

Study on the Application of PLC Automatic Control Technology in Frequency Converter

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Abstract: Programmable logic controller (PLC), as a new piece of industrial control equipment, emerges with the development of computer information technology. As industrial automation continuously speeds up in China, the application scope of PLC gradually extends, which promotes the development of industrial production capacity. To improve the application value of PLC automatic control technology in the frequency converter, relevant problems shall be investigated. This paper studies the application of PLC automatic control technology in the frequency converter.

1. Introduction

As an advanced technology in industrial field, PLC automatic control technology has been gradually popularized. The advantage of PLC automatic control technology in electrical engineering technology outperforms any other technology. In China's industrial production, frequency converter production ushers in a new opportunity. The application of PLC automatic control technology not merely accelerates production schedule and improves production efficiency, but also ensures production quality. To better give play to the function of PLC automatic control technology in the frequency converter, it is required to have a correct understanding of PLC automatic control technology and propose the application scheme.

2. Introduction to PLC automatic control technology

PLC refers to programmable logic controller. In industrial enterprise production, computer technology is applied in control technology to promote integration of the two, make the technology extensively applied in industrial construction and achieve production automation in industrial enterprise industry.

PLC is mainly composed of three hardware facilities, including CPU, storage and input/output circuit system. The software facilities include two application programs, namely system and user. PLC controls work procedure in industrial enterprise production, and the control content mainly includes three parts: sampling program input, program execution and refreshing program output.

When the control system operates, time sequence mismatching problem or contact competition problem will often occur in relay control. To apply PLC for control, cyclical scanning or continuous scanning is often adopted. When sampling is input, PLC adopts scanning mode. The scanning result analysis result is transmitted to image register. In the program execution stage, PLC operation is subject to the preset program, and all programs are executed as per the order. For on-state and off-state of each component, relevant data should be gained through output register and input register to calculate as per relevant program. Later, data information acquired is transmitted to the image register to save for future calling.

In refreshing program output stage, output image register is started and the information is transmitted to the output latch. Meanwhile, information conversion is performed to make it become external control signal and drive the output equipment to correctively identify the signal. Through operating the operational program, relatively complete scanning cycle can be established. Usually, a scanning cycle may be several milliseconds or dozens of milliseconds.

3. Introduction to frequency converter

Frequency converter as a convertor can convert 50Hz-60Hz power supply into AC power supply with different frequency. If the motor uses such converted power supply, the operation speed will be adjusted to meet production demand of industrial enterprises. In the aspect of circuit control, high-performance microprocessor plays an important role in frequency converter operation, which uses A/D and D/A interface to receive and process signals. In signal processing process, start-stop control signal and forward/reverse operation control signal play an important role. In general, although the converter receives the simulation signal in PLC automatic control system, such signal can be converted. Through A/D processing, such signal can be converted to digital signal which is transmitted to the microprocessor. There are many types of frequency converters, and their operating principles are basically same. With regard to control methods of various frequency converters, vector control, slip frequency control, torque control and coordination control are mainly adopted.

4. Method to apply PLC automatic control technology in frequency converter

4.1 Method to choose PLC and frequency converter model

PLC itself is a control system and core component. It is required to pay attention to selection of frequency converter model. During selecting frequency converter model in industrial production, the specific production condition and product property should be considered, and the cost performance of each element should be compared. Then, the selection shall be subject to the comparison result.

Among the frequency converters applied by industrial enterprises, 300 PLC product in Siemens S7 series is popular. In the concrete application, comparison should be conducted according to actual situations. Meanwhile, whether the control function conforms to production requirements should be taken into account to make better use of it. Except replacing the relay for frequency converter control, PLC can achieve automation control, guarantee operation efficiency of frequency converter and accelerate production schedule of industrial enterprises.

During selecting frequency converter model, environmental adaptation and satisfaction of application function should be considered. The frequency converter has been comprehensively popularized in China, and the degree of technology keeps improving, mainly because China's electric power technology goes on upgrading. Accelerated development of microelectronics field and the application of innovation technology make frequency converters emerge in endlessly. The development speed of semiconductor technology in China is also very fast, and production technology level improves rapidly, which will inevitably lower the capital investment in frequency converter. To make sure information transmission state between frequency converter and PLC in frequency converter operation, environmental factors and technical factors shall be fully considered. The use effect of G120 series frequency converter produced by Siemens is excellent.

4.2 Measures to achieve frequency converter automation control

4.2.1 The function of I/D terminal shall be fully applied in frequency converter automation control

When PLC automatic control technology is applied in the frequency converter to give play to the effect of I/D terminal, the frequency converter can be automatically controlled. In the process of frequency converter automation control, practical operation should be considered, and the research should start from the perspective of analog quantity terminal and PLC connection or digital input end and PLC connection. When the analog quantity terminal is connected to PLC, it has no terminal, and the achievement of automation control benefits from the function of PLC. PLC extension module is connected to analog quantity terminal of frequency converter to realize automation control of frequency converter. When digital input end is connected to PLC, it has VO terminal. When digital input end is connected to the input end of PLC and frequency converter, the frequency converter can achieve automation control in the operation process.

With such operation method, when the frequency converter starts or stops, automation control can be achieved. The frequency of frequency converter can be preset in advance. The number of digital quantity input terminals is positively correlated with fixed frequency. If the number of digital quantity input terminals increases, the fixed frequency is high; if the number of digital quantity input terminals reduces, the fixed frequency will lower accordingly.

4.2.2 The function of PROFIBUS communication protocol should be fully exerted in frequency converter automation control

To give full play to the function of PROFIBUS communication protocol in frequency converter automation control, 300 PLC product should be set as the master station, while G120 frequency converter product is set as the slave station. In frequency converter operation process, frequency converter process should be arranged as per the order received, and the order from 300 PLC to G120 shall be followed strictly.

G120 frequency converter works according to feedback signal and fault warning signal. The communication protocol in fieldbus control system of frequency converter plays the core role. During executing the automation control objective, the good effect can be gained by using PROFIBUS communication protocol. For data telegraph structure, PROFIBUS communication protocol works. Except network data information, protocol layer and telegram also work to achieve automation control of frequency converter.

Polyphenyl ether is data information generated in network operation, with main components including parameter value field data and process data. In the operation process of G120 frequency converter, parameter value field data are the function codes to ensure its operation, while process data are output speed feedback value, input speed feedback value and frequency set value generated when the frequency converter is in the operation state so that operation state of frequency converter is reflected digitally. In the aspect of PROFIBUS communication protocol, its network polyphenyl ether composition includes the process data without field data but with 2-6 characters and the process data with field data and 2-6 characters. With such method, network data can be defined so that data information is transmitted between field data and process data. Meanwhile, the two are in the independent operation state. The process data without field data but with 2-6 characters and the process data with field data and 2-6 characters will not interfere in each other to make sure the frequency converter can operate stably and reliably, work smoothly and complete the tasks. The frequency converter operates under the order, thus improving degree of automation and making each task proceed smoothly.

5. PLC application invariable frequency air conditioner

5.1 Total design scheme

Seeing from the composition of invariable frequency air conditioner, it is a closed-loop automatic control system which consists of PLC, master contactor, temperature detection device, frequency converter and pumping unit, etc. In the whole control system, PLC is a main control mechanism. The inverter is connected with each air conditioner unit to test system operation state in real time. The temperature signal detected by the transmitter and frequency converter is transmitted to PLC. After the calculation, the result is transmitted to the inverter. Under the effect of frequency converter, the frequency variation speed of the pump is controlled to effectively control the temperature.

5.2 Hardware design

In the hardware design of automatic control system of variable frequency air conditioner, the model selection of frequency converter should be stressed, and the model of PLC should meet requirements. Meanwhile, model selection of relevant hardware should be matched with other equipment installed in the system. In the system design, AC motor shall operate according to rate voltage and rated frequency, including power and output torque. In the design process of control

system, when variable-frequency speed control system is adopted, power supply frequency will change, and motor torque and output power will change, too. During model selection of frequency converter, the frequency converter should be chosen according to system application occasion, and the capacity of motor should be taken into account.

PLC is an important component of variable-frequency speed control system. PLC plays an important role in connecting frequency converter and each component of air conditioning system. PLC controls the frequency converter and controls variable frequency air conditioner through logic switch.

The signal is input into PLC. After the result is gained by calculation, corresponding control signal is sent to control corresponding executing mechanism, including frequency converter and variable frequency air conditioner. Other linkage devices also operate as per the control order.

In the hardware design of automatic control system of variable frequency air conditioner, variable frequency control function of frequency converter can be controlled by PLC, and the operation speed of water pump can be controlled by PLC to reach the purpose of indoor temperature control.

5.3 Software design

The main design purpose of automatic control system of variable frequency air conditioner is to reduce energy consumption. Under reasonable hardware design conditions, software design must control the system through PLC programming. PLC program can be used to detect inlet and outlet temperature of air conditioner. PLC is a frequency converter for control, which not just improves system operation efficiency, but also owns good energy-saving and cost-reducing effect.

PLC programming makes the temperature sensor gather temperature information and then transmits the information to PLC. Through the calculation result, the frequency of frequency converter is controlled. Thus, operation speed control of air conditioning equipment and indoor temperature conform to requirements. Variable frequency air conditioning system adopts such control method to reach the optimal effect, achieve energy conservation, reduce maintenance times and lengthen the service life.

6. Summary

In conclusion, PLC automatic control technology has entered the mature stage in China and plays an important role in the application field. In China's industrial development, PLC automatic control technology can achieve automation operation of frequency converter, guarantee safety and reliability of frequency converter and greatly promote industrial enterprises.

References

- [1] Cai Ming. ON Application of PLC Automatic Control Technology in Frequency Converter, PC Fan, 2017(03):57-58.
- [2] Yan Xiaoyang, Li Han. Exploration of PLC Automatic Control Technology Application in Frequency Converter, The Silk Road Vision, 2017(20):84-84.
- [3] Jia Dongyang. Design of Automatic Water Supply System with Variable Frequency Speed Control and Constant Voltage Control Based on PLC, Digital World, 2017(3):15-16.
- [4] Yan Jian. Application of PLC Variable Frequency Control Technology in Electrical Transformation, Plant Maintenance Engineering, 2017(18):65-66.
- [5] Gan Zijian. Analysis on PLC and Frequency Converter Technology in Motor Multi-stage Speed Control, China New Technologies and Products (05):98-99.