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INVESTIGATION OF IRREGULARITY OF YARN PRODUCED IN AN IMPROVED DRAWN TOOL

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Abstract: All spinning products, from staple fiber to yarn, are uneven in both linear density and texture. The greater the unevenness, the worse the quality of the product. There are various reasons for unevenness. The impact area of unevenness is the contact length of the crushing roller with the surface of the yarn, which consists of cotton fibers of different thickness and unevenness. The design of an improved stretching tool for ring spinning machines is proposed and researched.

Keywords: fiber, stretching device, tension cylinder, crushing roller, rubber, double roller, belt, yarn break, unevenness, ring spinning machine.

Introduction. The unevenness of the fiber product in the stretching machine mainly occurs when the linear density of the product changes and uncontrolled fibers appear during stretching. The nature of fiber movement in the stretching area and the differential law of fiber length distribution in the product being thinned determine the type of thinning curve in the stretching tool. The influence of the nature of fiber movement on the type of thinning curve was studied by V.E. Zotikov, Z.S. Kovner, A.G. Sevostyanov, L.N. Ginzburg et al.

In all considered constructions of stretching tools and devices, the control of the movement of fibers is achieved by existing methods, for example, by installing additional belts, rollers, couplings, guides, trays, etc. A common disadvantage of this design is that by correcting one defect, they cause others to appear, for example, the design of the device becomes more complicated or maintenance becomes more difficult, etc.

When analyzing the structural unevenness along the length of the product, from all the properties of the fibers, the property of their distribution along the length stands out as the most important, controllable and in some cases regulated property for the technology. However, uniformity of product thickness does not guarantee uniformity of its structure. The same number of fibers in groups, for example, only short fibers can be collected in one, and only long fibers in the other, which accordingly affects the strength or unevenness of the product of this thickness, which also affects the subsequent stretching process.

It is known that the product entering the supply cylinder of the stretching device also has an unevenness in its linear density. Therefore, this shortcoming can be overcome and the compression line will be most stable with a cylinder with a smaller diameter and a roller with a harder elastic coating.

It is known that during the operation of the stretching tool, the stretching also changes with the change of the distance. Due to the cyclic stretching, unevenness appears in the yarn due to the increase in the radial kick of the tension cylinder and crushing roller. This kick can be expressed as oscillations of the compression line. However, the experience of using stretching tools shows that in some cases, the difference in the distance between two adjacent rollers, even if it reaches several millimeters, does not cause significant changes in the amount of stretching and unevenness. This contradiction can be explained as follows. If the change in spacing does not affect the entire flow of fibers, but only affects a group of them, what happens when the axes of the crusher roll deviate? As a result of the displacement of the fibers of this group, unevenness occurs due to stretching.

The above experimental studies have shown that the installation of a two-roller crushing roller on the output cylinder of the stretching device reduces the unevenness of the thread. Therefore, it can be assumed that a drawing tool incorporating these improvements should further reduce yarn unevenness. For this purpose, a two-roller crushing roller was installed on the output cylinder of the stretching device.

Methods. Yigiruv ishlab chiqarishida olib borilgan tadqiqotlari shuni ko'rsatadiki, halqali yigiruv mashinasida ip uzilishining 70 - 60%i cho’zish asbobining chiqish silindri ustidagi ipning qamrov yoyi zonasida sodir bo'ladi, ya'ni bu yerda ipning kuchi minimal bo’lib, u uzilishga moyildir.

Many scientists and various companies have carried out effective scientific research on yarns obtained by ring spinning machines, factors affecting its quality indicators, production techniques and technology, requirements for the production of spun yarns. . Recognizing that in recent years, thread production techniques and technology in leading textile machinery enterprises have been mainly carried out on the improvement of spinning machines, the possibilities of assortment of yarns spun on these machines, their physic-mechanical and quality indicators have been researched.

The conducted studies show that the quality of the thread deteriorates in the stretching area of the stretching tool. This is explained by the fact that it is impossible to provide full control over "floating" fibers in the stretching zone in existing stretching devices and it is impossible to automatically adjust the linear density of the product.

It follows that the main way to reduce thread breakage and improve product quality is to improve the stretching device of the ring spinning machine, in particular, to improve the fiber control in the stretching zone and to reduce the coverage arc of the fiber on the output cylinder.

Until recently, only ring spinning machines were used to spin yarn from cotton fiber. The creation of new spinning methods led to a reduction in the scope of using the ring method. However, the structure of the thread made by the ring method is unique, and it has not been possible to create it in any new way. For this reason, ring spinning retains its position in the spinning of medium and especially high numbers (thin) yarns.

When analyzing the structural unevenness along the length of the product, among all the properties of the fibers, the property of their distribution along the length stands out as the most important, controllable and in some cases regulated property for the technology. However, uniformity of product thickness does not guarantee uniformity of its structure. The same number of fibers in groups, for example, only short fibers can be collected in one, and only long fibers in the other, which will accordingly affect the strength or unevenness of the product of this thickness, which will also affect the subsequent stretching process. A literature review has shown that if the movement and amount of controlled and uncontrolled fibers are the same up to the compression line of the discharge cylinder, then product unevenness is reduced.

It is known that during the operation of the stretching tool, the stretching also changes with the change of the distance. Due to the cyclic stretching, unevenness appears in the yarn due to the increase in the radial kick of the tension cylinder and crushing roller. This kick can be expressed as oscillations of the compression line. However, the experience of using stretching tools shows that in some cases, the difference in the distance between two adjacent rollers, even if it reaches several millimeters, does not cause significant changes in the amount of stretching and unevenness. This contradiction can be explained as follows. If the change in spacing does not affect the entire flow of fibers, but only affects a group of them, what happens when the axes of the crusher roll deviate? As a result of displacement of the fibers of this group, unevenness appears due to stretching.

The full factorial experiment [1, 2] method was used to conduct the experiments (Fig. 1). The technological test of the construction of the developed stretching devices gave a good result. Therefore, on the basis of combining some of the parts discussed above, an improved construction of the stretching tool was developed. A 3D drawing of the planter was obtained and based on it, the planter was prepared. In this case, the diameter of the crushing roller was reduced from Ø28 to Ø17.5 mm, the cylinder remained in its original state. In this case, the roller was covered with 3825s rubber product, the hardness of which is 65-95 according to Shora A.

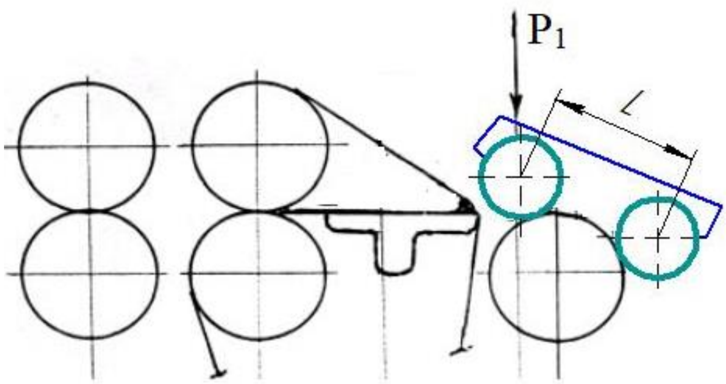

Figure 1. Schematic of an improved stretching tool

Loading is of great importance when stretching a product. It is known that if the load on the crushing roller is not enough, then the fiber starts to slip, or vice versa, if the load is more than enough, longer fibers can break [4]. Excessive load on the roller accelerates the wear of the tensioner parts and increases the deflection of the tension cylinder. This also has a negative impact on the quality of the manufactured product.

The impact area of unevenness is the contact length of the crushing roller with the surface of the yarn, which consists of cotton fibers of different thickness and unevenness. The leveling ability of the crushing roller has a great influence on the smooth movement of the thread between the pairs of the stretching device. It is known that the cylinders of the stretching tool are located at an angle to the horizontal. The fiber from the front pair of cylinders is directed to the yarn guide, where it forms a yarn coverage arc in the front cylinder. The larger the arc of coverage, the greater the length and number of fibers that cannot be heard, and the weaker it becomes.

Results. In order to improve the quality of the products produced by ring spinning machines, by reducing the uncontrolled fibers in the stretching zone, and to reduce the breakage of the fiber in the exit cylinder of the stretching device, a new construction of it was developed on the basis of the existing stretching devices.

Loading is of great importance when stretching a product. It is known that if the load on the crushing roller is insufficient, then the fiber starts to slip, or vice versa, if the load is too high, longer fibers can break. Excessive load on the roller accelerates the wear of the tensioner parts and increases the deflection of the tension cylinder. This also has a negative impact on the quality of the manufactured product.

The results of the experiment are processed in the same way as in work [1, 2] at the 95% confidence level.

Based on the obtained results, the following regression equations were obtained:

$$\text{25 tex: } \hat{Y} = 19{,}08 - 0{,}52X_1 - 0{,}262X_1X_2; \quad (1)$$

$$\text{28 tex: } \hat{Y} = 17{,}9 - 0{,}45X_1 - 0{,}5X_1X_2. \quad (2)$$

Discussion. From equations (1) and (2), which describe the unevenness of the product in the stretching device, the effect of the distance between the rollers on the two roller rollers is insignificant. Some other linear effects are not significant in these equations, but the effect of three factors is significant.

Checking the obtained equations according to Fisher's criterion is done as follows:

$$F = \frac{S^2_{\text{ад}}}{S^2_{\{y\}}}, \quad (3)$$

where $S^2_{\text{ад}}$ is the adequacy variance.

$S^2_{\text{ад}}$ - linear dispersion.

In our case, the table value of Fisher's criterion was equal to:

$$F = [\alpha = 95\%,\ f = N - n - 1 = 4] = 3{,}84.$$

Substituting the found variance values into equation (4), we get:

25 for tex: $F_{расч} = 2{,}0 \prec F_{таб}$.

28 for tex: $F_{расч} = 2{,}25 \prec F_{таб}$.

So, equations (1) and (2) can be considered adequate with a confidence level of 95%.

It is known that the non-priority position of the crushing shaft of the output cylinder of the stretching tool disrupts the stretching process. The design of the two-roller crushing roller that we have developed is of great priority. Therefore, we conducted experiments to determine the effect of the new design of the two-roller crushing roller on the unevenness of the yarn. The experiments were carried out in production conditions on ring spinning machines producing yarn with a linear density of 25 and 28 tex [5, 6].

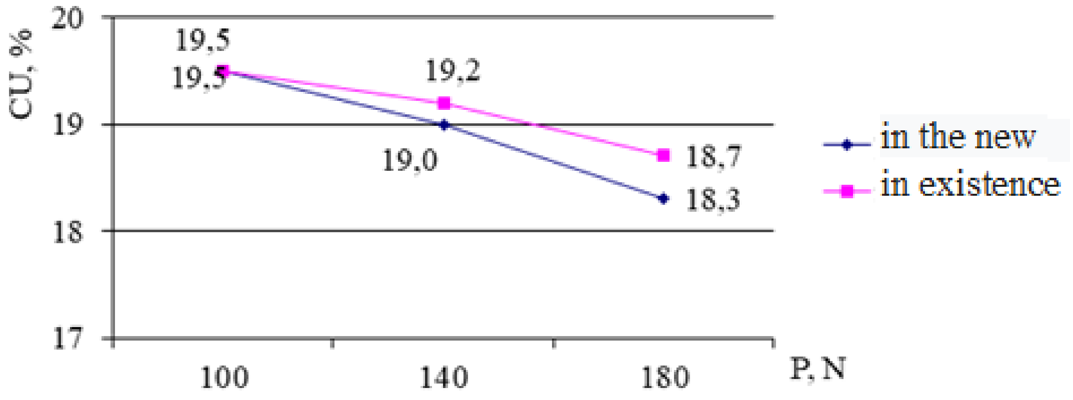

Figure 2. $l = 21mm$ obtained in constants

thread unevenness gradient (for a thread with a linear density of 25 tex).

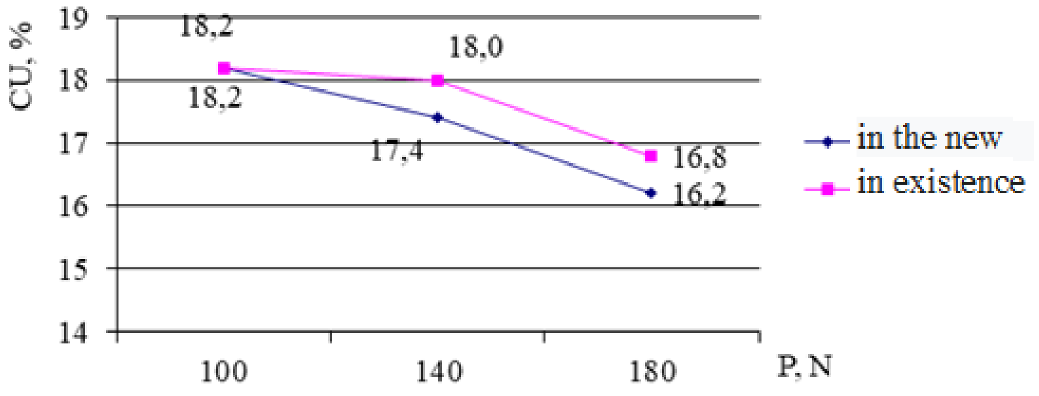

Figure 3. $l = 21mm$ obtained in constants

thread unevenness gradient (for a thread with a linear density of 28 tex).

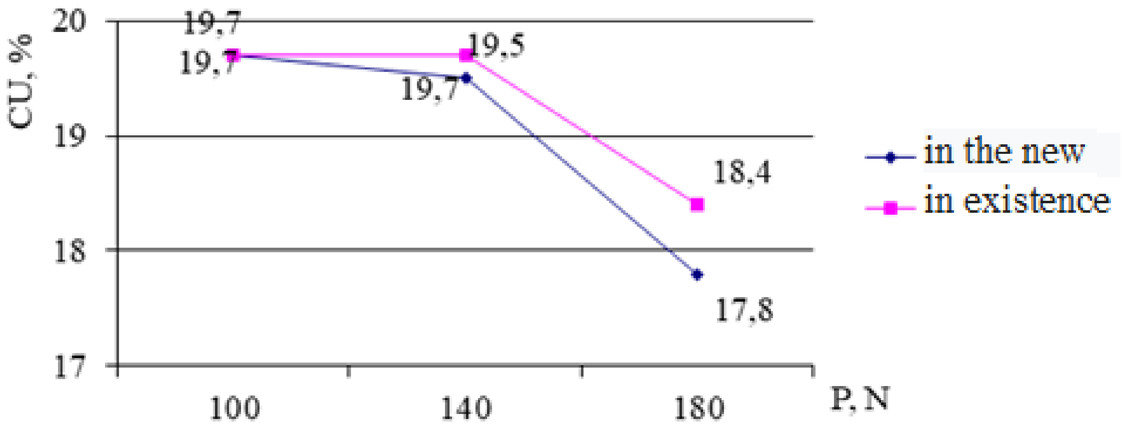

Figure 4. $l = 19mm$ obtained in constants

thread unevenness gradient (for a thread with a linear density of 25 tex).

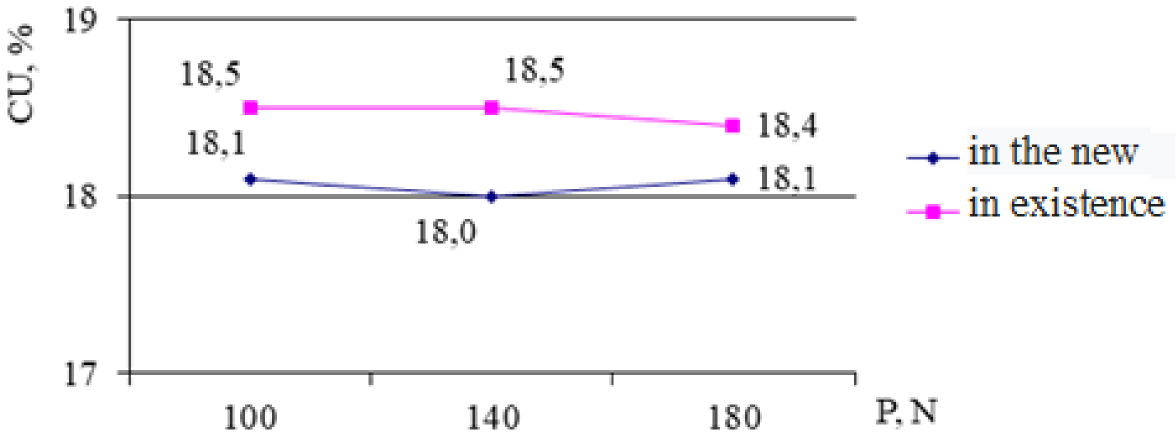

Figure 5. $l = 19mm$ obtained in constants
thread unevenness gradient (for a thread with a linear density of 28 tex).

The thread was produced in a drawing machine adjusted to the optimal values of the factors, and the unevenness of the product was determined by the MTS Evenness Tester device, which was compared with the indicators of these parameters determined using regression equations 1 and 2 (Table 2).

Conclusion. 8 bags were taken in each car. Yarn samples were tested on the MTS Evenness Tester. The analysis of the experimental results shows that the installation of the two-roller crushing roller on the output cylinder reduced the yarn unevenness by 2.3% in the production of 25-tex yarn and 0.8% in the production of 28-tex yarn.

We conducted experiments to determine the effect of the new design of the two-roller crushing roller on the unevenness of the thread. The analysis of the experimental results showed that the installation of a two-roller crushing roller on the output cylinder reduces yarn unevenness by 4.4% in the production of 25-tex yarn, and by 3.1% in the production of 28-tex yarn.

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