

Analysis of Electrical Commissioning of Elevator Door Machine System

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Abstract

This article mainly introduces the main points related to the electrical commissioning of the door machine system. At present, there are many kinds of door machines in the market, and many people will feel overwhelmed if they commission a new door machine after mastering the commissioning of a door machine. Since the basic characteristics of the door machine system are the same, this paper analyzes the commissioning method of the door machine from the perspective of generality and deepens the understanding of the door machine system. This paper mainly analyzes the following nodes: operation curve, frequency/speed, torque, input/output, position detection, etc.

Keywords

Elevator, Door machine, Commissioning.

1. INTRODUCTION

Elevator door machine is a servo system responsible for automatic opening and closing of elevator doors, which consists of mechanical mechanism, motor controller and position sensor. Here the motor is the actuator outputting mechanical energy, the controller is the torque and speed control mechanism outputting energy to the motor in time to control the motor speed and torque; the sensor provides the door position signal to the controller in time so that the controller outputs different speed and torque according to different positions, thus making the door of the elevator run smoothly and steadily, and through a series of adjustments to the running curve in the running stage a certain Comfortable feeling: no collision when the door is opened and closed, no noise, smooth switching between high and low speed without stuttering, accurate output signal, etc.

2. THE PRINCIPLE OF DOOR MACHINE

Door mechanical mechanism: door mechanical mechanism for a power source and a set of belt and wheel transmission system, as follows Figure-1 for the door transmission mechanism of a kind (divided, that is, to the two sides of the symmetrical door), in the elevator mechanical system door machine for the more complex and sophisticated institutions.

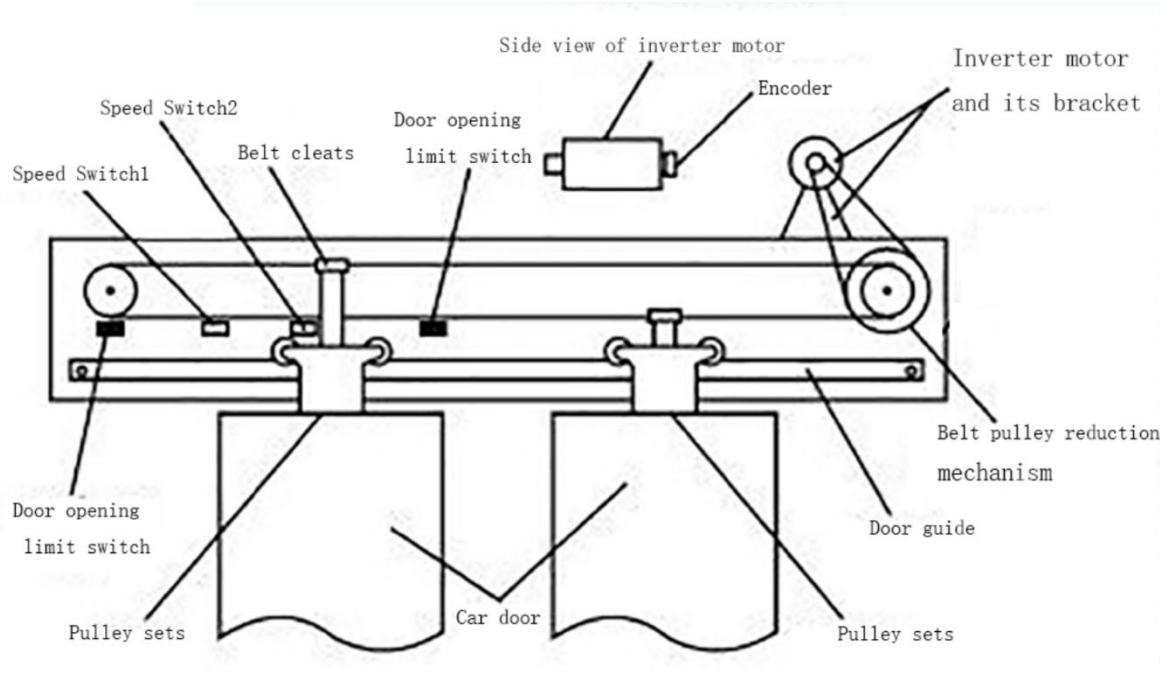


Figure 1. Basic structure of the middle division door machine

From Figure-1, we can see that the mechanical structure on the side of the door is composed of two doors and the upper can of the door, and various parts are distributed on the upper can, and the main parts are drawn in the figure. Among them, the pulley sets (two sets) are connected with the doors and the upper cantilever, which hang the doors on the upper cantilever rail, and the belt clamp of the pulley sets catches the belt, so that the belt can drag the pulley sets to move on the rail, thus dragging the doors to move. The opening limit switch and closing limit switch on the upper can are used to detect whether the car door moves to the opening limit position or closing limit position. The encoder at the end of the motor and the speed switch on the upper cage are not both needed at the same time, depending on the different motion control methods.

Door machine electrical system: door machine electrical system can generally be divided into DC door machine system and AC frequency conversion door machine system, DC door machine system controller for DC controller, motor for DC motor; AC frequency conversion door machine system referred to as VVVF, controller for AC frequency converter, working voltage is usually AC220V, motor for asynchronous motor or permanent magnet synchronous motor, which is characterized by low frequency long time blocking rotation, currently commonly used for AC variable frequency door machine.

Input and output of the door machine: The input and output points of the door machine are universal, and its common interfaces are: power supply AC220V, motor, position detection interface, open input, close input, open in place, close in place, fault output, etc., see Figure-2 and Figure-3. The common end of the input point is taken from the high or low level of the door machine itself, and the external system gives the signal by controlling the dry contact of the relay on/off, while the The outputs are the dry contact signals from the door machine itself to other external control sources when certain conditions are met, and the common terminal is taken from the external high or low level.

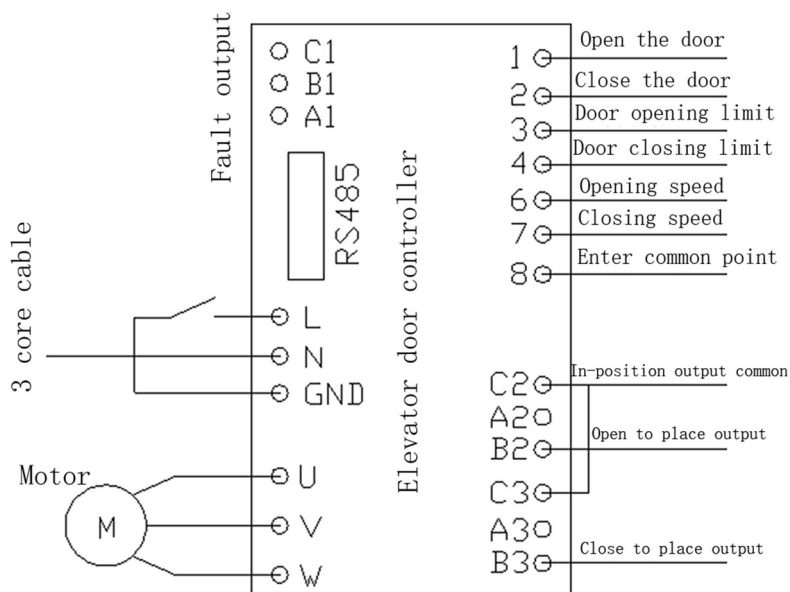


Figure 2. Position switch detection mode diagram

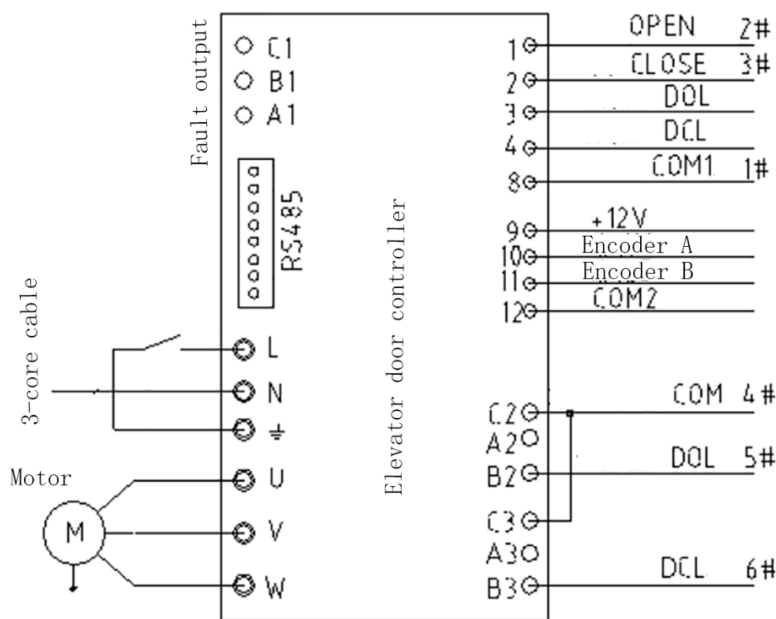


Figure 3. Encoder position detection mode diagram

3. THE POSITION DETECTION METHOD OF THE DOOR MACHINE:

Position detection can be divided into switch detection mode and encoder detection mode. These two detection modes need to be distinguished in the parameter setting or the door machine can not be properly debugged, where the encoder detection mode needs to be self-learning door width to ensure that the software can be divided into variable speed points and in place points, etc., commonly known as distance control.

Switch detection mode: Make sure that each switch moves reliably and the signal can enter the controller accurately. The common switch is a bistable switch, which is triggered by the magnet on the transmission mechanism to turn on and off. The computer board cannot issue the correct command. The reasons for the switch not working properly may include: the quality of the switch itself, wiring problems, inappropriate magnet induction distance (too far), and inappropriate switch installation position (too close to the limit position).

Encoder mode: ensure that the encoder is installed in place without slippage, eccentricity, the drive mechanism does not slip, while eliminating the encoder code loss problem through parameter setting and external sensor automatic correction, the so-called code loss refers to the mechanical in place but the code count is not in place, resulting in the door mechanical in place after the motor continues to run at high speed or blocking rotation, external correction switch is often installed with the door open or closed in place. The external correction switch is often installed with the door opening or closing position in place. If the switch is triggered when the door is closed in place, the position will be forcibly reset to 0. If the switch is installed when the door is opened in place, it will be forcibly reset to 100% of the door width. There are more parameters related to the encoder, such as mode selection, number of encoder lines, encoder direction, division of variable speed position and division of in-position position, and door width self-learning.

Feedback points of the door machine: open the door in place, close the door in place, fault output, etc. When the door machine receives the command in place, it will output the open or close the door in place signal to the elevator control system, and when the signal is not received, the effectiveness of the switch and the reasonableness of the installation position or the reasonableness of the door width distribution should be checked. If the switch detection mode does not receive the door opening signal, check the door opening switch and move its position appropriately, and for the encoder mode, reduce the percentage of the door opening in place appropriately, because the good or bad mechanical installation will also affect the actual width of the door, resulting in some differences in the opening width of each door. Reducing the percentage of door opening in place is actually increasing the margin of door opening in place detection.

4. DOOR MACHINE OPERATING CURVE CHARACTERISTICS:

The running speed of the door machine changes in time, and we can reflect the relationship between the speed and the width of the car door by a complete smooth curve. The curve of the door machine is mainly divided into the following sections: starting acceleration section, starting low-speed holding section, acceleration section, uniform high-speed section, deceleration section, low-speed holding section in place, deceleration section in place, holding section in place, as shown in the following figure:

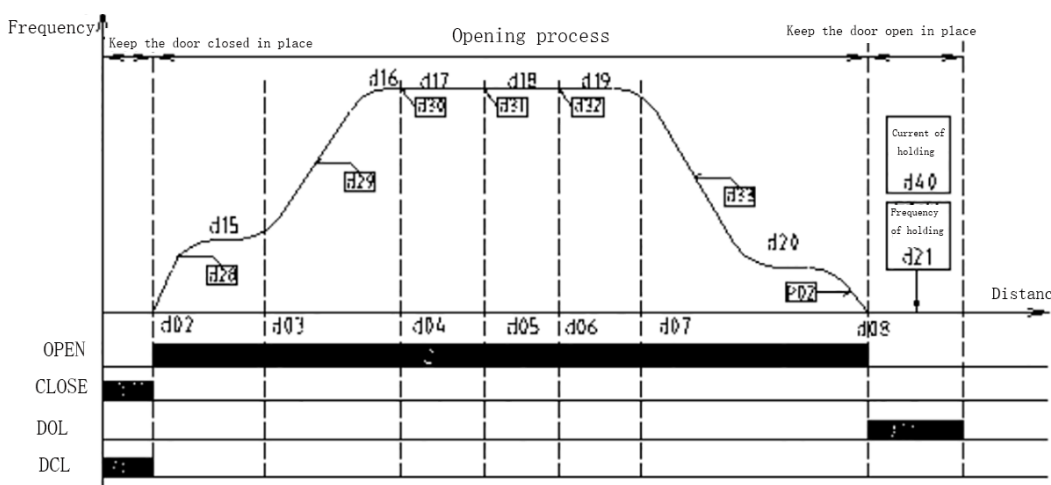


Figure 4. Open the door operation curve

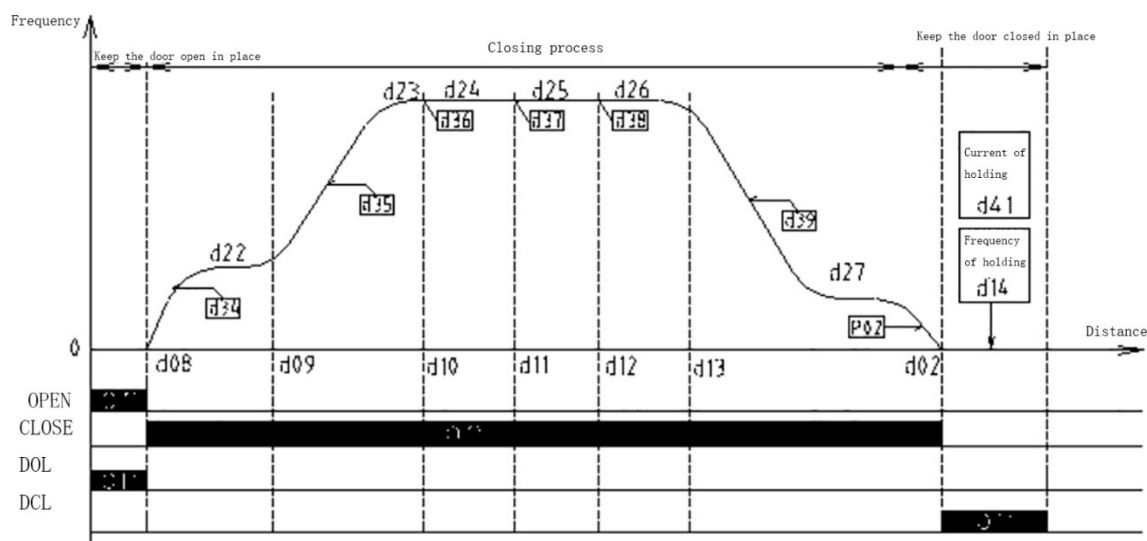


Figure 5. Close the door operation curve

The horizontal coordinate in the figure indicates the door travel or door width, and the vertical coordinate indicates the parameter corresponding to the running speed of the door machine, such as frequency, whose high or low reflects the size of the speed of the door machine. For the opening operation curve, the origin position of the horizontal coordinate represents the closing position in place, and in the encoder control mode, its origin coordinate can be set to (0,0), that is, the number increases to the right, indicating that the door gap width of the opening is getting larger; for the closing operation curve, the origin position of the horizontal coordinate represents the opening position in place, and in the encoder control mode its origin coordinate can be set to (100,0), then the horizontal coordinate of The coordinates of the closing position are (0,0), that is, the number decreases to the right, indicating that the door gap width of the closing door is getting smaller and smaller, of course, the definition of the coordinates of the origin can be determined according to the manufacturer's custom.

In the curve of the door machine upward sloping section for the acceleration section, with the increase of time speed, the steeper the slope of the acceleration, the greater the acceleration, the shorter the time to reach the predetermined speed, the shorter the acceleration distance, the more gentle the slope of the acceleration is smaller, the longer the time to reach the predetermined speed, the longer the acceleration distance, the efficiency of opening and closing the door is relatively small; the flat part of the curve is the high-speed uniform speed section of the door machine. At this time, the speed of the door machine is the highest, and does not change, in the process of debugging we often first set the high-speed section, and then adjust other parameters; the sloping downward section of the curve is the deceleration section, with the increase of time speed is getting smaller and smaller, the steeper the slope indicates that the greater the deceleration, the shorter the time to reach the predetermined speed, the shorter the deceleration distance, the more gentle the slope is the smaller the deceleration, the longer the time to reach the predetermined speed, the longer the deceleration The longer the distance, the longer the efficiency of opening and closing the door is relatively small, and may cause the door to crash due to the deceleration distance is too large (the door width is certain, so the speed is not reduced within a limited distance). Therefore, the following parameters are often involved in the operation curve of the door machine: speed, acceleration and deceleration time (equivalent to acceleration), and the position of the door. Behind these parameters also need the support of the torque, because the torque is not enough power and lead to the inability to drive, or too much torque and lead to clamping or impact force is too large to cause a large noise or damage equipment.

In the door machine curve there are more speed inflection points, in order to ensure the comfort of the door machine operation, in the process of commissioning in the different speed sections of the excessive need to maintain its coherence, do not form the phenomenon of rapid acceleration and deceleration, reasonable adjustment of acceleration and deceleration position and acceleration and deceleration time.

Note: In Figure-3 and Figure-4, the vertical coordinate data of the door machine are starting from zero and finally return to zero, the vertical coordinate data of such a door machine often indicates the speed, the distance between the starting and stopping point 0 is the door width, but the data is often marked with the frequency, so that when the vertical coordinate returns to 0, the frequency does not return to 0, because there is a door machine to maintain the frequency, the speed of the door machine at this time is 0 but still output the blocking torque to keep the door. If the vertical coordinate is not back to 0 after it is in place, the vertical coordinate only indicates the frequency.

5. SEVERAL KEY PARAMETERS FOR THE OPERATION OF THE DOOR MACHINE

Speed The debugging of the door machine is intuitively reflected in the speed, debugging can first set several major speeds (high speed, low speed, hold speed), because different door machines are marked with different speeds (mainly with frequency), so you can first test run to feel the correspondence between the speed and the displayed frequency, or first set the reference value according to the manual, and then correct.

Acceleration and deceleration position After the speed is set, you can try to determine the acceleration and deceleration position, switch mode, then move to adjust the switch position, encoder mode, then set its percentage, provided that it is determined, the door width 0 reference point;

Acceleration and deceleration time Acceleration and deceleration time, a direct response to the size of the acceleration, because the distance and speed has been determined, first of all, we must reasonably allocate time, because the total opening and closing time is not to exceed the national standard, acceleration time is too large, low speed time is long, sometimes to the opening and closing of the door to decelerate or place the position is still accelerating; deceleration is too long then the door in place the speed has not been lowered leading to impact.

According to the national standard GB/T10058-2009: the middle division automatic door width less than 800mm, the opening and closing time should not exceed 3.2 seconds, if the side opening automatic door, the opening and closing time should not exceed 3.7 seconds; 800 ~ 1000mm for 4 seconds and 4.3 seconds; 800 ~ 1100 for 4.3 seconds and 4.9 seconds; 1100 ~ 1300mm for 4.9 and 5.9 seconds. So in the process of curve adjustment to control the elevator open and close the door time should not exceed the national standard.

Torque National standards on the torque is more stringent provisions, the maximum closing clamping force shall not exceed 150 Nm, more than this value must be able to automatically pop open. Too much torque is often prone to clamping events or in place for a long time after the blocking leads to abnormal heating of the motor; only when the door can not be opened and closed on the appropriate increase in torque, but also can not exceed the national standard, usually can also be solved by increasing the inertia of movement to compensate for the slow or not in place, such as increasing the speed or deceleration time.

After the basic determination of the above parameters, according to the operation of the door machine to fine-tune the above parameters, a more reasonable adjustment sequence: acceleration and deceleration time, speed, acceleration and deceleration position, torque, of course, debugging can be used flexibly according to their own understanding, such as found that

the door can not open completely in place, can increase the speed of the door in place or increase the deceleration time or change the deceleration position, such as the use of inertia to rush past, or increase the holding torque .

6. DOOR MOTOR AND CONTROLLER WITH

The motor nameplate parameters are correctly entered into the controller, such as power, current, number of stages of the motor, rated frequency, etc., which can be entered according to the specific requirements of different controllers. Automatic adjustment of motor parameters (motor self-learning) may also be required when replacing the motor or inverter, such as the TD3200 door machine, which is the only way to ensure smooth operation of the motor. When opening and closing the door in the opposite direction can be set by the parameters or directly change the phase sequence of the motor. Of course, the door machine now on the motor has been debugged before the factory, although the door motor has a small size, long-term low-frequency blocking function, but debugging torque parameter input is too large, then a long time high-frequency blocking motor will be hot and burned. When the door motor failure (phase loss, short circuit, break), there will be torque reduction, noise, not running, reported over-current fault and a series of phenomena; door control system, especially the motor can not have a cover, such as the installation of personnel will cover the motor or controller of debris accumulation, because the motor and controller are stronger heating body, a long time is very likely to make the control system performance decline, damage, and even cause a fire.

7. THE DISTINCTION BETWEEN DOOR MACHINE SYSTEM FAILURE AND ELEVATOR SYSTEM FAILURE:

During the commissioning of the elevator, we often encounter abnormalities in the opening and closing of the door, such as not opening the door, not closing the door, suddenly opening the door midway, etc. At this time, it is impossible to determine whether it is a problem of the door machine, or a problem of the main control or a problem of the connection line between the door machine and the main control.

First from the output of the main control board by shorting the switch door method to determine whether the door machine problems, if the short switch door is normal is the main control board problems; if not normal, then short the switch door terminal of the door machine controller (first remove the system switch door connection line), if normal is likely to be the system connection line problems, if not normal is the door machine itself, because at this point is equivalent to cut off the peripheral interference.

Position detection is not accurate, will lead to the controller can not output in place signal, or in the process of operation suddenly open the door or has been high-speed blocking rotation, then need to check the position detection sensor, anti-clamping torque setting is reasonable.

Power problems, grounding problems, good or bad motor, especially mechanical problems can lead to abnormal operation of the door machine. If the machinery fails to adjust to open the door in place, the door machine torque is no longer large enough to bring the door into place.

8. CONCLUSION

With the rapid development of society, the demand for elevators continues to increase, and people need to use elevators every day in their daily lives and work. Elevator safety is related to people's life and property safety, the better the commissioning of elevator door machine system, the higher the reliability of elevator, and improving the reliability of elevator is an important foundation of elevator safety. Elevator installation and commissioning continue to emerge new

technology and new techniques, and the electrical commissioning requirements of elevator door machine system continue to improve.

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