Design of Five-Layer Elevator Frequency Control System

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Abstract: The impact of elevator performance on people's lives is becoming more and more significant. Therefore, efforts must be made to improve the performance of the elevator system to ensure that the elevator operation is efficient, energy-saving, safe and reliable. The traditional elevator control system uses a relay logic control circuit. This control is easy to malfunction, inconvenient to maintain, and it is short in operation life, but large in space, and is gradually being eliminated. The PLC control system has become the most widely used control method in the elevator control system due to its high operational reliability, and is convenient to use and maintenance. And it has strong anti-interference, short design and debugging cycle, etc. It is also widely used in the technical transformation of traditional relay control systems.

1. Introduction

At present, most of the elevators installed in the 1970s and 1980s in the country are controlled by relays, with complicated lines, many nodes and high failure rate. The research content of the subject mainly focuses on the defects of the old elevator adopting the relay control mode, such as many faults, weak functions, and poor reliability. Therefore, the control mode of the elevator is gradually replaced by PLC control. The control system of the elevator in the society generally adopts two control modes. The first control mode is to use the microcomputer to control the signal, and to realize the collection of the elevator signal, and to set the elevator function and operation state. It completes the automatic dispatch of the elevator and the collection operation function, and the drag control will be realized by the inverter. The second is to use the programmable controller as the signal control unit. The two methods are compared in terms of performance and control, and there are not many differences. However, in terms of reliability and program design flexibility, the advantages of PLC are more prominent.

2. Working principle and design method

By operating the button on the elevator, the PLC software system processes the elevator hardware to make the elevator perform the relevant action functions. The two ends of the hoisting rope are connected with the counterweight and the car, and are wound around the guide wheel and the traction sheave. The traction motor rotates the traction sheave after the speed of the reducer changes, and between the traction sheave and the hoisting rope. The friction generates traction, thereby completing the rise and fall of the car and the counterweight, thereby achieving the purpose of lifting. To understand the hardware components and corresponding functions of the elevator, and then realize the control system of the elevator through PLC control, and finally achieve the purpose of design.

2.1 System design content and steps

2.1.1 Determine the system hardware configuration

According to the expected function of the designed elevator, various hardware devices that meet the elevator function, such as contactors, door switches, sensors, indicator lights, call lights, motors, PLC models, models of inverters, etc., are determined.

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2.1.2 Calculate the number of I/O points and selection of PLC

After calculation and analysis, the number of input signals and output signals are determined, and the voltage type, level, and quantity of the input and output quantities are determined to select the appropriate PLC model.

2.2 I / O interface circuit design

The I/O circuit represents the connection between the PLC and the inverter and the control panel, the hoistway, and other appliances in the control cabinet, and the address assignment is performed according to the action of the input signal and the output type. Important input signals such as operating mode and operating conditions should be arranged in front, such as safety signals, door interlocks, presence/absence of drivers, door signals, overhaul, firefighting, etc. Outputs of the same load voltage type and level are grouped together, using the same common output point. For example, the indicator circuit can be used as a group of outputs, the contactor and relay are commonly used 220V, and another group of outputs is used.

2.3 Design of control circuit diagram

To design schematic diagram and wiring diagram of main drag circuit, signal control circuit, PLC and inverter I/O circuit, control panel, control cabinet and the schematic diagram and wiring diagram of the hoistway line.

2.4 Ladder design

According to the modular design idea, using the instructions provided by the PLC, ladder diagrams are designed for each control function in turn. After the ladder design is completed, the program [1] can be input to the PLC through the programmer. After the initial design, the program can be simulated and debugged. The actual input signal and feedback signal are simulated by buttons or switches. The output is not connected to the load, and the load status can be displayed by the LED of the output of PLC [2].

3. System software design

3.1 Switch door link

Switch door control: After the elevator is installed successfully, it waits at the base station. When someone calls, the elevator responds quickly and arrives at the layer. First, it delays for 3 seconds, and starts to open the door contactor Y0 to open the door. When the door is opened, X2 is turned on, Y0 is turned off, and the door is opened. At the same time, the T1 timer is turned on, and after a delay of 5 seconds, Y1 is turned on to close the door. When the door is closed, X3 is turned on, Y1 is turned off, and the door is closed.

During the process of closing the door, when a passenger is caught in the middle of the elevator door, the sensors X4 and X5 on the loading door are turned on, so that the M0 is powered, the elevator is delayed for 2 seconds, and the door is closed again. When it examined and repaired, the elevator door is opened by SB1 and SB2, namely X0 and X1.

3.2 Generation and elimination of layer signals

Generation and elimination of layer signals: The digital display tube is controlled by the layer signal sensed by the layer sensor to realize the layer display. When the elevator leaves the layer and reaches the next layer, the layer sensor loses power to realize the layer display clearing.

3.3 Registration and elimination of outgoing call signals

When the external call button is pressed, the corresponding external call assist relay is turned on, and the indicator light under the external call button is illuminated, indicating that the call request has been received and memorized by the elevator. The elimination of the signal is formed by the parallel connection of the breaking contact of the layer signal and the dynamic direction of the

running direction.

In this way, the direction of the call can be aligned with the direction of the elevator, and when the call layer is reached, the layer sensor will be turned on, the elevator will stop, the call destination has been reached, and the call signal is cleared. When the direction of the call of the elevator is inconsistent with the running direction, for example, when the elevator goes up from the second layer, the call request is down on the third layer. If there is an internal selection command request and an external call request on the fourth layer or above, the elevator arrives on the third layer. When the building cannot be stopped, the call request is not met, and the call signal cannot be cleared.

3.4 Registration and elimination of the stop signal

The passenger or driver can select the layer to go by operating the 1-5 layer selection buttons on the operation panel of the elevator car. After the layer selection signal is registered, the indicator light under the layer selection button lights up. When the elevator reaches the selected layer, the stop signal is removed and the indicator light should be extinguished.

3.5 Directional link of the elevator

When the elevator is in standby state, when receiving the external call signal and internal selection, the elevator's internal selection and location should be compared with the outgoing call signal to determine whether it should be uplink or downlink. As long as the elevator is oriented, the directional signal will not be eliminated if the outbound and internal selection requirements for the forward operation of the elevator are not met. The direction of operation in the case of maintenance will be determined by the upstream and downstream, without orientation. At the same time, in the directional operation, the reverse direction command is held by the memory, and it is temporarily not responded, and it is executed when the directional operation is reversed to the highest level instruction.

4. PLC debugger

Elevator PLC control installation and commissioning process is a relatively complicated process. The first step is to determine the device model. In addition to the current, voltage, and mechanical equipment, the choice of device model also needs to consider economical and practical issues. After the required components are ready, then the next step should be installed. The main circuit and PLC installed in the control cabinet [3] need to consider the interference between them. The indicator lights, buttons or digital display also need to be followed. Wiring with the same principle, after ensuring that all components are installed according to a certain number, you can start debugging. Since there are many input and output points in the program, the simple debugging diagrams for single-point input and output are not listed. Next, the elevator is debugged by three parts: switch door debugging, elevator directional debugging, elevator stable operation and brake debugging:

4.1 Switch door debugging

This is the easiest way to debug and check if the program being designed will fail when it completes its simplest control functions. The specific content of the single command operation and commissioning is as follows: When the power is turned on, the elevator is given an instruction [4], and the elevator will automatically open and close the door. For example: the elevator reaches the 2nd layer, delay 3 seconds, and achieve the door opening, with passengers in and out, delay 5 seconds, and achieve automatic closing, waiting for other orders.

4.2 Elevator directional debugging

After a single instruction is run and debugged, it is directional debugging to ensure that the program can achieve correct uplink and downlink when multiple instructions are running. This kind of debugging is to let the elevator run in the N layer in one direction. For example, the elevator car is originally on the 2nd layer. In this case, the inner box of the 5th layer has a call command, that is,

press X012 and X044, and start the 2nd layer indicator and the 5th layer. The memory light is on. The program determines the uplink by judgment, that is, the Y007 uplink indicator lights up to achieve the orientation indication.

4.3 Elevator stable operation and brake debugging

After the instructions of elevator up and down are realized, elevator acceleration and deceleration and braking are started commissioning [5]. When the elevator receives the inner box command within 5 layers, the elevator is turning Y2 to turn on, and Y4 is turned on to start high speed, and the delay is 2 seconds to accelerate; when the proximity switch is turned on, Y6 is turned on and starts to decelerate through the delay, and Y25~Y27 is turned on and is further braked until the layer signal X15 is turned on to achieve complete braking.

5. Conclusion

The elevator is controlled by PLC to realize the elevator's running speed, reflection time and the accuracy of the stop layer to a certain standard and reasonable design of the elevator speed, running state, safety, reliability and fire protection. Considering the elevator PLC control system comprehensively, it can meet the requirements of "stable, accurate and fast", which requires our design to be rigorous and reliable.

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