

Design of Positive Control of Three-phase Asynchronous Motor Based on MCGS and PLC

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Abstract. With the continuous development of industrial construction, PLC, touch screen and other automation technologies are more and more widely used in industrial production. In the production line, the positive and negative rotation control of the motor is also essential. In this paper, we realize the positive rotation control based on the double interlock of ac contactor and button. Our team studied the design of positive and negative rotation control of MCGS and PLC three-phase asynchronous motor. With the help of Siemens S7_200 series, the control function is realized. Touch screen MCGS realizes configuration software function, in the project of positive rotation of three-phase asynchronous motor controlled by MCGS and PLC, hardware configuration and software configuration must be completed simultaneously.

Keywords: MCGS, PLC, Positive Control, Three-phase Asynchronous Moto

1. RESEARCH BACKGROUND

In our daily life, all kinds of machines play different roles, whether simple or complex, their power is often provided by electric motors.

The round-trip operation of machinery equipment in the producer is also a common phenomenon, such as the rise and fall of the crane hook, the back and forth movement of the coal trolley, the forward and backward work table, etc., all of which are achieved by the positive and negative rotation of the three-phase asynchronous motor. With the development of industrial technology, automatic production has received more and more attention from enterprises, and configuration software has also been widely concerned.

Operators can complete the monitoring of the generation through configuration software to achieve intelligent control of industrial production.

Touch screen as a HMI device, its core is configuration software. In practical production applications, designers complete the design of human-computer interaction interface through the communication connection between touch screen and PLC, and field operators realize the control of automatic production equipment through the operation on touch screen.

Three-phase asynchronous motor, as a power component of production machinery, naturally becomes a part of automatic production design, which can be controlled by the automatic control design of MCGS and PLC^[1].

2. POSITIVE AND NEGATIVE ROTATION CONTROL CIRCUIT OF THREE-PHASE ASYNCHRONOUS MOTOR

2.1. Analysis of control objects

We need to analyze from its principle to realize the positive and negative rotation of three-phase asynchronous motor. When the stator windings of three-phase asynchronous motor (each with a difference of 120 degrees of electric Angle) are switched into the three-phase symmetrical alternating current, a rotating magnetic field will be generated, which cuts the rotor winding. Thus, induced current is generated in the rotor winding, and the rotor conductor carrying current will generate electromagnetic force under the action of stator rotating magnetic field, thus forming electromagnetic torque on the motor shaft and driving the motor to rotate, and the motor rotation direction is the same as that of rotating magnetic field. When the current phase sequence of three-phase electricity is changed, the direction of rotating magnetic field will change, and then the direction of electromagnetic torque will change to achieve the purpose of motor reversing, realizing positive and negative rotation.

2.2. Comparison of control methods

2.1.1 Double interlocking control of AC contactor and button

As shown in figure 1, by the ac contactor and implementation of the button double interlocking positive & negative control of three-phase asynchronous motor, the circuit is in interlocking control buttons and contactor interlock control on the basis of the combination of a new control method is easy to operate and safe and reliable, and also to avoid the risk of power supply two phase short circuit, but in practice easily occur in more complex circuit malfunction.

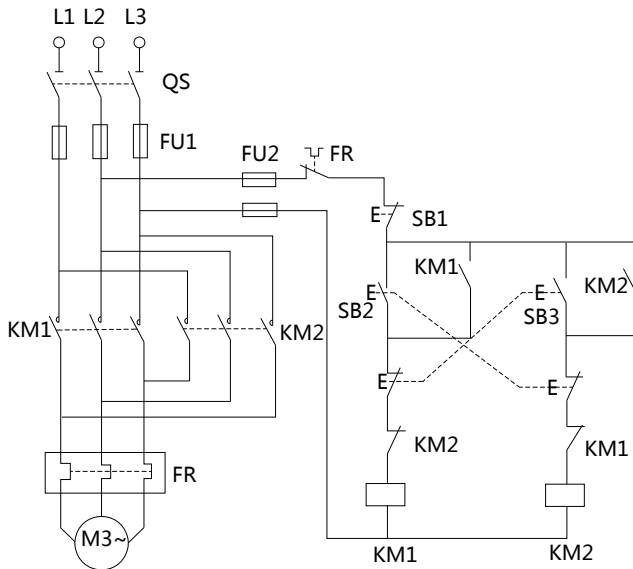


FIG. 1 AC contactor and button dual interlock positive rotation control circuit

2.1.2 PLC positive and negative rotation control

Based on the dual interlock control circuit of AC contactor and button, the control circuit is modified and the realization of hardware circuit is optimized into PLC software control, as shown in Figure 2. The circuit is simple, the structure is reasonable, and the operating cost can be well controlled, but the operating efficiency needs to be improved.

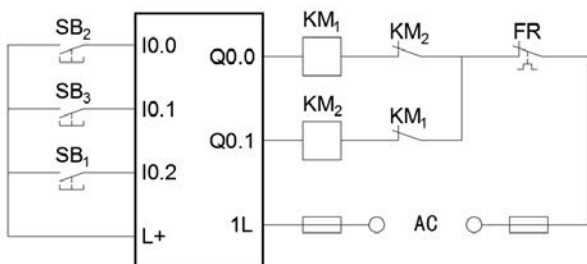


FIG. 2 Positive control circuit of PLC

To sum up, the positive and negative rotation control method of three-phase asynchronous motor is relatively flexible, which can be realized according to the dual interlocking control of AC contactor and button in the electrical control course [2], and can also be realized according to the application of PLC software in the programmable controller course. Each has its own advantages and disadvantages. Based on this, this paper discusses a kind of positive and negative rotation control design with high working efficiency and good system stability: the positive and negative rotation control of three-phase asynchronous motor based on MCGS and PLC.

3. REVERSE AND REVERSE ROTATION CONTROL REQUIREMENTS

Based on the MCGS and PLC, the three-phase asynchronous motor and reversing control design center carries on the discussion, for the double interlocking

control of three phase asynchronous motor and reversing, complete and reversing in the MCGS control interface including forward button, reverse button, stop button, the led light for forward and reverse indicator design, complete control program written in the PLC, PLC and MCGS communication design, and debugging, made when the press of a button to press forward after the motor is started, the reverse button forward to stop, start inversion; When the reverse start button is pressed, the motor will reverse to start, and then press the forward start button to reverse to stop and start the forward start. When the stop button is pressed, the motor should stop no matter it is in positive or reverse state.

4. REVERSE AND REVERSE ROTATION CONTROL REQUIREMENTS

According to the control requirements of three-phase asynchronous motor, the input and output devices are determined, and the input and output ports of response are allocated. The reverse and stop buttons of the motor are controlled by I0.0, I0.1 and I0.2 input ports respectively. The forward converter contactor is controlled by Q0.0 output port, while the reverse contactor is controlled by Q0.1 output port. The allocation of I/O ports is shown in Table 1.

Table. 1 PLC I/O allocation

IN	forward	reverse	stop	OUT	forward	reverse
	button	button	button		indicator	indicator
	I0.0	I0.1	I0.2		Q0.0	Q0.1

5. PLC I/O PORT DISTRIBUTION

5.1. MCGS User window design

The steps of making the control interface with the MCGS embedded configuration software are as follows: Open Configuration Environment - File - New Project - User Window - New Window - Window Properties - Animation Configuration [3]. The control interface consists of forward button, reverse button, stop button, forward indicator and reverse indicator. The corresponding MCGS control interface is shown in Figure 3.

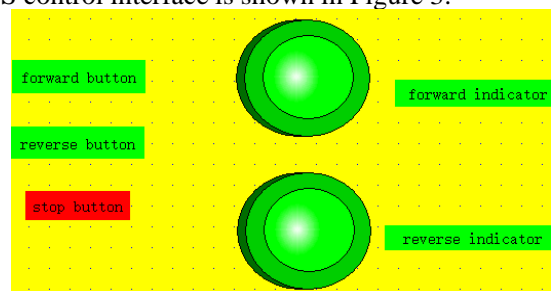


FIG. 3 MCGS positive and negative rotation control interface

5.2. MCGS control

The control interface setting requirements are as follows: press the forward turn start button, and the corresponding forward turn indicator light will be on on the MCGS monitoring interface. At this time, press the reverse button to turn the indicator light on and the forward turn indicator light will be off. Press the "reverse" start button, and the corresponding "reverse" indicator light will be on. At this time, press the "forward" button, the "forward" indicator light will be on, and the "reverse" indicator light will be off. The switch between positive and negative rotation can be made at random. Press the stop button and the forward and backward indicator lights will all go out.

5.3. Object Property Settings

Control interface drawing complete, complete forward button, reverse button, stop button, the led light for forward and reverse indicator of attribute set, ready for realization of human-computer interaction, to turn lights under the corresponding property is set as an example of setting, double click on the forward indicator into the unit attribute set, complete connection Settings in the data object menu, as shown in figure 4.

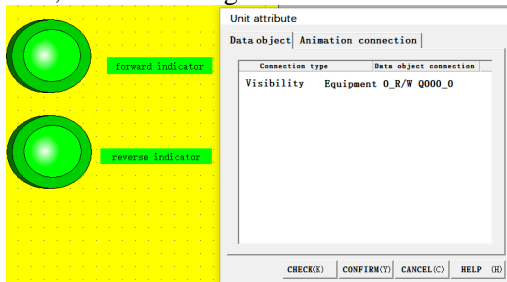


Fig. 4. Setting of indicator light attribute for forward turn

6. PLC PROGRAMMING

In order to better complete human-computer interaction and realize the control design between touch screen and PLC, the control program was written and debugged in Siemens S7_200 [4]. The program ladder diagram is shown in Figure 5.

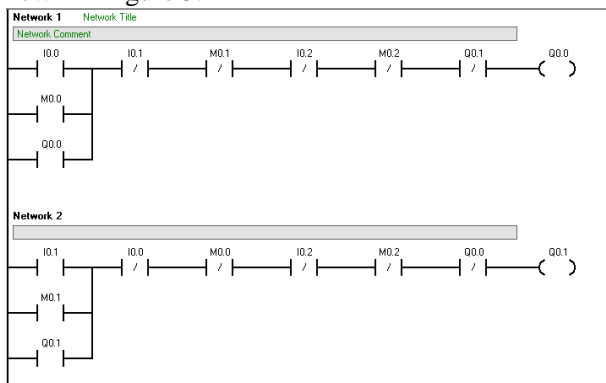


Fig. 5 Ladder diagram

7. ONLINE DEBUGGING

In order to realize the positive and negative rotation of MCGS and PLC controlled three-phase asynchronous

motor, after the completion of MCGS group design and PLC program debugging, MCGS and PLC shall be connected and debugged, complete hardware connection, communication setting, channel connection and other operations, and make the final preparation for human-computer interaction[5].

7.1. Equipment Introduction

Siemens S7_200PPI, this driver component is used for MCGS software to read and write the data of various registers of Siemens S7_200 series PLC equipment (Including Smart200, S7_21X, S7_22X, etc.)

Table. 2 S7_200PPI communication Settings

<i>Driving type</i>	The serial port child device must be attached to the "universal serial port parent device" to work
<i>Communication protocol</i>	Siemens PPI protocol
<i>Communication methods</i>	Master-slave mode of communication (master-slave).The driving component is the master station, and the equipment is the slave station.

7.2. Hardware Connection

Before the MCGS software can communicate with the device, it must be properly connected. Communication connection mode:

- i. Siemens PC/PPI cable with standard serial port model;
- ii. The converter connection adopts RS232/485. A positive pole and B negative pole connect to 3 positive pole 8 negative pole of PLC programming port;
- iii. TPC touch screen adopts RS485 interface. A positive pole and B negative pole connect to 3 positive pole 8 negative pole of PLC programming port;

The above hardware is used to realize the communication connection between PLC and MCGS and BETWEEN PLC and computer.

7.3. Equipment Communication parameters

Enter the configuration environment of MCGS embedded version, open the established engineering Selection device window - Device Configuration - General Serial port parent device property editing window to complete the basic property setting, parameter setting is shown in Table 3, and open the device toolbox to add the child device "Siemens _S7200PPI". Communication parameter Settings of "Universal Serial port parent Device" are shown in Table 3:

Table. 3 General serial port parent device parameter Settings

Set the item	Parameters of the item
<i>Communication baud rate</i>	187500, 19200, 9600(default)
<i>Data bits</i>	8
<i>Stop bits</i>	1
<i>Parity bit</i>	Parity checking

7.4. Channel Connection Settings

The channel connection is completed to realize the interaction between MCGS interface and PLC. The specific design takes the channel setting of the channel setting of the forward indicator light as examples, as shown in Fig.5.

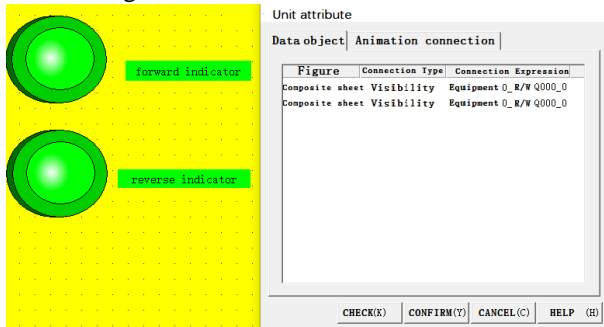


Fig. 5 Setting of forward indicator light channel

7.5. Debugging

Realize computer through USB cable communications with MCGS, download the MCGS engineering, through the PC/PPI cable to realize computer communication with PLC PLC program download is completed, the PC/PPI cable communication between the MCGS and PLC, began to run the test, in operation can be achieved by touching the MCGS screen button to control the motor and reversing and downtime, and can be observed in the PLC is turn, anyway, stop running lights light up, such as by running the PLC program can realize the MCGS control button on the screen, When the PLC program is running, the corresponding indicator light on MCGS can be observed, so as to realize the communication between PLC and MCGS, complete the man-machine dialogue, and realize the control of positive and negative rotation of three-phase asynchronous motor between MCGS and PLC.

8. CONCLUSION

This paper introduces the control system design based on MCGS and PLC. The simulation control system is designed with configuration software MCGS. We completed the production of simple visual operation interface, using user window template rendering, object properties, variable design and other functions to complete the screen rendering. Moreover, we use the CONTROL of PLC program to make the positive and negative rotation control operation of three-phase asynchronous motor more convenient.

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