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DETERMINATION OF THE INFLUENCE OF SPIN-OFF ROUNDESS ON THE VALUE OF SPINNING YARN DURING SPINNING

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Аннотация: *В статье приводятся результаты исследований влияниянеровномерности округлости прядильных колец на натяжения вырабатываемой пряжи. Также отмечается, что если форма кольца искажена, то траектория бегунка представляет собой не круг, а некоторую замкнутую кривую, повторяющую форму кольца, при этом , в общем случае, в каждый последующий момент времени бегунок движется по кривой с другим радиусом кривизны. Приводится расчетная схема и методика расчета натяжения пряжи от профиля кольца.*

Ключевые слова: *Колцо, бегунок, пряжа, момент времени, нить, намотка, частота вращения.*

Abstract: *The article presents the results of studies of the influence of the unevenness of roundness of the spinning rings on the tension of the yarn produced. It is also noted that if the shape of the ring is distorted, then the slider's trajectory is not a circle, but some closed curve that follows the shape of the ring, while, in general, at each subsequent time, the slider moves along a curve with a different curvature radius. The design scheme and the method for calculating the tension of the yarn from the profile of the ring are given.*

Keywords: *Ring, runner, yarn, moment of time, thread, winding, speed.*

Anotatsiya: *Keltirilgan maqolada xalqali yigiruv mashinalari xalqalari gardishi noteksligini o`rganayotgan ip tarangligiga ta`sirini o`rganish uchun o`tkazilgan izlanishlar natijalari keltirilgan. Agarda halqa gardishi notekslikka ega bo`lsa yugurdak harakat traektoriyasi ma`lum bir yopiq egri chiziqni tashkil etadi va har bir aylanish davrida yugurdak noteks yo`l bo`ylab harakatlanadi. Bunda ipga ta`sir etuvchi taranglik kuchini harakat yo`li qonuniga bog`liqligi hisoblash usuli keltirilgan.*

Kalit so'zlar: *Xalqa, yugurdak, kalava ip, vaqt momenti, ip, o`rash, aylanish chastotasi.*

When analyzing the causes of breakage on spinning machines, attention was paid to spinning rings. When the slider moves along the ring, the centrifugal forces press the slider against the ring, as a result of which a friction force appears, retarding the slider. If the slider moves along a ring having a perfect flat circle, then the friction force depends only on the rotation frequency and the mass of the slider. If the shape of the ring is distorted, then the trajectory of the slider is not a circle, but some closed curve that follows the shape of the ring, while in the general case, at each subsequent time, the slider moves along a curve with a different radius of curvature.

This means that at each subsequent time, the slider changes its trajectory while experiencing a varying pressure force from the ring. This force of pressure, directed radially, causes a change in the friction force, which inevitably leads to a change in the speed of movement of the thumb and, as a result, to a change in the tension of the yarn. As noted / 1. 2. 3 / the slider number is selected to provide a certain tension of the yarn, which is necessary for normal winding, then fluctuations in the tension of the thread occur around this initial set and can significantly exceed it.

Together with other factors affecting the tension of the yarn, this may lead to excess tension over the strength of the yarn, which leads to its breakage.

The influence of not roundness of the spinning rings and non-flatness of the surface is taken into account in their manufacture and is reflected in GOST.

Let us estimate the effect of non-roundness of the ring on the yarn tension.

In the first approximation, we assume that changing the position of the thumb in stopped motion with changing diameter of the ring does not lead to a change in the frequency of its rotation ω.

In this case, we can apply the equation for the uniform movement of the slider;

$$TSin\beta = N_1$$

$$N_2 + TCos\beta + Te^{f\varphi}Sin\gamma - M\omega^2 r = 0 \qquad (1)$$

$$Te^{f\varphi}Cos\gamma \geq f\sqrt{N_1^2 + N_2^2}$$

The variable parameter - the radius of the ring enters the second equation of the system in the term, which determines the centrifugal forces acting on the slider.

Since the radius of the ring changes in the considered small time interval from rï-1 to rï by a very small value, we can accept that in this area the change occurs according to a linear law and take into account the average value of the radius, which we will determine by the formula;

$$r_{cp} \frac{r_{i-1} + r_i}{2}$$

From the condition of conservation of momentum, it follows that the slider must maintain speed when changing the diameter of the ring. But this changes its angular velocity:

$$V_{i-1} = V = \omega_{i-1} 2\pi r_{i-1} = \omega_i 2\pi r_i$$

From where

$$\omega_i = \omega_{i-1} \frac{r_{i-1}}{r_i}$$

The average angular velocity for the considered period of time

$$\omega_{cp} = \frac{\omega_{i-1} + \omega_i}{2} = \omega_{i-1} \frac{r_{cp}}{r_i}$$

Centrifugal force

$$N_3 = M\omega_{cp}^2 r_{cp} = M\omega_{i-1}^2 \frac{r_{cp}^3}{r_i^2} \quad (2).$$

In the system of equations, <γ is the angle between the yarn in the section of the slider and the tangent and the ring at the point of contact with the slider, <β is the angle between the straight line in the section of the cylinder-slider and the vertical. In addition, another term appeared in the equation, reflecting the slider movement in the radial direction. The reaction force of the ring on the slider can be determined by the formula

$$N_ц = M\frac{2\Delta r}{t^2} \quad (3).$$

Where

M-mass of the runner, kg

Δr-movement of the slider in the radial direction during time t, m

t-time during which the slider runs through the part of the ring we have chosen (in degrees), sec.

In the second equation of the system (1), the forces N3 and Nц, to simplify the calculations, <β = 90o and having made the transformations, we obtain the equation for calculating the tension of the yarn T:

$$(\frac{1}{f} i^2 Cos^2\gamma - 1 - i^2 Sin^2\gamma)T^2 + 2M(\omega_{i-1}^2 \frac{r_{cp}^3}{r_i^2} + \frac{2\Delta r}{t^2}) i Sin\gamma T - M^2(\omega_{i-1}^2 \frac{r_{cp}^3}{r_i^2} + \frac{2\Delta r}{t^2})^2 \geq 0 \quad (4)$$

Here $i = e^{f\varphi}$

Designating

$$A = (\frac{1}{f} i^2 Cos^2\gamma - 1 - i^2 Sin^2\gamma) \quad (5)$$

$$B = 2M(\omega_{i-1}^2 \frac{r_{cp}^3}{r_i^2} + \frac{2\Delta r}{t^2}) i Sin\gamma T \quad (6)$$

$$C = -M^2(\omega_{i-1}^2 \frac{r_{cp}^3}{r_i^2} + \frac{2\Delta r}{t^2})^2 \quad (7)$$

Where $\Delta r = r_{i-1} - r_i$

Will get

$$T^2 + \frac{B}{A}T + \frac{C}{A} = T^2 + pT + q \geq 0$$

From where

$$T_{1.2} = -\frac{P}{2} \pm \sqrt{\frac{P^2}{4} - q} \quad (8)$$

Smashing the ring on the part with the central angles of 1 degree and calculating the tension alternately for each section, we get a picture of the change in the yarn tension in one turn of the runner around the ring.

The most common distortions in the shape of a ring are ovality, trihedral and tetrahedron.

T2 - is the time of one revolution of the runner on the ring

$$T_ц = \frac{1}{n} = \frac{2\pi}{\omega}$$

We take the sinusoidal law of change of the diameter of the ring. Let's turn the ring into a straight line and take the minimum diameter as the initial value. The actual scan for ovality is shown by the solid line in Figure 1.

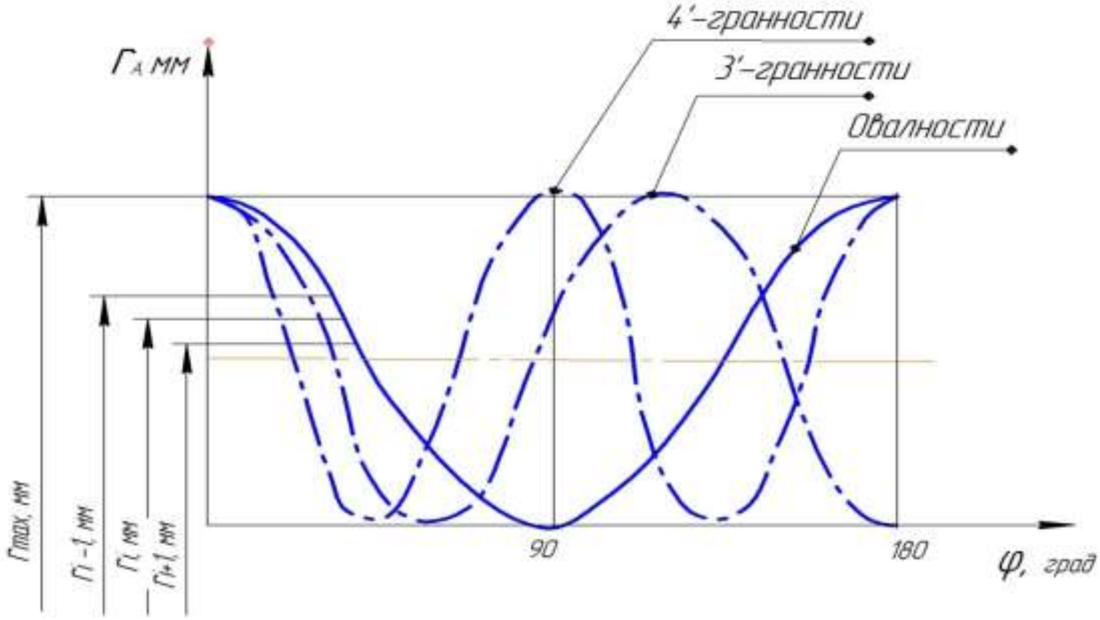

Fig. 1. Graph of the ovality of the ring around the perimeter.

For each moment of time, we determine the current radius of the ring ri.

$$r_i = r_{\min} + (\frac{r_{\max} - r_{\min}}{2} + \frac{r_{\max} - r_{\min}}{2} \cos\varphi_i) = r_{\min} + \frac{\triangleright r}{2}(1 + \cos\varphi_i) \qquad (9)$$

Where rmin, rmax is the smallest and largest radius of the ring for a given out-of-roundness

$$\triangleright r = r_{\max} - r_{\min}$$

φ_i -current angle.

Using formulas 4 and 8 as an algorithm, a program was compiled for calculating (on EKZEL) the values of the yarn tension at different facets of the spinning rings. The results of the calculations are presented in the form of graphs in Figures 2 and 3, reflecting the dependence of the yarn tension on the size of the cut, the type of cut of the ring, the rotational speed of the spindles of the spinning machine and the diameter of winding on the spool.

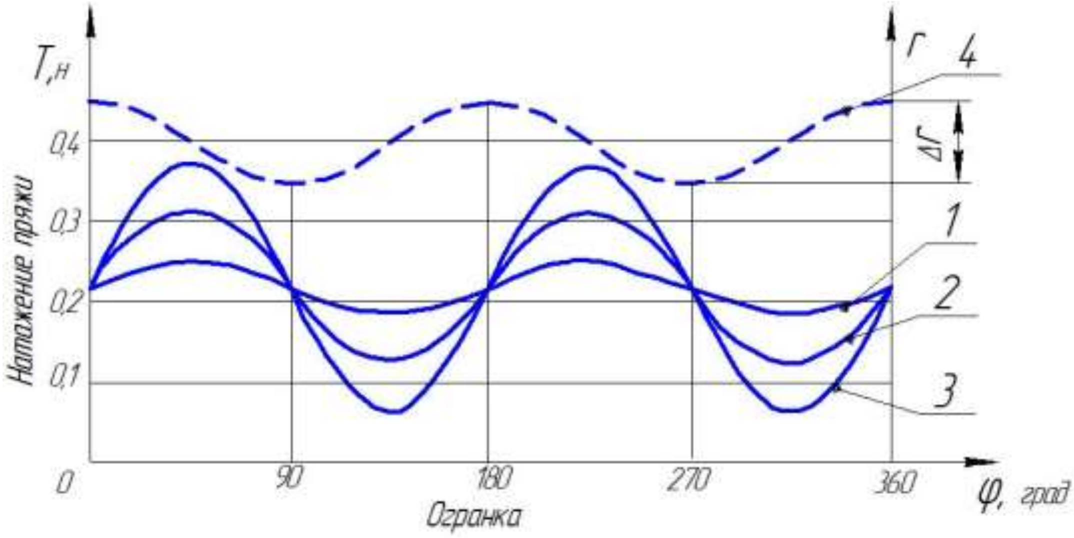

Fig. 2. Graphs of the dependence of the yarn tension on the cut size for one revolution of the runner on the ring when cutting the ring 2.

Spindle rotational speed nв = 10500 r / min.

1-Δr = 0.03mm; 2- Δr = 0.09 mm; 3- Δr = 0.15 mm.

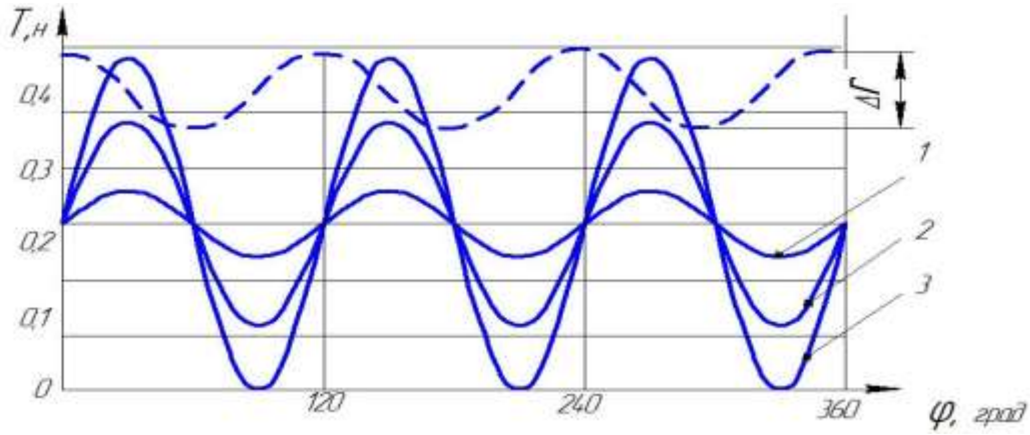

Fig. 3. Graphs of the yarn tension for one revolution of the slider on the ring with a ring cut equal to 3.

Spindle rotational speed nв = 10500 r / min.

1-Δr = 0.03mm; 2- Δr = 0.09 mm; 3- Δr = 0.15 mm.

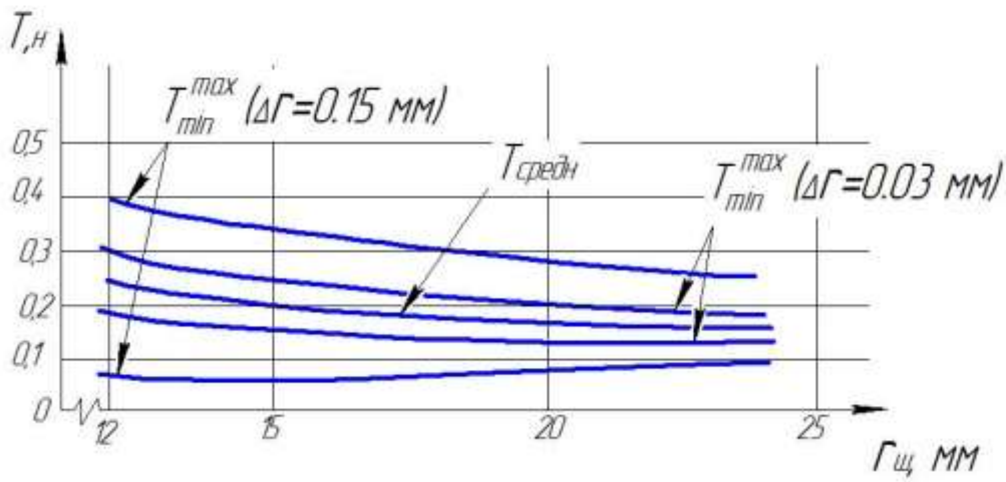

Fig.4. Graphs of yarn tension versus cartridge diameter for various non-roundness of the ring.

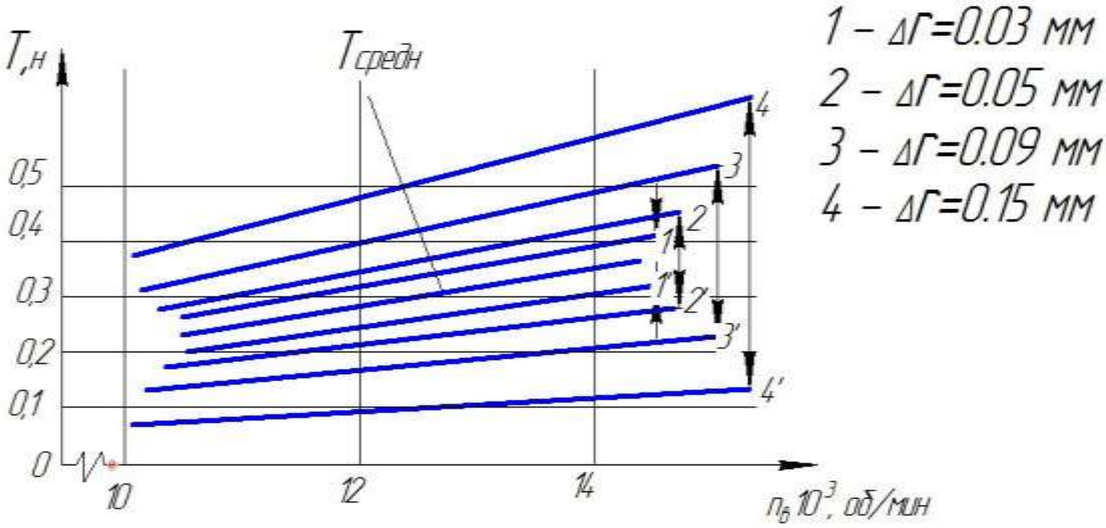

Fig.5 Graphs of the dependence of the yarn tension on turns for different numbers of the slider.

The calculations were carried out taking into account the change in the number of the slider when changing the rotational speed of the spindles in fig. five.

Graph analysis shows:

1. The law of changing the yarn tension repeats the law of changing the current radius of the spinning ring, fig. 2 and 3 .;
2. Yarn tension fluctuations for rings with non-roundness according to GOST is 40%. From the average value of the tension;
3. The triangular cut has a greater effect on the tension of the yarn than ovality;
4. The greatest influence on the tension of the yarn non-circularity has when winding the yarn on the smallest diameter, that is, an empty cartridge (Figure 4).
5. the actual tension of the yarn is in the aisles bounded by the curvature Tmin and Tmax, and the average calculated tension curve is the middle line of this region;
6. with an increase in the frequency of rotation of the spindles, the difference between Tmin and Tmax increases with a simultaneous increase in the average tension.

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