SERVICE MANUAL

Starke Energy Series

FBT20PSX

STARKE MATERIAL HANDLING GROUP
402 Allanburg Road • Thorold, ON L2V 1A4 • Canada
TOLL FREE 877-435-4352
www.starkeforklift.com • info@starkeforklift.com

STARKE ENERGY

wedge the wheels by wedge.

33) When the mast is tilted forth and back to the limiting position or the fork arms are lifted to the highest position, the lever shall be turned to the middle position immediately.
34) The pressure of safety valve has been adjusted appropriately before the forklift leaves factory. Users shall not modulate randomly because high pressure can damage hydraulic parts during the overload operation, or result in turnover accident.
35) On flat and tight ground, the maximum noise value outside the forklift is 80Db according to the testing method provided by EN2000－14－EC. However, as long as the alternation of road condition, the noise value will vibrate.
36) To satisfy the need of lifting over wide cargo, users can choose lengthen fork arms. Notice: the load capacity of lengthen fork arms shall conform to the specification of load curve strictly. Within load center specified, the load capacity is similar with standard fork arms. When the load center move forwards, do reduce the load. Raising or impact on goods is forbidden. Take care when driving and turning.
37) Below the clump weight of forklift there is tract bolt special for dragging forklift.
38) The driver shall be familiar and careful with the meaning and function of all kinds of nameplates on the forklift. After the extensive repair of forklift, it is necessary to check the integrity of nameplates.

6.Routine maintenance of forklift

The appropriate application of forklift lies in careful maintenance. The neglect of routine maintenance is possible to endanger personnel's life and damage property. For these reasons, the routine check is necessary. Abnormity shall be removed in time. Forklift with malfunctions shall not be used to ensure safety and lengthen the service life of forklift.

1) Requirement for routine maintenance
   a. Routine maintenance is carried out before and after the operation everyday.
   b. If abnormal conditions such as damage or failure are detected, report to personnel in charge of forklift management in time. Forklift shall not be used before repair.
   c. The routine maintenance is in charge of drivers and special personnel.
2) Content of routine maintenance
   a. Content of routine maintenance before every startup：
   b. Check the joint of storage battery in avoidance of looseness. Clean the sufficient storage battery. Open the key of electrical lock to check whether the voltage of battery is in allowed range.
   c. Raise the mast with empty load to the top position to check whether oil leakage happens to the raising oil cylinder and oil pipe. Check whether two chains moves smoothly and the roller in mast work well. Tilt the mast with empty load forth and back to check whether the two tilted oil cylinder is synchronous when the mast is tilted forth and back. Check whether oil leakage happens to the raising oil cylinder and oil pipe and whether the mast move in right way. If the rack and chain of mast is out of lubricant, add some lubricating grease.
   d. Start up the steering of forklift with empty load slowly to check whether the steering is normal; drive in director line and brake to check whether the braking is reliable. Watch the drive, steering and braking carefully to promise normal operation.
   e. If driving at night or in dark room, the lighting apparatus of forklift shall be complete. Light of site shall be enough and the road shall be clear.
   f. Content of maintenance after operation：
   g. Clean the surface of forklift and the storage battery. Check the joint of storage battery in avoidance of looseness.
   h. Check the tightness of wheel bolts.
   i. Check mast, oil cylinder, chain, brake and steering.
3) Charging of forklift
   a. The first charging of the batteries of forklift and supplementary charging shall strictly conform to the manual of battery.，
   b. As for the forklift with a nominal voltage of 24V, when the voltage indicated is 21V or the electrical

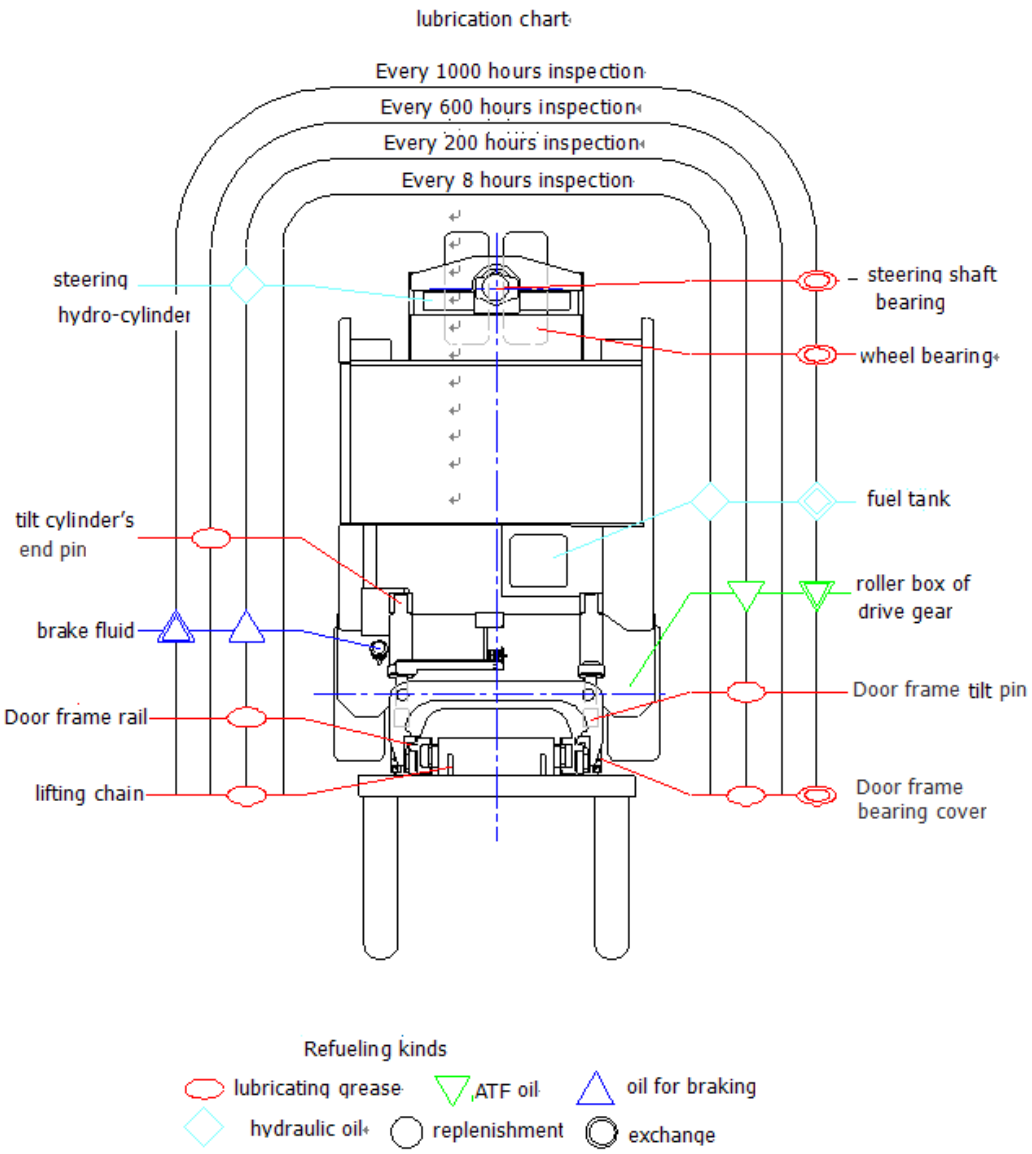
quantity is less than 30% or the voltage of single battery is reduced to 21V, charging shall be carried out. As for the forklift with a nominal voltage of 48V, when the voltage indicated is 40V or the electrical quantity is less than 30%, charging shall be carried out.

c. Selection of lubricating oil, grease and hydraulic oil for forklift

Name	Label, code		Quantity
	Home	Abroad	
Hydraulic oil	N32#orN46#	ISOVG30	26L
Gear oil	ATF		1.3L
Grease	3# Lithium and manufactured drop point170	JISK2220/2#	
Braking fluid	DOT3 synthetic brake fluid		1.5L

Note：Because the treatment of the waste produced by lubrication shall conform to related laws and regulation in different countries, the adding of oil and grease of forklift can referred to related standard of automobile.

7.Schematic drawing of lubrication position



III.Structure, principle, adjustment and maintenance of forklift.

1.Drive system

See the specific manual of the driving wheel

2.Steering system

2.1 Summarize

Steering system is mainly composed of steering wheel.Steering shaft.diverter.oil pump and steering axle.Steering shaft connects with diverter through cardan joint，connecting shaft connects with steering wheel through cardan joint，steering column can tilt to the proper location. (See figure 2.1),Steering axle is in the tailstock of the back of frame.hydro-cylinder promotes the gear rack moving in order to drive tooth sector ,which makes the forklift swerve.

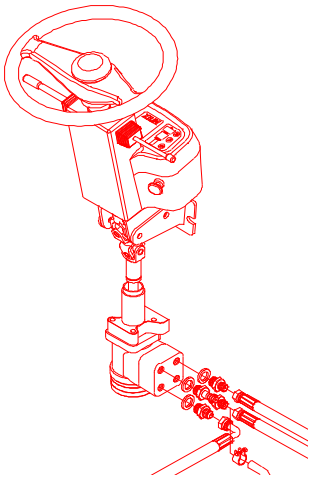


Figure2.1

2.2 Hydraulic steering gear

Hydraulic steering gear (figure 2—2)can deliver pressure oil to hydro-cylinder according to the steering wheel Angle measurement size .when the oil pump can not supply oil which can be instead of manual steering.

Diverter are composed of an common diverter and a combination valves , the hole of roof cover is system safety, besides there is a Two-way overload valve in valve body. It is has the function of protection the parts when the wheel by surprise external shocks as well as causes high pressure in .hydraulic system, The relief valve and two-way overload valve has adjusted by the manufacturer, users do not adjust at will.

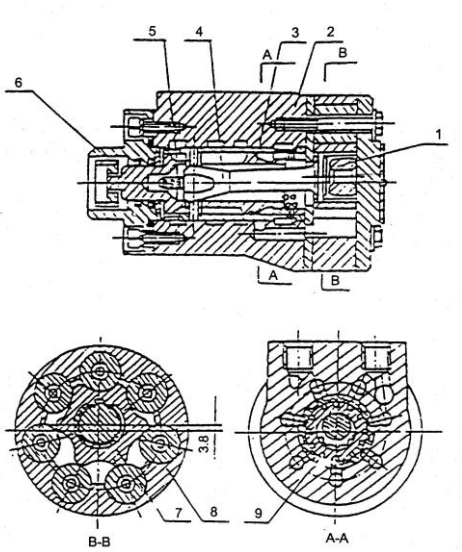


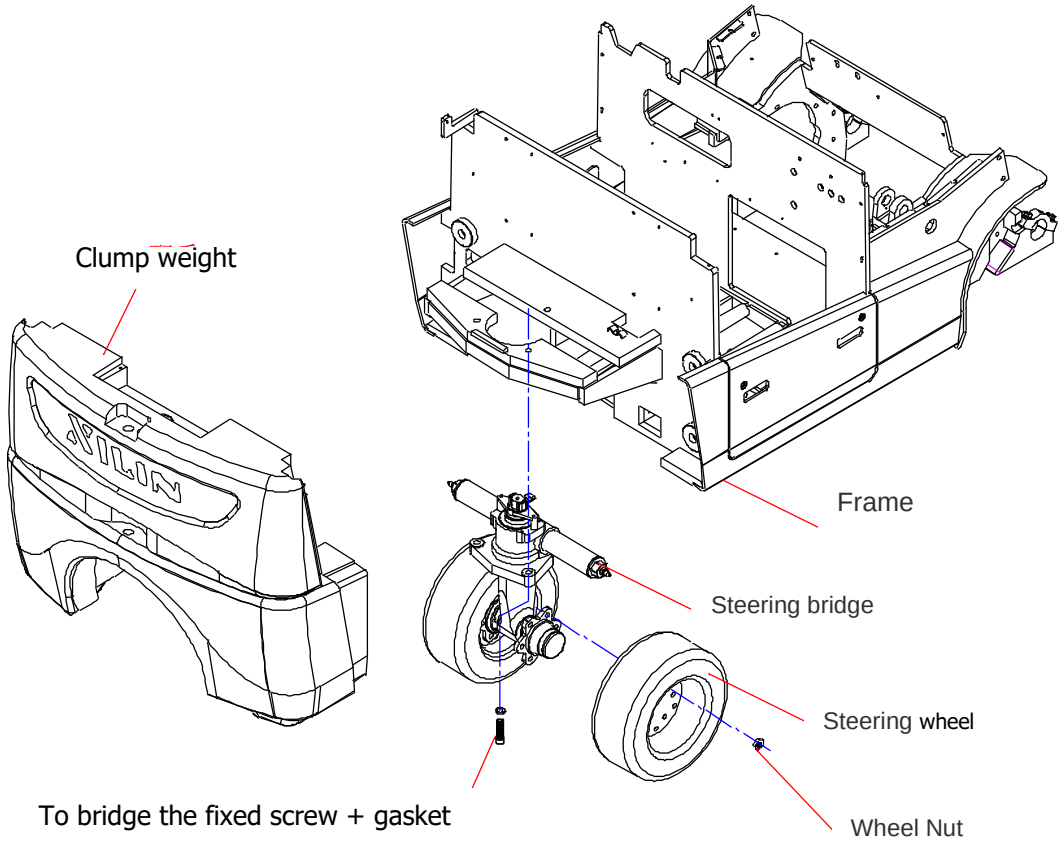
Figure 2-2 Hydraulic steering gear

1.limited post	2.valve body	3spool
4.linkage axle	5.spring lamination	6.contiguous block
7.Rotor	8.stator	9.Valve bush

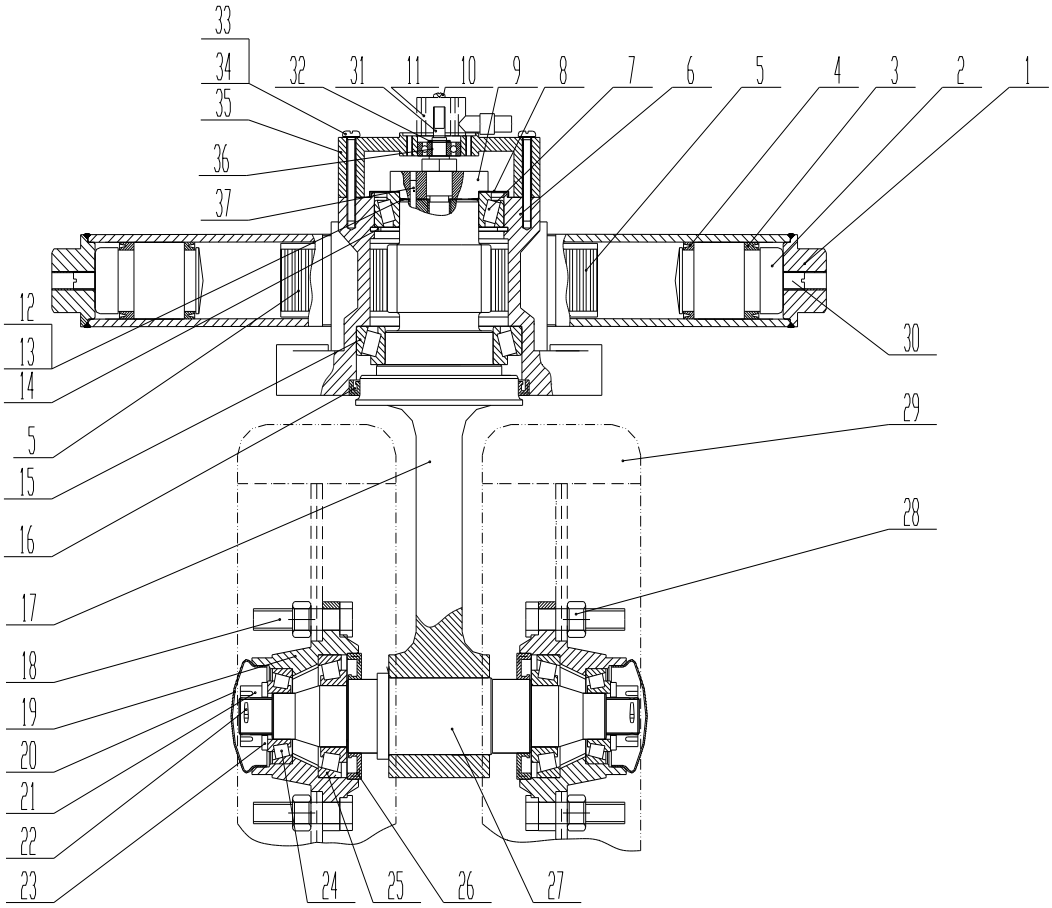
2.3. Steering bridge

The steering bridge is used to steer the vehicle and bear the weight of vehicle. The steering bridge of this vehicle is located at the end of forklift. The assembly of steering bridge and the whole vehicle shall follow the steps as:

a. When mounting and dismounting the steering bridge, hang up the end of forklift in advance. Then dismount the wheel of steering bridge and fit the steering bridge under the clump weight. Adjust the 3 mounting holes on the steering bridge body well with the 3 bolt holes on the clump weight, then fix it with 3 socket head cap screws and spring washers.
b. Mount the wheel on the wheel hub, and then fix it with blocking nut.
c. Connect the steering cylinder on both sides of steering bridge with hydraulic oil pipe.



2.3.1 Principle and construction of steering axle



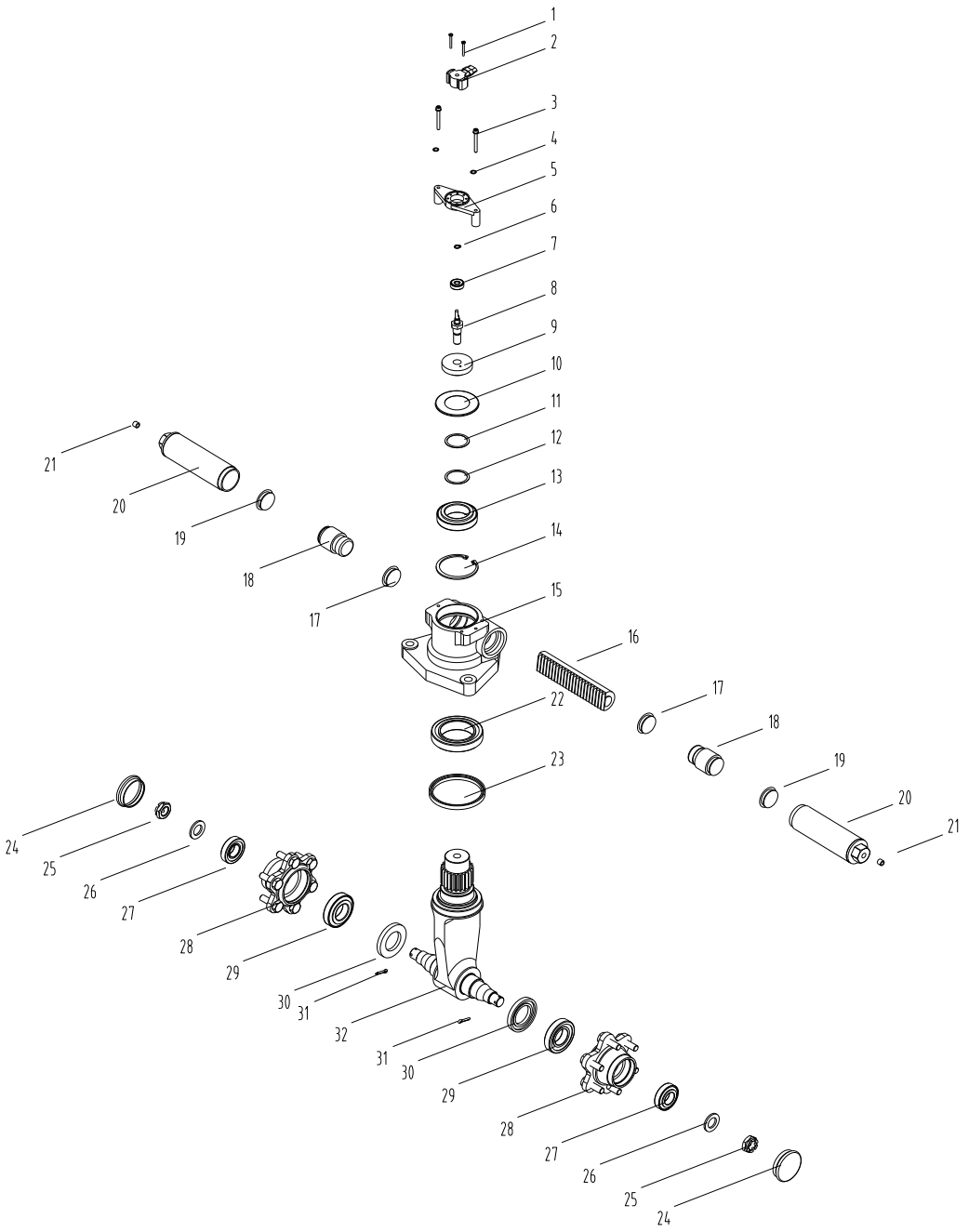
1. Cylinder assembly 2.Piston 3.UN40FSealing ring 40×50×10 4.Sealing ring 40×50×7.3
5. Gear rack 6. Steering gear box 7. Tapered roller bearing32011 (D class) 8. Dust ring 9. Pressing block 10. Cross recessed pan head screw 14×35 11. Potentiometer 12. Adjusting washer 1
13. Adjusting washer 2 14. Elastic washer for hole 15.Tapered roller bearing 32015 (D class)
16. Double-lip reinforced rubber oil seal 110-125-9 17. Gear shaft 18. T-shape screw for tyre
19. Wheel hub 20. Wheel hub cover 21. Hexagonal slotted thin nut m24×2 22.Split pin 5 ×40
23. Washer 24 24. Tapered roller bearing 30206 (D class) 25. Tapered roller bearing 30208 (D class)
26. Double-lip reinforced rubber oil seal 48-82-11 27. Steering wheel spindle 28. Tapering blocking nut for tyre M14
29.Steering wheel spindle 30.Fine adjustment plug screw 31. Connecting shaft of potentiometer
32.Elastic washer for shaft 33. Hexagon socket head cap screw M6×55 34. Spring washer 6
35.Potentiometer seat 36. deep groove balling bearing 6200(with dust ring) 37. Elastic cylinder shaft 4×18

- Principle of steering axle:

The hydraulic cylinder (1) is the driving force of the steering axle, which propels gear rack to drive gear shaft (17) to rotate. As a consequence, the steering wheel spindle would be driven to rotate around the center of gear shaft, thus rotation of steering wheel would be accomplished. Rotation angle of the steering wheel will be fed back to electric control of double electric machine by means of rotation angle potentiometer. The electric control would make electric machine rotating in different rotary speed in accordance with different rotation angle in order to achieve coordinated steering of vehicle.

- Construction of steering axle.

The steering axle mainly composed of cylinder assembly (20), gear rack (16), gear shaft (32), steering gear box (15), steering wheel hub (28), wheel hub cover (24), potentiometer (2), steering axle, steering wheel, bearing oil seal, and fasten pieces etc



1. Cross recessed pan head screw M4×35 2. Potentiometer 3.Hexagon socket head cap screwM6×55
4. Spring washer 6 5. Potentiometer seat 6. Elastic washer for shaft 10
7.Deep groove balling bearing 6200 8. Connecting shaft of potentiometer 9. Pressing block
10. Dust ring 11. Adjusting washer 1 12. Adjusting washer 2
13. Tapered roller bearing 32011 14. Elastic washer for hole 90 15. Steering gear box
16. Gear rack 17. UN40FSealing ring 40×50×10 18. Piston
19. Sealing ring 40×50×7.3 20. Cylinder assembly 21. Fine adjustment plug screw
22. Tapered roller bearing 32015 23. Double-lip reinforced rubber oil seal 110-125-9
24. wheel hub cover 25. Hexagonal slotted thin nut 26. Washer
27.Tapered roller bearing 30206 28. Wheel hub 29.Tapered roller bearing 30208
30. Double-lip reinforced rubber oil seal 48-82-11 31. Split pin 5×40 32.Gear rack

1) Points for attention for assemble of steering axle

During assemble of steering axle, lubricating grease shall be added onto the bearing. Quanta of grease shall be in appropriate amount to fill the roller track but shall not be too much. Clearance between the two tapered roller bearings (27 & 29) shall be adjusted to proper value. In adjustment, firstly press the nut to keep the bearing still, and then loosen it in reverse direction by 5 degree or so. Rotate the wheel hub (28) with hand. Be sure that the wheel hub rotates freely and without looseness in axial direction. Then plug the split pin to prevent loose

Lubricating grease is required to be coated both on gear wheel and bearing while install the two tapered roller bearing (13 & 22) onto the gear shaft (32). Clearance between the two tapered roller bearing shall be set to an appropriate value. Gear rack (16) and gear shaft (32) shall be in free rotation, and no looseness in axial direction is allowed.

While assembling cylinder assembly (20), the two oil seals (18 & 19) are installed onto piston (18). Lubricating grease shall be coated for sake of damage to oil seal. Thread fasten glue shall be coated on thread at the connection position when install the two cylinder assemblies onto the steering gear box before screw down.

2) Routine maintenance of steering axle

a. Lubricating grease shall be injected every half year.
b. Regular check shall be performed to see whether sealing of steering cylinder components is reliable, whether there is oil leakage.
c. Regular check shall be made to see whether connection between tire screw and other screw or nut is loose. If any, screw down at any moment.

2.3.2. Adjustment and maintenance of steering system

Angle of steering wheel may be adjusted in demand. Loosen the adjusting handle on the lower left part of steering wheel, and then the steering wheel may be swing in back and forth. After establishing required angle, lock the adjusting handle.

Routine maintenance: check whether there is oil leakage in hydraulic oil pipe.

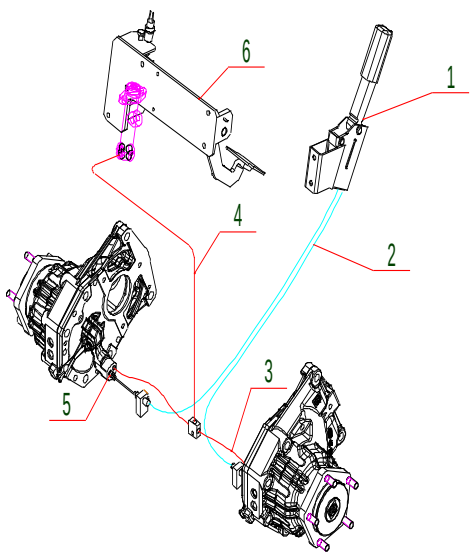
2.3.3. Regular failure of steering system and removal method

Failure	Possible reason	Removal method
Steering wheel too weight to rotate	Oil pump has been damaged, or there is fault with oil pump	Replace
	Air is contained within oil circuit or oil circuit been blocked	Wash, air discharge
	Pressure of safety valve is too low	Adjust pressure
Large noise	Oil level of oil tank is too low due to oil starvation	Add oil
	Oil suction pipe or filter has been blocked	Wash or replace
Oil leakage	The hydraulic joint has not been tightly screwed, or the joint or sealing members has been damaged	Screw up or replace

3.Braking system

3.1. Summarize

Braking system is composed of hand brake 1.brake flexshaft 2.footbrake assembly 6.brake line 3.Brake hard tube etc. See figure 3.1.



Footbrake acts with hand braking in driving wheel，which is a wet-type brake of front two-wheeled.

Figure 3.1

3.2 Brake pedal

Structure of brake pedal is shown as figure 3.2,which is fixed in the frame through holder.

Footstep through the push rod of brake master cylinder to convert foot power into brake oil pressure.

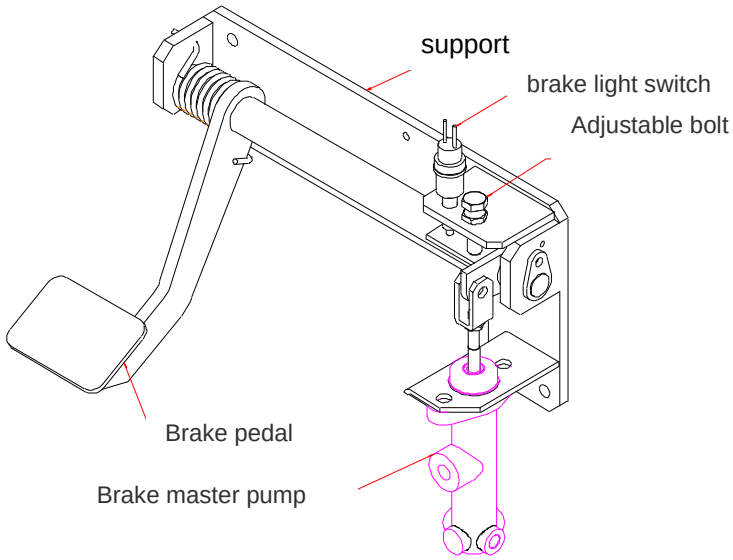
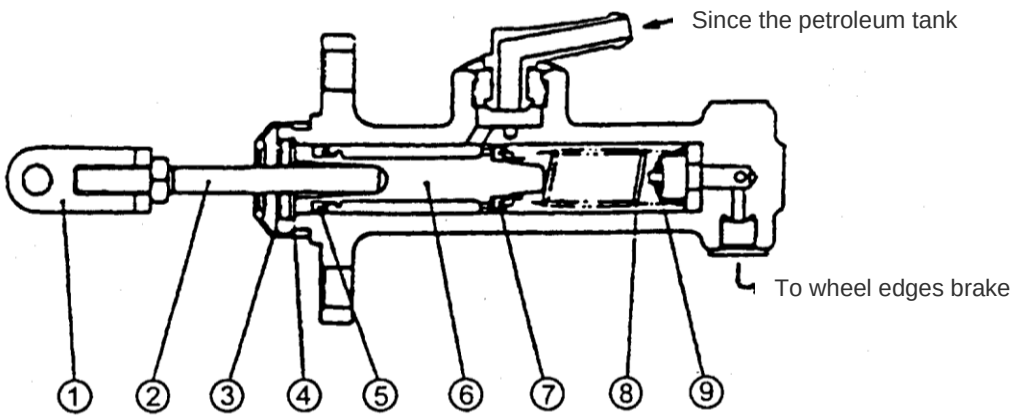


Figure 3.2

3.3 Brake master cylinder

Pump is composed of one valve seat.one check valve.one return spring and cup.piston and assistence cup ,see figure 3.3.Telos fixes with stop washer and steel wire, External protected through the rubber dust cover，pump piston is acted by push rod with brake pedal operation.，piston forward when stepped the brake pedal，Brake fluid of pump body returns to the storage tank through return opening untill primary cup blocks the oil return hole，brake fluid compressed and open check valve after the primary cup pushed return opening and then flew to wheel cylinder th

rough braking line.So,each wheel cylinder pump piston is outwardly and makes friction plate of brake shoe and drum brake connection in order to deceleration or brake.at this moment，piston metacoel will be filled with brake fluid which is from return opening and filler opening .Piston will be pressed by return spring ,and then brake fluid of each brake cylinder was compressed by return spring of brake shoe. Which makes brake fluid return to pump through check valve.Piston back to normal position，brake fluid runs back to oil box through return opening，Make the check valve pressure and braking pipeline and residual pressure of brake cylinder into certain proportion which make cup wheel cylinder piston install correctly to prevenr oill leaking and eliminate the air-resistor when emergency brake.



1.Connecting rod 2.Push rod 3.Shield 4.Circlip 5.assist leather collar
6.Piston 7.Main seal cup 8.Spring 9.Check valve

Figure 3.3 Brake master cylinder

3.4 Brake

See detailed 1.4 .brake connection.

3.5 Effector of braking.

The hand shank is cam type, use adjuster which is located at the end of brake handle to adjust braking force.

Braking force adjustment：

Braking force increase when adjuster has clockwise rotation； braking force reduce when counterclockwise running adjuster. See figure 3.5 Pull：20—30kg

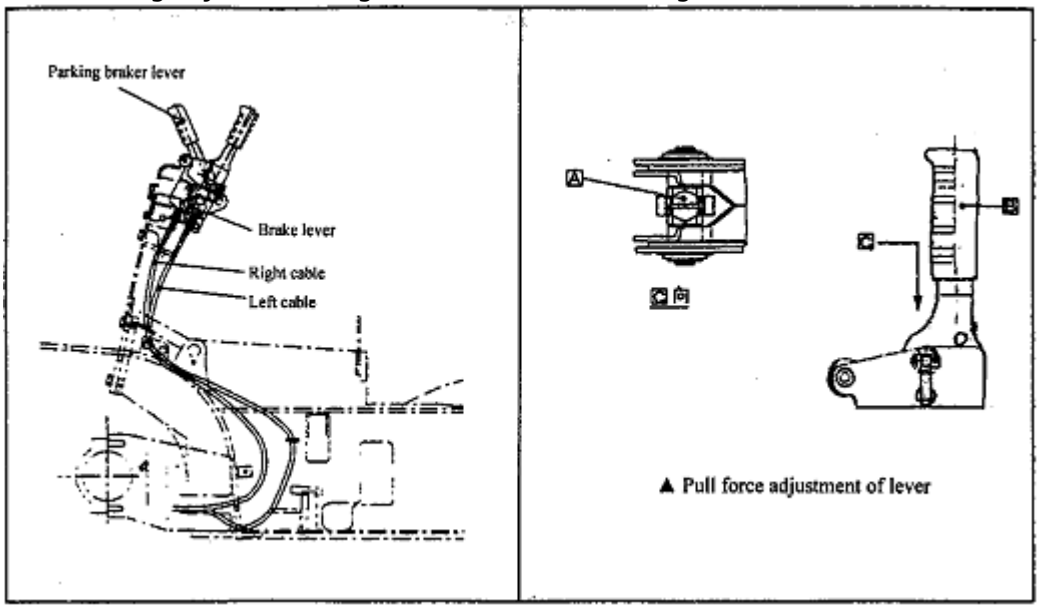


Figure 3.5

Switch adjustment。Figure 3.5.1

①Loosen 2 construction bolts。

②Pull on parking brake lever。

③Put the key of roller into the top joystick.and then press 1mm to fix.

④Parking brake release，pull a joystick again and comifrm the switch"ON"。

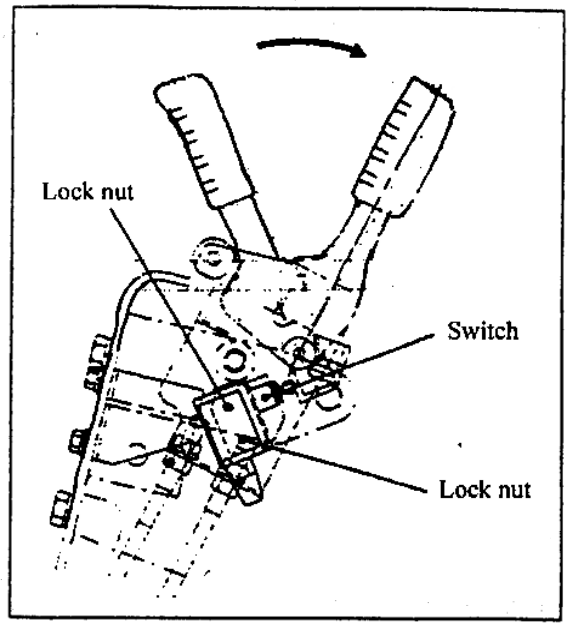


Figure 3.5.1

3.6Adjustment and maintenance of CPD21S braking system

The braking system concerns about driving safety of the forklift truck, thus everyday check shall be performed before driving, including whether braking system is reliable, whether the release spring has retracted to its original position. Otherwise spring shall be replaced. Whether clearance between brake disc and brake pad is suitable, otherwise adjustment shall be made. Whether riveted joint of braking cable / joint, or braking steel wire/joint has been loosened, whether the pulling mechanism between flexible sheath and cable is flexible. Whether locking of parking brake system is reliable. Whether release spring or torsional spring is in good condition, otherwise a new item shall be replaced.

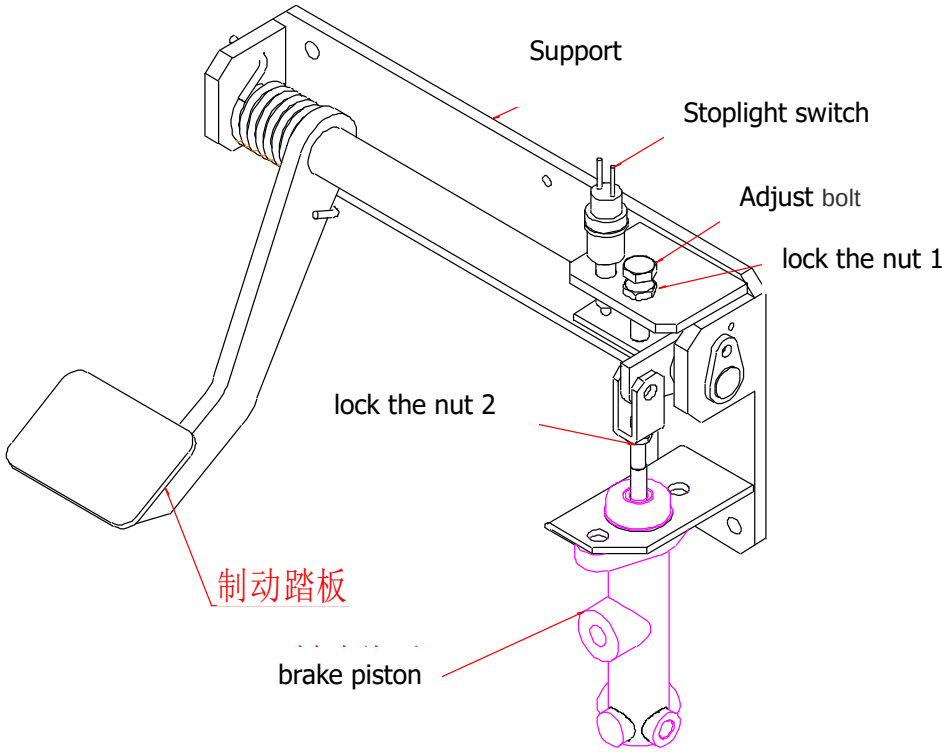
3.6.1Brake pedal adjustment .see figure 3.6

1) Get shorter push rod；
2) Adjust the dogbolt and the footstep to suitable height；
3) Step on the brake pedal, adjust the push rod untill to connect with the pump piston.
4) Screw down and lock the nut.

3.6.2Stoplight switch adjustment, see figure 3.6.

a. Loosen brake switch and lock the nut after brake pedal adjustment；
b. pull the plug makes the wire separation；
c. Turn the switch makes the intervalA=1mm；
d. Make sure the bright stoplight after step on brake pedal.

brake pedal



Fgure 3.6

3.7Fault diagnosis

fault	Reason analysis	Elimination ways
Poor braking	1.Brake system oil leakage 2. Clearance of brake piece is not adjusted. 3.Impurities mix in brake fluid 4.Incorrect adjustment of brake pedal(inching valve) 5. Wheel Cylinder is out of order.	Repair Arrester adjustment Inspect brake fluid Adjust Repair or replace
Brake lever.	1.Brake system oil leak 2.Arrester gap hasnot adjusted. 3.air mixes in brake system. 4.Incorrect adjustment of brake pedal.	Repair or replace Adjust the regulator Deflate Readjustment

4.Hydraulic system

4.1Summarize

Hydraulic system is composed of motor.hydraulic steering gear.multitandem valve.oilbox.steering cylinder.hydraulic pipe joint.hydraulic pressure pipeline.pressure oil is provided by oil pump. oil is assigned to each hydro-cylinder by multitandem valve.

Item	Type
primary pump	
Form	Gear type

Name	DSG05C16F9H9
Output volume	16ml / rev
drive mode	Motor connection
control valve	
Form	plunger type
Name	CBD2 一 F15
Adjustment pressure	14．5MPa
Lifting hydro-cylinder	
Form	single action piston with stop valve
Hydro-cylinder inner diameter	Φ45mm
Piston rod OD	Φ36mm
Route	1495mm(Lift height 3000mm)
Dump ram	
Form	Double action piston
Hydro-cylinder inner diameter	Φ63mm
Piston OD	Φ30mm
Route	65mm
Steering Cylinder	
Form	Double action piston
Oil cylinder bore	Φ50mm
Piston external diameter	Φ50mm
Route	100mm
hydraulic fluid chamber	
Capacity	23L～26L

4.2 Multitandem valve

Multitanderm valve adopts two pieces and four bodies, hydraulic oil is controlled by multitandem valve rod,and distributes high pressure oil to hoisting hydro-cylinder or dump ram.Safty and latching valve in multitandem valve.Safety valve located at upper filter opening of multitandem valve to control system pressure；Latching valve located at tilt valve plate to error control joystick without pressure source,which resulted in serious consequences. check valve is installed between and inlet port of as well as between lift valve filler opening and slant valve .Multitandem valve appearance as figure 4.2.

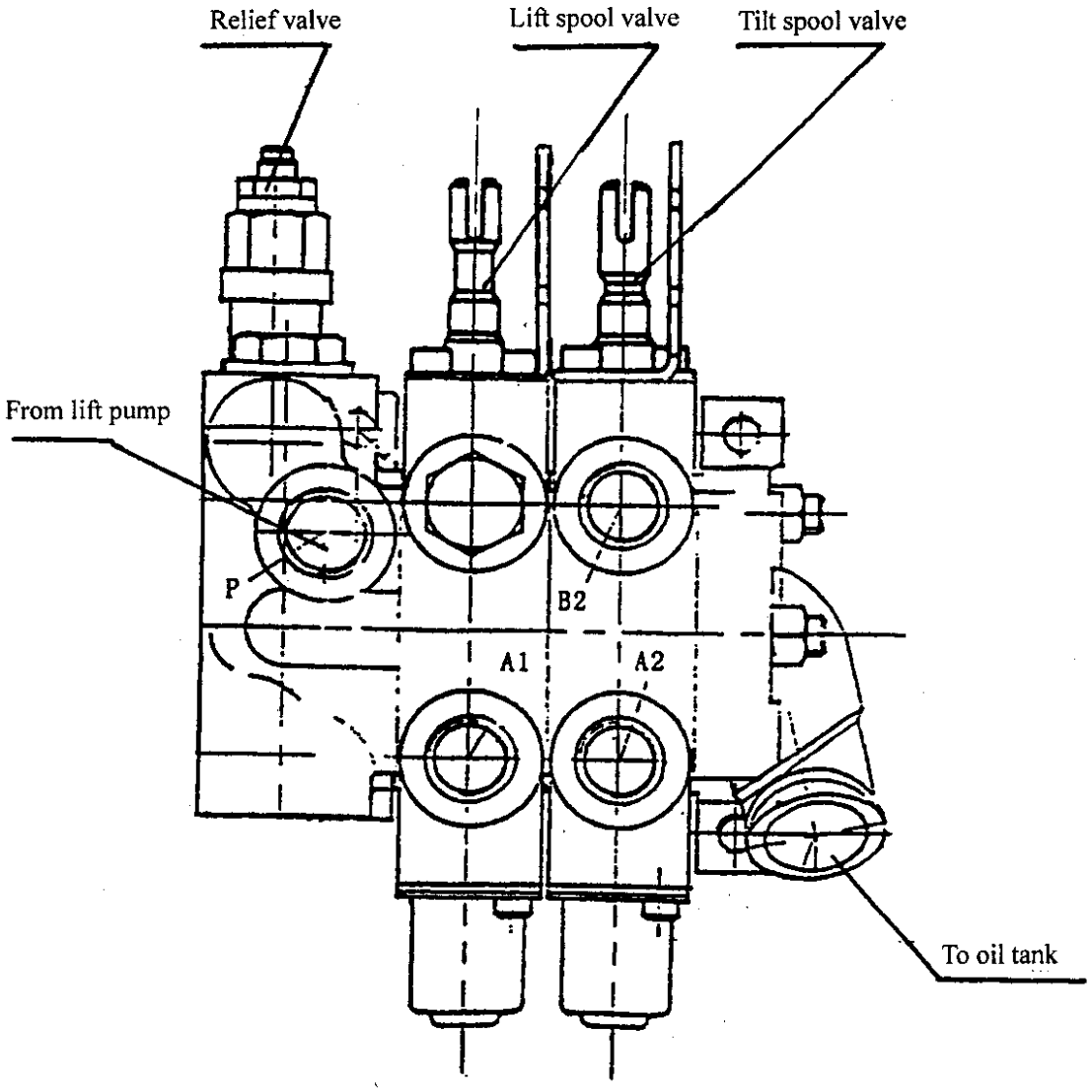
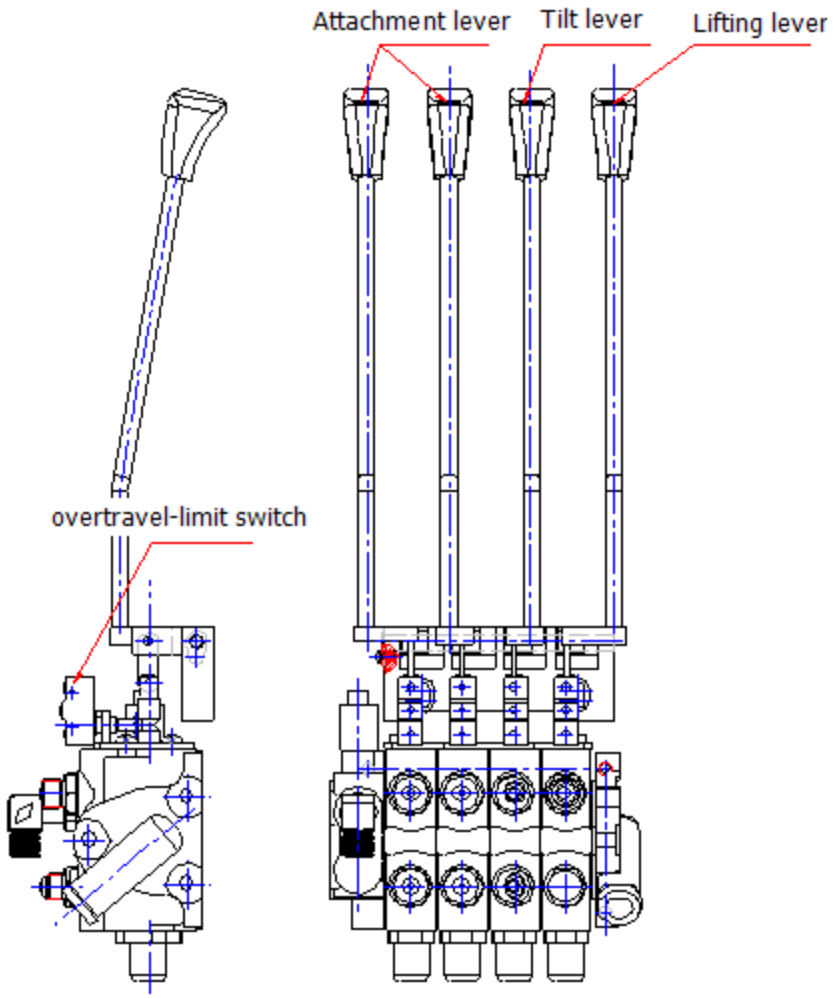


figure 4.2

1) Multitandem valve control

Multitandem valve is controlled by joystick，All joystick are installed on a connecting shaft.Axle is fixed at the right site of seat through holder，A joystick through the connecting rod tio control the slide valve .



▲Installation of valve overtravel-limit switch

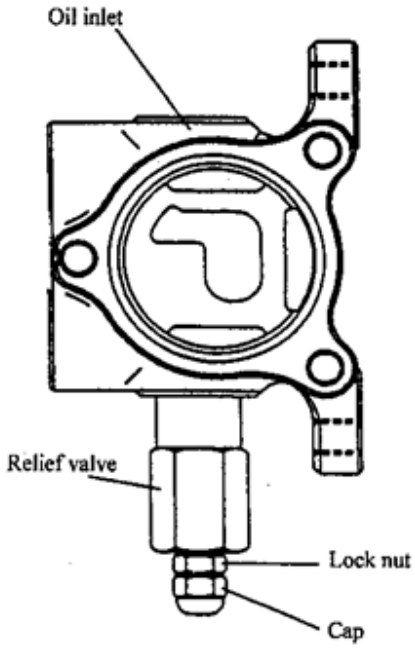
Press in 0．8±0．1mm to the scroll of valve switch and makes it in [ON] state.

And then，The switch of scroll of center and the center of the CAM shaft remain consistent.

2) Adjustment ways of safety valve pressure (Figure 7—3)

Safety pressure was set up before leave factory，user can not be adjusted at will，otherwise will make dangers for system and truck.If the oil prressure is different with specified value (see below figure)，professional should conduct as following steps according to JB／T3300(regulation test procedure)：

a. Screw down the Measurement orifices screw of imported part of multitandem valve and install aoilpressure gauge which can test 20Mpa.
b. Operate the tilt handle to measure the pressure when hydro-cylinder travelled to end.
c. When oil pressure is different with specified value,loosen the locknut of relief valve and turn the adjustment screw left and right to specified value.turn left when high pressure and turn right when low pressure.
d. Screw down the nut.



	1.6、1.8、2.0t	2.5、3.0t

Main relief pressure	14.5Mpa	17.5Mpa
Steering unit pressure	5.5Mpa	6.3Mpa

4.3 Lifting hydro-cylinder

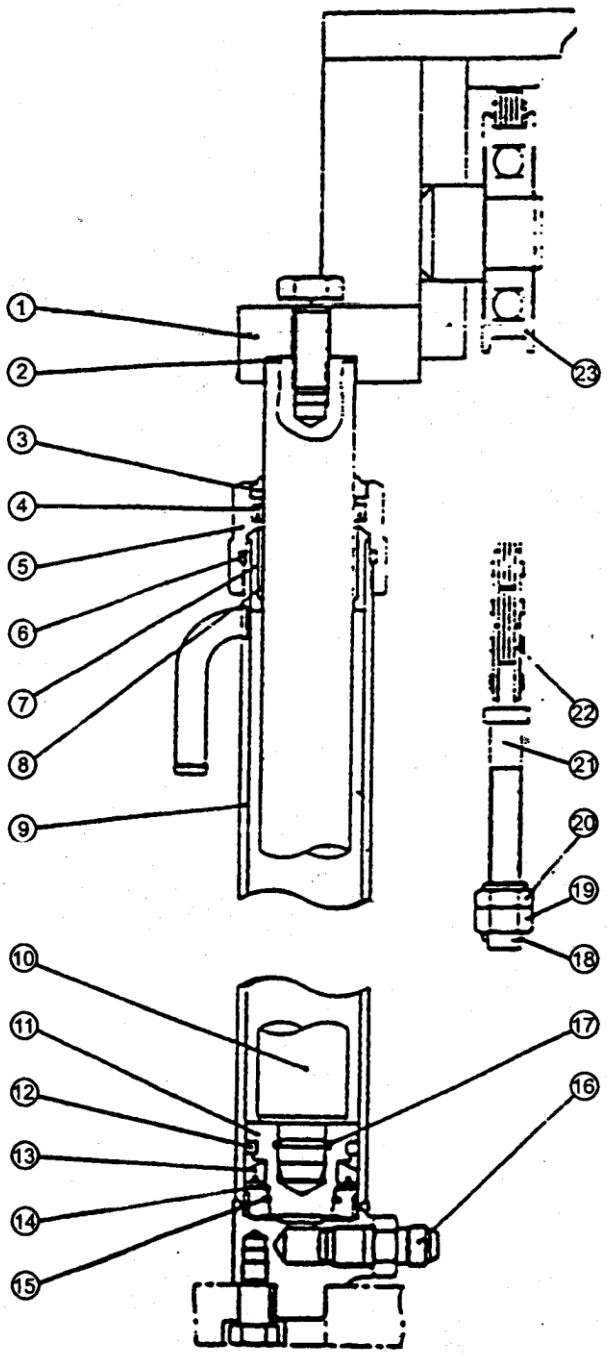
Lifting hydro-cylinder is singleacting piston pump,composed by cylinder block.piston rod.piston cylinder head etc.Two lifting hydro-cylinder are installed behind the out mast.，the bottom is fixed to the support of lift hydro-cylinder by pin and bolt .but the bottom of hydro-cylinder (pinston head) connected with top beam of outer mast.

Piston is fixed to piston rod by elasticity wire lock.outer ring of piston installed with oil seal and supporting ring.

Installed with stop valve at the bottom of hydro-cylinder，have the function of protection when the mast hoisting and high-voltage tube fracture suddenly.

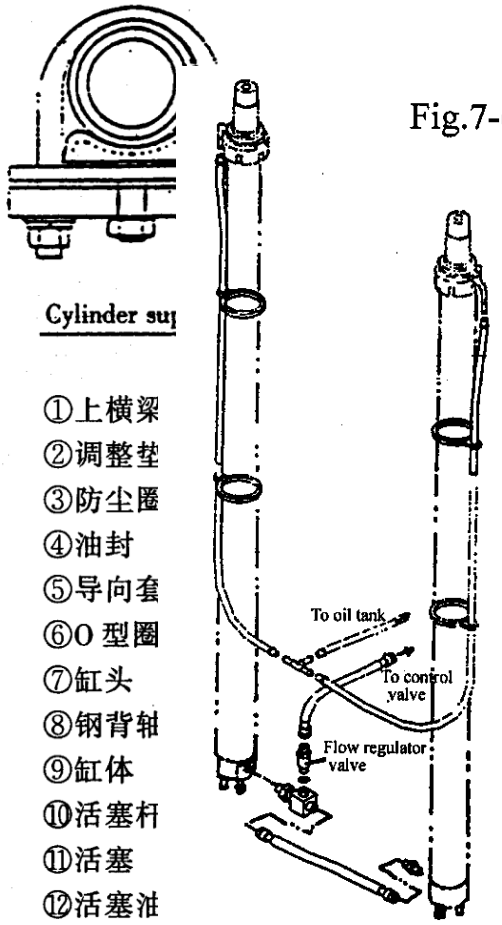
Installed with steel-backed bearing and oil seal on top hydro-cylinder to support piston rod and prevent dust entrance.

Lifting hydro-cylinder as figure 4.3



Figutre4.3

Fig.7-6



Cylinder su

①上横梁
②调整垫
③防尘圈
④油封
⑤导向套
⑥O 型圈
⑦缸头
⑧钢背轴
⑨缸体
⑩活塞杆
⑪活塞
⑫活塞油
⑬油封
⑭座圈
⑮弹性挡
⑯切断阀
⑰弹簧锁
⑱开口销
⑲锁紧螺
⑳调节螺
㉑端接头
㉒链条

17 Spring retainer
18 Cotter
19 Locknut
20 Rating nut
21End connector
22 Chain
23 Chain wheel

4.4 Speed limit valve

Speed limit valve controls the rate of decay and has the function of protection when happens accidents such as high pressure fracture.

See figure 4.4

▲Working condition of speed limit valve (See figure 4.4.1)

Oil return from lifting hydro-cylinder entered into valve [G] and through [F] [E] [D] [C] [B] [A] return to multitandem valve

pressure difference caused by spool makes it move right when oil flows into spool hole.

Gallery between [D] and [C] becomes narrow，oil return decreases and rate of decay of forks becomes slowly.

If want to lift forks ,high pressure oil from multitandem valve should enter into hydro-cylinder through [A] [B] [C] [D] [E] [F] and [G] .

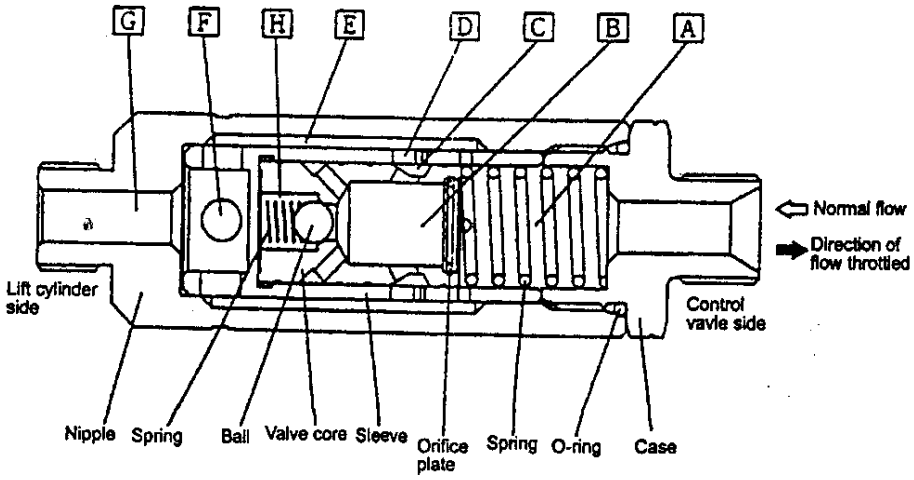


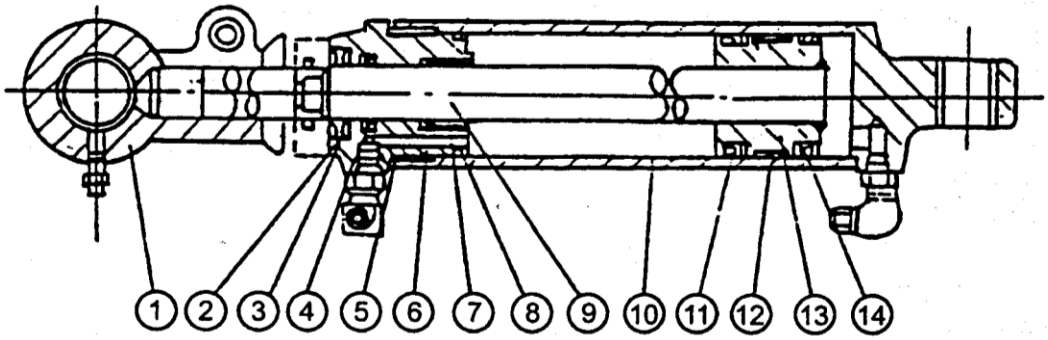
Fig.7-7 Flow regulator valve

4.5 Dump ram

Dump ram is double-acting, piston rod connected with mast through earrings，Tilt oil cylinder crock bottom with pins and frame connection, two sides of forklift has dump ram.

Dump ram is composed of piston.piston rod.cylinders.cylinder bottom.guide sleeve and sealing element，piston and piston rod use welded structure，piston outer edge has a back-up ring and two Yx seal rings，equipped with shaft sleeve and Yx seal ring .baffle ring and dust ring in guide sleeve hole.shaft sleeve supported piston rod.seal ring.baffle ring and dust ring in order to prevent oil leak and dustproof, together with Otype ring .see figure 4.5.

When rotary tilt forward, high pressure oil enter into the oil cylinder crock bottom ,thus push piston forward which makes mast forerake，high press is entered from front end of cylinder block when slide valve post tensioning and then drive the pistons backward and makes the mast hypsokinesis.



1. Earrings	2. Dust ring	3. Baffle ring	4.Yx seal ring	5. "O" type ring
6. Guide sleeve	7. Bearing	8. "O" type ring	9. Piston rod	10. Cylinder body
11. Yx seal ring	12.Support ring	13. Piston	14. Yx seal ring	

4.6Hydraulic fluid chamber

Hydraulic fluid chamber is on right box of frame，oil absorption filter in oil box，return filter in oil return line to ensure provide clean oil.

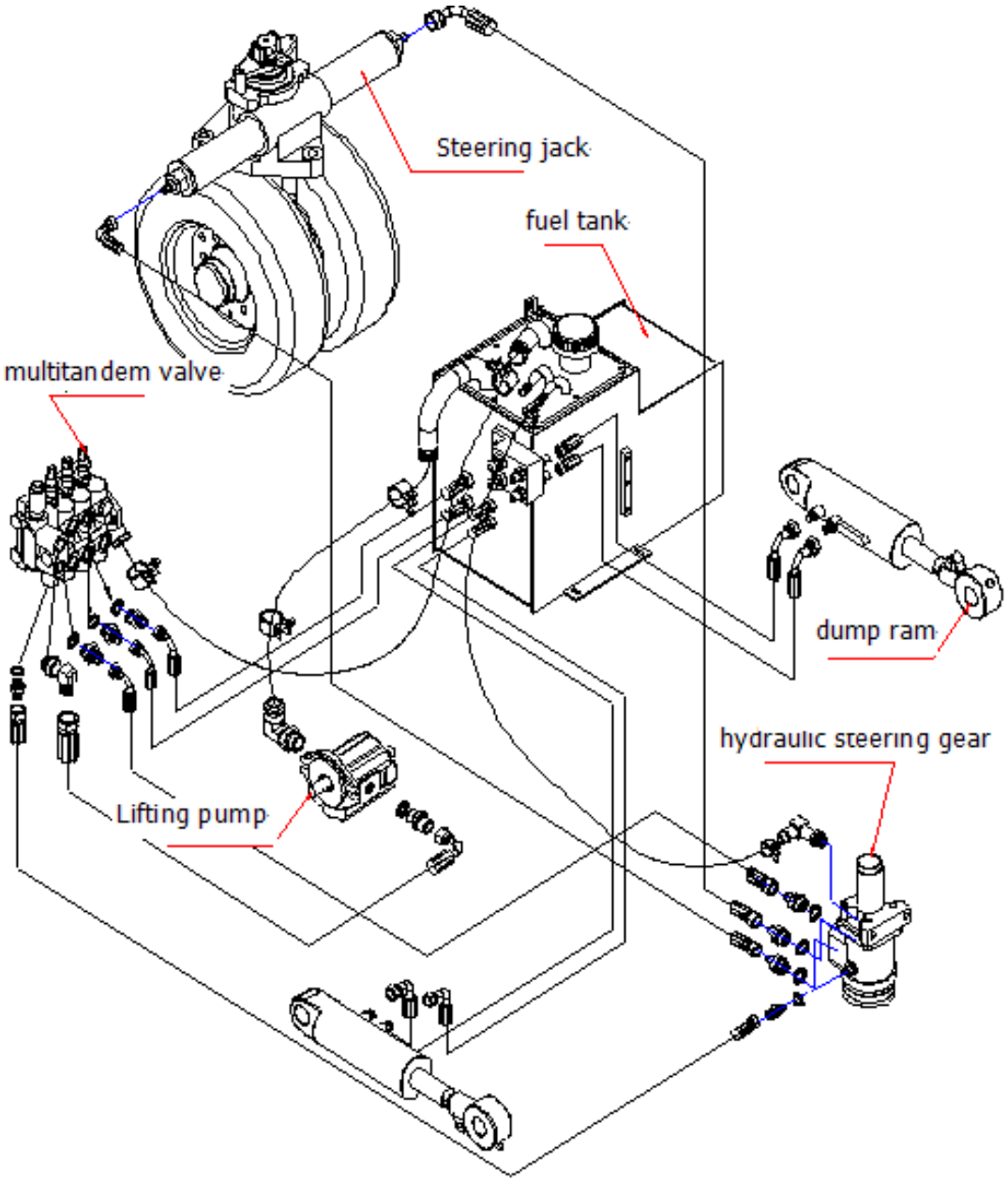
1) Replace the oil filter.

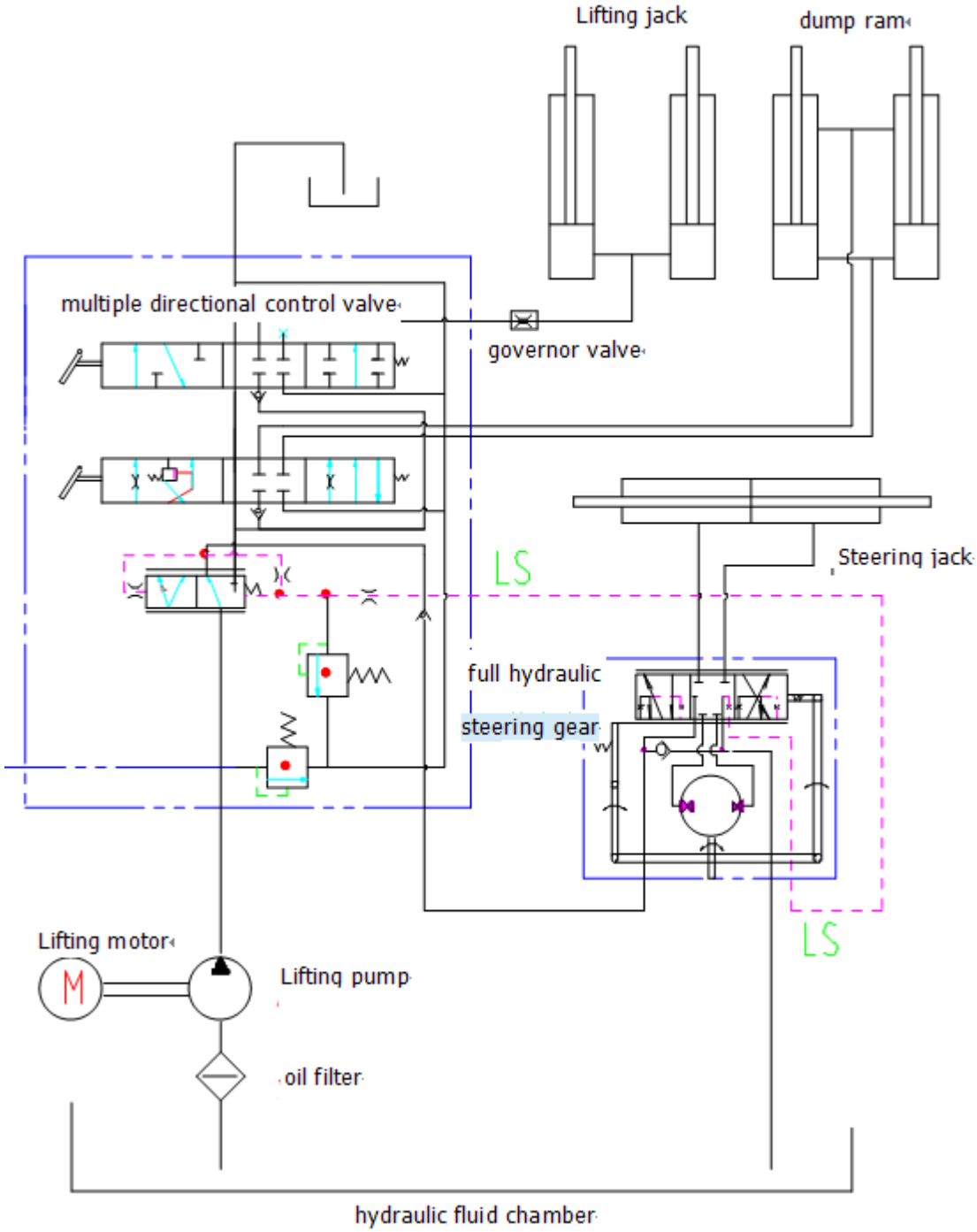
①Twist off purge cock to oil outlet.

②Clean tank cover and strike cover screw.
③Strike the oil suction pipe and oil return pipe.
④ Remove the cover plate of the oil box.
⑤Take off oil filter and replaced a new oil filter.
⑥Take off oil aborption filter and replaced a new oil filter.
⑦Remove old cushion of the cover plate, replace the new mat, besmear sealant again sealant： three Bood No.400#or equal
⑧Mounted cover plate of tank，Connected up fuel sucking pipe and oil return pipe.
⑨7.1.7 Schematic diagram of hydraulic system

4.7Hydraulic system

Hydraulic pipeline of Hydraulic system see figure 4.7




Lifting jack
dump ram
multiple directional control valve
governor valve
Steering jack
LS
full hydraulic
steering gear
LS
Lifting motor
M
Lifting pump
oil filter
hydraulic fluid chamber

4.8 Fault diagnosis

If hydraulic system failure, nee to necessary repairs according toimplement table to find out the reasons .

1) Multi-way valve

Stoppage	Cause	Repair ways
Press of hoisting oil-way cannot be increased.	Slide valve is out of nimbleness	Clean after resolving
	Oilhole blocked	Clean after resolving
Shake Press increased slowly.	Slide valve is out of out of nimbleness	Clean after resolving
	Venting insufficiency	Full venting
Pressure of steering oil-way isgreater than rated value.	Slide valve is out of nimbleness	Clean after resolving
	Oilhole blocked	Clean after resolving
Can not reach to specified fuel capacity	relief valve improper adjust.	Adjustment
Have noise	relief valve improper adjust.	Adjustment
	Sliding surface wore out.	Change relief valve
oil leak (external)	O type seal ring aging or damaged.	Change O type seal ring
Low setting pressure	Spring	Change spring
	Valve seat surface damaged	Adjust or change relief valve
oil leak (interior)	Valve seat surface damaged	Repair Valve seat surface
High setting pressure	Valve is out of nimbleness	Clean after resolving

2) Oil pump

Fault	Causes	Repair methods
Lower oil extraction	Lower oil level.	Add oil to specified amount
	Pipeline or oil filter blocking	Clean or change according to requirement
Lower pump pressure	Scaleboard damaged Support is damaged Poor seal ring, bush sealing or retaining ring	Change
	Improper adjustment of relief valve	Adjust relief valve pressure to specified value 值
	Air in system	Retighten side tubing of oil absorption. Refueling Repace sealing of the oil pump
Have noise when operation	Oil suction pipe damaged or oil filter blocked	Check up the pipe or repair oil filter
	Side oil absorption loosen and air leakage	Fastened the looseness
	Oil viscosity is too high	Change the viscosity oil according to t temperature of pump
	Bubble in oil	Find out the reason of bubble and take actions
Pump oil leaking	Pump oil sealing or sealing damaged	Change
	Pump damaged	Change

5.Lifting system

5.1 summarize

Lifting system is composed by inside and outside masts and carriages lifting system is 2 Level roller type vertical rise shrink,composed with inner.outer mast and fork frames.

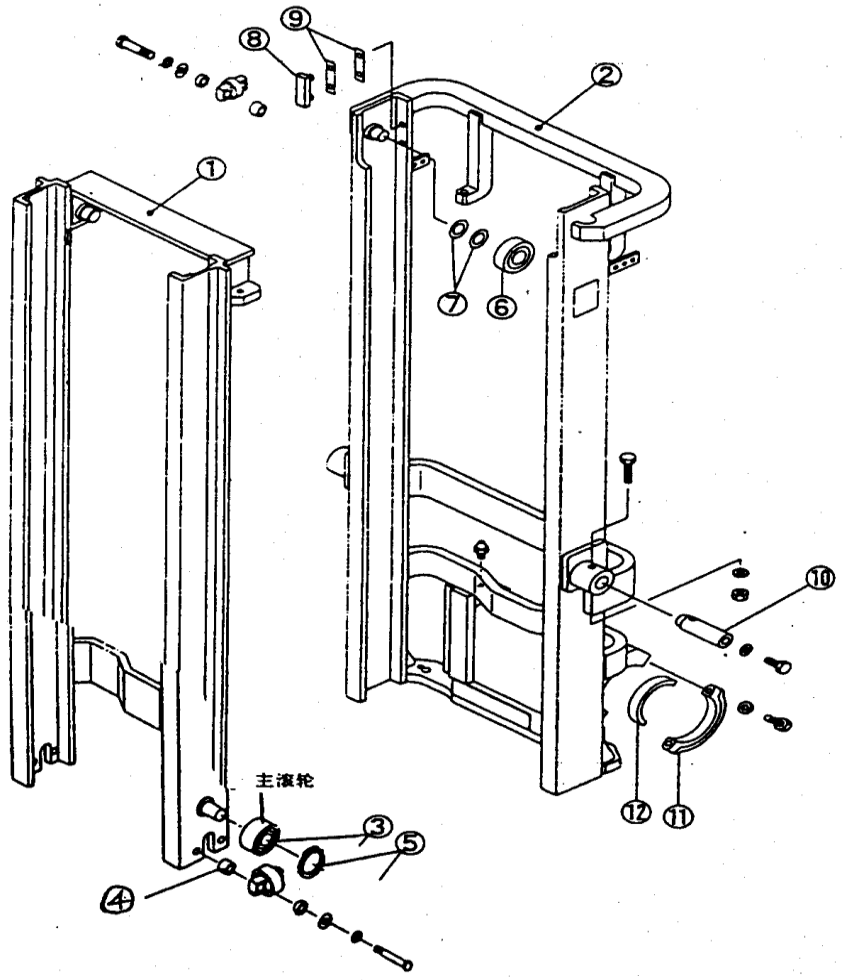
5.2Inside and outside mas (figure 5.2)

Inside and outside mast is a weld assembly,installed the drive bridge with support to the bottom of outer mast .

Central section of outer mast connected with frame by dump ram,and it can tilt forward or back.

U-bar of outer mast is C type，installed main idler wheel and side idler wheel on the top.

U-bar of inner mast is J type J，installed main idler wheel and side idler wheel .



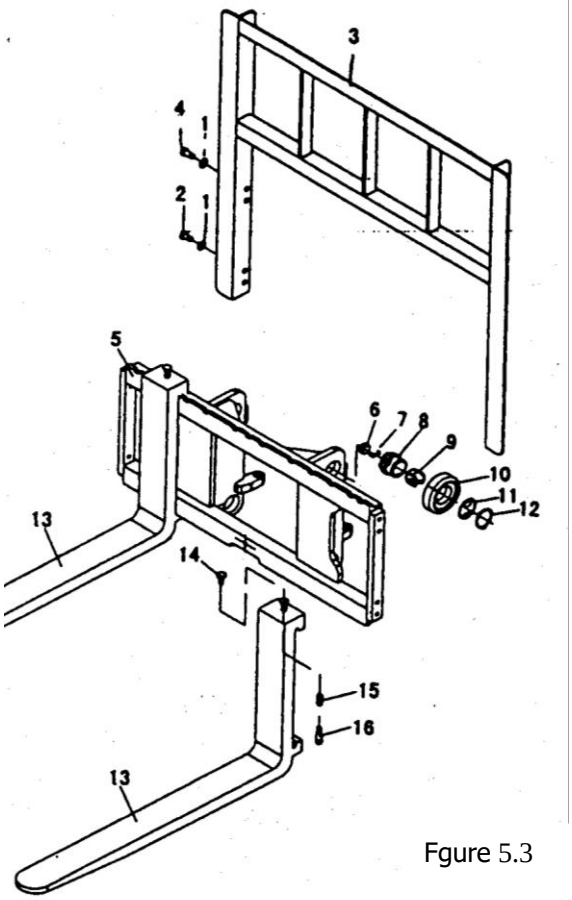
1. Inside mast
2. Outside mast
3. Main idler wheel
4. Gasket
5. Rand
6. Main idler wheel
7. slider
8. gasket
9. pin roll
10. Haff
11. bushing

Figure5.2 Inside and outside mast

5.3 Fork frame

Fork frame was rolled in inner mast through main idler wheel which is locked by circlip on roll wheel.

Roll wheel is weld on fork frame,， side idler wheel is fixed on fork by bolt. Along the interior door frame wing rolling, can be used to adjust the cushion adjustment.To prevent rolling clearance, use 2 fixed side roller along with inner mast flange frame.Vertical load is beared with main roller.Roller was shown from top mast when the fork reaches to the peak. Transverse load is beared with side roller.See figure 5.3.



Fgure 5.3

5.4 Maintain.adjust

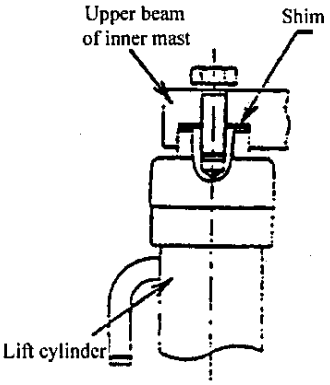
5.4.1Lifting jar adjustment.See figure 8-5

Lifting jar route need to re-adjust when lifting jar.inner mast or outer mast should dismantle or replace.adjusting ways as follow:

1) put the piston rod head without adjusting pad shelves into interior door beams.
2) Lifting the mast to the biggest extention of hydro-cylinder,check whether two cylinders synchronization or not .
3) Add adjustment pad between piston rod head of hydro-cylinder and upper beam of inner mast.thickness of adjustment pad is 0.2mm and 0.5mm.
4) Adjust tensioning degree of chain.

5.4.2High-low adjustment of fork frame.see figure8-6

1) Put the truck on lever ground and make mast vertical.



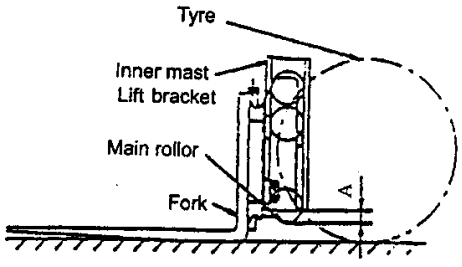


Fig. 8-6

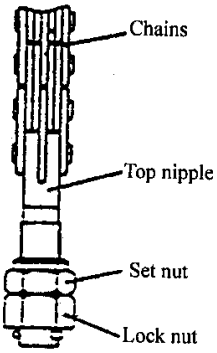


Fig. 8-7

2) Keep the fork underside to ground,adjust the nut of top chain joint which makes a distance A between main roller and fork frame.

Forklift type	A mm
1.6.1.8.2.0t	36～41

3) Fall the fork to ground and tilt it back in place.adjust the top joint of chain and Adjust the nuts make two chain tensioner have the same tensioner degree.

5.4.3 Change roller of fork frame, see figure 8-7

1) Put a tray on forks, and park the truck on level ground.
2) Put the forks and trays on the ground.
3) Take down upper connector of chain.
4) Lifting inner mast (figure 8—8 ①)
5) Ensure that fork frame has been divorce from outer mast, then reverse the forklift.(figure 8—8 ②)
6) Change main roller
   a) Strike all of spring collars ，take down the main roller with drawing equipment,should keep the adjustment pad.
   b) Confirm new roller is same as the replaced roller ,put new roller to fork frame and blocked with circlip .

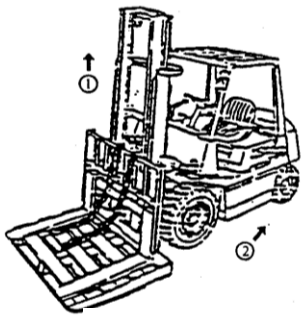


figure 8-8

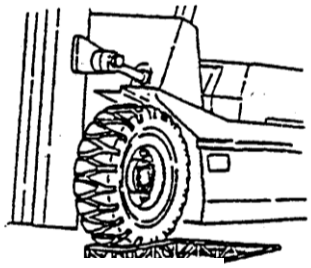


figure 8-9
图 8－9

5.4.4 Change mast roller.

1) The way to change the fork frame roller refer to 8．2．3，take down fork frame from inner mast.
2) Drive the truck to level ground and underlay the front wheel for 250～300mm.
3) Pull on hand brake and chock-up rear-wheel with wedge.
4) Take down the inner frame of lifting cylinder to fixed bolt.Sling inner mast，Take care not to lose the adjustment pad of piston rod head.
5) Take down the connecting bolt between lifting and outer mast bottom.take down the pipeline which connected with lifting and two cylinders.Do not to loosen pipeline joint.
6) Put down the inner mast,take down roller of innermast bottom.main roller of outer mast will be shown from top of inner mast.
7) Change the mail roller .
   (a)Take down top main roller with drawing equipment,donot to lose the adjustment pad.
   (b)Fit together with new roller and adjustment pad which is taken down by (a) step.
8) Lift inner mast in order to make all rollers enter into inner mast.
9) Loaded on lifting cylinder and fork frame According to the opposite of the steps with dismantle.

6.Electrical equipment

6.1Summarize

Electrical system includes battery, walking motor, lifting motor, peed setting controller assembly.control switch .Multifunctional LCD combination instrument and floodlight device etc.

6.2 Multifunction integration control system

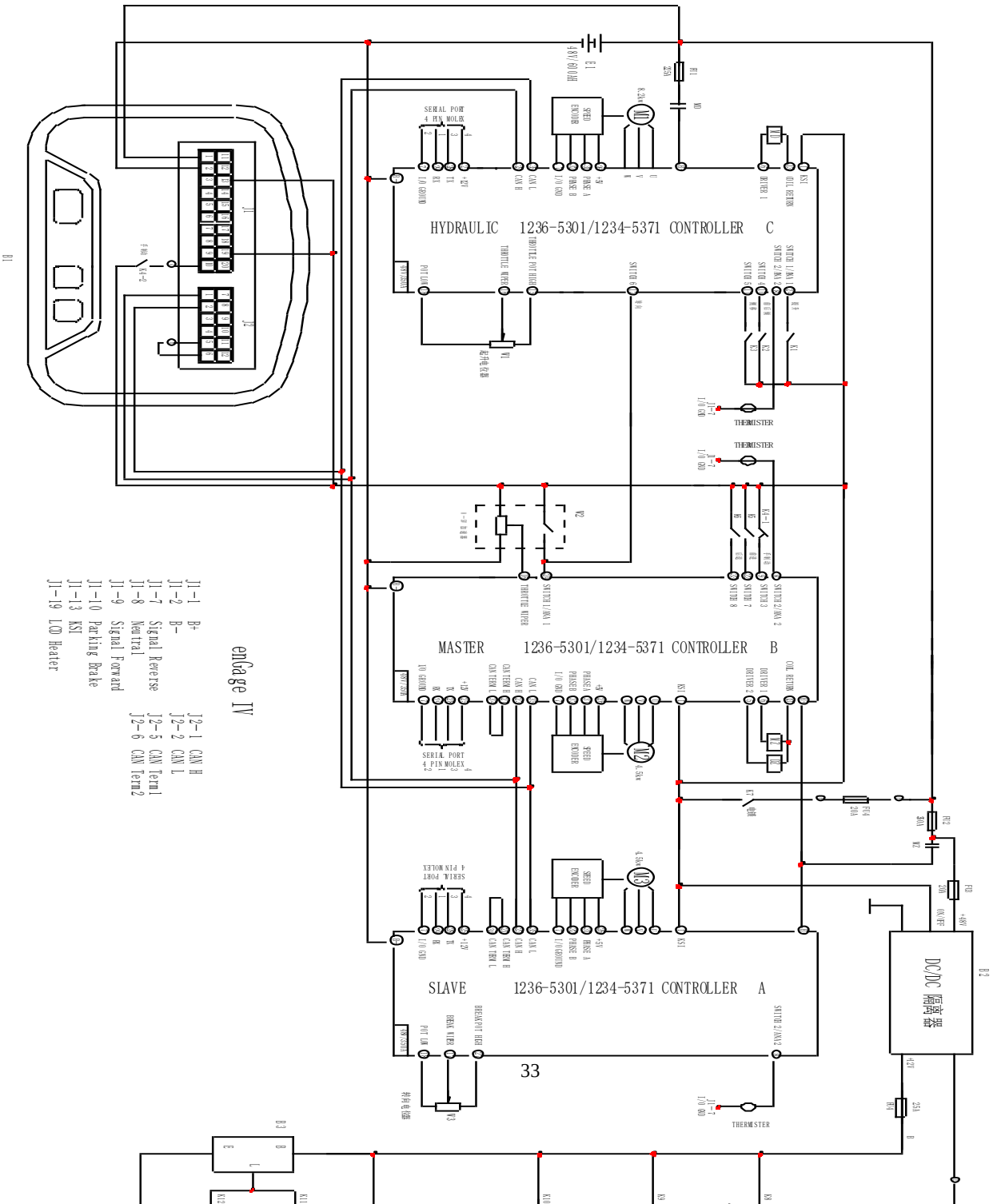
Multifunction integration control system is made of 2 speed setting controller whick controlls driving motor，motor of oil pump controller is composed by speed setting controller and accelerator.See figure 4—3.

6.3 Curtis 1236 Motor speed controller

Curtis 1236 Motor speed controller ensures the motor can running smoothly in different mode by advanced control soft ware .including regenerative braking which is in full speed and torque state.zero-speed and torsion control,proprietary input/output port and software ensures the economy and high efficiency of cotroller.

6.4 Accelerator

Accelerator is composed by start switch and potentiometer. Potentiometer converts angle into resistance variation and then converts into controller.



Electrical equipment

6.5 Inmotion controller

- Error code table

No.	Error code	Hexade-cimal	Description	Trouble shooting
1	**13**	**0x0D**	HPG CONTROLLER EEPROM KO	Reset key
2	**20**	**0x14**	Incorrect start Accelerator pedal switch active before key on	Release pedal switch
3	**21**	**0x15**	Incorrect start Forward switch or reverse switch active before key on	Turn off the direction switch
4	**22**	**0x16**	Forward switch and reverse switch active at the same time	Direction switch fault
5	**23**	**0x17**	Throttle analog value out of range	Throttle fault or analog need to be calibrated
6	**24**	**0x18**	Throttle analog fault	
7	**30**	**0x1E**	HPG controller battery voltage low	HPG controller battery voltage low need charge
8	**31**	**0x1F**	Traction controller CAN communication fault	Check CAN wire of controller and display
9	**32**	**0x20**	Battery voltage low	Need charge
10	**33**	**0x21**	DC motor voltage high	Reset key
11	**34**	**0x22**	CPU fault	Reset key
12	**36**	**0x24**	Incorrect start Tilt switch active before key on	Reset tilt switch

13	**37**	**0x25**	Incorrect start Side switch active before key on	Reset side switch
14	**38**	**0x26**	Incorrect start Attachment switch active before key on	Reset attachment switch
15	**39**	**0x27**	Incorrect start Lift switch active before key on	Reset lift switch
16	**40**	**0x28**	Lift analog value out of range	Lift analog fault or need to be calibrated
17	**43**	**0x2B**	Steer analog value out of range	Steer analog fault or need to be calibrated
18	**44**	**0x2C**	WARNING: Traction controller speed protection	Vehicle speed is too high alarm
19	**45**	**0x2D**	WARNING: Traction controller encoder fault	1.Traction controller encoder fault 2.Traction motor speed sensor connection wire is open
20	**49**	**0x31**	DC motor operating current is zero	HPG conrtoller sensor fault
21	**53**	**0x35**	HPG controller over current	HPG conrtoller over current
22	**62**	**0x3E**	HPG controller temperature high	HPG controller temperature high need cool
23	**66**	**0x42**	HPG Controller battery low	HPG controller battery low need charge
24	**74**	**0x4A**	HPG controller driver shorted	HPG controller driver shorted
25	**76**	**0x4C**	HPG controller coil shorted	HPG controller coil shorted
26	**78**	**0x4E**	HPG controller VACC not ok	HPG controller VACC not ok
27	**79**	**0x4F**	Incorrect start HPG controller incorrect start	HPG controller incorrect start
28	**81**	**0x51**	WARNING: Traction controller temperature is low	Traction controller temperature is low alarm
29	**82**	**0x52**	WARNING: Traction controller temperature is high	Traction controller temperature is high alarm
30	**83**	**0x53**	Traction controller temperature sensor fault	Traction controller temperature sensor fault
31	**84**	**0x54**	WARNING: Traction motor temperature is low	1.Traction motor temperature is low 2.raction motor temperature sensor is fault
32	**85**	**0x55**	WARNING: Traction motor temperature is high	1.Traction motor temperature is high 2.Traction motor temperature sensor is fault
33	**86**	**0x56**	Traction motor temperature sensor fault	1.Traction motor temperature sensor is fault 2.Traction motor temperature sensor connection wire is open
34	**87**	**0x57**	Traction motor encoder fault	.Traction motor encoder fault 2.Traction motor speed sensor connection wire is open
35	**88**	**0x58**	WARNING: DC bus voltage of traction controller is high	1.DC bus voltage high 2.The ramp is too steep
36	**89**	**0x59**	WARNING: DC bus voltage of traction controller is low	Need to charge or check power wiring
37	**90**	**0x5A**	WARNING: The default value of the traction controller is updated	Reset key
38	**91**	**0x5B**	WARNING: Traction drive limit	Battery low vehicle speed limit
39	**97**	**0x61**	Open drain of traction output open or short	Check the wire of open drain of traction output open or short

40	**98**	**0x62**	WARNING: Traction controller over current or short	Check power wiring
41	**101**	**0x65**	Traction controller short	Check power wiring 2.Controller enable before contactor pull
42	**102**	**0x66**	Traction controller temperature is high cut back	Traction controller temperature is high need cool
43	**103**	**0x67**	Traction motor temperature is high cut back	1.Traction motor temperature is high need cool 2.Traction motor temperature sensor fault
44	**104**	**0x68**	Traction controller over current	1.Vehicle overload or Mechanical clamping 2.Traction motor speed sensor fault
45	**105**	**0x69**	Traction controller precharge failed	Replace the pre charge resistance
46	**110**	**0x6E**	DC bus voltage of traction controller is low cut back	Battery need charge
47	**111**	**0x6F**	DC bus voltage of traction controller is high cut back	DC bus voltage of traction controller is high cut back
48	**112**	**0x70**	DC bus voltage of traction controller is high cut back(Hardware monitoring)	DC bus voltage of traction controller is high cut back(Hardware monitoring)
49	**114**	**0x72**	Internal power supply error	Traction motor temperature sensor or speed sensor connection
50	**121**	**0x79**	WARNING: Pump controller temperature is low	Pump controller temperature is low alarm
51	**122**	**0x7A**	WARNING: Pump controller temperature is high	Pump controller temperature is high alarm
52	**123**	**0x7B**	Pump controller temperature sensor fault	Pump controller temperature sensor fault
53	**124**	**0x7C**	Pump motor temperature is low	1.Pump motor temperature is low 2.Pump motor temperature sensor fault
54	**125**	**0x7D**	WARNING: Pump motor temperature is high	1.Pump motor temperature is high 2.Pump motor temperature sensor fault
55	**126**	**0x7E**	Pump motor temperature sensor fault	1.Pump motor temperature sensor fault 2.Pump motor temperature sensor connection wire is open
56	**127**	**0x7F**	Pump controller encoder fault	1.Pump motor speed sensor fault 2.Pump motor speed sensor connection wire is open
57	**128**	**0x80**	WARNING: DC bus voltage of pump controller is high	DC bus voltage of pump controller is high
58	**129**	**0x81**	WARNING: DC bus voltage of pump controller is low	Check power wiring
59	**130**	**0x82**	WARNING: The default value of the pump controller is updated	Reset key
60	**132**	**0x84**	WARNING: Pump drive limit	Battery voltage low need charge
61	**137**	**0x89**	Open drain of pump output open or short	Check the wire of open drain of pump output open or short
62	**138**	**0x8A**	WARNING: Pump controller over current or short	Check power wiring

63	**141**	**0x8D**	Pump controller short	
64	**142**	**0x8E**	Pump controller temperature is high cut back	
65	**143**	**0x8F**	Pump motor temperature is high cut back	Pump motor temperature is high alarm
66	**144**	**0x90**	Pump controller current calibration error	Reset key
67	**145**	**0x91**	Pump controller precharge failed	Replace the pre charge resistance
68	**150**	**0x96**	DC bus voltage of pump controller is low cut back	DC bus voltage of pump controller is low cut back
69	**151**	**0x97**	DC bus voltage of pump controller is high cut back	DC bus voltage of pump controller is high cut back
70	**152**	**0x98**	DC bus voltage of pump controller is high cut back(Hardware monitoring)	DC bus voltage of pump controller is high cut back(Hardware monitoring)
71	**153**	**0x99**	Pump controller CPU fault	Reset key
72	**154**	**0x9A**	Pump controller speed control fault	Pump controller speed control fault
73	**147**	**0x93**	BMS cell voltage too high	
74	**148**	**0x94**	BMS firstly fault	
75	**149**	**0x95**	BMS secondary fault	
76	**155**	**0x9B**	BMS CAN bus off	BMS CAN bus off
77	**156**	**0x9C**	Temperature protection	Temperature protection
78	**157**	**0x9D**	BMS over temperature protection	BMS over temperature protection need cool
79	**158**	**0x9E**	BMS single body over discharge	BMS single body over discharge need charge
80	**159**	**0x9F**	BMS over voltage protection	BMS over voltage protection
81	**161**	**0xA1**	Display can fault	Check display and controller can connection
82	**163**	**0XA3**	BMS over current	BMS over current
83	**164**	**0XA4**	Charge protection	Charge protection
84	**165**	**0XA5**	Seat switch off after a period of time, the direction of the request to reset	Reset direction switch
85	**168**	**0xA8**	BMS indicates Limit Current alarm	BMS indicates Limit Current alarm
86	**169**	**0xA9**	BMS indicates cutoff Current alarm	BMS indicates cutoff Current alarm
87	**170**	**0xAA**	BMS indicates brake Current alarm	BMS indicates brake Current alarm
88	**171**	**0xAB**	BMS CAN error	BMS CAN Error
89	**200**	**0xC8**	Proportional valve error	Proportional valve error
90	**241**	**0xF1**	HPG controller can bus ko	Check can wire open and can speed rate
91	**242**	**0xF2**	HPG controller battery over voltage	HPG controller battery over voltage
92	**243**	**0xF3**	HPG controller key shorted	HPG controller key shorted
93	**244**	**0xF4**	HPG controller watchdog error	Reset key switch
94	**246**	**0xF6**	HPG controller waiting for main contactor	Turn off the pump contactor parameter

6.6 Intelligent instrument

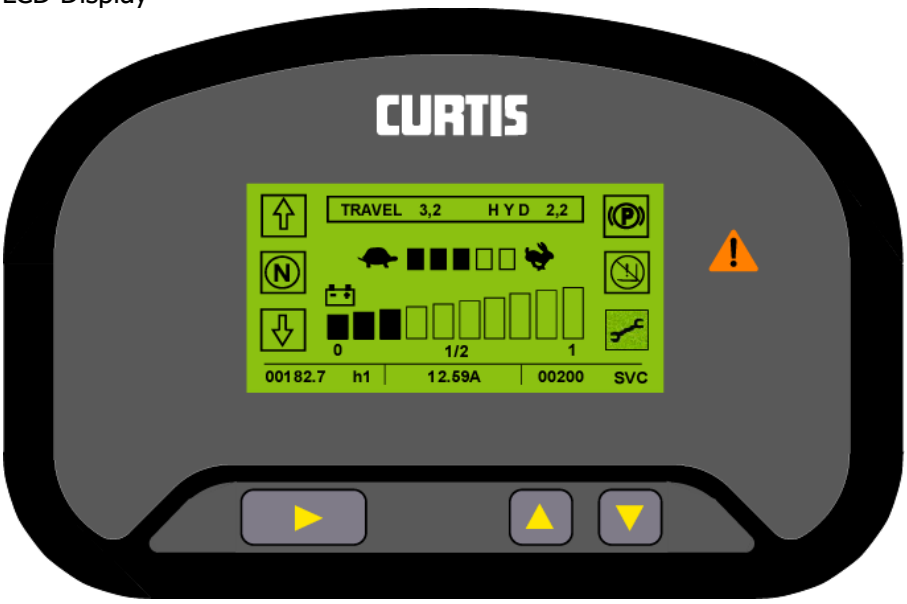
IDD-35C-D is a vehicle mounted color screen instrument based on CAN and wireless communication, which can display information such as vehicle speed, working time, battery power, Chinese and English display, password protection, fault code, etc. Meanwhile, it can realize industrial interconnection functions such as vehicle positioning, remote locking, remote help, etc. It can also modify and configure vehicle parameters according to users, provide online real-time communication, cloud data storage and background monitoring services. IDD-35C-D has the advantages of instant communication, precise positioning and high degree of visualization. It is the best terminal for the future Internet of things and cloud services of electric forklift. It is widely used in all kinds of industrial electric vehicles, such as forklift, balance vehicle, tractor, sightseeing vehicle, AGV, etc.

- Appearance and display instructions

1) Parameter name Description
   ① Hour meter
   Digital display of the accumulated working time of the current truck, with a maximum of 5 digits;
   ② Wheel angle indication
   The arrow represents the direction of the steering wheel;
   ③ Working mode indication
   Display the current working mode, including "S (low speed)", "P" and "E" three working modes
   ④ Travel speed display
   Displays the current truck speed in km/h or MPH
   ⑤ Battery level display:
   Display the current battery capacity;
   ⑥ Forward and backward indication
   "↑" indicates of traveling forward, while "↓" indicates of traveling backward. No indication for neutral.
2) Indication of the alarm lights
   1. Turtle shaped light is on when the truck is running in tortoise speed mode
   2. Fault light is on when the truck is in fault.
   3. Battery light is on when battery power is less than or equal to 20%
   4. When power level of lifting locking lamp is less than or equal to 10%, the lifting locking lamp will be on
   5. seat light when the driver leaves the seat: 0: on; 1: off
   6. Hand brake light is on when the driver operates the hand brake
3) Button description
   S Move the cursor up, or add 1 to the selected number; or switch to S mode (low speed mode) in the main interface;
   P Move the cursor left; or switch to P mode in the main interface.
   E Move the cursor right; or switch to E mode in the main interface.
   Move the cursor down, or minus 1 to the selected number; or switch to S mode (low speed mode) in the main interface;
   Cancel the current content or return to the previous menu;
   OK

Confirm the current operation; or enter the menu mode in the main interface;

6.7 Multifuctional LCD Display



6.7.1Function and use：

- Receive trouble signal from walking controller and trouble fan-out of pump controller in serial mode,and display on the instrument with digital format. "TRAVEL" means walking controller，"HYD"means pump controller.
- Give an alarm of battery displaying and insufficient;Provide the function of locking device .
- Icon "🐢"shows low speed，icon "🐇"shows speediness；five metres between them which shows the speed change.this 5 metres base on accelerator output signal of 0～5V.
- "⇧" is forward，high level trigger；"⇩"is fall back indicator，high level trigger；"Ⓝ"is neutral position，low level trigger；"Ⓟ" is braking，high level trigger；"⏚" is locked，controlled by instrument；"🔧" means maintainence,controlled by instrument.
- Hourmeter of clock and maintain.
- LED flicker
- 1A warning output（at most 3），Can be used to improve the lock function or drive other alarm device；

6.7.2 Lighting signalling devices

Including Including all kinds of lighting, lights and horns, buzzers etc.

headlamp：35W

Front combined lamps (swerve / wide)：21W / 8W

rear combined lamps (swerve / wide / back up)：21W red / 8W red / 10W white

Caution light (option)：21W

6.7.3 Brief description of operation

(1)Start: Put the parking switch in braking position before start .Put Shifting direction switch to zero span,otherwise safety return circuit will play a part，forklift can't start smoothly.

Turn the starting switch (electric lock) to first gear in clockwise rotation to power-on.instrument indicate

and electrical control loop.

Put down the hand brake switch after power-on.

Push forward the shifting direction switch, step on the accelerator footstep then forklifts moving.pull back the direction switch is R-reserve.

(2)Lighting switch：turn to first gear， front and back width lamps brights； Headlamp brights when turns to second gear, then width lamps still bright.

(3)Direction indicator：pull back the turn light switch.signal lights of front combination lights and rear combination lights flickering；push forward the turn signal swich，signal lights of front combination lights and rear combination lights flickering.

(4)Brake signal：When the forklift needs to brake, steps on brake pedal.rear combination lamp and stoplight(red) brights.

(5) Reverse signal: when forklift need to reverse, pull back switch direction, then walk motor reversal, combination lamp lightsr(white) bright,reverse buzzer tweeting.

6.8 Function of controller LED light.

There has two flash LED lights in controller shell, different flashings represent controller different working state, see following table.：

Displaying situation	Description
LED cannot light up	Controller power supply hasnot been connected; The batteries run out or, or other line fault.
LED yellow light flickers	Controller normal operation.
Yellow and red lights always lights up.	A controller is in a state of programs load.
Red LED light always lights up.	The watchdog failure or not to install the software. Restart the key switch, reinstall the software if need.
Red and yellow LED lights flickers alternately	Controller found fault. Fault display code composed by two numerals. The red lights flashing means code was the first figure or the second number, yellow lights flashing number corresponds to a specific number .

6.9 Controller failure cause and treatment list

LED Code	Pogramming unit display	**Fault** phenomenon	Failure cause
1，2	**CONTROLLER OVERCURRENT**	**Controller current overcurrent** —Motor stopped working —Main contactor disconnect —Electromagnetic brake disconnect —Accelerator failure —Pump lays off	1.U，V，W of external motor is cutting-out 2.Parameter of electric machine set error and mismatching 3.Controller fault **Note：phase current is out of limitation** **Solution：restart the switch**
1，3	**CURRENT SENSOR FAULT**	**Current sensor fault** —Motor lays off —Main contactor disconnect —Electromagnetic brake disconnect —Accelerator failure —Pump lays off	1. Relative car body of U，V，W is cutting-out(Motor stator is cutting out results in leakage. 2.Controller failure . **Note：Current sensor of controller has reading deviation** **Solution：restart the switch**

1，4	**PRECHARGE FAILED**	**Precharge failure** —otor stopped working —Main contactor disconnect —Electromagnetic brake disconnect —Accelerator failure —Pump lays off	1. External loading is connected with capacitor bank(B+terminal) prevents condenser from charging. 2. Check the capacitor voltage under monitoring menu. **Note：Key switch input voltage charges fail to condenser.** **Solution：Reset through VCL or interlock switch imput again.**
1，5	**CONTROLLER SEVERE UNDERTEMP**	**Controller under normal temperature** —Motor stopped working —Main contactor disconnect —Electromagnetic brake disconnect —Accelerator failure —Pump lays off	1. Controller works in a extreme environment (below-40℃) 2. Check the controller temperature under monitoring menu **Note：Radiator temperature is lower than-40°C** **Solution：Restart the key switch or interlock swith When the temperature rises to -40oC or above.**
1，6	**CONTROLLER SEVERE OVERTEMP**	**excess temperature of controller** —Motor stopped working —Main contactor disconnect —Electromagnetic brake disconnect —Accelerator failure —Pump lays off	1. Controller works in a extreme environment（higher than 95°C） 2.Truck overload 3.Improper installation of controller. 4.Check the controller temperature under monitoring menu. **Note：radiator temperature is higher than 95°C** **Solution：Reduce temperature to 95°C.** **Reset the key switch or interlock switch.**
1，7	**SEVERE UNDERVOLTAGE**	**Voltage below level** —Driving torque decrease	1.Battery voltage parameter set error. 2. the battery power run off 3. High resistance of battery 4.The battery ligature disconnection when driving. 5.B+Fuse wire has burnt out ormain contactor has not closed. 6.Check the capacitor voltage under monitoring menu. **Note：** capacitor voltage lower than minimum voltage **limitation when MOSFEET bridge operation.** **Solution：Rise** the capacitor voltage
1，8	**SEVERE OVERVOLTAGE**	**Overhigh valtage** —Motor stopped working —Main contactor disconnect —Electromagnetic brake disconnect —Accelerator failure —Pump lays off	1. The battery voltage parameters set wrong 2. High resistance of battery 3.Battery connection wire disconnection when regenerative braking 4. Check the capacitor voltage under monitoring menu **Note:**capacitor voltage over the maximum voltage **limitation when MOSFEET bridge operation** **Solution：Lower the voltage then restart the key switch.**
2，1	**CONTROLLER UNDERTEMP CUTBACK**	**Controller under normal temperature resulted in performance cut.** —driving and regenerative braking torque reduction	1.Controller works in a maxinum conditions. 2.Check controller temperature under monitoring menu. **Noto：** Cooling temperature is **lower than -30°C** **Solution：elevated temperature**
2，2	**CONTROLLER OVERTEMP CUTBACK**	**Excess temperature results in performance reduce.** --driving and regenerative braking torque reduction.	1.Controller works under limiting temperature condition. 2.Truck overloading. 3.Controller installation error. 4. Check controller temperature under monitoring menu. **Note：Heat dissipation temperature exceeds 85°C** **solution：temperature reduce**
2，3	**UNDERVOLTAGE CUTBACK**	voltage below level results in performance reduction**.** —Driving torquereduce	1.Low battery 2.Set wrong voltage parameter 3.Overtop internal resisitance of cell 4.Disconnect of battery ligature when driving.

			5. Fuse disconnection or main contactor disconnection 6. Check the capacitor voltage which is monitored by programming unit menu. **Note：Too low** capacitor voltage**.** **Solution：Increase** capacitor voltage
2，4	**OVERVOLTAGE CUTBACK**	**Voltage is too high performance reduction** —Torque reduce of Regenerative braking	1.Regenerative braking current resulted in battery voltage increased. 2.Battery voltage parameter seterror 3.Internal resistance of cell is too big. 4.Battery joint disconnection in Regenerative braking 5.Check the capacitor voltage which is monitored by programming unit menu. **Note：** capacitor voltage is more than the highest voltage limitation when **MOSFEET bridge operation.** **Solution：Reduce**capacitor voltage
2，5	**+5V SUPPLY FAILURE**	**Controller output +5V**Power failure —Controller won't work when V CL language executed failure.	Extrnal loading resistance which is connected with +5V supply end (pin 26) is too low. 2.Check the current supply of 5V and Ext which is monitored by programming unit menu. **Note：5V output has more than±10% error.** **Solution：Adjust the output valtage to normal range.**
2，6	**DIGITAL OUT 6 OVERCURREN**	**Drive 6 output overcurrent.** —Drive 6 output cannot be open.	1. Extrnal loading resistance which is connected with output driving end 6 is too low. **Note output current of driving end 6 is out of ：15mA** **Solution：adjust load and set by VCL.** **"set-digout" drive reset.**
2，7	**DIGITAL OUT 7 OVERCURREN**	**Drive 7 output overcurrent** —Drive 7 output cannot be open.	1. Extrnal loading resistance which is connected with output driving end 7（pin20） is too low 的 **Note：output current of driving end 7 is more than 15 mA** **Solution：adjust load then set by VCL.** **"set-digout" drive reset**
2，8	**MOTOR TEMP HOT CUTBACK**	**Overheating motor resulted in performance reduce.** —Reduce the drive torque	1.When motor temperature is reach or higher than procedure set value which results in output lower. 2.parameter set of motor temperature error. 3. If the motor dose not use temperature probe, programme parameterand "Temp compensation" "Temp cutback should set "OFF" 4.Check the motor temperature and Analog2 output uder programming console monitoring menu **Note：** The input voltage value of motor temperature sensor is zero or more than **10V.** **Solution：Adjust motor temperature back to normal range.**
2，9	**MOTOR TEMP SENSOR FAULT**	**Motor temperature probe failure.** —Restrict operation〈Reduced the maximum speed 〉 and cut function when motor overheating	1.Temperature probe connection error. 2.If the motor doesnot use the temperature probe.programe "Motor Temp Sensor Enable" Must be set to "OFF" **Note：Input voltage of moto rtemperature probe is 0 or more than 于 10V** **Solution：Adjust motor temperature back to normal range.**
3，1	**COILL DRIVER OPEN/SHORT**	—Drive 1 output closed	1.Load connection opens a way or shorted . 2.Lead pin of connector is stained. 3.wiring harness damaged or connnection error.

			Note：output driving 1（6 lead pin）opens a way or shorted.this fault only occurs when "Main Enable" is set by "OFF" **Solution ： Make correctly with open circuit/shorted,reset the output.**
	MAIN OPEN/SHORT	**Main contactor coil opens a way or shorted.** —Motor stopped working. —Main contactor disconneted. —electromagnetic brake disconnected. —Accelerator failure —Pump stopped working.	1. **Note：Main contactor coil opens a way or shorted** Main contactor coil opens a way or shorted. 2.Pin of connector is stained. 3.Wiring harness damaged or connected error. **Note：Main contactor coil opens a way（6 lead pin）or shorted** **Only occurs when "Main Enable" is set by "ON"** **Solution ：** Make open/short circuit correctly.**resart output.**
3，2	**COIL2 DRIVER OPEN/SHORT**	**Output driving 2 connection coil opens a way or shorted** —Drive 2 output closed	1. Connection load opens a way or shorted. 2. Connector pin is stained 3. Wiring harness damaged or error connection. **Note：output drive 2 （5 lead pin ）opens a way or shorted. This fault only ocurs when "EM brake Type" is set by "0"** **Solution ：** Make open/short circuit correctly.**resart output.**
	EM BRAKE OPEN/SHORT	Electromagnetic brake coil open/short circuit —Electromagnetic brake disconnection —Accelerator failure —Braking	1. Connection load opens a way or shorted. 2.Connector pin is stained 3.Wiring harness damaged or error connection. **Note：**Electromagnetic brake output**（5 pin）opens a way or shorted.this fault occurs in open circuit of shorted.This fault only occurs when "EM brake Type" is set more than "0".** **Solution ：** Make open/short circuit correctly.**resart output**
3，3	**COIL 3 DRIVER OPEN/SHORT**	**Connecting coil of output drive 3 opens a way /shorted** —Output drive 3 is closed.	1.Connection load opens a way or shorted. 2.Lead pin of connector is stained. 3. Wiring harness damaged or error connection. **Note：output drive 3（4 lead pin）opens a way or shorted.** **Solution ：** Make open/short circuit correctly.**resart output.**
3，4	**COIL 4 DRIVER OPEN/SHORT**	**Connecting coil of output drive 4 opens a way or shorted** —Drive 4 output closed	1.Connection load opens a way or shorted. 2.Lead pin of connector is stained. 3. Wiring harness damaged or error connection. **Note：driving 4 output (3 lead pin) （3 lead pin）opens a way or shorted.** **Solution：make open circuit/shorted correctly,reset output.**
3，5	**PD OPEN/SHORT**	**Proportional valve coil opens a way or shorted.** —Proportion drive is closed	1. Connection load opens a way or shorted. 2.Lead pin of connector is stained. 3. Wiring harness damaged or error connection **Note：** Proportion drive **（2 pin ）** opens a way or shorted. **Solution：make open circuit/shorted correctly,reset output.**
3，6	**ENCODER FAULT**	**Encoder faulty** —Limited operating function takes effect	1.Motor encoder failure. 2. Wiring harness damaged or connection error. 3.Check Motor monitoring menu ： Motor RPM **Note：Controll hasnot received A.B encoder output**

			signal **Solution：fault clearance，and reset the key switch.**
3,7	**MOTOR OPEN**	**Motor open circuit** —Motor lays off —Main contactor disconnected —Electromagnetic brake disconnected —Accelerator becomes invalid —Pump lays off	1.Motor phase 2.Cable damaged of error connection. **Note：Motor U.V.W one phase or multi-phase opens a way .** **Solution:check up the phase,restart the key switch.**
3,8	**MAIN CONTACTOR WELDED**	**Main contactor adhesion** —Motor lays off —Main contactor disconnected —electromagnetic brake disconnected —Accelerator becomes invalid —Pump lays off	1.Contact weld of main contactor. 2.Bad contact of motor U phase or V phase or open a way. 3.Circuit which connected with B+ connection end charges to capacitance. **Note：** Main contactor keep connected too much, Capacitor voltage cannot be released **Solution：Reset the key switch.**
3.9	**MAIN CONTACTOR Did NOT CLOSE**	**Main contactor isnot closed** —Motor lays off —Main contactor disconnected —electromagnetic brake disconnected —Accelerator becomes invalid —Pump lays off	1.Main contactor hasnot closed. 2. Contacts of main contactor oxidation, melt, or not good contact. 3. Capacitance（B+port）is charged by external devices 4. B+fusing wire **Note:capacitor voltage doesnot reach to B+voltage when close to main contactor.** **Solution：check up the contactor and restart the key switch .**
4,1	**THROTTLE WIPER HIGH**	**Little higher of accelerator output** —Accelerator becomes invalid	1.Output voltage of accelerator potentiometer is too high. 2.Check accelerator output of monitoring menu. **Note：** Output voltage of accelerator potentiometer is higher than output voltage limitation（**limitation value can be changed by VCL，setup-pot-faults**） **Solution： Lower output voltage of** accelerator potentiometer**.**
4,2	**THROTTLE WIPER LOW**	**accelerator output lower** —Accelerator becomes invalid	1.Too low output voltage of Accelerator potentiometer 2.Check accelerator output of monitoring menu. **Note：**Accelerator potentiometer（**16 lead pin ）output voltage is lower than output voltage limitation（Limitation value can be changed by VC L setup-pot-faults**） Solution：Increase the output voltage of accelerator potentiometer
4,3	**BRAKE WIPER HIGH**	**Output of potentiometer 2 is overtop.** —Braking completely	1.Output of potentiometer 2 is overtop. 2. Check monitoring menu potentiometer 2 output **Note：Potentionmeter 2 output voltage is higher than voltage limitation（17 lead pin ）** **output voltage is higher than output voltage limitation（can be changed by VCLthrough limitation value，setup-pot-faults**） **Solution：Lower potentiometer output voltage.**
4,4	**BRAKE WIPER LOW**	**Low output of potentiometer 2** —Brake compeletly	1.Lower output of potentiometer 2. 2.check potentiometer 2 outputinmonitoring menu. **Note：**potentiometer **2（17 lead pin ）output voltage is lower than output voltage limitation（Limitation value can be changed by VC L，setup-pot-faults**） **Solution：：** Increase the output voltage of accelerator potentiometer
4,5	**POT LOW OVERCURRENT**	**Low current of potentiometer is too high.**	1.Impedance two low. 2. Check monitoring menu potentiometer low output

		—Speed controller lost efficacy. —Braking completely	**Note：Current of low side of potentiometer （18 lead pin ）is over than 10mA.** **Solution：Reduce the low current and restart the key switch**
4,6	**EEPROM FAILURE**	**EEPROM storage become invalid** —Motor cease —Main contactor cease —Electric brake stopped —Accelerator stopped —Interlocking stopped —1-4 output stops —Proportion drive stopped —Pump stopped —Braking completely	1.EEPROM storage failure.or CAN BUS，or programmer parameter adjustment error. **Note：operating system of cotroller tries to enter to EEPROM ,but failure.** **Solution：Download the correct software（OS），set right parameter of controller，and then reset the key switch.**
4,7	**HPD/SEQUENCING FAULT**	**High footstep protection//Operations sequence error** —Accelerator lost efficacy	1. nput order of Key switch, interlock, direction, and the accelerator i mistakes. 2. Key switch, interlock, direction, and the accelerator input connection bad or switch fault. 3. View the programmer monitoring menu input items **Note：** key start, interlock, direction and the accelerator input set wrong leads to high footstep protection and startup sequence mistakes. **Solution：Input the right order.**
	EMER REV HPD	**High footstep of** Emergency reverse —Accelerator failure	1. Emergency reverse operation stopped , but the accelerator, back and forward input, interlock switch failed to return to neutral **Note：All kinds of outputs have not reset leads to failure.** **Solution：** According to the correct order to carry out the input.
4,9	**PARAMETER CHANGE FAULT**	**Parameter change error/failure** —Motor lays off —Main contactor lays off —electromagnetic brake stopped working. —Accelerator becomes invalid —Pump lays off —Braking	1. Specific parameter parameter should be changed after reseting the key switch. For example,if user changes the accelerator type will lead to this fault.Re-open the electric switch can control the truck. **Note：change the parameter should reset the key switch** **Solution：reset the key switch.**
5,1 — 6,7	**OEM FAULTS**	**OEM level error（user-defined fault）**	1. These faults are OEM level，should be seen by higher level
6,8	**VCL RUN TIME ERRO**	**VCL runtime error** —Motor stalling —Main contactor cease —Electromagnetic brake stopped —Accelerator stopped —Interlocking stopped —1-4 output stopped —Proportion drive stopped —Pump cease —Braking	1. Running time of VCL code overtime. 2. See 1311 controller Monitoring menu：VCL error moldand VCL error. **Note：VCL code error in runtime.** **Solution: internet applications revise error when editting VCL，check the new software to ensure other parameters matching correct.Restart the key switch.**
6,9	**EXTERNAL SUPPLY OUT OF RANGE**	**External power source input out of range.**	1. Input current of external load ,which connected with 5V and 12V is oversize or undersize,. 2. External menu parameter of fault inspection（Ext Supply Max）and minimum（Ext Supply Min） Input adjustment error. 3. See 1311input detection menu：external input current.

			Note：External supply current（mixed current，5V（26 pin）and 12V（25 pin））is out of limitation range，upper limit is defined byExt Supply Max，lower limit is defined by Ext Supply Min **Solution：Adjust the external current.**
7,1	**OS GENERAL**	Operation system fault —Motor stopped —Main contactor stopped —electromagnetic braking stops working —Accelerator stopped —Interlocking stopped —1-4 output stopped —Proportion drive stopped —Pump stopped —Braking	1. Interior controller fault. **Note：Interior controller failure.** **Solution：restart key switch**
7,2	**PDO TIMEOUT**	**CAN PDO acception overtime.** —Interlocking stopped —Set CAN NMT State to Preoperational	1. CAN PDOmessage receive timeis out of PDO limitation time. **Note：CAN PDO time of information reception is out of PDO limited time.** **Solution：restart the key switch or receive CAN NMT information**
7,3	**STALL DETECT**	**Encoder stops detecting.** —electromagnetic braking stop working. —Control mode convert to LOS mode（Limited operatiing state）	1. Motor turns. 2. Motor encoder fault. 3. Wiring harness damaged or wiring error. 4. Encoder power source has problems. 5. See 1311 Motor monitoring menu ：Motor RPM **Note：Cant not be detected the motor encoder.** **Solution：Restart key swtich，or** detect the effective signal of motor encoder in LOS mode,**and set the parameter to Throttle Command=0,** **Motor RPM=0**
8,7	**MOTOR CHARACTERIZATION FAULT**	**Motor matching error** —Motor stopped —Main contactor stopped —Eectromagnetic braking stopped —Accelerator stopped —Pump stopped —Braking	1. Code reference when motor matching. 0=normal 1= Controller receives encoder signal, but pulse quantity not defined. Please manually set pulse values 2=Motor temperature probe failure 3=Motor high-temperature reaction failure 4= Motor overheating reaction failure 5= Motor low temperature reaction failure 6= Low voltage response failure 7= High pressure reaction failure 8= Controller can not detect encoder signal, the channel signals disappeared 9= Motor parameter setting is out of range. **Note：Failure in Motor matching process.** **Solution：Revise mistake and restart the key switch.**
8,8	**ENCODER CHARACTERIZATION FAULT**	**Wrong matching of encoder** —Motor stopped —Main contactor stopped —Eectromagnetic braking stopped —Accelerator stopped —Pump stopped —Braking	1. encoder characteristics describes errors in the step of encoder describe 2. Motor encoder pulse frequency is not a standard values（32，48，64，80ppr）
8,9	**MOTOR TYPE FAULT**	**Motor type Parameter error of** —Motor stopped	1.parameter values of Motor_Type is out of range **Note：Motor_Type** Parameter is set to illegal value

		—Main contactor stopped —Electromagnetic braking stopped —Acceletator stopped —pump stopped —braking	**Solution：reset and re-start the key switch.**
9,1	**VCL/OS MISMATCH**	**VCL/OS mismatching** —motor stops —Main contactor stopped —Electromagnetic braking stopped working —Accelerator stopped —Interlocking stopped —1-4 Output stopped —Proportion drive stopped —Pump stopped —Braking	1. VCL procedure and OS procedure of controller cannot matched. **Note：** VCL procedure and OS procedure of controller cannot matched. **Solution：Update the correctVCL and OS procedure**
9,2	**EM BRAKE FAILED TO SET**	**magnetic brakestetting has lost efficacy** —electromagnetism braking stopped —Accelerator stopped	1. The truck is driving after sent out braking. 2.Braking force of magnetic brake is too small to hold tight the rotation of the motor. **Note：the truck still move after magnetic brake.** **Slotion：Check if the acceletatornormal or not.**
9,3	**ENCODER LOS（ LIMITED OPERATING STRATEGY）**	**Encoder is in a restricted state.**	1. Whether encoder fault (Code 36) or stalled detection fault (Code 73), the result is the limit operation control mode is activated 2. Motor encoder fault 3. Wiring harness damaged or wiring error. 4. Truck turns. **Note：**Because the motor turns or encoder fault, makes the limited operation state activated. **Solution：Restart key switch** **，** If it's because of the motor turning, please ensure that encoder works in normal operating. **，Throttle Command=0,** **Motor RPM=0**
9,4	**EMER REV TIMEOUT**	**emergency reverse reaction has overtime.** —electromagnetism braking stopped —Accelerator stopped	1. Because EMR Timer is out of date,which is actived the urgency reverse . 2. Urgency reverser is always in"on" position. **Note：As to EMR Timer has past due，which resulted in emergency reverse is actived** **Solution：check the state of emergency reverse.**
9,8	**ILLEGAL MODEL NUMBER**	**Wrong type of controller** —Motor stopped —Main contactor stopped —Electromagnetism brake stopped —Accelerator —Pump stopped —Braking	1. Cannot be identified the controller type 2. Software and hardware cannot matched. 3. Controller damaged **Note：** Cannot be identified the controller type **Solution：Select a correct controller and download a correct controller software.**

7.Battery and charger

7.1Summarize

- Property Parameter Table

	1.6、1.8t	2.0t
Storage battery		
Battery capacity	490AH / 5h	560AH / 5h
Battery model	7VBS490	8VBS560

Battery voltage	48v	48V
Electrolyte proportion	1.280g/cm3	1.280g/cm3
Weight	760kg	820 kg
Charger		
Charging mode	Intelligent control, single-phase AC charger	Intelligent control, single-phase AC charger
Rated capacity	4．5KVA	5．5KVA
Power supply voltage	380V／50HZ	380V／50HZ
Suitablebattery capacity	570AH	800AH
Output	65A	70A

7.2Battery

Battery is shelled with steel box,which is installed in series of 24 small batteries (2V,48V)).See figure 6.1.

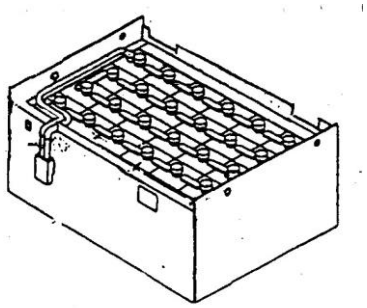


Figure 6.1 Battery assembly

- Use of battery

The most important is the battery do not overdischarge in operation. The deeper discharger, the shorterservice life.（see figure6.2）

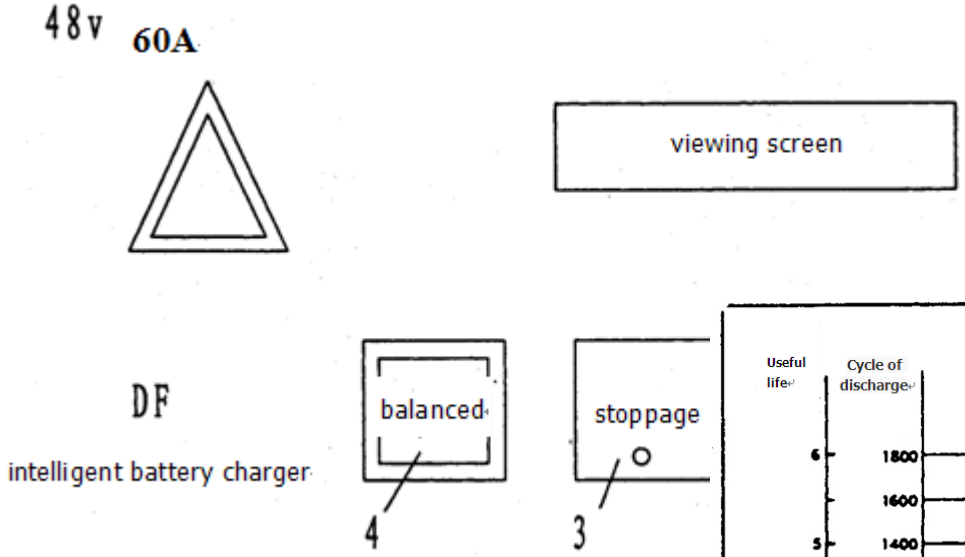
Discharge depth is obtained by proportion measurement.,rough standard as figure 6.3.

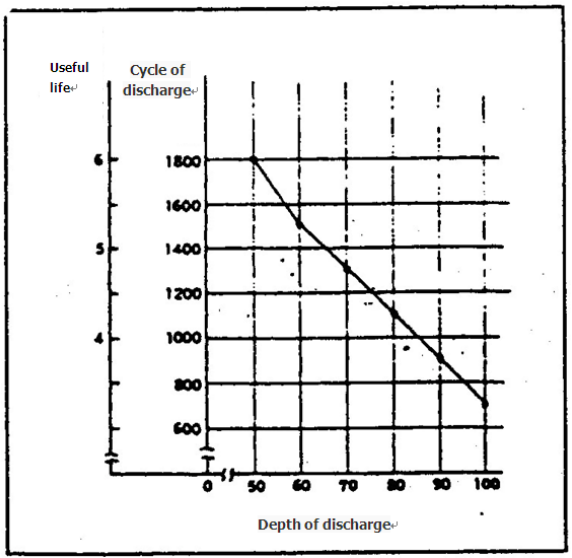
Besides，electrolyte liquid should comfirm every 10 days.

Please add distilled water before charging when liquid insufficient.

7.3 Charger

Charger is composed of controller，power block，transformer,which achieve to intelligentize closed-loop and has the function of fault condition displaying.Detect for battery .Dtrace. closed-loop control automatic is the battery in critical state of charging electrochemical reaction.





▲Charger panel

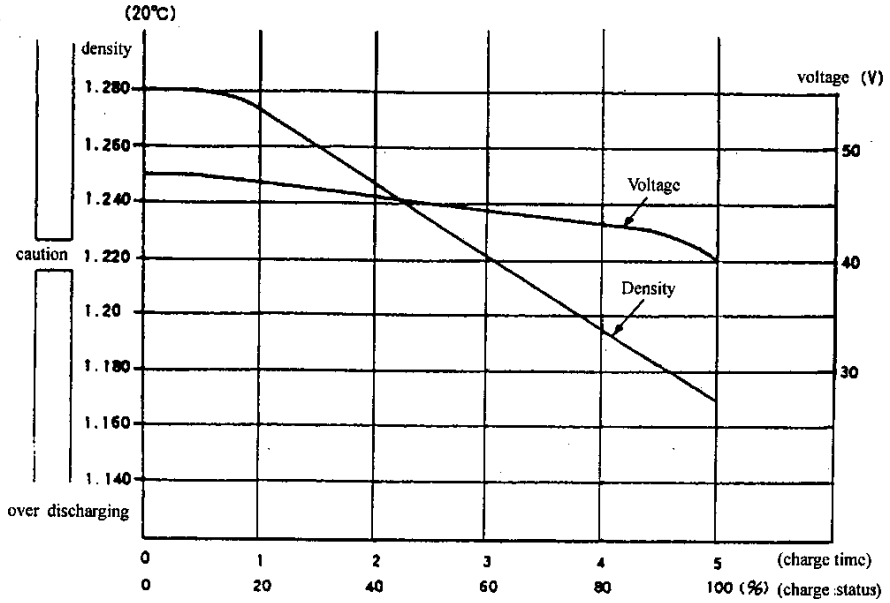
1．Plug in the outlet,open the air switch .indicate “1”

lights up.

2．When the battery is full charging,light “2” bright.and the display screens show“— FULL9’ and float current.

3. Fault indicating lamp “3”lights bright when the charger out of order and the display screens show ."DC-FIND"，details see instruction.

4．Should press the balanced switch when need equalizing charge.then the indicator light “4”brights Up and the display screen shows “－JH ——”，the charger becomes nomal after press again. ’



7.4 Battery charging

After discharge the battery must be charging in time，Discharge state long time storage and could cause the sulfuric acid salinization effect, make performance reduced.Not to use the truck in a long time, each month on a supplementary charge after a complete charge

Especially should charge the battery in time when battery discharged, and should not place more than one day .

measure proportion When discharged little electric quantity，when the proportion si lower than 1．179g/cm3 should be charge

When the proportion difference between each battry is more than 0.020 should have equal charging, always have 1-2times one month. When the D-value cannot reduce under eaqul charging circumstance should re-adjust the proportion.

Equalizing charge too much times will lead to charging excessive, and make service life shortened.

7.5 Charging announcements

(1) liquid temperature in above 50 ℃ before charging , a little set period of time and then start to charge after the liquid temperature become lower.

(2)Over discharge.overcharge may result in liquid temperaturerise. besides，please open the cover compeletly in order to prevent gas filled and heat dissipation difficulty.

▲ Temperature conversion of proportion

Electrolyte proportion changes with the changes of liquid temperature. Generally the proportion of electrolyte in 25 ℃ for fiducial.，out of 25 ℃ situation caculates by the following formula.

25=St+0．0007(t－25)

25……25℃ proportion

St……t℃ proportion (Measured value)

t……Liquid temperature (Measured value)

7.6The way of charging and use

1) Daily charging

Low valtage is shown on instrument when in operation,please charging as follow ways.：

a. Put the forklift to the assigned address，screw the key switch to ""OFF" and then press the attaching plug of battery.Can be hanged out of forklift when its need to replace battery.
b. Make sure imput power of charger is 380V／50Hz,contact capacity should greater than 30A,and should be matched with battery which need to be charged.
c. Electrolyte height should be higher than protected panel 15-25mm or within the rulling of specified stopple.
d. Put the cable plug into the reciprocal charger correctly.
e. Open the air switch, charger will show the present system version.battery voltage,the maximum of charging current,charger enter into automatic detection state.
f. Charger will be enter to the formal charging process after inspection.voltage displaying [＊＊.＊U]，current ［＊＊. ＊A]，Charging time［H＊＊. ＊＊］(show＊＊hour ＊＊minute) and [＊＊＊AH].
g. Battery is full when the indicate lights up,and the charger is into float state automatic.charge current is about1-3A.
h. Close to air switch after charging and breakt he cable plug and charger.
i. Make sure the electrolyte proportion has rise to below numeric value before use.

Liquid temperature	Proportion
5℃	1．294
15℃	1．287
25℃	1．280
35℃	1．273

2) Replenish charging

At the end of the operation，charging the same as daily at break.

When the battery 100％ overdischarge，Battery fill distilled water or all of the battery electrolyte proportion and liquid temperature was converted to 25 ℃ , its more than o. 02 these and other provisions of the storage battery, should have equal charging, balanced charging as the following order:：

Same operation as daily charge,press charging function key"equilibrium",then "balanced" light brights, and charging turns into equalization charging automatic.displaiying JH 一 indication in charging process.，and then artificial press the function key of "equalization" to release.Put the chager into normal condition.

8.Maintainence

Forklift started to use must be elaborate operation, adjustment, maintenance, which make forklift keep for a long time in good working condition. This should take the following measures

(1) New forklift truck work the first 100 hours should replace the gear oil of reducer and screw down again.

(2) Motor, electrical, storage battery should respectively according to the instructions of the provisions of the maintenance

(3) All plug-connecting inspection should be inspect monthly

(4) Pay attention of waterproof, avoid to use the water gun flushing, rainy days should be avoided in outdoor use

(5) Lifting motor switch should remove the dirt of photoelectric coupler

(6) battery surface should be clean, remove dirt constantly.

(7) After normal use, forklift should have regular maintenance as chart.

NO.	Item	Content	Maintenance period	Remark
1	Steering wheel bearing	Change grease	1000 hours	
4	Each motor point of hand braking	Get grease	200 hours	
5	Pinroll of foot brake	Get grease	200 hours	
7	Brake fluid	Append	At any time	
8	Pin roll of dump ram	Apply oil	400 hours	
10	Hydraulic fluid chamber and strainer	Clean	1000 hours	
11	Hydraulic Oil	Change	1000 hours	
12	Lifting chain	Change	3000 hours	Replace at anytime if damaged
13	High pressure airhose	Change	3000 hours	Replace at anytime

				if damaged
14	Switch of lifting motor	Photocoupler get rid of dirt	200 hours	

Record card of maintainence:

Item	Service time	Maintain part	Used material	Maintain staff	Remark

Customer's feedback:

Item	Occurrence time	Stoppage part	Failure cause	Exclusion ways	User

STARKE MATERIAL HANDLING GROUP
402 Allanburg Road • Thorold, ON L2V 1A4 • Canada
TOLL FREE 877-435-4352
www.starkeforklift.com • info@starkeforklift.com

STARKE ENERGY