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Design of Electric Control System for Slitter

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Abstract

Slitter is an important equipment in packaging industry, and its slitting quality directly affects the quality of product production. At present, there are many kinds of slitting products on the market, so the electric control system configuration of slitting machine is different for different products. The electric control system of the slitter designed in this paper takes Mitsubishi PLC as the control core, employs three Yaskawa inverters to control three motors, and realizes the high-speed and efficient slitting of the slitter.

Keywords

Slitter; PLC; Inverters; Electronic Control System.

1. Introduction

The packaging industry has received widespread attention, With the rapid development of trade in recent years. The production, transportation, and sales of commodities are inseparable from the support of the packaging industry, hence, as important processing equipment in the packaging industry, the slitter is also being focused [1]. The function of the slitter is to slit the semi-finished material with a larger width into the required width according to certain specifications. There are many types of slitting products, and the texture of different products is various, including paper, film, aluminum foil, and non-woven fabrics, etc. The slitting speeds, slitting specifications as well as electrical control configuration of the slitter are different for different products and textures [2].

The slitting efficiency and slitting quality of the slitter are directly affected by the choice of electronic control configuration. Therefore, this paper offered a three-motor high-speed slitting electrical control system. The system adopts Mitsubishi PLC core and MCGS as human-computer interaction and employs three Yaskawa inverters to control three motors respectively, realizing winding tension control and winding diameter calculation, transmission control, and other functions. The electronic control system has a high degree of automation while ensuring the precision and stability of the tension control, and the maximum operating speed can reach 500m/min.

2. Tension control

Under the same configuration, the slitting efficiency and the quality mainly depend on the tension control system. The more stable the tension control, the better the quality of the slitting. The factors affecting tension control include system configuration, material diameter, slitting width, and material characteristics, etc. [3] Tension control includes the tension control of the rewinding shaft and the tension control of the unwinding shaft [4].

Common rewinding shafts include the slip shaft and the air shaft. The control object of this system is the slip shaft, outputting the corresponding pulse signal to the Yaskawa A1000 series inverter through the PLC to control the rotation of the frequency conversion motors of the upper and lower rewinding shaft, hence, controlling the speed of the rewinding shaft. The PLC outputs the corresponding analog signal from 0 to 10 valve through the analog module and controls the electronic controlled

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proportional valve to output the corresponding air pressure to the slip shaft, thereby providing the corresponding tension control.

There are many conventional tension control systems of unwinding shafts, including the magnetic powder system, the air brake system, and the motor system [5]. The corresponding 0-10V analog signal is output to the tension plate through the PLC analog module to control the tension output of the magnetic powder, thereby controlling the unwinding tension. The electronic control system of tension control is shown in Figure 1.

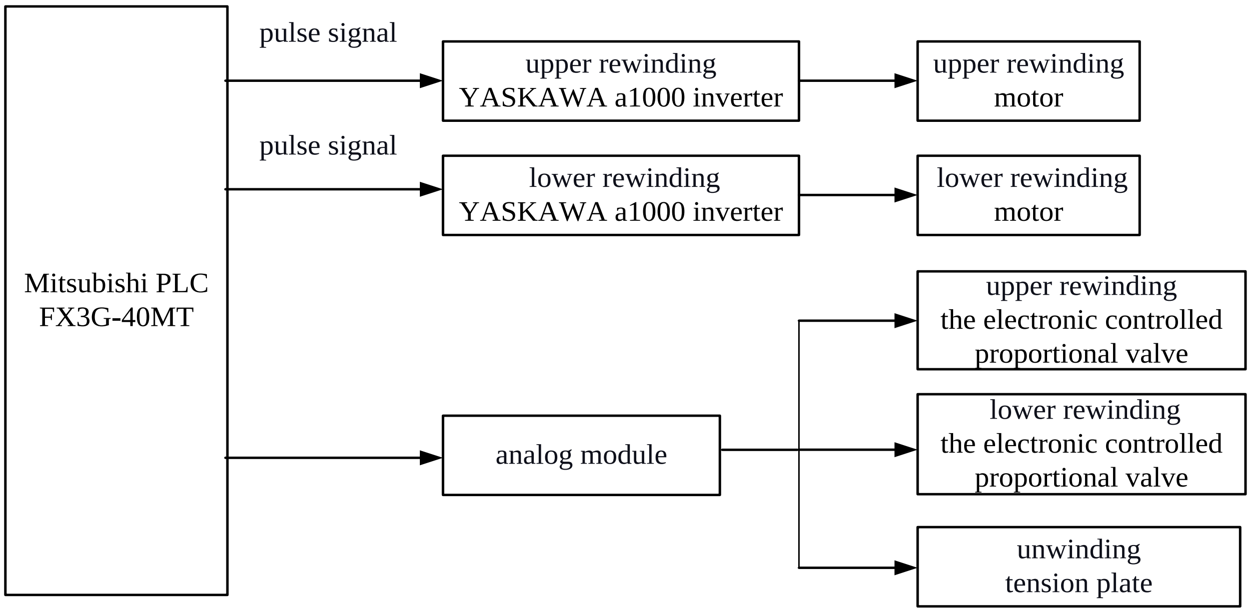

Figure 1. The electronic control system of tension control

3. Calculation of the winding diameter

The calculation of winding diameter includes the calculation of rewinding diameter and the unwinding diameter. The stability of the tension control is directly affected by the accuracy of the winding diameter calculation.

The rewinding diameter is calculated by Eq.1 and Eq.2.

$$L_0 = \frac{\pi}{w}\left(\frac{D_0}{2}\right)^2 \times \frac{1}{1000} \tag{1}$$

$$D_1 = 4 \times \sqrt{\frac{w(L + L_0)}{\pi}} \tag{2}$$

Where L_0 (meter, m) is the length corresponding to the initial rewinding diameter, w (millimeter, mm) is the thickness of the material, D_0 (mm) is the initial diameter of the rewinding shaft, D_1(mm) is the diameter of the rewinding shaft and L (m) is the movement length of the slitter.

The calculation method of unwinding diameter is different from that of rewinding diameter. A proximity switch with a transmission relationship of 1:1 can be placed on the unwinding shaft, and the proximity switch obtains a signal every time the unwinding shaft rotates. The unwinding diameter can be calculated by the counting of the proximity switch. The unwinding diameter is calculated by Eq.3.

$$D_2 = \frac{L_1}{N\pi} \times 1000 \tag{3}$$

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Where D_2 (mm) is the diameter of the unwinding shaft, N is the number of revolutions of the unwinding shaft (N can be a hypothetical value), L_1 (m) is the movement length of the slitter when the revolution number of unwinding shaft is N.

4. Conclusion

The configuration of the electronic control directly affects the slitting efficiency and the slitting quality of the slitter. This paper proposes the electronic control system of a three-motor slitter that uses Mitsubishi PLC and MCGS as controlling core. Moreover, introducing the tension control、Calculation of the winding diameter and the transmission control of the electronic control system respectively.This high-speed slitting electronic control system has wide applicability and high slitting efficiency, cooperating with the excellent tension control algorithm, which is generalized and marketable.

Acknowledgments

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