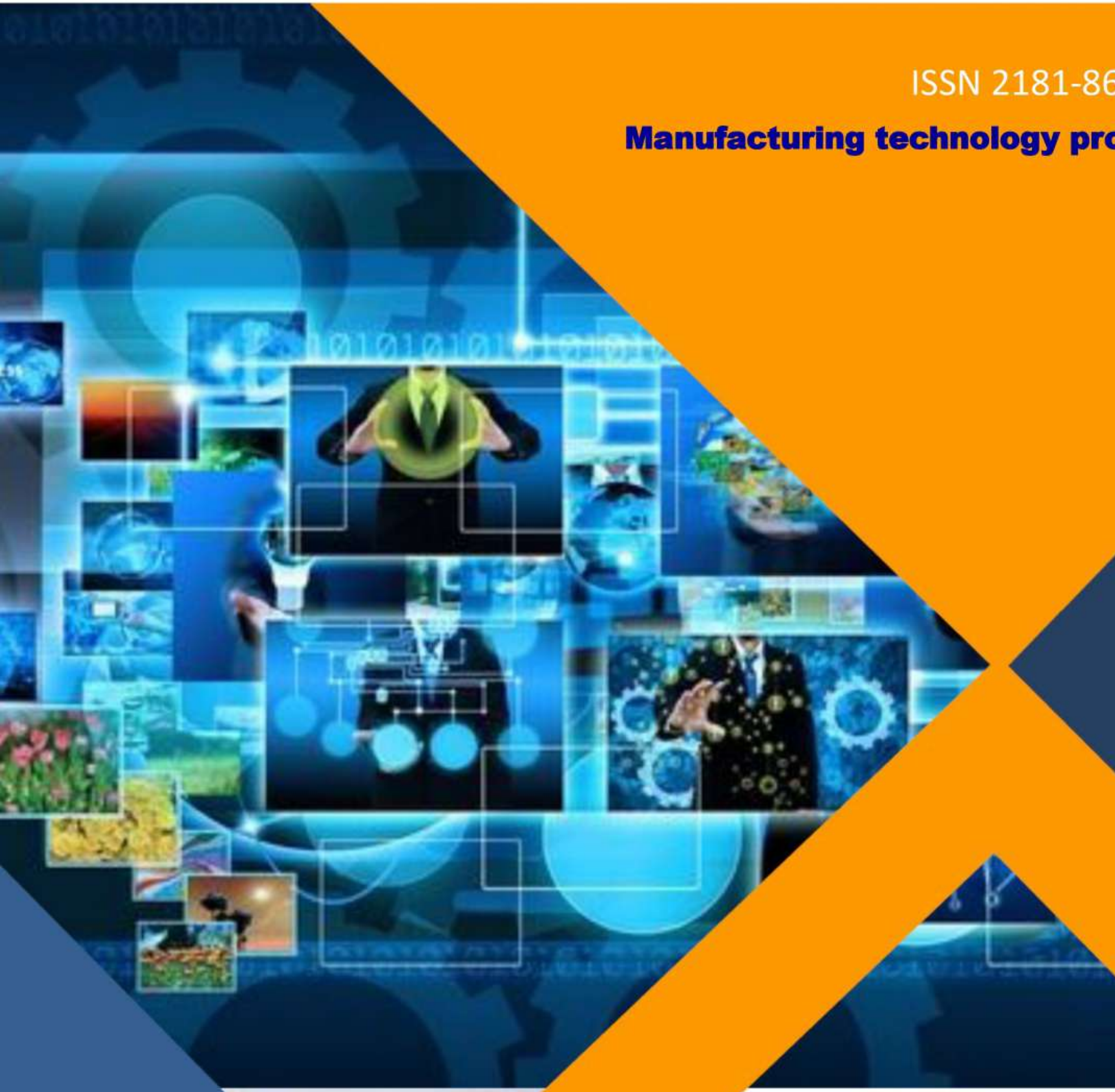

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PROGRESSIVE METHOD OF COTTON REGENERATION

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Abstract: According to the conducted research, the main working parts of the device when extracting fly beads from waste in operating regenerator machines are the sawn-off drum knives and the grate grid, and their location, shape, and influence on each other affect the cleaning. In the devices used, the grate shape is cylindrical. During the operation of the device in the separation of fly beads from waste, cutting off fly beads from mixed waste with the maximum possible efficiency depends on the grate's geometric shape and the blades' location.

Keywords: Cotton regenerator, knife, hexagonal and tetrahedral grate, working elements, deflection angle, equation of motion, projection of external forces, differential equation, Lagrange equation, result.

Introduction. In cleaning cotton raw materials from various impurities, the presence of cotton pieces in the waste generated in large quantities is one of the urgent problems of technological processes. Regenerative devices are widely used to separate cotton pieces from the impurities released during these processes. However, due to their low efficiency in separating cotton pieces, this device's working elements were improved due to our research and development work. Initially, the movement of cotton pieces in the working elements of the existing and newly proposed device and the forces acting as a result of their movement were theoretically studied.

According to the studies conducted, the main working elements of the device for separating cotton pieces from waste in existing regenerator machines are saw-toothed drum knives and a grate with a grate, and their location, shape, and interaction with each other affect the cleaning efficiency. In the current devices, the shape of the combs is a cylinder with a diameter of. During the operation of the device, the ability of the saw teeth to catch the cotton pieces from the waste mixed with cotton pieces, which continuously pass through the device, with the highest possible efficiency, depends on the geometric shape of the combs and the location of the blades. Taking into account the movement of the waste mixed with cotton pieces under the influence of the saw drum in the current combs and the factors affecting it, a new design of working bodies for the regenerator device was proposed, and the movement of cotton pieces in it and the processes of their separation from the waste were theoretically analyzed (Fig. 1).

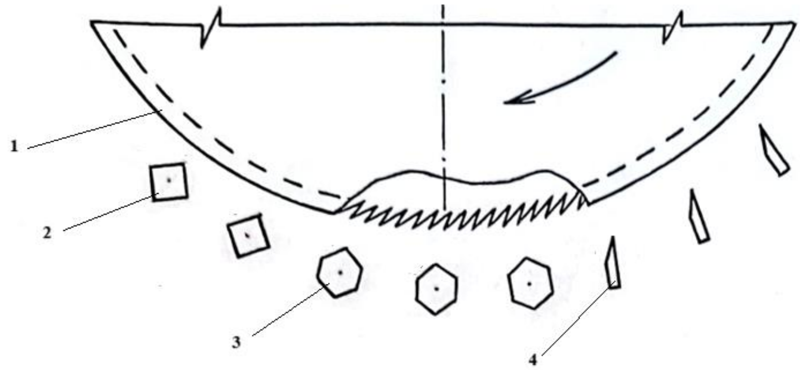

Fig.1. Newly proposed working elements for the regenerator device.
1-saw drum; 2-rectangular bars; 3-hexagonal bars; 4-knives

When separating cotton pieces from a mixture of cotton pieces, the cotton piece is affected by gravity and friction. The pressure of the gravity force conditions the force. Taking the distance *BA=r* as a generalized coordinate, we use Lagrange's equation of the second type to determine the movement of the cotton piece along the tooth of the saw drum, which is the main working body of the device. Let the saw drum teeth be in the position $r=r_0$ when the rotation time *t=0*, let the radius *OB* lie along the horizontally oriented axis *OX*, and let the axis *OY* be perpendicular to it. The center of the saw drum is designated as the origin of coordinates [3].

We write the coordinate location of the mass of cotton pieces on the sawtooth as follows:

$$\begin{aligned} x &= R\cos\omega t + r\cos(\alpha - \omega t) \\ y &= R\sin\omega t + r\sin(\alpha - \omega t) \end{aligned} \tag{2.1}$$

To determine the kinetic energy of a piece of cotton of mass m, we can derive the equation of motion concerning time from equation (2.1) and it is equal to:

$$T = \frac{m}{2}(\dot{x}^2 + \dot{y}^2) = \frac{m}{r}(R^2\omega^2 + r^2 + r^2\omega^2 + 2R\omega\dot{r}\sin\alpha - 2R\omega^2 rCos\alpha) \tag{2.2}$$

Using Lagrange's equation of the second kind, a special derivative is obtained from equality (2.2):

$$\frac{d}{dt}\left(\frac{\partial T}{\partial \dot{r}}\right) - \frac{\partial T}{\partial r} = Q_r \tag{2.3}$$

From equation (2.3), the generalized forces of external forces acting on the flow of cotton pieces on the surface of the saw teeth of the saw drum are determined, and the general and particular solutions of the inhomogeneous equation are calculated.

$$m\ddot{r} = m\omega^2(r - R\cos\alpha) + Q_r \tag{2.4}$$

Here: *Qr*– the following formula finds generalized power:

$$Q_r = \sum X_i \frac{\partial x}{\partial r} + \sum Y_i \frac{\partial y}{\partial r} \tag{2.5}$$

The projection of external forces on the axes *Xi, Yi – OX,* and *OY* is equal to:

$Y_i = mg\sin(\alpha - \omega t)$ $Xi=0$ We form an equation relating the weight of a cotton ball, the frictional force due to weight, and the Coriolis force.

$$F_{TP} = -f \cdot m \cdot g\cos(\alpha - \omega \cdot t) + f \cdot F_{кор} \quad (2.6)$$

Here, the Coriolis force is generated when the jet separates from the sawtooth of the plane.

$$F_{кор} = -2 \cdot \omega_e \cdot \dot{r}_r \cdot \sin\alpha \quad (2.7)$$

Here, the angle α is the angle between the relative velocity and the translational acceleration of the cotton ball, the force P in the compression is the weight of the cotton ball, and the angle λ is the relationship between the surface of the sawtooth.

$$P = S \cdot p\sin\lambda \quad (2.8)$$

Here S is the contact surface of the cotton piece with the tooth and λ is the angle between the force of gravity and the surface of the saw tooth.

$$\lambda = \arcsin\frac{R\sin\alpha}{\sqrt{R^2 + h_0^2 - 2Rh_0\cos\alpha}} \quad (2.9)$$

Taking this into account, the total bond strength of the denture to the tooth is determined by the following formula:

$$Q_r = -mg\sin(\alpha - \omega t) + fmg\cos(\alpha - \omega t) + 2mfr\omega\cos\alpha + P\sin\lambda, \quad (\frac{\pi}{2} < \alpha < \pi) \quad (2.10)$$

The second-order inhomogeneous differential equation for determining the motion of a piece of cotton under the action of the teeth of a sawing drum is as follows:

$$\ddot{r} - \omega^2 \cdot r + 2 \cdot f \cdot \dot{r}\omega \cdot \cos\alpha = -\omega^2 \cdot R \cdot \cos\alpha - g[\sin(\alpha - \omega t) - f\cos(\alpha - \omega t)] + (\frac{Q}{\rho \cdot \vartheta} - \vartheta_0) \cdot P \cdot \sin\lambda$$

(2.11)

Here: at $t=0$, we take $r=r_0$, $\ddot{r} = 0$, and find the initial condition for the movement of the cotton ball along the saw teeth of the saw drum. Condition $\ddot{r}(0) > 0$ must be fulfilled, giving the following:

$$\omega^2 r_0 - \omega^2 R\cos\alpha - g(\sin\alpha - f\cos\alpha) + \overline{P}\sin\lambda > 0$$

$$\ddot{r}(0) > 0 \quad (2.12)$$

Conclusion.

1. The movement of cotton, various impurities in the inlet and working chamber of the regenerator device, and the forces acting on them were determined.
2. As a result of the analysis of the working elements of the regenerator device, the effect of their geometric shape on the cleaning efficiency was studied.
3. The main working elements of the device are a saw drum, knives, and a grate, the location, shape, and interaction of which affect the cleaning efficiency.
4. Having determined the conditions for the separation of waste mixed with cotton chips in the current processes, polygonal grates with the highest efficiency were proposed.

5. The movement of the working elements of a new type of regenerator device relative to each other and the movement of cotton chips in them were theoretically studied when separating cotton chips from impurities.

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