ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 9 , September 2019

Improvement of designs and methods for calculating the parameters of vibrating polyhedral furnace bar

A.Djuraev, S.Elmonov,A.Nuriddinov, A.Gadayev

Doctor of Engineering Science, Department of Technological Machines and Equipment, Tashkent Institute of Textile and LightIndustry, Tashkent, Uzbekistan
Doctor of Philosophy, Department of labor education, Samarkand State University, Samarkand, Uzbekistan
Teacher, Department of labor education, Samarkand State University, Samarkand, Uzbekistan
Teacher, Department of labor education, Samarkand State University, Samarkand, Uzbekistan

ABSTRACT: The article describes the principle of operation of the recommended multifaceted grate on elastic supports, analyzes the analysis of grate vibrations, and substantiates the parameters. The results of comparative production tests are presented.

KEYWORDS: Cleaner, furnace bar, multi-faceted, rubber sleeve, oscillation, stiffness, law of motion, effect.

I.INTRODUCTION

Relevance. The maximum preservation of the natural qualities of cotton should be based on improving the design of machines and equipment for the primary processing of cotton and creating effective working bodies for machines that work on cotton. The main indicator of the operation of ginning machines is their ability to isolate litter, uluk and various impurities from raw cotton while preserving the natural qualities of fiber and seeds as much as possible [1].
At the same time, one of the drawbacks of existing machines and mechanisms for cleaning raw cotton is the low efficiency of the impact of working bodies on the processed material. This leads to an increase in cleaning ratio. Repeated exposure to raw cotton on existing mechanisms and machines damages fibers and seeds, reducing their natural qualities [2].
Therefore, the creation of new highly efficient vibrating polyhedral grates on the elastic supports of cotton cleaners from large litter, the development of methods for calculating their main parameters is an urgent scientific and technical task of the industry.

II. DESIGN OF A MULTIFACETED GRATE ON AN ELASTIC SUPPORT

To reduce the multiplicity of cleaning cotton from fine litter by intensifying the impact on the cotton of the elements of the cleaning zone, a new grate design has been developed.
The design consists of polyhedral grates 1, which are installed in the arcuate slats 4, by means of elastic bushings and a rotating saw cylinder 2 (see. Fig. 1).
In the proposed design, the process of cleaning the fibrous material is as follows. In the process, the raw cotton (fibrous material) enters the saw drum 2, the teeth of which capture the raw cotton and drag it along the grate. In the area of operation of the saw drum 2, the cotton hits the polyhedral grates 1.
In this case, the force and direction of blows in the direction of rotation of the drum 2 will be different due to the different number of faces of the grid-irons 1. In this case, with an increase in the number of faces of the grid-irons, the impulsive force of the impact of cotton on the edge of the grid-irons 1 decreases, and with a decrease in the number of faces of the grid-irons 1, on the contrary, the force increases hit. Such an interaction of cotton with polyhedral (various amounts) grates 1 contributes to the selection of weed impurities of different masses and with different depths in the cotton from raw cotton.
To control the cleaning process of raw cotton, the installation of grates 1 along the rotation of the drum 2 is carried out according to a sinusoidal law. At the same time, the monotony of the process is eliminated, the magnitude of the

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 9 , September 2019

direction of the impulsive impact of the cotton on the different faces of the grates 2 cyclically changes, which contributes to a significant release of weed impurities from raw cotton.

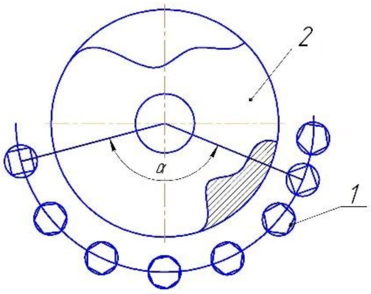


Fig. 1

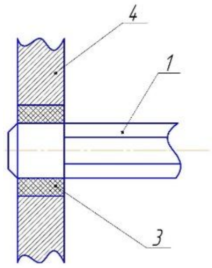


Fig. 2

Fig. 1. Grate of the fiber cleaner

Generalized expressions by which it is possible to determine the number of faces of grates are as follows:
$n_{i+1}= n_i+1$; $n_{i+2}= n_i+2$; $n_{i+3}= n_i+3$; $n_{i+4}= n_{i+2}$; $n_{i+5}= n_{i+1}$; $n_{i+6}= n_i$; $n_{i+7}= n_i+1$; $n_{i+8}= n_i+2$; $n_{i+9}= n_i+3$; $n_{i+10}= n_i+8$
where ni, ni + 1, ... ni + 10 is the number of faces i, i + 1, ..., i + 10-x grates.
For the embodiment of FIG. 1 corresponds to the graph of FIG. 2, where for i = 1; n1 = 4; n2 = 2; n3 = 6; n4 = 7; n6 = 5; n7 = 4; n8 = 5; n6 = 6; n10 = 7 etc.
The period of change in the number of faces is selected depending on the size of the grid-irons 1, the inter-grid-gap, the dimensions of the drum 2 and the gap between the grid-irons 1 and the drum 2.
Installing grates 1 in the arcuate planks 4 by means of elastic (rubber bushings) allows an increase in the process of separating litter from cotton due to additional vibrations of the grates 1.

III. CALCULATION OF THE PARAMETERS OF THE GRATE

Taking into account the random function of the disturbing force from the raw cotton, the nonlinearity of the restoring force of the elastic support, its dissipative characteristics, taking into account the works [1,2,3], we can write the equation of the oscillatory motion of the polyhedral grate in the form:

$$m\frac{d^2x}{dt^2}+в\frac{dx}{dt}+c_1x+\frac{c_2}{\mu}x^3=M(F_в)\pm\delta(F_в) \qquad (1)$$

where, in - coefficient of internal resistance of the elastic support of the grate.
In this case, the following calculated parameter values were taken into account:

$$m=4{,}0Hc^2/м;\ c_1=2{,}5\cdot10^4H/м;\ c_2=0{,}12\cdot10^4H/м;\ в=60\ Hc/м;\ \mu=1{,}0м^2;$$

$$M(F_k)=19{,}67+0{,}98\sin(x+55^012')+7{,}83\sin(2x+112^014')+$$
$$+1{,}8\sin(3x+103^023')+3{,}37\sin(4x+4^039')+$$
$$+6{,}96\sin(5x+93^024')+2{,}7\cos 6x$$

From the analysis of the experimental data and their processing by the method of mathematical statistics, the mathematical expectation of the perturbation force from the cotton to the grate was determined and its possible variations both in frequency and amplitude.
Figure 2 shows a fragment of the displacement, velocity, and acceleration of a polyhedral grate on an elastic support with a nonlinear restoring force at $m=3{,}0\,Hc^2/м$ и $c_1=2{,}5\cdot10^4H/м$, $c_2=1{,}2\cdot10^4H/м$, $M(F_в)=12{,}5H$, $\delta F_в=(0{,}8\div1{,}1)H$.
It should be noted that the grate oscillation frequency is (40 ... 55) Hz. In this case, the high-frequency component of the grate oscillations is (147 ... 178) Hz.
The low-frequency component of the forced oscillation frequency corresponds to the rotational speed of the saw cylinder of the UHK unit, and the high-frequency component corresponds to the number of grid-irons in the section.
From fig. Figure 2 shows that in forced vibrations of the polyhedral grate, the grate deviates on average by an amount and the amplitude of the oscillations at the calculated values of the parameters is

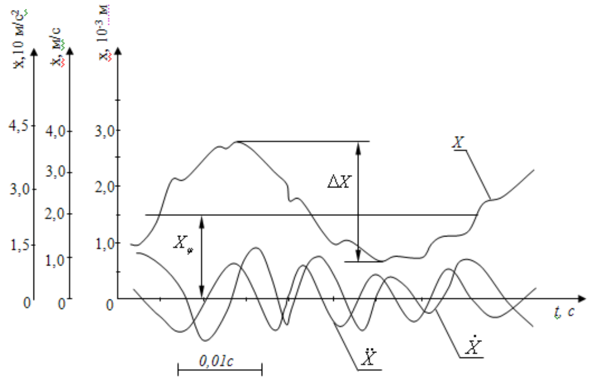
ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 9 , September 2019

For cylindrical grates on elastic supports according to [2], the amplitude of the oscillations is Comparison of the results shows that in the proposed design of the polyhedral grate, the amplitude of vibrations decreases by 20–25% due to the nonlinear rigid characteristic of the elastic support. The values of and change in a similar way. The range of velocity fluctuations reaches from 0.6 m / s to 1.25 m / s, and the amplitude of the acceleration oscillations at the calculated parameters of the system varies within (6.5 (10) m/s^2. The frequency of fluctuations in speed and acceleration corresponds to the high-frequency component of the technological load from cotton.

In fig. Figure 3 shows the graphical dependence of the change in the range of displacements, speed, and acceleration on the increase in the mass of the grate of the grate. It is known that with an increase in the mass of the oscillatory system, a large force will be required for its perturbation, that is, with an increase in mass, the amplitude of oscillations of the polyhedral grate decreases. With an increase in the mass of the grate from 1.0 ns2 / m to 5.0 ns2 / m, the oscillation range of the polyhedral grate decreases from to m according to a nonlinear regularity. Regarding the considered oscillatory system, it should be noted that with an increase in the mass of the grate, the decrease in speed and acceleration is also nonlinear. Particularly, the intensity of the decrease in the range of oscillations also decreases with increasing mass. This is due to the nonlinear rigid characteristic of the elastic support. In this case, with an increase in the load on the grate, the strain rate of the elastic support decreases, which leads to a decrease in the amplitude of vibrations of the grate

Recommended mass values for polyhedral grates are (3.5–4.0) ns2 / m.

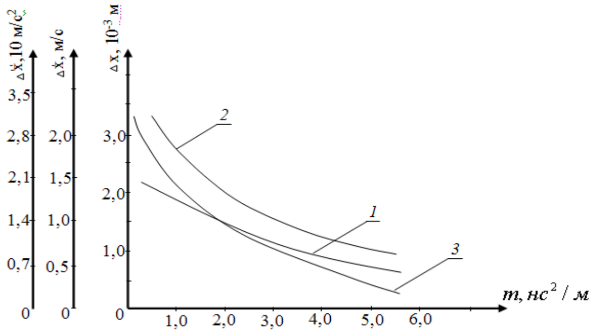
In the process of cleaning raw cotton from large litter, it is important to limit the amplitude of vibrations of grates. Since these fluctuations directly affect the gap between the grate and the saw cylinder. The values of the amplitude of oscillations of polyhedral grates in our case are governed by the nonlinear stiffness characteristics of the elastic support.



at $m = 3{,}0 нс^2 / м$; $c_1 = 2{,}5 \cdot 10^4 н/м$

$c_2 = 1{,}2 \cdot 10^4 н/м$ $M(F_в) = 12{,}5$ H $\delta F_в = (0{,}8 \div 1{,}1)$ H

Fig. 2 Changes in the displacement, speed, and acceleration of the polyhedral grate on an elastic support under random disturbance.

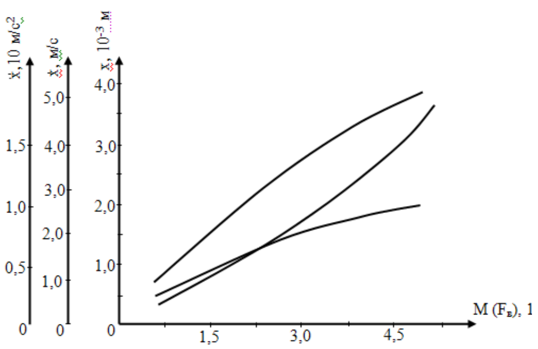


$1 - \Delta X = f(m); 2 - \Delta \dot{X} = f(m); 3 - \Delta \ddot{X} = f(m);$

at $c_1 = 2{,}5 \cdot 10^4 H/м$; $c_2 = 1{,}2 \cdot 10^4 H/м$;

deviations $\delta\Delta X, \delta\Delta\dot{X}, \delta\Delta\ddot{X} = (10 \div 12)\%$

Fig. 3 Graphical dependence of the change in the range of oscillations of movement, speed and acceleration of the polyhedral grate from the change in mass



In this case, deviations

$\delta x, \delta \dot{x}, \delta \ddot{x}, = (8{,}0 \div 10)\%$ $c_1 = 2{,}5 \cdot 10^4 н/м$

$c_2 = 1{,}5 \cdot 10^4 н/м$

Fig. 4. Dependences of changes in displacement, speed, and acceleration of polyhedral grates as a function of resistance to cotton.

Studies have shown that an increase in the stiffness coefficient of an elastic support leads to a proportional decrease in the amplitude of oscillations of polyhedral grates. To ensure oscillations of polyhedral grates with an amplitude (0.5÷1.0) $\cdot 10^{-3} м$, the nonlinear component of the stiffness coefficient of the elastic support should have values (1.42.0)$\cdot 10^{4} н/м$, and the stiffness coefficient. The change in the thickness of the rubber sleeve is up to $3{,}0 \cdot 10^{-3} м$ (for rubber grade HO-68).

Figure 4 shows the graphical dependences of changes in the displacement, speed, and acceleration of polyhedral grates on elastic supports with nonlinear stiffness when the load is varied from raw cotton. With an increase in resistance from cotton from 19.7 N to 60 N (average value), the movement of the grate increases from 0.65 to. In this case, the oscillation velocity increases nonlinearly to 2.45 m / s, and the acceleration increases to 21 m / s^2. In this case, deviations and depending on the random component of the load are within (8.0–10)%. To prevent the loss of bridges between the grates due to the large oscillation amplitudes of the grates and to reduce the technological gap between the saw drum and the grates, the amplitude of the polyhedral grates should not exceed the results of experiments.

Therefore, in order to provide the necessary oscillation amplitudes of polyhedral grates, it is advisable to choose the resistance from raw cotton in the range of (25–35) N, which corresponds to (5.0–7.0) T / h in the UHK machine.

IV. THE RESULTS OF THE USE OF MULTIFACETED GRID-IRONS ON ELASTIC SUPPORTS

Based on the results of a full-factor experiment, the following optimal values of the parameters of the coarse cleaning zone were recommended: the rotational speed of the saw drum - 300 rpm; the conicity of grid-irons on elastic supports -0.015; stiffness of the elastic support (rubber brand) HO – 68 ($c_1 = 3{,}0 \cdot 10^{4} H/м$; $c_2 = 1{,}6 \cdot 10^{4} H/м$.)

With these values of the parameters of the zone of large-scale cleaning of the UHK machine, a high cleaning effect is obtained, mechanical damage to the seeds and free fiber in the raw cotton are reduced. With these parameters, the grate of the coarse cleaning section of the UHK purifier was manufactured.

During testing, the recommended design of the grate with conical grates on elastic supports showed high reliability and stability. The test results showed that the cleaning effect compared to the existing version of the grate is increased on average by 8.11%, the mechanical damage to seeds is reduced by 1.09%, the free fiber in raw cotton is halved, by 0.113%. This is due to the fact that when the raw cotton interacts with the vibration-insulated conical grate, the cotton-raw shakes additionally, their course of movement increases due to the conicity of the grate, which leads to an increase in the cleaning effect. In addition, the interaction of raw cotton flies with grate will be elastic [3,4,5]. This is to reduce the mechanical damage to seeds, as well as to reduce the formation of additional free fiber.

V. CONCLUSION

A new effective design of the grate with conical grates on elastic supports with variable thickness has been developed. On the basis of a numerical solution of the problem, the nature and form of vibrations of the polyhedral grate of a cotton cleaner or large litter is obtained. The results of comparative production tests showed that with the recommended parameters of the cleaner using polyhedral grates on elastic supports, the cleaning effect increases by 8.11%, mechanical damage to seeds decreases by 1.09% and free fiber decreases by 0.113% in raw cotton.

REFERENCES

[1] A. Djuraev, J. Mirakhmedov and others. Theoretical foundations and improving the design of the grate of cotton cleaners from large litter // Monograph. Ed. Fargana, 2013 ISBN 978-9943-349-70-8 120 s.

[2] A. Dzhuraev, R. N. Tadzhtboyev, H. Nurullaev, Z. Toshboev. Grate of the fiber cleaner. Patent Res Uzbek. IAP 03338 Bull. No. 4, April 30, 2007.

[3] Kholturaev H.P. A.J. Juraev. Mirakhmedov J.Yu. A.V. Abdullaev. On the vibrations of chopping on an elastic base in cotton cleaners. Abstracts of RNPK for young scientists “Prospective development of technology of technology of cotton, textile, light and printing industries” Tashkent-2009, p. 11

[4] Mirakhmedov D.Yu. Kholturaev H.P.A.J.Dzhuraev. A.V. Abdullaev. Grate of the fiber cleaner. Patent Res Uzbek. FAP 00428 Bull. No. 12 2008.

[5] U. Karshiev, J. Mirakhmedov, H. Nurullaev, A.V. Abdullaev. Efficient grate for cotton cleaners. Abstracts of the first international Joldasbekov symposium, Almaty, 2011, from 77-78.