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Research Article

A DEVICE FOR MONITORING THE WEIGHT OF COTTON RIBBONS

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Abstract

The article describes the actual problem of automatic control of the linear density of cotton tape in the spinning of the textile industry. There are several methods for determining the linear density of cotton tape. In the article, the capacitive method of automatic control of the linear density of cotton tape is scientifically explained through formulas, block diagrams and diagrams.

Keywords

Textile industry, spinning, cotton tape, automatic linear density control, capacity method, formulas, device block diagram, funnel construction, time diagrams.

Introduction

Currently, a significant proportion of all yarn produced in the world is yarn from a mixture of dissimilar fibers. As you know, the combination of fibers of several types makes it possible to obtain yarn with a complex of valuable properties inherent in its individual components, but only with high-quality mixing of the components. Poor mixing quality leads to an increase in unevenness in all properties of the yarn, a decrease in the stability of the technological processes of its production and processing [1-4].

However, under production conditions, the unevenness of mixing components is not determined due to the lack of a proven instrumental method for its assessment. At the same time, the possibility of determining the unevenness of mixing dissimilar components in spinning products would make it possible to evaluate the efficiency of the processing of fiber mixtures and promptly make adjustments to the technology for the production of multicomponent yarn [5-9].

THE MAIN PART

One way to determine the unevenness of fibrous products by linear density is the use of instruments based on the capacitive measurement method. However, these instruments do not allow one to evaluate the unevenness of the mixing of components in heterogeneous fibrous products.

The solution of this problem is possible in the case of modernization of electron-capacitive devices by installing an additional sensor (capacitor) on them, which differs in the frequency of the electromagnetic field created between its plates. The signal from the main sensor is used to determine the traditional roughness characteristics of the spun products from the linear density [10-17].

Capacitive transducers (sensors) and measuring systems are based on the conversion of linear displacements into a change in plate capacitance [18-21]. The advantages of the capacitive measurement method are:

- measurement continuity; the ability to register continuously changing values, which is necessary when controlling the parameters of gears, wheels, movements of machine units, etc.;
- the possibility of counting the actual deviations of the measured value on the scale of the device;
- remoteness of measurements;
- high sensitivity and simple design of sensors.

The disadvantages of the method are the comparative complexity of the electrical circuits for switching on the sensors and the influence of deviations of the circuit parameters on the measurement results.

The operation of a capacitive position sensor is based on a change in the capacitance of the sensing element when the gap between it and a moving object inside its field changes [22-28].

The capacitive control method can be non-contact and contact. In non-contact capacitive measuring systems, a weight-controlled cotton tape is directly included in the magnetic circuit, forming a section of the magnetic circuit [29-33]. In recent years, experimental samples of non-contact capacitive sensors with high sensitivity have been developed. The capacitive method for measuring linear dimensions is based on the use of contact

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capacitive sensors, which are simple or differential. The force of magnetic attraction in a simple sensor can be significant and the measuring rod that moves the armature has to overcome it, which necessitates an increase in the measuring force and is one of the disadvantages of a simple capacitive sensor [34-38]. As the cotton tape passes through the funnel, the cotton tape weight control device increases or decreases the capacitance of the capacitor (see Fig. 1).

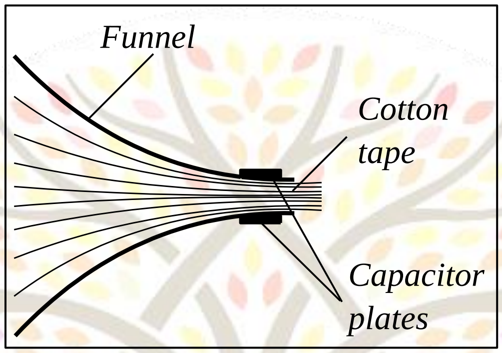

Fig.1. The design of the funnel for forming the weight of the cotton tape.

In a differential sensor, the forces of magnetic attraction in the air gaps are balanced and the measuring rod must overcome only the gravity of the sensor's movable system and the force in the spring hinge.

In capacitive sensors, the variable is the AC resistance of the capacitor. In this case, the alternating current resistance of the measuring capacitor is defined as

$$X_{C_T} = \frac{1}{2\pi f C_T} \qquad (1)$$

and the AC resistance of the reference capacitor is defined as

$$X_{C_0} = \frac{1}{2\pi f C_0} \qquad (2)$$

According to the block diagram of the device, when $X_{C_T} = X_{C0}$, the alternating currents in the arms of the measuring transformer are the same and their direction is opposite. As a result of which the total variable magnetic field in the cores of the measuring transformer as well as the

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voltage at its outputs is zero [39-44]. When there is a cotton tape on the measuring channel of the sensor, the capacitance of the measuring capacitor changes in proportion to the mass of cotton tapes that is in the measuring channel of the sensor. In this case, the difference in the capacitance of the measuring and reference capacitors is proportional to the linear density of cotton tapes T and is determined as:

$$C_{T}(T) - C_{0} = K_{0}T$$

Where:

C_T – is the capacitance of the measuring capacitor;

C_T – is the capacitance of the comparative capacitor;

K_0 – coefficient of proportionality.

The difference in the capacitance of the measuring and comparative capacitors leads to a change in the currents flowing through the corresponding transformer arms. Which leads at the output of the transformer to form a voltage proportional to the density of the cotton tapes (see Fig.1).

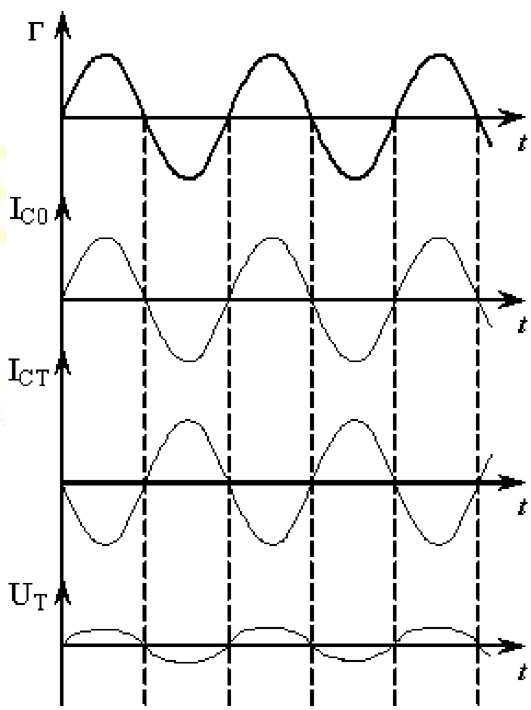

Fig 1. Timing diagram of a device for controlling the weight of cotton tapes.

The signal from the output of the transformer is amplified by the pre-amplifier U_1 and detected by the detector D. The detected signal from the output of the detector is amplified by the amplifier U_2 and fed to the recording device RD. According to the reading of the latter, the linear density of the controlled cotton tapes is determined (see Fig. 2).

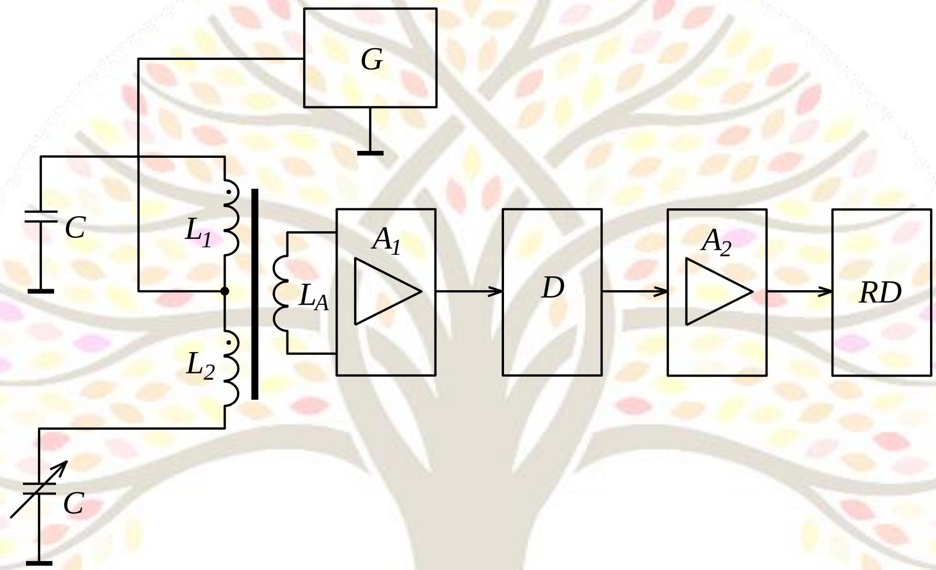

Fig. 2. Block diagram of a device for controlling the weight of cotton tapes.

The use of this device in spinning shops of light industry allows automatic control of the linear density of cotton tapes at the entrance of the technological process.

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