ISNN 3030-3907

2026/2
VOLUME 4

DEVELOPMENT OF SCIENCE

ILMIY JURNAL



Development of science

Ilmiy jurnal

2026/2 VOLUME 4

ISSN 3030 -3907

Ilmiy jurnal OAK rayosatining 2024 yil 27 sentabrdagi 361-son qaroriga asosan 02.00.00 kimyo fanlari hamda 2025 yil 12 fevral 367- son qaroriga asosan 05.00.00 texnika fanlari bo‘yicha falsafa doktori (PhD) va fan doktori (DSc) ilmiy darajasiga talabgorlarning dissertatsiya ishlari yuzasidan dissertatsiyalari asosiy ilmiy natijalarini chop etish tavsiya etilgan milliy ilmiy nashrlar ro‘yxatiga kiritilgan.

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ISSN 3030-3907

Development of science ilmiy jurnali 2024 yil 15 aprel kuni №256445 sonli guvohnoma bilan Davlat ro‘yxatidan o‘tgan.

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ISSN 3030-3907

RESEARCH AND CALCULATION OF LINE PARAMETERS RING SPINNING MACHINES

Dadakhanov Nurilla Karimovich
Ph.D., Professor, Namangan State Technikal University
Tel: (+99893) 403-13-39.
E-mail: nurilla28@mail.ru.

Abstract. In existing spinning systems in the processing of natural, artificial and synthetic fibers into yarn, the main task of the technological process is to obtain a ribbon, rovings and yarn uniform in structure and properties by folding and drawing. Based on research, we can conclude that the optimal condition for reducing the unevenness of the product being drawn in the exhaust device of ring spinning machines equipped with a new exhaust device will be minimal.

Keywords: ring spinning machines, fibers, flatness, exhaust device, grooved cylinder, pressure roller, field of friction forces, roller, strap.

Annotatsiya. Hozirdagi mavjud yigirish tizimlarida, tabiiy, sunhiy va sintetik tolalarni qayta ishlab, ipga aylantirish texnologik jarayonlarining maqsadi shundan iboratki, tolali mahsulotni tahlash va cho‘zish yo‘llari bilan bir xil struktura va hossali pilta, pilik va ip olishdir. Halqali yigiruv mashinasi cho‘zish asbobining takomillastirigan konstruktsiyasi tadqiqotlari shuni ko‘rsatdiki, unda ipning notekisligi mavjuddagiga nisbatan sezilarili kamaygan.

Kalit so‘zlar: halqali yigiruv mashinasi, tola, tekslanish, cho‘zish asbobi, taramli silindar, ezuvchi valik, ishqalanish kuch maydoni, tasma.

Аннотатция. В существующих системах прядения при переработке натуральных, искусственных и синтетических волокон в пряжу основной задачей технологического процесса является получение равномерной по структуре и свойствам ленты, ровницы и пряжи путем сложения и вытягивания. На основе исследований, можно сделать вывод, что оптимальное условие для уменьшения неровноты вытягиваемого продукта в вытяжном приборе кольцепрядильных машин, оснащенных, новым вытяжным прибором будет минимально.

Ключевые слова: кольцепрядильной машин, волокна, ровнота, вытяжной прибор, рифленой цилиндр, нажимной валик, поле сил трения, ролик, ремешок.

INTRODUCTION

The world's leading machine-building enterprises are conducting research in search of improving ring spinning machines and its individual parts, increasing its reliability and productivity, and improving the quality of products.

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The contact area of the roller with dynamic interaction with the sliver receives the possibility of small circumferential and radial displacements relative to the static position. The dynamic analysis of the considered mechanical system shows the possibility of the appearance of modes of unstable rotation of the bead if the frequencies of the radial and circumferential vibrations of the contact area are equal or exceed one another by 2 times. Initially, small deformations of the bead take on large values, which leads to a violation of the stationarity of the technological process of stretching[1].

MATERIALS AND METHODS

It is clear that the determination of the stable position of the roller on the cylinder has a great importance for the stretching process. An analysis of the designs of modern drawing machines for spinning machines shows that the pressure roller relative to the corrugated cylinder can occupy basically two positions [1]. In the first position, the roller and the cylinder are located vertically on the same axis (Fig. 1-a), and in the second position the roller is installed with a "blockage" forward relative to the cylinder (Fig. 1-b).

Leading machine-building enterprises of the world are conducting research in search of improving ring spinning machines and its individual parts, increasing its reliability and productivity, quality of products [1, 2, 3, 4, 5].

One of the main factors affecting the quality of the yarn produced on ring spinning machines is yarn breakage. High breakage leads to a decrease in the productivity of the equipment, deteriorates the quality of the produced yarn.

On the spinning machine, the drawing plane is obliquely positioned in the drafting system. The purpose of the tilt is to reduce the arc of the front cylinder with the protruding sliver. The twist does not extend to this section of the sliver, and therefore its tensile strength is 22-24% of the strength of the finished yarn.

If the filling line is chosen incorrectly, then the dimensions of the machine may increase, and the breakage of the product increases. When examining the spinning line of Penza Scientific Research and Experimental Design Institute of Spinning Machines, suggest that by choosing A=40 mm, b=110 mm, c=150 mm, at which the bending angles correspond to the above, we obtain a spinning line with the following parameters:

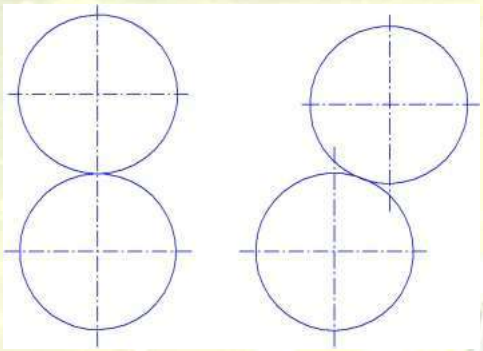
- flow angle from 2^0 30' to 12^0;

-bend angle corresponding to half of the angle at the top of the balloon and changing from 16^0 in the upper position of the annular strip to 8^0 in the lower position of the annular strip[6].

The contact area of the roller with dynamic interaction with the sliver receives the possibility of small circumferential and radial displacements relative

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to the static position. The dynamic analysis of the considered mechanical system shows the possibility of the appearance of modes of unstable rotation of the bead if the frequencies of the radial and circumferential vibrations of the contact area are equal or exceed one another by 2 times. Initially, small deformations of the bead take on large values, which leads to a violation of the stationarity of the technological process of stretching [6].



а) **б)**

Figure 1. Positions of the pressure roller relative to the reef cylinder.

Studies of individual parameters of the spinning line (flow angle, bend angle, etc.) were carried out by many researchers, however, they did not give a rigorous theoretical justification for these parameters. When analyzing the angle of inclination of the drafting device and the position of the clamping point of the outlet pair relative to the spindle axis, it was revealed that the optimal position can be considered the position at which the most free twist propagation in the section between the thread guide and the outlet pair [7] is provided. Studies of individual parameters of the spinning line (flow angle, bend angle, etc.) were carried out by many researchers, however, they did not give a rigorous theoretical substantiation of these parameters[8].

The clamping line should be as close as possible to the plane passing through the axis of the cylinder and roller. The most favorable situation for the stretching process is when the stress of the field of friction forces is uniform, and the contact patch has the shape of a rectangle, and the clamping line with smaller diameters of the cylinder and roller and greater rigidity of the elastic coating is the most stable [5].

It can be seen that by various design changes in the drafting device, the nature of the change in the stress of the friction force field and the clamping line approaches the ideal. In work [10], new designs of a drafting device with a magnet in the drawing area and a pressure roller in the form of a double roller were proposed. The installed rollers in this form increase the angle of the wrap of the fibrous masses, and the installation of the magnet in the extraction zone, being

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attracted to the lower bar, presses the straps to each other, thereby improving the field of friction forces.

RESULTS AND DISCUSSION

The calculations were carried out on the serial machines P-66-5M6 and P-76-5M6, which we selected for the study, equipped with exhaust devices of the SKF type, as well as modernized by us. The modernization consists in the fact (more about this in [9]) that in order to increase the stability of the pressure roller by the corrugation of the cylinder and to reduce the flow angle of the exhaust cylinder web, a new design of two roller pressure roller has been developed. The design scheme is shown in Fig. 2 initial data are shown in table 1.

Determine the flow angle δ_3. Figure 2 shows that as $\angle MOX_1 = \angle ДO_1M$ angles with mutually perpendicular sides:

$\angle MOX_1 = \alpha_1$, $\angle MOX_1 = \delta_3 + \delta_1 + 45^0$, from $\delta_3 = \alpha_1 - (\delta_1 + 45^0)$ (1).

For definition δ_1, consider ΔO_1AB. The size of the "blockage" of the pressure roller AB = 2 mm (Fig. 1). $AO_1 = R + r = 26{,}5$ mm.

$$\sin\delta_1 = \frac{AB}{AO_1} = 0{,}075 \text{ rad, from here } \delta_1 = 4_0 18'.$$

To determine the angle *a*, consider the following system of equations:

$\begin{cases} (X - X_1)^2 + (Y - Y_1)^2 = R^2 & \text{- equation of circle 1 line of cylinders;} \\ У = KX & \text{- equation of the straight line on which the yarn section lies between the thread guide and 1 cylinder line.} \end{cases}$

We place the origin of coordinates at point O (Fig. 3), i.e. in the center of the thread guide. Substituting in the 1st equation "Y" its value "KX" we have:

$$(X - X_1)^2 + (KX - Y_1)^2 = R^2,$$

$$X^2 - 2XX_1 + X_1^2 + K^2X^2 - 2KXY_1 + Y_1^2 = R^2,$$

$$(K^2+1)X^2 - (2X_1 + 2KY_1)X + (X_1^2 + Y_1^2 - R^2) = 0,$$

$$X^2 - \frac{2X_1 + 2KY_1}{K^2+1} - X + \frac{X_1^2 + Y_1^2 - R^2}{K^2+1} = 0,$$

$$X_{1,2} = \frac{X_1 + KY_1}{K^2+1} \pm \sqrt{\left(\frac{X_1 + KY_1}{K^2+1}\right)^2 - \frac{X_1^2 + Y_1^2 - R^2}{K^2+1}}.$$

$X_1 = X_2$ or otherwise, the straight line touches the circle (in our case, at the point M) if and only if the radical expression in the last equality vanishes:

$$\left(\frac{X_1 + KY_1}{K^2+1}\right)^2 - \frac{X_1^2 + Y_1^2 - R^2}{K^2+1} = 0$$

After transformations, we have:

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$$(X_1^2 - R^2)K^2 - (2X_1Y_1)K + (Y_1^2 - R^2) = 0,$$

$$K^2 - \frac{2X_1Y_1}{X_1^2 - R^2}K + \frac{Y_1^2 - R^2}{X_1^2 - R^2} = 0.$$

Table 1.

Value X_1, Y_1, R and r, mm.

Brand	P-66-5M6				P-76-5M6			
Calculated pairs.	Ring strip position							
	At the top		At the top		At the top		At the top	
	Exist	Exist	Exist	Exist	Exist	Exist	Exist	Exist
X1	38	37	37,5	36	38	37	37,5	36
У1	98,5	100	154	155	88,5	90	149	159
R	12,5	14	12,5	14	12,5	14	12,5	14
r	14	7	14	7	14	7	14	7

Let's solve the equation for "K":

$$K_{1,2} = \frac{X_1Y_1}{X_1^2 - R^2} \pm \sqrt{\left(\frac{X_1Y_1}{X_1^2 - R^2}\right)^2 - \frac{Y_1^2 - R^2}{X_1^2 - R^2}}.$$

Finally, we have: $K = \frac{X_1Y_1 + R\sqrt{(X_1^2 + Y_1^2 - R^2}}{X_1^2 - R^2}$, (2)

where X_1 and $У_1$ - coordinates of the position of the eye of the thread guide (table 1).

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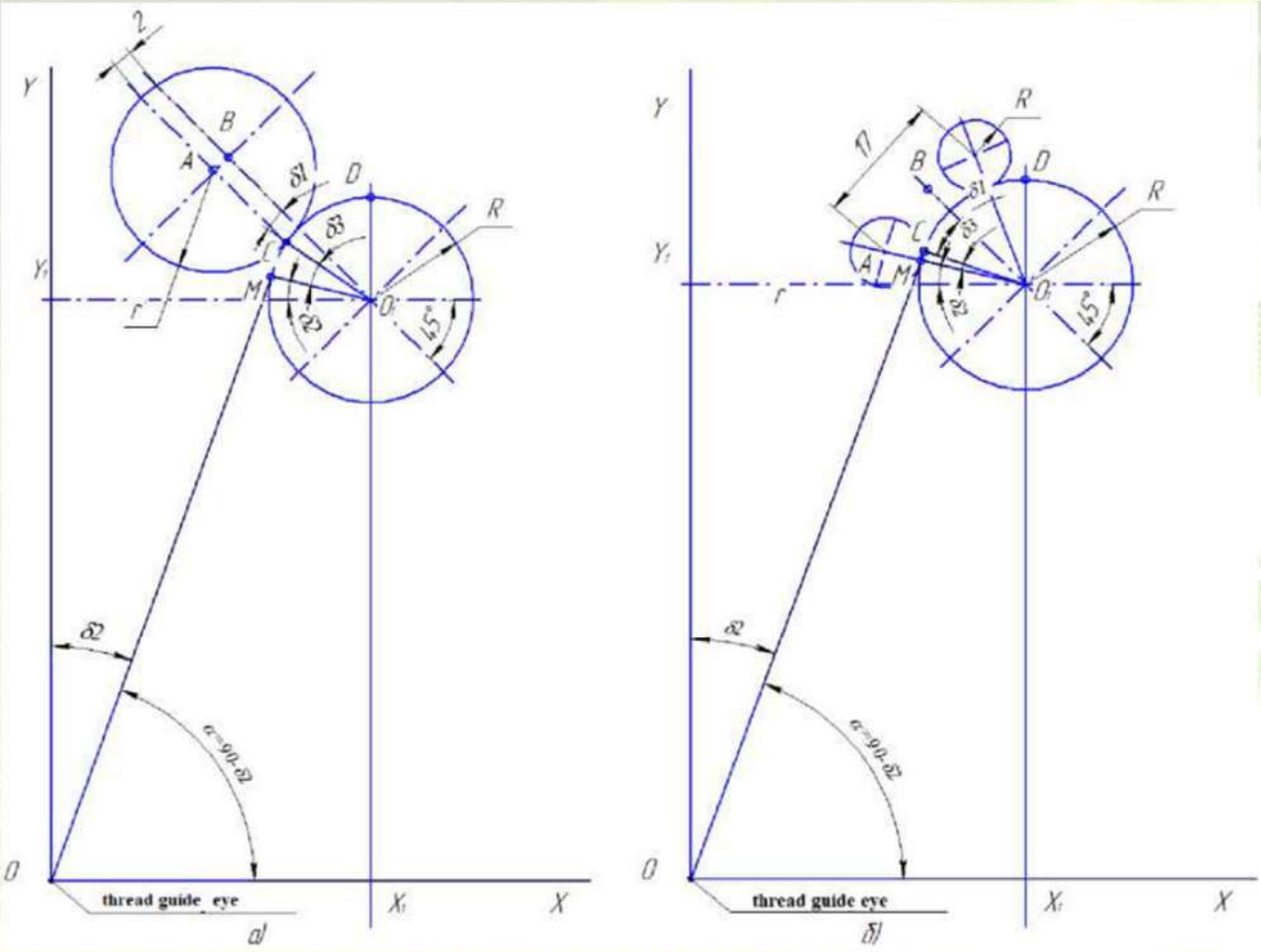


Figure 2. Scheme for determining the angle of flow around the sliver front cylinder: a) existing fume hood; б) a new hood.

It is known that in the equation of the straight line Y = KX, $K = tg\alpha_1$ which makes it possible to determine α_1 from formula (2), and then determine the flow angle δ_3 by formula (1). The values obtained by formulas (1) and (2) δ_3 are shown in table 2.

Table 2

Calculated values of the angle of flow around the front cylinder δ_3.

Machine brand	Ring strip position			
	At the top		At the top	
	Exist	New	Exist	New
П-66-5М6	$19^0\ 13'$	$0^0\ 48'$	$26^0\ 54'$	$8^0\ 6'$
П-76-5М6	$16^0\ 55$	$-1^0\ 12'$	26^0	$7^0\ 42'$

CONCLUSION

It can be seen from the data presented that the use of a new two-roller design of the pressure roller sharply reduces the angle of the flow around the front cylinder. If in the upper position of the annular strip on the machines P-66-5M6

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and P-76-5M6, the flow angle decreases, respectively, from 19^0 13' to 0^0 48' and from 16^0 55' to - 1^0 12', then the lower position of which, respectively, from 26^0 54' to 8^0 6' and from 26^0 to 7^0 42'. This, of course, should drastically reduce yarn breakage.

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ISSN 3030-3907