

# PLC based Intelligent Airshower Control Program Design

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## Abstract

**An introduction to the PLC as the core component, with energy saving lighting, automatic sterilization and time can be set and other functions of the intelligent airshower. A detailed description of the air shower room control system hardware composition, control principle, work process and software design and implementation. Equipment has a number of Companies in the clean room applications, program design, energy saving, safe passage efficiency is high, get the company praise.**

## Keywords

PLC; Control technology; Intelligent Airshower.

## 1. Introduction

In order to strictly control the whole material flow and prevent the hair chips and dust on the surface of human body and objects from being brought into the production area, an air shower room is set up between the production area and the non production area to play the role of isolation and cleaning. This paper introduces the whole hardware, process and program design of the air shower room of our color printing and packaging company, and explains the advantages of PLC technology application.

## 2. Control design principle

It has the function of automatic detection and discrimination priority detection, that is to start the entrance or exit procedures according to the priority detected personnel in the outer or inner doors. (1) after opening the outer door, when people enter the air shower room, they can automatically close the outer door, and then start the voice prompt function: "Hello! Please cooperate to remove the dust, hair, hair debris and other debris attached to the clothes, thank you for your cooperation Then, according to the setting of the air shower time, the fan is automatically turned on for air shower; when the air shower time is over, the voice prompt function is activated again: "please abide by the rules and regulations when entering the clean area, thank you!" Then open the inner door, and the inner door will close automatically when all the personnel are out of the air shower room; (2) after opening the inner door, when people enter the air shower room, the inner door will be closed automatically, and then the outer door will be opened automatically. When all the personnel are out of the air shower room, the outer door will be closed automatically.

It has safety protection function: safety light curtain protection is designed to prevent people from being crushed when closing the door, full opening function of emergency internal and external doors to prevent safety accidents, and automatic opening function of internal and external doors in case of power failure.

Set energy-saving lighting and automatic sterilization function: when there is no personnel passing through the air shower room for 5 minutes, the indoor lighting will be automatically turned off, and the ultraviolet germicidal lamp will be activated for sterilization; when the

infrared ray in the air shower room detects a person, the sterilization lamp will automatically turn off and the lighting lamp will start.

The time of wind shower can be set. By using the dial switch, the wind drenching time can be set from 0 to 99 sec, and the automatic control can be realized according to different seasons.

### 3. Main hardware composition

According to our design ideas and the company's existing conditions, we use Mitsubishi fx1s-30mr series PLC as the core component, which consists of two bit dip switch to form the wind shower time regulation circuit; four infrared body detectors constitute the detection circuit; two sets of safety light screens constitute the anti extrusion safety circuit; three buttons with lights constitute the emergency and indication circuit; four sets of  $\varnothing 50 * 500$  cylinder and two electromagnetic Valve consists of door actuator; 10 sets of low-noise air-conditioning fans constitute air shower mechanism; voice circuit constitutes voice recording and playback function; four 15W energy-saving lamps constitute lighting system; 20W ultraviolet fluorescent lamps constitute sterilization system.

### 4. Conception of work flow

According to the control idea, we first conceive the work flow chart of the air shower room. The idea of the flow chart is to visualize the design ideas, and also to lay the foundation for the program design.

### 5. Programming principle

The program design is composed of priority program, entry and exit procedure, safety protection program, time setting program, emergency program, energy saving and sterilization program.

#### (1) Design of priority program

The design of priority circuit is realized by self-locking of main control program in Mitsubishi PLC in the entry and exit procedures, as shown in Figure 1.

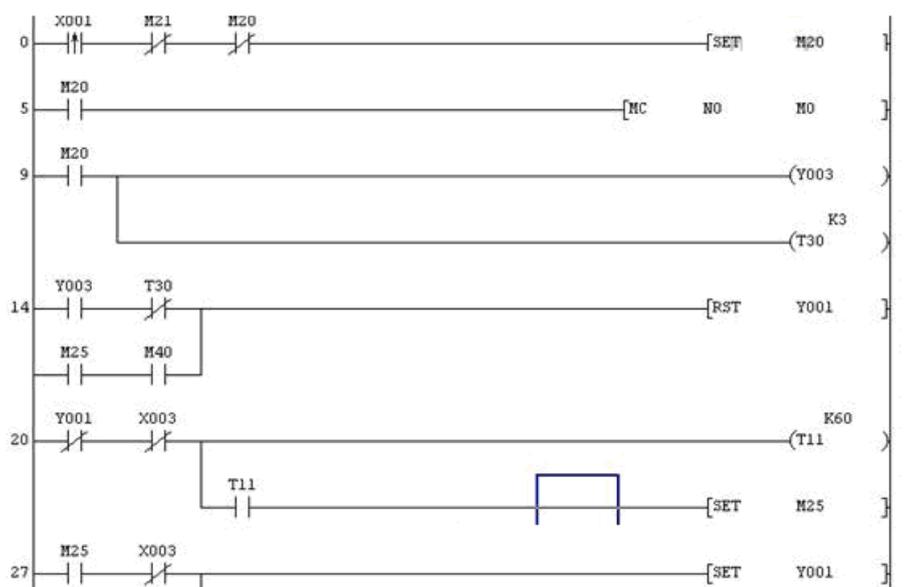


Fig. 1 Working procedure flow chart of air shower room

When the moving body pulse is sensed by the infrared body switch (X1 and x4), set the internal relay (M20) or the internal relay (M21) to start the program of main control (M0) or master

control (M1), so as to start various actions in the corresponding master control program. Through the design of main control interlock program, the priority feature of induction line is realized.

(2) The design of entrance, exit and safety protection program

In the entrance procedure and the exit procedure, the design of the entrance procedure is difficult due to the many intermediate links, while the exit procedure is relatively simple. When the entrance sensor first senses the moving body, the main control program (M0) starts, and the program inside the main control program M0 starts to work. In the process of personnel entering and leaving the door, safety protection is a protective circuit to prevent personnel from being crushed when the door is closed, which must also be included.

In the door entry procedure, if the safety light curtain switch (x4) does not detect personnel passing through the internal and external doors within 3 seconds (T3), the door circuit will start, that is, the door closing solenoid valve is connected (Y1, Y2) to make the air cylinder act and close the door. In the process of closing the door, if the safety light curtain senses the passing of objects or personnel, the door execution procedure will immediately turn over and execute the opening procedure; when the detected object or person moves away, the door closing procedure will be executed again. Through the design of the safety program, the safe passage of people or objects is ensured, as shown in Figure 2.

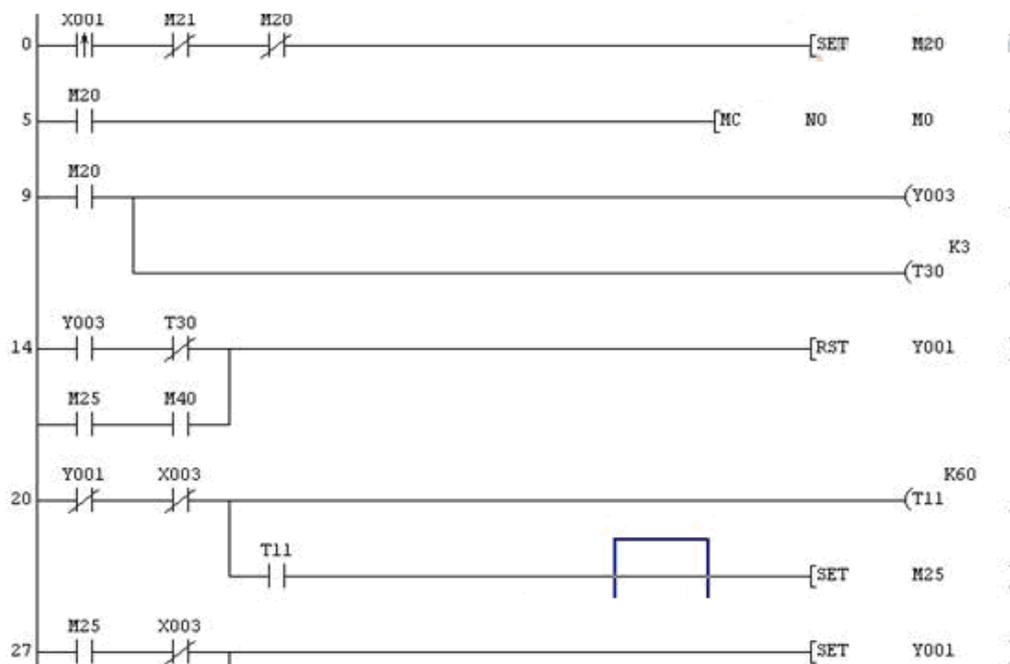


Fig.2 Entrance and safety protection procedure

In the entrance program, the design of the voice circuit 1 and 2 and the air shower circuit is based on the principle of time, while the design of the out door program is to complete the interlock function on the basis of the priority program, which are relatively easy to realize and will not be described in detail.

(3) Procedure for setting the time of air shower

According to the different seasons, setting the blowing time of the air shower room can save energy and save the entrance time. The setting program of air shower time is set by the two bit dial switch connected on K2 X10, multiplied by 10, and transmitted to the setting register of air shower time (time t = D11 is 0.1s), realizing the correspondence between setting time and air shower time, as shown in Fig. 3.

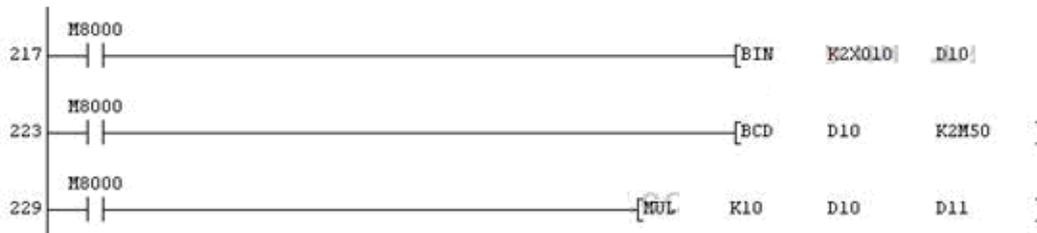


Fig. 3 Dial switch time setting

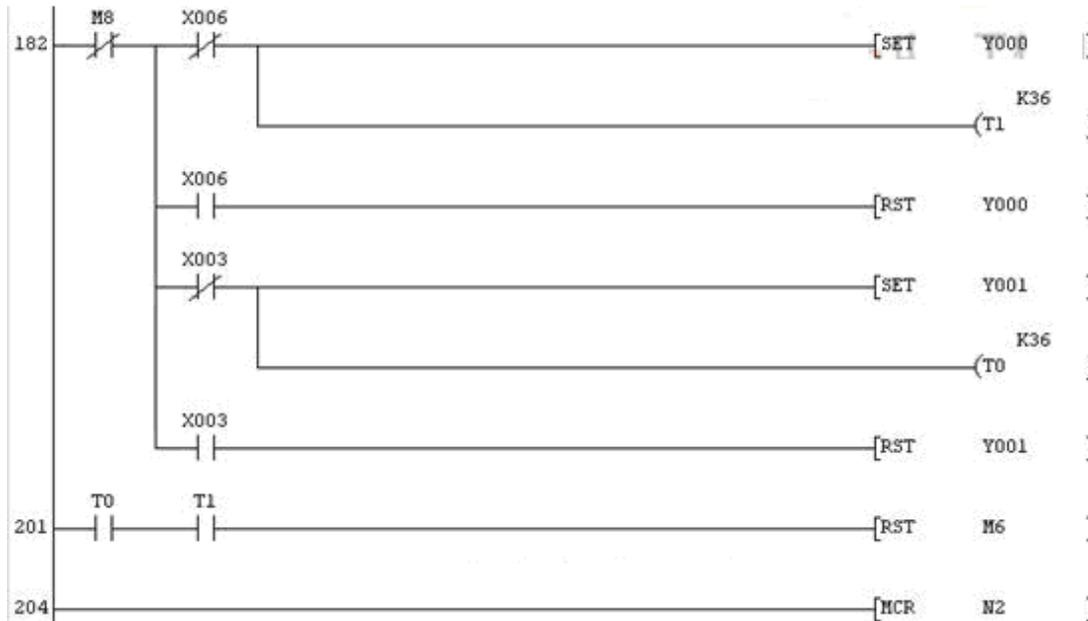


Fig.4 Design of emergency alternate output button

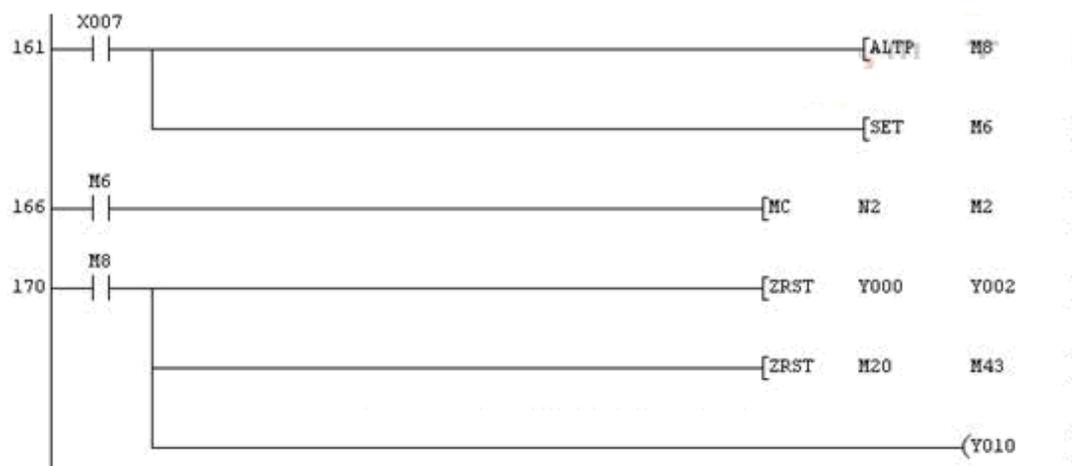


Fig.5 Emergency door opening design

(4) Safety emergency procedures

In case of safety problems or other emergency situations, no matter what the status of the air shower room is, the internal and external doors of the air shower room should be opened at the same time, which requires the design of safety emergency procedures. A button with light is installed on the inner door, outer door and inner door of the air shower room. The alternate output control of PLC is used to realize the emergency and release of one button (X7) (the light is in emergency state). When the emergency procedure is released, the protection procedure of

safety light curtain is also used to ensure that the safety protection is effective at any time. As shown in Figure 4 is the alternate output program, and figure 5 is the emergency door opening program.

In order to ensure the safety of sudden power failure, in the design of cylinder actuating door mechanism, the cylinder is opened when the power is off, and the cylinder is closed when the power is on, so that the personnel in the production area can go out in time when the power is off.

#### (5) Energy saving and sterilization procedures

The main energy consumption of the air shower room is the air shower fan, which can realize the energy control in different seasons by adjusting the external time. As described above, another energy consumption is the lighting. In the program design, the lighting circuit is triggered when the gate circuit is started. When the gate circuit does not act for more than 5 minutes, the lighting circuit will be automatically closed to realize the energy-saving control of the lamp.

The function of the air shower is to remove the dust from people or objects by the high-speed wind, so the sterilization in the air shower room is essential. In the design of the program, the ultraviolet lamp is used for sterilization, and the normally closed point of the lamp is used to trigger the germicidal lamp, which is just opposite to the control of the lamp. When the lamp is turned on, the germicidal lamp goes out, and when the lamp is turned off, the germicidal lamp starts.

The air shower room is designed and manufactured according to the needs of the company. Due to the safety, energy saving and high traffic efficiency of the program design, it has been highly praised by the company. At the same time, it also broadens the application range of PLC and improves the ability of technical personnel to integrate theory with practice.

## References

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