

STT293

TOWER CRANE

II. OPERATION & SERVICE MANUAL



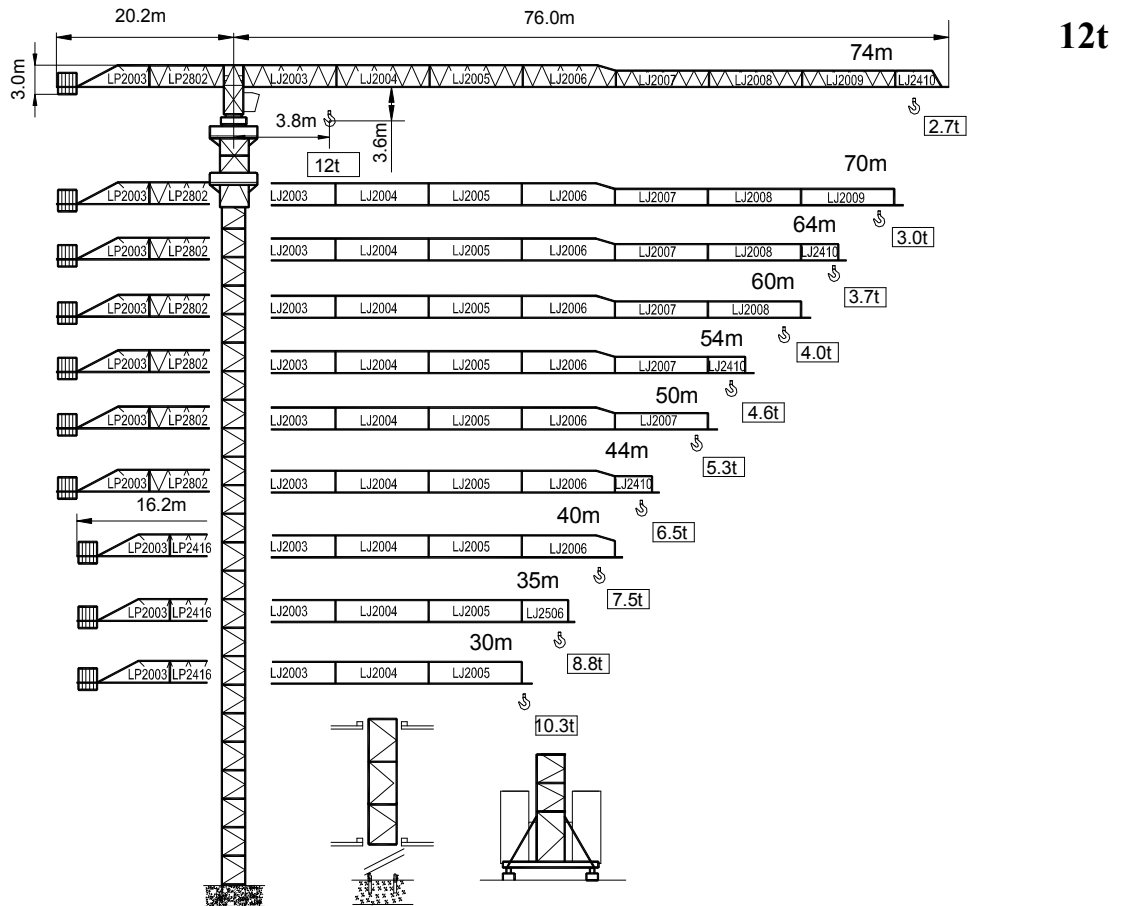
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Fushun Yongmao Construction Machinery Co. Ltd.

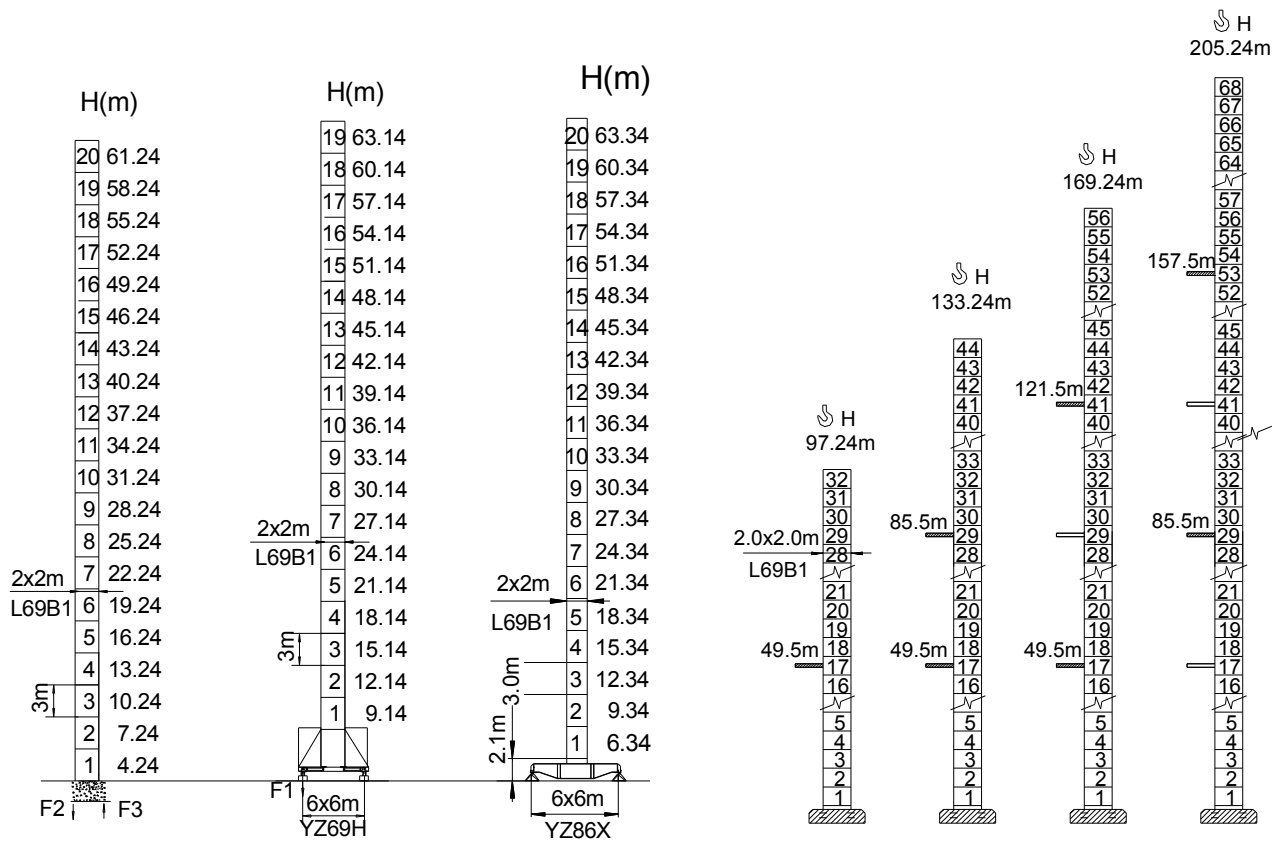
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1. Characteristic Parameter



R	Fall	R(max) m	C(max) t	30	35	40	44	50	54	60	64	70	74
74	IV	20.2	12.0	7.50	6.21	5.05	4.48	3.80	3.43	2.98	2.72	2.39	2.20
	II	37.3	6.0	6.00	6.00	5.55	4.98	4.30	3.93	3.48	3.22	2.89	2.70
70	IV	20.7	12.0	7.72	6.40	5.25	4.66	3.96	3.58	3.11	2.84	2.50	
	II	38.5	6.0	6.00	6.00	5.75	5.16	4.46	4.08	3.61	3.34	3.00	
64	IV	22.3	12.0	8.43	7.03	5.83	5.19	4.42	4.01	3.49	3.20		
	II	41.9	6.0	6.00	6.00	6.00	5.69	4.92	4.51	3.99	3.70		
60	IV	22.1	12.0	8.37	6.98	5.84	5.20	4.43	4.02	3.50			
	II	42.0	6.0	6.00	6.00	6.00	5.70	4.93	4.52	4.00			
54	IV	22.3	12.0	8.46	7.06	5.95	5.30	4.02	4.10				
	II	42.7	6.0	6.00	6.00	6.00	5.80	5.02	4.60				
50	IV	23.2	12.0	8.88	7.43	6.26	5.62	4.80					
	II	44.8	6.0	6.00	6.00	6.00	6.00	5.30					
44	IV	25.9	12.0	10.10	8.50	7.17	6.50						
	II	44.0	6.0	6.00	6.00	6.00	6.00						
40	IV	26.4	12.0	10.35	8.74	7.50							
	II	40.0	6.0	6.00	6.00	6.00							
35	IV	26.4	12.0	10.35	8.80								
	II	30.0	6.0	6.00	6.00								
30	IV	26.4	12.0	10.35									
	II	30.0	6.0	6.00									



	●	■			●	■
F2	182t	222t		F1	118t	130t
F3	126t	173t				
⊗	95t			⊗	107t	

● Reaction force in service ■ Reaction force out of service ⊗ Freestanding height (without counter-weight and base ballast weight)

Mechanisms main characteristic parameters

Name		Code	m/min	t	m/min	t		Kw
Hoisting							630m >630m*	55
		55LFV30B	0—44	6.0	0—22	12.0		
		55LFV30BB	0—53 0—88	4.0 1.7	0—27 0—44	8.0 3.5		
Trolleying		7.5DFV08		0→69				7.5
Slewing		7.5RFCV		0—0.8 rpm				2×7.5
		RTC290		0—0.8 rpm				2×145N.m
Traveling		RT		12.5-25 m/min				4×2.6/5.2

* please contact us

2. Safety rules

2.1 The regulation of correct used

- 1) It is forbidden to use the tower crane which has not passed the performance test;
- 2) According to the technical regulation and method of use, the crane must be used in its good condition. Pay more attention to the safety to prevent the dangerous! Eliminate all kinds of malfunctions in time which may cause the safety accident;
- 3) Operate the tower crane in specified scope of temperature: (-20°C~+40°C);
- 4) Operate the tower crane in specified limit of wind speed (the max. wind speed for operating is 20m/s, the max. wind speed out of service is 50m/s);
- 5) Observe the regulation in operation manual and regulation related to service and maintenance.

2.2 Safety measures

- 1) The operator should read the operation rules before operating the tower crane;
- 2) The operator should always remember every safety measure and recognize the hazard, meanwhile the operation rules should be visible;
- 3) It's forbidden for the operator to be with long hair, wearing robe or wearing jewelry;
- 4) Often read the warning board about safety and preventing from hazard;
- 5) If the crane is in abnormal condition, stop operation immediately and report it to the interested person;
- 6) It is forbidden to change or add any parts of the crane, unless the tower crane manufacturer permitted;
- 7) Service, lubricate and debug the tower crane according to the cycle specified in operation manual;
- 8) The crane operator should know the position of fire proofing equipment, and grasp the method of using it.

2.3 Personnel selecting and their qualifications

- 1) The tower crane must be operated by qualified person;
- 2) The crane operator must be trained. There must be a specific regulation about the ability of driver, erector, maintenance and service person;
- 3) Crane operators should clarify their responsibility, and make them know that they should refuse all the orders which act against the safety;
- 4) The experienced personnel must supervise on jobsite when the tower crane is operated by trainees or learners.
- 5) The installing, debug and maintenance of electric equipment must be operated by competent electrician.
- 6) The debug and maintenance for each mechanism must be operated by professional person;
- 7) The installing, debug and maintenance of hydraulic devices must be operated by experienced person.

2.4 The safety rules during working stage

1) Every time before starting up:

- a). Give audience to the order of jobsite supervisor;
- b). Switch on the power supply;
- c). Remove the cushion block, release the rail clamping device and other fixing devices (wind speed $\leq 13\text{m/s}$);
- d). Check that there is no obstacles on the track;
- e). Cancel the jib weathervane condition;
- f). Check that all the protective devices and safety devices are in normal condition.

2) In service

- a). The driver should operate the crane in the cabin;
- b). Test the motion of each mechanism with no load and low speed;
- c). It is forbidden to use any operating mode which may threaten the tower crane safety;
- d). Before traveling, drive the jib to the center line of the track;
- e). It is forbidden to pass the load over the person when the crane is in service;
- f). It requires someone to guide when the load is out of the sight of the driver;
- g). It is forbidden to sling overload out of the specified radius;
- h). It is forbidden to sling heavy load when the load has not been hang firmly;
- i). It is forbidden to canting pull the load;
- j). It is forbidden to sling the load which has fixed to the ground;
- k). It is forbidden to stop normal motion by emergency stop button; it only can be used in exceptional case which may threaten the safety;
- l). It is forbidden to use limiter and brake as an normal stop device;
- m). It is forbidden to short-circuit, change and adjust the safety device, or obstruct its normal operation;
- n). When the max. wind speed is less than 20m/s, the load should be lower than $1\text{m}^2/\text{t}$.
Stop working if the wind speed reaches to 20m/s;
- o). Make sure that there is no obstacle enters into jib slewing area after the tower crane traveling;
- p). If the crane operation is in bad condition, stop immediately and send somebody to repair;
- q). Make sure that there is enough distance between the tower crane and air electric wire;

3) After one day's work:

- a). Lift the hook below the limit point, meanwhile it is forbidden to leave any load on the hook;
- b). Drive the trolley close to the mast;c). Starting up the weather-vane effect;
- d). Grip the clamp rail devices on the track;
- e). Cut off the power supply and locked.

2.5 Maintenance and fault clearance during the tower crane operation

- 1) Debug, maintenance and check-up each part of the crane according to the method and cycle specified in operation manual; and replace some parts and devices according to the regulation;
- 2) If it needs to service and maintenance the tower crane with power off, adopt necessary measures to prevent false starting of the crane. First, lock the power supply panel and take off the key. Second, hang warning plate on the panel;
- 3) If it needs to dismantle some safety devices during service and maintenance, after this, it should be assembled and readjusted.

2.6 Instruction for special dangerous

- 1) When operating tower crane near the air line, there should be enough distance between the tower crane and air line.
 - a). Once the tower crane connected with the air line, the driver should stay in the cab, to prevent from getting an electric shock;
 - b). Drive the crane out of dangerous zone at once;
 - c). Notify the person around don't close to the crane;
 - d). Cut off the power supply which connected with the air line;
 - e). Don't leave the tower crane unless you can confirm that the electric wire has been cut off
- 2) Maintenance of the electrical equipment only can be carried out by qualified electrician or trainee which is supervised by a qualified electrician according to the electrical rules.
 - a) The tower crane must be cut off the electricity during maintenance and repair, meanwhile set up a warning plate of "manned operation, prohibit switch on" on the obvious position of power supply panel, then earth or short circuit the power line (after this, do please dismantle the earthing and short circuit line);
 - b). The electrical equipment of tower crane should be checked periodically. If discover some hidden danger, such as connection loosen, electrical wire earthing, component breakage, etc, it must be eliminated in time;
 - c). If it must carry out live-wire work, there should be someone to monitor, so that the main power supply can be cut off in emergency situation.

2.7 Hydraulic system

- a). Only the professional or experienced person can operate the hydraulic system;
- b). Periodically check every kind of conduct pipe, flexible pipe and joint, so that check up the oil leak and external malfunction, if so, eliminate it immediately (oil leak may cause damage and fire);
- c). Release the component pressure according to the relevant regulations before repairing.
- d). Install the hydraulic pipe line correctly. Do not connect the high and low pressure interfaces in reverse. Meanwhile, the joint length and quality of the flexible pipe should meet the requirement;
- e). Hold the oil quantity and quality in the oil box.

3. Operation

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Important notice:

A thorough debug must be made upon finishing the installation and erection of the tower crane. The tower crane can only be put into service when it is approved by local safety authorities with the issuance of license.

3.1 General rules

The tower crane driver must be the qualified person who has trained by authoritative board of labor or specified units and passed the exam.

The driver must operate, service and maintenance the crane correctly. It is important for reducing failure, improving device availability, avoiding loss of working time and prolonging service life of equipment.

Incorrect operating will result in damage of all electric motors, reducers, drums, brakes and wire ropes, even the integral steel construction. What is more, it may cause serious mechanical accident and result in personnel loss.

3.2 Operation highlights

- 1) The control panel is finishing equipment. It must be careful when operating it.
- 2) The control lever must be operated slowly when starting or stopping.
- 3) Change shift one by one, it is forbidden to get over shift.
- 4) It is forbidden to disobey sequential operation when stopping some action.
- 5) The control lever should turn to zero position gradually when actuating device making reverse movement. Operate until the mechanism completely stopped.
- 6) It is forbidden to operate the crane which safety device has a failure, unsoundness or inaccurate, furthermore it is forbidden to pick off or sealed the safety devices.
- 7) Once discover some failure, it must be stopped and checked immediately. It is

forbidden to operate the crane with failure.

- 8) The driver is entitled to refuse the command which against the safety rules.
- 9) The driver must master the moment curve, the max. load, the min. load (at the jib end) and the load under hook in random radius.

3.3 Operation instruction

3.3.1 Starting

- a) Check the tower crane before everyday starting according to the instruction regulation. If there is any problem, report it and it is not allowed to start any more.
- b) Switch on the main power supply and press down the start button.
- c) Test the working condition of all mechanisms with no load and low speed, check the limit devices of all mechanisms.
- d) Check that whether all safety devices are integrated and acting reliable.

3.3.2 Operating the hoisting winch

- a) Confirm the lifting load radius according to the moment curve (or table).
- b) Estimate the weight of lifting load
 - Lift the load 1m high slowly in small radius.
 - Move the load forward slowly by changing radius of trolley with low speed.
 - Stop forward movement when moving to the position of moment limiter.
 - Confirm the radius of trolley stopping position.
 - Estimate the weight of load according to moment characteristic diagram (table) and radius.
- c) Use the min. lifting speed before the wire rope tightened up.
- d) Use the min. lowering speed when lowering load.

- e) Use the medium speed when start lifting (after load taking off the ground) or be over lifting.
- f) If the height is allowable in normal lifting, use the rated speed of motor instead of medium speed.
- g) The speed was selected as per the weight of load. Heavy load selecte low speed (PV) and light load selecte high speed (GV).
- h) Stop moving before operating the stroke limiter.
- i) Don't put the hook on ground.
- j) Loosen the wire rope slowly to avoid rope winding when placing load.

3.3.3 Operating the slewing mechanism

- a) Select the slewing speed according to the shift to be reached.
- b) Every time use the max. speed as long as the angle allowed.
- c) If the slewing mechanism suddenly changes its speed, it may cause the mast twisting and jib swing. So acceleration and deceleration operation must be done gradually.
- d) It is forbidden to stop the jib by slewing brake. It should decelerate first, and then release the control lever, so that the brake can brake in minor slewing speed.
- e) The slewing brake can only be used in windy condition, which can keep jib in its position.
- f) When slewing the jib, it is recommended to operate the lifting or lowering movement at the same time, to avoid distorting of the wire rope and it is convenient for the rope swivel to work.
- g) Stop the slewing movement before slewing limiter start to work.

3.3.4 Operating the trolleying winch

- a) The trolley speed is selected by the distance of the trolley.
- b) It must accelerate or decelerate gradually to avoid swing when suddenly changing the shift of trolley operation.
- c) Stop the trolley movement before operating the trolley limiter.

3.3.5 Operating the traveling mechanism

- a) The traveling speed is selected by the distance of traveling.
- b) In order to ensure the tower crane safety, when it travels in the track, the trolley must be at the jib foot; if operating in the track curve, beside keep the trolley in the jib foot, it must travel with low speed. Meanwhile it is forbidden to keep the jib facing toward the inside of curve track.
- c) Before traveling to the end of the track, the tower crane operation must be stopped.
- d) There are two brakes in the traveling motor, one of them used for buffering and decelerating, the other used for stopping the crane movement which via 6-8 seconds time delay after powering off and automatically braked. After the control lever return to zero, the crane can still run a few meters, so this operation should be done in advance.
- e) Attention during crane traveling:
 - Warn people to leave the dangerous areas by hailer;
 - Observe that if there are some obstacles on the track;
 - It is forbidden to make the cable pileup or pull too tight.
- f) When tower crane traveling, the jib must be in the centerline of the track.

3.4 Precautions during operation

The working environmental temperature of tower crane is: $-20^{\circ}\text{C} \sim +40^{\circ}\text{C}$, the max. working wind speed is 20m/s and working grade is A4.

3.4.1 Each time before operation

- a) Make sure that the power supply, cables and switches are in perfect condition.
- b) Make sure that each pin, bolt and split pin are in normal condition, restrict the jib slewing freely (release the weather-vane effect).
- c) Make sure that the counter-weight blocks and base ballasts are fixed firmly.
- d) Check the hoisting and trolleying wire ropes.
- e) Check the lubricating condition of hoisting reducer and slewing ring.
- f) Switch on the power supply.
- g) Test all mechanisms with no load and check each mechanism, brake and limiter, if necessary, readjusted it.
- h) If the working height of tower crane is beyond 50m, an anemoscope must be installed. If the wind speed exceeds 20m/s, it can sent audible and visual alarm, then the tower crane must stop working.

3.4.2 During operation

- a) Never lift load beyond the permitted radius.
- b) Never pull load in an oblique direction.
- c) When entering into the cabin, check that whether the extinguisher, instruction plate and warning plate are in place.
- d) Check that whether the hailer is in perfect condition.
- e) Never lift load or other components which fixed on the ground.

 **Special notice:** If hear some abnormal noise, stop operating the tower crane immediately, and inform to the site supervisor; if the wind speed reaches to 20m/s, and sent audible and visual alarm, it must stop working; if the load is out of the sight of the driver, there must be someone as a guide; never cancel any safety device or adjust at random without authorization.

3.4.3 Each time after operation

- a) Lift the hook to the top end
- b) Drive the trolley to the jib foot, start the weather-vane and brake device, to make the jib slewing freely (weather-vane effect). If power off, manual operate this device. For traveling type of tower crane, anchor the crane by 4 rail clamping devices.

Note: The weather-vane effect, that is to say, above the upper slewing of the tower crane can slew freely, it can reduce the windward area automatically. Thus the crane driver must start the weather-vane effect after he is off duty.

- c) Turn off the main power supply switch and take the measures against rain.
- d) Press down the emergency stop button, and cut off the power supply.

3.4.4 Periodical inspection

3.4.4.1 Electricity

Inspection item	Cycle	
	After each erection	One month
Check the max. value of tower crane supply voltage		✓
Check that whether the connection of earth wire is in good condition	✓	✓
Check the connecting condition between tracks and between tracks and earth conductor		✓
Check the earth resistance of tower crane		✓
Check the insulation resistance of electric equipment		✓
Check the motion of relay in each circuit, which can protect the tower crane safety		✓
Check the insulation resistance of motor		✓
Check the contact condition of switch contact in circuit		✓
Check that whether the connecting terminal in each electrical panel and resistance box (including the inner binding screw and nut) is tightened up.	✓	✓
Ensure that every electrical component is in good condition, and connecting wire for them has already been tightened up	✓	✓

3.4.4.2 Machinery

Inspection item			Cycle	
			After each erection	One month
Metal structure	Mast verticality and levelness		√	√
	Visual inspection of gear ring bolt			√
	Tighten up of slewing gear ring bolt		√	√
	Visual inspection the fishplate connection on standard mast, jib, counter jib and fixing plate on base plate, including pin, split pin and bolt.		√	√
	Detect the crack of section steel and check the weld joint		√	√
Mechanical parts	Adjust and check the brake with max. load	Hoisting winch		√
		Slewing mechanism		√
		Trolleying winch		√
		Traveling mechanism		√
	Check the worn out of wearing plate	Hoisting winch	√	√
		Slewing mechanism	√	√
		Trolleying winch	√	√
		Traveling mechanism	√	√
	Check the oil level of reducer	Hoisting winch	√	√
		Slewing mechanism	√	√
		Trolleying winch	√	√
		Traveling mechanism	√	√
		Cable drum	√	√
		Hydraulic push rod	√	√
Others	Check the hook, hook pin and clamping plate		√	√
	Adjust the tensile force of trolley wire rope			√
	Check the wire rope and joint		√	√
	Check that whether the swing pulley is in perfect condition			√
	check that whether the prevent twist hook at fixing point of hook end is in perfect condition		√	√
	Check the automatic locking device in 2/4 fall or double trolley locking device		√	√

3.4.4.3 Safety devices

Inspection item	Cycle			
	Before everyday work	After changing fall	After each erection	One month
Load limiter	✓	✓	✓	✓
Moment limiter	✓	✓	✓	✓
Hoisting limiter	✓	✓	✓	✓
Slewing limiter	✓	✓	✓	✓
Trolleying limiter	✓	✓	✓	✓
Traveling limiter	✓	✓	✓	✓
Prevent rope broken devices	✓	✓	✓	✓
Prevent shaft broken devices	✓	✓	✓	✓

3.4.4.4 Lubrication

Inspection item		Cycle	
		After each erection	One month
Hoisting winch	guide pulley of hoisting wire rope	√	√
	bearing or axle box of hoisting drum		√
	lubricate the grooved clutch gear	√	√
	ball thrust bearing of prevent twist device for hoisting hook	√	√
	hoisting wire rope	√	√
	the prevent twist device of wire rope for jib end	√	√
Slewing mechanism	slewing ring		√
	external gear ring	√	√
Trolleying winch	bearing of drum		√
	trolley guide pulley		√
	wire rope		√
	The tensioner or tension spring of the wire rope		√
	hook assembly		√
Traveling mechanism	gear ring on driving bogie wheel		√
	roller support of driven bogie and motor		√
	ball gear ring for track curve device		√
Cable drum	bearing of drum		√
Safety devices	pin, spring, pinion, prevent rope broken device		√
Hinge of pivot joint	cabin door, turned-door		√
Track	wheel rim side of the bogie		√

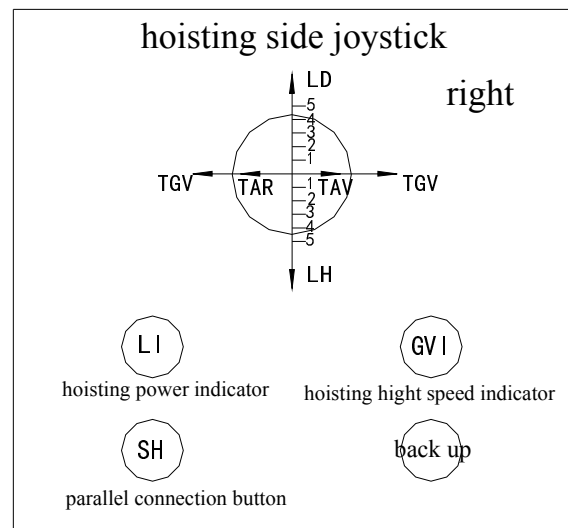
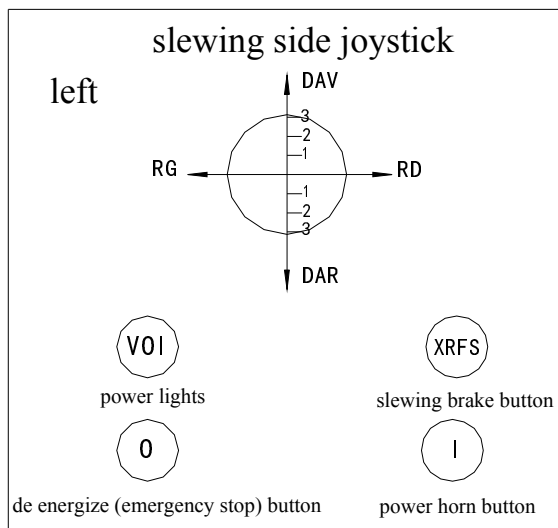
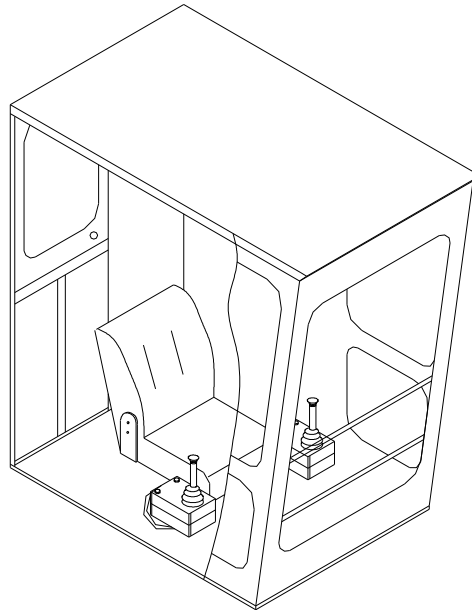
3.5 Operation

3.5.1 Control panel layout and operating method

There are left control panel and right control panel on both side of the seat (they are also called joystick).

There is a control lever in the center of the joystick. (See Figure of lever operating)

Cabin



RG : Slewing to the left
DAR : Trolley-in
LH : Hoisting
TAR : Travelling backwards

RD : Slewing to the right
DAV : Trolley-out
LD : Lowering
TAV : Travelling forwards

On the left control panel:

1). Power supply button (also horn button,) symbol  ; warning light VOI and de energize button (emergency stop button) O. First, turn the emergency button to the right till it was sprung out. Then press the power supply start button, the power supply of the tower crane was started up (main contactor P of electrical control panel A start work) while the horn hooting and warning light shining. When press the de energize button (emergency stop button) O, the power supply is turned off (main contactor P of electrical control panel A is released). The de energize button cannot reset (turn back) automatically. If required, turn it to the right until it springs up by itself. Press the button to cut off current when the crane is out of service or to meet the emergent requirement, such as the contactor attaching mechanism is out of control or other emergency requiring current break.

2). Slewing brake button XRFS, Graphical symbol  with functions as follows:

In the windy working circumstance and the wind speed is under 20m/s, it's necessary to hoist a load in fixed point. As the button was pressed down, the slewing brake de en energize and braked, which made the jib fixed in proper place. **Only use the brake button XRFS after the jib was fully stopped, so as to prevent the tower mast from distortion.** The control lever in left control panel can move in various directions. When push the lever forward, trolley-out **DAV**, in reverse **DAR**. When push the lever to the left, the jib slewing to the left **RG**, in reverse **RD**. There are three shifts respectively for moving forwards and backwards, while the lever can be pushed at random towards left or right without limit of shift. The bigger the turning angle of the lever is, the faster the speed of slewing will be. The lever can also pushed in oblique direction (to be controlled in the form of *) which drive both the trolleying and slewing operate in 2 direction at the same time.

The right control panel is equipped with:

Parallel connection button SH, Graphical symbol , with functions as follows:

The button is used in special case, such as telescoping, changing falls, and so on. When move the trolley-in or raise the hook and the limiter cut off, press down the button **SH**, continue operating, until the trolley reaches to the jib root or making the hook reaches to a highest position to finish the aforementioned job.

As shown on the panel, the lever in the right control panel can be pushed in accordance with “+” instead of “*”, that is to say, the lever can not be pushed in oblique direction. When pushing the lever forward, the hook lowers down. (When pushing the lever to the left or to the right (TAV, TAR), the tower crane travels. But for the cranes with anchorage or inside climbing cranes, there is no such kind of control lever and no control circuit setting on the panel.)

There are locking devices and zero protective devices for preventing the lever from unconscious movements, which is likely to run mechanisms and result in accidents. The power supply cannot be started up if the lever is not in neutral (zero) position. Take hold of the lever as shown in figure and lift the locking pin up, then push the lever. Before lifting the locking pin, it was strictly forbidden to push the lever, which may damage the mechanical parts.

The levers on both the left control panel and the right control panel have the same function of auto-reset (returning zero).

3.5.2 Precautions during operation

- 1) Observe the safety regulations strictly during operation. The operation which might influence the tower crane safety is absolutely forbidden. For example, lift a load buried in the ground; slings (rope clamps) are not in line with relative requirement or is damaged; the load is not bundled or colligated firmly; lift a load in oblique direction or operating after drinking and so on.
- 2) During all mechanisms operations, it was forbidden to use **lower shift** for a long time (**not exceed 10 seconds according to the regulation**), the shifts should be increased or reduced gradually, the time between two shifts should be **not less than 1~1.5 seconds**. During lifting operation, the shift 4 and shift 5 are not permitted to change so frequently which may damage the mechanical parts. When moving the trolley, try your best to switch from shift 1 to shift 2 then shift 3, and in the slewing operation, the lever control is required to be handled harmoniously.

In any case, it is absolutely forbidden to operate in reverse direction suddenly or press down the brake button forcibly during jib slewing.

- 3) Put the tower crane into weather-vane effect when one day's work has finished.
- 4) During operation, provided that the tower crane takes into trouble, please call on service man in time. It is forbidden to operate the crane with malfunctions. **In any case, for all kinds of safety devices which have adjusted correctly during their initial installation and calibration** (hoisting moment limiter SLMO, trolleying moment limiter SDMO, trolleying reducer RDMO, load limiter SLCHPV, limiting load speed SLCHGV1, SLCHGV2), **it is absolutely forbidden to modify their adjustments.**
- 5) Lubricate the crane during operation in accordance with relevant regulations (see "13B: Maintenance"). Pay special attention to the lubrication and worn state of the steel wire ropes (see "11B: Code for installation, examination and discard of steel wire rope for machinery").

3.5.3 Operation of weather vane effect (unlock the slewing brake):

- 1) When the tower crane is out of service, press down the button for 1S~2S, which is in the side of electrical control panel **HF**, the indicator lamp of weather vane lights up.
- 2) Cut off the power supply of left control panel by means of the break button O. At this time, the slewing brake is unlocked (in release state). At last, cut off the main power supply of the crane.
- 3) Unlock the slewing brake manually (in release state) (see “7B: slewing mechanism).

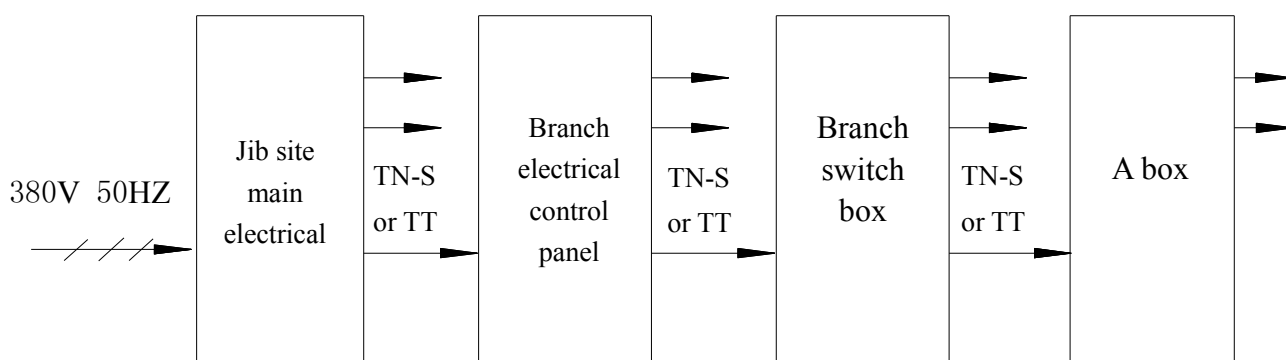
4. Power supply and schematic diagram

4.1 Power supply.....	4B-2
4.1.1 Power supply.....	4B-2
4.1.2 Earthing.....	4B-3
4.1.3 Power supply capacity and supply voltage requirement	4B-4
4.1.4 How to see electrical schematic diagrams	4B-4
4.1.5 Electrical schematic diagram symbol	4B-5
4.1.6 Electrical schematic diagram figure	4B-7
4.1.7 Wiring diagram of cable	4B-8

4.1 Power supply

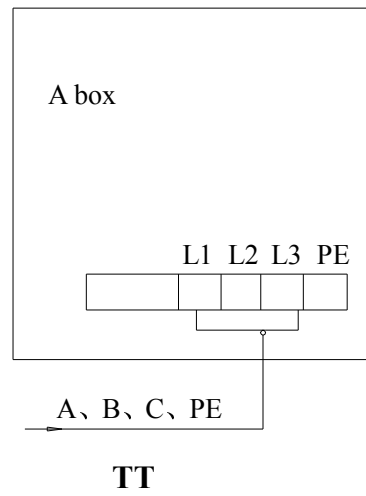
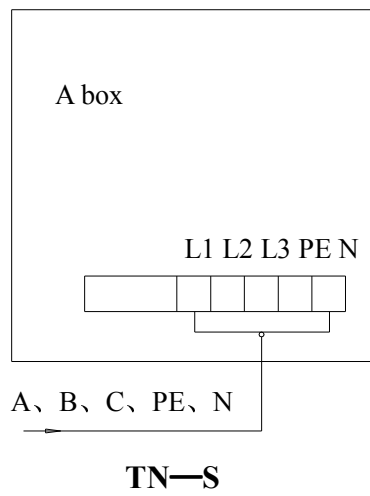
4.1.1 Power supply

Install the electrical equipment of tower crane according to the national standard requirement. ST series tower crane meet the relevant regulations in design and manufacture, the management regulation of power supply use on jobsite and the requirements of TN-S three-phase five-wire system or TT three-phase four-wire system power supply. The jobsite power supply must meet the national construction department requirements, the power supply use requirement “third class distribution and two class protection”. The following system diagram is for your reference:



Note:

- 1) Both the branch electrical control panel and branch switch box are equipped with air switches and leakage protectors.
- 2) The operating parameter of leakage protector in branch switch box: $\leq 250\text{mA}$
- 3) The user can select the installation method of TN-S or TT according to the local supply network administrative regulations.
- 4) All the devices before A box (including cable) should be prepared by user.

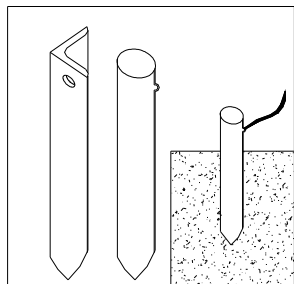
Connection mode of power supply entering into A box:

The tower crane must be earthed properly, no matter which mode of power supply it adopted.

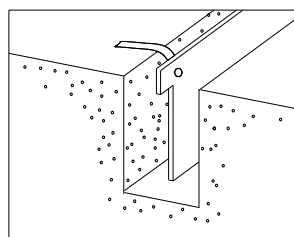
4.2 Earthing

Attention: The earth conductor of crane must neither include a fuse nor the core of a switch or a cable.

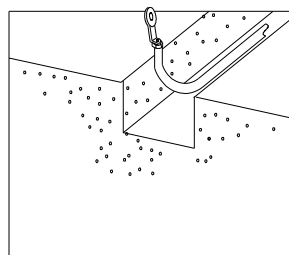
There are three types of earthing:



A. The earth substance is made of normal earth stake, either use $\phi 33 \times 4.5 \text{ mm}$ (length: 1.5m) tube or L70x70 (length 1.5m) angle.



B. The earth plate is made of steel plate or other stretched metal plate with an area of 1 m^2 . It was vertically buried 1.5m depth from the ground surface.



C. The copper conductor with cross section more than 28 mm^2 or iron conductors with cross section more than 50 mm^2 is buried in the wire casing. The buried depth is to be determined by the earth resistance.

In above earthing methods, the copper conductor section coming from the earth substance should be more than 25 mm^2 . If the soil conduction is poor, buried sodium chloride (salt) in the soil and pour some water. For traveling type of tower crane, each section of rails must be electrical connected, and the two rails must be electrical connected. The earth resistance is less than 4Ω .

4.3 Power supply capacity and supply voltage requirement

The requirement power voltage of **ST** series tower crane is in accordance with **CE138** and China National Standard: **50HZ/60HZ, 380V±5%**. This power voltage refers to the terminal voltage of Panel A during operating the tower crane. If the real power voltage is lower than this value, the capacity of transformer and the distance should be inspected and adjusted, or increase the cross section of power supply conductor.

Type	STT293(12t)	STT293(18t)
Power supply capacity	120KVA	140KVA

4.4 How to see electrical schematic diagrams

In the process of installing and service, it often needs to look up the electrical schematic diagram with the purpose to complete the installing and service work more quickly and accurately. The schematic diagram adopt letter symbols and graphic symbols in coordinate drawing which meanings could be find in the table 4-1-1 and 4-1-2. Horizontal coordinate numbers are under every electrical schematic diagram, there is a vertical line under every contactor (relay) coil graphic symbols, which marked coordinate numbers at both sides. It shows the quantity of main switch and auxiliary switch which the contactor (relay) used and the coordinate positions on the drawing. The number on the upper right quarter shows the position of auxiliary switch (contact). With transverse line above the number is NC switch (contact), and without this line is NO switch (contact). Arrow marked beside the number is time relay switch and the coordinate number marked at the lower left quarter of vertical line shows the position of main switch (contact). When a contactor (**relay**) was in working condition, look for the control position of contactor switches (**contact**) on the drawing coordinate as per number under the coil symbol.

4.5 Electrical schematic diagram symbol (see Table 4.5-1)**Table 4.5-1**

Symbol	Description	Symbol	Description
LI	Hoisting power indicator	LFaK	Hoisting brake auxiliary relay
GVI	Hoisting high speed indicator	GVK	High speed indicate relay
XLH	Hoisting 1 st shift	LDi	Hoisting air switch
XLD	Lowering 1 st shift	React	Reactor
XL2	Relay (2 nd shift)	LFV	Hoisting FC converter
XL3	Relay (3 rd shift)	BU1\BU2\BU3	Braking unit
XL4	Relay (4 th shift)	L/PG	Socket for L box to encoder
XL5	Relay (5 th shift)	L/SL	Socket for L Box to moment and proving ring
SBO	Reset button	L/R	Socket for L box to L1,L2 resistance
SH、SM	Short circuit hoisting limiter button	L/K	Socket for L box to K box control wire
SLMO	Hoisting moment	L/LM	Socket for L box to motor control wire
SLchPV	Max. load switch for proving ring	Bz	buzzer
SLchGV1	Proving ring limiter 4 th switch	EC	Cab light
SLchGV2	Proving ring limiter 5 th switch	ECB	Switch for cab light
RLH	Hoisting deceleration limiter	ECDi	Breaker for cab light
SLH	Hoisting stop limiter	A	hailer
RLD	Lowering deceleration limiter	An	anemoscope
SLD	Lowering stop limiter	XDv	Joystick control trolley forward switch
LM	hoisting motor	XDr	Joystick control trolley backward switch

Symbol	Description	Symbol	Description
R	Hoisting brake resistance	XD2	Joystick control trolley 2 nd switch
PG	encoder	XD3	Joystick control trolley 3 rd switch
LVeM	Hoisting blower fan	RDMo	Reduction switch for fixed radius
PTC	Hoisting thermistor	SDMo	Switch for fixed load variable radius
LTS	Hoisting control transformer	RDv	Trolley forward deceleration switch
TSDi\TSDi1 FanDi\PLCDi	Small breaker	SDv	Trolley forward stop switch
BS	thermostat	RDr	Trolley backward deceleration switch
XKM	Hoisting main relay	SDr	Trolley backward stop switch
KM	Hoisting main contactor	LO	Auto lubricating system control button
LFa	Hoisting brake contactor	LOW	Auto lubricating system oil level switch
Fan	Fan	S	Auto lubricating system cycle switch
PLC	Programmable controller	DFa	Trolley brake contactor
X1\X2\X3	Obstacle light	DFaK	Trolley brake relay
MHR	Hoisting sensor	AOK	Auto lubricating system relay
MDR	Trolley sensor	SD	Parallel connection relay
SLCL	Proving ring sensor	BZK	Buzzer relay
MONITOR	Indicator	LMM	Power supply for indicator
DFS	Trolley brake	DFV	Trolley FC converter
R	Trolley energy consumption resistance	XRGi1	Relay for weathervane effect
DM	Trolley motor	XRGi2	Relay for weathervane effect
RFs1\RFs2	Coil for slewing brake	TSR	Control transformer

Symbol	Description	Symbol	Description
GiFa1\GiFa2	Coil for weathervane	TSD	Control transformer
G1\G2	Weathervane switch	RD	Left slewing contactor
XRFs	Lock jib button	RG	Right slewing contactor
SRD	Slewing right handed limiter	XRa1、XRa2	Brake relay
SRG	Slewing left handed limiter	RFa	Slewing brake contactor
PXR	Slewing potentiometer	XRD	Left slewing auxiliary relay
RRa1\RRa2	Vortex coil	XRG	Right slewing auxiliary relay
RM1\RM2	Slewing motor	T	Terminal board
HVeM1 HVeM2	Slewing blower fan	MTC	Slewing silicon controlled
GT	Telescoping motor	RCV	Slewing controller
AOM	Auto lubricating system motor	H/K	Socket for control wire
TSDi	Transformer primary breaker	H/D	Trolleying control wire socket
TSDi1	Transformer secondary breaker	H/R1	Slewing control wire socket
PLDi	PLC power breaker	H/R2	Slewing control wire socket
FaDi	Cooling fan breaker	H/R3	Slewing control wire socket
RedDi	Diode breaker	H/A	Socket for H box to A box
DDi	Trolley main breaker	H/DMo	Socket for H box to moment
RDi	Slewing main breaker	H/AOM	Socket for H box to auto lubricating system
GTDi	Breaker for telescoping motor	I、XA	Start button
Red1\Red2	rectifier	VOI	power indicator
DA	Trolley main contactor	O	Emergency stop button

Symbol	Description	Symbol	Description
AO	Control lubricating system motor contactor	P	Main power contactor
XTAv	Traveling forward switch	XP	Main power supply relay
XTAr	Traveling backward switch	TAv	Traveling forward contactor
XTGv	Traveling 2 nd switch	TAr	Traveling backward contactor
E	Cable drum driven motor contactor	TPV	Traveling at low speed contactor
STAv	Forward end limit switch	RE	Cable drum relay
STAr	Backward end limit switch	TGV	Traveling high speed contactor
TM1、TM2 TM3、TM4	Traveling driving motor	EDi	Cable drum motor contactor
TFS	Traveling brake solenoid	XBa	Circuit-breaker (Control transformer)
XGi	Weathervane button	XJ	Phase sequence and open phase protection relay
VGi	Weather vane light	TDi	Traveling motor breaker
TSA	Control transformer		

4.6 Electrical schematic diagram figure (See table 4.6-1)

Table 4.6-1

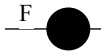
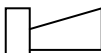
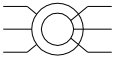
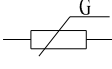
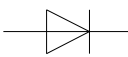
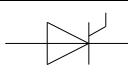
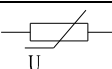
Figure	Description	Figure	Description
	Terminal strip (HF Panel)		Terminal strip (HF Panel)
	Terminal strip (L Panel)		Terminal strip (D Box)
	Terminal strip (R Box)		Electric Horn
	Switching off button (Emergency button switch)		Overload Auto-break switch
	Push-button switch		Power switch(Stroke switch)
	Panel Lever-controlled switch contact		Push-button switch
	Three phase squirrel cage asynchronous motor		Linkage switch
	Three phases wind rotor asynchronous motor		Resistance
	Transformer		Delay action N/C contact
	Brake DC excitation winding		Delay action N/O contact
	Bow wave brake winding		Delay action N/O contact

Figure	Description	Figure	Description
	Coil for relay contactor		Delay action N/C contact
	Coil of a slow releasing relay		Lighting
	Coil of a slow operating relay		Anemoscope
	N/O contact		Thermo-sensitive resistance
	N/C contact		Potentiometer
	Main contacts of contactor		Rectifying diode
	3 phase Autotransformer		Thyristor(silicon controlled rectifier)
	Plug socket		Plug
	Crossing junction		Crossing without electrical connection
	Earth		Pressure-sensitive resistance

4.7 Wiring diagram of cable

The consumer can install the cable according to this electrical schematic diagram.

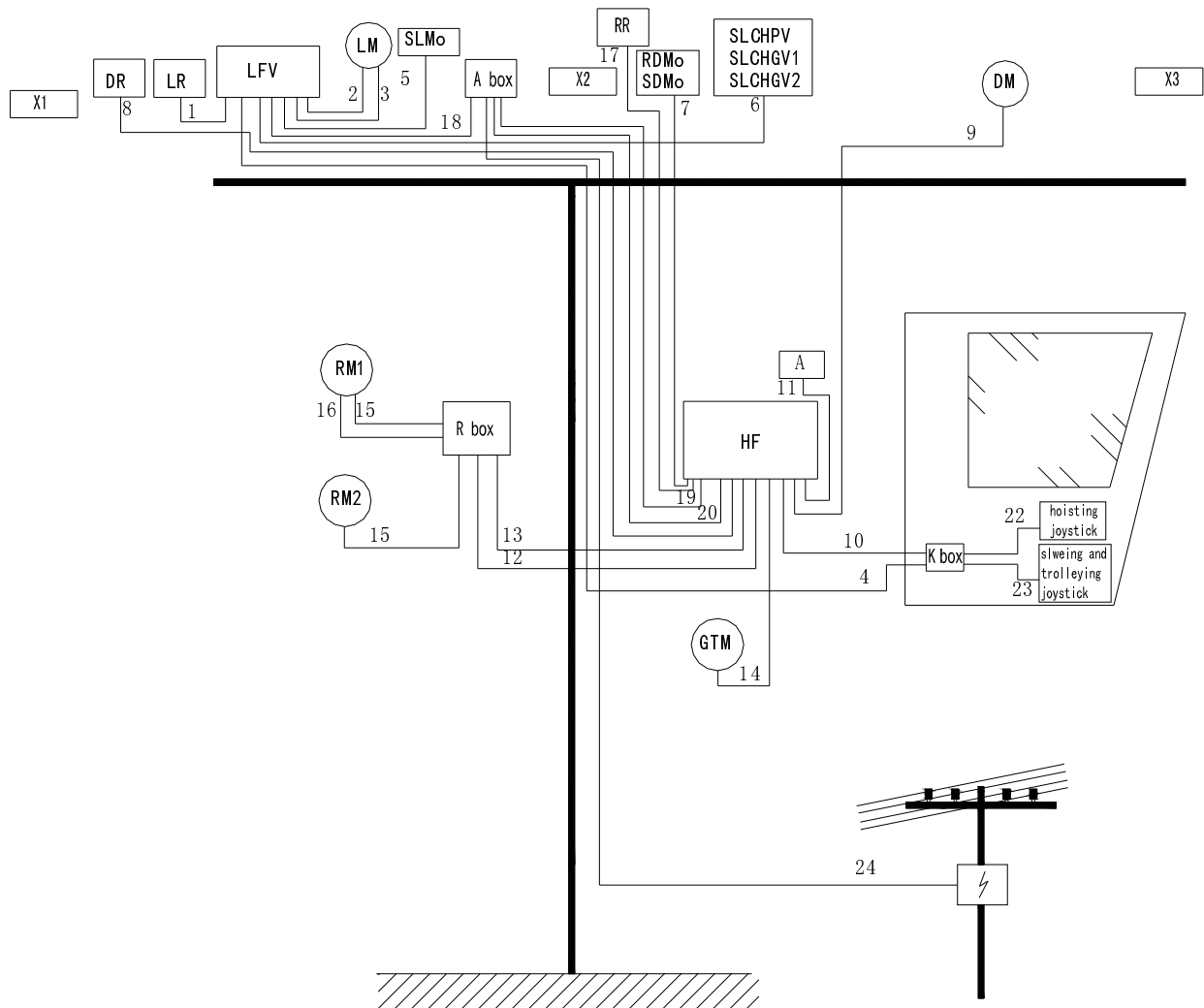
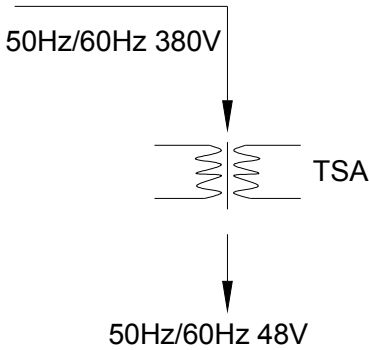
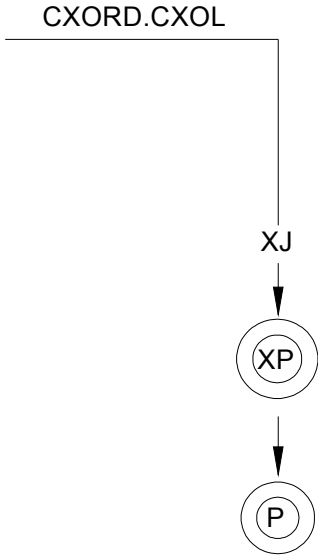
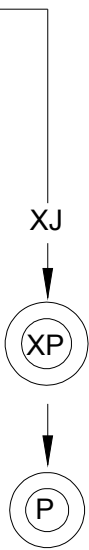


Fig. 4.7-1

Wiring diagram of cable for stationary type of tower crane

Control procedure charts for power supply A box

control element	electrify order	explanation
Di airbreaker	 50Hz/60Hz 380V TSA 50Hz/60Hz 48V	48V-control voltage
I starting	 CXORD.CXOL XJ XP P	CXORD-left interlock desk zero position CXOL- right interlock desk zero position XJ-phase protect relay XP-door relay P-door contactor
O stop	 XJ XP P	XP—P break off XP and P tripphase power supply break down

5. Traveling

The composition of bogie traveling system

The bogie traveling system is composed of four bogies (with motor), two limiters, a cable drum and an electric control panel. Each bogie is composed of a driving wheel and a driven wheel, a reducer which directly engaged with driving wheel, a dual-speed squirrel cage motor, and each motor equipped with two sets of brakes.

5.1 Working principle

The speed adjustment of bogie traveling adopts four sets of dual-speed motor, pole changing control, and each motor equipped with service brake and auxiliary brake.

TAv is a contactor to control moving forward; TAr is a contactor to control moving backward; TPv is a contactor to control first shift; TGv is a contactor to control second shift; RE controls the service brake; E controls the auxiliary brake and control the wind and unwind of cable drum.

5.2 Bogie brake

The two stage brake includes both soft brake and hard brake. They take effect one by one. RE controls the service brake, E controls the auxiliary brake. When stop the motion of bogie, it provides a soft friction first, then stable deceleration, after that it bands brake and make the bogie fully stopped.

5.3 Cable drum

The cable drum is installed on the horizontal bracing of chassis, and parallel with the rail.

5.3.1 Features and working principle of cable drum

The cable drum is composed of moment motor, reducer, slip ring, bracket, drum and roller box.

When the tower crane moving towards the power supply direction, start up the moment motor. The moment motor transfers the moment to drum via rotor disc and flange, then the drum slowly rotate, the cable is involved in the disc; when the tower crane moving against the power supply, via drawing of the cable to conquer the friction moment in the reducer, which pulling the disc rotate, and the cable auto exit.

5.3.2 Wiring of cable drum

The outer power supply cable pass through the roller box (see Fig. 5.3-1), as per the direction of arrow in Fig. 5.3-2 to induct the drum inner ring, via the inner hole of the reducer output shaft to get into the slip ring, connect with three real line connecting plates of the slip ring inner ring and a zero connecting plate; the service motor cable via the cable elbow into the slip ring, and connect it to the conductor clip on current conducting plate of the slip ring outer ring. The marked current conducting plate connect with zero line, the other three current conducting plates connect with the real line. (See Fig. 5.3-2, the P view.)

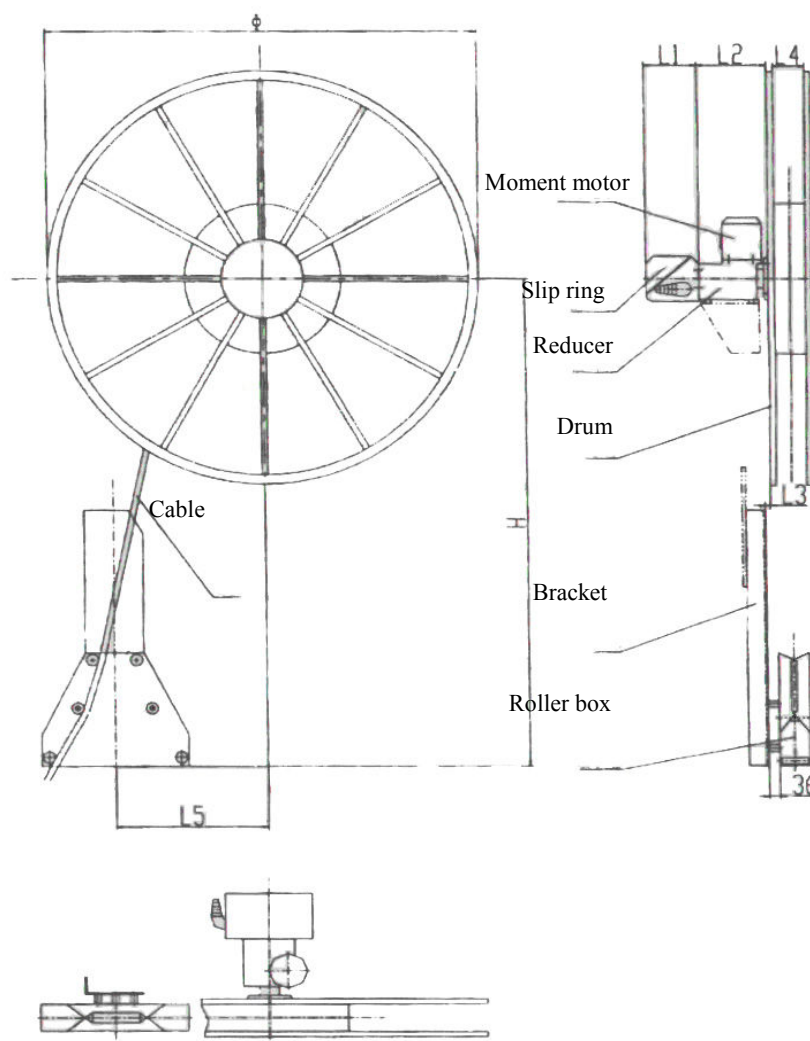
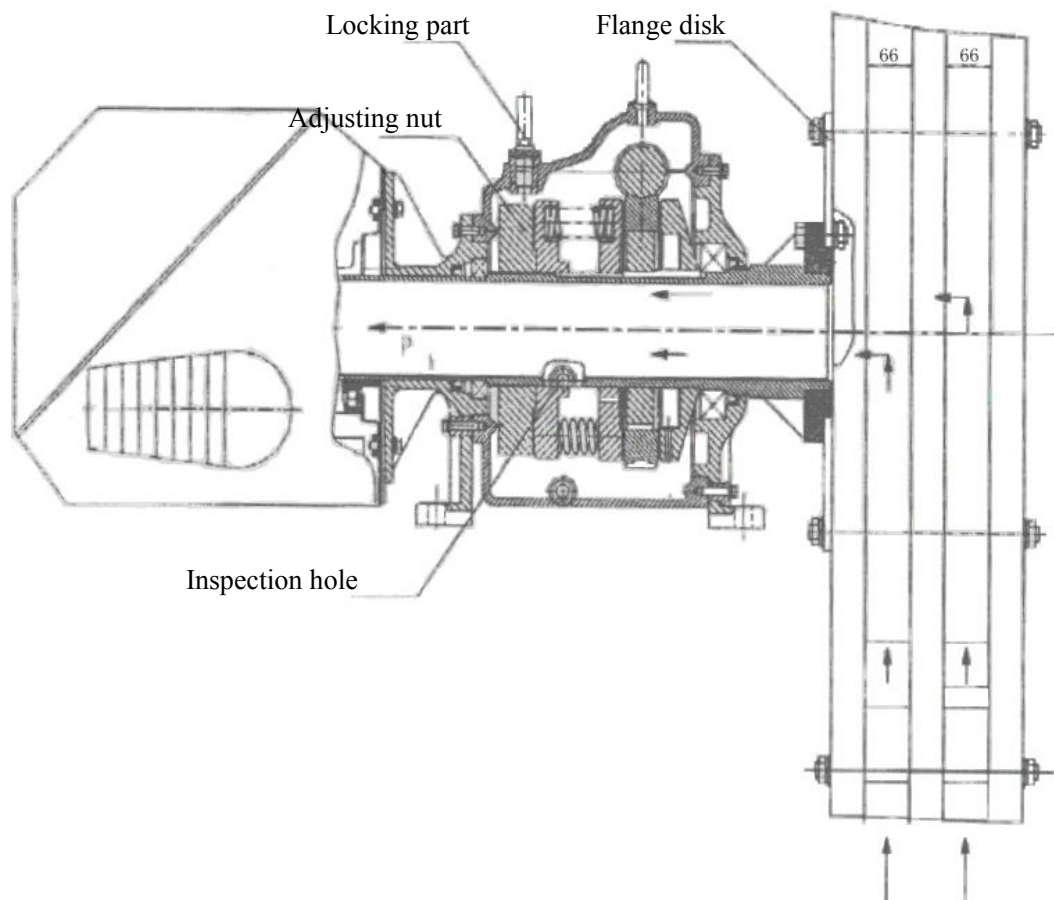


Fig. 5.3-1



P view

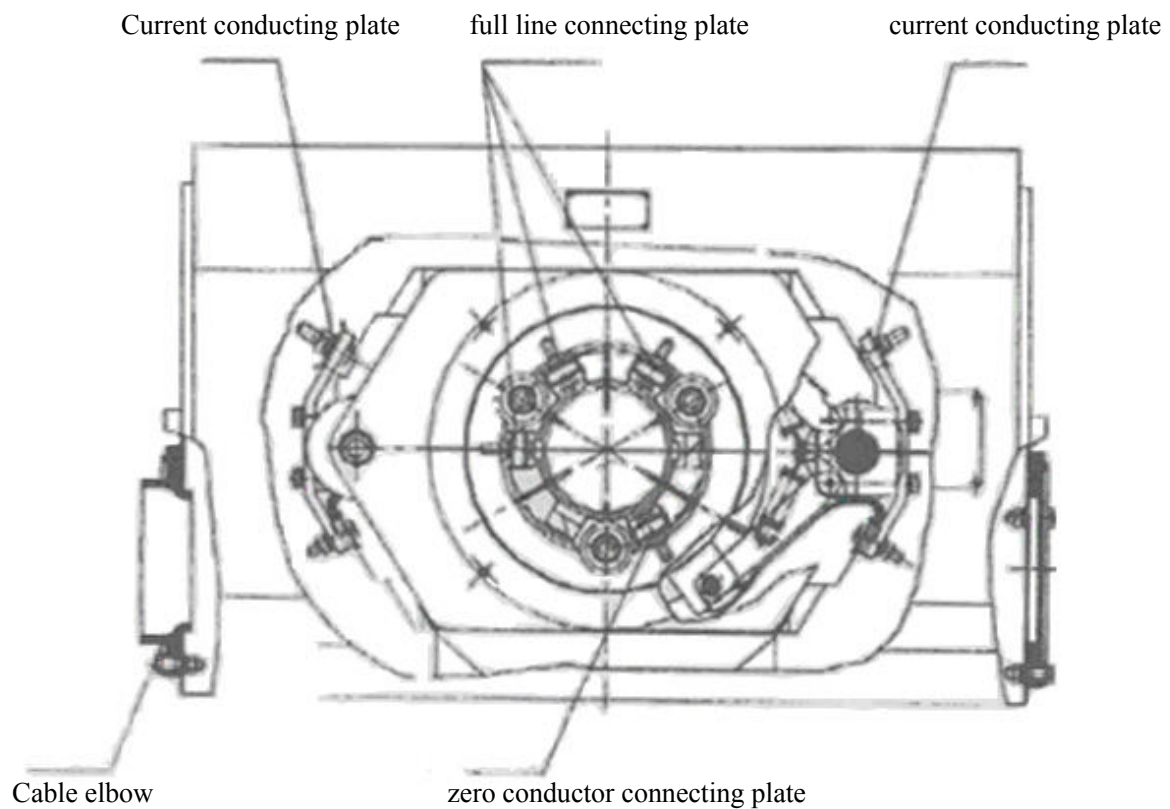


Fig. 5.3-2

5.3.3 Debug of the cable drum

Before the cable drum putting into service, screw out the locking parts on the shell of reducer (its position in reducer please see Fig. 5.3-2). Check that whether the groove of adjusting nut of reducer and the installing hole of locking parts are aligned. If not, manual rotate the disc until the groove is aligned with the hole, then insert the locking parts into the hole (see Fig. 5.3-3) and rotate the disc. The person stands outside the drum, if rotate the disk clockwise, the adjusting nut under the limit of locking parts moves towards the spring and increase the output torque by force. In reverse, rotate the disk anticlockwise will reduce the output torque. Adjust the output repeatedly, until the cable can wind successfully and avoid overheat of motor. This optimum position can extend the life of reducer. Pull out the locking parts, screw the locking parts which sides with threaded into the hole of reducer, see Fig. 5.3-4.

Installing direction of locking part:

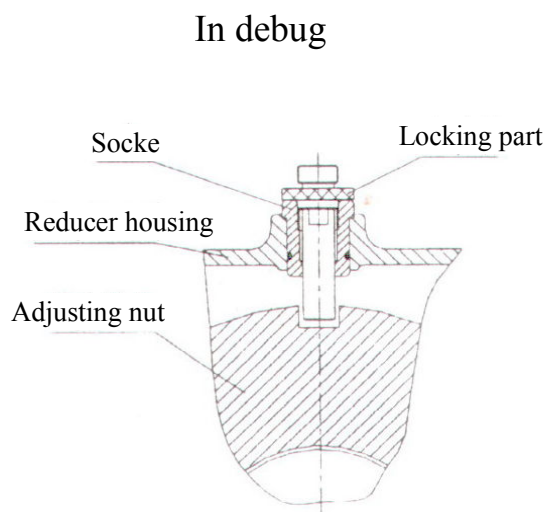


Figure 5.3-3

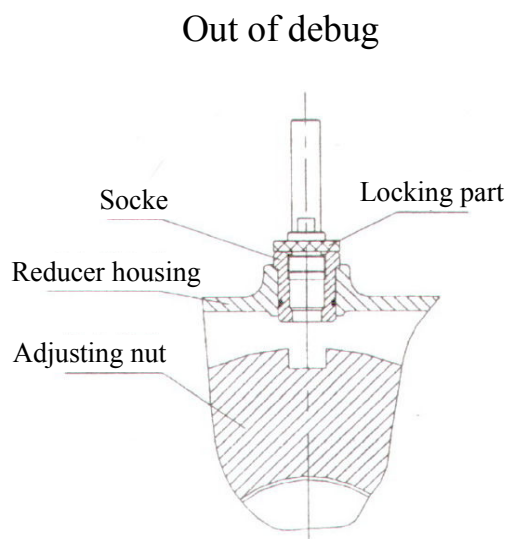


Figure 5.3-4

Notice:

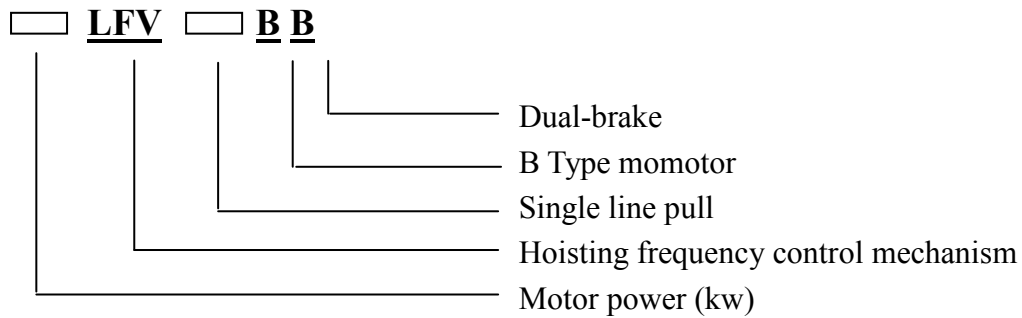
- 1). Switch off the power supply before opening the housing of slip ring;
- 2). It is strictly forbidden to insert the locking parts into the nut groove in working condition;
- 3). The grease level of the reducer should be above the center of inspection hole.

Service and maintenance

- 1). When the reducer putting into service first time, after the first month, the grease in the reducer must be replaced.
- 2). Check the oil level of reducer every two month, when it lowering than the center of inspection hole, add grease.
- 3). Check the tightening condition of electrical parts in slip ring every two month. Make sure that they contact well and the connection of cable joint is reliable.
- 4). After putting into service a period of time, check the winding and unwinding condition of the cable drum.
- 5). Replace the grease of reducer each year. When replacing the grease, screw out the locking parts, clear off the dirty oil, and then screw tightly the hexagonal plug, add the clear grease, and then screw up the locking parts.
- 6). Keep the surface of slip ring, motor and reducer clean.
- 7). If the parts worn a lot and has already influenced its working characteristics, it must be replaced at once.

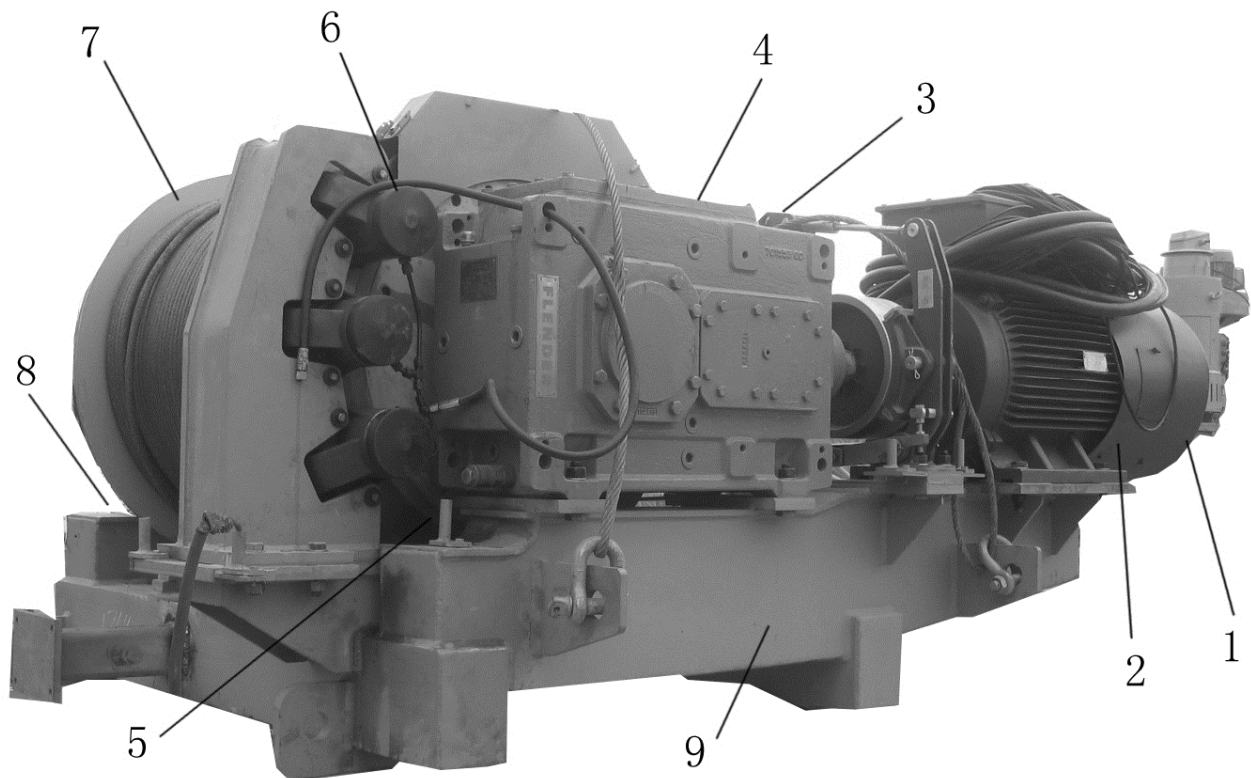
6. Hoisting winch (☐ LFV ☐ BB)

6.1 Explanation of symbols



6.2 Composition of hoisting winch

The LFV hoisting winch is composed of frequency converter motor, brake devices, reducer, drum, bracket, resistance box, electric control panel, etc. See Fig. 6.2.1.

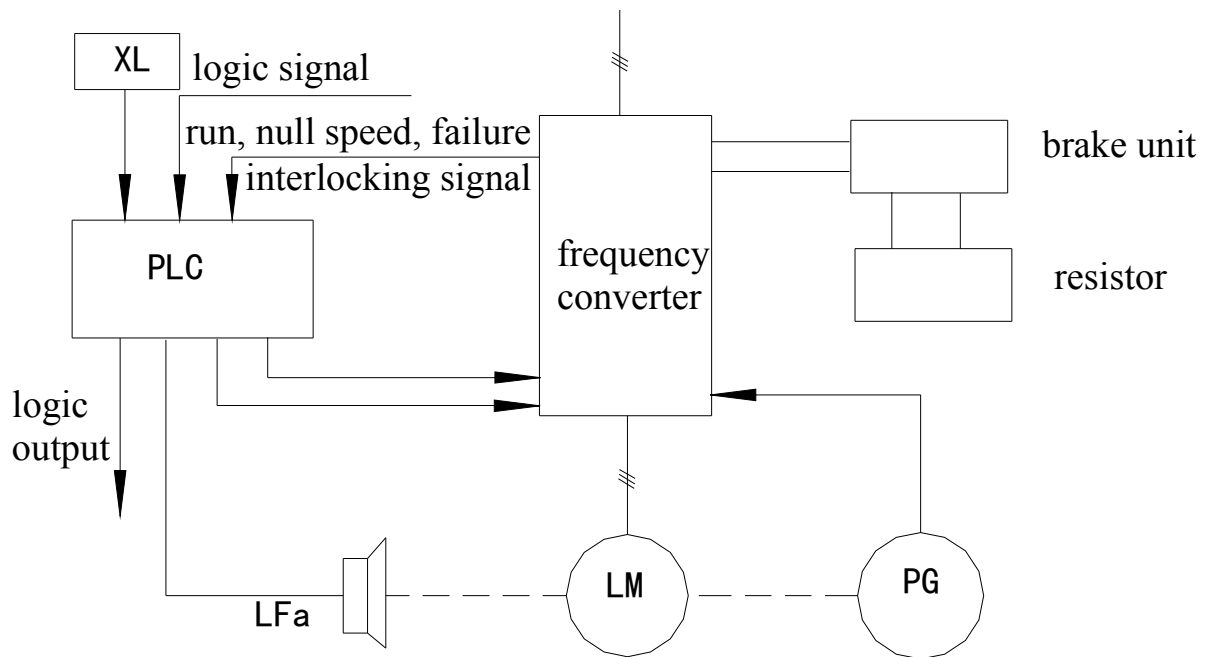


- | | | | |
|---------|--------------------|---------------------------|------------|
| 1. fan | 2. motor | 3. hydraulic pusher brake | 4. reducer |
| 5. pump | 6. hydraulic clamp | 7. drum | 8. limiter |
| | | | 9. chassis |

Fig. 6.2.1

6.3 Working principle

LFV system makes the frequency of 3-phase power supply and voltage changing into adjustable power via an AC frequency converter, which reaches to the frequency converter motor and drive the reducer and drum with the purpose to transport the load vertically. The electrical control system diagram sees Fig. 6.3.1



XL: joystick

PLC: programmable controller

LFa: brake

LM: hoisting frequency converter motor

PG: encoder

Fig. 6.3.1

Electric control system is composed of programmable controller (PLC) and vector control frequency converter. The software programming design can carry out the logic control. AC frequency converter equipped with velocity feedback block, and made of PWM with the frequency converter motor with velocity encoder - AC frequency converter adjusting system of vector control and the speed ratio is 1: 100. Start torque could reach to 150% at null speed and the accuracy of speed adjusting is within $\pm 0.02\%$.

Motor runs in 1, 2, 3 and 4 quadrants. When motor runs in deceleration state, it released the electric energy via brake unit to brake resistor. This system software design guarantees the precise adjustment of logic control and time parameters in case of the brake work frequently. It could ensure that the frequency converter equip with enough output current before the brake release and not cause free fall after releasing. It also can ensure that the torque reach to 150% of rated value after releasing at null speed so as to hoist the load successfully. The design could meet the requirements of every safety device for hoisting winch and enhance its safety and stability. Meanwhile it could realize the control function respectively for the max. running speed and improve the working efficiency.

The PLC and frequency converter software had been adjusted and checked strictly before the electric control system leaving factory. It is absolutely forbidden to modify it. If you have any doubt, please consult us

6.4 Main components and its maintenance

6.4.1 Programmable controller (PLC)

It should be periodical checked and maintenance in order to ensure the PLC running more reliable in long time. The checking and maintenance contents include: check the working voltage of power supply I/O terminal, ambient temperature, battery backup, etc.

Item	Check	Parameter
Power supply voltage	Voltage of PLC terminal	L.N: AC100~240V
Control cabinet	Ambient temperature, humidity No dirt and dust	0°C~55°C 30%~85%RH
I/O voltage	Voltage of input/output terminal	DC24V
Fixing condition	Fixing firm, wiring and terminal reliable	
Battery backup	Whether replacing periodical	Around 3 years

ERR light will be lightened when the voltage of battery backup is quite low. It must be replaced within a month as per the manual requirement.

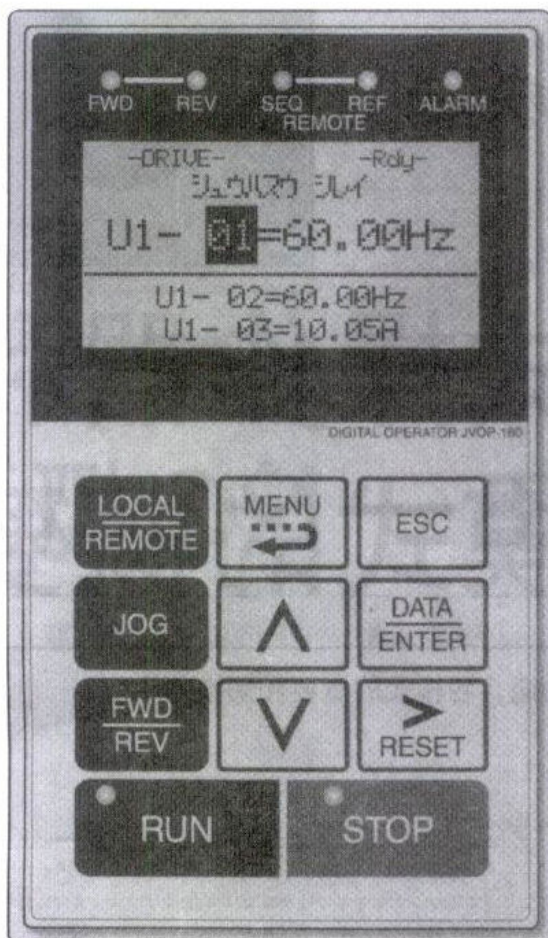
6.4.2 Frequency converter

Adopt CIMR-G7A frequency converter of current vector control, the outer wiring sees the electrical schematic diagram.

1) digital actuator operation instruction

a) display part of digital actuator

Name and function of the key



Display running mode

FWD: light up when co rotating

REV: light up when reversion

SEQ: light up when the running command of control circuit is effect

REF: light up when the frequency command of control circuit A1, A2 is effect

ALARM: light up when appear failure or warning

Display data (LCD)

DRIVE: drive mode

QUICK: program mode

ADV: advanced program mode

VERIFY: verify mode

A.TUNE: self-learning mode

Function key

Carry out parameter setting, monitoring, JOG running, self-learning mode and so on

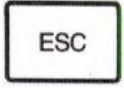
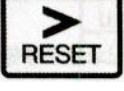
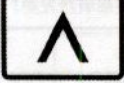
Name and function of digital actuator

Important notice: the charge light of frequency converter, not only shows whether the power supply is switching on, but also shows whether the charge has fully released after cutting off the power supply. The discharge time usually lasts several minutes. If not fully released, it will be dangerous for the person's health. So when repairing the frequency converter and its outside circuits, only can touch the current carrying part after the indicator fully lighten off.



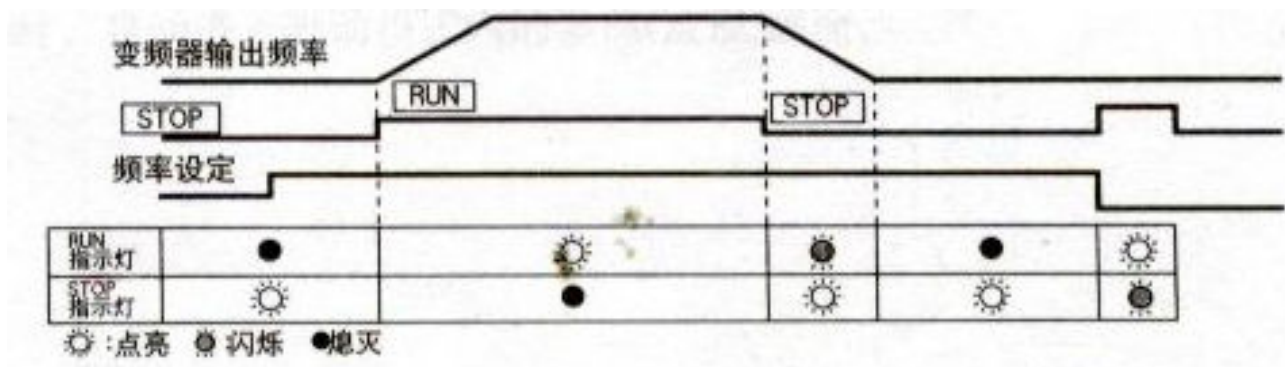
b) Operation part of digital actuator

Name and function of the key:

Key	Name	Function
	LOCAL/REMOTE key (choose running operation)	LOCACL/REMOTE key can switch the running of digital actuator and control circuit. Via setting parameter (o2-01), it can set availability/invalidation.
	MENU key (menu key)	Choose each mode.
	ESC key (exit key)	Press ESC key, back to previous state.
	JOG key (inching)	Inching key during operation.
	FWD/REV key (Co rotating/ reversion)	Switch the rotary direction during operating.
	SHIFT/RESET key (shift/reset)	Choose the digit of parameter setting. As reset key during occurring failure.
	Add key	Choose the mode, parameter number and setting value (add), etc. Use when carrying out next item and data.
	Reduce key	Choose the mode, parameter number and setting value (reduce), etc. Use when returning to the previous item and data.
	DATA/ENTER key (data/input)	Ensure the number of each mode, parameter and setting value. When changing from one menu to next menu, it can be used.
	RUN key (running)	Press this key to start up the frequency converter during operating.
	STOP key (stop)	Press this key to stop the frequency converter during operating. Via setting parameter (o2-02), it can set availability/invalidation when control circuit terminal running.

There are indicator lights on the left above the RUN, STOP key. There are three states: light up, flashing and light off.

During DB (initial excitation) state, the RUN key is flashing and STOP key is lighting up.



The parameter of frequency converter has already been set and adjusted before leaving factory. The code of frequency converter can ensure the system runs in correct, stable and safe conditions. The digital actuator is provided for repairing, checking and setting of parameters. Therefore, the customer needn't to open the electric control panel during the system is working in normal condition. If it is in abnormal condition, check the display state of digital actuator and write down the failure code to judge and clear the fault.

c) The malfunction monitoring and maintenance of the frequency converter

Display	Explanation	Causes	Solution
UV1	Low voltage of main circuit Standard: 380V (-10%~+6%)	1. loss of phase in power supply 2. momentary power failure 3. voltage unstable 4. bad contact	Find out the reason and resolve it.
OV	High voltage of main circuit	1. power voltage too high	Adjust the input voltage
		2. low deceleration time, higher motor heat	Set the deceleration time, check the brake resistor circuit
OC	Current is 200% of the rated current	1. output side earthed, short circuit 2. overload with too short acceleration or deceleration time	Find out the reason and resolve it.
GF	Output side earthed, current is 250% of the rated current.	Output side earthed	Resolve it.
UV2	The control power supply is abnormal.		Adjust the power ON/OFF.
	The voltage of control power supply is too low.		Replace the frequency converter.
PF	Main circuit voltage failure.	1. loss of phase in power supply 2. the phase voltage is unbalanced 3. momentary power failure	Find out the reason and resolve it.
LF	Loss of phase for output	1. output wire is broken 2. loosen of output terminal 3. motor winding is broken	Set the cooling devices Replace the fan
OH	The cooling fin is too hot.	Fan damaged	Adjust the load

Display	Explanation	Causes	Solution
OL1	The motor is overload	The rated value of motor is wrong	Adjust the set value
OS	Over speed	Overshoot/undershoot	Adjust gain.
		The speed is too high.	Adjust circuit and gain.
		F1-08, F1-09 is not set correct.	Confirm the set value.
PGO	PG open wire	PG open wire	Connect the open wire.
		PG connection is wrong.	Make the connection right.
		PG no power supply.	Power supply in normal condition.
DEV	Deviation of speed is to large	Over load.	Reduce load.
		Too short acceleration time.	Delay the acceleration time.
		The load speed is in locking state.	Check the mechanism system.
		F1-10, F1-11is not set correct.	Confirm the set value.
OPR	Poor contact of digital actuator		Check the PG signal. Confirm the income line.
CPF02	Base lockout is poor	Control circuit damaged.	Adjust the power ON/OFF Replace the frequency converter.
CPF03	EFROM is poor	Control circuit damaged.	Adjust the power ON/OFF.
CPF04		Control circuit damaged.	Adjust the power ON/OFF.
CPF05		Control circuit damaged.	Adjust the power ON/OFF.
CPF06	PG-B2 is in poor connect condition	Linkage fault	Power OFF, then insert card.
		Card damaged	Replace the card.
Notice: don't change the setting value.			

6.4.3 Rotary encoder

Rotary encoder is speed sensor which adopts technology of machinery, electric and light. It corresponds with different speed output pulse when motor rotating and identify the rotating direction. This system adopts NO. 3 signal of 90° angle difference, the pulse number of A, B and Z phase is 600-1024ppr, the power supply voltage $V_{DC}=5V$.

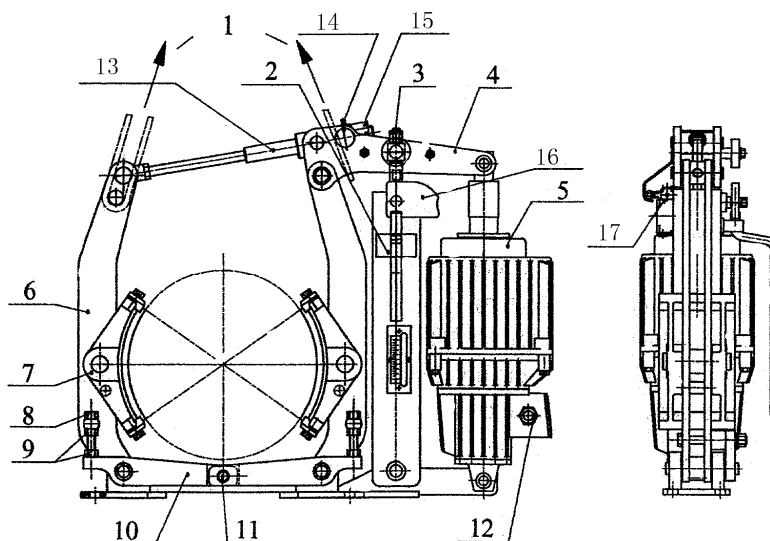
The rotary encoder fitted on the tail of motor. It must be protected seriously, with the purpose to waterproof, moisture proof, etc. The wiring diagram please see electrical schematic diagram.

6.4.4 Brake

The hoisting mechanism adopts both hydraulic pusher brake and flush type brake, which make the work more safe and reliable.

1) Pusher brake is N/C brake.

The adjustment of hydraulic pusher brake:



- | | | | | |
|-----------------------------|-------------------------|-------------------------|------------------|---------------------|
| 1. lifting spot | 2. Brake spring | 3. Torque adjusting nut | 4. Angle lever | 5. Thruster |
| 6. Arm | 7. brake shoe | 8. connecting bolt | 9. tighten nut | 10. balancing lever |
| 11. interlocking pin | 12. cable entry | 13. compensation device | 14. tighten bolt | |
| 15. clearance adjusting nut | 16. hand-released lever | 17. limit switch | | |

Working principle: when breaking, the brake wheel brakes via spring force, when power on, the hydraulic pusher overcome the spring force and release the brake

Adjustment of brake moment: loosen nut 3 and rotate it, adjust the spring length to the required requirement. There is a measuring scale on one side with the purpose to get each kind of different brake moment.

Adjustment of the brake pad: adjust nut 4, make the distance of brake pad between 0.7-1.2mm, then adjust bolt 7, make the brake pad and brake wheel can be contacted uniformly.

Maintenance: check the clearance of brake and the wearing condition of brake pad (the thickness can not $\leq 3\text{mm}$) each week, if necessary, adjust or replace it.

2) Flush type brake

Flush type brake is a safe brake, mechanical brake, hydraulic releasing brake. The brake force acted on the brake lateral plate, which machining by drum flange.

The brake is composed of a bracket and 3 brake tongs (B), this brake tongs is mechanical brake and hydraulic releasing brake.

When the mechanism works, it only can be stopped via the action of both tongs.

a). Release brake

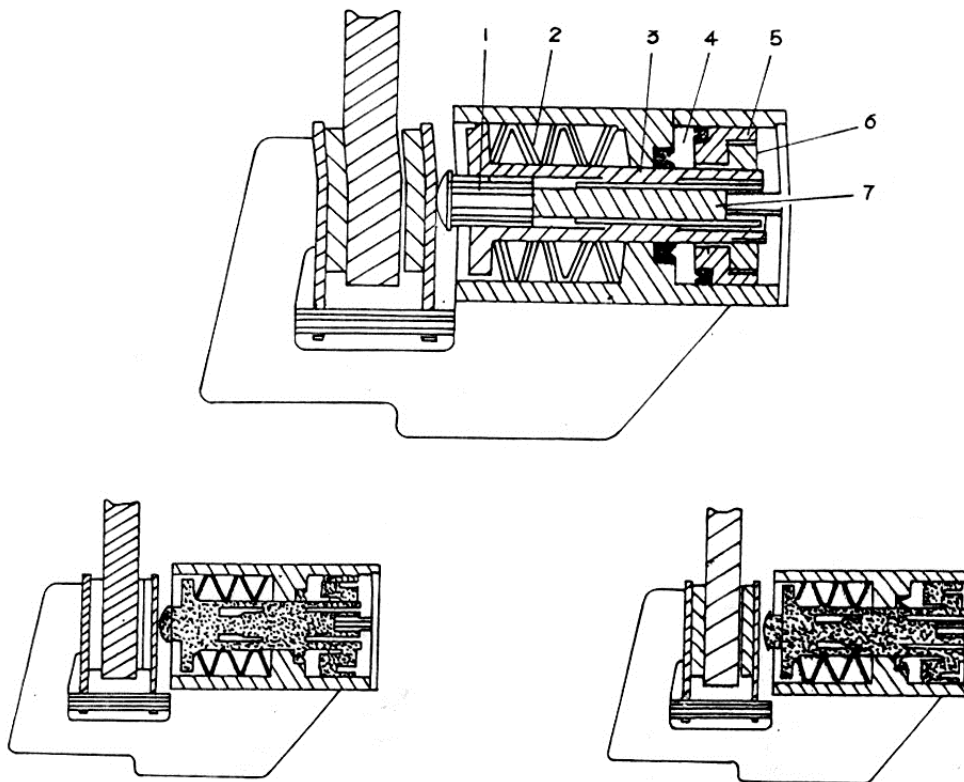
Fill 140 bar pressure into the cavity (4), push the piston rod (5) and nut (6) move backward, compress the disk spring (2) via piston rod (3). Push the temper screw (7) move backward: the push rod (1) released, there is no force on the brake lateral plate, and the brake moment is zero.

b). Brake

Remove the pressure. The disk spring(2) is no longer being compressed, the spring

force was acted on the brake lateral plate via piston rod (3), temper screw (7) and push rod (1). Meanwhile the piston rod (5) was fixed on the piston rod via temper screw.

The brake moment depends on the spring force of disk spring. The brake distance depends on the position of temper screw (7).



3) Hydraulic center

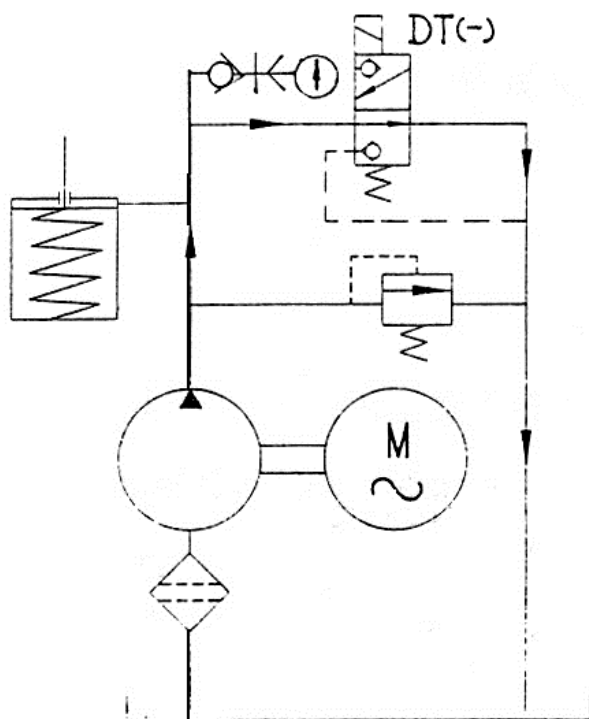
The hydraulic center is the device which provides the power to brake and also control the brake. This system is composed of motor, oil pump, oil filter, relief valve, magnet valve, quick disconnect coupling, pum, etc. The hydraulic oil is N15 (as per SY1181-76), dosage is 24L, the pollution grade is 6-7 (as per NAS1638), the replacing period is 12 months.

Brake principle (Fig. A)

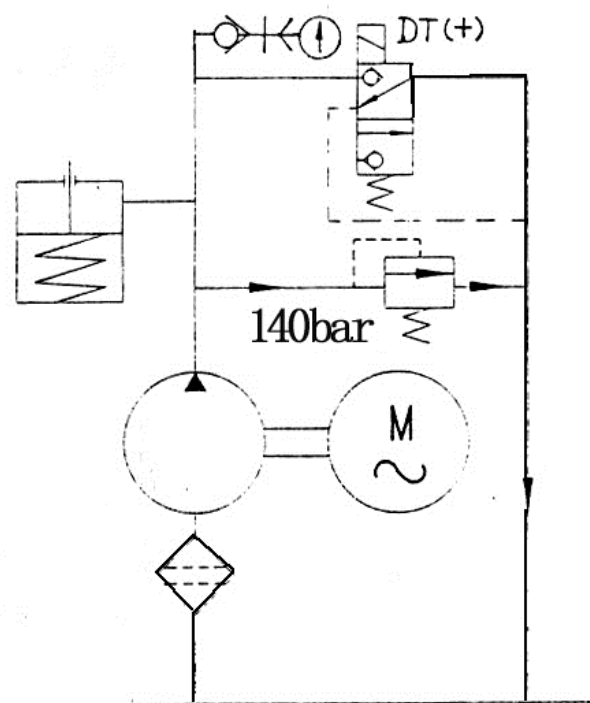
When the electromagnet (DT) loss of electron, the oil flow direction see Fig. A. The system pressure is nearly 0. The brake tongs brakes under the action of spring force.

Release brake (Fig. B)

When the electromagnet (DT) gain of electron, the oil flow direction see Fig. B. The system pressure is 140 bars. The brake tongs conquer the spring force via the action of hydraulic force to release brake.



A



B

4) The maintenance of clamp type brake

a. Check the brake tongs

1. Check the brake tongs every 200 hours or each month.
2. Stop the hoisting mechanism and check the brake tongs.
3. Carry out the following operations.

b. Check the characteristic of brake tongs

1. Check the piston stroke.
2. Insert pressure gauge (See Fig. 6.4.3A)
3. Release brake: set up the $P=140$ bar on brake tongs (See Fig. 6.4.3C)
4. Screw out the temper screw (3) via locking plate (2). (See Fig. 6.4.3D)
5. Cancel the pressure P , there is a clearance J (min. value). Otherwise, reset the pressure and screw out the adjusting rod (See Fig. 6.4.3E).
6. Set up the $P=140$ bar, measure the stroke C with dial gauge (max. value). The C must be 2.7 ± 0.2 mm. Otherwise, replace the brake tongs. It is forbidden to readjust the pressure adjusting nut (5) (See Fig. 6.4.3F).

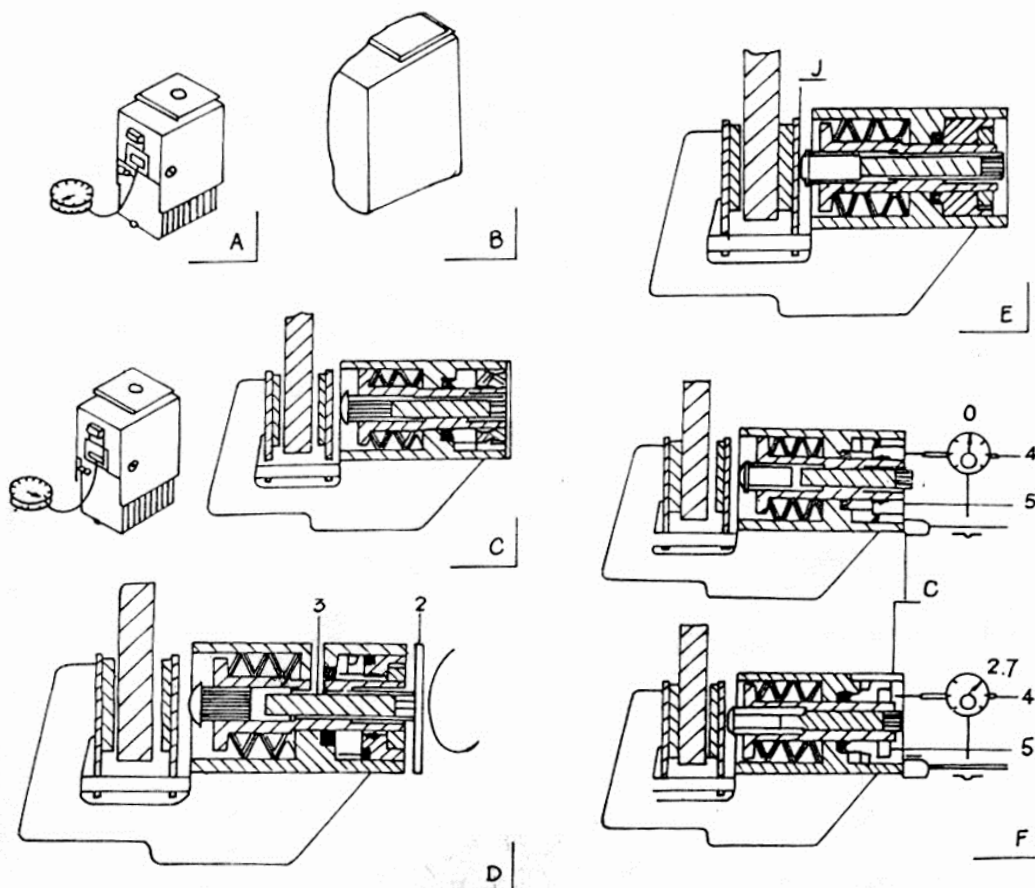


Fig. 6.4.3

c. Check the spring force of disk spring

1). Initial condition

See the adjustment of brake tongs working stroke (See Fig. 6.4.4), install the dial gauge and pressure gauge.

① The initial pressure of piston rod (See Fig.6.4.4A)

Adjust the relief valve (from 0-140bar), make the dial gauge shift 0.1mm, read out the P1, its value must: $65 < P1 < 85$ bar.

② The min. working pressure of piston rod (See Fig. 6.4.4A)

When the piston rod stroke is 2.7 ± 0.2 mm, the min. pressure value P2 occurs on the pressure gauge, its value must: $115 < P2 < 135$, the piston rod value displayed is all the same with the value of “checking of piston rod stroke”.

③ Adjust the system pressure is 140 ± 3 bars.

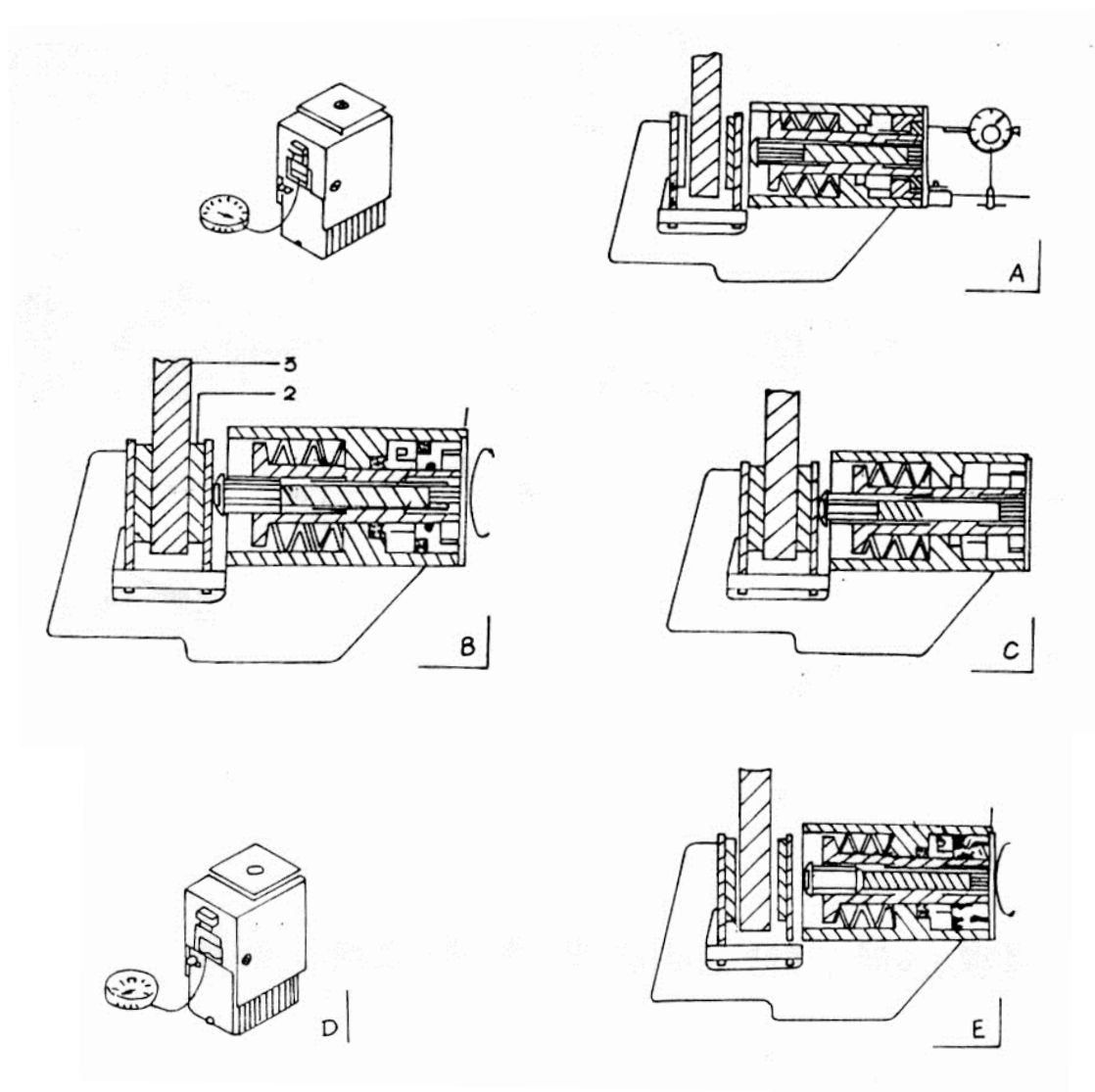


Fig. 6.4.4

2). Adjust the working stroke (brake-release brake)

- ① First step (See Fig. 6.4.4B): set up the pressure $P=140$ bar, rotate part (1) until the part (2) contacts with part (3).
- ② Second step (See Fig. 6.4.4C): release the pressure to zero, reset the move parts.
- ③ Repeat the second step twice or three times.
- ④ Set up $P=140$ bar (See Fig. 6.4.4D)
- ⑤ Screw out part (1) $1/2 \sim 3/4$ circles (See Fig. 6.4.4E)
- ⑥ Rotate part (1) in idle state to C1, make it can support the static state overload, $C1=0.8-1.2\text{mm}$ (See Fig. 6.4.5E-F)
- ⑦ If it can not support the max. rated load $+33\%$ after adjustment, check that:
 - the state of brake disc (oil stain)
 - the state of brake pad (max. wearing $>3\text{mm}$)
 - replace the brake each year or working 3000 hours.

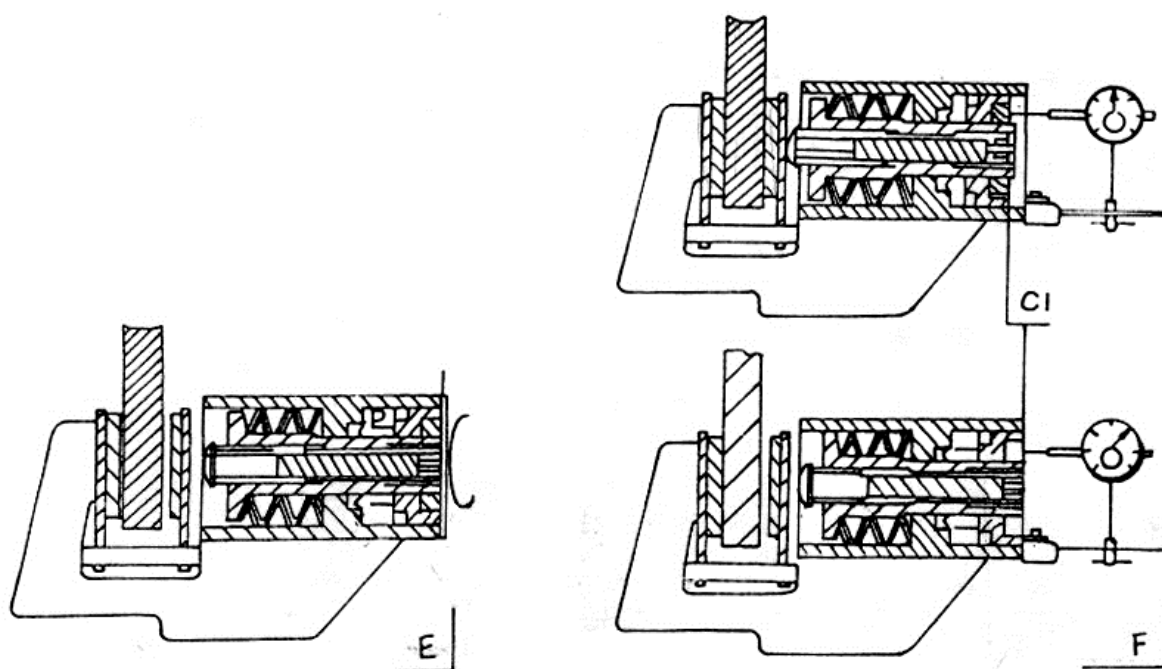


Fig. 6.4.5

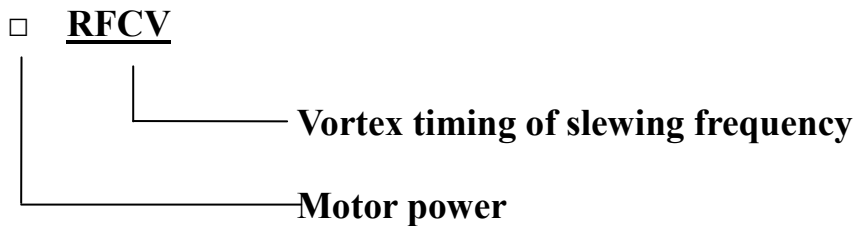
Coiling out table of encoder

Plug	Twin cable	Twin cable
VCC (V+)	Red	Red
A	Yellow	Blue
GND (0V)	Black	Black
B	Green	Green
$\bar{A}$	Pink	Black
$\bar{B}$	Gray	Black
Shield		

7. Slewing mechanism (RFCV)

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7.1 Explanation of symbols



Explanation:

Choose the slewing speed in accordance with the displacement required. Accelerate or decelerate the slewing speed gradually. Don't stop the jib by force via slewing brake, it must decelerate first, and then stop the slewing movement. The slewing brake is only used to position the jib for hoisting when the wind speed is less than 13m/s. If the slewing and hoisting actions are carried out at the same time, it must prevent the wire rope from distorting.

7.2 Composition of slewing mechanism and its working principle

The slewing mechanism is composed of torque motor or frequency converter motor, planetary reduction gear (see Fig. 7.2.1). It adopts frequency converter and electronic control eddy-current control system. Through adjusting the motor stator power frequency and the eddy-current brake voltage, the speed can be adjusted. **The slewing driving system is composed of torque motor, which adopts two sets of eddy-current brakes and one set of weathervane brakes, and planetary reduction gear.** Weathervane brake can be brake and released automatically or manually. Electromagnetic brake is released when power on, while brake when power off. When power on, the slewing brake is always released. During operation, if necessary adopt the slewing brake to protect the crane against action of wind, under the condition of **wind speed is less than 13m/s** and slewing movement stops completely. **At the end of each shift, make the electromagnetic brake work automatically or manually so that the tower crane getting into the state of weathervane effect.**

The eddy-current brake armature of the motor rotates with the shaft. The electromagnet of the eddy-current brake produces magnetic field in the air gap δ around the armature when the excited coil was supplied with direct current. The armature incises the magnetic field so as to form potential field and the current (that is eddy-current) is obtained. Because of the mutual action of magnetic field of eddy-current and electromagnet, produce brake moment that is directly proportional to excited current and rotate speed of the armature. Through the frequency control and the eddy-current braking, it can fulfill the stepless speed regulation perfectly.

1. Torque motor
2. Planetary reduction gear
3. Weathervane brake
4. Slewing ring
5. Travel limiter
6. Eddy-current brake

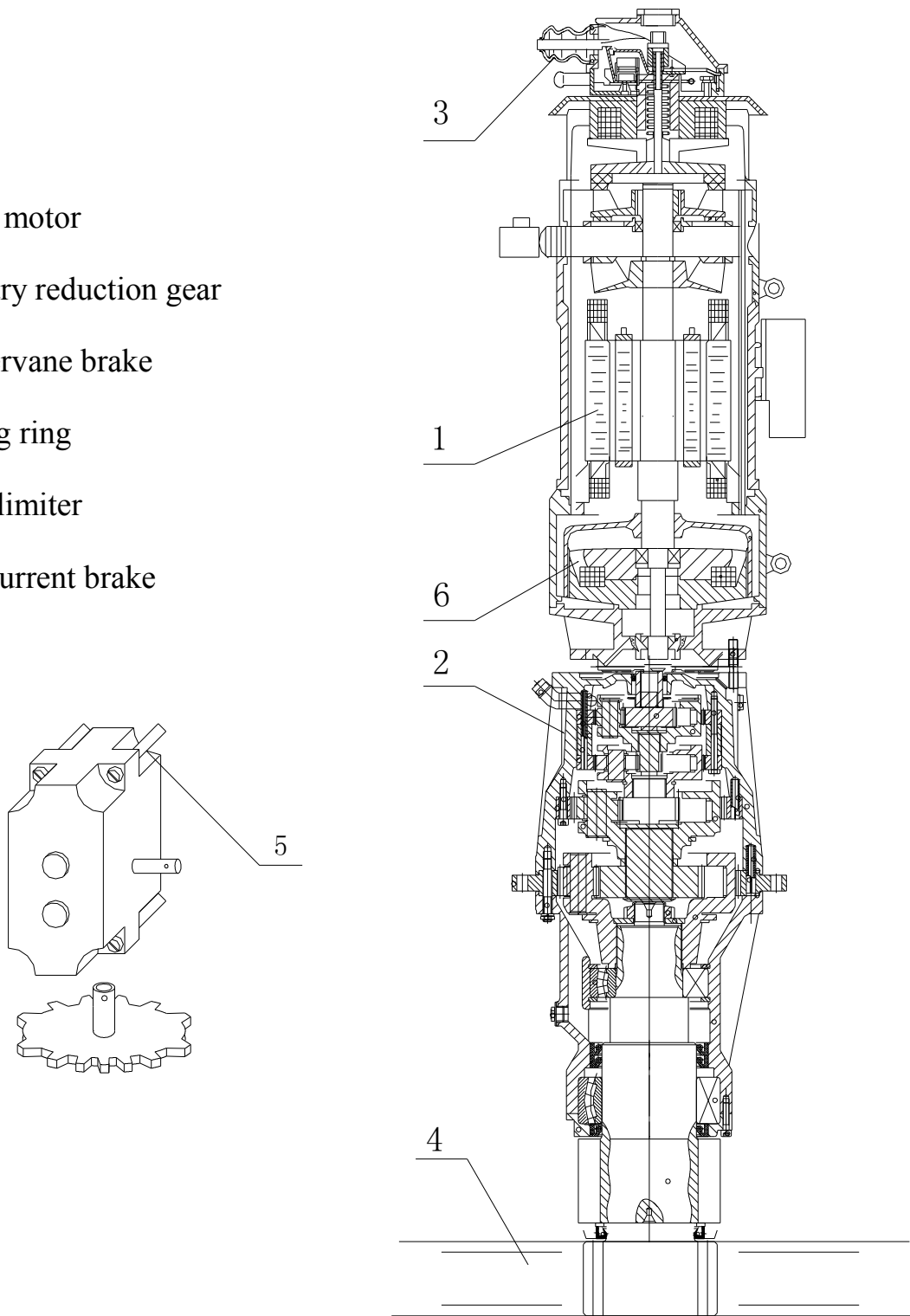


Fig. 7.2.1

7.4. RFCV slewing mechanism operating and troubleshooting

7.4.1 Notice for RFCV operating

1) In normal working condition, the push button of the slewing locking arm is N/O contact. When telescoping and lifting load, rotate the push button of the locking arm, to make it close, and then the brake de energize and brake. When stop with full speed, it was controlled by the internal circuit. It must to ensure that the button only active when the slewing arm stop completely.

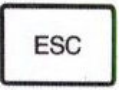
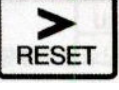
2) Maintenance and service the slewing mechanism in regular. Before the failure is eliminated, it is forbidden to continue operate it. Otherwise, it may serious destroy the transmission parts and structures, even result in serious accidents. When carrying out maintenance, it must cut off the power supply.

Note:

Note: it is forbidden to use slewing locking jib button in full speed state, with the purpose to prevent steel structure distortion.

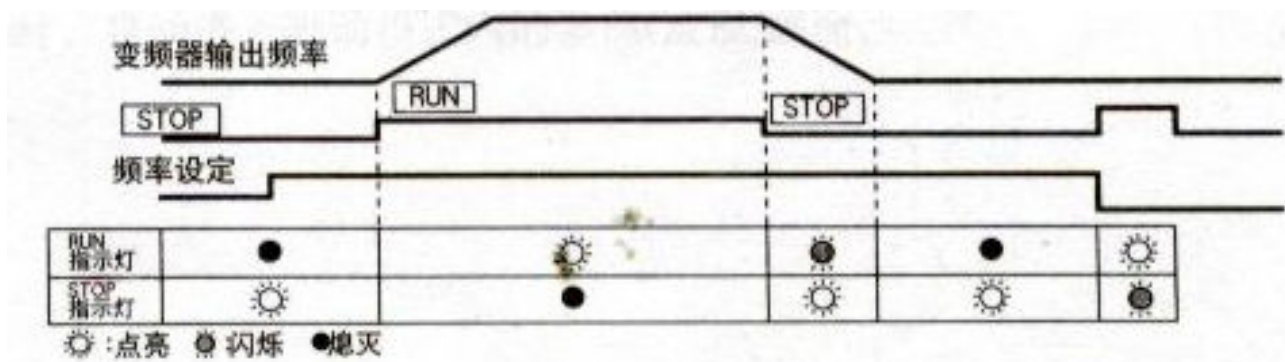
7.4.2 Operation part of digital actuator

Name and function of the key:

Key	Name	Function
	LOCAL/REMOTE key (choose running operation)	LOCACL/REMOTE key can switch the running of digital actuator and control circuit. Via setting parameter (o2-01), it can set availability/invalidation.
	MENU key (menu key)	Choose each mode.
	ESC key (exit key)	Press ESC key, back to previous state.
	JOG key (inching)	Inching key during operation.
	FWD/REV key (Co rotating/ reversion)	Switch the rotary direction during operating.
	SHIFT/RESET key (shift/reset)	Choose the digit of parameter setting. As reset key during occurring failure.
	Add key	Choose the mode, parameter number and setting value (add), etc. Use when carrying out next item and data.
	Reduce key	Choose the mode, parameter number and setting value (reduce), etc. Use when returning to the previous item and data.
	DATA/ENTER key (data/input)	Ensure the number of each mode, parameter and setting value. When changing from one menu to next menu, it can be used.
	RUN key (running)	Press this key to start up the frequency converter during operating.
	STOP key (stop)	Press this key to stop the frequency converter during operating. Via setting parameter (o2-02), it can set availability/invalidation when control circuit terminal running.

There are indicator lights on the left above the RUN, STOP key. There are three states: light up, flashing and light off.

During DB (initial excitation) state, the RUN key is flashing and STOP key is lighting up.



The parameter of frequency converter has already been set and adjusted before leaving factory. The code of frequency converter can ensure the system runs in correct, stable and safe conditions. The digital actuator is provided for repairing, checking and setting of parameters. Therefore, the customer needn't to open the electric control panel during the system is working in normal condition. If it is in abnormal condition, check the display state of digital actuator and write down the failure code to judge and clear the fault.

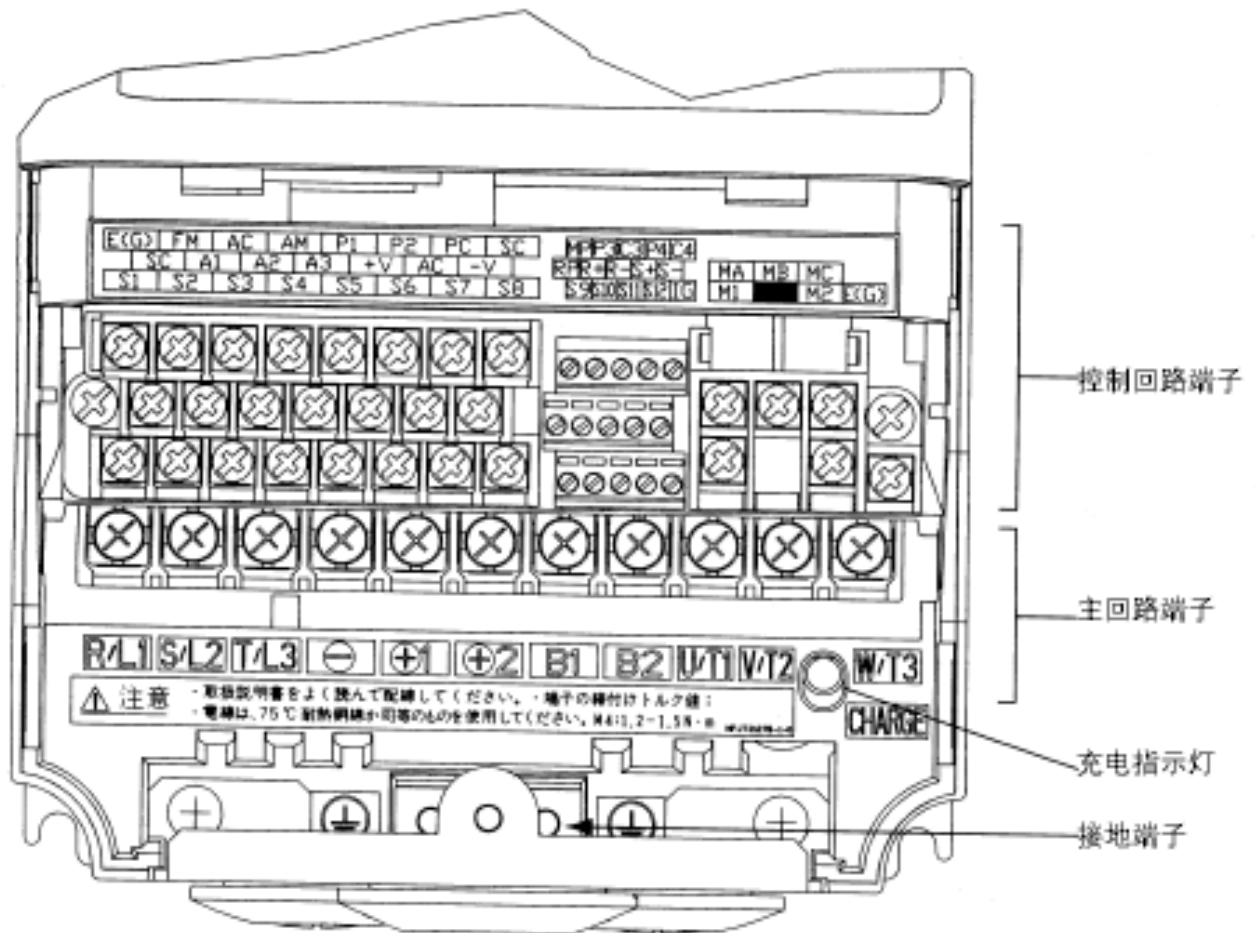
7.4.3 The malfunction monitoring and maintenance of the frequency converter

Display	Explanation	Causes	Solution
UV1	Low voltage of main circuit Standard: 380V (-10%~+6%)	1. loss of phase in power supply 2. momentary power failure 3. voltage unstable 4. bad contact	Find out the reason and resolve it.
OV	High voltage of main circuit	1. power voltage too high	Adjust the input voltage
		2. low deceleration time, higher motor heat	Set the deceleration time, check the brake resistor circuit
OC	Current is 200% of the rated current	1. output side earthed, short circuit 2. overload with too short acceleration or deceleration time	Find out the reason and resolve it.
GF	Output side earthed, current is 250% of the rated current.	Output side earthed	Resolve it.
UV2	The control power supply is abnormal.		Adjust the power ON/OFF.
	The voltage of control power supply is too low.		Replace the frequency converter.
PF	Main circuit voltage failure.	1. loss of phase in power supply 2. the phase voltage is unbalanced 3. momentary power failure	Find out the reason and resolve it.
LF	Loss of phase for output	1. output wire is broken 2. loosen of output terminal 3. motor winding is broken	Set the cooling devices Replace the fan
OH	The cooling fin is too hot.	Fan damaged	Adjust the load
OL1	The motor is overload	The rated value of motor is wrong	Adjust the set value

Display	Explanation	Causes	Solution
OS	Over speed	Overshoot/undershoot	Adjust gain.
		The speed is too high.	Adjust circuit and gain.
		F1-08, F1-09 is not set correct.	Confirm the set value.
PGO	PG open wire	PG open wire	Connect the open wire.
		PG connection is wrong.	Make the connection right.
		PG no power supply.	Power supply in normal condition.
DEV	Deviation of speed is to large	Over load.	Reduce load.
		Too short acceleration time.	Delay the acceleration time.
		The load speed is in locking state.	Check the mechanism system.
		F1-10, F1-11is not set correct.	Confirm the set value.
OPR	Poor contact of digital actuator		Check the PG signal. Confirm the income line.
CPF02	Base lockout is poor	Control circuit damaged.	Adjust the power ON/OFF Replace the frequency converter.
CPF03	EFROM is poor	Control circuit damaged.	Adjust the power ON/OFF.
CPF04		Control circuit damaged.	Adjust the power ON/OFF.
CPF05		Control circuit damaged.	Adjust the power ON/OFF.
CPF06	PG-B2 is in poor connect condition	Linkage fault	Power OFF, then insert card.
		Card damaged	Replace the card.
Notice: don't change the setting value.			

7.4.4. Instructions of charge light

a). Fitting position



b). Function

The charge light not only shows whether the power supply is switching on, but also shows whether the charge has fully released after cutting off the power supply. The discharge time usually lasts several minutes. If not fully released, it will be dangerous for the person's health. So when repairing the frequency converter and its outside circuits, only can touch the current carrying part after the indicator fully lighten off.

7.5. Slewing brake

7.5.1. Manual brake release (See Fig. 7.5.1)

1) Start the weathervane device

- a. Lift the manual brake release lever (1), i.e. movement A.
- b. Push the button (2) under the brake release lever (1).
- c. Release the manual brake release lever (1) and make it rest on the clip (3), then the lever (1) was locked by the clip (3), pin the clip.
- d. The weathervane effect accomplished and the slewing mechanism can rotate freely.

2) Release the weather vane device

- a. Lift the manual brake release lever (1), i.e. movement A.
- b. The clip (3) ejected out under the spring force (4).
- c. Release the manual brake release lever (1).
- d. The weathervane effect accomplished and the slewing should be standstill.

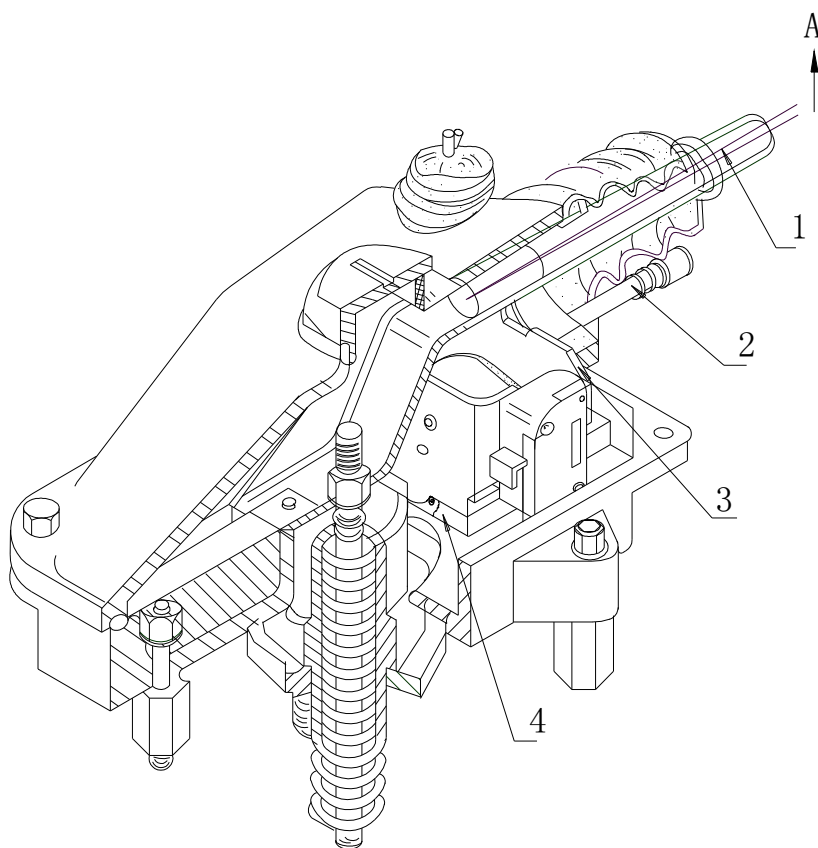
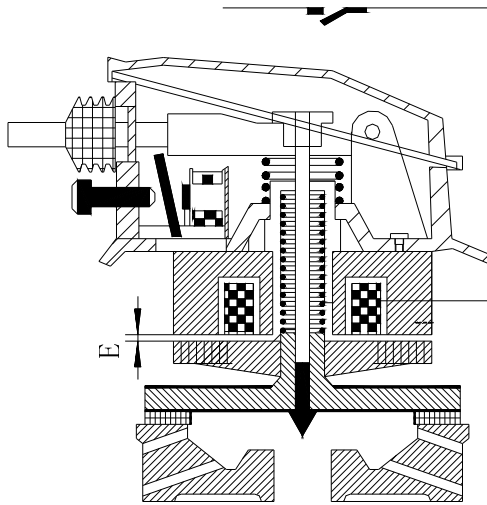


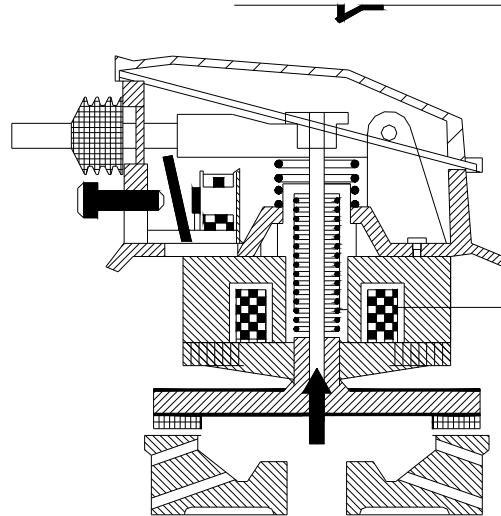
Fig. 7.5.1

3) Working principle

1. brake engaged



2. brake released

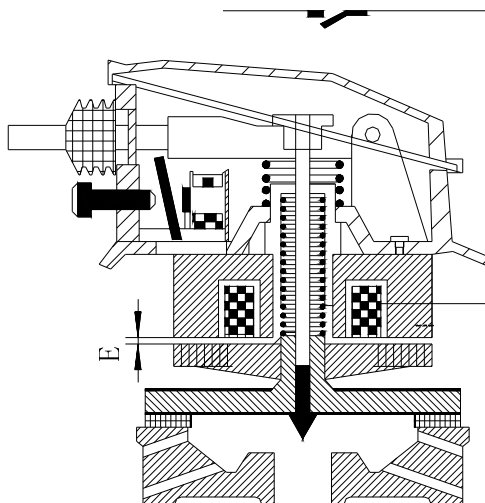


Note: “E” is the clearance of brake, which value must be kept between 0.8-1.2mm, if necessary adjust it.

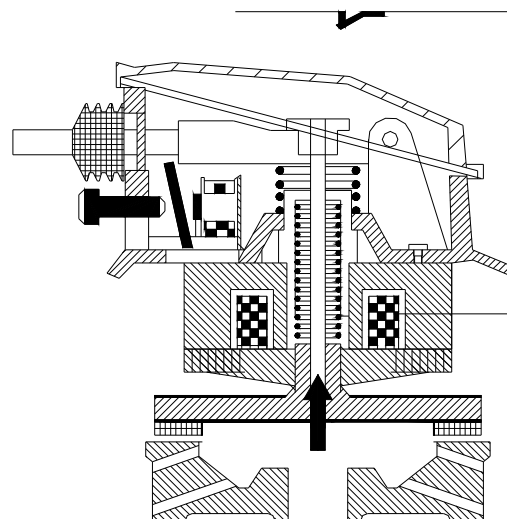
7.5.2 Electric startup of weather vane

Explanation: it is an electromagnetic brake, which is engaged as soon as the current cut off. It has its own and independent power supply.

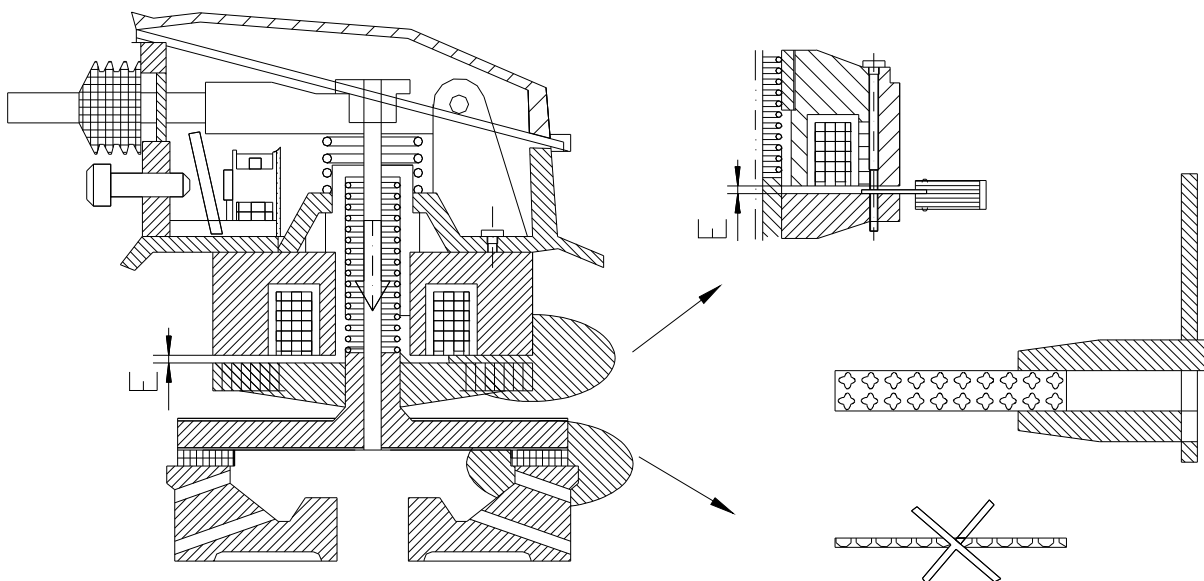
1. brake engaged



2. brake released



7.5.3 Maintenance and service of slewing brake



Note: it mustn't have any foreign bodies in the brakes (such as cement, sand, grease, etc.)

1) Unscheduled maintenance

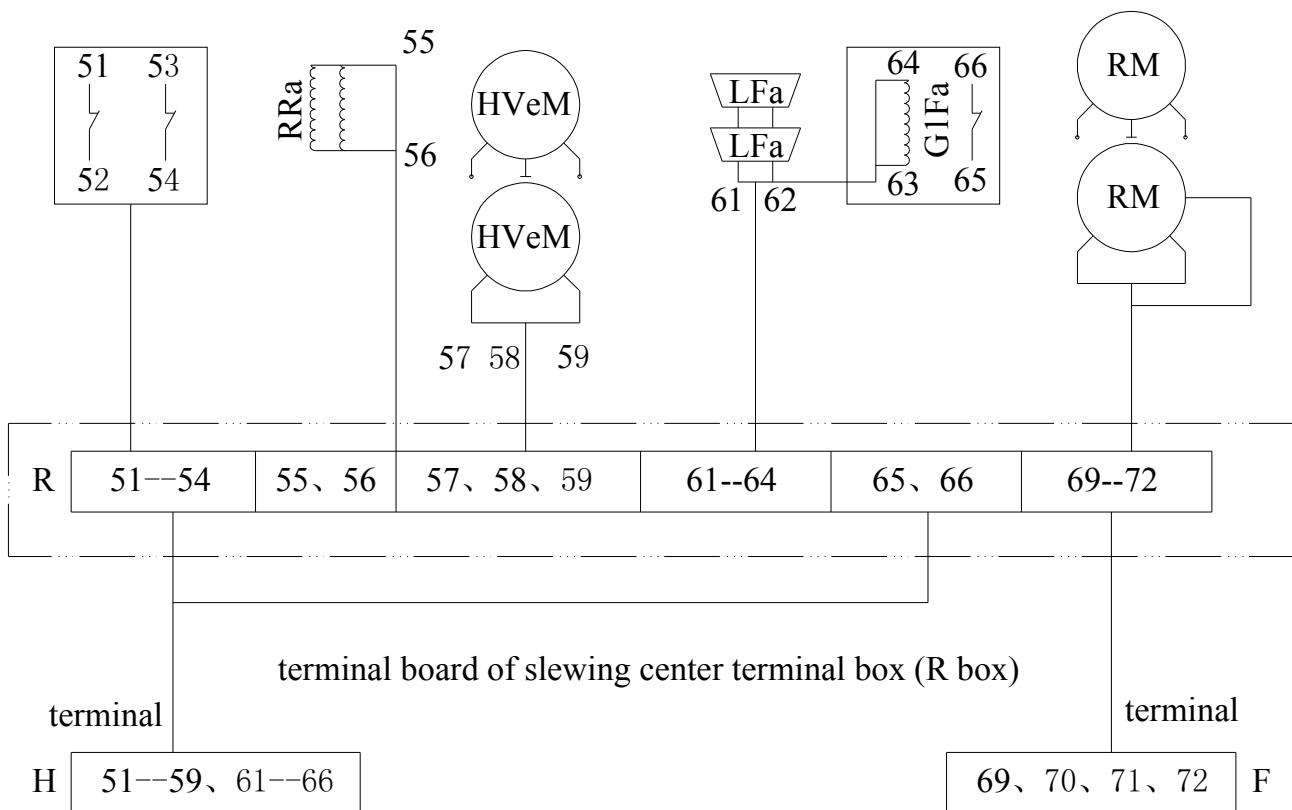
The maintenance should be carried out under the following conditions:

- a). Insufficient braking moment which is caused by worn and damage of brake pad.
- b). The indicator light is out of work.

2) Scheduled maintenance

- a). Maintenance the slewing brake every 200 hours or each month.
- b). Check the clearance and brake torque as well as the wear condition of the brake pad, replace them if necessary.
- c). Check that there are no foreign bodies in the brakes (such as cement, sand, grease, etc.)

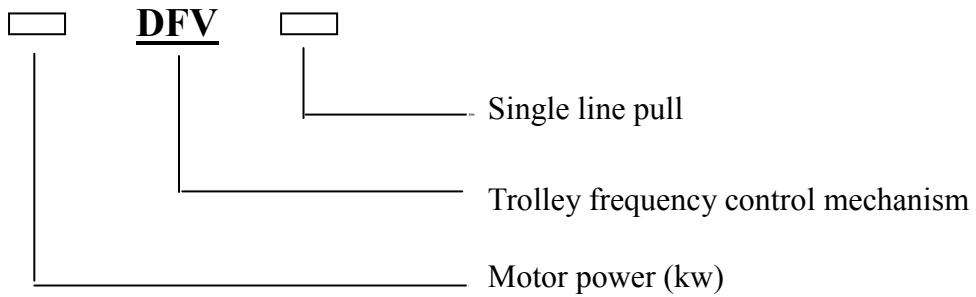
7.6 R box wiring diagram



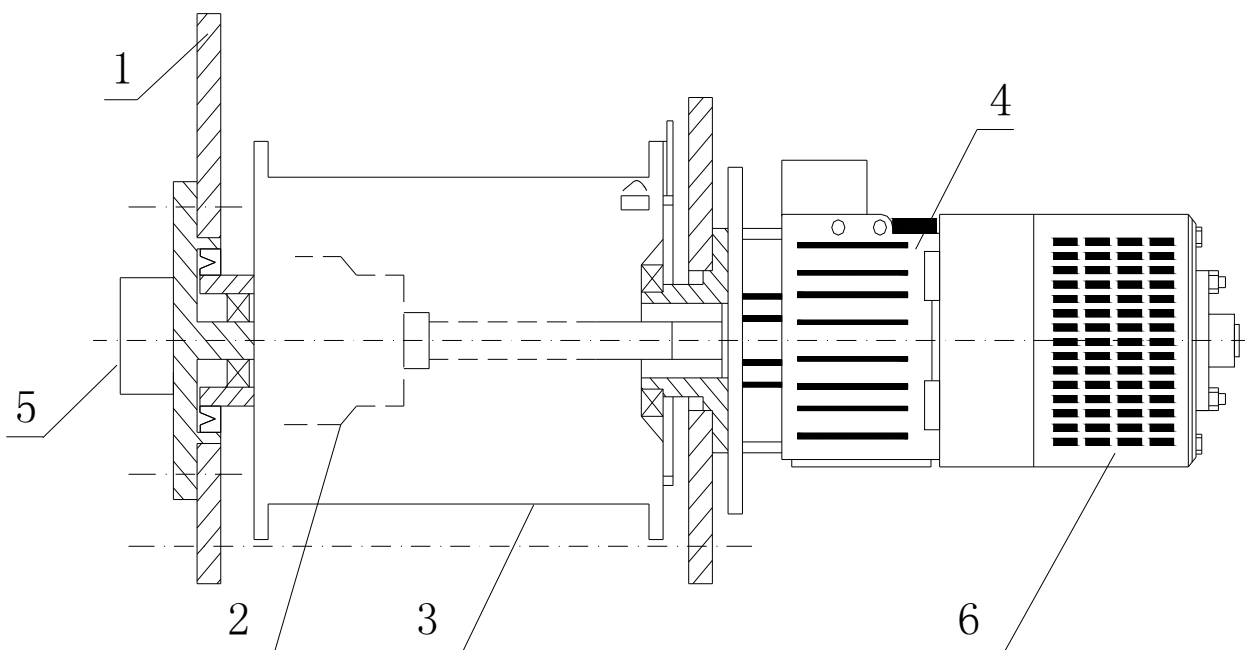
8. Trolley winch (DFV)

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8.1 Explanation of symbols

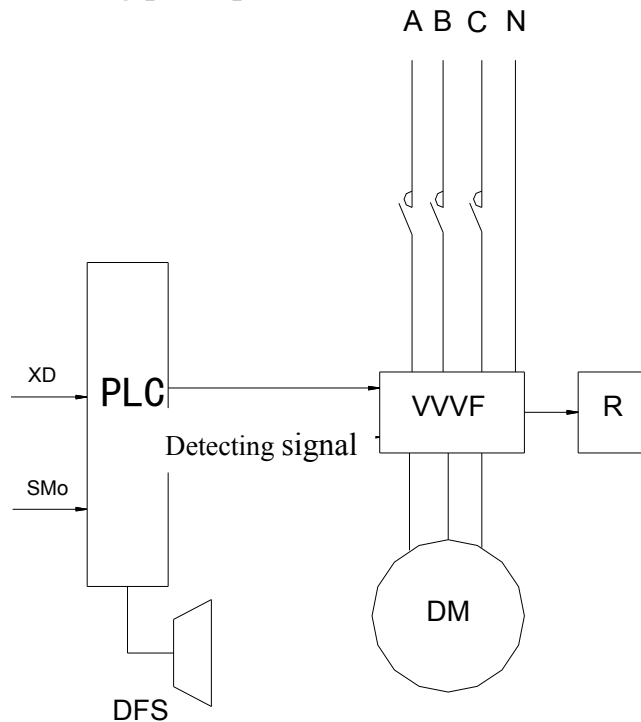


8.2 Composition of trolley winch and its working principle



1. outer support 2. reducer 3. drum 4. motor 5. limiter 6. brake

8.2.1 Mechanism working principle



Explanation: the choice of trolley speed must be in accordance with the trolley distance. It must accelerate or decelerate gradually.

8.2.2 Safety test signal

- Fixing load changing radius, the information sent at 80% of the rated radius (RDMO)
- Fixing radius changing load, the information sent at the rated radius (SDMO)
- PLC program reset (DB₀)
- The confirmation of frequency converter power supply (DA)
- The declutch conformation of motor (PC - P₁)
- The engagement conformation of motor (M₁ - M₂)

8.2.3 Output signal

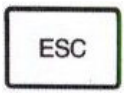
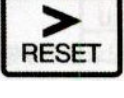
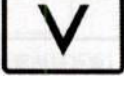
- The malfunction of frequency converter (MA - MC)
- Overheat protection of brake resistor (PC - P₂)

8.3 PLC controller

- Power supply: L.N. AC220V
- Input terminal: 0.00~0.11
- Output terminal: 10.00~10.07
- The voltage of output point: DC24V
- The max. permissible current of output point: 200mA

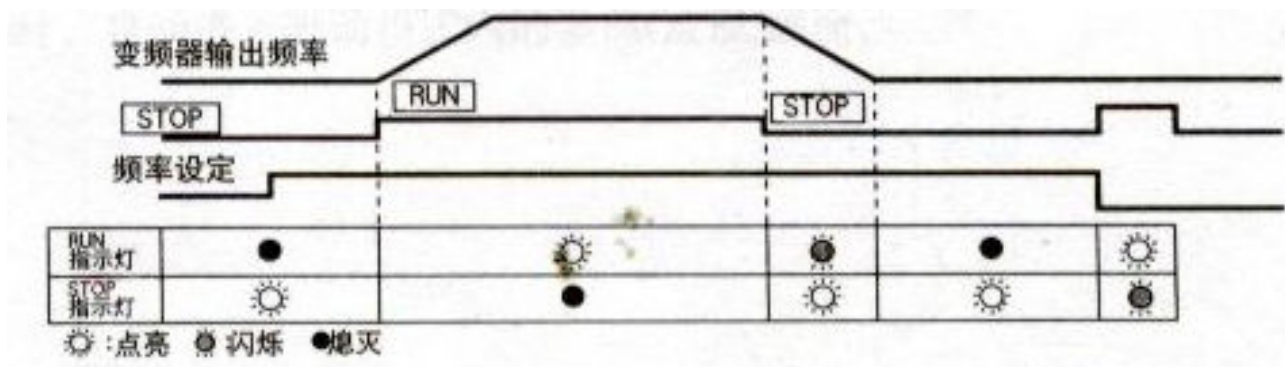
8.4 Main components and maintenance

8.4.1 Operation part of digital actuator - Name and function of the key:

Key	Name	Function
	LOCAL/REMOTE key (choose running operation)	LOCACL/REMOTE key can switch the running of digital actuator and control circuit. Via setting parameter (o2-01), it can set availability/invalidation.
	MENU key (menu key)	Choose each mode.
	ESC key (exit key)	Press ESC key, back to previous state.
	JOG key (inching)	Inching key during operation.
	FWD/REV key (Co rotating/ reversion)	Switch the rotary direction during operating.
	SHIFT/RESET key (shift/reset)	Choose the digit of parameter setting. As reset key during occurring failure.
	Add key	Choose the mode, parameter number and setting value (add), etc. Use when carrying out next item and data.
	Reduce key	Choose the mode, parameter number and setting value (reduce), etc. Use when returning to the previous item and data.
	DATA/ENTER key (data/input)	Ensure the number of each mode, parameter and setting value. When changing from one menu to next menu, it can be used.
	RUN key (running)	Press this key to start up the frequency converter during operating.
	STOP key (stop)	Press this key to stop the frequency converter during operating. Via setting parameter (o2-02), it can set availability/invalidation when control circuit terminal running.

There are indicator lights on the left above the RUN, STOP key. There are three states: light up, flashing and light off.

During DB (initial excitation) state, the RUN key is flashing and STOP key is lighting up.



The parameter of frequency converter has already been set and adjusted before leaving factory. The code of frequency converter can ensure the system runs in correct, stable and safe conditions. The digital actuator is provided for repairing, checking and setting of parameters. Therefore, the customer needn't to open the electric control panel during the system is working in normal condition. If it is in abnormal condition, check the display state of digital actuator and write down the failure code to judge and clear the fault.

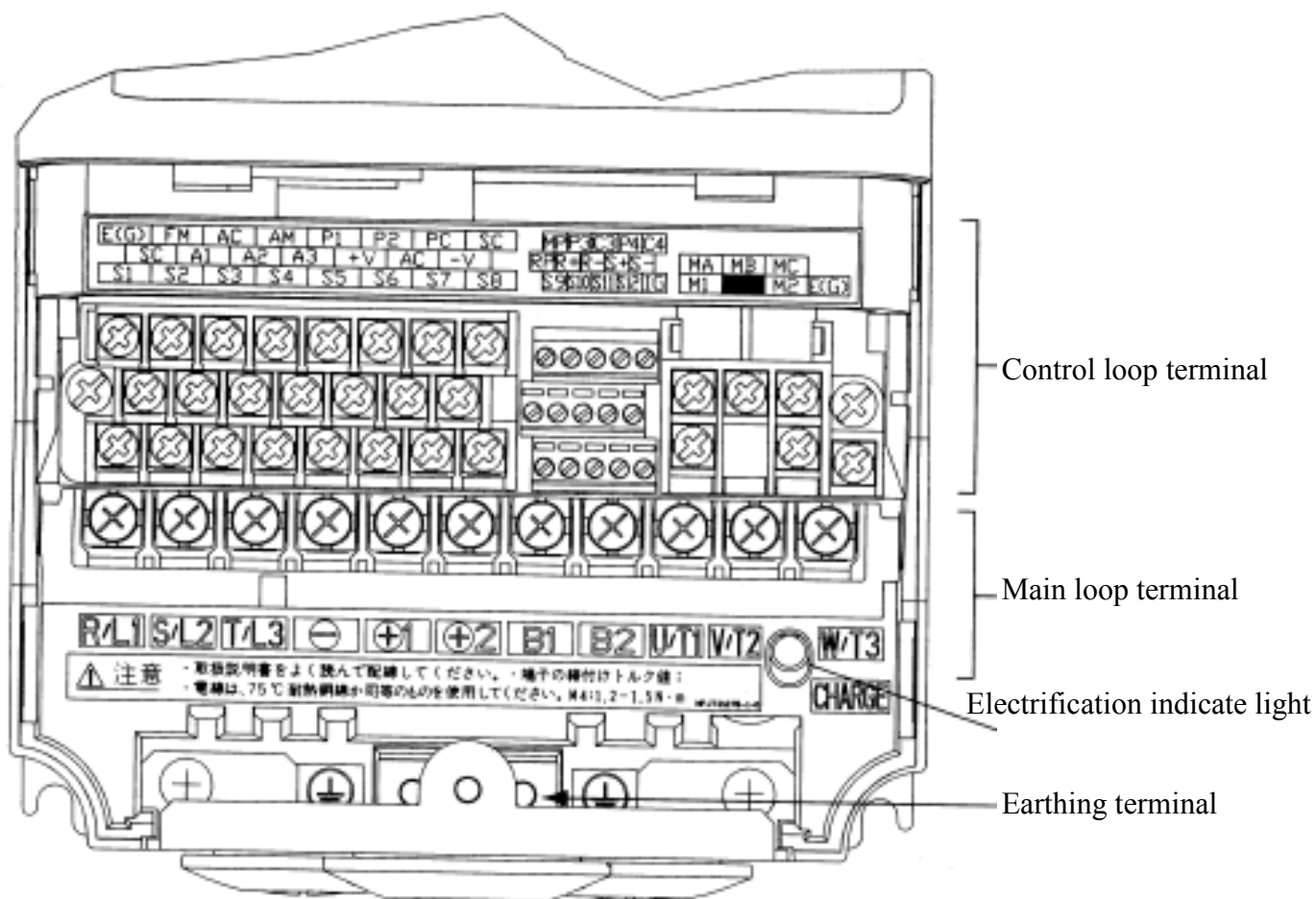
The malfunction monitoring and maintenance of the frequency converter

Display	Explanation	Causes	Solution
UV1	Low voltage of main circuit Standard: 380V (-10%~+6%)	1. loss of phase in power supply 2. momentary power failure 3. voltage unstable 4. bad contact	Find out the reason and resolve it.
OV	High voltage of main circuit	1. power voltage too high	Adjust the input voltage
		2. low deceleration time, higher motor heat	Set the deceleration time, check the brake resistor circuit
OC	Current is 200% of the rated current	1. output side earthed, short circuit 2. overload with too short acceleration or deceleration time	Find out the reason and resolve it.
GF	Output side earthed, current is 250% of the rated current.	Output side earthed	Resolve it.
UV2	The control power supply is abnormal.		Adjust the power ON/OFF.
	The voltage of control power supply is too low.		Replace the frequency converter.
PF	Main circuit voltage failure.	1. loss of phase in power supply 2. the phase voltage is unbalanced 3. momentary power failure	Find out the reason and resolve it.
LF	Loss of phase for output	1. output wire is broken 2. loosen of output terminal 3. motor winding is broken	Set the cooling devices Replace the fan
OH	The cooling fin is too hot.	Fan damaged	Adjust the load

Display	Explanation	Causes	Solution
OL1	The motor is overload	The rated value of motor is wrong	Adjust the set value
OS	Over speed	Overshoot/undershoot	Adjust gain.
		The speed is too high.	Adjust circuit and gain.
		F1-08, F1-09 is not set correct.	Confirm the set value.
PGO	PG open wire	PG open wire	Connect the open wire.
		PG connection is wrong.	Make the connection right.
		PG no power supply.	Power supply in normal condition.
DEV	Deviation of speed is to large	Over load.	Reduce load.
		Too short acceleration time.	Delay the acceleration time.
		The load speed is in locking state.	Check the mechanism system.
		F1-10, F1-11is not set correct.	Confirm the set value.
OPR	Poor contact of digital actuator		Check the PG signal. Confirm the income line.
CPF02	Base lockout is poor	Control circuit damaged.	Adjust the power ON/OFF Replace the frequency converter.
CPF03	EFROM is poor	Control circuit damaged.	Adjust the power ON/OFF.
CPF04		Control circuit damaged.	Adjust the power ON/OFF.
CPF05		Control circuit damaged.	Adjust the power ON/OFF.
CPF06	PG-B2 is in poor connect condition	Linkage fault	Power OFF, then insert card.
		Card damaged	Replace the card.
Notice: don't change the setting value.			

8.4.2 Instructions of charge light

a). Fitting position



b). Function

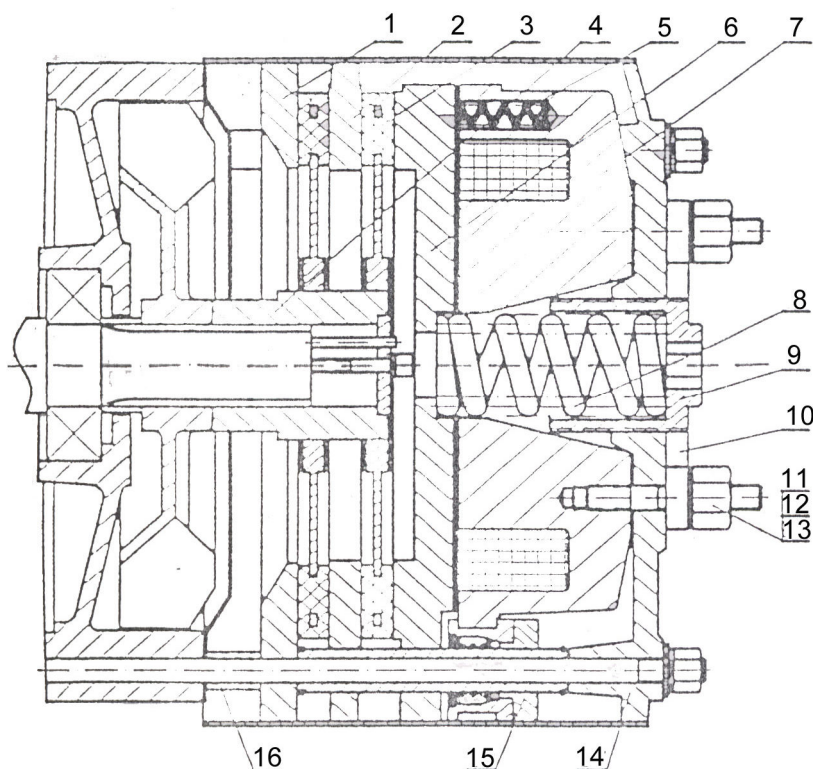
The charge light not only shows whether the power supply is switching on, but also shows whether the charge has fully released after cutting off the power supply. The discharge time usually lasts several minutes. If not fully released, it will be dangerous for the person's health. So when repairing the frequency converter and its outside circuits, only can touch the current carrying part after the indicator fully lighten off.

8.5 Trolley brake

The three-phase asynchronous motor is the new model which designed based on the advanced technology of oversea. This motor start smoothly, the impact force to the equipment is very small, low noise and low vibration, simple structure, convenient for operating and maintenance, safe and reliable characteristics. The electromagnet of brake parts can adjust the distance with armatures automatically.

8.5.1 Structure and working principle

a). The structure diagram of disc brake



- | | | |
|---------------------------|------------------------|-------------------------|
| 1. fixed brake disc | 2. two side brake disc | 3. disc type brake disc |
| 4. hexagonal spline | 5. small spring | 6. armature |
| 7. electromagnet | | |
| 8. main spring | 9. adjusting sleeve | 10. lever |
| 11. double threaded screw | | |
| 12. slotted nut | 13. split pin | 14. rear cover |
| 15. brake | 16. spacer | |

b). Working principle

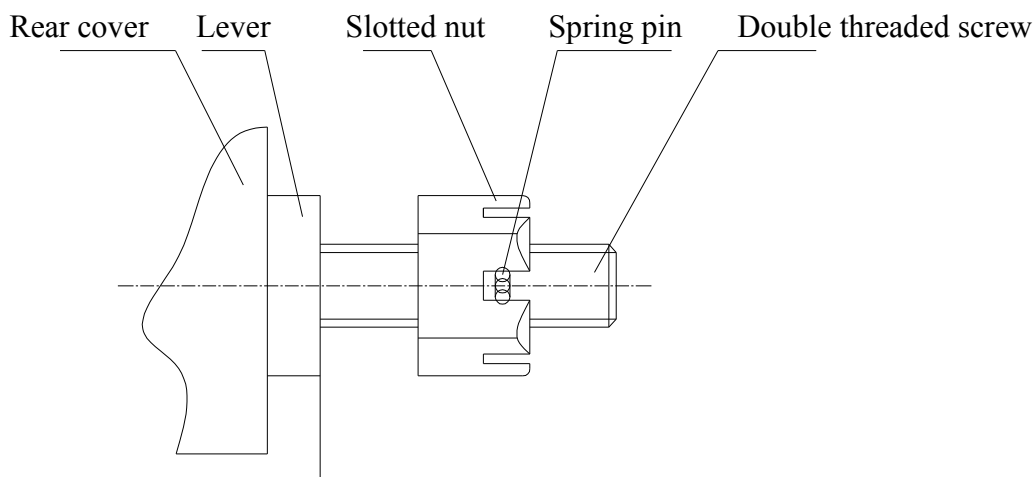
When the power supply is not switching on, owing to the effect of spring (8) via armature (6) to press on the brake disc (3), the motor is in brake state. When power on, the electromagnet (7) generate magnetic field, via the effect of spring (8), small spring (5) and the brake (15), make the armature (6) closed, rotor disc (hexagonal) (4) drive the brake disc (3) to break away from brake state, the motor start to work.

When the motor power off, owing to the brake effect of electromagnetic field released, the armature via the effect of the main and small spring to increase the pressure to the brake disc gradually, make the brake moment increase gradually to make the brake smoothly.

8.5.2 Maintenance and service

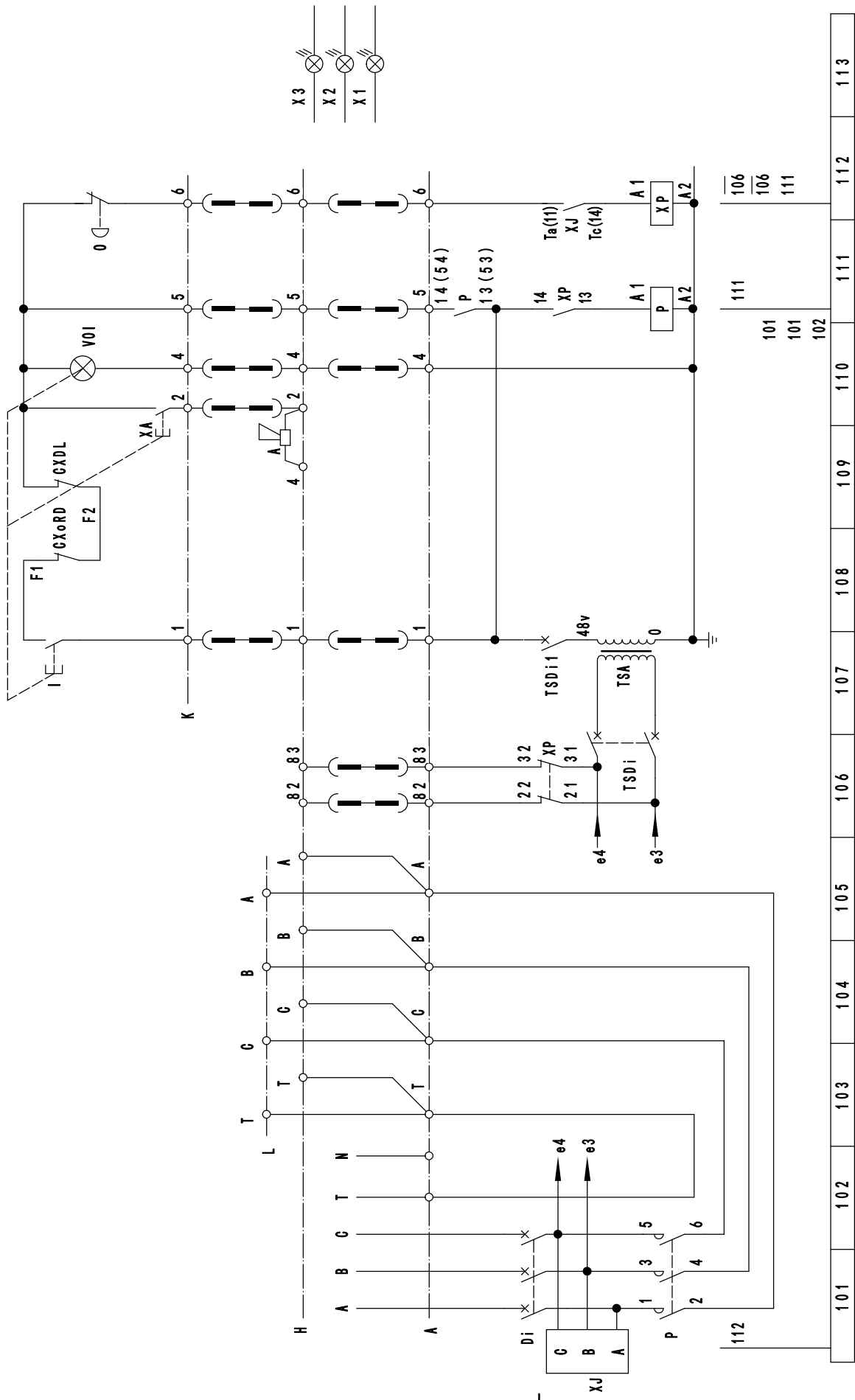
Maintenance: if found any abnormal condition, such as great vibration, overheat, burned taste, strange noise, it must be stopped immediately. It shouldn't be used until it is in normal working condition. If the brake moment is not enough, check that whether there was oil strain in the brake, clean it if necessary, if not, should screw up the adjusting sleeve (9) to increase the working pressure.

The brake disc is easy worn parts, when the distance between brake disc (3) and armature is near 0.5mm, it must replace the brake disc (3).



The manual release lever mounted at the end of motor. When trolley winch suddenly power off and brake occurs failure, cut off the power supply, pull out gradually by lever (10) and make the brake released.

Service: it must carry out scheduled maintenance every three months, and overhaul once a year, it only can be putting into service after commissioning.

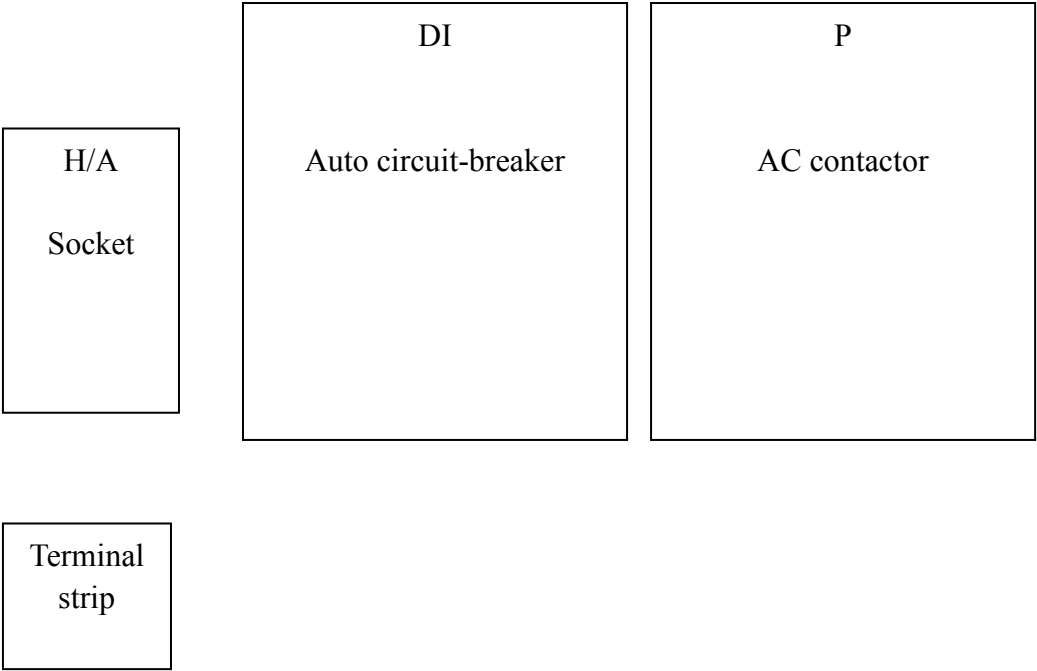


- H/A
- 1--A1
- 2--A4
- 3--A5
- 4--A6
- 5--A82
- 6--A83

电源电气原理图				A - D 4 0 3 C			
POWER SUPPLY				DRAWING MARK		WEIGHT SCALE	
PRINCIPLE DIAGRAM							
				Page of			
				YONGMAO			

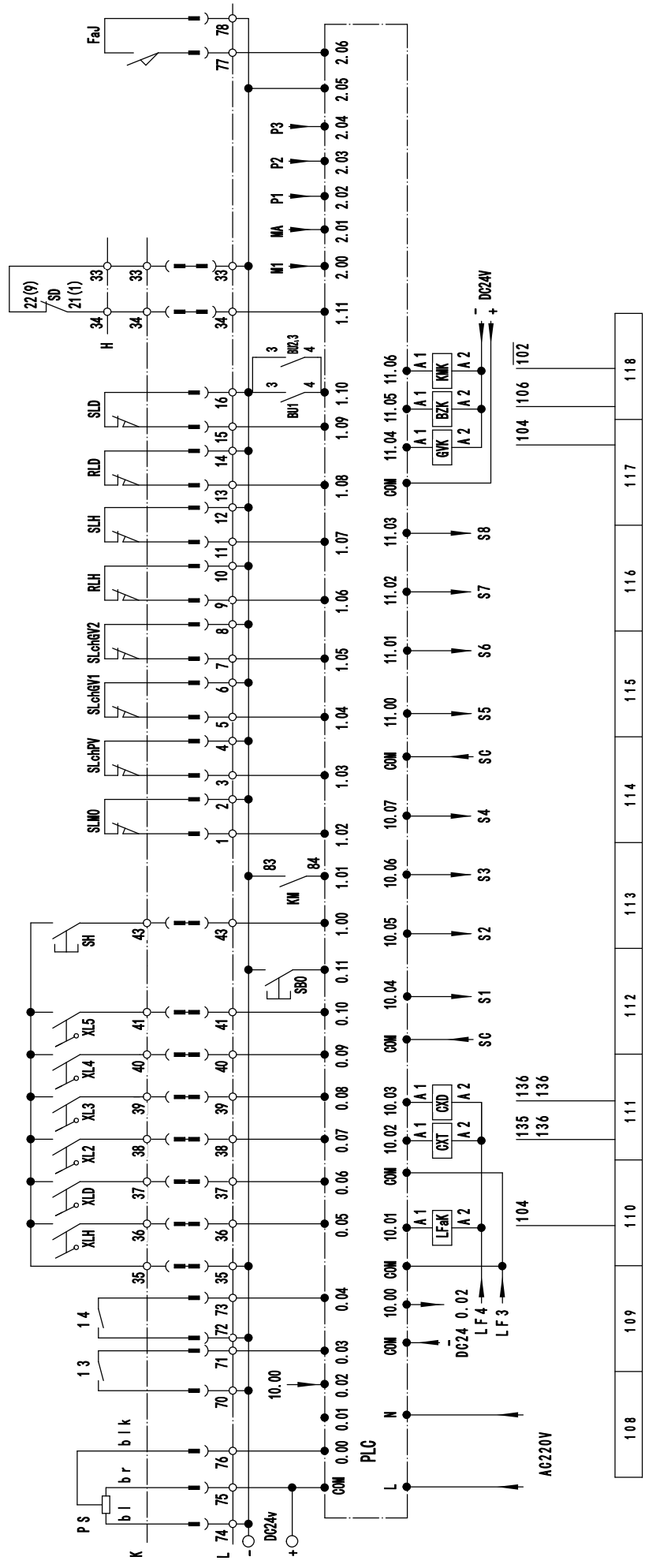
LAYOUT OF ELECTRIC SUPPLY

TS	TSFUP	TSFU1	XJ	XP
Control transformer	Circuit-breaker	Circuit-breaker	Phase detector	Assemble control relay

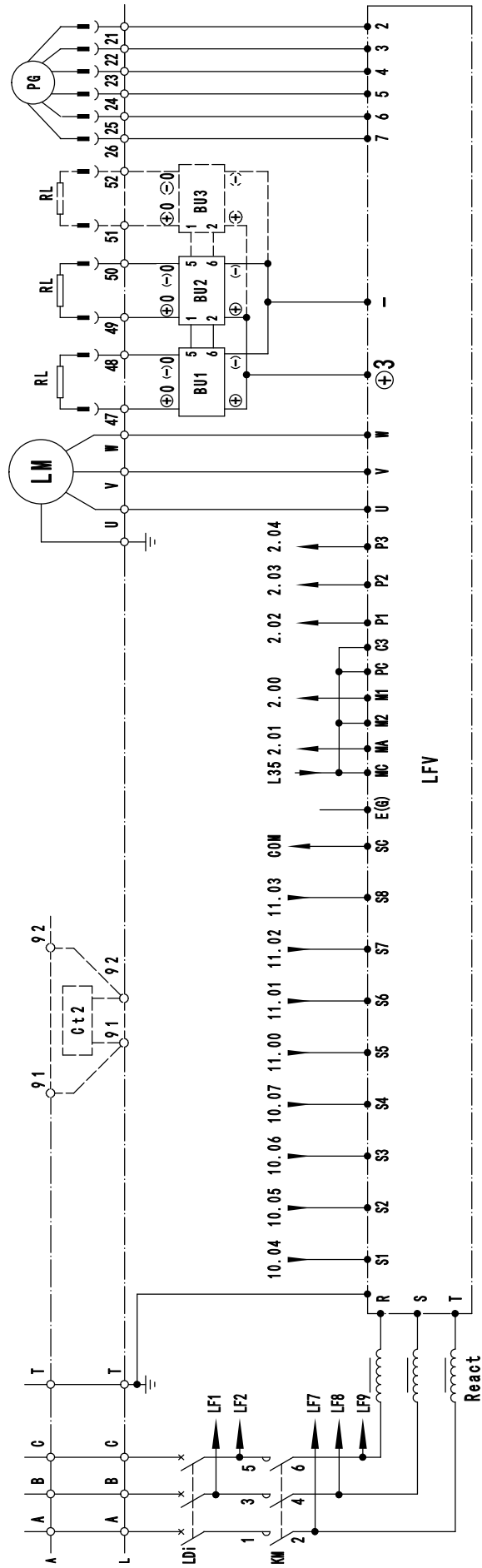


ELECTRIC PARTS LIST OF ELECTRIC SUPPLY

Symbol	Name	Q'ty
TSA	Transformer	1
Di	Auto circuit-breaker	1
TsDi , TsDi1	Circuit-breaker	2
XJ	3 Phase contactor	1
P	AC contactor	1
XP	Control relay	1
A	Terminal strip	4
H/A	Socket	1

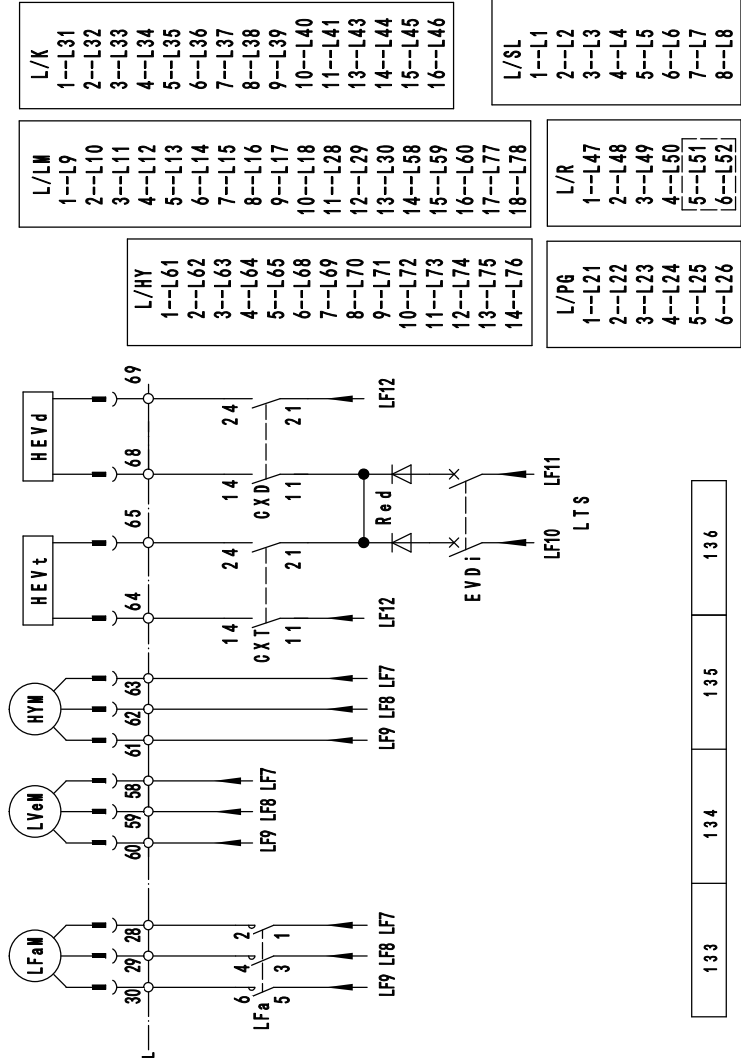


LFV-D027T-2



119	120	121	122	123	124	125	126	127	128	129	130	131	132
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LFV-D027T-3



LFV-D027T-4

LAYOUT OF HOIST

31-Fan

Fan

1-BU1

Braking unit

2-BU2

Braking unit

32-Fan

Fan

4-LTS

transformer

5-Red

Diode

6-SB0

Button

28-LDI

Auto circuit-breaker

7-TSDi	8-TSDi1	9-PLCDi	10-FanDi	11-EVDi	12-KMK	13-GVK	14-BzK	15-LFaK	16-CXT	17-CXD
Circuit-breaker	Circuit-breaker	Circuit-breaker	Circuit-breaker	Circuit-breaker	Control relay	Control relay	Control relay	Control relay	Control relay	Control relay

18-PLC	19-XKM	20-LFa
Programmable logic Controller	Control relay	AC contactor

27-LFU	29-KM
frequency conversion	AC contactor
	Auxiliary

21-L/SL	22-L/PG	23-L/R	24-L/LM	25-L/K
socket	socket	socket	socket	socket

33-L
Terminal Strip

26-L/HY

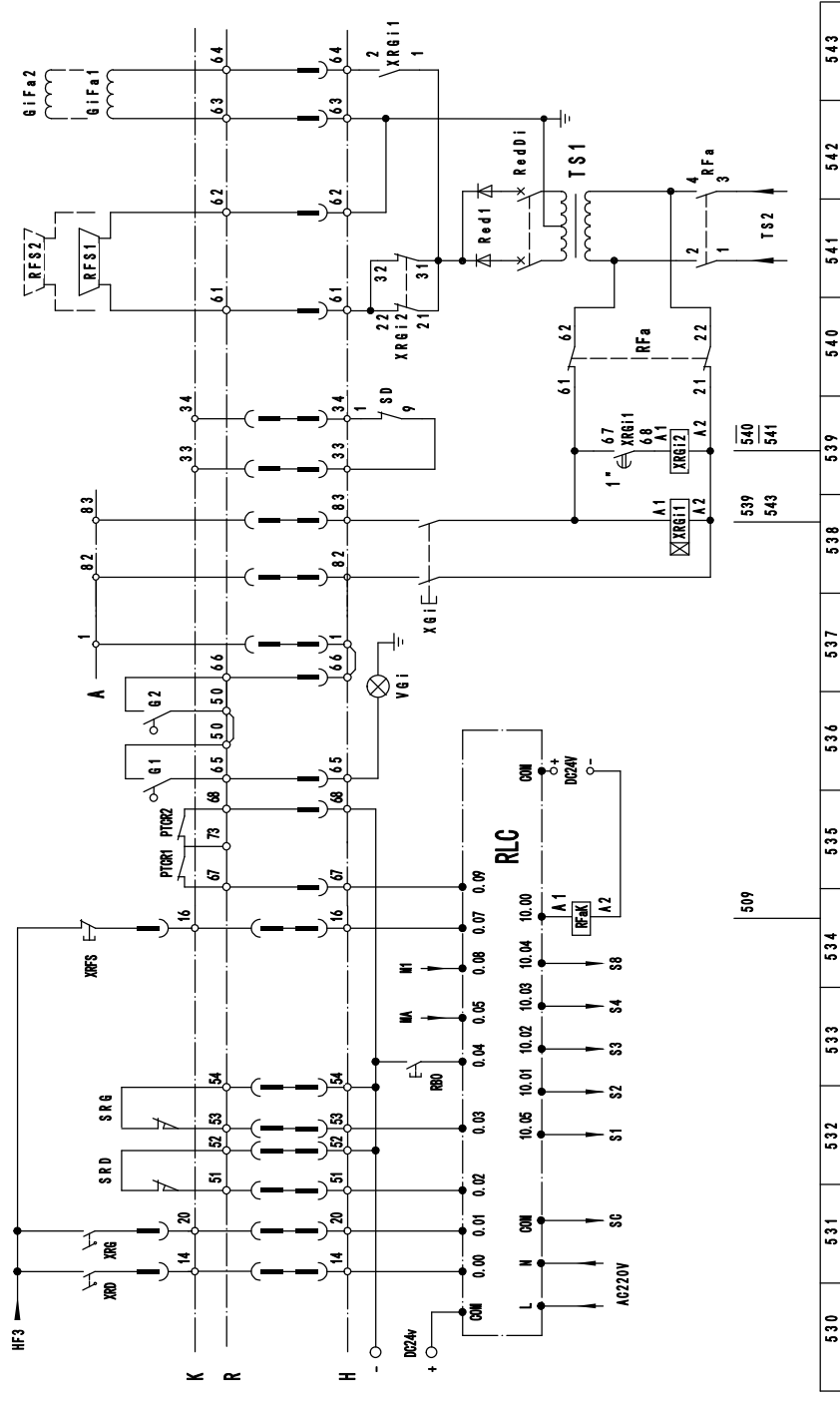
socket

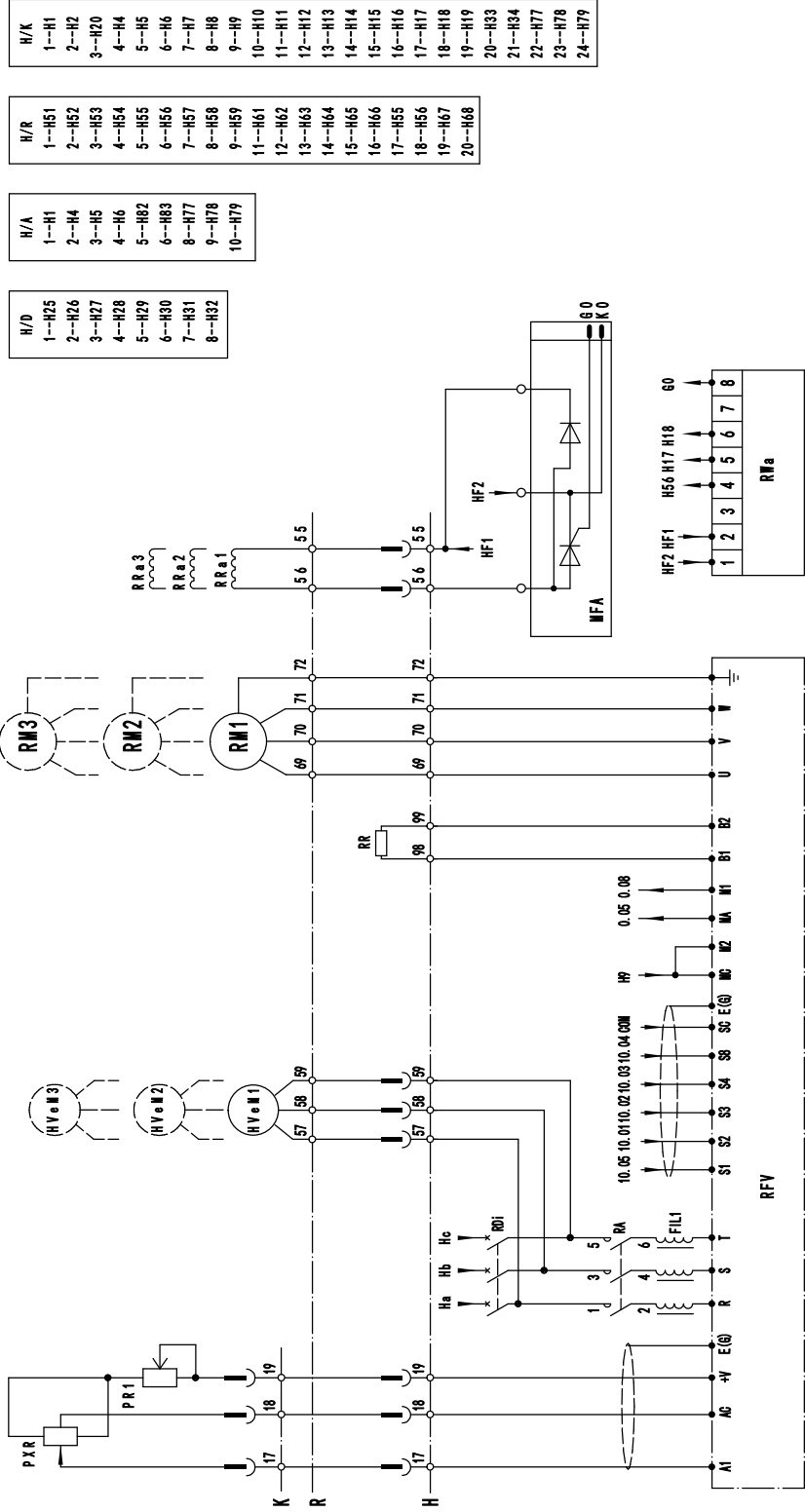
30-React

Reactor

ELECTRIC PARTS LIST OF HOIST

Symbol	Name	Q'ty
LTS	Transformer	1
FanDi 、 PLCDi	Circuit-breaker	2
TSDi、 EVDi		2
TSDi1		1
Red	Diode	1
KM	AC contactor	1
LFa		1
XKM	Control relay	1
CXT、 CXD、 LFaK		3
GVK、 KMK、 BzK		3
Connecting KM	Auxiliary	1
BU1、 BU2	Braking unit	2
LFV	Frequency conversion	1
PLC	Programmable logic Controller	1
LDI	Auto circuit-breaker	1
React	Reactor	1
L/SL、 L/PG	Socket	2
L/K 、 L/LM		2
L/R		1
L/HY		1
SB0	Button	1
Fan	Fan	2





H/D
1--H25
2--H26
3--H27
4--H28
5--H29
6--H30
7--H31
8--H32

H/A
1--H1
2--H4
3--H5
4--H6
5--H8
6--H8
7--H7
8--H8
9--H9
10--H9

H/R
1--H51
2--H52
3--H53
4--H54
5--H55
6--H56
7--H57
8--H58
9--H59
10--H60
11--H61
12--H62
13--H63
14--H64
15--H65
16--H66
17--H67
18--H68
19--H69
20--H70

H/K
1--H1
2--H2
3--H20
4--H4
5--H5
6--H6
7--H7
8--H8
9--H9
10--H10
11--H11
12--H12
13--H13
14--H14
15--H15
16--H16
17--H17
18--H18
19--H19
20--H20
21--H34
22--H77
23--H78
24--H79

544	545	546	547	548	549	550	551	552	553	554	555	556	557	558
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

LAYOUT OF SLEWING/TROLLEY

Red diode	Red1 diode	TS1 transformer	TS2 transformer	TSDi Circuit-breaker	TSDi1 Circuit-breaker	RedDi Circuit-breaker	FaDi Circuit-breaker	PLDi Circuit-breaker	MFA Silicon controlled rectifier
-----------	------------	-----------------	-----------------	----------------------	-----------------------	-----------------------	----------------------	----------------------	----------------------------------

RD Circuit-breaker	DD Circuit-breaker	GtDi Circuit-breaker
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DLC Programmable logic Controller

RLC Programmable logic Controller

RWa RFV-RRa Eddy current controller

DA AC contactor	DA1 AC contactor	DFa AC contactor	XRGi1 AC contactor	XRGi2 Control relay	RFa AC contactor	SD Control relay	DFaK Control relay	RFaK Control relay
--------------------	---------------------	---------------------	-----------------------	------------------------	---------------------	---------------------	-----------------------	-----------------------

DB0 Button	RB0 Button
---------------	---------------

Auxiliary

Auxiliary

RA AC contactor

RFV frequency conversion

FIL Filter

DFV frequency conversion

XGi Button	VGi Weathervane Light
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Fan

FIL Filter

H-K socket

H-R socket

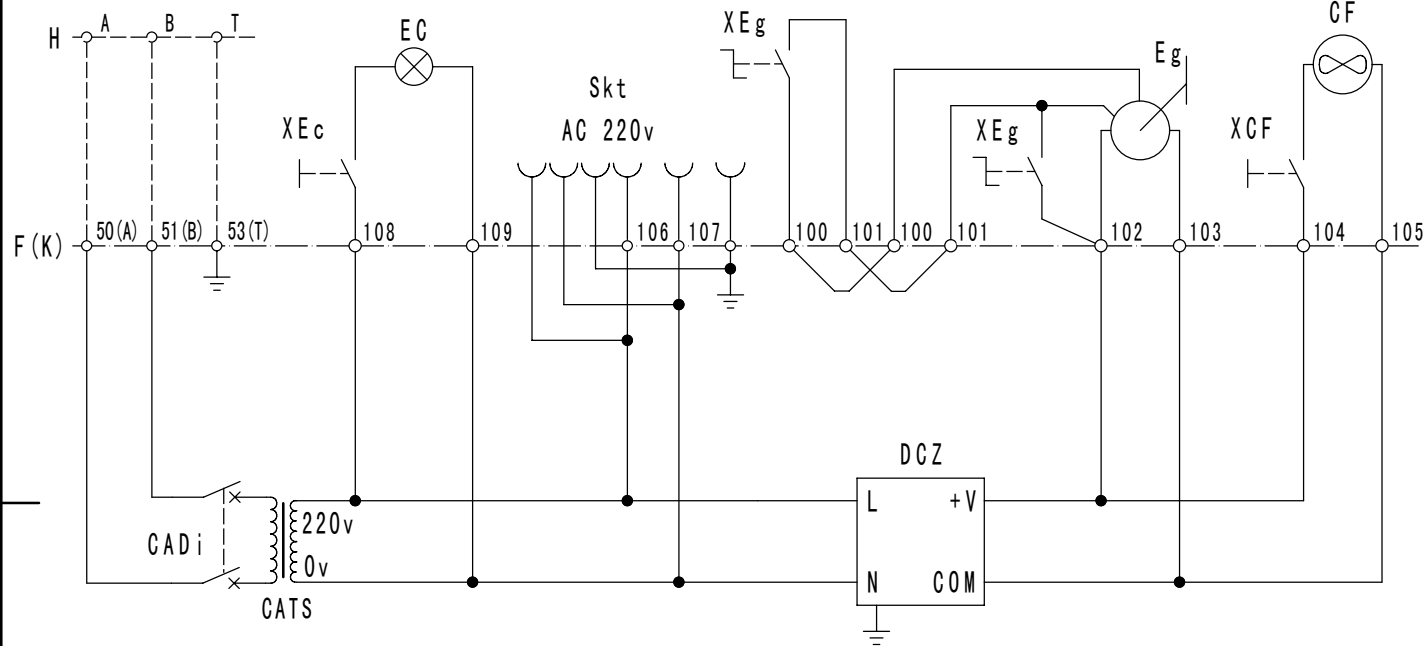
H-D socket

H-A socket

H Terminal strip

ELECTRIC PARTS LIST OF SLEWING/TROLLEY

Symbol	Name	Q'ty
TS1 , TS2	Transformer	2
red , red1	Rectifying diode	2
RDi , GtDi , DDi , RedDi , TsDi PLDi , TsDi1 , FaDi	Circuit-breaker	8
RA DA , DA1 , RFa , DFa , XRGi1	AC contactor	6
XRGi2 , SD , DFaK , RFaK	Control relay	4
XRGi1 , RFa	Auxiliary contact	1
H	Terminal strip	25
VGi	Weather vane Light	1
XGi , DB0 , RB0	Button	3
H-K , H-R , H-D , H-A	Socket	4
DLC , RLC	Programmable logic Controller	2
DFV	frequency conversion	2
FIL	Filter	2
Fan	Fan	2



- CADi: 变压器断路器
Safety Transformer Circuit Breaker
- CATS: 变压器
Safety Transformer
- XEc: 司机室灯开关
Control Cab Lighting
- Ec: 司机室灯
Cab Lighting
- XEg: 雨刷器开关
Control Windscreen Wipe
- Eg: 雨刷器
Windscreen Wipe
- Skt: 插座
Socket
- XCF: 风扇开关
Control Fan
- CF: 风扇
Fan
- DCZ: 直流电源
DC Power Supply

IND NUMBER	DOC. NO.	SIGN	DATE	
DESIGN				
		DATE	2007. 07. 09	

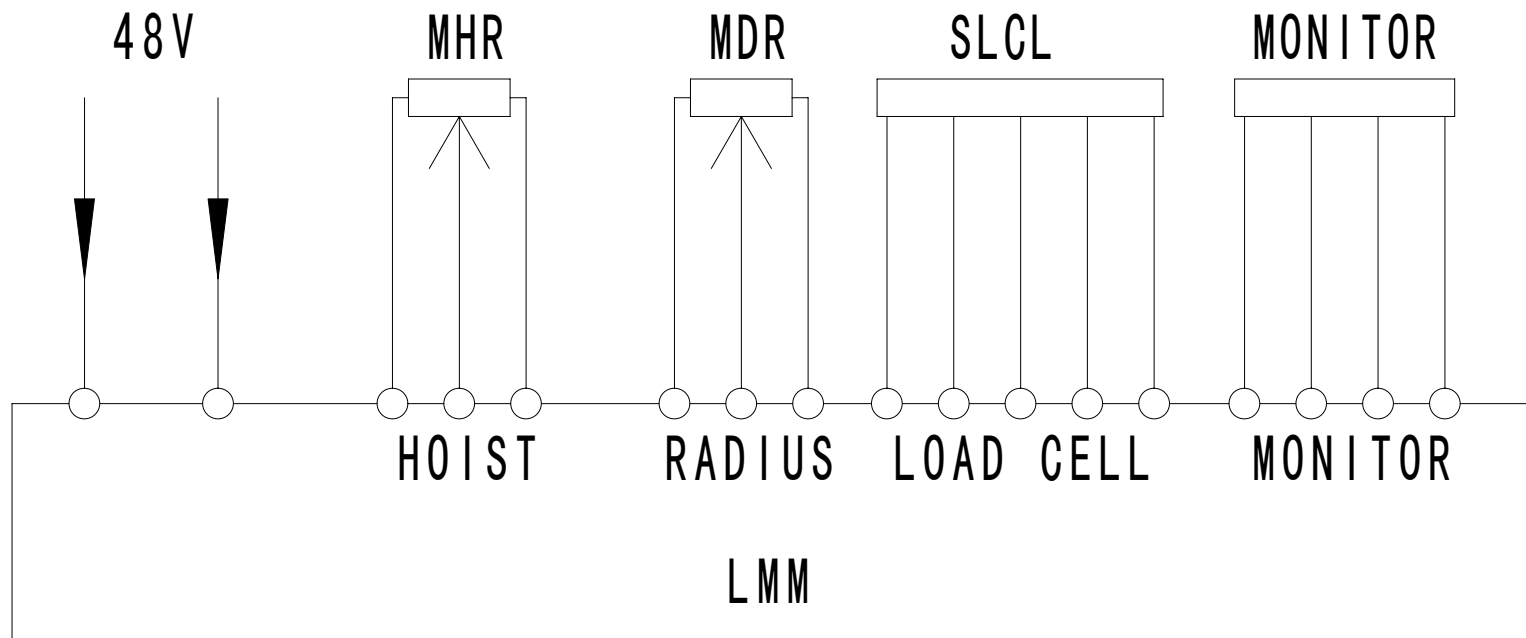
司机室接线图
WIRING DIAGRAM OF
THE CAB

CAB-D333E

DRAWING MARK	WEIGHT	SCALE
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Page of

YONGMAO



					DISPLAY WIRING DIAGRAM	LOAD-D333A		
						DRAWING MARK	WEIGHT	SCALE
IND	NUMBER	DOC. NO.	SIGN	DATE		Page of		
DESIGN						YONGMAO		
			DATE	060629				

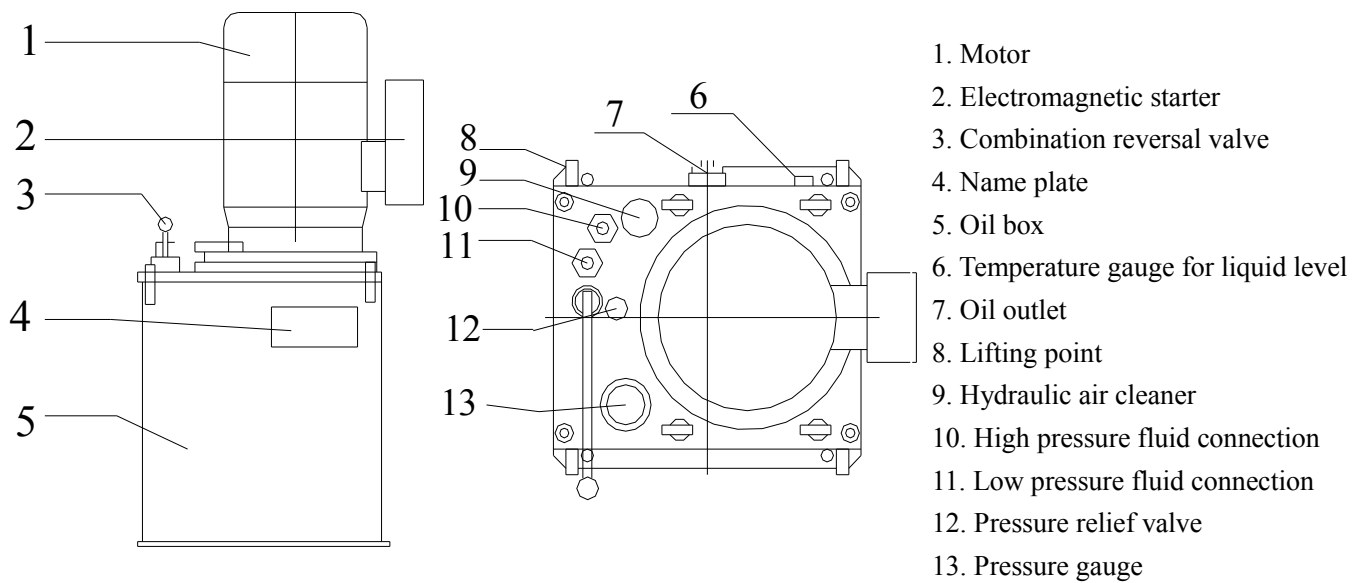
9. Hydraulic system

9.1 Composition of hydraulic devices	9B-2
9.2 Basic technical parameter	9B-3
9.3 Working principle	9B-3
9.4 Operating and maintenance	9B-5
9.5 The common failures and troubleshooting	9B-7

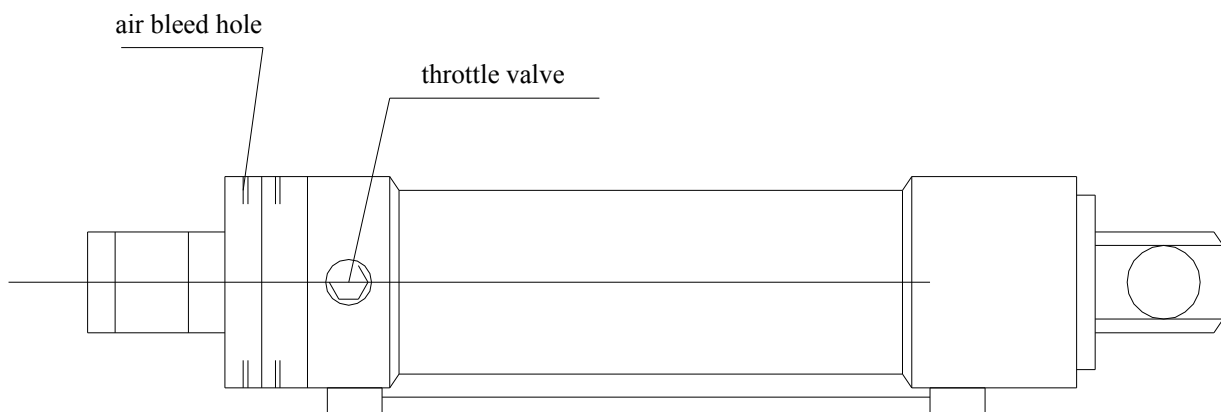
The hydraulic system of ST series tower crane is composed of: hydraulic pump, telescoping cylinder, joining hose and so on.

9.1 Composition of hydraulic pump station

It mainly makes up of oil box, filter, motor, oil pump, combination reversal valve, pressure limiting valve and pressure gauge.



Pump outline diagram



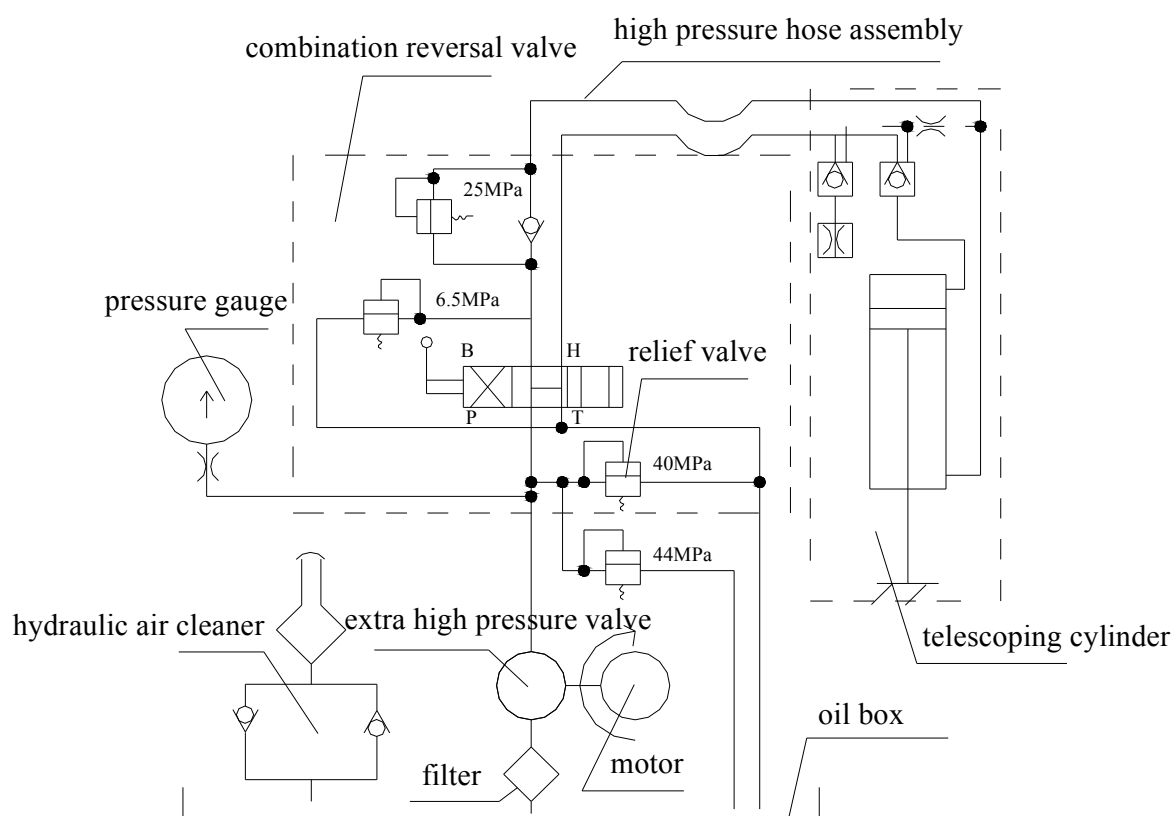
Outline drawing of telescoping cylinder

9.2 Basic technical parameter(YZ-3, YG-7)

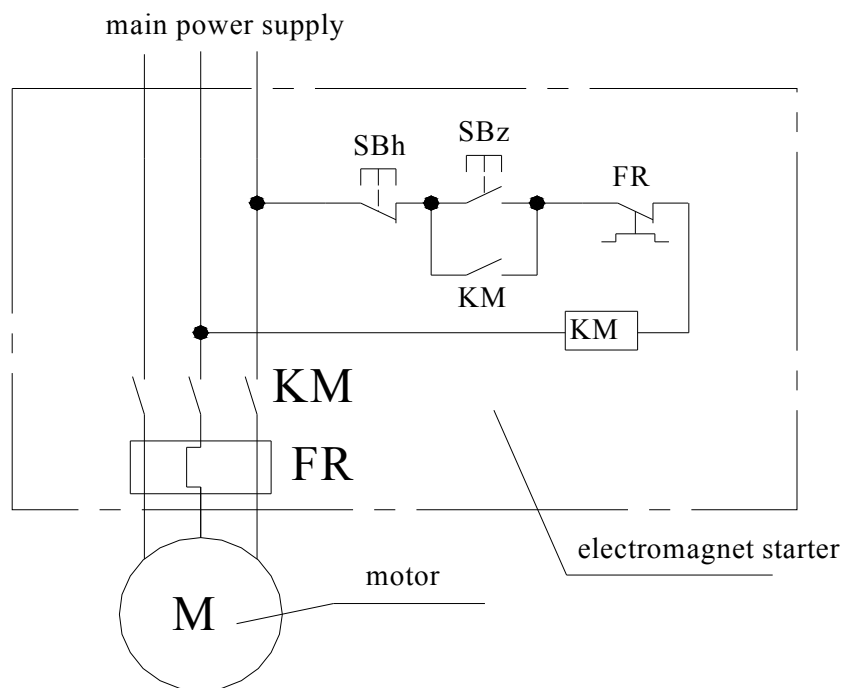
Hydraulic oil	N46 antiwear hydraulic oil or 40 thickened oil
Volume of oil box	130 L
Motor power	15 KW
Safety valve setting pressure	44 MPa
Max. working pressure for telescoping	40 MPa
Max. working pressure for lowering	6.5 MPa
Balance valve pressure	2.5 MPa
Oil pump capacity	23 L/mm
Cylinder inner diameter	Φ 180 mm
Piston rod diameter	Φ 125 mm
Max. telescoping force	100 t
Telescoping speed	0.8 m/min
Return speed	Adjustable in safe range
Cylinder travel	1600 mm
High pressure hose	West Germany standard: 4D-13-60
H type high pressure hose assembly	4 m

9.3 Working principle

Drive the oil pump by coupling after motor starting up. The oil pump makes the oil from oil box to telescoping cylinder via the filter, combination reversal valve and high pressure hose assembly. The setting pressure between the oil pump and combination reversal valve is 44MPa, the telescoping overflow valve of the combination valve is 40Mpa, the lowering overflow valve is 6.5Mpa and the balance valve is 2.5Mpa before leaving factory.



Hydraulic principle of telescoping system



Electrical principle of pump

The combination reversal valve in the middle position **H**, the opening **P** and opening **T** are joined together, the hydraulic oil of the oil pump outputted went back to the oil box, the hydraulic system is in offload condition at this moment.

Combination reversal valve is in the left position of figure (when lifting the lever of combination reversal valve), the hydraulic oil of oil pump outputted come into the big chamber via the combination reversal valve **P** and **H**, the high pressure hose assembly and the hydraulic lock. Open the hydraulic lock at the same time and make the piston of cylinder move downward; the hydraulic oil of the small chamber flow back to the oil box via the hydraulic lock, high pressure hose assembly and combination reversal valve **B** and **T**, the telescoping cylinder start to telescope. The telescoping speed depends on the flow of oil pump.

Combination reversal valve is in the right position of figure (when press down the lever of combination reversal valve), the hydraulic oil of oil pump outputted come into the small chamber via the combination reversal valve P and B, the high pressure hose assembly and the hydraulic lock. Open the hydraulic lock at the same time and make the piston of cylinder move upward; the hydraulic oil of the small chamber flow back to the oil box via the hydraulic lock, high pressure hose assembly and combination reversal valve H and T, the telescoping cylinder start to lower. The lower speed depends on the throttle valve of cylinder.

9.4 Operating and maintenance

9.4.1 Correct connect the main power supply of motor. Make the motor rotate anticlockwise. Open the cover of hydraulic air filter and fill up the clean and appointed hydraulic oil. Connect the hydraulic telescoping system pipeline according to the hydraulic system diagram and screw up the joint; test run and check that whether the hydraulic pump is in normal condition. The cylinder maybe jogging at beginning, turn left the airbleed screw via air bleed hole of cylinder and spurt some oil. Operate it several times, if it didn't jogging any more, tighten up the airbleed screw rightward; check the pressure of telescoping overflow valve (the overflow valve is 40Mpa before leaving factory, it no needs to adjust. If necessary, it can be adjusted and the overflow valve for lowering is 6.5Mpa), namely observe the pressure when the cylinder extends completely and retract completely. After the above work, it can be putting into service.

9.4.2 Although the oil box has been filled up with oil, some of them getting into the cylinder when it start up, so it need to add some hydraulic oil until it reaches to the upper limit of level gauge. Check the cleanliness of hydraulic oil every six month or after 2000 hours' running. According to the specific circumstances, it can be checked in advance. If the oil is milkiness, freezing and dirt, it must be replaced. In order to protect the seal ring of cylinder, wipe the dirty bodies on piston rod. The hydraulic pump should be covered well with plastic material after work with the purpose to protect the oil quality and prolong the service life.

9.4.3 Check that whether the oil is curdle if it didn't work for a long time. Operate the hydraulic system every two or three months with no load, which will protect the pump, valve and cylinder.

9.4.4 If the oil is milkiness, freezing and dirt, it must be replaced. The cylinder must be cleaned when replacing the oil and checked that some place have rusted. It so, get rid of the rust first, then add the new oil.

9.4.5 Check the oil quality before everyday work. It must be maintenance periodically.



Never adjust the throttle valve with load. Otherwise it may occur serious accident.

9.5 The common failures and troubleshooting

1) The cylinder shakes heavily when it lowering, even caused the mast swinging.

Reason: The adjustment of throttle valve for oil return circuit is unsuitable.

Troubleshooting: Adjust the throttle valve according to the operation manual, until it reaches to the optimum condition. If the opening position of throttle valve didn't align with the screw thread, it can not be adjusted.

2) The joint sleeve damaged

Reason: The manufacturing process of sleeve wasn't ensured.

Troubleshooting: Replace the joint or weld, i.e. weld the nut and direct connection completely. (At this time, the joint can't adjust the direction of oil pipe).

3) The cylinder continually falling down

Reason: Two chambers of the cylinder have residual gas left; not well sealed; or the hydraulic oil wasn't clear.

Troubleshooting: Eliminate the gas of the cylinder; ensure the seal of control piston and check valve; often check the oil cleanliness and ensure the oil box well sealed; the control valve of hydraulic pump must be accurately adjusted.



The high and low pressure interface of hydraulic telescoping system cannot be overturned; it is forbidden to adjust the throttle valve with load; it must be careful to adjust the high pressure throttle valve.

10. Safety devices

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10.2 Hoisting limit switch	10B-3
10.2.1 Purpose	10B-3
10.2.2 Working Principle.....	10B-3
10.2.3 Adjustments	10B-4
10.3 Slewing limit switch.....	10B-5
10.3.1 Purpose	10B-5
10.3.2 Working Principle.....	10B-5
10.3.3 Adjustments	10B-6
10. 4 Trolley limit switch.....	10B-7
10.4.1 Purpose	10B-7
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10.4.3 Adjustments	10B-7
10.5 Moment limiter	10B-9
10.5.1 Purpose	10B-9
10.5.2 Working Principle.....	10B-9
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10.6 Load limiter	10B-11
10.6.1 Purpose	10B-11
10.6.2 Working Principle.....	10B-11
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10.7 Anemoscope	10B-15

10.1 Introduction

The safety devices of tower crane are important devices to ensure the safety of person and equipment.

Among the safety devices, the moment limiter and the load limiter set a limit for the tower crane so as to protect it against overturning and the wire rope from breaking off. After the safety devices are set, don't modify their adjustments. The purpose of each limit switch is to limit the motion range of each mechanism.

NOTE:

- ① If the top of tower crane exceeds 30m, it is necessary to fit red obstacle indicator lights, which remain current feed even the tower crane stopped.
- ②. If the pivot joint height of jib foot exceeds 50m, it is necessary to fit an anemoscope, which send out warning to stop operation when wind speed exceeds max. limit of working speed.

10.2 Hoisting limit switch

10.2.1 Purpose

Hoisting limit switch is a device to avoid any possible error operation.

- a. To stop the hoisting-up motion as soon as the pulley block comes near the jib trolley (at 1-2m distance).
- b. To prevent the wire rope from completely unwinding or winding up onto the drum in the reverse direction when the pulley block is lowered.

10.2.2 Working Principle (See Fig. 10.2-1)

The limit switch, which equipped with a reduction gear and located on the chassis of drum, is driven either directly by the drum shaft or the pinion engaged a gear ring. It drives several cams to rotate which control the circuit breakers, so as to cut off the corresponding motion.

Note: Each time when transferring the tower crane to a new jobsite and before putting it into service, it is essential to unscrew the plug located at the lowest part of limit switch in order to drain away the condensing water. This plug must be re-screwed before the tower crane transportation.

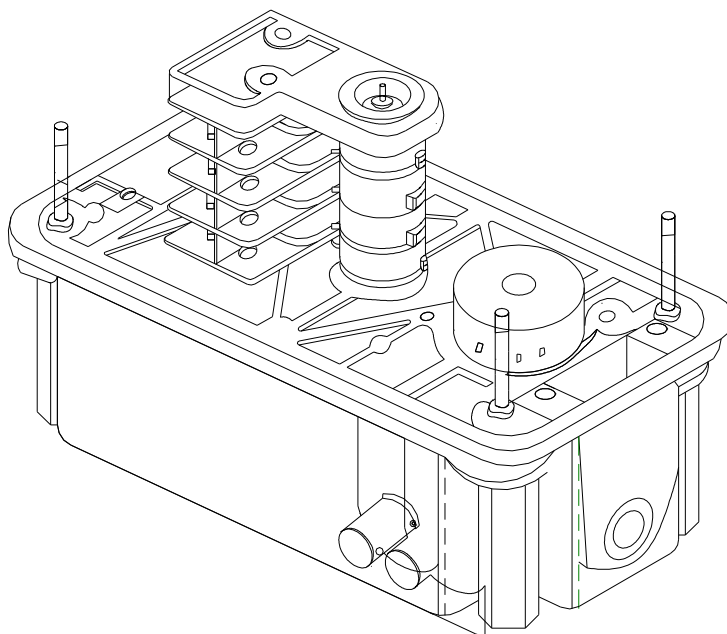


Fig. 10.2-1

10.2.3 Adjustments

After the tower crane reaches to the predetermined height:

Adjustments must be carried out with no load. Control the hoisting or lowering motion and operate contact A or D manually so as to determine the contact which cuts off the control motion. (Note: If changing the height or falls of tower crane, it is necessary to adjust the hoisting limit switch for hoisting and lowering.)

1) Adjusting the hoisting limit switch for lowering (SLD)

Lower the hook down with 2-fall or 4-fall. Rotate cam (1) via corresponding adjusting screw so as to depress the corresponding contact A. Here the hook stops before reaching to the ground (it is forbidden to make the hook reaches to the ground, with the purpose to prevent the rope unwinding from the drum. At least 3 layers of rope windings should remain on the drum (when the hook is at the lowest position).

2) Adjusting the deceleration limit switch for lowering (RLD)

Lower the hook down with 2-fall or 4-fall. Rotate cam (2) via corresponding adjusting screw so as to depress the corresponding contact B. Here the hook can stop away from the ground 6m and only can run with low speed.

3) Adjusting the deceleration limit switch for hoisting (RLH)

Hoist the hook up with 2-fall or 4-fall, until the distance between the trolley and hook block is only 6m. Rotate the cam (3) via corresponding adjusting screw. Check the hoisting control, until it depresses the corresponding contact C and only can hoist with low speed.

4) Adjusting the hoisting limit switch for hoisting (SLH)

Hoist the hook up with 2-fall or 4-fall, until the distance between the trolley and hook block is only 1m. Rotate the cam (4) via corresponding adjusting screw. Check the hoisting control, until it depresses the corresponding contact D and the hoisting motion stopped.

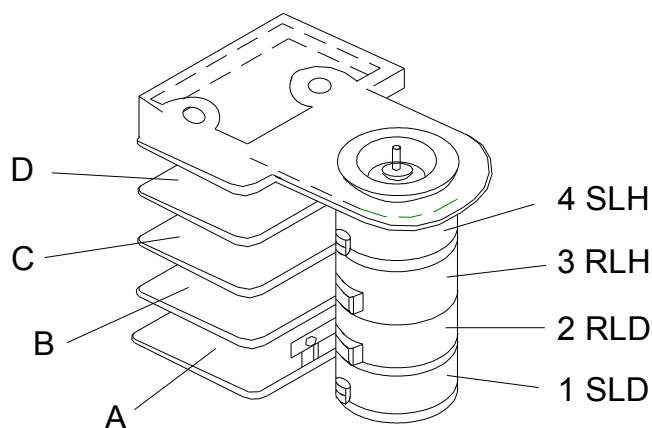


Fig. 10.2-2

10.3 Slewing limit switch

10.3.1 Purpose

It is provided for tower cranes without slip ring, with the purpose to prevent the cables from twisting and damage. The max. allowable slewing circles is 3 when the slewing limiter is installed.

10.3.2 Working Principle

The limit switch is a device with reduction gear which driven by a pinion engaged directly with the slewing ring gear. While the crane slewing, the reduction gear of limiter drives the cams 4 and 6 to rotate, which also controls the circuit breaker (inching switch), so as to stop the corresponding slewing motion at suitable position (See Fig. 10.3-1).

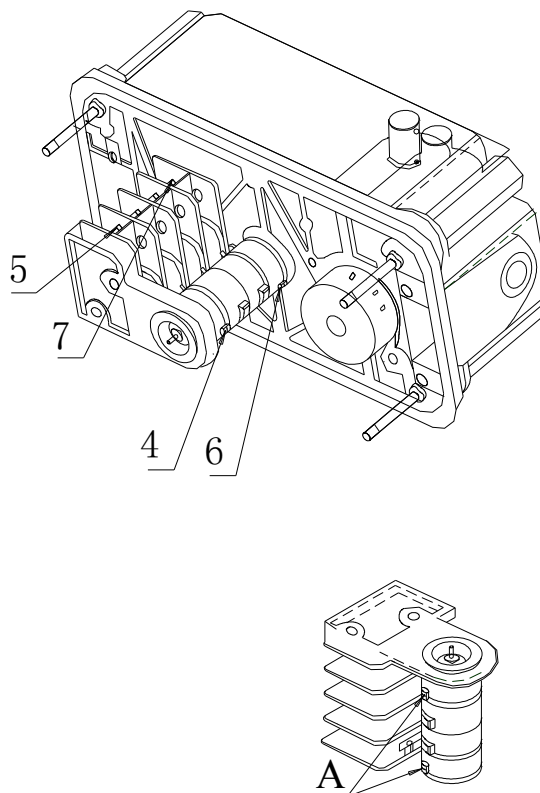


Fig. 10.3-1

10.3.3 Adjustments

The adjustment of slewing limiter should be carried out with no load. Control “left slewing” or “right slewing” motion, and adjust contact (A) manually to determine which one cuts off the slewing movement.

a). Adjusting the right slewing limiter (SRD): Slew the jib so that the cables won't be twisted. Slew one and a half circles to the right, then adjust the cam (4) and check its movement until it depresses the corresponding contact (5).

b). Adjusting the left slewing limiter (SRG): Slew 3 circles in the reverse direction. Adjust the cam (6) until it depresses the contact (7).

Note: Each time when transferring the tower crane to a new jobsite and before putting it into service, it is essential to unscrew the plug located at the lowest part of limit switch in order to drain away the condensing water. This plug must be re-screwed before the tower crane transportation.

10.4 Trolley limit switch

10.4.1 Purpose

The trolley limit switch is to avoid any possible error operation and to keep a safety distance between the trolley and jib nose or between the trolley and jib foot.

10.4.2 Working Principle

The trolley limit switch is a device with reduction gear which driven by a pinion engaged with the drum gear ring. The reduction gear of limiter drives the cams (3, 6, 7 and 9) to rotate, which controls the circuit breaker (inching switch 4, 5, 8, 10), so as to cut off the corresponding motion (See Fig. 10.4-1).

10.4.3 Adjustments

1) Adjusting the (trolley out - deceleration) safety device (RDAv): drive the trolley to a distance of 1.5m from the jib nose buffer. Rotate cam (3) until it depresses the corresponding contact (4).

2) Adjusting the trolley out limit switch (SDAv): Drive the trolley to a distance about 20cm from the jib nose buffer. Rotate cam (6) until it depresses the contact (5). Don't adjust the cam (3) any more.

3) Adjusting the trolley in-slewing down safety device (RDAr) and the trolley in limit switch (SDAr). Proceed as described above but move the trolley to the jib foot. Operate the slewing down cam (7) to depress the contact (8) and then regulate limit switch cam (9) to depress the contact (10).

Adjusting the (trolley in - deceleration) safety device (RDAr) and trolley in limiter (SDAr): drive the trolley to the jib foot. Rotate cam (7) until it depresses the corresponding contact (8), then adjust limit cam (9) until it depresses the corresponding contact (10).

NOTE: The adjustments must be checked daily before putting the tower crane into service.

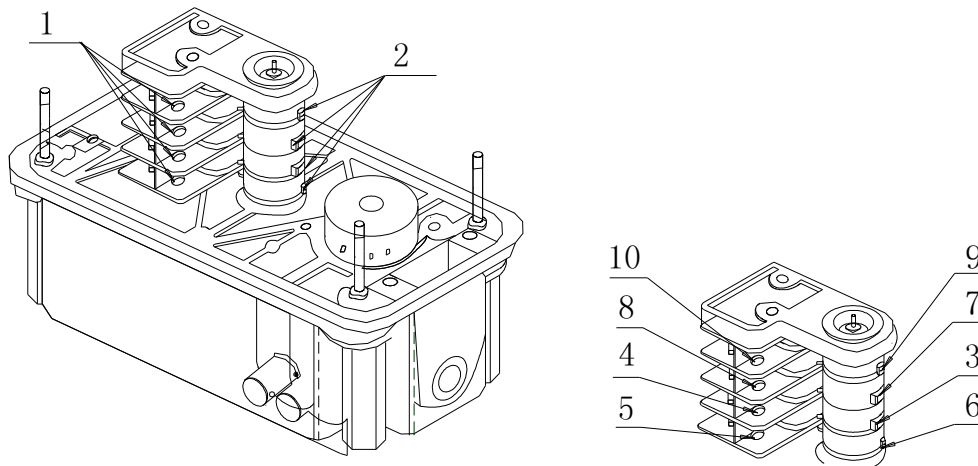


Fig. 10.4-1

10.5 Moment limiter

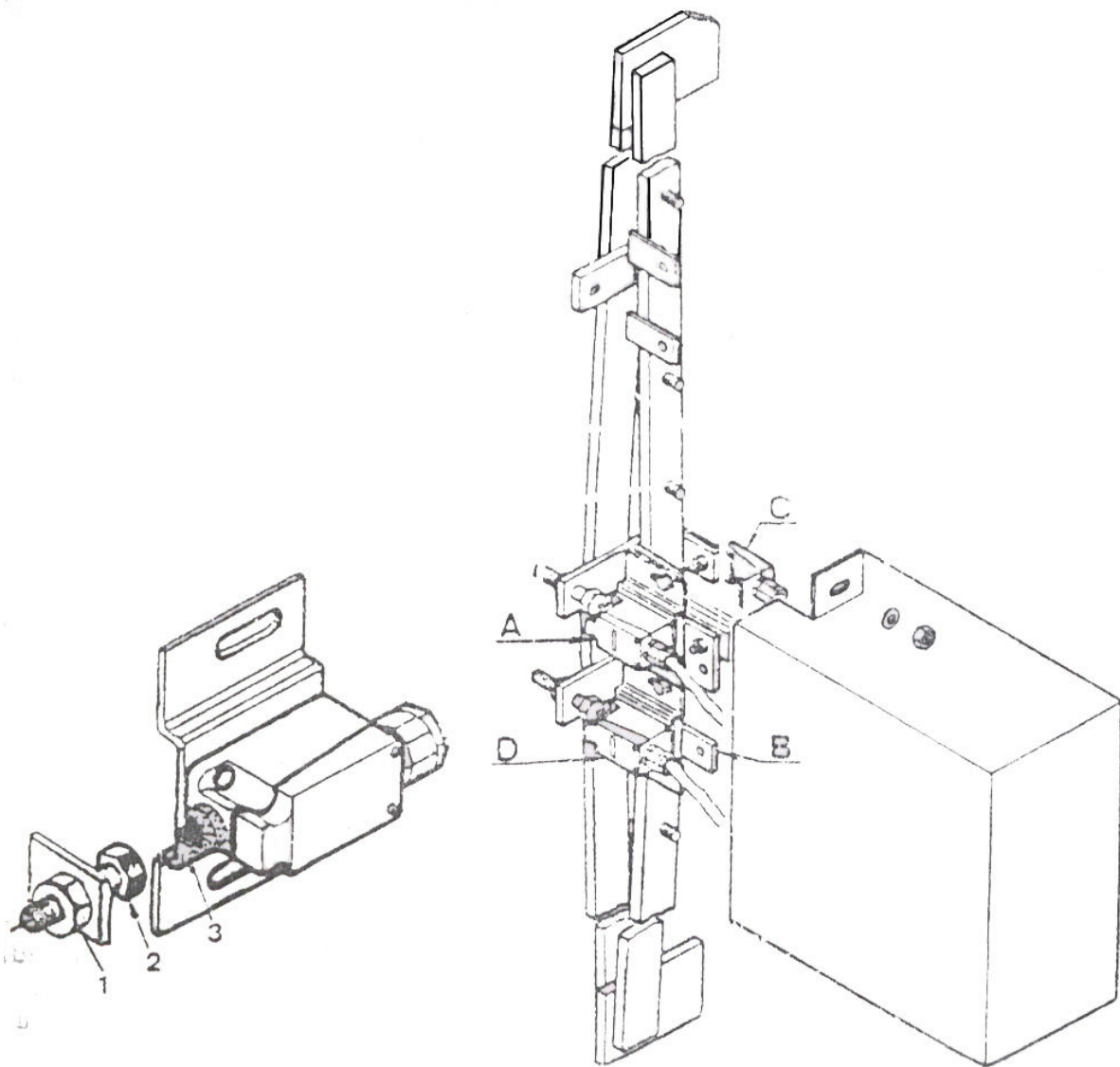


Fig 10.5-1

Adjust A, C and D:

Loosen the nut (1), rotate the bolt (2) until it touches the contact (3), then close the switch contact. Lock the nut (1) after exact adjustments.

10.5.1 Purpose

The tower crane is calculated and designed according to constant max. load moment. It is forbidden to exceed the max. load moment. The moment limiter is a device to inspect the hoisting and trolleying motion with rated load so as to prevent the tower crane from overturning.

10.5-2 Working Principle

The moment limiter, which is located on the main member at the counter-jib foot, is composed of a pair of elastic plate, three micro-inching limit switches as well as installation support, adjustable screw, housing and so on. When hoisting with load, the elastic plate began distorting (the distance between the two plates became smaller) due to the action of load moment. If the load exceeds rated value, the adjustable screw on one elastic plate depresses the switch contact which located on the other elastic plate so as to cut off the control circuit and stop the mechanism motion.

10.5.3 Adjustments



Special suggestion:

Confirm the rated load moment of tower crane before adjusting the moment limiter, then debug the relevant data.

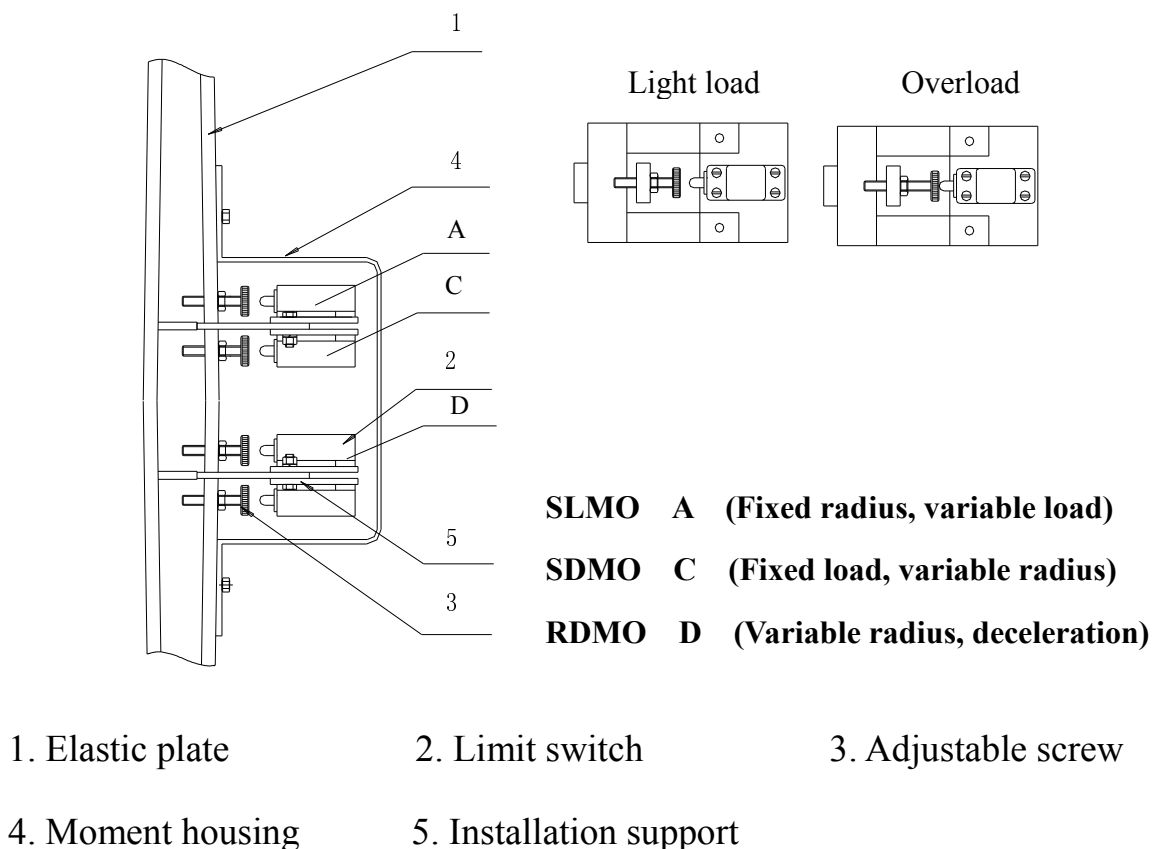
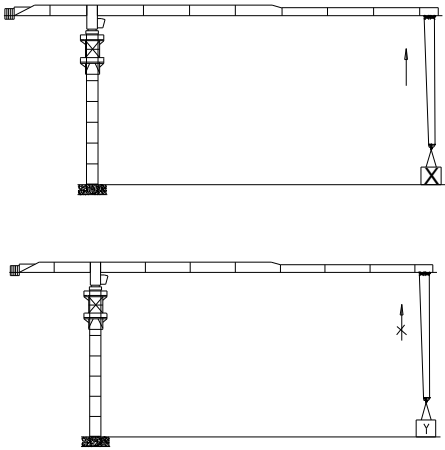
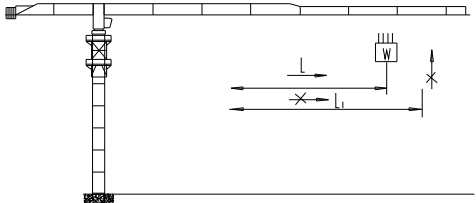
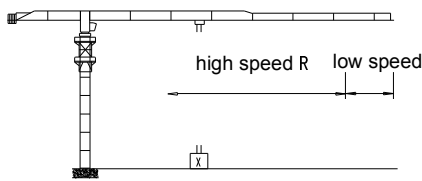


Fig. 10.5-1

Table 10.5-1

	1. Adjusting the hoisting moment limiter SLMO 1). Drive the trolley to the jib nose and lift the specified load X with rated speed in 2 falls according to the jib length (adjust device A) 2). Lower the load, then lift a load of $Y = X + X \cdot 10\%$ with the lowest speed in 2 falls. The inching switch SLMO will move and cut off the circuit, otherwise it should be readjusted.
	2. Adjusting the trolley moment limiter SDMO 1). Measure the distance and mark the valid radius (L) for max. load (W) and the radius $L' = L + L \cdot 10\%$ on the ground. 2). Lift the max. load (suspending in the air) and drive the hook to the marked radius (L). (Adjust device C) 3). Drive the trolley to the jib foot, then trolley out with rated speed. Before reaches to the marked (L'), the trolley motion should be cut off, otherwise readjust it.
	3. Adjusting the moment limiter RDMO, which decelerate before reaching to the max. trolley radius when trolley out. Lift the load X at the jib center, then trolley out with rated speed and adjust device D, so that the trolley can running with low speed instead of rated speed as soon as reaches to the radius D. $D = 0.8D_{MAX}$

Note:

- (a) The load X, W and radius L are selected according to the jib length and falls. (See table 10.6-3 and 10.6-4).
- (b) Adjusting the devices A, C and D: Unscrew the nuts and bolts until the bolts touches the contact of moment switch, but will not cause circuit break.

10.6 Load limiter MSWL

10.6.1 Purpose

The structure and hoisting winch of the tower crane are calculated and designed in accordance with maximum load. It is forbidden that the working load exceeds the max. load. The load limiter **MSWL** is a safety device to prevent the tower crane from overload.

10.6.2 Working Principle

When passing through the proving ring pulley of hoisting wire rope, the rope produces tension due to the action of load. The tension was transmitted to the proving ring (9) which connects with the pulley. As the load changes, the proving ring begins distorting, as well as the metal plate (10) which equipped with inching switches (2, 4, 6 and 7) and adjustable screw (1, 3, 5 and 8). According to the requirement of the load, via proper adjustment, the inching switch (2, 4, 6 and 7) was depressed so as to control the circuit.

10.6.3 Adjustments

Special suggestion:

Confirm the rated load of tower crane before adjusting the load limiter, then debug the relevant data.

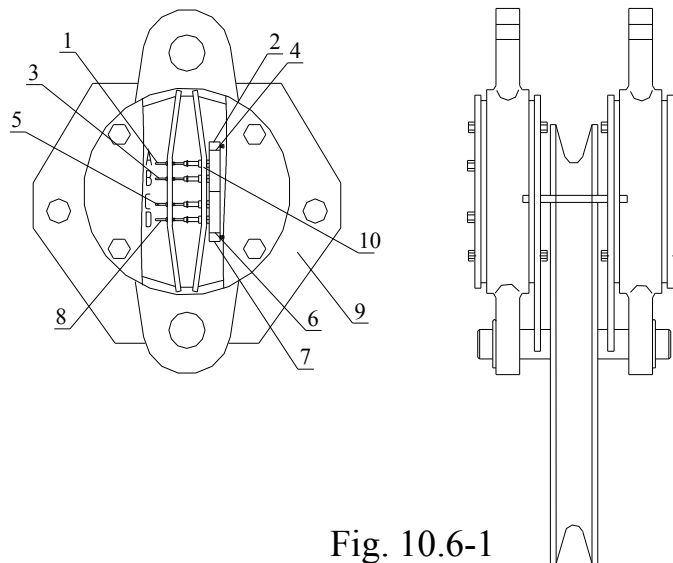


Fig. 10.6-1

1, 3, 5 and 8 - adjustable bolt

9. proving ring

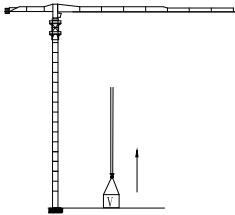
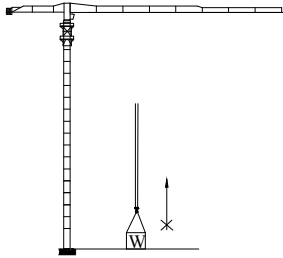
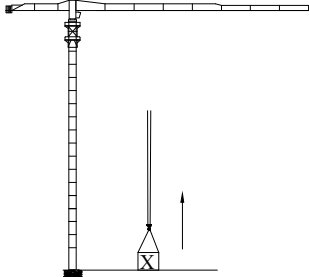
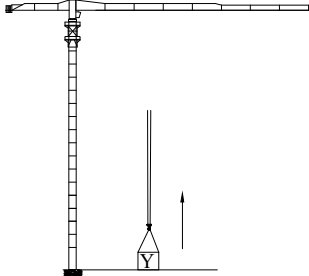
2, 4, 6 and 7 – inching switch

10. metal plate

Note:

- 1) The tower crane should be set 2 sensitive switches and adjustable bolts.
- 2) Except normal inspection and maintenance for the load limiter, after each erection and changing falls, it must be readjusted according to characteristic parameters.

Table 10.6-1

● Adjusting the speed limiter (SLCHGV)	
1. Lift the load V with low speed (PV), then hoist up with high speed.	
2. Adjusting bolt (1) until the bolt head touches the inching switch (2).	
3. Lower the load and add 10% to the load. Lift it with low speed, then try to hoist up with high speed. At this moment, it shouldn't be obtain the high speed (the five shift), otherwise, it should be readjusted.	
● Adjusting the max. load limiter (SLCHPV)	
1. Lift the load X with low speed.	
2. Adjusting bolt (3) until the bolt head touches the inching switch (4).	
3. Lower the load, and add 10% to the load. Lift it with low speed. If the load can be lifted, readjusted it.	

Note: For various load V, W, X and Y, see Table 10.6-2.

Load table for max. working load limiter (12t):

Table 10.6-2

	Load limiter for high speed limiting				Overload limiter	
	SLChGV1		LChGV2		SLChPV(MV)	
	V (10N)	W (10N)	V (10N)	W (10N)	X (10N)	Y (10N)
	4000	4400	1750	1925	6000	6600
	8000	8800	3500	3850	12000	13200

Adjusting load and radius table for the moment limiter (12t):

Table 10.6-3

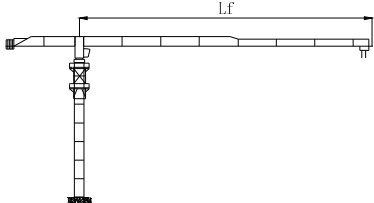
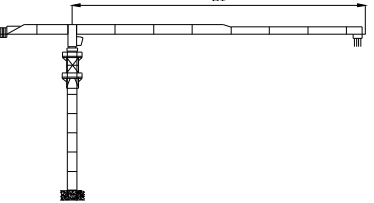
	2-fall SM	Hoisting moment limiter SLMO		Trolley moment limiter			
				SDMO			RDMO
	Lf (m)	X (10N)	Y (10N)	W (10N)	L (m)	L' (m)	D (m)
	74	2700	2970	6000	37.3	41.0	59
	70	3000	3300	6000	38.5	42.3	56
	64	3700	4070	6000	41.9	46.1	51
	60	4000	4400	6000	42.0	46.2	48
	54	4600	5060	6000	42.7	46.9	43
	50	5300	5830	6000	44.8	49.3	40
	44	6000	6600	6000	44.0	44.0	35
	40	6000	6600	6000	40.0	40.0	32

Table 10.6-4

	4-fall DM	Hoisting moment limiter SLMO		Trolley moment limiter			
				SDMO			RDMO
	Lf (m)	X (10N)	Y (10N)	W (10N)	L (m)	L' (m)	D (m)
	74	2200	2420	12000	20.2	22.2	59
	70	2500	2750	12000	20.7	22.8	56
	64	3200	3520	12000	22.3	24.5	51
	60	3500	3850	12000	22.1	24.3	48
	54	4100	4510	12000	22.3	24.5	43
	50	4800	5280	12000	23.2	25.5	40
	44	6500	7150	12000	25.9	28.5	35
	40	7500	8250	12000	26.4	29.0	32

10.7 Anemoscope

10.7.1 Technical specifications

10.7.1.1. Power voltage: 48VAc/50Hz;

10.7.1.2. Starting wind speed $\leq 1.5\text{m/s}$;

10.7.1.3. Dial gauge $\leq \pm 3\%$;

10.7.2 Operating environment temperature:

10.7.2.1. Wind speed sensor: $-40 - +50^{\circ}\text{C}$; 0 - 100%RH

10.7.2.2. Dial gauge: $-20 - +50^{\circ}\text{C}$; 0 - 70%RH

10.7.3 Working principles and instructions for use

10.7.3.1. Working principles

The wind speed sensor and the dial gauge are connected with three core cables. The wind speed sensor outputs the pulse signal which proportionated to the wind speed, the pulse was rearranged via the circuit into DC level. Then the current is magnified and fed into the gauge to show the wind speed. The LED light beam gauge processes the signal via exclusive circuit, which lights up 201 raster lines. The alarm sounds when the wind speed exceeds the limit value.

10.7.3.2 Instructions for use

Before power on, connect the sensor and dial gauge with the included cable. Screw tightly. When power on, it shows the wind speed and wind force both via ft/s and m/s readings. Green represents the operating zone; yellow represents the caution zone and red represents the danger zone. Set the limit value to 13 when it hoisting. Set the limit value to 20 when it working. When the wind speed exceeds the above limits, it sent out both audible and visual alarm, the relay contact began to work. When the wind speed is lower than the limit value, it can reset automatically.

10.7.4 Adjusting and service

10.7.4.1 The circuit of the wind anemoscope has already been adjusted, it is not necessary to readjust it. In the event of sufficient depreciation or rough transport conditions, the display can be inaccurate or the preset limit value can be biased. In this case, only a professional staff can open the anemoscope and adjust the corresponding potentiometer.

The purpose of each potentiometer is as follows:

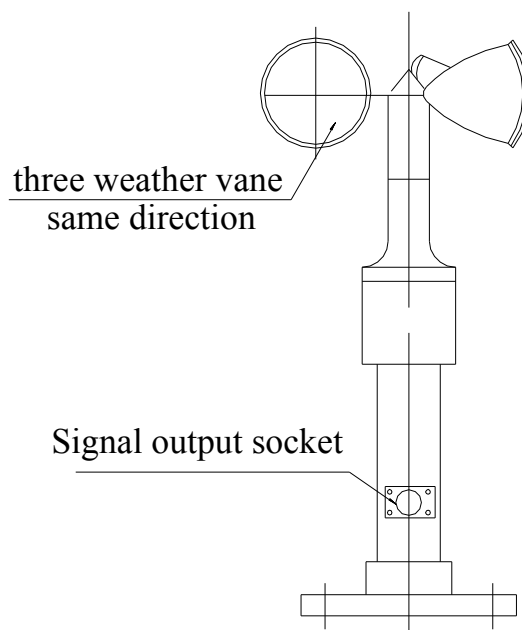
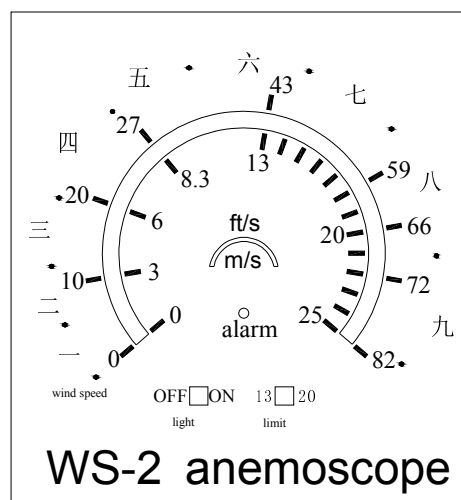
W1 - 13m/s limit alarm set;

W2 - 20m/s limit alarm setup;

W3 - LED light beam gauge full range adjustment;

W4 – wide angle gauge full range adjustment;

W5 - test signal amplitude adjustment;



Wind speed sensor

11. Fixing and testing rules for wire rope

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APPENDIX: Common wire rope defects

11.1 Explanation

Although its structure is compact and its appearance is strong, the fatigue and wear of wire rope is unavoidable. The fatigue and wear wire rope will be damaged rapidly, which may result in serious accidents (both on personal and equipment) if the users do not pay special attention to it.

The wire rope condition can be found by periodical inspection. For the hoist equipment, the wire rope should be taken as a kind of expendable. It should be replaced once its intensity and strength are reduced.

11.2 Fitting the wire rope

The type and specification of new wire rope should be the same as the original one. If not, the user must ensure that the characteristics and the capability of new wire rope are not lower than the original one and the new wire rope is applicable to the groove of drums and pulleys. Prevent the wire rope from knotting, twisting together, buckling or adhering sundries. Before putting the wire rope of tower crane into service, the users should ensure that all kinds of devices involved with the work of wire rope are in normal working condition. In order to keep the wire rope in place steadily, operate the tower crane with 10% of the rated load several times.

11.2.1 Fitting new wire rope

- 1) Completely unwind the wire rope on the clean ground and avoid any twist (see Fig. 2-1). If it is not possible to unwind the wire rope completely, unwind it in large loops. In this way it can avoid danger during enwinding the wire rope onto the drum.
- 2) Check the length of wire rope.

3) Enwind the wire rope onto the drum via a sling and fasten it with bulldog grips.

The distance between the wire rope and the last bulldog grip should be not less than **3cm** (the tightening moment of the screw is **9mdaN**).

4) Hoisting up and enwind the wire rope onto the drum 4-10 circles tightly (See Fig. 2-2).

5) Check the adjustment of limit switch and readjust it if necessary.

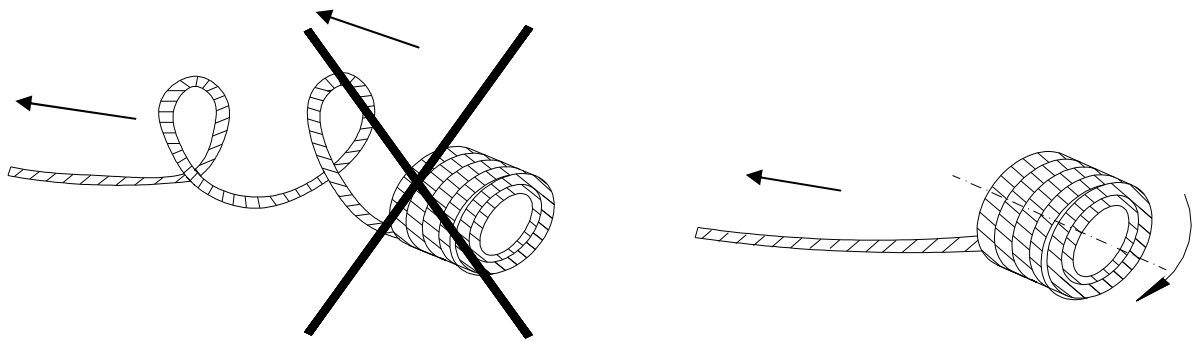


Fig. 2-1

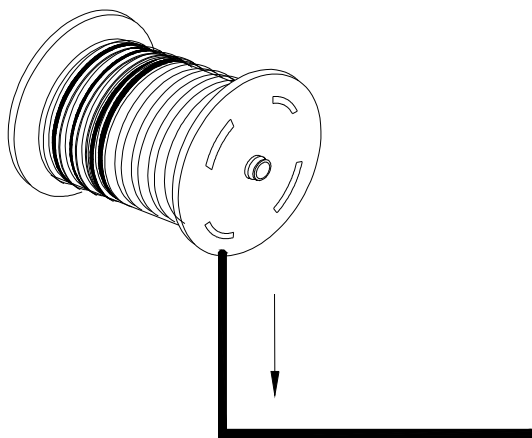


Fig. 2-2

11.3. Maintenance

The maintenance of wire rope depends on the purpose of hoisting machinery, the working environment as well as the wire rope used. If possible, the wire rope should be cleaned and greased, especially the bended and curved part of wire rope which reeled through the pulley. The type of lubricating oil should be suitable to the grease which used in the wire rope factory. Lack of maintenance is one of the common reasons for short life time of wire ropes, especially when the machinery works in corrosive environment or the wire rope can not be greased due to some reasons caused by the limitation of operation.

11.4 Inspections

11.4.1 Daily observation

It is recommended to observe all the visible parts of the wire rope every working day, so as to discover any damage or distortion in time. Pay special attention to the part which fixed on the tower crane, if any obvious change is found, inform the person in charge to inspect the wire rope according to the fourth item listed below.

11.4.2 Periodical inspection by person in charge

The following items should be taken into account in order to determine the inspection period and inspection cycle.

- a). National statute for hoisting machinery, such as GB5144-2006 “Safety rules of tower crane”;
- b). Types of hoisting machinery and it working environment;
- c). Working grade of hoisting machinery;
- d). The test results and the defects before;
- e). Working time of the wire rope since its initial use.

Ensure that the wire rope used on the tower crane was inspected at least once a week. After an accident or before putting the wire rope into service again after dismantling, inspect the wire rope thoroughly.

11.5 Inspection places

11.5.1 General inspecting places

Pay special attention to the following places although a thorough inspection on the whole length of the wire rope should be made.

- a). The places of rope running and two fixed ends of wire rope.
- b). For the rope or rope sections which reeving through the pulley block, pay special attention to all the places reeving through the pulleys during hoisting when the mechanism carrying out repeated operation.
- c). The rope sections which located on the balancing pulley.
- d). The rope sections which may be worn due to external factors.
- e). Internal inspection for corrosion and fatigue. The inspection results should be recorded on the equipment inspection notebook.

5.2 Inspecting the drum (See Fig. 5-1)

- a). Check the end places of the wire rope on the drum.
- b). Check for distortion and wear which caused by unqualified enwinding, especially at the wire rope groove jumping and overlapping places.
- c). Check for broken wire rope.
- d). Check for corrosion of the wire rope.
- e). Check for distortion which caused by adding load suddenly.

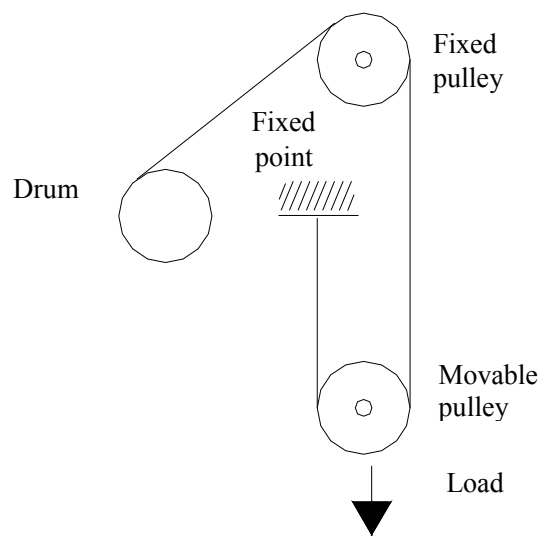


Fig. 5-1

11.5.3 Inspecting the fixed pulley and fixed points

- a). Check for the broken and wear of wire rope which reeving through pulleys.
- b). Check for broken and corrosion of wire rope on fixing points, as well as the wire rope sections around the balancing pulleys.

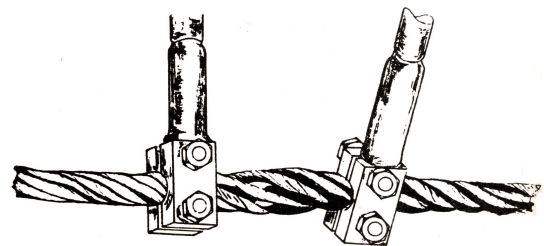
- c). Check for distortion of wire rope.
- d). Check for the diameter of wire rope.

Check for places around movable pulley

- a). Check carefully on the rope section which passing through the movable pulleys, especially the rope sections around the pulleys with load.
- b). Check for broken of the wire rope and surface wear.
- c). Check for corrosion of wire rope.

11.5.4 Internal inspecting of wire rope

Internal damage is mainly caused by the corrosion and fatigue of wire rope. Internal damage may not be discovered by external inspection even if the wire rope is nearly broken completely. The person in charge should carry out the internal inspection. The method of internal inspection is as follows:



Firmly tighten the wire ropes via two clamps with suitable dimensions. Screw the clamp so that the outer layers of the wire rope are divorced from the core of wire rope. When the wire rope is untwisted slightly, clear the grease and chip in the rope by screwdriver. The inspection items are as follows:

- a). Internal lubrication;
- b). Corrosion conditions;
- c). Wire rope impress which caused by extrusion and wear;
- d). Confirm if there are broken wire ropes. Make the wire rope to its original state, then grease. (This method is not applicable for the wire rope with multiple layers.)

11.5.5 Inspecting the wire rope end

It is very dangerous if the wire rope from the fixing end fatigue and wear, the same inspection should be made on other fixing devices, such as rope anchor box, cable clamp and so on. Check if there is crack; check for possible slide between rope anchor box, cable clamps and wire ropes; check the fixing of wire rope on the drum. In any case, the wire rope on the drum mustn't be less than 3 circles.

11.6 The discard standard of wire rope

11.6.1 The quality and quantity of broken wire rope

For wire ropes with 6 or 8 strands, the broken of wire rope mostly occurs on the appearance. For the wire rope with multilayer strands, it mostly occurs inside the wire rope.

The visible broken wire ropes which must discard for the hoisting machinery:

Table 6-1

The wire no. of outer strands	Wire rope structure	Mechanism working grade M3~M8			
		Alternate lay		Lang lay	
		Length range			
		6d	30d	6d	30d
101~120	6x19, 7x19, 6x(19) 6w(19), 34x7	10	19	5	10
221~240	6x37	19	38	10	19

Note:

- 1). The working grade of tower crane mechanism is M4.
- 2). “d” represents the diameter of wire rope.
- 3). The filling wires is not the load-bearing wires, so it must be take out from the inspection number.

Should take out the stuff steel wire from the check number because can't make stuff steel wire as load steel wire. The multilayer wire rope only considered its visible outer layer. For the wire rope with steel core, consider it as the internal strands.

11.6.2 Broken wire on rope end

When the wire rope breaks at rope end or around, it indicates that there is high stress on this part, which may be caused by incorrect installation of rope end. Find out the reason for damage. Cut off the broken part and fix it again if its length is allowable.

11.6.3 Broken wire part focusing

The rope should be discard if the broken wire part focusing within the length of wire rope less than **6d** or it concentrated in one strand even if the broken wire number is less than the table listed above.

11.6.4 Increase rate of broken wire rope

In some events, the fatigue is an important reason for rope damage. The broken wire occurs after using a period of time and its broken number increases in a short time. In this condition, check and write down the broken wire increasing rate in order to confirm the wire rope discard date.

11.6.5 Rope strand broken

The rope should be discarded if the whole wire rope broekn.

11.6.6 Rope diameter decreased due to the rope core broken

The wire rope should be discarded when the rope diameter decreased obviously due to the fiber core damage and steel core break (or inner wire rope strand for multilayer structure).

11.6.7 Elasticity decreased

In some conditions (generally related to the working environment), the flexibility of wire rope shall decrease obviously, it's not safe to use any more. Generally accompany with follow conditions:

- a). The rope diameter decreased;
- b). The length of wire rope lay extended;

- c). Lack of air gap between the wire rope and wire strand due to extrusion of each other.
- d). There is some brown dust at the wire rope sinking places;
- e). Although there is no broken wire, the wire rope became hard to bent and the diameter decreased, the wire rope should be discarded immediately.

6.8 External and internal wear

a). Internal wear:

The internal wear was caused by friction between the wire rope and wire strand, in particular the wire rope bend frequently.

b). External wear

The wear for outer layers of wire rope surface was caused by the wear of pulley and drum groove or the wear between ropes on the drums. The lack of lubrication, incorrect lubrication, dust and sand will enlarge the wear. The wire rope should be discarded if the outer layer wear reaches 40% of its diameter. If the wire rope diameter decreases 7% of its nominal diameter, even there is no broken wire, it also should be discarded.

11.6.9 External and internal corrosion:

a). External corrosion

The outer corrosion of wire rope can be observed by naked eye. The wire rope should be discarded if the surface appears pit and the wire rope became slack.

b). Internal corrosion

The wire rope should be discarded if the internal corrosion is serious.

11.6.10 Distortion

The wire rope can generate the visible deformation due to mechanical damage or local fatigue. They are undulation, cage distortion (appeared in multilayer wire rope) wire extruding, local diameter enlarged, kinking, local diameter decreased, part

collapsing, bending and so on. The wire rope should be discarded if it appeared the above conditions.

11.6.11 Damage which caused by heat or arc

If the surface of wire rope is in annealing condition due to the heat factor, it should be discarded.

11.7 Relevant equipment conditions for wire rope

The drum and pulley should be checked periodically, in order to keep them in normal condition. The radius of pulley groove should be suitable for the nominal diameter of wire rope.

Notice in particular

- It is forbidden to use the wire rope on mechanical drives after it damaged.
- It is forbidden to make the wire rope distorting, which may damage the safety and service life of wire rope.
- Visually inspect the whole length of the wire rope every three months.
- Replace the wire rope if occurs the following conditions:
 - breaking down.
 - the wire rope diameter decreased due to corrosion or wear.
 - distort, crushing, folding, knot or other damage.
 - twist distortion.
 - if the wire rope drying or oxidation, using the RC oil to lubricate.
- Dismantling the old wire rope
 - lower down the pulley block on fixing support.
 - loosen the wire rope from its fixing end.
 - unwind the wire rope from the drum.
 - dismantle the double bulldog of wire rope and loosen the single bulldog of wire rope, but don't dismantle it.

APPENDIX:**Common wire rope defects**

If the wire rope damaged, it must be replaced immediately. The damage causes are as follows:



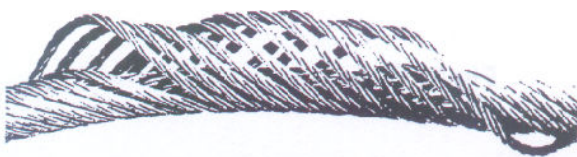
Individual wires bend up and protrude from the strands, the wire rope serious damaged which caused by stress changing.



Increased diameter of a parallel enwinding wire rope results in distortion to the metal core due to abrupt change stress. Corrosion and wear are often noted on the external layer of the wire rope.



Example of serious bending of the wire rope



Basket-slacking (birdcage) of multilayer wire rope (non rotating type) which caused by forced enwinding of the wire rope through narrow groove or large deflection angle.

12. Slewing ring

Periodical inspection for fastening bolt of slewing ring (type 013.50.1830.101)

Frequency of inspection: After the initial 100 hours' running of the slewing ring, the pretension of the bolt should be inspected. After this, it should be inspected every 500 hours. Enough pretension should be maintained. At the same time, the pretension of the bolt should be inspected each time when the tower crane is to be mounted and dismantled.

Method of inspection: make sure that the bolts to be checked are not influenced by the tension force due to load or counter weights.

Using a torque wrench to check the tightening torque of the bolts corresponds to the values as listed in Table 12.1-1.

Occasional replacement: It may happen that, during an inspection, one or several bolts show a tightening torque beyond the minimum and maximum torques as stated in the table. In such case, it will be necessary to replace part or all of the bolts.

Systematic replacement: The screws and bolts used for the slewing ring assembly must be systematically replaced every seven years or 14000 hours.

Re-tightening of the bolts: No matter it is after the replacement of the bolts or the slewing ring is re-assembled by using new bolts, the tightening of the bolts should be carried out continuously and symmetrically in 180° direction. Then re-tighten them one more time to make sure that all the bolts on the circle have the same pretension.

Table 12.1-1

Bolt diameter ϕ (mm)	Bolt type 10.9	
	Tightening moment (N.m)	
	Max.	Rated
$\Phi 20$	580	520
$\Phi 22$	780	700
$\Phi 24$	10000	900
◆ $\Phi 27$	◆ 1500	◆ 1350
$\Phi 30$	2000	1800

The bolts remarked with ◆ are selected for connecting the slewing mechanism of the tower crane, they must be checked weekly. If the bolts become loosen, please retighten it with the torque value shown in table 1.

13. Maintenance

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13.1 Every kind of lubricating symbols

Table 13.1-1

symbols	International standard or main characteristic
	T12032 16
	3 # industry lithium based grease
	HL-20 20 # gear oil
	2 # aircraft grease ZL45—2
	N100 gear oil
	MIL-L 2105B SAE80-VOIO3242 Used in the country with cold weather
	Compound calcium base MOS2 4#
	32 # antiwear hydraulic oil in winter, 46 # antiwear hydraulic oil in summer
	MIL-L 2105B SAE 90-JOIO3255 Used in the country with hot or comfort weather

13.2 General instruction

Table 13.2-1

M	When startig
N	Oil level
V	Draining
R	Fill up
G	Lubricating

13.2.1 Running-in period

Carry out the first draining of oil in the reducer after 450 working hours.

13.2.2 Using the grease gun

- 1) Grease all the connecting pieces without grease nipples (such as door and trap door hinges, joystick, locks and hinges of the safety devices).
- 2) In order to avoid any impurity getting into the oil when checking the oil level and draining, clean the parts which located around the plugs.
- 3) The oil quantities shown in this manual are only for the user's reference; it is essential that the oil reaches to the lower part of the oil level plug.

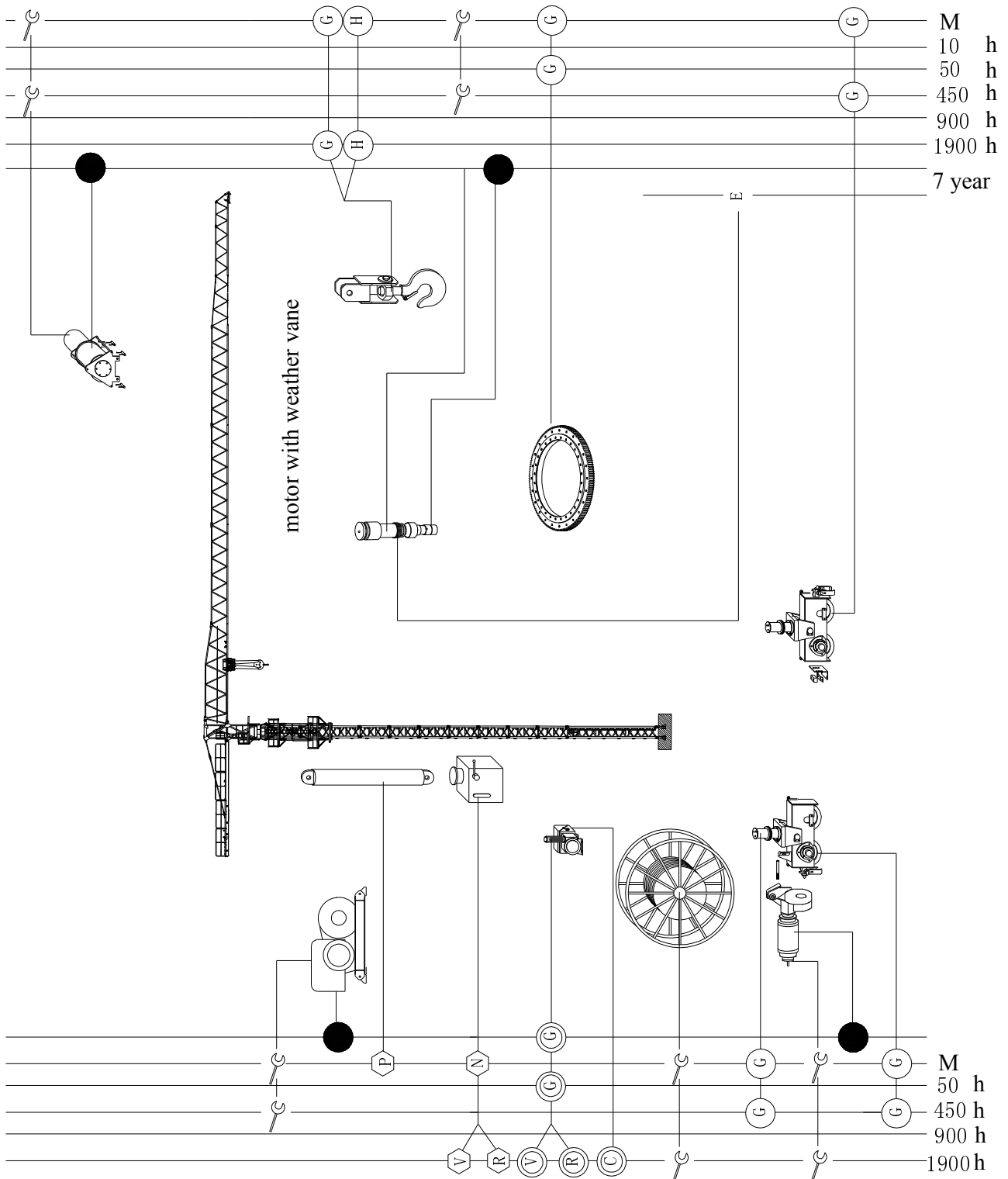
13.2.3 Checks to be carried out before assembling and disassembling

- 1). Check and adjust the brakes periodically according to the recommended cycles in the manual. Each time before the tower crane erection and dismantling, all the mechanisms should be inspected properly.
- 2). For fast erection and self-erection tower crane, it required the folded winch to installing and dismantling the jib. So it is necessary to check each mechanism.
- 3) Check the condition of brake disc, each friction surface and the pins. Adjust them if necessary.
- 4). Make sure that nothing will influence the good working order of tower crane (perfect motor and brake supply circuit , fuses in place and in good working order, flexible of the rod for manual brake release , remove the nut , if necessary)

Note: The drum must be locked when carrying out the above checks. Any carelessness of this warning may cause serious results.

13.3 Maintenance schedule

G: lubricating N: oil level R: fill up E: replacing H: oiling P: air blasting
V: draining ⌘: checking ●: lifetime lubricating h: hour T: air hole



13.3.1 Maintenance on trolley winch

The following rules should be strictly observed to do any kind of maintenance on trolley winch:

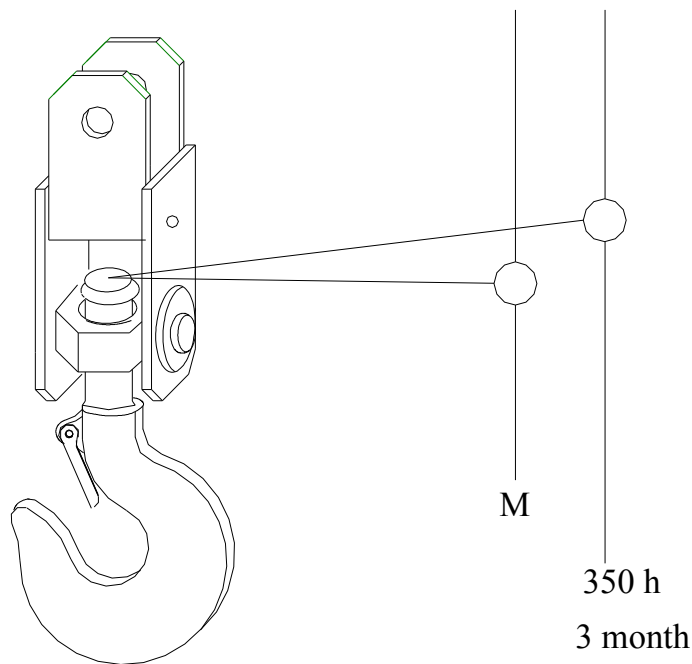
The operator must fasten the safety rope.

When carry out maintenance the brake, the operator must ride on the motor.

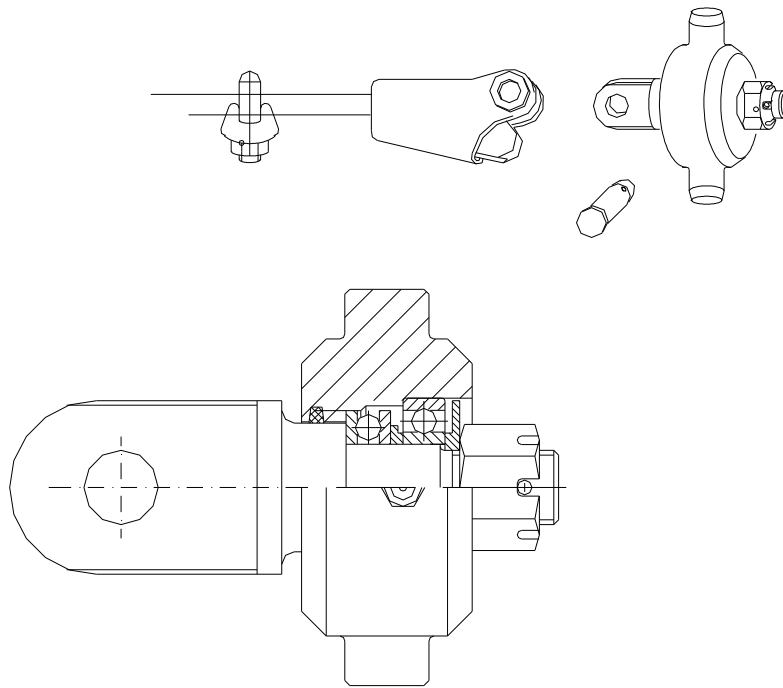
13.3.2 Maintenance on hook

The bearing on the traverse beam of the hook must be greased **every 200 hours** using calcium based grease.

○ Oil symbol



13.3.3 Maintenance on rope-twist protector



13.3.4 Greasing the wire ropes

The wire ropes must be greased every 6 months or when they seem to be dry or tend to oxidize. We recommended that lubricate them using 10 # mechanical lubrication. In case of long time no using of the wire rope, it should be grease (Detailed information please see “fixing and testing rules for wire rope”).

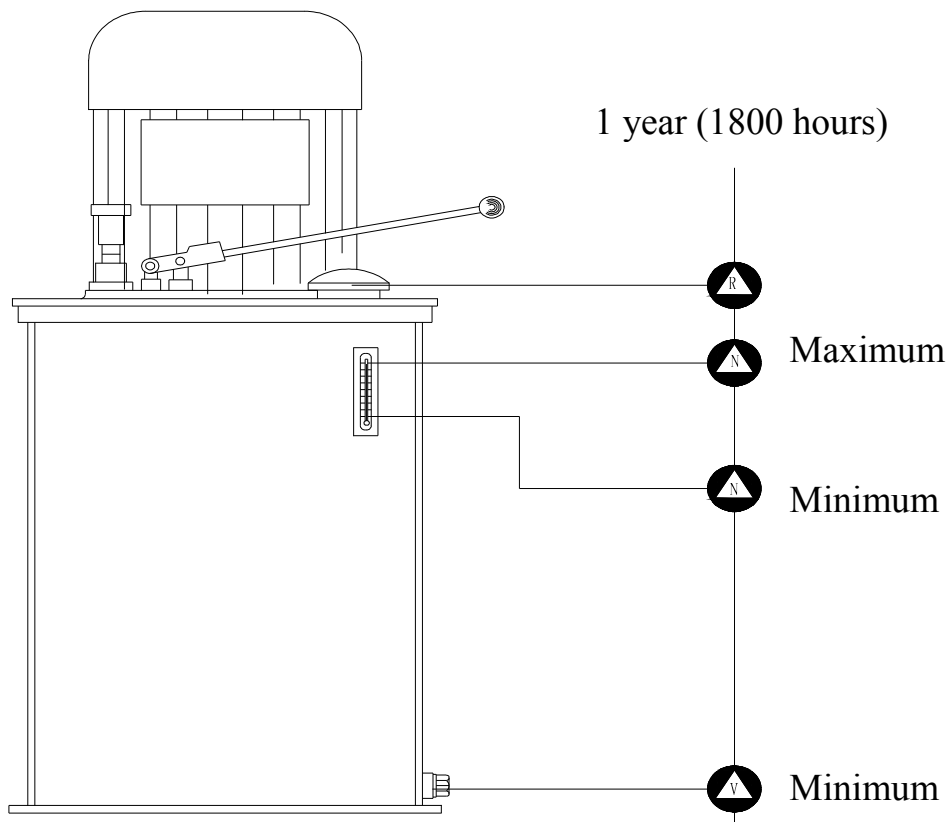
13.3.5 Maintenance on hydraulic pump station

M: when starting

N: oil level

V: draining

R: fill up



Because of different working environment temperature, the lubrication oil used in the hydraulic pump station should be different. The user should add proper hydraulic oil according to the environment temperature.

Number of hydraulic oil

environmental temperature	-30~-20°C	-20~-10°C	-10 -0°C	0~20°C	20~38°C	38~80°C
Code	YC-N46D	YC-N32	YB-N32	YB-N46	YB-N68	YB-N80 above
New grade	N46D Low freezing point hydraulic oil	N32# Low freezing point hydraulic oil	N32 Antiwear hydraulic oil	N46 Antiwear hydraulic oil	N68 Antiwear hydraulic oil	Above N80# Antiwear hydraulic oil
Original grade	30D#	20#	20#	30#	40#	≥50#

13.3.6 Greasing the rope guiding pulley

Before the rope guiding pulley putting into service, fill up the grease. Meanwhile add grease every 50 hours (2 # lithium based grease). Before greasing clean out the impurity oil on the shaft.

13.7 Greasing the slewing ring

Before installing the slewing ring, fill up the grease. Meanwhile add grease every 50 hours. In case of long time no using of the slewing ring, it should be greased. Each time when greasing, the gear ring should be fully greased until it bleed from the sealing place. Turn the slewing ring slowly while greasing which can make the grease evenly.

The tooth surface should be cleaned every 10 days and lubricate with calcium base grease.

The lubricating grease can be selected according to the following table:

Bear structure	Working conditions		Lubricating position	Lubricating grease		
				Name	Consistency grade	Standard code
rubber seal ring for plastic isolation block	low temperature, normal temperature, wet -40°C +60°C		raceway	extreme pressure lithium base grease	1#, 2#	BG7324-1994
			gear	carbon calcium base grease	ZG-S	SH0369-1992
labyrinth seal for metal isolation block	High temperature and wet	40°C — 140°C	raceway	extreme pressure lithium base grease	1#, 2#	GB7323-1994
				MOS2 complex calcium lubricating grease	2#	
			gear	4# high temperature grease	4#	SY1511-65
		80°C — 180°C	raceway	MOS2 complex calcium lubricating grease	2#	
				gear	4# high temperature grease	4#
	normal temperature, proof seawater corrosion - 50°C		raceway	2# complex aluminium base grease	2#	
			gear	4#, complex aluminium base grease	4#	SH0378-1992

13.8 Greasing the hoisting winch

- 1) Unscrew the drain plug of reducer and fill diesel oil for cleaning reducer. Tighten the plug after draining and volatilizing.
- 2) Fill 18-20 L gear lubricant. Oil level: reaching to about 1/5 of standard oil level, then tighten the plug. Keep the grease nipple and around clean. Prevent dirty or foreign bodies getting into the oil.
- 3) Check the oil level and add oil every 200 working hours. Drain the oil after working 2400 hours, clean it and then refill with oil.
- 4) The grease nipple which outside the bearing support on the drum tail, was filled up with 2# lithium based grease before leaving factory. Check and fill up with this kind of grease after working 200 hours.

13.4 Maintenance and service of frequency converter

13.4.1 Daily inspection

Check the following items in service:

- The motor should be no abnormal noises or vibration.
- There should be no abnormal heat generation.
- The ambient temperature should not be too high.
- The output current is not larger than the normal value.
- The cooling fan on the bottom of the frequency converter should be operating in normal condition.

13.4.2 Periodical inspection

Check the following items when carrying out the periodical inspection:

Cut off the power supply when inspecting. Confirm that the LCD and LED indicators lighten off and carry out the inspection after five minutes. Be sure not to touch the terminal when just cutting off the power supply which may result in electric shock.

Item	Inspection	Solution
External terminals, mounting bolts, connectors, etc.	Are screws loose?	Tighten loose screws.
	Are connectors loose?	Reconnect the loose connectors.
Cooling fins	Are the fins dirty or dusty?	Clean out any dirt and dust with dry air under the pressure of 39.2×10^4 - 58.8×10^4 Pa (4-6kg/cm ²).
PCBs	Is there any conductive dirt or oil mist on the PCBs?	Clean out any dirt and dust with dry air under the pressure of 39.2×10^4 - 58.8×10^4 Pa (4-6kg/cm ²), otherwise replace it.
Cooling fan	Is there any abnormal noise or vibration or the total operating time exceeds 20,000 hours?	Replace the cooling fan.
Power elements	Is there any dirt or dust on the elements?	Clean out any dirt and dust with dry air under the pressure of 39.2×10^4 - 58.8×10^4 Pa (4-6kg/cm ²).
Filtering electrolytic capacitor	Are there any disorders, such as discoloration or odor?	Replace the electrolytic capacitor or frequency converter.

13.4.3 Scheduled maintenance of parts and components

The frequency converter is composed of many parts and components. It is necessary to carry out maintenance for these parts and components as per their usage conditions.

Periodical inspection standards vary depending on the frequency converter's setting environment and usage conditions. The frequency converter's maintenance periods are noted below. Keep them as reference.

Name	Standard replacing period	Replacing method
Cooling fan	2 or 3 years	Replace it.
Filtering electrolytic capacitor	5 years	Replace the capacitor after inspection.
Braking relay		Determine after inspection.
Fuse	10 years	Replace the fuse.
Capacitors on PCBs	5 years	Replace the PCBs after inspection.

Note: the standard replacing period is based on the following usage conditions:

Ambient temperature: Yearly average of 30°C

Load factor: lower than 80%

Operating rate: lower than 12 hours / day

13.4.4 Replacing instructions of cooling fan

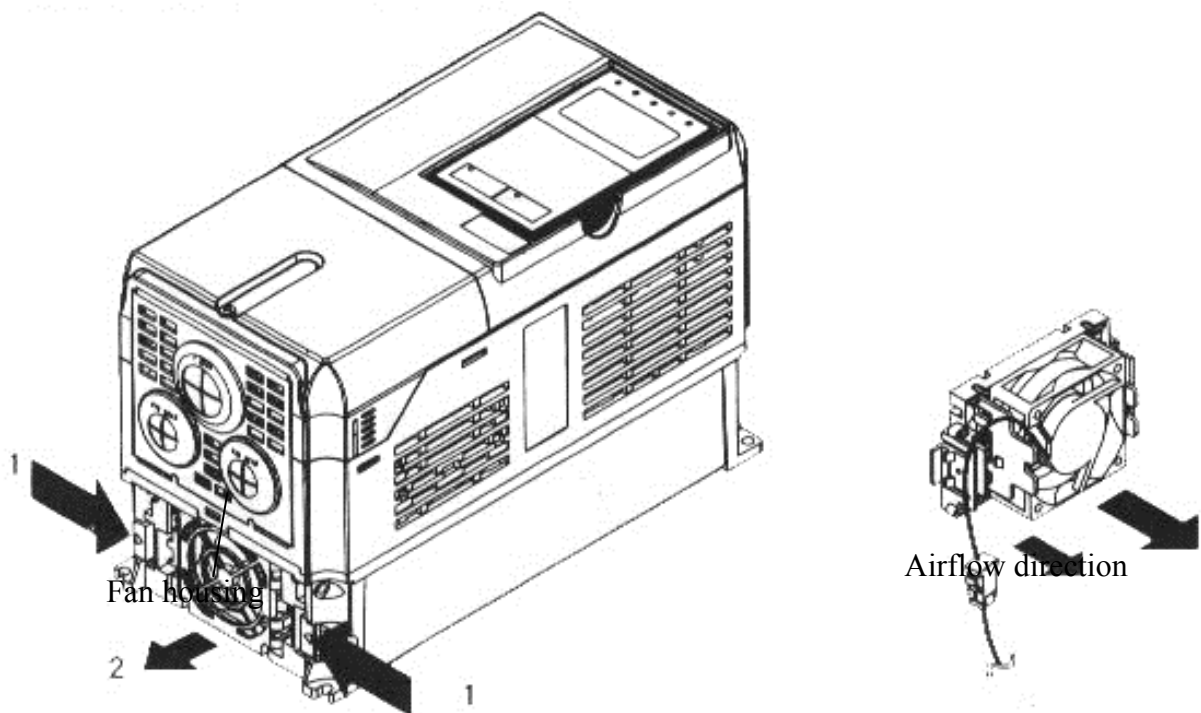
13.4.4.1 Frequency converter of 15kW or less

The cooling fan was installed at the bottom of frequency converter.

If using the mounting holes at the rear of the frequency converter, the cooling fan can be replaced without removing the frequency converter from the installation panel.

13.4.4.1.1 Removing the cooling fan

- a) Press down the right and left buckles of cooling fan housing as per the direction of arrows 1, then pull the fan out in the direction of arrow 2.
- b) Pull out the cable which connected with the fan from the fan housing and disconnect the connector.
- c) Open the left and right fan housing and remove the fan from the fan housing.



13.4.4.1.2 Mounting the cooling fan

- a) Install the cooling fan in the fan housing. Be sure that the airflow direction of the cooling fan faces to the frequency converter.
- b) Install the connector first, and then put the connector and cable in the fan housing.
- c) Mount the fan housing on the frequency converter. Be sure that the fan housing fix on the frequency converter firmly.

13.4.4.2 Frequency converter of 18.5kW or more

The cooling fan was installed on the top of frequency converter.

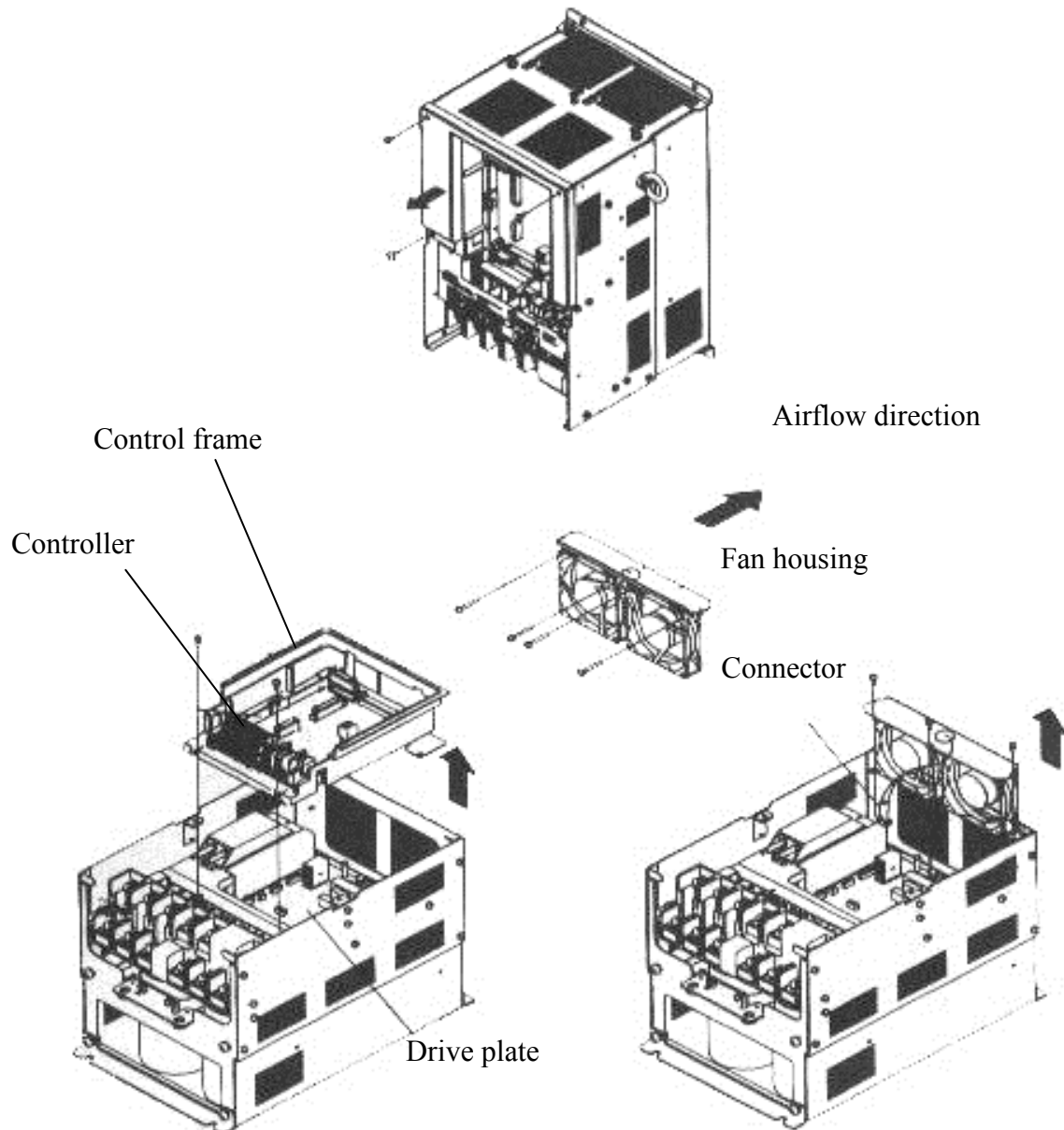
The cooling fan can be replaced without removing the frequency converter from the installation panel.

13.4.4.2.1 Removing the cooling fan

- a) Remove the terminal housing, mainframe housing, manipulator and front housing of frequency converter.
- b) Remove the control frame which equipped with control plate. Remove all the cables which connect with the controller.
- c) Remove the cooling fan power cable connector from the drive plate which placed at the rear of the controller.
- d) Loosen the fan cover screws and pull out the fan cover from the frequency converter.
- e) Remove the cooling fan from the fan housing.

13.4.4.2.2 Mounting the cooling fan

- a) After installing the new cooling fan, install all of the parts and components according to the reverse procedure of above.
- b) When installing the cooling fan on the metal frame, be sure that the airflow direction of cooling fan faces to the top of the frequency converter.



13.4.5 Dismantling and installing of terminal plate

The terminal plate can be removed without disconnecting the cables.

Note: Always confirm that the charge indicator light off before removing the terminal plate.

13.4.5.1 Removing the terminal plate

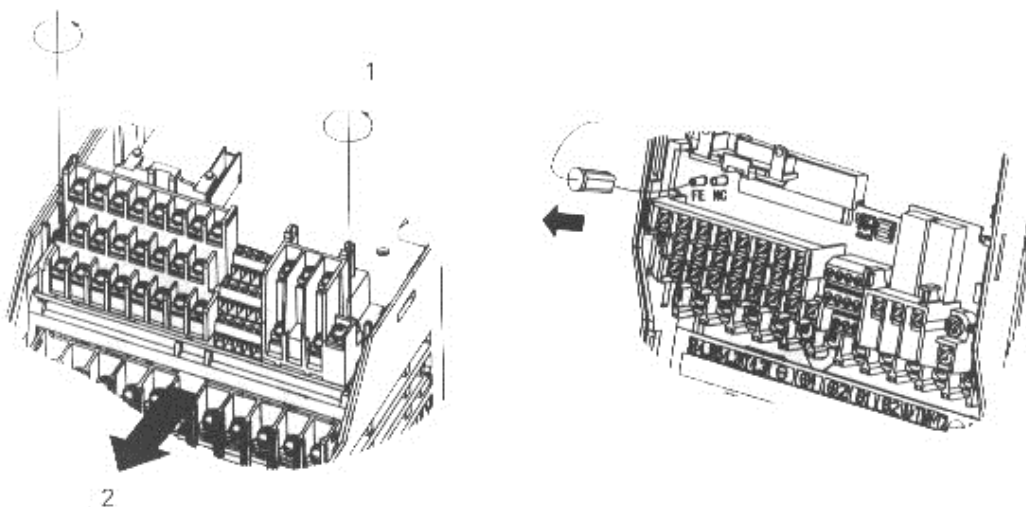
- a) Remove the manipulator and front housing.
- b) Remove the connectors of earth wire which connected to FE or NC on the terminal plate.
- c) Loosen the mounting screws on the left and right sides of the control circuit terminals until they are in sliding state. (It is not necessary to remove these screws.)
- d) Pull the terminal plate out in direction 2 when the screws are loosened.

13.4.5.2 Mounting the terminal plate

Install all of the parts and components according to the reverse procedure of removing.

Confirm that the terminal plate and the connector of the controller properly aligned, and then insert the terminal plate.

Otherwise, the connecting pin may be bent, which can not ensure the frequency converter working in normal condition.



Removing of the terminal plate

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