

DEVICE FOR CONTROL OF RAW SILK THICKNESS BASED ON OPTOELECTRONIC GENERATOR

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Abstract

The quality of products in the silk industry largely depends on the technological parameters of unwinding silkworm cocoons [1].

The produced cocoons are processed into raw silk by unwinding them in different ways, for example, on cocoon-winding machines using the method of immersing the cocoons, or on mechanical cocoon-winding machines using the method of floating the cocoons. Single cocoon thread is not used in industry, since the thread from which the cocoon is made is too thin and not strong enough to break. Therefore, during the unwinding process, threads from 5-8 cocoons are folded to obtain raw silk with the required strength and thickness, which are the main technological parameters of the unwinding process.

It is known that at present the thickness of raw silk is controlled by mechanical and electrical methods, which makes it difficult to automate the process of unwinding cocoons. One of the methods for controlling the thickness of raw silk that meets all the requirements of silk fabric production is the optoelectronic method.

Based on an optoelectronic generator, we have developed a device for monitoring the thickness of raw silk during the technological process, the block diagram of which is shown in Fig. 1. It contains an optoelectronic generator *OEG*, built on transistor switches *EK1* and *EK2*, an inverter, a pulse generator, filling the *PGF*, a matching circuit for the *CD*, a *CN* counter and an *IN* indicator.

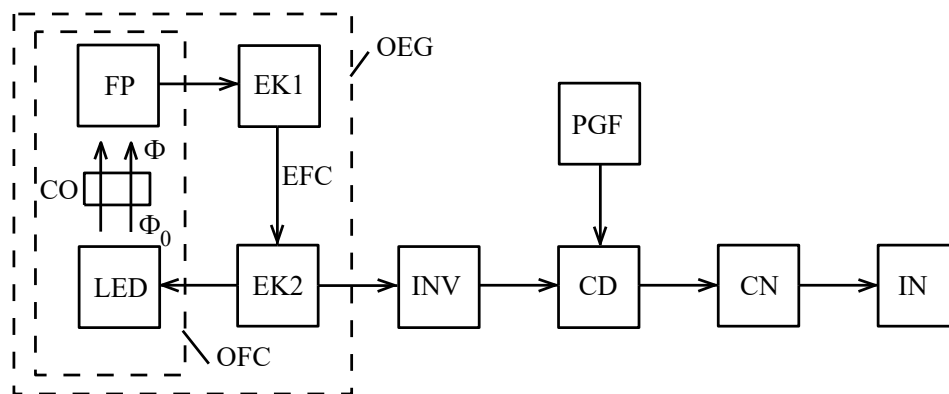


Fig.1. Block diagram of a device for monitoring the thickness of raw silk based on an optoelectronic generator.

The operating principle of the optoelectronic generator is illustrated by a block diagram and timing diagram shown in Fig. 1 and Fig. 2, respectively. Where: *EK1* - electronic key with a stable closed position; *EK2* - electronic key with a stable open position; *OFC* - optical feedback channel; *EFC* is an electrical feedback circuit. The optical feedback channel of the *OOS* consists of an emitting diode *LED* and a photodetector *FP*, optically connected through the controlled object *CO*.

The optoelectronic generator works as follows. When the *EK2* key is unlocked (see Fig. 1), the emitting diode *LED* begins to emit a constant flow of F_0 due to the direct current flowing through it. In this case, under the influence of the flow Φ passing through the controlled object *KO*, the conductivity of the photodetector *FP*

gradually increases, and the current $I_{\phi 1}$ passing through it increases (see Fig. 2) at a rate depending on the time constant of the photodetector and the magnitude of the flux Φ .

At the moment of time t_1 , when the photocurrent flowing in the photodetector circuit of the *FP* reaches the level I_{unl} (see Fig. 2), the key-*EK1* is unlocked, which leads to the receipt of a signal through the electrical feedback circuit-*EF* to the input of the key-*EK2*, which locks this key.

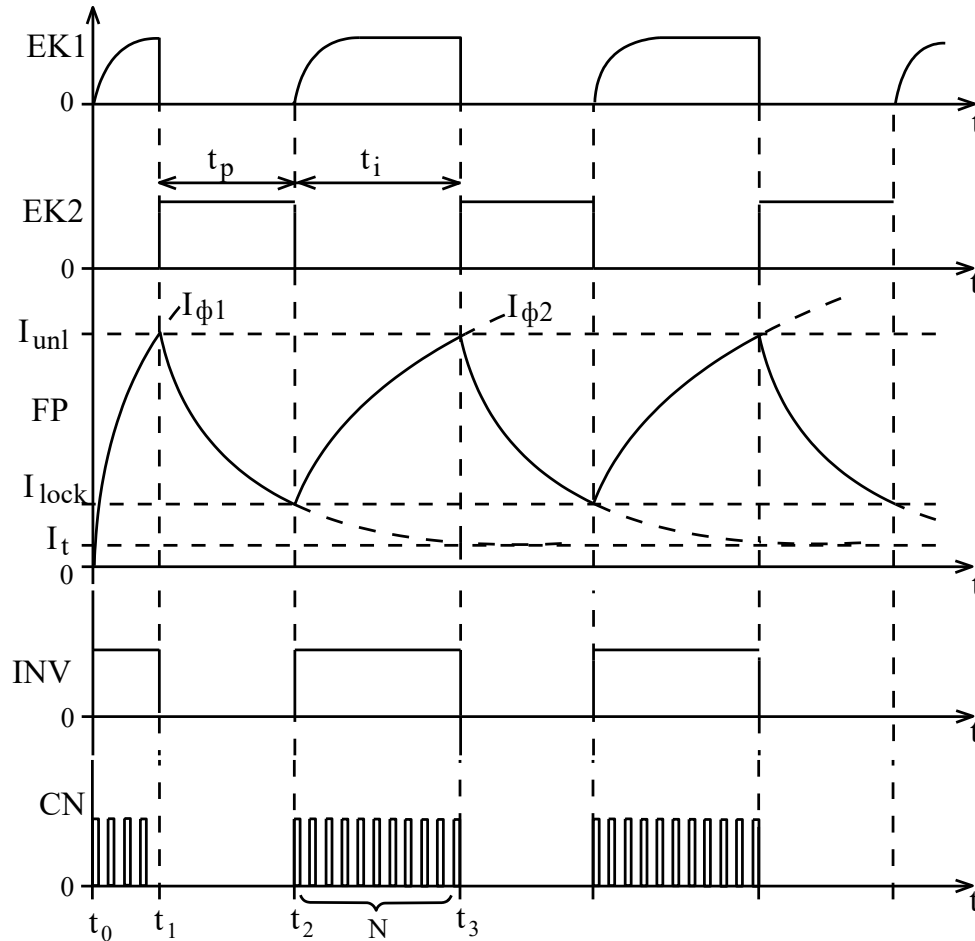


Fig.2. Timing diagrams of the operation of a device for monitoring the thickness of raw silk based on an optoelectronic generator.

Since the key-*EK2* is unlocked only when $U > U_{unl}$, and when the key-*EK1* is unlocked, $U < U_{unl}$, then at the moment t_1 , the key-*EK2* is locked, the emitting diode goes out and the photocurrent flowing through the photodetector-*PD* begins to gradually decrease (see. Fig.2).

At moment t_2 , when the photocurrent I_{ph1} flowing through the photodetector, decreasing, reaches the level I_{lock} (see Fig. 2), the switch-*EK1* is locked, the voltage supplied through the feedback circuit-*EFC* to the input of the key *EK2* reaches the level $U > U_{unl}$, the switch- *EK2* is unlocked and the operating mode of the entire circuit, which took place immediately before time t_1 , is restored.

At time t_3 , the current in the photodetector circuit again reaches the value I_{unl} and all the same processes that took place starting from moment t_1 are repeated in the circuit. Thus, shown in Fig.1 circuit operates as a pulse generator with a repetition period equal to $T = t_3 - t_1 = t_u + t_n$.

When a controlled object passes between the photodetector and the emitting diode, depending on the thickness of the *CO*, the flux acting on the photodetector is weakened and the rate of increase in the photodetector's photocurrent, that is, $I_{\phi 1} > I_{\phi 2}$, which leads to an increase in the pulse duration t_u [2].

Thus, a rectangular pulse is formed at the output of the optoelectronic generator, the duration of which is proportional to the thickness of the controlled object.

Formed at the output of the optoelectronic generator, rectangular pulses are sent through the INV inverter to one of the inputs of the SHC coincidence circuit and to the other - from the output of the FPG filling pulse generator. The repetition rate of the latter is 100 times greater than the maximum frequency of the optoelectronic generator. Therefore, at the output of the SHC coincidence circuit, a sequence of packets of rectangular pulses is formed. In this case, the number N of pulses in a packet is proportional to the duration of the output pulse of the optoelectronic generator [3].

The generated pulse trains are fed to the input of the midrange CN counter. The number of pulses N recorded in the counter is displayed by the IN indicator. The thickness of the raw silk is determined by the indicator readings.

The use of this device in the silk industry will allow automatic control of the thickness of raw silk during the technological process. In addition, the inclusion of this device as part of a closed system makes it possible to automatically regulate the thickness of raw silk [4]. As a result, uniform thickness of raw silk is ensured along its entire length.

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