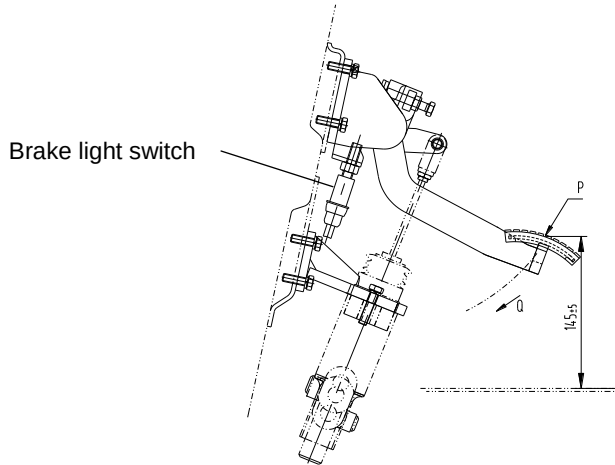


Fig. 4-2

#### Brake pedal adjustment requirement:

- 1) When the wearing parts are changed, they should be replaced according to the wearing parts. The fasteners (retaining rings and bolts) that are damaged during the replacement must be replaced, and ensure that the fasteners are installed in place, firm and reliable, and do not damage other components.
- 2) The relative sliding parts of the brake valve (brake valve push rod pin, brake bushing, spring hook) should be maintained with grease. If the brake fails or is weak, check the wearing parts of the brake valve and the braking system;
- 3) After adjusting the brake pedal, operate the brake pedal to the full stroke, and no abnormal sound or interference is allowed;
- 4) The pedal operation is absolutely free of jamming and other phenomena, and the cotter pin connecting the brake pedal and the brake valve push rod should be installed reliably;
- 5) The machine can not be installed without test after replacement.

4.2 Foot brake piping system

4.2.1 Foot brake piping system

Foot brake piping system consists of brake control piping and brake hydraulic oil circuit. See figure 4-3 and figure 4-4 for details.

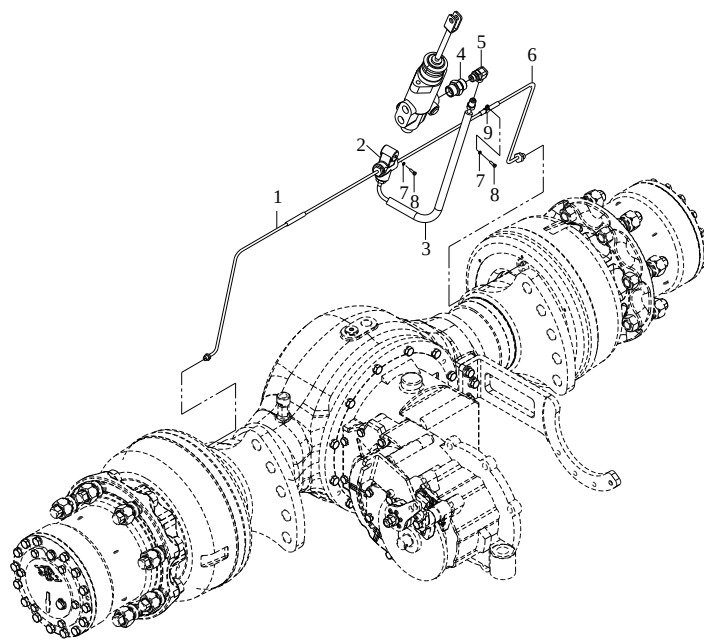


Fig.4-3 Brake control line

- |                            |                        |             |                   |
|----------------------------|------------------------|-------------|-------------------|
| 1-Left brake oil pipe assy | 2-Tee joint assy       | 3-Hose assy | 4-Pipe joint assy |
| 5-Right angle joint        | 6-Right brake oil pipe | 7-Washer    | 8-Bolt            |
| Bondi pipe clamp           |                        |             |                   |

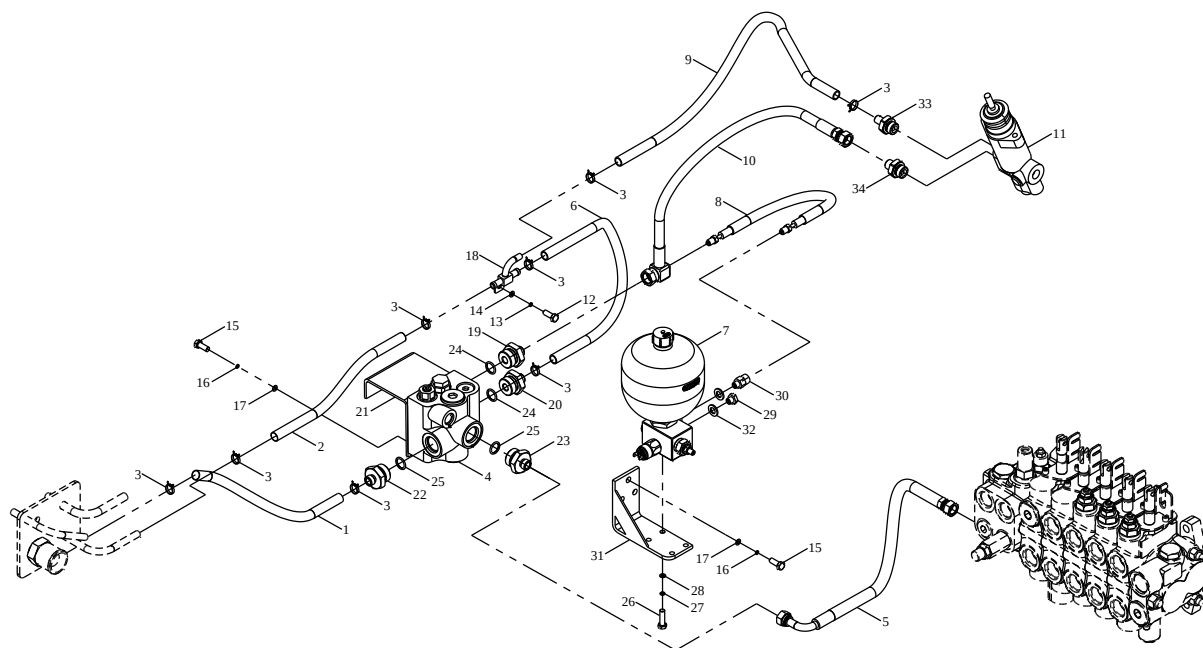


Fig 4-4 Brake hydraulic oil circuit

|                           |                     |                          |                       |
|---------------------------|---------------------|--------------------------|-----------------------|
| 1-Low pressure hose       | 2-Low pressure hose | 3-Double steel wire hoop | 4-Charging valve assy |
| 5-Hose assy               | 6-Low pressure hose | 7-Accumulator assy       | 8-Brake hose          |
| 9-Low pressure hose       | 10-Hose assy        | 11-Brake valve           | 12-Bol                |
| 13-Washer                 | 14-Washer           | 15-Bol                   | 16-Washer             |
| 17-Washer                 | 18-Tee joint        | 19-Pipe joint assy       | 20-Pipe joint assy    |
| 21-Charging valve bracket | 22-Pipe joint assy  | 23-Pipe joint assy       | 24-O-ring seal        |
| 25-O-ring seal            | 26-Bol              | 27-Washer                | 28-Washer             |
| 29-Plug                   | 30-Pipe joint       | 31-Accumulator support   | 32-Washer             |
| 33-Pipe joint             | 34-Pipe joint       |                          |                       |

#### 4.2.2 brake master cylinder

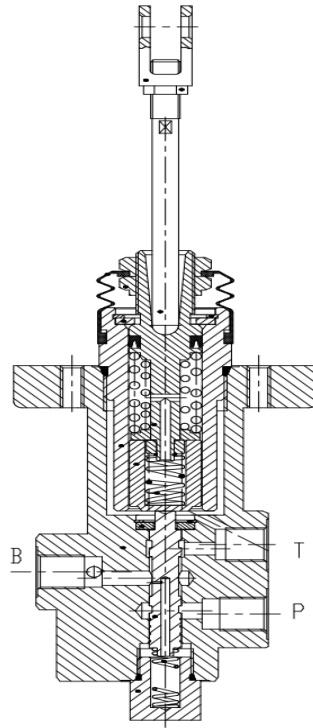


Fig.4-5 Structure of brake master cylinder

(1) When the brake is not applied, that is, before the pedal is pressed, as shown in figure 4-4, the B port is connected to the T port.

(2) As the pedal is depressed, the compression force of the regulator spring is getting smaller and smaller, and the reduction of the braking pressure is proportional to the movement of the operating part. If the displacement of the operating member remains constant, the spool moves to an equilibrium position and keeps the set pressure at port B constant. When depressed to the bottom, the B port is connected to the P port.

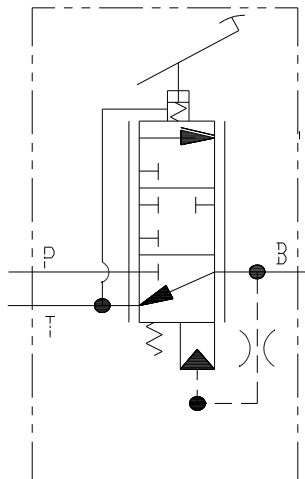


Fig.4-6 Hydraulic schematic diagram of brake master cylinder

(3) Loose the pedal, release the operating parts, the return spring pushes the spool, so that the B port and T port oil circuit are connected, the brake pressure reaches the highest.

| Fault                                 | Possible reason              | Correction measures |
|---------------------------------------|------------------------------|---------------------|
| Brake pressure is too low or too high | Faulty pressure spring       | Replace spring      |
|                                       | Spool jamming                | Replace spool       |
| External Leakage                      | Damage or aging of seal ring | Replace seal ring   |

#### 4.2.3 Accumulator

Piston accumulator consists of the components in the oil and gas parts, piston isolation on both sides of gas and liquid. Filled with nitrogen gas section. Liquid part and hydraulic circuits are interlinked, so when the pressure is compressed gas, oil is sucked piston accumulator. The pressure drop, gas expansion, thus the oil hydraulic circuit into the system.

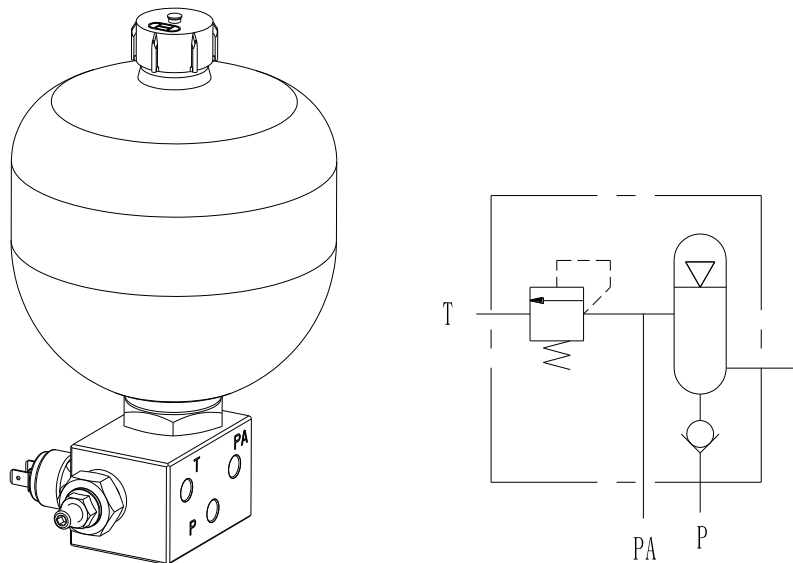


Fig.4-7 Structure of accumulator

Piston accumulators include: barrel with finished inner surface, O-ring seals on gas side and oil side end caps, floating steel or aluminum piston, sealing system adapted to specific applications. The piston is supported by two guide rings to prevent metal to metal contact, and is also supplied with materials suitable for low temperature environments.

The set pressure of the safety valve: 13MPa, the total available volume of the accumulator is 1L, the charging pressure of the accumulator: 5MPa (at 20°C), and the allowable oil temperature range: -10°C~130°C.

The system must be unpressurized before each installation or disassembly of the accumulator or accumulator device. Prior to dismantling the accumulator, the gas side and the liquid side must be depressurized, and the valve is unscrewed or opened. The piston must be free to move before removing the end cap.

Note: A drain valve (ball valve) is installed between the accumulator and the fuel tank, the vertical state is closed, and the horizontal state is open. There is high pressure in the hydraulic

system because the accumulator is connected. When repairing the hydraulic pipeline, the accumulator valve must be opened to release the pressure oil in the system. It should be closed immediately after the maintenance and inspection work is completed.

4.2.4 Braking prefill valve

Brake charging valve is mainly used to maintain the pressure of accumulator circuit within a certain limit value (cut-off pressure, turn-on pressure). The switching pressure difference is about 18% of the cut-off pressure. The valve is a normally open valve. It connects the pump's O signal to the fuel tank. It compares the accumulator pressure with its setting. If the accumulator pressure is too low, it will turn off and the O signal will start the pump to boost the accumulator. When the accumulator pressure reaches the preset value, the filling valve will open.

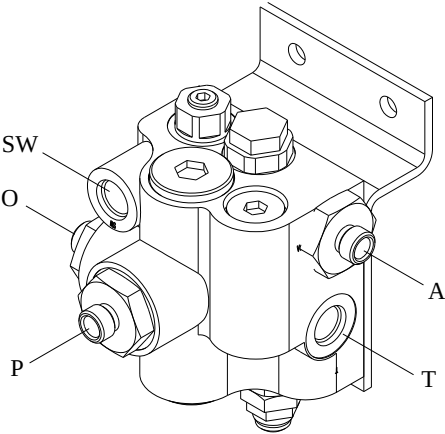


Fig.4-8 Brake filling valv

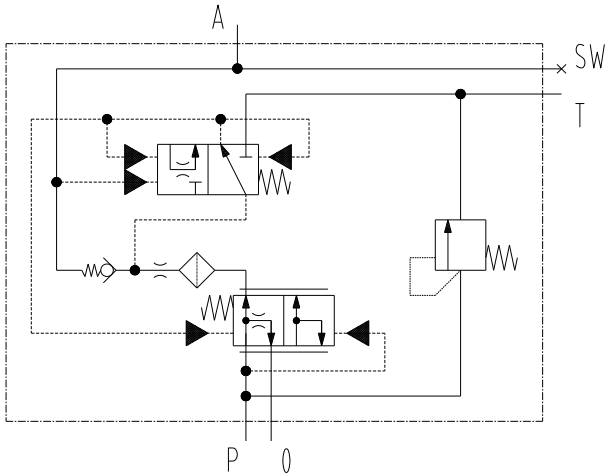


Fig.4-9 Brake filling valve schematic diagram

## 4.2.5 Brake System Air Removal

### WARNING



Remove air from the brake system after each installation or repair of hydraulic or brake system components or hydraulic lines. The brakes will not operate correctly with air in the system and can cause injury or damage.

- 1) Fill the hydraulic tank to the correct level.

**Note:** Keep the engine operating at idle speed to maintain the pressure.

- 2) Operate the engine to charge the accumulator to maximum pressure.
- 3) Push the brake pedals down as far as possible.
- 4) Connect one end of a hose to the special fitting on the brake caliper or other components.
- 5) Place other end of the hose in a container filled with clean hydraulic fluid.
- 6) To remove the air, loosen the fitting and operate the correct pedal until no air is seen coming out of the hose in the container.
- 7) Tighten the fitting after air stops coming out and before disconnecting the hose.
- 8) Connect the hose at each of the following points:
  - a. Special fitting at the parking brake caliper.
  - b. Special fittings at each wheel brake assembly.
- 9) Do Step a and Step b of Step 8 again after waiting approximate 2 hours to remove the last of the air.

## 4.2.6 Troubleshooting

| Problem                      | Possible cause                             | Procedure or action                                                                                                       |
|------------------------------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| Low or no pressure to brake. | Leakage of brake actuation fluid.          | See brake leaks actuation fluid in this troubleshooting section.                                                          |
| Vehicle does not move.       | Damaged hydraulic system.                  | Repair hydraulic system.                                                                                                  |
| Brakes dragging.             | Damaged piston return spring assembly.     | Repair or replace piston return spring assembly.                                                                          |
|                              | Piston not returning.                      | Check piston seals and seal separator for swelling or damage. Replace as necessary.                                       |
|                              | Wrong cooling and/or actuation fluid used. | Check piston seals and seal separator for swelling or damage. Replace as necessary. Purge system and use specified fluid. |

| Problem                                                                                         | Possible cause                                                                                                               | Procedure or action                                                                                                              |
|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Noticeable change or decrease in stopping performance.                                          | Inadequate pressure to apply brakes.                                                                                         | Check brake apply system. Check for leakage in brake system or brakes and correct cause.                                         |
|                                                                                                 | Worn or damaged discs.                                                                                                       | Inspect and replace discs if necessary.                                                                                          |
|                                                                                                 | Overheated seals and/or discs.                                                                                               | Inspect and replace discs and seals if necessary.                                                                                |
|                                                                                                 | Dirty or contaminated cooling fluid.                                                                                         | Drain and flush hydraulic oil. Replace with approved fluid. In some cases, it may be necessary to replace discs. Replace filter. |
| Brake leaks actuation fluid.                                                                    | Worn or damaged piston seal.                                                                                                 | Replace piston seals.                                                                                                            |
|                                                                                                 | Melted or extruded piston seals.                                                                                             | Correct cause of overheating and replace seals.                                                                                  |
|                                                                                                 | Corrosion, pitting, wear or other damage, marks, scratches to piston and/or brake housing bore in area of seal/sealing lips. | Clean, smooth, rework, or replace affected parts.                                                                                |
|                                                                                                 | Loose bleeder screw                                                                                                          | Tighten bleeder screw to 20 to 27 N•m                                                                                            |
|                                                                                                 | Loose inlet fitting or plugs.                                                                                                | Tighten inlet fitting to 34 to 47 N•m                                                                                            |
|                                                                                                 | Damaged inlet fitting, plugs, or seats.                                                                                      | Replace inlet fitting or plug and O-ring if used. Repair or resurface area or replace as necessary.                              |
| Coolant leaking out of brake housing.                                                           | Face seal damaged, worn, or improperly installed.                                                                            | Reinstall and/or replace face seal.                                                                                              |
|                                                                                                 | Loose drain plug, fill plug, or forced cooling plug.                                                                         | Tighten plug.                                                                                                                    |
|                                                                                                 | Damaged plug.                                                                                                                | Replace plug.                                                                                                                    |
|                                                                                                 | Deteriorated or inadequate sealant used at joint.                                                                            | Disassemble, clean, reseal, and reassemble joint.                                                                                |
| Axle housing filling with oil, forced cooling systems only, and may be forced out the breather. | Worn or damaged spindle to hub seal.                                                                                         | Replace spindle to hub seal. Check seal and journals.                                                                            |
|                                                                                                 | Brush hair lodged in grease under hub-to-spindle seal lip.                                                                   | Do not use brush to apply grease to seal areas.                                                                                  |

### 4.3 Hand brake

The hand brake device adopts a hand-pulling soft brake wire cable device. Hand brake is only used when the forklift is parked. See figure 3-10.

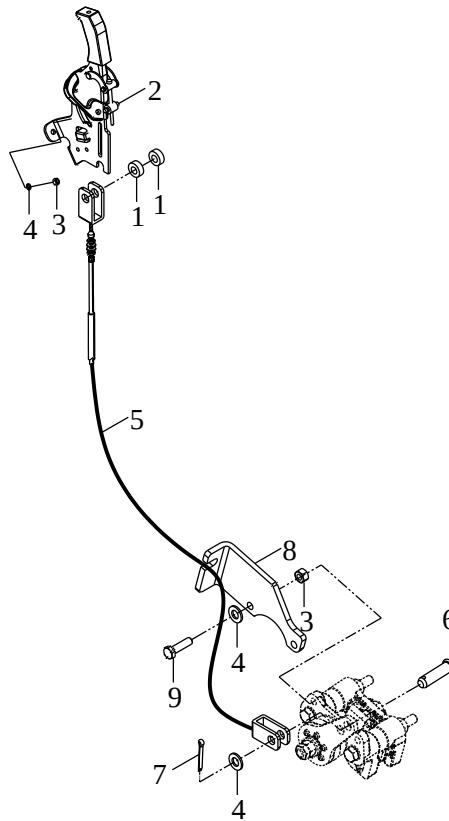


Fig.3-10 Hand brake

| Problem                  | Possible cause                      | Procedure or action |
|--------------------------|-------------------------------------|---------------------|
| Insufficient brake force | Friction lining wear                | Replace             |
|                          | Large control rod travel            | Adjust              |
|                          | Worn or damaged ratchet teeth       | Replace             |
|                          | Hand brake cable stretch            | Replace             |
|                          | Oil or water on the friction lining | Clean or replace    |
|                          | Uneven wear or contact of linings   | Grind or replace    |

## Hand brake adjustment

After using the parking brake for a period of time, if you find that the free travel of the parking brake handle is too large and the braking effect becomes worse, please adjust it in time. The adjustment is as follows:

- 1) Adjust the nut B so that the length is equal to 55mm, then tighten the locking nut B.
- 2) Screw the adjusting nut A to adjust the hand brake pull force. The pulling force is 147N-196N at point P in Q direction when locking the handle.
- 3) After the hand brake lever is properly adjusted, release the hand brake lever and make sure the brake is fully released.
- 4) Through the above adjustments, ensure that the hand brake is working properly.

Note: Apply an appropriate amount of lithium grease to the guide C and keep it applied frequently.

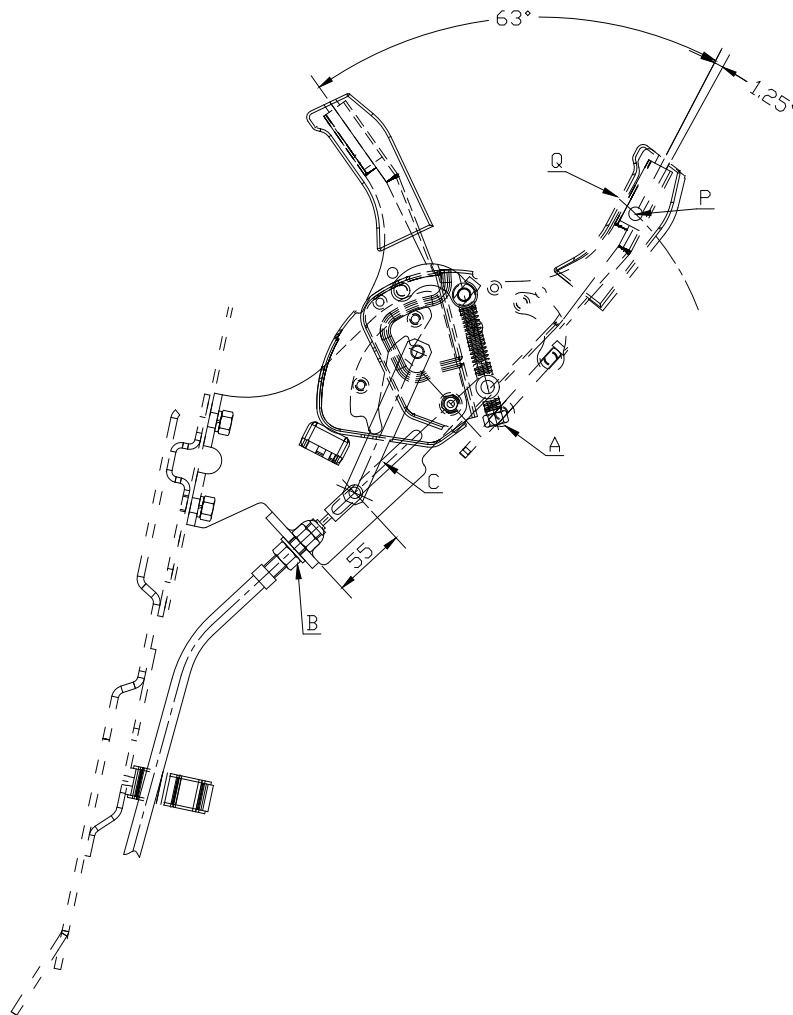


Fig.4-11

## 4.4 Foot brake

### 4.4.1 Foot brake structure

The foot brake is the internal expansion, hydraulic type consisting of brake shoes, spring, wheel cylinder, adjuster and backing plates. According to sign on brake (left, right) to connect brake and drive axle body, the bleeder screw is on the upper side, and the oil circuit must be cleaned before connection..

When brake shoes do not work and are on initial position, the friction plate and brake drum should have proper clearance, the clearance of this truck is 0.4-0.6mm. Please adjust clearance after friction plate wears. If the friction plate wears seriously (distance between bolt head and friction plate surface is less than 0.5mm), please replace in pairs. The brake structure is shown in Figure 4-12A, 4-12B.

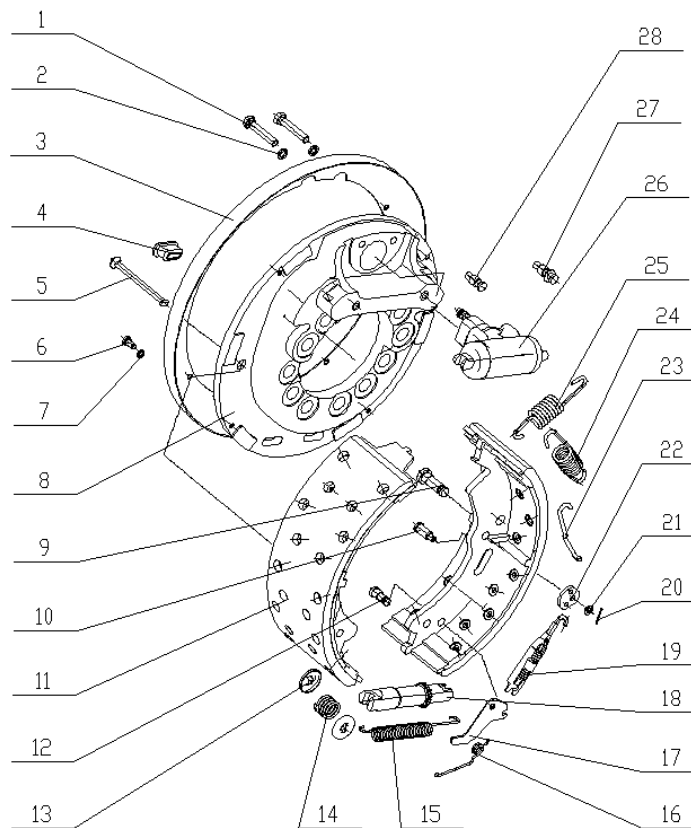


Fig.4-12A 6t-7t Brake assy

|                            |                      |                           |                        |
|----------------------------|----------------------|---------------------------|------------------------|
| 1-Bolt                     | 2-Washer             | 3-Housing                 | 4-Rubber plug          |
| 5-Pull rod,pressure spring | 6-Bolt               | 7-Washer                  | 8-Brake plate          |
| 9-Spring pin               | 10-Shake arm pin     | 11-Brake shoe with disc   | 12-Pin                 |
| 13-Support,pressure spring | 14-Pressure spring   | 15-Pullback spring        | 16-Torsional spring    |
| 17-Pawl                    | 18-Adjuster assembly | 19-Spring riveting device | 20-Cotter pin          |
| 21-Pad                     | 22-Rocker arm        | 23-Pull rod               | 24-Return spring,front |
| 25-Return spring,rear      | 26-Brake sub-pump    | 27-Pin                    | 28-Pin                 |

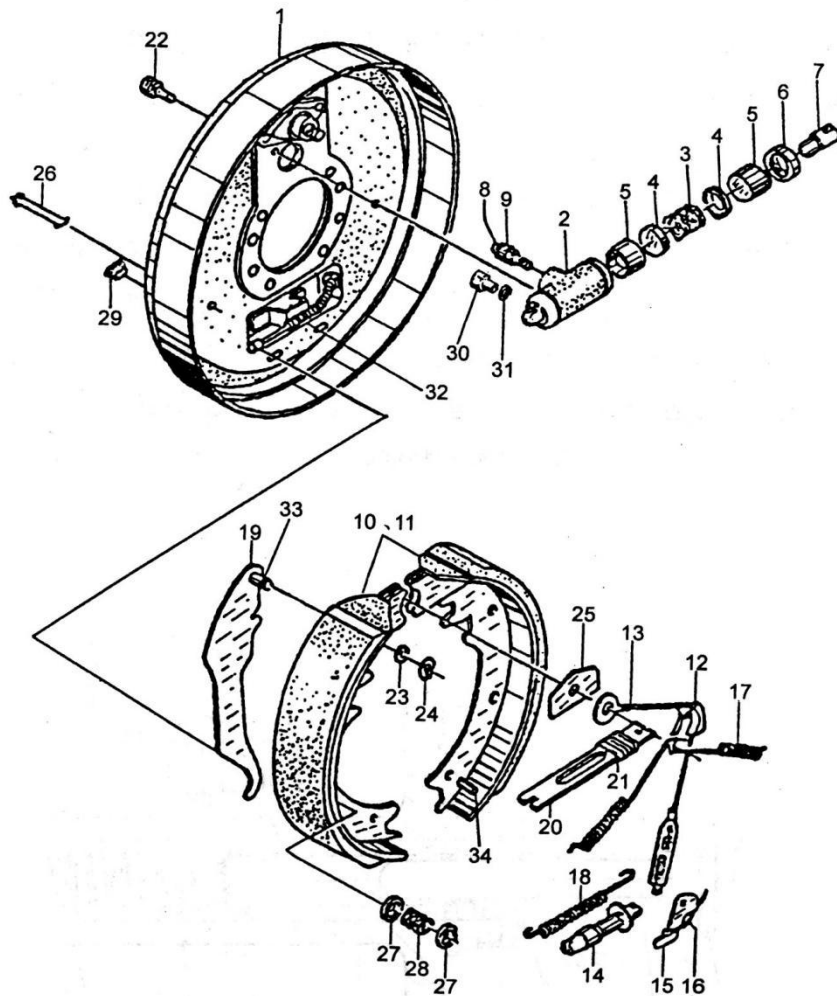


Fig.4-12B 8t-10t Brake assy

|                              |                           |                           |                      |
|------------------------------|---------------------------|---------------------------|----------------------|
| 1-Brake mountbracket         | 2-Wheel cylinderbody      | 3-Cylinder return spring  | 4-Rubber cap         |
| 5-Piston                     | 6-Cylinder dustcover      | 7-Push rod                | 8-Air bleeder cap    |
| 9-Air bleeder screw          | 10-Brake shoeassy (front) | 11-Brake shoe assy (rear) | 12-Guider            |
| 13- Adjuster cable           | 14-Adjusting bolt         | 15-Pawl                   | 16-Spring            |
| 17- Brake shoe return spring | 18-Return spring          | 19-Parking brake rod      | 20-Strut level       |
| 21-Spring                    | 22-Bolt                   | 23-Washer                 | 24-Snap ring         |
| 25-Guider                    | 26-Spring support rod     | 27-Spring bracket         | 28-Spring            |
| 29-Plug                      | 30-Oil connector          | 31-Bush                   | 32-Brake steel cable |

## Wheel cylinder

Wheel cylinder is a two-piston type, and is fixed on brake plate with bolts, two pistons are in cylinder, spring supports leather cup on pistons to make two pistons separate. Sealing of piston leather cup in brake cylinder can affect the brake performance. If there is brake oil in brake drum, please check piston leather cup and cylinder, repair or replace it if it is damaged, and do not make oil enter into brake drum when maintaining. It is forbidden to use mineral oil when installing leather cup, the brake oil is recommended.

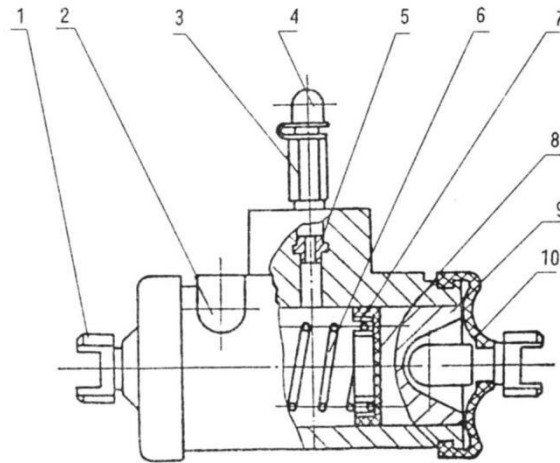


Fig 4-13 Wheel cylinder

|                  |                    |                   |                        |
|------------------|--------------------|-------------------|------------------------|
| 1.Ejector rod    | 2.Cylinder body    | 3.Air bleed screw | 4Air bleed head        |
| 5.Connector seat | 6.Spring           | 7.Spring seat     | 8.Cylinder leather cup |
| 9.Piston         | 10.Rustproof cover |                   |                        |

### 4.4.2 Disassembly and maintenance of brake

#### WARNING

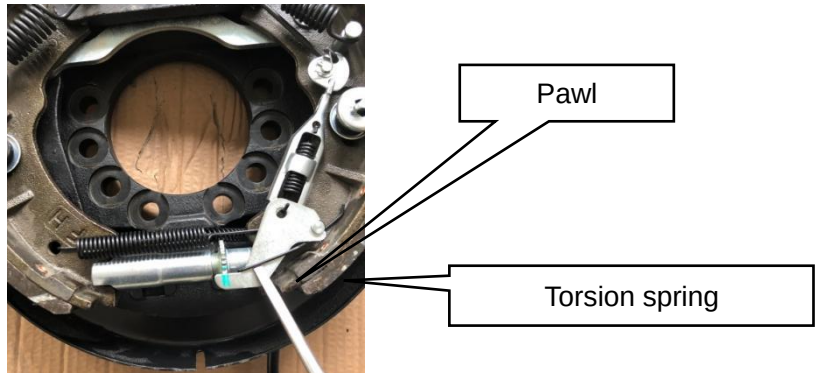


- a) Before repairing the hydraulic system and brake system, the vehicle should be turned off and the brake pedal should be pressed 5-10 times continuously to release the energy in the accumulator, otherwise the maintenance personnel will have a major accident and endanger personal safety.
- b) When the front axle is erected and the front wheels can be turned by turning them, it means that the release is complete. Only when the energy in the accumulator is released can the subsequent operation be performed.

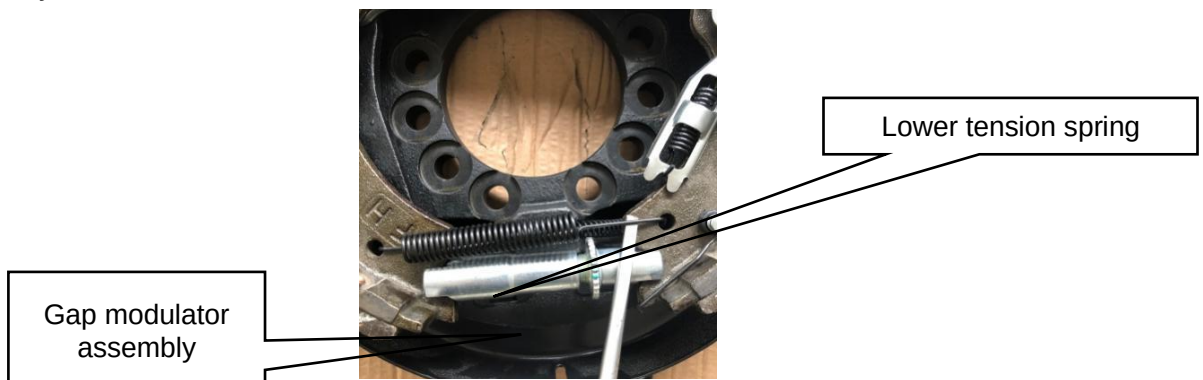
The brake mainly carries out disassembly, inspection, reassembly and adjustment maintenance of brake shoes friction plate assembly and brake distributor pump.

#### 4.4.2.1 Disassembly steps of brake shoe friction plate assembly

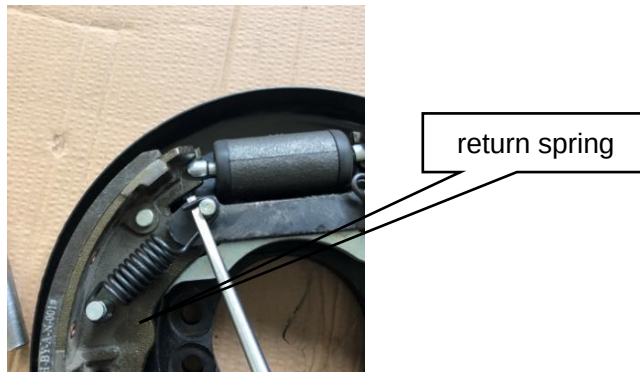
- 1) Pry the torsion spring on the pawl with a screwdriver and take off the pawl;



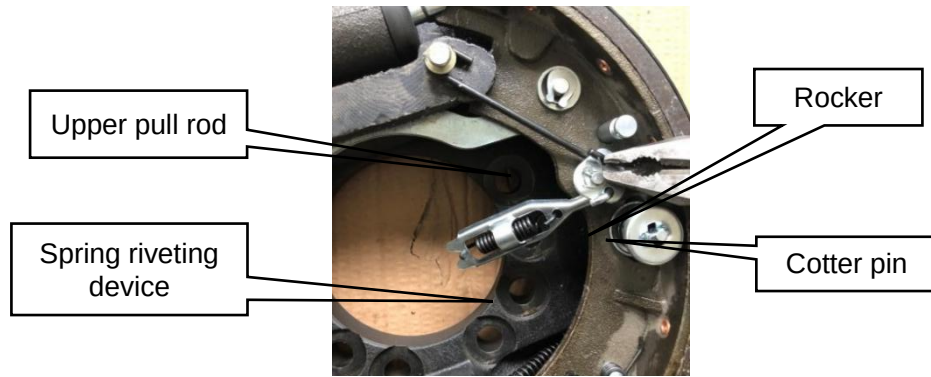
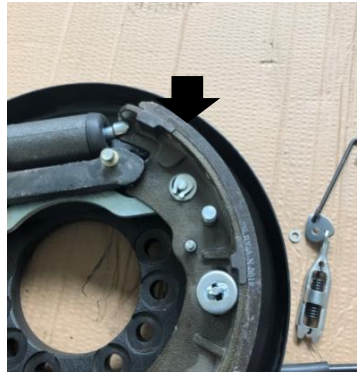
- 2) Pry the lower tension spring out with a screwdriver and take out the gap modulator assembly;



- 3) Pry out the return spring (one left and one right) with a screwdriver ;



- 4) Clamp down the cotter pin with pliers, take off the rocker arm, upper tie rod and spring riveting device;



5) Press open the upper compression spring seat with a tool and then remove the brake shoe friction plate assembly



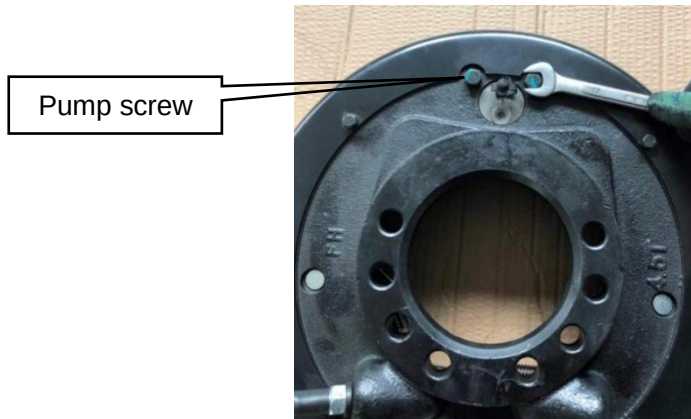
6) Grease the six projections of base plate and inside of the support pins. (Re-greasing is required to replace the shoe assembly).



7) The installation process is the opposite of the disassembly process.

### 3.4.2.2 Wheel cylinder disassembly steps

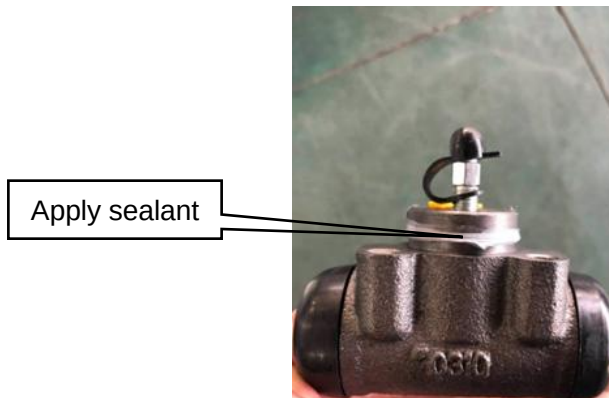
1) Unscrew two M8 × 25 cylinder screws;



2) Use a screwdriver to pry open the brake shoe assembly to both sides and then use the screwdriver to pry the top rod of the cylinder piston inward out of the slot to take out the cylinder.



3) Apply a ring of sealant to the mounting surface of the replaced wheel cylinder and install it on the base plate. Snap the top rod of the sub-pump piston into the slot of the shoe assembly and tighten the wheel cylinder screw (the tightening torque of the wheel cylinder screw is 17.6N-m~26.5N-m) and adjust the outer diameter of the brake to the required range. (Pay attention to the correct position of each slot to ensure that the parts do not fall off).



---

#### 4.4.3 Trouble diagnoses and correction

| Fault                                                    | Probable cause                                                                                                                                                                                                                                                                     | Corrective action                                                                                                                   |
|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Insufficient brake force                                 | Oil leakage in brake pipe<br>Air in brake pipe<br>Water or oil on linings<br>Uneven wear or contact of brake linings<br>Improper function of brake master cylinder or wheel cylinder<br>Clogged oil lines<br>Brake booster, hydraulic pump or diverter valve not function properly | Correct and replenish<br>Remove air<br>Wipe or replace<br>Grind or replace<br>Correct or replace<br><br>Clean<br>Correct or replace |
| Unequal braking<br>(forklift truck<br>veers to one side) | Uneven tire pressure<br>Improper brake adjustment<br>Water or oil on brake linings<br>Foreign matter on brake drum<br>Damage on friction lining<br>Improper contact of friction linings                                                                                            | Adjust<br>Adjust<br>Wipe or replace<br>Clean<br>Grind or replace<br>Grind or correct                                                |

|                |                                                                                                                                                                                                                                                                                                         |                                                                                                                              |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
|                | Worn friction lining<br>Worn, warped, rusted or damaged brake drums<br>Improper function of wheel cylinder<br>Incorrect brake shoe sliding<br>Guard plate bolt looseness<br>Guard plate warp<br>Improperly adjusted wheel bearing<br>Clogged oil lines                                                  | Replace<br>Correct or replace<br>Correct or replace<br>Adjust<br>Tighten or replace<br>Replace<br>Adjust or replace<br>Clean |
| Brake dragging | No free play of brake pedal<br>Incorrect brake shoe sliding<br>Improper function of wheel cylinder<br>Piston cup damage<br>Weak or broken return springs<br>Reflowing valve of brake master cylinder block<br>Clogged oil lines<br>Incorrect wheel bearing adjustment<br>Brake booster function failure | Adjust<br>Adjust<br>Adjust or replace<br>Replace<br>Replace<br>Clean<br>Clean<br>Adjust or replace<br>Adjust or replace      |
| Brake noise    | Lining surface harden or foreign matter on it<br>Warped back plates or loosed blots<br>Brake shoes warped or improper install<br>Worn linings<br>Loose wheel bearing                                                                                                                                    | Repair or replace<br>Repair or replace<br>Repair or replace<br>Replace<br>Repair                                             |

4.5 Schematic diagram of braking system

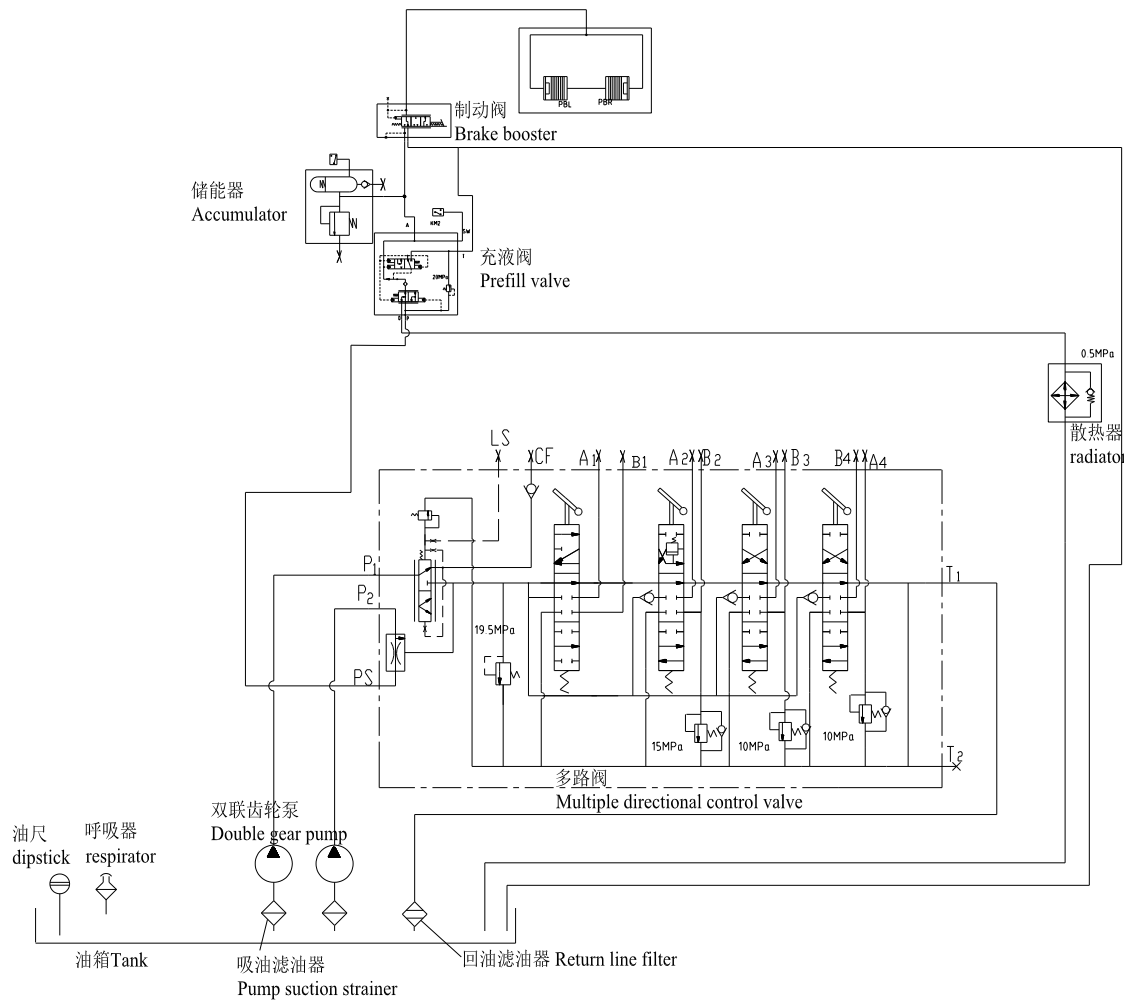


Fig.4-14 Schematic diagram of drum brake braking principle

## 5、Hydraulic system

WARNING



- a) During the maintenance of the hydraulic system, it may be necessary to disconnect the high-voltage cable on the electric control 2-in-1 of the oil pump motor, which involves the high-voltage part! Therefore, it is necessary to strictly follow the safety regulations in Chapter 1 for operation!
- b) Before maintenance, it is necessary to disconnect the power supply of the entire vehicle and the lithium battery MSD maintenance switch, and let it sit for 15-20 minutes before operation!

### 5.1 Hydraulic system circuit

Hydraulic system is mainly composed of hydraulic fuel tank and its accessories, oil pump motor, hydraulic steering gear, control valve, tilting cylinder, lift cylinders and hydraulic pipelines. As shown in figure 5-1 below

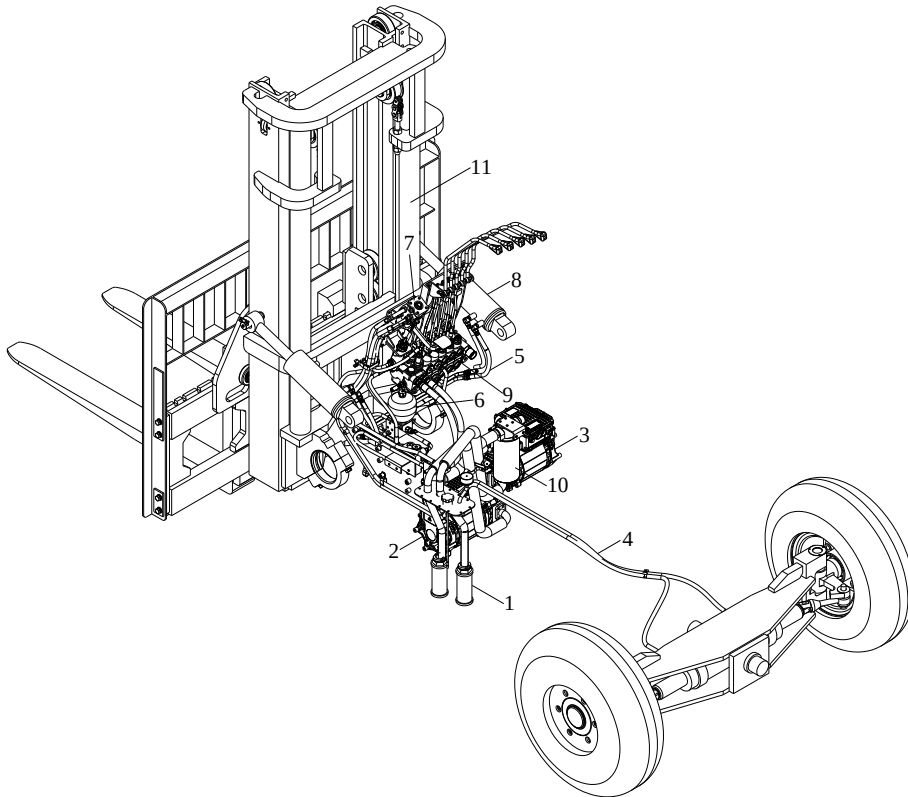


Fig.5-1 Hydraulic system composition

1-Hydraulic oil tank accessories

2-Main oil pump motor

3-Slave oil pump motor

4-Steering pipeline

5-Tilt pipeline

6-Brake oil circuit

7-Fully hydraulic steering gear

8-Tilt cylinder

9-Multiway valve

10-Return oil filter assy

11-Lifting cylinder

## 5.2 Hydraulic system principle

The high-pressure oil coming out of the main oil pump reaches the multi-way valve, and then is sent to the lifting cylinder or the tilting cylinder by the multi-way valve. When the lift slide valve is pulled, the high pressure oil flows under the piston of the lifting cylinder and pushes the piston rod upwards. When the lift spool valve is pushed, it is that bottom of lifting cylinder piston connects with low pressure line and then piston rod drops by deadweight and weight of cargo. In this time, oil from lifting cylinder goes by unidirectional speed limiting valve so as to control the falling speed. When operating tilt spool, high pressure oil goes to one chamber of tilting cylinder and the other one connects with low pressure line so as to make mast tilt forward or backward. The other way goes to the steering gear to prioritize the operation of the steering system. One more way goes to the brake master cylinder to provide power for the travel brake.

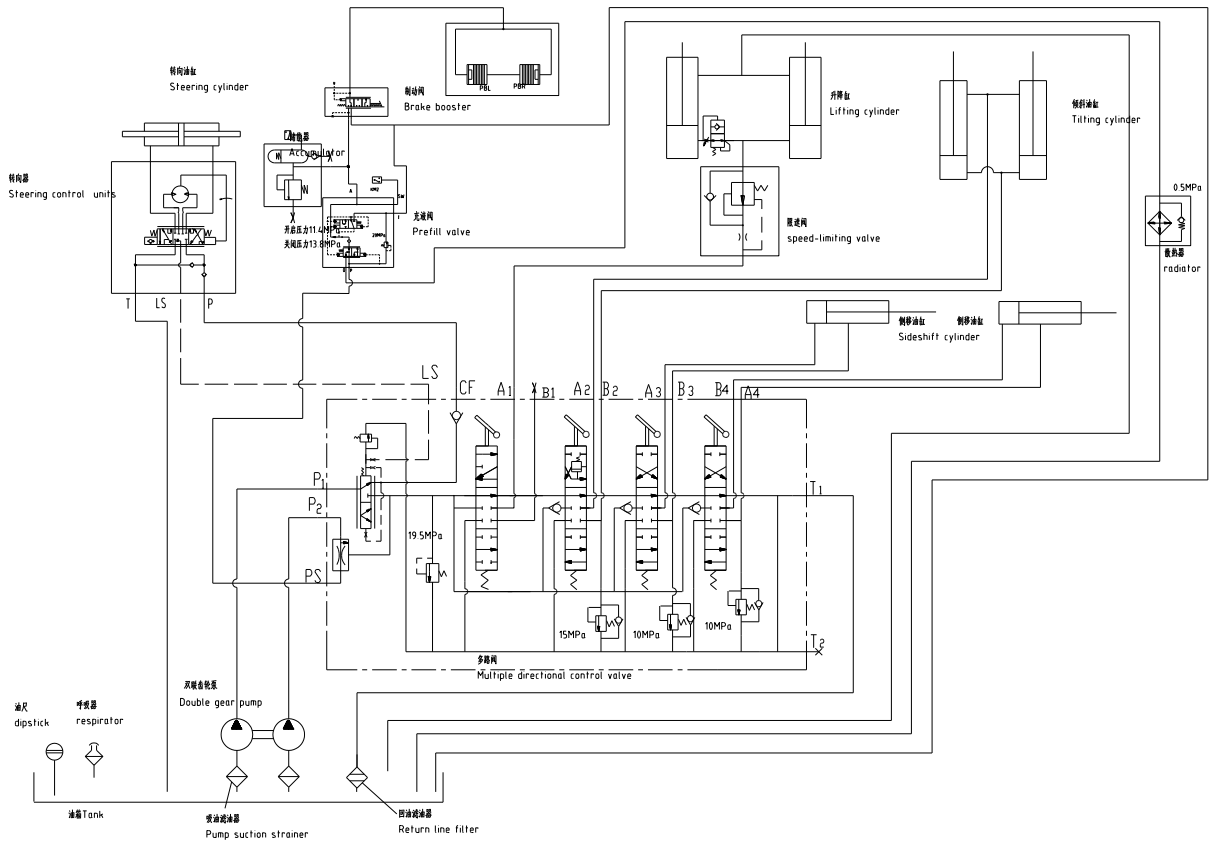


Fig.5-2 Hydraulic system schematic diagram

### 5.3 Fault and elimination

#### Oil pump

| Trouble                             | Probable cause                                                           | Corrective action                                                                            |
|-------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| No oil Slave oil pump               | Low oil level in tank.                                                   | Add oil to specified level.                                                                  |
|                                     | Clogged suction pipe or strainer.                                        | Clean oil line and tank. If oil is dirty, change.                                            |
| Low discharge pressure on oil pump. | Worn bearing damaged backup ring and O-ring.                             | Replace faulty parts.                                                                        |
|                                     | Maladjusted relief valve.                                                | Readjust to specified pressure using pressure gauge.                                         |
|                                     | Air in oil pump.                                                         | Retighten suction side pipe.                                                                 |
|                                     |                                                                          | Add oil in oil tank.                                                                         |
|                                     |                                                                          | Check pump oil seal.                                                                         |
|                                     |                                                                          | Do not operate pump until bubbles in tank disappear.                                         |
| Noisy oil pump                      | Cavitation due to crushed suction hose or clogged strainer.              | Adjust or replace crushed hose and clean strainer.                                           |
|                                     | Air being sucked from loose suction side joint.                          | Retighten each joint.                                                                        |
|                                     | Cavitation due to too high oil viscosity.                                | Replace with new oil having proper viscosity for temperature at which pump is to be operate. |
|                                     |                                                                          | To operate when oil temperature is normal.                                                   |
|                                     | Bubbles in hydraulic oil.                                                | Determine cause of bubbles and remedy.                                                       |
| Oil leaking Slave oil pump          | Faulty oil seal on pump, faulty O-ring or worn sliding surfaces on pump. | Replace faulty parts.                                                                        |

## Multiway valve

| Trouble                                                           | Probable cause                                                           | Corrective action                                      |
|-------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------|
| Pressure of relief valve is not steady or too low.                | Loose of pressure-adjust screw.                                          | Readjusted and retighten.                              |
|                                                                   | Distorted or damaged pressure-adjust spring.                             | Replace.                                               |
|                                                                   | Worn or blocked relief valve core.                                       | Replace or clean.                                      |
|                                                                   | Pump abated.                                                             | Examine and repair pump.                               |
| Fork tilt forward when control lever is used while engine is off. | Worn or damaged tilt lock valve.                                         | Replace valve core and tilt lock valve as an assembly. |
|                                                                   | Broken tilting lock spring.                                              | Replace spring.                                        |
|                                                                   | Damaged tilt valve plunger O-ring.                                       | Replace O-ring.                                        |
| Mast is unstable when tilting forward.                            | Malfunctioning tilt relief valve.                                        | Replace tilt relief valve assembly.                    |
| Spool valve is not return neutral position.                       | Damaged or distorted reposition-spring.                                  | Replace spring.                                        |
|                                                                   | Dirt exist between valve body and spool valve.                           | Clean.                                                 |
|                                                                   | Blocked control device.                                                  | Adjusted.                                              |
|                                                                   | Not coaxial parts at reposition                                          | Reinstall., be coaxial                                 |
| Spool valve is not return neutral position.                       | Damaged or distorted reposition-spring.                                  | Replace spring.                                        |
|                                                                   | Dirt exist between valve body and spool valve.                           | Clean.                                                 |
|                                                                   | Blocked control device.                                                  | Adjusted.                                              |
|                                                                   | Not coaxial parts at reposition                                          | Reinstall., be coaxial                                 |
| Leakage                                                           | Damaged O-ring.                                                          | Replace.                                               |
|                                                                   | Faulty seal of joint.                                                    | Check and retighten.                                   |
|                                                                   | Loose seal plate.                                                        | Clean seal plate and retighten bolts.                  |
|                                                                   | Loosed lock-nut of relief valve and connect-nut between plate and plate. | Tighten.                                               |
| Multi-way valve cannot move back and forth                        | Multi-way valve moves back and forth to adjust handle interference       | Adjustment                                             |

## 5.4 Oil pump unit

Overview of oil pump unit: It consists of oil pump, flange, suction pipe, hydraulic tank cover, etc. See Figure 5-3

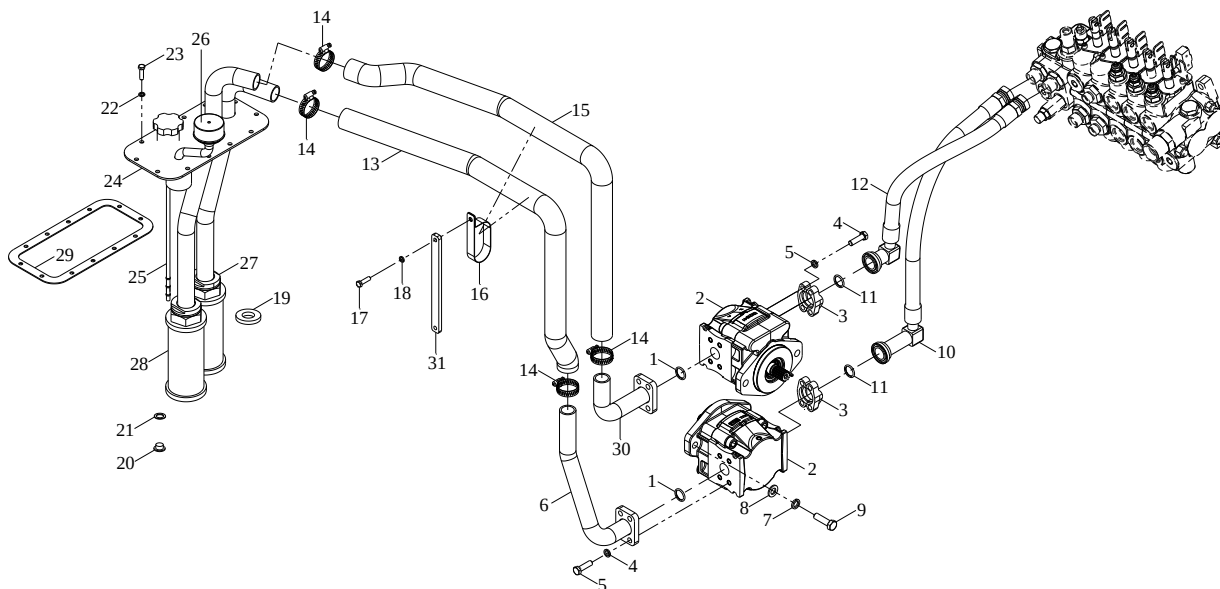


Fig.5-3 Oil pump unit

|                     |                           |                      |                       |
|---------------------|---------------------------|----------------------|-----------------------|
| 1-O-ring seal       | 2-Gear pump               | 3-Split flange clamp | 4-Bolt                |
| 5-Washer            | 6-Oil suction flange      | 7-Washer             | 8-Washer              |
| 9-Bolt              | 10-Hose assy              | 11-O-ring seal       | 12-Hose assy          |
| 13-Oil suction pipe | 14-Double steel wire hoop | 15-Oil suction pipe  | 16-Pipe clamp         |
| 17-Bolt             | 18-Washer                 | 19-Magnet            | 20-Screw plug         |
| 21-Washer           | 22-Washer                 | 23-Bolt              | 24-Cover plate assy   |
| 25-Dipstick assy    | 26-Air breathing filter   | 27-Washer            | 28-Oil suction filter |
| 29-Gasket           | 30-Oil suction flange     | 31-Bracket           |                       |

Installation notes.:

- 1、 Install the left and right brackets to ensure the horizontal direction of the motor axis
- 2、 If the motor sends out unstable vibrations, the installation of the two-bolt vibration damping pad needs to be checked.
- 3、 Bolt 4 tightening torque: 45 N-m~59 N-m, bolt 9 tightening torque: 76 N-m~102 N-m.

---

### 5.4.1 Gear Pump

This gear pump is a low-noise gear pump and the housing is a solid, compact two-piece cast iron gear pump. It has the following features: shock and high pressure resistance, low noise emission, integrated built-in valve, long life expectancy, higher volumetric efficiency and stability of cast iron gear pumps under high temperature and pressure compared to cast aluminum.

#### **Installation Instructions**

- 1) Before installation, make sure the rotation direction of gear pump can meet the system requirement;
- 2) The coaxially between the gear pump axle and the motor axle must be less than 0.05mm;
- 3) Connect the inlet and outlet connector, do not misconnect;
- 4) Install the flanges and connectors. No bump ,scratch or burr, in case of oil or gas leakage and noise-producing;
- 5) Avoid that there is no axial force or radial force on the gear pump axle. Install it smoothly during the installation, no mounting or dismounting by force.

#### **Operation and Maintenance**

- 1) Always follow the Instruction, never overload.
- 2) Hydraulic oil requirement: summer, L-HM32 or similar viscosity hydraulic oil; winter, L-HV32 low temperature hydraulic oil
- 3) Starting for the first time, run without load to bleed the air in hydraulic system,until there is no bubble.
- 4) Keep the oil clean. Clean the oil tank and oil lines fully before refilling.
- 5) Inspect the oil cleanliness and strainers periodically, replace as necessary

5.5 Multiway valve

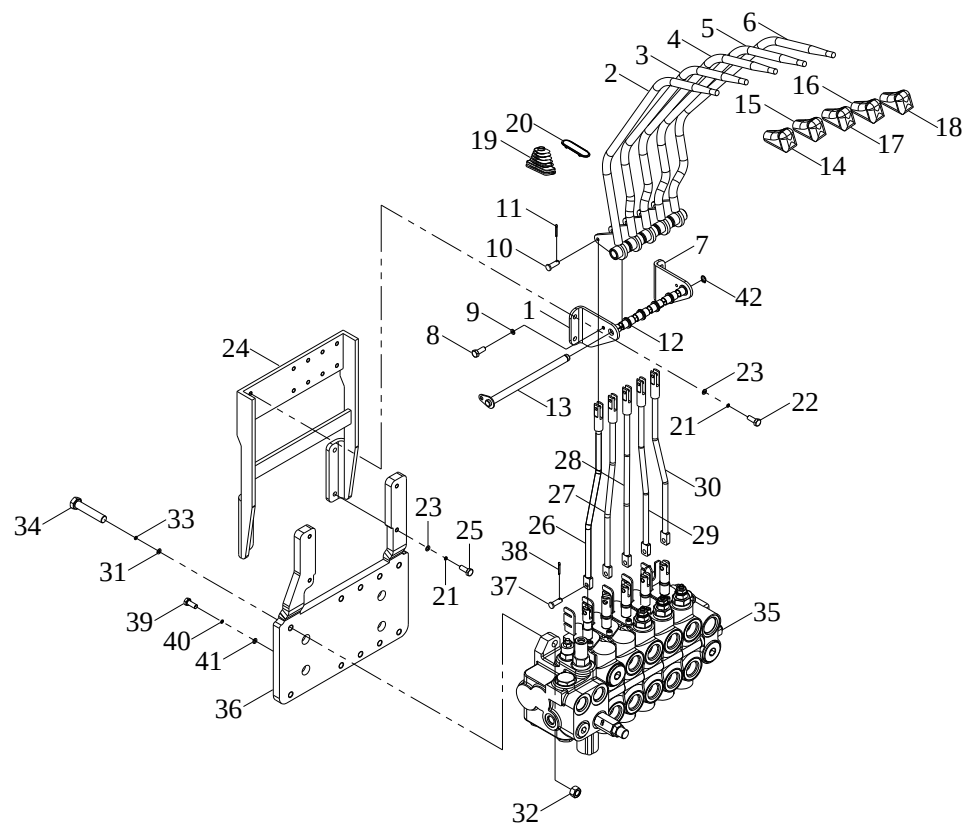


Fig.5-4 Multiway valve joystick

- 1-Left bracket

5-Multi way valve joystick 4

9-Washer

13-Pin shaft

17-Genus with handle

21-Washer

25-Bolt

29-Extension rod 4

33-Washer

37-Pin shaft

41-Washer
- 2-Multi way valve joystick 1

6-Multi way valve joystick 5

10-Pin shaft

14-Lifting handle

18-Genus with handle

22-Bolt

26-Extension rod 1

30-Extension rod 5

34-Bolt

38-Pin
- 3-Multi way valve joystick 2

7-Right bracket

11-Pin

15-Tilt handle

19-Sheath

23-Washer

27-Extension rod 2

31-Washer

35-Multi-way valve assy

39-Bolt
- 4-Multi way valve joystick 3

8-Bolt

12-Bushing

16-Genus with handle

20-Rubber stopper

24-Bracket

28-Extension rod 3

32-Nut

36-Mounting plate

40-Washer

|                       |       |
|-----------------------|-------|
| NO.                   | 39    |
| Tightening torque N·m | 45~59 |

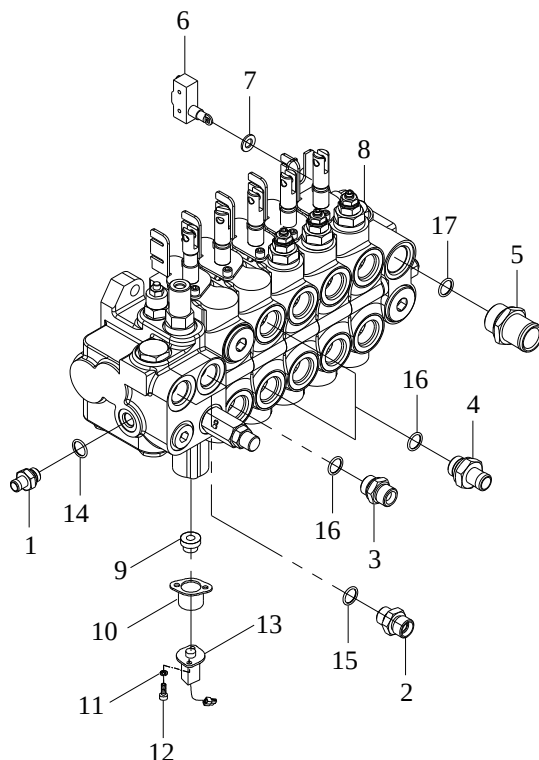


Fig.5-5 Multi-way valve assy

|                  |                          |                |                   |
|------------------|--------------------------|----------------|-------------------|
| 1-Pipe joint     | 2-Pipe joint             | 3-Pipe joint   | 4-Pipe joint      |
| 5-Pipe joint     | 6-Micro switch assy      | 7-Washer       | 8-Multi-way valve |
| 9-Cushion        | 10-Potentiometer bracket | 11-Washer      | 12-Screw          |
| 13-Potentiometer | 14-O-ring seal           | 15-O-ring seal | 16-O-ring seal    |
| 17-O-ring seal   |                          |                |                   |

Tightening torque of multi-way valve connector:

| NO.                   | 1     | 2      | 3       | 4       | 5       |
|-----------------------|-------|--------|---------|---------|---------|
| Tightening torque N·m | 36~44 | 90~110 | 117~143 | 117~143 | 144~176 |

#### Main safety valve pressure adjustment

The pressure of the main safety valve has been adjusted before leaving the factory. In general, users are not allowed to adjust it at will. The adjustment method is as follows :

- 1) Park the vehicle on a solid and level road, in neutral, pull on the hand brake handle, tilt the mast back to the bottom and lower the forks to the ground. Engine off.
- 2) Open the front base plate, loosen the bolt at the pressure measurement port of the multiway valve inlet pipeline, and place it in a clean place. There is hydraulic oil outflow, pay attention to protect the environment.
- 3) Connect the pressure gauge.

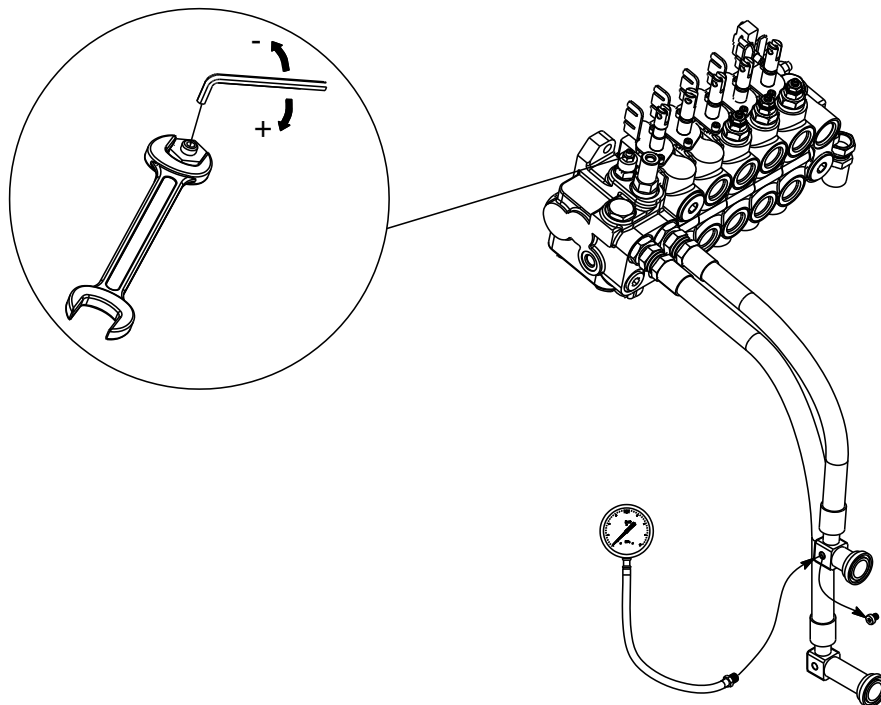


Fig.5-6

**CAUTION!**

a) The specification of the pressure gauge is greater than 20MPa.

b) Pressure tap thread fit: Rc1 / 8R1 / 8; c. Tightening torque is 20N·m -22N·m.

4) Start the forklift, put the mast vertical, and the forks are 300mm off ground.

5) Read the pressure gage, judge whether the main safety valve pressure is in normal range  
6-10t: 19.5MPa±0.25MPa

6) If the main safety valve pressure is not in normal range, release the main safety valve locknut, adjust adjusting screw. If the reading is less than normal range: screw the adjusting screw in clockwise(+) to increase main relief valve pressure. If the reading is larger than normal range, screw the adjusting screw in counterclockwise(-) to decrease main safety valve pressure.

7) Stable the pressure in the normal range of 30s.

8) Remove pressure gage, install the bolts, and the tightening torque is 20~22N·m. Drop the mast to the ground, and tilt it backward to the end.

9) Relock locknut, install front base plate.

## 5.6 Fully hydraulic steering redirector

It is the load sensing hydraulic steering gear, containing integrated valves, which can be used after connecting to priority valve by pipes. LS port of steering gear is connected to LS port of priority valve, by which, the steering load pressure signals from the gear can be sent to the priority valve and it control the oil supply to the steering gear from the system.

For the load sensing steering system, it can always meet the requirement of steering hydraulic circuit and relevant flow can be distributed to assure the smooth, smart and easy operation of steering regardless of load pressure, turning speed of the steering wheel.

The oil flow output from the pump, apart from the necessary supply to steering system, the spare can be used for operation system, which eliminates the power lose caused by oil oversupply to steering system and increase the system efficiency.

When the power steering is working, pressure oil flows into rotor and stator pair through valve element and valve pocket pair, and to drive rotor to rotate along with steering wheel, and push oil into left and right cavities of steering cylinder, and piston rod pushes steering wheel to steer.

When the power is cut off, the pump does not supply oil, and the steering action will be realized manually by turning the steering wheel to move valve spool, valve guide, coupling block, and to actuate the rotor to feed oil into steering cylinder, in this case, rotor and stator act as a hand pump, making manual steering possible.

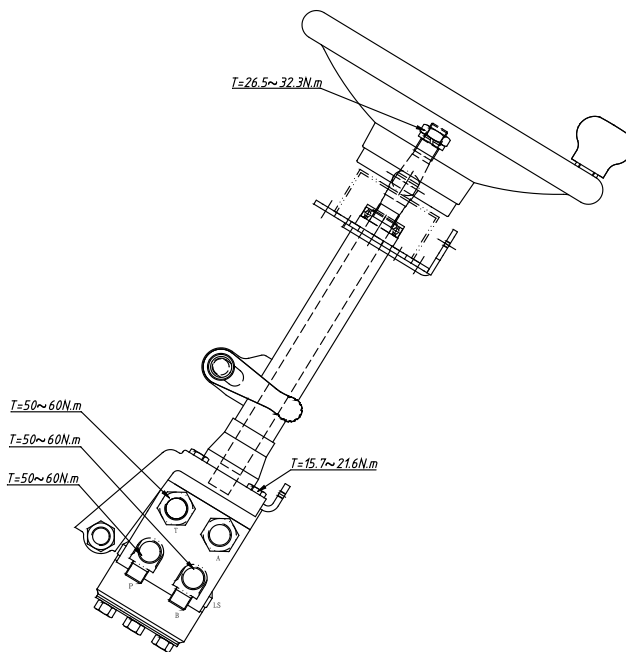
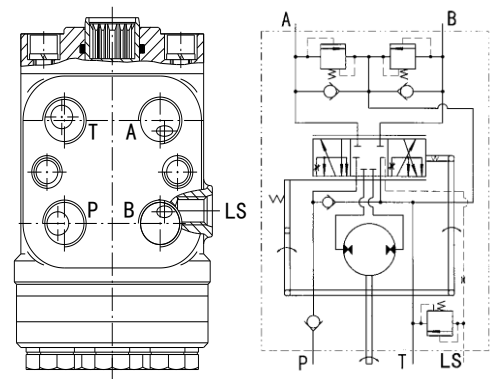


Fig.5-7 Steering gear

### Main function symbol



---

### **Attention on the steering gear installation and maintenance**

- 1) Keep the steering gear and the steering column in the same axle. Make sure there is axial clearance. Check for the flexibility of the steering wheel.
- 2) Avoid any axial force applied on input terminal of the steering gear during the installation
- 3) Assure all the parts clean and prevent dust or dirt going to the inner side of steering gear and hydraulic system.
- 4) Do clean the connectors of outlet pipes. Do not seal by tapes instead of seal rings.
- 5) Make sure all the hydraulic fluid ports are installed correctly. Follow the sequences below on pipelines installation. Connect P port (Pressure oil inlet) with the CF port of priority valve. Connect the T port (low pressure oil return port) with T port of the control valve. Connect LS port (load sensing) with the LS port of priority valve. Connect A port with the right fluid port of steering cylinder and B port with the left fluid port of steering cylinder.
- 6) A, B, P, T ports thread size  $M20 \times 1.5$ ,  $T=50 \sim 60 N \cdot m$ . LS ports thread size  $M12 \times 1.5$ ,  $T=30 \sim 36 N \cdot m$ .
- 7) Do not dismantle the steering gear frequently unless malfunction of the steering gear is confirmed.
- 8) Make sure all the parts are clean and protect the parts against crash when dismantling the steering.
- 9) Put or take out the spool and sleeve vertically to prevent the pull pin dislocated during the installation or dismantlement.
- 10) Pay attention to the match of markers when installing the universal driving shaft and the rotor.
- 11) Do not forget to fix the steel ball of the check valve and pull pin. Make sure the bolts are installed correctly.
- 12) Fasten the bolts evenly during the installation and guarantee the torque is between  $40 \sim 50 N \cdot m$ . Or else, it's easy to cause dead center or steering difficulty.
- 13) Make sure the fluid clean. Avoid the dirt block the spare parts of the steering gear and cause the malfunction of steering. Therefore, it's important to check the condition of the filter element and the fluid. Replace it as necessary.
- 14) If it is difficult to steer or the steering gear failed to turn, check for the cause carefully. In order to protect the spare parts, do not turn the steering wheel blindly. Neither casually dismantles the steering gear. It's prohibited to turn steering wheel by two operators simultaneously.
- 15) The maximum manual steering torque of the gear is  $130 N \cdot m$ .

## Hydraulic Steering Gear common failures and troubleshooting measures

| Fault             | Probable reason                                                | Phenomenon                                                                                                                  | Corrective action                                                                               |
|-------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Oil leakage       | Combined part bolts loosen                                     |                                                                                                                             | Retighten these bolts                                                                           |
|                   | Combined face or journal sealing ring damage                   |                                                                                                                             | Replace sealing ring                                                                            |
|                   | Gasket damage                                                  |                                                                                                                             | Replace gasket                                                                                  |
| Hard steering     | Insufficient oil supply<br>Slave oil pump                      | Turn steering wheel slowly is light and turn fast is heavy.                                                                 | Check for oil pump work condition                                                               |
|                   | Air in the steering system                                     | If there are bubbles in oil that give out irregular noise when rotating the steering wheel but the cylinder stops-and-goes. | Bleed the air in the system and check for oil suction pipe leakage                              |
|                   | Oil level is lower than specified position                     |                                                                                                                             | Refill oil to specified position                                                                |
|                   | oils are too viscous                                           |                                                                                                                             | Use specified oil                                                                               |
|                   | Ball check valve disorder.                                     | Steering wheel is heavy when turning fast or slowly, and no pressure in steering system                                     | If the ball losses, install another one. If the ball is blocked by dirt, clean it.              |
|                   | The pressure of steering system is lower than work pressure    | No load or light load steering is light, but much load steering is heavy.                                                   | Check out the reason, recover or improve system pressure                                        |
| Steering failure  | Spring leaf broken                                             | Steering wheel cannot return to the middle automatically                                                                    | Replace spring leaf                                                                             |
|                   | Dial pin or universal driving shaft opening broken or deformed | Pressure fluctuations increased significantly, even worse ,cannot steer                                                     | Replace dial pin or universal driving shaft                                                     |
|                   | Rotor or universal driving shaft opening broken or deformed    | Steering wheel rotates or moves from side to side freely                                                                    | Teeth space engagement between compact point teeth on universal driving shaft and on the rotor. |
| No human steering | Overlarge stator radial or axial clearance                     | Steer after misfire, steering wheel turns but the cylinder keep still.                                                      | Replace stator                                                                                  |

| Fault                                                                                 | Probable reason                                                                                                                             | Corrective action |
|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Turning steering wheel slowly is light and turning fast is heavy or no power to steer | steering pump efficiency is too low, cannot reach the required pressure                                                                     |                   |
|                                                                                       | The pressure of system relief valve is low or spring intensity of relief valve decreased                                                    |                   |
|                                                                                       | The pressure of relief valve of steering gear is low or the valve core get stuck                                                            |                   |
|                                                                                       | The oil of steering system returns unsmooth                                                                                                 |                   |
|                                                                                       | The load of steering is too heavy                                                                                                           |                   |
|                                                                                       | The pipelines of load sensor have leakage, work unsmooth or kink,                                                                           |                   |
|                                                                                       | Steering gear has inner leakage or the shut-down steering non-return valve cannot reset or has leakage                                      |                   |
|                                                                                       | The damaged inlet non-return valve plugged the oil to the steering gear                                                                     |                   |
| Steering wheel is heavy when turning fast or slowly,                                  | The resistance of steering column itself is very strong. The steering lever bends or it interferes with valve element of the steering gear. |                   |
|                                                                                       | The mechanical resistance of steering gear itself is big                                                                                    |                   |
|                                                                                       | Low steering pump efficiency                                                                                                                |                   |
|                                                                                       | Low relief valve pressure                                                                                                                   |                   |
| Steering wheel swings and the vehicle can not run straightly                          | Air in the steering system                                                                                                                  |                   |
|                                                                                       | The connecting rod of steering wheel has large clearance or bend                                                                            |                   |
|                                                                                       | Seal in steering cylinder damaged and generate inner leakage                                                                                |                   |
|                                                                                       | Trimmer valve or oil supply valve has large leakage                                                                                         |                   |
|                                                                                       | The load hold facility of A and B port of steering gear itself reduces                                                                      |                   |
| The vehicle can not run straightly                                                    | The connecting rod of steering wheel has large clearanc                                                                                     |                   |
|                                                                                       | Trimmer valve or oil supply valve has large leakage                                                                                         |                   |
|                                                                                       | The reset characteristics of steering gear is not well                                                                                      |                   |
|                                                                                       | The tire pressure difference of steering wheels is too big                                                                                  |                   |
| Hard to feel the terminal point of the steering wheel                                 | Steering gear has large inner leakage                                                                                                       |                   |
|                                                                                       | The relief valve or double-way overload valve set the same pressure                                                                         |                   |

| Fault                                                                                                      | Probable reason                                                                                   | Corrective action                     |
|------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------------|
|                                                                                                            | Steering cylinder has large inner leakage                                                         |                                       |
|                                                                                                            | The double-way overload valve or oil supply valve has large inner leakage or gets stuck           |                                       |
|                                                                                                            | The returning pipe plugged                                                                        |                                       |
| Steer inaccurate or crawl                                                                                  | Air in the steering system                                                                        |                                       |
|                                                                                                            | Steering cylinder has inner leakage                                                               |                                       |
| Steering wheel can turn easily, but the rear wheels keep still or turn slowly, just like no power to steer | Steering mechanism connection drops out                                                           |                                       |
|                                                                                                            | Trimmer valve or oil supply valve gets stuck                                                      |                                       |
|                                                                                                            | Cavities mixed of the steering cylinder. Piston falling off the cylinder lever.                   |                                       |
|                                                                                                            | The inner parts of steering gear damaged                                                          | Replace the steering gear             |
|                                                                                                            | Lack of oil                                                                                       | Refill hydraulic oil                  |
| Large empty stroke of steer wheel                                                                          | The clearance of the contacts between steering gear and steering column is big                    |                                       |
|                                                                                                            | The steer connecting mechanism has large clearance                                                |                                       |
|                                                                                                            | Air in the hydraulic system, and cavitation erosion of oil is serious                             | Bleed the air in the hydraulic system |
|                                                                                                            | The reset characteristics of trimmer valve or oil supply valve is not well                        | Replace the steering gear             |
| reset incorrect or Heel Turn                                                                               | The steering gear and steering column have interference which makes steering stiffly.             |                                       |
|                                                                                                            | There are burrs between valve core and valve sleeve                                               |                                       |
|                                                                                                            | High oil return backpressure may make reset incorrect.                                            |                                       |
|                                                                                                            | Spring leaf broke or lacks of elasticity                                                          |                                       |
|                                                                                                            | The frictional resistance between axle head of valve core and front cover of steering gear is big |                                       |
| Steering wheel turn itself or shake repeatedly                                                             | Faulty connection when steering gear assembling                                                   |                                       |
|                                                                                                            | Connect the inlet port to A or B port                                                             |                                       |
|                                                                                                            | The sleeve of valve core gets stuck.                                                              |                                       |
| The steering wheel gets stall                                                                              | Stator and rotor are stuck                                                                        |                                       |
|                                                                                                            | Pumping source or steering safety valve lacks of pressure.                                        |                                       |
|                                                                                                            | Plugged oil pipeline or faulty pipeline                                                           | check for the connection of oil       |

| Fault                                                                                                              | Probable reason                                                                                                     | Corrective action                       |
|--------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
|                                                                                                                    | connection                                                                                                          | pipeline                                |
|                                                                                                                    | Steering column gets stuck.                                                                                         | adjust the steering column              |
|                                                                                                                    | The inner parts of steering gear damaged                                                                            | Maintain or replace the steering gear   |
|                                                                                                                    | The damaged inlet non-return valve plugged the oil to the steering gear or non-return valve plugged when shut down. |                                         |
| The rear wheels make reverse turning when turning the steer wheel                                                  | A and B port connect reversely                                                                                      | Connect the steering pipeline correctly |
| Steering wheel is blocked                                                                                          | The inlet non-return valve of steering gear damaged, the oil flow back                                              | Maintain or replace the steering gear   |
| Pipeline shakes and there is hydraulic noise in the load sensing steering system. The truck vibrates when running, | Air in the pipeline                                                                                                 | Bleed the air in the hydraulic system   |
|                                                                                                                    | Orifice of load port is small                                                                                       |                                         |
|                                                                                                                    | Set the pressure of relief valve to an incorrect value                                                              |                                         |

## 5.7 Steering cylinder

Steering cylinder is di-functional. The piston rod can be connected with knuckle through the connecting rod. The fluid from hydraulic steering gear flows to the steering cylinder and drives the movement of piston rod to the left and right side, which drives the truck steer to left and right. See Fig. 4-8 for steering cylinder structure.

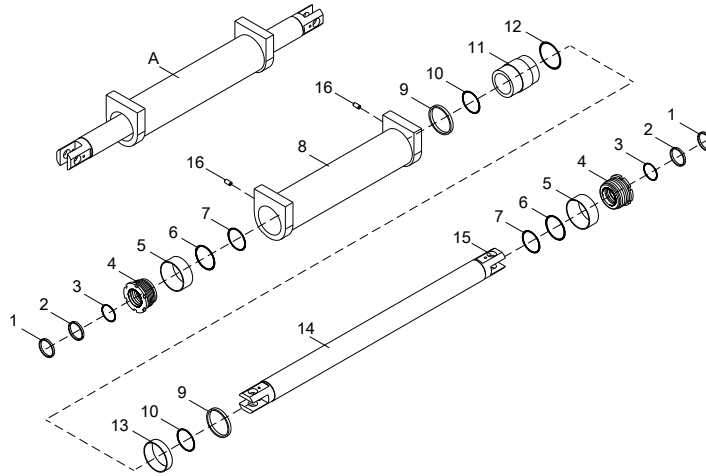


Fig.5-8 Steering Cylinder

|                 |                 |             |                 |
|-----------------|-----------------|-------------|-----------------|
| 1-BH dust ring  | 2-ISI seal ring | 3-Seal ring | 4-Guide bush    |
| 5-Bush          | 6-O-ring        | 7-O-ring    | 8-Body cylinder |
| 9-OSI seal ring | 10-O-ring       | 11-Piston   | 12-Steel ball   |
| 13-Support ring | 14.Piston rod   | 15-Bush     | 16-Plug         |

### Disassemble:

- 1) Remove the guide sleeves 4 on the left and right sides;
- 2) Remove the LBH dust ring 1, ISI seal ring 2, Seal ring 3, O-ring 6, O-ring 7, Bush 5, OSI seal ring 9, O-ring 10 in sequence;
- 3) Remove the Piston rod 14, Bush 15, Piston 11, Steel ball 12, Support ring 13;
- 4) Check: If each component is damaged, replace it.

The installation sequence is the reverse of the removal

### Attention on the installation and disassembly of the steering cylinder

- 1) Lubricate every part with clean hydraulic fluid.
- 2) Keep the cylinder away from any dust and dirt.
- 3) Prevent the cylinder barrel and inlet, outlet from scratching.
- 4) Keep the opening of ISI seal ring inward and the opening of LBH scraper seal outward.
- 5) Protect the O-ring from being damaged during the installation.
- 6) Push the guide sleeve carefully into the cylinder barrel. Protect the O-ring and inner seal ring from being damaged.
- 7) Lubricate the clearance of the seal rings with the same brand hydraulic fluid as the operating oil.

5.8 Tilt cylinder

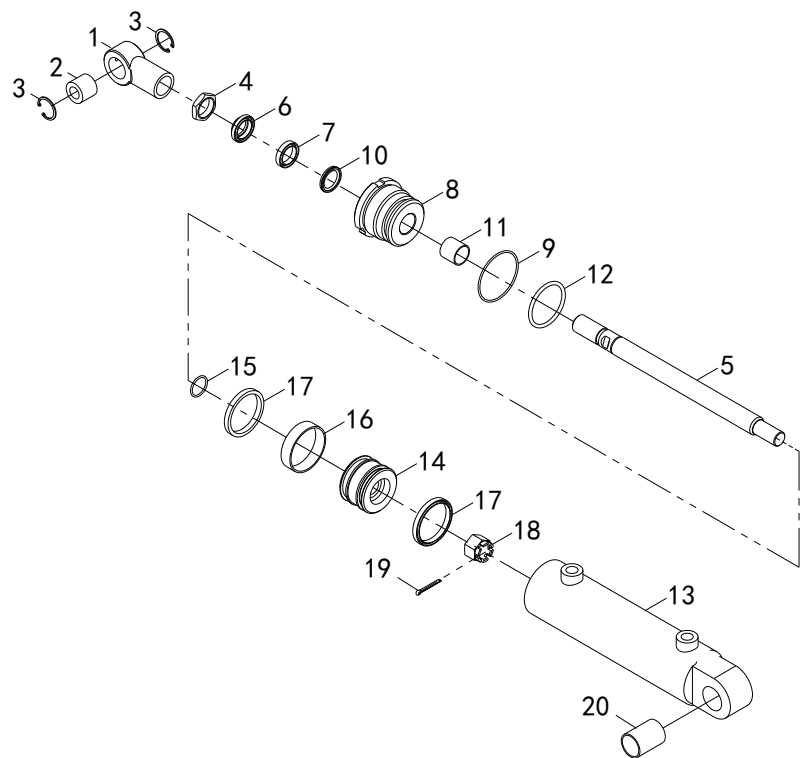


Fig.5-9 Tilt cylinder structure

|                   |                  |                  |           |              |
|-------------------|------------------|------------------|-----------|--------------|
| 1-Eye bar         | 2-Bearing        | 3-Snap ring      | 4-Nut     | 5-Piston rod |
| 6-Dust ring       | 7-ISI-seal rin   | 8-Guide bush     | 9- O-ring | 10-Step seal |
| 11-Composite bush | 12-O-ring        | 13-Cylinder body | 14-Piston | 15-O-ring    |
| 16-Support ring   | 17-OSI-seal ring | 18-Nu            | 19-Pin    | 20-bushing   |

### 5.8.1 Disassembly of tilting cylinder

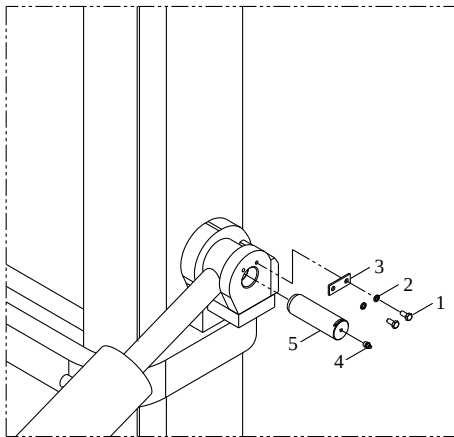
#### WARNING



- a) Fix the outer mast with steel wire of crane. Prevent the mast falling after disassembling the cylinders.
- b) Keep away from the truck. Never stand on the fork carriage when it's fitted with forks.

1) Lower down the fork carriage thoroughly.

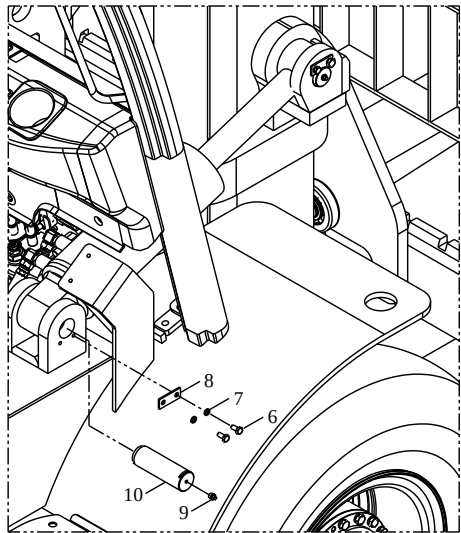
2) Remove bolts 1, washers 2, stop plates 3 from the left and right brackets on the outer mast and pull out pins 5 and oil cups 4.



3) Dismantle the oil pipe which is near the inlet of the tilting cylinder.

4) Remove the pedal pad, the front base plate assembly and the right side plate assembly in turn.

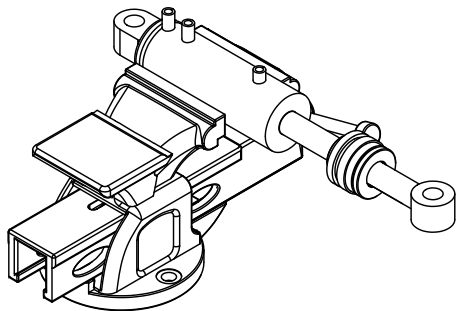
5) Remove bolt 1, washer 2, stop plate 3 from the frame support and pull out the pin 5 and oil cup 4 to remove the tilting cylinder.



6) Follow the reverse sequences of disassembly to install the cylinder.

### 5.8.2 Decomposition of tilting cylinder

The structure of the tilting cylinder is shown in Figure 4-9



Steps:

1) Retain the tilting cylinder with a jaw vice.

2) Drain out the remaining fluid in the cylinder by way of pulling the piston rod back and forth when both inlets and outlets are open.

Remove the circlip for hole 3 with a plier and take down the bearing 2.

3) Loosen nut 4.

4) Pull out the guide sleeve 8, piston rod

5, piston 14 and other accessories from the cylinder 13 by tie rod head 1.

5) Remove the pin 19 and screw down the nut 18.

6) Take out the piston 14 of the piston rod 5 and remove the OSI seal ring 17, support ring 21, O-ring 15 from the inner and outer rings of the piston.

7) Remove the guide sleeve 8 from the piston rod, and remove the LBH dustproof ring 6, ISI seal ring 7, St seal 10, composite bushing 11, O-ring 9, O-ring 11 from the inner and outer rings of the guide sleeve.



**CAUTION!**

-----  
The removed dust ring and seal ring are not allowed to be used twice.  
-----

### 5.8.3 Inspections on key components

1) Check for deformation and the scratch and corrosion of the inwall. If the cylinder is badly damaged or severely deformed, replace a new one. If the scratch or corrosion is not that serious, polish it with "00" abrasive paper and lubrication oil.

2) Check for the deformation of the piston rod and see if it is dent or with pocking marks and corrosion.

3) Light scars on the internal surface of the guide sleeve do not impact its performance. But if the unilateral abrasion loss reaches 0.2mm~0.3mm, the seal rings

fails to function. Replace timely.

4) Check for the scars, cracks on the piston and check if the seal groove is damaged or not. Keep the fit clearance of cylinder and piston between 0.10mm ~ 0.15mm. The maximum clearance should not exceed 0.2mm. Otherwise replace the piston.

5) If any seal ring is found overworn, aged or scratched or flaw lip, replace them timely.

### 5.8.4 Installation and adjustment of tilting cylinder

1) Clean up every part with gasoline and dry up with compressed air before installation. Smear some hydraulic fluid on the cylinder inwall, piston and piston rod surfaces and the surfaces of seals. (Hydraulic fluid should be the same type as the working oil.)

2) Follow the reverse sequences of the decomposition to assemble the cylinder. Keep an eye on the installing direction of the seals. When the lip of seal ring passes through the inlet and outlet, press it gently with a smooth pole, in case the chamfer edge of the inlet and outlet lip damages the lip.

3) After the piston is put in the cylinder, the movement in a whole stroke should be smooth and no obstruction and not jammed.

### 5.8.5 Inspection and adjustment of the mast tilting angles

1) Keep the truck fully loaded and the mast in a vertical direction.

2) Lift the forks 300~500mm off the ground. Leave the range quadrant on the tangent plane of the inner mast and read the angle.

3) Tilt the mast forward to the end. Value of the quadrant angle is the forward tilting angle. Tilt the mast backward to the end.

---

Value of the quadrant angle is the backward tilting angle.

4) If the angle is big or small, turn the earring on the top of the piston to reset and fasten with bolts and nut

## 5.9 Lifting cylinder

The lifting cylinder is piston type applied with shock absorber. For the structure of lifting cylinder, see figure 4-10.

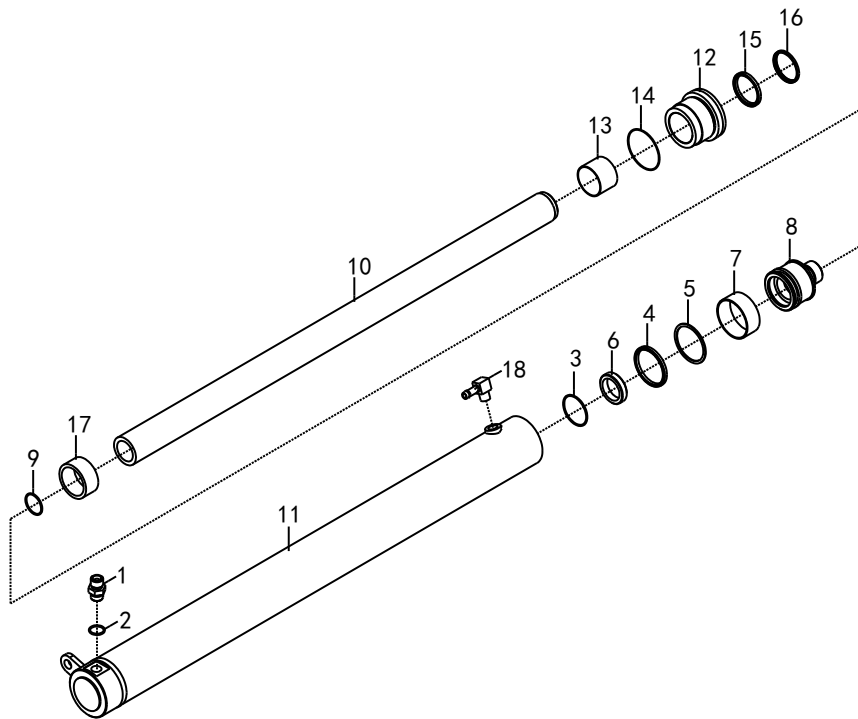


Fig.4-10 Structure of left (right) lifting cylinder

|                          |               |                  |                       |
|--------------------------|---------------|------------------|-----------------------|
| 1-Nozzle valve assy (RH) | 2-O-ring (RH) | 3-Snap ring      | 4-ODI- seal ring      |
| 5-Snap shim              | 6-Bushing     | 7-Support ring   | 8-Piston              |
| 9-Snap ring              | 10-Piston rod | 11-Cylinder body | 12-Guide sleeve       |
| 13-Combination bush      | 14-O-ring     | 15-ISI-seal ring | 16-DKI-dustproof ring |
| 17-Sheath                | 18-Connector  |                  |                       |

### 5.9.1 Disassembly of lifting cylinder

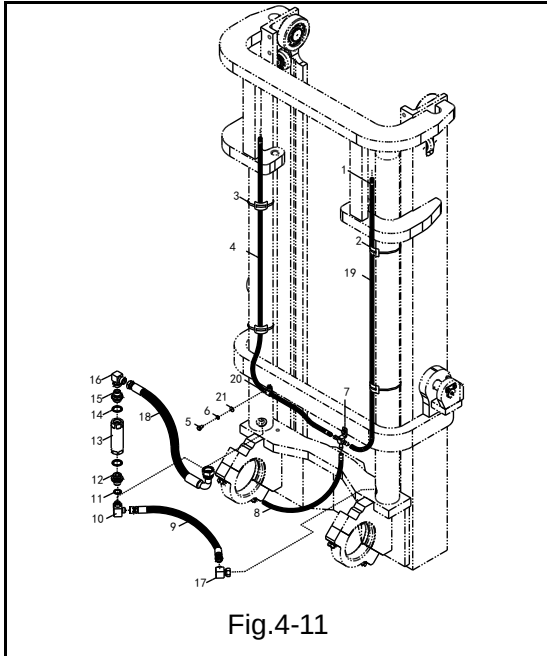


Fig.4-11

**CAUTION!**

-----  
Keep away from the truck.  
-----

Steps:

1) Lower the lifting cylinder to the end to compress the oil back to the tank. Close the electric switch.

2) Unscrew the cylinder support bolts on the piston rod and on the mast.

3) Disconnect the oil return pipe of lifting cylinder and disassemble inlet pressure hose of the bottom regulator valve and the pressure hose connected to the cylinders(see figure 4-11).

4) Remove the U bolts on the dead plate of outer mast beam and the fastening bolts on the opposite side.

5) Dismount the chain on the mast.

6) Lift the inner mast with steel wire and take away the left and right lifting cylinders.

Decomposition of lifting cylinder(See Figure 4-10 for structure)

Steps:

1) Retain the lifting cylinder with a jaw vice

2) Screw out the guide sleeve (12) with a hookwrench and take O-ring (14) and DKI scraper seal (16) and ISI seal ring (15) out of the guide sleeve.

3) Pull the piston rod (10) out of cylinder (11).

4) Take the spacer bush (17) out of piston rod.

5) Remove the steel cable baffle ring (3), lining(6), ODI seal ring (4), guard ring (5), and support ring (7) off the piston.

6) Dismount the piston (8) from the piston rod and remove steel cable baffle ring (9).

7) Remove nipple component (1) , O-ring (2) and connector (18) from cylinder body (11)

**CAUTION!**

-----  
Replace the scraper seal and seal rings once they are removed.  
-----

### 5.9.2 Inspections on key components

1) Check for deformation and the scratch and corrosion of the inwall. If the cylinder is badly damaged or severely deformed, replace a new one. If the scratch or corrosion is not that serious, polish it with"00" abrasive paper and lubrication oil.

2) Check for the deformation of the piston rod and see if it is dent or with pocking marks and corrosion.

3) Light scars on the internal surface of the guide sleeve do not impact its performance. But if the unilateral abrasion loss reaches 0.2mm~0.3mm, the seal rings fails to function. Replace timely.

4) Check for the scars, cracks on the piston and check if the seal groove is damaged or not.

---

5) If any seal ring is found over worn, aged or scratched or flawed lip, replace them timely.

### Installation and adjustment of lifting cylinder

1) Clean up every part with gasoline and dry up with compressed air before installation. Smear some hydraulic fluid on the cylinder inwall, piston and piston rod surfaces and the surfaces of seals. (Hydraulic fluid should be the same type as the working oil.)

2) Follow the reverse sequences of the decomposition to assemble the cylinder. Keep an eye on the installing direction of the seals. When the lip of seal ring passes through the inlet and outlet, press it gently with a smooth pole, in case the chamfer edge of the inlet and outlet lip damages the lip.

3) After the piston is put in the cylinder, the movement in a whole stroke should be smooth and no obstruction and not jammed.

4) Conduct the exhaust and running tests after truck is assembled. Check for oil leakage and the loosening bolts.

---

## 6、Lifting system

### 6.1 General description

The lifting system is composed of mast, fork carriage, forks, load backrest, lifting chain, rollers, lifting cylinder and tilting cylinder. It combines pipelines and hydraulic system to constitute the working device of a forklift, which is the executing unit to load and unload cargos for a forklift. Usually, it is classified by mast types which include single stage mast, duplex mast and triplex mast. The forklift trucks produced by Hangcha can be installed with wide view duplex mast; full free lift duplex mast (container mast included) and full free lifting triplex mast. The mast type brings in the CL coordinated rolling type.

The wide view duplex mast is composed by one outer mast which cannot be lifted or lowered and one inner mast with flexibility to stretching up and down. The cylinder bottom of lifting cylinders is fixed by bolts on the beam of outer mast. Ends of piston rod are connected to the beam assembly of the inner mast. Fix the oil cylinder to the dead plate with U bolts. Generally, the free lifting height is within 160mm. Installing the two lifting cylinders on the back of the mast contributes to the wide view for the operator. For some small ton trucks, the cylinders are mounted on the outside of the mast.

Forks are hooked on the fork carriage. Rollers and side rollers are applied on the fork carriage. Meanwhile main roller and side rollers are installed on the bottom of the inner mast.

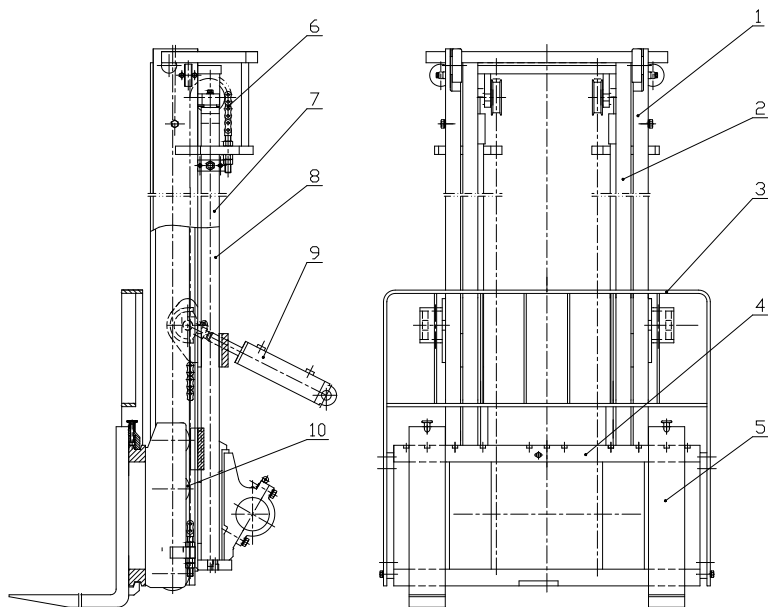
Hydraulic fluid from the control valve passes through the governor valve and comes into the lifting cylinder. It drives the piston and piston rod up which coordinately pushes the inner mast upward. In the meantime one end of chain from the chain wheel of the inner mast is remained still on the outer mast, while the other end is connected with the fork carriage. Fork carriage and forks can be lifted along with the lifting of the inner mast, which contributes to the loading lifting.

Our company will supply forklift trucks with 3.0m height as the basic type, special orders are as follows

wide view duplex mast: 2.5 m to 6m

full free lifting duplex mast: 2.5 m to 3.7m

full free lifting triplex mast: 4 m to 7m



- 1.Outer mast    2.Inner mast    3. Load bracket    4.Fork carriage    5.Fork  
6.Chain    7.Left lifting cylinder    8.Right lifting cylinder    9.Tilting cylinder    10.Roller

**Fig. 6-1 Wide view duplex mast**

## 6.2 Data of assembly and debugging

### Inspection and adjustment

| Position                                |    | Assy clearance  | Repair ( no replacement parts ) clearance |
|-----------------------------------------|----|-----------------|-------------------------------------------|
| Mast to lift roller                     | mm | 0.1~0.8         | 0.2~1.0                                   |
| Gasket                                  | mm | 0.5 / 1.0 / 2.0 |                                           |
| Mast to support guide plate             | mm | 0.1~0.8         | 0.2~1.0                                   |
| Gasket                                  | mm | 0.5 / 1.0 / 2.0 |                                           |
| Inner mast to fork carriage side roller | mm | 0.1~0.6         | 0.2~1.0                                   |
| Gasket                                  | mm | 0.5 / 1.0 / 1.5 |                                           |
| Lift chain deflection                   | mm | 25~30           |                                           |

### Tightening torque of main components

| Position                                 | N·m                         |
|------------------------------------------|-----------------------------|
| Lock nuts of lifting chain               | 176~216(M18), 245~314 (M20) |
| Bearing covers of mast to drive axle     | 176~216 (M18)               |
| Lock nuts of tilting cylinder            | 89~118 (M8)                 |
| Lifting cylinder bolt(head)              | 76~107 (M12)                |
| Lifting cylinder bolt (bottom)           | 44~58 (M10)                 |
| Fixing bolt of lifting cylinder (U type) | 29~39 (M10)                 |

### 6.3 Fault diagnosis and corrections

| Condition                                           | Probable cause                                                                                    | Corrective action                                                                                                    |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| Fork carriage or mast tilt automatically            | Tilt cylinder and ring abraded excessively                                                        | Replace piston ring tilt cylinder.                                                                                   |
|                                                     | The hydraulic control valve spring is inoperative.                                                | Replace it.                                                                                                          |
| The fork arms carrier moves up and down sluggishly. | Caused by piston jamming or piston rod bent.                                                      | Replace the faulty parts.                                                                                            |
|                                                     | Too much dirt is accumulated in the cylinder.                                                     | Clean                                                                                                                |
| Forks are lifted or lowered unsmooth.               | Carriage bracket assembly out of adjustment.                                                      | Adjust clearance with thrust metal and carriage side roller.                                                         |
|                                                     | Insufficient clearance between rollers and mast channel.                                          | Adjust roller clearance                                                                                              |
|                                                     | Biting foreign materials between moving part.                                                     | Remove foreign materials.                                                                                            |
|                                                     | Insufficient lubrication.                                                                         | Apply grease on contact surfaces of sliding parts. (butter)                                                          |
|                                                     | Inner mast deflection or fork carriage bent                                                       | Repair or replace.                                                                                                   |
| Forks are lifted unevenly                           | Lift chains out of adjustable.                                                                    | Adjust lift chains.                                                                                                  |
| Lift roller does not rotate                         | Grease stiffened or dirt accumulated on lift roller                                               | Clean and lubricate lift rollers.                                                                                    |
|                                                     | Improperly adjusted lift roller.                                                                  | Adjust.                                                                                                              |
| Excessive mast noise                                | Insufficient lubrication.                                                                         | Lubricate.                                                                                                           |
|                                                     | Improperly adjusted lift roller, after extending mast, descend to bump with mast channel          | Adjust roller, side roller adjusting shim                                                                            |
| Insufficient lift power or no lift movement.        | Excessive wear occurs between the oil pump body and gears, causing too much clearance.            | Replace the worn parts or the oil pump.                                                                              |
|                                                     | The lifting jack piston seal ring has worn, resulting in excessive inner leaks.                   | Replace Y-ring.                                                                                                      |
|                                                     | Springs of the multiple control valves and its relief valve are inoperative.                      | Replace new spring.                                                                                                  |
|                                                     | Excessive wear occurs of the hydraulic control valve, resulting in excessive oil leaks.           | Replace.                                                                                                             |
|                                                     | Oil leaks occur between the hydraulic control valve sections.                                     | Dismantle for regrinding the joint surfaces and reassemble the valve.                                                |
|                                                     | Leakage occurs in the hydraulic pipe.                                                             | Tighten the joint nuts and inspect the seal for damage.                                                              |
|                                                     | The hydraulic oil temperature is too high. Oil viscosity is too low and the rate is insufficient. | Change the wrong hydraulic oil or stop operation for reducing the oil, find out the reasons for high oil temperature |
|                                                     | The load carried is beyond the designed capacity.                                                 | Lift according to requirement.                                                                                       |

## 6.4 Mast\_disassembly and installation

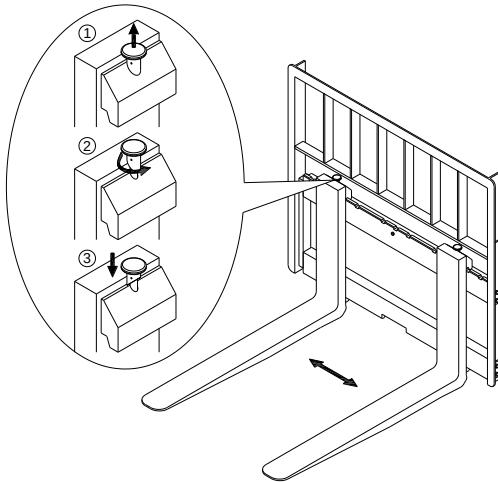
### WARNING



Be careful during the disassembly as the fork, fork carriage and mast are such heavy parts.

### 6.4.1 Dismantle the fork and mast assy

1) Pull out the fork pin and move the fork to the notched part in the middle of the fork carriage



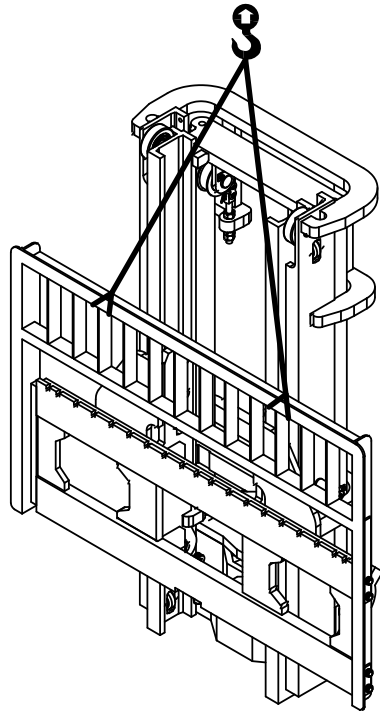
2) Tilt forward and lower the forks until the forks are out of the fork carriage and back up the vehicle.

### WARNING

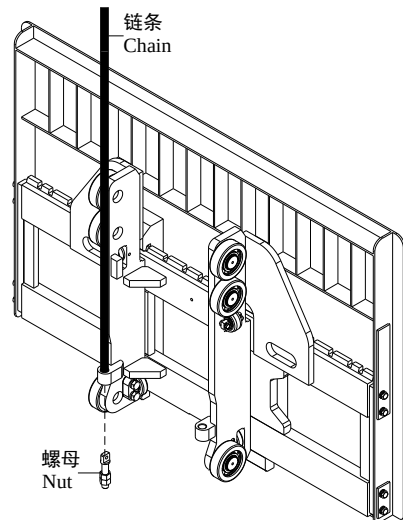


- Keep the hands and feet off the forks. Watch out when dismantling the forks. Do not put hands or feet under the forks or between the fork and carriage.
- Do not remove the forks from the top of the forks. Prevent any damage caused by fork falling.

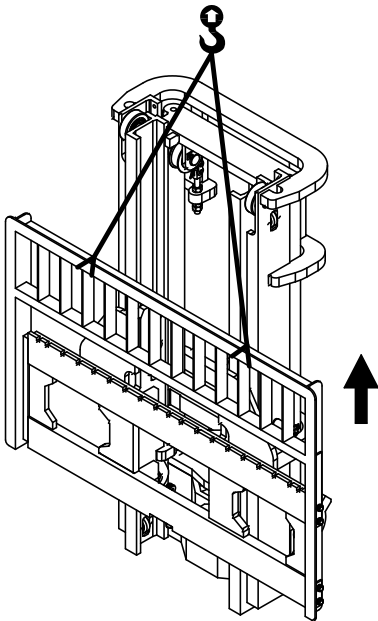
3) Tie up the fork carriage assy with steel wire and crane it with lifting equipment.



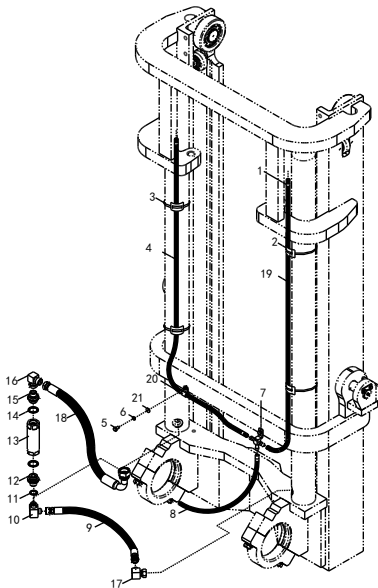
4) Screw out the nuts on ends of the chain and dismantle the chain from the fork carriage assy.



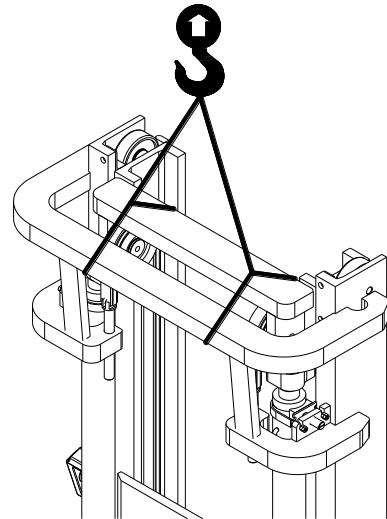
5) Dismount the fork carriage assembly from the inner mast.



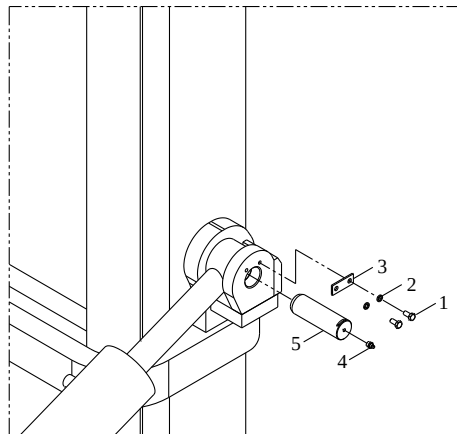
6) Remove the lifting pressure tube 18, 9 and the low pressure oil return tube 19, 8.



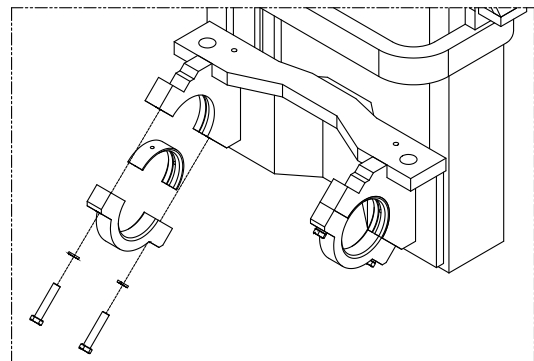
7) Lift the inner and outer masts with steel wire.



8) Remove bolts 1, washers 2, stop plates 3 from the left and right brackets on the outer mast and pull out pin 5 and oil cup 4.



9) Screw out the bolts on the bearing cover of the outer mast.



10) Lift out the inner and outer mast assembly.

11) Following the reverse sequences of disassembly to install the mast.

#### 6.4.2 Spare parts disassembly

##### WARNING



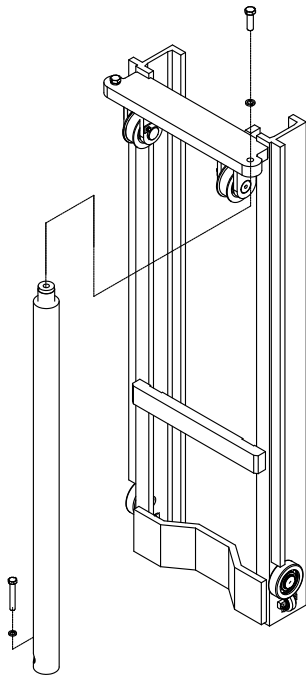
---

Be careful when disassembling the mast as it is quite heavy.

---

##### 6.4.2.1 Disassemble the lifting cylinder

1) Place the mast flat on the ground. Screw out the bolts on the piston rod of lifting cylinder and the fastening screws.



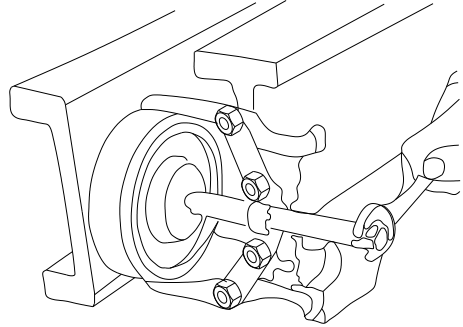
2) Slide the inner mast and disassemble the lifting cylinder.

##### 6.4.2.2 Take out the rollers

1) Stretch out the inner mast from the bottom. Take out the main rollers and the small

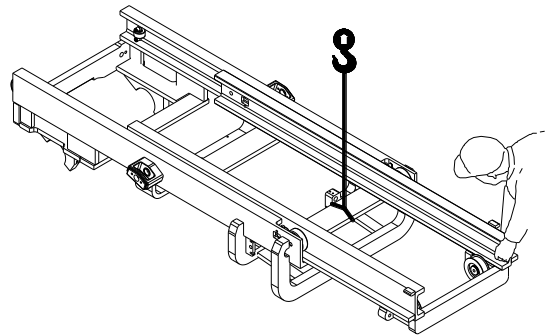
lateral rollers.

2) If there is no bearing puller, unclench the rollers carefully. (even unclenching power for all directions). Otherwise, the rollers would be damaged.



##### 6.4.2.3 Disassemble the inner mast

Tie up the inner mast with steel wire. Slide out the inner mast with a lifting equipment.



##### Inspection

1) Check for damage of the roller and roller holder and other involved parts

2) Replace the damaged parts as necessary.

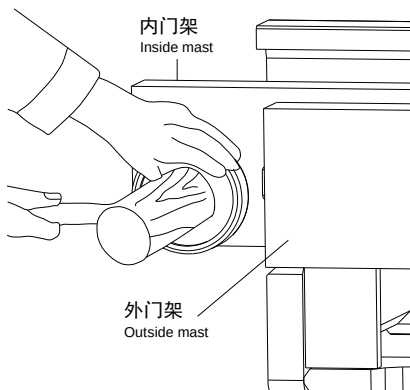
## 6.4.3 Assembly and adjustment

### WARNING



Be careful when assembling as the inner and outer masts are quite heavy.

Install the inner mast into the outer mast and mount the roller securely.



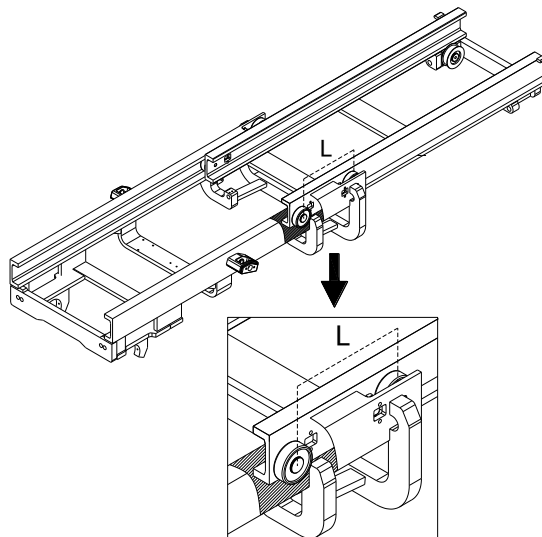
### 6.4.3.1 Adjust the clearance between the roller and mast channel

1) Name the distance between the rollers on inner mast and outer mast as L. And adjust as follow.

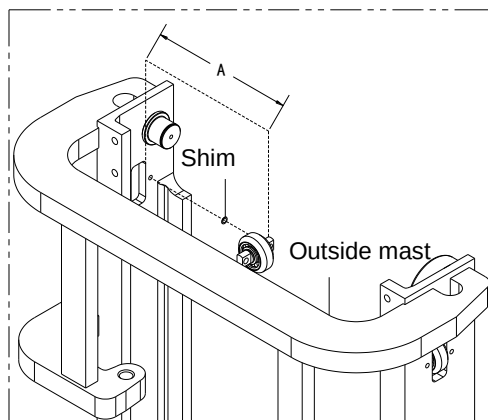
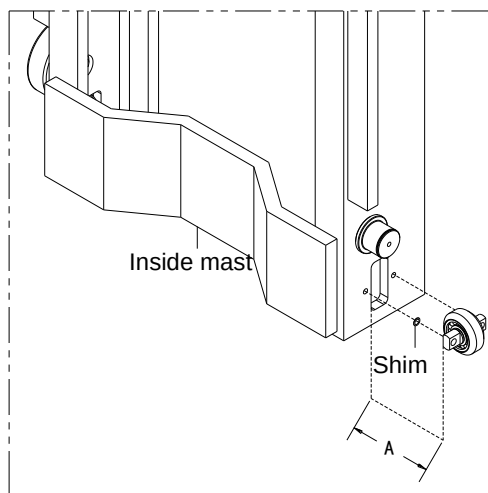
“L” dimension

Unit: mm

| Truck model<br>or tonnage<br>Max lifting<br>height mm | III<br>Class<br>3t | II Class<br>2~2.5t |
|-------------------------------------------------------|--------------------|--------------------|
| 2500~3300                                             | 368                | 328                |
| 3600                                                  | 388                | 348                |
| 4000                                                  | 418                | 378                |
| 4500                                                  | 443                | 403                |



- 2) Adjust the clearance A of left and right side evenly with a thin washer and make it to 0.5mm~1.2mm.



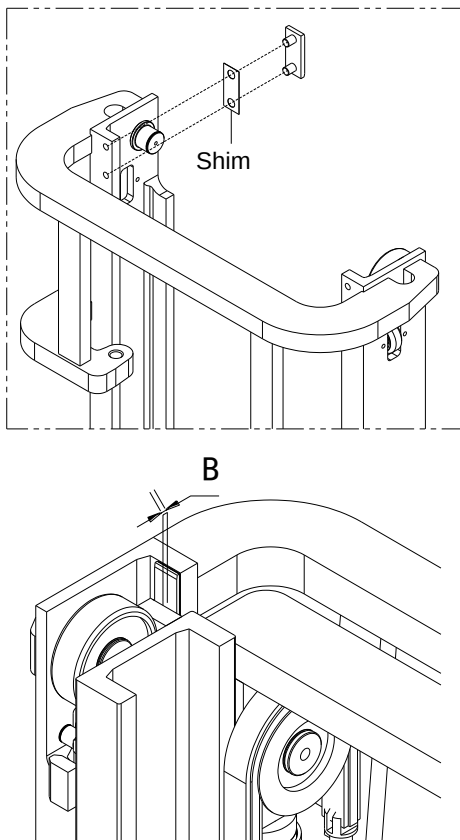
- 3) Keep the clearance of rolling channel flange within 0.8mm~1mm. Do not adjust the

clearance. If it is over worn, replace the rollers.

4) Smear some lubricating grease on the connecting surfaces of inner and outer mast and also on the rollers and channel rail. But in some areas with strong wind and sand, carefully decide whether to smear grease or not. Avoid the sand sticking on the surfaces.

#### 6.4.3.2 Clearance between the guide plate and mast channel

Adjust the clearance B between guide plate and inner mast column with a thin washer and make it within 0.5mm~1mm. Thin washer might not be wanted as necessary. The thickness of the washer should be around 0.2mm.



Smear a layer of lubricating grease on the guide plate and assemble the mast and lifting cylinder on the forklift truck. Connect the oil return tube and the high pressure tube.

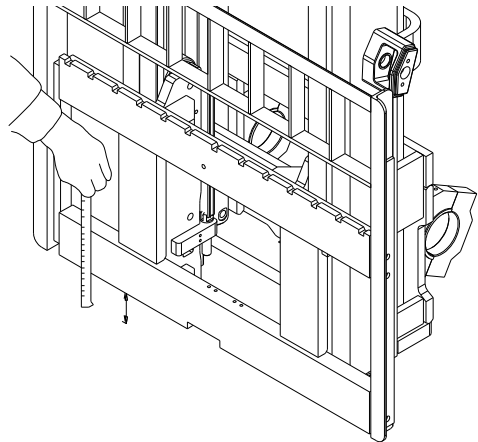
#### 6.4.4 Assemble the left and right cylinders and adjust the cylinder position

1) Install the left and right cylinders into the mast. Insert the locating pin to the location hole which is on the bottom beam of the outer mast.

2) Set the upper end of the piston rod into the cylinder holder of the inner mast. Make all directions evenly positioned. If there is height difference on left and right sides, apply a washer between the cylinder holder hole and the upper end of the piston rod and adjust.

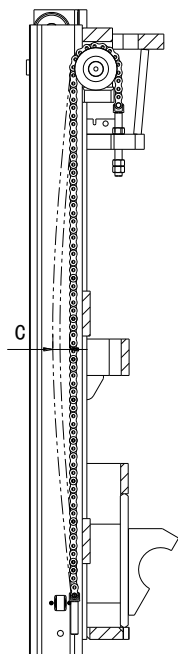
#### 6.4.5 Adjust the lifting chain

Install the fork carriage into the inner mast and mount the chain. Screw two bolts on each side of the chain. Make the mast in a vertical direction and lower down to the end. Adjust the nuts on the bottom of the chain and make the lower end of the fork carriage is about 74mm off the ground.



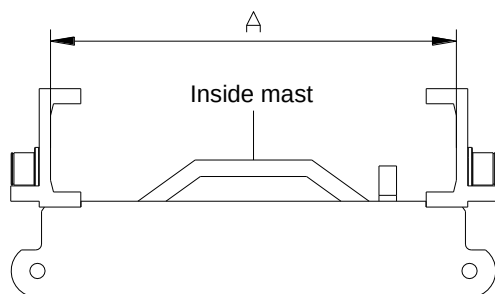
In order to adjust the tension of the chain, lower the lifting cylinder until the forks are on the ground. Adjust the chain nut (three nuts at each end) till length of C reaches to the rated value when the finger presses the central part of chain.

The length of "C" is around 25mm~30mm.



#### 6.4.6 Adjust the clearance of rollers on the fork carriage assy

1) Measure the distance **A** between the two channels of the inner mast. Collect the value on the top, central part, central beam of the inner mast and the bottom respectively.

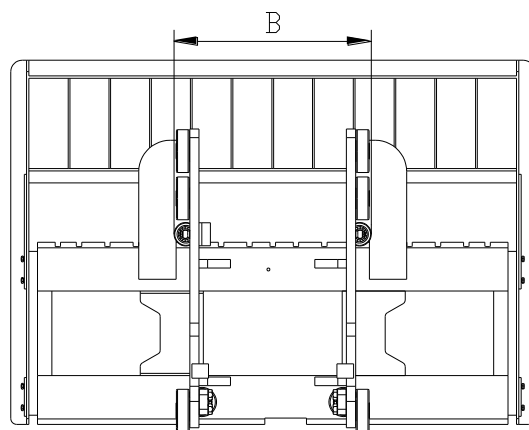


2) Measure the left and right spacing "**B**" of the side rollers of the fork carriage.

3) Calculate the difference values between **A** and **B**, and the difference value is the clearance between the roller and inner mast channel.

Evenly adjust the washers of each side roller on left and right. Make the clearance between the smallest part of the inner mast channel and the fork carriage side roller distance 0.2mm~1mm.

Clearance:  $A-B = 0.2 \text{ mm} \sim 1 \text{ mm}$



Thin adjusting washer: 0.5mm、1mm。

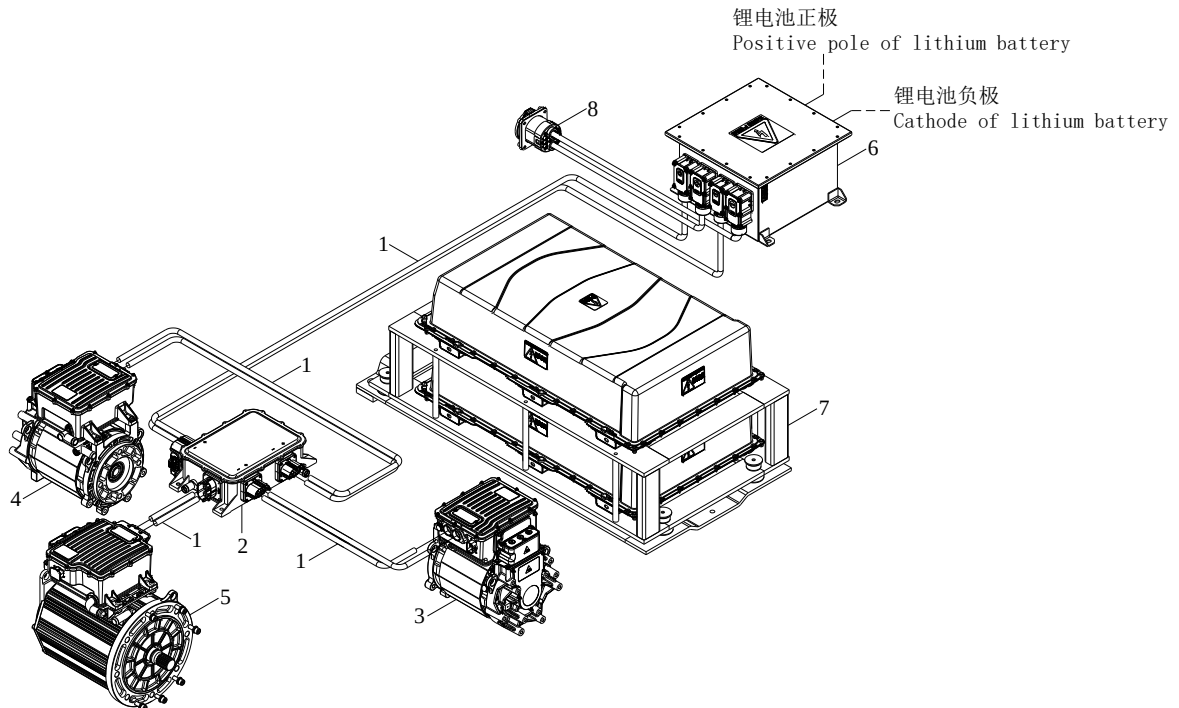
**CAUTION!**

- a) Use equal quantity of washers on left and right sides.
- b) After the clearance is set. Slide the fork carriage on the inner mast upward and downward. Check if it is smoothly operated.

## 7、Electrical system

The high-voltage electric forklift has a maximum DC voltage of 317V, which provides relatively large electric energy during operation. The connecting wires of the high voltage part are orange, and there are warning signs on the high voltage parts.

The high-voltage components of the truck are lithium battery, two-in-one traction motor electric control, two-in-one oil-motor electric control, two-in-one power supply, national standard charging base, junction box, water-cooled unit and high-voltage cables. The location of the high-voltage components is shown in the figure below.



- 1-High voltage cable   2-Two-in-one power supply   3-Two-in-one main oil pump motor electric control   4-Two-in-one slave oil pump motor electric control  
5-Two-in-one traction motor and electric control   6-Junction box   7-Lithium battery  
8-National standard charging base

Fig. 7-1 High voltage component layout

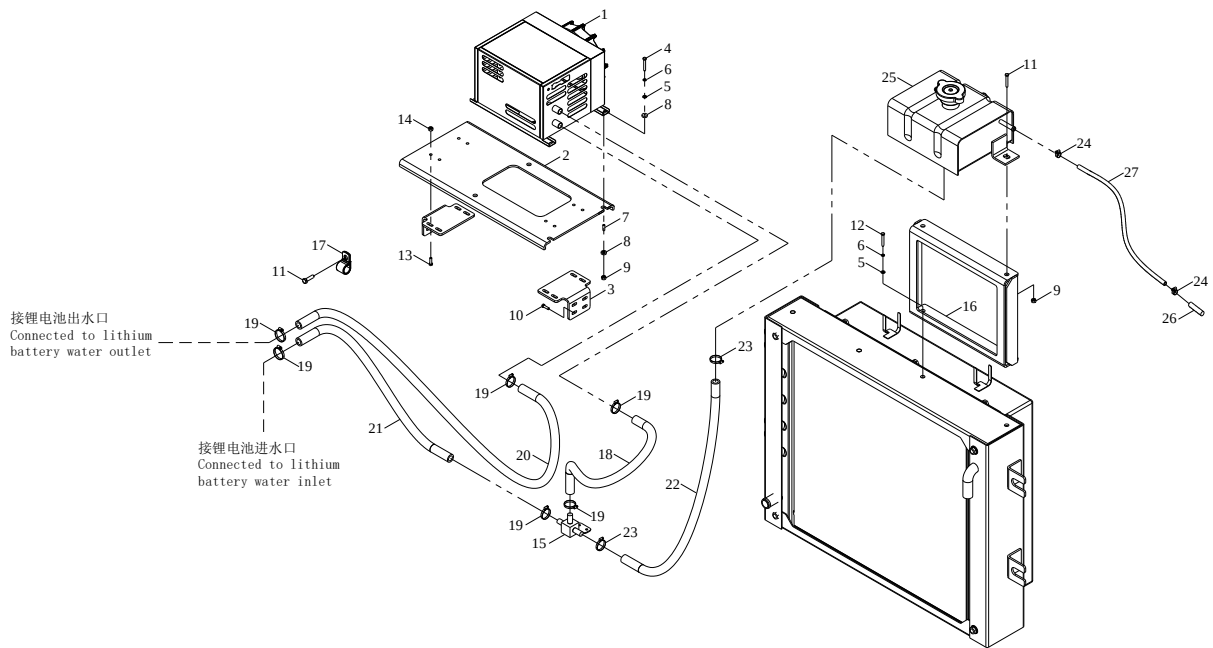


Fig. 7-2 Water-cooled unit 1

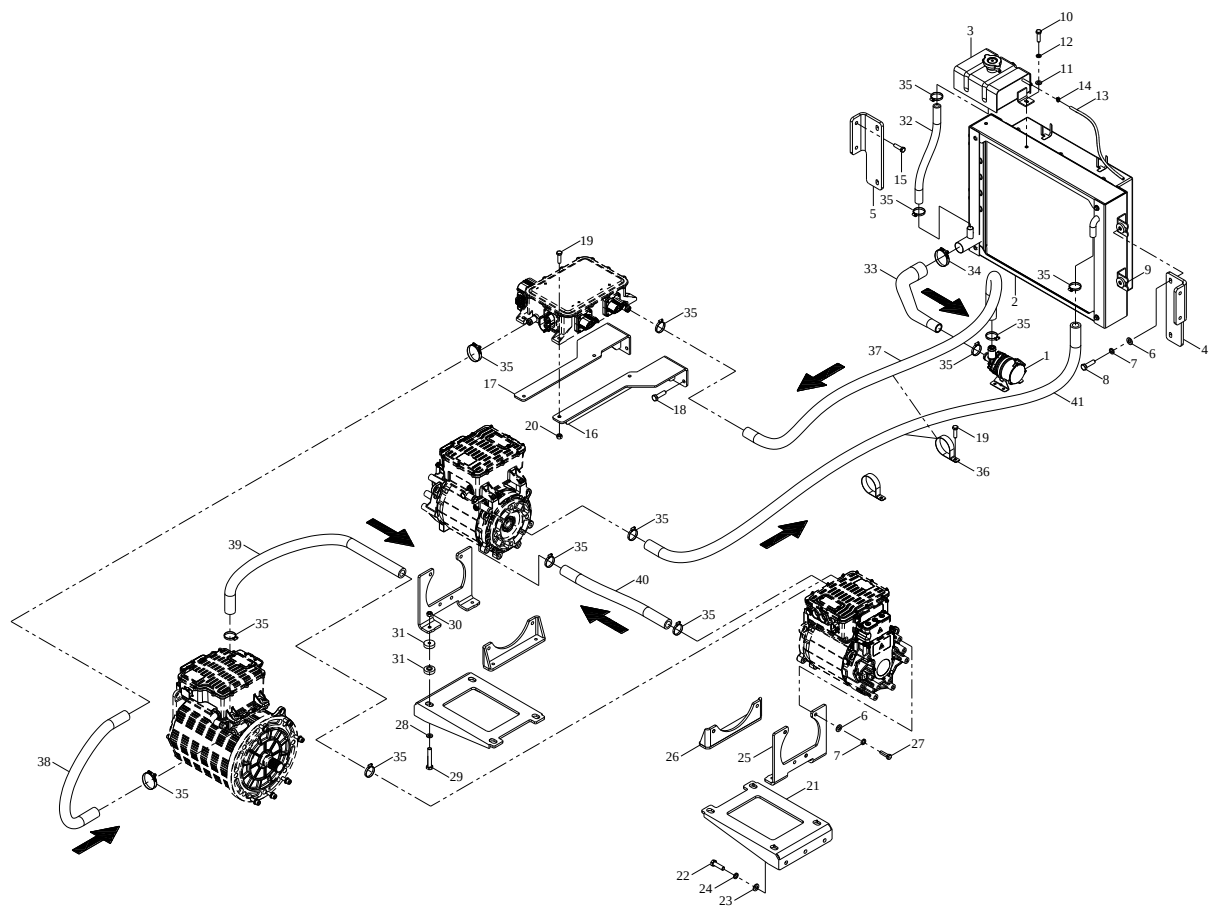


Fig. 7-3 Water-cooled unit 2

---

## WARNING



- 
- a) The parts involving high voltage are maintained by trained professional after-sales personnel.
  - b) Before performing any electrical repairs, The MSD service switch must be confirmed and turned off.
  - c) Before inspecting any electric components, put away conductive items such as jewelry and bracelet in case of shorten circuit, and turn off the start switch and disconnect the earth wire.
  - d) Make sure that the battery was disconnected before applying any electric maintenance.
- 

### 7.1 Special safety rules for high-voltage electric forklift

**The safety precautions and safety operating procedures related to high voltage constitute extremely important safety rules. And you and relevant personnel read the following again:**

- Safety precautions for high voltage;
- Safe operating procedures.

## WARNING



---

The inspection and maintenance of high-voltage parts shall be subject to special training on high-voltage electrical knowledge and obtain corresponding certificates. The inspection and maintenance of lithium batteries must be completed by professional manufacturers.

---

1.The high-voltage electric forklift has a maximum DC voltage of 309V, which provides relatively large electric energy during operation. The connecting wires of the high voltage part are orange, and there are warning signs on the high voltage parts.

Do not touch the high-voltage components at will, otherwise there is a danger of personal injury or death due to electric shock. For high-voltage components, see the front or the electrical part of the maintenance manual.

2.Inspection or maintenance personnel should wear insulating shoes; wear 1000V insulated gloves to check whether the gloves are damaged or aging, otherwise they must not be used. It is forbidden to directly contact the high voltage part without wearing gloves.



3. Dry insulating pads should be laid on the lower part of the truck body and the standing parts of maintenance personnel.



4. Place a warning triangle "Danger of touching during high-voltage operation".

5. Inspection and maintenance personnel are not allowed to carry or wear metal objects.

6. First confirm that there is no water (water accumulation, water droplets) in the ground and vehicle body. It is not allowed to work in a humid environment. Never perform high-voltage work when hands are wet, and do not work with wet high voltage parts. When the ground or surrounding humidity is too high, the operation should be stopped.

7. Dry powder fire extinguishers should be installed in the work area. Do not use other fire extinguishers.

8. Prepare the necessary maintenance tools, and the maintenance tools are insulated.

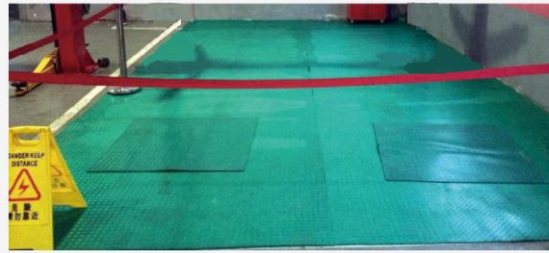


9. Before performing any maintenance, cut off the power supply of the high-voltage system, unplug the MSD maintenance switch from the junction box and wait 15~20 minutes for the high voltage system to be powered off.





10. Before maintenance work, please take safety isolation measures (use the warning fence to isolate), and place high-voltage warning signs to warn relevant personnel and avoid safety accidents.



11. Before repairing high-voltage components, connect the body with the ground wire to the ground wire of the dedicated repair station for the electric forklift.

12. High-voltage components and storage batteries are carried out by Hangcha or authorized institutions and personnel with special training (different from ordinary forklift training).

13. When repairing high-voltage battery packs with electrolyte leakage, you must wear protective glasses to prevent electrolyte from splashing into your eyes.

14. Before turning on the key switch of the vehicle, pay attention to confirm whether there are people performing high-voltage maintenance operations to avoid accidents.

15. When examining and repairing the high-voltage wiring harness, any removed high-voltage wiring should be immediately wrapped and insulated with green tape.

16. Do not touch the live parts of the high-voltage wiring harness connector with your fingers to avoid electric shock. In addition, prevent small metal tools or iron bars from contacting the live parts of the connector.

17. In the event of an abnormal accident or fire, the operator should immediately cut off the high-voltage circuit, and other personnel should immediately use a fire extinguisher to fight the fire (use dry powder fire extinguishers, water-based fire extinguishers are strictly prohibited).

18. When the battery leaks electrolyte, do not touch it with your hands. The electrolyte needs to be diluted with calcium gluconate ointment, not with water.

19. Pay attention to the colors or markings used for high-voltage components and area prompts during operation.

20. It is forbidden to get hands, truck body, parts, or environment wet, otherwise no operation is allowed.

21. It is forbidden to park the vehicle in rain or damp environment.

## 7.2 Electric drive system

### 7.2.1 Overview

The electric drive system consists of drive motor, motor controller and vehicle controller, and is optimized and matched according to the performance indicators of the vehicle to ensure that the power and economy of the vehicle meet the requirements. The traveling motor model is a permanent magnet synchronous motor 6t-7t : TZ220XS45kW309VT 、 8t-10t : TZ220XS54.5kW309VT, with rated voltage of 309 (VDC), rated power of 6t-7t: 45(kW)、 8t-10t: 54.5(kW);Traction motor controller model is MC3906, its rated voltage is 309V (DC), the continuous working current is 180 (A); the vehicle controller model is HCDN67VCU-42C, its operating voltage is 9~16 (V).

### 7.2.2 Controller fault code

#### **BMS related monitoring information and fault codes.**

| Fault code | Fault description                     | Possible Cause (Remarks) |
|------------|---------------------------------------|--------------------------|
| E1:01      | Discharge temperature difference high | /                        |
| E1:02      | Discharge overtemp                    | /                        |
| E1:03      | Discharge severe overtemp             | /                        |
| E1:04      | Discharge temperature low             | /                        |
| E1:05      | Discharge temperature severe low      | /                        |
| E1:06      | Discharge cell voltage high           | /                        |
| E1:07      | Discharge cell voltage severe high    | /                        |
| E1:08      | Regen current high                    | /                        |
| E1:09      | Discharge current high                | /                        |
| E1:10      | Discharge current severe high         | /                        |
| E1:11      | Discharge cell voltage low            | /                        |
| E1:12      | Discharge cell voltage severe low     | /                        |
| E1:13      | Battery voltage high                  | /                        |
| E1:14      | Battery voltage severe high           | /                        |
| E1:15      | Battery voltage low                   | /                        |
| E1:16      | Battery voltage severe low            | /                        |
| E1:17      | Cell voltage difference high          | /                        |
| E1:18      | SOC low                               | /                        |
| E1:19      | Charge positive contactor welded      | /                        |
| E1:20      | Discharge positive contactor welded   | /                        |
| E1:21      | Discharge negative contactor welded   | /                        |
| E1:22      | High voltage interlock fault          | /                        |

|       |                                         |                                                  |
|-------|-----------------------------------------|--------------------------------------------------|
| E1:23 | Communication fault                     | /                                                |
| E1:24 | Charge heat contactor fault             | /                                                |
| E1:25 | Discharge heat contactor fault          | /                                                |
| E1:26 | Voltage cable falls off                 | /                                                |
| E1:27 | Temperature cable falls off             | /                                                |
| E1:28 | Current cable falls off                 | /                                                |
| E1:29 | Inner communication fault               | /                                                |
| E1:30 | Insulation fault                        | /                                                |
| E1:31 | Charge overtemp                         | /                                                |
| E1:32 | Charge temperature low                  | /                                                |
| E1:33 | Charge overcurrent                      | /                                                |
| E1:34 | Charge temperature difference high      | /                                                |
| E1:35 | Charge voltage difference high          | /                                                |
| E1:36 | Charge cell voltage low                 | /                                                |
| E1:37 | Charge cell voltage high                | /                                                |
| E1:38 | Charge socket overtemp                  | /                                                |
| E1:39 | Charge socket severe overtemp           | /                                                |
| E1:40 | Supply voltage unusual                  | /                                                |
| E1:41 | Heating: remaining X minutes            | With this interface, press any key for 6 seconds |
| E1:42 | Battery low can not heat: please charge | With this interface, press any key for 6 seconds |

## DC-DC related monitoring information and fault codes

| Fault code | Fault description        | Problem solving methods                                                                                                                                                                                                       |
|------------|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| E2:01      | DCDC overtemp            | 1. Check the cooling water channel and remove faults (water pump, water channel, fan, water level, line, etc.); 2. Avoid the long-term overload state of driving DCDC; 3. After the system drops down, it is powered on again |
| E2:02      | DCDC severe overtemp     | 1、 Check the wiring harness and plug-in;<br>2、 Power on again;<br>3、 If the fault is still reported after multiple restarts, the controller needs to be replaced;                                                             |
| E2:03      | DCDC input voltage low   | 1、 Check whether the battery system is under-voltage, if under-voltage, use it after charging;<br>2、 Power on again;<br>3、 If the fault is still reported after multiple restarts, the controller needs to be replaced;       |
| E2:04      | DCDC input voltage high  | 1、 Check whether the battery system is over-voltage, if it is over-voltage, use it after charging;<br>2、 Power on again;<br>3、 If the fault is still reported after multiple restarts, the controller needs to be replaced;   |
| E2:05      | DCDC output voltage low  | 1、 Check whether the battery system is under-voltage, if under-voltage, use it after charging;<br>2、 Power on again;<br>3、 If the fault is still reported after multiple restarts, the controller needs to be replaced;       |
| E2:06      | DCDC output voltage high | 1、 Check whether the battery is over-voltage, if it is over-voltage, use it after maintenance;<br>2、 Power on again;<br>3、 If the fault is still reported after multiple restarts, the controller needs to be replaced;       |
| E2:07      | DCDC output current high | 1、 Power on again;<br>2、 If the fault is still reported after multiple restarts, the controller needs to be replaced;                                                                                                         |
| E2:08      | DCDC output power over   |                                                                                                                                                                                                                               |
| E2:09      | DCDC hardware fault      |                                                                                                                                                                                                                               |
| E2:10      | 12V supply fault         | 1、 Check whether the battery system is over-voltage or under-voltage, if it is over-voltage or under-voltage, use it after maintenance is normal;<br>2、 Power on again;<br>3、 If the fault is still reported after multiple   |

|       |                                  |                                                                                                                                                                   |
|-------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       |                                  | restarts, the controller needs to be replaced                                                                                                                     |
| E2:11 | DCDC awake up missing fault      | 1、 Check the hard-wire wake-up or NW wake-up line;<br>2、 Power on again;                                                                                          |
| E2:12 | CAN Busoff                       | 1、 Check the wiring harness and plug-in;<br>2、 Power on again;<br>3、 If the fault is still reported after multiple restarts, the controller needs to be replaced; |
| E2:13 | Communication with VCU Timeout   |                                                                                                                                                                   |
| E2:14 | DCDC output hardware overvoltage | 1、 Power on again;<br>2、 If the fault is still reported after multiple restarts, the controller needs to be replaced;                                             |
| E2:15 | DCDC output hardware open        | 1、 Check whether the battery system is under-voltage, if under-voltage, use it after charging;<br>2、 Power on again;                                              |
| E2:16 | DCDC output hardware short       | 1、 Check the wiring harness and plug-in;<br>2、 Power on again;<br>3、 If the fault is still reported after multiple restarts, the controller needs to be replaced; |

## Traction fault code

| Fault code | Fault description               | Problem solving methods                                                                                                                                                                                                                                                                                                                          |
|------------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| E3:02      | Igbt error failing              | 1、Power on again;                                                                                                                                                                                                                                                                                                                                |
| E3: 03     | Current sensor zero shift error | 2、If the fault is still reported after multiple restarts, the controller needs to be replaced;                                                                                                                                                                                                                                                   |
| E3:04      | MCU undervoltage fault          | 1、Check whether the battery system is over-voltage, if it is over-voltage, please do the battery maintenance before use;                                                                                                                                                                                                                         |
| E3:05      | MCU overvoltage fault           | 2、Power on again;<br>3、Non-battery system problem, the fault is still reported after multiple restarts, the controller needs to be replaced                                                                                                                                                                                                      |
| E3:07      | Resolver fault                  | 1、Power on again;;                                                                                                                                                                                                                                                                                                                               |
| E3:08      | Current sampling circuit fault  | 2、If the fault is still reported after multiple restarts, the controller needs to be replaced;                                                                                                                                                                                                                                                   |
| E3:09      | Hardware overcurrent            |                                                                                                                                                                                                                                                                                                                                                  |
| E3:10      | MCU overtemp fault              | 1 、 Check the heat dissipation waterway and troubleshoot (the working status of the water pump, waterway, fan, water level, wiring, etc.);<br>2、Avoid long-term overload conditions of the drive motor system (including long-term climbing and frequent acceleration and deceleration, etc.);<br>3、After the system cools down, power on again. |
| E3:11      | Motor overtemp fault            | 1 、 Check the heat dissipation waterway and troubleshoot (the working status of the water pump, waterway, fan, water level, wiring, etc.);<br>2、Avoid long-term overload conditions of the drive motor system (including long-term climbing and frequent acceleration and deceleration, etc.);<br>3、After the system cools down, power on again. |
| E3:12      | Software overcurrent            | 1、Power on again;                                                                                                                                                                                                                                                                                                                                |
| E3:13      | Motor overspeed                 |                                                                                                                                                                                                                                                                                                                                                  |
| E3:14      | Motor stall                     |                                                                                                                                                                                                                                                                                                                                                  |

|       |                          |                                                                                                                                                                                                                                                                                                                                                |
|-------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| E3:15 | Torque check error       | 1、Check the wiring harness and plug-in;<br>2、Power on again;                                                                                                                                                                                                                                                                                   |
| E3:45 | MCU undervoltage warning |                                                                                                                                                                                                                                                                                                                                                |
| E3:46 | MCU overvoltage warning  | 3、If the fault is still reported after multiple restarts, the controller needs to be replaced;                                                                                                                                                                                                                                                 |
| E3:47 | MCU overtemp warning     | 1、Check the heat dissipation waterway and troubleshoot (the working status of the water pump, waterway, fan, water level, wiring, etc.);<br>2、Avoid long-term overload conditions of the drive motor system (including long-term climbing and frequent acceleration and deceleration, etc.);<br>3、After the system cools down, power on again. |
| E3:48 | Motor overtemp warning   |                                                                                                                                                                                                                                                                                                                                                |

## Main oil pump fault code

| Fault code | Fault description               | Problem solving methods                                                                                                                                                                                                                                                                                                                        |
|------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| E4:02      | Igbt error failing              | 1、Power on again;                                                                                                                                                                                                                                                                                                                              |
| E4:03      | Current sensor zero shift error | 2、If the fault is still reported after multiple restarts, the controller needs to be replaced;                                                                                                                                                                                                                                                 |
| E4:04      | MCU undervoltage fault          | 1、Check whether the battery system is over-voltage, if it is over-voltage, please do the battery maintenance before use;                                                                                                                                                                                                                       |
| E4:05      | MCU overvoltage fault           | 2、Power on again;<br>3、Non-battery system problem, the fault is still reported after multiple restarts, the controller needs to be replaced                                                                                                                                                                                                    |
| E4:07      | Resolver fault                  | 1、Power on again;                                                                                                                                                                                                                                                                                                                              |
| E4:08      | Current sampling circuit fault  | 2、If the fault is still reported after multiple restarts, the controller needs to be replaced;                                                                                                                                                                                                                                                 |
| E4:09      | Hardware overcurrent            | 2、If the fault is still reported after multiple restarts, the controller needs to be replaced;                                                                                                                                                                                                                                                 |
| E4:10      | MCU overtemp fault              | 1、Check the heat dissipation waterway and troubleshoot (the working status of the water pump, waterway, fan, water level, wiring, etc.);<br>2、Avoid long-term overload conditions of the drive motor system (including long-term climbing and frequent acceleration and deceleration, etc.);<br>3、After the system cools down, power on again. |
| E4:11      | Motor overtemp fault            | 1、Check the heat dissipation waterway and troubleshoot (the working status of the water pump, waterway, fan, water level, wiring, etc.);<br>2、Avoid long-term overload conditions of the drive motor system (including long-term climbing and frequent acceleration and deceleration, etc.);<br>3、After the system cools down, power on again. |
| E4:12      | Software overcurrent            | 1、Power on again;                                                                                                                                                                                                                                                                                                                              |
| E4:13      | Motor overspeed                 |                                                                                                                                                                                                                                                                                                                                                |
| E4:14      | Motor stall                     |                                                                                                                                                                                                                                                                                                                                                |

|       |                                |                                                                                                                                                                                                                                                                                                                                                |
|-------|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| E4:15 | Torque check error             | 1、Check the wiring harness and plug-in;<br>2、Power on again;<br>3、If the fault is still reported after multiple restarts, the controller needs to be replaced;                                                                                                                                                                                 |
| E4:16 | Motor temperature sensor error |                                                                                                                                                                                                                                                                                                                                                |
| E4:17 | MCU temperature sensor error   |                                                                                                                                                                                                                                                                                                                                                |
| E4:45 | MCU undervoltage warning       | 1、Check whether the battery system is over-voltage, if it is over-voltage, please do the battery maintenance before use;<br>2、Power on again;<br>3、Non-battery system problem, the fault is still reported after multiple restarts, the controller needs to be replaced                                                                        |
| E4:46 | MCU overvoltage warning        |                                                                                                                                                                                                                                                                                                                                                |
| E4:47 | MCU overtemp warning           | 1、Check the heat dissipation waterway and troubleshoot (the working status of the water pump, waterway, fan, water level, wiring, etc.);<br>2、Avoid long-term overload conditions of the drive motor system (including long-term climbing and frequent acceleration and deceleration, etc.);<br>3、After the system cools down, power on again. |
| E4:48 | Motor overtemp warning         |                                                                                                                                                                                                                                                                                                                                                |

---

### Slave oil pump fault code

| Fault code | Fault description               | Remarks |
|------------|---------------------------------|---------|
| E6:02      | Igbt error failing              |         |
| E6:03      | Current sensor zero shift error |         |
| E6:04      | MCU undervoltage fault          |         |
| E6:05      | MCU overvoltage fault           |         |
| E6:07      | Resolver fault                  |         |
| E6:08      | Current sampling circuit fault  |         |
| E6:09      | Hardware overcurrent            |         |
| E6:10      | MCU overtemp fault              |         |
| E6:11      | Motor overtemp fault            |         |
| E6:12      | Software overcurrent            |         |
| E6:13      | Motor overspeed                 |         |
| E6:14      | Motor stall                     |         |
| E6:15      | Torque check error              |         |
| E6:16      | Motor temperature sensor error  |         |
| E6:17      | MCU temperature sensor error    |         |
| E6:18      | Bus off error                   |         |
| E6:19      | I2C check error                 |         |
| E6:45      | MCU undervoltage warning        |         |
| E6:46      | MCU overvoltage warning         |         |
| E6:47      | MCU overvoltage warning         |         |
| E6:48      | Motor overtemp warning          |         |

## VCU related monitoring information and fault codes

| Fault code | Fault description                                  | Problem solving methods                                                                                                     |
|------------|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| E5:101     | Communication with DCDC fault                      | 1、Harness problem;<br>2、Low-voltage power supply problem;<br>3、Vehicle controller failure;<br>4、Communication interference. |
| E5:102     | Communication with instrument fault                | 1、Harness problem;<br>2、Meter failure<br>3、CAN communication interference in the meter                                      |
| E5:103     | Communication with BMS fault                       | 1、Harness problem;<br>2、BMS failure<br>3、Vehicle controller failure;<br>4、Communication interference                        |
| E5:104     | Communication with Travel MCU fault                | 1、Harness problem.<br>2、MCU (traction) failure;<br>3、Vehicle controller failure;<br>4、Communication interference            |
| E5:105     | Communication with main pump MCU fault             | 1、Harness problem.<br>2、MCU (Main oil pump) failure;<br>3、Vehicle controller failure;<br>4、Communication interference       |
| E5:106     | Communication with auxiliary pump MCU fault        | 1、Harness problem.<br>2、MCU (Slave oil pump) failure;<br>3、Vehicle controller failure;<br>4、Communication interference      |
| E5:110     | Communication with BMS fault severe                | 1、Harness problem.<br>2、BMS failure<br>3、Vehicle controller failure;<br>4、Communication interference                        |
| E5:111     | Communication with Travel MCU fault severe         | 1、Harness problem.<br>2、MCU (traction) failure;<br>3、Vehicle controller failure;<br>4、Communication interference            |
| E5:112     | Communication with main pump MCU fault severe      | 1、Harness problem.<br>2、MCU (Main oil pump) failure;<br>3、Vehicle controller failure;<br>4、Communication interference       |
| E5:113     | Communication with auxiliary pump MCU fault severe | 1、Harness problem.<br>2、MCU (Slave oil pump) failure;<br>3、Vehicle controller failure;<br>4、Communication interference      |

|        |                                                         |                                                                     |
|--------|---------------------------------------------------------|---------------------------------------------------------------------|
| E5:121 | Forward switch & reverse switch active at the same time | 1、Harness problem.<br>2、Direction switch problem                    |
| E5:122 | Direction switch active before key on                   | 1、Operation sequence problem;<br>2、Direction switch problem         |
| E5:126 | Throttle short or open                                  | 1、Harness problem;<br>2、Controller problem<br>3、Accelerator failure |
| E5:127 | Throttle analog fault                                   | 1、Accelerator failure<br>2、Harness problem                          |
| E5:136 | Acid battery voltage low                                | 1、Battery problem<br>2、PDU problem                                  |
| E5:137 | Acid battery voltage unusual                            | 1、Battery problem<br>2、PDU problem                                  |
| E5:148 | Pump switch active before key on                        | 1、Operation sequence problem;<br>2、Harness problem;                 |
| E5:149 | Accumulator low pressure alarm                          |                                                                     |
| E5:155 | PDU High voltage interlock fault                        |                                                                     |

## 7.3 Safe operation specification

### 7.3.1 Safety precautions before maintenance

1) This battery runs with a maximum DC voltage of about 317V and there is a large current in operation. Its high-voltage connection line is orange and the high-voltage components have warning signs. The maintenance personnel must obtain the authorization of Hangcha Group; they must have the national special occupation certificate. In addition, the maintenance personnel must strictly follow the operating requirements to carry out standardized operations;



Fig 7-1 Warning sign



Fig 7-2 Orange high-voltage connection line

2) Before maintenance work, set up safety isolation area and place high-voltage warning signs to warn relevant personnel and avoid safety accidents.



Fig 7-3 Safety isolation area

3) Before repairing the high-voltage part, you must wear insulating protective equipment as gloves, shoes, goggles, etc.

4) It is strictly forbidden to wear metal decorations such as bracelets and rings during maintenance;

5) Before repairing the high-voltage part, make sure that all interfaces of the vehicle have been disconnected from the high-voltage power supply;

6) Before repairing the high-voltage part, turn off the key switch and remove the MSD maintenance switch, and be sure to disconnect the high-voltage power battery power supply to prevent short circuit

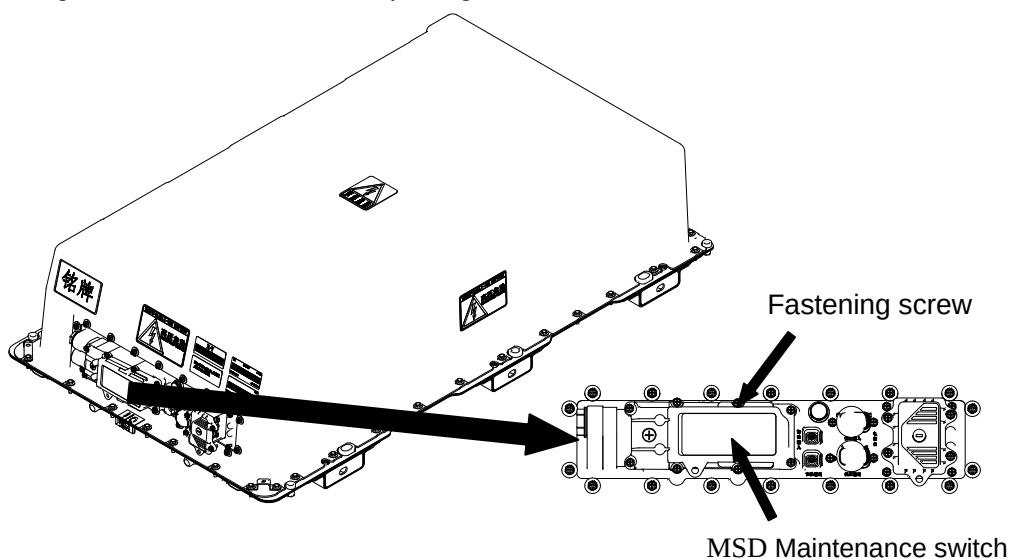


Fig.7-4 MSD maintenance switch

7) The maintenance site should be equipped with fire extinguishing equipment, and the battery pack storage area should be ventilated and dry, and there should be no combustibles around.

### 7.3.2 MSD use: On and Off

1) The MSD maintenance switch is located on the right side of the junction box and on each lithium battery box. The MSD maintenance switch on the right side of the junction box is visible after removing the rear tank cover and opening the front tank cover.



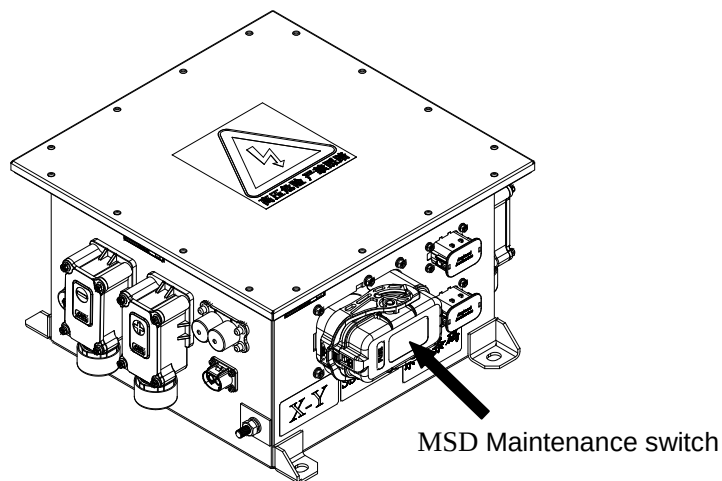


Fig.7-5

2) The maintenance switch (MSD) on the junction box is used to cut off the high voltage circuit, that is, cut off the high voltage between the battery and the whole machine, when the vehicle is maintained, inspected, repaired, or other emergency situations (such as electric shock, rain, flood, etc.) occur, please unplug the switch and wait 15~20 minutes for the high voltage system to power off. The MSD maintenance switch on the lithium battery can be used when replacing the lithium battery or overhauling the lithium battery, just remove 8 fastening screws and pull out the MSD maintenance switch, wait for 15-20 minutes and then the lithium battery will be powered off. The inspection and maintenance of the lithium battery must be done by the professional personnel designated by Hangcha, and other personnel are strictly prohibited to overhaul.

### 3) MSD cut-off steps

The following figure shows the status of the high-voltage MSD maintenance switch mounted on the junction box.

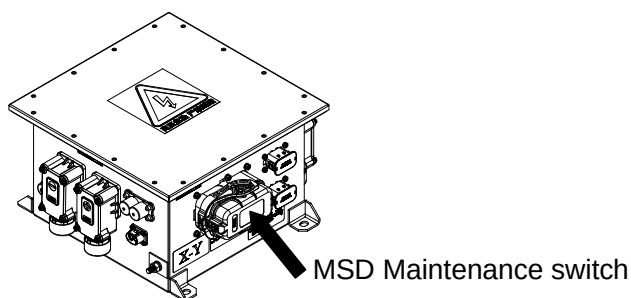


Fig.7-6

a) Pull out the locking terminal of the MSD handle, as shown in the figure below:

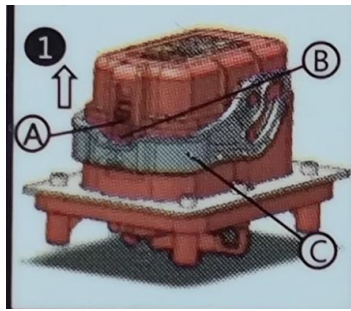


Fig. 7-7

b) Press the MSD buckle B.

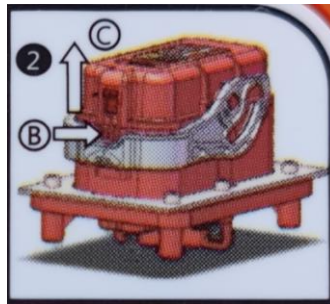


Fig. 7-8

c) Rotate the MSD black handle to the position shown in the figure below.

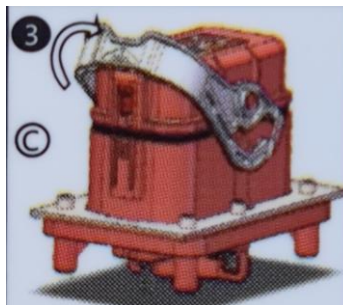


Fig. 7-9

d) Pull out the MSD switch forcefully and wait 15-20 minutes for the high voltage system to be disconnected.



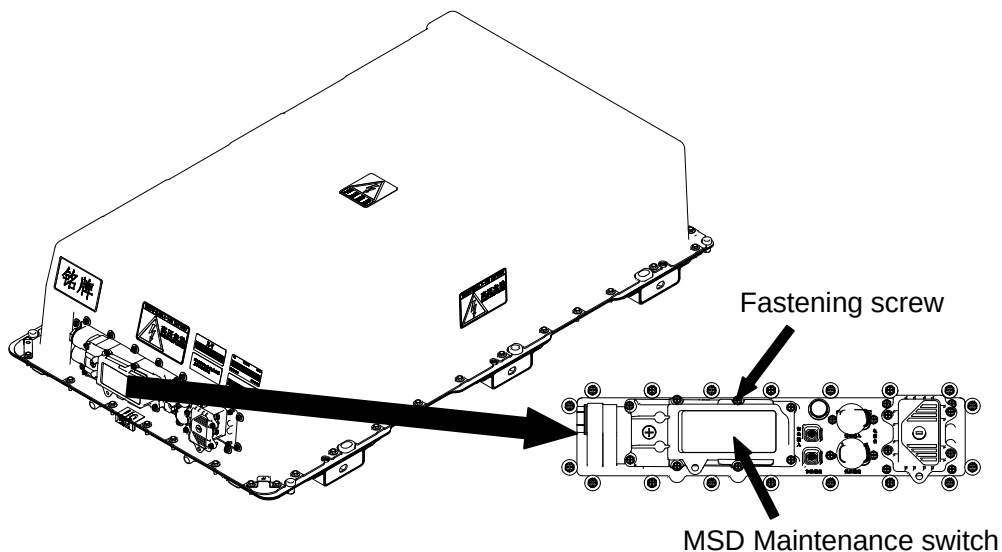
Fig. 7-10



Fig. 7-11

e) MSD installation can be done in sequence according to steps d/c/b/a.

The following figure shows the status of the high-voltage MSD maintenance switch mounted on the battery pack.



To disassemble, wear 1000V insulated gloves and use a 1000V insulated screwdriver to unscrew the fastening screw to pull out the MSD maintenance switch.

### 7.3.3 Safety precautions during maintenance

- 1) Identify the maintenance personnel of the high-voltage system and prevent other irrelevant personnel from touching the battery box during maintenance;
- 2) If the repair cannot be completed in a short time, the “High Voltage Danger” label should be pasted on the high voltage system components when not repairing;
- 3) If it is severely damaged, the power battery is deformed, broken or cracked, and the power battery cannot be touched without wearing insulating protective equipment;
- 4) After disconnecting the high-voltage components, immediately wrap the exposed ports of the copper bars and the exposed ports of the high-voltage components with electrical insulating cloth, and do the insulation treatment;
- 5) Keep the power battery box clean and dry during maintenance. Mark the disassembled parts so that the installation is accurate and correct;
- 6) Be sure to follow the correct steps to disassemble the power battery box, and the disassembled components must be properly kept in a dedicated area;

---

7) It is strictly forbidden to inspect and repair the power battery box when the high-voltage relay is closed to prevent electric shock.

#### 7.3.4 Installation safety precautions

- 1) When installing, strictly follow the order;
- 2) Before connecting the positive and negative output copper bars of the battery, check repeatedly to ensure that it is correct
- 3) The wiring harness connectors and bolts should be checked that they are installed in place, and the bolts should be tightened according to the specified torque and marked with tightening;
- 4) After confirming that all the high and low voltage connectors of the power battery box are connected correctly, then they can be connected and powered on;
- 5) After installation and inspection, connect the diagnostic instrument (host computer) to check whether the parameter information of the battery pack is normal.

#### WARNING



- 
- a) Wear protective equipment and use insulating tools during all disassembly and assembly processes; the MSD maintenance switch must be pulled out before maintenance
  - b) It is forbidden to wear any metal jewelry during the entire battery system maintenance process to avoid accidental short circuit causing personal injury or death;
  - c) It needs to be marked when disassembling, install in order.
- 

#### 7.3.5 First aid for high-voltage accident

##### 1) First aid measures for electric shock accident

When rescuing a person injured in an electrical accident, do not touch anyone who is still in contact with electricity. If possible, power off the electrical system immediately (turn off the key switch or pull out the maintenance switch immediately). Use non-conductive objects (wood strips, bamboo poles, etc.) to separate the rescued person or the conductive body from the discharge body.

When performing first aid after an electric shock accident, if the rescued person does not respond, the following rescue measures should be taken: first confirm that the victim has signs of life, such as pulse and breathing; immediately call the emergency doctor, or immediately ask others to call; perform artificial respiration and cardiopulmonary press until the doctor arrives; if breathing stops, use a defibrillator (if available) for rescue.

If the rescued person can respond to the inquiry, the following first aid measures should be taken: cool down the burn and wrap it with a sterile lint-free cloth; even if the rescued person refuses, he should be required to receive treatment (to avoid long-term sequelae).

##### 2) First aid measures for high-voltage battery accidents

When the high-voltage battery catches fire, please perform the following operations according to the actual situation:

- ① Turn off the key switch, and disconnect the 12V battery when conditions permit;

- 
- ② Disconnect the maintenance switch;
  - ③ Look for fire extinguishers nearby (dry powder fire extinguishers should be used, and water-based fire extinguishers should not be used);
  - ④ If the vehicle catches fire, the fire is small and slow, please use a dry powder fire extinguisher to extinguish the fire, and call for help immediately;  
If the fire is large and develops rapidly, please stay away from the vehicle immediately and call the fire telephone to wait for rescue;
  - ① Turn off the key switch and disconnect the 12V battery when conditions permit;
  - ② Disconnect the maintenance switch;
  - ③ When a small amount of leakage occurs, please stay away from fire, use absorbent cloth to absorb and place in a closed container, or dispose of by incineration. Please wear acid and alkali-proof gloves before operation;
  - ④ When a large amount of leakage occurs, please collect them and treat them in accordance with hazardous chemicals. Add calcium gluconate solution to treat the generated gas;
  - ⑤ When the human body accidentally touches the leaked liquid, rinse immediately with plenty of water (10-15) min. If there is pain, coat with 2.5% calcium gluconate ointment, or soak with 2%-2.5% calcium gluconate solution for pain relief, if there is no improvement or uncomfortable symptoms, please seek medical attention immediately.

## 7.4 Control box assembly

### Fuse disassemble

- 1) Turn key switch to "OFF";
- 2) Press lock buckle on control box, and open the cover;
- 3) Remove fuse from box;

### Explanation

If fuse or relay is broken, replace with new one, the schematic is as follows (see the inside of the forklift control box for details):

- ① If fuse is damaged, be sure to eliminate cause of problem before installing new fuses;
- ② Never use fuse higher than specified rating.

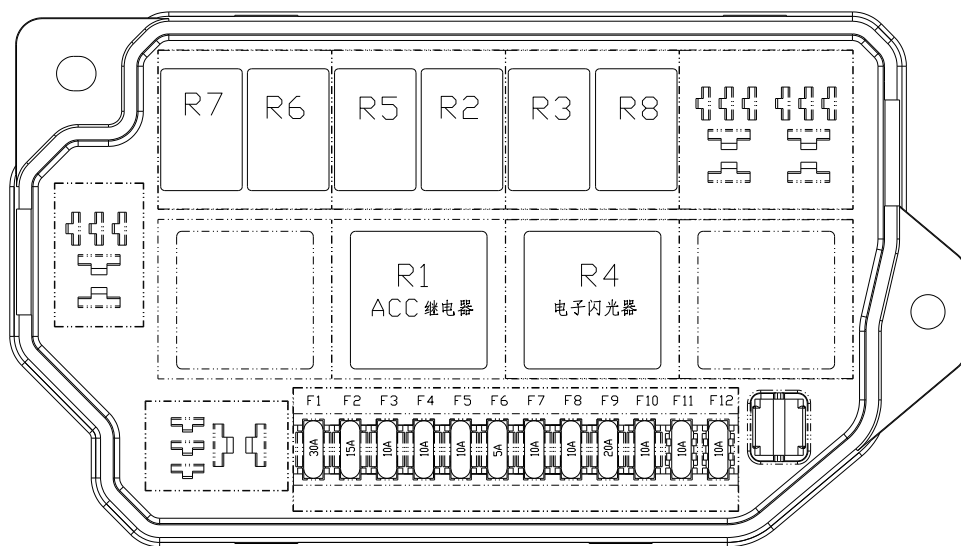


Fig.6-11

### Schematic diagram of control box:

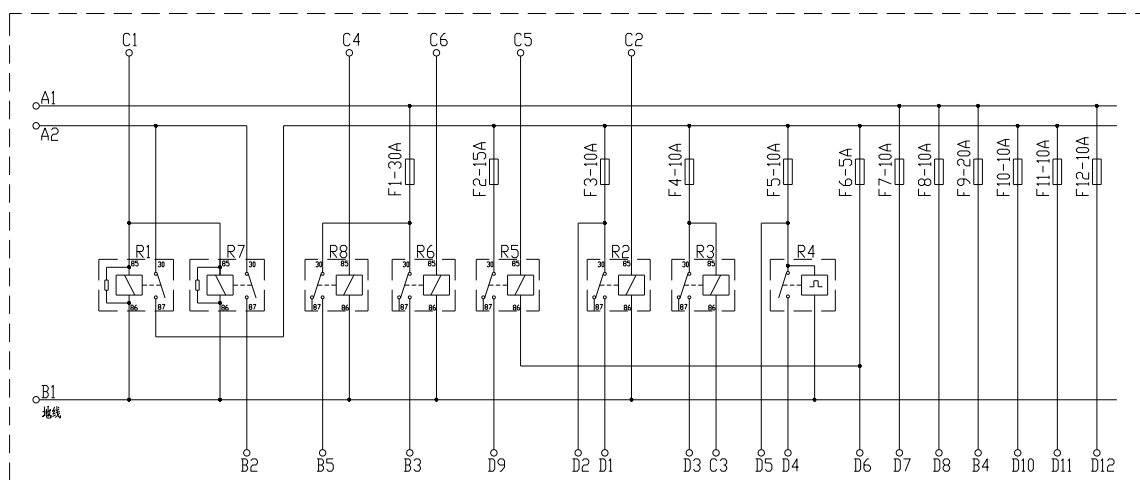


Fig.7-12

## Control box plug pin function details

| NO. | Function definition | NO. | Function definition |
|-----|---------------------|-----|---------------------|
| A1  | B+                  | D1  | R2 (87)             |
| A2  | B+                  | D2  | F3                  |
| B1  | Ground wire         | D3  | R3 (87)             |
| B2  | R7 (87)             | D4  | R4                  |
| B3  | R6 (87)             | D5  | F5                  |
| B4  | F9                  | D6  | F6                  |
| B5  | R8 (87)             | D7  | F7                  |
| C1  | R1 (85)             | D8  | F8                  |
| C2  | R2 (85)             | D9  | R5 (87)             |
| C3  | R3 (86)             | D10 | F10                 |
| C4  | R8 (85)             | D11 | F11                 |
| C5  | R5 (85)             | D12 | F12                 |
| C6  | R6 (85)             |     |                     |

### Fusible links

A melting fusible link can be watched or touched easily, if it is uncertain of melting, use multimeter or lamp to test.

#### Caution!

- 
- a) If fusible links is melted, maybe because of short circuit(power or current is too high). No matter which reason, please check and eliminate fault
  - b) Fusible links can cause heat, do not enlase with adhesive tape. Do not put fusible links near other rubber or wiring assembly.
-

## 7.5 Lighting System

Front combination light: universal working voltage 12~24V, 1.0mm<sup>2</sup> green wire for width lamp, 1.0mm<sup>2</sup> yellow wire for turn signal, 1.0mm<sup>2</sup> red wire for headlight, 1.0mm<sup>2</sup> black wire for grounding, length 1200mm, protection grade IP65.

Rear combination light: working voltage 9~32V, 1.0mm<sup>2</sup> green wire for width lamp, 1.0mm<sup>2</sup> blue wire for left turn signal, 1.0mm<sup>2</sup> white wire for right turn signal, 1.0mm<sup>2</sup> red wire for brake light, 1.0mm<sup>2</sup> gray wire for reversing light, 1.0mm<sup>2</sup> black wire for grounding, length 110mm, protection grade IP65.

### Location of light

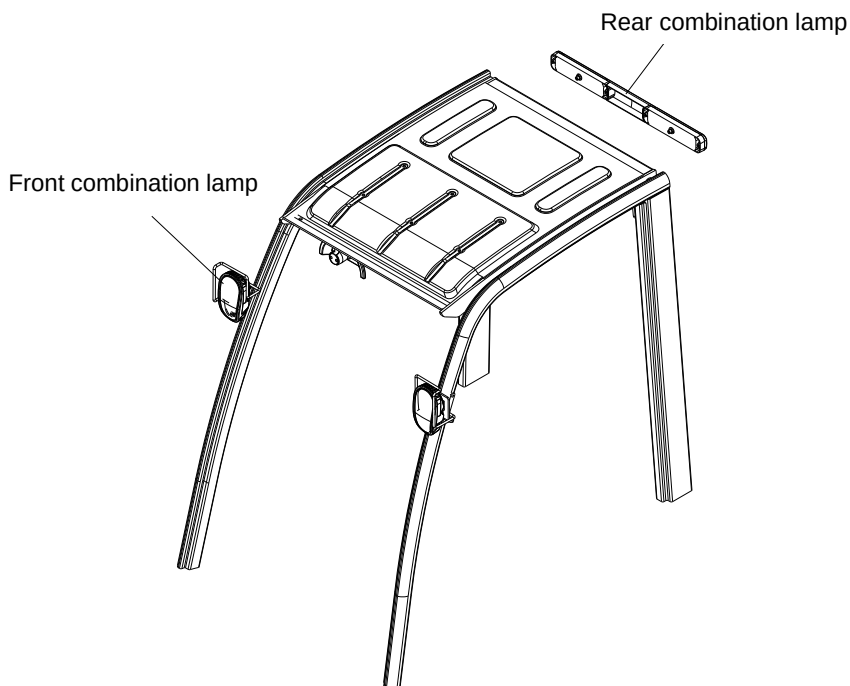
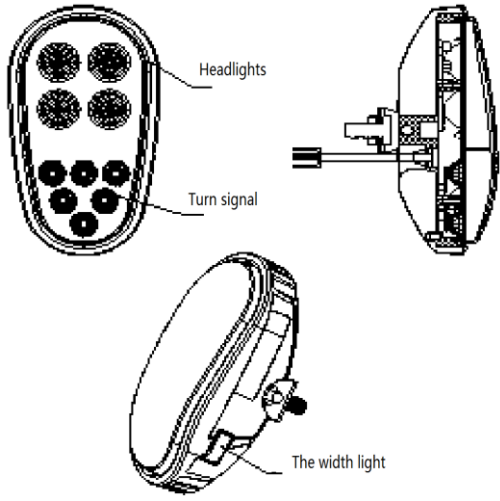


Fig.7-13

### Front combination lamp

#### Removal and installation

1. Remove fixing bolt of bracket
2. Disconnect the wiring connector.
3. Replace faulty bulb with new one.
4. Assembly is the opposite procedures.

|                                                                                   |            |                  |
|-----------------------------------------------------------------------------------|------------|------------------|
|  | Wire Color | Function         |
|                                                                                   | Red        | Headlamp         |
|                                                                                   | Yellow     | Turn signal lamp |
|                                                                                   | Black      | Width lamp       |
|                                                                                   | Green      | Width lamp       |

### Rear combination lamp

Removal and installation

1. Remove fixing bolt of bracket.
2. Disconnect the wiring connector.
3. Replace faulty bulb with new one.
4. Assembly is the opposite procedures.

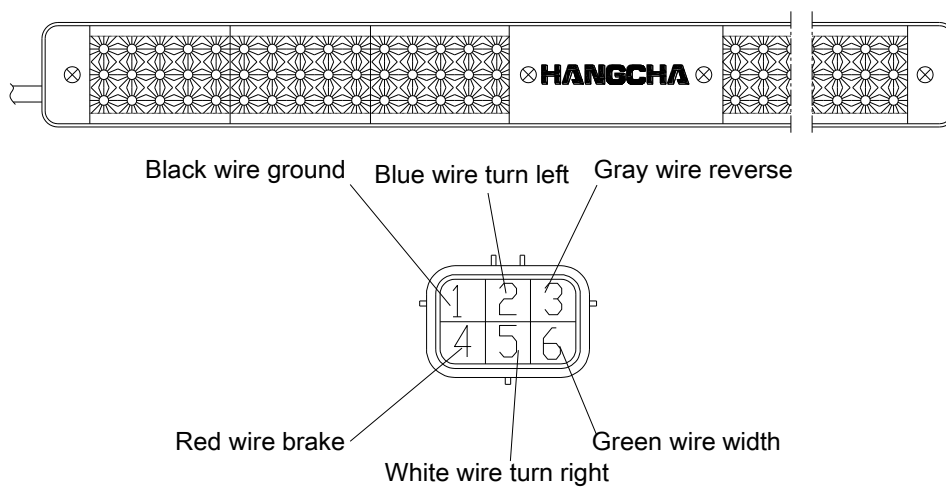


Fig.7-14

7.5 Switch

Combination switch

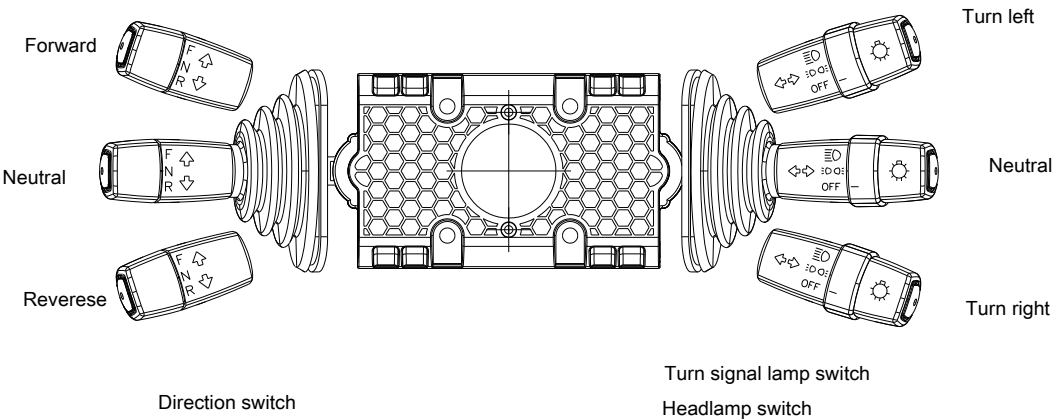


Fig.7-15

Direction switch

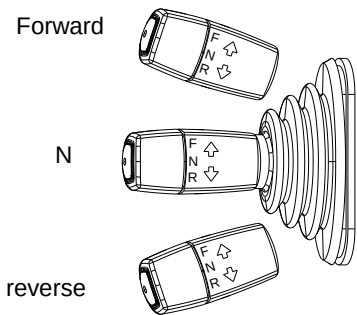
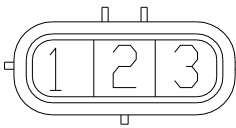
Removal

- 1. Remove combination meter;
- 2. Screw off bolt, disconnect connector of wiring;
- 3. To install, reverse removal procedures.

Inspect direction switch

Disconnect switch connector, and check whether each connection point is on

Use multimeter(with ohm) to inspect whether it is on when lighting switch is on these positions:forward , N, reverse.



| Hole site<br>Wire color | 1                     | 2                     | 3                      |
|-------------------------|-----------------------|-----------------------|------------------------|
| Color                   | Blue                  | Green                 | Yellow<br>and<br>Green |
| Power                   | 60W                   | 60W                   | 60W                    |
| Position                |                       |                       |                        |
| Forward                 | <input type="radio"/> |                       | <input type="radio"/>  |
| Neutral                 |                       |                       | <input type="radio"/>  |
| Reverse                 |                       | <input type="radio"/> | <input type="radio"/>  |

# Turn signal lamp switch

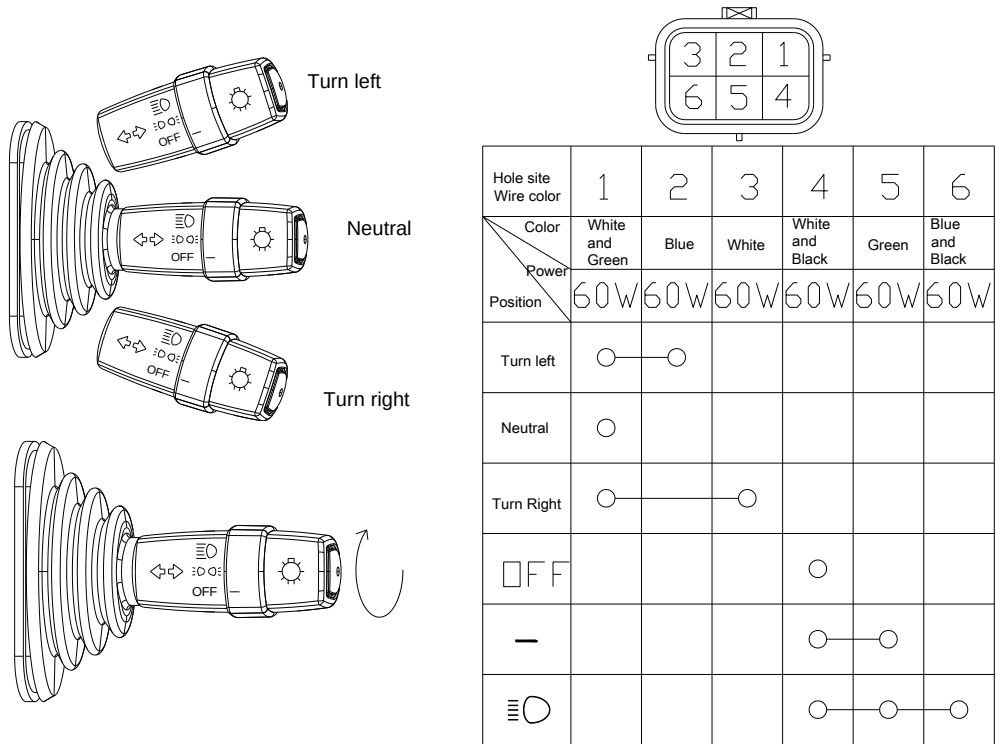
## Removal

- 1.Remove assembled instrument.
- 2.Remove bolt, and disconnect wiring terminal
- 3.Fixing sequence is opposite to removing sequence.

After installing turn signal lamp switch, insure the distance between turn signal lamp switch and top of steering column is 61mm.

## Check

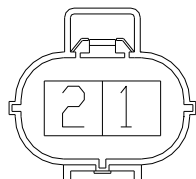
Use multimeter(with ohm) to inspect whether it is on when lighting switch is on these positions



**Horn switch**

- 1.Remove the combination switch.
- 2.Unscrew the screw and disconnect the wiring connector.
- 3.The installation sequence is opposite to the removal sequence.

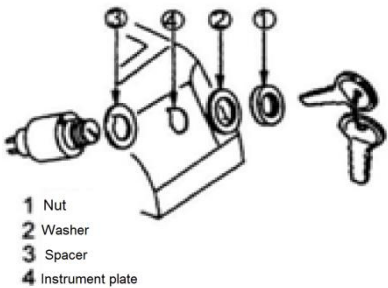
Use a multimeter (adjust to the ohm range) to check whether the position below the turn signal switch is on.



| Sheath hole position  | 1          | 2     |
|-----------------------|------------|-------|
| Color                 | Green-blue | black |
| Handle Power position | 60W        | 60W   |
| Horn                  |            |       |

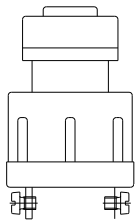
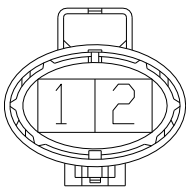
**Key (start) switch**

- (1) Remove combination meter.
  - (2) Disconnect connector of wiring.
  - (3) Remove nut, washer, spacer and instrument plate.
  - (4) To install, reverse removal procedures.
- Adjust ledge of switch to proper length when installing.



**Inspect**

Use multimeter (with ohm) to check key switch whether it is on at each position

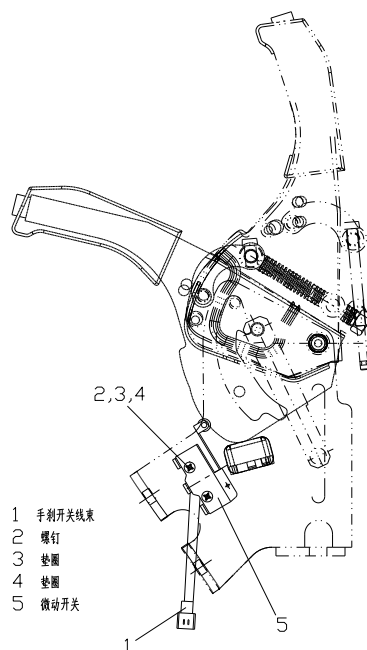


| Terminal Position |  |  |
|-------------------|--|--|
|                   |  |  |
|                   |  |  |

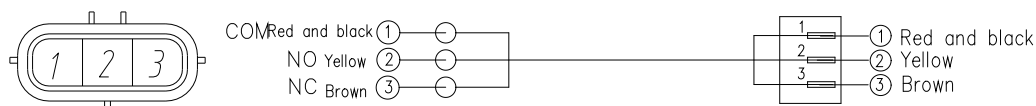
## 手刹开关 Hand brake switch

- 1) 拆下手刹。Remove the hand brake.
- 2) 断开配线插接件。Disconnect the wiring plug
- 3) 拆下螺螺钉、垫圈。Remove the screw and washer.
- 4) 安装与拆卸步骤相反。The installation and disassembly steps are opposite.

在安装时调整开关的突出部分到合适的长度。Adjust the protruding part of the switch to the appropriate length during installation.



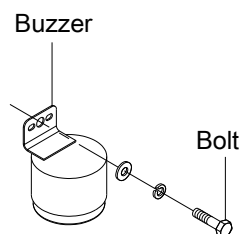
## Hand brake switch harness



## Back-up buzzer

### Disassembly and assembly

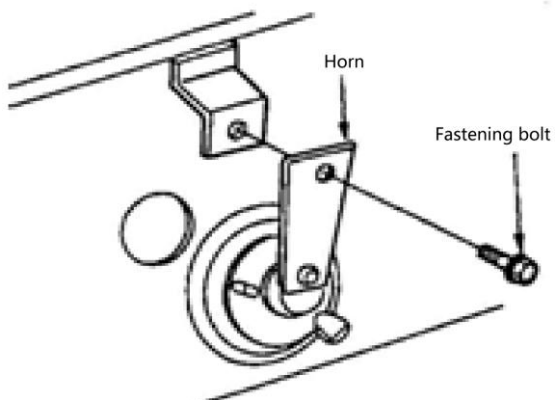
1. Disconnect connector of wiring and remove bolts.
2. To install, reverse removal procedures.



## Horn

### Disassembly and assembly

1. Remove the connector of the horn cable
2. Remove bolt and horn.
3. To install, reverse removal procedures.



## 7.6 Battery thermal management unit assy

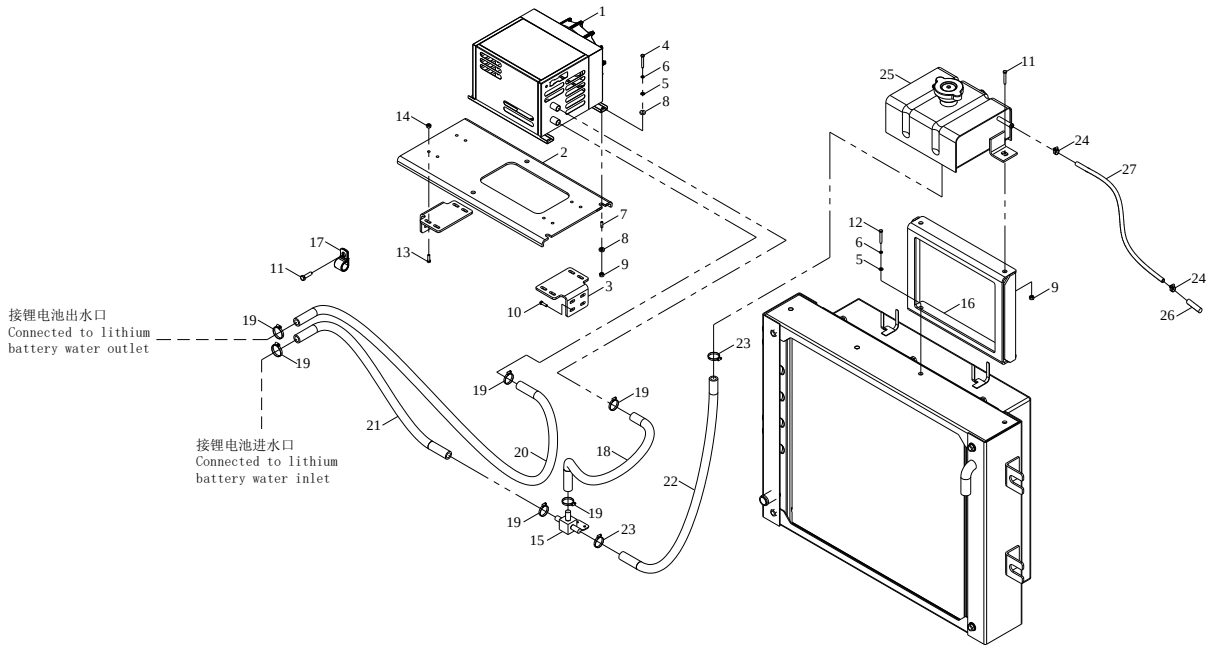


Fig.7-17 Battery thermal management unit assy

|                      |                        |                   |                       |
|----------------------|------------------------|-------------------|-----------------------|
| 1-Water cooling unit | 2-Mounting plate       | 3-Support seat    | 4-Bolt                |
| 5-Washer             | 6-Washer               | 7-Bushing         | 8-Annular damping pad |
| 9-Nut                | 10-Bolt                | 11-Bolt           | 12-Bolt               |
| 13-Bolt              | 14-Nut                 | 15-Tee parts      | 16- Bracket           |
| 17-Pipe clamp        | 18-Water inlet pipe    | 19-Hoop           | 20-Water outlet pipe  |
| 21- Water inlet pipe | 22-Water delivery pipe | 23-Hoop           | 24-Hoop               |
| 25-Expansion tank    | 26-Rubber sleeve       | 27-Degassing pipe |                       |

Table 7-1 Tightening torque of relevant fasteners of power battery thermal management unit

| NO. | Specification | Tightening torque | Remarks |
|-----|---------------|-------------------|---------|
| 4   | M8×80         | 22 N·m~30N·m      | Bolt    |
| 9   | M10×25        | 45 N·m~59N·m      | Bolt    |
| 11  | M8×30         | 22 N·m~30N·m      | Bolt    |
| 12  | M8×12         | 22 N·m~30N·m      | Bolt    |
| 14  | M10×35        | 45 N·m~59N·m      | Bolt    |

## WARNING



The power battery thermal management unit is a high-pressure component. For your life safety, please read the 6.2 chapter before overhaul and strictly abide by it!

### 7.7 Cooling system assembly

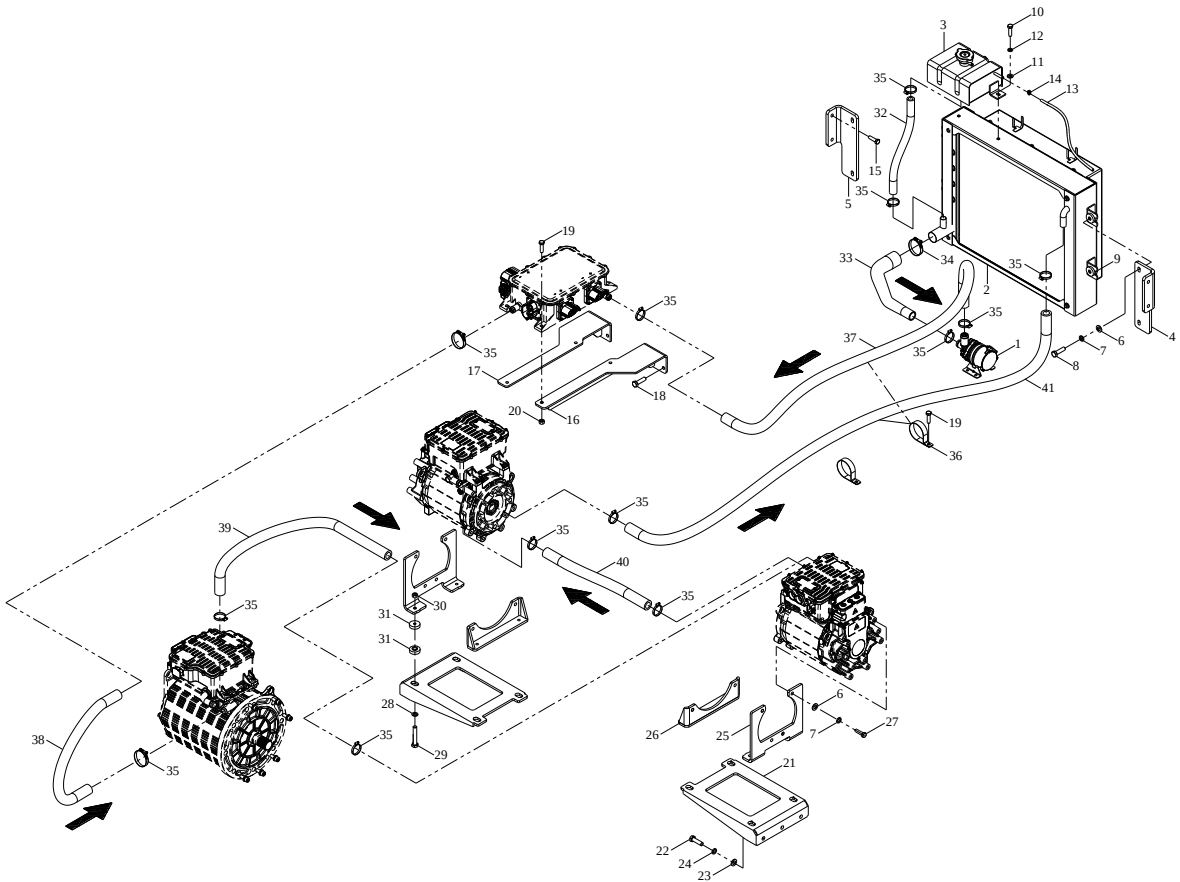


Fig. 6-18 Cooling system assembly

|                           |                        |                   |                         |
|---------------------------|------------------------|-------------------|-------------------------|
| 1-Electronic water pump   | 2-Radiator Components  | 3-Expansion tank  | 4-Radiator left bracket |
| 5-Radiator right bracket  | 6-Washer               | 7-Washer          | 8-Bolt                  |
| 9-Cushion                 | 10-Bolt                | 11-Washer         | 12-Washer               |
| 13-Degassing pipe         | 14-Hoop                | 15-Bolt           | 16-PDU left bracket     |
| 17-PDU right bracket      | 18-Bolt                | 19-Bolt           | 20-Nut                  |
| 21-Oil pump motor support | 22-Bolt                | 23-Washer         | 24-Washer               |
| 25-Oil pump motor base    | 26-Oil pump motor base | 27-Bolt           | 28-Washer               |
| 29-Bolt                   | 30-Nut                 | 31-Annular damper | 32-Water delivery pipe  |
| 33-Water pipe             | 34-Hoop                | 35-Hoop           | 36-Pipe clamp           |
| 37-PDU inlet pipe         | 38-PDU outlet pipe     | 39-Outlet pipe    | 40-Outlet pipe          |

---

Table 6-2 Tightening torque of relevant fasteners of cooling system assembly

| NO. | Specification | Tightening torque | Remarks |
|-----|---------------|-------------------|---------|
| 8   | M10×45        | 45 N·m~59N·m      | Bolt    |
| 10  | M8×15         | 22 N·m~30N·m      | Bolt    |
| 15  | M10×30        | 45 N·m~59N·m      | Bolt    |
| 18  | M10×25        | 45 N·m~59N·m      | Bolt    |
| 19  | M8×25         | 22 N·m~30N·m      | Bolt    |
| 22  | M12×30        | 78 N·m~104N·m     | Bolt    |
| 27  | M10×35        | 45 N·m~59N·m      | Bolt    |
| 28  | M8×55         | 22 N·m~30N·m      | Bolt    |

WARNING

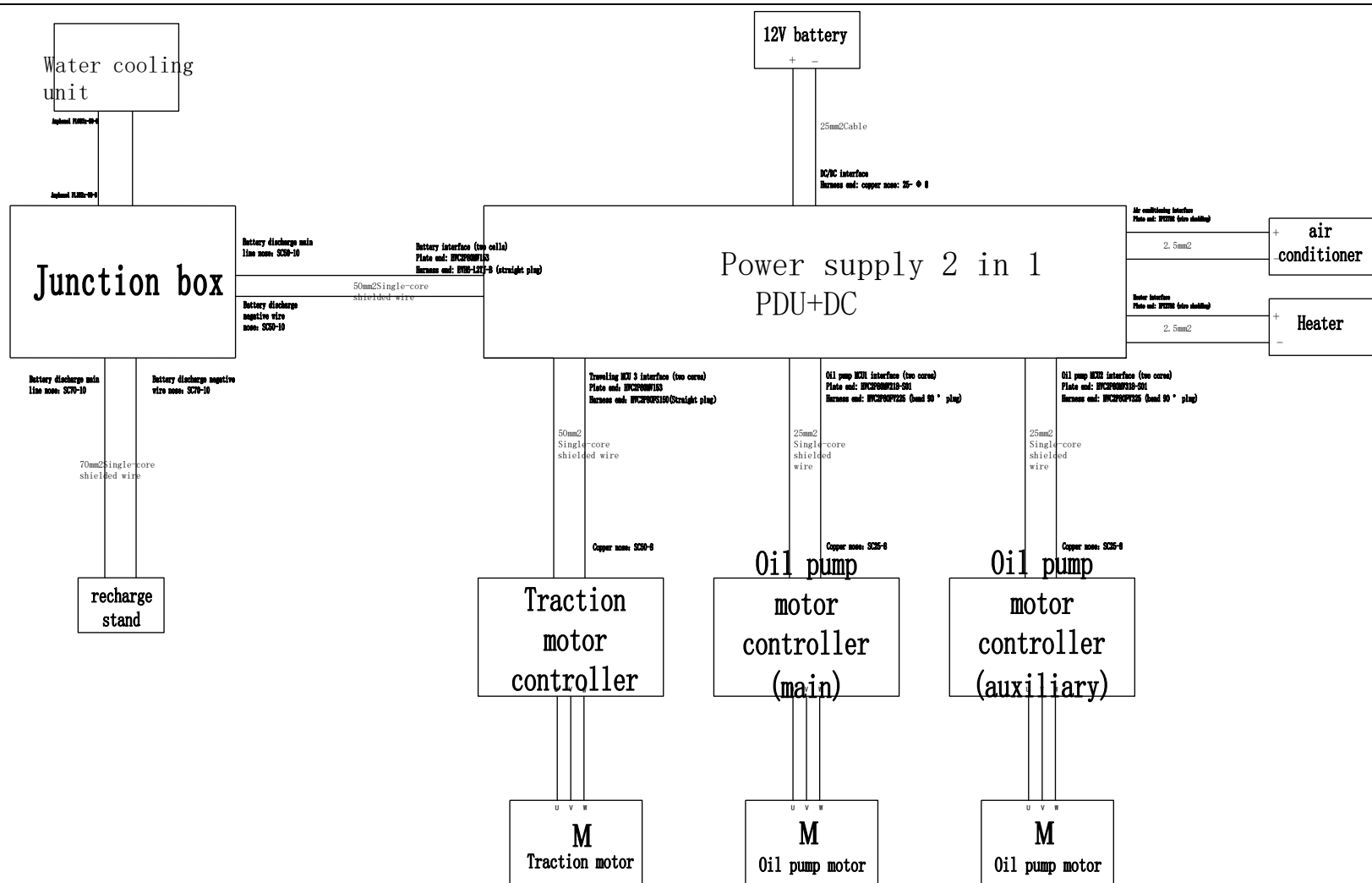



---

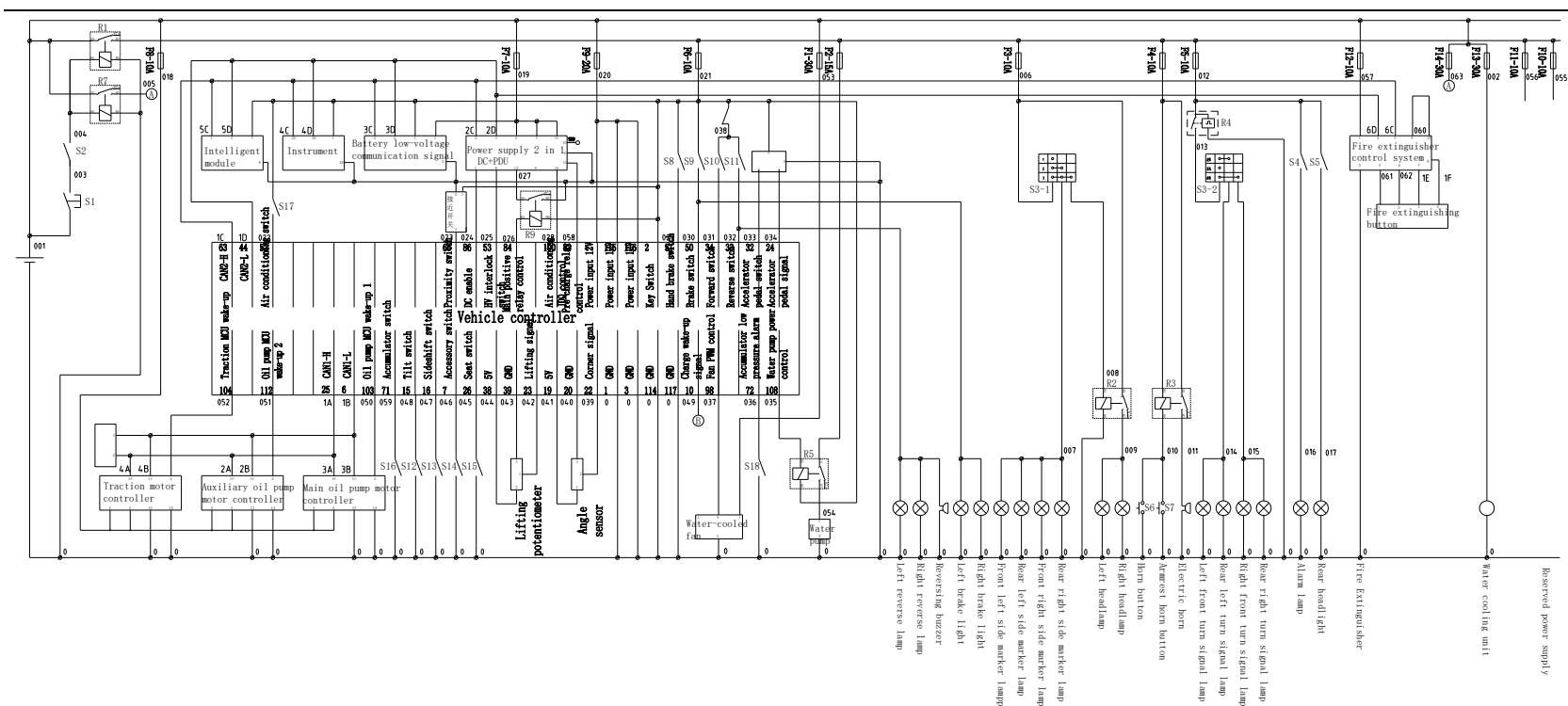
The cooling system is a high-pressure component. For your life safety, please read the 6.2 chapter before overhaul and strictly abide by it!

---

CPD60/70-XHY2G-W Electrical schematic diagram



CPD60/70-XHY2G-W High voltage schematic diagram





---

## Maintenance record

| Date | Maintenance, maintenance content | Maintenance personnel |
|------|----------------------------------|-----------------------|
|      |                                  |                       |
|      |                                  |                       |
|      |                                  |                       |
|      |                                  |                       |
|      |                                  |                       |
|      |                                  |                       |
|      |                                  |                       |
|      |                                  |                       |
|      |                                  |                       |



杭叉集团股份有限公司

HANGCHA GROUP CO., LTD.

全国客服热线：400-884-7888

- 
- 地址：中国浙江临安经济开发区相府路 666 号
  - 电话：0571-88926666（总机号）85191117
  - 传真：0571-85131772     ■ 邮编：311305
  - 网站：http://www.zjhc.cn   ■ 电子邮件：sales@zjhc.cn

■ Address For: OVERSEAS USERS

- Address: 666 Xiangfu Road, Lin'an Economic Development Zone, Zhejiang, China
- Fax: 0086-571-88926789   0086-571-88132890   ■ ZIP:311305
- Web: http://www.hcforklift.com   ■ E-mail: [sales@hcforklift.com](mailto:sales@hcforklift.com)