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STUDY OF A TORSION TRIANGLE BASED ON THE IMPROVEMENT OF A RING-CHAIN-BEATER

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Abstract. The article analyzes the works devoted to the study of the influence of the cooking triangle on the properties and structure of yarns produced on a ring-spinning machine. Based on the results of the analysis, the technology was improved using a new device. The improved technology was tested under production conditions and the properties of the manufactured knitting yarn were analyzed.

Basic words and phrases. Spinning, twist, ring, yarn, cooking triangle, knitting, thread, arc of coverage, stretching tool, construction.

85% of the world's yarn volume is produced by ring spinning. Threads spun in other ways are also being used instead [1]. However, still there is research being conducted by most textile machinery manufacturers to improve ring-spinning machines to produce a wide range of products.

Depending on the construction of the spinning machine, the parts for forming the fiber layer and twisting it are different. In ring spinning machines, the twist is between the roller and the stretching device pair (cylinder and roller), which is driven by the roller, and in the pneumomechanical spinning machines used in many production enterprises today, it occurs between the cam and the pulling pair due to the rotation of the cam.

In ring spinning machines, the productivity depends mainly on the spinning speed. Due to its rotation, the thread is formed and twisted, and the thread is wound into tubes. As a result of the research carried out by the authors, they determined that the quality indicators of the yarn, that is, the properties of the yarn, change in a negative direction as a result of the speed of spinning [2].

Today, a lot of research is being done to improve the construction of the ring-spinning machine, to ensure the quality of the obtained product, and to increase the productivity of the machine. In particular, research is being conducted to control the tension in thread formation, which is the main reason for thread breakage, to improve the construction of the stretching device, to form a thread with less twist and meet the standard requirements for hardness, i.e. to change the thread structure, to reduce the twist triangle, i.e., the angle of coverage of the fiber layer in the area of the stretching pair release.

In ring spinning machines, it is known that the stretching process has been improved in order to improve yarn quality [3]. In these machines, new devices have been created and the parameters of the baking triangle have been reduced. It is emphasized that as a result of minimizing the mass of the heart and the diameter of the ring, it is necessary to increase the frequency of heart cycles. It was proved that in order to increase the productivity of the ring spinning machine, it is necessary to

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reduce the height of the cylinder, the optimal diameter of the ring is 45 mm, and to increase the frequency of spinning [4].

As far as possible, the tensioning pair (roller and roller) of the threading thread should be as close to the fiber compression line as possible, but should not reach the line. Because the fibers must be straightened and wrapped together after leaving the stretching pair. The twist moves up until the angle of location of the fibers in the yarn is not equal to the angle of the cooking triangle (Figures 1-2).

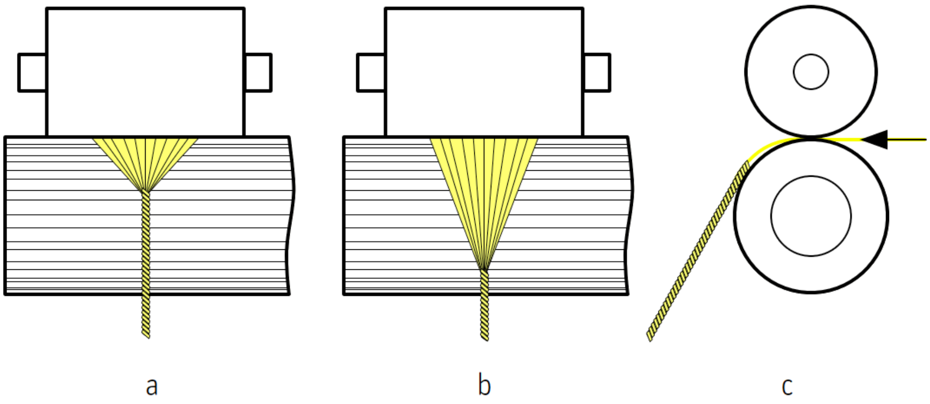

Figure 1. Short (a) and long (b) baking triangle, (s) side view

Because of this, the fibers from the stretching pair emerge as a tuft in a triangular shape, and this is called a cooking triangle. Of course, mainly breaks occur at this weak point, because the thread tension from the cylinder can reach unimpeded stretching torque, and the twist in the cooking triangle is zero [5].

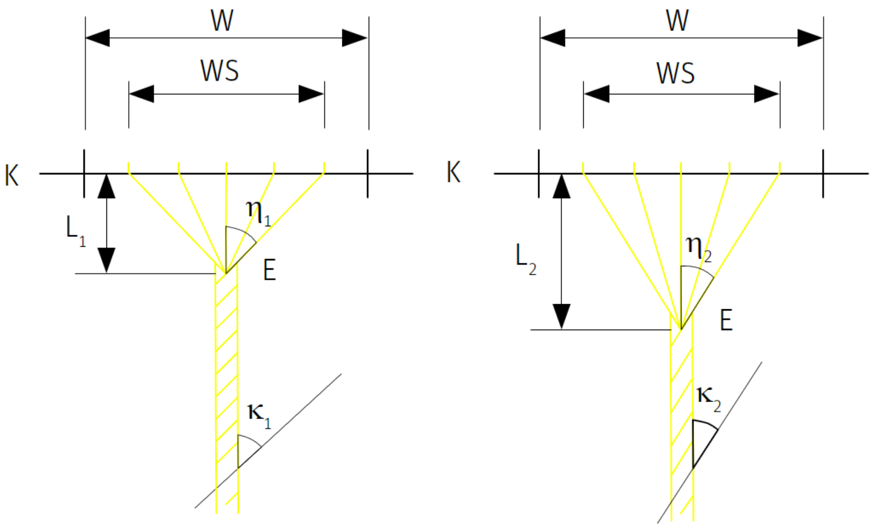

Figure 2. The effect of the cooking triangle on the twist

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The formation of the thread occurs in the cooking triangle and determines the structure of the thread. If the yarn is of high quality, low hairiness, fibers in the yarn for stretch ability: - the right direction; - evenly distributed along the length and cross-section; - spiral winding around the thread axis; - the fibers must all be connected by tension.

Of all the existing spinning methods, all of the above requirements are satisfied by the ring spinning method, and especially the last important conditions. However, this is true for the case where the optimum baking triangle and spinning geometry are good. The twist given to the thread will be insufficient due to the uneven distribution of the tension force, and the negative effect will increase. The structural structure of the thread will not be optimal, and due to this, most of the quality indicators of the thread will deteriorate.

Therefore, the twist triangle needs to be investigated as a factor that directly affects the productivity and efficiency of the machine, along with the formation and properties of the thread.

The author studied the twist triangle (Fig. 3) and the issue of reducing the height of the twist triangle (Fig. 3) by placing an additional device on the stretching device (Fig. 4) was studied theoretically and practically [6].

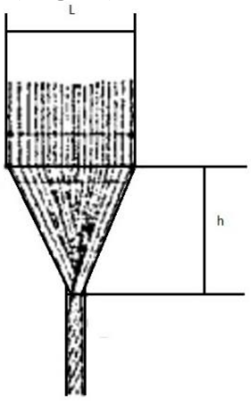
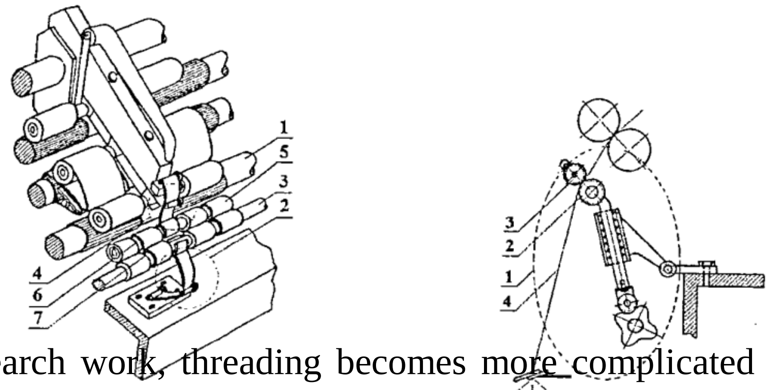


Figure 3. Derivation of the spiral triangle

Figure 4. The developed drawing scheme: a-improved stretching tool, b-fibrous layer release device



In this research work, threading becomes more complicated when the thread breaks or when the tube is full, and when the thread is renewed. Based on the above, preliminary studies were conducted on the production of yarns with the above properties by changing the structure of the ring spinning machine, placing an additional device after the stretching device.

Initially, based on the analysis of the cooking triangle, it is necessary to make an additional device without structural changes to the stretching tool (if additional rollers are installed on the stretching tool, the twist triangle will disappear and the structural structure of the thread will deteriorate in the analysis), while at the same time, it is possible to do this without major changes in the machine, that is, without spending a lot of money was studied.

By using an additional device after the ring spinning machine stretching device, the researchers aimed to reduce the twist triangle (in the working process), to make efficient use of the machine speed, to increase the yarn quality by reducing yarn breakage, and to expand the production possibilities of yarns with low twist and low linear density. Many scientists have researched and searched for ways to reduce the twist triangle in different ways. As mentioned above, the complexity of connecting when the thread breaks in these studies has hindered the generalization of the results of this study.

After initial experiments, technical and design work was carried out on the development of the exact design of the new device and its introduction into production. For this, first, the optimal place for the installation of the new device and its proper operation was determined, and the construction was prepared with the help of technical drawings (Fig. 5).

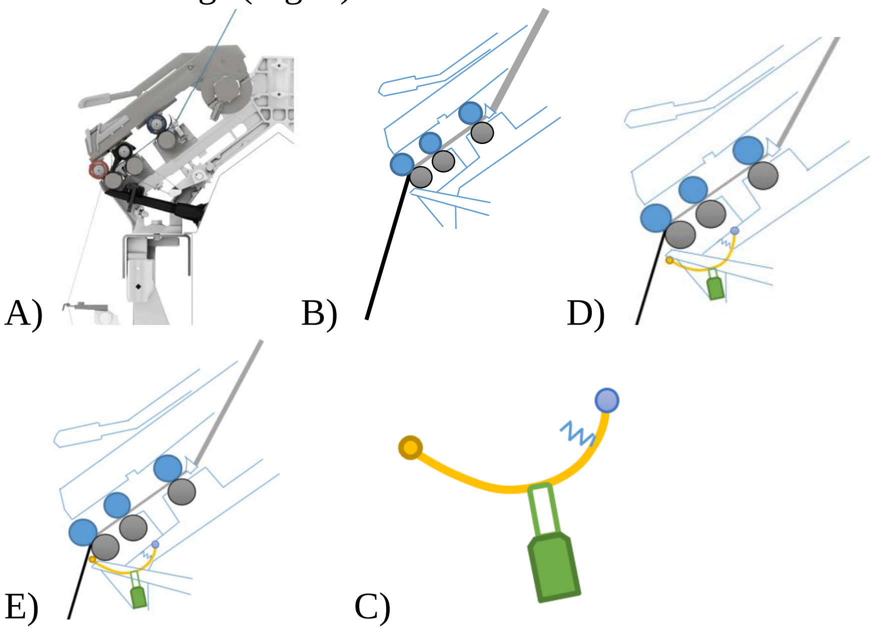
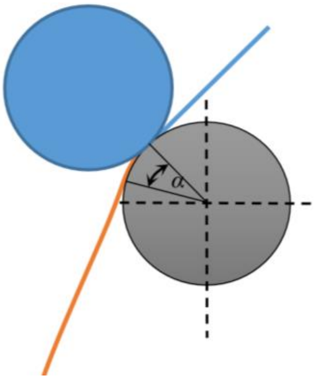


Figure 5. Place the new device based on the construction of the extension tool

To match the new device to the stretching tool (Fig. 5a), we drew its technological image (Fig. 5b). After that, based on the operation of the device, we found it necessary to raise and lower it with the help of a piston and to install a spring on the opposite side to ensure pressure (Fig. 5c). The picture shows the device in installed (Fig. 5d) and working condition (Fig. 5e).

An experimental plan was drawn up for conducting experiments on the ring spinning machine at the enterprise. According to it, it was planned to take the yarn produced at the enterprise as a control yarn and 4 experimental yarns.



A) B)

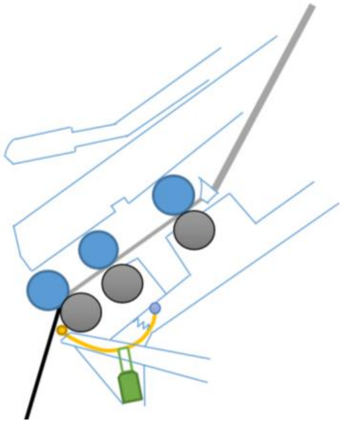


Figure 6. Controlling the cooking triangle with a new device

No change has been made to the control thread. In the experimental yarns, the exit angle of the yarns formed with the help of the device was reduced with respect to the heater, and as a result, the base of the baking triangle was reduced. That is, we reduce the coverage angle α of the fiber layer (Fig. 6a). To do this, we raise the thread being formed by lifting the piston on the device.

The experiments were carried out on the CSM 1124 ring spinning machine installed at the "Namangan Tokmachi" LLC enterprise (Fig. 7). The machine is currently producing knitting yarns of the number Ne 30/1. Initially, experiments were conducted based on the plan to determine the optimal coverage angle of the experiment. In the experiment, the spindle rotation speed, the linear density of the thread and the number of twists were carried out without changing the parameters of the production at the enterprise.

Figure 7. Conducting experiments using the device on a CSM 1124 ring spinning machine under production conditions at the enterprise

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During the experiments, the machine was adjusted and cleaned, and then the yarn was spun. The machine was monitored by working operators for one shift, i.e. 8 hours, and based on these, experimental results were obtained. The properties of the spun yarns were determined in the laboratory equipment of the enterprise. We will analyze the obtained results. To make it easier to analyze the indicators, we can bring them to the form of a histogram and a graph (Figure 8-11).

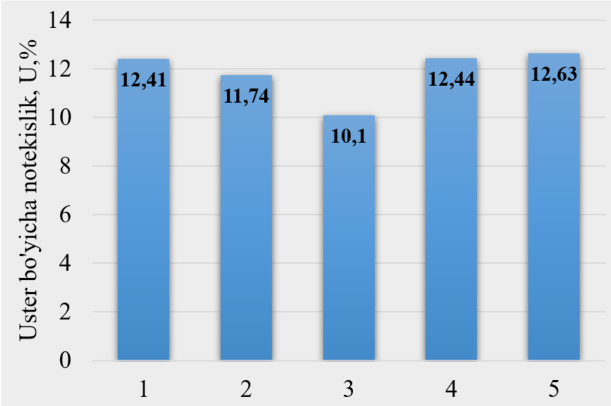

Figure 8

1- Control yarn, 2- Experimental yarn-1, 3- Experimental yarn-2, 4- Experimental yarn-3, 5- Experimental yarn-4 (Table 3.2)

It can be seen from the above histogram (Figure 8) that the reduction of the coverage arc does not produce a straight line relationship with the unevenness of the thread according to Uster. That is, when the coverage arc starts to decrease from 380 available on the factory machine, we can see that the Uster unevenness of the yarn decreases by 5% at 360 and 19% at 340, and increases by 1% at 320 and 2% at 300. In this case it was observed that the unevenness of the produced yarn according to Uster had a good performance in Experimental yarn-2.

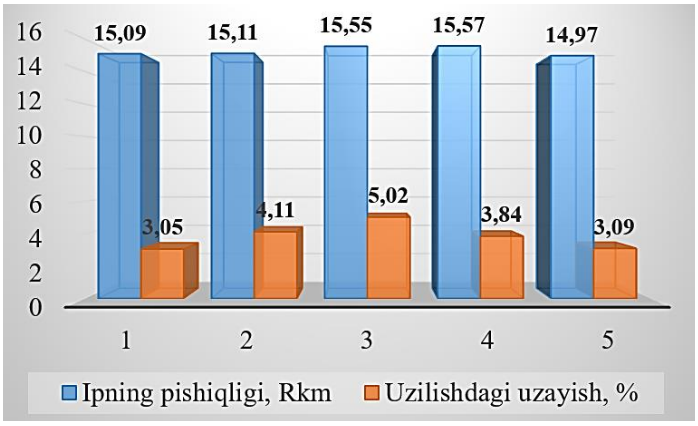

Figure 9. Histogram of hardness (blue) and elongation at break of yarns (orange)

The effect of the cooking triangle on the hardness and elongation at break of the threads is presented in a histogram (Fig. 9). It can be seen from the histogram that the thread has the highest toughness when the coverage arc is 320, however, the elongation at break of the thread was observed to decrease. In this case, it was

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observed that the Experimental yarn-2 had the best performance, the hardness of the yarn increased by 3% and the elongation at break increased by 40% compared to the existing machine. The lowest value was observed in Experimental thread-4, and even then, the elongation at break was higher than that of the control thread.

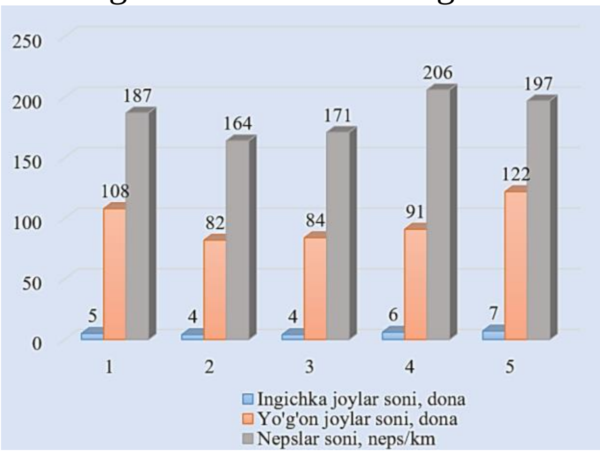

Figure 10. Histogram of the number of defects in the thread

In the histogram of the plant, the number of thread defects is studied (Figure 10), and we can see the variation of thread defects, thin and thick areas. In this case, the indicators that caused constant discussion by scientists were also observed in our study. In this case, the number of neps decreases and increases. Thick and thin areas can be associated with the number of thread breaks, but dramatic changes in the number of neps are the cause of ongoing discussion and in-depth research.

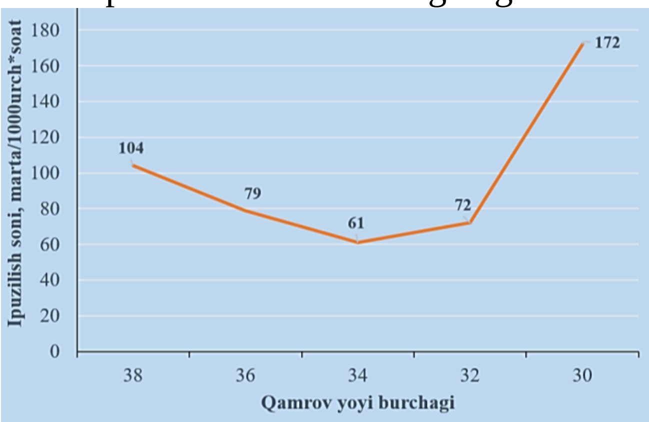

Figure 11. The graph of dependence of the arc angle of the cylinder coverage of the fibrous layer on the number of thread breaks

The graph above (Figure 11) shows the size of the cooking triangle in a ring spinning machine as a function of the number of yarn breaks.

In this case, we can see that in 3 cases compared to the control yarn: Experimental yarn-1, Experimental yarn-2 and Experimental yarn-3, the number of breaks has decreased, and only in one case, Experimental yarn-4 has a sharp increase in the number of breaks. From the results obtained from the experiment in this case, Experimental thread-2, that is, when the angle of coverage of the fiber layer is 340, we have an alternative angle and arc of coverage for the thread being prepared.

So, theoretical studies were proven in practical experiments, that is, excessive shortening of the cooking triangle, regardless of the length of the fiber, will cause the tension to increase and the yarn to break.

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