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INVESTIGATION OF WORKING PARTS OF FIXED DEVICE DESIGNED TO SEPARATE SPINNING FIBERS FROM FIBROUS WASTE THAT CAN BE SPUN

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ABSTRACT: This article examines the shaft strength of a spiked cylinder, a device designed to separate spinning fibers from fibrous waste (lint) produced at a gin. The study studied the number of fractions in the fiber mixture produced at the plant, as well as the characteristics of short fibers, developed a technological scheme of the new fiber separation device and gave the principle of its operation, the main factors influencing its operation. Then the strength of the spiked cylinder shaft, which is the main working body of the device, was studied. The study determined the resistance of the shaft to vibration as a result of periodic loading and the frequency of vibration along its axis through the critical rotational frequency.

KEYWORDS: Cotton, cotton fiber, spiked cylinder, headset, spinning, tension, fiber waste, lint.

I. INTRODUCTION

It is known that cotton fiber plays an important role in the economy of Uzbekistan. This issue has been highlighted not only in modern research, but also in many scientific studies conducted in any period of the Republic [1,2,3].

The industrial grade of cotton fiber is determined by the indicators of tensile strength, maturity, defects and contamination, moisture content (as a percentage of dry weight). Tensile strength and maturity are the most important criteria in determining the industrial grade of cotton fiber. The indicators of the introduction of cotton fiber in this or that industry navigation according to the state standard are given in Table 1 [4,5,6].

During the processing of cotton seeds, the complete hairs of the cotton seeds and their residual fiber (after fiber separation) are analyzed. And if the less hair is covered, the more oil is extracted from cottonseed in the production of oil or the more sprouts are grown in agriculture.

Place tables as close as possible to the text they refer to and aligned center. A table is labeled *Table* and given a number (*e.g.,* Table 1. Sample Datasheet with Attributes in Linguistic Term) it should be numbered consecutively. The table label and caption or title appears 12pt space above the table, 6pt space after the text or paragraph if any; it should be uniforms fonts and font size, and use 10pt font size and Helvetica style, capitalized similar to paper title, aligned center and bold face. Sources and notes appear below the table, aligned left. All tables must be in portrait orientation.

Table 1. Indicators describing the type of cotton fiber

Indicators	Norms by sorts						
	higher	I	II	III	IV	V	VI
Breaking strength	4.6 and more	4.8-4.4	4.3-3.4	3.8-3.4	3.3-3.0	3.9-2.5	Less than 2.5
Maturity coefficient	2.1	2.0	1.8	1.6	1.4	1.2	no less than1.2
Defects and pollution, in %	1.9	2.1	2.6	3.5	5.3	8.6	12.8
Moisture relatively to dry fiber weight, in %	8.0	8.0	9.0	10.0	11.0	12.0	12.0

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(for all cotton-growing districts)							

In addition, the size of the seed coat is of great importance for its proper use in industry as a fiber raw material. The lower the hair coverage of the processed seed, the more short fibers are obtained from the fiber coating of the seed.

Before fiber separation depending on the quality of cleaning the seeds, the growing conditions of the cotton, and the maturity of the seeds that brought in for processing, the short fiber will have different amounts of specific grains. According to the state standard, short-fiber industrial varieties are determined by the following quality indicators: maturity, staple length, contamination, ash content, seed weight and moisture [7,8].

Short fiber is divided into varieties, sorts and qualities depending on the above mentioned indications.

Short fiber is divided into three types depending on the length of the staple. Type I - staple length more than 20 mm; Type II - staple length from 11 to 20 mm; Type III - staple length less than 11 mm; and is obtained from not more than 11 percent hair-covered seeds. Short fibers type I and partially type II are mainly used in industry for downy hair.

Short fiber type III is used in the chemical industry. The main requirement for the quality of the hair used in this network is its cleanliness - very little contamination with external impurities and uniformity of length. It is not allowed for 3 types of short fibers to contain fibers with a length corresponding to another type [9].

In the production of textile products from cotton fiber, part of the raw materials delivered to the enterprise are separated into waste. In particular, the amount of waste in spinning according to the spinning system is on average about 20% of the mixture, 12-18% in the card spinning system and 32% in the re-spinning system. When weaving fabrics from yarn, the amount of waste is up to 5% [10].

If we take into account the waste generated in the process of dyeing and dyeing of fabrics, the production of garments from fabric, it is clear that the average amount of waste generated per year is several tens of thousands of tons. In addition, if we take into account the volume of non-consumable products used by the population of the Republic in many areas of industry, medicine and technology, and textiles that are no longer suitable for direct use, this amount will increase several times.

At present, the textile and light industry enterprises face great challenges. In particular, programs and measures are being developed for the production of cotton yarn and fabrics that can meet the requirements of world standards [11,12].

In ginnery, gin and linters are separated from the gutters, cyclone and dust chambers, fluff, fiber cleaners and saw-cylinder cleaners. The fiber extracted from the processing of fibrous waste is used as a raw material in the textile industry and other industries.

II. RESEARCH METHODS

According to the State Standard, fibrous wastes of ginneries are divided into three types depending on their quality: fibrous cotton regenerated (re-separated) cotton fiber, cotton wool.

In spinning mills, the spinning fibers in the lint-bearing mass are also pressed. The long fibers in the fleece are the result of incomplete separation of the fibers of the cotton seed by gin machines. Completely ginned seeds are usually separated from the total mass using a regenerator and returned to the gin machine. But this condition reduces the productivity of gin labor, leading to an increase in seed damage. As a result, fiber quality also deteriorates. In addition, it is unlikely that the partially ginned seed fiber will be completely separated from the total mass. Therefore, the bulk of such seeds return unchanged from the gin machine chamber. For this reason, most ginners do not use regenerators and the half-cleaned seeds are sent to a linter machine and the long fibers are scraped off the seed surface together. As a result, long-spinning fibers are formed in the fleece. This, in turn, leads, firstly, to the transfer and destruction of valuable textile raw materials into the fleece composition, and secondly, to the deterioration of quality as a result of the loss of uniformity in the length of the fleece composition.

The presence of long fibers in the wool makes it difficult to process in the chemical industry and usually requires cutting and shredding long fibers. This leads to additional costs [13].

In order to overcome these shortcomings, reduce fiber loss and improve fluff quality, it was proposed to install equipment to separate long fibers from the air-fluff mixture in the fluff conveyor pneumatic duct after the 1st stage linter machine. It has been suggested that the equipment should consist of a separating cylinder and a

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brush cylinder separating the longer fibers, lined with a headset in the form of a Spiked or solid metal saw tape (YAMAL) with a linear velocity greater than the air velocity during rotation of the working bodies [14].

The proposed device consists of the following main elements: 1 inlet pipe, 2 straight Spiked cylinder, 3 outlet pipe for short fiber, 4 limiter, 5 curved Spiked cylinder, 6 brush cylinder, 7 outlet pipe for long fiber, 8-pin cylinder electric motor, 9-brush cylinder electric motor (Fig. 1).

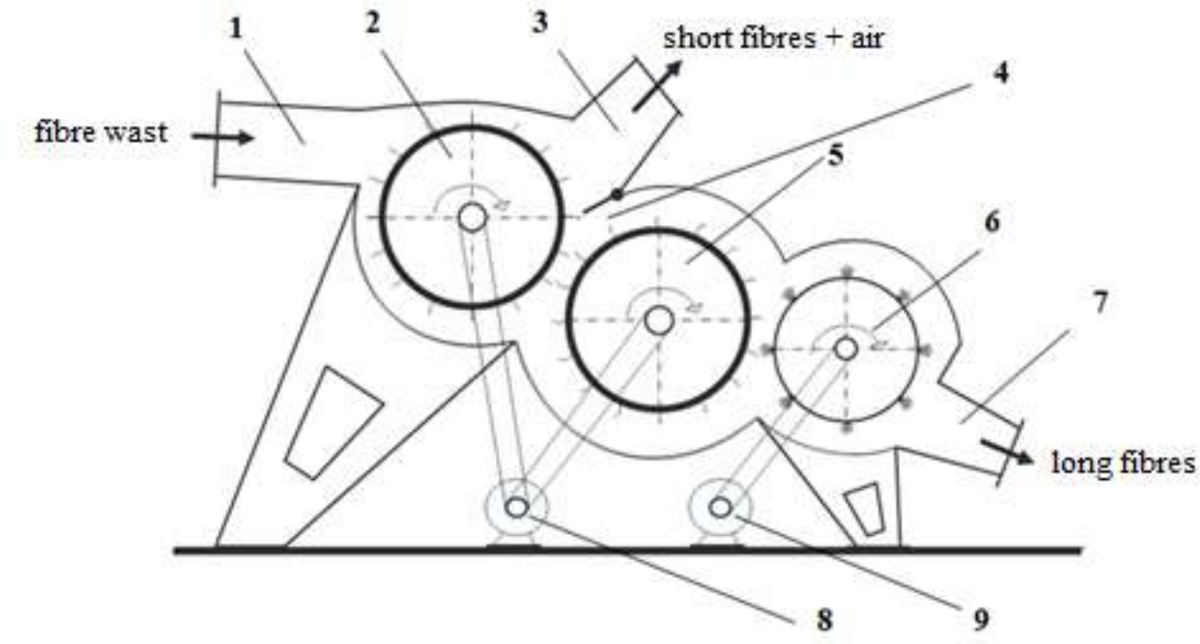

Figure 1. Double cylinder fiber separation device

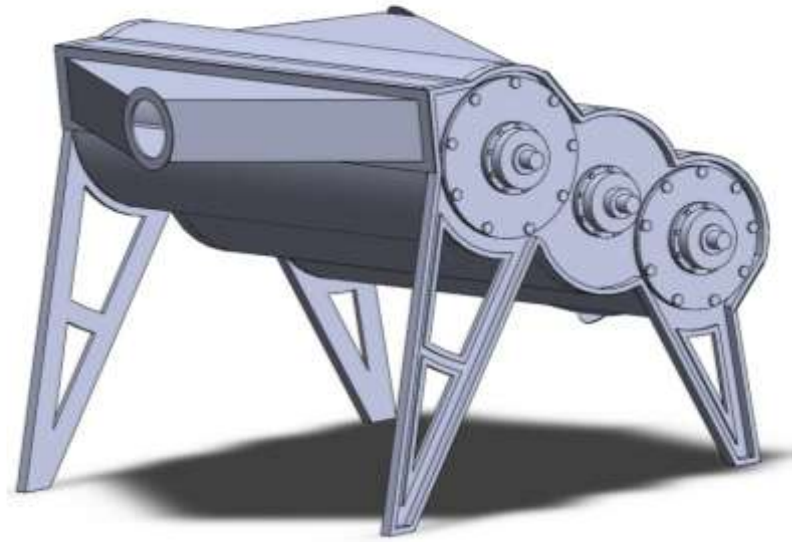

Figure 2. A view of the new device

The main working bodies of the new device are spiked cylinders, and the specified task can be achieved through the efficient use of these working parts. In this research, the strength of their shafts was examined in order to ensure that the spiked cylinders operated smoothly [15-18].

This method of calculating the spiked cylinder shafts of the new device is based on the laws of material resistance, the diameter of the dangerous section of the shaft is determined on the basis of the given torque, and the given torque is determined on the basis of bending and twisting torques.

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When selecting the calculation scheme, the shaft supports can be of three different types: a fixed hinge, a moving hinge, and a one-way compressed state. In this case, it is recommended to take a fixed hinged support on the bearing under the influence of radial and longitudinal forces, and only under the influence of radial forces on a movable hinged support. In addition to the moments acting on the defined method of calculating the strength of the shafts, the safety factor for the dangerous section is determined by taking into account the accumulation of stresses in the hazardous sections, the geometric dimensions of the shaft and the effect of surface roughness on the stress value [19-23].

The shafts are rated for strength, stamina, and vibration resistance. The calculation of the strength of the shafts is done to prevent the formation of plastic deformation and premature breakage. It is known that such cases occur when the shafts are in motion with overload. The main reason for this is random factors and the start-up period. The purpose of the calculation of virginity is to determine the elastic deformation under the influence of load and compare it with the allowable value [24].

The purpose of calculating vibration resistance is to determine the vibration resistance of the shafts as a result of periodic loading. The calculation of the shafts for stiffness and vibration is not shown here, as they fall into special cases (spindles of metalworking machines, long transmission shafts, etc.).

The aim of the study was to study the resistance, stiffness and vibration resistance of spiked cylinder shafts to bending torque and torque.

Certain methodologies [25,26] were used to perform the calculations and a shaft model was created for small experiments.

III. RESULTS AND DISCUSSION

The calculation of the strength of the shafts was performed in the following order: By drawing a sketch of the shaft, using an empirical formula for the approximate calculation, or taking into account the torque effect and it can be determined by the following equation [27]:

$$P_{ик} = \frac{M_u^2}{\left[\frac{\pi d l^2}{12} + \mu_1 dl(d + \frac{1}{2})\right]^2} + \frac{M_{K\max}^2}{\left\{\frac{\pi d^2 l \mu^2}{2}\right\}} \quad (1)$$

Where: M_u - bending moment of the shaft; $M_{K\max} = 2M_{Кню}$ - maximum and short-term torque; d - diameter of the porous part of the d-shaft; μ_1, μ_2 - coefficients of friction along the axis and in rotation; l - the length of the detail-forming joint.

The contact pressure acting on the surfaces of the attached part in a tight fit is determined from the following equation:

$$P_n = \frac{\frac{\Delta}{d}}{X\,\frac{1}{E_1}(1-\mu_1) + \frac{1}{E_2}\left(\frac{1+K_2^2}{1-K_2^2} + \mu_2\right)} \quad (2)$$

In this case: $K_2 = \frac{r_1}{r_2}$ - the inner and outer radius of the shaft cavity; The X-coefficient can be considered as $X = 1$; $\frac{1}{d} > 1$; E_1, E_2 - modulus of viscosity of shaft and shaft material; Δ - is the tight transfer index between the parts.

Based on the strength condition of the transitions between details:

$$P_n > P_{ик}$$
(3)

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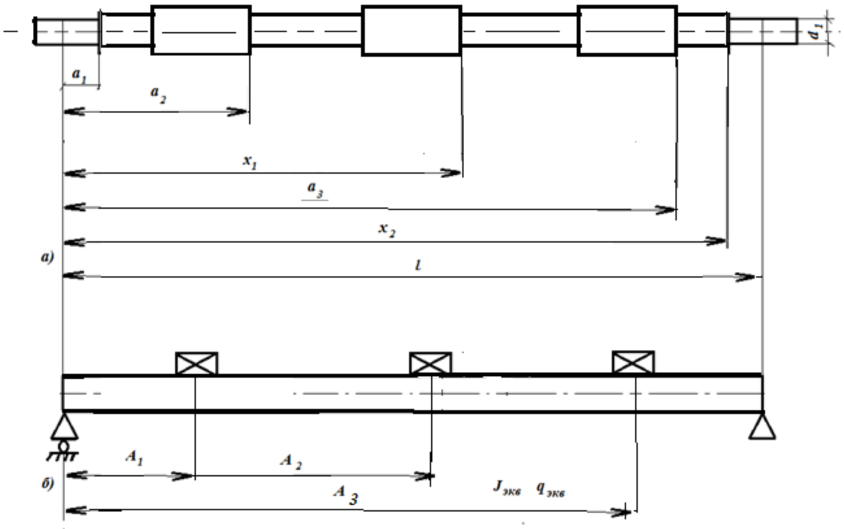

Figure 3. Scheme for calculating the critical rotation speed of the shaft:a) a variable section of the shaft on two supports on which the details are fastened, b) is a constant section of the equivalent shaft

Assuming that the elastic line of the shaft is sinusoidal, we write:

$$y = f\sin\frac{\pi X}{l} \tag{4}$$

Where: u is the bending of the shaft in the x section;

In Figure 3 (a), we replace the variable shear beam (b) with a continuous shear beam, resulting in: q_{ekv} - the specific equivalent mass of the shaft;

J_{ekv} - Equivalent moment of inertia of the shaft and m_i and J_i - moment of inertia of the details attached to the shaft and their relative to the free axis of the shaft; l is the distance between the shafts.

In this case, the specific rotation frequency of the system:

$$\rho = \sqrt{\frac{2U_O}{L}}$$

(5)

In this case: U_O - the potential energy of the displacement amplitude of the shaft

$$U_O = \frac{1}{2}\int_0^1 EJ_{ekv}\left(\frac{d^2y}{dX^2}\right)^2 dx = f^2\frac{EJ_{ekv}\pi^4}{2l^4}\int_0^1 \sin^2\frac{\pi x}{l}dx = f^2\frac{\pi^4 EJ_{ekv}}{4P} \tag{6}$$

Displacement of the first mass:

$$y_i = f\sin\frac{\pi x_i}{l}$$

(7)

Rotation of the first mass:

$$\theta = \left(\frac{dy}{dx}\right)_{x=x_i} = -\frac{\pi}{l}f\cos\frac{\pi x_i}{l}$$

(8)

Taking into consideration the specific gravity of the shaft, the total shear amplitude and its deflection are:

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$$L=\sum m_i y_i^2+\int_0^1 q_{ekv} y^2 dx+\sum J_i\theta_i^2 = f^2\left[\sum m_i \sin^2\frac{\pi x_i}{l}+\frac{q_{ekv} l}{2}+\frac{\pi^2}{l^2}\sum J_i \cos^2\frac{\pi x_i}{l}\right] \quad (9)$$

If we take U_O from (6) and L from (9) and put into Equation (5), we obtain:

$$\rho=\sqrt{\frac{2\frac{\pi^4 EJ_{ekv}}{4d^2}}{\frac{q_{ekv} l}{2}+\sum m_i \sin^2\frac{\pi x_1}{l}+\frac{\pi^2}{l^2}\sum J_i \cos^2\frac{\pi x_i}{l}}} \quad (10)$$

To find a convenient solution to the equation, we introduce the following notation:

$$\mu_i=\frac{m_i}{q_{ekv} l},\quad x_i=\frac{J_i}{q_{ekv} d^3}$$

In that case we get the following

$$\rho=\pi^2\sqrt{\frac{EJ_{ekv}}{q_{ekv} l^4}}\cdot\sqrt{\frac{1}{1+2\sum \mu_i \sin^2\frac{JLx_i}{l}+2\pi^2\sum x_i \cos^2\frac{\pi x_i}{l}}}$$

(11)

We need to find J_{zev} and q_{ekv} to solve Equation (11):

$$J_{zev}=(J_1-J_2)\phi\left(\frac{a_1}{l}\right)+(J_2-J_3)\phi\left(\frac{a_2}{l}\right)+\dots+(J_{n-1}-J_n)\phi\left(\frac{a_n-1}{l}\right)+J_n \quad (12)$$

$$q_{ekv}=(q_1-q_2)\phi\left(\frac{a_i}{l}\right)+(q_2-q_3)\phi\left(\frac{a_2}{l}\right)+\dots+(q_{n-1}-q_n)\phi\left(\frac{a_{n-1}}{l}\right)+q_n \quad (13)$$

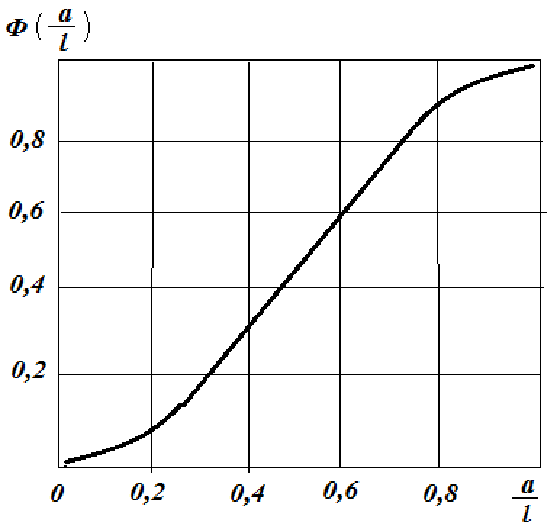

Figure 4. Shows a graph of the $\phi\left(\frac{a}{l}\right)$ function

We can find the specific oscillation frequency of the shaft by substituting the obtained values J_{zev} and q_{ekv} the into equation (11).

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Given the tensile stress along the shaft axis, it looks like this:

$$\rho = \pi^2 \sqrt{\frac{EJ_{ekv}}{ql^4}} \cdot \sqrt{\frac{1}{1 + 2\sum \mu_i \sin^2 \frac{\pi x_i}{l} + 2\pi^2 \sum x_i \cos^2 \frac{\pi x_i}{l}}} \sqrt{1 + \frac{A_0}{P_k}}$$

(14)

Where: A0 is the longitudinal force acting on the shaft; Pk is the critical force acting on the shaft, the shaft bending corresponding to the plane of oscillation of the shaft;

Determination of the critical velocity in the transverse vibration of the Spiked cylinder shaft. Spiked cylinder shaft: in the form of Spiked heads, covers, washers and nuts under the influence of a generally equally distributed tension G=100 H, the cantilever part of the shaft should be under the influence of gravity by the couplings and pulleys.

To perform the calculation, we use the scheme below (Figure 5).

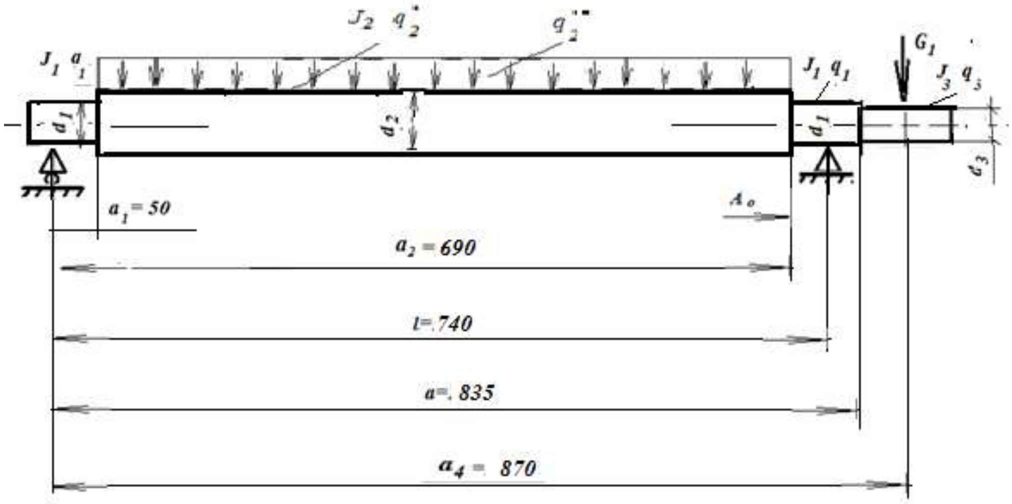

Figure 5. Scheme for determining the critical rotational speed of the spiked shaft

The following is the calculation data:

Viscosity modulus of shaft material: $E = 2{,}1 \cdot 10^7 ,\ N/sm^2$

The ratio of the weight of the clutch and pulleys to the weight of the equivalent shaft:

$$\mu_1 = \frac{G_1}{gq_{ekv}l} = \frac{100}{980 \cdot 1{,}854 \cdot 10^{-2} \cdot 174} = 0{,}574$$

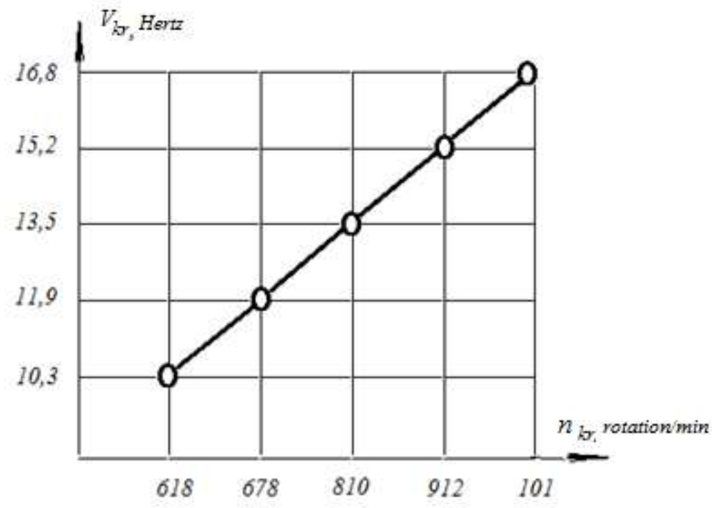

Figure 6. Graph of the relationship of the critical rotational speed of a shaft to the oscillation frequency along its axis

We accept certain definitions for the calculations [28] and obtain the following result:

$$\rho = \pi^2 \sqrt{\frac{2{,}1 \cdot 10^7 \cdot 49{,}1}{1{,}554 \cdot 10^{-2} \cdot 1{,}74 \cdot 10^8}} \sqrt{\frac{1}{1 + 0{,}248 \cdot \sin^2 \frac{3{,}14 \cdot 157}{174}}} = 63 \quad \frac{1}{\sec};$$

In this case: $V_{kr} = \frac{P}{2\pi} = \frac{63}{6{,}28} = 10{,}3 \ Hertz.$

From it: $n_{kr} = v_{kr} \cdot 60 = 10{,}3 \cdot 60 = 618 \quad rotation/\min.$

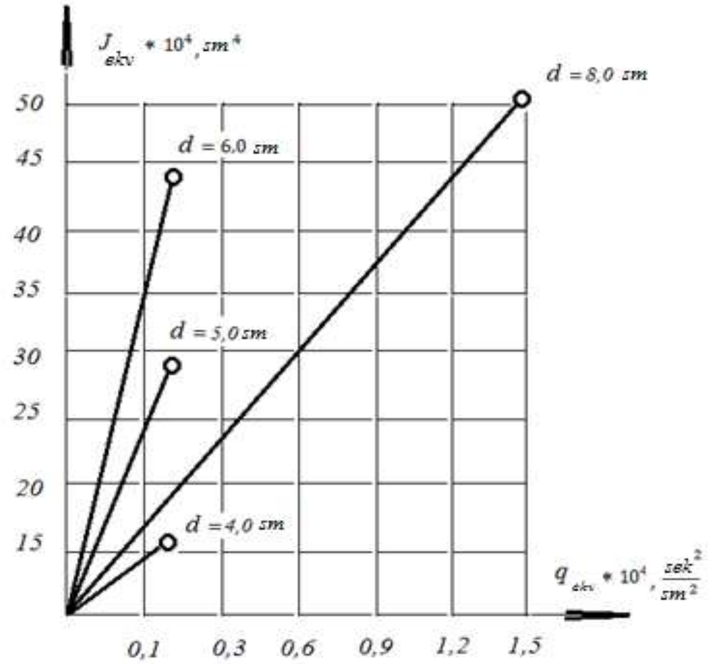

Figure 7. Graph of the relationship of the specific mass of an equivalent shaft at different diameters of the shaft to the equivalent moment of inertia

If we consider the tensile strength of spiked heads along the shaft axis: $A_0 = 2000$ N.

$$n'_{kr} = n_{kr}\sqrt{1+\frac{A_0}{P_K}} = 618\sqrt{1+\frac{2000}{348620}} = 618\cdot 1{,}003 = 620\ rotation/\min$$

Figures 6 and 7 show graphs of the relationship between the critical rotational speed of the shaft to its oscillation frequency along its axis and the relationship of the specific mass of the equivalent shaft at different diameters of the shaft to the equivalent moment of inertia, respectively.

V. CONCLUSIONS

As a result of the calculation of the shaft resistance to vibration and vibration, it was determined that the shafts are resistant to vibration as a result of periodic loading. Through the critical rotational frequency of the shaft, the oscillation frequency along its axis was determined and it is: vkr=10,3 Hertz

VI. REFERENCES

[1] Akhmedkhodjaev X.T., Karimov A.I., Obidov A. AStudy of vibrational movement of cotton seeds on vibrocarriages of parallel foundation. // Journal of Textile Problems. - Tashkent, 2003. - №4. - S.65-67.

[2] Lugachev A.E. The study of the main elements of raw cotton cleaners with the aim of improving the quality indicators of the process: Dis ... Ph.D.Tashkent, 2000.

[3] Ahmedhodjaev H.T. Development of the foundations of the theory and technology of processing derivatives of raw cotton after ginning: Dis. ... doctor. tech. sciences. - Kostroma: KSTU, 1995. 350 p

[4] Obidov A.A. Improvement of the technology of cleaning and sorting of ginned seeds. Dissertation of Candidate of Technical Sciences. - Tashkent: TITLI, 2007. - 200 p.

[5] Obidov A.A. Investigation of the working surface of a new seeding machine // Journal of Textile Problems. - Tashkent: TITLI, 2006. - №2. - 29-32 p.

[6] Obidov A., Sultonov M., Muhksinov I., Abdullaev Sh. The Theoretical Studies of the Cultivation of Three Cotton Seeds along the Plain. Engineering, 2018, 10, 514-520.

[7] UzDSt 614: 2014 State Standard.

[8] Akhmedkhodjaev, Kh.T. Fundamentals of the Theory and Technology of
Derivative Ginning. Fan, Tashkent, 2005, 173 p.

[9] Boboyev Utkirbek Obidov Avazbek Azamatovich, Matkarimov Kamoliddin Juraboyevich, Sultonov Mirzaolim Mirzarahmatovich. Research Capacity of the Fiber of Long Fiber Separating Cylinders from Waste Fibers Composition. International Journal of Innovative Studies in Sciences and Engineering Technology (IJISSET), 2019, 3/5, 28-31 p.

[10] A.Obidov, Kh.Akhmedhodjaev, O.Sarimsakov, Q.Holikov. Investigation of the Properties of Fibrous Cotton Seeds, for Sorting on a Mesh Surface. Engineering, 2018, 10, 572-578.

[11] Obidov A., Mamatqulov O., Sultonov M. Theoretical analysis of the movement of Cotton piece on the slope surface. International conference, 27.04.2018, Berlin, 151-156.

[12] Miroshnichenko G.I. Osnovy proektirovaniya mashin pervichnoy obrabotki khlopka. M. "Mashinostroenie" 1972 Str. 337.

[13] Avazbek Obidov, Nuriddin Karimov. Research capacity of the fiber of long fiber separating cylinders from waste fibers composition. International Conference «Science and practice: a new level of integration in the modern world». Conference Proceedings. London 27.04.2018.

[14] M.M.Sultanov, N.M.Safarov, A.A.Obidov. Investigation of the Spiked cylinder of the spinning fiber separation device. Journal of scientific and technical NamTI. №2, 2020 y.

[15] Azizov, S.M. and Axmedhodjaev, K.T. The Optimal Modeling of an Angular Position of Saw Cylinders in Single-Chamber Two Cylinders Gin. American Journal of Mechanical and Industrial Engineering, 2016, 1, 103-106.

[16] Abbazov, I., Sarimsakov, O., Khodjiev, M. and Mardonov, B. Effective Cleaning of Cotton Waste Produced at Cotton Cleaning Factories. American Joural ASCIT Communications, 2018, 5, 22-28

[17] Anvar Juraev and Ozod Rajabov, “Analysis of the interaction of Fibrous Material with a Multifaceted Grid of the cleaner”, International Journal of Recent Technology and Engineering, vol. 8, No 1, (2019), pp. 2661-2666.

[18] Djuraev Anvar and Kuliev Tokhir Mamarajapovich, “Improvement of the Construction and Justification of Parameters of the Fibrous Material Regenerator” International Journal of Advanced Science and Technology, Vol. 29, No. 8s, (2020), pp. 453-460.

[19] Rajabov O, Fazliddin K, and Salimov Sh., “Substantiation of Parameters of the Fibrous Material Cleaning Zone”, International Journal of Engineering and Advanced Technology, vol. 9, No 3, (2020), pp. 1052-1057.

[20] Akbar Abrorov, Matluba Kuvoncheva, Ozod Rajabov, Mukhsin Mukhammadov and Shakhrillo Jumaev, “Method of thermal treatment of saw disk teeth of fiber- processing machines by laser quenching”, IOP Conference Series: Materials Science and Engineering, (2020), 862 032034.

[21] O. I. Rajabov, A. S. Abrorov, N. I. Mirzaqulova, G. B. Zaripov, Kh. S. Ziyodullaeva, “An experimental study of the location of the grid bars cells installed under spiked cylinders in a cotton cleaner from small waste”, IOP Conference Series: Materials Science and Engineering, (2020), 862 0320049.

[22] O.I. Rajabov, F.A.Fazliddin, M. H. Gapparova and J. Shakhrillo, “The influence of the location of the cells on the allocation of weed impurities for cleaning raw cotton from fine waste”, IOP Conference Series: Materials Science and Engineering, (2020), 862 032027.

[23] Jurayev A., and Rajabov O., “Experimental study of the interactional of multifaceted and cylindrical spiky cylinder in cotton cleaner from small waste”, International Journal of Advanced Research in Science, Engineering and Technology. Vol. 6, Issue 3, (2019). pp. 8376-8381.

[24] Rajabov Ozod Isroilovich, “The influence of the mode of movement of the pieces cotton when interacting with a cotton grid”, International Journal of Advanced Research in Science, Engineering and Technology (India). Vol. 6, Issue 3, (2019). pp. 8455-8381.

[25] Ozod Rajabov and Ziyodullo Shodiyev, “Analysis of Small Fluctuations of a Multifaceted Mesh under the Influence of Technological Load from the Cleaned Cotton - Raw”, International Journal of Advanced Research in Science, Engineering and Technology, Vol. 6, Issue 10, (2019), pp. 11396-11399.

[26] Bekhruz Gaybulloev, Nigina Ergasheva, Ozod Rajabov, “The Structure of the Embroidery Machine and Dynamic Analysis of the Needle Mechanism”, International Journal of Advanced Research in Science, Engineering and Technology, Vol. 7, Issue 1, (2020). pp. 8376-8381.

[27] Anvar Djuraev and Ozod Isroilovich Rajabov, “Substantiation of the main parameters of the cylinder with multifaceted spiked of the cotton cleaner from small waste”, International scientific and practical conference Innovative ideas of modern youth in science, (2019), USA. P. 149-151

[28] Mavlyanov Aybek Palvanbaevich, Rajabov Ozod Isroilovich and Yakubova Aziza Vakil qizi, “Study of the influence of the parameters of the plastic grate on elastic supports with nonlinear stiffness on the oscillation frequency”, International scientific and practical conference "Innovative ideas of modern youth in science", (2019), USA. P. 152-15