OPTIMIZATION OF PARAMETERS OF A LINE OF SPINNING OF SPINNING MACHINES

Dadakhanov Nurilla Karimovich
Ph.D., Associate Professor, Namangan Institute of Engineering and Technology.
E-mail: nurilla28@mail.ru.
Karimov Rustamjon Ibragimovich
Researcher, Namangan Engineering and Technology Institute.

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. The article studies and obtained analytical dependences for calculating the angle of flow around the exhaust cylinder by the lobe on the spinning line of ring spinning machines. 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: *drafting device, streamline angle, pressure roller, double roller device, corrugated cylinder, spinning line, breakage.*

I. INTRODUCTION

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, 2].

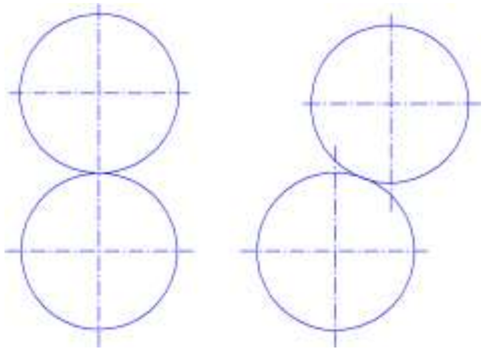
II. METHODS

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).

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 as the position at which the most free twist propagation in the section between the thread guide and the outlet pair is provided [3, 4].

Currently, in cotton spinning, both carded and combed systems are mainly used continuous ring spinning machines. New spinning machines of modern production have more powerful drafting devices, increased spindle speed, they are more reliable in operation and convenient in operation.

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, 6, 7, 8, 9].



а) б)

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

In existing spinning systems when processing natural, artificial and synthetic fibers into yarn, the main task of the technological process is to obtain a uniform in structure and properties of ribbon, roving and yarn by folding and pull.

In existing designs of drafting devices and devices, improved control over the movement of fibers is achieved in various ways, for example, by installing additional straps, rollers, clutches, guides, trays, etc. A common drawback of this design is that by correcting one drawback, others are promoted, for example, the design of the assembly becomes more complicated or maintenance is difficult, etc.

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.

III. EXPERIMENT

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.

When designing ring spinning machines, the choice of the design spinning line is of great importance, i.e. lines of passage of sliver-yarn from the drafting device to the spool. In some ring spinning machines, the front pressure roller tilts forward by about 5^0 to reduce the sweep angle. The sweep angle y is different for different types of ring spinning machines depending on the lift of the annular strips. For main ring spinning machines with a lift of 220 mm, $y = 2^0 - 3^0$, $y_2 = 17^0$.

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 [10].

If the spinning line is made on the basis of the above recommendations, the dimensions of the machine increase in height and width. This will complicate the maintenance of the machine, there will be additional difficulties when loading the pressure rollers of the drafting device. The main stage of the study is the choice of the optimal design and technological parameters of the new exhaust device, since the efficiency, reliability, ease of use, manufacture and cost of the exhaust device depend on it.

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 [11].

It can be seen that the determination of the stable position of the roller on the cylinder is of 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 basically occupy two positions. In the first position, the roller and the cylinder are located vertically on the same axis, and in the second position the roller is installed with a "blockage" forward relative to the cylinder.

Under the same external loads and fixing conditions, an elastic system can have not one, but several states of equilibrium. In order to solve a stable or unstable equilibrium of a mechanical system, it is necessary to use analytical stability criteria. The most general approach to the study of the stability of an equilibrium position in mechanics is the energy approach based on the study of the change in the total potential energy of the system with deviations from the equilibrium position.

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 [12] 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 [13].

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 [8].

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

IV. RESULTS AND DISCUSSIONS

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 [14, 15]) 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 $\Delta O_1 AB$. The size of the "blockage" of the pressure roller AB = 2 mm (Fig. 1). $AO_1 = R + r = 26{,}5$ mm.

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

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

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

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:

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

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

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 Y_1 - coordinates of the position of the eye of the thread guide (table 1).

Table 1.

Value X_1, $У_1$, 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	
	xist	xist	xist	xist	xist	xist	xist	xist
X_1	38	37	37,5	36	38	37	37,5	36
$У_1$	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

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	$7^0\ 42^/$

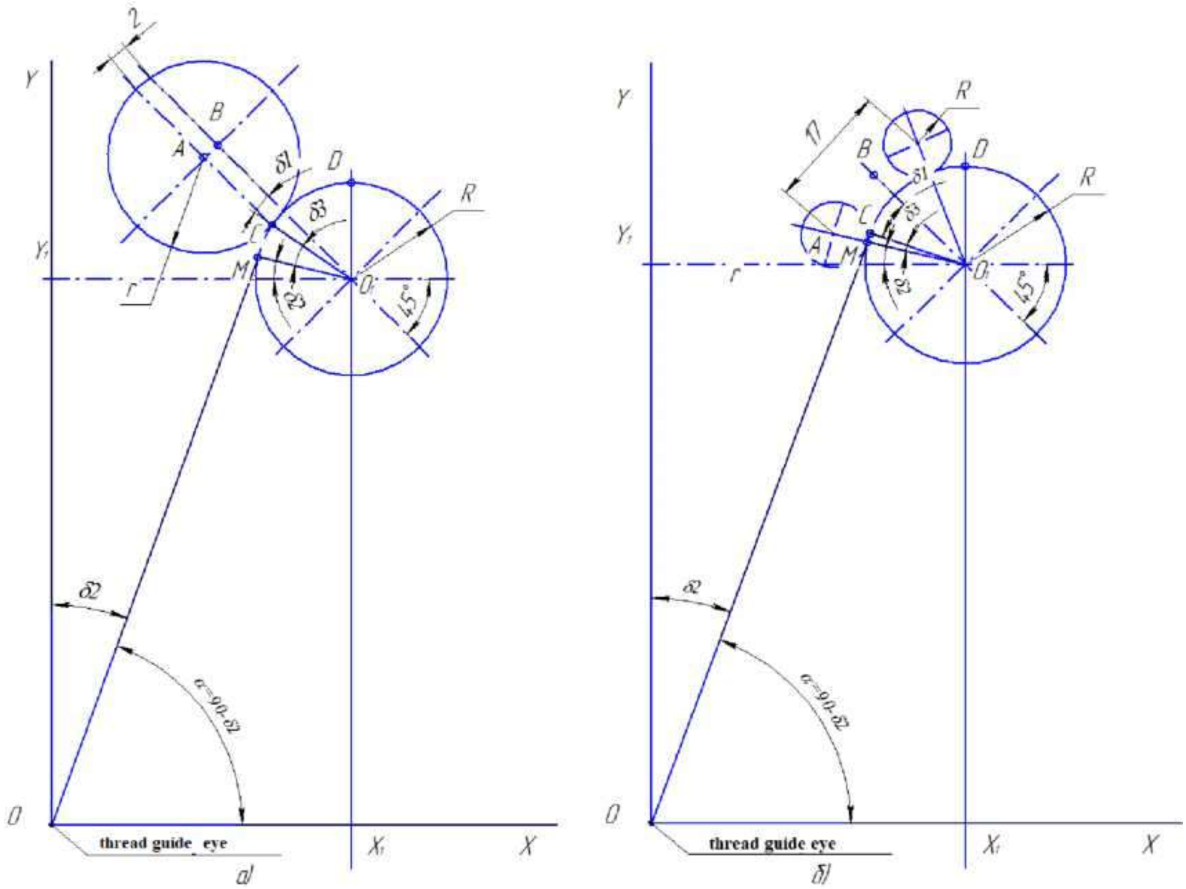


Figure 2. Scheme for determining the angle of flow around the sliver front cylinder: a) existing fume hood; б) a new hood.

V. 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 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.

REFERENCES

[1] Dadakhanov N.K. Research and calculation of line parameters ring spinning machines. //Solid State Technology Pennwell Corporation. Vol. 63, Issue 6, 2020. -p.9756-9762.

[2] Jumaniyazov K.J., Bobojanov X.T., Gafurov J.K. Sravnenie ustroystv dlya kompaktnoy kolsevoy pryaji [Comparison of compact ring yarn devices]. // To‘qimachilik muammolari, 2009 yil, №4, b. 19-21.

[3] Daffa Bhaskar, Bahejee S., Sengupta A. Vliyaniye gometricheskix parametrov koltsevoy pryadilnoy mashini na kachestva pryaji // Indian Text. J. – 1191. -101 – № 8. – C. 114–120.

[4] Ruixiang Baia, Weikang Li. Experimental study of yarn friction slip and tabric shear deformation in yarn pull-out test. Composites Part A // Applied Science and Manufacturing. –2018, April. – P. 529–535.
[5] Dadakhanov N.K; Boltaboev B.E. Optimization of parameters a line of spinning machines//"UNIVERSUM: Engineering". Moscow: 2019 No. 6(63), -p. 50-53.
[6] Dadakhanov N.K. Studying yarn incorpectiveness operated on the improved exhaust extractor.// ACADEMICIA. –Kurukshetra, Vol. 10, Issue 7, July 2020. -p.474-482.
[7] Dadaxanov N.K. Bdtaboev B.E. Research of the improved exhaust device on impact yarn levels. // "UNIVERSUM: Texnicheskie nauki" -M 2020 g. № 7 (76), -p 5-10.
[8] Dadaxanov N.K.,Turaboev G.U. Development of a new exhaust desing device and research of its work. // Ekanomika i sotsium -Saratov. 2020 g. № 6 (73).
[9] Dadakhanov N.K; Sidikov A.Kh; Karimov N.M. Study and theoretical research of the parameters of a line of spinning ring - spinning machines // "UNIVERSUM: Engineering" Moscow: 2019 No. 1 (58), -p. 34-37.
[10] Dadaxanov N.K. Bdtaboev B.E. Research of the improved exhaust device on impact yarn levels. // "UNIVERSUM: Texnicheskie nauki" -M 2020 g. № 7 (76), -p 5-10.
[11] Daffa Bhaskar, Bahejee S., Sengupta A.Influence of the geometric parameters of the uing spinnining machine on yarn quality. «Indian Text. J». -1191. -101 №8, -p. 114-120.
[12] Dadakhanov N.K. Studying yarn incorpectiveness operated on the improved exhaust extractor./ ACADEMICIA. -Kurukshetra, Vol. 10, Issue 7, July 2020. p.474-482.
[13] Dadaxanov N.K. Study of the contact plane of the exhaust pairs taking into account the misalignment of the axes of the pressure roller and the cylinder.// Proceedings of universities. Technology of the textile industry - Ivanovo, 2001. №2. s.104-106.
[14] Dadaxanov N.K., Shukurov M. Analiz nesoosnostey osey najimnogo valika i rifsilindra [Analysis of misalignment of the axes of the pressure roller and the riffle cylinder]. // «Izvestiya VUZov. Texnologiya tekstilnoy promyshlennosti» - Ivanovo, 1997. №1. s.116-117.
[15] Shukurov M.M., Dadakxanov N.K., Maxkamov R.G. About misalignment of the pressure roll and the grooved cylinder of the drafting system of the ring spinning machine // Dokladi Akademii nauk Respubliki Uzbekistan - 1997. - №1. -s. 26-28.