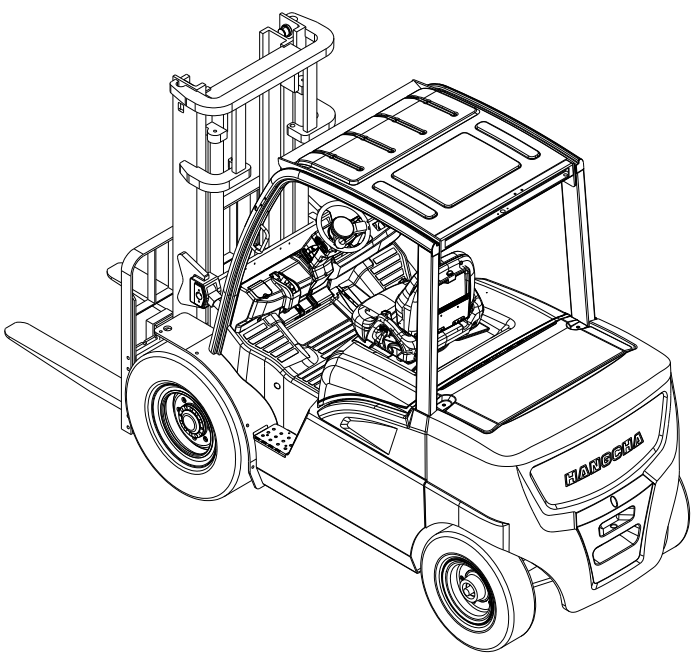
XH *Series*

High-voltage lithium battery forklift truck
ELECTRIC FORKLIFT TRUCK

CPD40/45/50-XHY2G-W
CPD50-XHXY2G-W

Service Manual

Original Instruction



HANGCHA GROUP CO., LTD.
SM23-XHW01(02/2023)

FOREWORD

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

XH series high-voltage lithium battery forklift truck is a newly developed product of our company, it owns characteristics as beautiful appearance, compact structure, low center of gravity, good stability and advanced performance.The full-load driving speed is 24km/h.

This manual is brief introductions of the structure, working principle and maintenance of 4.0t~5.0t XH high-voltage lithium battery forklift truck. In order to guarantee safety and utilize the truck performance to the best, relevant operator, equipment manager and maintainer must read this manual.

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

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

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

WARNING

a） For any inspection, maintenance, and repair, please be sure to cut off the power supply of the high-voltage system, that is, unplug the MSD maintenance switch on the junction box and wait for 15~20 minutes, during which no operation is allowed, otherwise it will cause personal safety accidents.

b） For the following inspections, maintenance and other situations, please be sure to consult and have Hangcha professional maintenance technicians to conduct on-site service processing：

--Involving the inspection, maintenance, and replacement of high-voltage components, components, and circuits;

--Check and maintain non-high-voltage components and circuits, but are affected by the assembly and disassembly of high-voltage components, components, and circuits;

--The fault may be caused by high voltage or non-high voltage crossing;

--Unable to judge whether the fault is caused by high voltage or non high voltage;

--Others that need to be touched or may touch high-voltage components or high-voltage lines.

c） The inspection and maintenance of high-voltage parts shall be subject to special training on high-voltage electrical knowledge and obtain corresponding certificates. The internal inspection and maintenance of the lithium battery must be completed by a professional manufacturer.

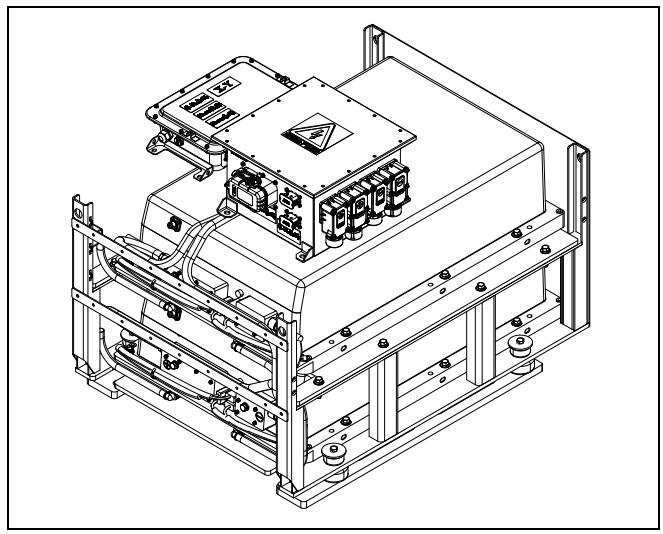
d） Any inspection, maintenance, and repair should strictly abide by the relevant high-voltage electric forklift safety precautions, operating specifications, safety rules, and the use of safety protection products and tools in this manual.

Content

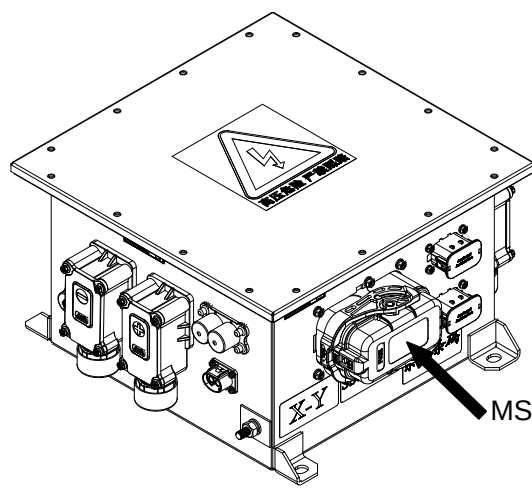
1. Safety regulations

1.1 Brief introduction of high voltage components

（1）Lithium battery pack



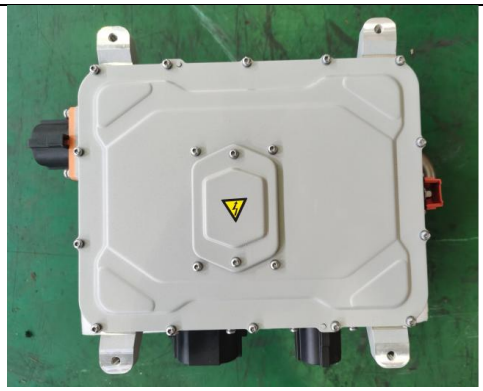
Lithium battery pack



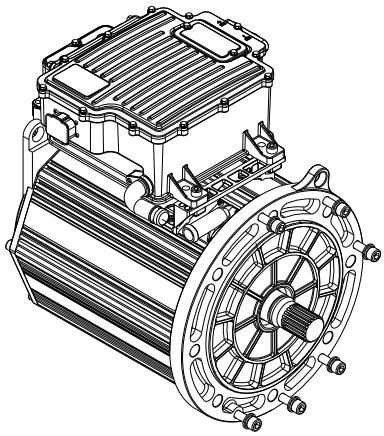
MSD Manual maintenance switch

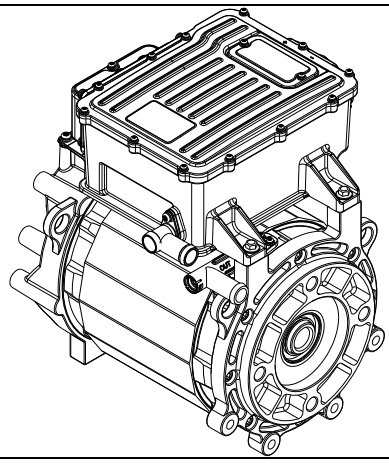
Manual maintenance switch on junction box（MSD）

（2）PDU power 2-in-1

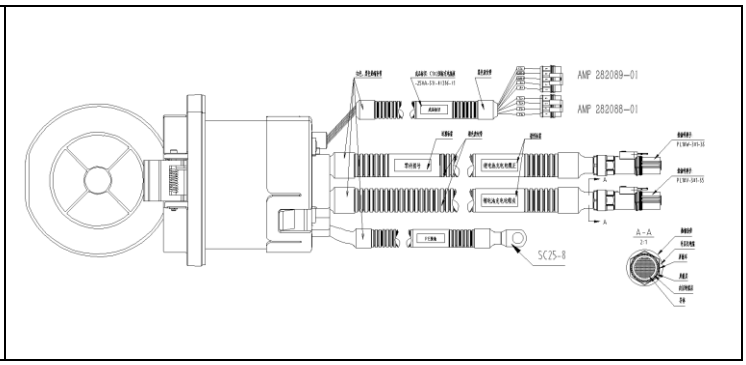


（3）Motor and electronic control 2-in-1 (traction/oil pump)





（4）National standard charging stand



（5）High voltage connection cable

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

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

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

Warning signs for high voltage components

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

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

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

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

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

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

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

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

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

Safe operation specification

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

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

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

4.When repairing high-voltage battery packs with electrolyte leakage, you must wear

protective glasses to prevent electrolyte from splashing into your eyes.

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

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

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

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

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

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

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

Maintenance equipment and site configuration

1.Common tools and equipment

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

2、Safety protective gear and equipment

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

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

name	unit	quantity	Specifications and requirements
Insulating gloves	pair	2	Withstand DC voltage above 1000V
Insulating shoes	pair	2	Withstand DC voltage above 1000V
Insulating rubber pad	piece	8	Single piece 1 m^2, withstand DC voltage above 1000V
protective glasses	piece	1	Acid and alkali resistance
Anti-acid and alkali gloves	pair	1	Acid and alkali resistance
Safety warning sign	piece	1	Specifications: 30cm×60cm, high-strength ABS plastic; content: "Danger! keep away " and high-voltage signs
Electrical tape	roll	2	Size: 18mm×20mm×0.18mm Voltage level: 600V; dielectric strength 1000V/mil (39.37kV/mm) Insulation resistance: >1012Ω
Dry powder fire extinguisher	piece	2	If the vehicle catches fire, the fire is small and slow, please use a dry powder fire extinguisher to extinguish the fire, and call for help immediately

				
Dry powder fire extinguisher	Insulating gloves	Insulating rubber shoes	Insulating rubber pad	Protective glasses
Protective equipment entity				

3.Maintenance station configuration standard

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

①Set up a dedicated maintenance station (equipped with a crane above 6t).

②Adopt safety isolation measures and set up high-voltage warning signs. The supplies are as shown in the figure below.

Maintenance station warning sign and isolation fence

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

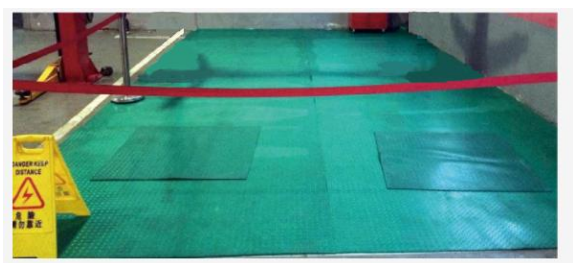
④The dedicated maintenance station is equipped with a single-phase and effectively grounded standard three-hole socket with a rated voltage of 250V and a rated current of 16A in accordance with GB2099.1.

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

①High-voltage warning signs (30cmx60cm, high-strength ABS plastic)

②Warning fence (total height 90cm, drawstring width 5cm, drawstring length 200cm, 300cm, 500cm, drawstring color is red);

③The insulating ground glue (insulates 1000V voltage, the waterproof level is similar to the plastic or rubber material, the size is 7mx4m), the paving effect is as shown in the figure below



Ground layout of maintenance station

1.3 First aid for high-voltage accident

1、First aid measures for electric shock accident

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

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

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

2、First aid measures for high-voltage battery accidents

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

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

②Disconnect the maintenance switch;

③Look for fire extinguishers nearby (dry powder fire extinguishers should be used, and water-based fire extinguishers should not be used);

④If the vehicle catches fire, the fire is small and slow, please use a dry powder fire extinguisher to extinguish the fire, and call for help immediately;

⑤If the fire is large and develops rapidly, please stay away from the vehicle immediately and call the fire telephone to wait for rescue;

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

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

②Disconnect the maintenance switch;

③When a small amount of leakage occurs, please stay away from fire, use absorbent cloth to absorb and place in a closed container, or dispose of by incineration. Please wear acid and alkali-proof gloves before operation;

④When a large amount of leakage occurs, please collect them and treat them in accordance with hazardous chemicals. Add calcium gluconate solution to treat the generated gas;

⑤When the human body accidentally touches the leaked liquid, rinse immediately with plenty of water (10-15) min. If there is pain, coat with 2.5% calcium gluconate ointment, or soak with 2%-2.5% calcium gluconate solution for pain relief, if there is no improvement or uncomfortable symptoms, please seek medical attention immediately.

2. Drive system

The drive system is composed of drive axle assembly 1, reduction gearbox 2, traction motor 3, and tire assembly 4.

WARNING

a) When repairing the transmission system, it is necessary to disconnect the high-voltage cable on the traction motor's electronic control 2-in-1, which involves the high-voltage part! Therefore, it is necessary to strictly follow the safety regulations in Chapter 1 for operation!

b) Before maintenance, it is necessary to disconnect the power supply of the entire vehicle and the lithium battery MSD maintenance switch, and let it sit for 15-20 minutes before operation!

2.1 Drive system disassembly and installation

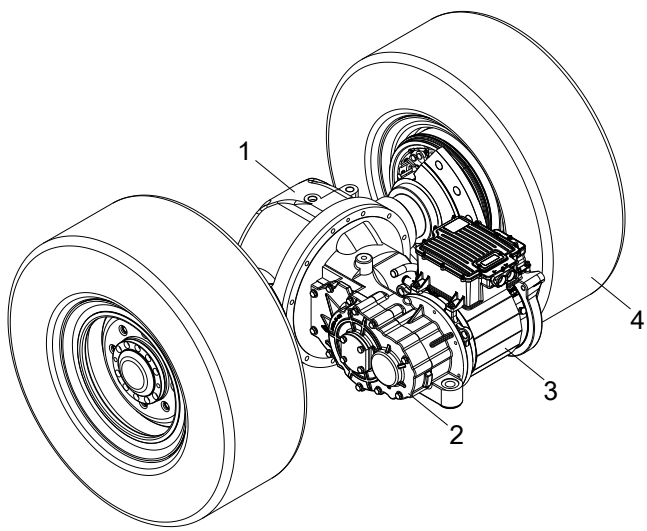


Fig 2-1

Dismantle the drive system from the truck：

a） Remove the mast tilting cylinder, remove the bearing cap bolts connected to the mast and the drive axle; hoist out the mast

b） Remove the brake line on the left and right brakes of the drive axle;

c） Remove the high-voltage cable, low-voltage signal wire, grounding wire, water inlet pipe and water outlet pipe on the traction motor controller 2-in-1;

d） Lift the drive axle, motor and reduction gearbox integral with the lifting device, bundle the drive axle left and right, and use the motor hook.

e） Remove one bolt connecting the reduction gear box to the frame, that is No. 14 in the figure below;

f） Loosen 8 bolts of the support plate and the frame, that is No.11.

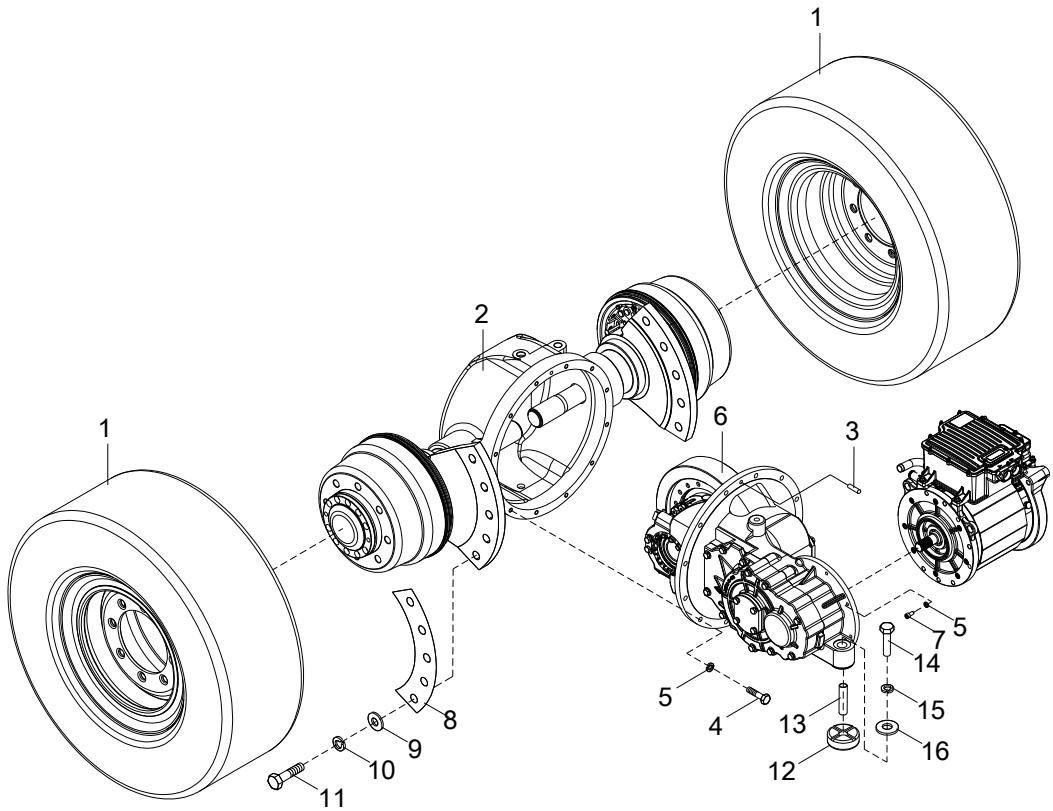


Fig 2-2

The entire transmission system is fastened to the frame by bolts 11 and 14. The vehicle is equipped with a high-power traction motor, which greatly increases the speed of the vehicle. The reduction box 6 and the motor are fastened by bolts 7.

Decompose the drive system：

a） The drive axle is laid flat, and the motor side is slightly 1cm high;

b） Place a container at the bottom of the drive axle housing, loosen the oil drain plug of the drive axle, and drain the gear oil in the bridge;

c） Loosen the no. 7,remove the Traction motor two in one,and place it on a clean tool rack.

d） Loosen the no. 3,4, remove the reduction gearbox 6, and place it on a clean tool rack.

e） The installation and disassembly of the transmission system are opposite.

Lubrication of transmission system: The axle housing is connected with the reducion gearbox, and the drive axle is filled with gear oil and gear oil enter the reducion gearbox.

1. Installation and adjustment requirements: The clearance between the supporting plate of axle and the left and right sides of the frame is not more than 3 mm, and If exceeded, gasket 8 should be used to adjust

2、 Tightening torque：

No.	Tightening torque N·m	Connecting part
11 Bolt（M24）	597~716	Connect support plate and frame
13 Bolt（M12）	71.4~85.8	Connect reduction gearbox and frame
17 Bolt（M12）	71.4~85.8	Connect motor and reduction gearbox

2.2 Traction motor

The traction motor adopts a 30kW permanent magnet synchronous AC motor. See the table below for other parameters.

Model	Rated Power kW	Insulation Grade	Cooling method	Protecting Grade	Duty
TZ220XS30kW309VT	30	H	liquid cooling	IP67	S2

CAUTION

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

2.3 Gear box

Remove the gearbox from the drive axle and remove the motor from the other end.

Gear box is two grades reduce speed gear, one grade straight gear and one grade planet gear. So the gear box is very small.

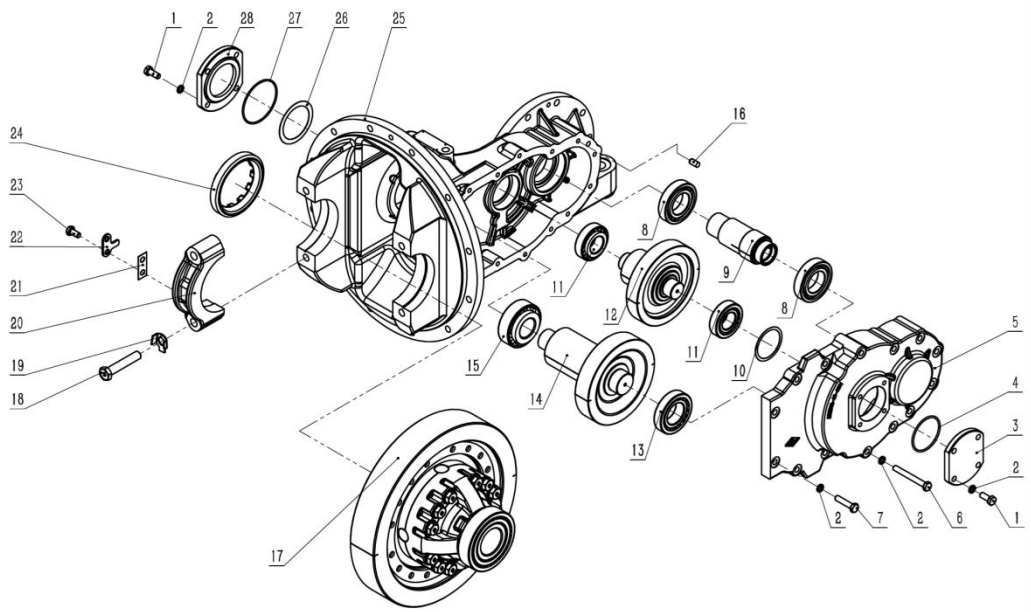


Fig 2-3 Gear box

1.Bolt	2.Spring washer	3.Bearing cove	4. O-ring	5.Cove
6.Bolt	7. Bolt	8.Bearing	9.Gear shaft	10.Shim
11.Bearing	12.Level 2 components	13.Bearing	14.Gear shaft	15.Bearing
16.Pin	17.Differential assembly	18.Bolt	19.Shim	20.Bearing seat
21.Locking plate	22.Stop plate	23.Bolt	24.Nut	25.Box
26.Washer	27.O-ring	28.Bearing cove		

Trouble	Probably cause	Method of troubleshooting
When traveling or change direction	Gear clearance is too big.	Adjust
	Too much worn of gear.	Replace
Too much noise when traveling	Oil level is low.	Add oil
	Gear clearance is too big.	Adjust
	Too much worn of gear.	Replace

2.4 Driving axle

Data

Model		4.0t～5.0t
Driving axle type		Full floating, axle and truck body direct install, front wheel driving
Tire pressure	MPa	1.0
Wheel hub rotation starting torque at hub blot	N	10～29
Axial play of wheel bearing	mm	less than 0.08

Trouble diagnoses and corrections

Condition	Probable cause	Corrective action
Abnormal noises	Loose driving axle and body connecting blots.	Tighten
	Loose wheel nut	Tighten
	Worn or damaged wheel hub bearing.	Replace
	Wheel hub bearing not properly adjusted.	Adjust
	Worn axle shaft spliner.	Replace
	Insufficient lubrication	Lubricate
Unstable driving	Loose wheel nut.	Tighten
	Deformed wheel.	Replace
	Worn or damaged wheel hub bearing.	Replace
	Loose driving axle and body connecting blots.	Tighten
	Wheel hub bearing not properly adjusted.	Adjust
	Improper tire pressure.	Adjust
Oil leakage	Worn or damaged axle shaft oil seal.	Replace
	Final drive improperly installed.	Replace gasket
	Loose drain plug.	Tighten.

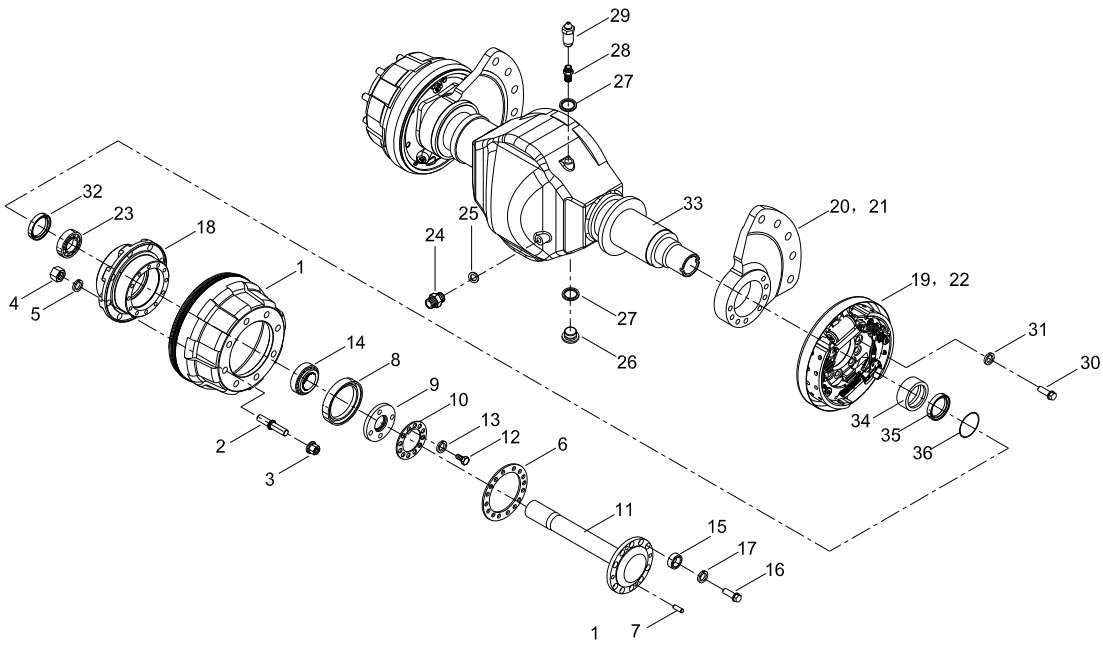


Fig 2-4　Driving axle

1、Brake drum	2、Hub bolt	3、Hub nut	4、Nut
5、Washer	6、Gasket	7、Pin	8、Oil seal
9、Lock nut	10、Lock washer	11、Half-axle	12、Bolt
13、Washer	14、Bearing	15、Clamp split-ring	16、Bolt
17、Washer	18、Wheel hub	19、Brake,L.H.	20、Plate,L.H.
21、Plate,R.H.	22、Brake,R.H.	23、Bearing	24、Plug
25、Washer	26、Plug	27、Washer	28、Plug
29、Vent plug	30、Bolt	31、Washer	32、Oil seal
33、Axle house	34、Oil seal seat	35、Oil seal	36、O-ring

Tightening torque of each key fastener of the drive axle (see Figure 1-5 Schematic diagram of the tightening torque of the drive

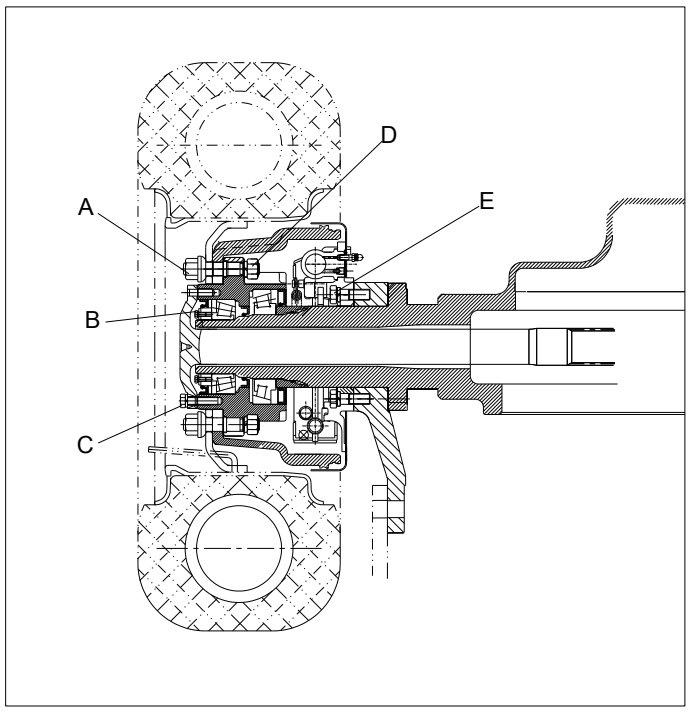


Fig 2-5 Schematic diagram of the tightening torque of the drive

Tighten torque : N·m

	4.0t~5.0t
Tyre nut A	363~490
Nut to lock washer B	4~8
Axle shaft bolt C	110~130
Nut connecting brake drum and hub D	324~373
Brake bottom plate bolt E	360~300

Driving axle assemble removal and installation

WARNING

- **Be careful when removal and installation driving axle as it is heavy.**

a） Raise front end of forklift truck and support frame with wooden blocks.

b） Remove mast assembles.

c） Slightly raise axle with a hoist and place wooden blacks under differential gear carrier and transmission case.

d） After placing a pan under axle case, loose oil plug, drain oil from axle case.

e） Disconnect brake nuts from left and right cylinders.(see fig.1-6）.

CAUTION

- **Plug brake tube openings to prevent oil from flowing out.**

f） Disconnect brake cable at hand brake lever.

g） Remove front wheels.

h） Remove axle shaft.

i） Support driving axle with wire ropes and lifting device.

j） Remove bolts securing axle mounting bracket to frame.（see fig.2-7）.

k） Remove nuts securing axle case to differential gear carrier.（see fig.2-8）.

l） Remove driving axle assemble.

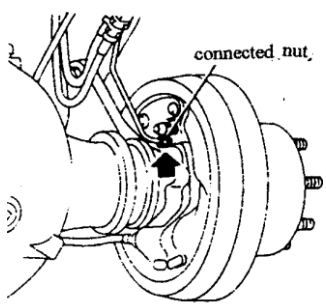


Fig.2-6

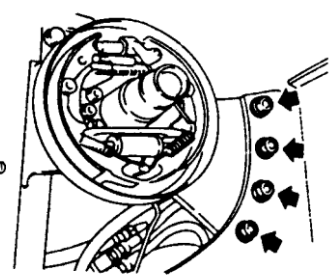


Fig.2-7

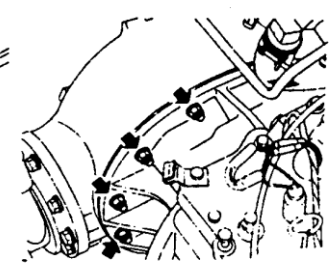


Fig.2-8

m） Remove brake drum，remove wheel hub.

n） Remove axle mounting bracket and brake component from axle tube.

o） Remove oil seal from axle tube.

p） To install driving axle assemble in the reverse order of removal. Observe the following:

1）When installing axle mounting bracket and brake component, apply a coat of calcium grease to axle tube.

2）Apply 1/3～2/3 of volume of calcium grease to wheel hub，then install them on axle tube.

3）Install oil seal with its part number facing to the inside of forklift truck.

4）attach seal tape （PVC, white）to drain plug then installed after cleaned it.

5）Replenish axle case with gear oil. Tighten vent plug after clearing.

Gear oil GL-5 85W/90 （Cold storage forklift selection： GL-5 80W/90）	4.0t~5.0t	8.0 L

CAUTION

- **The vent plug should be cleaned immediately to prevent the internal pressure of the hub from rising.**

Axle shaft and wheel hub

Remove

a） Raise the front end of forklift truck and support frame with wooden blocks.

b） Remove front wheel and axle shaft.

c） Remove lock nuts, lock washers, snap ring, felt ring, adjusting nut. Use special tools.

d） Remove brake drum（refer to Fig.2-9）;

e） If brake drum is difficult to remove:

1）Remove adjusting hole plug. Then with flat-blade screwdriver extend adjusting hole, turn adjusting ratchet wheel by 10 notches. To contract brake shoe lining(refer to Fig.2-10).

2）Evenly tapping on brake drum with brass bar or wooden mallet.

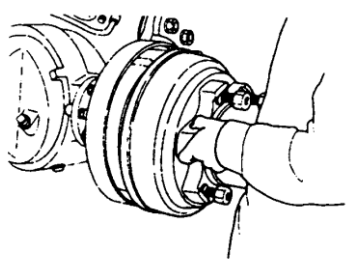


Fig.2-9

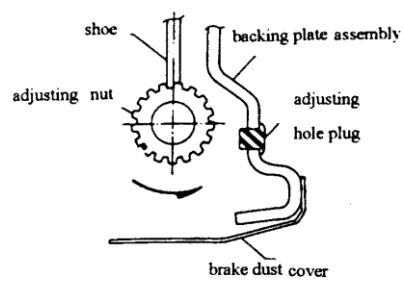


Fig.2-10

f） Remove wheel hub, be careful not to drop bearing inner race.

g） Remove oil seal and inner bearing as an assembly by evenly tapping on periphery of seal with a wooden mallet and brass bar.

h） Remove bearing outer race from wheel hub by evenly tapping on its periphery with a wooden mallet.

CAUTION

- **Be careful not to damage oil seal and outer race.**

Inspection

Stepped wear or cracks on axle shaft splines	Replace
Seized, scratched, noisy or rusted bearing or improper rotation of rollers	Replace
Cracked or damage wheel hub	Replace
Damaged oil seal felt ring.	Replace

Installation

Install reverse order of removal.

Bearing adjusting

a） Lubricate on taper roller bearing.

b） Tighten roller bearing lock nut in wheel hub until wheel hub can no longer be rotated with one hand.

c） From that position, turn back lock nut approx. 60^0.

d） Turn back wheel hub two or three rotations so that bearing settles down.

e） Again tighten lock nut until it can no longer be rotated with one hand; then turn back approx.60^0.

f） Install snap ring and settles down felt ring, install lock washer so as to set its hole in the pin of snap ring. Screw lock nut.

g） Turn wheel hub back and forth two or three rotations to see if rotation starting torque is within specifications. Rotation starting force:10～29N（refer to Fig.2-11）.

h） Measure axial play of wheel hub to see if it is within specification. Axial play is less than 0.08mm （refer to Fig.2-12）.

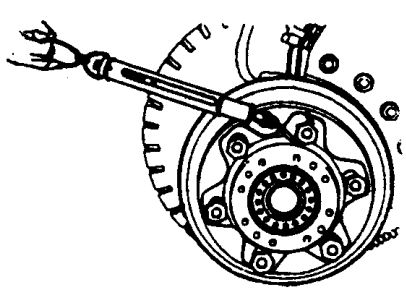


Fig.1-11

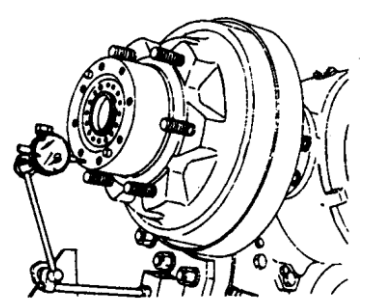


Fig.1-12

3. Steering system

3.1 Structure of Steering System

The steering system consists of steering device and steering axle assembly. See figure 3-1.

The steering device is composed of steering wheel assembly, steering tube device, locking handle and the hydraulic diverter. See figure 3-2. Both the steering column and steering wheel can be put forward and backward by an angle of 6° which can meet the requirements of different operators. When the truck is disconnected, turn the steeling wheel by a force of 1kg and release. The steering wheel can return by an angle of 10° automatically.

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

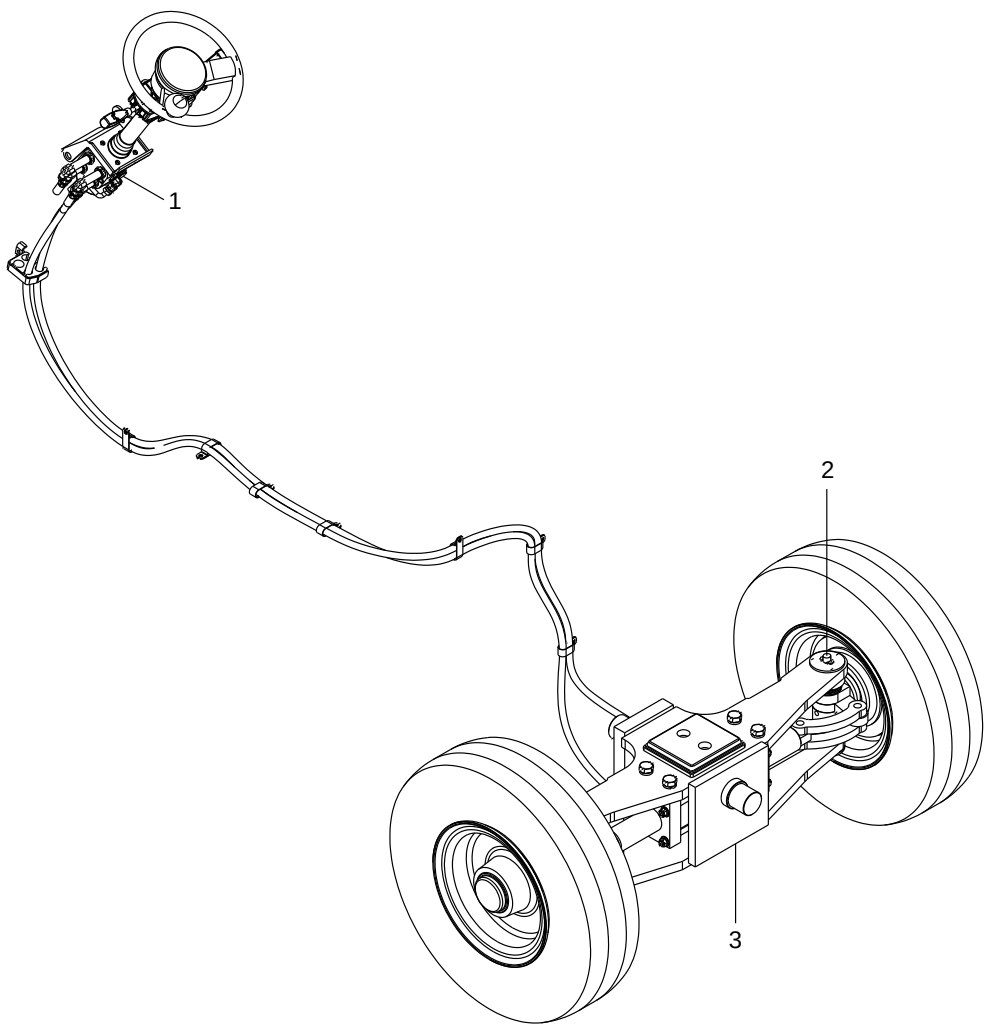
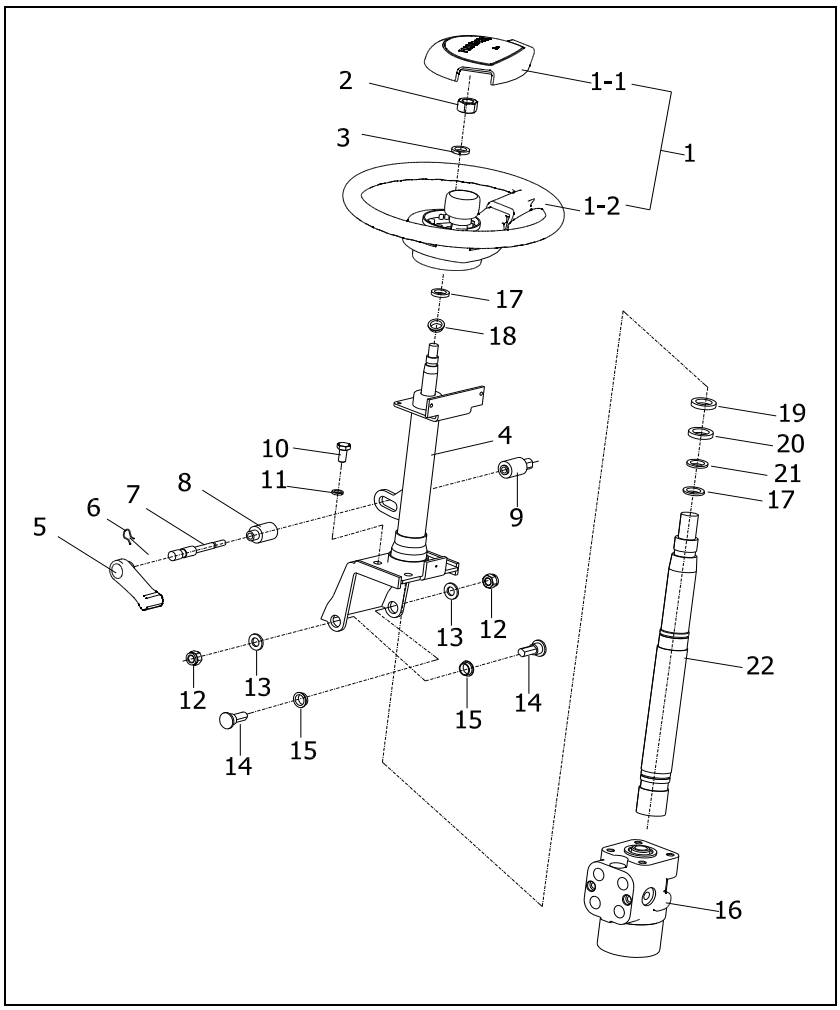


Fig 3-1 Steering System

1.Steering device 2.Angular transducer 3.Steering axle

3.2 Structure of Steering Device



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

Figure 3-2 Structure of Steering Device

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

3.3 Steering Axle

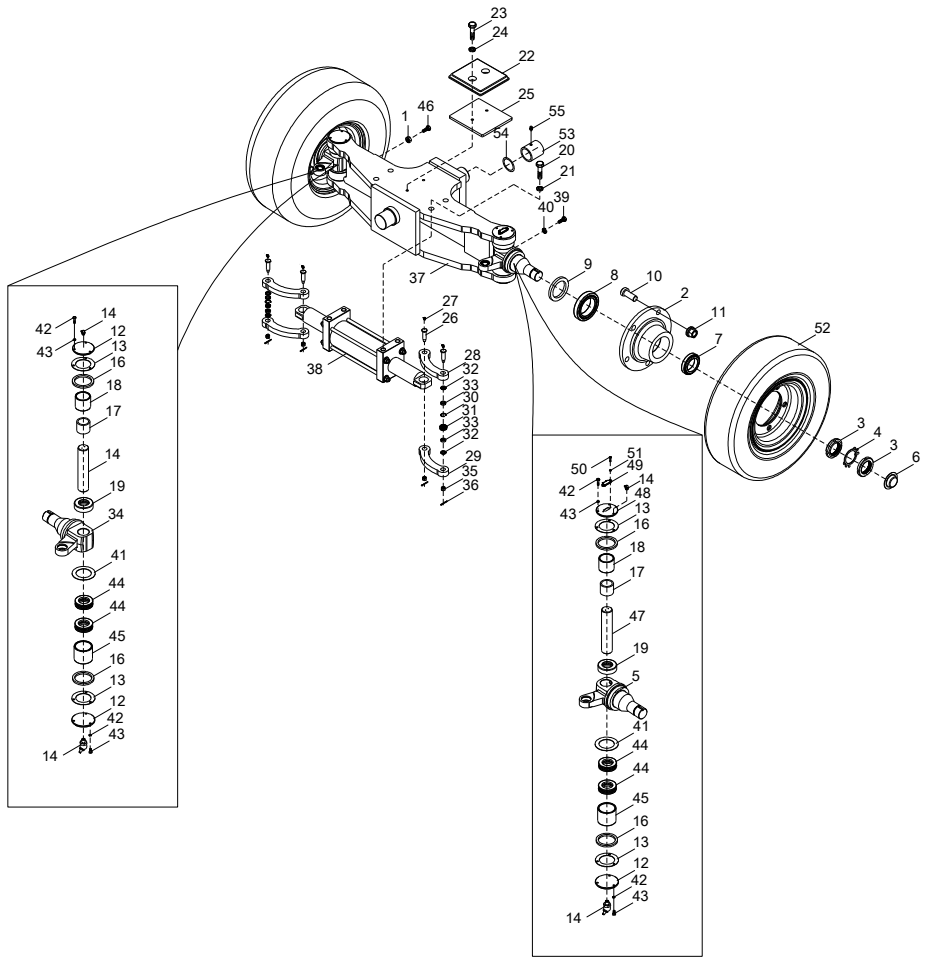


Fig 3-3 Steering Axle

1.Nut	2.Steering hub	3.Nut	4.Washer	5.Left steering knuckle	6.Hub cover
7.Bearing	8.Bearing	9.Oil seal	10.Hub bolt	11.Hub Nut	12.Cover
13.Gasket	14.Grease nipple	15.Left Kingpin	16.Oil seal	17.Bearing	18.Steel sleeve Ⅰ
19.Bearing	20.Bearing	21.Washer	22.Bump stop	23.Bolt	24.Washer
25.Backing board	26.Pin shaft	27.Grease nipple	28.Tie-rod bar	29.Tie-rod bar	30.Circlip for hole
31.Bearing	32.Scraper seal	33.Washer	34.Right steering knuckle	35.Nut	36.Pin
37.Steering axle body	38.Steering cylinder	39.Screw	40.Washer	41.Adjusting shim	42.Bolt
43.Washer	44.Bearing	45.Steel sleeve Ⅱ	46.Limit bolt	47.Right Kingpin	48.Cover
49.Angle sensor	50.Screw	51.Washer	52.Tyre assembly	53.Shaft sleeve	54.Adjusting shim
55.Grease nipple					

Key Data

Steering angle	Maximum steering angle of inside wheels		
Steering angle	Maximum steering angle of inside wheels	4.0t～5.0t	81.7°
	Maximum steering angle of outside wheels	4.0t～5.0t	60°
Longitudinal clearance mm	0～1		
Adjusting washers for longitudinal clearance	（δ=0.5mm、1.0mm、1.6mm）		

Hub bearing

Pretightening force	Screw down the nut of knuckle till the hub cannot be removed with hand. Or stop when the torque of hub bolt reaches 10 to 29 N. Turn the nut slightly to 1/8 to 1/6 of one circle.
Axial clearance	No clearance in the axial direction

3.4 Steering System Installation Attention

Precautions

a） Make sure the hydraulic connectors, bolts and hoses are clean before installing.

b） Check if the pipeline work is correct and make sure the left and right steering direction is not fitted reversely.

c） Turn the steering wheel to the left and right fully and check if the force is even on both sides and check for the stability of the truck.

d） Jack up the rear wheels. Turn the steering wheel to left and right slowly for several times. Bleed the air in hydraulic pipes and in the cylinders.

e） When the engine shuts down, turning the steering wheel with 1kg force. Releasing the hand and the steering wheel should turns back with 10°automatically.

3. 5 Dismounting and Adjustment of steering axle

Dismounting

Wheel hub

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

b） Remove tire.

c） Remove hubcap.

d） Remove steering spindle nut.

e） Pull off hub assembles.

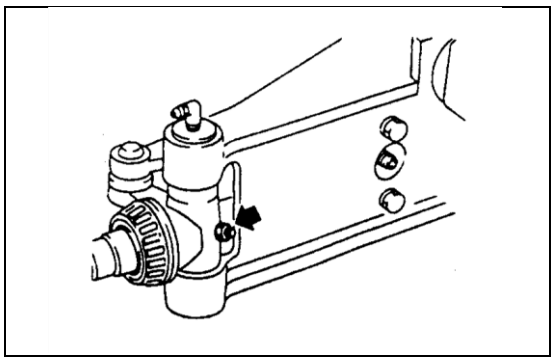
f） Remove bearing inner race.

> ⚠ **CAUTION**
> - **Not to drop bearing inner race.**
> - **Be careful not to damage oil seal.**

Master pin and steering spindle

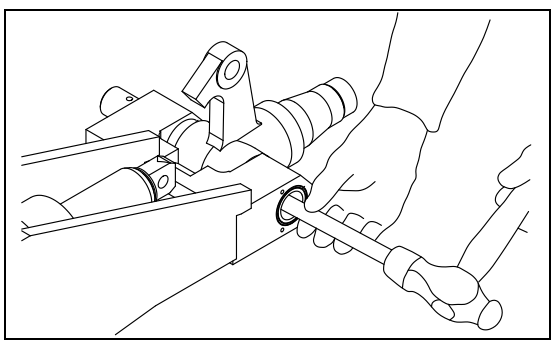
a） Remove the connecting rod;

b） Loosen the locking bolts;



c） Remove the grease nipple of the steering king pin;

d） Remove the master pin（Left and right main sales are different）;



> ⚠ **CAUTION**
> - **Hold master pin to prevent it from dropping**

e） Remove the entire steering knuckle (including thrust bearing, dust cover, gasket;).

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

Inspection：

a） Replace spindle if cracked.

b） Replace bearing if its rollers or roller

c） Surfaces are rusted or nicked.

d） Replace needle bearing if it is damaged

e） Replace thrust bearing and dust cap if them damaged.

Installation

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

a） Always insert master pin from the bottom.

b） Install thrust bearing, set the tighten-ring

c） Below the support and loosen-ring. Create the axial clearance by adding or decreasing some washers. Keep the axial clearance less than 0.2mm.

CAUTION

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

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

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

c） Put enough grease on all grease nipples.

Adjust wheel bearing

a） Slowly turn the wheel hub and tighten the lock nut until the tire cannot be turned with one hand;

b） Based on the above position, turn the lock nut 1/6 to 1/4 turn in the opposite direction. Then fix it. Measure the starting force at the hub bolt to be 10N -30 N;

c） Ensure that the steering tire rotates smoothly, and its axial clearance is within the specified value, and the axial clearance is less than 0.10mm.

3.6 Troubleshooting and corrections on the steering system

Condition	Cause and Analysis	Correction
Unstable driving	Steering wheel lock nut is loose	Tighten
	Wheel bearing out of adjusting range	Adjust
	Improper installation of end axle adjusted shims	Adjust
	Steering system fault	Refer to Steering system part
Noises	Insufficient lubrication	Apply lithium base grease
	Bolts and nuts looseness	Tighten
	Improper installation of end axle adjusting shims	Adjust
	knuckle bearing on both ends of connecting rod damage	Replace

4. Brake System

Brake system is composed of service brake and parking brake. Service brake refers to the hydraulic brake depressed on the hydraulic system by foot while parking brake refers to the mechanical brake applied by hand. Both service brake and parking brake function together with the wet disc brake located in the transmission of wheel edges of driving axle.

4.1 Foot brake piping system and brake master cylinder

4.1.1 Foot brake piping system

The foot brake piping system is composed of brake pedal 1,,oil pot 17, pipeline 20, brake master cylinder20, pipelines 22, 23, and hoops and so on. See Figure 3-1.

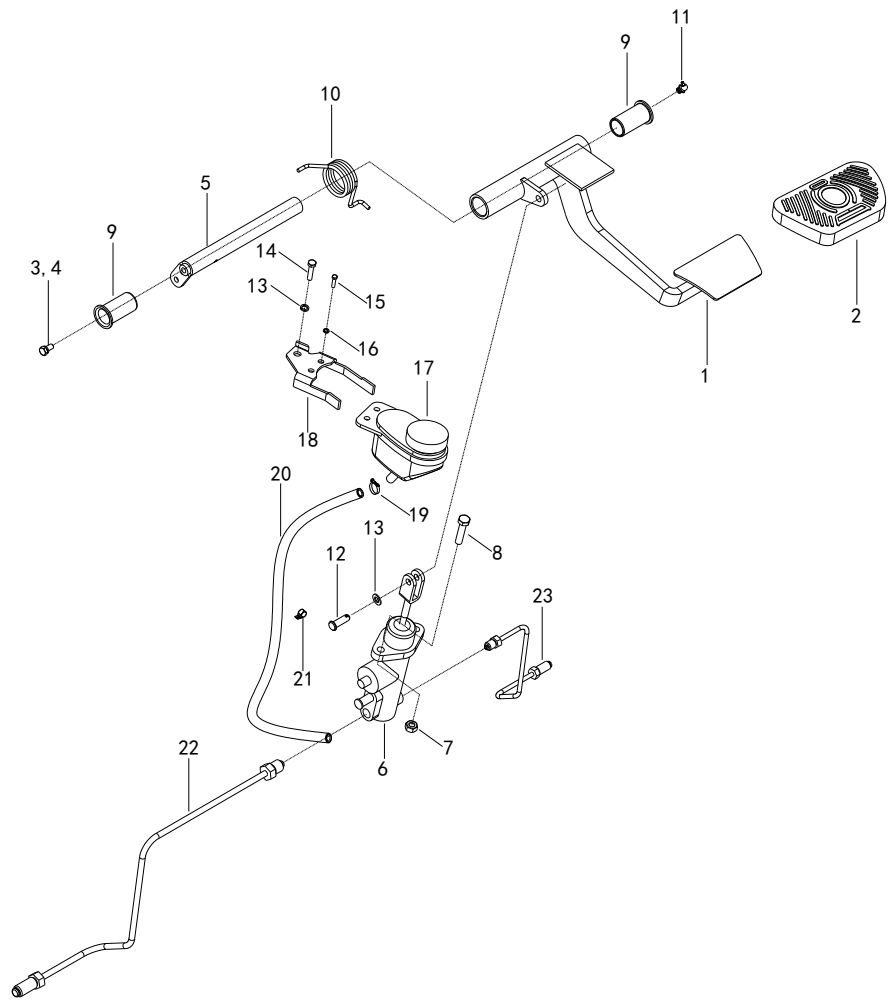


Fig.4-1

The oil pot is located on the left side of the instrument rack, and the oil pot can be seen by opening the cover. DOT3 brake fluid should be added to the oil pot. Check the pipeline for oil leakage every week. If it is insufficient, it should be added in time.

4.1.2 Brake master pump

The master pump contains a valve seat, check valve, return spring, primary cup, piston and secondary cup, which are kept in place with stop washer and stop wire. The exterior of the cylinder is protected against dust by means of a rubber dust cover. The piston is actuated through the push rod by operation of the brake pedal. Once the brake pedal is depressed, the push rod pushes the piston forwards. And the brake fluid in the front cavity of cylinder flows back to the reserve tank through the return port until the primary cup blocks up the return port. After the primary cup passes the return port, the brake fluid in the cylinder is pressurized and opens the check valve, flowing through the brake pipelines to the wheel cylinder. Thus, each wheel cylinder piston is forced outwards. It connects the brake shoes with the wheel drum which slows or stops the lift truck. Meanwhile, the back cavity of the piston is filled with brake fluid led through the return port and inlet port to lubricate the piston. When the brake pedal is released, the piston is forced backward by the return spring. At the same time, the brake fluid in each wheel cylinder is pressurized by the force of the brake shoe return spring, which makes the fluid returning into the master pump (front cavity of the piston) through the check valve. With the piston in original position, the fluid in the cylinder flows into the reserve tank through the return port. Reset the pressure of the check valve to keep it in proportion to the a residual pressure of The brake fluid in the brake lines and wheel cylinders in order to make sure each wheel cylinder piston cup is securely seated to prevent oil leakage and eliminates of vapor lock when the lift truck comes to an emergency stop.

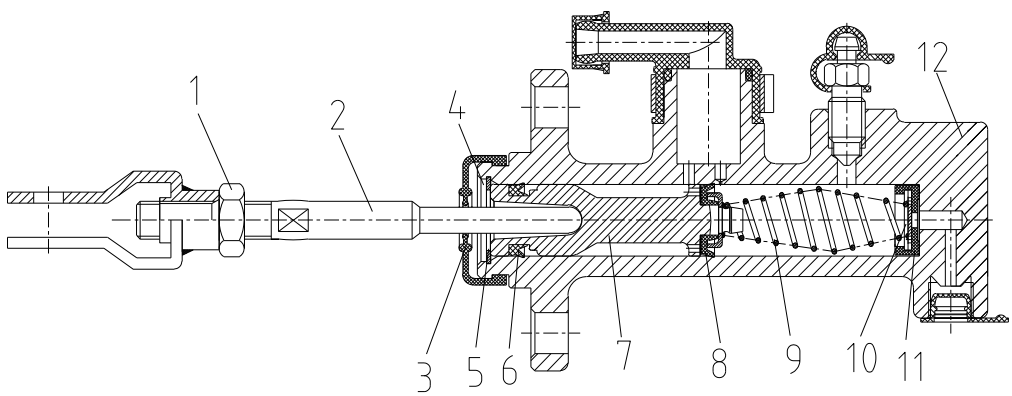


Fig 4-2 Brake Master Pump

1. Lock nut	2. Rod	3. Duct cover	4. Stop wire
5. Stop washer	6. Secondary cup	7. Piston	8. Primary cup
9. Spring	10. Check valve	11. Valve seat	12. Cylinder body

4.2 Hand brake device

The hand brake device adopts a hand-pulling soft brake wire cable device. It makes use of auto-assist pressure linings type brake together with foot brake. Only when parking truck, use the hand brake. Figure 3-3。

Condition	Cause and Analysis	Correction
Insufficient brake force	Oil leakage in brake lines.	Correct and refill oil
	Air in brake lines.	Bleed air
	Malfunction of master cylinder or wheel cylinder.	Correct or replace
	Oil lines plugged	Clean
Brake dragging	No free Stroke of brake pedal.	Adjust
	Piston cup damage	Replace
	Weak or broken return springs.	Replace
	Returning port of master cylinder plugged	Clean
	Oil lines plugged	Clean

The hand brake device uses a hand-held flexible shaft mechanism that uses an automatic power-assisted shoe brake that acts on the front wheel in conjunction with the foot brake. Use the hand brake only when the forklift is parked.

Before adjusting the hand brake, make sure the axle brake system is functioning properly.

a） Adjust nut B so that the length is equal to 68mm, then tighten lock nut B.

b） Tighten the adjusting nut A to adjust the hand brake tension. The pulling force is: when the handle is locked, the tension in the Q direction is 147N-196N.

c） After the handbrake lever is properly adjusted, release the handbrake lever to ensure that the brake is fully released.

d） Through the above adjustments, ensure that the hand brake device works normally.

Note: Apply a proper amount of lithium grease to the guide rail C and keep it applied frequently.

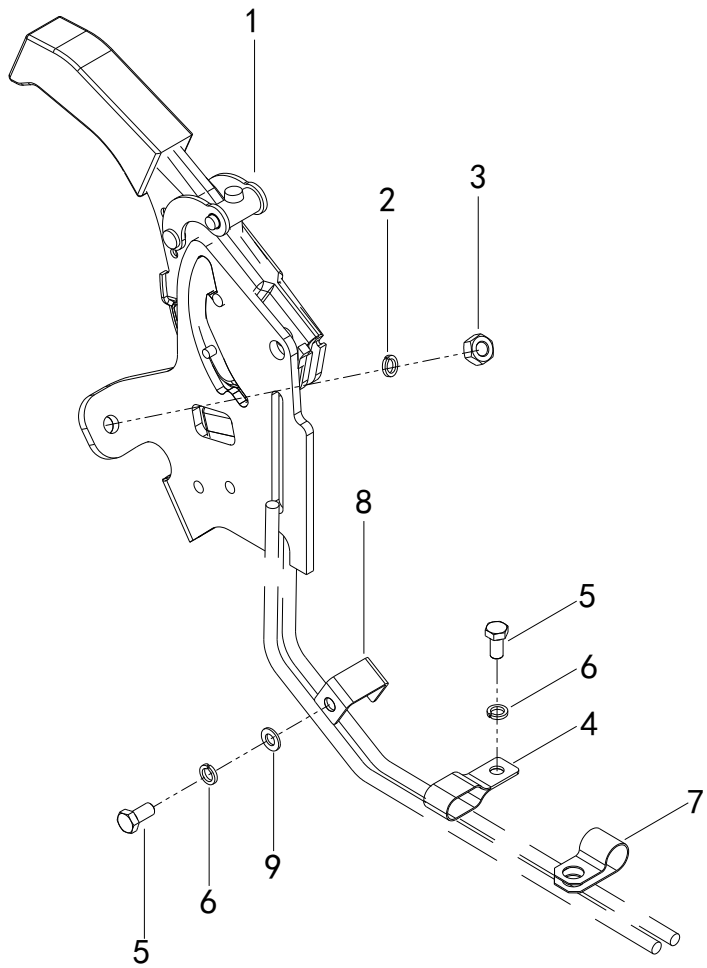


Fig.4-3Hand brake

1.Parking brake	2.Nut	3.Washer	4.Hoop
5.Bolt	6.Washer	7.Pipe clamp	8.Bracket
9.Washer			

4.3 Foot brake

4.3.1 Foot brake structure

Brake structure3-4.

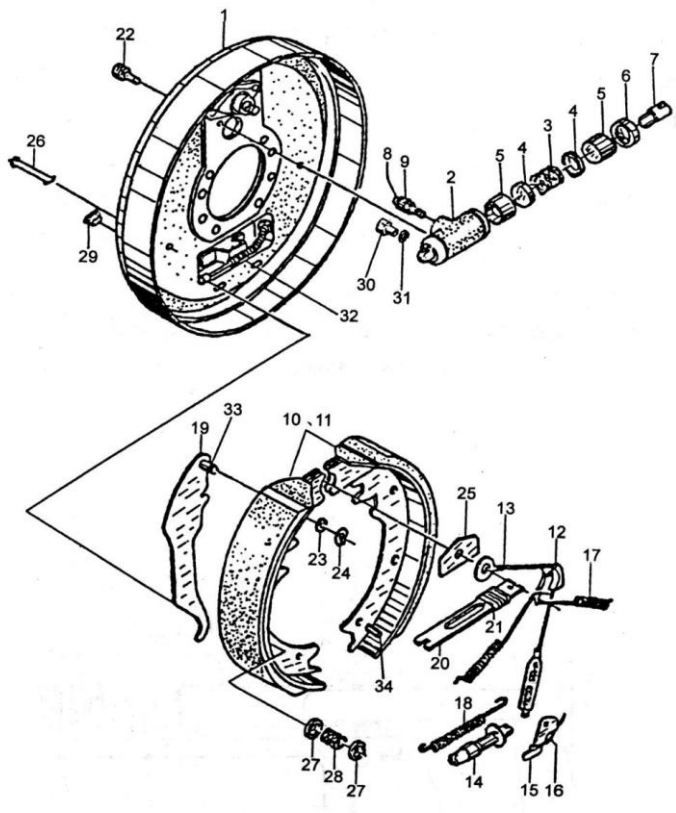


Fig.4-4 Right brake assy

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

4.3.2 Replace brake shoe:

a） Place the forklift truck on level concrete.

b） Start the forklift and raise carriage about 100mm.

c） Place chocks behind rear wheels to prevent movement of forklift truck.

d） Loosen wheel nuts two or three turns each.

e） Tilt mast fully backward, and place a wooden block under each side of outer mast.

⚠ WARNING

- **Do not allow wooden blocks to touch front tires.**

f） Tilt mast forward until front tires are raised from surface.

⚠ CAUTION

- Remove the wheel nuts after the front wheels are raised from the ground.

g） Support forklift truck by putting additional wooden blocks under each side of front-end frame.

h） Stop the forklift.

i） Remove wheel tire nuts and brake drum.

j） Replace brake shoes with new ones.

k） Install brake drum.

l） Adjust shoe to drum clearance:

1）Remove adjusting hole plug on the bottom of the brake assemble.

2）Insert a flat-blade screwdriver to adjusting hole, turn adjusting ratchet wheel downward to expand the brake shoes until wheel hub can not be turned by hand.

3）Move the ratchet wheel 2～3 notches to allow the wheel hub to be turned freely, slight friction is allowed between the brake and shoe lining.

4）Replace the plug.

5）Install wheels.

6）Properly adjusting pedal stroke.

7）Remove blocks.

8）make sure no person or obstacle is around forklift, then operate forklift in reverse at 2 to 3 km/h, set foot on brake pedal 2～3 times.

4.4 Brake system schematic

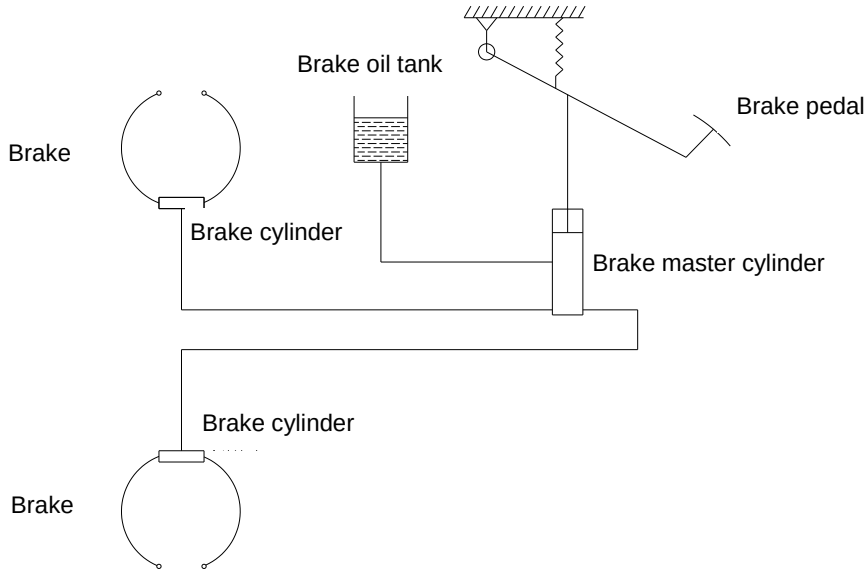


Fig 4-5 Schematic diagram of drum brake principle

5. Hydraulic system

WARNING

a) During the maintenance of the hydraulic system, it may be necessary to disconnect the high-voltage cable on the electric control 2-in-1 of the oil pump motor, which involves the high-voltage part! Therefore, it is necessary to strictly follow the safety regulations in Chapter 1 for operation!

b) Before maintenance, it is necessary to disconnect the power supply of the entire vehicle and the lithium battery MSD maintenance switch, and let it sit for 15-20 minutes before operation!

5.1 Structure of hydraulic

Hydraulic system mainly consists hydraulic fuel tank and its accessaries, gear pump, priority valve, hydraulic steering gear, control valve, steering cylinder, tilting cylinder, lift cylinders and hydraulic pipelines.See figure 4-1 as follow.

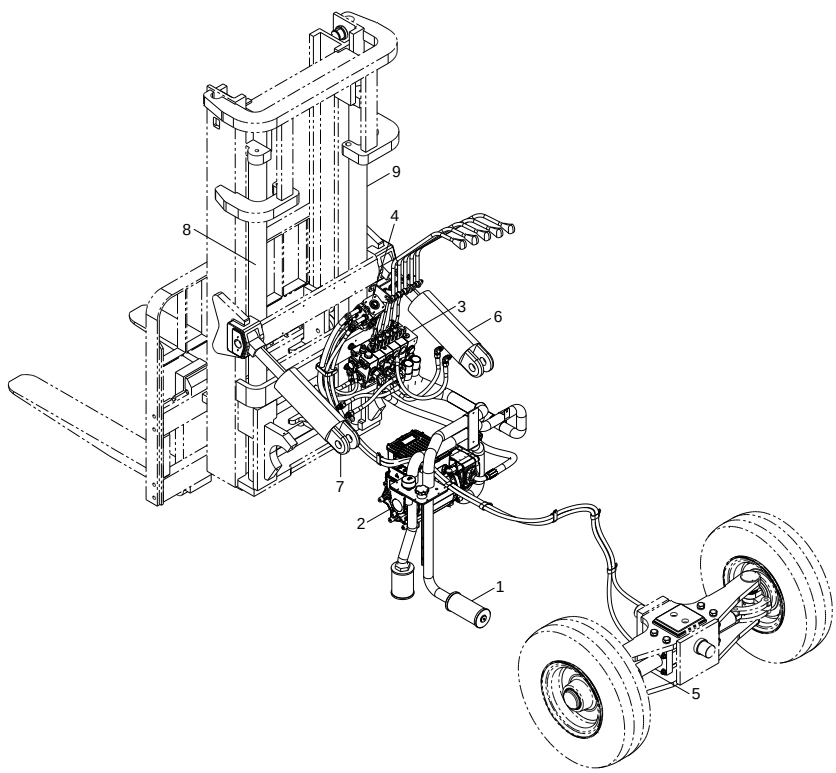


Figure 5-1 Structure of Hydraulic System

1.Hydraulic fuel tank and accessarie		2. Gear pump	3. Control valve
4. Hydraulic steering	5. Steering cylinder	6.Right tilting cylinder	7. Left tilting cylinder
8. Left lift cylinder	9. Right lift cylinder	10. Check valve	

5.2 Hydraulic system principle

The high pressure oil from main oil pump to the multi-way valve is sent to the lift cylinder or the tilt cylinder by the multi-way valve. When pulling the lift valve, the high pressure oil flows to the downside of the piston which push the piston rod upward. When pushing the lift valve, the downside of piston of lift cylinder is in connection with the low pressure and piston rod falls down by dead weight and the load weight. The oil flowing out from the lift cylinder passes through the check valve where slows down the falling speed. When operating the tilting valves, the high pressure oil flows to a cavity of tilt cylinder and the other cavity is in connection with the low pressure which realise the tilting back and forward of the mast. The other oil line flows to the steering gear which makes sure the steering operation always in priority.

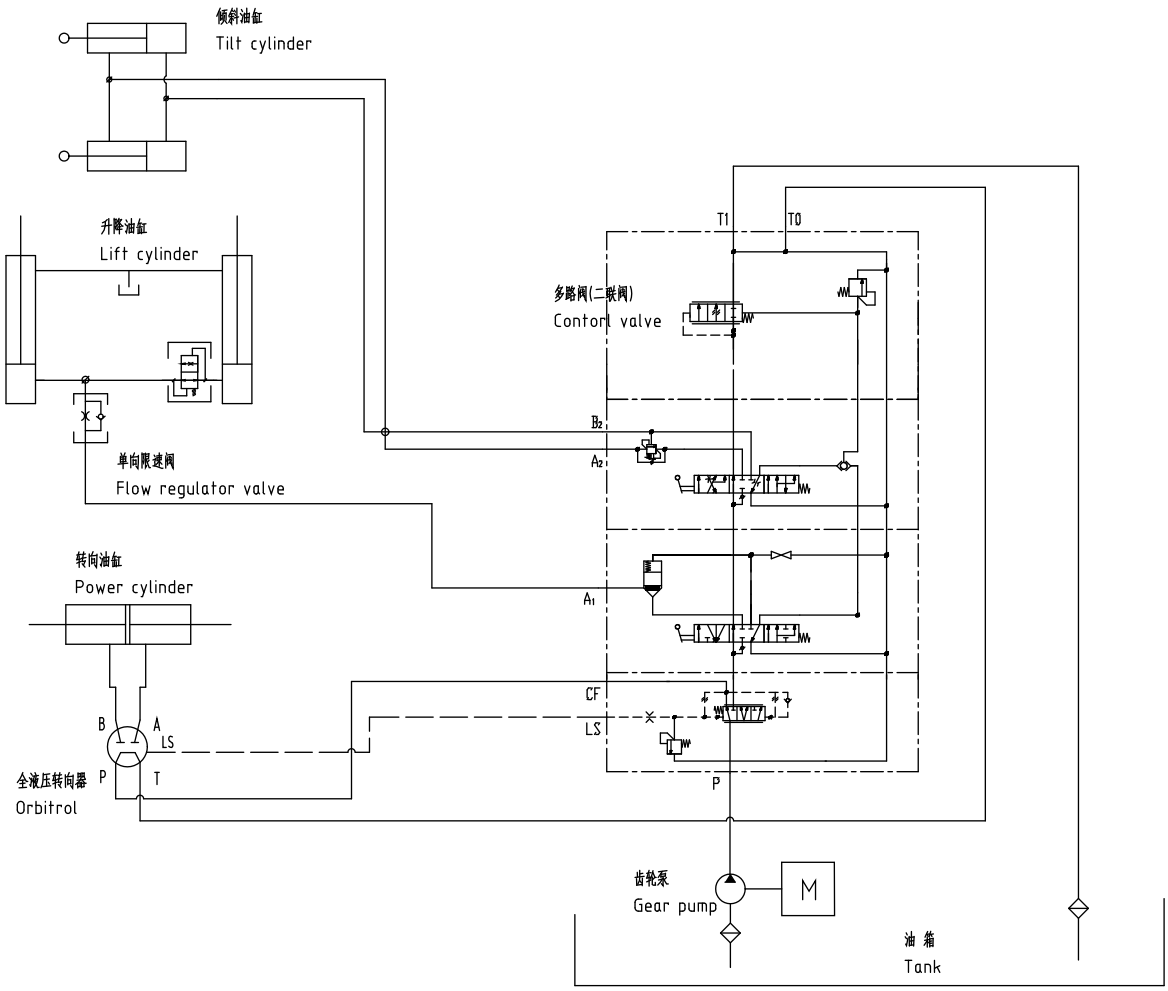


Fig.5-2 Schematic diagram of hydraulic oil

5.3 Fault and elimination

Main pump

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

Control valve

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

5.4 Oil pump unit and return oil filter assembly

Overview of oil pump device and oil return filter assembly: composed of motor, oil pump, oil suction pipe, oil return pipe, etc. See Figure 5-3

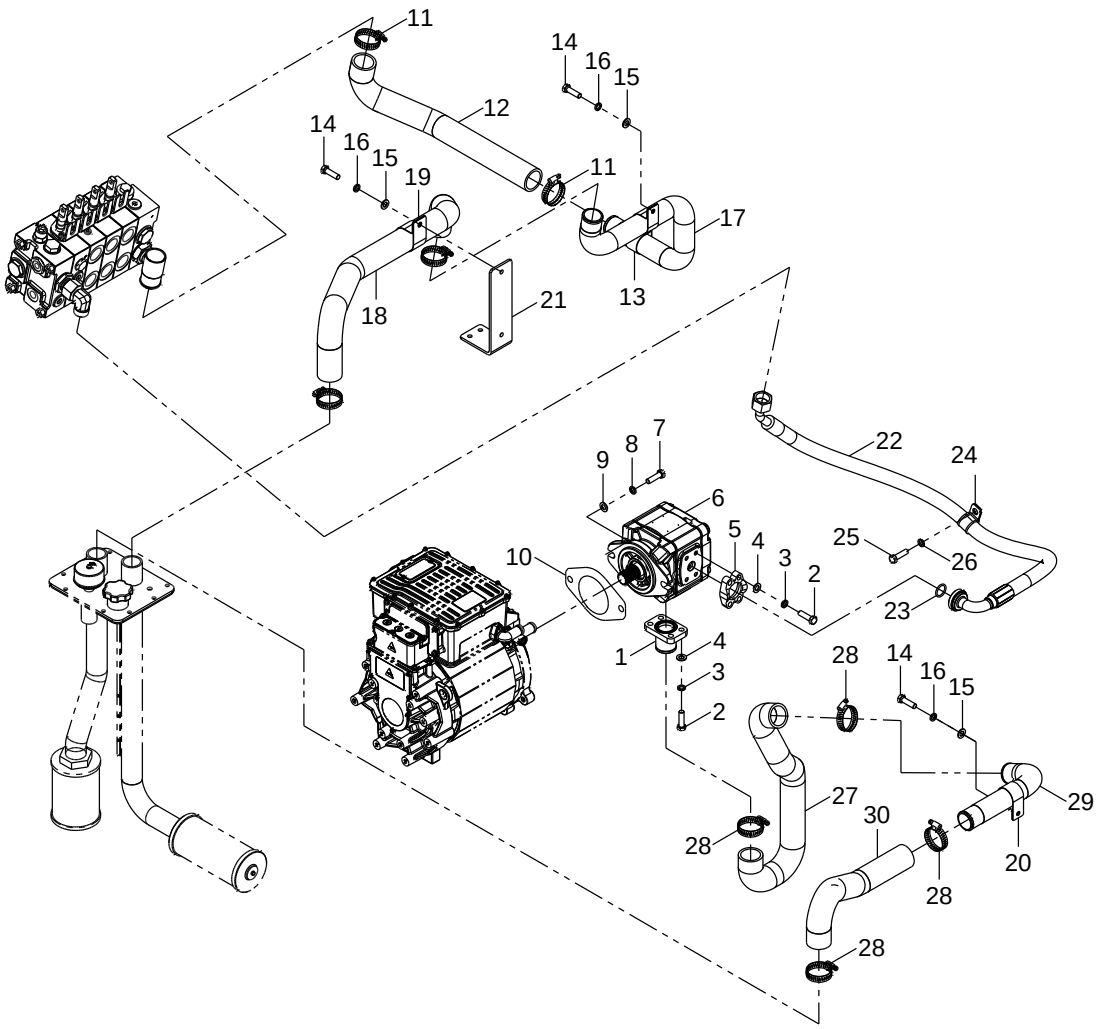


Fig. 5-3 Oil pump unit and return oil filter assembly

1-Inlet oil flange	2-Bolt	3-Washer	4-Washer
5-Flange clamp	6-Gear pump	7-Bolt	8-Washer
9-Washer	10-Shim	11-Clamp	12-Oil return pipe
13-Hoop	14-Bolt	15-Washer	16-Washer
17-Oil return hard pipe	18-Oil return pipe	19-Pipe clamp	20-Pipe clamp
21-Bracket	22-Oil pipe assy	23-O-ring	24-Pipe clamp
25-Bolt	26-Washer	27-Oil suction pipe	28-Clamp
29-Hard oil suction pipe	30-Oil suction pipe		

Installation Precautions：

1、Install the left and right brackets to ensure that the motor axis is horizontal；

2、If the motor is unstable, you need to check the installation of the double-bolt cushion.

3、Fastening torque between oil pump and motor：40 N·m-50N·m。

5.4.1 Gear Pump

This gear pump is a low-noise gear pump, with high operating pressure, low noise emission, super-long working life and reliable compact reality.

Installation Instructions

a） Before installation, make sure the rotation direction of gear pump can meet the system requirement

b） The coaxially between the gear pump axle and the motor axle must be less than 0.05mm,

c） Connect the inlet and outlet connector, do not misconnect.

d） Install the flanges and connectors. No bump ,scratch or burr, in case of oil or gas leakage and noise-producing

e） Avoid that there is no axial force or radial force on the gear pump axle. Install it smoothly during the installation, no mounting or dismounting by force.

Operation and Maintenance

a） Always follow the Instruction, never overload.

b） Hydraulic oil requirement: summer, L-HM32 or similar viscosity hydraulic oil; winter, L-HV32 low temperature hydraulic oil;

c） Starting for the first time, run without load to bleed the air in hydraulic system,until there is no bubble.

d） Keep the oil clean. Clean the oil tank and oil lines fully before refilling.

e） Inspect the oil cleanliness and strainers periodically, replace as necessary.

5.4.2 oil pump motor

AC motors rated at 24 kW.

Model	Rated power kW	Insulation class	Cooling method	Protection level	Quota min
TZ180XS35kW309VP	35	H	Liquid cooling	IP67	S3

Caution

- **AC motor does not have commutator and brush. No maintenance. But it needs regular inspection and dusty clearing.**

5.5 Multi-way valve

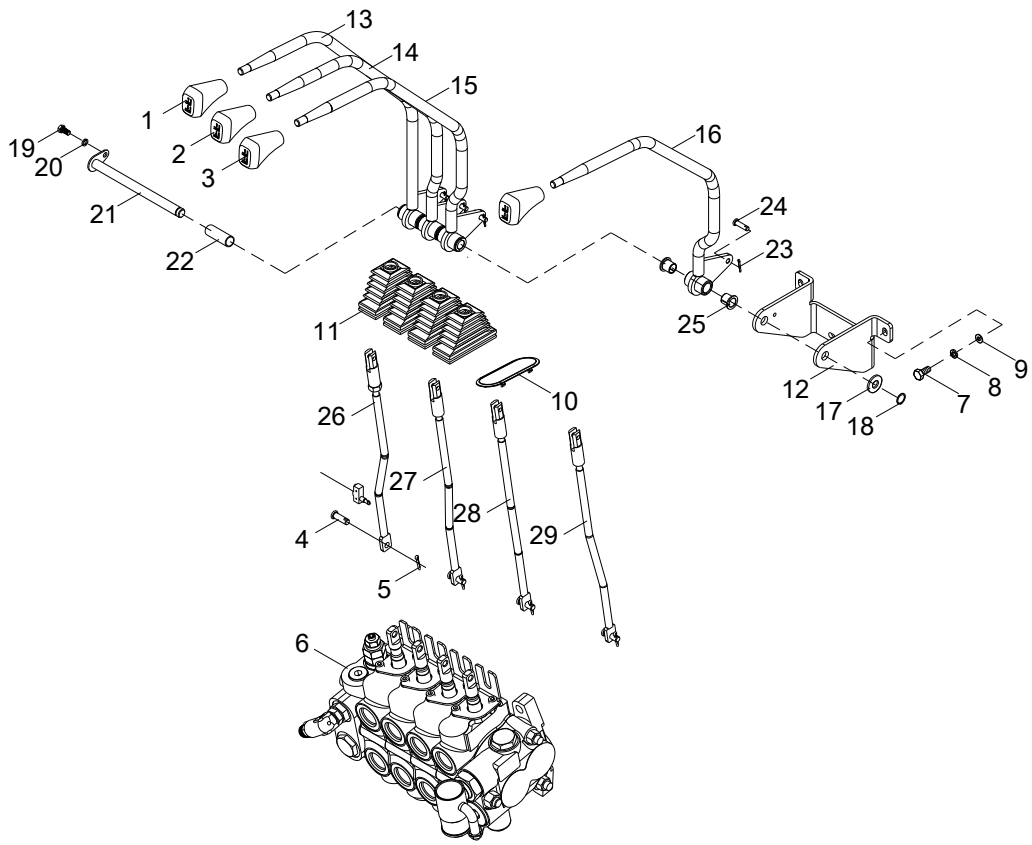


Fig.5-4 Multi-way valve handle

1-Lifting knob	2-Tilting knob	3-Accessory knob	4-Pin shaft
5-Pin	6-Multi-way valve assy	7-Bolt	8-Washer
9-Washer	10-Plug	11-Sleeve	12-Support
13-Multi-way valve handle 1	14-Multi-way valve handle 2	15-Multi-way valve handle 3	16-Multi-way valve handle 4
17-Adjustment washer	18-Circlip for shaft	19-Bolt	20-Washer
21-Pin shaft	22-Pin shaft	23-Shaft collar	24-Pin shaft
25-Bush	26-Rod 1	27-Rod 2	28-Rod 3
29-Rod 4			

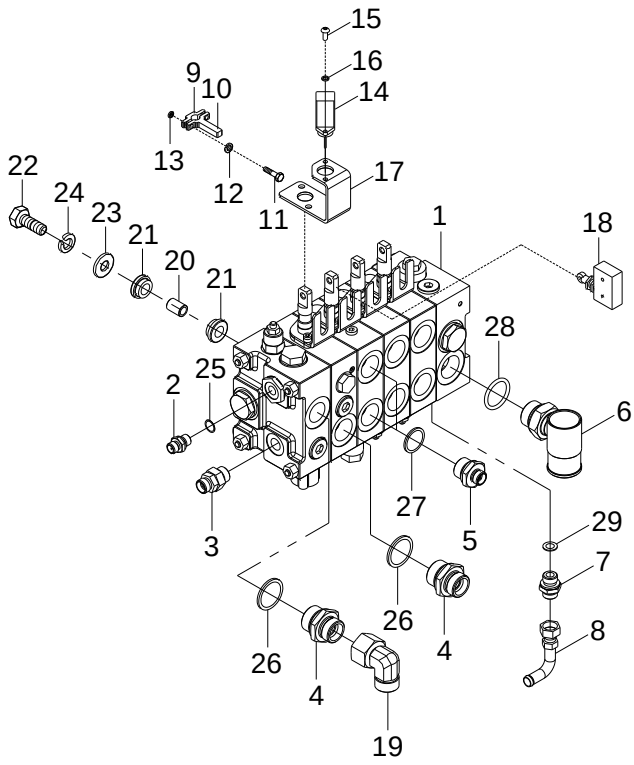


Fig 5-5 Multi-way valve

1-Multi-way valve	2-Pipe joint assy	3-Check valve	4-Straight pipe joint
5-Straight pipe joint	6-Return oil joint	7-Pipe joint assy	8-Hard pipe joint
9-Plate	10-Plate	11-Bolt	12-Washer
13-Nut	14-Potentiometer	15-Screw	16-Washer
17-Support	18-Micro switch	19-Right angle joint	20-Bushing
21-Cushion	22-Bolt	23-Washer	24-Washer
25-Sealant gasket	26-Sealant gasket	27-Sealant gasket	28-O-ring
29-Sealant gasket			

Adjusting the pressure of the main relieve valve

The main relieve valve has been adjusted before leaving the factory, , it is not allowed to adjust at will in general condition. Adjusting way is as follows:

a） Park the truck on solid and smooth road, place in neutral, pull up the hand brake handle, tilt the mast backwards to the end, and drop the fork to the ground. The engine stops.

b） Open front soleplate, release the pressure mouth bolt of oil inlet pipeline in the multi-way valve, and put in clean place. If hydraulic oil outflows, please protect the environment.

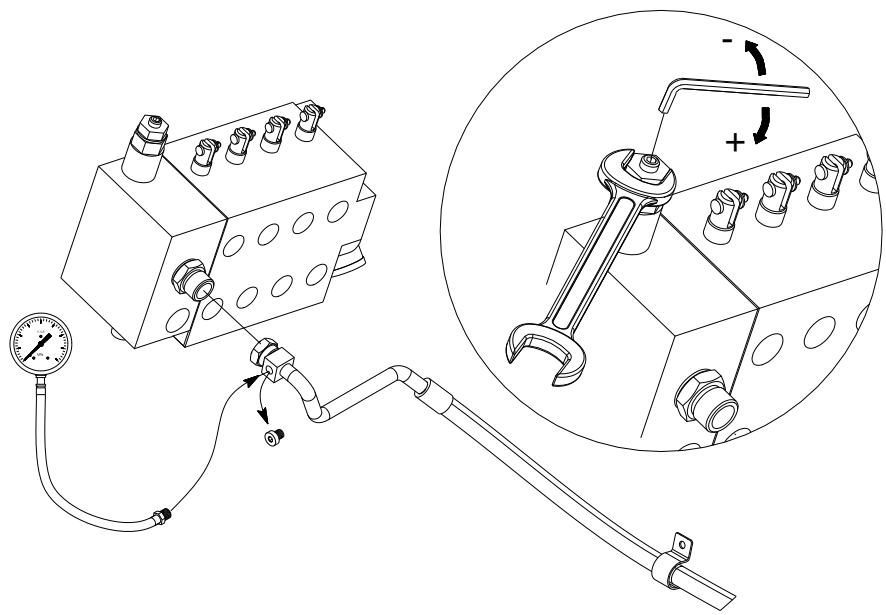


Fig 5-6

c） Connect the pressure gauge. Notice: a. Specification of gauge should be larger than 20Mpa. b. taper thread at pressure mouth matches: Rc1/8R1/8; c. tightening torque is 20N•m-22N•m.

d） Start the engine, place the mast in vertical, and the fork is 300mm from the ground.

e） Read out the indication in the pressure gauge, and judge is the main safety valve of multi-way valve is in normal scope.

4.0t~5.0t：18.5MPa±0.5 MPa

f） If the pressure is not in the normal scope, please release the main safety valve locknut, and adjust adjusting bolt.If the indication is smaller than the normal scope, inner hexagon spanner the adjusting bolt in clockwise (+) to increase main safety valve pressure.If the indication is larger than normal scope, inner hexagon spanner the adjusting bolt in counterclockwise (-) to decrease main safety valve pressure.

g） Stable the pressure in normal scope for 30’s.

h） Release pressure gauge, install the bolt, and the tightening torque is 20N•m-22N•m. Drop the mast to the ground and tilt backward to end.

i） Retighten the tightening nut, and fix it on the front soleplate.

5.6 Hydraulic Steering Gear

This hydraulic steering gear is load sensing type. There is a LS mouth in the steering gear connected to priority valve that makes steering load pressure signal transmit to priority valve through oil pipe, which controls the oil quantity supplied to the steering gear.

In the load sensing type steering system, whatever load pressure or steering wheel speed, it can prioritize corresponding flow according to oil line requirement, and guarantees the steering reliable, sensitive and light.

Besides the needed oil pump output flow to the steering system, the rest one is supplied to working oil line, thus eliminates power loss from over oil supply to steering oil line, and improves system efficiency.

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

There is no oil output from the pump when the truck is disconnected. The steering wheel drives the rotor through spool, sleeve and coupling. The stator and rotor works as a pump which can push the oil to flows to the steering cylinders and realize the manual steering.

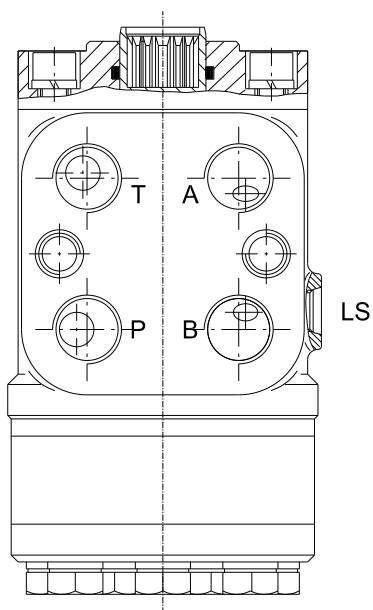
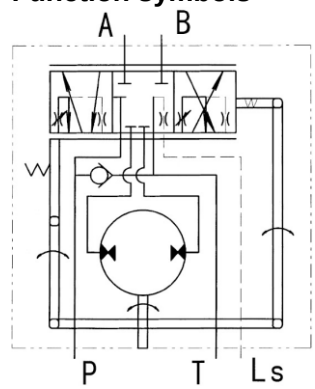


Fig5-7 Steering gear

Function symbols



Displacement：160mL/r

Max. inlet pressure：16Mpa

Oil port sealing type：taper port sealing

Assemble notice

a） When assembling the steering gear, make sure in the same axle with steering column, and there should be axial clearance. Check if steering wheel returns flexibly after assemble. Assemble should follow the following: “P”—connect muti-way valve Ps mouth; “T”—connect hydraulic oil tank; “A”—connect steering cylinder left chamber; “B”—connect steering cylinder right chamber; “Ls”—connect muti-way valve Ls mouth.

b） A, B, P, T mouth connect thread M20×1.5，T=50～60N·m；LS mouth connect thread M12×1.5，T=30～36N·m

c） Make sure the oil clean to avoid dirt block steering gear inner part and cause steering malfunction. Thus it needs check filter element of filter and oil work condition, replace if necessary.

d） If there occurs to heavy steering or malfunction during steering gear use, find out the reason firstly, it cannot wrench the steering wheel hard, or dismantle the steering gear, otherwise it may damage the parts. It is prohibited to rotate the steering wheel by two persons.

Hydraulic Steering Gear common failures and troubleshooting measures

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

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

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

Fault	Probable reason	Corrective action
Steering wheel is blocked	The inlet non-return valve of steering gear damaged, the oil flow back	Maintain or replace the steering gear
Pipeline shakes and there is hydraulic noise in the load sensing steering system. The truck vibrates when running,	Air in the pipeline	Bleed the air in the hydraulic system
	Orifice of load port is small	
	Set the pressure of relief valve to an incorrect value	

5.7 Steering Cylinder

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

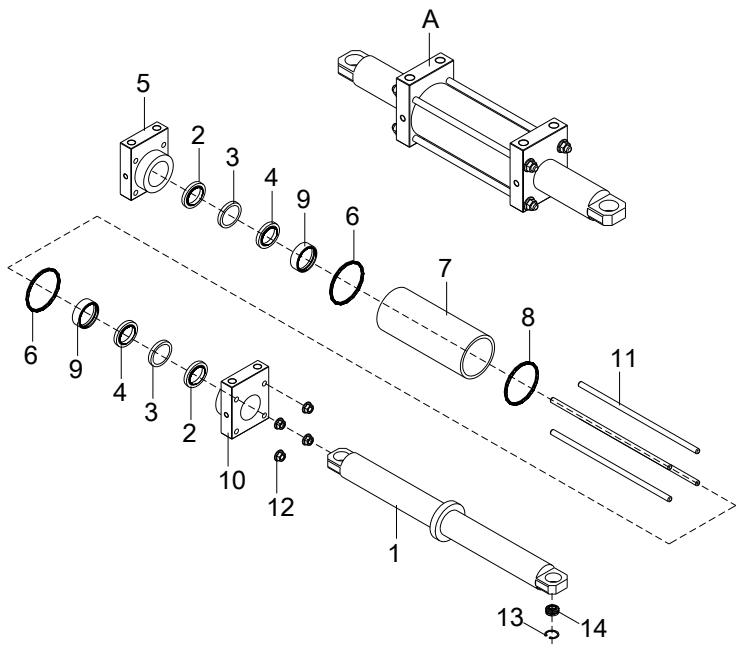


Fig 5-8 Structure of steering cylinder

1-Piston rod	2-LBH dust ring	3-Guard circle	4-ISI Seal ring
5-Left Guide bush	6-O-ring	7-Cylinder body	8-Ring
9-Bush	10-Right Guide bush	11-Screw	12-Nut
13-Circlip for hole	14-Bearing		

Disassembly steps：

a） Loosen the nut 12 and remove the Screw 11;

b） Remove the guide sleeves 5 and 10 on the left and right sides;

c） Remove LBH dustproof ring 2, protective ring 3, ISI sealing ring 4, composite bushing 9, and O-ring sealing 6 in sequence;

d） Remove the piston rod and remove the Glyd ring 8

e） Check: if each component is damaged, replace it.

Installation sequence is opposite to removal

Attention on the installation and disassembly of the steering cylinder

a） Lubricate every part with clean hydraulic fluid.

b） Keep the cylinder away from any dust and dirt.

c） Prevent the cylinder barrel and inlet, outlet from scratching.

d） Keep the opening of ISI seal ring inward and the opening of LBH scraper seal outward.

e） Protect the O-ring from being damaged during the installation.

f） Push the guide sleeve carefully into the cylinder barrel. Protect the O-ring and inner seal ring from being damaged. Lubricate the clearance of the seal rings with the same brand hydraulic fluid as the operating oil.

6. Lifting System

6.1 General Description

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

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

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

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

3 meters duplex mast is the standard mast type on HC forklift. Optional mast configurations are listed as follow.

wide view duplex mast: 2.5 m to 6m

full free lifting duplex mast: 2.5 m to 3.7m

full free lifting triplex mast: 4 m to 7m

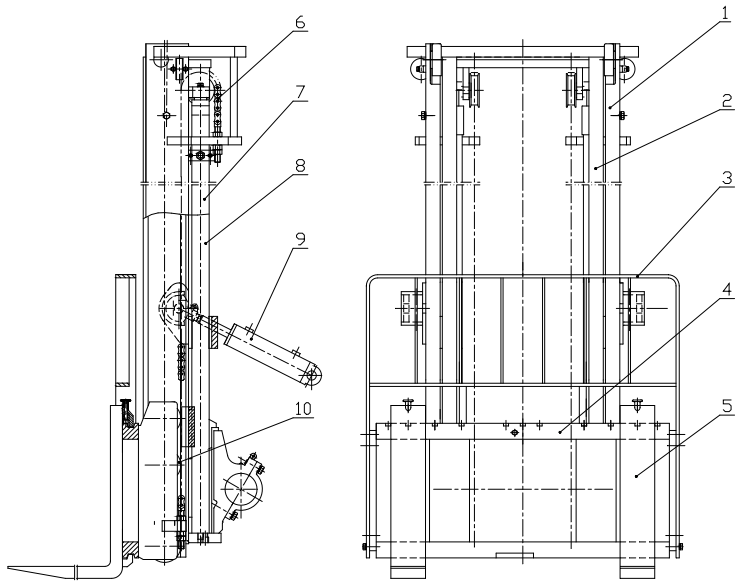


Figure 6-1 Vision of duplex mast

1.outer mast	2.inner mast	3.load backrest	4.carriage
5.fork	6.chain	7.left lifting cylinder	8.right lifting cylinder
9.tilting cylinder	10.roller		

6.2 Data of assembly and debugging

Inspection and adjustment

position		Assy clearance	Repair clearance
Mast to lift roller	mm	0.1～0.8	0.2～1.0
gasket	mm	0.5 / 1.0 / 2.0	
Mast to support guide plate	mm	0.1～0.8	0.2～1.0
gasket	mm	0.5 / 1.0 / 2.0	
Inner mast to carriage side roller	mm	0.1～0.6	0.2～1.0
gasket	mm	0.5 / 1.0 / 1.5	
Lift chain deflection	mm	25～30	

Tightening torque of main components

Place	Tightening torque (N·m)
Lifting chain locknut	441～539(M24×2)
Bearing cap of mast and drive axle	245～314(M20×1.5)
Tilting cylinder locknut	49～64(M12)
Lifting cylinder bolt	127～157(M16)
Lifting cylinder fixing bolt（U-bolt）	10～12(M8)

6.3 Trouble shooting and corrective action

Fault	Probable cause	Corrective action
Fork carriage or mast tilts automaticly	Tilting cylinder and seal ring abraded excessively	Replace piston seal ring or tilting cylinder.
	The valve control rod spring of multi-way valve disorder	Replace
Fork carriage raises up and down sluggishly.	piston jamming or piston rodbends	Replace the damage parts.
	Too much dirt is accumulated in the cylinder.	Clear
Fork carriage is lifted or lowered unsmoothly.	Carriage assembly adjustimproperly	Adjust clearance between channel steel rail and side roller.
	Insufficient clearance between rollers and inner and outer mast	Adjust clearance of rollers.
	Biting foreign materials between moving part.	Remove foreign materials.
	Insufficient lubrication.	Apply grease on contact surfaces of sliding parts.（butter）
	Inner mast deflection or carriage bends	Repair or replace.
Forks are lifted unevenly	Improper adjustment of lifting chains	Adjust lifting chains of both sides to the same tightness
Lifting roller cannot rotate	Grease stiffened or rollers get stuck by accumulated dirt	Clean and lubricate the rollers.
	Improperly adjustment of lifting roller.	Adjust.
Too much noise on the mast	Insufficient lubrication.	Lubricate.
	Side rollers on fork carriage adjust improperly. It strikes the mast channel steel, when the extended mast lowering.	Adjust the rollers and side rolling adjusting gaskets
	Rubber pad on lower of outer mast is out of work for container forklift truck.	By adjusting shims and rubber pad, piston rod will touch the bottom of cylinder body after inner mast is in touch with rubber pad.
Insufficient lifting power or unable to lift	Excessive wear occurs between the oil pump body and gears, causing too much clearance.	Replace the worn parts or the oil pump.
	The piston Yx-ring of lifting cylinder has been worn, resulting in inner leakage.	Replace Yx-ring.
	Springs of the multi-way valve and relief valve disorder	Replace with a new spring
	Excessive wearing of the hydraulic control valve occurs, resulting in excessive oil leakage.	Replace
	Oil leaks occur between the hydraulic control valve sections.	After regrinding, reassemble and rescrew the bolts in order
	hydraulic pipeline leakage	Tighten the joint nuts and check for damage of seal and connecting nuts
	High hydraulic oil temperature, low oil Viscosity and insufficient oil flow	Change the faulty hydraulic oil or stop to reduce the oil flow, and check for the reason of high oil temperature trouble.
	Overloaded	Observe the lifting capacity limit.

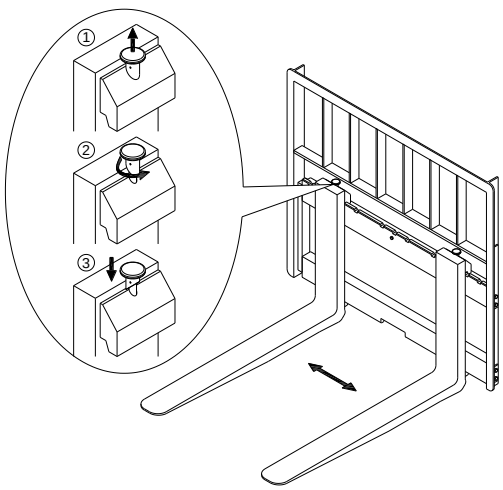
6.4 Mast Disassembly and Installation

Caution

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

6.4.1Dismantle the fork and mast assy

a） Screw out the fastening bolts from the central part of the fork carriage which prevents the forks from falling off the carriage. Pull out the fork pin and move the forks to the central breaches of the carriage.

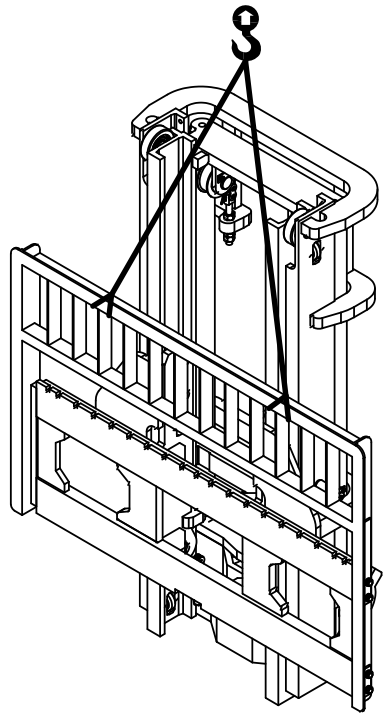


b） Remove the forks shank by dragging out the fork shanks.

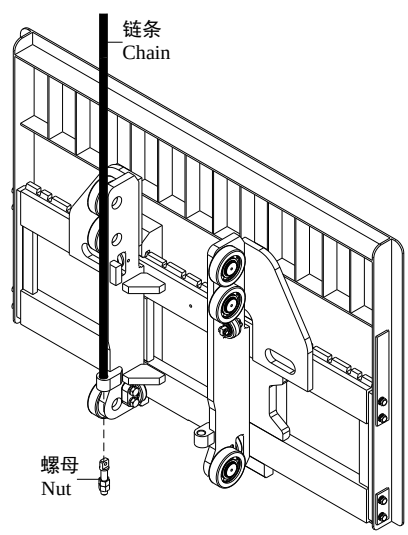
Warning

- **Keep the hands and feet off the forks. Watch out when dismantling the forks. Do not put hands for feet under the forks or between the fork and carriage.**
- **Do not dismantle the fork from the upper face of fork blade. Prevent any damage caused by fork falling.**

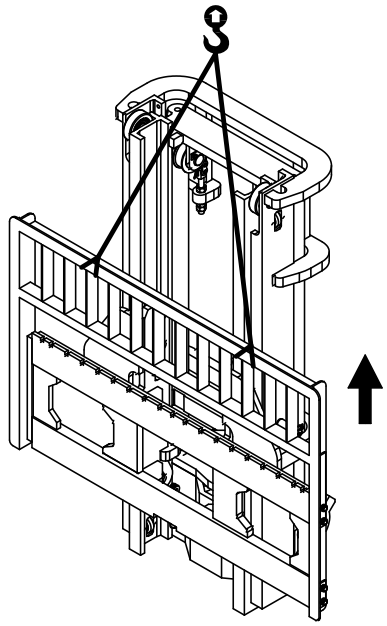
c） Tie up the carriage assy with steel wire and crane it with lifting equipment.



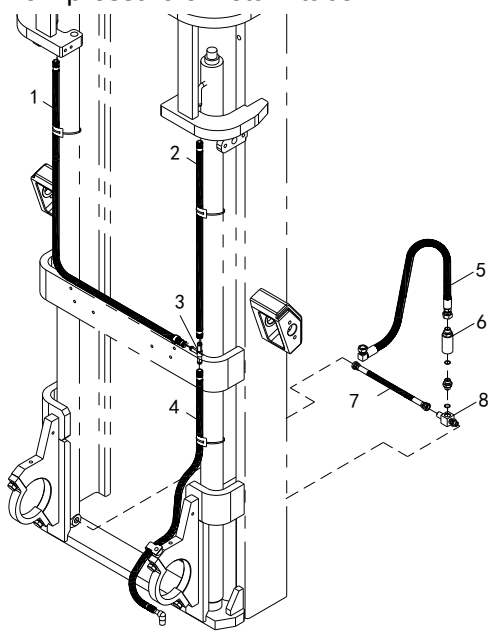
d） Screw out the nuts on ends of the chain and dismantle the chain from the carriage assy.



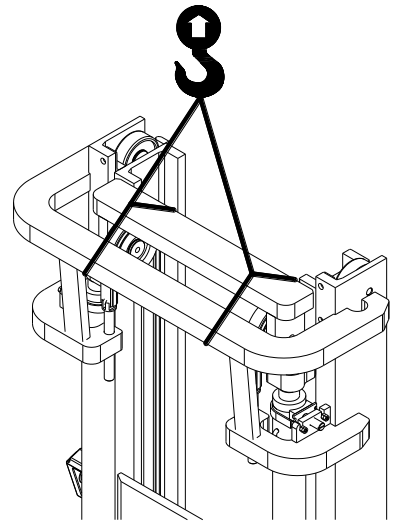
e） Dismount the carriage assembly from the inner mast.



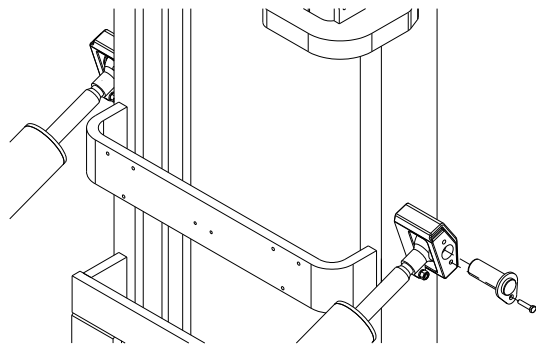
f） Remove the lifting pressure tube and the low pressure oil return tube.



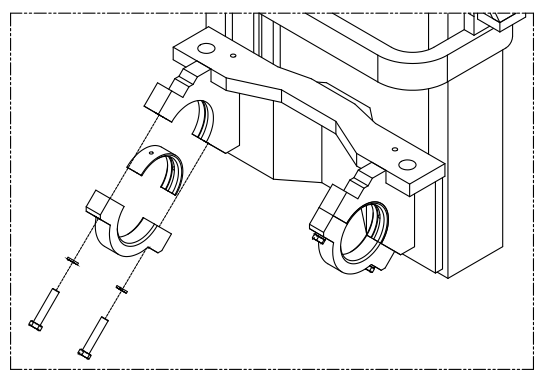
g） Lift the inner and outer masts with steel wire.



h） Remove the set bolt and shaft pin from the front of tilting cylinder.



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



j） Disassemble the mast assy.

Following the revers sequences of disassembly to install the mast.

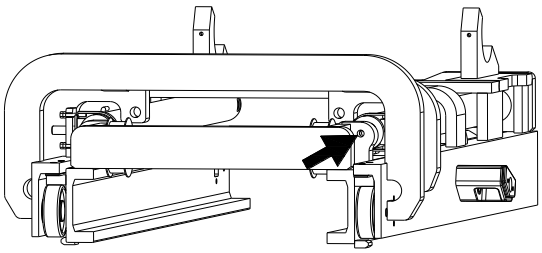
6.4.2 Spare Parts Disassembly

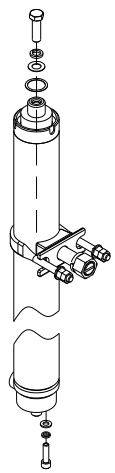
Warning

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

Disassemble the lifting cylinder.

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



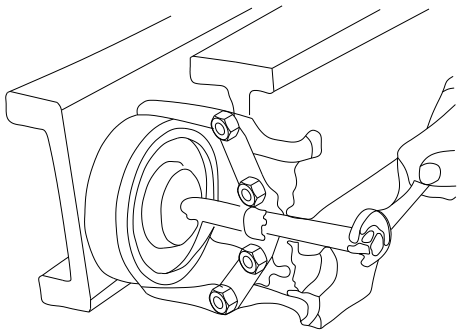


b） Slide the inner mast and disassemble the lifting cylinder.

Take out the rollers.

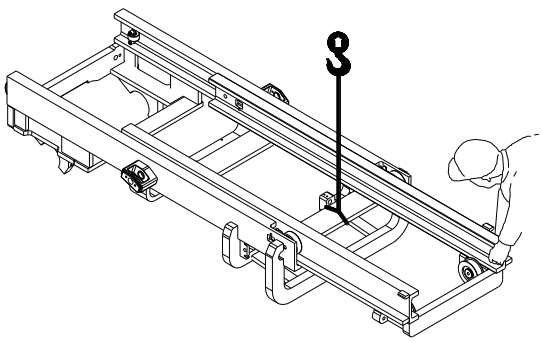
a） Stretch out the inner mast from the bottom. Remove the retainer rings from the composite rollers and take away the side rollers. Prepare twoplectanes with about 10mm thickness and diameter at Φ53 and Φ58 respectively. Cover the roller holder with the two plectanes. Dismount the composite rollers and main rollers with a bearing puller.

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



Disassemble the inner mas

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



Inspection

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

b） Replace the damaged parts as necessary.

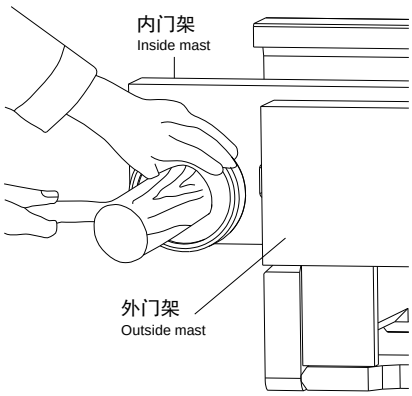
6.4.3 Assembly and adjustment

warning

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

Mount the roller

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

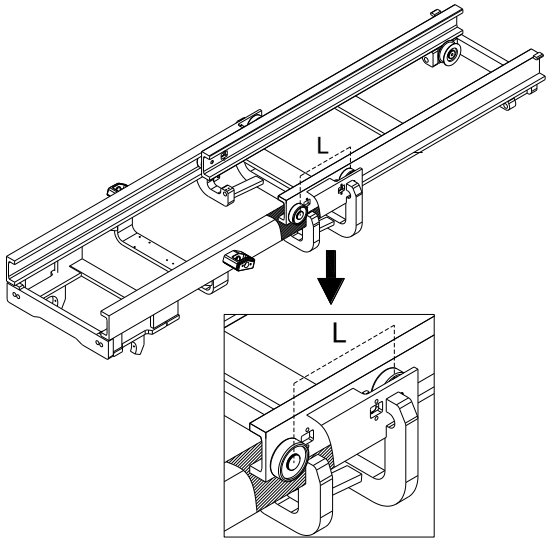


Adjust the clearance between the roller and mast channel.

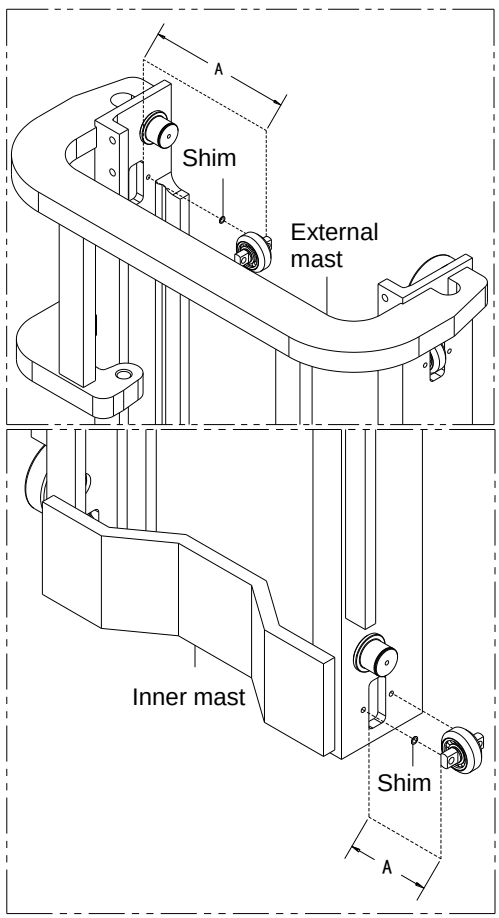
a） Name the distance between the rollers on inner mast and outer mast as L. And adjust as follow.

“L” dimension Unit：mm

Truck model / Max lifting height mm	4t~5t
2500~3300	480
3600	480
4000	530
4500	555



b） Adjust the clearance A of left and right side evenly with a thin washer and make it



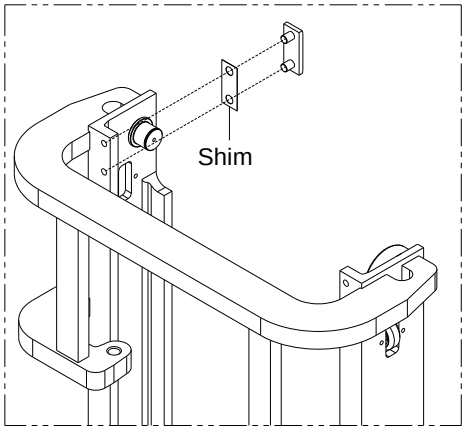
c） Keep the clearance of rolling channel flange within 0.8mm ～ 1mm. Do not

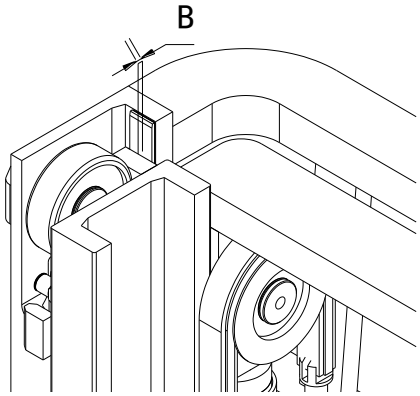
adjust the clearance. If it is over worn, replace the rollers.

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

Clearance between the guide plate and mast channel.

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





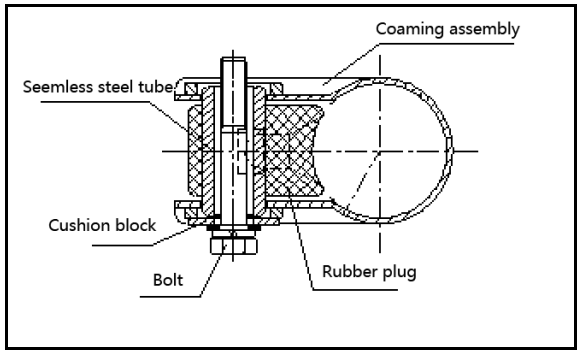
b） Smear a layer of lubricating grease on the guide plate and assemble the mast and lifting cylinder on the forklift truck. Connect the oil return tube and the high pressure tube.

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

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

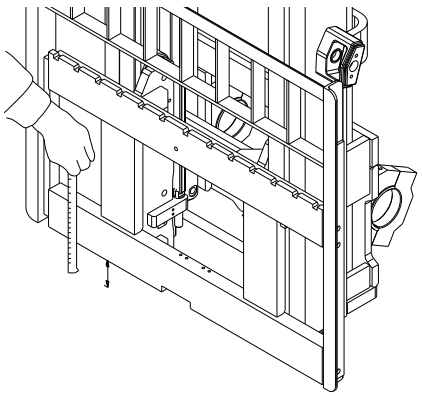
b） Set the upper end of the piston rod into the cylinder holder of the inner mast. Make all directions evenly positioned. If there is height difference on left and right sides, apply a washer between the cylinder holder hole and the upper end of the piston rod and adjust.

c） Fix the cylinder to the left and right channels (blocks) of the outer mast with a cylinder clamp. Mount the rubber plug and seamless tube. Finally, screw up the bolts.



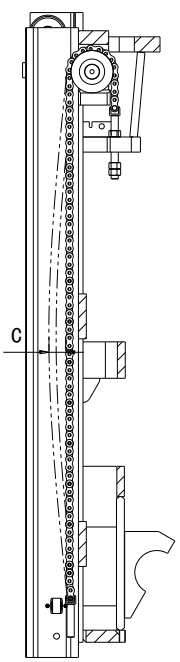
6.4.5 Adjust the lifting chain

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



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

The length of “C” is around 25mm~30mm.



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

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

b） Measure the space from left and right side B、B′、B" of rollers on fork carriage and side roller of the composite roller respectively.

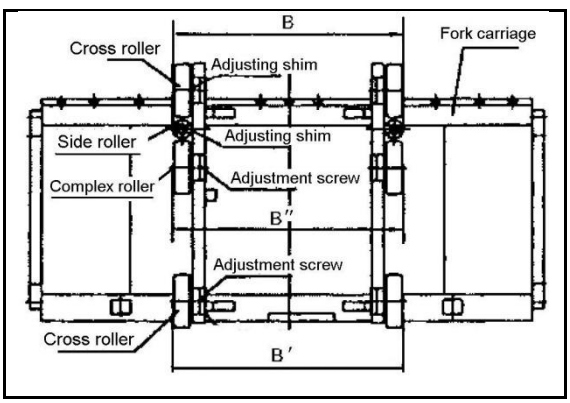
c） Calculate the difference values between A and B, A and B′, A and B" respectively. Each difference value is the clearance between the roller and inner mast channel.

Evenly adjust the washers of each side roller on left and right. Adjust the clearance to the following range.

A-B = 0.2 mm～1mm

A-B' = 0.1mm～0.8mm

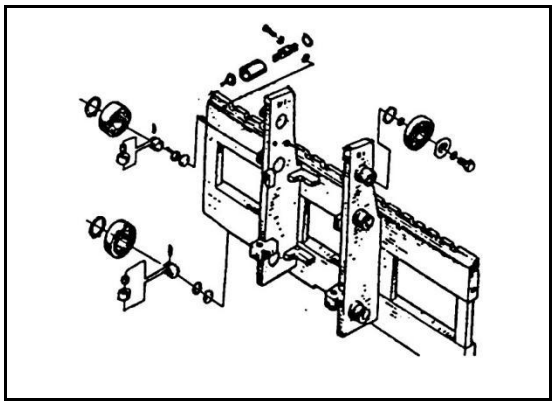
A-B" = 0.1mm～0.8mm



Thin adjusting washer：0.5mm、1mm.

a） Use equal quantity of washers on left and right sides.

b） After the clearance is set. Slide the fork carriage on the inner mast upward and downward. Check if it is smoothly operated.



6.6 Disassembly and installation of lifting cylinder

Warning

- **Keep body away from equipment.**

6.6.1 Dismantle lifting cylinder from truck

a） Shut down the engine to make lifting cylinder drop to the lowest condition (piston dropped to the cylinder bottom) and get oil flow back to tank completely.

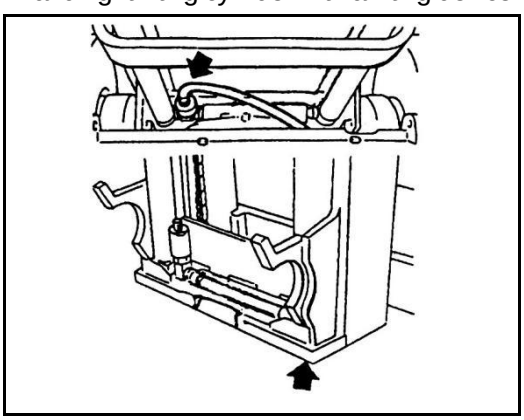
b） Unscrew piston rod and bolt.

c） Disconnect circle oil pipe, remove high pressure tubes.

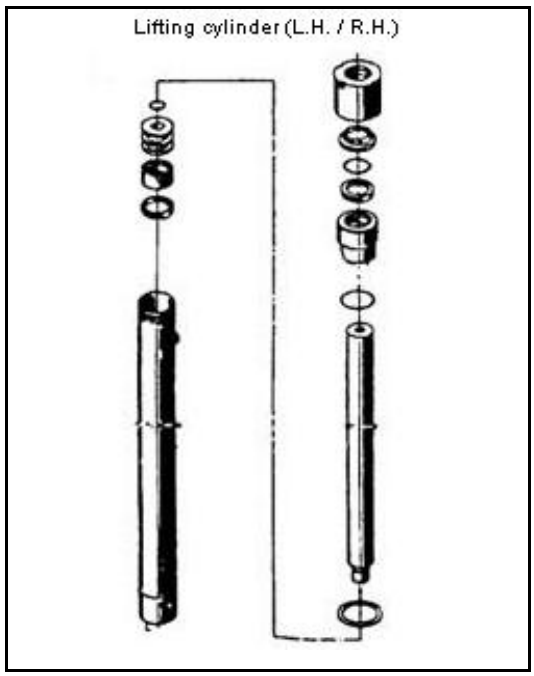
d） Remove U-bolt of outer mast fixation board and tighten skew of other side.

e） Remove chain of outer mast.

f） Attach wire rope to inner mast and remove left and right lifting cylinder with a lifting device.



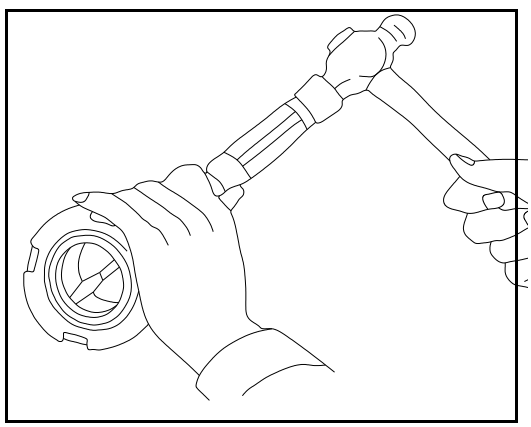
6.6.2 Disassembly of lifting cylinder

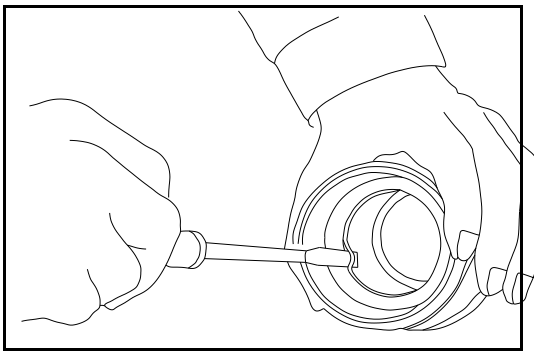


a） Removes tighten skew and nylon stopper, then remove cylinder head.

b） Remove dust ring.

c） Remove Y-ring with screwdriver.





Caution

- **Never reuse removed dust gasket ring, O-ring, Y-ring, must replace.**

d） Draw out piston rod, remove Y-ring from end of piston

Install and replace faulty parts

a） Cleanup parts with clean oil before installation

b） Then cleanup guiding bush and piston with hydraulic pressure oil the same as oil box trademark.

c） Dust or dunghill doesn't drop into lifting cylinder.

d） The order of installation is reverse the order of disassembly.

e） Install Y-ring on piston.

f） Install piston rod assembly into clean cylinder body.

Caution

- **The end of cylinder body must slick and clean, installation must set center, avoid scratching Y-ring.**

g） Install replaced dust ring and Y-ring in guiding bush and cylinder head.

Caution

- **Apply hydraulic pressure grease which trademark is the same with tank on guide sleeve installed gasket ring.**

h） Rip cylinder head into piston rod, screw down cylinder body.

6.7 Disassembly and installation of tilting cylinder

Warning

Pay attention to the following proceedings when removing cylinder：

- **Attach wire rope to outer mast, avoid mast fall down after removing tilting cylinder.**
- **Keep body away from equipment, no standing under the fork arm carrier.**

6.7.1 Dismantle tilting cylinder from truck

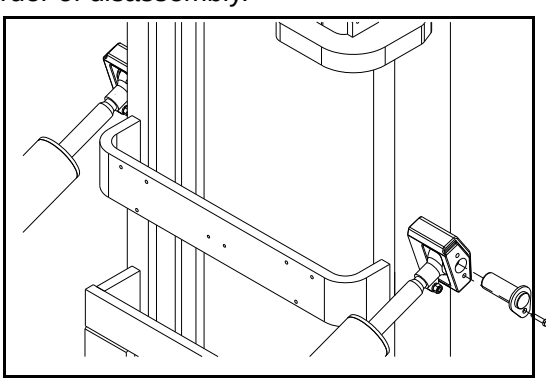
a） Lay down fork carriage completely.

b） Remove bolt on the left and right bracket from outer mast, moreover pull axis pin out.

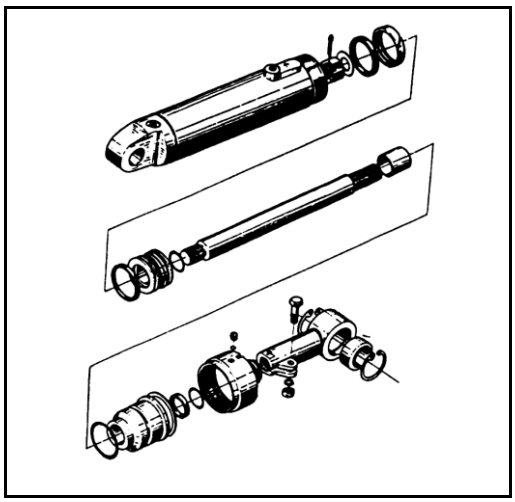
c） Remove oil pipe from the inlet of tilting cylinder.

d） Remove bolt from the bracket of chassis, and pull axle pin out, then move tilting cylinder.

The order of installation is reverse the order of disassembly.



6.7.2 Disassembly of tilting cylinder



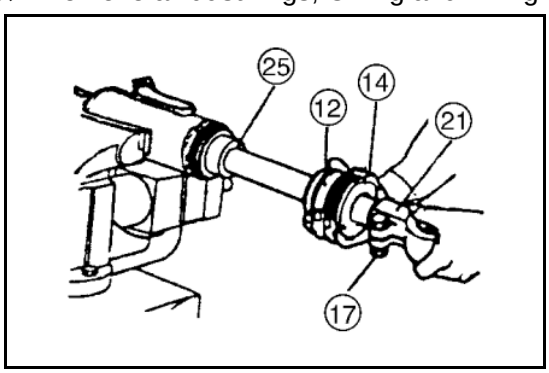
a） Clamp the tilting cylinder with pliers, then pull piston rod come-and-go as opening of inlet and outlet on the tilting cylinder, so remaining oil is discharged from tilting cylinder.

b） Screw earring bolts 2 loosely, and screw earring 1 out.

c） Remove guiding bush 3

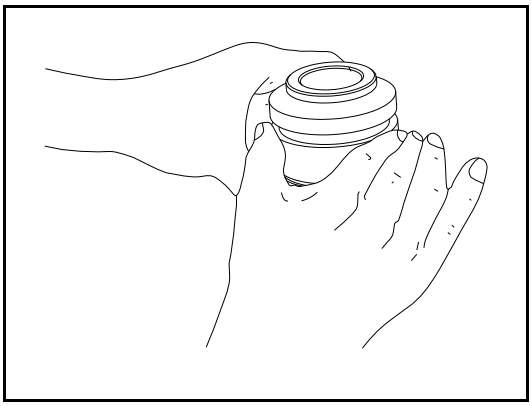
d） Draw out piston rod assembly 4 (see as follows)

e） Remove all dust rings, O-ring and Y-ring.



f） Remove dust gasket ring in the cylinder head. Means is the same as removal of dust gasket ring in the cylinder head of lifting cylinder (see disassembly and installation of lifting cylinder).

g） Remove O-ring from the outer ring of the guide sleeve.



h） Remove O-ring and Y-ring from the inner hole of guide sleeve (see disassembly and installation of lifting cylinder fig.).

Caution

- **Never use the dismantled dust ring and Y-ring**

Install tilting cylinder after replacing ring

The order of installation is reverse to the order of disassembly, but should notice follow proceedings:

a） Lubricate parts with clean hydraulic pressure oil.

b） Avoid dust and oil dirty dropping into tilting cylinder.

c） Avoid scratching the end of cylinder body, and inlet and outlet for oil.

d） Push piston rod to cylinder body when setting center, especially avoid scratching Y-ring.

e） Apply the same brand hydraulic oil as work oil to lubricate among seals.

f） Don’t scratch O-ring outside in the guiding bush when installing.

g） Remember to install nylon stopper and tighten screw after screw cylinder head.

6.8 Noticing proceeding of debugging

Adjust forward and backward of the mast

Park forklift truck on the level ground, operate control lever to realize that mast inclined forward or backward extremely. As assembly debugging data required, adjust combined screw thread length till meet data of backward. Then lock earring ring.

Readjust installation position of left and right lifting cylinder

a） Adjust washer in the middle of piston rod and inner mast bracket if one lifting cylinder is not synchronization with the others when rising or falling, and if one lifting cylinder is different height from the others.

b） Loose two nuts on the U-bolts. Lift or lower the mast for several times until relative position of U-bolt and lifting jack is suitable. Then screw down nuts and tightening screw on the U-bolt. Thus lifting cylinder can be used longer and wear of piston rod can be reduced.

Tightening torque

Please refer to our company regulated bolt tightening torque if you want know tightening force of bolt or screw.（refer to Operation and Maintenance Manual）.

7. Electrical system

The parts involving high voltage are maintained by trained professional after-sales personnel. For details of the high voltage parts, please refer to the operation and maintenance manual 1.2.

7.1 Special safety rules for high-voltage electric forklift

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

--Safety precautions for high voltage;

---Safe operating procedures.

WARNING

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

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

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

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

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

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

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

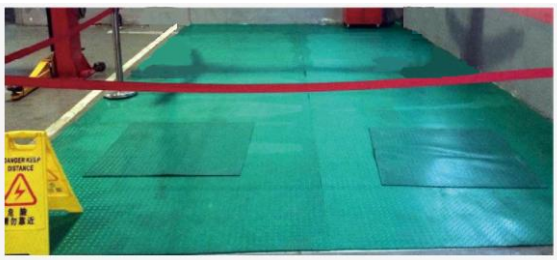
6.First confirm that there is no water (water accumulation, water droplets) in the ground and vehicle body. It is not allowed to work in a humid environment. Never perform high-voltage work when hands are wet, and do not work with wet high voltage parts. When the ground or surrounding humidity is too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

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

7.2 Enpower Controller

7.2.1 Overview

The MC3902 series motor controller is a motor controller used in high-speed electric passenger vehicles and industrial vehicles. Its main application object is pure electric forklifts. This series of controllers uses the international advanced brand single-tube IGBT as the power device, which is suitable for 200-500V permanent magnet synchronous drive system.

Features

1）Advanced multi-layer laminated busbar technology;

2）Multi-tube IGBT dynamic and static current sharing technology;

3）IGBT and bus capacitance are highly integrated;

4）IGBT multi-level overcurrent protection design;

5）Advanced vector control algorithm to achieve high-precision control of speed and torque;

6）Advanced heat dissipation bridge tube technology effectively reduces the IGBT junction temperature;

7 ） Advanced IGBT temperature detection technology effectively realizes rapid over-temperature energy protection;

7.2.2 Controller fault code

BMS related monitoring information and fault codes.

Fault code	Fault description	Possible reasons (remarks)
E1:01	Discharge temperature difference high	/
E1:02	Discharge overtemp	/
E1:03	Discharge severe overtemp	/
E1:04	Discharge temperature low	/
E1:05	Discharge temperature severe low	/
E1:06	Discharge cell voltage high	/
E1:07	Discharge cell voltage severe high	/
E1:08	Regen current high	/
E1:09	Discharge current high	/
E1:10	Discharge current severe high	/
E1:11	Discharge cell voltage low	/
E1:12	Discharge cell voltage severe low	/
E1:13	Battery voltage high	/
E1:14	Battery voltage severe high	/
E1:15	Battery voltage low	/

E1:16	Battery voltage severe low	/
E1:17	Cell voltage difference high	/
E1:18	SOC low	/
E1:19	Charge positive contactor welded	/
E1:20	Discharge positive contactor welded	/
E1:21	Discharge negative contactor welded	/
E1:22	High voltage interlock fault	/
E1:23	Communication fault	/
E1:24	Charge heat contactor fault	/
E1:25	Discharge heat contactor fault	/
E1:26	Voltage cable falls off	/
E1:27	Temperature cable falls off	/
E1:28	Current cable falls off	/
E1:29	Inner communication fault	/
E1:30	Insulation fault	/
E1:31	Charge overtemp	/
E1:32	Charge temperature low	/
E1:33	Charge overcurrent	/
E1:34	Charge temperature difference high	/
E1:35	Charge voltage difference high	/
E1:36	Charge cell voltage low	/
E1:37	Charge cell voltage high	/
E1:38	Charge socket overtempt	/
E1:39	Charge socket severe overtempt	/
E1:40	Supply voltage unusual	/
E1:41	Heating：remaining X minutes	6S When the secondary interface is displayed: press any key to eliminate 6S
E1:42	Battery low can not heat：please charge	6S When the secondary interface is displayed: press any key to eliminate 6S

DC-DC related monitoring information and fault code

Fault code	Fault description	Possible reasons (remarks)
E2:01	DCDC overtempt	1、Check the heat dissipation waterway and troubleshoot (the working status of the water pump, waterway, fan, water level, wiring, etc.); 2、Avoid long-term overload status of driving DCDC; 3、After the system cools down, power on again
E2:02	DCDC severe overtempt	1、Check the wiring harness and plug-in; 2、Power on again; 3、If the fault is still reported after multiple restarts, the controller needs to be replaced;
E2:03	DCDC input voltage low	1、Check whether the battery system is under-voltage, if under-voltage, use it after charging; 2、Power on again; 3、If the fault is still reported after multiple restarts, the controller needs to be replaced;
E2:04	DCDC input voltage high	1、Check whether the battery system is over-voltage, if it is over-voltage, use it after charging; 2、Power on again; 3、If the fault is still reported after multiple restarts, the controller needs to be replaced;
E2:05	DCDC output voltage low	1、Check whether the battery system is under-voltage, if under-voltage, use it after charging; 2、Power on again; 3、If the fault is still reported after multiple restarts, the controller needs to be replaced;
E2:06	DCDC output voltage high	1、Check whether the battery is over-voltage, if it is over-voltage, use it after maintenance; 2、Power on again; 3、If the fault is still reported after multiple restarts, the controller needs to be replaced;
E2:07	DCDC output current high	1、Power on again;

E2:08	DCDC output power over	2、If the fault is still reported after multiple restarts, the controller needs to be replaced;
E2:09	DCDC hardware fault	
E2:10	12V supply fault	1、Check whether the battery system is over-voltage or under-voltage, if it is over-voltage or under-voltage, use it after maintenance is normal; 2、Power on again; 3、If the fault is still reported after multiple restarts, the controller needs to be replaced
E2:11	DCDC awake up missing fault	1、Check the hard-wire wake-up or NW wake-up line; 2、Power on again;
E2:12	CAN Busoff	1、Check the wiring harness and plug-in; 2、Power on again; 3、If the fault is still reported after multiple restarts, the controller needs to be replaced;
E2:13	Communication with VCU Timeout	
E2:14	DCDC output hardware overvoltage	1、Power on again; 2、If the fault is still reported after multiple restarts, the controller needs to be replaced;
E2:15	DCDC output hardware open	1、Check whether the battery system is under-voltage, if under-voltage, use it after charging; 2、Power on again;
E2:16	DCDC output hardware short	1、Check the wiring harness and plug-in; 2、Power on again; 3、If the fault is still reported after multiple restarts, the controller needs to be replaced;

Traction MCU fault code

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

E3：13	Motor overspeed	
E3：14	Motor stall	
E3：15	Torque check error	1、Check the wiring harness and plug-in; 2、Power on again; 3、If the fault is still reported after multiple restarts, the controller needs to be replaced;
E3:45	MCU undervoltage warning	
E3:46	MCU overvoltage warning	
E3:47	MCU overtempt warning	1、Check the heat dissipation waterway and troubleshoot (the working status of the water pump, waterway, fan, water level, wiring, etc.); 2、Avoid long-term overload conditions of the drive motor system (including long-term climbing and frequent acceleration and deceleration, etc.); 3、After the system cools down, power on again.
E3:48	Motor overtempt warning	

Oil pump MCU fault code

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

		level, wiring, etc.); 2、Avoid long-term overload conditions of the drive motor system (including long-term climbing and frequent acceleration and deceleration, etc.); 3、After the system cools down, power on again.
E4：12	Software overcurrent	1、Power on again;
E4：13	Motor overspeed	
E4：14	Motor stall	
E4：15	Torque check error	1、Check the wiring harness and plug-in; 2、Power on again; 3、If the fault is still reported after multiple restarts, the controller needs to be replaced;
E4：16	Motor temperature sensor error	
E4：17	MCU temperature sensor error	
E4：45	MCU undervoltage warning	1、Check whether the battery system is over-voltage, if it is over-voltage, please do the battery maintenance before use; 2、Power on again; 3、Non-battery system problem, the fault is still reported after multiple restarts, the controller needs to be replaced
E4：46	MCU overvoltage warning	
E4：47	MCU overtempt warning	1、Check the heat dissipation waterway and troubleshoot (the working status of the water pump, waterway, fan, water level, wiring, etc.); 2、Avoid long-term overload conditions of the drive motor system (including long-term climbing and frequent acceleration and deceleration,
E4：48	Motor overtempt warning	

		etc.); 3、After the system cools down, power on again.

VCU related monitoring information and fault codes

Fault code	Fault description	Solution
E5：101	Communication with DCDC fault	1、Harness problem； 2、Low-voltage power supply problem； 3、Vehicle controller failure； 4、Communication interference.
E5：102	Communication with instrument fault	1、Harness problem； 2、Meter failure 3、CAN communication interference in the meter
E5：103	Communication with BMS fault	1、Harness problem； 2、BMS failure 3、Vehicle controller failure； 4、Communication interference
E5：104	Communication with Travel MCU fault	1、Harness problem. 2、MCU (traction) failure; 3、Vehicle controller failure； 4、Communication interference
E5：105	Communication with pump MCU fault	1、Harness problem. 2、MCU (oil pump) failure; 3、Vehicle controller failure； 4、Communication interference
E5：110	Communication with BMS fault severe	1、Harness problem. 2、BMS failure 3、Vehicle controller failure； 4、Communication interference
E5：111	Communication with Travel MCU fault severe	1、Harness problem. 2、MCU (traction) failure; 3、Vehicle controller failure； 4、Communication interference
E5:112	Communication with pump MCU fault severe	1、Harness problem. 2、MCU (oil pump) failure; 3、Vehicle controller failure； 4、Communication interference
E5:121	Forward switch & reverse switch active at the same time	1、Harness problem. 2、Direction switch problem
E5:122	Direction switch active before key on	1、Operation sequence problem; 2、Direction switch problem

E5:126	Throttle short or open	1、Harness problem； 2、Controller problem 3、Accelerator failure
E5:127	Throttle analog fault	1、Accelerator failure 2、Harness problem
E5:136	Acid battery voltage low	1、Battery problem 2、PDU problem
E5:137	Acid battery voltage unusual	1、Battery problem 2、PDU problem
E5:148	Pump switch active before key on	1、Operation sequence problem; 2、Harness problem；
E5:149	Water pump idle	
E5:150	Water pump over-current	
E5:151	Water pump voltage low	
E5:152	Water pump voltage high	
E5:153	Water pump stall	
E5:154	Water pump overtemp	

7.3 Lithium Battery Safety Operating Regulations

7.3.1 Safety precautions before maintenance

a） This battery runs with a maximum DC voltage of about 345V and there is a large current in operation. Its high-voltage connection line is orange and the high-voltage components have warning signs. The maintenance personnel must obtain the authorization of Hangcha Group; they must have the national special occupation certificate. In addition, the maintenance personnel must strictly follow the operating requirements to carry out standardized operations；

Warning sign

Orange high-voltage connection line

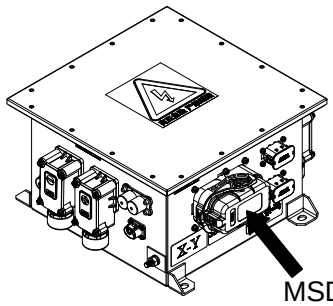
b） Before maintenance, a safety isolation area and warning signs should be set up to warn relevant personnel and avoid safety accidents.

Safe isolation area

c） Before repairing the battery pack, you must wear insulating protective equipment as gloves, shoes, goggles, etc.

d） It is strictly forbidden to wear metal decorations such as bracelets and rings during maintenance; 5) Before repairing the battery pack, make sure that all interfaces of the vehicle have been disconnected from the external high-voltage power supply;

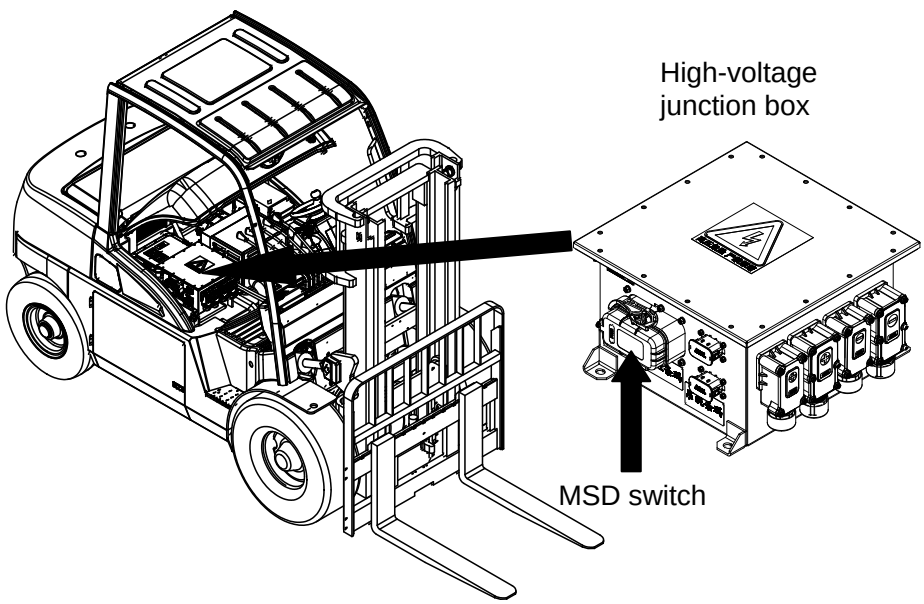
e） Before repairing the battery pack, turn off the key switch and remove the MSD maintenance switch (see 5.6 MSD Use for details), and be sure to disconnect the high-voltage power battery power supply to prevent short circuit;



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

7.3.2 MSD use: open and close

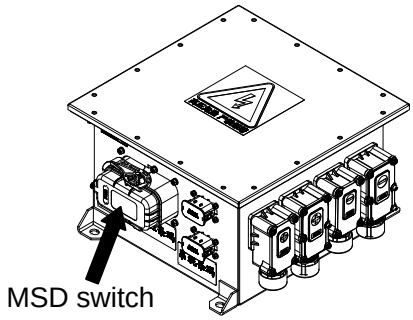
a） The MSD switch is installed on the high-voltage junction box. The high-voltage junction box is located on the right side of the body under the hood. Open the hood to see the position of the MSD maintenance switch.



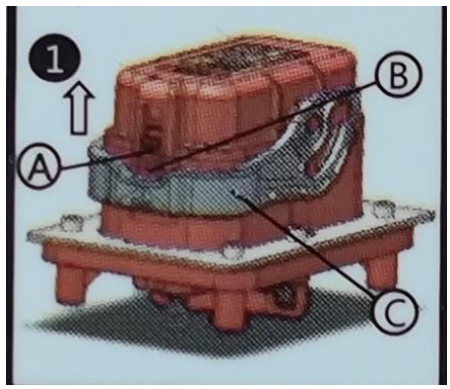
b） The maintenance disconnect device (MSD) is used to cut off the high voltage circuit, that is, cut off the high voltage between the battery and the whole machine, when the vehicle is maintained, inspected, repaired, or other emergency situations (such as electric shock, rain, flooding etc.), please cut off.

c） MSD cut-off step

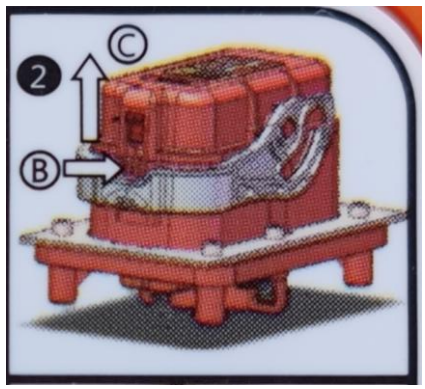
The following figure shows the status of the high voltage maintenance disconnect device (MSD) installed on the high voltage junction box:



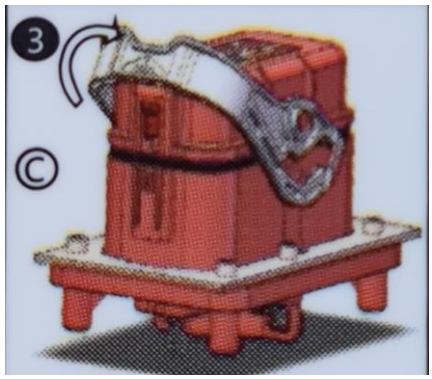
1）Pull out the locking terminal A of the MSD handle, as shown in the figure below.



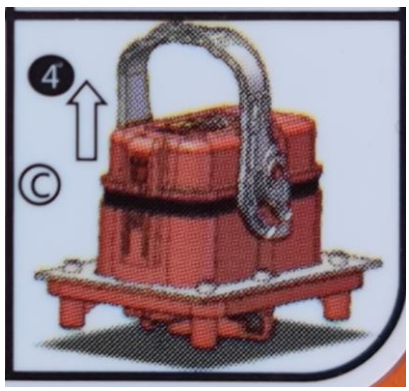
2）Press the clip B.



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



4）Pull out the MSD switch and wait for 15~20 minutes before the high-voltage system is powered off.



5）MSD installation can be done in sequence according to steps 4/3/2/1.

Warning

- **After removing the MSD device, stand for 15 minutes before performing high pressure operation.**

7.3.3 Safety precautions during maintenance

a） Identify the maintenance personnel of the high-voltage system and prevent other irrelevant personnel from touching the battery box during maintenance;

b） If the repair cannot be completed in a short time, the “High Voltage Danger” label should be pasted on the high voltage system components when not repairing;

c） If it is severely damaged, the power battery is deformed, broken or cracked, and the power battery cannot be touched without wearing insulating protective equipment;

d） After disconnecting the high-voltage components, immediately wrap the exposed ports of the copper bars and the exposed ports of the high-voltage components with electrical insulating cloth, and do the insulation treatment;

e） Keep the power battery box clean and dry during maintenance. Mark the disassembled parts so that the installation is accurate and correct;

f） Be sure to follow the correct steps to disassemble the power battery box, and the disassembled components must be properly kept in a dedicated area;

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

7.3.4 Installation safety precautions

a） When installing, strictly follow the order;

b） Before connecting the positive and negative output copper bars of the battery, check repeatedly to ensure that it is correct;

c） The wiring harness connectors and bolts should be checked that they are installed in place, and the bolts should be tightened according to the specified torque and marked with tightening;

d） After confirming that all the high and low voltage connectors of the power battery box are connected correctly, then they can be connected and powered on;

e） After installation and inspection, connect the diagnostic instrument (host computer) to check whether the parameter information of the battery pack is normal.

Warning

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

7.3.5 First aid for high-voltage accident

1）First aid measures for electric shock accident

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

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

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

2）First aid measures for high-voltage battery accidents

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

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

②Disconnect the maintenance switch;

③Look for fire extinguishers nearby (dry powder fire extinguishers should be used, and water-based fire extinguishers should not be used);

④If the vehicle catches fire, the fire is small and slow, please use a dry powder fire extinguisher to extinguish the fire, and call for help immediately;

If the fire is large and develops rapidly, please stay away from the vehicle immediately and call the fire telephone to wait for rescue;

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

②Disconnect the maintenance switch;

③When a small amount of leakage occurs, please stay away from fire, use absorbent cloth to absorb and place in a closed container, or dispose of by incineration. Please wear acid and alkali-proof gloves before operation;

④When a large amount of leakage occurs, please collect them and treat them in accordance with hazardous chemicals. Add calcium gluconate solution to treat the generated gas;

⑤When the human body accidentally touches the leaked liquid, rinse immediately with plenty of water (10-15) min. If there is pain, coat with 2.5% calcium gluconate ointment, or soak with 2%-2.5% calcium gluconate solution for pain relief, if there is no improvement or uncomfortable symptoms, please seek medical attention immediately.

7.4 Control box assembly

Fuse disassemble

1）Turn key switch to "OFF";

2）Press lock buckle on control box, and open the cover;

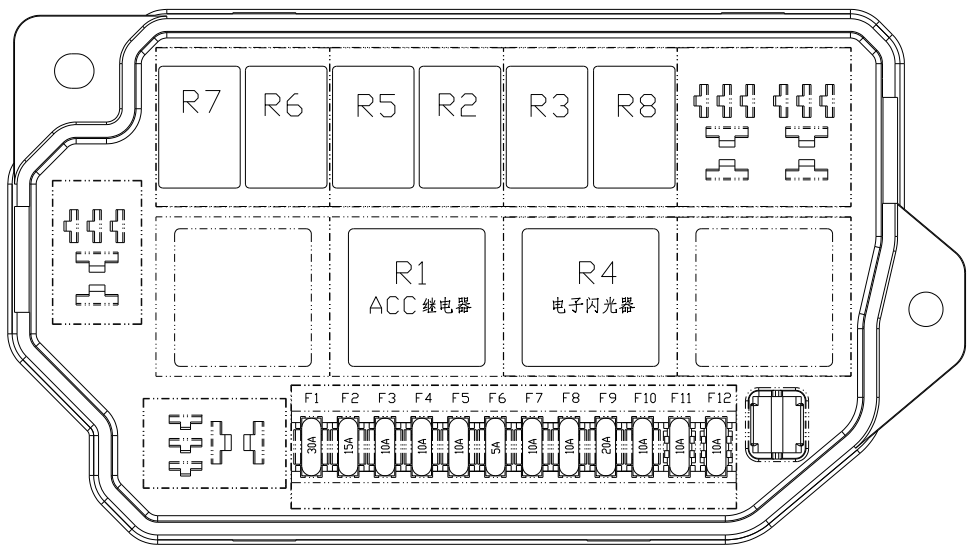
3）Remove fuse from box;

Explanation

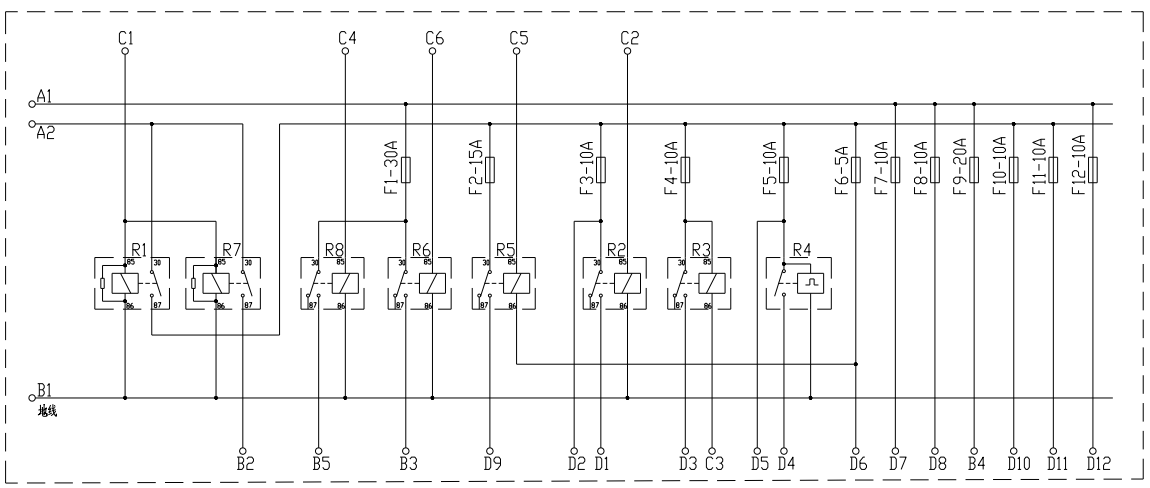
If fuse or relay is broken, replace with new one, the schematic is as follows (see the inside of the forklift control box for details):

①If fuse is damaged, be sure to eliminate cause of problem before installing new fuses;

②Never use fuse higher than specified rating.



Schematic diagram of control box：



Control box plug pin function details

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

Fusible links

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

Caution

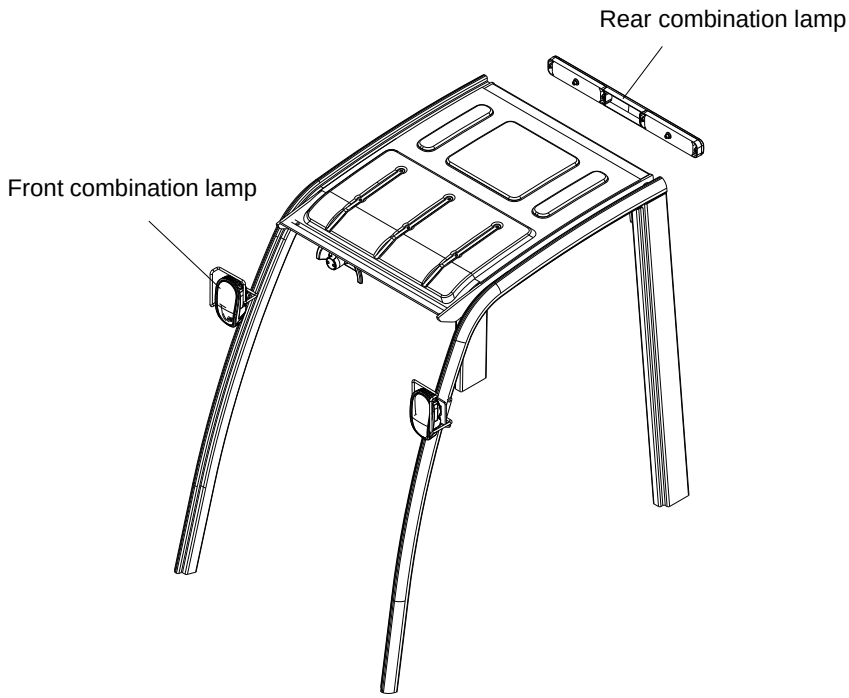
- **If fusible links is melted, maybe because of short circuit(power or current is too high). No matter which reason, please check and eliminate fault.**
- **Fusible links can cause heat, do not enlace with adhesive tape. Do not put fusible links near other rubber or wiring assembly.**

7.5 Lighting System

Bulb Specifications

Lamp	W
Front combination lamp	
Headlamp	10.08W-10.26W
Steering lamp	2W
Width lamp	2W
Rear combination lamp	
Brake and width lamp	12V-24V 1.6w
Steering lamp	
Reverse lamp	
Rear headlamp	36V-1.5W
Caution light	9V-80V (At 12V <1A, the current decreases as the voltage increases)

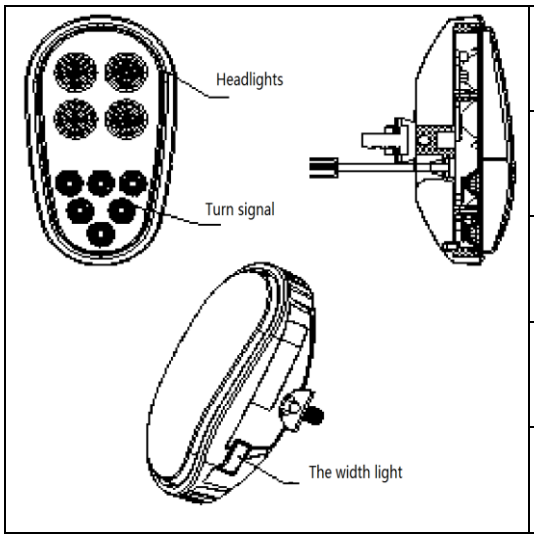
Location of light



Front combination lamp

Removal and installation

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



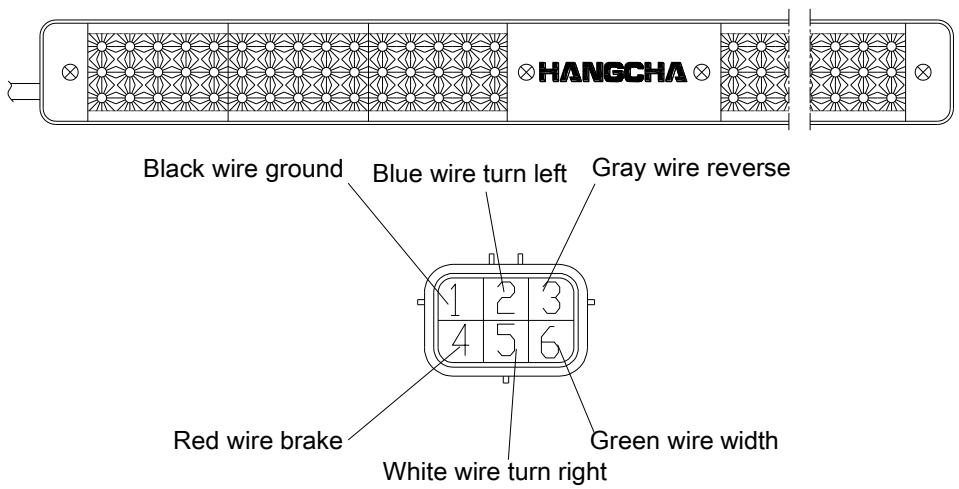
Wire Color	Function
Red	Headlamp
Yellow	Turn signal lamp
Black	Width lamp
Green	Width lamp

Rear combination lamp

Removal and installation

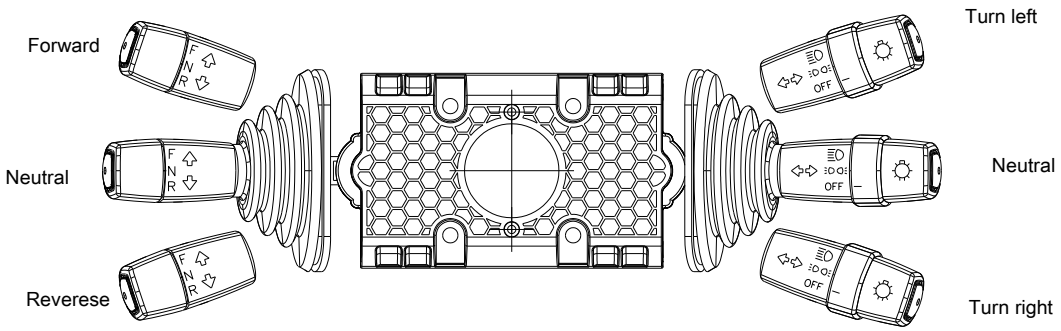
1. Remove fixing bolt of bracket. 2.Disconnect the wiring connector.

3. Replace faulty bulb with new one. 4. Assembly is the opposite procedures.



7.6 Switch

Combination switch



Direction switch

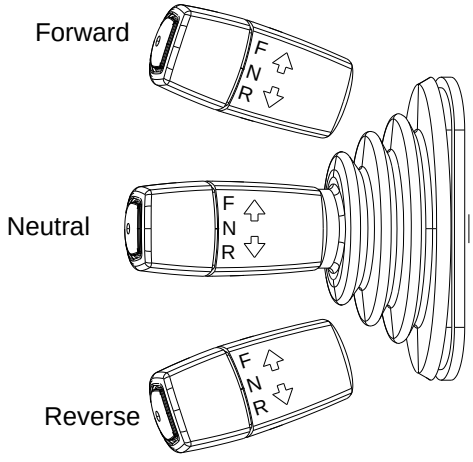
Removal

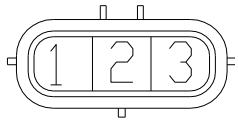
1. Remove combination meter;
2. Screw off bolt, disconnect connector of wiring;
3. To install, reverse removal procedures.

Inspect direction switch

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

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





Hole site / Wire color	1	2	3
Color	Blue	Green	Yellow and Green
Power / Position	60W	60W	60W
Forward	○		○
Neutral			○
Reverse		○	○

Turn signal lamp switch

Removal

1.Remove assembled instrument.

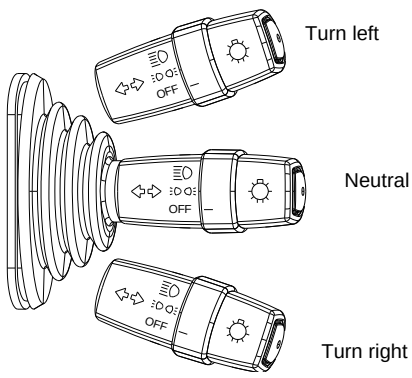
2.Remove bolt, and disconnect wiring terminal

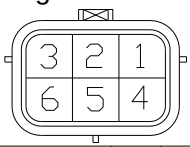
3.Fixing sequence is opposite to removing sequence.

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

Check

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





position	1	2	3
Color	White green	Blue	White
Handle position / Power	60W	60W	60W
Turn left	○	○	
Neutral	○		
Turn right	○		○

Headlamp switch

Removal

1.Remove assembled instrument.

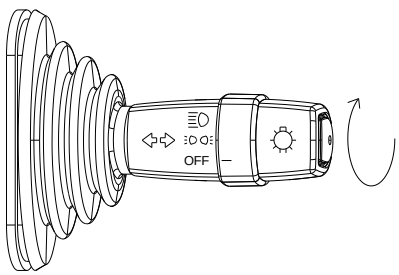
2.Remove bolt, disconnect wiring terminal

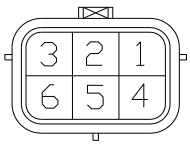
3.Fixing sequence is opposite to removing sequence.

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

Check

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





position	4	5	6
Color	White Black	Green	Blue-black
Handle position / Power	60W	60W	60W
OFF	○		
–	○	○	
≡○	○	○	○

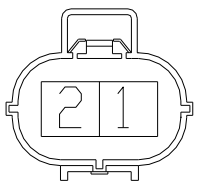
Horn switch

1.Remove the combination switch.

2.Unscrew the screw and disconnect the wiring connector.

3.The installation sequence is opposite to the removal sequence.

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



Sheath hole position	1	2
Color / Handle Power position	Green-blue	black
	60W	60W
Horn	○———	———○

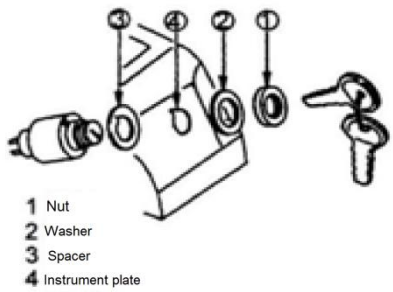
Key (start) switch

（1）Remove combination meter.

（2）Disconnect connector of wiring.

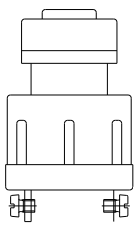
（3）Remove nut, washer, spacer and instrument plate.

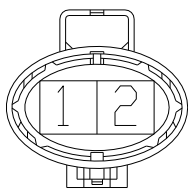
（4）To install, reverse removal procedures. Adjust ledge of switch to proper length when installing.



Inspect

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

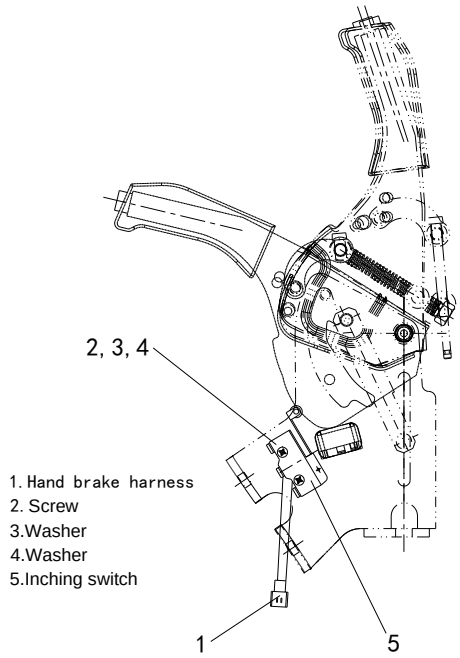




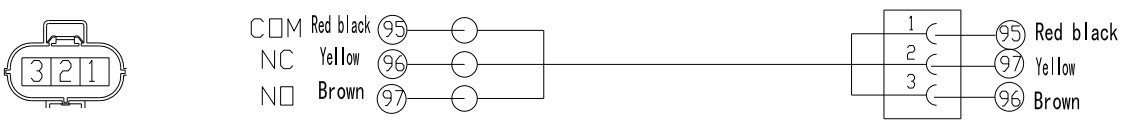
Terminal / Position		
	○	
	○	———○

Hand brake switch

1)Remove hand brake.
2) Disconnect connector of wiring.
3) Remove screws and washers.
4) To install, reverse removal procedures.
Adjust ledge of switch to proper length when installing.



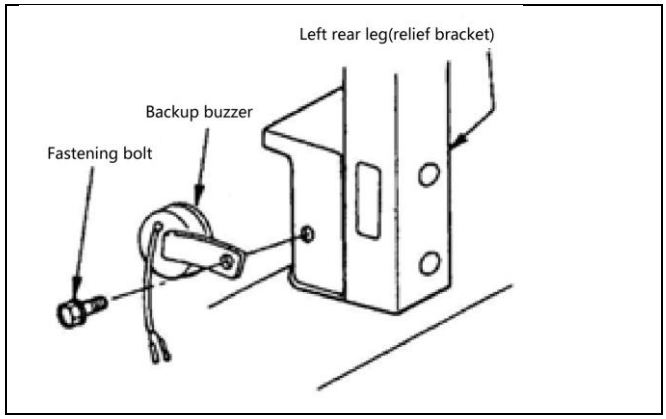
Hand brake wiring harness



Back-up buzzer

Disassembly and assembly

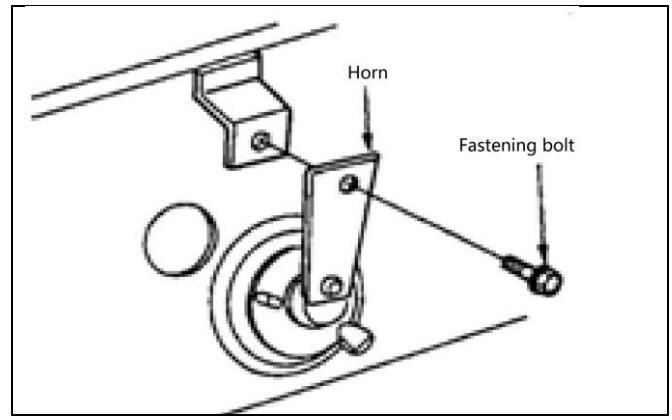
1.Disconnect connector of wiring and remove bolts.
2.To install, reverse removal procedures.



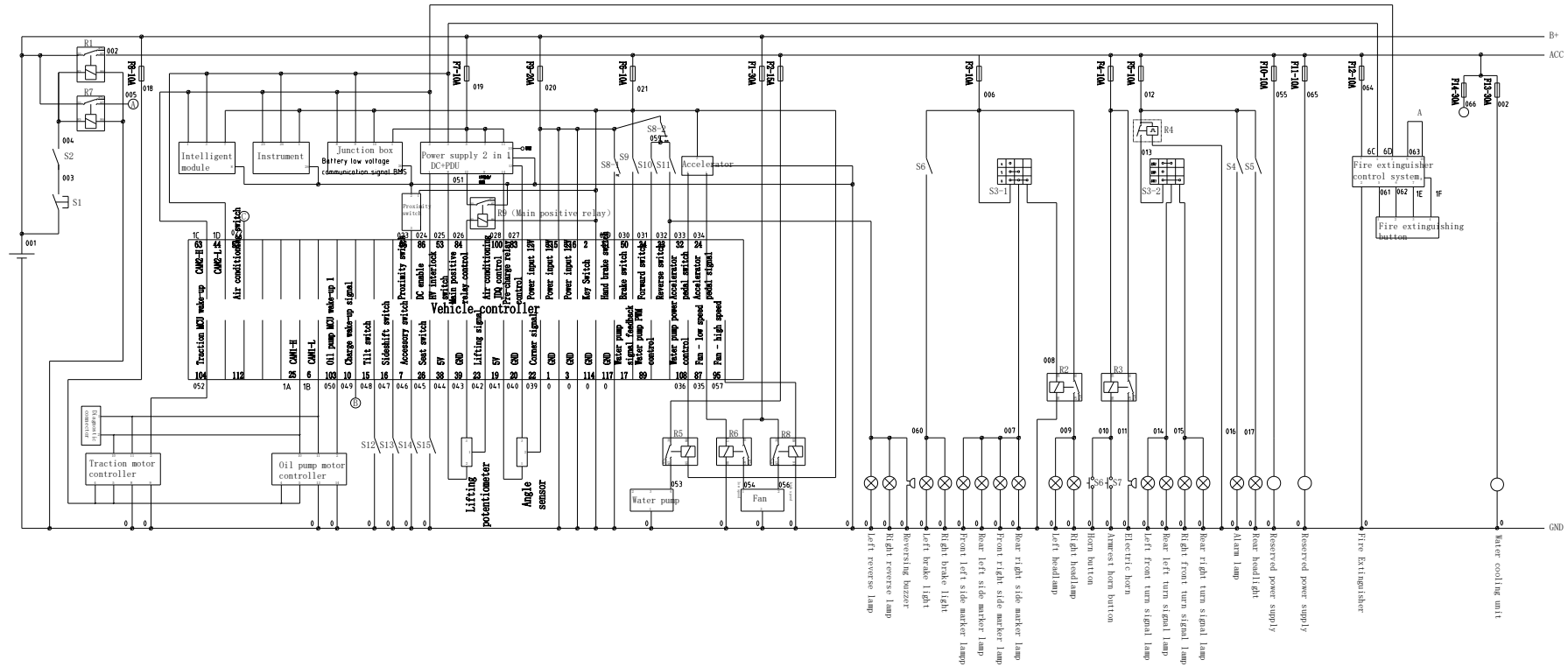
Horn

Disassembly and assembly

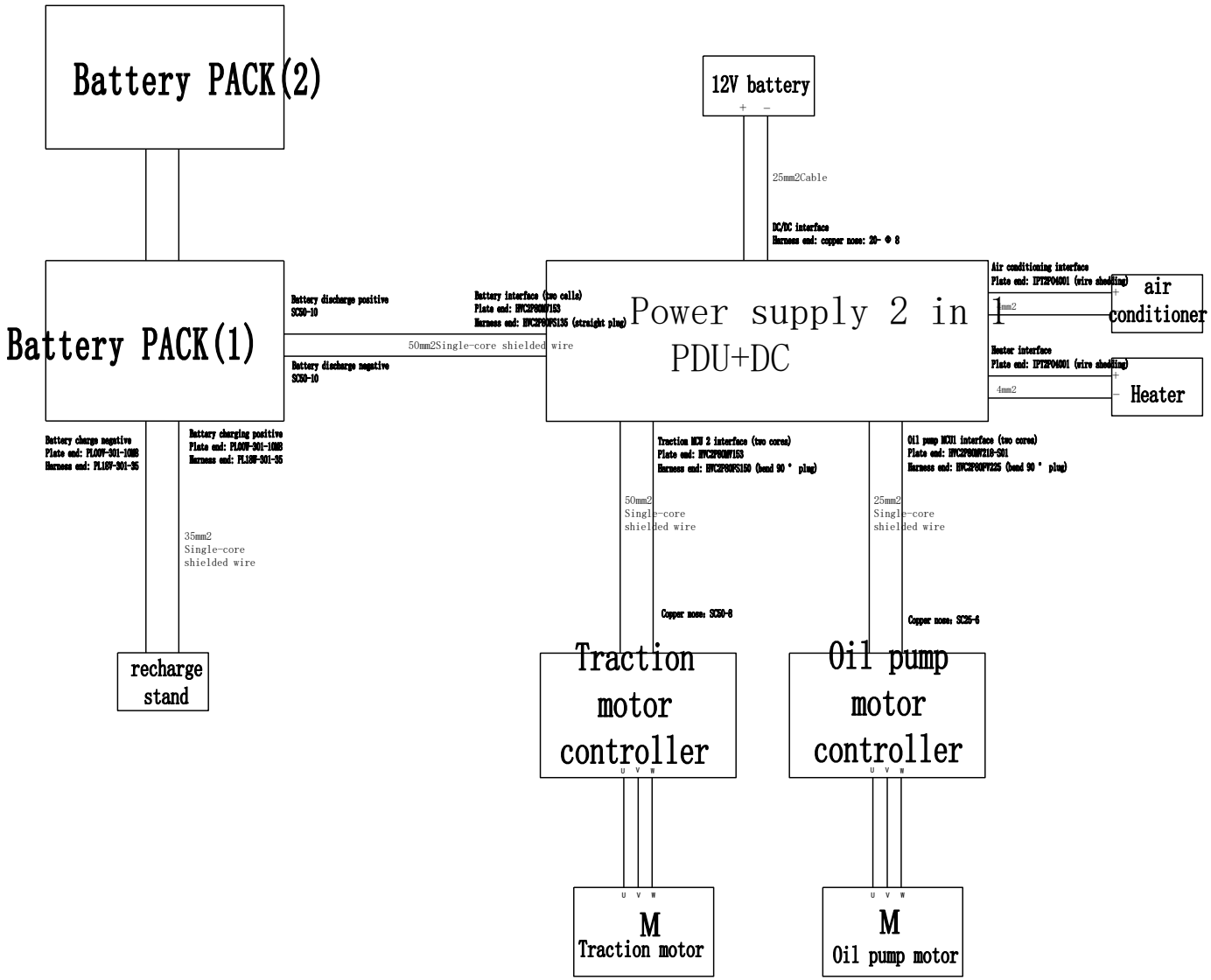
1. Remove the connector of the horn cable
2. Remove bolt and horn.
3. To install, reverse removal procedures.



7.7 Electrical system principle diagram



CPD40/45/50-XHY2G-W、CPD50-XHXY2G-W Electrical schematic diagram



CPD40/45/50-XHY2G-W、CPD50-XHXY2G-W High voltage schematic diagram

Revision Table

Revision	Version no.	Date	Note
00	SM23-XHW01	02/2023	Original

Maintenance record

Date	Maintain content	Maintainer

杭叉集团股份有限公司

HANGCHA GROUP CO., LTD.

全国客服热线：400-884-7888

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

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