Research on the Control of Multi Position Production Line based on PLC

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Abstract
In view of the disadvantages and limitations of the traditional manual production line with the cylinder processing system as the main body, this paper proposes an intelligent production line control system based on PLC. The rearrangement of production line and automatic planning of production process are realized. The application of the system in practical production shows that the designed system can achieve 8 hours of unmanned automatic operation. It greatly improves production efficiency and product quality, reduces labor intensity and production cost, and it makes the traditional production line intelligent and automatic.

Keywords: Cylinder, PLC, automatic control, production line, automatic production

1. Introduction
Production lines for processing products can be seen everywhere, but the traditional manufacturing production lines cannot achieve online control and real-time operation, so it is difficult to ensure operation accurately, fast and effectively of production lines. Based on the above discussion, the focus of this design is to add PLC intelligent equipment to the traditional production line equipment.

The object of this design is the automatic machining control system of the parts with the cylinder as the main body. A set of multi-station production line control system based on PLC and industrial computer is designed, which is applied to automatic machining of CU series cylinder cylinder parts with different cylinder diameters and strokes. 20 series cylinder parts with multiple cylinder diameter and multiple stroke are completed on the same production line, and two workpieces can be clamped and unloaded at the same time and run in multi-station mode through the design of the program. At the same time, the main parameters of the automatic control system can be timely viewed and modified to achieve real-time controllable requirements.

2. The hardware structure design
This design of the control system is based on PLC as the control core of the system, with the industrial computer as the upper computer. First, Solidworks software platform is used to draw a schematic diagram and design a reasonable layout. Finally, sensors, solenoid valves, cylinders and electric cylinders are used as control execution components of the production line to realize automatic processing of cylinder cylinder parts.

Delta PLC DVP28SV111T was chosen as the controller in the design. The 5-position 3-pass SMC solenoid valve is selected as the pneumatic control valve. Figure 1 is the overall layout of the production line designed.
Selection of Servo System

Motor type selection should be made according to the motion characteristics of the control object and the characteristics of the load, and power selection is also the primary one. Formula (2-1) can be applied to calculate the motor power to obtain the power of the servo motor to be selected.

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P = \frac{F \cdot V}{100} \quad (1)
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Considering that the motion of the mechanical arm of the automatic processing system, the cylinder body needs to be fast, stable and high-precision, the servo motor is chosen as the driving device of the mechanical arm. The control system uses delta's ASDA-A servo drive series. Next, draw the mechanical diagram required by this design through solidworks, as shown in figure 2.

3. Overall operation design

The design of the overall operation of this paper is combined with the process of technology, the overall layout and mechanism design for the overall operation of the system control. The overall operation of the design is #1 and #2 machining center as the center, mechanical arm as the transfer mechanism; Feeder, feeder and turnover mechanism are auxiliary mechanisms, which are logically matched with each other to complete automatic processing of cylinder body parts.

3.1. System Circuit Module Design

The power distribution cabinet of this design chooses 220V as the main power supply, and is equipped with the main power control switch to control the power supply on and off of the whole circuit; In order to ensure the safety of equipment and personnel, the main switch is equipped with an overcurrent circuit breaker; Each servo driver is connected to the power supply via a separate switch. The connection mode of communication between PLC and the touch screen RS485 is S/S and c0-c4 as the common end of the input and output sensor. Since the signal line derived from the previous servo IN1 is connected with the PLC terminal, a power circuit must be formed between IN1 and the common end of PLC to make the signal effective. The terminals here and CN1 share DC24V and 0V derived from CN1.

3.2 Operational Program Design

This design uses ISPSoft software to design the automatic start program, servo control program, alarm program, origin regression program and upper computer monitoring program. When operators operate the production line, users can choose automatic mode or manual mode according to their own needs. When the operator needs to run the automatic operation, it shall first carry out the origin regression to the device. When the origin regression is not completed, the automatic operation cannot be started, and the automatic operation can be started after the completion of the origin regression.

4. Assembly line design

The span length of the arm is 2,500mm, and the beam is made of aluminum standard parts. Flange joint is adopted between the aluminum profile of the beam and the support frame, which is connected with bolts to facilitate the transportation and installation of the equipment. The bottom of the frame and the ground are fixed with expansion bolts, so that the whole mechanical arm can have good stability and rigidity. Figure 3 is the design drawing of the robot arm.

4.1. Design of Feeding Mechanism

The function of feeding mechanism is automatic feeding of parts. The feeder is composed of silo, separating station and grasping station. The bin position of the feeder takes up most of the space of the feeder. The bin capacity design is calculated according to the processing time of a workpiece, and the single feeding can meet the requirement of 8 hours of operation. The feeder adopts cylinder and electric cylinder as actuators. The sensor is used to collect information, and the automatic feeding of
parts is completed by logic control. Feeding mechanism is shown in figure 4.

Fig.3 The design of the manipulator

Fig.4. Design drawing of feeding mechanism

4.2. Design of Flip Mechanism

The turnover mechanism consists of the turnover station, the cleaning station and the preparation station. After the completion of the first working procedure, the parts shall be turned over and the surface chips shall be cleaned to prepare for the second working procedure. Two guides are installed at the bottom of the tilting mechanism, whose function is to allow the tilting mechanism to move left and right as a whole. The flip mechanism is shown in figure 5.

Fig.5. Design of the flip mechanism

Fig.6. Structural drawing of feeder

4.3. Design of Blanking Mechanism

The part of the feeder is composed of the feeding place, the workpiece vertical place, the spacer place, the tray and the basket. The function of the feeder is to automatically stack the finished parts and then add spacers between the rows in the process of automatic stacking. It plays an isolation and protection role for the processed workpiece and prevents the processed parts from colliding with each other in the handling and subsequent processes. The feeder is shown in figure 6.

5. Conclusion

100 data statistics were made for 20 models of different cylinder diameters and different strokes processed by the production line. The results show that the production line has reached the operation requirements of the enterprise, and the production line has been put into actual production. The whole process of automatic operation of eight hours, the design can be multi - cylinder diameter and multi - stroke processing and multi - station loading and unloading. During the operation of mechanical arm, the material taking and feeding work can be completed within 10 seconds, which shortens the time compared with manual material unloading and improves the processing efficiency. The field operation diagram is shown in figure 7.

Fig.7. Field diagram
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