DETERMINATION OF THE THREAD TENSION ON THE WEAVING LOOM

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https://doi.org/10.5281/zenodo.10435176

ARTICLE INFO
Qabul qilindi: 20-December 2023 yil
Ma'qullandi: 24- December 2023 yil
Nashr qilindi: 27- December 2023 yil
KEY WORDS
warp thread, fabric, tension, weaving, strain gauge, shed, loom, device.

ABSTRACT
This article describes the effect of warp thread tension on the weaving process and the quality of the manufactured products. There is also a description of the operations of the weaving machine where it is necessary to control the tension of the warp threads so that these processes take place without any problems. The article describes devices for measuring the tension of both single threads and groups of threads, as well as for fabrics. The operating principle of these devices is described and an analysis of the effectiveness of these devices is carried out by taking into account their advantages and disadvantages.

In order for the technological process of fabric production to take place in accordance with established requirements, the yarn must have a certain tension, that is, the system of warp threads must be provided with the necessary tension with minimal cyclic deformation. During the process of shedding in the weaving, the length of the warp thread increases, and therefore its tension increases.

The degree of increase in thread tension depends on the size of the shed, that is, on the height and length of the front and back parts of the shed. [1, 2]

Warp thread tension is one of the main indicators of the weaving machine, which must be ensured during the following phases of shedding on the weaving machine:

shedding, filling insertion, beatup, let-off, and take-up.

- Spade phase - the warp threads occupy the middle level.
- The shed opening phase - part of the warp threads moves upward, and some moves downward from the middle level to form the shed.
- The holding phase - is holding the jaw open to ensure unhindered passage of the weft.
- The shed closing phase - the warp threads move in the opposite direction and occupy the middle level, that is, they return to the spade phase.

Deviation of the tension force of the warp threads on a weaving loom from the optimal one sometimes leads to a disruption in the process of fabric formation, a change in its structure, and an increase in the breakage

of the warp threads, which leads to a decrease in the productivity of the weaving loom.

In textile production, after the fibrous material begins to have sufficient strength, the task is to regulate its tension. For example, control of the tension of fibrous material occurs in spinning, weaving and finishing industries. [4]

The choice of methodology and devices for measuring and monitoring tension depends on the duration of the measurement, the properties and characteristics of the measurement object. Most tensile force measuring devices can be divided into classes and groups. The most widely used class of devices is those that use a universal method for assessing tension force. This method consists in the fact that the object under study bends around the thread conductors and the sensitive element. The pressing force exerted by the object on the sensitive element is the tension force. [5]

Instruments of this class are divided into five groups:

1. According to purpose:
- for measuring the tension of single threads;
- for measuring the tension of groups of threads;
- to compare thread tension.
2. According to the method of obtaining evidence:
- with direct calculation and determination of the average, maximum and minimum values, as well as standard deviation, etc.;
- registering indications.
3. According to the operating principle:
- Mechanical. Devices of this type have the following disadvantages: lack of recording of the process under study; lack of recording of distorted short-term fluctuations; method of fixing the object under study;
- Mechanical-optical. The advantages of this type of device are its simplicity and the ability to record dynamic thread tension. As for the disadvantages, they are insensitive and only single threads are recorded;
- Electrical with active resistance converters (measurement is carried out using electrical strain gauges). The advantages of this type of device are: low inertness and high sensitivity. Difficulty in operation is a disadvantage of this type of device;
- Electromechanical;
- Pneumatic;
- Hydraulic.
4. According to the number of thread guides:
- with one thread guide;
- with two thread guides;
- with three thread guides.
5. By type of thread guides:
- with rotating thread guides;
- with fixed thread guides.

Since the weaving industry uses thread systems and tension control must be carried out for all threads or for a group of threads at the same time, it is more expedient to use tension measuring devices that allow you to determine the tension of several threads at the same

time.

The device for measuring the tension of a group of threads is presented in Figure 1a. This device consists of thread guide rollers 1 made of light alloy and an elastic element (beam) 2, onto which the converter 1 is glued. The elastic element is selected according to the load and dimensions of the rollers. With such a device, you can usually measure the tension of 40-60 threads. [6]

Another type of device is shown in Figure 1b, c. There are two types of this device:

1. movable;
2. immovable.

The movable version is a plate (elastic element) 5, bent at the ends at a right angle. Wire strain gauges are glued on both planes of the plate, and the leads from them are fixed to terminals 6, mounted in panel 7, which is attached to the plate. The panel and gaskets are made of insulating material. Warp threads 8 in the amount of 20-30 pieces are suspended with the help of bracket 4 and rest on the curved ends of plate 5. During operation of the loom, the device moves along with the warp threads, thereby measuring the tension as they move at different points on the loom.

The immovable version of the device is a system of three rollers 9 mounted in a plate 10. Using flexible connections, the device is fixed above the base in a stationary state. The wire sensor leads are connected to the adjacent arms of the measuring bridge.

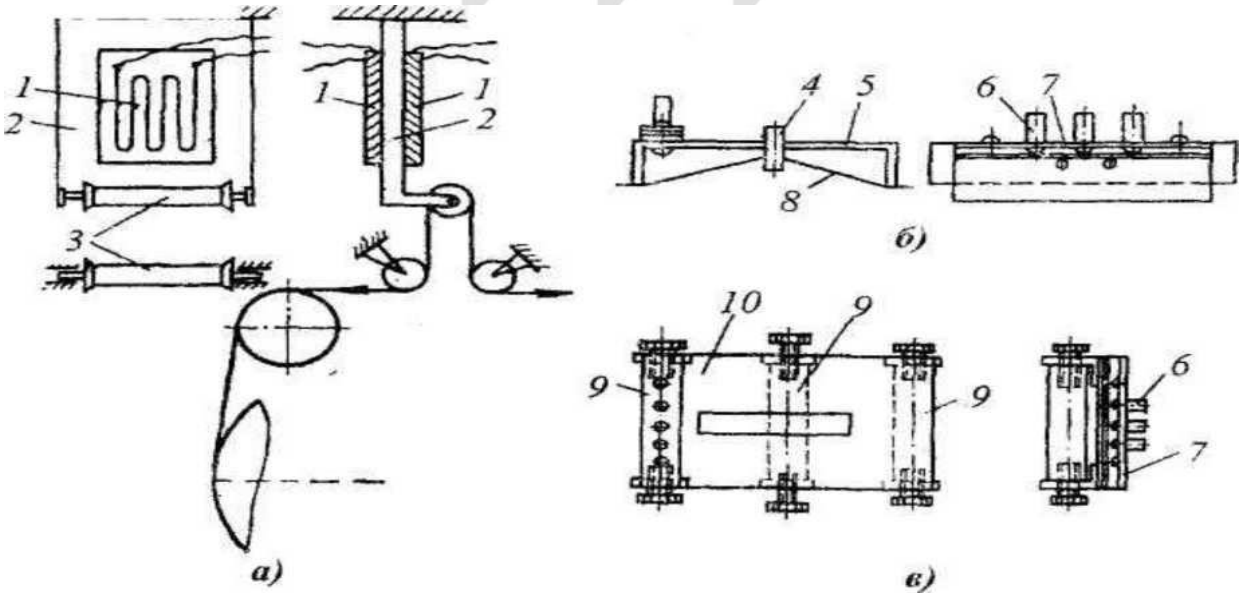

Fig 1 - Diagrams of wire strain gauges for measuring the tension of a group of main threads

In weaving factories, to produce quality products, it is necessary to control not only the tension of the warp threads, but also the tension of the fabric. To measure fabric tension, the following sensor design is used. The design of the sensor for measuring the tension of the fabric during the weaving process is similar to the design of the strain gauge for measuring the tension of the warp threads. The difference between the design and the first is the presence of needles at the ends of the elastic element (beam), which are intended for attaching the beam to the fabric. [7]

The tension of the fabric on the loom is also determined using ultrasonic tension transducers, which are mainly designed to determine the tension of the straightened fabric passing in the area between two guide rollers.

Table 1

Main characteristics of tension measuring devices

Characteristics	Values
Tension ranges	from 367 cN to 3732 cN
Permissible tension force measurement values	10 %;
Measurement frequency	1000 Hz
Voltage	220 V 50 Hz
Current power	no more than 1.5 W
Power supply for the electronic unit	2 pcs. lithium-ion batteries with a capacity of 750 mAh 2 x 3.6 V or from external 9V DC adapter;
Distances from sensor to block	3m;
Indicator type	20-digit single line text LCD display
Number of sensors	2 (tension sensor, Hall sensor)
Dimensions of the electronic unit	90 x 90 x 55 mm
Weight of the electronic unit	285g;
Tension sensor dimensions	62 x 50 x 25 mm;
Tension sensor weight	60 g.
Terms of Use:	
Temperature Range	from -10°C to +35°C
Relative humidity	1 to 90 percent (no condensation).

The principle of determining tension is based on the effect of resonant oscillations, which on a section of fabric fixed by guide rollers are a function of its tension. Ultrasonic transducers include:

1. ultrasound emitter (piezoelectric, magnetostrictive) aimed at the tissue;
2. receiver of ultrasonic waves reflected from tissue.

The use of a non-contact measurement method is an advantage of ultrasonic transducers, while the dependence of measurement results on the density and structure of the tissue can be considered a disadvantage.

Conclusion

Determining and controlling the tension of warp threads and fabric is one of the main indicators of a weaving machine. Based on the above, we come to the conclusion that control of the tension of the warp threads and fabric is a necessary operation in the weaving process. Also, modernization and improvement of tension sensors for warp and fabric threads in order to improve measurement accuracy is a primary task in weaving production. Since the currently known devices for measuring tension do not provide results with high accuracy and most of them are not digitized, that is, they do not have support and synchronization with modern computers.

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