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THEORETICAL STUDY OF THE EFFECT OF A BRUSHED DRUM SHAFT ON THE EFFICIENCY OF FLUSH SEPARATION

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Abstract: In this article, research was carried out to improve the brush drum-type Linter machine, which effectively cleans the fluffy product obtained by linting cotton seeds from impurities. In the study, a brush drum that effectively removes lint (fluff) from the saw teeth in a linting machine, a number of brushes located on the drum, and the length of the arc between the intersection and separation of the brushes with the saw teeth and The theoretical studies studied the intersection angles that form them. It was established that the wicker the drum effectively separates the saw teeth without negatively affecting the natural properties of the product.

Keywords: Linter machine, fluff, impurities, lint, brush drum, guide, mesh surface, beveled corner, supply roller, density valve, seed chamber, mixer, seed comb, coil grid, saw cylinder, lint discharge channel, die conveyor, air chamber.

Introduction. In connection with the entry of the Republic of Uzbekistan into the world market and the increasing need for the production of lint, scientists and the cotton ginning industry are faced with tasks related to the increase in product volume, quality and cost. This increases the economic importance of the production of products, which is an important factor not only in the development of industrial activity, but also in the improvement of the material and cultural standard of living and the well-being of the people. However, the ginning industry is currently not well equipped with modern equipment to ensure high productivity, high quality lint and seeds. Seed linting technology is one of the most labor-intensive and expensive stages of the cotton processing process. In linting, equipment and power consumption is up to 30%, and the production area is more than 40% of the cotton mill. In addition, the cost of buying lint is low compared to the production costs to obtain it, making lint production unprofitable. The introduction of new engineering and technical developments into production is of great importance in the development of industry and is the main factor of economic growth.

In the existing linter machine used in cotton cleaning enterprises, the short fibers cut from the cotton seed by the sharp teeth of the saw, the air flow coming out of the nozzle of the air chamber separates the lint (fluff) and short fibers from the saw teeth, the fluff is sucked into the pipe (lintootvod), and then transferred to the condenser. It is known from the researches that it is not possible to obtain a quality product by cleaning seed cotton, cotton pieces, fiber or lint (fluff) products transported by pneumatic transport from impurities during their movement in the air. Lint (fluff) is separated from the air and cleaned of fluff impurities in the OVM-A-1 fiber material cleaning device and sent to the pressing process. As a result of the study of the masking process, it was found that the VS-8 fan motor, which drives air at high pressure into the air chamber of the linter machine, and the OVM-A-1 type lint cleaning devices, which are used to improve the quality of lint despite the low cleaning efficiency, have a negative effect on the economy of the enterprise.

The goals and objectives of the study. The cleaning device of the proposed new construction is installed on the existing linter machine at the enterprise and works without affecting the technological process. This is it research did not have a negative impact on the technological process as it conformed to the requirements of the President of the Republic of Uzbekistan in the new Development Strategy of Uzbekistan for 2022-2026, including the requirements for the rapid development of the national economy and ensuring high growth rates, reducing the consumption of electricity in the production of products and introducing technologies that produce high-quality competitive products. in this case, an improved lint cleaning device, which increases the working life of the linter machine, was created and put into production.

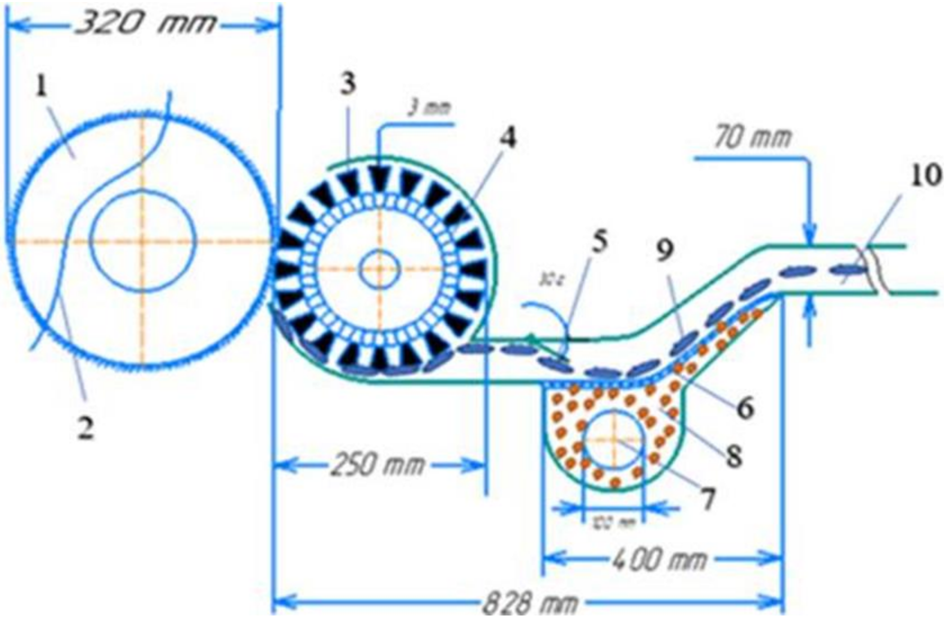

Figure 1. Lint separation of the brush drum from the saw tooth and its cleaning scheme

Tools involved in the main operation of the device: 1. Saw cylinder, 2. Colossal grid, 3. Body, 4. Brush drum, 5. Guide, 6. Mesh surface, 7. Dirt auger, 8. Dirt, 9. Lint (fluff), 10-Lint (fluff) discharge pipe to the condenser.

In recent years, brush drums that do not deform during cotton ginning have been developed with the help of many artificial nylon bristles. In this regard, the task of studying some aspects of this type of fluff removal arose. Information on the removal of fibrous materials using brush drums in literary sources does not allow optimal solution of design problems when creating new machines. There are also misconceptions about how brush drums work.

Results. According to the requirements for lint removal from the saw cylinder during the linting process, fibers of the drum brush should penetrate to the surface of the saw cylinder, i.e. between the saw blades, to a depth of approximately 2-2.5 mm (Fig. 1). Consequently, the interaction between the brush drum and the saw cylinder occurs in a small area limited by points.

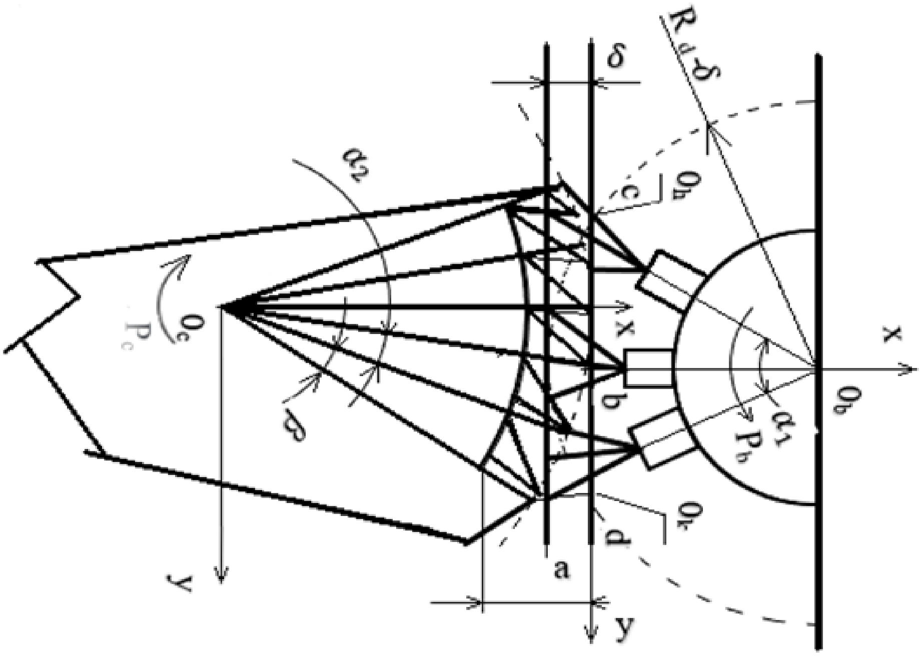

Figure 2. Scheme of interaction (period of contact) between the saw cylinder of the linter and the brush drum

According to Figure 2, we calculate the length of the arc using the following formula $\cup\, O_h O_k$, let's find out:

$$\cup\, O_h O_k = R_6 \beta \text{ , (rad)} \quad (1)$$

$\cup\, O_h O_k$ knowing the values, we can write:

$$Cos\frac{\beta}{2} = \frac{R_6-\delta}{R_6}, \quad (2)$$

(2) solving equation 3 with respect to and $R_b = 250$ mm. (existing construction P_b) by calculating $\beta = 0.32$ rad let's find out. If we consider the values of β, we $\cup\, O_h O_k = R_6\beta = 80$ mm we get.

Calculation of the turning angle of the saw cylinder. Diameter of existing saw drum structure $r_k = 320$ mm. Therefore, in order for the saw cylinder to completely rotate around its axis, its center must pass through an arc of the following length:

$$\cup\, l_{dr} = 2\pi r_k = 2 \cdot 3.14 \cdot 320 = 2009{,}6 \text{ mm}$$

Theoretically, in the interaction of the saw drum with the brush drum, the angle of rotation around its axis $\cup\, O_h O_k$ va $\cup\, l_{dr}$ can be determined by comparing the lengths of the arcs.

$$\varphi_{dr} = r_k = 3\frac{\cup O_h O_k}{\cup l_{dr}} \cdot 180^o = \frac{80}{2009{,}6} \cdot 180^o = 7.16^o$$

Calculation of the duration of exposure to the surface of the brush drum saw cylinder. Of the drum in existing cotton ginning equipment P_b=1100 ayl/min yoki 18,3 ayl/s knowing the rotations, we determine the path through the center of the saw drum in one second: $L = 2\pi R_d \cdot n_d = 2 \cdot 3.14 \cdot 250 \cdot 18{,}3 = 2873{,}1\ mm$

$$t_{air} = \frac{\cup O_h O_k}{L}, sek = \frac{80}{2873} = 0{,}027$$

Calculation of the angle of rotation of the brush drum when the saw cylinder interacts with the brush drums. According to the data, the rotation angle of the brush drum can be calculated using the following formula: $\theta = 2\pi{\cdot}P_c \cdot t_{\ air}/sek$

(3)

Here, P_c is the number of revolutions of the brush drum P_c=1100 ayl/min =18,3 ayl/sek;

θ =2·3.14·1100·0,027=186,7°.

If we consider that the number of brush plates in a brush drum is 20, then there are 10-11 plates at an angle of 186°, and accordingly, the number of strokes will also be within these limits.

In that case, it is possible to determine the rotation of the saw cylinder at an angle m μ_j:

$$\mu_j \cdot \frac{2\pi/z}{h^*}, \text{(rad/mm)} \tag{4}$$

According to the formula, we determine the length of the working arc of the circular saw cylinder with a single brush.

$$S^* = \mu_j AC\grave{}r_{dr} \tag{5}$$

Undoubtedly, in order to remove a piece of cotton from the surface of the saw cylinder with brushes, the rotation speed of the saw cylinder V_2 should be greater than V_1. Fiber-removable strips interact in the saw section. When the saw cylinder turns at an angle of 2α, the brush drum must turn at an angle not less than $2\alpha_2 + \beta$.

If τ_1 va τ_2, represent the angle of rotation of the saw cylinder and the brush drum, respectively, the removal of a piece of cotton from the saw cylinder can be expressed as follows:

$$\tau_1 > \tau_2,$$
$$\tau_1 = \tau_2, \tag{6}$$
$$\tau_1 = \frac{2\alpha_1}{\omega_1}; \qquad \tau_2 = \frac{2\alpha_2+\beta}{\omega_2},$$

Here ω_1, ω_2 are angular speeds of the saw cylinder and brush drums, respectively $\text{rad}/_{s}$; α_1, α_2 va β -angles, rad.

τ_1, τ_2 after substituting values into expression (6), the calculation formula takes the following form.

$$n_2 = n_1 \frac{K(2\alpha_2+\beta}{\alpha_1}\ \text{ayl/min}, \tag{7}$$

Here K is the safety factor (K = 1,15-1,25);

α - the central angle between two removable lines.

2- it follows from the picture:

$$\alpha_1 = arctg\frac{x_1}{(r_1+r_2)-y_x}\ \text{rad}, \tag{8}$$

$$\alpha_2 = arctg\frac{x_2}{(r_1+r_2)-y_d}\ \text{rad}, \tag{9}$$

The coordinates of point D are determined from the intersection of circles I and II:

$$y_1 = \frac{r_2^2+(r_1-r_2)^2}{2(r_1+r_2{}^2)}, \quad (10)$$

$$x_1 = \sqrt{r_2^2 - r_d^2}, \quad (11)$$

In that case, the equation takes the following form:

$$n_2 = n_1 \frac{K(\alpha_1+\beta)}{\alpha_1}; \quad (12)$$

The angles a α_1 va $\alpha_2$are determined by formulas (8) and (9) and the coordinates of point d are in accordance with the same formulas as in points (10) and (11).

Research shows that the available air flow in the area of fiber removal from the saw cylinder helps to remove the lint, that is, the removal of cotton from the saw cylinder continues mechanically and the air flow factor is limited to the cotton transport function.

The obtained results make it possible to objectively assess the effectiveness of the interaction of the saw cylinder with a brush drum during operation and to optimize the parameters of the lint removal zone from the saw cylinder.

Conclusion. The given equations make it possible to determine the angular speed of rotation of the drum, which is selected for machines of various purposes. For example, cylinders and drums with a diameter of 320 and 500 mm have an arc interval of 80 mm (=17°), the optimal required speed for linting is calculated.

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