

Design of Winding Machine Based on Motion Controller

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Abstract. The traditional winder commonly uses the relay or Single Chip Microcomputer to control it, but the relay control has shortcomings of complex line, huge volume and poor reliability; anti-jamming capability of Single Chip Microcomputer is poor. This paper describes the design of a winding machine based on motion controller, it can overcome the shortcomings existing in the traditional winding machine, and enhance the system flexibility and portability. It has a certain guiding significance to the development of winding machine.

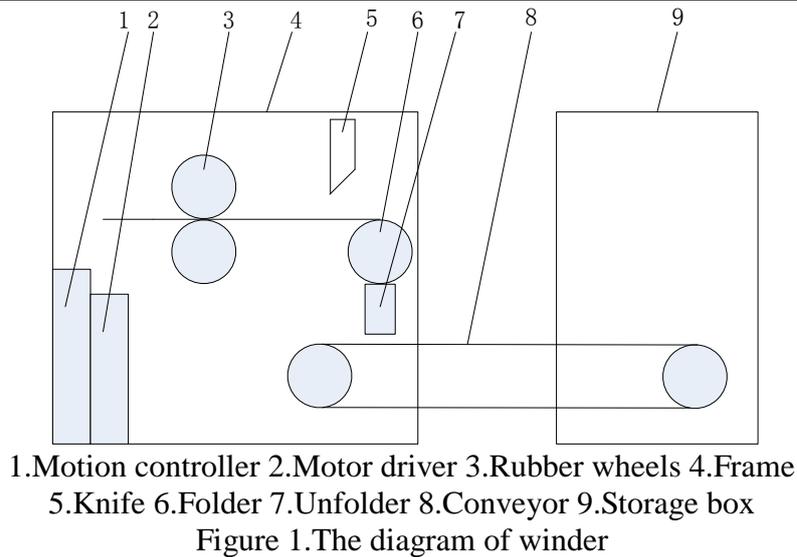
Keywords: Winding machine; Control system; Motion controller

Introduction

The winding machine has important applications in many industries, it can greatly improve the efficiency of work [1]. At present, the control system of the winding machine most uses relay. The wiring of relay control system is complex, and its volume is huge, once there is a problem in winding machine, it brings huge difficulty to repair [2]. At the same time, the relay control system is a special system which is designed for winding machine specially, it does not have the portability. If the winding machine needs to replace, the relay control system must also be redesigned, resulting in a waste of resources [3]. There are also some winding machines which control system uses single chip microcomputer. The anti-interference ability single chip microcomputer is poor, if electromagnetic interference is serious in the working environment, the problems of the system will arise, the failure rate is relatively high [4]. In recent years, the development of motion controller is rapid, it has been widely applied in control field. It has the advantages of convenient use, strong anti-interference ability, good openness, and portability. It is suitable for open control system design, designers can according to the equipment to make a rational allocation [5]. In this paper the motion controller is used to design the winding machine, which aims to provide a new idea for the development of winding machine.

The structure and working principle of the winding machine

The structure of the winding machine. Taking waterproof roll for example, as shown in Figure 1, winding machine is mainly composed of two parts, which are respectively the mechanical part and control part. The mechanical part is mainly composed of a feeding mechanism, cutting structure, folding mechanism and the unfolding mechanism etc. The feed mechanism is composed of two rubber wheels, one is driven by the motor to rotate, the friction between the two rubber wheels will drive the waterproof roll going forward. The cutting mechanism is a blade through the motor control, if the waterproof roll is folded in the specified length, cutting mechanism will cut the waterproof roll off. Folding mechanism will be responsible for a specified length of the waterproof roll to be folded in a roll. Unfolding mechanism will release the roll and put it on the conveyor belt, conveyor belt will ship the roll off the production line.



The working principle of the winding machine. The winding machine will fold the producing waterproofing roll into a roll in the specified length, the length can be set by the users. The length setting is done before working on, after setting, the feeding mechanism will send waterproof roll to the folding mechanism, through he folding mechanism, waterproof roll will be folded into a roll. There is a length sensor on the frame of winding machine, the real-time waterproof roll length signal will feedback to the system. Before the start of the folding mechanism, waterproof roll will touch the starting signal, the signal feedback to the system, the system control folding mechanism to move. At the beginning of the 1/5 setting length, the operation speed is low, then the motor accelerates gradually, reaching the 1/4 of the whole length, the speed comes to the maximum, until 2m prior to the completion, the motor decelerates, arriving at the designated length, the motor stops rotating. The velocity diagram of the motor is shown in figure 2.The cutting mechanism control the cutting knife to cut off the waterproof roll. The waterproof roll will be sent out of the winding machine through the conveyor belt, and the next cycle starts.

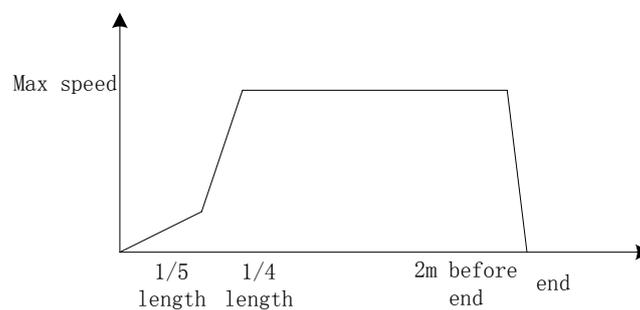


Figure 2. The velocity diagram of the motor

Software design

The software structure design. Motion controller is the core of winding machine control system. As shown in figure 3, machine control system adopts the form of the upper and lower computer. Due to the motion controller is based on the operation of the PC, so it is necessary to use PC as the upper computer, and the motion controller as lower computer. As shown in Figure 4, the software design adopts modularization way, it is divided into management module, motion control module and parameter module. The management module is accomplished by PC, including the procedures programming and management; motion control module is completed by the motion controller,

including motion control and logic control; parameter module is accomplished by touch screen, including parameter setting and display.

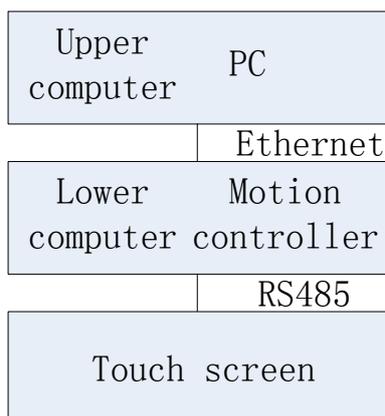


Figure3. The mode of control system

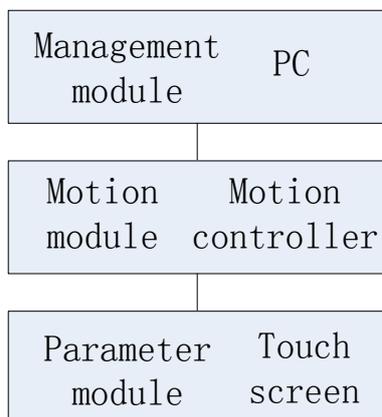


Figure4. The modular design of software

The I/O design. System receives and sends signals through the I/O interface of controller, including the position signal and speed signal, indicating signal etc. The system I/O design is shown in table 1.

Table1. System I/O design

| Input | | Output | |
|-------|-------------------|--------|---------------------|
| IN0 | position signal 1 | OUT0 | indicating signal 1 |
| IN1 | position signal 2 | OUT1 | indicating signal 2 |
| IN2 | position signal 3 | OUT2 | indicating signal 3 |
| IN3 | position signal 4 | OUT3 | indicating signal 4 |
| IN4 | position signal 5 | | |
| IN5 | counting signal | | |

The program flow design. The program flow design of winding machine is shown in figure 5. First of all, the system initialization starts, and examine operation state of the system, if there is an error, the system will give the instructions, if there is no error, after the initialization, do parameter settings. When the parameter setting is completed, the feeding mechanism starts, waterproof roll will be driven by the rubber wheels. The system starts to detect the waterproof roll position, and

through the position to control motor speed, when waterproof roll arrives at the designated location, the folding mechanism will run, and the waterproof roll will be folded into a roll, then be cut off by cutting knife, the coiled waterproof roll will be moved, and the next cycle will start.

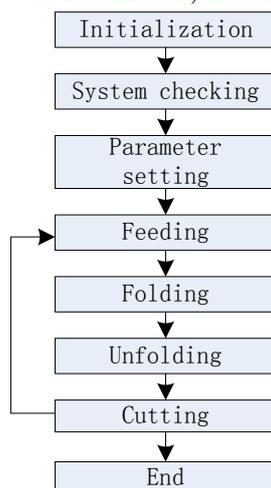


Figure5. Program flow design

Touch screen design. The touch screen communicates with the motion controller through RS485 interface, touch screen design is shown in Figure 6, length setting related parameter display is on the touch screen.



Figure6. Touch screen design

Summary

In view of the existing problem of the winding machine, a kind of automatic winding machine is designed based on motion controller. The winding machine uses motion controller as the core of the system, and improves the system's flexibility, expansibility and portability. And it can improve the reliability of winding machine. The touch screen can set the working length of winding machine, which improves the winding machine's range of work. It can improve the production efficiency, and ensure the quality of products. It can be applied to different industries.

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