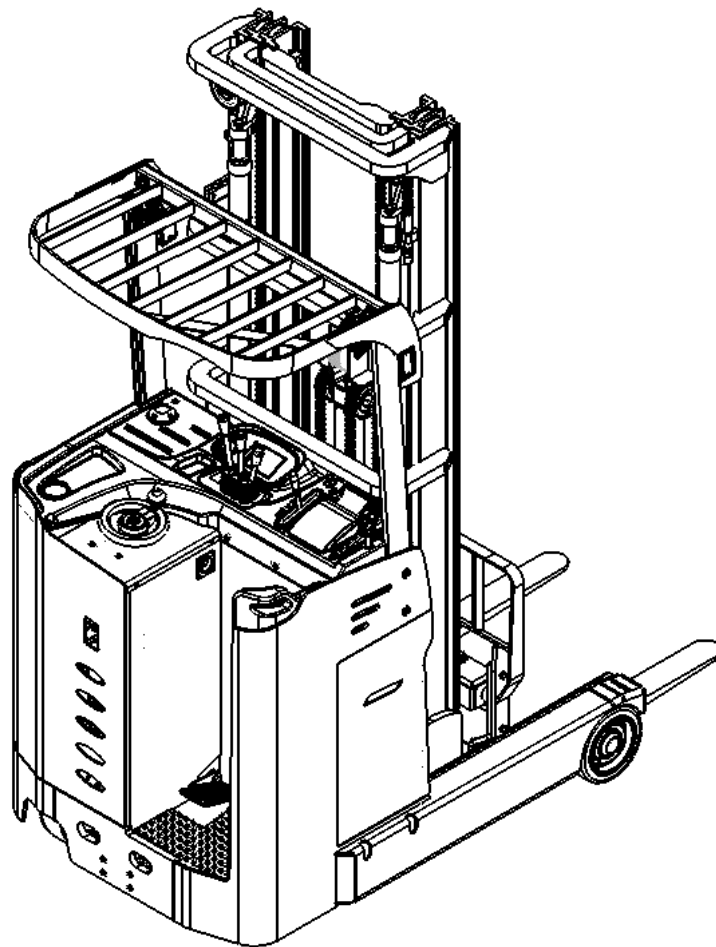




# Maintenance Instruction Manual

## MF Series Stand-on Electric Reach Truck



BANYITONG SCIENCE & TECHNOLOGY DEVELOPING CO.,LTD.

[www.mimaforklift.com](http://www.mimaforklift.com)

## **Preface**

In order to meet market demand, our company designs MF series stand-on electric reach truck, referring to international advanced technology. Due to its small appearance and comfortable operation, it can be applied into the warehouse, freight yard and supermarket, food and textile industries can also use it to load and unload, stack and move their pallets. With mast-tilt function and small radius, this series reach trucks are especially suitable to be used in warehouse system, with high standard for space utilization.

Due to wider mast lifting system, EPS system, imported famous brand speed-adjustable control system and multifunctional instrument, this series reach trucks perform well with excellent functions, easy operation, small noise and no pollution.

This instructions introduces all main parts structure, working principles and maintenance information of MF series stand-on reach truck, which can help the operator use it properly and maximizing its functions. We sincerely hope operator and machine administrator can read this instruction before use.

Considering products safety and quality, as the manufacturer, we may change some structures or specifications, which will bring some differences between this content and real situation, we will have no further notice.

Any unclear points or suggestions about this, please contact our local after-sales service department.

Version Number: 201703

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## Chapter I Introduction of MF series stand-on electric reach trucks

With lead acid battery, MF series reach trucks adopt stand-on steering wheel type. Its mast can move forward and backward towards the driving direction when lifting the mast. It can be used to lift goods in narrow aisles, with an outstanding high-position stacking function, which can maximize the warehouse space.

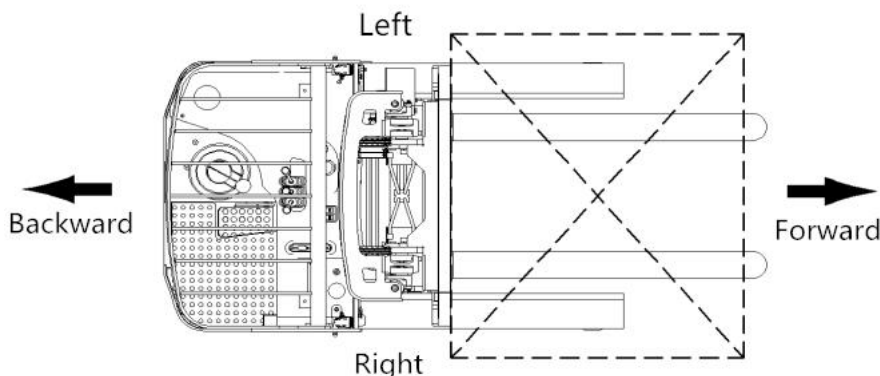
### 1.1 MF series models sheet

MF series models as below:

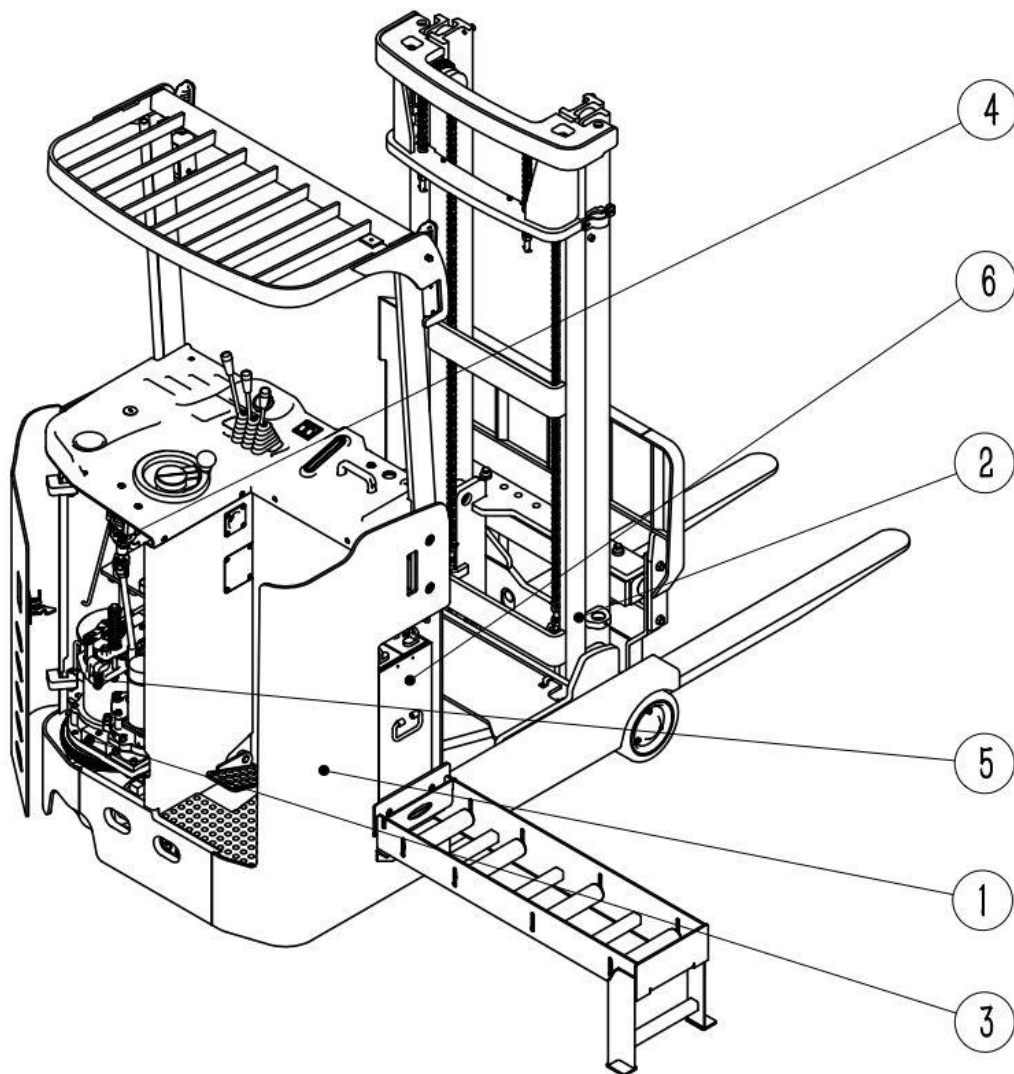
Model	Ranged Capacity (Kg)	Load Center (mm)	Standard Lifting Height (mm)	Mast Features
MF10	1000	500	3000	Duplex mast
MF12	1200	500	3000	Duplex mast
MF15	1500	500	3000	Duplex mast
MF20	2000	500	3000	Duplex mast
MF25	2500	500	3000	Duplex mast
MF30	3000	500	3000	Duplex mast
MF12SQ	1200	500	4500	Triplex full free mast
MF15SQ	1500	500	4500	Triplex full free mast
MF20SQ	2000	500	4500	Triplex full free mast
MF25SQ	2500	500	4500	Triplex full free mast
MF30SQ	3000	500	4500	Triplex full free mast

### 1.2 Definition of driving direction

Definition of driving direction as below



## Chapter II Main components of MF series reach trucks

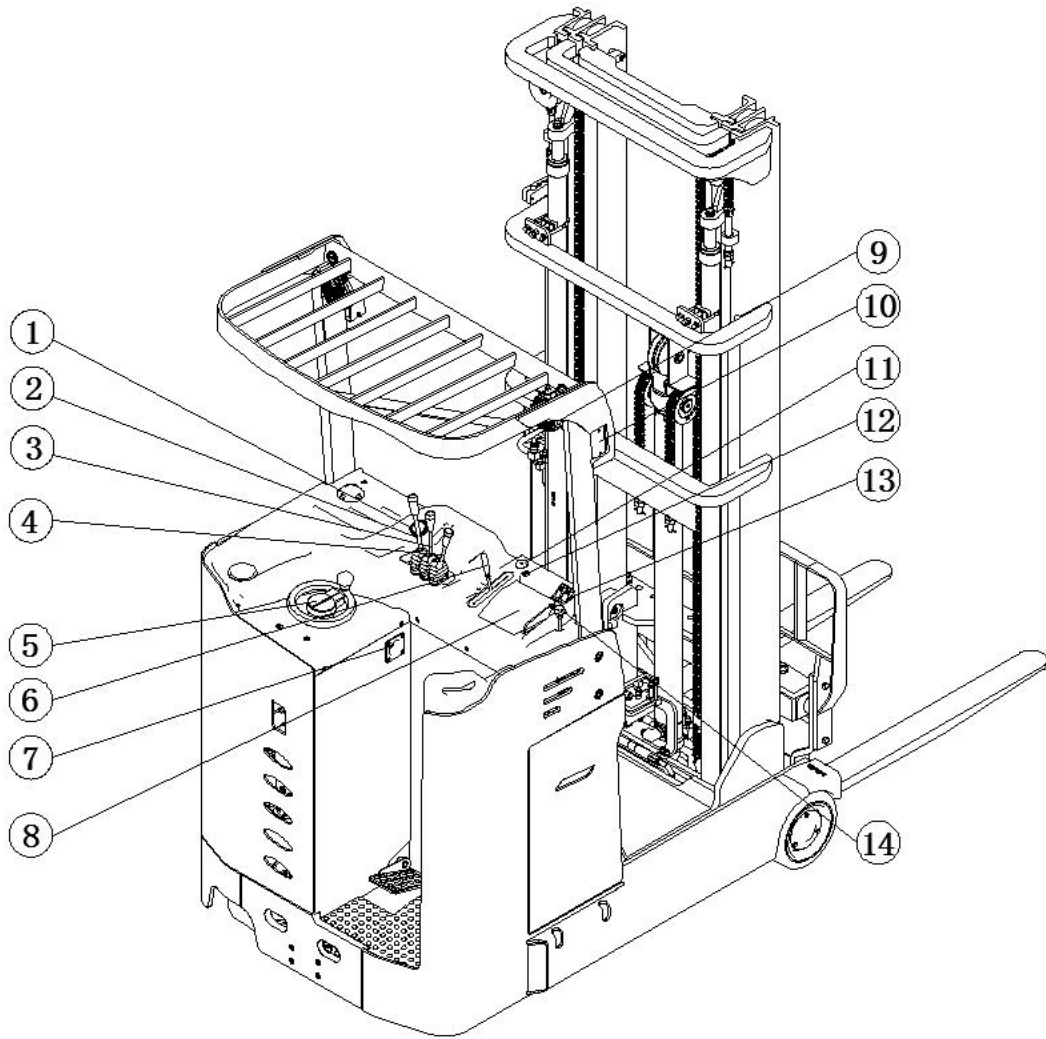


1. Body System  
4. Steering System

2. Lifting System  
5. Braking System

3. Driving System  
6. Electrical System

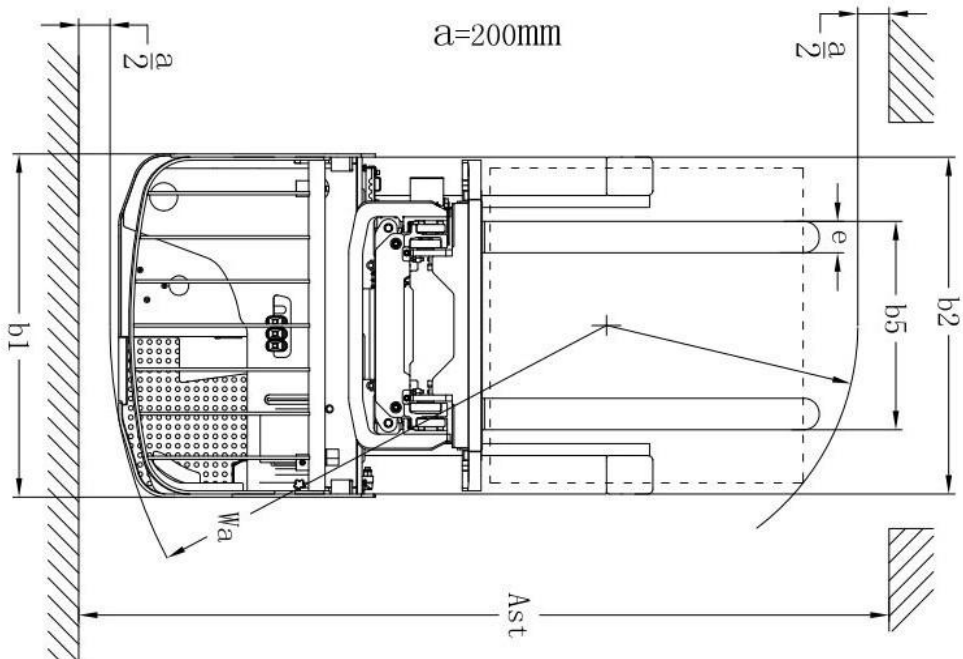
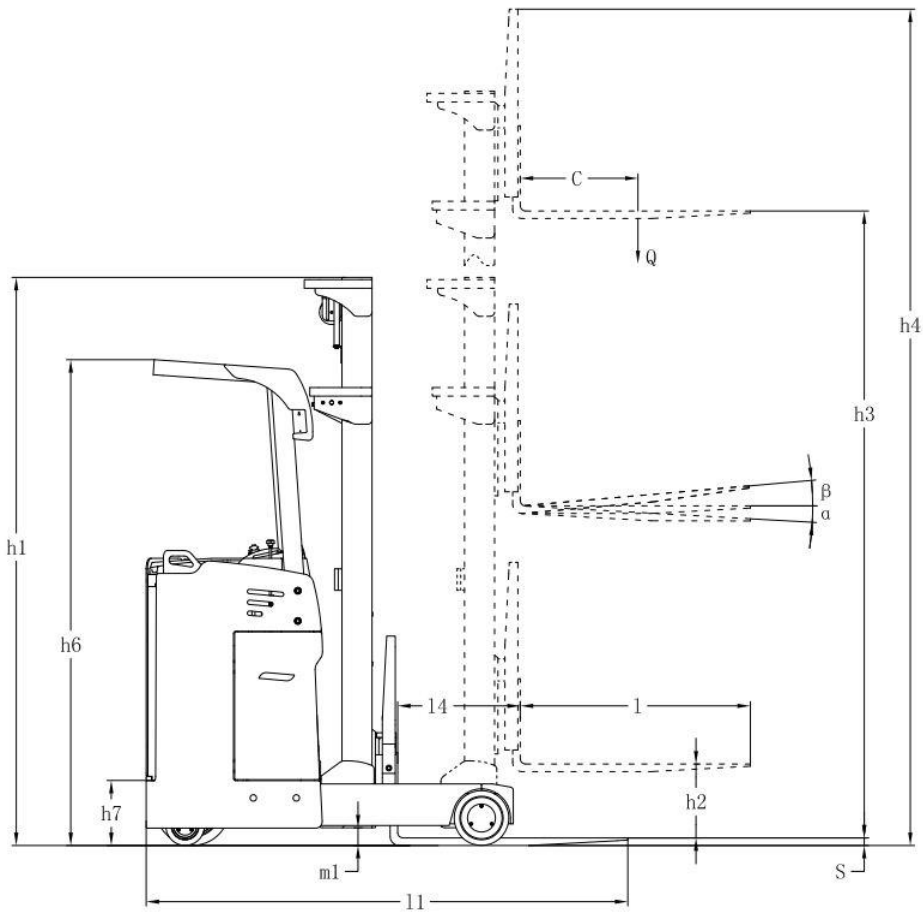
### Chapter III Operation panel description of MF series reach trucks



- |                   |                        |                       |                  |
|-------------------|------------------------|-----------------------|------------------|
| 1. Instrument     | 2. Tilt Joystick       | 3. Reach Joystick     | 4. Lift Joystick |
| 5. Steering Wheel | 6. Acceleration Handle | 7. Ignition Switch    | 8. Handrail      |
| 9. Floodlight     | 10. Cornering Light    | 11. USB Charging Port | 12. Horn Button  |
| 13. Light Switch  | 14. Emergency Rod      |                       |                  |

# Chapter IV Main specifications of MF series reach trucks

(Main specifications are referred to products specifications sheet)





## 5.1 Body System

### 5.1.1 Body system structure

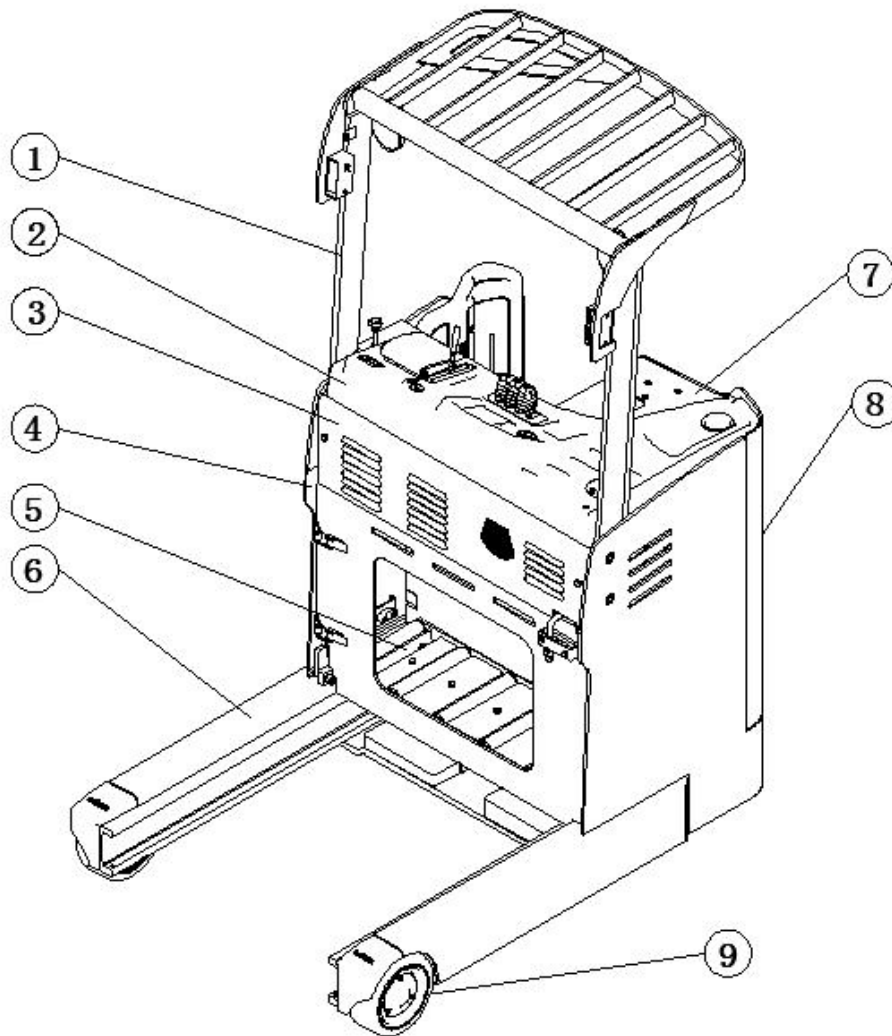


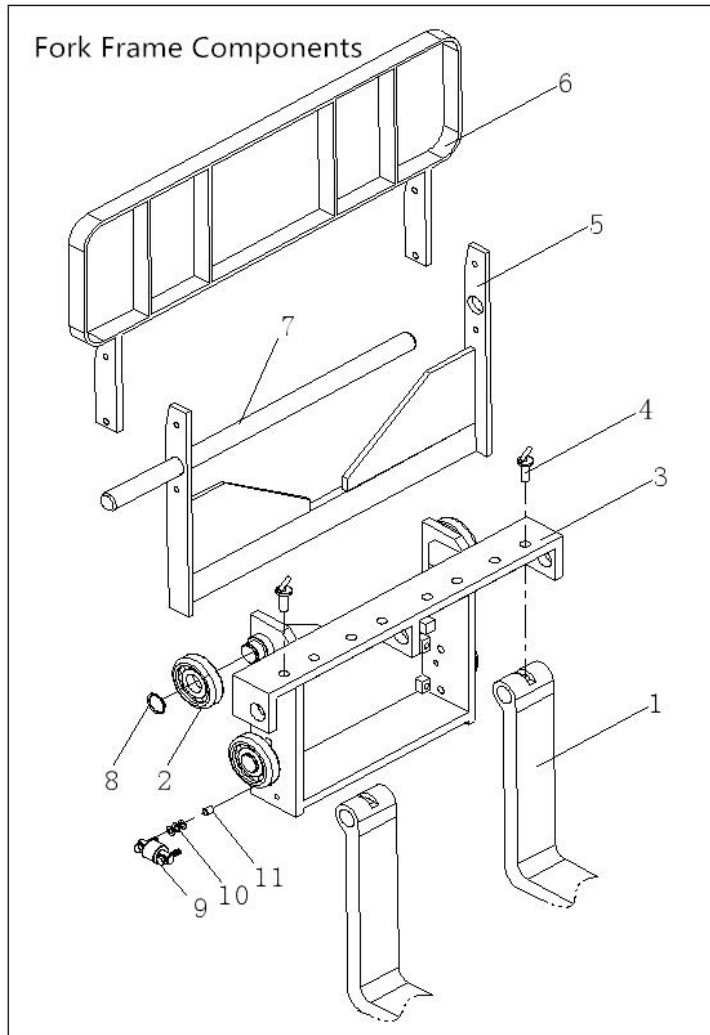
Fig.5-1-1-1

1. Head guard Components 2. Covered Part Components 3. Front Panel Components  
4. Side-door Components 5. Battery Rack Components 6. Frame Welding  
7. Steering Panel 8. Rear Panel Components 9. Front Wheels Components

## 5.2 Lifting System

### 5.2.1 Lifting System Structure

Lifting system consist of outer mast, inner mast, fork frame. Reaching cylinders (double function) control mast reaching function, lifting cylinders (single function) control forks lifting, lifting cylinders push inner mast, inner mast pushes fork frame by chains, which lifts the forks. There are tilting cylinders (double function), which can bring -3 to +5 tilting range, convenient to transportation and stacking.



1. Sleeve Forks
2. Roller
3. Inner Sliding Frame
4. Fork Dowel
5. Fork Frame
6. Shelving
7. Fork Shaft
8. Shaft Ring
9. Side Rollers
10. Adjusting Gasket Group
11. Side Roller Cushion

Diagram 5-2-1-1

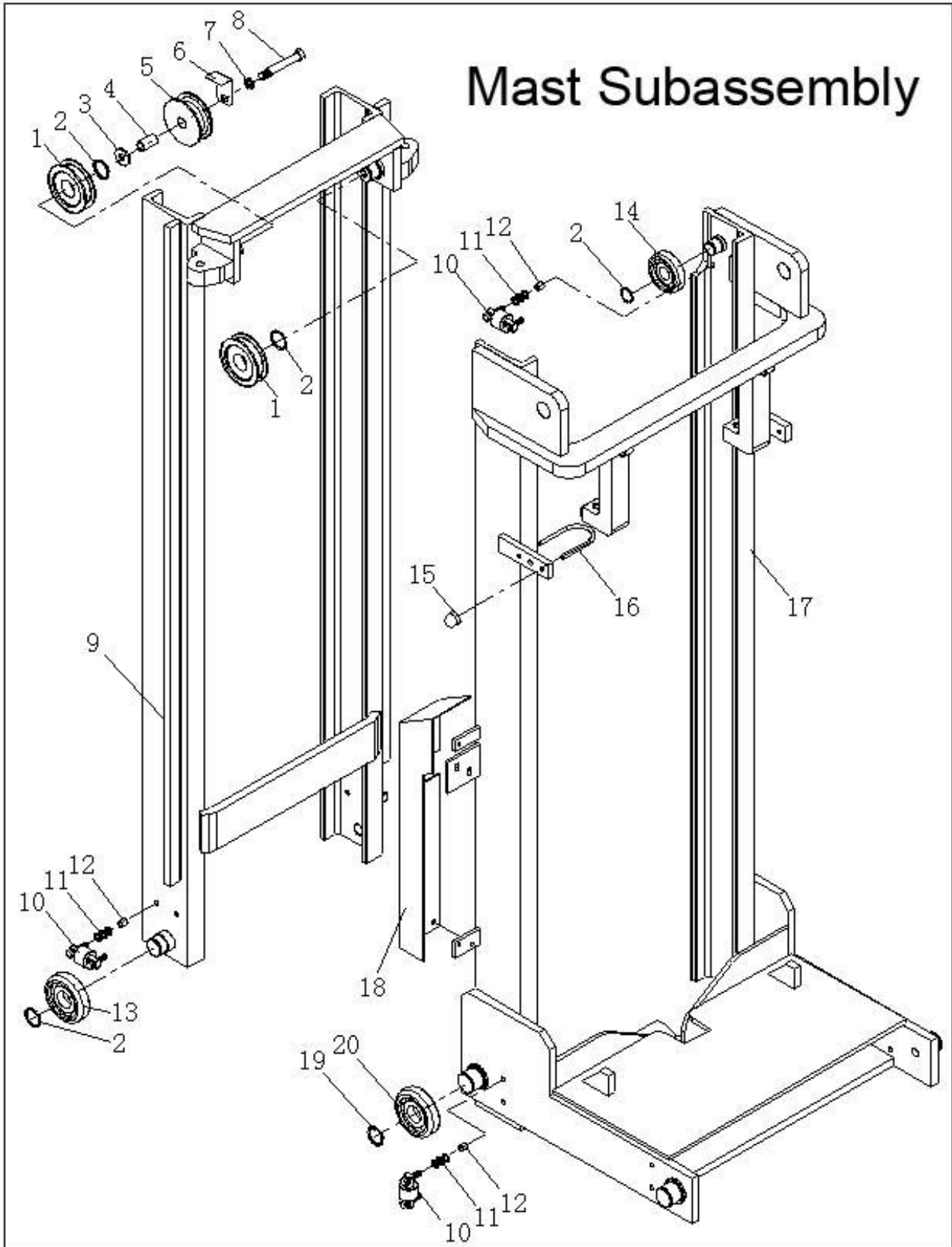


Chart 5-2-1-2

- |                             |                      |                  |                  |
|-----------------------------|----------------------|------------------|------------------|
| 1.non-toothed chain wheel   | 2.axle retainer ring | 3.spacer sleeve  | 4.spindle sleeve |
| 5.plastic core-rubber-tires | 6. Tubing baffle     | 7. spring gasket | 8. bolt          |
| 9. inner mast               |                      |                  |                  |

10.side idler wheel                      11. adjust gasket group                      12.side idler wheel gasket  
 13.inner mast idler wheel 14.out mast idler wheel    15.cover mould nut    16. U mould bolt  
 17.out mast 18.protect cover 19.axle retainer ring    20.forward idler wheel

### 5.2.2 Malfunction analyze and solution of lifting system

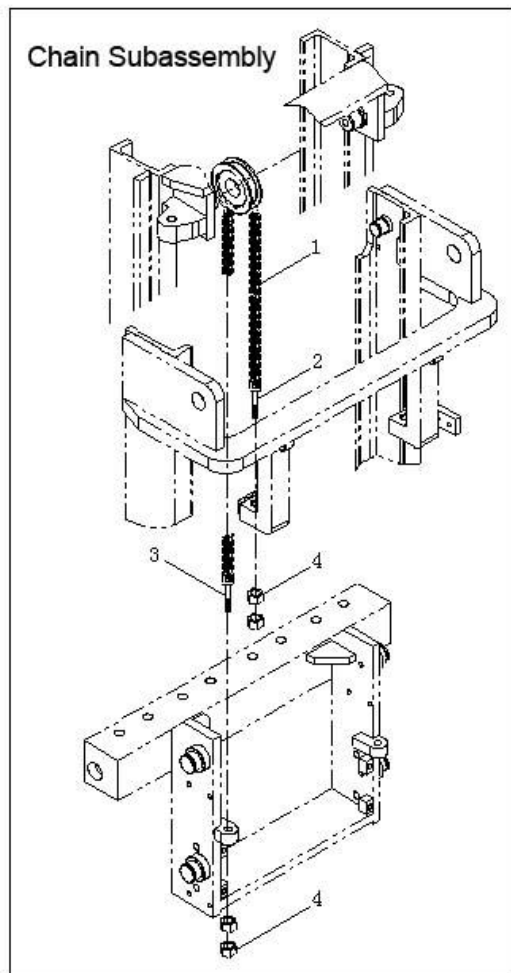
Malfunction	Cause	Solution method
Fork and mast incline	Incline oil tank and joint ring wear and tear	Change piston joint ring or oil tank
	Control valve handle spring malfunction	Change
Fork lift and fall not agile	Piston lock or piston curve	Change
	Much dirt in tank	Clean-out
Fork lift and fall not smooth	Forks adjust unsuitable	Adjust channel slide way and side idler wheel gap
	Small gap between idler wheel and mast channel	Adjust gap of idler wheel
	Much dirt in movement parts	Remove eye winker
	Lubricate not enough	Mop up grease on slide way
	Inner mast deflection or fork bend	Maintain or change
Fork lift and fall not asymmetry	Lifting chain is not in good condition	Adjust chains loosen and tighten
Lifting idler wheel not turn	Grease callosity or idler wheel dirt	Clean and lubricate idler wheel
	Lifting wheel not adjust well	Adjustment
Mast noise loudly for lifting	Lubricate insufficiency	Lubricate
	Fork idler wheel adjust asymmetry	Adjust the gasket
Not lifting or lift slowness	Pump wheel fray pump, gap increase	Change oil pump or fray
	Lifting tank piston joint ring fray	Change joint ring
	Multi-way valve and safety valve spring invalidation	Change spring
	Valve handle and valve body fray increase and oil leak much	Change
	Leak oil between multi-way valve	Reset and assembly as order
	Hydraulic tube leak oil	Check and repair
	Oil temperature high and rare, flux lack	Change oil and check oil temperature
	Loading overweight	Change gasket

Table 5-2-2-1

### 5.2.3 Adjustment methods of lifting system

①Pause truck on horizontal and make mast uprightness.Make fork underside touch ground, adjust the bolt nut on the chains, make left and right chains have similar tightness.

②When fork lift height, make sure inner slide guide calm and not noise. otherwise, adjust the idler wheel group to the suitable situation.



1.leaf chain

2.above adjusting bolt

3.below adjusting bolt

4.nut

Like the picture : Chain slide fixed on toothed chain wheel of inner mast, one side on outer mast and the other side on inner slide support. When inner mast lift at lifting jar action, the fork lift at same through the chain, the lifting height of fork is twice of lifting jar traveled.

When chain adjust unsuitable, the main cause is left and right tension not assorted, inner slide support will suffer force asymmetry and increase resistance and fray. Chain adjust is through the nut on adjust bolt to carry out. So please attention to adjust chain degree of tightness.。

Chart 5-2-3-1

## 2. Change idler wheel

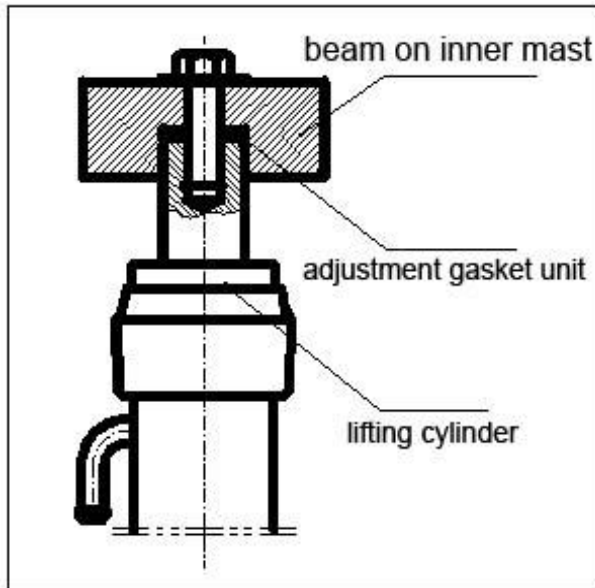
- ①. Take out the axle retainer ring and idler wheel with drawing tool.
- ②. Change a new idler wheel and advert the aspect of idler wheel ( bigger circle arc towards outside ) ;
- ③. Install axle retainer ring.

## 3. Change side idler wheel

- ①. Take out side idler wheel and take down the adjust piece quantity;

- ②. Install the adjusting shim and new side idler wheel together, and make ball bearing slot of side idler wheel to meet with adjusting shim;

If side idler wheel and mast are looseness, adjust side idler wheel shim group (0.1~0.5mm )



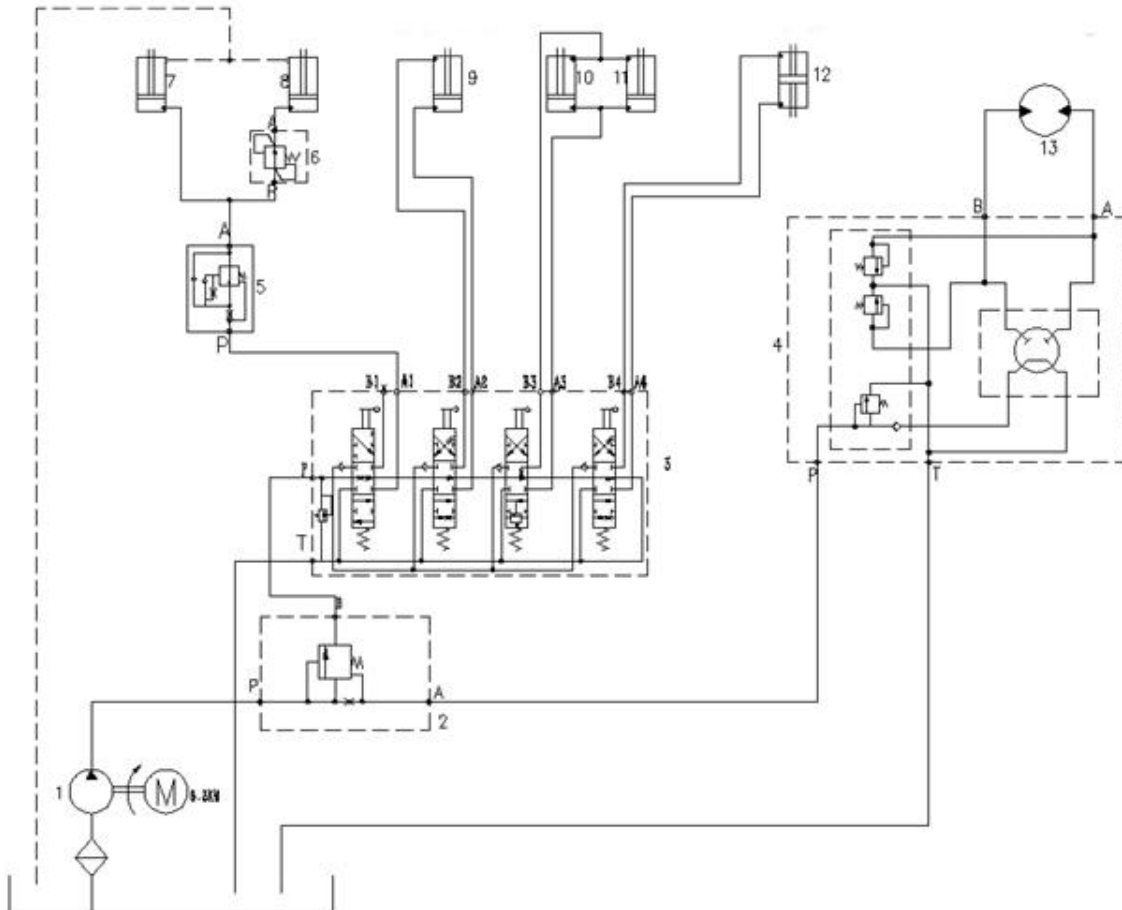
#### 4. Adjust main lifting jar

- ① Install piston rod head that not adjusting shim into inner mast;
- ② Lift mast to the most traveling of cylinder and check the two cylinder in-phase or not;
- ③ Adding adjusting shim between resting piston rod of cylinder and mast beam (Chart 5-2-3-2). adjusting shim thickness is 1~2mm.

## 5.3 Hydraulic system

### 5.3.1 Hydraulic principle diagram

Left lifting cylinder    Right lifting cylinder    Left/right tilting cylinder  
Forward cylinder    Side shifter    Steering motor



Remark: this Hydraulic principle diagram for hydraulic steering forklift, if your forklift is EPS steering, please ignore right side steering motor.

### 5.3.2 Hydraulic system structure

Hydraulic system is made up of oil pump, oil tank, multi-way valve, limit speed valve, cutoff valve, lifting and falling oil tank, reaching oil tank, incline oil tank, and oil tube. The motor drive gear oil pump directly. The Chart 5-2-3-1 is the truck hydraulic system diagram.

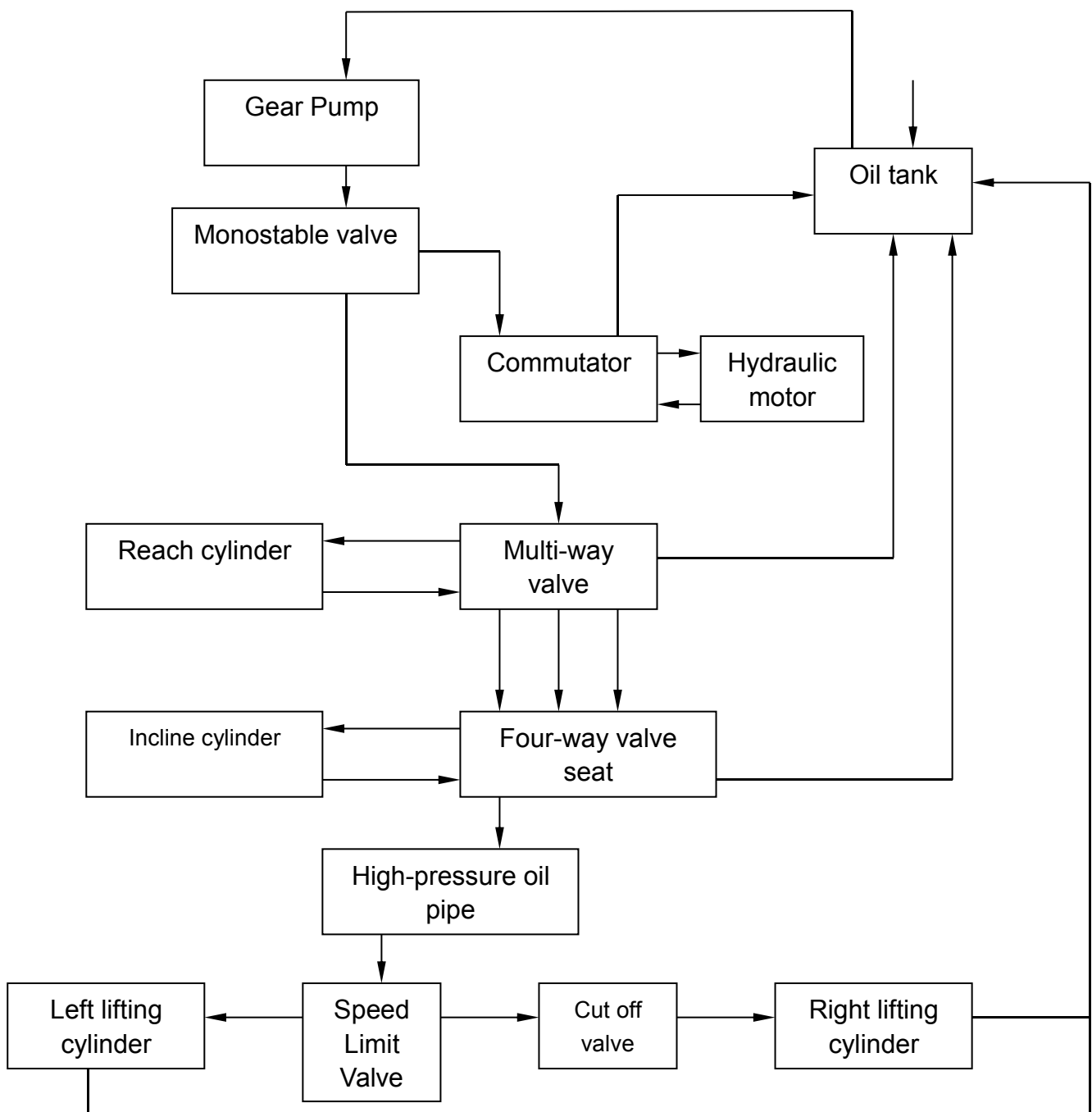
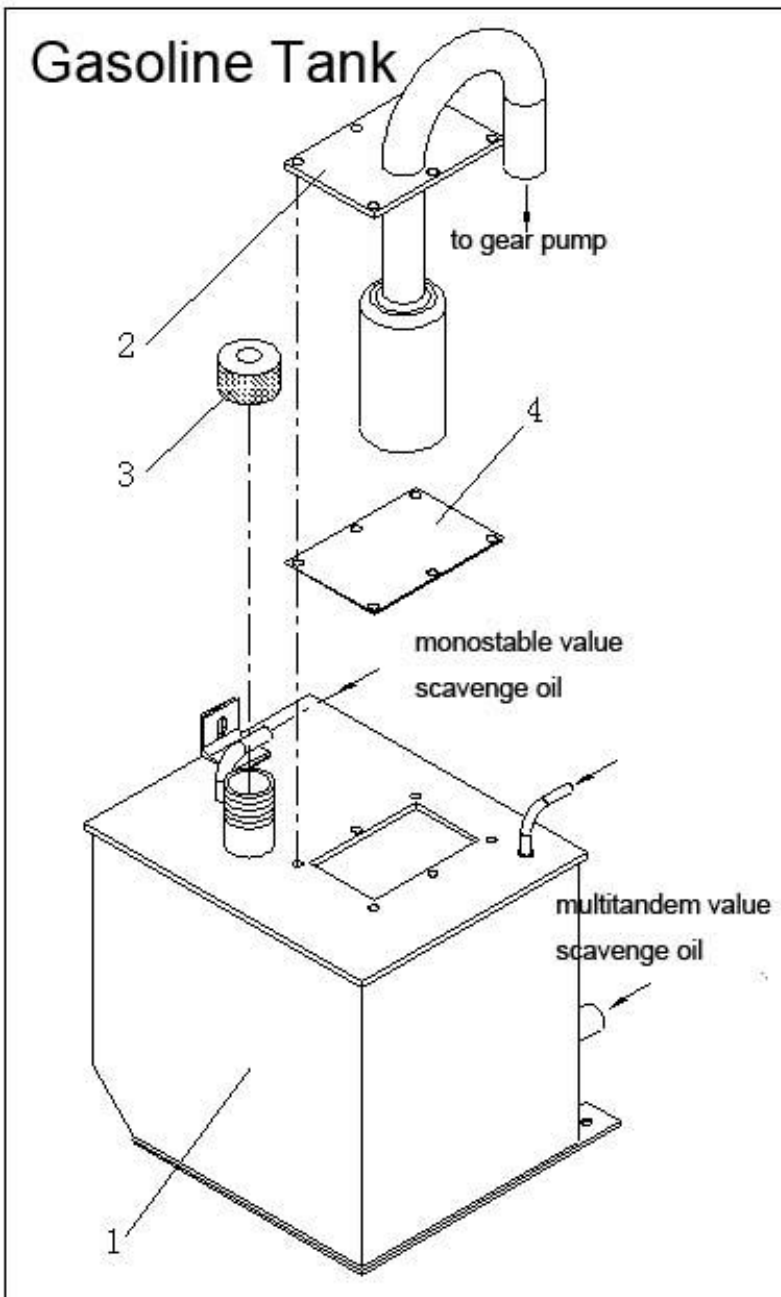


Chart 5-3-2-1



### 5.3.3 Oil tank



- 1.Oil tank
- 2.Oil header assembly
- 3.Filling aperture cover
- 4.Gasket ring

Change oil filter:

① Draw out oil suction pipe from oil header.

② Take out oil header assembly from gasoline tank.

attention: Get rid of old gasket ring

③ Change a new oil filter

④ Install shim and oil header assembly.

attention: Wipe sealant on two sides of shim.

Chart 5-3-3-1

Remark: Maybe different forklift model with different oil tank.

### 5.3.4 Malfunction analysis and solution

#### 1. Multi-way valve malfunction analysis

Malfunction	Cause	Solution method
Lifting oil channel pressure low	Slide valve clamping stagnation	Clean out after disconnect
	Oil hole jam	Clean out after disconnect
Shake and pressure lift low	Slide valve clamping stagnation	Clean out after disconnect
	Exhaust insufficiency	Exhaust sufficiency
Turning oil channel pressure high	Slide valve clamping stagnation	Clean out after disconnect
	Oil hole jam	Clean out after disconnect
Lack oil capacity	Overflow valve adjust unsuitable	Adjustment
Noisy	Overflow valve adjust unsuitable	Adjustment
	Glide face fray	Change overflow valve
Exterior leak oil	O shape joint ring aging or damage	Change O shape joint ring
Enactment pressure low	Spring damage	Change spring
	Valve seat damage	Adjust or change overflow valve
Inside leak oil	Valve seat damage	Repair valve seat
Enactment pressure high	Valve clamping stagnation	Clean out after disconnect

Table 5-3-4-1

#### 2. Adjust safety valve pressure

	1-1.8t	2-2.5t	3-3.5t
Magnitude of pressure regulation	14.5MPa	17.5MPa	17.5MPa
Adjust re-director pressure	4.5MPa	6.3MPa	6.3MPa

Table 5-3-4-2

#### 3. Adjustment method of safety valve pressure

Be sure to adjust as the follows:

- 1.Screw down the measure plug screw of multi-way and install the oil pressure gauge that can measure 20Mpa.
- 2.Operate incline handle and measure the pressure of oil tank travel to the end.
- 3.Oil pressure is unlike with prescribed value, loosening lock nut of overflow valve and adjust bolt to prescribed value, turning left when pressure is higher, turning right when pressure is lower.

#### 4. Working principle of dump valve

The dump valve is at the bottom of lifting jar, when high-pressure hose break off suddenly

that can prevent goods decline rapidly. The slide valve oil hole on dump valve can make pressure difference, when the pressure difference less than spring pressure, the slide valve is immobility, if the high-pressure break off and bring quite pressure difference to ward off around oil hole and make fork decline slowly.

#### 5. Working principle of governor valve

The governor valve control fork decline speed and achieve protected action when high-pressure hose break off. When a lot of returning oil inter into valve chamber and make two sides of valve key produce pressure difference to move valve key to lower pressure aspect, and returning oil channel become narrow, oil capacity reduce and fork decline speed slowly.

#### 6. Malfunction analyze of gear pump

Malfunction	Cause	Solution method
Lack oil output	Oil level lower	Add oil to prescribed value
	Oil tube or leak oil part jam	Clean out or change
Pump pressure lower	Scale board damage Supporting damage Joint ring, bush seal components or retaining ring not good	Change
	Overflow valve adjust unsuitable	Adjust overflow valve to prescribed value
	Air in system	Tighten oil suction pipe Put into oil Change oil pump seal
Noisy when turning	Oil suction pipe damage or oil filter jam	Check pipe or repair oil filter
	Intake side not tighten or leak air	Tighten not hard up place
	Oil viscosity too higher	Change oil to suitable for pump turning temperature
	Air bladder in oil	Find cause and solve
Pump leak oil	Pump oil seal or joint ring damaged	Change
	Pump damage	Change

Table 5-3-4-3

## 5.4 Drive System

### 5.4.1 Outline of Drive System Structure

When the rear axle is supporting the drive device, it can reduce the contact pressure between the drive wheel and the ground according to the road surface conditions during driving, and prevent the drive wheel from idling. If the casters and the driving device are fixed on the frame, when the casters or the driving wheels hit the raised portion of the road surface, the driving device and the frame will float together, causing the driving wheels to spin off the ground or tilt the body. In order to prevent the above situation, as shown in Figure 5-4-1-2, the reaction force of the spring is applied to the driving device in the opposite direction to the movement of the caster to compensate for the wheel pressure.

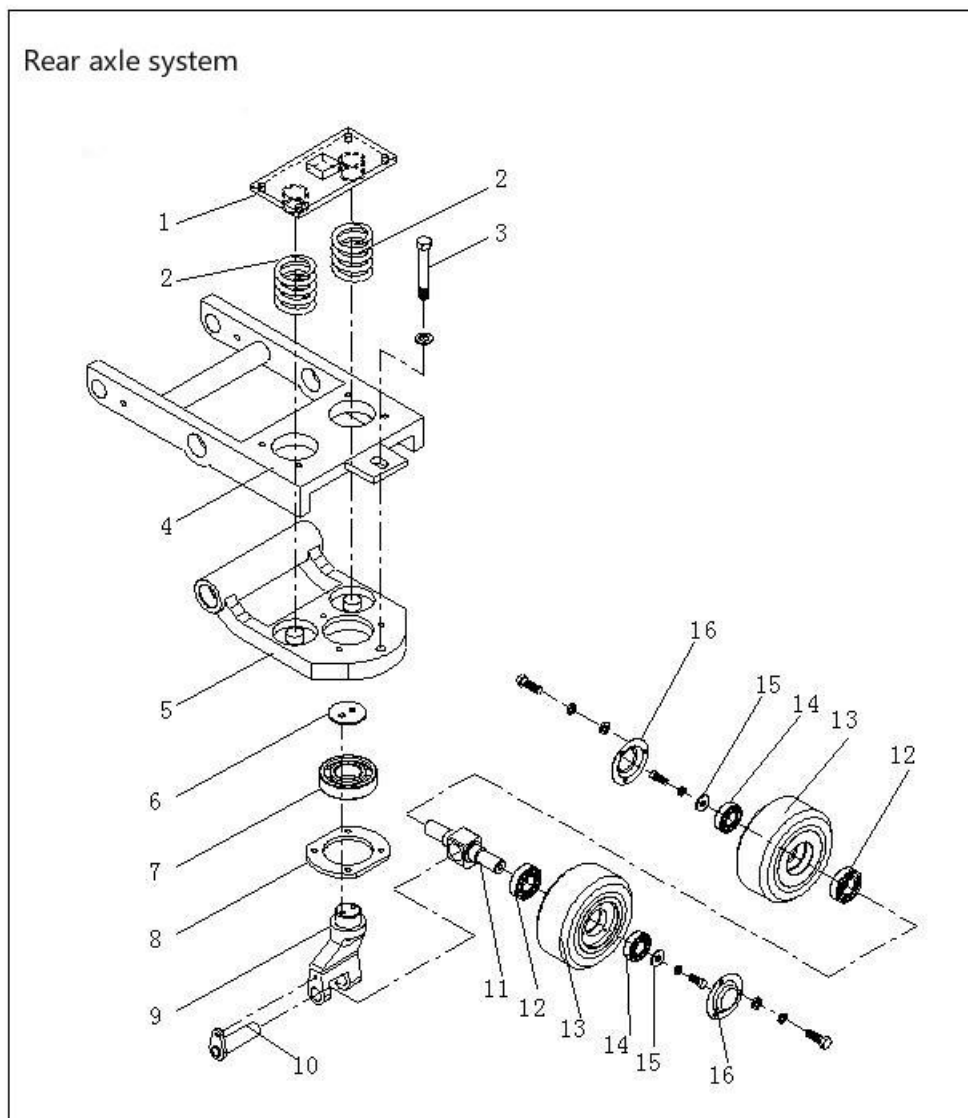


Table 5-4-1-1

1、damping spring plate    2、damping spring    3、adjusted bolt    4、connection

structure 5、Down connection structure      6、bearing lid plate    7、bearing    8、bearing block  
 9、universal wheel holder    10、 axle pin    11、 universal axle    12、 bearing  
 13、 rear universal wheel    14、 bearing    15、 bearing catch    16、 dust cap

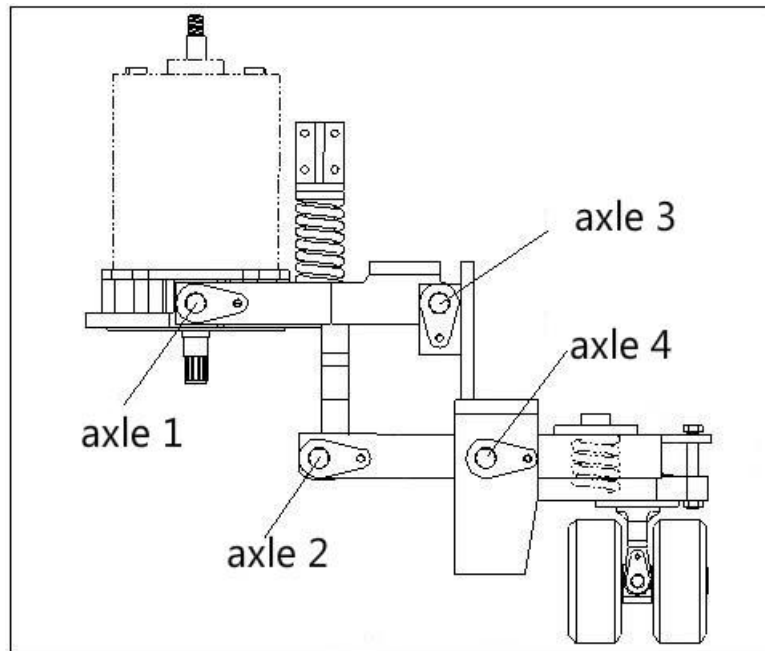


Table 5-4-1-2

As shown in Table 5-4-1-2, the four shafts connect the upper bridge, the lower bridge, the connecting plate, and the connecting bridge to the rear axle mount to form a four-bar linkage mechanism. Among them, axis 1, axis 2 is a moving axis, axis 3, axis 4 is a fixed axis (fixed on the rear axle mount). When the small caster encounters a small obstacle, the spring will compress and the caster will be lifted up, without affecting the stability of the frame; when the drive wheel encounters a small obstacle, the lower connecting bridge clocks the shaft four clockwise Turn, under the action of the spring, compress the caster to ground, not to idle, to maintain the stability of the vehicle. At the same time, under the effect of the spring force, the driver's comfort can be improved.

### 5.4.2 Drive system adjustment

The key to adjusting the drive axle lies in the adjustment of the damping spring. The spring force is too strong and the tail of the frame will be upturned; the spring force will be too weak and the frame will tilt towards the side of the caster, causing the frame to lose stability.

When adjusting the drive axle, the forklift should be placed on a flat surface. As shown in table 5-4-1-2, the upper and lower connecting bridges should be horizontal, and the damping spring is partially compressed.

### 5.4.3 Drive gear box structure

- 1. Drive motor    2. small gear wheel
- 3. Gear box    4. drive wheel
- 5. semi axle    6. oil seal holder
- 7. oil seal 8. semi axle lock nut 9. Oil cup    10. TRB
- 11.end ring 12. adjust gasket 13. semi axle sleeve of bearing
- 14. gear wheel 15. adjust gasket 16. big gasket 17. roller bearing
- 18. Lock nut    19. spin axle    20. Big gear wheel    21. roller bearing
- 22. adjust sleeve 23. bearing adjust gasket 24. TRB    25. lid

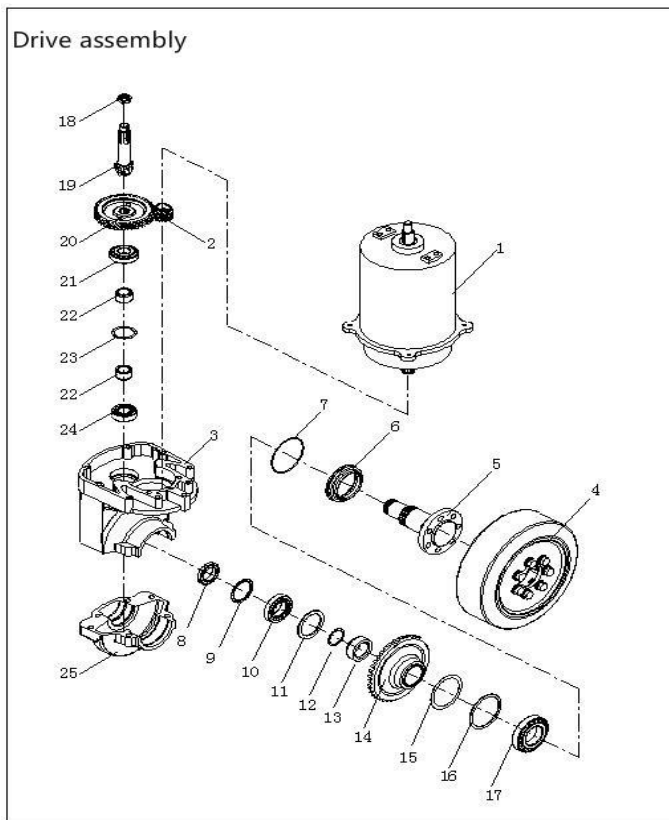


Table 5-4-3-1

#### 5.4.3.1 Drive gear box parameter

Drive gear box	MF10/MF12	MF15D	MF15/MF20	MF25/MF30
Speed rate	1: 18.43	1: 18.19	1: 17.96	1: 18.738
Drive wheel Diameter x width	PU Φ230x110	PU Φ280x135	PU Φ343x108	PU Φ380x165
Drive motor	AC	AC	AC	AC
Gear oil capacity	1.5L	3L	3.5L	3.5L
Oil type	85W/90	85W/90	85W/90	85W/90

Table 5-4-3-2

The transmission device of the reach truck is mainly a drive gear box (Table 5-4-3-1). The drive wheel is fastened to the flange of the drive half shaft through the hub bolt, and the power is transmitted to the drive shaft through the drive gear box. Drive the wheel to turn. The drive gear box is mainly composed of a box body, a box cover, a gear, a tooth shaft, a bearing and a seal. The motor power is transmitted to the input shaft through a gear, and the power of the input shaft is transmitted to the output shaft through a pair of spiral bevel gears, thereby driving the output shaft. Drive wheel turns. The entire space of the box is filled with gear oil for lubrication of all parts.

#### 5.4.4 Adjustment methods of driving gear box

##### 1. Remove the drive wheel

- (1) Put up the rear of the frame;
- (2) Turn the steering wheel so that the drive wheel rotates clockwise 90° so that its side faces backward;
- (3) Remove all bolts that mount the drive wheel;
- (4) The bolts in the center of the hub are replaced with a driving wheel mounting bolt;
- (5) Twist the hub center bolt and push the drive wheel out.

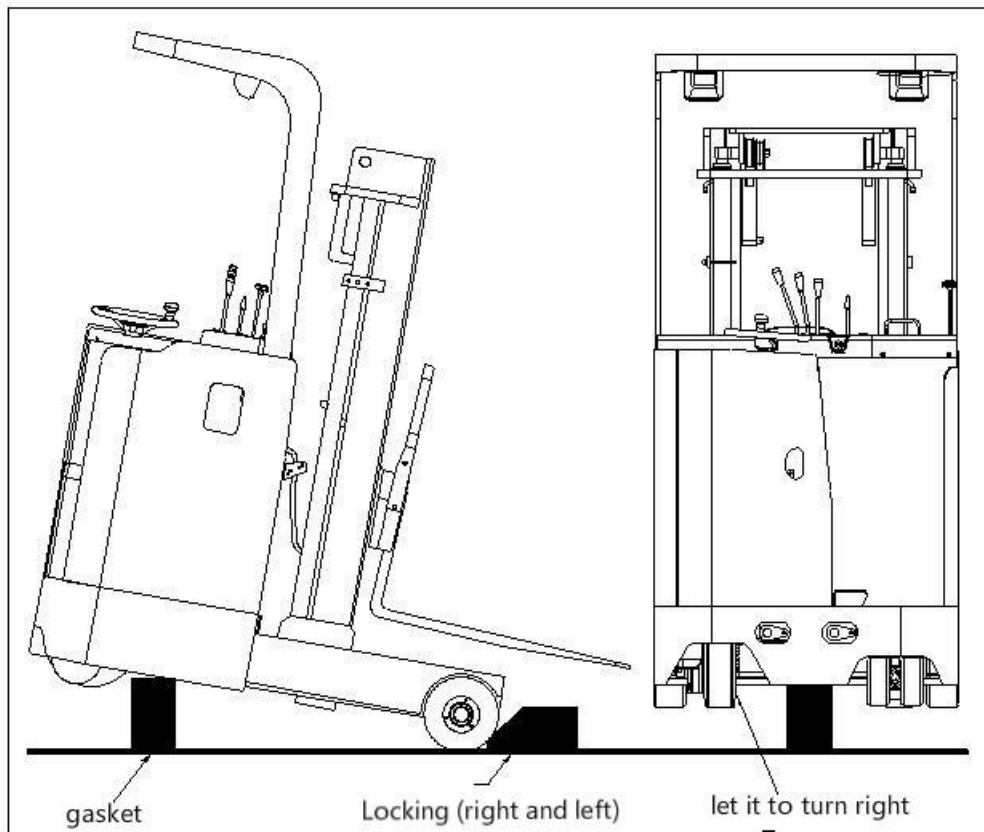


Table 5-4-4-1

##### 2. Install the drive wheel

- (1) align the hub bolt mounting hole with the screw hole of the drive shaft and insert it into

the drive wheel;

- (2) Tighten the bolts (coated with anti-loose rubber on the threads);
- (3) screw to the specified torque;
- (4) Assembling hub center bolts;
- (5) Turn the steering wheel to return the drive wheel to the straight-line state;
- (6) Remove the pad.

### 3. The addition of gear oil

When adding gear oil to the gearbox, please follow the following guidelines:

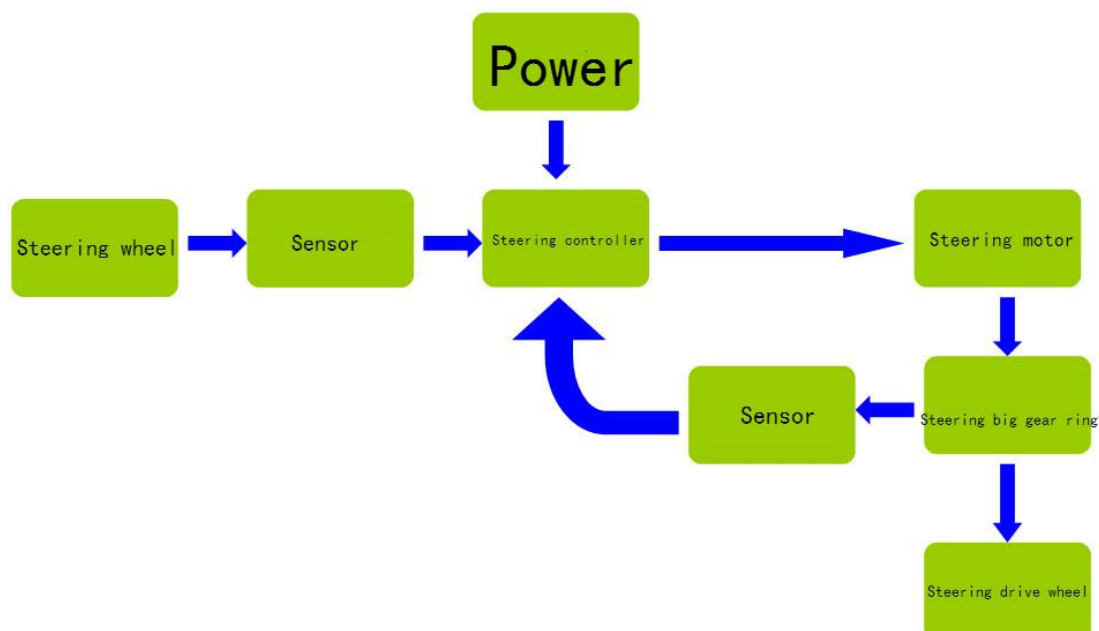
- (1) Add gear oil from the installation area of the vent pipe, so that the gear box is filled with a sufficient amount of gear oil;
- (2) After about ten minutes, the amount of oil is confirmed from the reference hole, and if it is insufficient, it is added from the vent pipe mounting portion.

## 5.5 Steering System

### 5.5.1 Steering system structure

MF stand on type reach-forklifts which make sure of Electric power steering, steering so easy, reduce fatigue, low consumption, high efficiency

### 5.5.2 Principle of Electric Power Steering System



As shown in the figure above, after the power is turned on, the operator rotates the



steering wheel to change the target position sensor value. The steering controller monitors and compares the difference between the two sensors in real time. According to the difference between positive and negative, the size is driven according to a certain algorithm. When the steering motor works, the motor drive steering large ring gear drives the drive wheel to turn and changes the real-time position sensor value until the difference reaches a reasonable range to stop the steering.

It can be seen from the above that the core components of the system are the steering controller and two position sensors. Therefore, the stable operation of the system must ensure that the steering controller program protection function is perfect and the position sensor assembly and debugging is accurate.

### 5.5.3 Advantages of EPS system



Electric power steering system has compact structure, the steering wheel and the steering wheel have no mechanical connection, and it is easy to design the space space; modular design, convenient installation, good maintenance performance; small steering force, simple operation and high efficiency; integrated turning speed limit function, The steering controller is directly controlled; the controller has a self-diagnosis function, and the fault is output by the indicator light; the relative hydraulic power steering is more energy-saving, pollution-free, and low in noise.

### 5.5.4 Precautions

1. The potentiometer is a precision component. It is strictly forbidden to collide, drop, splash water, direct sunlight, etc. during transportation and dis assembly.

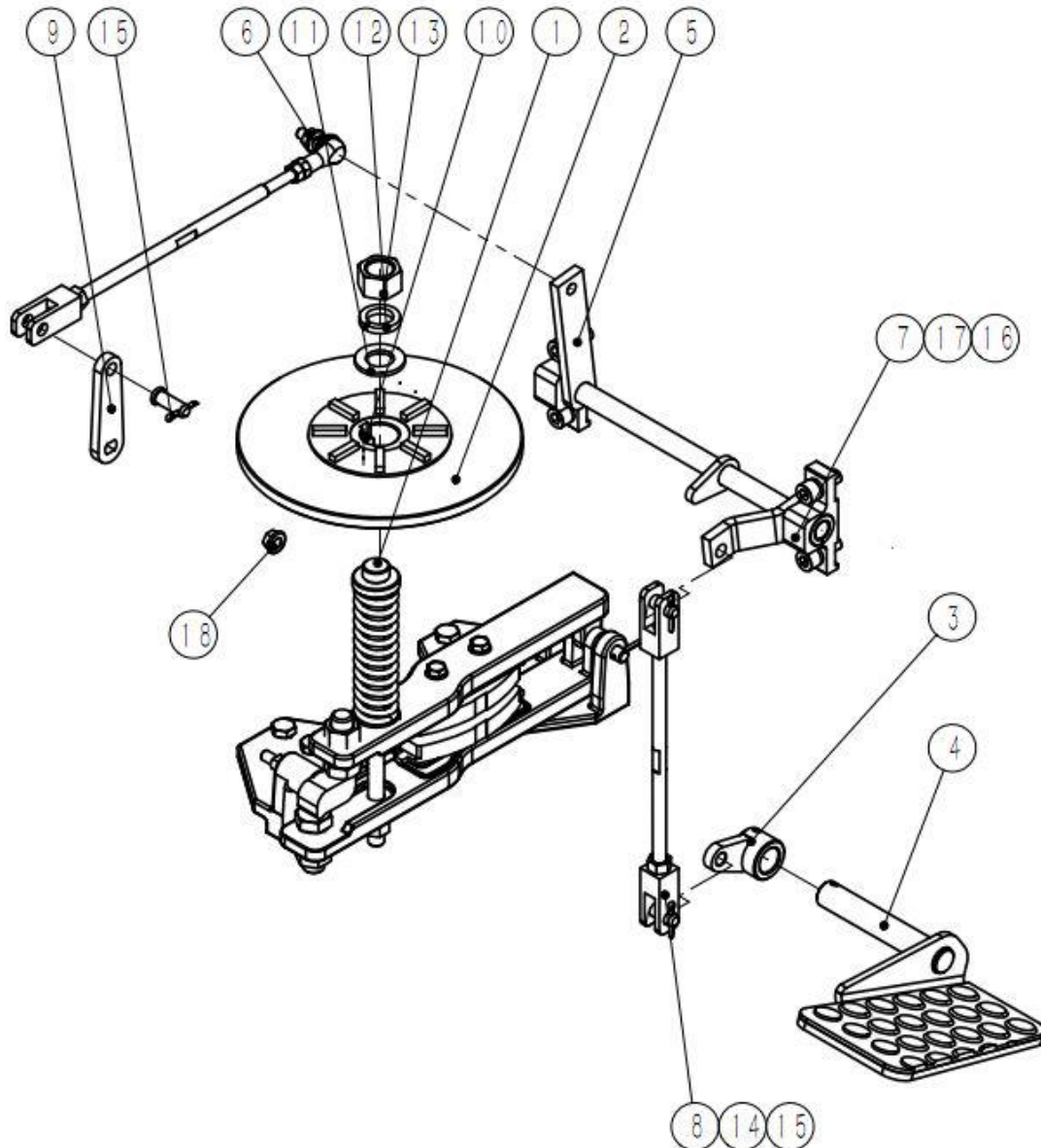
2. After the components are installed and tested after the after-sales service, check the wiring harness and the connector before power-on test to ensure the correct connection of the circuit and the good contact of the plug-in. The components are firmly fastened and can be powered after checking and confirming. test;

3. All connectors in the test and use are strictly prohibited from being plugged in and out;

4. Pay attention to the fixing and protection of the wiring harness.

## 5.6 Braking System

### 5.6.1 Braking system structure



1. Brake caliper assembly 2. Brake disc 3. Pedal rocker arm welding 4. Foot pedal assembly 5. Cross-bar welding 6. Straight connecting rod assembly 7. Horizontal connecting rod fixing seat assembly 8. Longitudinal connecting rod assembly 9. Pulling tab 10. Flat keys 11. Flat washers 12. Spring washers 13.1 Hexagon nuts 14. Pins 15. Cotter pin 16. Spring washer 17. Hexagon socket cap screw 18. Hex flange face nut

### 5.6.2 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 pull tab, an adjustment bolt,

and the like. When the pedal is rotated by the linkage mechanism to rotate the cam, the adjustment bolt fixed on the caliper is pushed out, and the brake disc originally held by the spring force is released, and the forklift changes from the braking state to the walking state. When the forklift is walking, a clearance of about 0.2~0.5mm is left between the brake pad and the brake disc to ensure the reliability during braking. When the forklift is used for a long time, the brake pads are worn and the position of the adjustment bolts should be adjusted so that The clearance is within the required range and the nuts are tightened to ensure reliable braking. When the required clearance cannot be achieved by adjusting the bolts, the brake pads must be replaced.

### **5.6.3 *Braking operation structure***

When the forklift is started, 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. Because the brake force acts on the high speed end, the braking effect is very obvious. The degree of pedal relaxation affects the size of the braking force. A skilled driver can achieve different braking effects by controlling how much or how fast the pedal is relaxed.

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. Because the linkage mechanism is connected with the travel switch, the driver will only start the electric forklift when he steps on the pedal. When the driver leaves the forklift or releases the pedal due to other reasons, the power of the traveling system of the forklift is automatically cut off to ensure safety.

### **5.6.4 *Adjustment of braking system***

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

- (1) Loosen the locking nut on the vertical link;
- (2) Turn the vertical link to adjust the height of the pedal (pedal and horizontal angle of 25-30 degrees);
- (3) Tighten the lock nut.

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

- (1) The brake pedal is depressed to the end and keeps this state;
- (2) Adjust the adjustment bolts on the caliper so that the brake pads are in line with the upper and lower clearances of the brake disc (gap: 0.3 to 0.4 mm).

#### **3. Adjustment of braking force**

The braking force is adjusted by adjusting the bolt to adjust the compression length of the spring.

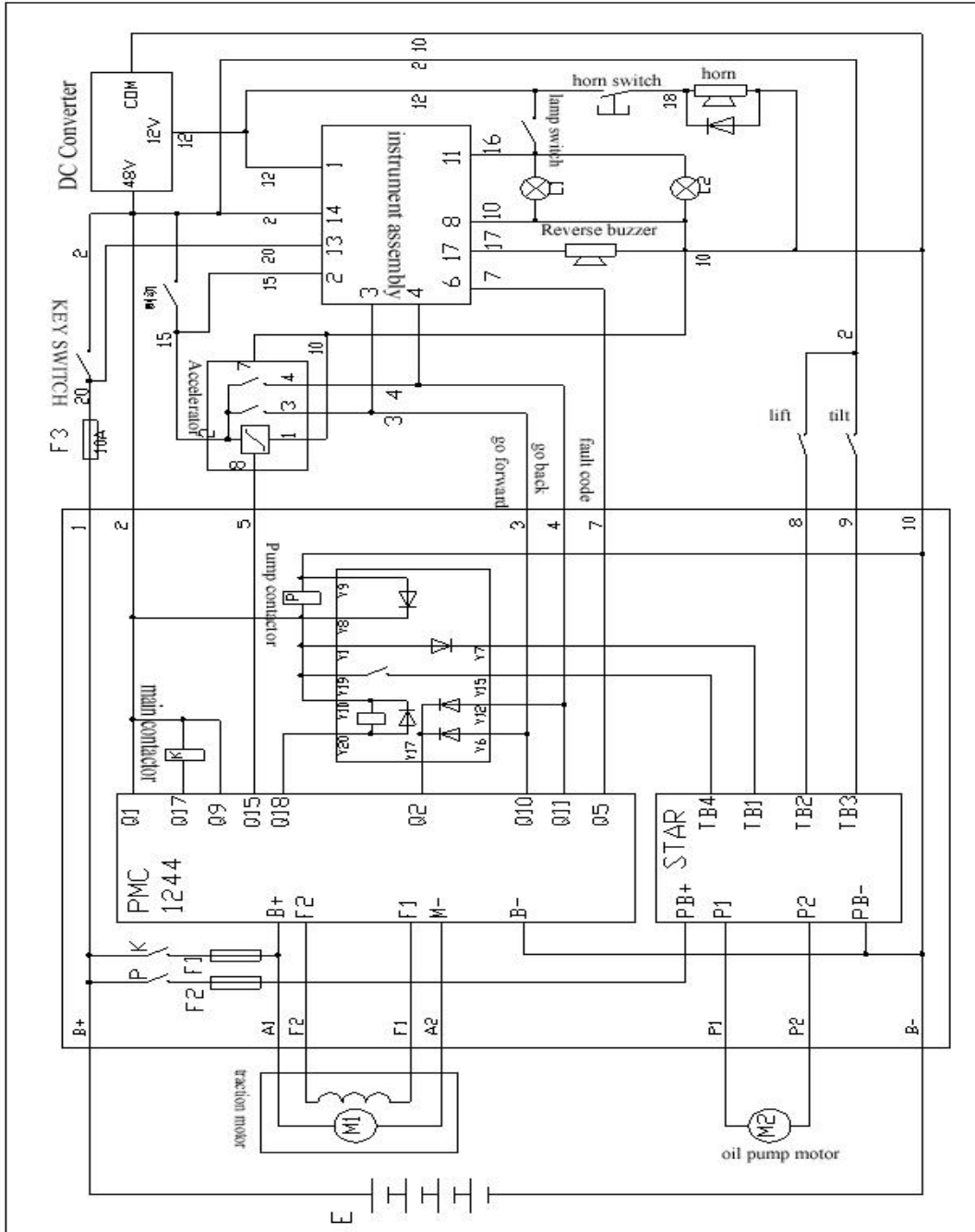
#### 4. Replacement of brake pads

After the forklift has been used for a period of time, the brake pads will wear out. They can continue to be used through adjustment. When the required clearance cannot be guaranteed through adjustment, the brake pads must be replaced as follows:

- (1) Loosen the adjusting bolt, and reduce the gap between the brake disc and the brake disc;
- (2) Remove the mounting bolts and brake pads;
- (3) Expand the gap between the caliper and the brake disc with the adjusting bolt and insert a new brake disc (tightening torque: 180 to 270 kg.cm).

## 5.7 Electrical System

### 5.7.1 Electrical schematic



### 5.7.2 Trouble shooting of DC motor

The fault of DC motor are focus on the commutator, See Table 5-7-2-1 for fault phenomena and causes:

NO.	Fault phenomena	Cause
1	All coppers heated	The pressure of brush is wrong
2	Commutator have regular blackening	A short circuit between the commutator or armature winding, the commutator and the armature winding with poor welding or circuit broken.
3	Commutator irregular blackening	The center line of commutator is displaced,the surface is not round or uneven.
4	Brush wear、discoloration、damaged	When vibration , the gap between brush holder and brush is large, and the distance between brush holder and commutator is too large, the mica between commutator are protruded, the brush' material or model are not correct.
5	Commutator with big sparks	The motor is overloaded, the commutator is not clean, the brush is not in good contact, the pressure is not enough or the brush is stuck, the brush holder is loose or vibrating, and the pole polarity and arrangement order are incorrect.
6	Brush and brush line heated	brush with large sparks, poor contact between brush and soft wire, soft cross-sectional area is too small.
7	Brush has noise during operation	The commutator surface is not smooth enough.

Table 5-7-2-1

### 5.7.3 Failure analysis of Battery

Fault	Features	Cause	Measures
Irreversible sulfation of plates	<ol style="list-style-type: none"> <li>1. The battery capacity is reduced.</li> <li>2. The electrolyte density is lower than normal.</li> <li>3. Battery voltage is too high at the beginning of charging and charging finishing</li> <li>4. Bubbles are generated too earlier when charging or bubbles generated when charging starts.</li> <li>5. The electrolyte temperature rises too quickly during charging.</li> </ol>	<ol style="list-style-type: none"> <li>1. Initial charge is not enough.</li> <li>2. Have been discharged or half-discharged for too long.</li> <li>3. Insufficient long-term charging.</li> <li>4. Over-discharge frequently.</li> <li>5. The electrolyte density exceeds the specified value.</li> <li>6. The electrolyte level is too low, causing the liquid level to appear on the plates.</li> <li>7. balance charging not in time.</li> <li>8. The discharge current is too large or too small.</li> <li>9. Impure electrolyte.</li> <li>10. Internal short-circuit or leakage.</li> </ol>	<ol style="list-style-type: none"> <li>1. The basic method is use balance charging.</li> <li>2. The serious method is use "hydrotherapy".</li> <li>3. Do not over discharge.</li> <li>4. The electrolyte density cannot exceed the specified value.</li> <li>5. The electrolyte level and impurity content should be within the specified range.</li> </ol>
Battery internal circuit failure	<ol style="list-style-type: none"> <li>1. The battery voltage is very low when charging, even close to zero.</li> <li>2. Less bubbles or no bubbles at the end of charging.</li> <li>3. The temperature of the</li> </ol>	<ol style="list-style-type: none"> <li>1. The plate bends and the active material expands or falls off, causing the separator to break down and short circuit.</li> <li>2. Too much precipitated material causes a short</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace the partition.</li> <li>2. Remove deposits and conductive material.</li> <li>3. Replace the</li> </ol>

	<p>electrolyte rises quickly when charging, the density rises slowly, or even does not rise.</p> <p>4. The battery has a low open circuit voltage and prematurely drops to the termination voltage during discharge.</p> <p>5. Serious self-discharge.</p>	<p>circuit.</p> <p>3. The battery falls into the conductive object, causing a short circuit.</p>	<p>plates.</p>
Battery life decay	<p>1. Battery capacity decreases.</p> <p>2. The electrolyte is cloudy.</p> <p>3. Sediment are too much.</p>	<p>1. The electrolyte does not meet quality standards.</p> <p>2. Charge or discharge is too frequent or overcharged or over-discharged.</p> <p>3. The electrolyte temperature is too high when charging.</p> <p>4. During the discharge, the external circuit is short-circuited.</p>	<p>Basic is remove sediment;</p> <p>Otherwise scrapping.</p>

Table 5-7-3-1

## 5.7.4 Maintenance and charging of Battery

### 5.7.4.1 Standard of Safe operation

1. Before operating , the truck must be parked in the specified position as required。
2. Battery charging, maintenance and replacement can only be performed by specially trained technicians.

This instruction manual must be strictly followed, as well as the relevant regulations of the battery and charger manufacture.

3. Do not smoke or use an open flame around the battery. For at least 2 meters around the charging forklift , can't place flammable materials and sparks. The work site must be well ventilated and equipped with fire fighting equipment.
4. The battery and charger must be kept dry and clean to avoid watering. Terminals and



cable lugs must be tightened, cleaned, and protected with a small amount of special grease. If the battery's electrodes are not insulated or the protective layer is peeled off, a non-slip insulating pad must be placed over the electrodes to protect it.

5. Disposal of used batteries must strictly comply with the environmental protection regulations in the country or relevant regulations for waste disposal. In the waste disposal process, must strictly follow the instructions from the battery manufacturer.

6. The liquid in the battery has a certain degree of corrosivity. Therefore, before any operation of the battery, it is necessary to wear a protective clothing and glasses to absolutely prevent the human body from directly contacting the battery liquid. If the battery fluid accidentally comes into contact with clothing, skin, or the eyes, it must be rinsed immediately with plenty of water. Contact with the skin or eyes should be promptly checked by a doctor. Spilled battery fluid must be neutralized or diluted immediately.

7. When closing the battery door, you must check whether the battery cable has damaged or not.

8. The battery can only be used after the battery door is closed.

9. The weight and size of the battery have a great influence on the safety of the forklift. The replacement of the storage battery or battery auxiliary equipment must be approved by the company.

#### 5.7.4.2 Standard of Battery Charging

1. Park the forklift in the charging area as required. Power off first, then press the emergency stop switch.

2. Only plug and unplug the battery plug when the forklift and the charging facility are in a power-off state.

3. To ensure good heat dissipation during charging, the battery surface must be exposed.

4. Before charging the battery, all cable connections and plug connections must be inspected for any obvious damage, and no other metal objects may be present on the battery surface.

5. The relevant safety regulations of the battery and charging equipment manufacturers must be strictly observed.

#### 5.7.5 Common controller fault code analysis chart

NO	PROGRAMMER LCD DISPLAY	CODE	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
	EFFECT OF FAULT			
1	<b>Controller Over-current</b> Shut down Motor; Shut down Main Contactor; Shut down EMBrake;	12	1. External short of phase U,V, or W motor connections. 2. Motor parameters are	Set: Phase current exceeded the current measurement limit. Clear: Cycle KSI.

	Shutdown Throttle; Full Brake; Shutdown Pump.		mismatch 3. Controller defective. 4. Speed encoder noise problems.	
2	<b>Current Sensor Fault</b> Shut down Motor; Shut down Main Contactor; Shut down EM Brake; Shut down Throttle; Full Brake; Shutdown Pump.	13	1. Leakage to vehicle frame from phase U, V, or W (short in motor stat-or). 2. Controller defective.	Set: Controller current sensors have invalid offset reading. Clear: Cycle KSI.
3	<b>Precharge Failed</b> Shut down Motor; Shut down Main Contactor; Shutdown EM Brake; Shut down Throttle; Full Brake; Shutdown Pump.	14	1. See Monitor menu » Battery: Capacitor Voltage. 2. External load on capacitor bank (B+ connection terminal) that prevents the capacitor bank from charging.	Set: Precharge failed to charge the capacitor bank to the KSI voltage. Clear: Cycle Interlock input or use VCL function Precharge ().
4	<b>Controller Severe Undertemp</b> Shut down Motor; Shutdown Main Contactor; Shut down EM Brake; Shut down Throttle; Full Brake; Shutdown Pump.	15	1. See Monitor menu » Controller: Temperature. 2. Controller is operating in an extreme environment.	Set: Heat sink temperature below -40°C. Clear: Bring heat sink temperature above -40°C, and cycle interlock or KSI.
5	<b>Controller Severe Overtemp.</b> Shut down Motor; Shut down Main Contactor; Shutdown EM Brake; Shutdown Throttle; Full Brake; Shutdown Pump.	16	1. 1. See Monitor menu » Controller: Temperature. 2. Controller is operating in an extreme environment. 3. 3. Excessive load on vehicle. 4. Improper mounting of controller.	Set: Heat sink temperature above +95°C. Clear: Bring heat sink temperature below +95°C, and cycle interlock or KSI.
6	<b>Severe Under-voltage</b> Reduced drive torque.	17	1. Battery Menu parameters are	Set: Capacitor bank voltage dropped

			<p>unadjusted.</p> <p>2. Non-controller system drain on battery.</p> <p>3. Battery resistance too high.</p> <p>4. Battery disconnected while driving.</p> <p>5. See Monitor menu » Battery: Capacitor Voltage.</p> <p>6. Blown B+ fuse or main contactor did not close.</p>	<p>below the Severe Under-voltage limit (see page 55) with FET bridge enabled.</p> <p>Clear: Bring capacitor voltage above Severe Under-voltage limit.</p>
7	<p><b>Severe Over-voltage</b>  Shut down Motor;  Shut down Main Contactor;  Shutdown EM Brake;  Shutdown Throttle;  Full Brake;  Shutdown Pump.</p>	18	<p>1. See Monitor menu » Battery: Capacitor Voltage.</p> <p>2. Battery menu parameters are misadjusted.</p> <p>3. Battery resistance too high for given regenerative current.</p> <p>4. Battery disconnected while Regenerative braking.</p>	<p>Set: Capacitor bank voltage exceeded the Severe Over voltage limit (see page 55) with FET bridge enabled.</p> <p>Clear: Bring capacitor voltage below Severe Over voltage limit, and then cycle KSI.</p>
8	<p><b>Controller Undertemp Cutback</b>  Reduced drive and brake torque.</p>	21	<p>1. See Monitor menu » Controller: Temperature.</p> <p>2. Controller is performance-limited at this temperature.</p> <p>3. Controller is operating in an extreme environment.</p> <p>4. Excessive load on vehicle.</p> <p>5. Improper mounting of controller.</p>	<p>Set: Heat sink temperature exceeded 85°C.</p> <p>Clear: Bring heat sink temperature below 85°C.</p>

9	<b>Controller Overtemp Cutback</b> Reduced drive and brake torque.	22	1. See Monitor menu » Controller: Temperature. 2. Controller is performance-limited at this temperature. 3. Controller is operating in an extreme environment. 4. Excessive load on vehicle. 5. Improper mounting of controller.	Set: Heat sink temperature exceeded 85°C. Clear: Bring heat sink temperature below 85°C.
10	<b>Under voltage Cutback</b> Reduced drive torque.	23	1. Normal operation. Fault shows that batteries need recharging. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Non-controller system drain on battery. 4. Battery resistance too high. 5. Battery disconnected while driving. 6. See Monitor menu » Battery: Capacitor Voltage. 7. Blown B+ fuse or main contactor did not close.	Set: Capacitor bank voltage dropped below the Under-voltage limit (see page 55) with the FET bridge enabled. Clear: Bring capacitor voltage above the Under-voltage limit.
11	<b>Over-voltage Cutback</b> Reduced brake torque.	24	1. Normal operation. Fault shows that regen braking currents elevated the battery	Set: Capacitor bank voltage exceeded the Over-voltage limit (see page 55) with the FET bridge

			<p>voltage during regen braking. Controller is performance limited at this voltage.</p> <p>2. Battery parameters are misadjusted.</p> <p>3. Battery resistance too high for given regen current.</p> <p>4. Battery disconnected while regen braking.</p> <p>5. See Monitor menu » Battery: Capacitor Voltage.</p>	<p>enabled.</p> <p>Clear: Bring capacitor voltage below the Over-voltage limit.</p>
12	<p><b>+5V Supply Failure</b> None, unless a fault action is programmed in VCL.</p>	25	<p>1. 1. External load impedance on the +5V supply (pin 26) is too low.</p> <p>2. 2. See Monitor menu » outputs: 5 Volts and Ext Supply Current.</p>	<p>Set: +5V supply (pin 26) outside the +5V±10% range.</p> <p>Clear: Bring voltage within range.</p>
13	<p><b>Digital Out 6 Failure</b> Digital Output 6 driver will not turn on.</p>	26	<p>1. External load impedance on Digital Output 6 driver (pin 19) is too low.</p>	<p>Set: Digital Output 6 (pin 19) current exceeded 15 MA.</p> <p>Clear: Remedy the overcurrent cause and use the VCL function Set_Dig Out() to turn the driver on again</p>
14	<p><b>Digital Out 7 Over current</b> Digital Output 7 driver will not turn on.</p>	27	<p>1. External load impedance on Digital Output 7 driver (pin 20) is too low.</p>	<p>Set: Digital Output 7 (pin 20) current exceeded 15 ma.</p> <p>Clear: Remedy the overcurrent cause and use the VCL function Set DigOut () to turn the driver on again.</p>
15	<p><b>Motor Temp Hot Cutback</b> Reduced drive torque.</p>	28	<p>1. Motor temperature is at or above the programmed</p>	<p>Set: Motor temperature is at or above the Temperature Hot</p>

			<p>Temperature Hot setting, and the requested current is being cut back.</p> <p>2. Motor Temperature Control Menu parameters are mis-tuned.</p> <p>3. See Monitor menu » Motor: Temperature and » Inputs: Analog2.</p> <p>4. If the application doesn't use a motor thermistor, Temp Compensation and Temp Cutback should be programmed Off.</p>	<p>parameter setting.</p> <p>Clear: Bring the motor temperature within range.</p>
16	<p><b>Motor Temp Sensor Fault</b></p> <p>Max.speed reduced (LOS, Limited Operating Strategy), and motor temperature cutback disabled.</p>	29	<p>1. Motor thermometer is not connected properly.</p> <p>2. If the application doesn't use a motor thermometer Motor Temp Sensor Enable should be programmed Off.</p> <p>3. See Monitor menu » Motor: Temperature and » Inputs: Analog2.</p>	<p>Set: Motor thermometer input (pin 8) is at the voltage rail (0 or 10V).</p> <p>Clear: Bring the motor thermometer input voltage within range.</p>
17	<p><b>Coll 1 Driver Open/Short</b></p> <p>ShutdownDriver1.</p>	31	<p>1.Open or short on driver load.</p> <p>2.Dirty connector pins.</p> <p>3.Bad crimps or faulty wiring.</p>	<p>Set: Driver 1 (pin 6) is either open or shorted. This fault can be set only when Main Enable = Off.</p> <p>Clear: Correct open or short, and cycle driver.</p>
18	<p><b>Main Open/Short</b></p> <p>Shut down Motor; Shutdown Main Contactor; Shutdown EM Brake;</p>	31	<p>1.Open or short on driver load.</p> <p>2.Dirty connector pins.</p> <p>3.Bad crimps or faulty</p>	<p>Set: Main contactor driver (pin 6) is either open or shorted. This fault can be set only</p>

	Shutdown Throttle; Full brake; Shutdown Pump.		wiring.	when Main Enable = On. Clear: Correct open or short, and cycle driver
19	<b>Coll 2 Driver Open/Short</b> ShutdownDriver2.	32	1.Open or short on driver load. 2.Dirty connector pins. 3.Bad crimps or faulty wiring.	Set: Driver 2 (pin 5) is either open or shorted. This fault can be set only when EM Brake Type = 0. Clear: Correct open or short, and cycle driver.
20	<b>EM brake Open/Short</b> Shutdown EMBrake; Shutdown Throttle; Full Brake.	32	1.Open or short on driver load. 2.Dirty connector pins. 3.Bad crimps or faulty wiring.	Set: Electromagnetic brake driver (pin 5) is either open or shorted. This fault can be set only when EM Brake Type > 0. Clear: Correct open or short, and cycle driver.
21	<b>Coll 3 Driver Open/Short</b> ShutdownDriver3.	33	1.Open or short on driver load. 2.Dirty connector pins. 3.Bad crimps or faulty wiring.	Set: Driver 3 (pin 4) is either open or shorted. Clear: Correct open or short, and cycle driver.
22	<b>Coll 4 Driver Open/Short</b> ShutdownDriver4.	34	1.Open or short on driver load. 2.Dirty connector pins. 3.Bad crimps or faulty wiring.	Set: Driver 4 (pin 3) is either open or shorted. Clear: Correct open or short, and cycle driver.
23	<b>PD Open/Short</b> Shutdown PD.	35	1.Open or short on driver load. 2.Dirty connector pins. 3.Bad crimps or faulty wiring.	Set: Proportional driver (pin 2) is either open or shorted. Clear: Correct open or short, and cycle driver.
24	<b>Encoder Fault</b>	36	1.Motor encoder failure.	Set: Motor encoder

	Shutdown EMBrake; Shutdown Throttle.		2.Bad crimps or faulty wiring. 3.See Monitor menu » Motor: Motor RPM.	phase failure detected. Clear: Cycle KSI.
25	<b>Motor Open</b> Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake; Shutdown Pump.	37	1.Motor phase is open. 2.Bad crimps or faulty wiring.	Set: Motor phase U, V, or W detected open. Clear: Cycle KSI.
26	<b>Main Contactor Welded</b> Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake; Shutdown Pump.	38	1.Main contactor tips are welded closed. 2.Motor phase U or V is disconnected or open. An alternate voltage path (such as an external precharge resistor) is providing a current to the capacitor 3.bank (B+ connection terminal).	Set: Just prior to the main contactor closing, the capacitor bank voltage (B+ connection terminal) was loaded for a short time and the voltage did not discharge. Clear: Cycle KSI
27	<b>Main Contactor Did Not Close</b> Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake; Shutdown Pump.	39	1.Main contactor did not close. 2.Main contactor tips are oxidized, burned, or not making good contact. 3.External load on capacitor bank (B+ connection terminal) that pre-vents capacitor bank from charging. 4.Blown B+ fuse.	Set: With the main contactor commanded closed, the capacitor bank voltage (B+ connection terminal) did not charge to B+. Clear: Cycle KSI.
28	<b>Throttle Wiper High</b> Shutdown Throttle.	41	1. See Monitor menu » Inputs: Throttle Pot. 2. Throttle pot wiper voltage too high.	Set: Throttle pot wiper (pin 16) voltage is higher than the high fault threshold (can be



				<p>changed with the VCL function Setup_Pot_Faults())</p> <p>.</p> <p>Clear: Bring throttle pot wiper voltage below the fault threshold.</p>
29	<b>Throttle Wiper Low Shutdown Throttle.</b>	42	<p>1. See Monitor menu »</p> <p>Inputs:</p> <p>Throttle Pot.</p> <p>2. Throttle pot wiper voltage too low.</p>	<p>Set: Throttle pot wiper (pin 16) voltage is lower than the low fault threshold (can be changed with the VCL function Setup_Pot_Faults())</p> <p>.</p> <p>Clear: Bring throttle pot wiper voltage above the fault threshold.</p>
30	<b>Pot2 Wiper High FullBrake.</b>	43	<p>1. See Monitor menu »</p> <p>Inputs: Pot2 Raw.</p> <p>2. Pot2 wiper voltage too high.</p>	<p>Set: Pot2 wiper (pin 17) voltage is higher than the high fault threshold (can be changed with the VCL function Setup_Pot_Faults())</p> <p>.</p> <p>Clear: Bring Pot2 wiper voltage below the fault threshold.</p>
31	<b>Pot2 Wiper Low FullBrake.</b>	44	<p>1. See Monitor menu »</p> <p>Inputs: Pot2 Raw.</p> <p>2. Pot2 wiper voltage too low.</p>	<p>Set: Pot2 wiper (pin 17) voltage is lower than the low fault threshold (can be changed with the VCL function Setup_Pot_Faults())</p> <p>.</p> <p>Clear: Bring Pot2 wiper voltage below the fault threshold.</p>
32	<b>Pot Low Overcurrent Shutdown Throttle;</b>	45	<p>1. See Monitor menu »</p> <p>Outputs: Pot Low.</p>	<p>Set: Pot low (pin 18) current exceeds</p>

	FullBrake.		2. Combined pot resistance connected to pot low is too low.	10mA. Clear: Clear pot low over current condition and cycle KSI.
33	<b>EEPROM Failure</b> Shutdown Motor; Shutdown MainContactor; Shutdown EMBrake; Shutdown Throttle; Shutdown Interlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; Shutdown PD; FullBrake; Shutdown Pump.	46	1. Failure to write to EEPROM memory. This can be caused by EEPROM memory writes initiated by VCL, by the CAN bus, by adjusting parameters with the programmer, or by loading new software into the controller.	Set: Controller operating system tried to write to EEPROM memory and failed. Clear: Download the correct software (OS ) and matching parameter default settings into the controller and cycle KSI.
34	HPD/Sequencing Fault	47	1.key switch start, interlock, direction, and accelerator input order set error 2.Connect, start key switch, interlock, direction or accelerator input fault	Reason:due to key switch start, interlock, direction and accelerator input set error, lead to high pedal protection and starting order Solution:Input according to correct order
35	Emergency reverse high speed pedal protection Accelerator invalid	47	1.Emergency reverse operation is over, but accelerator, forward, reverse input and interlock are not resetting	Reason:when emergency reverse is over, other inputs are not resetting, lead to fault
36	Parameter change fault motor stop main contactor electromagnetic brake stop accelerator invalid brake pump stop	49	1.In order to make safety, for change of some specific parameter, must be efficient after restarting key switch	Reason:Change of parameter need to restart key switch Solution:restart key switch

37	OEM failure(custom fault)	51-67	1.User can do custom fault for some phenomenons, show them by using VCL code	Based on user custom
38	VCL Run Time Error motor stop main contactor stop electromagnetic brake stop accelerator stop interlock stop 1-4 circuit output stop proportional drive stop Braken pump stop	68	1.VCL code for running time is timeout	Reason:running time VCL code error Solution>Edit VCL application software error removal, check new software parameter match correct, restart key switch
39	External power sully output is out of range	69	External load is too much or to small under 5V and 12V power supply current 1.Parameters error in the checking menu, for example“ExtSupply Max”, “ExtSupply Min”	Reason:external power supply current is out of limited range, the upper limit is defined by Ext Supply Max, the lower limit is defined by ExtSupply Min. Solution:adjust external current
40	Operating system fault motor stop main contactor stop electromagnetic brake stop accelerator stop interlock stop 1-4 circuit output stop proportional drive stop brake pump stop	71	1.Internal controller invalid	Reason:Internal controller invalid Solution:restart key switch
41	PDO Timeout interlock stop Set up CAN NMT State	72	1.CAN PDO information receiving time is out of PDO	Reason:CAN PDO information receiving time is out of PDO time

	to Pre-operational		time limited	limited Solution:Restart key switch, or receive CAN NMT information
42	Motor stalling electromagnetic brake stop Control model switch to LOS(limited operation status)	73	1.Motor stalling 2.Motor coder invalid 3.Wrong line connect 4.Output motor coder power supply fault	Reason:motor coder undetectable Solution:restart key switch, or detect motor coder effective signal under LOS model, and set parameter to Throttle Command=0, Motor RPM=0
43	Motor matching fault Motor stop main contactor stop electromagnetic brake stop accelerator stop brake pump stop	87		Reason:motor match fault Solution:correct mistake, restart key switch
44	Wrong motor type	89	1.Motor type parameter is out of range	Reason: set motor type parameter to invalid value Solution:reset, restart key switch
45	VCL/OS Mismatch motor stop main contactor stop electromagnetic brake stop accelerator stop interlock stop 1-4 circuit output stop proportional drive stop Brake pump stop	91	1.Controller VCL program does not match with OS	Reason:Controller VCL program does not match with OS Solution:update correct VCL and OS program
46	Electromagnetic brake is settled invalidly electromagnetic brake invalid accelerator invalid	92	1.Vehicle still walking after electromagnetic brake command is settled 2.electromagnetic brake power is too small	Reason:After electromagnetic brake dead lock, vehicle still in walking Solution:check whether accelerator is normal
47	Encoder is in limited	93	1.Due to motor	Reason:Due to motor

	operation status		stalling or coder fault, limited operation status is activated 2.incorrect line connect 3.motor stalling	stalling or coder fault, limited operation status is activated  Solution:Restart key switch, if the reason is motor stalling, please make sure encoder in normal operation.
48	Emergency reverse timeout electromagnetic brake invalid accelerator invalid	94	1.Due to EMR Timer is timeout, lead to emergency reverse timeout is activated 2.Emergency reverse switch is in the on position	Reason:Emergency reverse function is activated and in operation until emergency reverse timing is over Solution:check emergency reverse switch status
49	Controller model mistake motor stop main contactor stop electromagnetic brake stop accelerator stop brake pump stop	98	1.Controller model can not be identified 2.Software and hardware are not matched 3.controller damage	Reason:Controller model can not be identified, choose correct controller, download correct controller software
50	Dual motor parameter does not match shut down controller shut down main contactor shut down electric brake shut down accelerator shut down brake pump	99	Set dual motor enable parameter to OS, control model choose parameter is not settled to 0 (Speed Mode Express) or 1 (Speed Mode)	Reason:when dual drive software enable, control model choice should be settled to 0 (Speed Mode Express) or 1 (Speed Mode) , otherwise will be have fault Solution:adjust to the suitable value and turn on/off KSI

Table 5-7-5-1

## Chapter VI Forklift using

### 6.1 Nameplate and symbol

Forklift has the following marks(related content please read it carefully on the body)

- (1) Lift, reach, tilt, side walking handle
- (2) Safety marking nameplate

### 6.2 Safe regulations

- (1) Before using it, check all safety switch and device, make sure they are in good condition.
- (2) Check all warning signs and design parameter marks are good.
- (3) Battery must be safely fixed in battery box.
- (4) Forklift damage or has fault, prohibition of using.
- (5) When forklift is in adjustment or repairing, should specialized persons.

### 6.3 Operation instructions

#### 6.3.1 Forklift operation

Forklift to be used in cold room must do special designed, and have some limit in working condition.

- (1) Working place has flammable and combustible dust or gas
- (2) To be used as tractor
- (3) Used for staff transportation

#### 6.3.2 Operator responsibility

- (1) Must be trained
- (2) Must comply with user manual or local safety rules.
- (3) Prohibit operating when has oil on hand and foot.

#### 6.3.3 Working place

- (1) Only working on flat ground,Prohibit operating on the oil zone, avoid slipping.
- (2) Make sure ground can load forklift total weight, include self weight and operator weight.

#### 6.3.4 Walking and driving requirements

- (1) Do not brake and turn in high speed driving.
- (2) If pavement slips, should reduce speed, avoid forklift turning over or idling.
- (3) Keep some space with forward vehicle, person and object.
- (4) Press horn when in high speed.
- (5) Forklifts are strictly prohibited to transport personnel(not include operator)
- (6) Before forklift goes into elevator or floor, should make sure elevator or floor can load all weight.

#### 6.3.5 Load and upload goods

- (1) Only when upload or lift goods, fork can be lifted or descended, and keep certain

distance with around person, forbid lifting fork during travelling.

- (2) Keep goods in the right place of fork, forbid transporting when unstable or unsafe.
- (3) When goods lifting, forbid touching mast, in case of hurting.
- (4) Only load/upload goods within max load capacity and load center range, adjust fork position according to goods dimension.
- (5) Be careful when load/upload too high and too heavy goods.

#### 6.3.6 Parking attentions

- (1) When forklift stop, lift the forklift to the lowest point and make brake.
- (2) No parking on the slope
- (3) Parking in the designated place
- (4) No parking in the emergency exit
- (5) No parking in the working place
- (6) Must power off when stop

## **Chapter VII Maintenance**

### **7.1 Driving License**

Forklift trucks can only be operated by specially trained technicians, and operators must be skilled in vehicle driving and load handling skills.

### **7.2 Drives' Rights、Obligation and Code of Conduct**

The driver must know the rights and obligations, have received the training of ground transportation equipment operation and use, and be familiar with the contents of the operation instructions.

### **7.3 Non-members of the staff prohibited to use the equipment**

During the using, the driver is fully responsible for the equipment. Non-members of the workers should be prohibited from driving or operating forklift trucks. Forklift trucks are not allowed to carry or lift the person.

### **7.4 Equipment damage and defects**

If damage or other defects are found on the forklift and attachment, then should be submitted to the supervisor or professional maintenance personnel immediately. Forklift with poor operating performance, such as heavy wear or brake failure, can not be used without maintenance.

### **7.5 Equipment maintenance**

Without special training and license, the driver can't repair or change the forklift without authorization. Drivers must not deactivate or adjust safety devices and switches without authorization.

### **7.6 Dangerous area**

Dangerous areas are where people are vulnerable to injured. These dangerous mainly come from the forklift itself, its heavy load parts, heavy cargo running and lifting movement. Dangerous areas also include dangerous areas that may be caused by falling or overturning of heavy objects. Non-member of staff must stay away from dangerous areas. Warning signs must be hung in dangerous areas.

### **7.7 Safety devices and warning signs**

The requirements for safety devices, warning signs and warnings must be strictly observed in the manual and vehicle.



## Chapter VIII Transportation And Storage

### 8.1 Towing & Transporting Faulty Reach Trucks

(1)When you use towing or rope to tow the forklift, the towed forklift must be operated by a driver to steer and removed braking.

(2)When the braking function of the forklift is in good condition, tread the foot pedal and pull the forklift, and ask others to help pushing (pushing position is outside the mast), send the forklift to the destination or the maintenance department of our company to repair it.

(3)If the driving wheels of the forklift breaks down, you can pull the forklift with a trailer or a tow tractor.

#### **Be careful !**

The driving wheels of the forklift must be lifted over the ground, otherwise the wheels and the motor are damaged seriously.

### 8.2 Storage

If the forklift need store for a long time, please take the following measures for these parts:

Batteries:

(1)Charge the batteries again, then maintain them according to the daily method of maintaining the batteries.

(2)Do a charging maintenance every 3months and check electrolyte liquid level.

Hydraulic system:

If the forklift is stored over one year, you need change the hydraulic oil of the hydraulic system. Please refer to maintaining chapter and lubricating table.

Driving system:

If storage is over one week, you should fix and underlay the drive wheels or hang it in the air, do not let it move, unload goods at the same time.

### 8.3 Reuse notes after storage;

(1)Before reuse, you should take the function and security inspection as usual.

(2)If storing time is over 3 months, maintain it according to the instruction (interval) 500hours preventative.