Design and Realization of High Precision Counting Function of Filter Exchange Center

Yu-liang LI, Yong-an QIAN and Wan-li LIU
Kehai Road 118#, Hangzhou Cigarette Factory, Zhejiang Tobacco Industry, Hangzhou, China

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Abstract. In order to solve the problem of accurate counting of traditional Filter exchange centers, a high-precision counting device and a new control system based on the Siemens TIA Portal platform technology are designed. The system accurately counts Filters passing through the exchange. The results show that the system is stable, reliable and easy to operate. It can improve the work efficiency of all levels of staff and effectively monitor the process. The statistical accuracy is above 98.3%, which is of great reference to practical engineering application.

Introduction

The Filter exchange is an essential unit of production for a highly automated cigarette plant that functions to flexibly connect the Filter production area to the cigarette production area. In actual use, the actual usage of the Filter often cannot be accurately counted due to the lack or insufficient perfection of the counting function. In response to this situation, a new type of sensor and control system has been designed and the precise technical function of the filter counting has been achieved with a newly designed control system [1].

Sensor Designing

Traditional Designing

The traditional designing is like below: A section of seamless steel pipe, with transparent glass instead. Outside of the transparent glass tube, a pair of photoelectric switches is installed. The transparent glass tube is in the middle of the emitter and the receiver of the pair of photoelectric switches. When a cigarette Filter passes, the light of the photoelectric switch is blocked, and the photoelectric switch sends out a power Pulse, the counter records a cigarette Filter. The current method of counting the shortcomings: more dust on the job site, transparent glass tube wall accumulation of dust for too long, the counter cannot work, you need to regularly clean the outer wall of clear glass tube dust.

This situation lead to unnecessary maintenance and inaccurate counting, this is not suitable to excellent cigarette manufacturing plant requirements.

New Device Designing

The device comprises a pipeline system and a photoelectric switch system, wherein the pipeline system comprises a bracket, a transparent glass tube, an outlet connector and an inlet connector, the photoelectric switch system comprises a photoelectric switch and a light reflecting plate; the bracket is provided with an axial through hole, The two ends of the axial through hole are respectively provided with stepped holes, the outer sides of the stepped holes are respectively provided with a retaining ring, the stepped hole and the retaining ring form a mounting groove, a sealing ring is respectively arranged in the mounting groove, The outer wall of the transparent glass tube and the step hole are sealed with the outside through the sealing ring; the inner walls of the two ends of the transparent glass tube are respectively provided with flaring; the inlet joint is installed in the axial through One end of the hole and the inner end of the inlet joint abut against the retaining ring, and the
inner wall of the inner end of the inlet joint is provided with a chamfering structure which is opposite to the one flaring; the outlet joint is arranged on the shaft To the other end of the through hole, the inner end of the outlet connector is abutted against the other retaining ring, and the inner wall of the inner end of the outlet connector is provided with a large bell mouth structure, Flared opposing contact; and in the middle of the bracket is provided with a radial through-hole, a radial through hole penetrating through an axial hole provided photoelectric switches and the light reflection plate on both sides of the radial through holes, respectively. The device structure is as Fig. 1.

![Counting device structure](image)


Figure 1. Counting device structure.

**System Designing**

**System Structure**

Filter exchange center control system, from the connection signal acquisition, to the exchange center and the transmitter and the machine between the data communication, the control layer data communication layer monitoring, monitoring and management of all data communications using Industrial Ethernet[2], as Fig. 2.

![System structure](image)

Figure 2. System structure.

**System Communication**

Distributed Slaves the ET200M picks up the hardware circuit signals of the sender and the cigarette maker and is integrated as a Profinet slave into the Profinet network of the master PLC. Introduced by Profibus International (PI), the Profinet network is a new generation of automation bus standards based on Industrial Ethernet technology. Compared to Profibus, it has many advantages, such as: wider applications, more flexible topology, more convenient production, real-time communications
and more. It is a strategic technological innovation in the field of industrial automation all transmitters and cigarette makers have hardware circuit signal connections to the switching center and Industrial Ethernet-based S7 communication with the master PLC of the switching center. The S7 communication is Siemens In this way, the master PLC in the exchange center can obtain the program logic state of the signals in the transmitter and the cigarette maker PLC through the network and compare with the actual hardware circuit signals, and at the same time, realize the signal Redundant features. In addition, the communication volume of S7 communication can be relatively large, and the transmission status and the number of transmissions per transmitter can be transmitted to the master PLC via S7 communication over Industrial Ethernet. The monitoring layer software is designed with Siemens WinCC software and is directly connected to the master PLC via the S7 drive over Industrial Ethernet [3]. Based on the concept of Siemens Totally Integrated Automation, configuration is easy. Management through the OPC-based Industrial Ethernet interface access to the data monitoring layer, and then processed by the data for management system computer selectively access[4,5]. System communication configuration is like Fig. 3.

![System network configuration](image)

Figure 3. System network configuration.

Base on such system communication above and the new sensor device, we could set up a flow to make the precise filter counting.

**Function Realization**

In order to design the precise counting function, we setup the system flow chart as Fig. 4.
The idea of this design is to first set different brands for different transmitters and then correspond to different brand names of the receivers. Then, a count signal is obtained from the counter of the transmitter and then counted by the newly designed sensor Signal 2, and finally through the receiver sensor count signal 3, and so on, so that the entire transmission system of the actual input filter rod, consumption, the use of precision can count.

Conclusion
Through the application of the newly designed counting sensor and control system, the problem of inaccurate counting of the filter rod exchange center has been solved, and the counting accuracy rate has risen from 93% before the system application to 98.3%, which has a good realistic guiding significance.

Summary
If you follow the “checklist” your paper will conform to the requirements of the publisher and facilitate a problem-free publication process.

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Reference