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Experimental Study of the Interaction of Multifaceted and Cylindrical Spiky Cylinder in Cotton Cleaner From Small Waste

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ABSTRACT: The article presents the results of experimental studies of a drum drum with multifaceted prismatic and cylindrical pegs for cleaning cotton from small waste. Also the scheme and principle of work of an effective design of a drum with multifaceted and cylindrical spiky of cotton cleaner from small waste is given. Given the results of experimental studies to determine the strength of the interaction of spiky with cotton at different performance of the cleaner.

KEYWORDS: cotton cleaner, small waste, cylinder, spiky, multifaceted, cylindrical, interaction, impulse, strain gauging, effect.

I.INTRODUCTION

The main working bodies of cleaning machines from small waste are the spiked cylinder and the grid bar. The intensity of the cleaning of raw cotton from small waste depends not only on the rational design of the cylinder, but also on the correct choice of cleaning grid bar, which remove weed impurities from the working zone of cleaning. The requirements for the design of the mesh surface come from the general research strategy, in other words, with the minimum impact on raw cotton - the maximum cleaning effect is achieved.

In the existing cotton cleaners of small waste, the main working bodies are the spiky cylinder and the mesh surface under it. In order to increase the effect of cleaning cotton from small waste, it is necessary to intensify the effect of cylinder chops on raw cotton, as well as equip the drainage grid with activating elements, create designs of oscillating grids. At the same time, it is possible to achieve the required cleaning effect with a minimum cleaning ratio that allows not only obtaining high-quality products, but also reducing energy costs. At the same time, domestic and foreign researchers and specialists mainly pay great attention to the study and improvement of the spiked cylinder, in particular the construction of the hammer [1].

The cylinder cleaner of fibrous material, containing a cylindrical shell with strips and spiky fixed on them, installed by longitudinal rows are widely used in production cleaning lines. The disadvantage of this design is that due to the unsatisfactory capture of material by the spiky and dragging them along the perforated surface, a low cleaning effect is observed. In addition, evenly installed cylinder heads result in the monotony of the impact of the latter on the cotton bat. Since the waste is in cotton - raw material in a chaotic state at different depths, the monotony of the impact effects from the spiky does not provide optimal conditions for the separation of waste from arbitrary coordinates of location and occurrence on the surface of cotton raw.

In the spike cylinder of a fiber material cleaner, in order to eliminate the monotony of the impact, it was proposed to create flat working surfaces on the working part of the spiky and to install in a mixed order in each row of the cylinder at an angle of 30^0 relative to the direction of movement of the cotton - cotton particles [2]. This design leads to significant damage to the fibers and seeds of cotton.

We recommend a more efficient design of the cylinder [3]. The essence of the proposed design lies in the fact that the spike cylinder contains a cylindrical surface and rows of spiky installed on it, while the spikes are made of a cylindrical and multifaceted prismatic shape, which are mounted on the cylindrical surface of the cylinder in a checkerboard pattern. The chess arrangement of the cylindrical and multifaceted spiky allows the impact on the fibrous material with cyclically varying impulse force, which leads to the intensive release of small trash from the raw cotton.

The design consists of a cylinder 1, cylindrical 2 and multifaceted 3 spiky installed in a staggered manner on the surface of cylinder 1 (Fig. 1). In the process of operation, during the rotation of the cylinder 1, the splitting 2 and 3

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alternately alternating with will affect the fibrous material. In this case, the impulsive force of impact on cotton will change cyclically, which will lead to an intensive release of small waste from cotton. Depending on the characteristics of the original cotton, you can choose the required number of edges spiky 3.

The use of a spike cylinder of a fibrous material with cylindrical and multi-faceted spikes allows a significant increase in the cleaning effect.

View A Increased

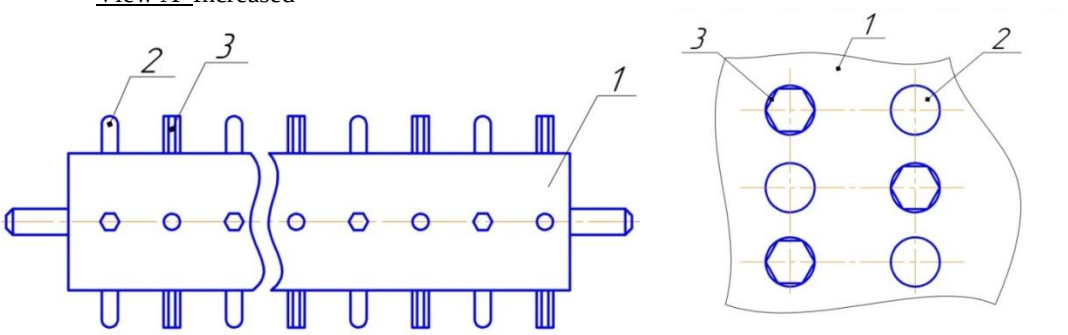


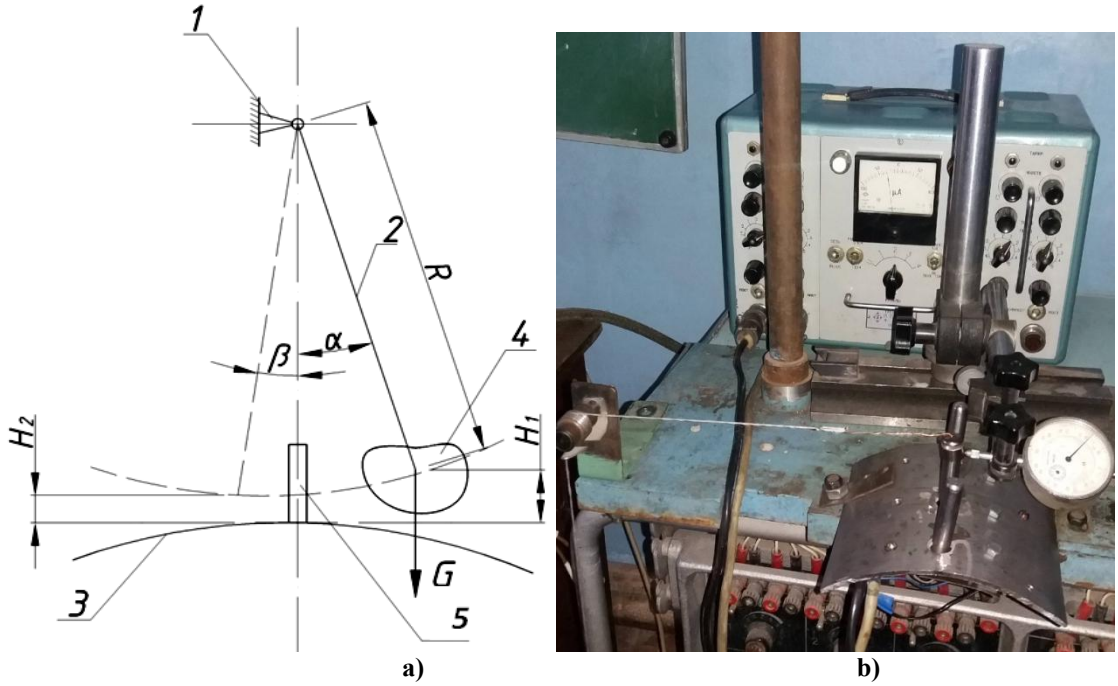
Fig. 1.Spikedcylinder of cotton cleaner

1 - cylinder, 2 - cylindrical spiky, 3 - multifaceted spiky

To ensure a significant effect of the interaction of spiky with cotton with minimal damage, experiments were conducted to determine the impact force of multifaceted and cylindrical spiky on cotton - raw. The experiments were carried out using the method of strain measurement [4,5,6].

The scheme and general view of the experimental setup are shown in Fig. 2. The experiments were carried out according to the following procedure.

A pendulum 2 with mass G at the end of which a shred 4 of raw cotton mass is fixed which, together with pendulum 2, rises to a height H_1 at the angle of inclination of the pendulum 2 (angle α) and lowers, a sample is set in the falling path (spike 5 with a circular or multifaceted section connected by an elastic element 3 with strain gauges). Falling, a scrap of 4 cotton, then - there is a fly with a pendulum 2 hits a spike 5 and rises to the height H_2 (angle β). H_2 height is less than H1, since part of the energy of the pendulum 2 is spent on the bending of the plate, 3 on which is fixed a spike 5.



a) **b)**

Fig.2. a) Diagram of the experimental setup for studying the impact force of a spike and (b) the general type of installation for measuring the impact force of a spike of a fixed cylinder

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The work performed by the pendulum 2 when falling before a collision with a sample is determined from the expression:

$$A = G \cdot H_1 \quad (1)$$

Where$G$ is the mass of the pendulum; H_1 is the height of the pendulum lift before impact.
The height H_1 can be determined from the following expression:

$$H_1 = R - R\cos\alpha = R(1-\cos\alpha) \quad (2)$$

In the case when $H_2 = 0$ or $\beta = 0$, no bending occurs, and the work expended on the elastic deformation of the specimen is determined.

$$A = G \cdot R(1-\cos\alpha) \quad (3)$$

If $H_2 \neq 0$ or $\beta \neq 0$, then the work A spent on bending the plate will be equal to

$$A = G \cdot H_1 - G \cdot H_2 = G(H_1 - H_2) \quad (4)$$

Since $H_1 = R - R\cos\alpha$, and $H_2 = R - R\cos\beta$, the plate deformation will be equal to

$$A = G \cdot R(\cos\alpha - \cos\beta) \quad (5)$$

Impact load σ (j/m^2) the sample is
The relation of work And to the area of its cross section:

$$\sigma = \frac{A}{F} \quad (6)$$

The mass of the rod of the pendulum is m_r = 367 g, the mass of the striker m_c = 299 g ,
Estimated Weight: $M_E = m_r/2 + m_c$= 367/2+299 = 482,5 g,surface cylindermer weight 101,6 g, weight of mounting bolts 55,2g, total weight M_{tw}= 482,5+55,2+101,6=639,3 g, the rod length of the pendulum is R = 469mm.

In the process of splitting, there are forces that contribute to tearing it from the cylinder surface with the force of inertia of the impact force from the mass of cotton to the grille dragged by the raw material leading to dragging it along the surface, which in turn causes the splitting to bend relative to the installation axis. The scheme of forces is shown in Fig.3.

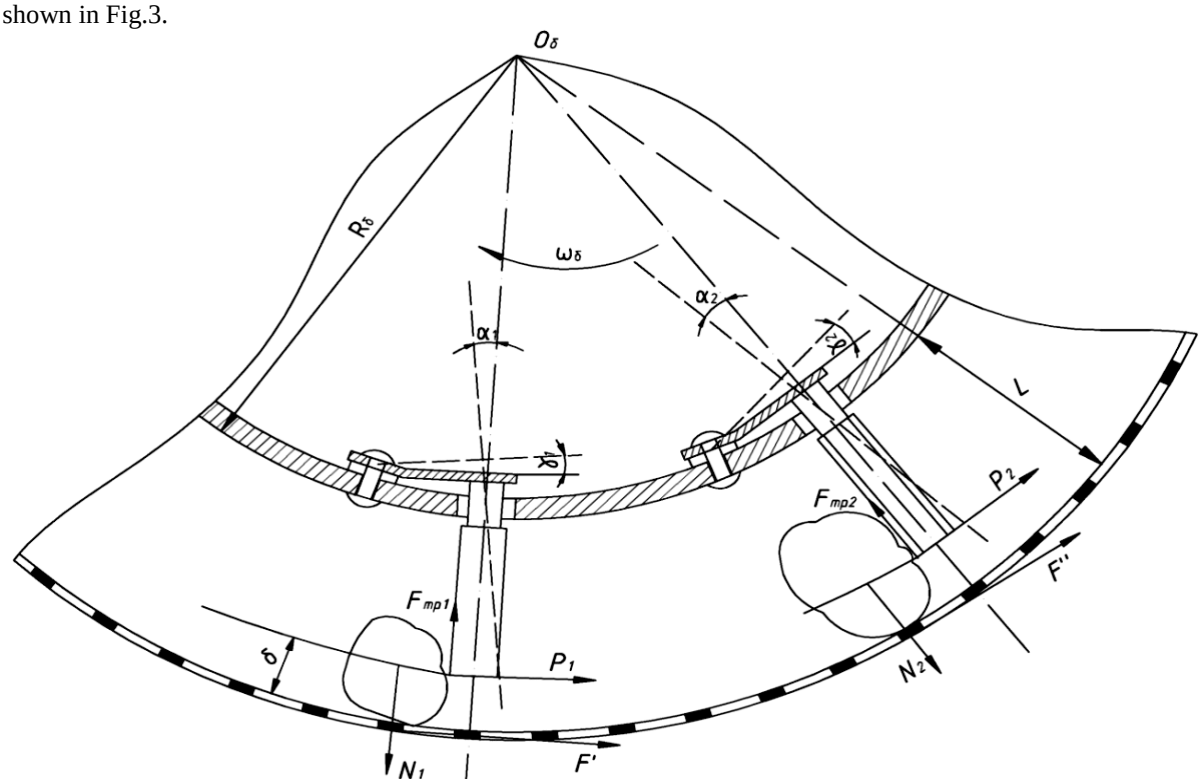

Fig. 3. The scheme of forces in the interaction of the hammer with fly.

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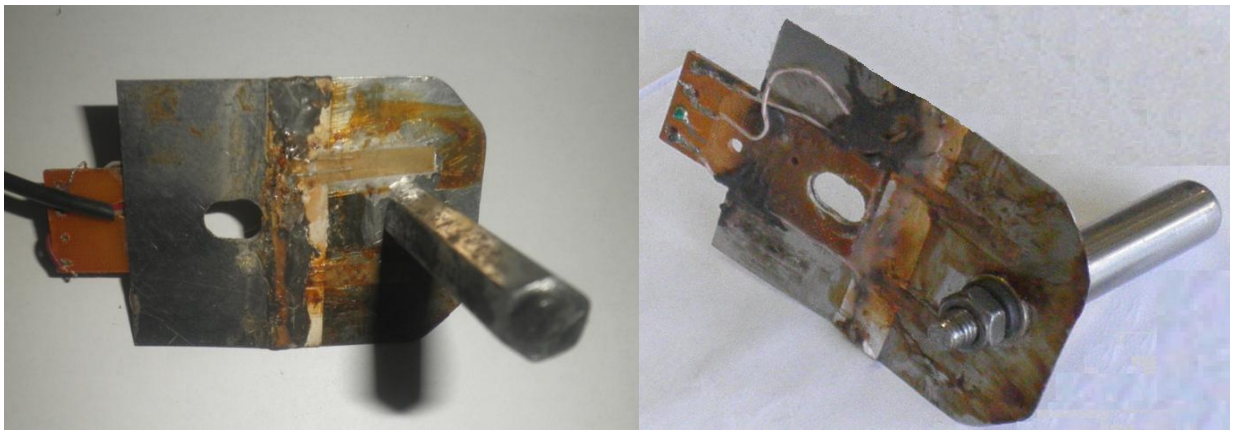
In studies, the force P was measured for different machine performance. To conduct experimental studies, we beat samples of volatile particles with seeds of mass that are given in Table 1.

table 1.

Mass of flyers N.	0,05	0,1	0,15	0,20	0,25
Impact force N.	0,1	0,125	0,195	0,23	0,3

In fig. 4 shows the experimental samples of multifaceted (a) cylindrical (b) jibs with an elastic plate support.



a) multifaceted peg with a mounting plate and strain gauges to control the load force on the spike.

b) A cylindrical peg with a mounting plate and strain gauges to control the load force on the spike.

Fig. 4. Cotton cylinder cleaning spiky

In fig. 5 shows the oscillogramm characterizing oscillations of multifaceted and cylindrical spiky at single interactions with cotton during its cleaning in an experimental setup. The analysis of the oscillograms shows that the amplitude of oscillations of the load on a multifaceted peg is more (7 ÷ 11%) in relation to the amplitude of the load (oscillations) on the cylindrical peg of the cylinder of the cotton cleaner from small waste. At the same time, with increasing machine performance, the load on the cylinder spiky increases. Table 2 presents the values of loads on pegs.

table 2.

Productivity	**Productivity is 3 tons / hour.**	**Productivity is 3 tons / hour.**	**Productivity is 3 tons / hour.**
Spike type	Spiked loadN.		
cylindrical spiky	1,75	2,2	2,8
multifacetedspiky	1,9	2,45	3,1

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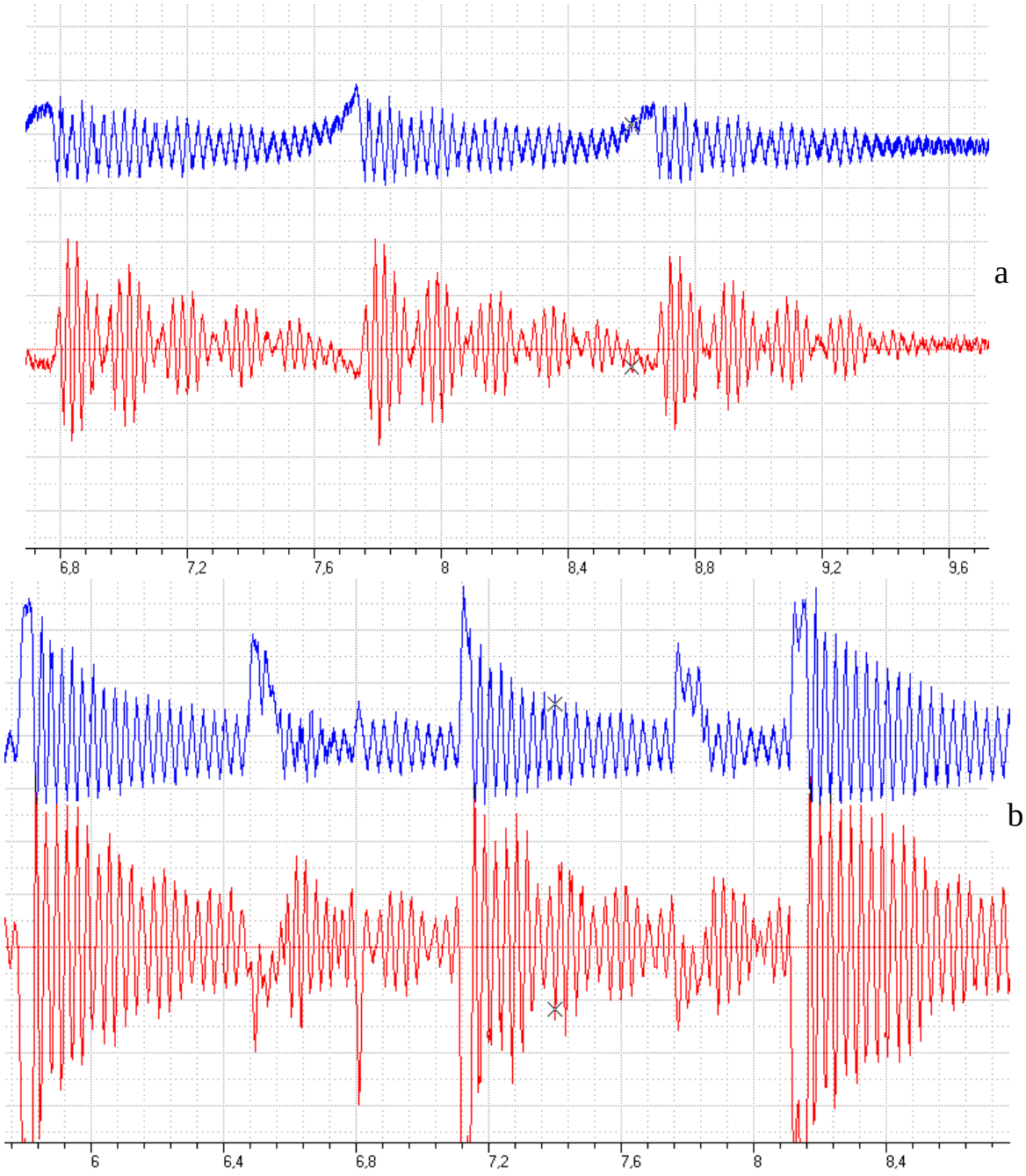

a - record with a load of 3.0 tons / hour
b – record with a load of 3.0 tons / hour

Fig. 5. Oscillograms characterizing the loading of multifaceted and cylindrical cylinder spikes.

It is known that in existing cylinders with cylindrical pegs, the interaction of spiky with cotton passes monotonously, the cleaning effect will not be high. In the proposed cylinder design, multi-faceted and cylindrical spiky with alternation will affect cotton with varying load (impulsive blows) [7,8], while the effect of cleaning from small waste increases significantly.

II.CONCLUSION

A new efficient cylinder design with multifaceted and cylindrical spiky is recommended. The experiments determined the values of the forces acting on the spiky with different performance of the cotton cleaner.

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