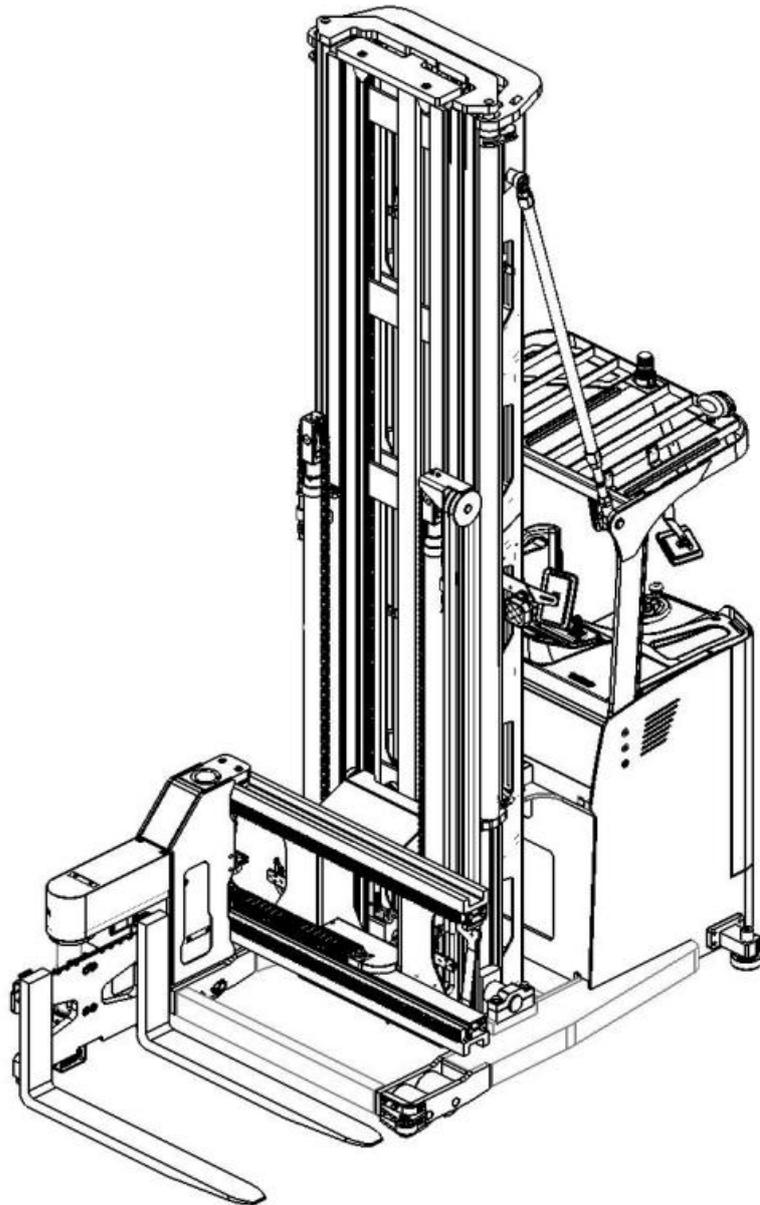


# Maintenance Instruction Manual

## MC Series 3-Way Pallet Stacker



# Preface

Referring to the advanced technology at home and abroad, MC series 3-way pallet stacker is our new product to meet the market needs. Due to its small and smart appearance and flexible operation, it is especially suitable for loading and unloading, stacking, handling and other work in the high-racking warehouse, freight yard, supermarket and so on, with even ground and temperature from -10 to 45°C.

Due to adopting the wide vision lifting system, EPS system, imported international famous brand speed-control system and the battery driving system, this forklift has the characteristics of excellent performance, simple and flexible operation, small noise, no pollution and so on.

This instruction clarifies the basic knowledge of the main components structure, working principles and maintenance of MC series electric 3-way pallet stacker. It can help the operator to use the forklift reasonably and make the forklift perform its maximum efficiency. We sincerely hope that operator and equipment manager will read this instruction carefully before operating the machine.

Through reading carefully of the original maintenance instruction, users can master the technical knowledge necessary for forklift safe operation. The information in the instructions is concise and clear.

This maintenance instruction manual is written for different types of Forklift. In the process of operation and maintenance, please pay attention to the specific provisions of each model.

Our company will continuously develop and optimize forklift equipment, so please understand that we have the right to amend the machine's appearance, equipment and technology. Out of this, the forklift users shall not derive any claims for any specific performance of our Forklift from the instruction manual content.



Dear customers :

Thank you for your trust and purchase of forklifts. The forklift you now have is made by us.

It is manufactured by experienced engineers through the application of the most advanced design methods and technologies. Our sole purpose is to provide efficient, reliable and safe products for your material handling purposes. The forklifts have a very wide range of multi-functional applications, which also makes MiMA series forklifts have been the leader of the material handling equipment industry.

Banyitong Science & Technology Developing Co.,Ltd

Purpose of this manual book:

This manual contains all the information for safe and efficient operation of MiMA forklift trucks. Please ensure that this manual and MiMA forklift are kept together at all times. Before operating the forklift, all drivers must read it;

- Drivers must follow the safety rules outlined in this manual.
- All operating guidelines and prohibitions in this manual must be followed at all times to ensure your life and the lives of others.
- Check daily and perform regular maintenance according to the instructions in this manual.

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## Chapter 1 Introduction of MC Series 3-way Pallet Stacker

The MC series forklift is a stand on type three way pallet stacker. This model can stack goods to the side and front. This model is suitable for stacking in narrow aisle. The MC series three way stacker significantly reduces the size of the working aisle, significantly increases storage capacity, and can maximize warehouse utilization.

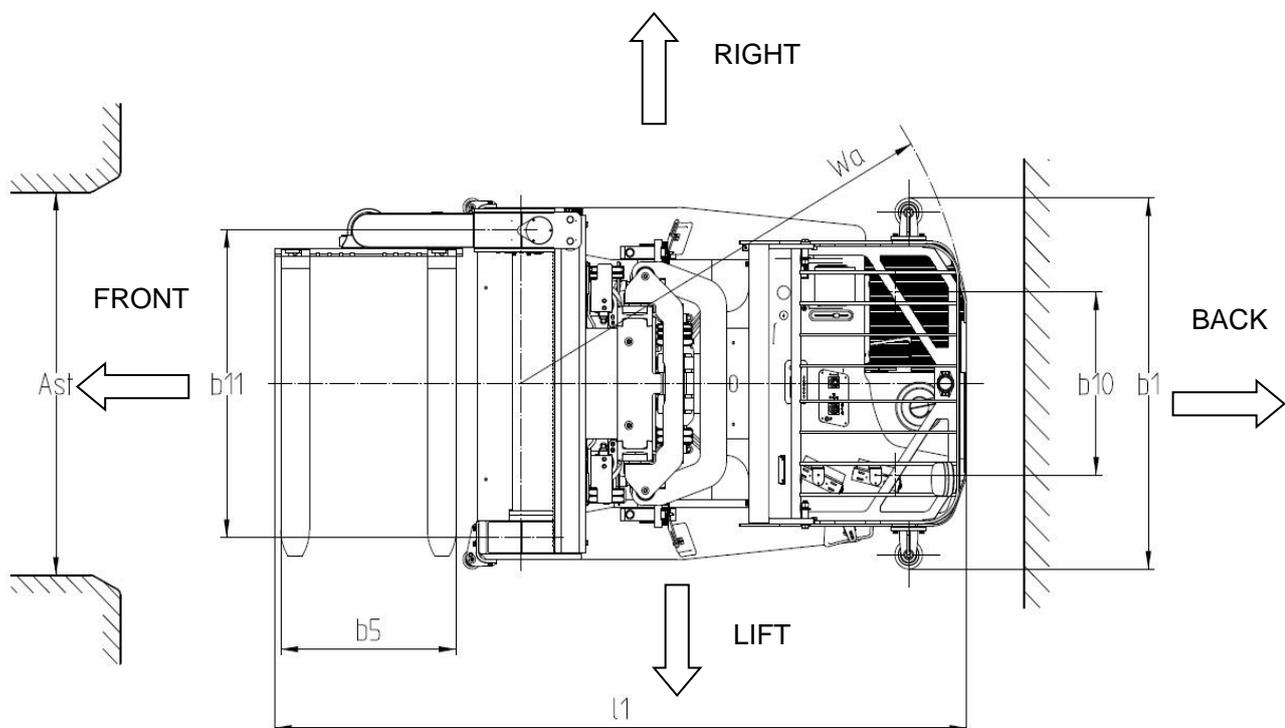
### 1.1 MC Series Model Table

The MC series models are shown in the table below :

| Model  | Capacity (Kg) | Load center (mm) | Lifting height (mm) | Mast    |
|--------|---------------|------------------|---------------------|---------|
| MC12   | 1200          | 550              | 3000-6000           | Duplex  |
| MC12SQ | 1200          | 550              | 4500-9000           | Triplex |
| MC16   | 1600          | 600              | 3000-6000           | Duplex  |
| MC16SQ | 1600          | 600              | 4500-10000          | Triplex |

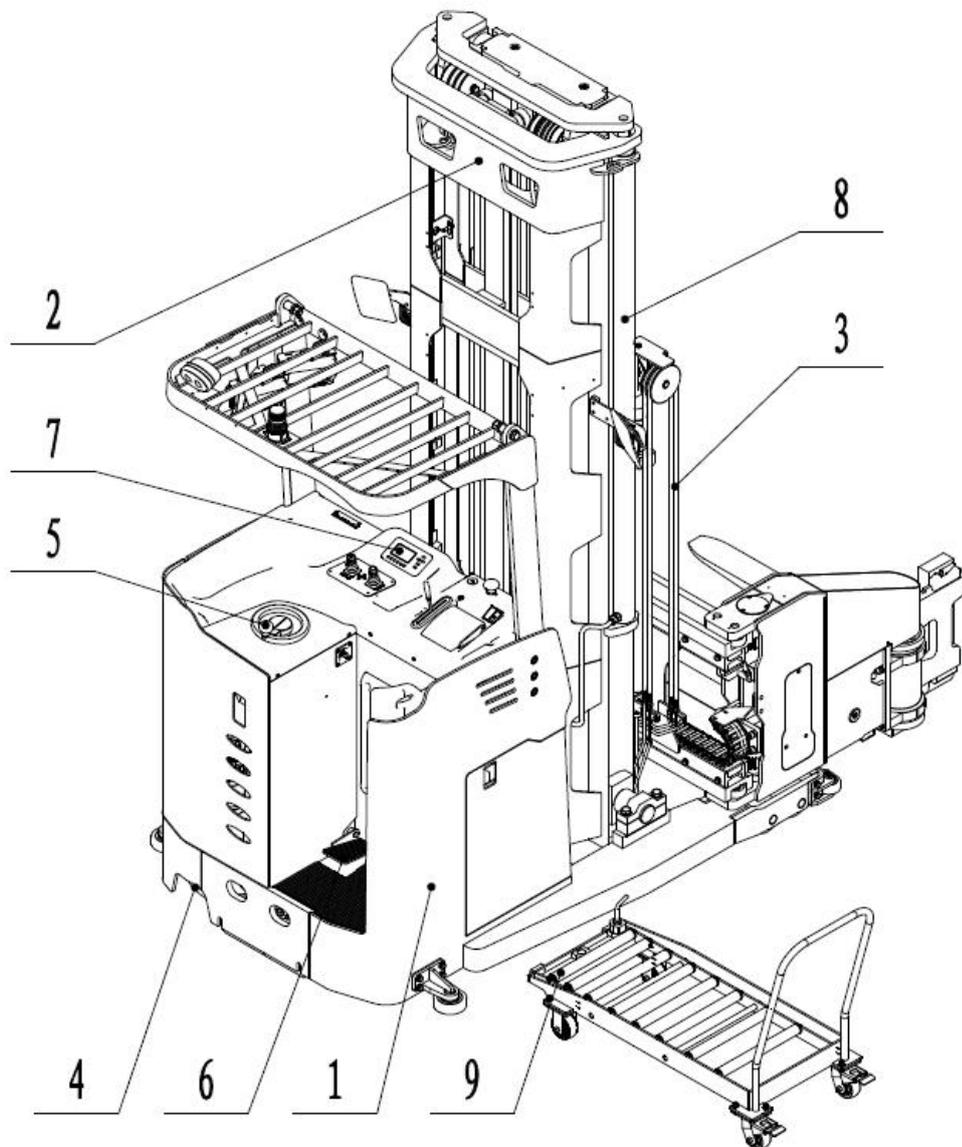
### 1.2 Definition of Driving Direction

The definition of the direction of travel is as follows:



Schematic diagram of forklift direction indication

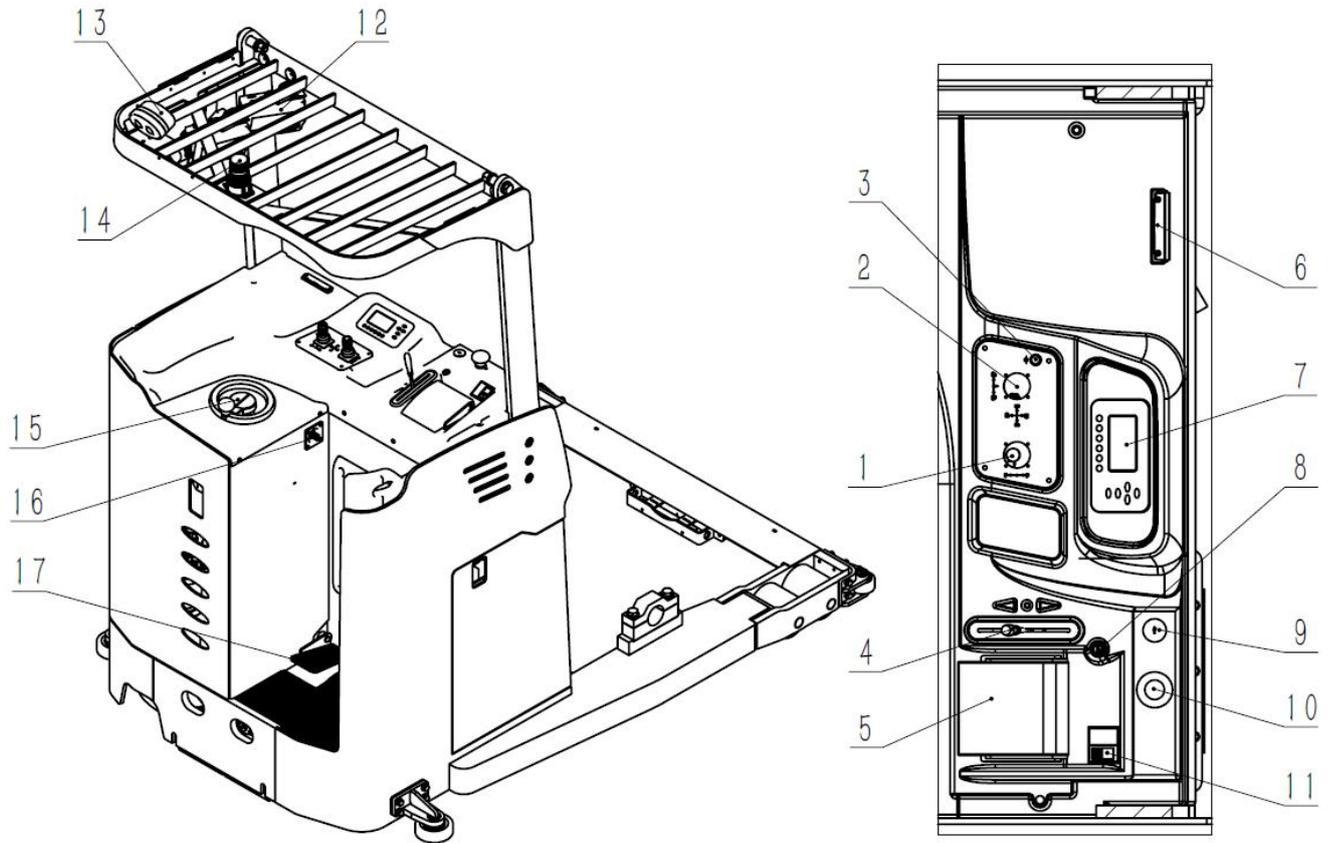
### 1.3 Main Components of MC Series Models



Schematic diagram of forklift structure and appearance

- |                   |                  |                     |                  |
|-------------------|------------------|---------------------|------------------|
| 1.Body system     | 2.Lifting system | 3.Hydraulic system  | 4.Driving system |
| 5.Steering system | 6.Braking system | 7.Electrical system | 8.Label          |
| 9.Battery rack    |                  |                     |                  |

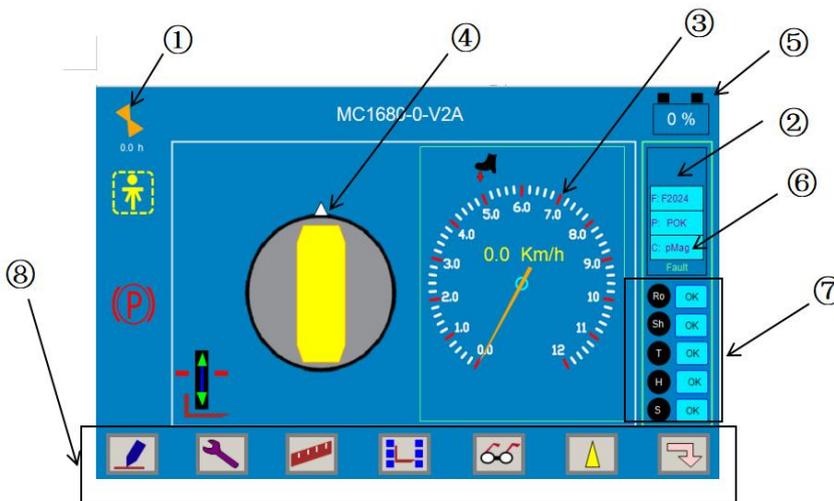
## 1.4 MC Series Vehicle Instrument and Each Control Mechanism Description



Position marks of instrument switches and operating mechanisms of standard models

- |                 |                           |                             |                                  |
|-----------------|---------------------------|-----------------------------|----------------------------------|
| 1. Cross handle | 2. Single axis handle     | 3. One button center button | 4. Direction acceleration handle |
| 5. Armrest      | 6. Folder                 | 7. Instrument               | 8. Horn button                   |
| 9. USB port     | 10. Emergency stop switch | 11. Lighting switch         | 12. Display                      |
| 13. Blue light  | 14. Warning light         | 15. Steering wheel          | 16. Key switch                   |
| 17. Brake pedal |                           |                             |                                  |

## 1.4.1 Meter (Display Panel)



Instrument panel diagram

1. Hourmeter
2. Information and code
3. Travel speed
4. Drive wheel angle
5. Battery display
6. CAN network status
7. Curtis fault code
8. Instrument function keys

### • Hourmeter

Display the total boot time since first use.

### • Information and code

This area displays the status information provided by the controller, and the system self checks after turning on the key switch.

In the display area“  ” represents:running in good condition;  
When a system malfunction occurs, the display area will display  and display the fault code. If two or more faults occur the fault occur, the fault code will scroll through the display in a cyclic manner.

Example: When the "F2000" fault code appears, the fault meaning is: the voltage is below 15% and needs to be charged in a timely manner.

Warning: When a fault code appears, please stop the operation immediately and contact the local (MIMA) after-sales service department in a timely manner until the fault is resolved before starting the machine!



### • Drive wheel angle

The driving wheel direction indicator indicates the current position of the driving wheel, which is the angle between the driving wheel and the direction of forklift travel.

### -Battery power display

When battery power is less than 15%, the operation should be stopped immediately and charged in time. (Tip: Enter voltage protection mode at this time, the speed slows down) Do not overdischarge! Excessive discharge may shorten the battery's life.



### -CAN device network status

Display current online status of the CAN device under the current vehicle, and display "COK" when there is no network fault.

### -Travel speed code meter

Display forklift actual speed.

### -Curtis controller fault code display area

Current vehicle controller fault code display area

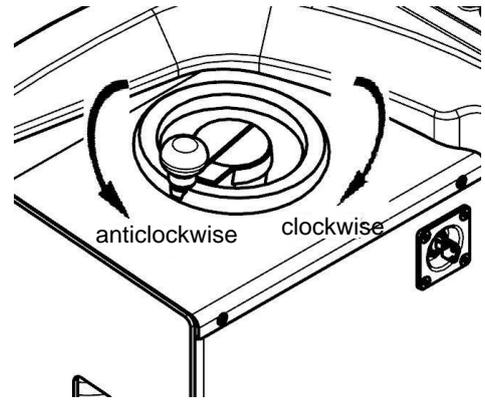
### -Instrument function button

- 1、 Press  enter the administrator setting interface, but this button is only designed for manufacturer(MIMA), the manufacturer has adjusted the parameters before delivery, please do not change the parameters!
- 2、 Press  enter magnetic navigation , use before switching navigation mode.
- 3、 Press  enter vehicle monitoring status page.



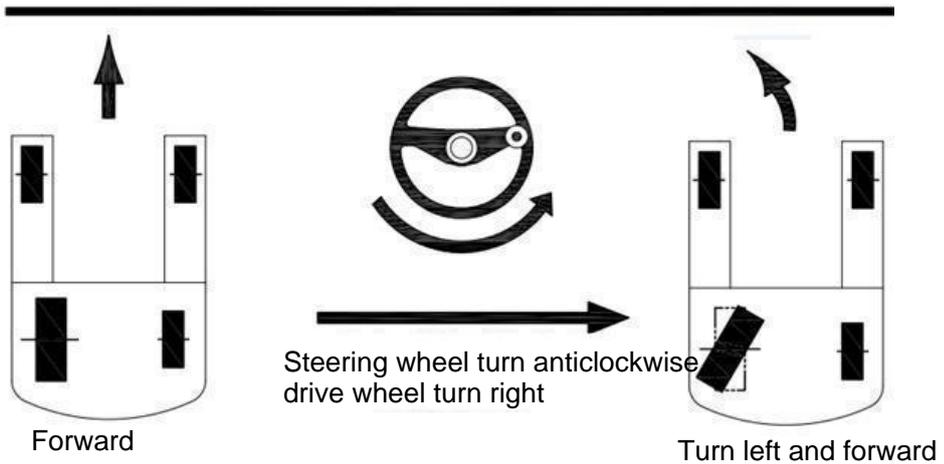
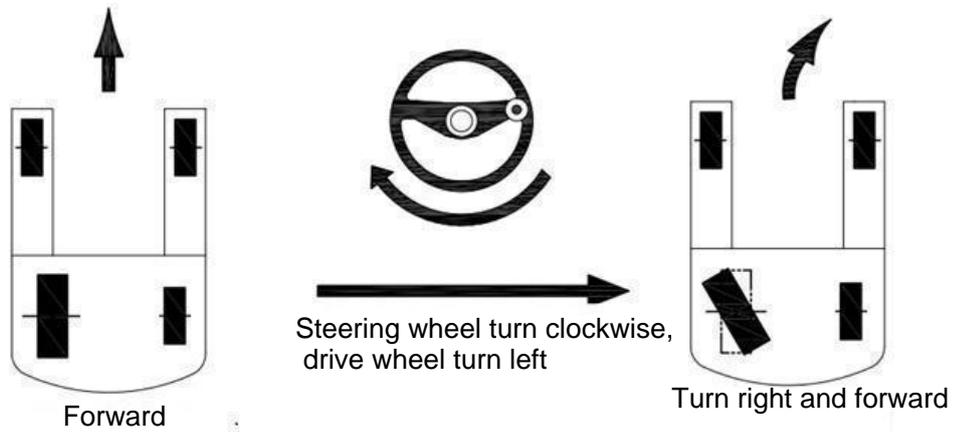
### 1.4.2 Steering wheel

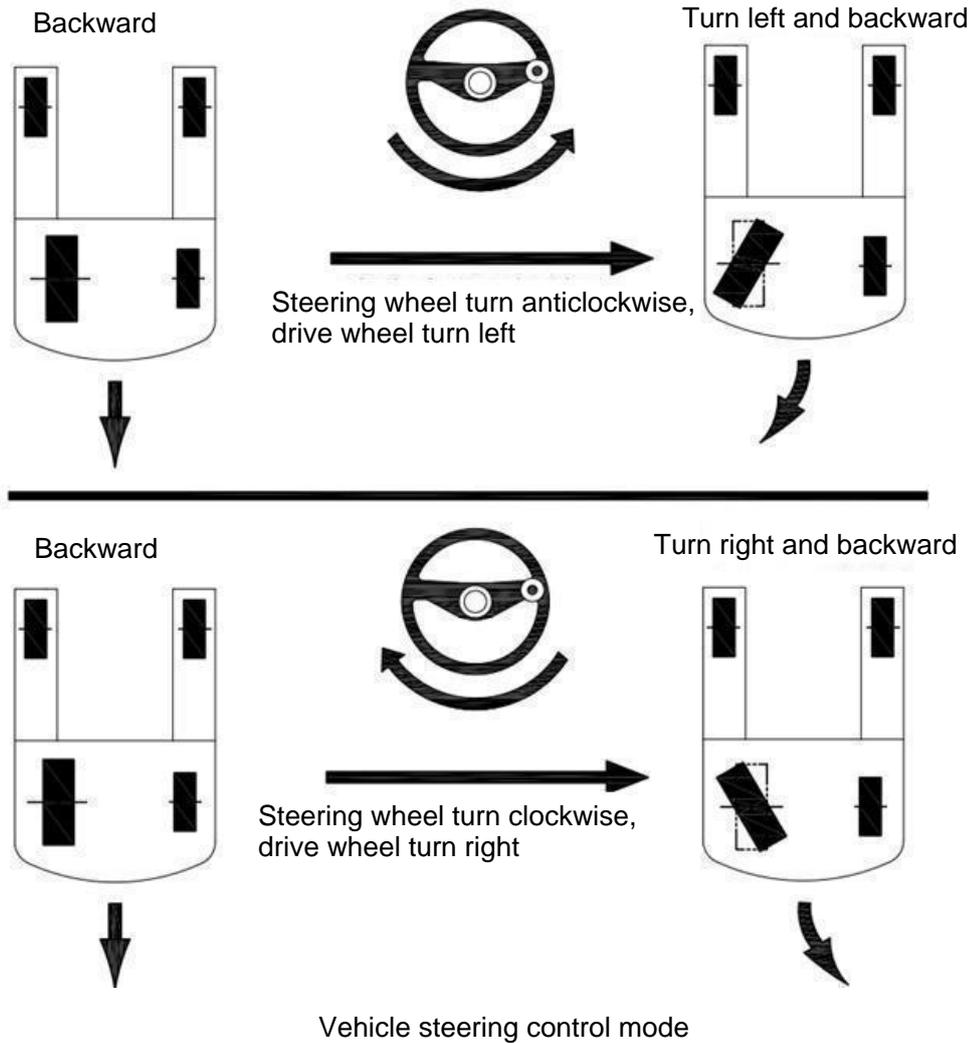
With standard electric power steering, when driving, left hand should be on the steering wheel handle, right hand should be close to armrest pad, operate acceleration handle.



Steering wheel

#### -Steering control model



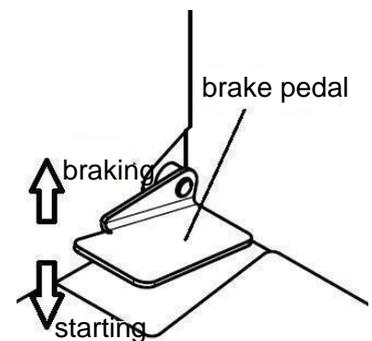


### 1.4.3 Brake pedal

Power on emergency switch and key switch, press brake pedal and control direction acceleration handle, vehicle start travelling !

Release brake pedal, vehicle will stop or rapid reduce speed.

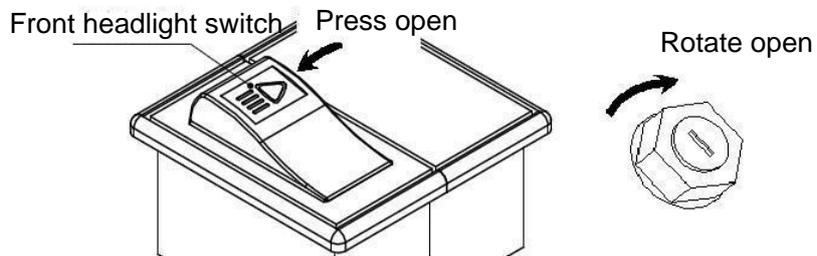
Note: Do not control direction acceleration handle before press brake pedal, otherwise fault code will appear on display.



Brake pedal

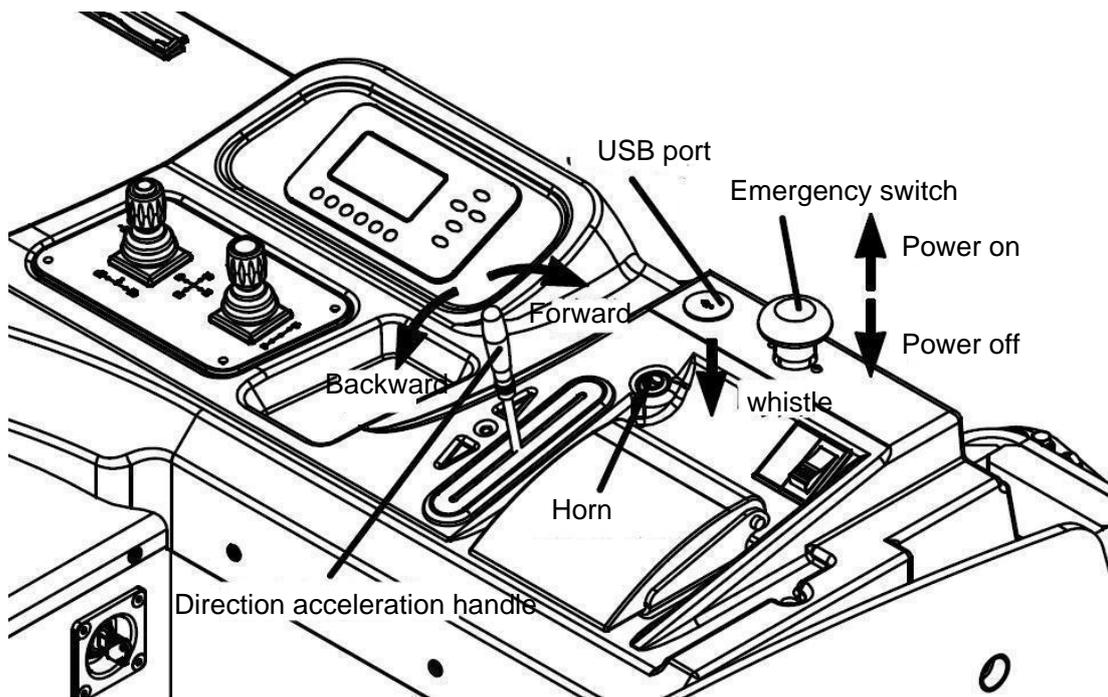
#### 1.4.4 Switch and Operation Handle

- Headligh and key switch



Insert key, rotate clockwise and can turn on power supply.

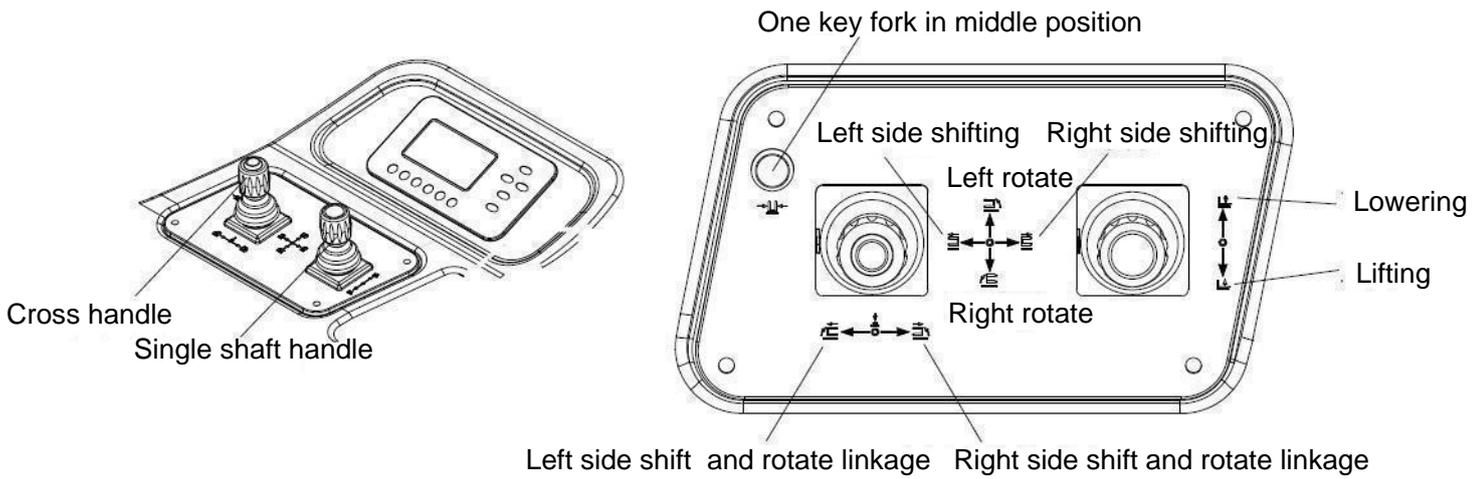
- Switch and operation handle



Control switch interface

Pay attention to:

In case of emergency, please quickly press emergency switch and cut off vehicle circuit.

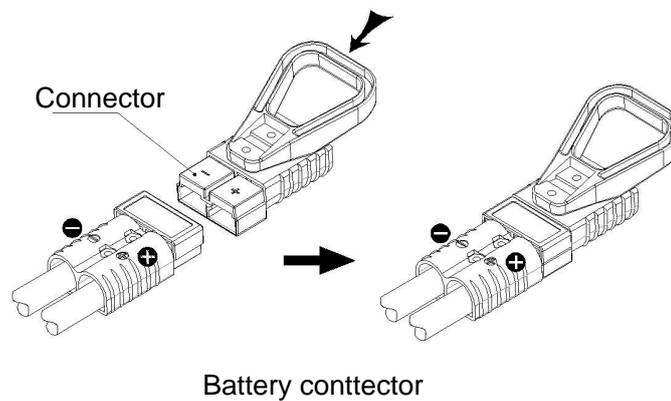


### Operation handle interface

Pay attention to :

- ※ Operation lever can control each action speed, **do not operate or release immediately.**
- ※ Push the lifting handle forward before turning on key switch, the fork will automatically land;  
At this time, the forklift does not respond to other operations.

### 1.4.5 Connector



Pay attention to anode and cathode sign when install connector, unplug connector when the battery is removed for charging or long-term storage of the forklift.



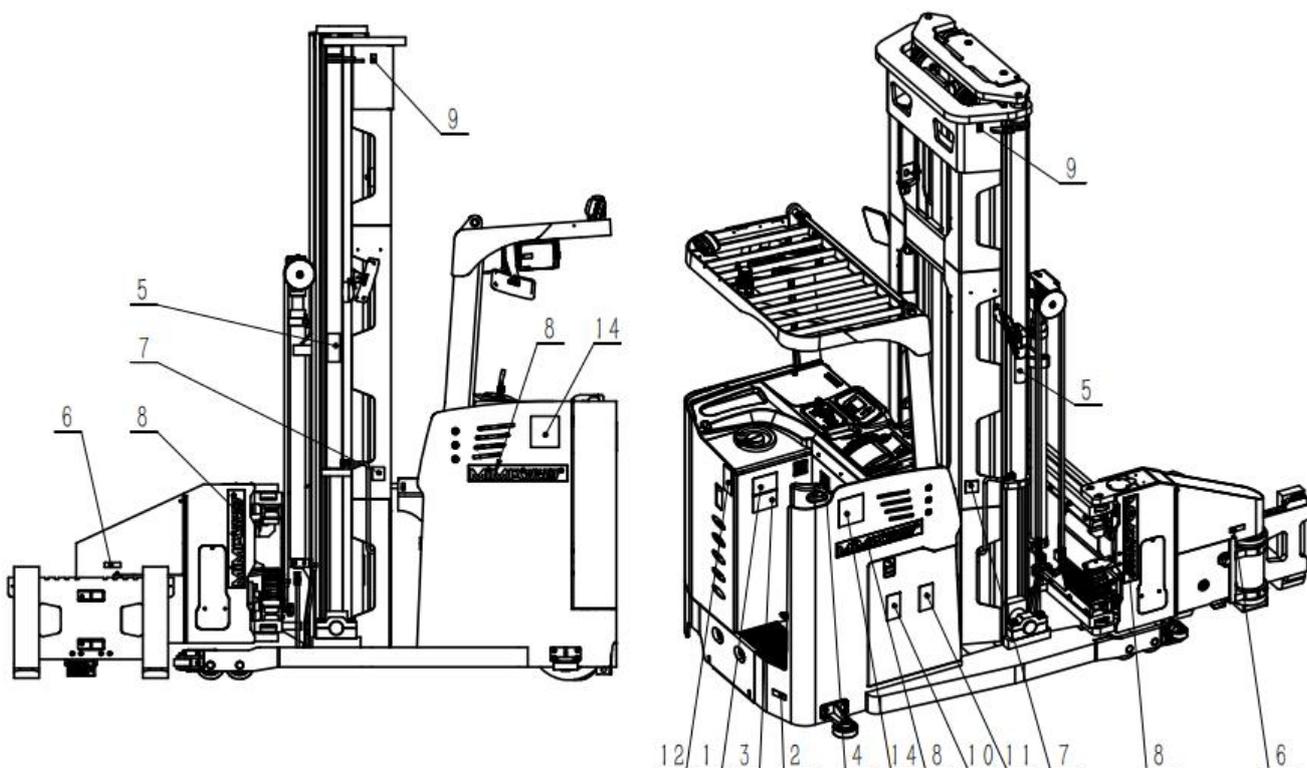
Warning

## Chapter 2 MC Series Safety Marks and Nameplates

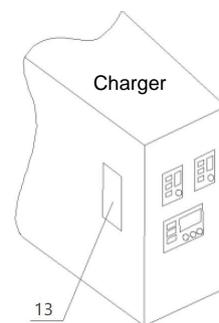
The forklift is equipped with safety signs and nameplates to remind the operator of potential dangers and precautions.



If the safety signs and nameplates on the forklift truck are unclear or moved, please immediately contact the agent in your place to replace the safety signs and nameplates.



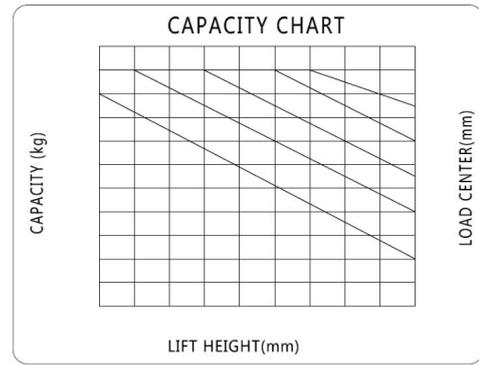
MC Series Forklift Nameplate and Marking Location



- |                                      |                            |                     |                 |
|--------------------------------------|----------------------------|---------------------|-----------------|
| 1. Nameplate                         | 2. Chassis number          | 3. Load chart       | 4. QR code      |
| 5. Danger warning sign near the fork | 6. Anti-pinch hand warning | 7. No climbing      | 8. MiMA Logo    |
| 9. Lifting sign                      | 10. Battery instruction    | 11. Charging notice | 12. Safety tips |
| 13. Charger instruction              | 14. Tonnage sign           |                     |                 |



1



3



5



6



7



9

**Battery Use Instruction**

**Charge**

- The electrolyte temperature should not exceed 45°C during charging.
- Open the cover cap of all battery cells when charging, and it is strictly forbidden to approach open flames.

**Use**

- Please strictly follow this use instruction, and don't undercharge, overcharge or overdischarge.
- Once the battery cell voltage is lower than 1.7V, it should be charged in time.
- The electrolyte density should be adjusted to 1.28g/cm<sup>3</sup>.

**Maintenance**

The replenishing liquid must be battery special water without any sand/des, otherwise it will cause self-discharge or produce toxic gas.

Do not add too much water and please keep battery surface clean and dry, otherwise it will reduce the battery capacity and shorten its service life.

The service engineer shall check liquid level and connection wires once a week. If the liquid level is too low, it will cause accidents such as battery heat or burst.

If the battery will not be used temporarily, it should be fully charged, stored in a ventilated and dry place, and recharged once amount.

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**Charger Use Instructions**

**Environment**

- It is forbidden to be used outdoors.
- It is forbidden to be operated and stored in inflammable, explosive, poisonous, harmful and dusty environment.
- Keep good ventilation during charging.

**Attention**

- Make sure charger with good grounding.
- Connect DC current first (step 1), then connect AC current (step 2).

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**Safety Tips**

**Starting**

- People without training or permission can not be allowed to operate forklift.
- Check all safety reflexives, equipments, warning status, loading chart and loaders before commencing every day to guarantee work security. Keep handle and feet clean during operation.
- It is forbidden to use broken forklift, which should be maintained by professional staff.

**Loading and unloading**

- Goods should be placed between forks evenly, which are forbidden to be put on single fork.
- Take safety protection measures when loading and unloading big or heavy goods.

**Driving**

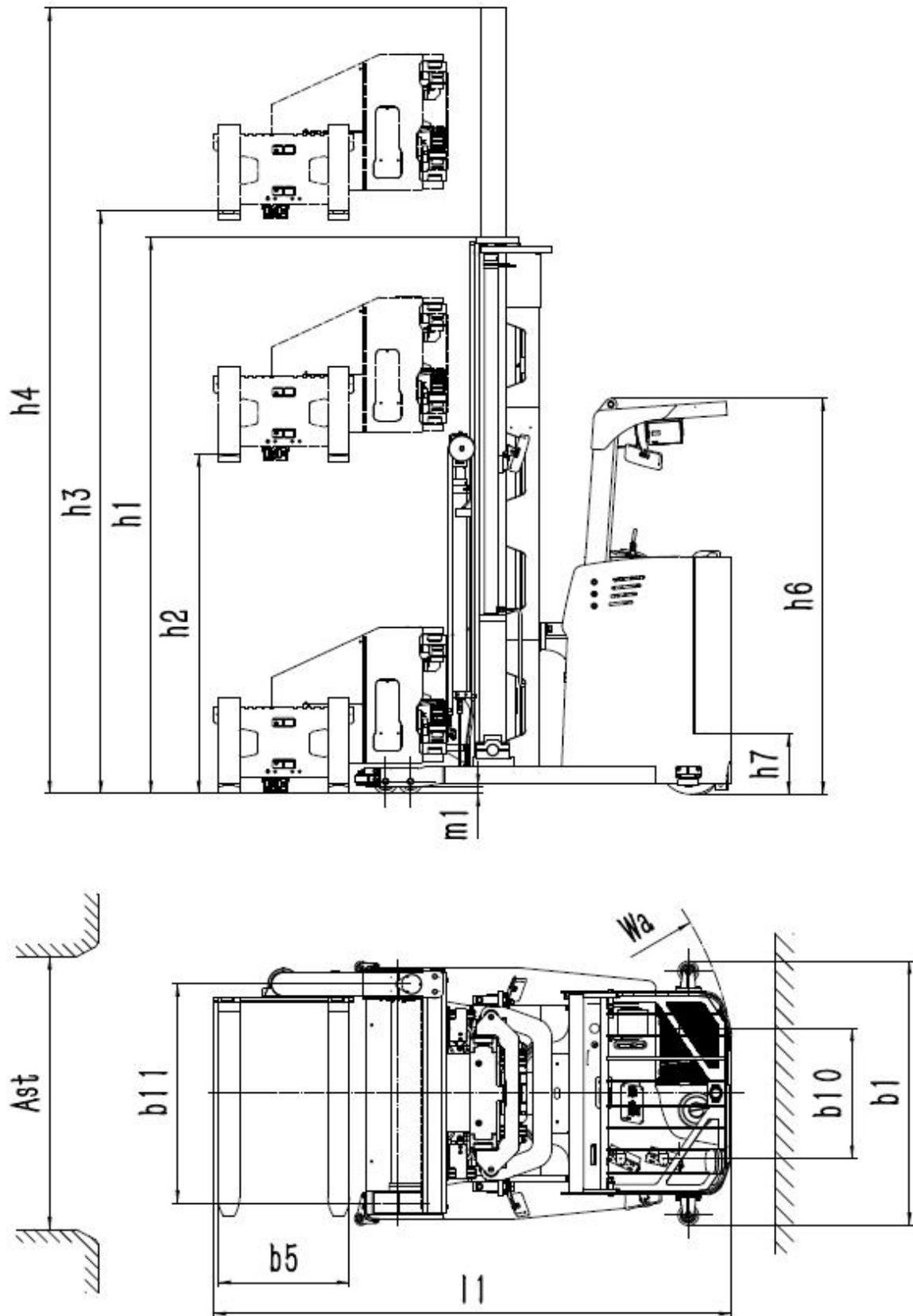
- Electric forklift should be driven on flat ground. Be careful and slow down when climbing, cross floor when driving in high speed, and avoid emergency brake and turning.
- When driving on slope, keep goods to the lowest position, and drive in low speed straightly to avoid turning around.
- Fork's ground clearance height can not exceed 200mm, respect for loading and unloading, avoid driving and leaving off goods at the same time, put ground clearance light on, ask other people to guide if necessary, keep safety distance to people and object safety.

**Parking**

- After parking, put forks to the lowest position and brake, avoid parking on slope and crowded place.

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# Chapter 3 MC Series Main parameters



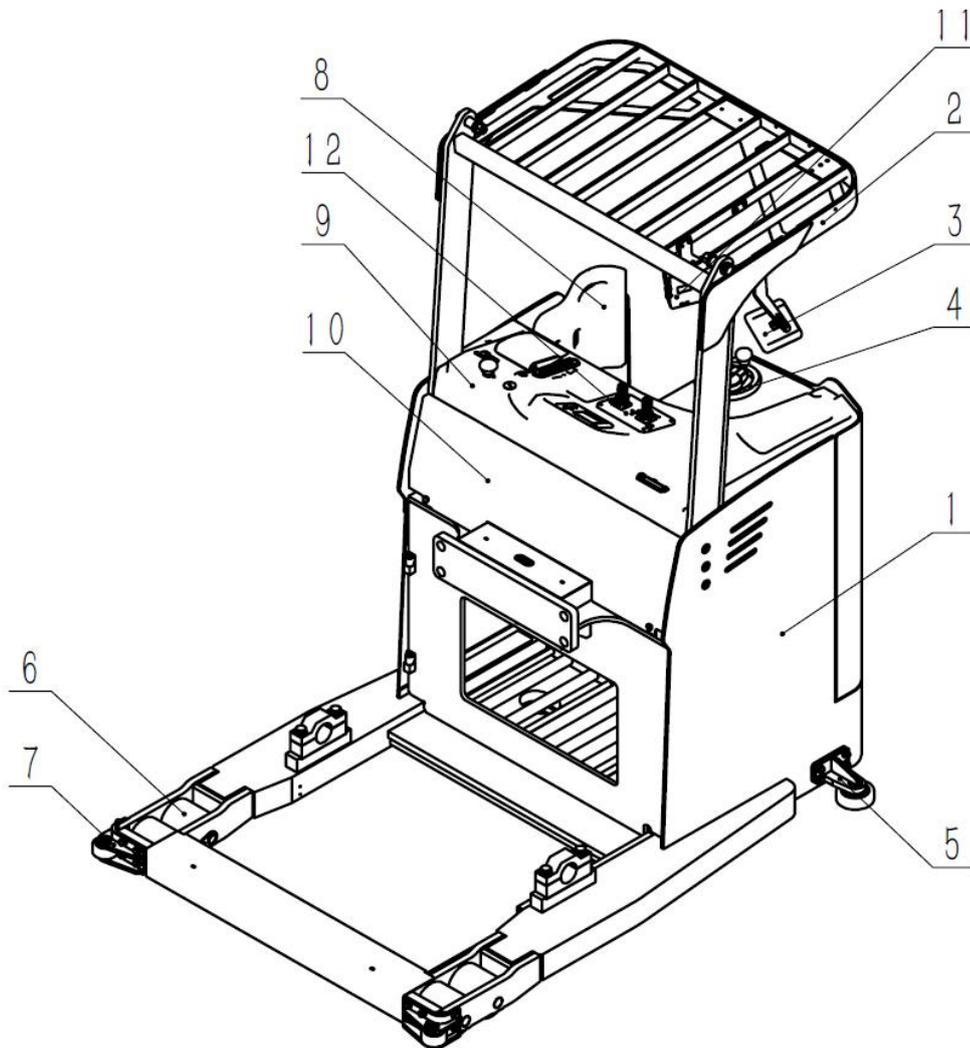
MC series 3 way pallet stacker parameters

|                  |        |   |           |                            |                            |                            |                            |
|------------------|--------|---|-----------|----------------------------|----------------------------|----------------------------|----------------------------|
| Characterization | 1.1    | Manufacturer                                      |           | MiMA                       | MiMA                       | MiMA                       | MiMA                       |
|                  | 1.2    | Model   |           | MC                         | MC                         | MC                         | MC                         |
|                  |        | Model code  |           | MC12                       | MC12SQ                     | MC16                       | MC16SQ                     |
|                  | 1.3    | Power Type  |           | Battery                    | Battery                    | Battery                    | Battery                    |
|                  | 1.4    | Driving mode                                      |           | Stand-on                   | Stand-on                   | Stand-on                   | Stand-on                   |
|                  | 1.5    | Load capacity                                     | Q(kg)     | 1200                       | 1200                       | 1600                       | 1600                       |
|                  | 1.6    | Load Center Distance                              | C(mm)     | 550                        | 550                        | 600                        | 600                        |
| Weight           | 1.9    | Wheelbase   | y(mm)     | 1640                       | 1640                       | 1700                       | 1700                       |
|                  | 2.1    | Service weight (incl.battery)                     | kg        | /                          | /                          | /                          | /                          |
|                  | 2.2    | Axle loading, laden front/rear                    | kg        |                            |                            |                            |                            |
| Tire             | 2.3    | Axle loading, unladen front/rear                  | kg        |                            |                            |                            |                            |
|                  | 3.1    | Tyre type, front/rear                             |           | PU                         | PU                         | PU                         | PU                         |
|                  | 3.2    | Tyre size, front                                  | mm        | φ140×100                   | φ140×100                   | φ140×127                   | φ140×127                   |
|                  | 3.3    | Tyre size, rear                                   | mm        | φ380×165                   | φ380×165                   | φ380×165                   | φ380×165                   |
|                  | 3.4    | Balance wheel size                                | mm        | φ204×76                    | φ204×76                    | φ204×76                    | φ204×76                    |
|                  | 3.5    | Wheels, number front/rear (X=driven)              |           | 4 /1X+2                    | 4 /1X+2                    | 4 /1X+2                    | 4 /1X+2                    |
|                  | 3.6    | Drive wheelbase                                   | b10(mm)   | 1210                       | 1210                       | 1280                       | 1280                       |
| Performance      | 3.7    | Track width, rear                                 | b11(mm)   | 726                        | 726                        | 726                        | 726                        |
|                  | 4.2    | Mast retracted height                             | h1(mm)    | 2435                       | 2635                       | 2565                       | 2765                       |
|                  | 4.3    | Free lift height                                  | h2(mm)    | /                          | 1690                       | /                          | 1750                       |
|                  | 4.4    | Lift height                                       | h3(mm)    | 3000                       | 4500                       | 3000                       | 4500                       |
|                  | 4.5    | Mast extended height                              | h4(mm)    | 3935                       | 5440                       | 4065                       | 5570                       |
|                  | 4.7    | Overhead guard height                             | h6(mm)    | 2260/2300                  | 2260/2300                  | 2260/2300                  | 2260/2300                  |
|                  | 4.8    | Platform height, raised                           | h7(mm)    | 355                        | 355                        | 355                        | 355                        |
|                  | 4.19   | Overall length                                    | l1(mm)    | 2940                       | 2940                       | 3020                       | 3020                       |
|                  | 4.21   | Overall width                                     | b1(mm)    | 1475 <sup>[1]</sup>        | 1475 <sup>[1]</sup>        | 1575 <sup>[1]</sup>        | 1575 <sup>[1]</sup>        |
|                  | 4.22   | Fork dimensions                                   | l/e/s(mm) | 1100/125/50                | 1100/125/50                | 1200/125/50                | 1200/125/50                |
|                  | 4.23   | Installation class                                |           | II-A                       | II-A                       | II-A                       | II-A                       |
|                  | 4.24   | Fork carriage width                               | b3(mm)    | 820                        | 820                        | 820                        | 820                        |
|                  | 4.25   | Fork outside spread                               | b5(mm)    | 765~265                    | 765~265                    | 765~265                    | 765~265                    |
|                  | 4.27   | Width over guide rollers                          | b6(mm)    | 1475                       | 1475                       | 1575                       | 1575                       |
|                  | 4.29   | Side shift distance                               | b7(mm)    | 1180                       | 1180                       | 1280                       | 1280                       |
|                  | 4.32   | Min. ground clearance                             | m1(mm)    | 60                         | 60                         | 60                         | 60                         |
|                  | 4.34.1 | Stacking aisle width pallet to pallet (1100×1100) | Ast(mm)   | 1500 <sup>[2]</sup>        | 1500 <sup>[2]</sup>        | 1600 <sup>[2]</sup>        | 1600 <sup>[2]</sup>        |
|                  | 4.34.2 | Stacking aisle width pallet to pallet (1200×1200) | Ast(mm)   | 1600 <sup>[2]</sup>        | 1600 <sup>[2]</sup>        | 1600 <sup>[2]</sup>        | 1600 <sup>[2]</sup>        |
|                  | 4.35   | Turning radius                                    | Wa(mm)    | 1910                       | 1910                       | 1980                       | 1980                       |
|                  | 4.38   | Center of axle to fork pivot                      | l8(mm)    | 675                        | 675                        | 645                        | 645                        |
| Performance      |        | Main aisle width                                  | Wa(mm)    | ≥(3350+350) <sup>[3]</sup> | ≥(3350+350) <sup>[3]</sup> | ≥(3450+350) <sup>[3]</sup> | ≥(3450+350) <sup>[3]</sup> |
|                  | 5.1    | Travelling speed, laden/unladen                   | km/h      | 7.5/8                      | 7.5/8                      | 7.5/8                      | 7.5/8                      |
|                  | 5.2    | Lift speed, laden/unladenload                     | mm/s      | 300/300                    | 300/300                    | 300/300                    | 300/300                    |
| Performance      | 5.3    | Lowering speed, laden/unladen                     | mm/s      | 340/340                    | 340/340                    | 340/340                    | 340/340                    |
|                  | 5.8    | Gradeability, laden/unladen                       | %(tanθ)   | 5/8                        | 5/8                        | 5/8                        | 5/8                        |
| Performance      | 5.10.1 | Service brake                                     |           | Mechanical/Regenerative    | Mechanical/Regenerative    | Mechanical/Regenerative    | Mechanical/Regenerative    |
|                  | 5.10.2 | Parking brake                                     |           | Mechanical                 | Mechanical                 | Mechanical                 | Mechanical                 |
| Driving          | 6.1    | Drive motor, rating S2=60                         | kw        | 5.5 AC                     | 5.5 AC                     | 5.5 AC                     | 5.5 AC                     |
|                  | 6.2    | Lift motor, rating S3=15%                         | kw        | 15 AC                      | 15 AC                      | 15 AC                      | 15 AC                      |
|                  | 6.4    | Battery voltage/nominal capacity                  | V/Ah      | 48/390 <sup>[4]</sup>      | 48/390 <sup>[4]</sup>      | 48/480 <sup>[4]</sup>      | 48/480 <sup>[4]</sup>      |
|                  | 6.5    | Battery weight                                    | kg        | 618                        | 618                        | 726                        | 726                        |
| Others           |        | Battery replacement method                        |           | Side-pull                  | Side-pull                  | Side-pull                  | Side-pull                  |
|                  |        | Steering system                                   |           | Electric Steering          | Electric Steering          | Electric Steering          | Electric Steering          |

## Chapter 4 Forklift Structure and Regular Fault Analysis

### 4.1 Body system

#### 4.1.1 Summary of Body System Structure

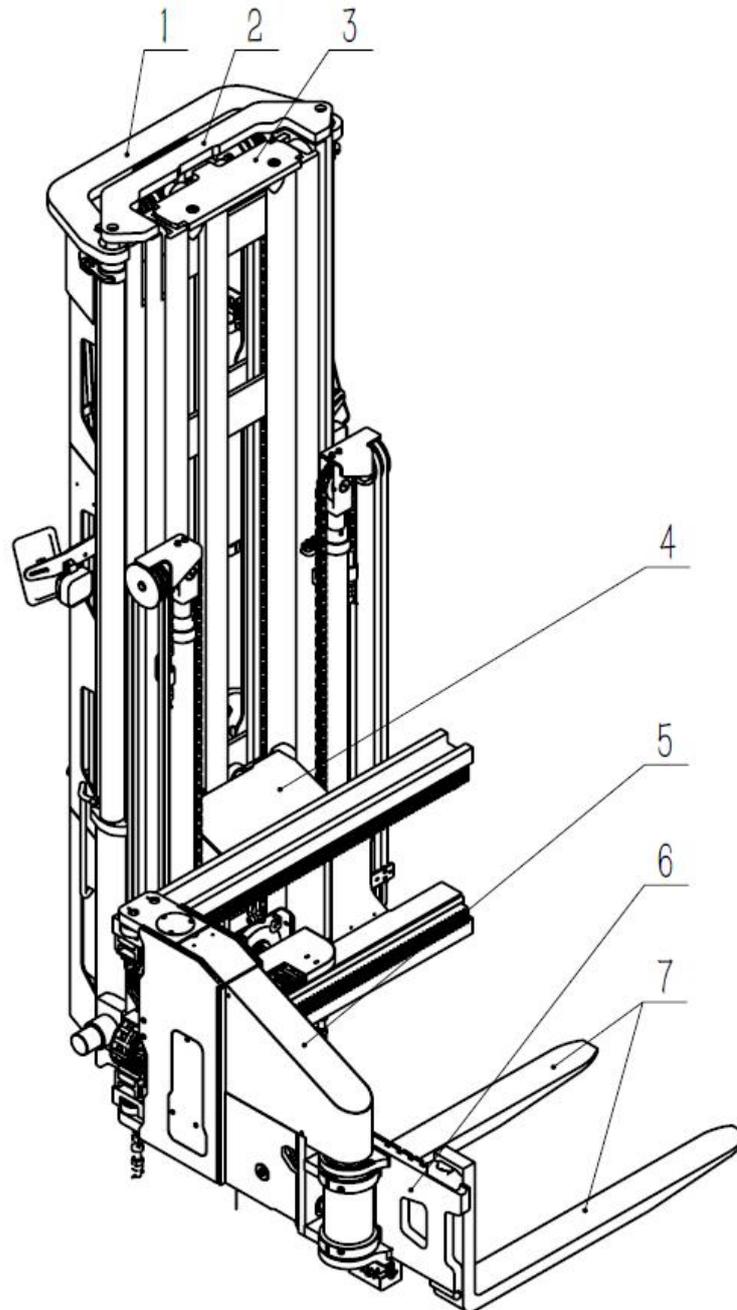


- |                    |                  |                     |                             |
|--------------------|------------------|---------------------|-----------------------------|
| 1 Body welding     | 2 Overhead guard | 3 Mirror assembly   | 4 Steering wheel            |
| 5 Back guide wheel | 6 Bearing wheel  | 7 Front guide wheel | 8 Backrest                  |
| 9 Upper cover      | 10 Front cover   | 11 Display          | 12 Operate handle component |

## 4.2 Lift System

### 4.2.1 Summary of Lifting System Structure

Lift system is composed of outer mast, middle mast, inner mast, inner sliding frame, axle and forks.



1 Outer mast

2 Middle mast

3 Inner mast

4 Inner sliding frame

5 Axle

6 Forks carrier

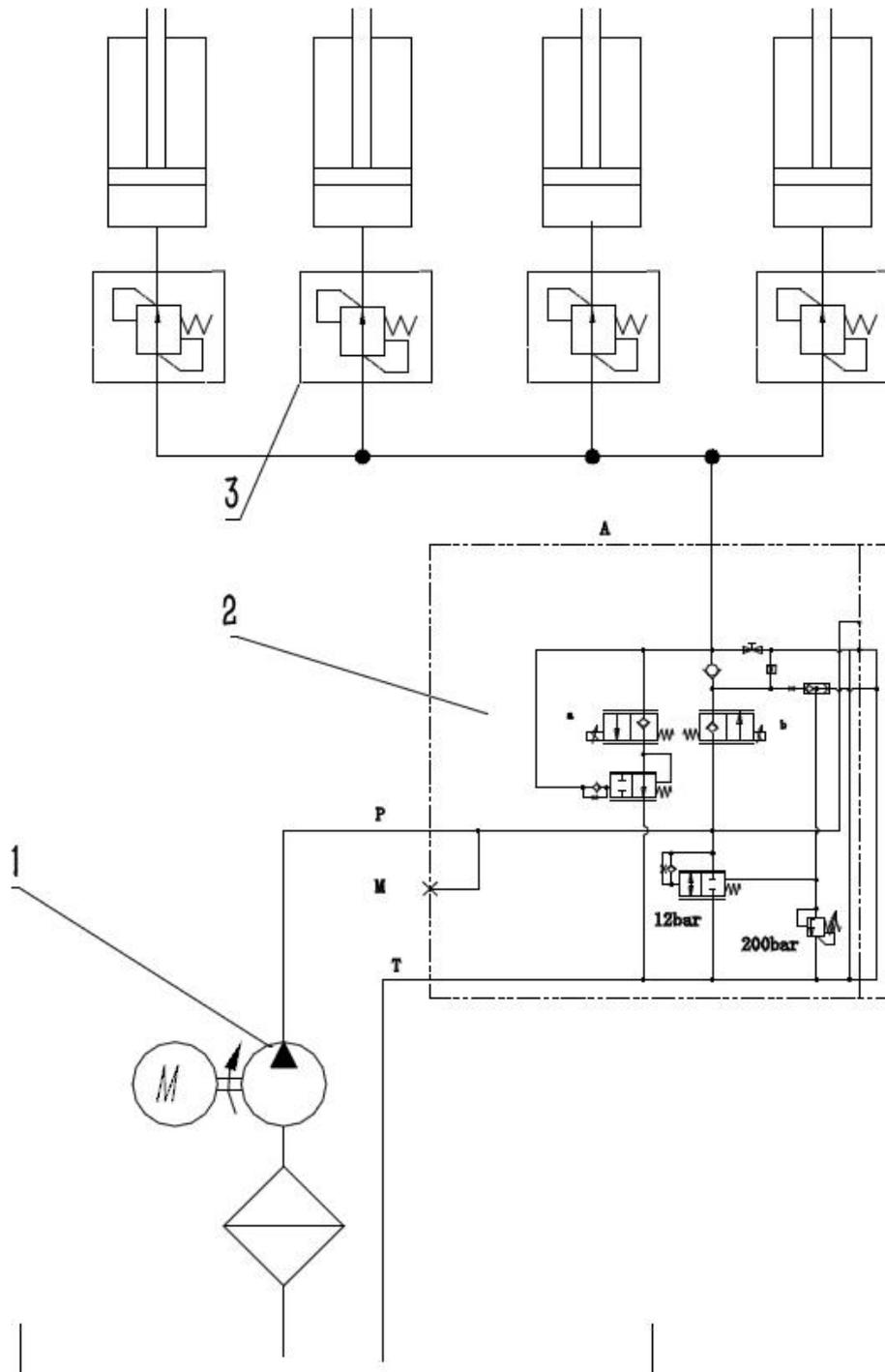
7 Forks

## 4.2.2 General Fault Analysis and Treatment of Lifting System

| <b>Faultsphenomenon</b>              | <b>Reasons</b>   | <b>Elimination methods</b>   |
|--------------------------------------|--|--|
| Fork carriage does not lift smoothly | Improper adjustment of cargo fork assembly                                       | Adjust the clearance of channel steel guide rail and side roller             |
|                                      | Insufficient clearance between roller and door rack                              | Adjust the clearance of the rollers  |
|                                      | There is dirt among moving parts   | Clean the dirt   |
|                                      | lubrication inadequate   | Apply grease on the contact surface of the guide rail                        |
|                                      | The inner frame is crooked or the cargo fork is bent                             | Repair or replacement  |
| The fork lifts unevenly              | The lifting chain has not been adjusted well                                     | Adjust both sides of the chain to be consistent                              |
| The lifting roller does not turn     | Grease hard or rollers with dirt   | Clean and lubricate the roller   |
|                                      | The lifting roller adjustment is not correct                                     | Correct the adjustment   |
| The mast is too noisy during lifting | Lubrication inadequate   | Lubricate  |
|                                      | Uneven adjustment of the upper side roller of the cargo fork                     | Adjust the adjusting gasket of roller and side roller                        |
| Unable to lift or very slow to lift  | The oil pump gear and pump body wear excessive, clearance is large               | Replace worn parts or pumps  |
|                                      | The cylinder piston seal ring wear and leak                                      | Replace the seal ring  |
|                                      | Multiple valve, relief valve spring failure                                      | Replace the spring   |
|                                      | Multiple valve stem and valve body wear large, oil leakage                       | Exchange   |
|                                      | Hydraulic oil leak   | Check and finishing  |
|                                      | Hydraulic oil temperature is too high, hydraulic oil too thin, insufficient flow | Replace the unqualified hydraulic oil and check the oil temperature too high |

## 4.3 Hydraulic System

### 4.3.1 Hydraulic Schematic Diagram

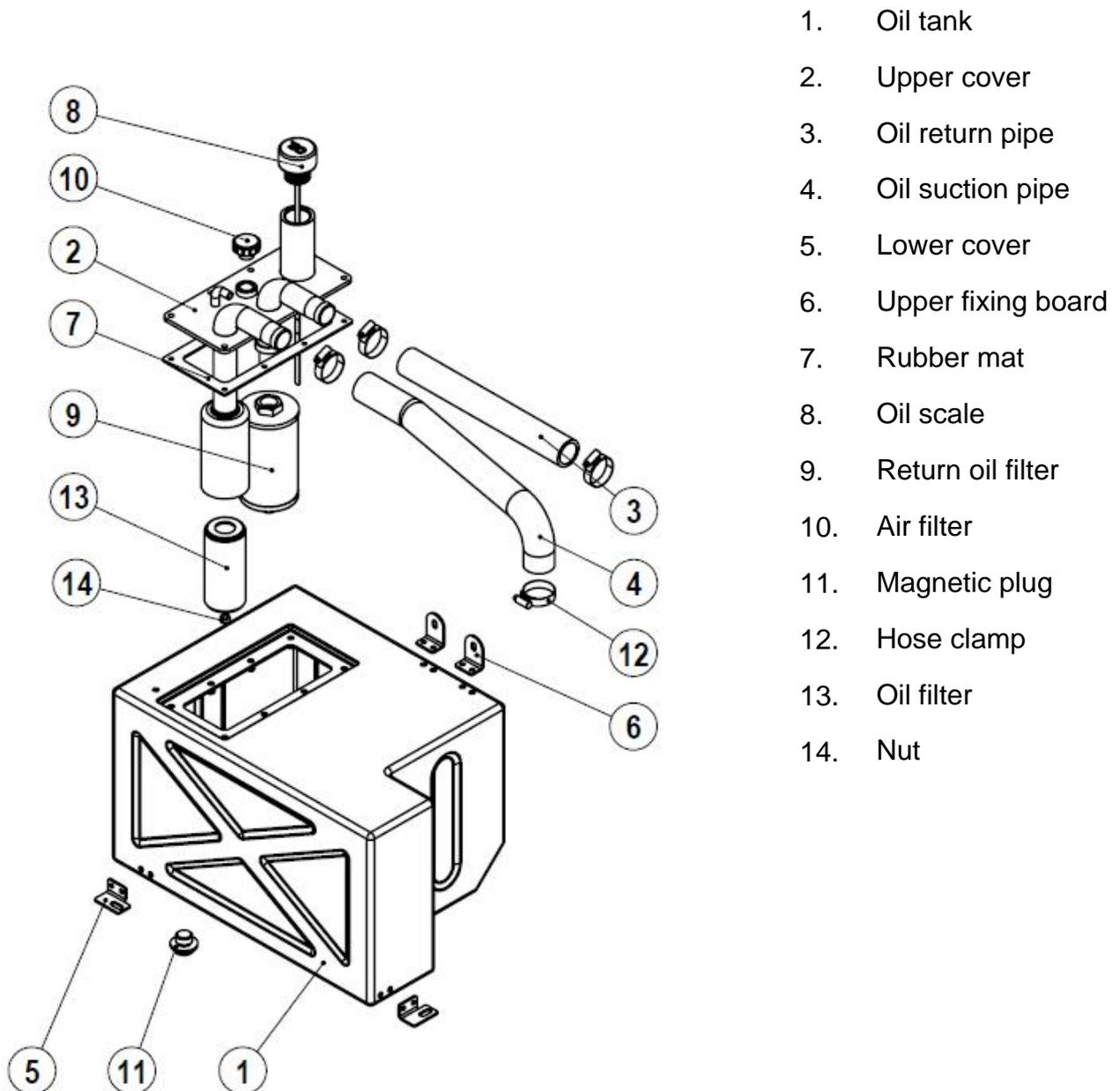


1. Gear pump 2 . Proportional valve 3. Shutoff valve

### 4.3.2 Summary of Hydraulic System Structure

The hydraulic system mainly consists of oil pump, oil tank, multi-way valve, speed limit valve, cut-off valve, oil cylinder and oil pipe, etc., and the motor directly drives the gear pump.

### 4.3.3 Oil tank



#### 4.3.4 Main Hydraulic Component Model and Specification

|                             |                            |                            |
|-----------------------------|----------------------------|----------------------------|
| Gear oil pump               | Model ( MC Series )        | DSG05C23F9H1-R213C         |
|                             | Displacement ( MC Series ) | 23ml/r                     |
|                             | Oil temperature range      | -20 —80                    |
| Solenoid proportional valve | Model                      | EHG04F-526                 |
|                             | Type                       | With relief valve          |
|                             | Adjust pressure            | 200bar                     |
| Lifting oil cylinder        | Type                       | Single acting plunger type |
|                             | Diameter of piston rod     | 55mm                       |
|                             | Cylinderbore               | 63mm                       |
|                             | Travel                     | As per machine             |
| Cut-off valve               | Rated flow                 | 80L/min                    |
|                             | Adjust range               | 10~30Mpa                   |

## 4.3.5 General Fault Analysis and Treatment

### 1. Fault Analysis of Electromagnetic Proportional Multi-way Valve

| Fault   | Reason                              | Approach                       |
|---|-------------------------------------|--------------------------------|
| The pressure in the lifting oil circuit cannot be increased | spool stuck                         | Cleaning after decomposition   |
|   | oil hole clogged                    | Cleaning after decomposition   |
| shock pressure rises slowly                                 | spool stuck                         | Cleaning after decomposition   |
|   | insufficient exhaust                | full exhaust                   |
| Cannot reach the specified oil quantity                     | Improper adjustment of relief valve | adjust                         |
| noisy   | improper adjustment of relief valve | adjust                         |
|   | sliding surface wear                | Replace the relief valve       |
| External oil spill  | O-ring seals are aged or damaged    | Replace the O-ring seal        |
| set pressure low  | spring damage                       | replace the spring             |
|   | valve surface damage                | Adjust or replace relief valve |
| internal oil leak   | valve surface damage                | surface fix                    |
| set pressure high   | spool stuck                         | Cleaning after decomposition   |
| Proportional valve not responding                           | loose joints                        | re-wiring                      |

### 2. Safety valve pressure adjustment

|   |         |
|---|---------|
| Pressure regulating value of safety valve | 20.0MPa |
|---|---------|

### 3. Safety valve pressure adjustment method

The pressure of the safety valve cannot be adjusted arbitrarily.

If it is necessary to adjust, please follow the steps below:

- ① Unscrew the plug of the measuring hole at the inlet of the multi-way valve, and install an oil pressure gauge capable of measuring 25MPa.
- ② Operate the lifting handle to measure the pressure when the cylinder travels to the bottom.
- ③ When the oil pressure is different from the specified value, loosen the lock nut of the relief valve, turn the adjusting screw left and right to adjust to the specified value, turn left when the pressure is high, and turn right when the pressure is low.
- ④ After adjustment, tighten the nut.

#### 4. Cut off valve working principle

A cut-off valve is installed at the bottom of the lifting cylinder to prevent the cargo from falling sharply when the high-pressure hose bursts suddenly. The oil in the self-lifting cylinder passes through the shut-off valve slide valve, and the oil holes around the slide valve make the pressure difference between the two chambers

When the pressure difference is less than the spring force, the slide valve does not move; if the high-pressure hose bursts suddenly, a large pressure difference is generated between the two chambers, which makes the slide valve move to block the oil holes around it, and only a small amount of oil is released. Fluid flows through the small hole at the end of the slide valve, causing the fork to slowly descend.

#### 5. Working principle of speed limiting valve

The speed limit valve controls the lowering speed of the fork, and the throttling of the spool narrows the oil return passage, so the oil return is reduced accordingly, and the lowering speed of the fork is slowed down to avoid risks caused by too fast lowering speed.

#### 6. Gear pump failure analysis

| Phenomenon             | Reason   | Approach   |
|------------------------|--|--|
| Low oil discharge      | Tank level low   | Refuel to the specified amount   |
|                        | Oil pipe or oil filter clogged   | Clean or replace   |
| Low pump pressure      | liner damage Support damage<br>Seals, bushing seals or back-up rings are not | Replace  |
|                        | Improper adjustment of relief valve  | Use a pressure gauge to adjust the pressure of the relief valve to the specified value |
|                        | Air in the system  | Re-tighten the suction side oil pipe to refuel Check pipe or repair oil filter         |
| Noisy during operation | Damaged oil suction pipe or clogged oil filter                               |  |
|                        | Oil suction side is loose or leaking air                                     | Loose fastening  |
|                        | Oil viscosity too high   | Replace with an oil of viscosity suitable for the operating temperature of the pump    |
|                        | Air bubbles in oil   | Find out the cause of bubbles and take action  |
| Pump oil leak          | Damaged pump oil seal or sea   | Replace  |
|                        | Pump damage  | Replace  |

## 4.4 Drive System

### 4.4.1 Summary of Drive System

|   |                    |
|---|--------------------|
| Drive wheel<br>Drive wheel diameter x width | PU wheel<br>380x16 |
| Weight                                      | 5<br>35kg          |
| Gear Oil Capacity                           | 3.7L               |
| Type of oil used                            | 85W/90             |

The transmission device of the three-way stacker is mainly a mechanical gearbox. The driving wheel is fastened to the flange of the drive half shaft through the hub bolts, and the power is transmitted to the drive shaft through the mechanical gearbox to drive the driving wheel to rotate.

The mechanical gearbox is mainly composed of a box body, a box cover, gears, gear shafts and seals, etc. The power of the motor is transmitted to the input shaft through the gears, and the power of the input shaft is transmitted to the output shaft through a pair of spiral bevel gears, thereby driving the drive wheel to rotate. The entire space of the box is sealed with gear oil to lubricate each part.

### 4.4.2 Driving System Adjustment Essentials

#### 1). Remove the drive wheel

Note: You can use the head of the fork of a counterbalanced forklift to lift the rear panel of the rear frame, and lift the vehicle slightly before using it.

The sleepers are placed on the lower parts of the fork legs on both sides, and then the frame is lowered onto the sleepers, and then the forklift can be exited.

2. Turn the steering wheel so that the side of the drive wheels faces rearward;
3. Remove all the bolts that install the drive wheel;
4. The bolt in the center of the hub is replaced with a drive wheel mounting bolt;
5. Unscrew the center bolt of the hub and eject the drive wheel.

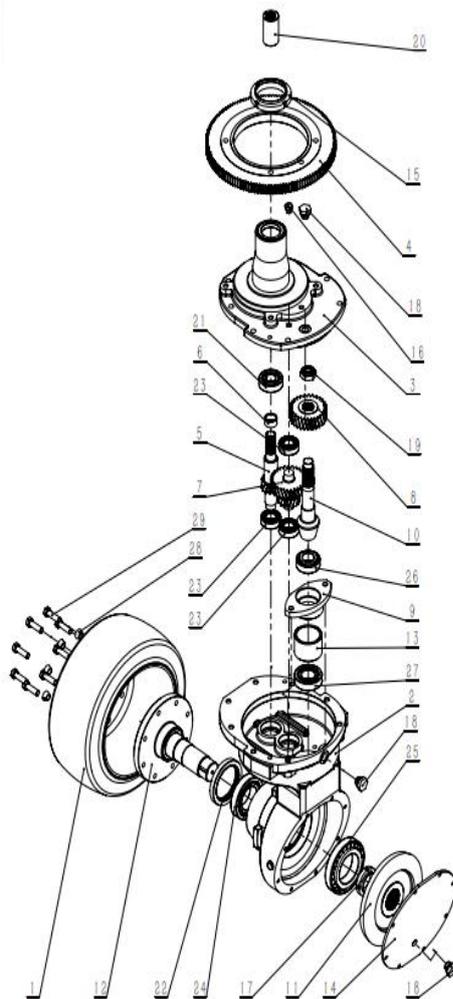
#### 2). Install the drive wheel

1. Align the hub bolt mounting hole with the screw hole of the drive shaft and install the drive wheel;
2. Screw on the bolt (apply anti-loose glue on the thread);
3. Screw to the specified torque;
4. Tightening torque: (650~900kg.cm);
5. Assemble hub center bolts;
6. Turn the steering wheel so that the drive wheels return to the straight state;
7. remove spacers

### 3). Addition of gear oil

When adding gear oil to the gear box, please follow the steps below:

1. Add gear oil from the installation part of the vent pipe to fill the gear box with gear oil;
2. After about ten minutes, check the amount of oil from the reference hole, and add it from the breather pipe installation part if it is insufficient.



1. Drive wheel 2. Box body 3. Box cover 4. Large ring gear

5. Input gear shaft 6. Sleeve 7. Duplex gear

8. Passive gear 9. Bevel shaft support

10. Bevel gear shaft 11. Spiral bevel gear 12. Half shaft

13. Bevel gear sleeve 14. Bottom cover 15. Large round nut 16. Vent plug 17. Medium round nut

18. Vernier plug assembly 19. Small round nut

21. Deep groove ball bearing 22. FB type lip seal ring 23-27. Single row tapered roller bearing 28. Hub expansion pad 29. Hub bolt

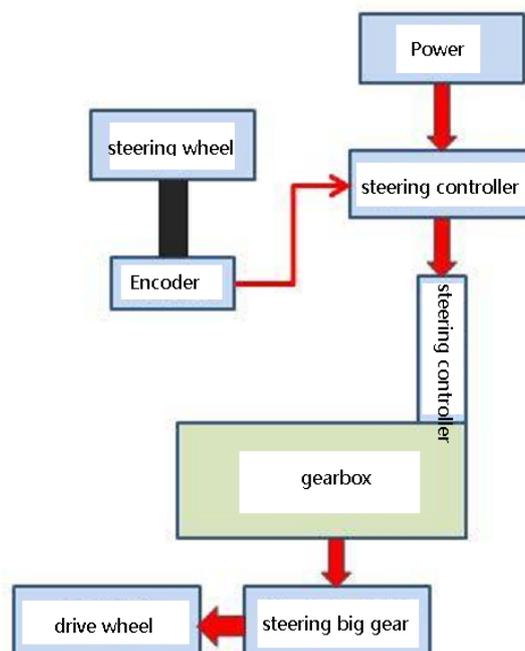
## 4.5 Steering System

### 4.5.1 Outline of Steering System Structure

All MC series stand-on three-way stacker trucks adopt pure electric steering system, which is a non-linear control steering system without connecting rod. It is mainly used for electric forklifts whose steering is controlled by the steering wheel. The rotating electric signal is transmitted to the AC steering motor, and the AC steering motor then drives the driving wheel to rotate, and the steering angle of the wheel and the angle of the handle are synchronized in real time

### 4.5.2 Principle of Pure Electric Steering System

As shown in the figure below: After the power is turned on, the driver rotates the steering wheel, the encoder under the steering wheel transmits the rotation signal to the steering controller, and the steering controller controls the AC steering motor to drive the drive wheel to rotate through the large ring gear.



It can be seen from the above that the core components of this system are encoder, steering controller and AC steering motor. Therefore, the stable operation of the system must ensure that the steering controller program protection function is perfect and the encoder assembly and debugging are accurate.

### 4.5.3 Advantages of Pure Electric Steering System



The structure of the pure electric steering system adopts a modular design, which is easy to install and has good maintenance performance; the steering is light, the steering force is reduced, the direction is followed in real time, and the road feeling is good; the controller has a self-diagnosis function, and the fault is output by the indicator light; no pollution, no noise It can save energy by about 80% under various driving conditions.

#### 4.5.4 Precautions

The pure electric steering system is a high-precision, sensitive, energy-saving, environmentally friendly and high-performance steering system. Correct use and maintenance can ensure the performance of the steering system and improve the service life of the steering system. It must be strictly followed during use. The following rules:

- 1)Keep the battery in good condition: battery loss will affect the steering and become heavy, and will also affect the normal operation of other electronic control systems in the vehicle
- 2)All the connectors of the system must be in good contact: the connectors should not be placed in a humid and high temperature environment, and their electrical conductivity must be guaranteed;
- 3)The wiring harness is not shared with other electronic control systems: the pure electric steering wiring harness and fuse are dedicated to the electronic steering system, and must not share the wiring harness with other electronic control systems in the vehicle, so as not to affect its power supply performance;
- 4) The controller cannot be placed in a humid or high temperature place;
- 5) During testing and use, all connectors are strictly prohibited from being plugged and pulled out with power on;
- 6) Pay attention to the fixing and protection of the wiring harness.

#### 4.5.5 LED Display Light for EPS Controller

The electric steering controller is equipped with LED display lights, which display different information through the flickering changes of the LED lights. As shown below.



Two LED lights (one red, one yellow) show all current fault messages. Among them, the red light flashes once, indicating that the number of flashes of the yellow light below is the first number of the fault code, and the red light flashes twice, indicating that the number of flashes of the yellow light below is the second number of the fault code. That is: the red light flashes once, then the yellow light flashes 4 times. Then the red light flashes 2 times, then the yellow light flashes 2 times, so the DTC is 42.

| LED display information description                      |  |
|--|--|
| show   | information  |
| both are off   | The controller power is not connected;<br>or a dead vehicle battery;<br>or other serious failures. |
| Yellow LED flashes normally                              | Controller is working fine   |
| Two lights are always on                                 | The controller is in the state of program loading  |
| Yellow and red lights flash alternately and continuously | Yellow and red lights flash alternately and continuously   |

After a fault occurs, find the corresponding fault content according to the fault code displayed by the controller, and then check whether the corresponding components are loosely fastened, whether the wiring harness is intact, whether the terminals are dropped or loose, resulting in poor contact, and whether the components are damaged.

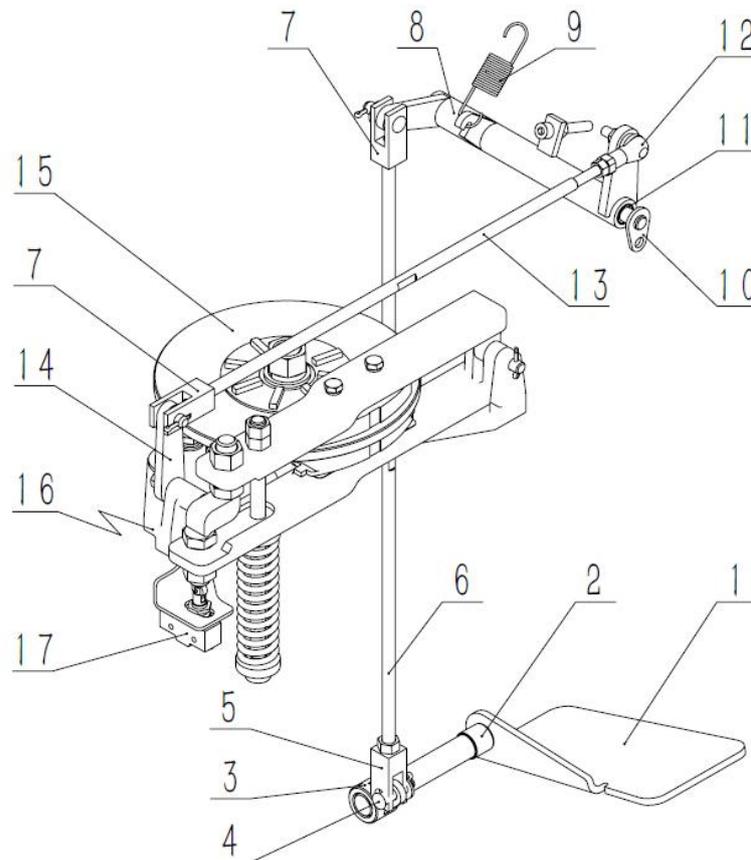
## 4.5.6 Common Fault Code Table

| Error Code | Name                               | Possible cause of failure   | Produce   | Method of exclusion   |
|------------|------------------------------------|---|---|---|
| 12         | Controller overcurrent 2           | 1. Motor UVW short circuit<br>2. Motor parameter misadjustment<br>3. Controller failure   | 1.Phasecurrent>120% of reference current limit<br>2.The phase current exceeds the current measurement limit   | Restart key switch  |
| 13         | Current sensor failure             | 1.UVW leakage to the car body<br>2.Controller failure   | The controller current sensor detected an invalid value   | Restart key switch  |
| 14         | Precharge                          | 1.The external load prevents the capacitor from charging<br>2.The controller is faulty  | The voltage of the capacitor can not be charged to 75% of the keys witch voltage  | Restart key switch  |
| 22         | Controller over temperature        | 1.The controller is unreasonably fixed or unreasonably cooled<br>2.The vehicle load is too large<br>3.The controller runs in aharsh environment | The temperature sensor of the controller has been greater than or equal to 85°C   | Temperature is less than 85°C                               |
| 27         | The motor is seriously over heated | 1. The motor is running in an extreme environment<br>2. The temperature control parameters of the motor are misadjusted                         | The sensor enable parameter status is ON, and the motor temperature is greater than the maximum temperature set by the program  | Restart key switch  |
| 28         | motor overheating deceleration     | 1. The motor is running in an extreme environment<br>2. The temperature control parameters of the motor are misadjusted                         | The status of the sensor enable parameter is ON, and the motor temperature is greater than the overheating temperature set by the program   | Sensor temperature is below programmed overheat temperature |
| 31         | Contactora open/short              | 1. The connection load is open or short-circuited<br>2. The connection pins are dirty<br>3. Wrong wiring  | Contactora drive output open circuit or short circuit   | Restart key switch  |
| 36         | Motor stall                        | 1.The steering motor is locked<br>2.Encoder failure<br>3.The cable is curled or the wiring is wrong<br>4.The encoder powers apply is faulty     | The motor is required to run at > 25% of the maximum motor speed or >95% of the available motor current when the motor speed is less than the programmed stall speed during the set stall time          | Restart key switch  |
| 53         | Return position not found          | Return switch failure   | When returning to the position, the distance between the wheel position when the return variable changes and the original position at the time of returning is greater than the parameter setting value | Restart key switch  |

|    |                           |   |   |                    |
|----|---------------------------|---|---|--------------------|
| 56 | Wheel position monitoring | Faulty position feedback device                         | <p>1.The difference between the wheel position and wheel position 2 is greaterthan the wheel position tolerance parameter for more than 80ms</p> <p>2.The difference between the wheel position and the encoder 3 position is greater than the encoder position tolerance</p> | Restart key switch |
| 71 | Software glitch 5         | <p>1. Software failure</p> <p>2. Controller failure</p> | Communication failure between internal microprocessors  | Restart key switch |

## 4.6 Braking System

### 4.6.1 Summary of Brake Control Structure



- 1.Foot pedal 2.Sliding bearing 3.Pedal rocker cover 4.Pin 5.Pitman head 6.Longitudinal link  
7.Left pitman head 8.Rotary sleeve welding 9.Return spring 10.Rotary shaft welding 11.Sliding bearing  
12.Ball bearing connector 13.Pin 14.Lifting tab 15.Brake disc 16.Brake clamp assembly 17.Micro switch

When the forklift starts, the driver must press the pedal with his left foot and open the caliper through the linkage mechanism so that the motor shaft can rotate freely and the forklift can drive. When the driver needs to brake, he only lifts his left foot and releases the pedal. The brake caliper on the caliper clamps the brake disc fixed on the motor shaft tightly under the action of the spring force, and the forklift realizes braking. Since the brake force acts on the high speed side, the braking effect is very obvious. The degree of pedal relaxation affects the size of the braking force. The skilled driver can achieve different braking effects by controlling the number or speed of the relaxation pedal.

The normal pedal and the horizontal plane maintain an inclination of 25-30 degrees. If the inclination angle is too small, the brake disc cannot be fully released.

At this time, the forklift's running resistance and power consumption will increase. In severe cases, the electronic control and the motor will be burned, which is very unfavorable for the forklift. Since the linkage mechanism is connected to the travel switch, the forklift will only be started electrically when the driver steps on the pedal. When the driver leaves the forklift or releases the pedal for other reasons, the power supply of the forklift driving system is automatically cut off to ensure safety.

#### **4.6.2 Overview of Brake Structure**

The brake consists of a brake disc (fixed on the motor shaft), a brake caliper fixing plate, an upper brake caliper, a lower brake caliper, a spring, a cam, a lifting piece, an adjusting bolt, etc.

When the pedal rotates the cam through the linkage mechanism, pushes away the adjusting bolt fixed on the brake caliper, and releases the brake disc that was held tightly by the spring force, the forklift will change from the braking state to the walking state. When the forklift is moving, there is a gap of about 0.2~0.5mm between the brake pads and the brake disc to ensure the reliability of braking. When the forklift is used for a long time, the brake pads will be worn, and the position of the adjusting bolt should be adjusted so that If the gap is within the required range, tighten the nuts to ensure reliable braking. When the required gap cannot be achieved by adjusting the bolts, replace the brake pads.

#### **4.6.3 Key Points for Adjusting the Braking System**

##### **1). Adjustment of the pedal height**

Loosen the locking nut on the longitudinal link;

Turn the longitudinal link to adjust the height of the pedal (the angle between the pedal and the horizontal plane is 25-30 degrees);

Tighten the lock nut.

##### **2). Adjustment of brake pad clearance**

Depress the brake pedal to the bottom and hold it there;

Adjust the adjusting bolt on the brake caliper to keep the gap between the brake pad and the brake disc consistent (gap: 0.3~0.4mm).

### 3). Adjustment of braking force

Braking force is adjusted by adjusting the length of the spring by adjusting the bolt.

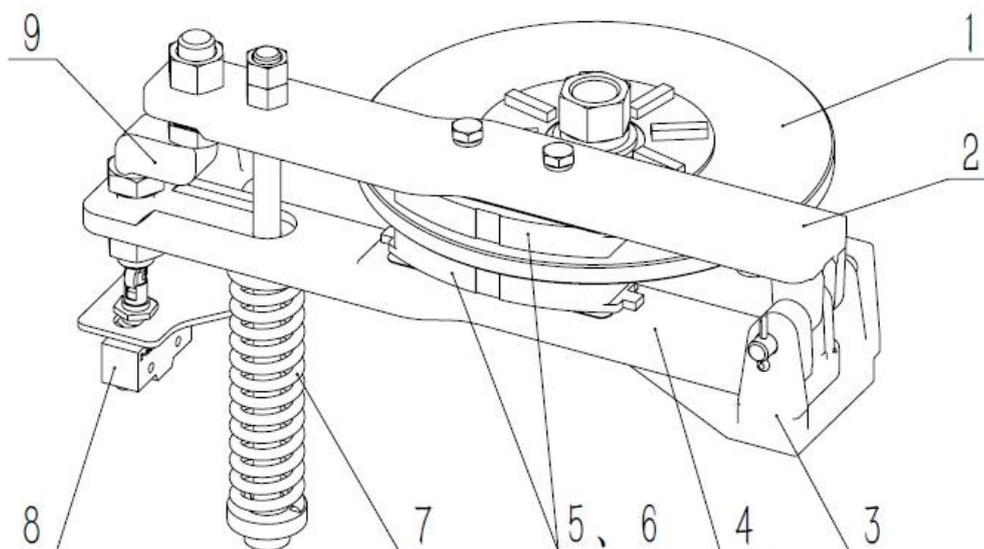
### 4). Replacement of brake pads

After the forklift has been used for a period of time, the brake pads will be worn, it can be used continuously through adjustment. When the required clearance cannot be guaranteed through adjustment, the brake pads must be replaced according to the following steps:

Loosen the adjustment bolts to reduce the gap between the brake pads and the brake disc;

Remove the mounting bolts and brake pads;

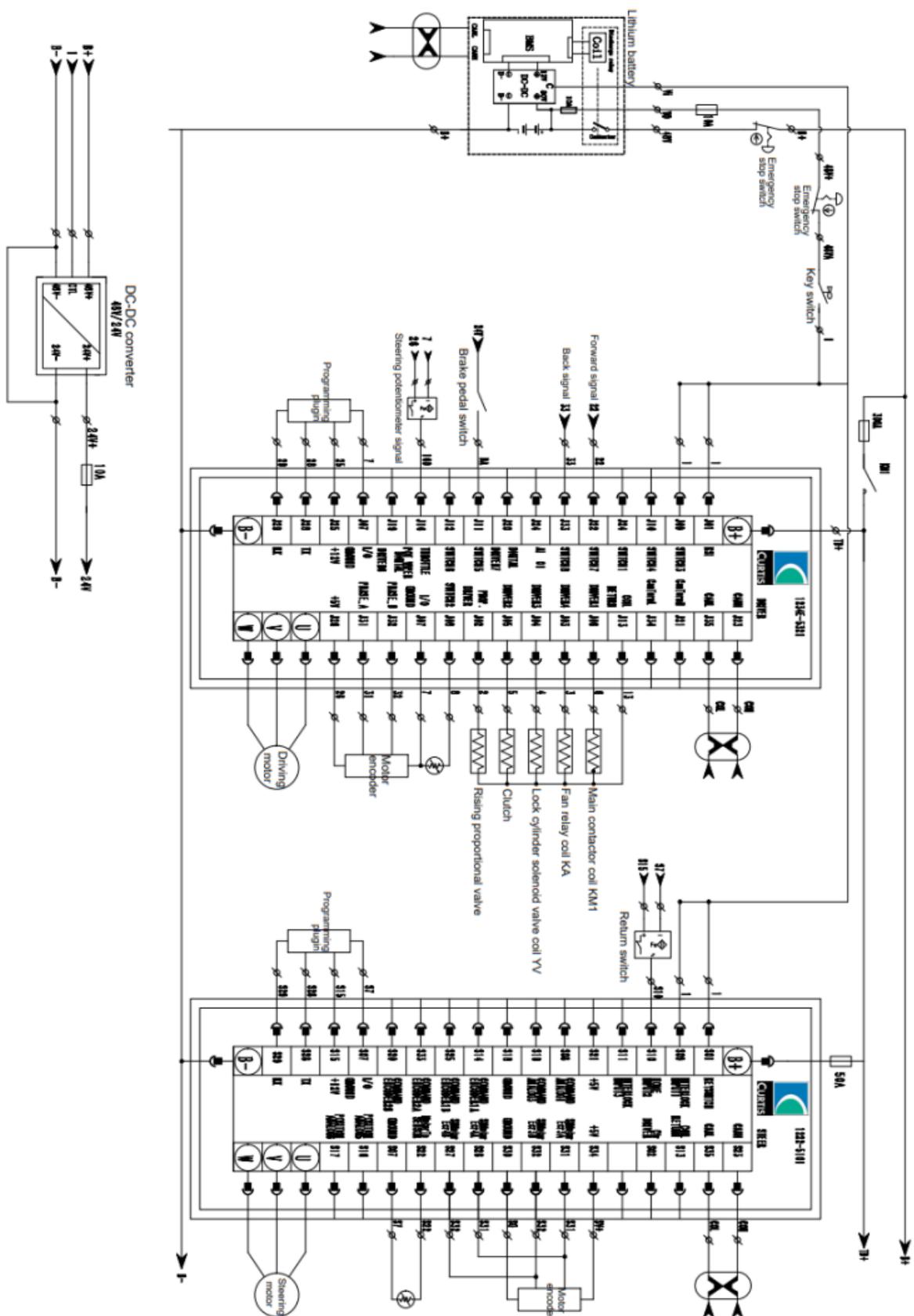
Use adjustment bolts to expand the gap between the caliper and the brake disc and install the new brake pad (tightening torque: 180 to 270 kg.cm).

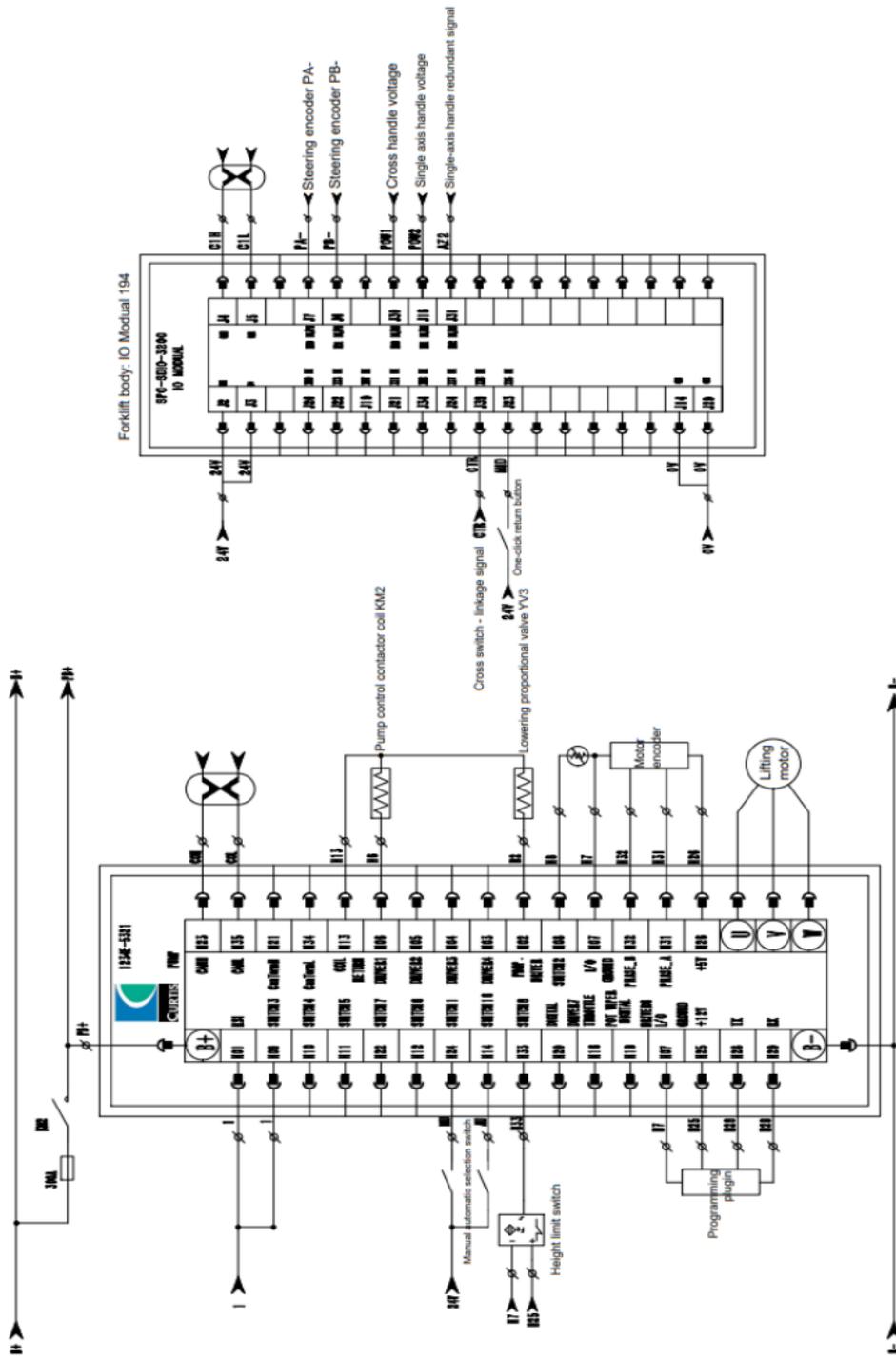


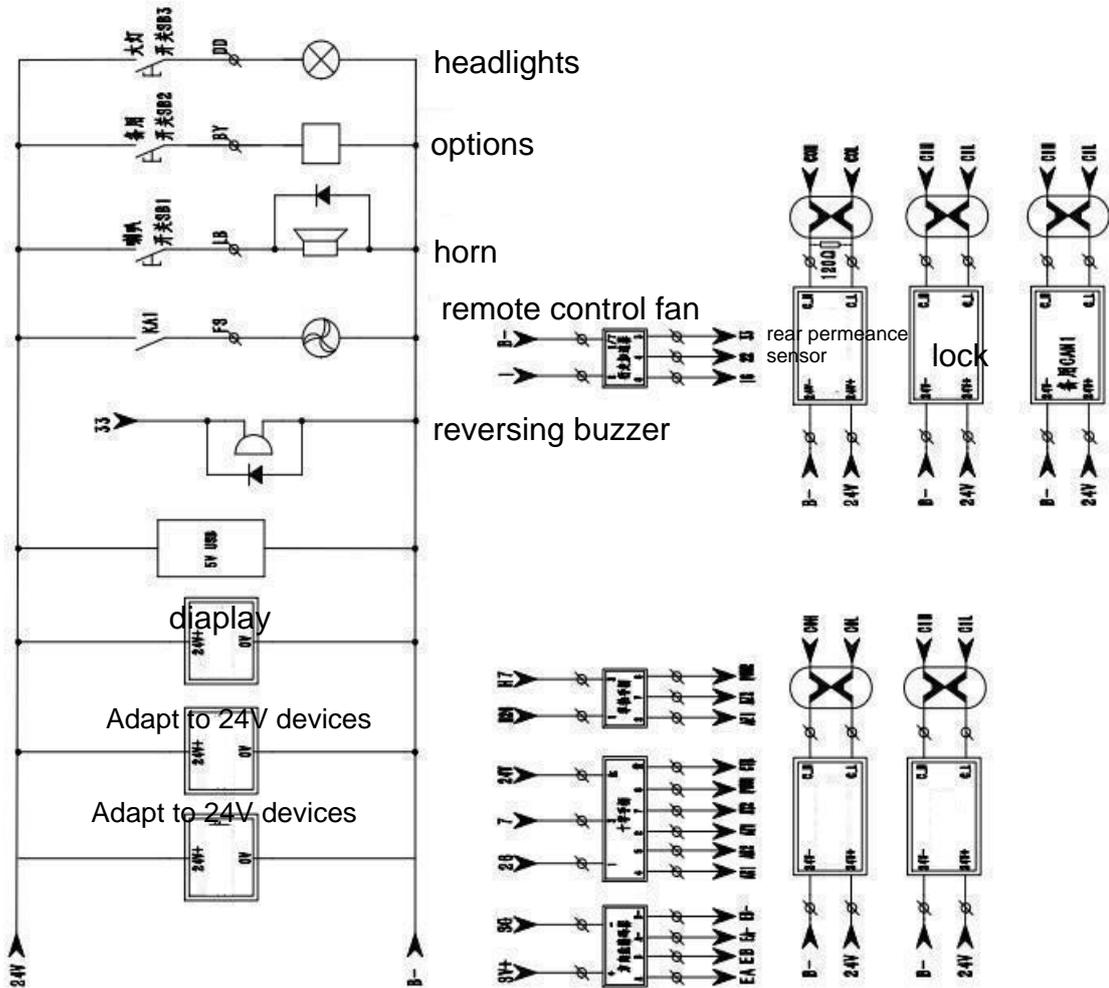
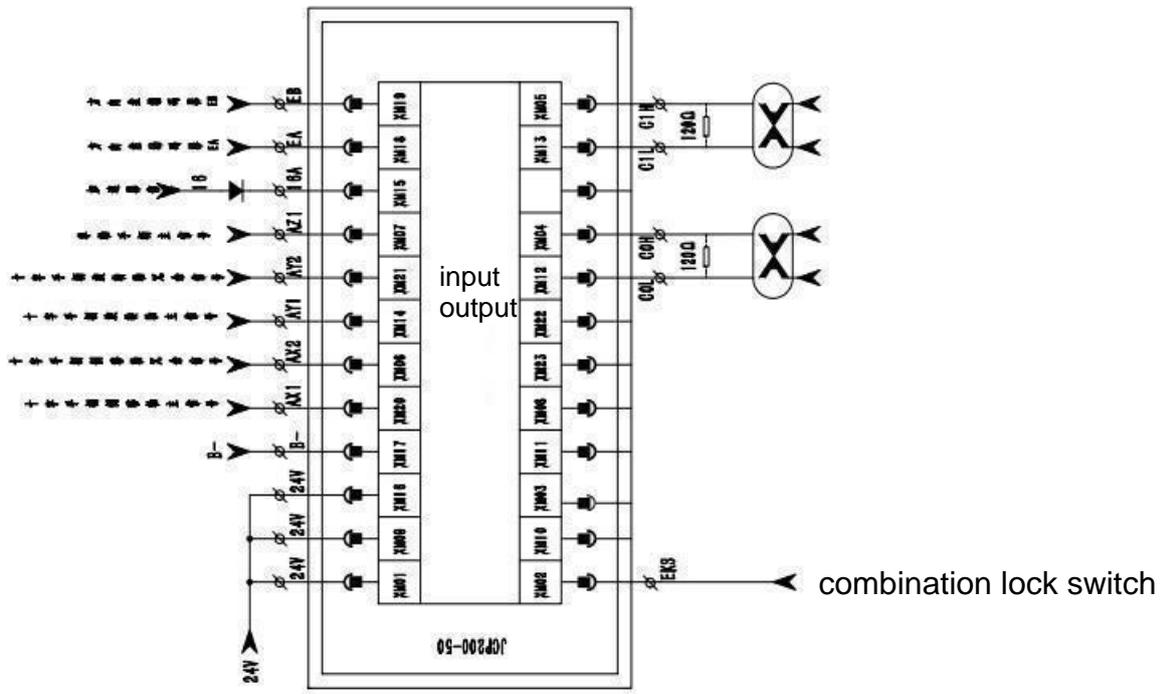
- 1.Brake disc    2.Upper brake caliper    3.Brake clamp fixed plate  
4.Lower brake caliper    5.Brake block    6.Brake block adjustment pad  
7.Brake spring assembly    8.Micro Switch    9.Cam

## 4.7 Electrical System

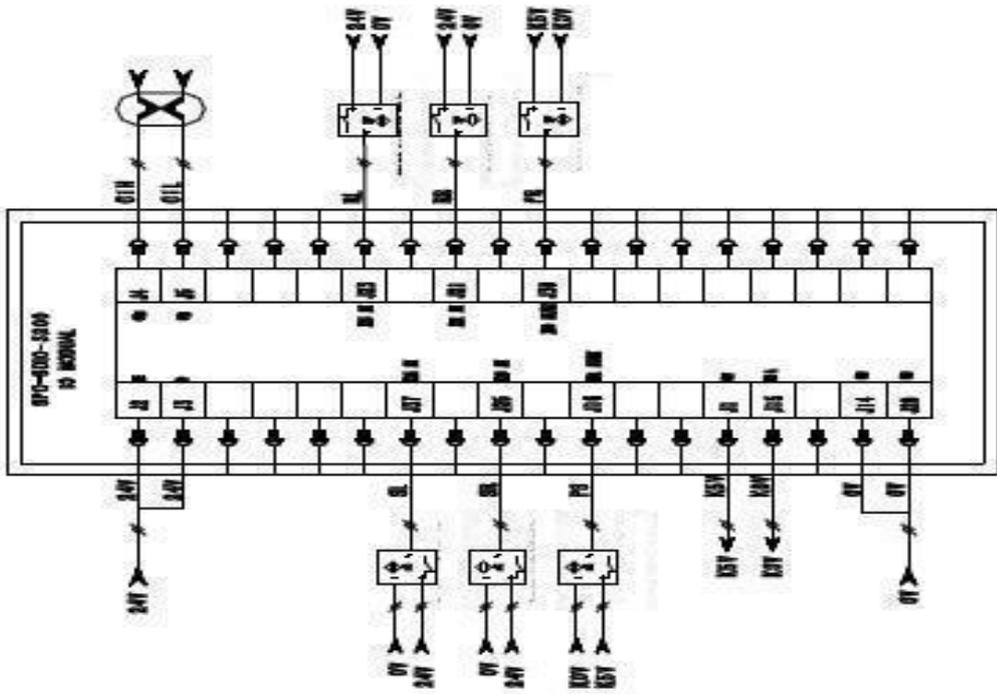
### 4.7.1 Electrical Schematic Diagram



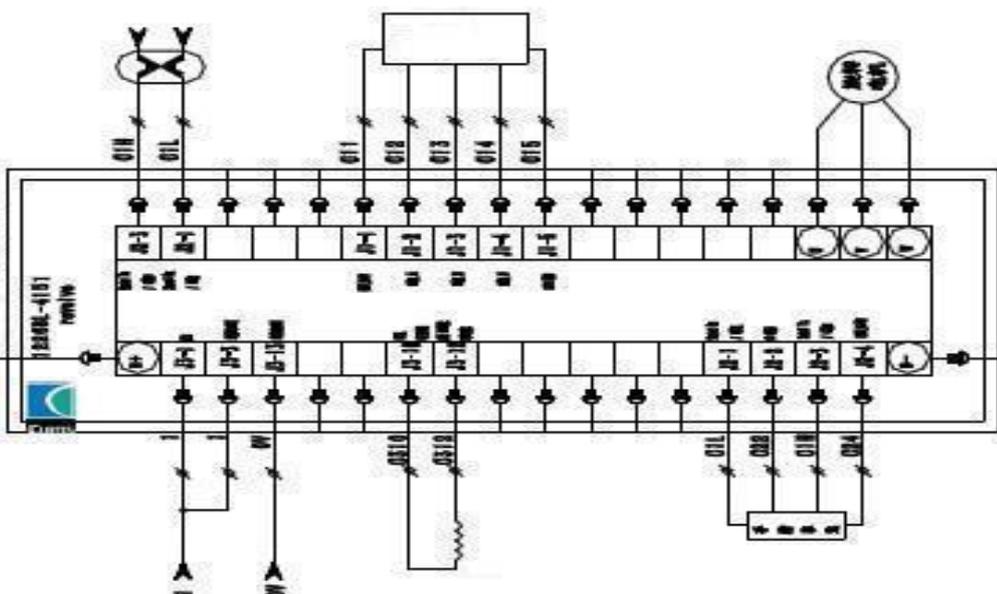




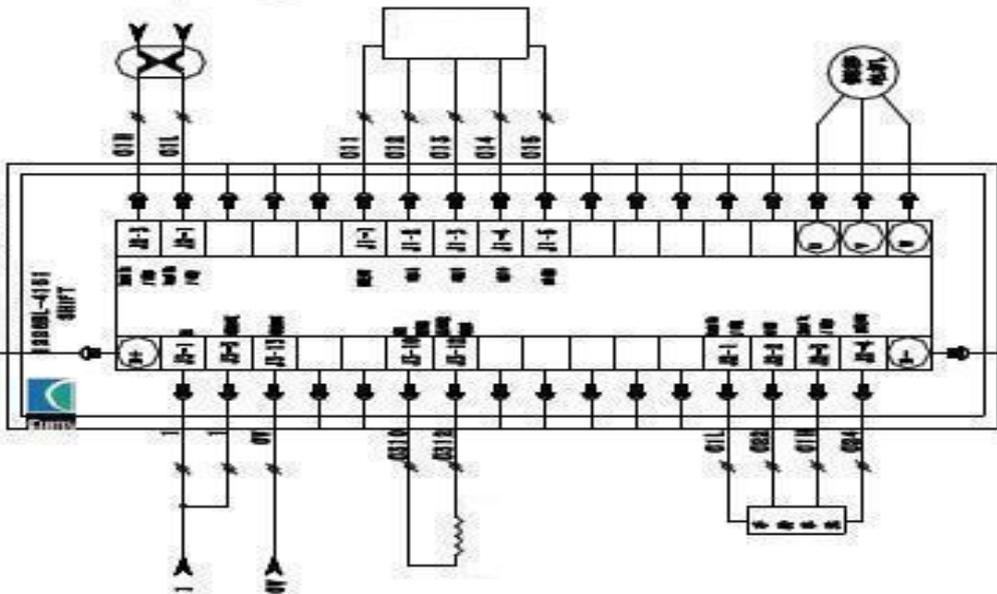
10模块1B3  
electric  
forkhead



旋转控制器  
electric  
forkhead



调速控制器  
electric  
forkhead



## 4.7.2 Battery Fault Analysis

| failure                          | features   | cause   | Remedial and Preventive Measures   |
|----------------------------------|--|---|--|
| Plate irreversible sulfation     | <ol style="list-style-type: none"> <li>1. Battery capacity is reduced.</li> <li>2. Electrolyte density is lower than normal.</li> <li>3. The battery terminal voltage is too high at the start of charging and at the end of charging.</li> <li>4. Air bubbles are generated prematurely during charging or bubbles are generated at the beginning of charging.</li> <li>5. Electrolyte temperature rises too fast during charging</li> </ol>  | <ol style="list-style-type: none"> <li>1. Insufficient initial charge.</li> <li>2. The battery has been placed in a discharged or half-discharged state for too long.</li> <li>3. Insufficient charging for a long time.</li> <li>4. Frequent excessive discharge.</li> <li>5. The electrolyte density exceeds the specified value.</li> <li>6. The liquid level of the electrolyte is too low, causing the liquid surface to be exposed on the plate.</li> <li>7. Failure to perform equalization charging in time.</li> <li>8. The discharge current is too large or too small.</li> <li>9. The electrolyte is impure.</li> <li>10. Internal short circuit partial action or leakage</li> </ol> | <ol style="list-style-type: none"> <li>1. For the light ones , use the method of balanced charging.</li> <li>2. Severe cases use "water therapy".</li> <li>3. Do not over discharge.</li> <li>4. The electrolyte density cannot exceed the specified value.</li> <li>5. The liquid level and impurity content of the electrolyte should be within the specified range</li> </ol> |
| Battery internal circuit failure | <ol style="list-style-type: none"> <li>1. When charging, the battery terminal voltage is very low, even close to zero.</li> <li>2. Few or no bubbles at the end of charging</li> <li>3. When charging, the temperature of the electrolyte rises quickly, and the density rises slowly, or even does not rise.</li> <li>4. The open circuit voltage of the battery is low, and it drops to the termination voltage prematurely during discharge.</li> <li>5. Serious self-discharge.</li> </ol> | <ol style="list-style-type: none"> <li>1. The plate is bent, and the active material expands or falls off, causing damage to the separator and causing a short circuit.</li> <li>2. Too much precipitated material, causing a short circuit.</li> <li>3. A conductive object falls into the battery, causing a short circuit</li> </ol>   | <ol style="list-style-type: none"> <li>1. Replace the bulkhead.</li> <li>2. Remove sediment and conductive matter.</li> <li>3. Replace the plate</li> </ol>  |
| battery life decay               | <ol style="list-style-type: none"> <li>1. Battery capacity is reduced.</li> <li>2. Electrolyte is cloudy.</li> <li>3. Excessive sediment.</li> </ol>   | <ol style="list-style-type: none"> <li>1. Electrolyte does not meet quality standards.</li> <li>2. Too frequent charging and discharging or overcharging and overdischarging</li> <li>3. The electrolyte temperature is too high during charging.</li> <li>4. When discharging, the external circuit is short-circuited.</li> </ol>   | <p>The light ones remove the sediment, and the heavy ones are scrapped</p>   |

### 4.7.3 Maintenance and Charging of Battery

Safety operation rules for using batteries:

1. Before operating the battery, the forklift must be parked in the specified position according to the regulations.
2. The charging, maintenance and replacement of the battery can only be carried out by specially trained technicians, and the operating instructions must be strictly followed during the operation, as well as the relevant regulations of the battery and charger manufacturer.
3. Do not smoke or use naked flames around the battery. At least 2 meters around the forklift that needs to be charged, no flammables and equipment that may generate sparks should be placed. The work site must have good ventilation and be equipped with fire extinguishing equipment.
4. The battery and charger must be kept dry and clean, avoiding water. Terminal posts and cable lugs must be kept tight, clean and protected with a small amount of special grease. If the electrodes of the battery are not insulated and protected, or the protective layer falls off, the electrodes must be covered with a non-slip insulating mat for protection.
5. To dispose of waste batteries, you must strictly abide by the environmental protection regulations of the country where you are located or the relevant regulations on waste disposal. During the waste treatment process, the operation must be strictly followed by the battery manufacturer's instructions.
6. The liquid in the battery is corrosive to a certain extent. Therefore, before any operation on the battery, you must wear protective clothing and protective glasses, and absolutely avoid direct contact with the battery liquid. If the liquid from the battery accidentally gets on the clothes, skin, or enters the eyes, the contact area must be washed with plenty of water immediately, and if there is skin or eye contact, it should be checked by a doctor in time. Spilled battery fluid must be neutralized or diluted immediately.
7. When closing the door of the battery box, it is necessary to check whether the cables of the battery are damaged.
8. The battery can only be used when the battery box door is closed.
9. The weight and size of the battery have a great influence on the operation safety of the forklift, and the consent of the company must be obtained when replacing the battery or battery auxiliary equipment delivered with the truck.

**Battery charging specification:**

1. Park the forklift in the charging area according to the regulations. After the vehicle is powered off, press the emergency stop switch.
2. Plug or unplug the battery plug only when the forklift and charging facilities are powered off.
3. In order to ensure a good heat dissipation effect during charging, the surface of the battery must be exposed.
4. Before charging the battery, it is necessary to check whether there is any obvious damage on all cable connections and plug connection parts, and there must be no other metal objects on the surface of the battery.
5. Must strictly abide by the relevant safety regulations of the battery and charging equipment manufacturers.

**4.7.4 Analysis of Drive Controller Fault Codes**

| NO | Programmer display content  | code | Possible cause of failure   | Deep fault cause/solution  |
|----|---|------|---|--|
|    | Malfunction   |      |   |  |
| 1  | <b>Controller Overcurrent</b><br>motor stops working<br>main connector disconnected<br>Accelerator failure<br>brake<br>pump stops working                                     | 12   | 1. The external U, V or W connection of the motor is short-circuited<br>2. The motor parameters do not match<br>3. Controller failure | Reason: The phase current exceeds the limit current<br>Solution: Restart the key switch  |
| 2  | <b>Current Sensor Fault</b><br>motor stops working<br>main connector disconnected<br>Electromagnetic brake disconnected<br>Accelerator failure<br>brake<br>pump stops working | 13   | 1. The motors U, V, and W are short-circuited to the car body through the stator, resulting in leakage<br>2. Controller failure       | Reason: reading deviation of controller current sensor<br>Solution: Restart the key switch   |
| 3  | <b>Precharge Failed</b><br>motor stops working<br>main connector disconnected<br>Electromagnetic brake disconnected<br>Accelerator failure<br>brake<br>pump stops working     | 14   | 1. The positive terminal of the capacitor is connected to an external load, so that the capacitor cannot be charged normally          | Cause: The input voltage of the key switch fails to charge the capacitor<br>Solution: through VCL function<br>precharge() reset or interlock switch re-enter |
| 4  | <b>Controller Severe</b>  | 15   | 1. The working environment of the controller is too harsh   | Reason: radiator temperature is lower than   |

|    |   |    |   |   |
|----|---|----|---|---|
|    | <b>Undertemp</b><br>1.Motor stops working<br>2.Main connector disconnected<br>3.EM brake disconnected<br>4.Accelerator failure<br>5.Brake<br>6.Pump stop working                  |    |   | -40°C<br><br>Solution:<br>Raise the temperature to above -40°C and restart the key switch or interlock switch   |
| 5  | <b>Controller Severe Overtemp</b><br>1.Motor stops working<br>2.Main connector disconnected<br>3.EM brake disconnected<br>4.Accelerator failure<br>5.Brake<br>6.Pump stop working | 16 | 1.The working environment of the controller is too harsh<br>2.The vehicle is overloaded<br>3.Controller installation error  | Cause:<br>The radiator temperature is higher than 95°C<br>Solution: Lower the temperature to below 95°C and restart the key switch or interlock switch            |
| 6  | <b>Severe Under voltage</b><br>Drive torque reduction   | 17 | 1.The battery parameters are set incorrectly<br>2.Power consumption of the controller system<br>3.The battery impedance is too large<br>4.The battery is disconnected continuously<br>5.The fuse is off, or the main contactor is not connected | Cause:<br>The capacitor voltage is lower than the minimum voltage limit when the MOSFET bridge is working<br>Solution:<br>Increase the capacitor voltage          |
| 7  | <b>Severe Over voltage</b><br>1.Motor stops working<br>2.Main connector disconnected<br>3.EM brake disconnected<br>4.Accelerator failure<br>5.Brake<br>6.Pump stop working        | 18 | 1.The battery parameters are set incorrectly<br>2.The battery impedance is too high<br>3.The battery connection is disconnected during regenerative braking   | Cause:<br>The capacitor voltage exceeds the maximum voltage limit when the MOSFET bridge is working<br>Solution:<br>Reduce the voltage and restart the key switch |
| 8  | <b>Controller Undertemp Cutback</b><br>No faults whatsoever (unless the VCL is set to produce fault symptoms)   | 21 | 1.The controller works under restricted conditions<br>2.The working environment of the controller is harsh  | Cause:<br>The radiator temperature is lower than -25°C<br>Solution: Raise the radiator temperature to above -25°C   |
| 9  | <b>Controller Overtemp Cutback</b><br>Drive and regenerative braking torque reduction   | 22 | 1.The working environment of the controller is too harsh<br>2.The vehicle is overloaded<br>3.Controller installation error  | Cause: The radiator temperature exceeds 85°C<br>Solution: Lower the temperature   |
| 10 | <b>Undervoltage Cutback</b>   | 23 | 1.Low battery<br>2.The battery parameters are set incorrectly   | 原因：电容电压过低<br>解决：提升电容电压  |

|    |   |    |  |   |
|----|---|----|--|---|
|    | Drive torque reduction  |    | 3.Non-controller systems run out of battery<br>4.The battery impedance is too large<br>5.The battery connection is disconnected<br>6.The fuse is disconnected or the main contactor is disconnected  |   |
| 11 | <b>Over voltage Cutback</b><br>Regenerative braking torque reduction  | 24 | 1.The regenerative braking current increases the battery voltage during regenerative braking<br>2.The battery parameters are set incorrectly<br>3.The battery impedance is too large<br>4.The battery connection is disconnected during regenerative braking   | Cause:<br>The capacitor voltage exceeds the maximum voltage limit when the MOSFET bridge is working<br>Solution:<br>Reduce the capacitor voltage                                  |
| 12 | <b>+5V Supply Failure</b><br>Controller output 5V power failure<br>No faults whatsoever (unless the VCL is set to produce fault symptoms) | 25 | 1. The external load impedance is too low  | Cause: 5v output has more than $\pm 10\%$ error range<br><br>Solution: adjust the output voltage to the normal range  |
| 13 | <b>Digital Out 6 Failure</b><br>Drive 6 output cannot be turned on  | 26 | 1. The external load impedance is too low  | Cause: Drive 6 output current exceeds 15mA<br>Solution: adjust the load, then restart the driver with VCL setting "set_digout()"  |
| 14 | <b>Digital Out 7 Over current</b><br>Drive 7 output cannot be turned on   | 27 | 1. The external load impedance is too low  | Reason: Drive 7 output current exceeds 15mA<br>Solution: adjust the load, then restart the driver with VCL vsetting "set_digout()"  |
| 15 | <b>Motor Temp Hot Cutback</b><br>Drive torque reduction   | 28 | 1.The temperature of the motor reaches or is higher than the warning temperature set by the program, resulting in a decrease in the current output<br>2.The motor temperature parameter setting is incorrect<br>3.If the motor does not use a temperature sensor, the programming parameters "Temp compensation" and "Temp cutback" must be set to "OFF" | Cause: The input voltage value of the motor temperature sensor is 0 or higher than 10V<br>Solution: Return the motor temperature to the normal range                              |
| 16 | <b>Motor Temp Sensor Fault</b><br>The maximum speed is reduced to the LOS state, and the motor temperature protection function is failure | 29 | 1. The motor temperature sensor is connected incorrectly<br>2. If the motor does not use a temperature sensor, the programming parameter "Temp compensation and Temp cutback" must be set to "OFF"   | Cause: The input voltage value of the motor temperature sensor is 0 or greater than 10V<br>Solution: Adjust the input voltage of the motor temperature sensor to the normal range |
| 17 | <b>Coll 1 Driver Open/Short</b>   | 31 | 1.Connected load open/short  |   |

|    |   |    |  |   |
|----|---|----|--|---|
|    | Drive 1 output connection coil is open or shorted<br>Drive 1 output off   |    | 2.Connected pins defiled<br>3. Wrong wiring                                | Cause: Diver1 output (6-pin) Open/Short. This fault only occur when "Main Enable" is set to be "OFF"<br>Solution: Correct open/short error, restart output      |
| 18 | <b>Main Open/Short</b><br>1.Motor stops working<br>2.Main connector disconnected<br>3.EM brake disconnected<br>4.Accelerator failure<br>5.Brake 6.Pump stop working | 31 | 1.Connected load open/short<br>2.Connected pins defiled<br>3. Wrong wiring | Cause: Main contactor coil (6pins) Open/Short. This fault only occur when "Main Enable" is set to be "ON"<br>Solution: Correct open/short error, restart output |
| 19 | <b>Coll 2 Driver Open/Short</b><br>Drive 2 output connection coil is open or shorted<br>Drive 2 output off  | 32 | 1.Connected load open/short<br>2.Connected pins defiled<br>3. Wrong wiring | Cause: Driver2 output (5-pin) Open/Short. This fault only occur when "EM Brake Type" is set to be "0"<br>Solution: Correct open/short error, restart output     |
| 20 | <b>EM brake Open/Short</b><br>Electromagnetic brake coil open/short<br>1.EM brake disconnected<br>2.Accelerator failure<br>3.Brake                                  | 32 | 1.Connected load open/short<br>2.Connected pins defiled<br>3. Wrong wiring | Cause: EM brake output (5-pin) Open/Short. This fault only occur when "EM Brake Type" is set above "0"<br>Solution: Correct open/short error, restart output    |
| 21 | <b>Coll 3 Driver Open/Short</b><br>Drive 3 output connection coil is open or shorted<br>Drive 3 output off  | 33 | 1.Connected load open/short<br>2.Connected pins defiled<br>3. Wrong wiring | Cause: Driver3 output (4-pin) Open/Short<br>Solution: Correct open/short error, restart output  |
| 22 | <b>Coll 4 Driver Open/Short</b><br>Drive 4 output connection coil is open or shorted<br>Drive 4 output off  | 34 | 1.Connected load open/short<br>2.Connected pins defiled<br>3. Wrong wiring | Cause: Driver4 output (3-pin) Open/Short<br>Solution: Correct open/short error, restart output  |
| 23 | <b>PD Open/Short</b><br>Proportional Drive Open/Short<br>Proportional drive off   | 35 | 1.Connected load open/short<br>2.Connected pins defiled<br>3. Wrong wiring | Cause: PD (2-pin) Open/Short<br>Solution: Correct open/short error, restart output  |
| 24 | <b>Encoder Fault</b><br>Encoder failure<br>EM disconnected  | 36 | 1. Motor encoder failure<br>2. Wrong wiring                                | Cause: Encoder fault<br>Solution: Restart key switch  |
| 25 | <b>MotorOpen</b><br>1.Motor stops working<br>2.Main connector disconnected<br>3.EM brake disconnected<br>4.Accelerator failure                                      | 37 | 1. Motor phase loss<br>2. Wrong wiring                                     | Cause: Motor phase loss, U, V, W one or more phases open circuit<br><br>Solution: Check phase, restart key switch   |

|    |   |    |   |  |
|----|---|----|---|--|
|    | 5.Brake<br>6.Pump stop working  |    |   |  |
| 26 | <b>Main Contactor Welded</b><br>1.Motor stops working<br>2.Main connector disconnected<br>3.EM brake disconnected<br>4.Accelerator failure<br>5.Brake<br>6.Pump stop working        | 38 | 1.Main contactor contact welding<br>2.The motor U or V is disconnected or the phase is missing<br>3.There is a circuit connected to the B+ terminal charging the capacitor                                      | Cause: Main contactor remain connected too much, capacitor voltage cannot be released<br><br>Solution: Restart key switch  |
| 27 | <b>Main Contactor Did Not Close</b><br>1.Motor stops working<br>2.Main connector disconnected<br>3.EM brake disconnected<br>4.Accelerator failure<br>5.Brake<br>6.Pump stop working | 39 | 1. The main contactor is not closed<br>2. The main contactor contacts are oxidized, melted, or the connection state is unstable<br>3. Capacitors are charged by external devices<br>4. The fuse is disconnected | Cause: When the main contactor needs to be closed, the capacitor voltage does not reach B+ voltage.<br><br>Solution: Check contactor and restart key switch  |
| 28 | <b>Throttle Wiper High</b><br>Accelerator output is too high<br><br>Accelerator failure   | 41 | 1.Accelerator potentiometer output voltage is too high  | Cause: Accelerator potentiometer (16-pin) output voltage is higher than limit, the limit value can be changed by VCL, setup_pot_faults( )<br><br>Solution: Reduce accelerator potentiometer output voltage |
| 29 | <b>Throttle Wiper Low</b><br>Accelerator output is too low<br><br>Accelerator failure   | 42 | 1.Accelerator potentiometer output voltage is too low   | Cause:Accelerator potentiometer (16-pin) output voltage is lower than limit, the limit value can be changed by VCL, setup_pot_faults( )<br><br>Solution:Raise accelerator potentiometer output voltage     |
| 30 | <b>Pot 2 Wiper High</b><br>Potentiometer 2 output is too high<br>Full brake   | 43 | 1.Potentiometer 2 output voltage is too high  | Cause:Pot2 (17-pin) output voltage is higher than limit, the limit value can be changed by VCL, setup_pot_faults( )<br>Solution: Reduce potentiometer output voltage                                       |
| 31 | <b>Pot 2 Wiper Low</b><br>Potentiometer 2 output is too low<br>Full brake   | 44 | 1.Potentiometer 2 output voltage is too low   | Cause:Pot2 (17-pin) output voltage is lower than limit, the limit value can be changed by VCL, etup_pot_faults( )<br>Solution: Raise potentiometer output voltage  |
| 32 | <b>Pot Low Over current</b>   | 45 | 1.Potentiometer impedance is too low  | 原因：电位器低端（18管   |

|    |   |       |  |   |
|----|---|-------|--|---|
|    | <b>Potentiometer low-end current is too high</b><br>Accelerator failure<br>Full brake   |       |  | Cause: Potentiometer low end (18-pin ) current exceeds 10mA<br>Solution: Lower low current and restart key switch   |
| 33 | <b>EEPROM Failure</b><br>1. Motor stops<br>2. Main contactor stops<br>3. EM brake stops<br>4. Accelerator stops<br>5. Interlock stops<br>6. 1-4 output stop<br>7. Proportional driver stop<br>8. Brake, pump stop | 46    | Failed to write to EEPROM storage. (This may be caused by VCL writing to the EEPROM storage, or CANBUS, or the wrong parameters programmed into the controller after the programmer parameters are adjusted) | Cause: Controller OS attempted to write to EEPROM and failed<br>Solution: Download the correct software (OS) to set the correct parameters of the controller, then restart the key switch             |
| 34 | <b>HPD/Sequencing Fault</b><br>Accelerator failure  | 47    | 1. Key start, interlock, direction and accelerator input sequence are set incorrectly<br>2. Wiring, switch key, interlock, direction, or accelerator input failure   | Cause: High pedal protection and incorrect start sequence due to incorrect key start, interlock, direction, and accelerator input settings<br><br>Solution: Re-enter each output in the correct order |
| 35 | <b>Emer Rev HPD</b><br>Accelerator failure  | 47    | Emergency reverse operation has ended, but accelerator, forward and reverse inputs and interlocks have not been reset  | Cause: At the end of the emergency reversal, various inputs are not reset, fault occurs<br>Solution: Re-enter each output in the correct order  |
| 36 | <b>Parameter Change Fault</b><br>1. Motor stops working<br>2. Main connector stops working<br>3. EM brake stops working<br>4. Accelerator failure<br>5. Brake/Pump stop working                                   | 49    | Ensure the safety of the vehicle, some specific parameters changes must take effect after the key switch is restarted  | Cause: Parameter changes require a restart of the key switch<br><br>Solution: Restart key switch  |
| 37 | <b>OEM Faults</b>   | 51-67 | Users can define their own faults for some phenomena, represented by VCL codes   | According to user definition  |
| 38 | <b>VCL RunTime Error</b><br>1. Motor stops<br>2. Main contactor stops<br>3. EM brake stops<br>4. Accelerator stops<br>5. Interlock stops  | 68    | VCL code timed out for run time  | Cause: Runtime VCL code error<br>Solution: Edit VCL application software, fix errors, check new software to make sure parameters match correctly, restart key switch                                  |

|    |  |    |  |  |
|----|--|----|--|--|
|    | 6.1-4 output stops<br>7.Proportional Drive Stop brake<br>8.pump stop   |    |  |  |
| 39 | <b>External Supply Out of Range</b>  | 69 | 1. External load between 5V and 12V power supply<br>The current is too large or too small<br>2. In the "Checking menu" wrong parameter, e.g.<br>"ExtSupply Max",<br>"Ext Supply Min" | Reason: The external supply current (total current: 5V (26 pins) and 12V (25 pins)) exceeds the limit range, the upper limit is defined by ExtSupply Max, and the lower limit is defined by ExtSupply Min<br>Solution: adjust the external current |
| 40 | <b>OS General</b><br>operating system failure<br>motor stop<br>Main contactor stopped<br>Electromagnetic brake stop<br>accelerator stop<br>interlock stop<br>1-4 outputs stop<br>Proportional Drive Stop<br>brake<br>pump stop | 71 | 1.Internal controller failure  | Cause: Internal controller failure<br>Solution: Restart the key switch   |
| 41 | <b>PDO Timeout</b><br>Interlock stop<br>CAN NMT State is set to Preoperational   | 72 | 1.CAN PDO message reception time exceeds PDO time limit  | Cause: CAN PDO message reception time exceeds PDO time limit<br>Solution: Restart the key switch, or receive CAN NMT messages  |
| 42 | <b>Stall Detected</b><br>motor stall<br>Electromagnetic brake stop<br>Control mode transition to LOS (Limited Operating State)   | 73 | 1. Motor stalled<br>2. Motor encoder failure<br>3. Wrong wiring<br>4. Input motor encoder power failure  | Reason: The motor encoder cannot be detected<br>Solution: Restart the key switch, or detect the valid signal of the motor encoder in LOS mode, and set the parameter to Throttle Command=0, Motor RPM=0  |
| 43 | <b>Motor Characterization Fault</b><br>Motor matching failed<br>motor stop<br>Main contactor stopped<br>Electromagnetic brake stop<br>accelerator stop<br>brake, pump stop   | 87 |  | Reason: Motor matching process failed<br>Solution: fix bug, restart key switch   |
| 44 | <b>Motor Type Fault</b>  | 89 | 1. Motor type parameter value is out of range  | Cause: The Motor Type parameter is set to an illegal value<br>Solution: reset and restart  |

|    |   |    |  |  |
|----|---|----|--|--|
|    |   |    |  | key switch   |
| 45 | <b>VCL/OS Mismatch</b><br>motor stop<br>Main contactor stopped<br>Electromagnetic brake stop<br>accelerator stop<br>interlock stop<br>1-4 outputs stop<br>Proportional Drive Stop<br>brake<br>pump stop | 91 | 1.The VCL program in the controller does not match the OS program  | Cause: The VCL program in the controller does not match the OS program<br>Solution: Update the correct VCL and OS programs   |
| 46 | <b>EMBrake Failed to Set</b><br>Electromagnetic brake failure<br>Accelerator failure  | 92 | 1. The vehicle still moves after the electromagnetic brake command is set<br>2. The braking force of the electromagnetic brake is too small          | Reason: After the electromagnetic brake is locked, the vehicle still moves<br>Solution: Check whether the accelerator is normal  |
| 47 | <b>Encoder LOS ( Limited Operating Strategy )</b>   | 93 | 1. Restricted operating state is activated due to motor stall or encoder failure<br>2. Wrong wiring<br>3. Vehicle stall                              | Cause: Restricted operating state activated due to motor stall or encoder failure<br>Solution: Restart the key switch , if it is caused by motor stall, please make sure the encoder works under normal operation, Throttle Command=0, Motor RPM=0 |
| 48 | <b>EmerRev Timeout</b><br>Electromagnetic brake failure<br>Accelerator failure  | 94 | 1. Emergency reverse timeout activated due to EMR Timer expiration<br>2. The emergency reverse switch is always in the On position                   | Reason: After the emergency reverse function is activated, it runs until the end of the emergency reverse timer<br>Solution: Check the status of the emergency reverse switch  |
| 49 | <b>Illega Model Number</b><br>wrong controller model<br>motor stop<br>Main contactor stopped<br>Electromagnetic brake stop<br>accelerator stop<br>brake, pump stop                                      | 98 | 1. The controller model cannot be recognized<br>2. Software and hardware do not match each other<br>3. The controller is damaged                     | Reason: The controller model cannot be recognized<br>Solution: Select the correct controller and download the correct controller software  |
| 50 | <b>Dualmotor Paramcter Mismatch</b><br>close controller<br>close the main contactor<br>turn off electric brake<br>turn off the accelerator<br>Full brake, shut off the pump                             | 99 | The Enable parameter of the dual motor is set to OS, and the control mode selection parameter is not set to 0 (Speed Mode Express) or 1 (Speed Mode) | Reason: When the dual driver software is enabled, the control mode selection should be set to 0 (Speed Mode Express) or 1 (Speed Mode), otherwise a fault will occur<br>Solution: adjust to a suitable value and switch KS I                       |

## Chapter 5 Optional of MC Series Models

### 5.1 Lithium Battery

#### 5.1.1 Main Structure of Lithium Battery

The lithium battery cell material used by our company is lithium iron phosphate battery (LFP). The main structure of the battery includes: battery control part, battery cell, and box, as shown in Figure 5-1-1.

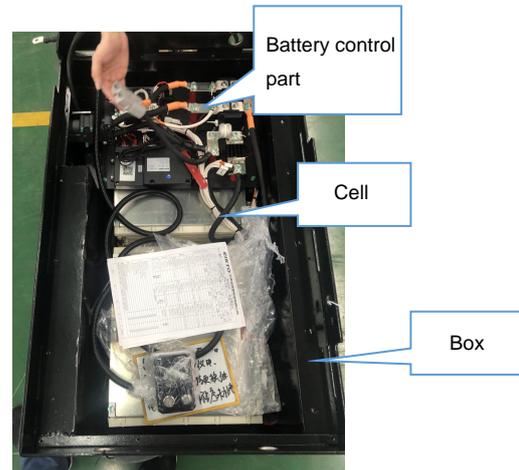


Fig. 5-1-1 Lithium battery structure

The battery control part is divided into two types: the same port for charging and discharging and the different port for charging and discharging. It contains BMS (battery management system), DC converter, relay, charging and discharging plug-in harness, buzzer and so on.

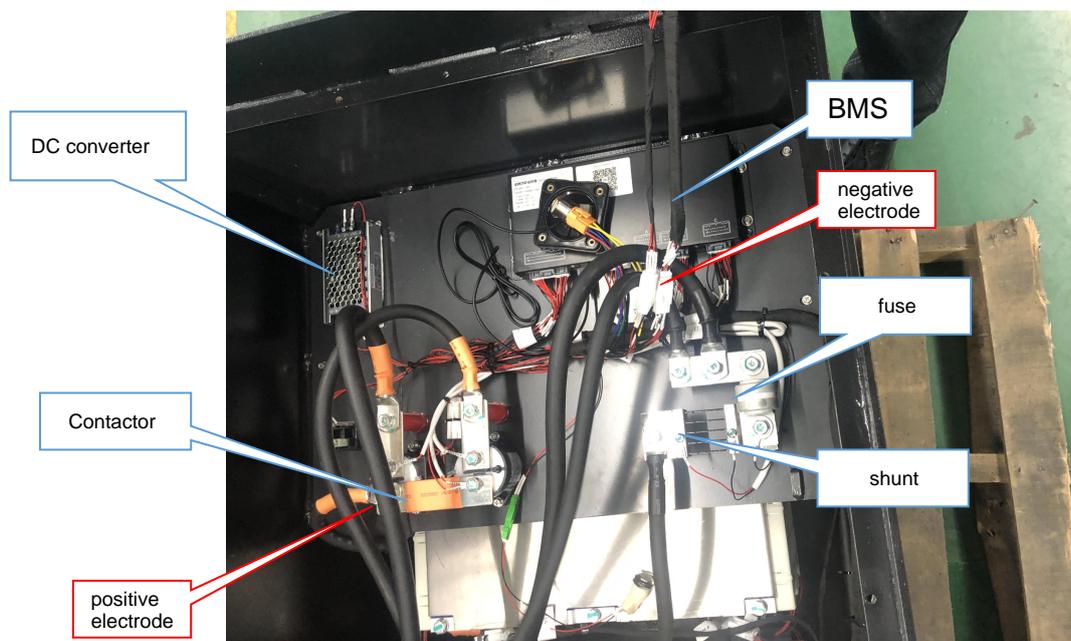
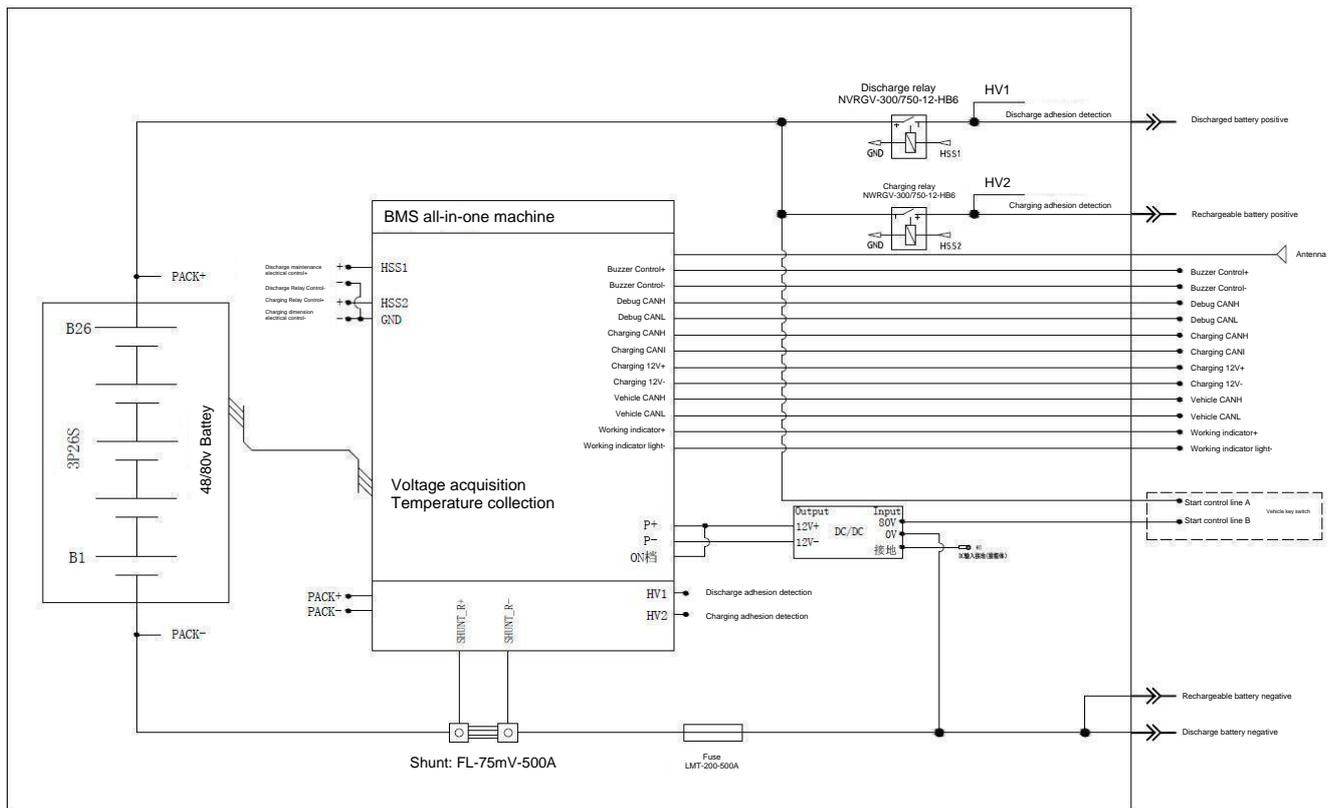


Fig.5-1-2 Lithium battery control part structure

The same port for charging and discharging means the same port for charging and discharging, the different port for charging and discharging means two ports for charging and discharging, and the different ports for 48V lithium battery MC models.



## Different port lithium battery electrical schematic diagram (48V lithium battery principle)



### 5.1.2 Operation Instructions for Lithium Battery Forklift

1. Stop the forklift and turn off the key switch of the vehicle, that is, the whole vehicle is not charged. The battery start and stop are controlled by the key switch.



2. Check the connector to ensure that there is no water or foreign matter in the port, ensure that the charger is turned off, and then insert the charging plug of the charger into the charging plug of the forklift.

Note: 48V models only need to connect the charging plug directly to the charger.

Lithium battery chargers of different specifications cannot be used together, otherwise the charger may malfunction or fail to charge.



Pay attention to the marks on the connectors when the connectors are mated. The marks on the battery connector and the charger connector must be the same, otherwise they cannot be connected, as shown in Figure 5-1-3.

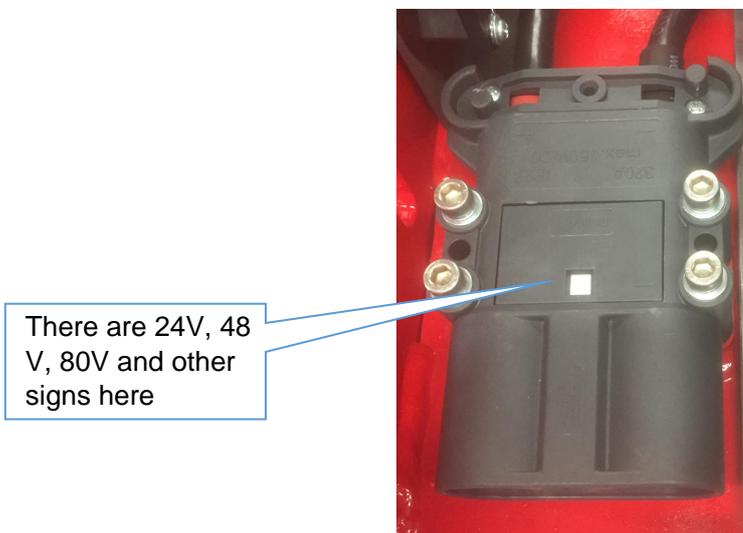
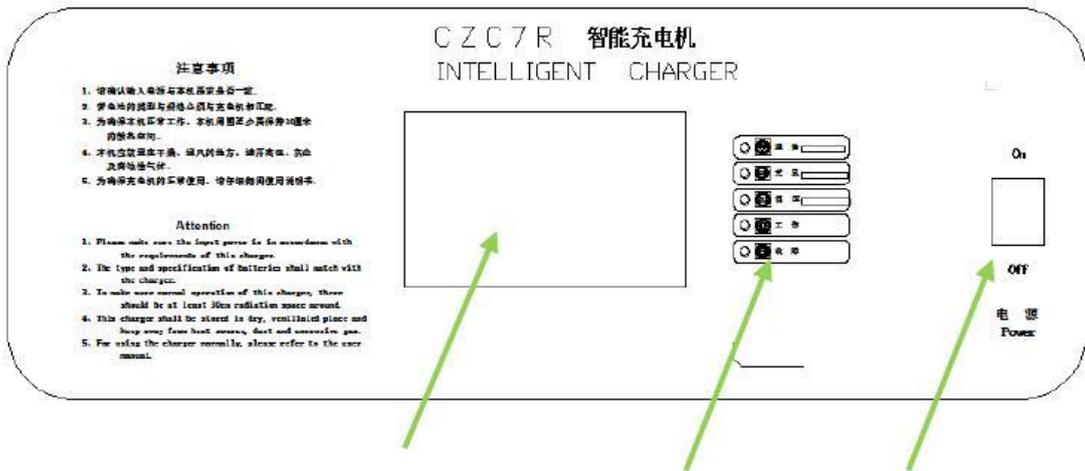


Fig 5-1-3 Connector identification

3. Close the charger input electric master valve and start the charger.

Turn the power switch to "ON", and the start/stop button on the touch screen can control the charging status. As shown in Figure 5-1-4



LCD Touchscreen Charging Status Indicator Power Switch



Fig.5-1-4 (>50A) Charger Operation Interface

### Charging status indicator——

**Communication:** A light indicates that the battery management system is communicating with the charger.

**Sufficient:** The light is on to indicate that this charging has been completed. The charger is sufficiently turned off and the battery can be removed for use.

**Constant Voltage:** The light indicates that the charger has entered the constant voltage state.

**Work:** The light indicates that the charger is in charging operation.



#### 4. Turn off the charger.

When the lithium battery is fully charged, the charger will stop charging automatically, at this time, the voltage and current on the display of the charger will be zero. Press the stop button (Figure 5-1-4) to turn off the charger. Press the stop button (as in Figure 5-1-4) to turn off the charger, and then unplug the charger.

If the lithium battery is not fully charged and needs to stop charging, press the stop button on the screen first. If you need to stop charging before the battery is full, press the stop button on the screen and wait for the charging current to reach 0A before removing the plug.

Do not suddenly disconnect the plug during charging, as this will cause the the plug will arc and be damaged.



5. Close the lithium battery charging cover or charging door.

### 5.1.3 Notes

1. Under no circumstances should the positive and negative terminals of the battery be short-circuited, the battery should not be heated, and the battery should not be thrown into water.
2. The battery safety valve must not be removed under any circumstances.
3. It is not allowed to open the lid of the lithium battery case for maintenance, when the lithium battery is faulty, contact the manufacturer in time.
4. Lithium batteries have a special charger, do not use other types of battery charger charging, in order to avoid charging bad lithium batteries.
5. If the battery emits strange odor, heat, discoloration, deformation, or any abnormal phenomenon during use, storage, or charging, the battery should be immediately removed from the device or charger and deactivated, please contact the relevant technical department or after-sales service department of the manufacturer in time to get the treatment method.
6. If there is any oxidization at the connection of the battery poles, wipe it with a dry cloth and polish it with fine sandpaper before use, otherwise it may lead to poor contact and malfunction.

7. It is prohibited to place the battery next to high temperature sources, dangerous goods or hazardous materials, such as fire, heaters, corrosive chemicals, hazardous machinery and equipment next to the use and retention; preserved when not in use, should be placed in a cool and dry environment.
8. Do not immerse the battery in water or other electrically conductive liquids, as this may result in personal injury or property damage.
9. It is prohibited to short-circuit the positive and negative terminals of the battery directly, and avoid any metal or other conductive objects other than the battery pole compression bolts and conductive tape from touching the positive and negative terminals of the battery.
10. Do not strike, throw or step on the battery.
11. It is prohibited to use this series of products in series or parallel with other models or types of batteries; it is prohibited to operate the whole power supply system containing lithium-ion battery protection circuit boards or battery management system in series or parallel, if necessary, please contact the relevant technical department of our company to obtain the correct technical support.
12. The use of this series of products by children and others who lack knowledge of the safe use of lithium-ion batteries is prohibited.
13. Prohibit disassembly, extrusion, puncture, high-temperature storage or baking of the battery, to avoid excessive vibration of the battery, external impact, high drop, etc.
14. Prohibit the use of strong static electricity and strong magnetic fields, otherwise it is easy to destroy the battery safety protection device, bringing potential safety hazards.
15. It is prohibited to charge the battery without proper charging protection (lithium-ion battery protection circuit boards, battery management system, etc.) or with charging equipment (charger, DC power supply, etc.) that is not approved by the battery manufacturer.
16. It is strictly prohibited to reverse charge the battery, a reverse charge can lead to the battery voltage to zero, early retirement.
17. If there is a lot of dust, metal shavings or other debris on the top cover and poles of the battery pack, use compressed air to clean them promptly. Avoid using water or water-soaked objects for cleaning.

18. Avoid splashing water or other conductive objects on the top cover and poles of the battery during charging and discharging, e.g. use in heavy rain.
19. In the event that a conductor comes into contact with both the positive and negative terminals of a single cell or battery pack and causes a short circuit, it is important to disconnect the short-circuiting circuit within the shortest possible time.
20. Once a traffic accident occurs, resulting in a destructive impact on the battery, a large amount of energy stored in the battery will be released in an instant, and a dry powder fire extinguisher can be used to cool down the battery.
21. Combustion or Smoke Hazard: LFP type batteries can leak/evaporate or decompose and release flammable electrolytes at 150°C if used improperly or under environmental influences. Hydrogen fluoride (HF) and phosphorus oxides may be formed in a fire, and fluoride and carbon dioxide will be produced by the chemical reaction between LIPF6 in the electrolyte and water.
22. Extinguishing Media: Spray with water or immerse smoldering or burning batteries in water. D extinguishers, CO2, dry chemical or foam extinguishers can be used.
23. Swallowing: Swallowing electrolytes can lead to throat or respiratory infections. If swallowed, drink plenty of fluids and seek medical attention immediately. Make sure the infected person is not using an emetic. Make sure mucus is not blocking the airway and do not give anything else to an unconscious person.
24. Contact with eyes: The electrolyte inside the battery can cause eye irritation. If contact is accidental, do not rub, flush immediately with plenty of water for at least 15 minutes, and go to the hospital immediately for treatment if necessary, or your eyes may be damaged.
25. Skin contact: The electrolyte inside the battery can cause skin infections. For inadvertent contact, remove contaminated clothing and wash the infected area with plenty of water and soap for at least 15 minutes, do not apply ointment.
26. Inhalation: When a battery leaks or ruptures, its internal components may cause mucus, edema and other problems in the respiratory tract, inadvertent inhalation, go to fresh air and ventilate the contaminated area. If necessary, administer oxygen or perform If necessary, administer oxygen or artificial respiration.

27. Special Protective Tools: Use breathing apparatus to avoid breathing irritating fumes. Wear protective clothing or other devices to avoid body contact with the electrolyte.
28. Forklift operators and managers must remember "Safety First" and operate the forklift safely in accordance with the forklift maintenance instructions.

#### **5.1.4 Battery operating and storage temperature and transportation requirements**

1. The operating temperature requirements of the battery is divided into charging temperature requirements and discharge temperature requirements:

- (1) Charging temperature range: 5 °C - 40 °C, 5 °C below the low temperature environment of the large rate charging will cause damage to the battery;
- (2) Discharge temperature range: -20 °C -40 °C, low temperature (-20 °C -0 °C) discharge capacity compared to room temperature conditions may be reduced, this is a normal phenomenon; batteries can be used in 40 °C -50 °C ambient temperature, but the ambient temperature of the battery is too high, especially the battery is in a high temperature environment for a long time, it will accelerate the aging of the internal materials of the battery to shorten the battery's service life, and is therefore not recommended! Therefore, it is not recommended to use the battery under this temperature for a long time;
- (3) If the ambient temperature exceeds the above charging and discharging temperature range, it will negatively affect or damage the performance of the battery, and may greatly shorten the service life of the battery, so it should be avoided to be used under the above temperature.

2. Storage Temperature.

- ( 1 ) Do not operate an electric vehicle with a battery pack in temperatures exceeding 40°C;
- ( 2 ) Stop charging the battery pack/vehicle when the ambient temperature is below 0°C;
- ( 3 ) Please avoid wading the battery pack in water as much as possible;
- ( 4 ) For long term storage (more than 2 months), the battery pack needs to be completely de-energized, and the manufacturer recommends storing the battery pack in a 70% SOC charged state;

( 5 ) Batteries need to be charged periodically during storage, approximately once every 1.0-1.5 months.

### 3、 Battery transport requirements :

( 1 ) During loading, unloading and transport, avoid violent vibration, large external impacts, and prohibit throwing, rolling, inverting, extrusion and high stacking;

( 2 ) Prevent rain during transport;

( 3 ) Ensure that the batteries or battery packs have been disconnected from the vehicle and charging equipment before transport without any form of charging or discharging behaviour.

#### 5.1.5 Safety Precautions for Lithium Battery Charging

1. Please choose to charge in a relatively safe environment (such as avoiding liquid, fire and other environments);

2. The charger should be equipped with the necessary fire extinguishing devices around (yellow sand and dry powder fire extinguishers), so that in the event of an extreme situation can be emergency fire extinguishing treatment;

3. Before charging, you need to make sure that there is no dust, water and other debris in the charging gun and charging socket, if there is any debris, you need to clean it up before charging, otherwise, it will lead to poor contact between the charging gun and charging seat, resulting in heat or even lead to fire;

4. Do not modify or disassemble the charging port and charging equipment, as this may cause charging malfunction and fire;

5. To avoid serious personal injury, when the vehicle is being charged, be aware of the following precautions.

( 1 ) Do not touch the charging port or the metal terminals inside the charging gun head;

( 2 ) When there is lightning, do not charge the vehicle or touch the vehicle, as lightning strikes may cause damage to the charging equipment, resulting in personal injury.

6. After charging, do not disconnect the charging equipment with wet hands or while standing in the water, as this may cause electric shock and personal injury.

7. After charging, do not disconnect the charging equipment with wet hands or while standing in the water, as this may cause electric shock and personal injury.

8. To avoid damage to the charging equipment, please note the following :

- ( 1 ) Do not close the charging port hatch with the charging port cover open ;
- ( 2 ) Do not pull or twist the charging cable ;
- ( 3 ) Do not subject the charging device to impact ;
- ( 4 ) Do not store or use the charging equipment in an environment where the temperature is higher than 50°C;
- ( 5 ) Prohibit the charger is still output charging current directly hot plugging and unplugging the charging gun, which may lead to electric arc phenomenon , resulting in property damage and personal injury;
- ( 6 ) Do not place the charging equipment near heaters or other heat sources.

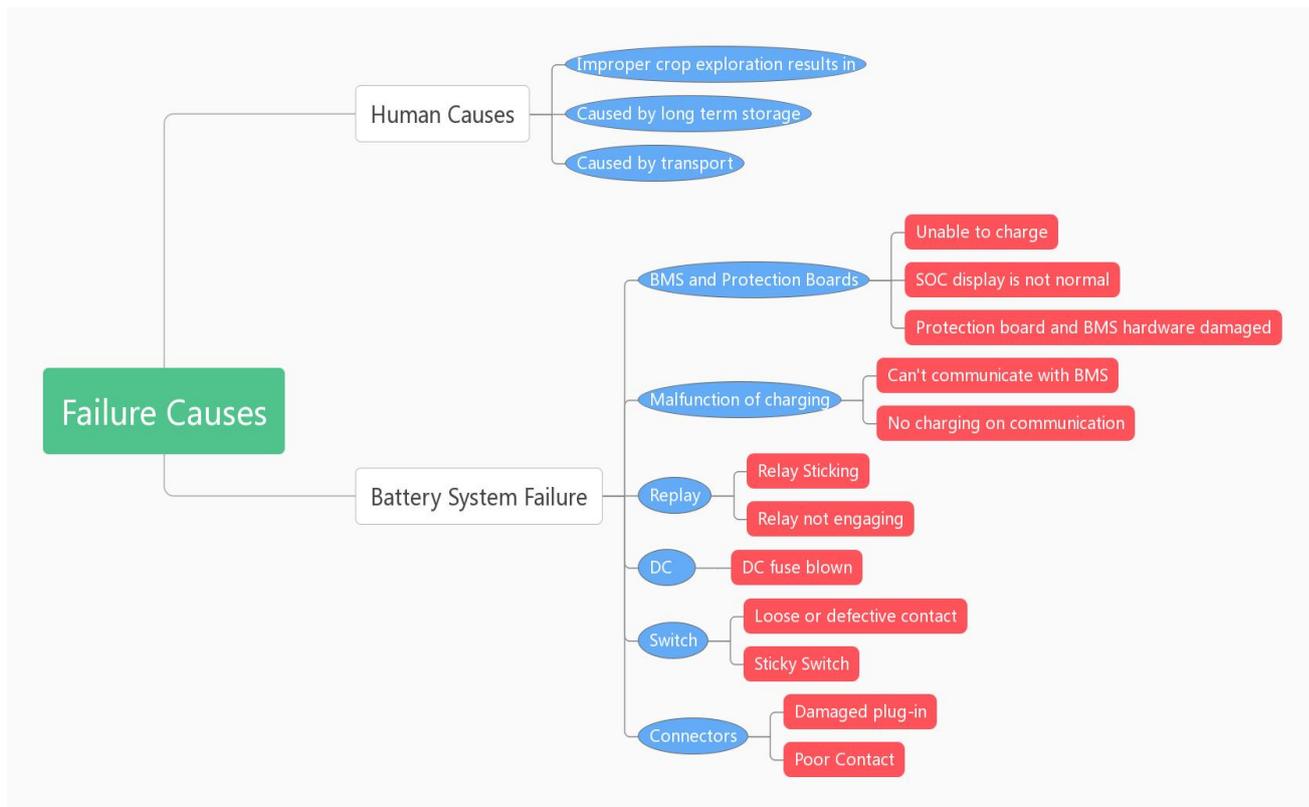
For first time use, it is recommended to have engineers and technicians with knowledge of lithium forklift electrics and electronics to participate or under the proper guidance of our technicians.

If there is any doubt or uncertainty, please contact the relevant technical department or after-sales service department of the lithium battery manufacturer.

It is prohibited for customers to disassemble the lithium battery without authorisation.



## 5.1.6 Common Faults and Solutions for Lithium Battery



### 1. Man-made reasons

( 1 ) Ignoring the alarm: the battery reaches the SOC low alarm value and sends out an alarm but the driver does not care about it and continues to use the battery until the battery reports a single, total low voltage fault until the relay is cut off. Until the battery reported single, total voltage low fault until the cut-off relay.

( 2 ) The battery is not fixed: the battery and the vehicle box impacted by rapid acceleration or braking during use.

( 3 ) Working outside in rainy days: In the battery without protection level requirements, working in the open air in rainy days without any waterproof measures, resulting in water inside the battery box, causing damage to the battery system.

( 4 ) Transport negligence: in the absence of protection level requirements of the battery, logistics companies do not do waterproof measures in the rain on the way to transport the battery box into the water, resulting in damage to the battery system.

( 5 ) Long-term placement: the battery has not been placed for a long time to replenish the battery, when you need to use it and found that it can not be started, at this time, the total battery voltage has been depleted to below the DC operating voltage, DC can not supply power to the BMS.

## 2. Lithium battery common faults and solutions

| Fault  | Vehicle situation  | Failure cause   | Solution   | Note   |
|--|--|---|--|--|
| Method of charging, Can discharge            | The vehicle can work normally, the buzzer has no alarm, the battery cannot be charged, the charger shows: please connect the battery   | <ol style="list-style-type: none"> <li>1. The charging plug-in is not plugged in in place</li> <li>2. The charging relay is stuck and cannot be closed</li> <li>3. Poor contact of the power supply line of the charging relay</li> </ol>   | <ol style="list-style-type: none"> <li>1. Plug in in the correct way</li> <li>2. Replace the relay</li> <li>3. Check whether the power supply line is loose and whether the line is disconnected</li> </ol>  | Knock the relay with hard objects, if it can absorb and can be temporarily used, the later accessories to be replaced  |
|  | The vehicle can work normally, beep, no alarm, the battery cannot be charged, the charger shows EB3  | <ol style="list-style-type: none"> <li>1. The charger plug of the charger does not correspond to the CAN communication point</li> <li>2. Battery charging plug-in CAN cable or charger CAN cable return pin and break</li> </ol>  | <ol style="list-style-type: none"> <li>1. Replace the battery or charger CAN communication point so that the point can match</li> <li>2. Reinstall the CAN cable or the charger CAN cable in the charging plug-in</li> </ol>                               |  |
|  | Vehicle emergency stop switch and key, the vehicle can still work when the switch is closed, the buzzer alarm, electricity, the pool can not be charged, the charger shows, please connect the battery | Discharge relay adhesion  | Replace the discharge relay  |  |
| Unable to charge, unable to discharge        | Can not move, the buzzer alarms, the battery can not be charged, the charger has a voltage and no current  | Charging relay adhesion   | Replace the charging relay   | Scan the QR code to show the relay fault   |
|  | The buzzer rings and the car doesn't work  | Level 3 fault alarm   | Check the relevant components and parameter settings according to the fault code   | The too low power fault code is 11AL   |
|  | Can not move, can not charge   | <ol style="list-style-type: none"> <li>1. Switch fault or the switch-related lines are disconnected</li> <li>2. The fuse is damaged</li> <li>3. The DC is damaged</li> <li>4. The BMS failure</li> <li>5. The battery voltage is too low due to excessive discharge or long time placement</li> </ol> | <ol style="list-style-type: none"> <li>1. Replace the switch or repair the related lines</li> <li>2. Replace the fuse and check the other components</li> <li>3. Replace the DC</li> <li>4. Replace the BMS</li> <li>5. Power up on the battery</li> </ol> | <ol style="list-style-type: none"> <li>1. The battery does not have an auxiliary power supply</li> <li>2. If the fuse is damaged and the relay is attached, check the vehicle for a short circuit</li> </ol> |
|  | The car cannot move; when charging, charging, the charger displays please connect the battery  | The fuse is damaged   | Replace the fuse   | Battery with auxiliary power supply  |
| Can be charged, unable to discharge          | Can not discharge, the battery can be charged, charging instrument bright;   | DC damage   | replace DC   | Battery with auxiliary power supply  |
| Short charging time and short discharge time | The battery is fully charged very quickly when charging, and the power supply drops very quickly when discharging  | <ol style="list-style-type: none"> <li>1. Poor module cell</li> <li>2. BMS harness</li> <li>3. The BMS parameter is set wrong</li> </ol>  | <ol style="list-style-type: none"> <li>1. Replace the module</li> <li>2. Replace the BMS wiring harness</li> <li>3. Change the parameter settings or update the program</li> </ol>   |  |

|   |  |  |  |   |
|---|--|--|--|---|
| Charging current small  | When charging, the current value is much less than the BMS request current, and the fault lamp of the charger is often on              | Some module of the charger fails   | Replace the charger module or replace the charger directly   | The charging current is small   |
|   | When charging, the current of the charger is about 30A, and the forklift instrument shows 09AL fault code (the temperature is too low) | No fault   | This phenomenon is normal. When the temperature of the cell is (0-5 ), the charging current is 30A. When the temperature of the cell rises, the charging current returns to normal and the fault code disappears     |   |
| When the battery power is greater than the alarm value (15%), the 02AL fault code appears | Battery capacity (SOC) greater than 15%: (such as 22%, 60%, etc.) forklift instrument reported 02AL fault (single undervoltage )       | <ol style="list-style-type: none"> <li>1. The BMS failure</li> <li>2. BMS harness or loose harness</li> <li>3. Poor cell</li> </ol>  | <ol style="list-style-type: none"> <li>1. Replace the BMS</li> <li>2. Replace the harness or plug the harness</li> <li>3. Replace the module</li> </ol>  | 24V battery   |
| Intermittent disconnection electricity  | The vehicle is interrupted in the working process, electricity, and can work again. This phenomenon is repeated                        | <ol style="list-style-type: none"> <li>1. Poor contact of the relay power supply wire</li> <li>2. Poor relay</li> <li>3. The operating current of the vehicle is too large, resulting in the undervoltage cutting off the relay</li> </ol> | <ol style="list-style-type: none"> <li>1. Check and reinforce the relay power supply line</li> <li>2. Replace the relay</li> <li>3. Repair the vehicle and adjust the BMS parameter setting appropriately</li> </ol> | BMS poor power supply; excessive battery pressure difference, also similar failure will occur |
| When charging, the temperature of the tank is high, and the charging line is hot          | When the battery is charged, the battery box and charging line temperature are much higher than usual                                  | Battery output bronze contact (connection between charging cable ear and battery copper row) screw is loose  | Retighten the screws at the battery bronze connector   | When charging, the battery box temperature is high, and the charging cable is hot             |
| Forklift work<br>When the power is not ac dump  | After a period of operation, the forklift power supply remains in the initial state  | <ol style="list-style-type: none"> <li>1. Drive controller parameters set correctly</li> <li>2. Forklift instrument and battery communication failure, generally loose terminal, terminal back pin, or open circuit signal line</li> </ol> | Check the correct setting of parameters and the normal CAN communication line  |   |

## 5.2 Operation Instructions of Fork Side Shift and Rotation

### 5.2.1 Overview of Operation Platform for Side Shift and Rotary Fork

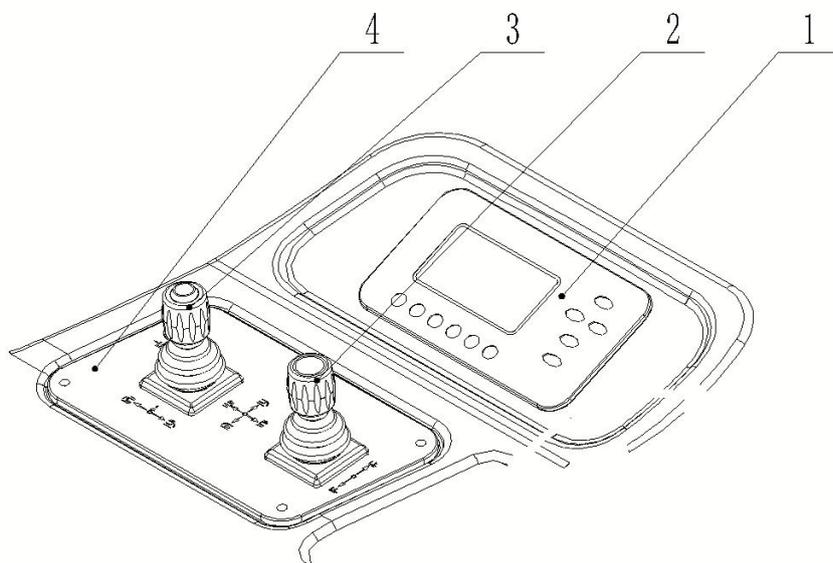


Fig.5-3-1

1.Instrument 2.Cross handle ( with button ) 3.single axis handle 4.Operation panel

### 5.2.2 Operation Handle

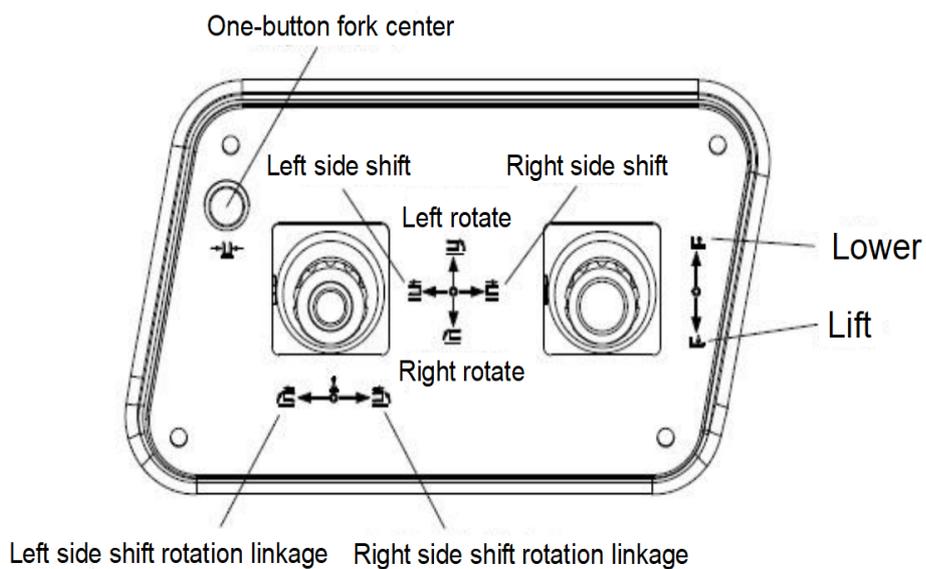


Fig.5-3-2

As shown in Figure 5-3-2, the operation steps of the fork are as follows:

1. Lifting : According to the lifting action mark, move the lifting handle backward;
2. Lowering : According to the lifting action mark, move the lifting handle forward;
3. Move to the left : Move the cross handle to the left according to the action signs of side shift and rotation;
4. Move to the right : Move the cross handle to the right according to the side movement and rotation action signs;
5. Rotate left : Move the cross handle forward according to the side movement and rotation action signs;
6. Rotate right : Move the cross handle backward according to the side movement and rotation action signs;
7. Left linkage : According to the side shift and rotation linkage logo, press and hold the red button, and move the cross handle to the left;
8. Right linkage : According to the side shift and rotation linkage logo, press and hold the red button, and move the cross handle to the right;

The premise of linkage operation: the fork head must be located at the left and right limit positions of the carriage.



For safety reasons, the linkage operation requires the vehicle to operate outside the roadway.  
Linkage operation with load in the roadway is prohibited.



For the sake of safety, it is forbidden to toggle the operating handle in the roadway when the stacker is running.



## 5.2.3 Instrument Interface

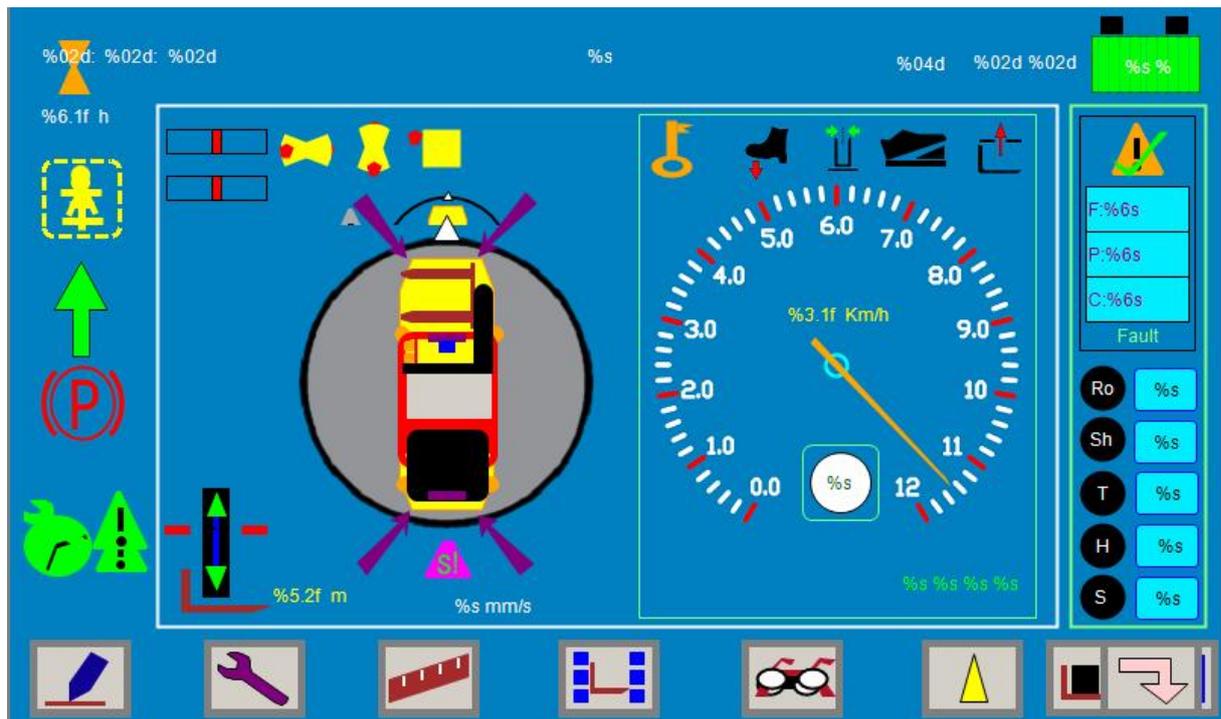


Fig.5-3-3

As shown in Figure 5-3-3, each display element of the instrument interface is defined as follows:

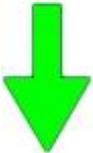
### 1. Hour meter, the cumulative power-on time of the stacker, the unit is h

| Icon display  | Element definition                             | Element explanation |
|---|--|---------------------|
|  | Record system cumulative power-on running time |                     |

### 2. The current stacker is in manual or magnetic navigation mode

| Icon display  | Element definition       | Element explanation   |
|---|--------------------------|---|
|  | Manual mode              | This mode is the default state, and the steering wheel needs to be turned manually before the stacker can turn.   |
|  | Magnetic navigation mode | At this time, turning the steering wheel is invalid, and the stacker will automatically adjust the direction when the magnetic strip is moving forward. |

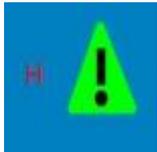
### 3. The current running direction of the vehicle

| Icon display  | Element definition | Element explanation                                |
|---|--------------------|--|
|  | Forward state      | Displayed when the travel handle is moved forward  |
|  | Backward state     | Displayed when the travel handle is moved backward |

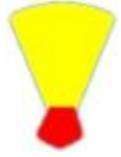
### 4. Stacker parking sign

| Icon display  | Element definition | Element explanation  |
|---|--------------------|--|
|  | Parking sign       | Displayed when the handle is released or the speed of the vehicle drive motor is 0 |

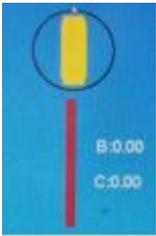
### 5. Forced mode of stacker hydraulic action

| Icon display  | Element definition              | Element explanation   |
|---|---------------------------------|---|
|  | Forced mode of hydraulic action | The hydraulic action of the whole stacker is realized through the operation of the connector inside the stacker body, which is suitable for operation when there is no one in the cab |

### 6. The typical position of the stacker is close to the switch state

| Icon display  | Element definition                        | Element explanation   |
|---|---|---|
|  | Left limit proximity switch of sideshift  | Triggered when the fork moves to the left limit position    |
|  | Right limit proximity switch of sideshift | Triggered when the fork moves to the right limit position   |
|  | Left limit proximity switch of rotate     | Triggered when the fork rotates to the left limit position  |
|  | Right limit proximity switch of rotate    | Triggered when the fork rotates to the right limit position |
|  | Proximity switch of mast to top           | Triggered when the mast lift to the highest position        |

## 7. Stacker driving status display

| Icon display  | Element definition                          | Element explanation  |
|---|---|--|
|  | The steering angle display of driving wheel | Wheel display angle display in manual mode   |
|  | Display of magnetic strip                   | The position of the magnetic strip relative to the stacker body in the magnetic navigation mode, and the automatic adjustment angle display of the magnetic navigation |

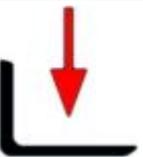
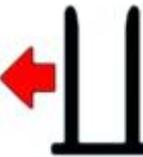
## 8. Height display

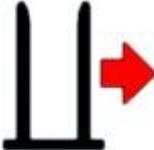
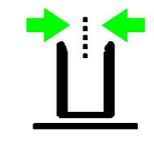
| Icon display  | Element definition                 | Element explanation  |
|---|------------------------------------|--|
|  | Height of the fork from the ground | The sum of mast lifting height and fork height from the ground |

## 9. Stacker total enable controll signal

| Icon display  | Element definition        | Element explanation  |
|---|---------------------------|--|
|  | Swipe card to unlock sign | When the password is not entered or the card is not swiped to unlock, it will flash until it is unlocked and then it will be off               |
|  | Pedal sign                | Step on the pedal, you can perform actions such as hydraulic walking, the pedal disappears, and it will display if you don't step on the pedal |

## 10. Hydraulic action prompt sign

| Icon display  | Element definition  | Element explanation |
|---|---------------------|---------------------|
|  | Fork lifting sign   |                     |
|  | Fork lowering sign  |                     |
|  | Fork move left sign |                     |

|   |                            |  |
|---|----------------------------|--|
|    | Fork right shift sign      |  |
|    | Fork left rotation sign    |  |
|    | Fork right rotation sign   |  |
|    | Left synchronous movement  |  |
|    | Right synchronous movement |  |
|  | Fork back to center        |  |

11. Device failure, operation failure, communication failure display

| Symbol  | Definition  | Explanation   |
|---|---|---|
|  | F: Device failure<br>P: Operation failure<br>C: Communication failure | Display FOK, POK, COK when the vehicle has no fault |

12.Speed display

| Symbol  | Definition                    | Explanation |
|---|-------------------------------|-------------|
|  | Speedometer and speed display |             |

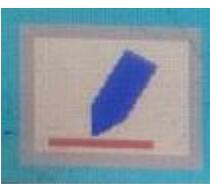
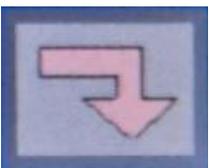
### 13. Module error code display

| Symbol  | Definition                   | Explanation  |
|---|------------------------------|--|
|  | Module comes with fault code | You can find out the specific fault by looking up the fault code table |

### 14. Battery display area

| Symbol  | Definition                 | Explanation |
|---|----------------------------|-------------|
|  | Battery display percentage |             |

### 15. Navigation bar

| Symbol  | Definition                           | Explanation  |
|---|--------------------------------------|--|
|  | Check components status              | Can check motor speed, current and sensor real time data   |
|  | Enter the parameter change interface | Enter the parameter change interface through different passwords, and set the common parameters and advanced parameters respectively |
|  | Enter the pre-selection height mode  | Enter pre-selection height mode, display element 7   |
|  | Exit current interface               | When the display interface is not in the initial interface, press this button to exit the current interface                          |

## **Chapter 6 Forklift Operation**

### **6.1 Nameplate and Symbols**

Forklifts have the following identifications:

(Please read the label on the car carefully for the relevant content)

1. Lifting, side shifting and rotating operating handles;
2. Safety sign nameplate;

### **6.2 Safety Regulation**

1. Before using the forklift every day, check all safety switches and equipment in advance according to the work requirements to ensure that these safety facilities are in good condition.
2. Check that all warning and design parameter signs on the vehicle have not been damaged.
3. The battery must be securely fixed in the battery box.
4. It is forbidden to use the forklift if it is damaged or malfunctions and affects the safe use.
5. Professionals should be responsible for repairing or adjusting the forklift.

### **6.3 Operating Instructions**

#### **6.3.1 Forklift Operation**

The forklift used in the cold room must be specially manufactured, and the design and manufacture of the forklift have certain restrictions on the use occasions:

1. Where the air contains flammable and explosive dust or gas.
2. As a tractor for other vehicles.
3. Used to transport people.

#### **6.3.2 Responsibilities of the operator**

1. Only after training and approval can the forklift be operated.
2. Obey this manual and relevant local safety regulations, rules, and traffic rules.
3. It is strictly forbidden to operate a forklift with oil on your hands and feet.

### **6.3.3 Workplace**

1. It can only be run on flat hard roads, such as concrete or asphalt roads, and it is strictly forbidden to work in oily areas to avoid slipping.
2. Make sure that the ground can bear the total weight of the stacking forklift, that is, the forklift's own weight, load weight and operator's weight.

### **6.3.4 Driving and guidance during driving**

1. Do not brake or turn suddenly when driving at high speed.
2. If the road surface is slippery, slow down to prevent the forklift from idling or overturning.
3. Keep a certain safe distance from the vehicles, people and objects ahead.
4. The horn should be sounded at high speed.
5. Forklifts are strictly prohibited to transport personnel (excluding forklift operators).
6. Before the forklift enters the elevator or floor, make sure that the elevator or floor can bear all the weight.

### **6.3.5 Loading and unloading cargo**

1. Only when unloading or forking goods, can the fork be lifted or lowered, and a certain safe distance should be kept from the surrounding people. Lifting and lowering the fork is strictly prohibited during walking.
2. The left and right positions of the loaded and unloaded goods on the fork are kept equal, and the transportation is not allowed if it is unstable or unsafe.
3. When lifting the goods, it is strictly forbidden to touch the mast to prevent pinching.
4. The goods can only be loaded and unloaded within the maximum lifting capacity and load center range allowed by the forklift, and the symmetrical position of the goods falling on the fork should be adjusted according to the external dimensions of the goods.

5. Special care should be taken when loading and unloading overly high and overweight cargo.

### **6.3.6 Parking Precautions**

1. After the forklift has stopped, put the fork to the lowest point and brake the forklift.
2. It is forbidden to park the forklift on the slope.
3. The forklift should be parked at the designated place.
4. Forklifts are prohibited from parking at emergency exits.
5. Do not park the forklift in a place that hinders work.
6. The power must be turned off after the forklift is parked.

## Chapter 7 Maintenance

**7.1 Driving authorization:** The forklift truck can only be operated by specially trained technicians who are familiar with the driving and load handling skills of the vehicle.

**7.2 Driver's rights: obligations and codes of conduct:** The driver must be aware of his rights and obligations, be trained in the operation and use of the ground conveyor and be familiar with the contents of these operating instructions.

**7.3 Prohibition of the use of the equipment by non-workers:** The driver is solely responsible for the forklift truck when it is in use. Driving or operating the forklift by non-workers shall be prohibited. Forklift trucks must not be used to carry or lift personnel.

**7.4 Damage and Defects:** If damage or other defects are found on the forklift truck or attachments, the situation must be reported immediately to the supervisor or maintenance professional. Forklifts that do not operate properly, such as badly worn tires or malfunctioning brakes, should not be used without repair.

**7.5 Equipment Maintenance:** The operator must not make repairs or modifications to the forklift without special training and authorization. The operator must never deactivate or adjust safety devices and switches without authorization.

**7.6 Hazardous areas:** Hazardous areas are areas where people are vulnerable to injury. These hazards arise mainly from the forklift truck itself, its load components, and the traveling and lifting movements of the load. The danger zone also includes areas where hazards can be caused by falling or overturning loads. Non-workers must keep out of the danger zone. Warning signs must be displayed in the danger zone.

**7.7 Safety Devices and Warning Signs:** All safety devices, warning signs and warning instructions in this manual and on the vehicle must be strictly observed.

### 7.8 Safety rules for maintenance work

Maintenance work may only be carried out after systematic study.

(1) Keep the maintenance site clean and hygienic.

(2) Do not carry loose objects or valuables on your person during maintenance. When repairing the electrical system of the forklift truck, if the metal touches the energized electronic components it is easy to cause short circuit or burning. So.

Please take off your watch, earrings or other jewelry.

(3) Unplug the forklift from the power outlet and disconnect the power supply before servicing the forklift.

(4) Turn off the key switch of the forklift before opening the left and right box covers or the electrical system.

(5) Before checking the hydraulic system, lower the forks to release the system pressure.

(6) When checking the oil leakage condition of the vehicle body use paper or cardboard to wipe it, do not touch it directly with your hands. To avoid burns.

(7) Please note that the oil temperature in the transmission or hydraulic system may be high, the forklift should be cooled down first, and then the tire oil or hydraulic oil should be replaced to prevent the high oil temperature from causing combustion.

(8) The hydraulic system should be filled with new clean oil.

If the hydraulic oil is not clean, it will affect the precise hydraulic components and reduce the capacity of the whole hydraulic system.

If different grades of hydraulic oil are used, it will damage the hydraulic components and also affect the system capacity. Therefore, when adding or replace the hydraulic fluid, pay attention to the use of uniform grade.

(9) Please observe the relevant laws and regulations to protect the environment, store and discharge the oil according to the regulations, and do not discharge it into the sewer pipe.

(10) When welding the vehicle body, disconnect the battery power. The welding current may enter the battery during welding, so disconnect the battery to avoid this.

(11) When working underneath the forklift, the forklift should be supported by a brace.

If the forklift is not properly supported, the forklift will tip over and hurt people. If the forklift is not protected by lifting equipment or support, it is forbidden to work under the forklift.

If the forklift is not protected by lifting equipment or supports, do not work under the forklift.

## **7.9 Cleaning the Forklift**

Routine weekly cleaning is important to ensure reliability. Before cleaning, be sure to unplug the electrical outlet. This is to avoid damage to the electrical system due to short circuits.

## External cleaning

- (1) Remove adhesives from the wheels every day to maintain flexible rotation.
- (2) After cleaning, the parts of the truck to be lubricated should be filled with lubricant according to the lubrication parts table.

When cleaning electrical components, use compressed air to blow off motor dust. It cannot be rinsed with high pressure rinsing device.

Do not destroy the electrical components on the circuit board. To maintain the position of the electrical components to avoid short circuits.

## 7.10 Battery Maintenance

- (1) Battery liquid hole plugs and air-permeable caps should be kept clean, removed or opened when charging, and should be installed or closed after charging. Battery surface, connecting wires and screws should be kept clean and dry. If there is sulfuric acid, use cotton gauze dipped in lye to wipe it off, and pay attention not to let the lye into the battery.
- (2) After the charging is completed, the battery level should be checked and distilled water should be added in time to keep the liquid level high. It is forbidden to add dilute sulfuric acid under normal condition.
- (3) After the battery is used, it should be charged in time, and the time of placing is generally not more than 24 hours.
- (4) When charging, good ventilation should be maintained, and fireworks are strictly prohibited.
- (5) In the following cases, the battery needs to be equalized charging.
  - a. Normal use of the battery (every 3 months to do an equalization of the charge).
  - b. Battery that has been left unused for a long time.
  - c. Battery packs in the presence of "backward battery" (backward battery refers to the charging and discharging process, the voltage value is lower than that of other batteries). Battery or due to faulty overhaul of the battery), at this time equalization charging only backward battery alone.
- (6) equalization charging method.
  - a. Ordinary charging first.
  - b. Stop charging for 1 hour when the battery is fully charged, and then charge with 0.25I5 for 1 hour.

Repeat according to article b several times until the charger is turned off, there are a lot of bubbles in the battery until it is intense.

(7) When the battery is not in use, the storage period of one month shall be replenished according to the common charging method.

(8) The battery should avoid direct sunlight, and the distance from the heat source should not be less than 2M.

(9) Avoid contact with any liquid and harmful substances, and any metal impurities shall not fall into the battery.

### **7.11 Maintenance of the motor:**

(1) Inspection and maintenance of the motor should be carried out under power failure.

(2) Measure the cold insulation resistance of the motor with a 250-volt megohmmeter every three months, and the resistance value should be more than 0.5M . If the resistance value is less than 0.5 M , it should be dried.

(3) Check whether the connecting wires of the motor are correct and firm.

(4) Check whether the commutator is clean and the brushes should slide freely in the brush box.

(5) Check whether all fasteners are tight.

(6) Check the wear and tear of the brushes every three months and replace the brushes as appropriate.

(7) Perform comprehensive maintenance on the motor once a year.

### **7.12 Maintenance of electromagnetic brake**

1) If the brake is used for a long time in an environment with high humidity, it is necessary to prevent rust from forming. Rust on the suction surface will affect the use, so please remove it.

2) The friction surface must not be touched directly by hand or be contaminated with oil, otherwise the maximum torque will not be achieved, so please wash and wipe the friction surface clean.

3) If the temperature of the environment is high, please install it in a place with ventilation, and the general applicable ambient temperature is  $-10 \sim 40^{\circ}\text{C}$ .

4) The torque value is low at the beginning of the use, please use and run for a period of time before the torque value stabilizes.

5) Please check regularly, the items of regular inspection include: whether the switch action is normal; whether there is noise; whether there is abnormal heat; whether the friction part and the rotary part are normal; whether the friction part and the rotary part are normal.

The following items should be checked periodically: whether the switch operates normally; whether there is any noise; whether there is any abnormal heat; whether there is any foreign matter, oil, etc. in the friction part and the rotary part; whether the gap of the friction part is suitable; whether the excitation voltage is normal.

Is the gap of the friction part appropriate, and is the excitation voltage normal?

## 7.13 Maintenance

1) Daily maintenance and safety inspection.

(1) Daily maintenance and inspection of the forklift is the responsibility of the operator.

(2) Failure to perform routine maintenance on the forklift will affect the safety and reliability of the forklift and may lead to serious accidents.

(3) Problems or malfunctions found during inspection should be immediately repaired and the forklift should be taken out of service. The checklist is as follows:

| Part No. | Inspection point                  | Inspection content                             |
|----------|-----------------------------------|--|
| 1        | Operation control                 | Check for proper functioning.                  |
| 2        | Accident prevention safety switch | Check for proper functioning.                  |
| 3        | Horn                              | Check for proper functioning.                  |
| 4        | Steering                          | Check for proper functioning.                  |
| 5        | Hydraulic unit                    | Check for proper functioning.                  |
| 6        | Power meter                       | Check for proper functioning.                  |
| 7        | Hydraulic system                  | Check for oil level and leakage.               |
| 8        | Drive unit                        | Check for abnormal noise and oil leakage.      |
| 9        | Electromagnetic clutch            | Check for proper functioning and poor contact. |
| 10       | Transmission                      | Check for proper functioning.                  |
| 11       | Wheel                             | Check for damage, remove oil and metal debris. |
| 12       | Frame                             | Check for damage, remove oil and dirt.         |
| 13       | Battery                           | Check electrolyte level.                       |
| 14       | Forks                             | Check for deformation or cracks.               |
| 15       | Lifting device                    | Check for damage, remove oil contamination.    |
| 16       | Oil cylinder                      | Check for damage and oil leakage.              |

(2) Maintenance can be completed within 1 day, 1 week and 1 month as indicated in the maintenance table.

(3) Other maintenance parts given in the maintenance schedule. Maintenance can only be performed by our maintenance personnel or our authorized maintenance organization.

The maintenance schedule is as follows :

| <b>Part code</b> | <b>Runtime</b>   | <b>8 H</b> | <b>60H</b> | <b>240H</b> | <b>720H</b> | <b>1400 H</b> | <b>2800 H</b> | <b>5700 H</b> |
|------------------|--|------------|------------|-------------|-------------|---------------|---------------|---------------|
| 1                | Body systems   |            |            |             |             |               |               |               |
| 1.1              | Check the cover(left and right)                                  |            |            |             | ★           |               |               |               |
| 1.2              | View battery box mounts  |            |            |             | ★           |               |               |               |
| 1.3              | Check the frame for cracks                                       |            |            |             | ★           |               |               |               |
| 1.4              | Check that the body is securely mounted                          |            |            |             | ★           |               |               |               |
| 2                | electrical machinery   |            |            |             |             |               |               |               |
| 2.1              | Check for loose couplings  |            |            | ★           |             |               |               |               |
| 2.2              | Cleaning motors  |            |            | ★           |             |               |               |               |
| 2.3              | Check that the mounting bolts are secure                         |            |            | ★           |             |               |               |               |
| 2.4              | Check for abnormal bearing noise                                 |            |            | ★           |             |               |               |               |
| 2.5              | Check insulation resistance                                      |            |            |             | ★           |               |               |               |
| 2.6              | Check commutator and carbon brushes                              |            |            |             | ★           |               |               |               |
| 3                | drive system   |            |            |             |             |               |               |               |
| 3.1              | Checking for leaks   |            |            |             |             | ★             |               |               |
| 3.2              | Check oil level  |            |            |             | ★           |               |               |               |
| 3.3              | Checking noise   |            |            |             |             | ★             |               |               |
| 4                | Wheel part   |            |            |             |             |               |               |               |
| 4.1              | Remove cords and debris from wheels                              | ★          |            |             |             |               |               |               |
| 4.2              | Check drive wheel wear and bolts                                 |            |            |             | ★           |               |               |               |
| 4.3              | Check the universal wheel and axle for flexibility and tightness |            |            |             | ★           |               |               |               |
| 4.4              | Check the universal wheel for wear                               |            |            |             | ★           |               |               |               |

|     |   |   |   |   |   |   |  |  |
|-----|---|---|---|---|---|---|--|--|
| 4.5 | Check that the support wheel can rotate and that the connections are tight. |   |   |   |   | ★ |  |  |
| 4.6 | Check support wheel wear  |   |   |   | ★ |   |  |  |
| 4.7 | Remove and lubricate wheel body bearings                                    |   |   |   |   | ★ |  |  |
| 5   | Brake section   |   |   |   |   |   |  |  |
| 5.1 | Cleaning the brake section  |   |   |   | ★ |   |  |  |
| 5.2 | Check brake friction pad wear   |   |   |   | ★ |   |  |  |
| 5.3 | Checking the brakes in the released position                                |   |   | ★ |   |   |  |  |
| 6   | Electronic control panel  |   |   |   |   |   |  |  |
| 6.1 | Cleaning and installation inspection  |   |   |   | ★ |   |  |  |
| 6.2 | Fixed tight cable glands  |   |   |   | ★ |   |  |  |
| 6.3 | Check contactor contacts  |   |   |   |   | ★ |  |  |
| 6.4 | Check contactor operation   |   |   |   |   | ★ |  |  |
| 7   | Battery (for accumulating batteries)  |   |   |   |   |   |  |  |
| 7.1 | Check electrolyte level (level should be 10 -15mm above the pole plate)     |   | ★ |   |   |   |  |  |
| 7.2 | Check the connections on the forklift and charger for tightness.            |   | ★ |   |   |   |  |  |
| 7.3 | Check each battery and its insulating sheath for displacement.              |   | ★ |   |   |   |  |  |
| 7.4 | Check electrolyte specific gravity and temperature                          |   |   | ★ |   |   |  |  |
| 7.5 | Cleaning the battery  | ★ |   |   |   |   |  |  |
| 8   | Hydraulic system  |   |   |   |   |   |  |  |
| 8.1 | Check lines and fittings for leaks  |   |   |   |   | ★ |  |  |
| 8.2 | Check line wear   |   |   |   |   | ★ |  |  |
| 8.3 | Check the fuel tank for leaks   |   |   |   |   | ★ |  |  |
| 8.4 | Check the oil level   |   |   |   |   | ★ |  |  |
| 8.5 | Oil change  |   |   |   |   |   |  |  |
| 9   | Cylinder  |   |   |   |   |   |  |  |

|      |   |  |  |  |   |   |  |  |
|------|---|--|--|--|---|---|--|--|
| 9.1  | Check for leaks   |  |  |  |   | ★ |  |  |
| 9.2  | Check the installation                                    |  |  |  |   | ★ |  |  |
| 10   | Master  |  |  |  |   |   |  |  |
| 10.1 | Check for damage and cracks                               |  |  |  |   | ★ |  |  |
| 10.2 | Check roller movement                                     |  |  |  |   | ★ |  |  |
| 10.3 | Damage to hoist chain and pins and wear on sprockets      |  |  |  | ★ |   |  |  |
| 10.4 | Check for signs of fork breakage                          |  |  |  | ★ |   |  |  |
| 11   | Control arm   |  |  |  |   |   |  |  |
| 11.1 | Check mounting fastening                                  |  |  |  |   | ★ |  |  |
| 11.2 | Check the brake switch                                    |  |  |  | ★ |   |  |  |
| 11.3 | Check that the fastening screws are not dislodged         |  |  |  |   | ★ |  |  |
| 11.4 | Checking the functioning of safety switches               |  |  |  |   | ★ |  |  |
| 11.5 | Check the damping springs for proper operation and adjust |  |  |  |   | ★ |  |  |

## 7.14 Lubrication part table

| Part code | Lubricating part             | Interval time(h) |      |      | Lubricants, grease categories |
|-----------|------------------------------|------------------|------|------|-------------------------------|
|           |                              | 500              | 1000 | 3000 |                               |
| 1         | Bridge Bearings              |                  | L    |      | A                             |
| 2         | hydraulic system             | H                | O    |      | B                             |
| 3         | Drive Gearbox                | H                |      | O    | C                             |
| 4         | Lifting Chain                | L                |      |      | D                             |
| 5         | Bearings for lifting systems | L                |      |      | G                             |

Above table: L=Lubricity      H=Check      O=Replace oil, lubricants, grease

| Grease category |                   | Norm                                   |                                  | Applicable Components   |
|-----------------|-------------------|--|----------------------------------|-------------------------|
|                 |                   | >-15° C                                | <-15° C                          |                         |
| A               | Grease            | 3#Lithium grease dripping point 170    |                                  | Bearings and Bushings   |
| B               | Hydraulic oils    | SHELL L-HM46                           | SHELL L-HV32                     | Hydraulic Systems       |
| C               | Transmission oils | 85W/90<br>(External SAE80W/90)         | 70W/75<br>(External SAE75W)      | Gearboxes               |
| D               | Lubricating oils  | CC30<br>(Ordinary temperatures SAE20W) | CC15W<br>(Low-temperatureSAE10W) | Chains and Piping       |
| G               | Greases           | 3#Lithium grease dripping point 170    |                                  | Lifting System Bearings |

## Chapter 8 . Transportation and Storage

### 8.1 Hauling and transportation of defective forklifts

1. When towing a forklift by towing or rope, the forklift being towed must have a driver to operate the steering and release the brakes.

2. When the brake function of the forklift truck is intact, you can pull the forklift truck with the foot pedal in the down position, and ask others to

When the brake function of the forklift is intact, you can pull the forklift with the foot pedal in the depressed position and ask others to assist in pushing the forklift (the pushing part is at the outer gantry), and send the forklift to the destination or our maintenance point for repair.

3. If the drive wheels of the forklift are faulty, the forklift can be towed by a trailer or tractor.

#### Note !

Forklift drive wheels must be lifted off the ground or the wheels and motor will be severely damaged.

### 8.2 Forklift storage

If the forklift is to be stored for a long period of time, please take the following measures for the following parts:

Battery:

1. Recharge the battery, then perform routine battery maintenance.
2. Perform charging maintenance and check electrolyte level every 1 month.

Hydraulic System:

When storing the forklift for more than one year, change the hydraulic fluid in the hydraulic system. See

Maintenance section and Lubrication Parts table.

See the maintenance section and lubrication parts table.

Drive system:

When stored for more than a week, securely pad the drive wheels, which can also be left hanging to prevent possible movement.

Move it. At the same time, unload the load.

### **8.3 Precautions for reuse of forklifts after storage:**

1. When stored for a certain period of time, before reuse, the same routine maintenance and safety checks should be performed as for the

Before reuse after storage for a certain period of time, it should be checked for functionality and safety as routine maintenance and safety check.

2. When stored for more than 3 months, preventive maintenance can be performed in accordance with the 500-hour requirement of this manual (interval).

Preventive maintenance may be performed in accordance with the 500-hour requirement of this manual (interval).