Design and Implementation of an Automobile Fuel Tank Rolling Valve Assembly and Detection System

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Abstract: At present, the structure of the reversing valve mainly used in the automobile industry is special, and the assembly thereof is basically in the manual stage, and the production efficiency of the reversing valve is generally low. This paper mainly designs a set of automatic assembly detection system based on PLC control system. It uses MCGS touch screen and upper computer Labview as a friendly human-computer interaction interface. Through the coordination of various parts, the purpose of automated assembly and testing is achieved. To solve the production capacity of the product. The test results show that the system can complete the automatic assembly and flow performance detection of the reversing valve stably and efficiently.

1 INTRODUCTION

Automobile fuel systems are generally equipped with rollover valves. In order to ensure a constant pressure difference between the fuel tank and the inside of the fuel tank, the fuel tank is prevented from sucking, the fuel tank is prevented from tilting, or a fuel leak occurs when the vehicle accident is turned over (Zhiming Wang, 2007). Due to the special assembly process of the rollover valve, the production is still in the manual assembly stage. In addition, the air tightness and the flow rate are detected after the manual assembly, which results in low production efficiency of the rollover valve.

This paper is mainly for a rollover valve. According to the assembly characteristics of the valve and assembly requirements, the overall design of the system structure is carried out by using relevant advanced technology. Based on the overall structure of the machine, the main control system was determined with the assembly process as the guide. Finally, a set of automatic assembly detection system based on Siemens PLC, MCGS touch screen and upper computer Labview was designed. The system includes six stations for discharging, assembling and testing. The valve flow and air tightness are tested during assembly.

2 ROLLOVER VALVE ASSEMBLY SYSTEM STRUCTURE DESIGN

Combined with the characteristics of the various components of the oil valve, the appropriate assembly process is matched. Considering the simultaneous assembly and detection during the assembly process, the rotary indexing operation mode is determined, and the disk type six-station assembly test structure is finally designed(Zhiming Wang, 2007; Lin Min, 2018). With the cooperation of the upper and lower position machines, the rhythm compact periodic action is realized, the operation is stable, the index is accurate, and the efficiency is excellent, which can meet the requirements of actual production (Zhao Dandan, 2018). The automatic assembly machine layout is shown in Figure 1.

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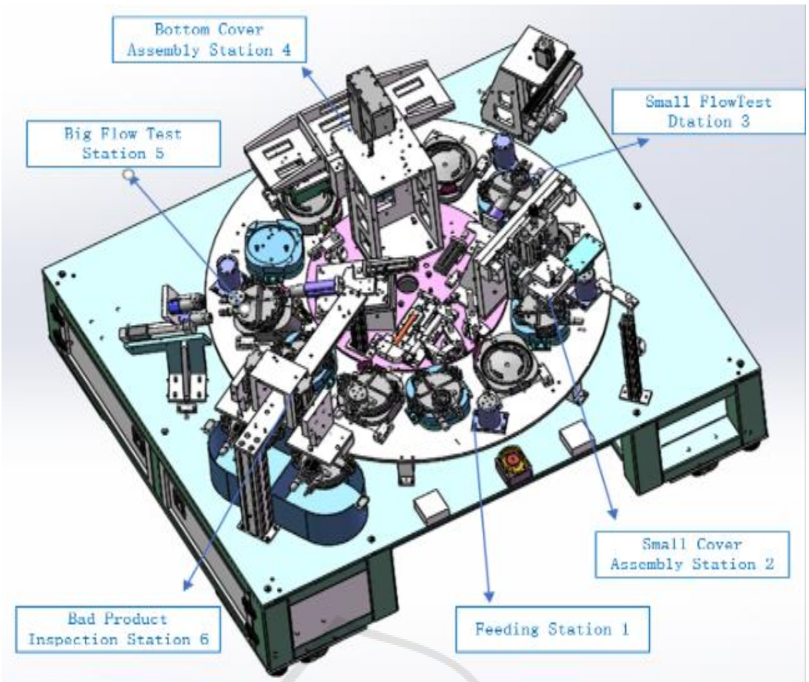

Fig 1. Automatic assembly system layout.

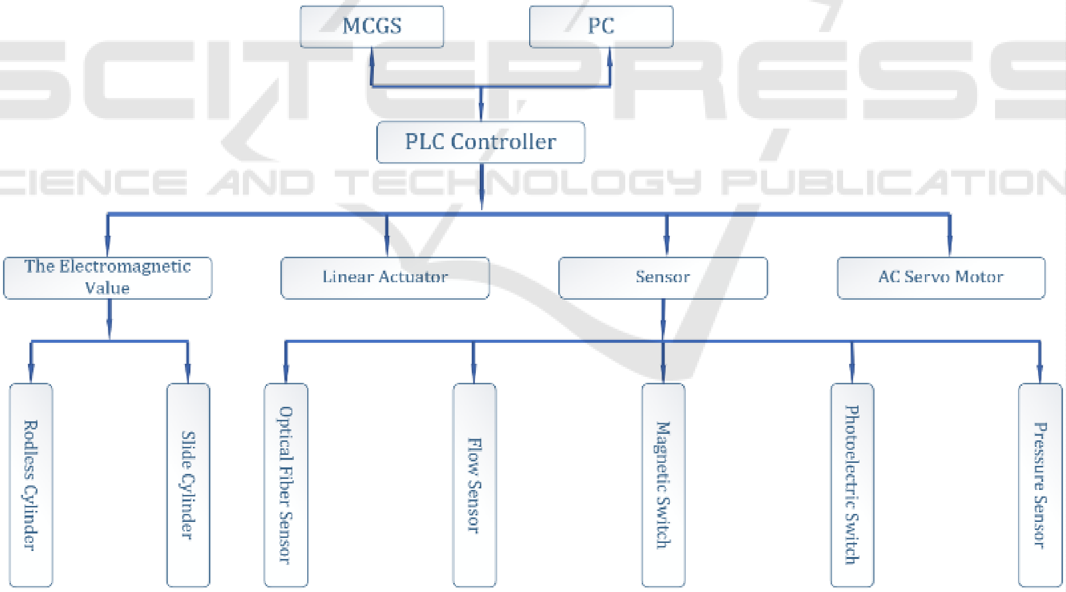

Fig. 2 Equipment control mode diagram.

3 CONTROL SYSTEM DESIGN

The disc type rotary automatic assembly test system is mainly coordinated by the PLC main control unit, servo motor, electric cylinder, cylinder, flow meter and other execution units to realize automatic assembly and measurement of the product. The bottom control of the rollover valve assembly is completed by Siemens PLC. The MCGS touch screen realizes the parameter setting and status monitoring of the assembly. The upper machine Labview realizes the display of the real-time measurement curve of the oil valve and the processing of the test data. Equipment control mode diagram is shown in Figure 2.

3.1 Section Headings

PLC is widely used in modern control systems due to its small size, low cost, high reliability and strong anti-interference ability. The system uses Siemens S7-1200 series CPU, combined with I/O expansion module, analog module, etc., and is programmed with TIA PORTAL V14. The control system mainly includes PLC controller, servo motor, electric cylinder, cylinder and other actuators, and each part is coordinated with each other to form an organic whole, realizing automatic assembly and detection (Suli Zhong, 2017).

3.1.1 Main Program Module

The main program module mainly includes a calling program segment for six FC modules, an Ethernet communication program segment of the upper computer Labview, an error code program segment, an emergency stop and an automatic interlocking program segment, and a data transfer processing program segment of the upper computer. Production ratio and timing block, alarm-light-discharge reminder. The FC1-FC6 modules respectively correspond to the logic programming of six stations (Wu Jianlong, 2018). The FC module contains the main program, manual program, single-step program, single-station program, automatic program and clear automatic program of the station.

3.1.2 Hand Automatic Interlock and Process Module

The module mainly includes program segments: screen button interlock, hand automatic interlock, output relay, sensor shielding, data single rotation, time conversion block and alarm.

3.1.3 IAI Electric Cylinder Servo Drive Module

The module mainly includes a program segment: reading the position of the servo electric cylinder and judging and calculating, finishing the writing position information, basic control commands, writing commands and positions (Zhao Dandan, 2018; Suli Zhong, 2017).

3.1.4 Sensor Conversion Module

The collected sensor data is processed, and then logically programmed in the program, finally achieving stable interaction with the machine, and transmitting the required measurement data to the host computer for display and saving.

3.2 Human-Computer Interaction Page Design

The system adopts MCGS touch screen and upper computer Labview as human-machine interface. The touch screen mainly realizes operation and monitoring of assembly process, realizes parameter configuration of equipment, fault alarm and so on (Wang Hongyi, 2017). The upper computer Labview mainly realizes the display of product detection curve and the processing of product quality inspection data.

3.2.1 Main Program Module

The main interface mainly realizes the product assembly status and data display. Basically contains all the information about the product assembly. Including production, the number and proportion of qualified products or non-conforming products, real-time test data of the product, assembly test time and cycle, alarm display, product status display of each station, including parameter setting, status monitoring, manual operation, etc. Entrance.

3.2.2 Main Program Module

The parameter setting interface mainly sets the parameters of each part of the system, including test parameters, analog parameters, servo parameters, delay parameters, I/O shielding, and function shielding (Wu Jianlong, 2018). As shown in Figure 4 test parameter setting interface, the pressure, time and flow parameters of the large and small flow test are mainly set, and the pressure limit of different stations is set.

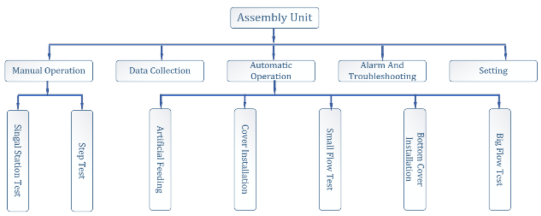

Fig 3. Assembly system control module diagram

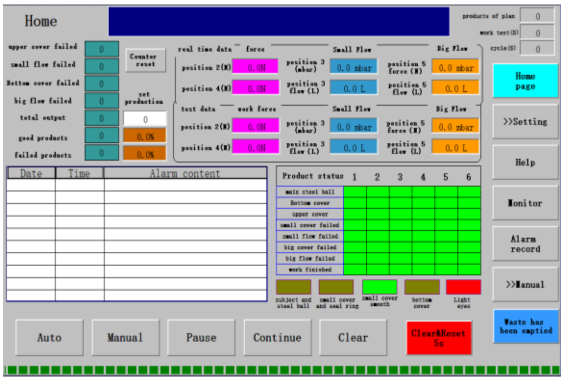

Fig 4. Human-computer interaction main interface.

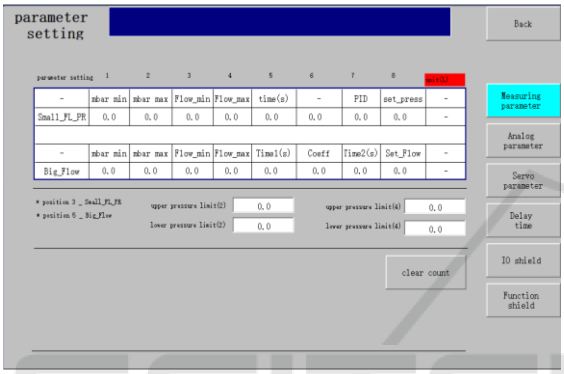

Fig 5. Parameter setting interface.

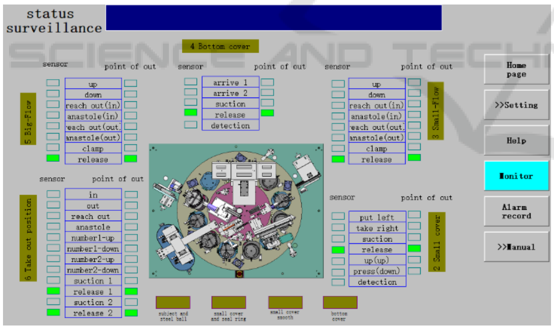

Fig 6. Status monitoring interface.

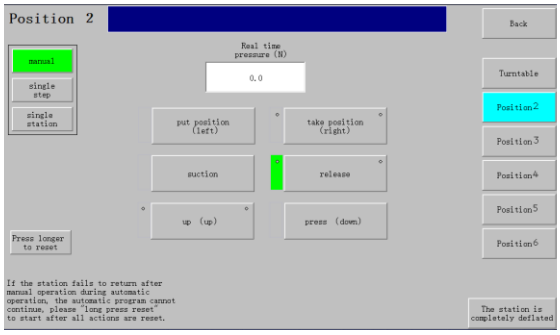

Fig 7. Manual operation interface.

3.2.3 Main Program Module

The status monitoring interface is mainly used to display the working status of each input and output point in real time. The screen display is intuitive and easy to understand, which facilitates the maintenance and maintenance of the equipment, making the human-machine interface more friendly.

3.2.4 Main Program Module

The manual operation interface includes operation inlets of six stations, which can operate separately for different stations. Each interface is independent of each other, and an interlock mechanism is added in the programming to prevent manual stations from interfering with each other. As shown in Figure 7, station 2, including manual operation, can perform any action in the interface; single-step operation can single-step the action of the station; single-station operation can execute the entire process of the station.

3.2.5 Main Program Module

The upper computer test interface mainly realizes the display of test values and the preservation of test data. The real-time flow curve of the three-station and five-station is displayed in the interface, which is intuitive and easy for the tester to observe. Each station test data provides the status of each station test. Save experimental data.

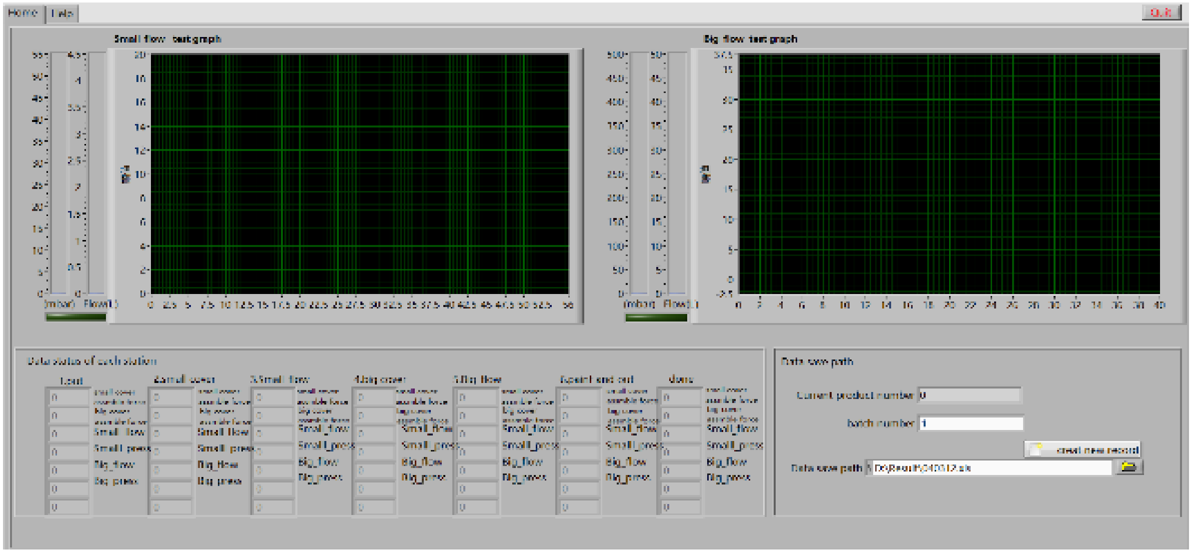

Fig 8. PC test interface.

4 COMMUNICATION

4.1 Ethernet Communication between the S7-1200 PLC and the Touch Screen and the Host Computer

The S7-1200 integrates a PROFINET communication port that supports Ethernet and TCP/IP-based communication standards. Set the IP address of the PLC and touch screen so that they are in the same network segment, so that the touch screen and the PLC are connected to the network cable (Zhiming Wang, 2018). After the PLC searches for an accessible device, it confirms that the connection is completed and communicates through the variables in the PLC. First check the optimized block access of the data block in the PLC and then generate the variables. When programming the touch screen, simply import the tags and select the user-defined global variables or elements in the global data block in the S7-1200 PLC. The S7-1200PLC and the host computer Labview are based on the Modbus TCP communication protocol, and the Modbus TCP server communicates via the PROFINET connection (Bao Dewei, 2007). The "MB_SERVER" instruction will process the connection request from the Modbus TCP client, receive and process the Modbus request and send a response.

4.2 Communication between S7-1200 PLC and Servo Drive

The S7-1200PLC expands the CB1241RS485 signal board to realize the communication function of the S7-1200 master station (Bao Dewei, 2007). The RS485-based serial port realizes free port communication between the PLC master station and the servo slave station (Zhiming Wang, 2018). Then configure the port parameters, complete the communication settings, and finally write the serial communication program.

5 EXPERIMENTAL RESULT

According to the actual production situation, in the case of normal continuous feeding, the system cycle period is 36 seconds, the product can be assembled according to the standard, and the flow performance of the assembled product is stably detected, and the performance curve is displayed on the screen of the upper computer. The system moves smoothly and the cycle is compact, which greatly shortens the assembly cycle of the special product, and realizes the measurement product performance during the assembly process, further improves the product completion efficiency, fully achieves the expected goal, and all the functions of the system are running normally during the system operation (Wu Jianlong, 2018), emergency stop, alarm, safety grating, etc.

make the system have good human-machine performance.

6 CONCLUSION

This paper mainly designs an automatic assembly detection system for automobile fuel tank turn-over valve, which mainly includes mechanical structure and control system.

This system uses PLC as the system controller, and uses AC servo motor, servo electric cylinder, cylinder and so on as the actuator. The system also uses closed-loop control to ensure higher assembly accuracy. Not only does Z take a variety of protective measures on the mechanical design, but also add logic protection in the software programming of the control system to achieve dual protection of the system. The system realizes the automatic operation of the control process based on the extremely stable stability and logic performance of the PLC. The MCGS touch screen and the Labview of the upper computer finally realize the coordinated operation of each station.

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