Theoretical Preservations for Cleaning Cotton in the Section for Cleaning from Little Device LKM-3

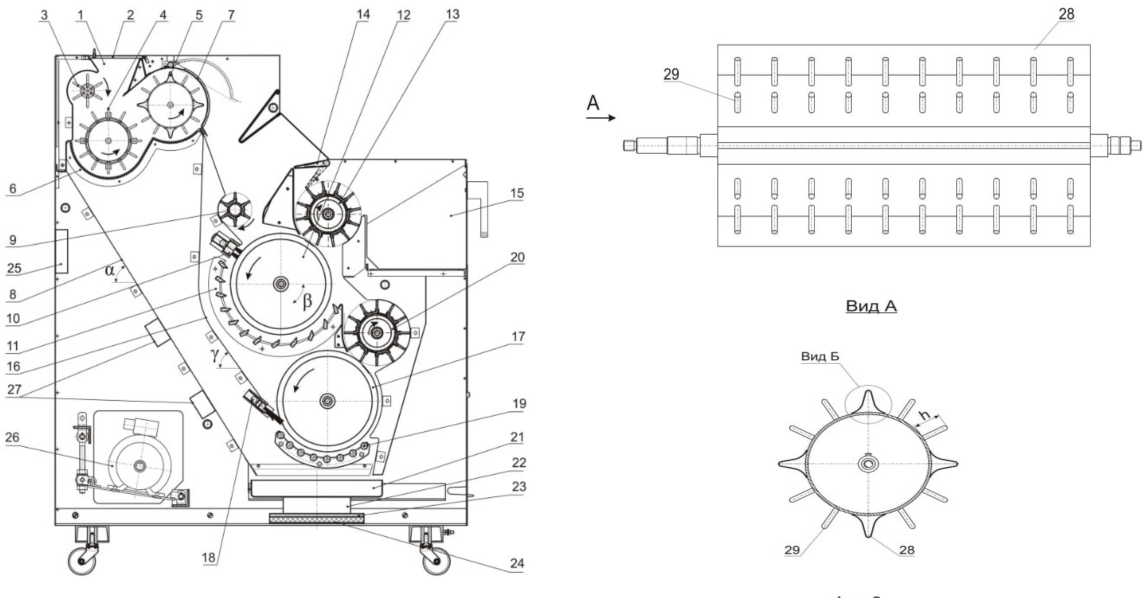
Zhumaniyov Kadam*[1]*, Karimov Ulugbek Kuvondikovich*[2]*,
***Akhmedov Akmal*[3]*, Marufkhanov Bekzadkhan Khairullaevich*[4]**
[1]*Doctor of Technical Sciences,* [2]*Leading researcher, Senior Research Fellow*
[3]*Chief Researcher, Candidate of Technical Sciences*
[4]*PhD (Joint stock company "Paxtasanoat ilmiy markazi")*

ABSTRACT

The results of theoretical analysis of cotton cleaning process in the fine trash cleaning section of LKM-3 device are given in the article. The regularities of cotton lump movement and the forces acting on it in the fine trash cleaning section depending on the parameters and operating mode of the flap-plate drums are derived.

KEYWORDS: *devices, clogging, fine debris, flap drum, speed, density*

As a result of the research work carried out at JSC "Paxtasanoat ilmiy markazi", a design was developed and an experimental device LKM-3 was developed to determine the contamination of raw cotton (Fig. 1).



A) B)

Figure 1. Diagram of the improved device for determining the contamination of raw cotton LKM-3. A) - general view of the device; B) - a diagram of a peg-slat drum for cleaning from fine litter.

The improved laboratory setup (Fig. 1) contains a hopper for loading a sample of raw cotton 1, with a lid 2 installed on a hinge, a section for cleaning fine debris containing a feed roller 3, two drums -

peg 4 and peg-slat 5, with a grate 6 with a hinged automatically opening deck 7, while in the second along the flow of cotton in the peg-slat drum, the slats 28 have a height h1 equal to the height h of the splitter 29 to enhance the air flow, a guide is installed under the grate, at an angle α = 58o fine litter 8, on the reverse side of which, in two (or three) sections, two shock-shaking mechanisms 27 are installed, which act on the fine litter guide with a frequency of 30 beats per minute alternately.

Below the peg section along the material feed there is a coarse debris cleaning section, which includes a feeding paddle roller 9, a lapping brush 10, a grate 11, a saw drum 12, a removable paddle drum 13 and a shutter 14 located above it, a container for a cleaned sample 15.

Axes the second in the course of feeding the material of the pick drum 5 and the saw drum 12 of the cleaning section and the feeding paddle roller 9 lie in the same plane inclined at an angle β = 58 to the horizontal, while they are installed with the possibility of interacting with each other, the direction of rotation of the peg drums 5 and serrated 12 coincide, and the supply paddle roller 9 has the opposite direction of rotation.

Below the barbed cleaning section, a regeneration section is installed, including a guide of coarse debris and fallen outlets 16, installed at an angle of γ = 45 ° relative to the horizontal, a saw drum 17, a lapping brush 18, a grate 19 and a removable blade drum 20, and the saw drums of the cleaning 12 and regeneration sections 17 are installed with the possibility of interaction with one another by means of a removable paddle drum of the regenerated section 20.

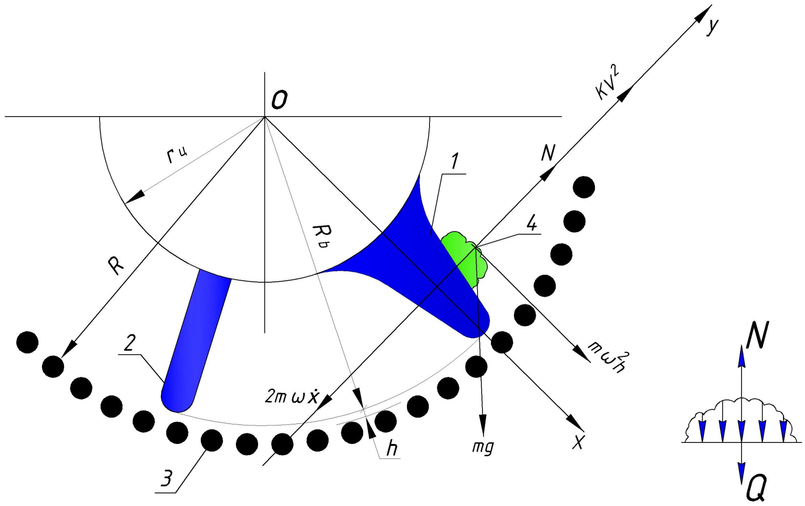
The serrated drums and removable paddle drums rotate in opposite directions. Under the grate of the regeneration section on the platform of electronic scales 22 on the plate 23, planted on the vibration damper 24, a collection of trash 21 is installed. The output of the electronic scales is connected to the control unit of the automatic control unit 25 located on the front panel.

Taking into account the developed scheme, it was planned to study the technological process of the LKM-3 device in order to substantiate its main parameters and operating mode.

Let the cotton flow move along the arc of contact and interact between the elements of the peg drum with the sample of raw cotton when cleaning the round surface of the peg-slat drum with radius (Fig. 2). Set the coordinate system from the center of the cylinder and direct the OX axis in the direction of the drum radius, the OY axis is perpendicular to it [1, 2, 3].

In the developed device LKM-3, on the second along the course, the peg drum is made peg-slatted, therefore, we will consider the distribution of the acting forces taking into account the introduced change. A diagram of the acting forces is shown in Fig. 2.

We take into account the actions of the distributed forces over the area of the bar $\vec{N} = \vec{Q} = \vec{q} \cdot AB$



1- drum bar; 2- drum peg; 3- grates; 4 - a lump of cotton Figure 2. Scheme of the acting resistance forces when cleaning cotton with a peeling-slat drum.

We analyze the process of cleaning small cotton litter, then the equation is written in the following form:

$$\begin{cases} kv^2 + q \cdot AB - 2m\omega\dot{x} - mg\sin\alpha = m\ddot{y} \\ m\omega^2(R_б + h) + mg\cos\alpha - \mu \cdot q \cdot AB = m\ddot{x} \end{cases} \quad (1)$$

The law on the change in the angular velocity of the rotating motion of the drum is determined by

$$\begin{cases} kv^2 + \frac{2}{m}AB - 2\omega\dot{x} - g\sin\alpha = \ddot{y} \\ \omega^2(r_ц + H) + g\cos\alpha - \frac{\mu q}{m}AB = \ddot{x} \end{cases} \quad (2)$$

If we assume equal $\overset{\frown}{AB} = l$, Then:

$$\begin{cases} \frac{k}{m}v^2 + \frac{ql}{m} - 2\omega\dot{x} - g\sin\alpha = \ddot{y} \\ \omega^2(r_ц + H) + g\cos\alpha - \frac{\mu q}{m}l = \ddot{x} \Rightarrow \end{cases}$$

$$\Rightarrow \dot{x} = \left(\omega^2(r_ц + H) - \frac{\mu q l}{m}\right)t - g\omega\sin\omega t + c_1 \quad (3)$$

From the boundary condition $(y)_{t=\tau} = L \Rightarrow$ the final equation becomes:

$$L = \left(\frac{ql}{m} + \frac{k}{m}v^2\right)\cdot\frac{\tau^2}{2} + \left(\frac{\omega\mu q l}{m} - \omega^2(R_б + h)\right)\cdot\frac{\tau^3}{3} - 2\omega^4 g\sin\omega\tau \quad (4)$$

Here: v - is the speed of the clap;

ω - angular velocity;

m - is the mass of the cotton ball;

μ - is the coefficient of friction;

q - is the distributed force;

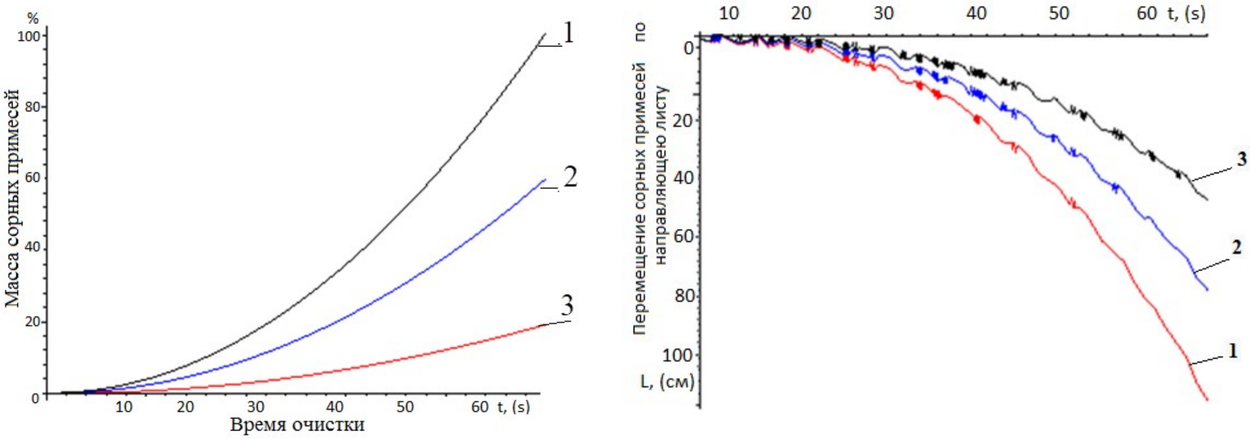
h - is the height of the splitter or strip;

k - coefficient of proportionality;

g - is the acceleration of gravity;

l - is the length of the arc of the cotton ball.

Equation (4) can be used to analyze the process of cleaning the trash impurities passing through the drum strips.



А) Б)

Figure 3. The mass of impurities separated from the cotton ball depending on the cleaning time (A), the speed of impurities from the rotation of the peg-slat drum (B); 1-v = 5.43 m / s, 2-v = 4.43 m / s, 3-v = 3.43 m / s.

From the graphs shown in Figure 3, it can be seen that the speed of rotation of the peg-slat drum is of great importance for the mass of trashes released from the cotton being cleaned and for the value of the movement of trashes separated from the drum.

It is possible to recommend increasing the rotation speed of the peg-slatted drum to 5.5 m/s, taking into account the possible increase in mechanical damage to the seeds contained in the cotton being cleaned.

The actual speed of rotation of the peg-slatted drum will be determined by conducting experimental studies on the developed device LKM-3 to determine the contamination of raw cotton.

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