International Journal for Innovative
Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

COPY RIGHT

IJIEMR Transactions, online available on 5th Nov 2020. Link :http://www.ijiemr.org/downloads.php?vol=Volume-09&issue=ISSUE-12

DOI: 10.48047/IJIEMR/V09/I12/15

Title: **PHOTOELECTRIC METHODS FOR AUTOMATIC LINEAR DENSITY CONTROL COTTON TAPES**

Volume 09, Issue 12, Pages: 82-87

Paper Authors

Mamasadikov Yusupjon, Alixonov Elmurod Jamoldinovich

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

PHOTOELECTRIC METHODS FOR AUTOMATIC LINEAR DENSITY CONTROL COTTON TAPES

Mamasadikov Yusupjon*, Alixonov Elmurod Jamoldinovich**
*Professor of Department "Electronics and Instrumentation"
Ferghana Polytechnic Institute Republic of UZBEKISTAN
**Assistant of Department metrology, Fergana Polytechnic Institute,
Ferghana, UZBEKISTAN
mamasadikov52@bk.ru, saroylik0112@gmail.com

ABSTRACT

The current problem of automatic control and stabilization of the weight of cotton belts at the spinning mill is highlighted. Structural diagrams are given and the principle of operation of an optoelectronic device for automatic control and stabilization of the weight of cotton bands is described. The principle of the optoelectronic method for monitoring the linear density of cotton tapes is stated.

KEYWORDS. Automatic control, stabilization, weight, cotton tape, production, structural diagrams, optoelectronics, devices, method, linear density, emitting diode, photodetector.

INTRODUCTION

The productivity of the cotton industry, as well as the quality of the products, is directly dependent on the quality of the yarn. Hence the correspondingly high requirements for spinning technology.

The main technological parameter of the spinning production is the linear mass density (weight) of the cotton ribbon. The most important task is the automatic control and stabilization of the weight at all stages of the spinning production. Oscillations in weight greater than the allowable lead to an increase in breakage, i.e., to a decrease in productivity, as well as the strength and appearance of the final product of the cotton industry.

MAIN PART

Photoelectric methods are based on the transmission of a test material between a light source and a photocell of any type (vacuum, photomultiplier, photodiode, photoresistor, etc.). When the thickness of the moving product changes, the current of the photocell with a linear light characteristic changes, there is a direct dependence of the photocurrent and the thickness of the investigated product. This relationship is used to measure and classify yarn defects and to determine the roughness of the spun product.

The device "Detexomat" by Qualitex (Holland) consists of stands and guide rods, a photocell, a lamp, a control unit with an amplifier and a relay [1]. The photocell and the lamp are fixed at opposite ends of two parallel guides through the (slot) that the warp threads pass. Light passes through a 2x26 mm slit. All threads are projected into one, blocking part of the light flux. A signal from a defect on one of the yarns is sent through a relay system to stop the warping machine drive, after which the defect is eliminated. The sensitivity is set in advance with a special knob.

The device "Automatic monitor yoke" by Short Brothers-Harland and Avart (Northern Ireland) is designed to analyze defects and short-wave irregularities of yarn [2]. The device uses a Linra sensor. Linen Industry Research Association. The yarn is passed in front of the photocell at a speed of 60 m/min. The second photocell is illuminated by the same lamp and has an adjustable slit. Since the voltage balance from the photocells is fed to the input of the differential amplifier, the amplitude of the output voltage oscillations of which is proportional to the thickness, and the duration - to the length of the thickened place. There are five length groups: 0-3.8; 3.8-12; 7; 12.7-25.4; 25.4-58.8 mm and over 50.8 mm. A pulse from a differential amplifier is fed to the input of five decision amplifiers, connected in series, and is recorded by the one that is turned on at the time of the arrival of the trailing edge of the pulse. The output of each amplifier is connected to a counter. The time constant is chosen so that defects up to 3.8 mm long are recorded by the first counter, up to 12.7 mm long by the second, etc. Thus, the number of defects in each of the five length groups is recorded.

The Injmarsh device was created at the Research Institute of the Indian Association of Jute Mills [2]. It consists of an optical and drive unit, an electrical amplifier and a counter. A photocell detects unevenness and thickening in the yarn. Then the signal is amplified and fed to the counter. There are three degrees of separation of defects in thickness: 120, 150 and 175 yarn diameters. For sizing, metal rods are used, installed at the point of passage of the yarn. The change in voltage from the introduction of a bar or the introduction of a corresponding equivalent resistance in the photocell circuit is amplified and fed to the counter. To install the device in the working position, press the button and change the resistance until the counter stops working. Then the required sensitivity is set. Yarn pulling speed 36.5 m/min.

Electronic device for automatic detection and counting of thread defects A.A. Bessonov (USSR) has an adjustable shell-diaphragm [3]. Four rollers with guide grooves fix the thread in front of the diaphragm to prevent proper counter triggering in case of elliptic thread. The device registers defects; exceeding the specified level of thickness by 0.05 - 2 mm.

The device for checking the apparent thickness of fancy yarns of the "Boucle" type of the Textile Institute (Holland) has a light source that projects the silhouette of the thread on the screen with two targets [2]. The slits are located on both sides of the thread core, making it possible to measure the apparent "bulk" of the thread from both sides. Special guides prevent the display of the thread core from entering the slit. The amplifier registers "bald" sections, i.e. segments without loops, over 1 cm long. The counter counts the number of pulses corresponding to the "bald" segments.

A device for automatic control of yarn, developed by Yu.N. Ivanov (USSR), makes it possible to measure yarn defects that obscure the modulated luminous flux of two illuminators, which shine through the yarn along the next one in two mutually perpendicular directions [3]. Light through a prism, mirrors and lens enters the screen. Light guides are located under the screen at the ends of which photodiodes are installed. Depending on the change in the yarn diameter, a certain number of light guides and photodiodes are switched on. You can simultaneously control the density of the yarn by passing it between pairs of mutually perpendicular capacitor plates.

Photosensor for controlling the thickness of the thread in the production process V.S. Kakhanovich et al. (USSR) consists of two identical photoresistors made in the form of right-angled triangles conjugated along the hypotenuses, included in a differential circuit with a transformer [4]. The optical system projects the image of the thread. The circuit is balanced when the axes of the photodetector and the filament shadow coincide. When the thickness of the filament fluctuates, the width of the shadow changes proportionally, changing the current in the output circuit of the transformer.

The device, developed at the Scientific and Technical Center of the Textile Industry of Belgium, has a current as a light source, and changes in its cross-sectional area are recorded. The length of the measuring zone is approximately 3 mm. The range of measured thicknesses is from 10 to 100 tex. The thread pulling speed can be smoothly changed in the range from 10 to 100 m/min.

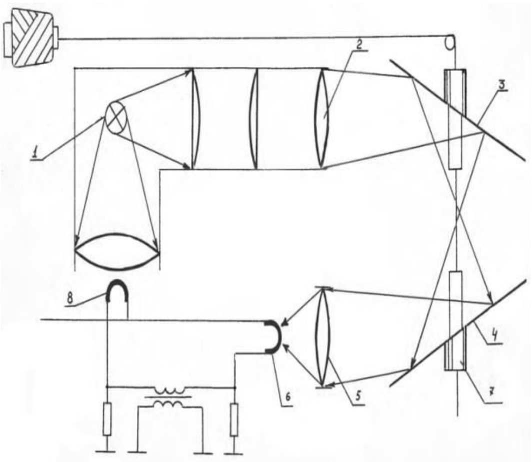

Fig. 1. Block diagram of the optoelectronic part of the EOPPP-1 device of the TsNIHBI System.
1-illuminator, 2-photo lens, 3,4-mirror, 5-lens, 6-photocell, 7-guide tube, 8-support photocell.

The device consists of a power supply unit, a measurement unit and a counter, placed on a special mobile table. The light from the lamp 1 (Fig. 1), having passed through the photo lens 2, is reflected from the mirror 3, is focused, and then, diverging, is reflected from the second mirror 4 and is focused by the lens 5 on the working photocell 6. The thread passes inside the light cones, being held at a point convergence with special tubes 7. The area near the convergence point is the measurement area. To exclude the influence of the instability of the luminous flux, the reference photocell 8 illuminated by the same lamp is connected to the working photocell by a bridge circuit. The bridge is powered from a 10 kHz sine wave generator. Before starting work, the light fluxes of the photocells are compensated. When the luminous flux changes due to fluctuations in the thickness of the yarn, the illumination of the working photocell changes and, consequently, the balancing of the bridge. After amplification, the imbalance signal is fed to the threshold circuit, which detects the change in the signal as a result of a defect. From the threshold circuit, after conversion, the signal enters the counter with a capacity of 10^4 units. According to the readings of the microammeter, you can control the correctness of the setting and the operation of the device. The automation system monitors changes in the thickness unevenness of the yarn over an extended area. An automatic engine stop is provided after checking a given number of yarn meters.

The automated yarn flaw discriminator ADPP-Z, developed at TsNIHBI, is based on the same optical-volumetric measurement method, but it makes it possible to register three types of defects: refinement less than 60 and thickening more than 150 and more than 200 of the average diameter [5].

Numerous methods developed so far have only been carried out under laboratory conditions. Their bulkiness, inertia, complexity and high error allow them to be widely used for the automation of production processes [6].

In order to automate the control and regulation of the linear density of cotton tape, we have developed an optoelectronic device for monitoring and regulation of the linear density of cotton tape. A block diagram of this device is shown in the figure. The device contains: master oscillator - 1, electronic key - 2, emitting diode - 3, controlled object - 4, photodetector - 5, bipolar threshold device 6, indicator of lower density - 7, indicator of higher density - 8, electromagnetic relay of lower density - 9 , electromagnetic relay of higher density - 10 and reversible motor - 11 [7].

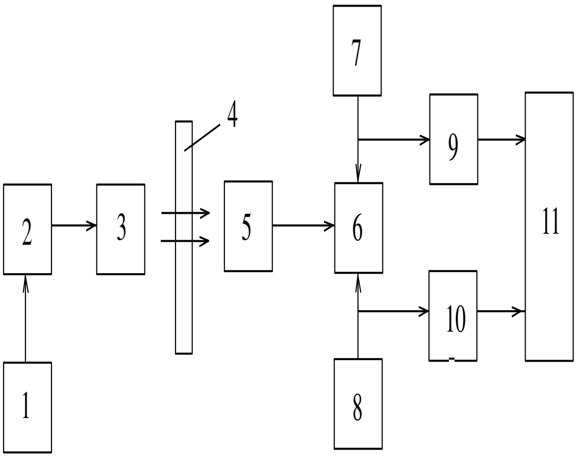

Fig. 2. Block diagram of an optoelectronic device for monitoring and regulating the linear density of cotton tape.

The device works as follows. The master generator generates rectangular pulses with a repetition rate f = 10 kHz, which are fed through an electronic switch to the emitting diode. The radiation flux of the emitting diode passes through the controlled object and is received by the photodetector, the photoelectric signal from the photodetector output is fed to the input of the bipolar threshold device, which forms a positive or negative pulse by the value of the photoelectric signal amplitude.

If the density of the cotton tape is higher than the nominal, a positive pulse is formed at the output of the bipolar threshold device (applied to the indicator of higher density and the electromagnetic relay), under the influence of which the reversible motor rotates in one direction; if the density of the tape is lower than the nominal, the reversible motor rotates in the other direction. Then the cycle is repeated.

Thus, control and regulation of the linear density of the cotton tape is carried out during the technological process.

One of the main units of the optoelectronic primary converter of the linear density of the cotton tape is the mechanical unit of the sensor in which the LED and the photodetector are installed.

The linear density of the cotton tape is the mass per unit volume and is determined by the expression.

$$\delta = \frac{m_0}{V} \qquad 1$$

where: m_0 is the mass of a cotton ribbon with a volume V.

It can be seen from this that to ensure the measurement of linear density, the cotton tape must pass through a certain calibration volume V. Equation (1) through the cross-sectional area of the cotton tape is written in the form:

$$\delta = \frac{m_0}{S_л \cdot l_л} \qquad 2$$

where $l_л$ is the length of the cotton ribbon.

In the technological process, for the formation of a cotton tape from a cotton canvas, a calibration funnel is used, the structural view of which is shown in Fig. 3.

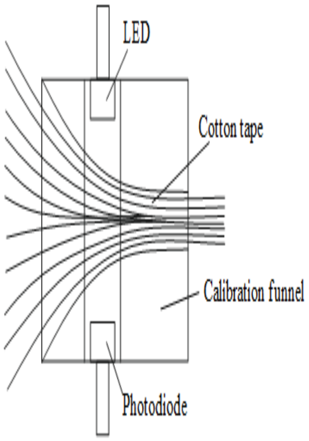

Fig.3. Design view of the sizing funnel for the formation of cotton tape from cotton canvas.

If the LED and photodiode are installed directly in the calibration funnel, then equation (2) can be rewritten as

$$\delta = \frac{m_0}{2\pi Dl} \qquad 3$$

where: D is the diameter of the funnel calibration channel.

Let us assume that d is the diameter of the optical channel in which the LED and PD are installed. Then, if D = d and l is constant, then equation (3) will take the form:

$$\delta = K_1 m_0 \qquad 4$$

i.e. the linear density of the cotton tape in the channel of the calibration funnel is proportional to the mass of the cotton tape, where

$K_1 = \frac{1}{2\pi Dl}$ – constant magnitude

To cover the diameter of the cotton tape with the radiation flux Φ, the distance between the cotton tape and the LED must be

$$L = D\left(\frac{1}{tg\psi} + 1\right) \qquad 5$$

where: 2ψ - front aperture angle of the optical channel of the sensor.

The transmitted radiation flux through the controlled object is determined according to the Bouguer-Lambert-Beer law as

$$\Phi = \Phi_0 e^{-K_2 m} \qquad 6$$

where: K_2 - coefficient of attenuation of the cotton tape;

m - is the mass of the cotton tape in the channel of the calibration funnel.

Based on equation (4), one can write

$$\Phi = \Phi_0 e^{-K_2 K_1 m} \qquad 7$$

or

$$\Phi = \Phi_0 e^{-K\delta} \qquad 8$$

where

$K = \frac{K_1}{K_2}$– constant magnitude

From equation (8) it can be seen that the transmitted radiation flux through the cotton tape is proportional to its linear density.

REFERENCES

[1]. Plant development new. The Detezomat. Man – made Textiles – 1960. – v36.

[2]. Electronic inspection of yarn. Textile Manufacturer. 1961. v87. №1037.

[3]. Электрический прибор для автоматического обнаружения и пдц-счета пороков нитей. Бессонов А.А.- Известия ВУЗ, - Приборостроение. 1962. т.5 . № I. с.9-15.

[4]. New instruments for counting slubs in jute yarns. Banerjee B.L. – Textile Manufacturer – 1962. v88. №1052-p.354-358.

[5]. Автоматизированный дискриминатор пороков пряжи АДПП-3. Егоров Ю.М., Львов В.А. Сб.работ ЦНИХБИ - 1971 г. - М.: 1973, - ч. 1.

[6]. Карих Е.Д. Оптоэлектроника. Минск. БГУ, 2002 г.

[7]. Ю. Мамасадиков, Э. Алихонов. Фотоэлектрические методы для автоматического контроля линейной плотности хлопковые ленты. Международной конференции «Оптические и фотоэлектрические явления в полупроводниковых микро- и наноструктурах». Часть II. Фергана, 13-14 ноября 2020, Ферганский политехнический институт, с 32-35.