Design of the Control System for Plate Cutting Machine

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Abstract. in this paper, the traditional plate cutting machine working principle and control requirements was analyzed. And the control system was designed. Through the analysis of the design of PLC type, input and output points distribution, external wiring, ladder diagram programming process, the plate cutting machine was provided with the high efficiency, high reliability, high degree of automation requirements.

Introduction

With the progress and development of automation technology, the degree of automation of plate cutting machine is gradually improved[1-3]. Microprocessor based programmable logic controller (PLC) can meet the requirements of high efficiency, high reliability and difficult automation in modern production. In this paper, through the analysis of the working principle and control requirements of the plate cutting machine, the detailed analysis of the selection of PLC, the allocation of input and output points, design of the external wiring, and the flow chart of the ladder diagram program are made. The main function of the cutting system is to complete the cutting and moving of the plate[4][5]. That is, through the tractor (CART), the plate is sent to the designated position (cutting gun or cutter position), and then through the cutting gun and cutter plate, cutting the plate. When a complete cutting process is finished, the cart moves forward a distance from the drive mechanism, which is the length required for the program to be set. Then continue the cutting process and cycle until the stop condition is reached.

Analysis and Research on Control System of Plate Cutting Machine

Machining Process Analysis of Cutting Machine. The process is as follows, which is shown as Fig.1.

(1) Firstly the cart carries the workpiece forward, so that the workpiece reaches the position under which the cutting gun is located, and can be detected by the limit switch at the lower part of the cutting gun.

(2) When the cart is in place, the pressing device is started and the compression is finished after the time delay.

(3) When the delay technique is over, the cutting gun falls in place.

(4) After falling in place, turn on the acetylene valve, cutting gun valve, high pressure oxygen valve in turn, and ignite the flame.

(5) After preheating for a period of time, start the cutting gun, move the motor around and start the cutting process.

(6) After cutting, the cutting gun is reset.

(7) Loosen the pressing mechanism, and move the fixed length under the driving of the stepping motor.

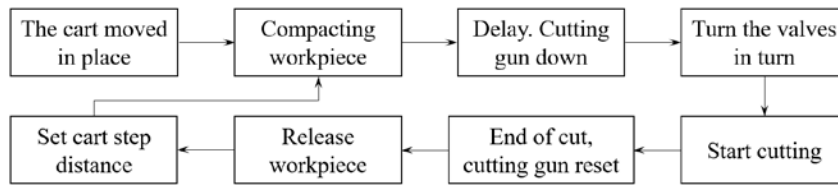(8) The cutting gun is used again, and the cutting cycle is carried out.

Fig. 1 The process of the plate cutting machine

Detection of Input Signals. The cutting machine control system mainly completes the operation button input detection, cart transportation in place detection, cutting gun position detection, cart step in place detection.

Detection of Output Signals. Control output are: the stepper motor control, motor control of the cutting gun around, cutting gun solenoid valve control valve, gas cutting gun control, pressing device control.

I/O Allocation

In this control system, the required inputs are basically digital, mainly including a variety of control buttons and various limit switches, a total of 19 digital inputs, as is shown in Table 1.

Table 1 Input address and input device

Input address	Input device	Input address	Input device
I0.0	Emergency stop	I1.2	Manual cart forward
I0.1	Reset	I1.3	Manual cart astern
I0.2	Manual / Automatic	I1.4	Manual workpiece compression
I0.3	Automatic cutting start	I1.5	Manual workpiece release
I0.4	Manual cutting gun rises	I1.6	Cutting gun upper limit switch
I0.5	Manual cutting gun down	I1.7	Lower limit switch of cutting gun
I0.6	Manual cutting gun shift left	I2.0	Cutting gun left limit switch
I0.7	Manual cutting gun shift right	I2.1	Right limit switch for cutting gun
I1.0	Manual cutting gun acetylene valve	I2.2	Cart switch
I1.1	Manual cutting gun oxygen valve		

In this control system, the main output control equipment has all kinds of contactors and motors, and there are 10 output points, and the specific allocation is shown in Table 2.

Table 2 Output address and output device

Output address	output device	Output address	output device
Q0.0	Step motor pulse output	Q0.5	Cutting gun down solenoid valve
Q0.1	Stepping motor direction	Q0.6	Acetylene valve for cutting gun
Q0.2	Cutting gun motor forward contactor	Q0.7	Cutting gun cutting oxygen valve
Q0.3	Cutting gun motor reverse contactor	Q1.0	Cutting gun high pressure oxygen valve
Q0.4	Cutting gun rising solenoid valve	Q1.1	pressing device

Control System External Wiring

The SIEMENS S7-200 series PLC is used as the host of the panel cutting control system. The wiring diagram has 19 inputs and 10 outputs, as shown in Fig.2.
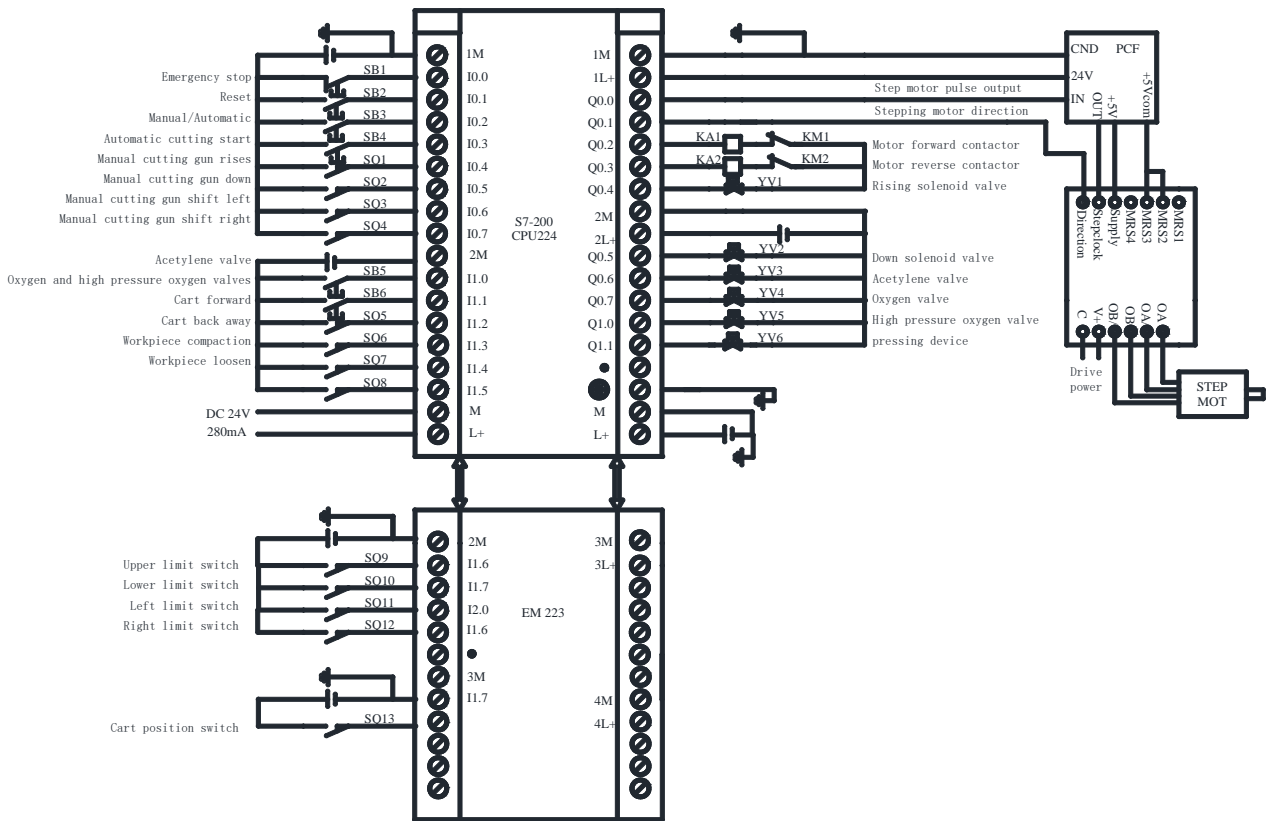
Fig. 2 Control system external wiring

Software Design

According to the functional requirement of the control system, the control process of plate cutting is divided into manual control mode and automatic control mode, the manual control mode, each device can be run separately, no order of each other, do not interfere with each other.

In manual control mode, the operation of each device can be controlled separately. The manual mode flow diagram is as follows:
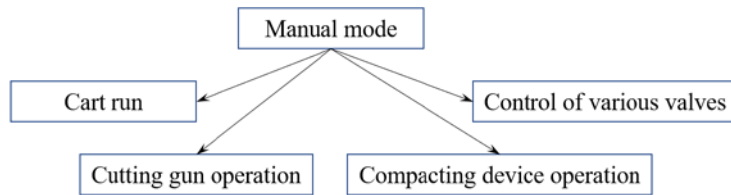

Fig. 3 Manual control mode

In the automatic state, after the system power on, press the cutting start, the system began to work, and its software flow as shown below.
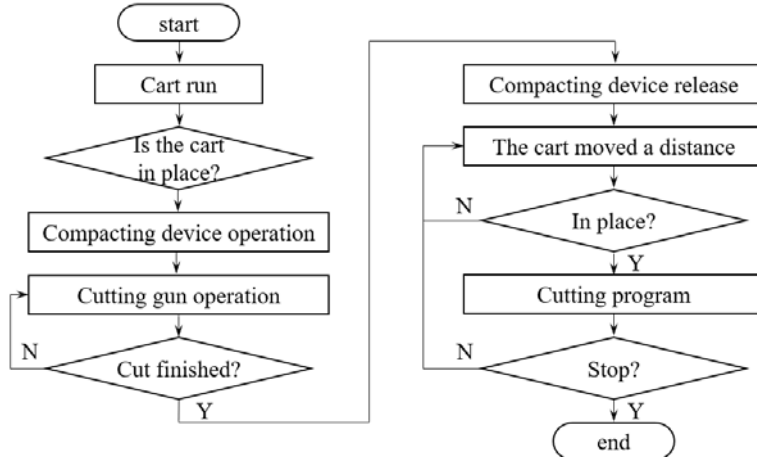

Fig. 4 Automatic control mode

Conclusion

Based on the detailed analysis of the existing plate cutting processing machine working principle, the design of PLC based control system, but the system to meet the high efficiency, high reliability, high automation and other requirements.

Acknowledgment

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